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SECOND FOR DIESEL GENERATOR CHECKOUT

REV.	REASONS FOR REVISION	DATE
0	New Procedure	
1†	On page 177 of 391 change order of step 4.47.4.r and 4.47.4.r.1	

1.0 PURPOSE

This procedure provides instructions for the Second EOC (END OF CYCLE) Checkout of the Diesel Generator in accordance with Technical Specification 4.8.1.1.2h.1.

2.0 PRECAUTIONS AND LIMITATIONS

2.1 If only portions of the procedure are required:

2.1.1 Contact the Maintenance Foreman.

2.1.2 Use only the steps that apply.

2.1.3 Document the steps used in the "Comments" section of the "Completion" or "Data" Sheet.

2.1.4 N/A the steps that were not used.

2.2 Steps in this procedure may be performed out of sequence only:

2.2.1 With prior approval of the Maintenance Foreman.

2.2.2 If they do not violate the intent of the procedure.

2.2.3 Are documented in the "Comments" section of the "Completion" Sheet.

2.3 Maintain area cleanliness in accordance with Procedure 20427-C, "Maintenance Cleanliness And Housekeeping Control".

2.4 Match mark parts and bag, if applicable, when any equipment disassembly is required.

2.5 Take appropriate action to minimize entry of foreign material into:

2.5.1 Working parts of the engine and turbochargers.

2.5.2 Associated piping that is breached.

2.5.3 Nearby equipment.

2.6 Procedure shall not be revised without a review of Owners Group Maintenance/Surveillance Matrix commitments. (Reference 6.3)

2.7 Inspections should be completed prior to Operations performing tests to satisfy Technical Specifications 4.8.1.1.2.g.2 and 4.8.1.1.2.h.2 through 4.8.1.1.2.h.12.

2.7.1 Inspections of Step 4.5.1 through 4.5.3 should be performed prior to tagging out of the Diesel Generator and prior to any engine disassembly in order to determine if additional inspections are required.

2.8 When tear down area requires that it be opened to the outside, internal area of the engine will be protected by covering all open accesses to internals.

2.9 When work is complete for the day, internal area of the engine will be protected by covering all access openings to internals.

2.10 Clean up all spilled oil, solvents or other contaminants immediately.

2.11 Store all tools properly after use.

2.12 Acceptance criteria and torque values will be in accordance with procedure body, manufacturer's instruction manual (Reference 6.1.1), or Reference 6.3 when not listed in procedure.

2.13 Group Parts List Numbers shown in brackets, e.g., [02-314A], are for information only.

2.14 Component weights listed below are approximate and are intended to assist in handling and assembly operations. Suitable equipment of sufficient weight lifting capacity should always be used when handling heavy and unwieldy parts and assemblies.

Item		Approximate Weight (lbs)
Cylinder head		1100
Piston and rings (less pin)		600
Piston pin		120
Master rod		624
Link rod and box		700
Cylinder liner		600
Cylinder head subcover		365
Cylinder head cover		30
Camshaft (less cams)		750
Cams (average)		20
Main bearing caps:	Front	370
	Intermediate	200
	Front rear	300
	Rear rear	300

2.15 Crankshaft rotation and cylinder bank designations are determined while viewing the engine from the flywheel end. Number one cylinder on each bank is that nearest the gear case, or auxiliary end. (See Figure 1).

2.16 During disassembly of the engine, observe that many parts are match marked and identified by part or assembly number.

2.16.1 Engine parts which have been in service should be returned to the same position in the same engine from which they were removed. This applies principally to the following:

a. Cylinder liners,

b. Pistons,

c. Connecting rods and bearing caps.

2.16.2 New parts should be marked in the same way as the parts which they replaced.

2.16.3 Safety clips, cotter pins and safety wire, where specified, must be re-installed correctly to ensure that the parts remain secure in use.

2.17 Prior to any activity that requires barring of the engine, lubricate the engine main bearings and cylinder liner walls (if pistons are installed) at least once per shift.

2.17.1 This may be accomplished by running the Lube Oil Keepwarm Pump or by hand oiling the main bearings and liner walls where accessible.

a. If main bearings are oiled by hand, the main bearing cap oil lines must be removed.

2.18 All torque values stated in this procedure, unless otherwise specified, are based on the use of a thread lubricant composed of equal parts by volume of engine lubricating oil and Dixon number two medium powdered flake graphite, or equal, ensuring that mixture is thoroughly mixed before each application.

2.18.1 The following procedure should be used when torquing fasteners:

a. Lubricate threads with a mixture of oil and graphite. Tighten hand tight.

b. Tighten all fasteners by snugging the first one, then moving to the one farthest removed and continue in a crisscross pattern until all fasteners are snug.

c. Unless otherwise specified, apply approximately 1/3 of the required torque to each fastener in a crisscross pattern, then repeat procedure for 2/3 and 100% of the required torque value.

d. Nuts which are secured with cotter pins must be brought to the specified torque value before attempting to align cotter pin holes.

(1) If the hole in the bolt is halfway between slots in the nut, or beyond, the nut should be tightened to make alignment.

(2) If the hole is short of the halfway points, nuts on bolts larger than one inch in diameter may be backed off to nearest point where it will align.

2.18.2 Reference Table 1 for torque values as required.

3.0 PREREQUISITES AND INITIAL CONDITIONS

3.1 Determine the safety classification of the equipment and, if applicable:

3.1.1 Check the appropriate classification on the "Power and Signal Removal/Replacement Data Sheet".

3.1.2 Check the appropriate classification on the "Completion" or "Data" Sheet.

3.2 Prior to beginning work, notify QC if:

3.2.1 Hold points are indicated on the "Completion" AND/OR "Data" Sheet.

3.2.2 The MWO/Work Package has a QC hold point.

3.3 Ensure that cleanliness class is marked on the MWO.

3.4 The Diesel Generator has been secured to prevent starting (see Table 4). Following performance of Section 4.5.1 through 4.5.3.

3.4.1 Starting air isolated AND tagged and supply lines drained.

3.4.2 Diesel Generator Breaker has been racked out AND tagged. (Operations' responsibility, Maintenance check.)

3.5 Jacket Water Keepwarm Pump and Heater have been de-energized and the breakers opened AND tagged if the cooling water system boundary is to be broken. (Operations' responsibility, Maintenance check.)

3.6 Jacket Water System has been drained, including engine block and stand pipe, if the cooling water system boundary is to be broken. (Operations' responsibility, Maintenance check.)

3.7 Lube Oil Keepwarm Pump and Heater have been de-energized and the breakers opened AND tagged if necessary to prevent inadvertent flow of oil to engine or if lube oil is removed from sump tanks. (Operations' responsibility, Maintenance check.)

3.8 Lube Oil has been drained from engine sump AND sump tanks if it is desired to reuse the oil and there exists a possibility of oil contamination from the maintenance activity to be performed.

3.9 Fuel oil day tank has been isolated from engine AND the fuel oil has been drained from fuel oil supply headers if the fuel oil system boundary is to be broken.

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4.39 GENERATOR PEDESTAL BEARING

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4.47 ENGINE OPERATION

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4.0 SECOND EOC CHECKOUT

4.1 */* Verify that Prerequisites AND Initial Conditions have been met.

4.2 Notify Shift Supervisor of work to be performed.

4.3 */* Verify that the Diesel Generator is fully isolated AND tagged in accordance with Procedure 00304-C, "Equipment Clearance And Tagging" following performance of Steps 4.5.1 through 4.5.3.

4.4 */* Ensure that a copy of the following procedures are included in work package to provide detailed disassembly and reassembly information as required.

4.4.1 27562-C, "Emergency Diesel Generator Maintenance"

4.4.2 25740-C, "Megger Testing The Emergency Diesel Generator"

4.4.3 27563-C, "Emergency Diesel Generator And Engine Control Panel Functional Test"

4.4.4 27592-C, "Emergency Diesel Generator Gear Train Inspection And Backlash"

4.5 INSPECTIONS REQUIRED PRIOR TO ENGINE TAG OUT AND DISASSEMBLY

NOTE

Cold compression is taken with the engine operating at 450 rpm unloaded.

4.5.1 Record cold compression pressures as follows: (Commitment 8993)

a. Start engine per Procedure 13145-1.

b. Allow engine speed to stabilize at 450 rpm.

c. At the cylinder to be checked momentarily (1 to 2 seconds) open the indicator cock (Kiene valve) on the cylinder head to ensure valve is clear.

d. Attach the firing pressure gauge and extension adaptor.

CAUTION

Maintain control of the rack on the fuel pump at all times. Do not allow rack mm to exceed mm setting of adjacent pumps.

e. Disconnect the fuel pump linkage from the fuel pump control shaft linkage and move the fuel pump's rack to 0 mm.

f. Open the indicator cock on the cylinder head.

g. Record cold compression pressure on Data Sheet 1. */*

h. Close the indicator cock on the cylinder head.

i. Reconnect the fuel pump linkage to the fuel pump control shaft linkage which was disconnected in Step e., being careful to return all parts to their original position.

j. */* Torque nut to 15 ft-lbs (torquing may be verified after all cylinders have been checked).

k. Remove the firing pressure gauge and extension adaptor.

l. Repeat Steps c through k for the remaining cylinders.

m. Stop engine per Procedure 13145-1 unless additional testing is to be performed.

n. */* Analyze data recorded and compare to previous data to determine if corrective action is required (e.g., grinding and reseating of valves)

4.5.2 Record maximum firing pressures as follows: (Commitment 8993)

a. Start engine per Procedure 13145-1.

b. Load engine to 6800 to 7000kw per Procedure 13145-1.

NOTE

For an accurate set of firing pressures, it is necessary for the engine to be maintained at a constant kw load while measurements are in progress. Have Operations personnel inform Maintenance personnel prior to any load adjustments or corrections.

c. Allow engine temperatures to stabilize after 6800 to 7000kw load is achieved (minimum of 1 hour).

d. At the cylinder to be checked, momentarily (1 to 2 seconds) open the indicator cock (Kiene valve) on the cylinder head to ensure valve is clear.

e. Attach the firing pressure gauge and extension adaptor to indicator cock.

CAUTION

Minimize the length of time the indicator cock is open while measuring firing pressure in the following step. Having valve open for prolonged periods of time exposes the valve to high temperatures which could result in the inability to close valve.

f. Open the indicator cock on the cylinder head.

g. */* Record maximum firing pressure on "Data" Sheet 1.

h. Close the indication cock on the cylinder head.

i. */* Record fuel pump rack mm reading on "Data" Sheet 1.

j. */* Have personnel note cylinder exhaust temperature for cylinder under test from the digital temperature indicator on the engine control panel and record on "Data" Sheet 1.

k. Remove the firing pressure gauge and extension adaptor.

l. Repeat Steps d through k for the remaining cylinders.

m. Unload and stop the engine per Procedure 13145-1 unless additional testing is to be performed.

n. */* Analyze data recorded and compare to previous data to determine if corrective action is required (e.g., rework of fuel injection pumps or fuel injectors).

4.5.3 Perform hot crankshaft web deflection as follows: (Commitment 8983)

NOTE

Generator vibration measurements should be performed per Step 4.38.1 and turbocharger vibration measurements per Step 4.7.1 during performance of this section.

a. Start engine per Procedure 13145-1.

b. Load engine to 6600 to 7000kw per Procedure 13145-1.

c. Allow engine to operate for a minimum of 8 hours to allow engine and foundation temperatures to stabilize.

d. Unload the engine as quickly as possible (less than 5 minutes) and stop the engine per Procedure 13145-1.

e. */* Isolate both air storage tanks and de-pressurize both air start headers between isolation valves and engine.

f. Stop lube oil keepwarm pump at 1NBI-15 (1NBO-15).

g. Remove all crankcase side covers.

h. */* Perform crankshaft web deflection as follows (Commitment 8983):

NOTES

a. Placement of the deflection gauge is vital if accurate readings are to be obtained. "Data" Sheet 2, illustrates the five positions of the crankshaft at which web deflections are to be measured, and the starting position of the crankshaft for each crank web.

b. Care must be exercised to ensure that the deflection gauge is positioned in the center of the web, exactly opposite the center of the crankpin, and one-fourth inch from the edge of the crank web.

c. Webs should already have been center punched for this purpose.

(1) Prior to barring of the engine, lubricate engine main bearings and cylinder liners in accordance with Step 2.17.

(2) Bar engine over in direction of normal rotation with barring device until number one crank is approximately 52 degrees after vertical bottom center.

(3) Insert deflection gauge between web for number one crank.

(a) Double check that crankshaft is properly positioned.

1 IF NOT in correct position, it is possible that the connecting rod will knock the deflection gauge out of the web as the engine is barred over to the next position.

(b) Ensure the two bearing points of the gauge are in a line exactly parallel to the centerline of the crankshaft.

1 IF gauge is not parallel, erroneous readings will be obtained.

(c) Zero the gauge.

(4) With the deflection gauge in place and not disturbed, bar the engine over, stopping at each position (2,3,4 & 5) as indicated on "Data" Sheet 2, Sheet 2.

(a) Record reading at each position in mils (plus or minus) in the appropriate space for each position.

(5) Repeat Steps (2) through (4) for each
/ crankshaft web and record readings on "Data" Sheet 2, Sheet 2.

(6) Compare all readings with each other. Evaluate results, based on the standards set forth in the following steps and determine need for corrective action.

(a) If the deflection in any crank exceeds 3 mils (0.003 inch/0.0762 mm), corrective action is indicated.

(b) Corrective action is also necessary if the total deflection in any pair of adjacent cranks exceeds 3 mils. For example, if the deflection in one crank is plus 2 mils, and the deflection in an adjacent crank is minus 2 mils, the total deflection is 4 mils, and corrective action is indicated.

(7) IF corrective action is required, record on
/ "Data" Sheet 2, Sheet 2 and repeat Steps (1) through (6).

i. Replace all crankcase side covers unless
/ additional maintenance is to be performed.

(1) Torque cap screws to 30 ft-lbs.

j. Compare deflection readings to previous readings
/ and determine need for corrective action.

4.5.4 Review trend information from Engineering Procedure 54169-C, 54170-C, or documentation from previous EOC's for the following items:

a. Engine Lube Oil Sample
/

Review oil sample results to determine need to replace lube oil and clean sump tank. (Commitment 9189)

b. Engine Hours
/

Determine the equivalent engine hours at 100% load on engine since last cylinder block top inspection to determine need to remove cylinder heads and inspect block top. (Also reference Step 4.11.13 of Procedure 27562-C.) (Commitment 8985, 9100)

c. Jacket Water Heat Exchanger
/

Review heat exchanger trend data to detect any loss of performance which would indicate fouling and the need to clean heat exchanger. (Commitment 9116, 9066, 14938, 14941)

d. Lube Oil Heat Exchanger
/

Review heat exchanger trend data to detect any loss of performance which would indicate fouling and the need to clean heat exchanger. (Commitment 9069, 9068, 14939, 14940)

e. Turbocharger Intercooler
/

Review intercooler trend data to detect any loss of performance which would indicate fouling and the need to clean intercooler.

f. Turbocharger
/

Review data to determine the number of non-prelubed engine starts since the last thrust bearing visual and blue check for both left and right bank turbochargers.

(1) IF there have been 40 or more non-prelubed starts, a visual and blue check must be performed on the thrust bearing. (Commitments 8976, 9106, 9107 and 13775)

g. Turbocharger
/

Review data to determine if anomalies were found on the nozzle ring components or inlet guide vanes on the turbocharger inspected at the previous EOC.

(1) IF anomalies were found, reinspect that turbocharger in addition to (not in lieu of) the turbocharger scheduled for this EOC. (See Reference 6.4)

h. Cylinder Exhaust Temperatures

/

Review trend data to detect change in cylinder exhaust temperature since previous EOC.

(1) Changes in cylinder exhaust temperature could indicate problem with fuel injector or fuel injection pump.

(2) Large temperature differentials between cylinders could indicate engine is operating in an unbalanced condition.

i. Cylinder Liners

/

Review data to determine if any pistons were removed at the two previous EOCs.

(1) IF any pistons were removed, the cylinder liners must be inspected for those cylinders.

j. Engine Base

/

Review data to determine if any cracks have been previously discovered in the engine base (e.g., bearing saddles).

(1) IF cracks have been found previously, perform a liquid penetrant (PT) or magnetic particle (MT) inspection of the crack(s) to determine any growth.

k. Lube Oil Keepwarm Pump

/

NOTE

Pump discharge pressure will vary considerably depending on cleanliness of keepwarm filter and strainer and oil temperature. Lowest pressure expected is 25 psig and highest pressure is 46 psig.

Review lube oil keepwarm pump discharge pressure trend data to detect any pump deterioration.

l. Crankshaft

/

Review data from Steps 4.5.2n and 4.5.4h to determine if the engine has been operated in a severely unbalanced condition.

(1) IF the engine has been operated in a severely unbalanced condition, then the inspections of Steps 4.11.9.4 through 4.11.9.7 of Procedure 27562-C must be performed on the crankshaft. This inspection would require the removal of main bearings No. 4, 6 and 8 and the removal of three connecting rods (chosen from No. 3 through No. 8).

m. Cylinder Heads

/

An inspection of new or reworked cylinder heads is required after 500 - 600 hours of operation. Perform the initial inspection if the Diesel Generator has accumulated 500 - 600 hours operation or if the Diesel Generator log or maintenance records indicated that 500 - 600 hours has elapsed since cylinder heads have been repaired or replaced. This inspection requires removal of the subcover bonnet and inspection of the interior for soot which indicates valve blow-by. Corrective action will be required if deficiencies are discovered. (Commitment 8996, 8995)

4.5.5 Megger lube oil keepwarm heater as follows:

/

a. Ensure heater has been in service during the past twelve hours.

b. Stop lube oil keepwarm pump at 1NBI-15 (1NBO-15).

c. Open lube oil heater breaker 1NBI-16 (1NBO-16).

d. Megger heater per appropriate plant procedure. Attach "Data" Sheet to package.

e. Restore keepwarm system to status required.

4.5.6 */* Megger jacket water keepwarm heater as follows:

a. Ensure heater has been in service during the past twelve hours.

b. Stop jacket water keepwarm pump at 1NBI-12 (1NBO-12).

c. Open jacket water heater breaker 1NBI-13 (1NBO-13).

d. Megger heater per appropriate plant procedure. Attach "Data" Sheet to package.

e. Restore keepwarm system to status required.

4.5.7 */* Perform crankshaft thrust clearance as follows (Commitment 9354):

4.5.8 Prior to checking thrust clearance, ensure that rear bearing caps No. 9 and No. 10 are installed and bearing cap studs nuts torqued.

4.5.9 Remove crankcase side cover(s) as required to gain access to crankshaft.

4.5.10 Lubricate main bearings per Step 2.17 and bar the engine over to establish an oil film between the main bearings and their journals to permit easy movement of crankshaft.

4.5.11 Check crankshaft thrust clearance as follows: (Commitment 9354)

a. Mount dial indicator on near of engine frame, between frame and flywheel.

CAUTION

The bar should not be inserted deeply enough to damage either the main bearing shell or the crankshaft journal.

NOTE

Crankshaft may be moved forward and aft in the horizontal plane with a pry bar porta power.

b. Insert the bar between rear crank web and nearest frame member inside crankcase.

c. Pry crankshaft forward, towards the gear case end as far as it will go.

(1) IF the crankshaft is all the way forward, it should be impossible to insert a 0.0015 inch feeler gauge between the crankshaft rear thrust collar and the rear thrust ring. (See "Data" Sheet 3, Sheet 1)

d. IF the crankshaft cannot be moved to the limit of its possible travel by use of the pry bar alone, it may be necessary to lubricate the main bearings and bar the engine over with the barring device while at the same time exerting a horizontal force on the crankshaft with the bar to move it.

e. Zero dial indicator, allowing for at least 0.050 inch movement towards the minus direction.

f. Reposition pry bar to move crankshaft to the rear, towards the flywheel end. Pry crankshaft to the rear as far as it will go.

(1) IF the crankshaft is all the way aft, it should be impossible to insert a 0.0015 inch feeler gauge between the forward crankshaft thrust collar and the forward thrust ring.

g. Observe dial indicator. The number of thousandths (minus) indicated on the dial is the crankshaft thrust clearance.

h. */* Record the observed reading of dial indicator on "Data" Sheet 3, Sheet 2 as the "As Found Thrust Clearance".

i. */* Compare the observed Thrust Clearance to the Acceptance Criteria (0.022 to 0.030 inch).

(1) IF not within tolerances, perform Step 4.5.12.

(2) IF within tolerance, record as "Final" Clearance on "Data" Sheet 3, Sheet 2.

