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AIRWORTHINESS LIMITATIONS DESCRIPTION

1. Airworthiness Limitations

CAUTION: OPERATORS ARE REQUIRED BY THE FAA TO COMPLY WITH THE PARTS LIFE LIMITATIONS INDICATED HEREIN. THE OPERATOR ALONE MUST MAINTAIN RECORDS OF BOTH HOURS AND CYCLES. BOTH TOTAL TIME AND ACCUMULATED CYCLES OF APPLICABLE COMPONENTS MUST BE RECORDED IN PART I SERVICE RECORD AND PART VI CYCLE RECORD PAGES RESPECTIVELY FOR THE COMPRESSOR ASSEMBLY AND TURBINE ASSEMBLY. SHOULD THE CYCLE COUNTER BECOME INADVERTENTLY DISCONNECTED, STOP COUNTING, OR COUNT TOO MANY OF TOO FEW CYCLES, THE CORRECT NUMBER OF CYCLES MUST STILL BE COUNTED. FAILURE TO RECORD HOUR AND CYCLE DATA OF APPLICABLE PARTS IN THE LOG BOOK WILL RESULT IN THOSE PARTS BEING REPLACED AT THE OPERATOR'S EXPENSE WHEN ENGINES OR COMPONENTS ARE RETURNED FOR OVERHAUL OR REPAIR. REFER TO LOG BOOK ENTRIES, PARA 13, SECTION 72-00-00, ENGINE-DESCRIPTION AND OPERATION FOR AN EXPLANATION OF LOG BOOK ENTRIES PERTAINING TO CYCLE AND HOUR RECORDS ON LIFE LIMITED PARTS.

NOTE: All Life Limited Parts removed from a type certificated product must be tagged to identify the part. The tag or record must include the part number, serial number and current life status of the part, hours, and cycles. Each time the part is removed, either a new tag or record must be created, or the existing tag or record must be updated with the current life status of the part. The tag or record must remain with the part at all times when not installed.

When a life limited part is removed from service due to meeting the published life limits, vibropeen or etch the words "life expired" next to or under the part number. A life limited part, other than new (however, proper paper work to provide traceability is still required), must have a tag or record attached.

The following airworthiness limitations have been substantiated based on engineering analysis that assumes this product will be operated and maintained using the procedures and inspections provided in the ICA supplied with this product by the type certificate holder, or its licensees. For engine life-limited parts, any repair, modification, or maintenance procedure must be assessed for its potential affect on the life of the life-limited parts and must be approved by the FAA.

2. Life Limited Parts

Chapter 05-10-00 contains FAA approved life limitations for those engine parts that are life limited.

Life limits of parts are based on total hours or total cycles, which ever occurs first.

Operating hours with respect to maintenance records means the time from the moment an aircraft leaves the surface of the earth until it touches at the next point of landing.

A cycle is defined as a start or start attempt. The operator is assisted in maintaining a cycle count by means of an engine furnished counter which will record the number of times the ignition exciter is energized. (It is considered that the number of times the ignition exciter is energized and lightoff does not occur is negligible.)

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LIFE LIMITS OF THE COMPRESSOR ROTOR

Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
Impeller	6871337	Original	2500	7500
	23060177	Ground Pin, Glass Bead Peen	2500	7500
Impeller	6876873	Hub relocated rearward	3550	9150
	23057117	No Pin	3550	9150
	23058146	Extended Adapter	3550	9150
	23058147	Extended Adapter	3550	9150
	23060417	Ground Pin, Glass Bead Peen	3550	9150
Impeller	23079638	Shortened Adapter	3550	9150
Impeller	23068237		3550	9150
1st-stage Wheel	23079060		15,000	30,000
2nd-3rd-stage Wheel	23079059		15,000	30,000
4th-stage Wheel	23079058		15,000	30,000
5th-stage Wheel	23079057		15,000	30,000
6th-stage Wheel	23079056		15,000	30,000

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LIFE LIMITS OF THE GAS PRODUCER TURBINE ROTOR ASSEMBLY

WARNING: IT IS NOT ALLOWED TO INSTALL A TURBINE WHEEL WITH ACCEPTABLE WHEEL RIM CRACKS IN ANY ENGINE/TURBINE DURING OVERHAUL. ACCEPTABLY CRACKED TURBINE WHEELS MAY BE REINSTALLED ONLY DURING A TIME CONTINUED ENGINE/TURBINE REPAIR.

Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
1st-stage Wheel	6853306	Original	1550	3000
1st-stage Wheel	6886407	Thick rim	1775	3000
1st-stage Wheel	23073853	Thick rim	1775	3000
1st-stage Wheel	23073813	Thick rim	1775	3000
2nd-stage Turbine Nozzle Diaphragm	23084419	----	1775	3000
2nd-stage Wheel	6857912	Original	1550	3000
2nd-stage Wheel	6871872	250-C18 to -C20 Conversion (250-CEB-115)	1550	3000
2nd-stage Wheel	6877092	Changed contour	1775	3000
2nd-stage Wheel	6898782	Pilot diameter	1775	3000
2nd-stage Wheel	23038220	Stepped Balance Piston Seal (RFSE 250-87-2)	1775	3000
2nd-stage Wheel	23073854	Pilot diameter	1775	3000
2nd-stage Wheel	23073814	Pilot diameter	1775	3000
Gas Producer Turbine Tie-Bolt	23068265	Thick Design	----	9000

NOTE: 1st-stage turbine wheels with acceptable wheel rim cracks which have been inspected and approved for time continued use in accordance with the 250-C20 Series Overhaul Manual, Pub No. 10W3, (for a repaired engine or turbine) may be continued in service to overhaul or an additional 500 hours or 500 cycles, whichever of these occurs first (provided the listed part hour/cycle life limit is not exceeded).

NOTE: 2nd-stage turbine wheels with acceptable wheel rim cracks which have been inspected and approved for time continued use in accordance with the 250-C20 Series Overhaul Manual, Pub No. 10W3, (for a repaired engine or turbine) may be continued in service to overhaul or completion of the wheel's maximum hour life or cycle limit, whichever of these occurs first.

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LIFE LIMITS OF THE POWER TURBINE ROTOR ASSEMBLY

Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
3rd–stage Wheel	23001967	Solid Shroud. Less 7–11 Seals	4550	6000
	6853282	Solid Shroud. Has 7–11 Seals	4550	6000
	6888633	Full slotted shroud. Has 7–11 seals	(1)	6000
	6887113	Full slotted shroud. Has 7–11 seals	(1)	6000
	6891588	Full slotted shroud. Has 7–11 seals	(1)	6000
	6896863	Full slotted shroud. Has 7–11 seals	(1)	6000
	6898551	Center slot. Has 7–11 seals	(1)	6000
	6898567	Center slot. Has 7–11 seals Machined web	(1)	6000
	6898733	Center slot. Less 7–11 seals Machined web	(1)	6000
	6898743	Center slot. Less 7–11 seals	(1)	6000
	6898753	Center slot. Less 7–11 seals Solid casting	(1)	6000
	6898763	Center slot. Machined web Less 7–11 seals Solid Casting	(1)	6000
	6898823	Full slot. Crimped shroud. Less 7–11 seals	(1)	6000
	6898967	Solid shroud. Less 7–11 seals	4550	6000
	6899364	Center slot extended to full slot and then crimped. Less 7–11 seals	(1)	6000
	6899373	Solid shroud. Less 7–11 seals	4550	6000
	6899406	Center slot scalloped and crimped. Has 7–11 seals	(1)	6000
	6899415	Center slot scalloped and crimped. Less 7–11 seals Machined web	(1)	6000
	6899416	Center slot scalloped and crimped. Less 7–11 seals	(1)	6000

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Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
3rd–stage Wheel (cont)	6899417	Center slot scalloped and crimped. Machined web. Has 7–11 seals	(1)	6000
	6899418	Center slot scalloped and crimped. Machined web. Less 7–11 seals.	(1)	6000
	6899419	Center slot scalloped and crimped. Machined web. Less 7–11 seals	(1)	6000
	23001967	Solid shroud less 7–11 seals	4550	6000
	23065818	Slotted shroud – improved design	4550	6000
	23065833	Slotted shroud – improved design	4550	6000

NOTE: P/N 23065833 turbine wheels are not to be installed on C20W engines.

Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
4th–stage Wheel	6853279	Original	4550	6000
	6891594	Machined web	4550	6000
	23055944	Improved design	4550	6000

(1) The 3rd–stage turbine wheels are to be removed from service in accordance with a phase–down schedule published in 250–C20 CEB A–1174.

WARNING: IT IS NOT ALLOWED TO INSTALL A TURBINE WHEEL WITH ACCEPTABLE WHEEL RIM CRACKS IN ANY ENGINE/TURBINE DURING OVERHAUL. ACCEPTABLY CRACKED TURBINE WHEELS MAY BE REINSTALLED ONLY DURING A TIME CONTINUED ENGINE/TURBINE REPAIR.

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COMPRESSOR SECTION - MAINTENANCE PRACTICES

1. Compressor Assembly Replacement

A. Removal (See Figure 201, 202 or 203.)

(1) Remove compressor oil supply and scavenge tubes from the compressor front support and from the power and accessory gearbox.

(2) (Bendix fuel system). Remove fuel control system compressor discharge pressure (P_c) sensing tube. Remove tube from the bracket mounted P_c filter and from the elbow at the scroll. Hold the P_c filter while disconnecting the coupling nut.

(3) (CECO fuel system). Remove fuel control system compressor discharge pressure (P_c) sensing tube. Remove tube from the tee at the governor and from the elbow at the scroll.

(4) Remove the compressor discharge pressure sensing tube at the compressor bleed control valve and at the diffuser scroll pressure probe elbow.

(5) Remove two pressure elbows from the diffuser scroll. Discard packing.

(6) Remove the three bolts, nuts and washers and separate the compressor bleed control valve and gasket from the compressor case. Discard gasket.

(7) Remove two anti-icing lines at the compressor front support and at the anti-icing air valve.

(8) Remove the nut and separate the anti-icing air valve from the diffuser scroll. Discard packing.

(9) Remove the turbine assembly from the engine. (Refer to the Turbine Assembly Removal, para 1.A. or 1.C., 72-50-00.)

(10) Lubricate (engine oil) the spur adapter gearshaft bearing guide (6872646 or 23006778) (whichever is applicable) and install it on the compressor spur adapter gearshaft. (See Figure 204.)

(a) Bearing guide P/N 23006778 can be used with any Series II spur adapter gearshaft and bearing guide P/N 6872646 can only be used with the short shaft spur adapter gearshaft.

(11) If the compressor assembly is to be reinstalled, count and record the number of shims at each mounting pad prior to complete removal of the compressor. Save the shims for reuse.

NOTE: Early engines incorporate five bolts to attach the compressor to the gearbox.

(12) Remove the nuts and washers at the two pads inboard on the gearbox and remove the three bolts at the outboard pads. Note the position of the three different bolts and one washer used at these pads. Remove the P_c filter and bracket assembly.

(13) Separate the compressor from the gearbox.

(14) Turbine-to-Compressor Coupling Spline Inspection

Examine the turbine-to-compressor coupling splines after compressor or turbine removal or turbine separation at the exhaust collector to power turbine support. Replace the coupling if unsatisfactory.

(a) Visually examine the splines for signs of damage or twisting. No damaged or twisted splines are permitted.

(b) Visually examine the splines for pitted, cracked, or broken teeth. No pitted, cracked, or broken teeth are permitted.

(c) Use a sharp pointed scribe, 0.020 in. (0.51 mm) radius, to examine the spline teeth for a wear step. Wear that you can feel with the scribe is not permitted.

(15) Spur Adapter Gearshaft Aft Spline Inspection

Examine the spur adapter gearshaft aft spline when the compressor is removed. Return the compressor to an approved maintenance facility for replacement of an unsatisfactory gearshaft.

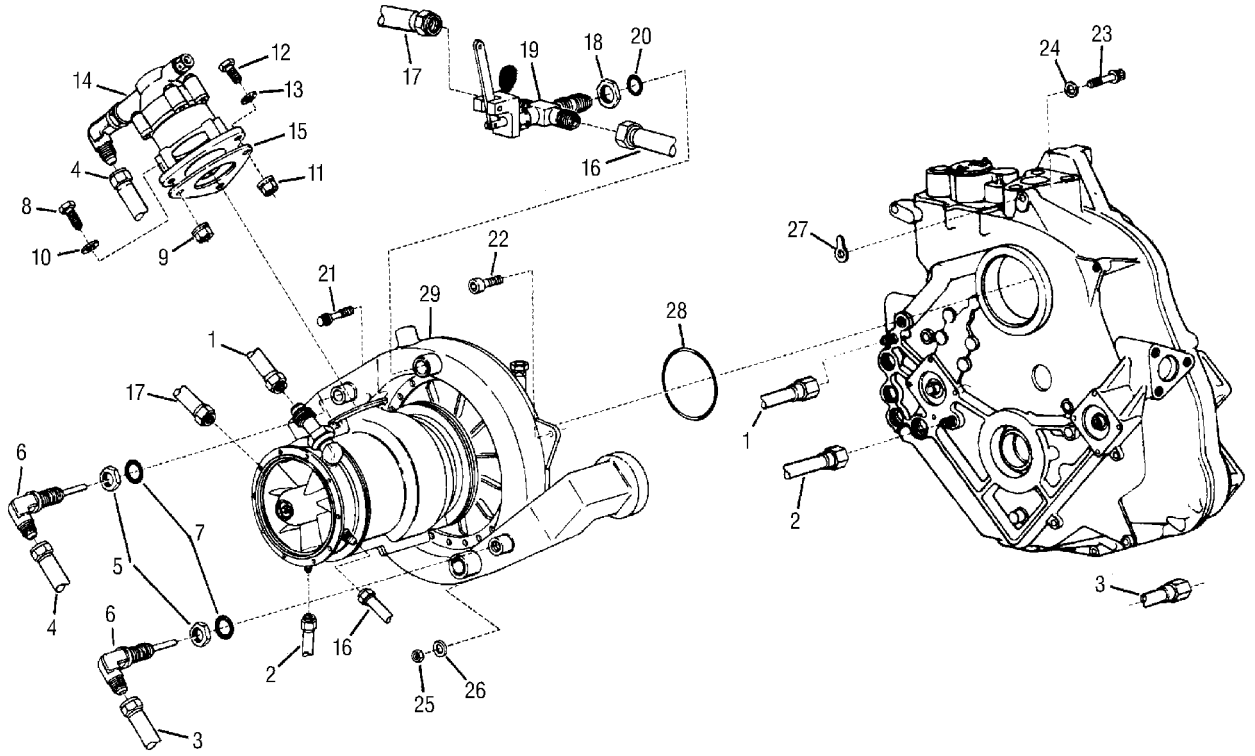
(a) Visually examine the splines for signs of damage or twisting. No damaged or twisted splines are permitted.

(b) Visually examine the splines for pitted, cracked or broken teeth. No pitted, cracked or broken teeth are permitted.

(c) Use a sharp pointed scribe, 0.020 in. (0.51 mm) radius, to examine the spline teeth for a wear step. Wear that you can feel with the scribe is not permitted.

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1. Oil Supply Tube
2. Scavenge Oil Tube
3. Control System P_c Tube
4. Bleed System P_c Tube
5. Nut (2)
6. Pressure Probe Elbow (2)
7. Packing (2)
8. Bolt (2)
9. Nut (2)
10. Washer (2)
11. Nut
12. Bolt
13. Washer
14. Bleed Valve
15. Gasket
16. LH Anti–icing Tube
17. RH Anti–icing Tube
18. Nut
19. Anti–icing Valve
20. Packing
21. Bolt
22. Bolt
23. Bolt
24. Washer
25. Nut (2)
26. Washer (2)
27. Shim
28. Packing
29. Compressor

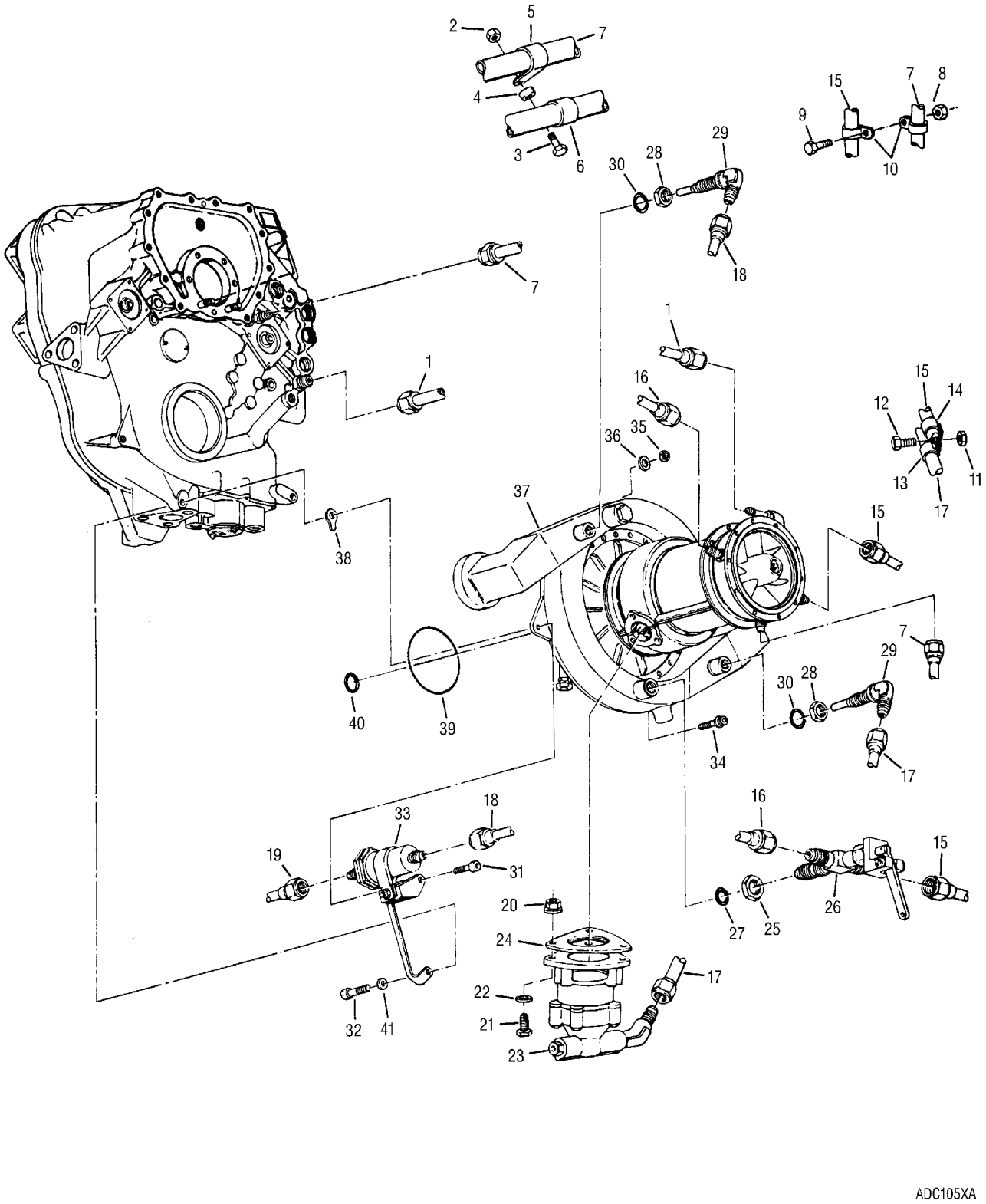
Compressor Removal (250–C20, –C20B, –C20F, –C20J)
Figure 201

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Legend for Figure 202

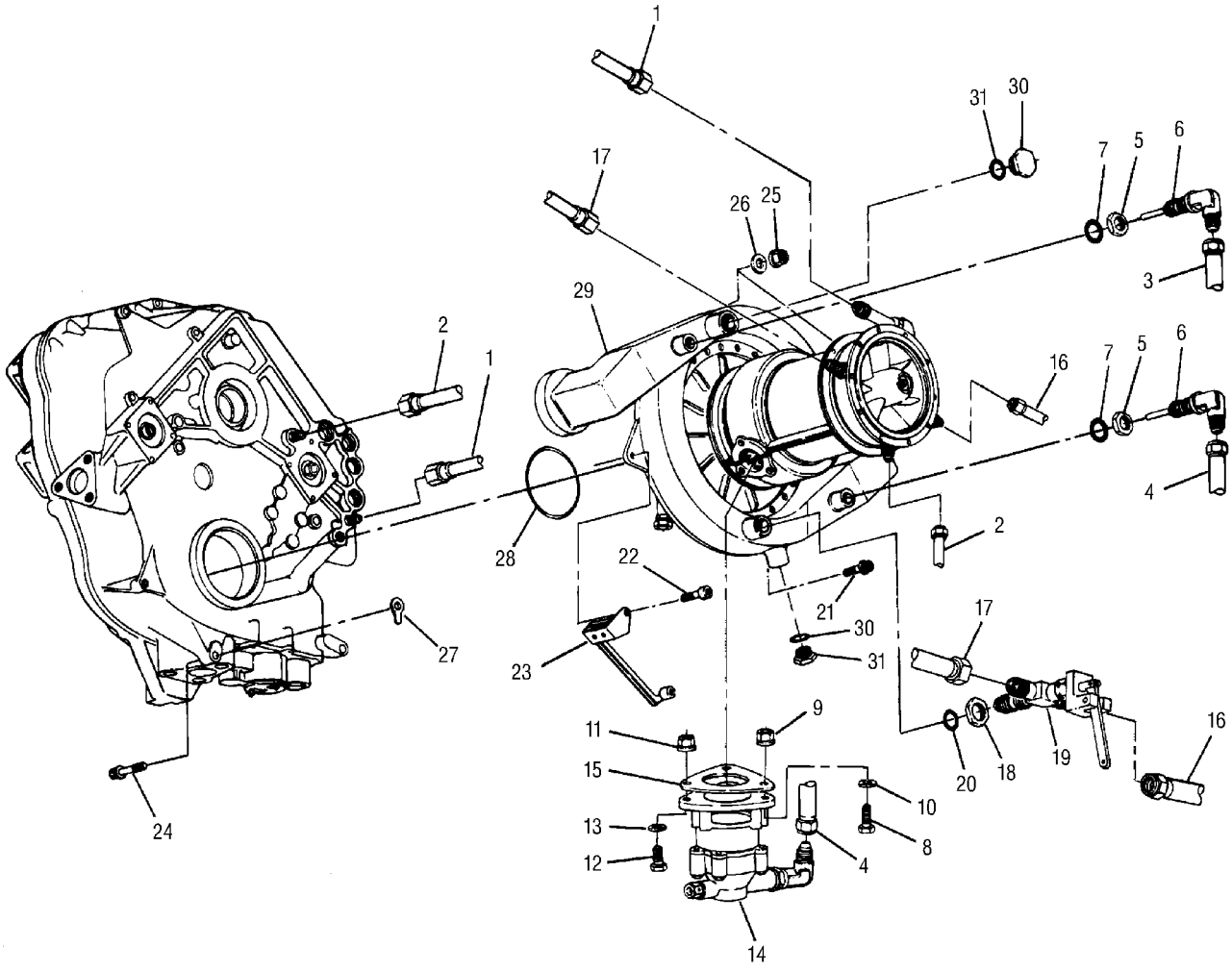
1. Gearbox–to–Front Support Pressure Oil Tube
2. Nut
3. Bolt
4. Bushing
5. Clamp
6. Clamp
7. Front Support–to–Gearbox Scavenge Oil Tube
8. Nut
9. Bolt
10. Clamp (2)
11. Nut
12. Bolt
13. Clamp
14. Clamp
15. LH Anti–icing Tube
16. RH Anti–icing Tube
17. Scroll–to–Bleed Valve Sensing Tube
18. Scroll–to–P_c Filter
19. P_c Filter–to–Control Sensing Tube
20. Nut (3)
21. Bolt (3)
22. Washer (3)
23. Bleed Control Valve
24. Gasket
25. Nut
26. Anti–icing Valve
27. Packing
28. Nut (2)
29. Pressure Probe Elbow (2)
30. Packing (2)
31. Bolt
32. Bolt
33. P_c Filter—Bracket Assembly
34. Bolt
35. Nut
36. Washer
37. Compressor Assembly
38. Shim
39. Packing
40. Packing
41. Washer

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Compressor Removal (250–C20S)
Figure 202

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1. Oil Supply Tube
2. Scavenge Oil Tube
3. Control System P_C Tube
4. Bleed System P_C Tube
5. Nut (2)
6. Pressure Probe Elbow (2)
7. Packing (2)
8. Bolt (2)
9. Nut (2)
10. Washer (2)
11. Nut
12. Bolt
13. Washer
14. Bleed Valve
15. Gasket
16. LH Anti–icing Tube
17. RH Anti–icing Tube
18. Nut
19. Anti–icing Valve
20. Packing
21. Bolt
22. Bolt
23. P_C Filter Bracket
24. Bolt
25. Nut (2)
26. Washer (2)
27. Shim
28. Packing
29. Compressor
30. Plug (2)
31. Packing (2)

Compressor Removal (250–C20W)
Figure 203

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(16) Remove bearing guide 6872646 or 23006778 from the spur adapter gearshaft.

(17) Make the following inspection of the compressor discharge air tube seal groove lands and split seal rings at the compressor (small) end.

(a) Remove the split seal rings from the small end of the air tubes.

(b) Replace the split seal rings if the edges show wear which could be detrimental to the sealing effect or if the expander ring is broken.

(c) Inspect the discharge air tube lands in accordance with Figure 207, 72-40-00.

(d) Apply antiseize compound to the components of the split seal rings. Install the rings on the discharge air tubes. Split seal ring gaps should be 180° apart.

(18) Inspect the compressor mounting inserts in the gearbox housing for looseness. (Refer to Insert Inspection, para 4.D., 72-60-00.)

(19) Remove the Spur Adapter Gearshaft.

(a) If necessary, remove the spur adapter gearshaft as follows:

1 Remove the compressor assembly from the engine. (Refer to para 1.A., this section.)

2 Match mark the installed relationship between the compressor impeller/splined adapter assembly and the spur adapter gearshaft with an approved marker.

3 Remove the retaining ring that secures the spur adapter gearshaft into the compressor.

4 Remove the spur adapter gearshaft. Do not remove the compressor splined adapter from the impeller.

5 Remove and discard the old forward seal ring from the spur adapter gearshaft.

B. Installation (Ref Figure 201, 202 or 203)

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

CAUTION: BE SURE THE TURBINE ASSEMBLY HAS BEEN REMOVED BEFORE ATTEMPTING TO INSTALL THE COMPRESSOR ASSEMBLY ON THE ENGINE. INSTALLATION OF THE COMPRESSOR ASSEMBLY WITHOUT FIRST REMOVING THE TURBINE ASSEMBLY CAN CAUSE DAMAGE TO THE NO. 2-1/2 BEARING, RESULTING IN PREMATURE REMOVAL OF THE ENGINE.

NOTE: Check to make sure that the compressor and gearbox mounting flanges are clean and free of foreign material which could cause misalignment. Check that the spur adapter gearshaft retaining ring is properly installed.

(1) Install the Spur Adapter Gearshaft.

(a) If necessary, install the spur adapter gearshaft as follows:

1 Install a new spur adapter gearshaft seal ring.

2 Clean the spur adapter gearshaft and the compressor splined adapter. Make sure there is no unwanted material in the splined adapter.

3 Lubricate the spur adapter gearshaft and the compressor splined adapter with engine oil.

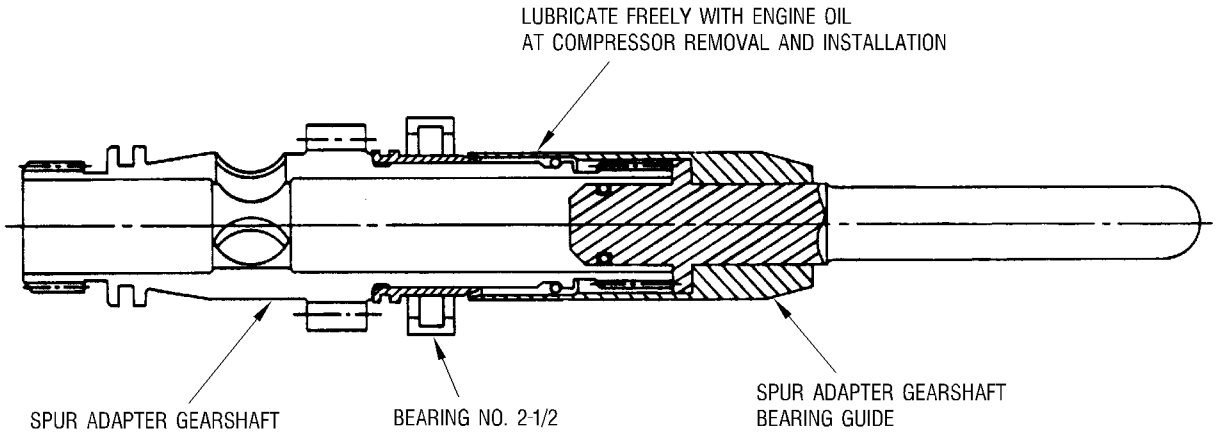
4 Install the spur adapter gearshaft into the compressor splined adapter. Make sure the match marks are aligned.

5 Install a new internal retaining ring on the spur adapter gearshaft.

6 Make sure the retaining ring is correctly attached and expanded into the retaining ring groove. Hold the spur adapter gearshaft, and pull it away from the impeller to try to remove it.

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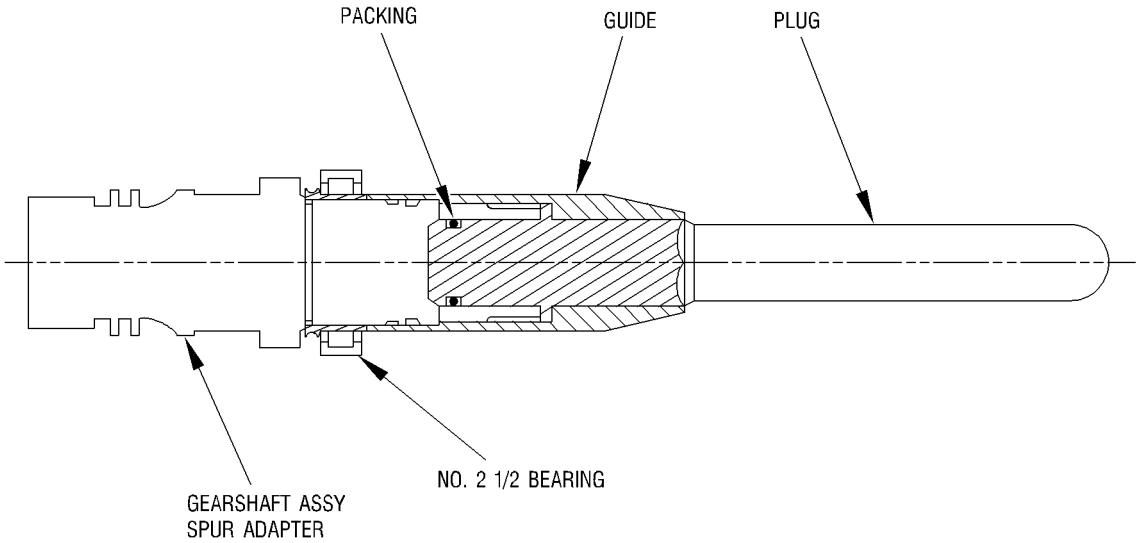
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P/N 6872646

Can only be used with the short shaft spur adapter gearshaft.

ADE052AD



P/N 23006778

Can be used with any Series II spur adapter gearshaft.

AEC001XD

Bearing Guide Installed on Spur Adapter Gearshaft
Figure 204

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(2) Lubricate and install new packings on the compressor rear diffuser and the spur adapter gearshaft.

(3) Lubricate (engine oil) bearing guide (6872646 or 23006778) and install it on the spur adapter gearshaft. (Ref. Figure 204.)

(4) Sparingly lubricate the rollers of the No. 2-1/2 bearing with petrolatum to hold the rollers out against the bearing outer race.

WARNING: FAILURE TO PROPERLY SHIM THE COMPRESSOR AT INSTALLATION CAN CAUSE THE SPUR ADAPTER GEARSHAFT TO FAIL RESULTING IN SUDDEN ENGINE STOPPAGE.

CAUTION: BE SURE THE SPUR ADAPTER GEARSHAFT IS IN MESH WITH THE GEARBOX MATING GEAR BEFORE TIGHTENING COMPRESSOR RETAINING BOLTS. IF YOU TIGHTEN THE COMPRESSOR RETAINING BOLTS WITH AN INCORRECT MESH OF THE SPUR ADAPTER GEARSHAFT AND THE GEARBOX MATING GEAR, THEN YOU MUST REPLACE BOTH THE MATING GEAR AND THE GEARSHAFT.

(5) Determine the number of shims required for compressor installation.

(a) When replacing a compressor, the total thickness of shims required at each attaching point has been determined during compressor buildup (overhaul) and marked near the appropriate bolt hole on the rear diffuser.

(b) When reinstalling the same compressor, install with the total thickness of shims marked on the rear diffuser. If the shim markings are not legible, missing, or in doubt, compute the total shim thickness requirements in accordance with paragraph 1.C., Compressor Shimming Procedure, this section.

(6) Place the compressor on the gearbox with the required shims in place at the bolt pads. Use 6799790 engine turning adapter to turn the gear train until it meshes with the spur adapter gearshaft.

(7) If interference is encountered between the compressor and one of the cast bosses on the gearbox, lightly dress the boss by filing. Remove only sufficient material to provide a positive clearance.

(a) Dichromate the machined area per AMS 2475.

(b) Apply engine gray enamel (AMS 2510).

(8) Install the P_c air filter and bracket assembly at the same time the compressor mounting bolts and nuts are installed. Use the same configuration of bolts, nuts and washers at each of the five compressor pads as was previously used. (If the gearbox is changed, different bolts or nuts may be required.) Tighten attachment features to 70-85 lb in. (7.9-9.6 N·m) and secure bolts with lockwire.

(9) Remove bearing guide 6872646 or 23006778 from the spur adapter gearshaft. Visually check that the spur adapter gearshaft packing is in place.

(10) Install the turbine assembly. (Refer to Turbine Assembly Installation, para 1.B. or 1.D., 72-50-00.)

(11) Install the anti-icing air valve on the diffuser scroll. Do not tighten the jam nut at this time. (Refer to Anti-Icing Air System, para 2.D., 75-10-01.)

(12) Attach the RH and LH anti-icing air tubes to the anti-icing air valve and tighten coupling nut(s) to 65-75 lb in. (7.3-8.5 N·m). Attach the RH and LH anti-icing air tubes to the front support and tighten coupling nut(s) to 150-200 lb in. (16.9-22.6 N·m). Tighten valve jam nut to 100-150 lb in. (11.3-16.9 N·m) and secure with lockwire.

(13) Install the bleed control valve on the compressor case mounting flange. (Refer to Bleed Air Control Valve, para 2.B., 75-10-02.)

(14) Apply anti-seize compound lightly to the threads; then install the two pressure elbows with new packing in the scroll. Do not tighten the jam nuts until final tube alignment is made.

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(15) Install pressure sensing line between bleed valve and pressure probe elbow. Tighten coupling nuts to 80-120 lb in. (9.0-13.6 N·m). Tighten elbow jam nuts to 55-80 lb in. (6.2-9.0 N·m) and secure with lockwire.

(16) Install the pressure sensing line between the tee at the governor and the pressure probe elbow (CECO control system). Attach the Scroll-to-P_c Filter Tube Assy to the scroll elbow and to the forward end of the P_c Filter. Attach the P_c Filter-to-Governor Tube Assy to the aft end of the P_c Filter. (Bendix Control System.) When attaching the lines to the P_c filter, hold the filter with the proper wrench at the hex flats of the filter assembly. Tighten the coupling nuts to 80-120 lb in. (9.0 to 13.6 N·m). Tighten elbow jam nut to 55-80 lb in. (6.2-9.0 N·m) and secure with lockwire. Clamp P_c filter-to-governor tube assy to ignition lead.

(17) Install the oil supply and scavenge tubes to the front support and to the gearbox. Tighten pressure tube coupling nuts to 65-100 lb in. (7.3-11.3 N·m) and scavenge tube coupling nuts to 150-200 lb in. (17-23 N·m).

(18) Make appropriate entry relative to compressor replacement in the Engine Log.

(19) Check run the engine and select the proper size diffuser vent orifice after compressor replacement. (Refer to Check Run, para 1. and Diffuser Vent Orifice Selection, para 1.B., 72-00-00, Engine-Adjustment/Test.)

C. Determining Compressor Mounting Shim Thickness Requirements.

(1) Place the compressor assembly in a vertical position (on blocks) with the impeller end up.

NOTE: Be sure the spur adapter gearshaft is match marked to the adapter coupling and the adapter coupling is match marked to the impeller hub prior to removal.

(2) Before removing the spur adapter gearshaft from the compressor assembly, match mark the spur adapter gearshaft to the adapter coupling and the adapter coupling to the impeller hub.

(3) Remove the internal retaining ring and remove the spur adapter gearshaft from the compressor.

(4) Using 6795588 wrench to hold the rotor and a six-point socket on the nut, remove the nut and washer securing the adapter coupling in the impeller hub. Using 6872832 puller, remove the coupling from the impeller hub.

(5) Install the plate of 6873066 fixture on the aft side of the rear diffuser.

(6) Attach the indicator and bracket on the impeller hub.

(7) Level the plate using the three leveling screws and the bracket mounted indicator.

(8) Position the dial indicator on the plate to contact the five mounting pads (C, Figure 205). Record the reading at the five positions.

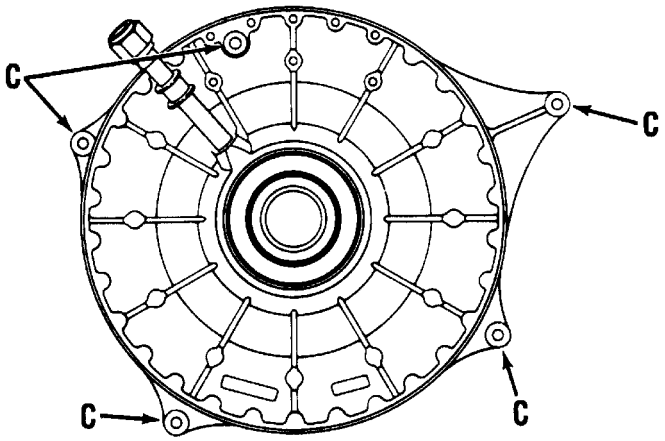
(9) Zero the indicator at the highest of the five positions. Measure and record the minus reading at each of the other four positions.

(10) Compute the total thickness of shims required to build the four (low) bolt holes up to the zero indicated hole as required to obtain an installed compressor squareness of 0.002 in. (0.05 mm) FIR. The total thickness of shims at any one location shall not exceed 0.020 in. (0.51mm). Electro-chemical etch the total shim thickness adjacent to the applicable bolt hole and cover the etched surfaces with Metcoseal AMS 3135 transparent silicone resin. Mark the zero indicated hole with a 0 (zero). (See Figure 205.) Shims are available in three sizes; 0.002, 0.004, and 0.008 in. (0.05, 0.10, 0.20 mm).

(11) Remove the 6873066 fixture from the compressor.

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MEASURE SQUARENESS OF DIFFUSER PADS MARKED **C** WITH RELATION TO ROTOR AXIS. ELECTROCHEMICAL ETCH (AS478–7A1) THE THICKNESS OF SHIMS REQUIRED AT EACH BOLT HOLE FOR COMPRESSOR INSTALLATION AND COAT ETCHED AREA WITH METCOSEAL.

NOTE: THE TOTAL THICKNESS OF SHIMS AT ANY ONE LOCATION SHALL NOT EXCEED 0.020 IN.(0.51 mm).

ADC002XD

Compressor Rotor Squareness Measurement
Figure 205

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(12) Align the match marks and install the adapter coupling into the splines of the impeller hub. Retain the coupling with a washer and nut. Hold the coupling with 6795588 wrench and Torque the nut to 50-55 lb in. (5.6-6.2 N·m) above locknut drag using a six-point socket.

(13) Align the match marks and install the spur adapter gearshaft into the splines of the adapter coupling. Retain the gearshaft in the coupling with the internal retaining ring.

2. Compressor Case Replacement

A. Removal (Compressor Case Top Half) (See Figure 206.)

CAUTION: DO NOT REMOVE BOTH CASE HALVES AT THE SAME TIME.

NOTE: Compressor cases are machined in lower and upper matched sets. Rejection and replacement of one case half is cause for rejection and replacement of the opposite case half. Note the serial numbers on both replacement case halves to assure that the case halves are a matched pair.

(1) Remove the pressure and scavenge oil lines between the gearbox and the compressor front support.

(2) Remove the RH and LH air lines between the anti-icing air valve and the compressor front support.

(3) Remove the compressor bleed control valve as follows:

(a) Remove the compressor bleed valve discharge pressure sensing line.

(b) Remove three nuts, bolts and washers; remove the compressor bleed valve and gasket.

(4) Remove the top compressor case half (marked "top") as follows:

(a) Remove the 17 horizontal splitline nuts and bolts.

NOTE: Note the location of the nameplate when the applicable compressor case-to-compressor front support nuts and bolts are removed. Return the nameplate to the same location during reassembly.

(b) Remove the 5 compressor case-to-compressor front support nuts and bolts.

(c) Remove the 8 compressor case-to-compressor front diffuser nuts and bolts.

(d) Carefully lift the top half straight out. If the case does not separate easily, loosen the two bolts and nuts at the aft flange and one bolt and nut at the front flange in the bottom half adjacent to each horizontal splitline.

B. Installation (Compressor Case Top Half) (See Figure 206.)

See Figure 207 for location of specific bolts and the numerical sequence in which they should be tightened. The illustration sequence numbers correspond to the numbers in the text.

NOTE: Be sure that the splitline mating flanges are clean before installation of the replacement case half.

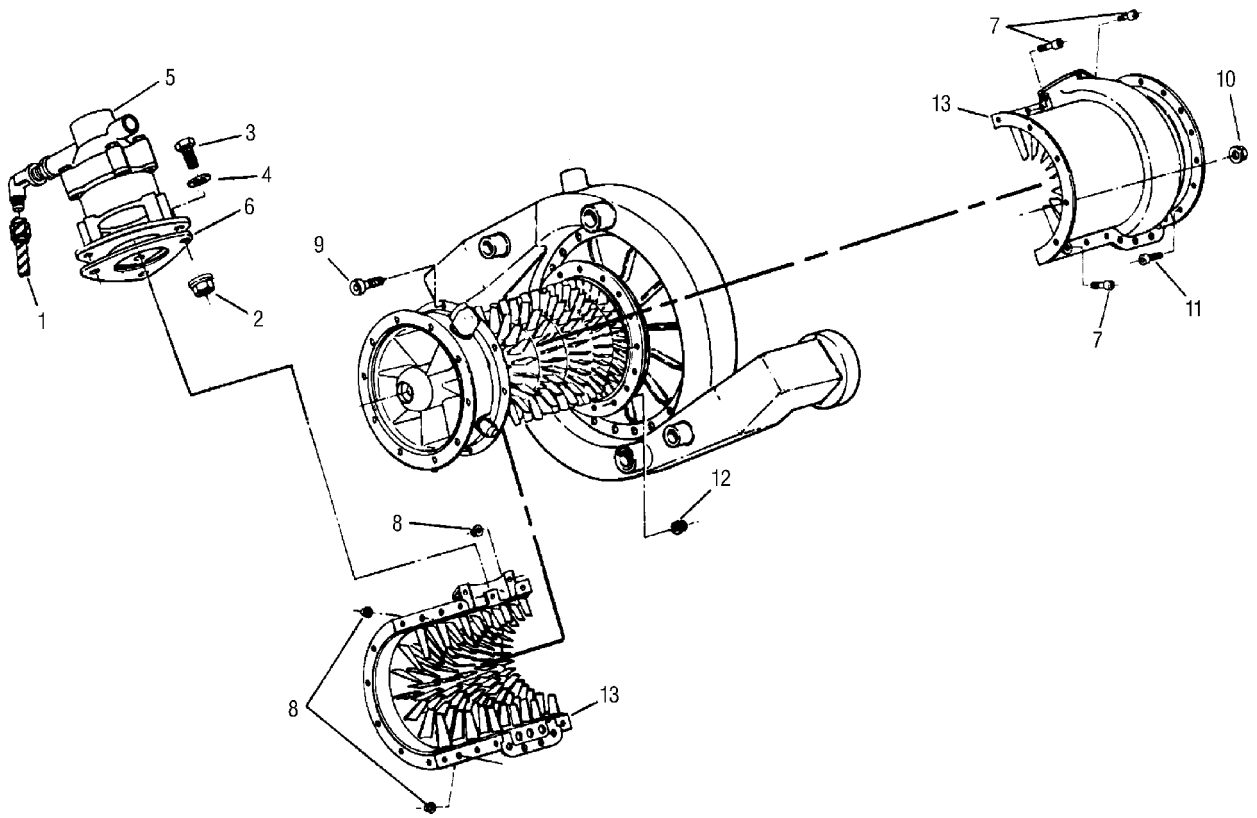
(1) Carefully position the top half over the rotor. Install a bolt and nut (1) in each of the four corner holes (adjacent to the end flanges) at the horizontal flange. Tighten the bolts to the minimum torque necessary to close the horizontal splitlines.

NOTE: Tighten all case splitline nuts to 10-15 lb in. (1.1-1.7 N·m) plus locknut drag unless otherwise specified. Locknut drag is the torque necessary to turn the nut on the bolt in the last turn prior to seating of the nut. Lubricate bolts lightly with engine oil before installation.

(2) Install and tighten two bolts and nuts (2) in the rear flange of the top case half. Use the two adjacent bolt holes midway between the horizontal splitlines (approximately 80 degrees from the horizontal flanges). If the bolt holes in the rear flange do not align with the flange holes in the front diffuser, loosen the rear flange bolts in the bottom case half to a snug fit. Using a drift inserted into a misaligned bolt hole, rotate the case sufficiently to align the holes. Tighten the two centermost bolts on the rear flange of the bottom case half; then install and tighten the two centermost bolts and nuts in the rear flange of the top case half.

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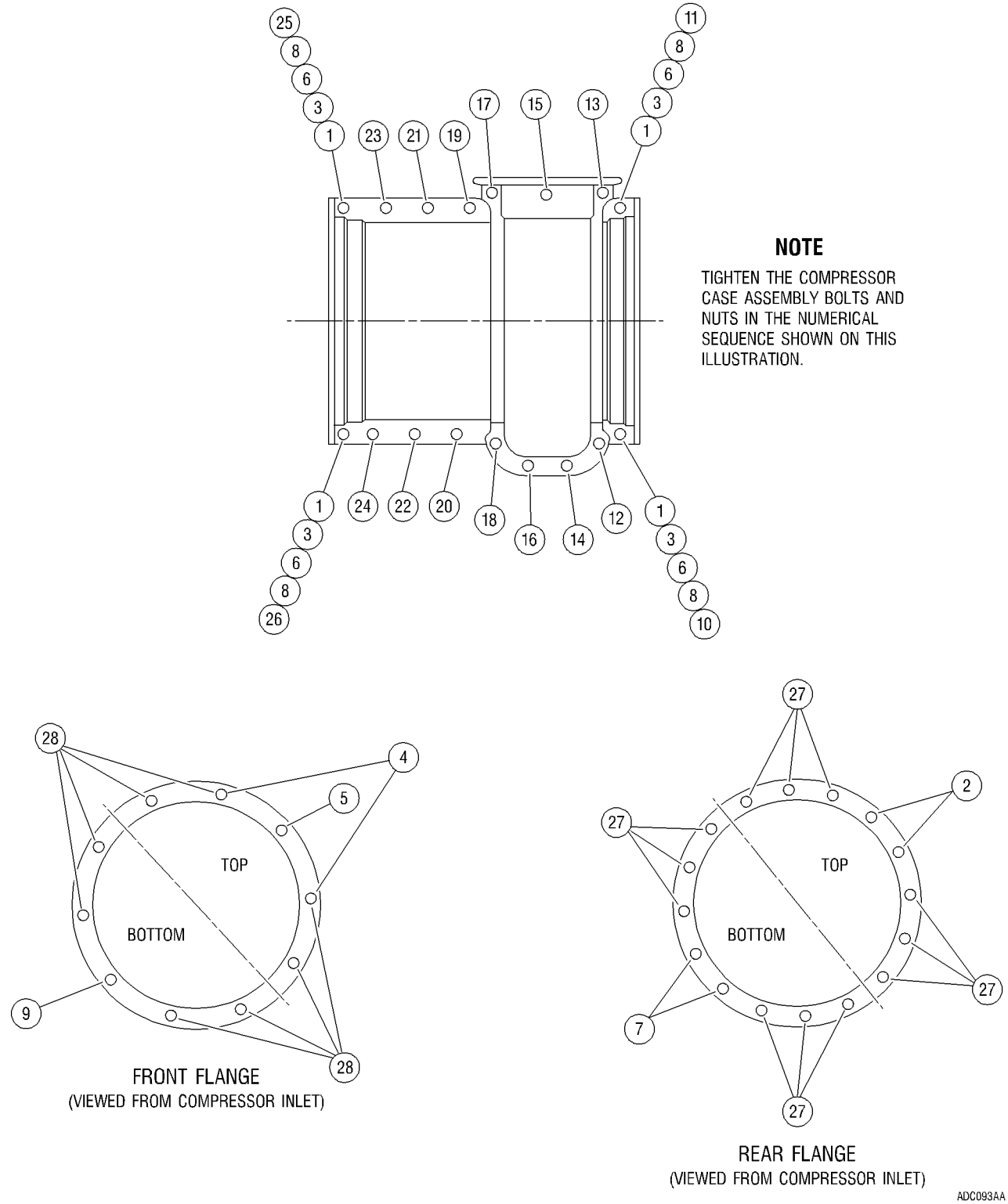
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1. Sensing lin
2. Nut (3)
3. Bolt (3)
4. Washer (3)
5. Bleed valve
6. Gasket
7. Bolt (16)
8. Nut (16)
9. Bolt (10)
10. Nut (10)
11. Bolt (16)
12. Nut (16)
13. Case half (2)

Compressor Case Removal (Typical)
Figure 206

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Compressor Case Installation Bolt Tightening Sequence
Figure 207

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(3) Loosen the four corner bolts (3) in the horizontal flanges. Allow the horizontal flange to reposition; then retighten the four bolts to the minimum torque necessary to close the horizontal splitlines.

(4) Install the bolts and nuts in the front flange of the top case half at the three centermost bolt hole positions. Tighten the two outer bolts (4) to a snug fit; then tighten the center bolt (5). If the bolt holes in the front flange do not align with the flange holes in the front support, loosen the front flange bolts in the bottom case half to a snug fit. Using a drift inserted into a misaligned bolt hole, rotate the front support sufficiently to align the holes. Install and tighten the three bolts and nuts.

C. Removal (Compressor Case Bottom Half) (See Figure 206.)

(1) Remove the four bolts and nuts in the horizontal splitlines.

(2) Remove the three bolts and nuts in the bottom half front flange.

(3) (Remove the eight bolts and nuts in the bottom half rear flange.

(4) Carefully lift the bottom half straight out. Do not pry against the top half.

D. Installation (Compressor Case Bottom Half) (See Figure 206.)

NOTE: The RTV 732 or RTV 736 sealer is used to seal the rear corners of the splitline. Use of the sealer is optional on engines that are not used with the water-alcohol injection system.

(1) Apply a sphere of approximately 0.12 in. (3 mm) dia of RTV 732, or equivalent (Compressor Case Splitline Sealer, Table 302), aft of the rearmost bolt hole on the bottom case half horizontal flange surfaces. Assemble and tighten all splitline bolts and nuts as soon as possible after application of RTV 732 (never exceed 30 minutes).

(2) Carefully position the bottom case half to cover the rotor. Install a bolt and nut (6) in each of the four corners (adjacent to the end flanges) at the horizontal flange. Tighten the bolts to the minimum torque necessary to close the horizontal splitlines.

(3) Install and tighten two bolts and nuts (7) in the rear flange of the bottom case half. Use the bolt holes which are diametrically opposite the top case half bolts.

(4) Loosen the four corner bolts in the horizontal flanges. Allow the horizontal flange to reposition; then retighten the four bolts (8) to the minimum torque necessary to close the horizontal splitlines.

(5) Install and tighten one bolt and nut (9) in the front flange at the center hole position (90 degrees from the horizontal flanges).

(6) Install the remaining 13 horizontal flange bolts and nuts. Loosen the two rear corner bolts and nuts; then tighten all bolts (10)-(26) starting from the rear and alternating from side to side.

(7) Install and tighten the remaining 12 bolts and nuts (27) in the rear flange and the eight bolts and nuts (28), plus nameplate, in the front flange.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(8) Attach the RH and LH anti-icing air tubes to the anti-icing air valve and tighten coupling nut(s) to 65-75 lb in. (7.3-8.5 N·m). Attach the RH and LH anti-icing air tubes to the front support and tighten coupling nut(s) to 150-200 lb in. (16.9-22.6 N·m).

(9) Attach the compressor pressure and scavenge oil tubes:

(a) Install the gearbox elbow-to-front support scavenge oil tube. Tighten coupling nuts to 150-200 lb in. (17-23 N·m).

(b) Install the gearbox union-to-pressure reducer pressure oil tube. Tighten coupling nuts to 65-100 lb in. (7.3-11.3 N·m).

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PARA 2.D. (cont)

(10) Apply antiseize compound to the bolt threads; then install the bleed control valve and gasket on the compressor case mounting flange. Retain with three nuts, bolts and washers. Tighten the 1/4–28 nut to 70–85 lb in. (7.9–9.6 N·m); tighten the remaining two nuts to 35–40 lb in. (3.9–4.5 N·m).

(11) Install the bleed control valve pressure sensing line between the elbows at the valve and the scroll. Tighten coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(12) Turn the compressor rotor using 6799790 engine turning adapter through the starter–generator pad. Use a wrench to rotate the turning adapter. No blade tip rub (evidenced by feel or noise) is acceptable. Minor touch may be tolerated.

(13) As an alternate method, motor the engine with the starter and without ignition to 10–15% N_1 speed. Listen for noise indicating a rub condition caused by case misalignment.

(14) Check run the engine after compressor case replacement. (Refer to Check Run, para 1., 72–00–00, Engine–Adjustment/Test.)

3. Compressor Front Bearing and/or Oil Seal Replacement (Engine Removed)

This is the preferred procedure for replacing the compressor front bearing or oil seal. Replace parts with engine removed from the aircraft and installed in 6795579 turnover stand. Turn engine to a vertical position in the stand with compressor inlet at the top. Replace bearing and/or seal as follows: (See Figure 208.)

A. Removal

(1) To prevent contamination of the P_y pneumatic line, remove the P_y line from the governor and fuel control before turning the engine to the vertical position.

(2) Turn the engine to a vertical position in the stand with the compressor inlet at the top.

CAUTION: TO PREVENT ASSEMBLY DIFFICULTIES AND TO MINIMIZE POSSIBLE PART DAMAGE, DO NOT REMOVE THE FRONT SUPPORT FROM THE COMPRESSOR UNLESS THE ENGINE IS VERTICAL, WITH THE COMPRESSOR INLET ON TOP.

(3) Remove the pressure and scavenge oil lines between the gearbox and the compressor front support.

(4) Remove the oil pressure reducer from the compressor front support. Discard packing.

NOTE: Anytime the compressor front bearing and/or front bearing oil seal is replaced or the oil system has been contaminated, disassemble and inspect the oil pressure reducer.

(a) Remove the internal retaining ring; then separate the restrictor from the oil pressure reducer body. (See Figure 208.)

(b) Clean all debris from the restrictor and the body using mineral spirits and a soft bristle brush.

(c) Inspect the restrictor for burrs and/or damage to the lands. Replace restrictor if either condition exists.

(d) Reassemble the oil pressure reducer by installing the restrictor threaded end first into the body. (See Figure 208.) Secure with the internal retaining ring. Be sure the retaining ring is properly seated in the groove in the body.

(e) Lubricate a new packing and install it with the oil pressure reducer in the compressor front support. Tighten to 50–75 lb in. (5.6–8.5 N·m).

(5) Remove the LH and RH line between the anti–icing air valve and the compressor front support.

(6) Remove the P_c air line between the bleed valve and the scroll.

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(7) Remove three nuts, bolts and washers and separate the bleed control valve and gasket from the mounting flange on the compressor case.

(8) Remove the compressor front support nut. Remove 10 bolts and nuts at the front support flange.

(9) Loosen, but do not remove, the compressor case (horizontal) splitline nuts and bolts.

(10) Separate the compressor front support from the compressor assembly. Discard two packings. The identification plate is removed by this operation.

(11) Release the internal retaining ring using 6893535 compressor and separate the compressor front bearing housing from the rotor assembly. Discard packing. If alternate configuration is used, separate front bearing housing by pulling the two spring pins.

(12) Remove the helical spring and spring cup from the rotor.

(13) If it is necessary to replace or reseat the bearing damper in the front bearing housing, remove the damper using 6799700 puller. (See Figure 209.)

CAUTION: DO NOT HOLD OR TURN THE N_1 GEAR TRAIN THROUGH THE SPARE DRIVE PAD. THIS COULD RESULT IN DAMAGE TO THE GEARBOX.

CAUTION: EXERCISE CARE WHEN REMOVING THE COMPRESSOR BEARING NUT. DO NOT ALLOW THE NUT WRENCH TO CONTACT THE BEARING.

CAUTION: THE COMPRESSOR FRONT BEARING CAN BE DAMAGED EASILY. REPLACE BEARING IF AT ANY TIME DURING REMOVAL OR INSTALLATION THE BEARING IS DROPPED, LOADED THROUGH THE BALLS TO THE INNER RACE OR THE OUTER RACE IS PULLED OFF.

(14) Remove the bearing retaining nut using a socket wrench with a broach depth no more than 7/16 in. (11 mm) (Snap-On SW 181 or equivalent). Hold the rotor from turning using 6799790 adapter in the starter-generator pad on the gearbox cover.

(15) For front compressor bearing configuration without a puller groove, install a 6796952 puller on the puller groove of the seal mating ring and pull both the seal mating ring and bearing together. For front bearing configurations with a puller groove, remove the bearing first using 23005023 puller followed by removal of the seal mating ring using the same puller. (See Figure 210.)

(16) Remove the oil seal from the rotor. Discard packing.

B. Installation

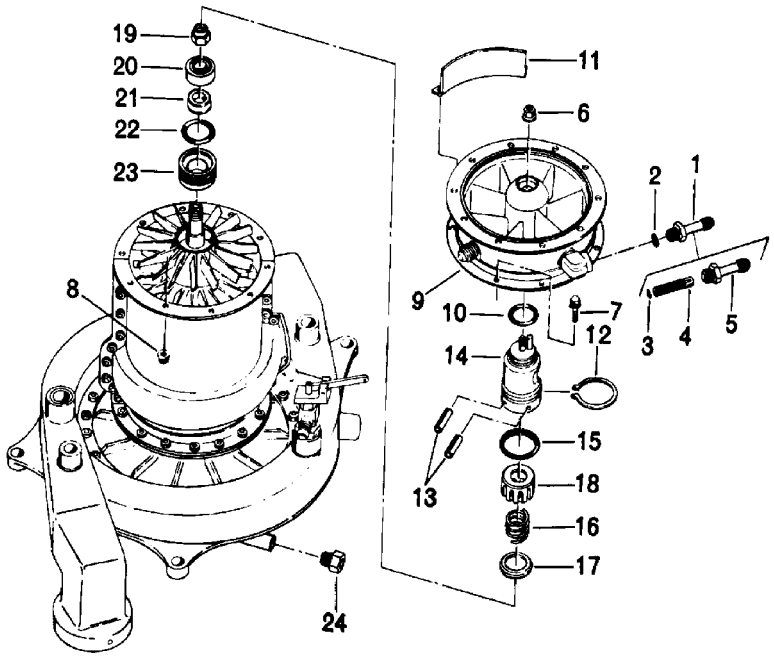
(1) If the vibration damper was removed, install the replacement damper or reseat the old damper as follows:

(a) Install the vibration damper on 6798796 drift. Chill the damper and the drift using dry ice. As an option, the bearing housing may be heated to 121°C (250°F) maximum.

(b) Press the damper into the front bearing housing until it bottoms out against the shoulder of the bearing housing. Apply constant pressure to the drift until such time the temperature of the damper and the housing have equalized. Remove the drift.

(c) Measure the installed position of the damper. The inside of the damper flange should be 1.218 in. (30.94 mm) minimum from the housing open end.

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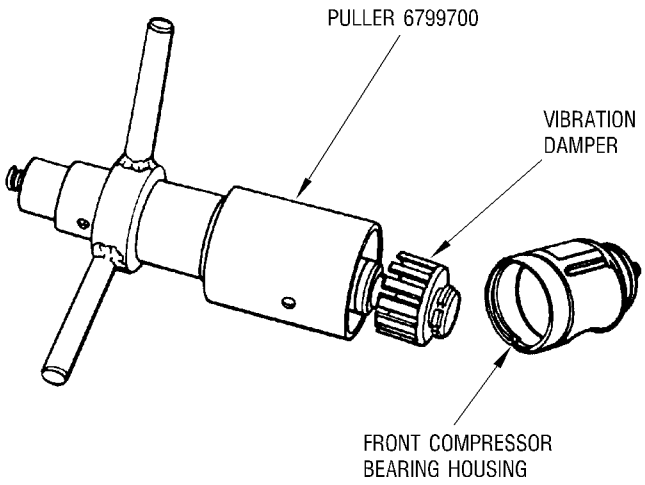


ADC099XD

1. Oil Pressure Reducer
2. Packing
3. Internal Retaining Ring
4. Restrictor
5. Body
6. Nut
7. Bolt (10)
8. Nut (10)
9. Front Support
10. Packing
11. Identification Plate
12. Retaining Ring
13. Pin (2)
14. Front Bearing Housing
15. Packing
16. Spring
17. Spring Cup
18. Vibration Damper
19. Nut
20. Ball Bearing (No. 1)
21. Seal Mating Ring
22. Packing
23. Oil Seal
24. Diffuser Vent Orifice

Compressor Front Bearing and Oil Seal Replacement
Figure 208

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Pulling the Compressor Front Bearing Vibration Damper
Figure 209

(2) Lubricate inside the replacement seal with engine oil (by soaking). Install lubricated packing on the seal; then install the seal on the rotor.

CAUTION: USE A RETAINING NUT WITH A BLACK NYLON CAP WITH NO. 1 BEARINGS HAVING A PULLER GROOVE. USE RED OR YELLOW NYLON CAP NUTS WITH BEARINGS WITHOUT PULLER GROOVES. IN ORDER FOR THE SELF-LOCKING FEATURE OF THE RETAINING NUT TO BE EFFECTIVE AND TO AVOID OIL LEAKAGE INTO THE ROTOR, DO NOT INTERCHANGE THESE NUT/BEARING COMBINATIONS.

CAUTION: EXERCISE CARE WHEN INSTALLING THE NUT. DO NOT ALLOW THE WRENCH TO CONTACT THE BEARING.

(3) Before installing the mating ring, bearing or nut, measure dimensions A, B, and C as indicated in Figure 210A.

(4) Install the seal mating ring with puller groove forward. Install the No.1 bearing with the puller groove forward. Do not heat the bearing.

(5) Install a slave nut and torque nut to 120-130 lb in. (13.6-14.7 N·m) above drag torque. Loosen and remove slave nut.

(6) Hold the rotor from turning using 6799790 adapter in the starter generator pad on the gearbox cover.

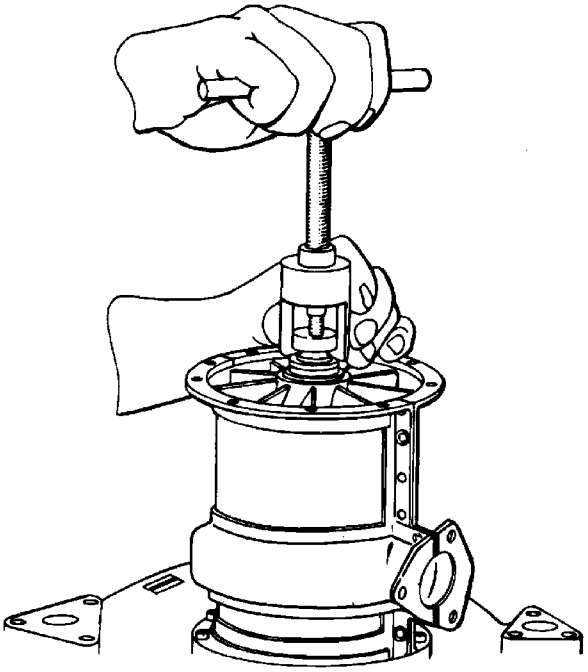
(7) With slave nut removed, measure dimension D as indicated in Figure 210A. Make sure that dimension D=A-(B+C).

(8) If dimension D is less than A-(B+C), reinstall slave nut and retorque nut to seat bearing and seal mating ring.
  (a) Remove slave nut and recheck dimension D.
  (b) If dimension D is still less than A-(B+C), remove bearing and mating ring to inspect the 1st stage wheel stub shaft, the bearing and the mating ring for wear that may cause this condition.
  (c) Once dimension D is determined to be acceptable, go to step (9).

(9) Install locknut and torque to 70-80 lb in. (7.9-9.0 N·m) above drag torque using a socket wrench with a broach depth of no more than 7/16 in. (11 mm) (Snap-On SW 181 or equivalent).

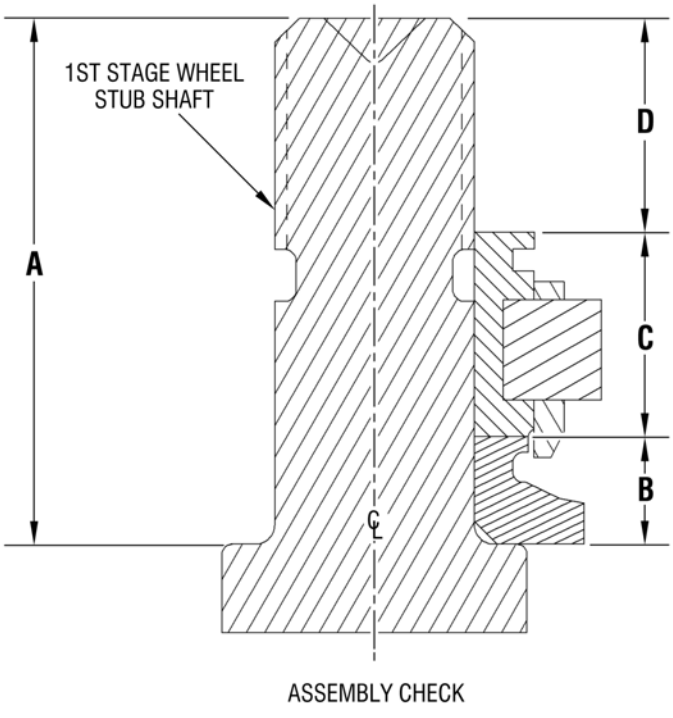
(10) Install the spring and spring clip. The cup sleeve fits over the spring on the end that contacts the bearing.

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Removing the Compressor Front Bearing and Seal Mating Ring
Figure 210

ADC100XD



ABC034XD

1st Stage Wheel Stub Shaft Dimension Check
Figure 210A

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(11) Install the retaining ring in the rear groove of the oil seal. Install the front bearing housing over the spring, bearing and oil seal. Compress the retaining ring in the seal groove and engage the ring in the inside groove of the bearing housing until it is fully seated using 6893535 compressor. Exercise care not to damage the seal face. On alternate configuration, press down (rearward) on the housing until the two pin holes of the housing align with the retaining ring groove of the seal. Insert the two pins. Lubricate and install two packings on the bearing housing.

CAUTION: DO NOT FORCE THE SUPPORT FLANGE INTO THE COMPRESSOR CASE PILOT. LOOSEN THE COMPRESSOR CASE HORIZONTAL SPLITLINE BOLTS AS NECESSARY FOR EASE OF ASSEMBLY, EVEN TO THE POINT OF REMOVING ONE CASE HALF.

(12) Visually align the pin of the bearing housing with the hole in the compressor front support then install the front support on the compressor assembly. This part is indexed correctly when the scavenge oil fitting is opposite the "O" mark on the front diffuser.

(13) Lubricate the threads of the front bearing housing with antiseize compound. Secure housing to the front support with a nut. Tighten nut to 35-40 lb in. (3.9-4.5 N·m).

(14) Install the identification plate and ten support-to-compressor case bolts and nuts. Tighten the compressor horizontal splitline and front support splitline nuts to 10-15 lb in. (1.1-1.7 N·m) plus locknut drag.

(15) Apply anti-seize compound to the bolt threads; then install the bleed control valve and gasket on the compressor case mounting flange. Retain with three nuts, bolts and washers. Tighten the 1/4-28 nut to 70-85 lb in. (7.9-9.6 N·m). Tighten the other two nuts to 35-40 lb in. (3.9-4.5 N·m).

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(16) Attach the compressor discharge pressure sensing tube assembly to the bleed valve and to the elbow at the scroll. Tighten coupling nuts to 80-120 lb in. (9.0-13.6 N·m).

(17) Attach the RH and LH anti-icing air tubes to the anti-icing air valve and tighten coupling nut(s) to 65-75 lb in. (7.3-8.5 N·m). Attach the RH and LH anti-icing air tubes to the front support and tighten coupling nut(s) to 150-200 lb in. (16.9-22.6 N·m).

(18) Check the oil seal for leakage by applying oil at 4-6 psi (27.6-41.4 kPa) for one minute to the oil pressure reducer location on the compressor front support. No leakage shall be permitted.

(19) Attach the compressor pressure and scavenge oil tubes:

(a) Install the gearbox-to-front support scavenge oil tube. Tighten coupling nut to 150-200 lb in. (17-23 N·m).

(b) Install the gearbox union-to-pressure reducer pressure oil tube. Tighten coupling nuts to 65-100 lb in. (7.3-11.3 N·m).

(c) Install the P_y line between the governor and the fuel control. Tighten coupling nuts to 80-120 lb in. (9.0-13.6 N·m).

(20) Install the starter-generator.

(21) After complete assembly of the compressor, check the compressor rotor for freedom of operation. If compressor drag or rubbing is detected either by feel or by sound, investigate to determine the cause by removing one or both halves of the case assembly.

(22) Check run the engine after seal or bearing replacement. (Refer to Check Run, para 1., 72-00-00, Engine-Adjustment/Test.)

4. Compressor Front Bearing and/or Oil Seal Replacement (Engine Installed)

This is an alternate procedure for replacing the compressor front bearing and/or oil seal. It is accomplished while the engine is installed and in a horizontal position.

CAUTION: THIS ALTERNATE PROCEDURE INVOLVES GREATER RISK FOR PART DAMAGE AND ASSEMBLY ERROR THAN THE PREFERRED PROCEDURE (PARA 3.A. AND 3.B., THIS SECTION). THE ALTERNATE PROCEDURE IS RECOMMENDED FOR SKILLED MECHANICS HAVING APPROVAL OF THEIR ROLLS-ROYCE AUTHORIZED MAINTENANCE CENTER (AMC).

A. Replacement Procedure

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(1) Support the compressor rotor in the compressor case by carefully installing shim stock between the first-stage wheel blade tips and the compressor case. Install the shim stock through the open end of the compressor front support at three equally spaced locations. One location shall be at the six o'clock position.

CAUTION: IN ORDER TO ENSURE REMOVAL OF THE SHIM STOCK AFTER COMPLETION OF THE BEARING AND/OR SEAL REPLACEMENT, ATTACH A STRING OR STREAMER TO THE PROTRUDING END OF THE SHIM STOCK BEFORE IT IS INSERTED INTO THE COMPRESSOR.

(2) Replace the compressor front bearing and/or oil seal in the same manner as used in the Engine Removed procedure (Para 3.A. and 3.B., this section).

(3) Once the compressor front support is properly installed, remove the shims from between the first-stage wheel blade tips and the case halves.

(4) Check run the engine. (Refer to Check Run, para 1., 72-00-00, Engine--Adjustment/Test.)

5. Inspection/Check

The cleaning and preservation practices which are necessary for the proper maintenance of the compressor are described in para 6., this section.

WARNING: CORROSION OR EROSION WILL CAUSE DAMAGE TO COMPRESSOR BLADES AND VANES WHICH CAN RESULT IN ENGINE FAILURE.

A. Diffuser Vent Orifice Inspection

Inspect the diffuser vent orifice for evidence of spewing or for looseness. If spewing has been encountered, resize the orifice. (Refer to Diffuser Vent Orifice Selection, para 1.B., 72-00-00, Engine-Adjustment/Test.)

B. Blade and Vane Inspection

NOTE: Do not remove both case halves at the same time.

NOTE: Before reworking any blades or vanes, refer to Blade Damage and Vane Damage, paras C and D, which follow.

The design of the compressor case permits inspection of blades and vanes by removing the compressor bleed control valve and one compressor half case. (Refer to Compressor Case Replacement, para 2., this section.) Remove the compressor and send it to an Authorized Maintenance Center (AMC) if vane rub marks are found on the hub area of the compressor rotor wheels during the blade and vane inspection. Rework all nicks, dents and corrosion pits by blending.

C. Blade Damage.

Replace the compressor if any blade is cracked or broken off. Recommended corrective actions for compressor blades are as follows:

NOTE: It is not possible to fully describe all of the damage conditions that could be incurred; therefore, if damage is within the rework limits of Figures 211 and 212, but there is reasonable doubt about the strength of the reworked blade as compared to a new blade, replace the compressor assembly.

NOTE: If the compressor wheels have a corrosion resistant coating, nicks, dents, etc. in the lower 25% of the airfoil cannot be polished/blended without glass bead peening and reapplication of the corrosion resistant coating. For these reasons, a coated compressor rotor that is damaged must be removed and sent to a Rolls-Royce Authorized Maintenance Center (AMC).

(1) General Practices.

(a) Blend and polish blades or vanes in a longitudinal direction only with the rework forming a smooth blend with the basic airfoil. The number of blades or vanes which may be reworked is not limited.

(b) The limiting factor of blade or vane rework is engine performance. Any reduction of blade or vane area will decrease the efficiency of the compressor and the performance of the engine. Remove as little material as possible.

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Para 5.C. (1) (cont)

(c) No sharp edges (with exception of blade tips), burrs, cracks or tears are acceptable.

(2) Leading and Trailing Edge Damage. (See Figure 211.)

(a) Blend and polish to remove damage.

(b) Replace compressor when the limits of Figure 211 are exceeded.

(3) Tip Damage. (See Figure 212.)

(a) Blend and polish to remove tip damage.

(b) Replace compressor when the limits of Figure 212 are exceeded.

(4) Surface Damage. (See Figure 213.)

(a) Blend and polish to remove surface damage.

(b) Replace the compressor when any of the limits of Figure 213 are exceeded.

(5) Corrosion. (Uncoated Blades)

(a) Blend and polish to remove all corrosion caused pits by blending to limits defined for damage. Replace the compressor when:

1 Pitting in any area of the blade forms a definite line.

2 Pit size or location exceeds blend limits.

(6) Corrosion – Coated Blades.

(a) Two similar aluminide coatings are used on the compressor blades, HI–51S (Alloy Surfaces Corp.) and A–12 (Chromalloy). Both HI–51S and A–12 consist of an intermetallic diffused aluminide coating and a conversion top coating. These coatings offer sacrificial protection against corrosion.

(b) Due to the sacrificial properties of the diffused coating, reddish brown colored products (superficial rust) may become visible on the airfoil surfaces if exposed to a corrosive environment. These products are actually corrosion of the coating surface, not the base blade material. The effective removal of the superficial rust may be accomplished by lightly brushing with a soft nylon brush using hot (65°C 150°F) soapy water (non–alkaline neutral) solution, followed by water rinse.

(c) This procedure pertains only to superficial rust indication. It is imperative that you not confuse superficial rust indication with corrosion pitting. If pitting is observed:

1 Blend and polish to remove all corrosion caused pits in the outer 75% of the blade by blending to limits defined for damage.

2 If corrosion caused pits or any form of damage is detected in the lower 25% of the airfoil, send the rotor to an Authorized Maintenance Center (AMC).

3 Replace the compressor when:

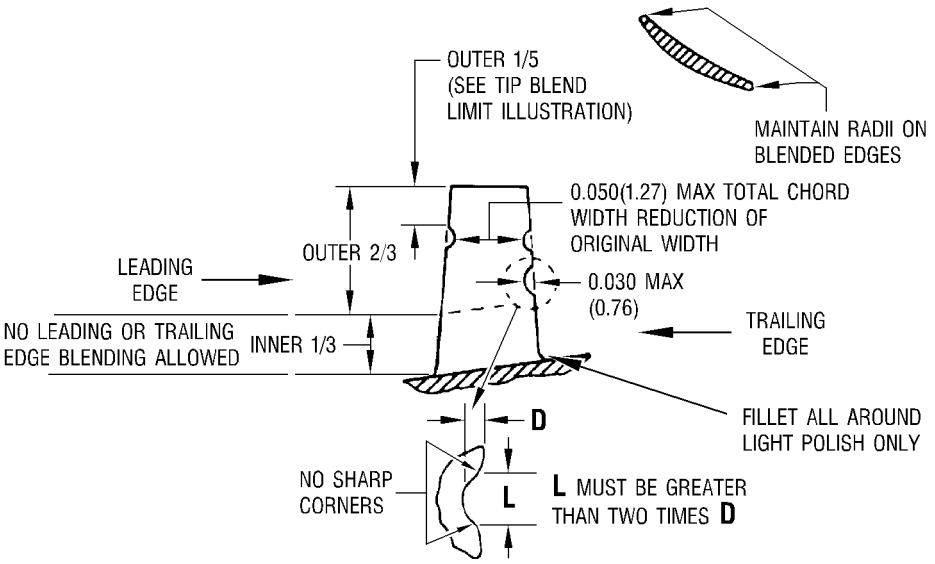
a Pitting in any area of the blade forms a definite line.

b Pit size or location exceeds blend limits.

(7) Erosion.

(a) Replace the compressor assembly when more than 50% of the blades in any stage have a chord width less than the limits shown in Figure 214.

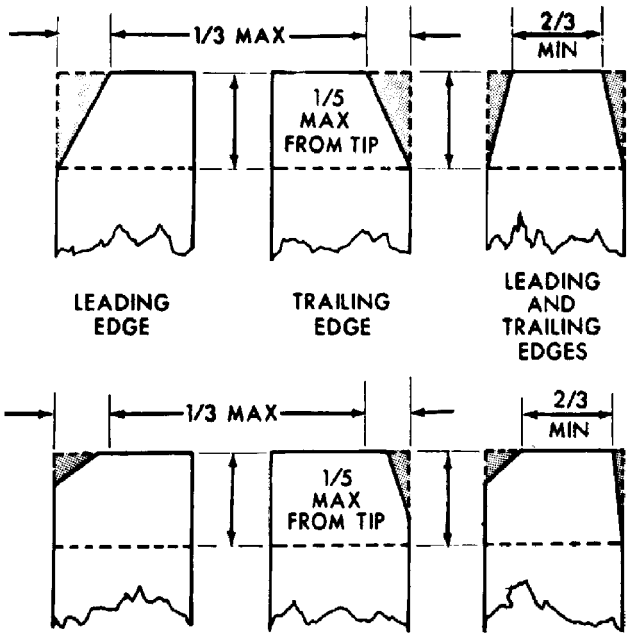
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NOTE: DIMENSIONS ARE IN INCHES (MILLIMETERS)

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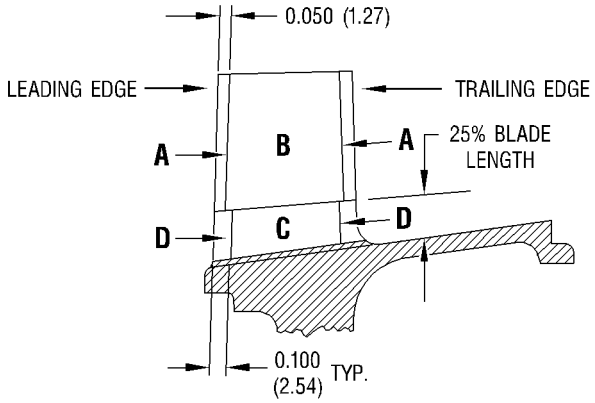
Compressor Rotor Blade Leading and Trailing Edge Blend Limits
Figure 211



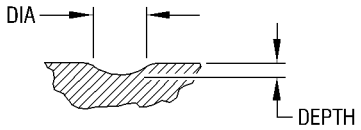
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Compressor Rotor Blade Tip Blend Limits
Figure 212

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VIEW 1. DEFINITION OF BLADE AND WHEEL SURFACES.



VIEW 2. ROUND EDGE, ROUND BOTTOM IMPERFECTIONS.

SURFACE BLENDING LIMIT FOR REMOVAL OF CORROSION PITS, NICKS AND DENTS

AREA	CONCAVE/ CONVEX	DIA. MAX IN. (mm)	DEPTH MAX IN. (mm)	
A	BOTH	0.020 (0.51)	0.008 (0.20)	NOT TO EXCEED 1/3 BLADE THICKNESS.
B	BOTH	0.060 (1.52)	0.020 (0.51)	
C	CONCAVE	0.020 (0.51)	0.010 (0.25)	
D	CONVEX	0.020 (0.51)	0.010 (0.25)	
C	CONVEX	POLISH ONLY - NO MEASURABLE METAL REMOVAL.		
D	CONCAVE	POLISH ONLY - NO MEASURABLE METAL REMOVAL.		

NOTE: ROUND EDGE, ROUND BOTTOM INDENTS (SEE VIEW 2) CAN OCCUR IN THE ORIGINAL AS-CAST SURFACE: THESE ARE NOT CORROSIN PITS. IF THE INDENT CANNOT BE WIPED CLEAN (DARK SPOT REMAINS IN INDENT), BLEND THE INDENT AS A CORROSION PIT.

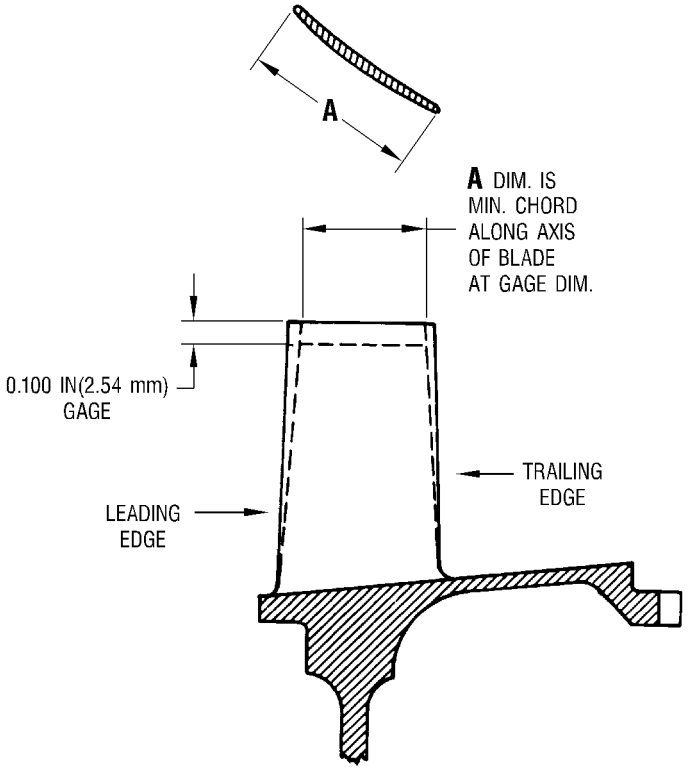
NOTE: COATED COMPRESSOR BLADES - REFER TO NOTE IN 72-30-00 PARA 5.C IF BLENDING IN LOWER 25% OF THE AIR FOIL.

NOTE: DIMENSIONS ARE IN INCHES (MILLIMETERS).

Compressor Blade Surface Blending Limits
Figure 213

ADC102AA

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STAGE	A DIM. IN.	STAGE
1	0.545	(13.84)
2	0.493	(12.52)
3	0.474	(12.04)
4	0.450	(11.43)
5	0.423	(10.74)
6	0.423	(10.74)

Typical Compressor Blade Erosion Limits
Figure 214

Para 5. (cont)

D. Vane Damage.

CAUTION: THE COMPRESSOR CASES SHALL NOT BE IMMERSED IN LIQUIDS. THE CASE MAY BE SET UP IN A VERTICAL POSITION AND SPRAYED WITH MINERAL SPIRITS THEN IMMEDIATELY BLOWN DRY.

Replace the compressor case if any vanes are cracked or broken off or show any evidence of tip rub on the rotor spacer. Refer to the General Practices in Blade Damage, PARA 5.C., this section before reworking any vanes. Inspection limits for the vanes are as follows:

NOTE: Replace the compressor case if vane damage exceeds the limits in Figure 215 or 216. Replace the compressor case if sharp edges, burrs, cracks or tears remain after rework.

(1) Leading and Trailing Edge Damage.

Blend and polish to remove damage within the limits shown in Figure 215. Replace the compressor when these limits are exceeded.

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Para 5.D. (cont)

(2) Surface Damage.

Blend and polish surface damage to the limits given in Figure 215. Replace the compressor when these limits are exceeded cracking is detected on the vane surface.

WARNING: CORROSION OR EROSION WILL CAUSE DAMAGE TO THE COMPRESSOR BLADES AND VANES WHICH CAN RESULT IN ENGINE FAILURE.

(3) Corrosion.

Remove all corrosion stains by polishing. Remove all corrosion pits by blending and polishing to the surface damage blend limits shown in Figure 215. Replace the compressor case when pitting in any area of the vane forms a line or the surface damage limits are exceeded.

(4) Erosion.

Replace the compressor case when vane erosion exceeds the limits defined in Figure 216.

E. Compressor Case Plastic Coating Inspection.

(1) Acceptable.

(a) Cracks in any area provided there is no evidence of debonding, lifting or missing plastic in the blade paths in stages 1 through 4. Refer to Sealing Compressor Case Plastic Coating Cracks, PARA 5.F., this section.

(b) Debonding and loss of plastic between stator vanes in stages 4 through 6. Seal edges around missing or loose plastic using the procedure in Sealing Compressor Case Plastic Coating Cracks, PARA 5.F., this section.

(c) Erosion of plastic coating but not to the extent of exposing any of the vane band adjacent to the vanes or between the vanes in any stage. Vane thickness and chord dimensions must be within the limits of Figure 216.

(d) Blade tip rub in the plastic if there is no evidence of heat discoloration on any blade tip.

(2) Unacceptable.

(a) Loss or removal of plastic sections exceeding 3/8 x 5/8 in. (9 x 16 mm) in the fifth–and sixth–stage blade paths. Remove loose sections of plastic in these stages. Seal the edges at the missing or removed loose plastic sections using the procedure in sealing Compressor Case Plastic Coating Cracks, PARA 5.F., this section.

(b) Cracks in the plastic along the horizontal splitline exceeding 3/4–inch (19 mm) at any blade path. Seal acceptable splitline cracks in accordance with Sealing Compressor Case Plastic Coating Cracks, PARA 5.F., this section.

(3) Limits on Loss of Plastic.

(a) Loss of plastic can have an adverse effect on compressor performance and is a justified reason for replacement of the case on low performance engines.

(b) If more than 50% of the plastic is missing between the vanes in stages 4 through 6, or if more than 20% of the plastic is missing in the blade path of stages 5 and 6, the case should be replaced.

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F. Sealing Compressor Case Plastic Coating Cracks.

Apply silicone resin sealer to plastic coating cracks found during maintenance inspection of in–service compressor cases. This is an interim repair to aid the arrest of compressor case corrosion that could contribute to vane–to–rotor rub problems. The procedure is recommended especially for operators using water rinse as a routine maintenance practice.

(1) Disassemble one case half in accordance with Compressor Case Replacement, PARA 2., this section.

(2) Inspect the case–half plastic coating in accordance with Compressor Case Plastic Coating Inspection, PARA 5.E., this section.

NOTE: The frequency of inspection and interim repair of compressor case plastic coating shall be determined by judgement of the operator based on knowledge of the aircraft operating environment. Inspection time periods of Inspection Checksheet, Table 602, 72–00–00, must not be exceeded.

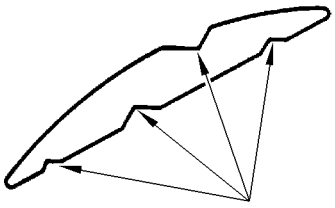
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BLEND LIMITS FOR LEADING AND TRAILING EDGES

GENERAL

IT IS NOT POSSIBLE TO FULLY DESCRIBE ALL OF THE CONDITIONS THAT COULD BE INCURRED; THEREFORE, IF DAMAGE IS WITHIN THE REWORK LIMITS BUT THERE IS REASONABLE DOUBT ABOUT THE STRENGTH OF THE REWORKED VANES, REPLACE THE COMPRESSOR ASSEMBLY.

SURFACE DAMAGE NICKS AND DENTS

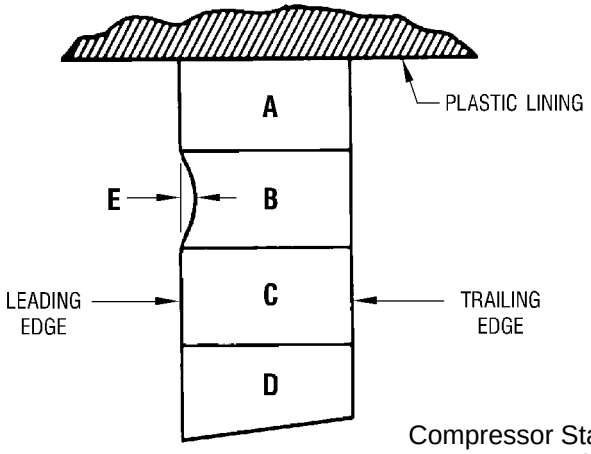


AIRFOIL SURFACE NICKS AND DENTS

OUTER 1/4 OF VANE (RELATED TO CASE AXIS)
MAX. DEPTH OF 1/4 AIRFOIL THICKNESS AFTER BLENDING. MAINTAIN 3/64 (1.19) MIN. BOTTOM RADIUS OF ALL BLENDING. BLENDS MUST NOT BE IN LINE PARALLEL WITH CASE CENTERLINE AND MUST NOT SHORTEN CHORDAL WIDTH OF VANE.

INNER 3/4 OF VANE (RELATED TO CASE AXIS)
MAX. DEPTH OF 1/2 AIRFOIL THICKNESS AFTER BLENDING. MAINTAIN 3/64 (1.19) MIN. BOTTOM RADIUS ON ALL BLENDING. BLENDS MUST NOT BE IN LINE PARALLEL WITH CASE CENTERLINE.

BLEND LIMITS FOR LEADING AND TRAILING EDGES



QUARTER	E-MAX.
A	0.030 (0.76) *
B-C	0.040 (1.02)
D	0.090 (2.29)

*STAGES 1, 2, AND 3 MINIMUM CHORDAL WIDTH IN A SHALL BE WITHIN 0.030 (0.762) OF MAX CHORD AT ANY LOCATION ON THE VANE.

DIMENSIONS ARE IN INCHES (MILLIMETERS)

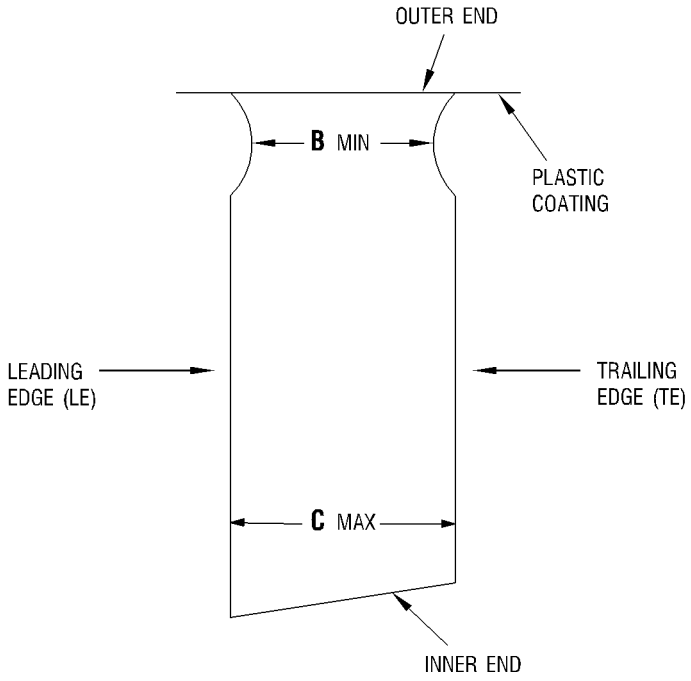
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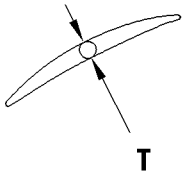
Compressor Stator Vane Blend Limits
Figure 215

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COMPRESSOR VANE EROSION LIMITS

NOTE: IF EROSION OF THE CASE PLASTIC COATING BETWEEN THE VANES AND/OR AROUND THE VANE CONTOUR IS TO THE DEGREE THAT ANY OF THE VANE BAND IS EXPOSED, REPLACE THE ENTIRE VANE SEGMENT (BOTH HALVES). IF THE VANE BAND IS NOT EXPOSED, THE THICKNESS AND CHORD LIMITS DEFINED BELOW APPLY.





STAGE	T MIN.
1	0.049 (1.24)
2	0.028 (0.71)
3	0.020 (0.51)
4	0.020 (0.51)
5	0.020 (0.51)
6	0.020 (0.51)

C MAX. = CHORDAL DIMENSION ALONG VANE AXIS, AS MEASURED AT ANY LOCATION ALONG SPAN.

T = MAJOR VANE THICKNESS MEASURED AT THE OUTER END

STAGES 1, 2, AND 3 (**B** MIN) SHALL NOT BE LESS THAN (**C** MAX) MINUS 0.030 (0.76).

MAJOR THICKNESS **T** IN STAGE 1 SHALL NOT BE LESS THAN 0.049 (1.25)

STAGES 4, 5, AND 6 (**B** MIN) SHALL NOT BE LESS THAN (**C** MAX) MINUS 0.060 (1.52).

MAJOR THICKNESS **T** IN STAGE 2 SHALL NOT BE LESS THAT 0.028 (0.71)

NOTE: VANES ERODED TO ALLOWED LIMITS CAN RESULT IN SIGNIFICANT REDUCTION IN OVERALL ENGINE PERFORMANCE.

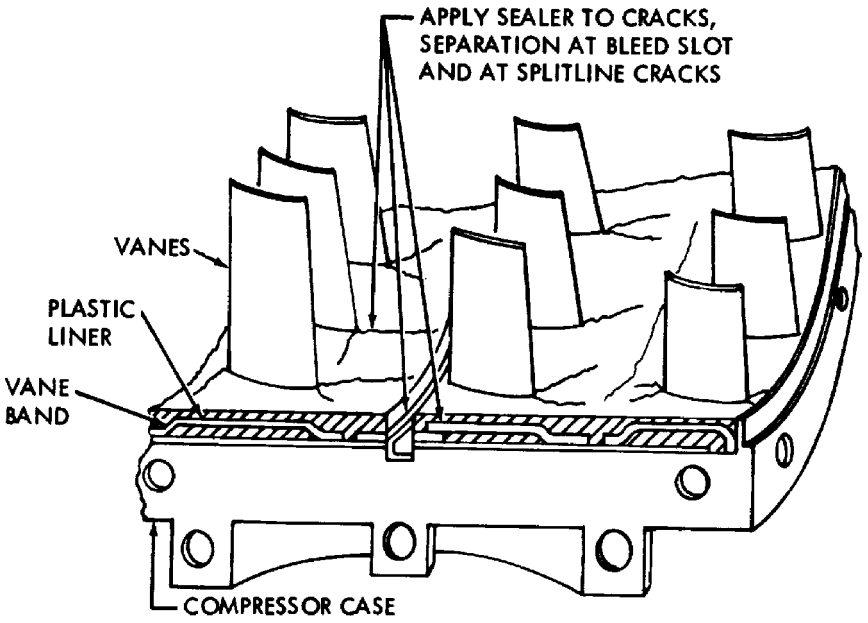
MAJOR THICKNESS **T** IN STAGE 3 THROUGH 6 SHALL NOT BE LESS THAN 0.020 (0.51)

DIMENSIONS ARE IN INCHES (MILLIMETERS)

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Compressor Vane Erosion Limits
Figure 216

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



Typical Plastic Coating Cracks
Figure 217

PARA 5.F. (cont)

(3) Apply silicone–resin sealer (Table 302, 72–00–00) to plastic coating cracks as follows:

NOTE: Do not use sealer on areas without cracks. The application of sealer is of no benefit until after the plastic has developed cracks.

(a) Wash the case ID surfaces with methylethylketone (MEK); thoroughly dry case before application of sealer.

(b) Coat the surface of the plastic in the area of all cracks using a small brush or cotton tip swab. Fill the cracks and exposed edges of the fifth–stage bleed slot. (See Figure 217)

(c) Wipe the excess sealer from the surface of the plastic using a clean cloth.

(d) Allow the first coat to air dry for at least 10 minutes; then apply a second coat to the cracks. Air dry the second coat for 15 minutes.

(e) Install the case half in accordance with Compressor Case Replacement, PARA 2., this section.

(f) Repeat the procedure with the second case half.

G. Compressor Front Support Inspection.

(1) Vanes.

(a) Cracks—none allowed.

(b) Dents—max. of 0.025 in. (0.64 mm) diameter . No punctures allowed.

(c) Bulged Vanes—bulges permitted. No cracks allowed.

(2) Bullet Nose. Evidence of damage not allowed.

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6. Compressor Cleaning

The cleaning and preservation practices which are necessary for proper maintenance of the compressor are as follows:

A. Water Rinse.

Accomplish on a daily basis, when operating in a corrosive atmosphere, using the best water available. Usable water can be obtained from the discharge of an air conditioner or from a cistern. It is not necessary to disconnect any tubing during the water rinse; however, the bleed valve must be blocked in the closed position.

WARNING: SALT LADEN HUMIDITY AND CHEMICALS WILL CORRODE COMPRESSOR BLADES AND VANES AND CAUSE THEM TO FAIL.

CAUTION: BE SURE THE IGNITION CIRCUIT BREAKER IS PULLED TO PREVENT IGNITION DURING THE RINSE CYCLE.

(1) Compressor Contamination Removal

Engines subjected to salt water or other chemically laden atmosphere (including pesticides, herbicides, industrial pollutants, sulfur laden atmosphere, etc.) shall undergo water rinsing after shutdown following the last flight of the day. Perform the rinse operation as soon as practical after flight, but not before the engine has cooled to near ambient temperature.

NOTE: Operators should be aware that salt or chemically laden air may be encountered for 75–150 miles (121–241 km) from the source under certain weather conditions. If there is any doubt about the condition in which your engines are operated, the compressors should be given a daily water rinse. Water will not damage the engine but salt and chemicals will.

(a) Precautions to be observed during the spray rinse:

1 Do not loosen or disconnect any pneumatic or fuel lines in performing the water rinse.

2 Never perform the rinse procedure while the engine is operating. Rinsing at operating speeds is ineffective in cleaning corrosive residue from the blade root and the compressor blades and vanes may be damaged.

3 A motored rinse procedure utilizing the starter with N_1 speed below 10% is the only authorized procedure for the Model 250–C20 Series engines.

4 Use the highest quality water available.

5 Do not spray water into a hot engine. The engine temperature should be satisfactory for water rinse when the bare hand can be placed on the outer combustion case without discomfort.

6 Avoid conditions which would allow the rinse water to freeze.

NOTE: Methyl alcohol may be added to the water to prevent freezing during water rinse in below freezing weather. Mix one part methyl alcohol to one part water. This mixture prevents freezing down to –40°C (–40°F). The methyl alcohol shall contain methanol in concentrations not less than 99.85% by volume. See Table 301, 72–00–00, Engine–Servicing.

7 Do not inject a solid stream of water into the engine. The nozzle must provide a diffused spray pattern.

8 Hold the nozzle so that the spray is centered around the bullet nose of the inlet to ensure that all of the spray is injected into the engine.

9 Spray a minimum of one quart (one liter) into the compressor; there is no maximum limit.

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PARA 6.A.(1) (cont)

(b) Materials and equipment.

1 The highest quality water available must be used.

a The most rapid and economical means to assess water quality is by measuring electrical conductivity. Control of electrical conductivity to a specific low level will automatically yield a low level of chlorides, sulfates, sodium, and other elements. Distilled, demineralized, or deionized water with a maximum electrical conductivity of 3 micromhos per cubic centimeter would be theoretically ideal. However, a more practical level of 20 micromhos per cubic centimeter maximum would control the above impurities to a level of less than 10 ppm.

NOTE: Most water deionizing equipment has the capability to determine electrical conductivity. Commercially purchase deionized/demineralized water, conductivity information should be requested from the vendor.

b Should the electrical conductivity of the water not be known, the use of distilled, demineralized, or deionized water is preferred.

2 Portable equipment such as a garden sprayer or fire extinguisher which can be pressurized to obtain the required flow rate is recommended for water rinse. To provide capability for rinse with either portable equipment or a water supply system, a nozzle capable of flowing the recommended rate at about 55 psig (379 kPa) is desired.

3 The spray nozzle shall provide a diffused spray of water at a flow rate of one quart (one liter) in nine to eleven seconds at the pressure conditions used during compressor rinse. The nozzle should be sized to provide the proper flow rate at the average pressure maintained during each rinse cycle.

NOTE: Test for proper water flow at the pressure to be used by placing the nozzle in a large container so that no water can splash out. Time the flow for 10 seconds and measure the quantity collected. Proper nozzle size for the pressure used should accumulate 1 to 1-1/8 quarts (1.0 to 1.1 liters). Adjust nozzle size as necessary to meet the specified flow limits.

4 A quick opening valve shall be installed in the supply tube as close to the nozzle as practical.

5 6886204 Compressor Cleaning Protector Kit (bleed valve wedge).

(c) Spray rinse procedure:

1 Make sure the anti-ice valve is in the “OFF” position.

2 Make sure the engine ignition circuit breaker is pulled.

3 Block the bleed valve in the closed position using the wedge in 6886204 compressor cleaning protector kit (See Figure 217). It is not necessary to disconnect any lines.

CAUTION: TO PREVENT POSSIBLE BLADE DAMAGE AND TO ASSURE ADEQUATE RINSE AT THE BASE OF THE BLADES, N1 MUST NOT EXCEED 10% RPM. IF N1 RPM REACHES 10%, RELEASE THE STARTER AND CONTINUE THE WATER SPRAY. PERMIT N1 RPM TO REDUCE TO APPROXIMATELY 5% AND THEN RE-ENERGIZE THE STARTER TO OBTAIN A FULL TEN SECONDS OF ENGINE ROTATION WHILE WATER IS SPRAYED INTO THE COMPRESSOR.

4 Start the water injection three seconds prior to engaging the starter. The three second delay will reduce the tendency of the engine to accelerate above 10% rpm.

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5 Spray water into the compressor inlet for 10 seconds while the engine is being motored with the starter. The spray must flow the water as close to the bullet nose of the compressor inlet as possible to ensure that all of the spray is injected into the engine. Do not flood the engine prior to starter engagement.

NOTE: Observe engine speed during the 10 second rinsing operation. The engine rpm will generally stagnate at or just below 10%, but when using a fully charged battery or an A.P.U., the rpm may tend to exceed 10%.

6 Continue injection of water spray during coast down until N_1 stops; this procedure improves the rinse of the base of the blades. Do not continue spray after engine stops.

7 Allow engine to drain. Combustion drain valves may be removed to improve rapid draining of the turbine.

8 Restore engine to operating configuration.

a Remove the wedge from the bleed valve.

b Reinstall the combustion drain valves, and plumbing, if previously removed.

9 Within 15 minutes of the water rinse, operate the engine at idle for five minutes to purge and evaporate all residual water as soon as possible, actuate anti-icing system for one minute.

NOTE: If exposure to excessive salt or other corrosive media has occurred, a repetition of the rinse procedure may be necessary. In cases where the engine has not been receiving regular daily water rinsing, a double rinse may be required to prevent corrosive attack of metals in the engine.

B. Cleaning Compressor Blading

CAUTION: NEVER PERFORM THE CLEANING PROCEDURE WHILE THE ENGINE IS OPERATING; THE COMPRESSOR BLADES AND VANES MAY BE DAMAGED. A MOTORED CLEANING PROCEDURE UTILIZING THE STARTER WITH N_1 SPEED BELOW 10% IS THE ONLY AUTHORIZED PROCEDURE FOR THE M250-C20 SERIES ENGINES.

CAUTION: ONCE THE COMPRESSOR BLADE CLEANING PROCEDURE HAS BEEN STARTED, IT MUST BE CARRIED THROUGH TO COMPLETION WITHOUT DELAY.

(1) Clean the compressor to regain lost performance due to buildup of dirt.

(2) Cleaning is normally required after 200-300 hr of operation in smoggy areas.

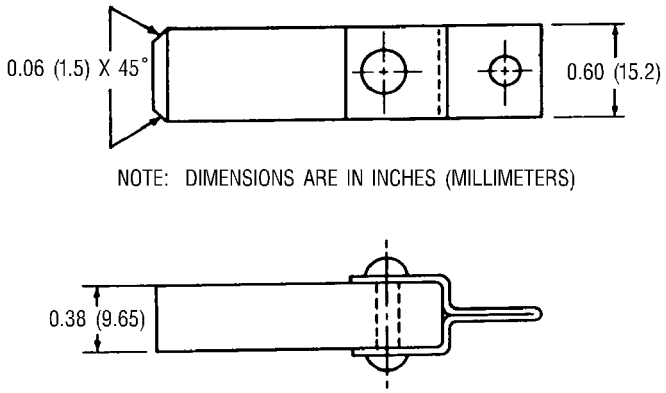
(3) Do not spray cleaning solution into a hot engine. The engine temperature should be satisfactory for cleaning when the bare hand can be placed on the outer combustion case without discomfort.

(4) Tubing must be removed and the bleed valve must be blocked closed during the cleaning.

(5) The solution for cleaning the compressor blading consists of an approved cleaner and water, distilled if available. Refer to Table 302, 72-00-00, Engine-Servicing.

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Bleed Valve Wedge
Figure 218

PARA 6.B. (cont)

(6) (All aircraft except McDonnell Douglas) On engines with Bendix controls, remove the bleed valve sensing tube and the scroll–to–P_c filter P_c tube by disconnecting each tube at both ends. On engines with CECO controls, remove the scroll–to–governor P_c tube by disconnecting at both ends. Removal of the tubes will prevent compressor cleaning solution from entering the fuel control/governor and the bleed valve pneumatic circuits. Cap and plug the disconnected fittings to prevent contamination of the pneumatic system and to prevent compressor cleaning solution from spraying into the engine compartment.

NOTE: Inspect the scroll–to–P_c filter tube at each end for cracks and fretting wear, especially beneath the area of the floating ferrule and at the flared ends. Also, inspect the P_c tube scroll elbow for cracks or damage.

(7) (McDonnell Douglas Aircraft Only) Remove the bleed valve sensing tube by disconnecting at both ends. Disconnect the control system P_c pressure sensing tube at the governor tee (T) fitting. Plug the tube and cap the tee fitting with a metal plug and cap. Dead–heading the P_c tube will minimize the amount of cleaning solution getting into the P_c filter.

(8) Make sure the anti–ice valve is in the “OFF” position.

(9) Make sure the engine ignition circuit breaker is pulled.

(10) Block the bleed valve in the closed position using the 0.60 in. (15.2 mm) dimension wedge in 6886204 compressor protector cleaning kit (See Figure 218).

(11) Disconnect any airframe installed bleed air system, heaters, environmental control units, etc., that may be damaged or contaminated by the compressor cleaning solution.

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PARA 6.B. (cont)

(12) Cap or plug all disconnected fittings.

CAUTION: DO NOT EXCEED 10% N1 RPM MOTORING SPEED DURING CLEANING OR RINSING CYCLES. DO NOT INJECT A SOLID STREAM OF FLUID INTO THE COMPRESSOR.

(13) Inject solution with an aspirator or sprayer equipped with a quick opening valve. Use a steam powered aspirator and hot water, if available.

(14) Start injection three seconds prior to starter engagement and disengage starter at 10% N_1 rpm.

(15) While motoring the engine with the starter, without ignition, inject one quart (one liter) in 9 to 11 seconds to maintain speed below 10% for duration of injection. Repeat injection cycle as necessary to clean compressor.

(16) (McDonnell Douglas aircraft only). Remove the metal plug from the end of the P_c tube. This will allow flushing the P_c filter in the next step.

(17) After injection of cleaning solution, spray steam or clean water (distilled preferred) into the compressor inlet. Start injection three seconds prior to starter engagement, injecting one pint to one quart (0.5 to 1.0 liter) in approximately 5 to 10 seconds, and again disengaging starter before speed accelerates above 10% N_1 rpm.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(18) Clean the bleed valve. (Refer to Cleaning Bleed Valve, Para 2.C., 75–10–02.)

(19) (All aircraft other than McDonnell Douglas aircraft). Reconnect the pressure sensing tubes and airframe bleed air plumbing. Tighten the P_c tube coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(20) (McDonnell Douglas aircraft only). Remove the cap from the governor tee (T) fitting and reconnect the P_c pressure sensing tube to the governor tee. Tighten the P_c tube coupling nut to 80–120 lb in. (9.0–13.6 N·m). Reconnect the bleed valve sensing tube and tighten the coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(21) Start and operate the engine for a minimum of five minutes. Operate the engine anti–icing system to purge any compressor cleaning solution from the compressor inlet housing. Operate all aircraft systems that utilize compressor bleed air. Complete the engine drying run as soon as possible after cleaning and rinsing.

(22) If power is not restored after the compressor has been cleaned, reclean as follows:

(a) Remove one case half and clean the blades and vanes with a small brush (toothbrush) and a mild dishwashing detergent (Lux or equivalent). (Refer to Compressor Case Replacement, para 2., this section, for proper procedure.)

(b) Reinstall the cleaned case half. Remove the second (dirty) case half. Clean blades and vanes and replace case half in the same manner as used with the first case half.

C. Cleaning Water–Alcohol Residue from Engine.

Regular use of water alcohol augmentation may temporarily reduce engine power if impure water has been used. Contaminants from impure water build up in the compressor airflow path. Restore normal power by removing contaminants using the normal compressor cleaning process (Brulin). If Brulin cleaning does not restore normal engine power, clean the engine with 0–200 micron dry Arizona road dust (AC Spark Plug Coarse Air Cleaner Test Dust, or equivalent) as follows:

(1) Start the engine. Load to power requirement just short of liftoff.

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PARA 6.B. (cont)

(2) Feed 1/4 pound (113 grams) of dry 0–200 micron Arizona road dust into the inlet. Feed the dust at a rate of 1/4 pound (113 grams) per 10–20 minutes.

CAUTION: EXCESSIVE USE OF THE DUST CLEANING PROCESS CAN CAUSE PERMANENT ENGINE POWER DEGRADATION DUE TO EROSION OF COMPRESSOR COMPONENTS.

(3) Check engine power output. If power has not recovered satisfactorily, repeat the dust cleaning procedure.

(4) When engine power has recovered satisfactorily, flush the engine with clean water (distilled is recommended) using the same procedure as used for compressor contamination removal. (Refer to Compressor Contamination Removal, para 6.A.(1), this section.)

D. Preservation

Accomplish when the engine will be idle for extended periods of time using moisture absorbing rust preventive. (Refer to para 12.D., 72–00–00, Engine–Servicing.)

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COMBUSTION SECTION-MAINTENANCE PRACTICES

1. Combustion Liner

   A. Removal

      (1) (250-C20S, -C20W) Remove the eight bolts and washers and remove the fireshield access panel.

      (2) Remove the following from the outer combustion case.

      WARNING: MAKE SURE THAT THE IGNITION SWITCH IS OFF BEFORE REMOVING THE SPARK IGNITER OR SPARK IGNITER LEAD ASSEMBLY AS DANGEROUS HIGH VOLTAGES MAY BE PRESENT. ALLOW FIVE MINUTES AFTER OPERATION FOR ELECTRICAL DISSIPATION BEFORE DISASSEMBLY.

         (a) Ignition lead from spark igniter. Ground the lead to the engine to dissipate any stored energy.

         (b) Fuel hose from fuel nozzle. Cap the fuel nozzle and plug the hose.

         (c) Drain hose from burner drain valve.

         NOTE: If the outer combustion case is also being replaced, remove the spark igniter, fuel nozzle and burner drain valve.

      (3) Remove the internal retaining rings attaching the compressor discharge air tubes to the outer combustion case.

      (4) Remove the 24 screws and nuts at the splitline and separate the outer combustion case from the turbine and compressor discharge air tubes.

      (5) Remove the combustion liner.

   B. Installation

      Install the replacement combustion liner as follows:

      (1) Place the combustion liner over the first-stage turbine nozzle shield with the igniter plug opening at the nine o'clock position (looking forward).

      (2) Slip the retaining rings over the large ends of the compressor discharge air tubes.

      (3) Install the spark igniter, fuel nozzle and burner drain valve if they were removed. Required torques are: spark igniter 150-200 lb in. (17-23 N·m), fuel nozzle 200-300 lb in. (23-34 N·m) and burner drain valve 120-140 lb in. (14-16 N·m).

      (4) Apply antiseize compound to the split seal rings. Compress the seal rings with 6799952 installation clamps. Split seal ring gaps should be 180° apart. Place the outer combustion case over the liner while mating it to the compressor discharge air tubes.

      (5) (250-C20, -C20B -C20F, -C20J) Secure the outer case to the turbine with 24 bolts and nuts. Coat bolt threads lightly with antiseize compound before installation. The half-inch (13 mm) length bolt goes at position 20. (On 6887190 engine assembly, the half-inch length bolts go at positions 6 and 20.) Tighten nuts of socket head cap screws to 20-30 lb in. (2.3-3.4 N·m). Tighten nuts of tee-head bolts to 35-40 lb in. (3.9-4.6 N·m) plus locknut drag.

      (6) (250-C20S, -C20W) Secure the outer case to the turbine with 24 bolts and nuts. Coat bolt threads lightly with antiseize compound before installation. Retained on this splitline is the fire shield supporting bracket (positions 4-5). Positions are determined with 1 at top center when looking forward. These two positions take the half-inch bolts. Tighten bolts of socket head cap screws to 20-30 lb in. (2.3-3.4 N·m). Tighten nuts of Tee-head bolts to 35-40 lb in. (3.9-4.5 N·m) plus locknut drag.

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(7) Remove the installation clamps. Seat the compressor discharge air tube anti-rotation pin, which is located in the outer combustion case, into the anti-rotation slot of the compressor discharge air tube by pushing the compressor discharge air tube aft while slightly rotating it CCW and CW until the pin engages the slot. Once the pin is engaged in the slot and the compressor discharge air tube can no longer be rotated, install the compressor discharge air tube retaining ring in the groove in the outer combustion case. Make sure that the compressor discharge air tube is properly seated in the outer combustion case by pulling forward on the compressor discharge air tube. There must be no significant movement in the forward direction.

NOTE: The compressor discharge air tube retaining ring can not be properly installed in the outer combustion case groove unless the anti-rotation pin is correctly seated in the compressor discharge air tube slot.

(8) Install the following on the outer combustion case.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(a) Ignition lead to spark igniter. Tighten coupling nut to 70-90 lb in. (7.9-10.2 N·m).

(b) Fuel hose to the fuel nozzle. Tighten coupling nut to 80-120 lb in. (9.0-13.6 N·m). Secure with lockwire.

(c) Drain hose to the burner drain valve.

(9) (250-C20S, -C20W) Reinstall the fireshield access panel and secure with eight washers and bolts. Tighten bolts to 22-26 lb in. (2.5-2.9 N·m).

(10) Check run the engine after combustion liner replacement. (Refer to Check Run, para 1, 72-00-00, Engine-Adjustment/Test)

C. Inspection and Repair

Inspect the combustion liner in accordance with Table 201. Remove the combustion section for the inspection as described in Combustion Liner, para 1.A., this section.

Table 201

Combustion Liner Inspection and Repair

Item	Condition	Serviceable Limit	Repairable Limit	Disposition
1	Louvers bent closed or restricted by carbon particles	Maintain 0.050-0.070 in. (1.27-1.78 mm) uniform opening		Lightly wire brush as required. Vapor degrease; then reposition by bending to proper opening.
2	Burnt louvers	Refer to Figure 201 for maximum material which can be burned away from individual louvers		Replace liner or send to an overhaul facility for repair.

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Table 201 (cont)

Item	Condition	Serviceable Limit	Repairable Limit	Disposition
3	Pulled or broken spot-welds at liner step	Max of six with no more than three adjacent welds	Four adjacent spotwelds or up to 40% of total per step	Plugweld repair. Drill 3/16-in. (5 mm) dia hole through outer section then press sections together and plugweld using 29-9 W Mo weld rod (AMS 5784).Grind weld material only if it blocks or restricts airflow.
4	Handling damage--mashed out of round	None	Unable to straighten to concentricity limits	Straighten and reform.
5	Handling damage--dented	None	Unable to straighten to concentricity limits or dent causes thin-out of metal	Straighten and reform dents in allowable areas indicated on fig. 202.
6	Localized high temperature distortion indicated by warping of liner surface (normally accompanied by discoloration)	Max of 3/16 in. (5 mm) depth over 1 in. (25 mm) dia and within allowable areas given on fig. 202		Replace liner or send to an overhaul facility for repair.
7	Burning in area of relief slots	Max of 1/16 in. (2 mm) on rear edge or both corners burned max of 1/4 in. (6 mm) along relief slot		Replace liner or send to an overhaul facility for repair.
8	Distortion in dome or exit end of liner	None		Replace liner or send to an overhaul facility for repair.
9	Cracks on outside of liner (dye check)	None		Gas tungsten-arc weld using 29-9 W Mo weld rod (AMS 5784). Crack must be completely welded. Weld material must not obstruct cooling air passage.
10	Crack in tab end inside liner (dye check)	Max of 1/4-in. (6 mm) length and limited to 2 cracks per tab	Three or more cracks, or one or more cracks in excess of 1/4-in. (6 mm) in length	Replace liner or send to an overhaul facility for repair.

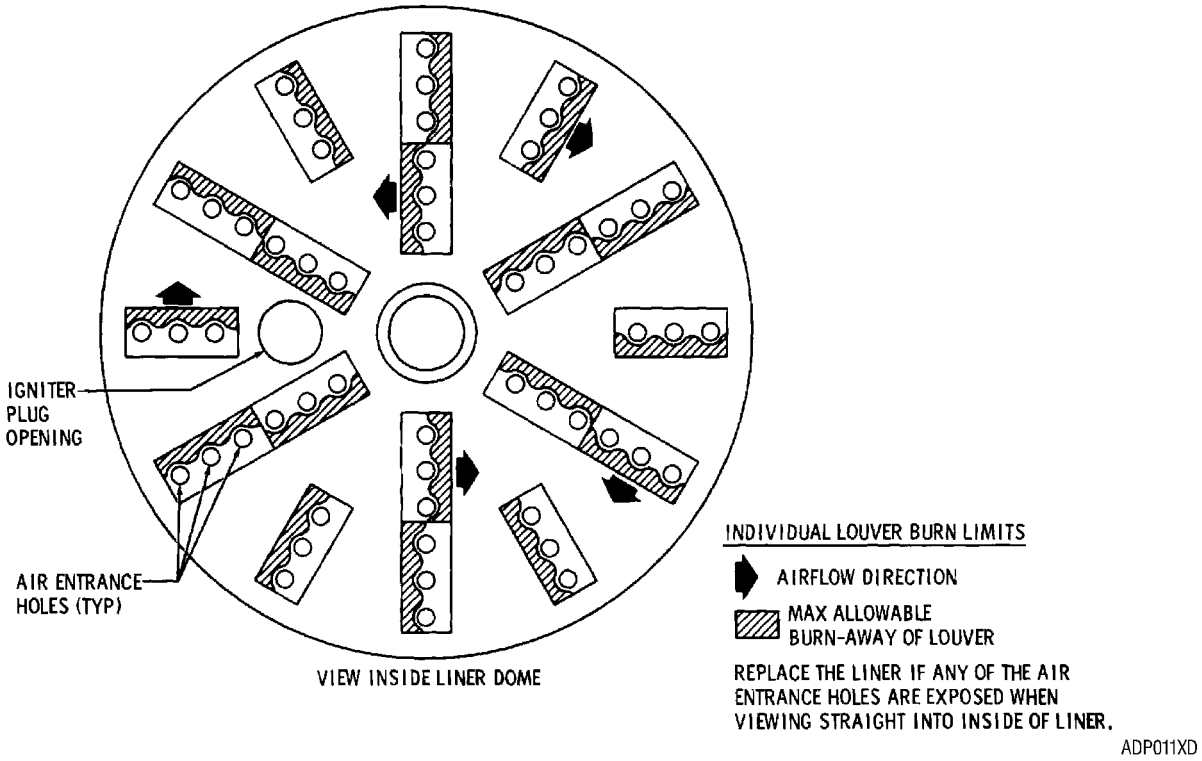
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Table 201 (cont)

Item	Condition	Serviceable Limit	Repairable Limit	Disposition
11	Cracks at two adjacent relief slots progressing toward same hole (dye check)	Max. of 1/8 in. (3 mm) length and limited to two cracks		Replace liner or send to an overhaul facility for repair.
12	Crack in relief slot at combustion liner steps (dye check)	Max of 3/16-in. (5 mm) in length (any number)	Cracks over 3/16-in. (5 mm) with other cracks extending more than 3/8-in. (10 mm) toward air holes	Gas tungsten-arc weld using 29-9 W Mo weld rod (AMS 5784.) Grind weld material only if it blocks or restricts airflow.
13	Crack in double lip area (dye check)	None		Gas tungsten-arc weld using 29-9 W Mo weld rod (AMS 5784). Surfaces between lips must be free of weld material.
14	Cracks in expansion slots	Max of 3/16 in. (5 mm) long		Gas tungsten-arc weld using 29-9 W Mo weld rod (AMS 5784). Surfaces between lips must be free of weld material.
15	Crack in igniter or fuel nozzle ferrule attaching weld (dye check)	None		Gas tungsten-arc weld using Hastelloy X weld rod (AMS 5798). Max width of weld 0.080 in. (2.03 mm).
16	Roughened igniter ferrule ID	Max of 0.560 in. (14.22 mm) ID after polishing		Send liner to an overhaul facility for repair if not within Serviceable Limit after polishing.
17	Worn or distorted (out-of-round) igniter ferrule	Min of 0.020 in. (0.508 mm) wall thickness and max of 0.560 in. (14.22 mm) ID		Replace liner or send to an overhaul facility for repair.
18	Worn or distorted (out-of-round) fuel nozzle ferrule	Max of 0.670 in. (17.02 mm) ID		Replace liner or send to an overhaul facility for repair.

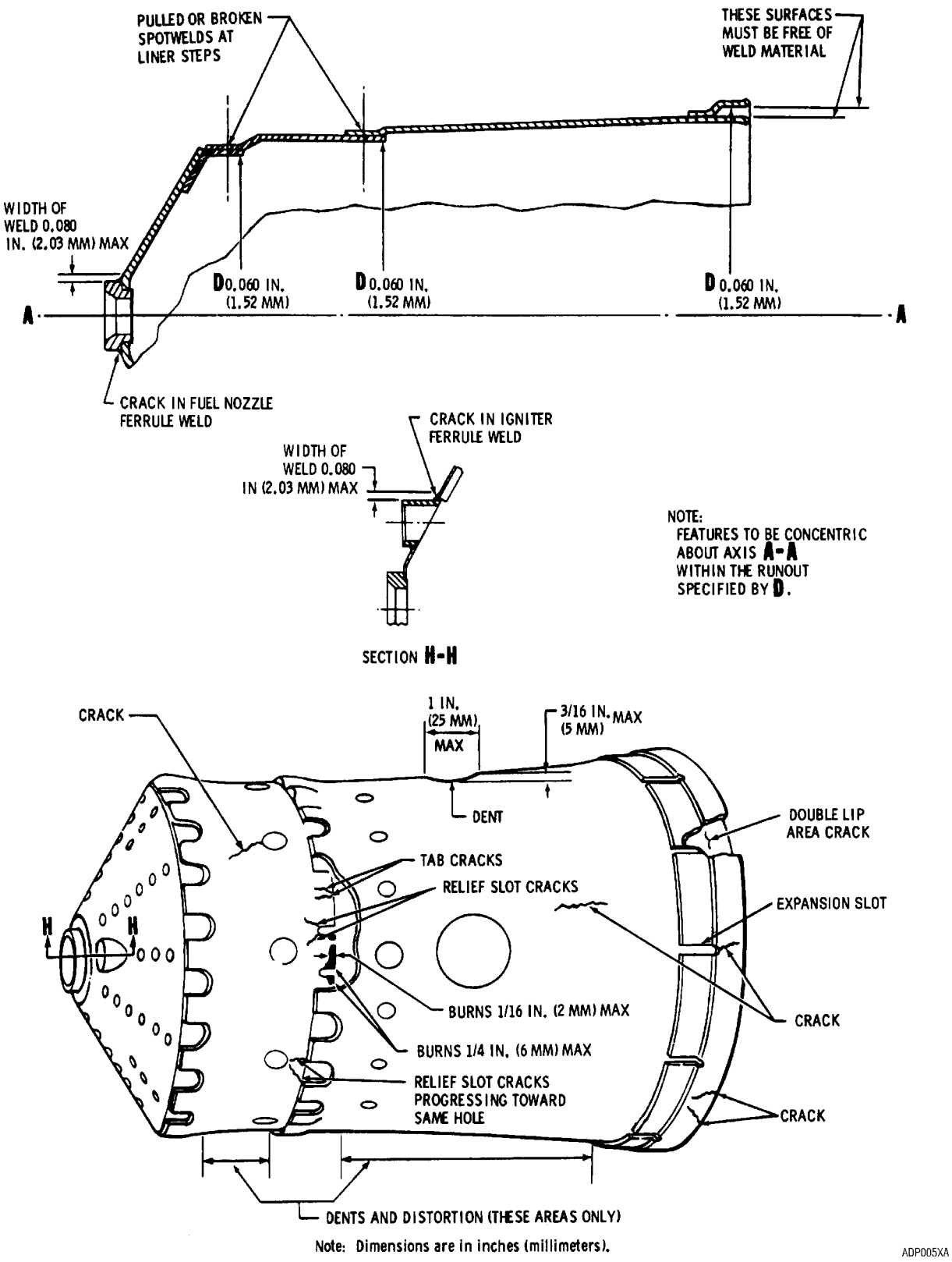
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Inspection of Combustion Liner Dome Louvers
Figure 201

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Inspection of Combustion Liner
Figure 202

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2. Outer Combustion Case

A. Removal/Installation

Refer to Removal and Installation para 1.A. and 1.B., this section, for procedures.

B. Inspection and Repair

Inspect, repair or replace the outer combustion case in accordance with Table 202. After any repair, make a careful, visual, leakage inspection of the outer case during the check run. Leakage is not acceptable.

Table 202
Outer Combustion Case Inspection

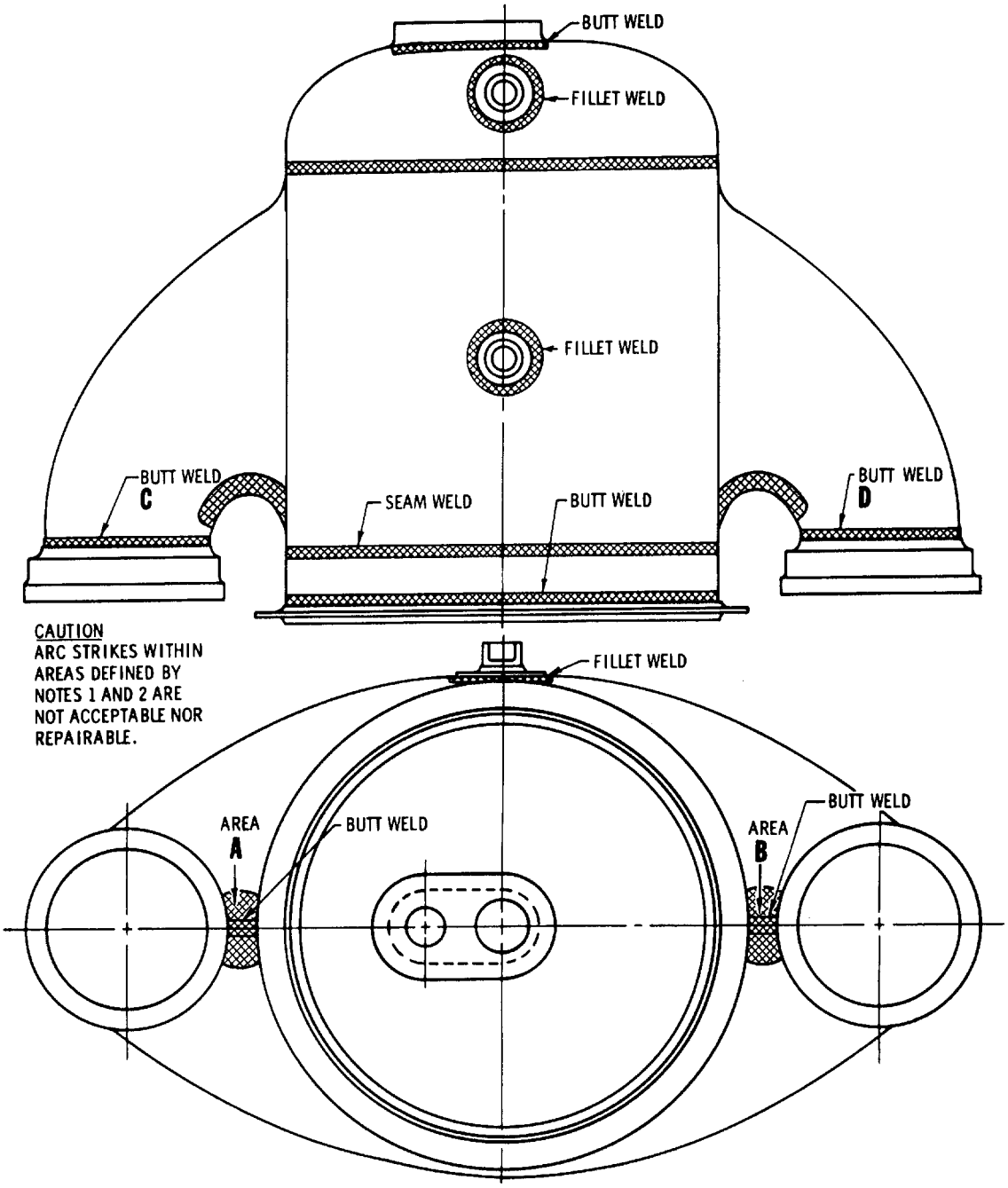
Item	Condition	Serviceable Limit	Repairable Limit	Disposition
1	Cracks in outer shell (dye check)	None		Weld using 29–9 W Mo weld rod (AMS 5784) or send case to an overhaul facility for the repair. Wall thickness shall be 0.016 in.(0.41 mm) minimum. (See Fig. 203.)
2	Cracks in liner inner basket (dye check)	None		Weld using 29–9 W Mo weld rod (AMS 5784) or send case to an overhaul facility for the repair.
3	Entrapped material underliner gasket (visual—dental mirror and/or borescope)	None		Dislodge entrapped material using locally fabricated wire hooks. Remove all foreign material.
4	Stripped or crossed threads in fuel nozzle or drain valve bosses	None	Max of one damaged thread per boss	Chase threads.
5	Dents	Area A, Figure 204. Max of one dent up to 1/8–in. depth x 3 in. length x 1 in. width (3 x 76 x 25 mm) Any other area: Max of 3 dents up to 1/4–in. (6 mm) depth and 1 in. (25 mm) dia.		Straighten and reform.

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Table 202 (cont)

Item	Condition	Serviceable Limit	Repairable Limit	Disposition
6	Crack in drain plug boss (dye check)	None		Weld using 29–9 W Mo weld rod (AMS 5784) or send case to an overhaul facility for the repair.
7	Crack in fuel nozzle or igniter plug boss (dye check)	None		Weld using 29–9 W Mo weld rod (AMS 5784) or send case to an overhaul facility for the repair.
8	Wear in air tube boss (See Fig. 205.)	Max or 0.004 in. (0.10 mm) wear (measured from adjacent unworn area)		Send case to an overhaul facility for repair.
9	Out of round at air tube boss (See Fig. 205.)	Max of 0.004 in. (0.10 mm) out of round		Send case to an overhaul facility for repair.

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NOTE: WELD REPAIR ON THE OUTER COMBUSTION CASE IS AS FOLLOWS:

1. WELD CRACKED AREA WITH SPECIFIED FILLER MATERIAL AND INSPECT.

2. IF CRACK IS WITHIN 1/4 IN. (6.4 MM) OF BUTT OR SEAM WELDS, REINFORCE AREA AS FOLLOWS:
   a. CUT WIRE SCREEN TO EXTEND 1/2 IN. (1.27 MM) MIN ALL THE WAY AROUND WELD.
   b. TACK WELD IN PLACE.
   c. DRY GLASS BEAD PEEN.
   d. CLEAN.
   e. TORCH BRAZE TO BOND ALL AREAS OF SCREEN.

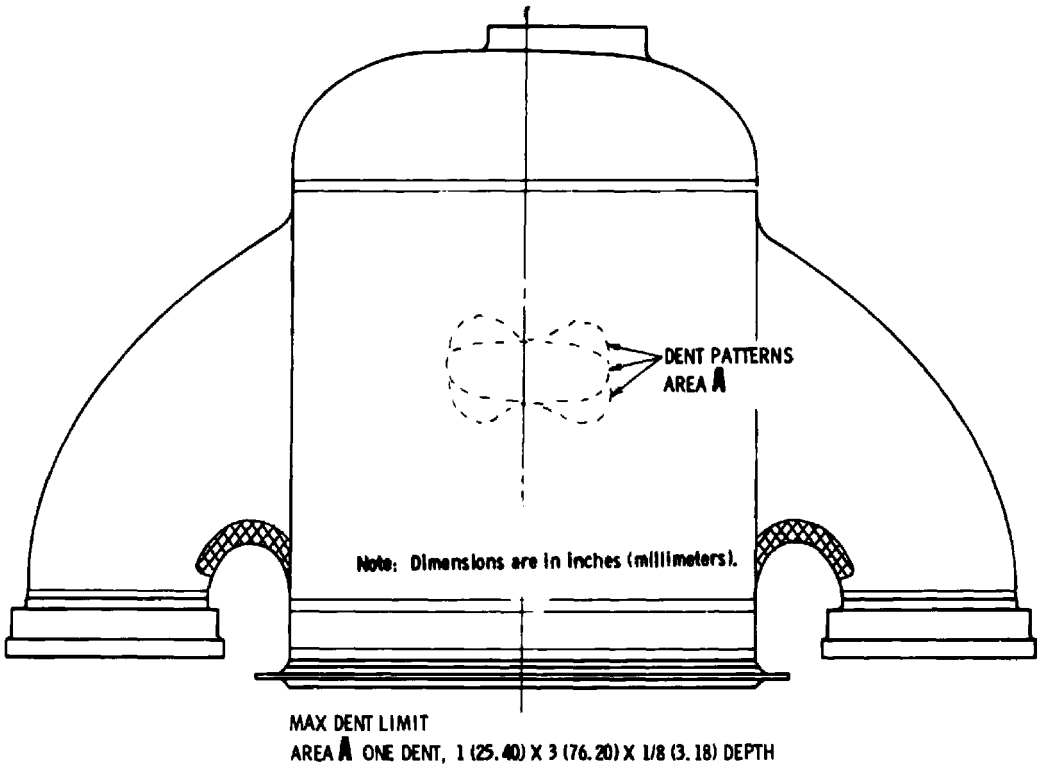
3. CHECK FLANGES FOR SIZE LOCATION AND FLATNESS.

4. PRESSURE TEST AT 130–140 PSI (896–965 kPa)

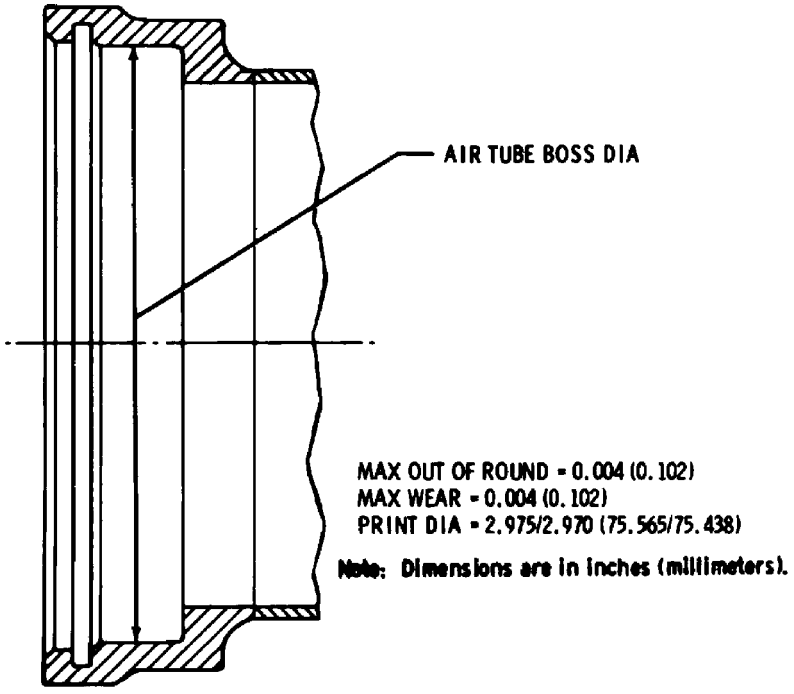
AFP002XA

Weld–Repairable Areas of Outer Combustion Case
Figure 203

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Dent Limits–Top of Outer Combustion Case
Figure 204



Outer Combustion Case Air Tube Boss
Figure 205

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3. Burner Drain Valve

A. Removal/Cleaning/Installation/Check

Remove, clean, install, and check the burner drain valve as follows: (See Figure 206.)

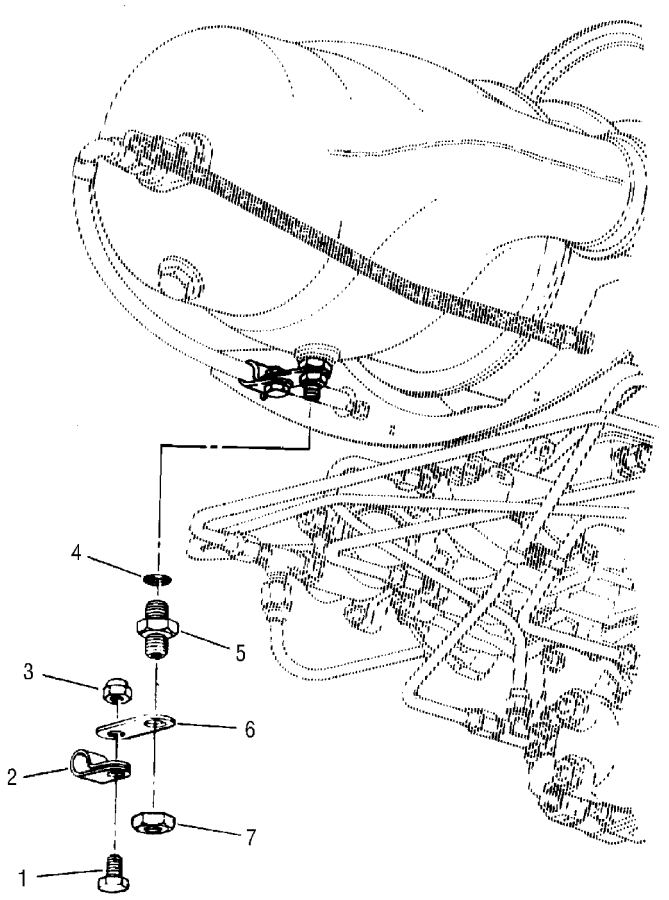
(1) Remove the burner drain valve. Use a wrench on the drain valve boss to offset torque when removing the valve.

(2) Clean the valve in carbon solvent (Pentatone ECS or equivalent). Flush the valve with Stoddard solvent or kerosene. Pass fluid through the valve to verify that it is open. Blow dry with clean shop air.

(3) Apply antiseize compound to the threads of the burner drain valve. Lubricate packing and place it on the burner drain valve. Install the valve in the outer combustion case. Tighten to 120–140 lb in. (14–16 N·m). Use a wrench on the boss to offset torque.

(4) Start the engine and check that the valve is closed to the passage of air. Replace valve if it does not close when the engine is operating. Attach drain hose to valve.

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ADP014XF

1. Bolt*
2. Clamp*
3. Nut*
4. Packing
5. Burner Drain Valve
6. Bracket*
7. Nut*

*Not used on 250–C20S, –C20W

Burner Drain Valve Removal/Installation
Figure 206

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4. Compressor Discharge Air Tubes

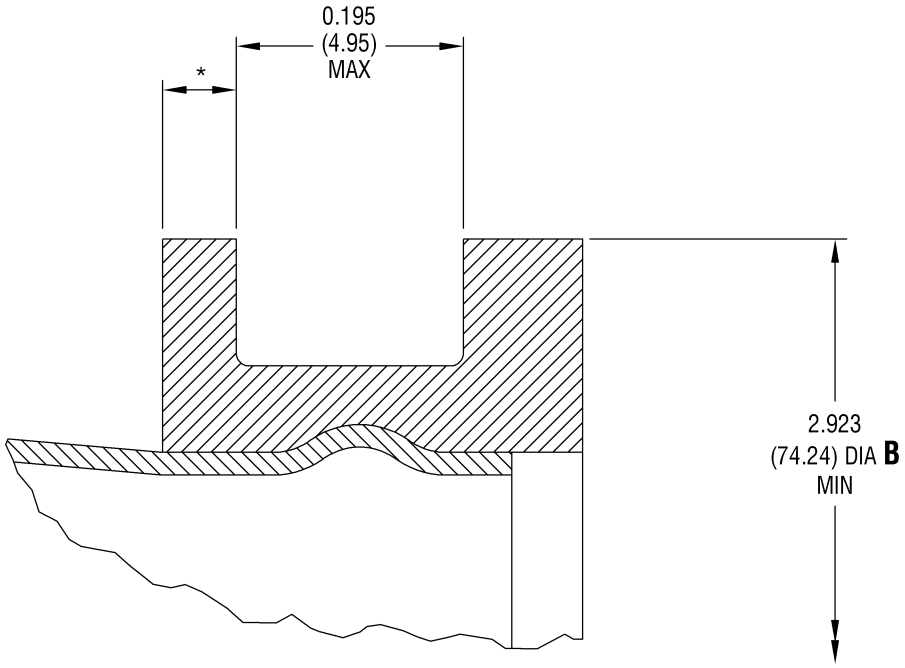
A. Inspection and Repair

Inspect the compressor discharge air tubes in accordance with Table 203. After any repair, make a careful visual, leakage inspection of the tube during the first engine operation following installation of the repaired part. Leakage is not acceptable.

Table 203
Compressor Discharge Air Tube Inspection

Item	Condition	Serviceable Limit	Repairable Limit	Disposition
1	Cracks (dye check)	None	Max of 3 in. (75 mm) (any number)	Weld using 29-9 W Mo weld rod (AMS 5784). Pressure test in 6798787 fixture at 150-160 psig (1034-1103 kPa) for three minutes. No leakage is acceptable. Send tube to an overhaul facility for repair.
2	Dents	Max of 3 dents per tube up to 1/8-in. (3 mm) depth by 1/2-in. (13 mm) dia		Straighten and reform. Dye check after repair.
3	Wear in seal ring groove	Max. of 0.195 in. (4.95 mm) groove width.		Send tube to an Authorized Overhaul Facility for repair.
4	Wear on land surface	Dia. B, 2.923 in. (74.24 mm) Min. Dia. F, 2.183 in. (55.45 mm) Min. (Ref. Figure 207).		Send tube to an Authorized Overhaul Facility for repair.
5	Wear of sheet metal surface	No appreciable loss of metal thickness	1/2 sheet metal thickness	Repair using brazed screen patch or replace. Pressure test 6798787 fixture at 150-160 psig (1034-1103 kPa) for 3 minutes. No leakage acceptable.

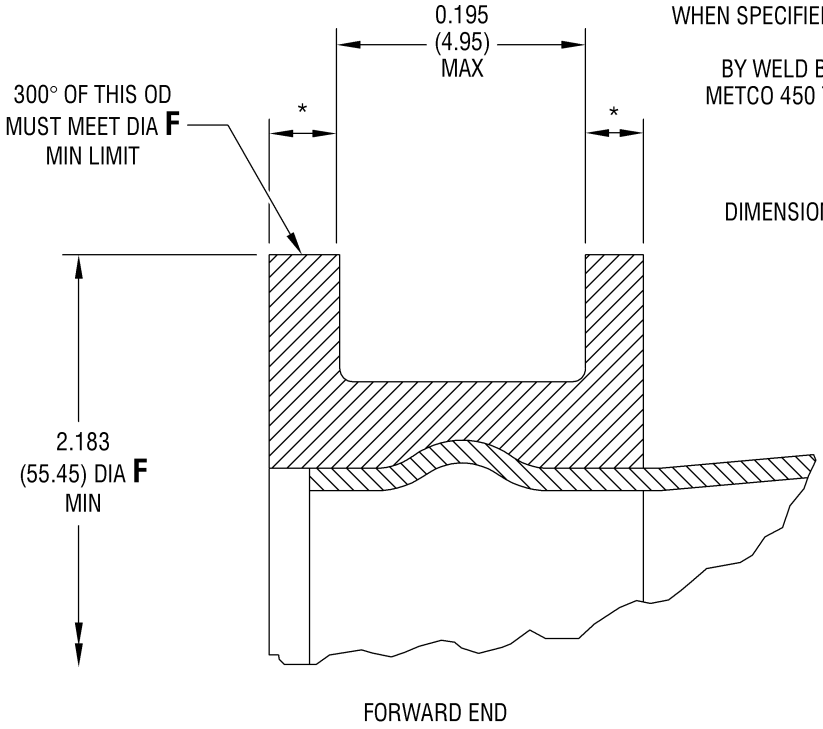
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*0.040 (1.02) MINIMUM PARENT STOCK REMAINING WHEN PREPARING FOR REPAIR.

REPAIR:
WHEN SPECIFIED SERVICEABLE LIMITS ARE EXCEEDED, RESTORE DETAILS BY WELD BUILD-UP OR METAL SPRAY USING METCO 450 THERMO OR PLASMA APPLICATION.

NOTE:
DIMENSIONS ARE IN INCHES (MILLIMETERS)



ACP026AA

Compressor Discharge Tube Inspection and Repair
Figure 207

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TURBINE SECTION–MAINTENANCE PRACTICES

WARNING: AN ENGINE WHICH HAS BEEN OPERATED ON LEADED FUEL HAS A PALE YELLOW POWDER RESIDUE ON THE EXHAUST PASSAGES. HANDLING LEAD RESIDUE COATED PARTS BY PERSONS WITH OPEN CUTS OR SCRATCHES ON THEIR HANDS CAN BE EXTREMELY DANGEROUS. ALWAYS WEAR GLOVES WHEN HANDLING RESIDUE COATED PARTS.

1. Turbine Assembly

A. Removal (250–C20, –C20B, –C20F, –C20J) (See Figure 201)

(1) Remove the following from the engine.

(a) Ignition lead from the spark igniter, firewall shield and clamping points.

(b) Fuel line from the fuel control, firewall shield and fuel nozzle.

(c) Drain hoses at the burner drain valve, firewall shield, and exhaust collector support.

(d) Gas producer fuel control and attached control and fuel lines. (Refer to Gas Producer Fuel Control, 73–20–02 or 73–20–04.)

(e) Power turbine fuel governor and attached control lines. (Refer to Power Turbine Fuel Governor, 73–20–01 or 73–20–05.)

(f) Accumulator and check valve loop type support clamp from the firewall shield. (Bendix control system only.)

(g) Turbine pressure and scavenge oil lines from the firewall shield and external sump.

(h) Remove the lead from the thermocouple terminal. Remove the thermocouple and two thermocouple lead clamps.

(2) Procedure for removal of the Outer Combustion Case, Combustion Liner, and Compressor Discharge and Air Tubes.

(a) Disengage the retaining rings that attach the compressor discharge air tubes to the outer combustion case. Slide the rings forward on the tubes.

(b) Remove the 24 Tee–head bolts and self locking nuts from the turbine–to–outer combustion case splitline and separate the outer combustion case from the engine.

(c) Remove the combustion liner from the aft end of the turbine.

(d) Remove the retaining rings from the aft end of the discharge air tubes.

(e) Remove the two compressor discharge air tubes and make the following inspection of the seal groovelands and of the split seal rings at the compressor (small) end.

1 Remove the split seal rings from the small end of the air tubes.

2 Replace the split seal rings if the edges show wear which could be detrimental to the sealing effect or if the expander ring is broken.

3 Inspect the discharge air tube lands in accordance with Figure 207, 72–40–00.

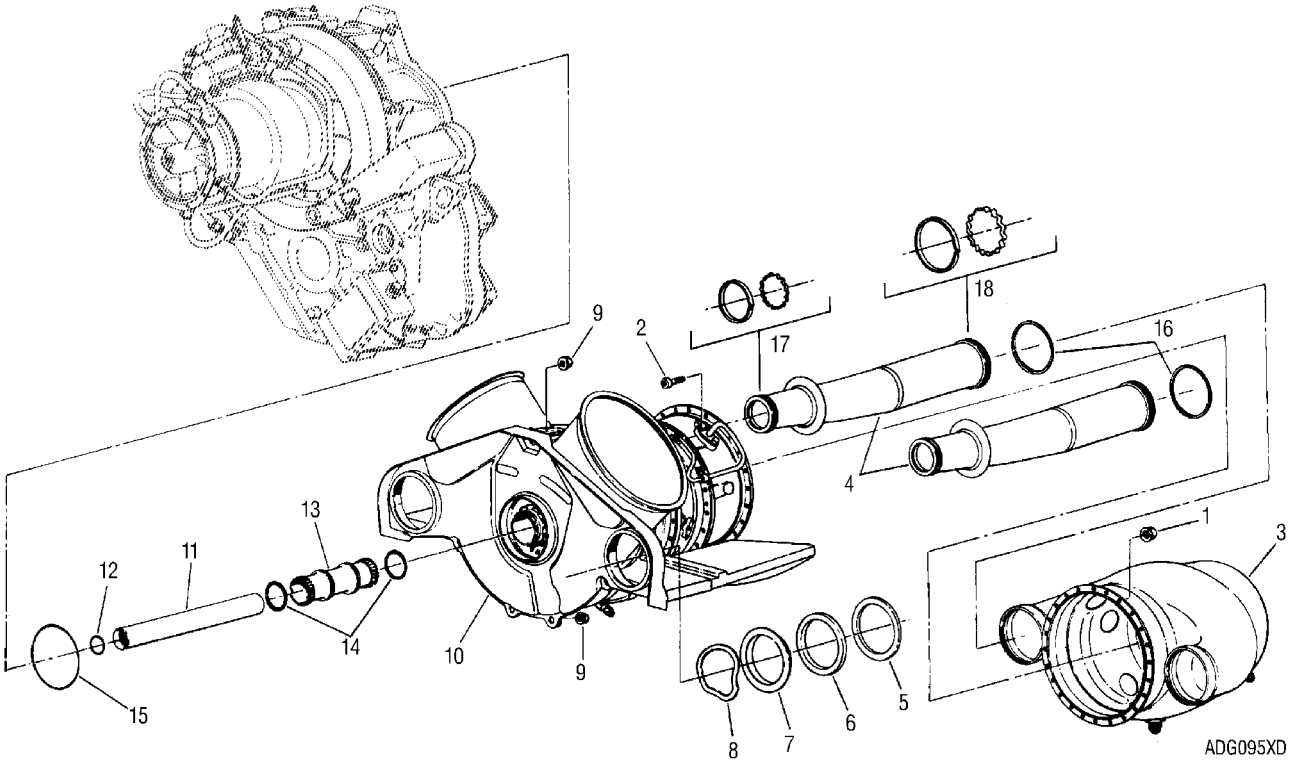
4 Apply antiseize compound to the components of the split seal rings. Install the rings on the discharge air tubes. Split seal ring gaps should be 180° apart.

(3) Remove the five nuts at the splitlines and separate the turbine assembly from the power and accessory gearbox.

(4) Remove the turbine shaft–to–pinion gear and turbine–to–compressor couplings. Discard packings. Replacement couplings are included in the turbine assembly unit exchange package.

(5) Make the following inspection of the turbine–to–compressor coupling splines, and the turbine–to–pinion gear coupling splines.

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1. Nut (24)
2. Bolt (24)
3. Outer Combustion Case
4. Compressor Discharge Air Tube (2)
5. Spacer (2)
6. Packing (2)
7. Seal Ring (2)
8. Wave Washer (2)
9. Nut (5)
10. Turbine Assembly
11. Turbine–to–Compressor Coupling
12. Packing
13. Turbine–to–Pinion Gear Coupling
14. Piston Ring Seal (2)
15. Packing
16. Retaining Ring (2)
17. Split Ring
18. Split Ring

Typical Turbine Removal (250–C20, –C20B, –C20F, –C20J)
Figure 201

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PARA 1.A. (2) (cont)

(a) Visually inspect for cracked or broken spline teeth. No cracked or broken teeth allowed.

(b) Using a sharp pointed scribe, 0.020 in. (0.051 mm) radius, inspect the splines for a wear step. Any discernable wear step that can be felt with the scribe is unacceptable. Polished spline surfaces are acceptable.

(6) Remove the burner drain valve from the outer combustion case (para 3, 72–40–00). Wash in hot detergent, rinse in water and blow dry.

(7) Install the burner drain valve in the outer combustion case. (Refer to para 3, 72–40–00.) Tighten valve to 120–140 lb in. (14–16 N·m).

B. Installation (250–C20, –C20B, –C20F, –C20J) (See Figure 201.)

NOTE: Always replace the packing on the spur adapter gearshaft each time the turbine assembly is removed or anytime the packing is exposed. Use only authorized P/N packings as replacements. (Refer to the 250–C20 Series Illustrated Parts Catalog, Pub. No. 10W4 for part numbers of packings.)

(1) Make a visual inspection through the gearbox bore to verify that the spur adapter gearshaft packing is installed and in good condition.

(2) Apply engine oil lightly to the splines of the two turbine couplings.

(3) Install the compressor–to–turbine coupling on the turbine second–stage splined adapter.

(4) Lubricate two new packings and install them on the turbine shaft–to–pinion gear coupling.

(5) Install the coupling on the rotor of the replacement turbine with the end having the four equally spaced grooves out (toward the gearbox).

(6) Lubricate packing and place it on the back of the power and accessory gearbox.

(7) Install the replacement turbine on the gearbox. Turn the gear trains with the 6799790 engine turning adapter as necessary to allow the coupling splines to mate.

(8) Retain the turbine with five nuts. Coat stud threads lightly with antiseize compound before installation. Tighten the top nut (5/16–24) to 110–120 lb in. (12–14 N·m). Tighten the four bottom nuts (1/4–28) to 55–65 lb in. (6.2–7.3 N·m).

(9) Place the packing, seal ring, and wave washers over the small end of one compressor discharge air tube, then insert the tube through the firewall into the diffuser scroll. Use 6799953 installation clamp to compress the split seal ring for the installation. Split seal ring gaps should be 180° apart. Install the second air tube in the same manner.

NOTE: These items are optional depending on engine configuration.

(10) Slip the retaining ring that attaches the discharge air tube to the outer combustion case over the large end of the discharge air tube.

(11) Install the right hand discharge air tube in the same manner.

(12) Place the combustion liner over the first–stage turbine nozzle shield with the igniter plug opening at the nine o'clock position (looking forward).

(13) Compress the seal rings with 6799952 installation clamps. Split seal ring gaps should be 180° apart. Place the outer combustion case over the liner while mating it to the compressor discharge air tubes.

(14) Secure the outer case to the turbine with 24 bolts and nuts. Coat bolt threads lightly with antiseize compound before installation. The half–inch (13 mm) length bolt goes at position 20. (On 6887190 engine assembly, the half–inch (13 mm) length bolts go at positions 6 and 20.

(15) Tighten nuts of the socket head cap screws to 20–30 lb in. (2.3–3.4 N·m). Tighten nuts of Tee–head bolts to 35–40 lb in. (3.9–4.5 N·m).

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PARA 1.B. (cont)

(16) Remove the installation clamps and secure the discharge air tubes with retaining rings.

(17) Install drain hoses at the burner drain valve, firewall shield, and exhaust collector support.

(18) Attach the ignition lead to the spark igniter, firewall shield and clamping points. Tighten spark igniter coupling nuts to 70–90 lb in. (7.9–10.2 N·m).

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(19) Install the gas producer fuel control and power turbine fuel governor with their control and fuel lines. (Refer to Gas Producer Fuel Control, 73–20–02 or 73–20–04, and Power Turbine Governor, 73–20–01 or 73–20–05.)

(20) Attach the fuel line to the fuel control, firewall shield and fuel nozzle. Tighten nozzle coupling nut to 80–120 lb in. (9.0–13.6 N·m). Secure with lockwire.

(21) Attach the accumulator loop–type support clamp to the firewall shield. (Bendix control system only.)

(22) Install turbine pressure and scavenge oil lines.

(23) Attach the thermocouple terminal to the exhaust collector support with two nuts and bolts. Tighten nuts to 20–25 lb in. (2.3–2.8 N·m).

(24) Clamp thermocouple lead to the firewall shield at two places using clamps, bolts, and nuts. Tighten nuts to 35–40 lb in. (3.9–4.5 N·m).

(25) Attach thermocouple leads to terminal; tighten chromel (small) nut to 10–15 lb in. (1.1–1.7 N·m) and alumel (large) nut to 30–40 lb in. (3.4–4.5 N·m).

(26) Make appropriate entry relative to turbine replacement in the Engine Log.

(27) Check run the engine after turbine replacement. (Refer to Check Run, para 1, 72–00–00, Engine – Adjustment / Test.)

C. Removal (250–C20S, –C20W) (See Figure 202.)

CAUTION: CHECK THE 250–C20 SERIES ILLUSTRATED PARTS CATALOG, PUB NO. 10W4, FOR COMPATIBILITY OF THE TURBINE WITH THE GEARBOX BEFORE ORDERING A REPLACEMENT FOR EITHER PART.

(1) Remove the bolt and washer securing the fire shield RH support bracket to the fire shield.

(2) Remove the gas producer fuel control. (Refer to Gas Producer Fuel Control, 73–20–02 or 73–20–03.)

(3) Remove the power and accessories gearbox–to–check valve and the check valve–to–fire shield pressure oil tubes.

(4) Remove the power and accessories gearbox–to–fire shield scavenge oil tubes.

(5) Remove the spark igniter lead.

(6) Disconnect the thermocouple lead from the aircraft terminal block.

(7) Remove the drain hoses from the exhaust collector support, fire shield, and burner drain valve.

(8) Disconnect the fire shield–to–fuel nozzle hose. Cap the fuel nozzle.

(9) Remove the gas producer support–to–fire shield and the external sump–to–fire shield scavenge oil tubes.

(10) Remove the bolt and washer securing the fire shield to the support bracket at the combustion case splitline. Remove the fire shield.

(11) Remove the internal retaining rings attaching the compressor discharge air tubes to the combustion outer case. Remove the 24 screws and nuts at the splitline and separate the combustion section from the turbine and from the discharge air tubes.

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PARA 1.C. (cont)

(12) Remove the two compressor discharge air tubes and make the following inspection of the seal groove lands and of the split seal rings at the compressor (small) end.

(a) Remove the split seal rings from the small end of the air tubes.

(b) Replace the split seal rings if the edges show wear which could be detrimental to the sealing effect or if the expander ring is broken.

(c) Inspect the discharge air tube lands in accordance with Figure 207, 72–40–00.

(d) Apply antiseize compound to the components of the split seal rings. Install the rings on the discharge air tubes. Split seal ring gaps should be 180° apart.

(13) Remove the burner drain valve from the outer combustion case. Wash the valve in hot detergent, rinse in water and blow dry. Install the cleaned valve in the outer combustion case. Tighten valve to 120–140 lb in. (14–16 N·m).

(14) Remove the five nuts at the splitline and separate the turbine from the power and accessories gearbox.

(15) Remove the turbine shaft–to–pinion gear and the turbine–to–compressor couplings. Discard packings.

(16) Make the following inspection of the turbine–to–compressor coupling splines and the turbine–to–pinion gear coupling splines:

(a) Visually inspect for cracked or broken spline teeth. No cracked or broken teeth allowed.

(b) Using a sharp pointed scribe, 0.020 in. (0.051 mm) radius, inspect the splines for a wear step. Any discernable wear step that can be felt with the scribe is unacceptable. Polished spline surfaces are acceptable.

D. Installation (250–C20S, –C20W) (See Figure 202.)

NOTE: Always replace the packing on the spur adapter gearshaft each time the turbine assembly is removed or anytime the packing is exposed. Use only authorized P/N packings as replacements. (Refer to 250–C20 Series Illustrated Parts Catalog, Pub. No. 10W4, for part numbers of packings.)

(1) Apply engine oil lightly to the splines of the two turbine couplings. Install the compressor–to–turbine coupling on the turbine second–stage splined adapter. Lubricate two new piston ring seals and install them on the turbine shaft–to pinion gear coupling. Install the coupling on the rotor of the replacement turbine with the end having the four equally spaced grooves out (toward the gearbox).

(2) Lubricate packing and place it on the back of the power and accessories gearbox. Install the replacement turbine on the gearbox. Turn the gear trains with 6799790 engine turning adapter as necessary to allow the coupling splines to mate. Retain the turbine with five nuts. Coat stud threads lightly with antiseize compound before installation. Tighten the bottom nut (5/16–24) to 110–120 lb in. (12–14 N·m) and the four top nuts (1/4–28) to 55–65 lb in. (6.2–7.3 N·m).

(3) Place the packing, seal ring, and wave washers over the small end of one compressor discharge air tube, then insert the tube through the firewall into the diffuser scroll. Use 6799953 installation clamp to compress the split seal ring for the installation. Install the second air tube in the same manner.

NOTE: These items are optional depending on engine configuration.

(4) Slip the retaining rings over the large ends of the compressor discharge air tubes.

(5) Place the combustion liner over the first–stage turbine nozzle shield with the igniter plug opening at the nine o'clock position (looking forward).

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(6) Compress the seal rings with 6799952 installation clamps. Place the outer combustion case over the liner while mating it to the compressor discharge air tubes. The fire shield aft support bracket and two half-inch bolts go at bolt positions 4 and 5. Locate the bracket on the aft side of the splitline. Secure the outer case to the turbine with 24 bolts and nuts. Coat bolt threads lightly with antiseize compound before installation. Tighten nuts of socket head cap screws to 20-30 lb in. (2.3-3.4 N·m). Tighten nuts of Tee-head bolts to 35-40 lb in. (3.9-4.5 N·m) plus locknut drag. Remove installation clamps and secure the air tubes with retaining rings.

(7) Place a washer on the pressure oil manifold and install the fire shield. Secure fire shield at the aft support bracket with a bolt and washer.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, AIR AND OIL FITTINGS COULD RESULT IN AN ENGINE FAILURE.

(8) Install the power and accessories gearbox-to-fire shield scavenge oil tubes. Tighten coupling nuts to 150-200 lb in. (17-23 N·m).

(9) Secure the manifold to the fire shield with a nut and washer. Tighten finger tight only. Secure the fireshield with four bolts and washers. The drilled head bolt goes at the position nearest to the gas produce support pressure oil fitting. Tighten bolts to 35-40 lb in. (3.9-4.5 N·m) and lockwire drilled bolt to oil fitting.

(10) Install the power and accessories gearbox-to-check valve pressure oil tube. Tighten coupling nuts to 150-200 lb in. (17-23 N·m).

(11) Install the gas producer support-to-fireshield and the external sump-to fire shield scavenge oil tubes. Tighten coupling nuts to 150-200 lb in. (17.23 N·m).

(12) Remove the cap from the fuel nozzle and install the fire shield-to-fuel nozzle hose. Tighten coupling nut to 80-120 lb in. (9.0-13.6 N·m).

(13) Install the gas producer fuel control. (Refer to Gas Producer Fuel Control, 73-20-02 or 73-20-03.)

(14) Install the check valve-to-fire shield pressure oil tube with screen. Tighten coupling nuts to 150-200 lb in. (17-23 N·m).

(15) Install the spark igniter lead. Tighten coupling nut to 70-90 lb in. (7.9-10.2 N·m).

(16) Install all drain hoses at the exhaust collector support, fire shield and burner drain valve.

(17) Connect the thermocouple lead to the aircraft terminal block.

(18) Make a check run of the engine. (Refer to Check Run, para 1, 72-00-00, Engine-Adjustment/Test.)

2. First-stage Turbine Nozzle and First-stage Turbine Nozzle Shield

Replace first-stage turbine components using the applicable part of the following procedure.

A. Removal

(1) Remove the turbine assembly from the engine. (Refer to Turbine Assembly--Removal, Para 1.A. or 1.C., this section.)

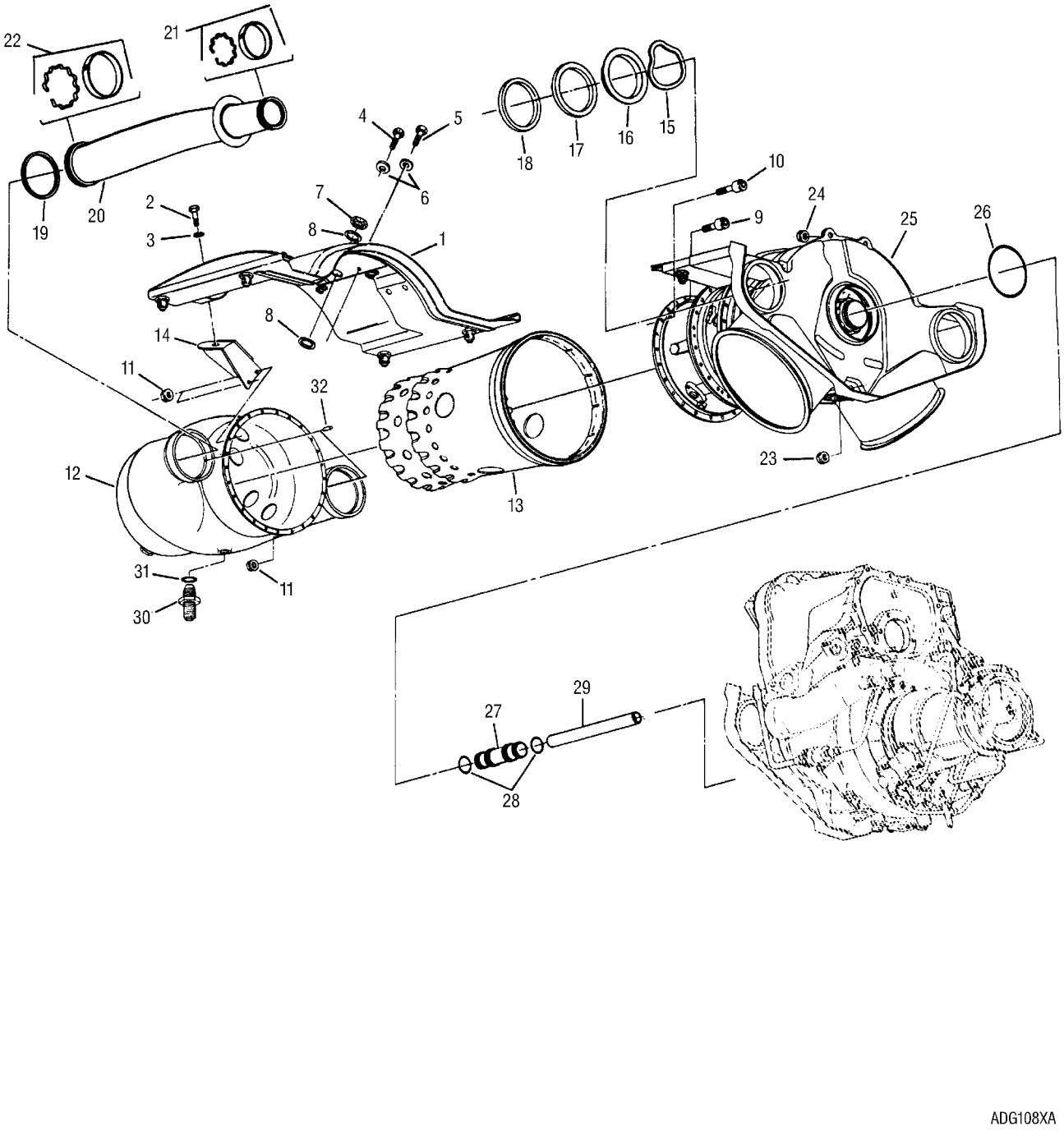
(2) Remove the two nuts, washers and bolts and separate the firewall from the turbine assembly.

(3) Attach the turbine assembly to the 6798089 supporting adapter at the three exhaust collector support bolt holes, with the gas producer support up.

NOTE: It may be necessary to reverse the three turbine attaching studs on the supporting adapter plate from an under side mounting position to a top side mounting position.

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Typical Turbine Removal (250–C20S, –C20W)
Figure 202

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Legend for Figure 202

1. Fire Shield
2. Bolt
3. Washer
4. Bolt (3)
5. Bolt
6. Washer
7. Nut
8. Washer (2)
9. Screw (22)
10. Screw (2)
11. Nut (24)
12. Outer Combustion Case
13. Liner
14. Bracket
15. Wave Washer (2)
16. Ring (2)
17. Packing (2)
18. Spacer (2)
19. Internal Retaining Ring
20. Discharge Air Tube
21. Split Ring (2)
22. Split Ring (2)
23. Nut
24. Nut (4)
25. Turbine
26. Packing
27. Turbine Shaft–to–Pinion Gear Coupling
28. Piston Ring Seal (2)
29. Turbine–to–Compressor Coupling
30. Burner Drain Valve
31. Packing
32. Pin

PARA 2.A. (cont)

(4) (250–C20, –C20B, –C20F, –C20J) Remove the fire shield. (Refer to Fire Shield Removal, Para 3.A., this section.)

(5) Clamp 6798045 holding wrench on the supporting adapter. The wrench fits through the power turbine drive and on the gas producer turbine rotor drive spline. The wrench is secured by two handknobs.

(6) (250–C20S, –C20W) Remove the four bolts securing the gas producer and power turbine pressure oil manifold. Remove the manifold and discard the two packings.

(7) Remove the two positioning plugs and separate the first–stage turbine nozzle shield from the turbine. (See Figure 203 or 204.)

(8) Remove G–type retaining ring.

(9) Remove the gas producer turbine sump and nut assembly using 6798047 sump wrench.

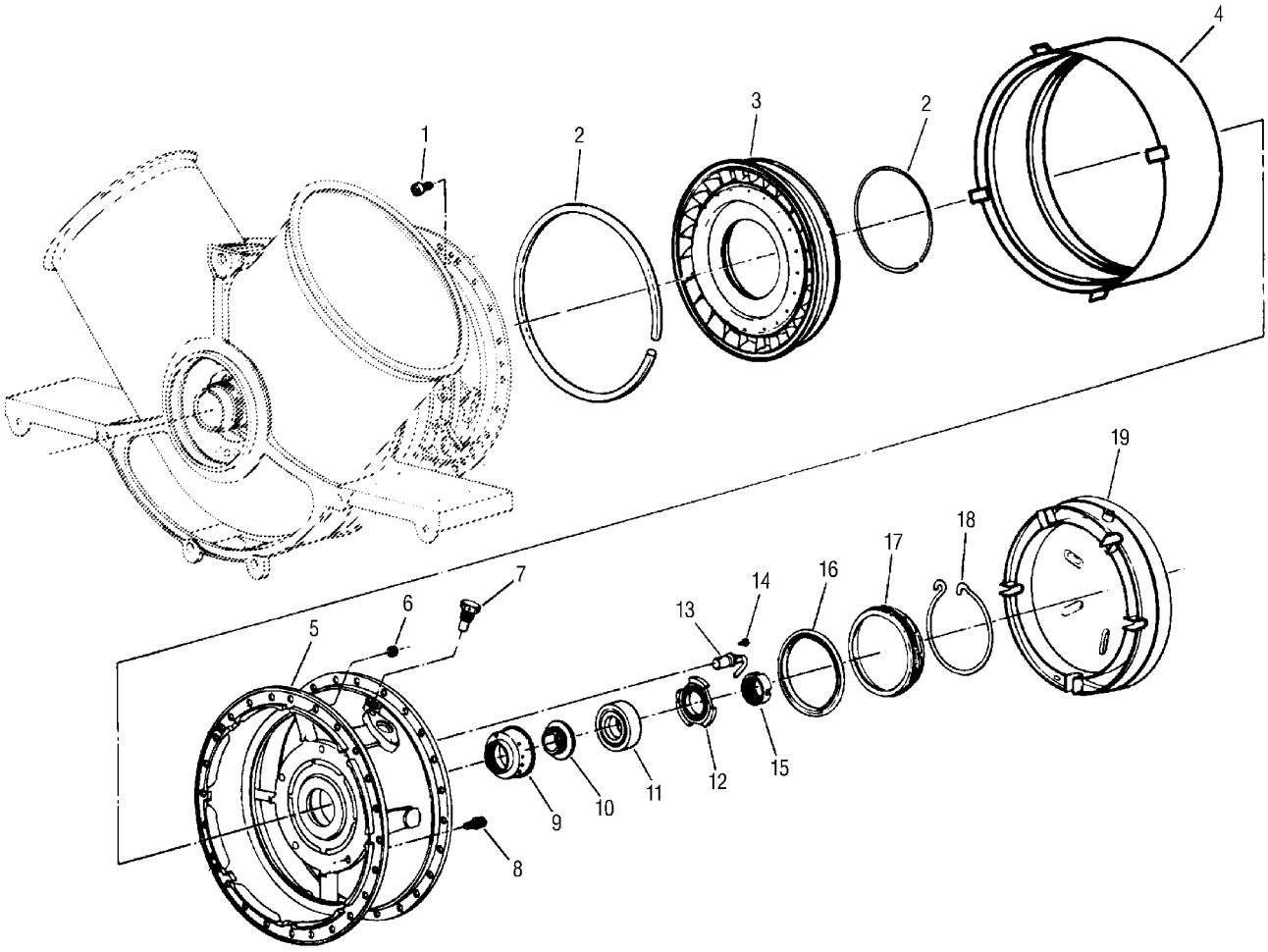
(10) Remove and discard metallic U–ring or E–ring gasket.

(11) Remove the gas producer turbine bearing oil nozzle using 6796920 puller.

(12) Remove the bearing retaining plate.

(13) Remove the spanner nut using 6798046 bearing locknut wrench. (This nut has a left–hand thread.)

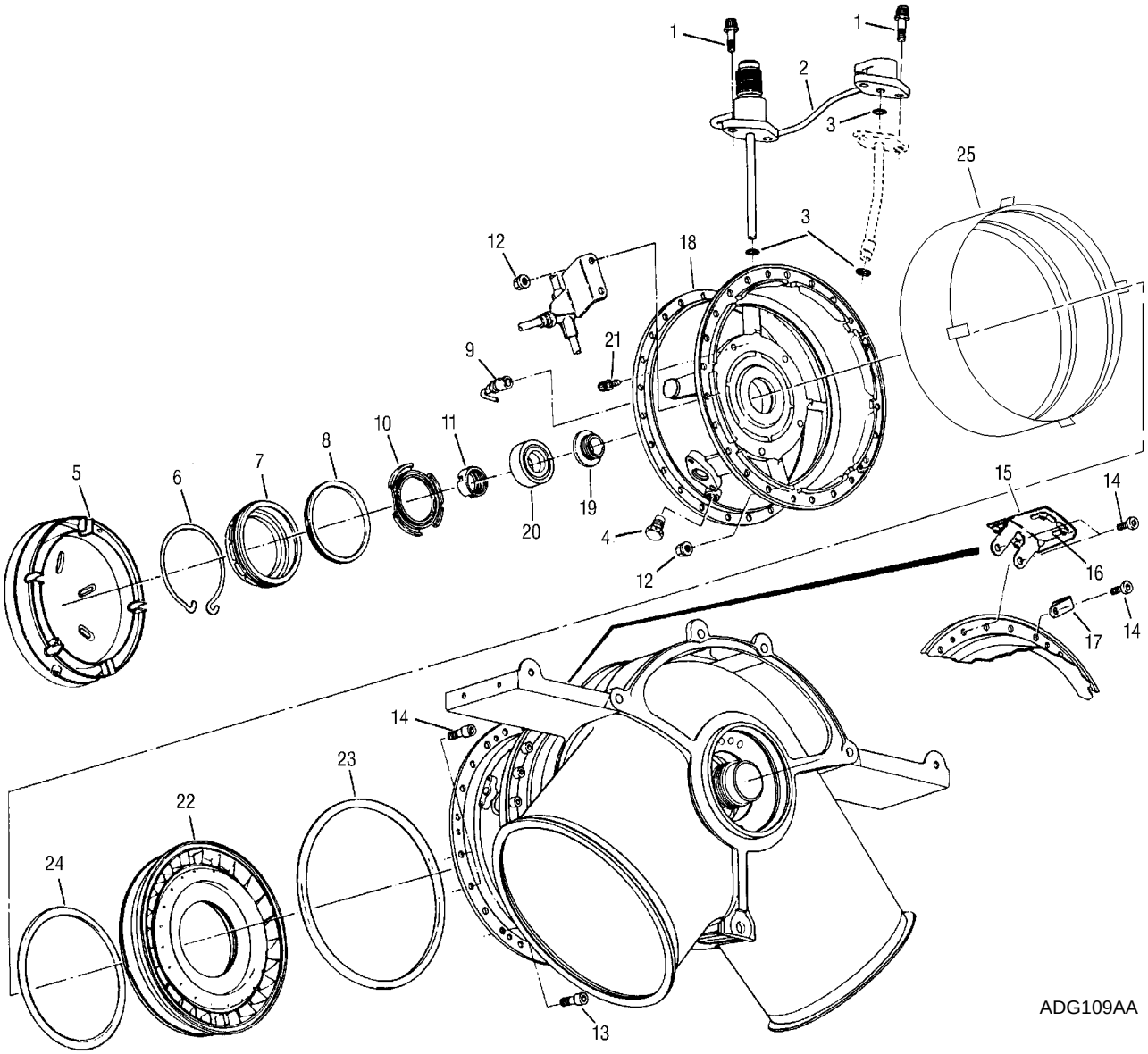
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1. Bolt
2. Preformed Fiberglass Packing
3. First–stage Turbine Nozzle
4. Internal Energy Absorbing Ring
5. Gas Producer Turbine Support
6. Nut
7. Positioning Plug
8. Bolt
9. Stationary Labyrinth Seal and Bearing Support
10. Rotating Labyrinth Seal
11. Bearing
12. Retaining Plate
13. Gas Producer Bearing Oil Nozzle
14. Anti–Rotation Pin
15. Spanner Nut
16. Metallic E–ring Gasket
17. Sump and Nut Assembly
18. G–type Retaining Ring
19. First–stage Turbine Nozzle Shield

First–stage Nozzle Replacement (250–C20, –C20B, –C20F, –C20J)
Figure 203

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1. Bolt (4)
2. Pressure Oil Manifold
3. Packing (3)
4. Positioning Plug (2)
5. First–Stage Turbine Nozzle Shield
6. G–type Retaining Ring
7. Sump and Nut Assembly
8. Metallic E–ring gasket
9. Gas Producer Bearing Oil Nozzle
10. Bearing Retaining Plate
11. Spanner Nut
12. Nut (24)
13. Bolts (19)
14. Bolts (5)
15. Bracket
16. Nut (4)
17. Angle Bracket
18. Gas Producer Turbine Support
19. Rotating Labyrinth Seal
20. Bearing
21. Bolts (5)
22. First–Stage Turbine Nozzle
23 Fiberglass Packing (20.25 in.)
24. Fiberglass Packing (11.12 in.)
25. Internal Energy Absorbing Ring

First–Stage Nozzle Replacement (250–C20S, –C20W)
Figure 204

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PARA 2.A. (cont)

(14) Remove the No. 8 bearing and then the rotating labyrinth seal using 6795590 puller.

(15) Remove the 24 nuts and bolts from the splitline; then lift the gas producer turbine support from the turbine. The thermocouple bracket and an angle bracket for support of the oil manifold clamp are removed during this step. On 250–C20S and –C20W engines, the bracket which supports the fire shield is also removed.

CAUTION: THE TURBINE TO COMPRESSOR COUPLING MAY DROP OUT SUSTAINING DAMAGE IF NOT REMOVED AND THE ENGINE OR TURBINE MODULE IS ROTATED.

NOTE: The second–stage nozzle tang is match marked opposite the small hole on the power turbine and gas producer support flanges. If this mark is not visible, mark it again, immediately after the gas producer turbine support is removed, before the gas producer turbine rotor has been moved in any manner. Match mark energy absorbing ring to the gas producer support using non–permanent marker.

(16) Remove lockwire and five bolts at the rear of the gas producer turbine support; remove the first–stage turbine nozzle. Discard the fiberglass packing.

B. Installation (See Figure 203 or 204.)

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

Install the first–stage turbine nozzle as follows:

(1) Apply petrolatum lightly to the ends to prevent fraying; then insert fiberglass packing (two places) in the first–stage turbine nozzle. Install the packing in such a manner as to get the most packing possible into the seal grooves.

NOTE: Do not lubricate or stretch packing to assist installation.

(1a) Install first–stage turbine nozzle in the support. Attach with five bolts lightly coated with antiseize compound. Before tightening the bolts, install the first–stage nozzle shield and use it to final position the first–stage turbine nozzle. When the nozzle is positioned, remove the shield and tighten the five bolts to 35–40 lb in. (3.9–4.5 N·m) and secure with lockwire. Recheck installation of the first–stage nozzle shield after tightening bolts.

(2) With the turbine installed in 6798089 supporting adapter and with the rotor retained by 6798045 holding wrench, position the index mark on the tang of the second–stage nozzle in alignment with the small hole in the power turbine support flange.

(3) Position the internal energy absorbing ring per previously made match marks.

(4) Place preformed rope packing in the first–stage turbine nozzle; then install the gas producer turbine support on the turbine. The power turbine and gas producer turbine supports are properly indexed when the No. 8 scavenge fitting is in line with the No. 6–7 scavenge port.

(5) (250–C20, –C20B, –C20F, –C20J) Coat the gas producer–to–power turbine support splitline bolt threads lightly with antiseize compound. The half–inch (13 mm) bolts go at positions 2, 3 and 20 counting clockwise with 1 at top center when looking forward. The thermocouple assembly bracket is retained on the aft side of this splitline at bolt positions 1 and 2. An angle bracket for support of the gas producer support pressure oil tube assembly clamp is retained on the forward side of the splitline at bolt position 20.

(6) (250–C20S, –C20W) Coat the gas producer–to–power turbine support splitline bolt threads lightly with antiseize compound. The half–inch (13 mm) bolts go at positions 8, 9, 21, 23 and 24 counting clockwise with 1 at top center when looking forward. The thermocouple assembly bracket is retained on the aft side of this splitline at bolt positions 8 and 9. An angle bracket for support of the gas producer support pressure oil manifold clamp is retained on the forward side of the splitline at bolt position 21. The firewall shield bracket is retained on the forward side of the splitline at bolt positions 23 and 24.

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PARA 2.B. (cont)

(7) When the gas producer turbine support is properly seated on the nozzle tangs, and if the turbine has been alignment built, install the three or four D–head bolts in the line reamed holes. Then install the remaining bolts and nuts.

(8) Alternately tighten nuts 180 degrees apart to 10–15 lb in. (1.1–1.7 N·m); then, repeat the process tightening the nuts of socket head cap screws to 20–30 lb in. (2.3–3.4 N·m) and the nuts of Tee–head bolts to 35–40 lb in. (3.9–4.5 N·m) plus prevailing torque.

(9) Establish the fully seated position of the gas producer sump nut as follows:

(a) Position the bearing retaining plate in the gas producer support sump. Use the pin in the support and the small slot in the plate for the index location. Install a dummy E–ring gasket (crushed to less than retaining plate thickness) during measurement build–up to center the bearing retaining plate.

(b) Lightly lubricate the threads with engine oil, then install the sump nut using 6798047 sump nut wrench. Tighten the sump nut to 40–50 lb ft (54–68 N·m) so that it is seated against the gas producer thrust bearing retaining plate.

(c) Using an approved white pencil, make an index reference mark across the sump nut assembly and the gas producer support castellations. This index mark indicates the fully seated relationship of the assembled sump nut to the gas producer support.

(d) Remove sump nut, dummy E–ring, and bearing retaining plate.

(10) Lubricate with engine oil; then install the No. 8 bearing rotating labyrinth seal on the first–stage turbine wheel stub shaft.

(11) Lubricate (engine oil) and install the gas producer turbine ball bearing using 6895538 press.

NOTE: Install the bearing in the position noted at disassembly.

(12) Lubricate (engine oil) and install the spanner nut using 6798046 bearing locknut wrench. Tighten nut (left–hand thread) to 150–175 lb in. (17–20 N·m) and stake nut edge into lock detent using 23003262 crimper.

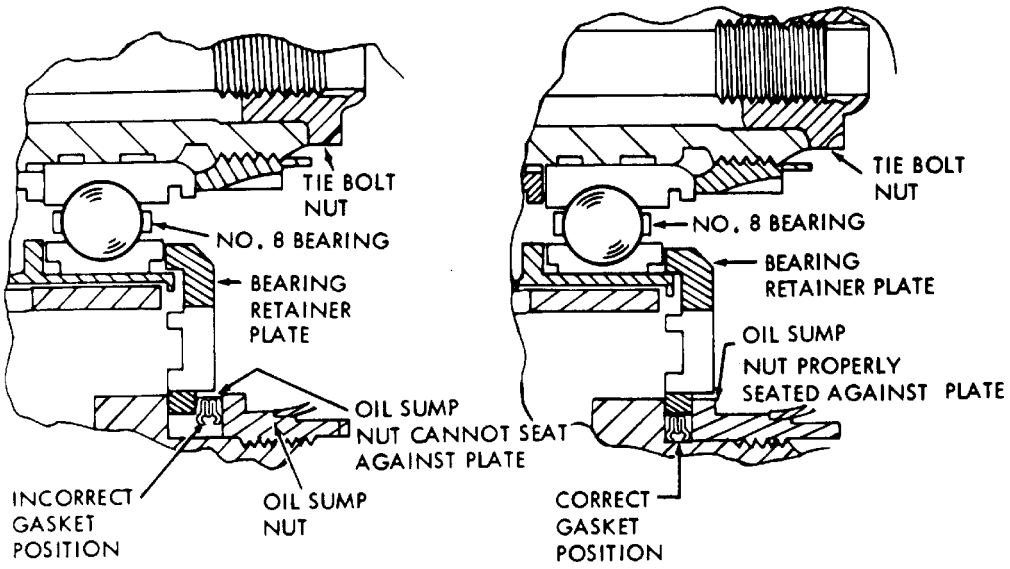
(13) Install the gas producer bearing oil nozzle using 6796920 puller. Be sure the antirotation pin aligns with the index slot of the oil nozzle. If the pin does not engage the slot of the nozzle, stake the pin into the slot in such a manner that the nozzle can be removed without removal of the pin. Replace pin having cracks or tears in the staked surface.

CAUTION: MAKE SURE THE CORRECT SIZE METALLIC E–RING GASKET IS INSTALLED. THE CORRECT SIZE GASKET FITS AROUND THE OD OF THE RETAINING PLATE. MAKE SURE THE GASKET DOES NOT HANG UP ON THE THREADS: THE GASKET AND PLATE MUST BE CORRECTLY SEATED IN THE SUPPORT BEFORE NUT INSTALLATION. (SEE FIGURE 205.) IMPROPER GASKET FIT OR INSTALLATION ALLOWS INCREASED AIR PRESSURE IN THE AREA OF THE NO. 8 BEARING. INCREASED AIR PRESSURE FORCES OIL THROUGH THE LABYRINTH SEAL ONTO THE FIRST–STAGE TURBINE WHEEL.

(14) Install the metallic E–ring gasket.

(a) Carefully coat the threads of the sump nut assembly with engine oil. Lubricate and position the metallic E–ring gasket with the rolled edge adjacent to the sump. (See Figure 205.) Position bearing retaining plate against the bearing. Use the pin in the support and small slot in the plate for index location. Install the sump nut using the 6798047 sump wrench.

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Metallic E–ring Gasket Installation
Figure 205

PARA 2.B. (14) (cont)

(b) Tighten until the nut is seated and the white reference index marks are aligned. Do not exceed 100 lb ft (135 N·m) torque.

(c) If the torque required to align the reference marks is less than 40 lb ft (54 N·m) or greater than 100 lb ft. (135 N·m), replace the E–ring gasket with a new part.

WARNING: AIR LEAKAGE ACROSS THE E–RING SEAL WILL RESULT IN PRESSURIZATION OF THE NUMBER 8 BEARING SUMP. PRESSURIZATION OF THE NUMBER 8 SUMP WILL CAUSE A FLOW REVERSAL ACROSS THE NUMBER 8 LABYRINTH SEAL. THIS LEAKAGE CAN RESULT IN AN ENGINE FIRE AND SUBSEQUENT TURBINE WHEEL RIM FAILURE.

(15) Install the G–type retaining ring.

(a) Make a leak check of the No. 8 bearing sump to ensure proper E–ring gasket installation. (Refer to E–ring Gasket Installation Leak Check, para 5., this section.)

NOTE: When a turbine assembly is removed for smoking or high oil consumption and leakage through the No. 8 bearing labyrinth seal is suspected, performing the pressure test prior to tear down will help to confirm or eliminate pressure leaks at the E–ring gasket or brazed cap of the sump nut.

(16) Install the first–stage turbine nozzle shield on the turbine. Retain with two positioning plugs. Coat threads of plugs lightly with antiseize compound before installation. Tighten positioning plugs to 100–150 lb in. (11–17 N·m) and secure with lockwire.

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PARA 2.B. (cont)

(17) (250–C20, –C20B, –C20F, –C20J) Install the firewall shield. (Refer to Fire Shield Installation, Para 3.B., this section.)

(18) Remove the turbine from the supporting adapter.

(19) Install the firewall on the front of the turbine. Retain with two each nuts, bolts, and washers. Coat threads of bolts lightly with antiseize compound before installation. Tighten nuts to 35–40 lb in. (3.9–4.5 N·m).

(20) Make a visual inspection through the gearbox bore to verify that the spur adapter gearshaft packing is installed and in good condition.

(21) Apply engine oil lightly to the splines; then install the turbine–to–compressor coupling on the spur adapter gearshaft. Lubricate two new packings and install on the turbine shaft–to–pinion gear coupling; then install the coupling on the turbine rotor. Be sure the coupling is installed on the turbine rotor with the end having four equally spaced grooves out (toward the gearbox).

(22) Install the turbine on the engine. (Refer to Turbine Assembly–Installation, Para 1.B. or 1.D., this section.)

(23) Check run the engine following replacement of the turbine nozzle. (Refer to Check Run, para 1., 72–00–00, Engine—Adjustment/Test.)

3. Fire Shield

The fire shield can be removed from the engine to gain access to turbine components and splitline bolts, nuts and brackets. It must be removed from the 250–C20, –C20B, –C20F, or C20J series engine before the thermocouple assembly can be removed. Remove the fireshield as follows:

A. Removal (250–C20, –C20B, –C20F, –C20J)

(1) Remove the gas producer fuel control assembly and attached control and fuel lines. (Refer to Gas Producer Fuel Control Replacement, Para 2.A., 73–20–02 and Para 2.A., 73–20–04.)

WARNING: TO PREVENT ELECTRICAL SHOCK DURING REMOVAL OF THE SPARK IGNITER AND THE LEAD, ALLOW FIVE MINUTES FOR ELECTRICAL DISSIPATION FOLLOWING IGNITION OPERATION OR TEST.

(2) Remove the nuts and bolts to disconnect the clamping arrangements on the igniter lead. Disconnect the igniter lead from the spark igniter. Remove two nuts and bolts securing the igniter lead to the fire shield and separate the lead from the fire shield.

(3) Remove the fire shield–to–fuel nozzle hose. Cap the fuel nozzle.

(4) Remove the gas producer support scavenge oil fitting–to–gearbox scavenge oil tube and the external sump–to–gearbox scavenge oil tube.

(5) Remove the gearbox–to–check valve pressure oil tube, check valve and check valve–to–fireshield pressure oil tube as an assembly.

(6) Disconnect the fire shield drain lines.

(7) Remove the two attaching screws and remove the oil sump.

(8) Remove the two nuts and washers retaining the fire shield to the scavenge oil fitting and to the pressure oil tube elbow.

(9) Remove the two attaching bolts and washers attaching the fire shield to the splitline brackets.

(10) Lower the fire shield to disengage the scavenge oil fitting and pull rearward to separate it from the turbine and exhaust collector support. Remove the washer and spacer from the scavenge oil fitting. Remove the washer from the pressure oil tube elbow.

(11) If the gas producer support scavenge oil fitting is cocked and/or shows evidence of oil leakage, remove the fitting.

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PARA 3. (cont)

NOTE: If these conditions do not exist, it is not necessary to remove the scavenge oil fitting.

B. Installation (250–C20, –C20B, –C20F, –C20J)

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

CAUTION: KEEP PERMATEX OUT OF SCAVENGE OIL PASSAGES.

(1) If the gas producer scavenge oil fitting was removed, reinstall it as follows:

(a) Apply a coat of sealer (Permatex 1372 or equivalent) to the seal recess of the pad for the scavenge fitting on the gas producer support.

(b) Install a new packing seal into the coated seal recess. Lightly overcoat the installed packing with Permatex (or equivalent).

(c) Install the scavenge oil fitting. Retain with two bolts. Tighten bolts alternately to 35–40 lb in. (3.9–4.5 N·m). Use care while tightening to prevent cocking the fitting.

(2) Install the fire shield as follows:

(a) Select the required bushing for the scavenge oil fitting. The bushing plus the washer shall be sized to accommodate the void and maintain a parallel relationship between the fitting and the horizontal fire shield. Install the bushing and washer on the scavenge fitting.

(b) Install a washer on the pressure oil tube elbow.

(c) Install the fire shield on the engine. Be sure the fire shield engages the flange on the turbine and exhaust collector support.

(d) Retain the fire shield at the scavenge oil fitting with a washer and hex nut. Tighten the nut to 55–80 lb in. (6.2–9.0 N·m).

(e) Retain the pressure oil tube elbow with a washer and nut. Tighten the nut to 55–80 lb in. (6.2–9.0 N·m).

(f) Install the fire shield with two retaining bolts and washers. Tighten bolts to 35–40 lb in. (3.9–4.5 N·m).

(3) Apply sealer (Permatex or equivalent) lightly to the power turbine support scavenge oil external sump packing. Install packing and sump. Retain sump with two bolts. Tighten bolts to 35–40 lb in. (3.9–4.5 N·m) alternately in small increments.

(4) Install the gas producer fuel control assembly. (Refer to Gas Producer Fuel Control Replacement, Para 2.B., 73–20–02 or 2.B., 73–20–04.)

CAUTION: WHEN TIGHTENING THE GAS PRODUCER SCAVENGE OIL TUBE COUPLING NUT ON THE SCAVENGE OIL FITTING, BE SURE THAT THE OIL TUBE DOES NOT CAUSE BINDING AT THE FITTING. ANY MISALIGNMENT OF THE TUBE THAT WILL PLACE A COCKING LOAD ON THE FITTING COULD CAUSE OIL LEAKAGE.

(5) Install the gearbox–to–check valve pressure oil tube, check valve and check valve–to–fire shield pressure oil tube as an assembly between the elbow at the fire shield and the elbow at the gearbox. Tighten coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(6) Install the external sump–to–gearbox and gas producer support scavenge oil fitting–to–gearbox scavenge oil tubes. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

(7) Clamp the check valve to the external sump–to–gearbox scavenge oil tube with a bolt and nut. Tighten nut to 35–40 lb in. (3.9–4.5 N·m).

(8) Install the fire shield drain lines.

(9) Remove the cap from the fuel nozzle and install the fire shield–to–fuel nozzle fuel hose. Tighten the coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

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PARA 3.B. (cont)

(10) Install the igniter lead through the fire shield and secure to the fire shield with two bolts and nuts. Tighten nuts to 35–40 lb in. (3.9–4.5 N·m). Attach the igniter lead to the igniter plug. Tighten coupling nut to 50–70 lb in. (5.6–7.9 N·m).

(11) Install the three clamping arrangements of the igniter lead. Tighten nuts to 35–40 lb in. (3.9–4.5 N·m).

C. Removal (250–C20S, –C20W)

(1) Remove the gas producer fuel control assembly and attached control and fuel lines. (Refer to Gas Producer Fuel Control Replacement, Para 2.A., 73–20–02 or 2.A., 73–20–03.)

(2) Remove the nuts and bolts to disconnect the clamping arrangements (three on 250–C20S; five on 250–C20W) on the igniter lead. (On the 250–C20W engine, note the location of the spacer on one of the clamping arrangements.) Disconnect the igniter lead from the spark igniter. Remove two nuts and bolts securing the igniter lead to the fire shield and separate the lead from the fire shield.

(3) Remove the fire shield–to–fuel nozzle hose. Cap the fuel nozzle.

(4) Remove the two scavenge oil tubes between the fireshield and gearbox.

(5) Disconnect the fire shield drain lines.

(6) Remove the two turbine scavenge oil tubes from the fittings at the fire shield and from the gas producer turbine scavenge oil fitting and from the external sump.

(7) Remove the bolt and nut securing the clamp on the turbine pressure oil check valve to the fire shield. Remove the gearbox–to–check valve pressure oil tube, check valve and check valve–to–turbine pressure oil tube as an assembly. Remove the screen from the manifold fitting. Flush the screen with mineral spirits.

(8) Remove the lockwire and remove nut, bolt and washers retaining the fire shield to the pressure oil manifold.

(9) Remove the four bolts and washers securing the fire shield to the fire shield support bracket.

(10) Lift the fire shield to disengage the pressure oil manifold and pull rearward to separate it from the turbine and exhaust collector support. Remove the washer from the pressure oil manifold.

D. Installation (250–C20S, –C20W)

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(1) Install the fire shield on the engine as follows:

(a) Place the washer on the pressure oil manifold.

(b) Install the fire shield on the engine. Be sure the fire shield engages the flange on the turbine and exhaust collector support.

(c) Retain the fire shield to the RH support bracket with a washer and bolt. Tighten bolt to 35–40 lb in. (3.9–4.5 N·m).

(d) Retain the fire shield to the pressure oil manifold with a washer and bolt. Tighten bolt to 35–40 lb in. (3.9–4.5 N·m).

(e) Secure the fire shield to the support bracket adjacent to the pressure oil manifold with four washers and bolts. The drilled–head bolt goes at the position nearest to the pressure oil manifold fitting. Tighten bolts to 35–40 lb in. (3.9–4.5 N·m.)

CAUTION: EXCESSIVE TIGHTENING OF THE MANIFOLD RETAINING NUT CAN CAUSE OIL LEAKAGE.

(f) Secure the fire shield to the pressure oil manifold with a washer and nut. Tighten nut finger tight only and lockwire to the drilled–head bolt.

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PARA 3.D. (cont)

(2) Install the screen in the pressure oil manifold fitting. Install the gearbox–to–check valve pressure oil tube, check valve and check valve–to–turbine pressure oil tube as an assembly between the pressure oil manifold and elbow at the gearbox. Tighten coupling nuts to 150–200 lb in. (17–23 N·m). Clamp the check valve to the fire shield with a bolt and nut. Tighten nut to 35–40 lb in. (3.9–4.5 N·m).

(3) Install the external sump–to–fire shield and gas producer support scavenge oil fitting–to–fire shield scavenge oil tubes. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

(4) Install the two fire shield–to–gearbox scavenge oil tubes. Tighten the coupling nuts to 150–200 lb in. (17–23 N·m).

(5) Install the fire shield drain lines.

(6) Remove the cap from the fuel nozzle and install the fire shield–to–fuel nozzle fuel hose. Tighten the coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(7) Install the gas producer fuel control assembly. (Refer to Gas Producer Fuel Control Replacement, Para 2.B., 73–20–02 or 2.B., 73–20–03.)

(8) Install the igniter lead through the fire shield and secure to the fire shield with two bolts and nuts. Tighten nuts to 35–40 lb in. (3.9–4.5 N·m). Attach the igniter lead to the igniter plug. Tighten coupling nut to 50–70 lb in. (5.6–7.9 N·m).

(9) Install the clamping arrangements of the igniter lead (three on 250–C20S; five on 250–C20W). Tighten nuts and bolts to 35–40 lb in. (3.9–4.5 N·m).

4. Fire Shield Access Panel (250–C20S, –C20W)

The fire shield access panel can be removed from the engine to gain access to turbine components and splitline bolts, nuts and brackets. It must be removed from the 250–C20S or –C20W series engine before the thermocouple assembly can be removed. Remove the fire shield access panel as follows:

A. Removal

(1) Remove the check valve–to–turbine pressure oil tube.

(2) Remove the lockwire and remove the nut, bolt and two washers retaining the access panel to the pressure oil manifold.

(3) Remove the four bolts and washers securing the access panel to the fire shield support bracket.

(4) Remove the six bolts and washers securing the access panel to the fire shield. Remove the access panel.

(5) Remove the washer from the gas producer and power turbine pressure oil manifold fitting.

B. Installation

(1) Place the washer on the gas producer and power turbine pressure oil manifold fitting. Align the access panel on the fire shield and retain with six washers and bolts. Tighten bolts to 35–40 lb in. (3.9–4.5 N·m).

(2) Secure the access panel to the pressure oil manifold with a washer and bolt. Tighten bolts to 35–40 lb in. (3.9–4.5 N·m).

(3) Secure the access panel to the support bracket adjacent to the pressure oil manifold with four washers and bolts. The drilled–head bolt goes at the position nearest to the pressure oil manifold fitting. Tighten bolts to 35–40 lb in. (3.9–4.5 N·m).

CAUTION: EXCESSIVE TIGHTENING OF THE MANIFOLD RETAINING NUT CAN CAUSE OIL LEAKAGE.

(4) Secure the access panel to the pressure oil manifold fitting with a washer and nut. Tighten the nut finger tight. Lockwire the pressure oil manifold nut to the drilled–head bolt.

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PARA 4.B. (cont)

5. E–ring Gasket Installation Leak Check

CAUTION: LEAK CHECK THE NO. 8 BEARING SUMP AREA TO ENSURE PROPER SEATING AND CRUSH OF THE E–RING METALLIC GASKET. OMISSION OF THIS CHECK COULD RESULT IN A TURBINE WHEEL BURST.

Make an air leakage check of the No. 8 bearing sump area to ensure proper seating of the metallic E–ring gasket. (See Figure 205.) Make this check any time the sump nut has been removed. The following equipment and procedures are required for the No. 8 bearing sump pressure check.

A. Equipment

(1) Shop air supply with pressure regulator, appropriate filtration fittings and lines as required to introduce clean, dry air into the No. 8 bearing scavenge fitting.

(2) Pressure gage with approximate range of 0–60 psig (0–414 kPag) and appropriate fittings and lines to connect to No. 8 bearing pressure oil tube.

B. Procedures

(1) Connect an air pressure regulator supplied with clean, dry shop air to the No. 8 bearing scavenge oil fitting and connect a pressure gauge (0–60 psig (0–414 kPag)) to the No. 8 bearing pressure oil tube.

CAUTION: CARE MUST BE TAKEN TO AVOID BENDING OR OTHERWISE DAMAGING THE NO. 8 BEARING PRESSURE OIL TUBE DURING THE INSTALLATION AND REMOVAL OF THE PRESSURE GAGE.

(2) With the turbine inclined to position the No. 8 bearing sump low, adjust the pressure regulator to maintain sump pressure at 50 ± 2 psig (345 ± 14 kPag) as measured on the gauge connected to the pressure oil tube.

NOTE: Air will leak across the No. 8 bearing labyrinth seal during this check and should not be of concern.

(3) Keep the position and the pressure established in the previous step. Slowly, apply Leak–tek or equivalent around the threads and brazed cap of the sump nut.

WARNING: AIR LEAKAGE ACROSS THE E–RING SEAL WILL RESULT IN PRESSURIZATION OF THE NUMBER 8 BEARING SUMP. PRESSURIZATION OF THE NUMBER 8 SUMP WILL CAUSE A FLOW REVERSAL ACROSS THE NUMBER 8 LABYRINTH SEAL. THIS LEAKAGE CAN RESULT IN AN ENGINE FIRE AND SUBSEQUENT TURBINE WHEEL RIM FAILURE.

(4) Hold pressure for one minute minimum. No leakage is acceptable. If leakage occurs, corrective action must be taken.

(5) Disconnect the pressure test apparatus.

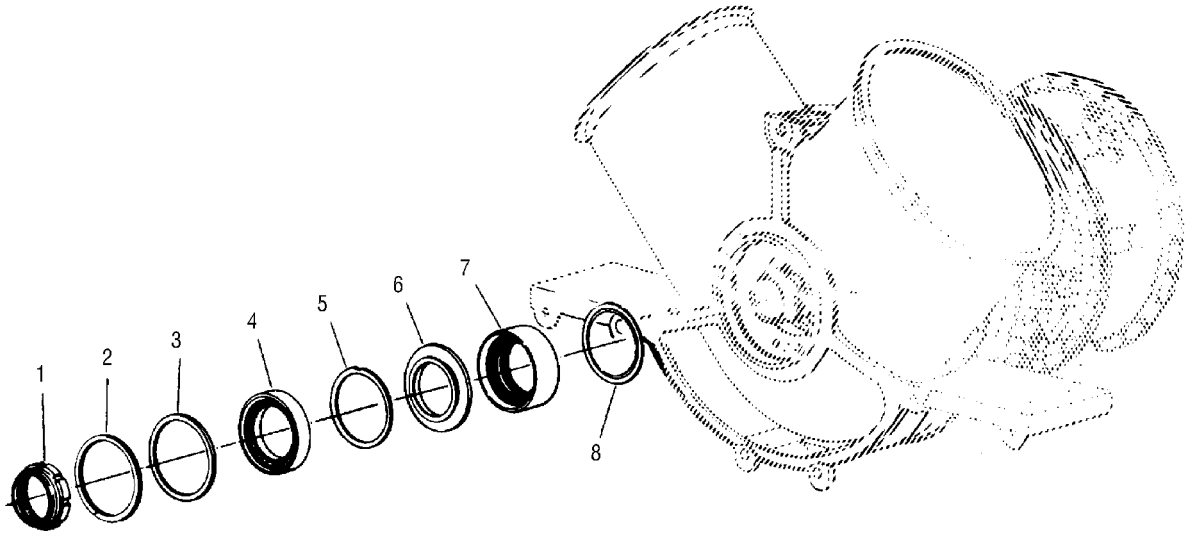
6. Oil Bellows Seal

A. Removal

Remove the oil bellows seal as follows:

(1) Remove the turbine and combustion section as a unit. (Refer to the applicable portions of para 1.A. or 1.C., this section.)

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1. Spanner Nut
2. Internal Retaining Ring
3. Spacer (washer)
4. Ball Bearing
5. Thrust Plate
6. Mating Ring Seal
7. Oil Bellows Seal
8. Plate, Thrust

Typical Oil Bellows Seal Removal
Figure 206

PARA 6.A. (cont)

(2) Remove two nuts, washers and bolts and remove the firewall assembly from the front of the turbine assembly.

(3) Attach the turbine and combustion section assembly on the 6798089 supporting adapter at the three exhaust collector support bolt holes, with the combustion section down.

NOTE: It may be necessary to reverse the three turbine attaching studs on the supporting adapter plate from a top side mounting position to an underside mounting position.

(4) Remove the power turbine shaft ball bearing spanner nut using 6795984 holder and 6795985 wrench. (See Figure 206.)

(5) Remove the internal retaining ring and spacers (washer) from the turbine and exhaust collector support.

NOTE: Make note of the exact bearing index location before removal so that it can be installed in the same position as it was in the preceding buildup.

(6) Pull the ball bearing from the power turbine shaft with 6872882 puller.

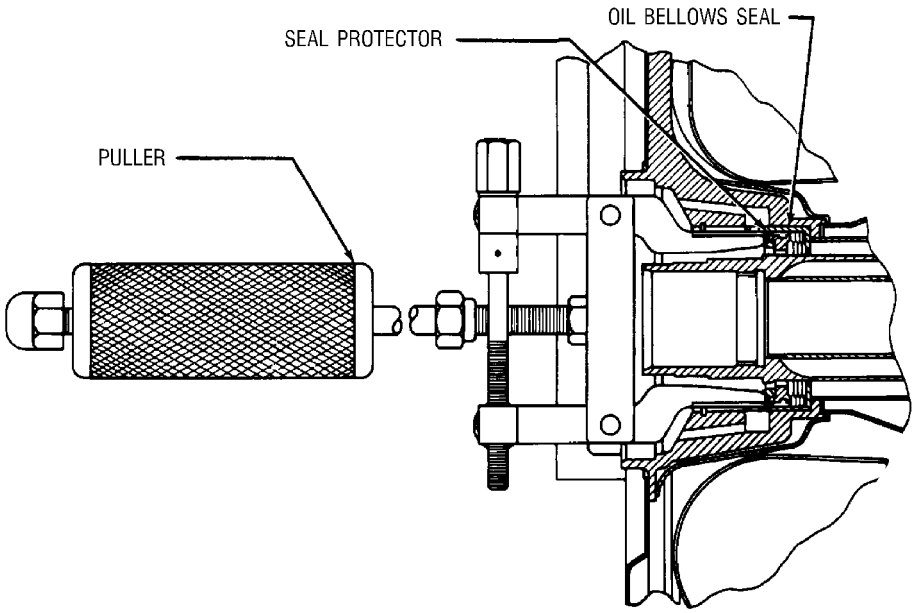
(7) Remove the thrust plate.

(8) Remove the rotating mating ring seal from the power turbine shaft using 6872882 puller.

NOTE: If facilities are not available to lap the mating ring rotating seal (to ensure flatness within six helium light bands—use optical flat and polarized light source), replace the mating ring rotating seal whenever the oil bellows seal is replaced.

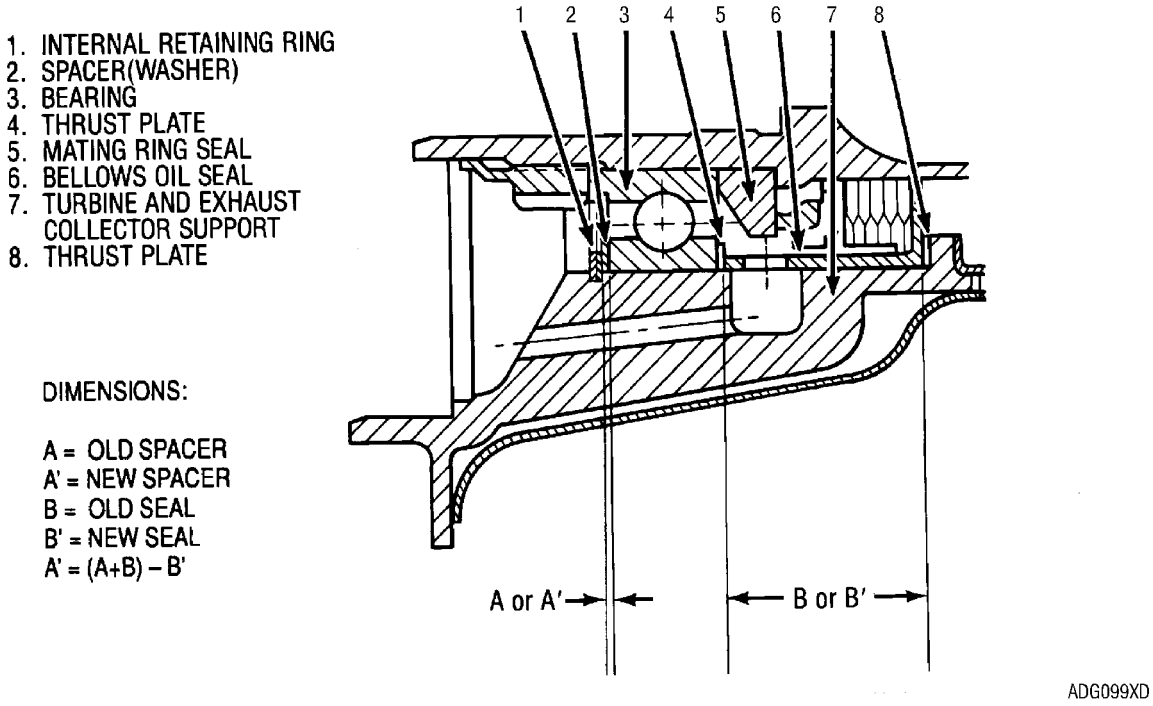
(9) Remove the oil bellows seal and the thrust plate from the turbine and exhaust collector support with 6799973 puller and 6798928 protector. (See Figure 207.)

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Pulling the Oil Bellows Seal from the Turbine
and Exhaust Collector Support
Figure 207

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Determining Spacer Thickness
Figure 208

PARA 6.A. (cont)

(10) To maintain the rotor total travel as in the preceding engine buildup, measure and record the new and old oil bellows seal thickness. Change the spacer (washer) thickness to account for any difference in seal thickness. The new seal and thrust plate plus the new spacers must be the same thickness as the old seal and thrust plate plus the old spacers. (See Figure 208.)

B. Installation

Install the oil bellows seal as follows:

(1) Thoroughly clean the bellows seal bore in the exhaust collector. Remove oil traces with methyl ethyl ketone. Apply a light coating of sealant (Permatex 1372W or equivalent) to the seal bore below the oil drain slots in the exhaust collector.

(2) Reinstall the thrust plate (see Figure 206) and install the replacement oil bellows seal using 6796918 drift. Chill the seal with dry ice to aid in assembly.

NOTE: If facilities are not available to lap the rotating mating ring seal (to ensure flatness within six helium light bands—use optical flat and polarized light source), replace the mating ring rotating seal whenever the oil bellows seal is replaced.

(3) Install the thrust plate and the rotating mating ring seal.

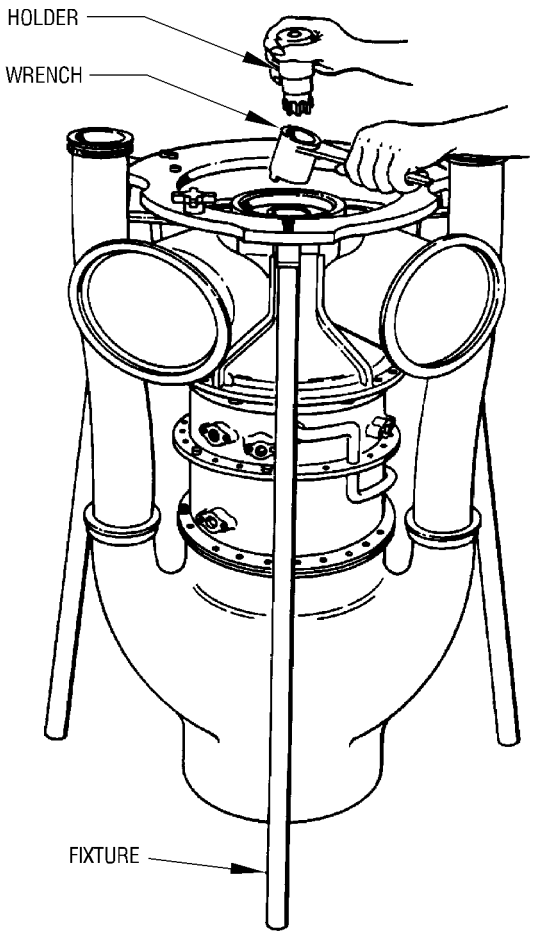
NOTE: Install the bearing in the position noted at disassembly.

(4) Install the ball bearing on the power turbine shaft using 23008725 pusher and guide (–2) of 6796918 drift assembly. The pusher locks on the splines inside the power turbine shaft.

(5) Insert spacers (washers) and internal retaining ring.

(6) Retain bearing stack with spanner nut lightly lubricated with engine oil. Tighten the nut to 250–300 lb in. (28–34 N·m) using 6795985 wrench and 6795984 holder. (See Figure 209.)

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Installing Power Turbine Shaft Spanner Nut
Figure 209

PARA 6.B. (cont)

(7) Stake nut edge into lock detent using 6798927 crimper; do not use a previous locking position.

(8) Remove the turbine and combustion section assembly from supporting adapter.

(9) Install the firewall assembly on the front of the turbine. Secure with two bolts, washers and nuts. Coat threads of bolts lightly with antiseize compound before installation. Tighten nuts to 35–40 lb in. (3.9–4.5 N·m).

(10) Install turbine and combustion section assembly. (Refer to applicable part of para 1.B. or 1.D., this section.)

(11) Make an engine check run. (Refer to Check Run, para 1., 72–00–00, Engine—Adjustment/Test.)

7. Inspection/Check

A. Blade and Vane Inspection

(1) Inspect the first–stage turbine blades and vanes with the combustion section removed. (Refer to Combustion Liner, para 1., 72–40–00.) Inspect the fourth–stage turbine blades through the exhaust ducts.

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PARA 7.A. (1) (cont)

(a) Blade Damage. Replace the turbine assembly if any of the following conditions exist:

1 Damage to inner 1/3 of blade.

2 Blade or stator vane broken off.

3 Cracked blade.

4 Melted vane or blade.

B. Power Turbine Outer Shaft Spline Inspection

(1) Inspect the power turbine outer shaft splines whenever the engine has been subjected to a sudden stoppage as defined in PARA 1.D.(4) or 1.D.(5), 72–00–00, Engine–Inspection/Check.

(2) If any of the following conditions exist, return the turbine to an Authorized Maintenance Center (AMC) for replacement of damaged parts: (See Figure 210.)

(a) Chipped, cracked, damaged, pitted or worn spline teeth.

NOTE: Use a sharp pointed scribe, 0.020 in. (0.51 mm) radius, to inspect the spline teeth for a wear step. Any discernable wear step that can be felt with the scribe is unacceptable.

(b) Evidence of spline deformation or twisting.

C. First–stage Turbine Nozzle and Nozzle Shield Inspection

The inspection limits and disposition regarding specific conditions which may be encountered are given in Table 201. The serviceable limits given in the table are defined as follows:

(1) Serviceable limit is the maximum degree of a specified condition which can be accepted, allowing the part to be placed back into service without repair.

(2) Repairable limit is the maximum degree of a specified condition which can be repaired. Any condition exceeding the limit cannot be corrected by the specified repair procedure; therefore, the part must be condemned.

D. Oil Flow Measurement

(1) Measure the quantity of oil flow from the gas producer support scavenge oil passage (C20W and C20S only) and from the power turbine support scavenge oil passage or the external sump as follows:

(a) Disconnect the scavenge oil tube from the gas producer scavenge oil fitting and connect a suitable hose to the fitting to direct scavenge flow into a calibrated container (C20W and C20S only).

(b) Disconnect the scavenge oil tube from the external sump at the power turbine support and connect a suitable hose to the external sump scavenge fitting to direct flow into another calibrated container. If the external sump is removed, use 23003267–8/–0 adapter and a length of suitable hose to direct flow into a calibrated container.

NOTE: Do not put the hoses from the scavenge passages into the same container. The flow from each scavenge passage must be measured individually.

(c) To ensure consistency, make the measurement during the following conditions:

1 Engine oil temperature no cooler than 50°F (10°C) and no hotter than normal operating temperatures.

2 Use of external power source, not aircraft battery, to ensure a minimum N_1 cranking speed of 16%.

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PARA 7. (cont)

3 Make a preliminary crank of the engine to ensure that the oil lines and external sump (if installed) are full of oil and that there is oil flow.

(d) Crank the engine with ignition disarmed for exactly 15 seconds.

(e) Collect and measure oil flow during the 15 second cranking period and during coast–down until the engine stops. It is not necessary to collect and measure minor drips. At least 16% N_1 speed must be achieved.

(f) A flow of 75 cc (2.5 oz) or less from the gas producer scavenge area (for C20S and C20W engines only) indicates a significant restriction of the gas producer support pressure oil manifold, screen, the oil nozzle and/or passages. Clean the following areas of the lubrication system and conduct the flow check once again.

1 The gas producer and power turbine pressure oil manifold. Refer to Gas Producer Support Pressure Oil Tube (Manifold) Replacement, PARA 7.I., this section.

2 The gas producer and power turbine pressure oil screen.

3 The pressure oil connector.

4 The scavenge oil fitting.

(g) A flow of 90 cc (3 oz) or less from the power turbine scavenge area indicates a significant restriction of the power turbine support pressure oil nozzle, screen, the connector, passages and/or external sump (if installed). Clean the following areas of the lubrication system and conduct the flow check once again.

1 The power turbine support pressure oil nozzle. Refer to Cleaning Power Turbine Support Pressure Oil Nozzle, PARA 7.G., this section.

2 The gas producer and power turbine pressure oil screen.

3 (250–C20, –C20B, –C20F, –C20J) The pressure oil connector. Refer to Cleaning Power Turbine Support Pressure Oil Nozzle, PARA 7.G., this section.

4 The power turbine support scavenge oil passage. Refer to Inspection and Cleaning of Power Turbine Support Scavenge Oil Strut, PARA 7.E., this section.

5 The external scavenge oil sump.

E. Inspection and Cleaning of Power Turbine Support Scavenge Oil Strut

Every 300 hours, or earlier if carbon buildup is found during the scheduled inspection, clean (as required) the power turbine support scavenge oil passage. Disassemble, inspect, clean, and reassemble the power turbine oil system components as follows:

(1) (250–C20, –C20B, –C20F, –C20J) Disassemble the oil passage components as follows:

(a) Disconnect the scavenge oil tube from the external sump. Plug the tube.

(b) Remove lockwire and the two external sump attaching bolts. Remove the sump. Discard the packing. Visually inspect sump for accumulation. Clean or replace sump as required.

NOTE: Removal of the following components is not necessary unless the scavenge oil passage requires cleaning.

(c) Remove the pressure oil tube extending between the elbow at the fire shield and the connector at the power turbine support pressure oil nozzle. Remove the screen.

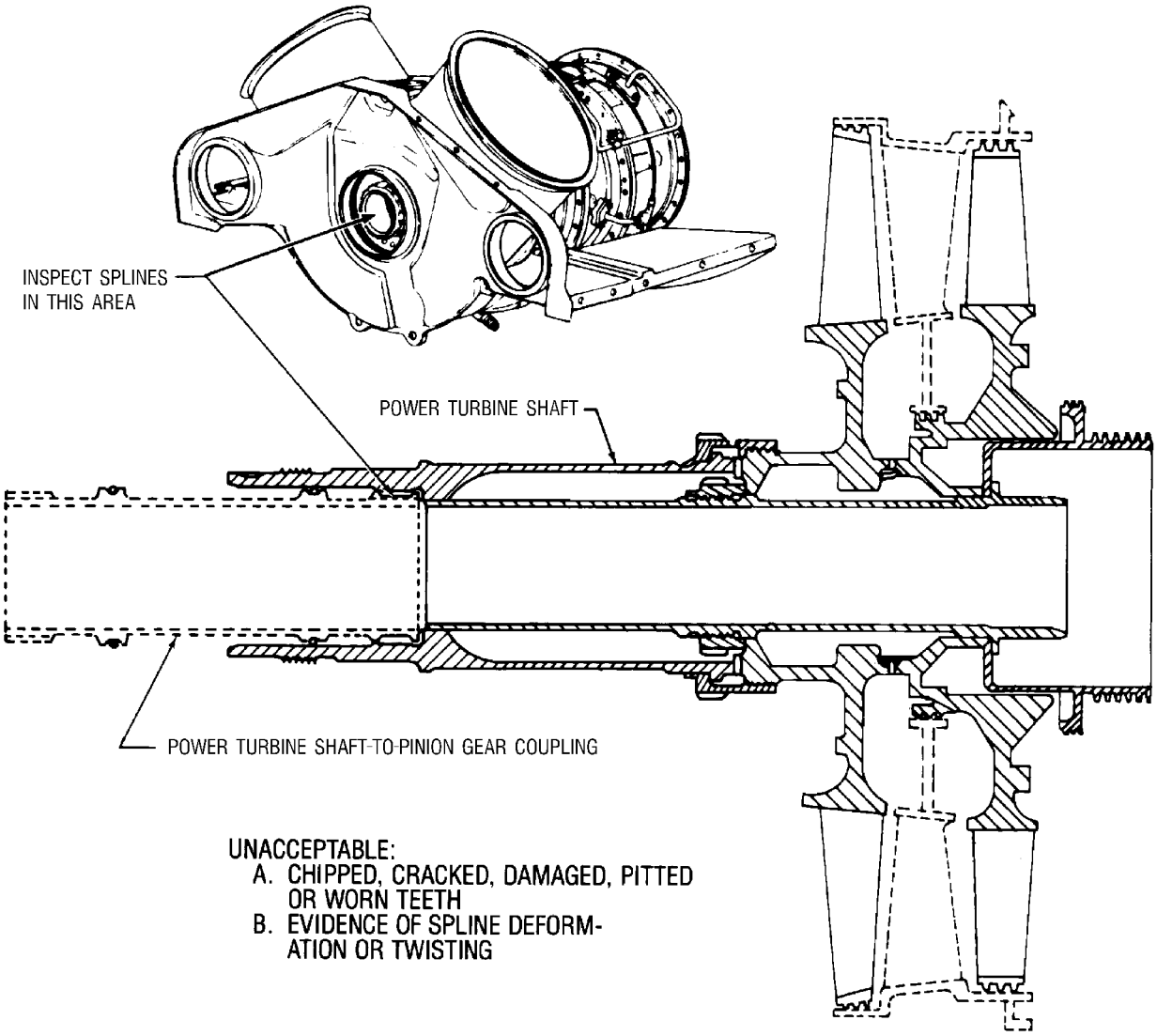
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Table 201

First–stage Turbine Nozzle and Nozzle Shield Inspection

Condition	Serviceable Limit	Disposition
	First–Stage Nozzle	
Axial cracks in vane airfoil.	Leading edge 0.25 in. (6 mm) max.; trailing edge 0.312 in. (8 mm) max. a. No two cracks in same plane. b. Adjacent cracks 0.25 in. (6 mm) apart. c. Adjacent cracks not progressing toward each other.	Send nozzle to an Authorized Maintenance Center (AMC) for repair.
Nicked or dented leading and trailing edge.	Leading edge 0.062 in. (2 mm) max.; trailing edge 0.125 in. (3 mm) max.	Repair nicks or dents by blending with fine grit stone. or send nozzle to an Authorized Maintenance Center for repair.
Warped or burned trailing edge only.	Trailing edge 0.125 in. (3 mm) max.	Send nozzle to an authorized facility for repair.
Fillet cracks—inner and outer band	Leading edge 0.25 in. (6 mm) max.; trailing edge 0.125 in. (3 mm) max.	Send nozzle to an Authorized Maintenance Center for repair.
Inner band cracked.	Leading edge 0.187 (5 mm) max. axially into the band and not in line with trailing edge cracks. Trailing edge–extending through inner band to sheet metal detail.	Send nozzle to an Authorized Maintenance Center for repair.
Outer band, leading and trailing edges cracked.	Extending 0.187 in. (5 mm) axially into the band and not in line with crack on opposite edge.	Send nozzle to an Authorized Maintenance Center for repair.
Sheet metal diaphragm cracked.	Extending 0.50 in. (13 mm) circumferentially, max. of two cracks at least two in. (50 mm) apart.	Replace nozzle.
	First–Stage Nozzle Shield	
Cracks around spotwelds.	Cracks are acceptable provided the length of the crack is not greater than 50% of the distance around the weld.	Send shield to an Authorized Maintenance Center for repair.

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Power Turbine Shaft Spline Inspection
Figure 210

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PARA 7.E. (cont)

(d) Loosen the gas producer support pressure oil tube at the connector. Do not remove the gas producer support pressure oil tube.

CAUTION: IF THE GAS PRODUCER SUPPORT PRESSURE OIL TUBE IS REMOVED, THE SUPPORT PASSAGE MUST BE FLUSHED. (REFER TO REPLACING GAS PRODUCER PRESSURE OIL PASSAGE PARA 7.H., THIS SECTION.)

CAUTION: IF POWER TURBINE SUPPORT OIL NOZZLE IS TWISTED OR IS SUSPECTED OF BEING TWISTED DURING REMOVAL, CHECK OIL JET PERPENDICULARITY PER PARA 7.G., THIS SECTION.

CAUTION: MAKE CERTAIN THAT NO FOREIGN MATERIAL ENTERS THE EXPOSED TUBES OR OPENINGS.

(e) Remove lockwire and two bolts; then, remove the power turbine support oil tube connector. Remove the power turbine support pressure oil nozzle. Discard two packings.

(2) (250–C20S, –C20W) Disassemble the oil passage components as follows:

(a) Remove the scavenge oil tube between the external sump and the elbow at the fire shield.

(b) Remove the lockwire and remove the two external sump attaching bolts. Remove the sump. Discard the packing. Visually inspect sump for accumulation. Clean or replace sump as required.

NOTE: Removal of the following components is not necessary unless the scavenge oil passage requires cleaning.

(c) Remove the fire shield access panel. (Refer to Fire Shield Access Panel, para 4., this section.)

CAUTION: IF THE GAS PRODUCER PRESSURE OIL MANIFOLD IS NOT PROPERLY REMOVED, IT WILL BE NECESSARY TO FLUSH THE GAS PRODUCER SUPPORT PRESSURE OIL PASSAGE. (REFER TO REPLACING GAS PRODUCER PRESSURE OIL MANIFOLD, PARA 7.H., THIS SECTION.)

MAKE CERTAIN THAT NO FOREIGN MATERIAL ENTERS THE EXPOSED TUBES OR OPENINGS.

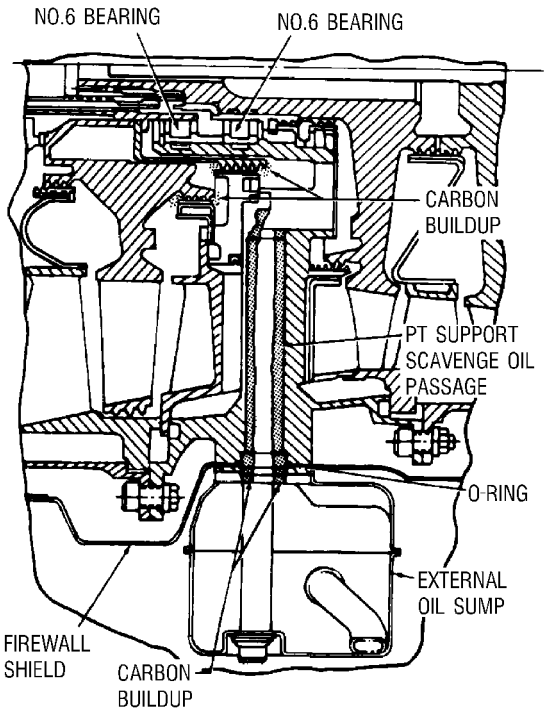
(d) Remove the gas producer pressure oil manifold from the turbine as outlined in Replacing Gas Producer Pressure Oil Manifold para 7.I., this section. Discard two packings.

CAUTION: IF THE POWER TURBINE SUPPORT OIL NOZZLE IS TWISTED OR IS SUSPECTED OF BEING TWISTED DURING REMOVAL, CHECK OIL JET PERPENDICULARITY PER PARA 7.G., THIS SECTION.

(e) Remove the power turbine support pressure oil nozzle. Discard packing.

(3) Inspect the power turbine support scavenge oil passage using a light and mirror. The cross section of the passage is oval and is approximately 0.50 x 0.15625 in. (13 x 4 mm). If carbon deposits (coke) are found, clean the passage; otherwise reassemble the oil passage components. (See Figure 211.)

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Carbon Buildup in Typical Power Turbine Support Scavenge Oil Strut and Rotating Labyrinth Seals
Figure 211

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PARA 7.E. (cont)

(4) Clean carbon deposits from the walls of the scavenge oil passage as follows:

(a) Use either of the following alternate methods for removing carbon deposits:

1 Use a soft wire with hook bent at one end. Pull the carbon downward away from the bearing area.

2 Clean the passage with 23003267 kit.

a Use the No. 22, 0.157 in. (3.99 mm) drill (–2) and hand power to clean out the carbon accumulation.

b Extract and clean the drill bit frequently. The No. 22 drill bit can be used to a depth of 2.625 in. (66.68 mm). This is the oval section.

c Clean the restricted inner end of the passage using the No. 27, 0.144 in. (3.66 mm) drill (–10). The drill should enter to a depth of 3.125 in. (79.38 mm). Do not use a power drill.

d Flush the passage frequently during cleaning using shop air or a hand–squirt oil can forcing oil through the pressure oil nozzle tee fitting. As an option, motor the engine as necessary to flush out carbon.

(b) Force shop air or engine oil (in a hand pump–type oil can) through the power turbine support pressure oil strut to dislodge any loosened carbon.

(c) Clean carbon accumulation from inside the external sump. Rinse the sump with petroleum solvent and dry.

(5) (250–C20, –C20B, –C20F, –C20J) Assemble the oil passage components as follows:

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(a) Lubricate and install two new packings with the power turbine support pressure oil nozzle. Install the connector and attach with two bolts. Tighten bolts to 35–40 lb in. (3.9–4.5 N·m) and secure with lockwire.

(b) Attach the gas producer pressure oil tube to the connector. Tighten coupling nut to 80–120 lb in. (9.0–13.6 N·m).

(c) Insert the screen and install the pressure oil tube between the connector and the elbow located in the fire shield. Tighten coupling nut to connector to 200–250 lb in. (23–28 N·m). Tighten coupling nut on elbow to 80–120 lb in. (9.0–13.6 N·m).

(d) Apply Permatex 1372 sealer lightly to the packing. Install packing at the power turbine support drain port. Install the external sump; retain with two bolts. Tighten bolts to 40 lb in. (4.5 N·m) and secure with lockwire. Apply torque in small equal increments.

(e) Install the external sump–to–gearbox scavenge oil tube. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

(6) (250–C20S, –C20W) Assemble the oil passage components as follows:

(a) Apply Permatex 1372 sealer lightly to the packing. Install packing at power turbine support drain port. Attach external sump; retain with two bolts. Tighten to 35–45 lb in. (3.9–5.1 N·m) and secure with lockwire. Apply torque in small equal increments.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(b) Install the scavenge oil tube between the external sump and the elbow at the fire shield. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

(c) Lubricate packing and install it with the power turbine support pressure oil nozzle.

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(d) Lubricate two packings and install with the gas producer support pressure oil manifold. Apply anti–seize compound to the four retaining bolts. Tighten bolts to 35–40 lb in. (3.9–4.5 N·m) and secure with lockwire.

(e) Blow through the installed manifold with clean compressed air to ensure that it is clear.

(f) Install the fire shield access panel. (Refer to Fire Shield Access Panel—Installation, para 4.B., this section)

F. Oil System Maintenance

WARNING: MAINTAIN THE COMPLETE OIL SYSTEM IN ACCORDANCE WITH ENGINE AND AIRCRAFT INSTRUCTIONS. FAILURE TO MAINTAIN THE OIL SYSTEM CAN RESULT IN SUDDEN ENGINE STOPPAGE.

To minimize oil system problems, the maintenance action given in 100 Hour Inspections, Table 602, 72–00–00, Engine–Inspection/Check, should be observed. Each operator must be aware of the symptoms of oil system difficulties in order that corrective action may be taken as quickly as possible.

(1) Symptoms:

If any of the following symptoms are present, return the engine to an Authorized Maintenance Center (AMC) immediately for turbine cleaning and inspection.

(a) Oil consumption in excess of one quart (0.9 liter) per flight hour.

(b) Heavy smoking out the exhaust.

(c) Heavy carbon deposits or blockage of the power turbine support scavenge oil strut and external sump.

(d) Oil temperature exceeds 107°C (225°F) for a period of less than ten minutes, but remains less than 120°C (248°F).

NOTE: If a ferry flight to the maintenance facility is necessary, make the following check before flight.

1 Disconnect the scavenge oil tube from the external sump. Place a container under the sump scavenge fitting.

2 Motor the engine for 15 seconds without ignition.

a If a solid stream of oil flows from the sump fitting, reconnect the scavenge oil tube to the sump. Tighten the coupling nut. Proceed to the maintenance facility (a ferry flight of less than four hours may be made).

b If no flow or if oil trickles from the sump fitting, replace the turbine and change the engine oil before further flight. (Refer to Turbine Assembly, Removal, para 1.A. or 1.C., this section and Oil Change, para 11.C. 72–00–00, Engine–Servicing)

(2) Corrective Action:

Clean, inspect and repair the turbine having any of the symptoms given in para 7.F.(1), this section as follows:

(a) At the Maintenance Facility , remove the turbine from the engine. (Refer to applicable part of Turbine Assembly, Removal, para 1.A. or 1.C., this section) Mount the turbine on 6799955 fixture. Retain the fixture at the rear flange of the gas producer support using the two bolts. Position vertically with the turbine and exhaust collector on top.

(b) Remove the fire shield (Refer to applicable part of Fire Shield–Removal para 3.A. or 3.C., this section)

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PARA 7.F.(2) (cont)

(c) Remove the 24 nuts and bolts from the exhaust collector–to–power turbine splitline and carefully lift the turbine and exhaust collector support, with the power turbine rotor assembly, from the power turbine support.

(d) Carefully remove loose carbon from the No. 6–7 bearings sump area.

(e) Carefully remove carbon and coke deposits from the rotating labyrinth seal knives.

CAUTION: DO NOT USE CARBON REMOVER ON THE STATIONARY MEMBER OF THE LABYRINTH SEAL ON THE SUMP COVER. CARBON REMOVER WILL DAMAGE THE NICKEL–GRAPHITE SURFACE.

(f) Soak the turbine–to–compressor coupling in methylethylketone or Pentatone ECS for 60 minutes. Repeat the process until all carbon is dissolved. Following the soak, clean any remaining carbon from the part using methyl ethyl ketone or Pentatone ECS and a soft bristle brush.

(g) Install a suitable plug in the power turbine inner shaft at the No. 6 bearing end.

(h) Fill the shaft with methylethylketone or Pentatone ECS. Allow the shaft to soak for 60 minutes; repeat the soak until all carbon is dissolved.

(i) Following the soak, clean any remaining carbon from the part using methyl ethyl ketone or Pentatone ECS and a soft bristle brush. Dry with shop air.

(j) Inspect the turbine–to–compressor coupling for circumferential rub. Replace the coupling if any evidence of rub exists.

(k) Inspect the power turbine inner shaft ID for corrosion pitting. If pitting is found, send the turbine to an Overhaul Facility for inner shaft replacement.

(l) Flush the gas producer turbine oil passage. (Refer to Replacing Gas Producer Turbine Support Pressure Oil Tube, para 7.H., this section.)

(m) Inspect and clean the power turbine support scavenge oil strut and external sump. (Refer to applicable part of Inspection and Cleaning of Power Turbine Support Scavenge Oil Strut, para 7.E., this section.)

(n) Clean the ID of the power turbine support pressure oil nozzle to make sure it is free of carbon deposits. (Refer to applicable part of Cleaning the Power Turbine Support Pressure Oil Nozzle, para 7.G., this section.)

(o) Before reassembly of the turbine and exhaust collector support and turbine rotor assembly to the turbine, press the No. 6 bearing rollers outboard to create the maximum opening for passage of the bearing inner race. It may be necessary to use grease to retain the rollers in this position.

(p) Position the turbine and exhaust collector support and power turbine rotor assembly on the power turbine support. Use care to prevent damage to the knife edges of the labyrinth seals and/or to the No. 6 bearing inner race and rollers. Index the support as required; then install four slab–head bolts which have been lightly coated with antiseize compound. Install these bolts in the line–reamed holes marked during the alignment build (at initial build or overhaul). Rotate the power turbine rotor by hand; ensure that there is not binding.

(q) Install the remaining 20 bolts and nuts, each lightly coated with antiseize compound. Alternately tighten nuts 180 degrees apart to 10–15 lb in. (1.1–1.7 N·m); then repeat the process tightening nuts of socket head bolts to 20–30 lb in. (2.3–3.4 N·m). If tee–head bolts are used, tighten to 35–40 lb in. (3.9–4.5 N·m) plus prevailing torque.

(r) Install the fie shield. (Refer to applicable part of Fire Shield—Installation, para 3.B. or 3.D., this section.

(s) Install the turbine on the engine assembly. (Refer to applicable part of Replacing the Turbine Assembly, Installation, para 1.B. or 1.D., this section.)

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PARA 7.F. (2) (cont)

(t) Change the engine oil. (Refer to Oil Change, para 11.C., 72–00–00, Engine–Servicing.)

(u) After the system has been filled, remove the magnetic drain plug on the bottom of the power and accessory gearbox.

(v) Motor the engine with the starter and without ignition long enough to allow one to two ounces (30 to 59 milliliters) of oil to flow from the opening.

(w) Observe flow for restriction and/or for extent of contamination. Motoring flushes carbon particles from the gearbox sump.

(x) Reinstall the magnetic drain plug; tighten to 60–80 lb in. (6.8–9.0 N·m) and secure with lockwire.

(y) Perform an oil flow measurement check. (Refer to Oil Flow Measurement, para 7.D., this section.)

(z) Replenish the oil supply tank with approved engine oil.

(aa) Motor the engine with the starter and without ignition until an indication of oil pressure is attained. When pressure is evidenced start the engine and operate at idle for five minutes.

(ab) Monitor oil pressure continuously during the five minute run.

G. Cleaning Power Turbine Support Pressure Oil Nozzle

Clean the pressure oil nozzle as follows:

(1) Inspect and clean the power turbine support scavenge oil strut. (Refer to Inspection and Cleaning of the Power Turbine Support Scavenge Oil Strut, para 7.E., this section.)

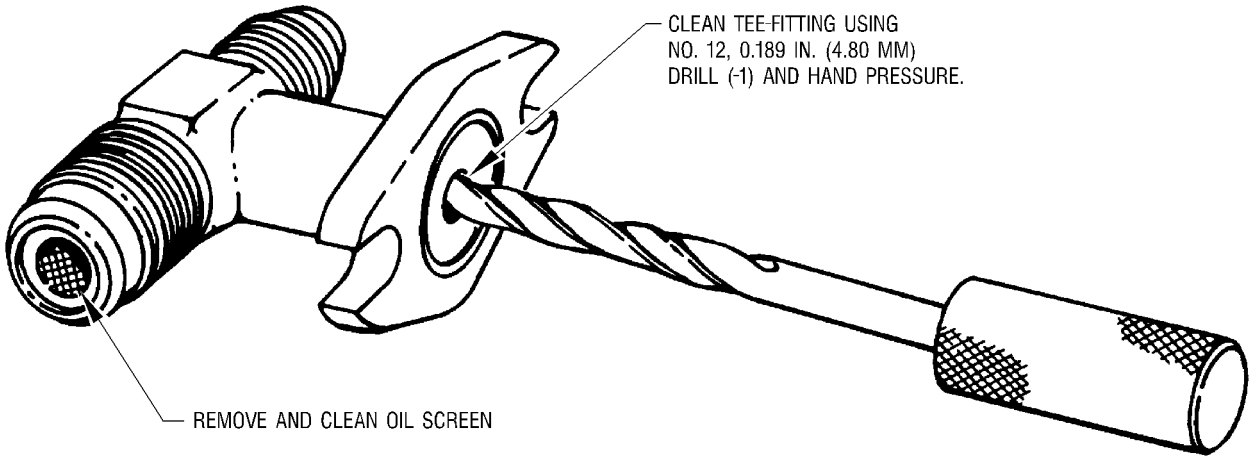
(2) Remove the oil nozzle in accordance with the applicable portions of Inspection and Cleaning of the Power Turbine Support Scavenge Oil Strut, para 7.E., this section.

(3) Clean the screen using a suitable solvent.

(4) (250–C20, –C20B, –C20F, –C20J) Clean the tee fitting. (See Figure 212.)

(5) Remove the pressure oil nozzle if it is possible to do so without damaging the nozzle or the flange. If the nozzle cannot be re moved without causing damage, clean the nozzle while it is in stalled.

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Cleaning Pressure Oil Tee–Fitting (250–C20, –C20B, –C20F, –C20J)
Figure 212

PARA 7.G. (cont)

(6) Flush the nozzle often during the cleaning using oil from a hand–squirt oil can or shop air.

(7) Clean and inspect the power turbine pressure oil nozzle as follows: (See Figures 213 and 214.)

NOTE: Dash number details (–1), (–2), etc., refer to detail parts of 23003267 power turbine support cleaning kit.

(a) Insert a No. 56 (0.047 in. (1.18 mm)) drill (–4) into the pressure oil jet hole.

(b) Establish the alignment holes on a horizontal plane. (See Figure 215.)

(c) Visually inspect for perpendicularity of the jet hole wire. Any visible deviation from perpendicular is cause to scrap and replace the jet nozzle. (See Figure 215.)

(d) Using a No. 52 (0.063 in. (1.61 mm) drill (–3), clean the upper 1.25 in. (32 mm) of the power turbine pressure oil nozzle. (See Figure 213.) Flush the nozzle and orifice several times during the cleaning process.

(e) Using the 0.050 in. (1.27 mm) spiral (round) saw blade (–6), clean accumulated carbon from the remainder of the nozzle. Use a twisting motion. (See Figure 213.)

(f) Ensure that the oil nozzle jet orifice is clean by inserting MS 20995C41 stainless steel safety wire, 0.041 in. (1.04 mm) diameter (–17) through from the top of the nozzle. (See Figure 214.) The safety wire contacts the end of the nozzle at 3.125 in. (79.4 mm) depth.

1 Using flat nose pliers, continue turning and pushing the wire into the nozzle until it is felt to exit out the jet orifice.

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PARA 7.G. (cont)

2 This penetration must be positively felt. Repeat as necessary.

H. Replacing Gas Producer Support Pressure Oil Tube (Manifold)—No. 8 Bearing Cavity, Exposed.

Removal of the gas producer turbine pressure oil tube (manifold) is not recommended as a standard maintenance practice. Removal and installation can leave carbon contaminant in the support passage. However, if the turbine has been disassembled to the extent that the No. 8 bearing cavity has been exposed, the tube can be removed and the passage can be flushed as follows:

NOTE: If the turbine has not been disassembled to the extent that the No. 8 bearing cavity has been exposed, the pressure oil tube can be removed and replaced as outlined in Replacing Gas Producer Turbine Support Pressure Oil Tube (Manifold)—No. 8 Bearing Cavity Not Exposed. Para 7.I., this section.

(1) (250–C20, –C20B, –C20F, –C20J) Remove the gas producer support pressure oil tube as follows:

(a) Disconnect the gas producer pressure oil tube from the tee fitting at the power turbine support.

(b) Disconnect the tube clamp from the bracket at the splitline.

(c) Remove the lockwire and remove the two bolts retaining the pressure oil tube to the gas producer support. Carefully remove the tube assembly from the support. Discard the packing.

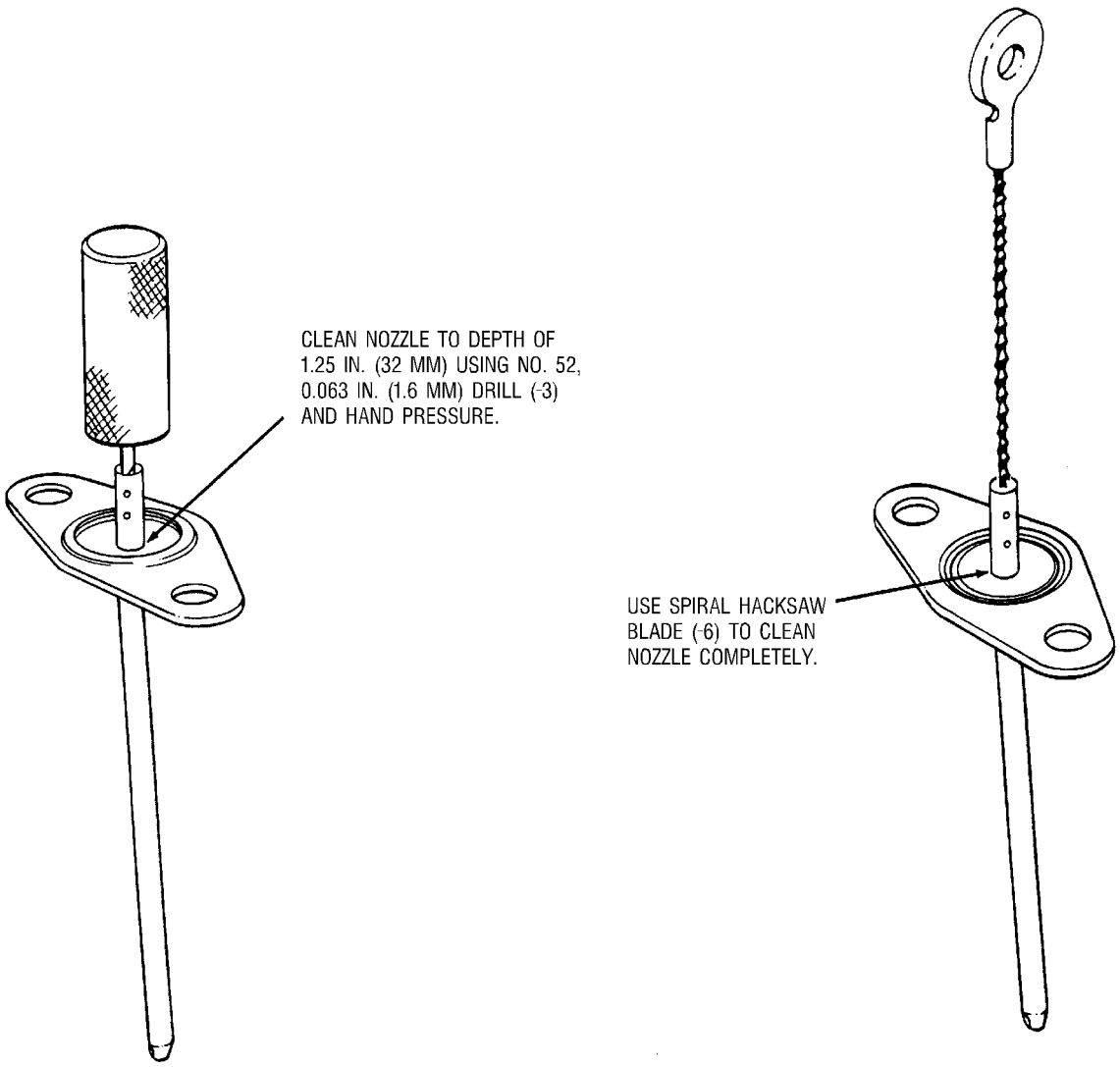
(2) (250–C20S, –C20W) Remove the gas producer support pressure oil manifold as follows:

(a) Disconnect the pressure oil tube from the fitting on the gas producer support pressure oil manifold.

(b) Remove the fire shield access panel. (Refer to Fire Shield Access Panel, Removal, para 4.A., this section.

(c) Remove the lockwire and remove the four bolts retaining the pressure oil manifold to the gas producer support and to the power turbine support. Carefully remove the manifold from the supports. Discard two packings.

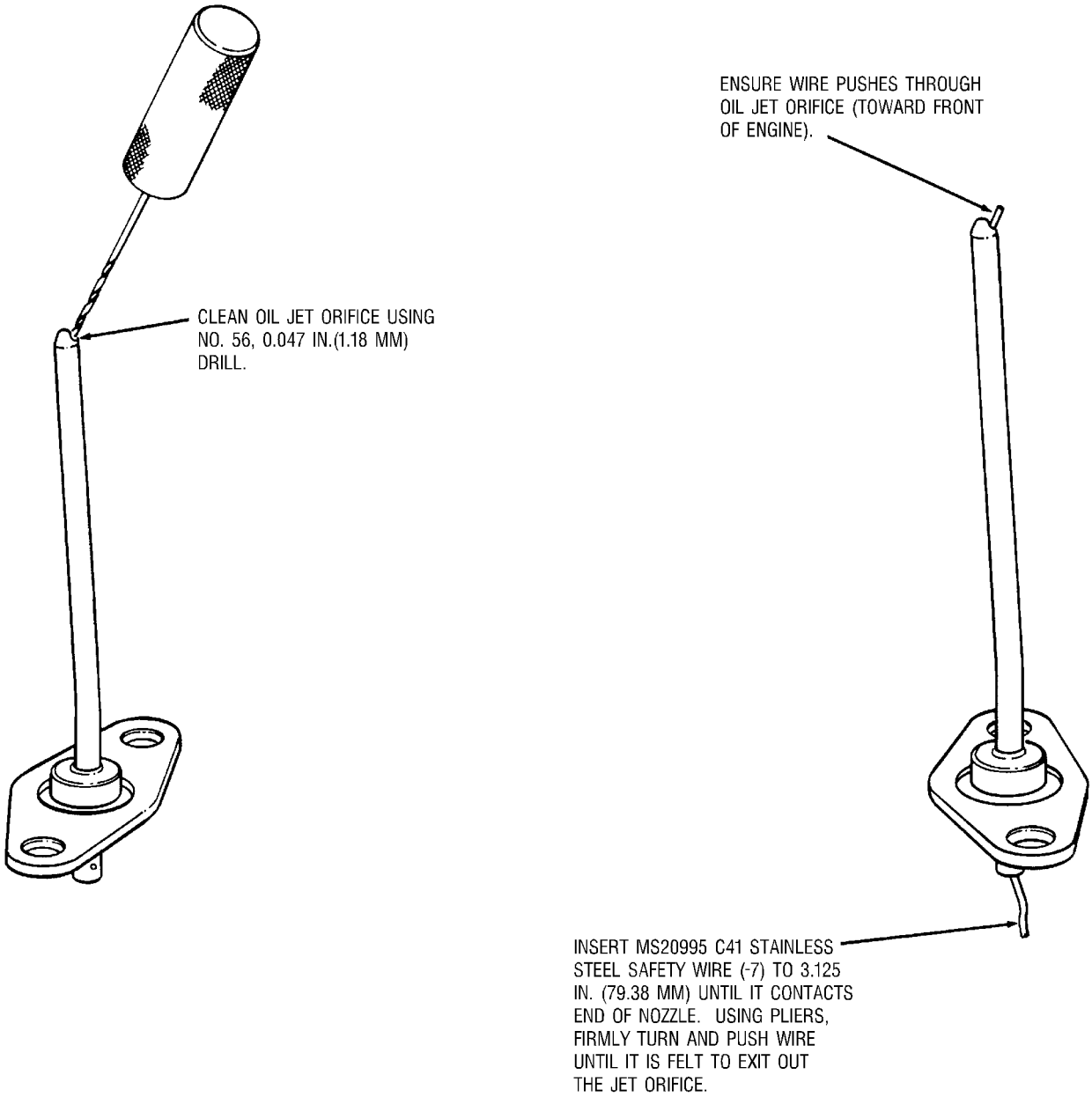
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Cleaning Power Turbine Support Pressure Oil Nozzle
Figure 213

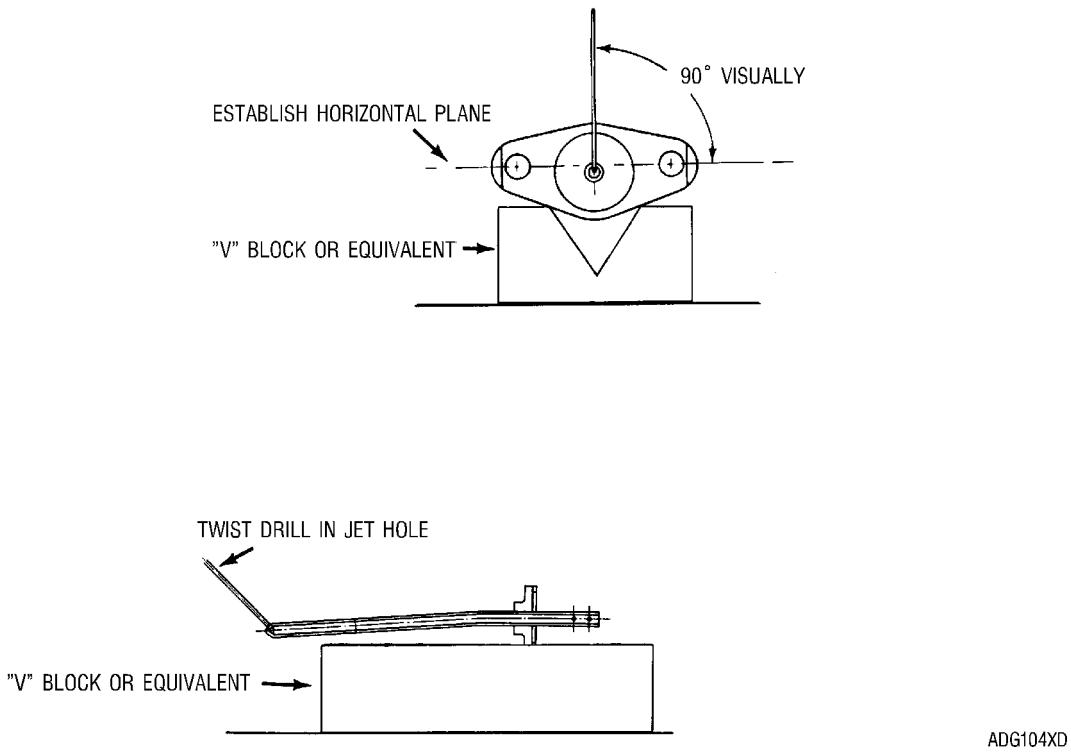
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Cleaning Power Turbine Support Pressure Oil Nozzle Jet
Figure 214

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Inspecting Power Turbine Pressure Oil Nozzle
Figure 215

PARA 7.H. (cont)

(3) If the pressure oil tube is to be reinstalled, check for carbon deposits and clean as required.

(4) If the No. 8 bearing oil nozzle has not been removed, remove it using 6796920 puller.

(5) To keep the washing fluid from the No. 8 bearing area, rotate the engine/turbine to a vertical position with the No. 8 bearing down.

(6) Place a bucket beneath the engine/turbine; then flow mineral spirits through the support passage into the bucket.

(7) Lubricate new packing (two required on 250–C20S, –C20W) and install with the pressure oil tube (manifold) into the gas producer turbine support.

(8) Apply antiseize compound and install the two retaining bolts (four required on 250–C20S, –C20W). Tighten bolts to 35–40 lb in. (3.9–4.5 N·m) and secure with lockwire.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(9) (250–C20, –C20B, –C20F, –C20J) Connect the oil tube to the power turbine support pressure oil tee fitting. Tighten coupling nut to 80–120 lb in. (9.0–13.6 N·m).

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PARA 7.H. (cont)

(10) (250–C20, –C20B, –C20F, –C20J) Position the tube clamp on the tube and secure to the splitline bracket with a bolt and nut. Tighten nut to 35–40 lb in. (3.9–4.5 N·m). If bracket needs to be repositioned, tighten splitline nut to 20–30 lb in. (2.3–3.4 N·m).

(11) (250–C20S, –C20W) Install the fire shield access panel. (Refer to Fire Shield Access Panel, Installation, para 4.B., this section.)

(12) (250–C20, –C20B, –C20F, –C20J) Disconnect fire shield–to–power turbine support pressure oil tube from the tee fitting. Remove the screen from the fitting.

(13) Blow through the pressure oil tube (manifold) with clean, compressed air to ensure that the tube is clear.

(14) Flush the screen in mineral spirits and shake dry. Reinstall the screen.

(15) Install the turbine pressure oil tube. Tighten the coupling nut at the tee fitting or manifold fitting to 80–120 lb in. (9.0–13.6 N.m); tighten the coupling nut at the fireshield elbow or check valve to 200–250 lb in. (23–28 N·m).

(16) Reassemble turbine. (Refer to the applicable part of Installation, First–stage Turbine Nozzle or First–stage Turbine Nozzle Shield Installation, para 2.B., this section.)

I. Replacing Gas Producer Turbine Support Pressure Oil Tube (Manifold)—No. 8 Bearing Cavity Not Exposed.

NOTE: While removal of this nozzle is not recommended as a standard maintenance practice, removal of this tube may be required from time to time to facilitate cleaning of the tube (manifold) replacement of leaking seals or replacement of broken or damaged tube assemblies.

(1) (250–C20, –C20B, –C20F, –C20J) Remove and/or replace the gas producer pressure oil tube assembly as follows:

(a) Disconnect and remove the No. 8 bearing scavenge oil tube assembly from the gearbox and turbine.

(b) Remove safety wire from the gas producer pressure oil tube attaching hardware.

(c) Disconnect the gas producer pressure oil tube from the power turbine support pressure oil tee fitting.

(d) Disconnect the tube clamp from the bracket at the splitline.

(e) Supply 30 psi (207 kPa) clean, dry shop air to the gas producer support scavenge fitting on the bottom of the gas producer support.

(f) Remove two bolts retaining the tube to the gas producer support. Carefully remove tube from gas producer support. Discard packing.

(2) (250–C20S, –C20W) Remove the gas producer pressure oil manifold as follows:

(a) Disconnect the gas producer support scavenge oil tube from the support and from the elbow at the fire shield.

(b) Remove the pressure oil tube from the gas producer support pressure oil manifold and from the check valve. Remove the screen from the manifold fitting.

(c) Remove the fire shield access panel. (Refer to Fire Shield Access Panel, para 4.A., this section.)

(d) Remove safety wire from the gas producer pressure oil manifold attaching hardware.

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PARA 7.I. (cont)

(e) Supply 30 psi (207 kPa) clean, dry shop air to the gas producer support scavenge fitting on the bottom of the gas producer support.

(f) Remove four bolts retaining the manifold to the gas producer and power turbine supports. Carefully remove the manifold from the gas producer support. Discard two packings.

(3) If the pressure oil tube (manifold) will not be immediately reinstalled, the air supply may be turned off. If the tube (manifold) is being immediately reinstalled or a new tube (manifold) is to be installed, maintain the 30 psi (207 kPa) air supply and proceed with step.

(4) If the pressure oil tube (manifold) is to be reinstalled, check for carbon deposits and clean as required.

NOTE: Air pressure to the gas producer support scavenge fitting must be maintained at 30 psi (207 kPa) during reassembly. Always use new packings when installing the pressure oil tube (manifold).

(5) Supply 30 psi (207 kPa) clean, dry shop air to the gas producer support scavenge oil fitting at the bottom of the gas producer support.

(6) Lubricate new packing (two required on 250–C20S, –C20W) and install with the pressure oil tube (manifold) into the gas producer support.

(7) Apply anti–seize compound and install the two retaining bolts (four required on 250–C20S, –C20W). Tighten bolts to 35–40 lb in. (3.9–4.5 N·m) and secure with lockwire.

(8) Disconnect the air supply.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(9) (250–C20, –C20B, –C20F, –C20J) Reinstall the pressure and scavenge oil tubing as follows:

(a) Connect the pressure oil tube to the power turbine support pressure oil tee fitting. Tighten coupling Nut to 80–120 lb in. (9.0–13.6 N·m).

(b) Position the tube clamp on the tube and secure to the splitline bracket with a bolt and nut. Tighten the nut to 35–40 lb in. (3.9–4.5 N·m). If bracket needs to be repositioned. Tighten splitline nut to 20–30 lb in. (2.3–3.4 N·m).

(c) Connect the gas producer turbine support scavenge oil tube to the scavenge oil fitting and to the elbow at the gearbox. Tighten coupling nuts to 150–200 lb in. (17–23 N·m). Position the tube clamps on the tubes and secure with a bolt and nut. Tighten the nut to 35–40 lb in. (3.9–4.5 N·m).

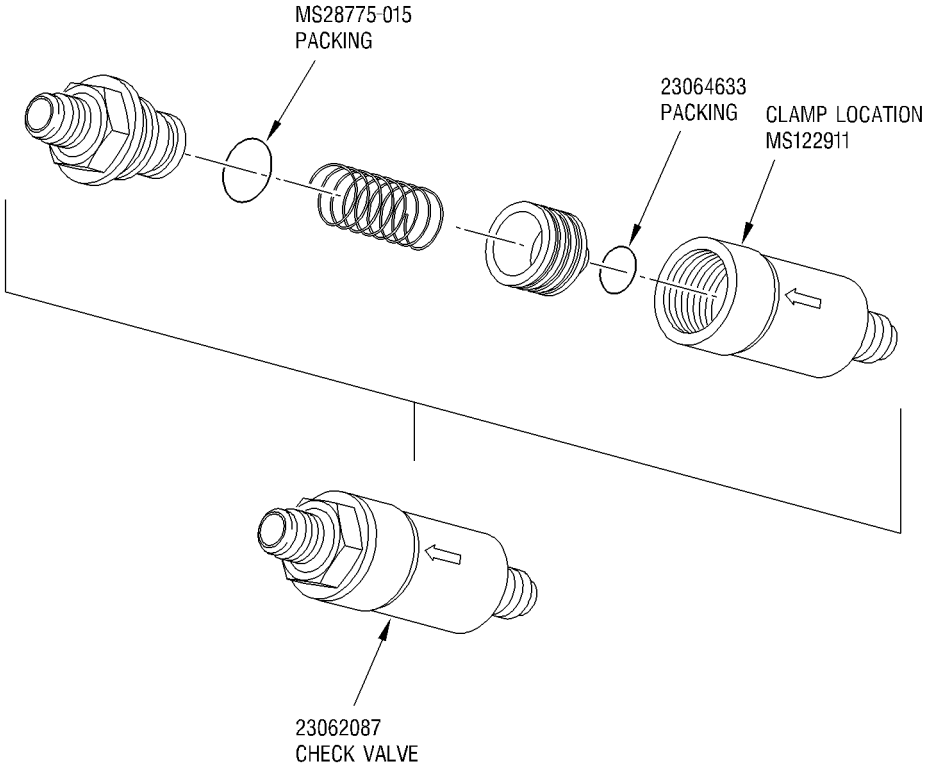
(10) (250–C20S, –C20W) Reinstall the pressure and scavenge oil tubing as follows:

(a) Reinstall the fire shield access panel. (Refer to Fire Shield Access Panel, para 4.B., this section.)

(b) Install the screen in the fitting on the gas producer support pressure oil manifold. Connect the pressure oil tube to the manifold fitting and to the check valve. Tighten coupling Nuts to 80–120 lb in. (9.0–13.6 N·m).

(c) Connect the gas producer turbine support scavenge oil tube to the scavenge oil fitting and to the elbow at the fire shield. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

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Turbine Pressure Oil System Check Valve
Figure 216

(11) Check run the engine. (Refer to Check Run, para 1, 72-00-00, Engine--Adjustment/Test.) Check for oil leaks in the area of disassembly.

(12) Alert maintenance and flight crews to monitor engine chip indications for the next two flight hours.

(a) Monitor engine chip indicators for the next two flight hours.

J. Cleaning Power Turbine Labyrinth Seals

Clean carbon buildup from the power turbine labyrinth seals as outlined in Oil System Maintenance, para 7.F.(2), this section.

K. Turbine Pressure Oil System Check Valve

(1) Disassemble, clean, inspect and assemble the check valve as follows: (See Figure 216.)

NOTE: Check Valve P/N 23074872 and subsequent part numbers are not applicable to this inspection (these valves are considered “ON CONDITION”).

(a) Remove the fitting from the check valve housing.

(b) Separate the packing, spring and poppet from the housing. Discard packing.

(c) Wash parts in mineral spirits.

(d) Inspect valve parts in accordance with Table 202.

(e) Insert poppet and spring into valve housing.

(f) Install fitting with new packing on housing.

CAUTION: BE SURE THE CHECK VALVE IS INSTALLED WITH THE ARROW POINTING TOWARD THE REAR OF THE ENGINE.

CAUTION: IF A CHECK VALVE IS INSTALLED (BLACK IN COLOR) VERIFY THAT THE PROPER PART NUMBER CLAMP IS INSTALLED. IF AN IMPROPER PART NUMBER CLAMP IS BEING USED, THE CHECK VALVE MUST BE REPLACED.

(g) Install check valve, ensure that the proper clamp is being used and that the clamp is positioned on the downstream end of check valve upon the raised shouldered area.

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(h) Inspect check valve for external leakage at first engine operation after valve installation on the engine. No leakage permitted.

L. Test the Turbine Pressure Oil System Check Valves. (See Figure 216.)

NOTE: Valves with part numbers 23074872 and subsequent are not field repairable.

WARNING: DO NOT BREATHE THE FUMES FROM SYNTHETIC LUBRICATING OIL. IT CAN CONTAIN TRICRESYL PHOSPHATE. USE IN AN AREA WITH CONTINUOUS AIRFLOW. KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAMES. DO NOT GET IT ON YOUR SKIN OR IN YOUR EYES. WEAR GOGGLES, CHEMICAL-RESISTANT GLOVES, AND SAFETY CLOTHING. IF YOU GET IT ON YOUR SKIN, CLEAN WITH SOAP AND WATER. IF YOU GET IT IN YOUR EYES, FLUSH WITH WATER. GET MEDICAL AID.

(1) Test the check valve using engine oil (MIL-L-23699 Series at 225°F (107°C) or MIL-L-7808 Series at 180°F (82°C)) as follows:

(a) Install the valve on the test stand with the large end down.

(b) Apply the test pressure to the input side of the valve.

(c) Cycle the valve open and closed at least once before taking pressure readings.

(d) Slowly increase the pressure and observe the opening pressure. Opening pressure must not exceed 5.0 psig (34.5 kPag).

(e) As the test pressure is reduced, the valve must be fully closed (with no leaks) at 3.0 psig (20.7 kPag).

8. Approved Repairs

A. Turbine and Exhaust Collector Support Crack Repair

Weld repair any cracks found in the exhaust ducts or outboard structure of the turbine and exhaust collector support.

CAUTION: TO PREVENT ELECTRICAL ARC BEARING DAMAGE, SEPARATE THE EXHAUST COLLECTOR FROM THE ENGINE/TURBINE AND REMOVE THE NO. 5 BEARING BEFORE THE WELD REPAIR IS MADE.

(1) Weld cracks in the exhaust ducts (areas -9 and -10 of Figure 217) using gas tungsten-arc process with 29-9 W Mo (AMS 5784) weld rod.

(2) Weld cracks in the outboard structure (area -3 of Figure 217) using gas tungsten-arc process with Hastelloy W (AMS 5786) weld rod.

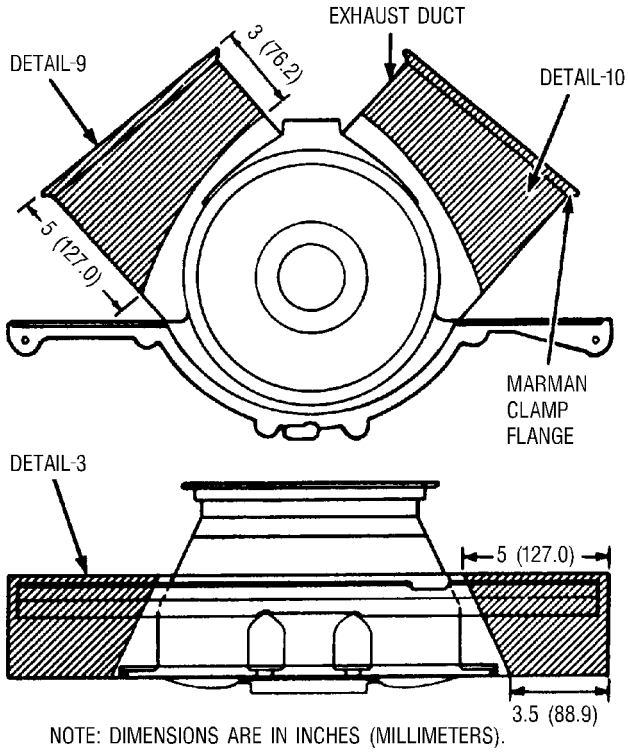
Table 202

Turbine Pressure Oil System Check Valve Inspection

Item	Condition	Serviceable Limit	Disposition
1	Stripped or crossed threads on fitting or housing.	None.	Chase threads. (Max. of one damaged thread
2	Nicks or scratches on flared tube sealing surface of fitting or housing.	None.	Repair or replace part.
3	Nicks or scratches on poppet seating surface or housing valve seat.	None.	Repair or replace part.
4	Fretting wear in bore of housing.	None.	Replace part.

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Weld Repairable Areas of the Turbine and Exhaust Collector Support
Figure 217

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POWER AND ACCESSORY GEARBOX – MAINTENANCE PRACTICES

1. Replacement

   A. Power and Accessory Gearbox Replacement

      (1) Remove the following from the rejected power and accessory gearbox.

         (a) Ignition Lead at Exciter

         (b) Ignition Exciter and Start Counter

         (c) Power Turbine Fuel Governor

         (d) Fuel Pump and Filter Assembly

         (e) Gas Producer Fuel Control

         (f) Lubrication System Tubing and Fittings

         (g) Engine Identification Plate

         (h) Engine electrical harness and brackets

      (2) Remove the compressor. (Refer to Compressor Removal, para 1.A., 72–30–00.)

      (3) Remove the turbine and combustion section assembly. (Refer to the Turbine Assembly Removal, para 1.A. or 1.C., 72–50–00). It is not necessary to separate the combustion section from the turbine.

      (4) Inspect all fuel, control air, and oil tubes. (Refer to Fuel System Air Leaks, para 1.B., 73–00–00.)

      (5) Remove the rejected gearbox and install the replacement unit.

         NOTE: Transfer the accessory pad covers as required from the rejected to the replacement gearbox.

      (6) Install the compressor. (Refer to Compressor Installation, para 1.C., 72–30–00.)

      (7) Install the turbine and combustion section assembly. (Refer to Turbine Assembly Installation, para 1.B. or 1.D., 72–50–00.)

      (8) Install the following on the engine:

         (a) Ignition Exciter and Start Counter (Refer to para 1.B., 74–10–01 and para 1.B., 74–20–03.)

         (b) Power Turbine Governor. (Refer to para 2.B., 73–20–01 or 2.B., 73–20–05.)

         (c) Fuel Pump and Filter Assembly. (Refer to para 2.B., 73–10–01.)

         (d) Gas Producer Fuel Control. (Refer to para 2.B., 73–20–02, 2.B., 73–20–03 or 2.B., 73–20–04.)

         (e) Engine Identification Plate.

         (f) Fittings and accessory pad covers. Transfer items from the rejected to the replacement gearbox as required.

            WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

         (g) Lubrication System Tubing and Fittings. (See Figure 201 or 202.) Apply a light coating of engine oil to lubrication system fitting threads and to packings to aid installation.

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(h) Ignition lead at exciter.

(9) Make appropriate entry relative to gearbox replacement in the Engine Log.

(10) Check run the engine after gearbox replacement. (Refer to Check Run, para 1., 72-00-00, Engine-Adjustment/Test.)

NOTE: When the power and accessory gearbox has been replaced, check the system oil level before and after the check run.

B. Oil Seals Replacement

Replace leaking power and accessory gearbox seals as follows:

(1) Remove the accessory or drive from the gearbox pad.

CAUTION: DO NOT PRY BETWEEN THE SEAL CAVITY IN THE HOUSING AND THE SEAL.

(2) Use the 6796941 seal replacement kit to remove the seal. Be careful not to contaminate the shaft bearing or damage the gear shaft. The seal will be damaged during removal, consequently it will not be salvageable.

CAUTION: DO NOT USE SILICONE LUBRICANTS EXCEPT WHERE SPECIFIED. USE ONLY THE LUBRICANTS RECOMMENDED IN THE TABLE 301, 72-00-00, ENGINE-SERVICING.

(3) Apply grease (Shell 6249, Mobil 28, engine oil or equivalent) to the seal lip to help the installation, then carefully drive (or press) the replacement seal in place.

(4) Reinstall the accessory or drive on the gearbox pad.

C. Oil Filter Replacement (See Figure 203 or 204.)

Remove, inspect, clean and install the oil filter as follows: (Refer to Gearbox Housing Lubrication System Components Disassembly, para 2.D., this section.)

(1) On M250-C20, -C20B, -C20F and -C20J engines, place a cloth between the gearbox and the turbine to catch oil which will overflow the element housing when the cap is removed. On M250-C20S and -C20W engines, place a container under the filter to catch the oil which will drain.

NOTE: Some engines have an impending oil filter bypass indicator cap.

(2) Remove two nuts and washers; then using 6798860 puller, remove the oil filter cap. Use a suction gun or other suitable device to remove the puddled oil from the filter housing before the element is removed.