4.5.12 IF crankshaft thrust clearance is required to be adjusted, proceed as follows:

NOTES

a. IF the thrust clearance is greater than or equal to 0.040 inch at least one thrust ring must be replaced.

b. IF the thrust clearance is greater than 0.030 inch but less than 0.040 inch the thrust clearance should be adjusted by adding shims if the thrust ring(s) has not been previously shimmed.

c. IF the thrust ring(s) has been previously shimmed, it will be necessary to determine what the clearance would be with all shims removed.

d. IF the clearance is determined to be greater than or equal to 0.040 inch with all shims removed, then at least one thrust ring should be replaced.

e. IF the clearance is determined to be less than 0.040 inch with all shims removed, then the thrust ring(s) may be shimmed to obtain an acceptable thrust clearance of 0.022-0.030 inch.

a. To replace a thrust ring(s) or to add shims to thrust ring(s) it will be necessary to remove the number 9 and/or number 10 main bearing cap per Steps 4.20.1a through 4.20.1r.
<u>Ø/1</u>

(1) Record on "Data" Sheet 3, Sheet 2 which bearing cap(s) was removed.

b. When the bearing cap(s) has been removed, remove the thrust ring by loosening and removing the four button head cap screws holding thrust ring to bearing cap.

c. */* Check Crankshaft thrust bearing for signs of cracks, gouges, wear or degradation. (Commitment 9354)
(1) Document on "Data Sheet 3, Sheet 2.

d. IF shim material is to be added, cut a continuous section of the thickness required to reduce clearance to within the acceptable tolerance.

(1) Drill four holes for the button head cap screws using the thrust ring as a template.

(2) Ensure all burrs have been removed.

(3) IF thrust ring(s) is to be replaced, discard existing thrust ring(s).

e. IF shims are being added, install the shims and thrust ring to the main bearing cap(s) using the button head cap screws and tighten securely.

f. IF thrust ring(s) is being replaced, install new thrust ring(s) using the button head cap screws and tighten securely.

g. */* Record on "Data" Sheet 3, Sheet 2 if thrust ring(s) was replaced or if shims were added.

(1) IF shims added, record thickness of shims added to thrust ring(s).

h. Number 9 and/or number 10 main bearing shells may be removed for inspection at this time in accordance with Steps 4.20.1s through 4.20.1x and 4.20.4.

i. Reinstall the main bearing cap(s) in accordance with applicable steps of steps 4.20.5 through 4.20.15

j. Re-perform Steps 4.5.11a through 4.5.11g and Step 4.5.11i.

4.6 ENGINE INTERNALS

4.6.1 */* Perform an overall inspection of engine internals as follows (document on "Data" Sheet 4, Sheet 1):

a. Check for any abnormal condition.

b. Check for presence of babbit flakes. (Commitment 9096)

c. Check for presence of excessive water or sludge. (Commitment 9096)

d. Check lube oil tubing for dents or crimps. (Commitment 8982)

e. Check pneumatic lines to main bearing temperature switches for dents or crimps.

f. Check internals of block and base for leaks.

NOTE

Jacket water stand pipe and water from lube oil heat exchanger should be drained prior to preceding with engine disassembly.

4.7 TURBOCHARGERS (MP-0022/23) AND INTERCOOLER (F-068)

4.7.1 */* Measure vibration and check with baseline data. (Maintenance Engineering to perform this step.) Include "Data" Sheet in package. (Commitment 9304)

4.7.2 */* Measure rotor end play (axial clearance) to identify trends of increasing clearance, i.e., thrust bearing degradation for both left and right bank turbochargers as follows: (Commitment 9304)

a. Remove expansion joint between intake air silencer and turbocharger inlet air adaptor.

b. Remove bolts from air inlet flange and remove intake air adaptor.

c. */* Using a dial indicator, check rotor float.

(1) Record on "Data" Sheet 5, Sheet 1.

(2) Compare reading to Table 3 allowables.

d. Review thrust bearing axial clearance from previous inspection (see Procedure 54169-C) to determine if a trend toward increasing axial clearance exists.

e. Any trend toward increased axial clearance could signify thrust bearing degradation.

f. IF required, inspect bearing per Step 4.7.7.
/

g. Reinstall intake air adaptor.
/

(1) Torque cap screws per Table 1.

h. Install expansion joint between intake air silencer and turbocharger inlet air adaptor.

(1) Tighten bands until snug.

4.7.3 */* IF it was determined in Step 4.5.4f that 40 or more non-prelubed starts have occurred since the last thrust bearing inspection, perform a visual and blue check of thrust bearing per Step 4.7.7 (Commitments 8976, 9106, 9107, 13775)

4.7.4 */* Visually check the nozzle ring components and inlet guide vanes for missing parts or parts showing distress.

a. IF such conditions are noted, the entire ring assembly should be replaced. (Checkout to be performed on one turbo/nuclear unit at each EOC.) (Commitment 9105)

b. IF it was determined in Step 4.5.4g that anomalies were found on the turbocharger inspected at the previous EOC, reinspect that turbocharger in addition to the turbocharger scheduled for this EOC.

4.7.5 TURBOCHARGER REMOVAL

a. Remove insulation from exhaust as needed.

b. Remove the thermocouple from the turbocharger outlet adaptor.

c. Remove turbocharger tie plate.

d. Remove bolts from exhaust flanges and remove exhaust adaptor and expansion joint.

e. Remove expansion joint between intake air silencer and turbocharger intake air adaptor.

f. Remove bolts from air intake flange and remove intake air adaptor.

g. Remove cooling water and lube oil lines as needed.

h. Disconnect the instrument tubing from the vibration switch.

(1) Tag lines as to which port it was disconnected, valve port or reset port.

i. Install rigging and connect to chain falls.

j. Remove bolts from turbocharger air outlet to aftercooler flange.

k. Remove bolts which secure exhaust manifold to the turbocharger turbine inlet casing.

l. Remove turbocharger base bolts.

m. Raise turbocharger and lower to floor.

n. Bag and tag or secure in place the shims that are installed between the turbocharger base and turbocharger support.

4.7.6 DISASSEMBLE

a. Remove bolts securing the Turbine Inlet Casing assembly to the turbine casing.

b. Install 3 guide rods in turbine casing.

c. Install jack bolts in turbine inlet casing and gradually separate turbine inlet casing from turbine casing.

d. Install eye bolts and lift turbine inlet casing off.

NOTE

If this inspection is to be used to take credit for the 5 year inspection, perform the following. If 5 year inspection is not being performed, go to Step 4.7.7j, applicable portions of 4.7.8 and 4.7.9.

e. Remove bolts attaching blower inlet casing to blower casing.

f. Install two guide rods.

g. Remove blower inlet casing using jack bolts.

h. Check and record rotor axial float on "Data" */* Sheet 5.

i. Apply a wrench to the projected flats of stud and hold it stationary as the elastic stop nut, washer and nose piece are removed from the impeller side.

j. Pry impeller nose cone off using two screwdrivers.

k. Install impeller remover and remove impeller.

l. Protect quill shaft and impeller fit with several layers of friction tape around end of shaft.

m. Carefully pull rotor out through exhaust side.

n. Remove snap ring holding oil seals in.

o. Remove oil seals using jack bolts.

p. IF it is necessary to clean the diffuser perform Steps q thru t. IF NOT, proceed to Step 4.7.7.

q. Remove blower casing bolts and using these bolts as jacking screws, break the flange connection between the intermediate casing and the blower casing.

r. Remove the blower casing assembly.

s. Remove the diffuser ring machine screws and lift the diffuser ring out of the blower casing.

t. Clean diffuser ring.

4.7.7 CLEAN AND CHECK

a. Clean oil from turbine end thrust bearing.

b. Clean oil from turbine end thrust collar and spread a thin layer of bluing on thrust collar.

c. Carefully install rotor with shaft sleeve (special tool), rotate against thrust collar and then carefully remove.

d. */* Evaluate thrust bearing wear based on information supplied in the Elliot Instruction Manual Figure 14 (AX4AK01-563) (Commitment 10347).

(1) The normal blue pattern for a new bearing should show a flat area approximately 5/16" wide, at the inner end of each radial oil groove, increasing in width to the outer edge of the bearing.

(2) The bearing should be replaced when an area of approximately 50% of the wedge surface is indicated by bluing as worn flat.

(3) Record on "Data" Sheet 5.

e. */* Check bearing surface for signs of scoring.

f. */* Check and record on "Data" Sheet 5 journal bearing clearances by measuring Shaft O.D. and Bearing I.D.

(1) Compare measured values to the requirements in Table 3.

g. Remove bearings using Elliot bearing puller, if bearing does not pass Steps 4.7.7d,e and f.

h. Measures the following dimensions, record on "Data" Sheet 5 and compare to the requirements of Table 3:

(1) */* Inside diameter of oil seals.

(2) */* Active and inactive thrust collars outside diameter in seal area.

i. */* Check impeller and turbine wheel for damage (nicks, rubs, cuts, blade tightness etc.).

(1) IF any damage is evident on rotor, return assembly to Elliot for repair and balance.

j. */* IF damage to nozzle ring is evident, remove nozzle ring and check. Replace as necessary. (Commitment 9105)

k. IF anomalies are found during nozzle ring inspection of Step 4.7.7j, the turbocharger must be reinspected at the next refueling outage.

4.7.8 REASSEMBLY

CAUTION

Cleanliness is of utmost importance.

a. */* Ensure parts are cleaned prior to assembly.

b. Nozzle ring installation

(1) Position nozzle ring on nose piece and install new nozzle ring bolts and washers using anti-seize thread compound. (Commitment 9105)

(2) With bolts snug, center nozzle ring in inlet casing shell using four feeler gauges 90 degrees apart.

(3) */* Torque nozzle ring bolts to 18-22 ft-lbs and record on "Data" Sheet 5.

c. Bearing installation - Turbine side

(1) The turbine side bearing, which has a grooved thrust flange, must have the slot on the back of the bearing flange lined up with the locating pin in the intermediate casing before inserting the bearing.

(2) Using the bearing inserting tool, press bearing into the intermediate casing.

(3) Check for proper bearing seating by
/ attempting to place a 0.001 inch feeler gauge between thrust flange and intermediate casing.

(a) IF feeler gauge can be inserted, remove and reinstall bearing.

(4) Ensure blower side bearing is installed prior to performing the following step.

(5) Check bearing alignment.
/

(a) Coat shaft thrust collar with bluing, install the shaft sleeve (special tool) and insert shaft thru bearings.

(b) Rotate shaft with pressure toward bearing a full 360°.

(c) Contact shown on 180° or less indicates misalignment of bearing in casing.

d. Bearing installation - Blower side

(1) The blower side bearing must have the slot on the back of the bearing flange lined up with the locating pin in the intermediate casing before inserting the bearing.

(2) Using the bearing inserting tool, press bearing into the intermediate casing.

(3) Check for proper bearing seating by
/ attempting to place a 0.001" feeler gauge between the bearing flange and intermediate casing.

(a) IF feeler gauge can be inserted, remove and reinstall bearing.

e. Blower Casing and Diffuser Installation

(1) IF blower casing was removed perform the following:

(2) IF the diffuser ring was removed from the blower casing, rainstall using the original machine screws.

(a) Tighten securely.

(3) Apply a coat of joint compound (Tite seal) to the blower casing mating surface.

(4) */* Install the blower casing to the intermediate casing.

(a) Torque the intermediate casing bolts to 40-50 ft-lbs.

(b) Record on "Data" Sheet 5.

f. Rotor Assembly and Oil Seal Installation

(1) Coat the mating surfaces of the turbine end oil seal with joint compound (Tite seal).

(2) */* Insert the turbine end oil seal into the intermediate casing and secure with the retaining ring (beveled side out).

(3) Install the shaft sleeve (special tool) on shaft. Coat the shaft and bearing surfaces with a light coat of engine oil.

(4) Carefully insert the shaft through the bearings taking extreme care not to damage bearing surfaces.

(a) Remove the shaft sleeve (special tool).

(5) */* Install blower end thrust collar onto shaft with flange toward bearing.

(6) Coat the mating surfaces of the blower end oil seal with joint compound (Tite seal).

(7) */* Insert the blower end oil seal into the intermediate casing and secure with the retaining ring (beveled side out).

(8) Coat impeller portion of shaft with shaft compound (Molykote or equivalent).

(9) Heat impeller inducer assembly in oil bath to between 190 to 212 °F.

(10) While holding the turbine disk against the thrust bearing, slide the impeller inducer assembly onto the shift until it contacts the thrust collar aligning key ways in impeller and shaft.

(a) Install key.

(11) Carefully install the nose piece on shaft, aligning match marks on nose piece and impeller.

(12) Install washer and elastic stop nut on shaft.

(13) */* While holding centering stud with wrench on flats provided, torque elastic stop nut to 80-120 ft-lbs.

(a) Record torque on "Data" Sheet 5.

(14) */* Using a dial indicator, check rotor float.

(a) Record on "Data" Sheet 5.

(b) Compare readings to Table 3 allowables.

(15) Oil bearings through the lube oil inlet pipe using engine oil.

(16) Turn the rotor by hand and ensure it turns freely.

g. Blower Inlet Casing Installation

(1) Coat the mating surface of the blower inlet casing-to-blower casing mating surfaces with joint compound (tita seal).

(2) */* Install the blower inlet casing to the blower casing.

(a) Torque the blower inlet casing bolts to 20-25 ft-lbs.

(b) Record on "Data" Sheet 5.

h. Turbine Inlet Casing Installation

(1) Apply a light coat of joint compound (Tite seal) to the turbine casing flange.

(2) Place turbine inlet casing in position.

(3) Apply anti-seize thread compound to bolt */* threads and install bolts, torquing to 55-60 ft-lbs.

(a) Record torque on "Data" Sheet 5.

(4) Install lockwire on turbine inlet casing */* bolts per step 1.

i. Safety Wire Installation

(1) Safety wire must be done correctly to be effective. (See Appendix A.)

(2) Wire must be wrapped around the fastener in the direction to tighten the fastener.

(3) Wire must be pulled tight but not overstressed.

(4) Wire must be twisted between adjacent fasteners and at the cut off end.

(a) Wire between adjacent fasteners should be twisted clockwise in a continuous twist. No eye in the middle.

(b) Wire at cut off and should be twisted counter-clockwise.

(5) Wire must not interfere with rotating parts.

(6) Cut ends of wire must be bent to a position where it will not injure personnel.

(7) Correct size and type of wire must be used.

(a) Stainless steel wire is recommended.

NOTE

Perform steps 4.7.10, 4.7.11 and 4.7.12 prior to installing turbocharge.

4.7.9 TURBOCHARGER REINSTALLATION

a. Attach chain hoists to lifting eyes on turbocharger.

b. Lower turbocharger and check to see that the flanges meet at same time.

c. Shim base as necessary to align turbocharger.

d. Install new gaskets and install bolts but do not tighten. (Apply Felpro C5A to bolt threads for the bolts which secure the exhaust manifold adaptors to the turbocharger inlet.)

e. */* Torque intercooler flange and exhaust flanges first per Table 1, record on "Completion" Sheet. (Turbo-to-intercooler flange cap screws may be torqued to 60 ft-lbs. See Reference 6.2.9.

NOTE

Any piping that is removed which has dresser style 65 couplings should be replaced with dresser style 90 couplings equipped with viton gaskets, if leakage has been a problem.

f. Install turbocharger exhaust outlet adaptor.

g. Install turbocharger tie plate, shimming as required to achieve a level installation.

h. Install exhaust expansion joint.

i. */* Torque exhaust outlet adaptor and expansion joint bolts per Table 1.

(1) Record on "Completion" Sheet.

j. */* Torque turbocharger tie plate bolts to 30 ft-lbs.

(1) Record on "Completion" Sheet.

k. Torque turbocharger base bolts to 60 ft-lbs.
/

(1) Record on "Completion" Sheet.

1. Using shim stock feeler gauges ensure that there
/ are no air gaps at the turbocharger-to-intercooler flange.

m. Install lines removed in Step 4.7.5g.
/

(1) Torque per Table 1.

n. Install the insulation removed in Step 4.7.5a.

o. Install the thermocouple in the turbocharger outlet adaptor removed in Step 4.7.5b.

p. Install the intake air adaptor.
/

(1) Torque cap screws per Table 1.

q. Install expansion joint between intake air silencer and turbocharger inlet air adapter.

(1) Tighten bands until snug.

r. Reconnect the instrument tubing for the vibration
/ switch ensuring tubes are reconnected as originally installed.

4.7.10 Visually check left bank intercooler inlet adaptor
/ turning vane for cracks in welds securing vane to adaptor housing (boreascopic inspection is acceptable if turbocharger not removed).

4.7.11 Visually check accessible intercooler tube fins, if
/ turbocharger has been removed for inspection.

4.7.12 IF it was determined, in Step 4.5.4e, from trend data
/ that the intercooler has fouled, inspect shell and tube sides, and clean as required. (Commitment 9108)

4.7.13 Visually inspect the turbocharger bracket-to-engine
/ cap screws and the turbocharger bracket-to-turbocharger base cap screws for both left and right bank turbochargers.

a. Replace any broken bolts.

b. Tighten any loose or replacement cap screws as follows: 125 ft-lbs for the bracket-to-engine cap screws and 75 ft-lbs for the bracket-to-turbocharger cap screws. (Commitment 9143, 13781)

4.8 FUEL OIL INJECTORS

4.8.1 Disconnect 1/4" return line from injector to drip header.

4.8.2 Remove holding clamp and line, if required.

a. Tag line for location.

b. Protect fitting on the injector to prevent debris from entering.

4.8.3 Remove injector as follows:

a. Remove two cap screws on the clamp for the 5/8" supply line to the injector nozzle.

b. Disconnect the injection line-to-burst header tubing.

(1) Protect fittings.

c. Remove the injection line.

(1) Protect the ends.

(2) Protect the fittings at the injector and tape.

(3) Tag the line for location.

(4) Reinstall injection line clamp and cap screws on subcover.

d. Remove the two 1 1/8" nuts on the injector nozzle retainer plate.

e. Remove injector from cylinder head.

(1) Tag for location.

f. Check injector to ensure that the nozzle gasket was removed with the injector.

g. Plug injector hole in cylinder head with a clean rag or equivalent.

WARNING

HIGH-PRESSURE SPRAY WILL PUNCTURE THE SKIN AND SERIOUS INJURY CAN RESULT.

4.8.4 Test the fuel injectors as follows; document on "Data" Sheet 6, Sheet 2. (Commitment 9002)

a. Ensure that pop tester is clean and the fuel oil is clean. Fuel oil should be filtered.

b. Install fuel injector in pop-tester.

NOTE

The valve should chatter sharply if it is seating properly.

c. */* Actuate the pump at approximately 30 strokes per minute to test for popping action.

(1) Document on "Data" Sheet6, Sheet 2.

d. Raise the pressure slowly to determine the pressure required to open valve.

(1) Valve should open at 3000 psi plus 200, minus 0 psi.

e. */* Record "As Found" opening pressure on "Data" Sheet 6, Sheet 2.

f. */* Dry off spray tip and raise pressure to within 100 psi of opening pressure and observe tip for dribbling of fuel.

(1) Document on "Data" Sheet 6, Sheet 2.

g. */* Place a clean piece of paper under nozzle tip and check spray pattern for uniform density and a symmetrical pattern.

(1) Note results on "Data" Sheet 6, Sheet 2.

h. Relieve pressure from injector and remove from pop tester.

i. */* Check tip and note on "Data" Sheet 6, Sheet 2 whether any spray tip holes are plugged.

j. */* Analyze the content of any significant buildup of deposits, pay particular attention to any zinc that may be present and note in comments Section on "Data" Sheet 6, Sheet 2. (Commitment 14242)

k. IF the results of Steps c, d and f are satisfactory perform Step 4.8.5.

(1) IF only the result of Step d is unsatisfactory perform Steps 4.8.6.

(2) IF the results of Step c or f are unsatisfactory perform Step 4.8.7.

NOTE

Numbers in parenthesis reference parts shown in Data Sheet 6.

4.8.5 IF the results of Steps 4.8.4c, d and f were satisfactory, clean and inspect spray tips as follows: (Commitment 9002)

a. Secure holder in vise so that the spray tip is up.

b. Remove assembly nut (9) and spray tip (8) without disturbing the rest of the assembly.

c. Soak carboned up spray tips for about 3 hours in Bendix Speedclene or equivalent.

d. Dry and lubricate tip.

e. Ensure correct cleaning needle size is used and clean carbon from orifices.

f. Wipe tip clean of all carbon.

g. Blow out spray tip from orifice end (outside) and then from large center hole end (inside) with clean, dry compressed air.

h. Use a split ring sleeve to hold spray tip by its small outside diameter in a collet or chuck.

CAUTION

Emery cloth or any form of wire brush should not be used to clean spray tips. This will cause bell-mouthing of the orifices and will roughen tip surfaces. A rough surface allows carbon to build up readily. Reference Figure 2.

i. Rotate chuck and polish entire "nose", first with a clean piece of crocus cloth, then with a small piece of hard felt and a little lapping compound (Bendix 11-5325-lapping rouge, yellow, coarse or equivalent).

j. Clean tip and blow it dry from large center hole first, then from orifice end with clean, dry compressed air.

NOTE

A badly worn orifice will have rounded shoulders rather than sharp square one.

k. */* Use a magnifying glass and check the spray tip (See Figure 2)

(1) IF the tip orifices show any signs of wear or enlargement, replace tip.

(2) Document on "Data" Sheet 6, Sheet 2.

l. Install spray tip and assembly nut.

m. */* Torque assembly nut to 350-375 ft-lbs using a 6 point 1-5/8 inch socket wrench.

(1) Record on "Data Sheet 6, Sheet 2.

4.8.6 IF the results of Step 4.8.4d was unsatisfactory, perform the following:

a. Perform Step 4.8.5a through 1. Do not torque assembly nut.

b. Install fuel injector in vase or pop tester with spray tip down.

c. Loosen assembly nut.

d. Carefully remove assembly nut allowing all parts to remain assembled in nut.

NOTE

Each 0.002 inch of shims added or removed varies the opening pressure by approximately 100 psi.

e. IF the opening pressure was low, add shims OR
/ if high, remove shims.

(1) Document on "Data" Sheet 6, Sheet 3, the number of shims added or removed.

f. Reassemble nut on body being careful to guide plate, guide, shims, spring and spring rod into cavity of body.

g. Torque assembly nut to 350-375 ft-lbs using a 6
/ point 1-5/8 inch socket wrench.

(1) Record on "Data" Sheet 6, Sheet 3.

h. Install fuel injector in pop tester.

i. Rapidly actuate pop-tester handle four to six times to allow the needle valve to seat properly.

j. Pump the pressure up to the point where the pressure gage needle falls away quickly. This point is the nozzle valve opening pressure.

k. IF opening pressure is not within 3000 to 3200 psi */* repeat Steps 4.8.6b through j.

(1) IF opening pressure is within 3000 to 3200 psi, record as "Final" value on "Data" Sheet, Sheet 3.

4.8.7 IF the results of Steps 4.8.4c or f were unsatisfactory overhaul the injector per Section 3 of Bendix Maintenance Manual Form L-510-3 which is part of Reference 6.13 or replace injector.

a. Repeat Step 4.8.4 through 4.8.7.

4.8.8 */* Fuel injectors tested.

NOTE

To facilitate the removal of any main bearings, it may be necessary to remove at least one set of piston/connecting rod assemblies adjacent to each of the two main bearings. (Also see Step 4.5.41)

4.9 SUBCOVERS (02-362A), ROCKER ARMS (02-390E, G) AND PUSHRODS (02-390C)

4.9.1 Remove subcovers for any cylinder heads to be removed.

4.9.2 Disconnect 1/4" air start tubing connections external to the subcover.

a. Tag tubing for cylinder location.

b. Protect exposed ends to prevent damage and debris from entering.

4.9.3 Disconnect 3/8" lube oil supply lines at the tee on subcover and the header.

a. Tag lines for location.

b. Protect the ends at the tee and the header.

4.9.4 Remove two cap screws on subcover for the fuel oil supply, recirculation and lube oil header clamps.

a. If all subcovers are to be removed, the fuel oil supply header, fuel oil recirculation header and lube oil header may be removed or must be supported.

NOTE

If fuel oil header is to be removed, perform the following steps. If not, go the Step 4.9.5.

(1) Disconnect 1/4" fuel recirculation line from the injection pump and the header.

(a) Remove the line.

(b) Tag for location.

(c) Protect both ends.

(2) Remove fuel supply line from supply header to fuel injection pump.

(a) Tag for location.

(b) Protect both ends.

(c) Protect fittings on injection pump.

4.9.5 Remove cylinder head cover.

a. Tag for location.

b. Ensure that gaskets are protected to prevent damage.

4.9.6 Remove intermediate, intake and exhaust push rods as follows:

a. Prior to barring of the engine, lubricate the engine main bearings and cylinder liners in accordance with Step 2.17.

b. Ensure all four valves are closed before removing push rods.

c. IF it is not possible to have the valves closed, relieve valve spring tension by adjusting rocker arm adjustment nuts.

d. IF push rods cannot be removed and the engine can not be barred proceed to Step 4.9.9.

e. Place a piece of flat metal or wrench between the tappet adjustment nuts and exhaust rocker webbing.

f. Using a pry bar or equivalent press down on wrench causing exhaust rocker to rotate downward.

g. Lift connector push rod out.

h. Release exhaust rocker arm.

i. Tag push rod for cylinder location.

(1) Protect ends with rags and tape.

j. Rotate intermediate rocker arm and lift exhaust push rod out.

(1) Tag push rod for cylinder location and as "exhaust".

(2) Protect ends with rags and tape.

k. Place a piece of flat metal or wrench between the tappet adjustment nuts and intake rocker webbing.

l. Using a pry bar or equivalent press down on wrench causing intake rocker to rotate downward.

m. Lift intake push rod out.

n. Release intake rocker arm.

o. Tag push rod for cylinder location and as "intake".

(1) Protect ends with rags and tape.

4.9.7 Remove 1/4" pilot line on inside of subcover running to the air start valve.

a. Tag pilot lines for proper location (i.e., fore and aft) and cylinder number.

b. Both ends of tubing should be protected.

4.9.8 Remove eleven socket head cap screws securing subcover to the cylinder head.

4.9.9 Pass lifting slings under rocker arms and connect to overhead hoist.

WARNING

ALL PERSONNEL SHOULD KEEP THEIR HANDS AND FINGERS AWAY FORM PINCH POINTS WHILE LIFTING THE SUB-COVER.

NOTE

Sub-cover should be guided by hand to clear valves and push rods.

4.9.10 Lift subcover from cylinder head.
/

a. List subcovers removed on completion sheet.
/

4.9.11 Tag subcover for proper cylinder location.

4.9.12 Repeat Step 4.9.6 and remove remaining push rods.

a. Tag push rods for cylinder location and type (intake, exhaust).

b. Protect ends with rags and tape.

4.9.13 If desired, remove the six cylinder head cover mounting studs from the subcover, to prevent studs from being damaged.

4.9.14 Inspect any subcovers removed.

a. */* Visually check subcover for evidence of valve guide blow-by (soot). (Commitment 8996)

(1) Record results on "Data" Sheet 7, Sheet 2.

b. Clean and disassemble subcover assembly.

c. */* Perform a visual inspection of the subcover assembly in the web area for indications of cracking.

(1) Record results on "Data" Sheet 7, Sheet 2.

NOTE

The following inspection is only required on subcovers which have the spring pins, discussed in step 4.9.14c, installed and then only if the rocker arm is removed from the subcover, otherwise the inspection is not required.

d. */* Perform a liquid penetrant test (PT) on the top and vertical machined surfaces of the subcover pedestals (connector push rod side only) for signs of cracking at the counterbores. (Commitment 9145)

(1) Subcovers with pedestal cracks that extend through the counterbore web down to the threads should be replaced.

(2) Attach PT inspection report.

e. Remove and discard or verify removed the two 5/16" spring pins installed in the oil passage between the subcover and the intake and exhaust rocker arm shafts. Pins are not to be reinstalled. (See Reference 6.2.7)

4.9.15 Inspect the rocker arm assemblies and push rods on any subcovers removed, (Commitment 9003).

a. Intake and intermediate rocker arm assembly:
/

(1) Visually inspect intake and intermediate rocker arm assembly [C2-390A] push rod cups.

(2) Replace any cups that have linear indications or chipped pieces in the outer lips in accordance with Subsection 4.21 of Procedure 27562-C.

(3) Note any indications on figure of"Data" Sheet 7, Sheet 1.

(4) Document Inspection on "Data" Sheet 7, Sheet 2.

b. Exhaust rocker arm assembly:
/

(1) Visually inspect exhaust rockar arm assembly [02-390B] push rod cups.

(2) Replace any cups that have linear indications or chipped pieces in the outer lip in accordance with Subsection 4.21 of Procedure 27562-C.

(3) Note any indications on figure of "Data" Sheet 7, Sheet 2.

(4) Document inspection on "Data" Sheet 7, Sheet 2.

c. Inspect intake and exhaust push rods [02-390C] as
/ follows:

(1) Visually inspect push rods and ensure that there are no visible cracks.

(2) Document on "Data" Sheet 7, Sheet 2.

(3) If a push rod is replaced, ensure that they are the friction welded type and perform a liquid penetrant test (PT) on the replacement push rod to ensure no surface cracks along the bond line between the rod end and the tube.

(4) Attach P.T. Inspection report.
/

d. */* Inspect connector push rods [02-390D] as follows:

(1) Visually inspect connector push rod and ensure that there are no visible cracks.

(2) Document on "Data" Sheet 7, Sheet 2.

(3) If a connector push rod is replaced, ensure that replacement is the friction welded type and perform a liquid penetrant test (PT) on the replacement push rod to ensure no surface cracks along the bond line between the rod end and the tube.

(4) */* Attach P.T. Inspection report.

NOTE

Step 4.9.15e is not required to be performed unless directed by the Maintenance Supervisor.

e. */* Rocker arm shaft-to-bearing clearances (Commitment 9172):

(1) Visually inspect the rocker arm shaft and bushing.

(2) Measure the inside diameter of rocker arm bushings in the vertical (y-y) and horizontal (x-x) planes, 90° apart.

(a) Measure on both ends one inch from end of bushing.

(3) Measure outside diameter of the rocker arm shaft in the vertical (y-y) and horizontal (x-x) planes, 90° apart.

(a) Measure the exhaust shaft in two places and the intake/intermediate shaft in four places in locations corresponding to those taken for the associated bushing.

(4) Determine maximum shaft-to-bushing clearance at each position.

(5) Record the measurements and clearances on
/ "Data" Sheet 7, Sheet 3 for the following rocker arm assemblies.

(a) Intake rocker arm bushing clearance.

(b) Intermediate rocker arm bushing.

(c) Exhaust rocker arm bushing clearance.

f. Perform the following inspections for the rocker arm cap screws and drive studs (pop rivets or allen screws) [02-390G].

(1) Ensure that rocker arm drive studs (pop
/ rivets or allen screws) are tight and intact. (Commitment 9003)

(a) Document on "Data" Sheet 7, Sheet 2.

(2) Assemble subcover assembly and ensure that
/ proper torque is applied to rocker arm cap screws (365 ft-lbs). (Commitment 9003, 9114)

(a) Document on "Data" Sheet 7, Sheet 3.

g. List Rocker Arms and pushrods inspected on
/ Completion Sheet.

4.9.16 Remove the intake/intermediate rocker arm assemblies on subcovers not removed (to allow removal of all the air start valves).

a. IF the subcover assembly is not to be removed, remove the intake/intermediate rocker arm assembly, for the cylinder for which the air start value is to be removed, as follows:

(1) Remove cylinder head cover.

(a) Tag for location.

(b) Ensure that gaskets are protected to prevent damage.

NOTE

Prior to barring of the engine, lubricate the engine main bearings and cylinder liners in accordance with Step 2.17.

(2) Ensure all four intake and exhaust valves are closed before removing push rods.

(3) IF it is not possible to have the valves closed, relieve valve spring tension by adjusting rocker arm adjustment nuts.

(4) IF push rods cannot be removed and the engine can not be barred proceed to Step (16).

(5) Place a piece of flat metal or wrench between the tappet adjustment nuts and exhaust rocker webbing.

(6) Using a pry bar or equivalent press down on wrench causing exhaust rocker to rotate downward.

(7) Lift connector push rod out.

(8) Release exhaust rocker arm.

(9) Tag push rod for cylinder location.

(a) Protect ends with rags and tape.

(10) Rotate intermediate rocker arm and lift exhaust push rod out.

(a) Tag push rod for cylinder location and as "exhaust".

(b) Protect ends with rags and tape.

(11) Place a piece of flat metal or wrench between the tappet adjustment nuts and intake rocker webbing.

(12) Using a pry bar or equivalent press down on wrench causing intake rocker to rotate downward.

(13) Lift intake push rod out.

(14) Release intake rocker arm.

(15) Tag push rod for cylinder location and as "intake".

(a) Protect ends with rags and tape.

(16) Remove the two intake/intermediate rocker arm cap screws.

(17) Pass lifting sling under intake/intermediate rocker arm assembly and connect to overhead hoist.

(18) Lift intake/intermediate rocker arm assembly from subcover.

(a) Tag Rocker Arms for proper cylinder alignment.

(19) Remove remaining push rods.

(a) Tag pushrods for cylinder location and type (intake, exhaust).

(b) Protect ends with rags and tape.

(20) Remove 1/4" pilot line on inside of subcover running to the air start valve.

(a) Tag pilot lines for proper location (i.e., fore and aft) and cylinder number.

(b) Both ends of tubing should be protected.

4.9.17 */* Inspect the intake/intermediate rocker arm assemblies and push rods per Step 4.9.15 (except for Step 4.9.15f (2)). (Commitment 9003)

4.10 AIR START VALVES (02-359)

4.10.1 Remove all air start valves.

a. Remove the two cap screws securing the air start valve to cylinder head.

b. Remove air start valve.

(1) Tag for proper location.

(2) Cover hole in head with rags.

4.10.2 */* Inspect air start valves. (Commitment 8989).

NOTE

Numbers in parenthesis reference parts shown in Figure 8.

a. Disassemble the air start valve as follows:

(1) Remove cap (21) and Piston assembly (13) from air start valve.

(2) Remove roll pin (12) from threaded end of valve to allow removal of nut (11).

CAUTION

Spring is under compression.

(3) Using a spanner wrench on face of valve to prevent valve from turning, remove the slotted nut (11) from valve stem.

(4) Remove spring washer (24), spring (25), spacer (26) and retaining washer (23).

(5) Slide valve (2) out of housing (1), and remove upper guide (3), spacer (10) and lower guide (4).

(6) Remove upper O-ring (18), lower O-ring (22) and copper gasket (17) from housing.

b. Check air start valve as follows:

(1) Clean all parts.

(2) */* Measure inside diameter of cap in the vertical (y-y) and horizontal (x-x) planes, 90° apart approximately one inch from top.

(a) Record on "Data" Sheet 8, Sheet 2.

(3) */* Measure outside diameter of piston in the vertical (y-y) and horizontal (x-x) planes, 90° apart approximately one inch from top.

(a) Record on "Data" Sheet 8, Sheet 2.

(4) */* Determine Maximum cap-to-piston clearance from the readings taken in (2) and (3) above. Clearance should be 0.001 to 0.003 inch when new. Replace components when clearance exceeds 0.009.

(a) Record on "Data" Sheet 8, Sheet 2.

(5) */* Visually check the following components for signs of obvious wear, for corrosion and document on "Data" Sheet 8, Sheet 2.

(a) Valve steam

(b) Lower guide inside diameter, outside diameter and rings

(c) Upper guide inside and outside diameter

(d) Cap inside diameter

(e) Piston outside diameter

(f) Housing inside diameter

(6) */* Visually check valve and seat for pitting.

(a) Document on "Data" Sheet 8, Sheet 3.

(7) Lap the valve and seat to polish seating surfaces.

(8) */* Blue the valve to check for valve or seat imperfections.

(a) Document results on "Data" Sheet 8, Sheet 3.

c. Reassemble air start valve as follows:
/

(1) Coat all surfaces with a light coat of engine oil prior to reassembly.

(2) Install lower guide (4) with rings installed, spacer (10) and upper guide (3) on valve stem.

(3) Insert valve into housing ensuring that the ring gaps on lower guide are 180° apart.

(4) From topside of valve, install spacer (26), retaining washer (23) and spring (25) on valve stem.

(5) Place spring washer (24) on top of spring and compress spring sufficiently to allow engagement of slotted nut (11) on valve stem.

(6) Use a spanner wrench on valve head to prevent valve from turning. Tighten nut until the valve, guides and spacers become solid.

(7) Advance nut until roll pin hole aligns with next slot.

(8) Install roll pin (12).

(9) Install piston (13) in cap (21).

(10) Place cap on valve assembly and temporarily secure with wire or tie wraps until ready for installation.

4.11 CYLINDER HEADS (02-360A), CYLINDER HEAD VALVES (02-360B)

4.11.1 IF any cylinder heads are to be removed, perform as follows. (Remove at least two cylinders head if it was determined in Step 4.5.4b that 490 equivalent engine hours at 100% load has been exceeded since last block top inspection. Also see Step 4.5.4l):

a. Disconnect intake elbow by removing six cap screws on cylinder head and eight cap screws on manifold.

(1) Remove intake elbow and tag.

(2) All cap screws for elbows should be bagged and labeled as to location.

NOTE

Blank flanges may be made from plywood, sized to cover the hole.

b. Install blank flange on air intake manifold to prevent debris from entering.

c. Disconnect air start line by removing 4 cap screws and Dresser coupling.

(1) Remove and tag for proper location.

(2) Protect ends from damage and to prevent debris entering.

d. Disconnect jacket water cooling piping by removing four cap screws and Dresser coupling.

(1) Remove line and tag for proper location.

(2) Protect ends from damage or from debris entering.

e. Disconnect exhaust elbow by removing four cap screws.

f. Remove the four cylinder head nut covers.

g. Install reaction post on injector studs and torque to 80 ft-lbs, if reaction post required.

h. Using a Muntz PT-7, or equivalent, power wrench remove the head nuts in a crisscross pattern. (See Figure 3)

i. Remove cylinder head nuts and washers.

j. Remove reaction post.

k. Attach cylinder head lifting fixture as shown in Figure 4.

l. Torque lifting fixture nuts to 80 ft-lbs.

m. Attach to overhead hoist and lift head from */* cylinder block. List cylinder heads removed on Completion Sheet.

n. Tag head as to original location and record */* foundry number and casting date from side of head on "Data" Sheet 9, Sheet 1.

o. Ensure that grommets are removed, tagged and saved for reassembly.

p. Cover cylinder bore with plywood covers.

q. Protect cylinder head studs with caps OR studs may be removed if desired.

r. Prior to barring of the engine, lubricate the engine main bearings and cylinder liners in accordance with Step 2.17.

s. Bar engine over until piston is at bottom dead center.

(1) Clean upper portion of cylinder bore.

(2) Clean carbon from cylinder liner using solvent and flexible blade putty knives if necessary.

t. Clean gasket surfaces of engine block and cylinder head.

NOTE

Steps 4.11.2a, b, and c are not to be performed unless directed by the Maintenance Supervisor.

4.11.2 Inspect cylinder heads removed.

x
a. Measure valve to guide clearance as follows: (Commitment 9367):

(1) Remove wedges, retainers and springs.

(2) Lay cylinder head on its side with valve axis in horizontal plane.

(3) Leave a wedge on valve stem and push valve out until stopped by wedge hitting guide.

(4) Position a dial indicator as shown in figure on "Data" Sheet 9, Sheet 3 so that spindle of indicator is bearing against side of valve head on the A-A axis.

(5) Zero the indicator, then apply sufficient pressure by hand at a point diametrically opposite the spindle to move the valve in the guide.

(6) Record deflection on "Data" Sheet 9, Sheet 3.
/

(7) Repeat above process in the B-B axis, record
/ on Data Sheet 9, Sheet 3.

b. Measure valve head thickness as follows: (Commitment 9367)

(1) Remove valves from head.

(2) Measure valve head thickness as shown in Figure on "Data" Sheet 9, Sheet 3.

(3) Record above measurement on "Data" Sheet 9,
/ Sheet 4.

c. Visually check intake and exhaust valve, discs,
/ stems and seats for the following: (Commitment 9367)

(1) Wire drawing,

(2) Pitting,

(3) Distortion,

(4) Concentricity,

(5) Any other abnormal condition.

(6) Record results on "Data" Sheet 9, Sheet 4.

d. Visually check valve springs [02-360D] as follows (document on "Data" Sheet 9, Sheet 4):

(1) Ensure no cracks in springs.
/

(2) Ensure that springs are proper type (i.e., No
/ gray springs with brown stripes or black springs with a white stripe). (Commitment 11075)

e. Visually check cylinder head combustion surfaces,
/ valve seats (not required unless head disassembled) and gasket surfaces (document on "Data" Sheet 9, Sheet 2). (Commitment 8991)

f. For any replacement heads ensure the following tests have been satisfactorily completed. (Attach NDE inspection reports.)

(1) Perform a liquid penetrant test (PT) of the
/ valve seating surfaces.

(a) No cracks allowed in the seating surface.

(b) Pin holes that do not exceed 1/32" diameter numbering 3 or less in one surface and not closer than 1/8" to each other, are acceptable.

(2) Perform a magnetic particle test (MT) on the
/ fire deck area excluding the valve seating area. See Acceptance Criteria 5.3.

(3) Determine the thickness of the fire deck area
/ by performing an Ultrasonic Test (UT) at six locations, see Figure 5. Nominal fire deck thickness is 0.500": minimum thickness is 0.400".

(4) Perform a liquid penetrant test (PT) on the
/ blended radius between the valve head and valve stem of the intake and exhaust valves. No cracks allowed at the blended radius.

(5) Ensure that the cylinder head has not had a
/ through wall weld repair in the area of the injector port (repairs made prior to October, 1984). Document on "Data" Sheet 9, Sheet 2.

g. Reassemble cylinder head, installing all wedges,
/ retainers and springs if head disassembled.

4.12 FUEL INJECTION PUMP (02-365A)

4.12.1 Remove at least one fuel oil injection pump to be used as a representative sample.

a. IF review of data of Step 4.5.4h indicates a possible problem with a pump(s), use that pump for sample.

b. Do not select pump previously inspected unless operating data dictates need for inspection.

c. IF this is the case, select at least one additional pump not previously inspected.