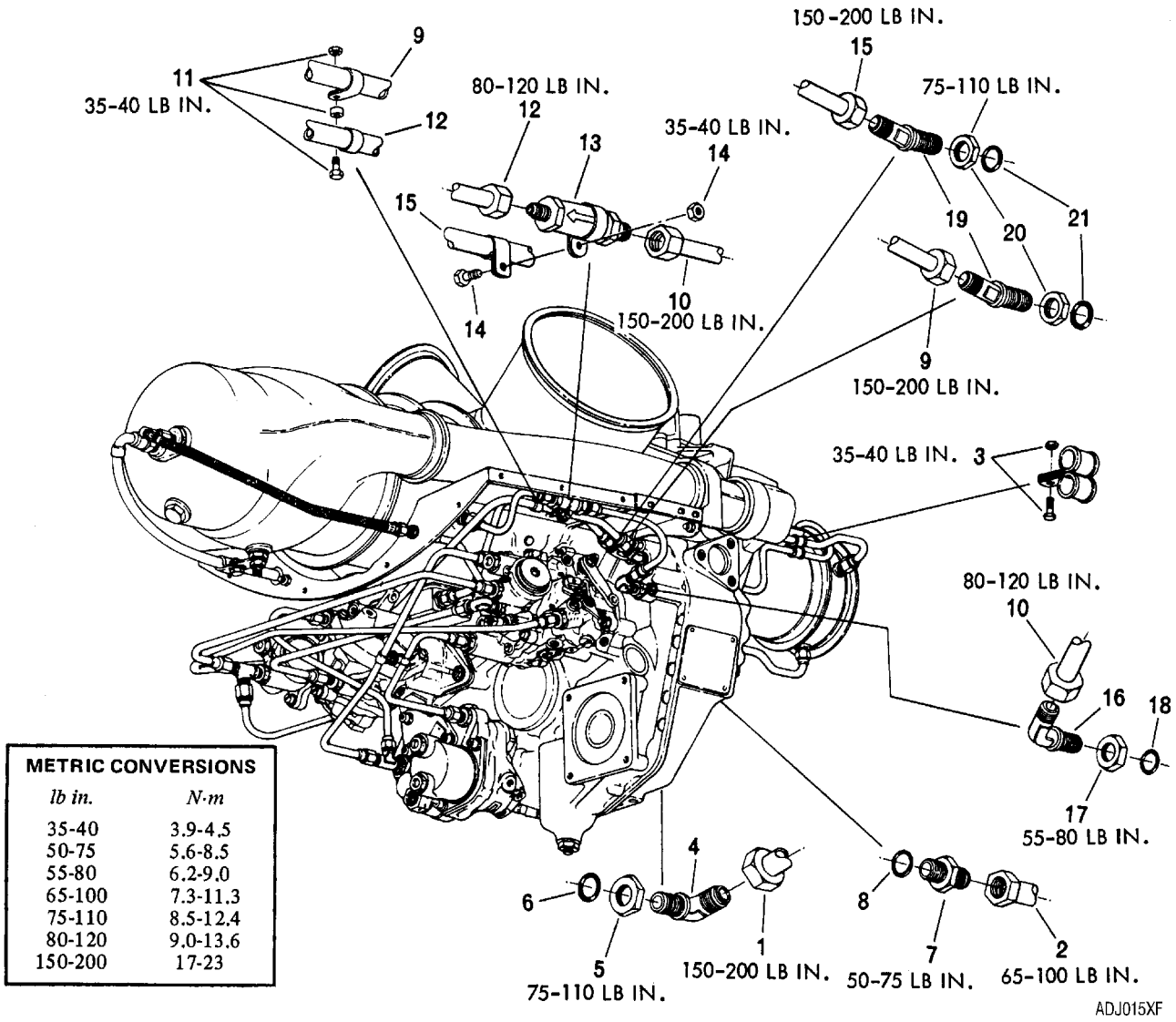
(3) Remove the filter element (and packing on applicable configurations) from the housing. Discard the packing.

(4) Inspect filter element and filter cavity for metal particles.

(a) A small amount of metallic debris is acceptable after recent overhaul or repair. If excessive metal contamination is present, clean filter and perform ground run for 30 minutes at power with rotors turning.

(b) Check filter after ground run for new accumulation of particles. If filter is clean, release aircraft for flight. If accumulation is present after second ground run, tag engine, noting cause for rejection.

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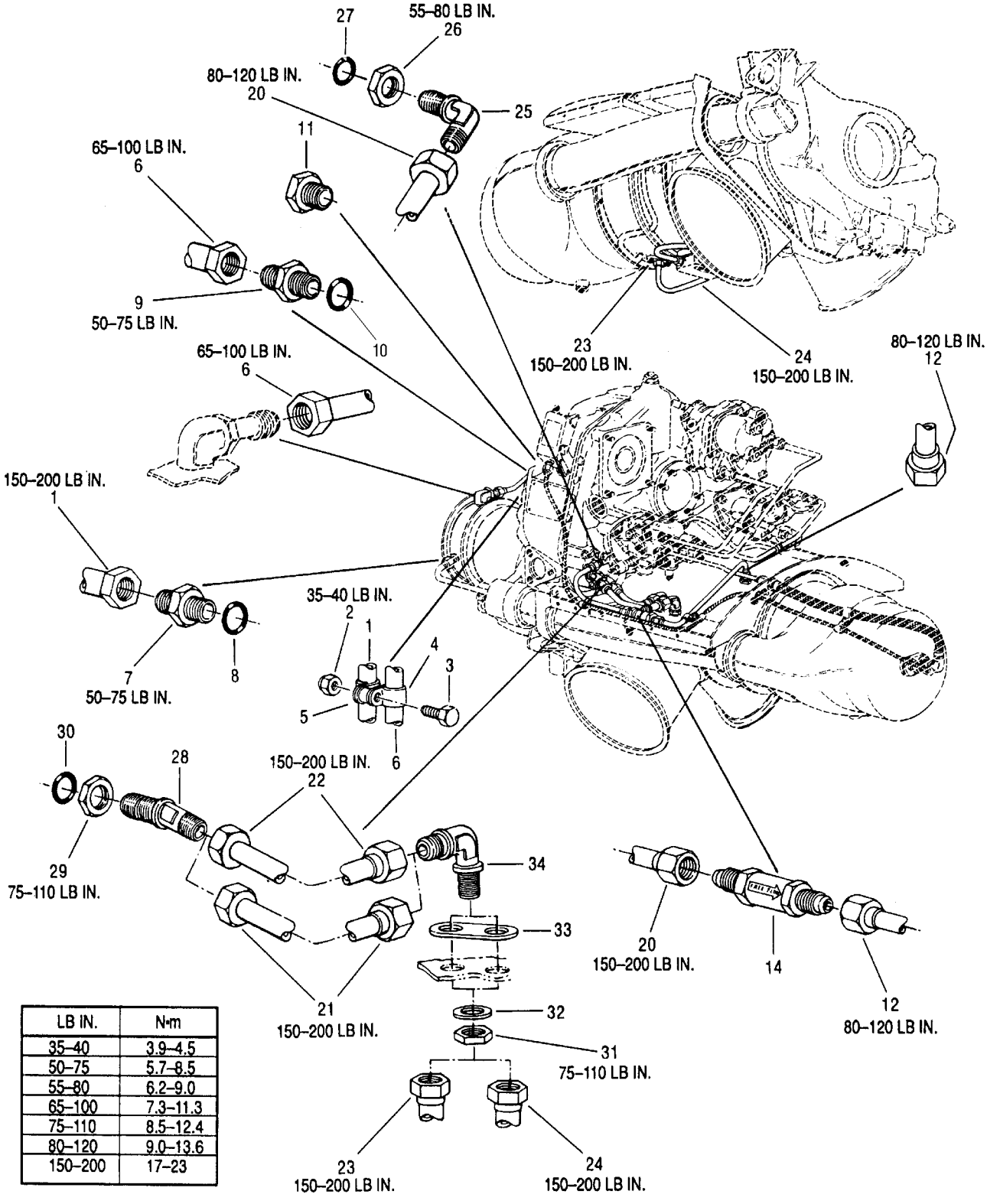


METRIC CONVERSIONS	
lb in.	*N·m*
35-40	3.9-4.5
50-75	5.6-8.5
55-80	6.2-9.0
65-100	7.3-11.3
75-110	8.5-12.4
80-120	9.0-13.6
150-200	17-23

1. Compressor Scavenge Oil Tube
2. Compressor Pressure Oil Tube
3. Bolt, Nut
4. Elbow
5. Nut
6. Packing
7. Reducer
8. Packing
9. GP Turbine Scavenge Oil Tube
10. G/B–to–Check Valve Pressure Oil Tube
11. Bolt, Nut, Bushing
12. Check Valve–to–Fireshield Pressure Oil Tube
13. Check Valve
14. Bolt, Nut
15. Sump–to–G/B Scavenge Oil Tube
16. Elbow
17. Nut
18. Packing
19. Elbow (2)
20. Nut (2)
21. Packing (2)

Lubrication System Tube and Fitting Torques (250–C20, –C20B, –C20F and –C20J)
Figure 201

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LB IN.	N·m
35–40	3.9–4.5
50–75	5.7–8.5
55–80	6.2–9.0
65–100	7.3–11.3
75–110	8.5–12.4
80–120	9.0–13.6
150–200	17–23

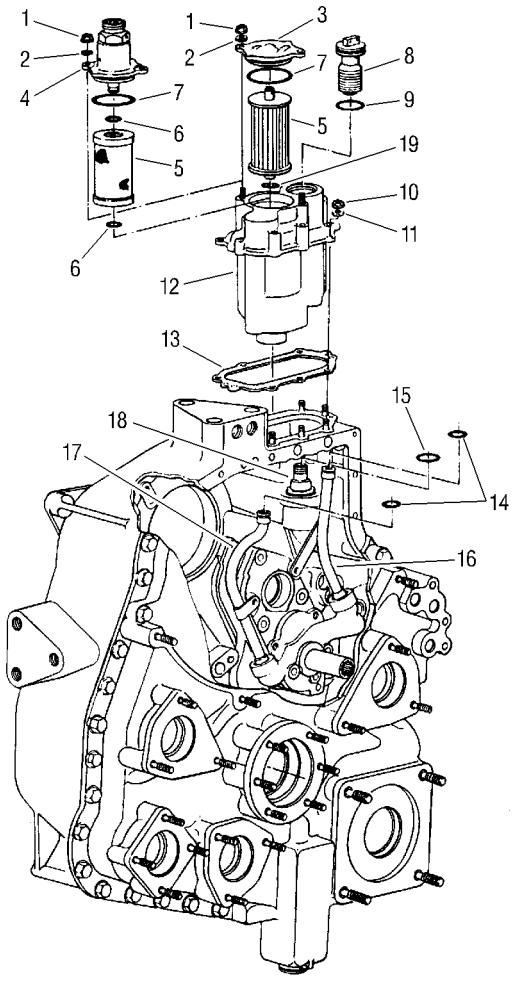
Lubrication System Tube and Fitting Torques (250–C20S, –C20W)
Figure 202

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 202

1. Front support scavenge oil tube
2. Nut
3. Bolt
4. Clamp
5. Clamp
6. Front support pressure oil tube
7. Union
8. Preformed packing
9. Reducer
10. Preformed packing
11. Plug
12. Check valve–to–fireshield pressure oil tube
13. Not used
14. Check valve
15. Not used
16. Not used
17. Not used
18. Not used
19. Not used
20. Accessory housing–to–check valve pressure oil tube
21. Fireshield–to–accessory housing scavenge oil tube
22. Fireshield–to–accessory housing scavenge oil tube
23. External sump–to–fireshield scavenge oil tube
24. GP turbine–to–fireshield scavenge oil tube
25. Elbow
26. Nut
27. Preformed packing
28. Elbow
29. Nut
30. Preformed packing
31. Nut
32. Washer
33. Spacer
34. Elbow

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

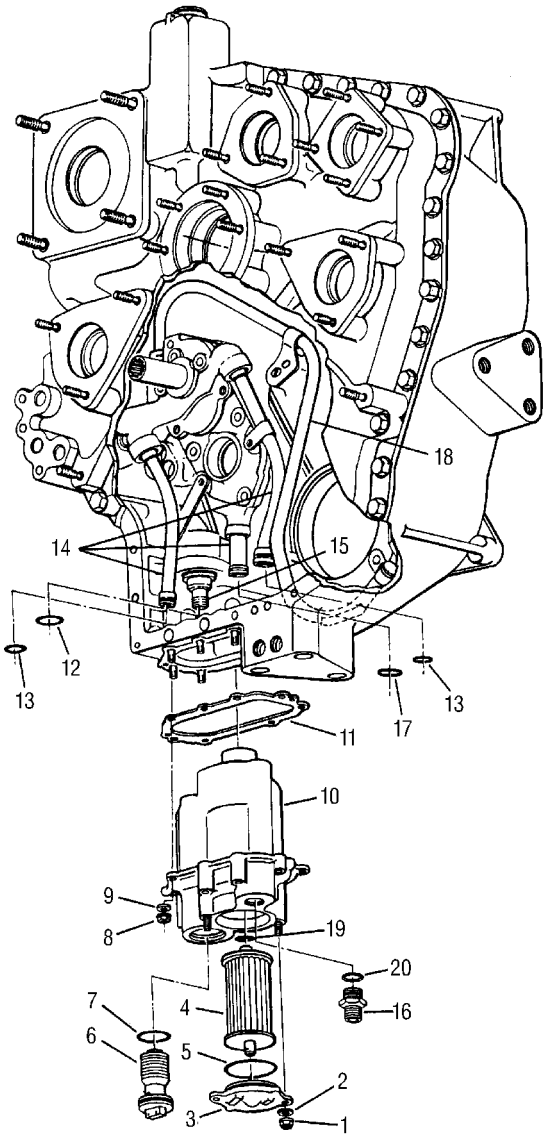


ADJ016XF

1. Nuts (2)
2. Washers (2)
3. Oil Filter Cap
4. Oil Filter Indicating Cap (250–C20F)
5. Oil Filter
6. Packing (250–C20F)
7. Packing
8. Pressure Regulating Valve
9. Packing
10. Nuts (8)
11. Washer (8)
12. Filter Housing
13. Gasket
14. Packing
15. Packing (2)
16. Bypass Tube (2)
17. Pressure–Out Tube
18. Check Valve
19. Packing (250–C20, –C20B)

Oil Filter, Filter Housing, and Pressure Regulating Valve (250–C20, –C20B, –C20F, –C20J)
Figure 203

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



1. Nuts (2)
2. Washers (2)
3. Oil Filter Cap
4. Oil Filter
5. Packing
6. Pressure Regulating Valve
7. Packing
8. Nuts (8)
9. Washers (8)
10. Filter Housing
11. Gasket
12. Packing
13. Packing (2)
14. Transfer Tube (3)
15. Check Valve
16. Magnetic Plug
17. Packing
18. Scavenge Tube
19. Packing
20. Packing

Oil Filter, Filter Housing, and Pressure Regulating Valve (250–C20S, –C20W)
Figure 204

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

PARA 1.C. (cont)

(5) Clean the filter ultrasonically in perchlorethylene. If equipment is not available, clean by agitating in mineral spirits.

(6) If excessive contamination is present the filter must be ultrasonically cleaned. If excessive carbon deposits are found, conduct the inspection and cleaning of the power turbine support pressure oil nozzle in accordance with Cleaning the Power Turbine Support Pressure Oil Nozzle, para 7.G., 72–50–00.

(7) Dry the filter by shaking (air dry), and inspect for any metal particles. If particles are present, reclean filter or replace filter element.

(8) Thoroughly clean the filter cavity of all residual oil and sludge.

(9) Install the cleaned filter with new packing and fill the filter cavity with engine oil. Install filter cap with new packing and secure with two nuts and washers. Tighten nuts to 30–40 lb in. (3.4–4.5 N·m).

D. Lube Oil Filter Housing Replacement

Replace the lube oil filter housing as follows: (See Figure 203 or 204)

(1) Remove the eight nuts and washers. On 250–C20S and –C20W engines, place a container beneath the gearbox to catch the oil that will drain. Remove the housing and the gasket.

(2) (250–C20S, –C20W) Remove the magnetic drain plug from the filter housing.

(3) Replace the packing seals on the filter housing mating ends of the two (three on 250–C20S and –C20W) transfer tubes.

(4) Replace packing seals on both ends of the check valve assembly.

(5) Replace the filter housing gasket.

(6) Install the replacement lube oil filter housing. Mate the housing to the two (three on 250–C20S and –C20W) transfer tubes and to the check valve during the assembly.

(7) Retain the lube oil filter housing with eight nuts and washers. Tighten nuts to 35–40 lb in. (3.9–4.5 N·m).

(8) (250–C20S, –C20W) Install the magnetic plug with new packing in the replacement housing.

NOTE: All 250–C20F engines incorporate an impending bypass visual (popout) indicator. This indicator is a customer option on other 250–C20 series engines. Nominal values for this system are:

Pre 250–C20 CEB–1154:

21–29 psid (145–200 kPad)	Visual indication of impending by-pass. This system has thermal lockout below 49–66°C (120–150°F)
80–130 psid (552–896 kPad)	Filter bypass valve opens, contaminated oil bypasses the filter.

Post 250–C20 CEB–1154:

26–34 psid (179–234 kPad)	Visual indication of impending bypass. This system has a thermal lockout below 38–54°C (100–130°F)
80–130 psid (552–896 kPad)	Filter bypass valve opens, contaminated oil bypasses the filter

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2. Gearbox Disassembly and Assembly

Applicable parts of the following procedure may be used by any knowledgeable and qualified maintenance facility to perform part replacement in the gearbox. Return the gearbox to an Authorized Maintenance Facility if repair beyond part replacement is required or if metal particles are detected inside the gearbox.

A. Gearbox Disassembly (See Figure 205, 206 or 207)

CAUTION: THE SPUR ADAPTER GEARSHAFT MAY FALL OUT AND BE DAMAGED, IF THE ENGINE IS EQUIPPED WITH BALL TYPE 2 1/2 BEARING AND IS TURNED DOWNWARD WHILE IN THE 6795579 TURNOVER STAND.

(1) Remove the engine from the aircraft and separate the gearbox from the engine. Refer to Power and Accessory Gearbox Replacement, PARA 1.A., this section.

(2) Install the gearbox in 6795579 turnover stand or equivalent.

(3) Remove the 39 nuts, 4 bolts, and 43 washers at the splitline and separate the cover from the housing.

B. Gearbox Cover Disassembly

Disassemble the gearbox cover as follows:

(1) Remove the two self–locking nuts and take the pinion bearing oil nozzle from the aft side of the gearbox cover. Discard the packing seal. (See Figure 205, 206 or 207)

(2) Remove the torquemeter shaft support spanner nut using 6795597 wrench. (See Figure 208) Remove the cup washer. Remove the torquemeter shaft support from the gearbox cover.

(3) Remove the headed pin; then press the bearing inner race from the support using 6796947 drift and 6796950 plate with detail –4. (See Figures 209 and 210)

(4) Simultaneously remove the helical power takeoff gearshaft and the helical torquemeter gearshaft. Remove the helical torquemeter gearshaft bearing end plate and thrust washer. Discard packing from the gearbox cover.

(5) Remove the bearing outer race and rollers from the helical torquemeter gearshaft. Remove the damper ring from the helical torquemeter gearshaft.

(6) Remove the ball bearing from the helical power takeoff gearshaft using 6796948 drift and 6796950 plate with detail –11. (See Figure 211) Remove the roller bearing inner race using 6796948 drift and 6796950 plate with detail –10. On 250–C20J engine, remove the two damper rings from the helical power takeoff gearshaft.

(7) Remove the power train drive helical gear from the gearbox cover as follows:

(a) Ball bearing configuration; remove the two ball bearings from the gear. Bearings which cannot be removed using detail –23 of puller 6796950 kit with 6796948 drift shall be removed by pulling at the outer race. Use 6872746 puller with 6796948 drift. Discard any bearings which have been pulled by the outer race.

(b) Roller bearing configuration; remove the internal retaining ring from the rear of the gearbox cover and remove the gear and bearings. The outer race of the No. 3 roller bearing will remain in the gearbox cover; remove it. Remove the two roller bearing inner race and rollers from the gear using 6872746 puller and 6796948 drift.

(8) Remove the internal retaining ring and roller bearing (No. 2 1/2) from inside the helical drive gear.

NOTE: Replace the No. 2 1/2 bearing if it must be pulled or driven from the helical drive gear.

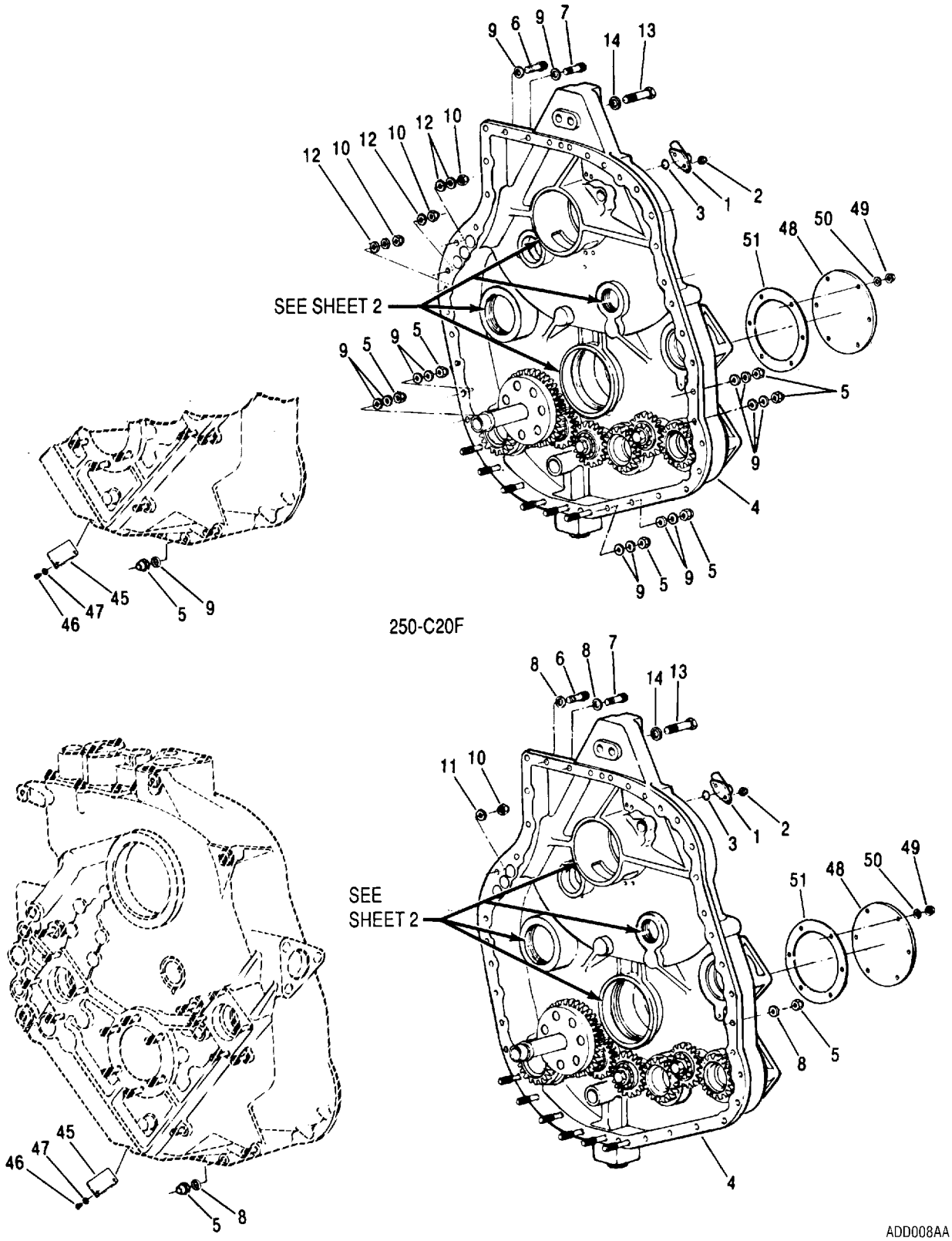
Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 205 (Sheet 1 and 2 of 4)

1. Pinion bearing oil nozzle
2. Nut
3. Packing
4. Gearbox cover
5. Nut (36)
6. Bolt
7. Bolt
* 8. Washer (38)
** 9. Washer (44)
10. Nut (3)
* 11. Washer (3)
** 12. Washer (5)
13. Bolt (2)
14. Washer (2)
15. Spanner Nut
16. Key Washer
17. Cup Washer
18. Torquemeter shaft support
19. Pin
20. Helical power takeoff gearshaft
21. Helical power takeoff gearshaft
** 22. Internal retaining ring
* 23. Internal retaining ring (2)
24. Roller bearing inner race
25. Ball bearing
26. Helical torquemeter gearshaft
27. Damper ring
28. Roller bearing
29. Thrust washer
30. Packing
31. Power train drive helical gear
32. Bearing (No. 3 and 4)
33. Internal retaining ring
34. Internal retaining ring
35. Bearing outer race and rollers
36. Fuel control spur gearshaft
37. Internal retaining ring
38. Pin
39. Splined adapter
40. Packing
41. External retaining ring
42. Bearing retainer
43. Ball bearing
44. Gearshaft bearing sleeve spacer
45. Identification plate
46. Screw (2)
47. Washer (2)
48. Plate, cover accessory
49. Nut (6)
50. Spacer
51. Gasket

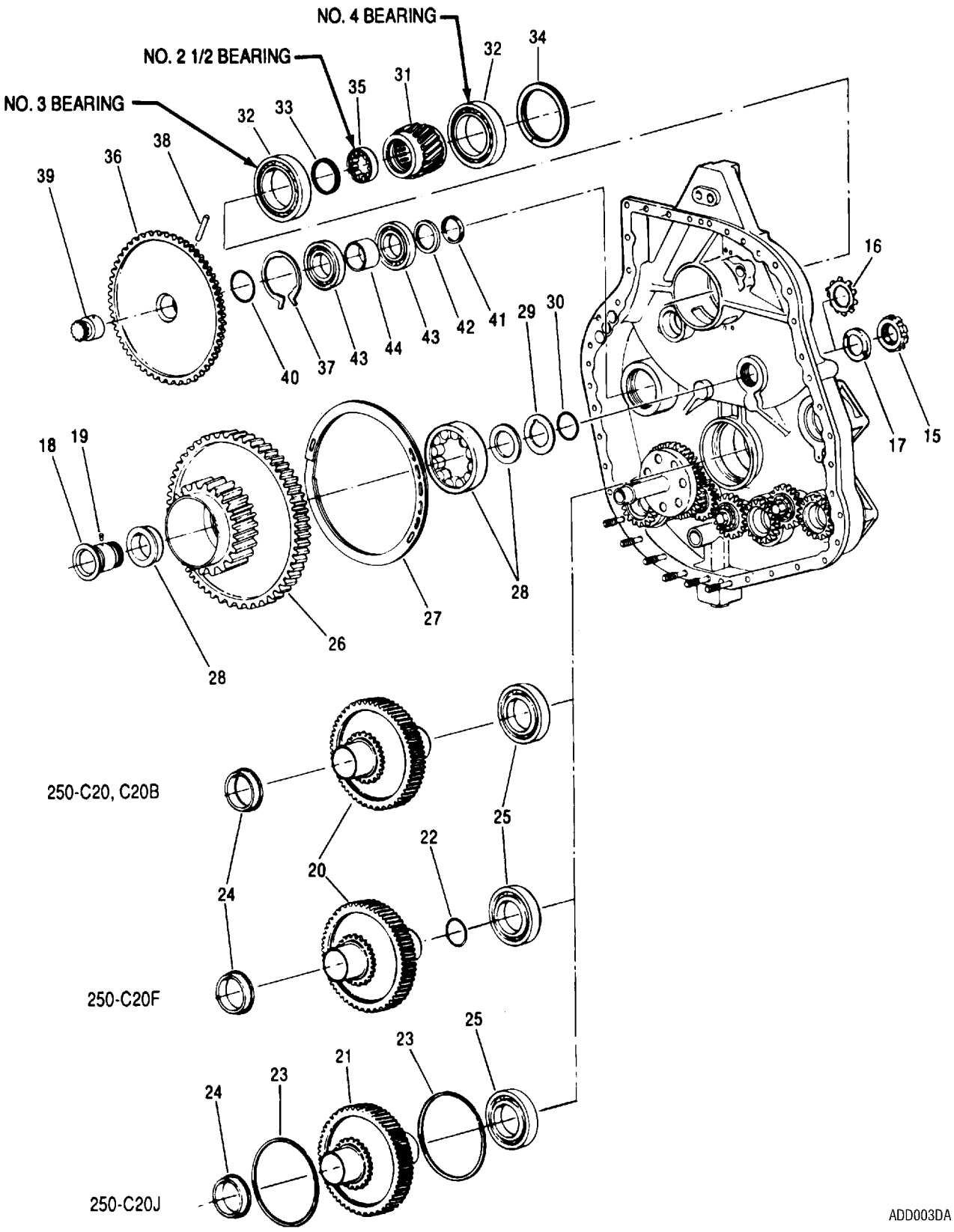
*250–C20J engines only
**250–C20F engines only

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Typical Power and Accessory Gearbox Cover Assembly,
250–C20, –C20B, –C20F, –C20J
Figure 205 (Sheet 1 of 4)

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Typical Power and Accessory Gearbox Cover Assembly,
250–C20, –C20B, –C20F, –C20J
Figure 205 (Sheet 2 of 4)

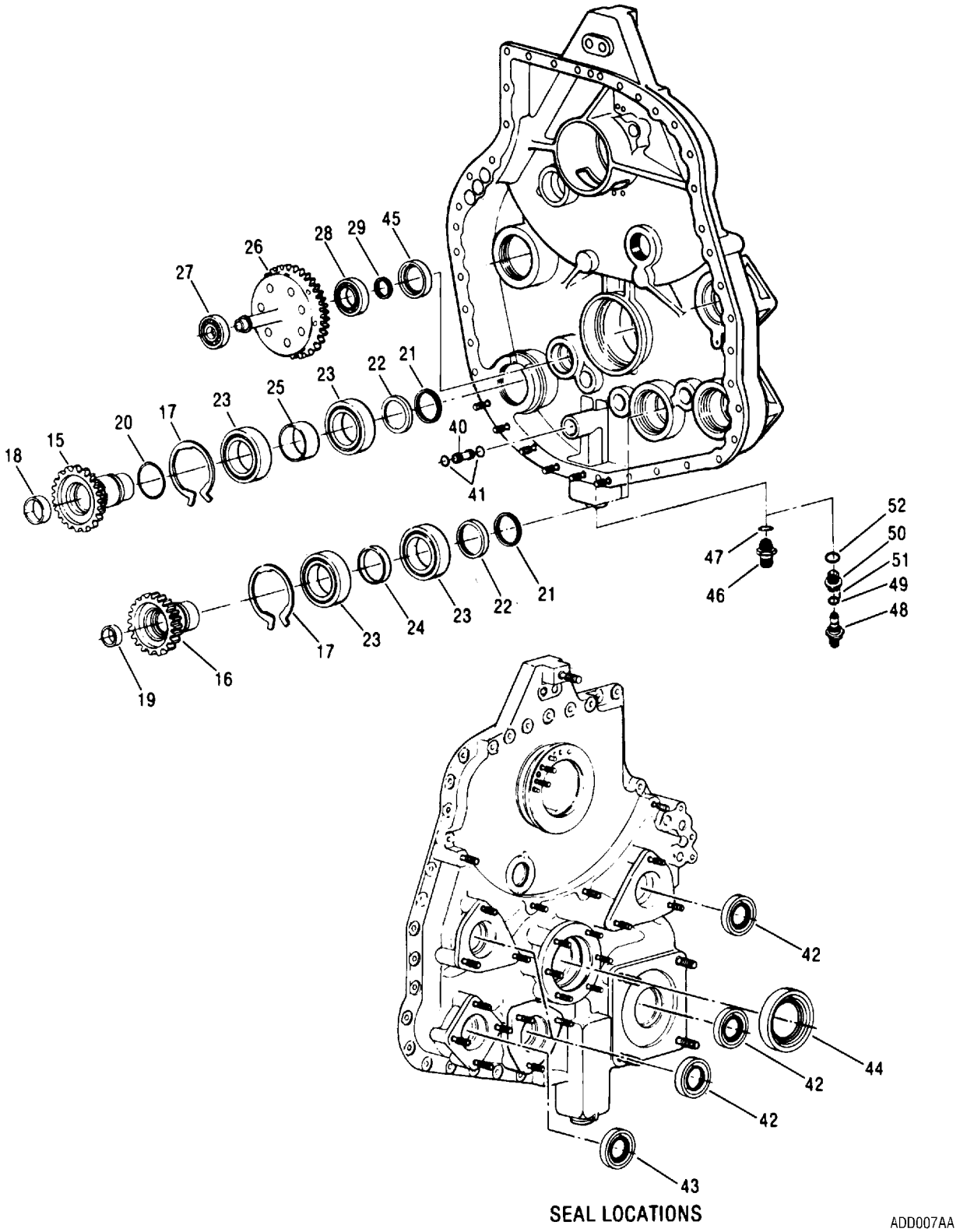
Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 205 (Sheet 3 and 4 of 4)

1. Accessory drive spur gearshaft*
2. Internal retaining ring*
3. Plug*
4. External retaining ring*
5. Bearing retainer*
6. Ball bearing (2)*
7. Spacer*
8. Gas producer train idler spur gear*
9. Bolt*
10. Key washer*
11. Keyway washer*
12. Internal retaining ring*
13. Ball bearing*
14. Idler gear support shaft*
15. Starter generator spur gearshaft assy
16. Fuel pump drive spur gearshaft assy
17. Internal retaining ring (2)
18. Plug
19. Plug
20. Packing
21. External retaining ring (2)
22. Bearing retainer (2)
23. Ball bearing (4)
24. Spacer
25. Spacer
26. Gas producer train idler spur gearshaft
27. Ball bearing
28. Ball bearing
29. Internal retaining ring
30. Gas producer train idler spur gear (2)
31. Bolt (2)
32. Nut (2)
33. Washer (2)
34. Washer (2)
35. Packing (2)
36. Packing (2)
37. Internal retaining ring (2)
38. Ball bearing (2)
39. Support shaft (2)
40. Oil transfer tube
41. Packing (2)
42. Seal (4)
43. Seal**
44. Seal
45. Seal
46. Magnetic plug
47. Packing
48. Magnetic plug, quick disconnect
49. Packing
50. Insert
51. Pin
52. Packing

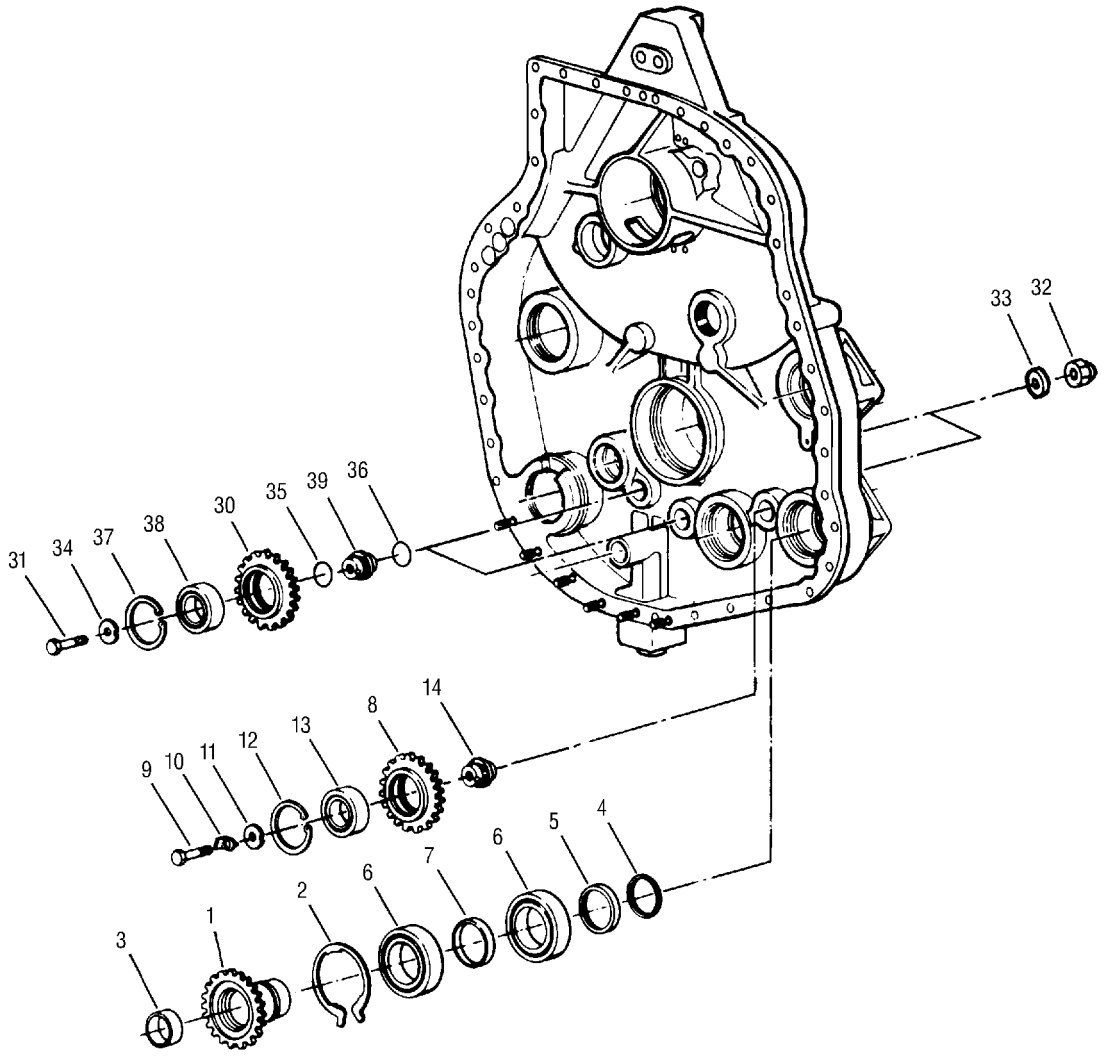
*Used on 250–C20J engine
**Used on 250–C20F engine

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



Typical Power and Accessory Gearbox Cover Assembly,
250–C20, –C20B, –C20F, –C20J
Figure 205 (Sheet 3 of 4)

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



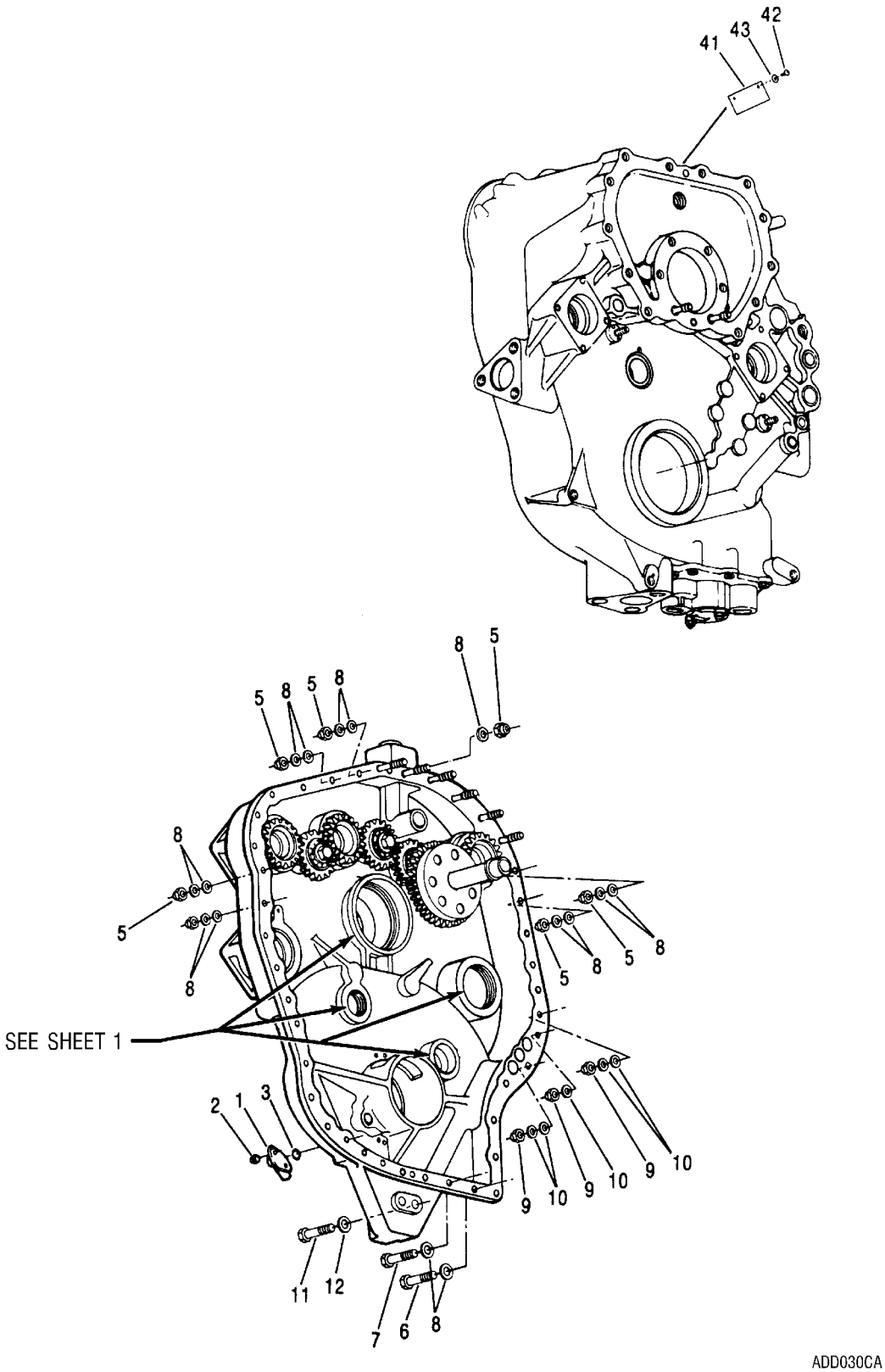
Typical Power and Accessory Gearbox Cover Assembly,
250–C20, –C20B, –C20F, –C20J
Figure 205 (Sheet 4 of 4)

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 206 (Sheets 1 and 2 of 4)

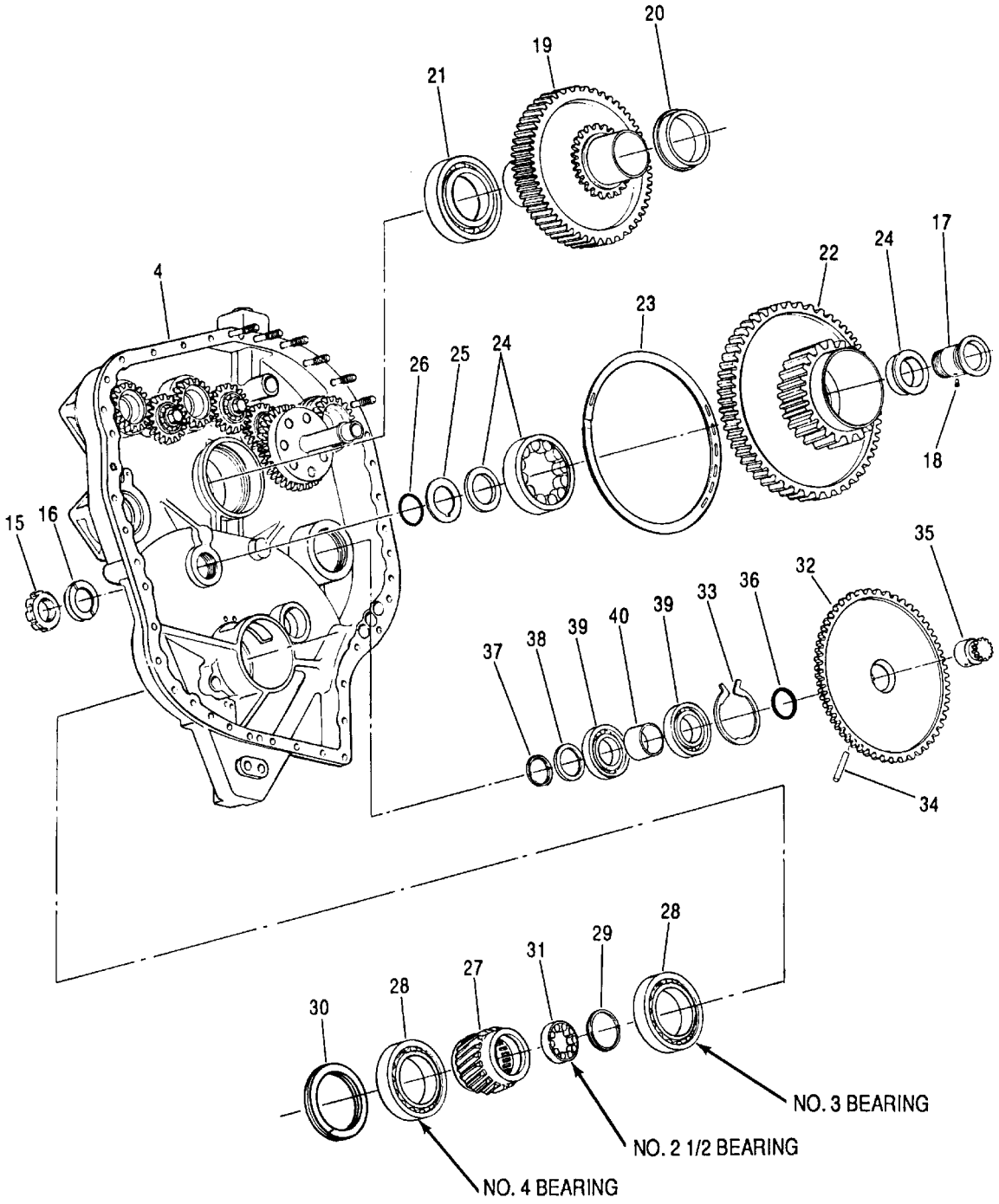
1. Pinion Bearing Oil Nozzle
2. Nut (2)
3. Packing
4. Gearbox cover
5. Nut (36)
6. Bolt
7. Bolt
8. Washer (38)
9. Nut (3)
10. Washer (5)
11. Bolt (2)
12. Washer (2)
13. Not Used
14. Not Used
15. Spanner nut
16. Cup washer
17. Torquemeter shaft support
18. Pin
19. Power takeoff helical gearshaft
20. Roller bearing inner race
21. Ball bearing
22. Torquemeter helical gearshaft
23. Internal retaining ring
24. Roller bearing
25. Thrust washer
26. Packing
27. Power train drive helical gear
28. Roller bearing (2)
29. Internal retaining ring
30. Internal retaining ring
31. Bearing outer race and rollers
32. Fuel control and oil pump spur gearshaft
33. Internal retaining ring
34. Pin
35. Splined adapter
36. Packing
37. Retaining ring
38. Bearing retainer
39. Ball bearing (2)
40. Spacer
41. Identification plate
42. Screw (2)
43. Washer (2)

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



Power and Accessories Gearbox Cover Assembly, 250–C20S
Figure 206 (Sheet 1 of 4)

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



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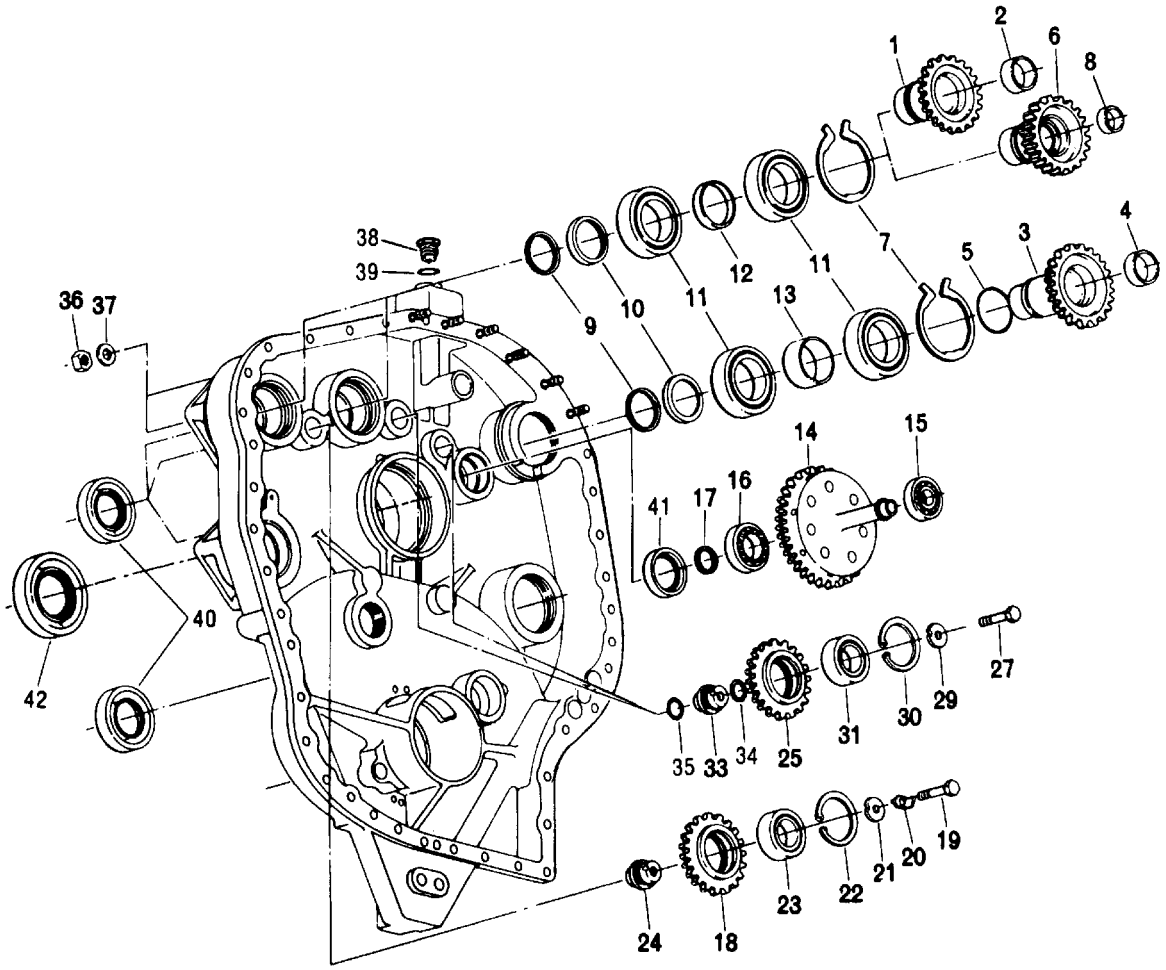
Power and Accessories Gearbox Cover Assembly, 250–C20S
Figure 206 (Sheet 2 of 4)

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 206 (Sheets 3 and 4 of 4)

1. Accessory drive spur gearshaft
2. Plug
3. Starter generator spur gearshaft
4. Plug
5. Packing
6. Fuel pump drive spur gearshaft
7. Internal retaining ring (3)
8. Drilled plug
9. External retaining ring (3)
10. Bearing retainer (3)
11. Ball bearing (6)
12. Gearshaft bearing sleeve spacer (2)
13. Gearshaft bearing sleeve spacer
14. Gas producer train idler spur gearshaft
15. Ball bearing
16. Ball bearing
17. Internal retaining ring
18. Gas producer train idler spur gear
19. Bolt
20. Key washer
21. Bearing retainer washer
22. Internal retaining ring
23. Ball bearing
24. Idler gear support shaft
25. Gas Producer Train Idler Spur Gear (2)
26. Bolt (2)
27. Bolt (2)
28. Key Washer (2)
29. Bearing Retaining Keyway Washer (2)
30. Internal Retaining Ring (2)
31. Ball Bearing (2)
32. Idler Gear Support Shaft (2)
33. Idler Gear Support Shaft (2)
34. Packing (2)
35. Packing (2)
36. Nut (2)
37. Washer (2)
38. Plug
39. Packing
40. Plain encased seal (5)
41. Plain encased seal
42. Plain encased seal

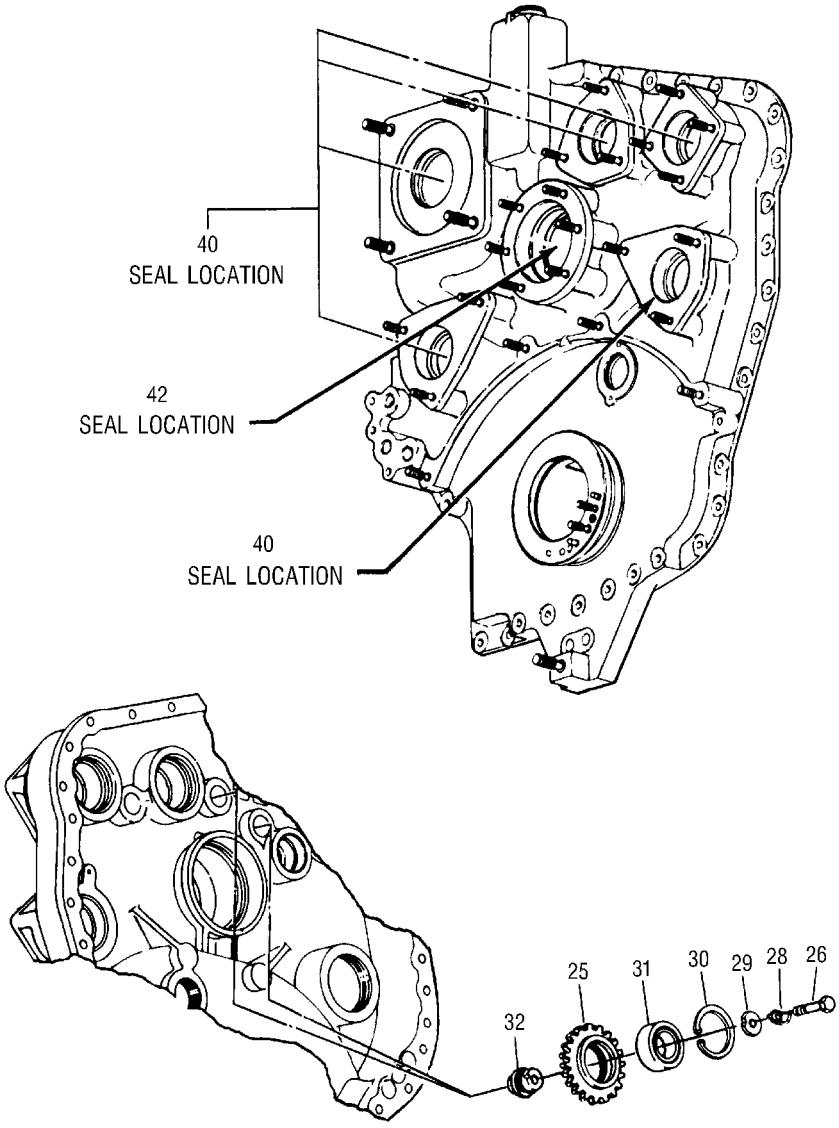
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Power and Accessories Gearbox Cover Assembly, 250–C20S
Figure 206 (Sheet 3 of 4)

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



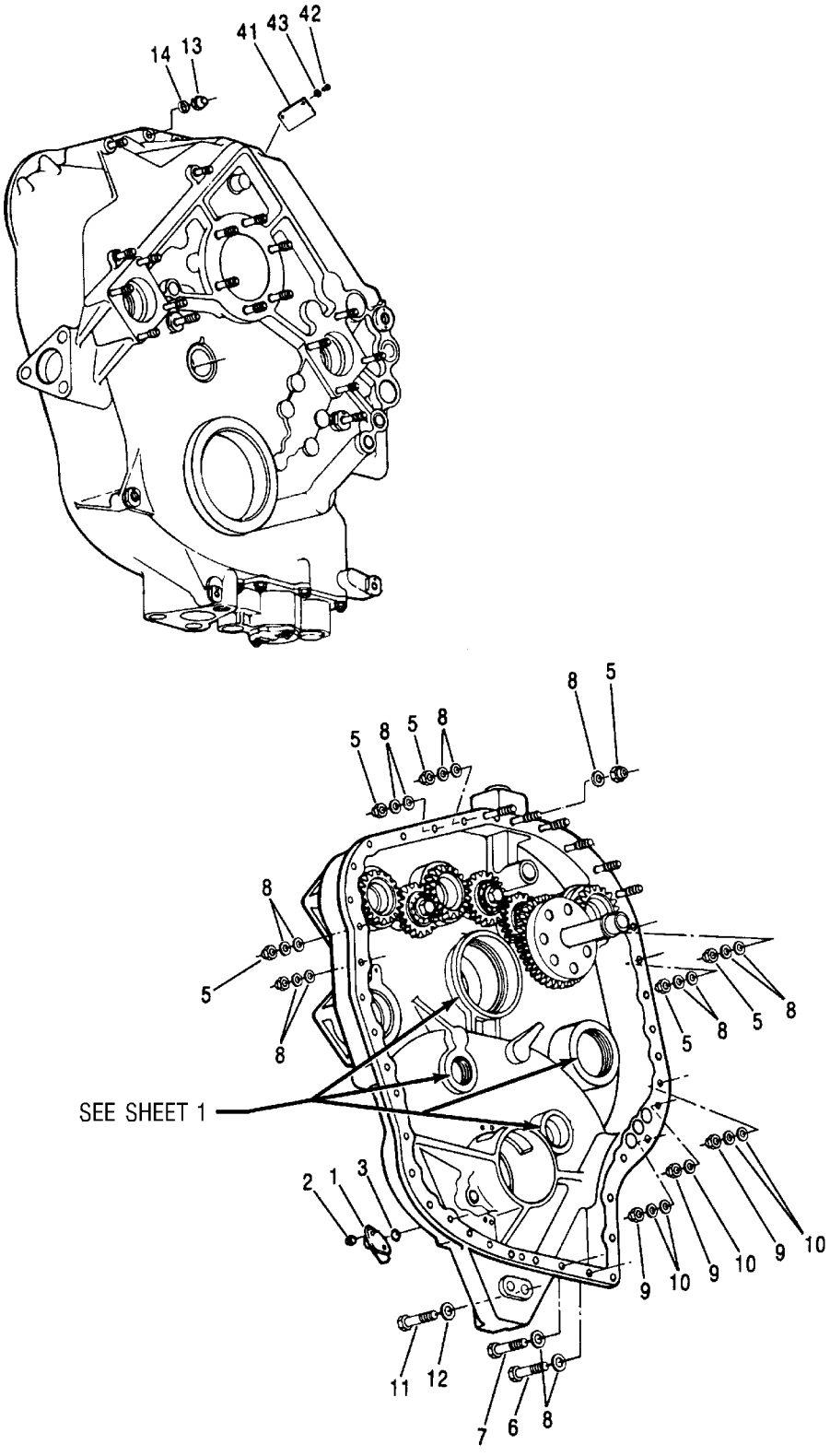
Power and Accessories Gearbox Cover Assembly, 250–C20S
Figure 206 (Sheet 4 of 4)

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 207 (Sheet 1 and 2 of 3)

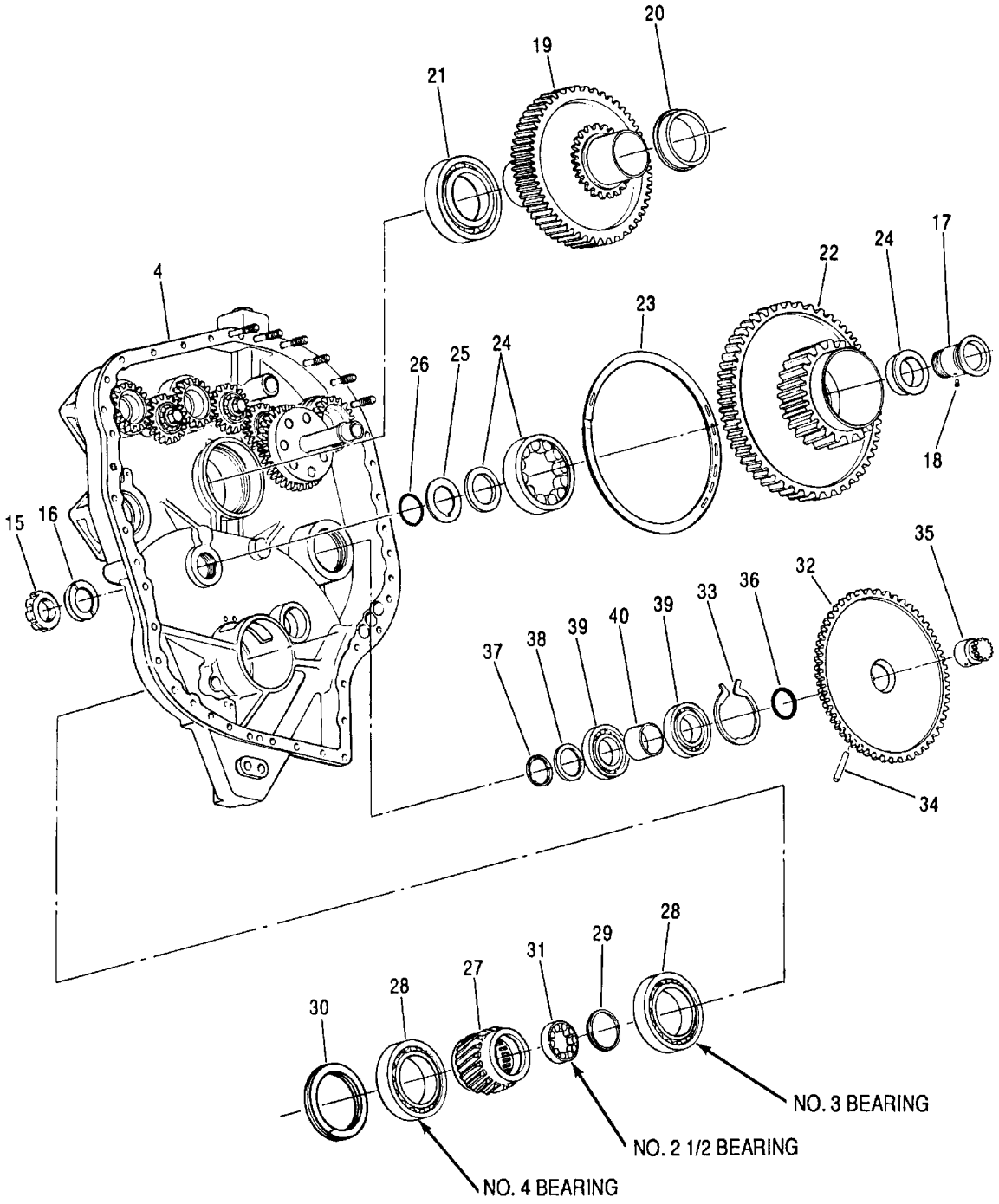
1. Pinion bearing oil nozzle
2. Nut (2)
3. Packing
4. Gearbox cover
5. Nut (36)
6. Bolt
7. Bolt
8. Washer (38)
9. Nut (3)
10. Washer (3)
11. Bolt (2)
12. Washer (2)
13. Nut (6)
14. Washer (6)
15. Spanner nut
16. Cup washer
17. Torquemeter shaft support
18. Pin
19. Power takeoff helical gearshaft
20. Roller bearing inner race
21. Ball bearing
22. Torquemeter helical gearshaft
23. Internal retaining ring
24. Roller bearing
25. Thrust washer
26. Packing
27. Power train drive helical gear
28. Bearing (No. 3 and 4)
29. Internal retaining ring
30. Internal retaining ring
31. Bearing outer race and rollers
32. Fuel control spur gearshaft
33. Internal retaining ring
34. Pin
35. Splined adapter
36. Packing
37. Retaining ring
38. Bearing retainer
39. Ball bearing (2)
40. Spacer
41. Identification plate
42. Screw (2)
43. Washer (2)

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



Power and Accessories Gearbox Cover Assembly, 250–C20W
Figure 207 (Sheet 1 of 3)

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



ADD029AA

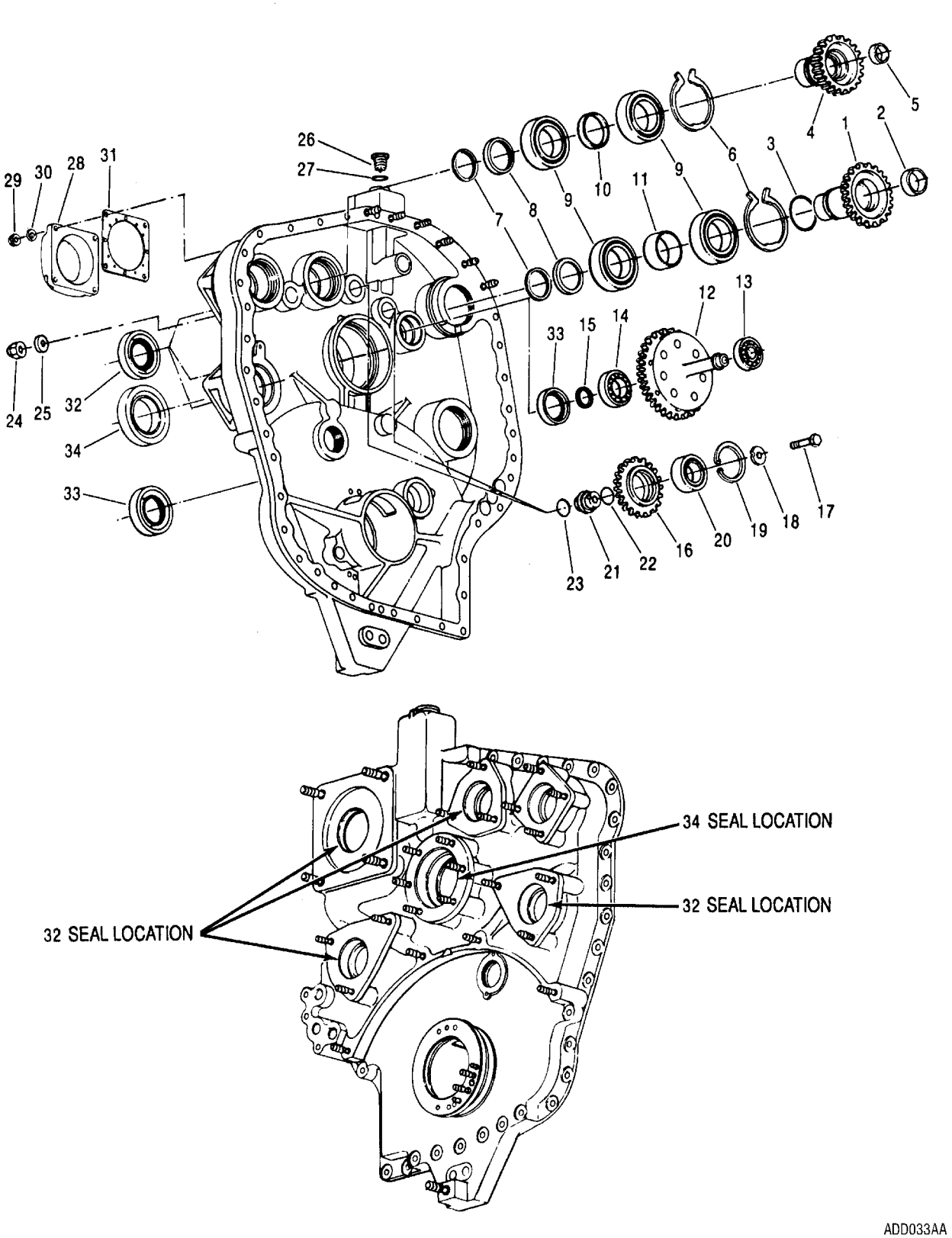
Power and Accessories Gearbox Cover Assembly, 250–C20W
Figure 207 (Sheet 2 of 3)

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 207 (Sheet 3 of 3)

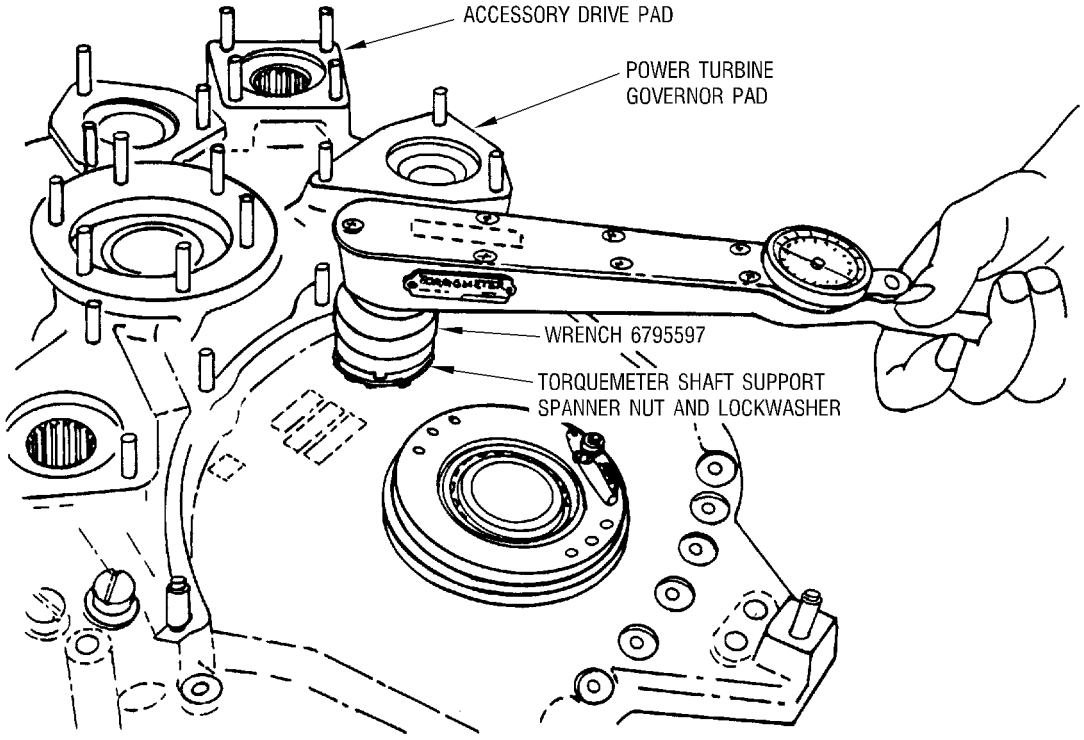
1. Starter generator spur gearshaft
2. Plug
3. Packing
4. Fuel pump drive spur gearshaft
5. Drilled plug
6. Internal retaining ring (2)
7. External retaining ring (2)
8. Bearing retainer (2)
9. Ball bearing (4)
10. Gearshaft bearing sleeve spacer
11. Gearshaft bearing sleeve spacer
12. Gas producer train idler spur gearshaft
13. Ball bearing
14. Ball bearing
15. Internal retaining ring
16. Gas producer train idler spur gear (2)
17. Bolt (2)
18. Bearing retaining keyway washer (2)
19. Internal retaining ring (2)
20. Ball bearing (2)
21. Idler gear support shaft (2)
22. Packing (2)
23. Packing (2)
24. Nut (2)
25. Washer (2)
26. Plug
27. Packing
28. Cover
29. Nut (4)
30. Washer (4)
31. Gasket
32. Plain encased seal (4)
33. Plain encased seal
34. Plain encased seal

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

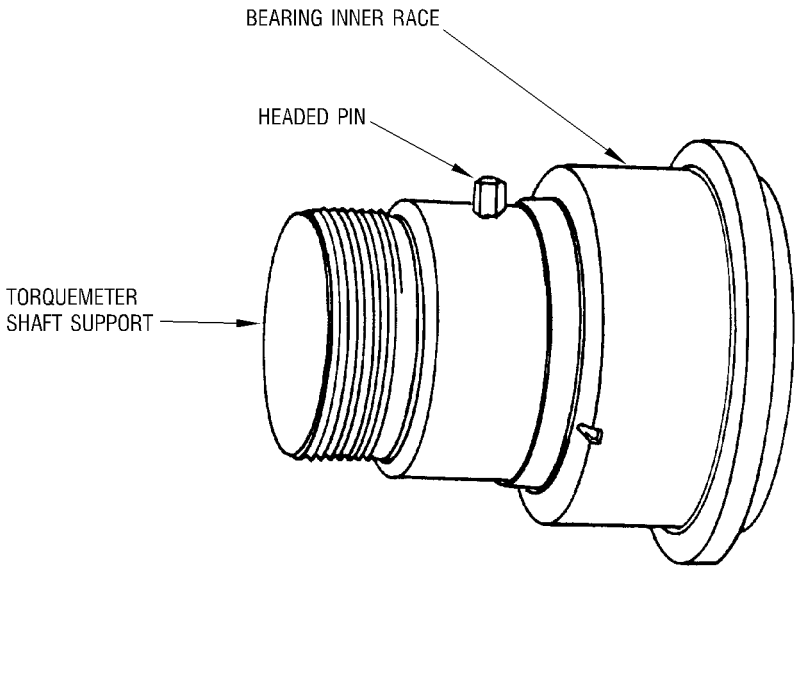


Power and Accessories Gearbox Cover Assembly, 250–C20W
Figure 207 (Sheet 3 of 3)

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

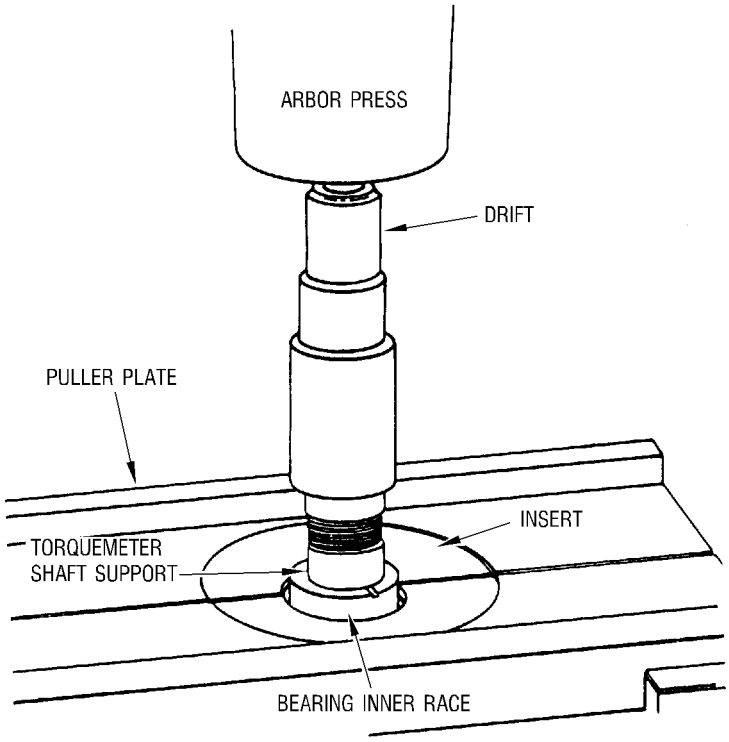


Removing or Installing Torquemeter Shaft Support Spanner Nut
Figure 208

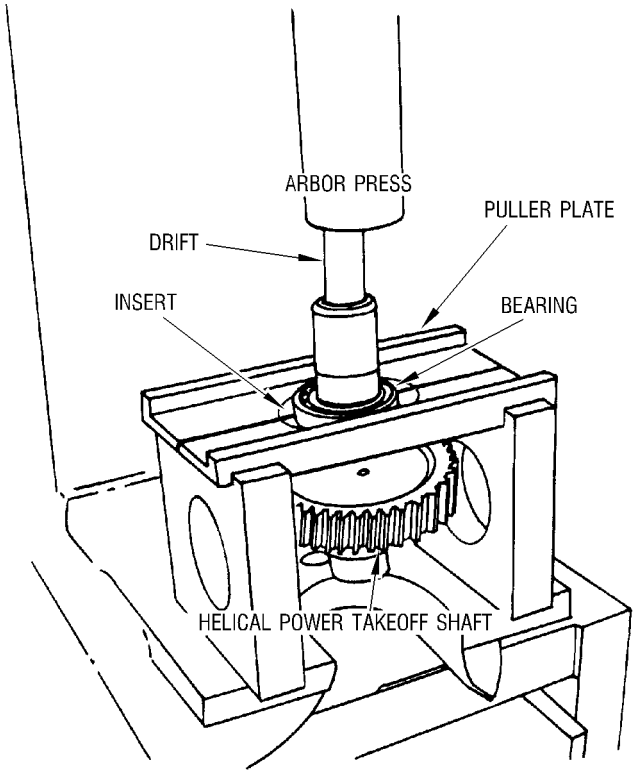


Torquemeter Shaft Support
Figure 209

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



Removing Roller Bearing Inner Race from the Torquemeter Shaft Support
Figure 210



Removing Ball Bearing from the Helical Power Takeoff Gearshaft
Figure 211

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

PARA 2.B. (cont)

(9) Remove the fuel control spur gearshaft from the cover by removing the internal retaining ring with 6796966 retaining ring pliers. (See Figure 212.) Do not remove the pin or splined adapter from the gearshaft.

(10) Remove the retaining ring and bearing retainer. (See Figure 213.) Remove the two bearings and the bearing spacer from the shaft using 6796946 drift and 6796950 plate with detail –12. Discard packing.

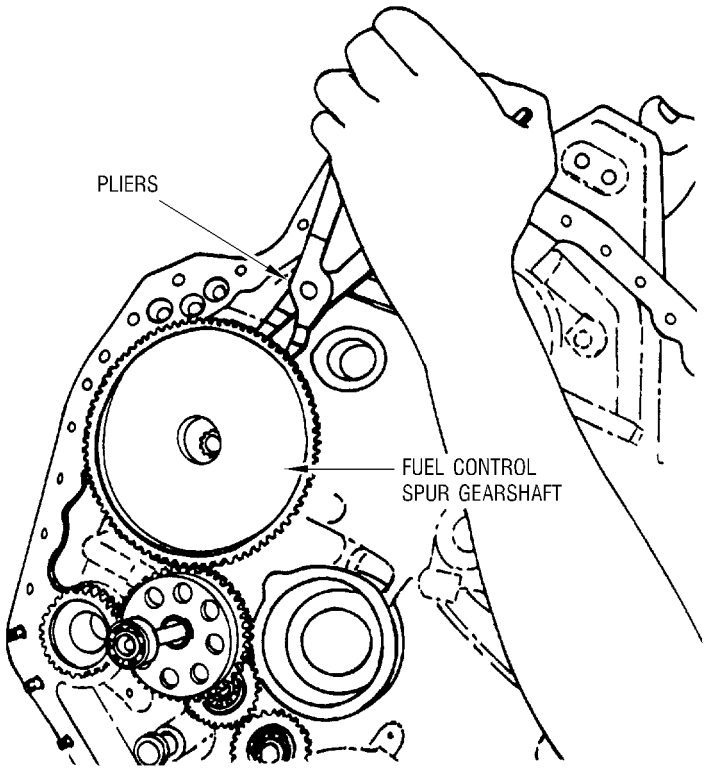
(11) On engines with spare accessory drive installation, remove the accessory drive spur gearshaft (spare) from the gearbox cover by removing the internal retaining ring with 6796966 pliers. (See Figures 205, 206 and 214.) Remove the external retaining ring and bearing retainer. Remove the bearings and spacer from the shaft using 6796946 drift and 6796950 plate with detail –12.

(12) Remove the starter generator spur gearshaft from the gearbox cover by removing the internal retaining ring with 6796966 pliers. (See Figures 205, 206 and 215.)

(13) Remove the external retaining ring and bearing retainer. Remove the bearings and spacer from the shaft using 6796946 drift and 6796950 plate with detail –12. Discard packing.

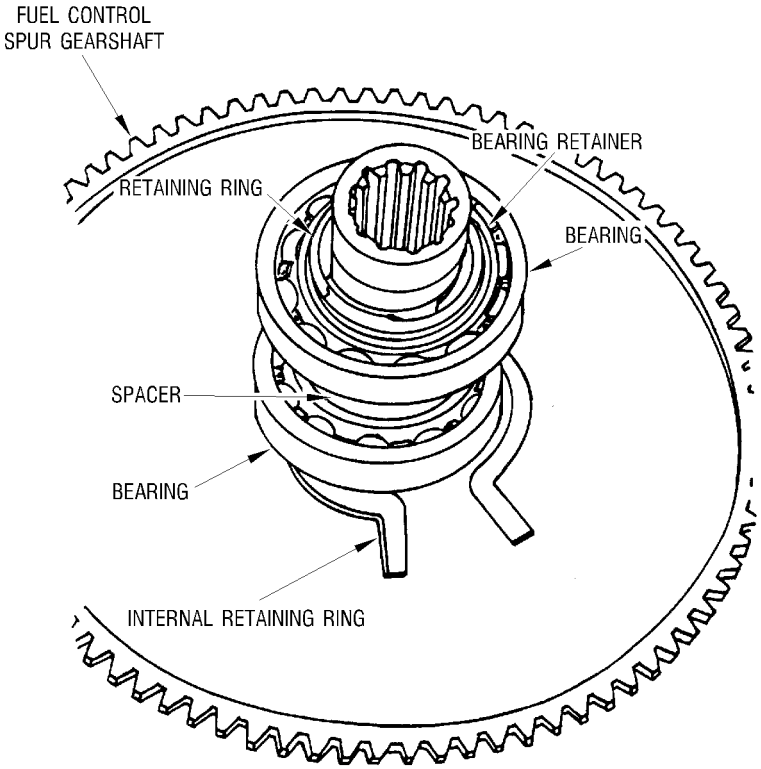
NOTE: Do not remove the plugs from the spur gearshafts unless they are loose. If replacement is necessary, press out plugs with a 5/8–in. (16 mm) OD drift.

(14) Remove the fuel pump drive spur gearshaft from the gearbox cover by removing the internal retaining ring with 6796966 pliers. (See Figure 215.) Remove the external retaining ring and bearing retainer. Remove the bearings and spacer from the shaft using 6796946 drift and 6796950 plate with detail –12.

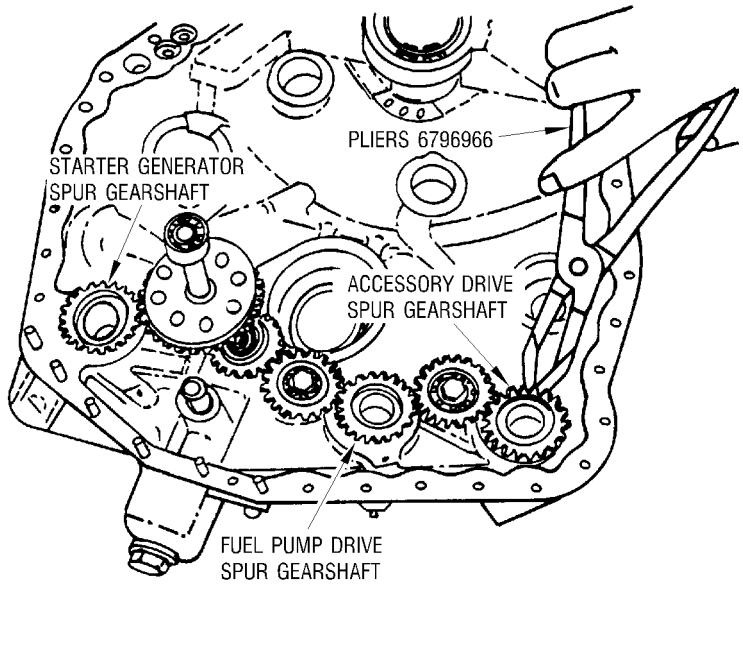


Removing Fuel Control Spur Gearshaft
Figure 212

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

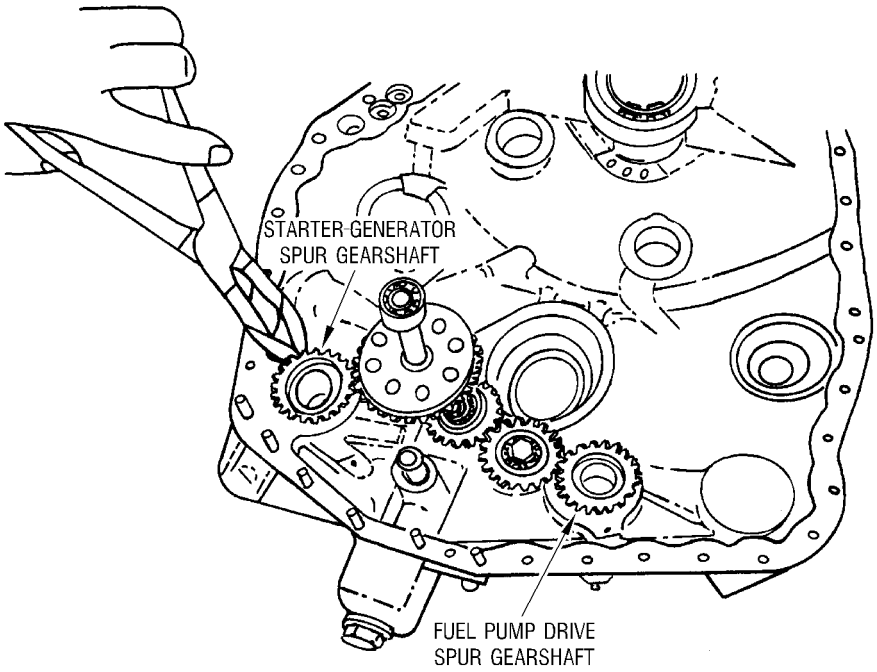


Fuel Control Spur Gearshaft Components
Figure 213



Removing or Installing Accessory Drive Spur Gearshaft
Figure 214

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



Removing or Installing Starter–Generator Spur Gearshaft
Figure 215

PARA 2.B. (cont)

(15) (250–C20, –C20B, –C20F, –C20S, –C20W) Remove the exposed gas producer gear train idler spur gear as follows:

(a) (Non–thru–bolt configuration) Unlock the key washer and remove the exposed bolt, key washer, and washer from the gas producer train idler spur gear. Remove the gear and bearings from the idler gear support shaft. Remove the bearings from the idler gear by removing the internal retaining ring. (See Figure 216.)

(b) (Thru–bolt configuration) Remove the external nut and washer and remove the exposed bolt, keyway washer, and gas producer train idler spur gear and bearings from the idler gear support shaft. Remove the bearings from the idler gear by removing the internal retaining ring. (See Figure 216.)

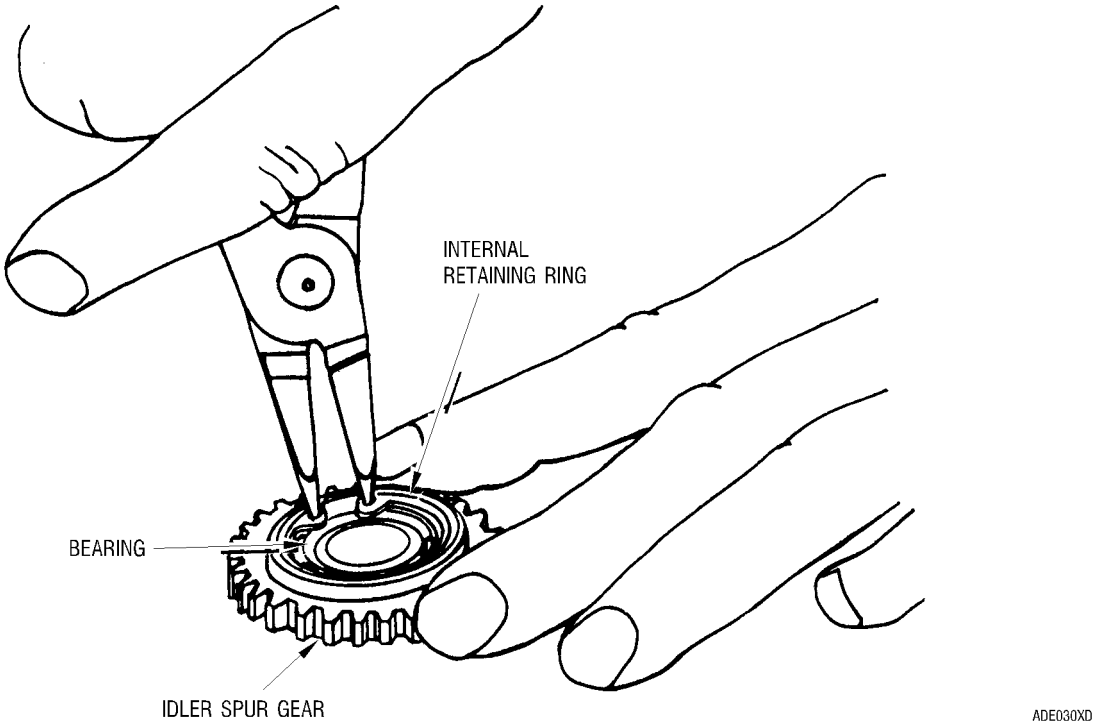
(16) (250–C20J) Unlock the key washers and remove the two exposed bolts, key washers and washers from the gas producer train idler spur gears. Remove the two gears and bearings from the idler gear support shafts. Remove the bearings from the idler gears by removing the internal retaining rings. (See Figure 216.)

(17) Remove the external nut and washer. Remove the through bolt, and washer from the gas producer gear train idler spur gear. Discard packing. Remove the gear and bearing from the idler gear support shaft. Remove the bearing from the idler gear by removing the internal retaining ring. (See Figure 216.)

(18) Remove the gas producer train idler spur gearshaft and the idler spur gear beneath the gearshaft as follows:

(a) (Non–thru–bolt configuration) Unlock the key washer of the gas producer train idler spur gear beneath the gas producer train idler spur gearshaft. Remove the idler spur gear, bolt, washer, and key washer as the gas producer train idler gearshaft is being lifted out.

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Removing or Installing Idler Spur Gear Retaining Ring
Figure 216

PARA 2.B. (cont)

(b) (Thru–bolt configuration) Remove the external nut and washer from the gas producer train idler spur gear retaining bolt beneath the gas producer train idler spur gearshaft. Remove the idler spur gear, bolt, and keyway washer as the gas producer train idler gearshaft is being lifted out.

(19) Remove the internal retaining ring. Remove the bearing from the cover end of the gearshaft using 6796946 drift and 6796950 plate with detail –8.

(20) Remove the bearing from the housing end of the gearshaft using 6796946 drift and 6796950 plate with detail –13. Remove retaining ring and separate bearing from gear.

(21) Remove the two idler gear support shafts (three on 250–C20J and –C20S) from the gearbox cover using 6795614 puller and pusher. (See Figure 217.) Discard packings.

(22) (250–C20, –C20B, –C20F, –C20J) Remove the oil transfer tube and packings from the gearbox cover. Discard packings.

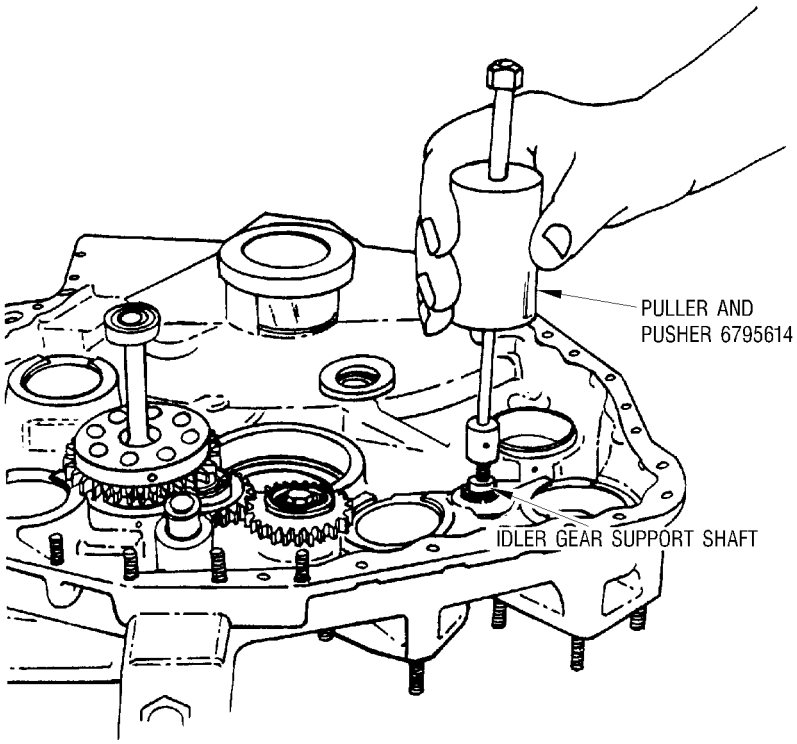
(23) Remove lockwire and separate the magnetic plug from the gearbox cover. Discard packing.

(24) Use 6796941 seal replacement kit to replace defective gearbox cover seals.

C. Gearbox Housing Disassembly

Disassemble the gearbox housing as follows: (See Figure 218.)

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Removing or Installing Idler Spur Gear Support Shaft
Figure 217

PARA 2.C. (cont)

(1) Remove the fuel control and oil pump spur gearshaft. Remove the bearings using 6796946 drift and 6796950 plate with details –13 and –14. Rotate bearings during removal to avoid brinelling the raceways.

(2) Remove the tachometer and governor power train spur gearshaft. Remove the bearings, using 6796946 drift and 6796950 plate with details –7 and –12. Do not remove the spring pin.

(3) Remove the power train idler spur gear as follows:

(a) (250–C20, –C20B, –C20J, –C20S, –C20W; Non–thru–bolt configuration) Unlock the key washer and remove the power train idler spur gear bolt, key washer, and keyway bearing retaining washer. Lift the gear and bearing from the idler gear support shaft. Pull the support shaft from the gearbox housing using 6795614 puller and pusher. Remove the bearing from the gear by removing the internal retaining ring.

(b) (250–C20, –C20B, –C20J, –C20W; Thru–bolt configuration) Remove the external nut and washer and remove the power train idler spur gear bolt, and keyway bearing retaining washer. Lift the gear and bearing from the idler gear support shaft. Pull the support shaft from the gearbox housing using 6795614 puller and pusher. Discard the packings. Remove the bearing from the gear by removing the internal retaining ring.

(c) (250–C20F) Unlock the key washer and remove the power train idler spur gear bolt, key washer and keyway bearing retaining washer. Lift the gear and bearing from the idler gear support shaft. Remove lockwire and 2 bolts and pull the support shaft from the gearbox housing using 6795614 puller and pusher. Remove the bearing from the gear by removing the internal retaining ring.

(4) (250–C20S, –C20W) Remove the lockwire and remove the magnetic drain plug from the lube oil filter housing. Discard packing.

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PARA 2.C. (cont)

(5) Lift the helical power takeoff gearshaft roller bearing outer race and rollers from the gearbox housing.

(6) Remove lockwire, then remove the torquemeter support shaft nut, using 6795597 wrench and 6795974 aligning fixture. (See Figures 220 and 221.) Remove packing and washer. Discard the packing.

(7) Remove the shaft.

(8) Remove the torquemeter support shaft bearing end plate and washer from the gearbox housing. Remove and discard packing from the shaft. Remove piston and bearing from the shaft.

(9) Remove expander and piston ring. Remove ball bearing from the piston using 6796947 drift and 6796950 plate with detail -6.

(10) Remove the bearing outer race and rollers from the support shaft. Remove the bearing inner race from the support shaft using 6796947 drift and 6796950 plate with detail -4.

D. Gearbox Housing Lubrication System Components Disassembly

Disassemble the gearbox housing lubrication system components as follows: (See Figure 222 or 223.)

NOTE: Some engines have an impending oil filter bypass indicator cap.

(1) Remove the two nuts, washers, oil filter cap, oil filter and packings from the filter housing. Discard the packings.

(2) Remove the eight nuts and washers and lift the lube oil filter housing from the gearbox housing. Discard the gasket.

NOTE: Do not remove the studs, standpipe or two valve seats in steps 3 and 4.

(3) Remove the lockwire and remove the pressure regulator components from the filter housing. These components are: poppet guide, packing, spring, and poppet.

(4) Remove the internal retaining ring and the filter bypass components from the filter housing. These components are: poppet guide, packing, spring, and poppet.

(5) (M250-C20S, -C20W) Remove the lockwire and remove the magnetic drain plug from the filter housing. Discard the packing.

(6) Remove the screw and separate the oil pressure tube from the gearbox housing. Discard the packing.

(7) Remove the screw and separate the oil delivery tube from the gearbox housing. Remove the screen and discard the three packings.

(8) Remove the three oil transfer tubes. Discard two packings from each tube.

(9) Remove the screw retaining the scavenge oil pickup tube. Do not remove the tube until the pump is removed (step 12).

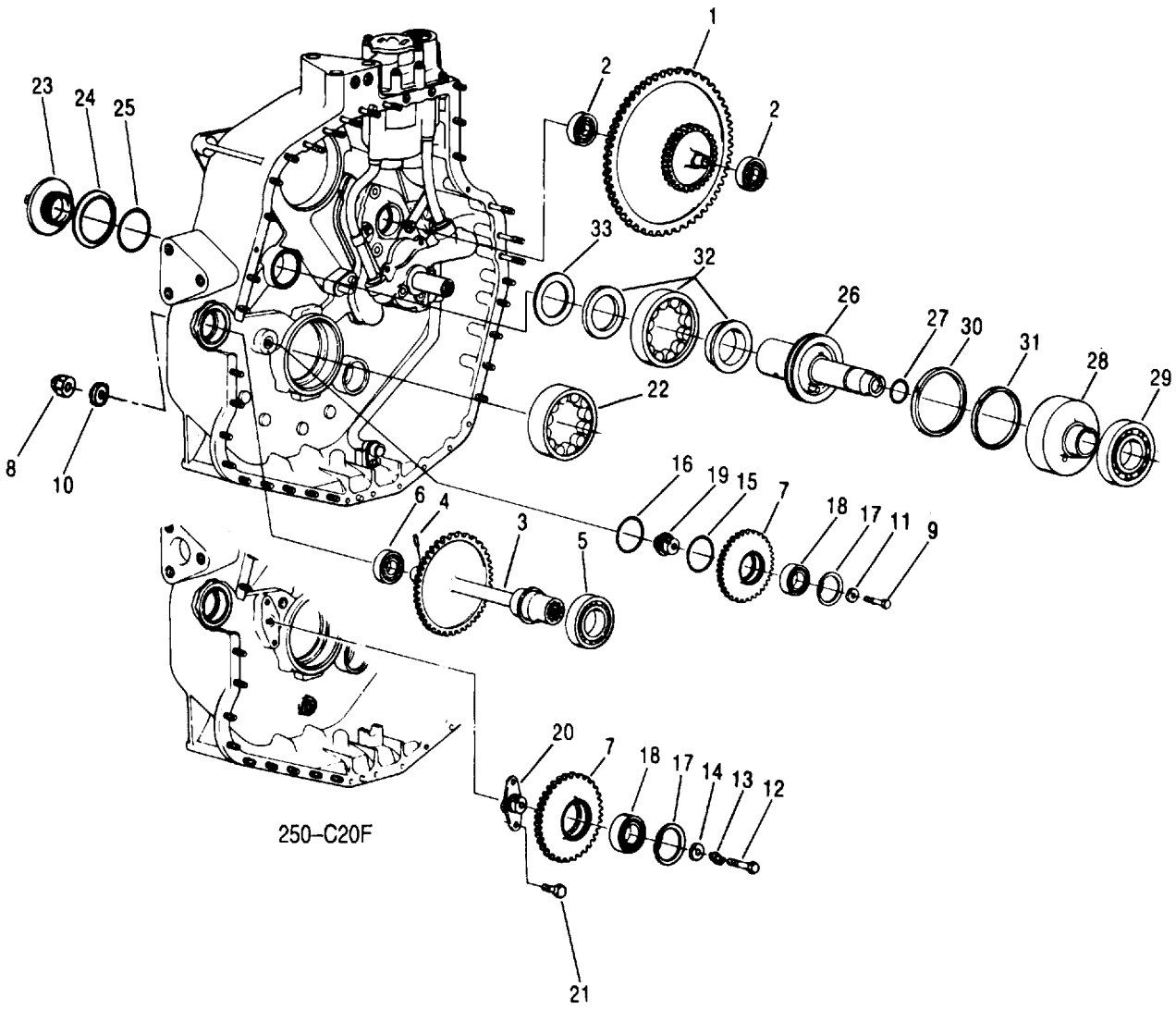
(10) Remove the check valve. (See Figure 221 or 222.) Remove and discard the two packings.

(11) Remove the fuel control and oil pump flex shaft coupling.

(12) Remove the eight pump attaching screws and six washers. Remove the oil filter inlet and bypass tubes. Remove the transfer tube to the filter housing (M250-C20S, -C20W only). Discard two packings from each. Remove the pump and the scavenge oil pickup tube. Discard the packing from the tube. Discard the gasket and packing beneath the pump. Do not disassemble the pump.

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Power and Accessory Gearbox Housing Assembly,
250–C20, –C20B, –C20F, –C20J
Figure 218

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 218

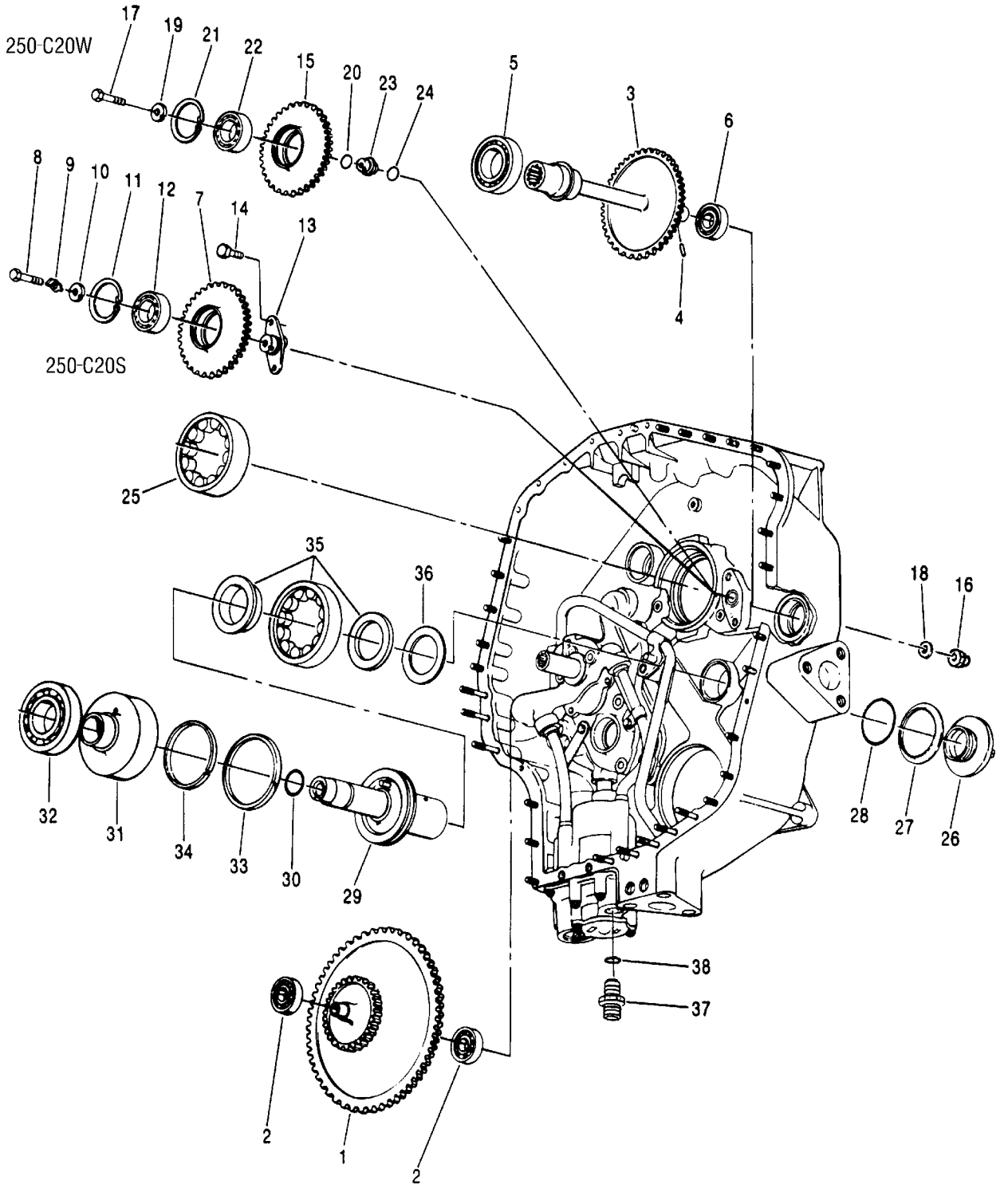
1. Fuel control and oil pump spur gearshaft
2. Ball bearing (2)
3. Power train tachometer and governor spur gearshaft
4. Spring pin
5. Ball bearing
6. Ball bearing
7. Power train idler spur gear
8. Bolt
9. Nut
10. Washer
11. Washer
12. Bolt*
13. Key washer*
14. Keyway washer*
15. Packing
16. Packing
17. Internal retaining ring
18. Ball bearing
19. Idler gear support shaft
20. Support shaft*
21. Bolt (2)*
22. Nut
23. Torquemeter support shaft nut
24. Internal flared washer
25. Packing
26. Torquemeter support shaft
27. Packing
28. Torquemeter piston
29. Ball bearing
30. Piston ring
31. Expander ring
32. Roller bearing
33. Flat washer

*Used on 250–C20F

Legend for Figure 219

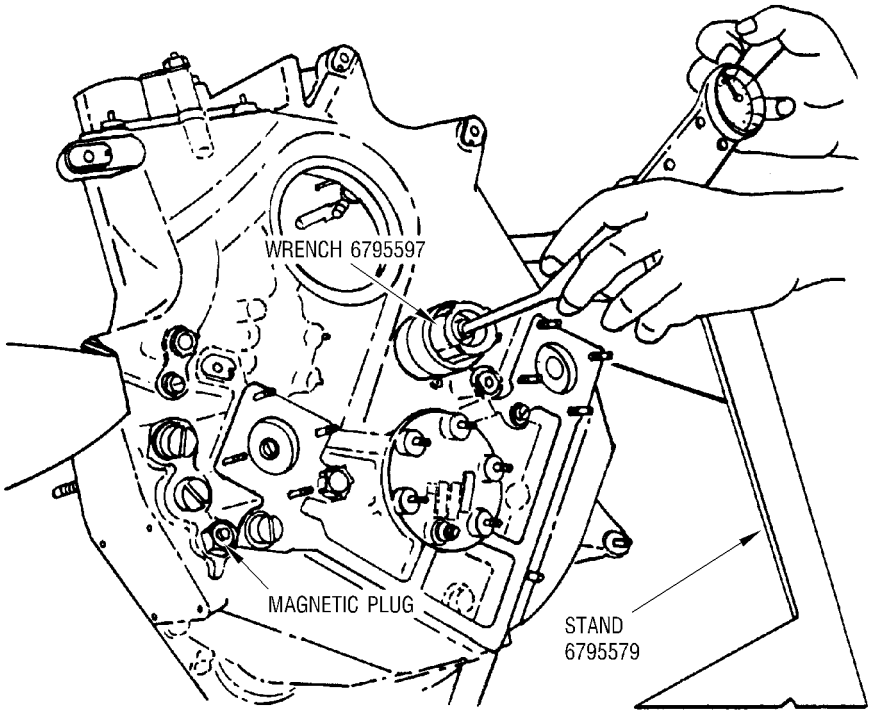
1. Fuel control and oil pump spur gearshaft
2. Ball bearing (2)
3. Tachometer and governor train spur gearshaft
4. Pin
5. Ball bearing
6. Ball bearing
7. Power train idler spur gear
8. Bolt
9. Key washer
10. Bearing retaining keyway washer
11. Internal retaining ring
12. Ball bearing
13. Support shaft
14. Bolt
15. Power train idler spur gear
16. Nut
17. Bolt
18. Washer
19. Bearing retaining keyway washer
20. Packing
21. Internal retaining ring
22. Ball bearing
23. Idler gear support shaft
24. Packing
25. Roller bearing
26. Torquemeter support shaft nut
27. Internal flared washer
28. Packing
29. Torquemeter support shaft
30. Packing
31. Torquemeter piston
32. Ball bearing
33. Piston ring
34. Expander ring
35. Roller bearing
36. Washer
37. Magnetic drain plug
38. Packing

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

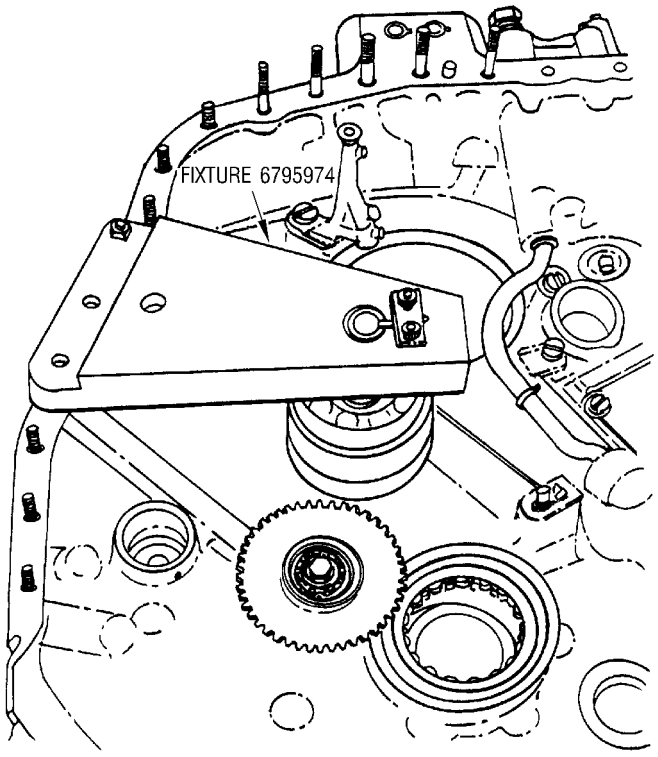


Power and Accessory Gearbox Housing Assembly, 250–C20S, –C20W
Figure 219

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



Removing or Installing Torquemeter Support Shaft Spanner Nut
Figure 220



Torquemeter Support Shaft Aligning Fixture
Figure 221

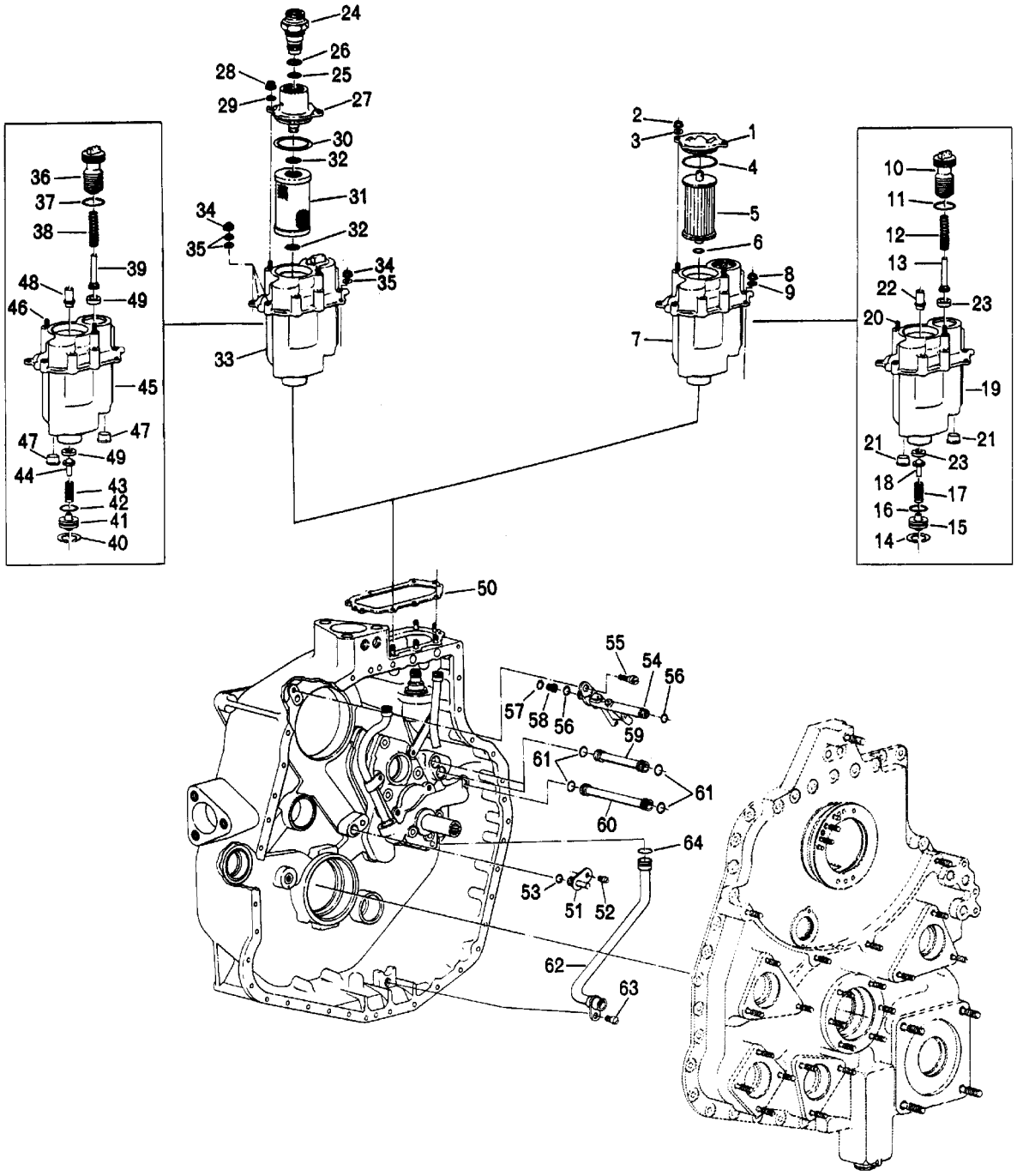
Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 222 (Sheet 1 of 2)

1. Oil filter cap
2. Nut (2)
3. Washer (2)
4. Packing
5. Lube oil filter
6. Packing
7. Filter housing
8. Nut (8)
9. Washer (8)
10. Poppet guide
11. Packing
12. Helical spring
13. Valve poppet
14. Internal retaining ring
15. Poppet guide
16. Packing
17. Helical spring
18. Valve poppet
19. Filter housing
20. Stepped stud (2)
21. Flanged bushing (2)
22. Standpipe
23. Bypass valve seat (2)
24. Differential pressure indicator*
25. Packing*
26. Packing*
27. Oil filter cap*
28. Nut (2)*
29. Washer (2)*
30. Packing*
31. Lube oil filter*
32. Packing (2)*
33. Filter housing*
34. Nut (8)*
35. Washer (8)*
36. Poppet guide*
37. Packing*
38. Helical spring*
39. Valve poppet*
40. Internal retaining ring*
41. Poppet guide*
42. Packing*
43. Helical spring*
44. Valve poppet*
45. Filter housing*
46. Stepped stud (2)*
47. Flanged bushing (2)*
48. Standpipe*
49. Valve seat (2)*
50. Gasket
51. Oil pressure tube
52. Screw
53. Packing
54. Oil delivery tube
55. Screw
56. Packing (2)
57. Packing
58. Pressure oil screen
59. Oil transfer tube (2)
60. Oil transfer tube
61. Packing (6)
62. Scavenge oil pickup tube
63. Screw
64. Packing

*250–C20F and 250–C20B Customer Option

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



Gearbox Housing Lube System Assembly,
250–C20, –C20B, –C20F, –C20J
Figure 222 (Sheet 1 of 2)

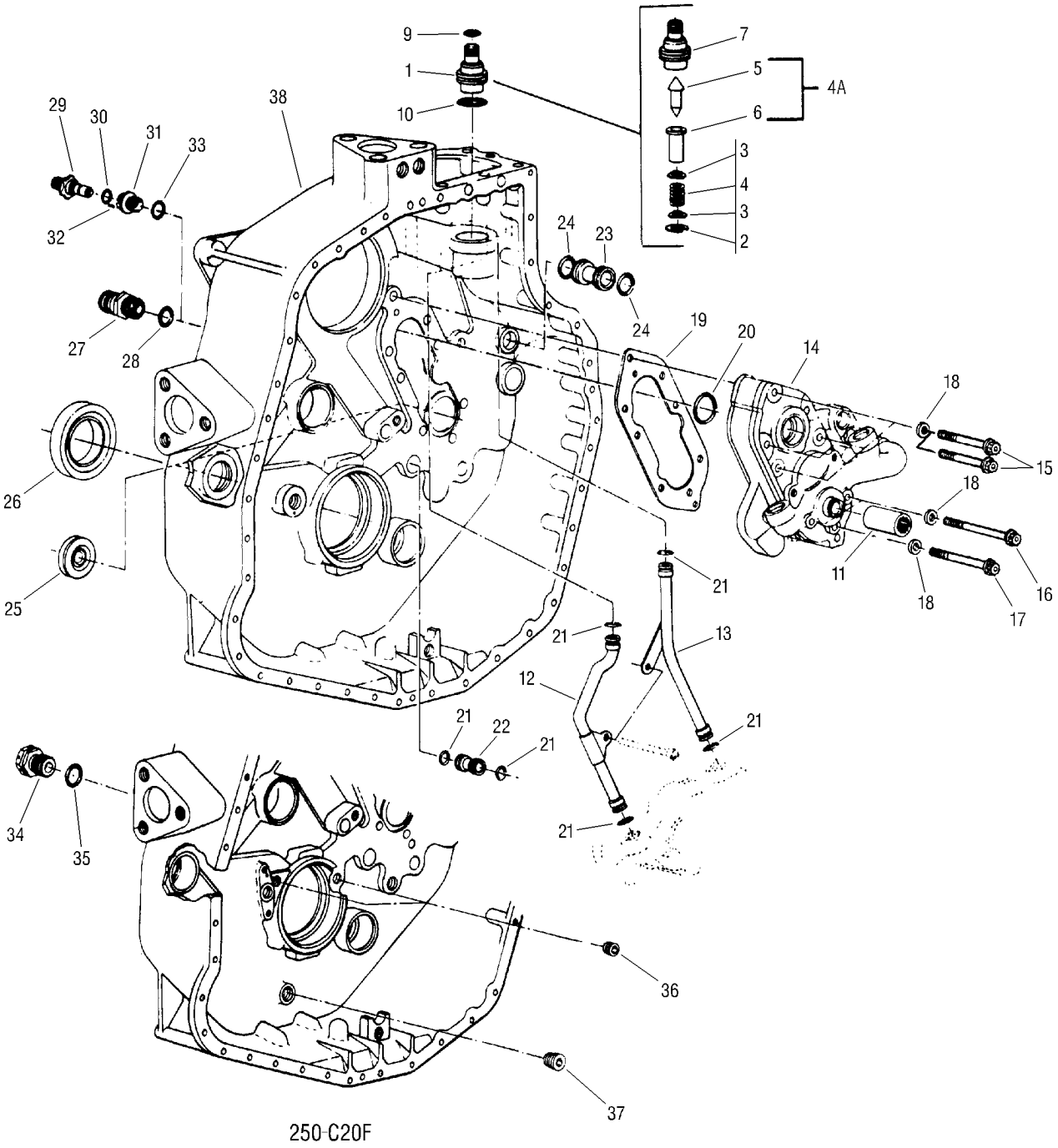
Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 222 (Sheet 2 of 2)

1. Check valve
2. Retaining ring
3. Guide (2)
4. Spring
5. Poppet assy
6. Seat
7. Stem
8. Body
9. Packing
10. Packing
11. Flex shaft coupling
12. Filter inlet tube
13. Filter bypass tube
14. Oil pump
15. Screw (5)
16. Screw
17. Screw (2)
18. Washer (6)
19. Gasket
20. Packing
21. Packing (6)
22. Oil transfer tube
23. Oil pump connector
24. Packing (2)
25. Plain encased seal (2)
26. Plain encased seal (2)
27. Magnetic plug
28. Packing
29. Magnetic plug quick disconnect
30. Packing
31. Flanged insert
32. Pin
33. Packing
34. Plug*
35. Packing*
36. Plug (2)*
37. Plug*
38. Gearbox housing

*250–C20F

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



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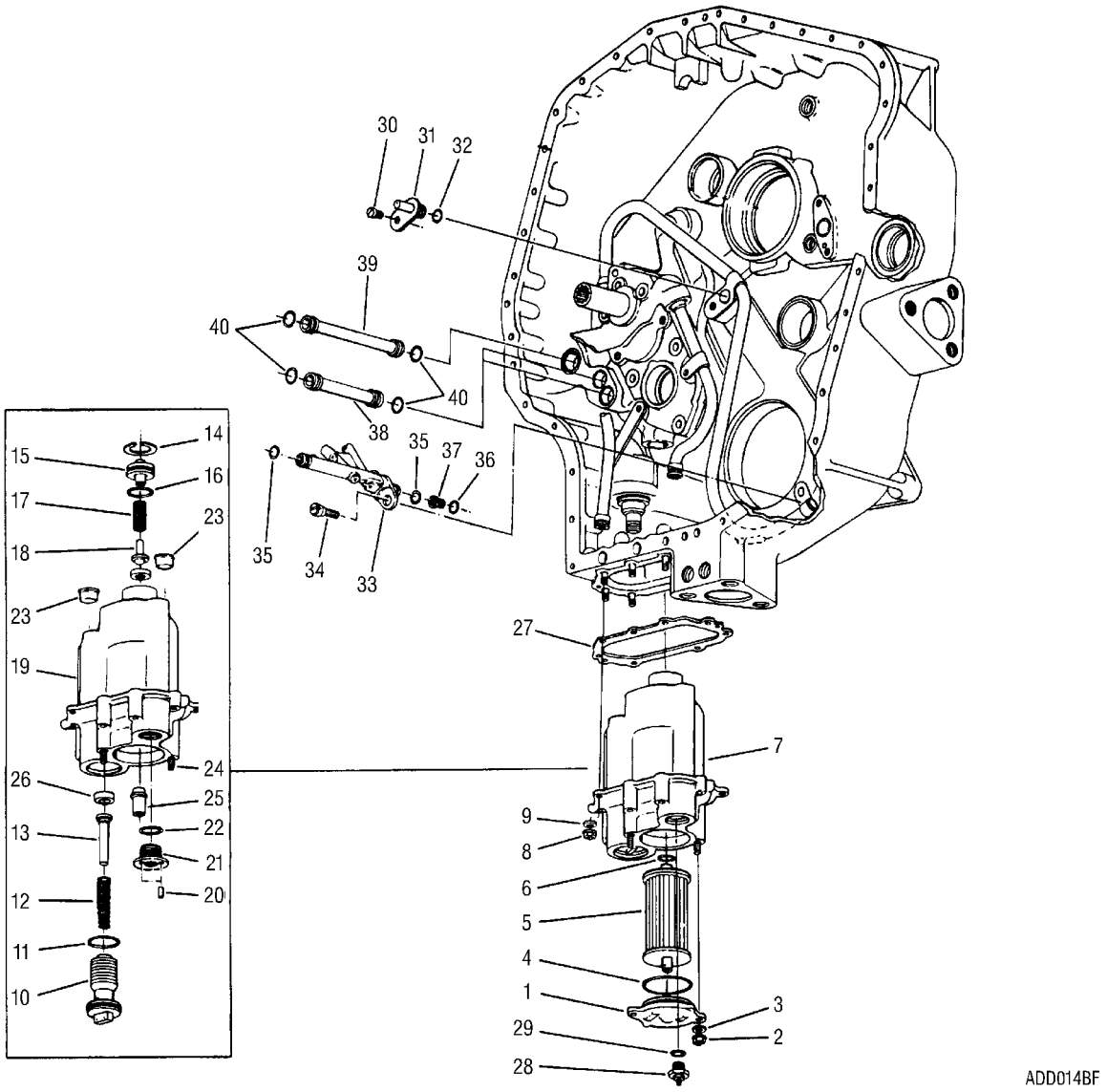
Gearbox Housing Lube System Assembly,
250–C20, –C20B, –C20F, –C20J
Figure 222 (Sheet 2 of 2)

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 223 (Sheet 1 of 2)

1. Oil filter cap
2. Nut (2)
3. Washer (2)
4. Packing
5. Lube oil filter
6. Packing
7. Lube oil filter housing
8. Nut (8)
9. Washer (8)
10. Pressure regulator valve poppet guide
11. Packing
12. Helical compression spring
13. Pressure regulator valve poppet
14. Internal retaining ring
15. Filter bypass poppet guide
16. Packing
17. Helical compression spring
18. Valve poppet
19. Lube oil filter housing
20. Pin (2)
21. Flanged insert
22. Packing
23. Flanged bushing (2)
24. Stud (2)
25. Oil filter standpipe
26. Filter bypass valve seat (2)
27. Filter housing gasket
28. Magnetic plug
29. Packing
30. Screw
31. Oil pressure tube
32. Packing
33. Oil delivery tube
34. Screw
35. Packing (2)
36. Packing
37. Pressure oil screen
38. Oil transfer tube (2)
39. Oil transfer tube
40. Packing (6)

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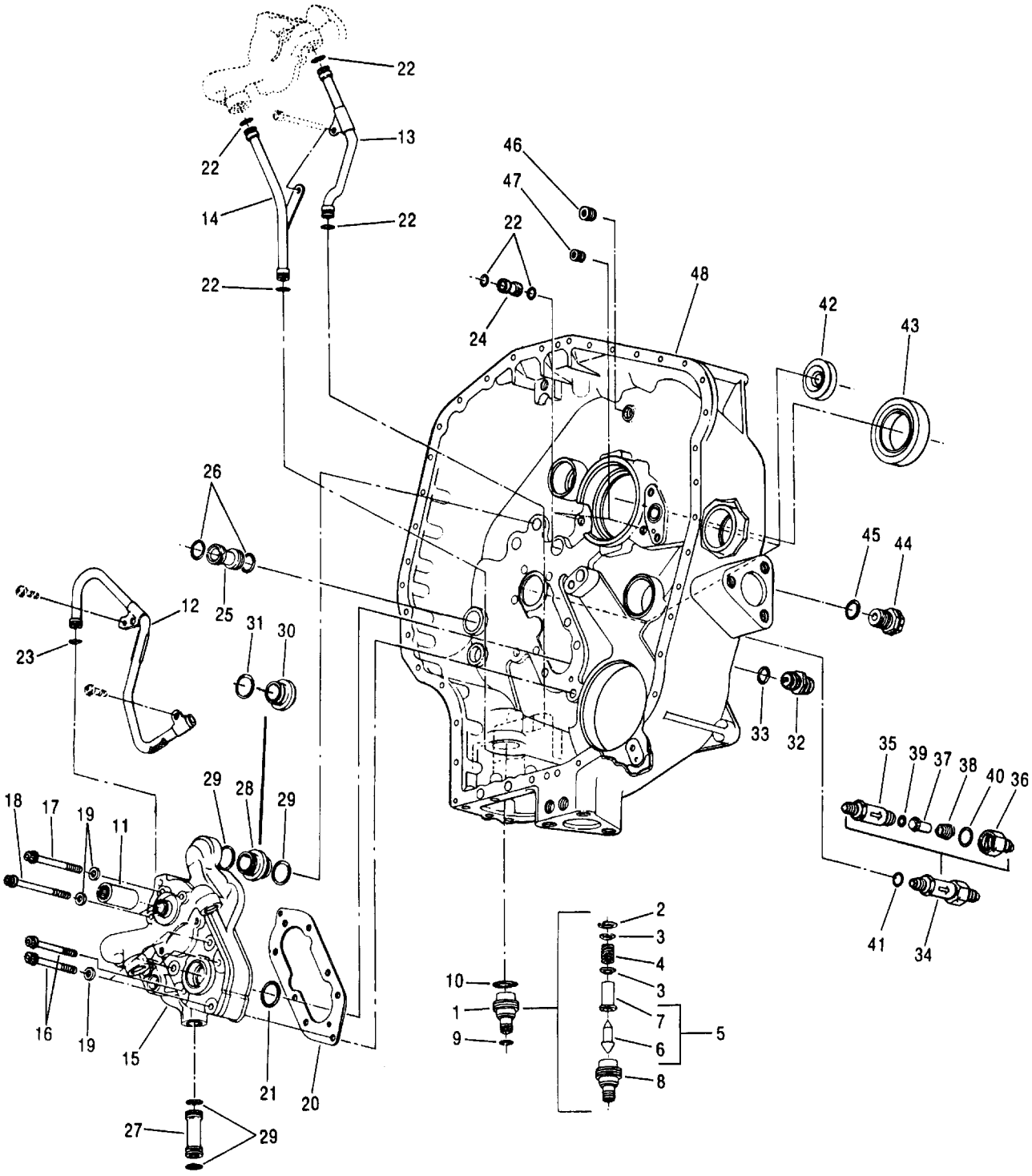
Gearbox Housing Lube System Assembly, 250–C20S, –C20W
Figure 223 (Sheet 1 of 2)

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Legend for Figure 223 (Sheet 2 of 2)

1. Check valve
2. Retaining ring
3. Poppet guide (3)
4. Spring
5. Poppet assy
6. Poppet
7. Stem
8. Body
9. Packing
10. Packing
11. Fuel control and oil pump flex shaft coupling
12. Scavenge oil tube
13. Oil filter inlet tube
14. Oil filter bypass tube
15. Lube oil pump
16. Screw (5)
17. Screw
18. Screw (2)
19. Washer (6)
20. Lube oil pump gasket
21. Packing
22. Packing (6)
23. Packing
24. Oil transfer tube
25. Oil pump supply connector
26. Packing (2)
27. Oil transfer tube
28. Oil transfer tube
29. Packing (4)
30. Plug
31. Packing
32. Magnetic plug
33. Packing
34. Check valve
35. Cap
36. Valve housing
37. Piston
38. Spring
39. Packing
40. Packing
41. Packing
42. Plain encased seal (2)
43. Plain encased seal
44. Plug
45. Packing
46. Plug (2)
47. Plug
48. Power and accessory gearbox housing

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Gearbox Housing Lube System Assembly, 250–C20S, –C20W
Figure 223 (Sheet 2 of 2)

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PARA 2.D. (cont)

(13) Remove the oil transfer tube and connector beneath the oil pump. Discard two packings from each.

(14) (250–C20S, –C20W) Remove the low pressure scavenge check valve from the gearbox housing. Discard packing.

(15) Remove the lockwire and separate the magnetic plug from the gearbox housing. Discard packing.

(16) Remove gearbox housing accessory pad seals using 6796941 seal replacement kit only if the seals are defective.

E. Oil Pump Disassembly, Inspection and Assembly

Disassemble and inspect the oil pump when it is the suspected cause of oil pressure and/or oil scavenging discrepancies. Remove pump in accordance with the Gearbox Housing Lubrication System Components Disassembly para 2.D., this section. Install pump in accordance with the Gearbox Housing Assembly and Check, para 2.G., this section.

(1) Disassemble the oil pump as follows: (See Figure 224 or 225.)

CAUTION: BE CAREFUL NOT TO PRY ON, OR DAMAGE, ANY LAPPED SURFACES.

(a) Remove two screws and separate the pressure oil pump body from the balance of the pump.

(b) Remove the oil pump idler spur gear. Remove and discard the packing in the pump body. Do not remove the pinned bushing cage or flanged bushings unless replacement is required.

(c) Remove the oil pump and gas producer tachometer spur gearshaft. Do not remove the oil seal plug unless it is loose. If replacement is necessary, press out the plug using 1/4–in. (6 mm) OD drift.

(d) Remove the pressure and scavenge oil pump separator body and scavenge oil pump cover from the scavenge oil pump body. Do not pry on lapped surfaces. Do not remove the three pinned oil pump gearshafts or the pinned bushing from the scavenge oil pump cover. Remove and discard two (four, 250–C20S, –C20W) packings from separator body.

(e) Remove the oil pump drive spur gear, three idler spur gears, the pump drive spur gear, and the idler spur gear (three, 250–C20S, –C20W) from the scavenge oil pump body. Remove and discard two (four, 250–C20S, –C20W) packings from the pump body. Do not remove the four dowel pins from the pump body unless replacement is necessary.

(2) Inspect the components of the oil pump in accordance with Table 201.

(3) Replace or secure loose oil pump gearshafts as follows:

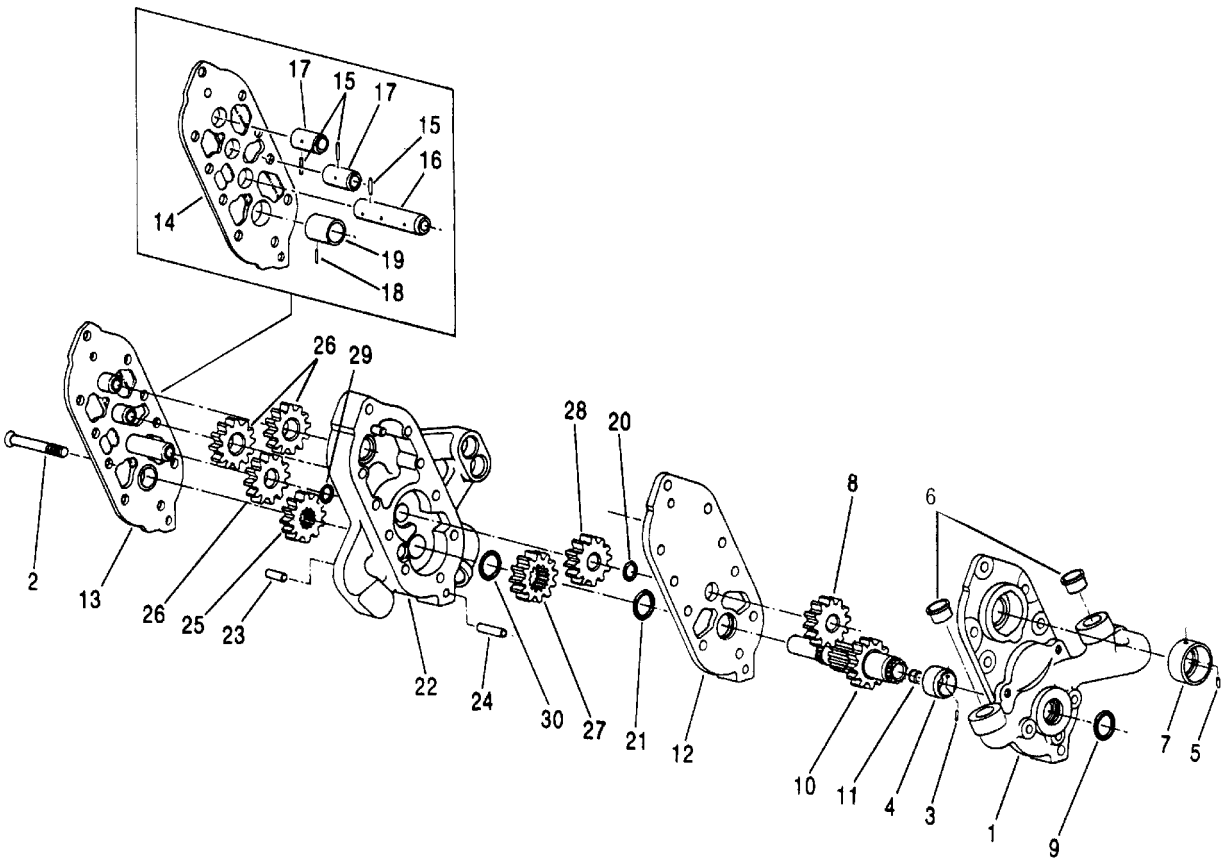
(a) Immediately prior to installing gearshafts, clean the bores and the gearshaft using cleaning agent recommended by Loctite Corporation. Apply Loctite 290, in accordance with Loctite Corporation recommendations, to the mating surfaces of the gearshaft OD only.

(b) Install gearshaft with the slot aligned with the antirotation pin and ensure that it bottoms in the cover assembly bore.

(c) Immediately after gearshaft installation, clean off any Loctite on the shaft OD and cover assembly.

(4) Assemble the lube oil pump as follows: (See Figure 224 or 225.)

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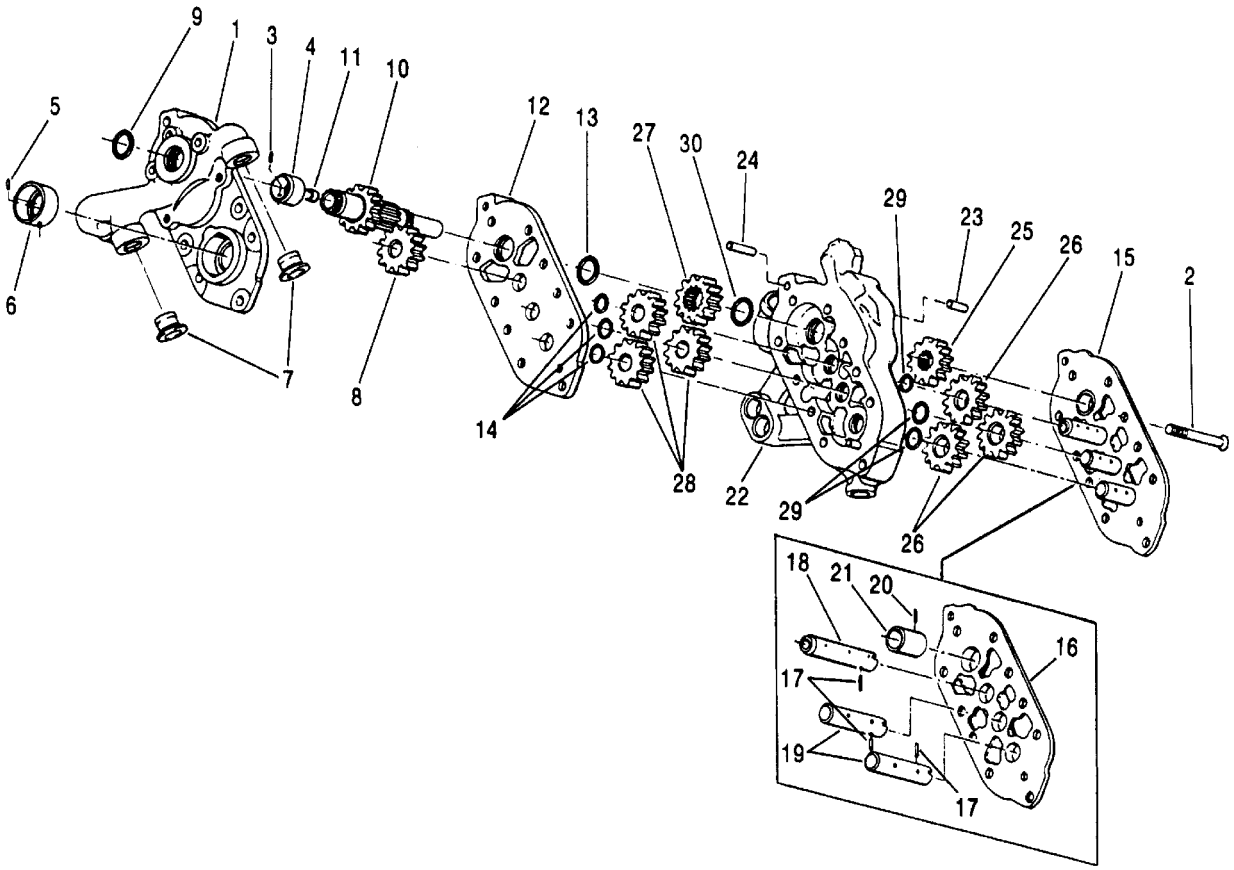


ADJ007XA

1. Pressure oil pump body
2. Screw (2)
3. Pin
4. Bushing
5. Pin
6. Flanged bushing (2)
7. Bearing cage
8. Oil pump idler spur gear
9. Packing
10. Oil pump and gas producer tachometer spur gearshaft
11. Plug
12. Pressure and scavenge oil pump separator body
13. Studding scavenge oil pump cover
14. Scavenge oil pump cover
15. Pin (3)
16. Oil pump gearshaft
17. Oil pump gearshaft (2)
18. Pin
19. Bushing
20. Packing
21. Packing
22. Scavenge oil pump body
23. Pin (2)
24. Pin (2)
25. Oil pump drive spur gear
26. Oil pump drive spur gear (3)
27. Oil pump drive spur gear
28. Oil pump drive spur gear
29. Packing
30. Packing

Oil Pump Assembly, 250–C20, –C20B, –C20F, –C20J
Figure 224

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



ADD062XA

1. Pressure oil pump body
2. Screw (2)
3. Pin
4. Sleeve bushing
5. Pin
6. Plain bearing cage
7. Flanged bushings (2)
8. Oil pump idler spur gear
9. Packing
10. Oil pump and gas producer tachometer spur gearshaft
11. Oil seal plug
12. Pressure and scavenge oil pump separator body
13. Packing
14. Packing (3)
15. Studding scavenge oil pump cover
16. Scavenge oil pump cover
17. Pin (3)
18. Oil pump gearshaft
19. Oil pump gearshaft (2)
20. Pin
21. Bushing
22. Scavenge oil pump body
23. Pin (2)
24. Pin (2)
25. Oil pump drive spur gear
26. Oil pump idler spur gear (3)
27. Oil pump drive spur gear
28. Oil pump idler spur gear (3)
29. Packing (3)
30. Packing

Oil Pump Assembly, 250–C20S, –C20W
Figure 225

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Table 201
Oil Pump Inspection Limits

Condition	Serviceable Limit	Disposition
Oil Pump Body, Separator, and Cover		
Cracks (FPI)	None	Replace pump.
Fretting of housing bores	Max. of 0.010 in. (0.25 mm)	Replace pump.
Wear of gear pockets	Max. of 0.005 in. (0.13 mm)	Replace pump.
Gear end clearance	0.0005–0.0015 in. (0.013–0.038 mm)	Select gears or lap parts (max. of 0.001 in.; 0.03 mm); total 0.003 in. (0.08 mm) per pump assembly or replace pump. (Refer to para 2.E., this section, for details.)
Oil Pump Gears		
Cracks in radii root corners of spline teeth in line or parallel in close proximity on involute of a gear tooth side (visual with magnification)	None	Replace pump.
Nonmetallic inclusion on small gears and gearshafts	Light scattered inclusions parallel to material flow lines	Replace pump.
	Open inclusion on shaft, 0.375 in. (10 mm) max. length and not extending into a radius hole or spline root	
Nicks and dents	Max. of 0.010 in. (0.25 mm) length, width or dia, and without sharp corners	Remove sharp edges by stoning. Max. of 0.060 in. (1.52 mm) length, width or dia after sharp corners are removed.
Tooth damage which involves metal displacement to a degree where subsurface damage is detected by magnetic inspection	None.	Replace pump.
Scuffing	Scuffing when accompanied by wearoff of metal pickup if gear assembly is still matched with mating gears.	Remove sharp edges by stoning.

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Table 201
Oil Pump Inspection Limits (cont)

Condition	Serviceable Limit	Disposition
Oil Pump and Gas Producer Tachometer Spur Gearshaft		
Seal journal wear	Max. of 0.0015 in. (0.038 mm) radial wear on dia.	Replace pump.
Spline wear	Max. of 0.002 in. (0.05 mm) wear measured from adjacent unworn area.	Replace pump.
Scoring, grooves, nicks, gouges, scuffing or minute flats on shaft seal journal surfaces.	Evenly polished surface in seal contact without lead or axial marking.	Replace pump.
Pump Bushings and Dowel Pins		
Loose or bent dowel pins.	None.	Replace pump.
Wear on ID of pump bushings.	None.	Replace pump.
Gearshafts		
Loose in scavenge oil pump cover	No looseness allowed	Replace or secure loose gearshafts with Loctite 290. (Refer to para 2.E., this section, for details.)

PARA 2.E. (cont)

CAUTION: USE SPECIFIED LUBRICANTS DURING PUMP ASSEMBLY. DO NOT USE SILICONE LUBRICANTS.

(a) Lubricate and install the two (four, 250–C20S, –C20W) packings in the scavenge body assembly. Install the oil pump drive gear and three oil pump idler gears.

1 Measure the gear end clearance in the pressure and scavenge elements between the splitline and gear end with a dial indicator. The gear end clearance must be 0.0005–0.0015 in. (0.013–0.038 mm).

2 If the end clearance limit is exceeded, select gears or lap scavenge oil pump body, pressure and scavenge oil pump separator body or pressure oil pump body as necessary to obtain required gear end clearance. Make sure that lapping is done on a flat lap surface and that the whole face of the item being lapped is smooth and square. Surface finish after lapping must be 32 microinches (0.80 micrometers) or better.

(b) Place cover assembly on the scavenge body assembly. Install oil pump drive gear and oil pump idler gear (250–C20S, –C20W has three oil pump idler gears). Lubricate and install two (four, 250–C20S, –C20W) packings in the separator body. Place separator body on the scavenge body assembly.

(c) Install oil seal plug in oil pump and gas producer tachometer spur gearshaft if it has been removed. Install oil pump idler spur gear and oil pump and gas producer tachometer spur gearshaft on the separator body.

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PARA 2.E. (cont)

(d) Lubricate and install packing in pressure oil pump body. Place pressure oil pump body on scavenge body assembly. Install two screws; tighten to 18-22 lb in. (2.0-2.5 N·m).

NOTE: The pump must turn freely by hand after assembly.

F. Lube Oil Filter Housing Assembly and Test

Assemble the Lube Oil Filter Housing as follows: (See Figure 216.)

(1) Assemble and test the lube oil filter housing as follows:

CAUTION: INSPECT THE RETAINING RING BEFORE INSTALLATION TO BE SURE IT HAS NO DEFECTS AND AFTER INSTALLATION TO BE SURE IT IS PROPERLY SEATED.

(a) Install the poppet, spring, lubricated packing, and guide in the filter housing. Retain with an internal retaining ring. Use 6798807 compressor to aid in installation of retaining ring.

(b) Lubricate and install the packing on the pressure regulator guide. Insert poppet, spring, and guide into the filter housing. Make an approximate adjustment of the regulator by bottoming the adjusting screw and backing out 5-1/2 turns.

(c) Test the lube oil filter housing as follows:

1 Plug the standpipe and install the cap on the filter housing.

2 Connect a supply of calibration fluid at 24-29°C (75-85°F) or engine oil at 27-38°C (80-100°F) to the filter housing inlet port.

3 Slowly apply increasing pressure until the bypass valve opens. Pressure must be 80-130 psig (552-896 kPag).

4 Decrease pressure to 30 psig (207 kPag). Leakage through the bypass valve must not exceed 63 cc per minute.

5 Connect the fluid supply to the outlet port and plug the inlet port.

6 Adjust the fluid supply to obtain a flow of 720 pph (327 kg/hr) across the filter.

7 Adjust the guide assembly until 130 ± 5 psig (896 ± 35 kPag) is obtained with 720 pph (327 kg/hr) flow.

8 Decrease flow to 15 pph (6.8 kg/hr). Pressure must not be less than 125 psig (862 kPag) If pressure is not within limits, repeat steps 6 and 7, adjusting the guide assembly for a higher pressure within the 130 ± 5 psig (896 ± 35 kPag) range. If pressure is less than 125 psig (862 kPag) at 15 pph (6.8 kg/hr) replace the pressure regulating poppet valve and repeat the entire test.

9 Remove the cap and remove the plug from the stand pipe. Remove the plug from the inlet port.

(d) Install the filter assembly with new lubricated packing in the filter housing. Install cap with lubricated packing in the filter housing. Some engines have indicating type caps.) Secure the cap with two nuts and washers. Tighten nuts to 35-40 lb in. (3.9-4.5 N·m).

G. Gearbox Housing Assembly and Check.

Assemble and check gearbox housing as follows:

(1) Install gearbox housing seals as necessary at the following locations using 6796941 seal installation kit with details -16 or -19. (See Figures 226, 227 and 228.) Apply engine oil to the seal lip to aid in installation.

(a) Power turbine tachometer generator pad (use detail -16).

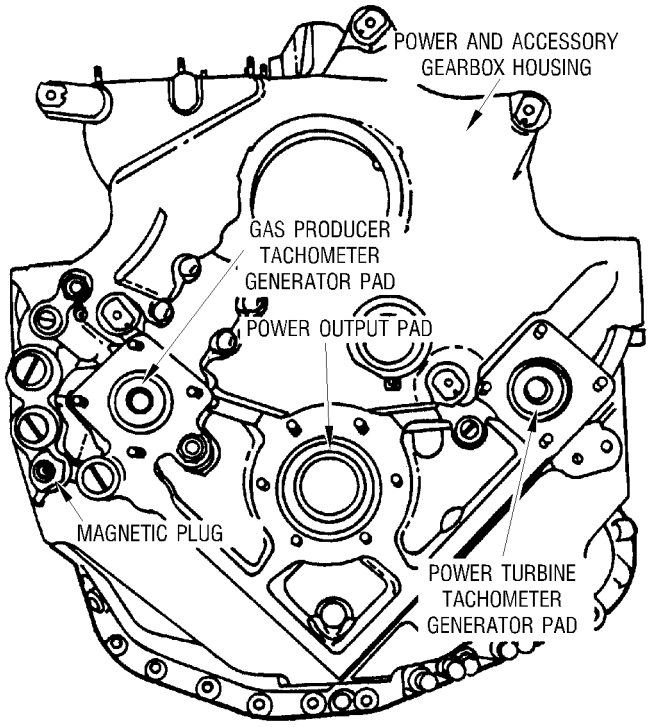
(b) Gas producer tachometer generator pad (use detail -16).

(c) Power takeoff pad (use detail -19).

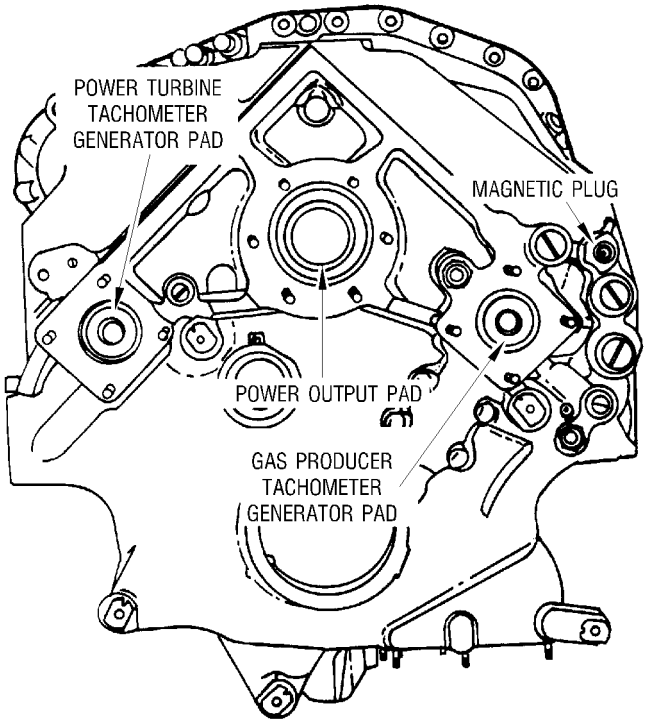
NOTE: Use of the Bell Helicopter tool for installation of double lip seals is recommended.

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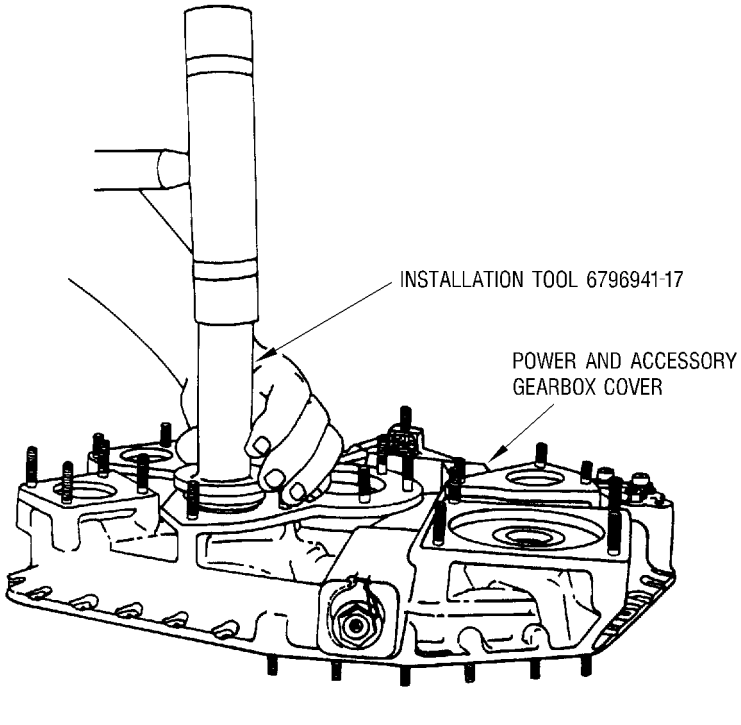


Typical Power and Accessory Gearbox Housing Oil Seal Location (250–C20, –C20B, –C20F, –C20J)
Figure 226



Typical Power and Accessory Gearbox Housing Oil Seal Location (250–C20S, –C20W)
Figure 227

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Typical Seal Installation
Figure 228

PARA 2.G. (cont)

(2) Lubricate and install the two packings on the oil transfer tube (two, 250–C20S, –C20W) and the two packings on the connector which go beneath the oil pump. Install the transfer tube and connector in the gearbox housing. (See Figure 229 or 230.)

(3) (250–C20, –C20B, –C20F, –C20J) Lubricate packing on oil scavenge pickup tube and insert tube in the pump. (See Figure 222.)

(4) (250–C20S, –C20W) Lubricate and install two packings on pump–to–filter housing oil transfer tube and insert tube in the pump. (See Figure 223.)

NOTE: On earlier configurations, the lube pump is installed in the gearbox housing with screws. Later configurations use bolts. Do not combine screws and bolts to install the lube pump in the gearbox housing. Refer to the 250–C20 Illustrated Parts Catalog, publication number 10W4, for the correct fasteners.

(5) Lubricate and install the packing on the underside of the lube pump. (See Figure 222 or 223.) Position the pump mounting gasket and install the pump in the gearbox housing using 6796941 seal guide with detail –13. (See Figure 231.) Install the filter inlet and filter bypass tubes with lubricated packings.

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PARA 2.G. (cont)

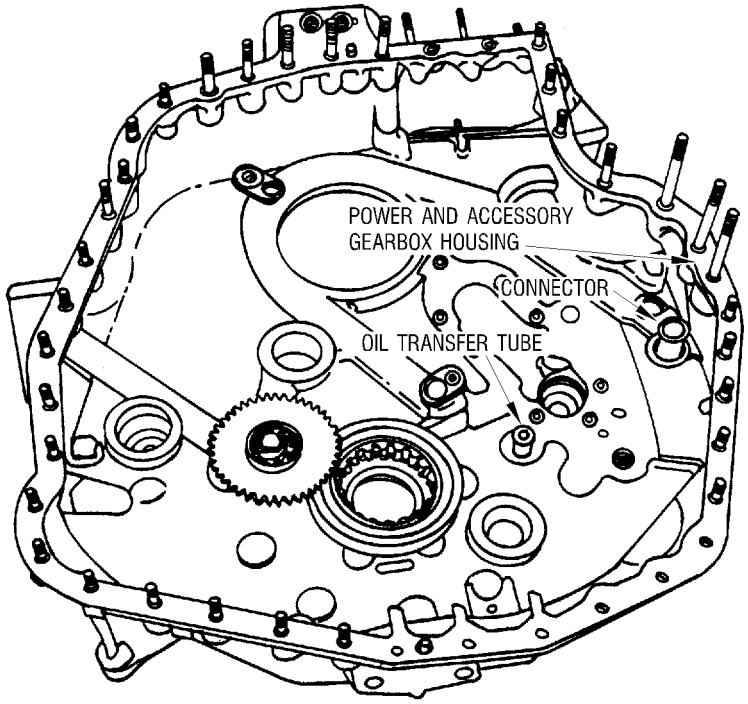
(6) Insert eight pump attaching bolts and six washers. Washers are used at positions 1, 3, 4, 5, 6, and 7 counting clockwise with 1 at the point nearest the filter housing. The five 10–32 X 2 in. (51 mm) bolts go at positions 1, 2, 3, 7, and 8; the two 10–32 X 2.750 in. (70 mm) bolts go at positions 4 and 6; the 10–32 X 2.375 in. (60 mm) bolt goes at position 5. Do not tighten bolts at positions 2 and 8 at this time, tighten others finger tight.

(7) (250–C20W) Lubricate O–ring and install it on the scavenge oil tube. Install the scavenge oil tube in the oil pump. Retain the scavenge oil tube with a screw at the oil pressure tube and with a screw at the oil delivery tube.

(8) Lubricate and install the two packings on the check valve; install the valve in the gearbox housing. (See Figure 232.)

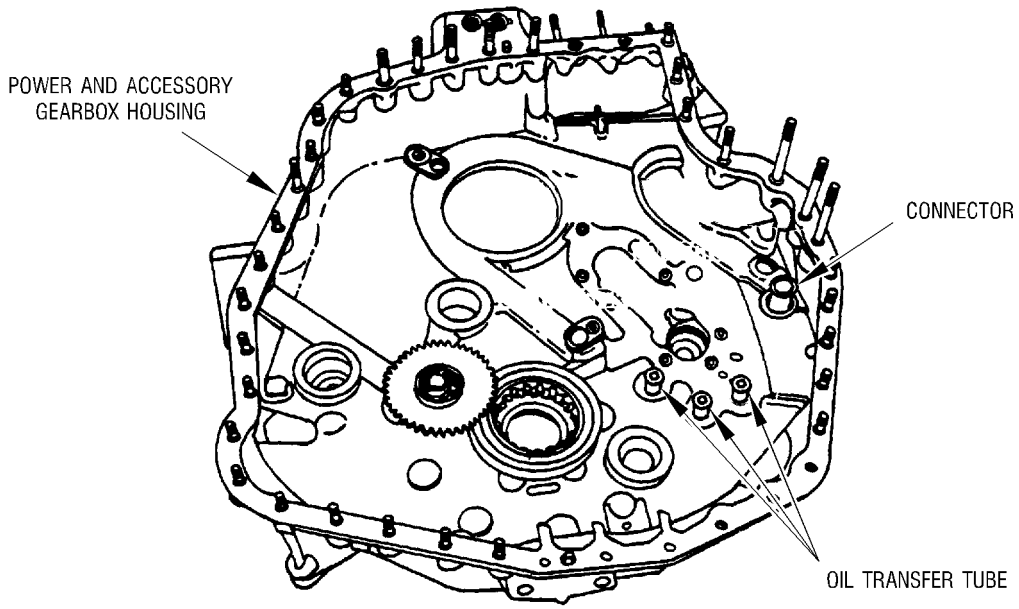
(9) Position the gasket and install the filter housing assembly in the gearbox housing. (See Figure 222 or 223.) Mate the filter inlet and filter bypass transfer tubes and check valve to the filter housing during the assembly. (See Figure 232.)

(10) Retain the housing with eight nuts and washers. Tighten nuts to 35–40 lb in. (3.9–4.5 N·m). Align the two tubes; then tighten the pump attaching screws to 35–40 lb in. (3.9–4.5 N·m). Loosen and retighten to 22–26 lb in. (2.5–2.9 N·m). Secure with lockwire. Tighten the scavenge pickup tube retaining screw (250–C20, –C20B, –C20F, –C20J) to 20–25 lb in. (2.3–2.8 N·m).



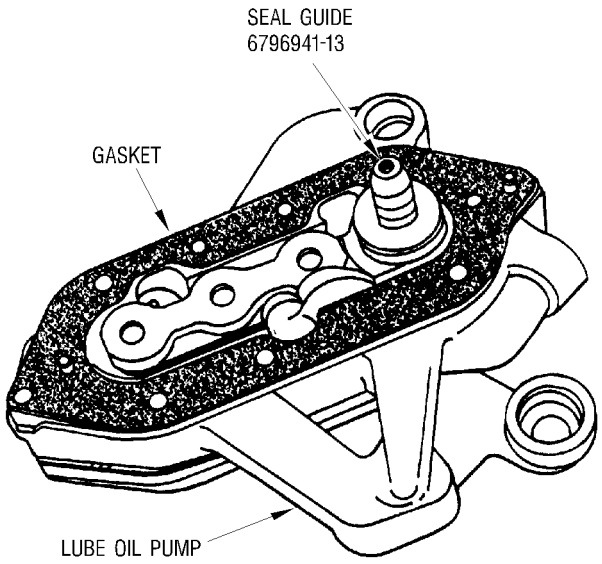
Oil Transfer Tube in Gearbox Housing (250–C20, –C20B, –C20F, –C20J)
Figure 229

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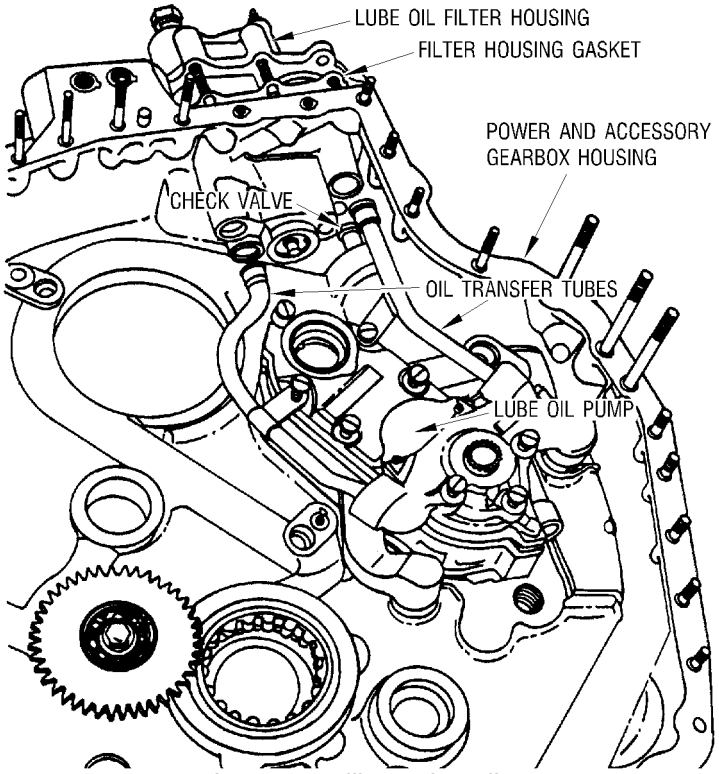
Oil Transfer Tube in Gearbox Housing (250–C20S, –C20W)
Figure 230

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ADE042XD

Lube Oil Pump and Seal Guide
Figure 231



ADE043XD

Removing or Installing Lube Oil Pump
and Filter Housing
Figure 232

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PARA 2.G. (cont)

(11) Lubricate and install two packings on each of the three oil scavenge transfer tubes; install the two short tubes in the pump and the long tube in the gearbox housing.

(12) Lubricate and install two packings on the oil delivery tube, one packing on the screen, and one packing on the oil pressure tube. Install the oil pressure tube (nozzle) and the oil delivery tube with screen in the gearbox housing. Retain each with a screw; tighten screws to 22–26 lb in. (2.5–2.9 N·m) and secure with lockwire.

(13) Make a static leak check of the oil filter housing and lube oil pump assembly.

(a) Equipment. A six foot length of one–inch (25.4 mm) ID copper tubing having a length of hose with a shutoff valve near the outlet end; a four foot (1.2 m) head of oil in the standpipe; and a fitting for connecting the hose to the oil–in port of the gearbox.

(b) Attach the fitting to the gearbox and the standpipe hose to the fitting. Keep the hose coupling loose until the system can be bled. Open the shutoff valve and bleed the air from the system, then tighten the hose coupling nut.

(c) Place the gearbox housing in a vertical position with the oil pump at the top.

(d) Visually check the partial assembly for oil leakage over a period of ten minutes.

NOTE: Leakage will be evident if a problem exists. Slight moistness or seepage should not be interpreted as leakage.

(e) Correct the condition causing leakage before proceeding with the assembly of the gearbox.

(14) Install the helical power takeoff bearing outer race and rollers in the gearbox housing. DO NOT apply petrolatum or grease to these rollers. Lubricate using engine oil or approved assembly fluid only.

(15) (250–C20, –C20B, –C20F, –C20W) Lubricate and install packing on idler gear support shaft. Install the idler spur gear support shaft in the gearbox housing using 6795614 pusher and puller. (See Figure 217.)

(16) (250–C20F, –C20S) Install the idler gear support shaft in the gearbox using 6795614 pusher and puller. Attach with two bolts and secure with lockwire.

(17) (250–C20, –C20B, –C20J, –C20W) Lubricate and install the bearing in the power train idler spur gear, retain with an internal retaining ring. Lubricate and install new packing on the idler gear support shaft and install the gear and bearing on the shaft. Retain the gear assembly on the shaft with a through bolt, keyway bearing retaining washer, and external washer and nut. Torque nut to 35–40 lb in. (3.9–4.5 N·m,)

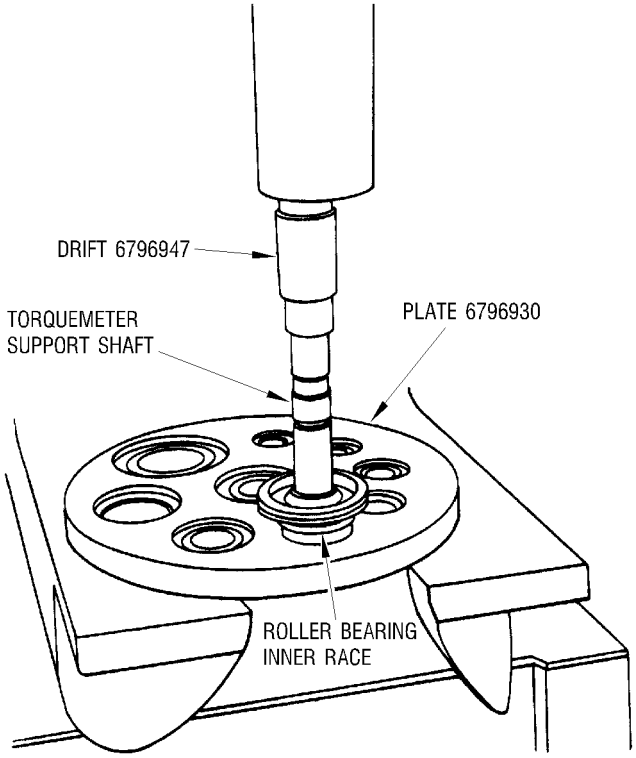
(18) (250–C20F, –C20S) Lubricate and install the bearing in the power train idler spur gear; retain with an internal retaining ring. Install the gear and bearing on the shaft. Apply Loctite No. 242 lightly to the bolt's threads; then retain the gear assembly on the shaft with a bolt, a key washer and a keyway bearing retaining washer. Torque bolt to 35–40 lb in. (3.9–4.5 N·m) and bend locktab.

(19) Install the bearing inner race on the torquemeter support shaft. Install with the thrust flange toward the torquemeter piston using 6796930 plate, location D, and 6796947 drift. (See Figure 233.)

(20) Apply a thin coat of petrolatum to the bearing and assemble the bearing outer race and rollers on the shaft. Install the bearing end plate and washer on the shaft.

(21) Lubricate and install the expander ring and piston ring in the torquemeter support shaft piston ring groove. The gap of the ring shall be 180° removed from the gap of the expander ring.

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Torquemeter Support Shaft Bearing Installation
Figure 233

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PARA 2.G. (cont)

(22) Lubricate and install the ball bearing on the torquemeter piston using 6796930 plate, location J and 6796947 drift. Install with the wide portion of the outer race away from the torquemeter piston. Install the piston on the torquemeter support shaft. Lubricate the packing and place it on the shaft.

(23) Install the torquemeter support shaft in the gearbox housing. (See Figure 218 or 219.) Install 6795974 aligning fixture. (See Figure 221.) Install the internal flared washer and lubricated packing on the shaft. Tighten the nut to 275-300 lb in. (31-34 N·m) using 6795597 wrench. (See Figure 220.) Secure with lockwire.

(24) Lubricate and install the bearings on the tachometer and governor power train spur gearshaft using 6796930 plate, locations C and G and 6796946 drift.

(25) Apply lubricant lightly to the splines then install the tachometer and governor spur gearshaft in the gearbox housing using 6796941 seal guide with detail -13.

(26) Lubricate and install the bearings on the fuel control and oil pump spur gearshaft using 6796930 plate, location H and 6796946 drift. The small ball bearing that was pulled by the outer race must be replaced with a new bearing at this step if there is any apparent indication of raceway brinelling. Install the gearshaft in the oil pump bearing cage.

(27) Apply lubricant lightly to the splines then install the fuel control and oil pump flex shaft coupling on the oil pump drive shaft. (See Figure 222 or 223.)

(28) Lubricate packing and install with magnetic plug in the gearbox housing. Tighten plug to 60-80 lb in. (6.8-9.0 N·m) and secure with lockwire.

(29) (250-C20S, -C20W) Lubricate packing and install with low pressure scavenge oil check valve on outside of gearbox housing. Install check valve with arrow pointing away from gearbox housing.

H. Gearbox Cover Assembly. (See Figure 205, 206 or 207.)

Assemble the gearbox cover as follows:

(1) Install gearbox cover seals as necessary at the following locations using 6796941 seal installation kit with details -16, -17, -19, and -20. (See Figures 228 and 234.) Apply engine oil to the seal lip to aid in installation.

(a) Power turbine governor pad (use detail -17).

(b) Power takeoff pad (use detail -19).

NOTE: Use of the Bell Helicopter tool for installation of double lip seals is recommended.

(c) Gas producer fuel control pad (use detail -17).

(d) Fuel pump pad (use detail -17).

(e) Accessory drive pad (use detail -17) (250-C20, -C20B, -C20J, -C20S)

(f) Starter generator pad (use detail -18).

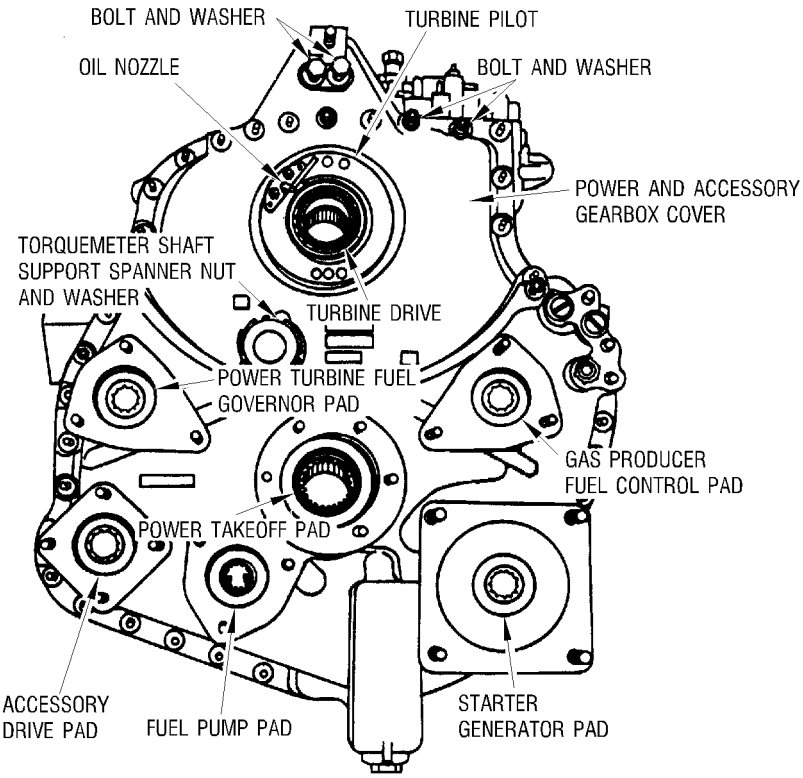
(g) Gas producer idler spur gearshaft (internal installation held by a retaining ring) (use detail -20).

NOTE: The accessory drive spur gearshaft and its associated idler spur gear are used in the 250-C20J and -C20S gearbox only.

(2) (250-C20J, -C20S) Install and idler gear support shaft in the bore adjacent to the accessory drive gearshaft bore using pusher and puller 6795614. (See Figure 217.) Lubricate and install the bearing in the gas producer gear train idler spur gear; retain with internal retaining rings. (See Figure 216.) Install the idler spur gear and bearing on the support shaft and retain with a bearing keyway washer, key washer, and bolt that has ben lightly coated with Loctite No. 242. Tighten the bolt to 35-40 lb in. (3.9-4.5 N·m) and bend the locktab of the key washer.

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Typical Power and Accessory Gearbox Cover
Figure 234

PARA 2.H. (cont)

(3) Lubricate and install packings on the two idler gear support shafts. Install the two idler gear support shafts in the gearbox cover using 6795614 pusher and puller. (See Figure 217.)

(4) Lubricate and install the bearings in the two gas producer gear train idler spur gears; retain with internal retaining rings. (See Figure 216.) Place a packing on the support shaft adjacent to the fuel pump drive pad bore and install one idler spur gear and bearing on the idler shaft. Retain gear assembly with through bolt, bearing keyway washer, and external washer and nut. Tighten nut to 35–40 lb in. (3.9–4.5 N·m).

(5) Lubricate and install the two ball bearings on the gas producer gear train idler spur gearshaft using 6796946 drift and 6796930 plate, locations I and H.

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PARA 2.H. (cont)

(6) Place a packing on the remaining idler gear support shaft. Install the remaining idler spur gear and bearing, through bolt, and bearing keyway washer on the shaft at the same time the gas producer gear train idler spur gearshaft is installed. Install an external washer and nut on the through bolt. Tighten the nut to 35–40 lb in. (3.9–4.5 N·m.)

(7) Install the internal retaining ring; then lubricate and install the two ball bearings, one at a time, and the bearing sleeve spacer on the fuel pump drive spur gearshaft using 6796949 drift and 6796930 plate, location C. A 0.0007 in. T (0.000–0.018 mm) fit between the inner race ID and the shaft OD must be maintained. Install the bearing retainer and secure it with an external retaining ring. Apply lubricant to the splines of the gearshaft and using 6796941 seal guide with detail –14, install the gearshaft in the gearbox cover. Secure with an internal retaining ring using 6796966 pliers.

(8) (250–C20J, –C20S) Install the accessory drive spur gearshaft in the same manner as the fuel pump drive spur gearshaft (step (7)).

(9) Lubricate packing and install it on the starter–generator spur gearshaft. Assemble the starter–generator spur gearshaft in the same manner that the fuel pump drive spur gearshaft was installed [step (7)].

(10) Lubricate two packings and install with oil transfer tube in the gearbox cover.

(11) (250–C20S, –C20W) Lubricate packing and install with plug at the top of the gearbox cover. Tighten plug to 60–80 lb in. (6.8–9.0 N·m) and secure with lockwire.

(12) Lubricate packing and install it on the fuel control spur gearshaft. Assemble the fuel control spur gearshaft in the same manner that the fuel pump drive spur gearshaft was installed [step (7)]. (See Figure 205, 206 or 207.)

CAUTION: FAILURE TO INSTALL THE INTERNAL RETAINING RING IN THE HELICAL POWER TRAIN DRIVE GEAR CAN ALLOW DISENGAGEMENT OF THE TURBINE SHAFT–TO–PINION GEAR COUPLING CAUSING POWER TURBINE OVERSPEED.

(13) The helical power train drive gear bearing journals and the inner race bores of the bearings shall be clean and oil free. Install the No. 2–1/2 roller bearing in the helical powertrain drive gear. Secure with an internal retaining ring.

(14) Select the No. 3 and No. 4 bearings to obtain an internal clearance of not less than 0.0003 in. (0.008 mm) after assembly on the gear. These bearings may be roller or ball bearings. Check internal clearance using 6872165 gage.

(15) Heat the bearings to 250–300°F (121–149°C) for one hour. Maintain the gear at room temperature. Apply a light coat of Loctite 290 to the entire surface of one of the bearing journals on the gear. Press the bearing onto the journal until it is seated against the journal shoulder using 6796948 drift and 6796930 plate, location A. Wipe off any excess Loctite. Repeat this procedure when installing the other bearing.

(16) When bearings have cooled, install roller bearing out races, lubricate bearings and install the gear in the gearbox cover. Retain roller bearing configuration with an internal retaining ring.

(17) (250–C20J) Install the two damper rings in the retaining grooves of the helical power takeoff gearshaft.

(18) Lubricate and install the ball bearing on the helical power takeoff gearshaft using 6796948 drift and 6796930 plate, location A. (See Figure 235.)

(19) Check to ensure that the gearshaft front bearing journal and the bearing inner race bore are clean and oil free. Maintain both the P.T.O. gearshaft and the bearing inner race at room temperature.

(20) Lubricate the outside diameter of the bearing inner race. Apply a light coat of Loctite 290 to the entire surface of the front bearing journal on the gearshaft. Press the bearing inner race onto the journal until it is seated against the shoulder on the gearshaft using 6796948 drift and 6796930 plate, Location B. Wipe off any excess Loctite.

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PARA 2.H. (cont)

(21) Apply lubricant to the splines of the gearshaft and using 6796941 seal guide with detail –15, install the gearshaft in the gearbox cover.

(22) Lubricate and install the packing in the groove at the torquemeter shaft opening of the gearbox cover. Lubricate and position the thrust washer and bearing end plate in the gearbox cover.

(23) Use petrolatum to retain the bearing outer race and rollers of the torquemeter bearing in the torquemeter gearshaft. Install the damper ring in the retaining groove of the helical torque meter gearshaft.

(24) Place the gearshaft in position in the cover, meshing the gear teeth with the teeth of the helical power train drive gear and the helical power takeoff gearshaft.

(25) Lubricate and install the roller bearing inner race on the torquemeter shaft support using 6796930 plate, location E and 6796947 drift.

(26) Install the headed pin in the shaft support.

(27) Install the shaft support in the cover through the gear using 6795969 holder. (See Figure 236.) Secure the support with a cup washer and spanner nut. Lightly coat the support threads and nut thrust face with antiseize compound. Tighten spanner nut to 390–400 lb in. (44–45 N·m) using 6795597 wrench. (See Figure 208.) Crimp cup washer securely into locknut slot.

(28) Apply antiseize compound to the oil nozzle mounting studs; install oil nozzle with lubricated packing. Secure with two nuts. Tighten nuts to 35–40 lb in. (3.9–4.5 N·m).

(29) (250–C20, –C20B, –C20F, –C20J) Lubricate packing and install with magnetic plug in the bottom of the gearbox cover. Tighten plug to 60–80 lb in. (6.8–9.0 N·m) and secure with lockwire.

I. Gearbox Cover–to–Housing Assembly

Assemble the power and accessory gearbox cover to the housing as follows:

(1) Apply a thin film of sealing compound (Scot Clad 776 or equivalent) to the gearbox housing splitline.

NOTE: A strand of silk thread, gently pressed into the sealing compound around the splitline, will give added assurance against oil leaks. Use silk threads only; other thread may damage splitline surface. Do not use dental floss or nylon thread. Install thread between stud holes and ID of cover as shown on Figure 237.

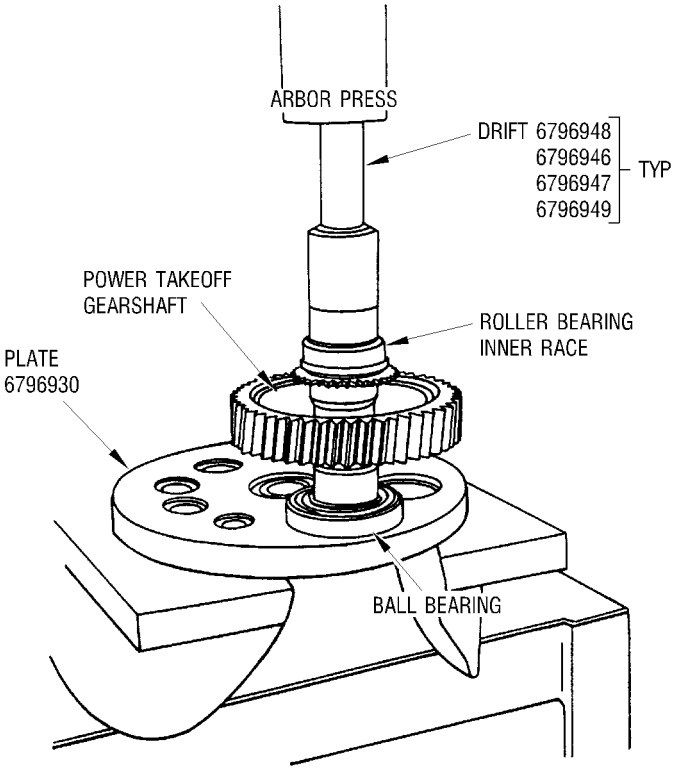
(2) Install the 6886201 power takeoff roller bearing guide in the helical power takeoff gearshaft. (See Figure 238.) Install 6796941 seal guide, detail –14 in the tachometer and governor power train spur gearshaft. (See Figure 239.) Install 6895957 alignment tool over the oil tubes at the oil pump.

(3) With the gearbox housing mounted in 6795579 stand, carefully assemble the gearbox cover to the gearbox housing, aligning the oil transfer tubes, the scavenge oil pickup tube, and the fuel control and oil pump flex shaft coupling.

(4) Insert 6799790 adapter in the tachometer and governor power train spur gearshaft. This may be used to turn the gear train to assist in assembly.

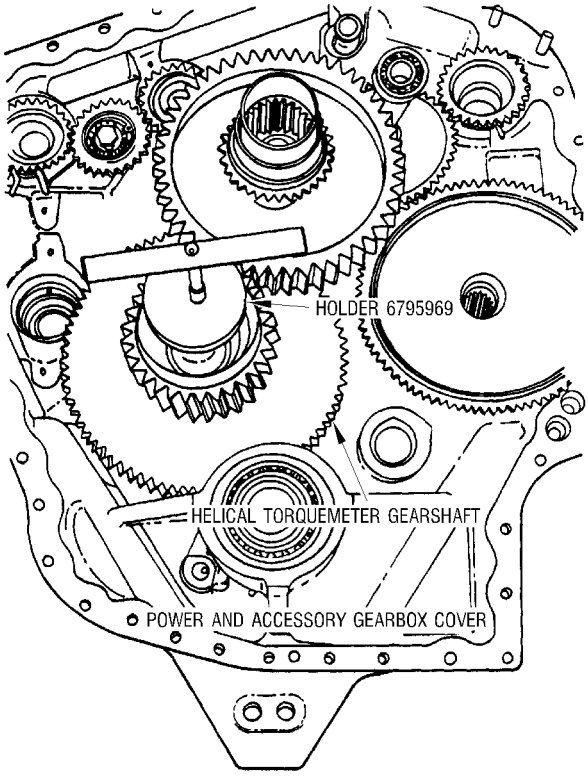
(5) Rotate the fuel control and oil pump spur idler gearshaft by hand to assure proper engagement with the fuel control spur gearshaft. Remove 6895957 alignment tool.

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Power Takeoff Gearshaft Bearing Installation
Figure 235

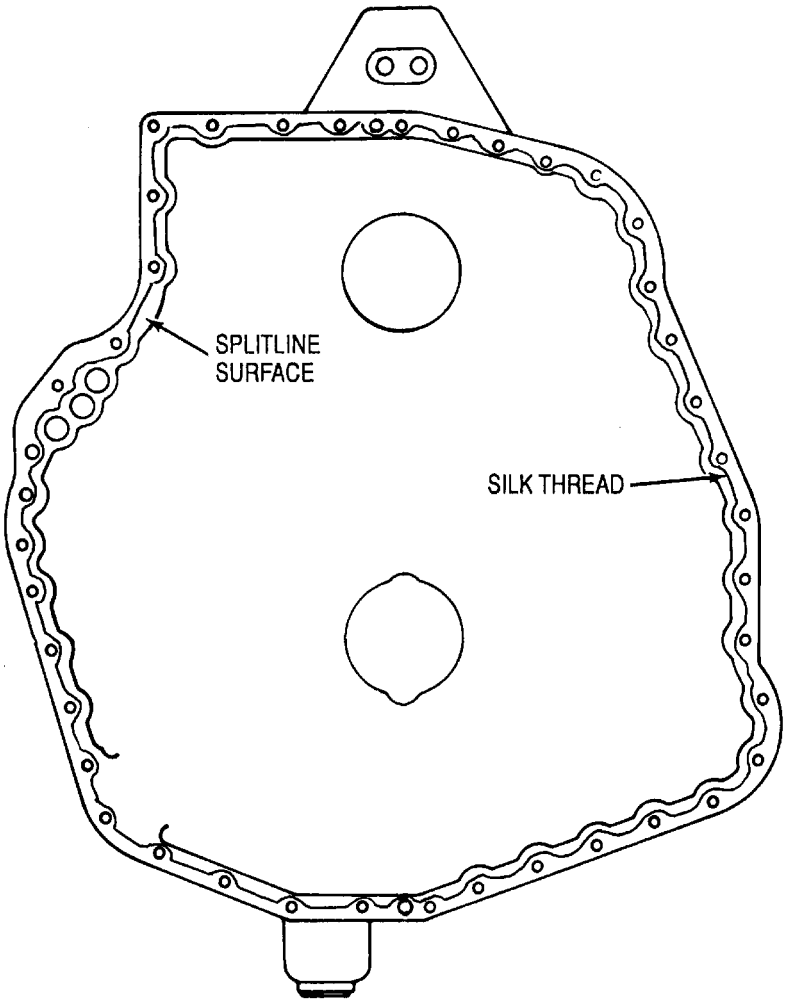
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Installing Torquemeter Shaft Support
Figure 236

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LOCATE SILK THREAD TOWARD THE INTERIOR OF THE COVER (BETWEEN BOLT HOLES, STUDS, AND DOWEL PINS AND THE INSIDE EDGE OF THE SPLITLINE FLANGE).

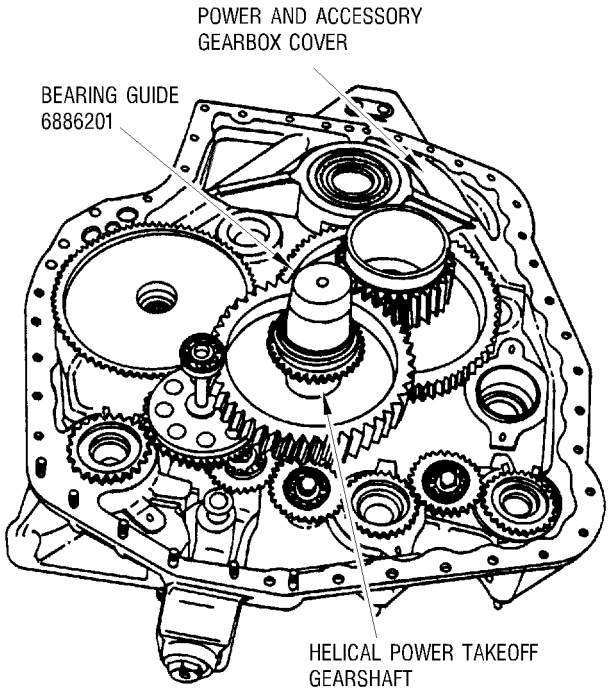
LOCATE THREAD ENDS AT TOP OF COVER.

GENTLY PRESS SILK THREAD INTO SEALING COMPOUND. DO NOT USE DENTAL FLOSS OR NYLON THREAD.

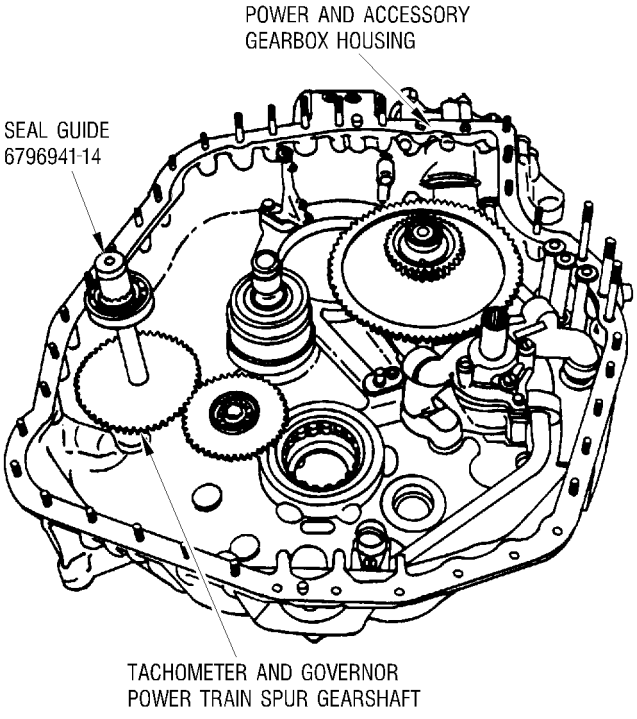
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Installing Silk Thread on Gearbox Cover Splitline
Figure 237

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Seal Guide Location (Cover)
Figure 238



Seal Guide Location (Housing)
Figure 239

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(6) Apply antiseize compound lightly to the threads of studs and bolts used to attach the gearbox cover to the gearbox housing. The cover is secured by 39 nuts, 4 bolts, and 43 washers. (See Figure 205, 206, or 207.)

(a) Tighten the two 10-32 bolts to 20-25 lb in. (2.3-2.8 N·m).

(b) Tighten the 10-32 nuts to 35-40 lb in. (3.9-4.5 N·m).

(c) Tighten the 1/4-28 nuts to 70-85 lb in. (7.9-9.6 N·m).

(d) Tighten the 5/16-24 bolts to 120-150 lb in. (14-17 N·m) and secure with lockwire.

(7) Check the operation of the power and control gear trains to make sure no binding is present between the meshing teeth.

(a) Turn the power train counterclockwise through the power turbine fuel governor pad. (See Figure 234.) Use 6799790 engine turning adapter. No binding is acceptable.

(b) Turn the control gear train counterclockwise through the gas producer fuel control pad. (See Figure 234.) Use 6799790 engine turning adapter. No binding is acceptable.

(8) Remove the 6886201 power takeoff roller bearing guide from the helical power takeoff gearshaft. Install the gearbox housing seal in the power output pad (use detail -19). Lubricate the seal with engine oil prior to installation.

J. (M250 - C20S) Low Pressure Scavenger Oil Check Valve

(1) Disassemble, clean, inspect, and re-assemble the check valve as follows: (See Figure 223, Sheet 2.)

(a) Remove the low pressure scavenge oil check valve (34) from the gearbox housing. Discard packing (41).

(b) Remove cap (1) from check valve housing (6). Discard two packings (2) and (5) (See Figure 239A).

(c) Separate piston (4) and spring (3) from the check valve housing (6).

WARNING: MINERAL SPIRITS IS TOXIC. PROVIDE ADEQUATE VENTILATION FOR PERSONNEL USING IT. INJURY TO PERSONNEL CAN OCCUR.

(d) Wash parts in mineral spirits.

(e) Inspect valve parts. Refer to Table 202.

(f) Install the packing (5) on the piston (4).

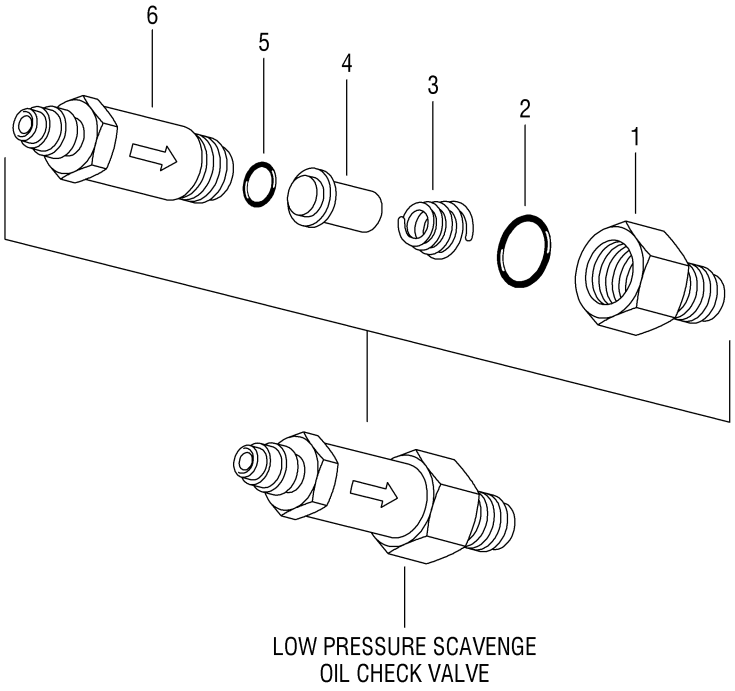
(g) Install piston (4) and spring (3) in the check valve housing (6).

(h) Install the packing (2) on the cap (1).

(i) Install cap (1) on the check valve housing (6). Torque the housing to 15 lb ft (20.4 N·m).

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1. Cap
2. Packing
3. Spring
4. Piston
5. Packing
6. Housing

Low Pressure Scavenge Oil Check Valve
Figure 239A

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Table 202
Low Pressure Scavenge Oil Check Valve Inspection

Item	Condition	Serviceable Limit	Repairable Limit	Disposition
1	Stripped or crossed threads on cap or housing.	None.	Max of one damaged thread.	Chase threads.
2	Nicks or scratches on flared tube sealing surface of cap or housing.	None.		Replace part.
3	Nicks or scratches on piston seating surface or housing valve seat.	None.		Replace part.

K. (M250-C20S) Test the Low Pressure Scavenge Oil Check Valve, (See Figure 239A)

(1) Test the low pressure scavenge oil check valve using engine oil (MIL-PRF-23699) as follows:

(a) Install the valve on the test fixture 6897878. The test fixture 6897878 is installed on 6798036 oil pump and accessories test stand.

(b) Apply pressure to the valve in a free-flowing direction. The valve will open at 1.0 psi (6.9 kPa) pressure.

NOTE: Bleed all lines before leakage check.

(c) Apply an oil pressure equivalent to 10 inches of water (2.49 kPa) in the reverse flow direction. Internal leakage must not be more than 1 drop per 10 minutes maximum.

(d) Replace valve if leakage is more than limit.

(e) No external leakage is allowed at 120 psi (827.4 kPa).

(2) Install packing (41) on the low pressure scavenge oil check valve (34). (See Figure 223, Sheet 2).

(3) Install low pressure scavenge oil check valve (34) on the gearbox housing.

CAUTION: MAKE SURE THE CHECK VALVE IS INSTALLED WITH THE ARROW POINTING TO THE FRONT OF THE ENGINE. DAMAGE CAN OCCUR.

(4) Inspect oil scavenge check valve for external leakage at the first engine operation after valve installation on the engine. No leaks are permitted.

3. Adjustment/Test

A. Oil Pressure Regulating Valve (See Figure 222 or 223.)

CAUTION: EXCEPT FOR INITIAL ADJUSTMENTS ON NEWLY INSTALLED ENGINES, DO NOT ADJUST THE PRESSURE REGULATING VALVE TO CORRECT FOR HIGH OIL PRESSURE. DO NOT MAKE A PRESSURE REGULATING VALVE ADJUSTMENT TO CORRECT FOR A SUDDEN INCREASE OR RAPID CHANGE IN OIL PRESSURE. THESE CONDITIONS ARE CAUSE TO SUSPECT OTHER OIL SYSTEM PROBLEMS HAVE DEVELOPED.

(1) Make necessary changes in the engine oil pressure by adjusting the pressure regulating valve. (Refer to Gearbox Housing Lubrication System Components Disassembly, para 2.D., this section.)

NOTE: During the initial check run of a newly installed engine the pressure regulating valve may be adjusted to increase or decrease oil pressure as per specified limits. A direct reading gage is to be utilized anytime an adjustment to the pressure regulating valve is required.

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(a) Remove the lockwire.

(b) Using a wrench turn the regulating valve clockwise to increase and counterclockwise to decrease the oil pressure. An approximate adjustment may be made by bottoming the valve and then backing it out 5-1/2 turns. One turn of the adjustment will change the oil pressure approximately 13 psig (90 kPag). Oil pressure is 115-130 psig (793-896 kPag) at 107°C (225°F) oil temperature.

B. Oil Pump Priming

Oil pumps of new or newly installed engines can need priming before initial start. Prime the pump as follows:

(1) Loosen the #1 bearing and the #8 bearing scavenge lines at the scavenge fittings and motor the engine until oil flow is at the two locations.

(2) Motor the engine with the starter to make sure the engine has oil pressure before start.

(3) After start, monitor the engine oil pressure and torque pressure continuously for five minutes. If you see a large decrease in engine oil pressure or torque pressure more than usual, then shut down the engine and do the inspection of the engine to find the cause.

(4) Use a torque wrench to torque the #1 bearing and the #8 bearing oil scavenge fittings to 150-200 lb in. (16.9-22.6 Nm).

(5) It is recommended to make sure a baseline for the power turbine pressure oil nozzle flow check (Ref. 72-50-00, para 6.D.).

4. Inspection/Check/Repair

A. Oil Leakage Inspection

Inspect the power and accessory gearbox for oil leaks. Replace the seal assembly if excessive oil leakage is detected at the accessory pad locations. (See Figure 240.)

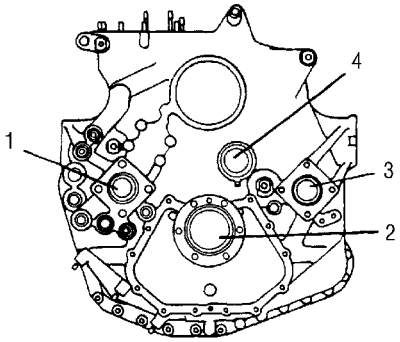
B. Starter-Generator Gearshaft Female Spline Inspection

(1) If the starter-generator is removed, then do the following;

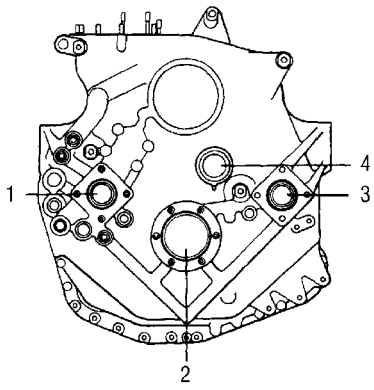
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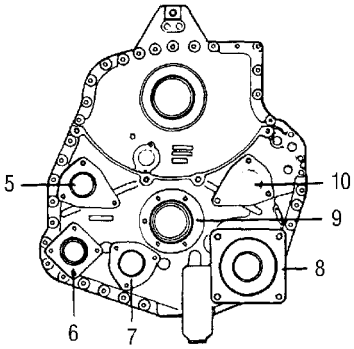
250-C20F



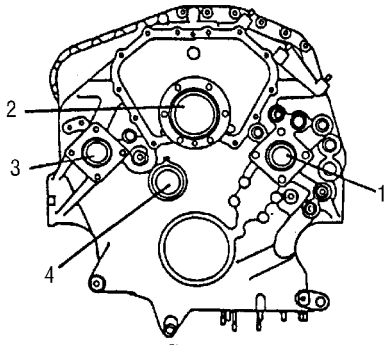
250-C20, -C20B, -C20J



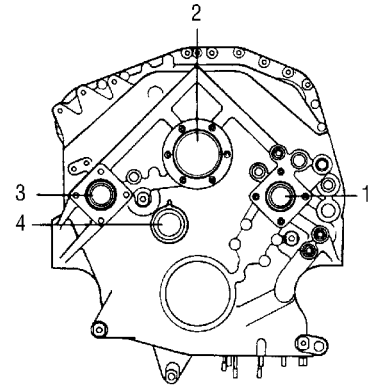
250-C20, -C20B, -C20F, -C20J



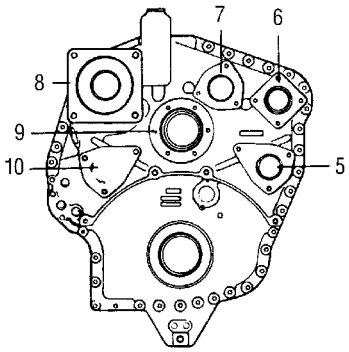
250-C20S



250-C20W



250-C20S, -C20W



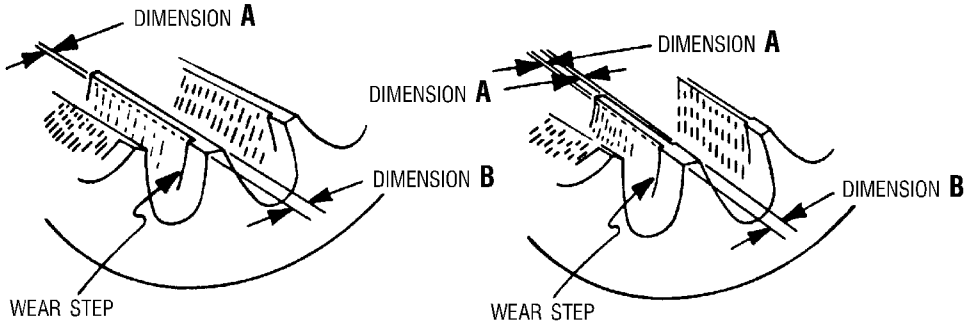
ADD064XA

1. Gas Turbine Tachometer-Generator Pad
2. Power Output Pad
3. Power Turbine Tachometer-Generator Pad
4. Torquemeter Spanner Nut
5. Power Turbine Fuel Governor Pad
6. Vacuum Hydraulic Pad (Spare)
7. Fuel Pump Pad
8. Starter Generator Pad
9. Power Takeoff Pad
10. Gas Producer Fuel Control Pad

Power and Accessory Gearbox Accessory Pad Locations
Figure 240

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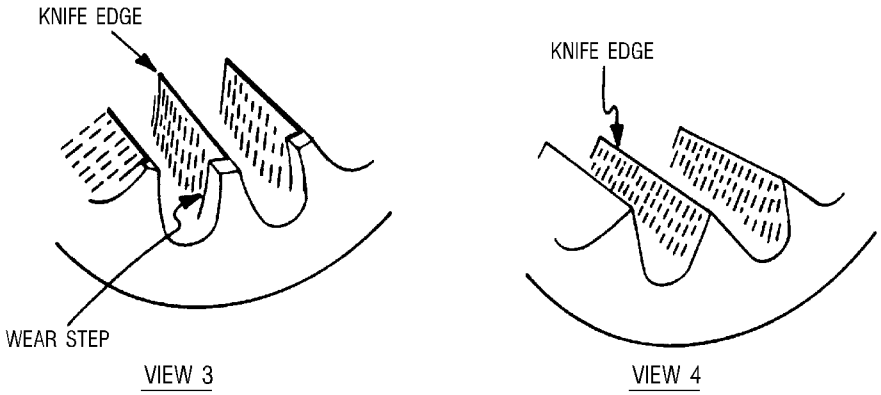


ACCEPTABLE WEAR PATTERNS

IF DIMENSION **A** ON EITHER SIDE OF THE TOOTH IS LESS THAN 0.010 IN. (0.0025 MM), OR LESS THAN 20 PERCENT OF DIMENSION **B** , SPLINE WEAR IS ACCEPTABLE AND THE STARTER-GENERATOR GEARSHAFT CAN REMAIN IN SERVICE.

IF DIMENSION **A** ON EITHER SIDE OF THE TOOTH IS GREATER THAN 0.010 IN. (0.0025 MM), OR GREATER THAN 20 PERCENT OF DIMENSION **B** , BUT NOT A KNIFE EDGE (VIEWS 3 AND 4), REPLACE THE STARTER-GENERATOR GEARSHAFT BEFORE 100 HOURS OR 50 START CYCLES ARE EXCEEDED.

*DIMENSION **B** IS THE THICKNESS AT THE TIP OF THE TOOTH IN AN AREA WITHOUT WEAR THAT IS STILL AT ORIGINAL TIP WIDTH.



UNACCEPTABLE WEAR PATTERNS

IF THE SPLINE TOOTH IS KNIFE EDGE IN APPEARANCE AND EXCESSIVELY WORN, REPLACE THE STARTER-GENERATOR GEARSHAFT PRIOR TO FURTHER FLIGHT.

ADD066XF

Starter-generator Gearshaft Spline Inspection
Figure 241

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(2) Clean the female splines of the starter-generator gearshaft and the male splines of the starter-generator driveshaft with mineral spirits and a soft brush.

(3) Using a bright light, inspect the splines in accordance with the criteria depicted in Figure 241.

NOTE: A sharp pointed scribe, 0.020 in. (0.51 mm) radius, can be used to detect a wear step. A 0.010 in. (0.25 mm) feeler gage can be helpful in visually comparing the depth of the wear step.

NOTE: Inspect the starter-generator brushes for wear in accordance with the Aircraft Manual at the same time the spline inspection is made.

(4) Lubricate acceptable splines with grease (Aeroshell No. 22 or equivalent.).

(5) Before reinstallation of the starter-generator, make sure the torsional damper members of the driveshaft in the starter generator are in hard contact with each other.

C. Opened Gearbox Inspection

Whenever the gearbox is opened for any reason, and at an Authorized Maintenance Facility make a general inspection of the assembly, paying particular attention to the following:

(1) Check condition of accessory gearshaft drive splines. If excessive wear is believed present, replace the gearshaft.

(2) Check condition of gears. Replace gears having spalled or chipped teeth.

(3) Check mounting and attachment security of all internal parts including tab lockwashers and safety wire. Secure as required.

(4) Check integrity of oil pump attaching screws and oil tube packings.

(5) Check condition of the accessory pad seal and packing for the gas producer gear train idler spur gearshaft (inside the gearbox cover). Replace seal and packing if it shows apparent damage or if the engine is prone to blow oil out the gearbox vent.

(6) Check the filter housing for excessive wear at the opening for the filter inlet and filter bypass tubes. Replace packings on the filter inlet and bypass tubes at each disassembly. Replace the filter housing if necessary to prevent air/oil leakage.

(7) Inspect bearing separators for low magnetic permeability per M250-C20 Series CEB-1201.

(8) If the records indicate that more than 3500 hours have elapsed since the gears were new or were last magnafluxed at overhaul or repair, all gears are to be magnetically inspected. (Refer to the Engine Overhaul Manual, publication No. 10W3, for inspection criteria.)

NOTE: If any doubt exists concerning the serviceability of any part, repair or replace the part before closing the gearbox.

D. Insert Inspection

Any time the compressor is removed or when insert looseness is known or suspected, check for space between each of the five inserts and the gearbox housing. If a piece of 0.0015 in. (0.038 mm) shim stock can be inserted anywhere under the insert, it must be reworked.

E. Repair of Compressor Mounting Inserts

Repair loose compressor mounting inserts in the gearbox housing as follows:

CAUTION: THE GEARBOX HOUSING MUST HAVE AT LEAST THREE GOOD COMPRESSOR MOUNTING INSERTS BEFORE REWORK CAN BE ACCOMPLISHED ON A LOOSE INSERT.

NOTE: The rework shall be made with the engine removed from the air frame and with the turbine and compressor assembly removed from the gearbox. (Refer to Compressor Assembly Replacement, para 1., 72-30-00.)

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(1) Clean the area of the loose insert on the gearbox housing with methylethylketone.

(2) If the insert is pinned, use a No. 53 drill to drill out the insert locking pin. Remove the insert using wrench 6872881 or 6872927 as applicable.

(3) File off the burrs and clean the threads and surrounding area of the housing using a brush and methylethylketone.

(4) Check the threads of the gearbox housing for wear by reinstalling the removed insert in the threaded opening of the housing. The threads should be snug when the bottom side of the insert flange is 1/8-in. (3 mm) above the surface of the gearbox. If any side movement or wobble is present, use an oversized insert for the replacement. Select the oversized insert to obtain the best fit.

(5) Install the selected insert. Tighten to 125-150 lb in. (14-17 N·m) plus running torque. Do not exceed 180 lb in. (20 N·m).

(6) Install checking fixture 6872880 over the five compressor mounting inserts. (See Figure 242.) Be sure the fixture does not touch any of the four bosses around the insert at the seven o'clock position. Determine the seven o'clock position by viewing the gearbox from the front (compressor) side.

(7) Use shim stock to feel for clearance between each insert flange and the bottom of the fixture. Rework insert flange using spot facing kit 6872879 until there is no clearance at any of the five locations. (See Figure 243.)

NOTE: When properly installed and reworked, the five compressor mounting inserts are the same height. In this condition the checking fixture rests on all five points and each insert-to-fixture fit will be closed to the passage of the shim stock feeler gage.

(8) Mark the gearbox boss at the location of the insert pin slot. Remove the insert using wrench 6872881 or 6872927 as applicable. Clean the threads of the insert and the gearbox using methyl ethyl ketone.

(9) Apply Resiweld FE 186, or equivalent, sealer to the threads of the replacement insert. Thread the insert into the gearbox. The insert will apply sealer to the threads in the gearbox. Repeat the application of sealer to the insert as necessary to cover all threads of both parts. Also, at the seven o'clock insert position, do not install the packing; however, be sure the packing groove is filled with sealer.

CAUTION: WIPE EXCESS SEALER FROM THE END OF THE INSERT TO MAKE SURE THAT NONE OF THE SEALER ENTERS THE GEARBOX AT THE SEVEN O'CLOCK INSERT POSITION THROUGH-HOLE. ON BOTTOM HOLED INSERT LOCATIONS, MAKE SURE THE HOLE DOES NOT ACCUMULATE EXCESS SEALER WHICH CAN PUSH UP THROUGH THE INSIDE THREAD OF THE INSERT. CLEAN SEALER FROM INSERT INSIDE THREADS BEFORE IT HARDENS, USING METHYL ETHYL KETONE AND A 1/4-28 BOLT. RETAP (1/4-28) THE INSIDE THREAD IF HARDENED SEALER IS ENCOUNTERED.

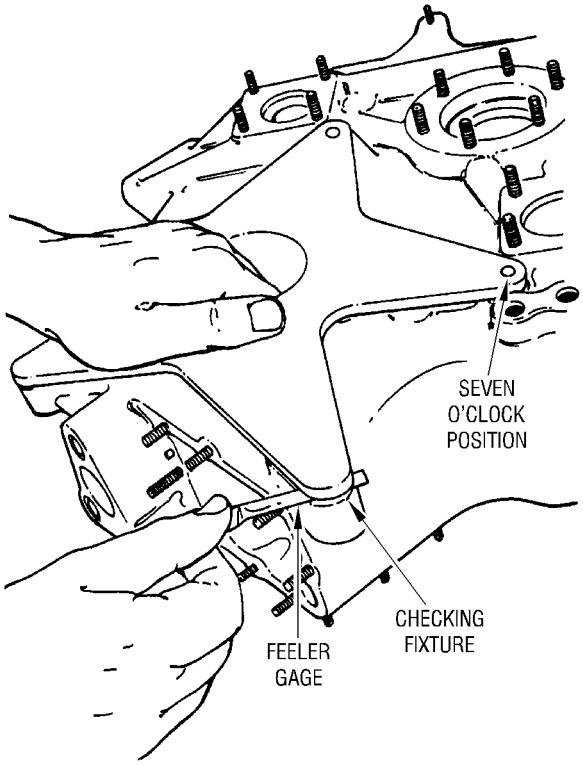
(10) Install the new insert. Tighten to 125-150 lb in. (14-17 N·m) plus running torque to a position where the pin slot aligns with the mark on the gearbox boss. (See step (8).) Do not exceed 180 lb in. (20 N·m).

(11) Wipe any excess sealer from the insert or gearbox. Recheck insert height. (See steps 6 and 7.) Cure sealer for 25-35 minutes at 177°C (350°F), or as an option, at 149°C (300°F) for two hours (to combine cure cycle with paint bake cycle).

(12) Install compressor and turbine assemblies on the gearbox. (Refer to Compressor Assembly Installation, para 1.C., 72-30-00.)

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Checking Insert Setting Height
Figure 242

(13) Return the engine to service. Inspect the insert at the seven o'clock position for any sign of oil leakage after the Check Run. Repair the insert if any leakage is detected.

F. Power Train Pinion Helical Gear Spline Inspection

Inspect the power train pinion helical gear spline whenever the engine has been subjected to a sudden stoppage as defined in para 1.C.(4) or 1.C.(5), 72-00-00, Engine-Inspection/Check. Replace the gear if any of the following conditions exist:

(1) Chipped, damaged, pitted or worn spline teeth.

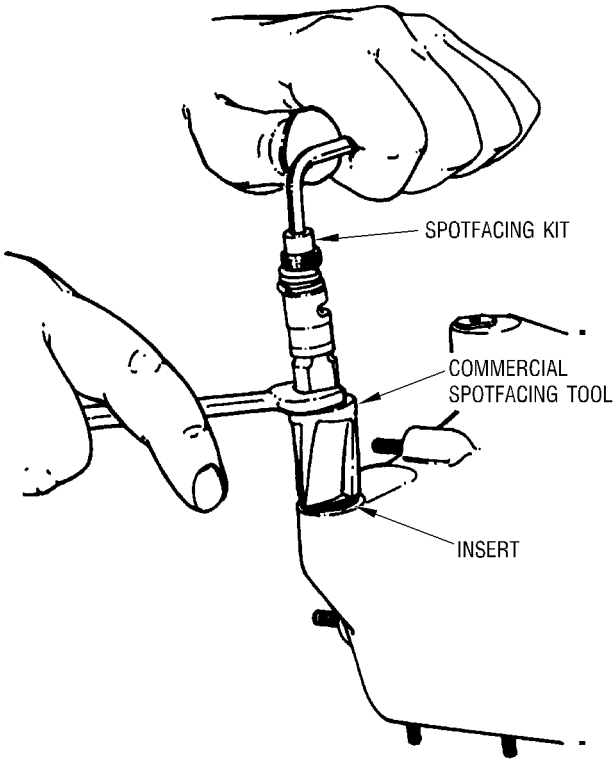
NOTE: A sharp pointed scribe, 0.020 in. (0.51 mm) radius, should be used to detect a wear step.

(2) Evidence of spline deformation or twisting.

G. Oil Filter Inlet Tube Assembly Drop Dimension Inspection

(1) Engines that exhibit low or fluctuating oil pressure may have been assembled with an incorrectly manufactured tube assembly, P/N 6876925A. If the gearbox modification log card does not show compliance with M250-C20 CEB 1307, proceed to the next step.

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Machining New Insert
Figure 243

(2) Remove the Lube Oil Filter Housing Assembly from the gearbox. Refer to para 2.D., this section.

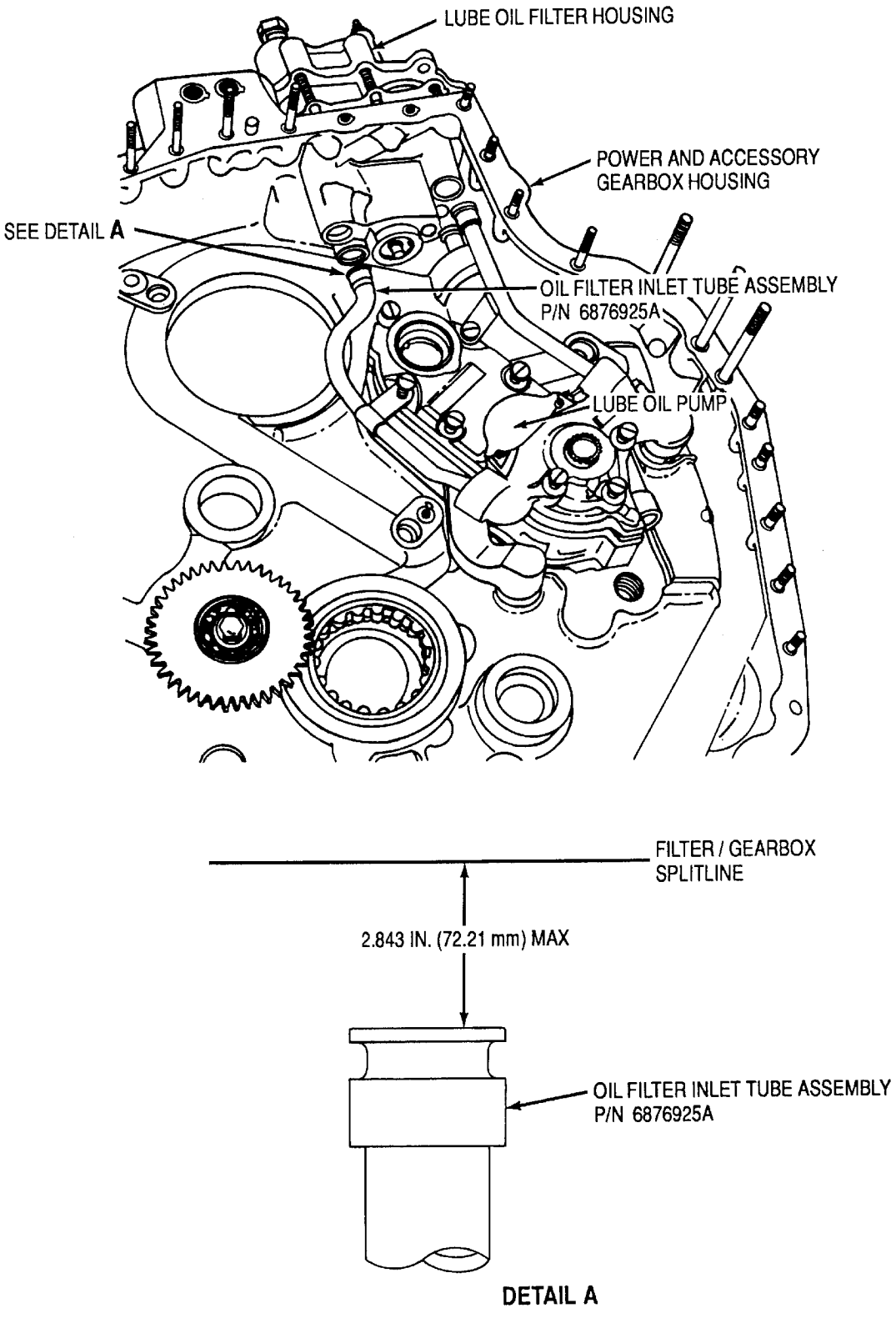
(3) Make sure that all gasket material is removed from the gearbox. Do not let gasket material or other foreign material fall into the gearbox.

(4) Using a 2-3 inch depth micrometer, measure the distance from the gearbox/filter housing splitline to the top of the filter inlet tube assembly, P/N 6876925A. (See Figure 244.)

(5) If this dimension exceeds 2.843 in. (72.21 mm), then the oil inlet tube assembly and the oil filter housing assembly may not be correctly engaged. Reject the gearbox for compliance of M250-C20 CEB 1307 or replace P/N 6876925A, Oil Filter Inlet Tube Assembly with P/N 6876925B (or later) Oil Filter Inlet Tube Assembly.

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Oil Filter Inlet Tube Drop Dimension Inspection
Figure 244

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FUEL PUMP AND FILTER ASSEMBLY––MAINTENANCE PRACTICES (SUNDSTRAND/PESCO AND ARGO–TECH/TRW PUMPS)

1. General

Replace the complete pump assembly if it is found to be the cause of engine malfunction or for TBO expiration. (See Figure 201 or 202.)

NOTE: The unit exchange fuel pump package can be either a dual element set or a single element set. Since the plumbing for the two pumps differs, exchange the two pump–to–control tubes with the pump. Also, remove the two 1/2–20 unions and keep them for installation in the replacement pump.

2. Replacement

A. Removal

Remove the fuel pump and filter assembly from the engine as follows:

(1) Remove the following from the pump:

(a) Fuel supply tube from the pump inlet.

(b) Fuel control–to–pump bypass (P_0) tube.

(c) Pump–to–fuel control inlet fuel (P_1) tube.

(d) Pump seal drain tube.

(e) Airframe furnished filter ΔP indicator equipment (if installed).

(2) Remove the three self–locking nuts and washers which secure the fuel pump to the power and accessory gearbox housing. Remove pump from mounting studs.

(3) Remove the mounting flange gasket. Discard packing.

(4) Remove the two unions and bushing from the pump and keep them for installation in the replacement pump. Discard packings.

B. Installation

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

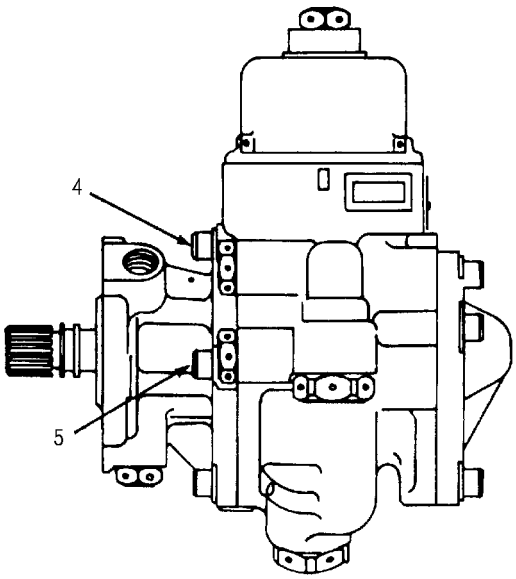
Install the replacement fuel pump and filter assembly on the engine as follows:

CAUTION: IF THE REPLACEMENT PUMP IS NOT THE SAME TYPE OF PUMP (SINGLE ELEMENT VS DUAL ELEMENT) AS THE PUMP BEING REPLACED, THE PORT LOCATIONS WILL BE DIFFERENT. CHECK THE APPROPRIATE ILLUSTRATION (FIGURE 201 OR 202) BEFORE INSTALLING THE BUSHING OR UNIONS. ALSO, THE TUBING CONFIGURATION DIFFERS FOR THE TWO PUMPS. DO NOT ATTEMPT TO REINSTALL THE EXISTING FUEL TUBES IF THE TYPE OF PUMP HAS CHANGED.

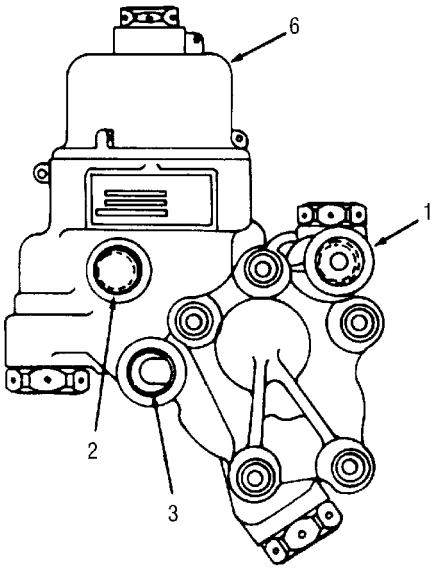
(1) Lubricate three packings and install one each with the union in the control bypass return port and one with the union in the pump discharge return port. Tighten the union to 75–110 lb in. (8.5–12.4 N·m). Install the bushing into the fuel pump inlet port. Tighten the bushing to 150–200 lb in. (17–23 N·m).

(2) Install a new fuel pump drive packing seal.

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LEFT SIDE VIEW



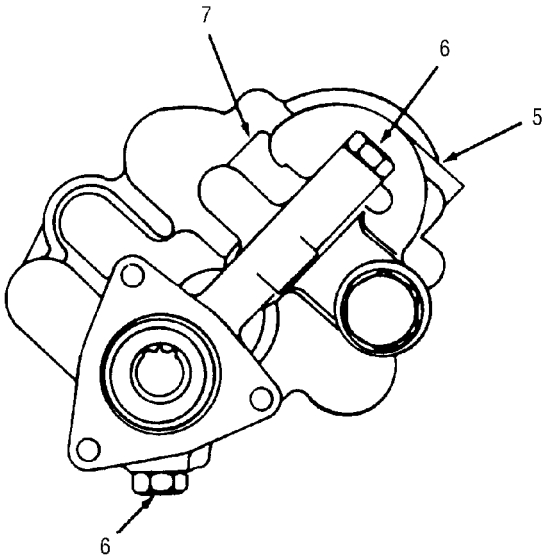
REAR VIEW

ADH064XD

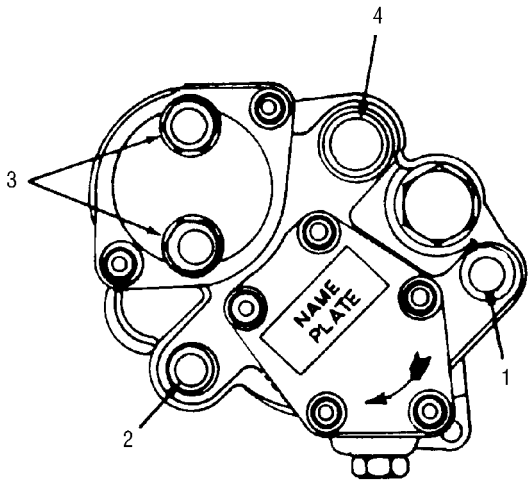
1. Pump Discharge Port
2. Fuel Inlet Supply Port
3. Control Bypass Return Port
4. Before Filter Pressure Drop Port
5. After Filter Pressure Drop Port
6. Filter Cover

Dual Element Fuel Pump and Filter Assembly
Figure 201

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FRONT VIEW



REAR VIEW

ADH065XD

1. Control Bypass Return Port
2. Pump Discharge Port
3. Filter Cover Drain Port (2)
4. Fuel Inlet Supply Port
5. Before Filter Pressure Drop Port
6. Seal Drain Port (2)
7. After Filter Pressure Drop Port

Single Element Fuel Pump and Filter Assembly
Figure 202

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PARA 2.B. (cont)

(3) Install gasket on mounting pad.

(4) Coat pump drive splines and packing with engine oil. Coat the fuel fitting with MIL–L–6081 oil (Atlantic Refining Co. 31100, or equivalent), and the studs with antiseize compound.

(5) Install pump on mounting studs. Install three washers and self–locking nuts.

(6) Tighten mount pad nuts to 70–85 lb in. (7.9–9.6 N·m). Tighten fuel line coupling nuts to 150–200 lb in. (17–23 N·m).

NOTE: Be sure the procedures and precautions of Rigid Tube Inspection and Installation, para 9., 72–00–00, Engine–Servicing, are observed when installing fuel system tubes.

(7) Install the fuel control–to–pump bypass (P_0) fuel tube. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

(8) Install the pump–to–fuel control inlet fuel (P_1) tube. Tighten coupling nuts to 150–200 lb in. (17–23 N·m). Clamp fuel control P_1 and P_0 tubes together. Tighten clamp nut to 35–40 lb in. (3.9–4.5 N·m).

(9) Purge air from the fuel system. (Refer to para 2.D., 73–00–00, for details.)

NOTE: After the fuel pump has been replaced, if a false start or a start that is not completed in a total time of one minute is encountered, return the gas producer lever to FUEL OFF and motor the engine without ignition for 10 seconds.

(10) Check run the engine after fuel pump replacement. (Refer to Check Run, para 1., 72–00–00, Engine–Adjustment/Test.)

(11) Make appropriate entry relative to pump replacement in the Engine Log.

C. Filter Element Replacement

(1) Replacing the Filter in a Single Element Fuel Pump. (See Figure 203.)

CAUTION: THIS IS A THROW–AWAY FILTER ELEMENT AND IS NOT TO BE CLEANED AND REUSED.

(a) Place a container under the pump assembly as some fuel spillage is likely. Remove the two screws and washers retaining the cover to the housing. Drain filter cover.

(b) Remove the cover and the element. Discard two packings and the contaminated filter element. If the element is a tight fit, remove by pulling straight out. Twisting may cause the element end cap to tear off.

(c) Clean the filter cap with a spray of mineral spirits or with a fuel–soaked cloth.

(d) Be sure the new element packing is in place; then install the element in the housing. Install the cover with new packing. Tighten cover screws to 95–105 lb in. (10.7–11.8 N·m).

(e) Purge air from the fuel system. (Refer to Purging the Fuel System, para 2.D., 73–00–00.)

(2) Replace the filter in a dual element fuel pump as follows: (See Figure 204.)

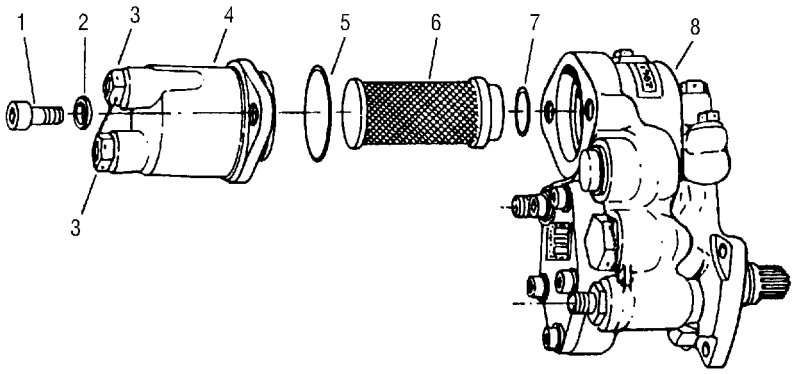
CAUTION: THIS IS A THROW–AWAY FILTER ELEMENT AND IS NOT TO BE CLEANED AND REUSED.

(a) Cut the lockwire and loosen the cover by turning the one inch (25.4 mm) hex. Place a container under the pump assembly as some fuel spillage likely.

(b) Remove the cover and the element. Discard two packings and the contaminated filter element. If the element is a tight fit, remove by pulling straight out. Twisting may cause the element end cap to tear off.

(c) Clean the filter cap with a spray of mineral spirits or with a fuel–soaked cloth.

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1. Screw (2)
2. Washer (2)
3. Plugs (2)
4. Filter Cover
5. Packing
6. Filter Element
7. Packing
8. Fuel Pump

ADH066XD

Fuel Filter Replacement in the Single Element Pump
Figure 203

PARA 2.C. (cont)

(d) Replace packing seal on filter element. Reinstall the filter in reverse of the order of removal. Replace the packing seal between the cover and housing. Tighten the cover to 180–220 lb in. (20–25 N·m) and secure with 0.032 in. (0.81 mm) lockwire.

(e) Purge air from the fuel system. (Refer to PARA 2.D., 73–00–00.)

3. Inspection/Check

A. Fuel Pump Filter Bypass Valve Operational Check

The fuel pump incorporates a filter bypass valve which allows fuel to bypass the pump filter element if it becomes clogged. An open valve allows unfiltered fuel to be supplied to the fuel control (and governor on a CECO fuel system). Make the filter bypass valve operational check whenever any of the following conditions exist:

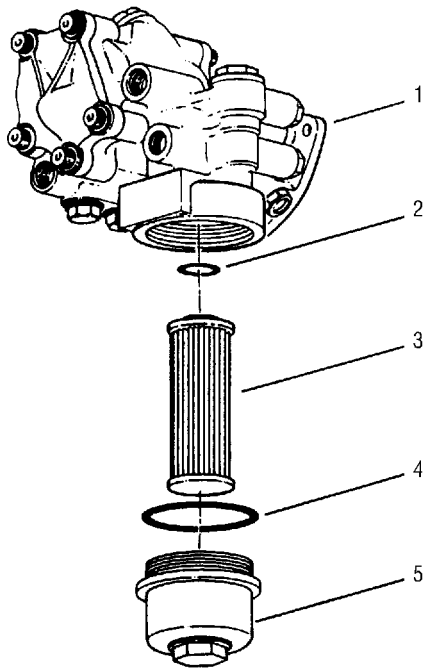
NOTE: If fuel system contamination is known or suspected, refer to Fuel Filter Bypassed in Table 604, Special Inspections, 72–00–00, Engine–Inspection/Check.

(1) The impending filter bypass warning light comes on (this feature is not on all aircraft).

(2) There is an indication the fuel pump filter bypass valve has been bypassing. Bypassing is evidenced by contamination in the fuel control or fuel control inlet filter and/or (CECO fuel system only) contamination of the high pressure filter.

(3) When the fuel pump filter is replaced. Replacement of the element is required when the impending filter bypass warning system has been activated or during the scheduled 300–hour inspection. Under no circumstance should the element be cleaned and reused or remain in service beyond the 300–hour limit.

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1. Fuel Pump
2. Packing
3. Filter Element
4. Packing
5. Cover

Fuel Filter Replacement in the Dual Element Pump
Figure 204

PARA 3. (cont)

B. Operational Checks

Check the fuel pump bypass valve to ensure that the valve is not stuck in bypass; the valve will bypass if the filter becomes clogged and the valve will return from bypass to the closed position.

(1) Determine that the bypass valve is not stuck in the open (bypass) position as follows:

(a) Remove lockwire and the filter cover. Separate the element from the pump. Discard two packings. (See Figure 203 or 204.)

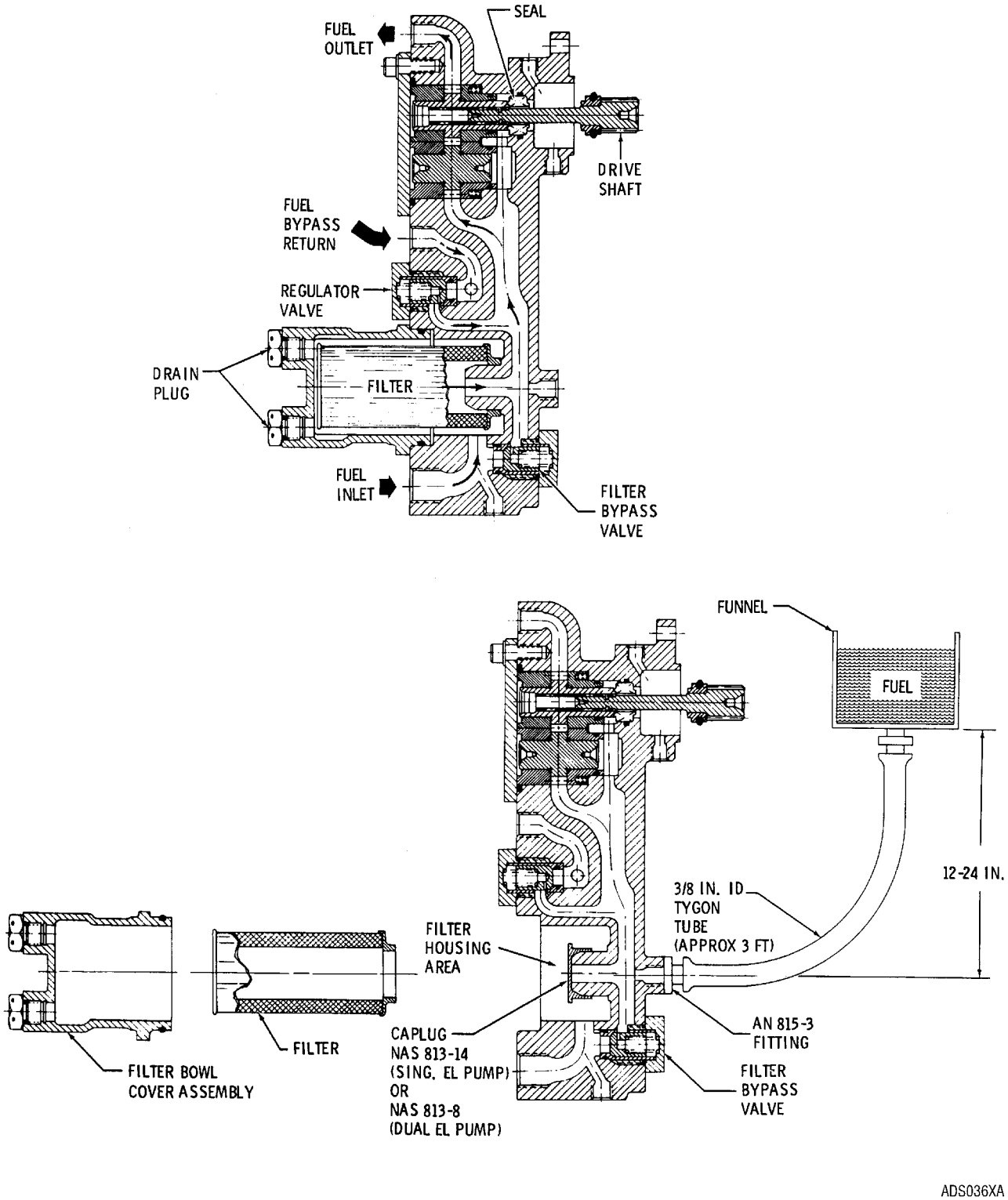
(b) Install a caplug in the filter housing. Use NAS 813–14 caplug for single element pumps. (See Figure 205.)

(c) Remove the hose (or plug) from the after filter (AF) pressure drop port. (See Figure 201 or 202.)

(d) Install an AN 815–3 fitting in the AF port. Install a length of Tygon tube on the AN 815–3 fitting. (See Figure 205.)

(e) Using a funnel, fill the Tygon tube with fuel. Maintain the 12 to 24 in. (305–610 mm) fuel head shown in Figure 205. Observe the filter housing area for leakage.

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Operational Check Schematic Diagram (Typical)
Figure 205

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PARA 3.B. (1) (cont)

1 Observed Fuel Leakage.

Leakage exceeding 10 drops per minute is excessive and indicates the valve is open (bypass position) and contaminated fuel has entered the fuel control system.

a Remove the fuel pump and send it to an Authorized Rolls–Royce Maintenance Center for repair/replacement of the bypass valve.

b On the fuel systems, comply with Table 602, 72–00–00, Engine–Inspection/Check.

2 No Observed Fuel Leakage.

No leakage is an indication that the bypass valve has satisfactorily closed (non–bypass position). Proceed with the check to ensure that the valve will open during clogged filter conditions.

(2) Determine that the bypass valve will open (bypass) if the filter becomes clogged as follows:

(a) With the caplug still in place in the filter housing, reinstall the filter bowl cover assembly.

WARNING: AVOID FUEL ACCUMULATION IN THE ENGINE COMPARTMENT BY PROVIDING A SUITABLE CONTAINER TO COLLECT FUEL DISCHARGED FROM THE TYGON TUBE ATTACHED TO THE AF PRESSURE PORT.

(b) Momentarily actuate the aircraft fuel boost (start) pump. If the aircraft is equipped with a differential pressure light, the light should come on, indicating bypass due to clogging.

(c) Check the fuel flow from the AF pressure tap.

1 No fuel flow is an indication the bypass valve is stuck closed. Return pump to an overhaul facility for repair.

2 Fuel flow from the AF pressure tap indicates the bypass valve has satisfactorily opened. Proceed with the check to ensure that the valve will return to the closed (non–bypass) position.

(3) Determine that the bypass valve will return to the closed (non–bypass) position as follows:

(a) Remove the filter bowl cover assembly. Leave the caplug in place.

(b) Using a funnel, fill the Tygon tube with fuel. Maintain the 12–24 in. (305–610 mm) fuel head shown in Figure 205. Observe the filter housing area for fuel leaks.

1 Observed Fuel Leakage.

Leakage in excess of 10 drops per minute is excessive and indicates the bypass valve is open (bypass position). Return the fuel pump to an overhaul facility for repair of this condition.

2 No Observed Fuel Leakage.

No leakage is an indication that the bypass valve has satisfactorily closed (non–bypass position).

(4) After the operational checks have been completed, return acceptable fuel pumps to service.

(a) Remove the caplug, the AN 815–3 fitting and the Tygon tube.

(b) Reinstall the filter element and the filter bowl cover with new packings. Install the differential pressure sensing line or plug, as required.

(c) Purge air from the filter bowl area of the single element pump. (Refer to Purging the Air from the Single Element Fuel Pump Filter Bowl, para 2.E., 73–00–00.)

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PARA 3. (cont)

C. Single Element Fuel Pump Driveshaft Inspection. Perform the inspection of the shouldered driveshaft of Sundstrand single element fuel pumps as follows: (See Figures 206 and 207.)

NOTE: This inspection is not required for ARGO–TECH (TRW) fuel pumps or Sundstrand fuel pumps P/N 23003114 (Sundstrand P/N 5002395C) and subsequent.

(1) Prior to removing the fuel pump from the engine, inspect the pump housing drain hole for signs of fuel leakage. Any fuel leakage in excess of service limits is cause for rejecting the pump from further service.

(2) Ensure that the fuel pump overboard drain is clear and unobstructed.

(3) Remove the pump from the engine. (Refer to removal, para 2.A., this section.)

(4) Extract the shouldered driveshaft from the pump. Pull sharply and evenly on the shaft to free it from the retaining ring in the pump spur gear.

(5) Remove the packing from the shouldered driveshaft. Discard packing.

(6) Clean the shouldered driveshaft using solvent (non–aromatic mineral spirits, PD 480, Stoddard solvent, refined kerosene or equivalent).

WARNING: IF THE SHOULDERED DRIVESHAFT IS REJECTED FOR ANY REASON, THE MATCHED PUMP SPUR GEAR SET MUST BE REPLACED SIMULTANEOUSLY. WEAR OF SHOULDERED DRIVESHAFT SMALL DIAMETER SPLINES IS INDICATIVE OF PROPORTIONAL WEAR ON INTERNAL SPLINES OF PUMP SPUR GEARSHAFT.

(7) Inspect the shouldered driveshaft small diameter splines for proper condition and wear. Accurately measure the amount of wear. (See Figure 207 for an illustration of measuring spline wear using a dial indicator.) Maximum allowable wear on the face of any one spline tooth is 0.002 in. (0.05 mm). Send the pump to a Rolls–Royce Authorized Maintenance Center (AMC) for replacement of both shouldered driveshaft and matched pump spur gear set if the shouldered driveshaft small diameter splines are worn more than 0.002 in. (0.05 mm).

(8) Inspect the internal surfaces of the pump drive housing cavity for signs of anti–fretting compound being washed out of the splines. Any signs or indication that the anti–fretting compound is being washed out is cause to reject the pump from further service.

(9) Inspect the retaining ring for proper location in its groove inside the pump spur gearshaft. If the retaining ring is broken or missing, reject the pump from further service.

(10) If the pump fails to pass the inspection requirements (para (1), (7), (8), or (9), send it to a Rolls–Royce Authorized Maintenance Center (AMC) for repair.

(11) Remove the nylon shaft stop (used in P/N 6895653 fuel pump) from the pump spur gearshaft.

(12) Clean the internal splines of the pump spur gearshaft using solvent. Hold the pump so that the spline cavity is vertical with the open end down to prevent solvent from entering the pump cavity past the seal. Use a cotton tipped swab (Q–tip or equivalent) to thoroughly clean out the internal spline. Dry using dry compressed shop air, 29 psig (200 kPag) or lower.

CAUTION: THE SPLINE CAVITY IS REACHED THROUGH THE SHAFT SEAL INSIDE DIAMETER. USE CARE NOT TO DAMAGE THE SHAFT SEAL OR ITS SEALING INTERFACE.

(13) Recoat the internal splines with Sundstrand P/N 718050 anti–fretting compound. Inject 0.3 to 0.4 cc of the compound into the spline cavity of the pump spur gearshaft. Ensure that the compound is pushed to the end of the spline cavity. Do not overfill. Keep compound away from seal face.

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PARA 3.C. (cont)

(14) Install the nylon shaft stop. Push in until bottomed.

NOTE: Sundstrand P/N 5003966 shaft stop is installed in P/N 6895653 fuel pump (Sundstrand P/N 024918–107).

(15) Lubricate new P/N AS3085–113 packing with clean engine oil and install it on the shouldered driveshaft.

(16) Coat the smaller diameter splines with Sundstrand P/N 718050 anti–fretting compound.

NOTE: Prior to use, ensure that the anti–fretting compound is thoroughly mixed. If the ingredients have separated or settled out, stir with a sturdy mixing paddle that is smooth and free of sharp edges. Avoid contaminating the compound.

(17) Insert the shouldered driveshaft into the pump spur gearshaft until the end contacts the retaining ring in the pump spur gearshaft.

CAUTION: ENSURE THAT THE SHOULDERED DRIVESHAFT IS PROPERLY LOCATED BY THE RETAINING RING. THE REFERENCE DIMENSION ENSURES THAT THE PACKING ON THE SHOULDERED DRIVESHAFT IS CORRECTLY POSITIONED IN THE GEARBOX DRIVESHAFT INSIDE DIAMETER TO ESTABLISH PROPER OIL SEAL AND PROPER DRIVE SPLINE ENGAGEMENT WHEN THE PUMP IS INSTALLED.

(18) Carefully push the shouldered driveshaft an additional approximate 0.5 in. (13 mm), until the retaining ring locks into the shaft groove. The shaft should be positively located. The end face of the shouldered driveshaft should be 1.287–1.387 in. (32.69–35.23 mm) from the face of the raised pump body pilot diameter. (See Figure 206.)

CAUTION: DO NOT USE GASKET CEMENT OR JOINTING COMPOUND ON GASKET, FUEL PUMP OR MOUNTING FACES.

CAUTION: USE A NEW GASKET AND ENSURE THAT THE PUMP AND GEARBOX MOUNTING FACES ARE CLEAN AND UNDAMAGED.

(19) Install the pump on the engine. (Refer to the installation procedures in paragraph 2.B., this section.)

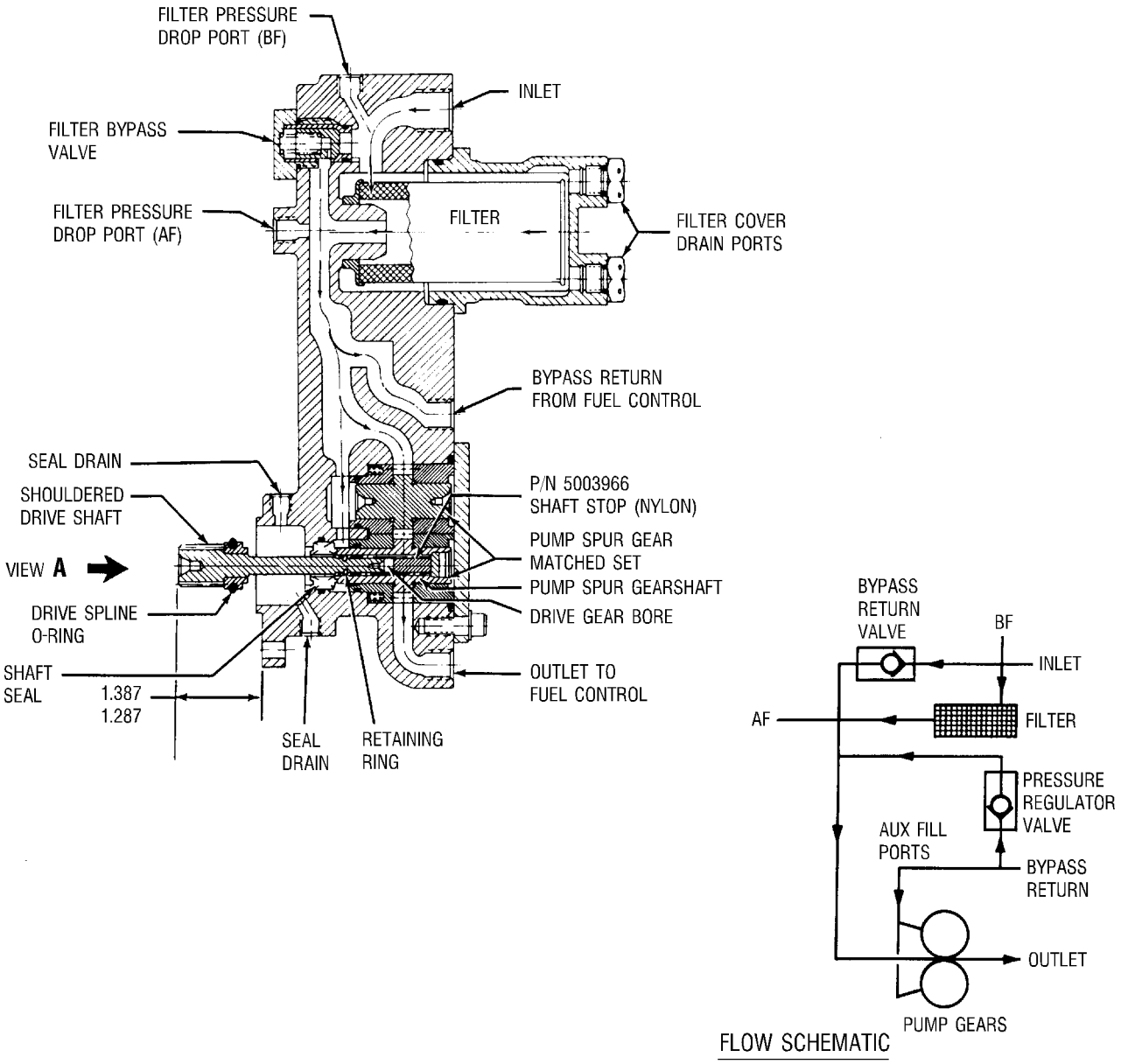
(20) Ensure that the fuel pump overboard drain is clear and unobstructed.

(21) Purge air from the fuel pump filter bowl in accordance with para 2.E., 73–00–00 and from the fuel system in accordance with para 2.D.(3), 73–00–00 (CECO) or 2.D.(2), 73–00–00 (Bendix).

(22) Make an engine check run. (Refer to Check Run, para 1., 72–00–00, Engine–Adjustment/Test.)

(23) Make the appropriate entry relative to pump driveshaft inspection on the inspection checksheet maintained as a part of the engine Log Book.

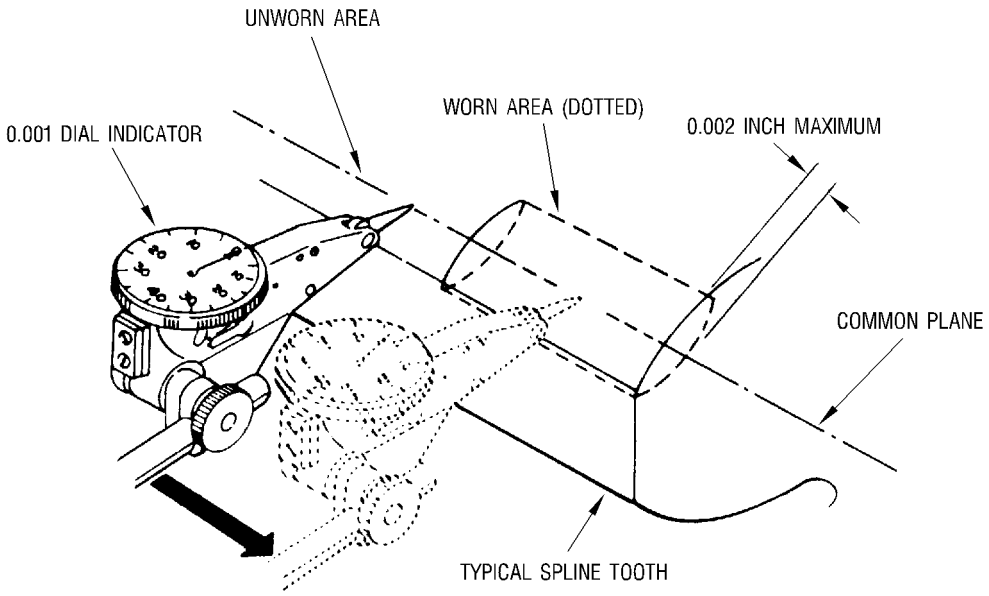
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Sundstrand Single Element Fuel Pump
Figure 206

ADH068XA

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Measurement of Wear on Driveshaft Splines
Figure 207

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DOUBLE CHECK VALVE –– MAINTENANCE PRACTICES

1. General

Replace the double check valve (if installed) as follows:

CAUTION: DO NOT APPLY TORQUE THROUGH THE DOUBLE CHECK VALVE OR THE ACCUMULATORS AT ANY TIME. USE A WRENCH ON ONLY THE VALVE COMPONENT THAT IS BEING TIGHTENED (OR LOOSENED).

CAUTION: WHEN THE DOUBLE CHECK VALVE IS REMOVED, MAKE SURE TO PREVENT FOREIGN MATERIALS FROM ENTERING THE PNEUMATIC LINES OR THE DOUBLE CHECK VALVE.

A. Removal

(1) Remove the accumulator–to–governor hose assembly from the union at the accumulator.

(2) Remove the clamp retaining the accumulator to the side of the fire shield.

(3) Remove the accumulator from the 90° elbow.

(4) Remove the union–elbow assembly from the double check valve. Discard packing.

(5) Remove the double check valve from the accumulator at the aft flange of the fire shield. Discard the packing.

B. Installation

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(1) Install the replacement double check valve with new packing in the accumulator. Tighten valve to 40–65 lb in. (4.5–7.3 N·m).

(2) Install the union–elbow assembly with new packing in the double check valve. Tighten to 55–80 lb in. (6.2–9.0 N·m).

(3) Install the accumulator with new packing in the 90° elbow. Tighten accumulator to 40–65 lb in. (4.5–7.3 N·m).

(4) Secure the accumulator to the fire shield side flange with a clamp, nut, bolt, washer and spacer. Tighten clamp nut to 35–40 lb in. (3.9–4.5 N·m).

(5) If removed, install union with new packing in the accumulator, tighten to 55–80 lb in. (6.2–9.0 N·m).

(6) Attach the accumulator–to–governor hose assembly to the union at the accumulator. Tighten coupling nut to 80–120 lb in. (9.0–13.6 N·m).

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FUEL NOZZLE - MAINTENANCE PRACTICES

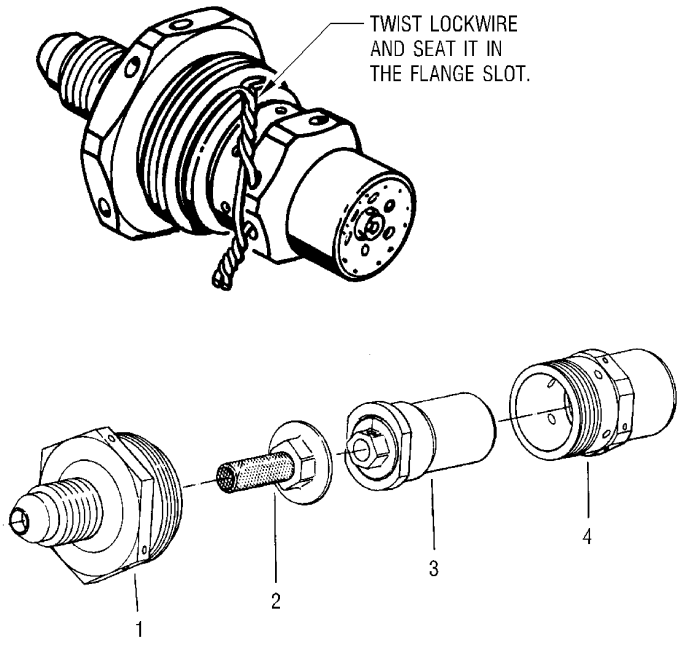
1. Replacement
   A. Removal
      CAUTION: PARTICULAR CARE MUST BE TAKEN DURING REMOVAL NOT TO DAMAGE THE FUEL INJECTOR SPRAY TIP.

      Remove the fuel nozzle as follows:
      (1) Remove lockwire and disconnect the fuel nozzle hose.
      (2) Remove lockwire; then using 23007638 wrench, unscrew the nozzle.
      (3) Carefully remove nozzle assembly.
   B. Installation
      WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.
      (1) Install the fuel nozzle as follows:
         (a) When replacing or reinstalling the fuel nozzle, apply a light coat of antiseize compound (NS-165) to the threads. Tighten nozzle to 200-300 lb in. (23-34 N·m) using 23007638 wrench. Lockwire to spark igniter. Tighten hose coupling nut to 80-120 lb in. (9.0-13.6 Nm). Secure hose coupling nut with lockwire.
         (b) Check run the engine after fuel nozzle replacement. Refer to Check Run, PARA 1., 72-00-00, Engine-Adjustment/Test.
2. Disassembly/Assembly

CAUTION: MAKE SURE TO PREVENT DAMAGE TO THE MIRROR FINISH AND EDGES OF THE SPRAY TIP. THE NOZZLE SHOULD BE DISASSEMBLED IN A CLEAN AREA AND CARE SHOULD BE TAKEN TO AVOID DIRT OR OTHER CONTAMINATION.

   A. Disassemble the fuel nozzle as follows: (See Figure 201):
      (1) Note the position of the lockwire on the fuel nozzle; then remove the lockwire.
      (2) Count the number of visible threads on the outer air shroud. Retain this number for verification that the fuel nozzle will be correctly reassembled.
      CAUTION: IF P/N 6897875 FIXTURE IS NOT AVAILABLE, THE WRENCHING SURFACES OF THE BODY MAY BE HELD IN A VISE. DO NOT OVERTIGHTEN THE VISE. MAKE SURE TO PREVENT DAMAGE TO THE NOZZLE ASSEMBLY.
      (3) Put the fuel nozzle body in the 6897875 holding fixture. Remove the outer air shroud.
      (4) Carefully remove the fuel injector spray tip assembly from the outer air shroud and the filter assembly from the fuel nozzle body. No further disassembly is permitted.
   B. Assemble the fuel nozzle as follows:
      (1) Hold the body in a vertical position and insert the filter assembly.
      (2) Place the spray tip assembly in the body. Make sure it is properly engaged with the filter.
      (3) Make sure that the filter assembly remains seated on the spray tip assembly.
      (4) Retain the nozzle in a vertical position. Screw the outer air shroud onto the body
      (5) Make sure that the nozzle has been correctly assembled by counting the number of visible threads on the outer air shroud. Refer to PARA 2.A.(2), this Section.
      CAUTION: IF P/N 6897875 FIXTURE IS NOT AVAILABLE, THE WRENCHING SURFACES OF THE BODY MAY BE HELD IN A VISE. DO NOT OVERTIGHTEN THE VISE MAKE SURE TO PREVENT DAMAGE TO THE NOZZLE ASSEMBLY.
      (6) Insert the fuel nozzle in holding fixture 6897875 or a vise and tighten the outer air shroud to 25--30 lb ft. (34--41 Nm) and secure with 0.020 in. (0.05 mm) lockwire.

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1. Fuel nozzle body
2. Filter assembly
3. Spray ti assembly
4. Outer air shroud

Fuel Nozzle Assembly
Figure 201

3. Inspection

A. Inspect the assembled fuel nozzle as follows:

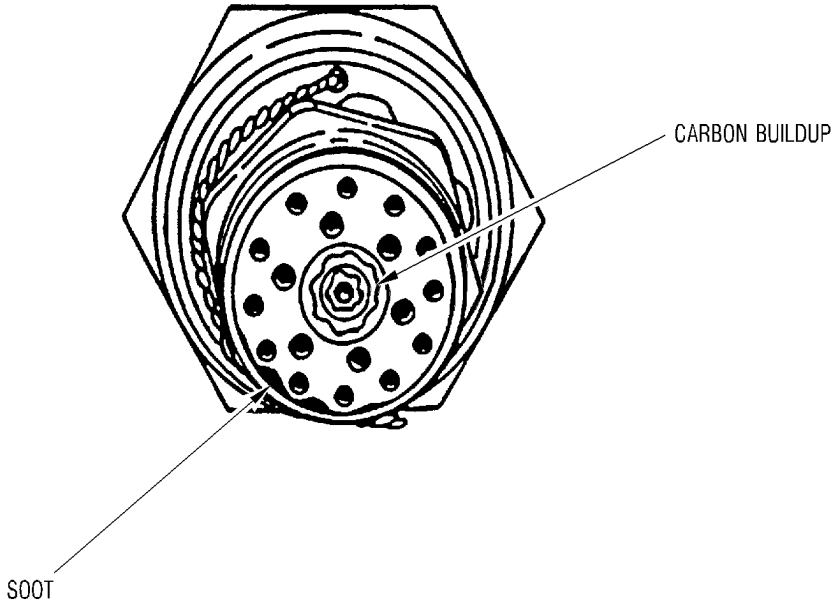
(1) Check for damage or carbon deposits on spray tip (See Figure 202).

(2) Damage to the fuel nozzle spray tip is cause for replacement of the fuel nozzle assembly.

(3) Replace the fuel nozzle if wear on the OD of the outer air shroud exceeds 0.005 in. (0.13 mm) maximum

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Carbon Buildup on Fuel Nozzle
Figure 202

AGH043XD

B. Inspect the Disassembled Fuel Nozzle as follows:

(1) Inspect for signs of contamination and serviceability. Return the entire fuel nozzle to a Rolls--Royce Authorized Maintenance Center if any of the following conditions are found:

(a) Contamination of the filter assembly.

(b) Tears or cracks in the filter assembly.

(c) Collapsed screen in the filter assembly.

(d) Obvious contamination or damage to other portions of the fuel nozzle assembly.

(e) If the nozzle has been inadvertently disassembled further than allowed. Refer to PARA 2.A., this Section.

C. Inspect the fuel nozzle flow pattern as follows:

(1) Remove nozzle.

(2) Connect supply hose coupling nut to fuel nozzle and tighten hand tight.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(3) Hold supply hose with attached nozzle and direct spray tip towards a container.

(4) Verify that all ignition system circuit breakers are open.

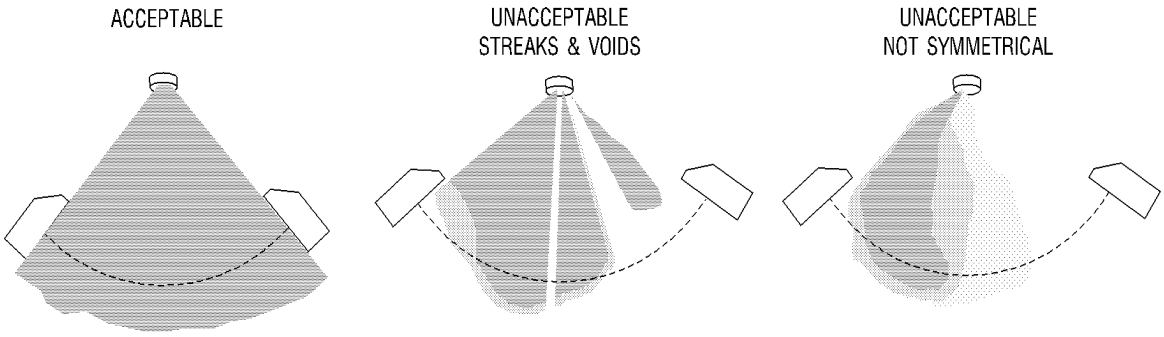
(5) Fuel boost pump must be on and the twist grip at idle detent.

(6) Motor engine for15 seconds.

(7) Inspect entire circumference of sprayed cone of fuel. Spray patterns must be symmetrical and free of streaks and voids. Acceptable and Unacceptable spray patterns can be seen in Figure 203.

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Fuel Nozzle Patterns
Figure 203
AJH038XD

4. Cleaning

CAUTION: DUE TO VARIATION IN FUELS AND OPERATING CONDITIONS, FUEL NOZZLE CLEANING MAY BE NECESSARY AT MORE FREQUENT INTERVALS THAN STATED IN TABLE 602, 72--00--00, ENGINE-- INSPECTION/CHECK, TO MAINTAIN PROPER COMBUSTION FLAME PATTERN.

A. Cleaning assembled fuel nozzle.

CAUTION: MAKE SURE NOT TO DAMAGE THE MIRROR FINISH AND EDGES OF THE SPRAY TIPS DURING THE CLEANING OPERATION.

NOTE: Removal of external carbon deposits from the fuel nozzle spray tip can correct a streaking problem. Therefore, cleaning the spray tip may make it unnecessary to disassemble the fuel nozzle.

(1) Suspend the fuel nozzle vertically with the tip immersed approximately 1/8 in. (3 mm) in cleaning solvent, Brulin Safety Solvent No. 512 M or equivalent. Soak the tip for one hour, or longer if deemed necessary, to remove all carbon. After carbon removal, flush the nozzle internally and externally using Stoddard solvent or kerosene. Dry with a soft cloth.

(2) After carbon removal, flush the nozzle internally and externally using Stoddard solvent or kerosene. Dry with a soft cloth.

CAUTION: DO NOT USE COMPRESSED AIR TO DRY NOZZLE. THIS CAN DAMAGE THE NOZZLE.

(3) Clean the face of the outer air shroud with a clean dry cloth; the air holes must be open. Be careful that loosened carbon does not enter the spray tips.

B. Cleaning assembled fuel nozzle (Alternate Procedure).

(1) Check for damage or carbon deposits on spray tips. Figure 202 shows the condition of a typical fuel nozzle removed from an operational engine. A nozzle in this condition should be cleaned, if possible, before reinstalling.

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CAUTION: MAKE SURE NOT TO DAMAGE THE MIRROR FINISH AND EDGES OF THE SPRAY TIPS DURING THE CLEANING OPERATION.

(2) Suspend the nozzle vertically with the tip immersed approximately 1/8 in. (3 mm) in Brulin 815 QR (or equivalent). Heating the solvent to 140°F (60°C) is optional. Approximately 8 hours is a desired soak time. All carbon should be removed or loosened after this process.

(3) Use a soft bristle nylon brush, such as a toothbrush, to remove any remaining carbon buildup from the nozzle tip. Be careful that loosened carbon does not enter the spray tip. After carbon removal, flush the nozzle internally and externally using Stoddard solvent or kerosene. Dry with a soft cloth

CAUTION: DO NOT USE COMPRESSED AIR TO DRY NOZZLE. THIS CAN DAMAGE THE NOZZLE.

(4) If carbon is still visible, soak nozzle tip in Turco 4181, or equivalent, at 140°F (60°C) for two hours. Flush nozzle thoroughly with hot water then with Stoddard solvent or kerosene. Dry with a soft cloth.

(5) Clean the face of the outer air shroud with a clean dry cloth; the air holes must be open. Be careful that loosened carbon does not enter the spray tips.

(6) If the nozzle is still streaking, carbon is probably not the issue. Send the nozzle to an authorized facility for further inspection.

C. Clean Disassembled Fuel Nozzle

(1) Use Kelite (No. 235), a solution of 75% Cities Service Solvent and 25% Stoddard Solvent (MIL-F-7024 Type II Fluid), or an equivalent solution of 75% carbon solvent and 25% petroleum solvent to clean the disassembled nozzle parts ultrasonically.

CAUTION: IF YOU DO NOT DO A CHECK OF THE CLEANING SOLUTIONS AT INTERVALS, DETERIORATION CAN OCCUR.

(2) Apply light pressure with a soft cloth dampened with a petroleum or carbon solvent to areas of the metering set and inner air shroud orifices to remove carbon particles not completely removed by ultrasonic cleaning. Flow a sufficient quantity of fuel through the metering set when you clean to prevent entry of carbon particles into the metering set.

(3) External carbon on the air shroud can be removed with a wire brush and/or grit blast. You must prevent damage to the threads and the wear surface of the air shroud when you use the wire brush or grit blast. Do not wire brush or grit blast internal parts or surfaces.

CAUTION: DO NOT WASH, FLUSH, OR SOAK THE PARTS IN WATER. RUST AND BLOCKAGE OF THE FUEL OPENINGS CAN OCCUR.

(4) After the nozzle parts are cleaned ultrasonically, flush the nozzle parts with clean fuel, acetone, Methyl Ethyl Ketone, or equivalent to make sure that all of the openings and orifices are free of contamination from the cleaning solutions.

(5) Dry the parts with dry, filtered compressed air.

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ACCUMULATOR –– MAINTENANCE PRACTICES

1. General

(Bendix fuel system only) Clean and test the accumulator any time it is removed from the engine. Remove, clean, test, and install the accumulators as follows: (See Figure 201, 202, 203 or 204.)

CAUTION: THE GOVERNOR PY FITTING IS NOT REMOVABLE FROM GOVERNOR ON P/N 23007865 (BENDIX P/N 2524769–10) AND SUBSEQUENT AND P/N 23007864 (BENDIX P/N 2524667–11) AND SUBSEQUENT. DO NOT DISTURB THIS FITTING!

A. Removal

(1) Remove the fuel control–to–governor tube from the tee; then separate the tee and union from the P_y accumulator. Discard packings.

NOTE: Refer to Figure 201, 202, 203 or 204 for the dismantling of applicable kitted installations.

(2) Remove the accumulator–to–fuel control tube and the accumulator–to–governor hose; then separate the elbow, unions and clamp from the Pg accumulator. Do not apply torque through the accumulator; use adjacent hexagonal surfaces for turning. Discard packings.

B. Installation

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

CAUTION: HOLD GOVERNOR FITTING WITH ONE WRENCH WHILE TIGHTENING NUTS TO FITTING WITH ANOTHER WRENCH.

(1) Install the P_y accumulator on the governor. Lubricate packings and install with union and accumulator in the tee. Install tee in the governor. Tighten union to 55–80 lb in. (6.2–9.0 N·m). Tighten jam nut to 55–80 lb in. (6.2–9.0 N·m). Install the fuel control–to–governor tube on the tee; tighten coupling nut to 80–120 lb in. (9.0–13.6 N·m).

(2) Lubricate packings and install with elbow and two unions in the Pg accumulator. Tighten elbow to 40–65 lb in. (4.5–7.3 N·m) and unions to 55–80 lb in. (6.2–9.0 N·m). Do not apply torque through the accumulator. Clamp accumulator to the fire shield using a clamp, bolt, nut and spacer. Tighten clamp nut to 35–40 lb in. (3.9–4.5 N·m). Install the accumulator–to–fuel control tube and the accumulator–to–governor hose. Tighten couplings nuts to 80–120 lb in. (9.0–13.6 N·m).

NOTE: Refer to Figures 201, 202, 203 and 204 for assembly of applicable kitted installations. Torque values given for the basic engine accumulator assembly are applicable to kitted installations.

2. Cleaning

A. Clean the accumulator as follows:

(1) Immerse the accumulator in mineral spirits; agitate until clean.

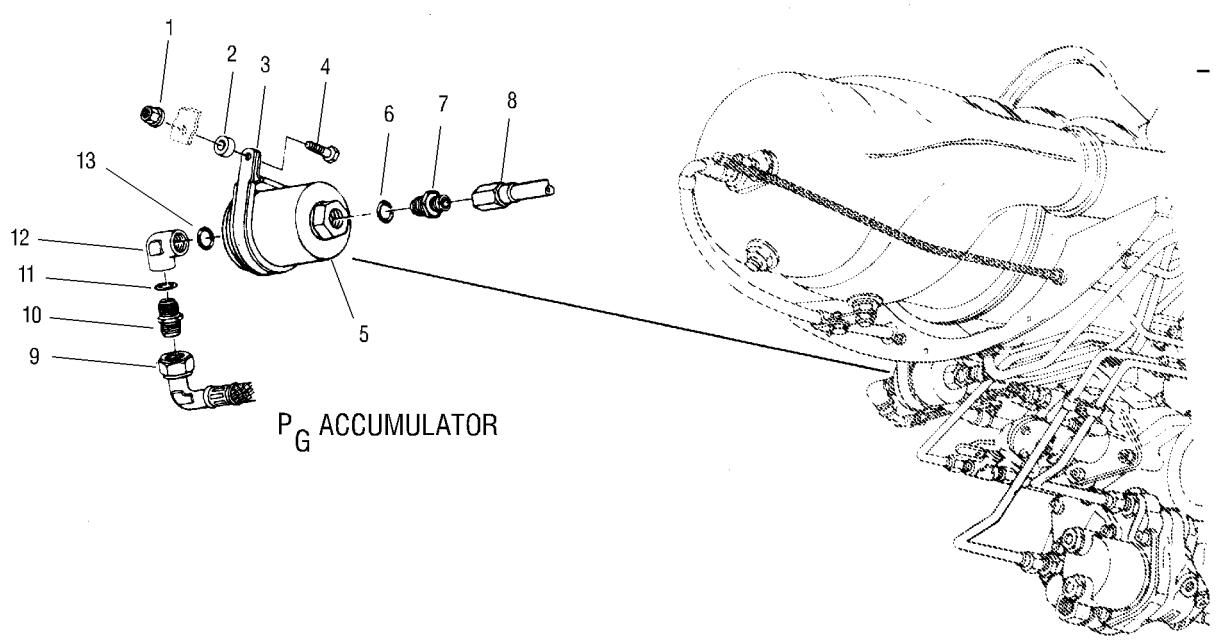
(2) Blow accumulator completely dry, using filtered dry air.

3. Inspection/Check

A. Check accumulator as follows:

(1) Pressurize the accumulator, using 35 psig (241 kPag) air pressure. Submerge in water and check for leaks. Replace or return the accumulator to the Authorized Maintenance Center for repair if leakage is detected.

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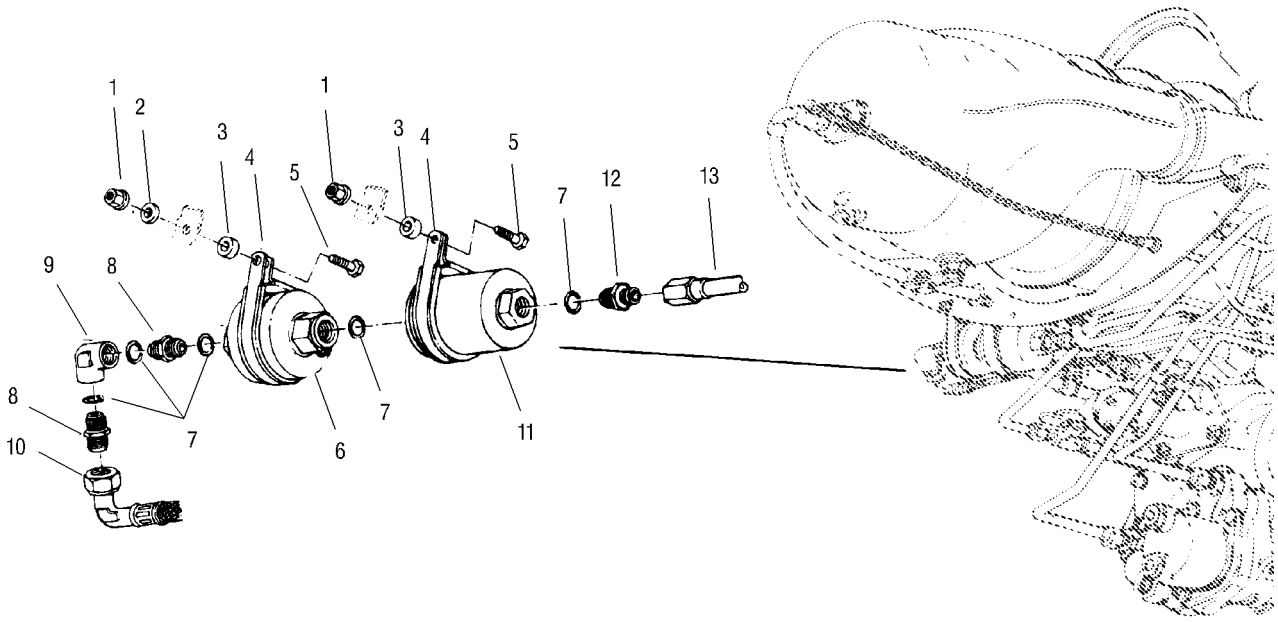


1. Nut
2. Spacer
3. Clamp
4. Bolt
5. P_g Accumulator (6 cubic in.)
6. Packing
7. Union
8. Accumulator–to–fuel control tube
9. Accumulator–to–governor hose
10. Union
11. Packing
12. Elbow
13. Packing

NOTE: Configuration of the basic 250–C20,–C20B, –C20F, –C20J engine.

Accumulator Installation (Bendix Fuel System)
Figure 201

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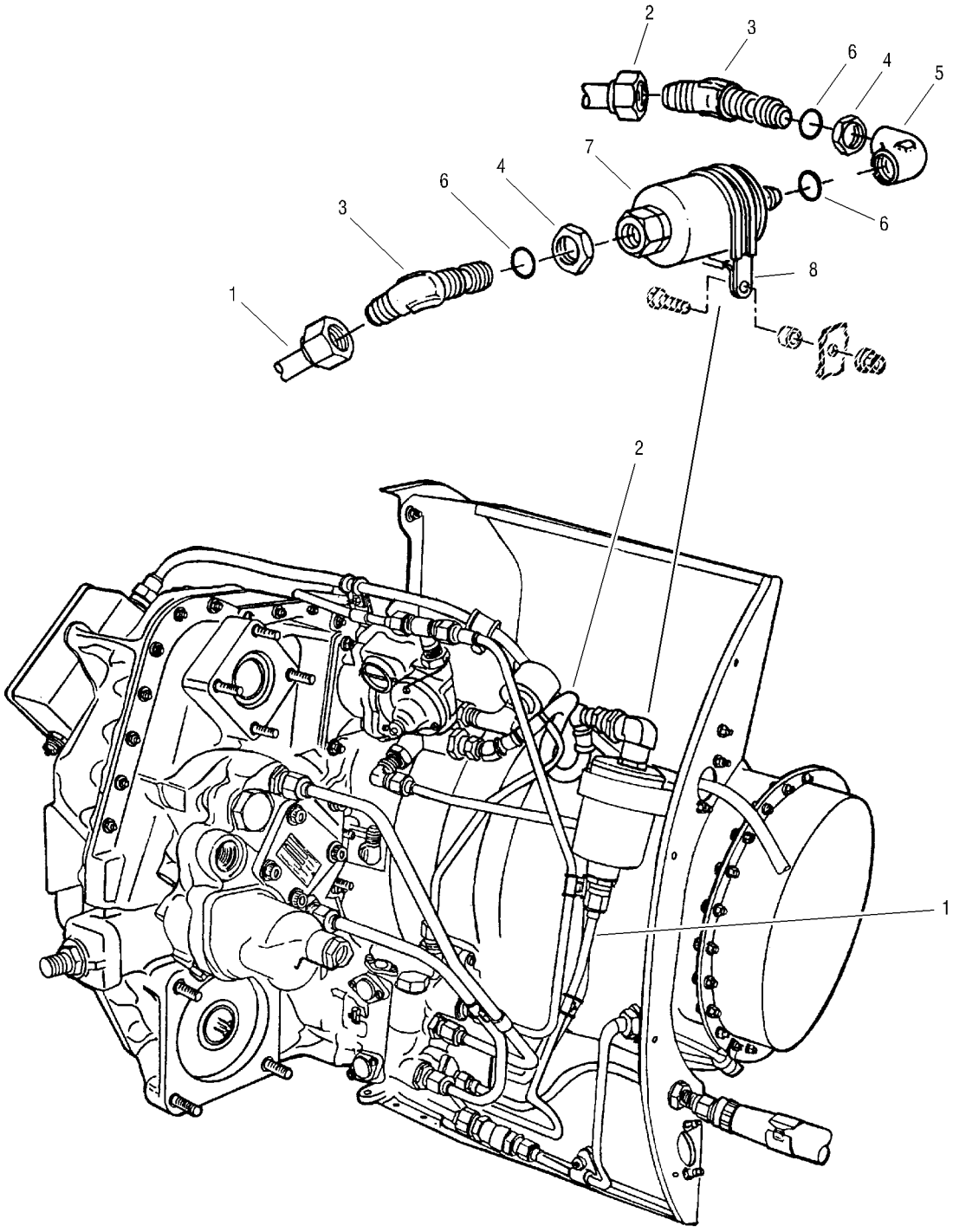


1. Nut (2)
2. Washer
3. Spacer (2)
4. Clamp (2)
5. Bolt (2)
6. P_g Accumulator (3 cubic in.)
7. Packing
8. Union
9. Elbow
10. Accumulator–to–governor hose
11. P_g Accumulator (6 cubic in.)
12. Union
13. Accumulator–to–fuel control tube

NOTE: Configuration as used on 250–C20 Series engine kitted for McDonnell Douglas (Hughes) Model 500C, 500D, 500E and Eurocopter (Boelkow) Model B0105C and B0105D helicopters.