4.12.2 Remove pump(s) as follows:

a. Disconnect 1/4" fuel recirculation line from the injector pump and the header.

(1) Remove the line.

(2) Tag for location.

(3) Protect both ends.

b. Remove fuel supply line from supply header to fuel injection pump.

(1) Tag for location.

(2) Protect both ends.

c. Protect fittings on the injection pump.

d. Remove cover for timing window on side of pump to check position of pump.

e. IF engine is barred during fuel pump removal, lubricate the engine main bearings and cylinder liners in accordance with Step 2.17.

f. Position piston at TDC to relieve pump spring pressure.

g. Remove cap screw at pump arm and allow connecting arm to drop.

h. Remove four nuts on pump base in a crisscross pattern to allow spring pressure to be slowly released.

i. Pull pump and tag for location.

/

(1) Record serial number on "Data" Sheet 10, Sheet 1.

j. Replace timing window cover and store pump.

k. IF pump shims are removed, wire together and tag for cylinder location.

l. Remove pin-and-deflector from the top of fuel tappet assembly and tag for proper location.

m. Cover opening in pump base assembly with plywood or metal cover and secure in place.

4.12.3 Disassemble, the fuel injection pump(s) removed. (Commitment 9169).

NOTE

Figure 6 is a sectional drawing of injection pump.

a. Place pump in a soft jaw holding device.

b. Remove bleed screw, gasket, pressure screws and copper gasket from pump housing.

c. Remove timing window cover if necessary.

d. Invert pump and using Compression Tool, press down plunger follower and insert a 1/8 inch diameter pin in the hole in pump flange.

e. Remove lock ring, again press follower down, and remove pin.

f. Remove plunger follower.

g. Remove lower spring plate from plunger and carefully remove plunger from barrel.

h. Carefully submerge plunger in spindle oil.

NOTE

A fabricated puller may be used as shown in Figure 7.

i. Remove plunger spring, control sleeve, and upper spring plate.

j. Secure pump in holding device in upright position.

k. Loosen and remove flange screws, flange and delivery valve holder.

CAUTIONS

a. When handling either the the delivery valve holder or delivery valve assembly parts, extreme care should be taken to prevent damaging their precision lapped surfaces.

b. The parts of delivery valve assembly are mated. DO NOT mix the parts of various assemblies.

l. Remove delivery valve spring, delivery valve stop and valve of delivery valve assembly.

m. Remove pre-formed packing.

n. Using Delivery Valve Puller, remove delivery valve from assembly body.

o. Operate Puller as follows:

(1) Turn four-pronged knob of the 11-5735 Puller to extreme end of threaded shaft and raise U-shaped support up against knob.

NOTE

Top of brass bushing has a scribe mark on its top surface and one end of U-shaped support also has a scribe mark. During installation, these marks should be on opposite sides.

(2) Lower shaft thru valve chamber and bushing into valve chamber.

(3) Rotate bushing 180° to bring its scribe mark to same side as scribe mark on support.

(4) Rotate knob until delivery valve body is free and remove puller.

p. Remove barrel locating screw and washer.

q. Remove barrel from pump and submerge in spindle oil.

r. Remove control rack locating screw, washer and control rack.

4.12.4 FUEL INJECTION PUMP CHECKOUT

a. Pressure Screw (Refer to Figure 8).

(1) Replace any standard pressure screw showing signs of erosion to a depth of 0.020 inch below original surface. (Commitment 9169)

(2) IF pump utilizes a carbide insert pressure screw, do not replace screw until erosion reaches a depth of 0.100 inch below original surface.

b. Delivery Valve Holder Assembly

(1) Carefully examine flat lapped surface of delivery valve holder for nicks, scratches, corrosion or other contamination.

(2) Repair or replace as necessary.

c. Delivery Valve Assembly

(1) Carefully examine each side of delivery valve body for nicks, scratches, corrosion or other contamination.

(2) Repair or replace as necessary.

(3) Minor blemishes may be removed by lightly lapping with 11-5325 Yellow Rouge or similar product.

d. Barrel

(1) Carefully examine barrel for nickr, scratches, corrosion or other contamination.

(2) Check port openings on inside of barrel for chipping.

(3) IF chipping exists on either top or bottom of ports, discard plunger and barrel assembly.

(4) Slight chipping on sides of ports is acceptable.

(5) Repair or replace as necessary.

e. Plunger follower

(1) Check plunger follower for wear at points of engine tappet and plunger contact.

(2) In time a depression will wear in follower surface. This depression should not exceed a total depth of 0.015 inch.

(3) Repair or replace as necessary.

f. Plunger

(1) Check plunger button thickness as shown in Figure 9. Minimum thickness should not be less than 0.302 inch.

(2) Pitting or erosion of plunger is permissible if eroded area is not too close to upper or leading edge of metering helix.

(3) Discard any plunger with severe erosion approaching helix as shown on plunger A, Figure 10.

(4) IF plunger and barrel assembly are replaced, re-calibrate pump.

g. Springs

(1) Check for breaks, cracks or severe rust.

(2) Replace as necessary.

h. Control Sleeve

(1) Check teeth for signs of excessive wear.

(2) Repair or replace as necessary.

i. Control Rack

(1) Check teeth and guide surfaces for signs of excessive wear.

(2) Repair or replace as necessary.

j. Housing

(1) Check passage which contains control rack for wear.

(2) Repair or replace as necessary.

k. Delivery Valve Guide or Stop

(1) Check for signs of wear.

(2) Replace as necessary.

l. Flat Lapped Surfaces

(1) Check for flatness using a monochromatic light and optical flats.

(2) Flat lapped surfaces should be flat within two light bands.

(3) Repair or replace as necessary

4.12.5 FUEL INJECTION PUMP REASSEMBLY

a. Secure pump housing vertically.

b. Position control rack in housing so teeth face toward center of pump.

c. Install lock washer and control rack locating screw and ensure that screw enters rack locating groove.

d. Insert barrel in pump housing and check to assure that locating groove is aligned with locating screw hole.

e. Install lock washer and locating screw.

f. Check to see that barrel is free to move vertically.

g. Invert pump.

NOTE

When installing control sleeve, internal pump timing is involved.

h. Install sleeve so tooth directly under timing groove meshes between the two teeth that are indicated by timing dot on control rac..

i. Position upper spring plate and plunger spring.

j. Carefully start plunger into barrel.

NOTE

Step 4.12.5k will properly locate metering helix with relation to spill ports.

k. Turn plunger so that marked end of crossbar will go into control sleeve slot that has a mark adjacent to it.

l. Check backlash between plunger, control sleeve and control rack.

(1) To check backlash, hold plunger steady while attempting to move control rack back and forth. Backlash should not exceed 0.020 inch.

m. Replace worst worn parts until backlash is less than 0.020 inch.

n. Position lower spring plate on end of plunger.

o. Align plunger crossbar with slots in control sleeve.

p. Fit plunger follower into housing.

q. Using compression tool or other suitable method, press follower down and insert pin in hole in housing flange to hold follower.

(1) IF follower will not push down far enough, it indicates that plunger crossbar did not enter control sleeve slots.

r. Install lock ring so that its opening is about 3/4 inch from removal groove.

u. Release follower by pressing it down and removing pin.

t. Install delivery valve assembly in pump housing.

u. Lubricate and install pre-formed packing.

v. Install delivery valve spring and delivery valve stop.

w. Place delivery valve holder and delivery valve flange on pump being sure to pilot spring and stop correctly in cavity of delivery valve holder.

x. Lubricate screws with lubricating oil and assemble flange to housing, finger tight.

y. Gradually tighten delivery flange screws to 20 to 25 ft-lbs in sequence shown in Figure 11.

z. Finish tightening screws to 47 to 53 ft-lbs in
/ same sequence. Document on "Data" Sheet 10, Sheet 2.

aa. Install pressure screw and copper gasket in proper outlet of housing.

bb. Install bleed screw and gasket.

cc. Install timing window gasket, cover, securing screws and washers.

dd. Fuel injection pumps inspected.
/

4.12.6 IF abnormal wear or damage is found in pump(s) inspected, choose at least two other pumps for inspections.

a. IF wear or damage is found in either of the two additional pumps, inspect all pumps per Steps 4.12.3 through 4.12.5. (Commitment 9169)

4.13 CAMSHAFT (02-350A) AND TAPPET ASSEMBLIES (02-345A, B)

NOTE

Steps 4.13.1, 4.13.2, and 4.13.3 are not required if inspections were performed at EOC1.

4.13.1 Inspect all cams as follows. (Commitment 9179):

a. Remove covers over right an/or left bank cam shafts.

b. Check cams [02-350] as follows (Document on
/ "Data" Sheet 11, Sheet 1):

(1) Visually check cam lobe surfaces for signs of cracking, pitting or spalling. (Commitment 9179)

(a) Any signs of cracking, pitting or spalling should be evaluated by Engineering. Signs of spalling should result in immediate replacement of the cam.

NOTES

a. Cams and camshafts are match-marked during manufacturer.

b. Circumferential marks locate the cams longitudinally.

c. Longitudinal marks locate the cams circumferentially.

d. Cams have a scribe mark on the side of the cam which passes through the center of the hole in the side of the cam.

e. Fuel cams may not align exactly with marks on cam shaft due to fact that they have been set in the field to achieve correct fuel timing.

(2) Ensure that cams are located properly on the camshafts.

4.13.2 Check all intake and exhaust tappet assemblies as follows and document on "Data" Sheet 11, Sheet 1 (Commitment 9356):

a. Visually check tappet roller assemblies.
/

b. Ensure that cam rollers are free to rotate.
/ (Commitment 9356)

c. Measure tappet roller clearances by unloading
/ tappets, positioning dial indicator to measure tappet travel, inserting pry bar (taking care not to damage roller) between tappet roller and tappet (see Figure 12), exerting slight upward force on tappet while maintaining roller against cam. (Commitment 9356)

(1) Record amount of tappet movement on "Data" Sheet 11, Sheet 1.

(2) If movement exceeds 0.012 inch, roller should be disassembled and individual roller-to-roller bushing, roller bushing-to-pin bushing and pin bushing-to-pin clearances measured and compared to Appendix III of Reference 6.1.1.

4.13.3 */* For any fuel tappets that have the fuel injection pump removed, check assemblies per Step 4.13.3. (Commitment 9356)

4.13.4 Check camshaft thrust clearance as follows, if accessible (ie. if doors are removed for other inspections):

a. Insert a pry bar in a position that will force the camshaft toward the rear.

b. */* Measure thrust clearance with a dial indicator. Record clearance on "Data" Sheet 12, Sheet 1.

4.13.5 */* Replace cam covers and torque bolts in accordance with Table 1.

4.14 GOVERNOR DRIVE (02-411A), GOVERNOR DRIVE COUPLING (02-411B), GOVERNOR (02-415A)

NOTE

Visual inspection of governor drive and shaft is required for engines which had less than 750 hours at initial inspection. (Reference 4.14.2a and b.)

4.14.1 Remove or verify removed the governor and governor drive housing as follows:

a. Remove or disconnect the extensible link and fuel rack actuator arm from governor.

(1) Tag and store.

b. Disconnect the electrical cable from the governor.

(1) Protect end of cable.

c. Disconnect the jacket water supply and return lines from the governor cooler.

(1) Protect both ends of tubing.

(2) Tag for location.

d. Drain the oil from the governor.

e. Disconnect the tubing between the governor and the booster servo mounted on the governor drive housing.

(1) Tag for location.

(2) Protect both ends of tubing.

f. Disconnect the air tubing from the booster servo.

(1) Protect end of tubing.

g. Remove the booster servo from the governor drive housing.

(1) Cap the oil line connection to prevent the oil from spilling out.

(2) Plug the air line connection.

h. Remove the governor drive coupling inspection plate.

i. Remove the 4 cap screws from the governor base.

j. Lift the governor off of the governor drive housing.

(1) Store the governor upright on blocks to prevent damaging governor drive shaft.

k. Replace inspection plate and cover hole in top of governor drive housing with tape unless housing is to be removed.

l. IF required, remove governor drive housing from gear case as follows:

(1) Remove three cap screws from the inserts of the flexible element of the drive coupling securing it to the lower coupling hub.

(2) Remove the governor coupling and drive coupling assembly from the governor drive housing.

(3) Remove the cap screws securing the governor drive housing to the gear case and remove governor housing.

(4) Cover opening in gear case.

4.14.2 Inspect governor drive and housing as follows (Commitment 9011 and 9009):

NOTE

Figure 13 identifies parts.

a. Remove the governor drive assembly as follows:

(1) */* Check governor driver-to-idler gear and governor drive-to-driven gear backlash in accordance with Procedure 27592-C.

(a) Bushing should be replaced if backlash exceeds 0.012 inch.

(2) Disconnect the governor drive lube oil supply tubing.

(3) Remove the lube oil spray tubing to the governor drive gear-to-driven gear.

(4) Remove the six cap screws securing the governor drive bracket to the crankcase.

(5) Remove the governor drive assembly from the gear case.

(6) Clean the governor drive assembly.

b. Disassemble and inspect the governor drive as follows:

(1) Measure the governor drive horizontal shaft end play by placing a dial indicator on gear or shaft and manually moving the shaft axially.

(2) */* Record the "As Found" reading on "Data" Sheet 13, Sheet 2.

(a) End play should be 0.005 to 0.003 inch when new.

(b) Bushing should be replaced when end play exceeds 0.010 inch.

(3) Measure the governor driven vertical shaft end play by placing a dial indicator on gear or shaft and manually moving the shaft axially.

(4) */* Record the "As Found" reading on "Data" Sheet 13, Sheet 2.

(a) End play should be 0.005 to 0.003 inch when new.

(b) Bushing should be replaced when end play exceeds 0.010 inch.

(5) Remove the taper pin from the governor drive gear (the smaller of the two gears on the horizontal shaft).

(6) Remove the governor drive gear and key from the horizontal shaft.

(7) Remove the horizontal shaft from the bushing.

(8) */* Visually check the shaft, gears and bushing.

(a) Document on "Data" Sheet 13, Sheet 2. (Commitment 9009)

(9) Measure the shaft-to-bushing clearances.

(a) Measure the inside diameter of bushing in the vertical (y-y) and horizontal (x-x) planes, 90° apart.

(b) Measure on both ends 1/2 to 1 inch from end of bushing.

(10) Measure outside diameter of the shaft in the vertical (y-y) and horizontal (x-x) planes, 90° apart in two places in locations corresponding to those taken for the bushing.

(a) Determine maximum shaft-to-bushing clearance at each position.

(11) */* Record the measurement and clearances on "Data" Sheet 13, Sheet 2. (See Step 4.14.2g(5))

(12) Remove the taper pin from the governor driven gear (on vertical shaft).

(13) Remove the governor driven gear and key from the vertical shaft.

(14) Remove the vertical shaft from the bushing.

(15) */* Visually check the shaft, gear and bushing.

(a) Document on "Data" Sheet 13, Sheet 2.

(16) Measure the shaft-to-bushing clearances in accordance with Step (9) and (10).

(17) */* Record the measure and clearances on "Data" Sheet 13, Sheet 2. (See Step 4.14.2a(1))

c. */* Check the vertical shaft flexible coupling as follows: (Commitment 9011)

(1) Check coupling lower hub for tightness on vertical shaft.

(a) IF hub is loose perform Step 4.14.2d.

(2) Check coupling upper hub for tightness on governor coupling adapter.

(a) IF hub is loose perform Step 4.14.2e.

(3) IF neither upper or lower hub is loose proceed to Step 4.14.2f.

d. */* IF the coupling lower hub is loose or a new coupling lower hub is to be installed, perform the following:

(1) Remove setscrew in hub.

(2) Remove hub and key.

(3) Clean lower hub, key and vertical shaft.

(4) Check mating surfaces of hub, key and shaft.

(5) Prepare mating surfaces of hub, key, setscrew and shaft with Loctite Safety Solvent No. 745 or equivalent.

(6) Coat mating surfaces of shaft, hub and key with Loctite 609. (Commitment 9011)

(7) Install hub and key on shaft.

(8) Align top of hub flush with top of vertical shaft.

(9) Install setscrew with Loctite 609.

e. */* IF the coupling upper hub is loose or a new coupling upper hub is to be installed, perform the following:

(1) Remove flexible element from hub by removing the three cap screws.

(2) Remove setscrew in hub.

(3) Remove hub and key.

(4) Clean upper hub, key and governor coupling adaptor.

(5) Check mating surfaces of hub, key and governor coupling adaptor.

(6) Prepare mating surfaces of hub, key, setscrew and governor coupling adaptor with Loctite Safety Solvent No. 745 or equivalent.

(7) Coat mating surfaces of governor coupling adaptor, hub and key with Loctite 609. (Commitment 9011)

(8) Install hub and key on governor coupling adaptor.

(9) Insert governor coupling adaptor through hub until the end of the adaptor extends 15/16 inch past hub face.

(10) Install setscrew with Loctite 609.

f. Assemble the governor drive as follows:

(1) Clean horizontal shaft and bushings.

(2) Coat shaft and bushing with engine oil.

(3) Insert shaft into bushing.

(4) Install gear and key on shaft.

(5) Install taper pin in gear with Loctite 609 and stake in two places. (Commitment 9011)

(6) Repeat Step 4.14.2b(1).

(7) Record as "Final" reading on "Data" Sheet 13, */* Sheet 2.

(a) End play should be 0.005 to 0.003 inch when new.

(b) Bushings should be replaced when end play exceeds 0.010 inch.

(8) Clean vertical shaft and bushings.

(9) Coat shaft and bushing with engine oil.

(10) Insert shaft into bushing.

(11) Install gear and key on shaft.

(12) Install taper pin in gear with Loctite 609 and stake in two places. (Commitment 9011)

(13) Repeat Step 4.14.2b(3).

(14) Record as "Final" reading on "Data" Sheet 13, */* Sheet 2.

(a) End play should be 0.005 to 0.003 inch when new.

(b) Bushings should be replaced when end play exceeds 0.010 inch.

g. Install the governor drive as follows:

(1) Ensure mating surfaces of governor drive and crankcase are clean.

(2) Install the governor drive to the crankcase aligning with the existing dowels.

(3) */* Attach with the six cap screws and locking tabs.

(4) */* Torque cap screws to 30 ft-lbs.

(a) Bend lock tabs to secure cap screws.

(b) Record on "Data" Sheet 13, Sheet 3.

(5) */* Check governor drive-to-idler gear and governor drive-to-driven gear backlash in accordance with Procedure 27592-C.

(a) Bushings should be replaced if backlash exceeds 0.012 inch.

(6) Install the lube oil spray tubing to the governor drive gear-to-driven gear.

(7) Connect the governor drive lube oil supply tubing.

h. Install the governor drive housing as follows:

(1) Ensure mating surfaces of governor drive housing and gear case are clean.

(2) Install the governor drive housing to the gear case.

(3) Align with the existing dowels.

(4) Attach with the twelve cap screws.

(5) Torque cap screws to 30 ft-lbs.
/

(a) Record on "Data" Sheet 13, Sheet 3.

i. Check the angular alignment of the governor adaptor plate to the governor drive as follows:

(1) If the adaptor plate has been removed:

(a) Ensure mating surfaces of adaptor plate and governor drive housing are clean.

(b) Install adaptor plate to governor drive housing.

(c) Align with existing dowels.

(d) Attach with the four cap screws.

(e) Torque cap screws to 30 ft-lbs and
/ record on "Data" Sheet 13, Sheet 3.

(2) Clamp a dial indicator to the lower hub of the vertical shaft coupling with the dial indicator button contacting the top face of the adaptor plate at a 2-1/2" radius.

(3) Prior to barring of the engine, lubricate the engine main bearings and cylinder liners in accordance with Step 2.17.

(4) Bar the engine over to sweep the adaptor plate mounting face.

(a) Total indicated runout (TIR) should not exceed 0.087 inches.

(b) The 0.087 inch TIR is based on a 1° misalignment with a 2-1/2" radius dial indicator sweep.

(5) */* Record "As Found" TIR on "Data" Sheet 13, Sheet 4.

(6) IF the angular alignment is greater than 0.087 inch (1°) the cause of the misalignment must be determined and corrected and then repeat Steps 4.14.2i(2), (3), (4) and (6).

(7) */* Record "Final TIR" on "Data" Sheet 13, Sheet 4.

j. Check the axial alignment of the governor adaptor plate to the governor drive as follows:

(1) Clamp a dial indicator to the lower hub of the vertical shaft coupling with the dial indicator button contacting the pilot diameter of the adaptor plate.

(2) Bar the engine over to sweep the inside diameter of the adaptor plate.

(a) Total indicated runout (TIR) should not exceed 0.029 inches.

(3) */* Record the "As Found" TIR on "Data" Sheet 13, Sheet 4.

(4) IF TIR is greater than 0.029 inches, remove dowels from adaptor plate, loosen bolts and adjust to obtain an offset less than 0.014 inches (offset is equal to 1/2 TIR).

(5) */* Torque bolts to 30 ft-lbs and re-dowel adaptor plate if moved in Step 4.14.2j(4).

(a) Record on "Data" Sheet 13, Sheet 3.

(6) IF adaptor plate was moved in Step 4.14.2j(4), repeat Steps 4.14.2j(1), (2), (4), (5) and (6).

(7) */* Record Final TIR on "Data" Sheet 13, Sheet 4.

4.15 OVERSPEED GOVERNOR AND ACCESSORY DRIVE (02-410B) AND OVERSPEED TRIP DRIVE COUPLING (02-410C)

4.15.1 Remove or verify removed the overspeed governor drive assembly as follows:

a. Remove fuel oil booster pump suction and discharge tubing.

(1) Tag for location.

(2) Protect both ends.

b. Disconnect magnetic pickup wiring (two circuits) from overspeed governor drive assembly.

c. Disconnect the pneumatic tubing from the overspeed trip valves.

(1) Protect end of tubing.

d. Disconnect lube oil supply and drain tubing from overspeed governor.

(1) Protect ends of tubing.

e. Remove the 2 inch lube oil line (lube oil supply to turbocharger and rocker arm header) to allow removal of accessory drive assembly.

(1) Tag for location.

(2) Protect ends of line.

(3) Place blind flanges on the flanges, where line was removed.

NOTE

Overspeed governor assembly and adaptor plate must be removed as an assembly since coupling will not fit through the opening in the adaptor plate.

f. */* Remove overspeed governor assembly, fuel oil booster pump and adaptor plate as an assembly from the gear case.

g. Cover opening in gear case.

4.15.2 */* Remove the accessory drive assembly as follows: (Commitment 9006, 9183):

a. Disconnect the lube oil tubing from the accessory drive assembly.

b. Remove the four cap screws securing the accessory drive bracket to the cylinder block.

c. Remove the accessory drive assembly from the gear case.

d. Clean accessory drive assembly.

4.15.3 Disassemble and check the accessory drive as follows: (Commitment 9006, 9183)

a. Remove the taper pin and setscrew from the accessory drive coupling.

b. Check that coupling is tight on shaft.

c. Remove the coupling and key from shaft.

d. Measure the accessory drive shaft end play by placing a dial indicator on gear or shaft and manually moving the shaft axially.

e. */* Record the "As Found" reading on "Data" Sheet 14, Sheet 2.

(1) The end play should be 0.010 to 0.008 when new.

(2) Bushings should be replaced when end play exceeds 0.020 inch.

f. Remove the groove pin from the thrust collar.

g. Remove the thrust collar from the shaft.

h. Mark the thrust collar for correct orientation on reassembly.

i. Remove the shaft from the bushing.

j. */* Visually check the shaft, gear and bushings.

(1) Document on "Data" Sheet 14, Sheet 2.

k. Measure the shaft-to-bushing clearances on both ends one inch from end of bushing. Measure the inside diameter of bushing in the vertical (y-y) and horizontal (x-x) planes, 90° apart.

l. Measure outside diameter of the shaft two places in locations corresponding to those taken for the bushing in the vertical (y-y) and horizontal (x-x) planes, 90° apart.

m. Determin maximum shaft-to-bushing clearance at each position.

n. */* Record the measurements and clearances on Data Sheet 14, Sheet 2.

(1) Clearances should be 0.004/0.001 inch when new.

(2) Bushings should be replaced when clearance exceeds 0.008 inch.

4.15.4 Reassembly the accessory drive as follows:

a. Clean shaft and bushing.

b. Coat shaft and bushing with engine oil.

c. Insert shaft into bushing.

d. Install thrust collar on shaft, ensuring collar is installed as removed, and install groove pin, staking in two places.

e. Repeat Step 4.15.3c.

f. */* Record final reading on "Data" Sheet 14, Sheet 2.

(1) The end play should be 0.010 to 0.008 when new.

(2) Bushings should be replaced when end play exceeds 0.020 inch.

g. Clean the accessory drive coupling, key and shaft.

h. Check mating surfaces of coupling, key and shaft.

i. Measure outside diameter of shaft and inside diameter of coupling.

(1) Interference fit should be below 0.0005 inch, if interference fit exists.

j. Prepare mating surfaces of coupling, key, taper pin, setscrew and shaft with Loctite Safety Solvent No. 745 or equivalent.

k. Coat mating surfaces of shaft, coupling and key with Loctite 609.

l. Install coupling and key on shaft.

m. Coat taper pin with Loctite 609, install and stake in two places.

n. Install setscrew with Loctite 609.

4.15.5 */* Install accessory drive assembly as follows:

a. Ensure both mating surfaces are clean.

b. Install the accessory drive to the cylinder block.

c. Align with the existing dowels.

d. Attach with four cap screws and locking tabs.

e. */* Torque cap screws to 30 ft-lbs and bend lock tabs to secure cap screws.

(1) Record on "Data" Sheet 14, Sheet 2.

f. Check gear backlash in accordance with Procedure 27592-C.

g. Connect the lube oil tubing to the accessory drive assembly.

4.15.6 Remove the overspeed governor drive from the adaptor plate as follows (Commitment 9183):

a. Remove the coupling shield from the backside of the adaptor plate.

b. Remove the taper pin from the overspeed governor drive coupling.

c. Check that coupling is tight on shaft.

d. Remove the coupling and key from the shaft.

e. Remove the overspeed governor drive from the adaptor plate.

f. */* Remove inspection plug from overspeed governor drive and check visually and with a magnet for the presence of magnetic particles inside of the drive. (Commitment 9006)

(1) Document "Data" Sheet 14, Sheet 2.

4.15.7 Check the angular alignment of the adaptor plate to the accessory drive as follows:

a. Install the adaptor plate on the gear case.

b. Torque the cap screws to 30 ft-lbs.

c. Clamp a dial indicator to the accessory drive coupling with the dial indicator button contacting the mounting face of the adaptor plate at a 2-1/2" radius.

d. Prior to barring of the engine, lubricate the engine main bearings and cylinder liners in accordance with Step 2.17.

e. Bar the engine over to sweep the adaptor plate mounting face.

(1) Total indicated runout (TIR) should not exceed 0.006 inches.

f. */* Record "As Found" TIR on "Data" Sheet 14, Sheet 3.

g. IF the angular alignment is greater than 0.006 inches the cause of the misalignment must be determined and corrected and then repeat Steps 4.15.7c, d, e and g.

h. */* Record Final TIR on "Data" Sheet 14, Sheet 3.

4.15.8 */* Check the axial alignment of the adaptor plate to the accessory drive as follows:

a. Clamp a dial indicator to the accessory drive coupling with the dial indicator button contacting the pilot diameter of the adaptor plate.

b. Bar the engine over to sweep the inside diameter of the adaptor plate.

(1) Total indicated runout (TIR) should not exceed 0.010 inches.

c. Record the "As Found" TIR on "Data" Sheet 14, */* Sheet 3.

d. IF TIR is greater than 0.010 inches, remove dowels from adaptor plate, loosen bolts and adjust to obtain an offset less than 0.005 inches (offset is equal to 1/2 TIR).

e. Torque bolts to 30 ft-lbs and re-dowel adaptor plate if moved in Step 4.15.8d.

f. IF adaptor plate was moved in Step 4.15.8d, repeat Steps 4.15.8a, b, d, e and f.

g. Record "Final" TIR on "Data" Sheet 14, Sheet 3. */*

4.16 GEAR TRAIN INSPECTION

NOTE

Visual inspection of the crankshaft gear in step 4.16.1d is not required to be performed unless directed by the Maintenance Supervisor.

4.16.1 Perform gear train visual inspection per Steps 4.16.2 through 4.16.9 for the following gears (Step 4.16.9 may be performed later per Step 4.28.10 if desired):

a. Cam Gears - Left and Right (02-350C) (Commitment 9098 and 9358)

b. Crank-To-Lube Oil Pump Gear (02-355A) (Commitment 9098 and 9361)

c. Idler Gears - Left and Right (02-355B) (Commitment 9098 and 9363)

d. Crankshaft Gear (02-310A)

e. Lube Oil Pump Driven Gear (02-420)

f. Governor Drive Gear (02-411A) (Commitment 9009)

g. Governor Driven Gear (02-411A)

h. Overspeed Trip/Accessory Drive Gear (02-410B) (Commitment 9006)

i. Jacket Water Pump Drive Gear (02-425) (Commitment 9176)

NOTE

The following section is written for a complete gear train inspection. If only selected gears are to be checked, remove only those covers or components required.

4.16.2 Remove gear inspection covers.

4.16.3 */* Remove or verify removed the Overspeed Governor/Fuel Oil Booster Pump Assembly per Step 4.15.1.

4.16.4 */* Remove or verify removed the Governor and Governor Drive Housing per Step 4.14.1.

4.16.5 Remove Lube Oil Pump as follows:

a. Remove the fuel oil booster pump suction and discharge tubing.

(1) Tag for location.

(2) Protect both ends.

(3) Plug inlet and outlet of fuel oil booster pump.

CAUTION

The lube oil lines may be filled with lube oil even if the sump tank is drained due to the check valve in the suction line (inside sump tank). Provisions should be made to catch any spilled lube oil.

b. Remove elbow from suction of lube oil pump.

c. Remove the fuel oil piping supports.

(1) Tag for location.

(2) Protect ends of tubing.

d. Install blank flanges over lube oil piping to lube oil sump tank and over pump suction flange.

e. Unbolt the discharge of the lube oil pump from the discharge piping.

f. Position a sling on the pump and attach a chain fall.

(1) Take up slack, to support pump.

g. Remove the bolts securing the lube oil pump to adaptor plate.

h. */* Remove lube oil pump from engine by pulling directly away from the engine until it clears.

i. */* Remove the lube oil pump adaptor plate if required.

j. Install blank flanges over lube oil pump discharge piping and on discharge of lube oil pump.

k. Cover opening in gear case.

4.16.6 Remove Jacket Water Pump As Follows:

CAUTION

The jacket water lines may contain water even if stand pipe has been drained. Provisions should be made to catch any spilled jacket water.

a. Disconnect the tubing on the discharge piping of the pump.

(1) Protect ends of tubing.

b. Disconnect the lube oil tubing from the jacket water pump.

(1) Protect end of tubing and fitting on pump.

c. Remove the jacket water pump discharge piping.

(1) Install blank flange on both ends of removed piping and on skid flange where pipe was removed.

d. Remove the jacket water pump suction piping.

(1) Tape over end of skid piping where dresser coupling was removed.

(2) Install blank flange over flanged end and tape over dresser coupling end of removed piping.

(3) Install blank flanges over suction and discharge of jacket water pump.

e. Position a sling on the pump and attach a chain fall. Take up slack to support pump.

f. Remove the bolts securing the jacket water pump to the adaptor plate.

g. */* Remove jacket water pump from engine by pulling directly away from the engine until it clears.

NOTE

It is necessary to remove the engine driven lube oil pump and its adaptor plate if the jacket water pump adaptor plate is to be removed, due to the fact the lube oil pump adaptor plate partially covers the jacket water pump adaptor plate.

h. */* Remove the jacket water pump adaptor plate if required.

i. Cover opening in gear case.

4.16.7 Clean gear teeth.

4.16.8 */* Visually check the following gears for chipped or broken teeth, pitting, excessive wear or other abnormal conditions (document on "Data" Sheet 15, Sheet 2):

a. Cam Gear - Left [02-350C] (Commitment 9098, 9358)

b. Cam Gear - Right [02-350C] (Commitment 9098, 9358)

c. Crank-to-Lube Oil Pump Gear [02-355A] (Commitment 9098, 9361)

d. Idler Gear - Left [02-355B] (Commitment 9098, 9363)

e. Idler Gear - Right [02-355B] (Commitment 9098, 9363)

f. Crankshaft Gear [02-310A]

g. Lube Oil Pump Driven Gear [02-420]

h. Governor Drive Gear [02-411A] (Commitment 9009)

i. Governor Driven Gear [02-411A]

j. Fuel Oil Pump/Overspeed Trip Drive Gear [02-410B] (Commitment 9006)

k. Jacket Water Pump Drive Gear [02-425] (Commitment 9176)

4.16.9 */* Start lube oil (keepwarm) pump and check lube oil spray lines.

a. Ensure good spray pattern is obtained at all gear meshes.

b. Document on "Data" Sheet 15, Sheet 4.

4.17 LUBE OIL SUMP TANK (02-540A), FILTERS AND STRAINERS

4.17.1 IF it was determined in Step 4.5.4a that the engine lube oil is not within specifications or IF it desired to remove the lube oil from the engine and sump tank for other reasons, perform the following:

NOTE

Steps 4.17.6, 4.17.9, 4.17.10 and 4.17.11 are required to be performed.

4.17.2 Remove lube oil from sump tanks by draining and/or pumping.

CAUTION

IF lube oil has not been drained from engine driven lube oil pump suction piping, a large amount of lube oil will discharge from foot valve when opened.

4.17.3 */* Clean tanks and the strainer which separates the two tanks. (Commitment 9059)

a. Record nature of material caught in strainer and found in bottom of tanks.

b. Inspect strainer assembly and replace wire mesh screen, per Reference 6.1.2 drawing R-3562, if damaged.

4.17.4 */* Visually check the condition of the elastomeric facing of the lube oil pump suction foot valve.

4.17.5 */* Visually check accessible elements of lube oil immersion heater for possible coke buildup or other adverse conditions (borescopic inspection is acceptable).

4.17.6 */* Advise I&C to perform calibration of lube oil sump tank level switch.

4.17.7 */* Lube oil pump suction side (east) of lube oil sump tank may be restored following inspections.

4.17.8 Do not close out lube oil return side (west) of sump tank until ready for final engine closeout and inspection.

4.17.9 Clean, inspect and replace lube oil keepwarm filter as follows:

a. */* Ensure that the filter is out of service.

(1) Lube oil keepwarm pump and heater are de-energized and tagged.

(2) Position pump discharge 3-way valve positioned to drain.

(3) Verify that the inlet and outlet gauges on the filter housing read near zero.

b. */* Remove the cap from the drain valve outlet pipe then slowly open the clean side drain valve on the filter housing.

(1) Drain lube oil from housing into a suitable container (filter may contain up to 40 gallons).

c. */* Remove the 1-1/2" pipe plug from the dirty side drain coupling.

(1) Drain lube oil from the dirty side of the filter housing into a suitable container (an additional 10 gallons may be contained in the dirty side after the clean side has been drained).

d. Disconnect the vent tubing from the filter housing cover assembly.

e. Loosen the eye nuts which secure the filter housing cover assembly. Do not remove eye nuts from eye bolts.

(1) Swing the eye bolts away from cover assembly.

f. Using the cover lift assembly, raise the cover until it clears all of the filter internals.

(1) Swing cover clear of filter housing.

g. Remove the top pressure plate assembly and center tube plug from the top of each filter element stack. Do not discard these parts.

h. Remove the filter elements from housing.

(1) */* Inspect filter elements to determine nature of material caught and record in "Comments" section of "Completion" Sheet.

(2) Place the filter elements in a suitable container for disposal.

i. */* Thoroughly clean the inside of the filter housing removing any sludge in the bottom of the housing.

j. */* Install the 1-1/2 pipe plug in the dirty side drain coupling.

(1) Apply thread sealant to plug.

(2) Tighten securely.

k. */* Close the clean side drain valve.

l. */* Install new filter elements (quantity 6).

(1) Inspect each new element for damage prior to installing.

(2) Ensure each element is properly seated.

m. */* Clean the center tube plug and top pressure plate assemblies.

n. */* Install the center tube plug and top pressure plate assembly in the top of each filter element stack.

o. */* Visually check the cover assembly-to-filter housing O-ring for damage.

(1) Replace O-ring if damage is found or if leakage was noted during operation.

(a) Using a screwdriver, carefully pry out the O-ring being extremely careful not to damage the O-ring groove.

(b) Install new O-ring is groove by stretching O-ring and pressing into groove taking care not to pinch or nick the O-ring.

p. */* Fill lube oil housing with engine oil (Mobil 412), to within a few inches of the top.

q. Swing the cover assembly until it is in line with filter housing.

r. Lower cover into place on filter housing.

(1) */* Verify around entire circumference that the head assembly is centered with housing.

s. Swing the eye bolts up to engage cover assembly.

t. */* Tighten eye nuts to 75 ft/lbs in a diagonal sequence while verifying that the head assembly stays centered with filter housing.

u. */* Connect the vent tubing to the vent connection on the filter housing cover.

v. */* Place lube oil keepwarm filter in service.

(1) Position lube oil keepwarm pump 3-way discharge valve to filter.

(2) Energize lube oil keepwarm pump and heater.

(3) */* Record clean filter differential pressure.

w. */* Once the filter housing pressure stabilizes check for leakage in the following areas:

(1) Cover-to-housing O-ring.

(2) Vent tubing connection.

(3) Dirty side drain plug.

(4) Discharge of clean side drain valve.

x. */* Install clean side drain valve outlet pipe cap.

(1) Apply thread sealant to pipe threads.

(2) Tighten cap securely.

4.17.10 Clean and inspect lube oil keepwarm strainer as follows:

a. */* Ensure that the strainer is out of service.

(1) Lube oil keepwarm pump and heater are de-energized and tagged.

(2) Position pump discharge 3-way valve to drain.

b. */* Remove the cap from the strainer drain valve outlet pipe and then open drain valve.

(1) Drain lube oil strainer into a suitable container (strainer may contain up to 6 gallons).

(2) IF the volume of lube oil drained is greater than expected and it continues to drain, there is a possibility that the outlet 2-1/2" check valve is leaking.

(a) */* A maintenance work order should be written to correct check valve when the activity can be scheduled and parts are available.

c. Disconnect the vent tubing from the strainer cover.

d. Remove cover bolts, washers and nuts.

e. Remove cover plate and cover gasket.

(1) Match mark cover to housing.

f. Lift out strainer element using handle.

g. Remove preformed packing from strainer element prior to start of cleaning.

h. */* Clean strainer housing internals with a cleaning solvent.

(1) Remove heavy dirt and oil with a stiff bristled non-metallic brush.

(2) Drain housing and blow off cleaning solvent with dry compressed air.

i. */* Clean strainer element as follows:

(1) Block off open end of strainer element.

(2) Immerse strainer element in cleaning solvent for 30 to 60 minutes to remove sludge and baked on contaminants.

(3) Remove heavy lint or direct deposits on outside surface with a stiff bristled, non-metallic brush.

(4) Remove element from cleaning solvent, unblock open end and rinse thoroughly in clean hot water.

(5) Drain or blow off with dry, filtered low pressure (less than 30 psi) compressed air.

j. */* Install new preformed packing.

k. */* Install strainer element into housing ensuring it is firmly seated.

l. */* Fill lube oil pre-lube strainer with engine oil (Mobil 412), to within a few inches of the top.

m. */* Install new cover gasket.

n. Install cover, cover bolts, washers and locknuts.

(1) Check that covered is centered on housing and in the same orientation as when removed.

(2) */* Tighten bolting per Table 1 in a diagonal sequence.

o. */* Connect the vent tubing to the vent connection on the strainer cover.

p. */* Place lube oil pre-lube strainer in service.

(1) Position lube oil keepwarm pump 3-way discharge valve to filter.

(2) Energize lube oil keepwarm pump and heater.

q. */* Once the strainer has been in service for a few minutes, check for leakage in the following areas:

(1) Cover-to-housing gasket.

(2) Vent tubing connection.

(3) Strainer drain valve outlet.

r. */* Install strainer drain valve outlet pipe cap.

(1) Apply thread sealant to pipe threads.

(2) Tighten cap securely.

4.17.11 Clean, inspect and replace lube oil full flow duplex filter for the section that had been in service as follows:

a. */* Ensure that the filter that is to be replaced is taken out of service (arrow on valves' operators point to filter in service).

(1) Verify that the inlet and outlet gauges on the filter housing, for which the elements are to be replaced, read near zero.

(2) Verify that the 1" filter equalizing valve is closed.

b. */* Remove the cap from the drain valve outlet pipe and then slowly open the clean side drain valve on the filter housing for which the filter elements are to be replaced.

(1) Drain lube oil from housing into a suitable container (filter may contain up to 180 gallons).

(2) IF the volume of lube oil drained is greater than expected and it continues to drain, this indicates that the inlet/outlet isolation valves are not fully isolating the out of service filter.

(a) Close drain valve.

(b) */* A maintenance work order should be written to correct valve when the activity can be scheduled and parts are available

c. */* Remove the 1-1/2" pipe plug from the dirty side drain coupling.

(1) Drain lube oil from the dirty side of the filter housing into a suitable contained (an additional 30 gallons may be contained in the dirty side after the clean side has been drained).

d. Disconnect the vent tubing from the filter housing head assembly.

e. Loosen the eye nuts which secure the filter housing head assembly. Do not remove eye nuts from eye bolts.

(1) Swing the eye bolts away from head assembly.

f. Using the cover lift assembly, jack the head assembly up until it clears all of the filter internals.