Accumulators Installation (Bendix Fuel System)
Figure 202

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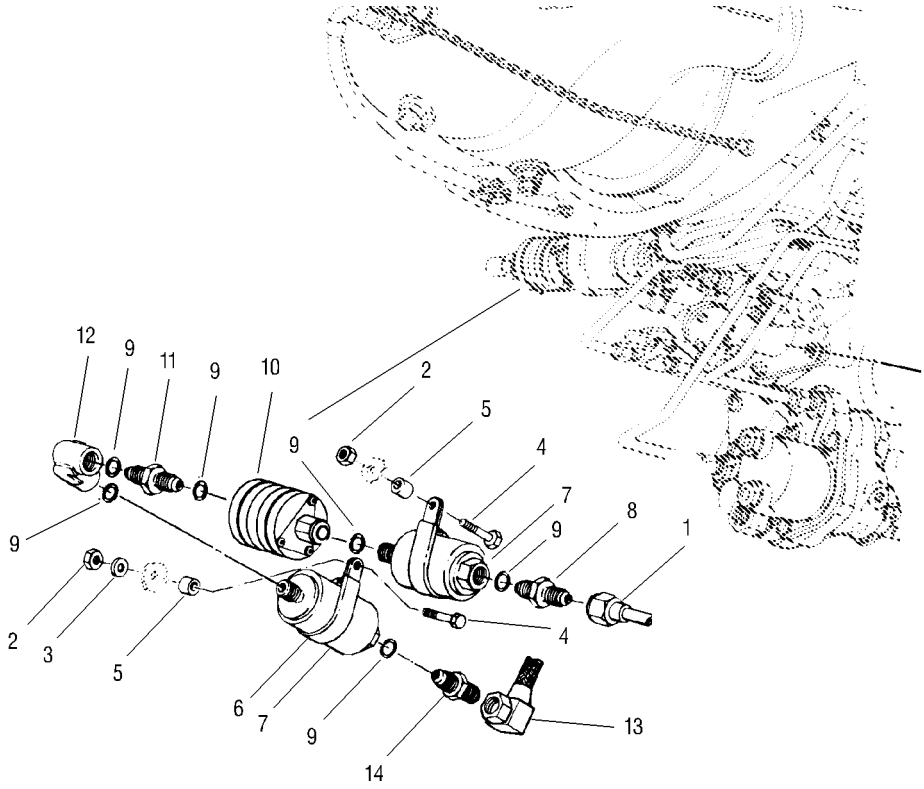
1. P_g Fuel Control to Accumulator Tube Assy
2. Check Valve to Governor Hose Assy
3. Elbow (2)
4. Nut (2)
5. Elbow
6. Packing (3)
7. Accumulator (6 cubic in.)
8. Clamp

ADH013BA

NOTE: Configuration as used on 250–C20W engine kitted for Enstrom TH–28 helicopters.

Accumulator Installation (250–C20W) (Bendix Fuel System)
Figure 203

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1. Fuel Control to Accumulator Tube
2. Nut (2)
3. Washer
4. Bolt (2)
5. Spacer (2)
6. Clamp (2)
7. P_g Accumulator (6–cubic in.) (2)
8. Union
9. Packing
10. Double Check Valve
11. Union
12. Elbow
13. Accumulator–to–Governor Hose
14. Union

NOTE: Configuration as used on 250–C20 engines kitted for Bell Model 206A and 206B helicopters (Jet Ranger II).

Configuration as used on 250–C20B engines kitted for Bell Model 206L and 206B (Jet Ranger III) helicopters.

Configuration as used on 250–C20J engines kitted for Bell 206B (Jet Ranger III) helicopters.

Accumulator–Double Check Valve Installation
(Bendix Fuel System)
Figure 204

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CECO HIGH PRESSURE FUEL FILTER ASSEMBLY –– MAINTENANCE PRACTICES CECO FUEL SYSTEM

1. General

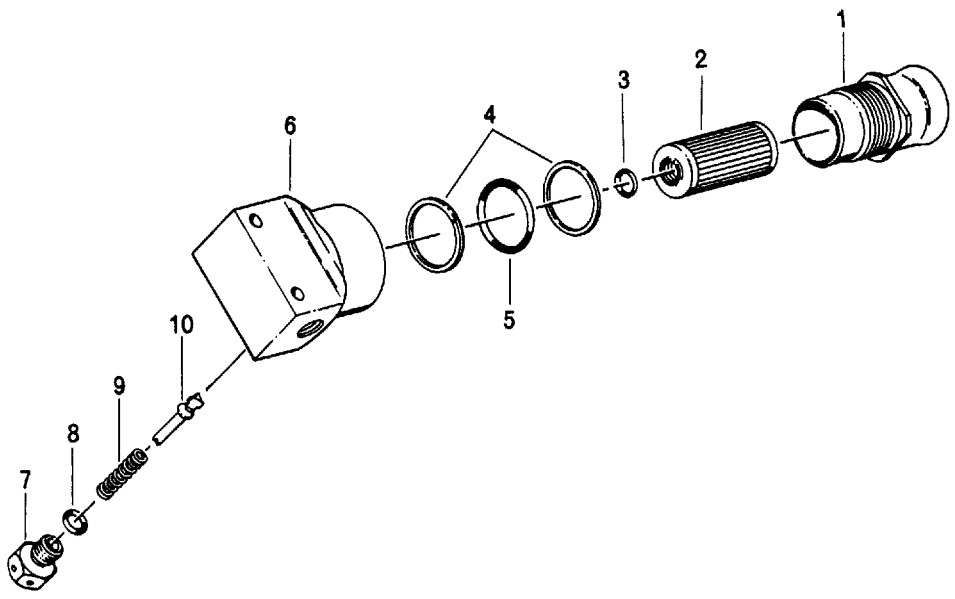
   Maintenance of the CECO high pressure fuel filter (CECO fuel system) consists of removal, cleaning, inspection and installation of the filter element.

2. Filter Element

   A. Removal

      (1) Remove lockwire and separate the bowl from the head. Discard packings. (See Figure 201.)

      (2) Remove the filter element from the head. Inspect the element prior to cleaning.



1. Bowl
2. Element
3. Packing (in element)
4. Backup ring (2)
5. Packing
6. Head
7. Plug
8. Packing
9. Spring
10. Valve

High Pressure Fuel Filter
Figure 201

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PARA 2. (cont)

B. Cleaning

NOTE: If the element is excessively dirty or buckled and it appears the high pressure filter was bypassing fuel, remove the fuel control and the governor and send them to a Distributor to be flushed or flush in accordance with 250–C20 CSL–1034 and –1035. Also, if the element is dirty, remove, clean and reinstall the fuel filter bypass valve, with new packing, in the filter assembly. Discard the element if it is buckled. If distress or wear is indicated on the bypass valve (seat or stem) the filter assembly must be sent to overhaul and the fuel control and governor must be flushed.

(1) Ultrasonically clean the filter element in mineral spirits for approximately 15 minutes. If ultrasonic equipment is not available, replace the element with a new part or thoroughly wash the element as follows:

CAUTION: DO NOT USE PERCHLORETHYLENE TO CLEAN THE FILTER ELEMENT. PERCHLORETHYLENE WILL DISSOLVE THE EPOXY USED IN ASSEMBLY OF THE ELEMENT.

(a) Fill the element cavity with an undiluted liquid dishwashing detergent (Joy, Ivory, Amway LOC, etc.)

(b) Place the element upright in a container of the liquid detergent. Soak for a minimum of five minutes.

(c) Remove the element from the detergent. Reverse flush the detergent from the element using clean shop air and a nozzle.

(d) Rinse the element in clean water.

(e) Repeat the clean, flush and rinse procedures (Steps (a) thru (d))

(f) Remove excessive moisture by shaking (air dry).

C. Inspection

(1) Test the cleaned element as follows:

WARNING: BE AWARE OF THE POTENTIAL FIRE HAZARD OF FUEL IN AN OPEN CONTAINER.

(a) Immerse the element upright to the top of the pleats in a container of fuel. Note the time required for the fuel to pass through the element and fill the center section.

(b) The element shall be considered clean if the center section fills with fuel within five seconds.

(c) If the center section of the element does not fill with fuel within five seconds, repeat the clean, flush and rinse procedures. If the center section still does not fill within five seconds, replace the element.

(2) Inspect the element for defects using a bright light and magnification. Replace the element if breaks or tears are found in the pleated areas.

D. Installation

(1) Clean the inside of the bowl and the inside of the head using a clean cloth dampened in mineral spirits.

(2) Install new packings; then place the element in the head.

(3) Install the bowl. Tighten bowl to 65–85 lb in. (7.3–9.6 N·m) and secure with 0.032 in. (0.81 mm) stainless steel lockwire.

(4) Purge air from the fuel system. (Refer to Purging the CECO Fuel System, para 2.D.(3), 73–00–00.)

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BENDIX POWER TURBINE GOVERNOR –– MAINTENANCE PRACTICES

1. General

   The Bendix power turbine governor Pg air circuit can be cleaned or the governor can be replaced as dictated by the engine trouble condition encountered.

2. Replacement (See Figure 201.)

   Replace the Bendix power turbine governor if it is found to be the cause of engine malfunction. (Check the maximum throttle stop and the aircraft rigging for erroneous settings before removal of the governor to correct engine malfunction.)

   A. Removal

      CAUTION: WHEN REPLACING EITHER THE ENGINE OR THE GOVERNOR, REFER TO THE 250–C20 SERIES PARTS CATALOG, PUB. NO. 10W4, FOR REQUIRED PART NUMBERS. THE ENGINE AND THE GOVERNOR REQUIRED FOR MULTI–ENGINE INSTALLATIONS MAY NOT BE THE SAME AS THOSE REQUIRED FOR SINGLE ENGINE INSTALLATIONS.

      CAUTION: WHEN THE POWER TURBINE GOVERNOR IS BEING REMOVED, MAKE SURE TO PREVENT FOREIGN MATERIALS FROM ENTERING THE PNEUMATIC TUBES OR GOVERNOR PORTS.

      Remove the Bendix power turbine governor from the engine as follows: (See Figure 202 or 203, 73–00–00.)

      (1) Disconnect tubes and linkage.

      (2) Remove three nuts and washers which secure the governor to the power and accessory gearbox housing.

      CAUTION: THE GOVERNOR P_R, P_G AND P_Y FILTER FITTINGS ARE NOT REMOVEABLE FROM P/N 23007865 (BENDIX P/N 2524769–10) AND SUBSEQUENT AND P/N 23007864 (BENDIX P/N 2524667–11) AND SUBSEQUENT. DO NOT DISTURB THESE FITTINGS.

      CAUTION: THE GOVERNOR P_C FILTER TEE FITTING IS NOT REMOVEABLE FROM P/N 23007506 (BENDIX P/N 2524769–11) AND SUBSEQUENT AND P/N 23007505 (BENDIX P/N 2524667–12) AND SUBSEQUENT. DO NOT DISTURB THIS FITTING.

      CAUTION: WHEN REMOVING FITTINGS ON GOVERNORS WITH REMOVEABLE FITTINGS (SEE P/N'S ABOVE), BE CAREFUL NOT TO CAUSE A LOAD ON THE GOVERNOR DRIVE SHAFT. USE THE WOODEN PROTECTIVE SHIPPING BLOCK TO PROTECT THE SHAFT FROM THE WORK BENCH.

      (3) Remove the governor assembly.

         NOTE: Depending on the configuration of the governor, certain fittings may be included as part of the governor assembly. Determine which fittings are a part of the replacement governor before removing any fittings from the replaced governor.

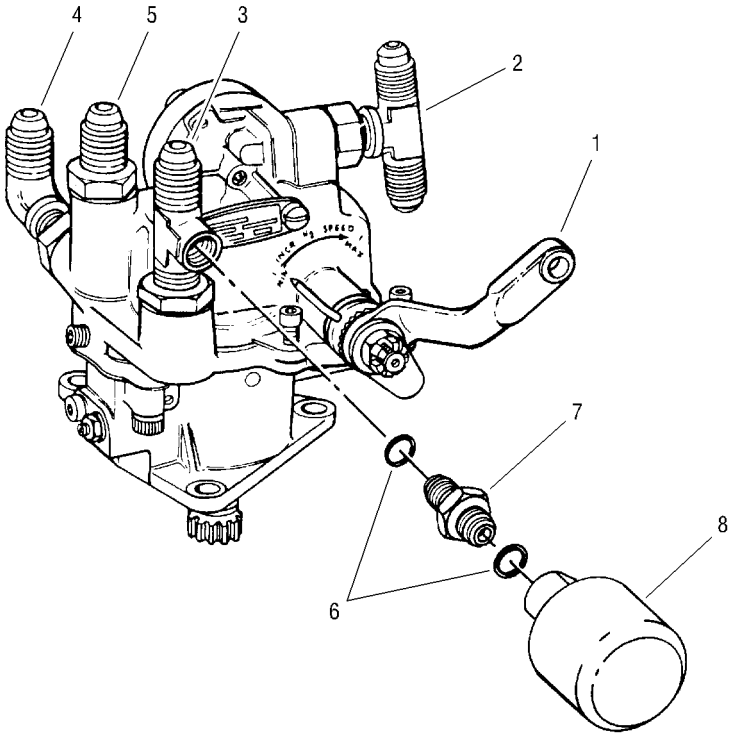
         NOTE: In installations where the power turbine governor lever is not required, remove the lever from the replacement governor and install it on the governor being returned for overhaul.

   B. Installation

      WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

      Install the Bendix power turbine governor on the engine as follows:

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NOTE: Do not change orientation of tee from the proper 15° as defined in the appropriate Operation and Maintenance Manual.

1. Power turbine governor lever
2. Sensing pressure tee–filter (Pc)
3. Governor servo pressure (Py)
4. Regulated air pressure (Pr)
5. Governing pressure (Pg)
6. Packings
7. Union
8. Py accumulator

Power Turbine Fuel Governor
Figure 201

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

PARA 2.B. (cont)

NOTE: Refer to applicable airframe manual for power turbine governor rigging/adjustment.

(1) Before installing the Bendix power turbine governor on the engine, install the required fittings:

(a) Remove and discard all old packings.

(b) Lubricate new packings and install on the fittings.

NOTE: Use the wooden protective shipping block to protect the shaft from the work bench when installing the fittings.

(c) Install P_y elbow and jam nut. Point elbow as shown in Figure 202 to 15 degree angle. Tighten jam nut to 45–50 lb in. (5.1–5.6 N·m).

(d) Install 0.7 cubic inch P_y accumulator in the P_y tee. Tighten union and accumulator to 55–80 lb in. (6.2–9.0 N·m).

(e) Install P_r and P_g fittings. Tighten P_r fitting jam nut to 45–50 lb in. (5.1–5.6 N·m). Tighten P_g fitting to 75–100 lb in. (8.5–12.4 N·m).

(f) Make sure there is clearance between P_y accumulator and fire shield.

(2) Coat drive shaft with Lubriplate 130A, 930AA or equivalent.

CAUTION: MAKE SURE THAT THE GOVERNOR DRIVE PILOT IS PROPERLY INSERTED IN THE GEARBOX. WHEN THE POWER TURBINE GOVERNOR IS BEING INSTALLED, MAKE SURE TO PREVENT FOREIGN MATERIALS FROM ENTERING THE PNEUMATIC TUBES OR GOVERNOR PORTS.

(3) Install in reverse order of removal.

CAUTION: OVERTIGHTENING CAUSES BINDING OF THE LEVER SHAFT.

(4) Tighten mount pad nuts to 70–85 lb in. (7.9–9.6 N·m). Tighten control air line coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

NOTE: Be sure the procedures and precautions of Rigid Tube Inspection and Installation, para 9., 72–00–00, Engine–Servicing, are observed when installing fuel system tubes.

NOTE: Hold governor fitting with one wrench while tightening “B” nut to fitting with another wrench.

(5) If the power turbine governor lever requires repositioning, loosen the nut, reposition, then tighten the nut to 40–50 lb in. (4.5–5.6 N·m).

(6) Check run the engine after governor replacement. (Refer to Check Run, para 1., 72–00–00, Engine–Adjustment/Test.)

(7) Make appropriate entry relative to governor replacement in the Engine Log.

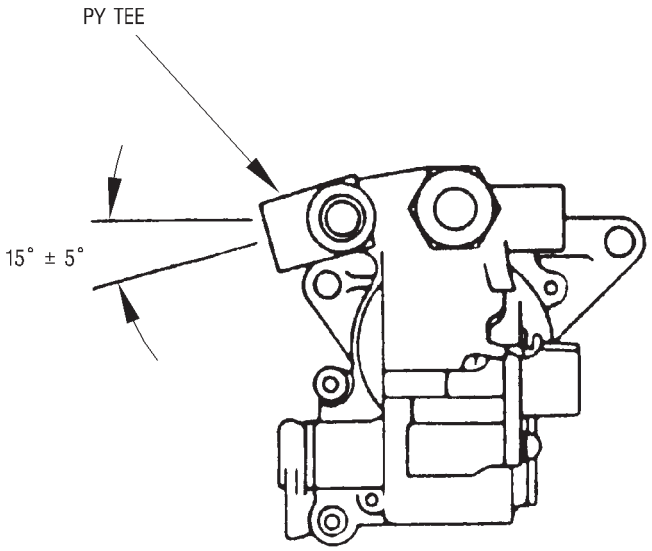
C. Rigging

The governor must be rigged on the aircraft. A protractor and a maximum throttle stop screw are incorporated in the governor to assist in proper rigging. Refer to aircraft manual for proper rigging.

D. Throttle Torque Check.

Higher than normal throttle torque can occur due to binding of the throttle shaft in the throttle shaft bushing. This binding can be the result of corrosion build–up on the throttle shaft assembly, causing and interference fit in the throttle shaft bushing.

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VIEW FROM REAR OF ENGINE
TOP VIEW OF GOVERNOR

ADH062XD

P_y Tee Assembly Orientation
Figure 202

PARA 2. (cont)

(1) Rotate the throttle and check for higher than normal torque.

(2) If higher than normal torque exists, apply lubricant, standard engine oil MIL–PRF–23699 (NATO Code 0–156) to the area shown in Figure 203.

(3) Rotate the throttle following lubricant application to assure penetration.

(4) Repeat the spray application if necessary.

E. Cleaning and Inspecting the Bendix Power Turbine Governor Pg Air Circuit

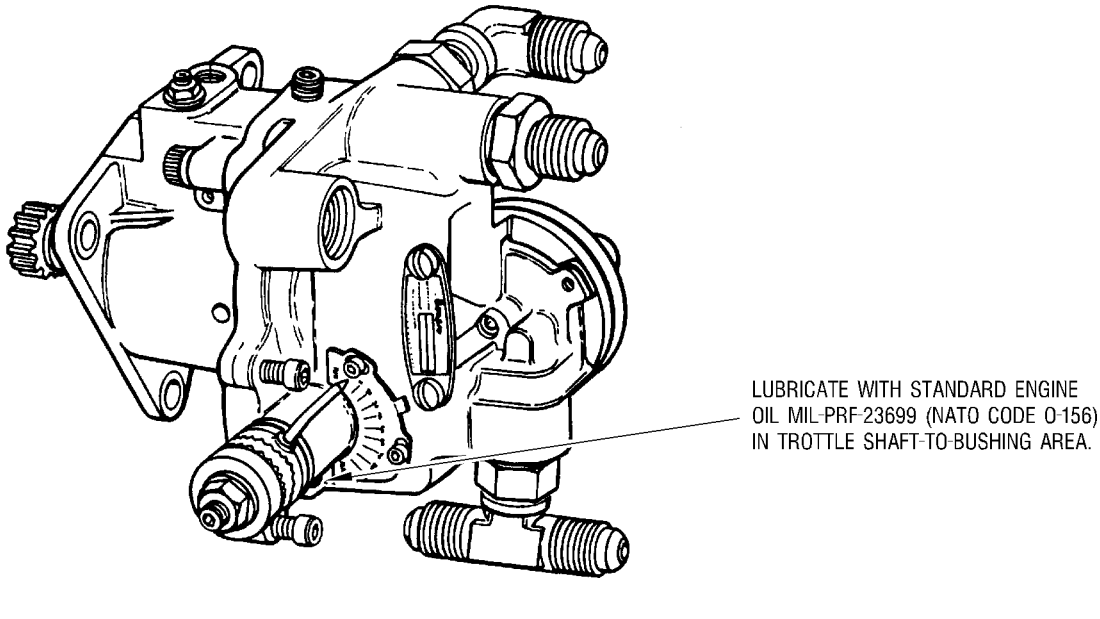
A contaminated Pg air circuit in the power turbine governor may cause droop, overshoot or hunting of the N_2 rotor. Correct this contamination condition by cleaning the governor Pg orifice. (See Figure 204.) The orifice can be cleaned with the governor either installed or removed from the engine. If the governor is removed from the engine, use the procedures in para 2.A., this section. Clean as follows:

(1) Carefully clean the exterior of the governor using methyl ethyl ketone. Be sure all contamination is removed in the area of the Pg orifice. Blow dry.

CAUTION: THE FOLLOWING IS AN IMPORTANT CHANGE IN PREVIOUSLY APPROVED PROCEDURE:

CAUTION: DO NOT REMOVE OR CLEAN THE FUEL GOVERNOR PG BLEED; HOWEVER, CONTINUED MAINTENANCE OF THE FUEL GOVERNOR PG ORIFICE IS RECOMMENDED.

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Lubricating Bendix Governor Shaft and Bushing
Figure 203

PARA 2.E. (cont)

CAUTION: MAKE SURE NOT TO LOSE THE ORIFICE IF AIR PRESSURE IS USED FOR DRYING.

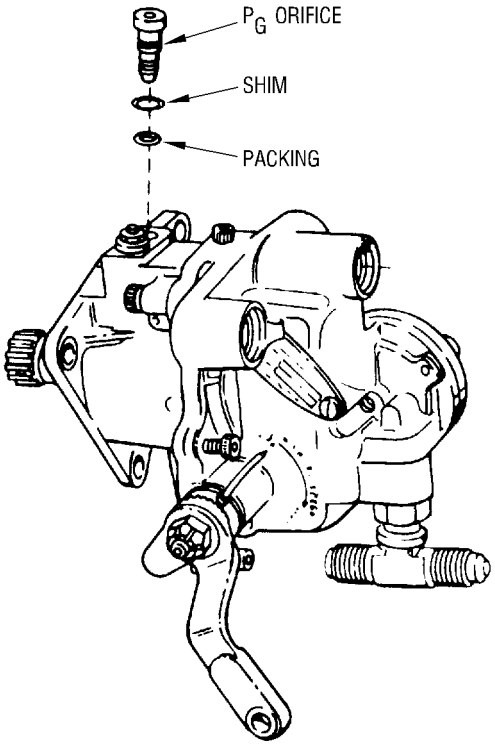
(2) Remove lockwire from the Pg orifice. Remove orifice using a 1/8 in. (3 mm) hex wrench. Use caution during removal from the engine not to lose the shims or damage the packing. The packing can be reused if undamaged. If the packing must be replaced, use Bendix P/N 953508–8.

(3) Use an ultrasonic cleaner if available; if it is not, agitate the part in perchloroethylene or mineral spirits in a clean container. Insert a sewing thread through the passage of the orifice (prescreened orifices only); slide the part back and forth on the thread to remove all traces of foreign matter. Air dry the part.

(4) Inspect the part for cleanliness. Inspect by placing the part in the center of a flashlight lens and sighting through the passage. No particles or coating of any kind should be seen. Repeat steps (3), and (4) if the part is not completely clean.

(5) Clean the surface of the Pg flapper valve that mates with the Pg orifice. Access to the flapper valve is through the hole in the governor body that retains the Pg orifice. Use a cotton swab with a highly volatile residue–free solvent (chlorothene or equivalent) applied to the tip.

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Power Turbine Governor P_g Orifice
Figure 204

PARA 2.E. (cont)

(6) Inspect the valve surface for cleanliness using a flashlight. Reclean the surface if any particles or coating can be seen.

(7) Lightly lubricate the packing with ASTM No. 5 (or equivalent). Install the Pg orifice with packing and shims. Be sure that all of the shims that were removed are reinstalled with the orifice. Tighten orifice finger tight. Be sure the shims are properly positioned before final tightening the orifice.

(8) Tighten the orifice to 14–15 lb in. (1.6–1.7 N·m) using a 1/8 in. hex wrench. This torque value is critical and must be strictly observed. Secure the orifice with lockwire.

(9) Make a record in the engine log book of cleaning the governor Pg orifice.

(10) Visually inspect the governor to ensure that all tubes, lockwires, etc., have been reinstalled. Start the engine. Allow five minutes for warm–up before checking operation of the governor. Replace the governor if N_2 continues to droop, overshoot or hunt.

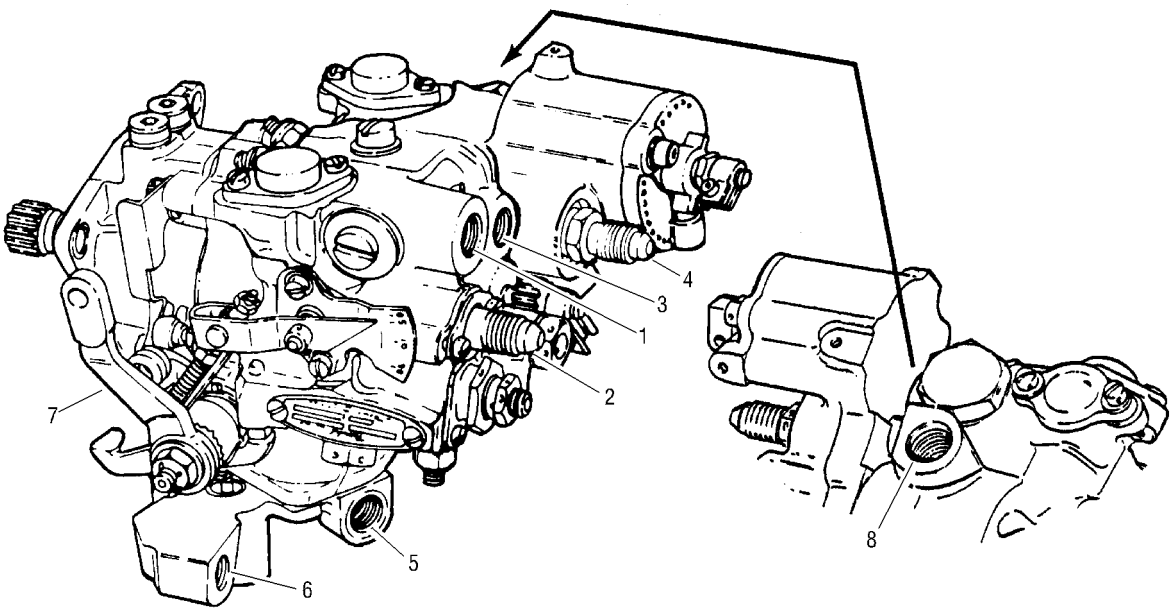
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BENDIX GAS PRODUCER FUEL CONTROL –– MAINTENANCE PRACTICES 250–C20, –C20B, –C20F, –C20J, –C20W SERIES ENGINES

1. General

The Bendix gas producer fuel control can be adjusted, the control fuel filter can be cleaned, or the control assembly can be replaced as dictated by the engine trouble condition encountered. (See Figure 201.)

NOTE: Refer to Fuel Control Operational Checks, PARA 3.A., this section for a ready method of ground checking the control system and associated linkage.



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1. Control inlet fuel (P_1)
2. Metered fuel flow (P_2)
3. Control bypass (P_o)
4. Sensing pressure (P_c)
5. Regulated air pressure (P_r)
6. Governing pressure (P_g)
7. Gas producer lever
8. Overspeed bleed (P_y)

Bendix Gas Producer Fuel Control, 250–C20, –C20B, –C20F, –C20J, –C20W
Figure 201

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2. Replacement

CAUTION: MAKE SURE THE PNEUMATIC TUBES AND FITTINGS ARE NOT LEAKING. ERRONEOUS PRESSURES WILL CAUSE FUEL CONTROL MALFUNCTION.

Replace the fuel control assembly if it is found to be the cause of engine malfunction.

A. Removal

Remove the gas producer fuel control from the engine as follows: (See Figure 202 or 203, 73–00–00.)

CAUTION: WHEN THE FUEL CONTROL IS BEING REMOVED, USE CARE TO PREVENT FOREIGN MATERIALS FROM ENTERING THE PNEUMATIC TUBES OR FUEL CONTROL PORTS.

(1) Remove the linkage connections, fuel and air tubes.

(2) Remove three nuts and washers which secure the control to its mounting pad on the power and accessory gearbox.

NOTE: The gas producer fuel controls P/N 23051985 and subsequent require P/N 23055346 special installation and removal tool. This tool is available from your Rolls–Royce Authorized Maintenance Center (AMC).

(3) Carefully remove the control.

CAUTION: WHEN REMOVING OR INSTALLING FITTINGS, MAKE SURE NOT TO CAUSE A LOAD ON THE FUEL CONTROL DRIVE SHAFT. USE THE WOODEN PROTECTIVE SHIPPING BLOCK TO PROTECT THE SHAFT FROM THE WORK BENCH.

(4) If the unit is to be replaced, remove all fittings necessary for installation of the replacement unit.

(5) Drain residual fuel from the rejected fuel control and fill the inlet and bypass ports with oil (Atlantic Refining Co. 31100, or equivalent). Open the cutoff valve, using the gas producer lever, and fill the outlet port with oil. Cap the inlet, bypass and cutoff ports.

NOTE: In installations where the gas producer lever is not required, remove the lever from the replacement fuel control and install it on the control being returned for overhaul.

B. Installation

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

Install the gas producer fuel control on the engine as follows:

(1) Before installing the Bendix fuel control on the engine, install the required fittings:

(a) Remove and discard all old packings.

(b) Lubricate new packings and install on the fittings.

(c) Install the fuel inlet and fuel bypass unions. Tighten to 75–110 lb in. (8.5–12.4 N·m).

(d) If required, install the Pg union. Tighten to 55–80 lb in. (6.2–9.0 N·m).

(e) If required, install the P_y union. Tighten to 55–80 lb in. (6.2–9.0 N·m).

(f) If required, install Pr elbow and jam nut. Do not tighten jam nut at this time.

NOTE: Use the wooden protective shipping block to protect the shaft from the work bench when installing the fittings.

(2) Coat fuel control drive shaft with Lubriplate 130A, 930AA or equivalent, the studs with anti–seize compound and fuel fittings with oil (Atlantic Refining Co. 31100, or equivalent).

CAUTION: MAKE SURE THAT THE CONTROL DRIVE PILOT IS PROPERLY INSERTED IN THE GEARBOX.

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PARA 2.B. (cont)

(3) Install in reverse of removal.

CAUTION: MAKE SURE THE PROCEDURES AND PRECAUTIONS OF RIGID TUBE INSPECTION AND INSTALLATION, PARA 9., 72–00–00, ENGINE–SERVICING, ARE OBSERVED WHEN INSTALLING FUEL SYSTEM TUBES.

CAUTION: HOLD FUEL CONTROL FITTINGS WITH ONE WRENCH WHILE TIGHTENING “B” NUT TO FITTING WITH ANOTHER WRENCH.

(4) Tighten mount pad nuts to 70–85 lb in. (7.9–9.6 N·m).

(5) Tighten fuel inlet and bypass lines coupling nuts to 150–200 lb in. (17–23 N·m).

(6) Tighten fuel outlet line coupling nut to 80–120 lb in. (9.0–13.6 N·m)

(7) Tighten fuel control air line coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(8) Tighten elbow jam nut 55–80 lb in. (6.2–9.0 N·m).

(9) Attach aircraft linkage to the fuel control lever.

(10) Check the fuel control lever travel using the cockpit control. The lever stop arm on the fuel control must bottom out on the maximum and minimum speed stops. (Refer to Rigging Check, para 3.C., this section.)

NOTE: During rigging of the linkage, the primary points of significance are the 30–degree mark and full travel, minimum stop to maximum stop. Ground Idle position is established with the pointer at the 30–degree mark on the quadrant.

CAUTION: OVERTIGHTENING CAUSES BINDING OF THE LEVER SHAFT.

(11) If the gas producer lever requires repositioning—loosen the nut, reposition, then tighten the nut to 40–50 lb in. (4.5–5.6 N·m).

(12) After the gas producer fuel control has been replaced, bleed air from the fuel system. (Refer to Purging the Fuel System, para 2.D., 73–00–00.)

(13) Check the pneumatic portion of the fuel control system for leaks. (Refer to Fuel Control System Pneumatic Leak Check, para 2.B., 73–00–00.)

(14) Check run the engine after fuel control replacement. (Refer to Check Run, para 1., 72–00–00, Engine–Adjustment/Test.)

NOTE: After the fuel control has been changed, if a false start is encountered or a start is not completed in one minute, return the throttle to FUEL OFF. Motor the engine without ignition for 10 seconds before attempting another start.

(15) Make a fuel control operational check. (Refer to Fuel Control Operational Checks, para 3.A., this section.)

(16) Make appropriate entry relative to fuel control replacement in the Engine Log.

3. Adjustment/Test

The adjustments that can be made on the fuel control are idle speed, maximum speed and start derichment. Also, on 6899262 (Bendix 2524644–9) or later fuel controls, there is a start/acceleration fuel flow schedule adjustment and a wide range start derichment adjustment.

A. Fuel Control Operational Checks

Ground check the control system and associated linkage by making a deceleration check (para 3.B., this section). Corrective action for an improper deceleration rate shall be as follows:

NOTE: Perform the steps of the corrective action in the sequence listed. Recheck the deceleration rate after each step to determine if there is a need for further correction. Replace the fuel control if the deceleration rate is still unsatisfactory after all steps of the corrective action have been completed.

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(1) Check rigging. (Refer to Rigging Check, para 3.C., this section.)

(2) Check idle speed setting. (Refer to Idle Speed Setting, para 3.F., this section.)

B. Deceleration Check

Make the following deceleration check during the shutdown for the last flight of each day.

(1) Position the twist grip or power levers to full open, hold collective at flat pitch and stabilize N_2 at exactly 100% for approximately 15 seconds (beep as required).

CAUTION: DURING RAPID THROTTLE MOVEMENTS, MAKE APPROPRIATE ANTI-TORQUE PEDAL CORRECTIONS TO PREVENT THE AIRCRAFT FROM TURNING ON LOOSE OR SLICK SURFACES.

(2) Snap the twist grip or power lever to the IDLE position. Simultaneously start a time count using a stop watch or watch with a sweep second hand. Stop the time as the N_1 needle passes through 65%. The minimum allowable deceleration time is two seconds.

NOTE: Practice and/or retakes may be required before proficiency is obtained in timing the deceleration.

(a) On single engine applications, if multiple controls are in stalled, make separate deceleration checks using the pilot and copilot twist grips.

(b) On multi-engine applications, make a deceleration check of each engine. Make separate decel checks using the pilot and the copilot twist grips.

(3) If deceleration time is less than two seconds, make two more checks to confirm the time. If the confirmed time is less than the minimum allowable time, proceed to the rigging check.

(4) If N_1 speed drops below 59%, or if a flame out is experienced during the deceleration check, proceed to the rigging check before making a second attempt.

C. Rigging Check

Check the rigging of the gas producer fuel control after a deceleration check has revealed the deceleration time to be less than the allowable limit. This check is also required after installation of a fuel control or any component of the rigging system. Make the rigging check with the engine shut down using the following procedure:

CAUTION: DO NOT ADJUST THE MINIMUM STOP TO COMPENSATE FOR AIRCRAFT RIGGING DIFFICULTIES. THE MINIMUM STOP IS SET ON A FLOW BENCH AND IS NOT A FIELD ADJUSTMENT.

(1) Check to ensure that sufficient travel is provided to allow physical contact with the gas producer minimum stop at or before the full closed position of the twist grip.

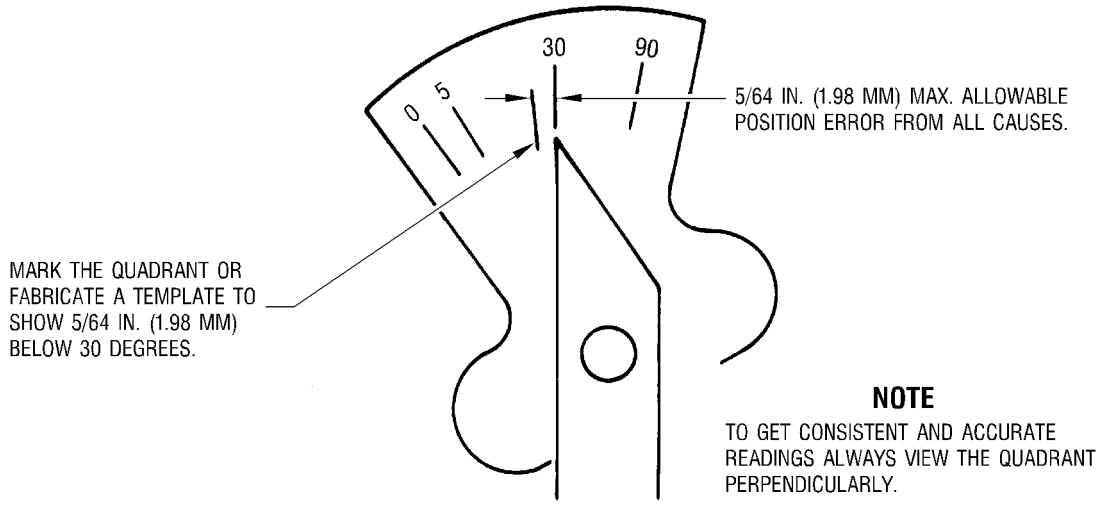
(2) Check the travel to the opposite end. Physical contact must be made with the gas producer maximum stop at or before the full open position of the twist grip.

(3) Looseness encountered in the rigging must be minimized by replacement of worn items and/or accuracy of the rigging. Looseness that cannot be removed must be within the limits indicated in Figure 202. Check the looseness as follows:

(a) Start with the twist grip or power levers at the full open position then rotate the grip to the IDLE position. The pointer must be at the 30 degree mark.

(b) Start with the throttle at the full closed position, then rotate the grip to the IDLE position. The pointer must be no more than 5/64 in. (2.0 mm) below the 30 degree mark.

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Fuel Control Quadrant and Pointer
Figure 202

PARA 3.C.(3) (cont)

NOTE: Make rigging adjustments on aircraft having dual controls using the pilots throttle. Recheck the linkage movement using the copilot throttle. The limits of Figure 202 are applicable to both sets of controls.

(4) Repeat the deceleration check. If the deceleration time is less than the allowable minimum proceed with the idle speed check.

D. Cutoff Valve Operational Check

An operational check of the fuel control cutoff valve shall be made when an early lightoff or an afterfire is encountered. Make the check as follows:

CAUTION: DO NOT ADJUST THE MINIMUM STOP TO COMPENSATE FOR AIRCRAFT RIGGING DIFFICULTIES. THE MINIMUM STOP IS SET ON A FLOW BENCH AND IS NOT A FIELD ADJUSTMENT.

(1) Make sure there is sufficient travel in the aircraft control system to allow physical contact with the gas producer fuel control minimum stop at or before the fully closed position of the twist grip or power lever.

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PARA 3.D. (cont)

(2) Deactivate the ignition system.

WARNING: THE FUEL/AIR DISCHARGE DURING THIS CHECK IS IRRITATING TO THE EYES AND HIGHLY FLAMMABLE. TAKE SUITABLE MEASURES TO PROTECT EYES AND PREVENT FIRE.

WARNING: MAKE SURE THAT THE AIRCRAFT IS ADEQUATELY GROUNDED. (SEE AIRCRAFT MANUFACTURER'S INSTRUCTIONS FOR PROPER GROUNDING PROCEDURES.)

(3) Disconnect the fuel supply hose from the fuel nozzle and place the hose in a clean container.

(4) Close the throttle so that it is seated firmly on the minimum throttle stop.

(5) Turn on the aircraft boost pumps/start pumps, if applicable.

(6) Motor the engine for approximately 15 sec. There should be no fuel coming from the fuel supply hose. If fuel flows during the motoring operation, the fuel control must be replaced.

(7) Purge air from the fuel system in accordance with para 2.D., 73–00–00.

(8) Reconnect the fuel supply hose to the fuel nozzle. Tighten coupling nut to 80–120 lb in. (9.0–13.6 N·m).

(9) Turn off the boost pumps and reactivate the ignition system.

E. Throttle Torque Check.

Higher than normal throttle torque can occur due to binding of the throttle shaft in the throttle shaft bushing. This binding can be the result of corrosion build–up on the throttle shaft assembly, causing an interference fit in the throttle shaft bushing.

(1) Rotate the throttle and check for higher than normal torque.

(2) If higher than normal torque exists, apply lubricant, standard engine oil MIL–PRF–23699 (NATO Code 0–156), to the area shown in Figure 203.

(3) Rotate the throttle following lubricant application to assure penetration.

(4) Repeat the spray application if necessary.

F. Idle Speed Setting

Check the idle speed setting with the engine running. Stabilized idle speed should repeat every time, whether the throttle is slowly rolled or snapped to the IDLE position. Failure of the stabilized speed to repeat is cause for a recheck of the rigging. Check for proper idle adjustment rigging as follows:

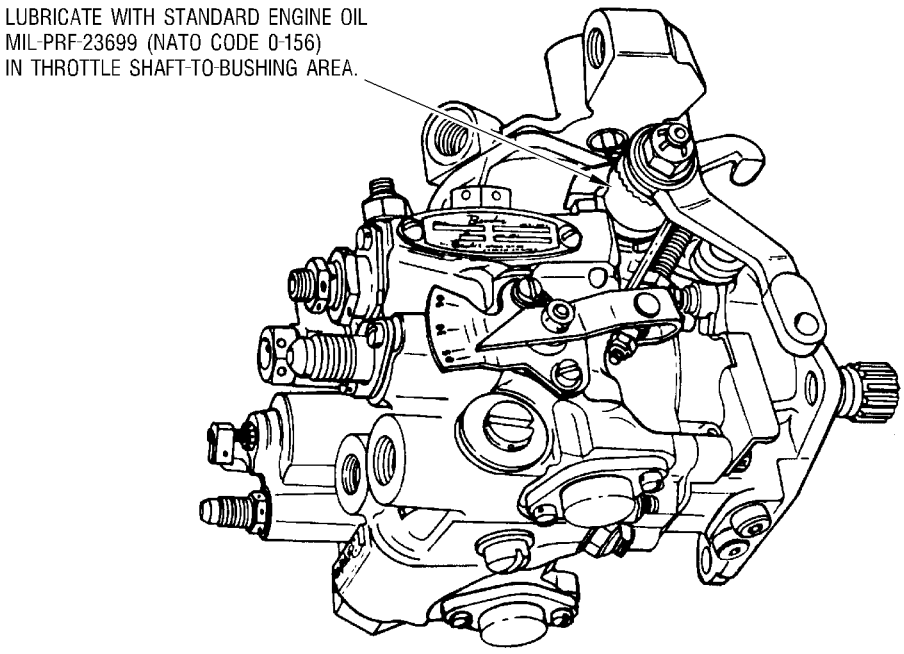
(1) Roll the throttle to IDLE and let N_1 stabilize. Mark (pencil) the precise position of the pointer tip on the fuel control quadrant.

(2) Release the idle detent on the throttle. Very slowly roll the throttle in the direction of cutoff just enough to obtain perceptible movement of the pointer tip (approximately the width of the pencil mark). If N_1 idle speed decreases take the following corrective action:

(a) If the pointer is at or above the 30 degree mark, rerig the aircraft linkage to move the pointer tip to a point just below the 30 degree mark.

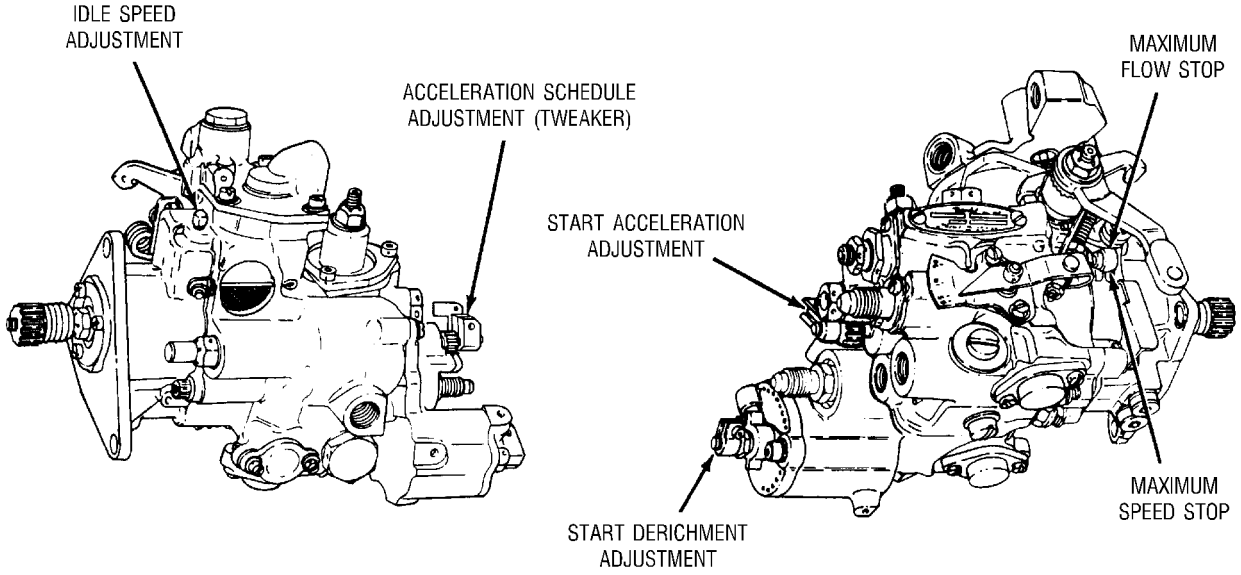
(b) If the pointer is more than 5/64 in. (2.0 mm) below the 30 degree mark, rerig the aircraft linkage to move the pointer closer to the 30 degree mark.

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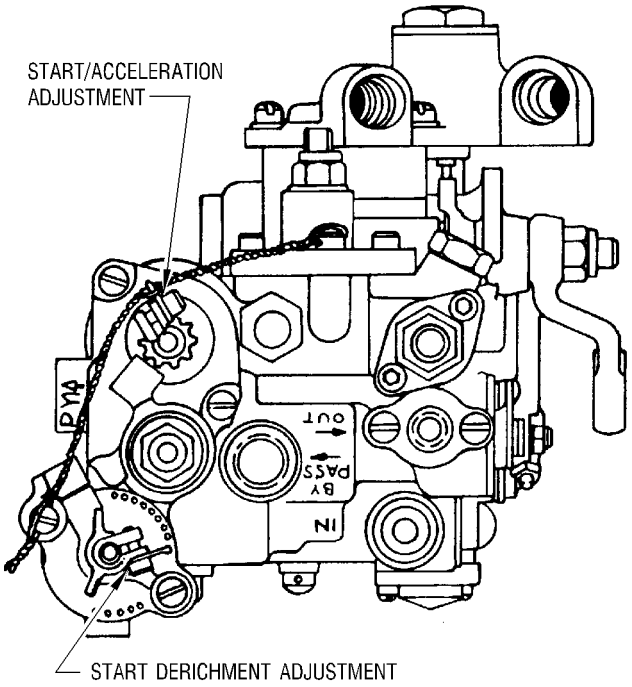
Lubricating Bendix/Allied Signal Fuel Control Throttle Shaft and Bushing
Figure 203



AEH027XD

Gas Producer Fuel Control Adjustments
Figure 204

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



Start/Acceleration and Start–Derichment Adjustments
Figure 205

PARA 3.F. (cont)

(3) If N_1 idle speed did not change when the throttle was rolled toward cutoff, very slowly roll the throttle in the direction of increased power. Obtain perceptible movement of the pointer tip. No increase in N_1 speed is permitted before the fuel control pointer indicates 30 degrees. An increase in speed before the pointer reaches 30 degrees indicates the fuel control internal rigging is incorrect. An increase at or above the 30 degree mark is normal.

CAUTION: THIS IS A SENSITIVE ADJUSTMENT; DO NOT ADJUST THE IDLE SPEED ADJUSTMENT SCREW MORE THAN 1/8 TURN AT A TIME.

(4) When the rigging is correct, change the idle speed adjustment screw to obtain a 59–65% N_1 speed setting with the generator switch off. (See Figure 204.) Using 6798292 wrench, turn the screw clockwise to increase or counterclockwise to decrease N_1 speed. A 1/8 turn adjustment changes engine speed approximately 5%. If N_1 speed does not respond to the idle speed screw adjustment, the rigging is establishing idle speed. Rerig as required. If N_1 speed does respond to the idle speed screw, make the 59–65% N_1 setting.

NOTE: Make sure that the Px and Py orifices are clean, the fuel control rigging is correct, and that no control pneumatic system leaks are present prior to adjusting the maximum speed stop.

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PARA 3. (cont)

G. Maximum Speed Stop. (See Figure 204.)

CAUTION: DO NOT ADJUST MAXIMUM SPEED STOP IF 793°C (1460°F) TOT CAN BE REACHED ON 250–C20 ENGINE OR 810°C (1490°F) TOT CAN BE REACHED ON 250–C20B, –C20F, –C20J, –C20S OR –C20W ENGINE. DO NOT EXCEED 105% N_1.

NOTE: Maximum speed adjustment is not a periodic adjustment. It should be made only when absolutely required. In situations where N_1 speed peaks below the stated limit and TOT is below the maximum limit, resulting in a low power condition, maximum speed adjustment may restore specified performance. Do not adjust more than one turn at a time. Operate the engine after each adjustment to confirm the results.

Adjust screw clockwise to increase or counterclockwise to decrease N_1 speed. One turn equals approximately 1% speed.

H. Engine Starting Characteristics Adjustment

CAUTION: INCORRECT FUEL CONTROL STARTING ADJUSTMENT MAY BE DETRIMENTAL TO THE GAS PRODUCER TURBINE LIFE. CONSISTENT LONG, COOL STARTS, AS WELL AS OVERTEMPERATURE STARTS, ARE POTENTIALLY DAMAGING TO THE GAS PRODUCER TURBINE.

There are two fuel control adjustments which can be used to change the starting characteristic of the engine. These adjustments are a Start–Derichment Adjustment in addition to a Start/Acceleration Adjustment which is on fuel controls P/N 6899262 or later. (See Figure 205.) The conditions which can be improved by these adjustments are given in Table 201. Correct these conditions using the stated recommended adjustment(s).

(1) Start–Derichment Adjustment. (See Figure 205.)

(a) The start–derichment (derich) adjustment can be used to correct lean (slow) start or rich (hot) start conditions. This adjustment is effective below 33% N_1 speed. (Refer to Table 201.) For slow starts at N_1 speeds between 35 and 55% N_1 speed, refer to Start/Acceleration Fuel Flow Adjustment, para 3.H.(2), this section.

NOTE: The start derichment adjustment on the 6899262 (or later) fuel control has a wider angular range than earlier models (200 degrees in place of 100 degrees). Neutral position for the 6899262 control is 7 dots/70° from the ccw stop. Neutral on controls prior to 6899262 is 4 dots/40° ccw. The effective start derichment speed range is between 20 and 33% N_1. Also, turning the adjustment to the CW stop closes the Py vent which deactivates the start derichment adjustment.

NOTE: To accurately determine the proper adjustment, conditions under which the adjustments are made should be consistent, i.e. a fully charged aircraft battery, the same residual TOT and the same lightoff speed.

(b) For low temperature with slow starts at 20–33% N_1 speed, adjust the start–derichment as follows:

CAUTION: DO NOT DISTURB THE POINTER–TO–SHAFT SEALED WIRE AT ANY TIME. THIS IS AN OVERHAUL FUNCTION ONLY.

1 Remove the lockwire securing the adjustment locknut to the P_c filter–fitting.

2 Loosen the adjustment locknut.

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PARA 3.H.(1) (b) (cont)

CAUTION: DURING THE ATTEMPTED START, TOT MUST BE CLOSELY MONITORED TO PREVENT OVERTEMPERATURE OPERATION. RECORD OVERTEMPERATURE IN THE ENGINE LOG.

3 Make the adjustment using an Allen wrench. Turn clockwise to enrich the starting fuel flow to improve stagnated starts, cold weather starts, or high altitude ground starts. Make the adjustment in 15° maximum increments (dots are 10° apart) and tighten the locknut to 20–25 lb in. (2.3–2.8 N·m) after each setting. Check the starting peak TOT after each setting until satisfactory starts are made.

NOTE: If satisfactory starts can not be attained with a few incremental adjustments of the start derichment adjustment and the start–acceleration adjustment, refer to para 3.H.(1)(d) below.

CAUTION: MONITOR TOT CLOSELY AFTER START–DERICHMENT ADJUSTMENT TO MAKE SURE OVERTEMPERATURE LIMITS ARE NOT EXCEEDED.

4 When the desired adjustment is obtained, secure the locknut to the P_c filter–fitting with lockwire.

5 On fuel controls prior to P/N 6899262 (Bendix P/L 2524644–9), if satisfactory starts are not obtained during steps (b) 1 through 4, proceed as follows:

a Return the start–derich pointer to the neutral position. Tighten locknut.

b Install a short No. 10–32 screw into the vent fitting on the start–derich cover. This deactivates the start–derich assembly and allows the operator to check the basic fuel schedule of the control.

c Enrich the basic schedule slightly by retightening the start–derich cover screws. Remove lockwire from the screws, then check screw retention torque. Torque should be 9–10 lb in. (1.02–1.13 N·m). Retorque the screws in 2 lb in. (0.23 N·m) increments to a maximum value of 14 lb in. (1.6 N·m). After each 2 lb in. (0.23 N·m) retightening operation, make a start attempt. It is not necessary to remove the No. 10–32 screw from the vent at this time; this is only a check of the integrity of the basic schedule. If satisfactory starts are obtained, lockwire the derich assembly cover screws and remove the No. 10–32 screw from the vent fitting. Make another start. It may be necessary to adjust the start–derich assembly from the neutral position. After final adjustments have been made, lockwire the start–derich assembly.

(c) On fuel controls prior to P/N 6899262 (Bendix P/N 2524644–9), if satisfactory starts are not obtained during steps (b) 1 through (b) 5, proceed as follows:

1 Return the pointer to the neutral position (4 dots/40° from the ccw stop).

2 Disconnect the fuel control–to–inline check valve tube. Provide a means of directing fuel that will be discharged from this port on the control into a clean container.

3 Deactivate primary power to the ignition system.

4 Motor the engine to approximately 15% N_1 speed; then open the throttle to the 30° (Ground Idle) position. Motor the engine for 15 seconds; then close the throttle.

NOTE: This procedure is based upon a 15 second fuel flow. Be sure the throttle is closed exactly 15 seconds after it is opened.

5 Using a calibrated beaker, measure the quantity of fuel in the container. There should be 85–95 cc of fuel in the beaker at sea level. At higher altitudes the flow will be less.

NOTE: For improved accuracy, take the average of three readings.

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PARA 3. (cont)

6 Enrich the basic schedule by adding one shim under the metering valve sleeve retainer. (See Figure 206). Select the shim to give the desired fuel flow schedule. The approximate fuel flow gain for each shim thickness is as follows:

Shim Thickness, in.	(mm)	Fuel Flow Gain, cc	Temp Increase, °C	(°F)
0.001	(0.025)	9	90	(162)
0.0015	(0.0381)	14	140	(252)
0.002	(0.051)	18	180	(324)
0.003	(0.076)	24	240	(432)

NOTE: Only one shim may be used. Maximum shim thickness must not exceed 0.003 in. (0.076 mm).

7 Cut out the selected size shim using the template shown in Figure 206. Clean up all burrs.

NOTE: A kit (Bendix P/N 350934) containing one each of the 0.001, 0.0015, 0.002 and 0.003 in. (0.025, 0.0381, 0.051 and 0.076 mm) shims is available through Bendix Supply Centers.

8 Remove lockwire and loosen screws securing the metering valve sleeve retainer. Loosen screws enough to allow insertion of the shim under the retainer. Insert selected shim and torque screws to 9–10 lb in. (1.02–1.13 N·m).

9 Recheck the fuel flow setting as was accomplished in steps (b) 1 through (b) 5.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

10 If the desired fuel flow is obtained, reinstall the fuel control–to–inline check valve tube. Torque coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

CAUTION: DURING A START ATTEMPT, TOT MUST BE CLOSELY MONITORED TO PREVENT OVERTEMPERATURE OPERATION. RECORD OVERTEMPERATURE IN THE ENGINE LOG.

11 Perform fuel system pneumatic leak check. (Refer to Fuel and Control System —Maintenance Practices, para 2.B., 73–00–00.)

12 Start the engine. If satisfactory starts are obtained, lockwire the screws on the metering valve sleeve retainer. It may be necessary to adjust the start–derich assembly from the neutral position. After final adjustments have been made, lockwire the start–derich assembly.

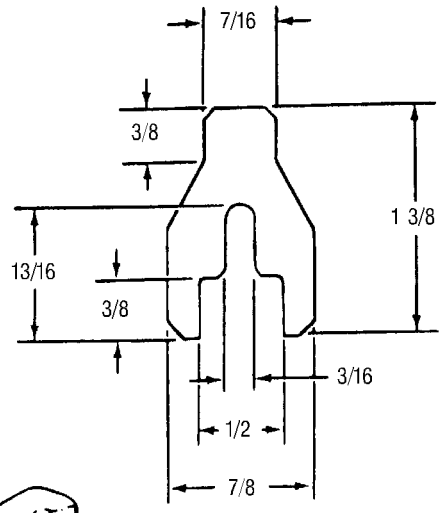
(d) Rich (hot) starts may be caused by delayed ignition, or premature opening of the throttle. However, hot starts due to high fuel flow are normally caused by the fuel control. When the fuel control is suspected, make an adjustment of the start–derich setting as follows:

1 Remove lockwire and loosen the adjustment locknut. (See Figure 204.)

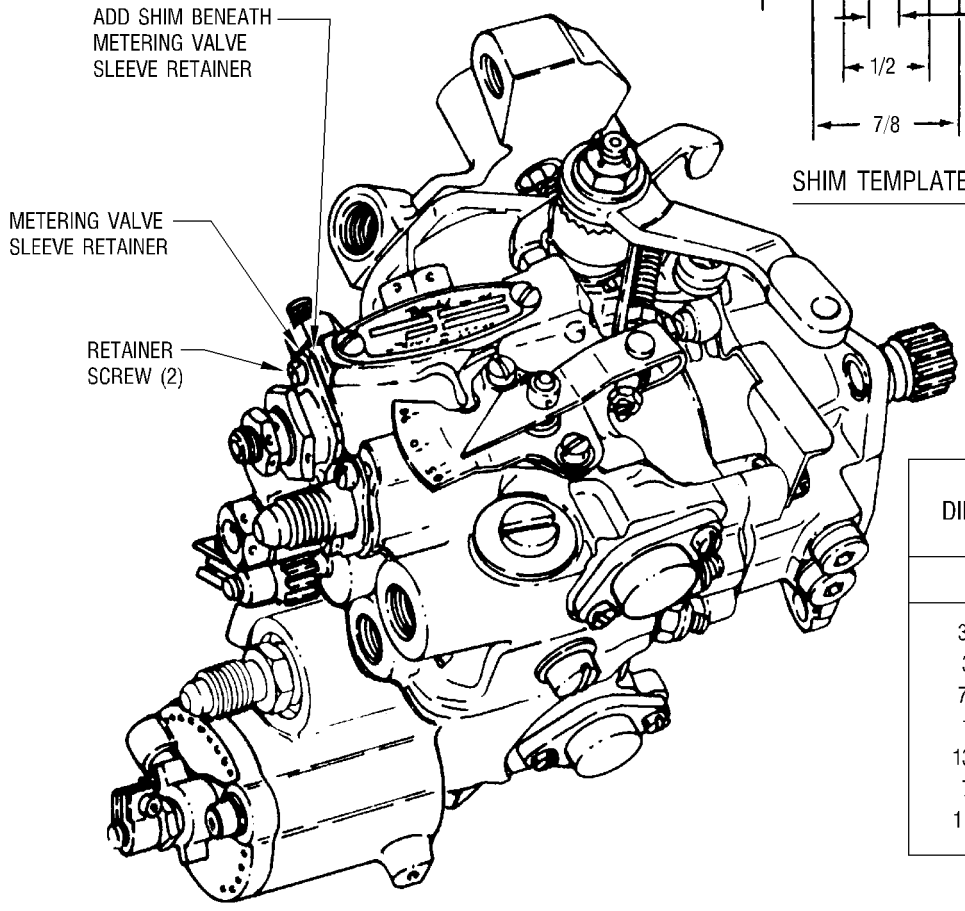
2 Make the adjustment using an Allen wrench. Turn counterclockwise (CCW) to lean–out the fuel flow. Make the adjustment in 15° maximum increments (dots are 10° apart) and tighten the locknut after each setting. Check the starting peak TOT after each setting until satisfactory starts are made.

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1. USE ONLY ONE SHIM SIZE.
2. SHIM THICKNESS SHALL NOT EXCEED 0.003 IN. (0.076 MM).
3. CHAMFER CORNERS AND REMOVE BURRS BEFORE USING.



SHIM TEMPLATE



SHIM TEMPLATE DIMENSION CONVERSION TABLE	
in.	mm
3/16	4.76
3/8	9.52
7/16	11.11
1/2	12.70
13/16	20.64
7/8	22.22
1 3/8	34.92

ADH059XA

Metering Valve Sleeve Retainer
Figure 206

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

PARA 3. (cont)

NOTE: If satisfactory starts can not be attained with a few incremental adjustments of the start derichment adjustment and the start–acceleration adjustment, refer to para 3.H.(1)(e) below.

3 When the desired adjustment is obtained, secure the locknut to the P_c filter–fitting with lockwire.

4 On fuel controls prior to P/N 6899262 (Bendix P/L 2524644–9), if satisfactory starts are not obtained during steps 1 through 3, return the pointer to the neutral position (4 dots/40° from the ccw stop) and proceed as follows:

a Inspect to determine that there is no obstruction in the vent hole in the start–derich cover.

b If visual inspection reveals no discrepancies in the start–derich assembly, troubleshoot the start–derich assembly by checking for air leakage at the vent while attempting a start. No leakage indicates improper functioning of the start–derich assembly.

CAUTION: DURING THE ATTEMPTED START, TOT MUST BE CLOSELY MONITORED TO PREVENT OVERTEMPERATURE OPERATION. RECORD OVERTEMPERATURE IN THE ENGINE LOG.

c Check the basic fuel schedule by monitoring the first TOT indication. TOT should not exceed 860°C (1580°F). If TOT is between 860°C (1580°F) and 927°C (1700°F), derich the basic schedule slightly by retightening the start–derich cover screws. Remove the lockwire from the screws; then check the screw retention torque. Torque should be 9–10 lb in. (1.02–1.13 N·m). Retorque the screws to the minimum value of 9 lb in. (1.02 N·m). Attempt another start. TOT must not exceed 860°C (1580°F). If satisfactory starts are obtained, lockwire the derich assembly cover screws and the start–derich assembly. If decreasing the cover assembly screw torque does not bring start TOT down to the 860°C (1580°F) limit, the fuel control must be removed and recalibrated.

(e) Determine the fuel flow quantity for starting as follows: (Note settings of start derichment and start acceleration adjustments prior to beginning this test.)

1 Return the pointer to the neutral position (7 dots/70° from the CCW stop).

2 Disconnect the fuel control–to–inline check valve tube. Provide a means of directing fuel that will be discharged from this port on the control into a clean container.

3 Deactivate primary power to the ignition system.

4 Motor the engine to approximately 15% N_1 speed; then open the throttle to the 30° (Ground Idle) position. Motor the engine for 15 seconds; then close the throttle.

NOTE: This procedure is based upon a 15 second fuel flow. Be sure the throttle is closed exactly 15 seconds after it is opened.

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Table 201
Adjustments to Improve Starting

Condition	Recommended Adjustments
Excessive lightoff temperature — N_1 speed below 20%, over 810°C (1490°F) with a momentary peak of one second max. at 927°C (1700°F) for a period not to exceed 10 seconds.	Adjust start/acceleration CCW. If any additional correction is necessary, adjust start–derichment CCW. (Refer to para 3.H., (1) and (2), this section for procedures.)
Low lightoff temperature — N_1 speed below 20% and slow acceleration, lightoff temperature below 550°C (1022°F).	Adjust start/acceleration CW. (Refer to para 3.H. (2), this section for procedure.)
High rapid temperature rise with N_1 speed at 25–30%.	Adjust start–derichment CCW. If any additional correction is necessary adjust start/acceleration CCW. (Refer to para 3.H. (1) and (2), this section for procedures.)
Low lightoff temperature with slow start — N_1 speed hesitation at 20–33%, lightoff temperature below approx 550°C (1022°F) with start time approaching 60 seconds (or more).	Adjust start–derichment CW. If additional correction is necessary, adjust start/acceleration CW. (Refer to para 3.H. (1) and (2), this section for procedures.)
High lightoff temperature — N_1 speed at 35–55%, over 810°C (1490°F) with momentary peak of one second max at 927°C (1700°F) for a period not to exceed 10 seconds.	Adjust start/acceleration CCW. (Refer to para 3.H. (2), this section for procedure.)
Low lightoff temperature with slow–to–hung starts — N_1 speed hesitation at 35–55%, lightoff temperature below approx 550°C (1022°F) with starting time approaching 60 seconds (or more).	Adjust start/acceleration CW. (Refer to para 3.H. (2), this section for procedure.)

PARA 3.H.(1) (e) (cont)

5 Using a calibrated beaker, measure the quantity of fuel in the container. There should be 85–95 cc of fuel in the beaker at sea level. At higher altitudes the flow will be less.

NOTE: For improved accuracy, take the average of three readings.

6 If start fuel flow does not meet the calibrated beaker test and adjustment with the start derichment and start acceleration adjustors can not bring the start fuel flow within defined limits, the fuel control unit must be sent to an authorized facility for adjustment/repair.

(2) Start/Acceleration Fuel Flow Adjustment (Applicable to 6899262, Bendix 2524644–9, or later fuel controls).

(a) The start/acceleration fuel flow schedule adjustment maintains the gas producer fuel control starting schedule within acceptable limits during normal service life. To optimize engine starting, the start–derichment adjustment should be made in conjunction with the start/acceleration adjustment. (Refer to Table 201.)

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PARA 3.H. (2) (cont)

(b) Remove lockwire and make the start–acceleration fuel flow adjustment as follows:

CAUTION: DO NOT USE THE START/ACCELERATION ADJUSTMENT TO CORRECT FOR NORMAL MAINTENANCE ITEMS SUCH AS MIS–RIGGING, AIR LEAKS, FUEL LEAKS, FAULTY FUEL NOZZLE, IGNITION PROBLEMS, STARTER–GENERATOR SYSTEM PROBLEMS ETC. DO NOT USE THE START/ACCELERATION ADJUSTMENT EXCLUSIVELY TO IMPROVE ENGINE STARTING. EXCESSIVE CW SETTINGS BEFORE ENCOUNTERING OVERTEMPERATURE RESULTS IN A SINGLE HIGH PEAK TOT OVER A WIDE SPEED RANGE FOR A LARGE PART OF THE STARTING TIME. USE THE START–DERICH ADJUSTMENT WITH THE START/ACCELERATION ADJUSTMENT TO OPTIMIZE ENGINE STARTING.

NOTE: To accurately determine the proper adjustment, conditions under which the adjustments are made should be consistent, i.e., a fully charged aircraft battery, the same residual TOT and the same lightoff speed.

NOTE: There are eight positions for the adjuster (the neutral position is three clicks from the CCW stop). Detent grooves hold the adjuster in the selected one of these positions without the need of a jam nut.

NOTE: A required adjustment of more than two clicks CW is an indication that the fuel control is not the cause of the problem.

1 For low lightoff temperature or slow/hung starts, turn the adjuster CW. Make the adjustment in changes of one detent (click) at a time.

CAUTION: AN OVER ADJUSTMENT OF THE START/ACCELERATION CW SETTING CAN CAUSE OVERTEMPERATURE STARTS OR COMPRESSOR SURGE.

2 If the adjuster is positioned to the full clockwise stop and low lightoff temperatures or slow/hung starts are still encountered.

a Ensure there are no pneumatic leaks. (Refer to Fuel Control System Pneumatic Leak Check, PARA 2.B., 73–00–00.)

CAUTION: AN OVER ADJUSTMENT OF THE START/ACCELERATION CCW SETTING CAN CAUSE A DECREASE IN STARTING TIME TO A POSSIBLE HUNG START.

b Shim the fuel control metering valve sleeve. (Refer to PARA 3.H.(1)(c), this Section for details.)

3 For excessive lightoff temperature starts, turn the adjuster CCW. Make the adjustment in changes of one detent (click) at a time.

4 When the final start/acceleration adjuster position is established, lockwire the pointer in accordance with Figure 204, if desired. Safety wiring of the Start/Acceleration Adjuster is required for shipping and handling, but may be omitted from installed units at the operator's discretion for field adjustment, as required in some changing ambient conditions.

5 Check idle speed and deceleration time after the final start setting is determined. (Refer to Idle Speed Setting, PARA 3.F., this Section, and Deceleration Check, PARA 3.B., this Section.)

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PARA 3. (cont)

I. Max. Fuel Flow Stop Adjustment

This adjustment is for Bendix fuel controls on 250-C20 engines operating in Bell 206A, 206B, 206B3 and Hughes 500C helicopters. Fuel controls 23007869 are bench calibrated to max flows of 235 pph (107 kg/hr) and 270 pph (122 kg/hr) with the pointer position at these flows scribe marked on the quadrant. Fuel controls 23033917 are bench calibrated to max flows of 243-248 pph (110-112 kg/hr) and 280-285 pph (127-129 kg/hr) with the pointer position at the LO and HI flow scribe marks on the quadrant. Position the pointer at the fuel flow specified in the aircraft maintenance manual. Make the adjustment as follows:

(1) Remove the lockwire from the jam nut. (See Figure 207.)

(2) Loosen the jam nut while holding the pointer in position with S1116 Bristol wrench in the internal wrenching screw.

(3) Turn the pointer with the Bristol wrench to the 235 or LO scribe mark. Turn in a clockwise direction.

(4) Hold the pointer at 235 or LO with the wrench while tightening the jam nut to 20-25 lb in. (2.3-2.8 N·m). Secure nut with lockwire.

CAUTION: AFTER MAX. FLOW STOP ADJUSTMENT IS COMPLETED, CYCLE THE LEVER THROUGH FULL RANGE TO ENSURE THAT NO CONTACT OF THE THROTTLE RETURN SPRING TO MAX. FLOW STOP OCCURS. CONTACT MAY RESTRICT FULL CUTOFF FROM BEING ATTAINED. THE CAUSE IS GENERALLY MISALIGNMENT OF THE THROTTLE RETURN SPRING BRACKET. THIS IS CAUSE FOR REJECTION OF THE FUEL CONTROL UNIT. THE UNIT SHOULD BE RETURNED TO AN AUTHORIZED MAINTENANCE CENTER FOR REPAIR.

NOTE: Fuel controls shipped new from the manufacturer or overhauled, and fuel controls on new or overhauled engines, are set at the max. mark as required for 250-C20 series engines used in Boelkow BO-105C, Aerospatiale AS-355, Bell 206L, Hughes 500D and Agusta 109 helicopters. (See Figure 207 for applicable adjustment.)

4. Cleaning

A. Cleaning the Gas Producer Fuel Control Fuel Filter

Remove, clean and reinstall the fuel control fuel filter as follows: (See Figure 208.)

(1) Remove lockwire from the plug.

NOTE: Thoroughly clean the exterior of the fuel control in the area of the plug to prevent contaminants from getting into the port after it is opened.

(2) Remove the plug, spring and filter assembly from the fuel control. Discard the packing.

(3) Remove the clip and spring pin. Separate the washer, spring and filter from the filter sleeve.

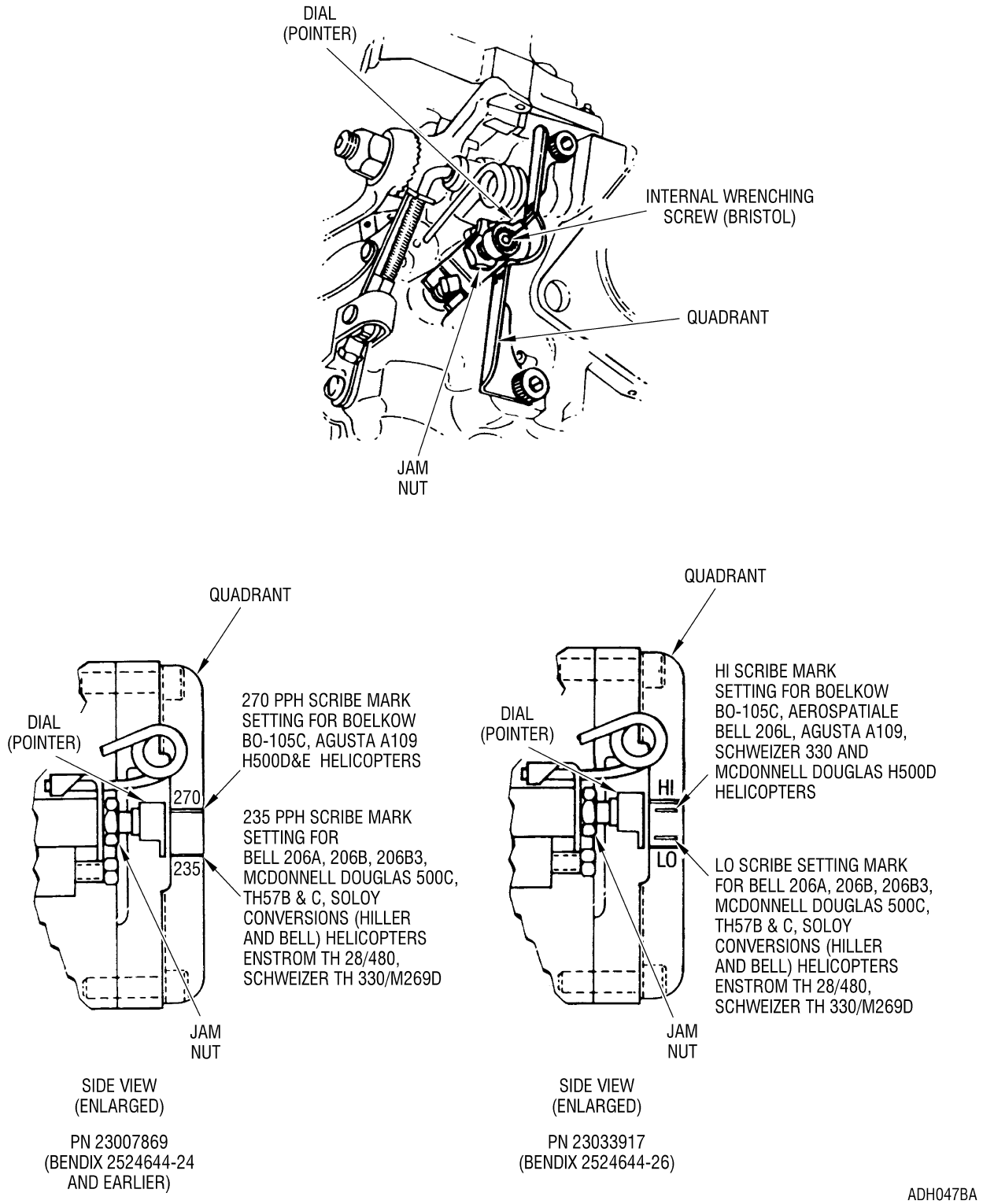
NOTE: The fuel control filter must be replaced at periodic intervals. (Refer to Table 602, 72-00-00, Engine-Inspection/Check, for time interval.) Inspect removed filter for contamination prior to discarding.

CAUTION: FUEL FLOW DIRECTION THROUGH THE FILTER IS FROM THE INSIDE TO THE OUTSIDE. MAKE SURE THAT THE INSIDE OF THE FILTER IS FREE OF CONTAMINATION.

CAUTION: DO NOT ATTEMPT TO OPEN A CLOGGED SCREEN WITH A SHARP INSTRUMENT.

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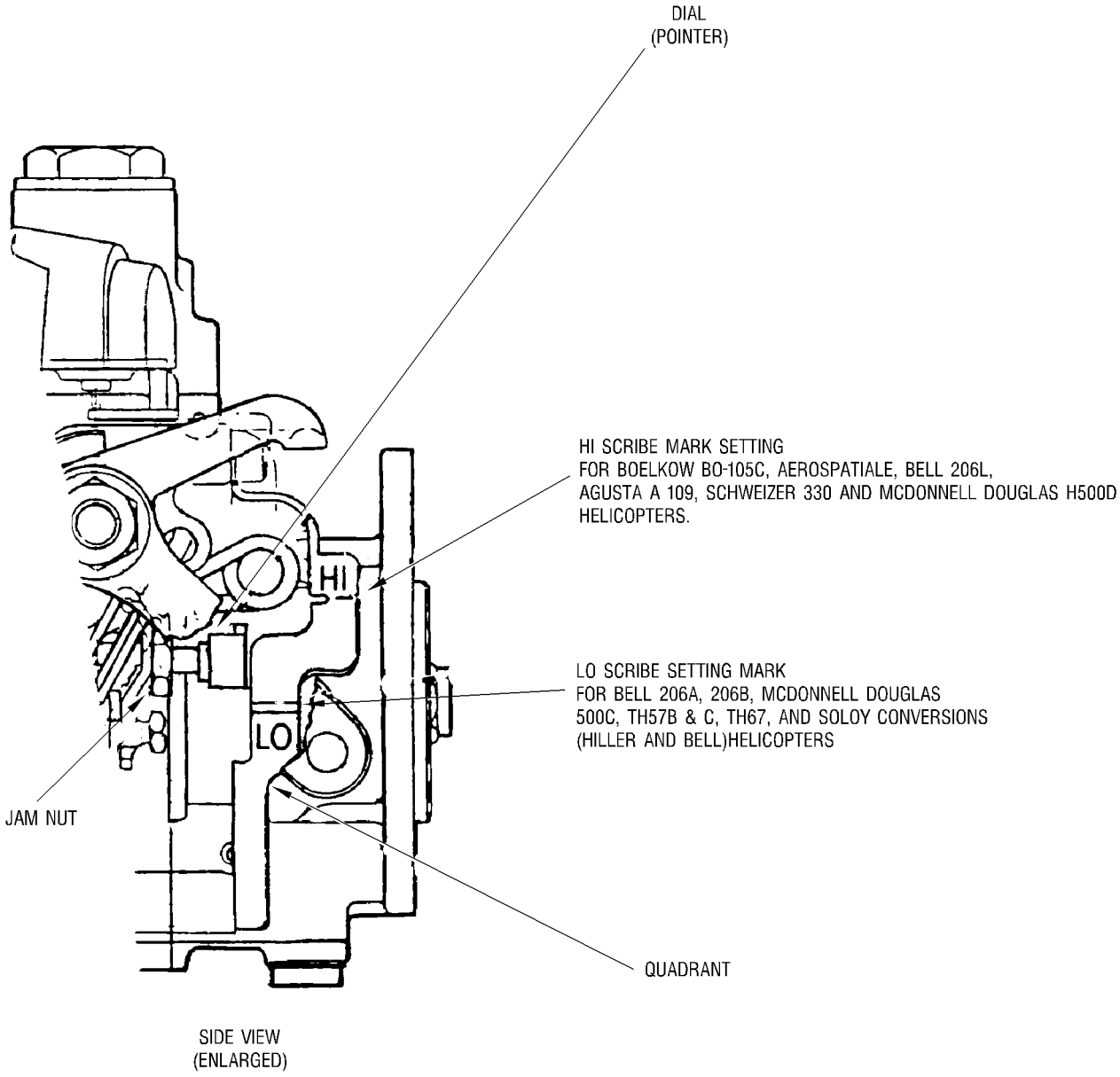
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Bendix Fuel Control Max Flow Stop Adjustment
Figure 207 (Sheet 1 of 2)

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Bendix Fuel Control Max Flow Stop Adjustment
Figure 207 (Sheet 2 of 2)

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PARA 4.A. (cont)

(4) Clean the filter assembly parts ultrasonically if equipment is available. If equipment is not available, agitate the parts in mineral spirits. Dry parts using clean shop air regulated to approximately 15 psig (103 kPag). Air pressure should be applied to the exterior of the filter. Repeat the procedure if visual inspection with a bright light shows that the interior of the filter is not entirely free of contaminants.

(5) The following cleaning procedure may be used as an alternate if the method described in step (4) does not clean the filter satisfactorily.

WARNING: SULPHURIC ACID CAUSES SEVERE BURNS. DO NOT GET IN EYES, ON SKIN, OR ON CLOTHING. DO NOT ADD WATER TO ACID WHILE IN A CONTAINER BECAUSE OF VIOLENT REACTION. IN THE EVENT OF CONTACT WITH SULPHURIC ACID, IMMEDIATELY FLOOD EXPOSED SKIN OR CLOTHING WITH WATER. FOR EYES, FLUSH HEAVILY WITH WATER AND OBTAIN IMMEDIATE MEDICAL ATTENTION.

(a) Immerse the filter in sulphuric acid (specific gravity 1.82 to 1.84) containing approximately 20 grams of sodium dichromate per liter (0.2642 U.S. gallon) for a period of two to five minutes at room temperature.

(b) Rinse in hot running water and dry with a hot air blast.

CAUTION: MAKE SURE THE FILTER ASSEMBLY IS INSTALLED AS SHOWN IN FIGURE 208 WITH THE OPEN END TOWARD THE OUTSIDE OF THE CONTROL, AWAY FROM THE SPRING. DO NOT INSTALL BACKWARDS.

(6) Reassemble the filter, spring, and washer in the filter sleeve. Secure the components in the sleeve with the spring pin and clip.

(7) Lightly lubricate a new packing (Bendix P/N 557S6) with engine fuel and place it on the plug. Install the filter assembly, spring and plug in the fuel control. Tighten plug to 65–70 lb in. (7.3–7.9 N·m) and secure with lockwire.

NOTE: If the old packing must be reused, dry it under a heat lamp to restore dimensions.

B. Cleaning the Gas Producer Fuel Control Air Circuit

If fast or slow deceleration, overspeed, slow acceleration, high idle speed, and/or auto acceleration are encountered, the air circuit of the fuel control may be contaminated. Clean the air circuit as follows:

(1) Remove the starter–generator from the engine to gain access to the fuel control.

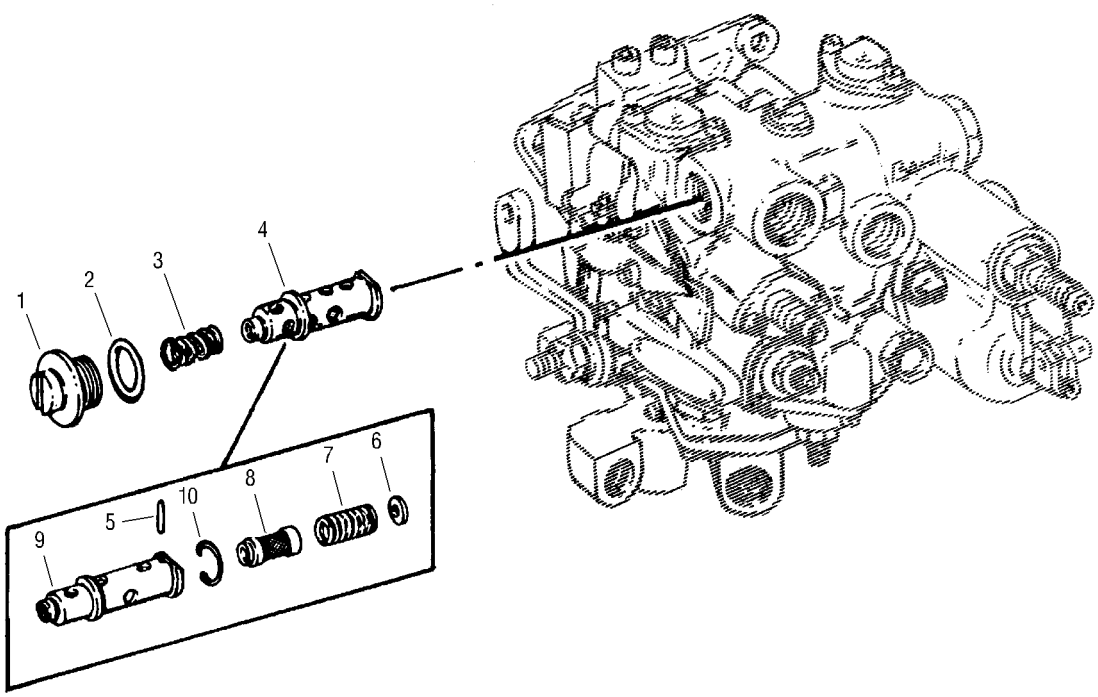
(2) If necessary, remove the fuel control from the engine. Immediately cap all open ports.

CAUTION: KEEP THE WORK AREA CLEAN AT ALL TIMES TO MAKE SURE THAT CONTAMINANTS DO NOT GET INTO THE FUEL CONTROL.

CAUTION: THE FOLLOWING IS AN IMPORTANT CHANGE IN PREVIOUSLY APPROVED PROCEDURE:

CAUTION: DO NOT REMOVE OR CLEAN FUEL CONTROL PC FILTER OR THE PX AND PY BLEEDS; HOWEVER, CONTINUED MAINTENANCE OF THE FUEL CONTROL PX AND PY RESTRICTORS (ORIFICES) IS RECOMMENDED.

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1. Plug
2. Packing
3. Spring
4. Filter assembly
5. Spring Pin
6. Washer
7. Spring
8. Filter
9. Filter sleeve
10. Clip

Fuel Control Fuel Filter Removal
Figure 208

PARA 4.B. (cont)

(3) Remove lockwire securing P_x and P_y restrictors (also referred to as orifices) to the fuel control. Using a 1/8–in. hex wrench, remove, clean and reinstall the P_x restrictor; then, remove clean and reinstall the Py restrictor. (See Figure 209.) Make note of the number of shims removed with each restrictor so that the restrictor will be installed with the exact number of shims that was used during the previous installation.

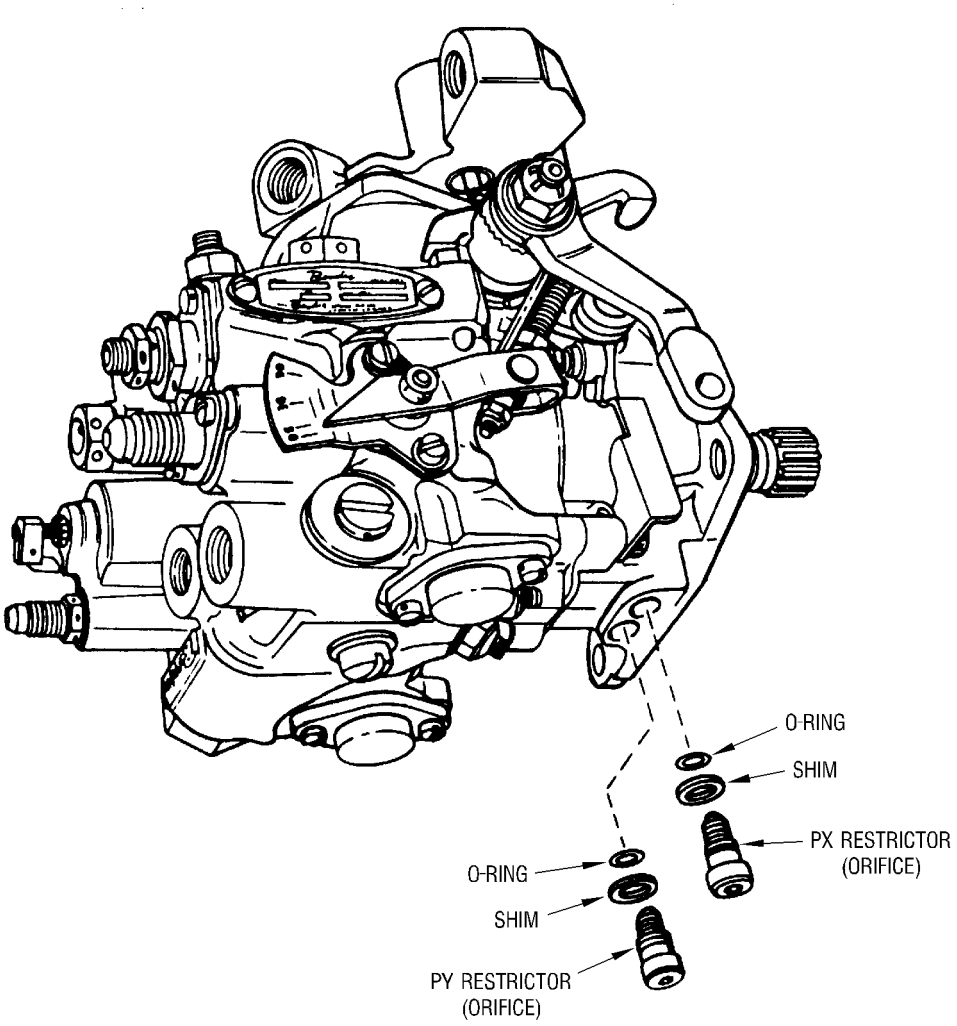
WARNING: PERCHLOROETHYLENE IS TOXIC AND MUST BE USED WITH EXTREME CAUTION. MAKE SURE ADEQUATE VENTILATION IS PROVIDED. REPEATED OR PROLONGED CONTACT WITH THE SKIN SHOULD BE AVOIDED.

(4) Clean the P_x or P_y restrictor ultrasonically if equipment is available. If it is not, agitate the restrictor in perchloroethylene or hydrocarbon solvent. Blow dry. Exercise care to prevent loss if air is directed on the restrictor.

(5) Insert a sewing thread through the restrictor passage; slide the restrictor back and forth on the thread to remove all traces of foreign matter (applies to pre–screened orifice only).

(6) Inspect the restrictor for cleanliness using a flashlight. Shine the light into the through–hole in the restrictor shaft. Look through the orifice end of the restrictor into the lighted through–hole. Reclean the restrictor if any particles or coating can be seen.

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Fuel Control Px and Py Restrictors (Orifices)
Figure 209

PARA 4.B. (cont)

(7) Clean the surface of the P_x (or P_y) flapper valve that mates with the P_x (or P_y) orifice. Access to the flapper valve is through the hole in the fuel control body that retains the P_x (or P_y) orifice. Use a cotton swab with a highly volatile residue–free solvent (chlorothene or equivalent) applied to the tip.

(8) Inspect the valve surface for cleanliness using a flashlight. Reclean the surface if any particles or coating can be seen.

(9) Lightly coat packing with oil conforming to ASTM No. 5 or equivalent and install it with the restrictor and shims into the fuel control. Each restrictor must have the same number of shims installed as were used on the previous installation. Screw in finger tight to ensure shims are properly located; then, tighten to 14–15 lb in. (1.6–1.7 N·m) using a 1/8–in. hex wrench. Do not deviate from this torque. Secure restrictors with lockwire.

(10) Install the starter–generator. Make a visual inspection to ensure the installation is complete.

(11) Make a record of cleaning the P_x restrictor and P_y restrictor in the Engine Log book.

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PARA 4.B. (cont)

(12) If removed, install the fuel control on the engine. (Refer to para 2.B., this section for details.)

(13) Repeat the deceleration check. If deceleration time is less than the allowable minimum, replace the fuel control. (Refer to Deceleration Check, para 3.B., this section, for details.)

(14) Perform an acceleration check.

WARNING: DURING THE ACCELERATION CHECK, THE AIRCRAFT MAY REACT OR BECOME LIGHT ON ITS SKIDS. DO NOT SNAP THE TWIST GRIP TO THE FULL THROTTLE POSITION.

CAUTION: DO NOT EXCEED TORQUE, TEMPERATURE, OR N1 SPEED LIMITS DURING THE ACCELERATION CHECK.

(a) Make a normal engine start. Allow the engine to operate at IDLE (59–65% N_1) until the indicators stabilize.

(b) With the generator switch OFF and the collective pitch control at its minimum position, move throttle control toward full open. Then return control to ground idle (detent) position. Throttle motion need only be rapid enough to demonstrate normal engine acceleration capability. Do not exceed airframe acceleration limits.

(c) Repeat the acceleration check three times to ensure repeat ability (within 1 second).

(d) If acceleration rates are inconsistent, check the rigging using the aircraft manual. Repeat the acceleration check.

(e) If acceleration rate is consistent, no further action is required.

C. Cleaning the Fuel Control P_r–P_g Valve

It is not necessary to remove the fuel control from the engine to clean the P_r–P_g valve. To clean the valve, move the throttle lever (twist grip) through the full range of travel (cutoff to wide open) several times. Check the P_r–P_g valve cam lever to ensure that it follows the cam contour on the throttle shaft. Failure of the cam lever to follow the cam contour indicates binding between the P_r– P_g valve and the housing. If binding does not exist, the problem encountered with the fuel control is not due to malfunction of the P_r–P_g valve. If binding does exist, clean the valve as follows:

(1) Place the throttle lever in the cutoff position.

(2) Pull the valve pin down out of the housing until the valve cam lever is in full contact with the throttle shaft cam.

CAUTION: DO NOT USE METALLIC TOOLS TO PULL THE VALVE DOWN; DAMAGE TO THE HARD COATED SURFACE MAY RESULT. USE A NONMETALLIC PULLER SIMILAR TO THE TYPE USED FOR AIRCRAFT FUSE REMOVAL, IF A PULLER MUST BE USED.

(3) With the valve pin in the fully extended position, carefully direct a spray of alcohol on the valve surface and the lower edge of the P_r–P_g housing. Allow the alcohol to set for at least two minutes to penetrate the dirt effectively.

(4) Wipe the valve clean using a clean cloth dampened with alcohol.

(5) Move the throttle lever through the full range of travel. Check the P_r–P_g valve cam lever to ensure that it follows the cam contour of the throttle shaft. Repeat the cleaning process if the valve still does not follow the cam contour. If after repeated cleaning the valve still does not follow the cam contour, send the fuel control to the distributor for necessary repairs.

NOTE: The P_r–P_g valve may be cleaned as often as necessary to ensure proper operation. Keep the valve clean and dry; do not apply lubricant to keep it operating freely.

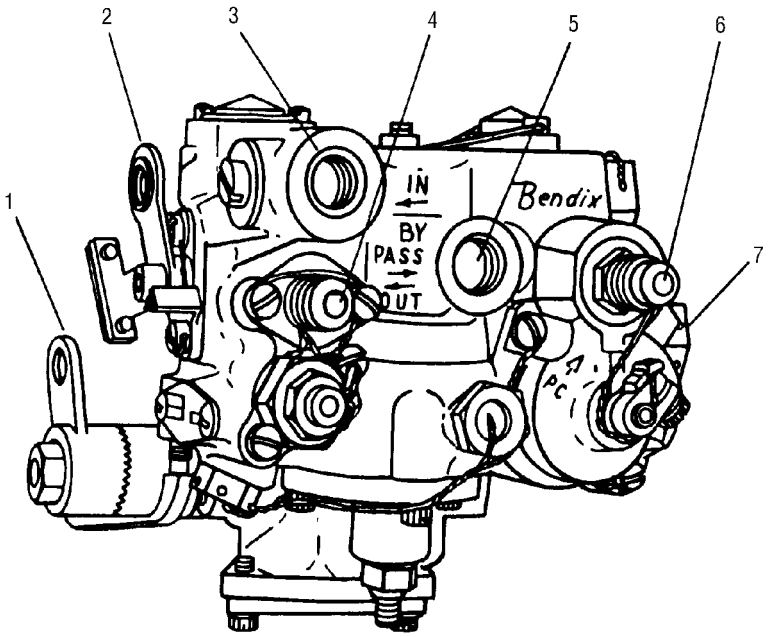
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BENDIX GAS PRODUCER FUEL CONTROL –– MAINTENANCE PRACTICES 250–C20S SERIES ENGINES

1. General

The Bendix gas producer fuel control can be adjusted, the control fuel filter can be cleaned, or the control assembly can be replaced as dictated by the engine trouble condition encountered. (See Figure 201.)

NOTE: Refer to Fuel Control Operational Checks, PARA 3.A., this Section, for a ready method of ground checking the control system and associated linkage.



ADH071XD

1. Throttle Lever
2. Fuel Cutoff Lever
3. Control Inlet Fuel (P_1)
4. Meter Fuel Flow (P_2)
5. Control Bypass (P_o)
6. Sensing Pressure (P_c)
7. Overspeed Bleed (P_y)

Bendix Gas Producer Fuel Control, 250–C20S
Figure 201

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

PARA 1. (cont)

2. Replacement

CAUTION: MAKE SURE THE PNEUMATIC TUBES AND FITTINGS ARE NOT LEAKING. ERRONEOUS PRESSURES WILL CAUSE FUEL CONTROL MALFUNCTION.

Replace the fuel control assembly if it is found to be the cause of engine malfunction.

A. Removal

Remove the gas producer fuel control from the engine as follows: (See Figure 203, 73–00–00.)

CAUTION: WHEN THE FUEL CONTROL IS BEING REMOVED, USE CARE TO PREVENT FOREIGN MATERIALS FROM ENTERING THE PNEUMATIC TUBES OR FUEL CONTROL PORTS.

(1) Remove the linkage connections, fuel and air tubes.

(2) Remove three nuts and washers which secure the control to the power and accessories gearbox housing.

(3) Carefully remove the control.

(4) If the unit is to be replaced, remove all fittings necessary for installation of the replacement unit.

CAUTION: WHEN REMOVING OR INSTALLING FITTINGS, BE CAREFUL NOT TO CAUSE A LOAD ON THE FUEL CONTROL DRIVE SHAFT. USE THE WOODEN PROTECTIVE SHIPPING BLOCK TO PROTECT THE SHAFT FROM THE WORK BENCH.

(5) Drain residual fuel from the rejected fuel control and fill the inlet and bypass ports with oil (Atlantic Refining Co. 31100, or equivalent). Open the cutoff valve, using the fuel cutoff lever, and fill the outlet port with oil. Cap the inlet, bypass and cutoff ports.

B. Installation

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

Install the gas producer fuel control on the engine as follows:

(1) Before installing the Bendix fuel control on the engine, install the required fittings:

CAUTION: USE WOODEN PROTECTIVE SHIPPING BLOCK TO PROTECT THE SHAFT FROM THE WORK BENCH WHEN INSTALLING THE FITTINGS.

(a) Remove and discard all old packings.

(b) Lubricate new packings and install on the fittings.

(c) Install the fuel inlet and fuel bypass unions. Tighten to 75–110 lb in. (8.5–12.4 N·m).

(d) If required, install the P_y union. Tighten to 55–80 lb in. (6.2–9.0 N·m).

(2) Coat fuel control drive shaft with Lubriplate 130A, 930AA or equivalent, the studs with antiseize compound and fuel fittings with oil (Atlantic Refining Co. 31100, or equivalent).

CAUTION: BE CERTAIN THAT THE CONTROL DRIVE PILOT IS PROPERLY INSERTED IN THE GEARBOX.

(3) Install in reverse of removal.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

CAUTION: MAKE SURE THE PROCEDURES AND PRECAUTIONS OF RIGID TUBE INSPECTION AND INSTALLATION, PARA 9., 72–00–00, ENGINE–SERVICING, ARE OBSERVED WHEN INSTALLING FUEL SYSTEM TUBES.

CAUTION: HOLD FUEL CONTROL FITTINGS WITH ONE WRENCH WHILE TIGHTENING B–NUT TO FITTING WITH ANOTHER WRENCH.

(4) Tighten mount pad nuts to 70–85 lb in. (7.9–9.6 N·m).

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PARA 2.B. (cont)

(5) Tighten fuel inlet and bypass lines coupling nuts to 150–200 lb in. (17–23 N·m).

(6) Tighten fuel outlet line coupling nut to 80–120 lb in. (9.0–13.6 N·m).

(7) Tighten fuel control air line coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(8) Attach aircraft linkage to the fuel control lever. If the lever requires repositioning, loosen the nut, reposition the lever, then tighten the nut to 40–50 lb in. (4.52–5.65 N·m).

(9) Check the fuel control lever travel using the cockpit control. The lever stop arm on the fuel control must bottom out on the minimum and maximum speed stops. (Refer to Rigging Check, para 3.B., this section.)

(10) After the fuel control has been replaced, bleed air from the system. (Refer to Purging the Fuel System, para 2.D., 73–00–00.)

(11) Perform fuel control system pneumatic leak check. (Refer to Fuel Control System Pneumatic Leak Check, para 2.B., 73–00–00.)

(12) Check run the engine after fuel control replacement. (Refer to Check Run, para 1., 72–00–00, Engine—Adjustment/Test.)

NOTE: After the fuel control has been changed, if a false start is encountered or a start is not completed in one minute, return the Fuel Cutoff lever to FUEL OFF and motor the engine without ignition for 10 seconds before attempting another start.

(13) Make a fuel control operational check. (Refer to Fuel Control Operational Checks, para 3.A., this section.)

(14) Make appropriate entry relative to fuel control replacement in the Engine Log.

3. Adjustment/Test

The adjustments that can be made on the fuel control are idle speed, maximum speed, a wide range start derichment and acceleration fuel flow schedule.

A. Fuel Control Operational Checks

Ground check the control system by making a check of the rigging followed by a check of the idle speed setting.

(1) Check rigging. (Refer to Rigging Check, para 3.B., this section.)

(2) Check idle speed setting. (Refer to Ground Idle Speed Setting, para 3.C., this section.)

(3) Clean the fuel control P_c filter. (Refer to P_c filter cleaning, para 4.B., this section.)

B. Rigging Check

Check the rigging of the gas producer fuel control, and the power turbine governor after installation. Make the rigging check using the following procedures prior to starting the engine.

(1) Gas Producer Fuel Control Rigging Check. (Refer to the appropriate Aircraft Maintenance Manual.)

(a) Begin the gas producer fuel control rigging check by moving the aircraft Power Lever to the FLIGHT IDLE position. Insert a 0.187 in. (4.75 mm) dia rig pin at the 40° throttle rigging location on the fuel control.

(b) Remove the rig pin and advance the aircraft Power Lever to the TAKEOFF position. Check to ensure that the gas producer fuel control throttle lever is against the maximum speed stop.

(c) Retard the aircraft Power Lever to the GROUND IDLE position. Check to ensure that the gas producer fuel control throttle lever is against the minimum speed stop.

(d) Move the aircraft Fuel Cutoff Lever to the full OPEN position. Check that the gas producer fuel control cutoff lever is at its maximum position.

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PARA 3.B. (cont)

(e) Move the aircraft Fuel Cutoff Lever to the CLOSED position. Check that the gas producer fuel control cutoff lever engages the fuel cutoff detent (labeled C.O.) on the detent plate.

(f) Repeat steps (a) through (e) and check for repeatability.

(2) Power Turbine Governor Rigging Check. (Refer to the appropriate Aircraft Maintenance Manual.)

(a) Set the power turbine governor lever at 40 + 1 degrees from the maximum speed stop.

C. Ground Idle Speed Setting

Check the ground idle speed setting with the engine running. Stabilized idle speed should repeat each time, whether the power lever is moved slowly or snapped to the idle position. Failure to repeat is cause for a recheck of the rigging. Check for proper idle adjustment and rigging as follows:

(1) Make a normal start. Stabilize at Idle.

(2) Turn generator switch off.

(3) Ensure that the Aircraft Control Lever is at the maximum (100% propeller speed) position.

(4) Advance the Power Lever above FLIGHT IDLE and stabilize for at least 15 seconds.

(5) Retard the Power Lever to GROUND IDLE and note the stabilized N_1 speed.

(6) Advance the Power Lever above FLIGHT IDLE again and stabilize for 15 seconds.

(7) Retard the power lever to GROUND IDLE and note the stabilized N_1 speed. It must be the same (approximately) as the N_1 speed noted in step d.

(8) Shut down the engine.

(9) If the idle speed did not repeat, improper rigging adjustment or excessive looseness in the airframe, or engine linkage is indicated. Check the linkage for general condition and looseness. Check the power lever–to–fuel control gas producer lever rigging. (Refer to Rigging Check, para 3.B., this section.)

(10) When repeatability is obtained within 1%, stabilize at GROUND IDLE and check to ensure that N_1 speed is within the range of 59–65%.

(11) If adjustment is required, turn the idle speed adjustment clockwise to increase, counterclockwise to decrease N_1 speed using wrench 6798292. (See Figure 202.) A 1/8 turn adjustment changes N_1 speed approximately 5%.

D. Acceleration Check

Perform the acceleration check as follows:

CAUTION: DO NOT EXCEED TORQUE, TEMPERATURE, OR N_1 SPEED LIMITS DURING THE ACCELERATION CHECK.

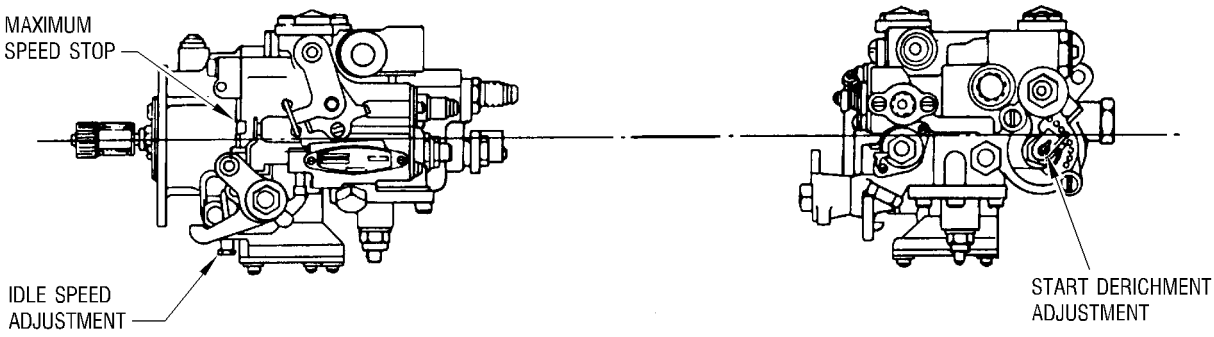
(1) Make a normal engine start. Stabilize at FLIGHT IDLE.

(2) Using a power lever (throttle) movement that is quick enough to require the engine to demonstrate normal engine acceleration capability, advance the power lever (throttle) to 100% N_2. Note that N_1 and N_2 acceleration rates are normal.

(3) Repeat the acceleration check three times to ensure repeatability.

(4) If acceleration is too slow, clean the fuel control air circuits. (Refer to Cleaning the Gas Producer Fuel Control Air Circuits, para 4.B., this section.)

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Gas Producer Fuel Control Adjustments
Figure 202

PARA 3.D. (cont)

(5) If acceleration rates are inconsistent check the rigging using the Aircraft Manual. Repeat the acceleration check.

(6) If acceleration check is consistent, no further action is required.

E. Cutoff Valve Operational Check

An operational check of the fuel control cutoff valve shall be made when an early lightoff or an afterfire is encountered. Make the check as follows:

CAUTION: DO NOT ADJUST THE MINIMUM STOP TO COMPENSATE FOR AIRCRAFT RIGGING DIFFICULTIES. THE MINIMUM STOP IS SET ON A FLOW BENCH AND IS NOT A FIELD ADJUSTMENT.

(1) Make sure there is sufficient travel in the aircraft control system to allow physical contact with the gas producer fuel control minimum stop at or before the fully closed position of the condition lever.

(2) Deactivate the ignition system.

WARNING: BE AWARE OF THE POTENTIAL FIRE HAZARD OF FUEL IN AN OPEN CONTAINER.

(3) Disconnect the fuel supply hose from the fuel nozzle and place the hose in a clean container.

(4) Close the condition lever until it is seated firmly on the fuel cutoff lever stop.

(5) Motor the engine for approximately 15 seconds. There should be no fuel coming from the fuel supply hose. If fuel continues to flow during the motoring operation, the fuel control must be replaced.

(6) Reconnect the fuel supply hose to the fuel nozzle. Tighten coupling nut to 80–120 lb in. (9.0–14.7 N·m).

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PARA 3.E. (cont)

(7) Reactivate the ignition system.

F. Maximum Speed Stop (See Figure 202.)

CAUTION: DO NOT ADJUST MAXIMUM SPEED STOP IF 810°C (1490°F) TOT CAN BE REACHED. DO NOT EXCEED 105% N_1.

NOTE: Maximum speed adjustment is not a periodic adjustment. It should be made only when absolutely required. In situations where N_1 speed peaks below the stated limit and TOT is below the maximum limit, resulting in a low power condition, maximum speed adjustment may restore specified performance. Do not adjust more than one turn at a time. Operate the engine after each adjustment to confirm the results.

Adjust screw clockwise to increase or counterclockwise to decrease N_1 speed. One turn equals approximately a 1% speed change.

G. Engine Starting Characteristics Adjustments

CAUTION: INCORRECT FUEL CONTROL STARTING ADJUSTMENT MAY BE DETRIMENTAL TO THE GAS PRODUCER TURBINE LIFE. CONSISTENT LONG, COOL STARTS, AS WELL AS OVERTEMPERATURE STARTS, ARE POTENTIALLY DAMAGING TO THE GAS PRODUCER TURBINE.

There are two fuel control adjustments which can be used to change the starting characteristics of the engine. These adjustments are a Start–Derichment Adjustment in addition to a Start/Acceleration Adjustment. (See Figure 203.) The conditions which can be improved by these adjustments are given in Table 201. Correct these conditions using the stated recommended adjustment(s).

(1) Start–Derichment Adjustment. (See Figure 202 and 203.)

The start–derichment (derich) adjustment can be used to correct lean (slow) start or rich (hot) start conditions. This adjustment is effective below 33% N_1 speed. For slow starts at N_1 speeds between 35% and 55% N_1 speed, refer to Start/Acceleration Fuel Flow Adjustment, para 3.G.(2), this section. (Refer to Table 201.)

NOTE: The start–derichment adjustment has a wide (200°) angular range. Neutral position is 7 dots (70°) from the CCW stop. The effective start–derichment speed range is between 20% and 33% N_1 speed. Also, turning the adjustment to the CW stop closes the Py vent which deactivates the start–derichment adjustment.

To accurately determine the proper adjustment, conditions under which the adjustment are made should be consistent; i.e., a fully charged aircraft battery, the same residual TOT and the same lightoff speed.

(a) For low temperature with slow starts at 20–33% N_1 speed, adjust the start derichment as follows:

1 Remove the lockwire securing the adjustment locknut to the P_c filter fitting.

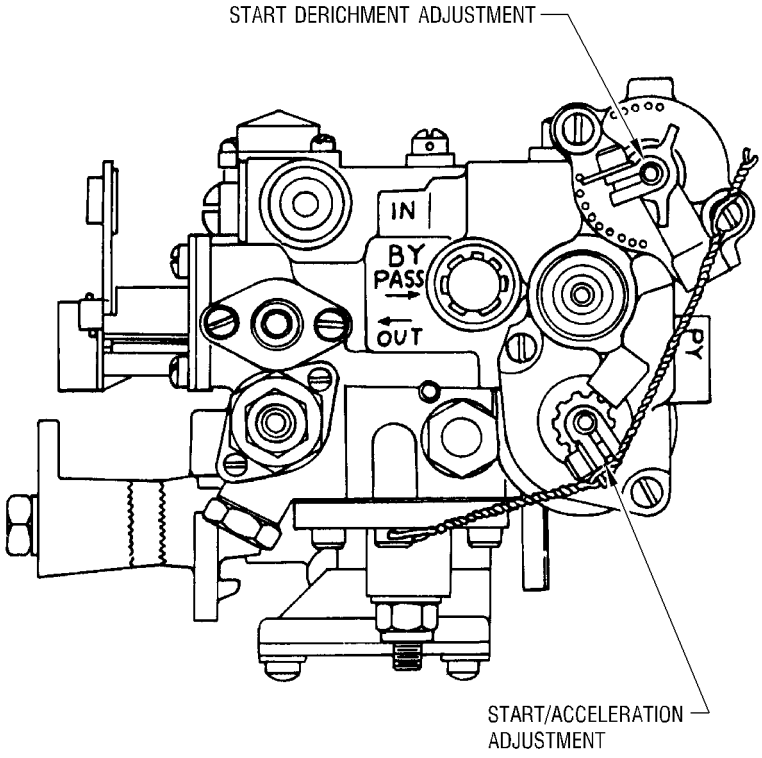
CAUTION: DO NOT DISTURB THE POINTER–TO–SHAFT SEALED WIRE AT ANY TIME. THIS IS AN OVERHAUL FUNCTION ONLY.

2 Loosen the adjustment locknut.

3 Make the adjustment using an Allen wrench. Turn clockwise to enrich the starting fuel flow to improve stagnated starts, cold weather starts, or high altitude ground starts. Make the adjustment in 15° maximum increments (dots are 10° apart) and tighten the locknut to 20–25 lb in. (2.3–2.8 N·m) after each setting. Check the starting peak TOT after each setting until satisfactory starts are made.

4 When the desired adjustment is obtained, secure the locknut to the P_c filter fitting with lockwire.

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Start/Acceleration and Start/Derichment Adjustments
Figure 203

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Table 201

Adjustments to Improve Starting

Condition	Recommended Adjustments
Excessive light off temperature — N_1 speed below 20% and over 1490°F (810°C) with a momentary peak of one second max at 1700°F (927°C) for a period not to exceed 10 seconds.	Adjust start/acceleration CCW. If any additional correction is necessary, adjust start–derichment CCW. Refer to PARA 3.G.(1) and (2), this section, for procedures.
Low lightoff temperature — N_1 speed below 20% and slow acceleration with lightoff temperature below 1022°F (550°C).	Adjust start/acceleration CW. Refer to PARA 3.G.(2), this section, for procedure.
High rapid temperature rise with N_1 speed at 25–30%.	Adjust start–derichment CCW. If any additional correction is necessary adjust start/acceleration CCW. Refer to PARA 3.G.(1) and (2), this section, for procedures.
Low lightoff temperature with slow start — N_1 speed hesitation at 20–30% and lightoff temperature below approx 1022°F (550°C) with starting time approaching 60 seconds (or more).	Adjust start–derichment CW. If any additional correction is necessary adjust start/acceleration CW. Refer to PARA 3.G.(1) and (2), this section, for procedures.
High lightoff temperature — N_1 speed at 35–55% and over 1490°F (810°C) with a momentary peak of one second max at 1700°F (927°C) for a period not to exceed 10 seconds.	Adjust start/acceleration CCW. Refer to PARA 3.G.(2), this section, for procedure.
Low lightoff temperature with slow–to–hung starts — N_1 speed hesitation at 35–55% and lightoff temperature below approx 1022°F (550°C) with starting time approaching 60 seconds (or more).	Adjust start/acceleration CW. Refer to PARA 3.G.(2), this section, for procedure.

PARA 3.G. (cont)

CAUTION: MONITOR TOT CLOSELY AFTER START–DERICHMENT ADJUSTMENT TO BE SURE OVERTEMPERATURE LIMITS ARE NOT EXCEEDED.

(b) Rich (hot) starts may be caused by delayed ignition, or premature opening of the throttle. However, hot starts due to high fuel flow are normally caused by the fuel control. When the fuel control is suspected, make an adjustment of the start–derich setting as follows:

1 Remove lockwire and loosen the adjustment locknut. (See Figure 203.)

2 Make the adjustment using an Allen wrench. Turn counterclockwise (CCW) to lean–out the fuel flow. Make the adjustment in 15° maximum decrements. The dots are 10° apart. and tighten the locknut after each setting. Check the starting peak TOT after each setting until satisfactory starts are made.

3 When the desired adjustment is obtained, secure the locknut to the P_c filter fitting with lockwire.

(2) Start/Acceleration Fuel Flow Adjustment.

The start/acceleration fuel flow schedule adjustment maintains the gas producer fuel control starting schedule within acceptable limits during normal service lift.

(a) To optimize engine starting, the start–derichment adjustment should be made in conjunction with the start/acceleration adjustment. Refer to Table 201.

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PARA 3.G. (cont)

(b) Remove lockwire and make the start–acceleration fuel flow adjustment as follows:

CAUTION: DO NOT USE THE START/ACCELERATION ADJUSTMENT TO CORRECT FOR NORMAL MAINTENANCE ITEM SUCH AS MIS–RIGGING, AIR LEAKS, FUEL LEAKS, FAULTY FUEL NOZZLE, IGNITION PROBLEMS, STARTER–GENERATOR SYSTEM PROBLEMS ETC. DO NOT USE THE START/ACCELERATION ADJUSTMENT EXCLUSIVELY TO IMPROVE ENGINE STARTING. EXCESSIVE CW SETTINGS BEFORE ENCOUNTERING OVERTEMPERATURE RESULTS IN A SINGLE HIGH PEAK TOT OVER A WIDE SPEED RANGE FOR A LARGE PART OF THE STARTING TIME. USE THE START–DERICH ADJUSTMENT WITH THE START/ACCELERATION ADJUSTMENT TO OPTIMIZE ENGINE STARTING.

NOTE: To accurately determine the proper adjustment, conditions under which the adjustments are made should be consistent, i.e., a fully charged aircraft battery, the same residual TOT and the same lightoff speed.

There are eight positions for the adjuster (the neutral position is three clicks from the CCW stop). Detent grooves hold the adjuster in the selected one of these positions without the need of a jam nut.

A required adjustment of more than two clicks CW is an indication that the fuel control is not the cause of the problem.

1 For low lightoff temperature or slow/hung starts, turn the adjuster CW. Make the adjustment in changes of one detent (click) at a time.

CAUTION: AN OVER ADJUSTMENT OF THE START/ACCELERATION CW SETTING CAN CAUSE OVERTEMPERATURE STARTS OR COMPRESSOR SURGE.

2 For excessive lightoff temperature starts, turn the adjuster CCW. Make the adjustment in changes of one detent (click) at a time.

CAUTION: AN OVER ADJUSTMENT OF THE START/ACCELERATION CCW SETTING CAN CAUSE A DECREASE IN STARTING TIME TO A POSSIBLE HUNG START.

3 When the final start/acceleration adjuster position is established, lockwire the pointer in accordance with Figure 203.

4 Check idle speed and deceleration time after the final start setting is determined. (Refer to Ground Idle Speed Setting, PARA 3.C., this Section.)

4. Cleaning

A. Cleaning Gas Producer Fuel Control Fuel Filter

Remove, clean and reinstall the fuel control fuel filter as follows: (See Figure 204.)

(1) Remove lockwire from the plug.

NOTE: Thoroughly clean the exterior of the fuel control in the area of the plug to prevent contaminants from getting into the port after it is opened.

(2) Remove the plug, spring and the filter from the fuel control. Discard packing.

(3) Remove the clip and spring pin. Separate the washer, spring and filter from the filter sleeve.

CAUTION: DO NOT ATTEMPT TO OPEN A CLOGGED SCREEN WITH A SHARP INSTRUMENT.

(4) Clean the filter parts ultrasonically if equipment is available. If equipment is not available, agitate the parts in mineral spirits. Dry parts using clean shop air regulated to approximately 15 psig (103 kPa). Air pressure should be applied to the exterior of the filter. Repeat the procedure if visual inspection with a bright light shows that the interior of the filter is not entirely free of contaminants.

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PARA 4. (cont)

(5) The following cleaning procedure may be used as an alternate if the method described in step (4) does not clean the filter satisfactorily.

WARNING: SULPHURIC ACID CAUSES SEVERE BURNS. DO NOT GET IN EYES, ON SKIN OR ON CLOTHING. DO NOT ADD WATER TO ACID WHILE IN A CONTAINER BECAUSE OF VIOLENT REACTION. IN THE EVENT OF CONTACT WITH SULPHURIC ACID, IMMEDIATELY FLOOD EXPOSED SKIN OR CLOTHING WITH WATER. FOR EYES, FLUSH HEAVILY WITH WATER AND OBTAIN IMMEDIATE MEDICAL ATTENTION.

(a) Immerse the filter in sulphuric acid (specific gravity 1.82 to 1.84) containing approximately 20 grams of sodium dichromate per liter (0.2642 U.S. gallon) for a period of two to five minutes at room temperature.

(b) Rinse in hot running water and dry with a hot air blast.

CAUTION: BE SURE THE FILTER ASSEMBLY IS INSTALLED AS SHOWN IN FIGURE 204 WITH THE OPEN END TOWARD THE OUTSIDE OF THE CONTROL, AWAY FROM THE SPRING. DO NOT INSTALL BACKWARDS.

(6) Reassemble the filter, spring, and washer in the filter sleeve. Secure the components in the sleeve with the spring pin and clip.

(7) Lightly lubricate a new packing (Bendix P/N 557S6) with engine fuel and place it on the plug. Install the filter assembly, spring and the plug in the fuel control. Tighten plug to 65–70 lb in. (7.3–7.9 N·m) and secure with lockwire.

NOTE: If the old packing must be reused, dry it under a heat lamp to restore dimensions.

B. Cleaning Gas Producer Fuel Control Air Circuits

If fast or slow deceleration, overspeed, slow acceleration, high idle speed, and/or auto acceleration are encountered, the air circuits of the fuel control may be contaminated. Clean the fuel control P_c filter, P_x and P_y bleeds and P_x and P_y restrictors when these difficulties are encountered.

(1) Remove and clean the P_c filter as follows:

(a) If necessary, remove the fuel control from the engine. Immediately cap all open ports.

CAUTION: KEEP THE WORK AREA CLEAN AT ALL TIMES TO ENSURE THAT CONTAMINANTS DO NOT GET INTO THE FUEL CONTROL.

(b) Clean the P_c filter area of the fuel control with methylethylketone. Blow dry.

(c) Remove the P_c filter. (See Figure 205.) Carefully remove the three packings from the filter. These packings are reusable if undamaged.

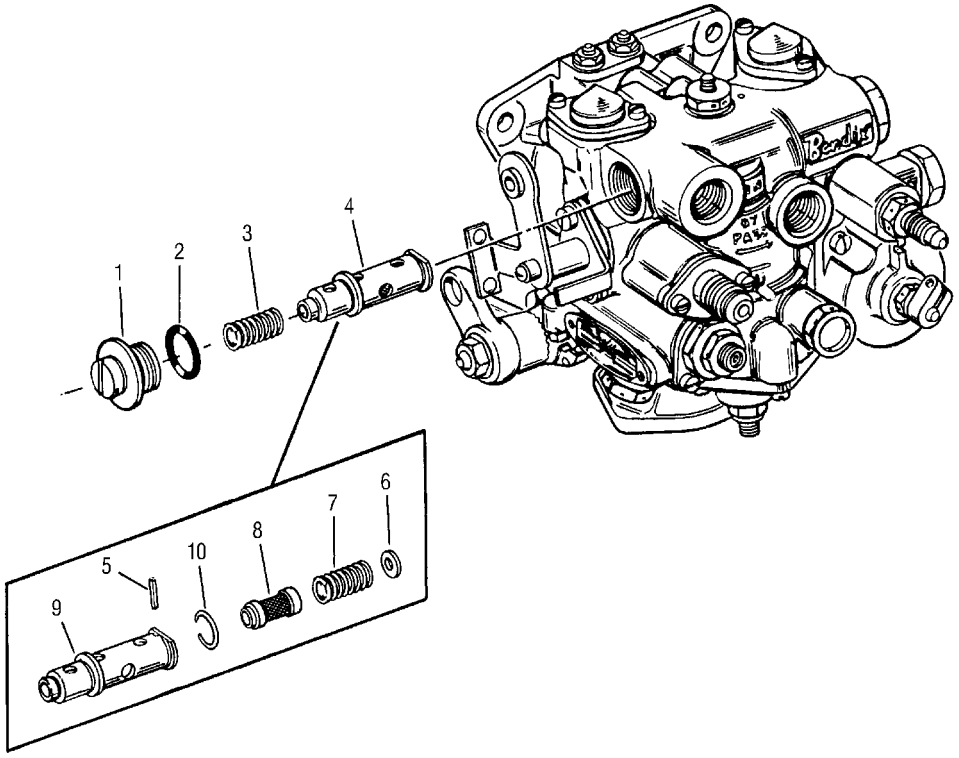
CAUTION: USE NORMAL PRECAUTIONS WHEN WORKING WITH SULPHURIC ACID. CLEANING TIME OF THE FILTER WHEN USING SULPHURIC ACID OF 1.175 SPECIFIC GRAVITY SHOULD NOT EXCEED 30 MINUTES.

(d) Agitate the P_c filter in a solution of sulphuric acid or electrolyte that has a specific gravity of approximately 1.175. After removal from the cleaning solution, thoroughly rinse the filter in water to neutralize the acid.

NOTE: Mineral spirits may be used if sulphuric acid is not available.

(e) Suction clean the P_c filter chamber in the fuel control. (See Figure 206.)

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1. Plug
2. O–ring
3. Spring
4. Filter Assembly
5. Spring Pin
6. Washer
7. Spring
8. Filter
9. Filter Sleeve
10. Clip

Fuel Control Fuel Filter Removal
Figure 204

PARA 4.B. (cont)

(2) Remove, clean and reinstall P_X and P_Y bleeds as follows:

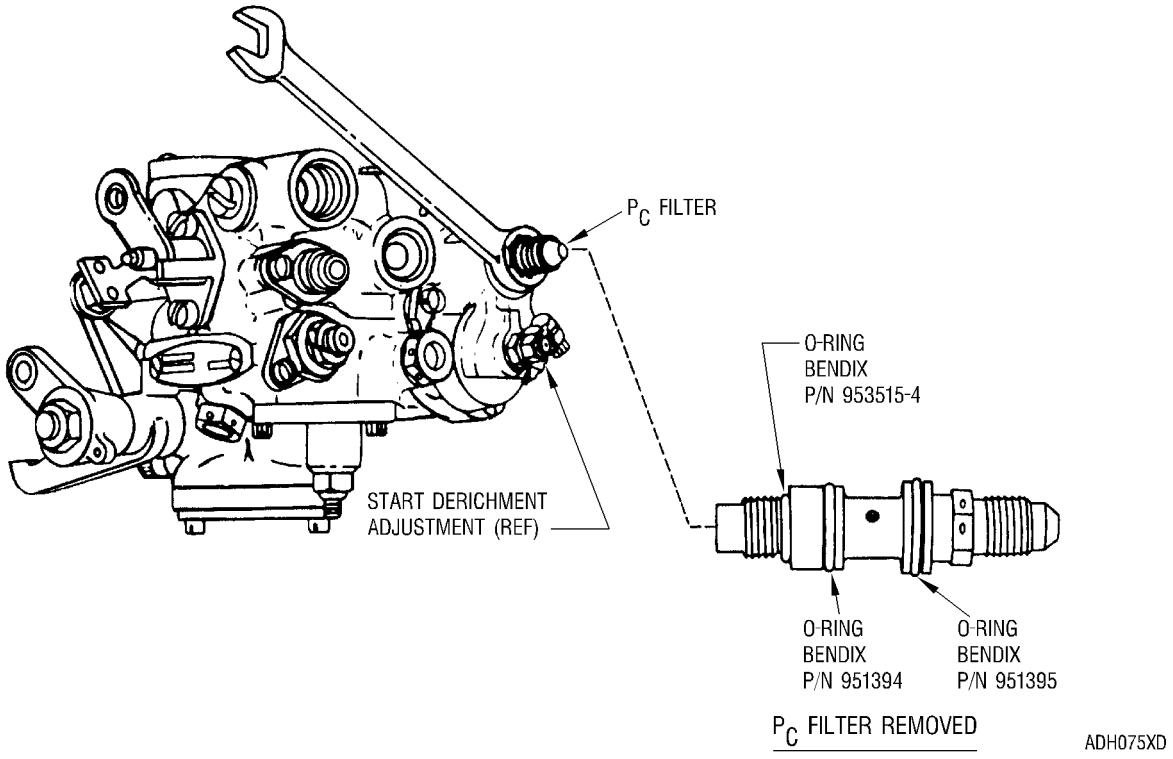
CAUTION: TO AVOID INTERMIXING THE P_X AND P_Y BLEEDS, DO NOT REMOVE BOTH BLEEDS AT THE SAME TIME. THE P_X AND P_Y BLEEDS ARE NOT INTERCHANGEABLE.

(a) Remove, clean, and reinstall the P_x bleed; then, remove, clean, and reinstall the P_y bleed. Use Bendix No. T26927 wrench or No. 2550678 screw driver (as required by the fuel control configuration) for removing or installing the bleeds. (See Figure 206.)

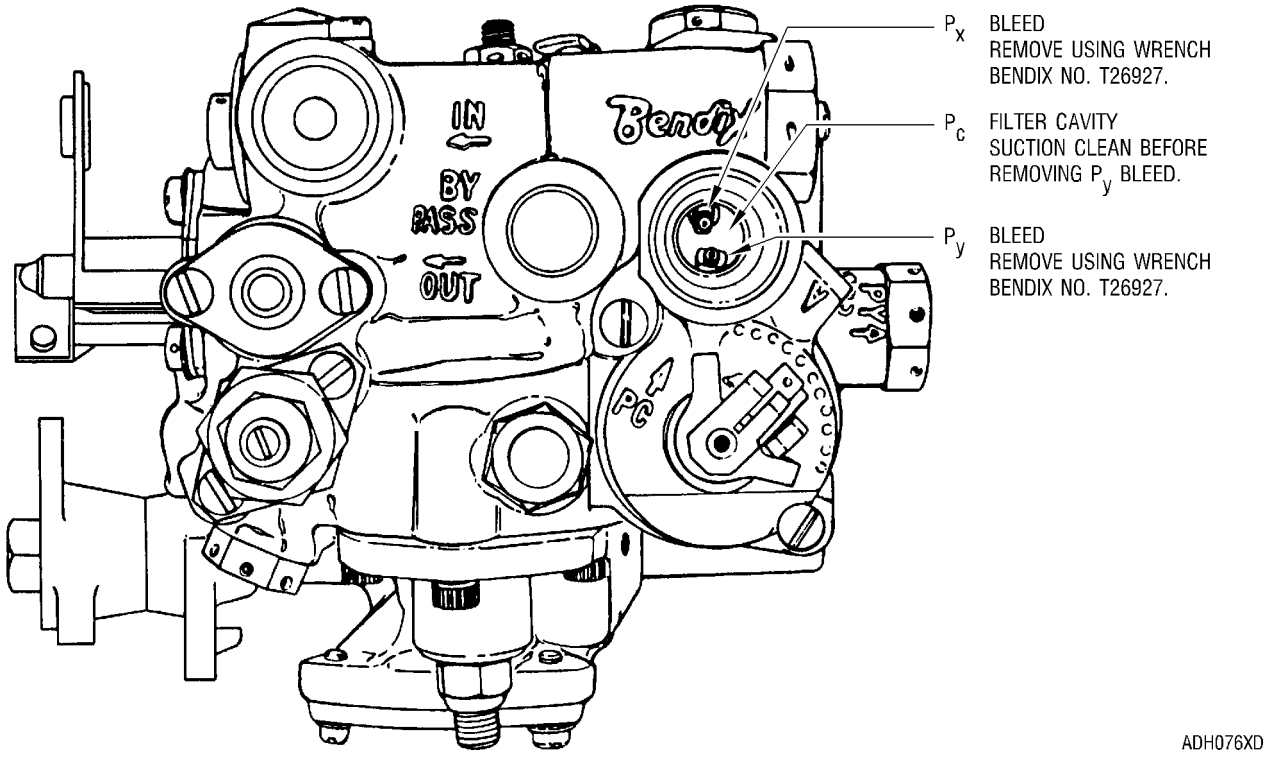
(b) Clean the P_x or P_y bleed ultrasonically if equipment is available; if it is not, hold the bleed with instrument tweezers and agitate it in mineral spirits in a clean container. Insert a sewing thread through the bleed hole. Slide the bleed back and forth on the thread to remove the film.

CAUTION: DO NOT BLOW THE BLEED DRY. THE SMALL BLEED CAN BE EASILY LOST OR DAMAGED.

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Fuel Control P_c Filter Removal
Figure 205



Fuel Control P_x and P_y Bleeds Removal
Figure 206

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PARA 4.B. (2) (cont)

(c) Inspect the P_x or P_y bleed for cleanliness using a flashlight. Place the bleed on the center of the lens so the light can be seen through the bleed hole. Reclean the bleed if any particles or coating can be seen.

CAUTION: DO NOT USE A PROBE TO REMOVE PARTICLES LODGED IN THE BLEED.

(d) Install the cleaned P_x or P_y bleed in the fuel control using wrench Bendix No. 726927. Tighten to 9–11 lb in. (1.02–1.24 N·m).

(3) Install the P_c filter in the fuel control. If new packings are required use Bendix P/N 953515–4, 951394, and 951395. Sparingly lubricate all packings with petrolatum. Tighten the fitting to 40–50 lb. in. (4.5–5.6 N·m).

(4) Remove, clean and reinstall P_x and P_y restrictors as follows:

CAUTION: TO AVOID INTERMIXING THE P_X AND P_Y RESTRICTORS, DO NOT REMOVE BOTH RESTRICTORS AT THE SAME TIME. THE RESTRICTORS ARE NOT INTERCHANGEABLE.

(a) Remove lockwire securing P_x and P_y restrictors (also referred to as orifices) to the fuel control. Using a 1/8–in. hex wrench, remove, clean and reinstall the P_x restrictor; then, remove, clean and reinstall the P_y restrictor. (See Figure 207.) Make note of the number of shims removed with each restrictor so that the restrictor will be installed with the exact number of shims that was used during the previous installation.

(b) Clean the P_x or P_y restrictor ultrasonically if equipment is available. If it is not, agitate the restrictor in chlorothene or hydrocarbon solvent. Blow dry. Exercise care to prevent loss if air is directed on the restrictor. Insert a sewing thread through the restrictor passage; slide the restrictor back and forth on the thread to remove all traces of foreign matter.

(c) Inspect the restrictor for cleanliness using a flashlight. Shine the light into the through–hole in the restrictor shaft. Look through the orifice end of the restrictor into the lighted through–hole. Reclean the restrictor if any particles or coating can be seen.

(d) Clean the surface of the P_x (or P_y) flapper valve that mates with the P_x (or P_y) orifice. Access to the flapper valve is through the hole in the fuel control body that retains the P_x (or P_y) orifice. Use a cotton swab with a highly volatile residue–free solvent (chlorothene or equivalent) applied to the tip.

(e) Inspect the valve surface for cleanliness using a flashlight. Reclean the surface if any particles or coating can be seen.

(f) Lightly coat packing with oil conforming to ASTM No. 5, or equivalent, and install it with the restrictor and shims into the fuel control. Each restrictor must have the same number of shims installed with it as were used on the previous installation of the restrictor. Screw in finger tight to ensure shims are properly installed; then, tighten to 14–15 lb in. (1.6–1.7 N·m) using a 1/8–in. (3 mm) hex wrench. Do not deviate from this torque. Secure restrictors with lockwire.

(5) Make a record of cleaning the P_c filter, P_x bleed, P_y bleed, P_x restrictor and P_y restrictor in the Engine Log.

(6) Install the fuel control on the engine.

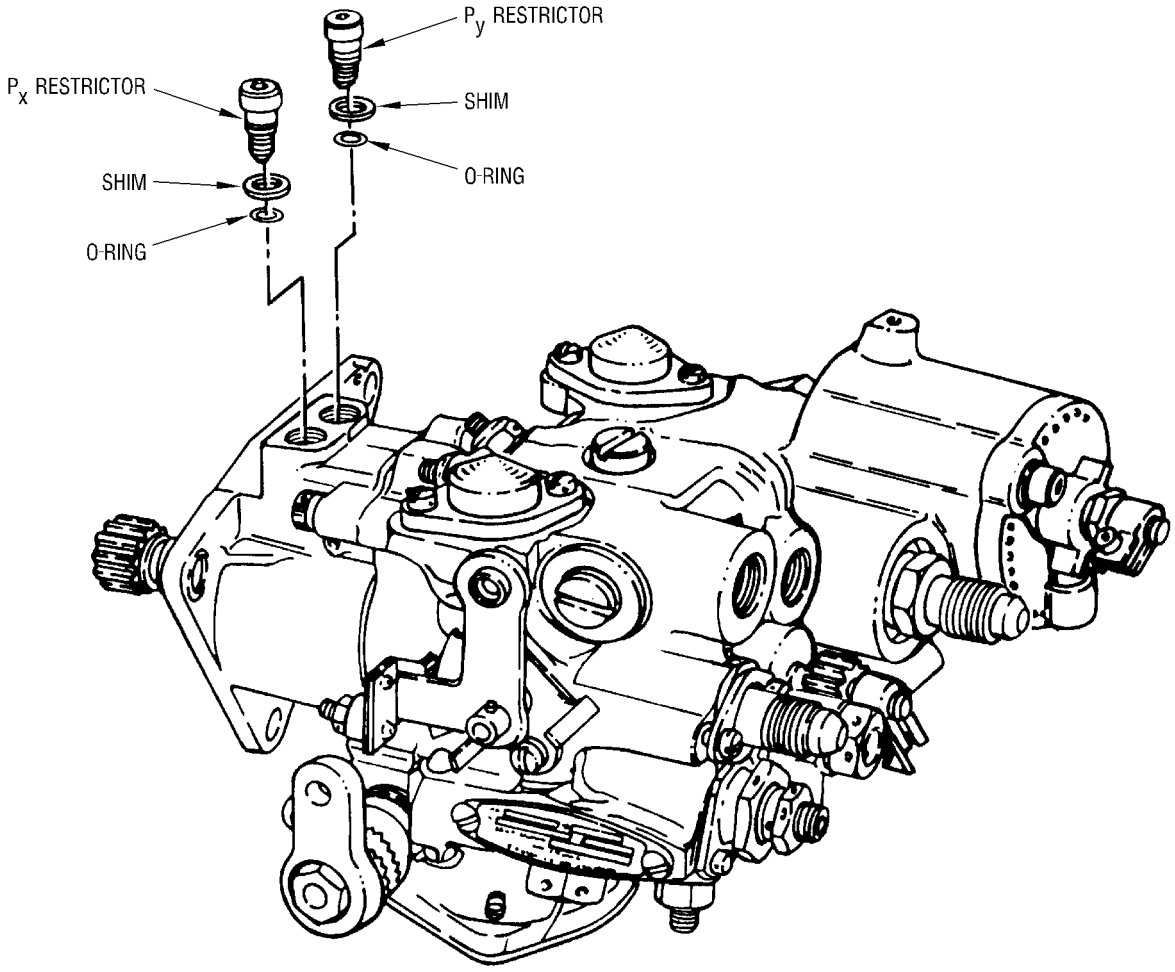
(7) Perform an acceleration check. (Refer to Acceleration Check, para 3.D., this section.)

(a) If acceleration is too slow, replace the fuel control.

(b) If acceleration rates are inconsistent check the rigging using the Aircraft Manual. Repeat the acceleration check.

(c) If acceleration check is consistent, no further action is required.

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Bendix Fuel Control P_x and P_y Restrictors (Orifices)
Figure 207

ADH077XF

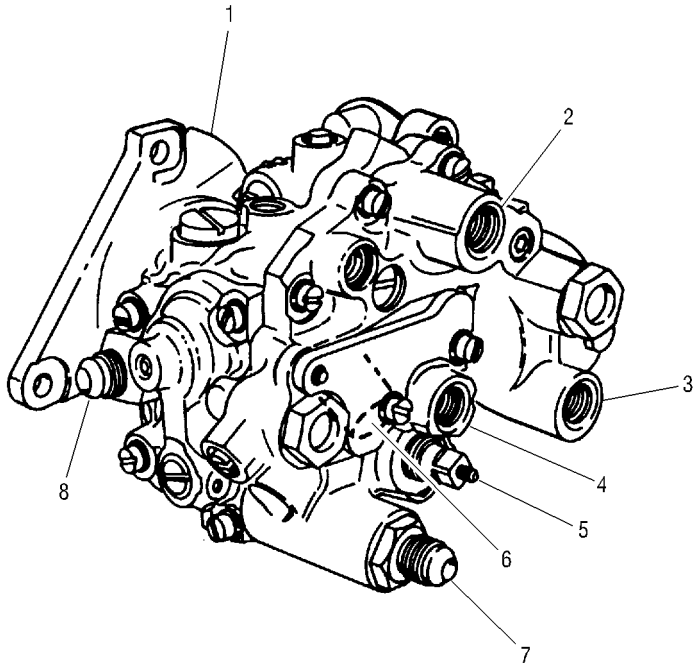
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CECO GAS PRODUCER FUEL CONTROL –– MAINTENANCE PRACTICES 250–C20, –C20B, –C20J SERIES ENGINES

1. General

The Chandler Evans (CECO) gas producer fuel control can be adjusted, the control fuel filter can be cleaned, or the control assembly can be replaced as dictated by the engine trouble condition encountered. (See Figure 201.)

NOTE: Refer to Fuel Control Operational Checks, para 3.A., this section, for a ready method of ground checking the control system and associated linkage.



ADH054XD

1. Overboard Drain (2)
2. Bypass Port (P_o)
3. Compressor Discharge Pressure (P_c)
4. Metered Fuel to Governor (P_2)
5. Lightoff Adjustment
6. Metered Fuel from Governor (P_3) (on unseen side of control)
7. Fuel Inlet from Pump (P_1)
8. Fuel to Nozzle (P_3)

CECO Gas Producer Fuel Control
Figure 201

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2. Replacement

CAUTION: BE SURE THE PNEUMATIC TUBES AND FITTINGS ARE NOT LEAKING. ERRONEOUS PRESSURES WILL CAUSE FUEL CONTROL MALFUNCTION.

Replace the fuel control assembly if it is found to be the cause of engine malfunction.

CAUTION: IF THE ENGINE INSTALLATION IN THE AIRCRAFT IS RESTRICTED TO LESS THAN 400 HP (298 KW), CHANGE THE MAX FUEL FLOW STOP SETTING OF THE REPLACEMENT CONTROL (OR THE CONTROL ON A REPLACEMENT ENGINE) FROM 270 PPH (122 KG/HR) TO THE VALUE SPECIFIED IN THE AIRCRAFT HANDBOOK. (FOR CONVENIENCE, THE CONTROL ADJUSTMENT INSTRUCTIONS ARE CONTAINED IN THE MAX FLOW STOP ADJUSTMENT PARA 3.H., THIS SECTION.

CAUTION: USE CONTAINERS AND RAGS AS NECESSARY TO MINIMIZE FUEL SPILLAGE IN THE ENGINE COMPARTMENT WHEN REMOVING LINES WHICH CONTAIN FUEL. ALSO USE CARE TO PREVENT FOREIGN MATERIALS FROM ENTERING THE LINES OR THE FUEL CONTROL PORTS.

A. Removal

Remove the gas producer fuel control from the engine as follows: (See Figure 201, 73–00–00.)

CAUTION: WHEN THE FUEL CONTROL IS BEING REMOVED, USE CARE TO PREVENT FOREIGN MATERIALS FROM ENTERING THE PNEUMATIC TUBES OR FUEL CONTROL PORTS.

(1) Disconnect the following tubes from the gas producer fuel control. Cap the control fittings when the tubes are removed.

(a) Compressor discharge pressure (P_c)

(b) Fuel supply (P_1)

(c) Fuel bypass (P_o)

(d) Metered fuel (two lines, P_2 and P_3)

(e) Overboard drain

(f) Outlet tube to fuel nozzle (fire shield)

(2) Remove the gas producer lever linkage.

(3) Remove the three nuts and washers. Remove the fuel control from the gearbox.

CAUTION: WHEN REMOVING OR INSTALLING FITTINGS, BE CAREFUL NOT TO APPLY A LOAD ON THE FUEL CONTROL DRIVE SHAFT.

(4) If the fuel control is to be replaced, remove all fittings needed for installation of the replacement unit. Discard packings.

B. Installation

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

Install the gas producer fuel control on the engine as follows:

(1) Before installing the CECO fuel control on the engine, install the required fittings:

(a) Remove and discard all old packings.

(b) Lubricate new packings and install on the fittings.

(c) Install the P_c to fuel control, governor to fuel control, and fuel control to fire shield unions. Tighten to 55–80 lb in. (6.2–9.0 N·m).

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PARA 2.B. (cont)

(d) Install the fuel bypass union. Tighten to 75–110 lb in. (8.5–12.4 N·m).

(e) Install the two elbows and jam nuts. Do not tighten jam nuts at this time.

(2) Coat the drive spline with lubriplate 130A, 930AA or equivalent, the studs with antiseize compound, and the fuel fittings with oil (Atlantic Refining Co. 31100, or equivalent); then install the replacement fuel control on the gearbox. Retain with three washers and three nuts. Tighten nuts to 70–85 lb in. (7.9–9.6 N·m).

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

CAUTION: WHEN TIGHTENING THE COUPLING NUT OF THE METERED FUEL–TO–GOVERNOR TUBE AT THE FUEL CONTROL, USE CARE TO PREVENT THE WRENCH FROM CONTACTING AND TURNING THE ADJACENT BENCH CALIBRATED ADJUSTMENT (SQUARE SHAFT).

NOTE: Make sure the procedures and precautions of Rigid Tube Installation, para 9, 72–00–00, Engine—Servicing, are observed when installing fuel system tubes and aligning elbows. Hold fuel control fittings with one wrench while tightening "B" nut to fitting with another wrench.

(3) Remove the caps from the fittings on the fuel control then install the tubes removed in para 2.A.(1), this section.

(a) Tighten fuel inlet and bypass tube coupling nuts to 150–200 lb in. (17–23 N·m).

(b) Tighten fuel control–to–fire shield (fuel outlet) coupling nut to 80–120 lb in. (9.0–13.6 N·m).

(c) Tighten fuel control–to–governor and governor–to–fuel control tube coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(d) Tighten fuel control air tube coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(e) Tighten fuel control–to–governor elbow jam nut to 55–80 lb in. (6.2–9.0 N·m).

(f) Tighten fuel control drain elbow jam nut to 50–75 lb in. (5.6–8.5 N·m).

(4) Check the min throttle stop setting. (See Figure 202.) With the throttle lever against the stop screw, the quadrant reading must be 0° or below. A 1/2 ccw turn on the min stop screw (to obtain minus 2°) should be made on aircraft configurations which permit additional pointer travel below 0°.

(5) Set the gas producer power lever at the 30° position and install a rigging pin of 5/32 in. (3.97 mm) drill stock. The pin locks the power lever in a fixed position during rigging. Attach the required linkage then remove the rigging pin.

NOTE: The rigging pin locks the gas producer power lever pointer at 30°. If the pointer is off the 30° mark, realign the quadrant to obtain the 30 reading.

(6) If the gas producer lever requires repositioning, loosen the nut, reposition and tighten the nut to 75–85 lb in. (8.5–9.6 N·m).

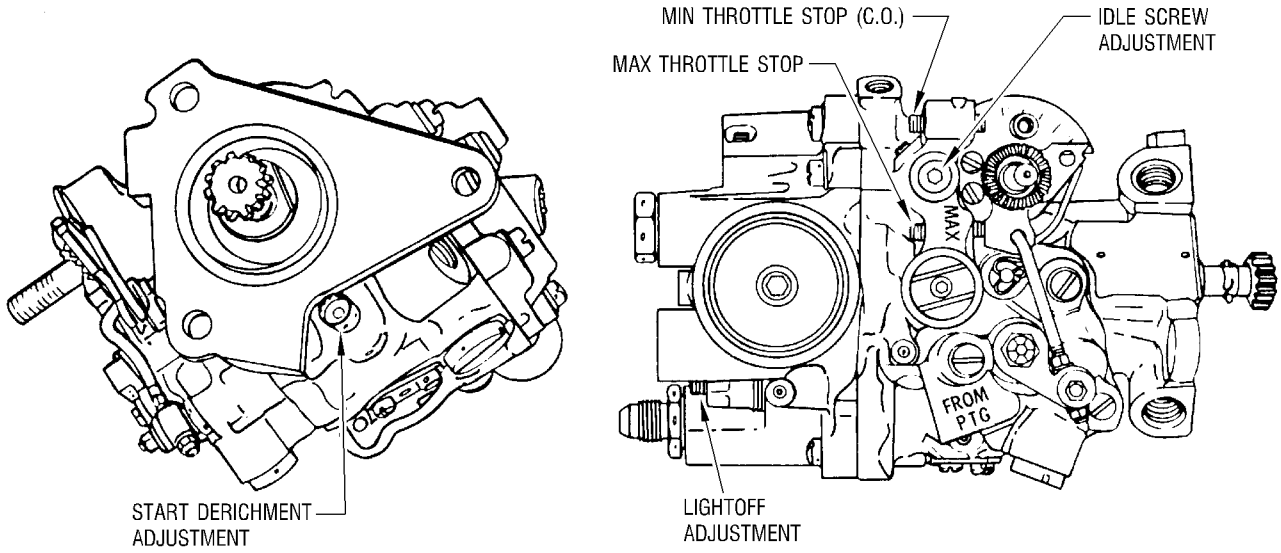
NOTE: The serrated washer must be installed with the word OUTSIDE facing nut.

(7) After the fuel control has been replaced, bleed air from the fuel system. (Refer to Purging the CECO Fuel System, para 2.D.(3), 73–00–00.

(8) Perform the operational checks given in CECO Fuel Control Operational Checks, para 3.A., this section.

(9) Check run the engine after fuel control replacement. (Refer to Check Run, para 1., 72–00–00, Engine—Adjustment/Test.)

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CECO Gas Producer Fuel Control Adjustments
Figure 202

3. Adjustment/Test

The adjustments that can be made on the fuel control are idle speed, maximum throttle stop, lightoff adjustment, start derichment and Maximum flow stop.

A. Fuel Control Operational Checks

Ground check the control system and associated linkage by making the following checks:

NOTE: Perform the steps in the sequence listed.

(1) Check rigging. (Refer to Rigging Check, para 3.C., this section.)

(2) Fuel cutoff operational check. (Refer to Cutoff Valve Operational Check, para 3.D., this section.)

(3) Check idle speed setting. (Refer to Idle Speed Setting, para 3.E., this section.)

B. Deceleration Check

To ensure proper engine performance, make the following deceleration check during shutdown for the last flight of each day.

(1) Rotate the twist grip or power levers to full open. Hold collective at flat pitch.

CAUTION: DURING RAPID THROTTLE MOVEMENTS, MAKE APPROPRIATE ANTI-TORQUE PEDAL CORRECTIONS TO PREVENT THE AIRCRAFT FROM TURNING ON LOOSE OR SLICK SURFACES.

(2) Snap the twist grip or throttle to the IDLE position. Simultaneously start a time count using a stop watch or a watch with a sweep second hand. Stop the time as the N_1 needle passes through 65%. The minimum allowable time is approximately two seconds.

NOTE: Practice and/or retakes may be required before proficiency is obtained in timing the deceleration.

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(a) On single engine applications, if multiple controls are installed, make separate deceleration checks using the pilot and copilot twist grips.

(b) On multi-engine applications, make a deceleration check of each engine. Make separate deceleration checks using the pilot and the copilot twist grips.

(3) If deceleration time is less than two seconds, make two more checks to confirm the time. If the confirmed time is less than the minimum allowable time, proceed to the rigging check.

(4) If N_1 speed drops below 59%, or if a flame out is experienced during the deceleration check, proceed to the rigging check before making a second attempt. If rigging is within limits (para 3.C., this section.), replace the MC-40 governor.

NOTE: Return the removed governor to an Authorized Maintenance Center (AMC) for investigation. Repeat the deceleration check on the replacement governor.

C. Rigging Check

Check the rigging after installation of a fuel control or any component of the rigging system. Make the rigging check with the engine shut down using the following procedure.

(1) Check to ensure that sufficient travel is provided to allow physical contact with the gas producer minimum stop before reaching the full closed position of the twist grip.

(2) Check the travel to the opposite end. Physical contact must be made with the gas producer maximum stop before reaching the full open position of the twist grip.

(3) Looseness encountered in the rigging must be minimized by replacement of worn items and/or accuracy of the rigging. Check rigging looseness with the control pointer locked in the 30° position with the rigging pin. Looseness that cannot be removed must be within the limits indicated in Figure 203). Check the looseness as follows:

(a) Start with the twist grip at the full open position then rotate the grip to the IDLE position. The pointer must be at the 30 degree mark and the rigging pin must be a free fit in the rigging pin hole.

(b) Start with the twist grip at the fully closed position then rotate the grip to the IDLE position. The pointer must be no more than 5.64 in. (2 mm) below the 30 degree mark.

NOTE: Make rigging adjustments on aircraft having dual controls using the pilots twist grip. Recheck the linkage movement using the copilots twist grip. The limits of Figure 203 are applicable to both sets of controls.

D. Cutoff Valve Operational Check

An operational check of the fuel control cutoff valve shall be made when an early lightoff or an afterfire is encountered. Make the check as follows:

(1) Check the fuel control quadrant reading.

(a) The quadrant pointer must be in the minus 2° position (1/32 in. (0.8 mm) below the 0° mark--see Figure 203) when the throttle lever is against the minimum stop and the throttle is in FUEL OFF.

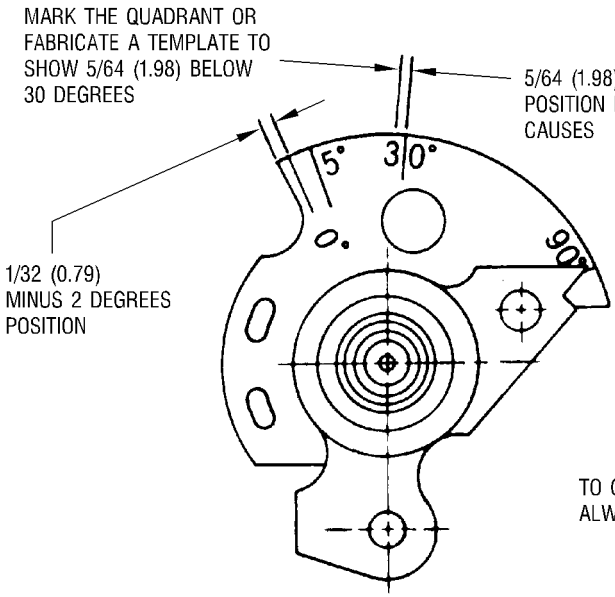
(b) If the quadrant pointer is not in the minus 2° position, readjust the minimum stop on the fuel control. To obtain minus 2°, adjust the minimum stop screw to 0°; then, back the screw out one-half turn from the 0° position.

(c) Recheck the pointer to be sure it is at the minus 2° position when the throttle is in FUEL OFF.

NOTE: On some installations, aircraft linkage prevents the pointer from going all the way to the minus 2° position. A minimum of 0° is acceptable provided that the cutoff lever link adjustment is made as specified for a 0° control in M250-C20 CSL-1023.

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CECO Fuel Control Quadrant and Pointer
Figure 203

PARA 3.D. (cont)

(d) Check the cutoff lever link nuts for red glyptal, showing incorporation of 250–C20 CSL–1023. If the nuts do not have the red glyptal identification, make the cutoff lever link adjustment described in 250–C20 CSL–1023.

NOTE: CECO 10400 A9 and subsequent fuel controls are preset at time of manufacturer and do not require the link nut adjustment described in 250–C20 CSL–1023.

(2) Check the fuel control cutoff valve.

(a) Disconnect the flexible fuel hose from the fuel nozzle. Place the free end of the hose in a suitable container.

(b) Turn on the aircraft switches required to provide fuel boost pump pressure to the engine. Pull the ignition circuit breaker.

(c) Motor the engine to 10% N_1 rpm using the starter.

(d) If fuel flows from the flexible fuel line in excess of a flow rate of 20 drops per minute with the twist grip in FUEL OFF, replace the fuel control.

NOTE: Repeat the check at least twice before accepting the fuel control.

(e) If the cutoff valve operates satisfactorily, connect the fuel hose. Tighten the hose coupling to 80–120 lb in. (9.0–13.6 N·m).

E. Idle Speed Setting

Check the idle speed setting with the engine running. Stabilized idle speed should repeat every time, whether the twist grip is slowly rolled or snapped to the IDLE position. Failure of the stabilized speed to repeat is an indication that the rigging is not adjusted properly. Check for proper idle adjustment rigging as follows:

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PARA 3.E. (cont)

(1) Roll the twist grip to IDLE and let N_1 stabilize. Mark (pencil) the precise position of the pointer tip on the fuel control quadrant.

(2) Release the idle detent on the twist grip. Very slowly roll the twist grip in the direction of cutoff just enough to obtain perceptible movement of the pointer tip (approximately the width of the pencil mark). If N_1 idle speed decreases take the following corrective action:

(a) If the pointer is at or above the 30 degree mark, rerig the aircraft linkage to move the pointer tip to a point just below the 30 degree mark.

(b) If the pointer is more than 5/64 in. (2 mm) below the 30 degree mark, rerig the aircraft linkage to move the pointer closer to the 30 degree mark.

(3) If N_1 idle speed did not change when the throttle was rolled toward cutoff, very slowly roll the throttle in the direction of increased power. Obtain perceptible movement of the pointer tip. An increase at or above the 30 degree mark is normal.

CAUTION: APPLICATION OF 20 LB IN. (2.3 N·M) ON THE IDLE ADJUSTMENT SCREW CAN DAMAGE THE IDLE STOP SCREW. APPLICATION OF 15 LB IN. (1.7 N·M) INDICATES THAT THE IDLE ADJUSTMENT IS AGAINST THE STOP SCREW. NO FURTHER ADJUSTMENT IS OBTAINABLE.

(4) When the rigging is correct, change the idle speed adjustment screw to obtain a 59–65% N_1 speed setting with the generator switch off. (See Figure 202.) Using a 5/32 in. Allen wrench and 0–25 lb in. (0–5 N·m) torque wrench, turn the screw clockwise to increase or counter–clockwise to decrease N_1 speed. A 1/8 turn adjustment changes engine speed approximately 1%. Running torque on the idle adjustment should be 10–12 lb in. (1.1–1.4 N·m). Do not exceed 15 lb in. (1.7 N·m) torque on the idle adjustment screw. If N_1 speed responds to the idle speed screw, make the 59–65% N_1 setting.

F. Lightoff Adjustment

CAUTION: MAKE THE LIGHTOFF ADJUSTMENT IN DECREMENTS OF 1/16 TURN MAXIMUM. THE CW ADJUSTMENT CAN BE TURNED BEYOND ITS CAPABILITY TO DECREASE FUEL FLOW. IN THIS EVENT THE DECREMENTAL ADJUSTMENT WILL INCREASE RATHER THAN DECREASE THE TEMPERATURE. IF INCREASED TEMPERATURE IS ENCOUNTERED, BACK OFF SLIGHTLY AND READJUST TO THE LOWEST TEMPERATURE SETTING.

Make the lightoff adjustment by trimming the screw with a 5/64 in. Allen wrench to obtain engine starting fuel and exhaust gas temperature requirements. Turn the screw clockwise to decrease lightoff fuel flow.

G. Start Derichment Adjustment

CAUTION: MAKE THE START DERICHMENT ADJUSTMENT IN INCREMENTS OF 1/8 TURN MAXIMUM.

The start derichment adjustment can be used to modify the starting fuel flow to improve cold weather starts, stagnated starts, or high altitude starts. Make the adjustment using a 1/4–in. Allen wrench having a 1/2 in. (13 mm) offset (or CECO wrench STD 67181). Turn clockwise (when viewed from end of adjustment screw) to enrich fuel flow for faster and hotter starts. Turn counter–clockwise for leaner fuel flow when starts are too hot. The normal setting is with the travel limiting screw at bottom center. Check the starting peak TOT after each setting until satisfactory starts are made.

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H. Max Flow Stop Adjustment--CECO Fuel Control in Bell 206B, 206B1, 206B3, Hughes 500C and Soloy Conversion (Hiller) Helicopters

The fuel control has been bench calibrated and the max flow stop screw positions etch marked on the housing at 270 pph (122 kg/hr)(+) and at 235 pph (107 kg/hr)(-). (See Figure 204.) Make the setting as specified in the Bell or Hughes maintenance manuals. Position the line on the screw opposite the desired calibration point using a 3/16 in. Allen wrench. Always turn the screw the shortest angular distance between the (+) and the (-) marks when making the adjustment. Do not loosen the 3/32 in. draglock set screw (located on the side of the fuel control) which provides friction drag for the fuel flow stop adjustment screw.

NOTE: Fuel controls shipped from the manufacturers and fuel controls on new or overhauled engines are set at the (+) mark. See Figure 204 for applicable adjustment.

I. Maximum Throttle Stop

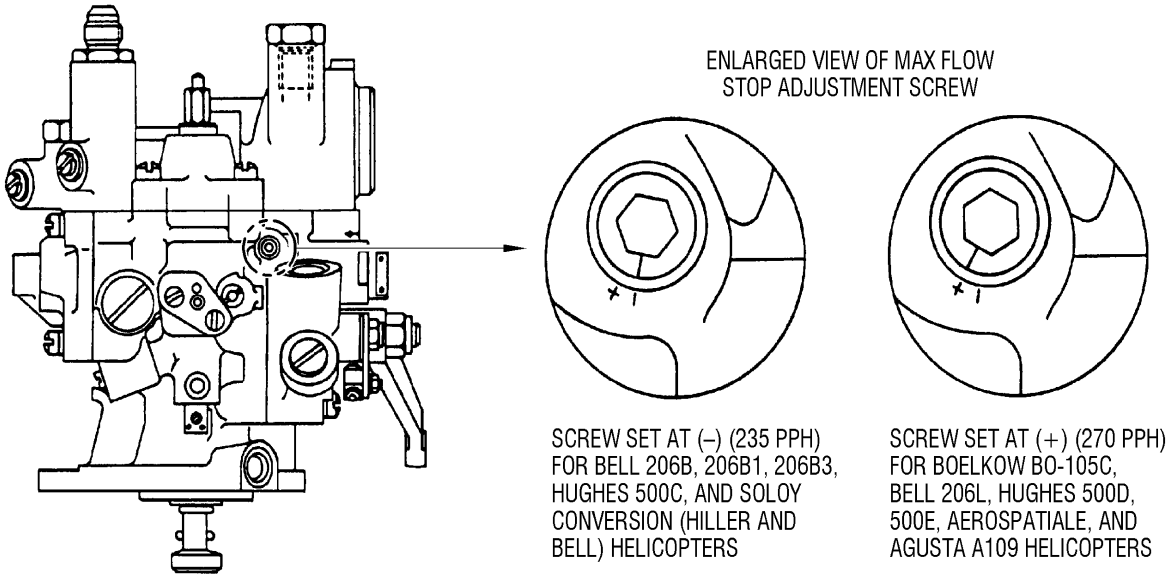
Using a 3/32 in. Allen wrench adjust the max throttle stop to obtain the required engine max power setting. Turn the stop screw clockwise to decrease angular travel or to reduce max N_1 speed. A 1/8 turn equals approximately 1% N_1.

4. Cleaning

A. Cleaning Fuel Control Filter.

Remove, clean, and install the CECO fuel control fuel filter as follows:

(1) If the engine is installed in the aircraft, remove the starter generator to obtain access to the fuel control inlet. Remove the fuel tube to the control inlet.



CECO Fuel Control Max Fuel Flow Stop Adjustment
Figure 204

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PARA 4.A. (cont)

(2) Clip the lockwire then remove the control inlet fitting. Discard packing.

CAUTION: USE A PROBE THAT CANNOT DAMAGE OR CONTAMINATE THE FILTER, SPRING, OR FUEL CONTROL.

(3) Remove the filter and spring. It may be necessary to use a probe to remove the filter. If the spring does not come out with the filter, also use the probe to remove it from the cavity. (See Figure 205.)

(4) Clean the fuel filter as follows:

WARNING: PERCHLORETHYLENE IS TOXIC AND MUST BE USED WITH EXTREME CAUTION. MAKE SURE ADEQUATE VENTILATION IS PROVIDED. REPEATED OR PROLONGED CONTACT WITH THE SKIN SHOULD BE AVOIDED.

(a) Use an ultrasonic cleaner with perchlorethylene to cleanse the filter if equipment is available. Soak the part for approximately 15 minutes with the cleaner set at maximum surface agitation.

(b) If ultrasonic equipment is not available, immerse the filter in a saturated solution of one liter sulfuric acid and 20 grams of sodium dichromate. Soak for one minute. Thoroughly rinse the filter in clean water. Dry with clean, dry, compressed air.

NOTE: It may be necessary to heat the solution to approximately 66°C (150°F) to dissolve the sodium dichromate crystals.

(c) If neither the ultrasonic nor the acid cleaning procedures can be performed, immerse the filter and spring in mineral spirits and clean with a stiff brush. Float the contaminants from the screens and out the assembly inlet.

(d) Hold the filter up to the light and visually inspect for contamination between the inside and outside screens. Repeat the cleaning procedure if contamination is found.

(5) Store the filter in a clean dust proof container until it is ready to be assembled into the fuel control.

CAUTION: THE FILTER MUST BE INSTALLED WITH THE OPEN END TOWARD THE INLET FITTING.

CAUTION: IF A PROBE IS USED FOR THE INSTALLATION, THE PROBE SHALL BE MADE FROM A MATERIAL THAT CANNOT DAMAGE OR CONTAMINATE THE FILTER, SPRING, OR FUEL CONTROL.

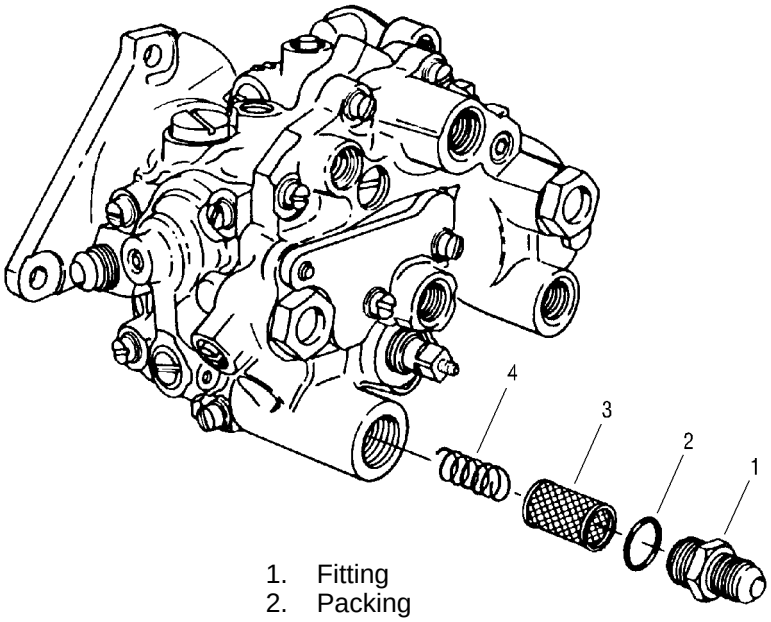
(6) Place the spring in the cupped end of the filter. Carefully fit the filter–spring assembly into the filter cavity of the fuel control (spring first). Hold the filter so the spring does not become separated during the installation. If necessary, use a little petrolatum to hold the spring in place. Seat the assembly, using a probe if necessary, so that light pressure on the filter will cause the element to move to the bypass position (spring depressed). Release of pressure will allow the spring to move the filter element back to the normal position.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(7) Install the fitting with new packing in the filter cavity. Torque fitting to 60–80 lb in. (6.8–9.0 N·m) and secure with lockwire.

(8) Install the fuel control inlet fuel tube. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

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1. Fitting
2. Packing
3. Filter Element
4. Spring

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CECO Fuel Control Fuel Filter Removal
Figure 205

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CECO POWER TURBINE GOVERNOR––MAINTENANCE PRACTICES

1. General

The Chandler Evans (CECO) power turbine governor can be adjusted, the fuel filter can be cleaned, or the governor assembly can be replaced as dictated by the trouble condition encountered.

CAUTION: WHEN REPLACING EITHER THE ENGINE OR THE GOVERNOR, REFER TO THE 250–C20 SERIES ILLUSTRATED PARTS CATALOG, PUB NO. 10W4, FOR REQUIRED PART NUMBERS. THE ENGINE AND THE GOVERNOR REQUIRED FOR MULTI–ENGINE INSTALLATIONS MAY NOT BE THE SAME AS THOSE REQUIRED FOR SINGLE ENGINE INSTALLATIONS.

2. Replacement

Replace the CECO power turbine governor if it is found to be the cause of engine malfunction. Check the governor lever maximum stop and the aircraft rigging for erroneous settings before removal of the governor to correct engine malfunction.

A. Removal

Remove the CECO power turbine governor from the engine as follows: (See Figure 201, 73–00–00.)

CAUTION: USE CONTAINERS AND RAGS AS NECESSARY TO MINIMIZE FUEL SPILLAGE IN THE ENGINE COMPARTMENT WHEN REMOVING LINES WHICH CONTAIN FUEL. ALSO USE CARE TO PREVENT FOREIGN MATERIALS FROM ENTERING THE LINES OR THE POWER TURBINE GOVERNOR PORTS.

(1) Disconnect the following lines from the power turbine governor. Cap the governor fittings when the lines are removed.

(a) Compressor discharge pressure (P_c)

(b) Inlet fuel (P_2)

NOTE: The fuel inlet fitting contains a fuel strainer.

(c) Outlet fuel (P_3)

(d) Fuel bypass (P_o)

(e) Overboard drain

(2) Remove the power turbine governor linkage.

(3) Remove the three nuts and washers. Remove the governor from gearbox.

CAUTION: WHEN REMOVING OR INSTALLING FITTINGS, BE CAREFUL NOT TO APPLY A LOAD ON THE GOVERNOR DRIVE SHAFT.

(4) If the governor is to be replaced, remove all fittings needed for installation of the replacement unit.

B. Installation

Install the CECO power turbine governor on the engine as follows: (See Figure 201, 73–00–00.)

(1) Before installing the CECO fuel control on the engine, install the required fittings:

(a) Remove and discard all old packings.

(b) Lubricate new packings and install on the fittings.

(c) Install the fuel bypass union. Tighten to 75–110 lb in. (8.5–12.4 N·m).

(d) Install the governor–to–fuel control union. Tighten to 55–80 lb in. (6.2–9.0 N·m).

(e) Install the fuel control–to–governor union. Tighten to 55–80 lb in. (6.2–9.0 N·m).

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PARA 2.B. (cont)

(f) Install the P_c tee fitting and jam nut. Do not tighten jam nut at this time.

(2) Coat the drive spline with Lubriplate 130A, 930AA or equivalent, the studs with antiseize compound, and the fuel fittings with oil (Atlantic Refining Co. 31100, or equivalent); then install the replacement governor on the gearbox. Retain with three washers and three nuts. Tighten nuts to 70–85 lb in. (7.9–9.6 N·m).

NOTE: Make sure the procedures and precautions of Rigid Tube Installation, para 9, 72–00–00, Engine—Servicing, are observed when installing fuel system tubes and aligning tee fitting. Hold governor fitting with one wrench while tightening "B" nut to fitting with one wrench.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(3) Remove the caps from the fittings on the governor; then install the tubes removed in para 2.A.(1), this section.

(a) Tighten fuel bypass lines coupling nut to 150–200 lb in. (17–23 N·m).

(b) Tighten fuel control–to–governor line coupling nut to 80–120 lb in. (9.0–13.6 N·m).

(c) Tighten governor–to–fuel control line coupling nut to 80–120 lb in. (9.0–13.6 N·m).

(d) Tighten air line coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(e) Tighten P_c tee fitting jam nut to 55–80 lb in. (6.2–9.0 N·m).

(4) Set the power turbine governor lever at 80° on the quadrant then attach linkage. Be sure that the 80° setting is maintained throughout the rigging operation. If the lever requires repositioning, loosen the nut, reposition the lever and/or serrated washer then tighten nut to 75–85 lb in. (8.5–9.6 N·m).

NOTE: The serrated washer must be installed with the word OUTSIDE facing out.

(5) After the governor has been replaced, bleed the air from the fuel system. (Refer to Purging the CECO Fuel System, para 2.D.(3), 73–00–00.)

(6) Make appropriate entry in the Engine Log relative to replacement of the power turbine governor.

(7) Check run the engine after governor replacement. (Refer to Check Run, para 1., 72–00–00, Engine—Adjustment/Test.)

3. Adjustment/Check

A. Maximum Stop Adjustment

The only field adjustment that can be made on the CECO power turbine governor is power turbine governor lever maximum speed stop. Adjust by turning the screw with a 3/32 in. Allen wrench to obtain the required free turbine (N_2) speed limitations. Turn the screw clockwise to decrease power turbine speed.

4. Cleaning

A. Cleaning Governor Fuel Filter

Remove, clean, and reinstall the CECO governor filter as follows:

(1) Remove the metered fuel from control tube. (See Figure 201.)

(2) Clip the lockwire and remove the filter fitting. Discard packing.

(3) Clean the filter–fitting as follows:

WARNING: PERCHLORETHYLENE IS TOXIC AND MUST BE USED WITH EXTREME CAUTION. MAKE SURE ADEQUATE VENTILATION IS PROVIDED. REPEATED OR PROLONGED CONTACT WITH THE SKIN SHOULD BE AVOIDED.

(a) If equipment is available use an ultrasonic cleaner with perchlorethylene to clean the filter–fitting. Soak the part for approximately 15 minutes with the cleaner set at maximum surface agitation.

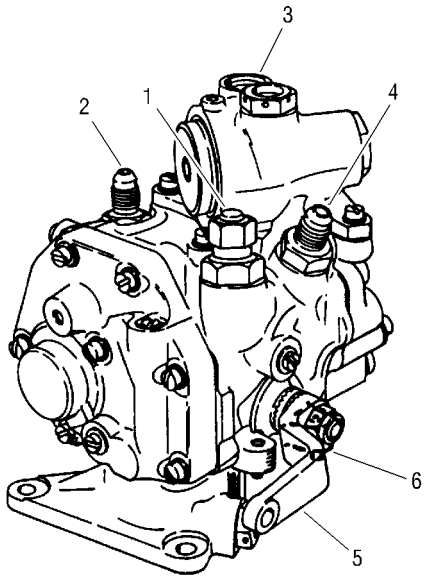
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PARA 4. (cont)

(b) If ultrasonic equipment is not available, immerse the filter–fitting in a saturated solution of one liter sulfuric acid and 20 grams of sodium dichromate. Soak filter for one minute.

NOTE: It may be necessary to heat the solution to approximately 66°C (150°F) to dissolve the sodium dichromate crystals.

(c) Thoroughly rinse the filter–fitting in clean water. Dry with lean, dry compressed air. Repeat the process until the filter is clean.



1. Bypass Port (P_o)
2. Metered Fuel from Control (P_2)
3. Compressor Discharge Pressure (P_c)
4. Metered Fuel to Control (P_3)
5. Power Turbine Governor Lever
6. Maximum Power Lever Stop (behind lever)

ADG107XD

CECO Power Turbine Governor
Figure 201

(d) Store the filter–fitting in a clean dust proof container until it is ready to be installed into the governor.

(4) Install the filter–fitting with new packing in the governor. Tighten to 40–65 lb in. (4.5–7.3 N·m) and secure with lockwire.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(5) Install the metered fuel from control tube. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

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P_C FILTER – MAINTENANCE PRACTICES

1. General

Remove, clean and install the P_C filter, which is bracket mounted to the gearbox. (See Figure 202 or 203, 73–00–00.)

2. Replacement

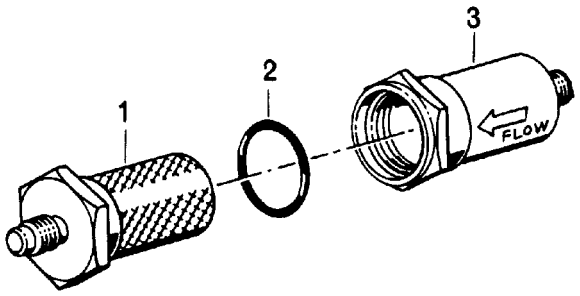
A. Removal

(1) Remove the scroll–to–P_C filter P_C tube by disconnecting the tube at both ends. Hold the filter assembly by placing the proper size wrench on the large hex flats of the housing or filter element while loosening the coupling nut.

(2) Disconnect the P_C air tube from the aft end of the filter. Hold the filter assembly as outlined above while loosening the coupling nut.

WARNING: FAILURE TO PROPERLY REMOVE OR INSTALL PC AIR LINES MAY DAMAGE LINES, FITTINGS, AND/OR FILTER ASSEMBLY WHICH CAN RESULT IN SUDDEN UNINTENDED ENGINE POWER LOSS.

(3) Remove the nut and bolt securing the filter clamp to filter mounting bracket. Remove the filter and separate the clamp from the filter.



ADH043XD

1. Filter element
2. Packing
3. Filter housing

P_C Filter Assembly
Figure 201

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PARA 2. (cont)

B. Installation

(1) Assemble the clamp on the filter and secure it to the filter mounting bracket with a bolt and nut. Tighten the nut to 35–40 lb in. (3.9–4.5 N·m). Make sure that the arrow on the filter is pointed rearward.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TORQUE FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(2) Install the Scroll–to P_c Filter Tube Assy to the compressor scroll. Torque coupling nut to 80–120 lb in. (9.0–13.6 N·m).

(3) Attach the Scroll–to–P_c Filter Tube Assy to the forward end of the P_c Filter. Attach the P_c Filter–to–Governor Tube Assy to the aft end of the filter. Hold the filter with the proper wrench at the hex flats of the filter assembly, while torquing the coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(4) Leak check the pneumatic system following installation of the P_c Filter. (Refer to para 2.B., 73–00–00.)

3. Cleaning and Inspection

A. Disassembly

(1) Remove the lockwire and separate the filter element and packing from the filter housing. (See Figure 201, this section.)

(2) When a vise is used, place the element hex (1) in the vise and use a wrench on the hex of the housing (3).

B. Cleaning the Element

Clean the filter element ultrasonically if equipment is available. If ultrasonic equipment is not available, use either of the following alternate cleaning methods.

(1) Solvent and brush method.

(a) Cap the outlet fitting of the element with a clean metal cap (AN 820–4 or equivalent).

(b) Wash the element with solvent and a soft bristle brush.

(c) Remove the cap and blow dry the element. Use clean, dry low–pressure air, 100–120 psig (689–827 kPag), in a reverse flow direction (through the outlet fitting).

(2) Sodium hydroxide soak method.

WARNING: SODIUM HYDROXIDE CAN CAUSE SEVERE BURNS. DO NOT GET IN EYES, ON SKIN OR ON CLOTHING. IN THE EVENT OF CONTACT WITH SODIUM HYDROXIDE, IMMEDIATELY FLOOD EXPOSED SKIN OR CLOTHING WITH WATER. FOR EYES, FLUSH HEAVILY WITH WATER AND OBTAIN IMMEDIATE MEDICAL ATTENTION.

WARNING: POTASSIUM PERMANGANATE CAN BE VERY DANGEROUS IF IMPROPERLY HANDLED. CONTACT WITH ORGANIC MATERIALS (OIL, GREASE) CAN CAUSE FIRE.

(a) Soak the filter element in a sodium hydroxide solution at 102–107°C (215–225°F) for a maximum of one hour.

NOTE: A typical solution is 13.5 oz (399 milliliters) sodium hydroxide and 4 oz (118 milliliters) potassium permanganate in one gallon (3.8 liter) deionized water.

(b) Thoroughly rinse the element in cold running water.

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PARA 3.B.(2) (cont)

(c) Blow dry the element. Use clean, dry low-pressure air, 100-120 psig (689-827 kPag), in a reverse flow direction (through the outlet fitting).

(d) Immerse the element in a neutralizing solution of phosphoric acid (50% acid, 50% water) at 21°C (70°F) for 5 minutes.

(e) Thoroughly rinse the element in cold running water.

(f) Blow dry the element. Use clean, dry low-pressure air, 100-120 psi (689-827 kPa), in a reverse flow direction (through the outlet fitting).

C. Inspection

Inspect the filter assembly for dirt or damage. Replace unserviceable filters.

D. Assembly

(1) Apply high temperature lubricant (Never-Seez or equivalent) lightly to the threads; then, assemble the packing and housing over the filter element.

(2) When a vise is used, place the element hex in the vise and use a wrench on the hex of the housing. If a metallic seal is used, tighten to 60-65 lb ft (81-88 N·m). If a rubber seal is used, tighten to 150-175 lb in. (16.9-19.8 N·m). Secure with lockwire.

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IGNITION EXCITER––MAINTENANCE PRACTICES

1. Replacement

   WARNING: MAKE SURE THAT THE IGNITION SWITCH IS OFF BEFORE REMOVING THE SPARK IGNITER OR SPARK IGNITER LEAD ASSEMBLY AS DANGEROUSLY HIGH VOLTAGES MAY BE PRESENT. ALLOW FIVE MINUTES AFTER OPERATION FOR ELECTRICAL DISSIPATION BEFORE DISASSEMBLY.

   A. Removal

      (1) (250–C20F, –C20S) Remove the start counter. (Refer to para 1.A., 74–20–03.)

      (2) Disconnect electrical leads and remove ignition exciter from the engine by removing three nuts and washers. (See Figure 201, 202 or 203, Section 74–00–00.)

   B. Installation

      (1) 250–C20, –C20B, –C20J, –C20W Engines:

         (a) Install a serviceable Ignition exciter on the gearbox. Retain at each end with a washer and nut. Tighten to 30–40 lb in. (3.9–4.5 N·m). Do not install the side nut at this time.

         (b) Place the start counter white lead on the stud on the side of the exciter. Retain with a washer and self–locking, drilled–head nut. Tighten nut to 30–40 lb in. (3.9–4.5 N·m).

         (c) Place the start counter black lead on the exciter input terminal. Retain with a washer and nut. Tighten nut to 8–12 lb in. (0.90–1.36 N·m).

         (d) Install the igniter lead. Tighten coupling nut to 50–70 lb in. (5.6–7.9 N·m).

      (2) 250–C20F, –C20S Engines:

         (a) Install a serviceable Ignition exciter on the gearbox. Retain at each end with a washer and nut. Tighten to 30–40 lb in. (3.9–4.5 N·m). Do not install the side nut at this time.

         (b) Place the start counter and its mounting bracket on the exciter forward mounting stud. Secure the bracket to the gearbox at the No. 3 and 4 positions (as viewed from the front of the engine) with two spacers and bolts. Install the nut on the exciter forward mounting stud. Tighten the nut and bolts to 35–40 lb in. (3.9–4.5 N·m).

         (c) Place the protective bracket over the start counter. Secure the protective bracket and start counter white lead to the mounting bracket with a washer and two screws. Tighten screws to 12–15 lb in. (1.4–1.7 N·m).

         (d) Place the start counter black lead on the exciter input terminal. Retain with a washer and nut. Tighten nut to 8–12 lb in. (0.90–1.36 N·m).

         (e) Install the igniter lead. Tighten coupling nut to 50–70 lb in. (5.6–7.9 N·m).

2. Inspection/Check (Exciter removed from engine.)

   A. Connect a known satisfactory lead and spark igniter of the type used on the engine to the ignition exciter.

      CAUTION: DO NOT ENERGIZE IGNITION EXCITER IF SPARK IGNITER AND LEAD ARE DISCONNECTED.

      CAUTION: DO NOT OPERATE THE LOW ENERGY EXCITER FOR MORE THAN FOUR MINUTES IN ANY 30 MINUTE PERIOD. THE HIGH ENERGY IGNITION EXCITER IS QUALIFIED FOR CONTINUOUS DUTY OPERATION. HOWEVER, USE OF THE IGNITION SYSTEM ON A CONTINUOUS BASIS IS NOT RECOMMENDED BECAUSE OF DEGRADATION OF THE SPARK IGNITER.

   B. Apply 28 volts dc to the input terminal of the ignition exciter using a minimum wire size of 16 gage (12.95 mm). Observe firing. If a repetitive spark rate of less than 6 sparks per second is observed, replace the ignition exciter.

   C. Apply 14 volts dc to the input of the ignition exciter if there is any question about its operation. The spark rate should not be less than three sparks per second and should be uniform.

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SPARK IGNITER––MAINTENANCE PRACTICES

1. Replacement (See Figure 201 or 202.)

   WARNING: MAKE SURE THAT THE IGNITION SWITCH IS OFF BEFORE REMOVING THE SPARK IGNITER OR SPARK IGNITER LEAD ASSEMBLY AS DANGEROUSLY HIGH VOLTAGES MAY BE PRESENT. ALLOW FIVE MINUTES AFTER OPERATION FOR ELECTRICAL DISSIPATION BEFORE DISASSEMBLY.

   CAUTION: THE EXCITER AND THE IGNITER CONNECTOR WELLS SHOULD BE KEPT DRY AND FREE FROM FOREIGN MATERIAL. CLEAN BY WIPING WITH A CLEAN DRY CLOTH, IF REQUIRED. DO NOT WASH WITH SOLVENT.

   A. Removal

      (1) Disconnect the ignition lead at the igniter. (See Figure 201, 202 or 203, 74–00–00.) Hold the lead to prevent its twisting while removing the nut. Separate the lead from the igniter by pulling straight out with no rotational motion.

      (2) Unscrew the igniter. Remove shim if one has been used. (Refer to para 2., this section.)

   B. Installation

      (1) When replacing and/or reinstalling a serviceable spark igniter, use shim, if required by para 2., this section. Apply a light coat of antiseize compound (NS–165) to the threads. Install the spark igniter, tighten to 150–200 lb in. (17–23 N·m) and lockwire to fuel nozzle.

      (2) Connect ignition lead; tighten to 70–90 lb in. (7.9–10.2 N·m).

2. Inspection/Check

   CAUTION: UNDER NO CIRCUMSTANCES SHOULD THE SPARK IGNITERS BE CLEANED BY WIRE BRUSHING, SAND BLASTING, VAPOR BLASTING OR SCRAPING ON THE IGNITER TIP. ANY OF THESE PRACTICES CAN DAMAGE THE SEMI–CONDUCTOR MATERIAL BETWEEN THE TWO ELECTRODES AND RESULT IN SHORTENED SPARK IGNITER LIFE OR IMMEDIATE SPARK IGNITER FAILURE.

   NOTE: Normal soot or carbon formation on the tip is not detrimental to the operation of the spark igniter and need not be removed. If cleaning is desired, for some special reason, wipe the metal tip with a soft cloth only. Remove any sizeable lump of carbon with a blunt instrument. Be careful not to damage the semi–conductor material.

   A. Inspection

      (1) Inspect the center electrode; replace igniter if the electrode is loose. (See Figure 201.)

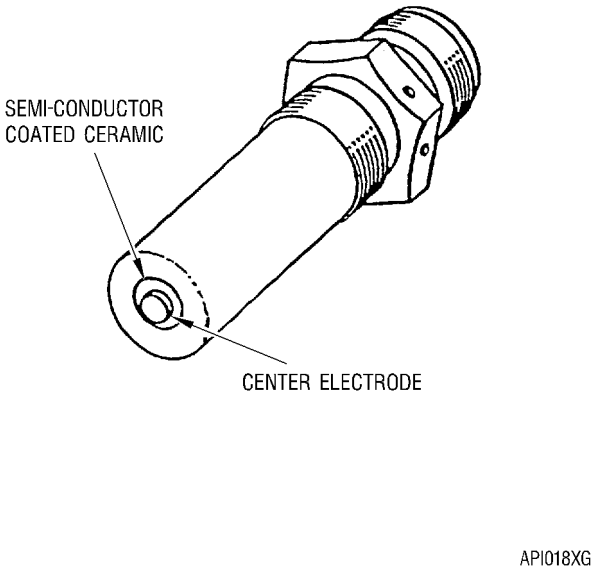
      (2) Inspect semi–conductor coated ceramic and body for cracks. If any cracks are visible through the carbon (soot) coating, replace the igniter.

      (3) Inspect spark igniter for fretting wear. Wear of 0.032 in. (0.81 mm) max. is serviceable without corrective action. Wear of 0.032 in. (0.81 mm) or more is acceptable if it does not affect the function of the spark igniter and if the following corrective action is taken:

         (a) Fabricate a shim from corrosion resistant steel shim stock to the dimensions given in Figure 202.

         (b) At installation of the spark igniter, place the fabricated shim between the outer combustion case and the igniter.

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Spark Igniter
Figure 201

PARA 2.A. (cont)

NOTE: A shim sized per Figure 202 will reduce the spark igniter installed thread length by 1/2 turn. Localized fretting is thereby moved 180° from the wear area of the previous installation. Be sure to remove the shim when a new spark igniter is installed.

(4) Check the general condition of the spark igniter; replace if excessive erosion is evident.

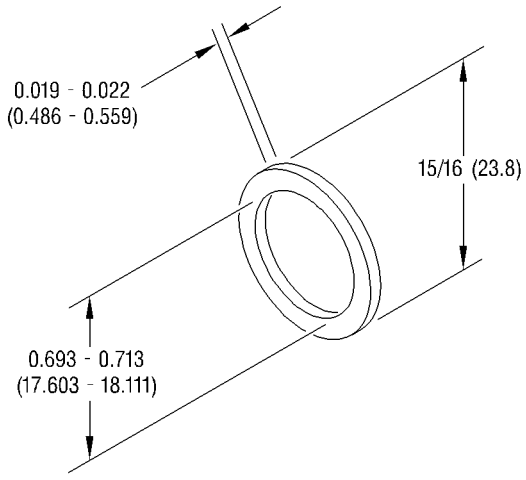
(5) Check the operation of the spark igniter after it has been removed from the engine. Apply 28 volts dc to the exciter and observe the rate of firing. Normal operation is six sparks per second minimum. Replace the spark igniter if it fails to fire or fires intermittently.

NOTE: Do not replace the spark igniter as defective until the ignition exciter is known to be acceptable. (Refer to Inspection Check, para 2., 74–10–01.)

3. Cleaning

Normal soot or carbon formation on the tip is not detrimental to the operation of the spark igniter and need not be removed. If cleaning is desired, for some special reason, wipe the metal type with a soft cloth only. Remove any sizeable lump of carbon with a blunt instrument. Be careful not to damage the semiconductor material.

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BREAK SHARP EDGES

NOTE: DIMENSIONS ARE IN INCHES (MILLIMETERS)

API017AD

Spark Igniter Shim
Figure 202

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SPARK IGNITER LEAD––MAINTENANCE PRACTICES

1. Replacement (See Figure 201 or 202, 74–20–01.)

   WARNING: MAKE SURE THAT THE IGNITION SWITCH IS OFF BEFORE REMOVING THE SPARK IGNITER OR THE SPARK IGNITER LEAD ASSEMBLY AS DANGEROUSLY HIGH VOLTAGES MAY BE PRESENT. ALLOW FIVE MINUTES AFTER OPERATION FOR ELECTRICAL DISSIPATION BEFORE DISASSEMBLY.

   A. Removal

      (1) Remove the lead from the ignition exciter and the spark igniter.

      (2) Detach from retention clamps from the aft flange of the fire shield.

   B. Installation

      (1) Attach lead to retention clamps at power turbine governor and at the aft flange of the fire shield.

      (2) Connect lead to ignition exciter and spark igniter.

      (3) Tighten igniter coupling to 70–90 lb in. (7.9–10.2 N·m); tighten exciter coupling to 50–70 lb in. (5.6–7.9 N·m).

2. Inspection/Check

   A. Inspect the outer part of the lead for braid damage; replace lead if damage is excessive.

   B. Inspect ends of the lead to be sure all parts are intact.

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START COUNTER––MAINTENANCE PRACTICES

1. Replacement (See Figure 201 or 202, 74–20–01.)

   Start Counter. In the event of malfunction of the start counter, replace as follows:

   A. Removal

      (1) 250–C20, –C20B, –C20J, –C20W Engines:

         (a) Remove the start counter leads from the exciter.

         (b) Remove two nuts and washers that retain the start counter to the gearbox web. Remove the counter.

      (2) 250–C20F, –C20S Engines:

         (a) Remove the start counter lead from the ignition exciter terminal.

         (b) Remove two screws and a washer and remove the start counter protective bracket.

         (c) Remove the ignition exciter forward attachment nut and two accessory gearbox attachment bolts and spacers. Remove the start counter and mounting bracket from the engine.

         (d) Remove the two nuts that retain the start counter to the mounting bracket. Remove the start counter.

   B. Installation

      (1) 250–C20, –C20B, –C20J, –C20W Engines:

         (a) Install a serviceable start counter on the gearbox. Retain with two washers and nuts. Tighten to 5–8 lb in. (0.56–0.90 N·m).

         (b) Place the start counter white lead on the stud on the side of the exciter. Retain with a washer and self locking, drilled–head nut. Tighten nut to 30–40 lb in. (3.9–4.5 N·m).

         (c) Place the start counter black lead on the exciter input terminal. Retain with a washer and nut. Tighten nut to 8–12 lb in. (0.90–1.36 N·m).

         (d) Record the number of accumulated starts on the old start counter in the Engine Log.

            NOTE: Refer to Adjustments for Invalid Start Counter Readings, para 13.F., 72–00–00, Engine—Description and Operation, for the procedure to be used when the cycles recorded on the start counter are known to be incorrect.

      (2) 250–C20F, –C20S Engines:

         (a) Install a serviceable start counter on its mounting bracket. Retain with two nuts. Tighten nuts to 5–8 lb in. (0.56–0.90 N·m).

         (b) Place the start counter and bracket on the exciter forward mounting stud. Secure the bracket to the gearbox at the No. 3 and 4 positions (as viewed from the front of the engine) with two spacers and bolts. Install the nut on the exciter forward mounting stud. Tighten the nut and bolts to 35–40 lb in. (3.9–4.5 N·m).

         (c) Place the protective bracket over the start counter. Secure the protective bracket and start counter white lead to the mounting bracket with a washer and two screws. Tighten screws to12–15 lb in. (1.4–1.7 N·m).

         (d) Place the start counter black lead on the exciter input terminal. Retain with a washer and nut. Tighten nut to 8–12 lb in. (0.90–1.36 N·m).

         (e) Record the number of accumulated starts on the old start counter in the Engine Log.

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PARA 1.B. (cont)

NOTE: Refer to Adjustments for Invalid Start Counter Readings, para 13.F., 72–00–00, Engine—Description and Operation, for the procedure to be used when the cycles recorded on the start counter are known to be incorrect.

2. Alternate to Replacement

A. An alternate procedure may be used in the event of start counter malfunction. Counter replacement is not necessary, provided:

(1) The counter leads are disconnected from the exciter.

(2) The number of accumulated starts is recorded in the Engine Log.

(3) Starts are accurately counted by pilots and mechanics for entry into the Engine Log.

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ANTI-ICING AIR VALVE--MAINTENANCE PRACTICES

1. General

   A mechanically operated valve used to control the flow of anti-icing air. The anti-icing air valve is mounted on the front of the compressor scroll.

2. Replacement (See Figure 201 or 202, 75-00-00.)

   A. Removal

      (1) Disconnect the anti-icing air tubes between the valve and the front support.

      (2) Disconnect the linkage from the anti-icing air valve control arm.

      (3) Remove lockwire, loosen jam nut and remove the valve assembly from the scroll. Discard packing.

   B. Disassembly

      Disassemble the anti-icing air valve as follows:

      (1) Disassemble the anti-icing air valve as follows:

         (a) Remove the cotter pin, washer, and pin. Detach the actuating lever from the valve. Discard cotter pin.

         (b) Remove the lockwire and unscrew the poppet guide assembly from the valve body. Separate the poppet assembly from the body.

   C. Assembly

      Assemble the valve assembly as follows:

      (1) Insert the poppet into the valve body.

      (2) Screw the poppet guide assembly into the body. Torque the coupling nut to 65-75 lb in. (7.3-8.5 N·m). Do not lockwire at this time.

      (3) Align the actuating lever with the hole in the poppet guide assembly (notch in lever toward the guide) and insert the pin. Secure the pin with a washer and cotter pin. Lockwire the poppet guide to the valve body.

   D. Installation

      (1) Apply antiseize compound lightly to the threads then install the valve with jam nut and new packing in the scroll.

         WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

      (2) Reconnect linkage and air tubes.

         (a) Tighten coupling nuts of air tubes to 65-75 lb in. (7.3-8.5 N·m).

         (b) Tighten valve-to-scroll jam nut to 100-150 lb in. (11-17 N·m) and secure with lockwire.

            NOTE: For convenience of installation, the anti-icing valve may be rotated 360°. Position valve as desired for the installation; then tighten coupling nut to 65-75 lb in. (7.3-8.5 N·m) and secure with lockwire.

      (3) Recheck the valve for leakage during first engine operation following installation of the repaired valve. Replace valve assembly if leakage is still excessive.

3. Cleaning

   Clean the anti-icing valve components in mineral spirits.

4. Inspection and Repair

   Inspect the anti-icing valve components in accordance with Table 201.

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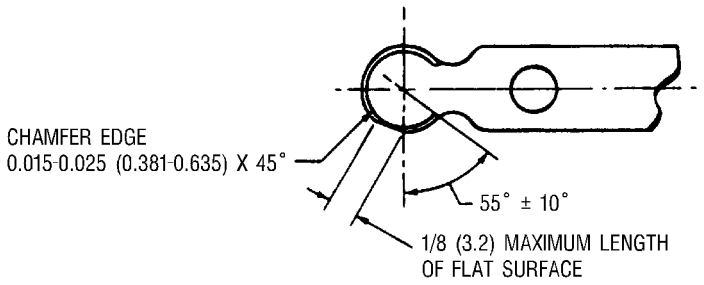
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Table 201

Anti–icing Air Valve Inspection and Repair

Item	Condition	Serviceable Limit	Repairable Limit	Disposition
1	Lever wear at poppet mating surface (creating flat)	Max flat length of 1/16 in. (2.0 mm)		Repair by grinding rounded end in accordance with Figure 201 or replace lever.
2	Wear at hole for air–frame linkage	Remaining wall thickness not less than 0.040 in. (1.02 mm)		Repair or replace lever.
3	Nicks or scratches in flared tube sealing surfaces of valve body	None		Repair or replace valve body.
4	Stripped or crossed threads on valve body or coupling nut of the poppet guide	None	Max of one damaged thread per connection	Chase threads.
5	Poppet wear	Max wear step of 0.005 in. (0.13 mm)		Replace poppet.
6	Poppet seat damage or wear (excessive valve leakage)	None		Remove screw and separate seat from poppet. Install new seat. Stake screw securely. (See Figure 202.)

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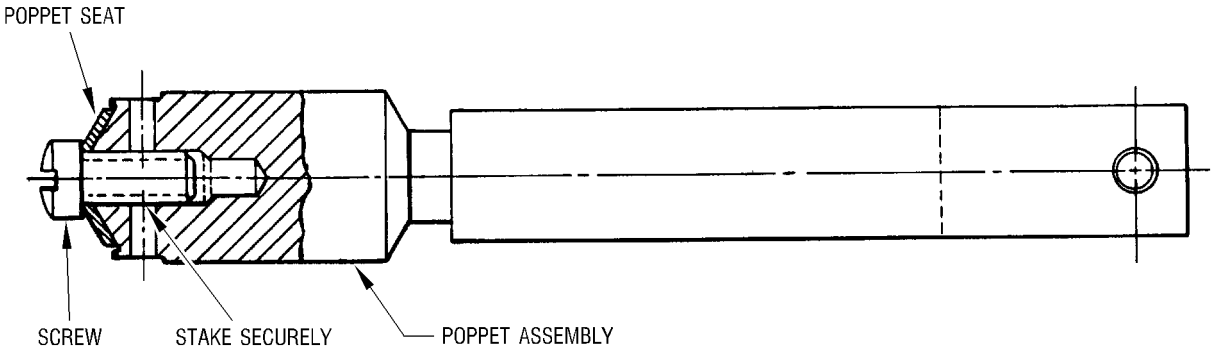


NOTE: DIMENSIONS ARE IN INCHES (MILLIMETERS).

GRIND ROUNDED END ONLY ENOUGH
TO REMOVE FLAT SURFACE.

ADK013XD

Anti–icing Valve Lever Repair
Figure 201



AEK015XD

Anti–icing Valve Poppet Seat Replacement
Figure 202

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BLEED AIR CONTROL SYSTEM––MAINTENANCE PRACTICES

1. General

Bleed air system maintenance includes replacement, cleaning and testing of the bleed control valve.

2. Bleed Valve Replacement (See Figure 201 or 202, 75–00–00.)

Bleed Valve. Test the bleed control valve on an installed engine. Clean the bleed valve if it does not operate in the range given in Figure 22, 72–00–00, Engine–Description and Operation. Clean valve in accordance with Bleed Valve Cleaning, para 2.C., this section. Replace the bleed control valve as follows if cleaning does not bring the valve into the desired operating range.

A. Removal

(1) Disconnect the compressor discharge pressure sensing tube assembly by loosening the coupling nut at the valve elbow.

(2) Remove the three bolts, nuts and washers. Separate the bleed control valve and gasket from the mounting flange on the compressor case. Discard gasket.

(3) Remove the elbow from the bleed valve. Discard packing.

B. Installation

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(1) Lubricate new packing and install it on the elbow. Install the elbow in the replacement bleed valve. Do not tighten the jam nut at this time.

(2) Apply antiseize compound to bolt threads, then install the replacement bleed control valve and gasket on the mounting flange. Retain with three bolts, nuts and washers. Assemble with washers beneath bolt heads. Tighten No. 10–32 nuts to 35–40 lb in. (3.9–4.5 N·m). Tighten the 1/4–28 nut to 70–85 lb in. (7.9–9.6 N·m).

(3) Attach the compressor discharge pressure sensing tube assembly to the bleed control valve with the coupling nut. Tighten the elbow jam nut to 55–80 lb in. (6.2–9.0 N·m), after final elbow positioning is determined. Secure nut with lockwire. Tighten coupling nut to 80–120 lb in. (9.0–13.6 N·m).

C. Cleaning Bleed Valve

Clean the bleed valve nozzle, filter, and jet as follows:

(1) Remove the air sensing line from the bleed valve elbow.

(2) Remove the elbow from the bleed valve. Discard the packing.

(3) Remove the internal retaining ring and separate the filter from the bleed valve. (See Figure 201.) Replace the retaining ring before assembly if it is damaged during the removal operation.

(4) Using a screwdriver, remove the jet from the bleed valve.

(5) Clip the lockwire then remove the nozzle from the bleed valve.

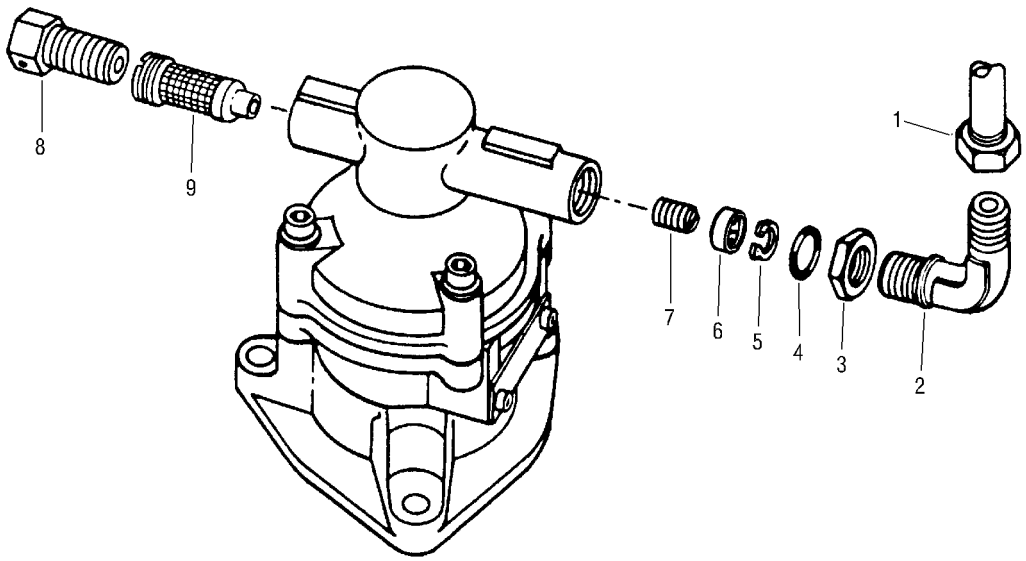
CAUTION: DO NOT BLOW THE JET DRY. THE SMALL JET CAN BE EASILY LOST OR DAMAGED.

(6) Clean the nozzle, filter, and jet ultrasonically in mineral spirits if equipment is available.

(7) If ultrasonic equipment is not available, agitate the parts in a clean container of mineral spirits. Use a soft bristle brush to clean exposed surfaces. Insert a sewing thread through the jet hole. Slide the jet back and forth on the thread to remove film. Clean the nozzle in the same manner.

NOTE: If the jet must be replaced, return the bleed valve to overhaul for part replacement and recalibration of the valve assembly.

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1. Air Sensing Tube
2. Elbow
3. Jam Nut
4. Packing
5. Internal Retaining Ring
6. Filter
7. Jet
8. Nozzle
9. Strainer

ADK016XD

Bleed Valve Jet and Nozzle Removal
Figure 201

PARA 2.C. (cont)

CAUTION: DO NOT USE A PROBE TO REMOVE PARTICLES LODGED IN THE JET OR NOZZLE.

(8) Inspect the jet and the nozzle using a flashlight. Place the part on the center of the lens so the light can be seen through the hole. Reclean the part if any particles or coating can be seen.

(9) Install the jet in the bleed valve. Tighten to 8–12 lb in. (0.90–1.36 N·m).

(10) Place the filter in the bleed valve (skirt end first). Secure with an internal retaining ring.

(11) Install the strainer and nozzle in the bleed valve. Tighten to 35–45 lb in. (3.9–5.1 N·m) and secure with lockwire.

(12) Lubricate the packing and install it with the elbow on the bleed valve. Do not tighten the elbow jam nut at this time.

(13) Position the elbow as required and install the air sensing line. Tighten the coupling nut to 80–120 lb in. (9.0–13.6 N·m). Tighten the elbow jam nut to 55–80 lb in. (6.2–9.0 N·m).

(14) Reconnect all pressure sensing lines and airframe bleed air plumbing. Tighten Pc line coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(15) Start and operate the engine for a minimum of five minutes.

(16) Operate the engine anti–ice system to purge any compressor cleaning solution from the compressor inlet housing.

(17) Operate all aircraft systems that utilize compressor bleed air.

(18) Complete the engine drying run as soon as possible after cleaning and rinse.

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TEMPERATURE MEASUREMENT SYSTEM–– MAINTENANCE PRACTICES

1. General

Temperature measurement system maintenance includes cleaning and inspection of the thermocouple harness.

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THERMOCOUPLES––MAINTENANCE PRACTICES

1. Replacement (See Figure 201.)

   A. Removal

      (1) (250–C20, –C20B, –C20F, –C20J) Remove the fire shield. (Refer to Fire Shield, para 3.A., 72–50–00.)

      (2) (250–C20S, –C20W) Remove the fire shield access panel. (Refer to Fire Shield Access Panel, para 4., 72–50–00.)

      (3) Remove the two thermocouple bracket mounting bolts and nuts; separate the bracket from the turbine.

      (4) Remove the eight thermocouple junction mounting bolts.

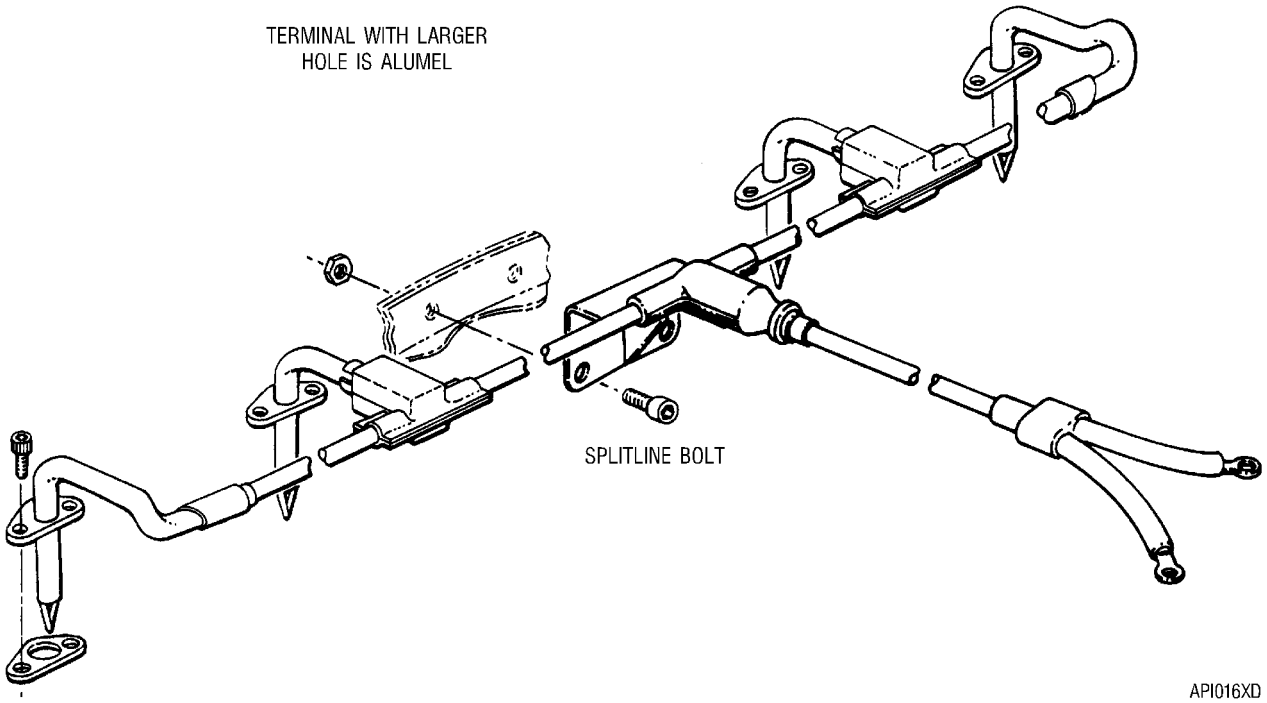
      (5) Remove the thermocouple assembly starting at either end. Discard gaskets.

   B. Installation

      (1) Install the thermocouple with new gaskets, starting in the middle of the harness and working toward either end.

      (2) Install the eight junction mounting flange bolts. Tighten bolts to 30–40 lb in. (3.4–4.5 N·m). Secure with lockwire.

      (3) Install the two thermocouple bracket mounting bolts at the gas producer support–to–power turbine support splitline at bolt hole positions 2 and 3 (8 and 9, 250–C20S, –C20W.) Tighten bolts to 20–30 lb in. (2.3–3.4 N·m) and the terminal nuts to 18–24 lb in. (2.0–2.7 N·m).



Thermocouple Assembly
Figure 201

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PARA 1.B. (cont)

(4) Check run the engine after thermocouple replacement. (Refer to Check Run, para 1., 72–00–00, Engine–Adjustment/Test.)

2. Thermocouple Inspection

Make a visual and electrical check of the thermocouple assembly.

A. Visual

Visually inspect the thermocouple harness assembly for wear, broken leads or other damage. Using a strong light and 10x magnification, inspect the thermocouple tips for cracks, erosion, and scale. Replace thermocouple assembly for any of the following reasons:

(1) Excessive wear or damage to the leads.

(2) Tip breaks or cracks detected by magnification.

(3) Probes or tips which indicate melting or show other evidence of overtemperature.

NOTE: Turbines must be inspected for overtemperature damage anytime thermocouples are rejected for melting or if they show other evidence of overtemperature.

(4) Tips which evidence erosion to the point that either wire has been reduced in area an estimated 25% or more.

CAUTION: DIRECT THE GRIT BLAST ON THE TIPS PERPENDICULAR TO THE PROBE AXIS—NOT ON THE END OF THE PROBE WHERE THE INSULATION COULD BE ERODED. AFTER THE SCALE IS REMOVED, REINSPECT THE TIP FOR CRACKS, USING A STRONG LIGHT AND 10X MAGNIFICATION.

(5) Tips having scale on either wire affecting 25% of the cross sectional area. If the thermocouple is otherwise satisfactory, remove the scale by soft grit blast.

B. Electrical

The electrical check of the thermocouple assembly consists of a continuity check and an insulation check.

NOTE: When performing any electrical check on an installed thermocouple harness assembly, at least one harness lead must be disconnected from the fireshield junction block. Disconnecting one lead isolates the thermocouple assembly from the airframe temperature measurement system.

(1) Continuity check

CAUTION: A HOT ENGINE WILL CAUSE THE THERMOCOUPLES TO GENERATE A SMALL POTENTIAL, WHICH WILL PRODUCE ERRORS IN MEASURED INTERNAL RESISTANCE VALUES. AN APPROXIMATE VALUE MAY BE OBTAINED BY REVERSING THE LEADS AND AVERAGING THE READINGS.

The internal resistance of an acceptable thermocouple harness assembly, measured across the alumel and chromel leads, is 0.55 to 0.65 ohms at room temperature for harness assemblies prior to p/n 23034926. For harness p/n 23034926, the acceptable internal resistance is, 0.50 to 0.60 ohms at room temperature. An open circuit in the harness assembly will cause this resistance to be high; a short circuit will cause it to be low.

NOTE: A check of these limits can be performed only by using test instruments that offer usable sensitivity in this range (null–type resistance bridge or an especially designed test instrument, such as the Barfield Model 2312G). If such instrumentation is not available, an ohmmeter (Simpson Meter or equivalent) can be used to detect an open circuit.

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PARA 2.B. (cont)

(2) Insulation check

CAUTION: ENGINE THERMOCOUPLES SHOULD NEVER BE IMMERSED OR SPRAYED WITH CLEANING SOLVENTS. LIQUID CLEANING SOLVENTS WILL PENETRATE THE POROUS MAGNESIUM OXIDE INSULATION. ENGINE HEAT WILL VAPORIZE THE SOLVENTS, LEAVING A RESIDUE CONTAINING CARBON, WHICH CAUSES A LOW RESISTANCE TO GROUND.

The minimum acceptable resistance to ground is 2,000 ohms. Carbon buildup on the probe tip will cause a short to ground. If resistance measures less than 2,000 ohms, clean carbon deposits from the probe, using a clean, soft cloth, or by soft grit blast. Repeat the check after cleaning the tip.

(a) On installed thermocouple assemblies, connect a portable multimeter between either harness lead and any probe flange.

(b) On uninstalled thermocouple assemblies, connect a portable multimeter between either harness lead and each of the four probe flanges.

(c) On uninstalled thermocouple assemblies, resistance to ground may also be checked by applying 650 ± 28°C (1200 ± 50°F) temperature to each thermocouple in succession (JetCal and kit BH8001, or equivalent).

1 The harness should indicate an upscale reading on the millivoltmeter and a gradual increase in resistance.

2 If the resistance of each probe increases above 2000 ohms during this hot check, the harness is acceptable.

3 Low resistance can be caused by carbon formation on the probe tip and/or magnesium oxide insulation shorting the probe to ground.

4 If the resistance of any probe decreases or indicates a dead short, replace the thermocouple harness.

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ENGINE–DESCRIPTION AND OPERATION

1. General

Engine description includes a discussion of each major component and each major system of the engine.

Numerical values in this manual are given in terms standard to existing practices in the United States.

2. Components

The major engine components are a compressor, combustion section, turbine, and power and accessory gearbox. (See Figure 1.)

A. Compressor

The compressor assembly consists of a compressor front support assembly, compressor rotor assembly, compressor case assembly, and compressor diffuser assembly. Air enters the engine through the compressor inlet and is compressed by six axial compressor stages and one centrifugal stage. The compressed air is discharged through the scroll type diffuser into two ducts which convey the air to the combustion section. (See Figure 2.)

B. Combustion Section

The combustion section consists of the outer combustion case and the combustion liner. A spark igniter and a fuel nozzle are mounted in the aft end of the outer combustion case. Air enters the single combustion liner at the aft end, through holes in the liner dome and skin. The air is mixed with fuel sprayed from the fuel nozzle and combustion takes place. Combustion gases move forward out of the combustion liner to the first–stage gas producer turbine nozzle.

C. Turbine

The turbine consists of a gas producer turbine support, a power turbine support, a turbine and exhaust collector support, a gas producer turbine rotor and a power turbine rotor. The turbine is mounted between the combustion section and the power and accessory gearbox. The two–stage gas producer turbine drives the compressor and accessory gear train. The two–stage power turbine furnishes the output power of the engine. The expanded gas discharges in an upward direction through the twin ducts of the turbine and exhaust collector support.

D. Power and Accessory Gearbox

The main power and accessory drive gear trains are enclosed in a single gear case. The gear case serves as the structural support of the engine. All engine components including the engine mounted accessory are attached to the case. A two–stage helical and spur gear set is used to reduce rotational speed from 33,290 rpm at the power turbine to 6016 rpm at the output drive spline. Accessories driven by the power turbine gear train are the airframe furnished power turbine tachometer–generator and the power turbine governor. The gas producer gear train drives the compressor, fuel pump, an airframe furnished gas producer tachometer–generator, and gas producer fuel control. The starter drive and a spare drive are in this gear train.

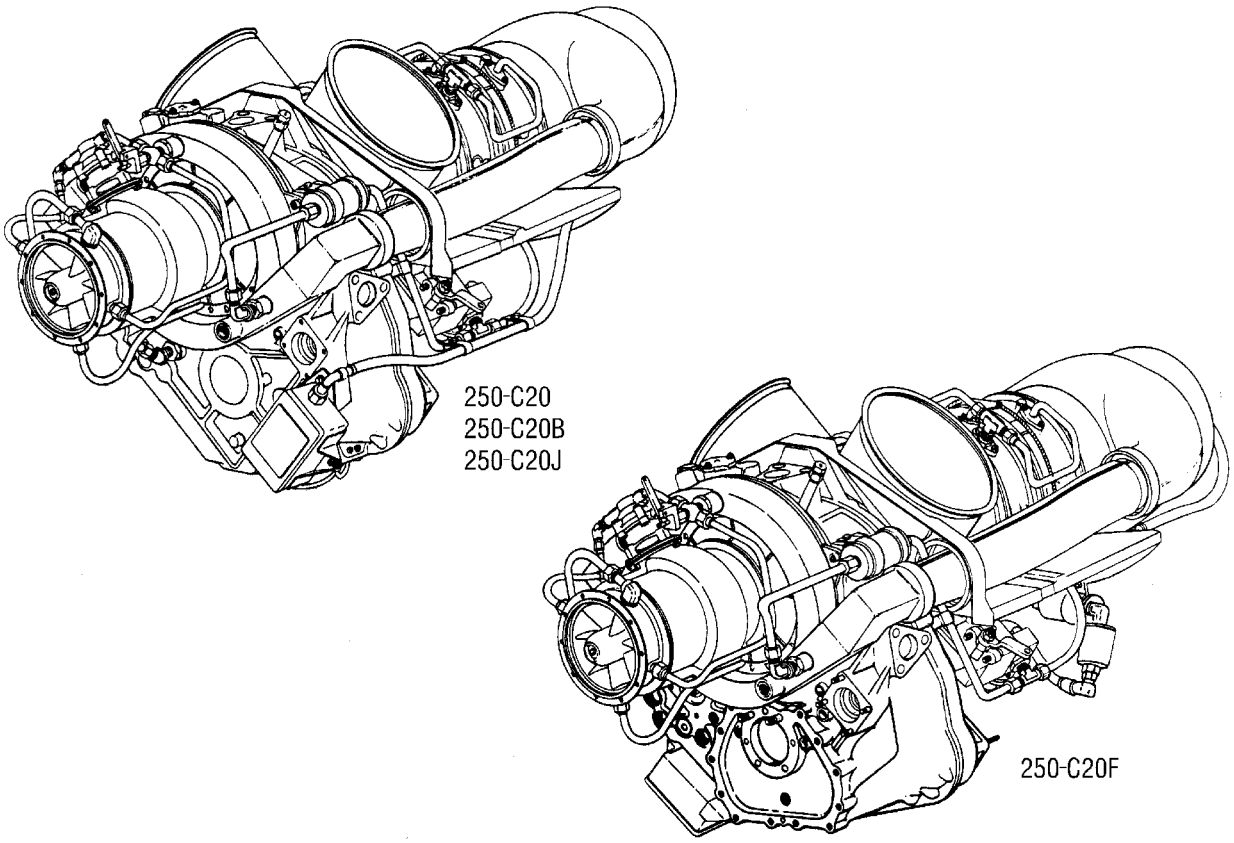
3. Systems

The major systems of the engine are fuel, lubrication, electrical, anti–icing air, and compressor bleed air. An optional water alcohol augmentation system can be used with the 250–C20B, –C20F, –C20J and C20S engines.

A. Fuel System

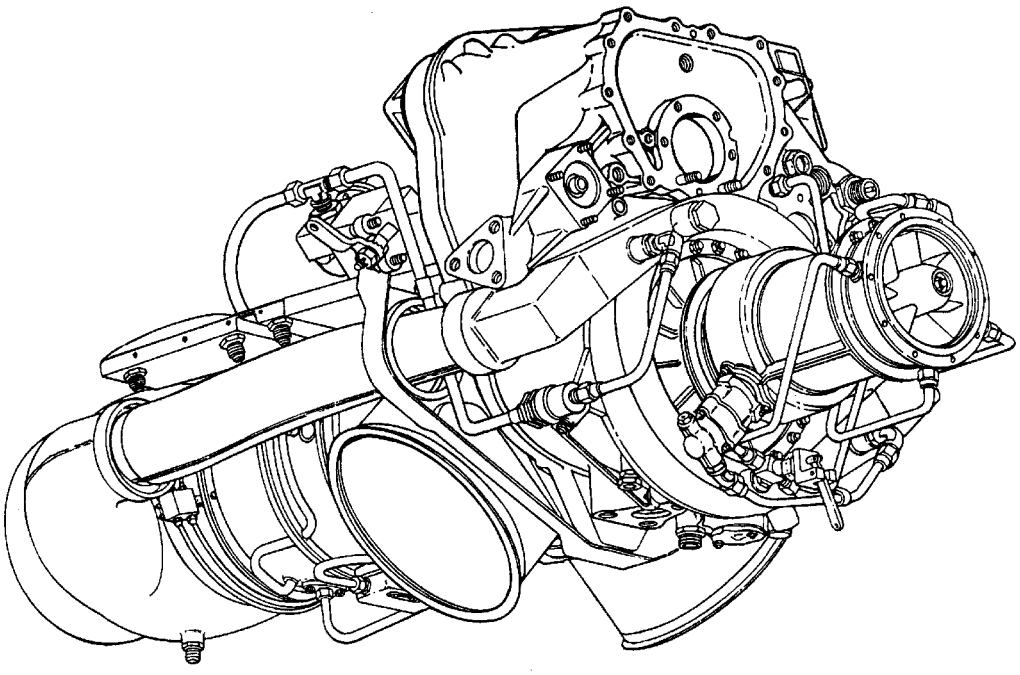
The principal components of the fuel system are a fuel pump, a gas producer fuel control, a power turbine governor, and a fuel nozzle. The fuel control and governor are located schematically in the system between the fuel pump and the fuel nozzle. (See Figures 3, 4 and 5.) A functional description of the fuel system which follows includes both Bendix and Chandler Evans (CECO) systems.

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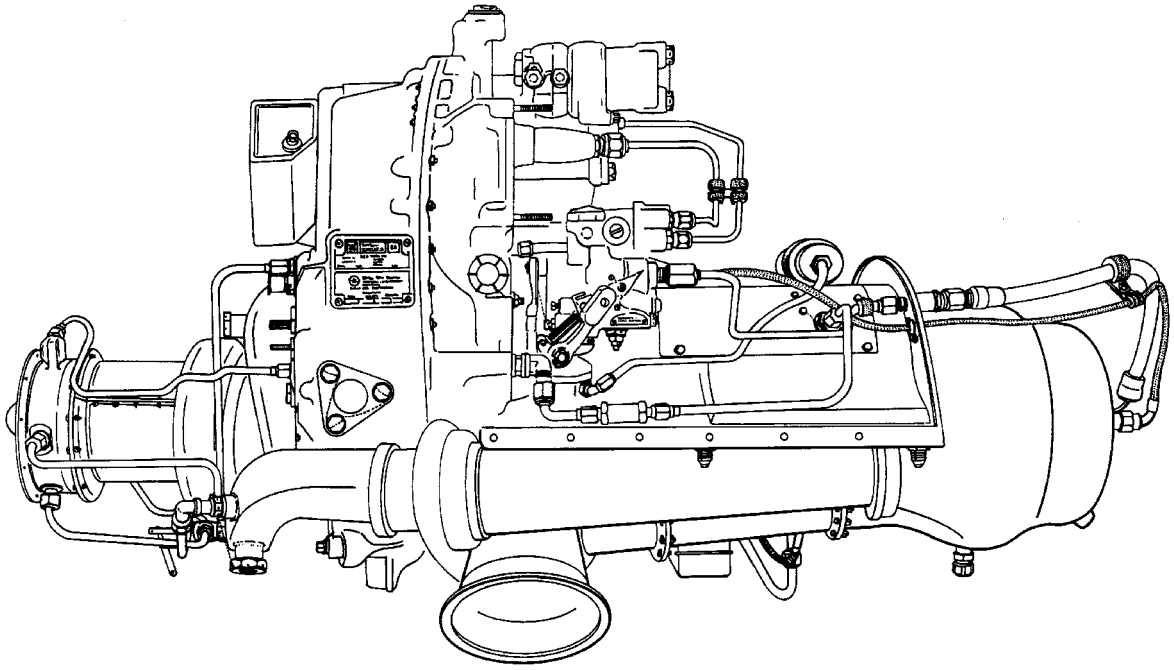
Engine Views
Figure 1 (Sheet 1 of 2)

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ADA006XD

250–C20S Engine

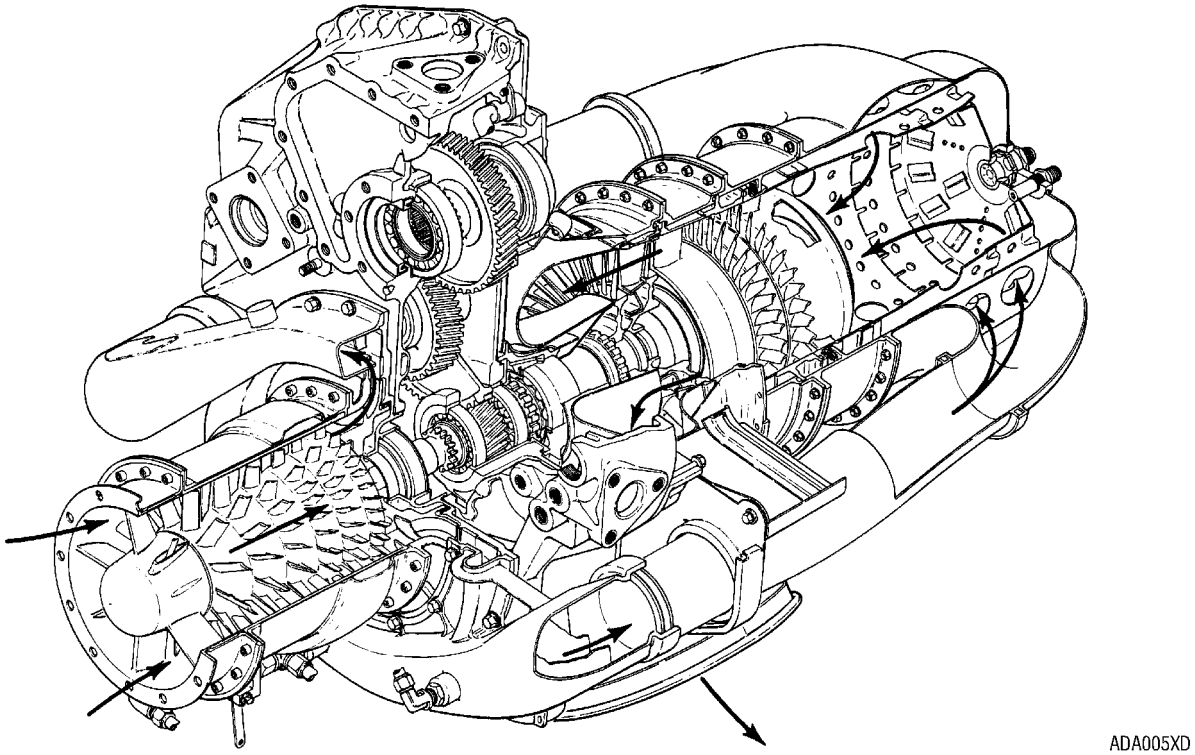


ADA012XD

250–C20W Engine

Engine Views
Figure 1 (Sheet 2 of 2)

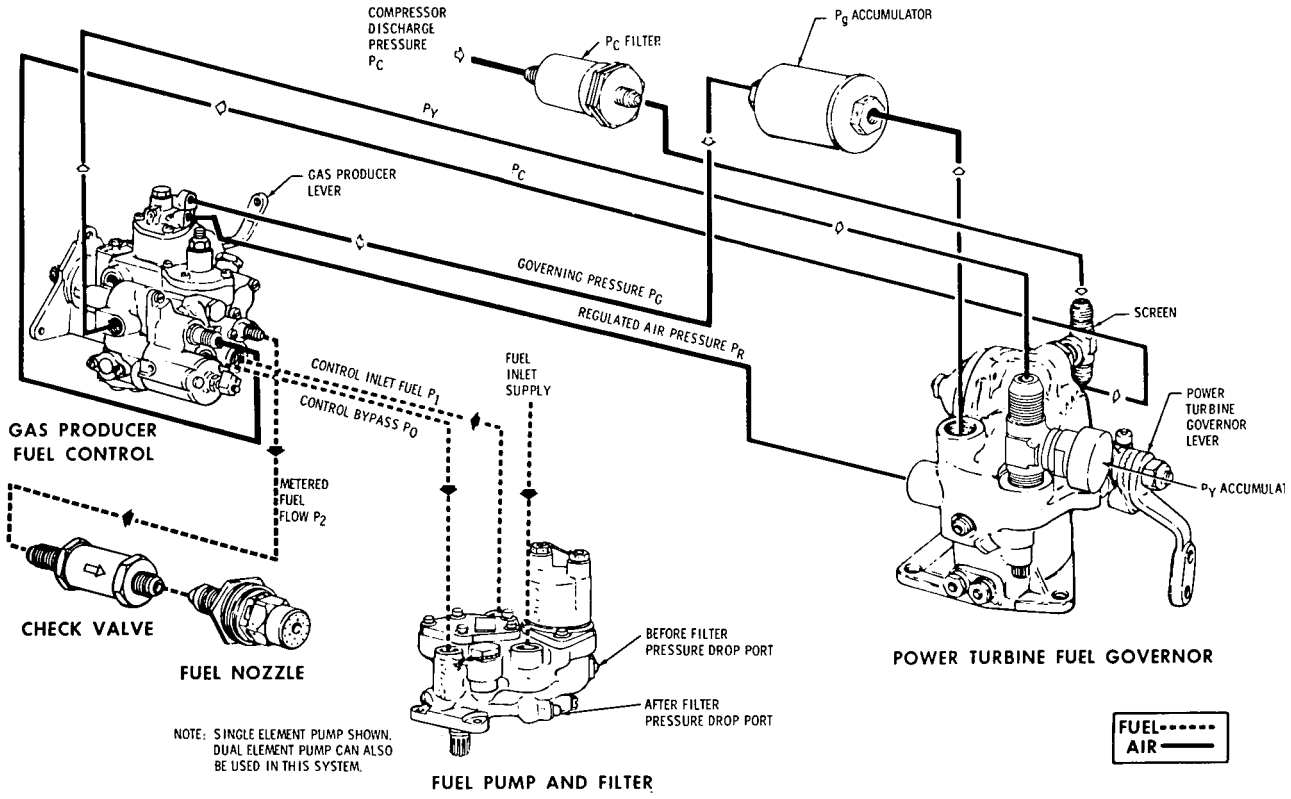
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250–C20S Engine

Typical Engine Airflow
Figure 2

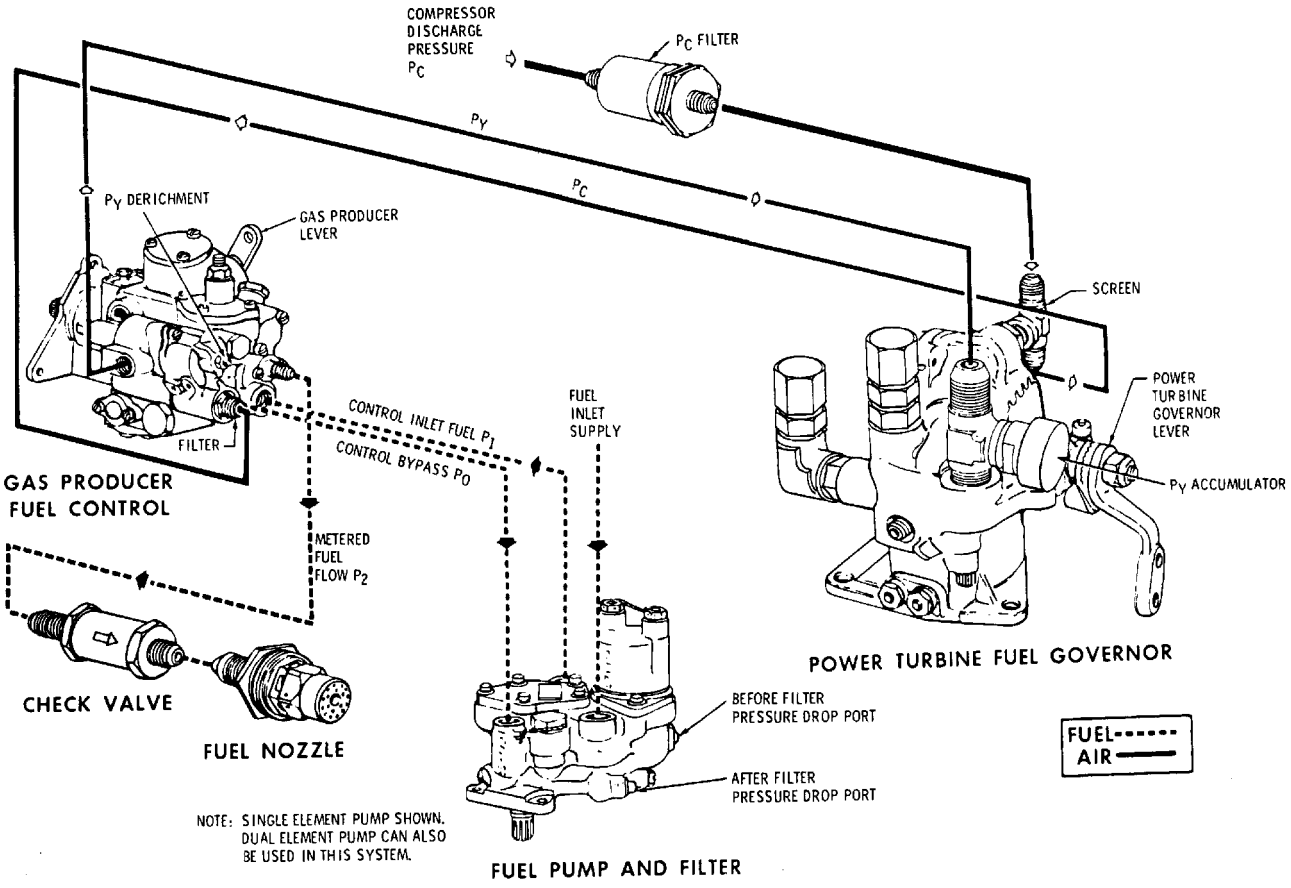
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ADS017XA

Engine Fuel Control System (Bendix) (250–C20, –C20B, –C20F, –C20J, –C20W)
Figure 3

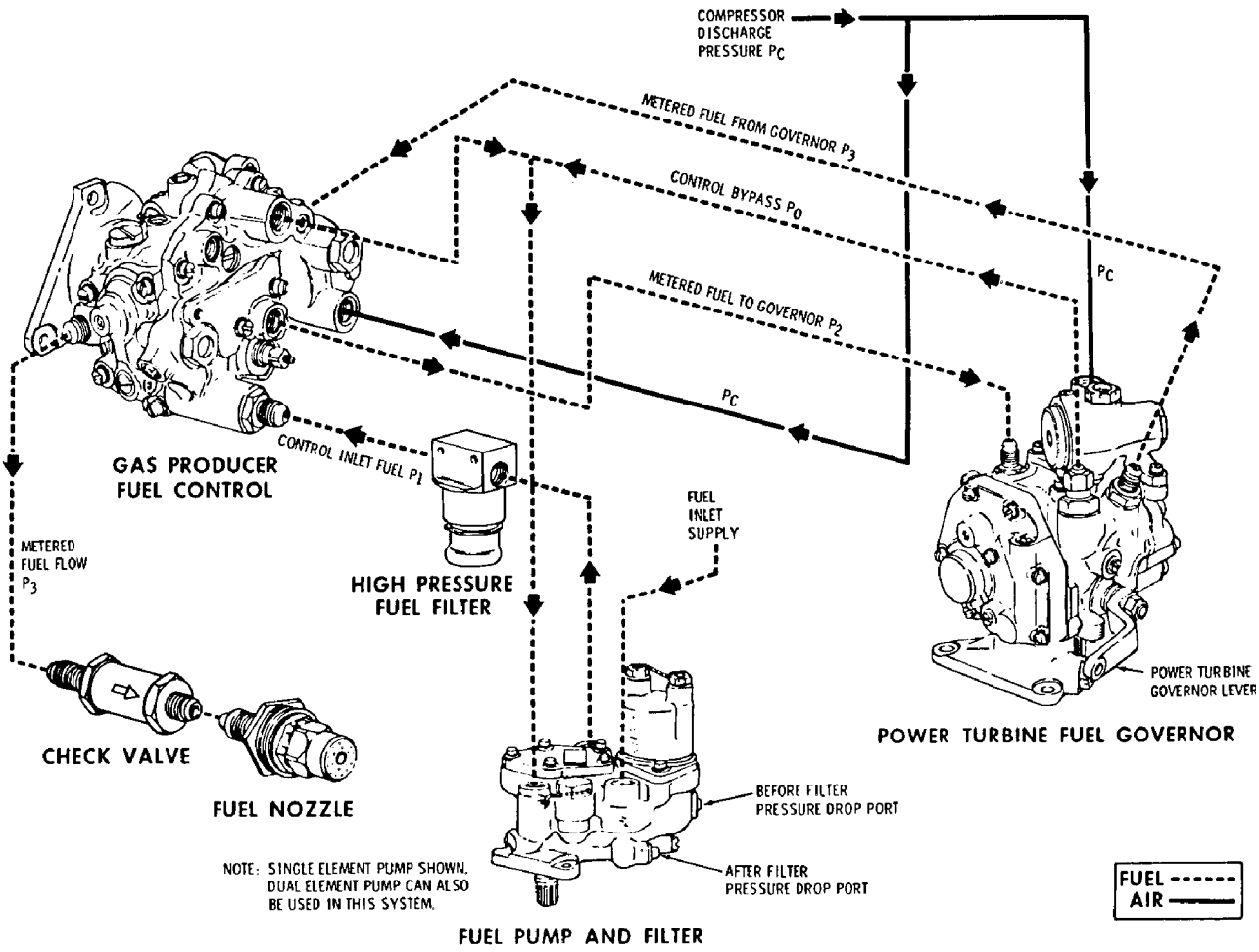
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ADS037XF

Engine Fuel Control System (Bendix) (250–C20S)
Figure 4

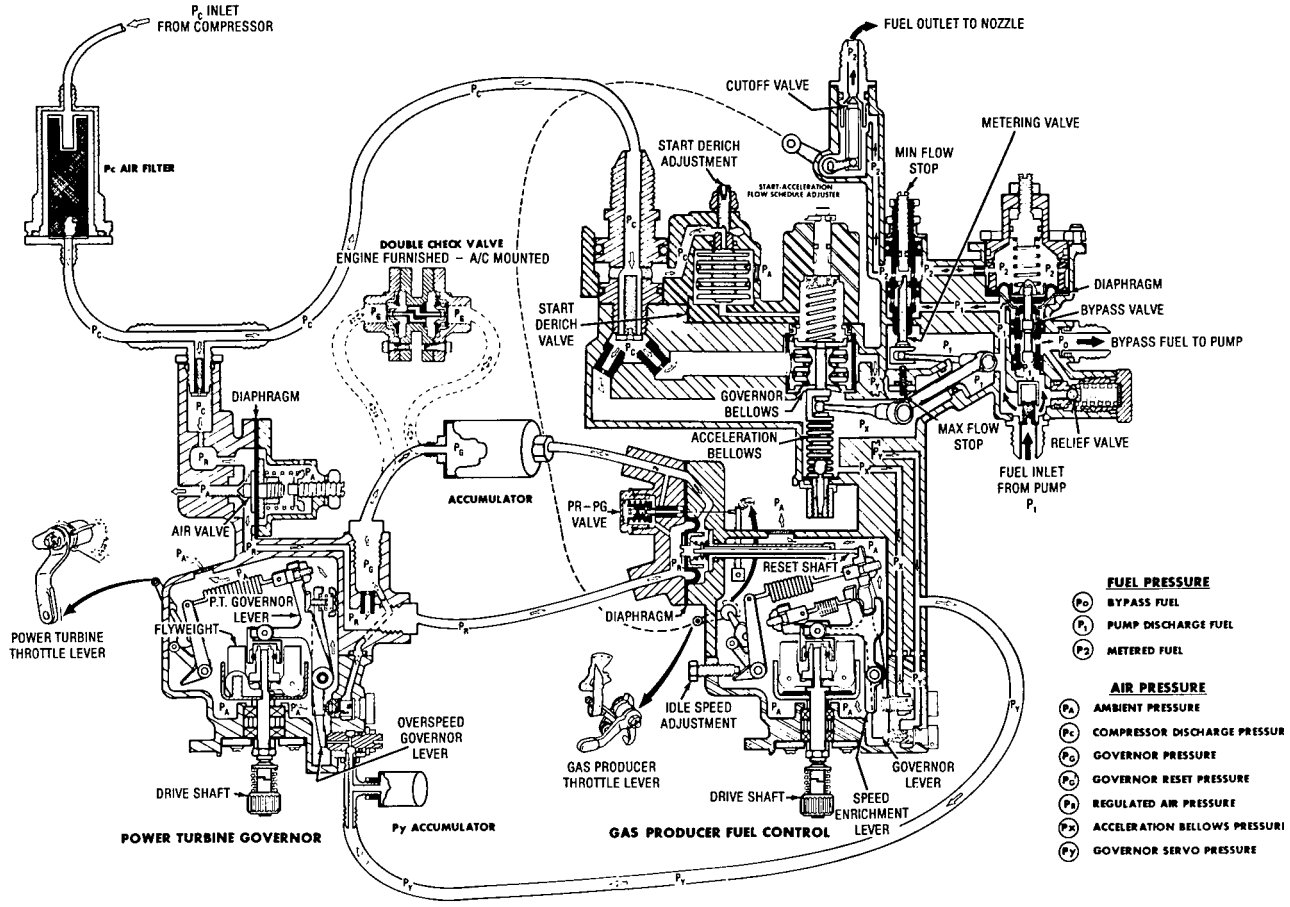
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ADS018XA

Engine Fuel Control System (CECO)
Figure 5

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ADS019XA

Bendix Engine Fuel Control Schematic (250–C20, –C20B, –C20F, –C20J, –C20W)
Figure 6

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PARA 3.A. (cont)

(1) Bendix Fuel Control System (250–C20, –C20B, –C20F, –C20J, –C20W) (See Figure 6.)

The system controls engine power output by controlling the gas producer speed. Gas producer speed levels are established by the action of the power turbine governor which senses power turbine speed. The power turbine (load) speed is selected by the operator and the power required to maintain this speed is automatically maintained by the power turbine governor resetting the fuel control.

The power turbine governor lever schedules the power turbine governor requirements. The power turbine governor, in turn, schedules the gas producer speed to a changed power output to maintain output shaft speed.

Fuel flow for engine control is established as a function of compressor discharge pressure (P_c), engine speed (gas producer–N_1 and/or power turbine–N_2), and gas producer lever angle. Fuel flow is a function of P_c as sensed in the fuel control. Variations of the fuel flow schedules are obtained by modulating the P_c to P_x and P_y pressures in the control through the action of a bleeddown circuit actuated by the governors. (See Figure 6.)

(a) Bendix Gas Producer Fuel Control (250–C20, –C20B, –C20F, –C20J, –C20W).

This gas producer fuel control has a bypass valve, metering valve, acceleration bellows, governing and enrichment bellows, manually–operated cutoff valve, maximum pressure relief valve, a start acceleration flow schedule adjuster and a start derichment valve. The maximum pressure relief valve is incorporated to protect the system from excessive fuel pressure.

Fuel enters the control from the engine fuel pump and filter assembly and is conveyed to the metering valve. The bypass valve maintains a constant pressure differential across the metering valve and bypasses excess fuel back to the fuel pump and filter assembly through an external line connecting the pump bypass inlet to the bypass outlet port of the gas producer fuel control.

The metering valve is operated by lever action through movement of the governor and acceleration bellows. Metering valve area is a function of valve travel. Before light–off and acceleration the metering valve is established at a predetermined open position by the acceleration bellows (aneroid) under influence of ambient pressure (P_c at zero rpm).

The start derichment valve is open during light–off and acceleration to a set P_c. The open derichment valve vents P_y pressure to atmosphere. Venting P_y allows the governor bellows to move the metering valve toward the min flow stop. Derichment provides the required lean fuel schedule after light–off. As compressor rpm increases, the derichment valve is closed by P_c acting on the derichment bellows. When the derichment valve is closed, control of the metering valve is returned to the normal operating schedule. The start derichment schedule can be varied by a manual adjustment on the fuel control. The start acceleration schedule adjuster allows field adjustment of the start and acceleration fuel flow schedule.

During acceleration the P_x and P_y pressures are equal to the modified compressor discharge pressure (P_c) up to the point where the speed enrichment orifice is opened by flyweight action. Opening the speed enrichment orifice bleeds P_x pressure while P_y remains at a value equal to P_c. Under the influence of the P_y minus P_x pressure drop across the governor bellows, the metering valve moves toward the max flow stop where it provides increased fuel flow.

Gas producer speed is controlled by the gas producer fuel control governor. A set of flyweights operate the governor lever which controls the governor bellows P_y pressure bleed off at the governing orifice. Flyweight operation of the governor lever is opposed by a variable spring load. The spring force is established by the throttle lever acting on a spring scheduling cam. Opening the governing orifice bleeds off P_y pressure. In response to this reduction in P_y pressure, the bellows moves the metering valve toward min flow and at a position where metered flow is at steady state requirements.

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PARA 3.A. (1)(a) (cont)

The governor reset section of the gas producer fuel control permits the power turbine governor to override the speed governing elements of the fuel control to alter the fuel schedule in response to changing load conditions applied to the power turbine. A $P_r - P_g$ valve incorporated in the fuel control prevents N_1 engine speed undershoot during gas producer decelerations when the N_1 throttle is moved to the Ground Idle position. This is accomplished by opening the throttle actuated $P_r - P_g$ valve which equalizes $P_r - P_g$ pressures, eliminating the reset action supplied from the power turbine governor.

(b) Bendix Power Turbine Governor (250–C20, –C20B, –C20F, –C20J, –C20W)

The power turbine speed is scheduled by the power turbine governor lever and the power turbine speed scheduling cam. The cam sets a governor spring load which opposes a speed–weight output. As the desired speed is approached the speed weights, operating against the governor spring, move a link to open the power turbine governor orifice. The speed weights also open the overspeed bleed (P_y) orifice, but, at a higher speed than where the regular governor orifice (P_g) is opened.

The governor orifice is downstream of a bleed supplied by a regulated air pressure, P_r. Opening the orifice results in a reduced pressure downstream of the bleed (P_g) as an inverse function of increasing speed. Regulated pressure (P_r) and governing pressure (P_g) are applied to opposite sides of a diaphragm in the governor reset section of the gas producer fuel control. The force generated by $P_r - P_g$ across the diaphragm acts on the gas producer power governor lever through the governor reset rod and supplements the weight force in the gas producer fuel governor to reset (reduce) the gas producer speed. Gas producer speed cannot exceed the gas producer fuel governor setting.

The $P_r - P_g$ diaphragm is preloaded for establishing the active P_r minus P_g range. P_r pressure is supplied from engine P_c pressure by an air regulator valve.

The overspeed orifice bleeds P_y pressure from the governing system of the gas producer fuel control. Bleeding P_y pressure at the power turbine governor gives the fuel control system a rapid response to overspeed conditions.

(c) Fuel Pump and Filter Assembly.

The fuel pump and filter assembly may be either a dual element or a single element unit.

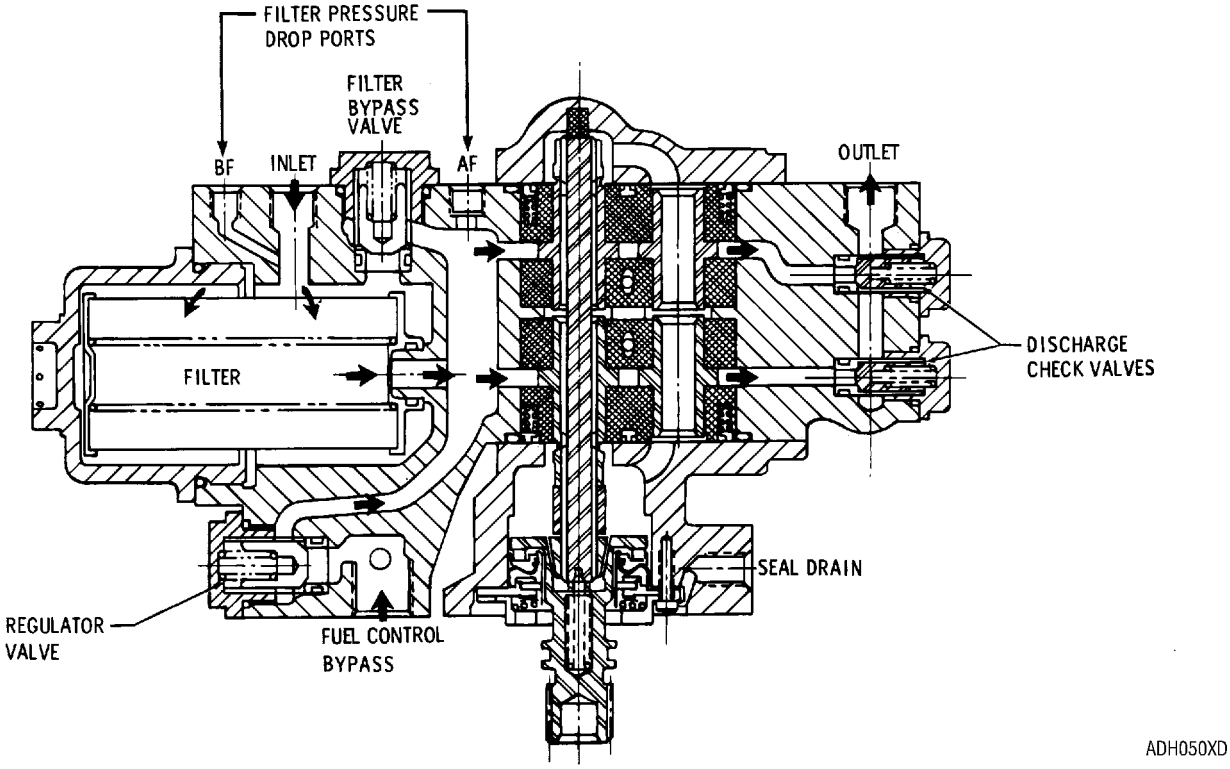
1 Dual Element Fuel Pump. (See Figure 7.)

The fuel pump and filter assembly incorporates two gear–type pumping elements arranged in tandem and driven by a common drive shaft. Fuel enters the engine fuel system at the inlet port of the pump and passes through a low pressure filter before entering the gear elements. The gear elements are arranged in parallel and each pumping element has sufficient capacity to permit takeoff power operation in the event of failure of the other pumping element. Two discharge check valves are provided in the assembly to prevent reverse flow in event of failure of one gear pumping element. A bypass valve in the pump assembly allows fuel to bypass the filter element if it becomes clogged.

The bypass return flow from the fuel control is passed back to the inlet of the gear elements through a pressure regulating valve which maintains the bypass flow pressure above inlet pressure. By means of passages leading to auxiliary filling ports on the periphery of the gear elements, a portion of the bypass flow is used to fill the gear teeth when vapor–liquid conditions exist at the inlet to the gear elements.

The 5 micron nominal/15 micron absolute replaceable filter is located inside the fuel pump assembly upstream of the gear elements. It is retained by a threaded cover (distinguished by a hex) which can be found on the lower side of the pump assembly. To minimize the spilling of fuel, fuel may be drained through the ‘‘Before Filter” pressure drop port (BF) before removing the filter cover. A container should be used to catch undrained fuel when the filter cover is removed.

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Dual Element Fuel Pump Assembly
Figure 7

PARA 3.A. (1)(c) (cont)

2 Single Element Fuel Pump and Filter Assembly. (See Figure 8 or 9.)

The fuel pump and filter assembly incorporates a single gear–type pumping element, a low pressure barrier filter, a filter bypass valve, and a bypass pressure regulating valve. Fuel enters the engine fuel system at the inlet port of the pump and passes through the low pressure filter before entering the gear element. The filter bypass valve allows fuel to bypass the filter element if it becomes clogged.

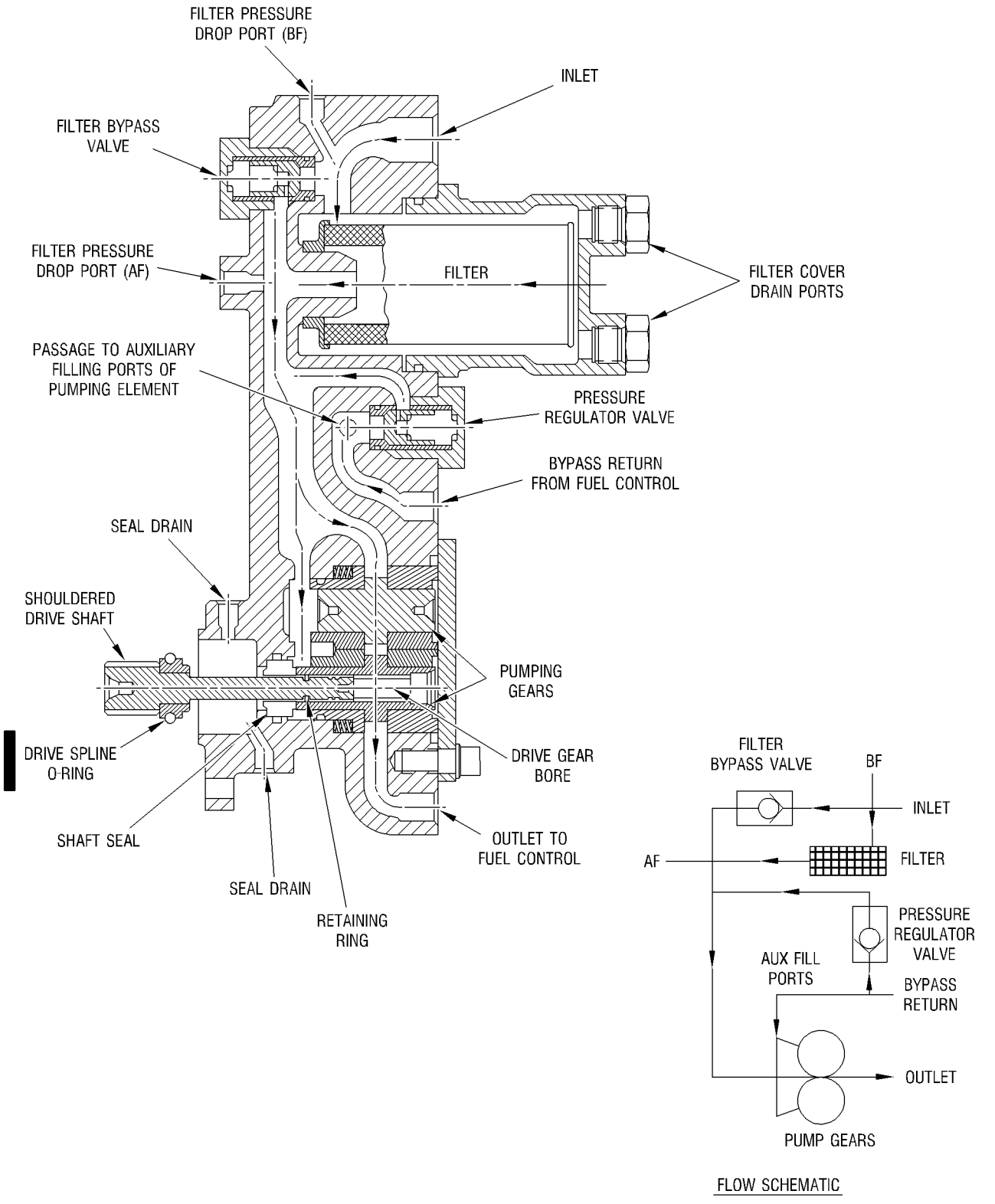
The bypass return flow from the fuel control is passed back to the inlet of the gear element through a pressure regulating valve which maintains the bypass flow pressure above inlet pressure. By means of passages leading to auxiliary filling ports on the periphery of the gear element, a portion of the bypass flow is used to fill the gear teeth when vapor–liquid conditions exist at the inlet to the gear element.

The 5 micron nominal/15 micron absolute replaceable filter is located inside the fuel pump assembly upstream of the gear element. It is retained by a cast cover attached to the pump housing by two socket head cap screws. The cover is located on the aft side of the pump. To minimize fuel spillage during filter replacement, fuel may be drained through the lower of the two drain ports located on the aft face of the filter cover. Pressure taps are provided before and after (labeled BF and AF) the filter element to permit measurement of filter pressure drop if desired.

(d) Fuel Nozzle.

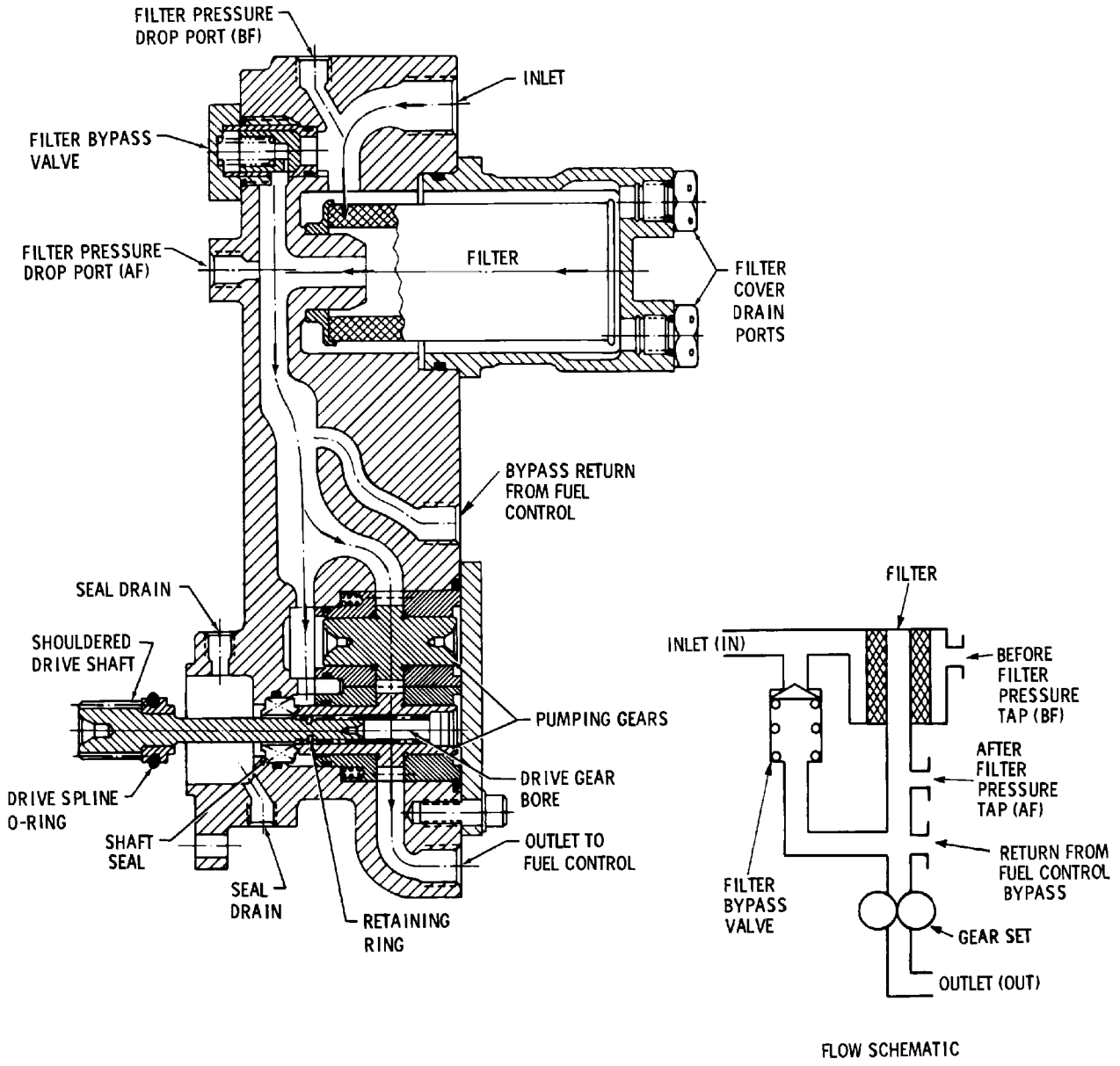
The fuel nozzle is a single–entry dual–orifice type unit which contains an integral valve for dividing primary and secondary flow.

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Single Element Fuel Pump and Filter Assembly (Sundstrand)
(Sundstrand/Pesco)
Figure 8

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Single Element Fuel Pump Assembly AGRO–TECH (TRW)
Figure 9

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PARA 3.A. (cont)

(2) Bendix Fuel Control System (250–C20S) (See Figure 10.)

The system controls engine power output by controlling the gas producer speed. Gas producer speed levels are established by selection of a Power Lever position.

The power turbine governor acts as an overspeed governor in addition to the installation furnished propeller governing system.

Fuel flow for engine control is established as a function of compressor discharge pressure (P_c), engine speed (gas producer–N_1), and gas producer lever angle. Fuel flow is a function of P_c as sensed in the fuel control. Variations of the fuel flow schedules are obtained by modulating the P_c to P_x and P_y pressures in the control through the action of a bleed–down circuit actuated by the governors. (See Figure 10.)

(a) Bendix Gas Producer Fuel Control (250–C20S).

The gas producer fuel control responds to input from compressor discharge pressure (P_c), gas producer turbine speed (N_1), and power lever (throttle) angle.

The gas producer fuel control has a bypass valve, metering valve, acceleration bellows, governing and enrichment bellows, manually operated cutoff valve, maximum pressure relief valve, a torque tube seal and lever assembly, and a start derichment valve. (See Figure 10.) Fuel enters the control from the engine fuel pump and filter assembly and is conveyed to the metering valve. The bypass valve maintains a constant pressure differential across the metering valve and bypasses excess fuel back to the fuel pump and filter assembly through an external line connecting the pump bypass inlet to the bypass outlet port of the gas producer fuel control.

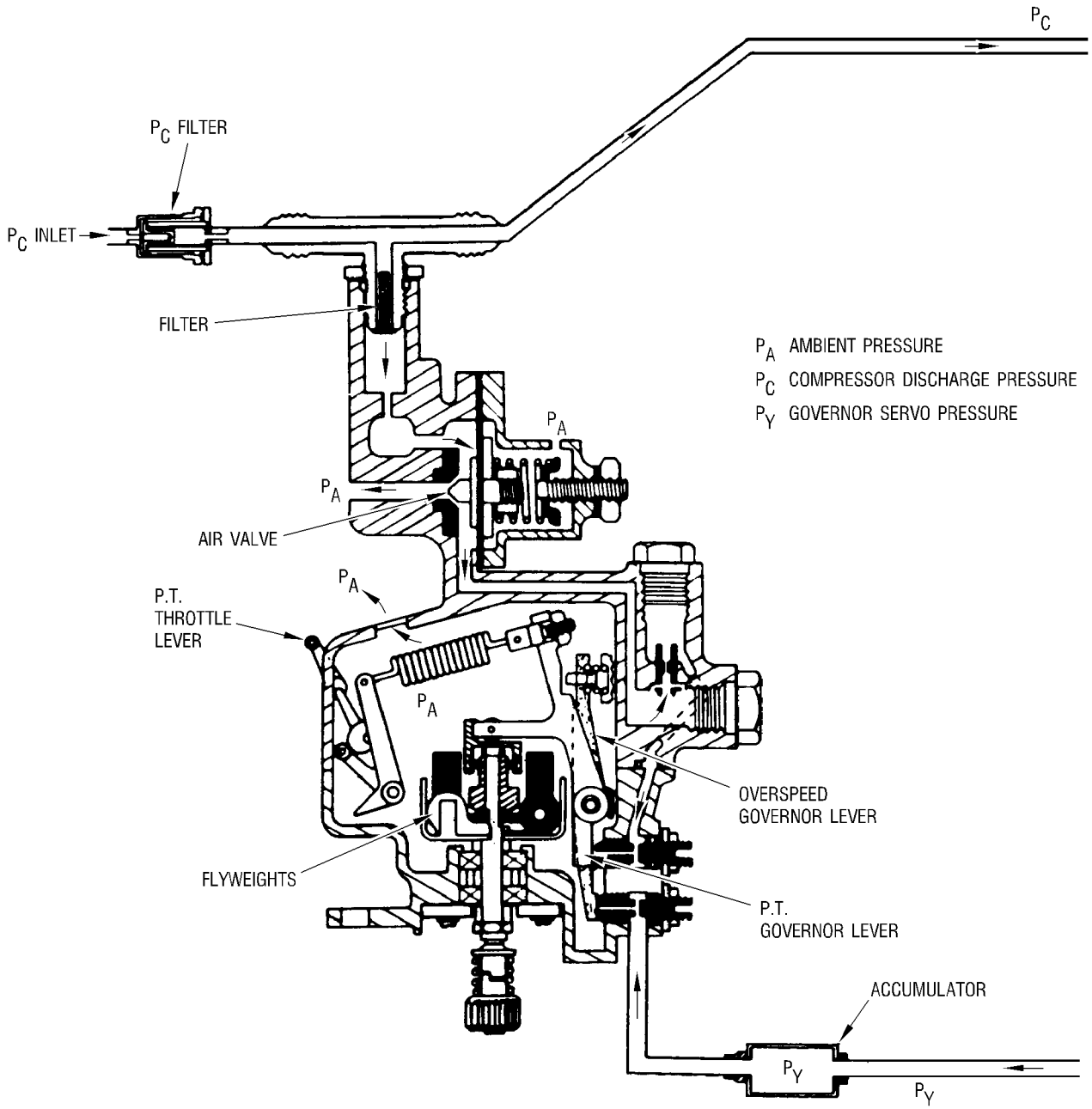
The metering valve is operated by lever action through movement of the governor and acceleration bellows. Metering valve area is a function of valve travel. Before light–off and acceleration the metering valve is established at a predetermined open position by the acceleration bellows (aneroid) under influence of ambient pressure (P_c at zero compressor rpm).

During light–off and acceleration to a set P_c, the start derichment valve is open allowing P_y pressure to vent to atmosphere. Venting P_y allows the governor bellows to move the metering valve against the min flow stop. At min flow the metering valve provides the required lean fuel schedule after light–off. As compressor rpm increases the derichment valve is closed by P_c acting on the derichment bellows. When the derichment valve is closed, control of the metering valve is returned to the normal operating schedule. The derichment schedule can be varied by a manual adjustment on the fuel control.

During acceleration the P_x and P_y pressures are equal to the modified compressor discharge pressure (P_c) up to the point where the speed enrichment orifice is opened by flyweight action. Opening the speed enrichment orifice bleeds P_x pressure while P_y remains at a value equal to P_c. Under the influence of the P_y minus P_x pressure drop access the governor bellows, the metering valve moves toward the max flow stop where it provides increased fuel flow.

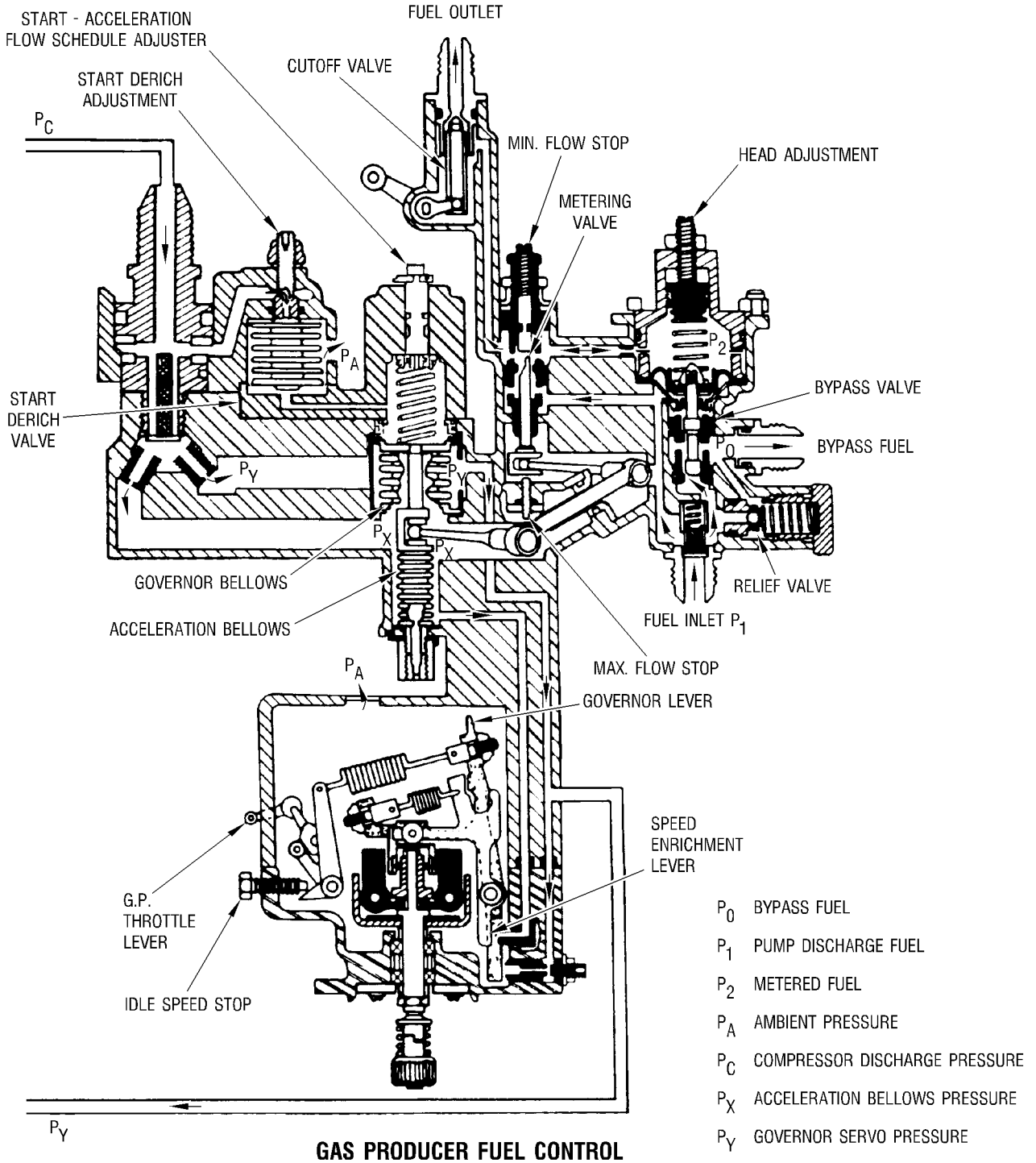
Gas producer speed is controlled by the gas producer fuel control governor. A set of flyweights operate the governor lever which controls governor bellows (P_y) bleed at the governing orifice. Flyweight operation of the governor lever is opposed by a variable spring load. The spring force is established by the gas producer fuel control lever acting on a spring scheduling cam. Opening the governing orifice bleeds P_y pressure and allows P_x pressure to control the governor bellows. The P_x influence on the bellows moves the metering valve toward min flow and at a position where metered flow is at steady state requirements.

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Bendix Engine Fuel Control Schematic (250–C20S) (Sheet 1 of 2)
Figure 10

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Bendix Engine Fuel Control Schematic (250–C20S) (Sheet 2 of 2)
Figure 10

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PARA 3.A.(2) (cont)

(b) Bendix Power Turbine Fuel Governor (250–C20S).

The power turbine overspeed is controlled by the preset position of the power turbine lever. The lever sets a governor spring load which opposes a speed–weight output. As the governor overspeed setting is approached the speed weights, operating against the governor spring, move a link to open the power turbine governor overspeed bleed (P_y) orifice.

The overspeed orifice bleeds P_y pressure from the governing system of the gas producer fuel control. Bleeding P_y pressure at the power turbine governor gives the fuel control system a rapid response to overspeed conditions.

(c) Fuel Pump and Fuel Nozzle.

The fuel pump and the fuel nozzle are the same as described for the 250–C20, –C20B, –C20F, –C20J, –C20W Bendix control system. (Refer to Fuel Pump and Filter Assembly. para 3.A.(1)(c), this section and Fuel Nozzle, para 3.A.(1)(d), this section.)

(3) Chandler Evans (CECO) Fuel Control System. (See Figure 11.)

This system uses a gas producer fuel control to provide automatic fuel management for the gas producer section of the engine. The power turbine section of the engine is maintained by the power turbine governor. The fuel control and the governor together schedule fuel as determined by the module calling for the least fuel. The engine assembly fuel system has two filters. The first filter is integral with the fuel pump it has a 5 micron nominal/15 micron absolute replaceable element. The second filter is mounted between the pump outlet and the fuel control inlet. The second filter has a cleanable metallic element rated at 5 micron nominal/15 micron absolute.

(a) CECO Gas Producer Fuel Control.

This gas producer fuel control responds to input from compressor discharge pressure (P_c), gas producer turbine speed (N_1), and fuel control throttle lever angle.

The systems and features making up the gas producer fuel control include the following:

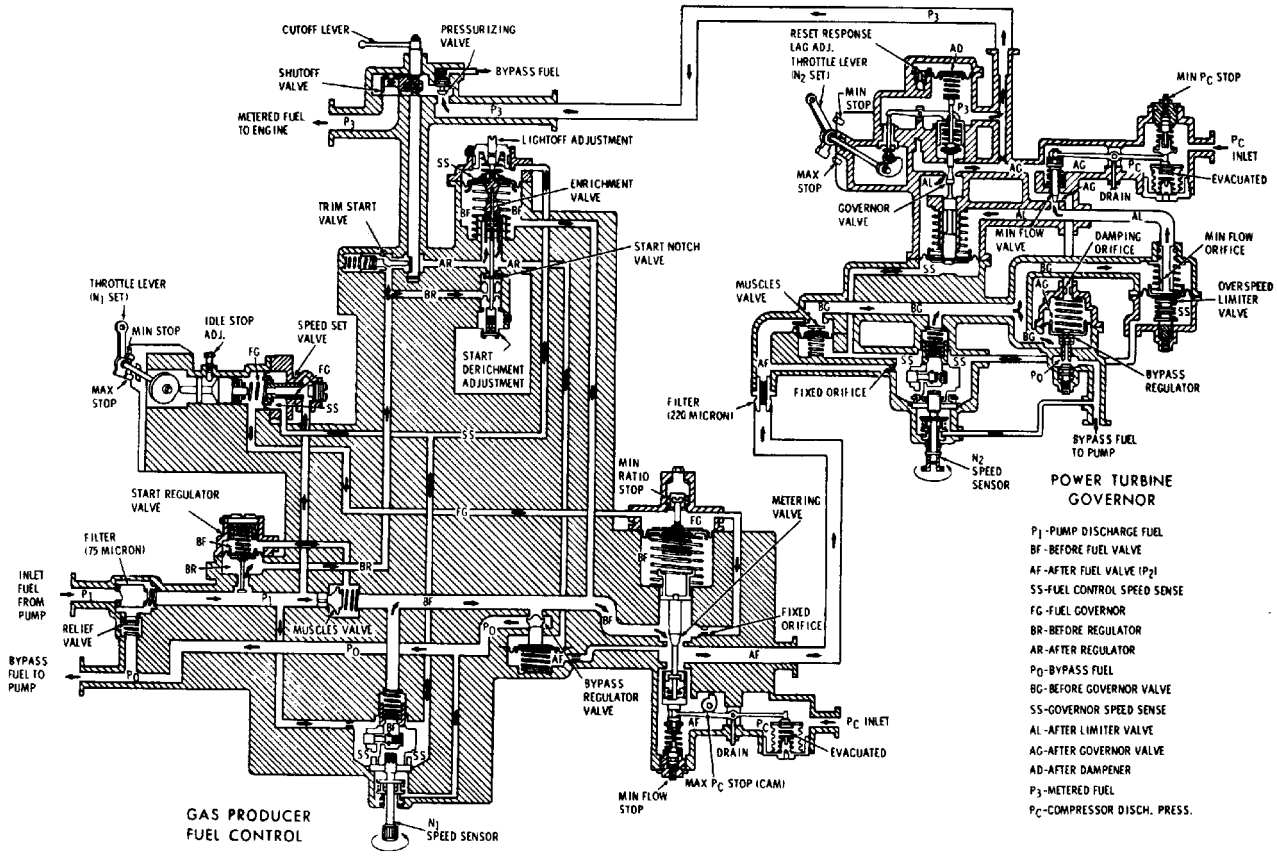
– Acceleration system
– Gas producer governing system
– Minimum ratio (deceleration assist) minimum flow
– Gas producer speed sensor
– Speed enrichment and starting system
– Shutoff valve
– Relief valve
– Pressurizing valve

1 Acceleration System.

The output of the acceleration system is a speed biased ration of fuel flow/compressor discharge pressure (W_f/P_c). The speed bias varies the ratio as required to skirt the compressor stall line. A metering valve is used to schedule fuel flow for acceleration, gas producer governing, and deceleration. Compressor discharge P_c pressure is supplied to an evacuated spring–loaded bellows where is produces s displacement of the bellows proportional to P_c. This displacement is transmitted to the metering valve through a detentable spring by the bellow lever.

During acceleration the metering valve is unloaded and the preload of the detentable spring assures that the metering valve will follow the bellows lever position exactly. The metering valve is contoured to produce a metering area proportional to displacement so that valve metering area is directly proportional to P_c.

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CECO Fuel Control System Schematic
Figure 11

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PARA 3.A.(3)(a)1 (cont)

A constant differential pressure is maintained by a bypass regulator which routes pump discharge fuel flow in excess of the metered engine flow back to the pump inlet. The pressure differential across the fuel valve metering area is a function of gas producer N_1 speed. Since metering area is proportional to compressor discharge P_c pressure, acceleration fuel flow delivered to the engine is proportional to P_c and biased by N_1.

2 Gas Producer Governing System.

The governing system in the gas producer fuel control is an all speed P_c compensated governor. The speed input to the governor is a differential pressure SS–BF produced by a speed sensor. The input pressure is proportional to speed squared.