(1) Swing head assembly clear of filter housing.

g. Remove the top pressure plate assembly and center tube plug from the top of each filter element stack. Do not discard these parts.

h. Remove the filter elements from housing.

(1) */* Inspect filter elements to determine nature of material caught and record in "Comments" section of "Completion" Sheet.

(2) Place the filter elements in a suitable container for disposal.

i. */* Thoroughly clean the inside of the filter housing removing any sludge in the bottom of the housing.

j. */* Install the 1-1/2" pipe plug in the dirty side drain coupling.

(1) Apply thread sealant to plug.

(2) Tighten securely.

k. */* Close the clean side drain valve.

l. */* Install new filter elements (quantity 27)

(1) Inspect each new element for damage prior to installing.

(2) Ensure each element is properly seated.

m. */* Clean the center tube plug and top pressure plate assemblies.

n. */* Install the center tube plug and top pressure plate assembly in the top of each filter element stack.

o. Visually check the head assembly-to-filter housing
/ O-ring for damage.

(1) Replace O-ring if damage is found or if leakage was noted during operation.

(a) Using a screw driver, carefully pry out the O-ring being extremely careful not to damage the O-ring groove.

(b) Install new O-ring in groove by stretching O-ring and pressing into groove taking care not to pinch or nick the O-ring.

p. Fill lube oil filter housing with engine oil
/ (Mobil 412), to within a few inches of the top.

q. Swing the head assembly until it is in line with filter housing.

r. Release jack pressure to allow cover to lower into place.

(1) Verify around entire circumference that the
/ head assembly is centered with housing.

s. Swing the eye bolts up to engage head assembly.

t. Tighten eye nuts to 75 ft/lbs in a diagonal
/ sequence while verifying that the head assembly stays centered with filter housing.

u. Connect the vent tubing to the vent connection on
/ filter housing head assembly.

NOTE

Perform Steps v through y when the engine is in operation.

CAUTION

The following steps could cause the engine to trip, if in operation, due to a momentary drop in lube oil pressure.

v. Slowly open the 1" filter equalizing valve a small amount.

w. Wait 30 - 60 seconds while observing the inlet and outlet gauges on the housing for which the filters were replaced.

(1) IF pressure does not change, slowly open the 1" filter equalizing valve a small amount more.

(2) The intent is to open the equalizing valve only enough to allow the pressure in the filter to slowly build up to system pressure without causing a system pressure drop.

x. */* Once the filter housing pressure reaches approximately the same as the inlet pressure of the filter in service, check for leakage in the following areas:

(1) Head assembly-to-housing O-ring.

(2) Vent tubing connection.

(3) Dirty side drain plug.

(4) Discharge of clean side drain valve.

y. */* Close the 1" filter equalizing valve.

z. */* Install clean side drain valve outlet pipe cap.

(1) Apply thread sealant to pipe threads.

(2) Tighten cap securely.

4.17.12 */* Drain lube oil from lube oil heat exchanger.

4.18 PISTONS (02-341A) AND CONNECTING RODS (02-340A)

4.18.1 IF any pistons and connecting rods are to be removed, perform as follows: (Also see Step 4.5.41)

NOTE

The method for turning piston and rod assemblies in Steps 4.18.2w through 4.18.2aa and 4.18.31 through 4.18.3p is the suggested method, however other methods may be used.

4.18.2 Remove Link Rod And Piston As Follows:

a. Clean piston crown of all carbon deposits.

(1) Ensure that there is a flat seating surface for the piston pulling fixture.

(2) Using a thread chaser, clean threaded holes in piston crown.

b. Prior to barring of the engine, lubricate the engine main bearings and cylinder liners in accordance with Step 2.17.

NOTE

To keep the crankshaft balanced it is recommended that piston sets be removed in the sequence 1 through 8 or 8 through 1.

c. Remove crankcase doors to allow access to connecting rods of piston(s) to be removed.

d. Position master rod at or just past Top Dead Center (TDC) using barring device.

e. Block crankshaft to prevent further movement.

NOTES

a. There is a licensing requirement to verify that the two pair of connecting rod bolts above the crank pin (1, 5, 3 and 6) have not lost bolt tension since last connecting rod assembly. This is accomplished by measuring the connecting rod bolt length ultrasonically prior to untorquing of bolts and comparing this value with the bolt length measured during last assembly and to the bolts free (untorqued) length. See "Data" Sheet 16 for example.

b. If connecting rod bolts have been replaced with studs and nuts, use applicable steps of Section 4.24 of Procedure 17562-C, instead of Steps f and o.

f. */* Remove safety wire and cotter pins from the connecting rod bolts.

(1) Ultrasonically measure connecting rod bolt length.

(2) Record on "Data" Sheet 16, Sheet 6.

(3) Loosen connecting rod bolts and rod-to-box bolts slightly, but do not removed.

g. Install connecting rod saddle and plate on master rod side of engine.

h. Adjust jacking screw of tool to position saddle snug against master rod to hold rod in place against crank pin. See Figure 17.

i. Attach chain puller bracket to side of crankcase, then attach chain puller.

j. Attach chains to each end of link pin with cap screws.

(1) Connect other end of chains to chain puller.

(2) Take up slack with chain puller to hold the link rod firmly against the crank pin.

k. Attach piston pulling fixture to crown of link rod piston.

l. If cylinder head studs are installed perform EITHER of the following:

(1) Place a piece of plywood vertically on the inner side of the outer studs.

(2) OR install aluminum sleeves over the studs to prevent piston from coming into contact with studs.

m. Attach a chain hoist to the overhead hoist.

n. Attach the chain hoist to the side lifting ring of pulling fixture.

o. Remove connecting rod bolts and rod-to-box bolts.

(1) Identify all bolts as they are removed as to their respective position in the rod. Use the numbering convention as shown on "Data" Sheet 16, Sheet 1.

(2) Bolts must be returned to original position during reassembly.

p. Slack off chain puller, allowing link rod to swing clear of crank pin.

q. Use chain puller as necessary to position connecting rod while clearing box from crankshaft.

r. Adjust chain puller until link rod is in line with axis of the cylinder liner.

s. Coat walls of cylinder liner with clean lubricating oil.

t. Coat side of gasket material which contacts liner wall with clean lubricating oil.

u. Place a piece of 3/32" compressed gasket material between link rod box and liner wall to prevent box from scoring liner wall.

NOTE

Piston pulling fixture has a socket available to insert a pipe or wrench to help free a bound up piston.

v. Carefully hoist piston and rod out of liner with hoist, taking care not to allow piston to bind in liner. See Figure 18.

w. Transport piston and rod to right front side of the engine with the overhead bridge hoist to a position near the monorail hoist.

x. Lower piston and rod assembly until the rod is a few feet from the floor.

y. Install connecting rod turning plate OR install sling through bottom two connecting rod bolt holes.

(1) Attach sling to monorail hoist.

(2) Place wooden blocks between piston skirt and rod.

z. Using monorail hoist raise connecting rod while lowering piston with overhead bridge hoist until the piston and rod have been inverted (piston hanging down).

aa. Remove piston pulling fixture from piston crown.

bb. Record piston identification numbers (located */* inside piston skirt over wrist pin boss) on "Data" Sheet 17, Sheet 1.

(1) Note orientation of piston (i.e., ID numbers on piston toward front (gear case end) or rear).

cc. Record link rod identification number (match */* number located on end of connecting rod) on "Data" Sheet 16, Sheet 2.

dd. Piston may be removed from rod at this time OR they may be stored as an assembly with piston crown setting on plywood.

4.18.3 Master Rod and Piston Removal

a. Attach piston pulling fixture to the master piston.

b. Attach master rod bar and chain puller as shown in Figure 19.

(1) Take up slack with chain puller to hold master rod in place.

c. Loosen connecting rod saddle assembly.

d. Adjust the position of piston and rod with the hoist if necessary.

e. Slack off on chain puller until master rod swings clear of crankshaft and is in line with the cylinder liner bore.

f. Prior to barring of the engine, lubricate engine main bearings and cylinders lines in accordance with Step 2.17.

g. Remove blocking and bar crankshaft approximately 30° past TDC, away from master rod to permit rod to clear crankshaft journal.

h. Coat walls of cylinder liner with clean lubricating oil.

i. Coat side of gasket material which contacts liner wall with clean lubricating oil.

j. Place a piece of 3/32" compressed gasket material between master rod and liner wall to prevent rod from scoring liner wall.

NOTE

Piston pulling fixture has a socket available to insert a pipe or wrench to help free a bound up piston.

k. */* Carefully hoist piston and rod out of liner with hoist, taking care not to allow piston to bind in liner. See Figure 20.

l. Transport piston and rod to right front side of the engine with the overhead bridge hoist to a position near the monorail hoist.

m. Lower piston and rod assembly until the rod is a few feet from the floor.

n. Install connecting rod turning plate OR install sling through bottom two connecting rod bolt holes.

(1) Attach sling to monorail hoist.

(2) Place wooden blocks between piston skirt and rod.

o. Using monorail hoist raise connecting rod while lowering piston with overhead bridge hoist until the piston and rod have been inverted (piston hanging down).

p. Remove piston pulling fixture from piston crown.

q. */* Record piston identification numbers (located inside piston skirt over wrist pin boss) on "Data" Sheet, Sheet 1.

(1) Note orientation of piston (i.e., ID numbers on piston toward front (gear case and) or rear).

r. */* Record master rod identification number (match number located on end of connecting rod) on "Data" Sheet 16, Sheet 2.

s. Piston may be removed from rod at this time or they may be stored as an assembly with piston crown setting on plywood.

t. Remove connecting rod saddle and plate, chain puller and chains.

4.18.4 Inspect any pistons removed as follows:

NOTE

Inspections of pistons in steps 4.18.4 are not required to be performed (except step 4.18.4f) unless directed by a Maintenance Supervisor.

a. Remove piston from rod as follows:

(1) Suspend piston and rod, with the piston down from the overhead hoist.

(2) Place a piece of plywood under the piston crown.

(3) Lower the piston and rod until the weight of the assembly is resting lightly on the piston crown.

(4) Remove piston pin retainer rings from grooves on skirt at the ends of the piston pin.

(5) Slide pin out of piston.

(6) Lift rod assembly clear of piston.

(7) Mark piston pin for the piston from which it was removed and the fore and aft orientation or reinstall in piston.

b. */* Measure piston ring side clearance in groove with feeler gauge in three locations, 120 degrees apart.

(1) Record on "Data" Sheet 17, Sheet 2.

c. Remove rings from piston, starting with the top ring, using a piston ring expander tool.

(1) Tag each ring to identify the piston and groove it was removed from.

CAUTION

Hardened steel scrapers, steel wire brushes or power wire buffers should not be used as they could damage the rings.

d. Clean piston rings using a commercial cleaning agent such as Magnaflux Cleaner or equivalent.

e. Check piston ring end gap as follows:

NOTES

a. Gap clearance of piston rings is measured with the ring in the liner. Used rings must be measured in the liner from which they were removed, and if new rings are to be used, their end clearance must be measured when installed in the liner in which they will be used.

b. The rings may be positioned in one of two locations in the liner. The preferred position being 6 inches from the bottom of the liner; the alternate position being 3 inches from the top of the liner.

c. It is preferred that the liner be de-glazed prior to performing this measurement.

(1) Position ring in the liner in either the preferred or alternate location.

(2) Ensure that ring is square with the surface of the bore, i.e., the ring is same distance from the top or bottom of liner all around.

(3) Measure gap between ends of ring with a
/ feeler gauge and record the measurement on "Data" Sheet 17, Sheet 2.

(4) Record on "Data" Sheet 17, Sheet 2
/ approximate percent ring face contact.

(5) If new rings are installed, note reasons in
/ "Remarks" section on "Data" Sheet 17, Sheet 2.

(6) If new rings are installed, record end gap
/ and side clearance is grooves on "Data" Sheet17, Sheet 2. (Commitment 9353)

f. Visually inspect piston for wear and other
/ abnormal conditions such as scuffing, scratches, etc. (Commitment 9353)

(1) Document any abnormal condition on "Data" Sheet 17, Sheet 4.

g. Measure piston skirt outside diameter at two locations as follows (record on "Data" Sheet 17, Sheet 3) (Commitment 9353):

(1) Approximately 4 inches below the bottom
/ ring groove measure skirt diameter at three positions B-B, C-C and D-D (see Figure C on "Data" Sheet 17).

(2) Approximately 4 inches above bottom of skirt
/ measure skirt diameter at four positions A-A, B-B, C-C and D-D (see Figure C on "Data" Sheet 17).

h. Measure the piston pin outside diameter and piston pin bore in piston skirt inside diameter as follows (Commitment 9353):

(1) Measure piston pin outside diameter at two
/ locations, 2 inches from each end (see Figure E on "Data" Sheet 17) at two positions A-A and B-B in each location (see Figure D on "Data" Sheet 17).

(2) Measure piston pin bore in piston skirt in
/ two positions A-A and B-B in each end of bore (see Figure D on "Data" Sheet 17).

(a) Record on "Data" Sheet 17, Sheet 3.

i. Determine piston pin to rod bushing and piston pin to piston bore clearances as follows (record on "Data" Sheet 17, Sheet 4):

NOTE

It will be required to compare all possible combinations of gear case end measurements and all combinations of flywheel end measurements to determine the maximum pin-to-bushing and pin-to-piston clearances.

(1) */* Compare measurements recorded in Step 4.18.4h(1) and 4.18.5b, and determine the maximum pin-to-bushing clearance.

(2) */* Compare measurements recorded in Step 4.18.4h(1) and 4.18.4h(2), and determine the maximum pin-to-piston clearance.

j. Inspect piston pins as follows:

(1) */* Visually inspect piston pin for chrome damage. (Commitment 9203)

(a) Replace piston pins that have chipped or blistered chroma. (Document on "Data" Sheet 17, Sheet 4.)

(2) */* Inspect piston pin end plugs. (Commitment 9203)

(a) Re-roll or replace any end plugs that are loose. (Document on "Data" Sheet 17, Sheet 4.)

(3) */* Perform a liquid penetrant or magnetic particle test on any replacement piston pins (attach PT or MT inspection report). See Reference 6.3 for acceptance criteria.

4.18.5 */* Inspect any connecting rods removed as follows: (Commitment 9314):

NOTE

Only steps 4.18.5e(3), e(4), and g are required to be performed on connecting rods removed. Remaining inspections of step 4.18.5 are not required to be performed unless directed by Maintenance Supervisor.

a. Disassemble link rod from the link pin as follows:

(1) Remove safety wire from the link pin bolts.

(2) Remove link pin bolts.

(a) Record break away torque on "Data" */* Sheet 16, Sheet 2.

(3) Remove link rod.

(a) Tag for proper location and orientation.

(4) Remove link pin.

(a) Tag for proper location and orientation.

b. */* Measure inside diameter of the link rod and master rod piston pin bushing with micrometer. Measure in vertical (A-A) and horizontal (B-B) planes, 90 degrees apart. Measure on both ends (gear case and flywheel), two inches from end of bushing. (See Figure on "Data" Sheet 16). (Commitment 8987)

(1) Record on "Data" Sheet 16, Sheet 3.

c. */* Measure link pin and link pin bushing as follows (record on "Data" Sheet 16, Sheet 3): (Commitment 8987)

(1) Measure the inside diameter of the link pin bushing with a micrometer. Take measurement in vertical (A-A) and horizontal (B-B) planes, 90 degrees apart. Measure on both ends (gear case and flywheel), 1 inch from end of bushing. (See figure on "Data" Sheet).

(2) Measure the outside diameter of the link pin with a micrometer. Measure on both ends, 1 inch in from end of pin in both vertical (A-A) and horizontal (B-B) planes. (See figure on "Data" Sheet 16).

(3) Determine maximum pin-to-bushing clearance. (It will be required to compare all possible combinations of gear case end measurements and all possible combinations of flywheel end measurements to determine the maximum pin-to-bushing clearance).

d. Check connecting rod bearing bore as follows: (Commitment 8997)

(1) Reassemble connecting rod box to measure for out of round conditions at connecting rod bearing bore. Do not install bearings.

(2) Torque nuts and bolts to full torque of 1649 to 1751 ft-lbs.

(3) */* Measure connecting rod bearing bore inside diameter on the fore and aft sides of oil groove at 45° intervals, 1 inch in from outer edges. Record on "Data" Sheet 16, Sheet 4. The average of the four measurements should be 14.250 to 14.259 inches with no single dimension deviating by more than ±0.003 inch (14.253 to 14.246 inch). Any measurement outside this tolerance must be evaluated by the engine manufacturer.

e. Perform the following non-destructive examinations (attach NDE Inspection reports), see Reference 6.3 for acceptance criteria unless otherwise noted:

(1) */* Liquid penetrant test (PT) on piston pin bushing bore. No linear indications on internal diameter bottom dead center ±15°. See Acceptance Criteria 5.4.

(2) */* Liquid penetrant test (PT) on connecting rod box. See Acceptance Criteria 5.4.

(3) */* Magnetic particle test (MT) on connecting rod studs/bolts. See Acceptance Criteria 5.3.

(4) Eddy Current test (ET) on connecting rod box */* female threads to verify absence of cracking. (Not required if bolts have been replaced with studs except just before stud initial installation.)

f. Visually inspect rack teeth (connecting rod mating */* surfaces) as follows:

(1) Visually inspect rack teeth surfaces of the connecting rods for signs of frettings, document any abnormalities on "Data" Sheet 16, Sheet 4. (Commitment 8987)

(2) Check mating surfaces to verify that the minimum recommended percent (75%) contact surface is available by bluing. With connecting rod flat on floor, blue one mating surface, assembly connecting rod (do not exceed 1700 ft-lbs when torquing rod bolts), disassemble connecting rod surfaces. (Required only for new connecting rods or if loss of connecting rod bolt pre-load is noted in Step 4.18.2f and 4.18.5g(2), or if fretting is noted in Step 4.18.5f(1). Record results on "Data" Sheet 16, Sheet 4.

NOTE

Perform Section 4.24.2 of Procedure 27562-C instead of 4.18.5g if connecting rod bolts have been replaced with studs.

g. Perform a visual inspection of all connecting rod bolt washers, nuts and bolts and bolt contact surfaces as follows and document on "Data" Sheet 16, Sheet 4.

(1) Ultrasonically measure the free length of the */* connecting rod bolts and record on "Data" Sheet 16, Sheet 6.

(2) Verify pre-load (stretch) has not decreased */* by more than 7% for rod-to-box bolts 1, 5, 3 and 6 since connecting rod was previously assembled. Record on "Data" Sheet 16, Sheet 7.

(3) */* Visually inspect connecting rod bolts, washers and nuts for signs of galling. Document on Data Sheet 16, Sheet 4.

(4) */* Replace any washers that are not of the nickel plated type.

(5) */* Visually inspect connecting rod surface at bolt contact areas. Document on Data Sheet 16, Sheet 4.

(6) Stone rod surface and bolts to remove any galls in the washer seating surfaces, if necessary.

(7) */* Visually inspect connecting rod bolt threads. Replace any bolts that have cracked threads or large grooves or galls in the threads (large being defined as greater than 25% of the width of the thread load bearing face).

NOTE

If a bolt is replaced due to galling, then it is probable that there are matching galls in the connecting rod box threads. These galls must be removed in order to restore proper contact between the new bolt and the box threads and to avoid the load intensifying effect of a gall pushing on a non-galled surface. Reference Section 4.23 of Procedure 27562-C for repair procedure.

h. Assemble link rod to the link rod pin as follows:

(1) Coat link pin with Felpro C5A, or equivalent and then, insert link rod pin in connecting rod box bore.

(2) Position link rod on link pin, aligning with dowel.

(3) Apply a lubricant consisting of a 50-50 mixture of powdered graphite and lubricating oil to the threads of the link-rod-to-pin bolts.

(a) Torque bolts to specified torque of 1019 */* to 1081 ft-lbs and record on "Data" Sheet 16, Sheet 2.

NOTE

Each link rod pin should be checked on both the gear case and flywheel end. Required only for new connecting rods.

(4) Check the clearance, between the bottom */* surface of the foot of the link rod and the mating surface of the link pin, by inserting a 0.0015 inch feeler gauge between the link rod box bushing and the pin. The feeler should go in no more than 1-1/4 inch. (See Figure 22) (Commitment 9314)

(a) Record on "Data" Sheet 16, Sheet 2.

(5) Secure with lock wire in accordance with */* Appendix A.

4.19 CONNECTING ROD BEARINGS (02-340b)

4.19.1 IF any connecting rod bearings are to be removed, perform as follows (also see Step 4.5.4):

a. Support lower bearing shell by hand and remove locking clips.

b. Remove both shells. */*

c. Protect crank pin bearing journal with red rubber gasket material.

d. Mark shells for location and orientation (top and */* bottom).

(1) Record the manufacturer's data and I.D. number on "Data" Sheet 18, Sheet 1.

e. Store shells in a safe location, preferably in paper with a light coating of oil.

(1) Bag and store locking clips.

f. Clean bearing shells.

4.19.2 Inspect any connecting rod bearings removed, as follows:

a. */* Visually check all surfaces of bearing shells for scratches, nicks, burrs, evidence of overheating and excessive wear. (Commitment 9351)

(1) Note any abnormalities on "Data" Sheet 18, Sheet 2.

b. */* Measure thickness of bearing shells using a micrometer at six points. (See figure on "Data" Sheet 18.) (Commitment 9351)

(1) Record on "Data" Sheet 18, Sheet 2.

c. */* Perform liquid penetrant (PT) on all bearing shell surfaces, including sides and ends of both top and bottom shells.

(1) Attach PT Inspection report. See Acceptance Criteria 5.4.

d. */* If bearing shell is replaced, perform a radiographic examination (RT) of replacement bearing. (Commitment 9314)

NOTE

Only one engine per station is required to have main bearing No. 5 and No. 7 inspected at EOC2.

(1) Attach RT Inspection Report. See Reference 6.3 (Volume 3 Section 02-340B Attachments A and B) for acceptance criteria.

4.20 CRANKSHAFT (02-310A) AND MAIN BEARINGS (02-310B)

4.20.1 IF any main bearings are to be removed, perform as follows (Also see Step 4.5.4i):

a. Remove crankcase side covers as required to gain access to bearing cap(s) to be removed.

CAUTION

When removing main bearings, never remove two adjacent bottom shells at the same time, because this would allow crankshaft to sag and would make it difficult to reinstall bearing shells.

b. To facilitate removal of the rear bearing, the upper half of the rear seal may be removed.

c. To facilitate removal of number one main bearing cap it will be necessary to remove lube oil pump and jacket water pump to allow removal of lube oil header.

d. Remove the following:

(1) Lubricating oil line and fittings.

(2) Temperature sensing devices with tubing.

(3) Locking plates from stud nuts.

(4) For number one main bearing cap, also remove lube oil header at gear case.

e. Attach adapters to pre-stressor assemblies and place a spacer over each of two diagonally opposite stud nuts.

f. Use jacking screws on micrometer bar to force piston flange against top of cylinder, then back off jacking screws one-quarter inch.

g. Assemble a pre-stressor to each of the two main bearing cap studs, running them down on the stud threads until pre-stressors are snug against adapters.

h. Attach hydraulic hose between two pre-stressors, and between one pre-stressor and a suitable hydraulic pumping unit.

i. Bleed air from system by opening pipe plug on second pre-stressor then operating pumping unit to supply a small pressure.

j. When all bubbles disappear, tighten pipe plug.

WARNING

DO NOT EXCEED MAXIMUM ALLOWABLE PRESSURE OF 13,000 PSI.

NOTE

Approximately 10,500 psi pressure will be required.

k. Slowly apply hydraulic pressure to pre-stressor assemblies until bearing cap studs have stretched sufficiently to permit stud nut to be loosened.

l. Use a brass drift pin through the spacer side opening to loosen nut.

m. Do not turn nut up tight against lower face of adapter as it will bind when hydraulic pressure is released.

n. Relieve hydraulic pressure on pre-stressors.

o. Remove stud nuts.

p. Repeat Steps e through o on remaining studs, following a crisscross pattern.

q. Remove studs if necessary.

r. Lift bearing cap from crankshaft as follows:

(1) Insert pivot bolt with offset chain link attached into engine frame above bearing or use cap lifting fixture.

(2) Install pipe plug with cable attached into bearing cap.

(3) Using a come-along pull cable tight and lift bearing cap. See Figure 21.

NOTE

It may be necessary to use jacking bolts in bearing cap in order to break the cap loose.

(4) Remove bearing cap from engine.

(5) Remove dowels from base and/or cap.

(a) Inspect from damage.

(b) Tag and store.

s. Remove the two socket head cap screws and lock rings that hold the upper bearing shell to the main bearing cap.

t. */* Carefully remove top shell from the cap.

u. */* Mark shell as per location and orientation (top) and record manufacturer's data and ID number (if there is one) on "Data" Sheet 19, Sheet 1.

NOTE

If bottom bearing shell is to be left installed Step v. should be performed. If bottom shell is to be removed Step w. should be performed.

v. Install locking plates (wrapped with tape) on both the right and left side of the main journal positioned to retain the bottom main bearing shells during barring operations.

(1) Ensure the locking plates do not touch the crankshaft journal.

(2) Secure the plates with aluminum sleeves over the studs and a washer and nut.

(3) Protect main journal to preventing scratching.

w. To remove the bottom bearing shell, perform the following:

(1) Install a bearing shell removal tool in the crankshaft journal oil hole then slowly rotate crankshaft until the tool is bearing against the bearing shell.

(2) */* Continue to slowly rotate crankshaft and roll the bottom bearing out of the journal.

(3) */* Mark shells as per location and orientation (bottom) and record manufacturer's data and I.D. number (if there is one) on "Data" Sheet 19, Sheet 1.

x. Clean bearing shells.

4.20.2 Inspect any accessible crankshaft journals as follows:

a. Inspect crankshaft as follows:

(1) */* Inspect crankpins for signs of scoring, wear or damage.

(a) Document on "Data" Sheet 20, Sheet 2.

(2) */* Inspect main journals for signs of scoring, wear or damage.

(a) Document on "Data" Sheet 20, Sheet 2.

b. */* Measure diameter of crank pin journals 1 inch in from web at either end (flywheel end and gear case end).

(1) Measure four different diameters (A-A, B-B, C-C, D-D) at each location (see figure on "Data" Sheet 20).

(2) Crank pin journal diameters should be within 13.002 to 12.998 inch.

(3) Record measurements on "Data" Sheet 20, Sheet 1.

c. */* Visually check crank shaft oil hole plugs for tightness.

(1) Document on "Data" Sheet 20, Sheet 2.

4.20.3 IF the review in Step 4.5.41 indicates that the engine has been operated in a severely unbalanced condition perform the following inspections.

a. */* Perform fluorescent liquid penetrant inspection of the fillets and oil holes of main bearing journals No. 4, 6 and 8. Attach PT Inspection report.

b. */* If indications are detected by liquid penetrant test of Step 4.20.3a, perform Eddy Current inspection of areas in question. Attach ET Inspection report.

c. */* Perform fluorescent liquid penetration inspection of the fillets and oil holes of three crank pin journals (choose from No. 3 through No. 8 inclusive). Attach PT Inspection report.

d. */* If indications are detected by liquid penetrant test of Step 4.20.3c, perform Eddy Current inspection of areas in question. Attach ET Inspection report.

4.20.4 Inspect any upper and/or lower main bearing shells removed as follows, (perform Step 4.20.4c only if thrust bearing is removed to correct crankshaft thrust clearance). (Commitment 9306, 9103)

a. Inspect main bearing shells as follows:

(1) */* Visually check all surfaces of bearing shells for scratches, nicks, burrs, evidence of over heating and excessive wear. (Commitment 9103 and 9306)

(a) Note any abnormalities on "Data" Sheet 19, Sheet 2.

(2) */* Measure thickness of bearing shells using a micrometer at six points. (See figure on "Data" Sheet 19.) (Commitment 9103 and 9306)

(a) Record measurements on "Data" Sheet 19, Sheet 2.

(3) */* Perform liquid penetrant (PT) on all bearing shell surfaces, including sides and ends of both top and bottom shells.

(a) Attach PT Inspection report. See Acceptance Criteria 5.4.

(4) */* If bearing shell is replaced, additionally perform a radiographic examination (RT) of replacement bearing.

(a) Attach RT Inspection report.

b. Inspect main bearing cap and engine base bearing cap mating surfaces as follows (document on "Data" Sheet 21, Sheet 1):

(1) */* Visually check the mating surface of the bearing cap for evidence of fretting. (Commitment 8981)

(2) */* Visually check engine base bearing pedestal cap mating surface for evidence of fretting. (Commitment 8981)

c. */* Check crankshaft thrust bearing for signs of cracks, gouges, wear or degradation.

4.20.5 Install any main bearings removed, as follows:

4.20.6 */* Ensure bearings that are being installed have satisfied the checkout requirements of Step 4.20.4.

4.20.7 */* Ensure that main journal is clean and free of burrs.

a. Place bottom bearing shell in position and slowly rotate crankshaft until tool rotates shell into position.

b. */* Record ID number of bearing shell used for reassembly, on "Data" Sheet 19, Sheet 1.

4.20.8 Remove shell removal tool.

4.20.9 */* Carefully replace upper shell in bearing cap.

a. Record ID number of bearing shell used for reassembly on "Data" Sheet 19, Sheet 1.

4.20.10 Replace lock rings and the two socket head cap screws.

4.20.11 */* Thoroughly clean main bearing cap mating surface and engine base bearing saddle mating surface with solvent ensuring that all lubricant and grit is removed and that no surface imperfections exist that might prevent tight bolt up. (Commitment 8981)

4.20.12 */* Ensure main journal is clean and free of burrs then replace bearing cap and stud nuts (and studs if removed).

4.20.13 Tighten bearing cap stud nuts as follows:

a. Ensure height of stud end is 11-3/16 inches above cap mounting surface to permit proper engagement with the pre-stressor assembly.

b. Lubricate threads with a 50 - 50 mixture of oil and graphite and tighten upper stud nuts hand tight.

c. Place spacers to the pre-stressor assemblies.

d. Force piston flange tight against top of cylinder using jacking screws.

e. Back off jacking screws 1/4 inch.

NOTE

Studs should be stretched in a crisscross pattern.

f. Install pre-stressor assembly(ies) on stud(s) and assemble the micrometer bar on the unit(s).

g. Attach hoses to pre-stressor(s) and apply pressure to bleed air.

h. Raise hydraulic pressure to approximately 500 psig to seat bearing cap.

(1) Run the nut up snug.

(2) Repeat for all studs.

i. Apply approximately 8000 psig to seat the bearing cap and release the pressure.

(1) Snug nuts up hand tight.

NOTE

If a dial indicator is used for measuring stretch of main bearing cap studs use Step j and N/A Steps k(4), k(9) and k(11). If a micrometer is used for measuring stretch of main bearing cap studs, use Step k and N/A Step j(6).

j. Perform the following if using a dial indicator:

(1) Insert a dial indicator into the hole in micrometer bar, making sure that it is fully seated.

(2) Tighten knurled knob to hold dial indicator in place.

(3) Set dial indicator on zero.

(4) Apply pressure (recommended approximately 9000 psi, not to exceed 13,000 psi) to pre-stressors and hold while using brass drift pin through spacer opening to tighten nut snugly.

(5) Relieve hydraulic pressure in hose.

(6) The stud should have stretched 0.051" to */* 0.056". Record reading from dial indicator on "Data" Sheet 21, Sheet 2 as "Distance Stretched".

(7) Place N/A in "Initial Stud Height" and "Stretched Height" entries.

(8) Proceed to Step 1.

k. Perform the following if using a micrometer.

(1) Insert micrometer head into the hole in micrometer bar, making sure that it is fully seated.

(2) Tighten knurled knob to hold micrometer head in place.

(3) Run micrometer spindle against micrometer pin until the pin is snug against end of the bearing cap stud.

(4) */* Observe and record micrometer reading on "Data" Sheet 21, Sheet 2, "Initial Stud Height".

(5) Back off on micrometer spindle.

(6) Apply pressure (recommended approximately 9000 psi, not to exceed 13,000 psi) to pre-stressors and hold while using brass drift pin through spacer opening to tighten nut snugly.

(7) Relieve hydraulic pressure in hose.

(8) Install micrometer head in micrometer bar.

(9) */* Run spindle snug against micrometer pin.

(a) Record reading on "Data" Sheet 21, Sheet 2 "Stretched Height".

(10) Subtract Step (4) from reading in above Step (9).

(11) */* The stud should have stretched 0.056" - 0.051".

(a) Record on "Data" Sheet 21, Sheet 2 "Distance Stretched".

l. Repeat above steps if stretch is less than 0.051".

m. Remove pre-stressor assemblies and repeat operation on next pair of diagonally opposite studs.

n. Perform above steps on all studs.

o. If unable to use pre-stressor unit on main bearing nuts, proceed as follows:

(1) Snug nuts on main bearing studs.

(2) */* Using pre-stressor spacer, mic down to top of of stud.

(a) Record "Initial Stud Height" on "Data" Sheet 21, Sheet 2.

(3) Using multiplier and pull handle, tighten nut.

(4) */* Record "Stretched Height" on "Data" Sheet 21, Sheet 2.

(5) Subtract the "Initial Stud Height" from the "Stretched Height".

(6) */* The stud should have stretched 0.056" - 0.051".

(a) Record on "Data" Sheet 21, Sheet 2 "Distance Stretched".

(7) Repeat above Step (3) until required stretch is obtained.

p. Replace lubricating oil fittings, and locking plates on stud nuts.

q. */* Check and install the main bearing high temperature trip valves as follows:

(1) Visually check the fuse rod to ensure that it is straight and not damaged.

(2) Ensure that fuse rod is not tripped (see Figure 23).

(3) Install temperature detector into the bearing cap until the fuse rod is flush with or just below the top of the guide tube (see Figure 24). Tighten nut.

(4) Attach the valve to the detector by sliding the valve over the top of the detector and engaging the spring clip into the groove on the detector (see Figure 24).

(5) Ensure there is a gap between the top of fuse rod and the bottom of valve stem. (see Figure 24).

(6) Attach pneumatic tubing to the valve.

4.20.14 */* Replace upper half of the rear seal if removed in Steps 4.20.1b and c.

a. Torque bolts to 60 ft-lbs.

b. Record on "Data" Sheet 22, Sheet 1.

4.20.15 If the internal lube oil header was removed for No. 1 main bearing cap in Step 4.20.1d, replace.

4.21 CYLINDER LINERS (02-315C)

4.21.1 */* IF it was determined in Step 4.5.4i that any pistons were removed at the two previous EOCs, visually inspect the liners for those pistons for progressive wear and to ensure that piston rings are seating properly. (Commitment 8985, 9369)

a. IF cylinder head is not removed, borescopically inspect liner per Step 4.21.2a.

b. IF cylinder head is removed, inspect liner per Step 4.21.2.

4.21.2 */* For any cylinder for which its cylinder head is removed, inspect liner per applicable steps of the following:

NOTE

Step 4.21.2a should be performed with a borescope through the fuel injector port if the head is installed.

a. */* Visually check the cylinder liner for scratches, scuffing or bright spots. (Commitments 8985, 9369)

(1) Record any findings on "Data" Sheet 23, Sheet 2.

NOTE

Dimensional check of cylinder liners in step 4.21.2b is not required to be performed unless directed by Maintenance Supervisor.

b. Perform dimensional check of cylinder liner as follows:

(1) Establish a reference position (see figure on "Data" Sheet 23).

(a) If piston is out of liner, or if liner is removed from block, use the preferred reference position 6 inches from bottom.

(b) If piston is installed in liner, use alternate reference position, 3 inches from top.

(2) */* Using an inside micrometer measure cylinder liner inside diameter (ID) at the reference position.

(a) Take two readings 90 degrees apart.

(b) Record on "Data" Sheet 23, Sheet 2.

(3) */* Take two ID measurements 90° apart for Position 1 approximately 5 inches from the top of cylinder liner.

(a) Record on "Data" Sheet 23, Sheet 2 as Position 1 A and B.

(4) */* Take two ID measurements 90° apart for the Position 2 approximately 16 inches from the top of cylinder liner.

(a) Record on "Data" Sheet 23, Sheet 2 as Position 2 A and B.

(5) */* From the measurements taken in Steps b, c and d, determine amount that liners are out of round (i.e., difference in two readings at each position).

(a) Record on "Data" Sheet 23, Sheet 2.

c. De-glaze the cylinder liner as follows if piston is removed:

(1) For a honing/de-glazing fluid, use kerosene, solvent, soapy water, or honing oils (diesel oil makes a very poor honing fluid).

(2) Ensure that stones remain in contact with surface of the liner bore to make sure the stones are cutting and to prevent the stones from "slapping" liner surface.

(3) Maintain a steady flow of honing fluid to the stones to wash away cuttings and to prevent stone glazing.

(a) If honing/de-glazing is performed with liners installed in the engine, arrange a sheet metal trough under the bottom of the cylinder liner to carry off the fluid and cuttings.

(b) Do not allow cutting-laden fluid to flow over the crankshaft and into the main bearings.

(c) Lay a series of clean wiping rags between the crankshaft webs and the main bearing caps to prevent splashed fluid from entering the main bearings.

(d) Exercise care when removing the rags that cuttings do not fall into the main bearings.

(4) Drive the hone/de-glazer with a powerful, slow turning electric or air drill motor. The surface speed of the stones must be in the range of 25 - 50 rpm, and maintain a stroking rate of approximately 30 complete cycles per minute.

(5) After the first minute of honing/de-glazing, remove the hone/de-glazer from the liner and wash the bore surface and dry it.

(a) Check the surface carefully to determine if there are any low spots.

(b) IF low spots are found, measure the bore carefully with an inside micrometer to determine if liner will be useable, or if it must be replaced.

(6) Continue honing/de-glazing until all surface glaze is removed.

(a) A properly de-glazed liner will have a uniform satin gray appearance with a good cross hatch pattern.

(b) The lines of cross hatch pattern should intersect at an angle of approximately 90 degrees.

(7) When honing/de-glazing is finished, wash the liner bore well with a stiff scrub brush and hot soap and water.

(a) After washing, the surface must be dried completely, and oiled with engine lubricating oil to prevent rust.

(b) Use an air jet to blow out the lubricator tubes or other liner lubrication fittings to remove hone grit which may have entered these fittings during honing.

d. */* Repeat Step 4.21.2b and record measurements in appropriate space on "Data" Sheet 23, Sheet 2.

e. */* For any replacement liners ensure the following dimensions exist or machine liner to meet the specified dimensions.

(1) Upper liner ledge diameter should be 19.496/19.494 inches. (See Figure 23 and Reference 6.2.7.)

(2) Lower liner pilot diameter should be 18.990/18.992 inches. (See Figure 25 and Reference 6.2.7.)

(3) Liner proudness (distance liner protrudes above cylinder block top) should be 0.000/0.007 inches. (See Figure 25 and Reference 6.2.7.)

4.22 CYLINDER BLOCK (02-315A)

4.22.1 */* For any location on the cylinder block top where two or more adjacent cylinder heads (e.g., 5R, 6R, 7R) have been removed, perform the following inspection.

a. If the cylinder heads are removed, perform a. or b., and if applicable c. (Attach NDE Inspection Report.)

(1) */* Liquid Penetrant test (PT) of the cylinder block top cylinder head mating surface to include area adjacent to stud holes and between adjacent cylinder heads. Perform c. if indications are noted. See 5.4 for Acceptance Criteria.

(2) */* Magnetic Particle test (MT) of the cylinder block top cylinder head mating surface to include area adjacent to stud holes and between adjacent cylinder heads. Perform c. if indications are noted. See 5.3 for Acceptance Criteria.

(3) */* Eddy Current test (ET) on the cylinder head stud holes if linear indications found at stud hole extending into thread during tests a. or b. above.

(a) Findings will be reviewed by Engineering.

4.22.2 */* Ensure System Engineer receives a copy of Data Sheet.

4.22.3 */o IF cracks are discovered this shall be reported promptly to NRC staff.

4.23 EXHAUST MANIFOLD (02-380A)

4.23.1 */* Visually examine accessible exhaust manifold pipe welds and corresponding heat affected zones for presence of cracks. (Commitment 9004, 14393)

4.24 CRANKCASE RELIEF VALVES (02-385A)

4.24.1 Remove all left side crankcase doors.

4.24.2 */* Disassemble, clean, inspect and reassemble the crankcase relief valves as follows (Commitment 9005):

a. Check crankcase relief valve [02-385A] located on the left crankcase side doors as follows (Document on "Data" Sheet 4, Sheet 1) (Commitment 9005):

(1) Remove the outside cover of the relief valve by removing the cap nuts.

(2) Remove the cotter pin from the slotted nut.

(3) Compress the spring.

(4) Remove the slotted nut, spring retainer and spring.

(5) Remove disc.

(6) Clean all parts of the relief valve and crankcase door.

(7) Visually check the seat and disc for any condition that might prevent proper seating. (No cuts in O-ring or burrs on seat.)

(8) Visually check shaft for signs of wear of corrosion.

(9) Lightly coat shaft with engine oil and place disc on shaft and check that disc moves easily on shaft.

(10) Install spring.

(11) Compress the spring and install spring retainer and slotted nut.

(12) Tighten nut until top of nut is flush with end of shaft and hole in shaft is aligned with slot in nut.

(13) Install cotter pin.

(14) Replace outside cover and secure with the cap nuts.

4.25 ENGINE BASE (02-305A) AND CRANKCASE (02-311A)

4.25.1 Perform inspection of engine base and crankcase as follows (Commitment 8980):

a. Check engine base internals as follows (document */* on "Data" Sheet 4, Sheet 1):

(1) Wipe down the internal surfaces adjacent to the main bearing stud nut pockets.