Speed sensor differential pressure SS–BF is applied across a spring loaded speed set diaphragm. The spring load on the diaphragm is determined by a throttle lever actuated cam and a cam follower. The spring load and the differential pressure SS–BF act on the speed set diaphragm to regulate the metering area of the speed set valve. The speed set valve creates differential pressure FG–BF which is equal to differential pressure SS–BF minus the load of the speed set spring. When the differential pressure FG–BF applied across the governor diaphragm overcomes the load of the casting referenced governor spring, the resultant travel of the governor diaphragm increases the load of the minimum ratio spring on the metering valve. When the load of the minimum ratio spring overcomes the load of the metering valve detent spring, the detent spring compresses resulting in translation of the metering valve. The resultant travel of the metering valve reduces metering valve flow area, thereby reducing fuel flow even though the P_c bellows lever is positioned to call for acceleration fuel flow.

Since the travel of the governor diaphragm must produce a load on the minimum ratio spring to overcome the preload of the detent spring, the breakpoint from the acceleration line for a given throttle setting is a function of valve opening and therefore a function of P_c. Once the load of the detent spring has been overcome by the minimum ratio spring, the force transmitted to the governor spring for any change in P_c depends on the rate of the compressor discharge pressure compensator spring.

3 Minimum Ratio.

Travel of the governor diaphragm as the result of large errors in the overspeed direction is mechanically limited by the minimum ratio stop. When the valve is at the minimum ratio stop, any change in bellows lever position due to a change in P_c will alter the load on the metering valve detent spring. Changing the detent spring load results in changing the fuel valve metering area in proportion to P_c.

4 Minimum Flow.

A mechanical stop prevents the metering valve from reaching the closed position. Stopping valve travel limits the minimum flow area of the metering valve.

5 Gas Producer Speed Sensor.

The speed signal is generated by an offcenter slinger piston which through the use of the variable and a fixed orifice creates differential pressure SS–BF. When applied across the unbalanced area of the slinger piston, differential pressure SS–BF is equal and opposite to a function of the centrifugal force of the slinger piston. The pressure head for operating the speed sensor is obtained with a flow area muscles valves in the fuel passage ahead of the sensing unit. The pressure drop across the muscles valve is flow sensitive and roughly proportional to speed squared plus an initial bias.

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All of the flow used to generate the speed sense differential pressure SS–BF recombines with the flow through the muscles valve. This arrangement meets the requirements of the speed sensor without overloading the pump in the low speed range. Also, all of the pump output is utilized for metered flow if needed.

6 Speed Enrichment and Starting System.

A secondary flow path upstream of the speed sense muscles valve goes to a start regulator valve. This valve maintains the differential pressure BR–BF across the start acceleration computer mechanism at value slightly less than the differential held by the muscles valve.

Downstream of the start regulator valve the flow divides into two paths. One path goes to the manual trim–start valve which is positioned by the cutoff lever. The second path goes to the speed sense positioned start notch valve. The two flow paths combine downstream of the trim–start valve and flow through the enrichment orifice to BF pressure upstream of the metering valve.

The pressure AR between the enrichment orifice and the trim–start valve is fed to the bypass valve diaphragm. The bypass valve maintains a constant differential pressure AR–AF and bypasses excess pump output, over and above metered flow to the engine, back to the pump inlet.

Differential pressure AR–AF is held constant by the bypass valve and differential pressure BR–BF is held constant by the start regulator valve. Therefore, differential pressure BF–AF across the metering valve is a function of the sum of the flow areas of the manual trim–start valve and the speed positioned start notch valve flowing in series with the speed positioned enrichment valve. These flow areas determine the acceleration ratio of W_f/P_c versus throttle lever angle and engine speed.

7 Shutoff Valve.

A sliding plate type shutoff valve, positioned by the cutoff lever shuts off fuel flow to the engine.

8 Relief Valve.

A pressure relief valve at the fuel control inlet limits inlet pressure and returns fuel flow to the pump inlet when the shutoff valve is closed.

The 75 micron filter at the fuel control inlet has a self relieving feature to prevent accumulation in the filter from completely blocking the fuel passage.

9 Pressurizing Valve.

A pressurizing valve near the fuel control outlet limits the minimum pressure in the control.

(b) CECO Power Turbine Governor.

The power turbine governor responds to input from compressor discharge pressure (P_c), power turbine speed (N_2), and governor throttle lever angle. The governor throttle lever is interconnected with the pitch control system to give automatic droop compensation. Further control is provided for the pilot by the GOV RPM INCR–DECR trim system operated from the collective pitch lever.

The power turbine governor has a power turbine (N_2) speed sensor, a mechanical speed set governor, a deceleration system, and an overspeed limiter.

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1 Power Turbine Speed Sensor.

The power turbine N_2 speed sensor is identical to the gas producer N_1 speed sensor. The only difference in the two is the method of maintaining the operating pressure head. In the power turbine governor the muscles valve maintains the pressure drop across the speed sensor jet at a given value above the speed sense differential pressure SS–BG. This makes fuel flow through the speed sensor a function of N_2 speed. All of the fuel flow through the speed sensor and through the muscles valve is recombined upstream of the governor valve so that no metered flow from the gas producer fuel control is wasted.

2 Mechanical Speed Set Governor.

Power turbine N_2 speed is maintained by a force balance on the governor valve. One force (SS–AL diaphragm) is a function of the governor throttle lever position which is transmitted to the governor spring by a cam follower and pivot assembly. An increasing speed signal causes the governor valve metering area to decrease. A reduction in the metering area of the governor valve causes a reduction in fuel flow to the engine.

The pressure drop across the governor valve metering area is maintained by a bypass valve which dumps excess fuel back to the pump inlet.

All of the metered fuel flow passes through a reset jet which creates a pressure drop that is a function of metered flow. This flow responsive differential pressure AG–P3 is applied across the reset diaphragm through a time delay restriction (Reset Response Lag Adj.). This dampened pressure AD creates a load on the reset diaphragm which is a function of fuel flow. The reset spring load is equal and opposite to the pressure load of the reset diaphragm and is added to the governor spring load.

As the differential pressure AG–P3 across the reset jet decreases because of decreased fuel flow, the decreased pressure force on the reset diaphragm allows the reset spring to reduce its load on the governor valve. The reduced load causes the governor valve metering area to decrease resulting in further reduction of fuel flow to the engine.

The basic governor has the relatively shallow governor slope required for engine stability while the reset system with the reset response lag adjustment maintains engine speed relatively constant for changing engine load conditions.

3 Deceleration Fuel Flow.

Deceleration fuel flow is a function of compressor discharge pressure P_c. P_c is supplied to an evacuated spring loaded bellows assembly which maintains a constant minimum ratio W_f/P_c at all flight conditions. This signal is transmitted through the bellows lever assembly to the minimum flow valve which flows fuel in parallel with fuel through the governor valve. The minimum and maximum travel of the minimum flow needle valve is controlled by the externally adjusted maximum P_c stop and minimum P_c stop.

4 Overspeed Limiter.

The overspeed limiter valve is spring loaded open and speed sense actuated. The valve is located upstream of the governor valve.

The bypass regulator maintains a pressure drop across the overspeed limiter valve and the governor valve which are located in series. In an underspeed condition the overspeed limiter valve is wide open and the pressure drop through the valve is nil. During this underspeed condition the governor valve operates as described in the mechanical speed set governor paragraphs.

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During overspeed conditions the speed sense differential pressure SS–BG acts on the overspeed limiter valve diaphragm with a pressure force that overcomes the spring load. This unbalanced load causes the valve to close its flow area and reduce fuel flow to the engine.

The minimum flow orifice offers a built–in flow path through the overspeed limiter valve to create a minimum fuel flow path even though the overspeed limiter valve is fully closed.

(c) Fuel Pump and Fuel Nozzle.

The fuel pump and the fuel nozzle are the same as described for the Bendix control system. (Refer to Fuel Pump and Filter Assembly, para 3.A.(1)(c), this section, and Fuel Nozzle, para 3.A.(1)(d), this section.)

B. Lubrication System (See Figures 12, 13, 14 and 15.)

CAUTION: OIL SCREENS SHOWN ON FIGURE 12 ARE NOT INTERCHANGEABLE. THE OD OF THE POWER TURBINE SUPPORT OIL SCREEN IS 0.325 INCH (8.26 MM) WHERE THE POWER AND ACCESSORY GEARBOX HOUSING SCREEN IS 0.360 INCH (9.14 MM).

The lubrication system is a dry sump type with an aircraft furnished external reservoir and heat exchanger. A gear–type pressure and scavenge pump assembly is mounted within the gearbox. An assembly containing an oil filter element, a filter bypass valve, and a pressure regulating valve is located in the upper right hand side of the gearbox housing and is accessible from the top of the engine. (On 250–C20S and 250–C20W engines it is located in the lower left hand side of the gearbox housing and is accessible from the bottom of the engine.) An impending bypass visual (popout) indicator is incorporated on all 250–C20F engines and is a customer option on other 250–C20 series engines. A check valve, located between the filter package and the accessories gearbox, prevents oil from draining into the engine from the aircraft tank when the engine is not in operation. Indicating type magnetic chip detectors (drain plugs) are installed at the bottom of the gearbox and at the engine oil outlet connection. On 250–C20S and 250–C20W engines the indicating type magnetic chip detectors (drain plugs) are installed in the oil filter housing assembly and the left front of the power and accessories gearbox. All engine oil system lines and connections are internal except the pressure and scavenge lines to the compressor front bearing and the bearings in the gas producer and power turbine supports.

C. Ignition System (See Figure 16, 17, 18, 19 or 20.)

The engine ignition system consists of a low tension capacitor discharge ignition exciter, a spark igniter lead, and a shunted surface gap spark igniter. The system derives its input power from a 14 to 29 volt, d–c external power source.

A start counter is mounted on the gearbox housing, adjacent to the ignition exciter. The counter records the total starts on the engine. It is electrically connected to the power input terminal of the exciter and counts one each time the ignition system is energized. A lead seal provides tamper–proof security.

D. Temperature Measurement System (See Figure 16, 17, 18, 19 or 20.)

The temperature measurement system consists of four chromel–alumel single junction thermocouples in the gas producer turbine outlet and an associated integral terminal. The voltages of the four thermocouples are electrically averaged in the assembly. The airframe temperature indicating system attaches to the integral terminal of the thermocouple assembly.

E. Anti–Icing System

The compressor inlet guide vanes and front bearing support hub are the engine components with anti–icing provisions. Anti–icing is provided by the use of compressor discharge air which is taken from a fitting at the twelve o'clock position (six o'clock position on 250–C20S and 250–C20W engines) on the front face of the compressor scroll. A manually operated air shutoff valve is mounted in this position to control the anti–icing air. An ice detector is not furnished with this engine.

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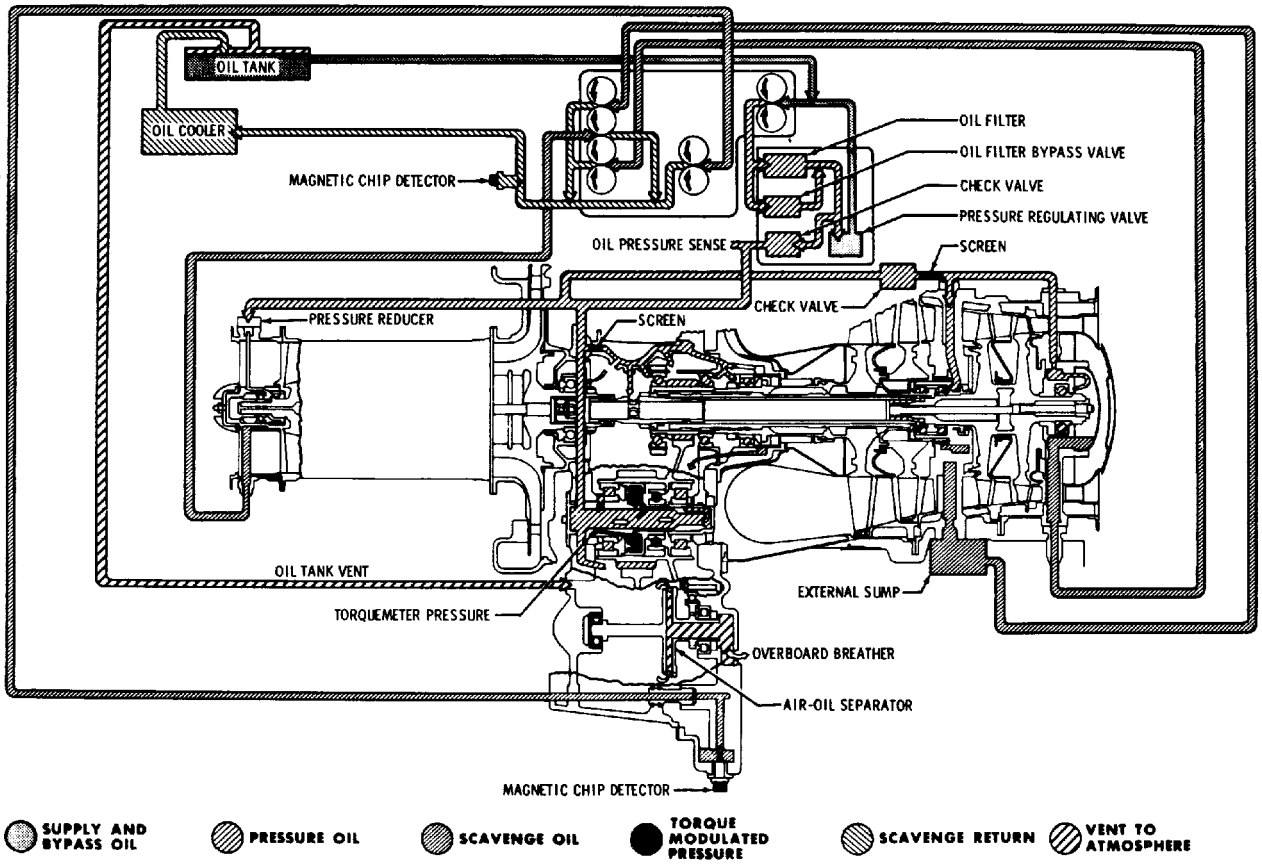
PARA 3.E. (cont)

The effect of anti–icing air flow on engine performance is as follows:

Type of Operation	Approximate Effect on Performance Available to Pilot at Power Levels Above 40,000 N_1 Speed*
	250–C20
Constant TOT 777°C (1430°F) Max continuous	A 47 hp (35 kW) decrease and a 2.28% (1173 rpm) decrease in N_1 (gas producer) speed
Constant N_1 speed 101% (51,490 rpm)	A 11 hp (8.2 kW) decrease and a 36°C (65°F) increase in TOT
Constant hp (385) and constant collective pitch	A 0.72% (361 rpm) increase in N_1 speed and a 48°C (85°F) increase in TOT
	250–C20B, –C20J
Constant TOT 779°C (1434°F)	A 38 hp (28.3 kW) decrease and a 1.74% (908 rpm) decrease in N_1
Constant N_1 speed 102% (52,220 rpm)	A 13 hp (9.7 kW) decrease and a 38°C (68°F) increase TOT
Constant hp (400) and constant collective pitch	A 0.97% (506 rpm) increase in N_1 speed and a 59°C (106°F) increase in TOT
	250–C20F, –C20S, –C20W
Constant TOT 810°C (1490°F) max continuous	A 37 hp (27.6 kW) decrease and a 1.82% (927 rpm) decrease in gas producer speed.
Constant gas producer speed 101% (51,480 rpm)	A 13 hp (9.7 kW) decrease and a 38°C (69°F) increase in TOT.
Constant hp (385) and constant collective pitch (load) operation	A 0.88% (450 rpm) increase in gas producer speed and a 56°C (102°F) increase in TOT

*These values are for Standard Day Sea Level conditions and will vary with changes in ambient temperature and altitude. The effects at lower powers and speeds will be only slightly different but still immediate and definite.

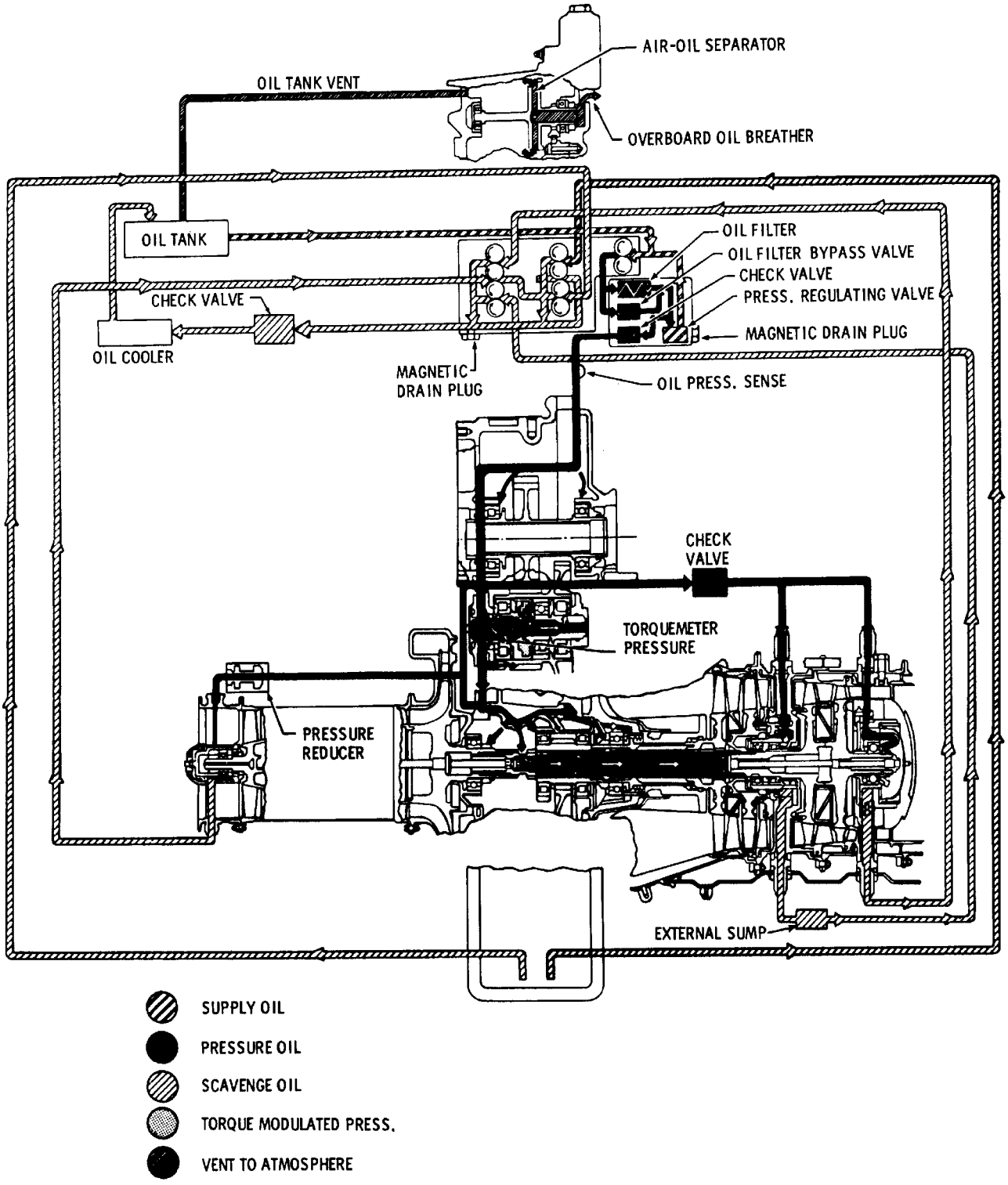
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Typical Lubrication System Schematic (250–C20, –C20B, –C20F, –C20J)
Figure 12

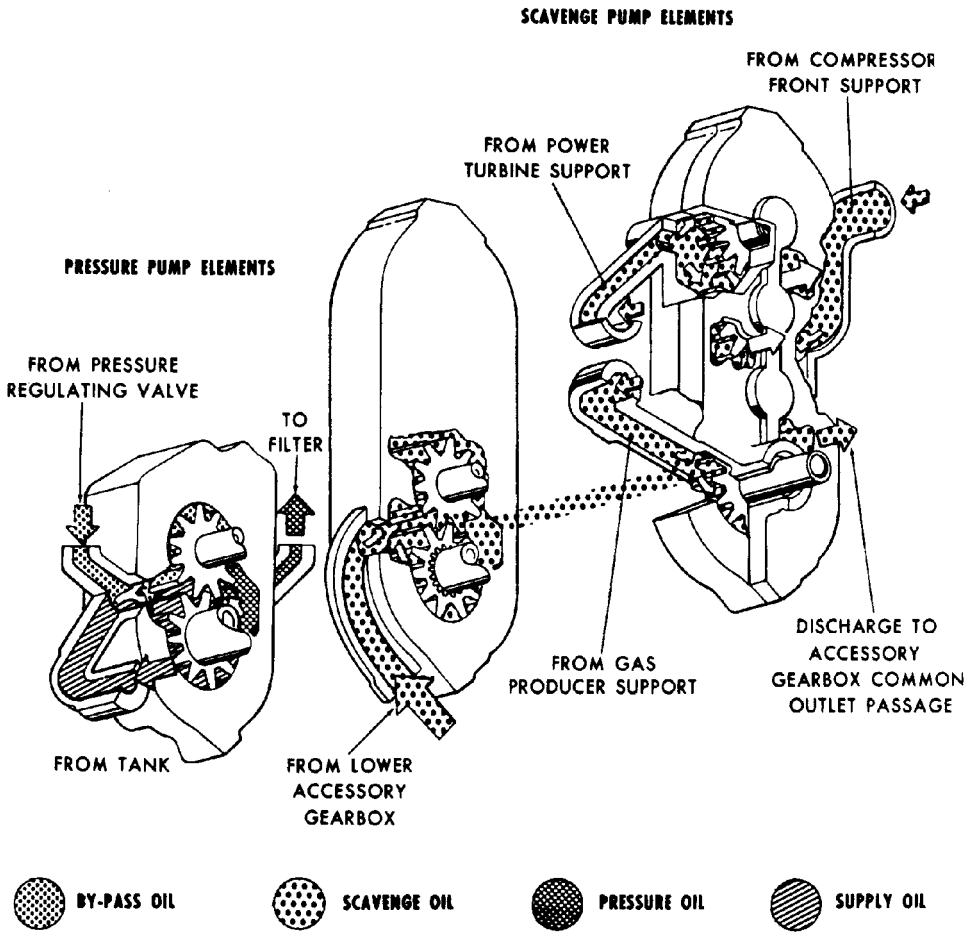
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Lubrication System Schematic (250–C20S, –C20W)
Figure 13

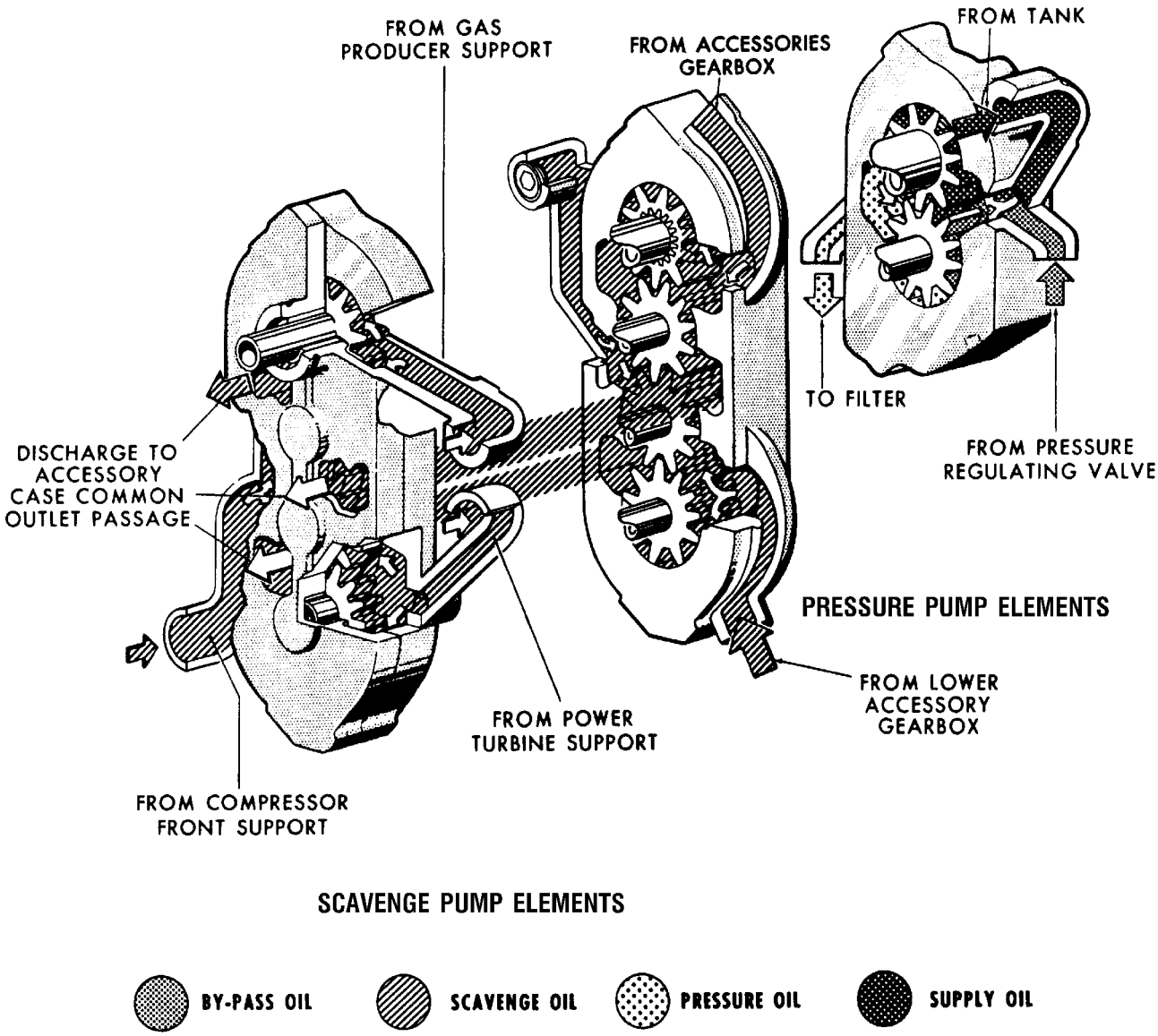
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Oil Pump Schematic (250–C20, –C20B, –C20F, –C20J)
Figure 14

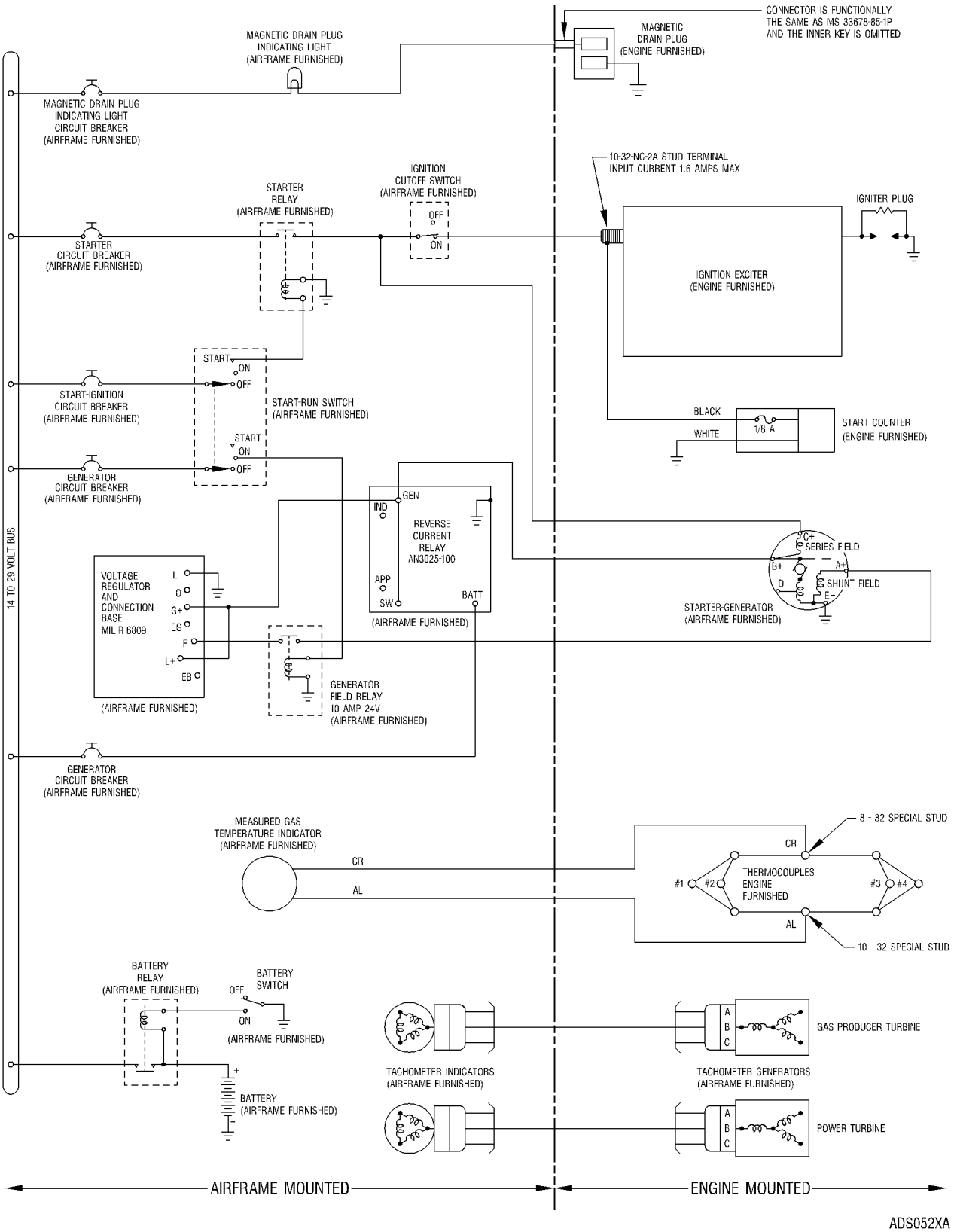
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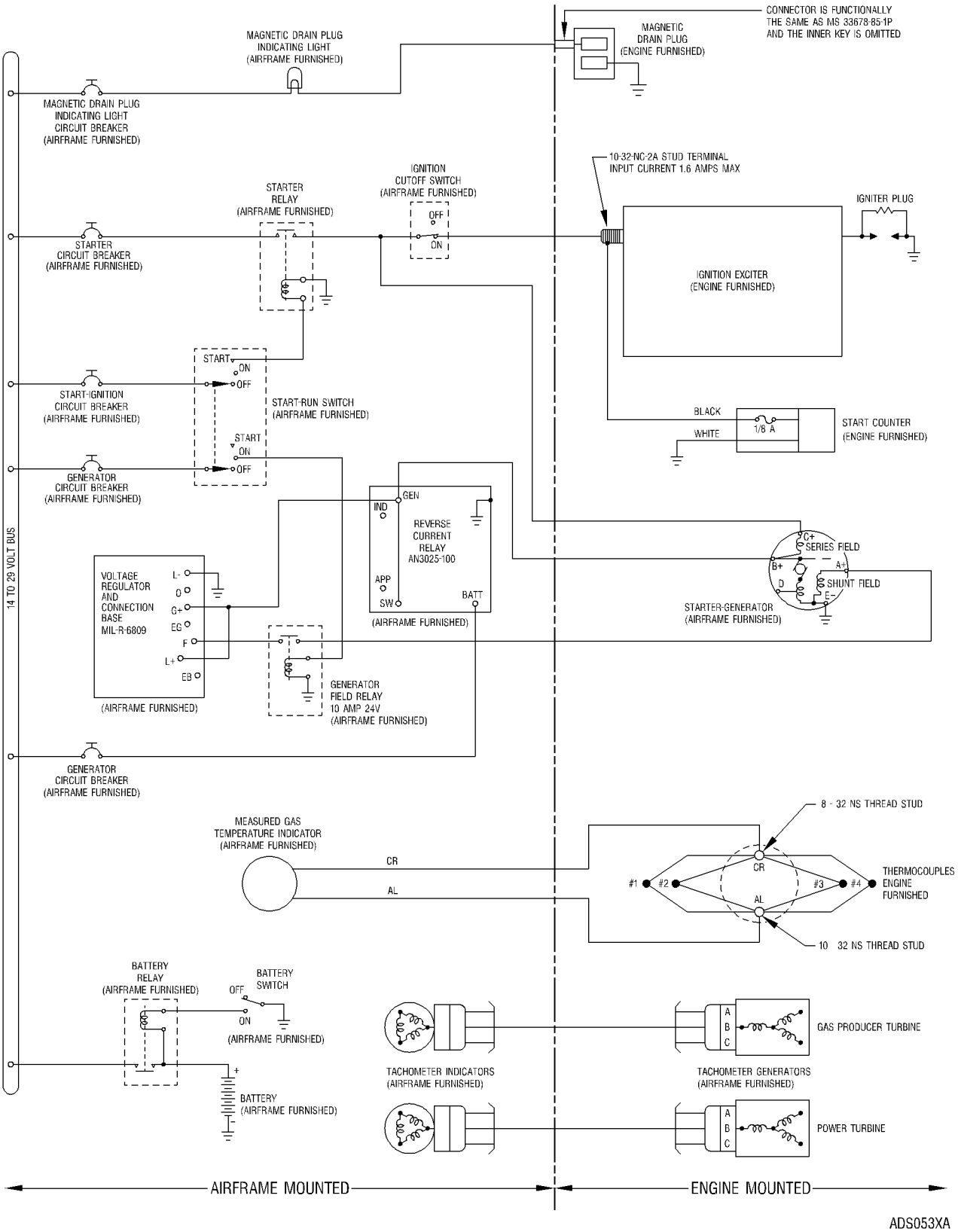
Oil Pump Schematic (250–C20S, –C20W)
Figure 15

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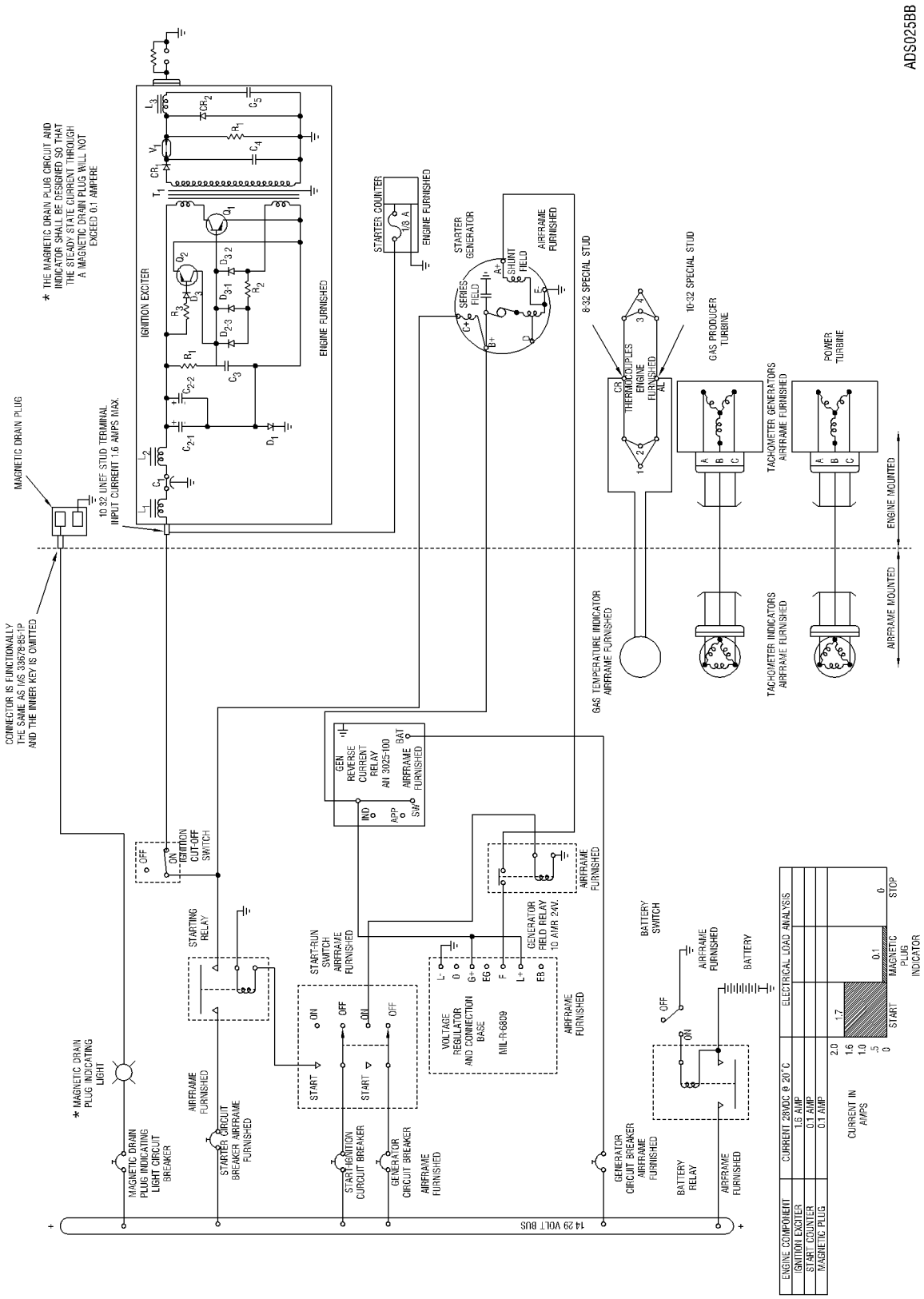
Recommended Electrical Wiring Schematic (250–C20, –C20B)
Figure 16

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Recommended Electrical Wiring Schematic (250–C20F)
Figure 17

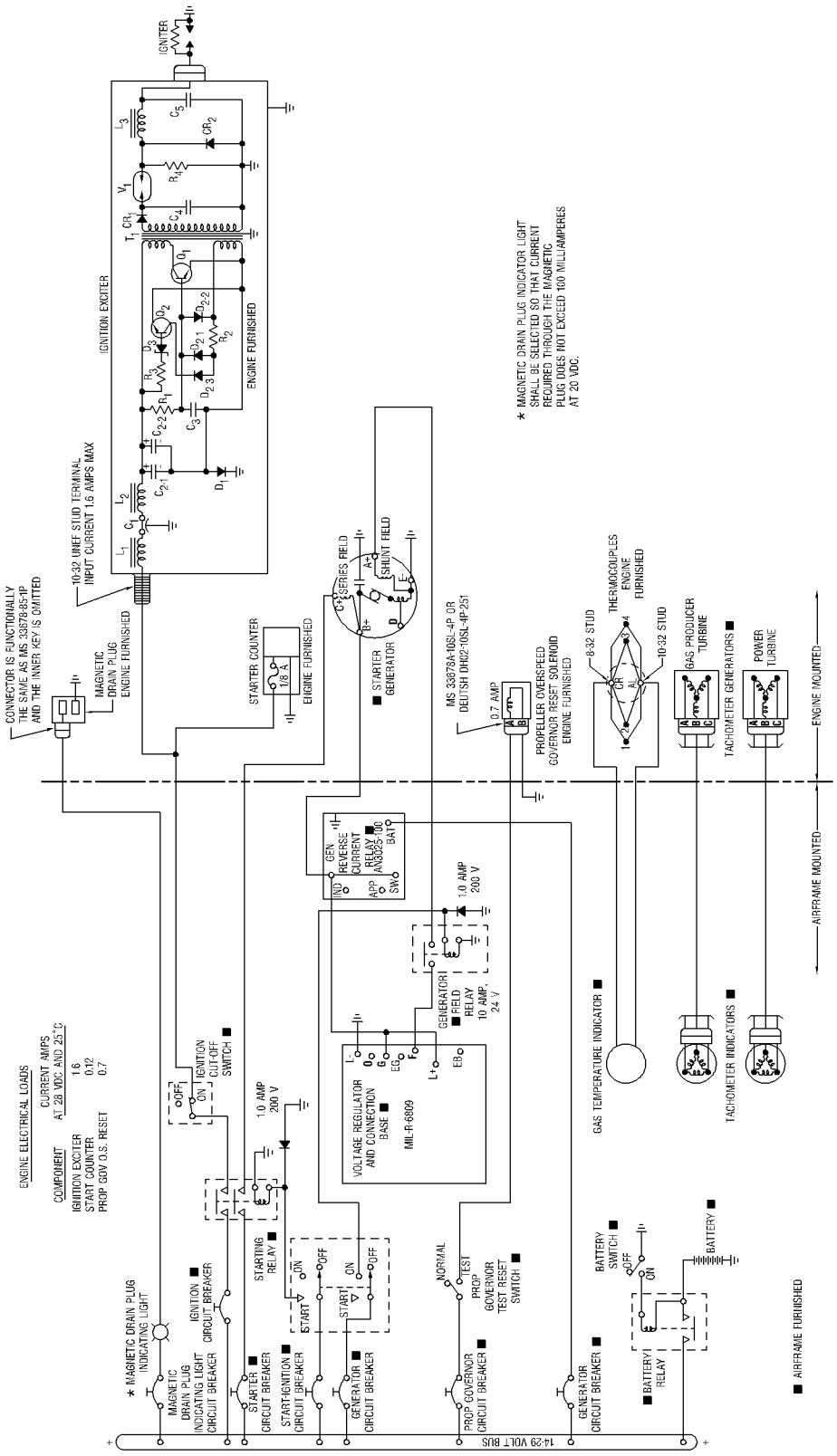
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Recommended Electrical Wiring Schematic (250–C20J)
Figure 18

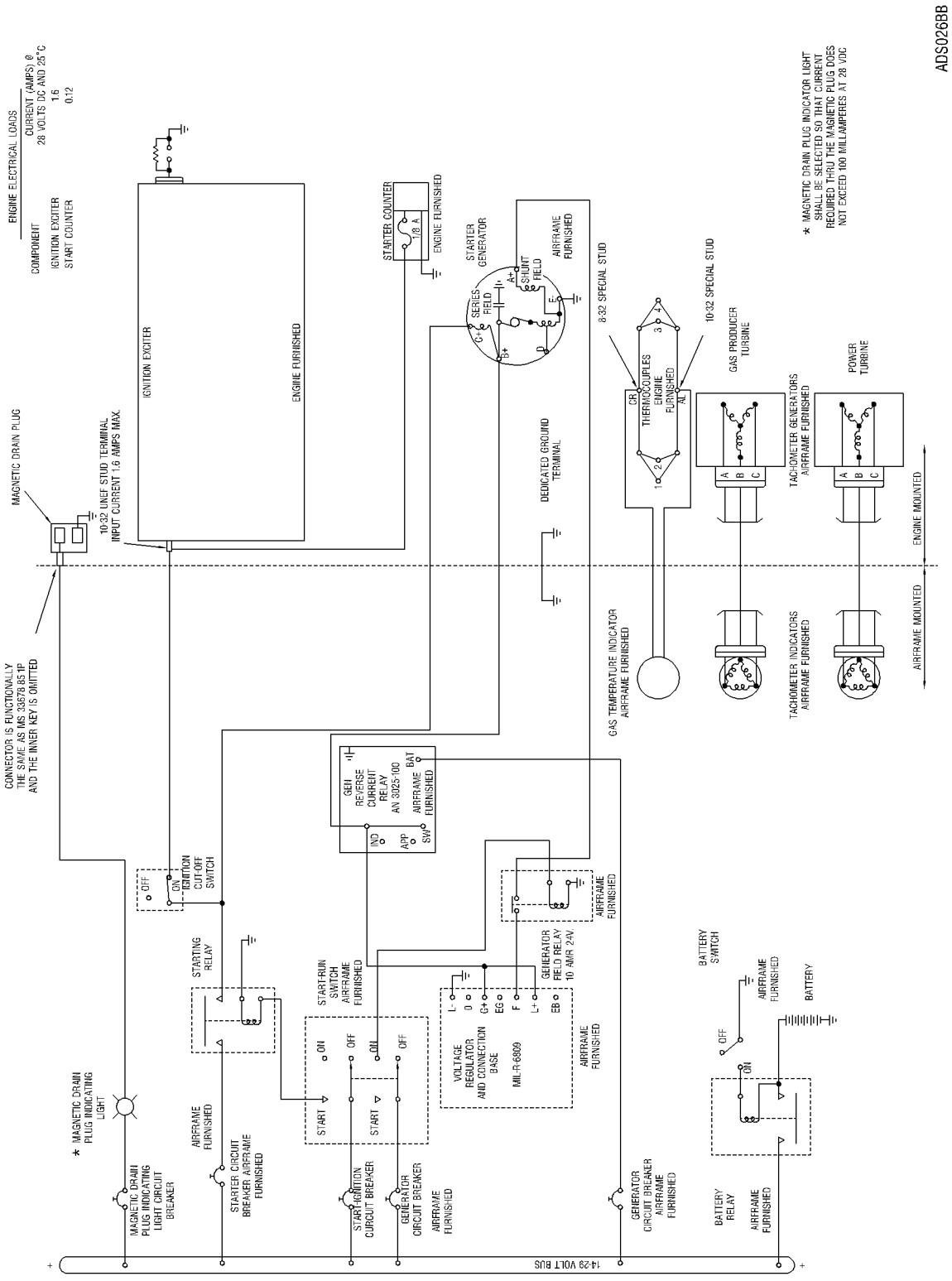
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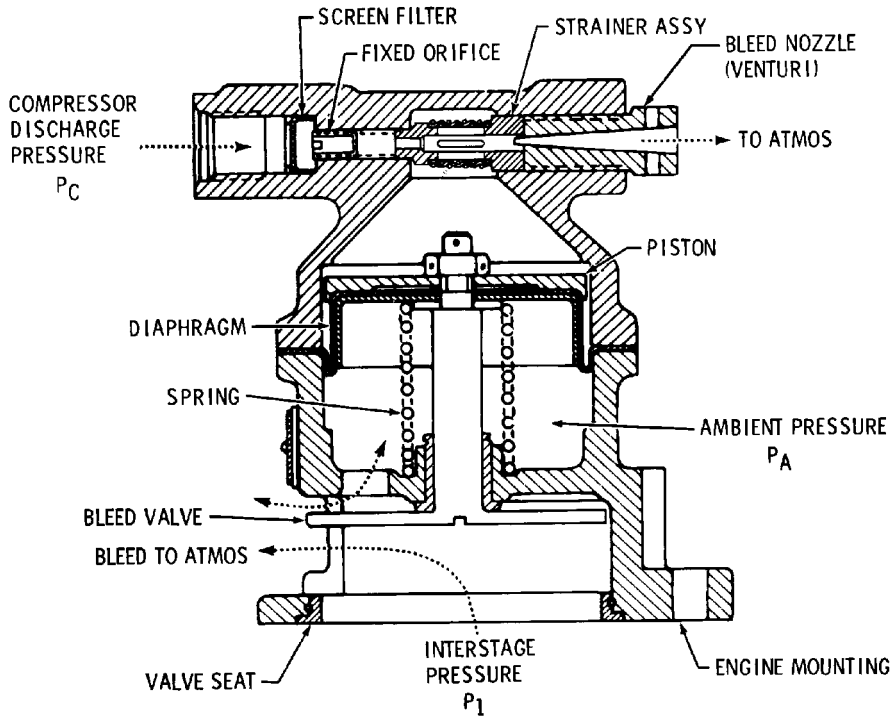
Recommended Electrical Wiring Schematic (250–C20S)
Figure 19

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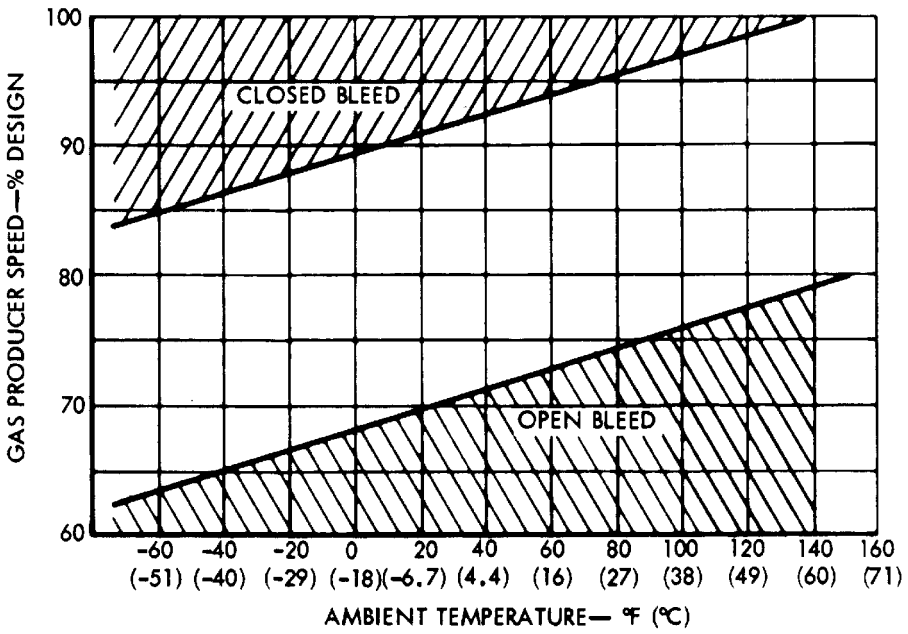


Recommended Electrical Wiring Schematic (250–C20W)
Figure 20

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Compressor Bleed Control Valve
Figure 21



NOTE: THE LINES ON THE FIGURE REPRESENT NOMINAL SETTINGS AND ARE NOT INTENDED AS SPECIFIC LIMITS. THE EXACT OPERATING RANGE MAY VARY DUE TO VARIATIONS IN ENGINE AND AIRCRAFT INSTALLATIONS.

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Compressor Bleed Control Valve Operation
Figure 22

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PARA 3. (cont)

F. Compressor Bleed Air System.

The compressor bleed air system permits rapid engine response. The system consists of a compressor discharge pressure sensing port on the scroll, tubing from the sensing port to the bleed valve, a compressor bleed control valve (Figure 21) and a bleed air manifold on the compressor case.

An annular slot over the compressor fifth–stage blades bleeds compressor air into a manifold which is an integral part of the compressor case. The manifold forms the mounting flange for the compressor bleed control valve when the compressor case halves are assembled.

Compressor discharge air pressure sensing, for bleed control valve operation, is obtained at a sensing port on the compressor scroll. The bleed control valve is normally open; it is closed by compressor discharge pressure. Refer to Figure 22 for bleed control valve opening and closing speeds.

G. Water–Alcohol System (Optional)

Water–alcohol augmentation can be added to the 250–C20B, –C20F, –C20J or –C20S engine to provide additional takeoff power when operating in high ambient temperatures. The effect of water–alcohol on shaft horsepower is given in Figures 23 and 24. The water–alcohol flow rate is given in Figure 25.

(1) Water–Alcohol System Components

The only engine–furnished components of the water–alcohol system are two injection nozzles which are airframe mounted. Other components of the system are airframe furnished.

The water–alcohol augmented engine requires a 200–mesh filter upstream of the injection nozzles. Each nozzle is designed to flow a nominal 0.625 gpm (2.36 lpm) at a pressure drop of 50 psi (345 kpa) on a 35°C (95°F) standard day. Flow rates are based on a water–alcohol mixture of one part by volume methyl alcohol and two parts by volume purified water. The water and alcohol shall conform to the following standards:

(a) Water.

Purified water obtained by the distillation process or water meeting the following requirements:

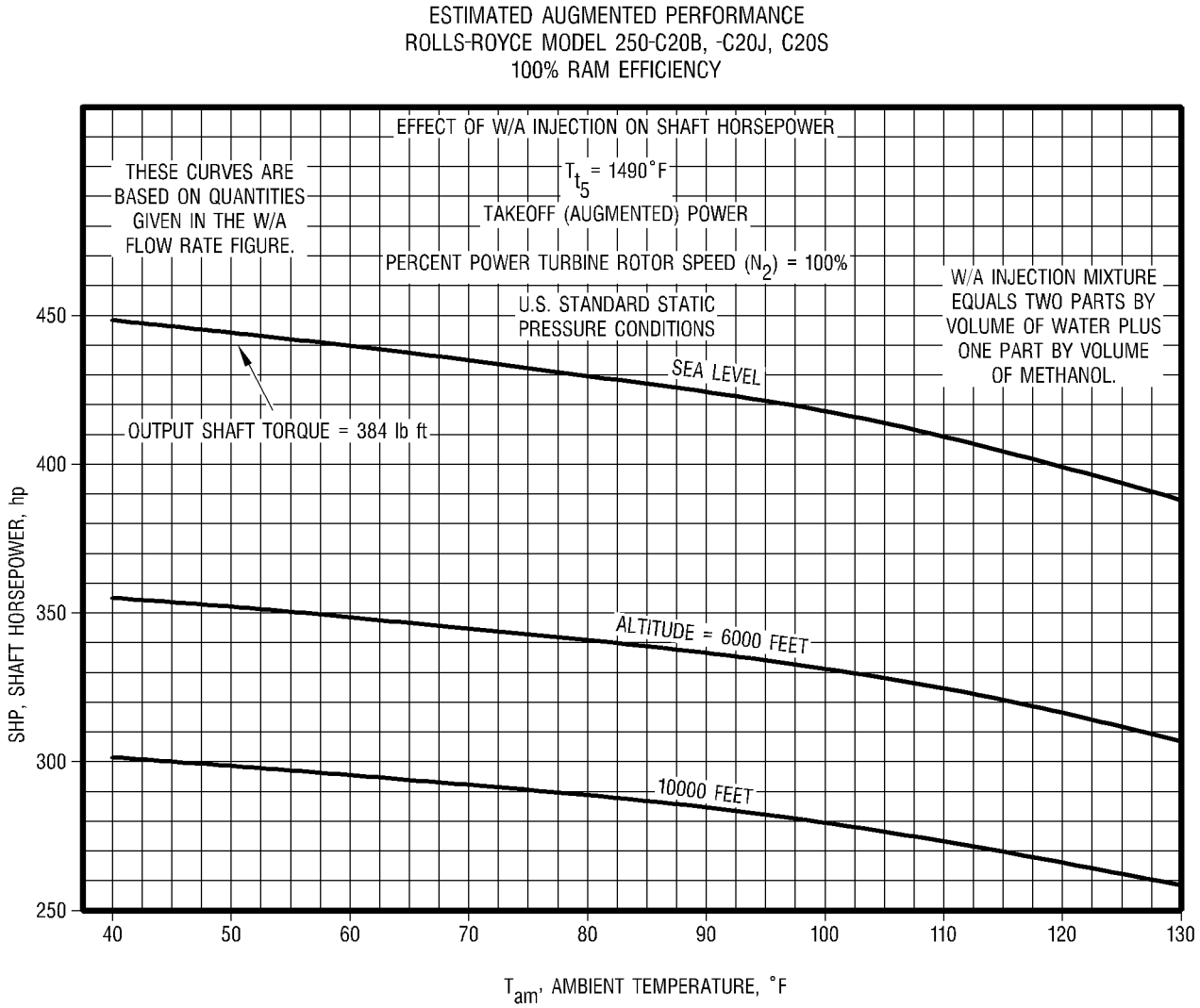
	Chemical Requirement	Test Method*
Total solids, ppm	15.0 max	ASTM D–1069–66
Dissolved solids, ppm	10.0 max	ASTM D–1069–66
Total hardness, epm	0.2 max	ASTM D–1126–65
pH	6.5—7.5	ASTM D–1293–65

*Refer 1966 American Society of Testing Materials Standards, Part 23.

(b) Methyl Alcohol.

Must contain methanol in concentrations not less than 99.85% by weight and must conform to Federal Specification O–M–232d, grade A. This product is available from Commercial Solvents Corporation, 245 Park Avenue, New York, N.Y. 10017 or Union Carbide Corporation Chemicals and Plastics, 270 Park Avenue, New York, N.Y. 10017.

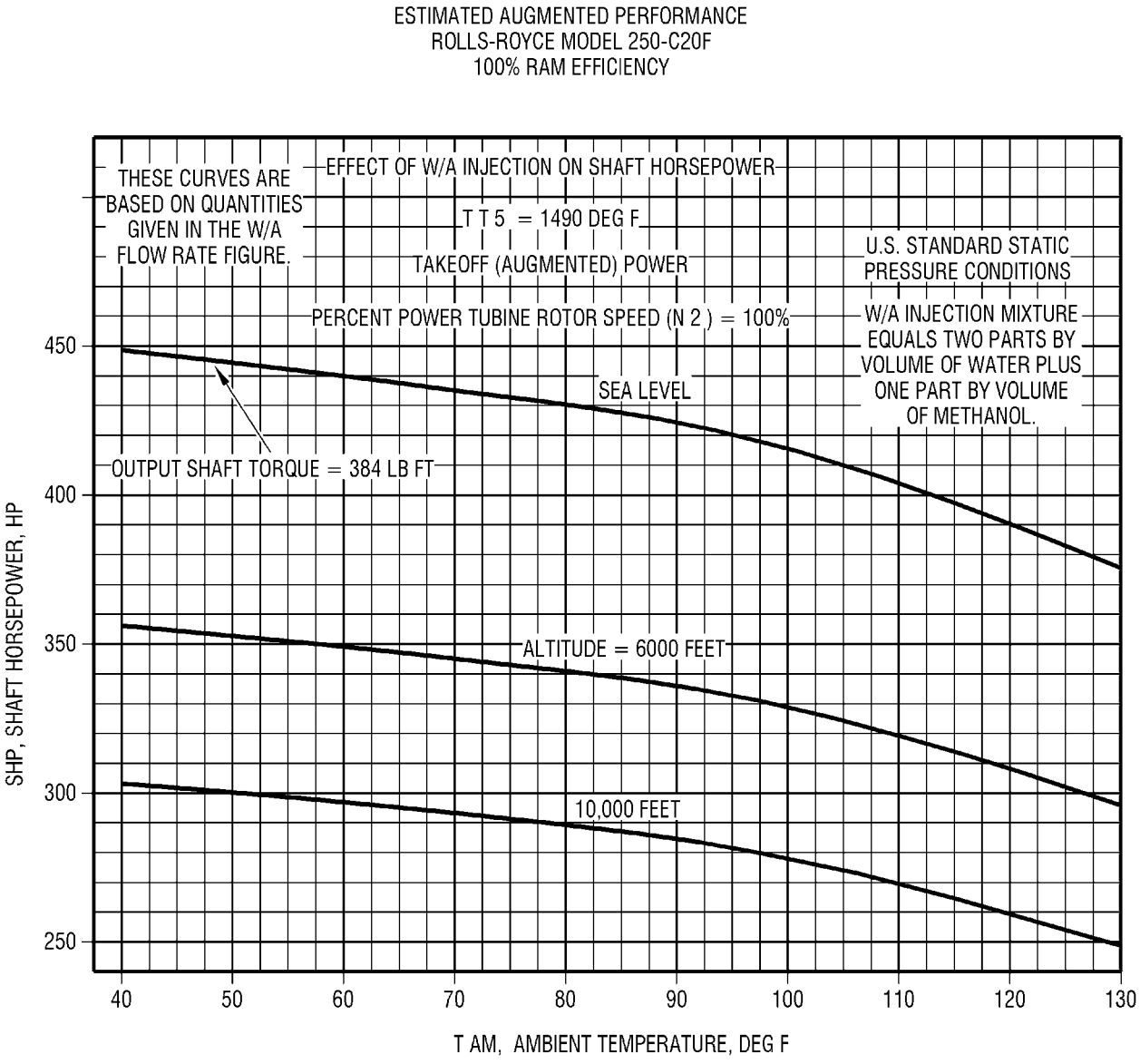
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Effect of Water-Alcohol Injection on Shaft Horsepower (250-C20B, -C20J, -C20S)
Figure 23

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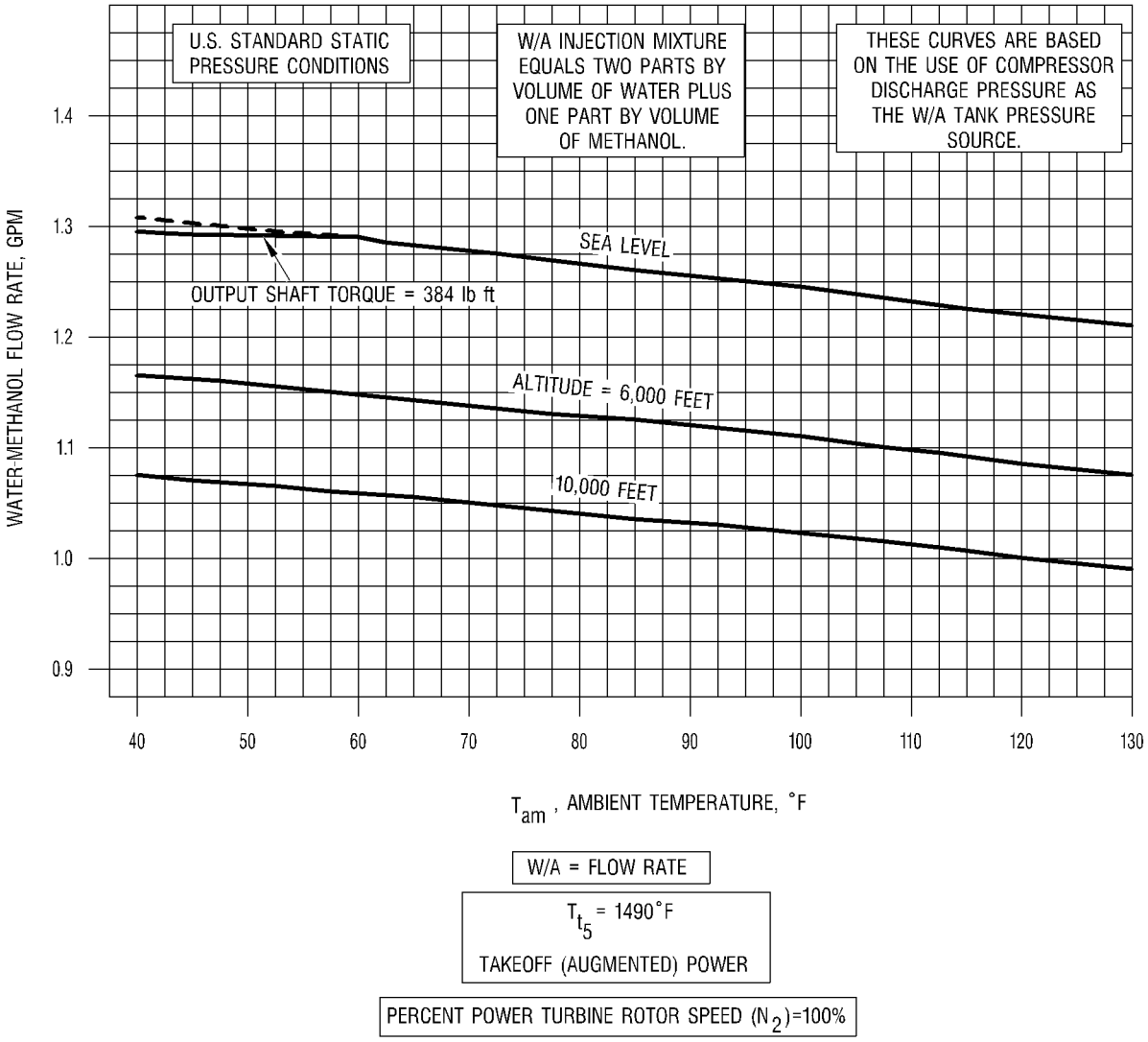


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Effect of Water-Alcohol Injection on Shaft Horsepower (250-C20F)
Figure 24

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ESTIMATED AUGMENTED PERFORMANCE
ROLLS-ROYCE MODEL 250-C20B, C20F, -C20J, -20S
100% RAM EFFICIENCY



ADS013AA

Water–Alcohol Flow Rate—GPM
Figure 25

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

4. Specifications

A. Engine Ratings

The specifications, limits, and performance ratings for the Model 250–C20 Series engines are as follows:

	250–C20	250–C20B, F, J, S, W
Design power output	400 shp (298 kW)	420 shp (313 kW)
Design speeds:		
Gas producer	100% (50,970 rpm)	
Power turbine	100% (33,290 rpm)	
Power output shaft	100% 6,016 rpm	
Maximum measured gas temperature—stabilized (TOT)	1490°F (810°C)	
Dimensions:		
Length	40.8 in. (1036 mm)	
Height (250–C20, –C20B, –C20F, –C20J, –C20W)	23.2 in. (589 mm)	
(250–C20S)	22.6 in. (574 mm)	
Width (250–C20, –C20B, –C20F, –C20J, –C20W)	19.1 in. (485 mm)	
(250–C20S)	18.8 in. (477 mm)	

Engine weight: dry	250–C20 B, J, W	250–C20F	250–C20S
	155 lb (70 kg) (Bendix) 158 lb (72 kg) (CECO)	158 lb (72 kg) (Bendix)	159 lb (72 kg) (Bendix)

WARNING: THE MAXIMUM OIL CONSUMPTION LIMIT IS ONE (1) QUART IN FIVE HOURS (0.05 GAL/HR, 0.19 LITER/HR). OPERATION IN EXCESS OF THIS LIMIT IS NOT PERMITTED. EXCESSIVE OIL CONSUMPTION CAN BE INDICATIVE OF A SERIOUS INTERNAL OIL LEAK. AN INTERNAL OIL LEAK CAN RESULT IN AN UNDETECTED INTERNAL OIL FIRE WHICH WILL RESULT IN A DISASTROUS TURBINE FAILURE.

Maximum oil consumption	0.05 US gallons per hour or 1 qt in 5 hours (0.9 liter in 5 hours)
Performance ratings	See Tables 1, 2, 3, 4, 5, 6 or 7.

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Table 1

Performance Ratings – Standard Static Sea Level Conditions (250–C20 Engine)

Rating	Shaft Power (min) hp	(kW)	Jet Thrust (est) lb	(N)	Gas Producer rpm (est)	Output Shaft rpm	Specific Fuel Cons. (max) lb/shp–hr	(mg/W·h)	Ram Power Rating Torque At Output Shaft (max) ft–lb	(N·m)	Measured Rated Gas Temp (max) °F	〈°C)
Takeoff (5 min)	400	(298)	40	(178)	52000	6016	0.630	(383.21)	367	(498)	1460	(793)
30–Min Power(1)	400	(298)	40	(178)	52000	6016	0.630	(383.21)	367	(498)	1460	(793)
Max. Cont.(2)	385	(287)	39	(173)	51490	6016	0.633	(385.04)	336	(456)	1430	(777)
Nor. Cruise(3)	346	(258)	36	(160)	50200	6016	0.645	(392.34)	302	(409)	1358	(737)
Cruise A(4)	311	(232)	33	(147)	49180	6016	0.661	(402.07)	302	(409)	1301	(705)
Cruise B(4)	260	(194)	30	(133)	47900	6016	0.698	(424.58)	302	(409)	1245	(674)
Ground Idle	35 max	(26)	10	(44)	33000	4500–6300	70 lb/hr	(31.75 kg/h)	—	—	700–900	(372–482)
Flight Autorotation	0	(0)	10	(44)	33000	5900–6480	70 lb/hr	(31.75 kg/h)	—	—	675–875	(358–468)
6000 Ft Altitude, 95°F (35°C) Ambient Static Conditions												
Takeoff	265	(198)	27	(120)	51050	6016	0.678	(412.41)	367	(498)	1460	(793)

Specific Fuel Consumption = Fuel Flow/SHP

(1) 30–minutes power is applicable only during one–engine inoperative (O.E.I) operation of multi–engine aircraft.

(2) Max Cont rating is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine inoperative (O.E.I.) operation of multi–engine aircraft and emergency operation.

(3) Nor cruise is the highest power ordinarily used in regular cruise operation.

(4) Cruise A and Cruise B are the power levels that are 90% and 75% respectively of the rated Normal Cruise power at standard seal level static conditions.

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Table 2

Performance Ratings – Normal Operation–250–C20B, –C20J Engines

Rating	Shaft Power (min) hp	(kW)	Jet Thrust (est) lb	(N)	Gas Producer rpm (est)	Output Shaft rpm	Specific Fuel Cons. (max) lb/shp–hr	(mg/W·h)	Measured Rated Gas Temp (max) °F	(°C)	Max Allowable Output Shaft Torque ft–lb	N·m
Standard Static Sea Level Conditions												
Takeoff (5 min)	420	(313)	42	(187)	53000	6016	0.650	(395.38)	1490	(810)	384	(521)
Normal Cruise	370	(276)	38	(169)	51200	6016	0.650	(395.38)	1360	(738)	323	(438)
Cruise A	333	(248)	36	(160)	50160	6016	0.665	(404.50)	—	—	323	(438)
Cruise B	278	(207)	32	(142)	48800	6016	0.709	(431.27)	—	—	323	(438)
Ground Idle	35 max	(26)	10	(44)	33000	4500–6300	70 lb/hr	(31.75 kg/h)	700–900	(372–482)	—	—
Flight Autorotation	0	(0)	10	(44)	33000	5900–6480	70 lb/hr	(31.75 kg/h)	675–875	(358–468)	—	—
Sea Level, 95°F Ambient Static Conditions												
Takeoff* (Augmented)	420	(313)	—	—	—	6016	—	—	1490	(810)	384	(521)
6000 Ft Altitude, 95°F (35°C) Ambient Static Conditions												
Takeoff	300	(224)	30	(133)	52640	6016	0.675	(410.59)	1490	(810)	384	(521)

Specific Fuel Consumption = Fuel Flow/SHP

Normal Cruise power is the highest power ordinarily used in regular cruise operation.

Cruise A and Cruise B are the power levels that are 90% and 75% respectively of the rated Normal Cruise power at standard sea level static conditions.

* The augmented rating is based upon a water–alcohol flow rate of 1.25 gpm (4.7 lpm) delivered to the injection nozzles at a pressure differential of 50 psi (345 kPa) across each nozzle, with installation of the nozzles in accordance with the requirements set forth on the installation drawings.

Table 3

Performance Ratings – One Engine Inoperative and/or Emergency Operation–250–C20B, –C20J Engines

Rating	Shaft Power (min) hp	(kW)	Jet Thrust (est) lb	(N)	Gas Producer rpm (est)	Output Shaft rpm	Specific Fuel Cons. (max) lb/shp–hr	(mg/W·h)	Measured Rated Gas Temp (max) °F	(°C)	Max Allowable Output Shaft Torque ft–lb	N·m
30 Min Power	420	(313)	42	(187)	53000	6016	0.650	(395.38)	1490	(810)	384	(521)
Max. Cont.	420	(313)	42	(187)	53000	6016	0.650	(395.38)	1490	(810)	384	(521)

Max Continuous rating is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine inoperative (O.E.I.) operation of multi–engine aircraft and emergency operation.

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Table 4

Performance Ratings for Normal Operation – 250–C20F, –C20W Engines

Rating	Shaft Power (min) hp	(kW)	Jet Thrust (est) lb	(N)	Gas Generator rpm (est)	Output Shaft rpm	Specific Fuel Cons. (max) lb/shp–hr	(mg/W·h)	Measured Rated Gas Temp (max) °F	(°C)	Output Shaft Torque Ft lb	(N·m)	Measured Gas Temp (max) °F	(°C)
													Maximum Allowable Operating Limits	
						Standard Sea Level Static Conditions								
Takeoff (5 min)	420	(313)	45	(200)	51790	6016	0.650	(395)	1490	(810)	384	(521)	1490	(810)
Normal Cruise(1)	370	(276)	40	(178)	50000	6016	0.650	(395)	1360	(738)	323	(438)	1360	(738)
Cruise A (90%)(2)	333	(248)	37	(165)	48880	6016	0.666	(405)	—		323	(438)	1360	(738)
Cruise B (75%)(2)	278	(207)	32	(142)	47420	6016	0.709	(431)	—		323	(438)	1360	(738)
Ground Idle	35 max	(26)	10	(44)	33000	4500–6300	70 lb/hr	(31.75 kg/h)	700–900	(371–483)	—	—	—	—
Flight Auto-rotation	0		10	(44)	33000	5900–6480	70 lb/hr	(31.75 kg/h)	675–875	(357–469)	—	—	—	—
						Sea Level, 95°F Ambient Static Conditions								
Takeoff* (Augmented)	420	(313)	—	—	—	6016	—	—	1490	(810)	384	(521)	—	—
						6000 Ft Altitude, 95°F (35°C) Ambient Static Conditions								
Takeoff	300	(224)	32	(142)	51340	6016	0.674	(410)	1490	(810)	384	(521)	1490	(810)

Specific Fuel Consumption = Fuel Flow/SHP

(1) Normal Cruise power is the highest power ordinarily used in regular cruise operation.

(2) Cruise A and Cruise B are the power levels that are 90% and 75% respectively of the rated Normal Cruise power at standard sea level static conditions.

* The augmented rating is based upon a water–alcohol flow rate of 1.25 gpm (4.7 lpm) delivered to the injection nozzles at a pressure differential of 50 psi (345 kPa) across each nozzle, with installation of the nozzles in accordance with the requirements set forth on the installation drawings.

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Table 5

Performance Ratings for One–Engine–Inoperative and/or Emergency Operation – 250–C20F, –C20W Engines

Rating	Shaft Power (min) hp	(kW)	Jet Thrust (est) lb	(N)	Gas Generator rpm (est)	Output Shaft rpm	Specific Fuel Cons. (max) lb/shp–hr	(mg/W·h)	Measured Rated Gas Temp (max) °F	(°C)	Maximum Allowable Operating Limits: Output Shaft Torque Ft lb	(N·m)	Maximum Allowable Operating Limits: Measured Gas Temp (max) °F	(°C)
Standard Sea Level Static Conditions														
30–Minute Power	420	(313)	45	(200)	51790	6016	0.650	(395)	1490	(810)	384	(521)	1490	(810)
Max Continuous*	420	(313)	45	(200)	51790	6016	0.650	(395)	1490	(810)	384	(521)	1490	(810)

Specific Fuel Consumption = Fuel Flow/SHP

* Max Continuous rating is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine –inoperative (O.E.I.) operation of multi–engine aircraft and emergency two engine operation.

Table 6

Performance Ratings—Normal Operation—250–C20S

Rating	Shaft Power (min) hp	(kW)	Jet Thrust (est) lb	(N)	Gas Producer Output rpm (est)	Gas Producer Output Shaft rpm	Specific Fuel Cons. (max) lb/shp–hr	(mg/W·h)	Measured Rated Gas Temp °F	(°C)	Maximum Allowable Output Shaft Torque ft–lb	N·m
Standard Static Sea Level Conditions												
Takeoff (5 min)	420	(313)	42	(187)	53000	6016	0.650	(395.38)	1490	(810)	384	(521)
Normal Cruise	370	(276)	38	(169)	51200	6016	0.650	(395.38)	1360	(738)	323	(438)
Cruise A	333	(248)	36	(160)	50160	6016	0.665	(404.50)	—	—	323	(438)
Cruise B	278	(207)	32	(142)	48800	6016	0.709	(431.27)	—	—	323	(438)
Idle	35 max	(26)	10	(44)	33000	4500–6300	70 lb/hr	(31.75 kg/h)	800 ±100	(427 ±55)	—	—
Takeoff* (Augmented)	420	(313)				6016			1490	(810)	384	(521)

Specific Fuel Consumption = Fuel Flow/SHP

Normal Cruise power is the highest power ordinarily used in regular cruise operation.

Cruise A and Cruise B are the power levels that are 90% and 75% respectively of the rated Normal Cruise power at standard sea level static conditions.

* The augmented rating is based upon a water–alcohol flow rate of 1.25 gpm (4.7 lpm) delivered to the injection nozzles at a pressure differential of 50 psi (345 kPa) across each nozzle, with installation of the nozzles in accordance with the requirements set forth on the installation drawings.

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Table 7

Performance Ratings--One Engine Inoperative and/or Emergency Operation--250-C20S

Rating	Shaft Power (min) hp	(kW)	Jet Thrust (est) lb	(N)	Gas Producer Output rpm (est)	Gas Producer Output Shaft rpm	Specific Fuel Cons. (max) lb/shp-hr	(mg/W·h)	Measured Rated Gas Temp °F	(°C)	Maximum Allowable Output Shaft Torque ft-lb	N·m
Max. Cont.	420	(313)	42	(187)	53000	6016	0.650	(395.38)	1490	(810)	384	(521)

Max Continuous rating is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one-engine-inoperative (O.E.I.) operation of multi-engine aircraft and emergency operation.

WARNING: IT IS VERY IMPORTANT THAT THE ENTIRE AIRCRAFT AND ENGINE FUEL SYSTEM BE MAINTAINED TO THE HIGHEST STANDARDS OF CLEANLINESS.

ROLLS-ROYCE HAS CONDUCTED TESTING OF APPLE JELLY TYPE CONTAMINATION WHICH SHOWS IT BEHAVES DIFFERENTLY THAN A SOLID CONTAMINANT. IT CAN PASS THROUGH VARIOUS AIRFRAME AND ENGINE FUEL FILTERS UNDETECTED WITHOUT ACTUATING THE IMPENDING BYPASS INDICATOR, AND IT CAN CAUSE PARTIAL OR COMPLETE BLOCKAGE OF THE FUEL NOZZLE SCREEN RESULTING IN REDUCED ENGINE PERFORMANCE OR FLAMEOUT.

SHOULD THIS GEL-LIKE MATERIAL BE DETECTED AT ANY POINT IN THE AIRCRAFT OR ENGINE FUEL SYSTEM, THE ENTIRE AIRFRAME AND ENGINE FUEL SYSTEM SHOULD BE INSPECTED.

WARNING: TO PREVENT ENGINE FUEL SYSTEM CONTAMINATION, WHICH COULD CAUSE ENGINE FLAMEOUT, AN EXTERNAL LOW PRESSURE FUEL FILTER SHOULD BE USED ON ANY AIRCRAFT REFUELING FROM REMOTE FUELING SITES (DRUMS, ETC).

CAUTION: TO DETERMINE IF A GIVEN FUEL MEETS THESE SPECIFICATIONS, THE BURDEN OF PROOF RESTS WITH THE OPERATOR AND HIS SUPPLIER.

B. Fuel Specification.

(1) Primary

Fuels that agree with the military and commercial specifications that follow are approved for unrestricted use in 250 Series engines.

(a) MIL-T-5624, Grades JP-4, JP-5

(b) ASTM D-1655, Grades Jet A, Jet A-1

(c) ASTM D-6615, Grade Jet B

(d) MIL-DTL-83133, Grade JP-8

(e) UK Defense Standard 91-91, Semi Synthetic and Fully Synthetic

(f) GOST 10227 (Russia), Grades TS-1 and RT

(g) STAS 5639-88 (Romania), Grade TH

(h) GB 6537 (Peoples Republic of China), Grade No. 3

(i) GSTU 320.00149943.007-97 (Ukraine), Grade RT (PT)
GSTU 320.00149943.011-99 (Ukraine), Grade TS-1 (TC-1)

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CAUTION: MIL-G-5572 FUEL CONTAINING TRICRESYLPHOSPHATE (TCP) ADDITIVE SHALL NOT BE USED.

(2) Emergency

Operation on ASTM D-910 AVGAS, all grades, is permitted for a maximum of six hours for each turbine overhaul period, if aircraft boost pumps are available and turned on.

WARNING: AT AMBIENT TEMPERATURES BELOW 4°C (40°F), SOME TYPE OF ANTI-ICE PROTECTION IS REQUIRED, SUCH AS AN ANTI-ICE ADDITIVE OR A MEANS OF AIRFRAME FUEL ICE ELIMINATION. ENGINE FLAMEOUT COULD RESULT FROM FAILURE TO USE ANTI- ICE PROTECTION. (REFER TO THE AIRCRAFT MANUAL FOR THEIR RECOMMENDATIONS AND PARA 4.B., THIS SECTION, FOR APPROVED ANTI-ICE ADDITIVE.)

(3) Cold Weather

To make sure of consistent starts below 4°C (40°F) the fuels that follow can be necessary:

(a) MIL-DTL-5624, JP-4

(b) ASTM D-6615, Jet B

(c) Alternate Cold Weather Fuel: ASTM D-910 AVGAS and Jet A, A-1, JP-5, or JP-8 mixture. Refer to para 9. Cold Weather Fuels, for instructions on correct mixture and use of cold weather fuels.

NOTE: Grade JP-4, Grade JP-5, and Grade JP-8 type fuels contain Fuel System Icing Inhibitor (FSII) that agree with MIL-DTL-85470. These fuels do not require more FSII unless specified by the airframe manufacturer.

NOTE: Jet A, A1, JP-5, or JP-8 fuels are not restricted from use at ambient temperatures below -18°C (0°F); however, special provisions for starting must be made. (Refer to Aircraft Flight Manual.) Once started, engine operation on Jet A, Jet A1, JP-5, or JP-8 will be satisfactory in outside air temperatures down to -32°C (-25°F).

NOTE: Prolonged and uninterrupted operation with only AVGAS mixture will induce lead buildup on turbine parts. This lead buildup can cause a gradual power reduction; consequently, this AVGAS mixture should be used only for cold weather operation. During operation with normal Jet A type fuel, the lead will slowly dissipate.

(4) Fuel System Icing Inhibitor (FSII):

FSII additives that agree with MIL-DTL-85470 are approved for use in the Model 250 series engine if used in accordance with the additive manufacturer instructions and if approved by the airframe manufacturer.

NOTE: Grade JP-4, Grade JP-5, and Grade JP-8 type fuels contain FSII that agrees with MIL-DTL-85470. These fuels do not require more FSII unless specified by the airframe manufacturer.

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WARNING: ONLY DISCRETIONARY MIXING OF OILS WITHIN AN OIL SERIES IS PERMITTED WITHOUT A TIME PENALTY. USE OF MIXED OILS FROM DIFFERENT SERIES IN AN ENGINE IS LIMITED TO FIVE HOURS TOTAL RUNNING TIME DURING ONE OVERHAUL PERIOD. ADEQUATE MAINTENANCE RECORDS MUST BE MAINTAINED TO ENSURE THAT THE FIVE HOUR LIMIT IS NOT EXCEEDED. FAILURE TO COMPLY WITH OIL MIXING RESTRICTIONS CAN RESULT IN ENGINE FAILURE.

CAUTION: IF HEAVY CARBON OR COKE DEPOSITS ARE FOUND ON THE ENGINE FILTER DURING REGULAR INSPECTIONS, IT IS RECOMMENDED THE FILTERS BE REPLACED; CONTINUE TO MONITOR BYPASS INDICATORS.

CAUTION: TO DECREASE THE LIKELIHOOD FOR CARBON OR COKE DEPOSITS BEING DISLODGED DURING THE CHANGEOVER TO "3RD GENERATION" OILS (E.G. MOBIL JET 254), THESE CHANGEOVERS SHOULD ONLY BE MADE WHEN THE ENGINE IS NEW OR REPAIRED, TO THE EXTENT THE LUBRICATION PASSAGES AND SUMPS HAVE BEEN CLEANED AND FLUSHED.

CAUTION: WHILE CONSIDERABLE LABORATORY DATA IS AVAILABLE TO DEMONSTRATE THE COMPATIBILITY OF ONE SYNTHETIC TURBINE OIL WITH OTHER TURBINE OILS MEETING THE SAME SPECIFICATION (AIRLINE EXPERIENCE DOES DEMONSTRATE THIS PROPERTY), THE INDISCRIMINATE MIXING OF APPROVED OILS DURING THE OPERATIONAL USE OF THE OIL IS NOT RECOMMENDED. HOWEVER, THERE MAY BE CIRCUMSTANCES WHERE EMERGENCY TOP-OFF, INADVERTENT MIXING, OR CHANGEOVER BY "TOP-OFF" TO ANOTHER BRAND MAY OCCUR. THESE ARE ACCEPTED PRACTICES.

CAUTION: FAILURE TO COMPLY WITH OIL MIXING RESTRICTIONS CAN RESULT IN ENGINE FAILURE.

CAUTION: REMOVE AND INSPECT THE OIL FILTER AFTER 25 HOURS OF ENGINE OPERATION IF THE TYPE OF OIL (MIL-PRF-7808, MIL-PRF-23699, OR DOD-85734) WAS MIXED IN AN EMERGENCY. (THERE IS A 5-HOUR LIMIT FOR THE USE OF MIXED OILS.)

CAUTION: THE FILTER INSPECTION IS TO DETERMINE IF COKE, WHICH WAS FORMED DURING PREVIOUS OPERATION, IS BEING DISLODGED DURING THE FIRST OPERATION FOLLOWING THE OIL CHANGE.

CAUTION: IF HEAVY CARBON DEPOSITS ARE OBSERVED ON THE ENGINE FILTER, IT IS SUGGESTED THAT THE ENGINE OIL BE CHANGED AGAIN. THE OIL IS TO BE DRAINED WHEN THE OIL IS HOT TO OBTAIN THE MAXIMUM BENEFIT. THE 25 HOUR OIL MONITORING IS TO CONTINUE UNTIL THE NEXT OIL CHANGE PERIOD.

CAUTION: USE OF OILS WHICH ARE NOT INCLUDED IN THE APPROVED OILS LISTING, OR FAILURE TO DRAIN OIL WITHIN THE PRESCRIBED INTERVAL GIVEN IN TABLE 602, 72-00-00, ENGINE-INSPECTION/CHECK WILL BE CONSIDERED AS MISUSE UNDER ITEM (4) OF THE WARRANTY POLICY.

C. Oil Specification.

The 250 series engines are certified and approved for use with only certain lubricating oils that agree with MIL-PRF-7808, MIL-PRF-23699, DOD-PRF-85734, or SAE AS5780 specifications. Vendor brands of lubricating oils that have been engine tested and approved for Model 250 engine use are listed in para 5.C.(2), Approved Oils. Refer to para 5.C.(1), Cold Weather Lubrication, for the type of oil recommended for specific ambient temperatures.

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(1) Cold Weather Lubrication

The types of oil recommended at specific ambient temperatures are as follows:

40°C (-40°F) and above . . . . . MIL-PRF-23699 , SAE AS5780, MIL-PRF-7808, or DOD-PRF-85734

-40°C (-40°F) and below MIL-PRF-7808

NOTE: Because of availability, decreased coking and better lubrication qualities at higher temperatures, MIL-PRF-23699 HTS or SAE AS5780 HPC oils are recommended for use in Model 250 engines.

NOTE: Check the engine oil quantity within 15 minutes of engine shutdown to avoid a false indication of excessive oil consumption. If the 15 minutes has been exceeded, motor the engine for 30 seconds with the starter before checking tank quantity. Motoring normally scavenges oil from the gearbox back to the aircraft oil tank. Check the airframe flight manual; some installations may require engine to be operated for at least a minute at ground idle to assure proper scavenging of the engine gearbox.

NOTE: Always refer to the airframe flight manual for proper oil servicing instructions; specific requirements may vary for different models.

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(2) Approved Oils

Manufacturer's Designation & Address	Manufacturer's Designation & Address
MIL-PRF-7808	MIL-PRF-7808
American PQ Lubricant 689 American Oil & Supply Co. 238 Wilson Avenue Newark, New Jersey 07105	Mobil Rm-201A Mobil Oil Corporation 3225 Gallows Road Fairfax, Virginia 22037
Brayco 880 Castrol Inc. Specialty Products Division 16715 Von Karman Ave, Suite 230 Irving, California 92714	Mobil RM-184A Mobil Oil Corporation 3225 Gallows Road Fairfax, Virginia 22037
EXXON Turbo Oil 2389 EXXON Company, U.S.A. P.O. Box 2180 Houston, Texas 77252-2180	Stauffer Jet 1 Stauffer Chemical Co. 380 Madison Avenue New York, New York 10017
Mobil Avrex S Turbo 256 Mobil OIl Corporation 3225 Gallows Road Fairfax, Virginia 22037	
MIL-PRF-23699 STD	MIL-PRF-23699 STD
Mobil Jet Oil II Mobil Oil Corporation 3225 Gallows Road Fairfax, Virginia 22037	Stauffer Jet II (Castrol 205) Stauffer Chemical Company 380 Madison Avenue New York, New York 10017
Turbonycoil 600 (TN600) NYCO S.A. 66, Champs-Elysees-51 Rue De Ponthieu 75008 Paris	Caltex RPM Jet Engine Oil 5 Caltex Petroleum Corporation 380 Madison Avenue New York, New York 10017
Aeroshell/Royco Turbine Oil 500 Royal Lubricants Company, Inc. River Road, P.O. Box 518 East Hanover, New Jersey 07936	Chevron Jet Engine Oil 5 Chevron International Oil Company 555 Market Street San Francisco, California 94105
American PQ Lubricant 6700 American Oil and Supply Co. 238 Wilson Avenue Newark, New Jersey 07105	Castrol 5050 Specialty Products Division 1001 West 31st Street Downers Grove, IL 60515
SAE AS5780 SPC	MJO II ExxonMobil Swedesboro, NJ
BPTO 2380 Air BP Lubricants Six Campus Drive Parsippany, NJ 07054	

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Manufacturer's Designation & Address	Manufacturer's Designation & Address
MIL-PRF-23699 STD (cont)	DOD-PRF-85734
Hatcol 3211 Hatcol Corporation King George Post Road Fords, New Jersey 08863	Deleted
EXXON Turbo Oil 2380 EXXON Company, USA P.O. Box 2180 Houston, Texas 77252-2180	Aeroshell/Royco Turbine Oil 555 Royal Lubricants Company, Inc. River Road , P.O. Box 518 East Hanover, New Jersey 07936
Castrol Aero Jet5 Specialty Products Division 1001 West 31st Street Downers Grove, IL 60515	Long term use of Aeroshell/Royco 555 oil may increase the probability of silicone rubber seal leakage in the accessory gearbox.
	Aeroshell Tubine Oil 555 Shell International Petroleum Co., Ltd International Aviation Sales Division Shell Centre London, SEI 7NA, England
MIL-PRF-23699 HTS	
Mobil Jet Oil 254 and Mobil Jet Oil 291 Mobil Oil Corporation 3225 Gallows Road Fairfax, Virginia 22037	NOTE: Long term use of Aeroshell 555 oil may increase the probability of silicone rubber seal leakage in the accessory gearbox.
Aeroshell/Royco Turbine Oil 560 Royal Lubricants Company, Inc. River Road, P.O. Box 518 East Hanover, New Jersey 07936	
BPTO 2197 Air BP Lubricants Six Campus Drive Parsippany, NJ	
SAE AS5780 HPC	
BPTO 2197 Air BP Lubricants Six Campus Drive Parsippany, NJ	
MJO 254 ExxonMobil Swedesboro, NJ	

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5. Operating Precautions

WARNING: THE PRIMARY APPLICATION OF THE TURBOSHAFT ENGINE IS TO POWER A HELICOPTER OR ROTORCRAFT. A HEIGHT-VELOCITY DIAGRAM, AS REQUIRED BY REGULATION AND PREPARED BY THE AIRFRAME MANUFACTURER, IS PUBLISHED IN THE AIRCRAFT FLIGHT MANUAL PERFORMANCE SECTION. THE OPERATOR MUST BECOME FAMILIAR WITH THIS DIAGRAM TO DETERMINE WHAT ALTITUDES AND AIRSPEEDS ARE REQUIRED TO SAFELY MAKE AN AUTOROTATIONAL LANDING IN CASE OF POWER LOSS OR ENGINE FAILURE. THE ALTITUDE-AIRSPEED COMBINATIONS WHERE A SAFE AUTOROTATIONAL LANDING MAY NOT BE POSSIBLE ARE REPRESENTED BY THE SHADED OR CROSS-HATCHED AREA OF THE DIAGRAM.

WARNING: SNOW OR ICE SLUGS CAN CAUSE THE ENGINE TO FLAME OUT. BE SURE AVAILABLE PREVENTIVE EQUIPMENT IS INSTALLED AND IN PROPER WORKING ORDER WHEN FLYING IN CONDITIONS WHERE SNOW OR ICE BUILDUP MIGHT OCCUR.

WARNING: CONSULT THE AIRCRAFT FLIGHT MANUAL FOR REQUIRED EQUIPMENT AND PROCEDURES FOR FLIGHT IN FALLING/BLOWING SNOW.

WARNING: SAND AND DUST WILL ERODE COMPRESSOR VANES AND CAUSE THEM TO FAIL.

WARNING: SALT LADEN HUMIDITY AND CHEMICALS WILL CORRODE COMPRESSOR BLADES AND VANES AND CAUSE THEM TO FAIL.

Observe the following precautions to reduce the danger of personnel injury or damage to the engine.

A. Before operating the engine, check the air inlet for foreign objects. (Refer to Compressor Inlet Air Blockage, PARA 1.D.(12), 72-00-00, Engine-Inspection/Check.)

B. If the engine does not operate within Operating Limits, PARA 6., this section, take the designated action.

C. If the aircraft is frequently operated in dusty or sandy areas, periodic erosion inspection is recommended. (Refer to Erosion Inspection, PARA 1.D.(9), 72-00-00, Engine-Inspection/Check.)

D. If a flameout has been experienced as the possible result of snow, ice, or water ingestion, refer to Snow Ingestion Inspection, PARA 1.D.(10), 72-00-00, Engine-Inspection/Check.

E. If the aircraft is being operated following an extended period of inactivity, refer to Special Inspections, Table 604, 72-00-00, Engine Inspection/Check, for recommended action.

F. If the engine is operated in a corrosive environment it must be subjected to a water wash. (Refer to Compressor Contamination Removal, PARA 6.A.(1), 72-30-00.)

G. If the installed engine will be shut down for more than five calendar days the compressor must receive an application of preservative. (Refer to Compressor Preservation, PARA 12.D., 72-00-00, Engine Servicing.)

6. Operating Limits

WARNING: TO PREVENT SERIOUS ENGINE MALFUNCTION OR CRUCIAL LOSS OF POWER, DO NOT OPERATE THE ENGINE IN EXCESS OF ANY SPECIFIED LIMIT.

NOTE: Operators may be faced with an engine that meets all specification power requirements in a certified test cell but apparently fails to meet the minimum installed power required by the aircraft flight manual.

NOTE: Please refer to the aircraft manual for other system troubleshooting.

NOTE: Operators should be aware that the FAA requires the Rolls-Royce Authorized Maintenance Centers to deliver engines of at least “specification horsepower” only after complete engine overhaul.

A. Engine Speed

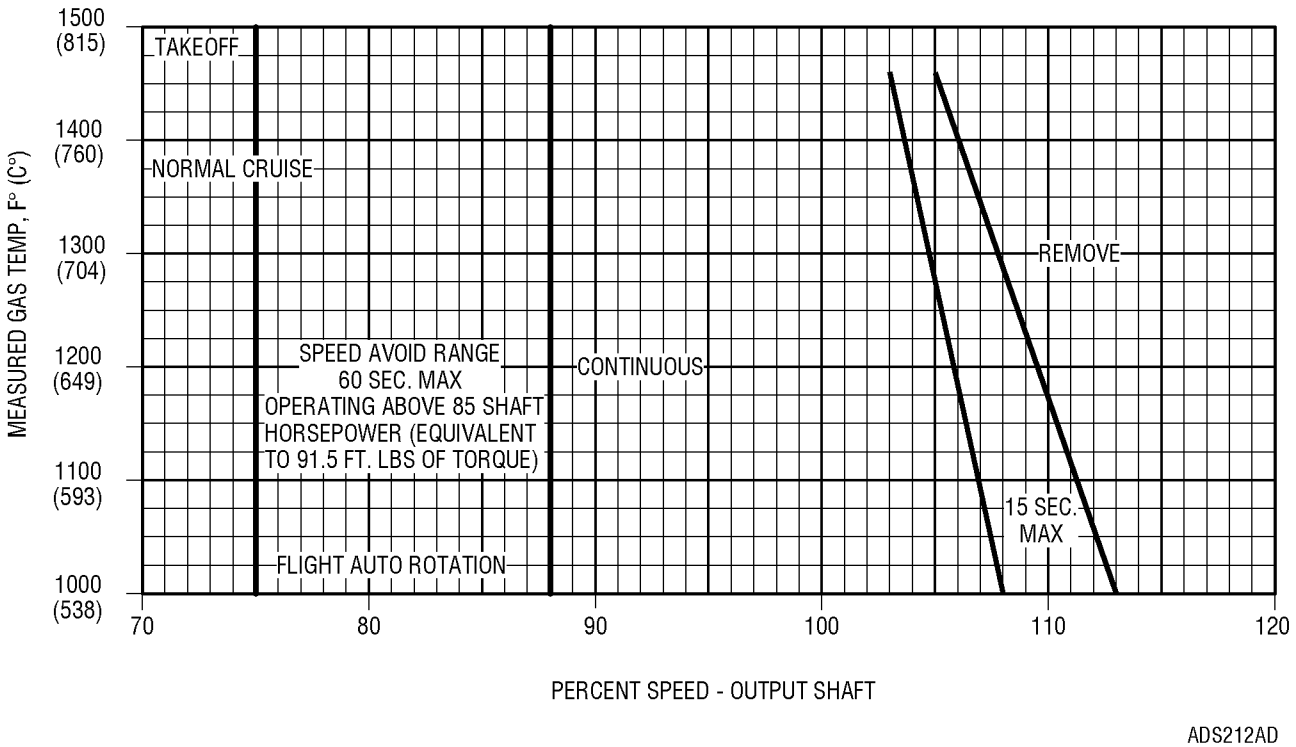
If any of the following limits are exceeded send the designated engine components to repair/overhaul. Record extent of overspeed in the engine log book. Record total time in speed-avoid range that exceeds 60 sec. operating above 85 shaft horsepower (equivalent to 91.5 ft. lbs. of torque) in the engine log book.

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PARA 6. (cont)

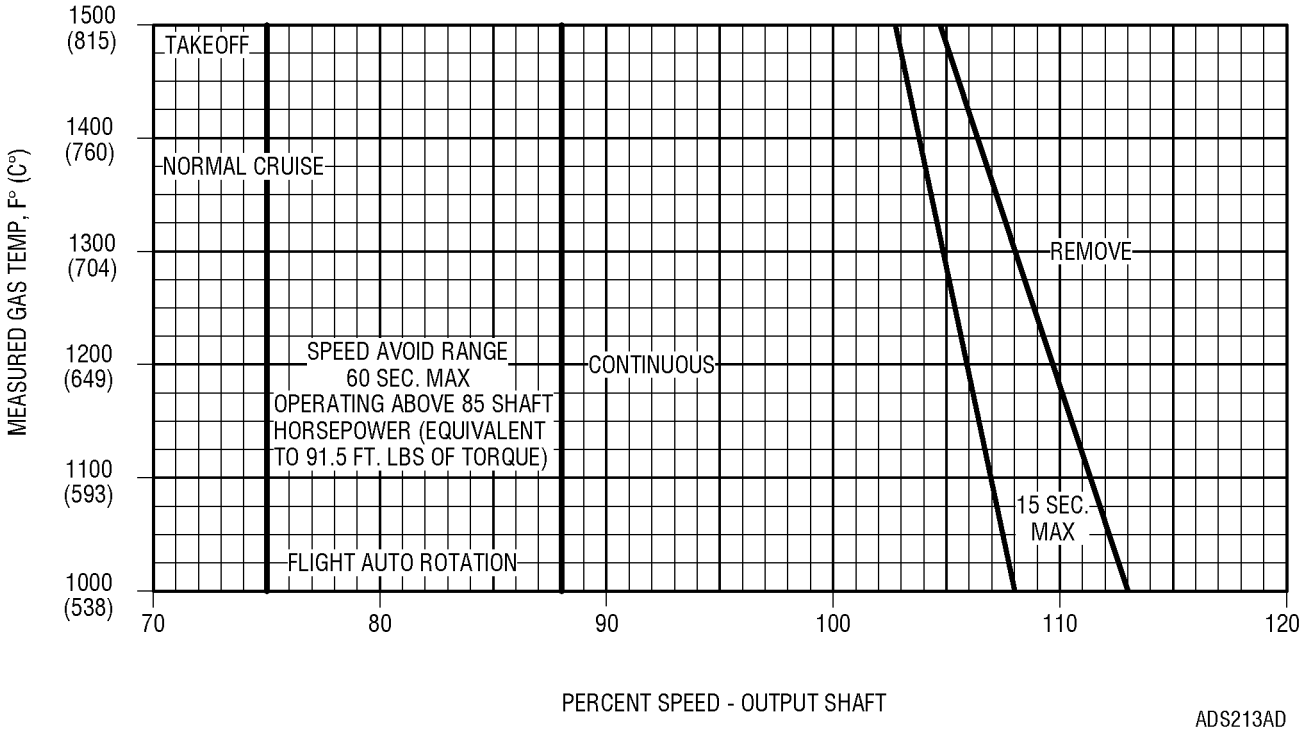
Limit	Component
N_1 (Gas Producer)	
105%--max. continuous	None
105-106%--15 sec max.	None
105%--over 15 sec	Turbine and compressor
Over 106%--not allowed	Turbine and compressor
N_2 (Power Turbine)	
Limits as shown in Figure 26, 27 or 28	Turbine
75-88%--60 sec. max. operating above 85 shaft horsepower (equivalent to 91.5 ft. lbs. of torque)	3rd-stage Turbine wheel
Complete loss of output shaft load	Turbine and gearbox
120% (40,000 rpm) or maximum indication shown on N_2 tachometer, whichever is first.	Turbine and gearbox



250-C20 Maximum Allowable Output Shaft Speeds
Figure 26

NOTE: Transition through the speed-avoid range is to be accomplished as quickly as possible.

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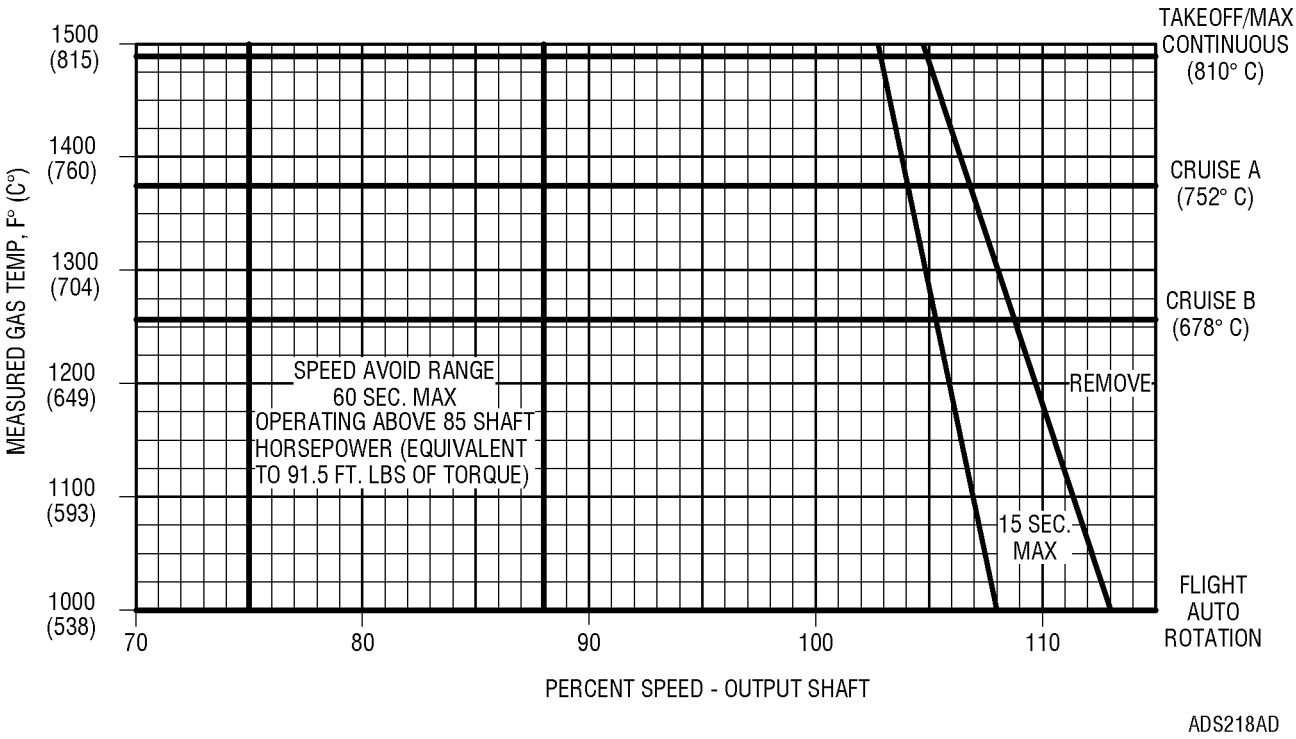


250-C20B, -C20F -C20W and-C20J Maximum Allowable Output Shaft Speeds
Figure 27

NOTE: Transition through the speed-avoid range is to be accomplished as quickly as possible.

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250-C20S Maximum Allowable Output Shaft Speeds
Figure 28

NOTE: Transition through the speed-avoid range is to be accomplished as quickly as possible.

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PARA 6.A. (cont)

Limit	Component
Slippage/sudden engagement of free wheel clutch unit	
a. Engine at Ground Idle; coupling shaft not broken.	Gearbox
b. Engine at Ground Idle; coupling shaft broken.	N_2 Turbine and Gearbox
c. Engine at any speed above Ground Idle.	N_2 Turbine and Gearbox

B. Engine Temperature

WARNING: HOT STARTS OR AFTERFIRES AFTER SHUTDOWN WILL CAUSE TURBINE BLADE AND WHEEL DAMAGE, WHICH CAN RESULT IN ENGINE FAILURE.

Refer to Table 8 or 9 for the measured gas temperature limits and the action to be taken when they are exceeded.

C. Engine Torque

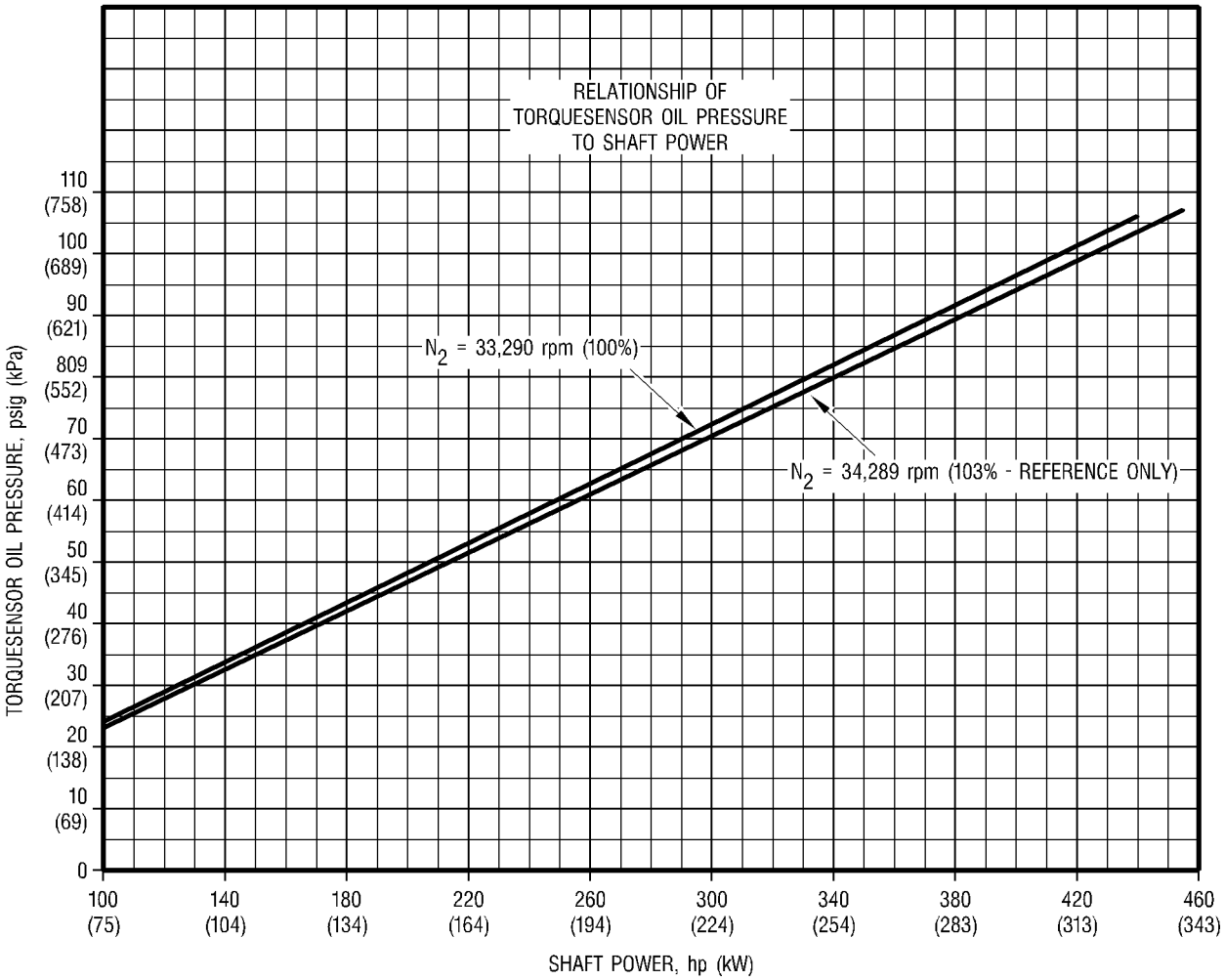
If maximum torque limit of Table 10, 11 or 12 is exceeded, the gearbox must be removed and sent to an Authorized Maintenance Center (AMC) to be overhaul inspected. Refer to Figure 29 for torquesensor oil pressure–to–shaft power relationship.

If slippage and/or sudden free wheel clutch engagement should occur with the engine at stabilized ground idle rpm and the output shaft and coupling shaft are not broken, a torque spike of unknown value is assumed and the gearbox must be sent to an authorized overhaul facility for an over–torque inspection.

If output shaft or coupling shaft is broken as a result of a sudden engagement of the free wheel unit at stabilized ground idle, or if the slippage/sudden engagement should occur at any engine speed above stabilized ground idle, with or without output shaft or coupling shaft damage, overtorque and overspeed conditions are assumed to have occurred and both the N_2 turbine and the gearbox require inspection at overhaul.

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ESTIMATED PERFORMANCE
ROLLS-ROYCE MODEL 250-C20 SERIES



ADS029AA

Torquesensor Oil Pressure and Shaft Power Relationship
Figure 29

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Table 8

Measured Gas Temperature Limits (TOT) – 250–C20 Engine

Steady State

Temp Range	Time	Maintenance Action
793°C (1460°F) 793°C (1460°F) 777°C (1430°F)	Takeoff (5 min.) 30 minute power (1) Max continuous (2)	If steady state time or condition limits are exceeded: Inspect turbine (3).
Over 927°C (1700°F)	Not Allowed	Remove the turbine for heavy maintenance or overhaul (5).

During Starting and Shutdown

Temp Range	Time	Maintenance Action
Up to 793°C (1460°F)	No limit	None.
793–927°C (1460–1700°F)	Over 10 sec (5)	Inspect turbine (3) (4).
927–999 °C (1700–1830°F)	Not allowed (5)	Inspect turbine (3) (4).
Over 999°C (1830°F)	Not allowed	Remove turbine for heavy maintenance or overhaul.

NOTE: Refer to Troubleshooting, 72–00–00, Table 101, item 9, (when start temperature consistently exceeds 860°C (1580°F).

During Power Transient

Temp Range	Time	Maintenance Action
Up to 777°C (1430°F)	No limit (Transient only)	None.
777–793°C (1430–1460°F)	Until stabilized (5 min max)	None.
793–843°C (1460–1550°F)	0 to 6 sec (intentional use of temperatures in excess of 793°C (1460°F) is not recommended)	None.
793–843°C (1460–1550°F)	Over 6 sec	Inspect turbine (3).
843–927°C (1550–1700°F)	Not allowed	Inspect turbine (3).
Over 927°C (1700°F)	Not allowed	Remove turbine for heavy maintenance or overhaul.

(1) This limit is applicable only during one–engine–inoperative (O.E.I.) operation of multi–engine aircraft.

(2) This limit is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine–inoperative (O.E.I.) operation of multi–engine aircraft, and emergency engine operation.

(3) Refer to Special Inspections, Table 604, Engine Inspection/Check, 72–00–00. Also, record temperature and duration in the Engine Log Book (pink pages, Turbine Assembly, Part IV, Inspection Record).

(4) Check Part V of the Engine Log for the part number of the 3rd–stage turbine wheel. If the 3rd–stage wheel is P/N 6898551, 6898567, 6898733, 6898743, 6898753 or 6898763, the following over–temperature limits shall apply: 1) 810–927°C (1490–1700°F) for 10 seconds maximum or 2) 927°C (1700°F) peak. If either of these limits are exceeded, record the condition encountered in Part I of the Engine Log. Return these Engine Log pages and the turbine to an Overhaul Agency for replacement of the 3rd–stage turbine wheel.

(5) Momentary peak temperature of 927°C (1700°F) is permitted for no more than one second.

NOTE: The time–at–temperature limits are not additive. The repeated, intentional use of transient temperature limits can result in reduced turbine life and is not recommended.

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Table 9

Measured Gas Temperature Limits (TOT) – 250–C20B, –C20F, –C20J, –C20S, –C20W Engines

Steady State

Temp Range	Time	Maintenance Action
810°C (1490°F)	Takeoff (5 min.)	If steady state time or condition limits are exceeded: Inspect turbine (3).
810°C (1490°F)	30 minute power (1)	
810°C (1490°F)	Max continuous (2)	
Over 927°C (1700°F)	Not Allowed	Remove turbine for heavy maintenance or overhaul (5).

During Starting and Shutdown

Temp Range	Time	Maintenance Action
Up to 810°C (1490°F)	No limit	None.
810–927°C (1490–1700°F)	Over 10 sec (5)	Inspect turbine (3) (4).
927–999°C (1700–1830°F)	Not allowed (5)	Inspect turbine (3) (4).
Over 999°C (1830°F)	Not allowed	Remove turbine for heavy maintenance or overhaul.

NOTE: Refer to Troubleshooting, 72–00–00, Table 101, item 9, when start temperature consistently exceeds 860°C (1580°F).

During Power Transient

Temp Range	Time	Maintenance Action
Up to 779°C (1434°F)	No limit (Transient only)	None.
779–810°C (1434–1490°F)	Until stabilized (5 min max)	None.
810–843°C (1490–1550°F)	0 to 6 sec (intentional use of temperatures in excess of 810°C (1490°F) is not recommended)	None.
810–843°C (1490–1550°F)	6 to 12 seconds	Max of 3 occurrences per life of each turbine wheel (3) (4).
810–843°C (1490–1550°F)	Over 12 seconds	Inspect turbine (3) (4).
843–927°C (1550–1700°F)	Not allowed	Inspect turbine (3) (4).
Over 927°C (1700°F)	Not allowed	Remove turbine for heavy maintenance or overhaul.

One Engine Inoperative and/or Emergency
Multi–Engine Operation (250–C20B, –C20F Engine)

Temp Range	Time	Maintenance Action
Up to 810°C (1490°F)	No limit	None.
810–843°C (1490–1550°F)	0 to 6 seconds	None.
843–899°C (1550–1650°F)	0 to 6 seconds	Inspect turbine.
810–899°C (1490–1650°F)	6 to 12 seconds	Max of 3 occurrences per life of each turbine wheel (3) (4).
810 to 899°C (1490–1650°F)	Over 12 seconds	Remove turbine for heavy maintenance or overhaul.
Over 899°C (1650°F)	Not allowed	Remove turbine for heavy maintenance or overhaul.

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Table 9 (cont)

(1) This limit is applicable only during one–engine–inoperative (O.E.I.) operation of multi–engine aircraft.

(2) This limit is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine–inoperative (O.E.I.) operation of multi–engine aircraft, and emergency engine operation.

(3) Refer to Special Inspections, Table 604, Engine–Inspection/Check, 72–00–00. Also, record temperature and duration in the Engine Log Book (pink pages, Turbine Assembly, Part IV, Inspection Record).

(4) Check Part V of the Engine Log for the part number of the 3rd–stage turbine wheel. If the 3rd–stage wheel is P/N 6898551, 6898567, 6898733, 6898743, 6898753 or 6898763, the following overtemperature limits shall apply: 1) 810–927°C (1490–1700°F) for 10 seconds maximum or 2) 927°C (1700°F) peak. If either of these limits are exceeded, record the condition encountered in Part I of the Engine Log. Return these Engine Log pages and the turbine to an Overhaul Agency for replacement of the 3rd–stage turbine wheel.

(5) Momentary peak temperature of 927°C (1700°F) is permitted for no more than one second.

NOTE: With the exception of the 810–899°C (1490–1650°F) temperature encountered for 6 to 12 seconds (max 3 occurrences on 250–C20B, –C20F), the time–at–temperature limits are not additive and may be repeated without restriction. The repeated intentional use of transient temperature limits can result in reduced turbine life and is not recommended.

Table 10

Output Shaft Torque Limits – 250–C20 Engine

Torque		Pressure		Power at 100% N_2		
lb ft	(N·m)	psi	(kPa)	hp	(kW)	Time Limit
393	(533)	109	(752)	450	(336)	10 sec
367	(498)	101	(696)	420	(313)	30 min
336	(456)	93	(641)	385	(287)	Max Continuous*
302	(410)	83	(572)	346	(258)	Continuous

NOTE: *This limit is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine–inoperative (O.E.I.) operation of multi–engine aircraft, and emergency engine operation.

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Table 11

Output Shaft Torque Limits – 250–C20B, –C20F, –C20J, –C20W Engines

Torque		Pressure		Power at 100% N_2		
lb ft	(N·m)	psi	(kPa)	hp	(kW)	Time Limit
430	(583)	119	(820)	—	—	16 sec
384	(521)	106	(731)	440	(328)	5 min (Takeoff)
384	(521)	106	(731)	440	(328)	30 min
384	(521)	106	(731)	440	(328)	Max Continuous*
323	(438)	89	(614)	370	(276)	Normal Cruise

NOTE: *This limit is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine–inoperative (O.E.I.) operation of multi–engine aircraft, and emergency engine operation.

Table 12

Output Shaft Torque Limits – 250–C20S Engines

Torque		Pressure		Power at 100% N_2		
lb ft	(N·m)	psi	(kPa)	hp	(kW)	Time Limit
393	(533)	109	(752)	450	(336)	10 sec
384	(521)	106	(731)	440	(328)	5 min (Takeoff)
384	(521)	106	(731)	440	(328)	30 min
384	(521)	106	(731)	440	(328)	Max Continuous*
323	(438)	89	(614)	370	(276)	Normal Cruise

NOTE: *This limit is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine–inoperative (O.E.I.) operation of multi–engine aircraft, and emergency engine operation.

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D. Oil Pressure and Temperature

If the oil pressure is not within the following limits, refer to Table 101, Engine-Troubleshooting, 72-00-00.

(1) 94.2% N_1 speed and above . . . 115-130 psig (792-896 kPag)

(2) 78.5 to 94.2% N_1 speed . . . . . 90-130 psig (621-896 kPag)

(3) (Below 78.5% N_1 speed . . . . . 50-130 psig (345-896 kPag)

(4) During start . . . . . a positive indication must be obtained when 59% (idle) is reached.

NOTE: At altitudes above 5000 ft (1524 m), the oil pressure lower limit declines at the rate of 2 psig (13.8 kPag) per 1000 ft (305 m) to a maximum reduction of 20 psig (140 kPag).

NOTE: During cold weather operation, 150 psig (1034 kPag) main oil pressure is allowable following an engine start. When the 130 psig (896 kPag) limit is exceeded, operate engine at minimum power until normal oil pressure limits are attained.

NOTE: If the engine has been operated with less than the required oil pressure, except for momentary fluctuation, inspect the oil system in accordance with Low Oil Pressure Operation, para. 11.D., 72-00-00, Engine-Servicing.

Oil temperature shall be within the following range. (If the maximum limit is exceeded, refer to Oil Temperature Limit Exceeded, para 11.B., 72-00-00, Engine-Servicing, for corrective action.)

(5) Minimum starting
MIL-PRF-7808 . . . . . -54°C (-65°F)
MIL-PRF-23699,
DOD-PRF-85734,
or SAE AS5780 . . . . . -40°C (-40°F)

(6) Maximum . . . . . 107°C (225°F)

(7) Minimum flight operation . . . . . 0°C (32°F)
(Providing engine oil pressure is within the specified limits of para 6.D.)

NOTE: When starting in ambient temperature conditions below -20°C (-4°F), after stabilizing at ground idle, increase throttle until 100% N2 is achieved. Operate at this condition until engine oil temperature is at least 0°C (32°F) before beginning flight operations.

E. Pressure Altitude And Ambient Temperature

The engine will start and operate satisfactorily at conditions of ambient pressure and temperature as shown in Figure 30 or 31.

7. Operating Procedures (250-C20, -C20B, -C20F, -C20J,-C20W)

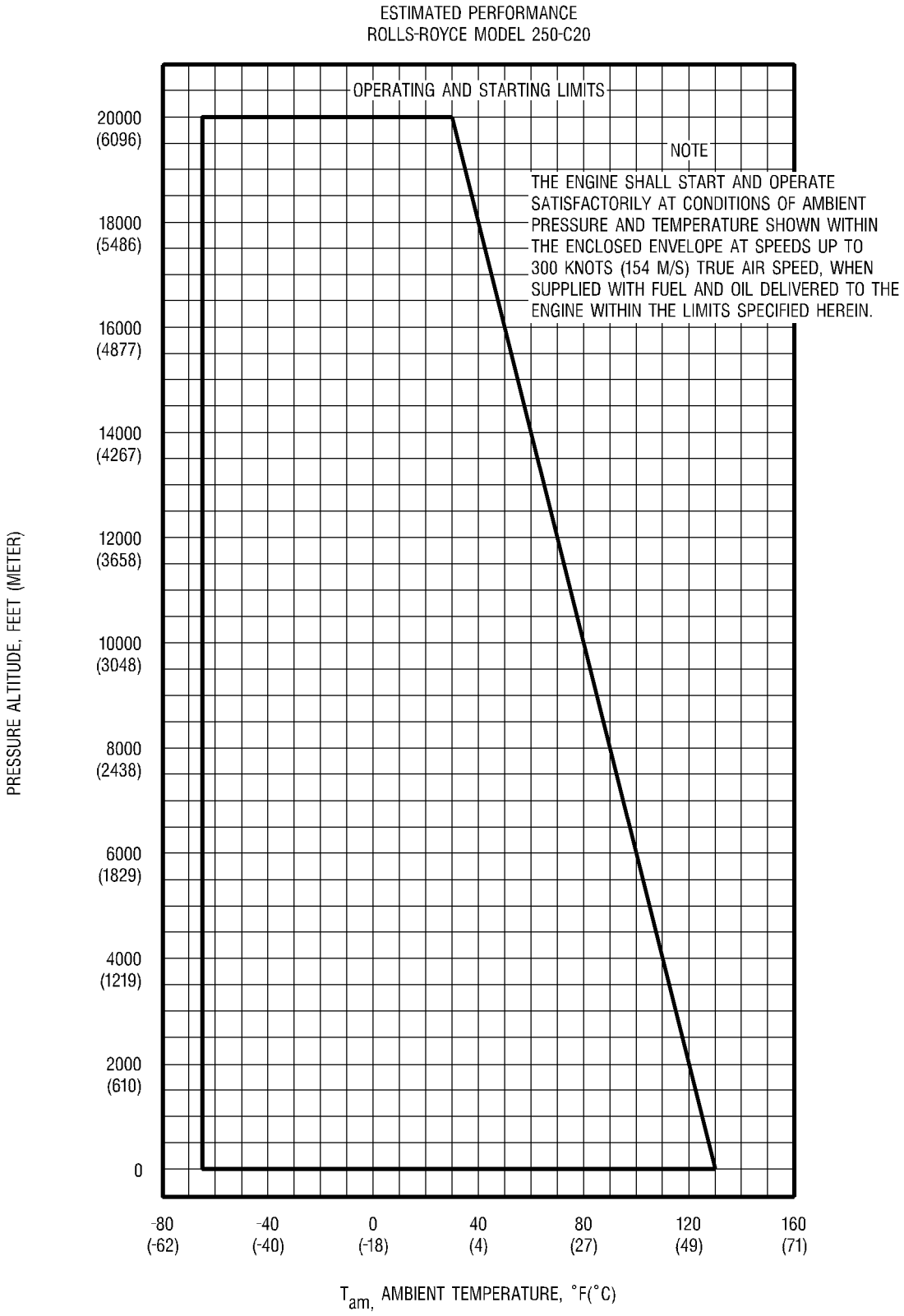
WARNING: TO PREVENT ENGINE FUEL STARVATION AND SUBSEQUENT FLAME-OUT, ANY AIRCRAFT REQUIRING FUEL BOOST PUMP(S) SHOULD USE THESE PUMPS AT ALL TIMES DURING FLIGHT OR AS DIRECTED IN THE AIRCRAFT FLIGHT MANUAL.

WARNING: TO PREVENT CRUCIAL DELAY IN REGAINING POWER IF AN ENGINE FLAMEOUT IS ENCOUNTERED, AIRCRAFT EQUIPPED WITH AN AUTO-RELIGHT SYSTEM SHOULD KEEP THAT SYSTEM ACTIVATED AT ALL TIMES WHILE THE AIRCRAFT IS INFLIGHT.

The procedures which follow pertain to operation of the engine at: start and ground idle; power range; practice autorotation descent and landing; air restart; stopping; and during an emergency.

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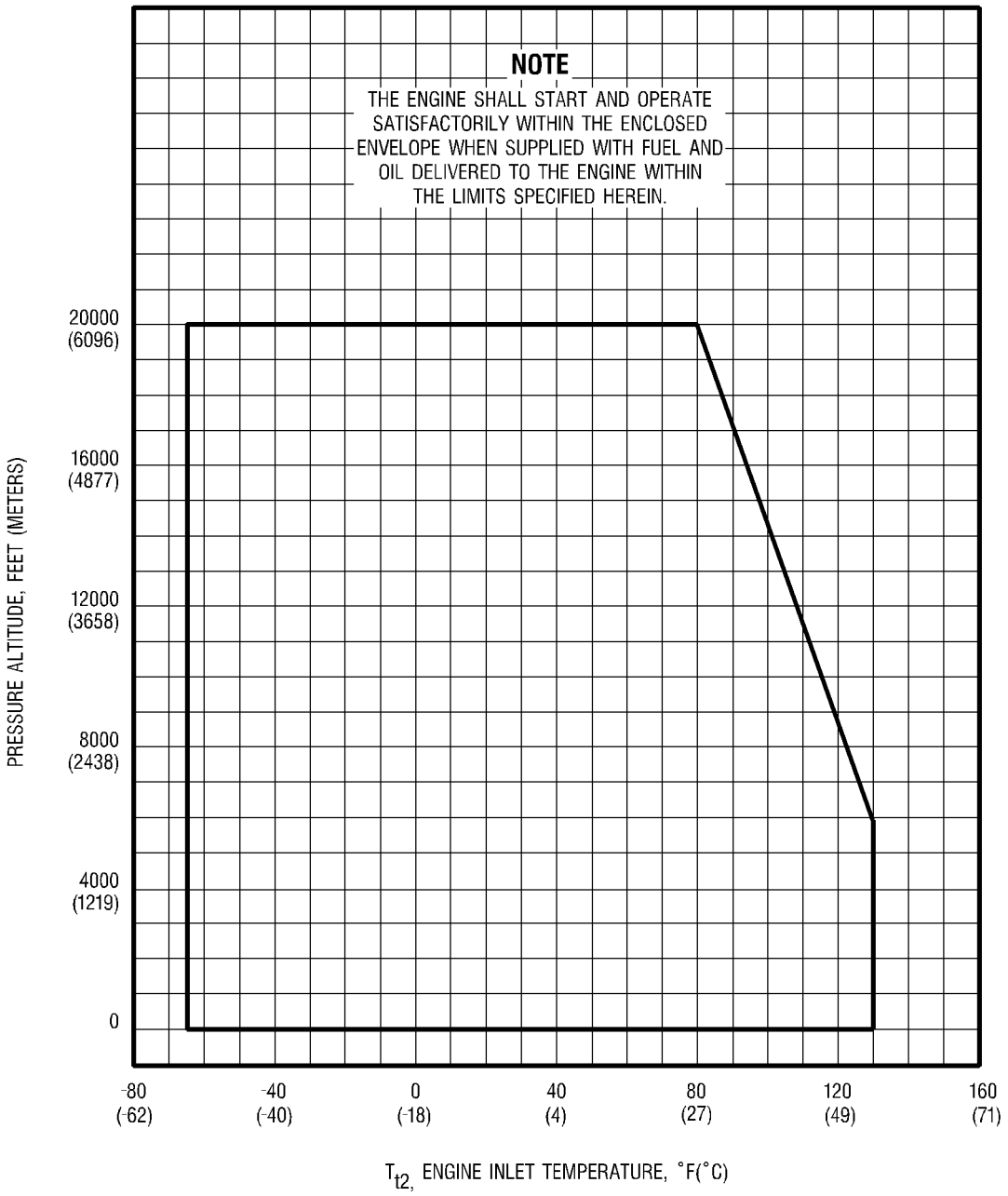


250–C20 Engine Operating Limits
Figure 30

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

ESTIMATED PERFORMANCE
ROLLS-ROYCE MODELS 250-C20B, -C20F, -C20J, -C20S, -C20W

OPERATING AND STARTING



AES004BA

250 –C20B, –C20F, – C20J, –C20S and –C20W Engine Operating Limits
Figure 31

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

PARA 7. (cont)

A. Preflight Inspections

Before starting the engine, make a preflight inspection. (Refer to Preflight and Postflight Inspections, Table 601, 72–00–00, Engine Inspection/Check.)

CAUTION: BEFORE THE ENGINE IS OPERATED, MAKE SURE THE COMPRESSOR INLET IS FREE OF DEBRIS. ALSO, MAKE SURE THE COMPRESSOR ROTOR IS NOT FROZEN IF THE AIRCRAFT IS IN A FREEZING ATMOSPHERE.

B. Engine Starting Procedures

WARNING: TO MAKE SURE OF ADEQUATE WARNING OF POSSIBLE EMERGENCY ENGINE OPERATING CONDITIONS, VERIFY THAT THE ENGINE WARNING SYSTEMS (ENGINE–OUT HORN, FILTER BYPASS LIGHT AND CHIP DETECTOR LIGHT) ARE OPERABLE BEFORE EACH FLIGHT.

WARNING: OVERTEMPERATURE STARTS OR AFTERFIRES AFTER SHUT–DOWN WILL CAUSE CRACKS IN THE TURBINE FIRST–STAGE WHEEL RIM. THESE CRACKS CAN EVENTUALLY CAUSE A SECTION OF THE WHEEL TO BREAK OFF, CAUSING TURBINE IMBALANCE AND ENGINE FAILURE.

CAUTION: FOR THE ULTIMATE SAFETY OF ALL PERSONNEL WHO COME IN CLOSE PROXIMITY WITH THE ENGINE, IT IS THE RESPONSIBILITY OF THE PILOT AND MAINTENANCE PERSONNEL TO RECORD AND TAKE RECOMMENDED CORRECTIVE ACTION WHEN OVERTEMPERATURE OCCURS.

The 250–C20 Series engines each have two qualified control systems; they are:

(1) CECO.

The MC–40 (250–C20, –C20B, –C20J) control system manufactured by the Chandler Evans Control Systems Division of Coltec Industries.

(2) Bendix.

The DP–N1 (250–C20) or DP–N2 (250–C20, –C20B, –C20F, –C20J), (control)/AL–AA1 (governor) control system manufactured by the Bendix Engine Controls Division of Allied Signal.

C. Starting Modes.

Starting procedures are given for an automatic start mode (CECO or Bendix system) and for a modulated start mode (CECO system only).

WARNING: OVERTEMPERATURE STARTS OR AFTERFIRES AFTER SHUTDOWN WILL CAUSE CRACKS IN THE FIRST–STAGE WHEEL RIM. THESE CRACKS CAN EVENTUALLY CAUSE A SECTION OF THE WHEEL TO BREAK OFF, CAUSING TURBINE IMBALANCE AND ENGINE FAILURE.

Automatic Start Mode:

The throttle is advanced directly to the IDLE detent when desired N_1 cranking speed is reached.

Modulated Start Mode:

The throttle is advanced toward the IDLE detent in increments as required to increase TOT and N_1 speed at a steady rate that remains within specified limits.

CAUTION: BEFORE THE ENGINE IS OPERATED, MAKE CERTAIN THE COMPRESSOR INLET IS FREE OF DEBRIS. ALSO, MAKE CERTAIN THE COMPRESSOR ROTOR IS NOT FROZEN IF THE AIRCRAFT IS IN A FREEZING ATMOSPHERE.

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PARA 7.C. (cont)

(1) Automatic Start Mode

The following procedure is applicable to either the CECO or the Bendix control system.

(a) Position the throttle at FUEL OFF and turn all switches off.

(b) Place the aircraft collective pitch (load) control in the minimum position.

(c) Turn on the aircraft switches required to provide fuel to the engine.

CAUTION: DURING A START THE THROTTLE MUST NEVER BE ADVANCED OUT OF THE FUEL OFF POSITION UNTIL AFTER THE STARTER AND IGNITION EXCITER HAVE BEEN ENERGIZED AND THE DESIRED CRANKING SPEED HAS BEEN ATTAINED. TO DO SO MIGHT RESULT IN AN EXPLOSIVE LIGHTOFF OR AN OVERTEMPERATURE START.

CAUTION: AN ENGINE FIRE (WITH THE RESULTANT FLAME EMANATING FROM THE TAILPIPE) CAN OCCUR DURING START IF THE COMBUSTION CHAMBER BECOMES OVERLOADED WITH FUEL BEFORE IGNITION TAKES PLACE. TO EXTINGUISH THE FIRE, CONTINUE TO MOTOR THE ENGINE USING THE STARTER, WITH THE THROTTLE FULLY CLOSED AND THE MAIN FUEL SWITCH OFF. (REFER TO THE ENGINE STOPPING PROCEDURE (PARA 7.J., THIS SECTION) FOR THE RECOMMENDED ACTION IF AN ENGINE FIRE IS ENCOUNTERED DURING SHUTDOWN.)

CAUTION: MONITOR OIL PRESSURE DURING START. DAMAGE TO ROTOR BEARINGS CAN RESULT IF A POSITIVE INDICATION OF OIL PRESSURE IS NOT OBTAINED BY THE TIME IDLE SPEED IS REACHED.

(d) Residual TOT should be no more than 150°C (302°F) when lightoff is attempted. (Residual TOT can be easily reduced to or below 150°C (302°F) by motoring engine with the starter.)

(e) Energize the starter motor and ignition exciter.

(f) As N_1 rpm accelerates through 12–15% N_1, move the throttle to the IDLE detent to begin fuel flow.

NOTE: Do not wait for N_1 peak out. Introduce fuel immediately upon reaching desired N_1 speed. Delay in moving the throttle to the idle detent may diminish battery capacity early in the start cycle.

CAUTION: A START SHOULD NOT BE ATTEMPTED AT N1 SPEEDS BELOW 12%. STARTING AT N1 SPEEDS LESS THAN 12% INCREASES THE POSSIBILITY OF EXCEEDING ENGINE TEMPERATURE LIMITS.

CAUTION: FOR ENGINES INCORPORATING LOW ENERGY EXCITERS, OPERATING TIME LIMITS ARE AS FOLLOWS: 2 MINUTES ON, 3 MINUTES OFF; 2 MINUTES ON, 23 MINUTES OFF. HIGH ENERGY IGNITION EXCITERS ARE QUALIFIED FOR CONTINUOUS DUTY OPERATION. HOWEVER, USE OF THE IGNITION SYSTEM ON A CONTINUOUS BASIS IS NOT RECOMMENDED BECAUSE OF DEGRADATION OF THE SPARK IGNITER.

(g) De–energize the starter and ignition exciter when 58% N_1 speed is reached. The start is completed when a stabilized N_1 speed of 59–65% is reached. Completion of the start normally occurs 25 to 60 seconds after starter engagement. A positive indication of oil pressure must be obtained by this point in the start. If it is not, shut down the engine and check to be sure that oil is available at the power and accessory gearbox inlet. Monitor the measured gas temperature; do not exceed the limits of Table 8 or 9, this section.

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PARA 7.C. (cont)

CAUTION: IF THE N_2 TURBINE IS NOT ROTATING BY 25% N_1 SPEED ABORT THE START. A SECOND OR THIRD START ATTEMPT MAY BE MADE; IF THE CONDITION STILL EXISTS REFER TO ITEM 65, ENGINE – TROUBLESHOOTING, TABLE 101, 72–00–00.

CAUTION: IF THE ENGINE HAS BEEN SHUT DOWN FOR MORE THAN 15 MINUTES, STABILIZE AT IDLE SPEED FOR ONE MINUTE BEFORE INCREASING POWER.

NOTE: If a stagnated start is experienced, shut down; then repeat start procedure.

NOTE: The start should be complete in one minute; however, if N_1 and N_2 are accelerating and TOT is within limits, the start may be continued longer than one minute.

NOTE: If the engine with a CECO control system starts and flames out at high altitude, especially above 5000 feet, during cold ambient conditions, make a start with the aircraft boost pump off. If engine starts are not improved, refer to Engine – Troubleshooting, Table 101, 72–00–00.

NOTE: If it appears that an overtemperature will occur during the start:

- On the CECO control system, reposition the throttle to between 5–20° on the quadrant to achieve a manually operated trim on fuel flow. When the temperature is reduced, advance the throttle toward IDLE to complete the start.
- On the Bendix fuel control, position the throttle to FUEL OFF and motor the engine without ignition for ten seconds then repeat the start.

NOTE: If the start is aborted turn the throttle to FUEL OFF and motor the engine for 10 seconds without ignition.

(h) Monitor N_1 and TOT when turning generator switch ON. If N_1 decays below 60 percent, or TOT approaches 810°C (1490°F), turn generator OFF and increase N_1 speed with throttle to 70 percent, then reset generator to ON.

(2) Modulated Start Mode

The modulated start mode is applicable to the CECO control system only. A modulated start is recommended when it is anticipated that the starting peak TOT may be higher than normal.

The modulated start procedure is the same as the automatic start procedure, including notes and cautions, except for the movement of the throttle to the IDLE detent. (Refer to Automatic Start Mode, para 7.C.(1), this section.) For a modulated start, advance the throttle as follows:

(a) When the desired N_1 cranking speed is reached, advance the throttle toward IDLE until the engine lights–off. Lightoff is evidenced by combustion noise and/or by an increase in TOT. From this point, TOT is controlled directly by the throttle; increase or decrease as required, by throttle movement.

(b) Monitor TOT and N_1 speed. Increase both at a steady rate. The rate of throttle opening action determines the maximum TOT and N_1 speed increase.

(c) Continue advancing the throttle until the IDLE detent is reached.

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PARA 7.C. (cont)

(3) Cold Weather Start Procedure

Some general practices recommended for improved cold weather operation of the engine are as follows:

CAUTION: IF THE ENGINE IS EQUIPPED WITH A BENDIX FUEL SYSTEM, CONDENSATION AND FREEZING OF MOISTURE IN THE PNEUMATIC CIRCUITS CAN OCCUR WHEN WEATHER CONDITIONS OF LOW TEMPERATURE AND HIGH RELATIVE HUMIDITY ARE ENCOUNTERED. THIS CONDITION CAN CAUSE AUTO (SPONTANEOUS) ACCELERATION OF THE ENGINE.

CAUTION: IF THE LANDING/TAKEOFF SURFACE IS SLIPPERY, CARE MUST BE TAKEN TO AVOID SKIDDING BY THE AIRCRAFT IF AUTO ACCELERATION OCCURS.

NOTE: Auto acceleration resulting from frozen moisture in the fuel system air circuits will not repeat unless the aircraft is again subjected to cold soak. To prevent icing/ auto acceleration, make a 10 minute ground warm–up run at IDLE before flight. This warm–up is recommended when the aircraft has been allowed to cold soak (remain out of hangar overnight) in low ambient temperature of –12°C (+10°F) or below and high relative humidity 45% or greater.

NOTE: If auto acceleration occurs, close the throttle and shut down the engine. Subsequently, restart the engine and resume the warm–up.

(a) When the aircraft is parked, use appropriate covers over the inlet ducts, exhaust stacks, etc.

(b) At temperatures below 4°C (40°F) use JP–4 or commercial Jet B fuel if available. As an alternate, use the AVGAS–jet fuel mixture described in Cold Weather Fuels, para 9., this section.

NOTE: At ambient temperatures below 4°C (40°F), some type of anti–ice protection is required, such as anti–ice additive or a means of airframe fuel ice elimination.

(c) If equipment is available and conditions allow, when the aircraft has been cold soaked at temperatures below 4°C (40°F), use an auxiliary power source for faster more satisfactory starts.

CAUTION: DO NOT USE AN OPEN FLAME HEATER TO PREHEAT THE ENGINE OR BATTERY.

(d) If the aircraft has been cold soaked at temperatures below minus 18°C (0°F) and a battery start must be made, preheat the engine fuel control area and battery if equipment is available and conditions allow.

(e) If the aircraft has been cold soaked and a battery start must be made without preheating the battery, remove and store the battery until it is required if conditions allow. Store the battery in an area where it can be maintained or warmed to a temperature above ambient outside conditions or to approximately 21°C (70°F).

(f) If stagnated starts are encountered, enrich the starting fuel flow in accordance with the start derichment and/or start acceleration adjustment procedure in Engine Starting Characteristic Adjustment, para 3.H., 73–20–02 or para 3.G., 73–20–04. On CECO control systems, a lightoff adjustment is also available and can be used if the lightoff temperature is not within limits. (Refer to Lightoff Adjustment, para 3.F., 73–20–04.)

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NOTE: Due to the variation in jet fuels available for commercial operation, in cold weather the engine may experience a short delay before lightoff after the throttle is advanced to the IDLE position. This delay should be less than three seconds regardless of the type of fuel used. If the lightoff delay exceeds three seconds, return the throttle to FUEL OFF and continue to motor the engine with the starter for thirty seconds to remove excess fuel from the combustion section.

NOTE: In some instances N_1 may accelerate slowly through the 25-30% speed range on a battery start after an engine has been cold soaked and not preheated. If the start is not completed within the starter engagement time limits, shut down the engine. Before attempting the next start, wait for the starter duty cycle limits to pass or for one minute, whichever is longer. This wait will allow residual heat from the previous start attempt to soak back into the engine and battery and improve conditions for the next start attempt.

D. Power Range

During operation in the power range place the throttle in the maximum position and utilize engine power with the collective pitch. Vary the collective pitch to avoid exceeding the measured gas temperature and torque limits given in Tables 8 through 12 or the N_2 speed limit given in Figure 26 or 27. It is recommended that large collective increases be made over a 2-3 second time period to avoid momentary N_2/N_R droop.

CAUTION: DECREASING COLLECTIVE TO THE LOW POWER RANGE WILL RESULT IN AN N_2/N_R INCREASE. IF THE RPM IS RESET WITH THE BEEP SWITCH, LOW N_2/N_R RPM CAN RESULT WHEN COLLECTIVE IS INCREASED TO THE HIGH POWER RANGE UNLESS THE BEEP SWITCH SETTING IS RETURNED TO NEAR THE PREVIOUS BEEP POSITION.

E. Takeoff With Water-Alcohol Augmentation

Augmented takeoffs are limited to ambient temperatures above 4°C (40°F) and shall not exceed five minutes in duration.

F. Operating Procedure When Using Water Alcohol Augmentation

(1) Make a water-alcohol augmented takeoff as follows:

(a) Make a normal engine start. Idle the engine one minute before increasing power.

CAUTION: DO NOT MAKE RAPID POWER DECELERATIONS OR OPERATE N_2 AT LESS THAN 95% SPEED WHILE USING WATER-ALCOHOL AUGMENTATION.

(2) Rotate throttle to full open and increase TOT to 738°C (1360°F). Then turn on the water alcohol system. (Power will remain steady while the TOT will decrease.) After TOT has stabilized, adjust power to desired setting but do not exceed 810C (1490°F), the maximum torque limit or the maximum N_1 speed limits.

NOTE: Acceleration time to augmented Takeoff power will require approximately two seconds more than acceleration time to nonaugmented Takeoff power.

(3) Before turning off the water-alcohol system, reduce TOT to not less than 738°C (1360°F).

G. Practice Autorotation Descent and Landing

CAUTION: BEFORE INITIATING A PRACTICE AUTOROTATION, MAKE SURE THAT A DECELERATION CHECK WAS MADE AFTER THE LAST FLIGHT FROM THE DAY BEFORE, OR BEFORE THE FIRST FLIGHT OF THE DAY. IF MULTIPLE CONTROLS ARE INSTALLED, MAKE SURE THAT THE CHECKS WERE MADE USING BOTH THE PILOT AND CO-PILOT THROTTLES. FAILURE TO MAKE A DECELERATION CHECK COULD CAUSE ENGINE FLAMEOUT.

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NOTE: Make sure the deceleration check was made during shutdown after the last flight from the day before, or before the first flight of the day. Make the decelereration check before initiating a practice autorotation. (Refer to Item 6, Table 601, Preflight and Postflight Inspections, 72-00-00, Engine-Inspection/Check.)

To make a practice autorotation landing at minimum engine power, position the throttle in the GROUND IDLE position and observe the following conditions.

(1) During autorotation, avoid a pausing or creeping movement of any throttle increase or decrease between IDLE and FULL OPEN. If the movement is not made at a firm and continuous rate, N_1 rpm undershoot and/or oscillation (which may cause a momentary, false Engine Out warning indication) may occur.

(2) The throttle must be positioned at maximum before making any collective increase, so full engine power will be available upon demand.

NOTE: N_2 instability may be encountered during practice auto rotation. This is a normal condition when in autorotation.

H. Air Restart

The following air start procedures apply to either starts made during an emergency or to starts made during normal restart conditions:

CAUTION: IF ENGINE MECHANICAL FAILURE IS SUSPECTED, AN AIR RESTART SHOULD NOT BE ATTEMPTED.

(1) Emergency Restart

When immediate power restoration is required, make an emergency air restart by energizing the starter within 10 seconds after power loss occurs.

NOTE: N_1 will not decrease below minimum starting speed within the 10 seconds because of rotational inertia plus possible ram effect. The throttle can be left in the open position since fuel flow during the start will be on the normal acceleration schedule.

CAUTION: DUE TO THERMAL CHANGES WITHIN THE TURBINE, THE GAS PRODUCER SECTION OF THE ENGINE MAY LOCK UP AFTER AN INFLIGHT SHUTDOWN. THIS IS A TEMPORARY CONDITION WHICH EXISTS AFTER THE ENGINE HAS BEEN SHUT DOWN FOR APPROXIMATELY ONE MINUTE AND WHICH MAY CONTINUE FOR UP TO TEN MINUTES FOLLOWING THE SHUTDOWN. THEREFORE, EXCEPT DURING AN EMERGENCY, AIR STARTS SHOULD NOT BE ATTEMPTED DURING THE TIME PERIOD BETWEEN ONE MINUTE AFTER SHUTDOWN AND TEN MINUTES AFTER SHUTDOWN.

(2) Normal Restart

Make a normal restart as follows:

(a) With the throttle in FUEL OFF, energize the starter and ignition exciter.

(b) At the desired N_1 speed (or above) position the throttle in the full open position. Use the following guide to determine desired N_1 starting speed versus outside air temperature.

15% N_1 rpm above 7°C (45°F)

13% N_1 rpm from minus 18 to plus 7°C (0 to 44°F)

12% N_1 rpm below minus 18°C (minus 1°F)

(c) De-energize the starter at 58% N_1 speed.

(d) Apply collective pitch as required.

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PARA 7. (cont)

I. Anti–icing Air

Use anti–icing air when any of the following conditions are encountered:

(1) Consult the aircraft operating manual for the outside air temperature (OAT) at which anti–icing air should be used. If the aircraft manual does not provide this temperature, use anti–icing air when flying into visible moisture at OAT below 5°C (40°F).

(2) During the drying run following compressor rinse or wash operations. (Refer to Compressor Cleaning, para 6., 72–30–00.)

(3) Every 25 flight hours during warm weather aircraft operation. Activation of anti–ice air for 1–2 minutes every 25 hours purges dirt and debris from the anti–ice air passages of the compressor front support.

J. Engine Stopping

WARNING: OVERTEMPERATURE STARTS OR AFTERFIRES AFTER SHUTDOWN WILL CAUSE CRACKS IN THE TURBINE FIRST–STAGE WHEEL RIM. THESE CRACKS CAN EVENTUALLY CAUSE A SECTION OF THE WHEEL TO BREAK OFF, CAUSING TURBINE IMBALANCE AND ENGINE FAILURE.

CAUTION: FOR THE ULTIMATE SAFETY OF ALL PERSONNEL WHO COME IN CLOSE PROXIMITY WITH THE ENGINE IN THE FUTURE, IT IS THE RESPONSIBILITY OF THE PILOT AND MAINTENANCE PERSONNEL TO RECORD AND TAKE RECOMMENDED CORRECTIVE ACTION WHEN OVERTEMPERATURE OCCURS.

Stop the engine as follows:

(1) Position the throttle to the IDLE position.

CAUTION: IDLE DWELL TIME PRIOR TO SHUTDOWN IS IMPORTANT TO PREVENT HARMFUL ACCUMULATION OF CARBON IN THE ENGINE WHICH CAN RESULT IN ENGINE FAILURE.

(2) Maintain the engine at 59–65% N_1 speed for a minimum of two minutes prior to shutdown.

NOTE: TOT at Ground Idle may be higher than those experienced at higher throttle settings.

(3) Position throttle in FUEL OFF. Monitor engine TOT until N_1 rotation has stopped.

(4) Turn off all engine switches.

CAUTION: AN ENGINE FIRE (RECOGNIZED BY A RAPID INCREASE IN TOT) CAN OCCUR DURING SHUTDOWN IF FUEL CUTOFF IS NOT COMPLETE. IF A SHUTDOWN FIRE OCCURS, IMMEDIATELY ENGAGE THE STARTER AND MOTOR THE ENGINE TO MINIMIZE THE TEMPERATURE ENCOUNTERED. TO EXTINGUISH THE FIRE, CONTINUE TO MOTOR THE ENGINE USING THE STARTER WITH THE THROTTLE FULLY CLOSED AND THE MAIN FUEL SWITCH OFF. THE TEMPERATURE LIMITATIONS AND MAINTENANCE ACTION IN TABLE 4 MUST BE OBSERVED.

(5) Monitor instrumentation to ensure that shutdown has occurred. To assure throttle cutoff, hold the throttle in the closed position until N_1 speed is zero and TOT has stabilized.

NOTE: A deceleration check is recommended during the shutdown for the last flight of each day. (Refer to Deceleration Check, para 3.B., 73–20–02, or para 3.B., 73–20–04.)

K. Alternate Shutdown

Use the following alternate shutdown procedure when operational conditions such as high winds require 100% N_2 (rotor speed) during the dwell period following flight.

WARNING: IDLE DWELL TIME PRIOR TO SHUTDOWN IS IMPORTANT TO PREVENT HARMFUL ACCUMULATION OF CARBON IN THE ENGINE, WHICH CAN RESULT IN ENGINE FAILURE.

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PARA 7.K. (cont)

(1) Position the collective and cyclic controls at the minimum power settings consistent with operational safety requirements.

(2) Stabilize the engine for a minimum of 2 minutes at minimum power.

(3) Position the throttle in FUEL OFF.

NOTE: It is not necessary to pause at the Idle position except to perform the deceleration check during shutdown for the last flight of each day.

(4) Turn off all engine switches.

CAUTION: AN ENGINE FIRE (RECOGNIZED BY A RAPID INCREASE IN TOT) CAN OCCUR DURING SHUTDOWN IF FUEL CUTOFF IS NOT COMPLETE. IF A SHUTDOWN FIRE OCCURS, IMMEDIATELY ENGAGE THE STARTER AND MOTOR THE ENGINE TO MINIMIZE THE TEMPERATURE ENCOUNTERED. TO EXTINGUISH THE FIRE, CONTINUE TO MOTOR THE ENGINE USING THE STARTER WITH THE THROTTLE FULLY CLOSED AND THE MAIN FUEL SWITCH OFF. THE TEMPERATURE LIMITATIONS AND MAINTENANCE ACTION IN TABLE 9 MUST BE OBSERVED.

(5) Monitor instrumentation to ensure that shutdown has occurred. To assure throttle cutoff, hold the throttle in the closed position until N_1 speed is zero and TOT has stabilized.

NOTE: A deceleration check is recommended during the shutdown for the last flight of each day. (Refer to Deceleration Check, para 3.B., 73–20–02 or para 3.B., 73–20–04.)

L. Emergency

If the power turbine governor should fail to function, resulting in a rapid N_2 speed increase, the throttle should be reduced to control overspeed.

(1) Manipulate the collective pitch to control the helicopter.

(2) Monitor the N_2 speed and vary the throttle setting to maintain desired speed.

NOTE: The same power range is available using the throttle in emergency as in normal power turbine governing.

The power turbine governor can also fail in a decrease fuel flow condition. This can be recognized by decreased N_1 speed and decreased torque output with the throttle in the full open position. In this event, initiate autorotation.

M. Postflight Inspection

Following the last flight of the day, conduct a postflight inspection. (Refer to Preflight and Postflight Inspections, Table 601, 72–00–00, Engine–Inspection/Check.)

8. Operating Procedures (250–C20S)

WARNING: TO PREVENT ENGINE FUEL STARVATION AND SUBSEQUENT FLAME–OUT, ANY AIRCRAFT REQUIRING FUEL BOOST PUMP(S) SHOULD USE THESE PUMPS AT ALL TIMES DURING FLIGHT OR AS DIRECTED IN THE AIRCRAFT FLIGHT MANUAL.

WARNING: TO PREVENT CRUCIAL DELAY IN REGAINING POWER IF AN ENGINE FLAMEOUT IS ENCOUNTERED, AIRCRAFT EQUIPPED WITH AN AUTO–RELIGHT SYSTEM SHOULD KEEP THAT SYSTEM ACTIVATED AT ALL TIMES WHILE THE AIRCRAFT IS IN FLIGHT.

The procedures which follow pertain to operation of the engine during: Starting, Taxi, Takeoff, Flight, Landing and Shutdown.

A. Preflight Inspections

Before starting the engine, make a preflight inspection. (Refer to Preflight and Postflight Inspections, Table 601, 72–00–00, Engine Inspection/Check.)

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PARA 8.A. (cont)

CAUTION: BEFORE THE ENGINE IS OPERATED, MAKE SURE THE COMPRESSOR INLET IS FREE OF DEBRIS. ALSO, MAKE SURE THE COMPRESSOR ROTOR IS NOT FROZEN IF THE AIRCRAFT IS IN A FREEZING ATMOSPHERE.

B. Ground Starting

WARNING: TO ENSURE ADEQUATE WARNING OF POSSIBLE EMERGENCY ENGINE OPERATING CONDITIONS, VERIFY THAT THE ENGINE WARNING SYSTEMS (ENGINE–OUT HORN, FILTER BYPASS LIGHT AND CHIP DETECTOR LIGHT) ARE OPERABLE BEFORE EACH FLIGHT.

WARNING: OVERTEMPERATURE STARTS OR AFTERFIRES AFTER SHUTDOWN WILL CAUSE CRACKS IN THE FIRST–STAGE WHEEL RIM. THESE CRACKS CAN EVENTUALLY CAUSE A SECTION OF THE WHEEL TO BREAK OUT AND EXIT THE ENGINE WITH POTENTIALLY DISASTROUS RESULTS.

CAUTION: BEFORE THE ENGINE IS OPERATED, MAKE CERTAIN THE COMPRESSOR INLET IS FREE OF DEBRIS. ALSO, MAKE CERTAIN THE COMPRESSOR ROTOR IS NOT FROZEN IF THE AIRCRAFT IS IN A FREEZING ATMOSPHERE.

Two starting procedures are provided for the engine. The normal starting procedure is for starts in ambient temperatures of 40°F (4°C) and above. (Refer to Normal Starting, para 8.B.(1), this section.) The cold weather starting procedure is for starts in ambient temperatures between plus 39°F (4°C) and minus 65°F (minus 54°C). (Refer to Cold Weather Starting, para 8.B.(2) this section.)

CAUTION: FOR THE ULTIMATE SAFETY OF ALL PERSONNEL WHO COME IN CLOSE PROXIMITY WITH THE ENGINE IN THE FUTURE, IT IS THE RESPONSIBILITY OF THE PILOT AND MAINTENANCE PERSONNEL TO RECORD AND TAKE RECOMMENDED CORRECTIVE ACTION WHEN OVERTEMPERATURE OCCURS.

(1) Normal Starting

Start the engine as follows:

(a) Position the Fuel Cutoff Lever at FUEL OFF and turn all switches off.

(b) Place the Propeller Control Lever in the minimum position.

(c) Turn on the aircraft switches required to provide fuel to the engine.

(d) Place the Power Lever at the IDLE position.

CAUTION: DURING A START THE FUEL CUTOFF LEVER MUST NEVER BE ADVANCED OUT OF THE FUEL OFF POSITION UNTIL AFTER THE STARTER AND IGNITION EXCITER HAVE BEEN ENERGIZED AND THE DESIRED CRANKING SPEED HAS BEEN ATTAINED. TO DO SO MIGHT RESULT IN AN EXPLOSIVE LIGHTOFF OR AN OVERTEMPERATURE START.

CAUTION: AN ENGINE FIRE (WITH THE RESULTANT FLAME EMANATING FROM THE TAILPIPE) CAN OCCUR DURING START IF THE COMBUSTION CHAMBER BECOMES OVERLOADED WITH FUEL BEFORE IGNITION TAKES PLACE. TO EXTINGUISH THE FIRE, CONTINUE TO MOTOR THE ENGINE USING THE STARTER, WITH THE FUEL CUTOFF LEVER FULLY CLOSED AND THE MAIN FUEL SWITCH OFF. (REFER TO GROUND SHUTDOWN, PARA 8.I., THIS SECTION, FOR THE RECOMMENDED ACTION IF AN ENGINE FIRE IS ENCOUNTERED DURING SHUTDOWN.)

CAUTION: MONITOR OIL PRESSURE DURING START. DAMAGE TO ROTOR BEARINGS CAN RESULT IF A POSITIVE INDICATION OF OIL PRESSURE IS NOT OBTAINED BY THE TIME IDLE SPEED IS REACHED.

(e) Residual TOT should be no more than 150°C (302°F) when lightoff is attempted. (Residual TOT can be readily reduced to or below 150°C (302°F) by motoring engine with the starter.)

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PARA 8.B. (cont)

(f) Energize the starter motor and ignition exciter.

(g) As N_1 rpm accelerates through 12–15% N_1, move the Fuel Cutoff lever to the FUEL ON position to begin fuel flow.

NOTE: Do not wait for N_1 peak out. Introduce fuel immediately upon reaching desired N_1 speed. Delay in moving the throttle to the idle detent may diminish battery capacity early in the start cycle.

CAUTION: A START SHOULD NOT BE ATTEMPTED AT N_1 SPEEDS BELOW 12%. STARTING AT N_1 SPEEDS LESS THAN 12% INCREASES THE POSSIBILITY OF EXCEEDING ENGINE TEMPERATURE LIMITS.

CAUTION: FOR ENGINE INCORPORATING LOW ENERGY EXCITERS, OPERATING TIME LIMITS ARE AS FOLLOWS: 2 MINUTES ON, 3 MINUTES OFF; 2 MINUTES ON, 23 MINUTES OFF.

CAUTION: HIGH ENERGY IGNITION EXCITERS ARE QUALIFIED FOR CONTINUOUS DUTY OPERATION. HOWEVER, USE OF THE IGNITION SYSTEM ON A CONTINUOUS BASIS IS NOT RECOMMENDED BECAUSE OF DEGRADATION OF THE SPARK IGNITER.

(h) De–energize the starter and ignition exciter when 58% N_1 speed is reached. The start is completed when a stabilized N_1 speed of 59–65% is reached. Completion of the start normally occurs 25–60 seconds after starter engagement. A positive indication of oil pressure must be obtained by this point in the start. If it is not, shut down the engine and check to be sure that oil is available at the power and accessories gearbox inlet. Monitor the measured gas temperature; do not exceed the limits of Table 9, this section.

CAUTION: IF THE N_2 TURBINE IS NOT ROTATING BY 25% N_1 SPEED, ABORT THE START. A SECOND OR THIRD START ATTEMPT MAY BE MADE; IF THE CONDITION STILL EXISTS REFER TO ENGINE–TROUBLESHOOTING, TABLE 101, 72–00–00.

CAUTION: IF THE ENGINE HAS BEEN SHUT DOWN FOR MORE THAN 15 MINUTES, STABILIZE AT IDLE SPEED FOR ONE MINUTE BEFORE INCREASING POWER.

NOTE: If a stagnated start is experienced, shut down, then repeat start procedure.

NOTE: The start should be complete in one minute; however, if N_1 and N_2 are accelerating and TOT is within limits, the start may be continued longer than one minute.

NOTE: If it appears that an overtemperature will occur during the start, position the Fuel Cutoff Lever to FUEL OFF and motor the engine without ignition for ten seconds, and then repeat the start.

NOTE: If the start is aborted, move the Fuel Cutoff Lever to FUEL OFF and motor the engine for ten seconds without ignition.

(i) Monitor N_1 and TOT when turning the generator switch ON. If N_1 decays below 60% or TOT approaches 810°C, turn the generator OFF and increase N_1 speed with the throttle to 70%; then reset the generator switch to ON.

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(2) Cold Weather Starting

Some general practices recommended for improved cold weather operation of the engine are as follows:

(a) Use appropriate covers on the inlet duct, exhaust stacks, etc. when the aircraft is parked.

(b) At temperatures below 4°C (40°F), use JP–4 or commercial Jet B fuel if available. As an alternate use the AVGAS–jet fuel mixture described in Cold Weather Fuels, para 4.B.(3), this section.

NOTE: Use the fuel containing an anti–ice additive whenever engine operations are conducted below 4°C (40°F).

(c) If equipment is available and conditions allow, when the aircraft has been cold soaked at temperatures below 4°C (40°F), use an auxiliary power source for faster more satisfactory starts.

CAUTION: DO NOT USE AN OPEN FLAME HEATER TO PREHEAT THE ENGINE OR BATTERY.

(d) If the aircraft has been cold soaked at temperatures below minus 18°C (0°F) and a battery start must be made, preheat the engine fuel control area and battery if equipment is available and conditions allow.

(e) If the aircraft has been cold soaked and a battery start must be made without preheating the battery, remove and store the battery until it is required if conditions allow. Store the battery in an area where it can be maintained or warmed to a temperature above ambient outside conditions or to approximately 21°C (70°F).

NOTE: Variations in jet fuels can affect engine lightoff in cold ambient conditions. The engine may experience a short delay before lightoff after the Fuel Cutoff Lever is moved to the maximum position. This delay should be less then three seconds regardless of the type of fuel used. If the lightoff delay exceeds three seconds, return the Fuel Cutoff Lever to FUEL OFF and continue to motor the engine with the starter for thirty seconds to purge unburned fuel from the engine.

CAUTION: POSITIVE OIL PRESSURE MUST BE OBTAINED BY THE TIME IDLE SPEED IS REACHED. IF NOT OBTAINED, SHUT DOWN THE ENGINE AND CHECK TO BE SURE THAT OIL IS AVAILABLE AT THE POWER AND ACCESSORIES GEARBOX INLET.

CAUTION: MONITOR MEASURED GAS TEMPERATURE. DO NOT EXCEED THE LIMITS OF TABLE 9, THIS SECTION. IF OVERTEMPERATURE OCCURS, MOVE THE FUEL CUTOFF LEVER TO FUEL OFF AND CONTINUE TO MOTOR THE ENGINE WITHOUT IGNITION FOR 10 SECONDS.

CAUTION: IF N_2 IS NOT ROTATING BY 25% N_1 SPEED, ABORT THE START. A SECOND OR THIRD START ATTEMPT MAY BE MADE; IF THE CONDITION STILL EXISTS, REFER TO ENGINE–TROUBLESHOOTING TABLE 101, 72–00–00.

NOTE: In some instances N_1 may accelerate slowly through the 25–30% speed range on a battery start after an engine has been cold soaked and not preheated. If the start is not completed within the starter engagement time limits, shut down the engine. Before attempting next start, wait for the starter duty cycle limits to pass or for one minute, whichever is longer. This wait will allow residual heat from the previous start attempt to soak back into the engine and battery and improve conditions for the next start attempt.

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PARA 8.B.(2) (cont)

CAUTION: TO AVOID AUTO–(SPONTANEOUS) ACCELERATION OF THE 250–C20S ENGINE, MAKE A GROUND WARM–UP AT IDLE SPEED FOR A PERIOD OF 10 MINUTES PRIOR TO FLIGHT IF ALL OF THE FOLLOWING CONDITIONS ARE ENCOUNTERED:

1 Low ambient temperature, 10°F (–12°C) or lower.

2 High relative humidity, 45% or higher.

3 The aircraft has not been hangared overnight or has otherwise been allowed to cold soak.

(f) If the auto–acceleration should occur, close the fuel cutoff lever and shutdown the engine. Subsequently, restart and resume the warm–up period.

(g) If the engine has been shut down for more than 15 minutes, stabilize at IDLE for one minute before increasing power.

NOTE: After a cold weather battery start, allow the engine to run at idle speed for two minutes before actuating the generator switch. This will prevent N_1 speed run down resulting from high generator loading.

C. Inflight Starting

The inflight starting procedure is the same as for normal ground starting except the power lever must be in the FLIGHT IDLE position.

CAUTION: DUE TO THERMAL CHANGES WITHIN THE TURBINE, THE GAS PRODUCER SECTION OF THE ENGINE MAY LOCK UP AFTER AN INFLIGHT SHUTDOWN. THIS IS A TEMPORARY CONDITION WHICH EXISTS AFTER THE ENGINE HAS BEEN SHUT DOWN FOR APPROXIMATELY ONE MINUTE AND WHICH MAY CONTINUE FOR UP TO TEN MINUTES FOLLOWING THE SHUTDOWN. THEREFORE, EXCEPT DURING AN EMERGENCY, AIR STARTS SHOULD NOT BE ATTEMPTED DURING THE TIME PERIOD BETWEEN ONE MINUTE AFTER SHUTDOWN AND TEN MINUTES AFTER SHUTDOWN.

D. Taxi Operation

During taxi operation, the gas producer fuel control regulates the fuel flow and the Propeller Control regulates the blade angle. The gas producer speed setting is established by the position of the Power Lever. The propeller governor automatically assumes control of the blade angle when high power levels are selected. (Refer to the appropriate aircraft manual for Taxi Operation Procedures.)

E. Takeoff

During takeoff operation, the gas producer governor regulates the fuel flow and the propeller governor regulates the blade angle position. The speed settings of the gas producer governor and the propeller governor are established by the position of the Power Lever and the Propeller Control Lever, respectively.

(1) The Propeller Control Lever should be in the position for 100% propeller speed.

(2) Maintain engine power control by using the Power Lever. The propeller governor will maintain power turbine speed control. Vary the Power Lever to avoid exceeding the measured gas temperature and torque limits given in Tables 9, 11 and 12 this section.

F. Takeoff With Water–Alcohol Augmentation

Augmented takeoffs are limited to ambient temperatures above 40°F (4°C) and shall not exceed 5 minutes in duration.

Make a water–alcohol augmented takeoff as follows:

(1) Make a normal engine start. Idle the engine one minute before increasing power.

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PARA 8.F. (cont)

(2) Advance Power Lever to approximately 738°C (1360°F) TOT; then turn on water–alcohol system. (Power will remain steady while the TOT will decrease.) After TOT has stabilized, increase power to desired setting but do not exceed max temperature limit of 810°C (1490°F), max torque limit, or max N_1 speed limits.

CAUTION: DO NOT MAKE RAPID POWER DECELERATIONS OR OPERATE N_2 AT LESS THAN 95% SPEED WHILE USING WATER–ALCOHOL AUGMENTATION.

(3) Before turning off the water–alcohol system, reduce power to not less than 738°C (1360°F) TOT.

G. Flight Operation

During flight operation, the gas producer governor regulates the fuel flow and the propeller governor regulates the blade angle position. The speed settings of the gas producer governor and the propeller governor are established by the position of the Power Lever and the Propeller Control Lever, respectively.

(1) Vary the Propeller Control Lever to establish the desired propeller governor speed setting. The propeller speed setting may be varied between 80 and 100%.

CAUTION: REFER TO APPROPRIATE AIRCRAFT FLIGHT MANUAL FOR MINIMUM POWER LEVER SETTING DURING FLIGHT OPERATION.

(2) Maintain engine power control by using the Power Lever. Vary the lever to avoid exceeding the measured gas temperature and torque limits given Tables 9, 11 and 12, this section.

H. Landing

For descent and landing proceed as follows:

(1) Position Propeller Control Lever at the 100% propeller speed position.

(2) For landing approach the Power Lever may be retarted to FLIGHT IDLE. Lever movement below FLIGHT IDLE is not permitted during flight operation. (See CAUTION in Flight Operation, para 8.G., this section.

NOTE: At low air speeds the propeller blade angle may reach the flight low pitch stop causing power turbine speed to droop below 100%.

CAUTION: THE POWER LEVER MUST NOT BE RETARDED BELOW FLIGHT IDLE AT SPEEDS GREATER THAN 90 MPH IAS DURING GROUND OPERATION.

(3) After the aircraft is on the ground the Power Lever may be retarded below FLIGHT IDLE when ground speed is 90 mph IAS or less.

I. Ground Shutdown

WARNING: OVERTEMPERATURE STARTS OR AFTERFIRES AFTER SHUTDOWN WILL CAUSE CRACKS IN THE FIRST–STAGE WHEEL RIM. THESE CRACKS CAN EVENTUALLY CAUSE A SECTION OF THE WHEEL TO BREAK OFF, CAUSING TURBINE IMBALANCE AND ENGINE FAILURE.

CAUTION: FOR THE ULTIMATE SAFETY OF ALL PERSONNEL WHO COME IN CLOSE PROXIMITY WITH THE ENGINE IN THE FUTURE, IT IS THE RESPONSIBILITY OF THE PILOT AND MAINTENANCE PERSONNEL TO RECORD AND TAKE RECOMMENDED CORRECTIVE ACTION WHEN OVERTEMPERATURE OCCURS.

Shut down the engine on the ground as follows:

(1) Retard the Power Lever to the GROUND IDLE position.

(2) When the engine has stabilized at GROUND IDLE move the Fuel Cutoff Lever to FUEL OFF position.

CAUTION: IDLE DWELL TIME PRIOR TO SHUTDOWN IS IMPORTANT TO PREVENT HARMFUL ACCUMULATION OF CARBON IN THE ENGINE, WHICH CAN RESULT IN ENGINE FAILURE.

NOTE: If the engine has been ground run at high power, maintain the engine at GROUND IDLE for two minutes before shutdown.

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(3) Turn off all engine switches.

(4) After each engine shutdown, visually check that the propeller blades are fully feathered immediately after propeller rotation stops.

J. Normal Inflight Shutdown

Make a normal inflight engine shutdown as follows:

CAUTION: DO NOT MOVE THE POWER LEVER BELOW THE FLIGHT IDLE POSITION DURING FLIGHT.

(1) Retard the Power Lever to the FLIGHT IDLE position.

(2) From the FLIGHT IDLE position move the Fuel Cutoff Lever to the FUEL OFF position. The propeller will feather automatically when the engine shuts down.

(3) Turn off all applicable engine switches.

CAUTION: DO NOT WINDMILL AT 120-125 KNOTS INDICATED AIR SPEED FOR MORE THAN 13 MINUTES.

K. Emergency Inflight Shutdown

Make an emergency inflight engine shutdown as follows:

(1) Move the Fuel Cutoff Lever to the FUEL OFF position. The propeller will feather automatically and the engine will shut down.

(2) Leave the Power Lever in the flight range.

(3) Turn off all applicable engine switches.

L. Feathering

Propeller feathering will occur automatically with engine shutdown by positioning the Fuel Cutoff Lever in the FUEL OFF position.

M. Anti-Icing Air

Consult the aircraft operating manual for the outside air temperature (OAT) at which anti-icing air should be used. If the aircraft manual does not provide this temperature, use anti-icing air when flying into visible moisture at OAT below 5°C (40°F).

N. Emergency

If the engine power turbine governor should fail to function, resulting in a rapid N_2 speed increase, the Power Lever should be reduced to control overspeed.

(1) Manipulate the aircraft controls to control the aircraft.

(2) Monitor the N_2 speed and vary the Power Lever setting to maintain desired speed.

NOTE: The same power range is available using the Power Lever in emergency as in normal power turbine governing.

The engine power turbine governor can also fail in a decrease fuel flow condition. This can be recognized by decreased N_1 speed and decreased torque output with the throttle in the normal operating range. In this event, initiate emergency power loss power reduction procedures, as described in the aircraft flight manual.

9. Cold Weather Fuels

WARNING: AT AMBIENT TEMPERATURES BELOW 4°C (40°F), SOME TYPE OF FUEL SYSTEM ICING INHIBITOR (FSII) IS REQUIRED, SUCH AS AN ANTI-ICE ADDITIVE OR A MEANS OF AIRFRAME FUEL ICE ELIMINATION. ENGINE FLAMEOUT COULD RESULT FROM FAILURE TO USE AN FSII THAT AGREES WITH MIL-DTL-85470. (REFER TO THE AIRCRAFT MANUAL FOR THEIR REQUIREMENTS AND PARA 4.B., THIS SECTION, FOR APPROVED FSII.)

NOTE: Grade JP-4, Grade JP-5, and Grade JP-8 type fuels contain an icing inhibitor that agrees with MIL-DTL-85470. These fuels do not require more icing inhibitor unless specified by the airframe manufacturer.

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The fuels recommended for consistent cold weather starting, 4°C (40°F) and below, are as follows:

(1) MIL-DTL-5624, JP-4

(2) ASTM D-6615, Jet B

(3) Alternate cold weather fuel: ASTM D-910 AVGAS and Jet A, A-1, JP-5, or JP-8 mixture. Refer to para 9.A., Mixing Alternate Cold Weather Fuel, for instructions on correct mixture and use of cold weather fuels.

CAUTION: JP-4 OR COMMERCIAL JET B FUEL MUST NOT BE MIXED WITH AVGAS.

NOTE: Jet A, Jet A1, JP-5, or JP-8 may start the engine at temperatures below 4°C (40°F); however, when cold soaked, marginal starts may result due to viscosity changes.

NOTE: Once started, the engine will operate satisfactorily on JP-5, JP-8, Jet A and Jet A1 at fuel and outside air temperatures down to -32°C (-25°F).

A. Mixing Alternate Cold Weather Fuel

CAUTION: THERE IS NO TIME LIMIT FOR ENGINE OPERATION WHEN THE AVGAS-JET FUEL MIXTURE IS USED WHEN ASTM D-910, GRADE 80 IS USED AND THE 1:2 VOLUME RATIO IS OBSERVED. USE OF ASTM D-910 GRADES 91, 100LL AVGAS-JET FUEL MIXTURE MUST BE LIMITED TO 300 HOURS IN ONE OVERHAUL PERIOD BECAUSE OF THE HIGH LEAD CONTENT OF THE FUEL.

The alternate cold weather fuel mixture must have one part by volume AVGAS and two parts by volume commercial jet fuel. The AVGAS must agree with ASTM D-910, Grades 80, 91, or 100LL with 0.53 mL/liter maximum lead content. Do not use grade ASTM D-910 Grade 100 with 1.06 mL/liter lead content. The commercial jet fuel can be JP-5, Jet A or A1.

Prolonged and uninterrupted operation with only AVGAS mixture will induce lead buildup on turbine parts. This lead build-up can cause a gradual power reduction; consequently, this AVGAS mixture should be used only for cold weather operation. During operation with normal Jet A or Jet B type turbine fuel, the lead buildup will slowly dissipate.

CAUTION: WHEN MIXING THE FUELS, AVOID HIGH FLOW RATES. DO NOT EXCEED A FLOW RATE OF 50 GALLONS (189 LITERS) PER MINUTE. ALSO, MAKE SURE THE FUEL NOZZLE AND FUEL TANK ARE GROUNDED TO THE AIRCRAFT.

(1) Make the fuel mix in the aircraft tank. The AVGAS can be added before or after the jet fuel. The only restriction is that the final mix (including fuel in the tank before starting the mix) be two parts by volume jet fuel to one part by volume AVGAS.

NOTE: Anti-ice additive is needed for the jet fuel-AVGAS fuel mixture unless qualified in accordance with para 9., Cold Weather Fuels, this section. (Refer to Specifications, para 4., this section.)

(2) The alternate fuel mixture is not recommended for warm weather operation. It is recommended only when the ambient temperature is below 4°C (40°F); aircraft boost pump ON. (Some missions may require operating the aircraft temporarily in both low and high ambient temperatures. Temperature restrictions refer to continuous temperatures of 16°C (60°F) or higher.)

WARNING: HANDLING LEAD RESIDUE COATED PARTS BY PERSONS WITH OPEN CUTS OR SCRATCHES ON THEIR HANDS CAN BE EXTREMELY DANGEROUS. ALWAYS WEAR GLOVES WHEN CHECKING RESIDUE COATED TURBINE OR EXHAUST PARTS.

(3) When the AVGAS-jet fuel mixture is used in the engine, the lead from the gasoline accumulates on the turbine and exhaust collector outlet ducts. The normal appearance after operation on leaded fuel is a pale yellow powder deposit on the exhaust surfaces.

(4) In order to obtain a lightoff when the alternate fuel mixture is made in the fuel tank it may be necessary to: (a) preheat the engine, or (b) bleed the unmixed fuel.

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CAUTION: DO NOT USE AN OPEN FLAME HEATER TO PREHEAT THE ENGINE.

(5) Preheat the engine in the area of the fuel control.

CAUTION: POST FIRE PROTECTION BEFORE OPENING THE FUEL LINE.

(6) (250-C20, -C20B, -C20F, -C20J) Bleed the unmixed fuel from the system as follows:

(a) Deactivate the igniter circuit breaker.

WARNING: BE CAREFUL OF THE POTENTIAL FIRE HAZARD OF FUEL IN AN OPEN CONTAINER.

(b) Disconnect the fuel line at the fuel nozzle.

(c) Place the fuel line in a container. Make sure to keep contaminants from entering the exposed fuel passage.

(d) Turn on the aircraft boost pump. Open the throttle. Continue the flow from the fuel line until the unmixed fuel has drained and the AVGAS mixture appears. The AVGAS mixture can be visually detected because it is light pink in color.

(e) Close the throttle. Turn off the boost pump. Reconnect the fuel line to the fuel nozzle. Tighten the coupling nut to 80-120 lb in. (9.0-13.6 N·m).

(f) Close the igniter circuit breaker.

(7) (250-C20S, -C20W) Bleed the unmixed fuel from the system as follows:

(a) Deactivate the igniter circuit breaker.

WARNING: BE AWARE OF THE POTENTIAL FIRE HAZARD OF FUEL IN AN OPEN CONTAINER.

(b) Disconnect the fuel line at the fuel nozzle.

(c) Place the fuel line in a container. Observe caution to keep contaminants from entering the exposed fuel passage.

(d) Place the Power Lever at TAKEOFF.

(e) Turn on the aircraft switches required to provide fuel to the engine.

(f) Move the Fuel Cutoff Lever to the FUEL ON position.

(g) Energize the starter and motor the engine without ignition and flow fuel from the fuel line until the unmixed fuel has drained and the AVGAS mixture appears. The AVGAS mixture can be visually detected because it is light pink in color.

(h) Discontinue motoring and move the Fuel Cutoff Lever to the FUEL OFF-FEATHER position.

(i) Turn off all engine switches.

(j) Reconnect the fuel line to the fuel nozzle. Tighten the coupling nut to 80-120 lb in. (9.0-13.6 N·m).

10. Cold Weather Oils

Refer to para 4.C.(1), Cold Weather Lubrication, for recommended oil type based on ambient temperatures.

11. Time Between Overhauls (TBO's)

The model 250 engine was originally designed to permit modular overhaul. The major components of the engine are the compressor, gearbox, and turbine. A premature removal of any of these components should not cause removal of the other components unless secondary damage has occurred.

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PARA 11. (cont)

A. Engine TBO

NOTE: Heavy maintenance inspection (HMI) shall consist of gas producer turbine rotor replacement and inspection of assembled components by an Authorized Maintenance Center (AMC).

For operators who do not wish to utilize the modular overhaul concept, Rolls-Royce recommends a time between overhauls of 1000 hours for the 250-C20 engine incorporating a non-product improved turbine. For 250-C20 engines incorporating the product improved turbine and 250-C20B, -C20F, -C20J, -C20S and -C20W engines, the recommended time between overhaul, excluding the TBO for individual accessories, is 3500 hours with a 1750-hour turbine heavy maintenance inspection. However, it is possible that the allowable cycle life limit of certain rotating parts specified in Airworthiness Limitations, Section 05-10-00 , may be exceeded before the recommended TBO is reached. It is, therefore, the responsibility of the operator to assure that neither the total time nor cycle life limits of these parts are exceeded.

B. Modular TBO

For operators who wish to utilize modular overhaul, Rolls-Royce recommends time between overhauls as listed in Tables 13 and 14. However, it is possible that the allowable cycle life limit of certain parts specified in Airworthiness Limitations, Section 05-10-00, may be exceeded before the recommended TBO. It is, therefore, the responsibility of the operator to assure that neither the total time nor cycle life limits of these parts are exceeded.

C. On-Condition Parts

The accessories and components that are on-condition are listed in Table 15.

Operating hours with respect to maintenance records means the time from the moment an aircraft leaves the surface of the earth until it touches at the next point of landing.

Table 13

Modular Overhaul-Components Recommended Time Between Overhauls

Component	Recommended TBO (Hours)	Recommended Heavy Maintenance Inspection (HMI) by Authorized Maintenance Center
Compressor	3500(1)	None
Gearbox	On condition	None
Turbine	3500(1)	1750 hr. (1)
Turbine-Non-Product Improved(2)	1000(1)	None

(1) Refer to Airworthiness Limitations, Section 05-10-00, for life limits on certain rotating parts. It is the responsibility of the operator to assure that life limits are never exceeded.

(2) Identified by turbine P/N 6853329.

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Table 14

Accessories Recommended Time Between Overhauls (Hours)
(250-C20, -C20B, -C20F, -C20J, -C20W)

Component	Recommended TBO Hours
Fuel Pump	
Sundstrand (PESCO) Dual Element	1500(1)
Sundstrand (PESCO) Dual Element	2250(2)
Sundstrand (PESCO) Single Element	2250(3)
ARGO-TECH/TRW - P/N 386500-5 (Rolls-Royce P/N 6899253)	4000
P/N 386500-1, -2, -3, -4	3500
Chandler Evans (GOODRICH) - P/N 113300-01A1 (Rolls-Royce P/N 23057338)	3500
- P/N 113300-02A1 (Rolls-Royce P/N 23065132)	3500
- P/N 113300-03A1 (Rolls-Royce P/N 23070459)	3500
- P/N 113300-04A1 (Rolls-Royce P/N 23074705)	3500
Fuel Control (GOODRICH)(4)	
P/N 104000A8 and subsequent	4000
P/N 104900A3 and subsequent	4000
All part numbers prior to above	1000
Power Turbine Governor (GOODRICH)(4)	
P/N 104100A12 and subsequent	4000
P/N 104500A7 (multi-engine) and subsequent	4000
P/N 104100A6 through A11	2000
P/N 104500A1 through A6 (multi-engine)	2000
All P/N prior to 104100A6	1000
Fuel Control (Bendix) (250-C20, -C20B, -C20F, -C20J, -C20W)	2500
(250-C20S)	2000
Power Turbine Governor (Bendix)	1500

NOTE: The TBO period on the following Bendix governors has been extended to 2000 hours. All governors that precede these part numbers must remain at 1500 hours.

Rolls-Royce P/N	Bendix P/N
23005493	2524769-7 and subsequent
23005492	2524667-8 and subsequent
23036657	2549025-1 and subsequent
23036658	2549026-1 and subsequent

Fuel Nozzle	
P/N 6890917	2500
P/N 6874959	1500
P/N 23077068	2500
Bleed Valve	1500

NOTE: Contact your Authorized Maintenance Center for extension of the TBO on eligible selected accessories.

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Table 14 (cont)

(1) P/N 6854292, 6857548, 6877719, 6856250 and 6876803 not complying with Rolls–Royce Commercial Engine Bulletin 250–C20 CEB–1051.

WARNING: MANDATORY COMPLIANCE DATE FOR 250–C20 CEB–1051 WAS AUGUST 30, 1980.

(2) Pumps which have complied with 250–C20 CEB–1051.

WARNING: MANDATORY COMPLIANCE DATE FOR 250–C20 CEB 1164 WAS JANUARY 1, 1985 FOR P/N 6895653 OCTOBER 31, 1985 FOR ALL OTHER P/N SINGLE ELEMENT PUMPS

(3) Pumps which have complied with 250–C20 CEB 1164.

(4) CECO fuel control and power turbine governor part numbers with “less issue” numbers have the same TBO as part numbers without “less issue” numbers. For example: CECO fuel control P/N 104000A11–A10 and P/N 104000A11 have the same TBO.

Table 15

On–Condition Accessories and Components(1)
Accumulators (Fuel System Pneumatic)
Anti–ice Valve
Burner Drain Valve
Combustion Liner
Compressor Discharge Air Tubes
Double Check Valve
Fuel System Check Valve
Igniter Lead
Igniter Plug
Ignition Exciter
Outer Combustion Case
P_c Air Filter
Tubes and Hoses (Fuel, Lube and Air)
Turbine Oil Check Valve

(1) May remain in service provided operation and condition is satisfactory. Refer to Inspection Checksheet, Table 602, and Special Inspections, Table 604, 72–00–00, Engine–Inspection/Check, for inspection requirements.

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12. Life Limited Parts

Section 05–10–00, Airworthiness Limitations, contains FAA approved life limitations for those engine parts that are life limited.

NOTE: Refer to paragraph 11, this section, for Time Between Overhaul (TBO) limits on the Model 250–C20 Series Engine.

13. Log Book Entries

CAUTION: WHENEVER A COMPRESSOR OR TURBINE IS PLACED IN SERVICE, THE CURRENT NUMBER OF CYCLES AND OPERATING HOURS ON THE LIFE LIMITED PARTS SHOULD BE REVIEWED AND COMPARED WITH THE MAXIMUM LIMITS SPECIFIED.

A. Maintenance of the Total Time and Cycle Records is the operator's responsibility. This information appears in the Part V Assembly Record of the Turbine and Compressor Log Book pages. The number of cycles remaining on a part can be determined by subtracting current cycles from the maximum cycles specified. The lowest number of cycles remaining for any part in the turbine or compressor can now be added to the present cycle counter reading. This figure must be entered in the appropriate Part VI page in the column headed by "Cycle Counter Reading Not to Exceed". This figure will provide a projected cycle counter reading at which the component must be removed from service unless time (maximum operating hours) is the limiting parameter. Other information such as Cycle Counter Reading at Installation, Date, Engine Serial Number, and Owner must be entered on the Part VI page at this time. Also make appropriate entries in the applicable Part I Service Record page.

B. At time of compressor or turbine removal, the number of cycles must be recorded in the "Removed Cycle Counter Reading" column of the applicable Cycle Record Page VI page. Also, the number of cycles acquired on the turbine or compressor in this installation must be recorded in the "Cycles This Installation" column (subtract cycle counter reading at installation from cycle counter reading at removal).

NOTE: When reading the cycle counter, note that the mounting studs are at the top of the counter and the word EVENTS is under the window.

C. Make appropriate entries regarding removal in the applicable Part I Service Record page.

NOTE: Be sure to return all turbine or compressor pages of respective components with the components at time of overhaul or repair.

D. Example of Part VI Log Book Page Recording for the turbine follows: (Refer to Figure 32 for Log Book page with entries.)

(1) Turbine – Installation. (Given: Cycle Counter Reading – 2000 Cycles)

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PARA 13.D.

(a) Review current number of cycles on life limited parts. (See Part V Assembly Record – Turbine Assembly of Log Book). Current cycles on parts are as follows:

1	First–stage Wheel, P/N 6886407	0 cycles
2	Second–stage Wheel, P/N 6898782	0 cycles
3	Third–stage Wheel, P/N 23001967	2000 cycles
4	Fourth–stage Wheel, P/N 6853279	2900 cycles

(b) Determine maximum cycles allowed on life limited parts. (Refer to Section 05–10–00, Airworthiness Limitations). Maximum cycles allowed are as follows:

1	First–stage Wheel, P/N 6886407	3000 cycles
2	Second–stage Wheel, P/N 6898782	3000 cycles
3	Third–stage Wheel, P/N 23001967	6000 cycles
4	Fourth–stage Wheel, P/N 6853279	6000 cycles

(c) Subtract the current cycles on parts, given in para (a), from the maximum cycles allowed on respective parts, given in para (b). Determine the lowest number of cycles remaining for any part of the turbine. Both the first–and second–stage turbine wheels have 3000 cycles remaining.

(d) Add the cycles remaining on either the first–or second–stage wheel (3000 cycles) to the given cycle counter reading (2000 cycles). Insert 5000 in the “Cycle Counter Reading Not to Exceed” column.

(e) Insert the date, owner, engine serial number, and cycle counter reading at installation (2000 cycles) in the Installed Section of the Part VI Log Book page.

(2) Turbine – Removal. (Given: Cycle Counter Reading – 5000 cycles)

(a) Insert the date and cycle counter reading (5000 cycles) in the Removed Section of the Log Book Page.

(b) Subtract the cycle counter reading at turbine installation (2000 cycles) from the cycle counter reading at turbine removal (5000 cycles) and insert this value (3000 cycles) in the “Cycles This Installation” column of the Log Book page.

E. Example of Part VI Log Book Page for the compressor follows: (Refer to Figure 33 for Log Book page with entries).

(1) Compressor – Installation. (Given: Cycle Counter Reading – 7525 Cycles)

(a) Review current number of cycles on life limited parts. (See Part V Assembly Record – Compressor Assembly of Log Book.) Current cycles on part are as follows:

Impeller, 23058147 . . . . . 1,475 cycles

(b) Determine maximum cycles allowed on life limited parts. (Refer to Section 05–10–00). Maximum cycles allowed are as follows:

Impeller, 23058147 . . . . . 9,150 cycles

(c) Subtract current cycles on parts, given in para (a), from maximum cycles allowed, given in para (b). Determine the number of cycles remaining on the impeller (7675 cycles).

(d) Add the cycles remaining or the impeller (7675 cycles) to the given cycle counter reading (7525 cycles). This total equals 15,200 cycles. Insert 5200 in the “Cycle Counter Reading Not to Exceed” column. The counter goes to only 9999 cycles, so 5200 will be the same as 15,200 cycles.

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CYCLE RECORD
TURBINE ASSEMBLY
(Refer to Life Limiting CSL)

Part VI
Page No. 1

Turbine Serial Number 3000 Engine Model 250-C20

Installed				Do Not Exceed Cycle Counter Reading	Removed		Cycles This Installation
Date	Owner	Eng S/N	Cycle Counter Reading		Date	Cycle Counter Reading	
6-10-71	XYZ Helicopter	820000	2,000	5,000	5-4-72	5,000	3,000

ADS032XF

Log Book Page (Part VI) – Turbine Assembly
Figure 32

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CYCLE RECORD
COMPRESSOR ASSEMBLY
(Refer to Life Limiting CSL)

Part VI
Page No. 1

Compressor Serial Number CAC XXXXXX Engine Model 250-C20

Installed				Do Not Exceed Cycle Counter Reading	Removed		Cycles This Installation
Date	Owner	Eng S/N	Cycle Counter Reading		Date	Cycle Counter Reading	
2-22-72	J. SMITH	CAE XXXXX	7525	0550	9-8-74	0550	3025

ADS033XF

Log Book Page (Part VI) – Compressor Assembly
Figure 33

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PARA 13.E. (1) (cont)

(e) Insert the date, owner, engine serial number, and cycle counter reading at installation (7525 cycles) in the Installed Section of the Log Book page.

(2) Compressor – Removal (Given: Cycle Counter Reading – 5200 Cycles)

(a) Insert the date and cycle counter reading (5200 cycles) in the Removed Section of the log book page.

(b) Subtract the cycle counter reading at Compressor Installation (7525 cycles) from the cycle counter reading at Compressor Removal (5200 being 15,200 cycles) and insert this value (7675 cycles) in the “Cycles This Installation” column of the Log Book page.

F. Adjustments For Invalid Start Counter Readings

It is a requirement to keep records of engine cycles. Cycle counts are equally as important as recording the hours on the engine.

Operators are required by the FAA to comply with the cycle life limits of parts as listed in Section 05–10–00, Airworthiness Limitations. Consequently, it is the responsibility of the operator to maintain records of both hours and cycles. A cycle is defined as a start or start attempt.

An engine furnished counter will assist the operator by verifying his engine start cycle count. The start counter records the number of times the ignition exciter is energized.

Should the cycle counter become inadvertently disconnected or otherwise inoperative, the number of cycles must still be counted.

There may be situations which cause the counter to record more cycles or less cycles than the engine has actually encountered. If the correct number of the cycles have not been recorded on the counter, the following correction procedure should be observed. (Refer to Figure 34 for the appropriate Log Book page with entries.)

NOTE: The example given is for the compressor, a similar entry should be made for the turbine.

(1) Record date of the entry in Date block.

(2) Enter the word “Error” in the Owner block.

(3) Enter the error number in the “Do Not Exceed Cycle Counter Reading” block. Identify the number as a plus or a minus error (plus = more cycles recorded on the counter than actually experienced). On the next line, record “Entered By.” This must be signed by a pilot or mechanic and include license number. Subtract or add the error as necessary from the latest entry in the “Do Not Exceed Cycle Counter Reading” block.

(4) Always keep the “Do Not Exceed Cycle Counter Reading” entry current by following this procedure.

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CYCLE RECORD
COMPRESSOR ASSEMBLY
(Refer to Life Limiting Table 16)

Part VI
Page No. 1

Compressor Serial Number xxxxx Engine Model 250-C20

Installed				Do Not Exceed Cycle Counter Reading	Removed		Cycles This Installation
Date	Owner	Eng S/N	Cycle Counter Reading		Date	Cycle Counter Reading	
2-2-72	J. Smith	xxxxxx	1000	5000			
3-3-73	ERROR	"		+ 200			
ERROR	Entered	by	(Pilot	name &	Lic.	- No. / Mechanic	name
						& Lic. No.)	
				5200			

ADS014XD

Entering Cycle Error in Log Book Page (Part VI)
Figure 34

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ENGINE - TROUBLESHOOTING

Troubleshooting table 101 has been prepared to assist in correction of malfunctions which could occur.

When troubleshooting the propeller power turbine governor check the appropriate Aircraft Maintenance Manual for adjustments. This troubleshooting guide is based on a Rolls-Royce approved propeller power turbine governor.

Consideration should also be made for tolerances on the accuracy of aircraft installed instruments. Instrument error could affect measured performance by approximately:

- 4% below actual power available for every +5°C error in outside air temperature (OAT).
  (Use a precision mercury type thermometer in the immediate vicinity of the OAT probe. Shade both thermometers for a minimum of 15 minutes before taking a reading. Compare accuracy of installed OAT gauge).
- 1% below actual power available for every 300 feet error in pressure altitude.
  (Determine pressure altitude by averaging the readings of the altimeters of known accuracy on the flight deck.)
- 2% below actual power available for every +6°C error in TOT.
  (Check calibrate the TOT system and gauge).
- 2% below actual power available for every +2% error in torquemeter.
  (Check accuracy of torquemeter).

Table 101
Troubleshooting

Item	Trouble	Probable Cause	Remedy
1	Engine fails to reach 15% cranking speed.	Inadequate torque at starter pad.	Check output of starter and battery.
		Binding N_1.	Check inlet for foreign object damage. Rotate N_1 by hand and listen for abnormal noise.
2	Engine fails to light off.	Preservation oil fouling the spark igniter.	Try a second start.
		Air in the gas producer fuel control and lines.	Purge air from the system. (Refer to para 2.D, 73-00-00.)
		Faulty circuit to ignition unit.	Listen for ignition operation. Observe for fuel vapor coming out of the exhaust. Check input power to ignition unit. Isolate and replace defective part.
		Faulty ignition exciter.	Listen for igniter operation. Observe for fuel vapor coming out of exhaust. Replace with known satisfactory unit. (Refer to para 1., 74-10-01.)
		Faulty spark igniter.	Listen for igniter operation. Observe for fuel vapor coming out of exhaust. Replace with known satisfactory unit. (Refer to para 1., 74-20-01.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
2 (cont)	Engine fails to light off (cont)	Insufficient fuel in tanks.	Fill tanks with fuel.
		Gas producer fuel control remains in cutoff.	Check linkage.
		Lightoff adjustment too low. (CECO control system only.)	Make lightoff adjustment. (Refer to para 3.F., 73-20-04.)
		Insufficient fuel pressure to fuel pump.	Turn on aircraft boost pump.
		Spark igniter firing intermittently	Check input voltage to exciter. Check ignition exciter by replacing temporarily with a known satisfactory unit.
		Fuel nozzle valve stuck	Replace fuel nozzle.
		Fuel pump inoperative (Fuel vapor will not be observed leaving the exhaust.)	Check pump for sheared drives or internal damage. Check for air leaks at inlet or fluid leaks at outlet.
		Water or other contaminant in fuel	Check a sample of fuel from the bottom of the tank, if contaminated, disconnect the fuel line at the fuel nozzle, drain all fuel then flush the system with clean fuel.
		Fuel nozzle orifice clogged	Check fuel pump filter, replace nozzle. (Refer to Filter Element Replacement, para 2.C., 73-10-01 or para 2., 73-10-05 and Fuel Nozzle, para 1., 73-10-03.)
		In-line fuel check valve fails to open	Replace in-line fuel check valve.
3	Early lightoff	Fuel control cutoff valve not closed	Make a fuel control cutoff valve operational check. (Refer to Cutoff Valve Operational Check-Bendix Fuel System, para 3.D., 73-20-02 or para 3.E., 73-20-03, or Cutoff Valve Operational Check-CECO Fuel System, para 3.D., 73-20-04.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
4	Engine lights off but will not accelerate to idle speed at a normal rate	Loose pneumatic fitting, cracked accumulator, or cracked pneumatic line causing air leak in control system (Bendix control system only)	Pressurize the system to check for leaks. (Refer to Bendix Fuel Control System Pneumatic Leak Check, para 2.B., 73-00-00.)
			Check for crack in air tubes or outer combustion case. Check for air seal leaks.
		Dirty P_c filter (Bendix control system only)	Clean P_c filter. (Refer to Cleaning P_c Filter, para 3., 73-20-06.)
		Cracked accumulator. (Bendix control system only)	Replace accumulator.
		Fuel leak at the fuel control or governor split lines or from overboard drains. (CECO control system only)	Replace component.
		Inadequate torque at starter pad	Check condition of battery and starter to determine if sufficient N_1 cranking speed is attainable.
		Dirty compressor	Clean compressor and bleed valve. (Refer to Compressor Cleaning para 6.B., 72-30-00 and Cleaning Bleed Valve, para 2.C., 75-10-02.)
		Insufficient fuel supply to gas producer fuel control	Check fuel system to ensure all valves are open and pumps are operative.
		Insufficient fuel pressure to fuel pump	Turn on aircraft boost pump.
		Gas producer fuel control bypass valve stuck open	Disconnect the fuel line at the fuel nozzle, flush system with clean fuel; then replace control.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
4 (cont)	Engine lights off but will not accelerate to idle speed at a normal rate (cont)	Fuel nozzle partially clogged with carbon	Clean fuel nozzle. (Refer to Fuel Nozzle Inspection/Cleaning, para 2., 73-10-03.)
		Fuel nozzle check valve stuck partially open	Replace fuel nozzle.
		Start derichment adjustment too low	Make start derichment adjustment. (Refer to Engine Starting Characteristics Adjustment, para 3.H., 73-20-02; para 3.G., 73-20-03; or Start Derichment Adjustment, para 3.G., 73-20-04.)
		Gas producer fuel control incorrectly adjusted or calibration has shifted	Replace control.
		Anti-icing valve open and cabin heat on	Close anti-icing valve and turn off cabin heat.
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damage or erosion exceeds acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.F., 72-30-00.)
		Faulty power turbine governor	Replace governor.
5	Slow starts or low turbine temperature in the 35-50% N_1 speed range.	Control schedule has shifted lean (6899262, Bendix 2524644-9, or later fuel controls)	Turn the start/acceleration adjuster cw to increase turbine temperature and decrease start time. Make a one detent adjustment; then observe starting temperature. One detent changes temperature 30-40°C (86-104°F). Make an additional one detent adjustment if necessary. (Refer to Start/Acceleration Fuel Flow Adjustment, para 3.H.(2), 73-20-02; para 3.G.(2), 73-20-03.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
6	Engine lights off but flames out during ground starts at high altitude, especially above 5000 feet (1524 meters), during cold ambient conditions.	Fuel nozzle partially clogged.	Inspect fuel nozzle for carbon buildup. Clean or replace as necessary.
		Start derichment adjustment too low.	Make start derichment adjustment. (Refer to Start Derichment Adjustment, para 3.H.(1), 73-20-02; para 3.G.(1), 73-20-03; or para 3.H., 73-20-04.)
		Temporary fluctuation of fuel pressure. (CECO control system only).	Make the start with the aircraft boost pump off. When idle speed is reached, turn on boost pumps if required by the Flight Manual. Do not disregard the requirements of the Flight Manual pertaining to operation of the boost pumps. If starts are not improved, adjust the start derichment (turn clockwise to enrich fuel flow). If there still is no improvement, inspect the fuel nozzle for carbon buildup. Clean or replace the fuel nozzle as necessary.
7	Low power and high TOT	Contaminated bleed valve jet	Clean bleed valve (Refer to Cleaning Bleed Valve, para 2.C., 75-10-02.)
8	Hot starts or high turbine temperature	Control schedule has shifted rich (6899262, Bendix 2524644-9, or later fuel controls).	Turn the start/acceleration adjuster ccw to decrease turbine temperature and to prevent hot starts. Make a one detent adjustment; then observe starting temperature. One detent changes temperature 30-40°C (86-104°F). Make an additional one detent adjustment if necessary. (Refer to Start/Acceleration Fuel Flow Adjustment, para 3.H.(2), 73-20-02 or para 3.G.(2), 73-20-03.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
9	Acceleration temperature too high during start	Insufficient time allowed for draining after an unsuccessful starting attempt	Purge the engine by motoring with the gas producer lever and ignition switch in OFF for approximately 10 sec. before attempting a second start.
		Reduced battery capacity (This can produce low cranking speed.)	Recharge or replace battery.
		High residual TOT in excess of 150°C (302°F)	Motor engine with starter leaving gas producer lever and ignition OFF.
		Depreciated starter which is not capable of dry motoring gas producer (N_1) above 15 percent	Replace starter.
		Gas producer lever (twist grip) or Fuel Cutoff Lever in ground idle (start) or ON position prior to and during starter engagement	Review starting procedure.
		Dirty compressor	Clean compressor and bleed valve. (Refer to Compressor Cleaning, para 6., 72-30-00 and Bleed Valve Cleaning, para 2.C., 75-10-02.)
		Fuel nozzle valve stuck full open	Replace fuel nozzle.
		Excessive compressor air leaking	Check for leaks. Be sure that anti-ice valve is fully closed.
		Bleed control valve stuck closed	Replace bleed control valve.
		Gas producer fuel control incorrectly adjusted or calibration has shifted	Replace faulty control if start temperature exceeds 927°C (1700°F).
		Gas producer fuel control start derichment too rich	Adjust start derichment. (Refer to start Derichment Adjustment, para 3.H.(1), 73-20-02; para 3.G.(1), 73-20-03 or para 3.G., 73-20-04.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
9 (cont)	Acceleration temperature too high during start (cont)	Lightoff adjustment too high. (CECO control system only.)	Make lightoff adjustment. (Refer to Lightoff Adjustment, para 3.F., 73-20-04.)
10	Acceleration temperature too low during starting	Loose pneumatic fitting, cracked accumulator, or cracked pneumatic line causing air leak in control system (Bendix system only)	Pressurize the system to check for leaks. (Refer to Fuel Control System Pneumatic Leak Check, para 2.B., 73-00-00.)
		Gas producer fuel control incorrectly adjusted or calibration has shifted	Replace control.
		Gas producer fuel control start derichment too lean	Adjust start derichment. (Refer to Start Derichment Adjustment, para 3.H.(1), 73-20-02; para 3.G.(1), 73-20-03 or para 3.G., 73-20-04.)
10 (cont)	Acceleration temperature too low during starting (cont)	Lightoff adjustment too low. (CECO control system only)	Make lightoff adjustment. (Refer to Lightoff Adjustment, para 3.F., 73-20-04.)
11	Engine speed cycles at idle	Gas producer fuel control bypass valve not operating freely	Disconnect the fuel line at the fuel nozzle; flush system with clean fuel. Inspect and clean the fuel control fuel filter. (Refer to Cleaning the Gas Producer Fuel Control Fuel Strainer Bendix Fuel Control, para 4.A., 73-20-02 or para 4.A., 73-20-03 or Cleaning Fuel Control Filter-CECO fuel control, para 4.A., 73-20-04.) If the same condition still exists, replace control.
12	Engine instability above idle speed	Double check valve (Bendix control system-not all installations)	Replace double check valve.
		Contamination in the pneumatic section of the gas producer fuel control and power turbine governor	Remove air lines and check P_g port in the governor and the P_c port in both control and governor. Replace control or governor if contaminated.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
13	Engine instability in power range	Loose pneumatic fitting, cracked accumulator, or cracked pneumatic line causing air leak in control system (Bendix system only)	Pressurize the system to check for leaks. (Refer to Bendix Fuel Control System Pneumatic Leak Check, para 2.B., 73-00-00.)
		Air in fuel system.	Bleed air from the fuel system. (Refer to Purging the Fuel System, para 2.D., 73-00-00.)
14	Idle speed too low	Incorrect gas producer lever setting	Check lever position and rigging. (Refer to Rigging Check, para 3.C., 73-20-02; 3.B., 73-20-03 or 3.C., 73-20-04.)
		Malfunctioning tachometer	Replace tachometer.
		Excessive generator load	Reduce electrical load requirement.
		Dirty compressor	Clean compressor and bleed valve. (Refer to Compressor Cleaning, para 6., 72-30-00 and Cleaning Bleed Valve, para 2.C., 75-10-02.)
		Gas producer fuel control idle adjustment incorrectly set	Correct the setting. (Refer to Idle Speed Setting, para 3.F., 73-20-02; 3.C., 73-20-03 or 3.E., 73-20-04.)
		Loose pneumatic fitting, cracked accumulator, or cracked pneumatic line causing air leak in control system (Bendix system only)	Pressurize the system to check for leaks. (Refer to Fuel Control System Pneumatic Leak Check, para 2.B., 73-00-00.)
15	Idle speed too high	Incorrect gas producer lever setting	Check lever position and rigging. (Refer to Rigging Check, para 3.C., 73-20-02; 3.B., 73-20-03 or 3.C., 73-20-04.)
		Malfunctioning tachometer	Replace tachometer.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
15	Idle speed too high (cont)	Gas producer fuel control idle adjustment incorrectly set	Correct the setting. (Refer to Idle Speed Setting, para 3.F., 73-20-02; 3.C., 73-20-03 or 3.E., 73-20-04.)
16	Oil pressure drops off severely	Oil supply low	Check oil supply and refill as necessary.
		Oil pressure transmitter or indicator giving false indication	Check transmitter or indicator and repair or replace if necessary.
		Regulator valve sticking or broken spring	Clean or replace spring.
		Defective oil pump	Replace pump or send power and accessories gearbox to an overhaul facility. (Refer to applicable part of Gearbox Disassembly and Assembly, para 2., 72-60-00.)
17	Engine operated more than 30 seconds without oil pressure.	Low oil quantity.	Remove engine and send to a Rolls-Royce Authorized Maintenance Center (AMC) for investigation (Refer to Engine Operated With No Oil Pressure, para 11.E., Engine-Servicing, 72-00-00.)
		Improper servicing after oil change.	Same as above.
		Oil pump failure.	Same as above.
18	Excessive oil pressure fluctuation	Air in sensing line	Bleed line.
		Gage records inaccurately	Check gage and transmitter.
		Faulty pressure regulating valve	Replace the valve.
		Oil contamination	Drain and replace filter. Inspect magnetic chip detectors for metallic particles. Thoroughly flush with engine oil while motoring engine. Drain and refill with engine oil.
		Low oil quantity	Check for excessive consumption.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
18 (cont)	Excessive oil pressure fluctuation (cont)	Wear of filter housing due to vibration of filter inlet and filter bypass tubes	Replace packings on the inlet and bypass tubes and/or replace the filter housing (as required).
		Oil filter inlet tube assembly too short	Dimensionally inspect tube length. (Refer to para 4.G., 72-60-00.)
19	Low oil pressure	Lack of oil in reservoir	Fill reservoir with correct oil.
		Gage records inaccurately	Check gage and transmitter.
		Oil leaks	Check all piping connections and the gearbox splitline. (Refer to Gearbox Cover-to-Housing Assembly, para 2.I., 72-60-00 for assembly technique to prevent splitline leakage.)
		Clogged oil filter	Clean or replace oil filter. If filter is clogged with carbon, inspect and clean the power turbine support pressure oil nozzle, the power turbine support scavenge oil strut and the external scavenge oil sump. (Refer to para 7.E. and 7.G., 72-50-00.)
		Oil contamination	Drain and replace filter. Inspect magnetic chip detectors for metallic particles. Thoroughly flush with engine oil while motoring engine.
			If carbon and sludge deposits are found, inspect the oil tank for similar deposits. If deposits are found, remove and clean the airframe oil tank and flush the airframe engine oil system in accordance with the applicable airframe manufacturer's manuals.
			Drain and refill with engine oil.

CAUTION: DO NOT MAKE A PRESSURE REGULATING VALVE ADJUSTMENT TO CORRECT FOR A RAPID CHANGE IN OIL PRESSURE. THESE CONDITIONS ARE CAUSE TO SUSPECT OTHER OIL SYSTEM PROBLEMS HAVE DEVELOPED.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
19 (cont)	Low oil pressure (cont)	Oil pressure not adjusted	Adjust oil pressure regulating valve. (Refer to Pressure Regulating Valve, para 3.A., 72-60-00.)
NOTE:	Before attempting oil pressure regulator adjustment, make sure that minimum N_1 rpm of 94% is attained during periods of reported low oil pressure readings.		
		Increase in oil pump internal clearances or sheared drive	Replace pump or send power and accessories gearbox to an overhaul facility. (Refer to applicable part of Gearbox Disassembly and Assembly, para 2., 72-60-00.)
		Wear of filter housing due to vibration of filter inlet and filter bypass tubes.	Replace packings on the inlet and bypass tubes and/or replace the filter housing (as required).
		Oil filter inlet tube assembly too short	Dimensionally inspect tube length per para 4.G., 72-60-00.)
20	High oil pressure	Oil pressure gage and transmitter records inaccurately	Check gage and transmitter.
CAUTION:	EXCEPT FOR INITIAL ADJUSTMENT ON NEWLY INSTALLED ENGINES, DO NOT ADJUST THE PRESSURE REGULATING VALVE TO CORRECT FOR HIGH OIL PRESSURE. DO NOT MAKE A PRESSURE REGULATING VALVE ADJUSTMENT TO CORRECT FOR A SUDDEN INCREASE OR RAPID CHANGE IN OIL PRESSURE. THESE CONDITIONS ARE CAUSE TO SUSPECT OTHER OIL SYSTEM PROBLEMS HAVE DEVELOPED.		
		Pressure regulating valve improperly adjusted	Readjust oil pressure regulating valve. (Refer Pressure Regulating Valve, para 3.A., 72-60-00.)
21	Oil consumption exceeds 0.05 gal (0.19 liter) per hour [1 quart (0.9 liter) per 5 hours]	Loose fittings, connections, or splitlines	Check all fittings, connections, and splitlines for sealant and proper torque. Wash entire engine and coat with whitener in suspected area. Operate engine to locate source of leakage. (Refer to Gearbox Cover-to-Housing Assembly, para 2.I., 72-60-00 for assembly technique to prevent gearbox splitline leakage.)
		Oil leakage from power turbine carbon face seal	Replace seal. (Refer to Oil Bellows Seal, para 6., 72-50-00.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
21 (cont)	Oil consumption exceeds 0.05 gal (0.19 liter) per hour [1 quart (0.9 liter) per 5 hours (cont)	Leaking accessory oil seals as evidenced by oil draining from weep hole (on gas producer fuel control and power turbine governor) or from drain on fuel pump	Replace defective seals. (Refer to Replacing Oil Seals, para 1.B., 72-60-00.)
NOTE:	Check the aircraft oil quantity within 15 minutes of engine shutdown to avoid a false indication of excessive oil consumption. If the 15 minutes has been exceeded, motor the engine for 30 seconds with the starter before checking tank quantity. Motoring normally scavenges oil from the gearbox back to the aircraft oil tank. Check the airframe flight manual; some installations may require engine to be operated for at least a minute at ground idle to assure proper scavenging of the engine gearbox.		
NOTE:	Always refer to the airframe flight manual for proper oil servicing instructions; specific requirements may vary for different aircraft models.		
22	Oil consumption in excess of one quart (0.9 liter) per hour	Coking and carbon buildup in power turbine support	Clean power turbine support scavenge oil strut, power turbine support pressure oil nozzle and the external scavenge oil sump. (Refer to para 7.E. and 7.G., 72-50-00.)
		Improper fit between the power turbine inner and outer shafts	Send engine to an overhaul facility for repair.
23	Oil blowing from gearbox vent.	Leaking accessory pad seal	Replace seal. (Refer to para 4.C.(5) and 1.B., 72-60-00.)
24	Oil spewing from diffuser vent orifice	Orifice improperly sized (smaller orifice needed)	Refer to Diffuser Vent Orifice Selection, para 1.B., Engine-Adjustment/Test, 72-00-00.)
25	Oil spewing at compressor bleed control valve	No. 1 bearing seal failure	Replace seal. (Refer to Compressor Front Bearing and/or Oil Seal Replacement, para 3. or 4., 72-30-00.)
26	Oil temperature exceeds 107°C (225°F)	Oil cooler air-flow restricted or oil cooler fan inoperative	Check cooler and fan; repair or replace. Inspect engine. (Refer to Oil Temperature Limit Exceeded, para 11.B., Engine-Servicing, 72-00-00.)
		Oil cooler bypass valve inoperative	Check valve, repair or replace. Inspect engine. (Refer to Oil Temperature Limit Exceeded, para 11.B., Engine-Servicing, 72-00-00.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
27	Oil temperature exceeds 107°C (225°F) remains less than 120°C (248°F) for a period not exceeding 10 minutes.	Contamination or carbon buildup in the turbine.	Inspect and clean oil system and passages. (Refer to Oil System Maintenance, para 7.F., 72-50-00.)
28	Low power with high TOT	Dirty compressor	Clean compressor (Refer to Compressor Cleaning, para 6., 72-30-00.)
		Compressor foreign object damage	Replace compressor if damage exceeds limits. Inspect turbine assembly for secondary damage.
		Engine air inlet blockage	Remove objects causing blockage. (Refer to Compressor Air Inlet Blockage, para 1.D.(12), Engine-Inspection/Check, 72-00-00.)
		Eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C., 5.D. and 5.E., 72-30-00.)
		New compressor case misaligned at installation	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement, para 2., 72-30-00.)
		Bleed control valve has failed to close.	Check compressor discharge pressure sensing line for leaks and for security. Clean valve nozzle, filter and jet. (Refer to Bleed Valve Cleaning, para 2.C. 75-10-02.)
		Excessive compressor air leaks	Replace bleed control valve. Repair leaks.
		Faulty TOT indicator	Check calibration of TOT system. Replace indicator as necessary. Also Refer to Item 30.
	Low power with high TOT (cont)	Anti-icing valve leaking	Check solenoid and tube fittings for leaks, replace valve as necessary.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
28 (cont)	Low power with high TOT (cont)	Faulty torquemeter indicating system	Check calibration of torque sensing system. Replace gage or transmitter as necessary. Also refer to Item 48.
		Compressor air discharge tubes leaking air at the piston ring split seals	Reposition the compressor air discharge tubes or replace the piston ring split seals. Inspect tubes for cracks. Check adapter for being out-of-round, or worn seal bore. Check outer combustion case flanges for warping.
		Compressor rotor-to-shroud clearance excessive	Repair or replace the compressor.
		Compressor impeller rub caused by dirt or No. 1 bearing failure	Clean or replace compressor.
		Compressor scroll internal erosion distorted elbow vanes or air leaks at joints	Repair or replace compressor.
		Outer combustion case cracked or distorted	Repair crack or replace outer combustion case.
		Warped or cracked combustion liner	Repair or replace combustion liner.
		1st-stage gas turbine nozzle cracked	Replace 1st-stage nozzle.
		Cracked first-stage turbine nozzle diaphragm	Replace the first-stage turbine nozzle diaphragm. (Refer to Replace the First-stage Turbine Nozzle or First-stage Turbine Nozzle Shield, para 2., 72-50-00.)
		Burned or missing turbine rotor blades	Replace turbine assembly.
		Turbine wheel or nozzle eroded excessively	Replace turbine.
		Turbine wheel blade tip excessive clearance	Replace turbine.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
28 (cont)	Low power with high TOT (cont)	Nos. 6 & 7 area labyrinth seals excessive clearance	Replace turbine.
		Blocked or restricted exhaust outlet	Remove blockage or replace turbine (e.g., flowsplitter damage).
		Leaking heating/environmental control bleed air system	Cap or blank off customer bleed pad on scroll to isolate cause.
29	Low power with TOT below max limit	Gas producer control lever not reaching maximum speed adjustment stop	Clean and adjust linkage to the gas producer fuel control. Correct any looseness, wear or lost travel. (Refer to Rigging Check, para 3.C., 73-20-02; 3.B., 73-20-03 or 3.C., 73-20-04.)
		Gas producer control lever maximum speed adjustment stop not properly set	Correct the maximum speed adjustment setting. (Refer to Fuel Control Max Speed Stop, para 3.G., 73-20-02; 3.F., 73-20-03 or 3.I., 73-20-04.)
CAUTION:	THIS IS AN OVERSPEED PROTECTION SETTING; MOVE IN ONE TURN INCREMENTS.		
		Loose pneumatic fitting, cracked accumulator, or cracked pneumatic line causing an air leak in the control system (Bendix control system only)	Pressurize the system to check for leaks. (Refer to Bendix Fuel Control System Pneumatic Leak Check, para 2.B., 73-00-00.)
		Contaminated fuel control air (Pneumatic) circuits (Bendix control system only)	Clean air circuit. (Refer to para 4.B., 73-20-02 or 4.B., 73-20-03.)
		L.P. Fuel Filter Blocked	Check bypass indicator. Replace filter element.
		Aircraft fuel system restriction, contamination or leakage	Refer to aircraft manual for corrective action.
		Blocked fuel nozzle	Clean or replace fuel nozzle (Refer to para 1. through 5., 73-10-03.)
		Faulty gas producer fuel control assembly	Replace gas producer fuel control assembly.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
30	Low measured TOT at normal or high power	Faulty TOT indicator	Check TOT system calibration. Replace indicator as necessary.
		Faulty TOT thermocouple assembly	Check TOT system calibration. Replace thermocouple assembly as necessary (Refer to Thermocouple Replacement, para 1., 77-20-01.)
		Same as Items 28 and 29	Correct as in Items 28 and 29.
31	Unable to obtain specified power.	Improper max flow stop adjustment. (CECO control system only)	Check adjustment. (Refer to para 3.H., 73-20-04, for adjustment required by some installations.)
		Foreign object damage (FOD) eroded blades, vanes and/or plastic coating.	Replace the case or compressor assembly if damage or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection para 5.C. through 5.F., 72-30-00.)
		New compressor case misaligned at installation.	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement para 2., 72-30-00.)
32	Abnormally high or low power.	Dirt in fuel system. (CECO control system only.)	Check condition of the fuel filters. (Refer to Fuel System Filter Maintenance, para 2.C., 73-00-00.) Return contaminated units for repair or overhaul.
			Review fuel handling techniques and facilities.
33	Unstable or erractic operation.	Air in fuel system causing loss of governing action.	Bleed the governor bypass P_o port. (Refer to applicable part of Purging the Fuel System, para 2.D., 73-00-00.)
			Bleed air from the fuel system. (Refer to para 2.D.(3), 73-00-00, CECO system or 2.D.(2), 73-00-00, Bendix system.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
34	Engine N_1 or N_2 overspeeds	Gas producer fuel control linkage not properly set	Check linkage for proper operation and adjustment.
		Defective gas producer fuel control or power turbine fuel governor	Replace defective control or governor.
		Faulty N_1 or N_2 tachometer	Replace tach-generator or indicator.
	NOTE: During ground run after overspeed incident, note the idle speed with the twist grip or throttle at the idle position. If idle speed is normal, suspect the governor. If idle speed is high, suspect the gas producer fuel control as the faulty component.		
35	Excessive NR droop at takeoff, hover, or cruise	Air in fuel system. (CECO control system only.)	Bleed the governor bypass P_o port if droop occurs following system maintenance or extended inactivity (overnight). (Refer to applicable part of Purging the Fuel System, para 2.D., 73-00-00.)
36	Fast decelerations	Dirty gas producer fuel control air circuit (Bendix control system only)	Clean circuit. (Refer to Cleaning the Gas Producer Fuel Control Air Circuit, para 4.B., 73-20-02 or para 4.B., 73-20-03.)
37	Auto decelerations	Dirty gas producer fuel control air circuit (Bendix control system only)	Clean circuit. (Refer to Cleaning the Gas Producer Fuel Control Air Circuit, para 4.B., 73-20-02 or para 4.B., 73-20-03.)
38	Excessive exhaust torching during transients	Fuel nozzle malfunction	Replace fuel nozzle.
		Excessively rich gas producer fuel control	Replace control.
		Leaking accessory bleed lines	Repair or replace lines.
39	Slow to accelerate from idle to power	Dirty compressor	Clean compressor and bleed valve. (Refer to Compressor Cleaning para 6., 72-30-00 and Bleed Valve Cleaning, para 2.C., 75-10-02.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
39 (cont)	Slow to accelerate from idle to power (cont)	Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damage or erosion exceeds acceptable limits. (Refer to Blade Damage, Vane Damage, and Case Plastic Coating Inspection, para 5.C. through 5.F., 72-30-00.)
		New compressor case misaligned at installation	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement, para 2., 72-30-00.)
		Bleed control valve malfunctioning	Replace bleed control valve.
		Loose pneumatic fitting, cracked accumulator, or cracked pneumatic line causing air leak in control system (Bendix system only)	Pressurize the system to check for leaks. (Refer to Fuel Control System Pneumatic Leak Check, para 2.B., 73-00-00.)
		Excessive generator load	Reduce electrical load.
		Excessive compressor air leakage	Check for leaks and repair.
		Gas producer fuel control acceleration schedule too lean	Replace control.
		Excessive bypass flow from power turbine governor.	Replace governor.
		Dirty gas producer fuel control air circuit (Bendix control system only.)	Clean circuit. (Refer to Cleaning the Gas Producer Fuel Control Air Circuit, para 4.B., 73-20-02 or para 4.B., 73-20-03.)
40	Slow to accelerate to power while in flight	Same as in Item 39 trouble	Correct as in Item 39 trouble.
		Governor linkage incorrectly rigged	Check rigging. Correct linkage as required.
41	TOT approx 30°C (54°F) lower than normal at idle	Bleed control valve stuck closed	Replace bleed control valve.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
42	Compressor surge during starting or near the idle speed	Dirty compressor	Clean compressor and bleed valve. (Refer to Compressor Cleaning para 6., 72-30-00 and Bleed Valve Cleaning, para 2.C., 75-10-02.)
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damaged or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.E., 72-30-00.)
		New compressor case misaligned at installation	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement, para 2., 72-30-00.)
		Excessively rich gas producer fuel control	Replace gas producer fuel control.
		Bleed control valve stuck closed	Replace bleed control valve.
43	Compressor surge during starting	Bleed control valve stuck closed	Replace bleed control valve.
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damage or erosion exceeds acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.E., 72-30-00.)
		Excessively rich gas producer fuel control	Adjust start/acceleration adjuster CCW one detent. Monitor start to make sure proper start temperatures are maintained. A second one detent adjustment may be made if proper start temperatures can be maintained. If surge continues after adjustment or acceptable start time start temperatures cannot be maintained, then replace gas producer fuel control.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
44	Compressor surge during acceleration	Bleed control valve failed to open	Replace bleed control valve.
		Excessively rich gas producer fuel control	Adjust start/acceleration adjuster CCW one detent. Monitor start to make sure proper start temperatures are maintained. A second one detent adjustment may be made if proper start temperatures can be maintained. If surge continues after adjustment or acceptable start time start temperatures cannot be maintained, then replace gas producer fuel control.
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damage or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.E., 72-30-00.)
		New compressor case misaligned at installation	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement, para 2., 72-30-00.)
45	Compressor surge during low power operation	Bleed control valve failed to open	Clean bleed valve filter, jet and strainer. If condition still exists, replace bleed control valve. (Refer to Bleed Valve Cleaning, para 2.C., 75-10-02.)
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damage or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.E., 72-30-00.)
		New compressor case misaligned at installation	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement, para 2., 72-30-00.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
46	More than 20 drops per minute fuel leaking from fuel pump overboard drain ports	Fuel pump drive shaft seal leaking	Replace fuel pump.
		Gearbox seal leaking	If leakage is fuel, replace pump; if leakage is oil, replace seal.
47	More than 5 drops per min fuel leakage from either the fuel control or the governor overboard drain line.	Gas producer fuel control failure.	Replace fuel control.
		Power turbine governor failure.	Replace governor
48	Faulty torquemeter indication	Faulty airframe installed transmitter	Replace transmitter.
		Clogged torquemeter pressure sensing oil line	Disassemble power and accessory gearbox and clean or send gearbox to an overhaul facility. (Refer to applicable part of Gearbox Disassembly and Assembly, para 2., 72-60-00.)
		Clogged fixed area torquemeter piston bleed orifice	Disassemble power and accessory gearbox and clean bleed orifice or send gearbox to an overhaul facility. (Refer to applicable part of Gearbox Disassembly and Assembly, para 2., 72-60-00.)
		Torquemeter supporting bearing failure	Replace bearing or send power and accessory gearbox to an overhaul facility. (Refer to applicable part of Gearbox Disassembly and Assembly, para 2., 72-60-00.)
49	Loss of power sharing during acceleration or torque split on multiengine applications.	Incorrect aircraft rigging.	Check rigging and adjust in accordance with aircraft manufacturer's instructions.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
49 (cont)	Loss of power sharing during acceleration or torque split on multi-engine applications. (cont)	Excessive collective/ P.T. Governor control system looseness, wear or lost travel	Correct looseness, wear or lost travel. Refer to aircraft manufacturer's instructions for corrective action.
50	Severe N_1 oscillation (Bendix control system) at approximately the 40° throttle lever position.	PrPg reset dump valve cycling.	Move throttle out of affected throttle range.
51	Lack of anti-icing air	Defective anti-ice air lines	Check lines.
		Anti-icing valve stuck closed	Replace valve.
		Dirt collected in vane trailing slot	Remove anti-icing air lines at the compressor front support, cap the bullet nose outlet holes and blow through struts and out slots at 40 psig (276 kPag) maximum.
52	Continuous exhaust smoking	Oil leakage from forward compressor bearing oil seal or power turbine carbon face seal	If oil consumption exceeds limits, replace faulty component(s) as necessary.
NOTE:	Remove external sump and measure oil flow. (Refer to para 7.D., 72-50-00.)		
53	Heavy smoking out exhaust.	Contamination or carbon buildup in the turbine.	Inspect and clean oil system and passages. (Refer to Oil System Maintenance, para 7.F., 72-50-00.)
54	Compressor rear bearing labyrinth seal vent smoking	Seal vent orifice improperly sized or improperly seated	Replace or repair vent orifice. (Refer to Diffuser Vent Orifice Selection, para 1.B., Engine-Adjustment/ Test, 72-00-00.)
55	Engine power reset to the takeoff setting	Aircraft gas producer linkage broken or disengaged	Replace linkage or reconnect.
56	Exhaust duct emitting sparks	Combustion liner damage	Inspect combustion liner and repair or replace. (Refer to Combustion Liner Inspection, para 1.C., 72-40-00.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
56 (cont)	Exhaust duct emitting sparks (cont)	Turbine or compressor blade, vane or seal damaged	Replace faulty component.
57	Excessive vibration	Loose engine mounts	Inspect for security and condition of mounts.
		Turbine wheel blade failure	Inspect the turbine wheel blades. (Refer to Blade and Vane Inspection, para 7.A., 72-50-00.)
		Compressor foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damage or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.F., 72-30-00.)
		Bearing failure or accessories section internal failure	Check the magnetic inspection plugs for particles. If accumulated particles are found, send engine to overhaul.
		Cause uncertain	Refer to Vibration Test Procedure, Engine-Adjustment/Test, para 2., 72-00-00 to analyze vibration level and identify vibration source. Install engine in another aircraft or in test stand for comparison. Send engine to overhaul if excessive vibration persists.
58	Unable to stop engine	Gas producer fuel control fuel cutoff valve not closed	Close the aircraft fuel shutoff valve to stop the engine. Then check control linkage rigging or replace gas producer fuel control if faulty.
59	Afterfire	Oil leak	See trouble condition, static oil leakage, item 64.
		Burner drain valve line obstruction	Check the drain lines. Clean or replace as necessary.
		Sticking burner drain valve	Replace valve.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
59 (cont)	Afterfire (cont)	Fuel nozzle valve stuck open	Replace fuel nozzle.
		Fuel control not in cutoff.	Make a fuel control cut-off valve operational check. (Refer to Cutoff Valve Operational Check-Bendix Fuel System, para 3.D., 73-20-02 or 3.E., 73-20-03 or Cutoff Valve Operational Check-CECO Fuel System, para 3.D., 73-20-04.)
		Inline check valve stuck open	Replace inline check valve.
60	Heavy smoking out exhaust following engine shutdown (light wisps of smoke are normal and not cause for engine rejection unless oil consumption limits are exceeded)	Oil seepage past No. 5 bearing oil bellows seal into hot exhaust and collector	If suspected, visually inspect for evidence of puddling in bottom of exhaust collector after engine has been inoperative. If leakage is present, replace No. 5 bearing oil bellows seal (Refer to replacement para 6., 72-50-00.)
		Oil seepage past turbine oil check valve onto hot turbine	Remove and inspect turbine check valve. (Refer to Turbine Pressure Oil System Check Valve, para 7.K., 72-50-00.)
		Residual oil in No. 6 and 7 bearing area, depositing on hot turbine parts	Remove external sump; inspect and clean strut. (Refer to Inspection and Cleaning of Power Turbine Support Scavenge Oil Strut, para 7.E., 72-50-00.)
		Excessive clearance of rotating knife seals located in No. 6 and 7 bearing area	This is usually accompanied by low power. If suspected, replace turbine.
		Oil leakage in aircraft scavenge oil check valve (Hughes H500)	Oil can be found leaking from the outer combustion case after the engine has been inoperative for an extended period.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
61	Heavy smoking out exhaust	Contamination or carbon buildup in the turbine	Inspect and clean oil system and passages. (Refer to Inspection and Cleaning of Power Turbine Support Scavenge Oil Strut, para 7.E., 72-50-00.)
62	Continuous exhaust smoking	Oil leakage from forward compressor bearing oil seal or power turbine carbon face seal	If oil consumption exceeds limits, replace faulty component(s) as necessary.
63	Oil leakage at compressor attachment insert in the Gearbox housing. (At insert adjacent to compressor oil supply fitting.)	Insert loose	Replace insert. (Refer to Insert Inspection, para 4.D., 72-60-00.)
64	Static oil leakage from power and accessories gearbox breather	Internal check valve stuck open	Clean or replace the internal check valve. (Refer to Lube Oil Filter Housing Replacement, para 1.D., 72-60-00.) Remove filter housing and inspect housing and transfer tubes (2) mating surfaces. Check packings on housing end of transfer tubes. Replace defective items.
65	Oil leaking from weep holes at power turbine governor. Oil leakage may be blue in color.	Check engine oil seal	Replace leaking seal. If oil leakage is blue in color, this is an indication of governor drive bearing grease washout, therefore replace the power turbine governor.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
66	Oil or fuel leaking from the fuel control weep holes. Leakage may be blue in color.	Oil seal leaking at gearbox.	Identify if the leakage is fuel or oil. Oil leaks require replacement of the gearbox seal and/or the fuel pump drive O-ring. Fuel leaks require replacement of the fuel pump. If the fuel or oil leakage is blue in color this is an indication of fuel control drive bearing grease washout, therefore replace the fuel control.
67	Starter unable to rotate engine immediately after shutdown	Turbine blade tip clearance	If engine will rotate after cooldown, no corrective action required. If unable to rotate engine after cooldown, remove turbine for further examination.
		Binding at the rear diffuser seal	Replace compressor.
68	Starter unable to rotate engine	Binding of compressor, turbine or gearbox	Determine which major component is binding; replace component or engine.
69	N_2 does not rotate by 25% N_1 speed during start	Turbine blade tip (N_2) rub.	Shut down. Repeat start procedure. If not rotating after second attempt, walk the main rotor or propeller backwards before again repeating the start procedure. ing the start procedure. (Refer to Item 69 NOTE.) Replace turbine if condition persists.
		Carbon formation around rotating labyrinth seals	Ensure that the oil being used is approved (MIL-L-7808G and subsequent or MIL-L-23699). Shut down. Repeat start procedure. If not rotating after second attempt, walk the main rotor or propeller backwards before again repeating

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
69 (cont)	N_2 does not rotate by 25% N_1 speed during start (cont)		the start procedure. (Refer to Item 69 NOTE.) If repeated walk-through does not free N_2, clean carbon from rotating labyrinth seals. (Refer to Cleaning Power Turbine Labyrinth Seals, para 7.J., 72-50-00.)
	NOTE: To help alleviate turbine rub or carbon conditions which prevent the N_2 rotor from turning by 25% N_1 speed, walk the main rotor backwards after a start attempt and/or while the engine is cooling down. If chatter is encountered, stop the walk-through. Repeat the procedure at the next convenient shutdown.		
		Aircraft power train seizure	Refer to aircraft maintenance manual.
70	Engine tubing cracked or broken at the flare	Excessive vibration	Check the engine for possible vibration causes. (Refer to Vibration Inspection, para 1.D.(2), Engine-Inspection/Check, 72-00-00.)
71	Bearing noise at compressor which may be accompanied by looseness of the impeller	Bearing failure	Inspect and/or replace compressor No. 1 and No. 2 bearings as required.
	NOTE: Inspect magnetic drain plugs to determine extent of contamination due to bearing failure. (Refer to Magnetic Plug Inspection, para 11.G., Engine-Servicing, 72-00-00.)		
72	Magnetic plug warning light illuminated	Engine metal generation	Refer to Magnetic Plug Inspection, para 11.G., Engine-Servicing, 72-00-00.)
73	Engine undershoots ground idle setting during practice autorotation	Dirty fuel control P_r -P_g valve. (Bendix control system only)	Clean valve. (Refer to Cleaning the Bendix Fuel Control P_r-P_g Valve, para 4.C. 73-20-02.)
74	High throttle shaft torque	Binding of fuel control or governor shaft due to corrosion build-up between shaft and bushing.	Spray lubrication (WD-40 or equivalent) on the shaft and bushing of the control and governor. Rotate throttle to assure penetration. Repeat spray application if necessary.
75	Loss of power sharing during acceleration or torque split on multi-engine applications.	Incorrect aircraft rigging.	Check rigging and adjust in accordance with aircraft manufacturer's instructions.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
75 (cont)	Loss of power sharing during acceleration or torque split on multi-engine applications. (cont)	Excessive collective/P.T. Governor control system looseness, wear or lost travel.	Correct looseness, wear or lost travel. Refer to aircraft manufacturer's instructions for corrective action.
		Contaminated fuel control air (pneumatic) circuits.	Clean air circuits. (Refer to para 4.B. and 4.C., 73-20-02 or para 4.B., 73-20-03.)

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ENGINE–SERVICING

1. General

This section describes engine maintenance requirements. Maintenance functions are grouped by component assembly or by system of the engine to which they are related.

Some general maintenance practices which do not apply to one specific system or component are included in addition to a listing of special tools required at the maintenance level.

Use engine turnover stand 6795579 or collapsible stand 6798092 (optional) to support an engine removed from the airframe for maintenance.

CAUTION: WHEN THE GAS PRODUCER FUEL CONTROL, POWER TURBINE FUEL GOVERNOR, CHECK VALVE, OR ACCUMULATOR ARE REMOVED FROM THE ENGINE, USE EXTREME CARE TO PREVENT FOREIGN MATERIALS FROM ENTERING THE PNEUMATIC LINES OR THE PORTS OF THE COMPONENT.

CAUTION: DURING OIL SERVICING OR ANY OTHER MAINTENANCE USE CARE TO ENSURE THAT NO METAL CHIPS, PARTICLES, OR DEBRIS OF ANY KIND IS ALLOWED TO ENTER THE ENGINE OIL SYSTEM.

CAUTION: USE PLASTIC OR RAWHIDE HAMMER HEADS—NEVER METAL—WHEN DRIVING ON ANY PART OF THE ENGINE. NEVER USE PLIERS ON NUTS AND BOLTS.

CAUTION: WHEN MARKING OR IDENTIFYING ANY PART SUBJECTED TO HIGH TEMPERATURES, DO NOT USE ANY MARKING MATERIAL CONTAINING GRAPHITE. (SEE TABLE 303).

CAUTION: THE COMPRESSOR–TO–TURBINE COUPLING SHAFT IS A NITRIDED PART AND IS SUSCEPTIBLE TO HANDLING DAMAGE. ANY HANDLING DAMAGE CAN RESULT IN CRACK PROPAGATION. IF THE COUPLING IS DROPPED IT MUST BE PROCESSED BY AN AUTHORIZED OVERHAUL SHOP PRIOR TO FURTHER SERVICE.

CAUTION: ALL ENGINE PARTS SHOULD BE CAREFULLY REEXAMINED FOR MISSING COMPONENTS OR DAMAGE PRIOR TO FINAL ASSEMBLY OF THE PART.

CAUTION: REMOVAL AND INSTALLATION OF THE STARTER GENERATOR SHOULD BE ACCOMPLISHED IN A CAREFUL MANNER TO PREVENT COMPONENT DAMAGE. CONSULT AIRFRAME AND/OR STARTER GENERATOR MAINTENANCE MANUALS FOR SPECIFIC GUIDELINES.

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2. Special Service Tools

Refer to Table 301 special service tools required for engine maintenance are as follows:

Table 301

Special Service Tool

Tool No.	Description	Application
6795579	Stand—Turnover, Engine Assembly	Used to hold, support and rotate the engine assembly for installation and removal of components (Use stand 6798092 as alternate.)
6795588	Wrench—Holding, 32/64 Pitch, 24 tooth spline	Holds the compressor rotor spur adapter gear shaft while installing or removing compressor front and rear retaining nuts or adapter shaft nut. Also used to hold the gas producer turbine shaft while installing or removing the front and rear bearing nuts.
6795590	Puller—Bearing, Gas Producer Turbine	Used to remove the No. 8 bearing and the gas producer front labyrinth seal.
6795597	Wrench—Spanner, Torquemeter Shaft and Shaft Support Nuts	Used for installation and removal of the spanner nuts on the torquemeter shaft support and support shaft. Used with 6795974 fixture.
6795614	Puller and Pusher—Idler Gear Support Shaft, Power and Accessory Gearbox	Used to install and remove the idler gear support shafts.
6795966	Fixture—Assembly, Compressor	Mounts on bench to support compressor assembly during assembly and disassembly.
6795969	Holder—Torquemeter Shaft Support	Used to install and remove the torquemeter shaft support and bearing at the power and accessories gearbox cover.
6795974	Fixture—Aligning, Torquemeter Support Shaft	Used to hold and align the torquemeter support shaft while removing and installing the torquemeter support shaft nut. Used with 6795597 wrench.
6795984	Holder—Power Turbine Shaft	Used to hold the power turbine shaft during installation and removal of the power turbine shaft ball bearing retaining nut. Used with 6795985 wrench.
6795985	Wrench—Power Turbine Shaft Ball Bearing Retaining Nut	Used to install and remove the power turbine shaft ball bearing retaining nut. Use with 6795984 holder.
6796918	Drift—Installation, Turbine and Exhaust Collector Support Oil Bellows Seal	Used to install and guide the oil bellows seal into turbine and exhaust collector support.
6796920	Puller—Oil Jet, Gas Producer Bearing	Used to remove or install the gas producer ball bearing oil jet tube in the gas producer support.

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Table 301 (cont)

Special Service Tool

Tool No.	Description	Application
6796930	Plate—Installation, Power and Accessory Gearbox Bearings	Used to install the following bearings on their respective shafts: power turbine governor and tachometer, gas turbine idler, oil pump idler, torquemeter support, torquemeter shaft support, torquemeter piston, power turbine takeoff, gas turbine fuel control, starter drive, accessories drive and fuel control drive. Used with 6796946, 6796947, 6796948 and 6796949 drifts.
6796941	Kit—Installation and Removal, Oil Seal	Used to install and remove lip–type oil seals in the power and accessory gearbox.
6796946	Drift—Installation and Removal, Power and Accessory Gearbox Bearings	Used to install or remove the following bearings: power turbine governor and tachometer shaft, gas turbine idler shaft and oil pump idler shaft. Used to remove the following bearings: gas turbine fuel control shaft, starter drive shaft, accessory drive shaft and fuel pump drive shaft. Used with 6796950 bearing removal plate or 6796930 bearing installation plate.
6796947	Drift—Installation and Removal, Power and Accessory Gearbox Torquemeter Bearings	Used to install or remove the torquemeter piston ball bearing, torquemeter support shaft roller bearing, and torquemeter shaft support roller bearing. Used with 6796950 bearing removal plate or 6796930 bearing installation plate.
6796948	Drift—Installation and Removal, Power and Accessory Gearbox Power Turbine Drive Bearings	Used to install or remove the power turbine takeoff drive shaft bearing and to remove the power turbine main drive pinion bearing. Used with 6796950 bearing removal plate or 6796930 bearing installation plate.
6796949	Drift—Installation, Power and Accessory Gearbox Bearings	Used to install the following bearings on their respective shafts: gas turbine fuel control, starter drive, accessories drive and fuel pump drive. Used with 6796930 bearing installation plate.
6796950	Kit—Puller, Power and Accessory Gearbox Bearing Removal	Used to remove the following bearings from their respective shafts: power turbine governor and tachometer, gas turbine idler, oil pump idler, gas turbine fuel control, starter drive, accessory drive, fuel pump drive, torquemeter piston, torquemeter support, torquemeter shaft support, power turbine takeoff drive, and power turbine main drive pinion. Used with 6796946, or 6796948 drifts.
6796963	Lift—Engine Assembly	Used to lift the engine assembly.
6796966	Pliers—Retaining Ring, Fuel Control Drive Bearing	Used to collapse the snap ring retaining the fuel control drive gear and bearing assembly during installation or removal.
6798045	Wrench—Holding, Gas Producer Turbine	Used to support and hold the gas producer rotor while removing the first–stage turbine nozzle.

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Table 301 (cont)

Special Service Tool

Tool No.	Description	Application
6798046	Wrench—Bearing Locknut, Gas Producer	Used to remove or install the gas producer turbine ball bearing locknut. Use with 6798045 wrench.
6798047	Wrench—Oil Sump, Turbine	Used to remove or install the oil sump and nut assembly.
6798089	Adapter—Supporting, Turbine Unit Assembly	Used to support the turbine assembly when removing the first–stage turbine nozzle or the oil bellows seal.
6798092	Stand—Engine, Collapsible	Used to hold and support engine assembly during installation and removal of components. (Use stand 6795579 as an alternate.)
6798292	Wrench—Ground Idle Adjusting	Used to adjust idle speed on Bendix Fuel Control.
6798787	Fixture–Compressor Discharge Air Tube Assembly Pressure Check	Used to pressure test discharge air tube.
6798796	Drift–Vibration Damper, Compressor Front Bearing	Used to press compressor front bearing vibration damper into bearing housing.
6798807	Compressor—Lube Oil Filter Poppet Valve	Used to install poppet valve in filter housing.
6798860	Puller–Lube Oil Filter Cap	Removes the oil filter cap from the oil filter housing assembly.
6798927	Crimper—Locknut, Compressor Impeller Assembly and Turbine Power Shaft	Used to crimp lock portion of spanner nut into spherical radius of shaft.
6798928	Protector—Power Turbine Oil Bellows Seal Puller	Used to protect oil bellows seal face when removing oil bellows seal assembly. Used with 6799973.
6799518	Puller—Gas Producer Ball Bearing Labyrinth Seal Assembly	Used to remove the ball bearing and oil seal from the gas producer turbine support.
6799700	Puller–Vibration Damper, Front Compressor Bearing	Used to remove the front compressor bearing vibration damper from the bearing housing.
6799790	Adapter—Turning, Engine	Used to turn the gear train when installing the turbine or compressor.
6799952	Clamp—Installation, Compressor Discharge Air Tube–to–Outer Combustion Case	Used to compress the steel seal ring when installing the compressor discharge air tube in the combustion outer case. Two (2) required.
6799953	Clamp–Installation, Compressor Discharge Air Tube–to–Compressor Scroll	Used to compress the steel seal ring when installing the compressor discharge air tube in the diffuser scroll.
6799955	Fixture—Assembly, Turbine	Used to hold and support the gas producer turbine support.

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Table 301 (cont)

Special Service Tool

Tool No.	Description	Application
6799973	Puller—Seal, Power Turbine Bellows	Used to remove oil bellows seal from the turbine and exhaust collector support.
6872165	Gage—Internal Clearance, Helical Drive Gear	Used to check internal clearance of ball bearings after assembly to helical drive gear.
6872541	Cover—Protective, Power Turbine Support	Prevents entrance of foreign objects into the turbine area.
6872646	Guide—Spur Adapter Gearshaft Bearing	Used to install or remove the compressor.
6872746	Puller—Power Train Drive Gear Bearing	Used to remove bearings from forward and aft ends of power train drive gear.
6872879	Kit–Spot facing	Used to machine compressor mounting inserts in the gearbox to required height.
6872880	Fixture—Checking	Used to check height of compressor mounting inserts in the gearbox.
6872881	Wrench—Insert	Used to remove or install compressor mounting inserts in the gearbox.
6872882	Puller—Turbine Front (No. 5) Bearing	Used to remove No. 5 bearing from the turbine and exhaust collector support.
6872927	Wrench—Gearbox Flanged Studs	Used to install or remove gearbox studs at compressor mounting location.
6873066	Fixture–Compressor	Used to determine the correct quantity of Axis Alignment shims required at the five mounting pads of the compressor rear diffuser to properly align the compressor rotor axis.
6886201	Guide—Power Takeoff Roller Bearing	Used to guide power takeoff shaft through the forward roller bearing during assembly of gearbox housing to cover.
6886204	Kit—Protector, Compressor Cleaning	Used to cap pressure probe elbows and bleed valve sensing lines and to hold bleed valve in closed position during compressor cleaning.
6895538	Press—Gas Producer Turbine Rotor and Bearing	Used to remove the gas producer turbine rotor from the turbine support. Also used to install the gas producer rear bearing and seal in the gas producer turbine support.
6895957	Alignment Tool–Gearbox Oil Tube	Aligns oil tubes during assembly of gearbox cover to housing.
23003262	Crimper—Locknut Gas Producer Rear Bearing	Used to stake No. 8 bearing spanner nut into lock detent.
23003267	Kit—Cleaning, Power Turbine Support and Oil Nozzle	Used to clean carbon from the power turbine support, oil nozzle and sump.
23005023	Puller–Forward Bearing and Seal Follower	Used to remove ball bearing and mating ring seal from the 1st–stage compressor wheel.

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Table 301 (cont)

Special Service Tool

Tool No.	Description	Application
23006778	Guide--Bearing Spur Adapter Gearshaft	Used to guide the SAG through the No. 2 1/2 bearing during installation of the compressor on the power and accessory gearbox.
23007638	Wrench--Fuel Injector	Used to remove or install the fuel nozzle.
23008725	Pusher--Installation, Power Turbine Ball Bearing	Used to install the ball bearing on the power turbine shaft. Used with guide (-2) from 6796918 drift.
23030169	Guide--Seal Installation, Starter Pad	Used to install seal in “Wet starter” pad.
23032992	Bracket-Accelerometer Mounting	Used to mount the accelerometer on the turbine and the compressor for engine test and troubleshooting.
23032993	Bracket-Accelerometer Mounting, Power and Accessory Gearbox.	Used to mount the accelerometer on the power and accessory gearbox for engine test and troubleshooting.
23038047	Bracket-Accelerometer Mounting, Turbine	Used to mount the accelerometer on the turbine at the 6:00 o’clock position for engine test and troubleshooting.
2550678	Screwdriver	Used to remove or install the P_x and P_y bleeds in the fuel control (late configuration controls) and the P_g bleed in the governor.

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3. Consumable Materials

Refer to Tables 302 and 303 for a summary of consumable materials used to maintain the engine. The Acceptable Source column of the table lists suppliers for each item; any equivalent product is acceptable. In determining whether or not an item is equivalent, the burden of proof rests with the operator and his supplier, not with the engine manufacturer.

Table 302

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
1	Engine oil	Lubricate bearings, packings, etc.	Refer to Oil Specification, para 4.C., 72-00-00, Engine-Description and Operation.
2	Carbon removal compound	Clean aluminum-coated steel parts	Gunk Hydroseal Decarbonizer (MIL-C-25107). 630 North Harlem Ave. Oak Park, Illinois 60302
3	Carbon solvent	Cleaning fuel nozzle	Penmul L460 Penetone Corp. 74 Hudson Avenue Tenafly, NJ 07670 Multi-Sol Bruning & Co., Inc. 2920 Dr. Andrew J. Brown Avenue Indianapolis, IN 46205 No. 26 Cities Service Oil Co., P. O. Box 300 Tulsa, Oklahoma 74102
4	Cresol base cleaning compound	Clean steel parts	Formula No. 3097 (MIL-C-5546). Turco Products Inc. 2400 South Main Street Wilmington, California 90746
5	Rust Preventive compound	Coat steel parts after cleaning	Anti-Corrode 204 (MIL-C-6529, type 1). Cities Service Oil Co. P.O. Box 300 Tulsa, Oklahoma 74102
		Shipping container bolts	Valvoline TECTYL 890 Ashland Petroleum Company Division of Ashland Oil Inc. P. O. Box 391 Ashland, Kentucky 41101 Royco 103 Royal Lubricants Company Inc. River Road E. Hanover, N. J. 07936

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
6	Preservation oil	Fuel system preservation	MIL–L–6081, Grade 1010 or 1005 NATO Symbol Code 0–132 and 0–133 Bray K–80, K–877, K–460 Bray Oil Company 1925 North Marina Ave. Los Angeles, California 94804 McMillan Jet Engine Oil 1005 or 1010 McMillan Ring Free Oil Company, Inc. 200 Petroleum Building El Dorado, Arkansas 71730 Royco 460, 481 Royal Lubricants Company, Inc. River Road East Hanover, New Jersey 07936 Aeroshell Turbine Oil 2 Shell International Petroleum Company Ltd. Shell Centre London SE1 7 NA United Kingdom No. 31100 (MIL–L–6081, grade 1010) Atlantic Richfield Co. 260 South Broad Street Philadelphia, Pennsylvania 19101 Gulflite 6 (MIL–L–7870A) Gulf Oil Corp. 439 7th Ave. Philadelphia, Pennsylvania 15230
7	Cleaner	Clean compressor airflow path, fuel nozzle, and burner drain valve	Turbine Cleaner 1191 or 512M Safety–Solv #715N (MIL–C–43616). The Brulin Corporation P. O. Box 270 2920 Dr. Andrew J. Brown Ave. Indianapolis, Indiana 46206

NOTE: Rolls–Royce strongly recommends strict adherence to the mixture ratios outlined by each cleaner manufacturer. The mixture ratios do vary from manufacturer to manufacturer and can be found on each container label. Strict adherence must be followed to the application procedures described in this manual to prevent compressor and/or engine and control system damage.

20–20 Plus (MIL–C–43616)
or B & B 3100
B&B Chemical Co. Inc.
P.O. Box 796
Miami, Florida 33166

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
7 (cont)	Cleaner (cont)	Clean compressor airflow path, fuel nozzle, and burner drain valve (cont)	No. 5884 Turco Products Division of Purex Corp. 24600 South Main Street Carson, California 90746 Racasan 512–M Odex Racasan, Ltd. Cromwell Road Elesmere Port South Wirral L654DP, England Turco 4181 Turco Products, Inc. Subsideriary of Elf Atochem 7320 Bolsa Ave. Westminster, CA 92684–3600 Brulin 815 Brulin & Co. P.O. Box 270 Indianapolis, IN 46206–0270 R–MC ECT, Inc. 771 First Ave King of Prussia, PA 19422 Turboclean 2 Kent Chemical Co., Ltd. George House, Bridwell Lane Tenterton, Kent TN306HS England ZOK 27 Airworthy Ltd. Wedglen Industrial Estate Midhurst Sussex G299RE, England ARDROX 624 Brent Chemicals International Ardrox Division Ridgeway, Iver, Buckinghamshire SL0955, England Krankwash Rochem U. S. Inc. 589 Franklin Turnpike Ridgewood, NJ 06450 Turco 6783–10 & –50 Turco Products, Inc. Subsidiary of ELF ATOCHEM 7320 Bolsa Ave. Westminster, CA 92684–3600

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
7 (cont)	Cleaner (cont)	Clean compressor airflow path, fuel nozzle, and burner drain valve (cont)	B & B TC–100N–1 B & B Tritech, Inc. Miami, FL 33266–0776 Ardrox 6367 – Turbo Clean 2 921 Sherwood Drive Lake Bluff, IL 60044–0215 Rochem GTE (krankwash) Rochem, Inc. 5619 S. Wayside Drive Houston, TX 77087 Penair M5704 Penetone Corporation 74 Hudson Avenue Tenafly, NJ 07670 Ardrox 6345 Sure Chem Industries Pty., Ltd. 23 Amax Ave, Girraween, New South Wales, 2145 MA–109C JAD Chemical Company Inc. P.O. Box 6786 Rancho Palos Verdes, CA 90734
NOTE: Rolls–Royce strongly recommends strict adherence to the mixture ratios outlined by each cleaner manufacturer. The mixture ratios do vary from manufacturer to manufacturer and can be found on each container label. Strict adherence must be followed to the application procedures described in this manual to prevent compressor and/or engine and control system damage.			
8	Sodium hydroxide and phosphoric acid	Cleaning Pc filter, Bendix control system	Commercial
9	Sodium dichromate and sulphuric acid	Cleaning P_c filter CECO control system	Commercial
10	Perchlorethylene or methylenechloride	Cleaning	Commercial
11	Heat resistant paint	Diffuser scroll touchup or galvanic corrosion protection	Actithane WC100 Saran Protective Coatings Co 17332 Shields Detroit, MI 48212
12	Lacquer reducer	Diffuser scroll touchup; used with Actithane WC100	Actithane H251 Saran Protective Coatings Co. 17332 Shields Detroit, MI 48212
13	Mineral spirits	General cleaning	Commercial
14	Chemical film	Treat cleaned anodized aluminum–alloy parts	Chem–Rite A22 (MIL–C–5541). M and T Chemicals Inc. Church St. Matawan, New Jersey 07747

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
15	Corrosion resistant aluminum paint	Compressor case and scroll touchup	SermeTel 196. Teleflex Inc. P.O. Box 218 North Wales, Pennsylvania 19454
16	Lubricant	Lubricate accessory splines (except starter–generator and front spare accessory drive splines and fuel pump external drive splines)	Lubriplate 130A or 930AA. Fiske Brothers Refining Co. 129 Lockwood Newark, New Jersey 07105 ASTM No. 5 Sun Oil Co. 1608 Walnut Street Philadelphia, Pennsylvania 19103 MIL–O–6081 grade 1010 oil Atlantic Refining Co. 260 South Broad Street Philadelphia, Pennsylvania 19101
17	Grease	Seal and bearing installation and assembly aid	ROYCO HF–825 Royal Lubricants Co., Inc. 280 Complex, 101 Eisenhower Parkway Roseland, New Jersey 07068 No. 6249 (MIL–G–23827). Shell Oil Co. Shell Building Houston, Texas 77002
		Starter generator gearshaft, fuel control and power turbine governor splines	Aeroshell No. 22 (MIL–G–81322) Shell Oil Co. Shell Building Houston, Texas 77002 Mobil #28 (MIL–G–81322) Mobil Oil Corp., P. O. Box 3311 Beaumont, Texas 77704 Sundstrand P/N 718050 or 71850 (recommended) Sundstrand Corp. 4751 Harrison Ave. Rockford, Illinois 61108
		Single element fuel pump drive shaft internal splines (external splines require engine oil)	Sundstrand P/N 718050 or 71850 (recommended) Sundstrand Corp. 4751 Harrison Ave. Rockford, Illinois 61108

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
17 (cont)	Grease (cont)	Lubricate packings in fuel control fuel or air passages.	ASTM No. 5 Oil Sun Oil Company 1608 Walnut Street Philadelphia, Pennsylvania 19103
		Lubricate packings in fuel control fuel or air passages. (cont)	Alternates to ASTM No. 5 Oil: 1. 45-55% fuel (MIL-C-7024B, Type II) mixed with 45-55% STP Oil Treatment 2. MIL-D-6081, Grade 1010 oil
		Fuel Pump internal drive shaft splines (TRW/Argo-Tech pumps only)	Plastitube No. 3 Warren Refining Division Parr Inc. 5151 Denison Ave. Cleveland, Ohio 44102
18	Antiseize	P_c filter threads and external threads-protects up to 232°C (450°F)	DC 550 Fluid Dow Corning Corp. South Saginaw Road Midland, Michigan 48641
		Hot section external threads (not to be used where exposed to the engine oil system) and Compressor tie bolt	Never Seez Nickel Special (NSN165) Bostik, Emhart Chemical Group Boston Street Middleton, MA 01949
			LOCTITE Nickel Anti-Seize (77164) Henkel Corp. 1001 Trout Brook Crossing Rocky Hill, CT 06067
		Assembly-Compressor adapter nut.	Never-Seez Nickel Special (NSN165) Bostik, Emhart Chemical Group Boston Street Middleton, MA 01949
			LOCTITE Nickel Anti-Seize (77164) Henkel Corp 1001 Trout Brook Crossing Rocky Hill, CT 06067
		External threads not exposed to oil system. Protects to 760°C (1400°F)	CP-63 (MIL-L-25681B) E/M Lubricants Inc. P.O. Box 2200 Highway 52, N.W. West Lafayette, Indiana 47906
19	Calibration fluid	Cleaning fuel nozzle tips	Stoddard solvent, refined kerosene (MIL-F-7024, type II) 300-400 boiling range.
20	Corrosion compound	Inhibiting fingerprint corrosion	Non-Rust X-210 Daubert Chemical Co., Inc. 4700 S. Central Ave. Chicago, Illinois 60038

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
20 (cont)	Corrosion compound (cont)		Ardrox 3968 Chemetall Aerospace Technologies Trakehner Str. 3 D60487 Frankfurt Main Germany
21	Weld rod	Exhaust collector support ducts	AISI 349, (29-9 W Mo). (MIL-R-5031, class 6) (AMS 5784).
22	Weld rod	Turbine and exhaust collector struts	Hastelloy W (AMS 5786) (MIL-R-5031 class 12)
23	Engine gray enamel	Gearbox touch-up	Actithane WC 100 Paint and Lacquer Reducer H251 Saran Protective Coatings Co. 17332 Shields Detroit, MI 48212 Pu Gray Paint, Code 03-GY-401 Color #16251 Fed. Std. 595B DEFT Chemical 17451 Von Karmon Ave. Irvine, CA 92714-6205
24	Petrolatum	Metallic seal and bearing installation	Commercial
25	Moisture proof barrier material	Engine packaging	Flexkin 100P (MIL-B-131). Acme Backing Corp. P.O. Box 360 Stamford, Connecticut 06904
26	Marking pencils	Marking hot section parts	See Table 303.
27	Dehydrating agent 16-unit bags	Storage and shipment	CS-16 (MIL-D-3464). Filtrol Corp. 3250 East Washington Los Angeles, California 90023
28	Pressure sensitive masking tape, one in. (25 mm) or two in. (51 mm) width	Storage and shipment	No. 260 Scotch Brand. Minnesota Mining and Mfg. Co. 3M Center St. Paul, Minnesota 55101
29	Black stencil ink	Storage and shipment	K-1 (TT-I-559). March Stencil Machine Co. 707 East B St. Belleville, Illinois 62222
30	Moisture absorbing rust preventative	Compressor preservation	No. 606 Rust-Lick Incorporated 755 Boylston Street Boston, Massachusetts 02116

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
30 (cont)	Moisture absorbing rust preventative (cont)	Compressor preservation (cont)	Rocket WD-40 (MIL-C-23411). WD-40 Co. San Diego, California WD-40 Dr. Oskar Trost Industrie und Auto Chemie 2350 Neumünster West Germany WD-40 Betriebs u. Werkstatt Zubehör GmbH Riedstrasse 25 7302 Ostfildern 1- Ruit West Germany WD-40 Hawker Pacific, Pty. Ltd. 4-8 Harley Crescent Condell Park New South Wales 2200 Australia Pengard Penetone Co. Ltd. Bassington Industrial Estate Cramlington, Northumberland United Kingdom Ardrox 3961 Ardrox Limited Commerce Road Brentford, Middlesex, England or Ardrox Australia Pty. Ltd. Birnie Avenue Lidscombe N.S.W., 2141 Australia CRC 3-36 CRC Chemicals Division C.J. Webb Inc. Limekiln Pike Dresher, Pennsylvania 19025
31	Methylethylketone	General cleaning	Commercial
32	Sealant	Assembly--oil bellows seal	Loctite 30558 Permatex Co. Inc. Box 1350 Flanger Court Bldg. West Palm Beach, FL 33402

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
33	High temperature lubricant	Where antiseize is specified in this manual.	Never-Seez Nickel Special. Bostik, Emhart Chemical Group Boston Street Middleton, MA 01949 Bearing Supply and Service 448-472 Notre Dame Ave. Winnipeg 2, Canada R. A. Rodriguez (U.K.) Ltd. Station House-Darkes Lane Potters Bar Herts, England Consolidated Brg, Co. Pty. Ltd. 238 Victoria Rd. Drummoyne, N.S.W. Australia Kyokuto Boeki Kaisha Ltd. 7th Floor, New Otemachi Bldg. 2-1, 2-Chome, Otemachi Chiyoda-Ku, Tokyo, 100-91 Japan S. A. Brasileira De Rolamentos E. Mancais BRM Av. Senador Queiroa, 605 Conj. 1609 Sao Paulo, Brazil Tekind Via F. Melzi D'Eril, 3 20154 Milano, Italy DSL Super Hi-Temp Davis-Howland Oil Corporation 200 Anderson Avenue Rochester, New York 14607
34	Sealer	Compressor mounting insert installation	Devcon F (aluminum). Devcon Corp. 59 Endicott St. Danvers, Massachusetts 01923 Resiweld FE186 H. B. Fuller Company 2400 Kasota Ave. St. Paul, Minnesota 55102

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
34 (cont)	Sealer (cont)	Compressor mounting insert installation	Metal Set A-4. Smooth-on Inc. 1000 Valley Road Gillette, New Jersey 07933 Epon 934 Hysol Div. Dexter Corp. 2850 Willow Pass Road Pittsburgh, California 94565 Loctite 609 Loctite Corporation 705 North Mountain Road Newington, Connecticut 06111 Scotch-Weld 2214 product of the 3M Company Adhesives and Sealers Division 2501 Hudson Road St. Paul, Minnesota 55119 Hysol EA9432NA, EA934, EA9394 Loctite Corporation 705 North Mountain Road Newington, Connecticut 06111 Epocast 938-A1, 938-A2 Huntsman Advanced Materials 10003 Woodloch Forest Dr. The Woodlands, TX 77380 Magnobond 6398 Magnolia Plastics Inc. 5547 Peachtree Industrial Blvd Chamblee, GA 30341-2296
		Compressor case vane band bolt holes and manifold to adapter splitline	RTV 736 or RTV 732 Dow Corning Corp. South Saginaw Road Midland, Michigan 48640 RTV 106 General Electric Corp. Waterford, New York 12188
		Assembly--gearbox splitline	Scot Clad 776 Scotch Clad Coatings Minnesota Mining and Mfg. Co. 3-M Centre St. Paul, Minnesota 55101

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
34 (cont)	Sealer (cont)	Assembly--gearbox splitline (cont)	DC 994 Dow Corning Corp. South Saginaw Road Midland, Michigan 48641
		Installation of labyrinth stationary seal bearing area	Loctite 620 or 602 Loctite Corp. 705 North Mountain Road Newington, CT 06111
35	Sealant remover	Removal of Loctite 620 or 602	Loctite “chisel” solvent Loctite Corp. 705 North Mountain Road Newington, CT 06111
36	Methyl alcohol (Fed Spec O-M 232d, grade A) (British Standard BS 506 Amend. 1)	Compressor water rinse	Commercial Solvents Corp., 245 Park Ave. New York, N.Y. 10017 Union Carbide Corp. Chemicals and Plastics, 270 Park Ave. New York, N.Y. 10017
37	Desiccant	Shipping package humidity control	No. 88 Absorbent Protective Dehydrating Agent (MIL-D-3464) Delta Packaging Products 4108 North Nashville Avenue Chicago, Illinois 60634
38	Liquid leak detector	Checking for pneumatic leaks	SNOOP (meets Mil Spec MIL-L-25567C, type 1 oxygen systems) Indiana Valve & Fitting Inc. P.O. Box 24267 Indianapolis, Ind 46224 Leak-Tec Formula 372E American Gas and Chemical Co. 5 Tefnakil Park Cresskill, New Jersey 07626
39	Adhesive	Oil pump gearshaft retention	Loctite 290 Loctite Corporation 705 North Mountain Road Newington, Connecticut 06111
40	Fuel additive	Fuel anti-ice	Prist (MIL-I-27686E) PPG Industries Inc. 5629 FM 1960 West Houston, Texas 77069

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
40 (cont)	Fuel additive (cont)	Anti-microbial growth MIL-S-53021A	Biobor JF Aviation Fuel Additive Hammonds Technical Services, Inc 910 Franklin Rd. Houston, TX 77073 Ph: (281) 999-2900 Fax: (281) 582-4224 Email: info@hammondscos.com Web: www.hammondscos.com
41	Torque Paint	Application of slippage marks to pneumatic and lubrication system B-nuts	Torque Seal F-900 Organic Products Company P. O. Box 428 Irving, Texas 75060-0428
42	Torque Paint Remover	Removal of torque paint (slippage marks)	F-100 Remover Organic Products Company P. O. Box 428 Irving, Texas 75060-0428
43	Silicone resin sealer-clear (AMS 3135)	Repair of compressor case plastic cracks	Metroseal AP Metco Inc. 1105 Prospect Ave. Westbury, Long Island, New York 11590 RC-21 Silicon Resin Amtex 890 Fern Hill Road West Chester, PA 19380 Sildon 30 Basildon Chemical Co. Lt Kimber Road Abingdon, Oxfordshire England OX14 1R2 1-2531 Dow Corning Corp. South Saginaw Road Midland, Michigan 48640
44	Assembly fluid	Assembly aid	Ultra Chem Co. 1 Ultra Chem Inc. 1400 N. Walnut Street Wilmington, Delaware 19899
45	Hi temperature aluminum paint	Various splitlines	TTP 28 Griggs Paint 3635 16th St. Pheonix, AZ 85040-1310

NOTE: Even though Rolls-Royce has approved these cleansers for use with Rolls-Royce engines, Rolls-Royce assumes no liability for injury to personnel or the environment by their use.

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Table 303

Acceptable Marking Pens and Pencils

Manufacturer		Trade Name	Number	Color
CAUTION: THESE PENCILS, MARKERS AND PAINT STIKS ARE ALSO APPROVED FOR MARKING TITANIUM ALLOYS PROVIDING THE MARKINGS ARE REMOVED PRIOR TO EXPOSURE OF THE PARTS TO TEMPERATURES ABOVE 500°F (260°C) BY HEAT TREATMENT OR ENGINE OPERATION.				
NOTE: The following pencils, fine tip and wide markers, ball point markers, and paint stiks are approved for marking iron, nickel and cobalt base alloys which are exposed to temperatures above 800°F (427°C) either by heat treatment or engine operation. Markings on these alloys do not have to be removed from the parts prior to heating above 800°F (427°C).				
The number in the parentheses that follows the manufacturer's name corresponds to the address listing at the end of this table.				
Pencils				
Venus	(1)	Unique	1237	Carmine Red
Berol Corp.	(2)	Eagle Verithin	745	Carmine Red
A. W. Faber	(3)	The Winner	2383	Dark Green
Berol Corp.	(2)	Eagle Verithin	751	True Green
A. W. Faber	(3)	The Winner	2388	White
Venus	(1)	Unique	1215	White
Berol Corp.	(2)	Eagle Verithin	734	White
Venus	(1)	Unique	1206	Blue
Koh-I-Noor	(4)	Flexicolor	X1800X25	Blue
Berol Corp.	(2)	Eagle Verithin	758	True Blue
Berol Corp.	(2)	Eagle Verithin	737	Orange
A. W. Faber	(3)	The Winner	2462	Silver
Berol Corp.	(2)	Eagle Verithin	753	Silver
Eberhard Faber	(5)	Colorbrite	2101	Silver
Fine Tip Markers				
Carters[6]		Marks-A-Lot	--	Yellow
Berol Corp.[2]		Flash 30	--	Red
--		Lindy	--	Green
Berol Corp.[2]		Flash 30	--	Blue
--		Lindy	--	Blue
Berol Corp.[2]		Flash 32	--	Blue
Sanford Corp.	(12)	T.E.C.	3201	Black
Sanford Corp.	(12)	T.E.C. Marker	13401	Black

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Table 303 (cont)

Acceptable Marking Pens and Pencils

Manufacturer	Trade Name	Number	Color
Wide Tip Markers			
Berol Corp.(2)	Liquid Tip	1100	Black
Berol Corp.(2)	Eagle Marker	8835	Black
Berol Corp.(2)	Liquid Tip	1100	Red
Berol Corp.(2)	Eagle Marker	8824	Red
Berol Corp.(2)	Eagle Marker	8802	Blue
Berol Corp.(2)	Eagle Marker	8816	Yellow
Sanford Corp. (12)	T.E.C. Marker	1501	Black
Ball Point Markers			
Markall(7)	—	—	Blue
Markall(7)	—	—	Yellow
Paint Stiks			
Markall Company(7)	Paintstik Type B	—	Yellow
Markall Company(7)	Paintstik Type B	—	White
Markall Company(7)	Paintstik Type B	—	Green
Markall Company(7)	Paintstik Type B	—	Brown
Markall Company(7)	Paintstik Type B	—	Orange
Markall Company(7)	Paintstik Type B	—	Purple
American Art Clay Co. (8)	Glass Cellophane	2346	Blue

CAUTION: DRI–MARQUETTE BLACK INK MAY BE USED ON TITANIUM ALLOYS BUT MUST BE REMOVED PRIOR TO EXPOSURE TO TEMPERATURES ABOVE 500°F (260°C).

NOTE: Dri–Marquette Black Ink, a product of the Irwin–Hodson Co., (9) is approved for marking on iron, nickel and cobalt base alloy parts. The markings do not have to be removed prior to exposure to temperature above 800°F (427°C).

NOTE: LNC–3 Nuclear–Grade Electrolyte, a product of the Lectrotech Company, (10) is approved for electrolytic etching on iron, nickel, cobalt, titanium, aluminum and magnesium alloys. This process is for permanent marking of identification on parts.

NOTE: Pyromarker, a product of Ball Point Metal Marker, Tempil Division, Big Three Industries, Inc, (11) is approved for marking on iron, nickel and cobalt base alloys and on titanium alloys. Markings on these alloys do not have to be removed prior to exposure to temperature above 500°F (260°C).

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Table 303 (cont)

Acceptable Marking Pens and Pencils

Manufacturer	Trade Name	Number	Color

Manufacturer Addresses

(1) Venus-Esterbrook Corp.; Lewisburg, Tenn. 37091
(2) Berol Corp.; P.O. Box 1000, Danbury, Conn. 06810
(3) Faber-Castell Corp.; P.O. Box 1708, 41 Dickerson St. Newark, New Jersey 07l03
(4) KOH-I-NOOR Rapidograph Inc.; 100 North Street, Bloomsbury, NewJersey 08804
(5) Eberhard Faber Inc.; Crestwood Industrial Park, Wilkes-Barre, Pennsylvania. 18703
(6) Carters Ink Co.; 275-T Wyman St., Waltham, Mass. 02154
(7) Markall Co.; 270 North Washtenaw Ave., Chicago, Ill 60612
(8) American Art Clay Co. Inc.; 4717 West 16th St., Indianapolis, Ind.46224
(9) Irwin-Hodson Co.; Ninth and S.E. Woodward, Portland, Oregon 97202
(10) The Lectroetch Co.; 14925 Elderwood Ave., Cleveland, Ohio 44112
(11) Tempil Division Big Three Industries Inc.; 2901 Hamilton Blvd,South Plainfield, N.J. 07080
(12) Sanford Corp., Bellwood, Ill, 60104

4. Hardware

A. Use 0.020 in. (0.51 mm) diameter stainless steel lockwire, MS20995-C20 where lockwire size is not specified. Double strand lockwire all drilled bolts, plugs, and screws, except those locked with self-locking nuts or lockwashers. Lockwire bolts in pairs where possible. When reassembling be sure to safety wherever lockwire was removed. Do not use zinc lockwire. Do not reuse lockwire, cotter pins, ring seals, lip seals, composition gaskets, and split or tab washers. Self-locking nuts can be reused if they have a minimum prevailing torque within the limits given in Table 304.

NOTE: It is not necessary to lockwire engine electrical and magnetic connectors that are of the self-locking, quick-disconnect type.

5. Torques

A. The paragraphs that follow contain general torque limits to tighten nuts, bolts, and screws. (Refer to Table 305). Torque limits for special applications are given under maintenance for the specific component. Reuse self-locking nuts that have a minimum prevailing torque within the limits given in Table 304. When the procedures to tighten call for locknut drag to be added to a given torque value, obtain the drag as follows:

(1) Tighten the nut snug.

(2) Back off one half turn.

(3) Locknut drag is the torque required to first turn the loosened nut.

B. Tighten without the use of a thread lubricant unless one is specified. Threads must be free of burrs or nicks, and they must turn freely. To prevent overstressed parts and twisted split-lines, do not completely tighten at the first draw-down. On bolt circles, alternatively tighten nuts, bolts, or screws that are 180° apart to half of minimum torque. Do this again to tighten to specified torque. On split-lines other than bolt circles, tighten midsection nuts, bolts, or screws first to half minimum torque. Tighten remaining threaded parts to half minimum torque. Do this again to tighten to specified torque.

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C. When screws are installed with nuts, the torque for the screw must apply. (Refer to Table 305.) On nuts with a thread size larger than one inch, tighten nuts to maximum specified torque to seat parts. Loosen and retighten as specified.

D. When you tighten or loosen coupling nuts, make sure the nipple does not turn on the seat of the mating fitting. Apply torque paint across the fitting threads after you tighten them. Bottoming torque on bushing type parts that seat metal over a seal is the same as for fittings with like thread size. For correct torque limits, refer to Table 306.

E. When you use an extension wrench that would change the effective length of the torque wrench, it is necessary to calculate the applied torque from the required torque (Ref. Figure 301A).

6. Universal Fittings (Ref. Figure 301)

A. Fittings With Backup Rings

Use this procedure to install universal fittings with backup rings.

(1) Install the nut on the fitting and run it back until the counterbore of the nut aligns with the upper inner corner of the gasket groove.

(2) Lubricate the seal and install it on the fitting.

(3) Work the backup ring into the counterbore of the nut.

(4) Turn the nut down until the seal is pushed firmly against the lower threaded section of the fitting.

(5) Install the fitting into the boss, making certain the nut turns with the fitting, until the seal touches the boss. Then tighten the fitting one and one-half turns more.

(6) Put a wrench on the nut to prevent its turning, and position the fitting by turning it in up to 270° or unscrewing it up to 90°.

(7) Hold the fitting in its position and tighten the nut against the boss.

B. Fittings Without Backup Rings

Use this procedure to install universal fittings without backup rings.

(1) Run the nut on the fitting end back until the washer face is aligned with the upper inner corner of the gasket groove.

(2) Lubricate the seal and place it in the groove. Use care not to damage seal.

(3) Screw the fitting into the boss until the seal barely touches the boss.

(4) Turn the fitting and nut together until the nut touches the boss.

(5) Put a wrench on the nut to prevent its turning, and position the fitting by turning it in up to 270° or unscrewing it up to 90°.

(6) Hold the fitting in its proper position and tighten the nut against the boss.

7. Locknut Installation (Ref. Figure 302)

Install locknuts (Klincher or equivalent) with the locking shoulder on the lead side. Tightening presses the nut against the bolted surface to create the stress required for locking. Nuts installed upside down will not achieve this desired locking feature.

8. Airframe/Engine Interface Connections

When airframe provided fittings are installed into the engine, refer to Table 307 for the recommended torque values.

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9. Rigid Tube Inspection and Installation

When a component to which rigid tube assemblies are attached is replaced, remove all interfering tube assemblies to permit easy removal and reinstallation of the component. This precaution will prevent subsequent damage to the tube assemblies. Tube–to–fitting alignment should be checked for proper fit, as described in Flared Tubes and Flanged Tubes, para 9.B. and 9.C., this section, anytime such a component is installed.

A. Inspection

Inspect fuel, control air, and oil tubes as follows:

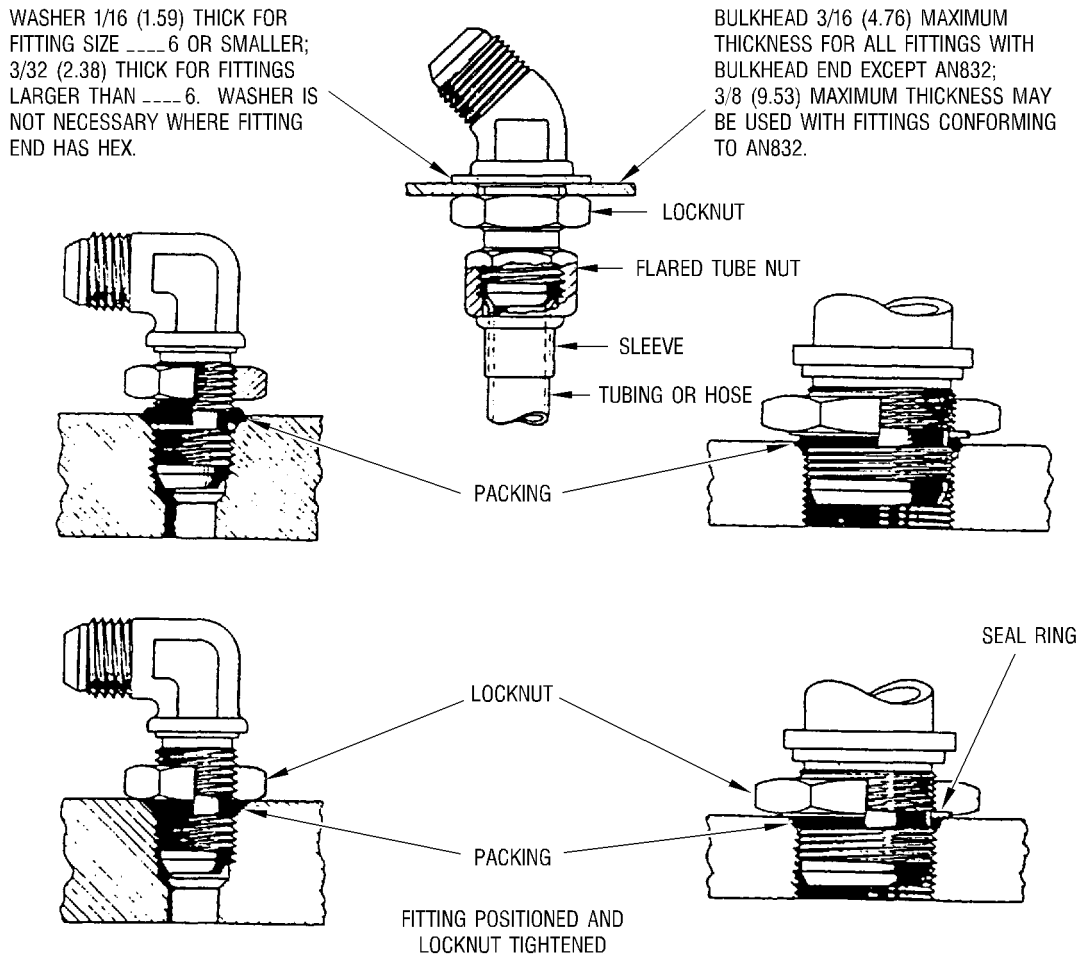
(1) Inspect tubes for dents, chafing or cracks.

(2) Reject tubes with cracks (dye check) in any area.

(3) Reject tubes having dents or chafing on the flared ends or on the retention clamps.

(4) Reject tubes with dents exceeding 0.125 in. (3 mm) depth or having a sharp radius.

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NOTE: DIMINSIONS ARE IN INCHES (MILLIMETERS).

AJY001XA

Universal Fittings
Figure 301

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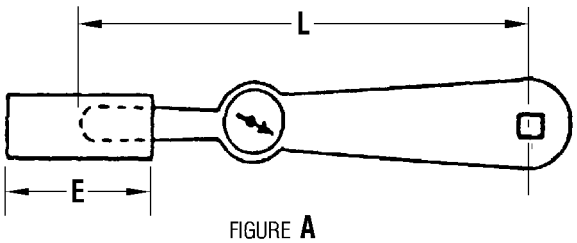


FIGURE **A**

WITH AN EXTENSION IN THIS POSITION I.T. = R.T.

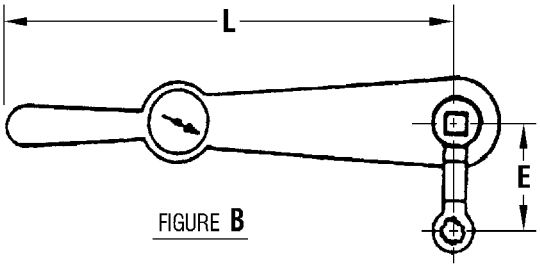


FIGURE **B**

WITH AN ADAPTER IN THIS POSITION I.T. = R.T.

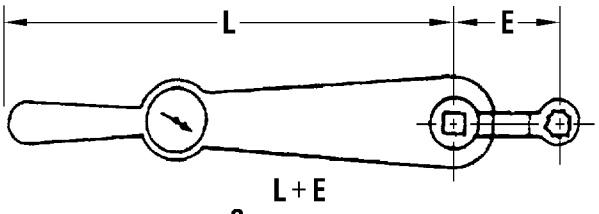


FIGURE **C**

WITH AN ADAPTER IN THIS POSITION

$$\text{I.T.} = \frac{\text{(R.T.)} \times L}{L + E}$$

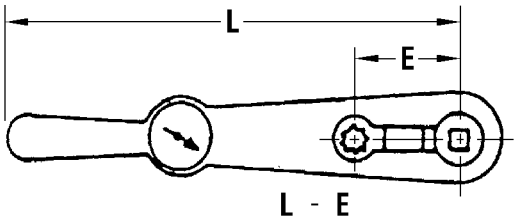


FIGURE **D**

WITH AN ADAPTER IN THIS POSITION

$$\text{I.T.} = \frac{\text{(R.T.)} \times L}{L - E}$$

L = EFFECTIVE LENGTH OF TORQUE WRENCH (INCHES).
E = EFFECTIVE LENGTH OF ADAPTER/EXTENSION (INCHES).
I.T. = TORQUE INDICATED ON TORQUE WRENCH.
R.T. = TORQUE REQUIRED FOR NUT/BOLT.

EXAMPLES: TO OBTAIN A REQUIRED 100 LB IN. (WITH **L** = 12 IN. AND **E** = 2 IN.) THE INDICATED TORQUE SHOULD BE:

FIGURE **C** CONFIGURATION: I.T. = $\frac{100 \times 12}{12 + 2} = \frac{1200}{14}$ = 85.7 LB IN.

FIGURE **D** CONFIGURATION: I.T. = $\frac{100 \times 12}{12 - 2} = \frac{1200}{14}$ = 120 LB IN.

AJY001XA
APT003XA

Torque Calculations
Figure 301A

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Table 304

Minimum Prevailing Torque for Used Locknuts

Fine Thread Series			Coarse Thread Series		
	Min Torque			Min Torque	
Nut Size	lb in.	N·m	Nut Size	lb in.	N·m
8–36	0.7	0.08	8–32	0.7	0.08
10–32	1	0.11	10–24	1	0.11
1/4–28	2	0.23	1/4–20	2	0.23
5/16–24	3	0.34	5/16–18	3	0.34
3/8–24	5	0.56	3/8–16	5	0.56
7/16–20	8	0.90	7/16–14	8	0.90
1/2–20	10	1.10	1/2–13	10	1.10
9/16–18	13	1.50	9/16–12	14	1.60
5/8–18	18	2.00	5/8–11	20	2.30
3/4–16	27	3.10	3/4–10	27	3.10
7/8–14	40	4.50	7/8–9	40	4.50
1–12	55	6.20	1–8	51	5.80
1 1/8–12	73	8.30	1 1/8–8	68	7.70
1 1/4–12	94	10.60	1 1/4–8	88	9.90

Table 305

General Torque Limits for Bolts, Nuts, and Screws

Thread Size	Type	Torque	
8–32	Screws, bolts and nuts	12–15 lb in.	(1.4–1.7 N·m)
8–36	Screws	17–20 lb in.	(1.9–2.3 N·m)
10–24	Screws	12–22 lb in.	(1.4–2.5 N·m)
10–24	Bolts and nuts	25–30 lb in.	(2.8–3.4 N·m)
10–32	Screws	22–26 lb in.	(2.5–2.9 N·m)
10–32	Bolts and nuts	35–40 lb in.	(3.9–4.5 N·m)
1/4–20	Bolts and nuts	60–65 lb in.	(6.8–7.3 N·m)
1/4–28	Flat, round, and fillister–head screws	55–58 lb in.	(5.6–6.6 N·m)
1/4–28	Bolts, nuts, and socket–head screws	70–85 lb in.	(7.9–9.6 N·m)
5/16–24	Bolts and nuts	120–150 lb in.	(14–17 N·m)
5/16–24	Self–locking nuts	140–170 lb in.	(16–19 N·m)
3/8–16	Bolts and nuts	205–245 lb in.	(23–28 N·m)

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Table 305 (cont)

General Torque Limits for Bolts, Nuts, and Screws

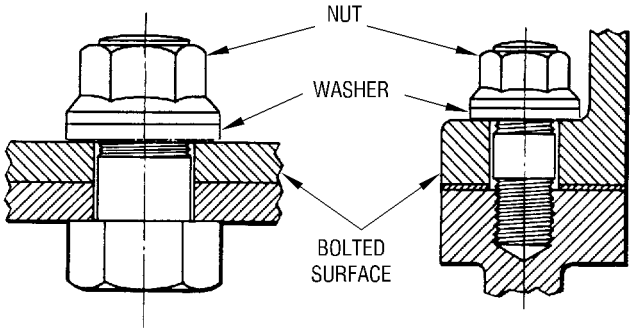
3/8–24	Bolts and nuts	240–280 lb in.	(27–32 N·m)
3/8–24	Self–locking nuts	265–300 lb in.	(30–34 N·m)
5/8–18	Bolts and nuts	90–100 lb ft.	(122–136 N·m)
	Palnuts	60° or one flat past finger tight	

Table 306

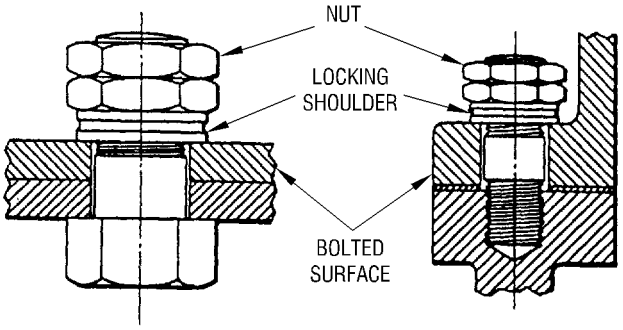
Torque Limits for Steel Couplings on Steel Fittings

Dash No.	Tubing OD Inches	Wrench Size	Torque lb in.	Torque N·m
–2	0.125	3/8	35–40	3.95–4.52
–3	0.187	7/16	65–100	7.34–11.30
–4	0.250	9/16	80–120	9.04–13.56
–5	0.312	5/8	150–200	16.95–22.60
–6	0.375	11/16	200–250	22.60–28.25
–8	0.500	7/8	325–400	36.72–45.19
–10	0.625	1	475–575	53.66–64.96
–12	0.750	1 1/4	660–780	74.57–88.12
–16	1.000	1 1/2	720–960	81.35–108.46
–20	1.250	2	1200–1500	135.58–169.47

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CURRENT CONFIGURATION



EARLY CONFIGURATION

ADY009XA

Typical Locknut Installation
Figure 302

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Table 307

Recommended Torque for Airframe/Engine Interface Connections

Thread Size	Torque lb in.	Torque N·m
0.375–24	25–40	2.8–4.5
0.4375–20	40–65	4.5–7.3
0.500–20	60–80	6.8–9.0
0.750–16	150–200	17–23
0.875–14	200–350	23–40
1.0625–12	300–500	34–56

PARA 9. (cont)

B. Flared Tubes

WARNING: PROPER TIGHTENING OF ENGINE TUBING CONNECTIONS IS CRITICAL TO FLIGHT SAFETY. CORRECT TORQUE VALUES MUST BE USED AT ALL TIMES. EXCESSIVE TORQUE ON PNEUMATIC SENSING SYSTEM CONNECTIONS RESULTS IN CRACKING OF THE FLARE OR ADJACENT TUBE AREA IN CONTACT WITH THE FERRULE. THIS PRODUCES AN AIR LEAK WHICH CAN CAUSE FLAMEOUT, POWER LOSS, OR OVERSPEED.

CAUTION: FAILURE OF ENGINE PNEUMATIC OR FUEL TUBES DUE TO FAULTY MAINTENANCE PRACTICE COULD CAUSE FLAMEOUT, POWER LOSS, OR OVERSPEED.

Tube assemblies must fit and be aligned with the mating flare tube fittings to the degree that at both ends of the assembly the flares shall be uniformly seated in a free state on the cones of the mating fittings. The fit shall be without distortion or stretching of the tube assembly and to the degree that the nuts can be fully engaged up to the final one–half turn with light finger pressure.

CAUTION: THE PRACTICE OF TIGHTENING FITTING LOCK NUTS WITH TUBE ASSEMBLIES INSTALLED CAN RESULT IN DAMAGE TO THE TUBE WITH POSSIBLE FAILURE OF THE TUBE ASSEMBLY.

In the event a tube does not align with the mating fittings, reposition the mating fittings to the degree that proper alignment may be attained. Final tightening of these fittings must be accomplished before the tube assembly is connected.

CAUTION: EXTREME CAUTION MUST BE OBSERVED WHILE HAND BENDING PREVIOUSLY FORMED TUBES TO PREVENT EXCESSIVE FLATTENING OF TUBES AT THE BEND RADIUS.

If proper alignment cannot be attained by repositioning mating flare tube fittings, bend the tube sufficiently to provide alignment in the free state as specified. Accomplish all bending with the tube removed from the engine. Adjustment of the fit may be accomplished by bending by hand at principal bends. In the event the tube cannot be bent by hand, the tube must be clamped in a fixture or device which will not scratch, indent, crimp, or mark the surface of the tube during the bending operation. The flattened effect of the cross section of the tube as a result of the reforming operation must not exceed 15 percent of the tube OD.

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PARA 9.B. (cont)

CAUTION: MAKE SURE NO LOOSE PARTICLES OF TORQUE PAINT ARE ALLOWED TO ENTER THE CONTROL SYSTEM TUBES OR FITTINGS.

WARNING: TUBING B–NUTS USED IN INSTALLATIONS EXPOSED TO A HIGH DEGREE OF VIBRATION AND PRESSURE SURGES ARE SUBJECT TO TORQUE RELAXATION WHEN IMPROPERLY TIGHTENED.

WARNING: USE ACCEPTABLE TECHNIQUES AND PRACTICES TO PREVENT TORQUE PAINT OR TORQUE PAINT REMOVER FROM CONTACTING RUBBER OR PLASTIC MATERIALS OR ENTERING EXPOSED AREAS.

When proper free state alignment is attained, complete tubing installation by simultaneously securing the coupling nuts. After all B–nuts are properly tightened to the correct torque values, apply a slippage mark (torque paint) of contrasting color approximately 0.063 inch (1.60 mm) wide minimum. The mark shall extend down the side of the B–nut and onto the mating fitting. Install necessary clamping. (Refer to 250–C20 Series Parts Catalog, Pub. No. 10W4, for clamping requirements.)

B–nuts shall be inspected for indications of slippage at 100 hour maintenance intervals.

Old slippage marks (torque paint) shall be completely removed, using torque paint remover, and reapplied each time the B–nut is tightened.

C. Flanged Tubes

WARNING: PROPER TIGHTENING OF ENGINE TUBING CONNECTIONS IS CRITICAL TO FLIGHT SAFETY. CORRECT TORQUE VALUES MUST BE USED AT ALL TIME. EXCESSIVE TORQUE ON PNEUMATIC SENSING SYSTEM CONNECTIONS RESULTS IN CRACKING OF THE FLARE OR ADJACENT TUBE AREA IN CONTACT WITH THE FERRULE. THIS PRODUCES AN AIR LEAK WHICH CAN CAUSE FLAMEOUT, POWER LOSS, OR OVERSPEED.

The alignment of tube fittings with mating sealing surfaces and the securing of tube clips must conform to the following:

(1) Nut and Nipple Joints. With one end hand tightened, it must be possible to locate the nipple at the free end in its conical seating, by flexing the tube by hand, without effecting a permanent set to the assembly. The alignment of the joint must be such that the nut readily engages with its mating thread.

(2) Setscrew Retained Flanged Adapters. The clearance and parallelism between flange and mating surface, with the opposite end secured, must be such that the total flange area contact can be achieved by flexing the tube by hand, without effecting a permanent set to the assembly. Flange clearance holes must line up with tapped holes, so that bolts can be fitted without subjecting the tube to a torsional load.

(3) Clipping Points. Locate clips to securing points such that the setscrews can be fitted by flexing the tube by hand, without effecting a permanent set to the assembly. Tubes which fail to meet this requirement may be removed from the engine and reformed as follows:

(a) Tubes must be clamped in a fixture which will not scratch, indent, crimp or mark the surface of the tube during the bending operation.

(b) Retention of the tube during bending should be made in a manner which does not permit bending or torsional loads across welded or brazed areas.

(c) Tubes which can be corrected for fit only by submitting welded areas to bending or torsional loads, must be reinspected by X–ray or Zyglo for any evidence of weld or braze fracture prior to reinstallation on the engine.

(d) Reformed tubes must meet the requirements of steps (1) and (2).

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PARA 9.C (cont)

(4) When removal of the tube from the engine would result in excessive lost time due to the need for teardown and rebuild, the tube may be reformed attached to the engine if the following precautions are followed:

(a) Bending and torsional loads must not be applied across welded or brazed areas.

(b) The tube attachment points are to be loosened after bending (attachment points which are inaccessible due to the state of assembly are excluded).

(c) Reformed tubes must meet the requirements of steps (1) and (2).

10. Lubricants

CAUTION: DO NOT USE MOLYBDENUM DISULFIDE LUBRICANTS ON INTERNAL THREADS OR ON ANY FUEL, LUBRICATION OR AIR SYSTEM TUBING, HOSE OR FITTINGS.

CAUTION: DO NOT USE SILICONE LUBRICANTS EXCEPT WHERE SPECIFIED. USE LUBRICANTS RECOMMENDED IN THE ENGINE PUBLICATIONS.

The following lubricants shall be used for assembly of the engine and at regular periodic lubrication of components.

Location	Lubricant
General use such as installation of bearings, oil seals and packings	Engine oil
Accessory gear splines and splines of engine components	Lubriplate 130A, 930AA, or equivalent
Gearbox seal lips and packing roller bearings for ease of assembly	Grease (Shell 6249, Mobil 28, engine oil or equivalent).
External spanner nut, nut, bolt and stud threads except male threads and attachments and plugs installed in the outer combustion case, turbine supports and and exhaust collector.	Silicon base molybdenum disulfide antiseize compound: DC550R--protects up to 232°C (450°F). CP-63--protects up to 760°C (1400°F).
Male threads of plugs and attachments installed in the outer case, turbine supports or exhaust. Also used on threads of bolts at splitlines between the outer case, turbine supports and exhaust collector.	Nickel base antiseize compound, NS165, Never Seez Nickel Special--high temperature, high pressure protection; DSL Super Hi-Temp.
Fuel system preservation	See Table 301.

NOTE: Apply a light coat of lubricant by hand; wipe off any excess. Lubricate only the male threads of fuel and oil lines; wipe the lubricant from the lead threads to prevent it from entering the system. Do not mix synthetic lubricating oil with petroleum based products. Do not lubricate air system component threads.

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11. Lubrication System Servicing

WARNING: MAINTAIN THE COMPLETE OIL SYSTEM IN ACCORDANCE WITH ENGINE AND AIRCRAFT INSTRUCTIONS. FAILURE TO MAINTAIN THE OIL SYSTEM CAN RESULT IN SUDDEN ENGINE STOPPAGE.

WARNING: IF A MAGNETIC PLUG WARNING LIGHT COMES ON DURING FLIGHT, LAND AND INSPECT THE MAGNETIC PLUGS AS SOON AS POSSIBLE. THIS LIGHT IS AN INDICATION OF CONDITIONS WHICH COULD CAUSE ENGINE FAILURE. WHEN FLYING A MULTI–ENGINE AIRCRAFT, REDUCE THE AFFECTED ENGINE OUTPUT POWER TO THE MINIMUM REQUIRED FOR FLIGHT AND LAND AS SOON AS PRACTICABLE. IF THE LIGHT IS ACCOMPANIED BY ABNORMAL NOISES, OIL PRESSURE OR TEMPERATURE, AND SINGLE–ENGINE FLIGHT CAN BE MAINTAINED, SHUT DOWN AFFECTED ENGINE AND LAND AS SOON AS PRACTICABLE. IF SINGLE–ENGINE FLIGHT IS NOT POSSIBLE, REDUCE POWER OF AFFECTED ENGINE TO THE MINIMUM AND LAND AS SOON AS POSSIBLE. AFTER LANDING, INSPECT THE MAGNETIC PLUGS ON THE AFFECTED ENGINE FOR THE METAL CONTAMINATION PRIOR TO FURTHER ENGINE OPERATION.

WARNING: OPERATORS MUST MAINTAIN THE ENGINE MAGNETIC DRAIN PLUGS AND INDICATING SYSTEM IN OPERATING ORDER AND COMPLY WITH AIRCRAFT FLIGHT MANUAL AND ENGINE OPERATION AND MAINTENANCE MANUAL INSTRUCTIONS WHEN AN INDICATION IS RECEIVED. NEVER ALLOW AN ACCEPTABLE SPECTROGRAPHIC OIL ANALYSIS PROGRAM (SOAP) READING TO OVERRIDE MAGNETIC DRAIN PLUG INDICATIONS.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

CAUTION: NORMAL ENGINES CONSUME A MINIMAL AMOUNT OF OIL. HOWEVER, ANY SUDDEN INCREASE IN OIL CONSUMPTION IS INDICATIVE OF OIL SYSTEM PROBLEMS AND MUST BE CORRECTED. (REFER TO ITEMS 18 AND 19 IN TABLE 101, TROUBLESHOOTING.)

A. General

CAUTION: DO NOT USE SILICONE LUBRICANTS EXCEPT WHERE SPECIFIED. USE ONLY THE LUBRICANTS RECOMMENDED IN THE ENGINE PUBLICATIONS.

CAUTION: THE GAS PRODUCER TURBINE SUPPORT PRESSURE OIL TUBE SHOULD NORMALLY NOT BE REMOVED. IF THIS TUBE MUST BE REMOVED, FLUSH THE TUBE PASSAGE IN THE SUPPORT BEFORE TUBE INSTALLATION. (REFER TO GAS PRODUCER SUPPORT PRESSURE OIL PASSAGE, PARA 7.H., 72–50–00.)

Lubrication system maintenance includes: cleaning and inspecting the magnetic drain plugs; changing the system oil; cleaning the oil filter; replacing the lube oil filter housing assembly; adjusting the pressure regulating valve; cleaning and inspecting the turbine pressure oil system check valve; flushing the gas producer support oil supply passage; inspecting and cleaning the power turbine support pressure oil nozzle, scavenge oil strut, and external sump; also cleaning of power turbine labyrinth seals.

B. Oil Temperature Limit Exceeded

The maintenance actions required when oil temperature limits have been exceeded are governed by the overtemperature conditions encountered. Specific conditions and their respective maintenance action requirements are as follows:

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PARA 11. (cont)

(1) Engine oil temperature exceeds 107°C (225°F) for a period not exceeding ten minutes but remains less than 120°C (248°F). Oil pressure remains normal.

(a) Check for carbon deposits (coking).

(b) Inspect and clean or replace the oil filter.

(c) Inspect and clean the external scavenge oil filter (if installed). Refer to the applicable airframe manual for cleaning instructions.

(d) Inspect and clean the magnetic drain plugs.

(e) Reservice the oil system with new oil. Ground run the engine for 10 minutes, obtain as high a power setting as possible without lift–off (without exceeding Max. Continuous rating).

(f) Reinspect the oil filter and the magnetic drain plugs. If no carbon particles can be found, return the engine to service. If carbon particles are found, perform oil system maintenance. (Refer to Oil System Maintenance, para 7.F., 72–50–00.)

(g) Reinspect the oil filter and the magnetic drain plugs after five hours of engine operation. If carbon particles are found, repeat the maintenance procedure.

(2) Engine oil temperature exceeds 107°C (225°F) for a period not exceeding 10 minutes but remains less than 120°C (248°F). Oil pressure abnormal.

(a) Overtemperature may adversely affect oil pressure regulation. Replace the oil filter housing assembly. (Refer to Lube Oil Filter Housing Replacement, para 1.D., 72–60–00.) If normal oil pressure and oil pressure regulation is restored by replacement of the housing assembly, send the removed housing assembly to an authorized facility for repair, noting the reason for removal.

(b) Check for carbon deposits (coking). (Refer to para 11.C., this section.)

(c) Inspect and clean or replace the oil filter. (Refer to 72–60–00, para 1.C.)

(d) Inspect and clean the external scavenge oil filter (if installed). Refer to the applicable airframe manual for cleaning instructions.

(e) Inspect and clean the magnetic drain plugs. (Refer to para 11.G., this section.)

(f) Reservice the oil system with new oil. Ground run the engine for 10 minutes, obtain as high a power setting as possible without lift–off (without exceeding Max. Continuous rating). Adjust engine oil pressure as required.

(g) Reinspect the engine oil filter, external scavenge oil filter (if installed) and the magnetic drain plugs. If no carbon particles can be found, return the engine to service. If carbon particles are found, perform oil system maintenance. (Refer to Oil System Maintenance, para 7.F., 72–50–00.)

(h) Reinspect the engine oil filter, external scavenge oil filter (if installed) and the magnetic drain plugs after five hours of engine operation. If carbon particles are found, repeat the maintenance procedure.

(3) Oil temperature exceeds 120°C (248°F) momentarily or 107°C (225°F) for a period exceeding 10 minutes.

(a) Remove the engine and send it to an Authorized Maintenance Center for inspection or repair as required.

(b) Tag the engine indicating that max allowable operating oil temperatures were exceeded. Give maximum temperature and elapsed time.

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PARA 11. (cont)

C. Oil Change

Change the engine oil at the time interval specified in Table 602, 72–00–00, Engine–Inspection/Check or when oil contamination is encountered.

(1) Drain the engine oil supply tank and engine oil cooler. Where the installation permits, inspect the oil tank and cooler for carbon and sludge deposits. If deposits are found, and an external scavenge filter is installed and has not bypassed, clean or replace the engine and scavenge oil filters. If the scavenge oil filter has bypassed, clean or replace the engine and scavenge oil filters, oil cooler, oil tank, and lubrication lines per the airframe manual instructions. Replace the engine oil.

(2) Remove the magnetic drain plugs from the power and accessory gearbox. Allow residual oil to drain from the magnetic plug openings in the gearbox. Inspect the plugs in accordance with Magnetic Plug Inspection, para 11.G., this section. Clean the plugs with solvent. Dry with a clean cloth.

(3) If an accumulation of magnetic particles, debris, chips, flakes or slivers is the cause for oil change, remove, disassemble, clean and inspect the oil pressure reducer at the compressor front support inlet to the number one bearing. (Refer to para 3., 72–30–00, Compressor Section–Maintenance Practices for inspection and cleaning details.)

(4) Remove the oil filter (and packing on applicable configurations) from the filter housing. Discard the packing. Thoroughly clean the oil filter cavity of all residual oil and sludge. Take the necessary precautions to prevent residual oil from entering the engine cavity or standpipe. Clean the oil filter. (Refer to Oil Filter Replacement, para 1.C., 72–60–00.)

NOTE: Some engine bearings feature silver–plated separators. If minute silver particles are found in the engine oil filter, clean and reinstall the filter. These minute particles are due to normal bearing wear and are not cause for further corrective action.

(5) Install the magnetic drain plugs. Use new packings lubricated with engine oil. Tighten plugs to 60–80 lb in. (6.8–9.0 N·m) and secure with lockwire.

(6) Install new or cleaned oil filter with new packing. Fill the filter cavity with appropriate engine oil. Install the filter cap with a new packing which has been lubricated with engine oil. Retain cap with two nuts and washers. Tighten nuts to 30–40 lb in. (3.4–4.5 N·m).

WARNING: MIXING OF OILS NOT IN THE SAME GROUP (PARA 4.C., 72–00–00, ENGINE DESCRIPTION AND OPERATION) IS PERMITTED ONLY IN AN EMERGENCY. USE OF MIXED OILS (OILS NOT IN THE SAME GROUP) IN AN ENGINE IS LIMITED TO FIVE HOURS TOTAL RUNNING TIME. ADEQUATE MAINTENANCE RECORDS MUST BE MAINTAINED TO ENSURE THAT THE FIVE HOUR LIMIT IS NOT EXCEEDED.

WARNING: ALTHOUGH EITHER MIL–L–23699 OR MIL–L–7808 OIL IS ACCEPTABLE, DO NOT MIX THESE OILS.

(7) Fill the oil supply tank with approved oil. Mixing of approved oil in the 250 series engine is permitted only within a given group. For example, an oil in Group 23 may be mixed with another brand of oil in Group 23. (Refer to Approved Oils, 4.C.(2), 72–00–00, Engine–Description and Operation.) (Refer to Airframe Manual for proper quantity of oil.)

(8) Motor the engine with the starter and without ignition until an indication of oil pressure is attained. When pressure is evidenced, start the engine and operate at Idle for five minutes. Monitor oil pressure continuously during the five minute run.

(9) Note the oil change in the Engine Log book.

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PARA 11. (cont)

CAUTION: OPERATORS ARE TO MONITOR THE OIL FILTER EACH 25 HOURS OF OPERATION FOLLOWING A CHANGE FROM MIL–L–7808 OIL TO MIL–L–23699, OR FROM MIL–L–23699 TO MIL–L–7808. THIS IS TO BE DONE TO DETERMINE IF COKE, WHICH WAS FORMED DURING PREVIOUS OPERATION WITH EITHER MIL–L–7808 OIL OR MIL–L–23699, IS BECOMING DISLODGED DURING PRESENT OPERATION FOLLOWING THE OIL CHANGE. IF HEAVY OIL DEPOSITS ARE OBSERVED ON THE ENGINE FILTER, IT IS SUGGESTED THAT THE ENGINE OIL BE CHANGED AGAIN. THE OIL IS TO BE DRAINED WHEN THE OIL IS HOT TO OBTAIN THE MAXIMUM BENEFIT. THE 25–HOUR OIL MONITORING IS TO CONTINUE UNTIL THE NEXT OIL CHANGE PERIOD.

CAUTION: USE OF OILS WHICH ARE NOT INCLUDED IN THE APPROVED OIL LISTING, PARA 4.C.(2), ENGINE—DESCRIPTION AND OPERATION 72–00–00, OR FAILURE TO DRAIN OIL WITHIN THE PRESCRIBED INTERVAL GIVEN IN SCHEDULED INSPECTIONS, TABLE 602, ENGINE INSPECTION/CHECK, 72–00–00, WILL BE CONSIDERED AS MISUSE UNDER ITEM (4) OF THE WARRANTY POLICY.

D. Low Oil Pressure Operation

If deterioration in engine oil pressure is experienced, the following sequence of checks is suggested.

(1) Check the quantity of oil in the tank to be sure it is adequate.

(2) Remove, inspect, clean, and reinstall the magnetic plugs and filter.

(3) Confirm the pressure discrepancy using a direct reading gage.

CAUTION: DO NOT MAKE A PRESSURE REGULATING VALVE ADJUSTMENT TO CORRECT FOR A RAPID CHANGE IN OIL PRESSURE. THESE CONDITIONS ARE CAUSE TO SUSPECT OTHER OIL SYSTEM PROBLEMS HAVE DEVELOPED.

(4) Increase the pressure adjustment if necessary. Check the gage for change in pressure. If no change in pressure is evident as a result of the adjustment, continue with the sequence of checks to isolate and correct the fault.

(5) Remove and check the bottom magnetic drain plug. Drain oil from the gearbox. Do not install the magnetic drain plug, after residual oil has drained, until a check for internal oil leakage has been made.

NOTE: Leakage from the bottom drain port is an indication that the oil tube packings and/or oil pump may be leaking. Leakage will also be evident if the check valve is not properly seated.

(6) If bottom drain port leakage is evident, remove the oil filter housing and fill the pump pressure–out tube with oil. (Refer to Gearbox Housing Lubrication System Components Disassembly, para 2.D., 72–60–00.) Cap the bypass oil tube and monitor the oil level in the pressure–out tube.

(a) A decrease in the tube oil level indicates a probable internal leakage of the oil pump and/or leakage past the packings located at the pump ports. Ascertain fault and replace part as necessary. (Refer to applicable part of Gearbox Disassembly and Assembly, para 2., 72–60–00.)

(b) If the oil level in the tube does not drop within approximately two minutes, the oil filter housing may be the cause of leakage. Replace part if any of the following conditions are noted and local repair not practical.

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PARA 11.D. (cont)

1 Excessive wear at the ID of the oil–out port.

2 Pressure regulating valve seat or poppet damage.

3 Packing seal deterioration.

CAUTION: REMOVE CAP FROM BYPASS TUBE BEFORE INSTALLING THE OIL FILTER HOUSING.

(7) Install acceptable oil filter housing in accordance with Lube Oil Filter Housing Replacement, para 1.D., 72–60–00.

E. Engine Operated With No Oil Pressure.

Any engine operated in excess of 30 seconds without oil pressure must be removed and sent to a Rolls–Royce Authorized Maintenance Center for disassembly and inspection as defined by the Rolls–Royce 250–C20 Series Engine Overhaul Manual, Publication No. 10W3.

F. Checking for Carbon Buildup

Check for carbon particles in the engine or oil system as follows:

(1) Drain the oil from the engine and from the oil tank. Drain oil through a clean cloth which is suitable for filtering (detecting) carbon particles.

(2) Inspect the No. 8 bearing and sump area. Do not remove the oil tube and nozzle. (Refer to appropriate part of Gas Producer Support Pressure Oil Tube, para 7.H., 72–50–00.)

(3) If carbon buildup is detected during the preceding inspections, measure scavenge oil flow and clean as required. (Refer to Oil Flow Measurement, para 7.D., 72–50–00.)

(4) If an external scavenge oil filter is installed, refer to the applicable airframe manual for cleaning instructions.

G. Magnetic Plug Inspection

WARNING: IF A MAGNETIC PLUG WARNING LIGHT COMES ON DURING FLIGHT, LAND AND INSPECT THE MAGNETIC PLUGS AS SOON AS POSSIBLE. THIS LIGHT IS AN INDICATION OF CONDITIONS WHICH COULD CAUSE ENGINE FAILURE. WHEN FLYING A MULTI–ENGINE AIRCRAFT, REDUCE THE AFFECTED ENGINE OUTPUT POWER TO THE MINIMUM REQUIRED FOR FLIGHT AND LAND AS SOON AS PRACTICABLE. IF THE LIGHT IS ACCOMPANIED BY ABNORMAL NOISES, OIL PRESSURE OR TEMPERATURE, AND SINGLE–ENGINE FLIGHT CAN BE MAINTAINED, SHUT DOWN AFFECTED ENGINE AND LAND AS SOON AS PRACTICABLE. IF SINGLE– ENGINE FLIGHT IS NOT POSSIBLE, REDUCE POWER OF AFFECTED ENGINE TO THE MINIMUM AND LAND AS SOON AS POSSIBLE. AFTER LANDING, INSPECT THE MAGNETIC PLUGS ON THE AFFECTED ENGINE FOR METAL CONTAMINATION PRIOR TO FURTHER ENGINE OPERATION.

Two indicating type magnetic drain plugs are installed in the power and accessory gearbox. If a warning light is received in the cockpit, or at scheduled maintenance intervals, remove and visually inspect the magnetic drain plugs. The contamination conditions which may be encountered on the magnetic plugs are defined as follows:

(1) Paste

(a) Paste is the result of fine soft particles which come from normal wear due to gear mesh, bearing rotation and/or spline engagement. These particles mix with oil or soft carbon to form paste.

(b) This condition is normal and is the reason for the 100 hour cleaning interval. Paste generally does not cause a warning light. If a light is encountered, make the magnetic plug check in para 11.G.(3), this section.

(c) Clean magnetic plugs with solvent and brush. Wipe dry with clean cloth or blow dry with filtered shop air. Reinstall, tighten to 60–80 lb in. (6.8–9.0 N·m).

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PARA 11.G. (1) (cont)

NOTE: Heavy accumulations of paste require inspection and cleaning of the magnetic plugs at intervals of 25 to 100 hours. Cleaning paste from the plugs is necessary to ensure that small chips, flakes, and slivers can be detected.

(2) Magnetic Particles

(a) Magnetic particles and debris, chips, flakes, and slivers are possible indications of bearing or gear failure and/or abnormal wear within the engine.

(b) Chips or flakes exceeding 0.03125 in. (0.79 mm) diameter or more than 4 slivers per event are not acceptable.

1 Remove engine and send to a Rolls–Royce Authorized Maintenance Center.

2 Prior to operation of the replacement engine, do the following:

a If a scavenge oil filter is installed and the filter bypass button has not extended, clean the airframe provided engine oil lines and replace the scavenge oil filter.

b Confirm proper operation of the scavenge oil filter impending bypass indicator by performing the STC filter manufactures recommended procedure.

c If the scavenge oil filter has bypassed, if the impending bypass fails the functional test, or if no scavenge filter is installed, clean or replace the scavenge oil filter, oil cooler, oil tank, and lubrication system oil lines per the STC filter and airframe manufacturer instructions. Drain and replace the engine oil.

(c) Chips or flakes less than 0.03125 in. (0.79 mm) diameter or fewer than 4 slivers per event are acceptable.

1 If a warning light is encountered, refer to para 11.G.(3), this section.

2 Reinstall the magnetic plug and tighten to 60–80 lb in. (6.8–9.0 N·m).

(3) Magnetic Light Indication

Perform the following maintenance action as a result of a magnetic chip light indication.

(a) Clean the magnetic drain plugs. Perform a 30–minute ground run at power with the rotor turning. Observe engine operating limits and chip warning lights. If operation is normal, remove, inspect, clean, and reinstall all chip detectors. Return engine to service.

(b) If chips or flakes less than 0.03125 in. (0.79 mm) diameter or fewer than four slivers are encountered during the 30–minute ground run, proceed to the next step.

(c) If a chip light is encountered during the first 30–minute ground run, the following steps must be taken before the second 30–minute ground run.

1 Drain oil.

2 Clean engine oil filter.

3 Flush the aircraft oil system to remove any circulating debris.

4 Clean engine chip detectors.

5 Service engine oil system with fresh, clean oil.

6 Perform a 30–minute ground run at power with rotor turning. Observe engine operating limits and chip warning lights. If operation is normal, remove, inspect, clean and reinstall all chip detectors. Return engine to service.

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7 If a chip light is encountered during the second 30-minute ground run, remove the engine from service and send to a Rolls-Royce Authorized Maintenance Center (AMC). Clean the aircraft engine oil system (Ref. para 11.G.(3)(c), this section).

NOTE: If warning light illuminates within the next eight operating hours following a 30-minute ground run and the cause is determined to be an accumulation of magnetic particles and debris (chips, flakes or slivers), remove the engine and send to an Rolls-Royce Authorized Maintenance Center. Tag engine noting cause for rejection. This note is applicable only after para 11.G.(3)(c), this section, has been completed (Reference Oil Drain and Flush) otherwise this is another event.

(d) A maximum of four (4) occurrences of magnetic chip warning light encountered within any 50 hours of engine operation requires removal of the engine for shipment to a Rolls-Royce Authorized Maintenance Center (AMC).

NOTE: Magnetic light indications where only paste is present must still be counted in the four and 50 hour criteria.

(4) Magnetic Plug Quick Disconnects

If quick disconnect magnetic chip detector plugs are installed, inspect the locking pins and flanged inserts for wear as follows:

(a) Inspect the three locking pins for proper condition and wear. The minimum allowable pin diameter on any one pin is 0.070 in. (1.78 mm). The plug should be replaced by a serviceable item if any one or more pins are worn to less than 0.070 in. (1.78 mm) diameter (Ref. Figure 303).

NOTE: The point of wear is usually on the side of the pin nearest the spring loaded ring. Push the ring back to obtain better access for inspection.

(b) Inspect the insert for proper condition and wear of the locking cam slot. The material remaining between the end of the cam slot and the edge of the insert must be more than 0.068 in. (1.73 mm) (Ref. Figure 303). Replace the insert with a serviceable item if excessively worn. (Refer to Commercial Engine Bulletin M250-C20 CEB 1143 for details of insert replacement.)

NOTE: If local personnel, tooling, and facilities are inadequate, send the gearbox assembly to an Authorized Maintenance Center.

(c) Reinstall serviceable magnetic plug.

(d) Reconnect electrical wiring as applicable.

(e) Replenish engine oil as necessary.

(f) Make the appropriate entry relative to the magnetic plug inspection on the Inspection Check Sheet maintained as a part of the engine records.

(5) Operational Check

(a) If magnetic plugs are removed for scheduled maintenance, perform an operational check prior to reinstallation. Connect harness lead and bridge plug with a suitable conductor. Check each plug separately for proper cockpit indication.

(b) Reinstall magnetic plug, tighten to 60-80 lb in. (6.8-9.0 N·m).

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PARA 11.G. (cont)

(6) Tedeco Manual Zapper

When operating an aircraft utilizing the Tedeco Manual Zapper the following applies:

(a) First Time Chip Light Illuminates

The “Chip Pulse” switch should be activated to “on”.

1 If the chip light goes out after activation of the “Chip Pulse” switch then continue the flight, make a log book entry accordingly and observe engine operation and warning lights.

2 If the chip light remains on after activation of the “Chip Pulse” switch, land and inspect the magnetic plugs as soon as possible. This light is an indication of conditions which could cause engine failure. When flying a multi–engine aircraft, reduce the affected engine output power to the minimum required for flight and land as soon as practical. If the light is accompanied by abnormal noises, oil pressure or temperature, and single–engine flight can be maintained, shutdown affected engine and land as soon as practical. If single–engine flight is not possible, reduce power of affected engine to the minimum and land as soon as possible. After landing, inspect the magnetic plugs on the affected engine for metal contamination prior to further engine operation. Refer to PARA 11.G., this section, and make a log book entry accordingly.

3 If during the 30 minutes following the first activation of the “Chip Pulse” switch, the annunciator light comes on, land as soon as possible. This light is an indication of conditions which could cause engine failure. When flying a multi–engine aircraft, reduce the affected engine output power to the minimum required for flight and land as soon as practical. If the light is accompanied by abnormal noises, oil pressure or temperature, and single–engine flight can be maintained, shutdown affected engine and land as soon as practical. If single–engine flight is not possible, reduce power of affected engine to the minimum and land as soon as possible. After landing, inspect the magnetic plugs on the affected engine for metal contamination prior to further engine operation. Refer to PARA 11.G., this section, and make a log book entry accordingly.

(b) Second Time Chip Light Illuminates

If within a 50 hour period of when the first chip light illuminated, the same chip light illuminates for the second time, follow the same procedures as indicated for the first time the chip light illuminates.

(c) Third Time Chip Light Illuminates

If within a 50 hour period of when the first chip light illuminated, the same chip light illuminates for the third time, do not activate “Chip Pulse”. Land and inspect the magnetic plugs as soon as possible. This light is an indication of conditions which could cause engine failure. When flying a multi–engine aircraft, reduce the affected engine output power to the minimum required for flight and land as soon as practical. If the light is accompanied by abnormal noises, oil pressure or temperature, and single–engine flight can be maintained, shutdown affected engine and land as soon as practical. If single–engine flight is not possible, reduce power of affected engine to the minimum and land as soon as possible. After landing, inspect the magnetic plugs on the affected engine for metal contamination prior to further engine operation. Refer to PARA 11.G., this section, and make a log book entry accordingly.

NOTE: If a magnetic drain plug warning light received in the cockpit is confirmed to be caused by an indicating system malfunction and no metal is found on the magnetic drain plugs, this chip light incident does not count toward the total of four chip lights in 50 hours.

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PARA 11.G. (cont)

(d) Fourth Time Chip LIght Illuminates

If the chip light illuminates a fourth time within 50 hours, do not activate ”Chip Pulse’’. Land as soon as possible. This light is an indication of conditions which would cause engine failure. When flying a multi–engine aircraft, reduce the affected engine output power to the minimum required for flight and land as soon as practical. If the light is accompanied by abnormal noises, oil pressure or temperature, and single–engine flight can be maintained, shutdown affected engine and land as soon as practical. If the single–engine flight is not possible, reduce power of affected engine to the minimum and land as soon as possible. Remove the affected engine and send it to an Authorized Maintenance Center. Tag engine noting the reason for rejection.

(e) If the 50 hour time period is obtained with two or fewer chip light indications, a new 50 hour sequence begins and appropriate adjustments to log entries should be made for previous 50 hour sequence.

(f) Suggested Logging Procedure For Chip Indications

All chip indications, whether physically inspected or zapped, must appear in the engine Maintenance Log. The maintenance records which are available to the pilots should reflect the total number of chip indications for the previous 50 hours so that the pilot can initiate the appropriate procedure if a chip light indication is received in the cockpit during that day’s operational period.

H. Emergency Oil Mix

CAUTION: REMOVE AND INSPECT THE OIL FILTER EACH 25 HOURS OF ENGINE OPERATION IF THE TYPE OF OIL (MIL–L–7808, MIL–L–23699 OR DOD–85734) IS CHANGED.

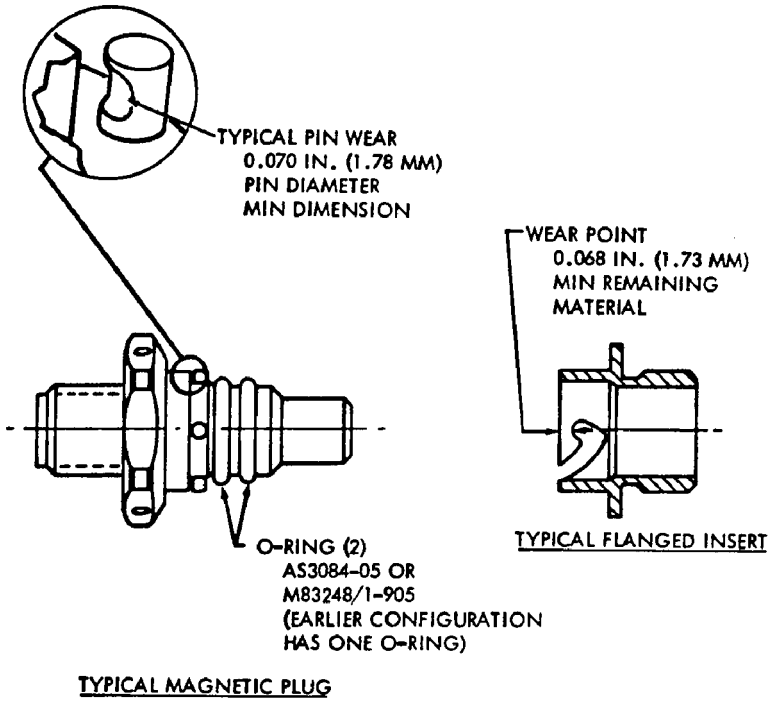
CAUTION: THE FILTER INSPECTION IS TO DETERMINE IF COKE, WHICH WAS FORMED DURING PREVIOUS OPERATION, IS BEING DISLODGED DURING THE INITIAL OPERATION FOLLOWING THE OIL CHANGE.

CAUTION: IF HEAVY CARBON DEPOSITS ARE OBSERVED ON THE ENGINE FILTER, IT IS SUGGESTED THAT THE ENGINE OIL BE CHANGED AGAIN. THE OIL IS TO BE DRAINED WHEN THE OIL IS HOT TO OBTAIN THE MAXIMUM BENEFIT. THE 25–HOUR OIL MONITORING IS TO CONTINUE UNTIL THE NEXT OIL CHANGE PERIOD.

CAUTION: USE OF OILS WHICH ARE NOT INCLUDED IN THE APPROVED OILS LISTING (PARA 4.C.(2), 72–00–00, ENGINE—DESCRIPTION AND OPERATION) OR FAILURE TO DRAIN OIL WITHIN THE PRESCRIBED INTERVAL GIVEN IN TABLE 602, 72–00–00, ENGINE–INSPECTION/CHECK WILL BE CONSIDERED AS MISUSE UNDER ITEM (4) OF THE WARRANTY POLICY.

The emergency use of mixed oils (oils not in the same group; refer to PARA 4.C., 72–00–00, Engine—Description and Operation) is limited to five hours running time. Following an emergency use of mixed oils, drain the system and clean the filter. (Refer to Oil Filter Replacement, PARA 1.C., 72–60–00.) Thoroughly flush the system with engine oil while motoring the engine. Drain and refill with approved oil in accordance with Oil Change, PARA 11.C., this section.

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Quick Disconnect Magnetic Plug Wear Limits
Figure 303

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PARA 11. (cont)

I. Cleaning

Clean the lubrication system as follows:

(1) Clean the oil filter element and filter cavity in accordance with Oil Filter, para 1.C., 72–60–00.

(2) Remove and clean the magnetic drain plug on the forward side of the power and accessory gearbox. (Refer to Magnetic Plug Inspection, para 11.G., this section.) While the magnetic plug is removed, motor the engine with the starter and without ignition long enough to allow one to two ounces (30–59 milliliters) of oil to flow from the opening. Observe flow for restriction and/or for extent of oil contamination. Motoring flushes residual carbon particles from the power and accessory gearbox. Reinstall magnetic drain plug; tighten to 60–80 lb in. (6.8–9.0 N·m) and secure with lockwire.

(3) (250–C20, –C20B, –C20F, –C20J) Detach clamp, then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the coupling nut at the fireshield end of the pressure oil tube; loosen only enough to permit movement of the tube from the connector. Remove the screen at the connector end of the tube. While the tube is disconnected, motor the engine with the starter and without ignition long enough to allow one to two ounces (30–59 milliliters) of oil to flow from the tube. Flush the screen in mineral spirits and shake dry. Reinstall the screen in the pressure oil tube. Attach the tube to the connector. Tighten the coupling nut at the connector end of the tube to 200–250 lb in. (23–28 N·m); tighten coupling nut at the fireshield elbow end of the tube to 80–120 lb in. (9.0–13.6 N·m). Secure tube clamp; tighten clamp nut to 35–40 lb in. (3.9–4.5 N·m).

(4) (250–C20S, –C20W) Disconnect the gas producer and power turbine pressure oil tube at the manifold connector. Loosen the coupling nut at the fireshield end of the pressure oil tube; loosen only enough to permit movement of the tube from the connector. Remove the screen at the connector end of the tube. While the tube is disconnected, motor the engine with the starter and without ignition long enough to allow one to two ounces (30–60 milliliters) of oil to flow from the tube. Flush the screen in mineral spirits and shake dry. Reinstall the screen in the pressure oil tube. Attach the tube to the connector. Tighten the coupling nut at the connector end of the tube to 200–250 lb in. (23–28 N·m); tighten coupling nut at the check valve end on the tube to 80–120 lb in. (9.0–13.6 N·m).

J. System On–condition Maintenance

Perform the following maintenance action following each encounter of magnetic light indication.

(1) If a scavenge oil filter is installed and the filter bypass button has not extended, clean the magnetic drain plugs and the engine oil filter. If the scavenge oil filter has bypassed, clean or replace the scavenge oil filter, oil cooler, oil tank, and lubrication system oil lines per the airframe manufacturer instructions. Drain and replace the engine oil.

(2) Perform a 30–minute ground run at power and observe engine operation and warning light prior to releasing the aircraft for flight. If a warning light is illuminated during 30–minute ground run, remove engine and send to a Rolls–Royce approved repair facility.

(3) If warning light does not illuminate during 30–minute ground run, inspect magnetic plugs for further accumulation of magnetic particles, debris, chips, flakes, and slivers. Chips or flakes less than 0.03125 in. (0.79 mm) diameter or fewer than 4 slivers are acceptable. Clean magnetic plugs using solvent and brush. Wipe dry with clean cloth or blow dry with filtered shop air. Reinstall, tighten to 60–80 lb in. (6.8–9.0 N·m).

(4) If a warning light illuminates within the next eight (8) operating hours following a 30–minute ground run and the cause is determined to be an accumulation of magnetic particles and debris (chips, flakes, or slivers), remove the engine and send it to a Rolls–Royce approved repair facility. Tag engine noting cause for rejection.

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PARA 11. (cont)

(5) A maximum of four (4) occurrences of magnetic chip warning lights encountered within any 50 hours of engine operation requires removal of the engine for shipment to a Rolls–Royce approved repair facility.

NOTE: A magnetic light indication where only paste is present must also be counted in the four occurrences and 50 hour criteria.

12. Preservation and Depreservation

Areas of the engine requiring preservation are the oil system, fuel system and the compressor.

A. Inactive Engine Preservation.

Preserve stored engines (not in shipping container) or any engine installed in stored aircraft as follows:

(1) Preserve the oil system in accordance with Oil System Preservation, para 12.B., this section, if shutdown period will exceed 45 days. Represerve at least each 90 days if stored outdoors and each 180 days if stored indoors.

(2) Preserve the fuel system in accordance with Fuel System Preservation, para 12.C., this section, if shutdown period will exceed 45 days. Represerve at least each 90 days if stored outdoors and each 180 days if stored indoors.

(3) Preserve the compressor and engine gas path in accordance with Compressor Preservation, para 12.D., this section, if warranted by local corrosive conditions. Represerve at least each 30 days if stored outdoors and each 90 days if stored indoors.

(4) Install compressor inlet cover. Attach No. 88 Absorbent Protective Dehydrating Agent, or equivalent (MIL–D–3464) to exhaust collector stack covers and install. Ensure that desiccant does not contact metal surfaces. Inspect desiccant periodically (based on local humidity conditions) and rejuvenate as necessary.

(5) During storage use a flagged wedge to hold the compressor bleed valve closed. Also, cover the diffuser vent orifice hole and gearbox overboard vent.

(6) Store engines indoors if not installed in an aircraft or engine shipping container. It is recommended that installed engines be stored indoors if possible.

B. Oil System Preservation.

If the engine will be inactive for over 45 days, the oil system shall be preserved as follows:

(1) For engines not installed in airframe or shipping container

(a) Remove oil filter cap and magnetic plugs. Service as necessary.

(b) Using 6799790 adapter and speed handle, turn engine while supplying clean, approved engine oil to the filter housing. Continue until fresh oil drains from gearbox.

(c) Disconnect the oil scavenge lines (two) from the turbine sumps. Remove the oil from these sumps with a suction pump or aspirator. Reconnect lines after oil has been removed.

(d) Install new packings on filter cap and magnetic plugs. Install cap and plugs. (Refer to Oil Filter Replacement, para 1.C., 72–60–00 and to para 11.C., this section.)

(2) For operable engines installed in airframe:

(a) Service engine oil system (Refer to para 11.C., this section.)

CAUTION: DO NOT EXCEED AIRFRAME MANUFACTURER STARTER ENGAGEMENT LIMITS.

(b) Motor engine approximately one minute to ensure oil flow to all engine bearings.

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PARA 12. (cont)

C. Fuel System Preservation.

If the engine will be stored for over 45 days the fuel system shall be preserved as follows:

(1) For engines not installed in airframe:

(a) Remove the hose from the fuel nozzle; place the open hose end in a bucket.

(b) Loosen the clamp supporting the two tubes (P_0) and (P_1) between the fuel control and the fuel pump. Remove the control bypass (P_0) tube and plug the (P_0) opening in the fuel control.

(c) Supply filtered (10 micron) MIL–L–6081 grade 1010 oil (Atlantic Refining Co. No. 31100 or equivalent) or alternate MIL–L–7870A oil (Gulf Oil Corp. Gulflite 6 or equivalent) at 50 psig (345 kPag) to the fuel inlet of a static engine.

(d) (250–C20, –C20B, –C20F, –C20J) Move the throttle out of the FUEL OFF position.

(e) (250–C20S, –C20W) Move the fuel control cutoff lever to the open position.

(f) When oil is observed flowing into the container, remove the oil supply to the pump and move the gas producer lever to FUEL OFF or the the fuel control cutoff lever to the closed position.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(g) Permit the excess oil to drain from the fuel system before removing the plug and reassembling the fuel system components. Tighten hose coupling to 80–120 lb in. (9.0–13.6 N·m); tighten (P_0) tube coupling nuts to 150–200 lb in. (17–23 N·m); tighten clamp nut to 35–40 lb in. (3.9–4.5 N·m).

(2) For operable engines installed in airframe:

(a) Remove the hose from the fuel nozzle; place the open hose end in a bucket.

(b) Supply MIL–L–6081 grade 1010 oil (Atlantic Refining Co. No. 31100 or equivalent) or alternate MIL–L–7870A oil (Gulf Oil Corp. Gulflite 6 or equivalent) to the fuel pump inlet.

CAUTION: DO NOT EXCEED STARTER LIMITATIONS WHILE MOTORING THE ENGINE.

(c) (250–C20, –C20B, –C20F, –C20J) Move the throttle to the IDLE detent and motor the engine with the starter (without ignition). When oil is observed flowing into the bucket, move the throttle to the FUEL OFF position. Remove the oil supply to the pump inlet.

(d) (250–C20S, –C20W) Move the Fuel Cutoff Lever to the FUEL ON position and motor the engine with the starter (without ignition). When oil is observed flowing into the bucket, move the Fuel Cutoff Lever to the FUEL OFF position. Remove the oil supply to the pump inlet.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(e) Permit excess oil to drain from the fuel control then reinstall the fuel line. Tighten hose coupling to 80–120 lb in. (9.0–13.6 N·m).

(f) Depreserve the fuel system by purging preservative oil and/or air from the fuel system. (Refer to Purging the Fuel System, para 2.D., 73–00–00.)

D. Compressor Preservation

Application of preservative to the compressor shall be made as warranted by local corrosive conditions encountered. In no case shall the shutdown period exceed 5 days in a corrosive environment without preserving the compressor.

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PARA 12.D. (cont)

(1) For engines not installed in airframe.

(a) Disconnect the fuel system pressure sensing (P_c) line from the P_c filter at the diffuser scroll. Hold the P_c filter while disconnecting the coupling nut. (On configurations without a P_c filter, disconnect this line from the elbow at the scroll.) Cap the line and the P_c filter. (Plug the elbow on configurations without the P_c filter.)

(b) Disconnect the bleed control valve pressure sensing (P_c) line from the elbow at the diffuser scroll. Cap the line and the elbow.

(c) Block the bleed control valve in the closed position using 6886204 compressor protector cleaning kit.

(d) Retain the anti–ice valve in the closed position.

(e) Turn the compressor rotor using a splined adapter and speed wrench at the spare pad on the rear of the gearbox (adjacent to governor). Spray the preservative (Rust–Lick No. 606, Rocket WD40, or equivalent) into the compressor inlet while the rotor is being turned. Apply preservative using an aerosol pressure–type spray can. Hold the can 8 to 12 in. (20–30 cm) in front of the compressor. Allow the preservative to be drawn into compressor for 15 to 20 seconds while spraying in a circular motion which covers entire intake area.

(f) Reconnect the control system and bleed control valve pressure sensing lines. Tighten coupling nuts to 80–120 lb in. (9.0–13.6 N·m). On configurations having a P_c filter, hold the filter while tightening the coupling nut.

(g) Remove the wedge which was used to block the bleed control valve in the closed position.

(h) Install the inlet and exhaust collector covers and keep the engine in a static condition after preservative application.

(i) Before starting the engine, remove the preservative and soft contaminants by water rinsing and drying the compressor in accordance with the procedure given in Compressor Cleaning, para 6., 72–30–00.

CAUTION: EXCEPTION TO THE RECOMMENDED WATER RINSE IS FOR PRESERVATIVE REMOVAL ONLY, AND DOES NOT ALTER THE REQUIREMENT FOR DAILY WATER RINSE FOLLOWING EXPOSURE TO A SALT WATER ENVIRONMENT. (REFER TO COMPRESSOR CLEANING, PARA. 6., 72–30–00.)

NOTE: Operation of the engine prior to removal of compressor preservative may contribute to early contamination of the compressor blades with a resultant decrease in compressor efficiency. The recommended water rinse may be omitted only if available power is closely monitored and a compressor cleaning schedule is established.

(2) For operable engine installed in airframe.

NOTE: To prevent the preservative from baking dry, be sure the compressor is cool to the touch (bare hand) before application is made.

(a) Disconnect the fuel system pressure sensing (P_c) line from the P_c filter at the diffuser scroll. Hold the P_c filter while disconnecting the coupling nut. (On configurations without a P_c filter, disconnect this line from the elbow at the scroll.) Cap the line and the P_c filter. (Plug the elbow on configurations without the P_c filter.)

(b) Disconnect the bleed control valve pressure sensing (P_c) line from the diffuser scroll. Cap the line and the scroll fitting.

(c) Block the bleed control valve in the closed position using the 6886204 compressor protector cleaning kit.

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PARA 12.D. (2) (cont)

(d) Retain the anti–ice valve in the closed position.

CAUTION: DO NOT EXCEED 10% N_1 RPM MOTORING SPEED. DO NOT INJECT A SOLID STREAM OF FLUID INTO THE COMPRESSOR.

(e) Spray 4 oz. (0.1 liter) of preservative into the engine while it is being motored with the starter and without ignition (ignition circuit breaker pulled). Use Rust–Lick No. 606, Rocket WD–40, or equivalent for preservation. Use a sprayer with a quick opening valve and a nozzle sized to spray 4 oz. (0.1 liter) of preservative in 1 to 3 seconds. Hold the can of sprayer 8 to 12 in. (20–30 cm) in front of the compressor. Allow the preservative to be drawn into the compressor while spraying in a circular motion which covers the entire intake area. As an alternate method of application use an aerosol pressure–type spray can. Spray preservative from the can for 15 to 20 seconds while the engine is being motored. Spray in a circular motion which covers the entire intake area.

(f) Reconnect the control system and bleed control valve pressure sensing lines. Tighten coupling nuts to 80–120 lb in. (9.0–13.6 N·m). Hold the P_c filter while tightening the coupling nut.

(g) Remove the wedge which was used to block the bleed control valve in the closed position.

(h) Install the inlet and exhaust collector covers and keep the engine in a static condition after spraying with preservative.

(i) Before starting the engine, remove the preservative and soft contaminants by water rinsing and drying the compressor in accordance with the procedure given in Compressor Cleaning, para 6., 72–30–00.

CAUTION: EXCEPTION TO THE RECOMMENDED WATER RINSE IS FOR PRESERVATIVE REMOVAL ONLY, AND DOES NOT ALTER THE REQUIREMENT FOR DAILY WATER RINSE FOLLOWING EXPOSURE TO A SALT WATER ENVIRONMENT. (REFER TO COMPRESSOR CLEANING, PARA 6., 72–30–00.)

NOTE: Operation of the engine prior to removal of compressor preservative may contribute to early contamination of the compressor blades with a resultant decrease in compressor efficiency. The recommended water rinse may be omitted only if available power is closely monitored and a compressor cleaning schedule is established.

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ENGINE-ADJUSTMENT/TEST

1. Check Run

   A. Operating Instructions.

   NOTE: Operators are recommended to do the oil pump priming (Ref. 72-60-00, para 3.B.) whenever an engine is installed to make sure that oil gets to the internal bearings.

   Check run the engine in the airframe when the compressor assembly, compressor case, turbine assembly, combustion section, gearbox, fuel control, governor, fuel pump, fuel nozzle, or thermocouple has been removed, repaired or replaced. Operate the engine in accordance with Operating Procedures, para 7, (M250-C20, -C20B, -C20F, -C20J), para 8, (M250-C20S, -C20W), 72-00-00, Engine--Description and Operation. Make note of all incidents of the run such as leaks, abnormal vibration or noises, and/or any irregular functioning of engine equipment. Also note that the following items are within limits (Refer to Operating Limits, para 6., 72-00-00, Engine--Description and Operation):

   (1) Measured gas temperature. (See Table 8 or 9, 72-00-00, Engine--Description and Operation.)

   (2) Output shaft torque. (See Table 10, 11 or 12, 72-00-00, Engine--Description and Operation.)

   (3) Oil pressure. (Refer to Oil Pressure and Temperature, para 6.D., 72-00-00, Engine--Description and Operation.)

   (4) Gas producer N_1 speed. (Refer to Engine Speed, para 6.A., 72-00-00, Engine--Description and Operation.)

   (5) Power turbine N_2 speed. (Refer to Engine Speed, para 6.A., 72-00-00, Engine--Description and Operation.)

   B. Diffuser Vent Orifice Selection

   Select and install the diffuser vent orifice as follows:

   (1) Install a -7 size orifice on the diffuser vent tube. (See Figure 501.)

   (2) Clean the area around the orifice.

   CAUTION: DO NOT INSTALL A SMALLER ORIFICE (LOWER DASH NUMBER) THAN THAT REQUIRED TO STOP SPEWING OR SMOKING AT THE VENT.

   (3) Following the next flight of at least five minutes' duration, inspect the area around the orifice. If there is any evidence of smoking or spewing from the vent, reduce the orifice size by installing the next lower dash number orifice.

   (4) Repeat the flight, inspection, and orifice replacement until no evidence of spewing or smoking is encountered.

   (5) As an alternate method for obtaining the desired orifice size, start with two -2 size orifices (No. 1 and No. 2).

      (a) Drill out No. 1 orifice to 0.236-0.244 in. (5.994-6.198 mm). No. 1 orifice then becomes a -3 orifice. If No. 1 does not smoke when checked during engine operation, resize No. 2 orifice.

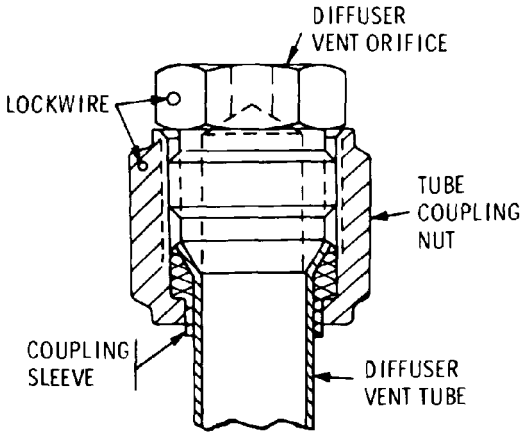
      NOTE: When smoking is encountered, reinstall the previously drilled smaller orifice that did not smoke.

      (b) Drill out the No. 2 orifice to 0.266-0.274 in. (6.76-6.96 mm). No. 2 orifice then becomes a -4 orifice. If No. 2 does not smoke when checked during engine operation, resize No. 1 orifice.

      (c) Drill out the No. 1 orifice to 0.296-0.304 in. (7.52-7.72 mm). No. 1 orifice then becomes a -5 orifice. If No. 1 does not smoke when checked during engine operation, continue alternately enlarging the No. 1 then the No. 2 orifice by one dash number size until the desired orifice is obtained.

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ADG092XD

Diffuser Vent Orifice Installation
Figure 501

PARA 1.B. (cont)

(6) Record the size of the finally selected orifice (by dash number) in the Engine Log.

C. Check Run Schedule

Check run the engine in the airframe in accordance with the following schedule:

Setting No.	Condition
1	Start engine and accelerate to Ground Idle. N_1 = 59–65% Observe engine oil pressure. Observe engine for abnormal conditions such as vibration, noise or leakage. Visually inspect all engine oil and fuel fittings to confirm no leaks are present before proceeding. Duration of run need not exceed five (5) minutes.
2	(250–C20, –C20B, –C20F, –C20J) Accelerate to a power setting just short of lift off. (250–C20S, –C20W) Accelerate to 100% N_1 and minimum power. Stabilize for five (5) minutes.
3	Reduce speed to Ground Idle. Check operation of anti–ice valve. Dwell for two (2) minutes.
4	Shut down.

NOTE: Give the engine a thorough visual inspection after shutdown. Repeat the check run if any repairs are necessary as a result of the run or the inspection.

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PARA 1. (cont)

D. Propeller Check Run.

(250–C20S) Following removal and replacement of the engine or the propeller, purge trapped air from the propeller oil system. Refer to the Aircraft Maintenance Manual. Purge the prop oil system and subject the propeller to a run cycle during ground operation prior to the first flight using the following check run:

(1) Perform a normal start.

(2) Advance the Power Lever to the highest power attainable during ground operation.

(3) Return the Power Lever to Ground Idle.

(4) Perform a normal shutdown.

(5) Repeat the procedure, steps a. through d., a second time.

2. Vibration Test Procedure

A. Description of Vibration Test Procedure

(1) The vibration test procedure will aid in evaluating vibration, identifying vibration sources and analyzing vibration levels so that corrective action may be taken. Continued engine operation with high vibration levels will cause excessive engine and component wear and can contribute to engine failure and premature engine removal.

(2) Engine vibration may be influenced by factors including aircraft installation, accessories, normal wear, maintenance practices, or unusual operating conditions. By measuring the frequency and magnitude of a vibration, then comparing the measurements with known vibration factors, such data may be used to obtain an indication of the engine area requiring corrective action.

(3) Vibration is a mechanical oscillation or motion about a reference point. Engine–induced vibration is generally observed at frequencies equal to N_1 or N_2 rotor speeds, gear rotational speed, gear mesh frequency, or bearing passage rate. In some instances, the vibration also appears as a harmonic or multiple of the basic frequency.

(4) Vibration pickups (transducers) are used to convert vibration motion to an electrical signal. These pickups may be calibrated in terms of vibration displacement (“mils”), acceleration (“G’s”), or velocity (“IPS”). Velocity is the most meaningful measure of vibration on Model 250 engines.

(5) A vibration signature should be performed on each engine or aircraft using a spectrum analyzer. The signature should be repeated at scheduled intervals, such as 100 hours, and a file should be maintained for each engine–aircraft combination. When a major change in the frequency response is noted, such as the level changing from 0.2 IPS to 0.6 IPS, closer monitoring should be maintained on such engine.

(6) Signatures should be taken with pickups installed in the vertical axis on the compressor, gearbox and turbine. The signatures should be taken at several specified N_1 speeds while the aircraft is on the ground; these N_1 speed points are to be used for each signature. An overall vibration reading can be obtained by using the broad band control on a Chadwick–Helmuth Model 192 analyzer, which is the equipment used in the following procedures.

(7) The test chart (See Vibration Recording Sheet, Figure 502) contains a number of test points. A vibration trend monitoring program can be initiated on an aircraft by using this chart to set the baseline. The monitoring program should be maintained by using points 3, 5 and 6 on Figure 502 at the specified intervals (100, 150, 200 hours, etc.). Any time there is a major variance in charted readings, or whenever high vibrations are indicated, a complete vibration survey should be made prior to initiating troubleshooting.

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VIBRATION RECORDING SHEET

AIRCRAFT TYPE: _____
AIRCRAFT SERIAL: _____
ENGINE SERIAL NUMBER: _____
GEARBOX SERIAL NUMBER: _____
COMPRESSOR SERIAL NUMBER: _____
TURBINE SERIAL NUMBER: _____

DATE: _____
TIME SINCE NEW: _____
ENGINE TSN/TSO: _____
GEARBOX TSN/TSO: _____
COMPRESSOR TSN/TSO: _____
TURBINE TSN/TSO: _____

	ALTITUDE	OAT	N_2	N_1 TORQUE	IPS BROAD BAND	NOTES
1					A/C B/D	GROUND IDLE
2			85%		A/C B/D	SEE FIGURE 502 SHEET 2
*3			100%		A/C B/D	FLAT PITCH
4			100%	87%	A/C B/D	
*5			100%	95%	A/C B/D	
*6			100%	95%	A/C B/D	USE GREEN CARD
7			100%		A/C B/D	**SEE NOTE 1
8			100%		A/C B/D	***SEE NOTE 2

* USED FOR ENGINE MONITORING PROGRAM.

** NOTE 1. DO NOT EXCEED ANY ENGINE/TRANSMISSION OR AIRCRAFT FLIGHT LIMITS UTILIZE MAXIMUM ALLOWABLE POWER AND MAINTAIN LEVEL FLIGHT.

*** NOTE 2. CLIMB 3000 FEET ABOVE THE ALTITUDE RECORDED IN CHECK #7 AND PERFORM MAXIMUM ALLOWABLE POWER CHECK (MAINTAIN LEVEL FLIGHT).

-- USE BLUE CARDS ON ALL CHECKS UNLESS OTHERWISE NOTED.

-- DEPRESS BROAD BAND SWITCH AT MAXIMUM RPM AND RECORD READING.

-- USE 10 IPS SIDE OF RECORDING CHART.

-- USE THREE PICKUPS ON THE NORMAL ENGINE VIBRATION PICKUP POINTS.

-- ALL THREE PICKUP POINTS CAN BE ON ONE CARD PROVIDING DIFFERENT COLORED PINS ARE USED AND THEY ARE APPROPRIATELY MARKED.

Vibration Recording Sheet
Figure 502 (Sheet 1)

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Series II 3rd Stage Wheel P/N	N2 Speed Avoid Range
23001967	No Limitations*
23065818	75-88%*
23065833	
-With Calibrated N2 Indication	
System (Zero Error)	87-95%*
-A109	85-97%*
-B206L	84.5-97.5%*
-BO105	86.5-95.5%*

*Reference CEB 1400, 72-4095, TP 1343, TP 72-2091

Vibration Recording Sheet
Figure 502 (Sheet 2)

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PARA 2. (cont)

B. Glossary of Terms

The following terms are included in the vibration test procedure:

ACCELERATION	Rate of change of velocity with time along a specified axis. Usually expressed as ‘‘G’s”, or gravitational units.
AVERAGE	Peak value multiplied by 0.637.
CYCLE	An interval of time during which sequence of a recurring succession of events is completed. In the case of vibration, one complete performance of a vibration.
DISCRETE FREQUENCY	A measure of vibration response at one frequency only.
DISPLACEMENT	Specifies change of position in mils. Usually measured from mean position (or position of rest) and applies to linear motion, although it can apply to angular motion.
FREQUENCY	A measure of vibration response expressed in Hertz (Hz).
HERTZ (Hz)	A measurement of the frequency of a vibration. Also, cycles per second (CPS) is sometimes used in association with frequency.
OVERALL	A vibration measurement of all frequencies as read on an average detecting meter.
PEAK	The extreme value of a varying quantity. Measured from zero, or mean value. Peak to peak is 2 times a peak level.
VELOCITY	Refers to rate of change of displacement with time along a specified axis; quickness of motion. Usually measured in Inches Per Second (IPS).

C. Equipment Requirements

(1) Equipment consists of transducers (pickups), brackets, attachment hardware, cables and a spectrum (frequency) analyzer with plotter. The equipment must function as an integrated system capable of vibration measurement over a minimum range of 15 to 1500 Hz (900 to 90,000 rpm); higher ranges are desirable. The system must be capable of measuring vibration levels from at least 0.050 to 5 IPS average velocity.

(2) Currently acceptable equipment is listed below.

(a) Chadwick–Helmuth Model 192, 192A, and 8500 Analyzer/Plotter with Model 7570 High Temperature Velometer Kits

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(b) Rotorturner by MCT Helitune

(c) Scientific Atlanta Model 2538

(d) Helitune Quan-Tech 9500 Spectrum Analyzer

(e) GE Aviation Systems Model RADS-AT

(f) Dynamic Solutions Systems, Inc. MicroVibe II

(g) SKF Model Microlog MX, Microlog GX

(h) ACES Systems Model 2015, 2020, and 4040

(3) Other equivalent units may also be utilized.

D. Test Procedure

CAUTION: PERFORMANCE OF THIS PROCEDURE REQUIRES KNOWLEDGE OF BOTH ENGINE AND AIRCRAFT MAINTENANCE PROCEDURES. REFER TO THE RESPECTIVE OPERATION AND MAINTENANCE MANUALS.

CAUTION: SECURE PICKUP LEAD WIRES TO PREVENT ENTANGLEMENT WITH AIRCRAFT CONTROL LINKAGES. ROUTE LEAD WIRE TO PREVENT SURFACE CONTACT WITH ENGINE.

NOTE: The following procedures apply to use of the Chadwick Model 192 analyzer. Operational procedures for other analyzers will be similar.

(1) Install vibration pickups vertically on each engine module as shown in Figure 503 and in the following instructions.

(a) Compressor. Install one vertical vibration pickup on the front side of the compressor-to-inlet housing splitline at the 12 o'clock position. Use a balance "T"-type bracket, such as Rolls-Royce part number 23032992 (see Figure 504) or use the equipment manufacturer's bracket.

(b) Gearbox. Install one vertical vibration pickup on the engine top mounting pad (bottom mounting pad on M250-C20S, -C20W) on the power and accessory gearbox. Use bracket such as Rolls-Royce part number 23032993. (See Figure 505.)

CAUTION: THE TURBINE PICKUP MUST BE A HIGH TEMPERATURE PICKUP IN ORDER TO WITHSTAND THE EXTREME HEAT OF THE TURBINE CASE.

NOTE: The bracket below fastens on the forward side of the splitline.

(c) Turbine (M250-C20, -C20B, -C20F, -C20J). Install one vertical vibration pickup on the forward side of the gas producer-to-power turbine support splitline at the 12 o'clock position. Use a balance "T"-type bracket such as Rolls-Royce part number 23032992 (see Figure 504) or use the equipment manufacturer's bracket.

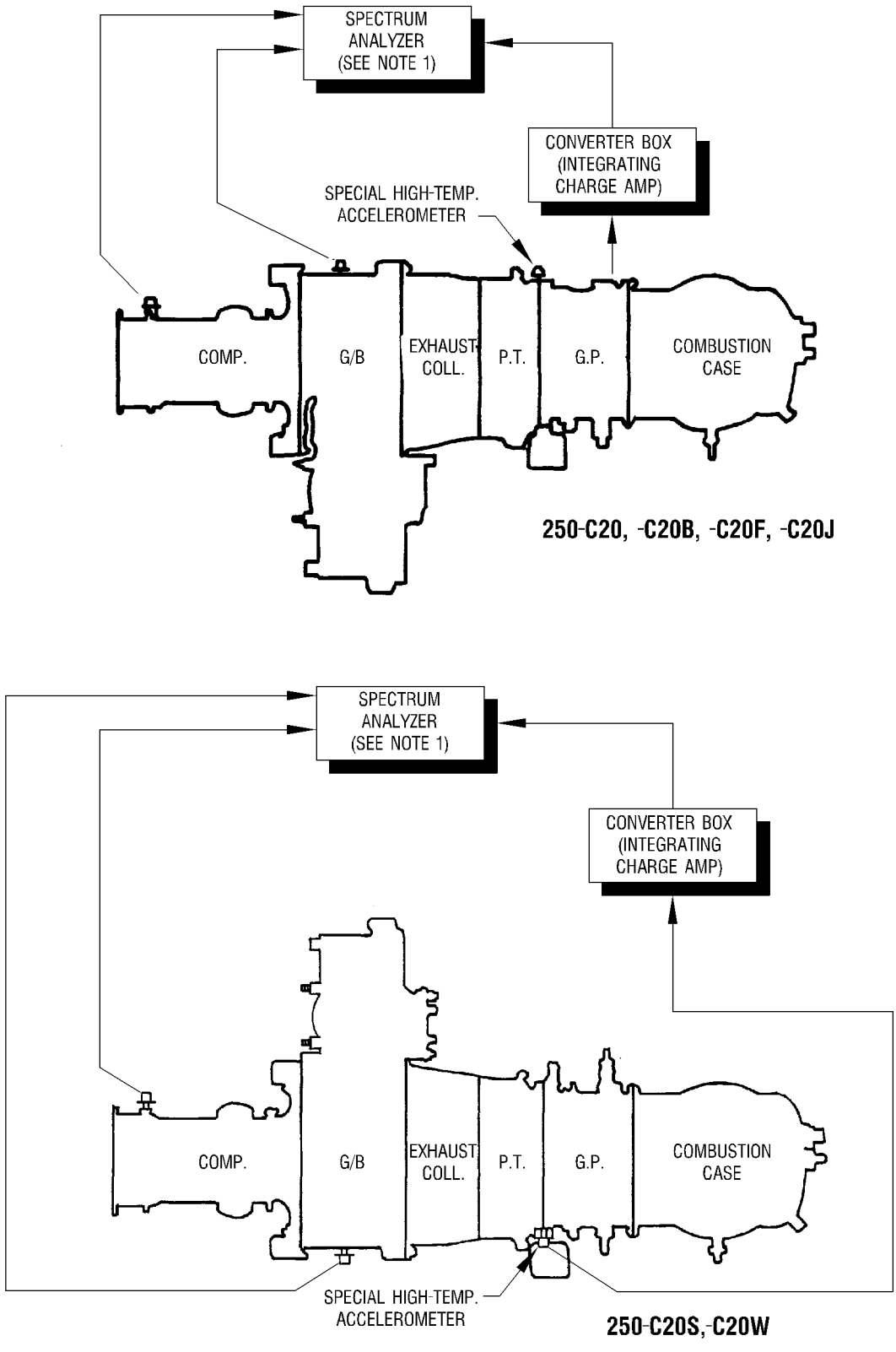
(d) Turbine (M250-C20S, -C20W). Install one vertical vibration pickup on the forward side of the gas producer-to-power turbine support splitline at the 6 o'clock position. Use a balance "T"-type bracket such as Rolls-Royce part number 23038047 (see Figure 506) or use the equipment manufacturer's bracket.

CAUTION: BE SURE THAT THE SPECTRUM ANALYZER AND VIBRATION PICKUPS ARE PROPERLY CALIBRATED. REFER TO MANUFACTURER CALIBRATION EQUIPMENT AND PROCEDURES. IT IS RECOMMENDED THAT PICKUPS BE CALIBRATED BEFORE EACH USE OR WHENEVER OUT-OF-NORMAL VIBRATION LEVELS ARE DETECTED, WITH MINIMUM CALIBRATION TIME EVERY SIX MONTHS.

(2) Using the blue card (10 IPS side) in the spectrum analyzer, measure the frequency range desired at any test point except test point 6. (See Figure 507.)

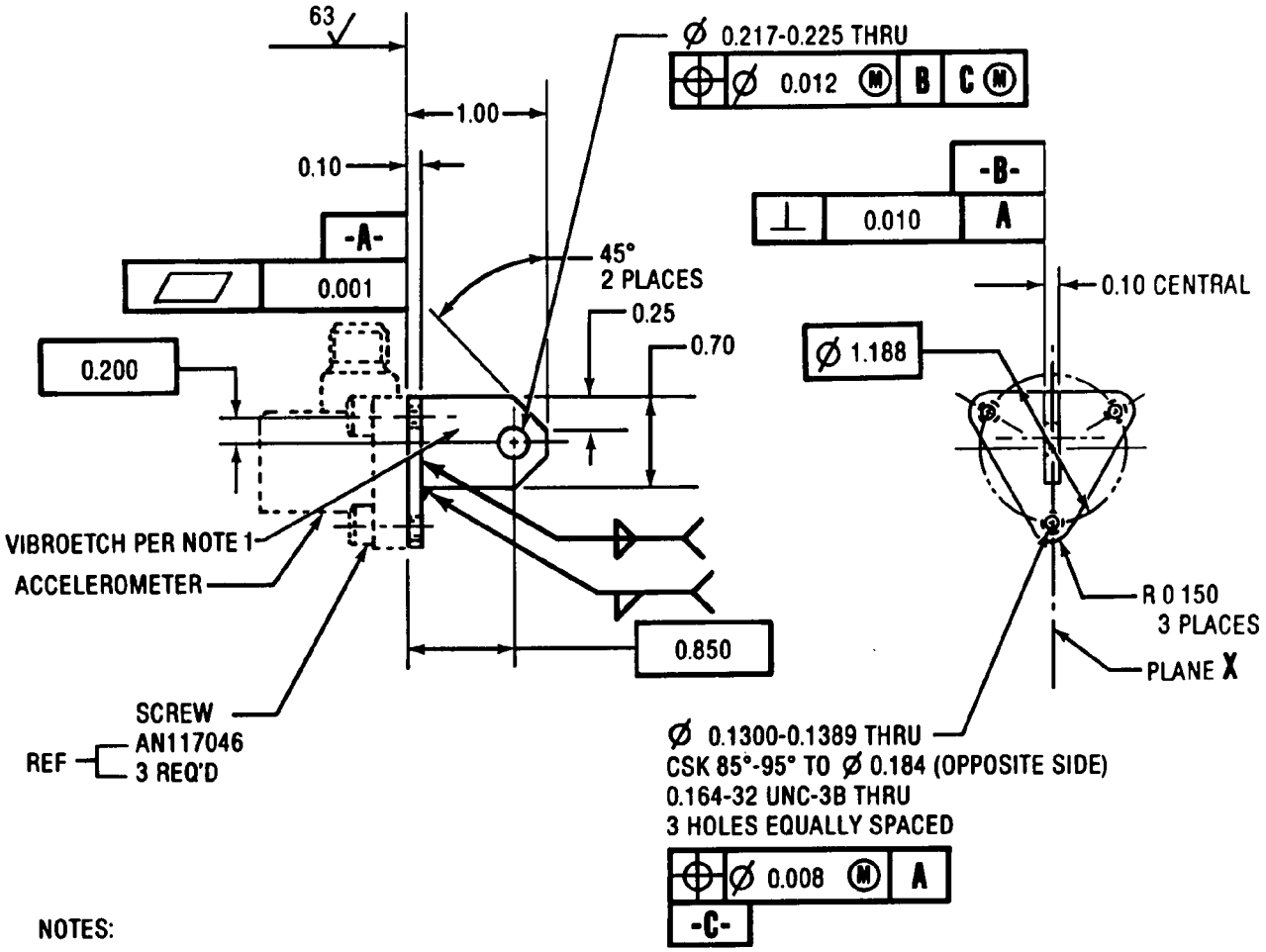
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Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



Installing Vibration Pickups
Figure 503

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NOTES:

1. MARK AS SPECIFIED IN LOCATION SHOWN WITH 1/8-3/16 HIGH FIGURES THE FOLLOWING:
   a) THE NAME "ALLISON" FOLLOWED BY THE TOOL NUMBER 23032992
   b) VENDOR NAME OR TRADEMARK
2. BREAK SHARP EDGES 0.020 UOS
3. SURFACE FINISH 125 UOS
4. MATERIAL-300 SERIES STAINLESS STEEL
5. TOL ON 3 PLACE DECIMALS ± 0.010
6. TOL ON 2 PLACE DECIMALS ± 0.02

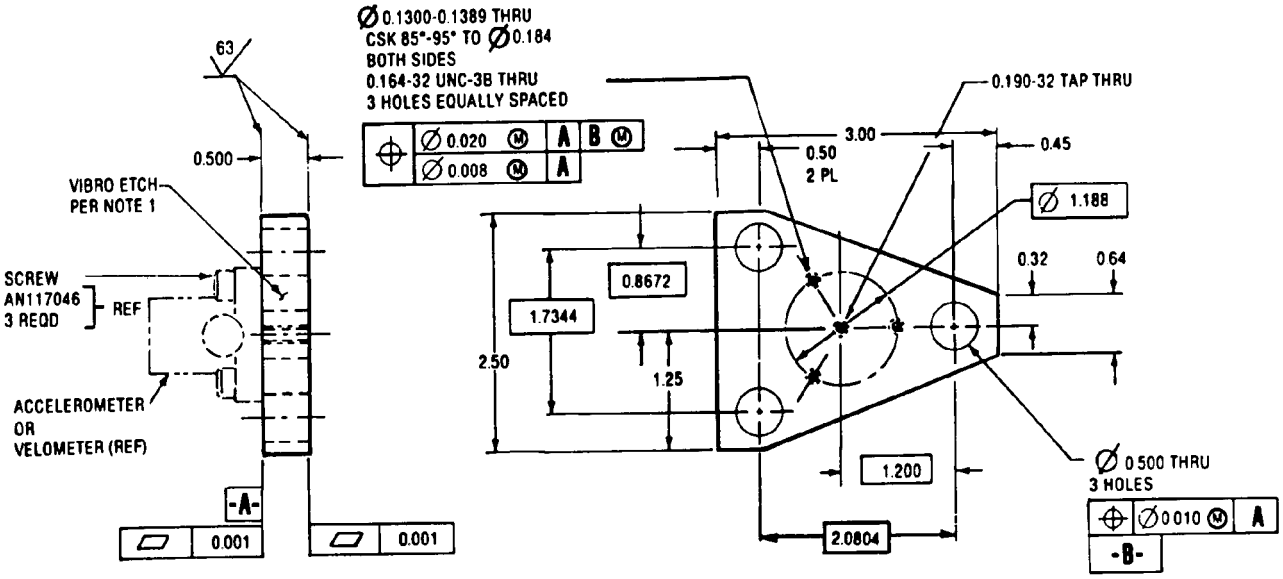
ACCELEROMETER CONNECTOR MUST LIE IN PLANE X

VIBRATION RESONANCE WITH PICKUP MOUNTED IS:	
DIRECTION	FREQ. - HERTZ
NORMAL TO SURFACE B	1120 - 1150
NORMAL TO SURFACE A	ABOVE 2000
PARALLEL TO SURFACES A AND B	245 - 290

AEY004XA

Accelerator Mounting Bracket P/N 23032992
Figure 504

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NOTES:

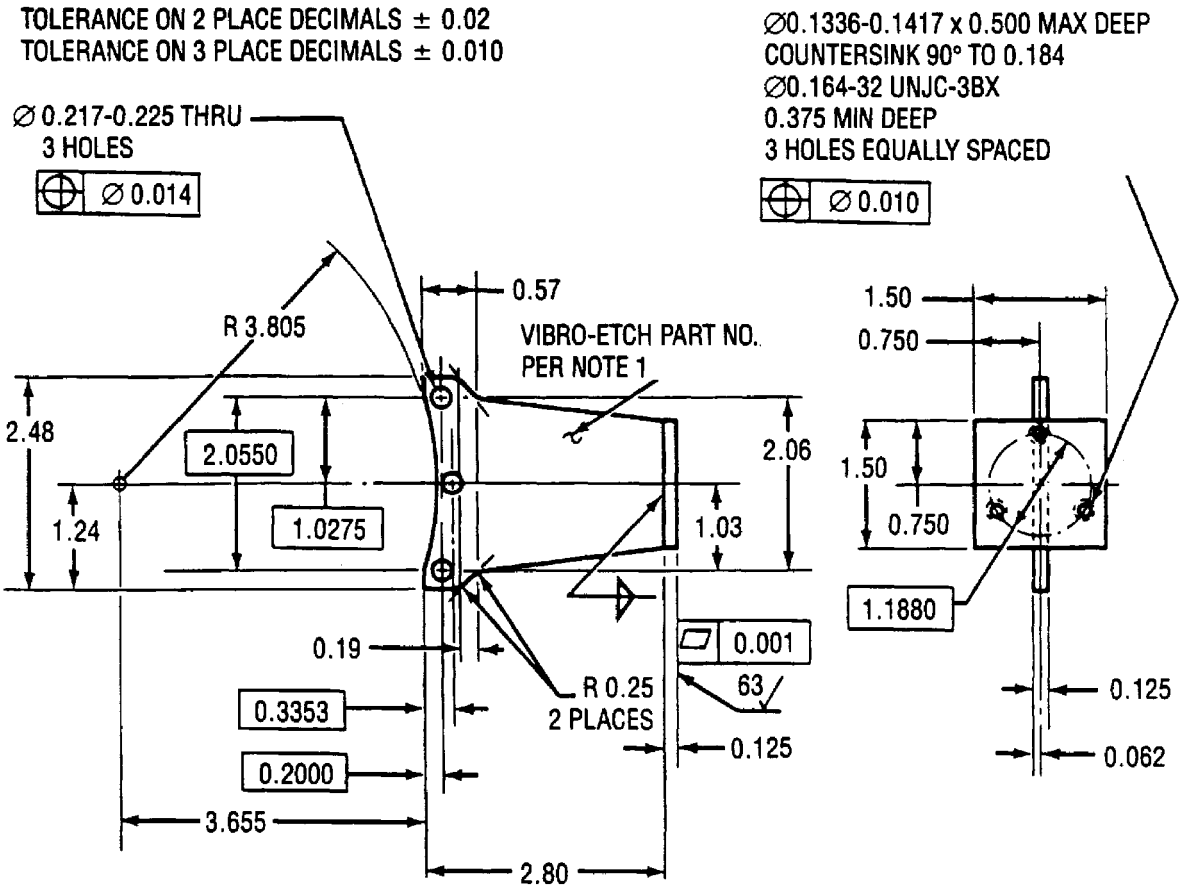
1. MARK AS SPECIFIED IN LOCATION SHOWN WITH 1/8-3/16 HIGH FIGURES THE FOLLOWING:
   a) THE NAME "ALLISON" FOLLOWED BY TOOL NUMBER 23032993
   b) VENDOR NAME OR TRADEMARK
2. BREAK SHARP EDGES 0.020 UOS
3. SURFACE FINISH 125 UOS
4. MATERIAL - 300 SERIES STAINLESS STEEL
5. TOL ON 3 PLACE DECIMALS ± 0.010
6. TOL ON 2 PLACE DECIMALS ± 0.02

NOTE: BRACKET MOUNTING HOLE PATTERN IS INTENTIONALLY SLOPPY ENOUGH TO ALLOW THE USE OF THIS BRACKET ON ALL SERIES ENGINES.

AEY005XF

Accessory Gearbox Mounting Pad P/N 23032993
Figure 505

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



NOTES:

1. MARK AS SPECIFIED IN LOCATION SHOWN
   WITH 1/8"-3/16" HIGH FIGURES THE FOLLOWING:
   a) THE NAME "ALLISON" FOLLOWED BY TOOL NUMBER 23038047
   b) VENDOR NAME OR TRADEMARK
2. REMOVE BURRS AND SHARP EDGES UOS
3. MACHINED SURFACES MAY BE 250 UOS
4. MATERIAL 300 SERIES STAINLESS STEEL
5. ATTACH PICKUP TO BRACKET WITH 3 AN 117046 (#8-32 x 0.50 LG) SCREWS SAFETY WIRE
6. USE 3 MS 9432-10 TEE HEAD BOLT FOR MOUNTING BRACKET TO SPLITLINE FLANGE
7. WELD SYMBOLS PER ANSI/AWSA 2.4

ADG094XA

Accelerometer Bracket, 250–C20S, –C20W, Turbine Vertical, P/N 23038047
Figure 506

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

PARA 2.D. (cont)

(3) Using the green–border card (10 IPS side) in the spectrum analyzer, measure the frequency range desired at test point 6. (See Figure 508.)

(4) Secure cowlings as required by aircraft flight manual for safe ground and flight operation.

CAUTION: ENSURE THAT ENGINE AND TRANSMISSION LIMITS ARE NOT EXCEEDED ON THE GROUND OR IN FLIGHT DURING THE TEST SEQUENCE. REFER TO APPLICABLE ENGINE/AIRFRAME MANUALS.

(5) Start engine to idle. Operate engine as necessary to bring oil system to normal operating temperature range.

(6) Record data indicated below:

(a) Ground Operation:

Record applicable vibration data. (See Figure 502.) Record as many test points as possible before flying.

CAUTION: PRIOR TO OPERATION IN FLIGHT, BE SURE THAT ALL EQUIPMENT AND CABLES ARE SECURED AND DO NOT INTERFERE WITH THE OPERATION OF THE ENGINE OR AIRCRAFT FLIGHT CONTROL SYSTEM.

(b) Flight Operation:

Fly the aircraft and record the remaining test points.

NOTE: Current average limits for discrete frequencies are 1.0 IPS, with an overall average of 1.5 IPS.

(7) Determine if maintenance action is indicated by comparing the newly acquired data with previously recorded data and with maximum allowable limits. (See Figure 509.)

E. Interpretation of Data

The first step is to determine if the vibration is airframe or engine related. Any rotational speed below 6000 rpm (100 Hz) is usually airframe related, because the slowest rotational speed of the engine is the power output shaft at 6000 rpm (except for some accessory drives).

Typical engine vibration signature cards are shown in Figures 507 and 508. These curves represent the peak vibration velocity for frequencies between 5,000 and 900,000 rpm. Analysis of this signature is accomplished as follows:

(1) Determine the vibration frequencies (rpm) and vibration velocity amplitude (IPS peak) of the major vibration peaks on the plot cards. Then convert these values to inches per second (IPS) average velocity.

Conversion Factors:

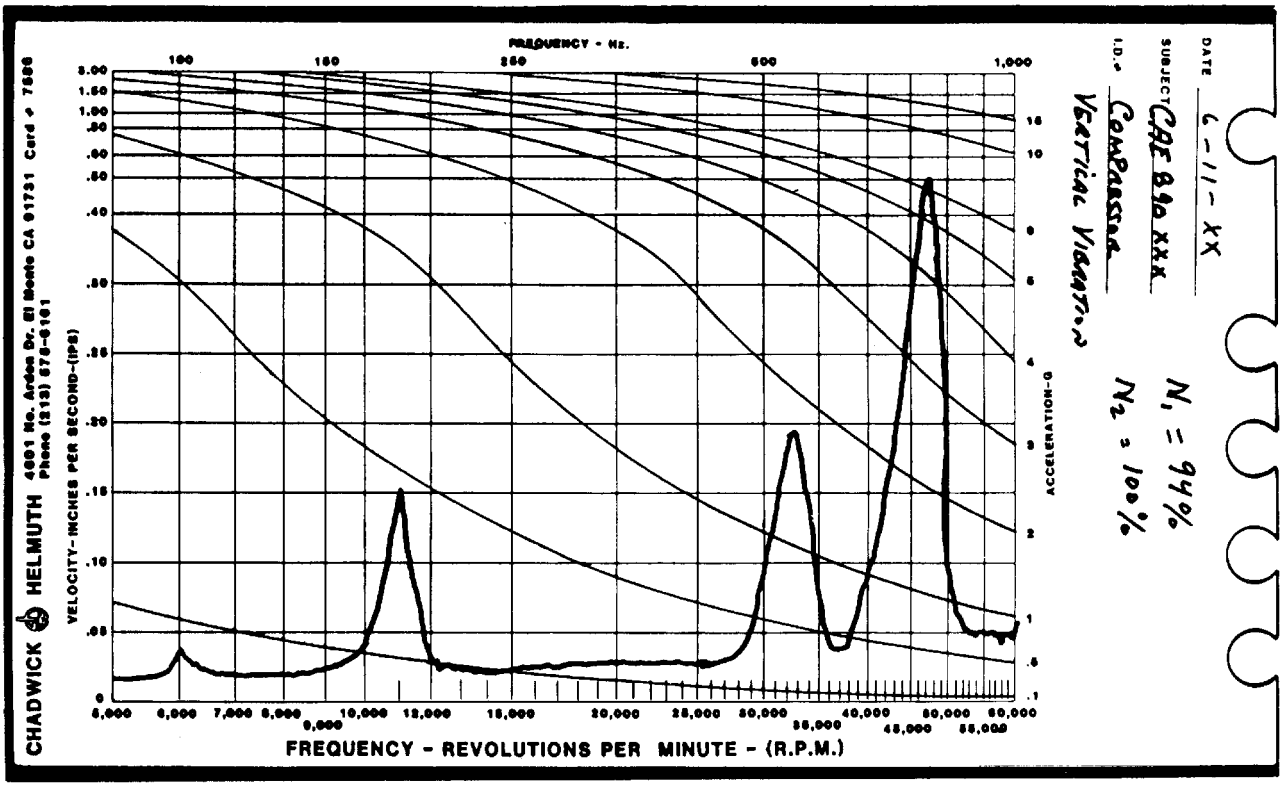
(a) IPS Peak multiplied by 0.637 = IPS Average Velocity

(b) RPM divided by 60 = Hertz (cycles per second)

(c) Gear rpm multiplied by the number of gear teeth = gear mesh frequency

NOTE: The vibration card used in the following example is for the frequency range 5,000 to 60,000 rpm only. The vibration level of the engine should be checked over the entire required range of frequencies (5,000 to 900,000 rpm).

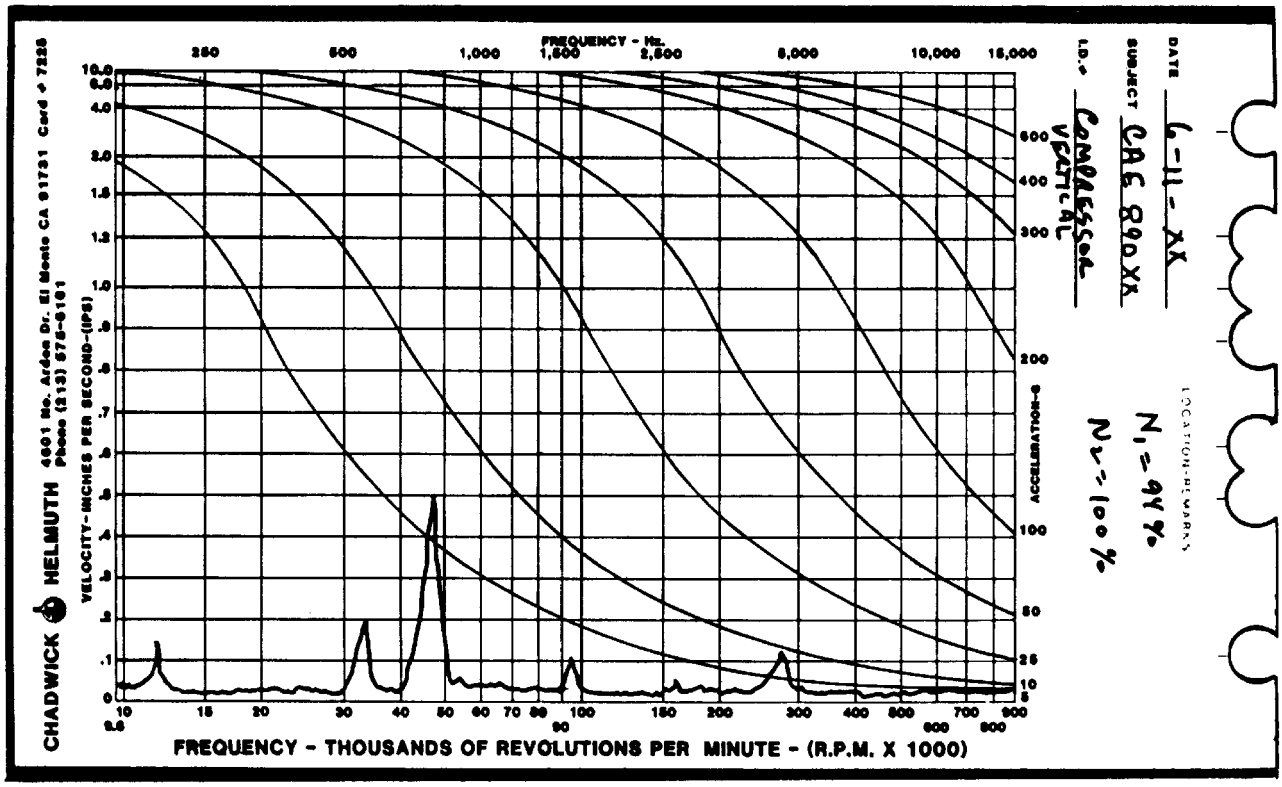
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APS043XF

Typical Chadwick Vibration Analysis Card 5,000 to 60,000 rpm
Figure 507

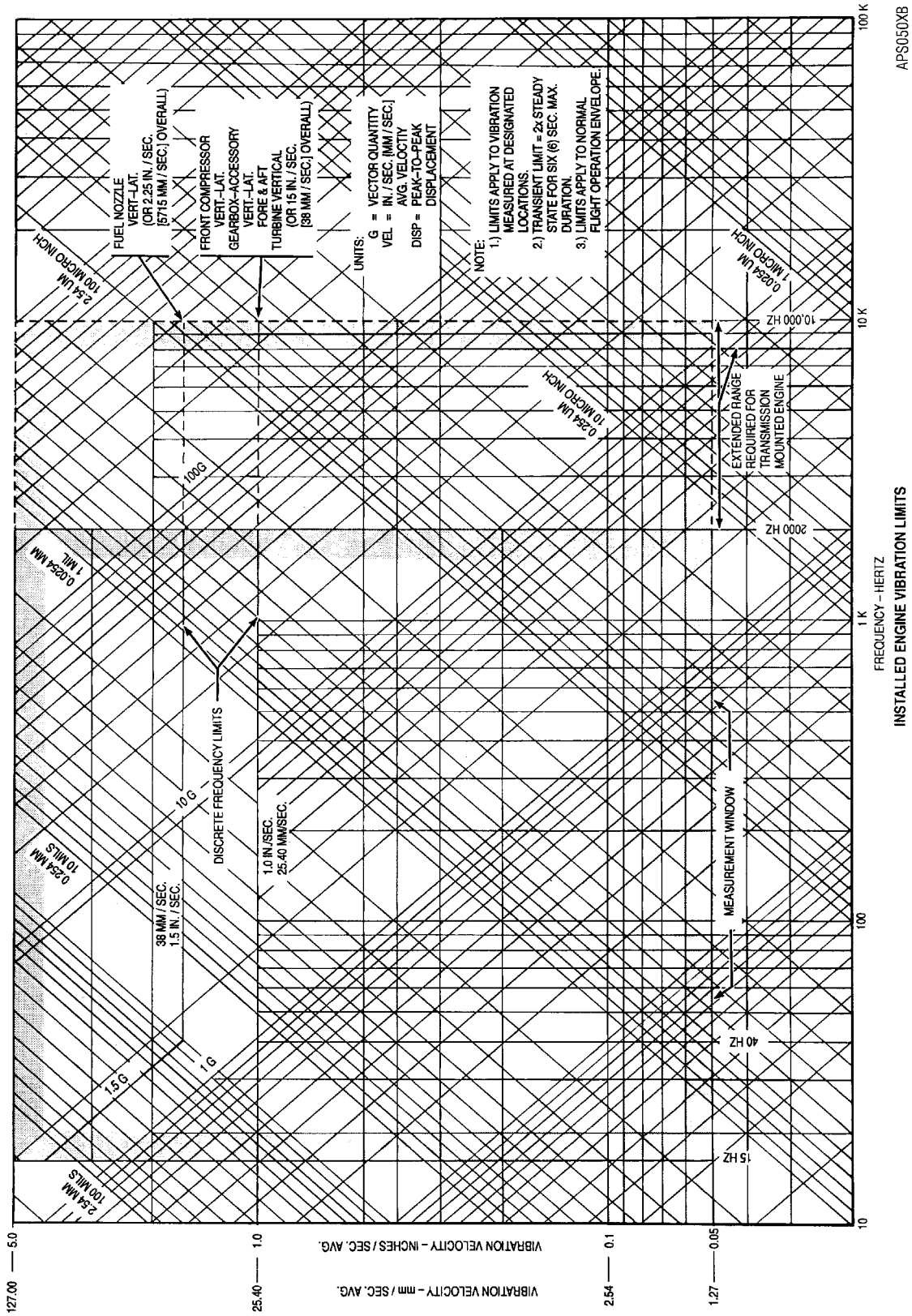
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APS044XF

Typical Chadwick Vibration Analysis Card 10,000 to 900,000 rpm
Figure 508

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Installed Engine Vibration Limits Normal Operation Range and Limits
Figure 509

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PARA 2.E. (cont)

(2) Example (Normal Vibration Range): The upper end of the normal vibration range for one discrete vibration frequency is 1.0 IPS (Avg.). Therefore, the engine in the following example is well within Rolls–Royce normal vibration range (normal vibration range is specified in Figure 509).

Frequency RPM	Frequency Hz	Velocity IPS (Peak)	Velocity IPS (Avg.)
11,300	188	0.15	0.10
33,000	550	0.19	0.121
48,000	800	0.50	0.319

(3) Normal Operating Range: Compare IPS average velocities shown below to the normal operating range shown in Figure 509. In this case, the vibration is within normal operating range.

Measured Frequency	Measured Velocity	Maximum Allowable Vibration Limits
188 Hz	0.10 IPS (Avg.)	1.0 IPS (Avg.)
550 Hz	0.121 IPS (Avg.)	1.0 IPS (Avg.)
800 Hz	0.319 IPS (Avg.)	1.0 IPS (Avg.)

(4) Sources of Engine Vibration: If vibration is not within normal operating limits, the source of vibration should be identified. Many possible sources of vibration exist, but the highest engine–related vibration levels normally occur at rotational speeds of the major engine components which are as follows:

(a) N_1 gas producer rotational speed

(b) N_2 power turbine rotational speed

(c) Starter generator rotational speed

(d) Output shaft rotational speed

(e) Rotational speeds of special engine–powered accessories

(5) Sources of Airframe Vibration: The most frequent sources of airframe vibration are as follows:

(a) Main rotor or propeller rotational speed

(b) Main rotor or propeller blade passage speed (and multiples of this speed)

(c) Tail rotor drive shaft speed

(d) Tail rotor rotational speed

(e) Tail rotor blade passage speed (and multiples of this speed)

(6) Identifying Engine–Related Vibrations.

(a) To identify engine–related vibrations, N_1 and N_2 rotational speeds should be determined first. Referring to Figure 507. N_1 was recorded as 94%, and N_2 was recorded as 100%. These speeds may be determined by analyzing the vibration signature.

(b) For example, to find N_1, look for a major peak in the measured frequency range between 510–850 Hz; this corresponds to 30,600–51,000 rpm, or 60%–100% N_1. Refer to the major peak occurring at 800 Hz (48,000 rpm) in Figure 507. By interpolating from the known 100% factor 850 Hz = 51,000 rpm, it can be determined that 800 Hz = 48,000 rpm, or 94.1%, which confirms the recorded N_1 speed of 94%.

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PARA 2.E. (cont)

(c) Similarly, N_2 can be found as a major peak between 330–550 Hz; this corresponds to 19,800–33,000 rpm, or 60–100% N_2. Refer to the major peak occurring at 550 Hz in Figure 507. The peak at 550 Hz – 33,000 rpm (which is the 100% factor), confirming the recorded N_2 speed of 100%.

(d) The remaining major peaks can be identified by using speed charts to help determine potential vibration sources. These charts list gear ratios and rotating shaft speeds for engine–driven components. Matching the vibration peak frequency (rpm) with a speed on the chart will indicate the most likely source for that vibration.

(7) Speed Chart Calculations.

(a) Shaft speeds on the speed charts were computed using 100% N_1 and N_2. If measured N_1 and N_2 are not at 100%, the vibration peak frequency (speed) at which the vibration would occur if N_1 and N_2 were 100% must be determined. The resulting speed is matched to a shaft speed in the chart.

(b) For example, the remaining major peak in Figure 507 occurs at 11,300 rpm. The notation on Figure 507 chart indicates N_1 = 94% and N_2 = 100%. Since N_1 is not 100%, the equivalent rpm for 100% N_1 must be found:

$$\frac{11{,}300 \text{ rpm}}{0.94\ N_1} = 12{,}021 \text{ rpm}$$

(c) Therefore, the 100% N_1 equivalent of 94% N_1 at 11,300 rpm is 12,021 rpm. It is not necessary to convert N_2, since N_2 is at 100%. However, both speeds (N_1 and N_2) are needed for charts since it is not known if the vibration is from the N_1 or N_2 gear trains.

(d) Examination of the speed chart (Figure 510) shows a starter generator gearshaft speed of 12,034 rpm in the N_1 gas producer and power turbine gear trains, which is close to the 12,021 calculated vibration frequency. This result indicates a vibration problem in the area of the N_1 starter generator gearshaft.

(e) Rule out the possibility that the vibration is from N_2 by comparing the 11,300 rpm 100% N_2 vibration with the speed chart (Figure 510). No shaft speeds are close to the 11,300 rpm peak on Figure 507.

(f) The actual starter generator gearshaft speed at 94% N_1 (0.94 x 12,034) is 11,312 rpm, and this gearshaft has caused the 11,300 rpm vibration frequency peak in Figure 507.

F. Limits

(1) Limits on Separate, Individual Vibrations. The discrete frequency guidelines apply to measurement of a particular frequency, such as 48,000 rpm (800 Hz). If tests reveal vibrations above the normal operating range (Figure 509) or above 1.0 IPS average velocity, action should be taken to determine the source of the vibration and perform corrective action.

(2) Overall Vibration Limits. The overall vibration guidelines apply when test equipment reads all vibration contributions over a broad band, such as 15 to 2,000 Hz. If overall limits are exceeded, analysis of each vibration must be made.

G. Maintenance Action. There are many potential causes of vibration. Suggested areas for possible corrective action are:

(1) N_1 Frequency Vibration

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PARA 2.G. (1) (cont)

(a) Check cables, spectrum analyzer and pickups to ensure that all test components are in proper working order and are calibrated properly.

(b) Inspect for foreign object damage.

(c) Check compressor and turbine attaching hardware. Retighten per applicable Operation and Maintenance Manual instructions.

(d) Inspect for main shaft bearing failure or impending failure. Such failure should generate metal particles and enable the chip indicator light. Check oil filter and magnetic chip detectors for evidence of metal contamination.

(e) Check for sources of N_1 internal engine vibration such as:

1 No. 1 bearing

2 Compressor or impeller imbalance

3 No. 2 bearing

4 N_1 system rubs including:

Axial stages to plastic coating

Impeller to shrouds

Labyrinth seal knives

5 Foreign Object Damage (FOD) to compressor (usually vibration with noise)

6 No. 1 seal

7 Alignment:

Front support

Compressor to gearbox

8 Spur adapter gearshaft

9 Loose turbine assembly tie bolt

10 No. 8 bearing

11 No. 7 bearing

12 N_1 turbine–to–compressor coupling shaft indexing

13 Gas turbine rotor

(2) N_2 Frequency Vibration. Check for sources of N_2 vibration frequency such as:

(a) Turbine balance

(b) Loose power turbine inner or outer nuts

(c) Improper gearbox–to–turbine shims

(d) No. 3, 4, 5, or 6 bearings

(3) Check output shaft frequency vibration:

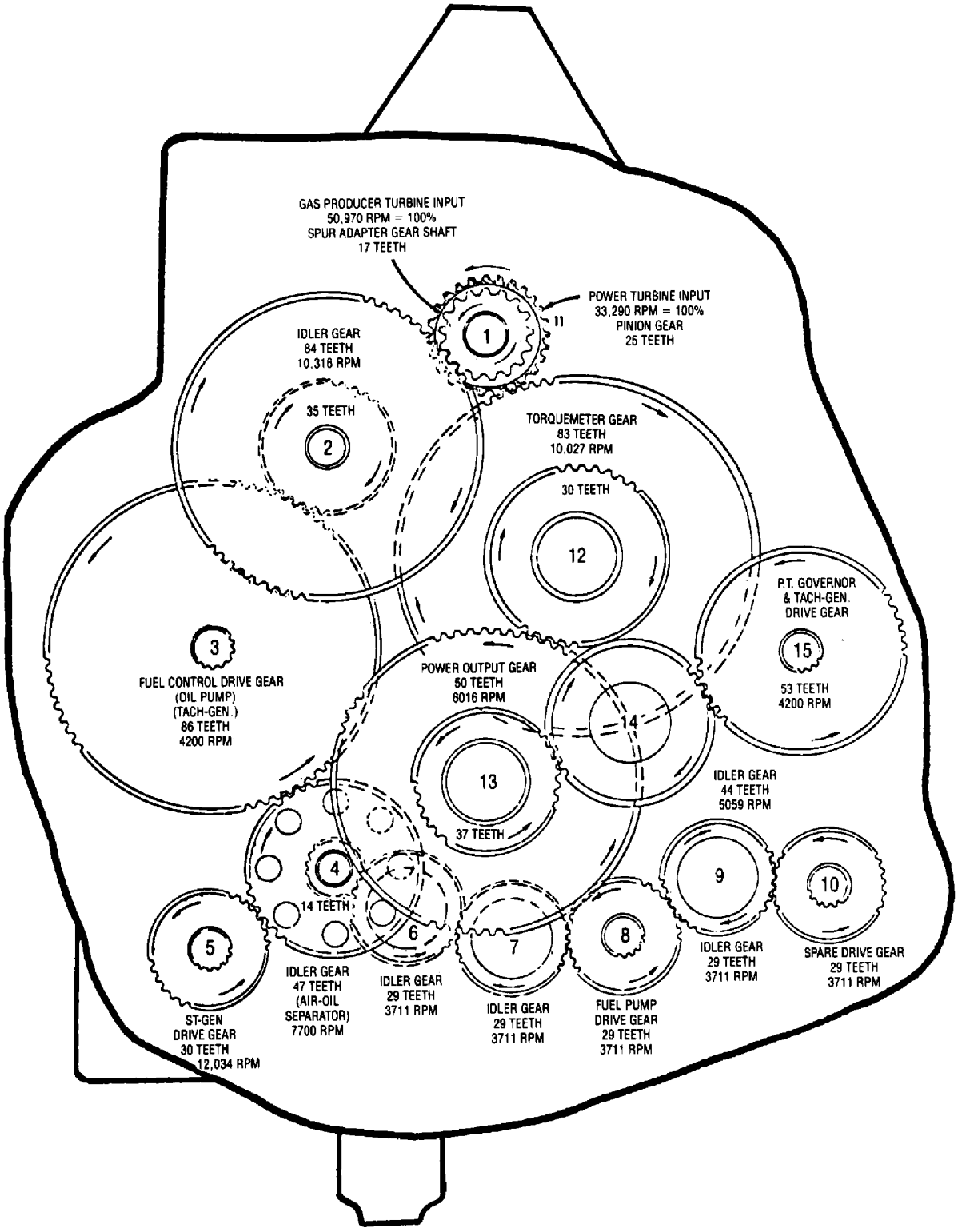
(a) Check output shaft flex couplings and shaft balance

(b) Check alignment of engine to aircraft

(c) Check power takeoff gear

(d) Check freewheeling unit (if installed)

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Schematic – Gas Producer and Power Turbine Gear Trains
Figure 510

AES019XA

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PARA 2.G. (cont)

(4) Check high gearbox vibrations:

(a) Loose compressor studs

(b) No. 2–1/2 bearings

(c) No. 3 and 4 bearings

(d) Alignment:

1 Pinion gear

2 Case or cover

(5) Check main rotor blade passage vibration:

(a) Vibration may be in main rotor rpm times number of blades, main rotor rpm, or multiples of these. Align, balance and track main rotor. Refer to appropriate airframe manual for procedures.

(b) Check engine to airframe mounts. Inspect and retighten per aircraft manual instructions.

(c) Check main rotor transmission mounts for condition and security per airframe manual instructions.

(6) Check starter generator frequency vibration:

(a) Replace unit

H. Manufacturer Assistance

If suspected airframe and engine components have been inspected, repaired, or replaced per the appropriate manufacturer's instructions as indicated by this vibration test data, and vibration symptoms still persist, contact Rolls–Royce for further assistance.

3. Engine Trend Check Analysis

The trend check analysis provides a method for the operator to monitor engine performance. The trend check will also allow the operator to more effectively predict when preventative maintenance is required and schedule some maintenance actions that were formerly unscheduled.

Rolls–Royce strongly encourages all operators on a voluntary basis to utilize performance trending to supplement their regular maintenance program. It should be noted that the use of performance trending does not change the requirement to operate the engine within established limits and according to applicable publications. Aircraft manufacturer engine trending procedures that are published in the applicable FAA approved flight manuals can be used in lieu of the procedure given in this manual if they are Rolls–Royce approved. (Refer to Aircraft Manufacturer Trend Check–Alternate Procedure, para 4.D. this section.)

The analysis given in the Engine Trend Check Procedure, para 4, this section, provides the necessary guidance, procedures, check lists, correction tables and graphic examples required to set up an engine trend check program. A trend check program can be initiated at any point in an engine's life. The effectiveness of the trending program is dependent on the quality of the uncorrected data. Anything that causes the inflight data to be in error will reflect adversely on the effectiveness of the program.

Consideration should be made for tolerances on the accuracy of aircraft installed instruments. Instrument error could affect measured performance by approximately:

A. 4% below actual power available for every + 5°C error in outside air temperature (OAT).

(1) Use a precision mercury type thermometer in the immediate vicinity of the OAT probe. Shade both thermometers for a minimum of 15 minutes before taking a reading. Compare accuracy of installed OAT gauge.

B. 1% below actual power available for every 300 feet error in pressure altitude.

(1) Determine pressure altitude by averaging the readings of altimeters of known accuracy with flight deck reading.

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PARA 3. (cont)

C. 2% below actual power available for every + 6°C error in TOT.

(1) Check calibration of TOT system and gauge.

D. 2% below actual power available for every + 2% error in torquemeter. (Check accuracy or torquemeter).

4. Engine Trend Check Procedure

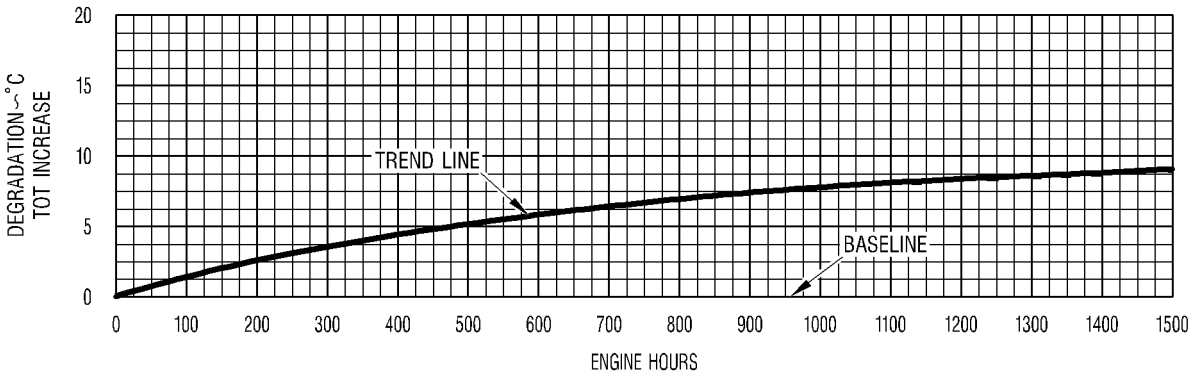
A. Description

(1) Trend checks can be used to monitor the health of the engine on a day to day basis. However, trending is best used to determine engine health over longer periods of sustained operation. The key to interpreting the data is a basic understanding of the engine characteristics. Turbine engines normally degrade or lose power through engine operation. If normal degradation is plotted against accumulated engine hours, the trend line of increased turbine outlet temperature (TOT) could appear as in Figure 511.

NOTE: Figures 511 through 515 and Figure 525 are for a typical engine. The degradation trend plotted for a specific engine should follow the general pattern of these curves; but, need not duplicate the illustrated values.

(2) Degradation is also affected by operation in erosive environments, excessive operation at high temperature or overtemperature conditions, and other abnormal conditions. The more erosive the environment, the longer the high temperature was maintained or the higher the overtemperature, the faster performance will degrade. Degradation due to this type of abnormal operation could appear as the trend line depicted in Figure 512.

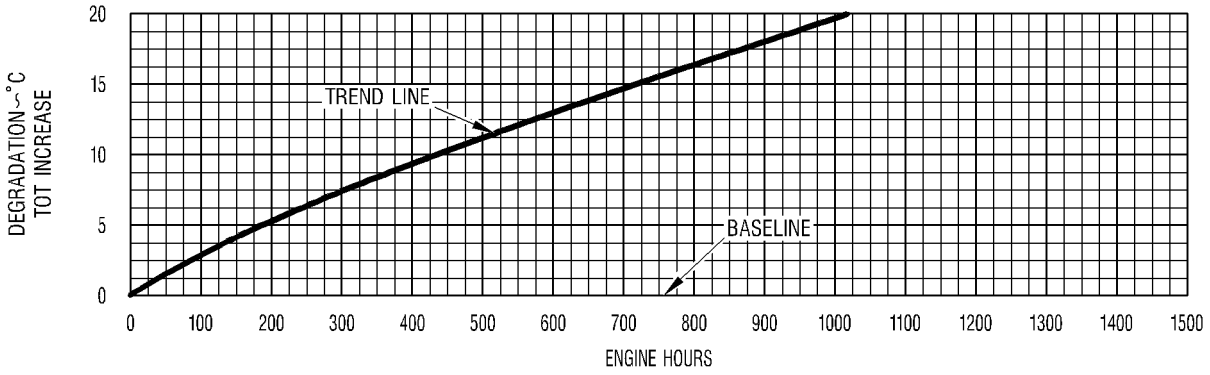
(3) When engine performance degrades beyond the limits allowed in applicable aircraft publications, maintenance should be performed. Each time that engine maintenance is performed, some measure of performance may be recovered. Normally, following this maintenance, the engine will not recover to the power level experienced when the engine was new or overhauled, without the replacement or rework of components to like new condition. Figure 513 shows a typical performance recovery resulting from regular engine washes. Note that engine performance does not return to the original baseline power available when the engine was new or overhauled.



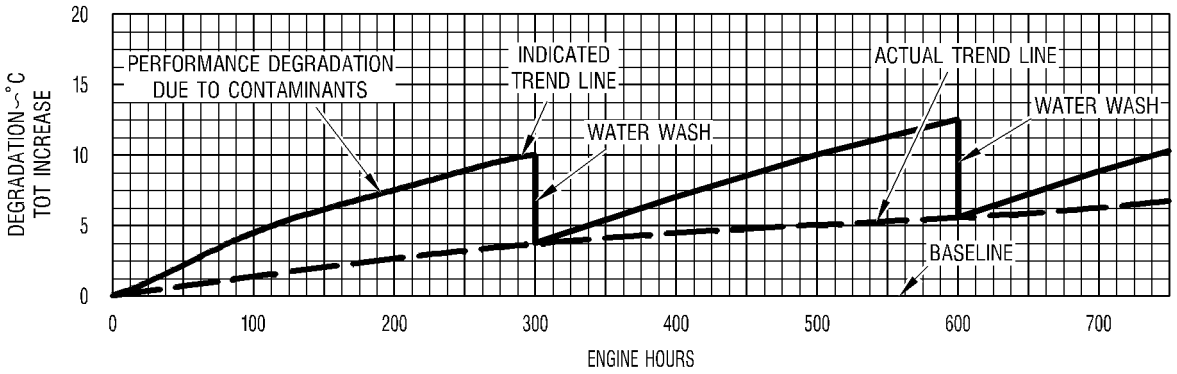
Normal Engine Degradation
Figure 511

APS026XD

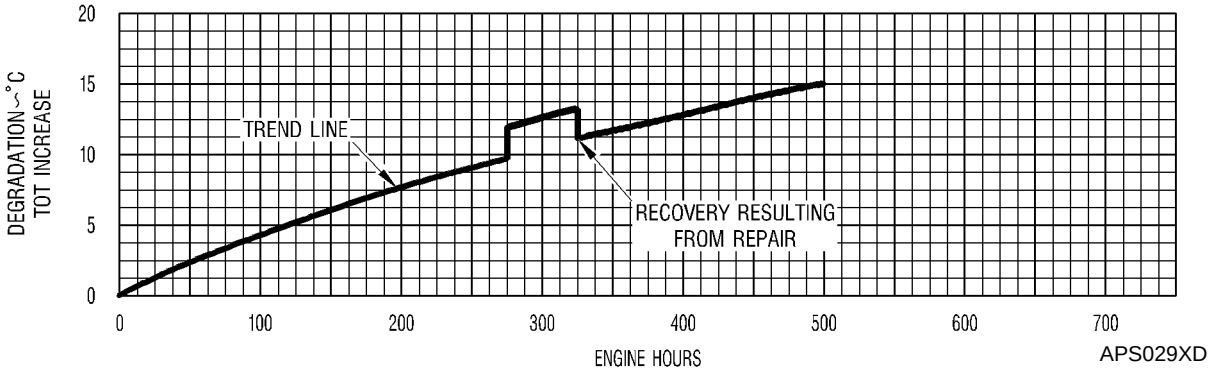
Rolls-Royce Proprietary Data – Uncontrolled Printed Copy



Abnormal Operation Engine Degradation
Figure 512

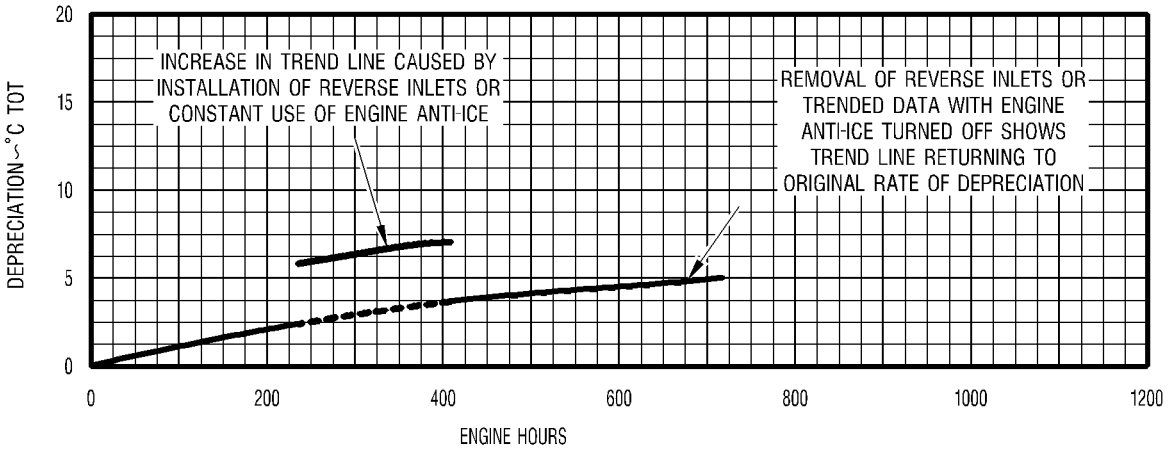


Performance Recovery Due to Engine Wash
Figure 513



Engine Degradation with Component Failure/Repair
Figure 514

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Engine Degradation Baseline Change
Figure 515

ADS034XD

PARA 4.A. (cont)

(4) Short term degradation can be caused by operating the engine in contaminated atmospheric conditions. Dust, smoke and other industrial contaminants can cause this type of power loss. Aircraft oil leaks, when they mix with the air entering the engine, can also result in a loss of power. This type of degradation can take place in minutes or hours and is generally corrected by rinsing or washing the engine. Following the engine rinse or wash, it is normal that power would return to the previous base line. If power is not recovered following a rinse or wash of a dirty engine, another problem is indicated.

(5) Engine components that are in the process of failing can also appear as short term degradation. When engine performance degrades over a short period of time, and rinsing or washing the engine doesn't recover the performance loss, a component failure or misadjustment should be investigated and corrected. Following maintenance, it would be normal to expect that trend line power would be recovered. This type of component failure or loss of adjustment could appear as in Figure 514.

(6) Figures 511 through 514 represent some of the typical data plots that can result when attempting to analyze or trend data. There are numerous combinations of these graphs that when properly analyzed can provide the operator useful information to determine that maintenance is, or soon will be, required. However, interpreting the data is not always a straight forward process. There are a number of factors that occur to confuse or mask both normal and abnormal readings.

WARNING: DO NOT EXCEED SPECIFIED AIRCRAFT OR ENGINE LIMITATIONS DURING PERFORMANCE OF THIS CHECK.

(7) Data scatter and pilot procedure can be a common source of inaccuracy in the trend procedure. It can result from the normal instrumentation error caused by allowable inaccuracy/readability or omission/change of a trend check procedure step. Following the daily flight trend check, the recorded data should be corrected and plotted. When the corrected TOT readings are more than plus or minus 20°C from the existing trend line, maintenance personnel should make sure no obvious failures have occurred before repeating the trend check to determine whether the variation was due to data scatter or pilot procedure. If, upon repeating the trend check, the newly plotted data returns to within plus or minus 20°C from the existing trend line without further action by the pilot or maintenance personnel, the problem was probably due to data scatter. Neither the aircraft nor engine should have to be operated beyond established limitations to perform the trend check procedure. If aircraft or engine limitations are encountered during performance of the trend check procedure, it is an indication that the check has either been improperly performed or that there is an aircraft or engine problem.

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PARA 4.A. (cont)

NOTE: Prior to initiating a trend check program, operators should assure that the aircraft instrumentation is properly calibrated.

(8) If repeated checks continue to give corrected plotted readings in excess of plus or minus 20°C corrected TOT change from the existing trend line, the cause can also be due to pilot procedure. Each step of the procedure should be reviewed to assure that all switches were properly positioned and instruments were read correctly. One of the most common causes for inaccuracy is leaving the anti–ice, bleed air heater, environmental control unit or other engine air–operated component turned on during the check. Also, be sure to allow the engine at least 1 minute to stabilize prior to taking any readings. If the procedure was performed correctly and the plus or minus 20°C corrected TOT change continues to result, then an aircraft or engine problem should be investigated.

(9) To assure accurate trend checks, the aircraft configuration must remain the same during the first and each subsequent check. For example, some aircraft have bleed air operated components such as pumps that cannot be turned off. Since each trend check would be made with these systems operational, it will have no visible effect on the trended data. Additionally, if an engine operated subsystem was usually required for safe flight during the period the trend check was normally performed, the first and each subsequent check should be performed with that system operational. For example, in some areas of the world, engine anti–ice is frequently required for normal operation and should therefore be operated during each trend check. Furthermore, when a new or overhauled engine, or an aircraft or engine component that may affect performance is installed, a new baseline trend must be established. A change in the trend line could appear as in Figure 515.

B. Example

(1) This example is provided to illustrate data tabulation, correction and graphing.

(a) Aircraft flight condition: 2,000 feet pressure altitude, 20°C outside air temperature, 100 knots airspeed with the following engine instrument indications: N_1 = 98%, N_2 = 100%, Torque = 80%, TOT = 720°C, Oil Pressure = 110 psig, Oil Temperature = 95°C.

(b) The maintenance or operations section shall record aircraft S/N, engine S/N, date and engine time on the 250 Trend Check Record. (See Figure 516.)

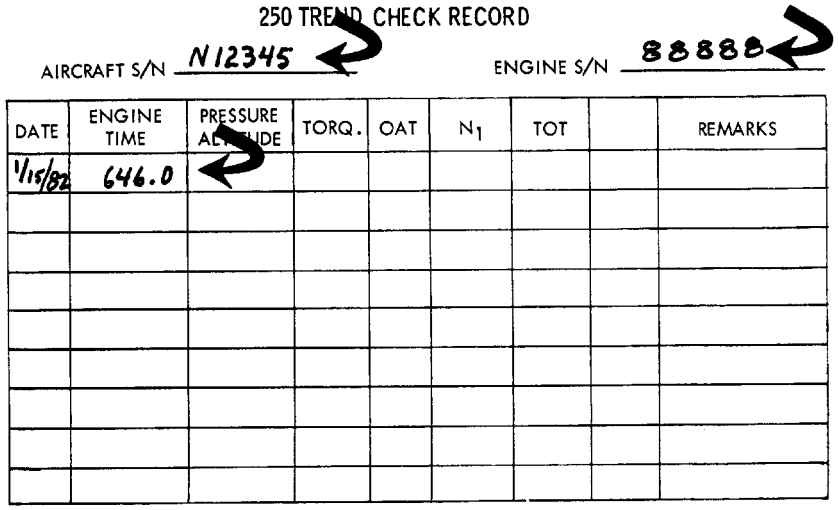
(c) After departure, the pilot notes the correct altimeter reading, sets the altimeter to 29.92 in. Hg and continues to climb the aircraft to 2000 ft pressure altitude.

NOTE: Any 1,000 foot increment in pressure altitude up to 10,000 feet can be selected for the check. However, data reduction is simplified when the same pressure altitude is used for each subsequent check.

NOTE: Any baseline torque that provided an indicated N_1 speed greater than 95% can be utilized. The indicated torque setting required will be obtained from the torque correction chart by entering the chosen base line torque and pressure altitude to be flown.

(d) The pilot now adjusts the engine power for cruise flight at 80% torque, checks that the N_1 is above 95% and waits for one minute to allow the engine to stabilize. The pilot now records PA = 2000 ft, TOR = 80%, OAT + 20°C, N_1 = 98% and TOT = 720°C on the 250 Trend Check Record. (See Figure 517.) Since light to moderate turbulence was experienced throughout the procedure, the pilot has noted “turbulence” in the remarks block to indicate that the data might be affected. The pilot then resets the altimeter to the correct reading.

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250 TREND CHECK RECORD

AIRCRAFT S/N N12345 ENGINE S/N 88888

DATE	ENGINE TIME	PRESSURE ALTITUDE	TORQ.	OAT	N_1	TOT		REMARKS
1/15/82	646.0							

Example — Data Filled in by Maintenance/Operations
Figure 516

APS051XD

PARA 4.B.(1) (cont)

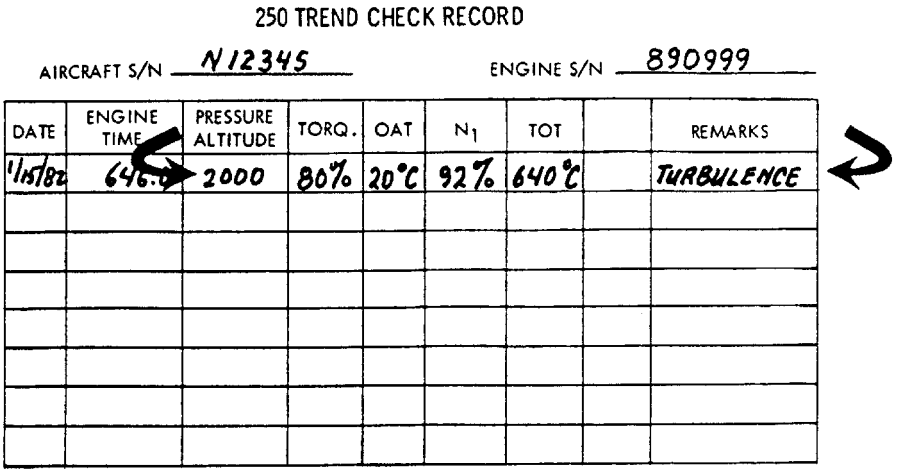
(e) Following flight, the recorded data can be corrected and trended. The baseline parameters for the graphed data are 2,000 feet pressure altitude and 80% indicated torque. After determining that these baseline parameters have been used, the resulting data can be corrected and graphed. Using Figure 518, determine the corrected N_1 speed value. Find the indicated OAT on the left vertical scale and the indicated N_1 speed on the top horizontal scale. Moving right and down, you will intersect at the corrected N_1 speed of 97%. Graph this speed as indicated in Figure 520.

NOTE: If the pilot cannot utilize the same baseline pressure altitude for each trend check, the trend procedure must be modified. The use of a nonstandard altitude described in step (h) will allow the pilot to perform the trend check at various altitudes.

(f) Using Figure 519, determine the corrected TOT. Find the indicated OAT on the left vertical scale and indicated TOT on the top horizontal scale. Moving right and down, you will intersect at the corrected TOT value of 703°C. For indicated TOT values under 650°C, consult the first page of Table 503. Graph this data as indicated in Figure 520.

(g) It should be noted that the data graphed in Figure 520 cannot always be directly compared to the background data depicted in Figures 511 through 515. The background data are for illustration purposes only, to show long term degradation of a typical engine. Actual graphed N_1 and TOT data can vary from the example. The important thing to remember is that the overall trend should be gradual. Step changes in the trend are significant and their causes should be determined.

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250 TREND CHECK RECORD

AIRCRAFT S/N N12345 ENGINE S/N 890999

DATE	ENGINE TIME	PRESSURE ALTITUDE	TORQ.	OAT	N_1	TOT		REMARKS
1/15/82	646.0	2000	80%	20°C	92%	640°C		TURBULENCE

Example — Data Added By the Pilot
Figure 517

APS052XD

PARA 4.B.(1) (cont)

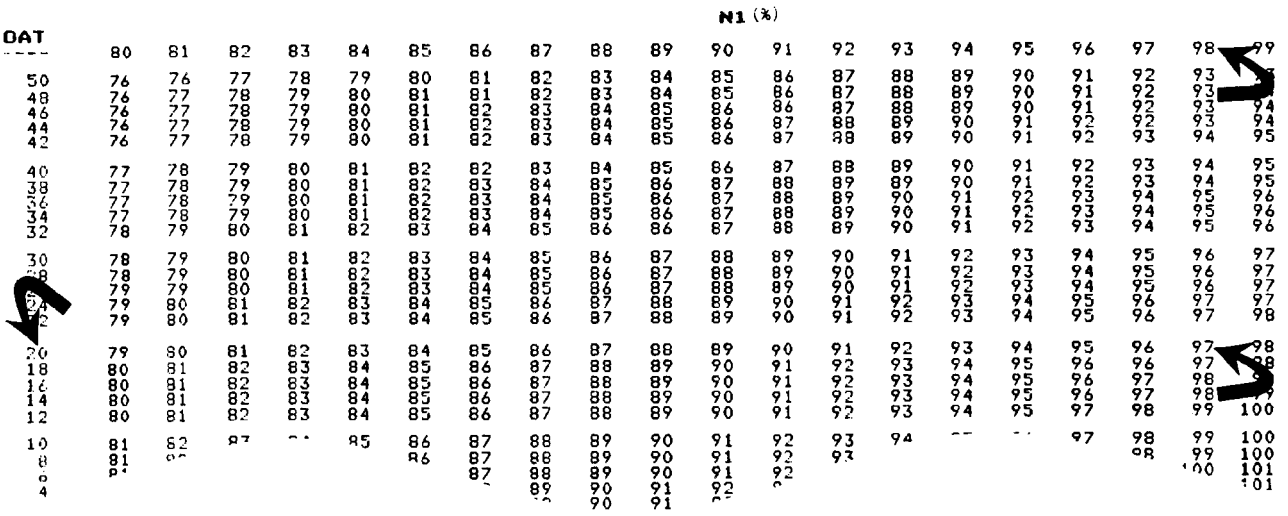
(h) If a baseline pressure altitude for performing the daily trend check procedure cannot be established, the check can still be completed by correcting the torque input value to sea level conditions prior to performing the check. (See Figure 521.) For example, if flight clearance is to climb and maintain 3000 feet, enter the chart at the baseline torque value of 80% torque, move right to intersect the 3000 foot pressure altitude value and read 72% torque as depicted. Accordingly, for this flight set the 72% on the aircraft torque gage, record the readings, correct the data and plot the values as described earlier. The use of a different baseline altitude for each check will require the torque correction chart depicted in Figure 521 to be carried in the aircraft for reference.

(i) Reduced torque values may be required at high altitudes to remain within engine or aircraft limitations. This can result in N_1 readings below 95% speed that will allow the engine bleed valve to open. If this data is plotted, it will erroneously appear as a step change increase in the TOT trend. Step change increases in the TOT trend must be compared to the trended N_1 to assure the bleed valve is closed. Data taken while the bleed valve is fully open or modulating will not be accurate.

(j) Step change variations in TOT or other graphed parameters should be investigated to determine their cause. Step changes that result from aircraft configuration changes, engine maintenance or other known causes are permissible and result in a new trend line as illustrated in Figure 514 or 515. Step changes resulting from unknown causes should be investigated systematically using the recommendations provided in the troubleshooting section of this manual. (See Table 101, Engine–Troubleshooting, 72–00–00.)

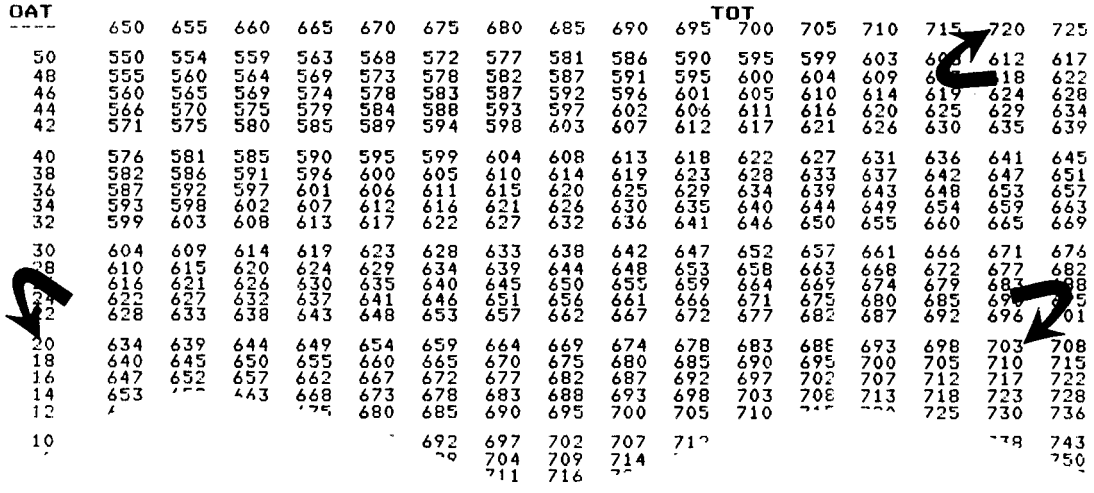
(k) The maximum amount of deterioration allowed is determined by the limits stated in the aircraft flight manual and in accordance with the aircraft manufacturer's FAA approved power assurance check procedure.

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ADS030XD

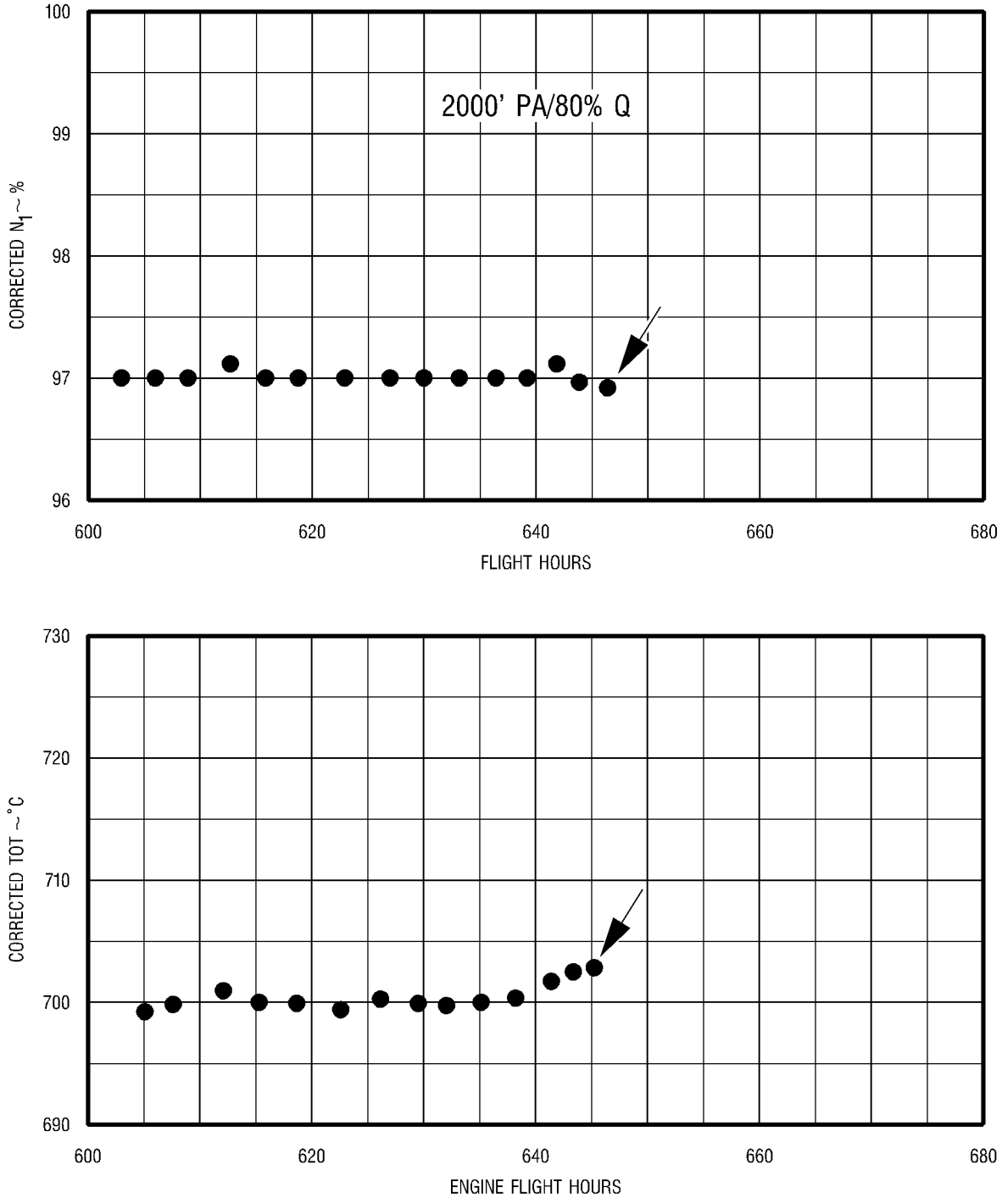
N_1 Correction Chart
Figure 518



TOT Correction Chart
Figure 519

ADS031XD

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Trend Check Graph
Figure 520

ADS035XA

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BASELINE TORQUE(%)	PRESSURE ALTITUDE (FT) SEA LEVEL	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
	INDICATED TORQUE (%)										
60	60	58	56	54	52	50	48	46	45	43	41
65	65	63	60	58	56	54	52	50	48	46	45
70	70	68	65	63	60	58	56	54	52	50	48
75	75	72	70	67	65	62	60	58	56	54	52
80	80	77	74	72	69	67	64	62	59	57	55
85	85	82	79	76	73	71	68	66	63	61	58
90	90	87	84	81	78	75	72	69	67	64	62
95	95	92	88	85	82	79	76	73	71	68	65
100	100	96	93	89	86	83	80	77	74	71	69

APS055XD

Torque Correction Chart
Figure 521

PARA 4. (cont)

C. Procedure

(1) Set the aircraft altimeter to 29.92 in. Hg and fly the aircraft at a pressure altitude convenient to normal flight and in increments of 1000 feet from sea level. The maximum altitude for the check is 10,000 ft. Assure the following conditions exist:

WARNING: DO NOT TURN OFF SYSTEMS OR COMPONENTS REQUIRED FOR SAFE FLIGHT. IF ANTI–ICE IS FREQUENTLY REQUIRED FOR SAFE FLIGHT, IT SHOULD BE OPERATED DURING EACH TREND CHECK.

(a) Anti–ice air — off

(b) Environmental control unit — off

(c) Bleed air heater — off

(d) Generator load is less than 20%

(2) Set engine N_2 speed at Normal Cruise rpm. This speed should remain constant on all subsequent checks.

NOTE: If N_2 rpm is changed for subsequent checks, a new baseline trend will be established.

(3) Keep the aircraft in a level cruise flight when this trend check is performed. Do not perform the check while in a climb or descent flight mode.

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250 TREND CHECK RECORD

AIRCRAFT S/N _____ ENGINE S/N _____

DATE	ENGINE TIME	PRESSURE ALTITUDE	TORQ.	OAT	N_1	TOT		REMARKS

APS045XD

Trend Check Data Recording Form
Figure 522

PARA 4.C. (cont)

(4) Set the engine power to a baseline torque value that provides at least 95% N_1 speed to be sure the engine bleed valve is closed and to ensure a valid trend check. If a nonstandard baseline altitude is used, determine the indicated torque requirement from the torque correction chart. (See Table 501.) If N_1 is not 95% or more, step (3) should be repeated at a higher torque value which will also establish a new trend line. Hold cruise power for one minute to allow the engine to stabilize prior to recording the data listed in step (5).

(5) Record the following values on the trend check record form provided as Figure 522.

(a) Pressure altitude

(b) OAT (C)

(c) N_1 — Gas Producer rpm

(d) Torque

(e) Turbine Outlet Temperature — TOT

(6) Following flight, correct N_1, TOT, and torque values using the charts provided in Tables 501 through 503. Record corrected values on the trend check graph provided in Figure 523.

NOTE: Refer to Figure 524 for a reference outline of the trend check procedure which can be conveniently carried in the aircraft.

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Table 501

Torque Correction Chart

Baseline Torque (%)	Pressure Altitude (ft)										
	Sea Level	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
	Indicated Torque %										
60	60	58	56	54	52	50	48	46	45	43	41
65	65	63	60	58	56	54	52	50	48	46	45
70	70	68	65	63	60	58	56	54	52	50	48
75	75	72	70	67	65	62	60	58	56	54	52
80	80	77	74	72	69	67	64	62	59	57	55
85	85	82	79	76	73	71	68	66	63	61	58
90	90	87	84	81	78	75	72	69	67	64	62
95	95	92	88	85	82	79	76	73	71	68	65
100	100	96	93	89	86	83	80	77	74	71	69

NOTE: Depending on aircraft gross weight and ambient conditions, performance of the trend check may not be possible using some of the above indicated torques if the trended torque figure selected produces an indicated torque value that is so low that an accurate trend check is not possible. Therefore, an increased baseline torque value may be required.

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Table 502

N_1 Correction Chart

OAT	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
50	76	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	93	94	95	96	97	98
48	76	77	78	79	80	81	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
46	76	77	78	79	80	81	82	83	84	85	86	86	87	88	89	90	91	92	93	94	95	96	97	98	99
44	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	92	93	94	95	96	97	98	99
42	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	98	99
40	77	78	79	80	81	82	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
38	77	78	79	80	81	82	83	84	85	86	87	88	89	89	90	91	92	93	94	95	96	97	98	99	100
36	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	98	99	100
34	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101
32	78	79	80	81	82	83	84	85	86	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101
30	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	97	98	99	100	101
28	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102
26	79	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102
24	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	97	98	99	100	101	102
22	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
20	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
18	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	96	97	98	99	100	101	102	103
16	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
14	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
12	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	97	98	99	100	101	102	103	104	105
10	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
8	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
6	81	82	83	84	85	86	87	88	89	90	91	92	93	94	96	97	98	99	100	101	102	103	104	105	106
4	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106
2	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106
0	82	83	84	85	86	87	88	89	90	91	92	93	94	96	97	98	99	100	101	102	103	104	105	106	107
–2	82	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107
–4	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	105	106	107	108
–6	83	84	85	86	87	88	89	90	91	92	93	95	96	97	98	99	100	101	102	103	104	105	106	107	108
–8	83	84	85	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108
–10	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	102	103	104	105	106	107	108	109
–12	84	85	86	87	88	89	90	91	92	93	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109
–14	84	85	86	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	107	108	109	110
–16	85	86	87	88	89	90	91	92	93	94	95	96	97	98	100	101	102	103	104	105	106	107	108	109	110
–18	85	86	87	88	89	90	91	92	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	111
–20	85	86	87	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	105	106	107	108	109	110	111
–22	86	87	88	89	90	91	92	93	94	95	96	97	99	100	101	102	103	104	105	106	107	108	109	110	111
–24	86	87	88	89	90	91	92	94	95	96	97	98	99	100	101	102	103	104	105	106	108	109	110	111	112
–26	86	87	89	90	91	92	93	94	95	96	97	98	99	100	102	103	104	105	106	107	108	109	110	111	112
–28	87	88	89	90	91	92	93	94	95	96	98	99	100	101	102	103	104	105	106	107	108	110	111	112	113
–30	87	88	89	90	91	93	94	95	96	97	98	99	100	101	102	103	105	106	107	108	109	110	111	112	113
–32	87	89	90	91	92	93	94	95	96	97	98	99	101	102	103	104	105	106	107	108	109	110	112	113	114
–34	88	89	90	91	92	93	94	96	97	98	99	100	101	102	103	104	105	106	108	109	110	111	112	113	114
–36	88	89	90	91	93	94	95	96	97	98	99	100	101	103	104	105	106	107	108	109	110	111	112	114	115
–38	89	90	91	92	93	94	95	96	97	99	100	101	102	103	104	105	106	107	108	110	111	112	113	114	115

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Table 503

TOT Correction Chart

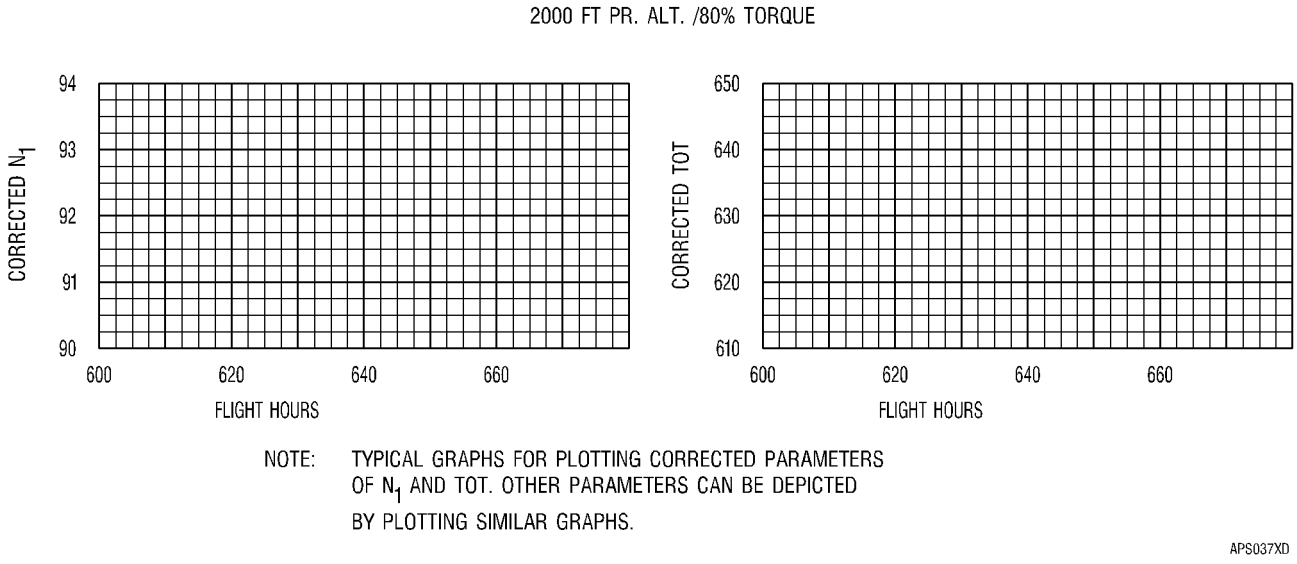
OAT	530	535	540	565	550	555	560	565	558	575	580	585	590	595	600	605	610	615	620	625	630	635	640	645	650
50	443	447	452	456	461	465	470	474	479	483	488	492	496	501	505	510	514	519	523	528	532	537	541	546	550
48	447	452	456	461	465	470	474	479	483	488	483	497	801	506	510	515	519	524	528	533	537	542	546	551	555
46	452	456	461	466	470	475	479	484	488	493	497	502	506	511	515	520	524	529	533	568	572	577	551	556	560
44	457	461	466	470	475	479	484	488	493	497	502	507	511	516	520	525	529	534	538	543	547	552	556	561	566
42	461	466	470	475	479	484	489	493	498	502	507	511	516	521	858	560	537	569	543	548	553	557	562	566	571
40	466	470	475	480	484	489	493	498	503	507	512	516	521	526	530	535	539	544	549	553	558	562	578	572	576
38	471	475	480	485	489	595	598	806	508	512	517	522	526	531	535	540	545	459	554	559	563	568	572	577	582
36	475	480	485	489	494	499	503	508	513	517	522	527	531	536	541	545	550	555	559	564	569	573	578	583	587
34	480	485	490	494	499	504	508	513	518	523	527	532	537	541	546	551	555	560	565	569	674	579	583	588	593
32	485	490	495	499	504	509	514	518	523	528	532	537	542	547	551	556	561	566	570	575	580	584	589	594	599
30	490	495	500	505	509	514	519	524	528	533	538	543	547	552	557	562	566	571	576	581	585	590	595	600	604
28	495	500	505	510	514	519	524	529	534	538	543	548	553	558	562	567	572	577	581	586	591	596	601	605	610
26	500	505	510	515	520	525	529	534	539	544	549	553	558	563	568	573	578	582	587	592	597	602	606	611	616
24	506	511	515	520	525	530	535	540	544	549	554	559	564	569	574	578	583	588	593	598	603	607	612	617	622
22	511	516	521	526	530	535	540	545	550	555	560	565	570	574	579	584	589	594	599	604	609	613	618	623	628
20	516	521	526	531	536	541	546	551	556	561	565	570	575	580	585	590	595	600	605	610	615	620	624	629	634
18	522	527	532	537	542	546	551	556	561	566	571	576	581	586	591	596	601	606	611	616	621	626	631	636	640
16	527	532	537	542	547	552	557	562	567	572	577	582	587	592	597	602	607	612	617	622	627	632	637	642	647
14	533	538	543	548	553	558	563	568	573	578	583	588	593	598	603	608	613	618	623	628	633	638	643	648	653
12	538	544	549	554	559	564	569	574	579	584	589	594	599	604	609	614	619	624	629	634	640	645	650	655	660
10	544	579	554	559	565	670	575	480	585	490	595	600	605	610	615	621	626	631	636	641	646	651	656	661	666
8	550	555	560	565	571	576	581	586	591	596	601	606	611	617	622	627	632	637	642	647	652	658	663	668	673
6	556	561	566	571	577	582	587	592	597	602	608	613	618	623	628	633	638	644	649	654	659	664	669	675	680
4	562	578	572	577	583	588	593	598	603	609	614	619	624	629	635	640	645	650	655	661	666	671	676	681	687
2	568	573	578	584	589	594	599	605	610	615	620	626	631	636	641	647	652	657	662	667	673	689	683	688	694
0	574	579	585	590	595	600	606	611	616	622	627	632	637	643	648	453	659	664	669	674	680	685	690	695	701
−2	580	586	591	596	602	607	612	618	623	628	634	639	644	649	655	660	665	671	676	681	687	692	697	703	708
−4	587	592	597	603	608	613	619	624	630	635	640	646	651	656	662	667	672	678	683	688	694	699	704	710	715
−6	593	599	604	609	615	620	626	631	636	642	647	652	658	663	669	674	679	685	690	696	701	706	712	717	723
−8	600	605	611	616	621	627	632	638	643	649	654	659	665	670	676	681	687	692	698	703	708	714	719	725	730
−10	606	612	617	623	628	634	639	645	650	656	661	667	672	678	683	688	694	699	705	710	716	721	727	732	738
−12	613	619	624	630	635	641	646	652	657	663	668	674	679	685	690	696	701	707	712	718	723	729	734	740	745
−14	620	625	631	637	642	648	653	659	664	670	676	681	687	692	698	703	709	714	720	726	731	737	742	748	753
−16	627	632	638	644	649	655	660	666	672	677	683	688	694	700	705	711	717	722	728	733	739	745	750	756	761
−18	634	640	645	651	657	662	668	673	679	685	690	696	702	707	713	719	724	730	736	741	747	753	758	764	769
−20	641	647	652	658	664	670	675	681	687	692	698	704	709	715	721	726	732	738	744	749	755	761	766	772	778
−22	648	654	660	666	671	677	683	689	694	700	706	711	717	723	729	734	740	746	752	757	763	769	775	780	786
−24	656	662	667	673	679	685	690	696	702	708	714	715	725	731	737	743	748	754	760	766	771	777	783	789	795
−26	663	669	675	681	687	692	698	704	710	716	722	727	733	739	745	751	757	762	768	774	780	786	792	797	803
−28	671	677	683	689	694	700	706	712	718	724	730	736	741	747	753	759	765	771	777	783	788	794	800	806	812
−30	679	685	691	696	702	708	714	720	726	732	738	744	750	756	762	768	774	779	785	791	797	803	809	815	821
−32	687	693	699	705	711	716	722	728	734	740	746	752	758	764	770	776	782	788	794	800	806	812	818	824	830
−34	695	701	707	713	719	725	731	737	743	749	755	761	767	773	779	785	791	797	803	809	715	821	827	833	839
−36	703	709	715	721	727	733	739	745	751	757	764	770	776	782	788	794	800	806	812	818	824	830	836	843	849
−38	711	717	723	729	736	742	748	754	760	766	772	779	785	791	797	803	809	815	821	828	834	840	846	852	858

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Table 503
TOT Correction Chart (cont)

OAT	650	655	660	665	670	675	680	685	690	695	700	705	710	715	720	725	730	735	740	745	750	755	760	765	770
50	550	554	559	563	568	572	577	571	586	590	595	599	603	608	612	617	621	626	630	635	639	644	648	653	657
48	555	560	564	569	573	578	582	587	591	595	600	304	609	613	618	622	627	631	636	640	645	649	654	658	663
46	560	565	569	574	578	583	587	592	596	604	605	610	614	619	624	628	633	637	642	646	651	655	660	664	669
44	566	570	575	579	584	588	593	597	602	606	611	616	620	625	629	634	638	643	647	652	656	661	665	670	675
42	571	575	580	585	589	594	598	603	607	612	617	621	626	630	635	639	644	649	653	658	662	667	671	676	681
40	576	581	585	590	595	599	604	608	613	618	622	627	631	636	641	645	650	654	659	664	668	673	677	682	687
38	582	586	591	596	600	605	610	614	619	623	628	633	637	642	647	651	656	660	665	670	674	679	684	688	693
36	587	592	597	601	606	611	615	620	625	629	634	639	643	648	653	657	662	666	671	676	680	685	690	694	699
34	593	598	602	607	612	616	621	626	630	635	640	644	649	654	689	663	668	673	677	682	687	691	696	701	705
32	599	603	608	613	617	622	627	632	636	641	646	650	655	660	665	669	674	679	684	688	693	698	702	707	712
30	604	609	614	619	623	628	633	638	642	647	652	657	661	666	671	676	680	685	690	695	699	704	709	714	718
28	610	615	620	624	629	634	639	644	648	653	658	663	668	672	677	682	687	691	696	701	706	711	715	720	725
26	616	621	626	630	635	640	645	650	655	659	664	669	674	679	683	688	693	698	703	718	712	717	722	727	732
24	622	627	632	637	641	646	651	656	661	666	671	675	680	685	690	695	700	704	709	714	719	724	729	734	738
22	628	633	638	643	648	653	657	662	667	672	677	682	687	692	696	701	706	711	716	714	726	731	735	740	745
20	634	639	644	649	654	659	664	669	674	678	683	688	693	698	703	708	713	718	723	728	733	737	742	747	752
18	640	645	650	655	660	665	670	675	680	685	690	695	700	705	710	715	720	725	730	735	739	744	749	754	759
16	647	652	657	662	667	672	677	682	687	692	697	702	707	712	717	822	727	732	736	741	746	751	756	761	766
14	653	658	663	668	673	678	683	688	693	698	703	708	713	718	723	728	733	739	744	749	754	759	764	769	774
12	660	665	670	675	680	685	690	695	700	705	710	715	720	725	730	736	741	746	751	756	761	766	771	776	781
10	666	671	676	682	687	692	697	702	707	712	717	722	727	732	738	743	748	753	757	763	768	773	778	783	788
8	673	678	683	688	693	699	704	709	714	719	724	729	734	740	745	750	755	760	765	770	775	781	786	791	796
6	680	685	690	695	700	706	711	716	721	726	731	737	742	747	752	757	762	768	773	778	783	788	793	798	804
4	687	692	697	702	707	713	718	723	728	733	739	744	749	754	759	765	770	775	780	785	791	796	801	806	811
2	694	699	704	709	715	720	725	730	736	741	746	751	756	762	767	772	777	783	788	793	798	804	809	814	819
0	701	706	711	717	722	727	732	738	743	748	753	759	764	769	775	780	785	790	796	801	806	811	817	822	827
−2	708	713	719	724	729	734	740	745	750	756	761	766	772	777	782	788	793	798	804	809	814	819	825	830	835
−4	715	721	726	731	737	742	747	753	758	763	769	774	779	785	790	795	801	806	812	817	822	828	833	838	844
−6	723	728	733	739	744	750	755	760	766	771	777	782	787	793	798	803	809	814	820	825	830	836	841	847	852
−8	730	736	741	746	752	757	763	768	774	779	784	790	795	801	806	812	817	822	828	833	839	844	850	855	861
−10	738	743	749	754	760	765	771	776	782	787	792	798	803	809	814	820	825	831	836	842	847	853	858	864	869
−12	745	751	757	762	768	773	779	784	790	785	801	806	812	817	823	828	834	839	845	850	856	861	867	872	878
−14	753	759	764	770	776	781	787	792	798	803	809	815	820	826	831	837	842	848	853	859	865	870	876	881	887
−16	761	767	773	778	784	789	795	801	806	812	817	823	829	834	840	845	851	857	862	868	873	879	885	890	896
−18	769	775	781	786	792	798	803	809	815	820	826	839	837	843	849	854	860	865	871	877	882	888	894	899	905
−20	778	783	789	795	800	806	812	818	823	829	835	840	746	852	857	863	869	874	880	886	892	897	903	909	914
−22	786	792	798	803	809	815	820	826	832	838	843	849	855	861	866	872	878	884	889	895	901	907	912	918	924
−24	795	800	806	812	818	823	829	835	841	847	852	858	864	870	876	881	887	893	899	904	910	916	922	958	933
−26	803	809	815	821	827	832	838	844	850	856	862	867	873	879	885	891	896	902	908	914	920	926	931	937	943
−28	812	819	824	830	836	841	847	853	859	865	871	877	883	888	894	900	906	912	918	924	930	935	941	947	853
−30	821	827	833	839	845	851	856	862	868	874	880	886	892	898	904	910	916	922	928	934	939	945	951	957	963
−32	830	836	842	848	854	860	866	872	878	884	890	896	902	908	914	920	926	932	938	944	950	955	961	967	973
−34	839	845	851	857	863	869	875	881	887	593	899	906	912	918	924	930	936	942	948	954	960	966	972	978	984
−36	849	855	861	867	873	879	885	891	897	903	909	915	922	928	934	940	946	952	958	964	970	976	982	988	994
−38	858	864	870	877	883	889	895	901	907	913	919	926	932	938	944	950	956	962	968	975	981	987	993	9991005	

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250 Trend Check Graph
Figure 523

PARA 4. (cont)

D. Aircraft Manufacturer Trend Check — Alternate Procedure

Most aircraft manufacturer power checks generate percent torque as part of the aircraft In–flight Power Assurance — Daily Trend Check. This procedure trends power or torque with appropriate corrections for ambient flight conditions and aircraft installation characteristics. The result of this procedure is Delta percentage of specifications torque. This Delta percentage of specification torque can be used for trend monitoring by plotting the observed torque margin on a daily basis. This plot would appear similar to Figure 525.

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ENGINE TREND CHECK PROCEDURE

WARNING: DO NOT EXCEED ENGINE/AIRCRAFT LIMITS.

1. Note altimeter pressure; set to 29.92 in. Hg and fly baseline torque and altitude for one minute.

   NOTE: Correct the torque setting if a non–standard baseline altitude is used.

   WARNING: ACCESSORIES REQUIRED FOR SAFE FLIGHT SHOULD BE OPERATED DURING EACH CHECK.

2. Turn off bleed air operated accessories (see WARNING); stabilize generator load below 20% and set full N_2 operating speed.

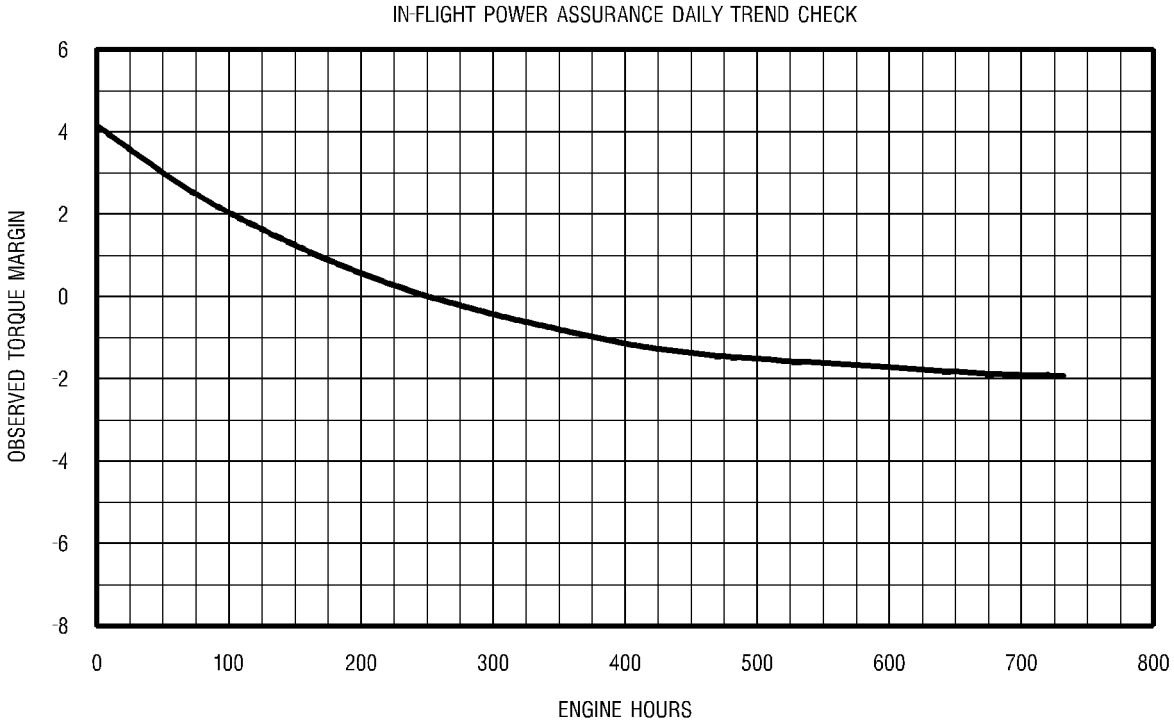
   NOTE: Be sure engine settings/configuration are identical for each check.

3. Record pressure altitude, OAT, N_1, torque and TOT.

4. Reset altimeter.

In–flight Check List
Figure 524

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APS032XA

In–Flight Power Assurance Daily Trend Check
Figure 525

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ENGINE – INSPECTION/CHECK

1. Inspections

The inspection requirements for the engine have been categorized into Preflight and Postflight Inspections, Scheduled Inspections and Special Inspections.

Detailed instructions and information on each item in the inspection tables is in the referenced Operation and Maintenance Manual paragraphs.

NOTE: Inspections may require using a bright light (flashlight or equivalent) and a mirror.

NOTE: When applicable, review engine records for compliance with all mandatory Bulletins, Inspections and Airworthiness Directives.

NOTE: Review Engine Records for Time and/or Cycle Limited Parts. Review Components, Accessories and Modules time between overhaul.

NOTE: When local conditions dictate, it is the responsibility of the operator to increase the scope and/or frequency of checks and/or inspections to assure an adequate level of serviceability and safety.

Operating and maintenance personnel should be alert to recognize signs of engine abnormal operation that may be indicative of an impending engine difficulty. Any or all of the following engine abnormalities may be indicative of an impending engine difficulty and should be investigated to determine the cause and the required corrective action.

NOTE: Cracks in the horizontal and/or vertical fireshield can be indicative of abnormally high engine vibration.

NOTE: Broken, cracked, or fretted fuel, lube, or air tubes can be indicative of abnormally high engine vibration.

NOTE: Polishing of tube assemblies in the tube clamping areas can be indicative of abnormally high engine vibration.

NOTE: N_1 rotor coast–down that is more rapid than what is normally experienced can be indicative of an impending engine difficulty. Example: Coastdown from idle in 4–5 seconds can be indicative of binding in the N_1 rotor system.

A. Preflight and Postflight Inspections

Inspections that must be made before flight and after the final flight of the day are given in Table 601.

NOTE: The following information will help when referencing Chapter 72–00–00 in the following Tables (601–604).

Description and Operation starts on page 1.
Troubleshooting starts on page 101.
Servicing starts on page 301.
Adjustment/Test starts on page 501.
Inspection/Check starts on page 601.
Cleaning/Painting starts on page 701.
Storage Instructions starts on page 901.

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Table 601

Preflight and Postflight Inspections

Item	Component	Preflight	Postflight*
NOTE: The letter designations in the Preflight and Postflight columns refer to the applicable Description of the Inspection.			
	ENGINE ASSEMBLY		
1	Engine, general	a, b	
2	Control linkage	c	
	COMPRESSOR		
3	Blades and vanes		d, e
	GEARBOX		
4	Magnetic drain plugs		f
	LUBRICATION		
5	Oil supply	g	h
	FUEL		
6	Fuel control		i
7	Fuel system, general		j
	ELECTRICAL		
8	Ignition		k
9	Start counter		l
10	Electrical Harness		m

*Postflight inspection shall be made after the final flight of the day.

Description of Inspections

Item 1. Engine, General

a. Inspect the entire engine for loose bolts, broken or loose connections, security of mounting accessory, and broken or missing lockwire. Visually check for the presence and alignment of slippage marks (torque paint) on all B–nuts. Check accessible area for obvious damage and evidence of fuel or oil leakage.

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Table 601 (cont)

Description of Inspections (cont)

CAUTION: BEFORE THE ENGINE IS OPERATED, MAKE CERTAIN THE COMPRESSOR INLET IS FREE OF DEBRIS. ALSO, MAKE CERTAIN THE COMPRESSOR ROTOR IS NOT FROZEN IF THE AIRCRAFT IS IN A FREEZING ATMOSPHERE.

b. Check to ascertain that mounting and support bolts are tight, lockwired, and in good condition. Check security of screws and rivets. Remove all foreign material which might be drawn into the compressor inlet.

Item 2. Control Linkage

c. Check for freedom of operation and full travel. Check security of linkage. Check for excessively loose or worn linkage and linkage bolts.

Item 3. Compressor Blades and Vanes

d. Anytime the aircraft has been operated in an atmosphere known (or suspected) to be corrosive, perform a water rinse of the compressor. Refer to Compressor Contamination Removal, PARA 6.A.(1), 72–30–00.

e. Inspect for obvious foreign object damage. If inspection of the compressor inlet is not possible due to an installed particle separator system; examine the air particle separator for external damage as well as a visual check for cracked, loose or clogged vortex generators. If damage is observed, remove the separator cowlings and fairing to permit inspection of the compressor blades and vanes for foreign object damage prior to further flight.

Item 4. Gearbox

f. If a warning light is received, inspect and clean the magnetic drain plugs. Refer to Magnetic Plug Inspection, PARA 11.G., 72–00–00, Engine–Servicing.

Item 5. Oil Supply

g. Check engine oil level. On 250–C20F engines and on other 250–C20 series engines with this customer option, check the impending oil filter bypass indicator. If indicator is extended, clean oil filter.

NOTE: It is possible for the impending oil bypass indicator to extend during a start, before the oil has warmed, and give an erroneous indication of a dirty oil filter. If the impending bypass filter indicator is extended, run the engine until the oil is at operative temperature and push the indicator button in. If the button remains in throughout the normal speed range of the engine, the filter does not require cleaning/changing.

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Table 601 (cont)

Description of Inspections (cont)	
h.	Check the engine oil quantity within 15 minutes of engine shutdown to avoid a false indication of excessive oil consumption. If the 15 minutes has been exceeded, motor the engine for 30 seconds with the starter before checking tank quantity. Motoring normally scavenges oil from the gearbox back to the aircraft oil tank. Check the airframe flight manual; some installations may require engine to be operated for at least a minute at ground idle to assure proper scavenging of the engine gearbox. NOTE: Always refer to the airframe flight manual for proper oil servicing instructions; specific requirements may vary for different aircraft models.
Item 6.	Fuel Control
i.	Check the fuel control by making a deceleration check during shutdown for the last flight of each day. Refer to Deceleration Check, PARA 3.B., 73-20-02 or para 3.B., 73-20-04.
Item 7.	Fuel System, General
j.	Carefully inspect the fuel control and governor for evidence of leakage. Accomplish with the boost pump on if available. Also, check condition of fittings and tubing (e.g. loose, chafed, bent, dented) which can contribute to leakage. If there is no evidence of leakage, further action is not required. If evidence of fuel leakage is found, refer to Fuel Leakage Inspection, PARA 2.A., 73-00-00, for required action. Perform fuel system pneumatic leak check anytime system maintenance is performed. Refer to Fuel System Pneumatic Leak Check, Para 2.B., 73-00-00.
Item 8.	Ignition Lead
k.	Inspect ignition lead for burning, chafing, or cracking of conduit and for loose connectors. Inspect for broken lockwire.
Item 9.	Start Counter. (If Applicable)
l.	Inspect for proper operation, increase in count, and for loose, chafed, frayed or broken wires and loose connectors.
Item 10.	Electrical Harness (250-C20R, -C20R/1, -C20R/1(RS) only)
m.	Inspect for loose, chafed, frayed or broken wires and loose connectors.

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PARA 1. (cont)

B. Scheduled Inspections

Scheduled inspections are made at periodic intervals in an effort to prevent engine malfunction and serve in the role of preventative maintenance for the engine. The component to be inspected, the nature of the inspection, and the elapsed time after which the inspection is to be performed are given in the Inspection Checksheet, Table 602. The inspection times are hours of engine operation.

Table 602
Scheduled Inspections

Inspection Checksheet

Owner _____ Date _____

A/C Make/Model _____ S/N _____ Reg No. _____ TSN _____

Engine S/N _____ TSN _____ TSO _____

This inspection checksheet is to be used when performing scheduled inspections. This form may be locally reproduced and/or expanded to reflect the aircraft operating environment. Keep the completed sheets as a permanent part of the aircraft engine records. Detailed information regarding each inspection item is contained in the referenced Operation and Maintenance Manual paragraphs.

CAUTION: BEFORE UNDERTAKING ANY INSPECTION OR MAINTENANCE ACTION, CONSULT THE REFERENCED PARAGRAPHS OF THE OPERATION AND MAINTENANCE MANUAL. FAILURE TO FOLLOW THE RECOMMENDED INSTRUCTIONS IN THE MANUAL COULD RESULT IN EQUIPMENT DAMAGE OR DESTRUCTION, POSSIBLY RESULTING IN PERSONNEL DEATH OR INJURY.

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	100 Hour Inspection			
1	Inspect the entire engine for loose or missing bolts, broken or loose connections, security of mounting accessory and broken or missing lockwire. Check accessible areas for obvious damage and evidence of fuel or oil leakage.	N/A		
2	Inspect all “B” nuts for application and alignment of torque paint. If missing, loosen “B” nut, retighten, and apply torque paint.	PARA 9.B., 72–00–00, Engine–Servicing		
3	Check mounting and support bolts to be sure they are tight, lockwired and in good condition. Check security of screws and rivets. Remove all foreign material which might be drawn into the compressor inlet.	N/A		
4	Check accessible fuel system components, lines, and connections for security, damage or leakage. Accomplish with the boost pump on, if available. Remove, visually inspect and clean if visual condition dictates.	PARA 2., 73–00–00		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	100 Hour Inspection (cont)			
5	Inspect P_c filter for proper clamping.	73-20-06		
6	Until CEB-A-1233 is complied with, inspect P_c filter assembly as follows: Without disassembly or removal of the P_c filter assembly from the mounting bracket, inspect using a 10x magnification glass and a bright light to detect any signs of cracks, paying particular attention to both of the end fittings at their junction with the end walls. If cracks are detected, remove assembly and comply with CEB-A-1233.	N/A		
7	Remove the Scroll-to-P_c Filter Tube Assembly at both ends and inspect for cracks using 10x power glass. Pay particular attention to the flared ends of the tube for cracks, and to the areas beneath the floating ferrules for fretting damage. Tubes-found to contain cracks and/or excessive fretting damage are to be replaced by new parts of the same part number as removed.	N/A		
	NOTE: Excessive fretting is present when the ferrule has chafed the tube sufficiently to wear a step in the tube that can be felt with a thumbnail or other inspection aid.			
8	With the Scroll-to-P_c Tube Assembly still removed and using a 10x power glass, inspect the elbow in the compressor scroll for distress/cracks/proper alignment. No cracks are permissible.	N/A		
9	Check fuel control and power turbine governor linkage for freedom of operation, full travel and proper rigging. Check security of linkage for loose or worn linkage and linkage bolts.	PARA 3.C., 73-20-02, 3.B., 73-20-03, 3.C., 73-20-04 and PARA 2.C., 73-20-01		
10	Inspect compressor inlet guide vanes and visible blades and vanes for foreign object damage.	N/A		
11	Clean compressor with chemical wash solution as required if operating in a smoggy area, conditions with airborn pollutants or with water alcohol.	PARA 6., 72-30-00		
12	Visually inspect the water-alcohol nozzles for build-up of contaminants which could restrict flow or alter the spray pattern. Ultrasonic clean nozzles if equipment is available.	N/A		
13	Clean the 200 mesh screen (if equipped with water-alcohol injection kit).	N/A		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	100 Hour Inspection (cont)			
14	Inspect the compressor scroll for cracks or breaks at the anti-ice air valve and customer bleed port. If cracks or breaks are detected, check engine for possible vibration causes.	PARA 1.D.(2), this section		
15	Inspect for discharge air tube inserts that are cocked or backing out of the scroll. If cocked or loose inserts are detected, check engine for possible vibration causes.	PARA 1 D. (2), this Section.		
16	Check compressor discharge air tubes for damage or deterioration.	PARA 4.A., 72-40-00		
17	Check anti-ice valve for security, worn parts and proper operation. Valve need not be removed or disassembled unless a problem is detected.	PARA 4., 75-10-01		
18	Inspect compressor mount inserts, bolts and nuts for looseness, fretting or oil leakage. Replace or retighten as required. Check engine for possible vibration causes.	PARA 4.D., 72-60-00 and PARA 1.D.(2), this section		
19	Inspect the turbine support assemblies and engine exhaust ducts for condition of welded joints, for cracks and buckling. Check exhaust duct clamps for proper installation, condition and torque.	PARA 8.A., 72-50-00		
20	Wet spline starter-generator gearshafts, new production or those replaced in accordance with the Rolls-Royce Commercial Engine Bulletin 250-C20 CEB-1082, do not need periodic inspection and lubrication. Clean and inspect any other starter-generator gearshaft. Clean the female splines of the starter-generator gearshafts and the male splines of the starter-generator with mineral spirits and a soft brush. Inspect splines. Refer to Starter-generator Gearshaft Female Spline Inspection paragraph.	PARA 4.B., 72-60-00		
	Inspect the starter-generator brushes for wear in accordance with the Aircraft Manual at the same time the spline inspection is made.	N/A		
	Lubricate acceptable splines with grease, Aeroshell No. 22, or equivalent. Before reinstallation of the starter-generator, make sure torsional damper members of the starter-generator driveshaft are in hard contact with each other.	N/A		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	100 Hour Inspection (cont)			
21	Lubrication system inspection			
	NOTE: Maximum interval between oil change is 100 hours or six months, whichever occurs first. This hour limit can be extended to 200 hours for those items indicated by an asterisk (*) if an external oil filter of a type that has a valid STC (Supplemental Type Certificate) is installed on the engine. The calendar limit can be extended to 12 months for those items indicated by an asterisk (*) and if an approved high stability oil (Third Generation) is used.			
	*a. Drain oil system.	PARA 11.C., 72-00-00, Engine-Servicing		
	b. Remove, inspect and clean the oil filter. Note any accumulation of metal chips, debris or carbon particles. Conduct further inspection of the lube system and/or engine gear train/bearings if metal chips or debris are found. See Items 21a, 21e, 38, 39 and 40 below if carbon particles are found.	PARA 1.C., 72-60-00		
	NOTE: Follow STC manufacturer's recommendations regarding replacement/cleaning of external oil filter elements. Inspect removed elements for any accumulations of metal chips, debris or carbon particles. It may prove helpful to cut apart disposable (paper) filler elements to facilitate this inspection. If chips, debris or carbon particles are found, proceed with additional inspection/maintenance as outlined in item 21b. above.			
	*c. Inspect and clean turbine pressure oil check valve.	PARA 7.K., 72-50-00		
	NOTE: Check Valve P/N 23074872 and subsequent part numbers are not applicable to this inspection (these valves are considered "ON CONDITION").			
	*d. Turbine pressure oil tube screen assembly. Detach clamp; then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the tube coupling nut at the fireshield elbow only enough to allow sufficient movement of the tube to enable removal of the screen. At assembly, tighten connector coupling nut to 200-250 lb in. (23-28 N·m). Tighten fireshield elbow coupling nut to 80-120 lb in. (9-14 N·m). Tighten clamp nut to 35-40 lb in. (3.9-4.5 N·m).	N/A		
	*e. Measure oil flow from the scavenge passage of the external sump and from the scavenge passage of the power turbine support. It is recommended that the external sump is not removed for this check.	PARA 7.D., 72-50-00		
	NOTE: This step must be performed before draining oil or after the oil system has been refilled.			

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	100 Hour Inspection (cont)			
	f. Inspect magnetic chip detector plugs.	PARA 11.G., 72-00-00, Engine-Servicing		
	g. Inspect quick disconnect magnetic chip detector plugs and flanged inserts for wear, if installed.	PARA 11.G., 72-00-00, Engine-Servicing		
	*h. Refill oil system.	PARA 11.C., 72-00-00, Engine-Servicing		
21.A	Remove, inspect and clean the fuel nozzle. If no airframe mounted fuel filter is installed, inspect the fuel nozzle filter.	73-10-03		
	NOTE: Operators may find it necessary to inspect and clean the fuel nozzle more often depending on past experience or operating conditions.			
22	Inspect the start counter for proper operation, increase in count, and for loose, chafed,frayed or broken wires and loose connectors.	PARA 1., 74-20-03		
23	Check the condition of the bleed valve gasket, without removing bleed valve. Replace gasket if air leaks (blowouts) can be detected.	PARA 2., 75-10-02		
24	Inspect the outer combustion case for condition. Inspect the weld joints of and in the brazed screen reinforcement in the armpit area.	PARA 2.B., 72-40-00		
25	Clean the burner drain valve.	PARA 3., 72-40-00		
26	Inspect the ignition lead for burning, chafing,or cracking of conduit and loose connectors and broken lockwire.	PARA 2., 74-20-02		
27	On engines with CECO fuel system, clean or replace the high pressure fuel filter.	PARA 2., 73-10-05		
28	On engines with CECO fuel systems, visually inspect the bleed hole at the low point in the scroll-to-governor P_c tube for any obstruction. If the hole is not completely open, remove any contamination which could obstruct drainage of moisture from the tube using a piece of lockwire.	N/A		
29	Review engine records for compliance with all mandatory bulletins, inspections and airworthiness directives.	N/A		
30	Review engine records for time limited parts components, accessory or modules.	N/A		
31	Enter component changes, inspection compliance, etc., in log book as required.	N/A		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	200 Hour Inspection			
	In addition to the 100 hour inspection items, perform the following:			
	WARNING: MANDATORY COMPLIANCE DATE FOR ROLLS-ROYCE COMMERCIAL ENGINE BULLETIN 250-C20 CEB-1051 WAS AUGUST 30, 1980.			
32	Perform fuel pump backlash inspection on Sundstrand dual element pump P/N 6854292, 6857548, 6877719, 6856250, 6876803.	250-CSL-1007		
	300 Hour Inspection			
	In addition to the 100 hour and applicable 200 hour inspection items, do the following:			
	CAUTION: INSPECTION FREQUENCY SHALL BE BASED ON THE NATURE OF THE EROSIVE AND/OR CORROSIVE ENVIRONMENT. THE OPERATING ENVIRONMENT MAY DICTATE A MORE FREQUENT INSPECTION INTERVAL.WHEN OPERATING IN A CORROSIVE AND/OR EROSIVE ENVIRONMENT FOR NON-COATED COMPRESSOR WHEELS, THE INSPECTION SHALL NOT EXCEED 300 HOURS OR 6 MONTHS. FOR COATED COMPRESSOR WHEELS, INSPECTION SHALL NOT EXCEED 300 HOURS OR 12 MONTHS. IF ANY PARENT METAL IS EXPOSED DUE TO CORROSION AND/OR EROSION, THE INSPECTION REQUIREMENT SHALL REVERT BACK TO 300 HOURS OR 6 MONTHS.			
33	Inspect the compressor case when operating in an erosive and/or corrosive environment.	PARA 1.D.(9), this Section		
	CAUTION: AIRCRAFT INSTALLED-ENGINE FUEL-PUMP FILTER DIFFERENTIAL PRESSURE WARNING SYSTEMS AND/OR OPERATING EXPERIENCE MAY DICTATE REPLACEMENT AT A LESSER TIME INTERVAL. IN NO INSTANCE SHOULD THE 300 HR REPLACEMENT INTERVAL BE EXCEEDED.			
34	Replace the fuel filter element. This filter is a throw-away item. It is not cleanable. Before discarding filter, inspect for signs of contaminants. If any are found, inspect the entire fuel system and clean if necessary.	PARA 2.C., 73-10-01		
	CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. (REFER TO SPECIAL INSPECTIONS, 72-00-00, TABLE 604) IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.			
	CAUTION: PURGE AIR FROM THE FUEL SYSTEM.			
35	Do a fuel pump bypass valve operation check when a fuel filter is replaced. NOTE: Applicable to Sundstrand/Pesco and Argo-Tech/TRW manufactured pumps only.	PARA 3.A., 73-10-01		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	300 Hour Inspection (cont)			
36	Remove, clean and inspect engine P_c filter every 300 hours or earlier as engine performance dictates.	PARA 3., 73-20-06		
37	Inspect and clean the No. 1 bearing oil pressure reducer.	PARA 3., 72-30-00		
38	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	PARA 7. E., 72-50-00		
39	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72-50-00		
40	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G., 72-50-00		
41	Inspect the thermocouple assembly.	PARA 2.B., 77-20-01		
41A	Remove and disassemble fuel nozzle. Clean and inspect fuel nozzle filter assembly. Assemble and install fuel nozzle.	73-10-03		
	500 Hour/1 Year Inspection			
42	Inspect all uncoated and coated P/N 6846278 and 6871338 power turbine outer couplings nuts for corrosion.	250-C20 CSL-1060		
	NOTE: Compliance with Rolls-Royce Commercial Engine Bulletin 250-C20 CEB-1120 and/or 250-C20 CEB-1158 removes this inspection requirement.			
	600 Hour Inspection			
43	Check the fuel pump driveshaft on Sundstrand single element pumps for spline wear.	N/A		
	NOTE: This inspection is not required for Agro-Tech (TRW) fuel pumps or Sundstrand fuel pumps P/N 23003114 and subsequent.			
44	Do the scavenge oil filter impending bypass functional test per Facet Service Bulletin No. 090589 (Ref. Rolls-Royce 250 CSL 1164) for aircraft equipped with this type of external scavenge filter system. Follow the Facet instructions and time intervals, or follow this recommended inspection interval each 600 hours.	N/A		
45	Replace the fuel control filter assembly. Bendix fuel controls P/N 2524552-4 or 2524552-6 (less-5) and prior unless 250-C20 CEB-1089 has been accomplished.	PARA 4.A., 73-20-02, 4.A., 73-20-03		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	1000 Hour Inspection			
46	Inspect Py port on Bendix power turbine governor per 250 CEB-A-1281. The governor must be removed from the engine to perform this inspection.	N/A		
	NOTE: If CEB-A-1289 or CEB 1330 have been accomplished, this inspection is not required.			
	1500 Hour Inspection			
47	Clean and Inspect the Fuel Control Strainer Assembly. Replace as necessary. NOTE: The Fuel Control Strainer Assembly must be replaced on any Fuel Control unit that has not had 250-C20 CEB-1089 accomplished.	PARA 4.A., 73-20-02, 4.A., 73-20-03		
48	Deleted			
	1750 Hour Inspection			
49	Inspect the compressor case. Inspection frequency shall be as made necessary by operating environment. In erosive environment, inspect case at least every 300 hours. In any environment do not exceed 1750 hours without case inspection.	PARA 1.D., this section and PARA 5., 72-30-00		
50	Heavy Maintenance Inspection (HMI). Heavy maintenance inspection shall consist of gas producer turbine wheels replacement and inspection of assembled components per Rolls-Royce published documents. It is the responsibility of the operator to assure that the total time and cycle life limits of specific parts listed in Section 05-10-00, Airworthiness Limitations, are not exceeded.	N/A		
	As Required Inspection			
51	Clean the bleed valve after each 10 hr of water-alcohol augmentation operation or after consumption of each 750 gallons (2840 liters) of water-alcohol mixture.	PARA 2.C., 75-10-02		

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C. Alternate Inspection Schedule

Based on current engine configuration and the use of modern oils, operators may use this alternate inspection schedule. Prerequisites for this include:

(1) The use of a wet spline starter/generator drive shaft (new production or those replaced in accordance with the Rolls–Royce Commercial Engine Bulletin 250–C20 CEB–1082).

(2) The use of High Thermal Stability (third generation) oils. Reference PARA 4.C., 72–00–00, Engine–Description and Operation, for oil specifications and mixing cautions.

(3) The engine must have an external oil filter installed that has a valid STC (Supplemental Type Certificate).

Table 603
Alternate Scheduled Inspections

Inspection Checksheet

Owner _____ Date _____

A/C Make/Model_____ S/N_____ Reg No._____ TSN_____

Engine S/N_____ TSN _____ TSO _____

This inspection checksheet is to be used when performing scheduled inspections. This form may be locally reproduced and/or expanded to reflect the aircraft operating environment. Keep the completed sheets as a permanent part of the aircraft engine records. Detailed information regarding each inspection item is contained in the referenced Operation and Maintenance Manual paragraphs.

CAUTION: BEFORE UNDERTAKING ANY INSPECTION OR MAINTENANCE ACTION, CONSULT THE REFERENCED PARAGRAPHS OF THE OPERATION AND MAINTENANCE MANUAL. FAILURE TO FOLLOW THE RECOMMENDED INSTRUCTIONS IN THE MANUAL COULD RESULT IN EQUIPMENT DAMAGE OR DESTRUCTION, POSSIBLY RESULTING IN PERSONNEL DEATH OR INJURY.

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	150 Hour Inspection			
1	Inspect the entire engine for loose or missing bolts, broken or loose connections, security of mounting accessory and broken or missing lockwire. Check accessible areas for obvious damage and evidence of fuel or oil leakage.	N/A		
2	Inspect all “B” nuts for application and alignment of torque paint. If missing, loosen “B” nut, retighten, and apply torque paint.	PARA 9.B., 72–00–00, Engine–Servicing		
3	Check mounting and support bolts to be sure they are tight, lockwired and in good condition. Check security of screws and rivets. Remove all foreign material which might be drawn into the compressor inlet.	N/A		
4	Check accessible fuel system components, lines, and connections for security, damage or leakage. Accomplish with the boost pump on, if available. Remove, visually inspect and clean if visual condition dictates.	PARA 2., 73–00–00		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	150 Hour Inspection (cont)			
5	Inspect P_C filter for proper clamping.	N/A		
6	Until CEB–A–1233 is complied with, inspect P_C filter assembly as follows: Without disassembly or removal of the P_C filter assembly from the mounting bracket, inspect using a 10x magnification glass and a bright light to detect any signs of cracks, paying particular attention to both of the end fittings at their junction with the end walls. If cracks are detected, remove assembly and comply with CEB–A–1233.	N/A		
7	Remove the Scroll–to–P_C Filter Tube Assembly at both ends and inspect for cracks using 10x power glass. Pay particular attention to the flared ends of the tube for cracks, and to the areas beneath the floating ferrules for fretting damage. Tubes–found to contain cracks and/or excessive fretting damage are to be replaced by new parts of the same part number as removed.	N/A		
	NOTE: Excessive fretting is present when the ferrule has chafed the tube sufficiently to wear a step in the tube that can be felt with a thumbnail or other inspection aid.			
8	With the Scroll–to–P_C Tube Assembly still removed and using a 10x power glass, inspect the elbow in the compressor scroll for distress/cracks/proper alignment. No cracks are permissible.	N/A		
9	Check fuel control and power turbine governor linkage for freedom of operation, full travel and proper rigging. Check security of linkage for loose or worn linkage and linkage bolts.	PARA 3.C., 73–20–02, 3.B., 73–20–03, 3.C., 73–20–04 and PARA 2.C., 73–20–01		
10	Inspect compressor inlet guide vanes and visible blades and vanes for foreign object damage.	N/A		
11	Clean compressor with chemical wash solution as required if operating in a smoggy area, conditions with airborn pollutants or with water alcohol.	PARA 6., 72–30–00		
12	Visually inspect the water–alcohol nozzles for build–up of contaminants which could restrict flow or alter the spray pattern. Ultrasonic clean nozzles if equipment is available.	N/A		
13	Clean the 200 mesh screen (if equipped with water–alcohol injection kit).	N/A		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	150 Hour Inspection (cont)			
14	Inspect the compressor scroll for cracks or breaks at the anti-ice air valve and customer bleed port. If cracks or breaks are detected, check engine for possible vibration causes.	PARA 1.D.(2), this section		
15	Inspect for discharge air tube inserts that are cocked or backing out of the scroll. If cocked or loose inserts are detected, check engine for possible vibration causes. Check air tubes for cracks.	PARA 1.D.(2), this section		
16	Check compressor discharge air tubes for damage or deterioration.	PARA 4.A., 72-40-00		
17	Check anti-ice valve for security, worn parts and proper operation. Valve need not be removed or disassembled unless a problem is detected.	PARA 4., 75-10-01		
18	Inspect compressor mount inserts, bolts and nuts for looseness, fretting or oil leakage. Replace or retighten as required. Check engine for possible vibration causes.	PARA 4.D., 72-60-00 and PARA 1.D.(2), this section		
19	Inspect the turbine support assemblies and engine exhaust ducts for condition of welded joints, for cracks and buckling. Check exhaust duct clamps for proper installation, condition and torque.	PARA 8.A., 72-50-00		
20	Inspect the starter-generator brushes for wear in accordance with the Aircraft Manual at the same time the spline inspection is made.	N/A		
21	Lubrication system inspection			
	a. Remove, inspect and clean the oil filter. Note any accumulation of metal chips, debris or carbon particles. Conduct further inspection of the lube system and/or engine gear train/bearings if metal chips or debris are found. See Items 36a, 37, 38 and 39 below if carbon particles are found.	PARA 1.C., 72-60-00		
	NOTE: Follow STC manufacturer's recommendations regarding replacement/cleaning of external oil filter elements. Inspect removed elements for any accumulations of metal chips, debris or carbon particles. It may prove helpful to cut apart disposable (paper) filler elements to facilitate this inspection. If chips, debris or carbon particles are found, proceed with additional inspection/maintenance as outlined in item 21b. below.			

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	150 Hour Inspection (cont)			
	b. Inspect magnetic chip detector plugs.	PARA 11.G., 72-00-00, Engine-Servicing		
	c. Inspect quick disconnect magnetic chip detector plugs and flanged inserts for wear, if installed.	PARA 11.G., 72-00-00, Engine-Servicing		
21A	Remove, examine, and clean the fuel nozzle. If no airframe mounted fuel filter is installed, examine the fuel nozzle filter.	73-10-03		
	NOTE: Operators may find it necessary to inspect and clean the fuel nozzle more often depending on past experience or operating conditions.			
22	Inspect the start counter for proper operation, increase in count, and for loose, chafed, frayed or broken wires and loose connectors.	PARA 1., 74-20-03		
23	Check the condition of the bleed valve gasket without removing bleed valve. Replace gasket if air leaks (blowouts) can be detected.	PARA 2., 75-10-02		
24	Inspect the outer combustion case for condition. Inspect the weld joints of and in the brazed screen reinforcement in the armpit area.	PARA 2.B., 72-40-00		
25	Clean the burner drain valve.	PARA 3., 72-40-00		
26	Inspect the ignition lead for burning, chafing, or cracking of conduit and loose connectors and broken lockwire.	PARA 2., 74-20-02		
27	On engines with CECO fuel system, clean or replace the high pressure fuel filter.	PARA 2., 73-10-05		
28	On engines with CECO fuel systems, visually inspect the bleed hole at the low point in the scroll-to-governor P_c tube for any obstruction. If the hole is not completely open, remove any contamination which could obstruct drainage of moisture from the tube using a piece of lockwire.	N/A		
29	Review engine records for compliance with all mandatory bulletins, inspections and airworthiness directives.	N/A		
30	Review engine records for time limited parts components, accessory or modules.	N/A		
31	Enter component changes, inspection compliance, etc., in log book as required.	N/A		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	300 Hour Inspection			
	In addition to the 150 hour inspection items, perform the following:			
	WARNING: MANDATORY COMPLIANCE DATE FOR ROLLS-ROYCE COMMERCIAL ENGINE BULLETIN 250-C20 CEB-1051 WAS AUGUST 30, 1980.			
32	Perform fuel pump backlash inspection on Sundstrand dual element pump P/N 6854292, 6857548, 6877719, 6856250, 6876803.	250-CSL-1007		
	CAUTION: INSPECTION FREQUENCY SHALL BE BASED ON THE NATURE OF THE EROSIVE AND/OR CORROSIVE ENVIRONMENT. THE OPERATING ENVIRONMENT MAY DICTATE A MORE FREQUENT INSPECTION INTERVAL. FOR NON-COATED COMPRESSOR WHEELS, THE INSPECTION SHALL NOT EXCEED 300 HOURS OR 6 MONTHS. FOR COATED COMPRESSOR WHEELS, INSPECTION SHALL NOT EXCEED 300 HOURS OR 12 MONTHS. IF ANY PARENT METAL IS EXPOSED DUE TO CORROSION AND/OR EROSION, THE INSPECTION REQUIREMENT SHALL REVERT BACK TO 300 HOURS OR 6 MONTHS.			
33	Inspect the compressor case when operating in an erosive and/or corrosive environment.	PARA 1.D.(9), this section		
	CAUTION: AIRCRAFT INSTALLED-ENGINE FUEL-PUMP FILTER DIFFERENTIAL PRESSURE WARNING SYSTEMS AND/OR OPERATING EXPERIENCE MAY DICTATE REPLACEMENT AT A LESSER TIME INTERVAL. IN NO INSTANCE SHOULD THE 300 HR REPLACEMENT INTERVAL BE EXCEEDED.			
34	Replace the fuel filter element. This filter is a throw-away item. It is not cleanable. Before discarding filter, inspect for signs of contaminants. If any are found, inspect the entire fuel system and clean if necessary.	PARA 2.C., 73-10-01		
	CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. (REFER TO SPECIAL INSPECTIONS, 72-00-00, TABLE 604) IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.			
	CAUTION: PURGE AIR FROM THE FUEL SYSTEM.			
35	Do a fuel pump bypass valve operation check when a fuel filter is replaced. NOTE: Applicable to Sundstrand/Pesco and Argo-Tech/TRW manufactured pumps only.	PARA 3.A., 73-10-01		

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Table 603(cont) Alternate Scheduled Inspections				
Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	300 Hour Inspection (cont)			
36	Lubrication system inspection			
	NOTE: Maximum interval between oil change is 300 hours or 12 months, whichever occurs first.			
	a. Drain oil system.	PARA 11.C., 72-00-00, Engine-Servicing		
	b. Inspect and clean turbine pressure oil check valve.	PARA 7.K., 72-50-00		
	c. Turbine pressure oil tube screen assembly. Detach clamp; then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the tube coupling nut at the fireshield elbow only enough to allow sufficient movement of the tube to enable removal of the screen. At assembly, tighten connector coupling nut to 200-250 lb in. (23-28 N·m). Tighten fireshield elbow coupling nut to 80-120 lb in. (9-14 N·m). Tighten clamp nut to 35-40 lb in. (3.9-4.5 N·m).	N/A		
	d. Measure oil flow from the scavenge passage of the external sump and from the scavenge passage of the gas producer support. It is recommended that the external sump is not removed for this check.	PARA 7.D., 72-50-00		
	NOTE: This step must be performed before draining oil or after the oil system has been refilled.			
	e. Refill oil system.	PARA .11.C., 72-00-00, Engine-Servicing		
37	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	PARA 7.E., 72-50-00		
38	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72-50-00		
39	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G. 72-50-00		
40	Inspect the thermocouple assembly.	PARA 2.B., 77-20-01		
40A	Remove and disassemble fuel nozzle. Clean and examine fuel nozzle filter assembly. Assemble and install fuel nozzle.	73-10-03		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	500 Hour/1 Year Inspection			
41	Inspect all uncoated and coated P/N 6846278 and 6871338 power turbine outer couplings nuts for corrosion.	250-C20 CSL-1060		
	NOTE: Compliance with Rolls-Royce Commercial Engine Bulletin 250-C20 CEB-1120 and/or 250-C20 CEB-1158 removes this inspection requirement.			
	600 Hour Inspection			
	In addition to the 150 hour and 300 hour inspection items, perform the following:			
42	Remove, clean and inspect engine P_c filter every 600 hours or earlier as engine performance dictates.	PARA 3., 73-20-06		
43	Inspect and clean the No. 1 bearing oil pressure reducer.	PARA 3., 72-30-00		
44	Check the fuel pump driveshaft on Sundstrand single element pumps for spline wear.	N/A		
	NOTE: This inspection is not required for Agro-Tech (TRW) fuel pumps or Sundstrand fuel pumps P/N 23003114 and subsequent.			
45	Do the scavenge oil filter impending bypass functional test per Facet Service Bulletin No. 090589 (Ref. Rolls-Royce 250 CSL 1164) for aircraft equipped with this type of external scavenge filter system. Follow the Facet instructions and time intervals, or follow this recommended inspection interval each 600 hours.	N/A		
46	Replace the fuel control strainer assembly. (Bendix fuel controls P/N 2524552-4 or 2524552-6 (less-5) and prior unless 250-C20 CEB-1089 has been accomplished).	PARA 4.A., 73-20-02, 4.A., 73-20-03		

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Table 603(cont) Alternate Scheduled Inspections				
Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	1000 Hour Inspection			
47	Inspect Py port on Bendix power turbine governor per 250 CEB-A-1281. The governor must be removed from the engine to perform this inspection.	N/A		
	NOTE: If CEB-A-1289 or CEB 1330 have been accomplished, this inspection is not required.			
	1500 Hour Inspection			
48	Clean and examine the fuel control strainer assembly. Replace as necessary.	PARA 4.A., 73-20-02, 4.A., 73-20-03		
	NOTE: The fuel control strainer assembly must be replaced on all fuel control units that have not had CEB-1089 accomplished.			
49	Deleted			
	1750 Hour Inspection			
50	Inspect the compressor case. Inspection frequency shall be as made necessary by operating environment. In erosive environment, inspect case at least every 300 hours. In any environment do not exceed 1750 hours without case inspection.	PARA 1.D., this section and PARA 5., 72-30-00		
51	Heavy Maintenance Inspection (HMI). Heavy maintenance inspection shall consist of gas producer turbine wheels replacement and inspection of assembled components per Rolls-Royce published documents. It is the responsibility of the operator to assure that the total time and cycle life limits of specific parts listed in Section 05-10-00, Airworthiness Limitations, are not exceeded.	N/A		
	As Required Inspection			
52	Clean the bleed valve after each 10 hr of water-alcohol augmentation operation or after consumption of each 750 gallons (2840 liters) of water-alcohol mixture.	PARA 2.C., 75-10-02		

D. Special Inspections

Special inspections are required when the engine has been subjected to abnormal operating conditions, when engine damage is suspected, or when associated parts are removed from the engine. The special occurrence, the component or system to be inspected, and the nature of the inspection are given in Table 604.

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Table 604
Special Inspections

Item	Occurrence	Component or System	Required Action
1	Engine removal from aircraft	Engine, general Start Counter (If Applicable)	a,d be
2	Compressor removal from engine	Anti-icing air valve Gearbox compressor mount inserts	p ad
3	Turbine removal from engine	Combustion liner Outer combustion case Compressor discharge air tubes Turbine pressure oil check valve Burner drain valve	aa z ab at ac
	NOTE: Check Valve P/N 23074872 and subsequent part numbers are not applicable to this inspection (these valves are considered "ON CONDITION").		
4	Rigid tube and/or accumulators removal from engine	Rigid tube and/or accumulators	f, ba
5	Hard landing (over 10g)	Engine, general	b
6	Sudden stoppage of rotor or propeller	Engine, general Compressor Magnetic drain plugs	c j ag
7	Operation in erosive environment	Compressor	l
8	Snow or ice ingestion	Compressor	i
9	Foreign object damage	Compressor Turbine	k q
10	Operation with inlet restricted	Compressor	g
11	Overtemperature operation	Turbine Thermocouples	r y
12	Oil temperature limit exceeded	Oil system	ap
13	Hot start encountered	Turbine Thermocouples	s y
14	Fuel filter bypassed	Fuel pump filter Fuel control strainer (Bendix) Fuel nozzle strainer Fuel control, governor and high pressure filters (CECO)	au aw bb av
15	Oil change	Oil System Oil filter	ah, aj as
16	Oil consumption	Turbine	u
17	Oil system contamination	Oil system	ak, al, am
	NOTE: When the oil system is contaminated with carbon or metallic particles, this inspection is not required if the engine has a valid STC (Supplemental Type Certificate) or aircraft manufacturer approved external scavenge oil filter which has not bypassed.		
18	Oil spray on first-stage wheel	Turbine	v
19	Engine operated in excess of 30 seconds without oil pressure	Oil system	aq

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Table 604 (cont)
Special Inspections

Item	Occurrence	Component or System	Required Action
20	Engine inactive more than 5 days	Compressor	n
21	Engine inactive more than 45 days	Oil system Fuel system Fuel control & PTG airflow restrictors	an bc ax
22	As dictated by performance	Fuel control P_c filter System P_c filter	ay az
23	Vibration	Compressor Gearbox	m ad
24	Engine submerged while in operation	Compressor Turbine	h t
25	On condition inspection	Power and accessory gearbox	ae
26	Known or suspected lightning strike	Engine, general Rotor or propeller general	e
27	Slippage and/or sudden engagement of freewheel clutch unit	Turbine Gearbox	w,x af
28	First 50 hours of operation on new, repaired or overhauled engines.	Oil system Oil filter	ar as
29	Replacement of fuel pump and/or fuel filter or fuel system connections being loosened	Fuel system	au,bd
30	Fuel system contamination (known high amount of particles or microbiologicals)	Fuel pump Fuel control Fuel nozzle	bd aw bb

NOTE: The letter designations in the Required Action column refer to the applicable Description of Inspection.

Description of Inspections

Engine, General

a. Anytime the engine is removed from the aircraft, inspect the compressor inlet for foreign object damage or condition. Clean and flush all aircraft drain lines. Wash the outside of the engine with mineral spirits. Touch up paint where peeling or chipping is evident. Refer to Corrosion Treatment and Surface Finish Repair, PARA 3., 72-00-00, Engine-Cleaning/Painting.

b. After a hard landing, inspect the complete engine. Refer to Hard Landing Limits, PARA 1.D.(3), 72-00-00, this section.

c. After the main rotor or propeller strikes an object or the engine N_2 power train is subjected to abnormal shock loading during operation, a sudden stoppage inspection must be performed. Refer to Sudden Stoppage Inspection, PARA 1.D.(4) or 1.D.(5), 72-00-00, this section.

d. (250-C20S only) Purge trapped air from the propeller oil system on the ground prior to the first flight anytime the propeller or the engine has been replaced. Refer to Propeller Check Run, PARA 1.D., 72-00-00, Engine-Adjustment/Test.

e. After a known or suspected lightning strike, inspect the complete engine. Refer to Lightning Strike Inspection, PARA 1.D.(7), 72-00-00, this section.

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Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Rigid Tubes and Accumulators

f. Inspect rigid tubes (CECO or Bendix control system) and/or accumulators (Bendix system only) anytime they are removed. Replace tube if any cracks (dye check) are detected or if the tube has kinks or dents which could affect seating or integrity. Refer to PARA 9., 72-00-00, Engine-Servicing. Replace accumulators if leaks are found. Refer to PARA 1., 73-10-04.

Compressor

g. After engine operation with inlet air restricted due to foreign objects,replace the compressor. Refer to Compressor Inlet Air Blockage, PARA 1.D.(12), this section.

h. If the engine is submerged in water while in operation, return the complete engine to an overhaul facility for replacement of all compressor and turbine wheels. Refer to Engine Submerged While in Operation, PARA 1.D.(6), this section.

i. After engine operation in snow, ice, or water, inspect the compressor inlet, without disassembly of engine parts, for damage due to ingestion of snow or ice buildup. Refer to PARA 1.D.(10), this section.

j. After the main rotor or propeller strikes an object or the engine N_2 power train is subjected to abnormal shock loading during operation, inspect the compressor inlet for foreign object damage. Also, inspect the compressor rotor blades and stator vanes. Refer to Sudden Stoppage Inspection, PARA 1.D.(4) or 1.D.(5), this section.

k. After suspected foreign object damage, inspect the compressor rotor blades and stator vanes. Refer to Blade Damage, and Vane Damage, PARA 5.C. and 5.D., 72-30-00.

l. After engine operation in an erosive environment, inspect compressor blades, vanes, and plastic lining for erosion. Refer to Erosion and Corrosion Inspection, PARA 1.D.(9), this section.

NOTE: If the aircraft is subjected to sand or dust ingestion, periodic compressor erosion inspection is recommended. The frequency of the inspection should be based on the frequency and degree of ingestion and condition of the compressor at the last inspection. Experience has shown that the bottom half of the compressor case is more prone to erosion.

m. If cracks are detected in the scroll at the anti-ice valve; if discharge air tube inserts are loose or backing out of the scroll, or if vibration is suspected, inspect for possible vibration causes. Refer to Vibration Inspection, PARA 1.D.(2), 72-00-00, this section.

n. If the engine will be shut down for more than five calendar days, preserve the compressor. Refer to PARA 12.D., 72-00-00, Engine-Servicing.

Anti-icing Valve

p. Anytime the compressor is removed from the engine, inspect the anti-icing air valve for wear or damage. Refer to PARA 4., 75-10-01.

Turbine

q. After suspected foreign object damage, inspect the first-stage turbine blades and vanes. Refer to PARA 7.A., 72-50-00.

r. After engine operation at temperatures exceeding the operating limits requiring turbine inspection in Table 8 or 9, 72-00-00, Engine-Description and Operation inspect the following parts:

1) First-stage turbine wheel in accordance with PARA 7.A., 72-50-00
2) First-stage turbine nozzle in accordance with Table 201, 72-50-00
3) Combustion liner in accordance with PARA 1.C., 72-40-00. Record temperature and duration in the Engine Log.

NOTE: If either the first-stage turbine wheel or first-stage turbine nozzle is rejected due to overtemperature operation, the complete turbine, both gas producer and power turbine sections, must be removed and sent to a Rolls-Royce Authorized Maintenance Center (AMC) for inspection.

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Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Turbine (cont)

s. After exceeding the starting temperature limits of Table 8 or 9, 72-00-00, Engine-Description and Operation, where turbine inspection is required, inspect the first-stage turbine wheel in accordance with Blade Damage, PARA 7.A., 72-50-00. Inspect first-stage turbine nozzle in accordance with Table 201, 72-50-00. Inspect the combustion liner in accordance with Table 201, 72-40-00. Refer to Hot Start Inspection, PARA 1.D.(8)(a), this section and Center Slotted Third-stage Turbine Wheels, PARA 1.D.(8)(b), this section. Record temperature and duration in the Engine Log.

NOTE: If either the first-stage turbine wheel of first-stage turbine nozzle is rejected due to overtemperature operation, the complete turbine, both gas producer and power turbine sections, must be removed and sent to a Rolls-Royce Authorized Maintenance Center (AMC) for inspection.

t. If the engine is submerged in water while in operation, return the complete engine to an overhaul facility for replacement of all compressor and turbine wheels. Refer to Engine Submerged While in Operation, PARA 1.D.(6), this section.

u. If oil consumption exceeds one quart (0.9 liter) per hour, clean the power turbine scavenge strut, the external scavenge oil sump and the power turbine support bearing pressure oil nozzle. Refer to PARA 7.E. and 7.G., 72-50-00.

v. Send the turbine to an overhaul facility for replacement of the first-stage wheel if oil has leaked or been forcibly sprayed onto the wheel during operation of the engine.

w. Send N_2 turbine to overhaul for overspeed inspection if slippage/sudden engagement of free wheel unit occurred at stabilized Ground Idle RPM and the output shaft was broken.

x. Send N_2 turbine to overhaul for overspeed inspection if slippage/ sudden engagement of free wheel unit occurred at any engine speed above stabilized Ground Idle RPM, with or without output shaft damage.

Thermocouples

y. After engine operation at temperatures exceeding the operating limits requiring turbine inspection in Table 8 or 9, 72-00-00, Engine-Description and Operation, inspect the thermocouples. Refer to Thermocouples, PARA 2., 77-20-01.

Outer Combustion Case

z. Anytime the turbine is removed from the engine, inspect the outer combustion case. Refer to PARA 2., 72-40-00.

Combustion Liner

aa. Anytime the turbine is removed from the engine, inspect the combustion liner. Refer to PARA 1.C., 72-40-00.

Compressor Discharge Air Tubes

ab. Anytime the turbine is removed from the engine, inspect the compressor discharge air tubes for dents, cracks, or wear. Refer to Compressor Discharge Air Tubes, PARA 4.A., 72-40-00.

Burner Drain Valve

ac. Anytime the turbine is removed from the engine, remove, clean and inspect the burner drain valve. Refer to Burner Drain Valve, PARA 3.A., 72-40-00.

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Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Gearbox

ad. Anytime the compressor is removed from the engine, and at an Authorized Maintenance Facility, inspect the mounting inserts on the gearbox for looseness. Refer to Insert Inspection, PARA 4.D., 72-60-00. If loose inserts are detected, check for possible vibration causes. Refer to Vibration Inspection, PARA 1.D.(2), this section.

ae. Anytime the power and accessory gearbox cover is separated from the gearbox housing at an Authorized Maintenance Facility and the Log Book indicates 3500 hours have elapsed since the gears were new or last magnafluxed, magnetically inspect all gears listed in PARA 1.D.(11), this section.

af. Send power and accessory gearbox to overhaul for overtorque inspection anytime a free wheel clutch slippage/sudden engagement incident occurs.

Magnetic Drain Plugs

ag. After the main rotor or propeller strikes an object or the engine N_2 power train is subjected to abnormal shock loading during operation, inspect the magnetic plugs for metal accumulation. Refer to Sudden Stoppage/Engagement Inspection, PARA 1.D.(4) or 1.D.(5), this section, and Magnetic Plug Inspection, PARA 11.G., 72-00-00, Engine-Servicing.

Oil System

ah. Drain oil from the system and refill, using the oils specified in Approved Oils, PARA 4.C., 72-00-00, Engine-Description and Operation. Remove, clean, and reinstall the oil filter at each oil change.

aj. Clean/replace oil cooler, lines and tank as require by airframe manufacturer or when heavy carbon deposits are noted in the engine lubrication system.

ak. Clean or replace the engine/scavenge oil filter(s), oil cooler, lines, tank and propeller cylinder (250-C20S) when heavy carbon deposits are found in the engine oil system. Consult the airframe or propeller manufacturer's publications for instructions to perform this work.

al. Clean or replace the engine oil filter, oil cooler, lines, tank and propeller cylinder (250-C20S) following oil system contamination. Clean the propeller cylinder prior to engine or propeller installation. When oil groups are mixed or changed, clean the propeller cylinder, engine oil filter, oil cooler, lines and tank before refilling the oil system. Consult the airframe or propeller manufacturer's publications for instructions to perform this work.

am. Flush the engine oil system following suspected or known contamination of the oil. Drain the oil system and service the oil tank with approved oil. Run the engine for 15 minutes at idle speed or until the oil has reached normal operating temperature. Drain the oil system. Clean or replace the engine/scavenge oil filter(s) and service the oil tank with an approved oil prior to flight.

an. If engine is inactive for more than 45 days, preserve oil system in accordance with Oil System Preservation, PARA 12.B., Engine-Servicing.

ap. Anytime the engine oil temperature limit has been exceeded, take the appropriate maintenance action given in Oil Temperature Limit Exceeded, PARA 11.B., 72-00-00, Engine-Servicing.

aq. Anytime the engine is operated in excess of 30 seconds without oil pressure, maintenance action is required. Refer to Engine Operated With No Oil Pressure, PARA 11.E., 72-00-00, Engine-Servicing.

ar. After 50 hours of operation or if chip indication occurs within the first 50 hours on a new, repaired or overhauled engine, check the oil filter(s) and magnetic chip plugs for contamination. Also, if decreased oil pressure is noticed during operation, check the engine oil filter(s) for contamination at that time. If debris is found, proceed as follows:

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Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Oil System, ar. (cont)

1. Drain engine and airframe oil systems. Pay particular attention for any metallic debris in the oil. Swab the oil tank and note any foreign material.
2. Flush the engine oil system and clean the main and scavenge oil filters.
3. Flush the airframe oil system including oil coolers (refer to applicable airframe manual).
4. Reinstall filters and fill the cavity with fresh oil. Fill the oil tank with fresh oil.
5. Perform 30-minute ground run at power observing cockpit gauges, warning lights and caution panel for normal condition. Check indicated oil level within 15 minutes after shutdown.
6. After ground run, remove and inspect main and scavenge oil filters and magnetic chip plugs. If no accumulated debris is present, release aircraft for flight. During the next 30 hours of operation, check engine oil filters and magnetic chip plugs at approximately 10-hour intervals to determine if additional debris has accumulated. If debris is present, follow instructions for magnetic chip plug inspection procedure.

Oil Filter

as. At each oil change, remove, clean, and reinstall the oil filter. Refer to Oil Filter, PARA 1.C., 72-60-00.

Turbine Pressure Oil System Check Valve

at. Anytime the turbine is removed from the engine, clean and inspect the check valve. Refer to Turbine Pressure Oil System Check Valve, PARA 7.K., 72-50-00.

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Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Fuel Pump Filter

CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER, AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.

au. The engine driven fuel pump is equipped with a throw-away filter element with a maximum replacement interval specified in the Scheduled Inspections, Table 602, this section. If the filter shows signs of contamination to the point of possibly bypassing, or if an impending bypass indication has been noted (some aircraft may incorporate this system), replace the filter element. Refer to PARA 2.C., 73-10-01 or PARA 2., 73-10-05 for filter replacement instructions.

Fuel Control, Governor and High Pressure Filters (CECO)

CAUTION: IF ANY FILTER SHOWS EVIDENCE OF CONTAMINATION TO THE POINT OF BYPASSING, RETURN THE FUEL CONTROL AND POWER TURBINE GOVERNOR TO AN AUTHORIZED FACILITY FOR FLUSHING, OR FLUSH IN ACCORDANCE WITH 250-C20 CSL-1034 AND -1035. ALSO, INSPECT THE FUEL NOZZLE FILTER FOR CONTAMINATION. IF ANY CONTAMINATION IS FOUND ON THE FUEL NOZZLE FILTER, THE FUEL NOZZLE MUST BE SENT TO AN AUTHORIZED FACILITY TO HAVE THE UNIT CLEANED AND TESTED.

av. Anytime fuel pump filter bypass is known or suspected to have taken place, inspect and if required, clean the filters in the gas producer fuel control and the power turbine governor. Refer to Cleaning the Fuel Control Fuel Filter, PARA 4.A., 73-20-04, and Cleaning the Governor Fuel Filter, PARA 4.A., 73-20-05. Also, clean or replace the high pressure fuel filter element. Refer to High Pressure Fuel Filter, PARA 2., 73-10-05.

Fuel Control Filter (Bendix)

CAUTION: IF THE FUEL CONTROL FILTER SHOWS EVIDENCE OF CONTAMINATION, RETURN THE FUEL CONTROL TO AN AUTHORIZED MAINTENANCE CENTER FOR CLEANING AND INSPECTION. ALSO, INSPECT THE FUEL NOZZLE FILTER FOR CONTAMINATION. IF CONTAMINATION IS FOUND ON THE FILTER, RETURN THE FUEL NOZZLE TO AN AUTHORIZED FACILITY FOR CLEANING AND TESTING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.

aw. Anytime fuel pump filter bypass is known or suspected to have taken place, inspect and if required, clean the fuel filter element in the gas producer fuel control. Refer to Cleaning the Gas Producer Fuel Control Fuel Filter, PARA 4.A., 73-20-02 or PARA 4.A., 73-20-03.

Bendix Fuel Control and Power Turbine Governor Airflow Restrictors

ax. When dictated by engine performance, remove, clean and reinstall the fuel control and power turbine governor airflow restrictors. Refer to PARA 4.B., 73-20-02 or PARA 4.B., 73-20-03 and PARA 2.E., 73-20-01.

Fuel Control P_c Filter (250-C20S)

ay. When dictated by engine performance, clean and reinstall the fuel control P_c filter. Refer to PARA 4.B., 73-20-03.

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Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Fuel System P_c Filter (Bendix fuel system only)

az. When dictated by engine performance, remove, clean and reinstall the fuel system Pc Filter. Refer to Cleaning and Inspection, PARA 3., 73-20-06.

Accumulators

ba. When an engine is replaced, transfer the accumulators to the replacement engine. While removed, clean and test accumulators in accordance with Accumulators, PARA 2., 73-10-04.

Fuel Nozzle Filter

CAUTION: IF THE FILTER HAS BEEN CONTAMINATED OR HAS COLLAPSED OR BUCKLED, RETURN THE FUEL NOZZLE TO AN AUTHORIZED FACILITY FOR CLEANING AND TESTING. THIS WILL ALSO REQUIRE THAT THE FUEL CONTROL BE SENT TO AN OVERHAUL FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.

bb. Anytime high pressure fuel filter bypass is known or suspected to have taken place or evidence of contamination is found in the fuel pump, fuel control or governor, inspect the fuel nozzle filter for contamination. Refer to, PARA 4.A., 73-10-03.

Fuel System

bc. If engine is inactive for more than 45 days, preserve fuel system in accordance with Fuel System Preservation, PARA 12.C., 72-00-00, Engine-Servicing.

bd. Anytime a fuel control system component is reinstalled or a pneumatic line is disconnected, a pneumatic leak check of the control system must be performed. Refer to PARA 2.B., 73-00-00.

Start Counter (If Applicable)

be. Anytime the engine is removed from the aircraft, inspect for chafed, frayed or broken wires and connectors. Also, inspect for broken glass in the viewing window or for housing dents.

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PARA 1.D. (cont)

(1) Gearbox Compressor–Mounting Insert Inspection

(a) Inspect the inserts for looseness anytime the compressor is removed from the gearbox. Refer to Insert Inspection, PARA 4.D., 72–60–00.

(2) Vibration Inspection

(a) Procedures are provided for evaluating vibration, identifying vibration sources, and analyzing vibration levels. Refer to Vibration Test Procedure, PARA 2., Engine–Adjustment/Test, 72–00–00. Continued operation with high vibration levels will cause excessive engine and component wear and can contribute to engine failure and premature engine removal.

(b) If engine vibration is suspected, or any of the vibration symptoms listed in the 100–hour inspection, Table 602 this section, are encountered, inspect the compressor and return it to repair/overhaul if any of the following conditions are encountered:

1 Remove the top half of the compressor case and check all blades and vanes for possible foreign object damage and/or for bent or distorted vanes. Blade and vane condition must be within the limits given in Blade and Vane Inspection, PARA 5.B., 72–30–00.

2 Remove the compressor assembly from the engine.

3 Check the scroll outlet ports (turning vanes) for evidence of damage. Damage is indicative of impeller vane tip or shroud failure.

(3) Hard Landing Limits

(a) Make a visual inspection of the installed engine for external damage from airframe components after any hard landing.

(b) Engines that have sustained landing forces exceeding 10g shall be sent to a Rolls–Royce Authorized Maintenance Center. Airframe conditions that can be used as an indication that the 10_g landing force limit has been exceeded are as follows:

Bell Aircraft.

Airframe landing skids and cross tubes deformed to a degree that the cabin fuselage touches, or shows evidence of having touched, the ground.

McDonnell Douglas (Hughes) Aircraft.

Pilot and co–pilot seat metal box frames buckled, dishpanned, and/or wrinkled.

Boelkow BO105C. Helicopter body touches the ground.

(c) Fuel controls and power turbine governors which have been subjected to a hard landing, in excess of 10_g, must be returned to a Rolls–Royce Authorized Maintenance Center for inspection in accordance with the 250–C20 Series Overhaul Manual, Pub. No. 10W3.

(4) Sudden Stoppage/Engagement Inspection (250–C20, –C20B, –C20F, –C20J, –C20W).

NOTE: The following specific items and/or functions are the minimum required actions when performing a sudden stoppage/engagement inspection. Each incident should be judged on an “as required” basis possibly requiring more than these minimum requirements. Engines involved in sudden stoppage do not require overhaul automatically. This judgement is the responsibility of the service facility performing the inspection.

NOTE: If the engine must be removed from the airframe as a result of the rotor sudden stoppage, specified in PARA (b) and (c) following, then the operator should take care to provide the Rolls–Royce Authorized Maintenance Center with all the details about the incident. This information should include a description of damage to the airframe power train and mounts, as well as any other pertinent information.

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PARA 1.D. (4) (cont)

(a) If a drive system component malfunctions, or the aircraft main rotor blade(s) strikes an object, and sustains damage which is field repairable in accordance with aircraft manufacturer's recommendations, perform the following:

1 Inspect magnetic plugs for metal accumulation. Refer to Magnetic Plug Inspection, PARA 11.G., 72–00–00, Engine–Servicing.

2 Inspect the engine inlet for foreign objects.

3 Inspect the compressor for foreign object damage.

4 Motor the engine and check for unusual noise.

5 Operate the engine for 30 minutes on the ground; then check the magnetic plugs for metal accumulation. Refer to Magnetic Plug Inspection, PARA 11.G., 72–00–00, Engine–Servicing.

a On twin engine aircraft, each engine should be operated at 100% Nr and flat pitch.

b On single engine aircraft, engine should be operated at power required to make aircraft light on its skids.

(b) If a drive system component malfunctions, or if a main rotor blade(s) strikes an object during operation, and sustains damage that requires removal from service of the main rotor blade(s) or any aircraft main rotor drive system component, remove the engine and perform the following:

1 Inspect the turbine shaft to pinion gear coupling and the power turbine outer shaft and pinion gear splines for evidence of damage, wear, and acceptability for further service. Refer to Power Turbine Outer Shaft Spline Inspection, PARA 7.B., 72–50–00, and Power Train Pinion Helical Gear Inspection, PARA 4.F., 72–60–00.

2 Magnetic particle inspect the turbine shaft–to–pinion gear coupling.

3 Send the accessory gearbox to a Rolls–Royce Authorized Maintenance Center (AMC) for inspection per the 250–C20 Series Overhaul Manual, Pub. No. 10W3.

4 Inspect the compressor for foreign object damage.

5 After engine reassembly, operate the engine for 30 minutes on the ground; then, check the magnetic plugs for metal accumulation. Refer to Magnetic Plug Inspection, PARA 11.G., 72–00–00, Engine–Servicing.

NOTE: Test cell run may be substituted for the above 30 minute ground run.

a On twin engine aircraft, each engine should be operated individually at 100% Nr and flat pitch.

b On single engine aircraft, engine should be operated at power required to make aircraft light on its skids.

(c) If a drive system component malfunctions, or a main rotor blade(s) strikes an object during operation and the engine or transmission mounts are fractured or misaligned, return engine to a Rolls–Royce Authorized Maintenance Center (AMC) for overhaul inspection with the following exceptions. The accessories listed below must be bench tested in accordance with the 250–C20 Series Overhaul Manual, Pub. No. 10W3, and meet all overhaul limits.

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PARA 1.D. (4) (cont)

1 Bleed Valve

2 Engine Driven Fuel Pump

3 Fuel Nozzle

4 Anti–Ice Valve

5 Electrical/Electronic Device

6 Fuel Control

7 Power Turbine Governor

(5) Sudden Stoppage Inspection (250–C20S).

The following inspections must be satisfactorily completed whenever the propeller strikes a moving or stationary object.

NOTE: Sudden stoppage is the momentary or complete interruption in the rotation of the aircraft propeller and engine drive system when the aircraft propeller comes in contact with the ground, water, trees or other obstacles.

NOTE: The shock felt by the drive system requires that the engine be inspected and/or overhauled by an Authorized Maintenance Center (AMC) as a result of possible damage.

NOTE: If the engine must be removed from the airframe as a result of the propeller sudden stoppage then the operator should take care to provide the Rolls–Royce Authorized Maintenance Center with all the details about the incident. This information should include a description of damage to the airframe power train and mounts, as well as any other pertinent information.

(a) If the aircraft propeller strikes an object causing damage to the propeller which can be corrected by light grinding or filling and normal blending of the blades (nicks, gouges, scratches, etc.) in accordance with applicable propeller service instructions, complete the following inspection.

1 Inspect engine mounts for security, cracks, or misalignment.

2 Inspect the engine inlet for foreign objects.

3 Inspect the compressor blades and vanes for foreign object damage.

4 Inspect the compressor case for evidence of blade tip rub.

5 Inspect all magnetic plugs for metal accumulation. Refer to Magnetic Plug Inspection, PARA 11.G., 72–00–00, Engine–Servicing.

6 Rotate the propeller by hand and check for unusual noise.

7 Motor the engine and check for unusual noise.

8 Operate the engine for 30 minutes on the ground then check the magnetic plugs for metal accumulation.

9 Check blade track and balance the propeller.

(b) If the aircraft propeller strikes an object causing damage to the propeller blades requiring blade replacement and overhaul of the propeller assembly, remove the engine and send it to an Authorized Maintenance Center (AMC) for inspection.

1 Refer to the appropriate propeller Service Instructions and Overhaul Manual.

2 Refer to the Special Inspections required after propeller strike and/or crash in the engine Overhaul Manual.

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PARA 1.D. (cont)

(6) Engine Submerged While in Operation

If the engine has been submerged in water while in operation, proceed as follows:

(a) Tag the engine indicating that it encountered submersion while in operation. Provide details of submersion event.

(b) Return the entire engine to a Rolls–Royce Authorized Maintenance Center as soon as possible for replacement of all compressor and turbine wheels.

(7) Lightning Strike Inspection

Aircraft lightning strikes occur when the airframe can serve as a least–resistance bridge for the electrical bolt as it travels through the air. Consequently, aircraft extremities (tail pylon, blades, nose, landing gear, etc.) typically act as points of entry or exit. However, since the exact electrical path through the aircraft may not be readily traceable following a strike, the following guidelines are recommended:

(a) In the event of a lightning strike in the immediate vicinity of the engine(s) (as evidenced by charring, burn marks or pitting associated with electrical arcing on the engine cowl, compartment or inlet) remove the engine(s) prior to further flight and send them to a Rolls–Royce Authorized Maintenance Center (AMC) for detailed teardown and inspection.

(b) Where the aircraft is known or suspected of having been involved in a lightning strike, and entry/exit points either cannot be determined or appear remote to the engine(s), perform the following:

1 Inspect the engine compartment for evidence of lightning strike damage.

2 Manually rotate N_1 and N_2 systems and check for binding and abnormal noise.

3 Remove, inspect, and clean the engine oil filter. Refer to Oil Filter Replacement, PARA 1.C., 72–60–00.

4 Remove, inspect, and clean the magnetic plugs. Refer to Magnetic Plug Inspection, PARA 11.G., Engine–Servicing, 72–00–00.

WARNING: NEVER RUN ENGINE(S) AT HIGH POWER ON WET OR FROZEN SURFACES.

5 Operate the engine(s) for 30 minutes on the ground and recheck the magnetic plugs for metal accumulation. Refer to PARA 11.G., 72–00–00, Engine– Servicing.

a On twin engine aircraft, each engine should be operated individually at 100% Nr and flat pitch.

b (250–C20, –C20B, –C20F, –C20J, –C20W) On single engine aircraft, engine should be operated at power required to make aircraft light on its skids.

c (250–C20S) On single engine aircraft, engine should be operated at 100% N_r and minimum power.

6 Listen for abnormal noise on coastdown and abnormally short coastdown time.

(8) Hot Start Inspection

(a) When the engine starting temperature limits of Table 8 or 9, 72–00–00, Engine–Description and Operation are exceeded, and turbine inspection is the recommended maintenance action, proceed as follows:

1 Remove the outer combustion case and combustion liner. Refer to Replacing the Combustion Liner, PARA 1., 72–40–00.

2 Inspect the first–stage nozzle in accordance with Table 201 and PARA 7.C., 72–50–00.

3 Inspect the first–stage turbine wheels. Refer to Blade and Vane Inspection, PARA 7.A., 72–50–00.

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PARA 1.D.(8) (cont)

4 Inspect the combustion liner. Refer to Table 201, 72–40–00.

5 Reassemble the engine. Refer to Replacing the Combustion Liner, PARA 1., 72–40–00.

(b) Center–Slotted 3rd–stage Turbine Wheels. Center–slotted turbine wheels P/N 6898551, 6898567, 6898733, 6898743, 6898753 or 6898763 which have encountered known or recorded hot starts exceeding 1490–1700°F (810–927°C) for 10 seconds maximum or 1700°F (927°C) peak shall be replaced. Record the event, temperature and duration in Part I of the Engine Log. Return these Engine Log pages and the turbine to an Authorized Maintenance Center (AMC) for replacement of the 3rd–stage turbine wheel.

(9) Erosion and Corrosion Inspection

If the aircraft is frequently subjected to sand or dust ingestion or operated in a corrosive environment (salt laden or other chemically laden atmosphere such as pesticides, herbicides, sulphur, industrial pollutants, etc.), inspect compressor blades, vanes, and case plastic coating for erosion or corrosion damage. Engines operated in a corrosive environment should be subjected to daily fresh water compressor rinses.

NOTE: If the aircraft is subjected to sand or dust ingestion, periodic compressor erosion inspection is recommended. The frequency of the inspection should be based on the degree of ingestion and condition of the compressor at the last inspection. The need for more frequent compressor rinse may also be indicated.

NOTE: See CSL–1135 for instructions on suggested contamination removal using water only and for maps of operating areas with salt laden air.

(10) Snow Ingestion Inspection

Inspect the engine for snow, ice, or water damage as follows:

(a) Obtain access to the compressor inlet but do not disassemble any engine parts.

(b) Replace the compressor assembly if any mechanical damage, distortion, or bending is detected on the compressor front support vanes or first–stages rotor blades.

(11) On Condition Inspection – Power and Accessory Gearbox

Any time the gearbox housing is separated from the cover, all gears shall be magnetic particle inspected if the log book indicates that more than 3500 hours have elapsed since the gears were new or last magnafluxed. Refer to 250–C20 Series Overhaul Manual, Pub. No. 10W3, for inspection criteria.

NOTE: Record compliance with this inspection in the appropriate section of the log book. Include date and hours.

(12) Compressor Inlet Air Blockage

Replace the compressor assembly if the engine has been operated with inlet air restricted due to foreign objects or materials which have become lodged in the compressor inlet. Tag the replaced compressor to indicate the cause of removal was inlet air blockage and send to a Rolls–Royce Authorized Maintenance Center. Conditions which constitute blockage are as follows:

(a) Foreign objects or materials found in the inlet during inspection of the aircraft when not in operation. If it can be determined that the blockage was not there during the last operation of the engine, remove the foreign object or material and leave the compressor in service.

(b) Power loss encountered following a restriction at the compressor inlet area while the engine is in operation. Blockage in flight can usually be verified by the inspection after landing (blockage still exists). However, some blockage may be followed by ingestion before inspection can take place. Objects or materials which were large enough to have stopped at the inlet guide vanes before ingestion, or which cause a noticeable raise in TOT, can be considered to have caused compressor inlet blockage.

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ENGINE–CLEANING/PAINTING

1. General.

Use care in separating metals for cleaning. Cleaners for steel will damage nonferrous parts.

WARNING: MINERAL SPIRITS IS TOXIC. PROVIDE ADEQUATE VENTILATION FOR PERSONNEL USING IT.

A. Mineral spirits is the cleaning solvent recommended for nonferrous parts. Do not use rust preventives on magnesium and aluminum parts.

(1) Clean aluminum–coated steel parts with carbon removal compound (Gunk Chicago Co., Gunk Hydroseal Decarbonizer, or equivalent). Rinse the parts with water and dry with an air blast.

(2) Clean steel parts with cresol base cleaning compound (Turco Products Inc., Formula 3097, or equivalent). Rinse the parts thoroughly with hot water. Coat parts with a compound made of one part of rust preventive (Cities Service Anti–Corrode 204, or equivalent) and three parts oil (Atlantic Refining Co. 31100, or equivalent).

NOTE: Do not allow bearings to spin during drying after the cleaning operation. Lubricate the cleaned bearings lightly with engine oil and wrap to keep clean while waiting for engine assembly.

2. Cleaning.

CAUTION: ENGINE THERMOCOUPLES SHOULD NEVER BE IMMERSED OR SPRAYED WITH CLEANING SOLVENTS. LIQUID CLEANING SOLVENTS WILL PENETRATE THE POROUS MAGNESIUM OXIDE INSULATION. ENGINE HEAT WILL VAPORIZE THE SOLVENTS LEAVING A RESIDUE CONTAINING CARBON WHICH CAUSES A LOW RESISTANCE TO GROUND.

NOTE: Even though Rolls–Royce has approved the following cleaners for use with Rolls–Royce engines, Rolls–Royce assumes no liability for injury to personnel or the environment by their use.

3. Corrosion Treatment and Surface Finish Repair

Make repair of corrosion and surface finish damage as follows:

A. Touch up damaged paint on magnesium alloy parts with engine gray enamel (AMS 2510).

B. On aluminum–alloy parts which were originally painted without anodizing, touch up reworked areas with zinc–chromate primer (AMS 3110), then repaint.

C. On aluminum–alloy parts which were originally anodized, clean damaged areas with mineral spirits and rinse the part with water. Treat the damaged area with chemical film. (Chem–Rite A22 or equivalent manufactured by M and T Chemicals, Inc., Matawan, N.J.). As an alternate use chromic acid. If the coating is soft and powdery, the solution is too strong or the reaction time is too long; dilute the solution with water. If little or no visible coating forms, increase either the solution concentration or the reaction time.

D. Use the following procedure on aluminum–coated steel parts. Apply corrosion–preventive paint only forward of the turbine unit; the surface heat of the engine aft of the gearbox will destroy the paint.

(1) Clean the damaged surface with perchlorethylene and let dry five to ten minutes; clean all welds with a stainless–steel brush.

(2) Mask all vent holes.

(3) Paint all surfaces with heat–resisting aluminum paint (Lankote P/N 620 or equivalent, made by J. Landau Co., N.Y.). Apply and let dry for one hour.

NOTE: Do not paint compressor case vanes.

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PARA 2. (cont)

E. Use the following corrosion treatment procedure for repair of the finish on the scroll and compressor case.

(1) Clean the area to be touched up with perchlorethylene, acetone, or alcohol and allow to air dry for 5 – 10 minutes.

(2) Sand an area slightly larger than the damaged area; feather out edges.

(3) Reclean area and dry with filtered, compressed air.

(4) Paint surface with SermeTel 196 paint, Teleflex, Inc., P. O. Box 218, North Wales, Pennsylvania. Air dry for at least one hour.

(5) Apply a second coat and air dry for 72 hours.

4. Galvanic Corrosion Protection

A. Specific engine areas shall be protected against galvanic corrosion by a protective paint seal covering joints between dissimilar materials. The protective paint must be applied to the specified area after the units are assembled when the area is accessible and not affected by subsequent disassembly or loosening of affected parts. If it becomes necessary to disturb an original paint seal, that area shall be resealed with paint.

B. Specific areas requiring protective paint (areas joining dissimilar metals) are as follows:

CAUTION: KEEP PAINT OFF THE COMPRESSOR MOUNTING INSERT FACE.

(1) Rear diffuser–to–gearbox mounting pads.

(2) All fittings and steel bushings except plastic shipping plugs.

(3) At steel accessory cover plates shipped on pads. Paint attachment fasteners and interface splitline after cover plate installation (splitlines for plates with gaskets excluded).

(4) Splitline washers and/or studs and mounting bolts attaching engine mounting brackets.

(5) Around magnetic drain plugs and their inserts after plug installation.

(6) Torquemeter support shaft nuts at interface splitlines after nut installation.

(7) Turbine assembly mounting pads on gearbox cover.

(8) Gearbox cover mounting face provided for the turbine. Paint the depressed (fireshield) area bounded by the four adjacent turbine mounting bosses.

C. Use the following paint, or equivalent, for galvanic corrosion protection:

(1) Actithane WC100 (Saran Protective Coatings Co., Detroit, Mich.)

(2) Actithane Thinner H251 (Saran Protective Coatings Co., Detroit, Mich.)

D. Clean, paint, and cure the area requiring protection as follows:

(1) Immediately before application of paint, thoroughly clean the area using acetone, methylethylketone, or toluene. Do not handle the area with bare hands or soiled gloves during or after cleaning.

(2) Apply paint by spray or brush. Air dry for 30 minutes. Flow a continuous film of paint at the interface area of all dissimilar metals so that the area is completely sealed against moisture. This applies to all areas not previously protected and/or to areas on which a previously applied film should need repair.

5. Fire Extinguisher Material (Cleaning)

In the event that fire extinguisher material is used on engines, Table 701 provides cleaning instructions after use of different extinguisher materials.

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Table 701
Cleaning Engine After Using Extinguisher Material

	Extinguisher Material	Immediate Action	Follow on or Final Cleaning Requirement
1.	Mil–spec: O–F–555C Animal Protein	Water rinse to remove residue. Steam clean if required on external surfaces. If ingested perform compressor cleaning, para 6., 72–30–00.	Same as immediate action.
2.	Detergent Foam	Water rinse to remove residue. Steam clean if required on external surfaces. If ingested perform water rinse, para 6.A., 72–30–00.	Same as immediate action.
3.	Mil–spec: Mil–F–22287A Dry chemical "PKP" Chemical Composition: Potassium Bicarbonate covered with silicone. "Methyl Polysilidoxane" to prevent absorption of moisture.	WARNING: USE WITH ADEQUATE VENTILATION. Remove as much loose powder as possible using either vacuum tools or compressed air at 30 psig. If PKP has been ingested use mixture of 60% isopropyl and 40% isobutyl alcohol injected or sprayed into compressor inlet while motoring on starter (cold engine) followed by water rinse, para 6.A., 72–30–00.	External surfaces can be cleaned of glaze by using mixture of 60% isopropyl and 40% isobutyl alcohol then steam clean.
4.	Mil–Spec: MIL–B–38741 Halon 1211 Chemical Composition: Bromochlorodifluoromethane CF_2ClBr	WARNING: DO NOT BREATH EXHAUST FUMES. At ambient temperature below 25°F (–4°C), start engine and run idle for 5 to 10 minutes to evaporate all liquid. Above 25°F (–4°C), no action is required except that to accelerate evaporation, i.e., running engine at idle. If starting of the engine is not possible, provide heat from an external source to evaporate the Halon 1211.	There is no residue from the Halon 1211.

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Table 701 (cont)
Cleaning Engine After Using Extinguisher Material

	Extinguisher Material	Immediate Action	Follow on or Final Cleaning Requirement
5.	Mil–Spec: MIL–B–49394D Halon 1011 Note: Engine internal Chemical Composition: Bromochloromethane CH_2BrCl	WARNING: USE WITH ADEQUATE VENTILATION. Clean externally and internally as much as possible with a mixture of 60% isopropyl and 40% isobutyl alcohol. P–D–680 Type II is acceptable as an alternate agent for external cleaning. Steam clean the exterior. Start engine and run at ground idle for five minutes. Note: When steam cleaning is not available the following procedure is recommended. Clean and neutralize all exterior surfaces. Wash all wetted surfaces with a rag saturated with solvent Spec P–D–680 Type II. Wash this with 10% solution of Sodium Bicarbonate, Spec O–S 576. Note: If engine was static when the agent was applied to the inlet duct or oil cooler, these should be cleaned the same as exterior surfaces.	Accomplish liquid cleaning upon return to home station. If aircraft was flying when the agent was applied by the fixed fire extinguisher system, no further action is required. If the airplane was on the ground when applied, as soon as the engine can be operated and the inlet has been inspected, the engine should be motored for one minute then started and operated at ground idle for five minutes. No further action is required as a result of usage of fire extinguisher agents. Halon 1011 is not soluble. Residue material can be removed with alcohol mixture.
6.	MIL–Spec: MIL–B–12218B Halon 1301 Chemical Composition: Bromotrifluoromethane CF_3Br	No action required.	No action required. Halon 1301 will not leave a residue.
7.	Mil Spec: BB–C–101B Carbon Dioxide CO_2 (gas)	No action required.	No clean up required.
8.	“Light Water” * Foam *Registered Trademark of 3M Company.	Water rinse to remove residue. Steam clean if required on external surfaces. If ingested, perform water rinse, para 6.A., 72–30–00.	Same as immediate action.

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ENGINE – STORAGE INSTRUCTIONS

1. General

   Engines that have been repaired and check run and will not be installed in an aircraft or engines going to overhaul shall be prepared for storage and/or shipment in accordance with the following paragraphs. Engines placed in storage must be inspected every 30 days. Refer to para 7., this section.

2. Preservation

   A. Preserve the engine as follows:

      (1) Short term storage:

         (a) Drain the oil from the power and accessory gearbox by removing the bottom drain plug. Clean and replace the plug after the oil has been drained.

         (b) Preserve the compressor in accordance with Compressor Preservation, para 12.D., 72–00–00, Engine–Servicing, if storage will exceed 5 days.

         (c) If the engine is to be stored for less than 45 days no further preservation is required.

      (2) Long Term Storage: If the storage period will exceed 45 days, preserve engine in accordance with Inactive Engine Preservation, para 12.A., 72–00–00, Engine–Servicing.

      (3) Preparation for Shipment: Complete short and long term storage requirements above.

3. Preparation of the Engine for Shipment.

   Prepare the preserved engine for shipment as follows:

   A. Coat accessory drives which do not have accessory installed on them with engine oil. Brush internal splines with anti–seize compound (Lubriplate 130A, 930AA or equivalent) and assemble shipping covers, gaskets, washers and nuts.

   B. Touch up paint film where damaged. Do not expose touch up areas to engine fluids or cleaning solvents for a minimum period of 72 hours after application.

   C. All shipping parts, except accessory drive pad covers and related parts attached to the engine, shall be identified by a light yellow color. The color may be paint or any other acceptable process which is noncorrosive, permanent and not subject to deterioration by engine fluids and solvents.

   D. Letters and numbers of stenciled markings shall be block letters 0.75 in. (19 mm) high minimum.

   E. Tighten aluminum and plastic shipping caps and plugs finger tight.

   F. Tighten threaded parts to standard torques.

   CAUTION: REMOVE ALL SHIPPING CLOSURES PRIOR TO ENGINE OPERATION EXCEPT COVERS ON THOSE ACCESSORY DRIVE PADS WHICH ARE NOT USED FOR ATTACHMENT OF AIRCRAFT ACCESSORY.

4. Installation of Engine in Container

   A. Install the 250–C20, –C20B, –C20F, or –C20J engine in the drum–type shipping container (P/N 6870176) as follows:

      (1) Prepare the container for the installation.

         (a) Depress and hold the relief valve manual release button until the air pressure inside the container is zero.

         (b) Remove the drum front head by removing the nut, bolt, and clamping band assembly.

         (c) Remove the cloth bag containing bracket mounting hardware.

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PARA 4.A. (1) (cont)

(d) Remove the two nuts, lockwashers, and bolts retaining the engine suspension frame assembly to the side rail assembly. Slide the frame from the drum. The frame will rest on two yokes.

(e) Remove a hairpin and flat head pin from each and separate the two engine mounting brackets from the engine mounting bracket support adapters. Remove a hairpin and flat head pin from each then slide the two adapters outboard until they are flush with the inside edge of the adapter support bushings.

(f) Remove the bottom engine mounting bracket. (The shipping container details include two bottom brackets. Remove the bracket which is identical to the two side brackets. Install the remaining bracket on the storage bracket assembly.)

(2) Assemble the bottom and two side mounting brackets on the engine. Secure each with three bolts and washers. Tighten bolts to 85–110 lb in. (9.6–12.4 N·m) and lockwire in threes.

CAUTION: AVOID SHARP BENDS WHEN COILING THE THERMOCOUPLE LEAD.

(3) Coil the thermocouple lead and secure it to the top of the turbine with one–inch (25 mm) masking tape.

(4) Lower the engine onto the engine suspension frame assembly. The bottom engine mounting bracket must engage the female adapter bracket. Stop lowering the engine when the side mounting brackets are aligned with the engine mounting bracket support adapters. Secure each of the two adapters to the mounting brackets with a flat head pin and hairpin. Secure each of the two adapters to the adapter support bushings with a flat head pin and hairpin. Release engine weight onto the frame.

(5) Tie the empty cloth bag to the desiccant receptacle for future use.

(6) Lift or hoist the engine loaded frame until the side rails align with the side rail assemblies. Slide the frame into the drum.

NOTE: If a hoist was used to lift the engine loaded frame assembly, the lift tool must be removed from the engine top pad before the engine can slide all the way into the drum.

(7) Secure the side rails to the side rail assemblies with a bolt, lockwasher, and nut on each side. Tighten nuts to 150–180 lb in. (17–20 N·m).

(8) Place two 16–unit bags of desiccant into the desiccant receptacle. Replace the humidity indicator element only if necessary.

(9) Assemble the closure gasket and the front head on the drum. Secure the head with the clamping band. Use a special scissors–type clinch tool to hold the band so that the retaining bolt and nut can be installed. Tighten nut until the head, gasket, and band are seated firmly. Lead–seal lockwire the bolt to the bushing sleeve.

(10) Place one copy of EDS 1311 and applicable engine records in a plastic envelope. Store the envelope in the records receptacle. Lead–seal lockwire the cover to the receptacle.

(11) Coat the nut end of the container closure bolt with corrosion preventive compound.

B. Install the 250–C20S or –C20W engine in the drum–type shipping container (P/N 6870176) as follows:

(1) Depress and hold the relief valve manual release button until the air pressure inside the container is zero.

(2) Remove the drum front head by removing the nut, bolt, and clamping band assembly.

(3) Remove the cloth bag containing bracket mounting hardware.

(4) Remove the two nuts, lockwashers, and bolts retaining the engine suspension frame assembly to the side rail assembly. Slide the frame from the drum. The frame will rest on two yokes.

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PARA 4.B. (cont)

(5) For an exhaust down engine installation the bottom mount shall be set up as follows:

(a) The male adapter bracket installed in the bracket support plate and retained by two flat head pins at the rear set of holes. Each pin secured by a hairpin.

(b) The female adapter bracket installed on the male adapter bracket and retained by a flat head pin. Pin secured by a hairpin.

(c) The exhaust down engine mounting bracket (VE–5–1647–100) installed on the bottom mount of the engine. Bracket secured with three bolts and was hers. Two long bolts tightened to 85–110 lb in. (9.6–12.4 N·m) and short bolt tightened to 140–165 lb in. (16–19 N·m). Bolts lockwired in threes.

NOTE: The exhaust up engine mounting bracket is secured to the storage bracket assembly in the drum.

(6) For an exhaust down engine installation the side mounts shall be set up as follows:

(a) The two engine mounting brackets installed on the side mounts of the engine. Each secured with three bolts and washers. Bolts tightened to 85–110 lb in. (9.6–12.4 N·m) and lockwired in threes.

(b) Pins pulled and the two engine mounting bracket support adapters moved outboard flush with the inside edge of the adapter support bushing.

(7) Coil the thermocouple lead and secure it to the top of the turbine with one–inch masking tape.

CAUTION: AVOID SHARP BENDS WHEN COILING THE THERMOCOUPLE LEAD.

(8) Lower the engine onto the engine suspension frame assembly. The bottom engine mounting bracket must engage the female adapter bracket. Stop lowering the engine when the side mounting brackets are aligned with the engine mounting bracket support adapters. Secure each of the two adapters to the mounting brackets with a flat head pin and hairpin. Secure each of the two adapters to the adapter support bushings with a flat heat pin and hairpin. Release engine weight onto the frame.

(9) Tie the empty cloth bag to the desiccant receptacle for future use.

(10) Lift or hoist the engine loaded frame until the side rails align with the side rail assemblies. Slide the frame into the drum.

NOTE: If a hoist was used to lift the engine loaded frame assembly, the lift tool must be removed from the engine top pad before the engine can slide all the way into the drum.

(11) Secure the side rails to the side rail assemblies with a bolt, lock washer, and nut on each side. Tighten nuts to 150–180 lb in. (17–20 N·m).

(12) Place two 16–unit bags of desiccant into the desiccant receptacle. Replace the humidity indicator element only if necessary.

(13) Assemble the closure gasket and the front head on the drum. Secure the head with the clamping band. Use a special scissors–type clinch tool to hold the band so that the retaining bolt and nut can be installed. Tighten nut until the head, gasket, and bank are seated firmly. Lead–seal lockwire the bolt to the bushing sleeve.

(14) Place one copy of EDS 1311 and applicable engine records in a plastic envelope. Store the envelope in the records receptacle. Lead–seal lockwire the cover to the receptacle.

(15) Coat the nut end of the container closure bolt with corrosion preventive compound.

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PARA 4. (cont)

C. Install the 250–C20, –C20B, –C20F, or –C20J engine in a rectangular–type shipping container (P/N 6873174) as follows:

(1) Prepare the container for the installation.

(a) Depress and hold the relief valve manual release button until air pressure inside the container is zero.

(b) Remove the eight nuts and screws securing the cover to the base. Attach a hoist at the lifting hooks and remove the container cover from the base.

(c) Separate the two side engine mounting brackets from the engine mounting bracket adapters by removing a hairpin and flat head pin from each.

(d) Loosen the two engine mounting bracket adapters in the upper mounting adapter support bracket by removing a hairpin and flat head pin from each. Slide the adapters outboard until they are flush with the inside edge of the support bracket.

(e) Remove the bottom engine mounting bracket. (The shipping container details include two brackets. Remove the bracket which is identical to the two side brackets. Install the remaining bracket at the storage location on the channel weldment.)

(2) Assemble the bottom and two side mounting brackets on the engine. Secure each with three bolts and washers. Tighten bolts to 85–110 lb in. (9.6–12.4 N·m) and lockwire in threes.

CAUTION: AVOID SHARP BENDS WHEN COILING THE THERMOCOUPLE LEAD.

(3) Coil the thermocouple lead and secure it to the top of the turbine with one–inch (25 mm) masking tape.

(4) Lower the engine onto the base assembly. The bottom engine mounting bracket must engage the tube of the lower mounting bracket. Stop lowering the engine when the side mounting brackets are aligned with the engine mounting bracket adapters. Slide the adapters inboard to engage the engine side mounting brackets. Secure each of the two adapters to the mounting brackets with a flat head pin and hairpin. Secure each of the two adapters to the upper mounting adapter support bracket with a flat head pin and hairpin. Release the engine weight onto the base. Remove the lifting hoist.

(5) Tie the empty cloth sack to the mounting frame upper tube for future use.

(6) Place two 16–unit bags of desiccant into the desiccant receptacle. Replace the humidity indicator element only if necessary.

(7) Position the closure gasket; then lower the cover over the engine loaded base. Align cover to base at each end with a locating pin. Be sure the closure gasket is properly seated.

(8) Remove the hoist from the cover. Attach the cover to the base with eight screws and nuts (nut end up). Tighten nuts to 150–165 lb in. (17–19 N·m).

(9) Lead–seal wire the cover to the base at the two tamper–proof security holes.

(10) Remove the records receptacle cover. Place one copy of EDS 1312 and applicable engine records in the receptacle. Install the cover; secure with four screws, flat washers, and rubber washers. Tighten screws to 30–40 lb in. (3.4–4.5 N·m). Lead–seal lockwire screws in pairs.

(11) Coat the nut end of the container closure bolts with corrosion preventive compound.

D. Install the 250–C20S or –C20W engine in a rectangular–type shipping container (P/N 6873174) as follows:

(1) Depress and hold the relief valve manual release button until air pressure inside the container is zero.

(2) Remove the eight nuts and screws securing the cover to the base. Attach a hoist at the lifting hooks and remove the container cover from the base.

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PARA 4.D. (cont)

(3) For an exhaust down engine installation the bottom mount shall be set up as follows:

(a) The lower mounting bracket installed in the lower mounting bracket plate with the tube nearer to the aft side of the channel than it is to the forward side, with the tube up. Bracket attached by two flat head pins, each secured with a hairpin.

(b) The exhaust down engine mounting bracket (3–12147–1) installed on the bottom mount of the engine. Bracket secure with three bolts and washers. Two long bolts tightened to 85–110 lb in. (9.6–12.4 N·m) and the short bolt tightened to 140–165 lb in. (16–19 N·m). Bolts lockwired in threes.

NOTE: The exhaust up engine mounting bracket (3–10301–1) is secured at the storage position on the channel weldment.

(4) For an exhaust down engine installation, the side mounts shall be set up as follows:

(a) The two engine mounting brackets installed on the side mounts of the engine. Each bracket secured with three bolts and washers. Bolts tightened to 85–110 lb in. (9.6–12.4 N·m) and lockwired in threes.

(b) Engine mounting bracket adapters installed in the bottom hole of the upper mounting adapter support bracket. Pins pulled and engine mounting bracket adapters moved outboard flush with the inside edge of the upper mounting support bracket.

CAUTION: AVOID SHARP BENDS WHEN COILING THE THERMOCOUPLE LEAD.

(5) Coil the thermocouple lead and secure it to the top of the turbine with one–inch masking tape.

(6) Lower the engine onto the base assembly. The bottom engine mounting bracket must engage the tube of the lower mounting bracket. Stop lowering the engine when the side mounting brackets are aligned with the engine mounting bracket adapters. Slide the adapters inboard to engage the engine side mounting brackets. Secure each of the two adapters to the mounting adapter support bracket with a flat head pin and hairpin. Release the engine weight onto the base. Remove the lifting hoist.

(7) Tie the empty cloth sack to the mounting frame upper tube for future use.

(8) Place two 16–unit bags of desiccant into the desiccant receptacle. Replace the humidity indicator element only if necessary.

(9) Position the closure gasket; then lower the cover over the engine loaded base. Align cover to base at each end with a locating pin. Be sure the closure gasket is properly seated.

(10) Remove the hoist from the cover. Attach the cover to the base with eight screws and nuts (nut end up). Tighten nuts to 150–165 lb in. (17–19 N·m).

(11) Lead–seal wire the cover to the base at the two tamper–proof security holes.

(12) Remove the records receptacle cover. Place one copy of EDS 1312 and applicable engine records in the receptacle. Install the cover; secure with four screws, flat washers, and rubber washers. Tighten screws to 30–40 lb in. (3.4–4.5 N·m). Lead seal lockwire screws in pairs.

(13) Coat the nut end of the container closure bolts with corrosion preventive compound.

E. Install the 250–C20, –C20B, –C20F or –C20J engine in the pressurized–type shipping container (P/N 6870352) as follows:

(1) Prepare the container for the installation.

(a) Loosen the nut; then swing the service receptacle cover out of the way. Reduce air pressure in the container to zero by loosening or removing the air valve or by pressing the manual release button on the relief valve.

(b) Remove the 32 screws and nuts at the container splitlines. Remove the cover using a hoist.

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PARA 4.E. (cont)

(c) Remove the cotter pins and flat head pins and separate the two engine mounting brackets for the engine side mounting pads from the two retaining tubes.

(d) Remove the cotter pins and flat head pins and separate the two retaining tubes from the upper engine mounting support bracket. Slide the tubes outboard until their inboard ends are flush with the inboard sides of the upper engine mounting support brackets.

(e) Remove the bottom engine mounting bracket from the yoke by removing the bolt and washer.

(2) Assemble the two engine mounting brackets to the side mounting pads of the engine. Secure each with three bolts and three washers. Tighten bolts to 85–110 lb in. (9.6–12.4 N·m) and lockwire in groups of three.

(3) Assemble the engine mounting bracket to the bottom mounting pad of the engine. Secure with three bolts and three washers. Tighten bolts to 85–110 lb in. (9.6–12.4 N·m) and lockwire in groups of three.

CAUTION: AVOID SHARP BENDS WHEN COILING THE THERMOCOUPLE LEAD.

(4) Coil the thermocouple lead and secure it to the top of the turbine with one–inch masking tape.

(5) Lower the engine into the shipping container base. Let the bottom engine mounting bracket engage the tube of the bottom container bracket. Stop lowering the engine when the shafts of the two side engine mounting brackets are aligned with their respective retaining tubes.

(6) Slide the two side mounting bracket retaining tubes inboard until they engage the mounting brackets on the engine. Secure each with a flat head pin and a cotter pin. Secure the retaining tubes to the upper engine mounting support brackets with a flat head pin and cotter pin at each bracket.

(7) Release the complete engine weight into the container. Remove the lifting brackets and/or slings.

(8) Tie the cloth sack to the desiccant basket.

(9) Place two 16–unit bags of desiccant in the desiccant basket.

(10) Position the closure gasket; then lower the cover over the engine loaded base.

(11) Remove the hoist from the cover. Attach the cover to the base with 32 screws and nuts (nut ends up). Tighten one nut on each side in the center and one at each of the four corners; then tighten the remaining nuts. Tighten nuts to 150–165 lb in. (17–19 N·m).

(12) Replace or retighten the air valve; then pressurize the container to 5.0 ± 0.5 psig (34.5 ± 3.4 kPag) at 21°C (70°F) using clean dry air. Refer to Table 901 for pressure vs temperature relationship applicable to containers.

(13) Check the records receptacle, humidity indicator, drain plug, service receptacle gasket, air valve, relief valve, and container splitline closure gasket for air leaks. Use a soap and water solution for the leak check. If leaks are found, retorque and/or repair as necessary to stop leaks. Recheck the pressure in accordance with the values in Table 901. Do not overtighten the closure bolts. Tamper proof the shipping container by lead seal lockwiring the container cover to the base at the holes provided at the two opposite corners.

NOTE: Recheck the container pressure and humidity indicator if the engine has not been shipped within 24 hours of the time the container was pressurized. Also, recheck the container pressure and the humidity indicator immediately before the time of actual shipment. (Refer to Preservation Surveillance, para 7, this section)

(14) Reassemble the service receptacle cover to the service receptacle. Secure with two nuts. Tighten nuts to 15–25 lb in. (1.7–2.8 N·m). Tamper proof the cover using lockwire with a lead seal.

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PARA 4.E. (cont)

(15) Place one copy of EDS 1337 and applicable engine records in a plastic envelope. Store the envelope in the records receptacle. Secure with two nuts. Tighten nuts to 30–45 lb in. (3.4–5.0 N·m). Tamper proof the cover using lockwire with a lead seal.

(16) Coat the nut ends of the records receptacle studs, the service receptacle bolts, and the closure screws with corrosion preventive compound.

Table 901
Shipping Container Air Pressure Chart

Temperature °F	(°C)	Pressure psig	(kPag)	Temperature °F	(°C)	Pressure psig	(kPag)
+140	(60)	7.6	(52.4)	+ 40	(4.4)	3.9	(26.9)
+130	(54)	7.3	(50.3)	+ 30	(1.1)	3.5	(24.1)
+120	(49)	6.9	(47.6)	+ 20	(–6.7)	3.2	(22.1)
+110	(43)	6.5	(44.8)	+ 10	(–12)	2.8	(19.3)
+100	(38)	6.1	(42.1)	0	(–18)	2.4	(16.5)
+ 90	(32)	5.8	(40.0)	–10	(–23)	2.0	(13.8)
+ 80	(28)	5.4	(37.2)	– 20	(–29)	1.7	(11.7)
+ 70	(21)	5.0	(34.5)	– 30	(–34)	1.3	(9.0)
+ 60	(16)	4.6	(31.7)	– 40	(–40)	0.9	(6.2)
+ 50	(10)	4.3	(29.6)				

F. Install the 250–C20S or –C20W engine in the pressurized–type shipping container (P/N 6870352) as follows:

(1) Loosen the nut then swing the service receptacle cover out of the way. Reduce air pressure in the container to zero psig by loosening or removing the air valve or by pressing the manual release button on the relief valve.

(2) Remove the 32 screws and nuts at the container splitline. Remove the cover using a hoist.

(3) For an exhaust down engine installation the bottom mount shall be set up as follows:

(a) The lower mounting bracket installed in the lower mounting bracket plate with the tube nearer to the aft side of the mounting yoke than it is to the forward side, with the tube up. Bracket attached by two flat head pins, each secured with a hairpin.

(b) The exhaust down engine bottom mounting bracket (3–12147–1) installed on the bottom mount of the engine. Bracket secured with three bolts and washers. Two short bolts tightened to 85–110 lb in. (9.6–12.4 N·m) and longbolt tightened to 140–165 lb in. (16–19 N·m). Bolts lockwired in threes.

NOTE: The turboshaft engine mounting bracket (3–10301–1) is secured at the storage position on the mounting yoke.

(4) For the exhaust down engine installation, the side mounts shall be set up as follows:

(a) The two engine mounting brackets installed on the side mounts of the engine. Each bracket secured with three bolts and washers. Bolts tightened to 85–110 lb in. (9.6–12.4 N·m) and lockwired in threes.

(b) Engine mounting bracket adapters installed in the bottom hole of the upper mounting adapter support bracket. Pins pulled and engine mounting bracket adapters moved outboard flush with the inside edge of the upper mounting support bracket.

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PARA 4.F. (cont)

CAUTION: AVOID SHARP BENDS WHEN COILING THE THERMOCOUPLE LEAD.

(5) Coil the thermocouple lead and secure it to the top of the turbine with one–inch masking tape.

(6) Lower the engine into the shipping container base. Let the bottom engine mounting bracket engage the tube of the bottom container bracket. Stop lowering the engine when the shafts of the two side engine mounting brackets are aligned with their respective retaining tubes.

(7) Slide the two side mounting bracket retaining tubes inboard until they engage the mounting brackets on the engine. Secure each with a flat head pin and a cotter pin. Secure the retaining tubes to the upper engine mounting support brackets with a flat head pin and cotter pin at each bracket.

(8) Release the complete engine weight into the container. Remove the lifting brackets and/or slings.

(9) Tie the cloth sack to the desiccant basket.

(10) Place two 16–unit bags of desiccant in the desiccant basket.

(11) Position the closure gasket; then lower the cover over the engine loaded base.

(12) Remove the hoist from the cover. Attach the cover to the base with 32 screws and nuts (nut ends up). Tighten one nut on each side in the center and one at each of the four corners then tighten the remaining nuts. Tighten nuts to 150–165 lb in. (17–19 N·m).

(13) Replace or retighten the air valve then pressurize the container to 5.0 + 0.5 psig (34.5 + 3.4 kPa) at 70°F (21.1°C) using clean dry air. Refer to Table 901 for pressure vs temperature relationship applicable to containers.

(14) Check the records receptacle, humidity indicator, drain plug, service receptacle gasket, air valve, relief valve, and container splitline closure gasket for air leaks. Use a soap and water solution for the leak check. If leaks are found retighten and/or repair as necessary to stop leaks. Recheck the pressure in accordance with the values in Table 901. Do not overtighten the closure bolts. Tamper proof the shipping container by lead–seal lockwiring the container cover to the base at the holes provided at the two opposite corners.

NOTE: Recheck the container pressure and humidity indicator if the engine has not been shipped within 24 hours of the time the container was pressurized. Also, recheck the container pressure and the humidity indicator immediately before the time of actual shipment. (Refer to Preservation Surveillance, para 7., this section.)

(15) Reassemble the service receptacle cover to the service receptacle. Secure with two nuts. Tighten nuts to 15–25 lb in. (1.7–2.8 N·m). Tamper proof the cover using lockwire with a lead seal.

(16) Place one copy of EDS 1337 and applicable engine records in a plastic envelope. Store the envelope in the records receptacle. Secure with two nuts. Tighten nuts to 30–45 lb in. (3.4–5.1 N·m). Tamper proof the cover using lockwire with a lead seal.

(17) Coat the nut ends of the records receptacle studs, the service receptacle bolts, and the closure screws with corrosion preventative compound.

5. Removal of Engine from Container

A. Remove the engine from the drum–type shipping container (P/N 6870176) as follows:

(1) Depress and hold the relief valve manual release button until the air pressure inside the container is zero. Remove the drum front head by removing the nut, bolt, and clamping band assembly.

(2) Remove the cloth bag containing bracket mounting hardware.

(3) Remove the two nuts, lockwashers, and bolts retaining the engine loaded frame assembly to the side rails. Slide the engine and frame assembly from the drum. The frame will rest on two yokes.

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PARA 5.A. (cont)

CAUTION: PROVIDE ADEQUATE SUPPORT AT BOTH ENDS OF THE LOADED FRAME TO PREVENT IT FROM FALLING TO THE FLOOR AS THE LOAD IS DISENGAGED FROM THE SIDE RAILS. THE FRAME CAN BE SUPPORTED BY ATTACHING A LIFT TOOL AND HOIST AT THE ENGINE TOP MOUNTING PAD WHEN THE FRAME IS ABOUT HALF WAY OUT OF THE DRUM.

(4) Adjust the hoist to take the engine weight off of the frame assembly.

(5) Separate the two engine mounting bracket support adapters from the adapter support bushings and from the engine mounting brackets by removing the hairpin and flat head pin at each location. Slide the two adapters outboard until they are flush with the inside edge of the adapter support bushings.

(6) Hoist the engine from the frame assembly.

(7) Remove the three mounting brackets from the engine.

(8) Reinstall container parts into their respective locations and place loose hardware in the cloth bag. Tie the bag to the desiccant receptacle for future use.

(9) If the container will be exposed to corrosive conditions, coat the nut end of the closure bolt with corrosion preventive compound.

B. Remove the engine from a rectangular–type shipping container (P/N 6873174) as follows:

(1) Depress and hold the relief valve manual release button until the air pressure inside the container is zero.

(2) Remove the eight screws and nuts securing the cover to the base. Attach a hoist at the lifting hooks and remove the container cover from the base.

(3) Attach a lift bracket and hoist to the engine top mounting pad. Adjust the hoist to take the engine weight off of the container suspension system.

(4) Separate the two engine mounting bracket adapters from the side engine mounting brackets and from the upper mounting adapter support brackets by removing a hairpin and flat head pin at each location. Slide the two adapters outboard until they are flush with the inside edge of the support brackets.

(5) Hoist the engine out of the container.

(6) Remove the engine mounting brackets from the bottom and both sides of the engine.

(7) Reinstall container parts into their respective locations and place loose hardware in the cloth sack. Tie the cloth sack to the mounting frame upper tube for future use.

(8) If the container will be exposed to corrosive conditions, coat the nut end of the eight closure screws with corrosion preventive compound.

C. Remove the engine from the pressurized–type shipping container (P/N 6870352) as follows:

(1) Loosen the nut; then swing the service receptacle cover out of the way. Reduce air pressure in the container to zero by loosening or removing the air valve or by pressing the manual release button on the relief valve.

(2) Remove the 32 nuts and screws at the splitline. Remove the container cover using a hoist.

(3) Remove the weight from the engine in the container using a hoist at the lifting bracket at the top of the engine.

(4) Remove the cotter pins and flat head pins securing the two retaining tubes at the upper engine mounting support brackets and at the mounting brackets for the engine side mounting pads. Slide the retaining tubes outboard until their inboard ends are flush with the inboard sides of the upper engine mounting support brackets.

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PARA 5. (cont)

(5) Hoist the engine out of the container.

(6) Remove the three mounting brackets from the engine.

(7) Reinstall container parts at their storage locations. Place loose hardware in the cloth bag.

(8) If the container will be subjected to weather or corrosive conditions during storage, coat nut ends of the records receptacle studs, the service receptacle bolts, and the closure screws with corrosive preventive compound.

6. Container Reuse

All of the containers are designed to be reusable. Reuse as many of the shipping parts stored within the container as possible.

7. Preservation Surveillance

The shipping package must undergo humidity indicator element inspection upon receipt of the engine. Repeat inspection every 30 days.

A. If the humidity indicator is light blue (white to blue is also acceptable), the moisture level in the bag or container has been satisfactory. Make note of the humidity inspection in the Engine Log.

B. If the humidity indicator is light lavender or pink, the moisture level in the bag or container has been unsatisfactory. Return the engine to storage condition as follows:

(1) Remove the engine from the container and inspect for evidence of moisture. Normally the first condition encountered will be galvanic corrosion in areas having dissimilar metals in contact with each other such as steel bolts and fittings contacting the magnesium gearbox.

(2) If corrosion is not found, replace the humidity indicator element and return the engine to storage.

(3) If corrosion is found, clean or replace the corroded parts as necessary. Remove shipping parts and install the engine on a test stand or in an airframe. Start the engine and accelerate to Ground Idle. Operate at this engine power setting or above for a sufficient length of time (approx. five minutes) to accomplish the following: depreserve the fuel system, recoat all lubricated interior components, and thoroughly remove moisture from the engine. Upon completion of the engine run, preserve the engine and return it to storage in the normal manner described in this section.

(4) Replace or rejuvenate the desiccant. Replace with No. 88 Absorbant Protective Dehydrating Agent, or equivalent (MIL–D–3464). Desiccant can be rejuvenated by heating in an oven at 121°C (250°F) for 16 hours.

(5) Make note of the inspection in the Engine Log.

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ENGINE FUEL AND CONTROL SYSTEM –– MAINTENANCE PRACTICES

1. General

WARNING: WATER OR CONTAMINATION IN THE FUEL CAN CAUSE FLAMEOUT OR POWER LOSS.

WARNING: AIR LEAKS IN THE FUEL SYSTEM OR THE PNEUMATIC SENSING SYSTEM CAN CAUSE FLAMEOUTS, POWER LOSS OR OVERSPEED.

WARNING: PROPER TIGHTENING OF ENGINE TUBING CONNECTIONS IS CRITICAL TO FLIGHT SAFETY. CORRECT TORQUE VALUES MUST BE USED AT ALL TIMES. EXCESSIVE TORQUE ON PNEUMATIC SENSING SYSTEM CONNECTIONS RESULTS IN CRACKING OF THE FLARE CAUSING AN AIR LEAK WHICH CAN CAUSE FLAMEOUT, POWER LOSS, OR OVERSPEED.

NOTE: Performance of vacuum check of the fuel system lines and components is recommended anytime a fuel system component is removed or replaced to ensure no engine or airframe fuel system leaks are present.

A. Fuel System Maintenance

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

The components of both the Bendix and the Chandler Evans (CECO) fuel systems are included in the fuel system maintenance paragraphs. Maintenance includes purging the fuel system, cleaning the Pc filter and fuel control and governor airflow restrictors; inspecting, cleaning, and/or replacing the fuel system filters; adjusting the gas producer fuel control; replacing the fuel control, power turbine governor, fuel pump and filter assembly; inspecting and cleaning the fuel nozzle; and inspecting and cleaning the accumulators. Proper maintenance of the fuel and control air system includes the correct installation of tubes, unions, fittings, and clamping systems employed on each engine. Illustration of the location of these items is provided in Figures 201, 202 and 203 of this section.

B. Fuel System Air Leaks

The two principal reasons for fuel system air leaks are loose lines and damaged or impaired fittings.

NOTE: Loose lines can develop from improperly tightened B–nuts. Damaged fittings are the result of incorrect handling or improper installation procedures. Insufficient tightening of the B–nut allows wear of the fitting through normal operating vibrations applied to a loose flare.

(1) When a loose line is detected, proceed as follows:

(a) Remove the line and check the flares for wear, bends, dents, feathered edges or other deformities.

(b) Inspect nipple portion of fitting for damage, grooves or wear. Detect grooves in the mating surface by placing a small metal straight edge on the beveled surface and viewing for gaps.

(c) Determine the cause of irregularities and take steps to correct the situation.

1 Tube clamping should be in accordance with the 250–C20 Series Parts Catalog (Pub. No. 10W4).

2 If a tube requires replacement, the fitting to which it mates should also be replaced.

(d) For detailed installation instructions, refer to Rigid Tube Inspection and Installation, para 9., 72–00–00, Engine–Servicing.

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Legend for Figure 201

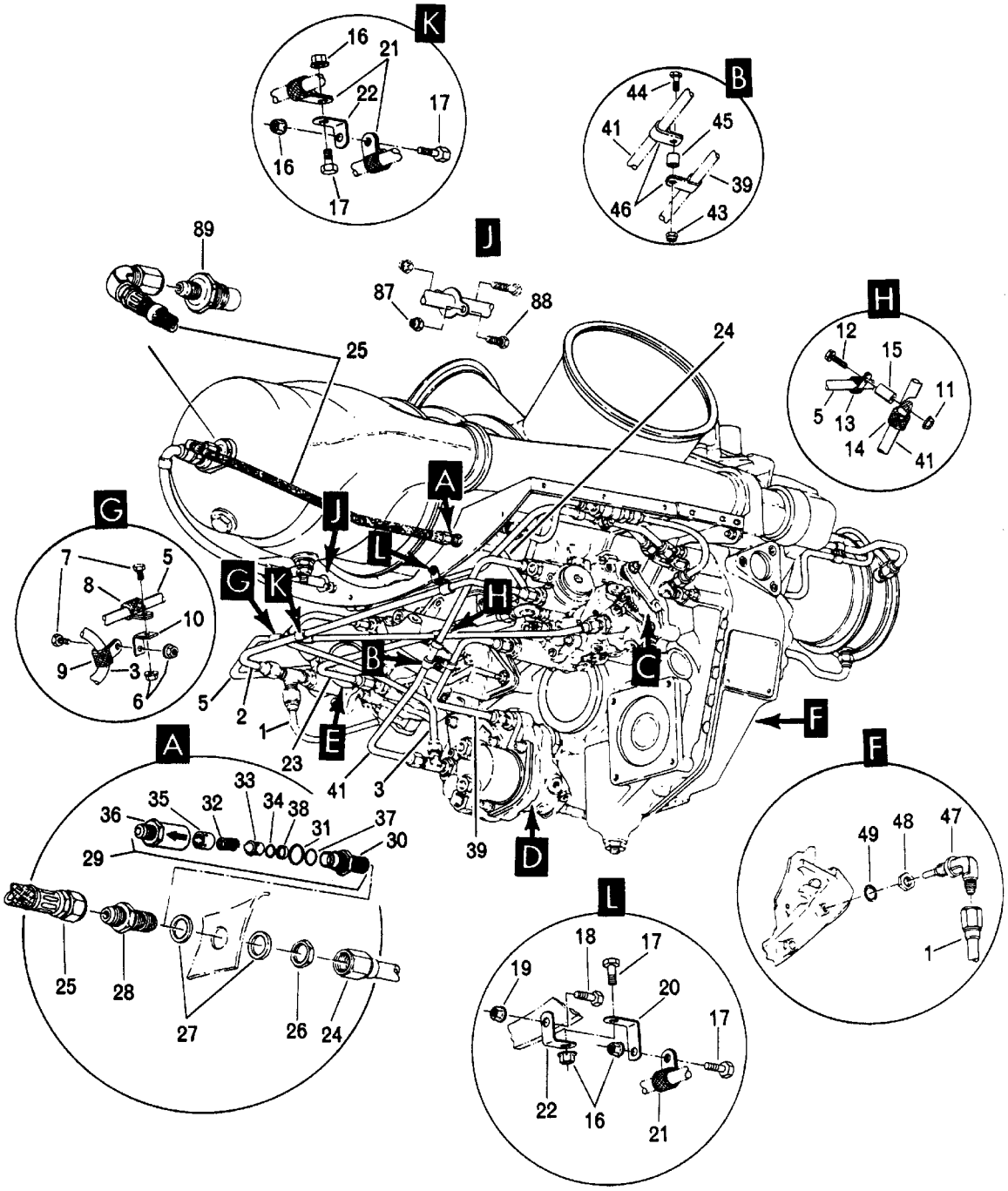
1. Scroll–to–tee tube
2. Tee–to–fuel control tube
3. Governor–to–pump bypass tube
4. Governor–to–pump bypass tube
5. Governor–to–pump control tube
6. Nut (2)
7. Bolt (2)
8. Clamp
9. Clamp
10. Bracket
11. Nut
12. Bolt
13. Clamp
14. Clamp
15. Sleeve bushing
16. Nut (4)
17. Bolt (4)
18. Bolt
19. Nut
20. Bracket
21. Clamp (3)
22. Bracket
23. Fuel control–to–governor tube
24. Fuel control–to–fireshield tube
25. Hose
26. Nut
27. Washer (2)
28. Union
29. Check valve assembly
30. End piece
31. Static gasket
32. Spring
33. Poppet
34. Dynamic Packing
35. Spring guide
36. Housing
37. Back–up ring
38. Shroud
39. Fuel pump–to–fuel control tube
40. Fuel pump–to–fuel control tube
41. Fuel control–to–pump bypass tube
42. Fuel control–to–pump bypass tube
43. Self–locking nut
44. Bolt
45. Bushing
46. Clamp
47. Pressure probe elbow
48. Nut
49. Packing
50. Tee
51. Nut
52. Packing
53. Elbow
54. Nut
55. Union (3)
56. Tee
57. Nut
58. Union
59. Packing
60. Packing (4)
61. Packing (4)
62. Bushing
63. Packing
64. Governor
65. Filter fitting
66. Packing

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Legend for Figure 201 (cont)

67. Fuel pump (single element)
68. Packing
69. Filter element
70. Packing
71. Fuel pump (dual element)
72. Packing
73. Filter element
74. Packing
75. Fuel control
76. Nut (9)
77. Washer (9)
78. Gasket
79. Packing
80. Inlet Filter
81. Packing
82. Inlet Filter
83. Spring
84. Elbow
85. Packing
86. Nut
87. Nut
88. Bolt
89. Fuel nozzle
90. Fuel pump–to–filter tube (single element pump config.)
91. Nut (3)
92. Bolt (3)
93. Bracket (2)
94. Clamp (2)
95. Filter–to–control tube (single element pump config.)
96. Nut
97. Bolt
98. Clamp (2)
99. Fuel pump–to–filter tube (dual element pump config.)
100. Nut (2)
101. Bolt (2)
102. Bracket
103. Clamp
104. Clamp
105. Filter–to–control tube (dual element pump config.)
106. Nut
107. Bolt
108. Bushing
109. Clamp (2)
110. High pressure filter
111. Nut (2)
112. Bolt (2)
113. Element assembly
114. Element
115. Packing
116. Backup ring (2)
117. Packing
118. Packing
119. Fuel filter bracket
120. Fuel filter bracket
121. Nut (4)
122. Washer (4)
123. Pad cover
124. Gasket
125. Elbow
126. Nut
127. Union
128. Packing (2)

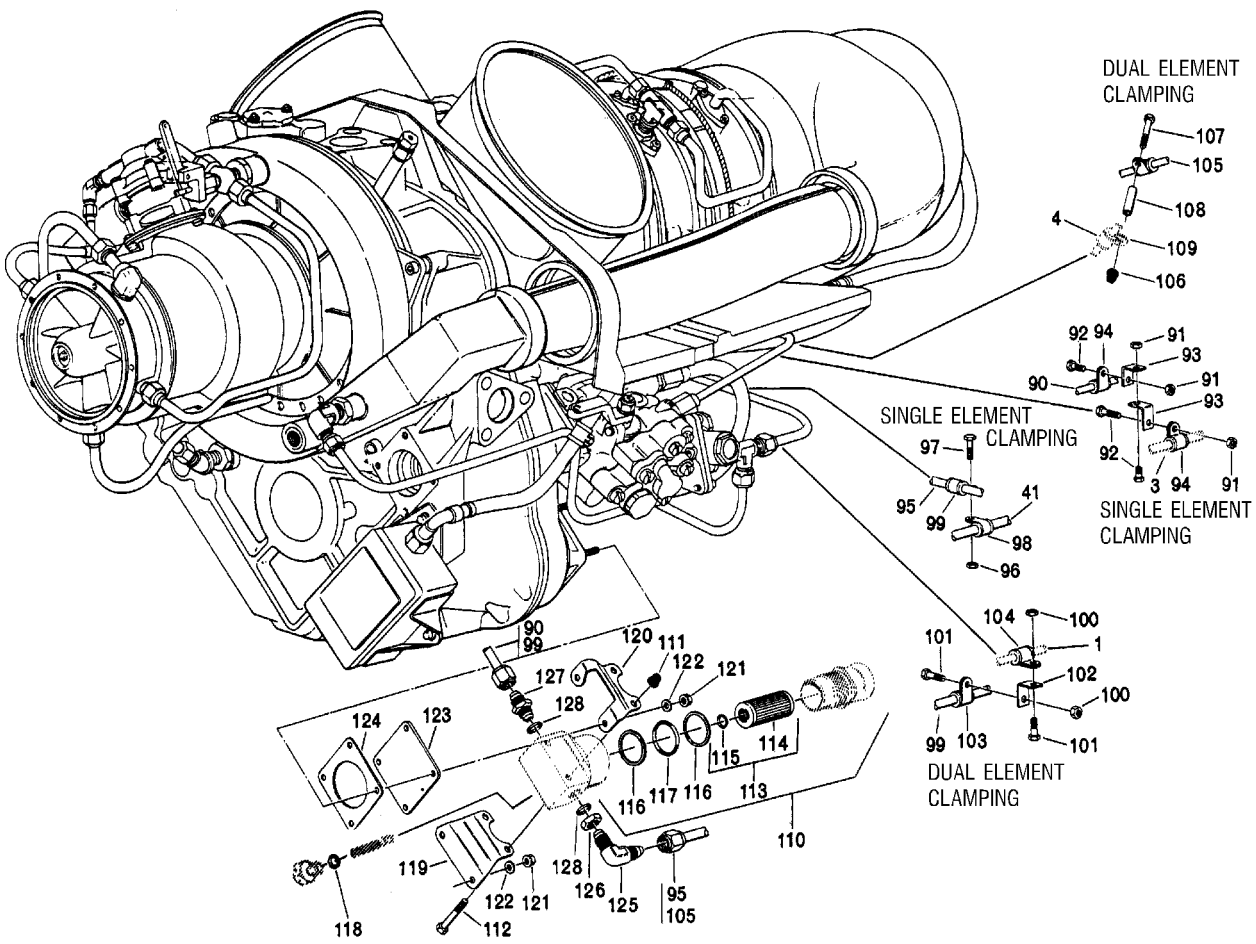
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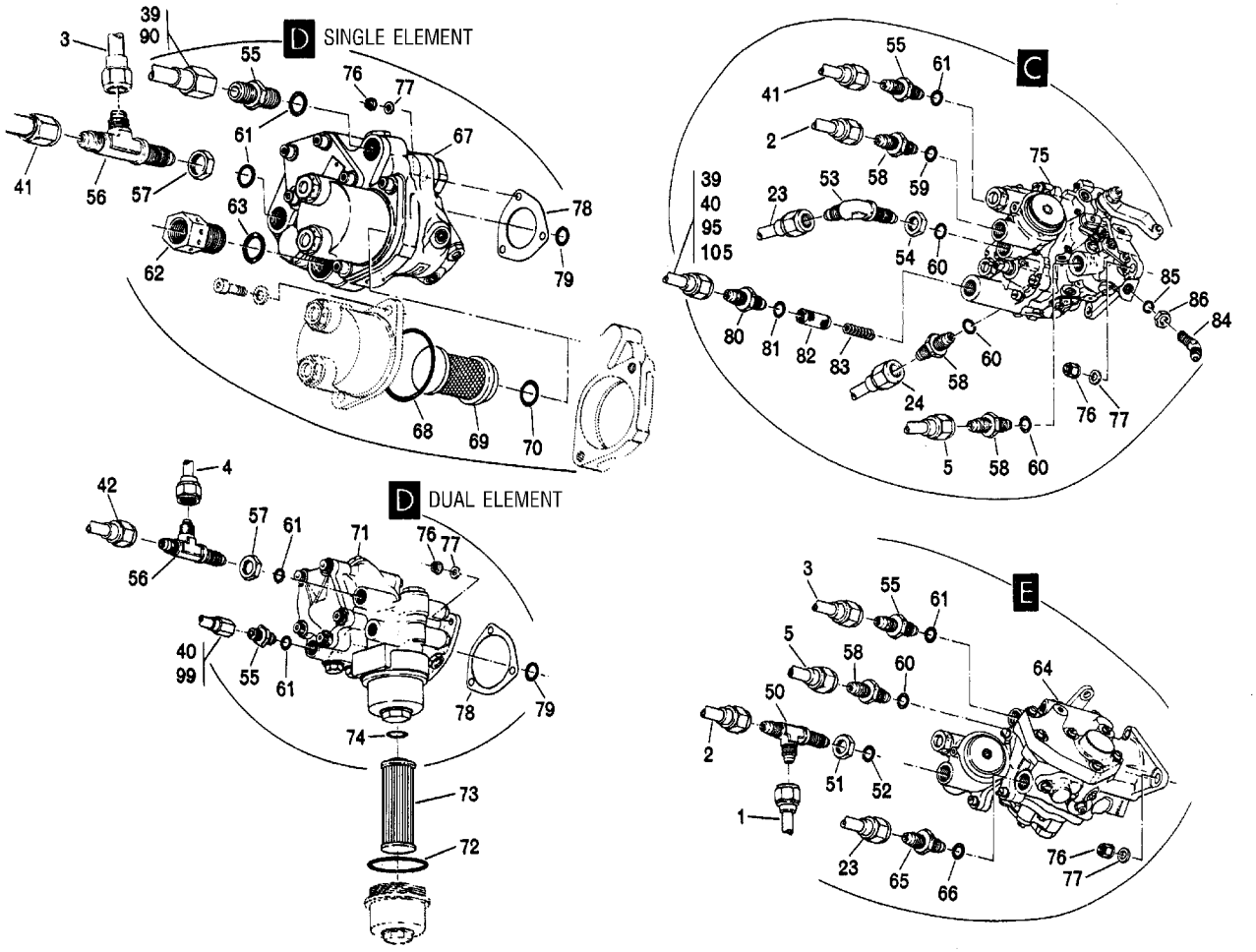
CECO Fuel System Components
Figure 201 (Sheet 1 of 3)

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CECO Fuel System Components
Figure 201 (Sheet 2 of 3)

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CECO Fuel System Components
Figure 201 (Sheet 3 of 3)

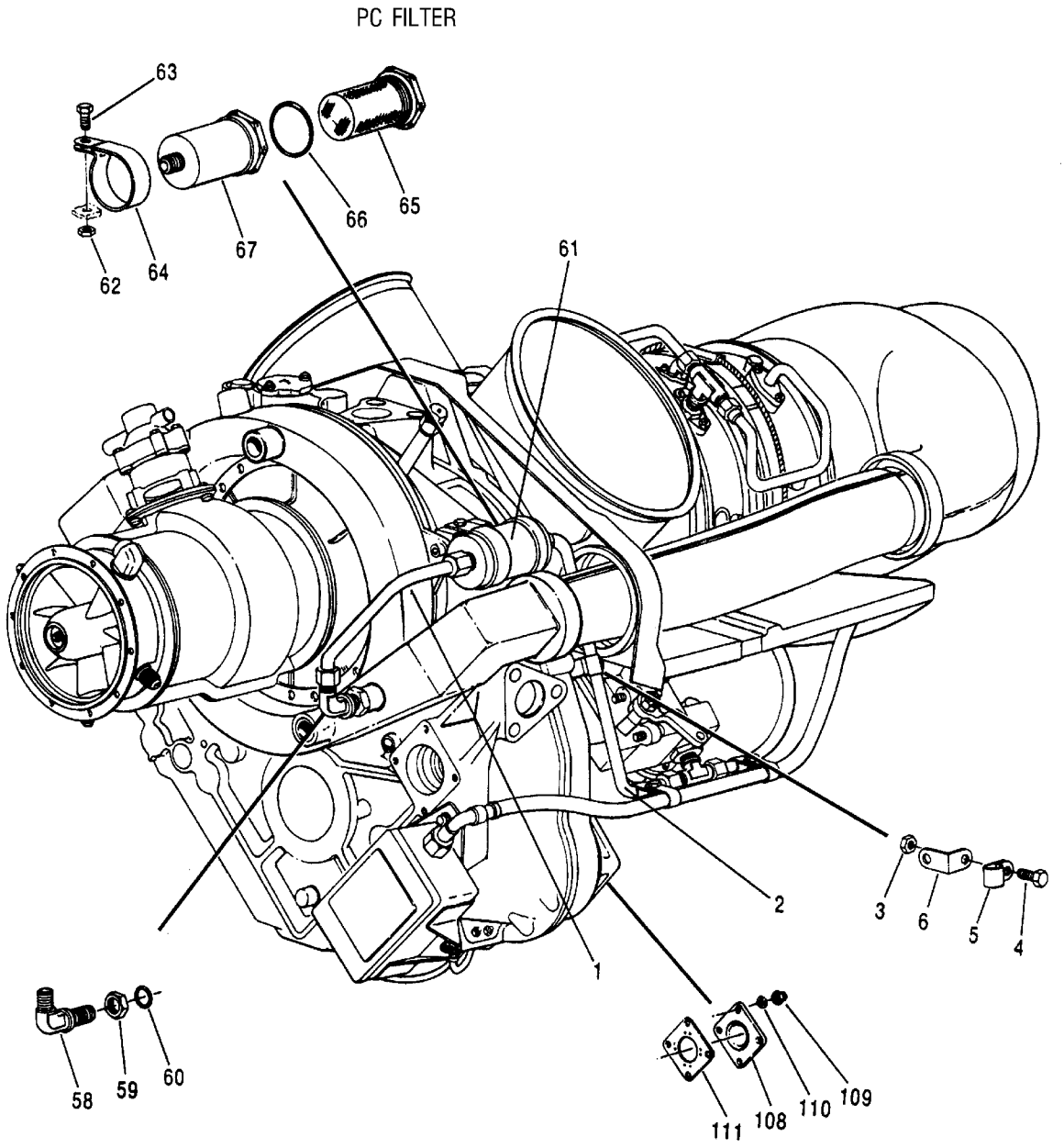
Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 202

1. Scroll–to–Pc filter tube
2. Pc filter–to–Governor tee tube
3. Nut
4. Bolt
5. Clamp
6. Bracket
7. Governor–to–fuel control tube
8. Accumulator–to–governor hose
9. Fuel control–to–accumulator tube
10. Fuel control–to–governor tube
11. Nut, bolt, spacer, clamps
12. Nut, bolt, bushing, clamps
13. Fuel control–to–fireshield tube
14. Firewall shield–to–fuel nozzle hose
15. Nut
16. Washer
17. Union
18. Check valve assembly
19. End piece
20. Static gasket
21. Spring
22. Poppet
23. Dynamic Packing
24. Spring Guide
25. Housing
26. Back–up ring
27. Shroud
28. Fuel pump–to–fuel control tube
29. Fuel pump–to–fuel control tube
30. Fuel control–to–pump tube
31. Fuel control–to–pump tube
32. Nut
33. Bolt
34. Bushing
35. Clamp

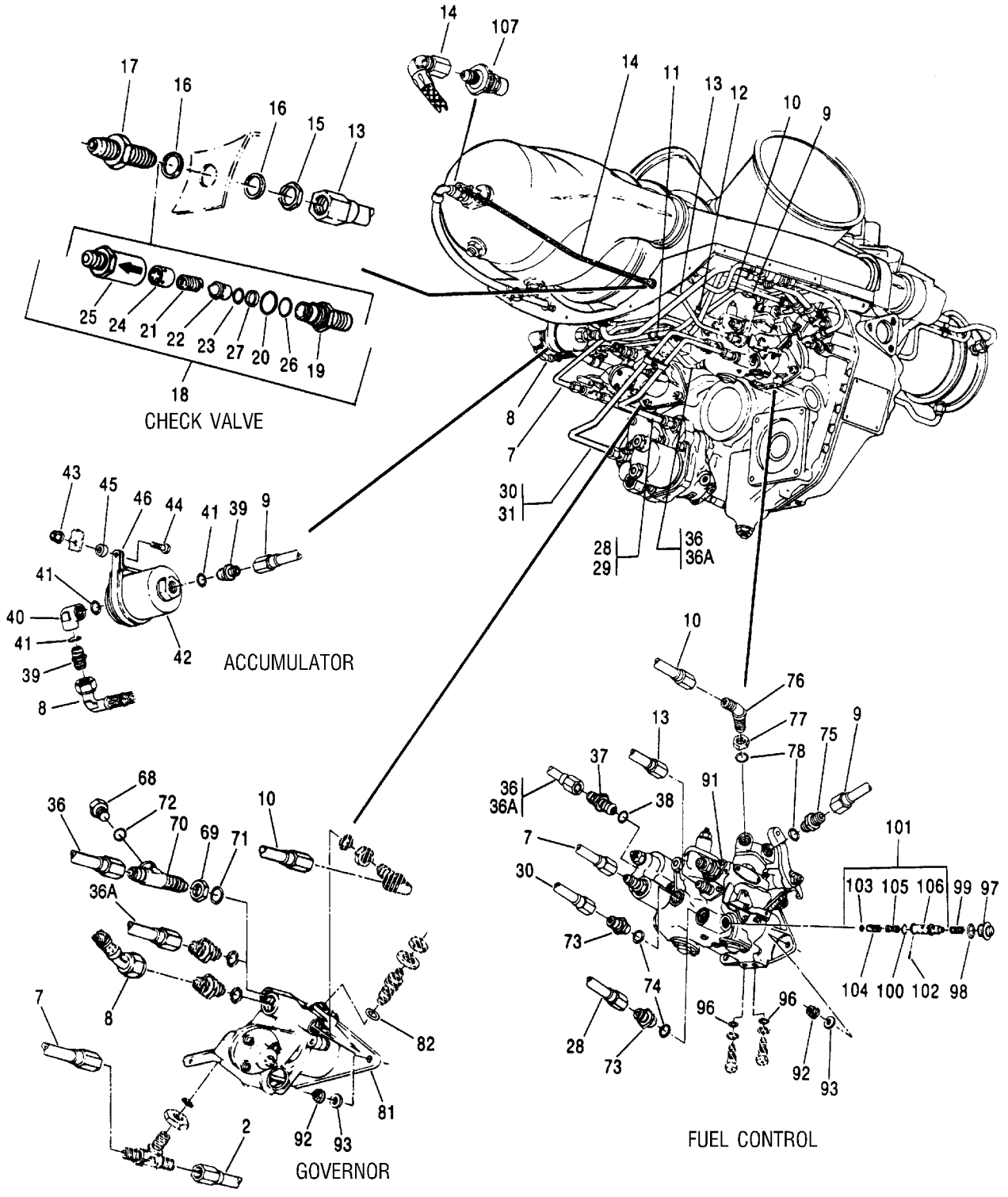
36A. Fuel control–to–governor Py tube
36. Fuel control–to–governor Py tube
37. Py Union
38. Packing
39. Union
40. Elbow
41. Packing
42. Accumulator (6 cubic in.)
43. Nut
44. Bolt
45. Spacer
46. Clamp
47. Union
48. Packing
49. Elbow
50. Accumulator (6 cubic in.)
51. Double check valve
52. Nut
53. Bolt
54. Washer
55. Spacer
56. Spacer
57. Clamp
58. Pressure probe elbow
59. Nut
60. Packing
61. Pc filter
62. Nut
63. Bolt
64. Clamp
65. Filter element
66. Packing seal
67. Housing
68. Plug
69. Nut
70. Py Tee
71. Union
72. Packing
73. Union
74. Packing
75. Pg Union
76. Pr Elbow
77. Nut
78. Packing
79. Bushing
80. Packing
81. Governor
82. Packing
83. Fuel pump (single element)
84. Packing
85. Filter element
86. Packing
87. Fuel pump (dual element)
88. Packing
89. Filter element
90. Packing
91. Fuel control
92. Nut
93. Washer
94. Gasket
95. Packing
96. Packing
97. Plug
98. Packing
99. Spring
100. Clip
101. Filter assembly
102. Pin
103. Washer
104. Spring
105. Strainer
106. Sleeve
107. Fuel nozzle
108. Cover
109. Nut
110. Washer
111. Gasket

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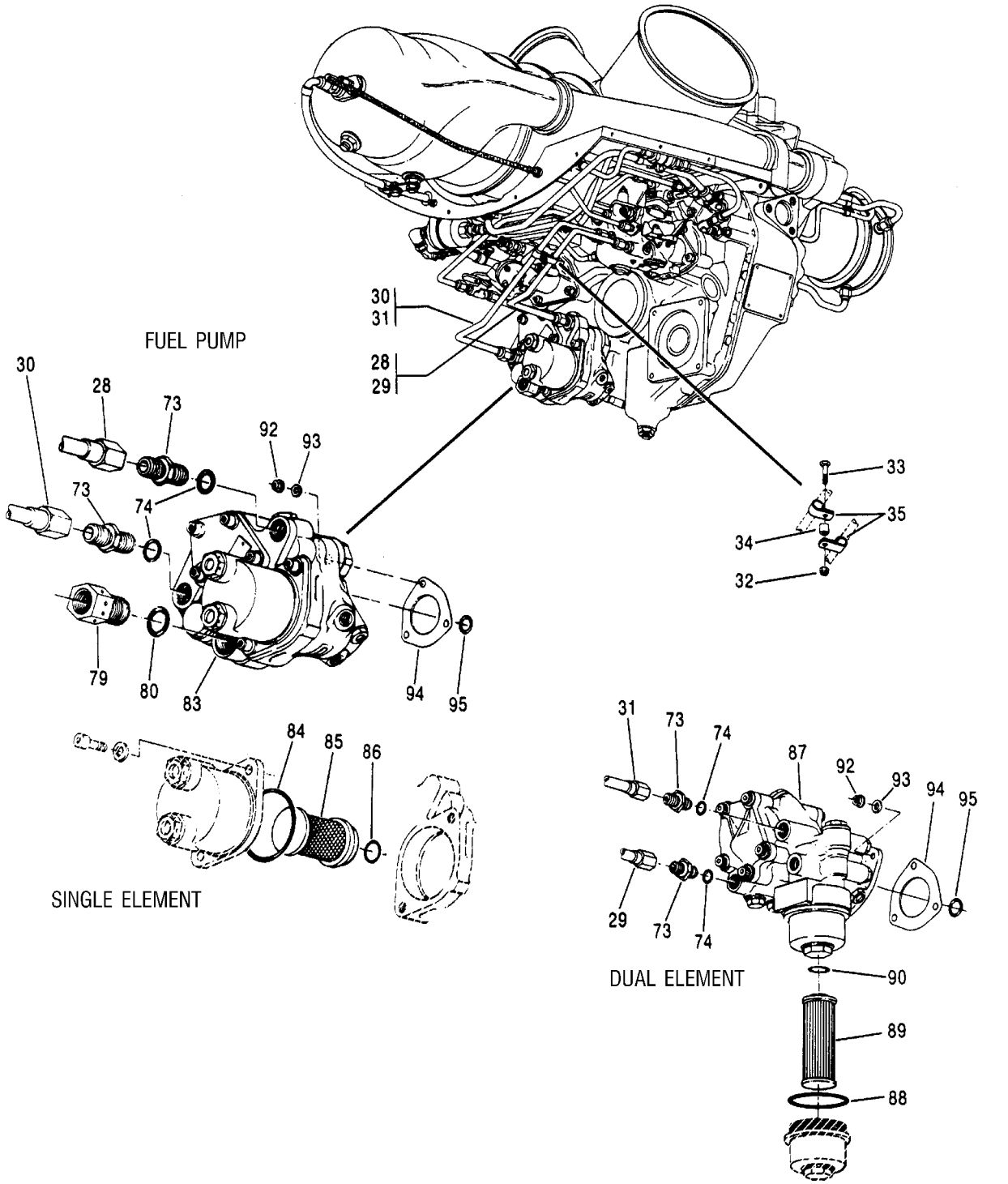
Bendix Fuel System Components (250–C20, –C20B, –C20F, –C20J)
Figure 202 (Sheet 1 of 4)

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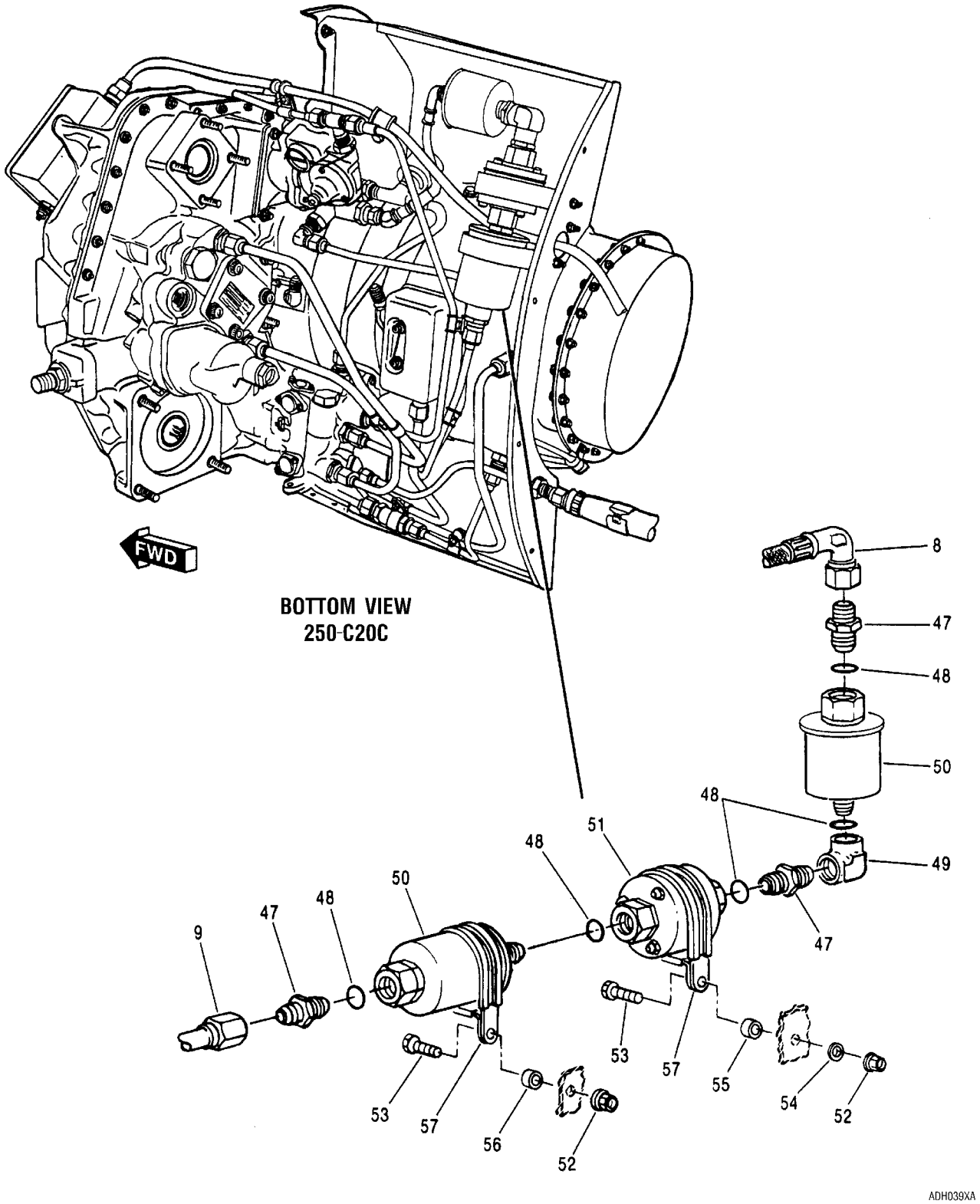
Bendix Fuel System Components (250–C20, –C20B, –C20F, –C20J)
Figure 202 (Sheet 2 of 4)

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Bendix Fuel System Components (250–C20, –C20B, –C20F, –C20J)
Figure 202 (Sheet 3 of 4)

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Bendix Fuel System Components (250–C20, –C20B, –C20F, –C20J)
Figure 202 (Sheet 4 of 4)

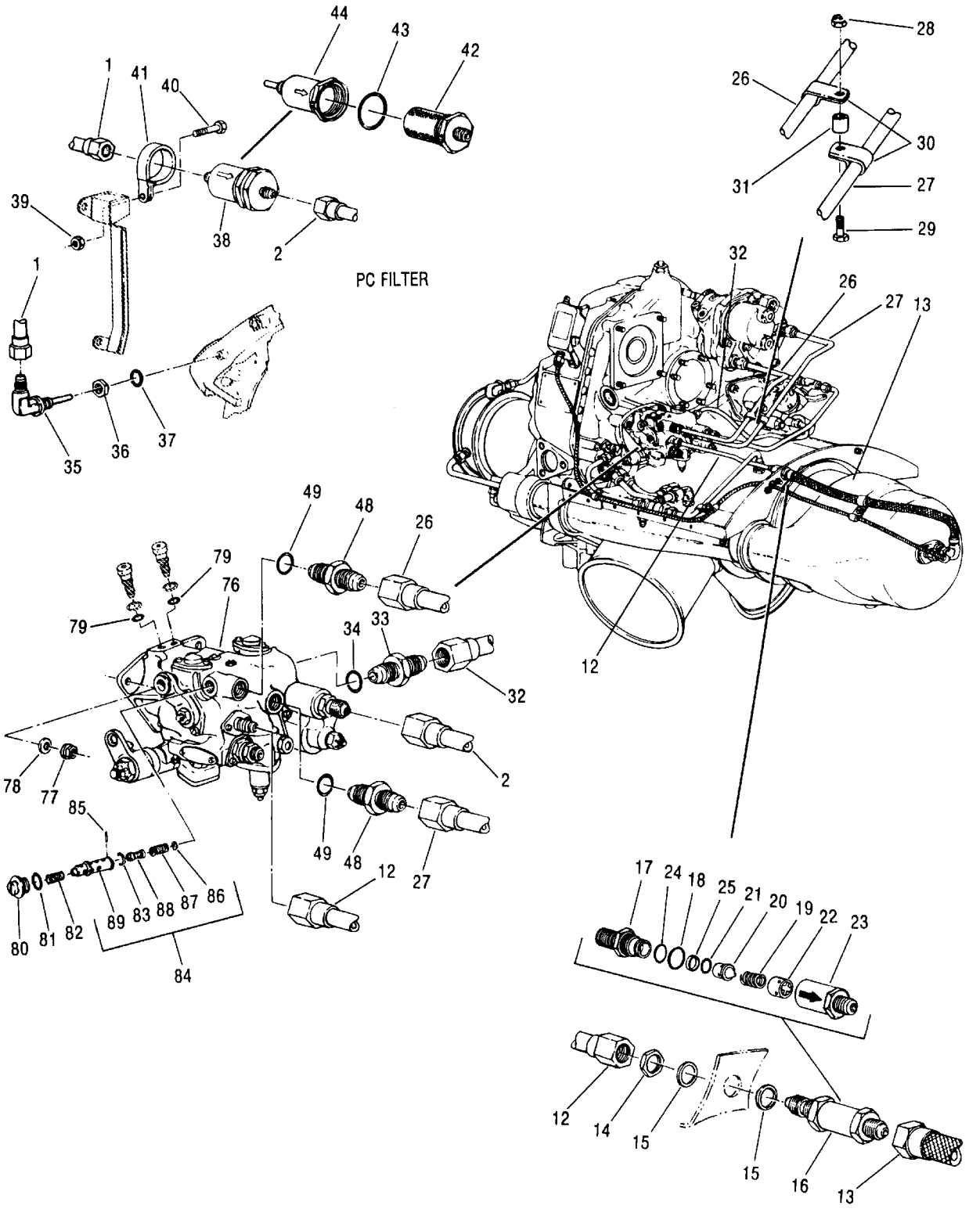
Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 203

1. Scroll–to–Pc filter tube
2. Pc filter–to–Governor tee tube
3. Nut
4. Bolt
5. Clamp
6. Bracket
7. Governor–to–fuel control tube
8. Not used
9. Not used
10. Not used
11. Not used
12. Fuel control–to–fireshield tube
13. Firewall shield–to–fuel nozzle hose
14. Nut
15. Washer (2)
16. Check valve assembly
17. End piece
18. Static gasket
19. Spring
20. Poppet
21. Dynamic Packing
22. Spring Guide
23. Housing
24. Back–up ring
25. Shroud
26. Fuel pump–to–fuel control tube
27. Fuel control–to–pump tube
28. Nut
29. Bolt
30. Clamps
31. Bushing

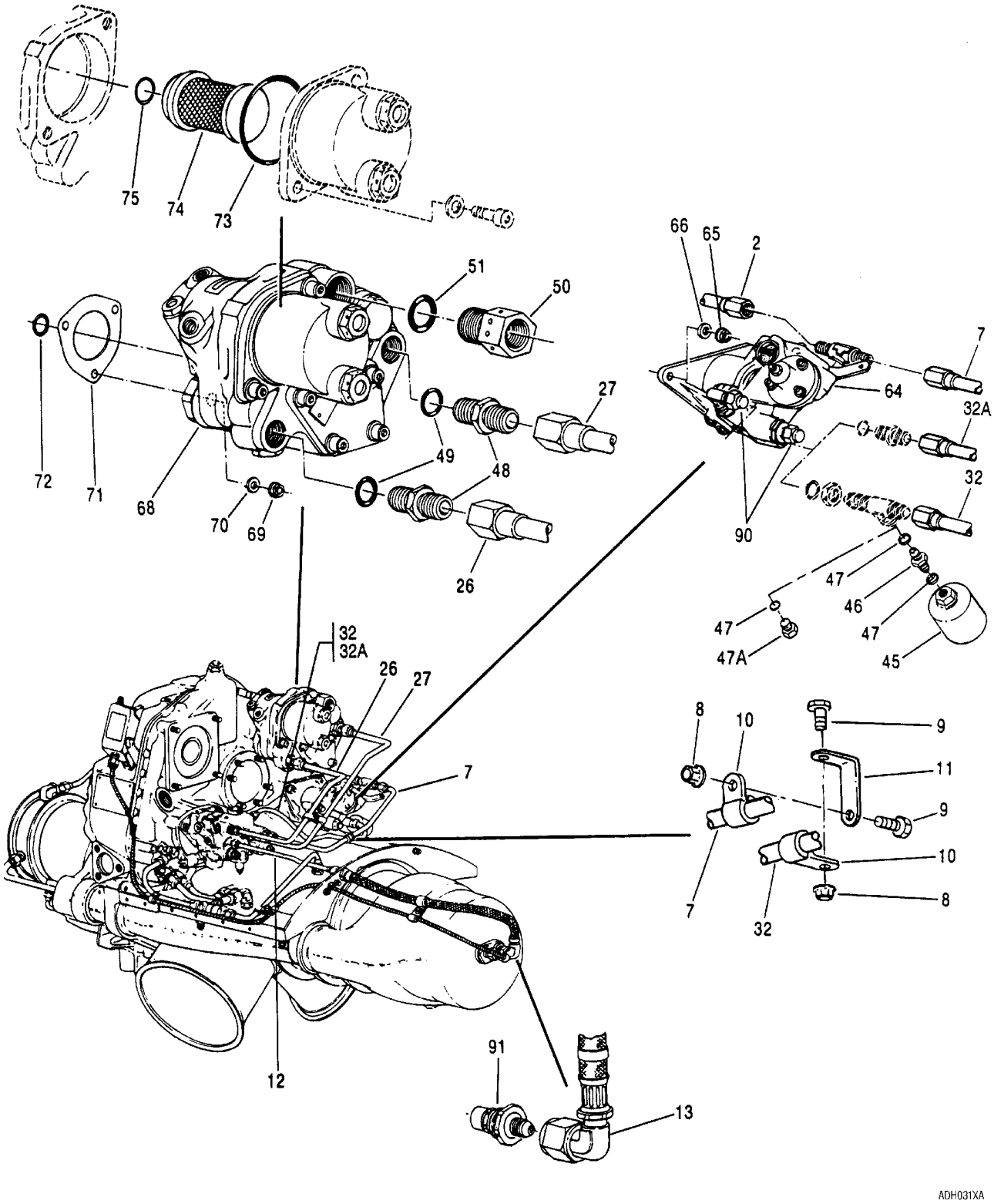
32A. Fuel control–to–governor Py tube
32. Fuel control–to–governor Py tube
33. Union
34. Packing
35. Pressure probe elbow
36. Nut
37. Packing
38. Pc filter
39. Nut
40. Bolt
41. Clamp
42. Filter element
43. Packing
44. Housing
45. Accumulator (0.7 cubic in.)
46. Union
47. Packing (2)
48. Union (4)
49. Packing (4)
50. Bushing
51. Packing
52. Fuel Control–to–Accumulator Pg Tube
53. Nut
54. Bolt
55. Spacer
56. Clamp
57. Nut
58. Elbow
59. Elbow
60. Packing
61. Accumulator (6 cubic in.)
62. Clamp
63. Check valve–to–governor hose
64. Governor
65. Nut (3)
66. Washer (3)
67. Packing
68. Fuel pump (single element)
69. Nut (3)
70. Washer (3)
71. Gasket
72. Packing
73. Packing
74. Filter element
75. Packing
76. Fuel control
77. Nut (3)
78. Washer (3)
79. Packing (2)
80. Plug
81. Packing
82. Spring
83. Clip
84. Filter assembly
85. Pin
86. Washer
87. Spring
88. Strainer
89. Sleeve
90. Not used
91. Fuel Nozzle

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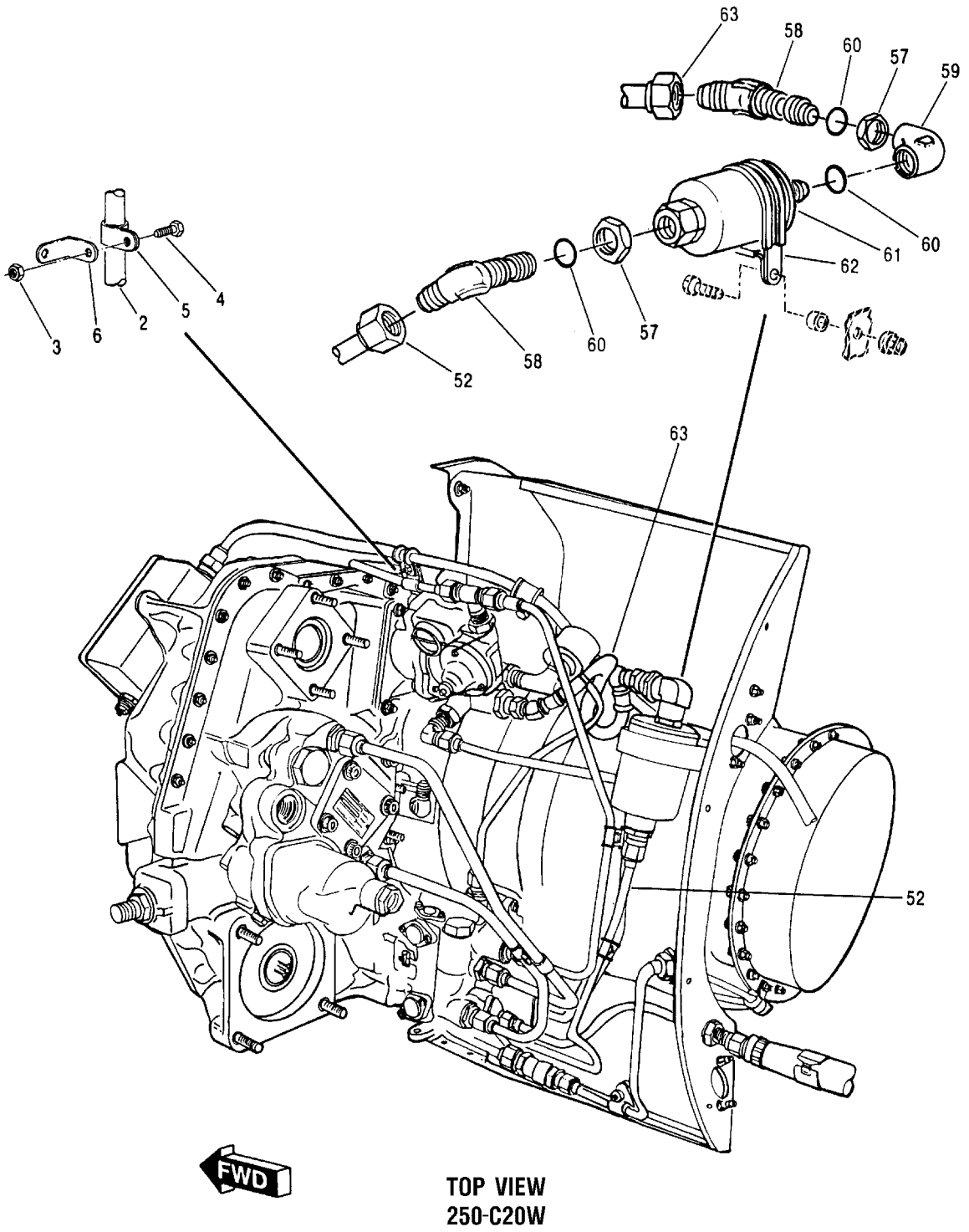
Bendix Fuel System Components 250–C20S, –C20W
Figure 203 (Sheet 1 of 3)

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Bendix Fuel System Components 250–C20S, –C20W
Figure 203 (Sheet 2 of 3)

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Bendix Fuel System Components 250–C20S, –C20W
Figure 203 (Sheet 3 of 3)

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2. Inspection/Check

A. Fuel Leakage Inspection

If evidence of fuel leakage is found during post-flight inspection of the fuel control, fuel pump, governor, fittings and/or tubing, proceed as follows:

(1) Isolate the source of leakage by immediately applying boost pump pressure to the system. Fuel leakage shall be limited to the following specific areas and quantities.

Unit or Area	Max. Leakage Rate Drops/min	cc/min
Seal drain of fuel control (CECO system only)	5	0.25
Seal drain of governor (CECO system only)	5	0.25
Seal drain of fuel pump (CECO or Bendix system)	20	1
Splitlines, tubes and fittings (CECO or Bendix system)	None	0

(2) If the fuel leak cannot be isolated using only boost pump pressure, make an engine start; then, carefully reinspect the engine compartment with the engine running. If necessary, reinspect immediately upon shutdown.

(3) Repair fuel leaks as follows:

(a) Tighten all component fittings and coupling nuts to the recommended torque. If leakage does not stop, replace the affected part.

(b) If leakage is isolated to the fuel control throttle shaft area, replace the throttle shaft packing (if authorized by CECO distributor or CECO representative). (Refer to M250-C20 CSL-1013.)

(c) If leakage is isolated to the governor throttle shaft area, replace the governor.

(d) After leakage repair has been accomplished, recheck the fuel system under boost pump pressure.

B. Fuel Control System Pneumatic Leak Check

If any fuel system pneumatic component (including piping) is removed/installed or any line is opened during maintenance of the control system, check the pneumatic portion of the fuel control system for leaks. Use the recommended method (1) or the alternative method (2) only if filtered air (10 micron) is not available as follows:

(1) Recommended method of checking for pneumatic leaks in the fuel system:

(a) Disconnect and remove the pressure sensing line between the scroll and the P_c filter. Hold the filter and loosen the coupling nut.

(b) Move the throttle to the full open position.

(c) Apply 50-80 psi (345-552 kPa) filtered air (10 micron) to the P_c filter. Air will immediately release from the pressure regulating air valve port on the power turbine governor.

(d) Use a liquid soap solution to check all fittings and lines in the system for leaks. Leakage is not permitted.

(e) Use a liquid soap solution to check cover and parting surfaces on the fuel control and governor. Cover and parting surfaces that produce small bubbles of the soap solution does not indicate a leak of sufficient quantity to warrant concern. These leaks were present during the initial calibration and were adjusted correctly at that time.

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(f) Decrease the pressure to 20-22 psi (138-152 kPa) and check the govornor diaphragm for leakage. No leakage is permitted. If leakage is found from the governor diaphragm, remove the safety wire from the screws, back off the screws and then tighten to 8-11 lb in. (0.9-1.2 N m). After 20 minutes retighten the screws to 8-11 lb in. (0.9-1.2 N m). If diaphragm continues to leak, replace governor.

(g) Return throttle to the closed position. Clean the soap solution from the engine after the check is completed.

(h) Reinstall P_c line. Tighten coupling nuts to 80-120 lb in. (9.0-13.6 N·m). Hold the P_c filter while tightening the coupling nut.

(2) Alternative methods for checking leaks in the fuel system (This alternative procedure must not be considered standard practice, but only used when filtered air (10 micron) is not available):

(a) Install removed components. Refer to the OMM for installation procedures and proper torque for all connections.

(b) Operate the engine at idle.

(c) Use a liquid soap solution to check all fittings and lines in the system for leaks. Leakage is not permitted.

(d) Use a liquid soap solution to check cover and parting surfaces on the fuel control and governor. Cover and parting surfaces that produce small bubbles of the soap solution does not indicate a leak of sufficient quantity to warrant concern. These leaks were present during the initial calibration and were adjusted correctly at that time.

(e) Return throttle to the closed position. Clean the soap solution from the engine after the check is completed.

(f) Operate the engine at maximum power to check for proper function of the fuel system components before the aircraft is returned for service.

C. Fuel System Filters

The filters which are maintained as a part of the engine assembly fuel system include: a fuel pump fuel filter, a gas producer fuel control fuel filter, and a fuel nozzle filter. In the Chandler Evans (CECO) control system there is also a high pressure fuel filter and a power turbine governor filter. In addition to the fuel filters, the Bendix control system has a fuel control P_c air filter and an engine (system) P_c filter which is bracket mounted to the gearbox.

CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. (REFER TO SPECIAL INSPECTIONS, TABLE 604, 72-00-00, ENGINE INSPECTION/CHECK FOR DETAILS.) CONTAMINATION FOUND IN THE FUEL NOZZLE FILTER WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN OVERHAUL/REPAIR FACILITY FOR INTERNAL CLEANING.

(1) Fuel Pump Filter (Sundstrand/Pesco and Argo-Tech/TRW pumps)

The fuel pump filter element is replaceable and has a 5 micron nominal/15 micron absolute rating. Replace the filter at intervals specified in Table 602, 72-00-00, Engine-Inspection/Check, unless an aircraft installed differential pressure warning system and/or operating experience dictate replacement at a lesser time interval.

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(2) Gas Producer Fuel Control Filter

The filter element in the fuel control is cleanable and has a rating of 64 microns. The filter shall be inspected for contamination and cleaned if required any time a fuel pump filter bypass is known or suspected to have taken place. (Refer to Cleaning the Gas Producer Fuel Control Fuel Filter, PARA 4.A., 73-20-02 or PARA 4.A., 73-20-03 for Bendix control or PARA 4.A., 73-20-04 for CECO control.)

(3) Fuel Nozzle Filter

The fuel nozzle filter should only be inspected and cleaned if a fuel filter bypass condition is known or suspected, or evidence of contamination found in the fuel pump and fuel control. (Refer to PARA 2., 73-10-03.) Contamination found in the fuel nozzle screen will require that the fuel control be sent to an Authorized Maintenance Center (AMC) for internal cleaning.

(4) High Pressure Fuel Filter (CECO control system)

A 5 micron nominal/15 micron absolute replaceable and cleanable fuel filter is located in the CECO fuel system between the fuel pump outlet and the fuel control inlet. (Refer to High Pressure Fuel Filter - Maintenance Practices, 73-10-05.)

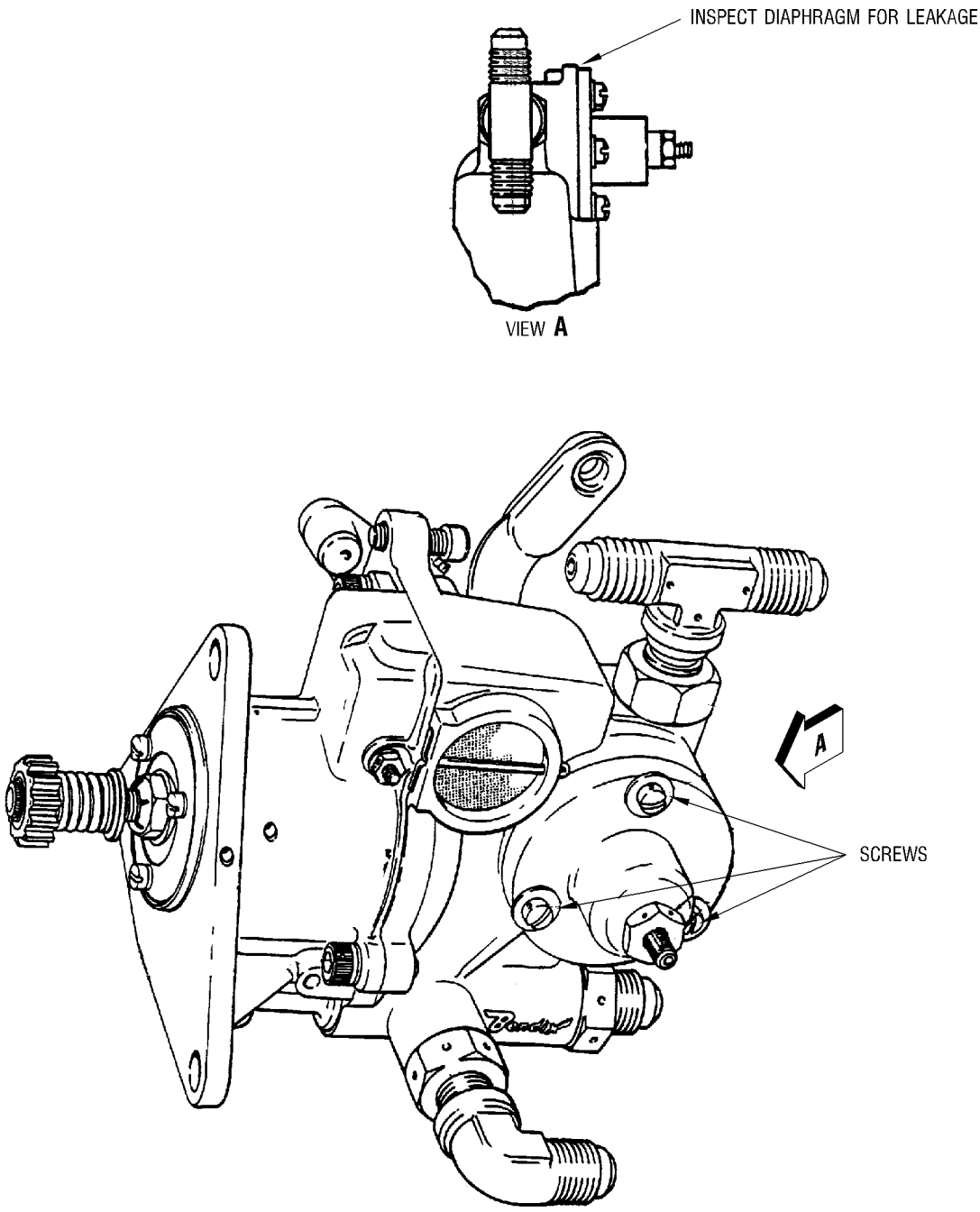
(5) Power Turbine Governor Filter

The CECO power turbine governor has a cleanable filter-fitting which has a rating of 220 micron. The filter shall be inspected for contamination and cleaned if required any time fuel pump filter bypass is known or suspected to have taken place. (Refer to the Chandler Evans Power Turbine Governor - Maintenance Practices, 73-20-04.)

(6) Engine (system) P_c Filter (Bendix control system)

The bracket mounted P_c filter shall be removed and cleaned when dictated by engine performance. (Refer to Table 101, 72-00-00, Engine-Troubleshooting and to P_c Filter-Maintenance Practices, Section 73-20-06.)

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Governor Diaphragm Leakage Inspection
Figure 204

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D. Purging the Fuel System

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(1) Maintenance of the fuel system can result in air entrapment in the fuel lines. To prevent subsequent false starts or flameouts, purge air from the fuel system whenever any of the following conditions are encountered:

WARNING: THE FUEL/AIR DISCHARGE DURING PURGING IS IRRITATING TO THE EYES AND HIGHLY FLAMMABLE. MECHANICS MUST TAKE SUITABLE MEASURES TO PROTECT THEIR EYES AND PREVENT FIRE.

WARNING: MAKE SURE THAT THE AIRCRAFT IS ADEQUATELY GROUNDED. (SEE AIRCRAFT MANUFACTURER'S INSTRUCTIONS FOR PROPER GROUNDING PROCEDURES.)

(a) The fuel filter element or the fuel pump assembly has been replaced.

(b) The fuel lines have been opened (anywhere between the fuel tank and the fuel nozzle).

(c) The engine has flamed out because of fuel exhaustion.

(d) The engine has been motored without fuel in the tank.

(e) The fuel pump fuel filter bowl has been drained without start or boost pumps on.

(f) The engine has been shut down using the emergency fuel shutoff valve.

(g) The fuel control is replaced on Bendix/Allied Signal/Honeywell systems.

(h) The fuel control or power turbine governor is replaced on Chandler Evans systems.

(i) Any symptom indicative of air being entrapped in the system is observed.

(2) Purge the Bendix fuel system as follows:

(a) Place a container under the aircraft to collect fuel drainage.

(b) Disconnect the fuel supply hose from the fuel nozzle. Be prepared to catch fuel from the fuel hose.

(c) Deactivate the ignition system.

(d) Open the firewall fuel valve.

(e) Turn on the boost pump(s)/start pump.

(f) Position the throttle to the 30° (Ground Idle) position.

(g) Motor the engine for approximately 15 sec or until there is no evidence of air coming from the fuel supply hose.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(h) Close the throttle and reconnect the fuel supply hose to the fuel nozzle. Tighten the coupling nut at the fuel nozzle to 80–120 lb in. (9.0–13.6 N·m).

(i) Turn off the boost pump(s)/start pump(s) and reactivate the ignition system.

(3) Purge the CECO fuel system as follows:

(a) Place a container under the aircraft to collect fuel drainage.

(b) Loosen the bypass tube at the governor bypass port (P_o). Cover the governor opening and the bypass tube open end with a rag to minimize fuel spray when the boost pumps(s) is started. (See Figure 205.)

(c) Disconnect the fuel line from the fuel nozzle. Be prepared to catch fuel from the fuel line.

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(d) Deactivate the ignition system.

(e) Open the fire wall fuel valve.

(f) Turn on the boost pump(s)/start pump.

(g) Position the throttle at full open.

(h) Allow fuel to flow from the governor port and the bypass line for 30 sec. If the fuel flow is without air (a solid stream), loosely install the bypass tube B-nut at the governor P_o port while the boost pump(s) remains in operation. If air is observed in the fuel flow, continue the bleed beyond the 30 sec until a solid stream of fuel is obtained.

NOTE: When loosely installing the bypass tube B-nut on the governor P_o port, contain the spray with a rag.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(i) With the fuel nozzle line still disconnected and the boost pump(s) still operating, motor the engine with the starter to purge air from the nozzle line. Allow fuel to flow from the line for 30 seconds. If fuel still contains air (not a solid stream) repeat the motoring steps as permitted by starter limitations. If fuel flow is without air, close the throttle, attach the fuel line to the fuel nozzle, and tighten the B-nut at the governor P_o port. Tighten P_o tube B-nut to 150-200 lb in. (17-23 N·m). Tighten coupling nut at the fuel nozzle to 80-120 lb in. (9.0-13.6 N·m).

(j) Turn off the boost pump(s) and reactivate the ignition system. Make a ground run as soon as possible.

NOTE: To prevent air in the fuel system, always start and operate the engine with the boost pump(s) operating.

Use the boost pump(s) to fill the system after component installation or after long idle periods.

E. Purging Air From Single Element Pump Filter Bowl (Sundstrand (Pesco) and Argo-Tech (TRW) Pumps)

WARNING: THE FUEL/AIR DISCHARGE DURING PURGING IS IRRITATING TO THE EYES AND HIGHLY FLAMMABLE. MAKE SURE TO PROTECT EYES AND PREVENT FIRE.

WARNING: MAKE SURE THAT THE AIRCRAFT IS ADEQUATELY GROUNDED (SEE AIRCRAFT MANUFACTURER'S INSTRUCTIONS FOR PROPER GROUNDING PROCEDURES.)

(1) Remove lockwire from the upper drain plug in the filter bowl cover.

(2) Deactivate the ignition system and place the gas producer lever in FUEL OFF.

(3) Turn on the aircraft boost pump.

(4) Loosen the upper drain plug (approx 1/2 turn) until a solid stream of fuel is emitted. Use a shop towel to catch the spray. Retighten the plug to 40-65 lb in. (4.5-7.3 N·m).

(5) Turn off the aircraft boost pump.

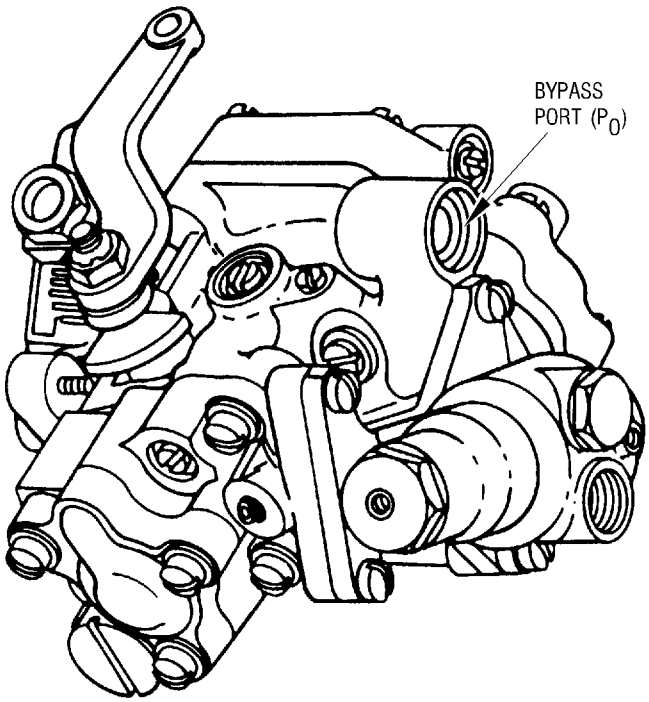
(6) Remove any fuel that may have spilled in the engine compartment.

(7) Secure the drain plug with lockwire.

(8) Purge the fuel system. (Refer to Purging the Bendix Fuel System, para 2.D.(2), this section or purging the CECO Fuel System, para 2.D.(3), this section.)

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CECO Power Turbine Governor P_o Port
Figure 205

F. Vacuum Check of Fuel System Lines and Components (Bendix fuel control system)

NOTE: The vacuum check is a troubleshooting procedure to detect engine or airframe fuel system leaks. (This procedure is a troubleshooting tool and not a mandatory inspection requirement).

The following vacuum check procedure is provided to check both the engine and airframe fuel system components to isolate the location of a possible leak in the fuel system. (Refer to the applicable airframe manual for additional information.)

NOTE: Figure 206 provides a flow diagram of the check procedure. Circled numbers on the flow diagram refer to procedural steps in this procedure.

(1) Verify at the aircraft fuel tank that the fuel selector valve is in the closed position.

NOTE: During the vacuum check procedure, it will be necessary to disconnect various fuel tubes. Prior to disconnecting any fuel tube, verify that the coupling nuts and fittings were tightened to the proper torque. If insufficient torque was applied, note how far the coupling nut or fitting rotates to reach the proper torque. Inspect the connection areas for damage or indications of misalignment, over-tightening, cracks, bends, grooves and fretting wear.

(2) Remove the upper drain plug from the rear of the engine fuel pump filter housing. Check the packing for damage. Connect a vacuum pump to the port. Ensure that the vacuum set-up includes a negative pressure gage (in. Hg) and a shutoff valve between the gage and pump. Apply 8 in. Hg vacuum and close the shutoff valve. Record gage reading after two minutes. If vacuum loss exceeds 1/2 in. Hg after the two minutes, proceed to the next step. If vacuum loss is 1/2 in. Hg or less, no further checks are required.

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(3) Disconnect the aircraft fuel line at the inlet to the engine fuel pump and cap the pump inlet port. Repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, the leakage is in the engine fuel system; proceed to next step. If vacuum loss is 1/2 in, Hg or less, the leakage is in the aircraft fuel supply system; proceed to step (12).

(4) Disconnect the bypass fuel line between the engine fuel control and the fuel pump. Install B-nut type caps on both the control and pump fittings. Repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, proceed to next step. If vacuum loss is 1/2 in. Hg or less, the leakage is in the bypass fuel line. Repair or replace parts as required, reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

(5) Disconnect the pressure fuel line between the fuel pump and the fuel control. Install a B-nut type cap on the fuel pump fitting. Repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, proceed to the next step. If vacuum loss is 1/2 in. Hg or less, proceed to step (10).

(6) Disconnect the impending filter bypass switch system at the AF and BF ports on the engine fuel pump. Cap or plug both ports. Repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, proceed to next step. If vacuum loss is 1/2 in. Hg or less, the leakage is in the filter bypass switch or its associated hoses. Refer to the applicable airframe manual and repair as required. Reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

(7) Inspect and check the two fuel bypass and pressure line fittings in the fuel pump and filter assembly as follows:

  (a) Remove the two fittings from the engine fuel pump and filter assembly.

  (b) Inspect the packings for damage or cuts.

  (c) Inspect the packing sealing surfaces for damage and repair or replace parts as required.

  (d) Reinstall the two capped fittings with new packings.

  (e) Repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, proceed to next step. If vacuum leakage is less than 1/2 in. Hg, reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

(8) Remove the lower drain valve on the rear of the engine fuel pump fuel filter housing. Inspect the packing for damage. Also, inspect the valve stem packing for damage. Install a plug and packing in the drain valve port and repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, proceed to next step. If vacuum loss is 1/2 in. Hg or less, the leakage is in the drain valve and/or packings. Replace parts as required, reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

(9) Inspect and check the engine fuel pump and filter assembly as follows:

  (a) Ensure that the filter housing was securely attached to the pump. Remove the housing and filter element. Inspect the large packing for damage or cuts. Inspect the packing sealing surfaces for damage and repair as required. Inspect inside the filter housing and pump housing for contamination and remove as required. Inspect the filter element (in the fuel-wetted state) for contamination and replace if required.

  (b) Reassemble the filter element and housing on the pump using a new packing on the housing.

  (c) Repeat the vacuum leakage check.

  (d) If vacuum loss exceeds 1/2 in. Hg, replace the fuel pump and filter assembly, reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

  (e) If vacuum loss is 1/2 in. Hg or less, reassemble the fuel system components and repeat step (3) to verify that the leak has been corrected.

(10) Connect the vacuum pump to the control inlet fuel fitting on the fuel control. Repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, proceed to the next step. If vacuum loss is 1/2 in. Hg or less, repair or replace the pressure fuel line, reassemble the engine fuel system components, and repeat step (3) to verify that the leak has been corrected.

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(11) Inspect and check the two fuel bypass and pressure line fittings in the fuel control as follows:

(a) Remove the two fittings from the engine fuel control.

(b) Inspect the packings for damage or cuts.

(c) Inspect the packing sealing surfaces for damage and repair or replace parts as required.

(d) Reinstall the two capped fittings with new packings. Be sure the bypass fitting is capped and the vacuum pump is reconnected to the pressure fitting.

(e) Repeat the vacuum leakage check.

(f) If vacuum loss exceeds 1/2 in. Hg, replace the fuel control, reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

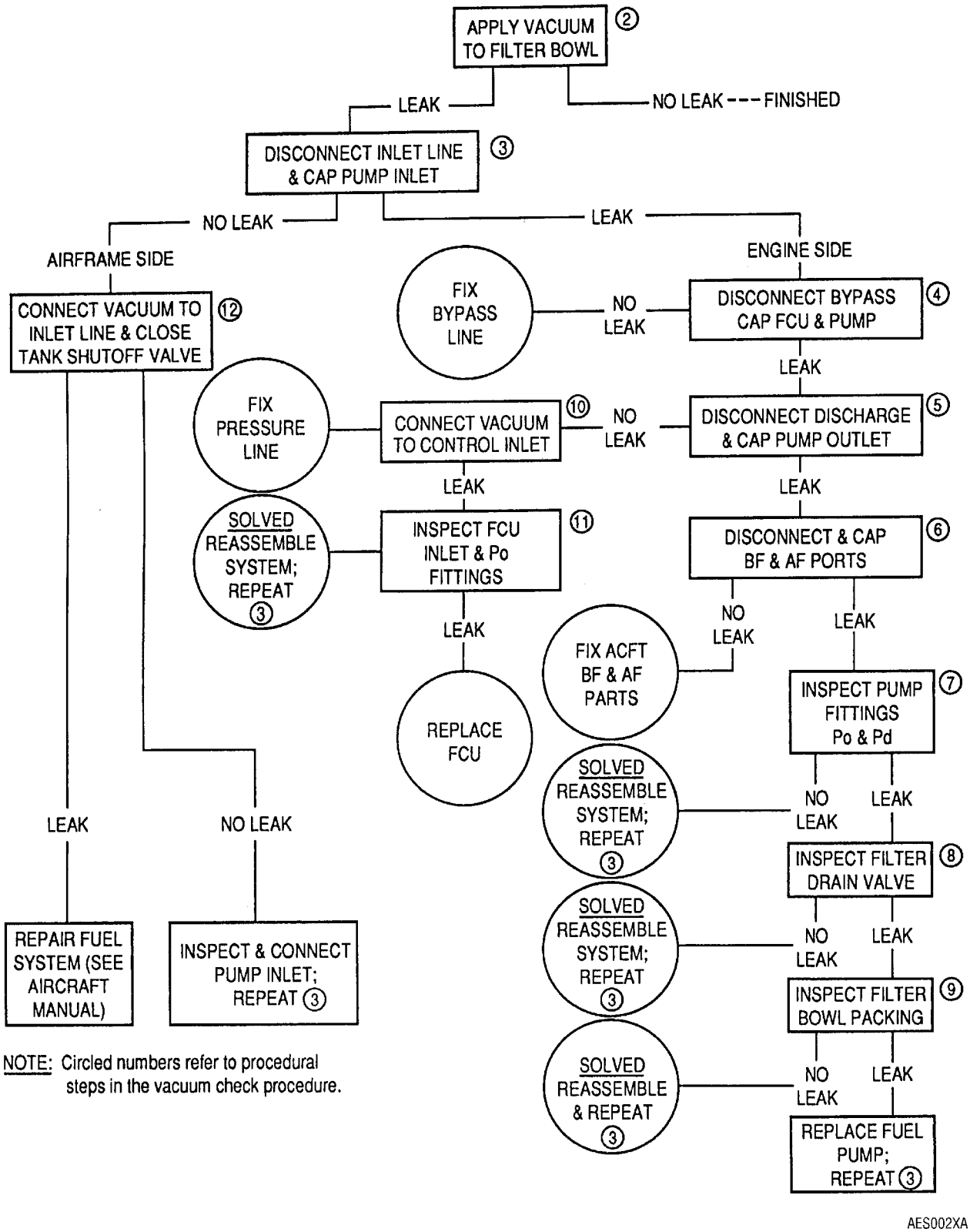
(g) If vacuum loss is 1/2 in. Hg or less, reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

(12) Connect the vacuum pump to the free end of the aircraft fuel line (the end that connects to the engine fuel pump). Apply 8 in. Hg vacuum and close the shutoff valve. Record gage reading after two minutes.

(a) If vacuum decreases, a leak in the aircraft fuel supply system is indicated. Check and repair the leak in accordance with the applicable airframe manual.

(b) If no leakage is detected, check the aircraft fuel line and the engine fuel pump inlet fitting. Repair or replace parts as required. Reconnect the aircraft fuel line to the inlet port of the engine fuel pump and filter assembly. Repeat step (3) to verify that the leak has been corrected.

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Bendix Fuel System Vacuum Check Flow Diagram
Figure 206

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IGNITION SYSTEM––MAINTENANCE PRACTICES

1. General

   A. Maintenance of the ignition system includes: (See Figure 201, 202 or 203.)

      (1) Replacing, cleaning and inspecting the spark igniter.

      (2) Replacing and inspecting the ignition exciter and spark igniter lead.

      (3) Making an ignition check.

      (4) Replacement of the start counter or the alternate of disconnecting it and manually tracking and recording starts.

   B. Ignition System Check

      WARNING: MAKE SURE THAT THE IGNITION SWITCH IS OFF BEFORE REMOVING THE SPARK IGNITER OR SPARK IGNITER LEAD ASSEMBLY AS DANGEROUSLY HIGH VOLTAGES MAY BE PRESENT. ALLOW FIVE MINUTES AFTER OPERATION FOR ELECTRICAL DISSIPATION BEFORE DISASSEMBLY.

      CAUTION: TURN THE LEAD NUT AND NOT THE SPARK IGNITER WHEN ASSEMBLING OR DISASSEMBLING A LEAD AND AN IGNITER WHICH IS NOT INSTALLED ON THE ENGINE.

      (1) Disconnect the spark igniter lead from the spark igniter.

      (2) Remove the spark igniter. (Refer to para 1., 74–20–01.)

      (3) Attach the spark igniter lead to the spark igniter.

      (4) Apply 28 volts dc across the ignition exciter. Observe or listen for spark.

      WARNING: TO PREVENT ELECTRICAL SHOCK DURING REMOVAL AND INSTALLATION OF THE SPARK IGNITER AND THE LEAD, ALLOW FIVE MINUTES FOR ELECTRICAL DISSIPATION FOLLOWING IGNITION OPERATION OR TEST.

      (5) When replacing and/or reinstalling a serviceable spark igniter, apply a light coat of antiseize compound (NS–165) to the threads.

      (6) Install spark igniter and spark igniter lead on the engine. Tighten the spark igniter to 150–200 lb in. (17–23 N·m) and lockwire to the fuel nozzle. Tighten the lead to 70–90 lb in. (7.9–10.2 N·m).

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Legend for Figure 201

1. Spark igniter lead
2. Spark igniter lead
3. Nut (4)
4. Bolt (2)
5. Bolt (2)
6. Bolt
7. Bolt (2)

7A. Bolt (2)

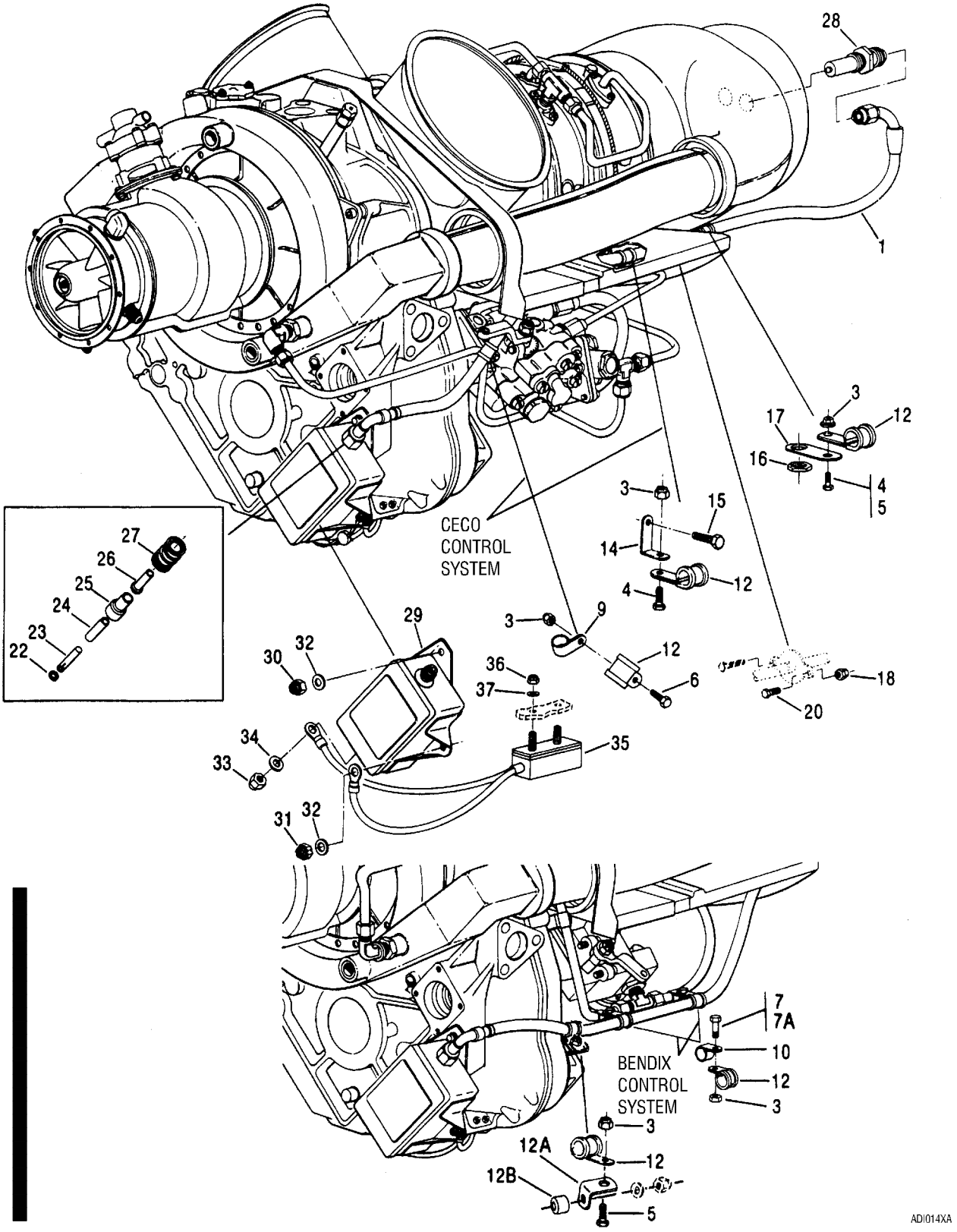
8. Bolt (3)
9. Clamp
10. Clamp (2)
11. Clamp (2)
12. Clamp (4)

12A. Bracket

12B. Spacer

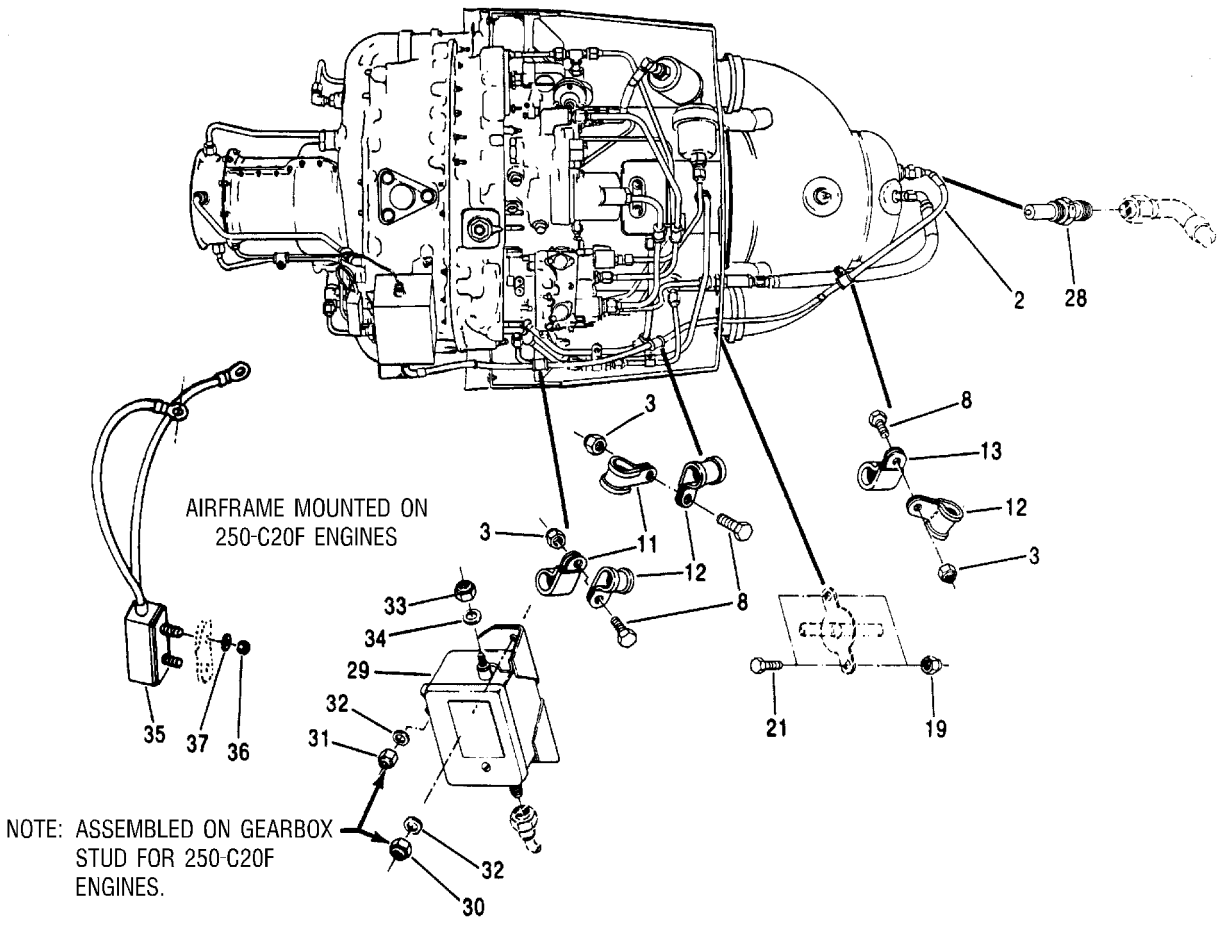
13. Clamp
14. Bracket
15. Bolt
16. Nut
17. Bracket
18. Nut
19. Nut (2)
20. Bolt
21. Screw (2)
22. Washer
23. Socket
24. Connector
25. Grommet
26. Grommet
27. Spring
28. Spark Igniter
29. Ignition exciter
30. Nut (2)
31. Nut
32. Washer (3)
33. Nut
34. Washer
35. Start counter
36. Nut (2)
37. Washer (2)

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Engine Electrical System Assembly (250–C20, –C20B, –C20F, –C20J)
Figure 201 (Sheet 1 of 2)

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250-C20F CONFIGURATION

AD1015XA

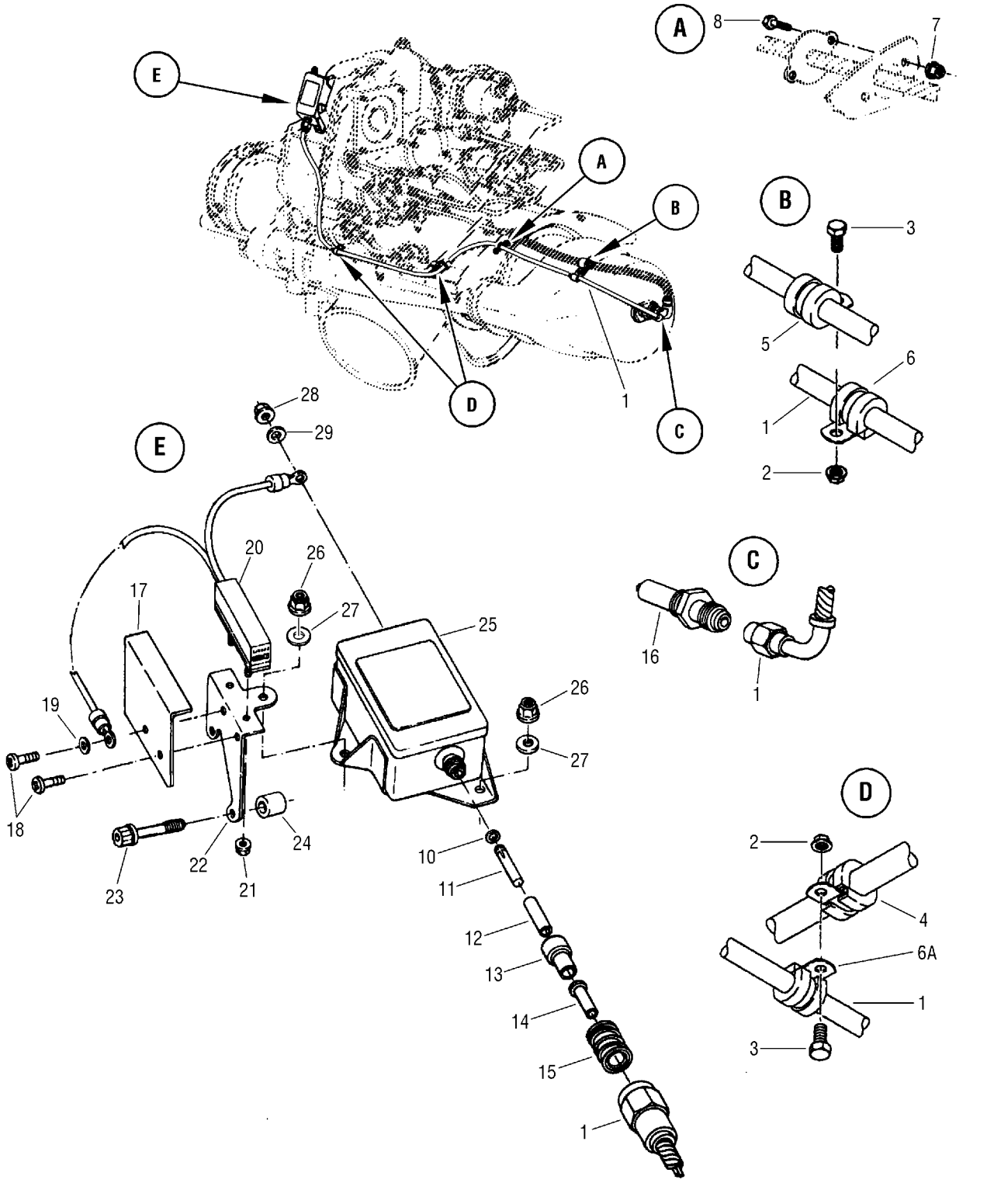
Engine Electrical System Assembly (250–C20, –C20B, –C20F, –C20J)
Figure 201 (Sheet 2 of 2)

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Legend for Figure 202

1. Spark igniter lead
2. Nut (3)
3. Bolt (3)
4. Clamp (2)
5. Clamp
6. Clamp
6A. Clamp(2)
7. Nut (2)
8. Bolt (2)
9. Not used
10. Washer
11. Socket
12. Connector
13. Grommet
14. Grommet
15. Spring
16. Spark Igniter
17. Protective bracket
18. Screw (2)
19. Washer
20. Start counter
21. Nut (2)
22. Bracket
23. Bolt (2)
24. Spacer (2)
25. Ignition exciter
26. Nut (3)
27. Washer (2)
28. Nut
29. Washer

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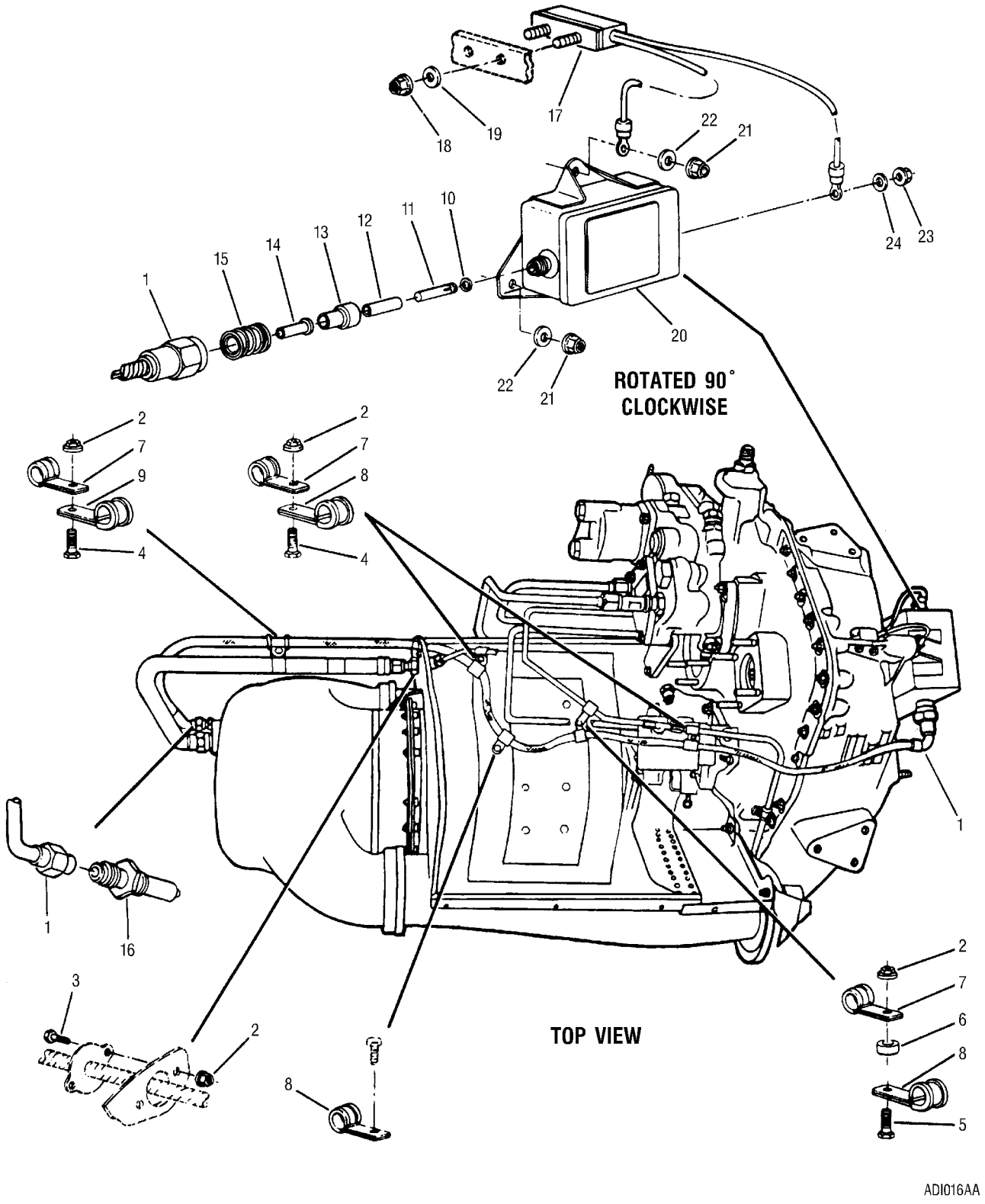
Engine Electrical System Assembly (250-C20S)
Figure 202

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Legend for Figure 203

1. Spark Igniter Lead
2. Nut (6)
3. Bolt (2)
4. Bolt (3)
5. Bolt
6. Spacer
7. Clamp (4)
8. Clamp (4)
9. Clamp
10. Washer
11. Socket
12. Connector
13. Grommet
14. Grommet
15. Spring
16. Spark Igniter
17. Start Counter
18. Nut (2)
19. Washer (2)
20. Ignition Exciter
21. Nut (3)
22. Washer (3)
23. Nut
24. Washer

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Engine Electrical System Assembly (250–C20W)
Figure 203

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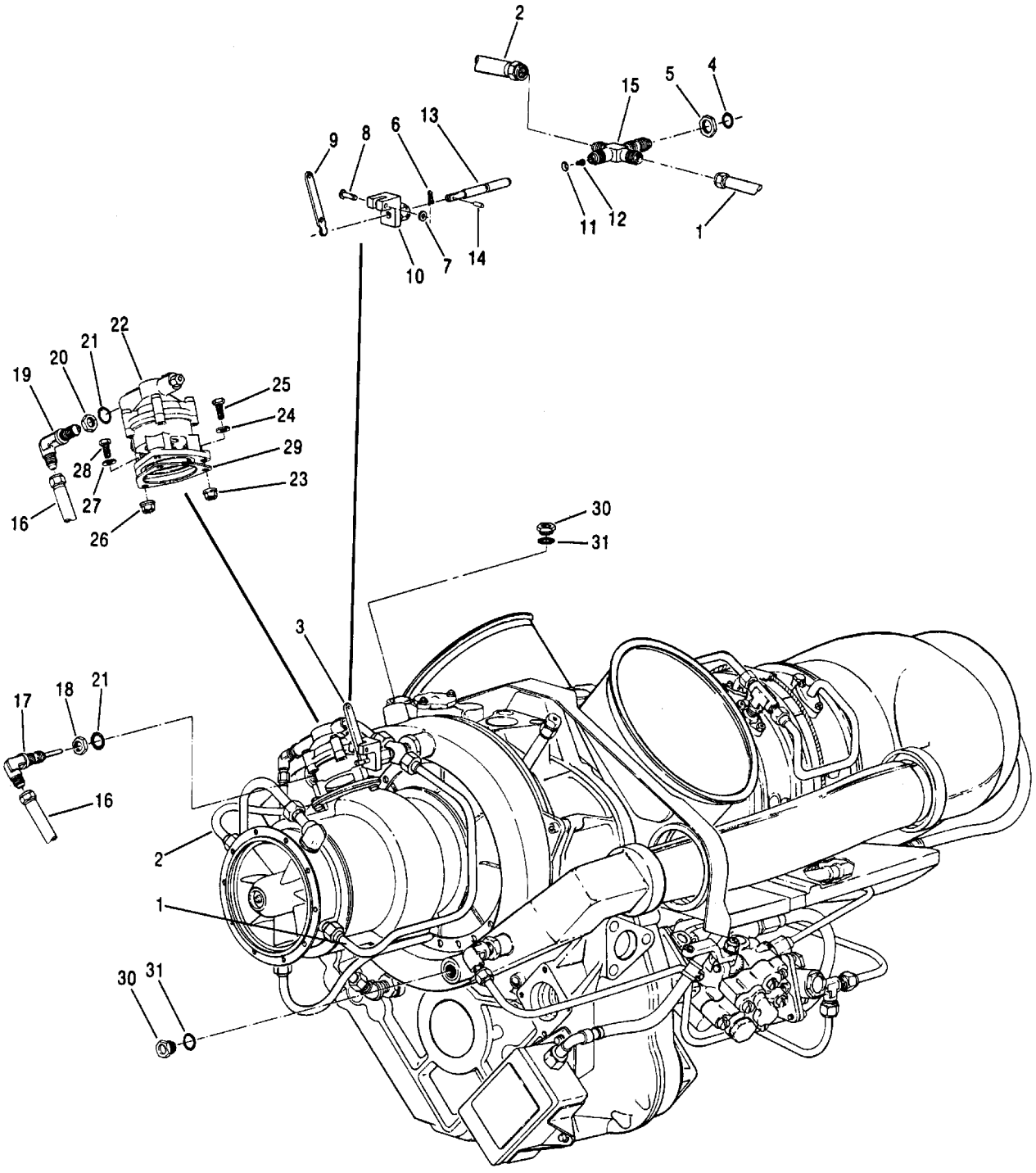
COMPRESSOR AIR SYSTEMS––MAINTENANCE PRACTICES

1. General

The compressor air systems include an anti–icing air system and a bleed air control system. (See Figures 201 and 202.)

Maintenance of the compressor air systems involves removing, inspecting, checking and installing the system components.

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Engine Air Systems (Anti–icing and Bleed Air)
(250–C20, –C20B, –C20F and –C20J)
Figure 201

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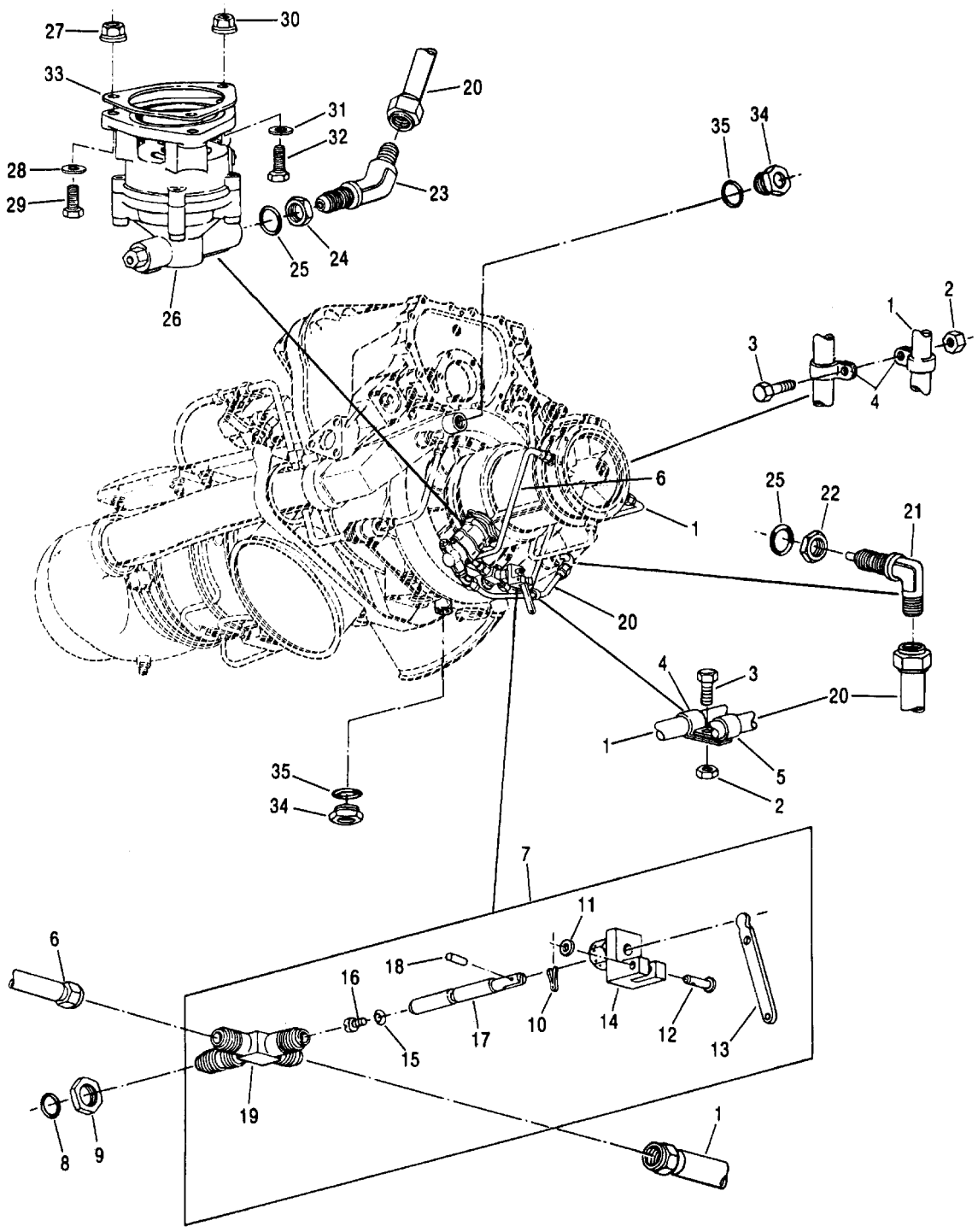
Legend for Figure 201

1. Anti–ice tube LH
2. Anti–ice tube RH
3. Anti–ice valve
4. Packing
5. Nut
6. Pin
7. Washer
8. Pin
9. Lever
10. Poppet guide
11. Poppet seat
12. Screw
13. Poppet assembly
14. Pin
15. Valve body
16. Air sensing tube
17. Pressure probe elbow
18. Nut
19. Elbow
20. Nut
21. Packing (2)
22. Bleed valve
23. Nut
24. Washer
25. Bolt
26. Nut (2)
27. Washer (2)
28. Bolt (2)
29. Gasket
30. Plug (2)
31. Packing (2)

Legend for Figure 202

1. LH anti–icing tube
2. Nut (2)
3. Bolt
4. Clamp (3)
5. Clamp
6. RH anti–icing tube
7. Anti–icing valve
8. Packing
9. Nut
10. Pin
11. Washer
12. Pin
13. Actuating Lever
14. Poppet guide
15. Poppet seat
16. Screw
17. Poppet
18. Pin
19. Body
20. Pressure sensing tube
21. Pressure probe elbow
22. Nut
23. Elbow
24. Nut
25. Packing
26. Bleed control valve
27. Nut
28. Washer
29. Bolt
30. Nut (2)
31. Washer (2)
32. Bolt (2)
33. Gasket
34. Plug (2)
35. Packing (2)

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Engine Air Systems (Anti–Icing and Bleed Air) (250–C20W)
Figure 202

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Operation and Maintenance Manual

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M250-C20B
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M250-C20J
M250-C20S
M250-C20W

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COMMERCIAL SERVICE INFORMATION

Commercial service information incorporated in whole, in part, or by reference in this operation and maintenance manual includes:

Commercial Service Letters	Date Incorporated
250–C20 CSL–1002	MAY 15/81
250–C20 CSL–1003	MAY 15/81
250–C20 CSL–1004	AUG 7/79
250–C20 CSL–1005	AUG 7/79
250–C20 CSL–1006	JAN 15/85
250–C20 CSL–1007 (ref. only)	MAR 20/74
250–C20 CSL–1011	DEC 1/95
250–C20 CSL–1012	DEC 1/95
250–C20 CSL–1013 (ref. only)	SEP 4/74
250–C20 CSL–1014	JAN 15/85
250–C20 CSL–1015	JAN 15/85
250–C20 CSL–1018	JAN 15/85
250–C20 CSL–1019	MAR 11/77
250–C20 CSL 1020	JAN 15/85
250–C20 CSL 1022	JAN 15/85
250–C20 CSL–1025	SEP 4/74
250–C20 CSL–1027	AUG 7/79
250–C20 CSL–1028	AUG 7/79
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250–C20 CSL–1030	JAN 15/93
250–C20 CSL–1031	SEP 4/74
250–C20 CSL–1032 (ref. only)	SEP 4/74
250–C20 CSL–1033	JUN 16/75
250–C20 CSL–1034 (ref. only)	JUL 9/80
250–C20 CSL–1035 (ref. only)	JUL 9/80
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250–C20 CSL–1047	MAR 11/77
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250–C20 CSL–1049	AUG 7/79
250–C20 CSL–1054	FEB 21/83

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250–C20 CSL–1083	JUL 9/80
250–C20 CSL–1084	AUG 7/79
250–C20 CSL–1088	JUL 9/80
250–C20 CSL–1089	JUL 9/80
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250–C20 CSL–1100	MAY 15/81
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INTRODUCTION

NOTE: Rolls-Royce technical publications, in whole or in part, cannot be utilized as a means to establish serviceability of material not manufactured or approved by Rolls-Royce. Rolls-Royce technical publications and documents are developed solely for use in support of applicable Rolls-Royce parts. Parts, materials, or processes not approved by Rolls-Royce were not considered in the development of Rolls-Royce technical publications due to Rolls-Royce not having knowledge of any specifications or design criteria for parts, overhaul or repair processes of parts or material not authorized by Rolls-Royce. Therefore, Rolls-Royce technical publications should not be used to support or maintain engines, modules, or parts using details, parts, materials, or processes that are not Rolls-Royce approved. Rolls-Royce disclaims any liability for the performance or the failure to perform of engines, modules or parts that have been maintained or supported using parts, materials, or processes not authorized by Rolls-Royce.

1. This publication provides descriptive information, operating instructions and maintenance information for the Rolls-Royce M250®-C20, -C20B, -C20F, -C20J, -C20S and -C20W turboshaft engines.

2. The engine consists of a compressor, a single combustion chamber, a two-stage gas producer turbine, and a two-stage power turbine which supplies the output power of the engine through the power and accessory gearbox.

3. The procedures and limits in this manual constitute the manufacturer's official recommendations for engine operation.

4. All information has been correlated with our Product Support and Engineering Groups for technical accuracy as of the published date on the title page.

5. Every task outlined in the Operation and Maintenance Manual has been successfully accomplished by organizations and individuals at the field maintenance level.

6. It is not expected that every organization or individual will possess the required special tooling, training, or experience to perform all tasks outlined. However, any task outlined herein may be performed if in the opinion of the organization or individual, the following conditions are met.

   A. Requisite knowledge of the task either through:

      (1) Formal instruction in a Rolls-Royce authorized training facility.

      (2) "On-the-job" instruction by a Rolls-Royce or Authorized Maintenance Center (AMC) representative.

      (3) Experience in performing the task.

   B. Suitable work environment to prevent contamination or damage to engine parts or modules.

   C. Suitable tools and fixtures as outlined in the Operation and Maintenance Manual.

   D. Reasonable and prudent maintenance practices are utilized.

   E. Requirements of the applicable regulatory authority regarding maintenance procedures are met.

7. Maintenance organizations and individuals are encouraged to contact Rolls-Royce through its worldwide AMC network for information and guidance on any of the tasks outlined herein. AMC directories are available from the Rolls-Royce customer support organization.

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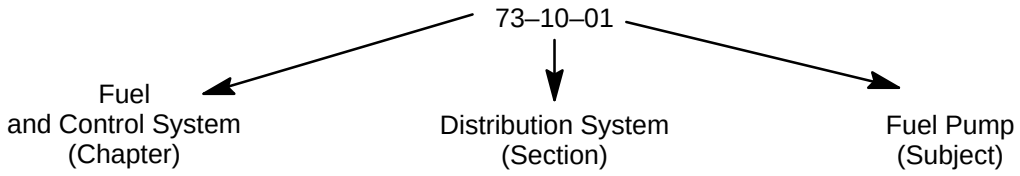
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HOW TO USE THE MANUAL

1. The 250–C20 Series Operation and Maintenance Manual format conforms to the Air Transport Association of America Specification for Manufacturer's Technical Data (ATA Specification No. 100).

2. The manual is divided into chapters, sections, and subjects. Each chapter is identified by a tab divider. The divider is followed by a chapter table of contents listing the sections and subjects in the chapter.

   A. The page number block is composed of three elements of two digits each. For example:



   B. A page numbering code identifies the type of information on any page by a page block system. These are the page blocks and the type of information they cover.

Pages 1 to 100	Description, Operation and General Information
Pages 101 to 200	Troubleshooting
Pages 201 to 300	Maintenance Practices (Includes general maintenance information, servicing, removal/installation, adjustment/test, inspection/check, cleaning/painting, and approved repairs)

   When topics become lengthy within Maintenance Practices the following page blocks are used.

Pages 201 to 300	General Maintenance Information
Pages 301 to 400	Servicing (Includes Preservation and Depreservation)
Pages 401 to 500	Removal/Installation
Pages 501 to 600	Adjustment/Test
Pages 601 to 700	Inspection/Check
Pages 701 to 800	Cleaning/Painting
Pages 801 to 900	Approved Repairs

   C. Each topic always begins with the first page number on the block: Description and Operation for any topic begins with page 1; Maintenance Practices always begins with page 201, and so on.

   D. A complete list of effective pages is behind the manual title page. This list is provided so that the recipient may check and make sure that no pages are missing. A new list of pages accompanies each revision.

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E. Both an alphabetical and numerical index of manual contents follow the list of pages.

F. A Commercial Service Information Listing follows the list of effective pages. This listing will numerically list all service letters, followed by the date the material was incorporated into the manual (in full or in part).

3. Two types of revisions will be published for the manual: temporary revisions and normal revisions.

A. Temporary revisions will be published to cover interim additions or changes rapidly. They will be printed on yellow paper and will supplement the basic text. Temporary revisions will be issued when required.

B. Normal revisions will be published on a periodic basis and will be printed on white paper. Normal revision pages will replace pages in the basic text and will supersede any previously published temporary revisions.

4. Definitions of terms used in the inspection tables are as follows:

A. Condition—This describes the type of wear or damage which may be found by inspection of the part involved.

B. Serviceable Limits—This is the maximum degree of a specified condition which can be accepted, allowing the part to be placed back into service without repair.

C. Disposition—This gives the recommended corrective action for a given condition; i.e., condition limits for scrapping a part or the preferred repair procedure for bringing a repairable condition within serviceable limits.

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WARNINGS

IMPORTANT SAFETY NOTICE

IT IS YOUR RESPONSIBILITY to be completely familiar with the warnings and cautions described in this manual. These warnings and cautions advise of specific operating and servicing methods that, if not observed, can cause a serious engine malfunction or cause the engine to lose power in flight which can result in loss of life, injury, or damage to equipment.

It is, however, important to understand that these warnings and cautions are not exhaustive. Rolls–Royce could not possibly know, evaluate and advise the user of all conceivable ways in which service might be done or of the possible hazardous consequences of each way. Consequently, Rolls–Royce has not undertaken any such broad evaluation.

Proper methods of operation, service, and repair are important to the safe, reliable operation of all equipment. The procedures recommended by Rolls–Royce and described in this manual are effective methods for performing these operations. Some of these service operations require the use of tools specially designed for the purpose. The special tools should be used when and as recommended. ROLLS–ROYCE STRONGLY RECOMMENDS THE PROCEDURES HEREIN SHOULD BE USED TO THE EXCLUSION OF OTHERS.

ANYONE WHO USES A SERVICE PROCEDURE OR TOOL WHICH IS NOT RECOMMENDED BY ROLLS–ROYCE MUST first be thoroughly satisfied that neither personal safety, the safety of the eventual engine user, nor the equipment will be jeopardized by the method selected. ANYONE USING PROCEDURES NOT RECOMMENDED BY ROLLS–ROYCE ASSUMES THE RISK OF ANY CONSEQUENCE THAT MIGHT OCCUR.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply in this manual.

WARNING: A PROCEDURE, PRACTICE, CONDITION, STATEMENT, ETC., WHICH IF NOT STRICTLY OBSERVED, COULD RESULT IN INJURY TO OR DEATH OF PERSONNEL.

CAUTION: A PROCEDURE, PRACTICE, CONDITION, STATEMENT, ETC., WHICH IF NOT STRICTLY OBSERVED, COULD RESULT IN DAMAGE TO, OR DESTRUCTION OF, EQUIPMENT. THIS COULD THEN POSSIBLE RESULT IN INJURY TO OR DEATH OF PERSONNEL.

NOTE: An essential procedure, condition, or statement, which must be highlighted.

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LIST OF WARNINGS

1. This manual contains the following warnings. It is your responsibility to be familiar with all of them.

OIL CONSUMPTION IN EXCESS OF 1 QUART IN 5 HOURS (0.05 GAL/HR, 0.19 LITER/HR) IS INDICATIVE OF SERIOUS INTERNAL LEAKAGE AND MUST NOT BE PERMITTED. INTERNAL OIL LEAKAGE CAN RESULT IN UNDETECTED INTERNAL OIL FIRES AND CAUSE DISASTROUS TURBINE FAILURES.

TO PREVENT ENGINE FUEL SYSTEM CONTAMINATION, WHICH COULD CAUSE ENGINE FLAMEOUT, AN EXTERNAL LOW PRESSURE FUEL FILTER SHOULD BE USED ON ANY AIRCRAFT REFUELING FROM REMOTE FUELING SITES (DRUMS ETC).

AT AMBIENT TEMPERATURES BELOW 4°C (40°F), SOME TYPE OF ANTI–ICE PROTECTION IS REQUIRED, SUCH AS AN ANTI–ICE ADDITIVE OR A MEANS OF AIRFRAME FUEL ICE ELIMINATION. ENGINE FLAMEOUT COULD RESULT FROM FAILURE TO USE ANTI–ICE PROTECTION. (REFER TO THE AIRCRAFT MANUAL FOR THEIR REQUIREMENTS.

MIXING OF OILS WITHIN AN OIL SERIES NOT IN THE SAME GROUP IS PERMITTED ONLY IN AN EMERGENCY. USE OF MIXED OILS (OILS NOT IN THE SAME GROUP) IN AN ENGINE IS LIMITED TO FIVE HOURS TOTAL RUNNING TIME. ADEQUATE MAINTENANCE RECORDS MUST BE MAINTAINED TO ENSURE THAT THE FIVE HOUR LIMIT IS NOT EXCEEDED. MIXING OF OILS FROM DIFFERENT SERIES IS NOT PERMITTED.

FAILURE TO COMPLY WITH OIL MIXING RESTRICTIONS CAN RESULT IN ENGINE FAILURE.

THE PRIMARY APPLICATION OF THE TURBOSHAFT ENGINE IS TO POWER A HELICOPTER OR ROTORCRAFT. A HEIGHT–VELOCITY DIAGRAM, AS REQUIRED BY REGULATION AND PREPARED BY THE AIRFRAME MANUFACTURER, IS PUBLISHED IN THE AIRCRAFT FLIGHT MANUAL PERFORMANCE SECTION. THE OPERATOR MUST BECOME FAMILIAR WITH THIS DIAGRAM TO DETERMINE WHAT ALTITUDES AND AIRSPEEDS ARE REQUIRED TO SAFELY MAKE AN AUTOROTATIONAL LANDING IN CASE OF POWER LOSS OR ENGINE FAILURE. THE ALTITUDE–AIRSPEED COMBINATIONS WHERE A SAFE AUTOROTATIONAL LANDING MAY NOT BE POSSIBLE ARE REPRESENTED BY THE SHADED OR CROSS–HATCHED AREA OF THE DIAGRAM.

SNOW OR ICE SLUGS CAN CAUSE THE ENGINE TO FLAME OUT. BE SURE AVAILABLE PREVENTIVE EQUIPMENT IS INSTALLED AND IN PROPER WORKING ORDER WHEN FLYING IN CONDITIONS WHERE SNOW OR ICE BUILDUP MIGHT OCCUR.

CONSULT THE AIRCRAFT FLIGHT MANUAL FOR REQUIRED EQUIPMENT AND PROCEDURES FOR FLIGHT IN FALLING/BLOWING SNOW.

SAND AND DUST WILL ERODE COMPRESSOR VANES AND CAUSE THEM TO FAIL.

SALT LADEN HUMIDITY AND CHEMICALS WILL CORRODE COMPRESSOR BLADES AND VANES AND CAUSE THEM TO FAIL.

TO PREVENT SERIOUS ENGINE MALFUNCTION OR CRUCIAL LOSS OF POWER, DO NOT OPERATE THE ENGINE IN EXCESS OF ANY SPECIFIED LIMIT.

HOT STARTS OR AFTERFIRES AFTER SHUTDOWN WILL CAUSE TURBINE BLADE AND WHEEL DAMAGE WHICH CAN RESULT IN ENGINE FAILURE.

TO PREVENT ENGINE FUEL STARVATION AND SUBSEQUENT FLAME–OUT, ANY AIRCRAFT REQUIRING FUEL BOOST PUMP(S) SHOULD USE THESE PUMPS AT ALL TIMES DURING FLIGHT OR AS DIRECTED IN THE AIRCRAFT FLIGHT MANUAL.

TO PREVENT CRUCIAL DELAY IN REGAINING POWER IF AN ENGINE FLAMEOUT IS ENCOUNTERED, AIRCRAFT EQUIPPED WITH AN AUTO–RELIGHT SYSTEM SHOULD KEEP THAT SYSTEM ACTIVATED AT ALL TIMES WHILE THE AIRCRAFT IS IN FLIGHT.

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LIST OF WARNINGS (cont)

TO MAKE SURE OF ADEQUATE WARNING OF POSSIBLE EMERGENCY ENGINE OPERATING CONDITIONS, VERIFY THAT THE ENGINE WARNING SYSTEMS (ENGINE–OUT HORN, FILTER BYPASS LIGHT AND CHIP DETECTOR LIGHT) ARE OPERABLE BEFORE EACH FLIGHT.

OVERTEMPERATURE STARTS OR AFTERFIRES AFTER SHUTDOWN WILL CAUSE CRACKS IN THE TURBINE FIRST–STAGE WHEEL RIM. THESE CRACKS CAN EVENTUALLY CAUSE A SECTION OF THE WHEEL TO BREAK OFF CAUSING TURBINE IMBALANCE AND ENGINE FAILURE.

IDLE DWELL TIME PRIOR TO SHUTDOWN IS IMPORTANT TO PREVENT HARMFUL ACCUMULATION OF CARBON IN THE ENGINE WHICH CAN RESULT IN ENGINE FAILURE.

MAINTAIN THE COMPLETE OIL SYSTEM IN ACCORDANCE WITH ENGINE AND AIRCRAFT INSTRUCTIONS. FAILURE TO MAINTAIN THE OIL SYSTEM CAN RESULT IN SUDDEN ENGINE STOPPAGE.

HANDLING LEAD RESIDUE COATED PARTS BY PERSONS WITH OPEN CUTS OR SCRATCHES ON THEIR HANDS CAN BE EXTREMELY DANGEROUS. ALWAYS WEAR GLOVES WHEN CHECKING RESIDUE COATED TURBINE OR EXHAUST PARTS.

DO NOT BURN DISCARDED TEFLON SEALS. TOXIC GASES WILL BE PRODUCED.

AN ENGINE WHICH HAS BEEN OPERATED ON LEADED FUEL HAS A PALE YELLOW POWDER RESIDUE ON THE EXHAUST PASSAGES. HANDLING LEAD RESIDUE COATED PARTS BY PERSONS WITH OPEN CUTS OR SCRATCHES ON THEIR HANDS CAN BE EXTREMELY DANGEROUS. ALWAYS WEAR GLOVES WHEN HANDLING RESIDUE COATED PARTS.

BE CAREFUL OF THE POTENTIAL FIRE HAZARD OF FUEL IN AN OPEN CONTAINER.

DO NOT EXCEED SPECIFIED AIRCRAFT OR ENGINE LIMITATIONS DURING PERFORMANCE OF A TREND CHECK.

DO NOT TURN OFF SYSTEMS OR COMPONENTS REQUIRED FOR SAFE FLIGHT. IF ANTI–ICE IS FREQUENTLY REQUIRED FOR SAFE FLIGHT, IT SHOULD BE OPERATED DURING EACH TREND CHECK.

PROPER TIGHTENING OF ENGINE TUBING CONNECTIONS IS CRITICAL TO FLIGHT SAFETY. CORRECT TORQUE VALUES MUST BE USED AT ALL TIMES. EXCESSIVE TORQUE ON PNEUMATIC SENSING SYSTEM CONNECTIONS RESULTS IN CRACKING OF THE FLARE OR ADJACENT TUBE AREA IN CONTACT WITH THE FERRULE. THIS PRODUCES AN AIR LEAK WHICH CAN CAUSE FLAMEOUT, POWER LOSS, OR OVERSPEED.

TORQUE PAINT (SLIPPAGE MARKS) SHALL BE APPLIED TO ALL RIGID TUBE B–NUTS IN ACCORDANCE WITH RIGID TUBE INSTALLATION PROCEDURES IN SECTION II. TORQUE PAINT SHALL BE REMOVED AND REAPPLIED ANYTIME THE B–NUT IS RETIGHTENED.

TUBING B–NUTS USED IN INSTALLATIONS EXPOSED TO A HIGH DEGREE OF VIBRATION AND PRESSURE SURGES ARE SUBJECT TO TORQUE RELAXATION WHEN IMPROPERLY TIGHTENED.

USE ACCEPTABLE TECHNIQUES AND PRACTICES TO PREVENT TORQUE PAINT OR TORQUE PAINT REMOVER FROM CONTACTING RUBBER OR PLASTIC MATERIALS OR ENTERING EXPOSED AREAS.

MAINTAIN THE COMPLETE OIL SYSTEM IN ACCORDANCE WITH ENGINE AND AIRCRAFT INSTRUCTIONS. FAILURE TO MAINTAIN THE OIL SYSTEM CAN RESULT IN SUDDEN ENGINE STOPPAGE.

IF A MAGNETIC PLUG WARNING LIGHT COMES ON DURING FLIGHT, LAND AND INSPECT THE MAGNETIC PLUGS AS SOON AS POSSIBLE. THIS LIGHT IS AN INDICATION OF CONDITIONS WHICH COULD CAUSE ENGINE FAILURE. WHEN FLYING A MULTI–ENGINE AIRCRAFT, REDUCE THE AFFECTED ENGINE OUTPUT POWER TO THE MINIMUM REQUIRED FOR FLIGHT AND LAND AS SOON AS PRACTICABLE. IF THE LIGHT IS ACCOMPANIED BY ABNORMAL NOISES, OIL PRESSURE OR TEMPERATURE, AND SINGLE–ENGINE FLIGHT CAN BE MAINTAINED, SHUT DOWN AFFECTED ENGINE AND LAND AS SOON AS PRACTICABLE. IF SINGLE–ENGINE FLIGHT IS NOT POSSIBLE, REDUCE POWER OF AFFECTED ENGINE TO THE MINIMUM AND LAND AS SOON AS POSSIBLE. AFTER LANDING, INSPECT THE MAGNETIC PLUGS ON THE AFFECTED ENGINE FOR THE METAL CONTAMINATION PRIOR TO FURTHER ENGINE OPERATION.

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LIST OF WARNINGS (cont)

OPERATORS MUST MAINTAIN THE ENGINE MAGNETIC DRAIN PLUGS AND INDICATING SYSTEM IN OPERATING ORDER AND COMPLY WITH AIRCRAFT FLIGHT MANUAL AND ENGINE OPERATION AND MAINTENANCE MANUAL INSTRUCTIONS WHEN AN INDICATION IS RECEIVED. NEVER ALLOW AN ACCEPTABLE SPECTROGRAPHIC OIL ANALYSIS PROGRAM (SOAP) READING TO OVERRIDE MAGNETIC DRAIN PLUG INDICATIONS.

FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

MINERAL SPIRITS IS TOXIC. PROVIDE ADEQUATE VENTILATION FOR PERSONNEL USING IT.

FAILURE TO PROPERLY SHIM THE COMPRESSOR AT INSTALLATION CAN CAUSE THE SPUR ADAPTER GEARSHAFT TO FAIL RESULTING IN SUDDEN ENGINE STOPPAGE.

CORROSION OR EROSION WILL CAUSE DAMAGE TO COMPRESSOR BLADES AND VANES WHICH CAN RESULT IN ENGINE FAILURE.

MAKE SURE THAT THE IGNITION SWITCH IS OFF BEFORE REMOVING THE SPARK IGNITER OR SPARK IGNITER LEAD ASSEMBLY, AS DANGEROUS HIGH VOLTAGES MAY BE PRESENT. ALLOW FIVE MINUTES AFTER OPERATION FOR ELECTRICAL DISSIPATION BEFORE DISASSEMBLY.

AIR LEAKAGE ACROSS THE E–RING SEAL WILL RESULT IN PRESSURIZATION OF THE NUMBER 8 BEARING SUMP. PRESSURIZATION OF THE NUMBER 8 SUMP WILL CAUSE A FLOW REVERSAL ACROSS THE NUMBER 8 LABYRINTH SEAL. THIS LEAKAGE CAN RESULT IN AN ENGINE FIRE AND SUBSEQUENT TURBINE WHEEL RIM FAILURE.

WATER OR CONTAMINATION IN THE FUEL CAN CAUSE FLAMEOUT OR POWER LOSS.

AIR LEAKS IN THE FUEL SYSTEM OR THE PNEUMATIC SENSING SYSTEM CAN CAUSE FLAMEOUTS, POWER LOSS OR OVERSPEED.

THE FUEL/AIR DISCHARGE DURING PURGING IS IRRITATING TO THE EYES AND HIGHLY FLAMMABLE. MECHANICS MUST TAKE SUITABLE MEASURES TO PROTECT THEIR EYES AND PREVENT FIRE.

THE FUEL/AIR DISCHARGE DURING THIS CHECK IS IRRITATING TO THE EYES AND HIGHLY FLAMMABLE. TAKE SUITABLE MEASURES TO PROTECT EYES AND PREVENT FIRE.

MAKE SURE THAT THE AIRCRAFT IS ADEQUATELY GROUNDED WHEN PURGING THE FUEL SYSTEM. (SEE AIRCRAFT MANUFACTURER'S INSTRUCTIONS FOR PROPER GROUNDING PROCEDURES.)

AVOID FUEL ACCUMULATION IN THE ENGINE COMPARTMENT BY PROVIDING A SUITABLE CONTAINER TO COLLECT FUEL DISCHARGED FROM THE TYGON TUBE ATTACHED TO THE AF PRESSURE PORT.

SULPHURIC ACID CAUSES SEVERE BURNS. DO NOT GET IN EYES, ON SKIN, OR ON CLOTHING. DO NOT ADD WATER TO ACID WHILE IN A CONTAINER BECAUSE OF VIOLENT REACTION. IN THE EVENT OF CONTACT WITH SULPHURIC ACID, IMMEDIATELY FLOOD EXPOSED SKIN OR CLOTHING WITH WATER. FOR EYES, FLUSH HEAVILY WITH WATER AND OBTAIN IMMEDIATE MEDICAL ATTENTION.

PERCHLORETHYLENE IS TOXIC AND MUST BE USED WITH EXTREME CAUTION. MAKE SURE ADEQUATE VENTILATION IS PRoVIDED. REPEATED OR PROLONGED CONTACT WITH THE SKIN SHOULD BE AVOIDED.

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LIST OF WARNINGS (cont)

DURING THE ACCELERATION CHECK, THE AIRCRAFT MAY REACT OR BECOME LIGHT ON ITS SKIDS. DO NOT SNAP THE TWIST GRIP TO THE FULL THROTTLE POSITION.

FAILURE TO PROPERLY REMOVE OR INSTALL PC AIR LINES MAY DAMAGE LINES, FITTINGS, AND/OR FILTER ASSEMBLY WHICH CAN RESULT IN SUDDEN UNINTENDED ENGINE POWER LOSS.

SODIUM HYDROXIDE CAN CAUSE SEVERE BURNS. DO NOT GET IN EYES, ON SKIN OR ON CLOTHING. IN THE EVENT OF CONTACT WITH SODIUM HYDROXIDE, IMMEDIATELY FLOOD EXPOSED SKIN OR CLOTHING WITH WATER. FOR EYES, FLUSH HEAVILY WITH WATER AND OBTAIN IMMEDIATE MEDICAL ATTENTION.

POTASSIUM PERMANGANATE CAN BE VERY DANGEROUS IF IMPROPERLY HANDLED. CONTACT WITH ORGANIC MATERIALS (OIL, GREASE) CAN CAUSE FIRE.

PERCHLORETHYLENE IS TOXIC AND MUST BE USED WITH EXTREME CAUTION. MAKE SURE ADEQUATE VENTILATION IS PROVIDED. REPEATED OR PROLONGED CONTACT WITH THE SKIN SHOULD BE AVOIDED.

TO PREVENT ELECTRICAL SHOCK DURING INSTALLATION OF THE SPARK IGNITER AND THE LEAD, ALLOW FIVE MINUTES FOR ELECTRICAL DISSIPATION FOLLOWING IGNITION OPERATION OR TEST.

ANTI–ICING AIR IS HOT ENOUGH TO CAUSE SEVERE BURNS. DO NOT CHECK AIR FLOW BY FEEL.

FAILURE OF A COMPRESSOR BLADE OR VANE CAN CAUSE RUBBING CONTACT BETWEEN THE TIPS OF THE FIRST– AND SECOND–STAGE TURBINE BLADES AND THE SECOND–STAGE TURBINE NOZZLE OUTER RING. THIS RUBBING CONTACT MAY INDUCE STRESSES IN THE BLADES WHICH CAN CONTRIBUTE TO A FATIGUE FAILURE OF THE BLADES IF THE TURBINE WHEEL IS RETURNED TO SERVICE. TO PRECLUDE THIS POSSIBILITY OF SUBSEQUENT TURBINE BLADE FAILURE, FIRST– AND SECOND–STAGE TURBINE WHEELS WHICH HAVE BEEN OPERATED IN ENGINES THAT HAVE EXPERIENCED A COMPRESSOR BLADE AND/OR VANE FAILURE SHALL BE REMOVED FROM SERVICE IF THE TIPS OF ANY OF THE BLADES OF THESE WHEELS SHOW EVIDENCE OF RUBBING CONTACT.

IT IS VERY IMPORTANT THAT THE ENTIRE AIRCRAFT AND ENGINE FUEL SYSTEM BE MAINTAINED TO THE HIGHEST STANDARDS OF CLEANLINESS. ROLLS–ROYCE HAS CONDUCTED TESTING OF APPLE JELLY TYPE CONTAMINATION WHICH SHOWS IT BEHAVES DIFFERENTLY THAN A SOLID CONTAMINANT. IT CAN PASS THROUGH VARIOUS AIRFRAME AND ENGINE FUEL FILTERS UNDETECTED WITHOUT ACTUATING THE IMPENDING BYPASS INDICATOR, AND IT CAN CAUSE PARTIAL OR COMPLETE BLOCKAGE OF THE FUEL NOZZLE SCREEN RESULTING IN REDUCED ENGINE PERFORMANCE OR FLAMEOUT. SHOULD THIS GEL–LIKE MATERIAL BE DETECTED AT ANY POINT IN THE AIRCRAFT OR ENGINE FUEL SYSTEM, THE ENTIRE AIRFRAME AND ENGINE FUEL SYSTEM SHOULD BE INSPECTED.

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Rolls-Royce

Operation and Maintenance Manual

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250–C20B
250–C20F
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Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
3rd–stage Wheel (cont)	6899417	Center slot scalloped and crimped. Machined web. Has 7–11 seals	(1)	6000
	6899418	Center slot scalloped and crimped. Machined web. Less 7–11 seals.	(1)	6000
	6899419	Center slot scalloped and crimped. Machined web. Less 7–11 seals	(1)	6000
	23001967	Solid shroud less 7–11 seals	4550	6000
	23065818	Slotted shroud – improved design	4550	6000
	23065833	Slotted shroud – improved design	4550	6000

NOTE: P/N 23065833 turbine wheels are not to be installed on C20W engines.

Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
4th–stage Wheel	6853279	Original	4550	6000
	6891594	Machined web	4550	6000
	23055944	Improved design	4550	6000

(1) The 3rd–stage turbine wheels are to be removed from service in accordance with a phase–down schedule published in 250–C20 CEB A–1174.

WARNING: IT IS NOT ALLOWED TO INSTALL A TURBINE WHEEL WITH ACCEPTABLE WHEEL RIM CRACKS IN ANY ENGINE/TURBINE DURING OVERHAUL. ACCEPTABLY CRACKED TURBINE WHEELS MAY BE REINSTALLED ONLY DURING A TIME CONTINUED ENGINE/TURBINE REPAIR.

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Table 14

Accessories Recommended Time Between Overhauls (Hours)
(250–C20, –C20B, –C20F, –C20J, –C20W)

Component	Recommended TBO Hours
Fuel Pump	
Sundstrand (PESCO) Dual Element	1500(1)
Sundstrand (PESCO) Dual Element	2250(2)
Sundstrand (PESCO) Single Element	2250(3)
ARGO–TECH/TRW – P/N 386500–5 (Rolls–Royce Allison P/N 6899253)	4000
P/N 386500–1, –2, –3, –4	3500
Chandler Evans (CECO) – P/N 113300–01A1 (Rolls–Royce Allison P/N 23057338)	3500
– P/N 113300–02A1 (Rolls–Royce Allison P/N 23065132)	3500
– P/N 113300–03A1 (Rolls–Royce Allison P/N) 23070459)	3500
Fuel Control (CECO)(4)	
P/N 104000A8 and subsequent	4000
P/N 104900A3 and subsequent	4000
All part numbers prior to above	1000
Power Turbine Governor (CECO)(4)	
P/N 104100A12 and subsequent	4000
P/N 104500A7 (multi–engine) and subsequent	4000
P/N 104100A6 through A11	2000
P/N 104500A1 through A6 (multi–engine)	2000
All P/N prior to 104100A6	1000
Fuel Control (Bendix) (250–C20, –C20B, –C20F, –C20J, –C20W)	2500
(250–C20S)	2000
Power Turbine Governor (Bendix)	1500

NOTE: The TBO period on the following Bendix governors has been extended to 2000 hours. All governors that precede these part numbers must remain at 1500 hours.

Allison P/N	Bendix P/N
23005493	2524769–7 and subsequent
23005492	2524667–8 and subsequent
23036657	2549025–1 and subsequent
23036658	2549026–1 and subsequent

Fuel Nozzle	
P/N 6890917	2500
P/N 6874959	1500
Bleed Valve	1500

NOTE: Contact your Authorized Maintenance Center for extension of the TBO on eligible selected accessories.

Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
15 (cont)	Idle speed too high (cont)	Gas producer fuel control idle adjustment incorrectly set	Correct the setting. (Refer to Idle Speed Setting, para 3.F., 73–20–02; 3.C., 73–20–03 or 3.E., 73–20–04.)
16	Oil pressure drops off severely	Oil supply low	Check oil supply and refill as necessary.
		Oil pressure transmitter or indicator giving false indication	Check transmitter or indicator and repair or replace if necessary.
		Regulator valve sticking or broken spring	Clean or replace spring.
		Defective oil pump	Replace pump or send power and accessories gearbox to an overhaul facility. (Refer to applicable part of Gearbox Disassembly and Assembly, para 2., 72–60–00.)
17	Engine operated more than 30 seconds without oil pressure.	Low oil quantity.	Remove engine and send to Allison Authorized Maintenance Center (AMC) for investigation (Refer to Engine Operated With No Oil Pressure, para 11.E., Engine–Servicing, 72–00–00.)
		Improper servicing after oil change.	Same as above.
		Oil pump failure.	Same as above.
18	Excessive oil pressure fluctuation	Air in sensing line	Bleed line.
		Gage records inaccurately	Check gage and transmitter.
		Faulty pressure regulating valve	Replace the valve.
		Oil contamination	Drain and replace filter. Inspect magnetic chip detectors for metallic particles. Thoroughly flush with engine oil while motoring engine. Drain and refill with engine oil.
		Low oil quantity	Check for excessive consumption.

Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
17 (cont)	Grease (cont)	Lubricate packings in fuel control fuel or air passages.	ASTM No. 5 Oil Sun Oil Company 1608 Walnut Street Philadelphia, Pennsylvania 19103
		Lubricate packings in fuel control fuel or air passages. (cont)	Alternates to ASTM No. 5 Oil: 1. 45–55% fuel (MIL–C–7024B, Type II) mixed with 45–55% STP Oil Treatment 2. MIL–D–6081, Grade 1010 oil
		Fuel Pump internal drive shaft splines (TRW/Argo–Tech pumps only)	Plastitube No. 3 Warren Refining Division Parr Inc. 5151 Denison Ave. Cleveland, Ohio 44102
18	Antiseize	P_c filter threads and external threads–protects up to 232°C (450°F)	DC 550 Fluid Dow Corning Corp. South Saginaw Road Midland, Michigan 48641
		Hot section external threads (not to be used where exposed to the engine oil system) and Compressor tie bolt	Never Seez Nickel Special NS165 (NS 165) Bostik, Emhart Chemical Group Boston Street Middleton, MA 01949
		Assembly–Compressor adapter nut.	Never–Seez Nickel Special (NS–165) Bostik, Emhart Chemical Group Boston Street Middleton, MA 01949
		External threads not exposed to oil system. Protects to 760°C (1400°F)	CP–63 (MIL–L–25681B) E/M Lubricants Inc. P.O. Box 2200 Highway 52, N.W. West Lafayette, Indiana 47906
19	Calibration fluid	Cleaning fuel nozzle tips	Stoddard solvent, refined kerosene (MIL–F–7024, type II) 300–400 boiling range.
20	Corrosion compound	Inhibiting fingerprint corrosion	Non–Rust X–210 Daubert Chemical Co., Inc. 4700 S. Central Ave. Chicago, Illinois 60038
21	Weld rod	Exhaust collector support ducts	AISI 349, (29–9 W Mo). (MIL–R–5031, class 6) (AMS 5784).

Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Gearbox

ad. Anytime the compressor is removed from the engine, inspect the mounting inserts on the gearbox for looseness. Refer to Insert Inspection, PARA 4.D., 72–60–00. If loose inserts are detected, check for possible vibration causes. Refer to Vibration Inspection, PARA 1.D.(2), this section.

ae. Anytime the power and accessory gearbox cover is separated from the gearbox housing at an Authorized Maintenance Facility and the Log Book indicates 3500 hours have elapsed since the gears were new or last magnafluxed, magnetically inspect all gears listed in PARA 1.D.(11), this section.

af. Send power and accessory gearbox to overhaul for overtorque inspection anytime a free wheel clutch slippage/sudden engagement incident occurs.

Magnetic Drain Plugs

ag. After the main rotor or propeller strikes an object or the engine N_2 power train is subjected to abnormal shock loading during operation, inspect the magnetic plugs for metal accumulation. Refer to Sudden Stoppage/Engagement Inspection, PARA 1.D.(4) or 1.D.(5), this section, and Magnetic Plug Inspection, PARA 11.G., 72–00–00, Engine–Servicing.

Oil System

ah. Drain oil from the system and refill, using the oils specified in Approved Oils, PARA 4.C., 72–00–00, Engine–Description and Operation. Remove, clean, and reinstall the oil filter at each oil change.

aj. Clean/replace oil cooler, lines and tank as require by airframe manufacturer or when heavy carbon deposits are noted in the engine lubrication system.

ak. Clean or replace the engine/scavenge oil filter(s), oil cooler, lines, tank and propeller cylinder (250–C20S) when heavy carbon deposits are found in the engine oil system. Consult the airframe or propeller manufacturer's publications for instructions to perform this work.

al. Clean or replace the engine oil filter, oil cooler, lines, tank and propeller cylinder (250–C20S) following oil system contamination. Clean the propeller cylinder prior to engine or propeller installation. When oil groups are mixed or changed, clean the propeller cylinder, engine oil filter, oil cooler, lines and tank before refilling the oil system. Consult the airframe or propeller manufacturer's publications for instructions to perform this work.

am. Flush the engine oil system following suspected or known contamination of the oil. Drain the oil system and service the oil tank with approved oil. Run the engine for 15 minutes at idle speed or until the oil has reached normal operating temperature. Drain the oil system. Clean or replace the engine/scavenge oil filter(s) and service the oil tank with an approved oil prior to flight.

an. If engine is inactive for more than 45 days, preserve oil system in accordance with Oil System Preservation, PARA 12.B., Engine–Servicing.

ap. Anytime the engine oil temperature limit has been exceeded, take the appropriate maintenance action given in Oil Temperature Limit Exceeded, PARA 11.B., 72–00–00, Engine–Servicing.

aq. Anytime the engine is operated in excess of 30 seconds without oil pressure, maintenance action is required. Refer to Engine Operated With No Oil Pressure, PARA 11.E., 72–00–00, Engine–Servicing.

aq1. After 50 hours of operation or if chip indication occurs within the first 50 hours on a new, repaired or overhauled engine, check the oil filter(s) and magnetic chip plugs for contamination. Also, if decreased oil pressure is noticed during operation, check the engine oil filter(s) for contamination at that time. If debris is found, proceed as follows:

Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Oil System, aq1. (cont)

1. Drain engine and airframe oil systems. Pay particular attention for any metallic debris in the oil. Swab the oil tank and note any foreign material.
2. Flush the engine oil system and clean the main and scavenge oil filters.
3. Flush the airframe oil system including oil coolers (refer to applicable airframe manual).
4. Reinstall filters and fill the cavity with fresh oil. Fill the oil tank with fresh oil.
5. Perform 30–minute ground run at power observing cockpit gauges, warning lights and caution panel for normal condition. Check indicated oil level within 15 minutes after shutdown.
6. After ground run, remove and inspect main and scavenge oil filters and magnetic chip plugs. If no accumulated debris is present, release aircraft for flight. During the next 30 hours of operation, check engine oil filters and magnetic chip plugs at approximately 10–hour intervals to determine if additional debris has accumulated. If debris is present, follow instructions for magnetic chip plug inspection procedure.

Oil Filter

ar. At each oil change, remove, clean, and reinstall the oil filter. Refer to Oil Filter, PARA 1.D., 72–60–00.

as. After 50 hours of operation or if chip indication occurs within the first 50 hours on a new, repaired or overhauled engine, check the oil filter(s) and magnetic chip plugs for contamination. Also, if decreased oil pressure is noticed during operation, check the engine oil filter(s) for contamination at that time. If debris is found, proceed as follows:

1. Drain engine and airframe oil systems. Pay particular attention for any metallic debris in the oil. Swab the oil tank and note any foreign material.
2. Flush the engine oil system and clean the main and scavenge oil filters.
3. Flush the airframe oil system including oil coolers (refer to applicable airframe manual).
4. Reinstall filters and fill the cavity with fresh oil. Fill the oil tank with fresh oil.
5. Perform 30–minute ground run at power observing cockpit gauges, warning lights and caution panel for normal condition. Check indicated oil level within 15 minutes after shutdown.
6. After ground run, remove and inspect main and scavenge oil filters and magnetic chip plugs. If no accumulated debris is present, release aircraft for flight. During the next 30 hours of operation, check engine oil filters and magnetic chip plugs at approximately 10–hour intervals to determine if additional debris has accumulated. If debris is present, follow instructions for magnetic chip plug inspection procedure.

Turbine Pressure Oil System Check Valve

at. Anytime the turbine is removed from the engine, clean and inspect the check valve. Refer to Turbine Pressure Oil System Check Valve, PARA 7.K., 72–50–00.

Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Fuel Pump Filter

CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER, AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.

au. The engine driven fuel pump is equipped with a throw–away filter element with a maximum replacement interval specified in the Scheduled Inspections, Table 602, this section. If the filter shows signs of contamination to the point of possibly bypassing, or if an impending bypass indication has been noted (some aircraft may incorporate this system), replace the filter element. Refer to PARA 2.C., 73–10–01 or PARA 2., 73–10–05 for filter replacement instructions.

Fuel Control, Governor and High Pressure Filters (CECO)

CAUTION: IF ANY FILTER SHOWS EVIDENCE OF CONTAMINATION TO THE POINT OF BYPASSING, RETURN THE FUEL CONTROL AND POWER TURBINE GOVERNOR TO AN AUTHORIZED FACILITY FOR FLUSHING, OR FLUSH IN ACCORDANCE WITH 250–C20 CSL–1034 AND –1035. ALSO, INSPECT THE FUEL NOZZLE FILTER FOR CONTAMINATION. IF ANY CONTAMINATION IS FOUND ON THE FUEL NOZZLE FILTER, THE FUEL NOZZLE MUST BE SENT TO AN AUTHORIZED FACILITY TO HAVE THE UNIT CLEANED AND TESTED.

av. Anytime fuel pump filter bypass is known or suspected to have taken place, inspect and if required, clean the filters in the gas producer fuel control and the power turbine governor. Refer to Cleaning the Fuel Control Fuel Filter, PARA 4., 73–10–04, and Cleaning the Governor Fuel Filter, PARA 4.A., 73–20–05. Also, clean or replace the high pressure fuel filter element. Refer to High Pressure Fuel Filter, PARA 2., 73–10–05.

Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Fuel Control Filter (Bendix)

CAUTION: IF THE FUEL CONTROL FILTER SHOWS EVIDENCE OF CONTAMINATION, RETURN THE FUEL CONTROL TO AN AUTHORIZED MAINTENANCE CENTER FOR CLEANING AND INSPECTION. ALSO, INSPECT THE FUEL NOZZLE FILTER FOR CONTAMINATION. IF CONTAMINATION IS FOUND ON THE FILTER, RETURN THE FUEL NOZZLE TO AN AUTHORIZED FACILITY FOR CLEANING AND TESTING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.

aw. Anytime fuel pump filter bypass is known or suspected to have taken place, inspect and if required, clean the fuel filter element in the gas producer fuel control. Refer to Cleaning the Gas Producer Fuel Control Fuel Filter, PARA 4.A., 73–20–02 or PARA 4.A., 73–20–03.

Bendix Fuel Control and Power Turbine Governor Airflow Restrictors

ax. When dictated by engine performance, remove, clean and reinstall the fuel control and power turbine governor airflow restrictors. Refer to PARA 4.B., 73–20–02 or PARA 4.B., 73–20–03 and PARA 2.D., 73–20–01.

Fuel Control P_c Filter (250–C20S)

ay. When dictated by engine performance, clean and reinstall the fuel control P_c filter. Refer to PARA 4.B., 73–20–03.

Fuel System P_c Filter (Bendix fuel system only)

az. When dictated by engine performance, remove, clean and reinstall the fuel system Pc Filter. Refer to Pc Air Filter Replacement, PARA 3., 73–20–06.

Accumulators

ba. When an engine is replaced, transfer the accumulators to the replacement engine. While removed, clean and test accumulators in accordance with Accumulators, PARA 2., 73–10–04.

Fuel Nozzle Filter

CAUTION: IF THE FILTER HAS BEEN CONTAMINATED OR HAS COLLAPSED OR BUCKLED, RETURN THE FUEL NOZZLE TO AN AUTHORIZED FACILITY FOR CLEANING AND TESTING. THIS WILL ALSO REQUIRE THAT THE FUEL CONTROL BE SENT TO AN OVERHAUL FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.

bb. Anytime high pressure fuel filter bypass is known or suspected to have taken place or evidence of contamination is found in the fuel pump, fuel control or governor, inspect the fuel nozzle filter for contamination. Refer to, PARA 4.A., 73–10–03.

Fuel System

bc. If engine is inactive for more than 45 days, preserve fuel system in accordance with Fuel System Preservation, PARA 12.C., 72–00–00, Engine–Servicing.

bd. Anytime a fuel control system component is reinstalled or a pneumatic line is disconnected, a pneumatic leak check of the control system must be performed. Refer to PARA 2.B., 73–00–00.

Start Counter

be. Anytime the engine is removed from the aircraft, inspect for chafed, frayed or broken wires and connectors. Also, inspect for broken glass in the viewing window or for housing dents.

PARA 1.D. (cont)

(1) Gearbox Compressor–Mounting Insert Inspection

(a) Inspect the inserts for looseness anytime the compressor is removed from the gearbox. Refer to Insert Inspection, PARA 4.D., 72–60–00.

(2) Vibration Inspection

(a) Procedures are provided for evaluating vibration, identifying vibration sources, and analyzing vibration levels. Refer to Vibration Test Procedure, PARA 2., Engine–Adjustment/Test, 72–00–00. Continued operation with high vibration levels will cause excessive engine and component wear and can contribute to engine failure and premature engine removal.

(b) If engine vibration is suspected, or any of the vibration symptoms listed in the 100–hour inspection, Table 602 this section, are encountered, inspect the compressor and return it to repair/overhaul if any of the following conditions are encountered:

1 Remove the top half of the compressor case and check all blades and vanes for possible foreign object damage and/or for bent or distorted vanes. Blade and vane condition must be within the limits given in Blade and Vane Inspection, PARA 5.B., 72–30–00.

2 Remove the compressor assembly from the engine.

3 Check the scroll outlet ports (turning vanes) for evidence of damage. Damage is indicative of impeller vane tip or shroud failure.

(3) Hard Landing Limits

(a) Make a visual inspection of the installed engine for external damage from airframe components after any hard landing.

(b) Engines that have sustained landing forces exceeding 10g shall be sent to a Rolls–Royce Authorized Maintenance Center. Airframe conditions that can be used as an indication that the 10_g landing force limit has been exceeded are as follows:

Bell Aircraft.

Airframe landing skids and cross tubes deformed to a degree that the cabin fuselage touches, or shows evidence of having touched, the ground.

McDonnell Douglas (Hughes) Aircraft.

Pilot and co–pilot seat metal box frames buckled, dishpanned, and/or wrinkled.

Boelkow BO105C. Helicopter body touches the ground.

(c) Fuel controls and power turbine governors which have been subjected to a hard landing, in excess of 10_g, must be returned to a Rolls–Royce Authorized Maintenance Center for inspection in accordance with the 250–C20 Series Overhaul Manual, Pub. No. 10W3.

(4) Sudden Stoppage/Engagement Inspection (250–C20, –C20B, –C20F, –C20J, –C20W).

NOTE: The following specific items and/or functions are the minimum required actions when performing a sudden stoppage/engagement inspection. Each incident should be judged on an "as required" basis possibly requiring more than these minimum requirements. Engines involved in sudden stoppage do not require overhaul automatically. This judgement is the responsibility of the service facility performing the inspection.

NOTE: If the engine must be removed from the airframe as a result of the rotor sudden stoppage, specified in PARA (b) and (c) following, then the operator should take care to provide the Rolls–Royce Authorized Maintenance Center with all the details about the incident. This information should include a description of damage to the airframe power train and mounts, as well as any other pertinent information.

PARA 1.D. (4) (cont)

(a) If a drive system component malfunctions, or the aircraft main rotor blade(s) strikes an object, and sustains damage which is field repairable in accordance with aircraft manufacturer's recommendations, perform the following:

1 Inspect magnetic plugs for metal accumulation. Refer to Magnetic Plug Inspection, PARA 11.G., 72–00–00, Engine–Servicing.

2 Inspect the engine inlet for foreign objects.

3 Inspect the compressor for foreign object damage.

4 Motor the engine and check for unusual noise.

5 Operate the engine for 30 minutes on the ground; then check the magnetic plugs for metal accumulation. Refer to Magnetic Plug Inspection, PARA 11.G., 72–00–00, Engine–Servicing.

a On twin engine aircraft, each engine should be operated at 100% Nr and flat pitch.

b On single engine aircraft, engine should be operated at power required to make aircraft light on its skids.

(b) If a drive system component malfunctions, or if a main rotor blade(s) strikes an object during operation, and sustains damage that requires removal from service of the main rotor blade(s) or any aircraft main rotor drive system component, remove the engine and perform the following:

1 Inspect the turbine shaft to pinion gear coupling and the power turbine outer shaft and pinion gear splines for evidence of damage, wear, and acceptability for further service. Refer to Power Turbine Outer Shaft Spline Inspection, PARA 7.B., 72–50–00, and Power Train Pinion Helical Gear Inspection, PARA 4.F., 72–60–00.

2 Magnetic particle inspect the turbine shaft–to–pinion gear coupling.

3 Send the accessory gearbox to a Rolls–Royce Authorized Maintenance Center (AMC) for inspection per the 250–C20 Series Overhaul Manual, Pub. No. 10W3.

4 Inspect the compressor for foreign object damage.

5 After engine reassembly, operate the engine for 30 minutes on the ground; then, check the magnetic plugs for metal accumulation. Refer to Magnetic Plug Inspection, PARA 11.G., 72–00–00, Engine–Servicing.

NOTE: Test cell run may be substituted for the above 30 minute ground run.

a On twin engine aircraft, each engine should be operated individually at 100% Nr and flat pitch.

b On single engine aircraft, engine should be operated at power required to make aircraft light on its skids.

(c) If a drive system component malfunctions, or a main rotor blade(s) strikes an object during operation and the engine or transmission mounts are fractured or misaligned, return engine to a Rolls–Royce Authorized Maintenance Center (AMC) for overhaul inspection with the following exceptions. The accessories listed below must be bench tested in accordance with the 250–C20 Series Overhaul Manual, Pub. No. 10W3, and meet all overhaul limits.

PARA 1.D. (4) (cont)

1 Bleed Valve

2 Engine Driven Fuel Pump

3 Fuel Nozzle

4 Anti–Ice Valve

5 Electrical/Electronic Device

6 Fuel Control

7 Power Turbine Governor

(5) Sudden Stoppage Inspection (250–C20S).

The following inspections must be satisfactorily completed whenever the propeller strikes a moving or stationary object.

NOTE: Sudden stoppage is the momentary or complete interruption in the rotation of the aircraft propeller and engine drive system when the aircraft propeller comes in contact with the ground, water, trees or other obstacles.

NOTE: The shock felt by the drive system requires that the engine be inspected and/or overhauled by an Authorized Maintenance Center (AMC) as a result of possible damage.

NOTE: If the engine must be removed from the airframe as a result of the propeller sudden stoppage then the operator should take care to provide the Rolls–Royce Authorized Maintenance Center with all the details about the incident. This information should include a description of damage to the airframe power train and mounts, as well as any other pertinent information.

(a) If the aircraft propeller strikes an object causing damage to the propeller which can be corrected by light grinding or filling and normal blending of the blades (nicks, gouges, scratches, etc.) in accordance with applicable propeller service instructions, complete the following inspection.

1 Inspect engine mounts for security, cracks, or misalignment.

2 Inspect the engine inlet for foreign objects.

3 Inspect the compressor blades and vanes for foreign object damage.

4 Inspect the compressor case for evidence of blade tip rub.

5 Inspect all magnetic plugs for metal accumulation. Refer to Magnetic Plug Inspection, PARA 11.G., 72–00–00, Engine–Servicing.

6 Rotate the propeller by hand and check for unusual noise.

7 Motor the engine and check for unusual noise.

8 Operate the engine for 30 minutes on the ground then check the magnetic plugs for metal accumulation.

9 Check blade track and balance the propeller.

(b) If the aircraft propeller strikes an object causing damage to the propeller blades requiring blade replacement and overhaul of the propeller assembly, remove the engine and send it to an Authorized Maintenance Center (AMC) for inspection.

1 Refer to the appropriate propeller Service Instructions and Overhaul Manual.

2 Refer to the Special Inspections required after propeller strike and/or crash in the engine Overhaul Manual.

PARA 1.D. (cont)

(6) Engine Submerged While in Operation

If the engine has been submerged in water while in operation, proceed as follows:

(a) Tag the engine indicating that it encountered submersion while in operation. Provide details of submersion event.

(b) Return the entire engine to a Rolls–Royce Authorized Maintenance Center as soon as possible for replacement of all compressor and turbine wheels.

(7) Lightning Strike Inspection

Aircraft lightning strikes occur when the airframe can serve as a least–resistance bridge for the electrical bolt as it travels through the air. Consequently, aircraft extremities (tail pylon, blades, nose, landing gear, etc.) typically act as points of entry or exit. However, since the exact electrical path through the aircraft may not be readily traceable following a strike, the following guidelines are recommended:

(a) In the event of a lightning strike in the immediate vicinity of the engine(s) (as evidenced by charring, burn marks or pitting associated with electrical arcing on the engine cowl, compartment or inlet) remove the engine(s) prior to further flight and send them to a Rolls–Royce Authorized Maintenance Center (AMC) for detailed teardown and inspection.

(b) Where the aircraft is known or suspected of having been involved in a lightning strike, and entry/exit points either cannot be determined or appear remote to the engine(s), perform the following:

1 Inspect the engine compartment for evidence of lightning strike damage.

2 Manually rotate N_1 and N_2 systems and check for binding and abnormal noise.

3 Remove, inspect, and clean the engine oil filter. Refer to Oil Filter Replacement, PARA 1.C., 72–60–00.

4 Remove, inspect, and clean the magnetic plugs. Refer to Magnetic Plug Inspection, PARA 11.G., Engine–Servicing, 72–00–00.

WARNING: NEVER RUN ENGINE(S) AT HIGH POWER ON WET OR FROZEN SURFACES.

5 Operate the engine(s) for 30 minutes on the ground and recheck the magnetic plugs for metal accumulation. Refer to PARA 11.G., 72–00–00, Engine– Servicing.

a On twin engine aircraft, each engine should be operated individually at 100% Nr and flat pitch.

b (250–C20, –C20B, –C20F, –C20J, –C20W) On single engine aircraft, engine should be operated at power required to make aircraft light on its skids.

c (250–C20S) On single engine aircraft, engine should be operated at 100% N_r and minimum power.

6 Listen for abnormal noise on coastdown and abnormally short coastdown time.

(8) Hot Start Inspection

(a) When the engine starting temperature limits of Table 8 or 9, 72–00–00, Engine–Description and Operation are exceeded, and turbine inspection is the recommended maintenance action, proceed as follows:

1 Remove the outer combustion case and combustion liner. Refer to Replacing the Combustion Liner, PARA 1., 72–40–00.

2 Inspect the first–stage nozzle in accordance with Table 201, PARA 7.C., 72–50–00.

3 Inspect the first–stage turbine wheels. Refer to Blade and Vane Inspection, PARA 7.A., 72–50–00.

PARA 1.D.(8) (cont)

4 Inspect the combustion liner. Refer to Table 201, 72–40–00.

5 Reassemble the engine. Refer to Replacing the Combustion Liner, PARA 1., 72–40–00.

(b) Center–Slotted 3rd–stage Turbine Wheels. Center–slotted turbine wheels P/N 6898551, 6898567, 6898733, 6898743, 6898753 or 6898763 which have encountered known or recorded hot starts exceeding 1490–1700°F (810–927°C) for 10 seconds maximum or 1700°F (927°C) peak shall be replaced. Record the event, temperature and duration in Part I of the Engine Log. Return these Engine Log pages and the turbine to an Authorized Maintenance Center (AMC) for replacement of the 3rd–stage turbine wheel.

(9) Erosion and Corrosion Inspection

If the aircraft is frequently subjected to sand or dust ingestion or operated in a corrosive environment (salt laden or other chemically laden atmosphere such as pesticides, herbicides, sulphur, industrial pollutants, etc.), inspect compressor blades, vanes, and case plastic coating for erosion or corrosion damage. Engines operated in a corrosive environment should be subjected to daily fresh water compressor rinses.

NOTE: If the aircraft is subjected to sand or dust ingestion, periodic compressor erosion inspection is recommended. The frequency of the inspection should be based on the degree of ingestion and condition of the compressor at the last inspection. The need for more frequent compressor rinse may also be indicated.

NOTE: See CSL–1135 for instructions on suggested contamination removal using water only and for maps of operating areas with salt laden air.

(10) Snow Ingestion Inspection

Inspect the engine for snow, ice, or water damage as follows:

(a) Obtain access to the compressor inlet but do not disassemble any engine parts.

(b) Replace the compressor assembly if any mechanical damage, distortion, or bending is detected on the compressor front support vanes or first–stages rotor blades.

(11) On Condition Inspection – Power and Accessory Gearbox

Any time the gearbox housing is separated from the cover, all gears shall be magnetic particle inspected if the log book indicates that more than 3500 hours have elapsed since the gears were new or last magnafluxed. Refer to 250–C20 Series Overhaul Manual, Pub. No. 10W3, for inspection criteria.

NOTE: Record compliance with this inspection in the appropriate section of the log book. Include date and hours.

(12) Compressor Inlet Air Blockage

Replace the compressor assembly if the engine has been operated with inlet air restricted due to foreign objects or materials which have become lodged in the compressor inlet. Tag the replaced compressor to indicate the cause of removal was inlet air blockage and send to a Rolls–Royce Authorized Maintenance Center. Conditions which constitute blockage are as follows:

(a) Foreign objects or materials found in the inlet during inspection of the aircraft when not in operation. If it can be determined that the blockage was not there during the last operation of the engine, remove the foreign object or material and leave the compressor in service.

(b) Power loss encountered following a restriction at the compressor inlet area while the engine is in operation. Blockage in flight can usually be verified by the inspection after landing (blockage still exists). However, some blockage may be followed by ingestion before inspection can take place. Objects or materials which were large enough to have stopped at the inlet guide vanes before ingestion, or which cause a noticeable raise in TOT, can be considered to have caused compressor inlet blockage.

ENGINE–CLEANING/PAINTING

1. Cleaning.

CAUTION: ENGINE THERMOCOUPLES SHOULD NEVER BE IMMERSED OR SPRAYED WITH CLEANING SOLVENTS. LIQUID CLEANING SOLVENTS WILL PENETRATE THE POROUS MAGNESIUM OXIDE INSULATION. ENGINE HEAT WILL VAPORIZE THE SOLVENTS LEAVING A RESIDUE CONTAINING CARBON WHICH CAUSES A LOW RESISTANCE TO GROUND.

NOTE: Even though Allison has approved the following cleaners for use with Allison engines, Allison assumes no liability for injury to personnel or the environment by their use.

A. General.

Use care in separating metals for cleaning. Cleaners for steel will damage nonferrous parts.

WARNING: MINERAL SPIRITS IS TOXIC. PROVIDE ADEQUATE VENTILATION FOR PERSONNEL USING IT.

(1) Mineral spirits is the cleaning solvent recommended for nonferrous parts. Do not use rust preventives on magnesium and aluminum parts.

(2) Clean aluminum–coated steel parts with carbon removal compound (Gunk Chicago Co., Gunk Hydroseal Decarbonizer, or equivalent). Rinse the parts with water and dry with an air blast.

(3) Clean steel parts with cresol base cleaning compound (Turco Products Inc., Formula 3097, or equivalent). Rinse the parts thoroughly with hot water. Coat parts with a compound made of one part of rust preventive (Cities Service Anti–Corrode 204, or equivalent) and three parts oil (Atlantic Refining Co. 31100, or equivalent).

NOTE: Do not allow bearings to spin during drying after the cleaning operation. Lubricate the cleaned bearings lightly with engine oil and wrap to keep clean while waiting for engine assembly.

2. Corrosion Treatment and Surface Finish Repair

Make repair of corrosion and surface finish damage as follows:

A. Touch up damaged paint on magnesium alloy parts with engine gray enamel (AMS 2510).

B. On aluminum–alloy parts which were originally painted without anodizing, touch up reworked areas with zinc–chromate primer (AMS 3110), then repaint.

C. On aluminum–alloy parts which were originally anodized, clean damaged areas with mineral spirits and rinse the part with water. Treat the damaged area with chemical film. (Chem–Rite A22 or equivalent manufactured by M and T Chemicals, Inc., Matawan, N.J.). As an alternate use chromic acid. If the coating is soft and powdery, the solution is too strong or the reaction time is too long; dilute the solution with water. If little or no visible coating forms, increase either the solution concentration or the reaction time.

D. Use the following procedure on aluminum–coated steel parts. Apply corrosion–preventive paint only forward of the turbine unit; the surface heat of the engine aft of the gearbox will destroy the paint.

(1) Clean the damaged surface with perchlorethylene and let dry five to ten minutes; clean all welds with a stainless–steel brush.

(2) Mask all vent holes.

(3) Paint all surfaces with heat–resisting aluminum paint (Lankote P/N 620 or equivalent, made by J. Landau Co., N.Y.). Apply and let dry for one hour.

NOTE: Do not paint compressor case vanes.

Table 701 (cont)
Cleaning Engine After Using Extinguisher Material

	Extinguisher Material	Immediate Action	Follow on or Final Cleaning Requirement
5.	Mil–Spec: MIL–B–49394D Halon 1011 Note: Engine internal Chemical Composition: Bromochloromethane CH_2BrCl	WARNING: USE WITH ADEQUATE VENTILATION. Clean externally and internally as much as possible with a mixture of 60% isopropyl and 40% isobutyl alcohol. F–D–680 Type II is acceptable as an alternate agent for external cleaning. Steam clean the exterior. Start engine and run at ground idle for five minutes. Note: When steam cleaning is not available the following procedure is recommended. Clean and neutralize all exterior surfaces. Wash all wetted surfaces with a rag saturated with solvent Spec P–D–608 Type II. Wash this with 10% solution of Sodium Bicarbonate, Spec O–S 576. Note: If engine was static when the agent was applied to the inlet duct or oil cooler, these should be cleaned the same as exterior surfaces.	Accomplish liquid cleaning upon return to home station. If aircraft was flying when the agent was applied by the fixed fire extinguisher system, no further action is required. If the airplane was on the ground when applied, as soon as the engine can be operated and the inlet has been inspected, the engine should be motored for one minute then started and operated at ground idle for five minutes. No further action is required as a result of usage of fire extinguisher agents. Halon 1011 is not soluble. Residue material can be removed with alcohol mixture.
6.	MIL–Spec: MIL–B–12218B Halon 1301 Chemical Composition: Bromotrifluoromethane CF_3Br	No action required.	No action required. Halon 1301 will not leave a residue.
7.	Mil Spec: BB–C–101B Carbon Dioxide CO_2 (gas)	No action required.	No clean up required.
8.	"Light Water" * Foam *Registered Trademark of 3M Company.	Water rinse to remove residue. Steam clean if required on external surfaces. If ingested, perform water rinse, para 6.A., 72–30–00.	Same as immediate action.

PARA 6.A.(1) (cont)

(b) Materials and equipment.

1 The highest quality water available must be used.

a The most rapid and economical means to assess water quality is by measuring electrical conductivity. Control of electrical conductivity to a specific low level will automatically yield a low level of chlorides, sulfates, sodium, and other elements. Distilled, demineralized, or deionized water with a maximum electrical conductivity of 3 micromhos per cubic centimeter would be theoretically ideal. However, a more practical level of 20 micromhos per cubic centimeter maximum would control the above impurities to a level of less than 10 ppm.

NOTE: Most water deionizing equipment has the capability to determine electrical conductivity. Commercially purchase deionized/demineralized water, conductivity information should be requested from the vendor.

b Should the electrical conductivity of the water not be known, the use of distilled, demineralized, or deionized water is preferred.

2 Portable equipment such as a garden sprayer or fire extinguisher which can be pressurized to obtain the required flow rate is recommended for water rinse. To provide capability for rinse with either portable equipment or a water supply system, a nozzle capable of flowing the recommended rate at about 55 psig (379 kPa) is desired.

3 The spray nozzle shall provide a diffused spray of water at a flow rate of one quart (one liter) in nine to eleven seconds at the pressure conditions used during compressor rinse. The nozzle should be sized to provide the proper flow rate at the average pressure maintained during each rinse cycle.

NOTE: Test for proper water flow at the pressure to be used by placing the nozzle in a large container so that no water can splash out. Time the flow for 10 seconds and measure the quantity collected. Proper nozzle size for the pressure used should accumulate 1 to 1–1/8 quarts (1.0 to 1.1 liters). Adjust nozzle size as necessary to meet the specified flow limits.

4 A quick opening valve shall be installed in the supply tube as close to the nozzle as practical.

5 6886024 Compressor Cleaning Protector Kit (bleed valve wedge).

(c) Spray rinse procedure:

1 Make sure the anti–ice valve is in the "OFF" position.

2 Make sure the engine ignition circuit breaker is pulled.

3 Block the bleed valve in the closed position using the wedge in 6886024 compressor cleaning protector kit (See Figure 217). It is not necessary to disconnect any lines.

CAUTION: TO PREVENT POSSIBLE BLADE DAMAGE AND TO ASSURE ADEQUATE RINSE AT THE BASE OF THE BLADES, N1 MUST NOT EXCEED 10% RPM. IF N1 RPM REACHES 10%, RELEASE THE STARTER AND CONTINUE THE WATER SPRAY. PERMIT N1 RPM TO REDUCE TO APPROXIMATELY 5% AND THEN RE–ENERGIZE THE STARTER TO OBTAIN A FULL TEN SECONDS OF ENGINE ROTATION WHILE WATER IS SPRAYED INTO THE COMPRESSOR.

4 Start the water injection three seconds prior to engaging the starter. The three second delay will reduce the tendency of the engine to accelerate above 10% rpm.

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250–C20W

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Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

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LIST OF WARNINGS (cont)

DURING THE ACCELERATION CHECK, THE AIRCRAFT MAY REACT OR BECOME LIGHT ON ITS SKIDS. DO NOT SNAP THE TWIST GRIP TO THE FULL THROTTLE POSITION.

FAILURE TO PROPERLY REMOVE OR INSTALL PC AIR LINES MAY DAMAGE LINES, FITTINGS, AND/OR FILTER ASSEMBLY WHICH CAN RESULT IN SUDDEN UNINTENDED ENGINE POWER LOSS.

SODIUM HYDROXIDE CAN CAUSE SEVERE BURNS. DO NOT GET IN EYES, ON SKIN OR ON CLOTHING. IN THE EVENT OF CONTACT WITH SODIUM HYDROXIDE, IMMEDIATELY FLOOD EXPOSED SKIN OR CLOTHING WITH WATER. FOR EYES, FLUSH HEAVILY WITH WATER AND OBTAIN IMMEDIATE MEDICAL ATTENTION.

POTASSIUM PERMANGANATE CAN BE VERY DANGEROUS IF IMPROPERLY HANDLED. CONTACT WITH ORGANIC MATERIALS (OIL, GREASE) CAN CAUSE FIRE.

PERCHLORETHYLENE IS TOXIC AND MUST BE USED WITH EXTREME CAUTION. MAKE SURE ADEQUATE VENTILATION IS PROVIDED. REPEATED OR PROLONGED CONTACT WITH THE SKIN SHOULD BE AVOIDED.

TO PREVENT ELECTRICAL SHOCK DURING INSTALLATION OF THE SPARK IGNITER AND THE LEAD, ALLOW FIVE MINUTES FOR ELECTRICAL DISSIPATION FOLLOWING IGNITION OPERATION OR TEST.

ANTI–ICING AIR IS HOT ENOUGH TO CAUSE SEVERE BURNS. DO NOT CHECK AIR FLOW BY FEEL.

FAILURE OF A COMPRESSOR BLADE OR VANE CAN CAUSE RUBBING CONTACT BETWEEN THE TIPS OF THE FIRST– AND SECOND–STAGE TURBINE BLADES AND THE SECOND–STAGE TURBINE NOZZLE OUTER RING. THIS RUBBING CONTACT MAY INDUCE STRESSES IN THE BLADES WHICH CAN CONTRIBUTE TO A FATIGUE FAILURE OF THE BLADES IF THE TURBINE WHEEL IS RETURNED TO SERVICE. TO PRECLUDE THIS POSSIBILITY OF SUBSEQUENT TURBINE BLADE FAILURE, FIRST– AND SECOND–STAGE TURBINE WHEELS WHICH HAVE BEEN OPERATED IN ENGINES THAT HAVE EXPERIENCED A COMPRESSOR BLADE AND/OR VANE FAILURE SHALL BE REMOVED FROM SERVICE IF THE TIPS OF ANY OF THE BLADES OF THESE WHEELS SHOW EVIDENCE OF RUBBING CONTACT.

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
3rd–stage Wheel (cont)	6899417	Center slot scalloped and crimped. Machined web. Has 7–11 seals	(1)	6000
	6899418	Center slot scalloped and crimped. Machined web. Less 7–11 seals.	(1)	6000
	6899419	Center slot scalloped and crimped. Machined web. Less 7–11 seals	(1)	6000
	23001967	Solid shroud less 7–11 seals	4550	6000
	23065818	Slotted shroud – improved design	4550	6000
	23065833	Slotted shroud – improved design	4550	6000
4th–stage Wheel	6853279	Original	4550	6000
	6891594	Machined web	4550	6000
	23055944	Improved design	4550	6000

(1) The 3rd–stage turbine wheels are to be removed from service in accordance with a phase–down schedule published in 250–C20 CEB A–1174.

WARNING: IT IS NOT ALLOWED TO INSTALL A TURBINE WHEEL WITH ACCEPTABLE WHEEL RIM CRACKS IN ANY ENGINE/TURBINE DURING OVERHAUL. ACCEPTABLY CRACKED TURBINE WHEELS MAY BE REINSTALLED ONLY DURING A TIME CONTINUED ENGINE/TURBINE REPAIR.

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4. Specifications

A. Engine Ratings

The specifications, limits, and performance ratings for the Model 250–C20 Series engines are as follows:

	250–C20	250–C20B, F, J, S, W
Design power output	400 shp (298 kW)	420 shp (313 kW)
Design speeds:		
Gas producer	100% (50,970 rpm)	
Power turbine	100% (33,290 rpm)	
Power output shaft	100% 6,016 rpm	
Maximum measured gas temperature— stabilized (TOT)	1490°F (810°C)	
Dimensions:		
Length	40.8 in. (1036 mm)	
Height (250–C20, –C20B, –C20F, –C20J, –C20W)	23.2 in. (589 mm)	
(250–C20S)	22.6 in. (574 mm)	
Width (250–C20, –C20B, –C20F, –C20J, –C20W)	19.1 in. (485 mm)	
(250–C20S)	18.8 in. (477 mm)	

Engine weight: dry	250–C20 B, J, W	250–C20F	250–C20S
	155 lb (70 kg) (Bendix) 158 lb (72 kg) (CECO)	158 lb (72 kg) (Bendix)	159 lb (72 kg) (Bendix)

WARNING: THE MAXIMUM OIL CONSUMPTION LIMIT IS ONE (1) QUART IN FIVE HOURS (0.05 GAL/HR, 0.19 LITER/HR). OPERATION IN EXCESS OF THIS LIMIT IS NOT PERMITTED. EXCESSIVE OIL CONSUMPTION CAN BE INDICATIVE OF A SERIOUS INTERNAL OIL LEAK. AN INTERNAL OIL LEAK CAN RESULT IN AN UNDETECTED INTERNAL OIL FIRE WHICH WILL RESULT IN A DISASTROUS TURBINE FAILURE.

Maximum oil consumption	0.05 US gallons per hour or 1 qt in 5 hours (0.9 liter in 5 hours)
Performance ratings	See Tables 1, 2, 3, 4, 5, 6 or 7.

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Table 5

Performance Ratings for One–Engine–Inoperative and/or Emergency Operation – 250–C20F, –C20W Engines

Rating	Shaft Power (min) hp (kW)	Jet Thrust (est) lb (N)	Gas Generator rpm (est)	Output Shaft rpm	Specific Fuel Cons. (max) lb/shp–hr (mg/W·h)	Maximum Allowable Operating Limits: Measured Rated Gas Temp (max) °F (°C)	Maximum Allowable Operating Limits: Output Shaft Torque Ft lb (N·m)	Maximum Allowable Operating Limits: Measured Gas Temp (max) °F (°C)
			Standard Sea Level Static Conditions					
30–Minute Power	420 (313)	45 (200)	51790	6016	0.650 (395)	1490 (810)	384 (521)	1490 (810)
Max Continuous*	420 (313)	45 (200)	51790	6016	0.650 (395)	1490 (810)	384 (521)	1490 (810)

Specific Fuel Consumption = Fuel Flow/SHP

* Max Continuous rating is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine –inop erative (O.E.I.) operation of multi–engine aircraft and emergency two engine operation.

Table 6

Performance Ratings—Normal Operation—250–C20S

Rating	Shaft Power (min) hp (kW)	Jet Thrust (est) lb (N)	Gas Producer Output rpm (est)	Gas Producer Output Shaft rpm	Specific Fuel Cons. (max) lb/shp–hr (mg/W·h)	Measured Rated Gas Temp °F (°C)	Maximum Allowable Output Shaft Torque ft–lb N·m
		Standard Static Sea Level Conditions					
Takeoff (5 min)	420 (313)	42 (187)	53000	6016	0.650 (395.38)	1490 (810)	384 (521)
Normal Cruise	370 (276)	38 (169)	51200	6016	0.650 (395.38)	1360 (738)	323 (438)
Cruise A	333 (248)	36 (160)	50160	6016	0.665 (404.50)	— —	323 (438)
Cruise B	278 (207)	32 (142)	48800	6016	0.709 (431.27)	— —	323 (438)
Idle	35 max (26)	10 (44)	33000	4500–6300	70 lb/hr (31.75 kg/h)	800 ±100 (427 ±55)	— —
Takeoff* (Augmented)	420 (313)			6016		1490 (810)	384 (521)

Specific Fuel Consumption = Fuel Flow/SHP

Normal Cruise power is the highest power ordinarily used in regular cruise operation.

Cruise A and Cruise B are the power levels that are 90% and 75% respectively of the rated Normal Cruise power at standard sea level static conditions.

* The augmented rating is based upon a water–alcohol flow rate of 1.25 gpm (4.7 lpm) delivered to the injection nozzles at a pressure differential of 50 psi (345 kPa) across each nozzle, with installation of the nozzles in accordance with the requirements set forth on the installation drawings.

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Table 7

Performance Ratings—One Engine Inoperative and/or Emergency Operation—250–C20S

Rating	Shaft Power (min) hp	(kW)	Jet Thrust (est) lb	(N)	Gas Producer Output rpm (est)	Gas Producer Output Shaft rpm	Specific Fuel Cons. (max) lb/shp–hr	(mg/W·h)	Measured Rated Gas Temp °F	(°C)	Maximum Allowable Output Shaft Torque ft–lb	N·m
Max. Cont.	420	(313)	42	(187)	53000	6016	0.650	(395.38)	1490	(810)	384	(521)

Max Continuous rating is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine–inoperative (O.E.I.) operation of multi–engine aircraft and emergency operation.

PARA 4. (cont)

WARNING: IT IS VERY IMPORTANT THAT THE ENTIRE AIRCRAFT AND ENGINE FUEL SYSTEM BE MAINTAINED TO THE HIGHEST STANDARDS OF CLEANLINESS.

ROLLS–ROYCE HAS CONDUCTED TESTING OF APPLE JELLY TYPE CONTAMINATION WHICH SHOWS IT BEHAVES DIFFERENTLY THAN A SOLID CONTAMINANT. IT CAN PASS THROUGH VARIOUS AIRFRAME AND ENGINE FUEL FILTERS UNDETECTED WITHOUT ACTUATING THE IMPENDING BYPASS INDICATOR, AND IT CAN CAUSE PARTIAL OR COMPLETE BLOCKAGE OF THE FUEL NOZZLE SCREEN RESULTING IN REDUCED ENGINE PERFORMANCE OR FLAMEOUT.

SHOULD THIS GEL–LIKE MATERIAL BE DETECTED AT ANY POINT IN THE AIRCRAFT OR ENGINE FUEL SYSTEM, THE ENTIRE AIRFRAME AND ENGINE FUEL SYSTEM SHOULD BE INSPECTED.

WARNING: TO PREVENT ENGINE FUEL SYSTEM CONTAMINATION, WHICH COULD CAUSE ENGINE FLAMEOUT, AN EXTERNAL LOW PRESSURE FUEL FILTER SHOULD BE USED ON ANY AIRCRAFT REFUELING FROM REMOTE FUELING SITES (DRUMS, ETC).

CAUTION: NOT ALL NO. 1 DIESEL FUELS, JP–1, OR ARCTIC DIESEL FUELS WILL MEET THE PRIMARY FUEL SPECIFICATIONS. IN DETERMINING WHETHER OR NOT A GIVEN FUEL MEETS THESE SPECIFICATIONS, THE BURDEN OF PROOF RESTS WITH THE OPERATOR AND HIS SUPPLIER.

B. Fuel Specification.

(1) Primary

Fuels conforming to the following military and commercial specifications are approved for unrestricted use in 250 Series engines.

(a) MIL–T–5624, grade JP–4 and JP–5

(b) MIL–T–83133, grade JP–8

(c) ASTM D–1655, Jet B

(d) ASTM D–1655, Jet A or A1

(e) JP–1 fuel conforming to ASTM D–1655, Jet A

(f) Arctic Diesel Fuel DF–A (VV–F–800B) conforming to ASTM D–1655, Jet A or Jet A1

(g) Diesel #1 fuel conforming to ASTM D–1655, Jet A

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PARA 4.B. (cont)

CAUTION: MIL–G–5572 FUEL CONTAINING TRICRESYLPHOSPHATE (TCP) ADDITIVE SHALL NOT BE USED.

(1) Emergency

MIL–G–5572E OR ASTM–D–910, all grades (aircraft boost or start pump on; maximum of 6 hours operation per overhaul period of turbine)

WARNING: AT AMBIENT TEMPERATURES BELOW 4°C (40°F), SOME TYPE OF ANTI–ICE PROTECTION IS REQUIRED, SUCH AS AN ANTI–ICE ADDITIVE OR A MEANS OF AIRFRAME FUEL ICE ELIMINATION. ENGINE FLAMEOUT COULD RESULT FROM FAILURE TO USE ANTI– ICE PROTECTION. (REFER TO THE AIRCRAFT MANUAL FOR THEIR RECOMMENDATIONS AND PARA 4.B., THIS SECTION, FOR APPROVED ANTI–ICE ADDITIVE.)

(2) Cold Weather

To assure consistent starts below 4°C (40°F) the following fuels may be necessary:

(a) MIL–T–5624, grade JP–4

(b) ASTM D–1655, Jet B

(c) AVGAS/Jet A, Jet A1, or JP–5 mixture (Refer to Para 8, Cold Weather Fuels, for mixing/use of cold weather fuel.)

NOTE: Grade JP–4 (MIL–T–5624), grade JP–5, and grade JP–8 (MIL–T–83133A, or later) type fuels contain anti–ice additive which conforms to MIL–I–27686 (or later). These fuels do not require additional anti–ice additive unless specified by the airframe manufacturer.

NOTE: Jet A, A1, JP–5, or JP–8 fuels are not restricted from use at ambient temperatures below –18°C (0°F); however, special provisions for starting must be made. (Refer to Aircraft Flight Manual.) Once started, engine operation on Jet A, Jet A1, JP–5, or JP–8 will be satisfactory in outside air temperatures down to –32°C (–25°F).

NOTE: Prolonged and uninterrupted operation with only AVGAS mixture will induce lead buildup on turbine parts. This lead buildup can cause a gradual power reduction; consequently, this AVGAS mixture should be used only for cold weather operation. During operation with normal Jet A type fuel, the lead will slowly dissipate.

(3) Prist (MIL–I–27686E) anti–ice additive is approved for use in the model 250–C20R series engines if used in accordance with the additive manufacturer's instructions and if approved by the airframe manufacturer.

NOTE: Prist is also an anti–biological agent, and may be used at the discretion of the operator to prevent microbiological fuel contamination.

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PARA 4. (cont)

WARNING: ONLY DISCRETIONARY MIXING OF OILS WITHIN AN OIL SERIES IS PERMITTED WITHOUT A TIME PENALTY. USE OF MIXED OILS FROM DIFFERENT SERIES IN AN ENGINE IS LIMITED TO FIVE HOURS TOTAL RUNNING TIME DURING ONE OVERHAUL PERIOD. ADEQUATE MAINTENANCE RECORDS MUST BE MAINTAINED TO ENSURE THAT THE FIVE HOUR LIMIT IS NOT EXCEEDED. FAILURE TO COMPLY WITH OIL MIXING RESTRICTIONS CAN RESULT IN ENGINE FAILURE.

CAUTION: IF HEAVY CARBON OR COKE DEPOSITS ARE FOUND ON THE ENGINE FILTER DURING REGULAR INSPECTIONS, IT IS RECOMMENDED THE FILTERS BE REPLACED; CONTINUE TO MONITOR BYPASS INDICATORS.

CAUTION: TO DECREASE THE LIKELIHOOD FOR CARBON OR COKE DEPOSITS BEING DISLODGED DURING THE CHANGEOVER TO "3RD GENERATION" OILS (E.G. MOBIL JET 254), THESE CHANGEOVERS SHOULD ONLY BE MADE WHEN THE ENGINE IS NEW OR REPAIRED, TO THE EXTENT THE LUBRICATION PASSAGES AND SUMPS HAVE BEEN CLEANED AND FLUSHED.

CAUTION: WHILE CONSIDERABLE LABORATORY DATA IS AVAILABLE TO DEMONSTRATE THE COMPATIBILITY OF ONE SYNTHETIC TURBINE OIL WITH OTHER TURBINE OILS MEETING THE SAME SPECIFICATION (AIRLINE EXPERIENCE DOES DEMONSTRATE THIS PROPERTY), THE INDISCRIMINATE MIXING OF APPROVED OILS DURING THE OPERATIONAL USE OF THE OIL IS NOT RECOMMENDED. HOWEVER, THERE MAY BE CIRCUMSTANCES WHERE EMERGENCY TOP–OFF, INADVERTENT MIXING, OR CHANGEOVER BY "TOP–OFF" TO ANOTHER BRAND MAY OCCUR. THESE ARE ACCEPTED PRACTICES.

CAUTION: FAILURE TO COMPLY WITH OIL MIXING RESTRICTIONS CAN RESULT IN ENGINE FAILURE.

CAUTION: REMOVE AND INSPECT THE OIL FILTER AFTER 25 HOURS OF ENGINE OPERATION IF THE TYPE OF OIL (MIL–PRF–7808, MIL–PRF–23699, OR DOD–85734) WAS MIXED IN AN EMERGENCY. (THERE IS A 5–HOUR LIMIT FOR THE USE OF MIXED OILS.)

CAUTION: THE FILTER INSPECTION IS TO DETERMINE IF COKE, WHICH WAS FORMED DURING PREVIOUS OPERATION, IS BEING DISLODGED DURING THE FIRST OPERATION FOLLOWING THE OIL CHANGE.

CAUTION: IF HEAVY CARBON DEPOSITS ARE OBSERVED ON THE ENGINE FILTER, IT IS SUGGESTED THAT THE ENGINE OIL BE CHANGED AGAIN. THE OIL IS TO BE DRAINED WHEN THE OIL IS HOT TO OBTAIN THE MAXIMUM BENEFIT. THE 25 HOUR OIL MONITORING IS TO CONTINUE UNTIL THE NEXT OIL CHANGE PERIOD.

CAUTION: USE OF OILS WHICH ARE NOT INCLUDED IN THE APPROVED OILS LISTING, OR FAILURE TO DRAIN OIL WITHIN THE PRESCRIBED INTERVAL GIVEN IN TABLE 602, 72–00–00, ENGINE–INSPECTION/CHECK WILL BE CONSIDERED AS MISUSE UNDER ITEM (4) OF THE WARRANTY POLICY.

C. Oil Specification.

The 250 series engines are qualified and certified for use with MIL–PRF–7808G and subsequent, MIL–PRF–23699 series and DOD–85734 series lubricating oils. The vendor brands of MIL–PRF–7808 series, MIL–PRF–23699 series, and DOD–85734 series lubricating oils, which have been engine tested and approved for use in the Model 250 engine are listed in para 4.C.(2), Approved Oils. Refer to paragraph C.(1), Cold Weather Lubrication, for the type of oil recommended at specific temperatures.

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PARA 4.C. (cont)

(1) Cold Weather Lubrication

The types of oil recommended at specific ambient temperatures are as follows:

0°C (32°F) and above	MIL–PRF–23699C or subsequent preferred
0°C (32°F) to –40°C (–40°F) . .	MIL–PRF–23699C or subsequent preferred or MIL–PRF–7808G or subsequent
–40°C (–40°F) and below	MIL–PRF–7808G or subsequent only
–40 C (–40 F) to 135 C (275 F)	DOD–85734

NOTE: Because of availability, reduced coking and better lubricating qualities at higher temperatures, MIL–PRF–23699 oils are preferred for use in Model 250 engines.

NOTE: Check the engine oil quantity within 15 minutes of engine shutdown to avoid a false indication of excessive oil consumption. If the 15 minutes has been exceeded, motor the engine for 30 seconds with the starter before checking tank quantity. Motoring normally scavenges oil from the gearbox back to the aircraft oil tank. Check the airframe flight manual; some installations may require engine to be operated for at least a minute at ground idle to assure proper scavenging of the engine gearbox.

NOTE: Always refer to the airframe flight manual for proper oil servicing instructions; specific requirements may vary for different models.

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PARA 4.C. (cont)

5. Operating Precautions

WARNING: THE PRIMARY APPLICATION OF THE TURBOSHAFT ENGINE IS TO POWER A HELICOPTER OR ROTORCRAFT. A HEIGHT–VELOCITY DIAGRAM, AS REQUIRED BY REGULATION AND PREPARED BY THE AIRFRAME MANUFACTURER, IS PUBLISHED IN THE AIRCRAFT FLIGHT MANUAL PERFORMANCE SECTION. THE OPERATOR MUST BECOME FAMILIAR WITH THIS DIAGRAM TO DETERMINE WHAT ALTITUDES AND AIRSPEEDS ARE REQUIRED TO SAFELY MAKE AN AUTOROTATIONAL LANDING IN CASE OF POWER LOSS OR ENGINE FAILURE. THE ALTITUDE–AIRSPEED COMBINATIONS WHERE A SAFE AUTOROTATIONAL LANDING MAY NOT BE POSSIBLE ARE REPRESENTED BY THE SHADED OR CROSS–HATCHED AREA OF THE DIAGRAM.

WARNING: SNOW OR ICE SLUGS CAN CAUSE THE ENGINE TO FLAME OUT. BE SURE AVAILABLE PREVENTIVE EQUIPMENT IS INSTALLED AND IN PROPER WORKING ORDER WHEN FLYING IN CONDITIONS WHERE SNOW OR ICE BUILDUP MIGHT OCCUR.

WARNING: CONSULT THE AIRCRAFT FLIGHT MANUAL FOR REQUIRED EQUIPMENT AND PROCEDURES FOR FLIGHT IN FALLING/BLOWING SNOW.

WARNING: SAND AND DUST WILL ERODE COMPRESSOR VANES AND CAUSE THEM TO FAIL.

WARNING: SALT LADEN HUMIDITY AND CHEMICALS WILL CORRODE COMPRESSOR BLADES AND VANES AND CAUSE THEM TO FAIL.

Observe the following precautions to reduce the danger of personnel injury or damage to the engine.

A. Before operating the engine, check the air inlet for foreign objects. (Refer to Compressor Inlet Air Blockage, PARA 1.C.(12), 72–00–00, Engine–Inspection/Check.)

B. If the engine does not operate within Operating Limits, PARA 6., this section, take the designated action.

C. If the aircraft is frequently operated in dusty or sandy areas, periodic erosion inspection is recommended. (Refer to Erosion Inspection, PARA 1.C.(9), 72–00–00, Engine–Inspection/Check.)

D. If a flameout has been experienced as the possible result of snow, ice, or water ingestion, refer to Snow Ingestion Inspection, PARA 1.C.(10), 72–00–00, Engine–Inspection/Check.

E. If the aircraft is being operated following an extended period of inactivity, refer to Special Inspections, Table 604, 72–00–00, Engine Inspection/Check, for recommended action.

F. If the engine is operated in a corrosive environment it must be subjected to a water wash. (Refer to Compressor Contamination Removal, PARA 6.A.(1), 72–30–00.)

G. If the installed engine will be shut down for more than five calendar days the compressor must receive an application of preservative. (Refer to Compressor Preservation, PARA 12.D., 72–00–00, Engine Servicing.)

6. Operating Limits

WARNING: TO PREVENT SERIOUS ENGINE MALFUNCTION OR CRUCIAL LOSS OF POWER, DO NOT OPERATE THE ENGINE IN EXCESS OF ANY SPECIFIED LIMIT.

NOTE: Operators may be faced with an engine that meets all specification power requirements in a certified test cell but apparently fails to meet the minimum installed power required by the aircraft flight manual.

NOTE: Please refer to the aircraft manual for other system troubleshooting.

NOTE: Operators should be aware that the FAA requires the Rolls–Royce Authorized Maintenance Centers to deliver engines of at least “specification horsepower” only after complete engine overhaul.

A. Engine Speed

If any of the following limits are exceeded send the designated engine components to repair/overhaul. Record extent of overspeed in the engine log book.

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Table 8

Measured Gas Temperature Limits (TOT) – 250–C20 Engine

Steady State

Temp Range	Time	Maintenance Action
793°C (1460°F) 793°C (1460°F) 777°C (1430°F)	Takeoff (5 min.) 30 minute power (1) Max continuous (2)	If steady state time or condition limits are exceeded: Inspect turbine (3).
Over 927°C (1700°F)	Not Allowed	Remove the turbine for heavy maintenance or overhaul (5).

During Starting and Shutdown

Temp Range	Time	Maintenance Action
Up to 793°C (1460°F)	No limit	None.
793–927°C (1460–1700°F)	Over 10 sec (5)	Inspect turbine (3) (4).
927–999 °C (1700–1830°F)	Not allowed (5)	Inspect turbine (3) (4).
Over 999°C (1830°F)	Not allowed	Remove turbine for heavy maintenance or overhaul.

NOTE: Refer to Troubleshooting, Section III, Table 5, item 9, (when start temperature consistently exceeds 860°C (1580°F).

During Power Transient

Temp Range	Time	Maintenance Action
Up to 777°C (1430°F)	No limit (Transient only)	None.
777–793°C (1430–1460°F)	Until stabilized (5 min max)	None.
793–843°C (1460–1550°F)	0 to 6 sec (intentional use of temperatures in excess of 793°C (1460°F) is not recommended)	None.
793–843°C (1460–1550°F)	Over 6 sec	Inspect turbine (3).
843–927°C (1550–1700°F)	Not allowed	Inspect turbine (3).
Over 927°C (1700°F)	Not allowed	Remove turbine for heavy maintenance or overhaul.

(1) This limit is applicable only during one–engine–inoperative (O.E.I.) operation of multi–engine aircraft.

(2) This limit is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine–inoperative (O.E.I.) operation of multi–engine aircraft, and emergency engine operation.

(3) Refer to Special Inspections, Table 604, Engine Inspection/Check, 72–00–00. Also, record tempera–ture and duration in the Engine Log Book (pink pages, Turbine Assembly, Part IV, Inspection Record).

(4) Check Part V of the Engine Log for the part number of the 3rd–stage turbine wheel. If the 3rd–stage wheel is P/N 6898551, 6898567, 6898733, 6898743, 6898753 or 6898763, the following over–temperature limits shall apply: 1) 810–927°C (1490–1700°F) for 10 seconds maximum or 2) 927°C (1700°F) peak. If either of these limits are exceeded, record the condition encountered in Part I of the Engine Log. Return these Engine Log pages and the turbine to an Overhaul Agency for replacement of the 3rd–stage turbine wheel.

(5) Momentary peak temperature of 927°C (1700°F) is permitted for no more than one second.

NOTE: The time–at–temperature limits are not additive. The repeated, intentional use of transient temperature limits can result in reduced turbine life and is not recommended.

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Table 9

Measured Gas Temperature Limits (TOT) – 250–C20B, –C20F, –C20J, –C20S, –C20W Engines

Steady State

Temp Range	Time	Maintenance Action
810°C (1490°F)	Takeoff (5 min.)	If steady state time or condition limits are exceeded: Inspect turbine (3).
810°C (1490°F)	30 minute power (1)	
810°C (1490°F)	Max continuous (2)	
Over 927°C (1700°F)	Not Allowed	Remove turbine for heavy maintenance or overhaul (5).

During Starting and Shutdown

Temp Range	Time	Maintenance Action
Up to 810°C (1490°F)	No limit	None.
810–927°C (1490–1700°F)	Over 10 sec (5)	Inspect turbine (3) (4).
927–999°C (1700–1830°F)	Not allowed (5)	Inspect turbine (3) (4).
Over 999°C (1830°F)	Not allowed	Remove turbine for heavy maintenance or overhaul.

NOTE: Refer to Troubleshooting, Section III, Table 5, item 9, when start temperature consistently exceeds 860°C (1580°F).

During Power Transient

Temp Range	Time	Maintenance Action
Up to 779°C (1434°F)	No limit (Transient only)	None.
779–810°C (1434–1490°F)	Until stabilized (5 min max)	None.
810–843°C (1490–1550°F)	0 to 6 sec (intentional use of temperatures in excess of 810°C (1490°F) is not recommended)	None.
810–843°C (1490–1550°F)	6 to 12 seconds	Max of 3 occurrences per life of each turbine wheel (3) (4).
810–843°C (1490–1550°F)	Over 12 seconds	Inspect turbine (3) (4).
843–927°C (1550–1700°F)	Not allowed	Inspect turbine (3) (4).
Over 927°C (1700°F)	Not allowed	Remove turbine for heavy maintenance or overhaul.

One Engine Inoperative and/or Emergency
Multi–Engine Operation (250–C20B, –C20F Engine)

Temp Range	Time	Maintenance Action
Up to 810°C (1490°F)	No limit	None.
810–843°C (1490–1550°F)	0 to 6 seconds	None.
843–899°C (1550–1650°F)	0 to 6 seconds	Inspect turbine.
810–899°C (1490–1650°F)	6 to 12 seconds	Max of 3 occurrences per life of each turbine wheel (3) (4).
810 to 899°C (1490–1650°F)	Over 12 seconds	Remove turbine for heavy maintenance or overhaul.
Over 899°C (1650°F)	Not allowed	Remove turbine for heavy maintenance or overhaul.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
4	Engine lights off but will not ac–celerate to idle speed at a nor–mal rate	Loose pneumatic fit–ting, cracked accumu–lator, or cracked pneumatic line causing air leak in control system (Bendix control system only)	Pressurize the system to check for leaks. (Refer to Bendix Fuel Control System Pneumatic Leak Check, para 2.B., 73–00–00.)
			Check for crack in air tubes or outer combustion case. Check for air seal leaks.
		Dirty P_c filter (Bendix control system only)	Clean P_c filter. (Refer to Cleaning P_c Filter, para 3., 73–20–06.)
		Cracked accumulator. (Bendix control system only)	Replace accumulator.
		Fuel leak at the fuel control or governor split lines or from overboard drains. (CECO control system only)	Replace component.
		Inadequate torque at starter pad	Check condition of battery and starter to determine if sufficient N_1 cranking speed is attainable.
		Dirty compressor	Clean compressor and bleed valve. (Refer to Compressor Cleaning para 6.B., 72–30–00 and Cleaning Bleed Valve, para 3., 75–10–02.)
		Insufficient fuel supply to gas producer fuel control	Check fuel system to ensure all valves are open and pumps are op–erative.
		Insufficient fuel pres–sure to fuel pump	Turn on aircraft boost pump.
		Gas producer fuel control bypass valve stuck open	Disconnect the fuel line at the fuel nozzle, flush sys–tem with clean fuel; then replace control.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
6	Engine lights off but flames out during ground starts at high altitude, especially above 5000 feet (1524 meters), during cold ambient conditions.	Fuel nozzle partially clogged.	Inspect fuel nozzle for carbon buildup. Clean or replace as necessary.
		Start derichment adjustment too low.	Make start derichment adjustment. (Refer to Start Derichment Adjustment, para 3.H.(1), 73–20–02; para 3.G.(1), 73–20–03; or para 3.H., 73–20–04.)
		Temporary fluctuation of fuel pressure. (CECO control system only).	Make the start with the aircraft boost pump off. When idle speed is reached, turn on boost pumps if required by the Flight Manual. Do not disregard the requirements of the Flight Manual pertaining to operation of the boost pumps. If starts are not improved, adjust the start derichment (turn clockwise to enrich fuel flow). If there still is no improvement, inspect the fuel nozzle for carbon buildup. Clean or replace the fuel nozzle as necessary.
7	Low power and high TOT	Contaminated bleed valve jet	Clean bleed valve (Refer to Cleaning Bleed Valve, para 3., 75–10–02.)
8	Hot starts or high turbine temperature	Control schedule has shifted rich (6899262, Bendix 2524644–9, or later fuel controls).	Turn the start/acceleration adjuster ccw to decrease turbine temperature and to prevent hot starts. Make a one detent adjustment; then observe starting temperature. One detent changes temperature 30–40°C (86–104°F). Make an additional one detent adjustment if necessary. (Refer to Start/Acceleration Fuel Flow Adjustment, para 3.H.(2), 73–20–02 or para 3.G.(2), 73–20–03.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
9	Acceleration temperature too high during start	Insufficient time allowed for draining after an unsuc–cessful starting attempt	Purge the engine by motor–ing with the gas producer lever and ignition switch in OFF for approximately 10 sec. before attempting a second start.
		Reduced battery capac–ity (This can produce low cranking speed.)	Recharge or replace battery.
		High residual TOT in excess of 150°C (302°F)	Motor engine with starter leaving gas producer lever and ignition OFF.
		Depreciated starter which is not capable of dry motoring gas producer (N_1) above 15 percent	Replace starter.
		Gas producer lever (twist grip) or Fuel Cutoff Lever in ground idle (start) or ON position prior to and during starter engagement	Review starting procedure.
		Dirty compressor	Clean compressor and bleed valve. (Refer to Compres–sor Cleaning, para 6., 72–30–00 and Bleed Valve Cleaning, para 3., 75–10–02.)
		Fuel nozzle valve stuck full open	Replace fuel nozzle.
		Excessive compressor air leaking	Check for leaks. Be sure that anti–ice valve is fully closed.
		Bleed control valve stuck closed	Replace bleed control valve.
		Gas producer fuel con–trol incorrectly ad–justed or calibration has shifted	Replace faulty control if start temperature exceeds 927°C (1700°F).
		Gas producer fuel con–trol start derichment too rich	Adjust start derichment. (Refer to start Derichment Ad-justment, para 3.H.(1), 73–20–02; para 3.G.(1), 73–20–03 or para 3.G., 73–20–04.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
13	Engine instability in power range	Loose pneumatic fitting, cracked accumulator, or cracked pneumatic line causing air leak in control system (Bendix system only)	Pressurize the system to check for leaks. (Refer to Bendix Fuel Control System Pneumatic Leak Check, para 2.B., 73–00–00.)
		Air in fuel system.	Bleed air from the fuel system. (Refer to Purging the Fuel System, para 2.D., 73–00–00.)
14	Idle speed too low	Incorrect gas producer lever setting	Check lever position and rigging. (Refer to Rigging Check, para 3.C., 73–20–02; 3.B., 73–20–03 or 3.C., 73–20–04.)
		Malfunctioning tachometer	Replace tachometer.
		Excessive generator load	Reduce electrical load requirement.
		Dirty compressor	Clean compressor and bleed valve. (Refer to Compressor Cleaning, para 6., 72–30–00 and Cleaning Bleed Valve, para 3., 75–10–02.)
		Gas producer fuel control idle adjustment incorrectly set	Correct the setting. (Refer to Idle Speed Setting, para 3.F., 73–20–02; 3.C., 73–20–03 or 3.E., 73–20–04.)
		Loose pneumatic fitting, cracked accumulator, or cracked pneumatic line causing air leak in control system (Bendix system only)	Pressurize the system to check for leaks. (Refer to Fuel Control System Pneumatic Leak Check, para 2.B., 73–00–00.)
15	Idle speed too high	Incorrect gas producer lever setting	Check lever position and rigging. (Refer to Rigging Check, para 3.C., 73–20–02; 3.B., 73–20–03 or 3.C., 73–20–04.)
		Malfunctioning tachometer	Replace tachometer.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
27	Oil temperature exceeds 107°C (225°F) remains less than 120°C (248°F) for a period not exceeding 10 minutes.	Contamination or carbon buildup in the turbine.	Inspect and clean oil system and passages. (Refer to Oil System Maintenance, para 7.F., 72–50–00.)
28	Low power with high TOT	Dirty compressor	Clean compressor (Refer to Compressor Cleaning, para 6., 72–30–00.)
		Compressor foreign object damage	Replace compressor if damage exceeds limits. Inspect turbine assembly for secondary damage.
		Engine air inlet blockage	Remove objects causing blockage. (Refer to Compressor Air Inlet Blockage, para 1.C.(12), Engine–Inspection/Check, 72–00–00.)
		Eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C., 5.D. and 5.E., 72–30–00.)
		New compressor case misaligned at installation	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement, para 2., 72–30–00.)
		Bleed control valve has failed to close.	Check compressor discharge pressure sensing line for leaks and for security. Clean valve nozzle, filter and jet. (Refer to Bleed Valve Cleaning, para 3., 75–10–02.)
		Excessive compressor air leaks	Replace bleed control valve. Repair leaks.
		Faulty TOT indicator	Check calibration of TOT system. Replace indicator as necessary. Also Refer to Item 30.
		Anti–icing valve leaking	Check solenoid and tube fittings for leaks, replace valve as necessary.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
34	Engine N_1 or N_2 overspeeds	Gas producer fuel con–trol linkage not properly set	Check linkage for proper operation and adjustment.
		Defective gas producer fuel control or power turbine fuel governor	Replace defective control or governor.
		Faulty N_1 or N_2 tachometer	Replace tach–generator or indicator.
	NOTE: During ground run after overspeed incident, note the idle speed with the twist grip or throttle at the idle position. If idle speed is normal, suspect the governor. If idle speed is high, suspect the gas producer fuel control as the faulty component.		
35	Excessive NR droop at takeoff, hover, or cruise	Air in fuel system. (CECO control system only.)	Bleed the governor bypass P_o port if droop occurs following system mainte–nance or extended inactivi–ty (overnight). (Refer to applicable part of Purging the Fuel System, para 2.D., 73–00–00.)
36	Fast decelerations	Dirty gas producer fuel control air circuit (Bendix con–trol system only)	Clean circuit. (Refer to Cleaning the Gas Producer Fuel Control Air Circuit, para 4.B., 73–20–02 or para 4.B., 73–20–03.)
37	Auto decelerations	Dirty gas producer fuel control air circuit (Bendix control system only)	Clean circuit. (Refer to Cleaning the Gas Producer Fuel Control Air Circuit, para 4.B., 73–20–02 or para 4.B., 73–20–03.)
38	Excessive exhaust torching during transients	Fuel nozzle malfunction	Replace fuel nozzle.
		Excessively rich gas producer fuel control	Replace control.
		Leaking accessory bleed lines	Repair or replace lines.
39	Slow to accelerate from idle to power	Dirty compressor	Clean compressor and bleed valve. (Refer to Compres–sor Cleaning para 6., 72–30–00 and Bleed Valve Cleaning, para 3., 75–10–02.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
42	Compressor surge during starting or near the idle speed	Dirty compressor	Clean compressor and bleed valve. (Refer to Compres–sor Cleaning para 6., 72–30–00 and Bleed Valve Cleaning, para 3., 75–10–02.)
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or com–pressor assembly if dam–aged or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Dam–age and Case Plastic Coat ing Inspection, para 5.C. through 5.F., 72–30–00.)
		New compressor case misaligned at instal–lation	If noise monitoring indi–cates rub, remove and re–install the case. (Refer to Case Replacement, para 2., 72–30–00.)
		Excessively rich gas producer fuel control	Replace gas producer fuel control.
		Bleed control valve stuck closed	Replace bleed control valve.
43	Compressor surge during starting	Bleed control valve stuck closed	Replace bleed control valve.
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or com–pressor assembly if damage or erosion exceeds accept–able limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.F., 72–30–00.)
		Excessively rich gas producer fuel control	Adjust start/acceleration adjuster CCW one detent. Monitor start to make sure proper start temperatures are maintained. A second one detent adjustment may be made if proper start temperatures can be main–tained. If surge continues after adjustment or accept–able start time start temp–eratures cannot be main–tained, then replace gas producer fuel control.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
44	Compressor surge during acceleration	Bleed control valve failed to open	Replace bleed control valve.
		Excessively rich gas producer fuel control	Adjust start/acceleration adjuster CCW one detent. Monitor start to make sure proper start temperatures are maintained. A second one detent adjustment may be made if proper start temperatures can be main–tained. If surge continues after adjustment or accept–able start time start temp–eratures cannot be main–tained, then replace gas producer fuel control.
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or com–pressor assembly if damage or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.F., 72–30–00.)
		New compressor case misaligned at instal–lation	If noise monitoring in–dicates rub, remove and reinstall the case. (Re–fer to Case Replacement, para 2., 72–30–00.)
45	Compressor surge during low power operation	Bleed control valve failed to open	Clean bleed valve filter, jet and strainer. If con–dition still exists, re–place bleed control valve. (Refer to Bleed Valve Cleaning, para 3., 75–10–02.)
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or com–pressor assembly if damage or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.F., 72–30–00.)
		New compressor case misaligned at instal–lation	If noise monitoring in–dicates rub, remove and reinstall the case. (Re–fer to Case Replacement, para 2., 72–30–00.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
69 (cont)	N_2 does not rotate by 25% N_1 speed during start (cont)		the start procedure. (Refer to Item 69 NOTE.) If re–peated walk–through does not free N_2, clean carbon from rotating labyrinth seals. (Refer to Cleaning Power Turbine Labyrinth Seals, para 7.J., 72–50–00.)
	NOTE: To help alleviate turbine rub or carbon conditions which prevent the N_2 rotor from turning by 25% N_1 speed, walk the main rotor backwards after a start attempt and/or while the engine is cooling down. If chatter is encountered, stop the walk–through. Repeat the procedure at the next convenient shutdown.		
		Aircraft power train seizure	Refer to aircraft mainten–ance manual.
70	Engine tubing cracked or broken at the flare	Excessive vibration	Check the engine for pos–sible vibration causes. (Refer to Vibration Inspec–tion, para 1.C.(2), Engine–In-spection/Check, 72–00–00.)
71	Bearing noise at compressor which may be accompanied by looseness of the impeller	Bearing failure	Inspect and/or replace compressor No. 1 and No. 2 bearings as required.
	NOTE: Inspect magnetic drain plugs to determine extent of contamination due to bearing failure. (Refer to Magnetic Plug Inspection, para 11.G., Engine–Servicing, 72–00–00.)		
72	Magnetic plug warning light illuminated	Engine metal gener–ation	Refer to Magnetic Plug Inspection, para 11.G., En-gine–Servicing, 72–00–00.)
73	Engine undershoots ground idle setting during practice autorotation	Dirty fuel control P_r –P_g valve. (Bendix control system only)	Clean valve. (Refer to Cleaning the Bendix Fuel Control P_r–P_g Valve, para 4.C. 73–20–02.)
74	High throttle shaft torque	Binding of fuel control or governor shaft due to corro–sion build–up between shaft and bushing.	Spray lubrication (WD–40 or equivalent) on the shaft and bushing of the control and governor. Rotate throttle to assure pene–tration. Repeat spray application if necessary.
75	Loss of power sharing during acceleration or torque split on multi–engine applications.	Incorrect aircraft rigging.	Check rigging and adjust in accordance with aircraft manufacturer's instructions.

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PARA 11. (cont)

C. Oil Change

Change the engine oil at the time interval specified in Table 602, 72–00–00, Engine–Inspection/Check or when oil contamination is encountered.

(1) Drain the engine oil supply tank and engine oil cooler. Where the installation permits, inspect the oil tank and cooler for carbon and sludge deposits. If deposits are found, and an external scavenge filter is installed and has not bypassed, clean or replace the engine and scavenge oil filters. If the scavenge oil filter has bypassed, clean or replace the engine and scavenge oil filters, oil cooler, oil tank, and lubrication lines per the airframe manual instructions. Replace the engine oil.

(2) Remove the magnetic drain plugs from the power and accessory gearbox. Allow residual oil to drain from the magnetic plug openings in the gearbox. Inspect the plugs in accordance with Magnetic Plug Inspection, para 11.G., this section. Clean the plugs with solvent. Dry with a clean cloth.

(3) If an accumulation of magnetic particles, debris, chips, flakes or slivers is the cause for oil change, remove, disassemble, clean and inspect the oil pressure reducer at the compressor front support inlet to the number one bearing. (Refer to para 3., 72–30–00, Compressor Section–Maintenance Practices for inspection and cleaning details.)

(4) Remove the oil filter (and packing on applicable configurations) from the filter housing. Discard the packing. Thoroughly clean the oil filter cavity of all residual oil and sludge. Take the necessary precautions to prevent residual oil from entering the engine cavity or standpipe. Clean the oil filter. (Refer to Oil Filter Replacement, para 1.C., 72–60–00.)

NOTE: Some engine bearings feature silver–plated separators. If minute silver particles are found in the engine oil filter, clean and reinstall the filter. These minute particles are due to normal bearing wear and are not cause for further corrective action.

(5) Install the magnetic drain plugs. Use new packings lubricated with engine oil. Tighten plugs to 60–80 lb in. (6.8–9.0 N·m) and secure with lockwire.

(6) Install new or cleaned oil filter with new packing. Fill the filter cavity with appropriate engine oil. Install the filter cap with a new packing which has been lubricated with engine oil. Retain cap with two nuts and washers. Tighten nuts to 30–40 lb in. (3.4–4.5 N·m).

WARNING: MIXING OF OILS NOT IN THE SAME GROUP (4.C., 72–00–00, ENGINE DESCRIPTION AND OPERATION) IS PERMITTED ONLY IN AN EMERGENCY. USE OF MIXED OILS (OILS NOT IN THE SAME GROUP) IN AN ENGINE IS LIMITED TO FIVE HOURS TOTAL RUNNING TIME. ADEQUATE MAINTENANCE RECORDS MUST BE MAINTAINED TO ENSURE THAT THE FIVE HOUR LIMIT IS NOT EXCEEDED.

WARNING: ALTHOUGH EITHER MIL–L–23699 OR MIL–L–7808 OIL IS ACCEPTABLE, DO NOT MIX THESE OILS.

(7) Fill the oil supply tank with approved oil. Mixing of approved oil in the 250 series engine is permitted only within a given group. For example, an oil in Group 23 may be mixed with another brand of oil in Group 23. (Refer to Approved Oils, 4.C.(2), 72–00–00, Engine–Description and Operation.) (Refer to Airframe Manual for proper quantity of oil.)

(8) Motor the engine with the starter and without ignition until an indication of oil pressure is attained. When pressure is evidenced, start the engine and operate at Idle for five minutes. Monitor oil pressure continuously during the five minute run.

(9) Note the oil change in the Engine Log book.

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PARA 11.G. (cont)

(6) Tedeco Manual Zapper

When operating an aircraft utilizing the Tedeco Manual Zapper the following applies:

(a) First Time Chip Light Illuminates

The “Chip Pulse” switch should be activated to “on”.

1 If the chip light goes out after activation of the “Chip Pulse” switch then continue the flight, make a log book entry accordingly and observe engine operation and warning lights.

2 If the chip light remains on after activation of the “Chip Pulse” switch, land and inspect the magnetic plugs as soon as possible. This light is an indication of conditions which could cause engine failure. When flying a multi–engine aircraft, reduce the affected engine output power to the minimum required for flight and land as soon as practical. If the light is accompanied by abnormal noises, oil pressure or temperature, and single–engine flight can be maintained, shutdown affected engine and land as soon as practical. If single–engine flight is not possible, reduce power of affected engine to the minimum and land as soon as possible. After landing, inspect the magnetic plugs on the affected engine for metal contamination prior to further engine operation. Refer to PARA 11.G., this section, and make a log book entry accordingly.

3 If during the 30 minutes following the first activation of the “Chip Pulse” switch, the annunciator light comes on, land as soon as possible. This light is an indication of conditions which could cause engine failure. When flying a multi–engine aircraft, reduce the affected engine output power to the minimum required for flight and land as soon as practical. If the light is accompanied by abnormal noises, oil pressure or temperature, and single–engine flight can be maintained, shutdown affected engine and land as soon as practical. If single–engine flight is not possible, reduce power of affected engine to the minimum and land as soon as possible. After landing, inspect the magnetic plugs on the affected engine for metal contamination prior to further engine operation. Refer to PARA 10.G., this section, and make a log book entry accordingly.

(b) Second Time Chip Light Illuminates

If within a 50 hour period of when the first chip light illuminated, the same chip light illuminates for the second time, follow the same procedures as indicated for the first time the chip light illuminates.

(c) Third Time Chip Light Illuminates

If within a 50 hour period of when the first chip light illuminated, the same chip light illuminates for the third time, do not activate “Chip Pulse”. Land and inspect the magnetic plugs as soon as possible. This light is an indication of conditions which could cause engine failure. When flying a multi–engine aircraft, reduce the affected engine output power to the minimum required for flight and land as soon as practical. If the light is accompanied by abnormal noises, oil pressure or temperature, and single–engine flight can be maintained, shutdown affected engine and land as soon as practical. If single–engine flight is not possible, reduce power of affected engine to the minimum and land as soon as possible. After landing, inspect the magnetic plugs on the affected engine for metal contamination prior to further engine operation. Refer to PARA 11.G., this section, and make a log book entry accordingly.

NOTE: If a magnetic drain plug warning light received in the cockpit is confirmed to be caused by an indicating system malfunction and no metal is found on the magnetic drain plugs, this chip light incident does not count toward the total of four chip lights in 50 hours.

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PARA 11.G. (cont)

(d) Fourth Time Chip LIght Illuminates

If the chip light illuminates a fourth time within 50 hours, do not activate ”Chip Pulse’’. Land as soon as possible. This light is an indication of conditions which would cause engine failure. When flying a multi–engine aircraft, reduce the affected engine output power to the minimum required for flight and land as soon as practical. If the light is accompanied by abnormal noises, oil pressure or temperature, and single–engine flight can be maintained, shutdown affected engine and land as soon as practical. If the single–engine flight is not possible, reduce power of affected engine to the minimum and land as soon as possible. Remove the affected engine and send it to an Authorized Maintenance Center. Tag engine noting the reason for rejection.

(e) If the 50 hour time period is obtained with two or fewer chip light indications, a new 50 hour sequence begins and appropriate adjustments to log entries should be made for previous 50 hour sequence.

(f) Suggested Logging Procedure For Chip Indications

All chip indications, whether physically inspected or zapped, must appear in the engine Maintenance Log. The maintenance records which are available to the pilots should reflect the total number of chip indications for the previous 50 hours so that the pilot can initiate the appropriate procedure if a chip light indication is received in the cockpit during that day’s operational period.

H. Emergency Oil Mix

CAUTION: REMOVE AND INSPECT THE OIL FILTER EACH 25 HOURS OF ENGINE OPERATION IF THE TYPE OF OIL (MIL–L–7808, MIL–L–23699 OR DOD–85734) IS CHANGED.

CAUTION: THE FILTER INSPECTION IS TO DETERMINE IF COKE, WHICH WAS FORMED DURING PREVIOUS OPERATION, IS BEING DISLODGED DURING THE INITIAL OPERATION FOLLOWING THE OIL CHANGE.

CAUTION: IF HEAVY CARBON DEPOSITS ARE OBSERVED ON THE ENGINE FILTER, IT IS SUGGESTED THAT THE ENGINE OIL BE CHANGED AGAIN. THE OIL IS TO BE DRAINED WHEN THE OIL IS HOT TO OBTAIN THE MAXIMUM BENEFIT. THE 25–HOUR OIL MONITORING IS TO CONTINUE UNTIL THE NEXT OIL CHANGE PERIOD.

CAUTION: USE OF OILS WHICH ARE NOT INCLUDED IN THE APPROVED OILS LISTING (PARA 4.C., 72–00–00, ENGINE—DESCRIPTION AND OPERATION) OR FAILURE TO DRAIN OIL WITHIN THE PRESCRIBED INTERVAL GIVEN IN TABLE 602, 72–00–00, ENGINE–INSPECTION/CHECK WILL BE CONSIDERED AS MISUSE UNDER ITEM (4) OF THE WARRANTY POLICY.

The emergency use of mixed oils (oils not in the same group; refer to PARA 4.C., 72–00–00, Engine—Description and Operation) is limited to five hours running time. Following an emergency use of mixed oils, drain the system and clean the filter. (Refer to Oil Filter Replacement, PARA 1.C., 72–60–00.) Thoroughly flush the system with engine oil while motoring the engine. Drain and refill with approved oil in accordance with Oil Change, PARA 11.C., this section.

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	100 Hour Inspection (cont)			
	f. Inspect magnetic chip detector plugs.	PARA 11.G., 72–00–00, Engine–Servicing		
	g. Inspect quick disconnect magnetic chip detector plugs and flanged inserts for wear, if installed.	PARA 11.G., 72–00–00, Engine–Servicing		
	*h. Refill oil system.	PARA 11.C., 72–00–00, Engine–Servicing		
21.A	Remove, inspect and clean the fuel nozzle. If no airframe mounted fuel filter is installed, inspect the fuel nozzle filter.	PARA 2., 73–10–03		
	NOTE: Operators may find it necessary to inspect and clean the fuel nozzle more often depending on past experience or operating conditions.			
22	Inspect the start counter for proper operation, increase in count, and for loose, chafed,frayed or broken wires and loose connectors.	PARA 1., 74–20–03		
23	Check the condition of the bleed valve gasket, without removing bleed valve. Replace gasket if air leaks (blowouts) can be detected.	PARA 2., 75–10–02		
24	Inspect the outer combustion case for condition. Inspect the weld joints of and in the brazed screen reinforcement in the armpit area.	PARA 2.B., 72–40–00		
25	Clean the burner drain valve.	PARA 3., 72–40–00		
26	Inspect the ignition lead for burning, chafing,or cracking of conduit and loose connectors and broken lockwire.	N/A		
27	On engines with CECO fuel system, clean or replace the high pressure fuel filter.	N/A		
28	On engines with CECO fuel systems, visually inspect the bleed hole at the low point in the scroll–to–governor P_C tube for any obstruction. If the hole is not completely open, remove any contamination which could obstruct drainage of moisture from the tube using a piece of lockwire.	N/A		
29	Review engine records for compliance with all mandatory bulletins, inspections and airworthiness directives.	N/A		
30	Review engine records for time limited parts components, accessory or modules.	N/A		
31	Enter component changes, inspection compliance, etc., in log book as required.	N/A		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	200 Hour Inspection			
	In addition to the 100 hour inspection items, perform the following:			
	WARNING: MANDATORY COMPLIANCE DATE FOR ROLLS–ROYCE COMMERCIAL ENGINE BULLETIN 250–C20 CEB–1051 WAS AUGUST 30, 1980.			
32	Perform fuel pump backlash inspection on Sundstrand dual element pump P/N 6854292, 6857548, 6877719, 6856250, 6876803.	250–CSL–1007		
	300 Hour Inspection			
	In addition to the 100 hour and applicable 200 hour inspection items, perform the following:			
	CAUTION: INSPECTION FREQUENCY SHALL BE BASED ON THE NATURE OF THE EROSIVE AND/OR CORROSIVE ENVIRONMENT. THE OPERATING ENVIRONMENT MAY DICTATE A MORE FREQUENT INSPECTION INTERVAL. FOR NON–COATED COMPRESSOR WHEELS, THE INSPECTION SHALL NOT EXCEED 300 HOURS OR 6 MONTHS. FOR COATED COMPRESSOR WHEELS, INSPECTION SHALL NOT EXCEED 300 HOURS OR 12 MONTHS. IF ANY PARENT METAL IS EXPOSED DUE TO CORROSION AND/OR EROSION, THE INSPECTION REQUIREMENT SHALL REVERT BACK TO 300 HOURS OR 6 MONTHS.			
33	Inspect the compressor case when operating in an erosive and/or corrosive environment.	PARA 1.D.(9), this Section		
	CAUTION: AIRCRAFT INSTALLED–ENGINE FUEL–PUMP FILTER DIFFERENTIAL PRESSURE WARNING SYSTEMS AND/OR OPERATING EXPERIENCE MAY DICTATE REPLACEMENT AT A LESSER TIME INTERVAL. IN NO INSTANCE SHOULD THE 300 HR REPLACEMENT INTERVAL BE EXCEEDED.			
34	Replace the fuel filter element. This filter is a throw–away item. It is not cleanable. Before discarding filter, inspect for signs of contaminants. If any are found, inspect the entire fuel system and clean if necessary.	PARA 2.C., 73–10–01		
	CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. (REFER TO SPECIAL INSPECTIONS, 72–00–00, TABLE 604) IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.			
	CAUTION: PURGE AIR FROM THE FUEL SYSTEM.			
35	Perform a fuel pump bypass valve operational check whenever a fuel filter is replaced.	PARA 3.A., 73–10–01		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	300 Hour Inspection (cont)			
36	Remove, clean and inspect engine P_c filter every 300 hours or earlier as engine performance dictates.	PARA 3., 73–20–06		
37	Inspect and clean the No. 1 bearing oil pressure reducer.	PARA 3., 72–30–00		
38	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	N/A		
39	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72–50–00		
40	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G., 72–50–00		
41	Deleted			
	500 Hour/1 Year Inspection			
42	Inspect all uncoated and coated P/N 6846278 and 6871338 power turbine outer couplings nuts for corrosion.	250–C20 CSL–1060		
	NOTE: Compliance with Rolls–Royce Commercial Engine Bulletin 250–C20 CEB–1120 and/or 250–C20 CEB–1158 removes this inspection requirement.			
	600 Hour Inspection			
43	Check the fuel pump driveshaft on Sundstrand single element pumps for spline wear.	N/A		
	NOTE: This inspection is not required for Agro–Tech (TRW) fuel pumps or Sundstrand fuel pumps P/N 23003114 and subsequent.			
44	Perform scavenge oil filter impending bypass functional test per Facet Service Bulletin No. 090589 (ref. Rolls–Royce 250 CSL 1164) for aircraft equipped with this type of external scavenge filter system.	N/A		
45	Replace the fuel control filter assembly. Bendix fuel controls P/N 2524552–4 or 2524552–6 (less–5) and prior unless 250–C20 CEB–1089 has been accomplished.	PARA 4.A., 73–20–02, 4.A., 73–20–03		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	1000 Hour Inspection			
46	Inspect Py port on Bendix power turbine governor per 250 CEB–A–1281. The governor must be removed from the engine to perform this inspection.	N/A		
	NOTE: If CEB–A–1289 or CEB 1330 have been accomplished, this inspection is not required.			
	1500 Hour Inspection			
47	Replace the fuel control filter assembly. Bendix fuel controls P/N 2524552–5 and subsequent and those earlier fuel controls which have had Rolls–Royce Commercial Engine Bulletin 250–C20 CEB–1089 accomplished.	PARA 4.A., 73–20–02, 4.A., 73–20–03		
48	Inspect fuel nozzle filter.	PARA 3.A., 73–10–03		
	1750 Hour Inspection			
49	Inspect the compressor case. Inspection frequency shall be as made necessary by operating environment. In erosive environment, inspect case at least every 300 hours. In any environment do not exceed 1750 hours without case inspection.	PARA 1.D., 72–00–00, 5., 72–30–00		
50	Heavy Maintenance Inspection (HMI). Heavy maintenance inspection shall consist of gas producer turbine wheels replacement and inspection of assembled components per Rolls–Royce published documents. It is the responsibility of the operator to assure that the total time and cycle life limits of specific parts listed in Section 05–10–00, Airworthiness Limitations, are not exceeded.	N/A		
	As Required Inspection			
51	Clean the bleed valve after each 10 hr of water–alcohol augmentation operation or after consumption of each 750 gallons (2840 liters) of water–alcohol mixture.	PARA 3., 75–10–02		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	150 Hour Inspection (cont)			
14	Inspect the compressor scroll for cracks or breaks at the anti–ice air valve and customer bleed port. If cracks or breaks are detected, check engine for possible vibration causes.	PARA 1.D.(2), this section		
15	Inspect for discharge air tube inserts that are cocked or backing out of the scroll. If cocked or loose inserts are detected, check engine for possible vibration causes. Check air tubes for cracks.	N/A		
16	Check compressor discharge air tubes for damage or deterioration.	PARA 4.A., 72–40–00		
17	Check anti–ice valve for security, worn parts and proper operation. Valve need not be removed or disassembled unless a problem is detected.	PARA 4., 75–10–01		
18	Inspect compressor mount inserts, bolts and nuts for looseness, fretting or oil leakage. Replace or retighten as required. Check engine for possible vibration causes.	PARA 4.D., 72–60–00 and PARA 1.D.(2), this section		
19	Inspect the turbine support assemblies and engine exhaust ducts for condition of welded joints, for cracks and buckling. Check exhaust duct clamps for proper installation, condition and torque.	PARA 8.A., 72–50–00		
20	Inspect the starter–generator brushes for wear in accordance with the Aircraft Manual at the same time the spline inspection is made.	PARA 4.B., 72–60–00		
21	Lubrication system inspection			
	a. Remove, inspect and clean the oil filter. Note any accumulation of metal chips, debris or carbon particles. Conduct further inspection of the lube system and/or engine gear train/bearings if metal chips or debris are found. See Items 36a, 37, 38 and 39 below if carbon particles are found.	PARA 1.C., 72–60–00		
	NOTE: Follow STC manufacturer's recommendations regarding replacement/cleaning of external oil filter elements. Inspect removed elements for any accumulations of metal chips, debris or carbon particles. It may prove helpful to cut apart disposable (paper) filler elements to facilitate this inspection. If chips, debris or carbon particles are found, proceed with additional inspection/maintenance as outlined in item 21b. above.			

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Table 603 (cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	150 Hour Inspection (cont)			
	b. Inspect magnetic chip detector plugs.	PARA 11.G., 72–00–00, Engine–Servicing		
	c. Inspect quick disconnect magnetic chip detector plugs and flanged inserts for wear, if installed.	PARA 11.G., 72–00–00, Engine–Servicing		
21.A	Remove, inspect and clean the fuel nozzle exterior. If no airframe mounted fuel filter is installed, inspect the fuel nozzle filter.	PARA 2., 73–10–03		
	NOTE: Operators may find it necessary to inspect and clean the fuel nozzle more often depending on past experience or operating conditions.			
22	Inspect the start counter for proper operation, increase in count, and for loose, chafed, frayed or broken wires and loose connectors.	PARA 1., 74–20–03		
23	Check the condition of the bleed valve gasket without removing bleed valve. Replace gasket if air leaks (blowouts) can be detected.	PARA 2., 75–10–02		
24	Inspect the outer combustion case for condition. Inspect the weld joints of and in the brazed screen reinforcement in the armpit area.	PARA 2.B., 72–40–00		
25	Clean the burner drain valve.	PARA 3., 72–40–00		
26	Inspect the ignition lead for burning, chafing, or cracking of conduit and loose connectors and broken lockwire.	N/A		
27	On engines with CECO fuel system, clean or replace the high pressure fuel filter.	N/A		
28	On engines with CECO fuel systems, visually inspect the bleed hole at the low point in the scroll–to–governor P_C tube for any obstruction. If the hole is not completely open, remove any contamination which could obstruct drainage of moisture from the tube using a piece of lockwire.	N/A		
29	Review engine records for compliance with all mandatory bulletins, inspections and airworthiness directives.	N/A		
30	Review engine records for time limited parts components, accessory or modules.	N/A		
31	Enter component changes, inspection compliance, etc., in log book as required.	N/A		

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Table 603 (cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	300 Hour Inspection			
	In addition to the 150 hour inspection items, perform the following:			
	WARNING: MANDATORY COMPLIANCE DATE FOR ROLLS–ROYCE COMMERCIAL ENGINE BULLETIN 250–C20 CEB–1051 WAS AUGUST 30, 1980.			
32	Perform fuel pump backlash inspection on Sundstrand dual element pump P/N 6854292, 6857548, 6877719, 6856250, 6876803.	250–CSL–1007		
	CAUTION: INSPECTION FREQUENCY SHALL BE BASED ON THE NATURE OF THE EROSIVE AND/OR CORROSIVE ENVIRONMENT. THE OPERATING ENVIRONMENT MAY DICTATE A MORE FREQUENT INSPECTION INTERVAL. FOR NON–COATED COMPRESSOR WHEELS, THE INSPECTION SHALL NOT EXCEED 300 HOURS OR 6 MONTHS. FOR COATED COMPRESSOR WHEELS, INSPECTION SHALL NOT EXCEED 300 HOURS OR 12 MONTHS. IF ANY PARENT METAL IS EXPOSED DUE TO CORROSION AND/OR EROSION, THE INSPECTION REQUIREMENT SHALL REVERT BACK TO 300 HOURS OR 6 MONTHS.			
33	Inspect the compressor case when operating in an erosive and/or corrosive environment.	PARA 1.D.(9), this section		
	CAUTION: AIRCRAFT INSTALLED–ENGINE FUEL–PUMP FILTER DIFFERENTIAL PRESSURE WARNING SYSTEMS AND/OR OPERATING EXPERIENCE MAY DICTATE REPLACEMENT AT A LESSER TIME INTERVAL. IN NO INSTANCE SHOULD THE 300 HR REPLACEMENT INTERVAL BE EXCEEDED.			
34	Replace the fuel filter element. This filter is a throw–away item. It is not cleanable. Before discarding filter, inspect for signs of contaminants. If any are found, inspect the entire fuel system and clean if necessary.	PARA 2.C., 73–10–01		
	CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. (REFER TO SPECIAL INSPECTIONS, 72–00–00, TABLE 604) IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.			
	CAUTION: PURGE AIR FROM THE FUEL SYSTEM.			
35	Perform a fuel pump bypass valve operational check whenever a fuel filter is replaced.	PARA 3.A., 73–10–01		

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Table 603 (cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	300 Hour Inspection (cont)			
36	Lubrication system inspection			
	NOTE: Maximum interval between oil change is 300 hours or 6 months whichever occurs first.			
	a. Drain oil system.	PARA 11.C., 72–00–00, Engine–Servicing		
	b. Inspect and clean turbine pressure oil check valve.	PARA 7.K., 72–50–00		
	c. Turbine pressure oil tube screen assembly. Detach clamp; then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the tube coupling nut at the fireshield elbow only enough to allow sufficient movement of the tube to enable removal of the screen. At assembly, tighten connector coupling nut to 200–250 lb in. (23–28 N·m). Tighten fireshield elbow coupling nut to 80–120 lb in. (9–14 N·m). Tighten clamp nut to 35–40 lb in. (3.9–4.5 N·m).	N/A		
	d. Measure oil flow from the scavenge passage of the external sump and from the scavenge passage of the gas producer support. It is recommended that the external sump is not removed for this check.	PARA 7.D., 72–50–00		
	NOTE: This step must be performed before draining oil or after the oil system has been refilled.			
	e. Refill oil system.	PARA 11.C., 72–00–00, Engine–Servicing		
37	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	N/A		
38	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72–50–00		
39	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G., 72–50–00		
40	Deleted			

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	1000 Hour Inspection			
47	Inspect Py port on Bendix power turbine governor per 250 CEB–A–1281. The governor must be removed from the engine to perform this inspection.	N/A		
	NOTE: If CEB–A–1289 or CEB 1330 have been accomplished, this inspection is not required.			
	1500 Hour Inspection			
48	Replace the fuel control strainer assembly. Bendix fuel controls P/N 2524552–5 and subsequent and those earlier fuel controls which have had Rolls–Royce Commercial Engine Bulletin 250–C20 CEB–1089 accomplished.	PARA 4.A., 73–20–02, 4.A., 73–20–03		
49	Inspect fuel nozzle filter.	PARA 3.A., 73–10–03		
	1750 Hour Inspection			
50	Inspect the compressor case. Inspection frequency shall be as made necessary by operating environment. In erosive environment, inspect case at least every 300 hours. In any environment do not exceed 1750 hours without case inspection.	PARA 1.D., 72–00–00, 5., 72–30–00		
51	Heavy Maintenance Inspection (HMI). Heavy maintenance inspection shall consist of gas producer turbine wheels replacement and inspection of assembled components per Rolls–Royce published documents. It is the responsibility of the operator to assure that the total time and cycle life limits of specific parts listed in Section 05–10–00, Airworthiness Limitations, are not exceeded.	N/A		
	As Required Inspection			
52	Clean the bleed valve after each 10 hr of water–alcohol augmentation operation or after consumption of each 750 gallons (2840 liters) of water–alcohol mixture.	PARA 3., 75–10–02		

PARA 1. (cont)

D. Special Inspections

Special inspections are required when the engine has been subjected to abnormal operating conditions, when engine damage is suspected, or when associated parts are removed from the engine. The special occurrence, the component or system to be inspected, and the nature of the inspection are given in Table 604.

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Table 604 (cont)
Special Inspections

Item	Occurrence	Component or System	Required Action
20	Engine inactive more than 5 days	Compressor	n
21	Engine inactive more than 45 days	Oil system Fuel system	an bc
22	As dictated by performance	Fuel control P_c filter System P_c filter	ax ba
23	Vibration	Compressor Gearbox	m ad
24	Engine submerged while in operation	Compressor Turbine	h t
25	On condition inspection	Power and accessory gearbox	ae
26	Known or suspected lightning strike	Engine, general Rotor or propeller general	e
27	Slippage and/or sudden engagement of freewheel clutch unit	Turbine Gearbox	w,x af
28	First 50 hours of operation on new, repaired or overhauled engines.	Oil system Oil filter	aq1 as
29	Replacement of fuel pump and/or fuel filter or fuel system connections being loosened	Fuel system	au,bd
30	Fuel system contamination (known high amount of particles or microbiologicals)	Fuel pump Fuel control Fuel nozzle	bd aw bb

NOTE: The letter designations in the Required Action column refer to the applicable Description of Inspection.

Description of Inspections

Engine, General

a. Anytime the engine is removed from the aircraft, inspect the compressor inlet for foreign object damage or condition. Clean and flush all aircraft drain lines. Wash the outside of the engine with mineral spirits. Touch up paint where peeling or chipping is evident. Refer to Corrosion Treatment and Surface Finish Repair, PARA 2., 72–00–00, Engine–Cleaning/Painting.

b. After a hard landing, inspect the complete engine. Refer to Hard Landing Limits, PARA 1.D.(3), 72–00–00, this section.

c. After the main rotor or propeller strikes an object or the engine N_2 power train is subjected to abnormal shock loading during operation, a sudden stoppage inspection must be performed. Refer to Sudden Stoppage Inspection, PARA 1.D.(4) or 1.D.(5), 72–00–00, this section.

d. (250–C20S only) Purge trapped air from the propeller oil system on the ground prior to the first flight anytime the propeller or the engine has been replaced. Refer to Propeller Check Run, PARA 1.D., 72–00–00, Engine–Adjustment/Test.

e. After a known or suspected lightning strike, inspect the complete engine. Refer to Lightning Strike Inspection, PARA 1.D.(7), 72–00–00, this section.

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Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Fuel Pump Filter

CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER, AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.

au. The engine driven fuel pump is equipped with a throw–away filter element with a maximum replacement interval specified in the Scheduled Inspections, Table 602, this section. If the filter shows signs of contamination to the point of possibly bypassing, or if an impending bypass indication has been noted (some aircraft may incorporate this system), replace the filter element. Refer to PARA 2.C., 73–10–01 or PARA 2., 73–10–05 for filter replacement instructions.

Fuel Control, Governor and High Pressure Filters (CECO)

CAUTION: IF ANY FILTER SHOWS EVIDENCE OF CONTAMINATION TO THE POINT OF BYPASSING, RETURN THE FUEL CONTROL AND POWER TURBINE GOVERNOR TO AN AUTHORIZED FACILITY FOR FLUSHING, OR FLUSH IN ACCORDANCE WITH 250–C20 CSL–1034 AND –1035. ALSO, INSPECT THE FUEL NOZZLE FILTER FOR CONTAMINATION. IF ANY CONTAMINATION IS FOUND ON THE FUEL NOZZLE FILTER, THE FUEL NOZZLE MUST BE SENT TO AN AUTHORIZED FACILITY TO HAVE THE UNIT CLEANED AND TESTED.

av. Anytime fuel pump filter bypass is known or suspected to have taken place, inspect and if required, clean the filters in the gas producer fuel control and the power turbine governor. Refer to Cleaning the Fuel Control Fuel Filter, PARA 4., 73–10–04, and Cleaning the Governor Fuel Filter, PARA 4.A., 73–20–05. Also, clean or replace the high pressure fuel filter element. Refer to High Pressure Fuel Filter, PARA 2., 73–10–05.

Fuel Control Filter (Bendix)

CAUTION: IF THE FUEL CONTROL FILTER SHOWS EVIDENCE OF CONTAMINATION, RETURN THE FUEL CONTROL TO AN AUTHORIZED MAINTENANCE CENTER FOR CLEANING AND INSPECTION. ALSO, INSPECT THE FUEL NOZZLE FILTER FOR CONTAMINATION. IF CONTAMINATION IS FOUND ON THE FILTER, RETURN THE FUEL NOZZLE TO AN AUTHORIZED FACILITY FOR CLEANING AND TESTING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.

aw. Anytime fuel pump filter bypass is known or suspected to have taken place, inspect and if required, clean the fuel filter element in the gas producer fuel control. Refer to Cleaning the Gas Producer Fuel Control Fuel Filter, PARA 4.A., 73–20–02 or PARA 4.A., 73–20–03.

Bendix Fuel Control and Power Turbine Governor Airflow Restrictors

ax. When dictated by engine performance, remove, clean and reinstall the fuel control and power turbine governor airflow restrictors. Refer to PARA 4.B., 73–20–02 or PARA 4.B., 73–20–03 and PARA 2.D., 73–20–01.

Fuel Control P_c Filter (250–C20S)

ay. When dictated by engine performance, clean and reinstall the fuel control P_c filter. Refer to PARA 4.B., 73–20–03.

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PARA 1.D. (cont)

(6) Engine Submerged While in Operation

If the engine has been submerged in water while in operation, proceed as follows:

(a) Tag the engine indicating that it encountered submersion while in operation. Provide details of submersion event.

(b) Return the entire engine to a Rolls–Royce Authorized Maintenance Center as soon as possible for replacement of all compressor and turbine wheels.

(7) Lightning Strike Inspection

Aircraft lightning strikes occur when the airframe can serve as a least–resistance bridge for the electrical bolt as it travels through the air. Consequently, aircraft extremities (tail pylon, blades, nose, landing gear, etc.) typically act as points of entry or exit. However, since the exact electrical path through the aircraft may not be readily traceable following a strike, the following guidelines are recommended:

(a) In the event of a lightning strike in the immediate vicinity of the engine(s) (as evidenced by charring, burn marks or pitting associated with electrical arcing on the engine cowl, compartment or inlet) remove the engine(s) prior to further flight and send them to a Rolls–Royce Authorized Maintenance Center (AMC) for detailed teardown and inspection.

(b) Where the aircraft is known or suspected of having been involved in a lightning strike, and entry/exit points either cannot be determined or appear remote to the engine(s), perform the following:

1 Inspect the engine compartment for evidence of lightning strike damage.

2 Manually rotate N_1 and N_2 systems and check for binding and abnormal noise.

3 Remove, inspect, and clean the engine oil filter. Refer to Oil Filter Replacement, PARA 1.C., 72–60–00.

4 Remove, inspect, and clean the magnetic plugs. Refer to Magnetic Plug Inspection, PARA 11.G., Engine–Servicing, 72–00–00.

WARNING: NEVER RUN ENGINE(S) AT HIGH POWER ON WET OR FROZEN SURFACES.

5 Operate the engine(s) for 30 minutes on the ground and recheck the magnetic plugs for metal accumulation. Refer to PARA 11.G., 72–00–00, Engine– Servicing.

a On twin engine aircraft, each engine should be operated individually at 100% Nr and flat pitch.

b (250–C20, –C20B, –C20F, –C20J, –C20W) On single engine aircraft, engine should be operated at power required to make aircraft light on its skids.

c (250–C20S) On single engine aircraft, engine should be operated at 100% N_r and minimum power.

6 Listen for abnormal noise on coastdown and abnormally short coastdown time.

(8) Hot Start Inspection

(a) When the engine starting temperature limits of Table 8 or 9, 72–00–00, Engine–Description and Operation are exceeded, and turbine inspection is the recommended maintenance action, proceed as follows:

1 Remove the outer combustion case and combustion liner. Refer to Replacing the Combustion Liner, PARA 1., 72–40–00.

2 Inspect the first–stage nozzle in accordance with Table 201, PARA 7.C., 72–50–00.

3 Inspect the first–stage turbine wheels. Refer to Blade and Vane Inspection, PARA 7.A., 72–50–00.

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PARA 2.B. (cont)

(3) Loosen the four corner bolts (3) in the horizontal flanges. Allow the horizontal flange to reposition; then retighten the four bolts to the minimum torque necessary to close the horizontal splitlines.

(4) Install the bolts and nuts in the front flange of the top case half at the three centermost bolt hole positions. Tighten the two outer bolts (4) to a snug fit; then tighten the center bolt (5). If the bolt holes in the front flange do not align with the flange holes in the front support, loosen the front flange bolts in the bottom case half to a snug fit. Using a drift inserted into a misaligned bolt hole, rotate the front support sufficiently to align the holes. Install and tighten the three bolts and nuts.

C. Removal (Compressor Case Bottom Half) (See Figure 206.)

(1) Remove the four bolts and nuts in the horizontal splitlines.

(2) Remove the three bolts and nuts in the bottom half front flange.

(3) (Remove the eight bolts and nuts in the bottom half rear flange.

(4) Carefully lift the bottom half straight out. Do not pry against the top half.

D. Installation (Compressor Case Bottom Half) (See Figure 206.)

NOTE: The RTV 732 or RTV 736 sealer is used to seal the rear corners of the splitline. Use of the sealer is optional on engines that are not used with the water–alcohol injection system.

(1) Apply a sphere of approximately 0.12 in. (3 mm) dia of RTV 732, or equivalent (Compressor Case Splitline Sealer, Table 111–1), aft of the rearmost bolt hole on the bottom case half horizontal flange surfaces. Assemble and tighten all splitline bolts and nuts as soon as possible after application of RTV 732 (never exceed 30 minutes).

(2) Carefully position the bottom case half to cover the rotor. Install a bolt and nut (6) in each of the four corners (adjacent to the end flanges) at the horizontal flange. Tighten the bolts to the minimum torque necessary to close the horizontal splitlines.

(3) Install and tighten two bolts and nuts (7) in the rear flange of the bottom case half. Use the bolt holes which are diametrically opposite the top case half bolts.

(4) Loosen the four corner bolts in the horizontal flanges. Allow the horizontal flange to reposition; then retighten the four bolts (8) to the minimum torque necessary to close the horizontal splitlines.

(5) Install and tighten one bolt and nut (9) in the front flange at the center hole position (90 degrees from the horizontal flanges).

(6) Install the remaining 13 horizontal flange bolts and nuts. Loosen the two rear corner bolts and nuts; then tighten all bolts (10)–(26) starting from the rear and alternating from side to side.

(7) Install and tighten the remaining 12 bolts and nuts (27) in the rear flange and the eight bolts and nuts (28), plus nameplate, in the front flange.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(8) Attach the RH and LH anti–icing air tubes to the anti–icing air valve and to the front support. Tighten coupling nuts to 200–250 lb in. (23–29 N·m).

(9) Attach the compressor pressure and scavenge oil tubes:

(a) Install the gearbox elbow–to–front support scavenge oil tube. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

(b) Install the gearbox union–to–pressure reducer pressure oil tube. Tighten coupling nuts to 65–100 lb in. (7.3–11.3 N·m).

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Para 5.C. (1) (cont)

(c) No sharp edges (with exception of blade tips), burrs, cracks or tears are acceptable.

(2) Leading and Trailing Edge Damage. (See Figure 211.)

(a) Blend and polish to remove damage.

(b) Replace compressor when the limits of Figure 211 are exceeded.

(3) Tip Damage. (See Figure 212.)

(a) Blend and polish to remove tip damage.

(b) Replace compressor when the limits of Figure 212 are exceeded.

(4) Surface Damage. (See Figure 213.)

(a) Blend and polish to remove surface damage.

(b) Replace the compressor when any of the limits of Figure 213 are exceeded.

(5) Corrosion. (Uncoated Blades)

(a) Blend and polish to remove all corrosion caused pits by blending to limits defined for damage. Replace the compressor when:

1 Pitting in any area of the blade forms a definite line.

2 Pit size or location exceeds blend limits.

(6) Corrosion – Coated Blades.

(a) Two similar aluminide coatings are used on the compressor blades, HI–51S (Alloy Surfaces Corp.) and A–12 (Chromalloy). Both HI–51S and A–12 consist of an intermetallic diffused aluminide coating and a conversion top coating. These coatings offer sacrificial protection against corrosion.

(b) Due to the sacrificial properties of the diffused coating, reddish brown colored products (superficial rust) may become visible on the airfoil surfaces if exposed to a corrosive environment. These products are actually corrosion of the coating surface, not the base blade material. The effective removal of the superficial rust may be accomplished by lightly brushing with a soft nylon brush using hot (65°C 150°F)) soapy water (non–alkaline neutral) solution, followed by water rinse.

(c) This procedure pertains only to superficial rust indication. It is imperative that you not confuse superficial rust indication with corrosion pitting. If pitting is observed:

1 Blend and polish to remove all corrosion caused pits in the outer 75% of the blade by blending to limits defined for damage.

2 If corrosion caused pits or any form of damage is detected in the lower 25% of the airfoil, send the rotor to an Authorized Maintenance Center (AMC).

3 Replace the compressor when:

a Pitting in any area of the blade forms a definite line.

b Pit size or location exceeds blend limits.

(7) Erosion.

(a) Replace the compressor assembly when more than 50% of the blades in any stage have a chord width less than the limits shown in Figure 214.

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PARA 6.B. (cont)

(12) Cap or plug all disconnected fittings.

CAUTION: DO NOT EXCEED 10% N1 RPM MOTORING SPEED DURING CLEANING OR RINSING CYCLES. DO NOT INJECT A SOLID STREAM OF FLUID INTO THE COMPRESSOR.

(13) Inject solution with an aspirator or sprayer equipped with a quick opening valve. Use a steam powered aspirator and hot water, if available.

(14) Start injection three seconds prior to starter engagement and disengage starter at 10% N_1 rpm.

(15) While motoring the engine with the starter, without ignition, inject one quart (one liter) in 9 to 11 seconds to maintain speed below 10% for duration of injection. Repeat injection cycle as necessary to clean compressor.

(16) (McDonnell Douglas aircraft only). Remove the metal plug from the end of the P_c tube. This will allow flushing the P_c filter in the next step.

(17) After injection of cleaning solution, spray steam or clean water (distilled preferred) into the compressor inlet. Start injection three seconds prior to starter engagement, injecting one pint to one quart (0.5 to 1.0 liter) in approximately 5 to 10 seconds, and again disengaging starter before speed accelerates above 10% N_1 rpm.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(18) Clean the bleed valve. (Refer to Cleaning Bleed Valve, Para 3., 75–10–02.)

(19) (All aircraft other than McDonnell Douglas aircraft). Reconnect the pressure sensing tubes and airframe bleed air plumbing. Tighten the P_c tube coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(20) (McDonnell Douglas aircraft only). Remove the cap from the governor tee (T) fitting and reconnect the P_c pressure sensing tube to the governor tee. Tighten the P_c tube coupling nut to 80–120 lb in. (9.0–13.6 N·m). Reconnect the bleed valve sensing tube and tighten the coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(21) Start and operate the engine for a minimum of five minutes. Operate the engine anti–icing system to purge any compressor cleaning solution from the compressor inlet housing. Operate all aircraft systems that utilize compressor bleed air. Complete the engine drying run as soon as possible after cleaning and rinsing.

(22) If power is not restored after the compressor has been cleaned, reclean as follows:

(a) Remove one case half and clean the blades and vanes with a small brush (toothbrush) and a mild dishwashing detergent (Lux or equivalent). (Refer to Compressor Case Replacement, para 2., this section, for proper procedure.)

(b) Reinstall the cleaned case half. Remove the second (dirty) case half. Clean blades and vanes and replace case half in the same manner as used with the first case half.

C. Cleaning Water–Alcohol Residue from Engine.

Regular use of water alcohol augmentation may temporarily reduce engine power if impure water has been used. Contaminants from impure water build up in the compressor airflow path. Restore normal power by removing contaminants using the normal compressor cleaning process (Brulin). If Brulin cleaning does not restore normal engine power, clean the engine with 0–200 micron dry Arizona road dust (AC Spark Plug Coarse Air Cleaner Test Dust, or equivalent) as follows:

(1) Start the engine. Load to power requirement just short of liftoff.

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PARA 1.C. (cont)

(12) Remove the two compressor discharge air tubes and make the following inspection of the seal groove lands and of the split seal rings at the compressor (small) end.

(a) Remove the split seal rings from the small end of the air tubes.

(b) Replace the split seal rings if the edges show wear which could be detrimental to the sealing effect or if the expander ring is broken.

(c) Inspect the discharge air tube lands in accordance with Figure 207, 72–40–00.)

(d) Apply antiseize compound to the components of the split seal rings. Install the rings on the discharge air tubes. Split seal ring gaps should be 180° apart.

(13) Remove the burner drain valve from the outer combustion case. Wash the valve in hot detergent, rinse in water and blow dry. Install the cleaned valve in the outer combustion case. Tighten valve to 120–140 lb in. (14–16 N·m).

(14) Remove the five nuts at the splitline and separate the turbine from the power and accessories gearbox.

(15) Remove the turbine shaft–to–pinion gear and the turbine–to–compressor couplings. Discard packings.

(16) Make the following inspection of the turbine–to–compressor coupling splines and the turbine–to–pinion gear coupling splines:

(a) Visually inspect for cracked or broken spline teeth. No cracked or broken teeth allowed.

(b) Using a sharp pointed scribe, 0.020 in. (0.051 mm) radius, inspect the splines for a wear step. Any discernable wear step that can be felt with the scribe is unacceptable. Polished spline surfaces are acceptable.

D. Installation (250–C20S, –C20W) (See Figure 202.)

NOTE: Always replace the packing on the spur adapter gearshaft each time the turbine assembly is removed or anytime the packing is exposed. Use only authorized P/N packings as replacements. (Refer to 250–C20 Series Illustrated Parts Catalog, Pub. No. 10W4, for part numbers of packings.)

(1) Apply engine oil lightly to the splines of the two turbine couplings. Install the compressor–to–turbine coupling on the turbine second–stage splined adapter. Lubricate two new piston ring seals and install them on the turbine shaft–to pinion gear coupling. Install the coupling on the rotor of the replacement turbine with the end having the four equally spaced grooves out (toward the gearbox).

(2) Lubricate packing and place it on the back of the power and accessories gearbox. Install the replacement turbine on the gearbox. Turn the gear trains with 6799790 engine turning adapter as necessary to allow the coupling splines to mate. Retain the turbine with five nuts. Coat stud threads lightly with antiseize compound before installation. Tighten the bottom nut (5/16–24) to 110–120 lb in. (12–14 N·m) and the four top nuts (1/4–28) to 55–65 lb in. (6.2–7.3 N·m).

(3) Place the packing, seal ring, and wave washers over the small end of one compressor discharge air tube, then insert the tube through the firewall into the diffuser scroll. Use 6799953 installation clamp to compress the split seal ring for the installation. Install the second air tube in the same manner.

NOTE: These items are optional depending on engine configuration.

(4) Slip the retaining rings over the large ends of the compressor discharge air tubes.

(5) Place the combustion liner over the first–stage turbine nozzle shield with the igniter plug opening at the nine o'clock position (looking forward).

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PARA 2.B. (cont)

(17) (250–C20, –C20B, –C20F, –C20J) Install the firewall shield. (Refer to Fire Shield Installation, Para 3.B., this section.)

(18) Remove the turbine from the supporting adapter.

(19) Install the firewall on the front of the turbine. Retain with two each nuts, bolts, and washers. Coat threads of bolts lightly with antiseize compound before installation. Tighten nuts to 35–40 lb in. (3.9–4.5 N·m).

(20) Make a visual inspection through the gearbox bore to verify that the spur adapter gearshaft packing is installed and in good condition.

(21) Apply engine oil lightly to the splines; then install the turbine–to–compressor coupling on the spur adapter gearshaft. Lubricate two new packings and install on the turbine shaft–to–pinion gear coupling; then install the coupling on the turbine rotor. Be sure the coupling is installed on the turbine rotor with the end having four equally spaced grooves out (toward the gearbox).

(22) Install the turbine on the engine. (Refer to Turbine Assembly–Installation, Para 1.B. or 1.D., this section.)

(23) Check run the engine following replacement of the turbine nozzle. (Refer to Check Run, para 1., 72–00–00, Engine—Adjustment/Test.)

3. Fire Shield

The fire shield can be removed from the engine to gain access to turbine components and splitline bolts, nuts and brackets. It must be removed from the 250–C20, –C20B, –C20F, or C20J series engine before the thermocouple assembly can be removed. Remove the fireshield as follows:

A. Removal (250–C20, –C20B, –C20F, –C20J)

(1) Remove the gas producer fuel control assembly and attached control and fuel lines. (Refer to Gas Producer Fuel Control Replacement, Para 2.A., 73–20–02 2.A., 73–20–04.)

WARNING: TO PREVENT ELECTRICAL SHOCK DURING REMOVAL OF THE SPARK IGNITER AND THE LEAD, ALLOW FIVE MINUTES FOR ELECTRICAL DISSIPATION FOLLOWING IGNITION OPERATION OR TEST.

(2) Remove the nuts and bolts to disconnect the clamping arrangements on the igniter lead. Disconnect the igniter lead from the spark igniter. Remove two nuts and bolts securing the igniter lead to the fire shield and separate the lead from the fire shield.

(3) Remove the fire shield–to–fuel nozzle hose. Cap the fuel nozzle.

(4) Remove the gas producer support scavenge oil fitting–to–gearbox scavenge oil tube and the external sump–to–gearbox scavenge oil tube.

(5) Remove the gearbox–to–check valve pressure oil tube, check valve and check valve–to–fireshield pressure oil tube as an assembly.

(6) Disconnect the fire shield drain lines.

(7) Remove the two attaching screws and remove the oil sump.

(8) Remove the two nuts and washers retaining the fire shield to the scavenge oil fitting and to the pressure oil tube elbow.

(9) Remove the two attaching bolts and washers attaching the fire shield to the splitline brackets.

(10) Lower the fire shield to disengage the scavenge oil fitting and pull rearward to separate it from the turbine and exhaust collector support. Remove the washer and spacer from the scavenge oil fitting. Remove the washer from the pressure oil tube elbow.

(11) If the gas producer support scavenge oil fitting is cocked and/or shows evidence of oil leakage, remove the fitting.

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PARA 7.A. (1) (cont)

(a) Blade Damage. Replace the turbine assembly if any of the following conditions exist:

1 Damage to inner 1/3 of blade.

2 Blade or stator vane broken off.

3 Cracked blade.

4 Melted vane or blade.

B. Power Turbine Outer Shaft Spline Inspection

(1) Inspect the power turbine outer shaft splines whenever the engine has been subjected to a sudden stoppage as defined in PARA 1.C.(4) or 1.C.(5), 72–00–00, Engine–Inspection/Check.

(2) If any of the following conditions exist, return the turbine to an Authorized Maintenance Center (AMC) for replacement of damaged parts: (See Figure 210.)

(a) Chipped, cracked, damaged, pitted or worn spline teeth.

NOTE: Use a sharp pointed scribe, 0.020 in. (0.51 mm) radius, to inspect the spline teeth for a wear step. Any discernable wear step that can be felt with the scribe is unacceptable.

(b) Evidence of spline deformation or twisting.

C. First–stage Turbine Nozzle and Nozzle Shield Inspection

The inspection limits and disposition regarding specific conditions which may be encountered are given in Table 201. The serviceable limits given in the table are defined as follows:

(1) Serviceable limit is the maximum degree of a specified condition which can be accepted, allowing the part to be placed back into service without repair.

(2) Repairable limit is the maximum degree of a specified condition which can be repaired. Any condition exceeding the limit cannot be corrected by the specified repair procedure; therefore, the part must be condemned.

D. Oil Flow Measurement

(1) Measure the quantity of oil flow from the gas producer support scavenge oil passage (C20W and C20S only) and from the power turbine support scavenge oil passage or the external sump as follows:

(a) Disconnect the scavenge oil tube from the gas producer scavenge oil fitting and connect a suitable hose to the fitting to direct scavenge flow into a calibrated container (C20W and C20S only).

(b) Disconnect the scavenge oil tube from the external sump at the power turbine support and connect a suitable hose to the external sump scavenge fitting to direct flow into another calibrated container. If the external sump is removed, use 23003267–8/–0 adapter and a length of suitable hose to direct flow into a calibrated container.

NOTE: Do not put the hoses from the scavenge passages into the same container. The flow from each scavenge passage must be measured individually.

(c) To ensure consistency, make the measurement during the following conditions:

1 Engine oil temperature no cooler than 50°F (10°C) and no hotter than normal operating temperatures.

2 Use of external power source, not aircraft battery, to ensure a minimum N_1 cranking speed of 16%.

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PARA 7.E. (cont)

(d) Loosen the gas producer support pressure oil tube at the connector. Do not remove the gas producer support pressure oil tube.

CAUTION: IF THE GAS PRODUCER SUPPORT PRESSURE OIL TUBE IS REMOVED, THE SUPPORT PASSAGE MUST BE FLUSHED. (REFER TO REPLACING GAS PRODUCER PRESSURE OIL PASSAGE PARA 7.H., THIS SECTION.)

CAUTION: IF POWER TURBINE SUPPORT OIL NOZZLE IS TWISTED OR IS SUSPECTED OF BEING TWISTED DURING REMOVAL, CHECK OIL JET PERPENDICULARITY PER PARA 6.G., THIS SECTION.

CAUTION: MAKE CERTAIN THAT NO FOREIGN MATERIAL ENTERS THE EXPOSED TUBES OR OPENINGS.

(e) Remove lockwire and two bolts; then, remove the power turbine support oil tube connector. Remove the power turbine support pressure oil nozzle. Discard two packings.

(2) (250–C20S, –C20W) Disassemble the oil passage components as follows:

(a) Remove the scavenge oil tube between the external sump and the elbow at the fire shield.

(b) Remove the lockwire and remove the two external sump attaching bolts. Remove the sump. Discard the packing. Visually inspect sump for accumulation. Clean or replace sump as required.

NOTE: Removal of the following components is not necessary unless the scavenge oil passage requires cleaning.

(c) Remove the fire shield access panel. (Refer to Fire Shield Access Panel, para 4., this section.)

CAUTION: IF THE GAS PRODUCER PRESSURE OIL MANIFOLD IS NOT PROPERLY REMOVED, IT WILL BE NECESSARY TO FLUSH THE GAS PRODUCER SUPPORT PRESSURE OIL PASSAGE. (REFER TO REPLACING GAS PRODUCER PRESSURE OIL MANIFOLD, PARA 7.H., THIS SECTION.)

MAKE CERTAIN THAT NO FOREIGN MATERIAL ENTERS THE EXPOSED TUBES OR OPENINGS.

(d) Remove the gas producer pressure oil manifold from the turbine as outlined in Replacing Gas Producer Pressure Oil Manifold para 7.I., this section. Discard two packings.

CAUTION: IF THE POWER TURBINE SUPPORT OIL NOZZLE IS TWISTED OR IS SUSPECTED OF BEING TWISTED DURING REMOVAL, CHECK OIL JET PERPENDICULARITY PER PARA 7.G., THIS SECTION.

(e) Remove the power turbine support pressure oil nozzle. Discard packing.

(3) Inspect the power turbine support scavenge oil passage using a light and mirror. The cross section of the passage is oval and is approximately 0.50 x 0.15625 in. (13 x 4 mm). If carbon deposits (coke) are found, clean the passage; otherwise reassemble the oil passage components. (See Figure 211.)

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(d) Lubricate two packings and install with the gas producer support pressure oil manifold. Apply anti–seize compound to the four retaining bolts. Tighten bolts to 35–40 lb in. (3.9–4.5 N·m) and secure with lockwire.

(e) Blow through the installed manifold with clean compressed air to ensure that it is clear.

(f) Install the fire shield access panel. (Refer to Fire Shield Access Panel—Installation, para 4.B., this section)

F. Oil System Maintenance

WARNING: MAINTAIN THE COMPLETE OIL SYSTEM IN ACCORDANCE WITH ENGINE AND AIRCRAFT INSTRUCTIONS. FAILURE TO MAINTAIN THE OIL SYSTEM CAN RESULT IN SUDDEN ENGINE STOPPAGE.

To minimize oil system problems, the maintenance action given in 100 Hour Inspections, Table 602, 72–00–00, Engine–Inspection/Check, should be observed. Each operator must be aware of the symptoms of oil system difficulties in order that corrective action may be taken as quickly as possible.

(1) Symptoms:

If any of the following symptoms are present, return the engine to an Authorized Maintenance Center (AMC) immediately for turbine cleaning and inspection.

(a) Oil consumption in excess of one quart (0.9 liter) per flight hour.

(b) Heavy smoking out the exhaust.

(c) Heavy carbon deposits or blockage of the power turbine support scavenge oil strut and external sump.

(d) Oil temperature exceeds 107°C (225°F) for a period of less than ten minutes, but remains less than 120°C (248°F).

NOTE: If a ferry flight to the maintenance facility is necessary, make the following check before flight.

1 Disconnect the scavenge oil tube from the external sump. Place a container under the sump scavenge fitting.

2 Motor the engine for 15 seconds without ignition.

a If a solid stream of oil flows from the sump fitting, reconnect the scavenge oil tube to the sump. Tighten the coupling nut. Proceed to the maintenance facility (a ferry flight of less than four hours may be made).

b If no flow or if oil trickles from the sump fitting, replace the turbine and change the engine oil before further flight. (Refer to Turbine Assembly, Removal, para 1.A. or 1.C., this section and Oil Change, para 11.C. 72–00–00, Engine–Servicing)

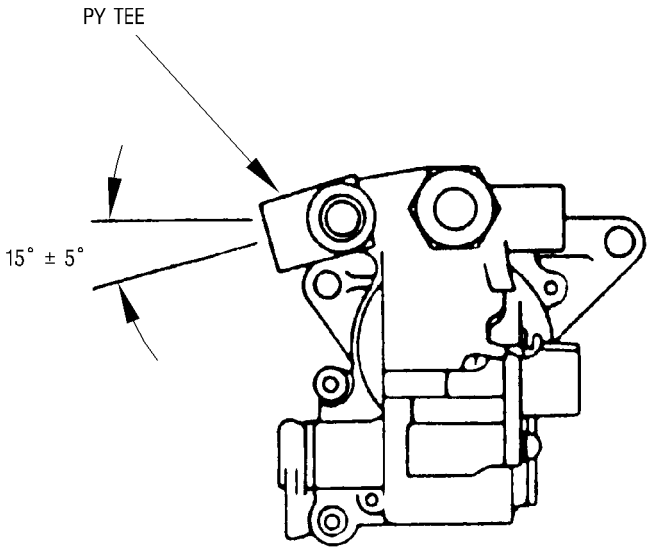
(2) Corrective Action:

Clean, inspect and repair the turbine having any of the symptoms given in para 6.F.(1), this section as follows:

(a) At the Maintenance Facility , remove the turbine from the engine. (Refer to applicable part of Turbine Assembly, Removal, para 1.A. or 1.C., this section) Mount the turbine on 6799955 fixture. Retain the fixture at the rear flange of the gas producer support using the two bolts. Position vertically with the turbine and exhaust collector on top.

(b) Remove the fire shield (Refer to applicable part of Fire Shield–Removal para 3.A. or 3.C., this section)

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VIEW FROM REAR OF ENGINE
TOP VIEW OF GOVERNOR

ADH062XD

P_y Tee Assembly Orientation
Figure 202

PARA 2. (cont)

(1) Rotate the throttle and check for higher than normal torque.

(2) If higher than normal torque exists, apply lubricant, standard engine oil MIL–PRF–23699 (NATO Code 0–156) to the area shown in Figure 203.

(3) Rotate the throttle following lubricant application to assure penetration.

(4) Repeat the spray application if necessary.

E. Cleaning and Inspecting the Bendix Power Turbine Governor Pg Air Circuit

A contaminated Pg air circuit in the power turbine governor may cause droop, overshoot or hunting of the N_2 rotor. Correct this contamination condition by cleaning the governor Pg orifice. (See Figure 204.) The orifice can be cleaned with the governor either installed or removed from the engine. If the governor is removed from the engine, use the procedures in para 1.A., this section. Clean as follows:

(1) Carefully clean the exterior of the governor using methyl ethyl ketone. Be sure all contamination is removed in the area of the Pg orifice. Blow dry.

CAUTION: THE FOLLOWING IS AN IMPORTANT CHANGE IN PREVIOUSLY APPROVED PROCEDURE:

CAUTION: DO NOT REMOVE OR CLEAN THE FUEL GOVERNOR PG BLEED; HOWEVER, CONTINUED MAINTENANCE OF THE FUEL GOVERNOR PG ORIFICE IS RECOMMENDED.

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PARA 3.H.(1) (b) (cont)

CAUTION: DURING THE ATTEMPTED START, TOT MUST BE CLOSELY MONITORED TO PREVENT OVERTEMPERATURE OPERATION. RECORD OVERTEMPERATURE IN THE ENGINE LOG.

3 Make the adjustment using an Allen wrench. Turn clockwise to enrich the starting fuel flow to improve stagnated starts, cold weather starts, or high altitude ground starts. Make the adjustment in 15° maximum increments (dots are 10° apart) and tighten the locknut to 20–25 lb in. (2.3–2.8 N·m) after each setting. Check the starting peak TOT after each setting until satisfactory starts are made.

NOTE: If satisfactory starts can not be attained with a few incremental adjustments of the start derichment adjustment and the start–acceleration adjustment, refer to para 3.C.(1)(d) below.

CAUTION: MONITOR TOT CLOSELY AFTER START–DERICHMENT ADJUSTMENT TO MAKE SURE OVERTEMPERATURE LIMITS ARE NOT EXCEEDED.

4 When the desired adjustment is obtained, secure the locknut to the P_c filter–fitting with lockwire.

5 On fuel controls prior to P/N 6899262 (Bendix P/L 2524644–9), if satisfactory starts are not obtained during steps (b) 1 through 4, proceed as follows:

a Return the start–derich pointer to the neutral position. Tighten locknut.

b Install a short No. 10–32 screw into the vent fitting on the start–derich cover. This deactivates the start–derich assembly and allows the operator to check the basic fuel schedule of the control.

c Enrich the basic schedule slightly by retightening the start–derich cover screws. Remove lockwire from the screws, then check screw retention torque. Torque should be 9–10 lb in. (1.02–1.13 N·m). Retorque the screws in 2 lb in. (0.23 N·m) increments to a maximum value of 14 lb in. (1.6 N·m). After each 2 lb in. (0.23 N·m) retightening operation, make a start attempt. It is not necessary to remove the No. 10–32 screw from the vent at this time; this is only a check of the integrity of the basic schedule. If satisfactory starts are obtained, lockwire the derich assembly cover screws and remove the No. 10–32 screw from the vent fitting. Make another start. It may be necessary to adjust the start–derich assembly from the neutral position. After final adjustments have been made, lockwire the start–derich assembly.

(c) On fuel controls prior to P/N 6899262 (Bendix P/N 2524644–9), if satisfactory starts are not obtained during steps (b) 1 through (a) 5, proceed as follows:

1 Return the pointer to the neutral position (4 dots/40° from the ccw stop).

2 Disconnect the fuel control–to–inline check valve tube. Provide a means of directing fuel that will be discharged from this port on the control into a clean container.

3 Deactivate primary power to the ignition system.

4 Motor the engine to approximately 15% N_1 speed; then open the throttle to the 30° (Ground Idle) position. Motor the engine for 15 seconds; then close the throttle.

NOTE: This procedure is based upon a 15 second fuel flow. Be sure the throttle is closed exactly 15 seconds after it is opened.

5 Using a calibrated beaker, measure the quantity of fuel in the container. There should be 85–95 cc of fuel in the beaker at sea level. At higher altitudes the flow will be less.

NOTE: For improved accuracy, take the average of three readings.

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BLEED AIR CONTROL SYSTEM––MAINTENANCE PRACTICES

1. General

   Bleed air system maintenance includes replacement, cleaning and testing of the bleed control valve.

2. Bleed Valve Replacement (See Figure 201 or 202, 75–00–00.)

   Bleed Valve. Test the bleed control valve on an installed engine. Clean the bleed valve if it does not operate in the range given in Figure 22, 72–00–00, Engine–Description and Operation. Clean valve in accordance with Bleed Valve Cleaning, para 3., this section. Replace the bleed control valve as follows if cleaning does not bring the valve into the desired operating range.

   A. Removal

      (1) Disconnect the compressor discharge pressure sensing tube assembly by loosening the coupling nut at the valve elbow.

      (2) Remove the three bolts, nuts and washers. Separate the bleed control valve and gasket from the mounting flange on the compressor case. Discard gasket.

      (3) Remove the elbow from the bleed valve. Discard packing.

   B. Installation

      WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

      (1) Lubricate new packing and install it on the elbow. Install the elbow in the replacement bleed valve. Do not tighten the jam nut at this time.

      (2) Apply antiseize compound to bolt threads, then install the replacement bleed control valve and gasket on the mounting flange. Retain with three bolts, nuts and washers. Assemble with washers beneath bolt heads. Tighten No. 10–32 nuts to 35–40 lb in. (3.9–4.5 N·m). Tighten the 1/4–28 nut to 70–85 lb in. (7.9–9.6 N·m).

      (3) Attach the compressor discharge pressure sensing tube assembly to the bleed control valve with the coupling nut. Tighten the elbow jam nut to 55–80 lb in. (6.2–9.0 N·m), after final elbow positioning is determined. Secure nut with lockwire. Tighten coupling nut to 80–120 lb in. (9.0–13.6 N·m).

   C. Cleaning Bleed Valve

      Clean the bleed valve nozzle, filter, and jet as follows:

      (1) Remove the air sensing line from the bleed valve elbow.

      (2) Remove the elbow from the bleed valve. Discard the packing.

      (3) Remove the internal retaining ring and separate the filter from the bleed valve. (See Figure 201.) Replace the retaining ring before assembly if it is damaged during the removal operation.

      (4) Using a screwdriver, remove the jet from the bleed valve.

      (5) Clip the lockwire then remove the nozzle from the bleed valve.

         CAUTION: DO NOT BLOW THE JET DRY. THE SMALL JET CAN BE EASILY LOST OR DAMAGED.

      (6) Clean the nozzle, filter, and jet ultrasonically in mineral spirits if equipment is available.

      (7) If ultrasonic equipment is not available, agitate the parts in a clean container of mineral spirits. Use a soft bristle brush to clean exposed surfaces. Insert a sewing thread through the jet hole. Slide the jet back and forth on the thread to remove film. Clean the nozzle in the same manner.

         NOTE: If the jet must be replaced, return the bleed valve to overhaul for part replacement and recalibration of the valve assembly.

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Rolls-Royce

Operation and Maintenance Manual

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250–C20
250–C20B
250–C20F
250–C20J
250–C20S
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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
42	Compressor surge during starting or near the idle speed	Dirty compressor	Clean compressor and bleed valve. (Refer to Compressor Cleaning para 6., 72–30–00 and Bleed Valve Cleaning, para 2.C., 75–10–02.)
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damaged or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.F., 72–30–00.)
		New compressor case misaligned at installation	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement, para 2., 72–30–00.)
		Excessively rich gas producer fuel control	Replace gas producer fuel control.
		Bleed control valve stuck closed	Replace bleed control valve.
43	Compressor surge during starting	Bleed control valve stuck closed	Replace bleed control valve.
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damage or erosion exceeds acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.F., 72–30–00.)
		Excessively rich gas producer fuel control	Adjust start/acceleration adjuster CCW one detent. Monitor start to make sure proper start temperatures are maintained. A second one detent adjustment may be made if proper start temperatures can be maintained. If surge continues after adjustment or acceptable start time start temperatures cannot be maintained, then replace gas producer fuel control.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
44	Compressor surge during acceleration	Bleed control valve failed to open	Replace bleed control valve.
		Excessively rich gas producer fuel control	Adjust start/acceleration adjuster CCW one detent. Monitor start to make sure proper start temperatures are maintained. A second one detent adjustment may be made if proper start temperatures can be main–tained. If surge continues after adjustment or accept–able start time start temp–eratures cannot be main–tained, then replace gas producer fuel control.
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or com–pressor assembly if damage or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.F., 72–30–00.)
		New compressor case misaligned at instal–lation	If noise monitoring in–dicates rub, remove and reinstall the case. (Re–fer to Case Replacement, para 2., 72–30–00.)
45	Compressor surge during low power operation	Bleed control valve failed to open	Clean bleed valve filter, jet and strainer. If con–dition still exists, re–place bleed control valve. (Refer to Bleed Valve Cleaning, para 2.C., 75–10–02.)
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or com–pressor assembly if damage or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.F., 72–30–00.)
		New compressor case misaligned at instal–lation	If noise monitoring in–dicates rub, remove and reinstall the case. (Re–fer to Case Replacement, para 2., 72–30–00.)

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PARA 11. (cont)

C. Oil Change

Change the engine oil at the time interval specified in Table 602, 72–00–00, Engine–Inspection/Check or when oil contamination is encountered.

(1) Drain the engine oil supply tank and engine oil cooler. Where the installation permits, inspect the oil tank and cooler for carbon and sludge deposits. If deposits are found, and an external scavenge filter is installed and has not bypassed, clean or replace the engine and scavenge oil filters. If the scavenge oil filter has bypassed, clean or replace the engine and scavenge oil filters, oil cooler, oil tank, and lubrication lines per the airframe manual instructions. Replace the engine oil.

(2) Remove the magnetic drain plugs from the power and accessory gearbox. Allow residual oil to drain from the magnetic plug openings in the gearbox. Inspect the plugs in accordance with Magnetic Plug Inspection, para 11.G., this section. Clean the plugs with solvent. Dry with a clean cloth.

(3) If an accumulation of magnetic particles, debris, chips, flakes or slivers is the cause for oil change, remove, disassemble, clean and inspect the oil pressure reducer at the compressor front support inlet to the number one bearing. (Refer to para 3., 72–30–00, Compressor Section–Maintenance Practices for inspection and cleaning details.)

(4) Remove the oil filter (and packing on applicable configurations) from the filter housing. Discard the packing. Thoroughly clean the oil filter cavity of all residual oil and sludge. Take the necessary precautions to prevent residual oil from entering the engine cavity or standpipe. Clean the oil filter. (Refer to Oil Filter Replacement, para 1.C., 72–60–00.)

NOTE: Some engine bearings feature silver–plated separators. If minute silver particles are found in the engine oil filter, clean and reinstall the filter. These minute particles are due to normal bearing wear and are not cause for further corrective action.

(5) Install the magnetic drain plugs. Use new packings lubricated with engine oil. Tighten plugs to 60–80 lb in. (6.8–9.0 N·m) and secure with lockwire.

(6) Install new or cleaned oil filter with new packing. Fill the filter cavity with appropriate engine oil. Install the filter cap with a new packing which has been lubricated with engine oil. Retain cap with two nuts and washers. Tighten nuts to 30–40 lb in. (3.4–4.5 N·m).

WARNING: MIXING OF OILS NOT IN THE SAME GROUP (4.C., 72–00–00, ENGINE DESCRIPTION AND OPERATION) IS PERMITTED ONLY IN AN EMERGENCY. USE OF MIXED OILS (OILS NOT IN THE SAME GROUP) IN AN ENGINE IS LIMITED TO FIVE HOURS TOTAL RUNNING TIME. ADEQUATE MAINTENANCE RECORDS MUST BE MAINTAINED TO ENSURE THAT THE FIVE HOUR LIMIT IS NOT EXCEEDED.

WARNING: ALTHOUGH EITHER MIL–L–23699 OR MIL–L–7808 OIL IS ACCEPTABLE, DO NOT MIX THESE OILS.

(7) Fill the oil supply tank with approved oil. Mixing of approved oil in the 250 series engine is permitted only within a given group. For example, an oil in Group 23 may be mixed with another brand of oil in Group 23. (Refer to Approved Oils, 4.C.(2), 72–00–00, Engine–Description and Operation.) (Refer to Airframe Manual for proper quantity of oil.)

(8) Motor the engine with the starter and without ignition until an indication of oil pressure is attained. When pressure is evidenced, start the engine and operate at Idle for five minutes. Monitor oil pressure continuously during the five minute run.

(9) Note the oil change in the Engine Log book.

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Rolls-Royce

Operation and Maintenance Manual

Sixth Edition 30 December 1996
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250–C20
250–C20B
250–C20F
250–C20J
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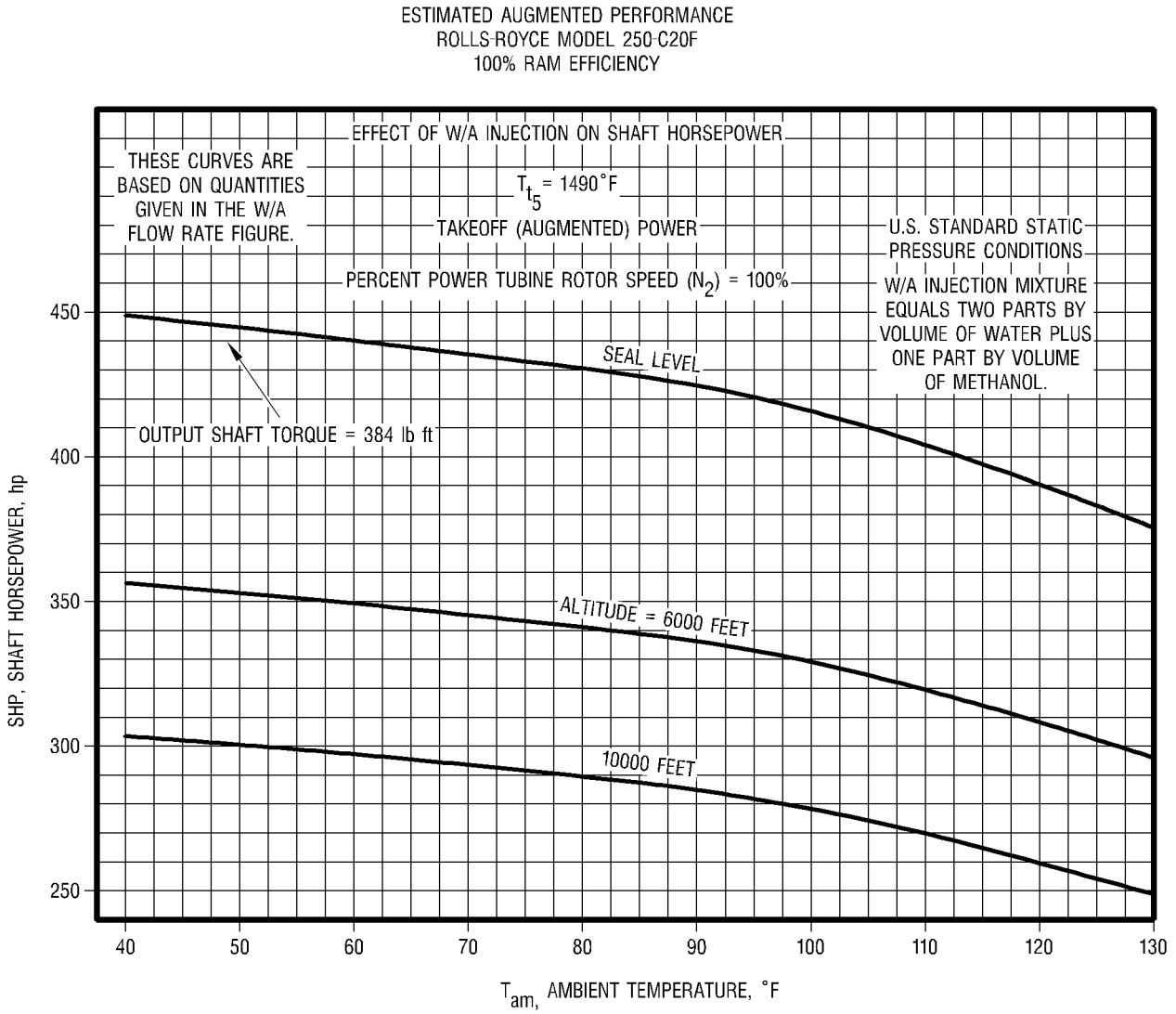
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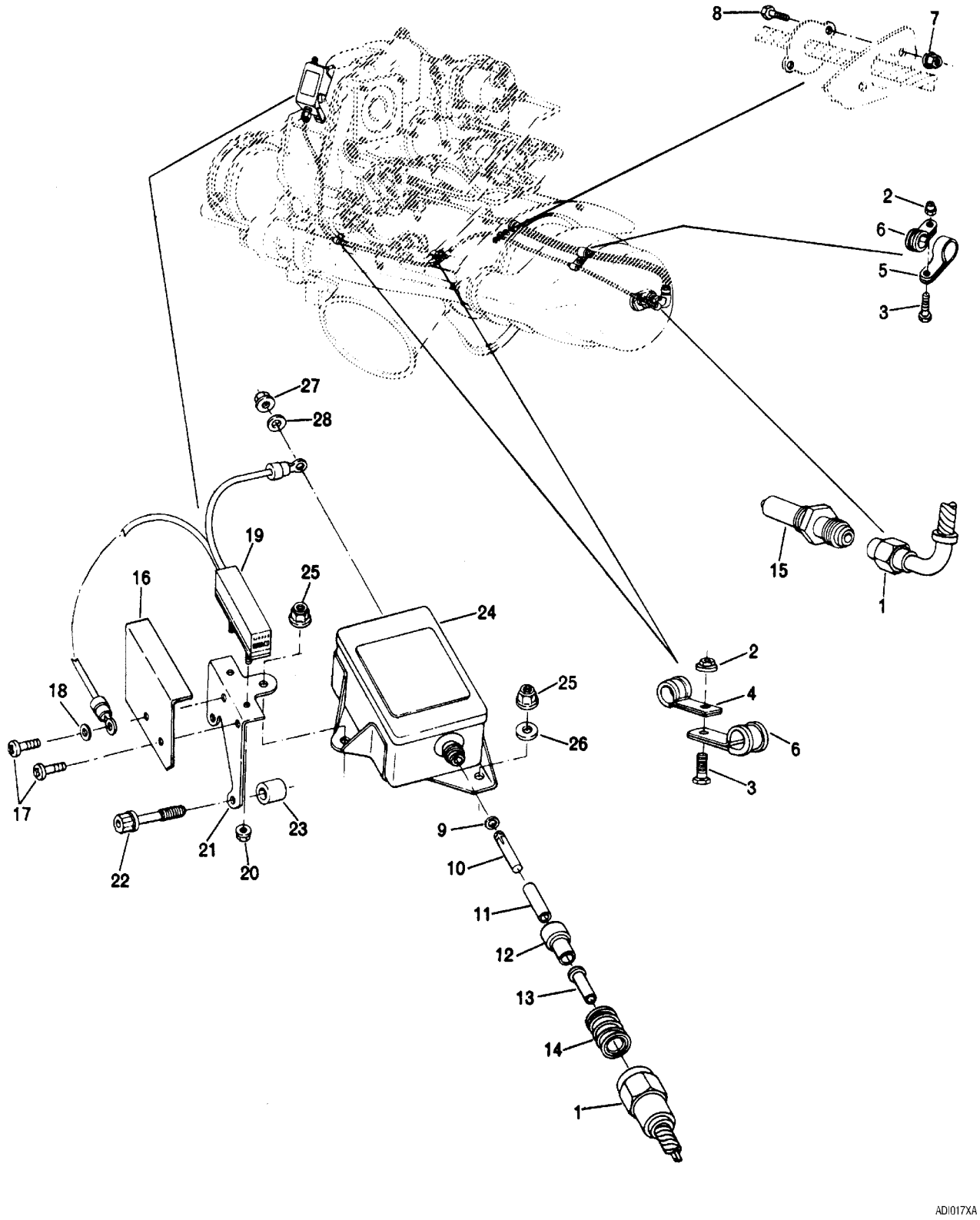
Effect of Water–Alcohol Injection on Shaft Horsepower (250–C20F)
Figure 24

Rolls-Royce Proprietary Data – Uncontrolled Printed Copy

Legend for Figure 202

1. Spark igniter lead
2. Bolt (3)
3. Bolt (3)
4. Clamp (2)
5. Clamp
6. Clamp (3)
7. Nut (2)
8. Bolt (2)
9. Washer
10. Socket
11. Connector
12. Grommet
13. Grommet
14. Spring
15. Spark Igniter
16. Protective bracket
17. Screw (2)
18. Washer
19. Start counter
20. Nut (2)
21. Bracket
22. Bolt (2)
23. Spacer (2)
24. Ignition exciter
25. Nut (3)
26. Washer (2)
27. Nut
28. Washer

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Engine Electrical System Assembly (250–C20S)
Figure 202

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Rolls-Royce

Operation and Maintenance Manual

Sixth Edition 30 December 1996
Revision 10 1 June 2006

Publication ref. 10W2

250-C20
250-C20B
250-C20F
250-C20J
250-C20S
250-C20W

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Revision Number	**Date**
Preliminary Edition	21 April 1970
First Revision	1 June 1970
Second Revision	1 September 1970
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First Edition	1 February 1971
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Second Revision	1 September 1971
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Ninth Revision	1 June 2005

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Revision Number	Date
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TECHNICAL ASPECTS ARE FAA APPROVED TEMPORARY REVISION E6R10-05-1

LIFE LIMITS OF THE COMPRESSOR ROTOR

Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
Impeller	6871337	Original	2500	7500
	23060177	Ground Pin, Glass Bead Peen	2500	7500
Impeller	6876873	Hub relocated rearward	3550	9150
	23057117	No Pin	3550	9150
	23058146	Extended Adapter	3550	9150
	23058147	Extended Adapter	3550	9150
	23060417	Ground Pin, Glass Bead Peen	3550	9150
1st-stage Wheel	23079060			30,000
2nd-3rd-stage Wheel	23079059			30,000
4th-stage Wheel	23079058			30,000
5th-stage Wheel	23079057			30,000
6th-stage Wheel	23079056			30,000

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
36	Methyl alcohol (Fed Spec O–M 232d, grade A; Rolls–Royce EMS–125) (British Standard BS 506 Amend. 1)	Compressor water rinse	Commercial Solvents Corp., 245 Park Ave. New York, N.Y. 10017 Union Carbide Corp. Chemicals and Plastics, 270 Park Ave. New York, N.Y. 10017
37	Desiccant	Shipping package humidity control	No. 88 Absorbent Protective Dehydrating Agent (MIL–D–3464) Delta Packaging Products 4108 North Nashville Avenue Chicago, Illinois 60634
38	Liquid leak detector	Checking for pneumatic leaks	SNOOP (meets Mil Spec MIL–L–25567C, type 1 oxygen systems) Indiana Valve & Fitting Inc. P.O. Box 24267 Indianapolis, Ind 46224 Leak–Tec Formula 372E American Gas and Chemical Co. 5 Tefnakil Park Cresskill, New Jersey 07626
39	Adhesive	Oil pump gearshaft retention	Loctite 290 Loctite Corporation 705 North Mountain Road Newington, Connecticut 06111
40	Fuel anti–ice additive	Fuel anti–ice	Prist (MIL–I–27686E) PPG Industries Inc. 5629 FM 1960 West Houston, Texas 77069
41	Torque Paint	Application of slippage marks to pneumatic and lubrication system B–nuts	Torque Seal F–900 Organic Products Company P. O. Box 428 Irving, Texas 75060–0428
42	Torque Paint Remover	Removal of torque paint (slippage marks)	F–100 Remover Organic Products Company P. O. Box 428 Irving, Texas 75060–0428
43	Silicone resin sealer–clear (AMS 3135)	Repair of compressor case plastic cracks	Metroseal AP Metco Inc. 1105 Prospect Ave. Westbury, Long Island, New York 11590

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
43 (cont)	Silicone resin sealer–clear (AMS 3135) (cont)	Repair of compressor case plastic cracks. (cont)	RC–21 Silicon Resin Amtex 890 Fern Hill Road West Chester, PA 19380 Sildon 30 Basildon Chemical Co. Lt Kimber Road Abingdon, Oxfordshire England OX14 1R2 1–2531 Dow Corning Corp. South Saginaw Road Midland, Michigan 48640
44	Assembly fluid	Assembly aid	Ultra Chem Co. 1 Ultra Chem Inc. 1400 N. Walnut Street Wilmington, Delaware 19899
45	Hi temperature aluminum paint	Various splitlines	TTP 28 Griggs Paint 3635 16th St. Pheonix, AZ 85040–1310

NOTE: Even though Rolls–Royce has approved these cleansers for use with Rolls–Royce engines, Rolls–Royce assumes no liability for injury to personnel or the environment by their use.

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COMPRESSOR SECTION – MAINTENANCE PRACTICES

1. Compressor Assembly Replacement

   A. Removal (See Figure 201, 202 or 203.)

      (1) Remove compressor oil supply and scavenge tubes from the compressor front support and from the power and accessory gearbox.

      (2) (Bendix fuel system). Remove fuel control system compressor discharge pressure (P_c) sensing tube. Remove tube from the bracket mounted P_c filter and from the elbow at the scroll. Hold the P_c filter while disconnecting the coupling nut.

      (3) (CECO fuel system). Remove fuel control system compressor discharge pressure (P_c) sensing tube. Remove tube from the tee at the governor and from the elbow at the scroll.

      (4) Remove the compressor discharge pressure sensing tube at the compressor bleed control valve and at the diffuser scroll pressure probe elbow.

      (5) Remove two pressure elbows from the diffuser scroll. Discard packing.

      (6) Remove the three bolts, nuts and washers and separate the compressor bleed control valve and gasket from the compressor case. Discard gasket.

      (7) Remove two anti–icing lines at the compressor front support and at the anti–icing air valve.

      (8) Remove the nut and separate the anti–icing air valve from the diffuser scroll. Discard packing.

      (9) Remove the turbine assembly from the engine. (Refer to the Turbine Assembly Removal, para 1.A. or 1.C., 72–50–00.)

      (10) Lubricate (engine oil) the spur adapter gearshaft bearing guide (6872646 or 23006778) (whichever is applicable) and install it on the compressor spur adapter gearshaft. (See Figure 204.)

      (11) If the compressor assembly is to be reinstalled, count and record the number of shims at each mounting pad prior to complete removal of the compressor. Save the shims for reuse.

         NOTE: Early engines incorporate five bolts to attach the compressor to the gearbox.

      (12) Remove the nuts and washers at the two pads inboard on the gearbox and remove the three bolts at the outboard pads. Note the position of the three different bolts and one washer used at these pads. Remove the P_c filter and bracket assembly.

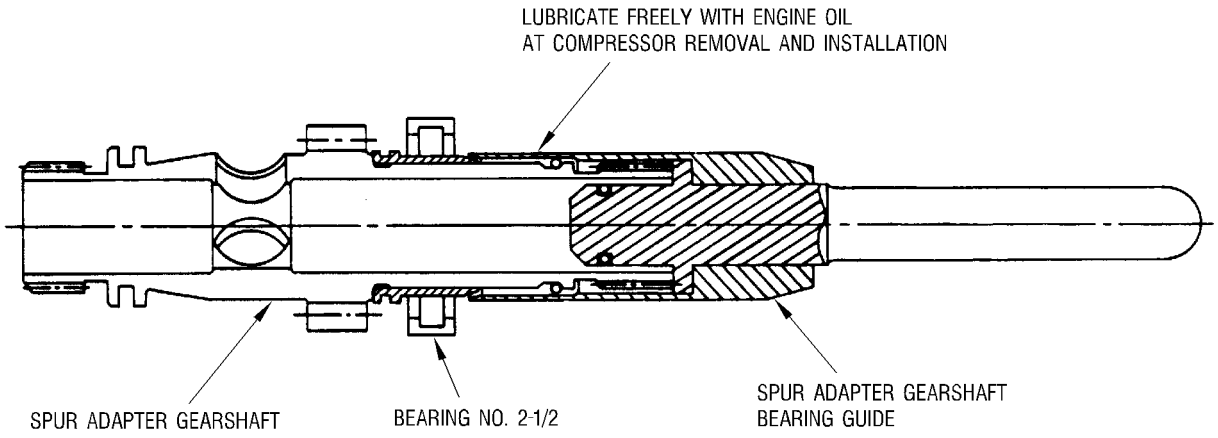
      (13) Separate the compressor from the gearbox.

      (14) Make the following inspection of the turbine–to–compressor coupling splines and the turbine–to–pinion gear coupling splines.

         (a) Run a sharp pointed scribe across the spline surfaces at both coupling ends to check for a wear step.

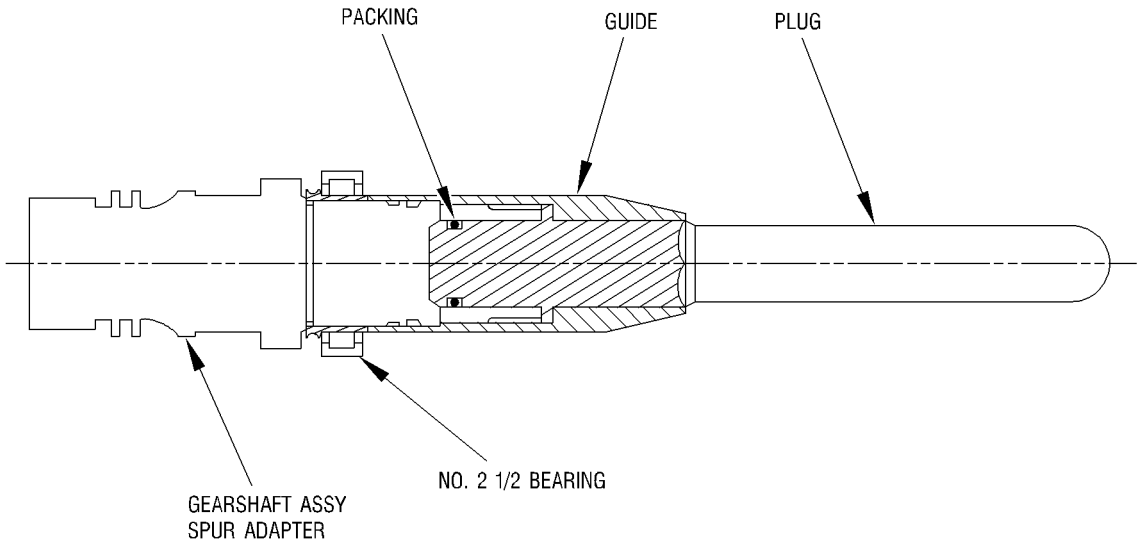
         (b) Reject the coupling if the pointed object catches on any wear step. Polished spline surfaces are acceptable. If there is any doubt on the depth of the wear step, reject the coupling.

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P/N 6872646

ADE052AD



AEC001XD

P/N 23006778

Bearing Guide Installed on Spur Adapter Gearshaft
Figure 204

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PARA 1.C. (cont)

(1) Lubricate and install new packings on the compressor rear diffuser and the spur adapter gearshaft.

(2) Lubricate (engine oil) bearing guide (6872646 or 23006778) and install it on the spur adapter gearshaft. (See Figure 204.)

(3) Sparingly lubricate the rollers of the No. 2-1/2 bearing with petrolatum to hold the rollers out against the bearing outer race.

WARNING: FAILURE TO PROPERLY SHIM THE COMPRESSOR AT INSTALLATION CAN CAUSE THE SPUR ADAPTER GEARSHAFT TO FAIL RESULTING IN SUDDEN ENGINE STOPPAGE.

CAUTION: BE SURE THE SPUR ADAPTER GEARSHAFT IS IN MESH WITH THE GEARBOX MATING GEAR BEFORE TIGHTENING COMPRESSOR RETAINING BOLTS. IF YOU TIGHTEN THE COMPRESSOR RETAINING BOLTS WITH AN INCORRECT MESH OF THE SPUR ADAPTER GEARSHAFT AND THE GEARBOX MATING GEAR, THEN YOU MUST REPLACE BOTH THE MATING GEAR AND THE GEARSHAFT.

(4) Determine the number of shims required for compressor installation.

(a) When replacing a compressor, the total thickness of shims required at each attaching point has been determined during compressor buildup (overhaul) and marked near the appropriate bolt hole on the rear diffuser.

(b) When reinstalling the same compressor, install with the total thickness of shims marked on the rear diffuser. If the shim markings are not legible, missing, or in doubt, compute the total shim thickness requirements in accordance with paragraph 1.C., Compressor Shimming Procedure, this section.

(5) Place the compressor on the gearbox with the required shims in place at the bolt pads. Use 6799790 engine turning adapter to turn the gear train until it meshes with the spur adapter gearshaft.

(6) If interference is encountered between the compressor and one of the cast bosses on the gearbox, lightly dress the boss by filing. Remove only sufficient material to provide a positive clearance.

(a) Dichromate the machined area per AMS 2475.

(b) Apply engine gray enamel (AMS 2510).

(7) Install the P_c air filter and bracket assembly at the same time the compressor mounting bolts and nuts are installed. Use the same configuration of bolts, nuts and washers at each of the five compressor pads as was previously used. (If the gearbox is changed, different bolts or nuts may be required.) Tighten attachment features to 70-85 lb in. (7.9-9.6 N·m) and secure bolts with lockwire.

(8) Remove bearing guide 6872646 or 23006778 from the spur adapter gearshaft. Visually check that the spur adapter gearshaft packing is in place.

(9) Install the turbine assembly. (Refer to Turbine Assembly Installation, para 1.B. or 1.D., 72-50-00.)

(10) Install the anti-icing air valve on the diffuser scroll. Do not tighten the jam nut at this time. (Refer to Anti-Icing Air System, para 2.D., 75-10-01.)

(11) Install the two anti-icing air tubes. Tighten coupling nuts to 150-200 lb in. (17-23 N·m). Tighten valve jam nut to 100-150 lb in. (11-17 N·m) and secure with lockwire.

(12) Install the bleed control valve on the compressor case mounting flange. (Refer to Bleed Air Control Valve, para 2.B., 75-10-02.)

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(13) Apply anti-seize compound lightly to the threads; then install the two pressure elbows with new packing in the scroll. Do not tighten the jam nuts until final tube alignment is made.

(14) Install pressure sensing line between bleed valve and pressure probe elbow. Tighten coupling nuts to 80-120 lb in. (9.0-13.6 N·m). Tighten elbow jam nuts to 55-80 lb in. (6.2-9.0 N·m) and secure with lockwire.

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PARA 1.C. (cont)

(15) Install the pressure sensing line between the tee at the governor and the pressure probe elbow (CECO control system). Attach the Scroll–to–P_C Filter Tube Assy to the scroll elbow and to the forward end of the P_C Filter. Attach the P_C Filter–to–Governor Tube Assy to the aft end of the P_C Filter. (Bendix Control System.) When attaching the lines to the P_C filter, hold the filter with the proper wrench at the hex flats of the filter assembly. Tighten the coupling nuts to 80–120 lb in. (9.0 to 13.6 N·m). Tighten elbow jam nut to 55–80 lb in. (6.2–9.0 N·m) and secure with lockwire. Clamp P_C filter–to–governor tube assy to ignition lead.

(16) Install the oil supply and scavenge tubes to the front support and to the gearbox. Tighten pressure tube coupling nuts to 65–100 lb in. (7.3–11.3 N·m) and scavenge tube coupling nuts to 150–200 lb in. (17–23 N·m).

(17) Make appropriate entry relative to compressor replacement in the Engine Log.

(18) Check run the engine and select the proper size diffuser vent orifice after compressor replacement. (Refer to Check Run, para 1. and Diffuser Vent Orifice Selection, para 1.B., 72–00–00, Engine–Adjustment/Test.)

D. Determining Compressor Mounting Shim Thickness Requirements.

(1) Place the compressor assembly in a vertical position (on blocks) with the impeller end up.

NOTE: Be sure the spur adapter gearshaft is match marked to the adapter coupling and the adapter coupling is match marked to the impeller hub prior to removal.

(2) Before removing the spur adapter gearshaft from the compressor assembly, match mark the spur adapter gearshaft to the adapter coupling and the adapter coupling to the impeller hub.

(3) Remove the internal retaining ring and remove the spur adapter gearshaft from the compressor.

(4) Using 6795588 wrench to hold the rotor and a six–point socket on the nut, remove the nut and washer securing the adapter coupling in the impeller hub. Using 6872832 puller, remove the coupling from the impeller hub.

(5) Install the plate of 6873066 fixture on the aft side of the rear diffuser.

(6) Attach the indicator and bracket on the impeller hub.

(7) Level the plate using the three leveling screws and the bracket mounted indicator.

(8) Position the dial indicator on the plate to contact the five mounting pads (C, Figure 205). Record the reading at the five positions.

(9) Zero the indicator at the highest of the five positions. Measure and record the minus reading at each of the other four positions.

(10) Compute the total thickness of shims required to build the four (low) bolt holes up to the zero indicated hole as required to obtain an installed compressor squareness of 0.002 in. (0.05 mm) FIR. The total thickness of shims at any one location shall not exceed 0.020 in. (0.51mm). Electro–chemical etch the total shim thickness adjacent to the applicable bolt hole and cover the etched surfaces with Metcoseal AMS 3135 transparent silicone resin. Mark the zero indicated hole with a 0 (zero). (See Figure 205.) Shims are available in three sizes; 0.002, 0.004, and 0.008 in. (0.05, 0.10, 0.20 mm).

(11) Remove the 6873066 fixture from the compressor.

(12) Align the match marks and install the adapter coupling into the splines of the impeller hub. Retain the coupling with a washer and nut. Hold the coupling with 6795588 wrench and Torque the nut to 50–55 lb in. (5.6–6.2 N·m) above locknut drag using a six–point socket.

(13) Align the match marks and install the spur adapter gearshaft into the splines of the adapter coupling. Retain the gearshaft in the coupling with the internal retaining ring.

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2. Compressor Case Replacement

A. Removal (Compressor Case Top Half) (See Figure 206.)

CAUTION: DO NOT REMOVE BOTH CASE HALVES AT THE SAME TIME.

NOTE: Compressor cases are machined in lower and upper matched sets. Rejection and replacement of one case half is cause for rejection and replacement of the opposite case half. Note the serial numbers on both replacement case halves to assure that the case halves are a matched pair.

(1) Remove the pressure and scavenge oil lines between the gearbox and the compressor front support.

(2) Remove the RH and LH air lines between the anti–icing air valve and the compressor front support.

(3) Remove the compressor bleed control valve as follows:

(a) Remove the compressor bleed valve discharge pressure sensing line.

(b) Remove three nuts, bolts and washers; remove the compressor bleed valve and gasket.

(4) Remove the top compressor case half (marked ‘‘top”) as follows:

(a) Remove the 17 horizontal splitline nuts and bolts.

NOTE: Note the location of the nameplate when the applicable compressor case–to–compressor front support nuts and bolts are removed. Return the nameplate to the same location during reassembly.

(b) Remove the 5 compressor case–to–compressor front support nuts and bolts.

(c) Remove the 8 compressor case–to–compressor front diffuser nuts and bolts.

(d) Carefully lift the top half straight out. If the case does not separate easily, loosen the two bolts and nuts at the aft flange and one bolt and nut at the front flange in the bottom half adjacent to each horizontal splitline.

B. Installation (Compressor Case Top Half) (See Figure 206.)

See Figure 207 for location of specific bolts and the numerical sequence in which they should be tightened. The illustration sequence numbers correspond to the numbers in the text.

NOTE: Be sure that the splitline mating flanges are clean before installation of the replacement case half.

(1) Carefully position the top half over the rotor. Install a bolt and nut (1) in each of the four corner holes (adjacent to the end flanges) at the horizontal flange. Tighten the bolts to the minimum torque necessary to close the horizontal splitlines.

NOTE: Tighten all case splitline nuts to 10–15 lb in. (1.1–1.7 N·m) plus locknut drag unless otherwise specified. Locknut drag is the torque necessary to turn the nut on the bolt in the last turn prior to seating of the nut. Lubricate bolts lightly with engine oil before installation.

(2) Install and tighten two bolts and nuts (2) in the rear flange of the top case half. Use the two adjacent bolt holes midway between the horizontal splitlines (approximately 80 degrees from the horizontal flanges). If the bolt holes in the rear flange do not align with the flange holes in the front diffuser, loosen the rear flange bolts in the bottom case half to a snug fit. Using a drift inserted into a misaligned bolt hole, rotate the case sufficiently to align the holes. Tighten the two centermost bolts on the rear flange of the bottom case half; then install and tighten the two centermost bolts and nuts in the rear flange of the top case half.

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4. Compressor Discharge Air Tubes

A. Inspection and Repair

Inspect the compressor discharge air tubes in accordance with Table 203. After any repair, make a careful visual, leakage inspection of the tube during the first engine operation following installation of the repaired part. Leakage is not acceptable.

Table 203
Compressor Discharge Air Tube Inspection

Item	Condition	Serviceable Limit	Repairable Limit	Disposition
1	Cracks (dye check)	None	Max of 3 in. (75 mm) (any number)	Weld using 29–9 W Mo weld rod (AMS 5784). Pressure test in 6798787 fixture at 150–160 psig (1034–1103 kPa) for three minutes. No leakage is acceptable. Send tube to an overhaul facility for repair.
2	Dents	Max of 3 dents per tube up to 1/8–in. (3 mm) depth by 1/2–in. (13 mm) dia		Straighten and reform. Dye check after repair.
3	Wear in seal ring groove	See Figure 207.		See Figure 207.
4	Wear on land surface	See Figure 207.		See Figure 207.
5	Wear of sheet metal surface	No appreciable loss of metal thickness	1/2 sheet metal thickness	Repair using brazed screen patch or replace. Pressure test 6798787 fixture at 100 psig (689 kPa) for 3 minutes. No leakage acceptable.

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PARA 3.B.(2) (cont)

(c) Blow dry the element. Use clean, dry low–pressure air, 100–120 psig (689–827 kPag), in a reverse flow direction (through the outlet fitting).

(d) Immerse the element in a neutralizing solution of phosphoric acid (50% acid, 50% water) at 21°C (70°F) for 5 minutes.

(e) Thoroughly rinse the element in cold running water.

(f) Blow dry the element. Use clean, dry low–pressure air, 100–120 psi (689–827 kPa), in a reverse flow direction (through the outlet fitting).

C. Inspection

Inspect the filter assembly for dirt or damage. Replace unserviceable filters.

D. Assembly

(1) Apply high temperature lubricant (Never–Seez or equivalent) lightly to the threads; then, assemble the packing and housing over the filter element.

(2) When a vise is used, place the element hex in the vise and use a wrench on the hex of the housing. If a metallic seal is used, tighten to 60–65 lb ft (81–88 N·m). If a rubber seal is used, tighten to 60–65 lb in. (6.8–7.3 N·m). Secure with lockwire.

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ANTI–ICING AIR VALVE––MAINTENANCE PRACTICES

1. General

   A mechanically operated valve used to control the flow of anti–icing air. The anti–icing air valve is mounted on the front of the compressor scroll.

2. Replacement (See Figure 201 or 202, 75–00–00.)

   A. Removal

      (1) Disconnect the anti–icing air tubes between the valve and the front support.

      (2) Disconnect the linkage from the anti–icing air valve control arm.

      (3) Remove lockwire, loosen jam nut and remove the valve assembly from the scroll. Discard packing.

   B. Disassembly

      Disassemble the anti–icing air valve as follows:

      (1) Disassemble the anti–icing air valve as follows:

         (a) Remove the cotter pin, washer, and pin. Detach the actuating lever from the valve. Discard cotter pin.

         (b) Remove the lockwire and unscrew the poppet guide assembly from the valve body. Separate the poppet assembly from the body.

   C. Assembly

      Assemble the valve assembly as follows:

      (1) Insert the poppet into the valve body.

      (2) Screw the poppet guide assembly into the body. Torque the coupling nut to 65–75 lb in. (7.3–8.5 N·m). Do not lockwire at this time.

      (3) Align the actuating lever with the hole in the poppet guide assembly (notch in lever toward the guide) and insert the pin. Secure the pin with a washer and cotter pin. Lockwire the poppet guide to the valve body.

   D. Installation

      (1) Apply antiseize compound lightly to the threads then install the valve with jam nut and new packing in the scroll.

         WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

      (2) Reconnect linkage and air tubes.

         (a) Tighten coupling nuts of air tubes to 150–200 lb in. (17–23 N·m).

         (b) Tighten valve–to–scroll jam nut to 100–150 lb in. (11–17 N·m) and secure with lockwire.

            NOTE: For convenience of installation, the anti–icing valve may be rotated 360°. Position valve as desired for the installation; then tighten coupling nut to 65–75 lb in. (7.3–8.5 N·m) and secure with lockwire.

      (3) Recheck the valve for leakage during first engine operation following installation of the repaired valve. Replace valve assembly if leakage is still excessive.

3. Cleaning

   Clean the anti–icing valve components in mineral spirits.

4. Inspection and Repair

   Inspect the anti–icing valve components in accordance with Table 201.

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Rolls-Royce

Operation and Maintenance Manual

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Seventh Revision	9 July 1980
Eighth Revision	15 May 1981
Ninth Revision	15 March 1982
Tenth Revision	21 February 1983
Third Edition	15 January 1985
Fourth Edition	1 June 1989
First Revision	15 August 1991
Second Revision	15 January 1993
Fifth Edition	1 December 1995
Sixth Edition	30 December 1996
First Revision	15 October 1997
Second Revision	15 December 1998
Third Revision	15 July 1999
Fourth Revision	15 August 2000
Fifth Revision	1 June 2001
Sixth Revision	1 June 2002
Seventh Revision	1 June 2003
Eighth Revision	1 June 2004
Ninth Revision	1 June 2005

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Revision Number	Date
Sixth Edition (cont)	
Tenth Revision	1 June 2006
Eleventh Revision	1 June 2007

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E6R11-72-5	72-00-00	608	Apr 11/08
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AIRWORTHINESS LIMITATIONS DESCRIPTION

1. Airworthiness Limitations

CAUTION: OPERATORS ARE REQUIRED BY THE FAA TO COMPLY WITH THE PARTS LIFE LIMITATIONS INDICATED HEREIN. THE OPERATOR ALONE MUST MAINTAIN RECORDS OF BOTH HOURS AND CYCLES. BOTH TOTAL TIME AND ACCUMULATED CYCLES OF APPLICABLE COMPONENTS MUST BE RECORDED IN PART I SERVICE RECORD AND PART VI CYCLE RECORD PAGES RESPECTIVELY FOR THE COMPRESSOR ASSEMBLY AND TURBINE ASSEMBLY. SHOULD THE CYCLE COUNTER BECOME INADVERTENTLY DISCONNECTED, STOP COUNTING, OR COUNT TOO MANY OF TOO FEW CYCLES, THE CORRECT NUMBER OF CYCLES MUST STILL BE COUNTED. FAILURE TO RECORD HOUR AND CYCLE DATA OF APPLICABLE PARTS IN THE LOG BOOK WILL RESULT IN THOSE PARTS BEING REPLACED AT THE OPERATOR'S EXPENSE WHEN ENGINES OR COMPONENTS ARE RETURNED FOR OVERHAUL OR REPAIR. REFER TO LOG BOOK ENTRIES, PARA 13, SECTION 72–00–00, ENGINE–DESCRIPTION AND OPERATION FOR AN EXPLANATION OF LOG BOOK ENTRIES PERTAINING TO CYCLE AND HOUR RECORDS ON LIFE LIMITED PARTS.

NOTE: All Life Limited Parts removed from a type certificated product must be tagged to identify the part. The tag or record must include the part number, serial number and current life status of the part, hours, and cycles. Each time the part is removed, either a new tag or record must be created, or the existing tag or record must be updated with the current life status of the part. The tag or record must remain with the part at all times when not installed.

When a life limited part is removed from service due to meeting the published life limits, vibropeen or etch the words "life expired" next to or under the part number. A life limited part, other than new (however, proper paper work to provide traceability is still required), must have a tag or record attached.

2. Life Limited Parts

Chapter 05–10–00 contains FAA approved life limitations for those engine parts that are life limited.

Life limits of parts are based on total hours or total cycles, which ever occurs first.

Operating hours with respect to maintenance records means the time from the moment an aircraft leaves the surface of the earth until it touches at the next point of landing.

A cycle is defined as a start or start attempt. The operator is assisted in maintaining a cycle count by means of an engine furnished counter which will record the number of times the ignition exciter is energized. (It is considered that the number of times the ignition exciter is energized and lightoff does not occur is negligible.)

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LIFE LIMITS OF THE COMPRESSOR ROTOR

Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
Impeller	6871337	Original	2500	7500
	23060177	Ground Pin, Glass Bead Peen	2500	7500
Impeller	6876873	Hub relocated rearward	3550	9150
	23057117	No Pin	3550	9150
	23058146	Extended Adapter	3550	9150
	23058147	Extended Adapter	3550	9150
	23060417	Ground Pin, Glass Bead Peen	3550	9150
Impeller	23079638	Shortened Adapter	3550	9150
1st-stage Wheel	23079060			30,000
2nd-3rd-stage Wheel	23079059			30,000
4th-stage Wheel	23079058			30,000
5th-stage Wheel	23079057			30,000
6th-stage Wheel	23079056			30,000

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LIFE LIMITS OF THE GAS PRODUCER TURBINE ROTOR ASSEMBLY

WARNING: IT IS NOT ALLOWED TO INSTALL A TURBINE WHEEL WITH ACCEPTABLE WHEEL RIM CRACKS IN ANY ENGINE/TURBINE DURING OVERHAUL. ACCEPTABLY CRACKED TURBINE WHEELS MAY BE REINSTALLED ONLY DURING A TIME CONTINUED ENGINE/TURBINE REPAIR.

Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
1st-stage Wheel	6853306	Original	1550	3000
1st-stage Wheel	6886407	Thick rim	1775	3000
1st-stage Wheel	23073853	Thick rim	1775	3000
1st-stage Wheel	23073813	Thick rim	1775	3000
2nd-stage Turbine Nozzle Diaphragm	23084419	----	1775	3000
2nd-stage Wheel	6857912	Original	1550	3000
2nd-stage Wheel	6871872	250-C18 to -C20 Conversion (250-CEB-115)	1550	3000
2nd-stage Wheel	6877092	Changed contour	1775	3000
2nd-stage Wheel	6898782	Pilot diameter	1775	3000
2nd-stage Wheel	23038220	Stepped Balance Piston Seal (RFSE 250-87-2)	1775	3000
2nd-stage Wheel	23073854	Pilot diameter	1775	3000
2nd-stage Wheel	23073814	Pilot diameter	1775	3000
Gas Producer Turbine Tie-Bolt	23068265	Thick Design	----	9000

NOTE: 1st-stage turbine wheels with acceptable wheel rim cracks which have been inspected and approved for time continued use in accordance with the 250-C20 Series Overhaul Manual, Pub No. 10W3, (for a repaired engine or turbine) may be continued in service to overhaul or an additional 500 hours or 500 cycles, whichever of these occurs first (provided the listed part hour/cycle life limit is not exceeded).

NOTE: 2nd-stage turbine wheels with acceptable wheel rim cracks which have been inspected and approved for time continued use in accordance with the 250-C20 Series Overhaul Manual, Pub No. 10W3, (for a repaired engine or turbine) may be continued in service to overhaul or completion of the wheel's maximum hour life or cycle limit, whichever of these occurs first.

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5. Operating Precautions

WARNING: THE PRIMARY APPLICATION OF THE TURBOSHAFT ENGINE IS TO POWER A HELICOPTER OR ROTORCRAFT. A HEIGHT-VELOCITY DIAGRAM, AS REQUIRED BY REGULATION AND PREPARED BY THE AIRFRAME MANUFACTURER, IS PUBLISHED IN THE AIRCRAFT FLIGHT MANUAL PERFORMANCE SECTION. THE OPERATOR MUST BECOME FAMILIAR WITH THIS DIAGRAM TO DETERMINE WHAT ALTITUDES AND AIRSPEEDS ARE REQUIRED TO SAFELY MAKE AN AUTOROTATIONAL LANDING IN CASE OF POWER LOSS OR ENGINE FAILURE. THE ALTITUDE-AIRSPEED COMBINATIONS WHERE A SAFE AUTOROTATIONAL LANDING MAY NOT BE POSSIBLE ARE REPRESENTED BY THE SHADED OR CROSS-HATCHED AREA OF THE DIAGRAM.

WARNING: SNOW OR ICE SLUGS CAN CAUSE THE ENGINE TO FLAME OUT. BE SURE AVAILABLE PREVENTIVE EQUIPMENT IS INSTALLED AND IN PROPER WORKING ORDER WHEN FLYING IN CONDITIONS WHERE SNOW OR ICE BUILDUP MIGHT OCCUR.

WARNING: CONSULT THE AIRCRAFT FLIGHT MANUAL FOR REQUIRED EQUIPMENT AND PROCEDURES FOR FLIGHT IN FALLING/BLOWING SNOW.

WARNING: SAND AND DUST WILL ERODE COMPRESSOR VANES AND CAUSE THEM TO FAIL.

WARNING: SALT LADEN HUMIDITY AND CHEMICALS WILL CORRODE COMPRESSOR BLADES AND VANES AND CAUSE THEM TO FAIL.

Observe the following precautions to reduce the danger of personnel injury or damage to the engine.

A. Before operating the engine, check the air inlet for foreign objects. (Refer to Compressor Inlet Air Blockage, PARA 1.D.(12), 72-00-00, Engine-Inspection/Check.)

B. If the engine does not operate within Operating Limits, PARA 6., this section, take the designated action.

C. If the aircraft is frequently operated in dusty or sandy areas, periodic erosion inspection is recommended. (Refer to Erosion Inspection, PARA 1.D.(9), 72-00-00, Engine-Inspection/Check.)

D. If a flameout has been experienced as the possible result of snow, ice, or water ingestion, refer to Snow Ingestion Inspection, PARA 1.D.(10), 72-00-00, Engine-Inspection/Check.

E. If the aircraft is being operated following an extended period of inactivity, refer to Special Inspections, Table 604, 72-00-00, Engine Inspection/Check, for recommended action.

F. If the engine is operated in a corrosive environment it must be subjected to a water wash. (Refer to Compressor Contamination Removal, PARA 6.A.(1), 72-30-00.)

G. If the installed engine will be shut down for more than five calendar days the compressor must receive an application of preservative. (Refer to Compressor Preservation, PARA 12.D., 72-00-00, Engine Servicing.)

6. Operating Limits

WARNING: TO PREVENT SERIOUS ENGINE MALFUNCTION OR CRUCIAL LOSS OF POWER, DO NOT OPERATE THE ENGINE IN EXCESS OF ANY SPECIFIED LIMIT.

NOTE: Operators may be faced with an engine that meets all specification power requirements in a certified test cell but apparently fails to meet the minimum installed power required by the aircraft flight manual.

NOTE: Please refer to the aircraft manual for other system troubleshooting.

NOTE: Operators should be aware that the FAA requires the Rolls-Royce Authorized Maintenance Centers to deliver engines of at least “specification horsepower” only after complete engine overhaul.

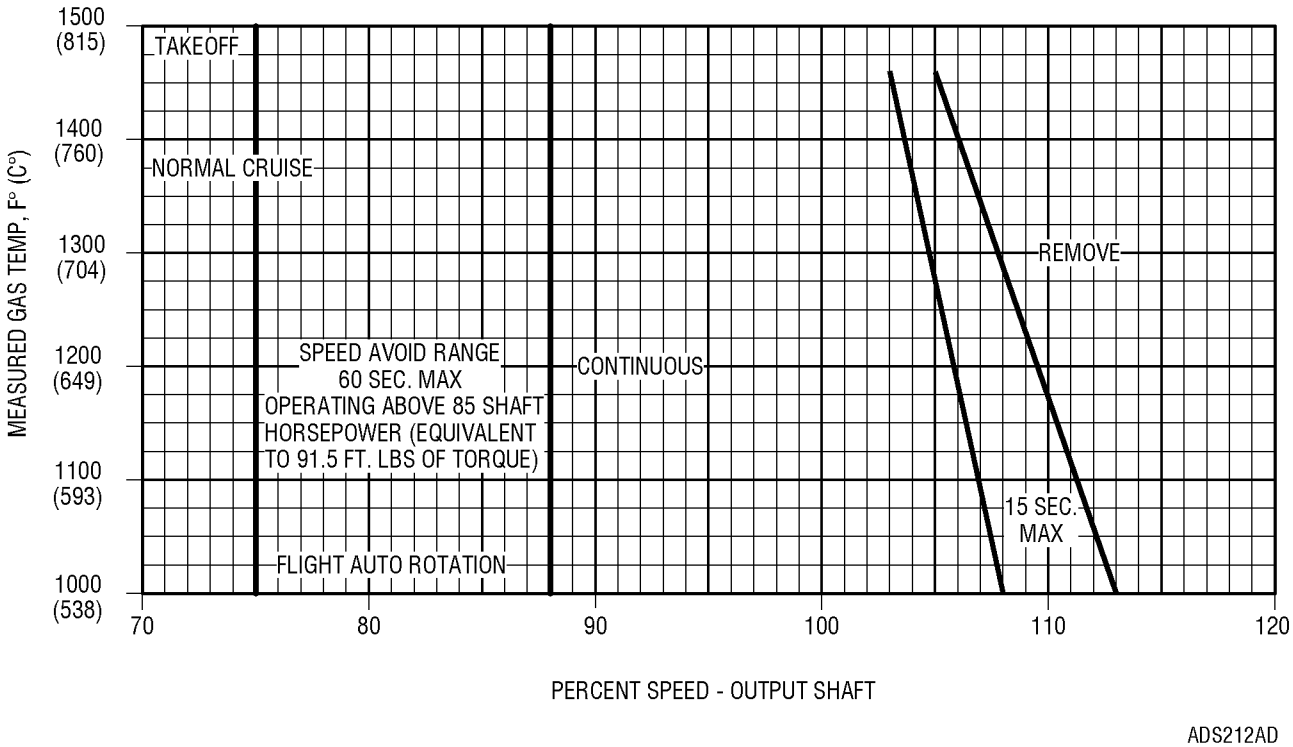
A. Engine Speed

If any of the following limits are exceeded send the designated engine components to repair/overhaul. Record extent of overspeed in the engine log book. Record total time in speed-avoid range that exceeds 60 sec. operating above 85 shaft horsepower (equivalent to 91.5 ft. lbs. of torque) in the engine log book.

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PARA 6. (cont)

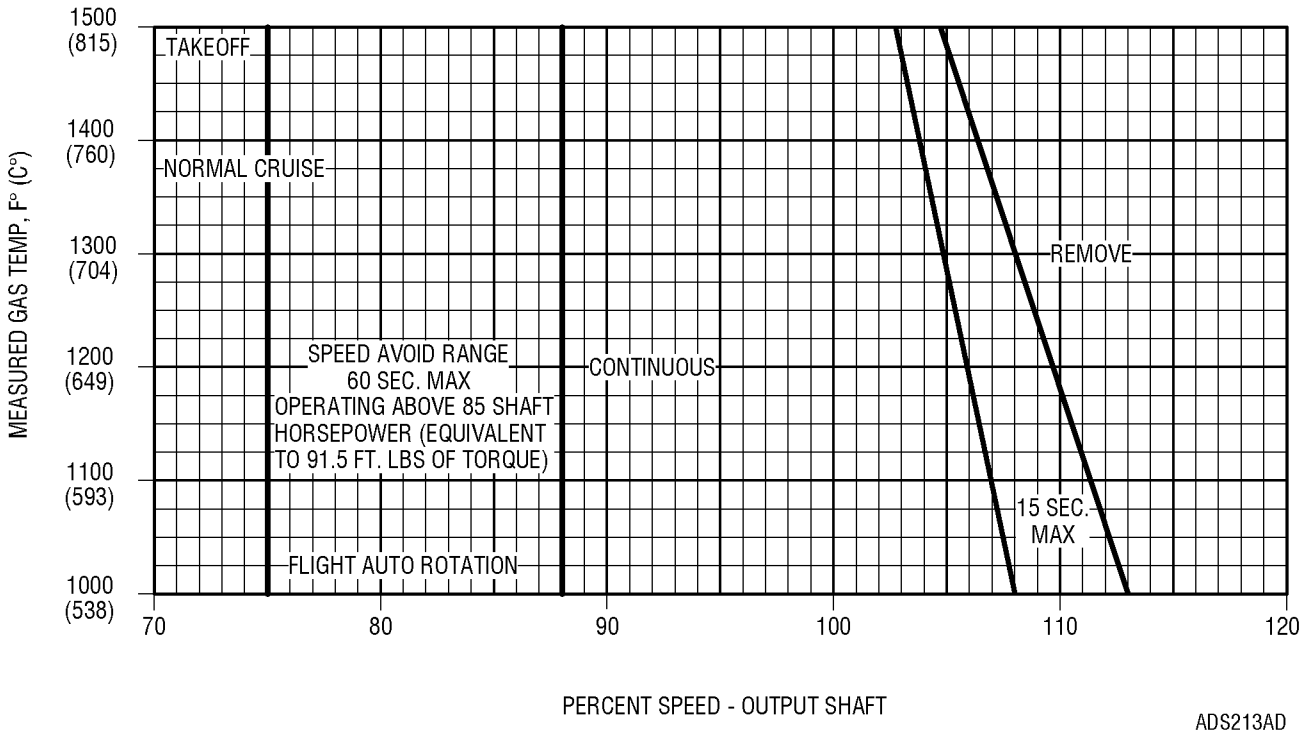
Limit	Component
N_1 (Gas Producer)	
105%--max. continuous	None
105-106%--15 sec max.	None
105%--over 15 sec	Turbine and compressor
Over 106%--not allowed	Turbine and compressor
N_2 (Power Turbine)	
Limits as shown in Figure 26, 27 or 28	Turbine
75-88%--60 sec. max. operating above 85 shaft horsepower (equivalent to 91.5 ft. lbs. of torque)	3rd-stage Turbine wheel
Complete loss of output shaft load	Turbine and gearbox
120% (40,000 rpm) or maximum indication shown on N_2 tachometer, whichever is first.	Turbine and gearbox



250-C20 Maximum Allowable Output Shaft Speeds
Figure 26

NOTE: Transition through the speed avoid-range is to be accomplished as quickly as possible.

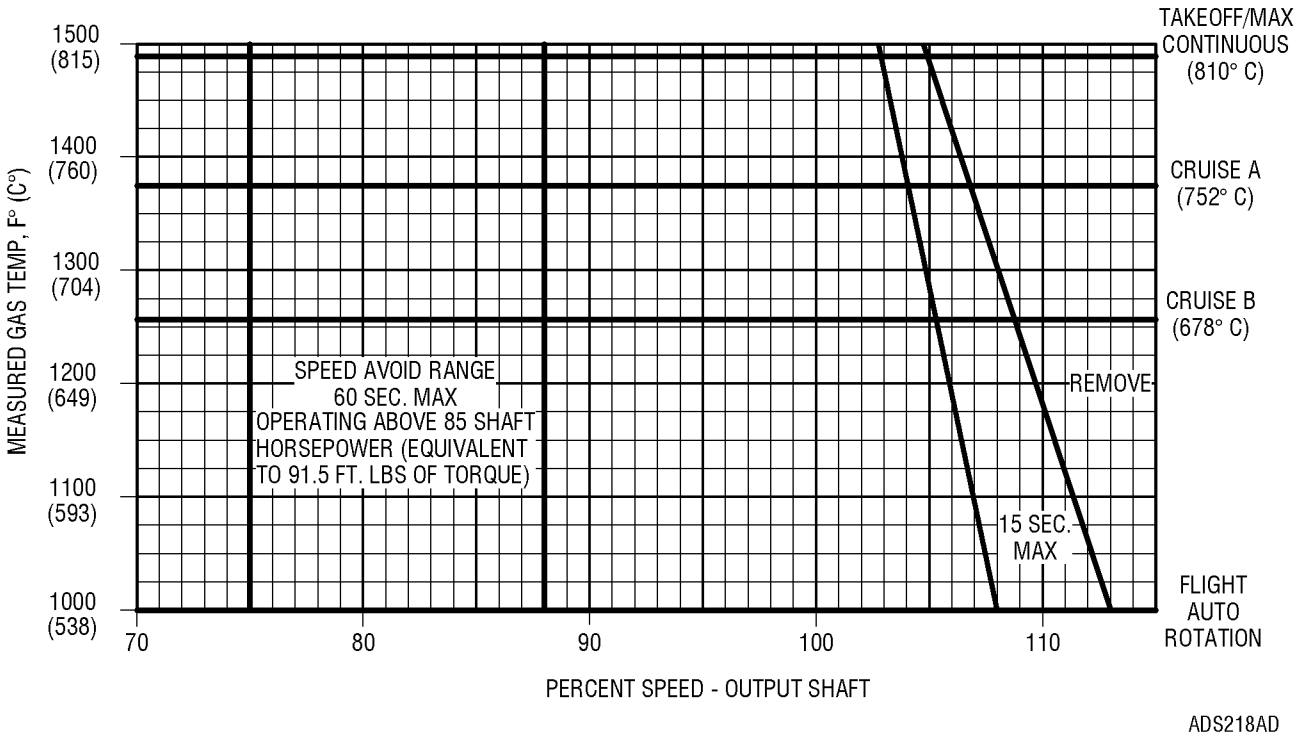
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250-C20B, -C20F -C20W and-C20J Maximum Allowable Output Shaft Speeds
Figure 27

NOTE: Transition through the speed-avoid range is to be accomplished as quickly as possible.

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250-C20S Maximum Allowable Output Shaft Speeds
Figure 28

NOTE: Transition through the speed-avoid range is to be accomplished as quickly as possible.

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PARA 11. (cont)

A. Engine TBO

NOTE: Heavy maintenance inspection (HMI) shall consist of gas producer turbine rotor replacement and inspection of assembled components by an Authorized Maintenance Center (AMC).

For operators who do not wish to utilize the modular overhaul concept, Allison recommends a time between overhauls of 1000 hours for the 250–C20 engine incorporating a non–product improved turbine. For 250–C20 engines incorporating the product improved turbine and 250–C20B, –C20F, –C20J, –C20S and –C20W engines, the recommended time between overhaul, excluding the TBO for individual accessories, is 3500 hours with a 1750–hour turbine heavy maintenance inspection. However, it is possible that the allowable cycle life limit of certain rotating parts specified in Airworthiness Limitations, Section 05–10–00 , may be exceeded before the recommended TBO is reached. It is, therefore, the responsibility of the operator to assure that neither the total time nor cycle life limits of these parts are exceeded.

B. Modular TBO

For operators who wish to utilize modular overhaul, Rolls–Royce recommends time between overhauls as listed in Tables 13 and 14. However, it is possible that the allowable cycle life limit of certain parts specified in Airworthiness Limitations, Section 05–10–00, may be exceeded before the recommended TBO. It is, therefore, the responsibility of the operator to assure that neither the total time nor cycle life limits of these parts are exceeded.

C. On–Condition Parts

The accessories and components that are on–condition are listed in Table 15.

Operating hours with respect to maintenance records means the time from the moment an aircraft leaves the surface of the earth until it touches at the next point of landing.

Table 13

Modular Overhaul–Components Recommended Time Between Overhauls

Component	Recommended TBO (Hours)	Recommended Heavy Maintenance Inspection (HMI) by Authorized Maintenance Center
Compressor	3500(1)	None
Gearbox	On condition	None
Turbine	3500(1)	1750 hr. (1)
Turbine–Non–Product Improved(2)	1000(1)	None

(1) Refer to Airworthiness Limitations, Section 05–10–00, for life limits on certain rotating parts. It is the responsibility of the operator to assure that life limits are never exceeded.

(2) Identified by turbine P/N 6853329.

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ENGINE – TROUBLESHOOTING

Troubleshooting table 101 has been prepared to assist in correction of malfunctions which could occur.

When troubleshooting the propeller power turbine governor check the appropriate Aircraft Maintenance Manual for adjustments. This troubleshooting guide is based on an Allison approved propeller power turbine governor.

Consideration should also be made for tolerances on the accuracy of aircraft installed instruments. Instrument error could affect measured performance by approximately:

– 4% below actual power available for every +5°C error in outside air temperature (OAT).
(Use a precision mercury type thermometer in the immediate vicinity of the OAT probe. Shade both thermometers for a minimum of 15 minutes before taking a reading. Compare accuracy of installed OAT gauge).
– 1% below actual power available for every 300 feet error in pressure altitude.
(Determine pressure altitude by averaging the readings of the altimeters of known accuracy on the flight deck.)
– 2% below actual power available for every +6°C error in TOT.
(Check calibrate the TOT system and gauge).
– 2% below actual power available for every +2% error in torquemeter.
(Check accuracy of torquemeter).

Table 101
Troubleshooting

Item	Trouble	Probable Cause	Remedy
1	Engine fails to reach 15% cranking speed.	Inadequate torque at starter pad.	Check output of starter and battery.
		Binding N_1.	Check inlet for foreign object damage. Rotate N_1 by hand and listen for abnormal noise.
2	Engine fails to light off.	Preservation oil fouling the spark igniter.	Try a second start.
		Air in the gas producer fuel control and lines.	Purge air from the system. (Refer to para 2.D, 73–00–00.)
		Faulty circuit to ignition unit.	Listen for ignition operation. Observe for fuel vapor coming out of the exhaust. Check input power to ignition unit. Isolate and replace defective part.
		Faulty ignition exciter.	Listen for igniter operation. Observe for fuel vapor coming out of exhaust. Replace with known satisfactory unit. (Refer to para 1., 74–10–01.)
		Faulty spark igniter.	Listen for igniter operation. Observe for fuel vapor coming out of exhaust. Replace with known satisfactory unit. (Refer to para 1., 74–20–01.)

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3. Consumable Materials

Refer to Tables 302 and 303 for a summary of consumable materials used to maintain the engine. The Acceptable Source column of the table lists suppliers for each item; any equivalent product is acceptable. In determining whether or not an item is equivalent, the burden of proof rests with the operator and his supplier, not with the engine manufacturer.

Table 302

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
1	Engine oil	Lubricate bearings, packings, etc.	Refer to Oil Specification, para 4.C., 72–00–00, Engine–Description and Operation.
2	Carbon removal compound	Clean aluminum–coated steel parts	Gunk Hydroseal Decarbonizer (MIL–C–25107). 630 North Harlem Ave. Oak Park, Illinois 60302
3	Carbon solvent	Cleaning fuel nozzle	Penetone ECS Penetone Corp. 74 Hudson Avenue Tenafly, NJ 07670 Multi–Sol Bruning & Co., Inc. 2920 Dr. Andrew J. Brown Avenue Indianapolis, IN 46205 No. 26 Cities Service Oil Co., P. O. Box 300 Tulsa, Oklahoma 74102
4	Cresol base cleaning compound	Clean steel parts	Formula No. 3097 (MIL–C–5546). Turco Products Inc. 2400 South Main Street Wilmington, California 90746
5	Rust Preventive compound	Coat steel parts after cleaning	Anti–Corrode 204 (MIL–C–6529, type 1). Cities Service Oil Co. P.O. Box 300 Tulsa, Oklahoma 74102
		Shipping container bolts	Valvoline TECTYL 890 Ashland Petroleum Company Division of Ashland Oil Inc. P. O. Box 391 Ashland, Kentucky 41101 Royco 103 Royal Lubricants Company Inc. River Road E. Hanover, N. J. 07936

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PARA 9.C (cont)

(4) When removal of the tube from the engine would result in excessive lost time due to the need for teardown and rebuild, the tube may be reformed attached to the engine if the following precautions are followed:

(a) Bending and torsional loads must not be applied across welded or brazed areas.

(b) The tube attachment points are to be loosened after bending (attachment points which are inaccessible due to the state of assembly are excluded).

(c) Reformed tubes must meet the requirements of steps (1) and (2).

10. Lubricants

CAUTION: DO NOT USE MOLYBDENUM DISULFIDE LUBRICANTS ON INTERNAL THREADS OR ON ANY FUEL, LUBRICATION OR AIR SYSTEM TUBING, HOSE OR FITTINGS.

CAUTION: DO NOT USE SILICONE LUBRICANTS EXCEPT WHERE SPECIFIED. USE LUBRICANTS RECOMMENDED IN THE ENGINE PUBLICATIONS.

The following lubricants shall be used for assembly of the engine and at regular periodic lubrication of components.

Location	Lubricant
General use such as installation of bearings, oil seals and packings	Engine oil
Accessory gear splines and splines of engine components	Lubriplate 130A, 930AA, or equivalent
Gearbox seal lips and packing roller bearings for ease of assembly	Grease (Shell 6249 or equivalent)
External spanner nut, nut, bolt and stud threads except male threads and attachments and plugs installed in the outer combustion case, turbine supports and and exhaust collector.	Silicon base molybdenum disulfide antiseize compound: DC550R—protects up to 232°C (450°F). CP–63—protects up to 760°C (1400°F).
Male threads of plugs and attachments installed in the outer case, turbine supports or exhaust. Also used on threads of bolts at splitlines between the outer case, turbine supports and exhaust collector.	Nickel base antiseize compound, NS165, Never Seez Nickel Special—high temperature, high pressure protection; DSL Super Hi–Temp.
Fuel system preservation	See Table 301.

NOTE: Apply a light coat of lubricant by hand; wipe off any excess. Lubricate only the male threads of fuel and oil lines; wipe the lubricant from the lead threads to prevent it from entering the system. Do not mix synthetic lubricating oil with petroleum based products. Do not lubricate air system component threads.

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	100 Hour Inspection (cont)			
Item	Inspection/Maintenance Action	REF. PARA	✓	Initial
21	Lubrication system inspection			
	NOTE: Maximum interval between oil change is 100 hours or 6 months, whichever occurs first. This time period may be extended to 200 hours or 12 month intervals for those items indicated by an asterisk (*) if an external oil filter of a type that has a valid STC (Supplemental Type Certificate) is installed on the engine.			
	*a. Drain oil system.	PARA 11.C., 72-00-00, Engine-Servicing		
	b. Remove, inspect and clean the oil filter. Note any accumulation of metal chips, debris or carbon particles. Conduct further inspection of the lube system and/or engine gear train/bearings if metal chips or debris are found. See Items 21a, 21e, 38, 39 and 40 below if carbon particles are found.	PARA 1.C., 72-60-00		
	NOTE: Follow STC manufacturer's recommendations regarding replacement/cleaning of external oil filter elements. Inspect removed elements for any accumulations of metal chips, debris or carbon particles. It may prove helpful to cut apart disposable (paper) filler elements to facilitate this inspection. If chips, debris or carbon particles are found, proceed with additional inspection/maintenance as outlined in item 21b. above.			
	*c. Inspect and clean turbine pressure oil check valve.	PARA 7.K., 72-50-00		
	*d. Turbine pressure oil tube screen assembly. Detach clamp; then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the tube coupling nut at the fireshield elbow only enough to allow sufficient movement of the tube to enable removal of the screen. At assembly, tighten connector coupling nut to 200-250 lb in. (23-28 N·m). Tighten fireshield elbow coupling nut to 80-120 lb in. (9-14 N·m). Tighten clamp nut to 35-40 lb in. (3.9-4.5 N·m).	N/A		
	*e. Measure oil flow from the scavenge passage of the external sump and from the scavenge passage of the gas producer support. It is recommended that the external sump is not removed for this check.	PARA 7.D., 72-50-00		
	NOTE: This step must be performed before draining oil or after the oil system has been refilled.			

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	300 Hour Inspection (cont)			
36	Remove, clean and inspect engine P_c filter every 300 hours or earlier as engine performance dictates.	PARA 3., 73–20–06		
37	Inspect and clean the No. 1 bearing oil pressure reducer.	PARA 3., 72–30–00		
38	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	N/A		
39	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72–50–00		
40	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G., 72–50–00		
41	Deleted			
	500 Hour/1 Year Inspection			
42	Inspect all uncoated and coated P/N 6846278 and 6871338 power turbine outer couplings nuts for corrosion.	250–C20 CSL–1060		
	NOTE: Compliance with Rolls–Royce Commercial Engine Bulletin 250–C20 CEB–1120 and/or 250–C20 CEB–1158 removes this inspection requirement.			
	600 Hour Inspection			
43	Check the fuel pump driveshaft on Sundstrand single element pumps for spline wear.	N/A		
	NOTE: This inspection is not required for Agro–Tech (TRW) fuel pumps or Sundstrand fuel pumps P/N 23003114 and subsequent.			
44	Perform scavenge oil filter impending bypass functional test per Facet Service Bulletin No. 090589 (ref. Rolls–Royce 250 CSL 1164) for aircraft equipped with this type of external scavenge filter system.	N/A		
45	Replace the fuel control filter assembly. Bendix fuel controls P/N 2524552–4 or 2524552–6 (less–5) and prior unless 250–C20 CEB–1089 has been accomplished.	PARA 4.A., 73–20–02, 4.A., 73–20–03		

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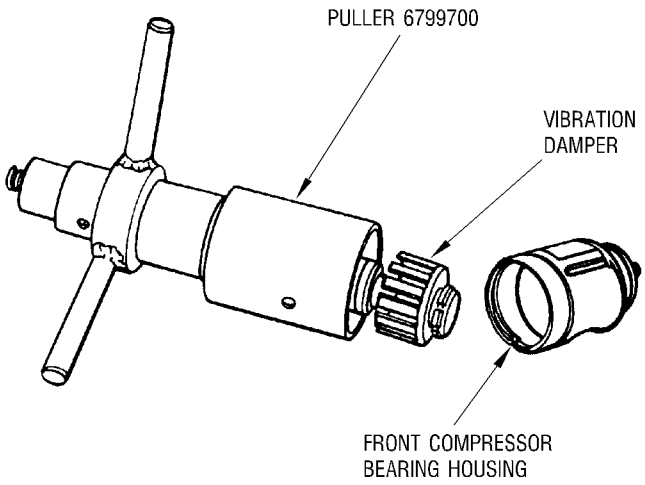
	300 Hour Inspection (cont)			
Item	Inspection/Maintenance Action	REF. PARA	✓	Initial
36	Lubrication system inspection			
	NOTE: Maximum interval between oil change is 300 hours or 12 months, whichever occurs first.			
	a. Drain oil system.	PARA 11.C., 72-00-00, Engine-Servicing		
	b. Inspect and clean turbine pressure oil check valve.	PARA 7.K., 72-50-00		
	c. Turbine pressure oil tube screen assembly. Detach clamp; then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the tube coupling nut at the fireshield elbow only enough to allow sufficient movement of the tube to enable removal of the screen. At assembly, tighten connector coupling nut to 200-250 lb in. (23-28 N·m). Tighten fireshield elbow coupling nut to 80-120 lb in. (9-14 N·m). Tighten clamp nut to 35-40 lb in. (3.9-4.5 N·m).	N/A		
	d. Measure oil flow from the scavenge passage of the external sump and from the scavenge passage of the gas producer support. It is recommended that the external sump is not removed for this check.	PARA 7.D., 72-50-00		
	NOTE: This step must be performed before draining oil or after the oil system has been refilled.			
	e. Refill oil system.	PARA 11.C., 72-00-00, Engine-Servicing		
37	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	N/A		
38	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72-50-00		
39	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G., 72-50-00		
40	Deleted			

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Table 604
Special Inspections

Item	Occurrence	Component or System	Required Action
1	Engine removal from aircraft	Engine, general	a
2	Compressor removal from engine	Anti–icing air valve Gearbox compressor mount inserts	p ad
3	Turbine removal from engine	Combustion liner Outer combustion case Compressor discharge air tubes Turbine pressure oil check valve Burner drain valve	aa z ab at ac
4	Rigid tube and/or accumulators removal from engine	Rigid tube and/or accumulators	f, ba
5	Hard landing (over 10g)	Engine, general	b
6	Sudden stoppage of rotor or propeller	Engine, general Compressor Magnetic drain plugs	c
7	Operation in erosive environment	Compressor	l
8	Snow or ice ingestion	Compressor	h
9	Foreign object damage	Compressor Turbine	k q
10	Operation with inlet restricted	Compressor	f
11	Overtemperature operation	Turbine Thermocouples	r y
12	Oil temperature limit exceeded	Oil system	ap
13	Hot start encountered	Turbine Thermocouples	s y
14	Fuel filter bypassed	Fuel pump filter Fuel control strainer (Bendix) Fuel nozzle strainer Fuel control, governor and high pressure filters (CECO)	au aw bb av
15	Oil change	Oil System Oil filter	ah, aj as
16	Oil consumption	Turbine	u
17	Oil system contamination	Oil system	ak, al, am
	NOTE: When the oil system is contaminated with carbon or metallic particles, this inspection is not required if the engine has a valid STC (Supplemental Type Certificate) or aircraft manufacturer approved external scavenge oil filter which has not bypassed.		
18	Oil spray on first–stage wheel	Turbine	v
19	Engine operated in excess of 30 seconds without oil pressure	Oil system	aq

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Pulling the Compressor Front Bearing Vibration Damper
Figure 209

(2) Lubricate inside the replacement seal with engine oil (by soaking). Install lubricated packing on the seal; then install the seal on the rotor.

CAUTION: USE A RETAINING NUT WITH A BLACK NYLON CAP WITH NO. 1 BEARINGS HAVING A PULLER GROOVE. USE RED OR YELLOW NYLON CAP NUTS WITH BEARINGS WITHOUT PULLER GROOVES. IN ORDER FOR THE SELF-LOCKING FEATURE OF THE RETAINING NUT TO BE EFFECTIVE AND TO AVOID OIL LEAKAGE INTO THE ROTOR, DO NOT INTERCHANGE THESE NUT/BEARING COMBINATIONS.

CAUTION: EXERCISE CARE WHEN INSTALLING THE NUT. DO NOT ALLOW THE WRENCH TO CONTACT THE BEARING.

(3) Before installing the mating ring, bearing or nut, measure dimensions A, B, and C as indicated in Figure 210A.

(3.1) Install the seal mating ring with puller groove forward. Install the No.1 bearing with the puller groove forward. Do not heat the bearing.

(3.2) Install a slave nut and torque nut to 120-130 lb in. (13.6-14.7 N·m) above drag torque. Loosen and remove slave nut.

(3.3) Hold the rotor from turning using 6799790 adapter in the starter generator pad on the gearbox cover.

(3.4) With slave nut removed, measure dimension D as indicated in Figure 210A. Make sure that dimension D=A-(B+C).

(3.5) If dimension D is greater or less than A-(B+C), reinstall slave nut and retorque nut to seat bearing and seal mating ring.

(a) Remove slave nut and recheck dimension D.

(b) If dimension D is still greater or less than A-(B+C), remove bearing and mating ring to inspect the 1st stage wheel stub shaft, the bearing and the mating ring for wear that may cause this condition.

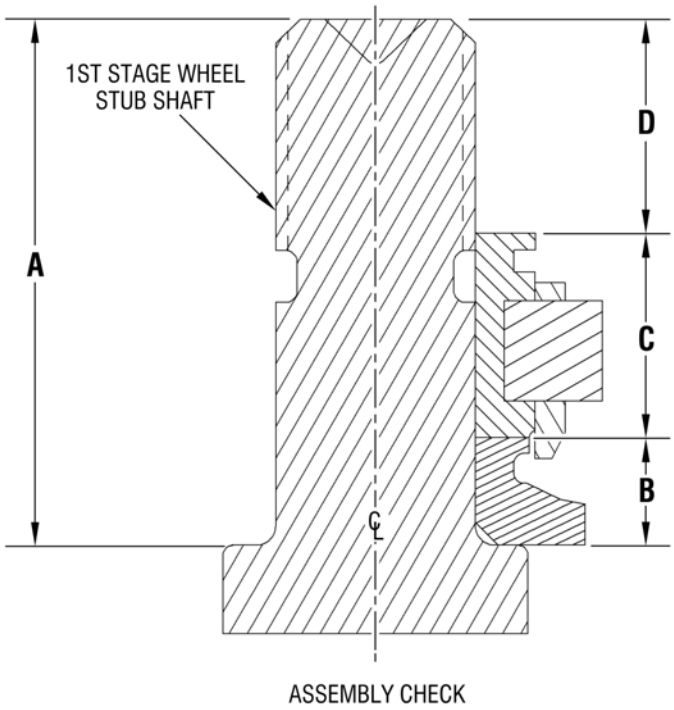
(c) Once dimension D is determined to be acceptable, go to step (3.6).

(3.6) Install locknut and torque to 70-80 lb in. (7.9-9.0 N·m) above drag torque using a socket wrench with a broach depth of no more than 7/16 in. (11 mm) (Snap-On SW 181 or equivalent).

(4) Install the spring and spring clip. The cup sleeve fits over the spring on the end that contacts the bearing.

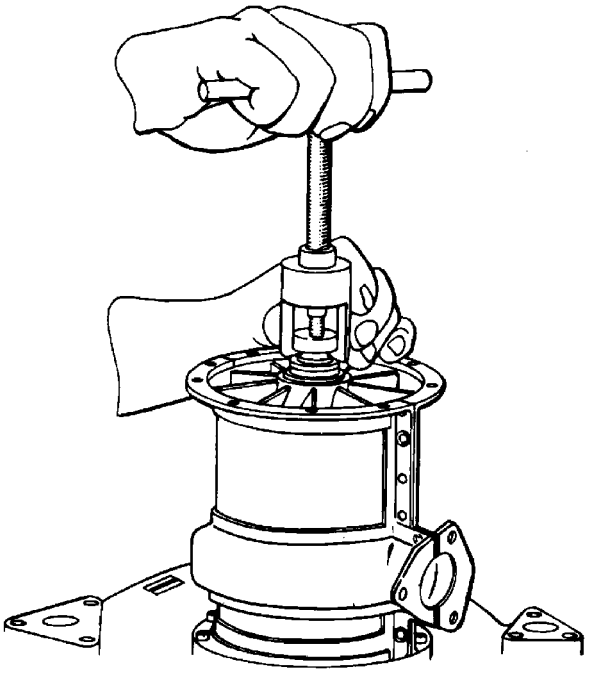
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1st Stage Wheel Stub Shaft Dimension Check
Figure 210A

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ADC100XD

Removing the Compressor Front Bearing and Seal Mating Ring
Figure 210

PARA 3.B. (cont)

(5) Install the retaining ring in the rear groove of the oil seal. Install the front bearing housing over the spring, bearing and oil seal. Compress the retaining ring in the seal groove and engage the ring in the inside groove of the bearing housing until it is fully seated using 6893535 compressor. Exercise care not to damage the seal face. On alternate configuration, press down (rearward) on the housing until the two pin holes of the housing align with the retaining ring groove of the seal. Insert the two pins. Lubricate and install two packings on the bearing housing.

CAUTION: DO NOT FORCE THE SUPPORT FLANGE INTO THE COMPRESSOR CASE PILOT. LOOSEN THE COMPRESSOR CASE HORIZONTAL SPLITLINE BOLTS AS NECESSARY FOR EASE OF ASSEMBLY, EVEN TO THE POINT OF REMOVING ONE CASE HALF.

(6) Visually align the pin of the bearing housing with the hole in the compressor front support then install the front support on the compressor assembly. This part is indexed correctly when the scavenge oil fitting is opposite the ‘‘O” mark on the front diffuser.

(7) Lubricate the threads of the front bearing housing with antiseize compound. Secure housing to the front support with a nut. Tighten nut to 35–40 lb in. (3.9–4.5 N·m).

(8) Install the identification plate and ten support–to–compressor case bolts and nuts. Tighten the compressor horizontal splitline and front support splitline nuts to 10–15 lb in. (1.1–1.7 N·m) plus locknut drag.

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PARA 3.B. (cont)

(9) Apply anti–seize compound to the bolt threads; then install the bleed control valve and gasket on the compressor case mounting flange. Retain with three nuts, bolts and washers. Tighten the 1/4–28 nut to 70–85 lb in. (7.9–9.6 N·m). Tighten the other two nuts to 35–40 lb in. (3.9–4.5 N·m).

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(10) Attach the compressor discharge pressure sensing tube assembly to the bleed valve and to the elbow at the scroll. Tighten coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(11) Attach the RH and LH anti–icing air tubes to the anti–icing valve and to the front support. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

(12) Check the oil seal for leakage by applying oil at 4–6 psi (27.6–41.4 kPa) for one minute to the oil pressure reducer location on the compressor front support. No leakage shall be permitted.

(13) Attach the compressor pressure and scavenge oil tubes:

(a) Install the gearbox–to–front support scavenge oil tube. Tighten coupling nut to 150–200 lb in. (17–23 N·m).

(b) Install the gearbox union–to–pressure reducer pressure oil tube. Tighten coupling nuts to 65–100 lb in. (7.3–11.3 N·m).

(c) Install the P_y line between the governor and the fuel control. Tighten coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(14) Install the starter–generator.

(15) After complete assembly of the compressor, check the compressor rotor for freedom of operation. If compressor drag or rubbing is detected either by feel or by sound, investigate to determine the cause by removing one or both halves of the case assembly.

(16) Check run the engine after seal or bearing replacement. (Refer to Check Run, para 1., 72–00–00, Engine–Adjustment/Test.)

4. Compressor Front Bearing and/or Oil Seal Replacement (Engine Installed)

This is an alternate procedure for replacing the compressor front bearing and/or oil seal. It is accomplished while the engine is installed and in a horizontal position.

CAUTION: THIS ALTERNATE PROCEDURE INVOLVES GREATER RISK FOR PART DAMAGE AND ASSEMBLY ERROR THAN THE PREFERRED PROCEDURE (PARA 3.A. AND 3.B., THIS SECTION). THE ALTERNATE PROCEDURE IS RECOMMENDED FOR SKILLED MECHANICS HAVING APPROVAL OF THEIR ROLLS–ROYCE AUTHORIZED MAINTENANCE CENTER (AMC).

A. Replacement Procedure

(1) Support the compressor rotor in the compressor case by carefully installing shim stock between the first–stage wheel blade tips and the compressor case. Install the shim stock through the open end of the compressor front support at three equally spaced locations. One location shall be at the six o'clock position.

CAUTION: IN ORDER TO ENSURE REMOVAL OF THE SHIM STOCK AFTER COMPLETION OF THE BEARING AND/OR SEAL REPLACEMENT, ATTACH A STRING OR STREAMER TO THE PROTRUDING END OF THE SHIM STOCK BEFORE IT IS INSERTED INTO THE COMPRESSOR.

(2) Replace the compressor front bearing and/or oil seal in the same manner as used in the Engine Removed procedure (Para 3.A. and 3.B., this section).

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PARA 4.A. (cont)

(3) Once the compressor front support is properly installed, remove the shims from between the first–stage wheel blade tips and the case halves.

(4) Check run the engine. (Refer to Check Run, para 1., 72–00–00, Engine—Adjustment/Test.)

5. Inspection/Check

The cleaning and preservation practices which are necessary for the proper maintenance of the compressor are described in para 6., this section.

WARNING: CORROSION OR EROSION WILL CAUSE DAMAGE TO COMPRESSOR BLADES AND VANES WHICH CAN RESULT IN ENGINE FAILURE.

A. Diffuser Vent Orifice Inspection

Inspect the diffuser vent orifice for evidence of spewing or for looseness. If spewing has been encountered, resize the orifice. (Refer to Diffuser Vent Orifice Selection, para 1.B., 72–00–00, Engine–Adjustment/Test.)

B. Blade and Vane Inspection

NOTE: Do not remove both case halves at the same time.

NOTE: Before reworking any blades or vanes, refer to Blade Damage and Vane Damage, paras C and D, which follow.

The design of the compressor case permits inspection of blades and vanes by removing the compressor bleed control valve and one compressor half case. (Refer to Compressor Case Replacement, para 2., this section.) Remove the compressor and send it to an Authorized Maintenance Center (AMC) if vane rub marks are found on the hub area of the compressor rotor wheels during the blade and vane inspection. Rework all nicks, dents and corrosion pits by blending.

C. Blade Damage.

Replace the compressor if any blade is cracked or broken off. Recommended corrective actions for compressor blades are as follows:

NOTE: It is not possible to fully describe all of the damage conditions that could be incurred; therefore, if damage is within the rework limits of Figures 211 and 212, but there is reasonable doubt about the strength of the reworked blade as compared to a new blade, replace the compressor assembly.

NOTE: If the compressor wheels have a corrosion resistant coating, nicks, dents, etc. in the lower 25% of the airfoil cannot be polished/blended without glass bead peening and reapplication of the corrosion resistant coating. For these reasons, a coated compressor rotor that is damaged must be removed and sent to a Rolls–Royce Authorized Maintenance Center (AMC).

(1) General Practices.

(a) Blend and polish blades or vanes in a longitudinal direction only with the rework forming a smooth blend with the basic airfoil. The number of blades or vanes which may be reworked is not limited.

(b) The limiting factor of blade or vane rework is engine performance. Any reduction of blade or vane area will decrease the efficiency of the compressor and the performance of the engine. Remove as little material as possible.

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PARA 6.A.(1) (cont)

(b) Materials and equipment.

1 The highest quality water available must be used.

a The most rapid and economical means to assess water quality is by measuring electrical conductivity. Control of electrical conductivity to a specific low level will automatically yield a low level of chlorides, sulfates, sodium, and other elements. Distilled, demineralized, or deionized water with a maximum electrical conductivity of 3 micromhos per cubic centimeter would be theoretically ideal. However, a more practical level of 20 micromhos per cubic centimeter maximum would control the above impurities to a level of less than 10 ppm.

NOTE: Most water deionizing equipment has the capability to determine electrical conductivity. Commercially purchase deionized/demineralized water, conductivity information should be requested from the vendor.

b Should the electrical conductivity of the water not be known, the use of distilled, demineralized, or deionized water is preferred.

2 Portable equipment such as a garden sprayer or fire extinguisher which can be pressurized to obtain the required flow rate is recommended for water rinse. To provide capability for rinse with either portable equipment or a water supply system, a nozzle capable of flowing the recommended rate at about 55 psig (379 kPa) is desired.

3 The spray nozzle shall provide a diffused spray of water at a flow rate of one quart (one liter) in nine to eleven seconds at the pressure conditions used during compressor rinse. The nozzle should be sized to provide the proper flow rate at the average pressure maintained during each rinse cycle.

NOTE: Test for proper water flow at the pressure to be used by placing the nozzle in a large container so that no water can splash out. Time the flow for 10 seconds and measure the quantity collected. Proper nozzle size for the pressure used should accumulate 1 to 1-1/8 quarts (1.0 to 1.1 liters). Adjust nozzle size as necessary to meet the specified flow limits.

4 A quick opening valve shall be installed in the supply tube as close to the nozzle as practical.

5 6886204 Compressor Cleaning Protector Kit (bleed valve wedge).

(c) Spray rinse procedure:

1 Make sure the anti-ice valve is in the "OFF" position.

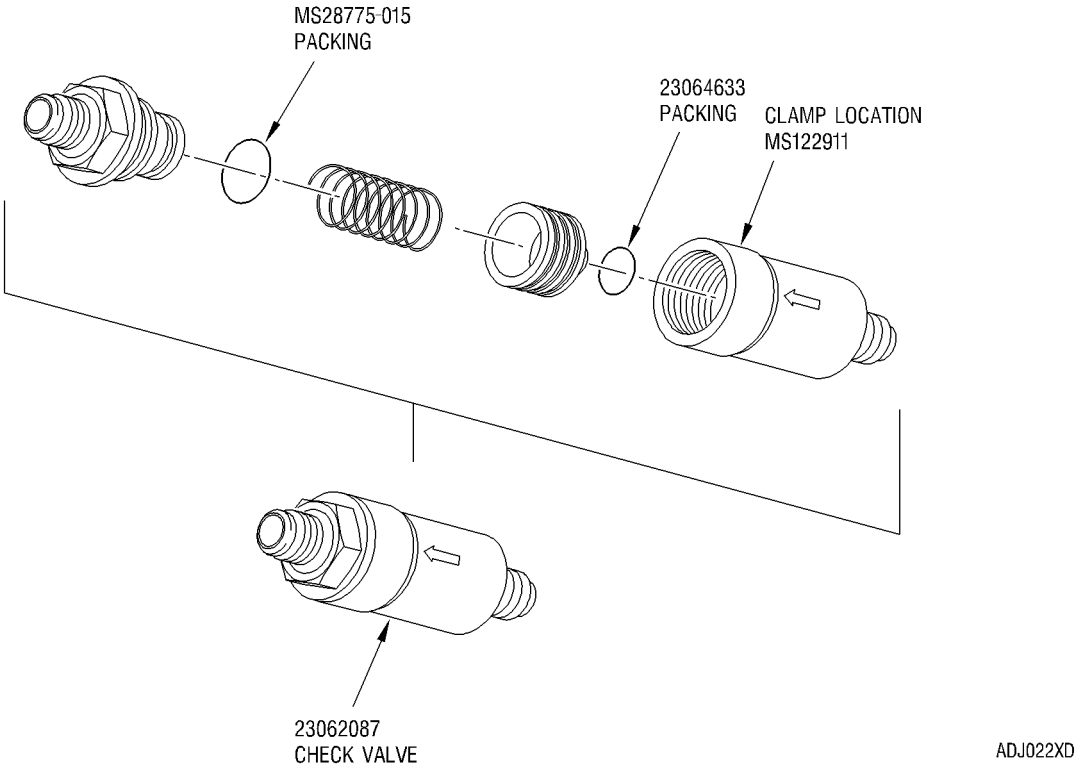
2 Make sure the engine ignition circuit breaker is pulled.

3 Block the bleed valve in the closed position using the wedge in 6886204 compressor cleaning protector kit (See Figure 217). It is not necessary to disconnect any lines.

CAUTION: TO PREVENT POSSIBLE BLADE DAMAGE AND TO ASSURE ADEQUATE RINSE AT THE BASE OF THE BLADES, N1 MUST NOT EXCEED 10% RPM. IF N1 RPM REACHES 10%, RELEASE THE STARTER AND CONTINUE THE WATER SPRAY. PERMIT N1 RPM TO REDUCE TO APPROXIMATELY 5% AND THEN RE-ENERGIZE THE STARTER TO OBTAIN A FULL TEN SECONDS OF ENGINE ROTATION WHILE WATER IS SPRAYED INTO THE COMPRESSOR.

4 Start the water injection three seconds prior to engaging the starter. The three second delay will reduce the tendency of the engine to accelerate above 10% rpm.

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Turbine Pressure Oil System Check Valve
Figure 216

PARA 7. (cont)

(11) Check run the engine. (Refer to Check Run, para 1, 72–00–00, Engine—Adjustment/Test.) Check for oil leaks in the area of disassembly.

(12) Alert maintenance and flight crews to monitor engine chip indications for the next two flight hours.

(a) Monitor engine chip indicators for the next two flight hours.

J. Cleaning Power Turbine Labyrinth Seals

Clean carbon buildup from the power turbine labyrinth seals as outlined in Oil System Maintenance, para 7.F.(2), this section.

K. Turbine Pressure Oil System Check Valve

(1) Disassemble, clean, inspect and assemble the check valve as follows: (See Figure 216.)

(a) Remove the fitting from the check valve housing.

(b) Separate the packing, spring and poppet from the housing. Discard packing.

(c) Wash parts in mineral spirits.

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PARA 7. (cont)

(d) Inspect valve parts in accordance with Table 202.

(e) Insert poppet and spring into valve housing.

(f) Install fitting with new packing on housing.

CAUTION: BE SURE THE CHECK VALVE IS INSTALLED WITH THE ARROW POINTING TOWARD THE REAR OF THE ENGINE.

CAUTION: IF A CHECK VALVE IS INSTALLED (BLACK IN COLOR) VERIFY THAT THE PROPER PART NUMBER CLAMP IS INSTALLED. IF AN IMPROPER PART NUMBER CLAMP IS BEING USED, THE CHECK VALVE MUST BE REPLACED.

(g) Install check valve, ensure that the proper clamp is being used and that the clamp is positioned on the downstream end of check valve upon the raised shouldered area.

(h) Inspect check valve for external leakage at first engine operation after valve installation on the engine. No leakage permitted.

L. Test the Turbine Pressure Oil System Check Valves. (See Figure 216.)

NOTE: Valves with part numbers 23074872 and subsequent are not field repairable.

WARNING: DO NOT BREATHE THE FUMES FROM SYNTHETIC LUBRICATING OIL. IT CAN CONTAIN TRICRESYL PHOSPHATE. USE IN AN AREA WITH CONTINUOUS AIRFLOW. KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAMES. DO NOT GET IT ON YOUR SKIN OR IN YOUR EYES. WEAR GOGGLES, CHEMICAL-RESISTANT GLOVES, AND SAFETY CLOTHING. IF YOU GET IT ON YOUR SKIN, CLEAN WITH SOAP AND WATER. IF YOU GET IT IN YOUR EYES, FLUSH WITH WATER. GET MEDICAL AID.

(1) Test the check valve using engine oil (MIL-L-7808) at 80°F (27°C) as follows:

(a) Install the valve on the test stand with the large end down.

(b) Apply the test pressure to the small end of the valve.

(c) Cycle the valve open and closed at least once before taking pressure readings.

(d) Slowly increase the pressure and observe the opening pressure. Opening pressure must not exceed 5.0 psig (34.5 kPag).

(e) As the test pressure is reduced, the valve must be fully closed (with no leaks) at 3.0 psig (20.7 kPag).

8. Approved Repairs

A. Turbine and Exhaust Collector Support Crack Repair

Weld repair any cracks found in the exhaust ducts or outboard structure of the turbine and exhaust collector support.

CAUTION: TO PREVENT ELECTRICAL ARC BEARING DAMAGE, SEPARATE THE EXHAUST COLLECTOR FROM THE ENGINE/TURBINE AND REMOVE THE NO. 5 BEARING BEFORE THE WELD REPAIR IS MADE.

(1) Weld cracks in the exhaust ducts (areas -9 and -10 of Figure 217) using gas tungsten-arc process with 29-9 W Mo (AMS 5784) weld rod.

(2) Weld cracks in the outboard structure (area -3 of Figure 217) using gas tungsten-arc process with Hastelloy W (AMS 5786) weld rod.

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Table 202

Turbine Pressure Oil System Check Valve Inspection

Item	Condition	Serviceable Limit	Disposition
1	Stripped or crossed threads on fitting or housing.	None.	Chase threads. (Max. of one damaged thread
2	Nicks or scratches on flared tube sealing surface of fitting or housing.	None.	Repair or replace part.
3	Nicks or scratches on poppet seating surface or housing valve seat.	None.	Repair or replace part.
4	Fretting wear in bore of housing.	None.	Replace part.

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PARA 2.E. (cont)

(d) Lubricate and install packing in pressure oil pump body. Place pressure oil pump body on scavenge body assembly. Install two screws; tighten to 18–22 lb in. (2.0–2.5 N·m).

NOTE: The pump must turn freely by hand after assembly.

F. Lube Oil Filter Housing Assembly and Test

Assemble the Lube Oil Filter Housing as follows: (See Figure 216.)

(1) Assemble and test the lube oil filter housing as follows:

CAUTION: INSPECT THE RETAINING RING BEFORE INSTALLATION TO BE SURE IT HAS NO DEFECTS AND AFTER INSTALLATION TO BE SURE IT IS PROPERLY SEATED.

(a) Install the poppet, spring, lubricated packing, and guide in the filter housing. Retain with an internal retaining ring. Use 6798807 compressor to aid in installation of retaining ring.

(b) Lubricate and install the packing on the pressure regulator guide. Insert poppet, spring, and guide into the filter housing. Make an approximate adjustment of the regulator by bottoming the adjusting screw and backing out 5–1/2 turns.

(c) Test the lube oil filter housing as follows:

1 Plug the standpipe and install the cap on the filter housing.

2 Connect a supply of calibration fluid at 24–29°C (75–85°F) or engine oil at 27–38°C (80–100°F) to the filter housing inlet port.

3 Slowly apply increasing pressure until the bypass valve opens. Pressure must be 80–130 psig (552–896 kPag).

4 Decrease pressure to 30 psig (207 kPag). Leakage through the bypass valve must not exceed 63 cc per minute.

5 Connect the fluid supply to the outlet port and plug the inlet port.

6 Adjust the fluid supply to obtain a flow of 720 pph (327 kg/hr) across the filter.

7 Adjust the guide assembly until 130 ± 5 psig (896 ± 35 kPag) is obtained with 720 pph (327 kg/hr) flow.

8 Decrease flow to 15 pph (6.8 kg/hr). Pressure must not be less than 125 psig (862 kPag) If pressure is not within limits, repeat steps 6 and 7, adjusting the guide assembly for a higher pressure within the 130 ± 5 psig (896 ± 35 kPag) range. If pressure is less than 125 psig (862 kPag) at 15 pph (6.8 kg/hr) replace the pressure regulating poppet valve and repeat the entire test.

9 Remove the cap and remove the plug from the stand pipe. Remove the plug from the inlet port.

(d) Install the filter assembly with new lubricated packing in the filter housing. Install cap with lubricated packing in the filter housing. Some engines have indicating type caps.) Secure the cap with two nuts and washers. Tighten nuts to 35–40 lb in. (3.9–4.5 N·m).

G. Gearbox Housing Assembly and Check.

Assemble and check gearbox housing as follows:

(1) Install gearbox housing seals as necessary at the following locations using 6796941 seal installation kit with details –16 or –19. (See Figures 226, 227 and 228.) Apply engine oil to the seal lip to aid in installation.

(a) Power turbine tachometer generator pad (use detail –16).

(b) Gas producer tachometer generator pad (use detail –16).

(c) Power takeoff pad (use detail –19).

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PARA 2.G. (cont)

(22) Lubricate and install the ball bearing on the torquemeter piston using 6796930 plate, location J and 6796947 drift. Install with the wide portion of the outer race away from the torquemeter piston. Install the piston on the torquemeter support shaft. Lubricate the packing and place it on the shaft.

(23) Install the torquemeter support shaft in the gearbox housing. (See Figure 218 or 219.) Install 6795974 aligning fixture. (See Figure 221.) Install the internal flared washer and lubricated packing on the shaft. Tighten the nut to 275–300 lb in. (31–34 N·m) using 6795597 wrench. (See Figure 220.) Secure with lockwire.

(24) Lubricate and install the bearings on the tachometer and governor power train spur gearshaft using 6796930 plate, locations C and G and 6796946 drift.

(25) Apply lubricant lightly to the splines then install the tachometer and governor spur gearshaft in the gearbox housing using 6796941 seal guide with detail –13.

(26) Lubricate and install the bearings on the fuel control and oil pump spur gearshaft using 6796930 plate, location H and 6796946 drift. The small ball bearing that was pulled by the outer race must be replaced with a new bearing at this step if there is any apparent indication of raceway brinelling. Install the gearshaft in the oil pump bearing cage.

(27) Apply lubricant lightly to the splines then install the fuel control and oil pump flex shaft coupling on the oil pump drive shaft. (See Figure 222 or 223.)

(28) Lubricate packing and install with magnetic plug in the gearbox housing. Tighten plug to 60–80 lb in. (6.8–9.0 N·m) and secure with lockwire.

(29) (250–C20S, –C20W) Lubricate packing and install with low pressure scavenge oil check valve on outside of gearbox housing. Install check valve with arrow pointing away from gearbox housing.

H. Gearbox Cover Assembly. (See Figure 205, 206 or 207.)

Assemble the gearbox cover as follows:

(1) Install gearbox cover seals as necessary at the following locations using 6796941 seal installation kit with details –16, –17, –19, and –20. (See Figures 228 and 234.) Apply engine oil to the seal lip to aid in installation.

(a) Power turbine governor pad (use detail –17).

(b) Power takeoff pad (use detail –19).

(c) Gas producer fuel control pad (use detail –17).

(d) Fuel pump pad (use detail –17).

(e) Accessory drive pad (use detail –17) (250–C20, –C20B, –C20J, –C20S)

(f) Starter generator pad (use detail –18).

(g) Gas producer idler spur gearshaft (internal installation held by a retaining ring) (use detail –20).

NOTE: The accessory drive spur gearshaft and its associated idler spur gear are used in the 250–C20J and –C20S gearbox only.

(2) (250–C20J, –C20S) Install and idler gear support shaft in the bore adjacent to the accessory drive gearshaft bore using pusher and puller 6795614. (See Figure 217.) Lubricate and install the bearing in the gas producer gear train idler spur gear; retain with internal retaining rings. (See Figure 216.) Install the idler spur gear and bearing on the support shaft and retain with a bearing keyway washer, key washer, and bolt that has ben lightly coated with Loctite No. 242. Tighten the bolt to 35–40 lb in. (3.9–4.5 N·m) and bend the locktab of the key washer.

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	319	Jun 1/02
	320	Jun 1/02
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	322	Jun 1/02
	323	Jun 1/02
	324	Jun 1/02
	325	Jun 1/02
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	329	Jun 1/02
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Table 14

Accessories Recommended Time Between Overhauls (Hours)
(250–C20, –C20B, –C20F, –C20J, –C20W)

Component	Recommended TBO Hours
Fuel Pump	
Sundstrand (PESCO) Dual Element	1500(1)
Sundstrand (PESCO) Dual Element	2250(2)
Sundstrand (PESCO) Single Element	2250(3)
ARGO–TECH/TRW – P/N 386500–5 (Rolls–Royce P/N 6899253)	4000
P/N 386500–1, –2, –3, –4	3500
Chandler Evans (CECO) – P/N 113300–01A1 (Rolls–Royce P/N 23057338)	3500
– P/N 113300–02A1 (Rolls–Royce P/N 23065132)	3500
– P/N 113300–03A1 (Rolls–Royce P/N) 23070459)	3500
Fuel Control (CECO)(4)	
P/N 104000A8 and subsequent	4000
P/N 104900A3 and subsequent	4000
All part numbers prior to above	1000
Power Turbine Governor (CECO)(4)	
P/N 104100A12 and subsequent	4000
P/N 104500A7 (multi–engine) and subsequent	4000
P/N 104100A6 through A11	2000
P/N 104500A1 through A6 (multi–engine)	2000
All P/N prior to 104100A6	1000
Fuel Control (Bendix) (250–C20, –C20B, –C20F, –C20J, –C20W)	2500
(250–C20S)	2000
Power Turbine Governor (Bendix)	1500

NOTE: The TBO period on the following Bendix governors has been extended to 2000 hours. All governors that precede these part numbers must remain at 1500 hours.

Rolls–Royce P/N	Bendix P/N
23005493	2524769–7 and subsequent
23005492	2524667–8 and subsequent
23036657	2549025–1 and subsequent
23036658	2549026–1 and subsequent

Fuel Nozzle	
P/N 6890917	2500
P/N 6874959	1500
Bleed Valve	1500

NOTE: Contact your Authorized Maintenance Center for extension of the TBO on eligible selected accessories.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
2 (cont)	Engine fails to light off (cont)	Insufficient fuel in tanks.	Fill tanks with fuel.
		Gas producer fuel control remains in cutoff.	Check linkage.
		Lightoff adjustment too low. (CECO control system only.)	Make lightoff adjustment. (Refer to para 3.F., 73–20–04.)
		Insufficient fuel pressure to fuel pump.	Turn on aircraft boost pump.
		Spark igniter firing intermittently	Check input voltage to exciter. Check ignition exciter by replacing temporarily with a known satisfactory unit.
		Fuel nozzle valve stuck	Replace fuel nozzle.
		Fuel pump inoperative (Fuel vapor will not be observed leaving the exhaust.)	Check pump for sheared drives or internal damage. Check for air leaks at in–let or fluid leaks at outlet.
		Water or other con–taminant in fuel	Check a sample of fuel from the bottom of the tank, if contaminated, disconnect the fuel line at the fuel nozzle, drain all fuel then flush the system with clean fuel.
		Fuel nozzle orifice clogged	Check fuel pump filter, re–place nozzle. (Refer to Filter Element Replacement, para 2.C., 73–10–01 or para 2., 73–10–05 and Fuel Nozzle, para 1., 73–10–03.)
		In–line fuel check valve fails to open	Replace in–line fuel check valve.
3	Early lightoff	Fuel control cutoff valve not closed	Make a fuel control cutoff valve operational check. (Refer to Cutoff Valve Operational Check–Bendix Fuel System, para 3.D., 73–20–02 or para 3.E., 73–20–03, or Cutoff Valve Operational Check–CECO Fuel System, para 3.D., 73–20–04.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
4	Engine lights off but will not ac–celerate to idle speed at a nor–mal rate	Loose pneumatic fit–ting, cracked accumu–lator, or cracked pneumatic line causing air leak in control system (Bendix control system only)	Pressurize the system to check for leaks. (Refer to Bendix Fuel Control System Pneumatic Leak Check, para 2.B., 73–00–00.)
			Check for crack in air tubes or outer combustion case. Check for air seal leaks.
		Dirty P_c filter (Bendix control system only)	Clean P_c filter. (Refer to Cleaning P_c Filter, para 3., 73–20–06.)
		Cracked accumulator. (Bendix control system only)	Replace accumulator.
		Fuel leak at the fuel control or governor split lines or from overboard drains. (CECO control system only)	Replace component.
		Inadequate torque at starter pad	Check condition of battery and starter to determine if sufficient N_1 cranking speed is attainable.
		Dirty compressor	Clean compressor and bleed valve. (Refer to Compressor Cleaning para 6.B., 72–30–00 and Cleaning Bleed Valve, para 2.C., 75–10–02.)
		Insufficient fuel supply to gas producer fuel control	Check fuel system to ensure all valves are open and pumps are op–erative.
		Insufficient fuel pres–sure to fuel pump	Turn on aircraft boost pump.
		Gas producer fuel control bypass valve stuck open	Disconnect the fuel line at the fuel nozzle, flush sys–tem with clean fuel; then replace control.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
4 (cont)	Engine lights off but will not ac–celerate to idle speed at a normal rate (cont)	Fuel nozzle partially clogged with carbon	Clean fuel nozzle. (Refer to Fuel Nozzle Inspection/Cleaning, para 2., 73–10–03.)
		Fuel nozzle check valve stuck partially open	Replace fuel nozzle.
		Start derichment ad–justment too low	Make start derichment ad–justment. (Refer to Engine Starting Characteristics Adjustment, para 3.H., 73–20–02; para 3.G., 73–20–03; or Start Derich-ment Adjustment, para 3.G., 73–20–04.)
		Gas producer fuel control incorrectly adjusted or calibr–ation has shifted	Replace control.
		Anti–icing valve open and cabin heat on	Close anti–icing valve and turn off cabin heat.
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or com–pressor assembly if damage or erosion exceeds accept–able limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.F., 72–30–00.)
		Faulty power turbine governor	Replace governor.
5	Slow starts or low turbine temperature in the 35–50% N_1 speed range.	Control schedule has shifted lean (6899262, Bendix 2524644–9, or later fuel controls)	Turn the start/acceleration adjuster cw to increase tur–bine temperature and decrease start time. Make a one detent adjustment; then observe starting temp–erature. One detent changes temperature 30–40°C (86–104°F). Make an addi-tional one detent adjustment if necessary. (Refer to Start/Ac-celeration Fuel Flow Adjust-ment, para 3.H.(2), 73–20–02; para 3.G.(2), 73–20–03.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
6	Engine lights off but flames out during ground starts at high altitude, especially above 5000 feet (1524 meters), during cold ambient conditions.	Fuel nozzle partially clogged.	Inspect fuel nozzle for carbon buildup. Clean or replace as necessary.
		Start derichment adjustment too low.	Make start derichment adjustment. (Refer to Start Derichment Adjustment, para 3.H.(1), 73–20–02; para 3.G.(1), 73–20–03; or para 3.H., 73–20–04.)
		Temporary fluctuation of fuel pressure. (CECO control system only).	Make the start with the aircraft boost pump off. When idle speed is reached, turn on boost pumps if required by the Flight Manual. Do not disregard the requirements of the Flight Manual pertaining to operation of the boost pumps. If starts are not improved, adjust the start derichment (turn clockwise to enrich fuel flow). If there still is no improvement, inspect the fuel nozzle for carbon buildup. Clean or replace the fuel nozzle as necessary.
7	Low power and high TOT	Contaminated bleed valve jet	Clean bleed valve (Refer to Cleaning Bleed Valve, para 2.C., 75–10–02.)
8	Hot starts or high turbine temperature	Control schedule has shifted rich (6899262, Bendix 2524644–9, or later fuel controls).	Turn the start/acceleration adjuster ccw to decrease turbine temperature and to prevent hot starts. Make a one detent adjustment; then observe starting temperature. One detent changes temperature 30–40°C (86–104°F). Make an additional one detent adjustment if necessary. (Refer to Start/Acceleration Fuel Flow Adjustment, para 3.H.(2), 73–20–02 or para 3.G.(2), 73–20–03.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
9	Acceleration temperature too high during start	Insufficient time allowed for draining after an unsuc–cessful starting attempt	Purge the engine by motor–ing with the gas producer lever and ignition switch in OFF for approximately 10 sec. before attempting a second start.
		Reduced battery capac–ity (This can produce low cranking speed.)	Recharge or replace battery.
		High residual TOT in excess of 150°C (302°F)	Motor engine with starter leaving gas producer lever and ignition OFF.
		Depreciated starter which is not capable of dry motoring gas producer (N_1) above 15 percent	Replace starter.
		Gas producer lever (twist grip) or Fuel Cutoff Lever in ground idle (start) or ON position prior to and during starter engagement	Review starting procedure.
		Dirty compressor	Clean compressor and bleed valve. (Refer to Compres–sor Cleaning, para 6., 72–30–00 and Bleed Valve Cleaning, para 2.C., 75–10–02.)
		Fuel nozzle valve stuck full open	Replace fuel nozzle.
		Excessive compressor air leaking	Check for leaks. Be sure that anti–ice valve is fully closed.
		Bleed control valve stuck closed	Replace bleed control valve.
		Gas producer fuel con–trol incorrectly ad–justed or calibration has shifted	Replace faulty control if start temperature exceeds 927°C (1700°F).
		Gas producer fuel con–trol start derichment too rich	Adjust start derichment. (Refer to start Derichment Ad-justment, para 3.H.(1), 73–20–02; para 3.G.(1), 73–20–03 or para 3.G., 73–20–04.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
9 (cont)	Acceleration temp–erature too high during start (cont)	Lightoff adjustment too high. (CECO control system only.)	Make lightoff adjustment. (Refer to Lightoff Adjustment, para 3.F., 73–20–04.)
10	Acceleration temp–erature too low during starting	Loose pneumatic fit–ting, cracked accumu–lator, or cracked pneumatic line causing air leak in control system (Bendix system only)	Pressurize the system to check for leaks. (Refer to Fuel Control System Pneu–matic Leak Check, para 2.B., 73–00–00.)
		Gas producer fuel con–trol incorrectly ad–justed or calibration has shifted	Replace control.
		Gas producer fuel con–trol start derichment too lean	Adjust start derichment. (Refer to Start Derichment Adjustment, para 3.H.(1), 73–20–02; para 3.G.(1), 73–20–03 or para 3.G., 73–20–04.)
		Lightoff adjustment too low. (CECO control system only)	Make lightoff adjustment. (Refer to Lightoff Adjustment, para 3.F., 73–20–04.)
11	Engine speed cycles at idle	Gas producer fuel con–trol bypass valve not operating freely	Disconnect the fuel line at the fuel nozzle; flush system with clean fuel. Inspect and clean the fuel control fuel filter. (Re–fer to Cleaning the Gas Producer Fuel Control Fuel Strainer Bendix Fuel Control, para 4.A., 73–20–02 or para 4.A., 73–20–03 or Cleaning Fuel Control Filter–CECO fuel control, para 4.A., 73–20–04.) If the same condition still exists, replace control.
12	Engine instability above idle speed	Double check valve (Bendix control system–not all installations)	Replace double check valve.
		Contamination in the pneumatic section of the gas producer fuel control and power turbine governor	Remove air lines and check P_g port in the governor and the P_c port in both control and governor. Re–place control or governor if contaminated.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
13	Engine instability in power range	Loose pneumatic fitting, cracked accumulator, or cracked pneumatic line causing air leak in control system (Bendix system only)	Pressurize the system to check for leaks. (Refer to Bendix Fuel Control System Pneumatic Leak Check, para 2.B., 73–00–00.)
		Air in fuel system.	Bleed air from the fuel system. (Refer to Purging the Fuel System, para 2.D., 73–00–00.)
14	Idle speed too low	Incorrect gas producer lever setting	Check lever position and rigging. (Refer to Rigging Check, para 3.C., 73–20–02; 3.B., 73–20–03 or 3.C., 73–20–04.)
		Malfunctioning tachometer	Replace tachometer.
		Excessive generator load	Reduce electrical load requirement.
		Dirty compressor	Clean compressor and bleed valve. (Refer to Compressor Cleaning, para 6., 72–30–00 and Cleaning Bleed Valve, para 2.C., 75–10–02.)
		Gas producer fuel control idle adjustment incorrectly set	Correct the setting. (Refer to Idle Speed Setting, para 3.F., 73–20–02; 3.C., 73–20–03 or 3.E., 73–20–04.)
		Loose pneumatic fitting, cracked accumulator, or cracked pneumatic line causing air leak in control system (Bendix system only)	Pressurize the system to check for leaks. (Refer to Fuel Control System Pneumatic Leak Check, para 2.B., 73–00–00.)
15	Idle speed too high	Incorrect gas producer lever setting	Check lever position and rigging. (Refer to Rigging Check, para 3.C., 73–20–02; 3.B., 73–20–03 or 3.C., 73–20–04.)
		Malfunctioning tachometer	Replace tachometer.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
15 (cont)	Idle speed too high (cont)	Gas producer fuel control idle adjustment incorrectly set	Correct the setting. (Refer to Idle Speed Setting, para 3.F., 73–20–02; 3.C., 73–20–03 or 3.E., 73–20–04.)
16	Oil pressure drops off severely	Oil supply low	Check oil supply and refill as necessary.
		Oil pressure transmitter or indicator giving false indication	Check transmitter or indicator and repair or replace if necessary.
		Regulator valve sticking or broken spring	Clean or replace spring.
		Defective oil pump	Replace pump or send power and accessories gearbox to an overhaul facility. (Refer to applicable part of Gearbox Disassembly and Assembly, para 2., 72–60–00.)
17	Engine operated more than 30 seconds without oil pressure.	Low oil quantity.	Remove engine and send to a Rolls–Royce Authorized Maintenance Center (AMC) for investigation (Refer to Engine Operated With No Oil Pressure, para 11.E., Engine–Servicing, 72–00–00.)
		Improper servicing after oil change.	Same as above.
		Oil pump failure.	Same as above.
18	Excessive oil pressure fluctuation	Air in sensing line	Bleed line.
		Gage records inaccurately	Check gage and transmitter.
		Faulty pressure regulating valve	Replace the valve.
		Oil contamination	Drain and replace filter. Inspect magnetic chip detectors for metallic particles. Thoroughly flush with engine oil while motoring engine. Drain and refill with engine oil.
		Low oil quantity	Check for excessive consumption.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
18 (cont)	Excessive oil pressure fluctuation (cont)	Wear of filter housing due to vibration of filter inlet and filter bypass tubes	Replace packings on the inlet and bypass tubes and/or replace the filter housing (as required).
		Oil filter inlet tube assembly too short	Dimensionally inspect tube length. (Refer to para 4.G., 72–60–00.)
19	Low oil pressure	Lack of oil in reser–voir	Fill reservoir with correct oil.
		Gage records inaccurately	Check gage and transmitter.
		Oil leaks	Check all piping connections and the gearbox splitline. (Refer to Gearbox Cover–to–Housing Assembly, para 2.I., 72–60–00 for assembly technique to prevent splitline leakage.)
		Clogged oil filter	Clean or replace oil filter. If filter is clogged with carbon, inspect and clean the power turbine support pressure oil nozzle, the power turbine support scavenge oil strut and the external scavenge oil sump. (Refer to para 7.E. and 7.G., 72–50–00.)
		Oil contamination	Drain and replace filter. Inspect magnetic chip detectors for metallic particles. Thoroughly flush with engine oil while motoring engine.
			If carbon and sludge deposits are found, inspect the oil tank for similar deposits. If deposits are found, remove and clean the airframe oil tank and flush the airframe engine oil system in accordance with the applicable airframe manufacturer's manuals.
			Drain and refill with engine oil.

CAUTION: DO NOT MAKE A PRESSURE REGULATING VALVE ADJUSTMENT TO CORRECT FOR A RAPID CHANGE IN OIL PRESSURE. THESE CONDITIONS ARE CAUSE TO SUSPECT OTHER OIL SYSTEM PROBLEMS HAVE DEVELOPED.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
19 (cont)	Low oil pressure (cont)	Oil pressure not adjusted	Adjust oil pressure regulating valve. (Refer to Pressure Regulating Valve, para 3.A., 72–60–00.)
	NOTE: Before attempting oil pressure regulator adjustment, make sure that minimum N_1 rpm of 94% is attained during periods of reported low oil pressure readings.		
		Increase in oil pump internal clearances or sheared drive	Replace pump or send power and accessories gearbox to an overhaul facility. (Refer to applicable part of Gearbox Disassembly and Assembly, para 2., 72–60–00.)
		Wear of filter housing due to vibration of filter inlet and filter bypass tubes.	Replace packings on the inlet and bypass tubes and/or replace the filter housing (as required).
		Oil filter inlet tube assembly too short	Dimensionally inspect tube length per para 4.G., 72–60–00.)
20	High oil pressure	Oil pressure gage and transmitter records inaccurately	Check gage and trans–mitter.
CAUTION:	EXCEPT FOR INITIAL ADJUSTMENT ON NEWLY INSTALLED ENGINES, DO NOT ADJUST THE PRESSURE REGULATING VALVE TO CORRECT FOR HIGH OIL PRESSURE. DO NOT MAKE A PRESSURE REGULATING VALVE ADJUSTMENT TO CORRECT FOR A SUDDEN INCREASE OR RAPID CHANGE IN OIL PRESSURE. THESE CONDITIONS ARE CAUSE TO SUSPECT OTHER OIL SYSTEM PROBLEMS HAVE DEVELOPED.		
		Pressure regulating valve improperly adjusted	Readjust oil pressure regulating valve. (Refer Pressure Regulating Valve, para 3.A., 72–60–00.)
21	Oil consumption exceeds 0.05 gal (0.19 liter) per hour [1 quart (0.9 liter) per 5 hours]	Loose fittings, connections, or splitlines	Check all fittings, con–nections, and splitlines for sealant and proper torque. Wash entire engine and coat with whitener in suspected area. Operate engine to locate source of leakage. (Refer to Gearbox Cover–to–Housing Assembly, para 2.I., 72–60–00 for assembly technique to prevent gearbox split–line leakage.)
		Oil leakage from power turbine carbon face seal	Replace seal. (Refer to Oil Bellows Seal, para 6., 72–50–00.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
21 (cont)	Oil consumption exceeds 0.05 gal (0.19 liter) per hour [1 quart (0.9 liter) per 5 hours] (cont)	Leaking accessory oil seals as evidenced by oil draining from weep hole (on gas produ–cer fuel control and power turbine gov–ernor) or from drain on fuel pump	Replace defective seals. (Refer to Replacing Oil Seals, para 1.B., 72–60–00.)
	NOTE: Check the aircraft oil quantity within 15 minutes of engine shutdown to avoid a false indication of excessive oil consumption. If the 15 minutes has been exceeded, motor the engine for 30 seconds with the starter before checking tank quantity. Motoring normally scavenges oil from the gearbox back to the aircraft oil tank. Check the airframe flight manual; some installations may require engine to be operated for at least a minute at ground idle to assure proper scavenging of the engine gearbox.		
	NOTE: Always refer to the airframe flight manual for proper oil servicing instructions; specific requirements may vary for different aircraft models.		
22	Oil consumption in excess of one quart (0.9 liter) per hour	Coking and carbon buildup in power turbine support	Clean power turbine support scavenge oil strut, power turbine support pressure oil nozzle and the external scavenge oil sump. (Refer to para 7.E. and 7.G., 72–50–00.)
		Improper fit between the power turbine inner and outer shafts	Send engine to an overhaul facility for repair.
23	Oil blowing from gearbox vent.	Leaking accessory pad seal	Replace seal. (Refer to para 4.C.(5) and 1.B., 72–60–00.)
24	Oil spewing from diffuser vent orifice	Orifice improperly sized (smaller orifice needed)	Refer to Diffuser Vent Orifice Selection, para 1.B., Engine–Adjustment/ Test, 72–00–00.)
25	Oil spewing at compressor bleed control valve	No. 1 bearing seal failure	Replace seal. (Refer to Compressor Front Bearing and/or Oil Seal Replacement, para 3. or 4., 72–30–00.)
26	Oil temperature exceeds 107°C (225°F)	Oil cooler air–flow restricted or oil cooler fan inoperative	Check cooler and fan; repair or replace. Inspect engine. (Refer to Oil Temperature Limit Exceeded, para 11.B., Engine–Servicing, 72–00–00.)
		Oil cooler bypass valve inoperative	Check valve, repair or replace. Inspect engine. (Refer to Oil Temperature Limit Exceeded, para 11.B., Engine–Servicing, 72–00–00.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
27	Oil temperature exceeds 107°C (225°F) remains less than 120°C (248°F) for a period not exceeding 10 minutes.	Contamination or carbon buildup in the turbine.	Inspect and clean oil system and passages. (Refer to Oil System Maintenance, para 7.F., 72–50–00.)
28	Low power with high TOT	Dirty compressor	Clean compressor (Refer to Compressor Cleaning, para 6., 72–30–00.)
		Compressor foreign object damage	Replace compressor if damage exceeds limits. Inspect turbine assembly for secondary damage.
		Engine air inlet blockage	Remove objects causing blockage. (Refer to Compressor Air Inlet Blockage, para 1.D.(12), Engine–Inspection/Check, 72–00–00.)
		Eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C., 5.D. and 5.E., 72–30–00.)
		New compressor case misaligned at installation	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement, para 2., 72–30–00.)
		Bleed control valve has failed to close.	Check compressor discharge pressure sensing line for leaks and for security. Clean valve nozzle, filter and jet. (Refer to Bleed Valve Cleaning, para 2.C. 75–10–02.)
		Excessive compressor air leaks	Replace bleed control valve. Repair leaks.
		Faulty TOT indicator	Check calibration of TOT system. Replace indicator as necessary. Also Refer to Item 30.
		Anti–icing valve leaking	Check solenoid and tube fittings for leaks, replace valve as necessary.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
28 (cont)	Low power with high TOT (cont)	Faulty torquemeter indicating system	Check calibration of torque sensing system. Replace gage or transmitter as necessary. Also refer to Item 48.
		Compressor air discharge tubes leaking air at the piston ring split seals	Reposition the compressor air discharge tubes or replace the piston ring split seals. Inspect tubes for cracks. Check adapter for being out–of–round, or worn seal bore. Check outer combustion case flanges for warping.
		Compressor rotor–to–shroud clearance excessive	Repair or replace the compressor.
		Compressor impeller rub caused by dirt or No. 1 bearing failure	Clean or replace compressor.
		Compressor scroll internal erosion distorted elbow vanes or air leaks at joints	Repair or replace compressor.
		Outer combustion case cracked or distorted	Repair crack or replace outer combustion case.
		Warped or cracked combustion liner	Repair or replace combustion liner.
		1st–stage gas turbine nozzle cracked	Replace 1st–stage nozzle.
		Cracked first–stage turbine nozzle diaphragm	Replace the first–stage turbine nozzle diaphragm. (Refer to Replace the First–stage Turbine Nozzle or First–stage Turbine Nozzle Shield, para 2., 72–50–00.)
		Burned or missing turbine rotor blades	Replace turbine assembly.
		Turbine wheel or nozzle eroded excessively	Replace turbine.
		Turbine wheel blade tip excessive clearance	Replace turbine.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
28 (cont)	Low power with high TOT (cont)	Nos. 6 & 7 area labyrinth seals excessive clearance	Replace turbine.
		Blocked or restrict–ed exhaust outlet	Remove blockage or replace turbine (e.g., flowsplitter damage).
		Leaking heating/en–vironmental control bleed air system	Cap or blank off customer bleed pad on scroll to isolate cause.
29	Low power with TOT below max limit	Gas producer control lever not reaching maximum speed adjust–ment stop	Clean and adjust linkage to the gas producer fuel con–trol. Correct any loose–ness, wear or lost travel. (Refer to Rigging Check, para 3.C., 73–20–02; 3.B., 73–20–03 or 3.C., 73–20–04.)
		Gas producer control lever maximum speed adjustment stop not properly set	Correct the maximum speed adjustment setting. (Refer to Fuel Control Max Speed Stop, para 3.G., 73–20–02; 3.F., 73–20–03 or 3.I., 73–20–04.)
CAUTION:	THIS IS AN OVERSPEED PROTECTION SETTING; MOVE IN ONE TURN INCREMENTS.		
		Loose pneumatic fit–ting, cracked accumu–lator, or cracked pneumatic line caus–ing an air leak in the control system (Bendix control system only)	Pressurize the system to check for leaks. (Refer to Bendix Fuel Control System Pneumatic Leak Check, para 2.B., 73–00–00.)
		Contaminated fuel control air (Pneu–matic) circuits (Bendix control system only)	Clean air circuit. (Refer to para 4.B., 73–20–02 or 4.B., 73–20–03.)
		L.P. Fuel Filter Blocked	Check bypass indicator. Replace filter element.
		Aircraft fuel sys–tem restriction, contamination or leakage	Refer to aircraft manual for corrective action.
		Blocked fuel nozzle	Clean or replace fuel nozzle (Refer to para 1. through 5., 73–10–03.)
		Faulty gas producer fuel control assembly	Replace gas producer fuel control assembly.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
30	Low measured TOT at normal or high power	Faulty TOT indicator	Check TOT system calibration. Replace indicator as necessary.
		Faulty TOT thermocouple assembly	Check TOT system calibration. Replace thermocouple assembly as necessary (Refer to Thermocouple Replacement, para 1., 77–20–01.)
		Same as Items 28 and 29	Correct as in Items 28 and 29.
31	Unable to obtain specified power.	Improper max flow stop adjustment. (CECO control system only)	Check adjustment. (Refer to para 3.H., 73–20–04, for adjustment required by some installations.)
		Foreign object damage (FOD) eroded blades, vanes and/or plastic coating.	Replace the case or compressor assembly if damage or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection para 5.C. through 5.F., 72–30–00.)
		New compressor case misaligned at installation.	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement para 2., 72–30–00.)
32	Abnormally high or low power.	Dirt in fuel system. (CECO control system only.)	Check condition of the fuel filters. (Refer to Fuel System Filter Maintenance, para 2.C., 73–00–00.) Return contaminated units for repair or overhaul.
			Review fuel handling techniques and facilities.
33	Unstable or erractic operation.	Air in fuel system causing loss of governing action.	Bleed the governor bypass P_0 port. (Refer to applicable part of Purging the Fuel System, para 2.D., 73–00–00.)
			Bleed air from the fuel system. (Refer to para 2.D.(3), 73–00–00, CECO system or 2.D.(2), 73–00–00, Bendix system.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
34	Engine N_1 or N_2 overspeeds	Gas producer fuel con–trol linkage not properly set	Check linkage for proper operation and adjustment.
		Defective gas producer fuel control or power turbine fuel governor	Replace defective control or governor.
		Faulty N_1 or N_2 tachometer	Replace tach–generator or indicator.
	NOTE: During ground run after overspeed incident, note the idle speed with the twist grip or throttle at the idle position. If idle speed is normal, suspect the governor. If idle speed is high, suspect the gas producer fuel control as the faulty component.		
35	Excessive NR droop at takeoff, hover, or cruise	Air in fuel system. (CECO control system only.)	Bleed the governor bypass P_0 port if droop occurs following system mainte–nance or extended inactivi–ty (overnight). (Refer to applicable part of Purging the Fuel System, para 2.D., 73–00–00.)
36	Fast decelerations	Dirty gas producer fuel control air circuit (Bendix con–trol system only)	Clean circuit. (Refer to Cleaning the Gas Producer Fuel Control Air Circuit, para 4.B., 73–20–02 or para 4.B., 73–20–03.)
37	Auto decelerations	Dirty gas producer fuel control air circuit (Bendix control system only)	Clean circuit. (Refer to Cleaning the Gas Producer Fuel Control Air Circuit, para 4.B., 73–20–02 or para 4.B., 73–20–03.)
38	Excessive exhaust torching during transients	Fuel nozzle malfunction	Replace fuel nozzle.
		Excessively rich gas producer fuel control	Replace control.
		Leaking accessory bleed lines	Repair or replace lines.
39	Slow to accelerate from idle to power	Dirty compressor	Clean compressor and bleed valve. (Refer to Compres–sor Cleaning para 6., 72–30–00 and Bleed Valve Cleaning, para 2.C., 75–10–02.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
39 (cont)	Slow to accelerate from idle to power (cont)	Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damage or erosion exceeds acceptable limits. (Refer to Blade Damage, Vane Damage, and Case Plastic Coating Inspection, para 5.C. through 5.F., 72–30–00.)
		New compressor case misaligned at installation	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement, para 2., 72–30–00.)
		Bleed control valve malfunctioning	Replace bleed control valve.
		Loose pneumatic fitting, cracked accumulator, or cracked pneumatic line causing air leak in control system (Bendix system only)	Pressurize the system to check for leaks. (Refer to Fuel Control System Pneumatic Leak Check, para 2.B., 73–00–00.)
		Excessive generator load	Reduce electrical load.
		Excessive compressor air leakage	Check for leaks and repair.
		Gas producer fuel control acceleration schedule too lean	Replace control.
		Excessive bypass flow from power turbine governor.	Replace governor.
		Dirty gas producer fuel control air circuit (Bendix control system only.)	Clean circuit. (Refer to Cleaning the Gas Producer Fuel Control Air Circuit, para 4.B., 73–20–02 or para 4.B., 73–20–03.)
40	Slow to accelerate to power while in flight	Same as in Item 39 trouble	Correct as in Item 39 trouble.
		Governor linkage incorrectly rigged	Check rigging. Correct linkage as required.
41	TOT approx 30°C (54°F) lower than normal at idle	Bleed control valve stuck closed	Replace bleed control valve.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
42	Compressor surge during starting or near the idle speed	Dirty compressor	Clean compressor and bleed valve. (Refer to Compressor Cleaning para 6., 72–30–00 and Bleed Valve Cleaning, para 2.C., 75–10–02.)
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damaged or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.E., 72–30–00.)
		New compressor case misaligned at installation	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement, para 2., 72–30–00.)
		Excessively rich gas producer fuel control	Replace gas producer fuel control.
		Bleed control valve stuck closed	Replace bleed control valve.
43	Compressor surge during starting	Bleed control valve stuck closed	Replace bleed control valve.
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damage or erosion exceeds acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.E., 72–30–00.)
		Excessively rich gas producer fuel control	Adjust start/acceleration adjuster CCW one detent. Monitor start to make sure proper start temperatures are maintained. A second one detent adjustment may be made if proper start temperatures can be maintained. If surge continues after adjustment or acceptable start time start temperatures cannot be maintained, then replace gas producer fuel control.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
44	Compressor surge during acceleration	Bleed control valve failed to open	Replace bleed control valve.
		Excessively rich gas producer fuel control	Adjust start/acceleration adjuster CCW one detent. Monitor start to make sure proper start temperatures are maintained. A second one detent adjustment may be made if proper start temperatures can be maintained. If surge continues after adjustment or acceptable start time start temperatures cannot be maintained, then replace gas producer fuel control.
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damage or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.E., 72–30–00.)
		New compressor case misaligned at installation	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement, para 2., 72–30–00.)
45	Compressor surge during low power operation	Bleed control valve failed to open	Clean bleed valve filter, jet and strainer. If condition still exists, replace bleed control valve. (Refer to Bleed Valve Cleaning, para 2.C., 75–10–02.)
		Foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damage or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.E., 72–30–00.)
		New compressor case misaligned at installation	If noise monitoring indicates rub, remove and reinstall the case. (Refer to Case Replacement, para 2., 72–30–00.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
46	More than 20 drops per minute fuel leaking from fuel pump overboard drain ports	Fuel pump drive shaft seal leaking	Replace fuel pump.
		Gearbox seal leaking	If leakage is fuel, replace pump; if leakage is oil, replace seal.
47	More than 5 drops per min fuel leak–age from either the fuel control or the governor overboard drain line.	Gas producer fuel con–trol failure.	Replace fuel control.
		Power turbine governor failure.	Replace governor
48	Faulty torque–meter indication	Faulty airframe in–stalled transmitter	Replace transmitter.
		Clogged torquemeter pressure sensing oil line	Disassemble power and accessory gearbox and clean or send gearbox to an overhaul facility. (Refer to applicable part of Gearbox Disassembly and Assembly, para 2., 72–60–00.)
		Clogged fixed area torquemeter piston bleed orifice	Disassemble power and accessory gearbox and clean bleed orifice or send gearbox to an overhaul facility. (Refer to applicable part of Gearbox Disassembly and Assembly, para 2., 72–60–00.)
		Torquemeter supporting bearing failure	Replace bearing or send pow-er and accessory gearbox to an overhaul facility. (Refer to applicable part of Gearbox Disassembly and Assembly, para 2., 72–60–00.)
49	Loss of power shar–ing during accel–eration or torque split on multi–engine applications.	Incorrect aircraft rigging.	Check rigging and adjust in accordance with aircraft manufacturer’s instructions.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
49 (cont)	Loss of power shar–ing during accel–eration or torque split on multi–engine applications. (cont)	Excessive collective/ P.T. Governor control system looseness, wear or lost travel	Correct looseness, wear or lost travel. Refer to air–craft manufacturer's in–structions for corrective action.
50	Severe N_1 oscilla–tion (Bendix control system) at approxi–mately the 40° throttle lever position.	PrPg reset dump valve cycling.	Move throttle out of affected throttle range.
51	Lack of anti–icing air	Defective anti–ice air lines	Check lines.
		Anti–icing valve stuck closed	Replace valve.
		Dirt collected in vane trailing slot	Remove anti–icing air lines at the compressor front support, cap the bullet nose outlet holes and blow through struts and out slots at 40 psig (276 kPag) maximum.
52	Continuous exhaust smoking	Oil leakage from forward compressor bearing oil seal or power turbine carbon face seal	If oil consumption exceeds limits, replace faulty component(s) as necessary.
NOTE:	Remove external sump and measure oil flow. (Refer to para 7.D., 72–50–00.)		
53	Heavy smoking out exhaust.	Contamination or carbon buildup in the turbine.	Inspect and clean oil system and passages. (Refer to Oil System Maintenance, para 7.F., 72–50–00.)
54	Compressor rear bearing labyrinth seal vent smoking	Seal vent orifice im–properly sized or improperly seated	Replace or repair vent ori–fice. (Refer to Diffuser Vent Orifice Selection, para 1.B., Engine–Adjustment/ Test, 72–00–00.)
55	Engine power reset to the takeoff setting	Aircraft gas producer linkage broken or disengaged	Replace linkage or reconnect.
56	Exhaust duct emitting sparks	Combustion liner damage	Inspect combustion liner and repair or replace. (Refer to Combustion Liner Inspection, para 1.C., 72–40–00.)

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
56 (cont)	Exhaust duct emitting sparks (cont)	Turbine or compressor blade, vane or seal damaged	Replace faulty component.
57	Excessive vibration	Loose engine mounts	Inspect for security and condition of mounts.
		Turbine wheel blade failure	Inspect the turbine wheel blades. (Refer to Blade and Vane Inspection, para 7.A., 72–50–00.)
		Compressor foreign object damage (FOD), eroded blades, vanes and/or plastic coating	Replace the case or compressor assembly if damage or erosion exceeds the acceptable limits. (Refer to Blade Damage, Vane Damage and Case Plastic Coating Inspection, para 5.C. through 5.F., 72–30–00.)
		Bearing failure or accessories section internal failure	Check the magnetic inspection plugs for particles. If accumulated particles are found, send engine to overhaul.
		Cause uncertain	Refer to Vibration Test Procedure, Engine–Adjustment/Test, para 2., 72–00–00 to analyze vibration level and identify vibration source. Install engine in another aircraft or in test stand for comparison. Send engine to overhaul if excessive vibration persists.
58	Unable to stop engine	Gas producer fuel control fuel cutoff valve not closed	Close the aircraft fuel shutoff valve to stop the engine. Then check control linkage rigging or replace gas producer fuel control if faulty.
59	Afterfire	Oil leak	See trouble condition, static oil leakage, item 64.
		Burner drain valve line obstruction	Check the drain lines. Clean or replace as necessary.
		Sticking burner drain valve	Replace valve.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
59 (cont)	Afterfire (cont)	Fuel nozzle valve stuck open	Replace fuel nozzle.
		Fuel control not in cutoff.	Make a fuel control cut–off valve operational check. (Refer to Cutoff Valve Operational Check–Bendix Fuel System, para 3.D., 73–20–02 or 3.E., 73–20–03 or Cutoff Valve Operational Check–CECO Fuel System, para 3.D., 73–20–04.)
		Inline check valve stuck open	Replace inline check valve.
60	Heavy smoking out exhaust following engine shutdown (light wisps of smoke are normal and not cause for engine rejection unless oil consump–tion limits are exceeded)	Oil seepage past No. 5 bearing oil bellows seal into hot exhaust and collector	If suspected, visually inspect for evidence of puddling in bottom of exhaust collector after engine has been inoper–ative. If leakage is present, replace No. 5 bearing oil bellows seal (Refer to replacement para 6., 72–50–00.)
		Oil seepage past tur–bine oil check valve onto hot turbine	Remove and inspect turbine check valve. (Refer to Turbine Pressure Oil System Check Valve, para 7.K., 72–50–00.)
		Residual oil in No. 6 and 7 bearing area, depositing on hot tur–bine parts	Remove external sump; inspect and clean strut. (Refer to Inspection and Cleaning of Power Turbine Support Scavenge Oil Strut, para 7.E., 72–50–00.)
		Excessive clearance of rotating knife seals located in No. 6 and 7 bearing area	This is usually accom–panied by low power. If suspected, replace turbine.
		Oil leakage in air–craft scavenge oil check valve (Hughes H500)	Oil can be found leaking from the outer combustion case after the engine has been inoperative for an ex–tended period.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
61	Heavy smoking out exhaust	Contamination or car–bon buildup in the turbine	Inspect and clean oil sys–tem and passages. (Refer to Inspection and Cleaning of Power Turbine Support Scavenge Oil Strut, para 7.E., 72–50–00.)
62	Continuous exhaust smoking	Oil leakage from for–ward compressor bear–ing oil seal or power turbine carbon face seal	If oil consumption exceeds limits, replace faulty com–ponent(s) as necessary.
63	Oil leakage at com–pressor attachment insert in the Gear–box housing. (At insert adjacent to compressor oil supply fitting.)	Insert loose	Replace insert. (Refer to Insert Inspection, para 4.D., 72–60–00.)
64	Static oil leakage from power and accessories gearbox breather	Internal check valve stuck open	Clean or replace the inter–nal check valve. (Refer to Lube Oil Filter Housing Re-placement, para 1.D., 72–60–00.) Remove filter housing and inspect housing and trans–fer tubes (2) mating sur–faces. Check packings on housing end of transfer tubes. Replace defective items.
65	Oil leaking from weep holes at power turbine governor. Oil leakage may be blue in color.	Check engine oil seal	Replace leaking seal. If oil leakage is blue in color, this is an in–dication of governor drive bearing grease washout, therefore replace the power turbine governor.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
66	Oil or fuel leaking from the fuel con–trol weep holes. Leakage may be blue in color.	Oil seal leaking at gearbox.	Identify if the leakage is fuel or oil. Oil leaks require replacement of the gearbox seal and/or the fuel pump drive O–ring. Fuel leaks require replacement of the fuel pump. If the fuel or oil leakage is blue in color this is an indication of fuel control drive bearing grease washout, therefore replace the fuel control.
67	Starter unable to rotate engine immediately after shutdown	Turbine blade tip clearance	If engine will rotate after cooldown, no corrective action required. If unable to rotate engine after cooldown, remove turbine for further examination.
		Binding at the rear diffuser seal	Replace compressor.
68	Starter unable to rotate engine	Binding of compressor, turbine or gearbox	Determine which major component is binding; replace component or engine.
69	N_2 does not rotate by 25% N_1 speed during start	Turbine blade tip (N_2) rub.	Shut down. Repeat start procedure. If not rota–ting after second attempt, walk the main rotor or propel-ler backwards before again re-peating the start procedure. ing the start procedure. (Refer to Item 69 NOTE.) Replace turbine if condi–tion persists.
		Carbon formation around rotating labyrinth seals	Ensure that the oil being used is approved (MIL–L–7808G and subse-quent or MIL–L–23699). Shut down. Repeat start proce-dure. If not rotating after second attempt, walk the main rotor or propeller back-wards before again repeating

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
69 (cont)	N_2 does not rotate by 25% N_1 speed during start (cont)		the start procedure. (Refer to Item 69 NOTE.) If repeated walk–through does not free N_2, clean carbon from rotating labyrinth seals. (Refer to Cleaning Power Turbine Labyrinth Seals, para 7.J., 72–50–00.)
	NOTE: To help alleviate turbine rub or carbon conditions which prevent the N_2 rotor from turning by 25% N_1 speed, walk the main rotor backwards after a start attempt and/or while the engine is cooling down. If chatter is encountered, stop the walk–through. Repeat the procedure at the next convenient shutdown.		
		Aircraft power train seizure	Refer to aircraft maintenance manual.
70	Engine tubing cracked or broken at the flare	Excessive vibration	Check the engine for possible vibration causes. (Refer to Vibration Inspection, para 1.D.(2), Engine–Inspection/Check, 72–00–00.)
71	Bearing noise at compressor which may be accompanied by looseness of the impeller	Bearing failure	Inspect and/or replace compressor No. 1 and No. 2 bearings as required.
	NOTE: Inspect magnetic drain plugs to determine extent of contamination due to bearing failure. (Refer to Magnetic Plug Inspection, para 11.G., Engine–Servicing, 72–00–00.)		
72	Magnetic plug warning light illuminated	Engine metal generation	Refer to Magnetic Plug Inspection, para 11.G., Engine–Servicing, 72–00–00.)
73	Engine undershoots ground idle setting during practice autorotation	Dirty fuel control P_r –P_g valve. (Bendix control system only)	Clean valve. (Refer to Cleaning the Bendix Fuel Control P_r–P_g Valve, para 4.C. 73–20–02.)
74	High throttle shaft torque	Binding of fuel control or governor shaft due to corrosion build–up between shaft and bushing.	Spray lubrication (WD–40 or equivalent) on the shaft and bushing of the control and governor. Rotate throttle to assure penetration. Repeat spray application if necessary.
75	Loss of power sharing during acceleration or torque split on multi–engine applications.	Incorrect aircraft rigging.	Check rigging and adjust in accordance with aircraft manufacturer's instructions.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
75 (cont)	Loss of power sharing during acceleration or torque split on multi–engine applications. (cont)	Excessive collective/P.T. Governor control system looseness, wear or lost travel.	Correct looseness, wear or lost travel. Refer to aircraft manufacturer's instructions for corrective action.
		Contaminated fuel control air (pneumatic) circuits.	Clean air circuits. (Refer to para 4.B. and 4.C., 73–20–02 or para 4.B., 73–20–03.)

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PARA 1.B. (cont)

(8) Install the following on the outer combustion case.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(a) Ignition lead to spark igniter. Tighten coupling nut to 70–90 lb in. (7.9–10.2 N·m).

(b) Fuel hose to the fuel nozzle. Tighten coupling nut to 80–120 lb in. (9.0–13.6 N·m). Secure with lockwire.

(c) Drain hose to the burner drain valve.

(9) (250–C20S, –C20W) Reinstall the fireshield access panel and secure with eight washers and bolts. Tighten bolts to 22–26 lb in. (2.5–2.9 N·m).

(10) Check run the engine after combustion liner replacement. (Refer to Check Run, para 1, 72–00–00, Engine–Adjustment/Test)

C. Inspection and Repair

Inspect the combustion liner in accordance with Table 201. Remove the combustion section for the inspection as described in Combustion Liner, para 1.A., this section.

Table 201

Combustion Liner Inspection and Repair

Item	Condition	Serviceable Limit	Repairable Limit	Disposition
1	Louvers bent closed or restricted by carbon particles	Maintain 0.060–0.065 in. (1.52–1.65 mm) uniform opening		Lightly wire brush as required. Vapor degrease; then reposition by bending to proper opening.
2	Burnt louvers	Refer to Figure 201 for maximum material which can be burned away from individual louvers		Replace liner or send to an overhaul facility for repair.
3	Pulled or broken spotwelds at liner step	Max of six with no more than three adjacent welds	Four adjacent spotwelds or up to 40% of total per step	Plugweld repair. Drill 3/16–in. (5 mm) dia hole through outer section then press sections together and plugweld using 29–9 W Mo weld rod (AMS 5784).Grind weld material only if it blocks or restricts airflow.
4	Handling damage—mashed out of round	None	Unable to straighten to concentricity limits	Straighten and reform.

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PARA 1.D. (cont)

(6) Compress the seal rings with 6799952 installation clamps. Place the outer combustion case over the liner while mating it to the compressor discharge air tubes. The fire shield aft support bracket and two half-inch bolts go at bolt positions 4 and 5. Locate the bracket on the aft side of the splitline. Secure the outer case to the turbine with 24 bolts and nuts. Coat bolt threads lightly with antiseize compound before installation. Tighten nuts of socket head cap screws to 20-30 lb in. (2.3-3.4 N·m). Tighten nuts of Tee-head bolts to 35-40 lb in. (3.9-4.5 N·m) plus locknut drag. Remove installation clamps and secure the air tubes with retaining rings.

(7) Place a washer on the pressure oil manifold and install the fire shield. Secure fire shield at the aft support bracket with a bolt and washer.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, AIR AND OIL FITTINGS COULD RESULT IN AN ENGINE FAILURE.

(8) Install the power and accessories gearbox-to-fire shield scavenge oil tubes. Tighten coupling nuts to 150-200 lb in. (17-23 N·m).

(9) Secure the manifold to the fire shield with a nut and washer. Tighten finger tight only. Secure the fireshield with four bolts and washers. The drilled head bolt goes at the position nearest to the gas produce support pressure oil fitting. Tighten bolts to 35-40 lb in. (3.9-4.5 N·m) and lockwire drilled bolt to oil fitting.

(10) Install the power and accessories gearbox-to-check valve pressure oil tube. Tighten coupling nuts to 150-200 lb in. (17-23 N·m).

(11) Install the gas producer support-to-fireshield and the external sump-to fire shield scavenge oil tubes. Tighten coupling nuts to 150-200 lb in. (17.23 N·m).

(12) Remove the cap from the fuel nozzle and install the fire shield-to-fuel nozzle hose. Tighten coupling nut to 80-120 lb in. (9.0-13.6 N·m).

(13) Install the gas producer fuel control. (Refer to Gas Producer Fuel Control, 73-20-02 or 73-20-03.)

(14) Install the check valve-to-fire shield pressure oil tube with screen. Tighten coupling nuts to 150-200 lb in. (17-23 N·m).

(15) Install the spark igniter lead. Tighten coupling nut to 70-90 lb in. (7.9-10.2 N·m).

(16) Install all drain hoses at the exhaust collector support, fire shield and burner drain valve.

(17) Connect the thermocouple lead to the aircraft terminal block.

(18) Make a check run of the engine. (Refer to Check Run, para 1, 72-00-00, Engine-Adjustment/Test.)

2. First-stage Turbine Nozzle and First-stage Turbine Nozzle Shield

Replace first-stage turbine components using the applicable part of the following procedure.

A. Removal

(1) Remove the turbine assembly from the engine. (Refer to Turbine Assembly--Removal, Para 1.A. or 1.C., this section.)

(2) Remove the two nuts, washers and bolts and separate the firewall from the turbine assembly.

(3) Attach the turbine assembly to the 6798089 supporting adapter at the three exhaust collector support bolt holes, with the gas producer support up.

NOTE: It may be necessary to reverse the three turbine attaching studs on the supporting adapter plate from an under side mounting position to a top side mounting position.

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(h) Inspect check valve for external leakage at first engine operation after valve installation on the engine. No leakage permitted.

L. Test the Turbine Pressure Oil System Check Valves. (See Figure 216.)

NOTE: Valves with part numbers 23074872 and subsequent are not field repairable.

WARNING: DO NOT BREATHE THE FUMES FROM SYNTHETIC LUBRICATING OIL. IT CAN CONTAIN TRICRESYL PHOSPHATE. USE IN AN AREA WITH CONTINUOUS AIRFLOW. KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAMES. DO NOT GET IT ON YOUR SKIN OR IN YOUR EYES. WEAR GOGGLES, CHEMICAL-RESISTANT GLOVES, AND SAFETY CLOTHING. IF YOU GET IT ON YOUR SKIN, CLEAN WITH SOAP AND WATER. IF YOU GET IT IN YOUR EYES, FLUSH WITH WATER. GET MEDICAL AID.

(1) Test the check valve using engine oil (MIL-L-7808) at 80°F (27°C) as follows:

(a) Install the valve on the test stand with the large end down.

(b) Apply the test pressure to the input side of the valve.

(c) Cycle the valve open and closed at least once before taking pressure readings.

(d) Slowly increase the pressure and observe the opening pressure. Opening pressure must not exceed 5.0 psig (34.5 kPag).

(e) As the test pressure is reduced, the valve must be fully closed (with no leaks) at 3.0 psig (20.7 kPag).

8. Approved Repairs

A. Turbine and Exhaust Collector Support Crack Repair

Weld repair any cracks found in the exhaust ducts or outboard structure of the turbine and exhaust collector support.

CAUTION: TO PREVENT ELECTRICAL ARC BEARING DAMAGE, SEPARATE THE EXHAUST COLLECTOR FROM THE ENGINE/TURBINE AND REMOVE THE NO. 5 BEARING BEFORE THE WELD REPAIR IS MADE.

(1) Weld cracks in the exhaust ducts (areas -9 and -10 of Figure 217) using gas tungsten-arc process with 29-9 W Mo (AMS 5784) weld rod.

(2) Weld cracks in the outboard structure (area -3 of Figure 217) using gas tungsten-arc process with Hastelloy W (AMS 5786) weld rod.

Table 202

Turbine Pressure Oil System Check Valve Inspection

Item	Condition	Serviceable Limit	Disposition
1	Stripped or crossed threads on fitting or housing.	None.	Chase threads. (Max. of one damaged thread
2	Nicks or scratches on flared tube sealing surface of fitting or housing.	None.	Repair or replace part.
3	Nicks or scratches on poppet seating surface or housing valve seat.	None.	Repair or replace part.
4	Fretting wear in bore of housing.	None.	Replace part.

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250-C20W

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	617	Jun 1/04
	618	Jun 1/08
	619	Jun 1/02
	620	Jun 1/04
	621	Jun 1/08
	622	Jun 1/04
	623	Dec 15/98
	624	Dec 15/98
	625	Jun 1/03
	626	Jun 1/03
	627	Jun 1/04
	628	Jun 1/03
	629	Jun 1/03
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	906	Dec 30/96
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	251	Oct 15/97
	252	Jun 1/08
	253	Jun 1/02
	254	Dec 30/96
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	258	Dec 30/96
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	260	Jun 1/08
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Table 7

Performance Ratings--One Engine Inoperative and/or Emergency Operation--250-C20S

Rating	Shaft Power (min) hp	(kW)	Jet Thrust (est) lb	(N)	Gas Producer Output rpm (est)	Gas Producer Output Shaft rpm	Specific Fuel Cons. (max) lb/shp-hr	(mg/W·h)	Measured Rated Gas Temp °F	(°C)	Maximum Allowable Output Shaft Torque ft-lb	N·m
Max. Cont.	420	(313)	42	(187)	53000	6016	0.650	(395.38)	1490	(810)	384	(521)

Max Continuous rating is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one-engine-inoperative (O.E.I.) operation of multi-engine aircraft and emergency operation.

WARNING: IT IS VERY IMPORTANT THAT THE ENTIRE AIRCRAFT AND ENGINE FUEL SYSTEM BE MAINTAINED TO THE HIGHEST STANDARDS OF CLEANLINESS.

ROLLS-ROYCE HAS CONDUCTED TESTING OF APPLE JELLY TYPE CONTAMINATION WHICH SHOWS IT BEHAVES DIFFERENTLY THAN A SOLID CONTAMINANT. IT CAN PASS THROUGH VARIOUS AIRFRAME AND ENGINE FUEL FILTERS UNDETECTED WITHOUT ACTUATING THE IMPENDING BYPASS INDICATOR, AND IT CAN CAUSE PARTIAL OR COMPLETE BLOCKAGE OF THE FUEL NOZZLE SCREEN RESULTING IN REDUCED ENGINE PERFORMANCE OR FLAMEOUT.

SHOULD THIS GEL-LIKE MATERIAL BE DETECTED AT ANY POINT IN THE AIRCRAFT OR ENGINE FUEL SYSTEM, THE ENTIRE AIRFRAME AND ENGINE FUEL SYSTEM SHOULD BE INSPECTED.

WARNING: TO PREVENT ENGINE FUEL SYSTEM CONTAMINATION, WHICH COULD CAUSE ENGINE FLAMEOUT, AN EXTERNAL LOW PRESSURE FUEL FILTER SHOULD BE USED ON ANY AIRCRAFT REFUELING FROM REMOTE FUELING SITES (DRUMS, ETC).

CAUTION: TO DETERMINE IF A GIVEN FUEL MEETS THESE SPECIFICATIONS, THE BURDEN OF PROOF RESTS WITH THE OPERATOR AND HIS SUPPLIER.

B. Fuel Specification.

(1) Primary

Fuels that agree with the military and commercial specifications that follow are approved for unrestricted use in 250 Series engines.

(a) MIL-T-5624, Grades JP-4, JP-5

(b) ASTM D-1655, Grades Jet A, Jet A-1

(c) ASTM D-6615, Grade Jet B

(d) MIL-DTL-83133, Grade JP-8

(e) UK Defense Standard 91-91, Semi Synthetic and Fully Synthetic

(f) GOST 10227 (Russia), Grades TS-1 and RT

(g) STAS 5639-88 (Romania), Grade TH

(h) GB 6537 (Peoples Republic of China), Grade No. 3

(i) GSTU 320.00149943.007-97 (Ukraine), Grade RT (PT)
GSTU 320.00149943.011-99 (Ukraine), Grade TS-1 (TC-1)

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CAUTION: MIL-G-5572 FUEL CONTAINING TRICRESYLPHOSPHATE (TCP) ADDITIVE SHALL NOT BE USED.

(2) Emergency

Operation on ASTM D-910 AVGAS, all grades, is permitted for a maximum of six hours for each turbine overhaul period, if aircraft boost pumps are available and turned on.

WARNING: AT AMBIENT TEMPERATURES BELOW 4°C (40°F), SOME TYPE OF ANTI-ICE PROTECTION IS REQUIRED, SUCH AS AN ANTI-ICE ADDITIVE OR A MEANS OF AIRFRAME FUEL ICE ELIMINATION. ENGINE FLAMEOUT COULD RESULT FROM FAILURE TO USE ANTI- ICE PROTECTION. (REFER TO THE AIRCRAFT MANUAL FOR THEIR RECOMMENDATIONS AND PARA 4.B., THIS SECTION, FOR APPROVED ANTI-ICE ADDITIVE.)

(3) Cold Weather

To make sure of consistent starts below 4°C (40°F) the fuels that follow can be necessary:

(a) MIL-DTL-5624, JP-4

(b) ASTM D-6615, Jet B

(c) Alternate Cold Weather Fuel: ASTM D-910 AVGAS and Jet A, A-1, JP-5, or JP-8 mixture. Refer to para 9. Cold Weather Fuels, for instructions on correct mixture and use of cold weather fuels.

NOTE: Grade JP-4, Grade JP-5, and Grade JP-8 type fuels contain Fuel System Icing Inhibitor (FSII) that agree with MIL-DTL-85470. These fuels do not require more FSII unless specified by the airframe manufacturer.

NOTE: Jet A, A1, JP-5, or JP-8 fuels are not restricted from use at ambient temperatures below -18°C (0°F); however, special provisions for starting must be made. (Refer to Aircraft Flight Manual.) Once started, engine operation on Jet A, Jet A1, JP-5, or JP-8 will be satisfactory in outside air temperatures down to -32°C (-25°F).

NOTE: Prolonged and uninterrupted operation with only AVGAS mixture will induce lead buildup on turbine parts. This lead buildup can cause a gradual power reduction; consequently, this AVGAS mixture should be used only for cold weather operation. During operation with normal Jet A type fuel, the lead will slowly dissipate.

(4) Fuel System Icing Inhibitor (FSII):

FSII additives that agree with MIL-DTL-85470 are approved for use in the Model 250 series engine if used in accordance with the additive manufacturer instructions and if approved by the airframe manufacturer.

NOTE: Grade JP-4, Grade JP-5, and Grade JP-8 type fuels contain FSII that agrees with MIL-DTL-85470. These fuels do not require more FSII unless specified by the airframe manufacturer.

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WARNING: ONLY DISCRETIONARY MIXING OF OILS WITHIN AN OIL SERIES IS PERMITTED WITHOUT A TIME PENALTY. USE OF MIXED OILS FROM DIFFERENT SERIES IN AN ENGINE IS LIMITED TO FIVE HOURS TOTAL RUNNING TIME DURING ONE OVERHAUL PERIOD. ADEQUATE MAINTENANCE RECORDS MUST BE MAINTAINED TO ENSURE THAT THE FIVE HOUR LIMIT IS NOT EXCEEDED. FAILURE TO COMPLY WITH OIL MIXING RESTRICTIONS CAN RESULT IN ENGINE FAILURE.

CAUTION: IF HEAVY CARBON OR COKE DEPOSITS ARE FOUND ON THE ENGINE FILTER DURING REGULAR INSPECTIONS, IT IS RECOMMENDED THE FILTERS BE REPLACED; CONTINUE TO MONITOR BYPASS INDICATORS.

CAUTION: TO DECREASE THE LIKELIHOOD FOR CARBON OR COKE DEPOSITS BEING DISLODGED DURING THE CHANGEOVER TO "3RD GENERATION" OILS (E.G. MOBIL JET 254), THESE CHANGEOVERS SHOULD ONLY BE MADE WHEN THE ENGINE IS NEW OR REPAIRED, TO THE EXTENT THE LUBRICATION PASSAGES AND SUMPS HAVE BEEN CLEANED AND FLUSHED.

CAUTION: WHILE CONSIDERABLE LABORATORY DATA IS AVAILABLE TO DEMONSTRATE THE COMPATIBILITY OF ONE SYNTHETIC TURBINE OIL WITH OTHER TURBINE OILS MEETING THE SAME SPECIFICATION (AIRLINE EXPERIENCE DOES DEMONSTRATE THIS PROPERTY), THE INDISCRIMINATE MIXING OF APPROVED OILS DURING THE OPERATIONAL USE OF THE OIL IS NOT RECOMMENDED. HOWEVER, THERE MAY BE CIRCUMSTANCES WHERE EMERGENCY TOP-OFF, INADVERTENT MIXING, OR CHANGEOVER BY "TOP-OFF" TO ANOTHER BRAND MAY OCCUR. THESE ARE ACCEPTED PRACTICES.

CAUTION: FAILURE TO COMPLY WITH OIL MIXING RESTRICTIONS CAN RESULT IN ENGINE FAILURE.

CAUTION: REMOVE AND INSPECT THE OIL FILTER AFTER 25 HOURS OF ENGINE OPERATION IF THE TYPE OF OIL (MIL-PRF-7808, MIL-PRF-23699, OR DOD-85734) WAS MIXED IN AN EMERGENCY. (THERE IS A 5-HOUR LIMIT FOR THE USE OF MIXED OILS.)

CAUTION: THE FILTER INSPECTION IS TO DETERMINE IF COKE, WHICH WAS FORMED DURING PREVIOUS OPERATION, IS BEING DISLODGED DURING THE FIRST OPERATION FOLLOWING THE OIL CHANGE.

CAUTION: IF HEAVY CARBON DEPOSITS ARE OBSERVED ON THE ENGINE FILTER, IT IS SUGGESTED THAT THE ENGINE OIL BE CHANGED AGAIN. THE OIL IS TO BE DRAINED WHEN THE OIL IS HOT TO OBTAIN THE MAXIMUM BENEFIT. THE 25 HOUR OIL MONITORING IS TO CONTINUE UNTIL THE NEXT OIL CHANGE PERIOD.

CAUTION: USE OF OILS WHICH ARE NOT INCLUDED IN THE APPROVED OILS LISTING, OR FAILURE TO DRAIN OIL WITHIN THE PRESCRIBED INTERVAL GIVEN IN TABLE 602, 72-00-00, ENGINE-INSPECTION/CHECK WILL BE CONSIDERED AS MISUSE UNDER ITEM (4) OF THE WARRANTY POLICY.

C. Oil Specification.

The 250 series engines are certified and approved for use with only certain lubricating oils that agree with MIL-PRF-7808, MIL-PRF-23699, DOD-PRF-85734, or SAE AS5780 specifications. Vendor brands of lubricating oils that have been engine tested and approved for Model 250 engine use are listed in para 5.C.(2), Approved Oils. Refer to para 5.C.(1), Cold Weather Lubrication, for the type of oil recommended for specific ambient temperatures.

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(1) Cold Weather Lubrication

The types of oil recommended at specific ambient temperatures are as follows:

-40°C (-40°F) and above . . . . . MIL-PRF-23699 , SAE AS5780, MIL-PRF-7808, or DOD-PRF-85734

-40°C (-40°F) and below MIL-PRF-7808

NOTE: Because of availability, decreased coking and better lubrication qualities at higher temperatures, MIL-PRF-23699 HTS or SAE AS5780 HPC oils are recommended for use in Model 250 engines.

NOTE: Check the engine oil quantity within 15 minutes of engine shutdown to avoid a false indication of excessive oil consumption. If the 15 minutes has been exceeded, motor the engine for 30 seconds with the starter before checking tank quantity. Motoring normally scavenges oil from the gearbox back to the aircraft oil tank. Check the airframe flight manual; some installations may require engine to be operated for at least a minute at ground idle to assure proper scavenging of the engine gearbox.

NOTE: Always refer to the airframe flight manual for proper oil servicing instructions; specific requirements may vary for different models.

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(2) Approved Oils

Manufacturer's Designation & Address	Manufacturer's Designation & Address
MIL-PRF-7808	MIL-PRF-7808
American PQ Lubricant 689 American Oil & Supply Co. 238 Wilson Avenue Newark, New Jersey 07105	Mobil Rm-201A Mobil Oil Corporation 3225 Gallows Road Fairfax, Virginia 22037
Brayco 880 Castrol Inc. Specialty Products Division 16715 Von Karman Ave, Suite 230 Irving, California 92714	Mobil RM-184A Mobil Oil Corporation 3225 Gallows Road Fairfax, Virginia 22037
EXXON Turbo Oil 2389 EXXON Company, U.S.A. P.O. Box 2180 Houston, Texas 77252-2180	Stauffer Jet 1 Stauffer Chemical Co. 380 Madison Avenue New York, New York 10017
Mobil Avrex S Turbo 256 Mobil Oll Corporation 3225 Gallows Road Fairfax, Virginia 22037	
MIL-PRF-23699 STD	MIL-PRF-23699 STD
Mobil Jet Oil II Mobil Oil Corporation 3225 Gallows Road Fairfax, Virginia 22037	Stauffer Jet II (Castrol 205) Stauffer Chemical Company 380 Madison Avenue New York, New York 10017
Turbonycoil 600 (TN600) NYCO S.A. 66, Champs-Elysees-51 Rue De Ponthieu 75008 Paris	Caltex RPM Jet Engine Oil 5 Caltex Petroleum Corporation 380 Madison Avenue New York, New York 10017
Aeroshell/Royco Turbine Oil 500 Royal Lubricants Company, Inc. River Road, P.O. Box 518 East Hanover, New Jersey 07936	Chevron Jet Engine Oil 5 Chevron International Oil Company 555 Market Street San Francisco, California 94105
American PQ Lubricant 6700 American Oil and Supply Co. 238 Wilson Avenue Newark, New Jersey 07105	Castrol 5050 Specialty Products Division 1001 West 31st Street Downers Grove, IL 60515
SAE AS5780 SPC	MJO II ExxonMobil Swedesboro, NJ
BPTO 2380 Air BP Lubricants Six Campus Drive Parsippany, NJ 07054	

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Manufacturer's Designation & Address

MIL-PRF-23699 STD (cont)

Hatcol 3211
Hatcol Corporation
King George Post Road
Fords, New Jersey 08863

EXXON Turbo Oil 2380
EXXON Company, USA
P.O. Box 2180
Houston, Texas 77252-2180

Castrol Aero Jet5
Specialty Products Division
1001 West 31st Street
Downers Grove, IL 60515

MIL-PRF-23699 HTS

Mobil Jet Oil 254 and Mobil Jet Oil 291
Mobil Oil Corporation
3225 Gallows Road
Fairfax, Virginia 22037

Aeroshell/Royco Turbine Oil 560
Royal Lubricants Company, Inc.
River Road, P.O. Box 518
East Hanover, New Jersey 07936

BPTO 2197
Air BP Lubricants
Six Campus Drive
Parsippany, NJ

SAE AS5780 HPC

BPTO 2197
Air BP Lubricants
Six Campus Drive
Parsippany, NJ

MJO 254
ExxonMobil
Swedesboro, NJ

Manufacturer's Designation & Address

DOD-PRF-85734

Aeroshell Turbine Oil 560
Shell International Petroleum Co., Ltd.
International Aviation Sales Division
Shell Centre
London, SEI 7NA, England

Aeroshell/Royco Turbine Oil 555
Royal Lubricants Company, Inc.
River Road , P.O. Box 518
East Hanover, New Jersey 07936

NOTE: Long term use of Aeroshell/Royco 555 oil may increase the probability of silicone rubber seal leakage in the accessory gearbox.

Aeroshell Tubine Oil 555
Shell International Petroleum Co., Ltd
International Aviation Sales Division
Shell Centre
London, SEI 7NA, England

NOTE: Long term use of Aeroshell 555 oil may increase the probability of silicone rubber seal leakage in the accessory gearbox.

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D. Oil Pressure and Temperature

If the oil pressure is not within the following limits, refer to Table 101, Engine-Troubleshooting, 72-00-00.

(1) 94.2% N_1 speed and above . . . 115-130 psig (792-896 kPag)

(2) 78.5 to 94.2% N_1 speed . . . . . 90-130 psig (621-896 kPag)

(3) (Below 78.5% N_1 speed . . . . . 50-130 psig (345-896 kPag)

(4) During start . . . . . a positive indication must be obtained when 59% (idle) is reached.

NOTE: At altitudes above 5000 ft (1524 m), the oil pressure lower limit declines at the rate of 2 psig (13.8 kPag) per 1000 ft (305 m) to a maximum reduction of 20 psig (140 kPag).

NOTE: During cold weather operation, 150 psig (1034 kPag) main oil pressure is allowable following an engine start. When the 130 psig (896 kPag) limit is exceeded, operate engine at minimum power until normal oil pressure limits are attained.

NOTE: If the engine has been operated with less than the required oil pressure, except for momentary fluctuation, inspect the oil system in accordance with Low Oil Pressure Operation, para. 11.D., 72-00-00, Engine-Servicing.

Oil temperature shall be within the following range. (If the maximum limit is exceeded, refer to Oil Temperature Limit Exceeded, para 11.B., 72-00-00, Engine-Servicing, for corrective action.)

(5) Minimum starting
MIL-PRF-7808 . . . . . -54°C (-65°F)
MIL-PRF-23699,
DOD-PRF-85734,
or SAE AS5780 . . . . . -40°C (-40°F)

(6) Maximum . . . . . 107°C (225°F)

(7) Minimum flight operation . . . . . 0°C (32°F)
(Providing engine oil pressure is within the specified limits of para 6.D.)

NOTE: When starting in ambient temperature conditions below -20°C (-4°F), after stabilizing at ground idle, increase throttle until 100% N2 is achieved. Operate at this condition until engine oil temperature is at least 0°C (32°F) before beginning flight operations.

E. Pressure Altitude And Ambient Temperature

The engine will start and operate satisfactorily at conditions of ambient pressure and temperature as shown in Figure 30 or 31.

7. Operating Procedures (250-C20, -C20B, -C20F, -C20J,-C20W)

WARNING: TO PREVENT ENGINE FUEL STARVATION AND SUBSEQUENT FLAME-OUT, ANY AIRCRAFT REQUIRING FUEL BOOST PUMP(S) SHOULD USE THESE PUMPS AT ALL TIMES DURING FLIGHT OR AS DIRECTED IN THE AIRCRAFT FLIGHT MANUAL.

WARNING: TO PREVENT CRUCIAL DELAY IN REGAINING POWER IF AN ENGINE FLAMEOUT IS ENCOUNTERED, AIRCRAFT EQUIPPED WITH AN AUTO-RELIGHT SYSTEM SHOULD KEEP THAT SYSTEM ACTIVATED AT ALL TIMES WHILE THE AIRCRAFT IS INFLIGHT.

The procedures which follow pertain to operation of the engine at: start and ground idle; power range; practice autorotation descent and landing; air restart; stopping; and during an emergency.

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(3) Turn off all engine switches.

(4) After each engine shutdown, visually check that the propeller blades are fully feathered immediately after propeller rotation stops.

J. Normal Inflight Shutdown

Make a normal inflight engine shutdown as follows:

CAUTION: DO NOT MOVE THE POWER LEVER BELOW THE FLIGHT IDLE POSITION DURING FLIGHT.

(1) Retard the Power Lever to the FLIGHT IDLE position.

(2) From the FLIGHT IDLE position move the Fuel Cutoff Lever to the FUEL OFF position. The propeller will feather automatically when the engine shuts down.

(3) Turn off all applicable engine switches.

CAUTION: DO NOT WINDMILL AT 120-125 KNOTS INDICATED AIR SPEED FOR MORE THAN 13 MINUTES.

K. Emergency Inflight Shutdown

Make an emergency inflight engine shutdown as follows:

(1) Move the Fuel Cutoff Lever to the FUEL OFF position. The propeller will feather automatically and the engine will shut down.

(2) Leave the Power Lever in the flight range.

(3) Turn off all applicable engine switches.

L. Feathering

Propeller feathering will occur automatically with engine shutdown by positioning the Fuel Cutoff Lever in the FUEL OFF position.

M. Anti-Icing Air

Consult the aircraft operating manual for the outside air temperature (OAT) at which anti-icing air should be used. If the aircraft manual does not provide this temperature, use anti-icing air when flying into visible moisture at OAT below 5°C (40°F).

N. Emergency

If the engine power turbine governor should fail to function, resulting in a rapid N_2 speed increase, the Power Lever should be reduced to control overspeed.

(1) Manipulate the aircraft controls to control the aircraft.

(2) Monitor the N_2 speed and vary the Power Lever setting to maintain desired speed.

NOTE: The same power range is available using the Power Lever in emergency as in normal power turbine governing.

The engine power turbine governor can also fail in a decrease fuel flow condition. This can be recognized by decreased N_1 speed and decreased torque output with the throttle in the normal operating range. In this event, initiate emergency power loss power reduction procedures, as described in the aircraft flight manual.

9. Cold Weather Fuels

WARNING: AT AMBIENT TEMPERATURES BELOW 4°C (40°F), SOME TYPE OF FUEL SYSTEM ICING INHIBITOR (FSII) IS REQUIRED, SUCH AS AN ANTI-ICE ADDITIVE OR A MEANS OF AIRFRAME FUEL ICE ELIMINATION. ENGINE FLAMEOUT COULD RESULT FROM FAILURE TO USE AN FSII THAT AGREES WITH MIL-DTL-85470. (REFER TO THE AIRCRAFT MANUAL FOR THEIR REQUIREMENTS AND PARA 4.B., THIS SECTION, FOR APPROVED FSII.)

NOTE: Grade JP-4, Grade JP-5, and Grade JP-8 type fuels contain an icing inhibitor that agrees with MIL-DTL-85470. These fuels do not require more icing inhibitor unless specified by the airframe manufacturer.

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The fuels recommended for consistent cold weather starting, 4°C (40°F) and below, are as follows:

(1) MIL-DTL-5624, JP-4

(2) ASTM D-6615, Jet B

(3) Alternate cold weather fuel: ASTM D-910 AVGAS and Jet A, A-1, JP-5, or JP-8 mixture. Refer to para 9.A., Mixing Alternate Cold Weather Fuel, for instructions on correct mixture and use of cold weather fuels.

CAUTION: JP-4 OR COMMERCIAL JET B FUEL MUST NOT BE MIXED WITH AVGAS.

NOTE: Jet A, Jet A1, JP-5, or JP-8 may start the engine at temperatures below 4°C (40°F); however, when cold soaked, marginal starts may result due to viscosity changes.

NOTE: Once started, the engine will operate satisfactorily on JP-5, JP-8, Jet A and Jet A1 at fuel and outside air temperatures down to -32°C (-25°F).

A. Mixing Alternate Cold Weather Fuel

CAUTION: THERE IS NO TIME LIMIT FOR ENGINE OPERATION WHEN THE AVGAS-JET FUEL MIXTURE IS USED WHEN ASTM D-910, GRADE 80 IS USED AND THE 1:2 VOLUME RATIO IS OBSERVED. USE OF ASTM D-910 GRADES 91, 100LL AVGAS-JET FUEL MIXTURE MUST BE LIMITED TO 300 HOURS IN ONE OVERHAUL PERIOD BECAUSE OF THE HIGH LEAD CONTENT OF THE FUEL.

The alternate cold weather fuel mixture must have one part by volume AVGAS and two parts by volume commercial jet fuel. The AVGAS must agree with ASTM D-910, Grades 80, 91, or 100LL with 0.53 mL/liter maximum lead content. Do not use grade ASTM D-910 Grade 100 with 1.06 mL/liter lead content. The commercial jet fuel can be JP-5, Jet A or A1.

Prolonged and uninterrupted operation with only AVGAS mixture will induce lead buildup on turbine parts. This lead build-up can cause a gradual power reduction; consequently, this AVGAS mixture should be used only for cold weather operation. During operation with normal Jet A or Jet B type turbine fuel, the lead buildup will slowly dissipate.

CAUTION: WHEN MIXING THE FUELS, AVOID HIGH FLOW RATES. DO NOT EXCEED A FLOW RATE OF 50 GALLONS (189 LITERS) PER MINUTE. ALSO, MAKE SURE THE FUEL NOZZLE AND FUEL TANK ARE GROUNDED TO THE AIRCRAFT.

(1) Make the fuel mix in the aircraft tank. The AVGAS can be added before or after the jet fuel. The only restriction is that the final mix (including fuel in the tank before starting the mix) be two parts by volume jet fuel to one part by volume AVGAS.

NOTE: Anti-ice additive is needed for the jet fuel-AVGAS fuel mixture unless qualified in accordance with para 9., Cold Weather Fuels, this section. (Refer to Specifications, para 4., this section.)

(2) The alternate fuel mixture is not recommended for warm weather operation. It is recommended only when the ambient temperature is below 4°C (40°F); aircraft boost pump ON. (Some missions may require operating the aircraft temporarily in both low and high ambient temperatures. Temperature restrictions refer to continuous temperatures of 16°C (60°F) or higher.)

WARNING: HANDLING LEAD RESIDUE COATED PARTS BY PERSONS WITH OPEN CUTS OR SCRATCHES ON THEIR HANDS CAN BE EXTREMELY DANGEROUS. ALWAYS WEAR GLOVES WHEN CHECKING RESIDUE COATED TURBINE OR EXHAUST PARTS.

(3) When the AVGAS-jet fuel mixture is used in the engine, the lead from the gasoline accumulates on the turbine and exhaust collector outlet ducts. The normal appearance after operation on leaded fuel is a pale yellow powder deposit on the exhaust surfaces.

(4) In order to obtain a lightoff when the alternate fuel mixture is made in the fuel tank it may be necessary to: (a) preheat the engine, or (b) bleed the unmixed fuel.

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CAUTION: DO NOT USE AN OPEN FLAME HEATER TO PREHEAT THE ENGINE.

(5) Preheat the engine in the area of the fuel control.

CAUTION: POST FIRE PROTECTION BEFORE OPENING THE FUEL LINE.

(6) (250-C20, -C20B, -C20F, -C20J) Bleed the unmixed fuel from the system as follows:

(a) Deactivate the igniter circuit breaker.

WARNING: BE CAREFUL OF THE POTENTIAL FIRE HAZARD OF FUEL IN AN OPEN CONTAINER.

(b) Disconnect the fuel line at the fuel nozzle.

(c) Place the fuel line in a container. Make sure to keep contaminants from entering the exposed fuel passage.

(d) Turn on the aircraft boost pump. Open the throttle. Continue the flow from the fuel line until the unmixed fuel has drained and the AVGAS mixture appears. The AVGAS mixture can be visually detected because it is light pink in color.

(e) Close the throttle. Turn off the boost pump. Reconnect the fuel line to the fuel nozzle. Tighten the coupling nut to 80-120 lb in. (9.0-13.6 N·m).

(f) Close the igniter circuit breaker.

(7) (250-C20S, -C20W) Bleed the unmixed fuel from the system as follows:

(a) Deactivate the igniter circuit breaker.

WARNING: BE AWARE OF THE POTENTIAL FIRE HAZARD OF FUEL IN AN OPEN CONTAINER.

(b) Disconnect the fuel line at the fuel nozzle.

(c) Place the fuel line in a container. Observe caution to keep contaminants from entering the exposed fuel passage.

(d) Place the Power Lever at TAKEOFF.

(e) Turn on the aircraft switches required to provide fuel to the engine.

(f) Move the Fuel Cutoff Lever to the FUEL ON position.

(g) Energize the starter and motor the engine without ignition and flow fuel from the fuel line until the unmixed fuel has drained and the AVGAS mixture appears. The AVGAS mixture can be visually detected because it is light pink in color.

(h) Discontinue motoring and move the Fuel Cutoff Lever to the FUEL OFF-FEATHER position.

(i) Turn off all engine switches.

(j) Reconnect the fuel line to the fuel nozzle. Tighten the coupling nut to 80-120 lb in. (9.0-13.6 N·m).

10. Cold Weather Oils

Refer to para 4.C.(1), Cold Weather Lubrication, for recommended oil type based on ambient temperatures.

11. Time Between Overhauls (TBO's)

The model 250 engine was originally designed to permit modular overhaul. The major components of the engine are the compressor, gearbox, and turbine. A premature removal of any of these components should not cause removal of the other components unless secondary damage has occurred.

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Table 101
Troubleshooting (cont)

Item	Trouble	Probable Cause	Remedy
75 (cont)	N_2 does not rotate by 25% N_1 speed during start (cont)	Excessive collective/P.T. Governor control system looseness, wear or lost travel.	Correct looseness, wear or lost travel. Refer to aircraft manufacturer's instructions for corrective action.
		Contaminated fuel control air (pneumatic) circuits.	Clean air circuits. (Refer to para 4.B. and 4.C., 73-20-02 or para 4.B., 73-20-03.)

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Table 301 (cont)

Special Service Tool

Tool No.	Description	Application
23006778	Guide—Bearing Spur Adapter Gearshaft	Used to guide the SAG through the No. 2 1/2 bearing during installation of the compressor on the power and accessory gearbox.
23007638	Wrench—Fuel Injector	Used to remove or install the fuel nozzle.
23008725	Pusher—Installation, Power Turbine Ball Bearing	Used to install the ball bearing on the power turbine shaft. Used with guide (–2) from 6796918 drift.
23030169	Guide—Seal Installation, Starter Pad	Used to install seal in “Wet starter” pad.
23032992	Bracket–Accelerometer Mounting	Used to mount the accelerometer on the turbine and the compressor for engine test and troubleshooting.
23032993	Bracket–Accelerometer Mounting, Power and Accessory Gearbox.	Used to mount the accelerometer on the power and accessory gearbox for engine test and troubleshooting.
23038047	Bracket–Accelerometer Mounting, Turbine	Used to mount the accelerometer on the turbine at the 6:00 o’clock position for engine test and troubleshooting.
2550678	Screwdriver	Used to remove or install the P_x and P_y bleeds in the fuel control (late configuration controls) and the P_g bleed in the governor.
STD67891	Reset Tool–Impending Bypass Indicator	Used to reset the impending bypass indicator on the fuel pump and filter assembly.

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
36	Methyl alcohol (Fed Spec O-M 232d, grade A; Rolls-Royce EMS-125) (British Standard BS 506 Amend. 1)	Compressor water rinse	Commercial Solvents Corp., 245 Park Ave. New York, N.Y. 10017 Union Carbide Corp. Chemicals and Plastics, 270 Park Ave. New York, N.Y. 10017
37	Desiccant	Shipping package humidity control	No. 88 Absorbent Protective Dehydrating Agent (MIL-D-3464) Delta Packaging Products 4108 North Nashville Avenue Chicago, Illinois 60634
38	Liquid leak detector	Checking for pneumatic leaks	SNOOP (meets Mil Spec MIL-L-25567C, type 1 oxygen systems) Indiana Valve & Fitting Inc. P.O. Box 24267 Indianapolis, Ind 46224 Leak-Tec Formula 372E American Gas and Chemical Co. 5 Tefnakil Park Cresskill, New Jersey 07626
39	Adhesive	Oil pump gearshaft retention	Loctite 290 Loctite Corporation 705 North Mountain Road Newington, Connecticut 06111
40	Fuel additive	Fuel anti-ice	Prist (MIL-I-27686E) PPG Industries Inc. 5629 FM 1960 West Houston, Texas 77069
		Anti-microbial growth MIL-S-53021A	Biobor JF Aviation Fuel Additive Hammonds Technical Services, Inc 910 Franklin Rd. Houston, TX 77073 Ph: (281) 999-2900 Fax: (281) 582-4224 Email: info@hammondscos.com Web: www.hammondscos.com
41	Torque Paint	Application of slippage marks to pneumatic and lubrication system B-nuts	Torque Seal F-900 Organic Products Company P. O. Box 428 Irving, Texas 75060-0428
42	Torque Paint Remover	Removal of torque paint (slippage marks)	F-100 Remover Organic Products Company P. O. Box 428 Irving, Texas 75060-0428

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Table 303

Acceptable Marking Pens and Pencils

Manufacturer		Trade Name	Number	Color

CAUTION: THESE PENCILS, MARKERS AND PAINT STIKS ARE ALSO APPROVED FOR MARKING TITANIUM ALLOYS PROVIDING THE MARKINGS ARE REMOVED PRIOR TO EXPOSURE OF THE PARTS TO TEMPERATURES ABOVE 500°F (260°C) BY HEAT TREATMENT OR ENGINE OPERATION.

NOTE: The following pencils, fine tip and wide markers, ball point markers, and paint stiks are approved for marking iron, nickel and cobalt base alloys which are exposed to temperatures above 800°F (427°C) either by heat treatment or engine operation. Markings on these alloys do not have to be removed from the parts prior to heating above 800°F (427°C).

The number in the parentheses that follows the manufacturer's name corresponds to the address listing at the end of this table.

Pencils				
Venus	(1)	Unique	1237	Carmine Red
Berol Corp.	(2)	Eagle Verithin	745	Carmine Red
A. W. Faber	(3)	The Winner	2383	Dark Green
Berol Corp.	(2)	Eagle Verithin	751	True Green
A. W. Faber	(3)	The Winner	2388	White
Venus	(1)	Unique	1215	White
Berol Corp.	(2)	Eagle Verithin	734	White
Venus	(1)	Unique	1206	Blue
Koh–I–Noor	(4)	Flexicolor	X1800X25	Blue
Berol Corp.	(2)	Eagle Verithin	758	True Blue
Berol Corp.	(2)	Eagle Verithin	737	Orange
A. W. Faber	(3)	The Winner	2462	Silver
Berol Corp.	(2)	Eagle Verithin	753	Silver
Eberhard Faber	(5)	Colorbrite	2101	Silver
Fine Tip Markers				
Carters[6]		Marks–A–Lot	—	Yellow
Berol Corp.[2]		Flash 30	—	Red
—		Lindy	—	Green
Berol Corp.[2]		Flash 30	—	Blue
—		Lindy	—	Blue
Berol Corp.[2]		Flash 32	—	Blue
Sanford Corp.	(12)	T.E.C.	3201	Black

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Table 303 (cont)

Acceptable Marking Pens and Pencils

Manufacturer	Trade Name	Number	Color

Manufacturer Addresses

(1) Venus–Esterbrook Corp.; Lewisburg, Tenn. 37091
(2) Berol Corp.; P.O. Box 1000, Danbury, Conn. 06810
(3) Faber–Castell Corp.; P.O. Box 1708, 41 Dickerson St. Newark, New Jersey 07l03
(4) KOH–I–NOOR Rapidograph Inc.; 100 North Street, Bloomsbury, NewJersey 08804
(5) Eberhard Faber Inc.; Crestwood Industrial Park, Wilkes–Barre, Pennsylvania. 18703
(6) Carters Ink Co.; 275–T Wyman St., Waltham, Mass. 02154
(7) Markall Co.; 270 North Washtenaw Ave., Chicago, Ill 60612
(8) American Art Clay Co. Inc.; 4717 West 16th St., Indianapolis, Ind.46224
(9) Irwin–Hodson Co.; Ninth and S.E. Woodward, Portland, Oregon 97202
(10) The Lectroetch Co.; 14925 Elderwood Ave., Cleveland, Ohio 44112
(11) Tempil Division Big Three Industries Inc.; 2901 Hamilton Blvd,South Plainfield, N.J. 07080
(12) Sanford Corp., Bellwood, Ill, 60104

4. Hardware

A. Use 0.020 in. (0.51 mm) diameter stainless steel lockwire, MS20995–C20 where lockwire size is not specified. Double strand lockwire all drilled bolts, plugs, and screws, except those locked with self–locking nuts or lockwashers. Lockwire bolts in pairs where possible. When reassembling be sure to safety wherever lockwire was removed. Do not use zinc lockwire. Do not reuse lockwire, cotter pins, ring seals, lip seals, composition gaskets, and split or tab washers. Self–locking nuts can be reused if they have a minimum prevailing torque within the limits given in Table 304.

NOTE: It is not necessary to lockwire engine electrical and magnetic connectors that are of the self–locking, quick–disconnect type.

5. Torques

A. The following paragraphs contain general torque limits for tightening nuts, bolts, and screws. (Refer to Table 305). Torque limits for special applications are provided under maintenance for the specific component. Reuse self–locking nuts having a minimum prevailing torque within the limits given in Table 304. When the tightening procedures calls for locknut drag to be added to a given torque value, obtain the drag as follows:

(1) Tighten the nut snug.

(2) Back off one half turn.

(3) Locknut drag is the torque required to first turn the loosened nut.

B. Tighten without the use of a thread lubricant unless one is specified. Threads must be free of burrs or nicks, and they must turn freely. Complete tightening at the first draw–down causes overstressing of parts and distorted splitlines. On bolt circles, alternatively tighten nuts, bolts, or screws that are 180° apart to half of minimum torque. Repeat the process, tightening to specified torque. On splitlines other than bolt circles tighten midsection nuts, bolts, or screws first to half minimum torque; then tighten remaining threaded parts to half minimum torque. Repeat the process, tightening to specified torque.

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C. When screws are installed with nuts, the torque for the screw shall apply. (Refer to Table 305.) On nuts with a thread size larger than one inch, tighten nuts to maximum specified torque to seat parts. Loosen and retighten as specified.

D. When tightening or loosening coupling nuts, make sure the nipple does not turn on the seat of the mating fitting. Apply torque paint across the fitting threads after tightening them. Bottoming torque on bushing type parts that seat metal over a seal is the same as for fittings with like thread size. For correct torque limits, see Table 306.

6. Universal Fittings (See Figure 301.)

A. Fittings With Backup Rings

Use this procedure to install universal fittings with backup rings.

(1) Install the nut on the fitting and run it back until the counterbore of the nut aligns with the upper inner corner of the gasket groove.

(2) Lubricate the seal and install it on the fitting.

(3) Work the backup ring into the counterbore of the nut.

(4) Turn the nut down until the seal is pushed firmly against the lower threaded section of the fitting.

(5) Install the fitting into the boss, making certain the nut turns with the fitting, until the seal touches the boss. Then tighten the fitting one and one–half turns more.

(6) Put a wrench on the nut to prevent its turning, and position the fitting by turning it in up to 270° or unscrewing it up to 90°.

(7) Hold the fitting in its position and tighten the nut against the boss.

B. Fittings Without Backup Rings

Use this procedure to install universal fittings without backup rings.

(1) Run the nut on the fitting end back until the washer face is aligned with the upper inner corner of the gasket groove.

(2) Lubricate the seal and place it in the groove. Use care not to damage seal.

(3) Screw the fitting into the boss until the seal barely touches the boss.

(4) Turn the fitting and nut together until the nut touches the boss.

(5) Put a wrench on the nut to prevent its turning, and position the fitting by turning it in up to 270° or unscrewing it up to 90°.

(6) Hold the fitting in its proper position and tighten the nut against the boss.

7. Locknut Installation (See Figure 302.)

Install locknuts (Klincher or equivalent) with the locking shoulder on the lead side. Tightening presses the nut against the bolted surface to create the stress required for locking. Nuts installed upside down will not achieve this desired locking feature.

8. Airframe/Engine Interface Connections

When airframe provided fittings are installed into the engine, refer to Table 307 for the recommended torque values.

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9. Rigid Tube Inspection and Installation

When a component to which rigid tube assemblies are attached is replaced, remove all interfering tube assemblies to permit easy removal and reinstallation of the component. This precaution will prevent subsequent damage to the tube assemblies. Tube–to–fitting alignment should be checked for proper fit, as described in Flared Tubes and Flanged Tubes, para 9.B. and 9.C., this section, anytime such a component is installed.

A. Inspection

Inspect fuel, control air, and oil tubes as follows:

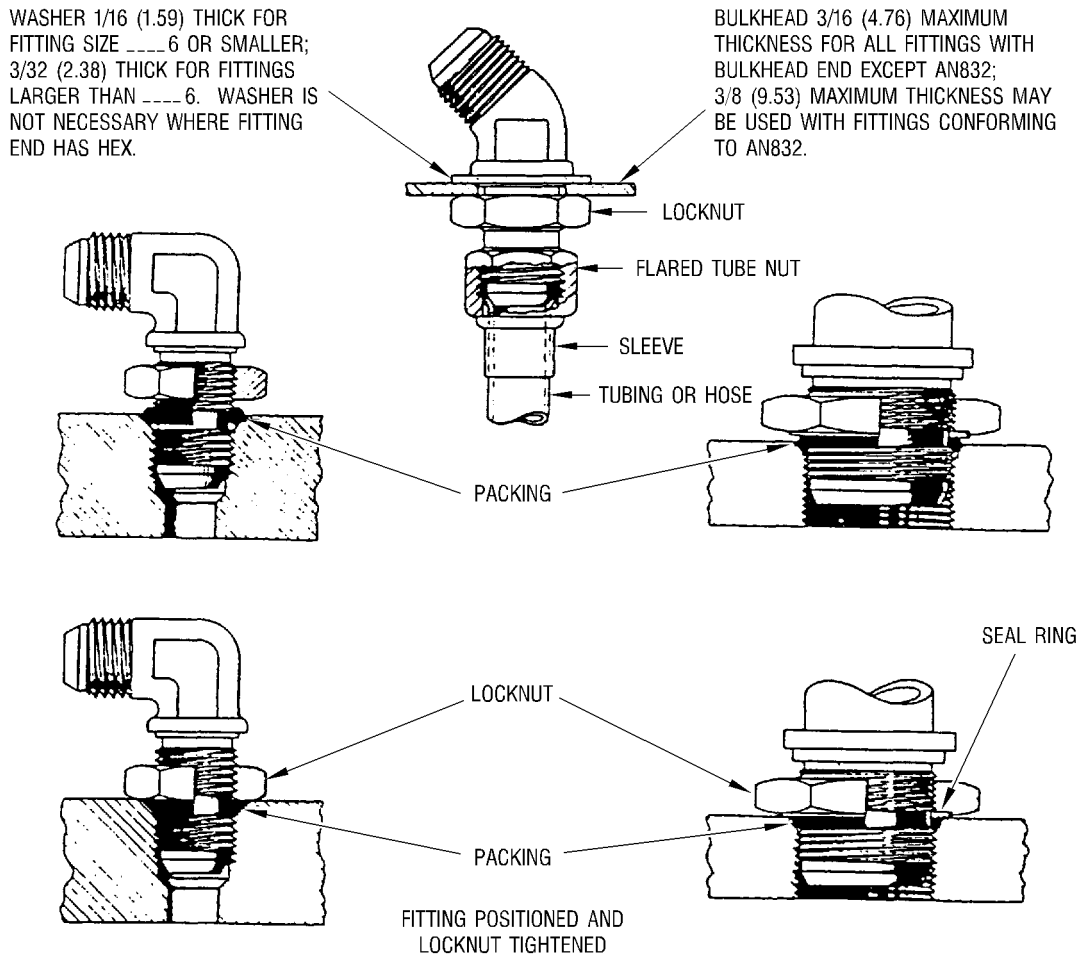
(1) Inspect tubes for dents, chafing or cracks.

(2) Reject tubes with cracks (dye check) in any area.

(3) Reject tubes having dents or chafing on the flared ends or on the retention clamps.

(4) Reject tubes with dents exceeding 0.125 in. (3 mm) depth or having a sharp radius.

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NOTE: DIMINSIONS ARE IN INCHES (MILLIMETERS).

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Universal Fittings
Figure 301

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Table 601 (cont)

Description of Inspections (cont)	
h.	Check the engine oil quantity within 15 minutes of engine shutdown to avoid a false indication of excessive oil consumption. If the 15 minutes has been exceeded, motor the engine for 30 seconds with the starter before checking tank quantity. Motoring normally scavenges oil from the gearbox back to the aircraft oil tank. Check the airframe flight manual; some installations may require engine to be operated for at least a minute at ground idle to assure proper scavenging of the engine gearbox. NOTE: Always refer to the airframe flight manual for proper oil servicing instructions; specific requirements may vary for different aircraft models.
Item 6.	Fuel Control
i.	Check the fuel control by making a deceleration check during shutdown for the last flight of each day. Refer to Deceleration Check, PARA 3.B., 73–20–02 or para 3.B., 73–20–04.
Item 7.	Fuel System, General
j.	Carefully inspect the fuel control and governor for evidence of leakage. Accomplish with the boost pump on if available. Also, check condition of fittings and tubing (e.g. loose, chafed, bent, dented) which can contribute to leakage. If there is no evidence of leakage, further action is not required. If evidence of fuel leakage is found, refer to Fuel Leakage Inspection, PARA 2.A., 73–00–00, for required action. Perform fuel system pneumatic leak check anytime system maintenance is performed. Refer to Fuel System Pneumatic Leak Check, Para 2.B., 73–00–00.
Item 8.	Ignition Lead
k.	Inspect ignition lead for burning, chafing, or cracking of conduit and for loose connectors. Inspect for broken lockwire.
Item 9.	Start Counter.
l.	Inspect for proper operation, increase in count, and for loose, chafed, frayed or broken wires and loose connectors.
Item 10.	Electrical Harness (250–C20R, –C20R/1, –C20R/1(RS) only)
m.	Inspect for loose, chafed, frayed or broken wires and loose connectors.

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	100 Hour Inspection (cont)			
5	Inspect P_c filter for proper clamping.	N/A		
6	Until CEB–A–1233 is complied with, inspect P_c filter assembly as follows: Without disassembly or removal of the P_c filter assembly from the mounting bracket, inspect using a 10x magnification glass and a bright light to detect any signs of cracks, paying particular attention to both of the end fittings at their junction with the end walls. If cracks are detected, remove assembly and comply with CEB–A–1233.	N/A		
7	Remove the Scroll–to–P_c Filter Tube Assembly at both ends and inspect for cracks using 10x power glass. Pay particular attention to the flared ends of the tube for cracks, and to the areas beneath the floating ferrules for fretting damage. Tubes–found to contain cracks and/or excessive fretting damage are to be replaced by new parts of the same part number as removed.	N/A		
	NOTE: Excessive fretting is present when the ferrule has chafed the tube sufficiently to wear a step in the tube that can be felt with a thumbnail or other inspection aid.			
8	With the Scroll–to–P_c Tube Assembly still removed and using a 10x power glass, inspect the elbow in the compressor scroll for distress/cracks/proper alignment. No cracks are permissible.	N/A		
9	Check fuel control and power turbine governor linkage for freedom of operation, full travel and proper rigging. Check security of linkage for loose or worn linkage and linkage bolts.	PARA 3.C., 73–20–02, 3.B., 73–20–03, 3.C., 73–20–04 and PARA 2.C., 73–20–01		
10	Inspect compressor inlet guide vanes and visible blades and vanes for foreign object damage.	N/A		
11	Clean compressor with chemical wash solution as required if operating in a smoggy area, conditions with airborn pollutants or with water alcohol.	PARA 6., 72–30–00		
12	Visually inspect the water–alcohol nozzles for build–up of contaminants which could restrict flow or alter the spray pattern. Ultrasonic clean nozzles if equipment is available.	N/A		
13	Clean the 200 mesh screen (if equipped with water–alcohol injection kit).	N/A		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	100 Hour Inspection (cont)			
14	Inspect the compressor scroll for cracks or breaks at the anti–ice air valve and customer bleed port. If cracks or breaks are detected, check engine for possible vibration causes.	PARA 1.D.(2), this section		
15	Inspect for discharge air tube inserts that are cocked or backing out of the scroll. If cocked or loose inserts are detected, check engine for possible vibration causes.	N/A		
16	Check compressor discharge air tubes for damage or deterioration.	PARA 4.A., 72–40–00		
17	Check anti–ice valve for security, worn parts and proper operation. Valve need not be removed or disassembled unless a problem is detected.	PARA 4., 75–10–01		
18	Inspect compressor mount inserts, bolts and nuts for looseness, fretting or oil leakage. Replace or retighten as required. Check engine for possible vibration causes.	PARA 4.D., 72–60–00 and PARA 1.D.(2), this section		
19	Inspect the turbine support assemblies and engine exhaust ducts for condition of welded joints, for cracks and buckling. Check exhaust duct clamps for proper installation, condition and torque.	PARA 8.A., 72–50–00		
20	Wet spline starter–generator gearshafts, new production or those replaced in accordance with the Rolls–Royce Commercial Engine Bulletin 250–C20 CEB–1082, do not need periodic inspection and lubrication. Clean and inspect any other starter–generator gearshaft. Clean the female splines of the starter–generator gearshafts and the male splines of the starter–generator with mineral spirits and a soft brush. Inspect splines. Refer to Starter–generator Gearshaft Female Spline Inspection paragraph.	PARA 4.B., 72–60–00		
	Inspect the starter–generator brushes for wear in accordance with the Aircraft Manual at the same time the spline inspection is made.	N/A		
	Lubricate acceptable splines with grease, Aeroshell No. 22, or equivalent. Before reinstallation of the starter–generator, make sure torsional damper members of the starter–generator driveshaft are in hard contact with each other.	N/A		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	100 Hour Inspection (cont)			
21	Lubrication system inspection			
	NOTE: Maximum interval between oil change is 100 hours or six months, whichever occurs first. This hour limit can be extended to 200 hours for those items indicated by an asterisk (*) if an external oil filter of a type that has a valid STC (Supplemental Type Certificate) is installed on the engine. The calendar limit can be extended to 12 months for those items indicated by an asterisk (*) and if an approved high stability oil (Third Generation) is used.			
	*a. Drain oil system.	PARA 11.C., 72-00-00, Engine-Servicing		
	b. Remove, inspect and clean the oil filter. Note any accumulation of metal chips, debris or carbon particles. Conduct further inspection of the lube system and/or engine gear train/bearings if metal chips or debris are found. See Items 21a, 21e, 38, 39 and 40 below if carbon particles are found.	PARA 1.C., 72-60-00		
	NOTE: Follow STC manufacturer's recommendations regarding replacement/cleaning of external oil filter elements. Inspect removed elements for any accumulations of metal chips, debris or carbon particles. It may prove helpful to cut apart disposable (paper) filler elements to facilitate this inspection. If chips, debris or carbon particles are found, proceed with additional inspection/maintenance as outlined in item 21b. above.			
	*c. Inspect and clean turbine pressure oil check valve.	PARA 7.K., 72-50-00		
	NOTE: Check Valve P/N 23074872 and subsequent part numbers are not applicable to this inspection (these valves are considered "ON CONDITION").			
	*d. Turbine pressure oil tube screen assembly. Detach clamp; then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the tube coupling nut at the fireshield elbow only enough to allow sufficient movement of the tube to enable removal of the screen. At assembly, tighten connector coupling nut to 200-250 lb in. (23-28 N·m). Tighten fireshield elbow coupling nut to 80-120 lb in. (9-14 N·m). Tighten clamp nut to 35-40 lb in. (3.9-4.5 N·m).	N/A		
	*e. Measure oil flow from the scavenge passage of the external sump and from the scavenge passage of the gas producer support. It is recommended that the external sump is not removed for this check.	PARA 7.D., 72-50-00		
	NOTE: This step must be performed before draining oil or after the oil system has been refilled.			

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	100 Hour Inspection (cont)			
	f. Inspect magnetic chip detector plugs.	PARA 11.G., 72–00–00, Engine–Servicing		
	g. Inspect quick disconnect magnetic chip detector plugs and flanged inserts for wear, if installed.	PARA 11.G., 72–00–00, Engine–Servicing		
	*h. Refill oil system.	PARA 11.C., 72–00–00, Engine–Servicing		
21.A	Remove, inspect and clean the fuel nozzle. If no airframe mounted fuel filter is installed, inspect the fuel nozzle filter.	PARA 2., 73–10–03		
	NOTE: Operators may find it necessary to inspect and clean the fuel nozzle more often depending on past experience or operating conditions.			
22	Inspect the start counter for proper operation, increase in count, and for loose, chafed,frayed or broken wires and loose connectors.	PARA 1., 74–20–03		
23	Check the condition of the bleed valve gasket, without removing bleed valve. Replace gasket if air leaks (blowouts) can be detected.	PARA 2., 75–10–02		
24	Inspect the outer combustion case for condition. Inspect the weld joints of and in the brazed screen reinforcement in the armpit area.	PARA 2.B., 72–40–00		
25	Clean the burner drain valve.	PARA 3., 72–40–00		
26	Inspect the ignition lead for burning, chafing,or cracking of conduit and loose connectors and broken lockwire.	N/A		
27	On engines with CECO fuel system, clean or replace the high pressure fuel filter.	N/A		
28	On engines with CECO fuel systems, visually inspect the bleed hole at the low point in the scroll–to–governor P_c tube for any obstruction. If the hole is not completely open, remove any contamination which could obstruct drainage of moisture from the tube using a piece of lockwire.	N/A		
29	Review engine records for compliance with all mandatory bulletins, inspections and airworthiness directives.	N/A		
30	Review engine records for time limited parts components, accessory or modules.	N/A		
31	Enter component changes, inspection compliance, etc., in log book as required.	N/A		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	200 Hour Inspection			
	In addition to the 100 hour inspection items, perform the following:			
	WARNING: MANDATORY COMPLIANCE DATE FOR ROLLS–ROYCE COMMERCIAL ENGINE BULLETIN 250–C20 CEB–1051 WAS AUGUST 30, 1980.			
32	Perform fuel pump backlash inspection on Sundstrand dual element pump P/N 6854292, 6857548, 6877719, 6856250, 6876803.	250–CSL–1007		
	300 Hour Inspection			
	In addition to the 100 hour and applicable 200 hour inspection items, perform the following:			
	CAUTION: INSPECTION FREQUENCY SHALL BE BASED ON THE NATURE OF THE EROSIVE AND/OR CORROSIVE ENVIRONMENT. THE OPERATING ENVIRONMENT MAY DICTATE A MORE FREQUENT INSPECTION INTERVAL. FOR NON–COATED COMPRESSOR WHEELS, THE INSPECTION SHALL NOT EXCEED 300 HOURS OR 6 MONTHS. FOR COATED COMPRESSOR WHEELS, INSPECTION SHALL NOT EXCEED 300 HOURS OR 12 MONTHS. IF ANY PARENT METAL IS EXPOSED DUE TO CORROSION AND/OR EROSION, THE INSPECTION REQUIREMENT SHALL REVERT BACK TO 300 HOURS OR 6 MONTHS.			
33	Inspect the compressor case when operating in an erosive and/or corrosive environment.	PARA 1.D.(9), this Section		
	CAUTION: AIRCRAFT INSTALLED–ENGINE FUEL–PUMP FILTER DIFFERENTIAL PRESSURE WARNING SYSTEMS AND/OR OPERATING EXPERIENCE MAY DICTATE REPLACEMENT AT A LESSER TIME INTERVAL. IN NO INSTANCE SHOULD THE 300 HR REPLACEMENT INTERVAL BE EXCEEDED.			
34	Replace the fuel filter element. This filter is a throw–away item. It is not cleanable. Before discarding filter, inspect for signs of contaminants. If any are found, inspect the entire fuel system and clean if necessary.	PARA 2.C., 73–10–01		
	CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. (REFER TO SPECIAL INSPECTIONS, 72–00–00, TABLE 604) IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.			
	CAUTION: PURGE AIR FROM THE FUEL SYSTEM.			
35	Perform a fuel pump bypass valve operational check whenever a fuel filter is replaced.	PARA 3.A., 73–10–01		

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Table 602
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	300 Hour Inspection (cont)			
36	Remove, clean and inspect engine P_c filter every 300 hours or earlier as engine performance dictates.	PARA 3., 73-20-06		
37	Inspect and clean the No. 1 bearing oil pressure reducer.	PARA 3., 72-30-00		
38	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	N/A		
39	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72-50-00		
40	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G., 72-50-00		
41	Inspect the thermocouple assembly.	PARA 2.B., 77-20-01		
	500 Hour/1 Year Inspection			
42	Inspect all uncoated and coated P/N 6846278 and 6871338 power turbine outer couplings nuts for corrosion.	250-C20 CSL-1060		
	NOTE: Compliance with Rolls-Royce Commercial Engine Bulletin 250-C20 CEB-1120 and/or 250-C20 CEB-1158 removes this inspection requirement.			
	600 Hour Inspection			
43	Check the fuel pump driveshaft on Sundstrand single element pumps for spline wear.	N/A		
	NOTE: This inspection is not required for Agro-Tech (TRW) fuel pumps or Sundstrand fuel pumps P/N 23003114 and subsequent.			
44	Perform scavenge oil filter impending bypass functional test per Facet Service Bulletin No. 090589 (ref. Rolls-Royce 250 CSL 1164) for aircraft equipped with this type of external scavenge filter system.	N/A		
45	Replace the fuel control filter assembly. Bendix fuel controls P/N 2524552-4 or 2524552-6 (less-5) and prior unless 250-C20 CEB-1089 has been accomplished.	PARA 4.A., 73-20-02, 4.A., 73-20-03		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	1000 Hour Inspection			
46	Inspect Py port on Bendix power turbine governor per 250 CEB–A–1281. The governor must be removed from the engine to perform this inspection.	N/A		
	NOTE: If CEB–A–1289 or CEB 1330 have been accomplished, this inspection is not required.			
	1500 Hour Inspection			
47	Replace the fuel control filter assembly. Bendix fuel controls P/N 2524552–5 and subsequent and those earlier fuel controls which have had Rolls–Royce Commercial Engine Bulletin 250–C20 CEB–1089 accomplished.	PARA 4.A., 73–20–02, 4.A., 73–20–03		
48	Inspect fuel nozzle filter.	PARA 2.A., 73–10–03		
	1750 Hour Inspection			
49	Inspect the compressor case. Inspection frequency shall be as made necessary by operating environment. In erosive environment, inspect case at least every 300 hours. In any environment do not exceed 1750 hours without case inspection.	PARA 1.D., 72–00–00, 5., 72–30–00		
50	Heavy Maintenance Inspection (HMI). Heavy maintenance inspection shall consist of gas producer turbine wheels replacement and inspection of assembled components per Rolls–Royce published documents. It is the responsibility of the operator to assure that the total time and cycle life limits of specific parts listed in Section 05–10–00, Airworthiness Limitations, are not exceeded.	N/A		
	As Required Inspection			
51	Clean the bleed valve after each 10 hr of water–alcohol augmentation operation or after consumption of each 750 gallons (2840 liters) of water–alcohol mixture.	PARA 2.C., 75–10–02		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	150 Hour Inspection (cont)			
14	Inspect the compressor scroll for cracks or breaks at the anti–ice air valve and customer bleed port. If cracks or breaks are detected, check engine for possible vibration causes.	PARA 1.D.(2), this section		
15	Inspect for discharge air tube inserts that are cocked or backing out of the scroll. If cocked or loose inserts are detected, check engine for possible vibration causes. Check air tubes for cracks.	N/A		
16	Check compressor discharge air tubes for damage or deterioration.	PARA 4.A., 72–40–00		
17	Check anti–ice valve for security, worn parts and proper operation. Valve need not be removed or disassembled unless a problem is detected.	PARA 4., 75–10–01		
18	Inspect compressor mount inserts, bolts and nuts for looseness, fretting or oil leakage. Replace or retighten as required. Check engine for possible vibration causes.	PARA 4.D., 72–60–00 and PARA 1.D.(2), this section		
19	Inspect the turbine support assemblies and engine exhaust ducts for condition of welded joints, for cracks and buckling. Check exhaust duct clamps for proper installation, condition and torque.	PARA 8.A., 72–50–00		
20	Inspect the starter–generator brushes for wear in accordance with the Aircraft Manual at the same time the spline inspection is made.	PARA 4.B., 72–60–00		
21	Lubrication system inspection			
	a. Remove, inspect and clean the oil filter. Note any accumulation of metal chips, debris or carbon particles. Conduct further inspection of the lube system and/or engine gear train/bearings if metal chips or debris are found. See Items 36a, 37, 38 and 39 below if carbon particles are found.	PARA 1.C., 72–60–00		
	NOTE: Follow STC manufacturer's recommendations regarding replacement/cleaning of external oil filter elements. Inspect removed elements for any accumulations of metal chips, debris or carbon particles. It may prove helpful to cut apart disposable (paper) filler elements to facilitate this inspection. If chips, debris or carbon particles are found, proceed with additional inspection/maintenance as outlined in item 21b. below.			

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	150 Hour Inspection (cont)			
	b. Inspect magnetic chip detector plugs.	PARA 11.G., 72–00–00, Engine–Servicing		
	c. Inspect quick disconnect magnetic chip detector plugs and flanged inserts for wear, if installed.	PARA 11.G., 72–00–00, Engine–Servicing		
21.A	Remove, inspect and clean the fuel nozzle exterior. If no airframe mounted fuel filter is installed, inspect the fuel nozzle filter.	PARA 2., 73–10–03		
	NOTE: Operators may find it necessary to inspect and clean the fuel nozzle more often depending on past experience or operating conditions.			
22	Inspect the start counter for proper operation, increase in count, and for loose, chafed, frayed or broken wires and loose connectors.	PARA 1., 74–20–03		
23	Check the condition of the bleed valve gasket without removing bleed valve. Replace gasket if air leaks (blowouts) can be detected.	PARA 2., 75–10–02		
24	Inspect the outer combustion case for condition. Inspect the weld joints of and in the brazed screen reinforcement in the armpit area.	PARA 2.B., 72–40–00		
25	Clean the burner drain valve.	PARA 3., 72–40–00		
26	Inspect the ignition lead for burning, chafing, or cracking of conduit and loose connectors and broken lockwire.	N/A		
27	On engines with CECO fuel system, clean or replace the high pressure fuel filter.	N/A		
28	On engines with CECO fuel systems, visually inspect the bleed hole at the low point in the scroll–to–governor P_c tube for any obstruction. If the hole is not completely open, remove any contamination which could obstruct drainage of moisture from the tube using a piece of lockwire.	N/A		
29	Review engine records for compliance with all mandatory bulletins, inspections and airworthiness directives.	N/A		
30	Review engine records for time limited parts components, accessory or modules.	N/A		
31	Enter component changes, inspection compliance, etc., in log book as required.	N/A		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	300 Hour Inspection (cont)			
36	Lubrication system inspection			
	NOTE: Maximum interval between oil change is 300 hours or 12 months, whichever occurs first.			
	a. Drain oil system.	PARA 11.C., 72-00-00, Engine-Servicing		
	b. Inspect and clean turbine pressure oil check valve.	PARA 7.K., 72-50-00		
	c. Turbine pressure oil tube screen assembly. Detach clamp; then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the tube coupling nut at the fireshield elbow only enough to allow sufficient movement of the tube to enable removal of the screen. At assembly, tighten connector coupling nut to 200-250 lb in. (23-28 N·m). Tighten fireshield elbow coupling nut to 80-120 lb in. (9-14 N·m). Tighten clamp nut to 35-40 lb in. (3.9-4.5 N·m).	N/A		
	d. Measure oil flow from the scavenge passage of the external sump and from the scavenge passage of the gas producer support. It is recommended that the external sump is not removed for this check.	PARA 7.D., 72-50-00		
	NOTE: This step must be performed before draining oil or after the oil system has been refilled.			
	e. Refill oil system.	PARA 11.C., 72-00-00, Engine-Servicing		
37	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	N/A		
38	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72-50-00		
39	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G., 72-50-00		
40	Deleted			

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	1000 Hour Inspection			
47	Inspect Py port on Bendix power turbine governor per 250 CEB–A–1281. The governor must be removed from the engine to perform this inspection.	N/A		
	NOTE: If CEB–A–1289 or CEB 1330 have been accomplished, this inspection is not required.			
	1500 Hour Inspection			
48	Replace the fuel control strainer assembly. Bendix fuel controls P/N 2524552–5 and subsequent and those earlier fuel controls which have had Rolls–Royce Commercial Engine Bulletin 250–C20 CEB–1089 accomplished.	PARA 4.A., 73–20–02, 4.A., 73–20–03		
49	Inspect fuel nozzle filter.	PARA 3.A., 73–10–03		
	1750 Hour Inspection			
50	Inspect the compressor case. Inspection frequency shall be as made necessary by operating environment. In erosive environment, inspect case at least every 300 hours. In any environment do not exceed 1750 hours without case inspection.	PARA 1.D., 72–00–00, 5., 72–30–00		
51	Heavy Maintenance Inspection (HMI). Heavy maintenance inspection shall consist of gas producer turbine wheels replacement and inspection of assembled components per Rolls–Royce published documents. It is the responsibility of the operator to assure that the total time and cycle life limits of specific parts listed in Section 05–10–00, Airworthiness Limitations, are not exceeded.	N/A		
	As Required Inspection			
52	Clean the bleed valve after each 10 hr of water–alcohol augmentation operation or after consumption of each 750 gallons (2840 liters) of water–alcohol mixture.	PARA 2.C., 75–10–02		

PARA 1. (cont)

D. Special Inspections

Special inspections are required when the engine has been subjected to abnormal operating conditions, when engine damage is suspected, or when associated parts are removed from the engine. The special occurrence, the component or system to be inspected, and the nature of the inspection are given in Table 604.

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Table 604
Special Inspections

Item	Occurrence	Component or System	Required Action
1	Engine removal from aircraft	Engine, general	a
2	Compressor removal from engine	Anti-icing air valve Gearbox compressor mount inserts	p ad
3	Turbine removal from engine	Combustion liner Outer combustion case Compressor discharge air tubes Turbine pressure oil check valve Burner drain valve	aa z ab at ac
	NOTE: Check Valve P/N 23074872 and subsequent part numbers are not applicable to this inspection (these valves are considered "ON CONDITION").		
4	Rigid tube and/or accumulators removal from engine	Rigid tube and/or accumulators	f, ba
5	Hard landing (over 10g)	Engine, general	b
6	Sudden stoppage of rotor or propeller	Engine, general Compressor Magnetic drain plugs	c
7	Operation in erosive environment	Compressor	l
8	Snow or ice ingestion	Compressor	h
9	Foreign object damage	Compressor Turbine	k q
10	Operation with inlet restricted	Compressor	f
11	Overtemperature operation	Turbine Thermocouples	r y
12	Oil temperature limit exceeded	Oil system	ap
13	Hot start encountered	Turbine Thermocouples	s y
14	Fuel filter bypassed	Fuel pump filter Fuel control strainer (Bendix) Fuel nozzle strainer Fuel control, governor and high pressure filters (CECO)	au aw bb av
15	Oil change	Oil System Oil filter	ah, aj as
16	Oil consumption	Turbine	u
17	Oil system contamination	Oil system	ak, al, am
	NOTE: When the oil system is contaminated with carbon or metallic particles, this inspection is not required if the engine has a valid STC (Supplemental Type Certificate) or aircraft manufacturer approved external scavenge oil filter which has not bypassed.		
18	Oil spray on first-stage wheel	Turbine	v
19	Engine operated in excess of 30 seconds without oil pressure	Oil system	aq

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Table 604 (cont)
Special Inspections

Item	Occurrence	Component or System	Required Action
20	Engine inactive more than 5 days	Compressor	n
21	Engine inactive more than 45 days	Oil system Fuel system	an bc
22	As dictated by performance	Fuel control P_c filter System P_c filter	ax ba
23	Vibration	Compressor Gearbox	m ad
24	Engine submerged while in operation	Compressor Turbine	h t
25	On condition inspection	Power and accessory gearbox	ae
26	Known or suspected lightning strike	Engine, general Rotor or propeller general	e
27	Slippage and/or sudden engagement of freewheel clutch unit	Turbine Gearbox	w,x af
28	First 50 hours of operation on new, repaired or overhauled engines.	Oil system Oil filter	aq1 as
29	Replacement of fuel pump and/or fuel filter or fuel system connections being loosened	Fuel system	au,bd
30	Fuel system contamination (known high amount of particles or microbiologicals)	Fuel pump Fuel control Fuel nozzle	bd aw bb

NOTE: The letter designations in the Required Action column refer to the applicable Description of Inspection.

Description of Inspections

Engine, General

a. Anytime the engine is removed from the aircraft, inspect the compressor inlet for foreign object damage or condition. Clean and flush all aircraft drain lines. Wash the outside of the engine with mineral spirits. Touch up paint where peeling or chipping is evident. Refer to Corrosion Treatment and Surface Finish Repair, PARA 3., 72–00–00, Engine–Cleaning/Painting.

b. After a hard landing, inspect the complete engine. Refer to Hard Landing Limits, PARA 1.D.(3), 72–00–00, this section.

c. After the main rotor or propeller strikes an object or the engine N_2 power train is subjected to abnormal shock loading during operation, a sudden stoppage inspection must be performed. Refer to Sudden Stoppage Inspection, PARA 1.D.(4) or 1.D.(5), 72–00–00, this section.

d. (250–C20S only) Purge trapped air from the propeller oil system on the ground prior to the first flight anytime the propeller or the engine has been replaced. Refer to Propeller Check Run, PARA 1.D., 72–00–00, Engine–Adjustment/Test.

e. After a known or suspected lightning strike, inspect the complete engine. Refer to Lightning Strike Inspection, PARA 1.D.(7), 72–00–00, this section.

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Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Rigid Tubes and Accumulators

f. Inspect rigid tubes (CECO or Bendix control system) and/or accumulators (Bendix system only) anytime they are removed. Replace tube if any cracks (dye check) are detected or if the tube has kinks or dents which could affect seating or integrity. Refer to PARA 9., 72–00–00, Engine–Servicing. Replace accumulators if leaks are found. Refer to PARA 1., 73–10–04.

Compressor

g. After engine operation with inlet air restricted due to foreign objects,replace the compressor. Refer to Compressor Inlet Air Blockage, PARA 1.D.(12), this section.

h. If the engine is submerged in water while in operation, return the complete engine to an overhaul facility for replacement of all compressor and turbine wheels. Refer to Engine Submerged While in Operation, PARA 1.D.(6), this section.

i. After engine operation in snow, ice, or water, inspect the compressor inlet, without disassembly of engine parts, for damage due to ingestion of snow or ice buildup. Refer to PARA 1.D.(10), this section.

j. After the main rotor or propeller strikes an object or the engine N_2 power train is subjected to abnormal shock loading during operation, inspect the compressor inlet for foreign object damage. Also, inspect the compressor rotor blades and stator vanes. Refer to Sudden Stoppage Inspection, PARA 1.D.(4) or 1.D.(5), this section.

k. After suspected foreign object damage, inspect the compressor rotor blades and stator vanes. Refer to Blade Damage, and Vane Damage, PARA 5.C. and 5.D., 72–30–00.

l. After engine operation in an erosive environment, inspect compressor blades, vanes, and plastic lining for erosion. Refer to Erosion and Corrosion Inspection, PARA 1.D.(9), this section.

NOTE: If the aircraft is subjected to sand or dust ingestion, periodic compressor erosion inspection is recommended. The frequency of the inspection should be based on the frequency and degree of ingestion and condition of the compressor at the last inspection. Experience has shown that the bottom half of the compressor case is more prone to erosion.

m. If cracks are detected in the scroll at the anti–ice valve; if discharge air tube inserts are loose or backing out of the scroll, or if vibration is suspected, inspect for possible vibration causes. Refer to Vibration Inspection, PARA 1.D.(2), 72–00–00, this section.

n. If the engine will be shut down for more than five calendar days, preserve the compressor. Refer to PARA 12.D., 72–00–00, Engine–Servicing.

Anti–icing Valve

p. Anytime the compressor is removed from the engine, inspect the anti–icing air valve for wear or damage. Refer to PARA 4., 75–10–01.

Turbine

q. After suspected foreign object damage, inspect the first–stage turbine blades and vanes. Refer to PARA 7.A., 72–50–00.

r. After engine operation at temperatures exceeding the operating limits requiring turbine inspection in Table 8 or 9, 72–00–00, Engine–Description and Operation inspect the following parts:

1) First–stage turbine wheel in accordance with PARA 7.A., 72–50–00
2) First–stage turbine nozzle in accordance with Table 201, 72–50–00
3) Combustion liner in accordance with Table 201, 72–40–00. Record temperature and duration in the Engine Log.

NOTE: If either the first–stage turbine wheel or first–stage turbine nozzle is rejected due to overtemperature operation, the complete turbine, both gas producer and power turbine sections, must be removed and sent to a Rolls–Royce Authorized Maintenance Center (AMC) for inspection.

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Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Turbine (cont)

s. After exceeding the starting temperature limits of Table 8 or 9, 72–00–00, Engine–Description and Operation, where turbine inspection is required, inspect the first–stage turbine wheel in accordance with Blade Damage, PARA 7.A., 72–50–00. Inspect first–stage turbine nozzle in accordance with Table 201, 72–50–00. Inspect the combustion liner in accordance with Table 201, 72–40–00. Refer to Hot Start Inspection, PARA 1.D.(8)(a), this section and Center Slotted Third–stage Turbine Wheels, PARA 1.D.(8)(b), this section. Record temperature and duration in the Engine Log.

NOTE: If either the first–stage turbine wheel of first–stage turbine nozzle is rejected due to overtemperature operation, the complete turbine, both gas producer and power turbine sections, must be removed and sent to a Rolls–Royce Authorized Maintenance Center (AMC) for inspection.

t. If the engine is submerged in water while in operation, return the complete engine to an overhaul facility for replacement of all compressor and turbine wheels. Refer to Engine Submerged While in Operation, PARA 1.D.(6), this section.

u. If oil consumption exceeds one quart (0.9 liter) per hour, clean the power turbine scavenge strut, the external scavenge oil sump and the power turbine support bearing pressure oil nozzle. Refer to PARA 7.E. and 7.G., 72–50–00.

v. Send the turbine to an overhaul facility for replacement of the first–stage wheel if oil has leaked or been forcibly sprayed onto the wheel during operation of the engine.

w. Send N_2 turbine to overhaul for overspeed inspection if slippage/sudden engagement of free wheel unit occurred at stabilized Ground Idle RPM and the output shaft was broken.

x. Send N_2 turbine to overhaul for overspeed inspection if slippage/ sudden engagement of free wheel unit occurred at any engine speed above stabilized Ground Idle RPM, with or without output shaft damage.

Thermocouples

y. After engine operation at temperatures exceeding the operating limits requiring turbine inspection in Table 8 or 9, 72–00–00, Engine–Description and Operation, inspect the thermocouples. Refer to Thermocouples, PARA 2., 77–20–01.

Outer Combustion Case

z. Anytime the turbine is removed from the engine, inspect the outer combustion case. Refer to PARA 2., 72–40–00.

Combustion Liner

aa. Anytime the turbine is removed from the engine, inspect the combustion liner. Refer to Table 202, 72–40–00.

Compressor Discharge Air Tubes

ab. Anytime the turbine is removed from the engine, inspect the compressor discharge air tubes for dents, cracks, or wear. Refer to Compressor Discharge Air Tubes, PARA 4.A., 72–40–00.

Burner Drain Valve

ac. Anytime the turbine is removed from the engine, remove, clean and inspect the burner drain valve. Refer to Burner Drain Valve, PARA 3.A., 72–40–00.

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Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Gearbox

ad. Anytime the compressor is removed from the engine, inspect the mounting inserts on the gearbox for looseness. Refer to Insert Inspection, PARA 4.D., 72–60–00. If loose inserts are detected, check for possible vibration causes. Refer to Vibration Inspection, PARA 1.D.(2), this section.

ae. Anytime the power and accessory gearbox cover is separated from the gearbox housing at an Authorized Maintenance Facility and the Log Book indicates 3500 hours have elapsed since the gears were new or last magnafluxed, magnetically inspect all gears listed in PARA 1.D.(11), this section.

af. Send power and accessory gearbox to overhaul for overtorque inspection anytime a free wheel clutch slippage/sudden engagement incident occurs.

Magnetic Drain Plugs

ag. After the main rotor or propeller strikes an object or the engine N_2 power train is subjected to abnormal shock loading during operation, inspect the magnetic plugs for metal accumulation. Refer to Sudden Stoppage/Engagement Inspection, PARA 1.D.(4) or 1.D.(5), this section, and Magnetic Plug Inspection, PARA 11.G., 72–00–00, Engine–Servicing.

Oil System

ah. Drain oil from the system and refill, using the oils specified in Approved Oils, PARA 4.C., 72–00–00, Engine–Description and Operation. Remove, clean, and reinstall the oil filter at each oil change.

aj. Clean/replace oil cooler, lines and tank as require by airframe manufacturer or when heavy carbon deposits are noted in the engine lubrication system.

ak. Clean or replace the engine/scavenge oil filter(s), oil cooler, lines, tank and propeller cylinder (250–C20S) when heavy carbon deposits are found in the engine oil system. Consult the airframe or propeller manufacturer's publications for instructions to perform this work.

al. Clean or replace the engine oil filter, oil cooler, lines, tank and propeller cylinder (250–C20S) following oil system contamination. Clean the propeller cylinder prior to engine or propeller installation. When oil groups are mixed or changed, clean the propeller cylinder, engine oil filter, oil cooler, lines and tank before refilling the oil system. Consult the airframe or propeller manufacturer's publications for instructions to perform this work.

am. Flush the engine oil system following suspected or known contamination of the oil. Drain the oil system and service the oil tank with approved oil. Run the engine for 15 minutes at idle speed or until the oil has reached normal operating temperature. Drain the oil system. Clean or replace the engine/scavenge oil filter(s) and service the oil tank with an approved oil prior to flight.

an. If engine is inactive for more than 45 days, preserve oil system in accordance with Oil System Preservation, PARA 12.B., Engine–Servicing.

ap. Anytime the engine oil temperature limit has been exceeded, take the appropriate maintenance action given in Oil Temperature Limit Exceeded, PARA 11.B., 72–00–00, Engine–Servicing.

aq. Anytime the engine is operated in excess of 30 seconds without oil pressure, maintenance action is required. Refer to Engine Operated With No Oil Pressure, PARA 11.E., 72–00–00, Engine–Servicing.

aq1. After 50 hours of operation or if chip indication occurs within the first 50 hours on a new, repaired or overhauled engine, check the oil filter(s) and magnetic chip plugs for contamination. Also, if decreased oil pressure is noticed during operation, check the engine oil filter(s) for contamination at that time. If debris is found, proceed as follows:

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Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Oil System, aq1. (cont)

1. Drain engine and airframe oil systems. Pay particular attention for any metallic debris in the oil. Swab the oil tank and note any foreign material.
2. Flush the engine oil system and clean the main and scavenge oil filters.
3. Flush the airframe oil system including oil coolers (refer to applicable airframe manual).
4. Reinstall filters and fill the cavity with fresh oil. Fill the oil tank with fresh oil.
5. Perform 30–minute ground run at power observing cockpit gauges, warning lights and caution panel for normal condition. Check indicated oil level within 15 minutes after shutdown.
6. After ground run, remove and inspect main and scavenge oil filters and magnetic chip plugs. If no accumulated debris is present, release aircraft for flight. During the next 30 hours of operation, check engine oil filters and magnetic chip plugs at approximately 10–hour intervals to determine if additional debris has accumulated. If debris is present, follow instructions for magnetic chip plug inspection procedure.

Oil Filter

ar. At each oil change, remove, clean, and reinstall the oil filter. Refer to Oil Filter, PARA 1.D., 72–60–00.

as. After 50 hours of operation or if chip indication occurs within the first 50 hours on a new, repaired or overhauled engine, check the oil filter(s) and magnetic chip plugs for contamination. Also, if decreased oil pressure is noticed during operation, check the engine oil filter(s) for contamination at that time. If debris is found, proceed as follows:

1. Drain engine and airframe oil systems. Pay particular attention for any metallic debris in the oil. Swab the oil tank and note any foreign material.
2. Flush the engine oil system and clean the main and scavenge oil filters.
3. Flush the airframe oil system including oil coolers (refer to applicable airframe manual).
4. Reinstall filters and fill the cavity with fresh oil. Fill the oil tank with fresh oil.
5. Perform 30–minute ground run at power observing cockpit gauges, warning lights and caution panel for normal condition. Check indicated oil level within 15 minutes after shutdown.
6. After ground run, remove and inspect main and scavenge oil filters and magnetic chip plugs. If no accumulated debris is present, release aircraft for flight. During the next 30 hours of operation, check engine oil filters and magnetic chip plugs at approximately 10–hour intervals to determine if additional debris has accumulated. If debris is present, follow instructions for magnetic chip plug inspection procedure.

Turbine Pressure Oil System Check Valve

at. Anytime the turbine is removed from the engine, clean and inspect the check valve. Refer to Turbine Pressure Oil System Check Valve, PARA 7.K., 72–50–00.

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Table 604 (cont)
Special Inspections

Description of Inspections (cont)

Fuel Pump Filter

CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER, AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.

au. The engine driven fuel pump is equipped with a throw–away filter element with a maximum replacement interval specified in the Scheduled Inspections, Table 602, this section. If the filter shows signs of contamination to the point of possibly bypassing, or if an impending bypass indication has been noted (some aircraft may incorporate this system), replace the filter element. Refer to PARA 2.C., 73–10–01 or PARA 2., 73–10–05 for filter replacement instructions.

Fuel Control, Governor and High Pressure Filters (CECO)

CAUTION: IF ANY FILTER SHOWS EVIDENCE OF CONTAMINATION TO THE POINT OF BYPASSING, RETURN THE FUEL CONTROL AND POWER TURBINE GOVERNOR TO AN AUTHORIZED FACILITY FOR FLUSHING, OR FLUSH IN ACCORDANCE WITH 250–C20 CSL–1034 AND –1035. ALSO, INSPECT THE FUEL NOZZLE FILTER FOR CONTAMINATION. IF ANY CONTAMINATION IS FOUND ON THE FUEL NOZZLE FILTER, THE FUEL NOZZLE MUST BE SENT TO AN AUTHORIZED FACILITY TO HAVE THE UNIT CLEANED AND TESTED.

av. Anytime fuel pump filter bypass is known or suspected to have taken place, inspect and if required, clean the filters in the gas producer fuel control and the power turbine governor. Refer to Cleaning the Fuel Control Fuel Filter, PARA 4.A., 73–20–04, and Cleaning the Governor Fuel Filter, PARA 4.A., 73–20–05. Also, clean or replace the high pressure fuel filter element. Refer to High Pressure Fuel Filter, PARA 2., 73–10–05.

Fuel Control Filter (Bendix)

CAUTION: IF THE FUEL CONTROL FILTER SHOWS EVIDENCE OF CONTAMINATION, RETURN THE FUEL CONTROL TO AN AUTHORIZED MAINTENANCE CENTER FOR CLEANING AND INSPECTION. ALSO, INSPECT THE FUEL NOZZLE FILTER FOR CONTAMINATION. IF CONTAMINATION IS FOUND ON THE FILTER, RETURN THE FUEL NOZZLE TO AN AUTHORIZED FACILITY FOR CLEANING AND TESTING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.

aw. Anytime fuel pump filter bypass is known or suspected to have taken place, inspect and if required, clean the fuel filter element in the gas producer fuel control. Refer to Cleaning the Gas Producer Fuel Control Fuel Filter, PARA 4.A., 73–20–02 or PARA 4.A., 73–20–03.

Bendix Fuel Control and Power Turbine Governor Airflow Restrictors

ax. When dictated by engine performance, remove, clean and reinstall the fuel control and power turbine governor airflow restrictors. Refer to PARA 4.B., 73–20–02 or PARA 4.B., 73–20–03 and PARA 2.D., 73–20–01.

Fuel Control P_c Filter (250–C20S)

ay. When dictated by engine performance, clean and reinstall the fuel control P_c filter. Refer to PARA 4.B., 73–20–03.

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Table 604 (cont)
Special Inspections

Description of Inspections (cont)	
Fuel System P_c Filter (Bendix fuel system only)	
az.	When dictated by engine performance, remove, clean and reinstall the fuel system Pc Filter. Refer to Pc Air Filter Replacement, PARA 3., 73–20–06.
Accumulators	
ba.	When an engine is replaced, transfer the accumulators to the replacement engine. While removed, clean and test accumulators in accordance with Accumulators, PARA 2., 73–10–04.
Fuel Nozzle Filter	
CAUTION:	IF THE FILTER HAS BEEN CONTAMINATED OR HAS COLLAPSED OR BUCKLED, RETURN THE FUEL NOZZLE TO AN AUTHORIZED FACILITY FOR CLEANING AND TESTING. THIS WILL ALSO REQUIRE THAT THE FUEL CONTROL BE SENT TO AN OVERHAUL FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.
bb.	Anytime high pressure fuel filter bypass is known or suspected to have taken place or evidence of contamination is found in the fuel pump, fuel control or governor, inspect the fuel nozzle filter for contamination. Refer to, PARA 4.A., 73–10–03.
Fuel System	
bc.	If engine is inactive for more than 45 days, preserve fuel system in accordance with Fuel System Preservation, PARA 12.C., 72–00–00, Engine–Servicing.
bd.	Anytime a fuel control system component is reinstalled or a pneumatic line is disconnected, a pneumatic leak check of the control system must be performed. Refer to PARA 2.B., 73–00–00.
Start Counter	
be.	Anytime the engine is removed from the aircraft, inspect for chafed, frayed or broken wires and connectors. Also, inspect for broken glass in the viewing window or for housing dents.

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COMPRESSOR SECTION - MAINTENANCE PRACTICES

1. Compressor Assembly Replacement

A. Removal (See Figure 201, 202 or 203.)

(1) Remove compressor oil supply and scavenge tubes from the compressor front support and from the power and accessory gearbox.

(2) (Bendix fuel system). Remove fuel control system compressor discharge pressure (P_c) sensing tube. Remove tube from the bracket mounted P_c filter and from the elbow at the scroll. Hold the P_c filter while disconnecting the coupling nut.

(3) (CECO fuel system). Remove fuel control system compressor discharge pressure (P_c) sensing tube. Remove tube from the tee at the governor and from the elbow at the scroll.

(4) Remove the compressor discharge pressure sensing tube at the compressor bleed control valve and at the diffuser scroll pressure probe elbow.

(5) Remove two pressure elbows from the diffuser scroll. Discard packing.

(6) Remove the three bolts, nuts and washers and separate the compressor bleed control valve and gasket from the compressor case. Discard gasket.

(7) Remove two anti-icing lines at the compressor front support and at the anti-icing air valve.

(8) Remove the nut and separate the anti-icing air valve from the diffuser scroll. Discard packing.

(9) Remove the turbine assembly from the engine. (Refer to the Turbine Assembly Removal, para 1.A. or 1.C., 72-50-00.)

(10) Lubricate (engine oil) the spur adapter gearshaft bearing guide (6872646 or 23006778) (whichever is applicable) and install it on the compressor spur adapter gearshaft. (See Figure 204.)

(a) Bearing guide P/N 23006778 can be used with any Series II spur adapter gearshaft and bearing guide P/N 6872646 can only be used with the short shaft spur adapter gearshaft.

(11) If the compressor assembly is to be reinstalled, count and record the number of shims at each mounting pad prior to complete removal of the compressor. Save the shims for reuse.

NOTE: Early engines incorporate five bolts to attach the compressor to the gearbox.

(12) Remove the nuts and washers at the two pads inboard on the gearbox and remove the three bolts at the outboard pads. Note the position of the three different bolts and one washer used at these pads. Remove the P_c filter and bracket assembly.

(13) Separate the compressor from the gearbox.

(14) Turbine-to-Compressor Coupling Spline Inspection

Examine the turbine-to-compressor coupling splines after compressor or turbine removal or turbine separation at the exhaust collector to power turbine support. Replace the coupling if unsatisfactory.

(a) Visually examine the splines for signs of damage or twisting. No damaged or twisted splines are permitted.

(b) Visually examine the splines for pitted, cracked, or broken teeth. No pitted, cracked, or broken teeth are permitted.

(c) Use a sharp pointed scribe, 0.020 in. (0.51 mm) radius, to examine the spline teeth for a wear step. Wear that you can feel with the scribe is not permitted.

(14A) Spur Adapter Gearshaft Aft Spline Inspection

Examine the spur adapter gearshaft aft spline when the compressor is removed. Return the compressor to an approved maintenance facility for replacement of an unsatisfactory gearshaft.

(a) Visually examine the splines for signs of damage or twisting. No damaged or twisted splines are permitted.

(b) Visually examine the splines for pitted, cracked or broken teeth. No pitted, cracked or broken teeth are permitted.

(c) Use a sharp pointed scribe, 0.020 in. (0.51 mm) radius, to examine the spline teeth for a wear step. Wear that you can feel with the scribe is not permitted.

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PARA 1.A. (cont)

(15) Remove bearing guide 6872646 or 23006778 from the spur adapter gearshaft.

(16) Make the following inspection of the compressor discharge air tube seal groove lands and split seal rings at the compressor (small) end.

(a) Remove the split seal rings from the small end of the air tubes.

(b) Replace the split seal rings if the edges show wear which could be detrimental to the sealing effect or if the expander ring is broken.

(c) Inspect the discharge air tube lands in accordance with Figure 207, 72–40–00.

(d) Apply antiseize compound to the components of the split seal rings. Install the rings on the discharge air tubes. Split seal ring gaps should be 180° apart.

(17) Inspect the compressor mounting inserts in the gearbox housing for looseness. (Refer to Insert Inspection, para 4.D., 72–60–00.)

B. Removing the Spur Adapter Gearshaft.

If removal of the spur adapter gearshaft is required, the procedure is as follows:

(1) Remove the compressor assembly from the engine. (Refer to para 1.A., this section.)

(2) Match mark the installed relationship between the compressor impeller/splined adapter assembly and the spur adapter gearshaft with an approved marker.

(3) Remove the retaining ring that secures the spur adapter gearshaft into the compressor.

(4) Remove the spur adapter gearshaft. Do not remove the compressor splined adapter from the impeller.

(5) Remove and discard the old forward seal ring from the spur adapter gearshaft.

(6) Install a new seal ring.

(7) Clean spur adapter gearshaft and the compressor splined adapter. Make sure there is no debris trapped in the splined adapter.

(8) Lubricate the spur adapter gearshaft and the compressor splined adapter with engine oil.

(9) Install the spur adapter gearshaft into the compressor splined adapter. Make sure the match marks are aligned.

(10) Install a new internal retaining ring on the spur adapter gearshaft.

(11) Make sure the retaining ring is secured and expanded into the retaining ring groove by grasping the spur adapter gearshaft and attempting to remove it by pulling it away from the impeller.

(12) Install the compressor assembly onto the engine. (Refer to para 1.C., this section.)

C. Installation (See Figure 201, 202 or 203.)

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

CAUTION: BE SURE THE TURBINE ASSEMBLY HAS BEEN REMOVED BEFORE ATTEMPTING TO INSTALL THE COMPRESSOR ASSEMBLY ON THE ENGINE. INSTALLATION OF THE COMPRESSOR ASSEMBLY WITHOUT FIRST REMOVING THE TURBINE ASSEMBLY CAN CAUSE DAMAGE TO THE NO. 2–1/2 BEARING, RESULTING IN PREMATURE REMOVAL OF THE ENGINE.

NOTE: Check to make sure that the compressor and gearbox mounting flanges are clean and free of foreign material which could cause misalignment. Check that the spur adapter gearshaft retaining ring is properly installed.

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PARA 1.C. (cont)

(1) Lubricate and install new packings on the compressor rear diffuser and the spur adapter gearshaft.

(2) Lubricate (engine oil) bearing guide (6872646 or 23006778) and install it on the spur adapter gearshaft. (Ref. Figure 204.)

(3) Sparingly lubricate the rollers of the No. 2-1/2 bearing with petrolatum to hold the rollers out against the bearing outer race.

WARNING: FAILURE TO PROPERLY SHIM THE COMPRESSOR AT INSTALLATION CAN CAUSE THE SPUR ADAPTER GEARSHAFT TO FAIL RESULTING IN SUDDEN ENGINE STOPPAGE.

CAUTION: BE SURE THE SPUR ADAPTER GEARSHAFT IS IN MESH WITH THE GEARBOX MATING GEAR BEFORE TIGHTENING COMPRESSOR RETAINING BOLTS. IF YOU TIGHTEN THE COMPRESSOR RETAINING BOLTS WITH AN INCORRECT MESH OF THE SPUR ADAPTER GEARSHAFT AND THE GEARBOX MATING GEAR, THEN YOU MUST REPLACE BOTH THE MATING GEAR AND THE GEARSHAFT.

(4) Determine the number of shims required for compressor installation.

(a) When replacing a compressor, the total thickness of shims required at each attaching point has been determined during compressor buildup (overhaul) and marked near the appropriate bolt hole on the rear diffuser.

(b) When reinstalling the same compressor, install with the total thickness of shims marked on the rear diffuser. If the shim markings are not legible, missing, or in doubt, compute the total shim thickness requirements in accordance with paragraph 1.C., Compressor Shimming Procedure, this section.

(5) Place the compressor on the gearbox with the required shims in place at the bolt pads. Use 6799790 engine turning adapter to turn the gear train until it meshes with the spur adapter gearshaft.

(6) If interference is encountered between the compressor and one of the cast bosses on the gearbox, lightly dress the boss by filing. Remove only sufficient material to provide a positive clearance.

(a) Dichromate the machined area per AMS 2475.

(b) Apply engine gray enamel (AMS 2510).

(7) Install the P_c air filter and bracket assembly at the same time the compressor mounting bolts and nuts are installed. Use the same configuration of bolts, nuts and washers at each of the five compressor pads as was previously used. (If the gearbox is changed, different bolts or nuts may be required.) Tighten attachment features to 70-85 lb in. (7.9-9.6 N·m) and secure bolts with lockwire.

(8) Remove bearing guide 6872646 or 23006778 from the spur adapter gearshaft. Visually check that the spur adapter gearshaft packing is in place.

(9) Install the turbine assembly. (Refer to Turbine Assembly Installation, para 1.B. or 1.D., 72-50-00.)

(10) Install the anti-icing air valve on the diffuser scroll. Do not tighten the jam nut at this time. (Refer to Anti-Icing Air System, para 2.D., 75-10-01.)

(11) Attach the RH and LH anti-icing air tubes to the anti-icing air valve and tighten coupling nut(s) to 65-75 lb in. (7.3-8.5 N·m). Attach the RH and LH anti-icing air tubes to the front support and tighten coupling nut(s) to 150-200 lb in. (16.9-22.6 N·m). Tighten valve jam nut to 100-150 lb in. (11.3-16.9 N·m) and secure with lockwire.

(12) Install the bleed control valve on the compressor case mounting flange. (Refer to Bleed Air Control Valve, para 2.B., 75-10-02.)

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PARA 1.C. (cont)

(13) Apply anti-seize compound lightly to the threads; then install the two pressure elbows with new packing in the scroll. Do not tighten the jam nuts until final tube alignment is made.

(14) Install pressure sensing line between bleed valve and pressure probe elbow. Tighten coupling nuts to 80-120 lb in. (9.0-13.6 N·m). Tighten elbow jam nuts to 55-80 lb in. (6.2-9.0 N·m) and secure with lockwire.

(15) Install the pressure sensing line between the tee at the governor and the pressure probe elbow (CECO control system). Attach the Scroll-to-P_c Filter Tube Assy to the scroll elbow and to the forward end of the P_c Filter. Attach the P_c Filter-to-Governor Tube Assy to the aft end of the P_c Filter. (Bendix Control System.) When attaching the lines to the P_c filter, hold the filter with the proper wrench at the hex flats of the filter assembly. Tighten the coupling nuts to 80-120 lb in. (9.0 to 13.6 N·m). Tighten elbow jam nut to 55-80 lb in. (6.2-9.0 N·m) and secure with lockwire. Clamp P_c filter-to-governor tube assy to ignition lead.

(16) Install the oil supply and scavenge tubes to the front support and to the gearbox. Tighten pressure tube coupling nuts to 65-100 lb in. (7.3-11.3 N·m) and scavenge tube coupling nuts to 150-200 lb in. (17-23 N·m).

(17) Make appropriate entry relative to compressor replacement in the Engine Log.

(18) Check run the engine and select the proper size diffuser vent orifice after compressor replacement. (Refer to Check Run, para 1. and Diffuser Vent Orifice Selection, para 1.B., 72-00-00, Engine-Adjustment/Test.)

D. Determining Compressor Mounting Shim Thickness Requirements.

(1) Place the compressor assembly in a vertical position (on blocks) with the impeller end up.

NOTE: Be sure the spur adapter gearshaft is match marked to the adapter coupling and the adapter coupling is match marked to the impeller hub prior to removal.

(2) Before removing the spur adapter gearshaft from the compressor assembly, match mark the spur adapter gearshaft to the adapter coupling and the adapter coupling to the impeller hub.

(3) Remove the internal retaining ring and remove the spur adapter gearshaft from the compressor.

(4) Using 6795588 wrench to hold the rotor and a six-point socket on the nut, remove the nut and washer securing the adapter coupling in the impeller hub. Using 6872832 puller, remove the coupling from the impeller hub.

(5) Install the plate of 6873066 fixture on the aft side of the rear diffuser.

(6) Attach the indicator and bracket on the impeller hub.

(7) Level the plate using the three leveling screws and the bracket mounted indicator.

(8) Position the dial indicator on the plate to contact the five mounting pads (C, Figure 205). Record the reading at the five positions.

(9) Zero the indicator at the highest of the five positions. Measure and record the minus reading at each of the other four positions.

(10) Compute the total thickness of shims required to build the four (low) bolt holes up to the zero indicated hole as required to obtain an installed compressor squareness of 0.002 in. (0.05 mm) FIR. The total thickness of shims at any one location shall not exceed 0.020 in. (0.51mm). Electro-chemical etch the total shim thickness adjacent to the applicable bolt hole and cover the etched surfaces with Metcoseal AMS 3135 transparent silicone resin. Mark the zero indicated hole with a 0 (zero). (See Figure 205.) Shims are available in three sizes; 0.002, 0.004, and 0.008 in. (0.05, 0.10, 0.20 mm).

(11) Remove the 6873066 fixture from the compressor.

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PARA 1.D. (cont)

(12) Align the match marks and install the adapter coupling into the splines of the impeller hub. Retain the coupling with a washer and nut. Hold the coupling with 6795588 wrench and Torque the nut to 50-55 lb in. (5.6-6.2 N·m) above locknut drag using a six-point socket.

(13) Align the match marks and install the spur adapter gearshaft into the splines of the adapter coupling. Retain the gearshaft in the coupling with the internal retaining ring.

2. Compressor Case Replacement

A. Removal (Compressor Case Top Half) (See Figure 206.)

CAUTION: DO NOT REMOVE BOTH CASE HALVES AT THE SAME TIME.

NOTE: Compressor cases are machined in lower and upper matched sets. Rejection and replacement of one case half is cause for rejection and replacement of the opposite case half. Note the serial numbers on both replacement case halves to assure that the case halves are a matched pair.

(1) Remove the pressure and scavenge oil lines between the gearbox and the compressor front support.

(2) Remove the RH and LH air lines between the anti-icing air valve and the compressor front support.

(3) Remove the compressor bleed control valve as follows:

(a) Remove the compressor bleed valve discharge pressure sensing line.

(b) Remove three nuts, bolts and washers; remove the compressor bleed valve and gasket.

(4) Remove the top compressor case half (marked “top”) as follows:

(a) Remove the 17 horizontal splitline nuts and bolts.

NOTE: Note the location of the nameplate when the applicable compressor case-to-compressor front support nuts and bolts are removed. Return the nameplate to the same location during reassembly.

(b) Remove the 5 compressor case-to-compressor front support nuts and bolts.

(c) Remove the 8 compressor case-to-compressor front diffuser nuts and bolts.

(d) Carefully lift the top half straight out. If the case does not separate easily, loosen the two bolts and nuts at the aft flange and one bolt and nut at the front flange in the bottom half adjacent to each horizontal splitline.

B. Installation (Compressor Case Top Half) (See Figure 206.)

See Figure 207 for location of specific bolts and the numerical sequence in which they should be tightened. The illustration sequence numbers correspond to the numbers in the text.

NOTE: Be sure that the splitline mating flanges are clean before installation of the replacement case half.

(1) Carefully position the top half over the rotor. Install a bolt and nut (1) in each of the four corner holes (adjacent to the end flanges) at the horizontal flange. Tighten the bolts to the minimum torque necessary to close the horizontal splitlines.

NOTE: Tighten all case splitline nuts to 10-15 lb in. (1.1-1.7 N·m) plus locknut drag unless otherwise specified. Locknut drag is the torque necessary to turn the nut on the bolt in the last turn prior to seating of the nut. Lubricate bolts lightly with engine oil before installation.

(2) Install and tighten two bolts and nuts (2) in the rear flange of the top case half. Use the two adjacent bolt holes midway between the horizontal splitlines (approximately 80 degrees from the horizontal flanges). If the bolt holes in the rear flange do not align with the flange holes in the front diffuser, loosen the rear flange bolts in the bottom case half to a snug fit. Using a drift inserted into a misaligned bolt hole, rotate the case sufficiently to align the holes. Tighten the two centermost bolts on the rear flange of the bottom case half; then install and tighten the two centermost bolts and nuts in the rear flange of the top case half.

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(3) Loosen the four corner bolts (3) in the horizontal flanges. Allow the horizontal flange to reposition; then retighten the four bolts to the minimum torque necessary to close the horizontal splitlines.

(4) Install the bolts and nuts in the front flange of the top case half at the three centermost bolt hole positions. Tighten the two outer bolts (4) to a snug fit; then tighten the center bolt (5). If the bolt holes in the front flange do not align with the flange holes in the front support, loosen the front flange bolts in the bottom case half to a snug fit. Using a drift inserted into a misaligned bolt hole, rotate the front support sufficiently to align the holes. Install and tighten the three bolts and nuts.

C. Removal (Compressor Case Bottom Half) (See Figure 206.)

(1) Remove the four bolts and nuts in the horizontal splitlines.

(2) Remove the three bolts and nuts in the bottom half front flange.

(3) (Remove the eight bolts and nuts in the bottom half rear flange.

(4) Carefully lift the bottom half straight out. Do not pry against the top half.

D. Installation (Compressor Case Bottom Half) (See Figure 206.)

NOTE: The RTV 732 or RTV 736 sealer is used to seal the rear corners of the splitline. Use of the sealer is optional on engines that are not used with the water-alcohol injection system.

(1) Apply a sphere of approximately 0.12 in. (3 mm) dia of RTV 732, or equivalent (Compressor Case Splitline Sealer, Table 302), aft of the rearmost bolt hole on the bottom case half horizontal flange surfaces. Assemble and tighten all splitline bolts and nuts as soon as possible after application of RTV 732 (never exceed 30 minutes).

(2) Carefully position the bottom case half to cover the rotor. Install a bolt and nut (6) in each of the four corners (adjacent to the end flanges) at the horizontal flange. Tighten the bolts to the minimum torque necessary to close the horizontal splitlines.

(3) Install and tighten two bolts and nuts (7) in the rear flange of the bottom case half. Use the bolt holes which are diametrically opposite the top case half bolts.

(4) Loosen the four corner bolts in the horizontal flanges. Allow the horizontal flange to reposition; then retighten the four bolts (8) to the minimum torque necessary to close the horizontal splitlines.

(5) Install and tighten one bolt and nut (9) in the front flange at the center hole position (90 degrees from the horizontal flanges).

(6) Install the remaining 13 horizontal flange bolts and nuts. Loosen the two rear corner bolts and nuts; then tighten all bolts (10)-(26) starting from the rear and alternating from side to side.

(7) Install and tighten the remaining 12 bolts and nuts (27) in the rear flange and the eight bolts and nuts (28), plus nameplate, in the front flange.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(8) Attach the RH and LH anti-icing air tubes to the anti-icing air valve and tighten coupling nut(s) to 65-75 lb in. (7.3-8.5 N·m). Attach the RH and LH anti-icing air tubes to the front support and tighten coupling nut(s) to 150-200 lb in. (16.9-22.6 N·m).

(9) Attach the compressor pressure and scavenge oil tubes:

(a) Install the gearbox elbow-to-front support scavenge oil tube. Tighten coupling nuts to 150-200 lb in. (17-23 N·m).

(b) Install the gearbox union-to-pressure reducer pressure oil tube. Tighten coupling nuts to 65-100 lb in. (7.3-11.3 N·m).

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PARA 3.A. (cont)

(7) Remove three nuts, bolts and washers and separate the bleed control valve and gasket from the mounting flange on the compressor case.

(8) Remove the compressor front support nut. Remove 10 bolts and nuts at the front support flange.

(9) Loosen, but do not remove, the compressor case (horizontal) splitline nuts and bolts.

(10) Separate the compressor front support from the compressor assembly. Discard two packings. The identification plate is removed by this operation.

(11) Release the internal retaining ring using 6893535 compressor and separate the compressor front bearing housing from the rotor assembly. Discard packing. If alternate configuration is used, separate front bearing housing by pulling the two spring pins.

(12) Remove the helical spring and spring cup from the rotor.

(13) If it is necessary to replace or reseat the bearing damper in the front bearing housing, remove the damper using 6799700 puller. (See Figure 209.)

CAUTION: DO NOT HOLD OR TURN THE N_1 GEAR TRAIN THROUGH THE SPARE DRIVE PAD. THIS COULD RESULT IN DAMAGE TO THE GEARBOX.

CAUTION: EXERCISE CARE WHEN REMOVING THE COMPRESSOR BEARING NUT. DO NOT ALLOW THE NUT WRENCH TO CONTACT THE BEARING.

CAUTION: THE COMPRESSOR FRONT BEARING CAN BE DAMAGED EASILY. REPLACE BEARING IF AT ANY TIME DURING REMOVAL OR INSTALLATION THE BEARING IS DROPPED, LOADED THROUGH THE BALLS TO THE INNER RACE OR THE OUTER RACE IS PULLED OFF.

(14) Remove the bearing retaining nut using a socket wrench with a broach depth no more than 7/16 in. (11 mm) (Snap–On SW 181 or equivalent). Hold the rotor from turning using 6799790 adapter in the starter–generator pad on the gearbox cover.

(15) For front compressor bearing configuration without a puller groove, install a 6796952 puller on the puller groove of the seal mating ring and pull both the seal mating ring and bearing together. For front bearing configurations with a puller groove, remove the bearing first using 23005023 puller followed by removal of the seal mating ring using the same puller. (See Figure 210.)

(16) Remove the oil seal from the rotor. Discard packing.

B. Installation

(1) If the vibration damper was removed, install the replacement damper or reseat the old damper as follows:

(a) Install the vibration damper on 6798796 drift. Chill the damper and the drift using dry ice. As an option, the bearing housing may be heated to 121°C (250°F) maximum.

(b) Press the damper into the front bearing housing until it bottoms out against the shoulder of the bearing housing. Apply constant pressure to the drift until such time the temperature of the damper and the housing have equalized. Remove the drift.

(c) Measure the installed position of the damper. The inside of the damper flange should be 1.218 in. (30.94 mm) minimum from the housing open end.

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(11) Install the retaining ring in the rear groove of the oil seal. Install the front bearing housing over the spring, bearing and oil seal. Compress the retaining ring in the seal groove and engage the ring in the inside groove of the bearing housing until it is fully seated using 6893535 compressor. Exercise care not to damage the seal face. On alternate configuration, press down (rearward) on the housing until the two pin holes of the housing align with the retaining ring groove of the seal. Insert the two pins. Lubricate and install two packings on the bearing housing.

CAUTION: DO NOT FORCE THE SUPPORT FLANGE INTO THE COMPRESSOR CASE PILOT. LOOSEN THE COMPRESSOR CASE HORIZONTAL SPLITLINE BOLTS AS NECESSARY FOR EASE OF ASSEMBLY, EVEN TO THE POINT OF REMOVING ONE CASE HALF.

(12) Visually align the pin of the bearing housing with the hole in the compressor front support then install the front support on the compressor assembly. This part is indexed correctly when the scavenge oil fitting is opposite the "O" mark on the front diffuser.

(13) Lubricate the threads of the front bearing housing with antiseize compound. Secure housing to the front support with a nut. Tighten nut to 35-40 lb in. (3.9-4.5 N·m).

(14) Install the identification plate and ten support-to-compressor case bolts and nuts. Tighten the compressor horizontal splitline and front support splitline nuts to 10-15 lb in. (1.1-1.7 N·m) plus locknut drag.

(15) Apply anti-seize compound to the bolt threads; then install the bleed control valve and gasket on the compressor case mounting flange. Retain with three nuts, bolts and washers. Tighten the 1/4-28 nut to 70-85 lb in. (7.9-9.6 N·m). Tighten the other two nuts to 35-40 lb in. (3.9-4.5 N·m).

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(16) Attach the compressor discharge pressure sensing tube assembly to the bleed valve and to the elbow at the scroll. Tighten coupling nuts to 80-120 lb in. (9.0-13.6 N·m).

(17) Attach the RH and LH anti-icing air tubes to the anti-icing air valve and tighten coupling nut(s) to 65-75 lb in. (7.3-8.5 N·m). Attach the RH and LH anti-icing air tubes to the front support and tighten coupling nut(s) to 150-200 lb in. (16.9-22.6 N·m).

(18) Check the oil seal for leakage by applying oil at 4-6 psi (27.6-41.4 kPa) for one minute to the oil pressure reducer location on the compressor front support. No leakage shall be permitted.

(19) Attach the compressor pressure and scavenge oil tubes:

(a) Install the gearbox-to-front support scavenge oil tube. Tighten coupling nut to 150-200 lb in. (17-23 N·m).

(b) Install the gearbox union-to-pressure reducer pressure oil tube. Tighten coupling nuts to 65-100 lb in. (7.3-11.3 N·m).

(c) Install the P_y line between the governor and the fuel control. Tighten coupling nuts to 80-120 lb in. (9.0-13.6 N·m).

(20) Install the starter-generator.

(21) After complete assembly of the compressor, check the compressor rotor for freedom of operation. If compressor drag or rubbing is detected either by feel or by sound, investigate to determine the cause by removing one or both halves of the case assembly.

(22) Check run the engine after seal or bearing replacement. (Refer to Check Run, para 1., 72-00-00, Engine-Adjustment/Test.)

4. Compressor Front Bearing and/or Oil Seal Replacement (Engine Installed)

This is an alternate procedure for replacing the compressor front bearing and/or oil seal. It is accomplished while the engine is installed and in a horizontal position.

CAUTION: THIS ALTERNATE PROCEDURE INVOLVES GREATER RISK FOR PART DAMAGE AND ASSEMBLY ERROR THAN THE PREFERRED PROCEDURE (PARA 3.A. AND 3.B., THIS SECTION). THE ALTERNATE PROCEDURE IS RECOMMENDED FOR SKILLED MECHANICS HAVING APPROVAL OF THEIR ROLLS-ROYCE AUTHORIZED MAINTENANCE CENTER (AMC).

A. Replacement Procedure

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4. Compressor Discharge Air Tubes

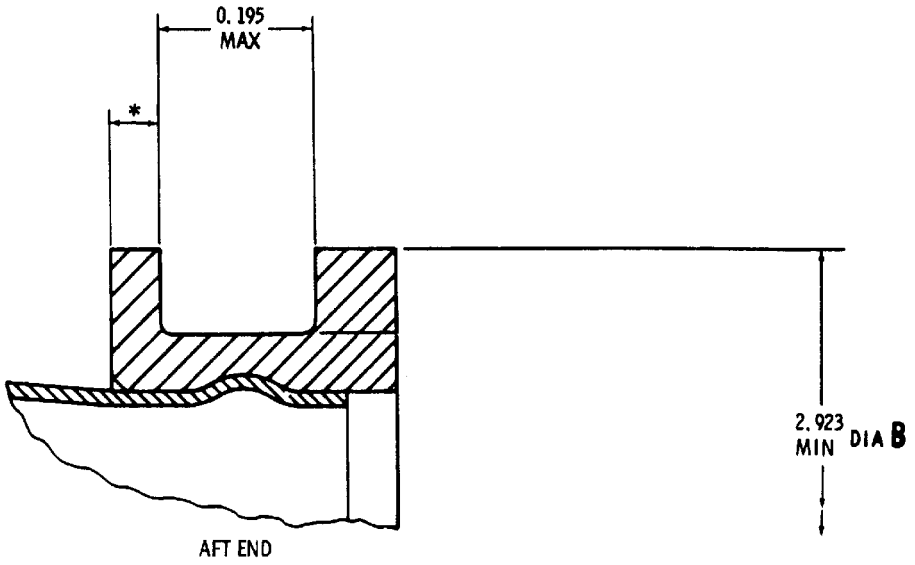
A. Inspection and Repair

Inspect the compressor discharge air tubes in accordance with Table 203. After any repair, make a careful visual, leakage inspection of the tube during the first engine operation following installation of the repaired part. Leakage is not acceptable.

Table 203
Compressor Discharge Air Tube Inspection

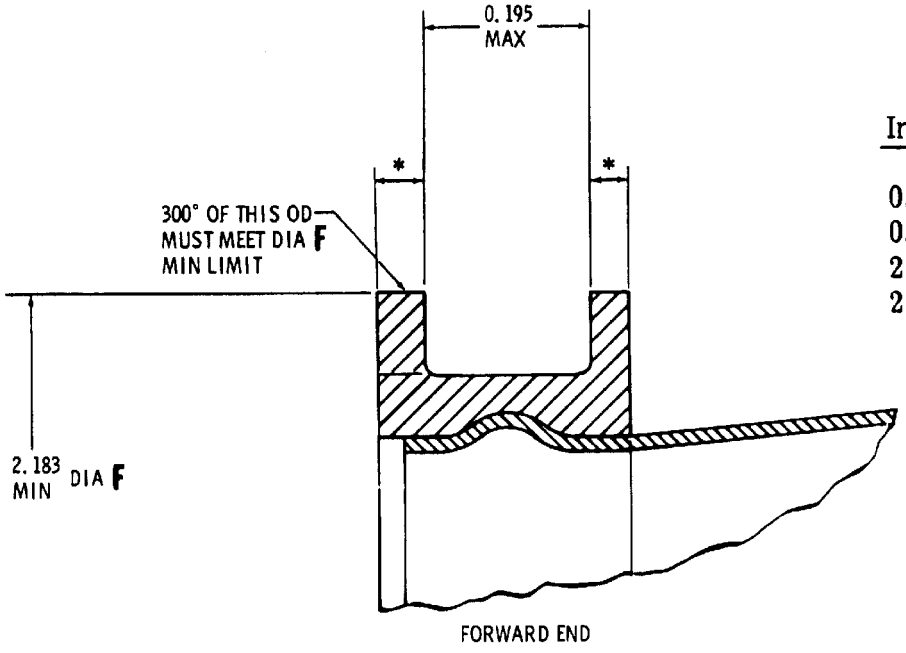
Item	Condition	Serviceable Limit	Repairable Limit	Disposition
1	Cracks (dye check)	None	Max of 3 in. (75 mm) (any number)	Weld using 29-9 W Mo weld rod (AMS 5784). Pressure test in 6798787 fixture at 150-160 psig (1034-1103 kPa) for three minutes. No leakage is acceptable. Send tube to an overhaul facility for repair.
2	Dents	Max of 3 dents per tube up to 1/8-in. (3 mm) depth by 1/2-in. (13 mm) dia		Straighten and reform. Dye check after repair.
3	Wear in seal ring groove	See Figure 207.		See Figure 207.
4	Wear on land surface	See Figure 207.		See Figure 207.
5	Wear of sheet metal surface	No appreciable loss of metal thickness	1/2 sheet metal thickness	Repair using brazed screen patch or replace. Pressure test 6798787 fixture at 150-160 psig (1034-1103 kPa) for 3 minutes. No leakage acceptable.

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REPAIR:
WHEN SPECIFIED SERVICEABLE LIMITS ARE EXCEEDED. RESTORE DETAILS TO LATEST DRAWING DIMENSIONS BY WELD BUILD-UP OR METAL SPRAY USING METCO 450 THERMO OR PLASMA APPLICATION.

* 0.040 IN. MINIMUM PARENT STOCK REMAINING WHEN PREPARING FOR REPAIR.



Inches	Millimeters
0.040	1.02
0.195	4.95
2.183	55.45
2.923	74.42

ADC081XA

Compressor Discharge Tube Inspection and Repair
Figure 207

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(h) Inspect check valve for external leakage at first engine operation after valve installation on the engine. No leakage permitted.

L. Test the Turbine Pressure Oil System Check Valves. (See Figure 216.)

NOTE: Valves with part numbers 23074872 and subsequent are not field repairable.

WARNING: DO NOT BREATHE THE FUMES FROM SYNTHETIC LUBRICATING OIL. IT CAN CONTAIN TRICRESYL PHOSPHATE. USE IN AN AREA WITH CONTINUOUS AIRFLOW. KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAMES. DO NOT GET IT ON YOUR SKIN OR IN YOUR EYES. WEAR GOGGLES, CHEMICAL-RESISTANT GLOVES, AND SAFETY CLOTHING. IF YOU GET IT ON YOUR SKIN, CLEAN WITH SOAP AND WATER. IF YOU GET IT IN YOUR EYES, FLUSH WITH WATER. GET MEDICAL AID.

(1) Test the check valve using engine oil (MIL-L-23699 Series at 225°F (107°C) or MIL-L-7808 Series at 180°F (82°C)) as follows:

(a) Install the valve on the test stand with the large end down.

(b) Apply the test pressure to the input side of the valve.

(c) Cycle the valve open and closed at least once before taking pressure readings.

(d) Slowly increase the pressure and observe the opening pressure. Opening pressure must not exceed 5.0 psig (34.5 kPag).

(e) As the test pressure is reduced, the valve must be fully closed (with no leaks) at 3.0 psig (20.7 kPag).

8. Approved Repairs

A. Turbine and Exhaust Collector Support Crack Repair

Weld repair any cracks found in the exhaust ducts or outboard structure of the turbine and exhaust collector support.

CAUTION: TO PREVENT ELECTRICAL ARC BEARING DAMAGE, SEPARATE THE EXHAUST COLLECTOR FROM THE ENGINE/TURBINE AND REMOVE THE NO. 5 BEARING BEFORE THE WELD REPAIR IS MADE.

(1) Weld cracks in the exhaust ducts (areas -9 and -10 of Figure 217) using gas tungsten-arc process with 29-9 W Mo (AMS 5784) weld rod.

(2) Weld cracks in the outboard structure (area -3 of Figure 217) using gas tungsten-arc process with Hastelloy W (AMS 5786) weld rod.

Table 202

Turbine Pressure Oil System Check Valve Inspection

Item	Condition	Serviceable Limit	Disposition
1	Stripped or crossed threads on fitting or housing.	None.	Chase threads. (Max. of one damaged thread
2	Nicks or scratches on flared tube sealing surface of fitting or housing.	None.	Repair or replace part.
3	Nicks or scratches on poppet seating surface or housing valve seat.	None.	Repair or replace part.
4	Fretting wear in bore of housing.	None.	Replace part.

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PARA 4. (cont)

(2) Clean the female splines of the starter–generator gearshaft and the male splines of the starter–generator driveshaft with mineral spirits and a soft brush.

(3) Using a bright light, inspect the splines in accordance with the criteria depicted in Figure 241.

NOTE: A sharp pointed scribe, 0.020 in. (0.51 mm) radius, can be used to detect a wear step. A 0.010 in. (0.25 mm) feeler gage can be helpful in visually comparing the depth of the wear step.

NOTE: Inspect the starter–generator brushes for wear in accordance with the Aircraft Manual at the same time the spline inspection is made.

(4) Lubricate acceptable splines with grease (Aeroshell No. 22 or equivalent.).

(5) Before reinstallation of the starter–generator, make sure the torsional damper members of the driveshaft in the starter generator are in hard contact with each other.

C. Opened Gearbox Inspection

Whenever the gearbox is opened for any reason, make a general inspection of the assembly, paying particular attention to the following:

(1) Check condition of accessory gearshaft drive splines. If excessive wear is believed present, replace the gearshaft.

(2) Check condition of gears. Replace gears having spalled or chipped teeth.

(3) Check mounting and attachment security of all internal parts including tab lockwashers and safety wire. Secure as required.

(4) Check integrity of oil pump attaching screws and oil tube packings.

(5) Check condition of the accessory pad seal and packing for the gas producer gear train idler spur gearshaft (inside the gearbox cover). Replace seal and packing if it shows apparent damage or if the engine is prone to blow oil out the gearbox vent.

(6) Check the filter housing for excessive wear at the opening for the filter inlet and filter bypass tubes. Replace packings on the filter inlet and bypass tubes at each disassembly. Replace the filter housing if necessary to prevent air/oil leakage.

(7) Inspect bearing separators for low magnetic permeability per 250–C20 Series CEB–1201.

(8) If the records indicate that more than 3500 hours have elapsed since the gears were new or were last magnafluxed at overhaul or repair, all gears are to be magnetically inspected. (Refer to the Engine Overhaul Manual, publication No. 10W3, for inspection criteria.)

NOTE: If any doubt exists concerning the serviceability of any part, repair or replace the part before closing the gearbox.

D. Insert Inspection

Any time the compressor is removed or when insert looseness is known or suspected, check for space between each of the five inserts and the gearbox housing. If a piece of 0.0015 in. (0.038 mm) shim stock can be inserted anywhere under the insert, it must be reworked.

E. Repair of Compressor Mounting Inserts

Repair loose compressor mounting inserts in the gearbox housing as follows:

CAUTION: THE GEARBOX HOUSING MUST HAVE AT LEAST THREE GOOD COMPRESSOR MOUNTING INSERTS BEFORE REWORK CAN BE ACCOMPLISHED ON A LOOSE INSERT.

NOTE: The rework shall be made with the engine removed from the air frame and with the turbine and compressor assembly removed from the gearbox. (Refer to Compressor Assembly Replacement, para 1., 72–30–00.)

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FUEL NOZZLE –– MAINTENANCE PRACTICES

1. General

   A. Removal

      CAUTION: MAKE SURE NOT TO DAMAGE THE NOZZLE SPRAY TIPS DURING REMOVAL.

      Remove the fuel nozzle as follows:

      (1) Remove lockwire and disconnect the fuel nozzle hose.

      (2) Remove lockwire; then using 23007638 wrench, unscrew the nozzle.

      (3) Carefully remove nozzle assembly.

   B. Installation

      WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

      (1) Install the fuel nozzle as follows:

         (a) When replacing or reinstalling the fuel nozzle, apply a light coat of antiseize compound (NS–165) to the threads. Tighten nozzle to 200–300 lb in. (23–34 N·m) using 23007638 wrench. Lockwire to spark igniter. Tighten hose coupling nut to 80–120 lb in. (9.0–13.6 N·m). Secure hose coupling nut with lockwire.

         (b) Check run the engine after fuel nozzle replacement. Refer to Check Run, PARA 1., 72–00–00, Engine–Adjustment/Test.

2. Inspection/Cleaning

   NOTE: Due to variation in fuels and operating conditions, fuel nozzle cleaning may be necessary at more frequent intervals than stated in Table 602, 72–00–00, Engine– Inspection/Check, to maintain proper combustion flame pattern.

   A. Inspect and clean the fuel nozzle as follows:

      (1) Check for damage or carbon deposits on spray tips. Figure 201 shows the condition of a typical fuel nozzle removed from an operational engine. A nozzle in this condition should be cleaned, if possible, before being reinstalled.

      CAUTION: MAKE SURE NOT TO DAMAGE THE MIRROR FINISH AND EDGES OF THE SPRAY TIPS DURING THE CLEANING OPERATION.

      (2) Suspend the fuel nozzle vertically with the tip immersed approximately 1/8 in. (3 mm) in cleaning solvent, Brulin Safety Solvent No. 512 M or equivalent. Soak the tip for one hour, or longer if deemed necessary, to remove all carbon. After carbon removal, flush the nozzle internally and externally using Stoddard solvent or kerosene. Dry with a soft cloth.

      CAUTION: DO NOT USE COMPRESSED AIR TO DRY NOZZLE. THIS CAN DAMAGE THE NOZZLE.

      (3) Any damage to the nozzle spray tips is cause for replacement of the fuel nozzle assembly.

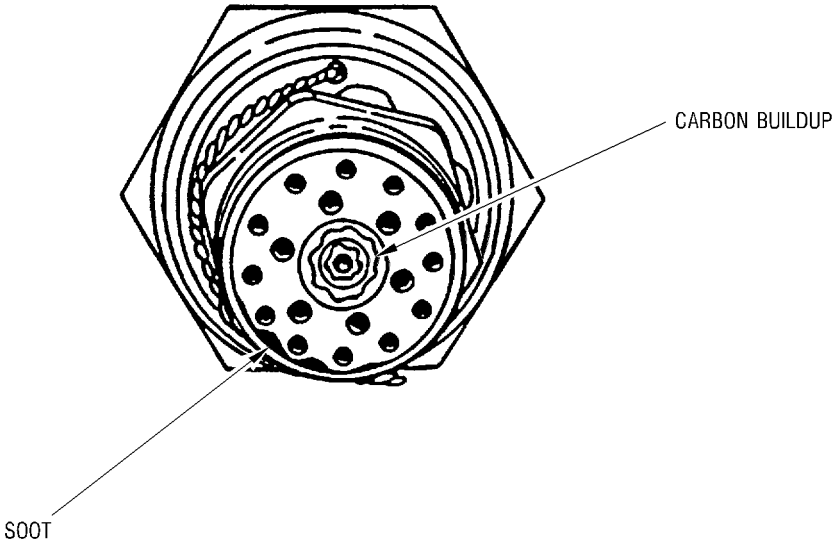
      (4) Reject nozzles exceeding 0.005 in. (0.13 mm) max. wear on OD of the outer air shroud.

      (5) Clean the face of the outer air shroud with a clean dry cloth; the air holes must be open. Be careful that loosened carbon does not enter the spray tips.

         NOTE: Removal of external carbon deposits from the fuel nozzle spray tip can correct a streaking problem. Therefore, cleaning the spray tip may make it unnecessary to disassemble the fuel nozzle.

      (6) Use of soft bristle nylon brush, such as a tooth brush, to remove any remaining carbon buildup from the nozzle tip. Be careful that loosened carbon does not enter the spray tip.

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Carbon Buildup on Fuel Nozzle
Figure 201

B. Inspect and clean the fuel nozzle as follows: (Alternate Procedure)

(1) Check for damage or carbon deposits on spray tips. Figure 201 shows the condition of a typical fuel nozzle removed from an operational engine. A nozzle in this condition should be cleaned, if possible, before reinstalling.

CAUTION: MAKE SURE NOT TO DAMAGE THE MIRROR FINISH AND EDGES OF THE SPRAY TIPS DURING THE CLEANING OPERATION.

(2) Suspend the nozzle vertically with the tip immersed approximately 1/8 in. (3 mm) in Brulin 815 QR (or equivalent). Heating the solvent to 140°F (60°C) is optional. Approximately 8 hours is a desired soak time. All carbon should be removed or loosened after this process.

(3) Use a soft bristle nylon brush, such as a toothbrush, to remove any remaining carbon buildup from the nozzle tip. Be careful that loosened carbon does not enter the spray tip. After carbon removal, flush the nozzle internally and externally using Stoddard solvent or kerosene. Dry with a soft cloth.

CAUTION: DO NOT USE COMPRESSED AIR TO DRY NOZZLE. THIS CAN DAMAGE THE NOZZLE.

(4) If carbon is still visible, soak nozzle tip in Turco 4181, or equivalent, at 140°F (60°C) for two hours. Flush nozzle thoroughly with hot water then with Stoddard solvent or kerosene. Dry with a soft cloth.

(5) If the nozzle is still streaking, carbon is probably not the issue. Send the nozzle to an authorized facility for further inspection.

(6) Any damage to the nozzle spray tips is cause for replacement of the fuel nozzle.

(7) Reject nozzles exceeding 0.005 in. (0.13mm) maximum wear on the OD of the outer shroud.

(8) Clean the face of the outer air shroud with a clean dry cloth; the air holes must be open. Be careful that loosened carbon does not enter the spray tips.

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3. Disassembly

CAUTION: MAKE SURE TO PREVENT DAMAGE TO THE MIRROR FINISH AND EDGES OF THE SPRAY TIP. THE NOZZLE SHOULD BE DISASSEMBLED IN A CLEAN AREA AND CARE SHOULD BE TAKEN TO AVOID DIRT OR OTHER CONTAMINATION.

A. Disassemble the fuel nozzle as follows: (See Figure 202)

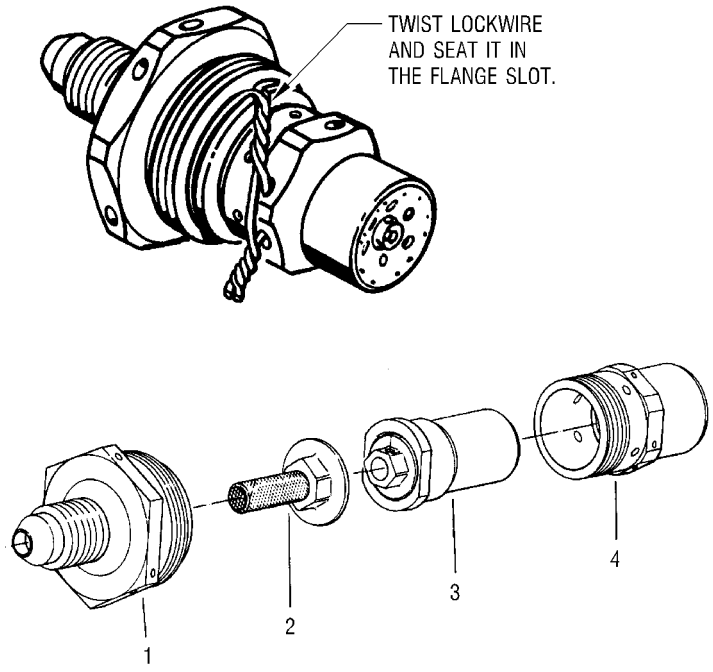
(1) Note the position of the lockwire on the fuel nozzle; then remove the lockwire.

(2) Count the number of visible threads on the outer air shroud. Retain this number for verification that the fuel nozzle will be correctly reassembled.

CAUTION: IF P/N 6897875 FIXTURE IS NOT AVAILABLE, THE WRENCHING SURFACES OF THE BODY MAY BE HELD IN A VISE. DO NOT OVERTIGHTEN THE VISE. MAKE SURE TO PREVENT DAMAGE TO THE NOZZLE ASSEMBLY.

(3) Insert the fuel nozzle body in 6897875 holding fixture. Unscrew the outer air shroud.

(4) Carefully remove the spray tip assembly from the outer air shroud and the filter from the body. No further disassembly is permitted.



1. Fuel nozzle body
2. Filter assembly
3. Spray tip assembly
4. Outer air shroud

Fuel Nozzle Assembly
Figure 202

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4. Inspection of Disassembled Nozzle

A. Inspect the Disassembled Fuel Nozzle as follows:

(1) Inspect for signs of contamination and serviceability. Return the entire fuel nozzle to a Rolls–Royce Authorized Maintenance Center if any of the following conditions are found:

(a) Any contamination of the filter assembly.

(b) Tears or cracks in the filter assembly.

(c) Collapsed screen in the filter assembly.

(d) Obvious contamination or damage to other portions of the fuel nozzle assembly.

(e) If the nozzle has been inadvertently disassembled further than allowed. Refer to PARA 3.A., this Section.

5. Assembly

A. Assemble the fuel nozzle as follows:

(1) Hold the body in a vertical position and insert the filter assembly.

(2) Place the spray tip assembly in the body. Make sure it is properly engaged with the filter.

NOTE: Make sure that the filter assembly remains seated on the spray tip assembly.

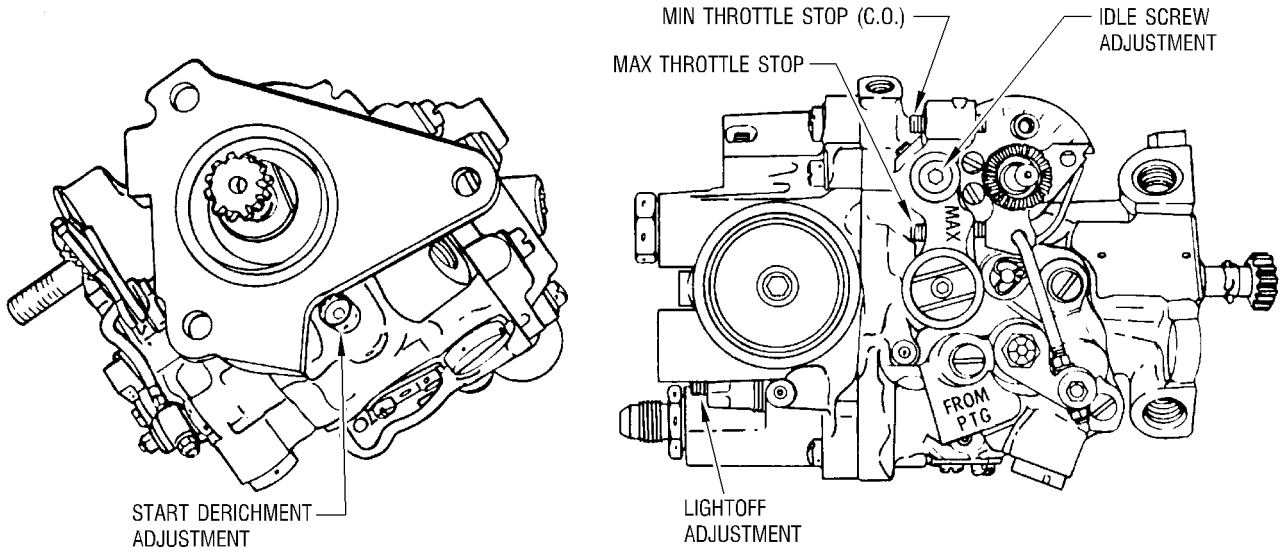
(3) Retain the nozzle in a vertical position. Screw the outer air shroud onto the body.

(4) Verify that the nozzle has been correctly assembled by counting the number of visible threads on the outer air shroud. Refer to PARA 3.A.(2), this Section.

CAUTION: IF P/N 6897875 FIXTURE IS NOT AVAILABLE, THE WRENCHING SURFACES OF THE BODY MAY BE HELD IN A VISE. DO NOT OVERTIGHTEN THE VISE. MAKE SURE TO PREVENT DAMAGE TO THE NOZZLE ASSEMBLY.

(5) Insert the fuel nozzle in holding fixture 6897875 or a vise and tighten the outer air shroud to 25–30 lb ft. (34–41 N·m) and secure with 0.020 in. (0.05 mm) lockwire.

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CECO Gas Producer Fuel Control Adjustments
Figure 202

3. Adjustment/Test

The adjustments that can be made on the fuel control are idle speed, maximum throttle stop, lightoff adjustment, start derichment and Maximum flow stop.

A. Fuel Control Operational Checks

Ground check the control system and associated linkage by making the following checks:

NOTE: Perform the steps in the sequence listed.

(1) Check rigging. (Refer to Rigging Check, para 3.C., this section.)

(2) Fuel cutoff operational check. (Refer to Cutoff Valve Operational Check, para 3.D., this section.)

(3) Check idle speed setting. (Refer to Idle Speed Setting, para 3.E., this section.)

B. Deceleration Check

To ensure proper engine performance, make the following deceleration check during shutdown for the last flight of each day.

(1) Turn the generator switch off.

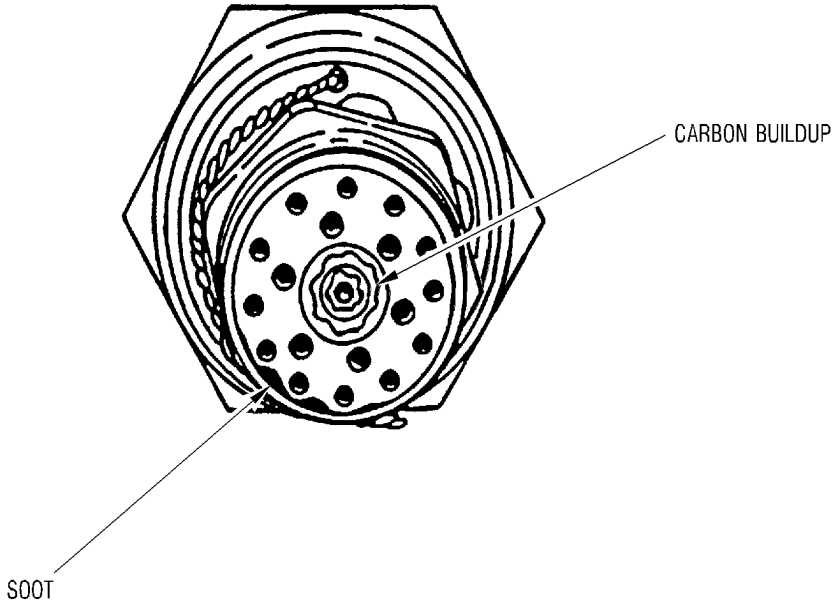
(2) Rotate the twist grip or power levers to full open. Hold collective at flat pitch.

CAUTION: DURING RAPID THROTTLE MOVEMENTS, MAKE APPROPRIATE ANTI–TORQUE PEDAL CORRECTIONS TO PREVENT THE AIRCRAFT FROM TURNING ON LOOSE OR SLICK SURFACES.

(3) Snap the twist grip or throttle to the IDLE position. Simultaneously start a time count using a stop watch or a watch with a sweep second hand. Stop the time as the N_1 needle passes through 65%. The minimum allowable time is two seconds.

NOTE: Practice and/or retakes may be required before proficiency is obtained in timing the deceleration.

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Carbon Buildup on Fuel Nozzle
Figure 202

AGH043XD

B. Inspect the Disassembled Fuel Nozzle as follows:

(1) Inspect for signs of contamination and serviceability. Return the entire fuel nozzle to a Rolls--Royce Authorized Maintenance Center if any of the following conditions are found:

(a) Contamination of the filter assembly.

(b) Tears or cracks in the filter assembly.

(c) Collapsed screen in the filter assembly.

(d) Obvious contamination or damage to other portions of the fuel nozzle assembly.

(e) If the nozzle has been inadvertently disassembled further than allowed. Refer to PARA 2.A., this Section.

C. Inspect the fuel nozzle flow pattern as follows:

(1) Remove nozzle.

(2) Connect supply hose coupling nut to fuel nozzle and tighten hand tight.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(3) Hold supply hose with attached nozzle and direct spray tip towards a container.

(4) Verify that all ignition system circuit breakers are open.

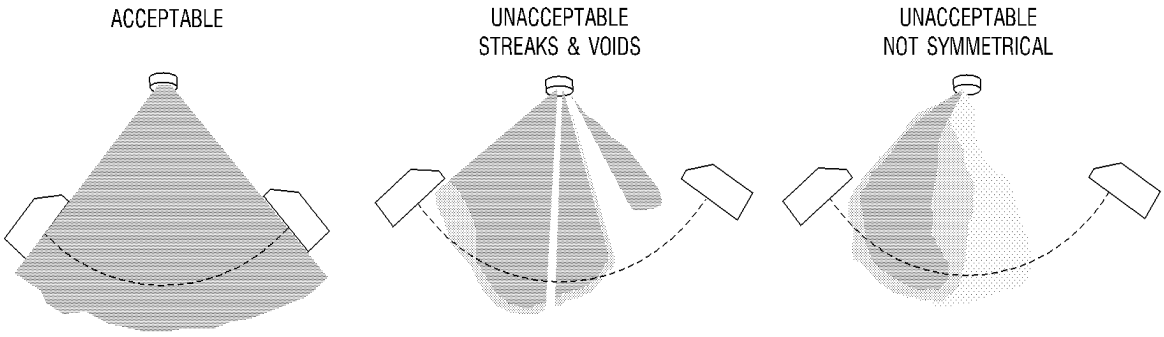
(5) Fuel boost pump must be on and the twist grip at idle detent.

(6) Motor engine for15 seconds.

(7) Inspect entire circumference of sprayed cone of fuel. Spray patterns must be symmetrical and free of streaks and voids. Acceptable and Unacceptable spray patterns can be seen in Figure 203.

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Fuel Nozzle Patterns
Figure 203

AJH038XD

4. Cleaning

CAUTION: DUE TO VARIATION IN FUELS AND OPERATING CONDITIONS, FUEL NOZZLE CLEANING MAY BE NECESSARY AT MORE FREQUENT INTERVALS THAN STATED IN TABLE 602, 72--00--00, ENGINE-- INSPECTION/CHECK, TO MAINTAIN PROPER COMBUSTION FLAME PATTERN.

A. Cleaning assembled fuel nozzle.

CAUTION: MAKE SURE NOT TO DAMAGE THE MIRROR FINISH AND EDGES OF THE SPRAY TIPS DURING THE CLEANING OPERATION.

NOTE: Removal of external carbon deposits from the fuel nozzle spray tip can correct a streaking problem. Therefore, cleaning the spray tip may make it unnecessary to disassemble the fuel nozzle.

(1) Suspend the fuel nozzle vertically with the tip immersed approximately 1/8 in. (3 mm) in cleaning solvent, Brulin Safety Solvent No. 512 M or equivalent. Soak the tip for one hour, or longer if deemed necessary, to remove all carbon. After carbon removal, flush the nozzle internally and externally using Stoddard solvent or kerosene. Dry with a soft cloth.

(2) After carbon removal, flush the nozzle internally and externally using Stoddard solvent or kerosene. Dry with a soft cloth.

CAUTION: DO NOT USE COMPRESSED AIR TO DRY NOZZLE. THIS CAN DAMAGE THE NOZZLE.

(3) Clean the face of the outer air shroud with a clean dry cloth; the air holes must be open. Be careful that loosened carbon does not enter the spray tips.

B. Cleaning assembled fuel nozzle (Alternate Procedure).

(1) Check for damage or carbon deposits on spray tips. Figure 202 shows the condition of a typical fuel nozzle removed from an operational engine. A nozzle in this condition should be cleaned, if possible, before reinstalling.

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250-C20
250-C20B
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250-C20J
250-C20S
250-C20W

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LIFE LIMITS OF THE COMPRESSOR ROTOR

Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
Impeller	6871337	Original	2500	7500
	23060177	Ground Pin, Glass Bead Peen	2500	7500
Impeller	6876873	Hub relocated rearward	3550	9150
	23057117	No Pin	3550	9150
	23058146	Extended Adapter	3550	9150
	23058147	Extended Adapter	3550	9150
	23060417	Ground Pin, Glass Bead Peen	3550	9150
Impeller	23079638	Shortened Adapter	3550	9150
1st-stage Wheel	23079060		15,000	30,000
2nd-3rd-stage Wheel	23079059		15,000	30,000
4th-stage Wheel	23079058		15,000	30,000
5th-stage Wheel	23079057		15,000	30,000
6th-stage Wheel	23079056		15,000	30,000

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Table 14

Accessories Recommended Time Between Overhauls (Hours)
(250-C20, -C20B, -C20F, -C20J, -C20W)

Component	Recommended TBO Hours
Fuel Pump	
Sundstrand (PESCO) Dual Element	1500(1)
Sundstrand (PESCO) Dual Element	2250(2)
Sundstrand (PESCO) Single Element	2250(3)
ARGO-TECH/TRW - P/N 386500-5 (Rolls-Royce P/N 6899253)	4000
P/N 386500-1, -2, -3, -4	3500
Chandler Evans (CECO) - P/N 113300-01A1 (Rolls-Royce P/N 23057338)	3500
- P/N 113300-02A1 (Rolls-Royce P/N 23065132)	3500
- P/N 113300-03A1 (Rolls-Royce P/N) 23070459)	3500
Fuel Control (CECO)(4)	
P/N 104000A8 and subsequent	4000
P/N 104900A3 and subsequent	4000
All part numbers prior to above	1000
Power Turbine Governor (CECO)(4)	
P/N 104100A12 and subsequent	4000
P/N 104500A7 (multi-engine) and subsequent	4000
P/N 104100A6 through A11	2000
P/N 104500A1 through A6 (multi-engine)	2000
All P/N prior to 104100A6	1000
Fuel Control (Bendix) (250-C20, -C20B, -C20F, -C20J, -C20W)	2500
(250-C20S)	2000
Power Turbine Governor (Bendix)	1500

NOTE: The TBO period on the following Bendix governors has been extended to 2000 hours. All governors that precede these part numbers must remain at 1500 hours.

Rolls-Royce P/N	Bendix P/N
23005493	2524769-7 and subsequent
23005492	2524667-8 and subsequent
23036657	2549025-1 and subsequent
23036658	2549026-1 and subsequent

Fuel Nozzle	
P/N 6890917	2500
P/N 6874959	1500
P/N 23077068	2500
Bleed Valve	1500

NOTE: Contact your Authorized Maintenance Center for extension of the TBO on eligible selected accessories.

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
17 (cont)	Grease (cont)	Lubricate packings in fuel control fuel or air passages.	ASTM No. 5 Oil Sun Oil Company 1608 Walnut Street Philadelphia, Pennsylvania 19103
		Lubricate packings in fuel control fuel or air passages. (cont)	Alternates to ASTM No. 5 Oil: 1. 45–55% fuel (MIL–C–7024B, Type II) mixed with 45–55% STP Oil Treatment 2. MIL–D–6081, Grade 1010 oil
		Fuel Pump internal drive shaft splines (TRW/Argo–Tech pumps only)	Plastitube No. 3 Warren Refining Division Parr Inc. 5151 Denison Ave. Cleveland, Ohio 44102
18	Antiseize	P_c filter threads and external threads–protects up to 232°C (450°F)	DC 550 Fluid Dow Corning Corp. South Saginaw Road Midland, Michigan 48641
		Hot section external threads (not to be used where exposed to the engine oil system) and Compressor tie bolt	Never Seez Nickel Special (NSN165) Bostik, Emhart Chemical Group Boston Street Middleton, MA 01949
		Assembly–Compressor adapter nut.	Never–Seez Nickel Special (NSN165) Bostik, Emhart Chemical Group Boston Street Middleton, MA 01949
		External threads not exposed to oil system. Protects to 760°C (1400°F)	CP–63 (MIL–L–25681B) E/M Lubricants Inc. P.O. Box 2200 Highway 52, N.W. West Lafayette, Indiana 47906
19	Calibration fluid	Cleaning fuel nozzle tips	Stoddard solvent, refined kerosene (MIL–F–7024, type II) 300–400 boiling range.
20	Corrosion compound	Inhibiting fingerprint corrosion	Non–Rust X–210 Daubert Chemical Co., Inc. 4700 S. Central Ave. Chicago, Illinois 60038
21	Weld rod	Exhaust collector support ducts	AISI 349, (29–9 W Mo). (MIL–R–5031, class 6) (AMS 5784).

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VIBRATION RECORDING SHEET

AIRCRAFT TYPE: _____
AIRCRAFT SERIAL: _____
ENGINE SERIAL NUMBER: _____
GEARBOX SERIAL NUMBER: _____
COMPRESSOR SERIAL NUMBER: _____
TURBINE SERIAL NUMBER: _____

DATE: _____
TIME SINCE NEW: _____
ENGINE TSN/TSO: _____
GEARBOX TSN/TSO: _____
COMPRESSOR TSN/TSO: _____
TURBINE TSN/TSO: _____

	ALTITUDE	OAT	N_2	N_1 TORQUE	IPS BROAD BAND	NOTES
1					A B / C D	GROUND IDLE
2			85%		A B / C D	
* 3			100%		A B / C D	FLAT PITCH
4			100%	87%	A B / C D	
* 5			100%	95%	A B / C D	
* 6			100%	95%	A B / C D	USE GREEN CARD
7			100%		A B / C D	**SEE NOTE 1
8			100%		A B / C D	***SEE NOTE 2

* USED FOR ENGINE MONITORING PROGRAM.

** NOTE 1. DO NOT EXCEED ANY ENGINE/TRANSMISSION OR AIRCRAFT FLIGHT LIMITS UTILIZE MAXIMUM ALLOWABLE POWER AND MAINTAIN LEVEL FLIGHT.

*** NOTE 2. CLIMB 3000 FEET ABOVE THE ALTITUDE RECORDED IN CHECK #7 AND PERFORM MAXIMUM ALLOWABLE POWER CHECK (MAINTAIN LEVEL FLIGHT).

— USE BLUE CARDS ON ALL CHECKS UNLESS OTHERWISE NOTED.

— DEPRESS BROAD BAND SWITCH AT MAXIMUM RPM AND RECORD READING.

— USE 10 IPS SIDE OF RECORDING CHART.

— USE THREE PICKUPS ON THE NORMAL ENGINE VIBRATION PICKUP POINTS.

— ALL THREE PICKUP POINTS CAN BE ON ONE CARD PROVIDING DIFFERENT COLORED PINS ARE USED AND THEY ARE APPROPRIATELY MARKED.

Vibration Recording Sheet
Figure 502

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	100 Hour Inspection (cont)			
	f. Inspect magnetic chip detector plugs.	PARA 11.G., 72-00-00, Engine-Servicing		
	g. Inspect quick disconnect magnetic chip detector plugs and flanged inserts for wear, if installed.	PARA 11.G., 72-00-00, Engine-Servicing		
	*h. Refill oil system.	PARA 11.C., 72-00-00, Engine-Servicing		
21.A	Remove, inspect and clean the fuel nozzle. If no airframe mounted fuel filter is installed, inspect the fuel nozzle filter.	PARA 2., 73-10-03		
	NOTE: Operators may find it necessary to inspect and clean the fuel nozzle more often depending on past experience or operating conditions.			
22	Inspect the start counter for proper operation, increase in count, and for loose, chafed,frayed or broken wires and loose connectors.	PARA 1., 74-20-03		
23	Check the condition of the bleed valve gasket, without removing bleed valve. Replace gasket if air leaks (blowouts) can be detected.	PARA 2., 75-10-02		
24	Inspect the outer combustion case for condition. Inspect the weld joints of and in the brazed screen reinforcement in the armpit area.	PARA 2.B., 72-40-00		
25	Clean the burner drain valve.	PARA 3., 72-40-00		
26	Inspect the ignition lead for burning, chafing,or cracking of conduit and loose connectors and broken lockwire.	PARA 2., 74-20-02		
27	On engines with CECO fuel system, clean or replace the high pressure fuel filter.	PARA 2., 73-10-05		
28	On engines with CECO fuel systems, visually inspect the bleed hole at the low point in the scroll-to-governor P_c tube for any obstruction. If the hole is not completely open, remove any contamination which could obstruct drainage of moisture from the tube using a piece of lockwire.	N/A		
29	Review engine records for compliance with all mandatory bulletins, inspections and airworthiness directives.	N/A		
30	Review engine records for time limited parts components, accessory or modules.	N/A		
31	Enter component changes, inspection compliance, etc., in log book as required.	N/A		

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	200 Hour Inspection			
	In addition to the 100 hour inspection items, perform the following:			
	WARNING: MANDATORY COMPLIANCE DATE FOR ROLLS-ROYCE COMMERCIAL ENGINE BULLETIN 250-C20 CEB-1051 WAS AUGUST 30, 1980.			
32	Perform fuel pump backlash inspection on Sundstrand dual element pump P/N 6854292, 6857548, 6877719, 6856250, 6876803.	250-CSL-1007		
	300 Hour Inspection			
	In addition to the 100 hour and applicable 200 hour inspection items, do the following:			
	CAUTION: INSPECTION FREQUENCY SHALL BE BASED ON THE NATURE OF THE EROSIVE AND/OR CORROSIVE ENVIRONMENT. THE OPERATING ENVIRONMENT MAY DICTATE A MORE FREQUENT INSPECTION INTERVAL.WHEN OPERATING IN A CORROSIVE AND/OR EROSIVE ENVIRONMENT FOR NON-COATED COMPRESSOR WHEELS, THE INSPECTION SHALL NOT EXCEED 300 HOURS OR 6 MONTHS. FOR COATED COMPRESSOR WHEELS, INSPECTION SHALL NOT EXCEED 300 HOURS OR 12 MONTHS. IF ANY PARENT METAL IS EXPOSED DUE TO CORROSION AND/OR EROSION, THE INSPECTION REQUIREMENT SHALL REVERT BACK TO 300 HOURS OR 6 MONTHS.			
33	Inspect the compressor case when operating in an erosive and/or corrosive environment.	PARA 1.D.(9), this Section		
	CAUTION: AIRCRAFT INSTALLED-ENGINE FUEL-PUMP FILTER DIFFERENTIAL PRESSURE WARNING SYSTEMS AND/OR OPERATING EXPERIENCE MAY DICTATE REPLACEMENT AT A LESSER TIME INTERVAL. IN NO INSTANCE SHOULD THE 300 HR REPLACEMENT INTERVAL BE EXCEEDED.			
34	Replace the fuel filter element. This filter is a throw-away item. It is not cleanable. Before discarding filter, inspect for signs of contaminants. If any are found, inspect the entire fuel system and clean if necessary.	PARA 2.C., 73-10-01		
	CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. (REFER TO SPECIAL INSPECTIONS, 72-00-00, TABLE NO TAG) IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.			
	CAUTION: PURGE AIR FROM THE FUEL SYSTEM.			
35	Do a fuel pump bypass valve operation check when a fuel filter is replaced. NOTE: Applicable to Sundstrand/Pesco and Argo-Tech/TRW manufactured pumps only.	PARA 3.A., 73-10-01		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	300 Hour Inspection (cont)			
36	Remove, clean and inspect engine P_c filter every 300 hours or earlier as engine performance dictates.	PARA 3., 73-20-06		
37	Inspect and clean the No. 1 bearing oil pressure reducer.	PARA 3., 72-30-00		
38	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	PARA 7. E., 72-50-00		
39	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72-50-00		
40	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G., 72-50-00		
41	Inspect the thermocouple assembly.	PARA 2.B., 77-20-01		
41A	Remove and disassemble fuel nozzle. Clean and inspect fuel nozzle filter assembly. Assemble and install fuel nozzle.	73-10-03		
	500 Hour/1 Year Inspection			
42	Inspect all uncoated and coated P/N 6846278 and 6871338 power turbine outer couplings nuts for corrosion.	250-C20 CSL-1060		
	NOTE: Compliance with Rolls-Royce Commercial Engine Bulletin 250-C20 CEB-1120 and/or 250-C20 CEB-1158 removes this inspection requirement.			
	600 Hour Inspection			
43	Check the fuel pump driveshaft on Sundstrand single element pumps for spline wear.	N/A		
	NOTE: This inspection is not required for Agro-Tech (TRW) fuel pumps or Sundstrand fuel pumps P/N 23003114 and subsequent.			
44	Perform scavenge oil filter impending bypass functional test per Facet Service Bulletin No. 090589 (ref. Rolls-Royce 250 CSL 1164) for aircraft equipped with this type of external scavenge filter system.	N/A		
45	Replace the fuel control filter assembly. Bendix fuel controls P/N 2524552-4 or 2524552-6 (less-5) and prior unless 250-C20 CEB-1089 has been accomplished.	PARA 4.A., 73-20-02, 4.A., 73-20-03		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	1000 Hour Inspection			
46	Inspect Py port on Bendix power turbine governor per 250 CEB-A-1281. The governor must be removed from the engine to perform this inspection.	N/A		
	NOTE: If CEB-A-1289 or CEB 1330 have been accomplished, this inspection is not required.			
	1500 Hour Inspection			
47	Clean and Inspect the Fuel Control Strainer Assembly. Replace as necessary. NOTE: The Fuel Control Strainer Assembly must be replaced on any Fuel Control unit that has not had 250-C20 CEB-1089 accomplished.	PARA 4.A., 73-20-02, 4.A., 73-20-03		
48	Inspect fuel nozzle filter.	PARA 4.A., 73-10-03		
	1750 Hour Inspection			
49	Inspect the compressor case. Inspection frequency shall be as made necessary by operating environment. In erosive environment, inspect case at least every 300 hours. In any environment do not exceed 1750 hours without case inspection.	PARA 1.D., this section and PARA 5., 72-30-00		
50	Heavy Maintenance Inspection (HMI). Heavy maintenance inspection shall consist of gas producer turbine wheels replacement and inspection of assembled components per Rolls-Royce published documents. It is the responsibility of the operator to assure that the total time and cycle life limits of specific parts listed in Section 05-10-00, Airworthiness Limitations, are not exceeded.	N/A		
	As Required Inspection			
51	Clean the bleed valve after each 10 hr of water-alcohol augmentation operation or after consumption of each 750 gallons (2840 liters) of water-alcohol mixture.	PARA 2.C., 75-10-02		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	150 Hour Inspection (cont)			
	b. Inspect magnetic chip detector plugs.	PARA 11.G., 72-00-00, Engine-Servicing		
	c. Inspect quick disconnect magnetic chip detector plugs and flanged inserts for wear, if installed.	PARA 11.G., 72-00-00, Engine-Servicing		
21.A	Remove, inspect and clean the fuel nozzle exterior. If no airframe mounted fuel filter is installed, inspect the fuel nozzle filter.	PARA 2., 73-10-03		
	NOTE: Operators may find it necessary to inspect and clean the fuel nozzle more often depending on past experience or operating conditions.			
22	Inspect the start counter for proper operation, increase in count, and for loose, chafed, frayed or broken wires and loose connectors.	PARA 1., 74-20-03		
23	Check the condition of the bleed valve gasket without removing bleed valve. Replace gasket if air leaks (blowouts) can be detected.	PARA 2., 75-10-02		
24	Inspect the outer combustion case for condition. Inspect the weld joints of and in the brazed screen reinforcement in the armpit area.	PARA 2.B., 72-40-00		
25	Clean the burner drain valve.	PARA 3., 72-40-00		
26	Inspect the ignition lead for burning, chafing, or cracking of conduit and loose connectors and broken lockwire.	PARA 2., 74-20-02		
27	On engines with CECO fuel system, clean or replace the high pressure fuel filter.	PARA 2., 73-10-05		
28	On engines with CECO fuel systems, visually inspect the bleed hole at the low point in the scroll-to-governor P_c tube for any obstruction. If the hole is not completely open, remove any contamination which could obstruct drainage of moisture from the tube using a piece of lockwire.	N/A		
29	Review engine records for compliance with all mandatory bulletins, inspections and airworthiness directives.	N/A		
30	Review engine records for time limited parts components, accessory or modules.	N/A		
31	Enter component changes, inspection compliance, etc., in log book as required.	N/A		

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	300 Hour Inspection			
	In addition to the 150 hour inspection items, perform the following:			
	WARNING: MANDATORY COMPLIANCE DATE FOR ROLLS-ROYCE COMMERCIAL ENGINE BULLETIN 250-C20 CEB-1051 WAS AUGUST 30, 1980.			
32	Perform fuel pump backlash inspection on Sundstrand dual element pump P/N 6854292, 6857548, 6877719, 6856250, 6876803.	250-CSL-1007		
	CAUTION: INSPECTION FREQUENCY SHALL BE BASED ON THE NATURE OF THE EROSIVE AND/OR CORROSIVE ENVIRONMENT. THE OPERATING ENVIRONMENT MAY DICTATE A MORE FREQUENT INSPECTION INTERVAL. FOR NON-COATED COMPRESSOR WHEELS, THE INSPECTION SHALL NOT EXCEED 300 HOURS OR 6 MONTHS. FOR COATED COMPRESSOR WHEELS, INSPECTION SHALL NOT EXCEED 300 HOURS OR 12 MONTHS. IF ANY PARENT METAL IS EXPOSED DUE TO CORROSION AND/OR EROSION, THE INSPECTION REQUIREMENT SHALL REVERT BACK TO 300 HOURS OR 6 MONTHS.			
33	Inspect the compressor case when operating in an erosive and/or corrosive environment.	PARA 1.D.(9), this section		
	CAUTION: AIRCRAFT INSTALLED-ENGINE FUEL-PUMP FILTER DIFFERENTIAL PRESSURE WARNING SYSTEMS AND/OR OPERATING EXPERIENCE MAY DICTATE REPLACEMENT AT A LESSER TIME INTERVAL. IN NO INSTANCE SHOULD THE 300 HR REPLACEMENT INTERVAL BE EXCEEDED.			
34	Replace the fuel filter element. This filter is a throw-away item. It is not cleanable. Before discarding filter, inspect for signs of contaminants. If any are found, inspect the entire fuel system and clean if necessary.	PARA 2.C., 73-10-01		
	CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. (REFER TO SPECIAL INSPECTIONS, 72-00-00, TABLE NO TAG) IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.			
	CAUTION: PURGE AIR FROM THE FUEL SYSTEM.			
35	Do a fuel pump bypass valve operation check when a fuel filter is replaced. NOTE: Applicable to Sundstrand/Pesco and Argo-Tech/TRW manufactured pumps only.	PARA 3.A., 73-10-01		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	300 Hour Inspection (cont)			
36	Lubrication system inspection			
	NOTE: Maximum interval between oil change is 300 hours or 12 months, whichever occurs first.			
	a. Drain oil system.	PARA 11.C., 72-00-00, Engine-Servicing		
	b. Inspect and clean turbine pressure oil check valve.	PARA 7.K., 72-50-00		
	c. Turbine pressure oil tube screen assembly. Detach clamp; then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the tube coupling nut at the fireshield elbow only enough to allow sufficient movement of the tube to enable removal of the screen. At assembly, tighten connector coupling nut to 200-250 lb in. (23-28 N·m). Tighten fireshield elbow coupling nut to 80-120 lb in. (9-14 N·m). Tighten clamp nut to 35-40 lb in. (3.9-4.5 N·m).	N/A		
	d. Measure oil flow from the scavenge passage of the external sump and from the scavenge passage of the gas producer support. It is recommended that the external sump is not removed for this check.	PARA 7.D., 72-50-00		
	NOTE: This step must be performed before draining oil or after the oil system has been refilled.			
	e. Refill oil system.	PARA .11.C., 72-00-00, Engine-Servicing		
37	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	PARA 7.E., 72-50-00		
38	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72-50-00		
39	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G. 72-50-00		
40	Inspect the thermocouple assembly.	PARA 2.B., 77-20-01		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	500 Hour/1 Year Inspection			
41	Inspect all uncoated and coated P/N 6846278 and 6871338 power turbine outer couplings nuts for corrosion.	250–C20 CSL–1060		
	NOTE: Compliance with Rolls–Royce Commercial Engine Bulletin 250–C20 CEB–1120 and/or 250–C20 CEB–1158 removes this inspection requirement.			
	600 Hour Inspection			
	In addition to the 150 hour and 300 hour inspection items, perform the following:			
42	Remove, clean and inspect engine P_c filter every 600 hours or earlier as engine performance dictates.	PARA 3., 73–20–06		
43	Inspect and clean the No. 1 bearing oil pressure reducer.	PARA 3., 72–30–00		
44	Check the fuel pump driveshaft on Sundstrand single element pumps for spline wear.	N/A		
	NOTE: This inspection is not required for Agro–Tech (TRW) fuel pumps or Sundstrand fuel pumps P/N 23003114 and subsequent.			
45	Perform scavenge oil filter impending bypass functional test per Facet Service Bulletin No. 090589 (ref. Rolls–Royce 250 CSL 1164) for aircraft equipped with this type of external scavenge filter system.	N/A		
46	Replace the fuel control strainer assembly. (Bendix fuel controls P/N 2524552–4 or 2524552–6 (less–5) and prior unless 250–C20 CEB–1089 has been accomplished).	PARA 4.A., 73–20–02, 4.A., 73–20–03		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	1000 Hour Inspection			
47	Inspect Py port on Bendix power turbine governor per 250 CEB-A-1281. The governor must be removed from the engine to perform this inspection.	N/A		
	NOTE: If CEB-A-1289 or CEB 1330 have been accomplished, this inspection is not required.			
	1500 Hour Inspection			
48	Replace the fuel control strainer assembly. Bendix fuel controls P/N 2524552-5 and subsequent and those earlier fuel controls which have had Rolls-Royce Commercial Engine Bulletin 250-C20 CEB-1089 accomplished.	PARA 4.A., 73-20-02, 4.A., 73-20-03		
49	Inspect fuel nozzle filter.	PARA 4.A., 73-10-03		
	1750 Hour Inspection			
50	Inspect the compressor case. Inspection frequency shall be as made necessary by operating environment. In erosive environment, inspect case at least every 300 hours. In any environment do not exceed 1750 hours without case inspection.	PARA 1.D., this section and PARA 5., 72-30-00		
51	Heavy Maintenance Inspection (HMI). Heavy maintenance inspection shall consist of gas producer turbine wheels replacement and inspection of assembled components per Rolls-Royce published documents. It is the responsibility of the operator to assure that the total time and cycle life limits of specific parts listed in Section 05-10-00, Airworthiness Limitations, are not exceeded.	N/A		
	As Required Inspection			
52	Clean the bleed valve after each 10 hr of water-alcohol augmentation operation or after consumption of each 750 gallons (2840 liters) of water-alcohol mixture.	PARA 2.C., 75-10-02		

PARA 1. (cont)

D. Special Inspections

Special inspections are required when the engine has been subjected to abnormal operating conditions, when engine damage is suspected, or when associated parts are removed from the engine. The special occurrence, the component or system to be inspected, and the nature of the inspection are given in Table 604.

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COMBUSTION SECTION-MAINTENANCE PRACTICES

1. Combustion Liner

   A. Removal

      (1) (250-C20S, -C20W) Remove the eight bolts and washers and remove the fireshield access panel.

      (2) Remove the following from the outer combustion case.

      WARNING: MAKE SURE THAT THE IGNITION SWITCH IS OFF BEFORE REMOVING THE SPARK IGNITER OR SPARK IGNITER LEAD ASSEMBLY AS DANGEROUS HIGH VOLTAGES MAY BE PRESENT. ALLOW FIVE MINUTES AFTER OPERATION FOR ELECTRICAL DISSIPATION BEFORE DISASSEMBLY.

         (a) Ignition lead from spark igniter. Ground the lead to the engine to dissipate any stored energy.

         (b) Fuel hose from fuel nozzle. Cap the fuel nozzle and plug the hose.

         (c) Drain hose from burner drain valve.

            NOTE: If the outer combustion case is also being replaced, remove the spark igniter, fuel nozzle and burner drain valve.

      (3) Remove the internal retaining rings attaching the compressor discharge air tubes to the outer combustion case.

      (4) Remove the 24 screws and nuts at the splitline and separate the outer combustion case from the turbine and compressor discharge air tubes.

      (5) Remove the combustion liner.

   B. Installation

      Install the replacement combustion liner as follows:

      (1) Place the combustion liner over the first-stage turbine nozzle shield with the igniter plug opening at the nine o'clock position (looking forward).

      (2) Slip the retaining rings over the large ends of the compressor discharge air tubes.

      (3) Install the spark igniter, fuel nozzle and burner drain valve if they were removed. Required torques are: spark igniter 150-200 lb in. (17-23 N·m), fuel nozzle 200-300 lb in. (23-34 N·m) and burner drain valve 120-140 lb in. (14-16 N·m).

      (4) Apply antiseize compound to the split seal rings. Compress the seal rings with 6799952 installation clamps. Split seal ring gaps should be 180° apart. Place the outer combustion case over the liner while mating it to the compressor discharge air tubes.

      (5) (250-C20, -C20B -C20F, -C20J) Secure the outer case to the turbine with 24 bolts and nuts. Coat bolt threads lightly with antiseize compound before installation. The half-inch (13 mm) length bolt goes at position 20. (On 6887190 engine assembly, the half-inch length bolts go at positions 6 and 20.) Tighten nuts of socket head cap screws to 20-30 lb in. (2.3-3.4 N·m). Tighten nuts of tee-head bolts to 35-40 lb in. (3.9-4.6 N·m) plus locknut drag.

      (6) (250-C20S, -C20W) Secure the outer case to the turbine with 24 bolts and nuts. Coat bolt threads lightly with antiseize compound before installation. Retained on this splitline is the fire shield supporting bracket (positions 4-5). Positions are determined with 1 at top center when looking forward. These two positions take the half-inch bolts. Tighten bolts of socket head cap screws to 20-30 lb in. (2.3-3.4 N·m). Tighten nuts of Tee-head bolts to 35-40 lb in. (3.9-4.5 N·m) plus locknut drag.

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(7) Remove the installation clamps. Seat the compressor discharge air tube anti-rotation pin, which is located in the outer combustion case, into the anti-rotation slot of the compressor discharge air tube by pushing the compressor discharge air tube aft while slightly rotating it CCW and CW until the pin engages the slot. Once the pin is engaged in the slot and the compressor discharge air tube can no longer be rotated, install the compressor discharge air tube retaining ring in the groove in the outer combustion case. Make sure that the compressor discharge air tube is properly seated in the outer combustion case by pulling forward on the compressor discharge air tube. There must be no significant movement in the forward direction.

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PARA 1.B. (cont)

(8) Install the following on the outer combustion case.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(a) Ignition lead to spark igniter. Tighten coupling nut to 70-90 lb in. (7.9-10.2 N·m).

(b) Fuel hose to the fuel nozzle. Tighten coupling nut to 80-120 lb in. (9.0-13.6 N·m). Secure with lockwire.

(c) Drain hose to the burner drain valve.

(9) (250-C20S, -C20W) Reinstall the fireshield access panel and secure with eight washers and bolts. Tighten bolts to 22-26 lb in. (2.5-2.9 N·m).

(10) Check run the engine after combustion liner replacement. (Refer to Check Run, para 1, 72-00-00, Engine-Adjustment/Test)

C. Inspection and Repair

Inspect the combustion liner in accordance with Table 201. Remove the combustion section for the inspection as described in Combustion Liner, para 1.A., this section.

Table 201

Combustion Liner Inspection and Repair

Item	Condition	Serviceable Limit	Repairable Limit	Disposition
1	Louvers bent closed or restricted by carbon particles	Maintain 0.050-0.070 in. (1.27-1.78 mm) uniform opening		Lightly wire brush as required. Vapor degrease; then reposition by bending to proper opening.
2	Burnt louvers	Refer to Figure 201 for maximum material which can be burned away from individual louvers		Replace liner or send to an overhaul facility for repair.
3	Pulled or broken spotwelds at liner step	Max of six with no more than three adjacent welds	Four adjacent spotwelds or up to 40% of total per step	Plugweld repair. Drill 3/16-in. (5 mm) dia hole through outer section then press sections together and plugweld using 29-9 W Mo weld rod (AMS 5784).Grind weld material only if it blocks or restricts airflow.
4	Handling damage--mashed out of round	None	Unable to straighten to concentricity limits	Straighten and reform.

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Table 201 (cont)

Item	Condition	Serviceable Limit	Repairable Limit	Disposition
5	Handling damage—dented	None	Unable to straighten to concentricity limits or dent causes thin–out of metal	Straighten and reform dents in allowable areas indicated on fig. 202.
6	Localized high temperature distortion indicated by warping of liner surface (normally accompanied by discoloration)	Max of 3/16 in. (5 mm) depth over 1 in. (25 mm) dia and within allowable areas given on fig. 202		Replace liner or send to an overhaul facility for repair.
7	Burning in area of relief slots	Max of 1/16 in. (2 mm) on rear edge or both corners burned max of 1/4 in. (6 mm) along relief slot		Replace liner or send to an overhaul facility for repair.
8	Distortion in dome or exit end of liner	None		Replace liner or send to an overhaul facility for repair.
9	Cracks on outside of liner (dye check)	None		Gas tungsten–arc weld using 29–9 W Mo weld rod (AMS 5784). Crack must be completely welded. Weld material must not obstruct cooling air passage.
10	Crack in tab end inside liner (dye check)	Max of 1/4–in. (6 mm) length and limited to 2 cracks per tab	Three or more cracks, or one or more cracks in excess of 1/4–in. (6 mm) in length	Replace liner or send to an overhaul facility for repair.
11	Cracks at two adjacent relief slots progressing toward same hole (dye check)	Max. of 1/8 in. (3 mm) length and limited to two cracks		Replace liner or send to an overhaul facility for repair.
12	Crack in relief slot at combustion liner steps (dye check)	Max of 3/16–in. (5 mm) in length (any number)	Cracks over 3/16–in. (5 mm) with other cracks extending more than 3/8–in. (10 mm) toward air holes	Gas tungsten–arc weld using 29–9 W Mo weld rod (AMS 5784.) Grind weld material only if it blocks or restricts airflow.

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Table 201 (cont)

Item	Condition	Serviceable Limit	Repairable Limit	Disposition
13	Crack in double lip area (dye check)	None		Gas tungsten–arc weld using 29–9 W Mo weld rod (AMS 5784). Surfaces between lips must be free of weld material.
14	Cracks in expansion slots	Max of 3/16 in. (5 mm) long		Gas tungsten–arc weld using 29–9 W Mo weld rod (AMS 5784). Surfaces between lips must be free of weld material.
15	Crack in igniter or fuel nozzle ferrule attaching weld (dye check)	None		Gas tungsten–arc weld using Hastelloy X weld rod (AMS 5798). Max width of weld 0.080 in. (2.03 mm).
16	Roughened igniter ferrule ID	Max of 0.560 in. (14.22 mm) ID after polishing		Send liner to an overhaul facility for repair if not within Serviceable Limit after polishing.
17	Worn or distorted (out–of–round) igniter ferrule	Min of 0.020 in. (0.508 mm) wall thickness and max of 0.560 in. (14.22 mm) ID		Replace liner or send to an overhaul facility for repair.
18	Worn or distorted (out–of–round) fuel nozzle ferrule	Max of 0.670 in. (17.02 mm) ID		Replace liner or send to an overhaul facility for repair.

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FUEL NOZZLE - MAINTENANCE PRACTICES

1. Replacement

A. Removal

CAUTION: PARTICULAR CARE MUST BE TAKEN DURING REMOVAL NOT TO DAMAGE THE FUEL INJECTOR SPRAY TIP.

Remove the fuel nozzle as follows:

(1) Remove lockwire and disconnect the fuel nozzle hose.

(2) Remove lockwire; then using 23007638 wrench, unscrew the nozzle.

(3) Carefully remove nozzle assembly.

B. Installation

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(1) Install the fuel nozzle as follows:

(a) When replacing or reinstalling the fuel nozzle, apply a light coat of antiseize compound (NS-165) to the threads. Tighten nozzle to 200-300 lb in. (23-34 N·m) using 23007638 wrench. Lockwire to spark igniter. Tighten hose coupling nut to 80-120 lb in. (9.0-13.6 Nm). Secure hose coupling nut with lockwire.

(b) Check run the engine after fuel nozzle replacement. Refer to Check Run, PARA 1., 72-00-00, Engine-Adjustment/Test.

2. Disassembly/Assembly

CAUTION: MAKE SURE TO PREVENT DAMAGE TO THE MIRROR FINISH AND EDGES OF THE SPRAY TIP. THE NOZZLE SHOULD BE DISASSEMBLED IN A CLEAN AREA AND CARE SHOULD BE TAKEN TO AVOID DIRT OR OTHER CONTAMINATION.

A. Disassemble the fuel nozzle as follows: (See Figure 201):

(1) Note the position of the lockwire on the fuel nozzle; then remove the lockwire.

(2) Count the number of visible threads on the outer air shroud. Retain this number for verification that the fuel nozzle will be correctly reassembled.

CAUTION: IF P/N 6897875 FIXTURE IS NOT AVAILABLE, THE WRENCHING SURFACES OF THE BODY MAY BE HELD IN A VISE. DO NOT OVERTIGHTEN THE VISE. MAKE SURE TO PREVENT DAMAGE TO THE NOZZLE ASSEMBLY.

B. Assemble the fuel nozzle as follows:

(1) Hold the body in a vertical position and insert the filter assembly.

(2) Place the spray tip assembly in the body. Make sure it is properly engaged with the filter.

(3) Make sure that the filter assembly remains seated on the spray tip assembly.

(4) Retain the nozzle in a vertical position. Screw the outer air shroud onto the body

(5) Make sure that the nozzle has been correctly assembled by counting the number of visible threads on the outer air shroud. Refer to PARA 2.A.(2), this Section.

CAUTION: IF P/N 6897875 FIXTURE IS NOT AVAILABLE, THE WRENCHING SURFACES OF THE BODY MAY BE HELD IN A VISE. DO NOT OVERTIGHTEN THE VISE MAKE SURE TO PREVENT DAMAGE TO THE NOZZLE ASSEMBLY.

(6) Insert the fuel nozzle in holding fixture 6897875 or a vise and tighten the outer air shroud to 25--30 lb ft. (34--41 Nm) and secure with 0.020 in. (0.05 mm) lockwire.

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CAUTION: MAKE SURE NOT TO DAMAGE THE MIRROR FINISH AND EDGES OF THE SPRAY TIPS DURING THE CLEANING OPERATION.

(2) Suspend the nozzle vertically with the tip immersed approximately 1/8 in. (3 mm) in Brulin 815 QR (or equivalent). Heating the solvent to 140°F (60°C) is optional. Approximately 8 hours is a desired soak time. All carbon should be removed or loosened after this process.

(3) Use a soft bristle nylon brush, such as a toothbrush, to remove any remaining carbon buildup from the nozzle tip. Be careful that loosened carbon does not enter the spray tip. After carbon removal, flush the nozzle internally and externally using Stoddard solvent or kerosene. Dry with a soft cloth

CAUTION: DO NOT USE COMPRESSED AIR TO DRY NOZZLE. THIS CAN DAMAGE THE NOZZLE.

(4) If carbon is still visible, soak nozzle tip in Turco 4181, or equivalent, at 140°F (60°C) for two hours. Flush nozzle thoroughly with hot water then with Stoddard solvent or kerosene. Dry with a soft cloth.

(5) Clean the face of the outer air shroud with a clean dry cloth; the air holes must be open. Be careful that loosened carbon does not enter the spray tips.

(6) If the nozzle is still streaking, carbon is probably not the issue. Send the nozzle to an authorized facility for further inspection.

C. Clean Disassembled Fuel Nozzle

(1) Use Kelite (No. 235), a solution of 75% Cities Service Solvent and 25% Stoddard Solvent (MIL-F-7024 Type II Fluid), or an equivalent solution of 75% carbon solvent and 25% petroleum solvent to clean the disassembled nozzle parts ultrasonically.

CAUTION: IF YOU DO NOT DO A CHECK OF THE CLEANING SOLUTIONS AT INTERVALS, DETERIORATION CAN OCCUR.

(2) Apply light pressure with a soft cloth dampened with a petroleum or carbon solvent to areas of the metering set and inner air shroud orifices to remove carbon particles not completely removed by ultrasonic cleaning. Flow a sufficient quantity of fuel through the metering set when you clean to prevent entry of carbon particles into the metering set.

(3) External carbon on the air shroud can be removed with a wire brush and/or grit blast. You must prevent damage to the threads and the wear surface of the air shroud when you use the wire brush or grit blast. Do not wire brush or grit blast internal parts or surfaces.

CAUTION: DO NOT WASH, FLUSH, OR SOAK THE PARTS IN WATER. RUST AND BLOCKAGE OF THE FUEL OPENINGS CAN OCCUR.

(4) After the nozzle parts are cleaned ultrasonically, flush the nozzle parts with clean fuel, acetone, Methyl Ethyl Ketone, or equivalent to make sure that all of the openings and orifices are free of contamination from the cleaning solutions.

(5) Dry the parts with dry, filtered compressed air.

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PARA 3. (cont)

I. Max. Fuel Flow Stop Adjustment

This adjustment is for Bendix fuel controls on 250–C20 engines operating in Bell 206A, 206B and Hughes 500C helicopters. Fuel controls 23007869 are bench calibrated to max flows of 235 pph (107 kg/hr) and 270 pph (122 kg/hr) with the pointer position at these flows scribe marked on the quadrant. Fuel controls 23033917 are bench calibrated to max flows of 243–248 pph (110–112 kg/hr) and 280–285 pph (127–129 kg/hr) with the pointer position at the LO and HI flow scribe marks on the quadrant. Position the pointer at the fuel flow specified in the aircraft maintenance manual. Make the adjustment as follows:

(1) Remove the lockwire from the jam nut. (See Figure 207.)

(2) Loosen the jam nut while holding the pointer in position with S1116 Bristol wrench in the internal wrenching screw.

(3) Turn the pointer with the Bristol wrench to the 235 or LO scribe mark. Turn in a clockwise direction.

(4) Hold the pointer at 235 or LO with the wrench while tightening the jam nut to 20–25 lb in. (2.3–2.8 N·m). Secure nut with lockwire.

CAUTION: AFTER MAX. FLOW STOP ADJUSTMENT IS COMPLETED, CYCLE THE LEVER THROUGH FULL RANGE TO ENSURE THAT NO CONTACT OF THE THROTTLE RETURN SPRING TO MAX. FLOW STOP OCCURS. CONTACT MAY RESTRICT FULL CUTOFF FROM BEING ATTAINED. THE CAUSE IS GENERALLY MISALIGNMENT OF THE THROTTLE RETURN SPRING BRACKET. THIS IS CAUSE FOR REJECTION OF THE FUEL CONTROL UNIT. THE UNIT SHOULD BE RETURNED TO AN AUTHORIZED MAINTENANCE CENTER FOR REPAIR.

NOTE: Fuel controls shipped new from the manufacturer or overhauled, and fuel controls on new or overhauled engines, are set at the max. mark as required for 250–C20 series engines used in Boelkow BO–105C, Aerospatiale AS–355, Bell 206L, Hughes 500D and Agusta 109 helicopters. (See Figure 207 for applicable adjustment.)

4. Cleaning

A. Cleaning the Gas Producer Fuel Control Fuel Filter

Remove, clean and reinstall the fuel control fuel filter as follows: (See Figure 208.)

(1) Remove lockwire from the plug.

NOTE: Thoroughly clean the exterior of the fuel control in the area of the plug to prevent contaminants from getting into the port after it is opened.

(2) Remove the plug, spring and filter assembly from the fuel control. Discard the packing.

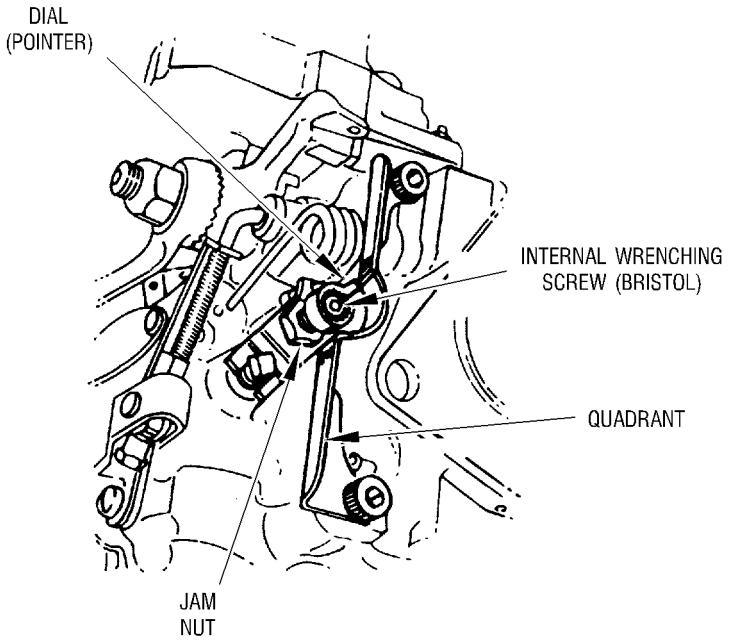
(3) Remove the clip and spring pin. Separate the washer, spring and filter from the filter sleeve.

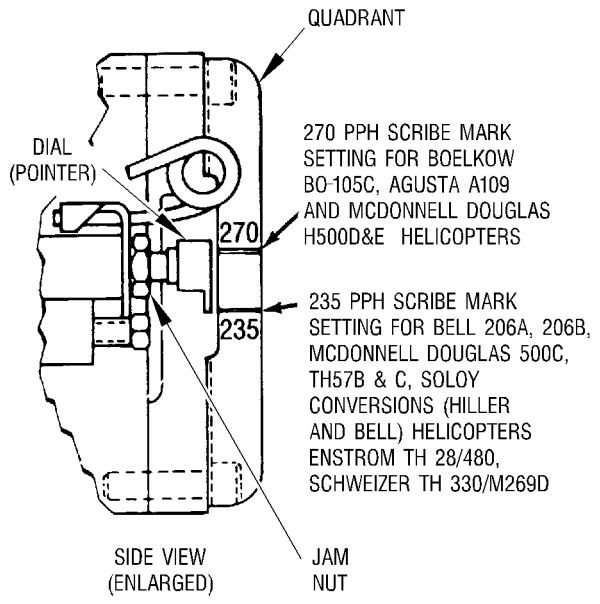
NOTE: The fuel control filter must be replaced at periodic intervals. (Refer to Table 602, 72–00–00, Engine–Inspection/Check, for time interval.) Inspect removed filter for contamination prior to discarding.

CAUTION: FUEL FLOW DIRECTION THROUGH THE FILTER IS FROM THE INSIDE TO THE OUTSIDE. MAKE SURE THAT THE INSIDE OF THE FILTER IS FREE OF CONTAMINATION.

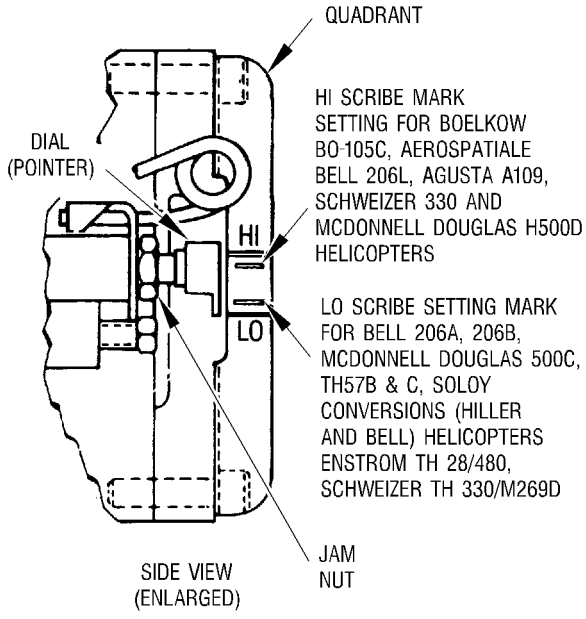
CAUTION: DO NOT ATTEMPT TO OPEN A CLOGGED SCREEN WITH A SHARP INSTRUMENT.

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P/N 23007869
(Bendix 2524644-24
and earlier)



P/N 23033917
(Bendix 2524644-26)

ADH047AA

Bendix Fuel Control Max Flow Stop Adjustment
Figure 207 (Sheet 1 of 2)

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PARA 3. (cont)

H. Max Flow Stop Adjustment—CECO Fuel Control in Bell 206B, 206B1, Hughes 500C and Soloy Conversion (Hiller) Helicopters

The fuel control has been bench calibrated and the max flow stop screw positions etch marked on the housing at 270 pph (122 kg/hr)(+) and at 235 pph (107 kg/hr)(–). (See Figure 204.) Make the setting as specified in the Bell or Hughes maintenance manuals. Position the line on the screw opposite the desired calibration point using a 3/16 in. Allen wrench. Always turn the screw the shortest angular distance between the (+) and the (–) marks when making the adjustment. Do not loosen the 3/32 in. draglock set screw (located on the side of the fuel control) which provides friction drag for the fuel flow stop adjustment screw.

NOTE: Fuel controls shipped from the manufacturers and fuel controls on new or overhauled engines are set at the (+) mark. See Figure 204 for applicable adjustment.

I. Maximum Throttle Stop

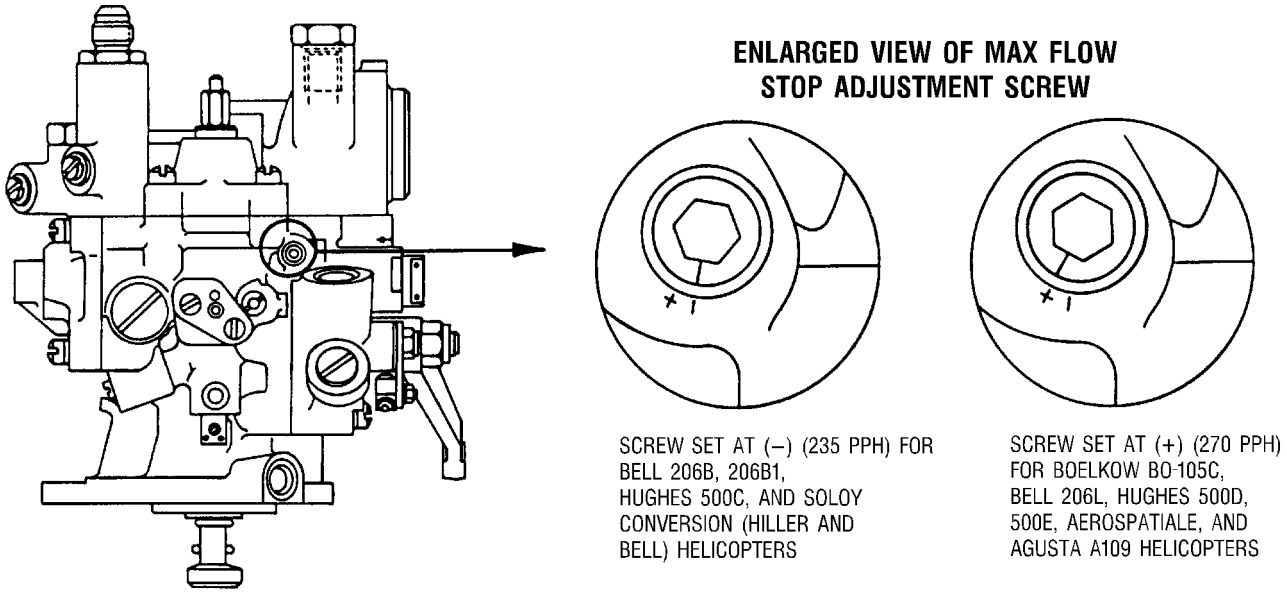
Using a 3/32 in. Allen wrench adjust the max throttle stop to obtain the required engine max power setting. Turn the stop screw clockwise to decrease angular travel or to reduce max N_1 speed. A 1/8 turn equals approximately 1% N_1.

4. Cleaning

A. Cleaning Fuel Control Filter.

Remove, clean, and install the CECO fuel control fuel filter as follows:

(1) If the engine is installed in the aircraft, remove the starter generator to obtain access to the fuel control inlet. Remove the fuel tube to the control inlet.



CECO Fuel Control Max Fuel Flow Stop Adjustment
Figure 204

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Rolls-Royce

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250-C20
250-C20B
250-C20F
250-C20J
250-C20S
250-C20W

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INTRODUCTION

NOTE: Rolls–Royce technical publications, in whole or in part, cannot be utilized as a means to establish serviceability of material not manufactured or approved by Rolls–Royce. Rolls–Royce technical publications and documents are developed solely for use in support of applicable Rolls–Royce parts. Parts, materials, or processes not approved by Rolls–Royce were not considered in the development of Rolls–Royce technical publications due to Rolls–Royce not having knowledge of any specifications or design criteria for parts, overhaul or repair processes of parts or material not authorized by Rolls–Royce. Therefore, Rolls–Royce technical publications should not be used to support or maintain engines, modules, or parts using details, parts, materials, or processes that are not Rolls–Royce approved. Rolls–Royce disclaims any liability for the performance or the failure to perform of engines, modules or parts that have been maintained or supported using parts, materials, or processes not authorized by Rolls–Royce.

1. This publication provides descriptive information, operating instructions and maintenance information for the Rolls–Royce Model 250–C20, –C20B, –C20F, –C20J, –C20S and –C20W turboshaft engines.

2. The engine consists of a compressor, a single combustion chamber, a two–stage gas producer turbine, and a two–stage power turbine which supplies the output power of the engine through the power and accessory gearbox.

3. The procedures and limits in this manual constitute the manufacturer's official recommendations for engine operation.

4. All information has been correlated with our Product Support and Engineering Groups for technical accuracy as of the published date on the title page.

5. Every task outlined in the Operation and Maintenance Manual has been successfully accomplished by organizations and individuals at the field maintenance level.

6. It is not expected that every organization or individual will possess the required special tooling, training, or experience to perform all tasks outlined. However, any task outlined herein may be performed if in the opinion of the organization or individual, the following conditions are met.

   A. Requisite knowledge of the task either through:

      (1) Formal instruction in a Rolls–Royce authorized training facility.

      (2) "On–the–job" instruction by a Rolls–Royce or Authorized Maintenance Center (AMC) representative.

      (3) Experience in performing the task.

   B. Suitable work environment to prevent contamination or damage to engine parts or modules.

   C. Suitable tools and fixtures as outlined in the Operation and Maintenance Manual.

   D. Reasonable and prudent maintenance practices are utilized.

   E. Requirements of the applicable regulatory authority regarding maintenance procedures are met.

7. Maintenance organizations and individuals are encouraged to contact Rolls–Royce through its worldwide AMC network for information and guidance on any of the tasks outlined herein. AMC directories are available from the Rolls–Royce customer support organization.

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PARA 7.C. (3) (cont)

NOTE: Due to the variation in jet fuels available for commercial operation, in cold weather the engine may experience a short delay before lightoff after the throttle is advanced to the IDLE position. This delay should be less than three seconds regardless of the type of fuel used. If the lightoff delay exceeds three seconds, return the throttle to FUEL OFF and continue to motor the engine with the starter for thirty seconds to remove excess fuel from the combustion section.

NOTE: In some instances N_1 may accelerate slowly through the 25–30% speed range on a battery start after an engine has been cold soaked and not preheated. If the start is not completed within the starter engagement time limits, shut down the engine. Before attempting the next start, wait for the starter duty cycle limits to pass or for one minute, whichever is longer. This wait will allow residual heat from the previous start attempt to soak back into the engine and battery and improve conditions for the next start attempt.

D. Power Range

During operation in the power range place the throttle in the maximum position and utilize engine power with the collective pitch. Vary the collective pitch to avoid exceeding the measured gas temperature and torque limits given in Tables 8 through 12 or the N_2 speed limit given in Figure 26, or 27. It is recommended that large collective increases be made over a 2–3 second time period to avoid momentary N_2/N_R droop.

CAUTION: DECREASING COLLECTIVE TO THE LOW POWER RANGE WILL RESULT IN AN N_2/N_R INCREASE. IF THE RPM IS RESET WITH THE BEEP SWITCH, LOW N_2/N_R RPM CAN RESULT WHEN COLLECTIVE IS INCREASED TO THE HIGH POWER RANGE UNLESS THE BEEP SWITCH SETTING IS RETURNED TO NEAR THE PREVIOUS BEEP POSITION.

E. Takeoff With Water–Alcohol Augmentation

Augmented takeoffs are limited to ambient temperatures above 4°C (40°F) and shall not exceed five minutes in duration.

F. Operating Procedure When Using Water Alcohol Augmentation

(1) Make a water–alcohol augmented takeoff as follows:

(a) Make a normal engine start. Idle the engine one minute before increasing power.

CAUTION: DO NOT MAKE RAPID POWER DECELERATIONS OR OPERATE N_2 AT LESS THAN 95% SPEED WHILE USING WATER–ALCOHOL AUGMENTATION.

(2) Rotate throttle to full open and increase TOT to 738°C (1360°F). Then turn on the water alcohol system. (Power will remain steady while the TOT will decrease.) After TOT has stabilized, adjust power to desired setting but do not exceed 810C (1490°F), the maximum torque limit or the maximum N_1 speed limits.

NOTE: Acceleration time to augmented Takeoff power will require approximately two seconds more than acceleration time to nonaugmented Takeoff power.

(3) Before turning off the water–alcohol system, reduce TOT to not less than 738°C (1360°F).

G. Practice Autorotation Descent and Landing

CAUTION: BEFORE INITIATING A PRACTICE AUTOROTATION, MAKE SURE THAT A DECELERATION CHECK WAS MADE AFTER THE LAST FLIGHT OF THE PREVIOUS DAY. IF MULTIPLE CONTROLS ARE INSTALLED, MAKE SURE THAT THE CHECKS WERE MADE USING BOTH THE PILOT AND CO–PILOT THROTTLES. FAILURE TO MAKE A DECELERATION CHECK COULD CAUSE ENGINE FLAMEOUT.

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PARA 7.G. (cont)

NOTE: If there is any doubt that the deceleration check was made during shutdown after the last flight of the previous day, make the decel check before initiating a practice autorotation. (Refer to Item 6, Table 601, Preflight and Postflight Inspections, 72–00–00, Engine–Inspection/Check.)

To make a practice autorotation landing at minimum engine power, position the throttle in the GROUND IDLE position and observe the following conditions.

(1) During autorotation, avoid a pausing or creeping movement of any throttle increase or decrease between IDLE and FULL OPEN. If the movement is not made at a firm and continuous rate, N_1 rpm undershoot and/or oscillation (which may cause a momentary, false Engine Out warning indication) may occur.

(2) The throttle must be positioned at maximum before making any collective increase, so full engine power will be available upon demand.

NOTE: N_2 instability may be encountered during practice auto rotation. This is a normal condition when in autorotation.

H. Air Restart

The following air start procedures apply to either starts made during an emergency or to starts made during normal restart conditions:

CAUTION: IF ENGINE MECHANICAL FAILURE IS SUSPECTED, AN AIR RESTART SHOULD NOT BE ATTEMPTED.

(1) Emergency Restart

When immediate power restoration is required, make an emergency air restart by energizing the starter within 10 seconds after power loss occurs.

NOTE: N_1 will not decrease below minimum starting speed within the 10 seconds because of rotational inertia plus possible ram effect. The throttle can be left in the open position since fuel flow during the start will be on the normal acceleration schedule.

CAUTION: DUE TO THERMAL CHANGES WITHIN THE TURBINE, THE GAS PRODUCER SECTION OF THE ENGINE MAY LOCK UP AFTER AN INFLIGHT SHUTDOWN. THIS IS A TEMPORARY CONDITION WHICH EXISTS AFTER THE ENGINE HAS BEEN SHUT DOWN FOR APPROXIMATELY ONE MINUTE AND WHICH MAY CONTINUE FOR UP TO TEN MINUTES FOLLOWING THE SHUTDOWN. THEREFORE, EXCEPT DURING AN EMERGENCY, AIR STARTS SHOULD NOT BE ATTEMPTED DURING THE TIME PERIOD BETWEEN ONE MINUTE AFTER SHUTDOWN AND TEN MINUTES AFTER SHUTDOWN.

(2) Normal Restart

Make a normal restart as follows:

(a) With the throttle in FUEL OFF, energize the starter and ignition exciter.

(b) At the desired N_1 speed (or above) position the throttle in the full open position. Use the following guide to determine desired N_1 starting speed versus outside air temperature.

15% N_1 rpm above 7°C (45°F)

13% N_1 rpm from minus 18 to plus 7°C (0 to 44°F)

12% N_1 rpm below minus 18°C (minus 1°F)

(c) De–energize the starter at 58% N_1 speed.

(d) Apply collective pitch as required.

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
17 (cont)	Grease (cont)	Lubricate packings in fuel control fuel or air passages.	ASTM No. 5 Oil Sun Oil Company 1608 Walnut Street Philadelphia, Pennsylvania 19103
		Lubricate packings in fuel control fuel or air passages. (cont)	Alternates to ASTM No. 5 Oil: 1. 45-55% fuel (MIL-C-7024B, Type II) mixed with 45-55% STP Oil Treatment 2. MIL-D-6081, Grade 1010 oil
		Fuel Pump internal drive shaft splines (TRW/Argo-Tech pumps only)	Plastitube No. 3 Warren Refining Division Parr Inc. 5151 Denison Ave. Cleveland, Ohio 44102
18	Antiseize	P_c filter threads and external threads-protects up to 232°C (450°F)	DC 550 Fluid Dow Corning Corp. South Saginaw Road Midland, Michigan 48641
		Hot section external threads (not to be used where exposed to the engine oil system) and Compressor tie bolt	Never Seez Nickel Special (NSN165) Bostik, Emhart Chemical Group Boston Street Middleton, MA 01949
			LOCTITE Nickel Anti-Seize (77164) Henkel Corp. 1001 Trout Brook Crossing Rocky Hill, CT 06067
		Assembly-Compressor adapter nut.	Never-Seez Nickel Special (NSN165) Bostik, Emhart Chemical Group Boston Street Middleton, MA 01949
			LOCTITE Nickel Anti-Seize (77164) Henkel Corp 1001 Trout Brook Crossing Rocky Hill, CT 06067
		External threads not exposed to oil system. Protects to 760°C (1400°F)	CP-63 (MIL-L-25681B) E/M Lubricants Inc. P.O. Box 2200 Highway 52, N.W. West Lafayette, Indiana 47906
19	Calibration fluid	Cleaning fuel nozzle tips	Stoddard solvent, refined kerosene (MIL-F-7024, type II) 300-400 boiling range.
20	Corrosion compound	Inhibiting fingerprint corrosion	Non-Rust X-210 Daubert Chemical Co., Inc. 4700 S. Central Ave. Chicago, Illinois 60038
21	Weld rod	Exhaust collector support ducts	AISI 349, (29-9 W Mo). (MIL-R-5031, class 6) (AMS 5784).

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
22	Weld rod	Turbine and exhaust collector struts	Hastelloy W (AMS 5786) (MIL–R–5031 class 12)
23	Engine gray enamel	Gearbox touch–up	Actithane WC 100 Paint and Lacquer Reducer H251 Saran Protective Coatings Co. 17332 Shields Detroit, MI 48212 Pu Gray Paint, Code 03–GY–401 Color #16251 Fed. Std. 595B DEFT Chemical 17451 Von Karmon Ave. Irvine, CA 92714–6205
24	Petrolatum	Metallic seal and bearing installation	Commercial
25	Moisture proof barrier material	Engine packaging	Flexkin 100P (MIL–B–131). Acme Backing Corp. P.O. Box 360 Stamford, Connecticut 06904
26	Marking pencils	Marking hot section parts	See Table 303.
27	Dehydrating agent 16–unit bags	Storage and shipment	CS–16 (MIL–D–3464). Filtrol Corp. 3250 East Washington Los Angeles, California 90023
28	Pressure sensitive masking tape, one in. (25 mm) or two in. (51 mm) width	Storage and shipment	No. 260 Scotch Brand. Minnesota Mining and Mfg. Co. 3M Center St. Paul, Minnesota 55101
29	Black stencil ink	Storage and shipment	K–1 (TT–I–559). March Stencil Machine Co. 707 East B St. Belleville, Illinois 62222
30	Moisture absorbing rust preventative	Compressor preservation	No. 606 Rust–Lick Incorporated 755 Boylston Street Boston, Massachusetts 02116 Rocket WD–40 (MIL–C–23411). WD–40 Co. San Diego, California

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
30 (cont)	Moisture absorbing rust preventative (cont)	Compressor preservation (cont)	WD–40 Dr. Oskar Trost Industrie und Auto Chemie 2350 Neumünster West Germany WD–40 Betriebs u. Werkstatt Zubehör GmbH Riedstrasse 25 7302 Ostfildern 1– Ruit West Germany WD–40 Hawker Pacific, Pty. Ltd. 4–8 Harley Crescent Condell Park New South Wales 2200 Australia Pengard Penetone Co. Ltd. Bassington Industrial Estate Cramlington, Northumberland United Kingdom Ardrox 3961 Ardrox Limited Commerce Road Brentford, Middlesex, England or Ardrox Australia Pty. Ltd. Birnie Avenue Lidscombe N.S.W., 2141 Australia CRC 3–36 CRC Chemicals Division C.J. Webb Inc. Limekiln Pike Dresher, Pennsylvania 19025
31	Methylethylketone	General cleaning	Commercial
32	Sealant	Assembly—oil bellows seal	Loctite 30558 Permatex Co. Inc. Box 1350 Flanger Court Bldg. West Palm Beach, FL 33402
33	High temperature lubricant	Where antiseize is specified in this manual.	Never–Seez Nickel Special. Bostik, Emhart Chemical Group Boston Street Middleton, MA 01949

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
33 (cont)	High temperature lubricant (cont)	Where antiseize is specified in this manual. (cont)	Bearing Supply and Service 448–472 Notre Dame Ave. Winnipeg 2, Canada R. A. Rodriguez (U.K.) Ltd. Station House–Darkes Lane Potters Bar Herts, England Consolidated Brg, Co. Pty. Ltd. 238 Victoria Rd. Drummoyne, N.S.W. Australia Kyokuto Boeki Kaisha Ltd. 7th Floor, New Otemachi Bldg. 2–1, 2–Chome, Otemachi Chiyoda–Ku, Tokyo, 100–91 Japan S. A. Brasileira De Rolamentos E. Mancais BRM Av. Senador Queiroa, 605 Conj. 1609 Sao Paulo, Brazil Tekind Via F. Melzi D'Eril, 3 20154 Milano, Italy DSL Super Hi–Temp Davis–Howland Oil Corporation 200 Anderson Avenue Rochester, New York 14607
34	Sealer	Compressor mounting insert installation	Devcon F (aluminum). Devcon Corp. 59 Endicott St. Danvers, Massachusetts 01923 Resiweld FE186 H. B. Fuller Company 2400 Kasota Ave. St. Paul, Minnesota 55102 Metal Set A–4. Smooth–on Inc. 1000 Valley Road Gillette, New Jersey 07933

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
34 (cont)	Sealer (cont)		Epon 934 Hysol Div. Dexter Corp. 2850 Willow Pass Road Pittsburgh, California 94565 Loctite 609 Loctite Corporation 705 North Mountain Road Newington, Connecticut 06111
		Compressor mounting insert installation	Scotch–Weld 2214 product of the 3M Company Adhesives and Sealers Division 2501 Hudson Road St. Paul, Minnesota 55119
		Compressor case vane band bolt holes and manifold to adapter splitline	RTV 736 or RTV 732 Dow Corning Corp. South Saginaw Road Midland, Michigan 48640 RTV 106 General Electric Corp. Waterford, New York 12188
		Assembly—gearbox splitline	Scot Clad 776 Scotch Clad Coatings Minnesota Mining and Mfg. Co. 3–M Centre St. Paul, Minnesota 55101 DC 994 Dow Corning Corp. South Saginaw Road Midland, Michigan 48641
		Installation of labyrinth stationary seal bearing area	Loctite 620 or 602 Loctite Corp. 705 North Mountain Road Newington, CT 06111
35	Sealant remover	Removal of Loctite 620 or 602	Loctite “chisel” solvent Loctite Corp. 705 North Mountain Road Newington, CT 06111

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
36	Methyl alcohol (Fed Spec O-M 232d, grade A) (British Standard BS 506 Amend. 1)	Compressor water rinse	Commercial Solvents Corp., 245 Park Ave. New York, N.Y. 10017 Union Carbide Corp. Chemicals and Plastics, 270 Park Ave. New York, N.Y. 10017
37	Desiccant	Shipping package humidity control	No. 88 Absorbent Protective Dehydrating Agent (MIL-D-3464) Delta Packaging Products 4108 North Nashville Avenue Chicago, Illinois 60634
38	Liquid leak detector	Checking for pneumatic leaks	SNOOP (meets Mil Spec MIL-L-25567C, type 1 oxygen systems) Indiana Valve & Fitting Inc. P.O. Box 24267 Indianapolis, Ind 46224 Leak-Tec Formula 372E American Gas and Chemical Co. 5 Tefnakil Park Cresskill, New Jersey 07626
39	Adhesive	Oil pump gearshaft retention	Loctite 290 Loctite Corporation 705 North Mountain Road Newington, Connecticut 06111
40	Fuel additive	Fuel anti-ice	Prist (MIL-I-27686E) PPG Industries Inc. 5629 FM 1960 West Houston, Texas 77069
		Anti-microbial growth MIL-S-53021A	Biobor JF Aviation Fuel Additive Hammonds Technical Services, Inc 910 Franklin Rd. Houston, TX 77073 Ph: (281) 999-2900 Fax: (281) 582-4224 Email: info@hammondscos.com Web: www.hammondscos.com
41	Torque Paint	Application of slippage marks to pneumatic and lubrication system B-nuts	Torque Seal F-900 Organic Products Company P. O. Box 428 Irving, Texas 75060-0428
42	Torque Paint Remover	Removal of torque paint (slippage marks)	F-100 Remover Organic Products Company P. O. Box 428 Irving, Texas 75060-0428

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Table 302 (cont)

Summary of Consumable Materials

Item	Material	Usage	Acceptable Source
43	Silicone resin sealer-clear (AMS 3135)	Repair of compressor case plastic cracks	Metroseal AP Metco Inc. 1105 Prospect Ave. Westbury, Long Island, New York 11590 RC-21 Silicon Resin Amtex 890 Fern Hill Road West Chester, PA 19380 Sildon 30 Basildon Chemical Co. Lt Kimber Road Abingdon, Oxfordshire England OX14 1R2 1-2531 Dow Corning Corp. South Saginaw Road Midland, Michigan 48640
44	Assembly fluid	Assembly aid	Ultra Chem Co. 1 Ultra Chem Inc. 1400 N. Walnut Street Wilmington, Delaware 19899
45	Hi temperature aluminum paint	Various splitlines	TTP 28 Griggs Paint 3635 16th St. Pheonix, AZ 85040-1310

NOTE: Even though Rolls-Royce has approved these cleansers for use with Rolls-Royce engines, Rolls-Royce assumes no liability for injury to personnel or the environment by their use.

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7 If a chip light is encountered during the second 30-minute ground run, remove the engine from service and send to a Rolls-Royce Authorized Maintenance Center (AMC). Clean the aircraft engine oil system (Ref. para 11.G.(3)(c), this section).

NOTE: If warning light illuminates within the next eight operating hours following a 30-minute ground run and the cause is determined to be an accumulation of magnetic particles and debris (chips, flakes or slivers), remove the engine and send to an Rolls-Royce Authorized Maintenance Center. Tag engine noting cause for rejection. This note is applicable only after para 11.G.(3)(c), this section, has been completed (Reference Oil Drain and Flush) otherwise this is another event.

(d) A maximum of four (4) occurrences of magnetic chip warning light encountered within any 50 hours of engine operation requires removal of the engine for shipment to a Rolls-Royce Authorized Maintenance Center (AMC).

NOTE: Magnetic light indications where only paste is present must still be counted in the four and 50 hour criteria.

(4) Magnetic Plug Quick Disconnects

If quick disconnect magnetic chip detector plugs are installed, inspect the locking pins and flanged inserts for wear as follows:

(a) Inspect the three locking pins for proper condition and wear. The minimum allowable pin diameter on any one pin is 0.070 in. (1.78 mm). The plug should be replaced by a serviceable item if any one or more pins are worn to less than 0.070 in. (1.78 mm) diameter (Ref. Figure 303).

NOTE: The point of wear is usually on the side of the pin nearest the spring loaded ring. Push the ring back to obtain better access for inspection.

(b) Inspect the insert for proper condition and wear of the locking cam slot. The material remaining between the end of the cam slot and the edge of the insert must be more than 0.068 in. (1.73 mm) (Ref. Figure 303). Replace the insert with a serviceable item if excessively worn. (Refer to Commercial Engine Bulletin 250-C20 CEB 1143 for details of insert replacement.)

NOTE: If local personnel, tooling, and facilities are inadequate, send the gearbox assembly to an Authorized Maintenance Center.

(c) Reinstall serviceable magnetic plug.

(d) Reconnect electrical wiring as applicable.

(e) Replenish engine oil as necessary.

(f) Make the appropriate entry relative to the magnetic plug inspection on the Inspection Check Sheet maintained as a part of the engine records.

(5) Operational Check

(a) If magnetic plugs are removed for scheduled maintenance, perform an operational check prior to reinstallation. Connect harness lead and bridge plug with a suitable conductor. Check each plug separately for proper cockpit indication.

(b) Reinstall magnetic plug, tighten to 60-80 lb in. (6.8-9.0 N·m).

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ENGINE–ADJUSTMENT/TEST

1. Check Run

   A. Operating Instructions.

   Check run the engine in the airframe when the compressor assembly, compressor case, turbine assembly, combustion section, gearbox, fuel control, governor, fuel pump, fuel nozzle, or thermocouple has been removed, repaired or replaced. Operate the engine in accordance with Operating Procedures, para 7, (250–C20, –C20B, –C20F, –C20J), para 8, (250–C20S, –C20W), 72–00–00, Engine—Description and Operation. Make note of all incidents of the run such as leaks, abnormal vibration or noises, and/or any irregular functioning of engine equipment. Also note that the following items are within limits (Refer to Operating Limits, para 6., 72–00–00, Engine—Description and Operation):

   (1) Measured gas temperature. (See Table 8 or 9, 72–00–00, Engine—Description and Operation.)

   (2) Output shaft torque. (See Table 10, 11 or 12, 72–00–00, Engine—Description and Operation.)

   (3) Oil pressure. (Refer to Oil Pressure and Temperature, para 6.D., 72–00–00, Engine—Description and Operation.)

   (4) Gas producer N_1 speed. (Refer to Engine Speed, para 6.A., 72–00–00, Engine—Description and Operation.)

   (5) Power turbine N_2 speed. (Refer to Engine Speed, para 6.A., 72–00–00, Engine—Description and Operation.)

   B. Diffuser Vent Orifice Selection

   Select and install the diffuser vent orifice as follows:

   (1) Install a –7 size orifice on the diffuser vent tube. (See Figure 501.)

   (2) Clean the area around the orifice.

   CAUTION: DO NOT INSTALL A SMALLER ORIFICE (LOWER DASH NUMBER) THAN THAT REQUIRED TO STOP SPEWING OR SMOKING AT THE VENT.

   (3) Following the next flight of at least five minutes' duration, inspect the area around the orifice. If there is any evidence of smoking or spewing from the vent, reduce the orifice size by installing the next lower dash number orifice.

   (4) Repeat the flight, inspection, and orifice replacement until no evidence of spewing or smoking is encountered.

   (5) As an alternate method for obtaining the desired orifice size, start with two –2 size orifices (No. 1 and No. 2).

      (a) Drill out No. 1 orifice to 0.236–0.244 in. (5.994–6.198 mm). No. 1 orifice then becomes a –3 orifice. If No. 1 does not smoke when checked during engine operation, resize No. 2 orifice.

         NOTE: When smoking is encountered, reinstall the previously drilled smaller orifice that did not smoke.

      (b) Drill out the No. 2 orifice to 0.266–0.274 in. (6.76–6.96 mm). No. 2 orifice then becomes a –4 orifice. If No. 2 does not smoke when checked during engine operation, resize No. 1 orifice.

      (c) Drill out the No. 1 orifice to 0.296–0.304 in. (7.52–7.72 mm). No. 1 orifice then becomes a –5 orifice. If No. 1 does not smoke when checked during engine operation, continue alternately enlarging the No. 1 then the No. 2 orifice by one dash number size until the desired orifice is obtained.

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PARA 2.C. (2) (cont)

(b) Rotorturner by MCT Helitune

(c) Scientific Atlanta Model 2538

(d) Helitune Quan–Tech 9500 Spectrum Analyzer

(3) Other equivalent units may also be utilized.

D. Test Procedure

CAUTION: PERFORMANCE OF THIS PROCEDURE REQUIRES KNOWLEDGE OF BOTH ENGINE AND AIRCRAFT MAINTENANCE PROCEDURES. REFER TO THE RESPECTIVE OPERATION AND MAINTENANCE MANUALS.

CAUTION: SECURE PICKUP LEAD WIRES TO PREVENT ENTANGLEMENT WITH AIRCRAFT CONTROL LINKAGES. ROUTE LEAD WIRE TO PREVENT SURFACE CONTACT WITH ENGINE.

NOTE: The following procedures apply to use of the Chadwick Model 192 analyzer. Operational procedures for other analyzers will be similar.

(1) Install vibration pickups vertically on each engine module as shown in Figure 503 and in the following instructions.

(a) Compressor. Install one vertical vibration pickup on the front side of the compressor–to–inlet housing splitline at the 12 o'clock position. Use a balance ''T''–type bracket, such as Rolls–Royce part number 23032992 (see Figure 504) or use the equipment manufacturer's bracket.

(b) Gearbox. Install one vertical vibration pickup on the engine top mounting pad (bottom mounting pad on 250–C20S, –C20W) on the power and accessory gearbox. Use bracket such as Rolls–Royce part number 23032993. (See Figure 505.)

CAUTION: THE TURBINE PICKUP MUST BE A HIGH TEMPERATURE PICKUP IN ORDER TO WITHSTAND THE EXTREME HEAT OF THE TURBINE CASE.

NOTE: The bracket below fastens on the forward side of the splitline.

(c) Turbine (250–C20, –C20B, –C20F, –C20J). Install one vertical vibration pickup on the forward side of the gas producer–to–power turbine support splitline at the 12 o'clock position. Use a balance ''T''–type bracket such as Rolls–Royce part number 23032992 (see Figure 504) or use the equipment manufacturer's bracket.

(d) Turbine (250–C20S, –C20W). Install one vertical vibration pickup on the forward side of the gas producer–to–power turbine support splitline at the 6 o'clock position. Use a balance ''T''–type bracket such as Rolls–Royce part number 23038047 (see Figure 506) or use the equipment manufacturer's bracket.

CAUTION: BE SURE THAT THE SPECTRUM ANALYZER AND VIBRATION PICKUPS ARE PROPERLY CALIBRATED. REFER TO MANUFACTURER CALIBRATION EQUIPMENT AND PROCEDURES. IT IS RECOMMENDED THAT PICKUPS BE CALIBRATED BEFORE EACH USE OR WHENEVER OUT–OF–NORMAL VIBRATION LEVELS ARE DETECTED, WITH MINIMUM CALIBRATION TIME EVERY SIX MONTHS.

(2) Using the blue card (10 IPS side) in the spectrum analyzer, measure the frequency range desired at any test point except test point 6. (See Figure 507.)

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	100 Hour Inspection (cont)			
21	Lubrication system inspection			
	NOTE: Maximum interval between oil change is 100 hours or six months, whichever occurs first. This hour limit can be extended to 200 hours for those items indicated by an asterisk (*) if an external oil filter of a type that has a valid STC (Supplemental Type Certificate) is installed on the engine. The calendar limit can be extended to 12 months for those items indicated by an asterisk (*) and if an approved high stability oil (Third Generation) is used.			
	*a. Drain oil system.	PARA 11.C., 72-00-00, Engine-Servicing		
	b. Remove, inspect and clean the oil filter. Note any accumulation of metal chips, debris or carbon particles. Conduct further inspection of the lube system and/or engine gear train/bearings if metal chips or debris are found. See Items 21a, 21e, 38, 39 and 40 below if carbon particles are found.	PARA 1.C., 72-60-00		
	NOTE: Follow STC manufacturer's recommendations regarding replacement/cleaning of external oil filter elements. Inspect removed elements for any accumulations of metal chips, debris or carbon particles. It may prove helpful to cut apart disposable (paper) filler elements to facilitate this inspection. If chips, debris or carbon particles are found, proceed with additional inspection/maintenance as outlined in item 21b. above.			
	*c. Inspect and clean turbine pressure oil check valve.	PARA 7.K., 72-50-00		
	NOTE: Check Valve P/N 23074872 and subsequent part numbers are not applicable to this inspection (these valves are considered "ON CONDITION").			
	*d. Turbine pressure oil tube screen assembly. Detach clamp; then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the tube coupling nut at the fireshield elbow only enough to allow sufficient movement of the tube to enable removal of the screen. At assembly, tighten connector coupling nut to 200-250 lb in. (23-28 N·m). Tighten fireshield elbow coupling nut to 80-120 lb in. (9-14 N·m). Tighten clamp nut to 35-40 lb in. (3.9-4.5 N·m).	N/A		
	*e. Measure oil flow from the scavenge passage of the external sump and from the scavenge passage of the gas producer support. It is recommended that the external sump is not removed for this check.	PARA 7.D., 72-50-00		
	NOTE: This step must be performed before draining oil or after the oil system has been refilled.			

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PARA 6.A.(1)(c) (cont)

5 Spray water into the compressor inlet for 10 seconds while the engine is being motored with the starter. The spray must flow the water as close to the bullet nose of the compressor inlet as possible to ensure that all of the spray is injected into the engine. Do not flood the engine prior to starter engagement.

NOTE: Observe engine speed during the 10 second rinsing operation. The engine rpm will generally stagnate at or just below 10%, but when using a fully charged battery or an A.P.U., the rpm may tend to exceed 10%.

6 Continue injection of water spray during coast down until N_1 stops; this procedure improves the rinse of the base of the blades. Do not continue spray after engine stops.

7 Allow engine to drain. Combustion drain valves may be removed to improve rapid draining of the turbine.

8 Restore engine to operating configuration.

a Remove the wedge from the bleed valve.

b Reinstall the combustion drain valves, and plumbing, if previously removed.

9 Within 15 minutes of the water rinse, operate the engine at idle for five minutes to purge and evaporate all residual water as soon as possible, actuate anti–icing system for one minute.

NOTE: If exposure to excessive salt or other corrosive media has occurred, a repetition of the rinse procedure may be necessary. In cases where the engine has not been receiving regular daily water rinsing, a double rinse may be required to prevent corrosive attack of metals in the engine.

B. Cleaning Compressor Blading

CAUTION: NEVER PERFORM THE CLEANING PROCEDURE WHILE THE ENGINE IS OPERATING; THE COMPRESSOR BLADES AND VANES MAY BE DAMAGED. A MOTORED CLEANING PROCEDURE UTILIZING THE STARTER WITH N_1 SPEED BELOW 10% IS THE ONLY AUTHORIZED PROCEDURE FOR THE MODEL 250–C20 SERIES ENGINES.

CAUTION: ONCE THE COMPRESSOR BLADE CLEANING PROCEDURE HAS BEEN STARTED, IT MUST BE CARRIED THROUGH TO COMPLETION WITHOUT DELAY.

(1) Clean the compressor to regain lost performance due to buildup of dirt.

(2) Cleaning is normally required after 200–300 hr of operation in smoggy areas.

(3) Do not spray cleaning solution into a hot engine. The engine temperature should be satisfactory for cleaning when the bare hand can be placed on the outer combustion case without discomfort.

(4) Tubing must be removed and the bleed valve must be blocked closed during the cleaning.

(5) The solution for cleaning the compressor blading consists of an approved cleaner and water, distilled if available. Refer to Table 301, 72–00–00, Engine–Servicing.

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PARA 1. (cont)

(h) Ignition lead at exciter.

(9) Make appropriate entry relative to gearbox replacement in the Engine Log.

(10) Check run the engine after gearbox replacement. (Refer to Check Run, para 1., 72–00–00, Engine–Adjustment/Test.)

NOTE: When the power and accessory gearbox has been replaced, check the system oil level before and after the check run.

B. Oil Seals Replacement

Replace leaking power and accessory gearbox seals as follows:

(1) Remove the accessory or drive from the gearbox pad.

CAUTION: DO NOT PRY BETWEEN THE SEAL CAVITY IN THE HOUSING AND THE SEAL.

(2) Use the 6796941 seal replacement kit to remove the seal. Be careful not to contaminate the shaft bearing or damage the gear shaft. The seal will be damaged during removal, consequently it will not be salvageable.

CAUTION: DO NOT USE SILICONE LUBRICANTS EXCEPT WHERE SPECIFIED. USE ONLY THE LUBRICANTS RECOMMENDED IN THE TABLE 301, 72–00–00, ENGINE–SERVICING.

(3) Apply engine oil to the seal lip to aid the installation, then carefully drive (or press) the replacement seal in place.

(4) Reinstall the accessory or drive on the gearbox pad.

C. Oil Filter Replacement (See Figure 203 or 204.)

Remove, inspect, clean and install the oil filter as follows: (Refer to Gearbox Housing Lubrication System Components Disassembly, para 2.D., this section.)

(1) On 250–C20, –C20B, –C20F and –C20J engines, place a cloth between the gearbox and the turbine to catch oil which will overflow the element housing when the cap is removed. On 250–C20S and –C20W engines, place a container under the filter to catch the oil which will drain.

NOTE: Some engines have an impending oil filter bypass indicator cap.

(2) Remove two nuts and washers; then using 6798860 puller, remove the oil filter cap. Use a suction gun or other suitable device to remove the puddled oil from the filter housing before the element is removed.

(3) Remove the filter element (and packing on applicable configurations) from the housing. Discard the packing.

(4) Inspect filter element and filter cavity for metal particles.

(a) A small amount of metallic debris is acceptable after recent overhaul or repair. If excessive metal contamination is present, clean filter and perform ground run for 30 minutes at power with rotors turning.

(b) Check filter after ground run for new accumulation of particles. If filter is clean, release aircraft for flight. If accumulation is present after second ground run, tag engine, noting cause for rejection.

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PARA 2.C. (cont)

(5) Lift the helical power takeoff gearshaft roller bearing outer race and rollers from the gearbox housing.

(6) Remove lockwire, then remove the torquemeter support shaft nut, using 6795597 wrench and 6795974 aligning fixture. (See Figures 220 and 221.) Remove packing and washer. Discard the packing.

(7) Remove the shaft.

(8) Remove the torquemeter support shaft bearing end plate and washer from the gearbox housing. Remove and discard packing from the shaft. Remove piston and bearing from the shaft.

(9) Remove expander and piston ring. Remove ball bearing from the piston using 6796947 drift and 6796950 plate with detail –6.

(10) Remove the bearing outer race and rollers from the support shaft. Remove the bearing inner race from the support shaft using 6796947 drift and 6796950 plate with detail –4.

D. Gearbox Housing Lubrication System Components Disassembly

Disassemble the gearbox housing lubrication system components as follows: (See Figure 222 or 223.)

NOTE: Some engines have an impending oil filter bypass indicator cap.

(1) Remove the two nuts, washers, oil filter cap, oil filter and packings from the filter housing. Discard the packings.

(2) Remove the eight nuts and washers and lift the lube oil filter housing from the gearbox housing. Discard the gasket.

NOTE: Do not remove the studs, standpipe or two valve seats in steps 3 and 4.

(3) Remove the lockwire and remove the pressure regulator components from the filter housing. These components are: poppet guide, packing, spring, and poppet.

(4) Remove the internal retaining ring and the filter bypass components from the filter housing. These components are: poppet guide, packing, spring, and poppet.

(5) (250–C20S, –C20W) Remove the lockwire and remove the magnetic drain plug from the filter housing. Discard the packing.

(6) Remove the screw and separate the oil pressure tube from the gearbox housing. Discard the packing.

(7) Remove the screw and separate the oil delivery tube from the gearbox housing. Remove the screen and discard the three packings.

(8) Remove the three oil transfer tubes. Discard two packings from each tube.

(9) Remove the screw retaining the scavenge oil pickup tube. Do not remove the tube until the pump is removed (step 12).

(10) Remove the check valve. (See Figure 221 or 222.) Remove and discard the two packings. Do not disassemble the check valve.

(11) Remove the fuel control and oil pump flex shaft coupling.

(12) Remove the eight pump attaching screws and six washers. Remove the oil filter inlet and bypass tubes. Remove the transfer tube to the filter housing (250–C20S, –C20W only). Discard two packings from each. Remove the pump and the scavenge oil pickup tube. Discard the packing from the tube. Discard the gasket and packing beneath the pump. Do not disassemble the pump.

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PARA 2.I. (cont)

(6) Apply antiseize compound lightly to the threads of studs and bolts used to attach the gearbox cover to the gearbox housing. The cover is secured by 39 nuts, 4 bolts, and 43 washers. (See Figure 205, 206 or 207.)

(a) Tighten the two 10–32 bolts to 20–25 lb in. (2.3–2.8 N·m).

(b) Tighten the 10–32 nuts to 35–40 lb in. (3.9–4.5 N·m).

(c) Tighten the 1/4–28 nuts to 70–85 lb in. (7.9–9.6 N·m).

(d) Tighten the 5/16–24 bolts to 120–150 lb in. (14–17 N·m) and secure with lockwire.

(7) Check the operation of the power and control gear trains to make sure no binding is present between the meshing teeth.

(a) Turn the power train counterclockwise through the power turbine fuel governor pad. (See Figure 234.) Use 6799790 engine turning adapter. No binding is acceptable.

(b) Turn the control gear train counterclockwise through the gas producer fuel control pad. (See Figure 234.) Use 6799790 engine turning adapter. No binding is acceptable.

(8) Remove the 6886201 power takeoff roller bearing guide from the helical power takeoff gearshaft. Install the gearbox housing seal in the power output pad (use detail –19). Lubricate the seal with engine oil prior to installation.

3. Adjustment/Test

A. Oil Pressure Regulating Valve (See Figure 222 or 223.)

CAUTION: EXCEPT FOR INITIAL ADJUSTMENTS ON NEWLY INSTALLED ENGINES, DO NOT ADJUST THE PRESSURE REGULATING VALVE TO CORRECT FOR HIGH OIL PRESSURE. DO NOT MAKE A PRESSURE REGULATING VALVE ADJUSTMENT TO CORRECT FOR A SUDDEN INCREASE OR RAPID CHANGE IN OIL PRESSURE. THESE CONDITIONS ARE CAUSE TO SUSPECT OTHER OIL SYSTEM PROBLEMS HAVE DEVELOPED.

(1) Make necessary changes in the engine oil pressure by adjusting the pressure regulating valve. (Refer to Gearbox Housing Lubrication System Components Disassembly, para 2.D., this section.)

NOTE: During the initial check run of a newly installed engine the pressure regulating valve may be adjusted to increase or decrease oil pressure as per specified limits. A direct reading gage is to be utilized anytime an adjustment to the pressure regulating valve is required.

(a) Remove the lockwire.

(b) Using a wrench turn the regulating valve clockwise to increase and counterclockwise to decrease the oil pressure. An approximate adjustment may be made by bottoming the valve and then backing it out 5–1/2 turns. One turn of the adjustment will change the oil pressure approximately 13 psig (90 kPag). Oil pressure is 115–130 psig (793–896 kPag) at 107°C (225°F) oil temperature.

4. Inspection/Check/Repair

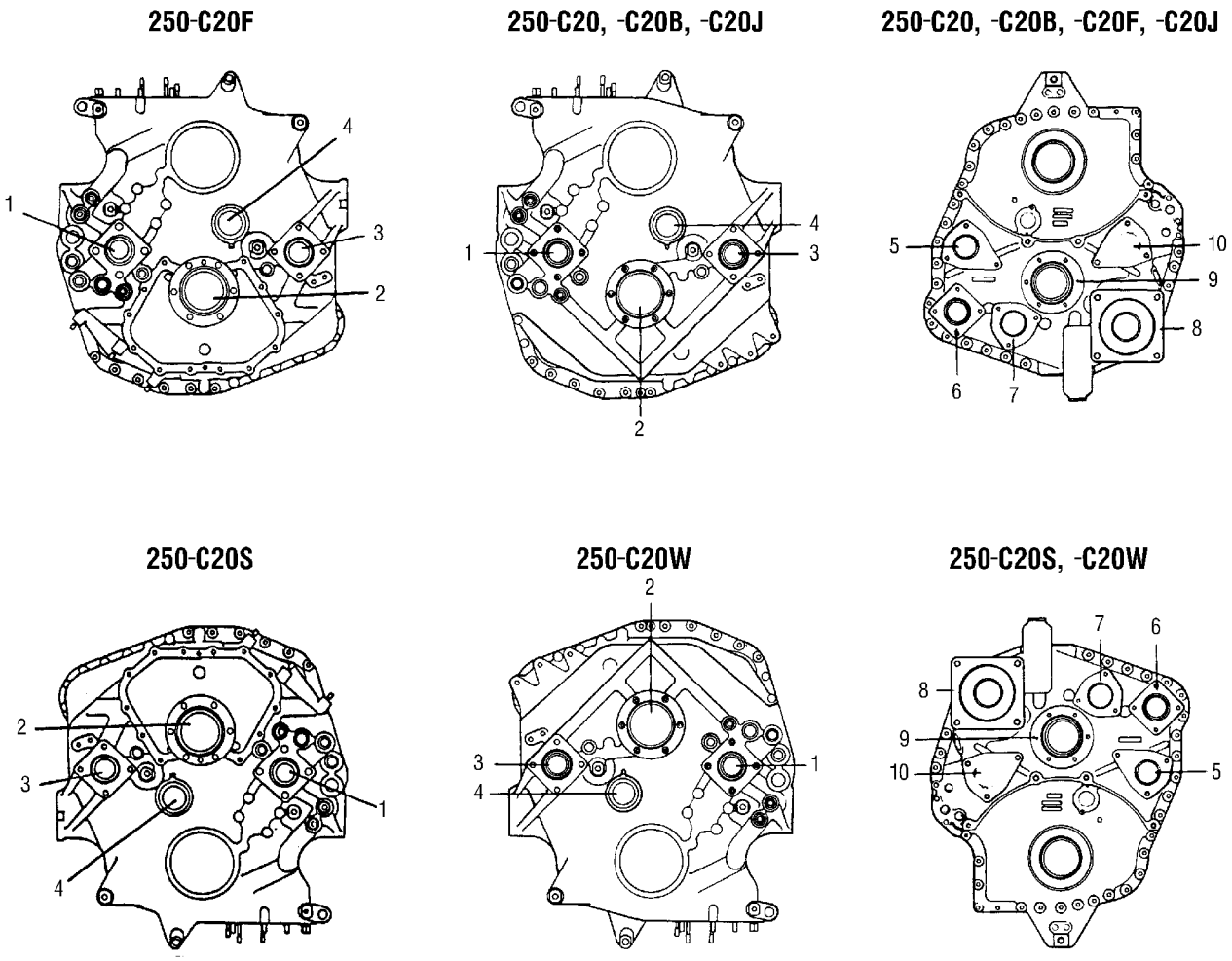
A. Oil Leakage Inspection

Inspect the power and accessory gearbox for oil leaks. Replace the seal assembly if excessive oil leakage is detected at the accessory pad locations. (See Figure 240.)

B. Starter–Generator Gearshaft Female Spline Inspection

(1) If the starter–generator is removed, then do the following;

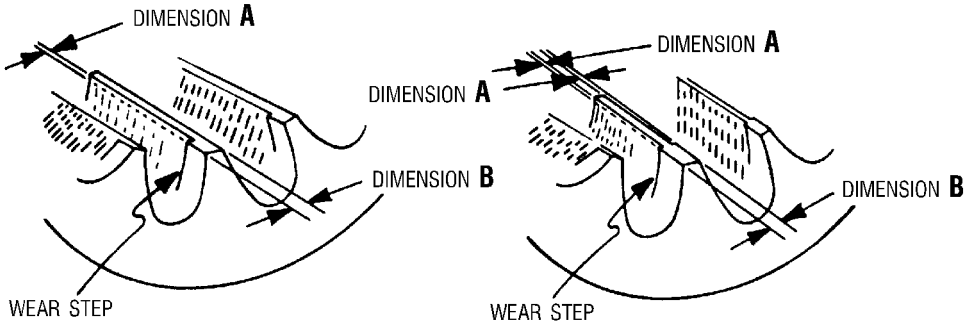
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1. Gas Turbine Tachometer–Generator Pad
2. Power Output Pad
3. Power Turbine Tachometer–Generator Pad
4. Torquemeter Spanner Nut
5. Power Turbine Fuel Governor Pad
6. Vacuum Hydraulic Pad (Spare)
7. Fuel Pump Pad
8. Starter Generator Pad
9. Power Takeoff Pad
10. Gas Producer Fuel Control Pad

Power and Accessory Gearbox Accessory Pad Locations
Figure 240

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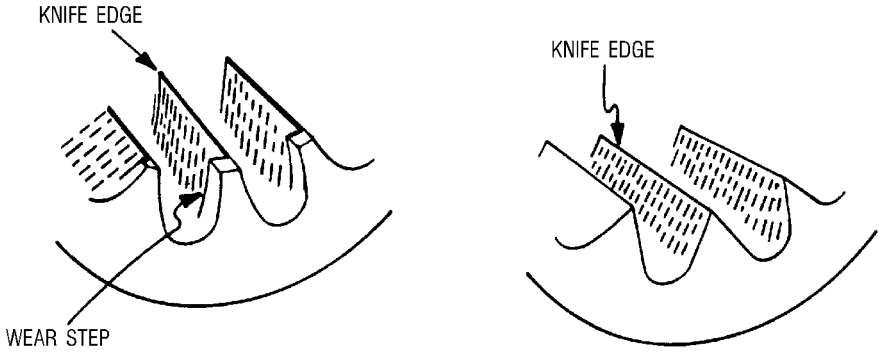


ACCEPTABLE WEAR PATTERNS

IF DIMENSION **A** ON EITHER SIDE OF THE TOOTH IS LESS THAN 0.010 IN. (0.0025 MM), OR LESS THAN 20 PERCENT OF DIMENSION **B** , SPLINE WEAR IS ACCEPTABLE AND THE STARTER-GENERATOR GEARSHAFT CAN REMAIN IN SERVICE.

IF DIMENSION **A** ON EITHER SIDE OF THE TOOTH IS GREATER THAN 0.010 IN. (0.0025 MM), OR GREATER THAN 20 PERCENT OF DIMENSION **B** , BUT NOT A KNIFE EDGE (VIEWS 3 AND 4), REPLACE THE STARTER-GENERATOR GEARSHAFT BEFORE 100 HOURS OR 50 START CYCLES ARE EXCEEDED.

*DIMENSION **B** IS THE THICKNESS AT THE TIP OF THE TOOTH IN AN AREA WITHOUT WEAR THAT IS STILL AT ORIGINAL TIP WIDTH.



UNACCEPTABLE WEAR PATTERNS

IF THE SPLINE TOOTH IS KNIFE EDGE IN APPEARANCE AND EXCESSIVELY WORN, REPLACE THE STARTER-GENERATOR GEARSHAFT PRIOR TO FURTHER FLIGHT.

ADD066XF

Starter–generator Gearshaft Spline Inspection
Figure 241

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PARA 4. (cont)

(2) Clean the female splines of the starter-generator gearshaft and the male splines of the starter-generator driveshaft with mineral spirits and a soft brush.

(3) Using a bright light, inspect the splines in accordance with the criteria depicted in Figure 241.

NOTE: A sharp pointed scribe, 0.020 in. (0.51 mm) radius, can be used to detect a wear step. A 0.010 in. (0.25 mm) feeler gage can be helpful in visually comparing the depth of the wear step.

NOTE: Inspect the starter-generator brushes for wear in accordance with the Aircraft Manual at the same time the spline inspection is made.

(4) Lubricate acceptable splines with grease (Aeroshell No. 22 or equivalent.).

(5) Before reinstallation of the starter-generator, make sure the torsional damper members of the driveshaft in the starter generator are in hard contact with each other.

C. Opened Gearbox Inspection

Whenever the gearbox is opened for any reason, and at an Authorized Maintenance Facility make a general inspection of the assembly, paying particular attention to the following:

(1) Check condition of accessory gearshaft drive splines. If excessive wear is believed present, replace the gearshaft.

(2) Check condition of gears. Replace gears having spalled or chipped teeth.

(3) Check mounting and attachment security of all internal parts including tab lockwashers and safety wire. Secure as required.

(4) Check integrity of oil pump attaching screws and oil tube packings.

(5) Check condition of the accessory pad seal and packing for the gas producer gear train idler spur gearshaft (inside the gearbox cover). Replace seal and packing if it shows apparent damage or if the engine is prone to blow oil out the gearbox vent.

(6) Check the filter housing for excessive wear at the opening for the filter inlet and filter bypass tubes. Replace packings on the filter inlet and bypass tubes at each disassembly. Replace the filter housing if necessary to prevent air/oil leakage.

(7) Inspect bearing separators for low magnetic permeability per 250-C20 Series CEB-1201.

(8) If the records indicate that more than 3500 hours have elapsed since the gears were new or were last magnafluxed at overhaul or repair, all gears are to be magnetically inspected. (Refer to the Engine Overhaul Manual, publication No. 10W3, for inspection criteria.)

NOTE: If any doubt exists concerning the serviceability of any part, repair or replace the part before closing the gearbox.

D. Insert Inspection

Any time the compressor is removed or when insert looseness is known or suspected, check for space between each of the five inserts and the gearbox housing. If a piece of 0.0015 in. (0.038 mm) shim stock can be inserted anywhere under the insert, it must be reworked.

E. Repair of Compressor Mounting Inserts

Repair loose compressor mounting inserts in the gearbox housing as follows:

CAUTION: THE GEARBOX HOUSING MUST HAVE AT LEAST THREE GOOD COMPRESSOR MOUNTING INSERTS BEFORE REWORK CAN BE ACCOMPLISHED ON A LOOSE INSERT.

NOTE: The rework shall be made with the engine removed from the air frame and with the turbine and compressor assembly removed from the gearbox. (Refer to Compressor Assembly Replacement, para 1., 72-30-00.)

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PARA 4. (cont)

(1) Clean the area of the loose insert on the gearbox housing with methylethylketone.

(2) If the insert is pinned, use a No. 53 drill to drill out the insert locking pin. Remove the insert using wrench 6872881 or 6872927 as applicable.

(3) File off the burrs and clean the threads and surrounding area of the housing using a brush and methylethylketone.

(4) Check the threads of the gearbox housing for wear by reinstalling the removed insert in the threaded opening of the housing. The threads should be snug when the bottom side of the insert flange is 1/8–in. (3 mm) above the surface of the gearbox. If any side movement or wobble is present, use an oversized insert for the replacement. Select the oversized insert to obtain the best fit.

(5) Install the selected insert. Tighten to 125–150 lb in. (14–17 N·m) plus running torque. Do not exceed 180 lb in. (20 N·m).

(6) Install checking fixture 6872880 over the five compressor mounting inserts. (See Figure 242.) Be sure the fixture does not touch any of the four bosses around the insert at the seven o'clock position. Determine the seven o'clock position by viewing the gearbox from the front (compressor) side.

(7) Use shim stock to feel for clearance between each insert flange and the bottom of the fixture. Rework insert flange using spot facing kit 6872879 until there is no clearance at any of the five locations. (See Figure 243.)

NOTE: When properly installed and reworked, the five compressor mounting inserts are the same height. In this condition the checking fixture rests on all five points and each insert–to–fixture fit will be closed to the passage of the shim stock feeler gage.

(8) Mark the gearbox boss at the location of the insert pin slot. Remove the insert using wrench 6872881 or 6872927 as applicable. Clean the threads of the insert and the gearbox using methyl ethyl ketone.

(9) Apply Resiweld FE 186, or equivalent, sealer to the threads of the replacement insert. Thread the insert into the gearbox. The insert will apply sealer to the threads in the gearbox. Repeat the application of sealer to the insert as necessary to cover all threads of both parts. Also, at the seven o'clock insert position, do not install the packing; however, be sure the packing groove is filled with sealer.

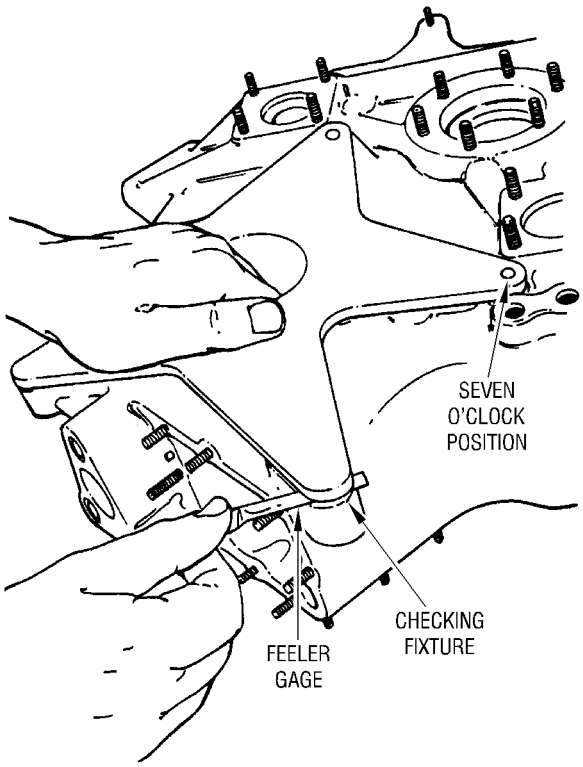
CAUTION: WIPE EXCESS SEALER FROM THE END OF THE INSERT TO MAKE SURE THAT NONE OF THE SEALER ENTERS THE GEARBOX AT THE SEVEN O'CLOCK INSERT POSITION THROUGH–HOLE. ON BOTTOM HOLED INSERT LOCATIONS, MAKE SURE THE HOLE DOES NOT ACCUMULATE EXCESS SEALER WHICH CAN PUSH UP THROUGH THE INSIDE THREAD OF THE INSERT. CLEAN SEALER FROM INSERT INSIDE THREADS BEFORE IT HARDENS, USING METHYL ETHYL KETONE AND A 1/4–28 BOLT. RETAP (1/4–28) THE INSIDE THREAD IF HARDENED SEALER IS ENCOUNTERED.

(10) Install the new insert. Tighten to 125–150 lb in. (14–17 N·m) plus running torque to a position where the pin slot aligns with the mark on the gearbox boss. (See step (8).) Do not exceed 180 lb in. (20 N·m).

(11) Wipe any excess sealer from the insert or gearbox. Recheck insert height. (See steps 6 and 7.) Cure sealer for 25–35 minutes at 177°C (350°F), or as an option, at 149°C (300°F) for two hours (to combine cure cycle with paint bake cycle).

(12) Install compressor and turbine assemblies on the gearbox. (Refer to Compressor Assembly Installation, para 1.C., 72–30–00.)

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Checking Insert Setting Height
Figure 242

PARA 4.E. (cont)

(13) Return the engine to service. Inspect the insert at the seven o'clock position for any sign of oil leakage after the Check Run. Repair the insert if any leakage is detected.

F. Power Train Pinion Helical Gear Spline Inspection

Inspect the power train pinion helical gear spline whenever the engine has been subjected to a sudden stoppage as defined in para 1.C.(4) or 1.C.(5), 72–00–00, Engine–Inspection/Check. Replace the gear if any of the following conditions exist:

(1) Chipped, damaged, pitted or worn spline teeth.

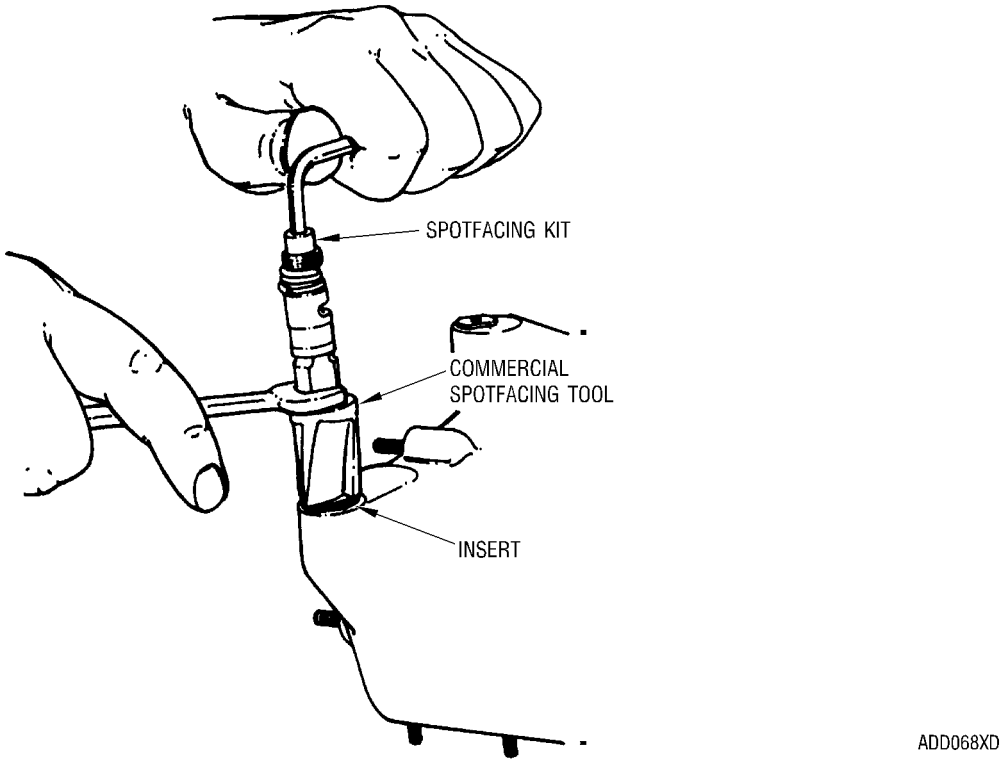
NOTE: A sharp pointed scribe, 0.020 in. (0.51 mm) radius, should be used to detect a wear step.

(2) Evidence of spline deformation or twisting.

G. Oil Filter Inlet Tube Assembly Drop Dimension Inspection

(1) Engines that exhibit low or fluctuating oil pressure may have been assembled with an incorrectly manufactured tube assembly, P/N 6876925A. If the gearbox modification log card does not show compliance with 250–C20 CEB 1307, proceed to the next step.

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Machining New Insert
Figure 243

PARA 4.G. (cont)

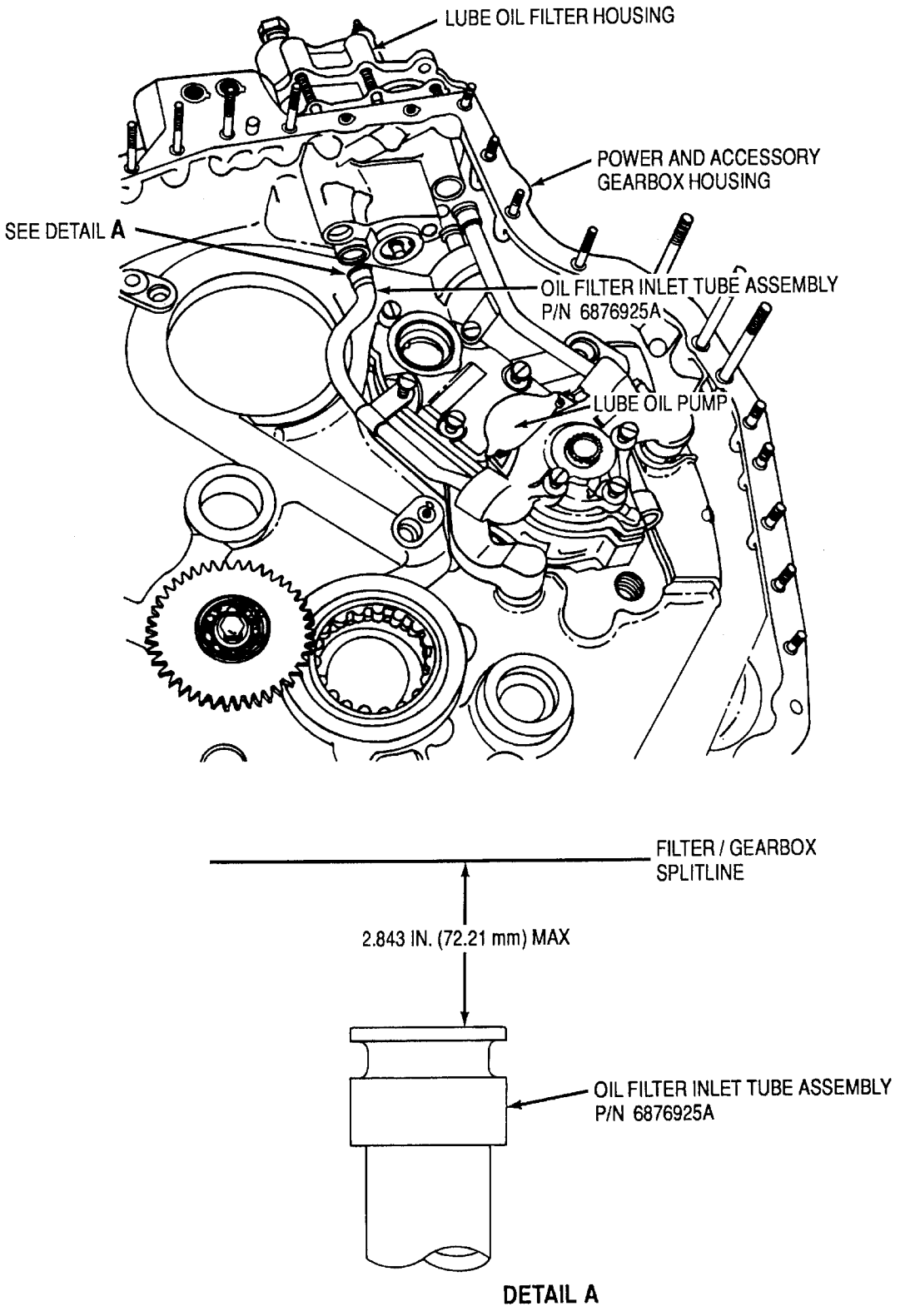
(2) Remove the Lube Oil Filter Housing Assembly from the gearbox. Refer to para 2.D., this section.

(3) Make sure that all gasket material is removed from the gearbox. Do not let gasket material or other foreign material fall into the gearbox.

(4) Using a 2–3 inch depth micrometer, measure the distance from the gearbox/filter housing splitline to the top of the filter inlet tube assembly, P/N 6876925A. (See Figure 244.)

(5) If this dimension exceeds 2.843 in. (72.21 mm), then the oil inlet tube assembly and the oil filter housing assembly may not be correctly engaged. Reject the gearbox for compliance of 250–C20 CEB 1307 or replace P/N 6876925A, Oil Filter Inlet Tube Assembly with P/N 6876925B (or later) Oil Filter Inlet Tube Assembly.

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Oil Filter Inlet Tube Drop Dimension Inspection
Figure 244

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2. Inspection/Check

A. Fuel Leakage Inspection

If evidence of fuel leakage is found during post–flight inspection of the fuel control, fuel pump, governor, fittings and/or tubing, proceed as follows:

(1) Isolate the source of leakage by immediately applying boost pump pressure to the system. Fuel leakage shall be limited to the following specific areas and quantities.

Unit or Area	Max. Leakage Rate Drops/min	cc/min
Seal drain of fuel control (CECO system only)	5	0.25
Seal drain of governor (CECO system only)	5	0.25
Seal drain of fuel pump (CECO or Bendix system)	20	1
Splitlines, tubes and fittings (CECO or Bendix system)	None	0

(2) If the fuel leak cannot be isolated using only boost pump pressure, make an engine start; then, carefully reinspect the engine compartment with the engine running. If necessary, reinspect immediately upon shutdown.

(3) Repair fuel leaks as follows:

(a) Tighten all component fittings and coupling nuts to the recommended torque. If leakage does not stop, replace the affected part.

(b) If leakage is isolated to the fuel control throttle shaft area, replace the throttle shaft packing (if authorized by CECO distributor or CECO representative). (Refer to 250–C20 CSL–1013.)

(c) If leakage is isolated to the governor throttle shaft area, replace the governor.

(d) After leakage repair has been accomplished, recheck the fuel system under boost pump pressure.

B. Fuel Control System Pneumatic Leak Check

If any fuel system pneumatic component (including piping) is removed/installed or any pneumatic line is opened during maintenance of the control system, check the pneumatic portion of the fuel control system for leaks as follows:

(1) Disconnect and remove the pressure sensing line between the scroll and the Pc filter. Hold the filter while loosening the coupling nut.

(2) Move the throttle to the full open position.

(3) Apply 50–80 psi (345–552 kPa) filtered air (10 micron) to the P_c filter. Air will immediately escape from the pressure regulating air valve port on the power turbine governor.

(4) Use a liquid soap solution to check all fittings and lines in the system for leaks. Leakage is not acceptable.

(5) Use a liquid soap solution to check cover and parting surfaces on the fuel control and governor. Cover and parting surfaces that produce a slight bubbling of the soap solution do not represent a leak of sufficient magnitude to warrant concern. These leaks were present during original calibration and were compensated for at that time.

(6) Reduce the pressure to 20–22 psi (138–152 kPa) and check the governor diaphragm for leakage. (See Figure 204.) No leakage is acceptable. If leakage is noted from the governor diaphragm, remove the safety wire from the screws, back off screws and then tighten to 8–11 lb in. (0.9–1.2 N·m). Let screws rest for 20 minutes and retighten to same value. If after this is completed, the governor diaphragm still leaks, replace governor. (See Figure 204.)

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PARA 2.B. (cont)

(7) Return throttle to the closed position. Clean the soap solution from the engine after the check is completed.

(8) Reinstall P_c line. Tighten coupling nuts to 80–120 lb in. (9.0–13.6 N·m). Hold Pc filter while tightening coupling nut.

C. Fuel System Filters

The filters which are maintained as a part of the engine assembly fuel system include: a fuel pump fuel filter, a gas producer fuel control fuel filter, and a fuel nozzle filter. In the Chandler Evans (CECO) control system there is also a high pressure fuel filter and a power turbine governor filter. In addition to the fuel filters, the Bendix control system has a fuel control P_c air filter and an engine (system) P_c filter which is bracket mounted to the gearbox.

CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. (REFER TO SPECIAL INSPECTIONS, TABLE 604, 72–00–00, ENGINE INSPECTION/CHECK FOR DETAILS.) CONTAMINATION FOUND IN THE FUEL NOZZLE FILTER WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN OVERHAUL/REPAIR FACILITY FOR INTERNAL CLEANING.

(1) Fuel Pump Filter (Sundstrand/Pesco and Argo–Tech/TRW pumps)

The fuel pump filter element is replaceable and has a 5 micron nominal/15 micron absolute rating. Replace the filter at intervals specified in Table 602, 72–00–00, Engine–Inspection/Check, unless an aircraft installed differential pressure warning system and/or operating experience dictate replacement at a lesser time interval.

(2) Gas Producer Fuel Control Filter

The filter element in the fuel control is cleanable and has a rating of 64 microns. The filter shall be inspected for contamination and cleaned if required any time a fuel pump filter bypass is known or suspected to have taken place. (Refer to Cleaning the Gas Producer Fuel Control Fuel Filter, PARA 4.A., 73–20–02 or PARA 4.A., 73–20–03 for Bendix control or PARA 4.A., 73–20–04 for CECO control.)

(3) Fuel Nozzle Filter

The fuel nozzle filter should only be inspected and cleaned if a fuel filter bypass condition is known or suspected, or evidence of contamination found in the fuel pump and fuel control. (Refer to PARA 2., 73–10–03.) Contamination found in the fuel nozzle screen will require that the fuel control be sent to an Authorized Maintenance Center (AMC) for internal cleaning.

(4) High Pressure Fuel Filter (CECO control system)

A 5 micron nominal/15 micron absolute replaceable and cleanable fuel filter is located in the CECO fuel system between the fuel pump outlet and the fuel control inlet. (Refer to High Pressure Fuel Filter – Maintenance Practices, 73–10–05.)

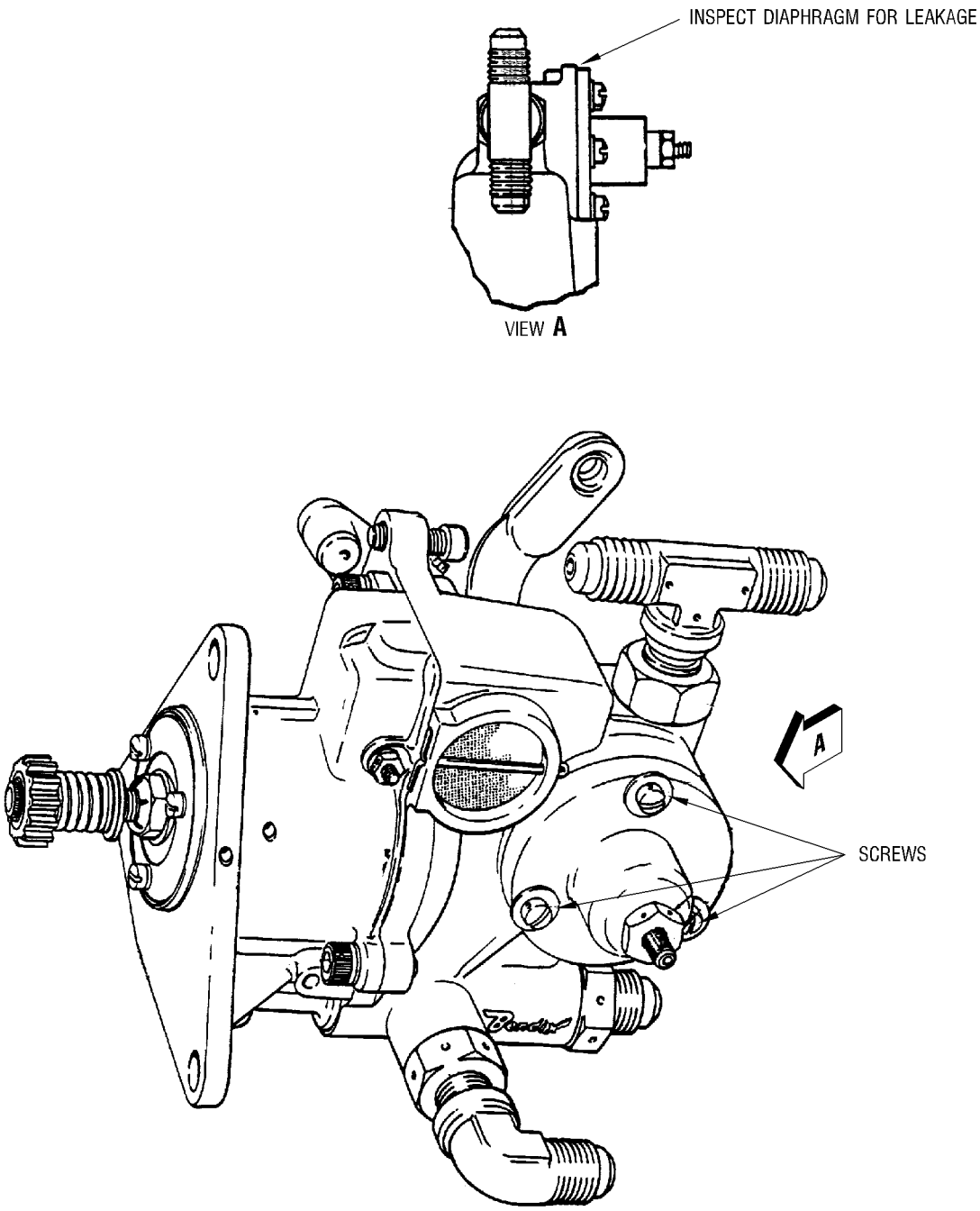
(5) Power Turbine Governor Filter

The CECO power turbine governor has a cleanable filter–fitting which has a rating of 220 micron. The filter shall be inspected for contamination and cleaned if required any time fuel pump filter bypass is known or suspected to have taken place. (Refer to the Chandler Evans Power Turbine Governor – Maintenance Practices, 73–20–04.)

(6) Engine (system) P_c Filter (Bendix control system)

The bracket mounted P_c filter shall be removed and cleaned when dictated by engine performance. (Refer to Table 101, 72–00–00, Engine–Troubleshooting and to P_c Filter–Maintenance Practices, Section 73–20–06.)

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Governor Diaphragm Leakage Inspection
Figure 204

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PARA 2. (cont)

D. Purging the Fuel System

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(1) Maintenance of the fuel system can result in air entrapment in the fuel lines. To prevent subsequent false starts or flameouts, purge air from the fuel system whenever any of the following conditions are encountered:

WARNING: THE FUEL/AIR DISCHARGE DURING PURGING IS IRRITATING TO THE EYES AND HIGHLY FLAMMABLE. MECHANICS MUST TAKE SUITABLE MEASURES TO PROTECT THEIR EYES AND PREVENT FIRE.

WARNING: MAKE SURE THAT THE AIRCRAFT IS ADEQUATELY GROUNDED. (SEE AIRCRAFT MANUFACTURER'S INSTRUCTIONS FOR PROPER GROUNDING PROCEDURES.)

(a) The fuel filter element or the fuel pump assembly has been replaced.

(b) The fuel lines have been opened (anywhere between the fuel tank and the fuel nozzle).

(c) The engine has flamed out because of fuel exhaustion.

(d) The engine has been motored without fuel in the tank.

(e) The fuel pump fuel filter bowl has been drained without start or boost pumps on.

(f) The engine has been shut down using the emergency fuel shutoff valve.

(g) The fuel control is replaced on Bendix/Allied Signal/Honeywell systems.

(h) The fuel control or power turbine governor is replaced on Chandler Evans systems.

(i) Any symptom indicative of air being entrapped in the system is observed.

(2) Purge the Bendix fuel system as follows:

(a) Place a container under the aircraft to collect fuel drainage.

(b) Disconnect the fuel supply hose from the fuel nozzle. Be prepared to catch fuel from the fuel hose.

(c) Deactivate the ignition system.

(d) Open the firewall fuel valve.

(e) Turn on the boost pump(s)/start pump.

(f) Position the throttle to the 30° (Ground Idle) position.

(g) Motor the engine for approximately 15 sec or until there is no evidence of air coming from the fuel supply hose.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(h) Close the throttle and reconnect the fuel supply hose to the fuel nozzle. Tighten the coupling nut at the fuel nozzle to 80–120 lb in. (9.0–13.6 N·m).

(i) Turn off the boost pump(s)/start pump(s) and reactivate the ignition system.

(3) Purge the CECO fuel system as follows:

(a) Place a container under the aircraft to collect fuel drainage.

(b) Loosen the bypass tube at the governor bypass port (P_o). Cover the governor opening and the bypass tube open end with a rag to minimize fuel spray when the boost pumps(s) is started. (See Figure 205.)

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PARA 2.D. (3) (cont)

(c) Disconnect the fuel line from the fuel nozzle. Be prepared to catch fuel from the fuel line.

(d) Deactivate the ignition system.

(e) Open the fire wall fuel valve.

(f) Turn on the boost pump(s)/start pump.

(g) Position the throttle at full open.

(h) Allow fuel to flow from the governor port and the bypass line for 30 sec. If the fuel flow is without air (a solid stream), loosely install the bypass tube B–nut at the governor P_0 port while the boost pump(s) remains in operation. If air is observed in the fuel flow, continue the bleed beyond the 30 sec until a solid stream of fuel is obtained.

NOTE: When loosely installing the bypass tube B–nut on the governor P_0 port, contain the spray with a rag.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(i) With the fuel nozzle line still disconnected and the boost pump(s) still operating, motor the engine with the starter to purge air from the nozzle line. Allow fuel to flow from the line for 30 seconds. If fuel still contains air (not a solid stream) repeat the motoring steps as permitted by starter limitations. If fuel flow is without air, close the throttle, attach the fuel line to the fuel nozzle, and tighten the B–nut at the governor P_0 port. Tighten P_0 tube B–nut to 150–200 lb in. (17–23 N·m). Tighten coupling nut at the fuel nozzle to 80–120 lb in. (9.0–13.6 N·m).

(j) Turn off the boost pump(s) and reactivate the ignition system. Make a ground run as soon as possible.

NOTE: To prevent air in the fuel system, always start and operate the engine with the boost pump(s) operating.

Use the boost pump(s) to fill the system after component installation or after long idle periods.

E. Purging Air From Single Element Pump Filter Bowl (Sundstrand (Pesco) and Argo–Tech (TRW) Pumps)

WARNING: THE FUEL/AIR DISCHARGE DURING PURGING IS IRRITATING TO THE EYES AND HIGHLY FLAMMABLE. MAKE SURE TO PROTECT EYES AND PREVENT FIRE.

WARNING: MAKE SURE THAT THE AIRCRAFT IS ADEQUATELY GROUNDED (SEE AIRCRAFT MANUFACTURER'S INSTRUCTIONS FOR PROPER GROUNDING PROCEDURES.)

(1) Remove lockwire from the upper drain plug in the filter bowl cover.

(2) Deactivate the ignition system and place the gas producer lever in FUEL OFF.

(3) Turn on the aircraft boost pump.

(4) Loosen the upper drain plug (approx 1/2 turn) until a solid stream of fuel is emitted. Use a shop towel to catch the spray. Retighten the plug to 40–65 lb in. (4.5–7.3 N·m).

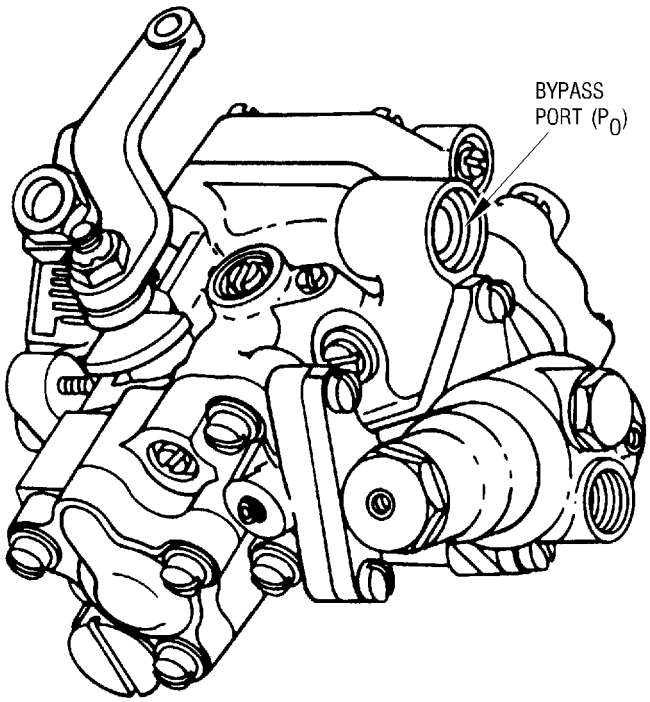
(5) Turn off the aircraft boost pump.

(6) Remove any fuel that may have spilled in the engine compartment.

(7) Secure the drain plug with lockwire.

(8) Purge the fuel system. (Refer to Purging the Bendix Fuel System, para 2.D.(2), this section or purging the CECO Fuel System, para 2.D.(3), this section.)

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CECO Power Turbine Governor P_o Port
Figure 205

PARA 2. (cont)

F. Vacuum Check of Fuel System Lines and Components (Bendix fuel control system)

NOTE: The vacuum check is a troubleshooting procedure to detect engine or airframe fuel system leaks. (This procedure is a troubleshooting tool and not a mandatory inspection requirement).

The following vacuum check procedure is provided to check both the engine and airframe fuel system components to isolate the location of a possible leak in the fuel system. (Refer to the applicable airframe manual for additional information.)

NOTE: Figure 206 provides a flow diagram of the check procedure. Circled numbers on the flow diagram refer to procedural steps in this procedure.

(1) Verify at the aircraft fuel tank that the fuel selector valve is in the closed position.

NOTE: During the vacuum check procedure, it will be necessary to disconnect various fuel tubes. Prior to disconnecting any fuel tube, verify that the coupling nuts and fittings were tightened to the proper torque. If insufficient torque was applied, note how far the coupling nut or fitting rotates to reach the proper torque. Inspect the connection areas for damage or indications of misalignment, over–tightening, cracks, bends, grooves and fretting wear.

(2) Remove the upper drain plug from the rear of the engine fuel pump filter housing. Check the packing for damage. Connect a vacuum pump to the port. Ensure that the vacuum set–up includes a negative pressure gage (in. Hg) and a shutoff valve between the gage and pump. Apply 8 in. Hg vacuum and close the shutoff valve. Record gage reading after two minutes. If vacuum loss exceeds 1/2 in. Hg after the two minutes, proceed to the next step. If vacuum loss is 1/2 in. Hg or less, no further checks are required.

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PARA 2.F. (cont)

(3) Disconnect the aircraft fuel line at the inlet to the engine fuel pump and cap the pump inlet port. Repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, the leakage is in the engine fuel system; proceed to next step. If vacuum loss is 1/2 in, Hg or less, the leakage is in the aircraft fuel supply system; proceed to step (12).

(4) Disconnect the bypass fuel line between the engine fuel control and the fuel pump. Install B–nut type caps on both the control and pump fittings. Repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, proceed to next step. If vacuum loss is 1/2 in. Hg or less, the leakage is in the bypass fuel line. Repair or replace parts as required, reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

(5) Disconnect the pressure fuel line between the fuel pump and the fuel control. Install a B–nut type cap on the fuel pump fitting. Repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, proceed to the next step. If vacuum loss is 1/2 in. Hg or less, proceed to step (10).

(6) Disconnect the impending filter bypass switch system at the AF and BF ports on the engine fuel pump. Cap or plug both ports. Repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, proceed to next step. If vacuum loss is 1/2 in. Hg or less, the leakage is in the filter bypass switch or its associated hoses. Refer to the applicable airframe manual and repair as required. Reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

(7) Inspect and check the two fuel bypass and pressure line fittings in the fuel pump and filter assembly as follows:

(a) Remove the two fittings from the engine fuel pump and filter assembly.

(b) Inspect the packings for damage or cuts.

(c) Inspect the packing sealing surfaces for damage and repair or replace parts as required.

(d) Reinstall the two capped fittings with new packings.

(e) Repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, proceed to next step. If vacuum leakage is less than 1/2 in. Hg, reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

(8) Remove the lower drain valve on the rear of the engine fuel pump fuel filter housing. Inspect the packing for damage. Also, inspect the valve stem packing for damage. Install a plug and packing in the drain valve port and repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, proceed to next step. If vacuum loss is 1/2 in. Hg or less, the leakage is in the drain valve and/or packings. Replace parts as required, reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

(9) Inspect and check the engine fuel pump and filter assembly as follows:

(a) Ensure that the filter housing was securely attached to the pump. Remove the housing and filter element. Inspect the large packing for damage or cuts. Inspect the packing sealing surfaces for damage and repair as required. Inspect inside the filter housing and pump housing for contamination and remove as required. Inspect the filter element (in the fuel–wetted state) for contamination and replace if required.

(b) Reassemble the filter element and housing on the pump using a new packing on the housing.

(c) Repeat the vacuum leakage check.

(d) If vacuum loss exceeds 1/2 in. Hg, replace the fuel pump and filter assembly, reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

(e) If vacuum loss is 1/2 in. Hg or less, reassemble the fuel system components and repeat step (3) to verify that the leak has been corrected.

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PARA 2.F. (cont)

(10) Connect the vacuum pump to the control inlet fuel fitting on the fuel control. Repeat the vacuum leakage check. If vacuum loss exceeds 1/2 in. Hg, proceed to the next step. If vacuum loss is 1/2 in. Hg or less, repair or replace the pressure fuel line, reassemble the engine fuel system components, and repeat step (3) to verify that the leak has been corrected.

(11) Inspect and check the two fuel bypass and pressure line fittings in the fuel control as follows:

(a) Remove the two fittings from the engine fuel control.

(b) Inspect the packings for damage or cuts.

(c) Inspect the packing sealing surfaces for damage and repair or replace parts as required.

(d) Reinstall the two capped fittings with new packings. Be sure the bypass fitting is capped and the vacuum pump is reconnected to the pressure fitting.

(e) Repeat the vacuum leakage check.

(f) If vacuum loss exceeds 1/2 in. Hg, replace the fuel control, reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

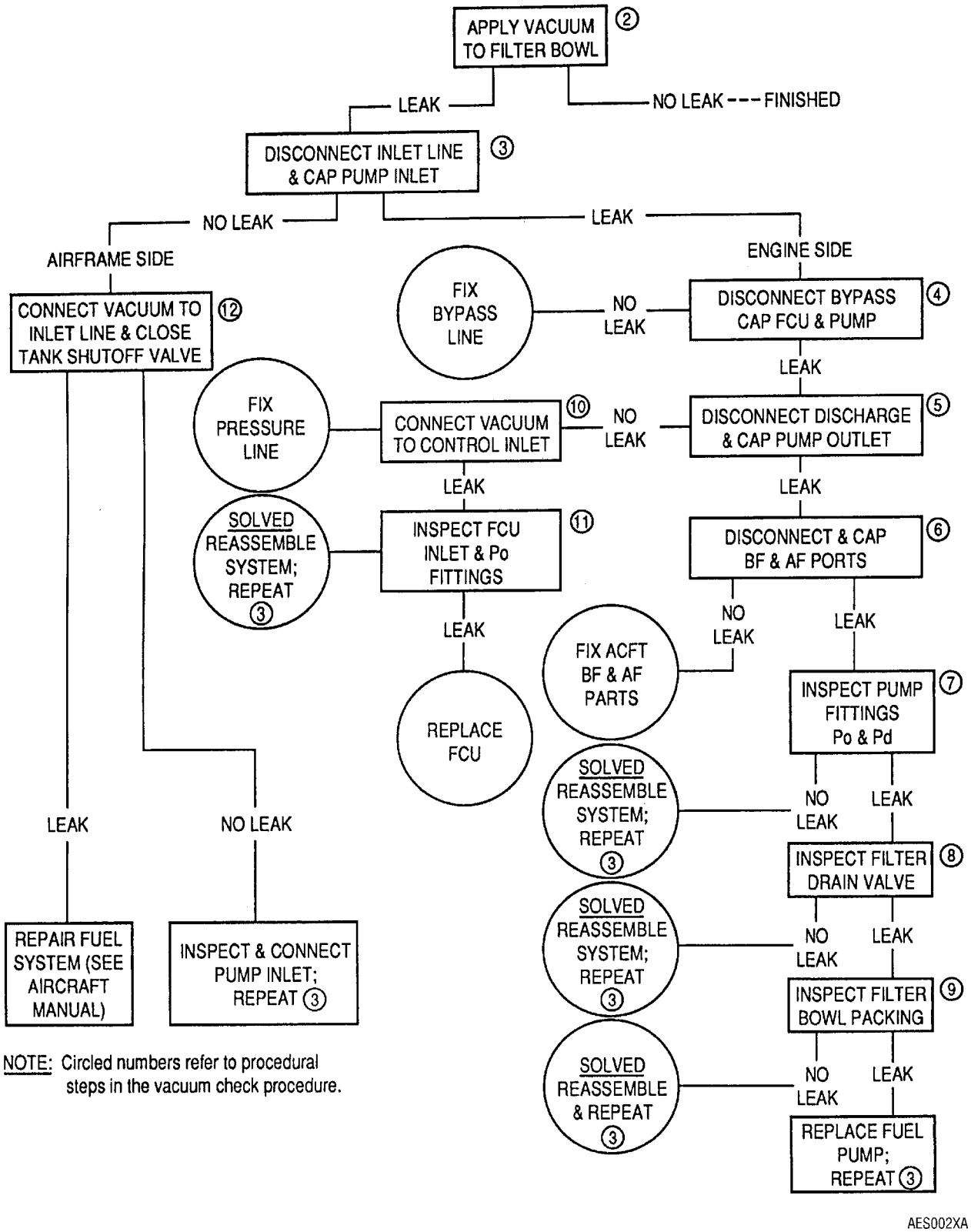
(g) If vacuum loss is 1/2 in. Hg or less, reassemble the engine fuel system components and repeat step (3) to verify that the leak has been corrected.

(12) Connect the vacuum pump to the free end of the aircraft fuel line (the end that connects to the engine fuel pump). Apply 8 in. Hg vacuum and close the shutoff valve. Record gage reading after two minutes.

(a) If vacuum decreases, a leak in the aircraft fuel supply system is indicated. Check and repair the leak in accordance with the applicable airframe manual.

(b) If no leakage is detected, check the aircraft fuel line and the engine fuel pump inlet fitting. Repair or replace parts as required. Reconnect the aircraft fuel line to the inlet port of the engine fuel pump and filter assembly. Repeat step (3) to verify that the leak has been corrected.

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Bendix Fuel System Vacuum Check Flow Diagram
Figure 206

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PARA 3.A. (cont)

(1) Check rigging. (Refer to Rigging Check, para 3.C., this section.)

(2) Check idle speed setting. (Refer to Idle Speed Setting, para 3.F., this section.)

B. Deceleration Check

Make the following deceleration check during the shutdown for the last flight of each day.

(1) Turn the generator switch off.

(2) Position the twist grip or power levers to full open, hold collective at flat pitch and stabilize N_2 at exactly 100% for approximately 15 seconds (beep as required).

CAUTION: DURING RAPID THROTTLE MOVEMENTS, MAKE APPROPRIATE ANTI–TORQUE PEDAL CORRECTIONS TO PREVENT THE AIRCRAFT FROM TURNING ON LOOSE OR SLICK SURFACES.

(3) Snap the twist grip or power lever to the IDLE position. Simultaneously start a time count using a stop watch or watch with a sweep second hand. Stop the time as the N_1 needle passes through 65%. The minimum allowable deceleration time is two seconds.

NOTE: Practice and/or retakes may be required before proficiency is obtained in timing the deceleration.

(a) On single engine applications, if multiple controls are in stalled, make separate deceleration checks using the pilot and copilot twist grips.

(b) On multi–engine applications, make a deceleration check of each engine. Make separate decel checks using the pilot and the copilot twist grips.

(4) If deceleration time is less than two seconds, make two more checks to confirm the time. If the confirmed time is less than the minimum allowable time, proceed to the rigging check.

(5) If N_1 speed drops below 59%, or if a flame out is experienced during the deceleration check, proceed to the rigging check before making a second attempt.

C. Rigging Check

Check the rigging of the gas producer fuel control after a deceleration check has revealed the deceleration time to be less than the allowable limit. This check is also required after installation of a fuel control or any component of the rigging system. Make the rigging check with the engine shut down using the following procedure:

CAUTION: DO NOT ADJUST THE MINIMUM STOP TO COMPENSATE FOR AIRCRAFT RIGGING DIFFICULTIES. THE MINIMUM STOP IS SET ON A FLOW BENCH AND IS NOT A FIELD ADJUSTMENT.

(1) Check to ensure that sufficient travel is provided to allow physical contact with the gas producer minimum stop at or before the full closed position of the twist grip.

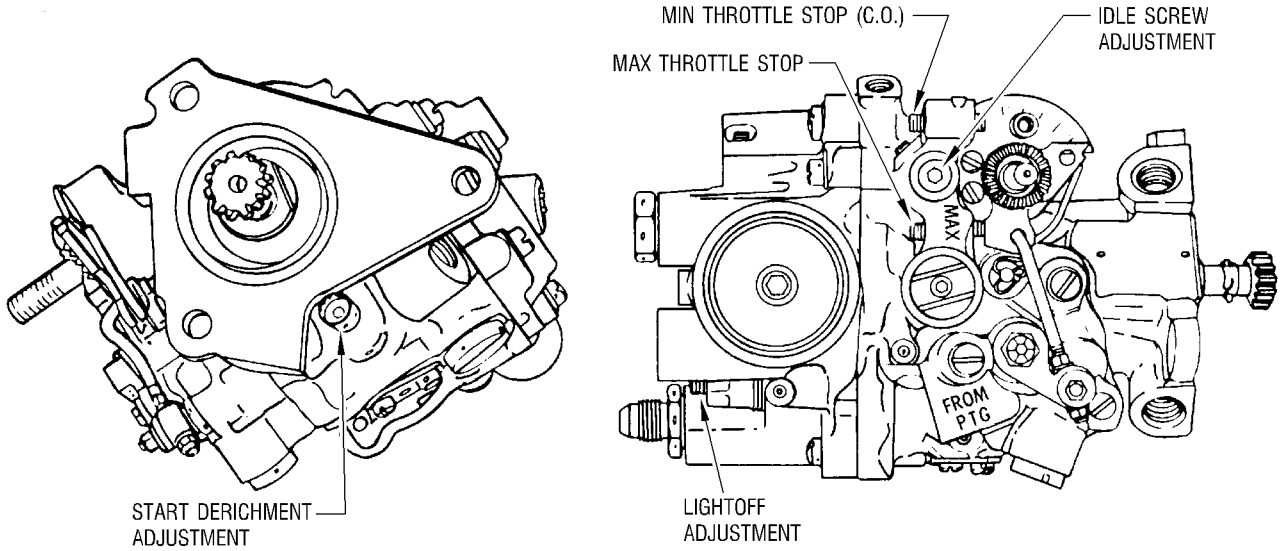
(2) Check the travel to the opposite end. Physical contact must be made with the gas producer maximum stop at or before the full open position of the twist grip.

(3) Looseness encountered in the rigging must be minimized by replacement of worn items and/or accuracy of the rigging. Looseness that cannot be removed must be within the limits indicated in Figure 202. Check the looseness as follows:

(a) Start with the twist grip or power levers at the full open position then rotate the grip to the IDLE position. The pointer must be at the 30 degree mark.

(b) Start with the throttle at the full closed position, then rotate the grip to the IDLE position. The pointer must be no more than 5/64 in. (2.0 mm) below the 30 degree mark.

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CECO Gas Producer Fuel Control Adjustments
Figure 202

3. Adjustment/Test

The adjustments that can be made on the fuel control are idle speed, maximum throttle stop, lightoff adjustment, start derichment and Maximum flow stop.

A. Fuel Control Operational Checks

Ground check the control system and associated linkage by making the following checks:

NOTE: Perform the steps in the sequence listed.

(1) Check rigging. (Refer to Rigging Check, para 3.C., this section.)

(2) Fuel cutoff operational check. (Refer to Cutoff Valve Operational Check, para 3.D., this section.)

(3) Check idle speed setting. (Refer to Idle Speed Setting, para 3.E., this section.)

B. Deceleration Check

To ensure proper engine performance, make the following deceleration check during shutdown for the last flight of each day.

(1) Turn the generator switch off.

(2) Rotate the twist grip or power levers to full open. Hold collective at flat pitch.

CAUTION: DURING RAPID THROTTLE MOVEMENTS, MAKE APPROPRIATE ANTI-TORQUE PEDAL CORRECTIONS TO PREVENT THE AIRCRAFT FROM TURNING ON LOOSE OR SLICK SURFACES.

(3) Snap the twist grip or throttle to the IDLE position. Simultaneously start a time count using a stop watch or a watch with a sweep second hand. Stop the time as the N_1 needle passes through 65%. The minimum allowable time is approximately two seconds.

NOTE: Practice and/or retakes may be required before proficiency is obtained in timing the deceleration.

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PARA 3.B. (cont)

(a) On single engine applications, if multiple controls are installed, make separate deceleration checks using the pilot and copilot twist grips.

(b) On multi–engine applications, make a deceleration check of each engine. Make separate deceleration checks using the pilot and the copilot twist grips.

(4) If deceleration time is less than two seconds, make two more checks to confirm the time. If the confirmed time is less than the minimum allowable time, proceed to the rigging check.

(5) If N_1 speed drops below 59%, or if a flame out is experienced during the deceleration check, proceed to the rigging check before making a second attempt. If rigging is within limits (para 3.C., this section.), replace the MC–40 governor.

NOTE: Return the removed governor to an Authorized Maintenance Center (AMC) for investigation. Repeat the deceleration check on the replacement governor.

C. Rigging Check

Check the rigging after installation of a fuel control or any component of the rigging system. Make the rigging check with the engine shut down using the following procedure.

(1) Check to ensure that sufficient travel is provided to allow physical contact with the gas producer minimum stop before reaching the full closed position of the twist grip.

(2) Check the travel to the opposite end. Physical contact must be made with the gas producer maximum stop before reaching the full open position of the twist grip.

(3) Looseness encountered in the rigging must be minimized by replacement of worn items and/or accuracy of the rigging. Check rigging looseness with the control pointer locked in the 30° position with the rigging pin. Looseness that cannot be removed must be within the limits indicated in Figure 203). Check the looseness as follows:

(a) Start with the twist grip at the full open position then rotate the grip to the IDLE position. The pointer must be at the 30 degree mark and the rigging pin must be a free fit in the rigging pin hole.

(b) Start with the twist grip at the fully closed position then rotate the grip to the IDLE position. The pointer must be no more than 5.64 in. (2 mm) below the 30 degree mark.

NOTE: Make rigging adjustments on aircraft having dual controls using the pilots twist grip. Recheck the linkage movement using the copilots twist grip. The limits of Figure 203 are applicable to both sets of controls.

D. Cutoff Valve Operational Check

An operational check of the fuel control cutoff valve shall be made when an early lightoff or an afterfire is encountered. Make the check as follows:

(1) Check the fuel control quadrant reading.

(a) The quadrant pointer must be in the minus 2° position (1/32 in. (0.8 mm) below the 0° mark—see Figure 203) when the throttle lever is against the minimum stop and the throttle is in FUEL OFF.

(b) If the quadrant pointer is not in the minus 2° position, readjust the minimum stop on the fuel control. To obtain minus 2°, adjust the minimum stop screw to 0°; then, back the screw out one–half turn from the 0° position.

(c) Recheck the pointer to be sure it is at the minus 2° position when the throttle is in FUEL OFF.

NOTE: On some installations, aircraft linkage prevents the pointer from going all the way to the minus 2° position. A minimum of 0° is acceptable provided that the cutoff lever link adjustment is made as specified for a 0° control in 250–C20 CSL–1023.

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PARA 3. (cont)

4. Specifications

A. Engine Ratings

The specifications, limits, and performance ratings for the Model 250–C20 Series engines are as follows:

	250–C20	250–C20B, F, J, S, W
Design power output	400 shp (298 kW)	420 shp (313 kW)
Design speeds:		
Gas producer	100% (50,970 rpm)	
Power turbine	100% (33,290 rpm)	
Power output shaft	100% 6,016 rpm	
Maximum measured gas temperature— stabilized (TOT)	1490°F (810°C)	
Dimensions:		
Length	40.8 in. (1036 mm)	
Height (250–C20, –C20B, –C20F, –C20J, –C20W)	23.2 in. (589 mm)	
(250–C20S)	22.6 in. (574 mm)	
Width (250–C20, –C20B, –C20F, –C20J, –C20W)	19.1 in. (485 mm)	
(250–C20S)	18.8 in. (477 mm)	

Engine weight: dry	250–C20 B, J, W	250–C20F	250–C20S
	155 lb (70 kg) (Bendix) 158 lb (72 kg) (CECO)	158 lb (72 kg) (Bendix)	159 lb (72 kg) (Bendix)

WARNING: THE MAXIMUM OIL CONSUMPTION LIMIT IS ONE (1) QUART IN FIVE HOURS (0.05 GAL/HR, 0.19 LITER/HR). OPERATION IN EXCESS OF THIS LIMIT IS NOT PERMITTED. EXCESSIVE OIL CONSUMPTION CAN BE INDICATIVE OF A SERIOUS INTERNAL OIL LEAK. AN INTERNAL OIL LEAK CAN RESULT IN AN UNDETECTED INTERNAL OIL FIRE WHICH WILL RESULT IN A DISASTROUS TURBINE FAILURE.

Maximum oil consumption	0.05 US gallons per hour or 1 qt in 5 hours (0.9 liter in 5 hours)
Performance ratings	See Tables 1, 2, 3, 4, 5, 6 or 7.

B. Fuel Specification.

WARNING: TO PREVENT ENGINE FUEL SYSTEM CONTAMINATION, WHICH COULD CAUSE ENGINE FLAMEOUT, AN EXTERNAL LOW PRESSURE FUEL FILTER SHOULD BE USED ON ANY AIRCRAFT REFUELING FROM REMOTE FUELING SITES (DRUMS, ETC).

CAUTION: NOT ALL NO. 1 DIESEL FUELS, JP–1, OR ARCTIC DIESEL FUELS WILL MEET THE PRIMARY FUEL SPECIFICATIONS. IN DETERMINING WHETHER OR NOT A GIVEN FUEL MEETS THESE SPECIFICATIONS, THE BURDEN OF PROOF RESTS WITH THE OPERATOR AND HIS SUPPLIER.

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Table 5

Performance Ratings for One–Engine–Inoperative and/or Emergency Operation – 250–C20F, –C20W Engines

Rating	Shaft Power (min) hp	(kW)	Jet Thrust (est) lb	(N)	Gas Generator rpm (est)	Output Shaft rpm	Specific Fuel Cons. (max) lb/shp–hr	(mg/W·h)	Maximum Allowable Operating Limits: Measured Rated Gas Temp (max) °F	(°C)	Output Shaft Torque Ft lb	(N·m)	Measured Gas Temp (max) °F	(°C)
						Standard Sea Level Static Conditions								
30–Minute Power	420	(313)	45	(200)	51790	6016	0.650	(395)	1490	(810)	384	(521)	1490	(810)
Max Continuous*	420	(313)	45	(200)	51790	6016	0.650	(395)	1490	(810)	384	(521)	1490	(810)

Specific Fuel Consumption = Fuel Flow/SHP

* Max Continuous rating is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine –inoperative (O.E.I.) operation of multi–engine aircraft and emergency two engine operation.

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Table 6

Performance Ratings—Normal Operation—250–C20S

Rating	Shaft Power (min) hp	(kW)	Jet Thrust (est) lb	(N)	Gas Producer Output rpm (est)	Gas Producer Output Shaft rpm	Specific Fuel Cons. (max) lb/shp–hr	(mg/W·h)	Measured Rated Gas Temp °F	(°C)	Maximum Allowable Output Shaft Torque ft–lb	N·m
					Standard Static Sea Level Conditions							
Takeoff (5 min)	420	(313)	42	(187)	53000	6016	0.650	(395.38)	1490	(810)	384	(521)
Normal Cruise	370	(276)	38	(169)	51200	6016	0.650	(395.38)	1360	(738)	323	(438)
Cruise A	333	(248)	36	(160)	50160	6016	0.665	(404.50)	—	—	323	(438)
Cruise B	278	(207)	32	(142)	48800	6016	0.709	(431.27)	—	—	323	(438)
Idle	35 max	(26)	10	(44)	33000	4500–6300	70 lb/hr	(31.75 kg/h)	800 ±100	(427 ±55)	—	—
Takeoff* (Augmented)	420	(313)				6016			1490	(810)	384	(521)

Specific Fuel Consumption = Fuel Flow/SHP

Normal Cruise power is the highest power ordinarily used in regular cruise operation.

Cruise A and Cruise B are the power levels that are 90% and 75% respectively of the rated Normal Cruise power at standard sea level static conditions.

* The augmented rating is based upon a water–alcohol flow rate of 1.25 gpm (4.7 lpm) delivered to the injection nozzles at a pressure differential of 50 psi (345 kPa) across each nozzle, with installation of the nozzles in accordance with the requirements set forth on the installation drawings.

Table 7

Performance Ratings—One Engine Inoperative and/or Emergency Operation—250–C20S

Rating	Shaft Power (min) hp	(kW)	Jet Thrust (est) lb	(N)	Gas Producer Output rpm (est)	Gas Producer Output Shaft rpm	Specific Fuel Cons. (max) lb/shp–hr	(mg/W·h)	Measured Rated Gas Temp °F	(°C)	Maximum Allowable Output Shaft Torque ft–lb	N·m
Max. Cont.	420	(313)	42	(187)	53000	6016	0.650	(395.38)	1490	(810)	384	(521)

Max Continuous rating is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine –inoperative (O.E.I.) operation of multi–engine aircraft and emergency operation.

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PARA 4.B. (cont)

(1) Primary

Fuels conforming to the following military and commercial specifications are approved for unrestricted use in 250 Series engines.

(a) MIL–T–5624, grade JP–4 and JP–5

(b) MIL–T–83133, grade JP–8

(c) ASTM D–1655, Jet B

(d) ASTM D–1655, Jet A or A1

(e) JP–1 fuel conforming to ASTM D–1655, Jet A

(f) Arctic Diesel Fuel DF–A (VV–F–800B) conforming to ASTM D–1655, Jet A or Jet A1

(g) Diesel #1 fuel conforming to ASTM D–1655, Jet A

CAUTION: MIL–G–5572 FUEL CONTAINING TRICRESYLPHOSPHATE (TCP) ADDITIVE SHALL NOT BE USED.

(2) Emergency

MIL–G–5572E OR ASTM–D–910, all grades (aircraft boost or start pump on; maximum of 6 hours operation per overhaul period of turbine)

(3) Cold Weather

WARNING: AT AMBIENT TEMPERATURES BELOW 4°C (40°F), SOME TYPE OF ANTI–ICE PROTECTION IS REQUIRED, SUCH AS AN ANTI–ICE ADDITIVE OR A MEANS OF AIRFRAME FUEL ICE ELIMINATION. ENGINE FLAMEOUT COULD RESULT FROM FAILURE TO USE ANTI– ICE PROTECTION. (REFER TO THE AIRCRAFT MANUAL FOR THEIR RECOMMENDATIONS AND PARA 4.B., THIS SECTION, FOR APPROVED ANTI–ICE ADDITIVE.)

NOTE: Grade JP–4 (MIL–T–5624), grade JP–5, and grade JP–8 (MIL–T–83133A, or later) type fuels contain anti–ice additive which conforms to MIL–I–27686 (or later). These fuels do not require additional anti–ice additive unless specified by the airframe manufacturer.

To assure consistent starts below 4°C (40°F) the following fuels may be necessary:

(a) MIL–T–5624, grade JP–4

(b) ASTM D–1655, Jet B

(c) AVGAS/Jet A, Jet A1, or JP–5 mixture (Refer to Para 8, Cold Weather Fuels, for mixing/use of cold weather fuel.)

NOTE: Jet A, A1, JP–5, or JP–8 fuels are not restricted from use at ambient temperatures below –18°C (0°F); however, special provisions for starting must be made. (Refer to Aircraft Flight Manual.) Once started, engine operation on Jet A, Jet A1, JP–5, or JP–8 will be satisfactory in outside air temperatures down to –32°C (–25°F).

NOTE: Prolonged and uninterrupted operation with only AVGAS mixture will induce lead buildup on turbine parts. This lead buildup can cause a gradual power reduction; consequently, this AVGAS mixture should be used only for cold weather operation. During operation with normal Jet A type fuel, the lead will slowly dissipate.

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PARA 4.B. (cont)

(4) Prist (MIL–I–27686E) anti–ice additive is approved for use in the model 250–C20R series engines if used in accordance with the additive manufacturer's instructions and if approved by the airframe manufacturer.

NOTE: Prist is also an anti–biological agent, and may be used at the discretion of the operator to prevent microbiological fuel contamination.

C. Oil Specification.

The 250 series engines are qualified and certified for use with MIL–PRF–7808G and subsequent, MIL–PRF–23699 series and DOD–85734 series lubricating oils. The vendor brands of MIL–PRF–7808 series, MIL–PRF–23699 series, and DOD–85734 series lubricating oils, which have been engine tested and approved for use in the Model 250 engine are listed in para 4.C.(2), Approved Oils. Refer to paragraph C.(1), Cold Weather Lubrication, for the type of oil recommended at specific temperatures.

WARNING: ONLY DISCRETIONARY MIXING OF OILS WITHIN AN OIL SERIES IS PERMITTED WITHOUT A TIME PENALTY. USE OF MIXED OILS FROM DIFFERENT SERIES IN AN ENGINE IS LIMITED TO FIVE HOURS TOTAL RUNNING TIME DURING ONE OVERHAUL PERIOD. ADEQUATE MAINTENANCE RECORDS MUST BE MAINTAINED TO ENSURE THAT THE FIVE HOUR LIMIT IS NOT EXCEEDED. FAILURE TO COMPLY WITH OIL MIXING RESTRICTIONS CAN RESULT IN ENGINE FAILURE.

CAUTION: IF HEAVY CARBON OR COKE DEPOSITS ARE FOUND ON THE ENGINE FILTER DURING REGULAR INSPECTIONS, IT IS RECOMMENDED THE FILTERS BE REPLACED; CONTINUE TO MONITOR BYPASS INDICATORS.

CAUTION: TO DECREASE THE LIKELIHOOD FOR CARBON OR COKE DEPOSITS BEING DISLODGED DURING THE CHANGEOVER TO ''3RD GENERATION'' OILS (E.G. MOBIL JET 254), THESE CHANGEOVERS SHOULD ONLY BE MADE WHEN THE ENGINE IS NEW OR REPAIRED, TO THE EXTENT THE LUBRICATION PASSAGES AND SUMPS HAVE BEEN CLEANED AND FLUSHED.

CAUTION: WHILE CONSIDERABLE LABORATORY DATA IS AVAILABLE TO DEMONSTRATE THE COMPATIBILITY OF ONE SYNTHETIC TURBINE OIL WITH OTHER TURBINE OILS MEETING THE SAME SPECIFICATION (AIRLINE EXPERIENCE DOES DEMONSTRATE THIS PROPERTY), THE INDISCRIMINATE MIXING OF APPROVED OILS DURING THE OPERATIONAL USE OF THE OIL IS NOT RECOMMENDED. HOWEVER, THERE MAY BE CIRCUMSTANCES WHERE EMERGENCY TOP–OFF, INADVERTENT MIXING, OR CHANGEOVER BY ''TOP–OFF'' TO ANOTHER BRAND MAY OCCUR. THESE ARE ACCEPTED PRACTICES.

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PARA 4.C. (cont)

CAUTION: FAILURE TO COMPLY WITH OIL MIXING RESTRICTIONS CAN RESULT IN ENGINE FAILURE.

CAUTION: REMOVE AND INSPECT THE OIL FILTER AFTER 25 HOURS OF ENGINE OPERATION IF THE TYPE OF OIL (MIL–PRF–7808, MIL–PRF–23699, OR DOD–85734) WAS MIXED IN AN EMERGENCY. (THERE IS A 5–HOUR LIMIT FOR THE USE OF MIXED OILS.)

CAUTION: THE FILTER INSPECTION IS TO DETERMINE IF COKE, WHICH WAS FORMED DURING PREVIOUS OPERATION, IS BEING DISLODGED DURING THE FIRST OPERATION FOLLOWING THE OIL CHANGE.

CAUTION: IF HEAVY CARBON DEPOSITS ARE OBSERVED ON THE ENGINE FILTER, IT IS SUGGESTED THAT THE ENGINE OIL BE CHANGED AGAIN. THE OIL IS TO BE DRAINED WHEN THE OIL IS HOT TO OBTAIN THE MAXIMUM BENEFIT. THE 25 HOUR OIL MONITORING IS TO CONTINUE UNTIL THE NEXT OIL CHANGE PERIOD.

CAUTION: USE OF OILS WHICH ARE NOT INCLUDED IN THE APPROVED OILS LISTING, OR FAILURE TO DRAIN OIL WITHIN THE PRESCRIBED INTERVAL GIVEN IN TABLE 602, 72–00–00, ENGINE–INSPECTION/CHECK WILL BE CONSIDERED AS MISUSE UNDER ITEM (4) OF THE WARRANTY POLICY.

(1) Cold Weather Lubrication

The types of oil recommended at specific ambient temperatures are as follows:

0°C (32°F) and above	MIL–PRF–23699C or subsequent preferred
0°C (32°F) to –40°C (–40°F)	MIL–PRF–23699C or subsequent preferred or MIL–PRF–7808G or subsequent
–40°C (–40°F) and below	MIL–PRF–7808G or subsequent only
–40 C (–40 F) to 135 C (275 F)	DOD–85734

NOTE: Because of availability, reduced coking and better lubricating qualities at higher temperatures, MIL–PRF–23699 oils are preferred for use in Model 250 engines.

NOTE: Check the engine oil quantity within 15 minutes of engine shutdown to avoid a false indication of excessive oil consumption. If the 15 minutes has been exceeded, motor the engine for 30 seconds with the starter before checking tank quantity. Motoring normally scavenges oil from the gearbox back to the aircraft oil tank. Check the airframe flight manual; some installations may require engine to be operated for at least a minute at ground idle to assure proper scavenging of the engine gearbox.

NOTE: Always refer to the airframe flight manual for proper oil servicing instructions; specific requirements may vary for different models.

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	100 Hour Inspection (cont)			
	f. Inspect magnetic chip detector plugs.	PARA 11.G., 72–00–00, Engine–Servicing		
	g. Inspect quick disconnect magnetic chip detector plugs and flanged inserts for wear, if installed.	PARA 11.G., 72–00–00, Engine–Servicing		
	*h. Refill oil system.	PARA 11.C., 72–00–00, Engine–Servicing		
22	Inspect the start counter for proper operation, increase in count, and for loose, chafed,frayed or broken wires and loose connectors.	PARA 1., 74–20–03		
23	Check the condition of the bleed valve gasket, without removing bleed valve. Replace gasket if air leaks (blowouts) can be detected.	PARA 2., 75–10–02		
24	Inspect the outer combustion case for condition. Inspect the weld joints of and in the brazed screen reinforcement in the armpit area.	PARA 2.B., 72–40–00		
25	Clean the burner drain valve.	PARA 3., 72–40–00		
26	Inspect the ignition lead for burning, chafing,or cracking of conduit and loose connectors and broken lockwire.	N/A		
27	On engines with CECO fuel system, clean or replace the high pressure fuel filter.	N/A		
28	On engines with CECO fuel systems, visually inspect the bleed hole at the low point in the scroll–to–governor P_C tube for any obstruction. If the hole is not completely open, remove any contamination which could obstruct drainage of moisture from the tube using a piece of lockwire.	N/A		
29	Review engine records for compliance with all mandatory bulletins, inspections and airworthiness directives.	N/A		
30	Review engine records for time limited parts components, accessory or modules.	N/A		
31	Enter component changes, inspection compliance, etc., in log book as required.	N/A		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	200 Hour Inspection			
	In addition to the 100 hour inspection items, perform the following:			
	WARNING: MANDATORY COMPLIANCE DATE FOR ROLLS–ROYCE COMMERCIAL ENGINE BULLETIN 250–C20 CEB–1051 WAS AUGUST 30, 1980.			
32	Perform fuel pump backlash inspection on Sundstrand dual element pump P/N 6854292, 6857548, 6877719, 6856250, 6876803.	250–CSL–1007		
	300 Hour Inspection			
	In addition to the 100 hour and applicable 200 hour inspection items, perform the following:			
	CAUTION: INSPECTION FREQUENCY SHALL BE BASED ON THE NATURE OF THE EROSIVE AND/OR CORROSIVE ENVIRONMENT. THE OPERATING ENVIRONMENT MAY DICTATE A MORE FREQUENT INSPECTION INTERVAL. FOR NON–COATED COMPRESSOR WHEELS, THE INSPECTION SHALL NOT EXCEED 300 HOURS OR 6 MONTHS. FOR COATED COMPRESSOR WHEELS, INSPECTION SHALL NOT EXCEED 300 HOURS OR 12 MONTHS. IF ANY PARENT METAL IS EXPOSED DUE TO CORROSION AND/OR EROSION, THE INSPECTION REQUIREMENT SHALL REVERT BACK TO 300 HOURS OR 6 MONTHS.			
33	Inspect the compressor case when operating in an erosive and/or corrosive environment.	PARA 1.D.(9), this Section		
	CAUTION: AIRCRAFT INSTALLED–ENGINE FUEL–PUMP FILTER DIFFERENTIAL PRESSURE WARNING SYSTEMS AND/OR OPERATING EXPERIENCE MAY DICTATE REPLACEMENT AT A LESSER TIME INTERVAL. IN NO INSTANCE SHOULD THE 300 HR REPLACEMENT INTERVAL BE EXCEEDED.			
34	Replace the fuel filter element. This filter is a throw–away item. It is not cleanable.	PARA 2.C., 73–10–01		
	CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. (REFER TO SPECIAL INSPECTIONS, 72–00–00, TABLE 604) IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.			
	CAUTION: PURGE AIR FROM THE FUEL SYSTEM.			
35	Perform a fuel pump bypass valve operational check whenever a fuel filter is replaced.	PARA 3.A., 73–10–01		

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	300 Hour Inspection (cont)			
36	Remove, clean and inspect engine P_c filter every 300 hours or earlier as engine performance dictates.	PARA 3., 73–20–06		
37	Inspect and clean the No. 1 bearing oil pressure reducer.	PARA 3., 72–30–00		
38	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	N/A		
39	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72–50–00		
40	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G., 72–50–00		
41	Remove, inspect and clean the fuel nozzle. If no airframe mounted fuel filter is installed, inspect the fuel nozzle filter.	PARA 2., 73–10–03		
	NOTE: Operators may find it necessary to inspect and clean the fuel nozzle more often depending on past experience or operating conditions.			
	500 Hour/1 Year Inspection			
42	Inspect all uncoated and coated P/N 6846278 and 6871338 power turbine outer couplings nuts for corrosion.	250–C20 CSL–1060		
	NOTE: Compliance with Rolls–Royce Commercial Engine Bulletin 250–C20 CEB–1120 and/or 250–C20 CEB–1158 removes this inspection requirement.			
	600 Hour Inspection			
43	Check the fuel pump driveshaft on Sundstrand single element pumps for spline wear.	N/A		
	NOTE: This inspection is not required for Agro–Tech (TRW) fuel pumps or Sundstrand fuel pumps P/N 23003114 and subsequent.			
44	Perform scavenge oil filter impending bypass functional test per Facet Service Bulletin No. 090589 (ref. Rolls–Royce 250 CSL 1164) for aircraft equipped with this type of external scavenge filter system.	N/A		
45	Replace the fuel control filter assembly. Bendix fuel controls P/N 2524552–4 or 2524552–6 (less–5) and prior unless 250–C20 CEB–1089 has been accomplished.	PARA 4.A., 73–20–02, 4.A., 73–20–03		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	150 Hour Inspection (cont)			
	b. Inspect magnetic chip detector plugs.	PARA 11.G., 72–00–00, Engine–Servicing		
	c. Inspect quick disconnect magnetic chip detector plugs and flanged inserts for wear, if installed.	PARA 11.G., 72–00–00, Engine–Servicing		
22	Inspect the start counter for proper operation, increase in count, and for loose, chafed, frayed or broken wires and loose connectors.	PARA 1., 74–20–03		
23	Check the condition of the bleed valve gasket without removing bleed valve. Replace gasket if air leaks (blowouts) can be detected.	PARA 2., 75–10–02		
24	Inspect the outer combustion case for condition. Inspect the weld joints of and in the brazed screen reinforcement in the armpit area.	PARA 2.B., 72–40–00		
25	Clean the burner drain valve.	PARA 3., 72–40–00		
26	Inspect the ignition lead for burning, chafing, or cracking of conduit and loose connectors and broken lockwire.	N/A		
27	On engines with CECO fuel system, clean or replace the high pressure fuel filter.	N/A		
28	On engines with CECO fuel systems, visually inspect the bleed hole at the low point in the scroll–to–governor P_c tube for any obstruction. If the hole is not completely open, remove any contamination which could obstruct drainage of moisture from the tube using a piece of lockwire.	N/A		
29	Review engine records for compliance with all mandatory bulletins, inspections and airworthiness directives.	N/A		
30	Review engine records for time limited parts components, accessory or modules.	N/A		
31	Enter component changes, inspection compliance, etc., in log book as required.	N/A		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	300 Hour Inspection			
	In addition to the 150 hour inspection items, perform the following:			
	WARNING: MANDATORY COMPLIANCE DATE FOR ROLLS–ROYCE COMMERCIAL ENGINE BULLETIN 250–C20 CEB–1051 WAS AUGUST 30, 1980.			
32	Perform fuel pump backlash inspection on Sundstrand dual element pump P/N 6854292, 6857548, 6877719, 6856250, 6876803.	250–CSL–1007		
	CAUTION: INSPECTION FREQUENCY SHALL BE BASED ON THE NATURE OF THE EROSIVE AND/OR CORROSIVE ENVIRONMENT. THE OPERATING ENVIRONMENT MAY DICTATE A MORE FREQUENT INSPECTION INTERVAL. FOR NON–COATED COMPRESSOR WHEELS, THE INSPECTION SHALL NOT EXCEED 300 HOURS OR 6 MONTHS. FOR COATED COMPRESSOR WHEELS, INSPECTION SHALL NOT EXCEED 300 HOURS OR 12 MONTHS. IF ANY PARENT METAL IS EXPOSED DUE TO CORROSION AND/OR EROSION, THE INSPECTION REQUIREMENT SHALL REVERT BACK TO 300 HOURS OR 6 MONTHS.			
33	Inspect the compressor case when operating in an erosive and/or corrosive environment.	PARA 1.D.(9), this section		
	CAUTION: AIRCRAFT INSTALLED–ENGINE FUEL–PUMP FILTER DIFFERENTIAL PRESSURE WARNING SYSTEMS AND/OR OPERATING EXPERIENCE MAY DICTATE REPLACEMENT AT A LESSER TIME INTERVAL. IN NO INSTANCE SHOULD THE 300 HR REPLACEMENT INTERVAL BE EXCEEDED.			
34	Replace the fuel filter element. This filter is a throw–away item. It is not cleanable.	PARA 2.C., 73–10–01		
	CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. (REFER TO SPECIAL INSPECTIONS, 72–00–00, TABLE 604) IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.			
	CAUTION: PURGE AIR FROM THE FUEL SYSTEM.			
35	Perform a fuel pump bypass valve operational check whenever a fuel filter is replaced.	PARA 3.A., 73–10–01		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	300 Hour Inspection (cont)			
36	Lubrication system inspection			
	NOTE: Maximum interval between oil change is 300 hours or 6 months whichever occurs first.			
	a. Drain oil system.	PARA 11.C., 72–00–00, Engine–Servicing		
	b. Inspect and clean turbine pressure oil check valve.	PARA 7.K., 72–50–00		
	c. Turbine pressure oil tube screen assembly. Detach clamp; then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the tube coupling nut at the fireshield elbow only enough to allow sufficient movement of the tube to enable removal of the screen. At assembly, tighten connector coupling nut to 200–250 lb in. (23–28 N·m). Tighten fireshield elbow coupling nut to 80–120 lb in. (9–14 N·m). Tighten clamp nut to 35–40 lb in. (3.9–4.5 N·m).	N/A		
	d. Measure oil flow from the scavenge passage of the external sump and from the scavenge passage of the gas producer support. It is recommended that the external sump is not removed for this check.	PARA 7.D., 72–50–00		
	NOTE: This step must be performed before draining oil or after the oil system has been refilled.			
	e. Refill oil system.	PARA 11.C., 72–00–00, Engine–Servicing		
37	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	N/A		
38	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72–50–00		
39	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G., 72–50–00		
40	Remove, inspect and clean the fuel nozzle exterior. If no airframe mounted fuel filter is installed, inspect the fuel nozzle filter.	PARA 2., 73–10–03		
	NOTE: Operators may find it necessary to inspect and clean the fuel nozzle more often depending on past experience or operating conditions.			

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LIFE LIMITS OF THE COMPRESSOR ROTOR

Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
Impeller	6871337	Original	2500	7500
	23060177	Ground Pin, Glass Bead Peen	2500	7500
Impeller	6876873	Hub relocated rearward	3550	9150
	23057117	No Pin	3550	9150
	23058146	Extended Adapter	3550	9150
	23058147	Extended Adapter	3550	9150
	23060417	Ground Pin, Glass Bead Peen	3550	9150

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PARA 1.C. (cont)

(1) Lubricate and install new packings on the compressor rear diffuser and the spur adapter gearshaft.

(2) Lubricate (engine oil) bearing guide (6872646 or 23006778) and install it on the spur adapter gearshaft. (See Figure 204.)

(3) Sparingly lubricate the rollers of the No. 2–1/2 bearing with petrolatum to hold the rollers out against the bearing outer race.

WARNING: FAILURE TO PROPERLY SHIM THE COMPRESSOR AT INSTALLATION CAN CAUSE THE SPUR ADAPTER GEARSHAFT TO FAIL RESULTING IN SUDDEN ENGINE STOPPAGE.

CAUTION: BE SURE THE SPUR ADAPTER GEARSHAFT IS IN MESH WITH THE GEARBOX MATING GEAR BEFORE TIGHTENING COMPRESSOR RETAINING BOLTS.

(4) Determine the number of shims required for compressor installation.

(a) When replacing a compressor, the total thickness of shims required at each attaching point has been determined during compressor buildup (overhaul) and marked near the appropriate bolt hole on the rear diffuser.

(b) When reinstalling the same compressor, install with the total thickness of shims marked on the rear diffuser. If the shim markings are not legible, missing, or in doubt, compute the total shim thickness requirements in accordance with paragraph 1.C., Compressor Shimming Procedure, this section.

(5) Place the compressor on the gearbox with the required shims in place at the bolt pads. Use 6799790 engine turning adapter to turn the gear train until it meshes with the spur adapter gearshaft.

(6) If interference is encountered between the compressor and one of the cast bosses on the gearbox, lightly dress the boss by filing. Remove only sufficient material to provide a positive clearance.

(a) Dichromate the machined area per AMS 2475.

(b) Apply engine gray enamel (AMS 2510).

(7) Install the P_c air filter and bracket assembly at the same time the compressor mounting bolts and nuts are installed. Use the same configuration of bolts, nuts and washers at each of the five compressor pads as was previously used. (If the gearbox is changed, different bolts or nuts may be required.) Tighten attachment features to 70–85 lb in. (7.9–9.6 N·m) and secure bolts with lockwire.

(8) Remove bearing guide 6872646 or 23006778 from the spur adapter gearshaft. Visually check that the spur adapter gearshaft packing is in place.

(9) Install the turbine assembly. (Refer to Turbine Assembly Installation, para 1.B. or 1.D., 72–50–00.)

(10) Install the anti–icing air valve on the diffuser scroll. Do not tighten the jam nut at this time. (Refer to Anti–Icing Air System, para 2.D., 75–10–01.)

(11) Install the two anti–icing air tubes. Tighten coupling nuts to 150–200 lb in. (17–23 N·m). Tighten valve jam nut to 100–150 lb in. (11–17 N·m) and secure with lockwire.

(12) Install the bleed control valve on the compressor case mounting flange. (Refer to Bleed Air Control Valve, para 2.B., 75–10–02.)

(13) Apply anti–seize compound lightly to the threads; then install the two pressure elbows with new packing in the scroll. Do not tighten the jam nuts until final tube alignment is made.

(14) Install pressure sensing line between bleed valve and pressure probe elbow. Tighten coupling nuts to 80–120 lb in. (9.0–13.6 N·m). Tighten elbow jam nuts to 55–80 lb in. (6.2–9.0 N·m) and secure with lockwire.

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	72-00-00	51	Dec 12/07
	72-00-00	52	Dec 12/07
E6R11-72-3	72-30-00	218	Jan 15/08
	72-30-00	218A	Jan 15/08

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LIFE LIMITS OF THE GAS PRODUCER TURBINE ROTOR ASSEMBLY

WARNING: IT IS NOT ALLOWED TO INSTALL A TURBINE WHEEL WITH ACCEPTABLE WHEEL RIM CRACKS IN ANY ENGINE/TURBINE DURING OVERHAUL. ACCEPTABLY CRACKED TURBINE WHEELS MAY BE REINSTALLED ONLY DURING A TIME CONTINUED ENGINE/TURBINE REPAIR.

Nomenclature	Part No.	Description	Maximum Operating Hours	Maximum Cycles
1st–stage Wheel	6853306	Original	1550	3000
1st–stage Wheel	6886407	Thick rim	1775	3000
1st–stage Wheel	23073853	Thick rim	1775	3000
1st–stage Wheel	23073813	Thick rim	1775	3000
2nd–stage Wheel	6857912	Original	1550	3000
2nd–stage Wheel	6871872	250–C18 to –C20 Conversion (250–CEB–115)	1550	3000
2nd–stage Wheel	6877092	Changed contour	1775	3000
2nd–stage Wheel	6898782	Pilot diameter	1775	3000
2nd–stage Wheel	23038220	Stepped Balance Piston Seal (RFSE 250–87–2)	1775	3000
2nd–stage Wheel	23073854	Pilot diameter	1775	3000
2nd–stage Wheel	23073814	Pilot diameter	1775	3000
Gas Producer Turbine Tie–Bolt	23068265	Thick Design	——	9000

NOTE: 1st–stage turbine wheels with acceptable wheel rim cracks which have been inspected and approved for time continued use in accordance with the 250–C20 Series Overhaul Manual, Pub No. 10W3, (for a repaired engine or turbine) may be continued in service to overhaul or an additional 500 hours or 500 cycles, whichever of these occurs first (provided the listed part hour/cycle life limit is not exceeded).

NOTE: 2nd–stage turbine wheels with acceptable wheel rim cracks which have been inspected and approved for time continued use in accordance with the 250–C20 Series Overhaul Manual, Pub No. 10W3, (for a repaired engine or turbine) may be continued in service to overhaul or completion of the wheel's maximum hour life or cycle limit, whichever of these occurs first.

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PARA 6.A.(1) (cont)

(b) Materials and equipment.

1 The highest quality water available must be used.

a The most rapid and economical means to assess water quality is by measuring electrical conductivity. Control of electrical conductivity to a specific low level will automatically yield a low level of chlorides, sulfates, sodium, and other elements. Distilled, demineralized, or deionized water with a maximum electrical conductivity of 3 micro–ohms per cubic centimeter would be theoretically ideal. However, a more practical level of 20 micro–ohms per cubic centimeter maximum would control the above impurities to a level of less than 10 ppm.

NOTE: Most water deionizing equipment has the capability to determine electrical conductivity. Commercially purchase deionized/demineralized water, conductivity information should be requested from the vendor.

b Should the electrical conductivity of the water not be known, the use of distilled, demineralized, or deionized water is preferred.

2 Portable equipment such as a garden sprayer or fire extinguisher which can be pressurized to obtain the required flow rate is recommended for water rinse. To provide capability for rinse with either portable equipment or a water supply system, a nozzle capable of flowing the recommended rate at about 55 psig (379 kPa) is desired.

3 The spray nozzle shall provide a diffused spray of water at a flow rate of one quart (one liter) in nine to eleven seconds at the pressure conditions used during compressor rinse. The nozzle should be sized to provide the proper flow rate at the average pressure maintained during each rinse cycle.

NOTE: Test for proper water flow at the pressure to be used by placing the nozzle in a large container so that no water can splash out. Time the flow for 10 seconds and measure the quantity collected. Proper nozzle size for the pressure used should accumulate 1 to 1–1/8 quarts (1.0 to 1.1 liters). Adjust nozzle size as necessary to meet the specified flow limits.

4 A quick opening valve shall be installed in the supply tube as close to the nozzle as practical.

5 6886204 Compressor Cleaning Protector Kit (bleed valve wedge).

(c) Spray rinse procedure:

1 Make sure the anti–ice valve is in the ‘‘OFF” position.

2 Make sure the engine ignition circuit breaker is pulled.

3 Block the bleed valve in the closed position using the wedge in 6886204 compressor cleaning protector kit (See Figure 217). It is not necessary to disconnect any lines.

CAUTION: TO PREVENT POSSIBLE BLADE DAMAGE AND TO ASSURE ADEQUATE RINSE AT THE BASE OF THE BLADES, N1 MUST NOT EXCEED 10% RPM. IF N1 RPM REACHES 10%, RELEASE THE STARTER AND CONTINUE THE WATER SPRAY. PERMIT N1 RPM TO REDUCE TO APPROXIMATELY 5% AND THEN RE–ENERGIZE THE STARTER TO OBTAIN A FULL TEN SECONDS OF ENGINE ROTATION WHILE WATER IS SPRAYED INTO THE COMPRESSOR.

4 Start the water injection three seconds prior to engaging the starter. The three second delay will reduce the tendency of the engine to accelerate above 10% rpm.

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5. Operating Precautions

WARNING: THE PRIMARY APPLICATION OF THE TURBOSHAFT ENGINE IS TO POWER A HELICOPTER OR ROTORCRAFT. A HEIGHT–VELOCITY DIAGRAM, AS REQUIRED BY REGULATION AND PREPARED BY THE AIRFRAME MANUFACTURER, IS PUBLISHED IN THE AIRCRAFT FLIGHT MANUAL PERFORMANCE SECTION. THE OPERATOR MUST BECOME FAMILIAR WITH THIS DIAGRAM TO DETERMINE WHAT ALTITUDES AND AIRSPEEDS ARE REQUIRED TO SAFELY MAKE AN AUTOROTATIONAL LANDING IN CASE OF POWER LOSS OR ENGINE FAILURE. THE ALTITUDE–AIRSPEED COMBINATIONS WHERE A SAFE AUTOROTATIONAL LANDING MAY NOT BE POSSIBLE ARE REPRESENTED BY THE SHADED OR CROSS–HATCHED AREA OF THE DIAGRAM.

WARNING: SNOW OR ICE SLUGS CAN CAUSE THE ENGINE TO FLAME OUT. BE SURE AVAILABLE PREVENTIVE EQUIPMENT IS INSTALLED AND IN PROPER WORKING ORDER WHEN FLYING IN CONDITIONS WHERE SNOW OR ICE BUILDUP MIGHT OCCUR.

WARNING: CONSULT THE AIRCRAFT FLIGHT MANUAL FOR REQUIRED EQUIPMENT AND PROCEDURES FOR FLIGHT IN FALLING/BLOWING SNOW.

WARNING: SAND AND DUST WILL ERODE COMPRESSOR VANES AND CAUSE THEM TO FAIL.

WARNING: SALT LADEN HUMIDITY AND CHEMICALS WILL CORRODE COMPRESSOR BLADES AND VANES AND CAUSE THEM TO FAIL.

Observe the following precautions to reduce the danger of personnel injury or damage to the engine.

A. Before operating the engine, check the air inlet for foreign objects. (Refer to Compressor Inlet Air Blockage, PARA 1.D.(12), 72–00–00, Engine–Inspection/Check.)

B. If the engine does not operate within Operating Limits, PARA 6., this section, take the designated action.

C. If the aircraft is frequently operated in dusty or sandy areas, periodic erosion inspection is recommended. (Refer to Erosion Inspection, PARA 1.D.(9), 72–00–00, Engine–Inspection/Check.)

D. If a flameout has been experienced as the possible result of snow, ice, or water ingestion, refer to Snow Ingestion Inspection, PARA 1.D.(10), 72–00–00, Engine–Inspection/Check.

E. If the aircraft is being operated following an extended period of inactivity, refer to Special Inspections, Table 604, 72–00–00, Engine Inspection/Check, for recommended action.

F. If the engine is operated in a corrosive environment it must be subjected to a water wash. (Refer to Compressor Contamination Removal, PARA 6.A.(1), 72–30–00.)

G. If the installed engine will be shut down for more than five calendar days the compressor must receive an application of preservative. (Refer to Compressor Preservation, PARA 12.D., 72–00–00, Engine Servicing.)

6. Operating Limits

WARNING: TO PREVENT SERIOUS ENGINE MALFUNCTION OR CRUCIAL LOSS OF POWER, DO NOT OPERATE THE ENGINE IN EXCESS OF ANY SPECIFIED LIMIT.

NOTE: Operators may be faced with an engine that meets all specification power requirements in a certified test cell but apparently fails to meet the minimum installed power required by the aircraft flight manual.

NOTE: Please refer to the aircraft manual for other system troubleshooting.

NOTE: Operators should be aware that the FAA requires the Rolls–Royce Authorized Maintenance Centers to deliver engines of at least “specification horsepower” only after complete engine overhaul.

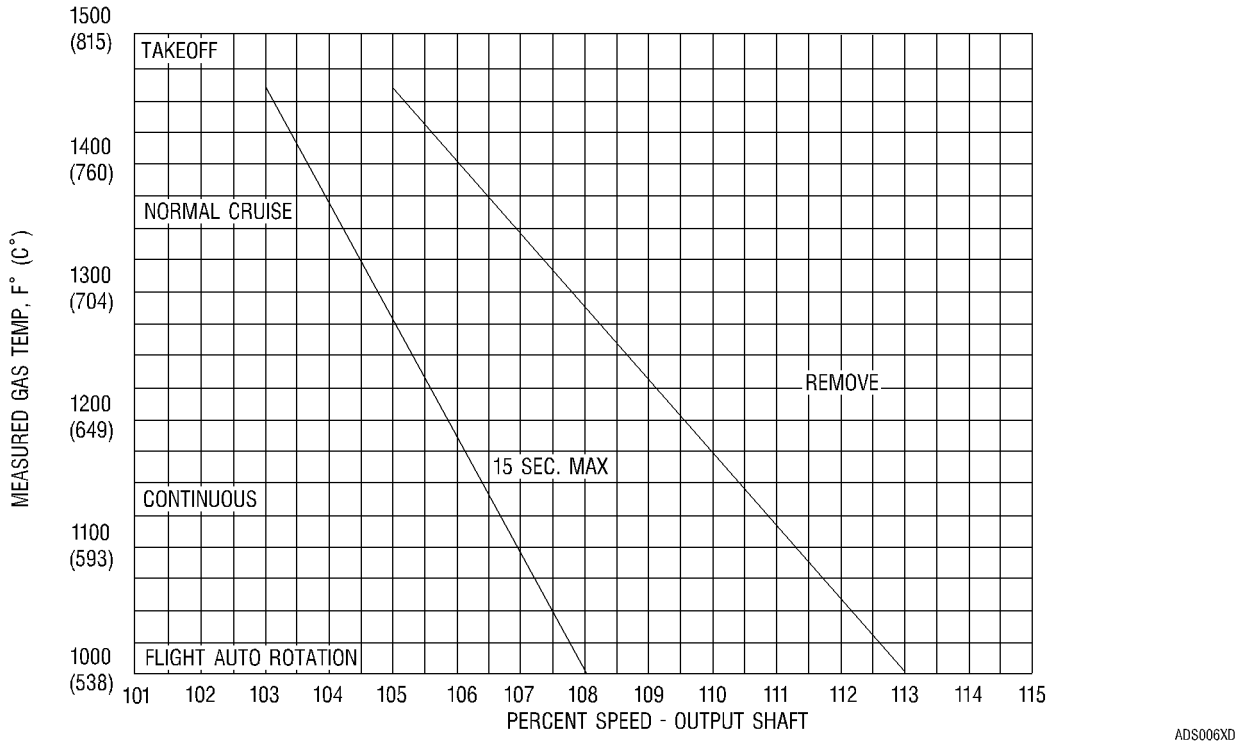
A. Engine Speed

If any of the following limits are exceeded send the designated engine components to repair/overhaul. Record extent of overspeed in the engine log book.

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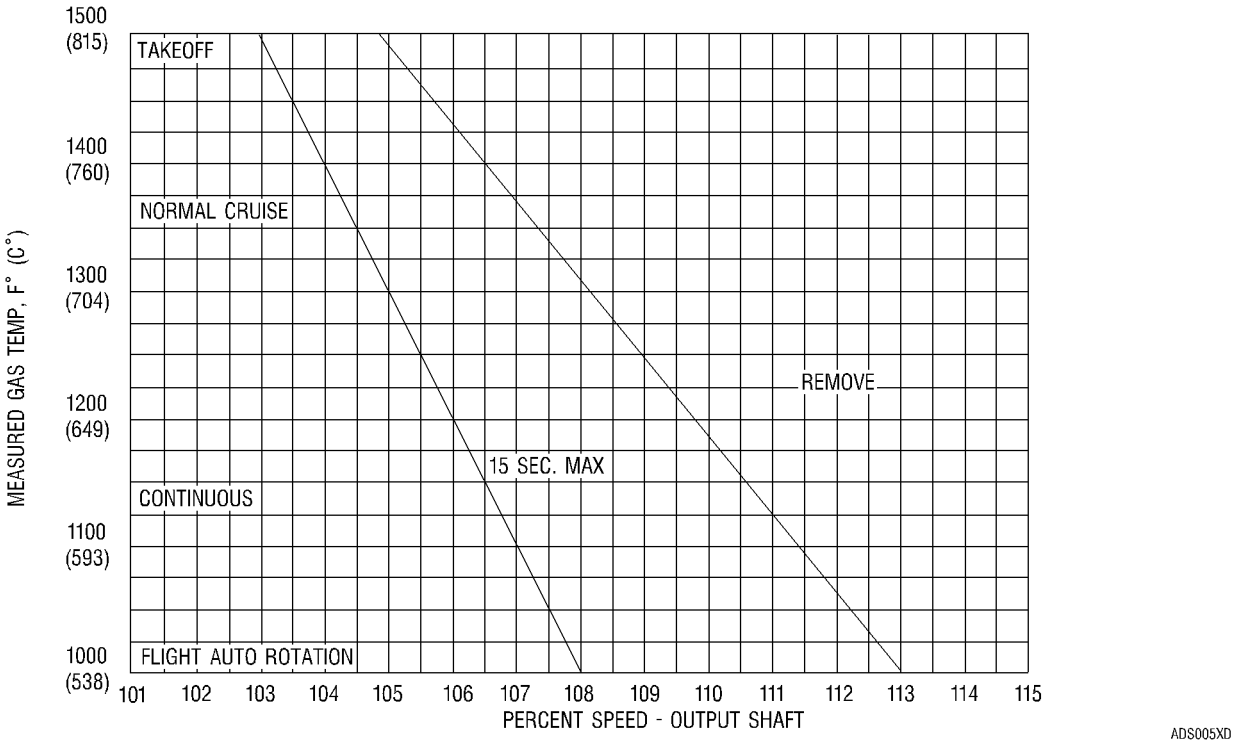
PARA 6. (cont)

Limit	Component
N_1 (Gas Producer)	
105%—max. continuous	None
105–106%—15 sec max.	None
105%—over 15 sec	Turbine and compressor
Over 106%—not allowed	Turbine and compressor
N_2 (Power Turbine)	
Limits as shown in Figure 26, 27 or 28	Turbine
Complete loss of output shaft load	Turbine and gearbox
120% (40,000 rpm) or maximum indication shown on N_2 tachometer, whichever is first.	Turbine and gearbox



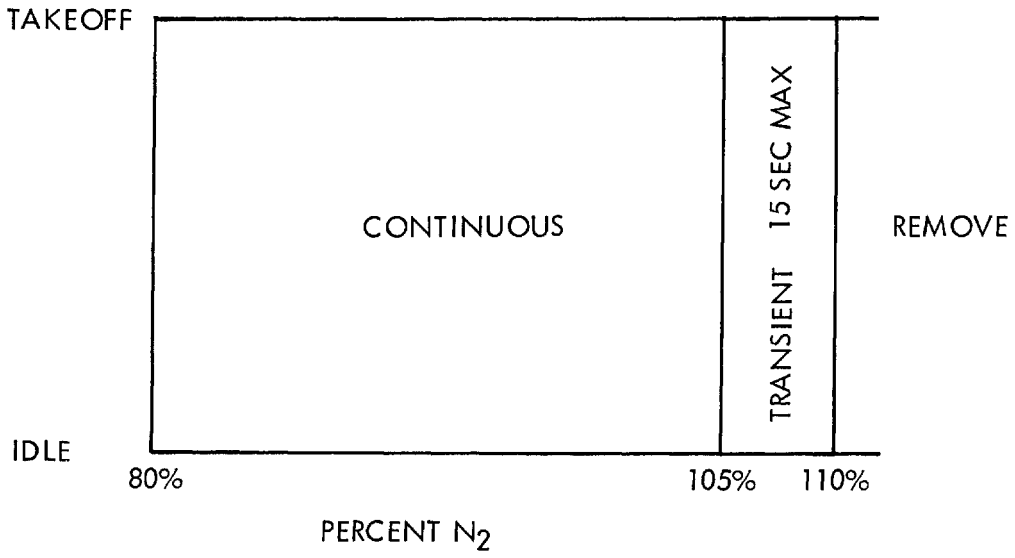
250–C20 Maximum Allowable Output Shaft Speeds
Figure 26

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250–C20B, –C20F –C20W and–C20J Maximum Allowable Output Shaft Speeds
Figure 27

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ADS042XD

250–C20S Maximum Allowable Output Shaft Speeds
Figure 28

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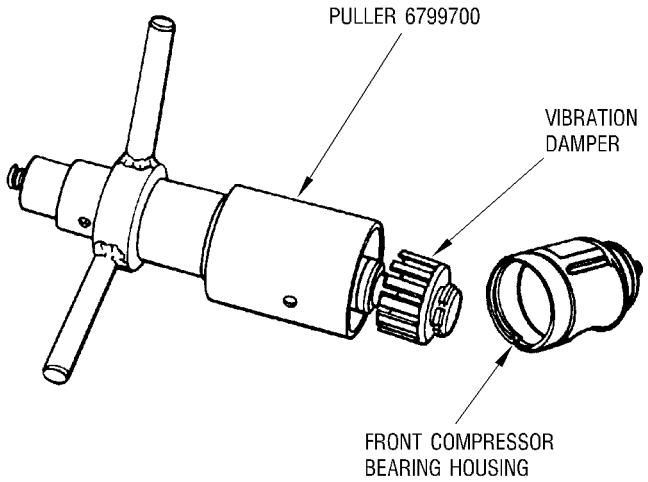
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E6R11-72-2	72-00-00	50	Dec 12/07
E6R11-72-2	72-00-00	51	Dec 12/07
E6R11-72-2	72-00-00	52	Dec 12/07

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Pulling the Compressor Front Bearing Vibration Damper
Figure 209

PARA 3.B. (cont)

(2) Lubricate inside the replacement seal with engine oil (by soaking). Install lubricated packing on the seal; then install the seal on the rotor.

CAUTION: USE A RETAINING NUT WITH A BLACK NYLON CAP WITH NO. 1 BEARINGS HAVING A PULLER GROOVE. USE RED OR YELLOW NYLON CAP NUTS WITH BEARINGS WITHOUT PULLER GROOVES. IN ORDER FOR THE SELF–LOCKING FEATURE OF THE RETAINING NUT TO BE EFFECTIVE AND TO AVOID OIL LEAKAGE INTO THE ROTOR, DO NOT INTERCHANGE THESE NUT/BEARING COMBINATIONS.

CAUTION: EXERCISE CARE WHEN INSTALLING THE NUT. DO NOT ALLOW THE WRENCH TO CONTACT THE BEARING.

(3) Install the seal mating ring (pulling lip forward) and the bearing (wire clip or pulling lip forward) on the compressor rotor. Secure with a nut. Torque nut to 120–130 lb in. (14–15 N·m) above torque due to locknut drag. Loosen and retorque to 70–80 lb in. (7.9–9.0 N·m) above torque due to locknut drag. Use a socket wrench with a broach depth of no more than 7/16 in. (11 mm) (Snap–On SW 181, or equivalent). Hold the rotor from turning using 6799790 adapter in the starter–generator pad on the gearbox cover.

(4) Install the spring and spring clip. The cup sleeve fits over the spring on the end that contacts the bearing.

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	72-00-00	52	Dec 12/07
E6R11-72-3	72-30-00	218	Jan 15/08
	72-30-00	218A	Jan 15/08
E6R11-05-1	05-10-03	1	Feb 5/08

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PARA 7. (cont)

(d) Inspect valve parts in accordance with Table 202.

(e) Insert poppet and spring into valve housing.

(f) Install fitting with new packing on housing.

CAUTION: BE SURE THE CHECK VALVE IS INSTALLED WITH THE ARROW POINTING TOWARD THE REAR OF THE ENGINE.

CAUTION: IF A CHECK VALVE IS INSTALLED (BLACK IN COLOR) VERIFY THAT THE PROPER PART NUMBER CLAMP IS INSTALLED. IF AN IMPROPER PART NUMBER CLAMP IS BEING USED, THE CHECK VALVE MUST BE REPLACED.

(g) Install check valve, ensure that the proper clamp is being used and that the clamp is positioned on the downstream end of check valve upon the raised shouldered area.

(h) Inspect check valve for external leakage at first engine operation after valve installation on the engine. No leakage permitted.

8. Approved Repairs

A. Turbine and Exhaust Collector Support Crack Repair

Weld repair any cracks found in the exhaust ducts or outboard structure of the turbine and exhaust collector support.

CAUTION: TO PREVENT ELECTRICAL ARC BEARING DAMAGE, SEPARATE THE EXHAUST COLLECTOR FROM THE ENGINE/TURBINE AND REMOVE THE NO. 5 BEARING BEFORE THE WELD REPAIR IS MADE.

(1) Weld cracks in the exhaust ducts (areas –9 and –10 of Figure 217) using gas tungsten–arc process with 29–9 W Mo (AMS 5784) weld rod.

(2) Weld cracks in the outboard structure (area –3 of Figure 217) using gas tungsten–arc process with Hastelloy W (AMS 5786) weld rod.

Table 202
Turbine Pressure Oil System Check Valve Inspection

Item	Condition	Serviceable Limit	Disposition
1	Stripped or crossed threads on fitting or housing.	None.	Chase threads. (Max. of one damaged thread
2	Nicks or scratches on flared tube sealing surface of fitting or housing.	None.	Repair or replace part.
3	Nicks or scratches on poppet seating surface or housing valve seat.	None.	Repair or replace part.
4	Fretting wear in bore of housing.	None.	Replace part.

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	72-30-00	218A	Jan 15/08
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E6R11-72-4	72-50-00	241	Feb 15/08
	72-50-00	241A	Feb 15/08

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	100 Hour Inspection (cont)			
21	Lubrication system inspection			
	NOTE: Maximum interval between oil change is 100 hours or 6 months whichever occurs first. This time period may be extended to 200 hr intervals for those items indicated by an asterisk (*) if an external oil filter of a type that has a valid STC (Supplemental Type Certificate) is installed on the engine.			
	*a. Drain oil system.	PARA 11.C., 72–00–00, Engine–Servicing		
	b. Remove, inspect and clean the oil filter. Note any accumulation of metal chips, debris or carbon particles. Conduct further inspection of the lube system and/or engine gear train/bearings if metal chips or debris are found. See Items 21a, 21e, 38, 39 and 40 below if carbon particles are found.	PARA 1.C., 72–60–00		
	NOTE: Follow STC manufacturer's recommendations regarding replacement/cleaning of external oil filter elements. Inspect removed elements for any accumulations of metal chips, debris or carbon particles. It may prove helpful to cut apart disposable (paper) filler elements to facilitate this inspection. If chips, debris or carbon particles are found, proceed with additional inspection/maintenance as outlined in item 21b. above.			
	*c. Inspect and clean turbine pressure oil check valve.	PARA 7.K., 72–50–00		
	*d. Turbine pressure oil tube screen assembly. Detach clamp; then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the tube coupling nut at the fireshield elbow only enough to allow sufficient movement of the tube to enable removal of the screen. At assembly, tighten connector coupling nut to 200–250 lb in. (23–28 N·m). Tighten fireshield elbow coupling nut to 80–120 lb in. (9–14 N·m). Tighten clamp nut to 35–40 lb in. (3.9–4.5 N·m).	N/A		
	*e. Measure oil flow from the scavenge passage of the external sump and from the scavenge passage of the gas producer support. It is recommended that the external sump is not removed for this check.	PARA 7.D., 72–50–00		
	NOTE: This step must be performed before draining oil or after the oil system has been refilled.			

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	300 Hour Inspection (cont)			
36	Lubrication system inspection			
	NOTE: Maximum interval between oil change is 300 hours or 6 months whichever occurs first.			
	a. Drain oil system.	PARA 11.C., 72–00–00, Engine–Servicing		
	b. Inspect and clean turbine pressure oil check valve.	PARA 7.K., 72–50–00		
	c. Turbine pressure oil tube screen assembly. Detach clamp; then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the tube coupling nut at the fireshield elbow only enough to allow sufficient movement of the tube to enable removal of the screen. At assembly, tighten connector coupling nut to 200–250 lb in. (23–28 N·m). Tighten fireshield elbow coupling nut to 80–120 lb in. (9–14 N·m). Tighten clamp nut to 35–40 lb in. (3.9–4.5 N·m).	N/A		
	d. Measure oil flow from the scavenge passage of the external sump and from the scavenge passage of the gas producer support. It is recommended that the external sump is not removed for this check.	PARA 7.D., 72–50–00		
	NOTE: This step must be performed before draining oil or after the oil system has been refilled.			
	e. Refill oil system.	PARA 11.C., 72–00–00, Engine–Servicing		
37	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	N/A		
38	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72–50–00		
39	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G., 72–50–00		
40	Deleted			

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PARA 1.D. (cont)

(6) Compress the seal rings with 6799952 installation clamps. Place the outer combustion case over the liner while mating it to the compressor discharge air tubes. The fire shield aft support bracket and two half–inch bolts go at bolt positions 4 and 5. Locate the bracket on the aft side of the splitline. Secure the outer case to the turbine with 24 bolts and nuts. Coat bolt threads lightly with antiseize compound before installation. Tighten nuts of socket head cap screws to 20–30 lb in. (2.3–3.4 N·m). Tighten nuts of Tee–head bolts to 35–40 lb in. (3.9–4.5 N·m) plus locknut drag. Remove installation clamps and secure the air tubes with retaining rings.

(7) Place a washer on the pressure oil manifold and install the fire shield. Secure fire shield at the aft support bracket with a bolt and washer.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN, AND TIGHTEN FUEL, AIR AND OIL FITTINGS COULD RESULT IN AN ENGINE FAILURE.

(8) Install the power and accessories gearbox–to–fire shield scavenge oil tubes. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

(9) Secure the manifold to the fire shield with a nut and washer. Tighten finger tight only. Secure the fireshield with four bolts and washers. The drilled head bolt goes at the position nearest to the gas produce support pressure oil fitting. Tighten bolts to 35–40 lb in. (3.9–4.5 N·m) and lockwire drilled bolt to oil fitting.

(10) Install the power and accessories gearbox–to–check valve pressure oil tube. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

(11) Install the gas producer support–to–fireshield and the external sump–to fire shield scavenge oil tubes. Tighten coupling nuts to 150–200 lb in. (17.23 N·m).

(12) Remove the cap from the fuel nozzle and install the fire shield–to–fuel nozzle hose. Tighten coupling nut to 8–120 lb in. (9.0–13.6 N·m).

(13) Install the gas producer fuel control. (Refer to Gas Producer Fuel Control, 73–20–02 or 73–20–03.)

(14) Install the check valve–to–fire shield pressure oil tube with screen. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

(15) Install the spark igniter lead. Tighten coupling nut to 70–90 lb in. (7.9–10.2 N·m).

(16) Install all drain hoses at the exhaust collector support, fire shield and burner drain valve.

(17) Connect the thermocouple lead to the aircraft terminal block.

(18) Make a check run of the engine. (Refer to Check Run, para 1, 72–00–00, Engine–Adjustment/Test.)

2. First–stage Turbine Nozzle and First–stage Turbine Nozzle Shield

Replace first–stage turbine components using the applicable part of the following procedure.

A. Removal

(1) Remove the turbine assembly from the engine. (Refer to Turbine Assembly—Removal, Para 1.A. or 1.C., this section.)

(2) Remove the two nuts, washers and bolts and separate the firewall from the turbine assembly.

(3) Attach the turbine assembly to the 6798089 supporting adapter at the three exhaust collector support bolt holes, with the gas producer support up.

NOTE: It may be necessary to reverse the three turbine attaching studs on the supporting adapter plate from an under side mounting position to a top side mounting position.

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(h) Inspect check valve for external leakage at first engine operation after valve installation on the engine. No leakage permitted.

L. Test the Turbine Pressure Oil System Check Valves. (See Figure 216.)

NOTE: Valves with part numbers 23074872 and subsequent are not field repairable.

WARNING: DO NOT BREATHE THE FUMES FROM SYNTHETIC LUBRICATING OIL. IT CAN CONTAIN TRICRESYL PHOSPHATE. USE IN AN AREA WITH CONTINUOUS AIRFLOW. KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAMES. DO NOT GET IT ON YOUR SKIN OR IN YOUR EYES. WEAR GOGGLES, CHEMICAL-RESISTANT GLOVES, AND SAFETY CLOTHING. IF YOU GET IT ON YOUR SKIN, CLEAN WITH SOAP AND WATER. IF YOU GET IT IN YOUR EYES, FLUSH WITH WATER. GET MEDICAL AID.

(1) Test the check valve using engine oil (MIL-L-7808) at 80°F (27°C) as follows:

(a) Install the valve on the test stand with the large end down.

(b) Apply the test pressure to the small end of the valve.

(c) Cycle the valve open and closed at least once before taking pressure readings.

(d) Slowly increase the pressure and observe the opening pressure. Opening pressure must not exceed 5.0 psig (34.5 kPag).

(e) As the test pressure is reduced, the valve must be fully closed (with no leaks) at 3.0 psig (20.7 kPag).

8. Approved Repairs

A. Turbine and Exhaust Collector Support Crack Repair

Weld repair any cracks found in the exhaust ducts or outboard structure of the turbine and exhaust collector support.

CAUTION: TO PREVENT ELECTRICAL ARC BEARING DAMAGE, SEPARATE THE EXHAUST COLLECTOR FROM THE ENGINE/TURBINE AND REMOVE THE NO. 5 BEARING BEFORE THE WELD REPAIR IS MADE.

(1) Weld cracks in the exhaust ducts (areas -9 and -10 of Figure 217) using gas tungsten-arc process with 29-9 W Mo (AMS 5784) weld rod.

(2) Weld cracks in the outboard structure (area -3 of Figure 217) using gas tungsten-arc process with Hastelloy W (AMS 5786) weld rod.

Table 202

Turbine Pressure Oil System Check Valve Inspection

Item	Condition	Serviceable Limit	Disposition
1	Stripped or crossed threads on fitting or housing.	None.	Chase threads. (Max. of one damaged thread
2	Nicks or scratches on flared tube sealing surface of fitting or housing.	None.	Repair or replace part.
3	Nicks or scratches on poppet seating surface or housing valve seat.	None.	Repair or replace part.
4	Fretting wear in bore of housing.	None.	Replace part.

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No.	Dated	By	Date	By	Date

(h) Inspect check valve for external leakage at first engine operation after valve installation on the engine. No leakage permitted.

L. Test the Turbine Pressure Oil System Check Valves. (See Figure 216.)

NOTE: Valves with part numbers 23074872 and subsequent are not field repairable.

WARNING: DO NOT BREATHE THE FUMES FROM SYNTHETIC LUBRICATING OIL. IT CAN CONTAIN TRICRESYL PHOSPHATE. USE IN AN AREA WITH CONTINUOUS AIRFLOW. KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAMES. DO NOT GET IT ON YOUR SKIN OR IN YOUR EYES. WEAR GOGGLES, CHEMICAL-RESISTANT GLOVES, AND SAFETY CLOTHING. IF YOU GET IT ON YOUR SKIN, CLEAN WITH SOAP AND WATER. IF YOU GET IT IN YOUR EYES, FLUSH WITH WATER. GET MEDICAL AID.

(1) Test the check valve using engine oil (MIL-L-7808) at 80°F (27°C) as follows:

(a) Install the valve on the test stand with the large end down.

(b) Apply the test pressure to the input side of the valve.

(c) Cycle the valve open and closed at least once before taking pressure readings.

(d) Slowly increase the pressure and observe the opening pressure. Opening pressure must not exceed 5.0 psig (34.5 kPag).

(e) As the test pressure is reduced, the valve must be fully closed (with no leaks) at 3.0 psig (20.7 kPag).

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(2) Weld cracks in the outboard structure (area -3 of Figure 217) using gas tungsten-arc process with Hastelloy W (AMS 5786) weld rod.

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Item	Condition	Serviceable Limit	Disposition
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2	Nicks or scratches on flared tube sealing surface of fitting or housing.	None.	Repair or replace part.
3	Nicks or scratches on poppet seating surface or housing valve seat.	None.	Repair or replace part.
4	Fretting wear in bore of housing.	None.	Replace part.

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COMPRESSOR SECTION - MAINTENANCE PRACTICES

1. Compressor Assembly Replacement

A. Removal (See Figure 201, 202 or 203.)

(1) Remove compressor oil supply and scavenge tubes from the compressor front support and from the power and accessory gearbox.

(2) (Bendix fuel system). Remove fuel control system compressor discharge pressure (P_c) sensing tube. Remove tube from the bracket mounted P_c filter and from the elbow at the scroll. Hold the P_c filter while disconnecting the coupling nut.

(3) (CECO fuel system). Remove fuel control system compressor discharge pressure (P_c) sensing tube. Remove tube from the tee at the governor and from the elbow at the scroll.

(4) Remove the compressor discharge pressure sensing tube at the compressor bleed control valve and at the diffuser scroll pressure probe elbow.

(5) Remove two pressure elbows from the diffuser scroll. Discard packing.

(6) Remove the three bolts, nuts and washers and separate the compressor bleed control valve and gasket from the compressor case. Discard gasket.

(7) Remove two anti-icing lines at the compressor front support and at the anti-icing air valve.

(8) Remove the nut and separate the anti-icing air valve from the diffuser scroll. Discard packing.

(9) Remove the turbine assembly from the engine. (Refer to the Turbine Assembly Removal, para 1.A. or 1.C., 72-50-00.)

(10) Lubricate (engine oil) the spur adapter gearshaft bearing guide (6872646 or 23006778) (whichever is applicable) and install it on the compressor spur adapter gearshaft. (See Figure 204.)

(a) Bearing guide P/N 23006778 can be used with any Series II spur adapter gearshaft and bearing guide P/N 6872646 can only be used with the short shaft spur adapter gearshaft.

(11) If the compressor assembly is to be reinstalled, count and record the number of shims at each mounting pad prior to complete removal of the compressor. Save the shims for reuse.

NOTE: Early engines incorporate five bolts to attach the compressor to the gearbox.

(12) Remove the nuts and washers at the two pads inboard on the gearbox and remove the three bolts at the outboard pads. Note the position of the three different bolts and one washer used at these pads. Remove the P_c filter and bracket assembly.

(13) Separate the compressor from the gearbox.

(14) Make the following inspection of the turbine-to-compressor coupling splines and the turbine-to-pinion gear coupling splines.

(a) Run a sharp pointed scribe across the spline surfaces at both coupling ends to check for a wear step.

(b) Reject the coupling if the pointed object catches on any wear step. Polished spline surfaces are acceptable. If there is any doubt on the depth of the wear step, reject the coupling.

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E6R13-72-2	72-30-00	201	Jan 20/09

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	100 Hour Inspection (cont)			
21	Lubrication system inspection			
	NOTE: Maximum interval between oil change is 100 hours or 6 months, whichever occurs first. This time period may be extended to 200 hours or 12 month intervals for those items indicated by an asterisk (*) if an external oil filter of a type that has a valid STC (Supplemental Type Certificate) is installed on the engine.			
	*a. Drain oil system.	PARA 11.C., 72-00-00, Engine-Servicing		
	b. Remove, inspect and clean the oil filter. Note any accumulation of metal chips, debris or carbon particles. Conduct further inspection of the lube system and/or engine gear train/bearings if metal chips or debris are found. See Items 21a, 21e, 38, 39 and 40 below if carbon particles are found.	PARA 1.C., 72-60-00		
	NOTE: Follow STC manufacturer's recommendations regarding replacement/cleaning of external oil filter elements. Inspect removed elements for any accumulations of metal chips, debris or carbon particles. It may prove helpful to cut apart disposable (paper) filler elements to facilitate this inspection. If chips, debris or carbon particles are found, proceed with additional inspection/maintenance as outlined in item 21b. above.			
	*c. Inspect and clean turbine pressure oil check valve.	PARA 7.K., 72-50-00		
	NOTE: Check Valve P/N 23074872 and subsequent part numbers are not applicable to this inspection (these valves are considered "ON CONDITION").			
	*d. Turbine pressure oil tube screen assembly. Detach clamp; then disconnect the power turbine pressure oil tube at the connector (tee). Loosen the tube coupling nut at the fireshield elbow only enough to allow sufficient movement of the tube to enable removal of the screen. At assembly, tighten connector coupling nut to 200-250 lb in. (23-28 N·m). Tighten fireshield elbow coupling nut to 80-120 lb in. (9-14 N·m). Tighten clamp nut to 35-40 lb in. (3.9-4.5 N·m).	N/A		
	*e. Measure oil flow from the scavenge passage of the external sump and from the scavenge passage of the gas producer support. It is recommended that the external sump is not removed for this check.	PARA 7.D., 72-50-00		
	NOTE: This step must be performed before draining oil or after the oil system has been refilled.			

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Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	300 Hour Inspection (cont)			
36	Remove, clean and inspect engine P_c filter every 300 hours or earlier as engine performance dictates.	PARA 3., 73-20-06		
37	Inspect and clean the No. 1 bearing oil pressure reducer.	PARA 3., 72-30-00		
38	Visually inspect external sump. Clean internal carbonous deposits and build up from sump or replace if necessary.	N/A		
39	Inspect scavenge oil strut in the power turbine support. Clean carbonous deposits from strut.	PARA 7.E., 72-50-00		
40	Inspect No. 6 and 7 bearing pressure oil nozzle. Clean internal carbonous deposits from nozzle.	PARA 7.G., 72-50-00		
41	Inspect the thermocouple assembly.	PARA 2., 77-20-01		
	500 Hour/1 Year Inspection			
42	Inspect all uncoated and coated P/N 6846278 and 6871338 power turbine outer couplings nuts for corrosion.	250-C20 CSL-1060		
	NOTE: Compliance with Rolls-Royce Commercial Engine Bulletin 250-C20 CEB-1120 and/or 250-C20 CEB-1158 removes this inspection requirement.			
	600 Hour Inspection			
43	Check the fuel pump driveshaft on Sundstrand single element pumps for spline wear.	N/A		
	NOTE: This inspection is not required for Agro-Tech (TRW) fuel pumps or Sundstrand fuel pumps P/N 23003114 and subsequent.			
44	Perform scavenge oil filter impending bypass functional test per Facet Service Bulletin No. 090589 (ref. Rolls-Royce 250 CSL 1164) for aircraft equipped with this type of external scavenge filter system.	N/A		
45	Replace the fuel control filter assembly. Bendix fuel controls P/N 2524552-4 or 2524552-6 (less-5) and prior unless 250-C20 CEB-1089 has been accomplished.	PARA 4.A., 73-20-02, 4.A., 73-20-03		

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PARA 1.C. (cont)

(1) Lubricate and install new packings on the compressor rear diffuser and the spur adapter gearshaft.

(2) Lubricate (engine oil) bearing guide (6872646 or 23006778) and install it on the spur adapter gearshaft. (See Figure 204.)

(3) Sparingly lubricate the rollers of the No. 2-1/2 bearing with petrolatum to hold the rollers out against the bearing outer race.

WARNING: FAILURE TO PROPERLY SHIM THE COMPRESSOR AT INSTALLATION CAN CAUSE THE SPUR ADAPTER GEARSHAFT TO FAIL RESULTING IN SUDDEN ENGINE STOPPAGE.

CAUTION: BE SURE THE SPUR ADAPTER GEARSHAFT IS IN MESH WITH THE GEARBOX MATING GEAR BEFORE TIGHTENING COMPRESSOR RETAINING BOLTS. IF YOU TIGHTEN THE COMPRESSOR RETAINING BOLTS WITH AN INCORRECT MESH OF THE SPUR ADAPTER GEARSHAFT AND THE GEARBOX MATING GEAR, THEN YOU MUST REPLACE BOTH THE MATING GEAR AND THE GEARSHAFT.

(4) Determine the number of shims required for compressor installation.

(a) When replacing a compressor, the total thickness of shims required at each attaching point has been determined during compressor buildup (overhaul) and marked near the appropriate bolt hole on the rear diffuser.

(b) When reinstalling the same compressor, install with the total thickness of shims marked on the rear diffuser. If the shim markings are not legible, missing, or in doubt, compute the total shim thickness requirements in accordance with paragraph 1.C., Compressor Shimming Procedure, this section.

(5) Place the compressor on the gearbox with the required shims in place at the bolt pads. Use 6799790 engine turning adapter to turn the gear train until it meshes with the spur adapter gearshaft.

(6) If interference is encountered between the compressor and one of the cast bosses on the gearbox, lightly dress the boss by filing. Remove only sufficient material to provide a positive clearance.

(a) Dichromate the machined area per AMS 2475.

(b) Apply engine gray enamel (AMS 2510).

(7) Install the P_c air filter and bracket assembly at the same time the compressor mounting bolts and nuts are installed. Use the same configuration of bolts, nuts and washers at each of the five compressor pads as was previously used. (If the gearbox is changed, different bolts or nuts may be required.) Tighten attachment features to 70-85 lb in. (7.9-9.6 N·m) and secure bolts with lockwire.

(8) Remove bearing guide 6872646 or 23006778 from the spur adapter gearshaft. Visually check that the spur adapter gearshaft packing is in place.

(9) Install the turbine assembly. (Refer to Turbine Assembly Installation, para 1.B. or 1.D., 72-50-00.)

(10) Install the anti-icing air valve on the diffuser scroll. Do not tighten the jam nut at this time. (Refer to Anti-Icing Air System, para 2.D., 75-10-01.)

(11) Install the two anti-icing air tubes. Tighten coupling nuts to 150-200 lb in. (17-23 N·m). Tighten valve jam nut to 100-150 lb in. (11-17 N·m) and secure with lockwire.

(12) Install the bleed control valve on the compressor case mounting flange. (Refer to Bleed Air Control Valve, para 2.B., 75-10-02.)

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PARA 2.B. (cont)

(3) Loosen the four corner bolts (3) in the horizontal flanges. Allow the horizontal flange to reposition; then retighten the four bolts to the minimum torque necessary to close the horizontal splitlines.

(4) Install the bolts and nuts in the front flange of the top case half at the three centermost bolt hole positions. Tighten the two outer bolts (4) to a snug fit; then tighten the center bolt (5). If the bolt holes in the front flange do not align with the flange holes in the front support, loosen the front flange bolts in the bottom case half to a snug fit. Using a drift inserted into a misaligned bolt hole, rotate the front support sufficiently to align the holes. Install and tighten the three bolts and nuts.

C. Removal (Compressor Case Bottom Half) (See Figure 206.)

(1) Remove the four bolts and nuts in the horizontal splitlines.

(2) Remove the three bolts and nuts in the bottom half front flange.

(3) (Remove the eight bolts and nuts in the bottom half rear flange.

(4) Carefully lift the bottom half straight out. Do not pry against the top half.

D. Installation (Compressor Case Bottom Half) (See Figure 206.)

NOTE: The RTV 732 or RTV 736 sealer is used to seal the rear corners of the splitline. Use of the sealer is optional on engines that are not used with the water–alcohol injection system.

(1) Apply a sphere of approximately 0.12 in. (3 mm) dia of RTV 732, or equivalent (Compressor Case Splitline Sealer, Table 302), aft of the rearmost bolt hole on the bottom case half horizontal flange surfaces. Assemble and tighten all splitline bolts and nuts as soon as possible after application of RTV 732 (never exceed 30 minutes).

(2) Carefully position the bottom case half to cover the rotor. Install a bolt and nut (6) in each of the four corners (adjacent to the end flanges) at the horizontal flange. Tighten the bolts to the minimum torque necessary to close the horizontal splitlines.

(3) Install and tighten two bolts and nuts (7) in the rear flange of the bottom case half. Use the bolt holes which are diametrically opposite the top case half bolts.

(4) Loosen the four corner bolts in the horizontal flanges. Allow the horizontal flange to reposition; then retighten the four bolts (8) to the minimum torque necessary to close the horizontal splitlines.

(5) Install and tighten one bolt and nut (9) in the front flange at the center hole position (90 degrees from the horizontal flanges).

(6) Install the remaining 13 horizontal flange bolts and nuts. Loosen the two rear corner bolts and nuts; then tighten all bolts (10)–(26) starting from the rear and alternating from side to side.

(7) Install and tighten the remaining 12 bolts and nuts (27) in the rear flange and the eight bolts and nuts (28), plus nameplate, in the front flange.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(8) Attach the RH and LH anti–icing air tubes to the anti–icing air valve and to the front support. Tighten coupling nuts to 200–250 lb in. (23–29 N·m).

(9) Attach the compressor pressure and scavenge oil tubes:

(a) Install the gearbox elbow–to–front support scavenge oil tube. Tighten coupling nuts to 150–200 lb in. (17–23 N·m).

(b) Install the gearbox union–to–pressure reducer pressure oil tube. Tighten coupling nuts to 65–100 lb in. (7.3–11.3 N·m).

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(11) Install the retaining ring in the rear groove of the oil seal. Install the front bearing housing over the spring, bearing and oil seal. Compress the retaining ring in the seal groove and engage the ring in the inside groove of the bearing housing until it is fully seated using 6893535 compressor. Exercise care not to damage the seal face. On alternate configuration, press down (rearward) on the housing until the two pin holes of the housing align with the retaining ring groove of the seal. Insert the two pins. Lubricate and install two packings on the bearing housing.

CAUTION: DO NOT FORCE THE SUPPORT FLANGE INTO THE COMPRESSOR CASE PILOT. LOOSEN THE COMPRESSOR CASE HORIZONTAL SPLITLINE BOLTS AS NECESSARY FOR EASE OF ASSEMBLY, EVEN TO THE POINT OF REMOVING ONE CASE HALF.

(12) Visually align the pin of the bearing housing with the hole in the compressor front support then install the front support on the compressor assembly. This part is indexed correctly when the scavenge oil fitting is opposite the "O" mark on the front diffuser.

(13) Lubricate the threads of the front bearing housing with antiseize compound. Secure housing to the front support with a nut. Tighten nut to 35-40 lb in. (3.9-4.5 N·m).

(14) Install the identification plate and ten support-to-compressor case bolts and nuts. Tighten the compressor horizontal splitline and front support splitline nuts to 10-15 lb in. (1.1-1.7 N·m) plus locknut drag.

(15) Apply anti-seize compound to the bolt threads; then install the bleed control valve and gasket on the compressor case mounting flange. Retain with three nuts, bolts and washers. Tighten the 1/4-28 nut to 70-85 lb in. (7.9-9.6 N·m). Tighten the other two nuts to 35-40 lb in. (3.9-4.5 N·m).

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(16) Attach the compressor discharge pressure sensing tube assembly to the bleed valve and to the elbow at the scroll. Tighten coupling nuts to 80-120 lb in. (9.0-13.6 N·m).

(17) Attach the RH and LH anti-icing air tubes to the anti-icing valve and to the front support. Tighten coupling nuts to 150-200 lb in. (17-23 N·m).

(18) Check the oil seal for leakage by applying oil at 4-6 psi (27.6-41.4 kPa) for one minute to the oil pressure reducer location on the compressor front support. No leakage shall be permitted.

(19) Attach the compressor pressure and scavenge oil tubes:

(a) Install the gearbox-to-front support scavenge oil tube. Tighten coupling nut to 150-200 lb in. (17-23 N·m).

(b) Install the gearbox union-to-pressure reducer pressure oil tube. Tighten coupling nuts to 65-100 lb in. (7.3-11.3 N·m).

(c) Install the P_y line between the governor and the fuel control. Tighten coupling nuts to 80-120 lb in. (9.0-13.6 N·m).

(20) Install the starter-generator.

(21) After complete assembly of the compressor, check the compressor rotor for freedom of operation. If compressor drag or rubbing is detected either by feel or by sound, investigate to determine the cause by removing one or both halves of the case assembly.

(22) Check run the engine after seal or bearing replacement. (Refer to Check Run, para 1., 72-00-00, Engine-Adjustment/Test.)

4. Compressor Front Bearing and/or Oil Seal Replacement (Engine Installed)

This is an alternate procedure for replacing the compressor front bearing and/or oil seal. It is accomplished while the engine is installed and in a horizontal position.

CAUTION: THIS ALTERNATE PROCEDURE INVOLVES GREATER RISK FOR PART DAMAGE AND ASSEMBLY ERROR THAN THE PREFERRED PROCEDURE (PARA 3.A. AND 3.B., THIS SECTION). THE ALTERNATE PROCEDURE IS RECOMMENDED FOR SKILLED MECHANICS HAVING APPROVAL OF THEIR ROLLS-ROYCE AUTHORIZED MAINTENANCE CENTER (AMC).

A. Replacement Procedure

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Table 7

Performance Ratings—One Engine Inoperative and/or Emergency Operation—250–C20S

Rating	Shaft Power (min) hp	(kW)	Jet Thrust (est) lb	(N)	Gas Producer Output rpm (est)	Gas Producer Output Shaft rpm	Specific Fuel Cons. (max) lb/shp–hr	(mg/W·h)	Measured Rated Gas Temp °F	(°C)	Maximum Allowable Output Shaft Torque ft–lb	N·m
Max. Cont.	420	(313)	42	(187)	53000	6016	0.650	(395.38)	1490	(810)	384	(521)

Max Continuous rating is FAA approved for continuous operation; but is authorized by the engine manufacturer only during one–engine–inoperative (O.E.I.) operation of multi–engine aircraft and emergency operation.

PARA 4. (cont)

WARNING: IT IS VERY IMPORTANT THAT THE ENTIRE AIRCRAFT AND ENGINE FUEL SYSTEM BE MAINTAINED TO THE HIGHEST STANDARDS OF CLEANLINESS.

ROLLS–ROYCE HAS CONDUCTED TESTING OF APPLE JELLY TYPE CONTAMINATION WHICH SHOWS IT BEHAVES DIFFERENTLY THAN A SOLID CONTAMINANT. IT CAN PASS THROUGH VARIOUS AIRFRAME AND ENGINE FUEL FILTERS UNDETECTED WITHOUT ACTUATING THE IMPENDING BYPASS INDICATOR, AND IT CAN CAUSE PARTIAL OR COMPLETE BLOCKAGE OF THE FUEL NOZZLE SCREEN RESULTING IN REDUCED ENGINE PERFORMANCE OR FLAMEOUT.

SHOULD THIS GEL–LIKE MATERIAL BE DETECTED AT ANY POINT IN THE AIRCRAFT OR ENGINE FUEL SYSTEM, THE ENTIRE AIRFRAME AND ENGINE FUEL SYSTEM SHOULD BE INSPECTED.

WARNING: TO PREVENT ENGINE FUEL SYSTEM CONTAMINATION, WHICH COULD CAUSE ENGINE FLAMEOUT, AN EXTERNAL LOW PRESSURE FUEL FILTER SHOULD BE USED ON ANY AIRCRAFT REFUELING FROM REMOTE FUELING SITES (DRUMS, ETC).

CAUTION: NOT ALL NO. 1 DIESEL FUELS, JP–1, OR ARCTIC DIESEL FUELS WILL MEET THE PRIMARY FUEL SPECIFICATIONS. IN DETERMINING WHETHER OR NOT A GIVEN FUEL MEETS THESE SPECIFICATIONS, THE BURDEN OF PROOF RESTS WITH THE OPERATOR AND HIS SUPPLIER.

B. Fuel Specification.

(1) Primary

Fuels conforming to the following military and commercial specifications are approved for unrestricted use in 250 Series engines.

(a) MIL–T–5624, grade JP–4 and JP–5

(b) MIL–T–83133, grade JP–8

(c) ASTM D–1655, Jet B

(d) ASTM D–1655, Jet A or A1

(e) JP–1 fuel conforming to ASTM D–1655, Jet A

(f) Arctic Diesel Fuel DF–A (VV–F–800B) conforming to ASTM D–1655, Jet A or Jet A1

(g) Diesel #1 fuel conforming to ASTM D–1655, Jet A

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PARA 4.B. (cont)

CAUTION: MIL–G–5572 FUEL CONTAINING TRICRESYLPHOSPHATE (TCP) ADDITIVE SHALL NOT BE USED.

(2) Emergency

MIL–G–5572E OR ASTM–D–910, all grades (aircraft boost or start pump on; maximum of 6 hours operation per overhaul period of turbine)

WARNING: AT AMBIENT TEMPERATURES BELOW 4°C (40°F), SOME TYPE OF ANTI–ICE PROTECTION IS REQUIRED, SUCH AS AN ANTI–ICE ADDITIVE OR A MEANS OF AIRFRAME FUEL ICE ELIMINATION. ENGINE FLAMEOUT COULD RESULT FROM FAILURE TO USE ANTI– ICE PROTECTION. (REFER TO THE AIRCRAFT MANUAL FOR THEIR RECOMMENDATIONS AND PARA 4.B., THIS SECTION, FOR APPROVED ANTI–ICE ADDITIVE.)

(3) Cold Weather

To assure consistent starts below 4°C (40°F) the following fuels may be necessary:

(a) MIL–T–5624, grade JP–4

(b) ASTM D–1655, Jet B

(c) AVGAS/Jet A, Jet A1, or JP–5 mixture (Refer to Para 9, Cold Weather Fuels, for mixing/use of cold weather fuel.)

NOTE: Grade JP–4 (MIL–T–5624), grade JP–5, and grade JP–8 (MIL–T–83133A, or later) type fuels contain anti–ice additive which conforms to MIL–I–27686 (or later). These fuels do not require additional anti–ice additive unless specified by the airframe manufacturer.

NOTE: Jet A, A1, JP–5, or JP–8 fuels are not restricted from use at ambient temperatures below –18°C (0°F); however, special provisions for starting must be made. (Refer to Aircraft Flight Manual.) Once started, engine operation on Jet A, Jet A1, JP–5, or JP–8 will be satisfactory in outside air temperatures down to –32°C (–25°F).

NOTE: Prolonged and uninterrupted operation with only AVGAS mixture will induce lead buildup on turbine parts. This lead buildup can cause a gradual power reduction; consequently, this AVGAS mixture should be used only for cold weather operation. During operation with normal Jet A type fuel, the lead will slowly dissipate.

(4) Prist (MIL–I–27686E) anti–ice additive is approved for use in the model 250–C20R series engines if used in accordance with the additive manufacturer's instructions and if approved by the airframe manufacturer.

NOTE: Prist is also an anti–biological agent, and may be used at the discretion of the operator to prevent microbiological fuel contamination.

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PARA 4. (cont)

WARNING: ONLY DISCRETIONARY MIXING OF OILS WITHIN AN OIL SERIES IS PERMITTED WITHOUT A TIME PENALTY. USE OF MIXED OILS FROM DIFFERENT SERIES IN AN ENGINE IS LIMITED TO FIVE HOURS TOTAL RUNNING TIME DURING ONE OVERHAUL PERIOD. ADEQUATE MAINTENANCE RECORDS MUST BE MAINTAINED TO ENSURE THAT THE FIVE HOUR LIMIT IS NOT EXCEEDED. FAILURE TO COMPLY WITH OIL MIXING RESTRICTIONS CAN RESULT IN ENGINE FAILURE.

CAUTION: IF HEAVY CARBON OR COKE DEPOSITS ARE FOUND ON THE ENGINE FILTER DURING REGULAR INSPECTIONS, IT IS RECOMMENDED THE FILTERS BE REPLACED; CONTINUE TO MONITOR BYPASS INDICATORS.

CAUTION: TO DECREASE THE LIKELIHOOD FOR CARBON OR COKE DEPOSITS BEING DISLODGED DURING THE CHANGEOVER TO "3RD GENERATION" OILS (E.G. MOBIL JET 254), THESE CHANGEOVERS SHOULD ONLY BE MADE WHEN THE ENGINE IS NEW OR REPAIRED, TO THE EXTENT THE LUBRICATION PASSAGES AND SUMPS HAVE BEEN CLEANED AND FLUSHED.

CAUTION: WHILE CONSIDERABLE LABORATORY DATA IS AVAILABLE TO DEMONSTRATE THE COMPATIBILITY OF ONE SYNTHETIC TURBINE OIL WITH OTHER TURBINE OILS MEETING THE SAME SPECIFICATION (AIRLINE EXPERIENCE DOES DEMONSTRATE THIS PROPERTY), THE INDISCRIMINATE MIXING OF APPROVED OILS DURING THE OPERATIONAL USE OF THE OIL IS NOT RECOMMENDED. HOWEVER, THERE MAY BE CIRCUMSTANCES WHERE EMERGENCY TOP–OFF, INADVERTENT MIXING, OR CHANGEOVER BY "TOP–OFF" TO ANOTHER BRAND MAY OCCUR. THESE ARE ACCEPTED PRACTICES.

CAUTION: FAILURE TO COMPLY WITH OIL MIXING RESTRICTIONS CAN RESULT IN ENGINE FAILURE.

CAUTION: REMOVE AND INSPECT THE OIL FILTER AFTER 25 HOURS OF ENGINE OPERATION IF THE TYPE OF OIL (MIL–PRF–7808, MIL–PRF–23699, OR DOD–85734) WAS MIXED IN AN EMERGENCY. (THERE IS A 5–HOUR LIMIT FOR THE USE OF MIXED OILS.)

CAUTION: THE FILTER INSPECTION IS TO DETERMINE IF COKE, WHICH WAS FORMED DURING PREVIOUS OPERATION, IS BEING DISLODGED DURING THE FIRST OPERATION FOLLOWING THE OIL CHANGE.

CAUTION: IF HEAVY CARBON DEPOSITS ARE OBSERVED ON THE ENGINE FILTER, IT IS SUGGESTED THAT THE ENGINE OIL BE CHANGED AGAIN. THE OIL IS TO BE DRAINED WHEN THE OIL IS HOT TO OBTAIN THE MAXIMUM BENEFIT. THE 25 HOUR OIL MONITORING IS TO CONTINUE UNTIL THE NEXT OIL CHANGE PERIOD.

CAUTION: USE OF OILS WHICH ARE NOT INCLUDED IN THE APPROVED OILS LISTING, OR FAILURE TO DRAIN OIL WITHIN THE PRESCRIBED INTERVAL GIVEN IN TABLE 602, 72–00–00, ENGINE–INSPECTION/CHECK WILL BE CONSIDERED AS MISUSE UNDER ITEM (4) OF THE WARRANTY POLICY.

C. Oil Specification.

The 250 series engines are qualified and certified for use with MIL–PRF–7808G and subsequent, MIL–PRF–23699 series and DOD–85734 series lubricating oils. The vendor brands of MIL–PRF–7808 series, MIL–PRF–23699 series, and DOD–85734 series lubricating oils, which have been engine tested and approved for use in the Model 250 engine are listed in para 4.C.(2), Approved Oils. Refer to paragraph C.(1), Cold Weather Lubrication, for the type of oil recommended at specific temperatures.

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PARA 4.C. (cont)

(1) Cold Weather Lubrication

The types of oil recommended at specific ambient temperatures are as follows:

0°C (32°F) and above	MIL–PRF–23699C or subsequent preferred
0°C (32°F) to –40°C (–40°F) . .	MIL–PRF–23699C or subsequent preferred or MIL–PRF–7808G or subsequent
–40°C (–40°F) and below	MIL–PRF–7808G or subsequent only
–40 C (–40 F) to 135 C (275 F)	DOD–85734

NOTE: Because of availability, reduced coking and better lubricating qualities at higher temperatures, MIL–PRF–23699 oils are preferred for use in Model 250 engines.

NOTE: Check the engine oil quantity within 15 minutes of engine shutdown to avoid a false indication of excessive oil consumption. If the 15 minutes has been exceeded, motor the engine for 30 seconds with the starter before checking tank quantity. Motoring normally scavenges oil from the gearbox back to the aircraft oil tank. Check the airframe flight manual; some installations may require engine to be operated for at least a minute at ground idle to assure proper scavenging of the engine gearbox.

NOTE: Always refer to the airframe flight manual for proper oil servicing instructions; specific requirements may vary for different models.

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(2) Approved Oils

Manufacturer's Designation & Address	Manufacturer's Designation & Address
MIL–PRF–7808 Series (Formerly MIL–L–7808) American PQ Lubricant 689 American Oil & Supply Co. 238 Wilson Avenue Newark, New Jersey 07105	MIL–PRF–7808 Series (Formerly MIL–L–7808) Mobil Rm–201A Mobil Oil Corporation 3225 Gallows Road Fairfax, Virginia 22037
Brayco 880 Castrol Inc. Specialty Products Division 16715 Von Karman Ave, Suite 230 Irving, California 92714	Mobil RM–184A Mobil Oil Corporation 3225 Gallows Road Fairfax, Virginia 22037
EXXON Turbo Oil 2389 EXXON Company, U.S.A. P.O. Box 2180 Houston, Texas 77252–2180	Stauffer Jet 1 Stauffer Chemical Co. 380 Madison Avenue New York, New York 10017
Mobil Avrex S Turbo 256 Mobil OIl Corporation 3225 Gallows Road Fairfax, Virginia 22037	
MIL–PRF–23699 Series (Formerly MIL–L–23699) Mobil Jet Oil II Mobil Oil Corporation 3225 Gallows Road Fairfax, Virginia 22037	MIL–PRF–23699 Series (Formerly MIL–L–23699) Stauffer Jet II (Castrol 205) Stauffer Chemical Company 380 Madison Avenue New York, New York 10017
Turbonycoil 600 (TN600) NYCO S.A. 66, Champs–Elysees–51 Rue De Ponthieu 75008 Paris	Caltex RPM Jet Engine Oil 5 Caltex Petroleum Corporation 380 Madison Avenue New York, New York 10017
Aeroshell/Royco Turbine Oil 500 Royal Lubricants Company, Inc. River Road, P.O. Box 518 East Hanover, New Jersey 07936	Cheveron Jet Engine Oil 5 Chevron International Oil Company 555 Market Street San Francisco, California 94105

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Manufacturer's Designation & Address	Manufacturer's Designation & Address
MIL–PRF–23699 Series (cont) (Formerly MIL–L–23699)	DOD–85734 Series
American PQ Lubricant 6700 American Oil and Supply Co. 238 Wilson Avenue Newark, New Jersey 07105	Aeroshell Turbine Oil 560 Shell International Petroleum Co., Ltd. International Aviation Sales Division Shell Centre London, SEI 7NA, England
Brayco 899 Castrol Inc. Specialty Products Division 16715 Von Karman Ave., Suite 230 Los Angeles, California 90032	Aeroshell/Royco Turbine Oil 555 Royal Lubricants Company, Inc. River Road , P.O. Box 518 East Hanover, New Jersey 07936
Hatcol 3211 Hatcol Corporation King George Post Road Fords, New Jersey 08863	NOTE: Long term use of Aeroshell/Royco 555 oil may increase the probability of silicone rubber seal leakage in the accessory gearbox.
EXXON Turbo Oil 2380 EXXON Company, USA P.O. Box 2180 Houston, Texas 77252–2180	Aeroshell Tubine Oil 555 Shell International Petroleum Co., Ltd International Aviation Sales Division Shell Centre London, SEI 7NA, England
Castrol Aero Jet5 Specialty Products Division 1001 West 31st Street Downers Grove, IL 60515	NOTE: Long term use of Aeroshell 555 oil may increase the probability of silicone rubber seal leakage in the accessory gearbox.
MIL–PRF–23699F Series High Thermal Stability (HTS)	
Mobil Jet Oil 254 and Mobil Jet Oil 291 Mobil Oil Corporation 3225 Gallows Road Fairfax, Virginia 22037	
Aeroshell/Royco Turbine Oil 560 Royal Lubricants Company, Inc. River Road, P.O. Box 518 East Hanover, New Jersey 07936	
Exxon ETO 2197 (BPTO 2197) Air BP BP Exploration & Oil, Inc Maple Plaza II–1N Six Campus Drive Parsippany, NJ 07054	

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PARA 6. (cont)

D. Oil Pressure and Temperature

If the oil pressure is not within the following limits, refer to Table 101, Engine–Troubleshooting, 72–00–00.

(1) 94.2% N_1 speed and above . . . 115–130 psig (792–896 kPag)

(2) 78.5 to 94.2% N_1 speed . . . . . 90–130 psig (621–896 kPag)

(3) (Below 78.5% N_1 speed . . . . . 50–130 psig (345–896 kPag)

(4) During start . . . . . a positive indication must be obtained when 59% (idle) is reached.

NOTE: At altitudes above 5000 ft (1524 m), the oil pressure lower limit declines at the rate of 2 psig (13.8 kPag) per 1000 ft (305 m) to a maximum reduction of 20 psig (140 kPag).

NOTE: During cold weather operation, 150 psig (1034 kPag) main oil pressure is allowable following an engine start. When the 130 psig (896 kPag) limit is exceeded, operate engine at minimum power until normal oil pressure limits are attained.

NOTE: If the engine has been operated with less than the required oil pressure, except for momentary fluctuation, inspect the oil system in accordance with Low Oil Pressure Operation, para. 11.D., 72–00–00, Engine–Servicing.

Oil temperature shall be within the following range. (If the maximum limit is exceeded, refer to Oil Temperature Limit Exceeded, para 11.B., 72–00–00, Engine–Servicing, for corrective action.)

(5) Minimum starting
MIL–PRF–7808F or later . . . . . –54°C (–65°F)
MIL–PRF–23699 . . . . . –40°C (–40°F)

(6) Maximum . . . . . 107°C (225°F)

(7) Minimum flight operation . . . . . 0°C (32°F)
(Providing engine oil pressure is within the specified limits of para 6.D.)

NOTE: When starting in ambient temperature conditions below –20°C (–4°F), after stabilizing at ground idle, increase throttle until 100% N2 is achieved. Operate at this condition until engine oil temperature is at least 0°C (32°F) before beginning flight operations.

E. Pressure Altitude And Ambient Temperature

The engine will start and operate satisfactorily at conditions of ambient pressure and temperature as shown in Figure 30 or 31.

7. Operating Procedures (250–C20, –C20B, –C20F, –C20J,–C20W)

WARNING: TO PREVENT ENGINE FUEL STARVATION AND SUBSEQUENT FLAME–OUT, ANY AIRCRAFT REQUIRING FUEL BOOST PUMP(S) SHOULD USE THESE PUMPS AT ALL TIMES DURING FLIGHT OR AS DIRECTED IN THE AIRCRAFT FLIGHT MANUAL.

WARNING: TO PREVENT CRUCIAL DELAY IN REGAINING POWER IF AN ENGINE FLAMEOUT IS ENCOUNTERED, AIRCRAFT EQUIPPED WITH AN AUTO–RELIGHT SYSTEM SHOULD KEEP THAT SYSTEM ACTIVATED AT ALL TIMES WHILE THE AIRCRAFT IS INFLIGHT.

The procedures which follow pertain to operation of the engine at: start and ground idle; power range; practice autorotation descent and landing; air restart; stopping; and during an emergency.

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PARA 8.I. (cont)

(3) Turn off all engine switches.

(4) After each engine shutdown, visually check that the propeller blades are fully feathered immediately after propeller rotation stops.

J. Normal Inflight Shutdown

Make a normal inflight engine shutdown as follows:

CAUTION: DO NOT MOVE THE POWER LEVER BELOW THE FLIGHT IDLE POSITION DURING FLIGHT.

(1) Retard the Power Lever to the FLIGHT IDLE position.

(2) From the FLIGHT IDLE position move the Fuel Cutoff Lever to the FUEL OFF position. The propeller will feather automatically when the engine shuts down.

(3) Turn off all applicable engine switches.

CAUTION: DO NOT WINDMILL AT 120–125 KNOTS INDICATED AIR SPEED FOR MORE THAN 13 MINUTES.

K. Emergency Inflight Shutdown

Make an emergency inflight engine shutdown as follows:

(1) Move the Fuel Cutoff Lever to the FUEL OFF position. The propeller will feather automatically and the engine will shut down.

(2) Leave the Power Lever in the flight range.

(3) Turn off all applicable engine switches.

L. Feathering

Propeller feathering will occur automatically with engine shutdown by positioning the Fuel Cutoff Lever in the FUEL OFF position.

M. Anti–Icing Air

Consult the aircraft operating manual for the outside air temperature (OAT) at which anti–icing air should be used. If the aircraft manual does not provide this temperature, use anti–icing air when flying into visible moisture at OAT below 5°C (40°F).

N. Emergency

If the engine power turbine governor should fail to function, resulting in a rapid N_2 speed increase, the Power Lever should be reduced to control overspeed.

(1) Manipulate the aircraft controls to control the aircraft.

(2) Monitor the N_2 speed and vary the Power Lever setting to maintain desired speed.

NOTE: The same power range is available using the Power Lever in emergency as in normal power turbine governing.

The engine power turbine governor can also fail in a decrease fuel flow condition. This can be recognized by decreased N_1 speed and decreased torque output with the throttle in the normal operating range. In this event, initiate emergency power loss power reduction procedures, as described in the aircraft flight manual.

9. Cold Weather Fuels

WARNING: AT AMBIENT TEMPERATURES BELOW 4°C (40°F), SOME TYPE OF ANTI–ICE PROTECTION IS REQUIRED, SUCH AS AN ANTI–ICE ADDITIVE OR A MEANS OF AIRFRAME FUEL ICE ELIMINATION. ENGINE FLAMEOUT COULD RESULT FROM FAILURE TO USE ANTI–ICE PROTECTION. (REFER TO THE AIRCRAFT MANUAL FOR THEIR REQUIREMENTS AND PARA 4.B., THIS SECTION, FOR APPROVED ANTI–ICE ADDITIVE.)

NOTE: Grade JP–4 (MIL–T–5624), grade JP–5, and grade JP–8 (MIL–I–83133A, or later) type fuels contain anti–ice additive which conforms to MIL–I–27686 (or later). These fuels do not require additional anti–ice additive unless specified by the airframe manufacturer.

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PARA 9. (cont)

The fuels recommended for consistent cold weather starting, 4°C (40°F) and below, are as follows:

JP–4 (MIL–T–5624)

Jet B (ASTM D–1655)

AVGAS/Jet A, A–1, JP–5 or JP–8 (MIL–T–83133A) mixture. This mixture is an alternate fuel. Commercial jet fuels meeting ASTM: D–1655 Jet A, Jet A1, standards are generally referred to as aviation Kerosene, JP–5, and Commercial Jet A fuel.

CAUTION: JP–4 OR COMMERCIAL JET B FUEL MUST NOT BE MIXED WITH AVGAS.

NOTE: Jet A, Jet A1, JP–5, or JP–8 may start the engine at temperatures below 4°C (40°F); however, when cold soaked, marginal starts may result due to viscosity changes.

NOTE: Once started, the engine will operate satisfactorily on JP–5, JP–8, Jet A and Jet A1 at fuel and outside air temperatures down to –32°C (–25°F).

A. Mixing Alternate Cold Weather Fuel

CAUTION: THERE IS NO TIME LIMIT FOR ENGINE OPERATION USING THE AVGAS JET FUEL MIXTURE AS LONG AS 80/87 GRADE AVGAS IS USED AND THE 1:2 VOLUME RATIO IS OBSERVED.

CAUTION: USE OF 100/130 (100L) GRADE AVGAS–JET FUEL MIXTURE SHALL BE RESTRICTED TO 300 HOURS IN ONE OVERHAUL PERIOD DUE TO THE HIGH LEAD CONTENT OF THE FUEL.

The alternate cold weather fuel mixture shall consist of one part by volume AVGAS and two parts by volume commercial jet fuel. The AVGAS shall conform to MIL–G–5572C, grade 80/87, or grade 100/130 with 2.0 ml/gal max lead content. Do not use grade 100/130 with 4.6 ml/gal lead content. (The 2.0 ml/gal lead, grade 100/130, AVGAS is known as 100L AVGAS in European areas.) The commercial jet fuel may be kerosene; JP–5; or commercial Jet A conforming to MIL–T–5624, grade JP–5 or ASTM D–1655, Jet A or A1.

Prolonged and uninterrupted operation with only AVGAS mixture will induce lead buildup on turbine parts. This lead build–up can cause a gradual power reduction; consequently, this AVGAS mixture should be used only for cold weather operation. During operation with normal Jet A or Jet B type turbine fuel, the lead buildup will slowly dissipate.

CAUTION: WHEN MIXING THE FUELS, AVOID HIGH FLOW RATES. DO NOT EXCEED A FLOW RATE OF 50 GALLONS (189 LITERS) PER MINUTE. ALSO, MAKE SURE THE FUEL NOZZLE AND FUEL TANK ARE GROUNDED TO THE AIRCRAFT.

(1) Make the fuel mix in the aircraft tank. The AVGAS can be added before or after the jet fuel. The only restriction is that the final mix (including fuel in the tank before starting the mix) be two parts by volume jet fuel to one part by volume AVGAS.

NOTE: Anti–ice additive is needed for the jet fuel–AVGAS fuel mixture unless qualified in accordance with para 9., Cold Weather Fuels, this section. (Refer to Specifications, para 4., this section.)

(2) The alternate fuel mixture is not recommended for warm weather operation. It is recommended only when the ambient temperature is below 4°C (40°F); aircraft boost pump ON. (Some missions may require operating the aircraft temporarily in both low and high ambient temperatures. Temperature restrictions refer to continuous temperatures of 16°C (60°F) or higher.)

WARNING: HANDLING LEAD RESIDUE COATED PARTS BY PERSONS WITH OPEN CUTS OR SCRATCHES ON THEIR HANDS CAN BE EXTREMELY DANGEROUS. ALWAYS WEAR GLOVES WHEN CHECKING RESIDUE COATED TURBINE OR EXHAUST PARTS.

(3) When the AVGAS–jet fuel mixture is used in the engine, the lead from the gasoline accumulates on the turbine and exhaust collector outlet ducts. The normal appearance after operation on leaded fuel is a pale yellow powder deposit on the exhaust surfaces.

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PARA 9.A. (cont)

(4) In order to obtain a lightoff when the alternate fuel mixture is made in the fuel tank it may be necessary to: (a) preheat the engine, or (b) bleed the unmixed fuel.

CAUTION: DO NOT USE AN OPEN FLAME HEATER TO PREHEAT THE ENGINE.

(5) Preheat the engine in the area of the fuel control.

CAUTION: POST FIRE PROTECTION BEFORE OPENING THE FUEL LINE.

(6) (250–C20, –C20B, –C20F, –C20J) Bleed the unmixed fuel from the system as follows:

(a) Deactivate the igniter circuit breaker.

WARNING: BE CAREFUL OF THE POTENTIAL FIRE HAZARD OF FUEL IN AN OPEN CONTAINER.

(b) Disconnect the fuel line at the fuel nozzle.

(c) Place the fuel line in a container. Make sure to keep contaminants from entering the exposed fuel passage.

(d) Turn on the aircraft boost pump. Open the throttle. Continue the flow from the fuel line until the unmixed fuel has drained and the AVGAS mixture appears. The AVGAS mixture can be visually detected because it is light pink in color.

(e) Close the throttle. Turn off the boost pump. Reconnect the fuel line to the fuel nozzle. Tighten the coupling nut to 80–120 lb in. (9.0–13.6 N·m).

(f) Close the igniter circuit breaker.

(7) (250–C20S, –C20W) Bleed the unmixed fuel from the system as follows:

(a) Deactivate the igniter circuit breaker.

WARNING: BE AWARE OF THE POTENTIAL FIRE HAZARD OF FUEL IN AN OPEN CONTAINER.

(b) Disconnect the fuel line at the fuel nozzle.

(c) Place the fuel line in a container. Observe caution to keep contaminants from entering the exposed fuel passage.

(d) Place the Power Lever at TAKEOFF.

(e) Turn on the aircraft switches required to provide fuel to the engine.

(f) Move the Fuel Cutoff Lever to the FUEL ON position.

(g) Energize the starter and motor the engine without ignition and flow fuel from the fuel line until the unmixed fuel has drained and the AVGAS mixture appears. The AVGAS mixture can be visually detected because it is light pink in color.

(h) Discontinue motoring and move the Fuel Cutoff Lever to the FUEL OFF–FEATHER position.

(i) Turn off all engine switches.

(j) Reconnect the fuel line to the fuel nozzle. Tighten the coupling nut to 80–120 lb in. (9.0–13.6 N·m).

10. Cold Weather Oils

If ambient temperatures are below –40°C (–40°F), use MIL–L–7808G and subsequent oils.

11. Time Between Overhauls (TBO's)

The model 250 engine was originally designed to permit modular overhaul. The major components of the engine are the compressor, gearbox, and turbine. A premature removal of any of these components should not cause removal of the other components unless secondary damage has occurred.

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(1) Cold Weather Lubrication

The types of oil recommended at specific ambient temperatures are as follows:

40°C (-40°F) and above . . . . . MIL-PRF-23699 , SAE AS5780, MIL-PRF-7808, or DOD-PRF-85734

-40°C (-40°F) and below MIL-PRF-7808

NOTE: Because of availability, decreased coking and better lubrication qualities at higher temperatures, MIL-PRF-23699 HTS or SAE AS5780 HPC oils are recommended for use in Model 250 engines.

NOTE: Check the engine oil quantity within 15 minutes of engine shutdown to avoid a false indication of excessive oil consumption. If the 15 minutes has been exceeded, motor the engine for 30 seconds with the starter before checking tank quantity. Motoring normally scavenges oil from the gearbox back to the aircraft oil tank. Check the airframe flight manual; some installations may require engine to be operated for at least a minute at ground idle to assure proper scavenging of the engine gearbox.

NOTE: Always refer to the airframe flight manual for proper oil servicing instructions; specific requirements may vary for different models.

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Record of temporary revisions

Revision		Inserted		Removed	
No.	Dated	By	Date	By	Date

Table 602 (cont)
Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	✓	Initial
	200 Hour Inspection			
	In addition to the 100 hour inspection items, perform the following:			
	WARNING: MANDATORY COMPLIANCE DATE FOR ROLLS-ROYCE COMMERCIAL ENGINE BULLETIN 250-C20 CEB-1051 WAS AUGUST 30, 1980.			
32	Perform fuel pump backlash inspection on Sundstrand dual element pump P/N 6854292, 6857548, 6877719, 6856250, 6876803.	250-CSL-1007		
	300 Hour Inspection			
	In addition to the 100 hour and applicable 200 hour inspection items, perform the following:			
	CAUTION: INSPECTION FREQUENCY SHALL BE BASED ON THE NATURE OF THE EROSIVE AND/OR CORROSIVE ENVIRONMENT. THE OPERATING ENVIRONMENT MAY DICTATE A MORE FREQUENT INSPECTION INTERVAL.WHEN OPERATING IN A CORROSIVE AND/OR EROSIVE ENVIRONMENT FOR NON-COATED COMPRESSOR WHEELS, THE INSPECTION SHALL NOT EXCEED 300 HOURS OR 6 MONTHS. FOR COATED COMPRESSOR WHEELS, INSPECTION SHALL NOT EXCEED 300 HOURS OR 12 MONTHS. IF ANY PARENT METAL IS EXPOSED DUE TO CORROSION AND/OR EROSION, THE INSPECTION REQUIREMENT SHALL REVERT BACK TO 300 HOURS OR 6 MONTHS.			
33	Inspect the compressor case when operating in an erosive and/or corrosive environment.	PARA 1.D.(9), this Section		
	CAUTION: AIRCRAFT INSTALLED-ENGINE FUEL-PUMP FILTER DIFFERENTIAL PRESSURE WARNING SYSTEMS AND/OR OPERATING EXPERIENCE MAY DICTATE REPLACEMENT AT A LESSER TIME INTERVAL. IN NO INSTANCE SHOULD THE 300 HR REPLACEMENT INTERVAL BE EXCEEDED.			
34	Replace the fuel filter element. This filter is a throw-away item. It is not cleanable. Before discarding filter, inspect for signs of contaminants. If any are found, inspect the entire fuel system and clean if necessary.	PARA 2.C., 73-10-01		
	CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. (REFER TO SPECIAL INSPECTIONS, 72-00-00, TABLE 604) IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.			
	CAUTION: PURGE AIR FROM THE FUEL SYSTEM.			
35	Perform a fuel pump bypass valve operational check whenever a fuel filter is replaced.	PARA 3.A., 73-10-01		

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Table 603(cont)
Alternate Scheduled Inspections

Item	Inspection/Maintenance Action	REF PARA	©	Initial
	300 Hour Inspection			
	In addition to the 150 hour inspection items, perform the following:			
	WARNING: MANDATORY COMPLIANCE DATE FOR ROLLS–ROYCE COMMERCIAL ENGINE BULLETIN 250–C20 CEB–1051 WAS AUGUST 30, 1980.			
32	Perform fuel pump backlash inspection on Sundstrand dual element pump P/N 6854292, 6857548, 6877719, 6856250, 6876803.	250–CSL–1007		
	CAUTION: INSPECTION FREQUENCY SHALL BE BASED ON THE NATURE OF THE EROSIVE AND/OR CORROSIVE ENVIRONMENT. THE OPERATING ENVIRONMENT MAY DICTATE A MORE FREQUENT INSPECTION INTERVAL. FOR NON–COATED COMPRESSOR WHEELS, THE INSPECTION SHALL NOT EXCEED 300 HOURS OR 6 MONTHS. FOR COATED COMPRESSOR WHEELS, INSPECTION SHALL NOT EXCEED 300 HOURS OR 12 MONTHS. IF ANY PARENT METAL IS EXPOSED DUE TO CORROSION AND/OR EROSION, THE INSPECTION REQUIREMENT SHALL REVERT BACK TO 300 HOURS OR 6 MONTHS.			
33	Inspect the compressor case when operating in an erosive and/or corrosive environment.	PARA 1.D.(9), this section		
	CAUTION: AIRCRAFT INSTALLED–ENGINE FUEL–PUMP FILTER DIFFERENTIAL PRESSURE WARNING SYSTEMS AND/OR OPERATING EXPERIENCE MAY DICTATE REPLACEMENT AT A LESSER TIME INTERVAL. IN NO INSTANCE SHOULD THE 300 HR REPLACEMENT INTERVAL BE EXCEEDED.			
34	Replace the fuel filter element. This filter is a throw–away item. It is not cleanable. Before discarding filter, inspect for signs of contaminants. If any are found, inspect the entire fuel system and clean if necessary.	PARA 2.C., 73–10–01		
	CAUTION: WHEN THERE IS EVIDENCE THAT THE FUEL PUMP FILTER HAS BEEN BYPASSED, THE GAS PRODUCER FUEL CONTROL INLET FILTER, THE FUEL NOZZLE FILTER, THE GOVERNOR FILTER AND THE HIGH PRESSURE FUEL FILTER, IF APPLICABLE, MUST BE CLEANED. (REFER TO SPECIAL INSPECTIONS, 72–00–00, TABLE 604) IF ANY CONTAMINATION IS FOUND IN THE FUEL NOZZLE FILTER, THIS WILL REQUIRE THAT THE FUEL CONTROL BE SENT TO AN AUTHORIZED REPAIR FACILITY FOR INTERNAL CLEANING. REFERENCE MUST ALSO BE MADE TO THE AIRFRAME MAINTENANCE MANUAL FOR FUEL SYSTEM MAINTENANCE FOLLOWING FUEL CONTAMINATION.			
	CAUTION: PURGE AIR FROM THE FUEL SYSTEM.			
35	Perform a fuel pump bypass valve operational check whenever a fuel filter is replaced.	PARA 3.A., 73–10–01		

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E6R14-72-1	72-00-00	610	Jan 22/10
	72-00-00	617	Jan 22/10
E6R14-73-1	73-10-03	205	Feb 15/10

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COMBUSTION SECTION–MAINTENANCE PRACTICES

1. Combustion Liner

A. Removal

(1) (250–C20S, –C20W) Remove the eight bolts and washers and remove the fireshield access panel.

(2) Remove the following from the outer combustion case.

WARNING: MAKE SURE THAT THE IGNITION SWITCH IS OFF BEFORE REMOVING THE SPARK IGNITER OR SPARK IGNITER LEAD ASSEMBLY AS DANGEROUS HIGH VOLTAGES MAY BE PRESENT. ALLOW FIVE MINUTES AFTER OPERATION FOR ELECTRICAL DISSIPATION BEFORE DISASSEMBLY.

(a) Ignition lead from spark igniter. Ground the lead to the engine to dissipate any stored energy.

(b) Fuel hose from fuel nozzle. Cap the fuel nozzle and plug the hose.

(c) Drain hose from burner drain valve.

NOTE: If the outer combustion case is also being replaced, remove the spark igniter, fuel nozzle and burner drain valve.

(3) Remove the internal retaining rings attaching the compressor discharge air tubes to the outer combustion case.

(4) Remove the 24 screws and nuts at the splitline and separate the outer combustion case from the turbine and compressor discharge air tubes.

(5) Remove the combustion liner.

B. Installation

Install the replacement combustion liner as follows:

(1) Place the combustion liner over the first–stage turbine nozzle shield with the igniter plug opening at the nine o'clock position (looking forward).

(2) Slip the retaining rings over the large ends of the compressor discharge air tubes.

(3) Install the spark igniter, fuel nozzle and burner drain valve if they were removed. Required torques are: spark igniter 150–200 lb in. (17–23 N·m), fuel nozzle 200–300 lb in. (23–34 N·m) and burner drain valve 120–140 lb in. (14–16 N·m).

(4) Apply antiseize compound to the split seal rings. Compress the seal rings with 6799952 installation clamps. Split seal ring gaps should be 180° apart. Place the outer combustion case over the liner while mating it to the compressor discharge air tubes.

(5) (250–C20, –C20B –C20F, –C20J) Secure the outer case to the turbine with 24 bolts and nuts. Coat bolt threads lightly with antiseize compound before installation. The half–inch (13 mm) length bolt goes at position 20. (On 6887190 engine assembly, the half–inch length bolts go at positions 6 and 20.) Tighten nuts of socket head cap screws to 20–30 lb in. (2.3–3.4 N·m). Tighten nuts of tee–head bolts to 35–40 lb in. (3.9–4.6 N·m) plus locknut drag.

(6) (250–C20S, –C20W) Secure the outer case to the turbine with 24 bolts and nuts. Coat bolt threads lightly with antiseize compound before installation. Retained on this splitline is the fire shield supporting bracket (positions 4–5). Positions are determined with 1 at top center when looking forward. These two positions take the half–inch bolts. Tighten bolts of socket head cap screws to 20–30 lb in. (2.3–3.4 N·m). Tighten nuts of Tee–head bolts to 35–40 lb in. (3.9–4.5 N·m) plus locknut drag.

(7) Remove the installation clamps and seat the air tube retaining rings in the retaining ring grooves.

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CAUTION: MAKE SURE NOT TO DAMAGE THE MIRROR FINISH AND EDGES OF THE SPRAY TIPS DURING THE CLEANING OPERATION.

(2) Suspend the nozzle vertically with the tip immersed approximately 1/8 in. (3 mm) in Brulin 815 QR (or equivalent). Heating the solvent to 140°F (60°C) is optional. Approximately 8 hours is a desired soak time. All carbon should be removed or loosened after this process.

(3) Use a soft bristle nylon brush, such as a toothbrush, to remove any remaining carbon buildup from the nozzle tip. Be careful that loosened carbon does not enter the spray tip. After carbon removal, flush the nozzle internally and externally using Stoddard solvent or kerosene. Dry with a soft cloth

CAUTION: DO NOT USE COMPRESSED AIR TO DRY NOZZLE. THIS CAN DAMAGE THE NOZZLE.

(4) If carbon is still visible, soak nozzle tip in Turco 4181, or equivalent, at 140°F (60°C) for two hours. Flush nozzle thoroughly with hot water then with Stoddard solvent or kerosene. Dry with a soft cloth.

(5) Clean the face of the outer air shroud with a clean dry cloth; the air holes must be open. Be careful that loosened carbon does not enter the spray tips.

(6) If the nozzle is still streaking, carbon is probably not the issue. Send the nozzle to an authorized facility for further inspection.

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Revision		Inserted		Removed	
No.	Dated	By	Date	By	Date

PARA 11.G. (3) (cont)

7 If a chip light is encountered during the second 30–minute ground run, remove the engine from service and send to a Rolls–Royce Authorized Maintenance Center (AMC). Clean the aircraft engine oil system per para 11.G.(2)(b) this section.

NOTE: If warning light illuminates within the next eight operating hours following a 30–minute ground run and the cause is determined to be an accumulation of magnetic particles and debris (chips, flakes or slivers), remove the engine and send to an Rolls–Royce Authorized Maintenance Center. Tag engine noting cause for rejection. This note is applicable only after para 11.G.(3)(c), this section, has been completed (Reference Oil Drain and Flush) otherwise this is another event.

(d) A maximum of four (4) occurrences of magnetic chip warning light encountered within any 50 hours of engine operation requires removal of the engine for shipment to a Rolls–Royce Authorized Maintenance Center (AMC).

NOTE: Magnetic light indications where only paste is present must still be counted in the four and 50 hour criteria.

(4) Magnetic Plug Quick Disconnects

If quick disconnect magnetic chip detector plugs are installed, inspect the locking pins and flanged inserts for wear as follows:

(a) Inspect the three locking pins for proper condition and wear. The minimum allowable pin diameter on any one pin is 0.070 in. (1.78 mm). The plug should be replaced by a serviceable item if any one or more pins are worn to less than 0.070 in. (1.78 mm) diameter. (See Figure 303.)

NOTE: The point of wear is usually on the side of the pin nearest the spring loaded ring. Push the ring back to obtain better access for inspection.

(b) Inspect the insert for proper condition and wear of the locking cam slot. The material remaining between the end of the cam slot and the edge of the insert must be more than 0.068 in. (1.73 mm). (See Figure 303.) Replace the insert with a serviceable item if excessively worn. (Refer to Commercial Engine Bulletin 250–C20 CEB 1143 for details of insert replacement.)

NOTE: If local personnel, tooling, and facilities are inadequate, send the gearbox assembly to an Authorized Maintenance Center.

(c) Reinstall serviceable magnetic plug.

(d) Reconnect electrical wiring as applicable.

(e) Replenish engine oil as necessary.

(f) Make the appropriate entry relative to the magnetic plug inspection on the Inspection Check Sheet maintained as a part of the engine records.

(5) Operational Check

(a) If magnetic plugs are removed for scheduled maintenance, perform an operational check prior to reinstallation. Connect harness lead and bridge plug with a suitable conductor. Check each plug separately for proper cockpit indication.

(b) Reinstall magnetic plug, tighten to 60–80 lb in. (6.8–9.0 N·m).

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