(2) Perform a visual check of the base, including the areas adjacent to the main bearing stud nut pockets, for cracks. (Commitment 8980)

(3) If cracks have been previously discovered or new cracks were discovered in Step 4.25.1a(2) above, perform a liquid penetrant (PT) or magnetic particle (MT) inspection of cracks to determine extent and/or growth of crack(s). (Acceptance Criteria per Step 5.4 or 5.3.)

b. */* Check engine crankcase internals as follows (document on "Data" Sheet 4, Sheet 1):

(1) Wipe down the internal surfaces of the crankcase.

(2) Perform a visual check of the vertical crankcase arch wall for cracks. (Commitment 8984)

(3) Perform a visual check of the crankcase-to-base nut pocket area for cracks. (Commitment 3984)

(4) If cracks have been previously discovered or new cracks were discovered in Steps 4.25.1b(2) or (3) above, perform a liquid penetrant (PT) or magnetic particle (MT) inspection of crack(s) to determine extent and/or growth of crack(s). (Acceptance Criteria per Step 5.4 or 5.3.)

4.25.2 */* IF it was determined in Step 4.5.4j that cracks have been previously discovered or new cracks were discovered in Step 4.25.1 above, perform a liquid penetrant (PT) or magnetic particle (MT) inspection of crack(s) to determine extent and/or growth of crack(s). (Acceptance criteria per Step 5.4 or 5.3.)

4.26 JACKET WATER HEAT EXCHANGER

4.26.1 IF it was determined from the trend data in Step 4.5.4c, that the jacket water heat exchanger may be fouling, clean the heat exchanger.

a. Isolate and tag NSCW to the jacket water heat exchanger.

b. Drain the tube side of the heat exchanger.

c. Ensure the jacket water system has been drained.

d. Drain the shell side of the heat exchanger.

e. Remove both end covers of the heat exchanger.

(1) */* Inspect tubes for fouling and clean as required.

(2) */* Inspect epoxy coating on exposed interior surfaces of heat exchanger to ensure no cracking or peeling.

f. */* Install both end covers using new gaskets.

g. */* Remove the jacket water outlet pipe from the south end of the heat exchanger.

(1) Inspect shell side of tubing for fouling.

(2) IF fouling is present it will be necessary to remove tube bundle for cleaning.

(3) Inspect top row of tubes at outlet to verify no tube deformation.

h. */* Install jacket water outlet pipe at south end of the heat exchanger.

4.27 LUBE OIL HEAT EXCHANGER

4.27.1 IF it was determined from the trend data in Step 4.5.4d, that the lube oil heat exchanger may be fouling, clean the heat exchanger.

a. Drain the tube side (jacket water) of the heat exchanger.

b. Drain the shell side (lube oil) of the heat exchanger.

c. Remove both end covers of the heat exchanger.

(1) */* Inspect tubes for fouling and clean as required.

(2) Inspect epoxy coating on exposed interior */* surfaces of heat exchanger to ensure no cracking or peeling.

d. */* Install both end covers using new gaskets.

e. */* Remove the lube oil inlet pipe from the north end of the heat exchanger.

(1) Inspect shell side of tubing for fouling.

(2) If fouling is present it will be necessary to remove tube bundle for cleaning.

f. */* Install lube oil inlet pipe at north end of the heat exchanger.

4.28 ENGINE REASSEMBLY

4.28.1 Install any pistons and connecting rods removed as follows:

a. */* Assemble piston to rods as follows:

(1) Place piston upside down, resting on its crown, on a sheet of plywood.

(2) Ensure piston, piston pin and rods are reassembled in the same relative position as they occupied before disassembly.

(3) Lift connecting rod with rod turning plate or sling then lower end of connecting rod into piston, aligning piston pin hole in rod with that of piston.

CAUTION

Do not permit Felpro C5A or any mixture of it to come into contact with any threaded fasteners as it could damage the fasteners. Damage would occur due to different lubrication properties C5A/Graphite and oil 50/50 mixture.

(4) Coat piston pin with Felpro C5A, or equivalent, prior to assembling in bushing.

(5) Insert piston pin through piston and rod.

(6) Clean piston groove and the outside end of the piston pin retainer rings.

(7) Insert retainer rings into piston grooves at both ends of piston pin.

(8) Apply "Loctite #271" to ends of retainer rings to prevent rings from rotating in the grooves.

b. Install piston and master rod (link rod removed) as follows:

(1) Lubricate walls of cylinder liner with clean lubricating oil.

(2) Install piston ring guide over top of cylinder liner.

(3) If the cylinder head studs are installed, place a piece of 1/2" plywood vertically on the inner side of the outer studs or install aluminum sleeves over the studs.

(4) Prior to barring of the engine, lubricate engine main bearings and cylinder liners in accordance with Step 2.17.

(5) Position crankshaft with crank pin approximately 30° past top center, away from master rod side.

(6) Install a piston pulling fixture on the piston crown.

(a) Record on "Data" Sheet 17, Sheet 1 ID */* numbers for piston used during reassembly.

(b) Record on "Data" Sheet 16, Sheet 2 ID */* number of connecting rod used during reassembly.

(7) Pick up piston and rod with overhead hoist and position over cylinder liner.

(8) Visually check piston and rod assembly for cleanliness.

(9) Lubricate one side of a piece of 3/32-inch compressed gasket material with clean lubricating oil and wrap around lower end of connecting rod with oiled side towards liner wall.

(10) Lower rod into cylinder liner.

(a) Hold piston rings in place as they enter the piston ring guide.

(b) Ensure ring gaps are staggered around */* the circumference of the piston.

(11) Continue to lower piston until connecting rod */* bore is opposite crank pin then remove gasket material.

(12) Install connecting rod bearings as follows:

(a) Ensure all shells have satisfied */* inspection requirements of Step 4.19.2.

(b) Ensure any shells marked for "bottom */* only" are used only as a bottom shell.

(c) Ensure crank pin is clean and free of */* burrs.

(d) Supporting lower shell be hand, place */* shells on crank pin and install locking clips.

(e) Record on "Data" Sheet 18, Sheet 1 */* connecting rod bearing shell ID number for bearing shells used for reassembly.

(13) Attach chain puller bracket, chain puller, chains and master rod bar, then bar crankshaft towards rod.

(14) Install connecting rod saddle and plate on master rod side of crankcase (see Figure 19).

(15) Adjust to hold master rod tight against crank pin.

e. Installation of Piston And Link Rod

(1) Do not rotate crankshaft until link rod has been assembled and bolted to master rod. Block crankshaft to prevent further movement.

(2) Lubricate walls of cylinder liner with clean lubricating oil.

(3) Install piston ring guide over top of cylinder liner.

(4) If the cylinder head studs are installed, place a piece of 1/2" plywood vertically on the inner side of the outer studs or install aluminum sleeves over the studs.

(5) Install a piston pulling fixture on the piston crown.

(a) Record on "Data" Sheet 17, Sheet 1 ID
/ numbers for piston used during reassembly.

(b) Record on "Data" Sheet 16, Sheet 2 ID
/ number of connecting rod used during reassembly.

(6) Pick up piston and rod with overhead hoist and position over cylinder liner.

(7) Visually check piston and rod assembly for cleanliness.

(8) Lubricate one side of a piece of 3/32 inch compressed gasket material with clean lubricating oil and wrap around lower end of connecting rod with oiled side towards liner wall.

(9) Lower rod into cylinder liner.

(a) Hold piston rings in place as they enter the piston ring guide.

(b) Ensure ring gaps are staggered around
/ the circumference of the piston.

(10) Continue to lower piston until connecting
/ rod bore is opposite crank pin then remove gasket material.

(11) Attach chain puller bracket to master rod side of crankcase.

(12) Attach chains to each end of link pin with cap screws, connect other end of chains to chain puller (see Figure 17).

(13) Draw connecting rod box into engagement with crank pin and master rod.

(a) Ensure serrated joints are properly engaged.

CAUTION

All fasteners, washers, contact surfaces and threaded holes should be completely clean prior to applying the graphite and oil mixture.

NOTES

a. The inspections of Steps 4.18.5e(3), 4.18.5e(4) and 4.18.5g or 4.24.2 of Procedure 27562-C should have been performed on all connecting rod fasteners prior to assembly.

b. If connecting rod bolts have been replaced with studs and nuts, use applicable steps of Section 4.24 of Procedure 27562-C, instead of Steps 4.28.1c(14) through (18).

(14) Apply a mixture of powdered graphite and lubricating oil to the threads of the connecting rod bolts and the rod-to-box bolts, washers, nuts and all contact surfaces.

(15) Assemble bolts, nickel plated washers and nuts. Install washers so that bolt head or nut rests in the counter bore of the washer. Ensure rod to box bolts are installed into the holes which they were removed.

(16) Torque the connecting rod, bolt nuts and rod-to-box bolts as follows (record on "Data" Sheet 16, Sheet 8):

(a) Snug all the fasteners down in a crisscross pattern (See Figure on Data Sheet 16) hand tight.

(b) */* Ultrasonically measure all bolt lengths and record on "Data" Sheet 16, Sheet 8.

(c) Using a torque wrench, tighten the fasteners in two steps to 1360 ft-lbs in a crisscross pattern (See Figure on Data Sheet 16). (i.e., apply 680 ft-lbs to each nut or bolt in the sequence shown in Figure on Data Sheet 16 and then repeat for 1360 ft-lbs.)

NOTE

The final step in tightening the connecting rod, nuts and rod-to-box bolts is to stretch the bolts to the specified lengths without exceeding 2000 ft-lbs.

(d) */* Using a torque wrench, tighten the connecting rod bolt nuts until the bolts have stretched 38 mils (± 1 mil) and the rod-to-box bolts until they have stretched 22.5 mils (± 0.5 mil) over the values recorded in Step (2) above, (Stretch is to be determined ultrasonically) tightening in the crisscross pattern shown in Figure on Data Sheet 16. If the required stretch can not be accomplished by applying 2000 ft-lbs or less torque, remove the bolt and examine for the cause of excessive friction. Record the amount of stretch and the torque applied for each bolt on "Data" Sheet 16, Sheet 8.

(e) Align the connecting rod bolt nut cotter pin holes per Step 2.18.1d.

(17) Unblock crankshaft.

(18) Safety-wire bolt heads and install cotter */* pins in slotted nuts in accordance with Appendix A.

(19) Remove all tools. */*

4.28.2 Install any cylinder heads removed as follows:

a. Install or check cylinder head studs as follows:

(1) Lubricate cylinder head stud block side threads with a 50 - 50 mixture of graphite and lubricating oil.

CAUTION

The use of impact type tools to tighten the studs may damage the studs.

NOTE

The free length is measured from the block top to the end of the cylinder head stud.

(2) */* Torque the studs into the block to 80 to 120 ft-lbs.

(a) Measure the free length of the stud.

(b) Use the necessary lock washers (shims) to obtain a stud-free length of 15" ± 1/16".

(c) Record stud-free length on "Data" Sheet 9, Sheet 5.

(3) Any new studs should conform with Reference 6.2.7.

b. Visually check cylinder head for cleanliness and install gaskets.

c. Attach lifting fixture to cylinder head and hoist head in place over cylinder head studs.

d. */* Carefully lower head into place, taking care not to damage stud threads or seals.

(1) */* Record cylinder head used for reassembly on "Data" Sheet 9, Sheet 1.

e. Lubricate cylinder head studs, washers and nut threads with a 50 - 50 mixture of graphite and lubricating oil.

f. Assembly washers and nuts on studs and run down on the threads. Ensure studs are not loose.

g. Install intake elbow to manifold and cylinder head as follows: (Commitment 9001)

(1) Ensure a clean and smooth surface on cylinder head and air inlet manifold.

(2) Visually check the inside of the elbow and manifold for cleanliness.

(3) Install air elbow and check fit between cylinder head and elbow flange with feeler gauges.

(4) Check for freedom of movement of cap screws in the flange holes.

(5) Re-drill or elongate flange holes up to 1/8 inch oversize if necessary to ensure freedom of movement of the elbow and the abutment of the elbow flange to the cylinder head.

(6) Some filing or scraping may be necessary to ensure a reasonably parallel surface, (less than one gasket thickness), between head surface and elbow flange and/or manifold surface and elbow flange.

(7) Double gaskets and R.T.V. may be used to adjust height and/or distance between mating parts. Other castings may be tried in an attempt at a better fit if necessary.

(8) Positively identify elbow to ensure proper reinstallation during subsequent overhauls.

h. Install exhaust elbow by installing the four cap screws.

NOTE

Care should be taken not to further tighten the head studs during installation of heads and torquing of the head stud nuts.

i. */* Tighten cylinder head nuts in three increments, and in a crisscross pattern (reference Figure 3) to 3492 to 3708 ft-lbs.

(1) Repeat crisscross pattern until no nut movement is observed.

(2) Record on "Data" Sheet 9, Sheet 5.

j. Replace cylinder head nut covers.

k. */* Torque intake elbow cap screws to 30 ft-lbs.

(1) Record on "Data" Sheet 22, Sheets 2 and 3.

l. */* Torque the exhaust elbow cap screws to 60 ft-lbs. Record on "Data" Sheet 22, Sheet 4.

m. */* Install jacket water piping to cylinder head by connecting dresser coupling and installing four cap screws.

(1) Torque the jacket water piping cap screws to 30 ft-lbs.

(2) Record on "Data" Sheet 22, Sheet 6.

(3) */* Tighten dresser couplings.

n. Visually check starting air piping for cleanliness.

e. Connect dresser coupling and install four
/ cap screws to cylinder head.

(1) Torque the air start piping cap screws to 30 ft-lbs.

(2) Record on "Data" Sheet 22, Sheet 7.

(3) Tighten dresser couplings.
/

4.28.3 Install air start valves as follows:

a. Remove rags in air start valve hole and ensure that hole is clear.

b. Install new copper gasket for air start valve to
/ cylinder head.

c. Visually check air start valve for cleanliness and then set into place.

d. Check air start valve cap screws for proper
/ length.

(1) Replace any cap screws that exceed 2-3/4 inches.

(2) Document on "Data" Sheet 22, Sheet 5.

e. Run down the two cap screws hand tight.

f. Torque the two cap screws to 150 ft-lbs.
/

(1) Record on "Data" Sheet 22, Sheet 5.

g. Re-torque cap screws after every 8 hours of
/ engine operation until no change in torque is observed.

(1) Record on "Data" Sheet 24.

4.28.4 Install any subcovers removed as follows:

a. Remove rags from intake and exhaust push rod holes in cylinder head.

b. Visually check push rods for cleanliness and then insert into holes.

c. Attach slings to subcover with a shorter sling inboard to establish approximately 45° tilt on cover.

d. Visually check subcover for cleanliness and then lift subcover over head.

e. Apply RTV or equivalent if necessary to ensure that new gasket is in place and start lowering cover.

f. Guide cover down over head clearing valve springs.

g. */* Slowly lower cover until rocker arms come in contact with valves and push rods.

h. Insert bolts into holes and hand tighten.

i. */* Torque subcover bolts to 120 ft-lbs in three increments in a crisscross pattern.

(1) Record on "Data" Sheet 22, Sheet 9.

j. Using a flat wrench roll intermediate rocker arm down and insert connector push rod and release rocker arm.

k. Install the two 1/4" pilot air lines and connect to the air start valve.

l. Blow out and then install the fuel oil supply header, fuel oil recirculation header and lube oil header (if removed). Install subcover clamps for the fuel oil and lube oil headers.

m. Blow out and then install the 3/8" lube oil supply lines from header to the tee on subcover.

n. Blow out and then install the 1/4" air start tubing to connections on each subcover.

o. */* Install and torque rocker arms per Step 4.9.15f(2) for subcovers that were not removed.

4.28.3 Clean crankcase and engine base internals if lube oil was removed.

4.28.6 */* Inspect engine internals as follows:

a. Check lube oil tubing for dents or crimps. (Commitment 8982)

b. Check pneumatic lines to main bearing temperature switches for dents or crimps.

c. Inspect internals for cleanliness including the engine sump drain line to lube oil sump tank, if lube oil was removed.

d. Ensure main bearing cap oil lines are reinstalled if they were removed for manually oiling main bearings.

4.28.7 */* Make a final inspection of the return side (west) of the lube oil sump tank for cleanliness and install manhole cover, if lube oil was removed.

4.28.8 */* IF lube oil system was drained, fill with new lube oil.

a. Fill lube oil sump tank until level reaches MAX STATIC.

b. Remove cover from the lube oil full flow duplex filter for the filter that is in service and add lube oil to fill lube oil heat exchanger and filter.

(1) Fill until level in sump tank begins to rise.

(2) Replace cover on lube oil filter.

4.28.9 Align lube oil keepwarm system for operation.

4.28.10 */* Start lube oil keepwarm pump and check gear train lube oil spray nozzles for flow per Step 4.16.9. (Commitment 9359)

4.28.11 */* Replace crankcase side covers and torque bolts to 30 ft-lbs.

4.28.12 */* Complete gear train inspection of Step 4.16.1 if not complete.

4.28.13 **Replace gear train inspection covers, engine driven jacket water pump and engine driven lube oil pump as follows:**

a. Replace gear inspection covers using new gaskets and torque bolts in accordance with Table 1. */*

b. Install jacket water pump as follows: */*

(1) Ensure both mating surfaces are clean.

(2) Install the jacket water pump adaptor plate to front of gear case using the twelve cap screws.

(3) Torque cap screws to 100 ft-lbs. */*

(a) Record on "Data" Sheet 22, Sheet 10.

(4) Ensure mating surfaces of jacket water pump and adaptor plant are clean.

(5) Install the jacket water pump to the adaptor plate using the eight cap screws.

(6) Torque cap screws to 60 ft-lbs. */*

(a) Record on "Data" Sheet 22, Sheet 10.

(7) Install the jacket water pump suction piping.

(8) Torque the twelve bolts in accordance with Table 1. */*

(a) Record on "Data" Sheet 22, Sheet 10.

(9) Install the jacket water pump discharge piping.

(10) Torque the eight bolts in accordance with Table 1. */*

(a) Record on "Data" Sheet 22, Sheet 11.

(11) Connect the lube oil tubing to the jacket water pump.

(12) Connect the tubing on the discharge piping of the jacket water pump.

c. Install lube oil pump as follows:
/

(1) Ensure mating surfaces of lube oil adaptor plate and gear case are clean.

(2) Install the lube oil pump adaptor plate to the front of the gear case using the eight socket head cap screws and seven hex head cap screws.

(3) Torque socket head cap screws to 60 ft-lbs.
/ and hex head cap screws to 30 ft-lbs.

(a) Record on "Data" Sheet 22, Sheet 11.

(4) Ensure mating surfaces of lube oil pump and adaptor plate are clean.

(a) Install the lube oil pump to the adapter plate using the eight socket head capscrews.

(5) Torque cap screws to 100 ft-lbs.
/

(a) Record on "Data" Sheet 22, Sheet 11.

(6) Install the eight bolts in lube oil pump
/ discharge flange and torque in accordance with Table 1.

(a) Record on "Data" Sheet 22, Sheet 12.

(7) Install elbow on suction of lube oil pump and the fuel oil piping supports using twelve cap screws.

(8) Torque cap screws to 60 ft-lbs.
/

(a) Record on "Data" Sheet 22, Sheet 12.

4.28.14 Complete camshaft inspection of Section 4.13 if not
/ complete.

4.28.15 Complete governor drive inspection of Step 4.14.2 if
/ not complete.

4.28.16 Replace governor coupling flexible element as follows (Commitment 9011, 9110):

a. Position governor coupling adaptor assembly in place above governor drive.

b. Place a few drops of machine oil into the tapped holes in both hubs.

CAUTION

New coupling element should be stamped "N" for neoprene or it should not be installed.

c. Place flexible element into general position with inserts in line with slots in hub flange.

(1) Verify that new coupling element is stamped */* "N" for neoprene.

d. Place a fastener with washer into each of the two solid inserts immediately adjacent to the split insert and engage the threads two or three turns.

e. Repeat this procedure on all other solid inserts working progressively around the circumference.

f. Finally install the fastener with washer in the split insert.

NOTE

The flexible element is now ready to be compressed.

g. Beginning at the split insert, tighten all fasteners to approximately half the distance required to seat the insert in the slot.

CAUTION

The coupling fasteners must be re-torqued after 24 hours of operation or at first stop after at least one hour of operation which ever comes first per Step 4.48.2.

h. */* Tighten the fastener in the split insert to 48 inch-lbs. Move progressively around hubs tightening all fasteners to 48 inch-lbs.

(1) If the split insert does not seat evenly, strike the flexible element with a soft hammer in the area near the insert.

(2) Record on "Data" Sheet 13, Sheet 4.

4.28.17 Install governor as follows (Commitment 9015):

a. Remove inspection plate from front of governor drive housing if installed.

b. Ensure governor coupling is installed.

c. Clean governor adaptor plate mounting surface and install gasket.

d. Set governor on governor adaptor plate engaging governor drive shaft into governor coupling.

e. Install loosely the four cap screws with lock washers through the governor base into adapter plate.

f. Check that the governor coupling adaptor shaft is not being forced against the top of the governor drive vertical shaft.

(1) There should be at least 1/16 inch gap between ends of shafts.

g. */* Torque the four cap screws for the governor base to 30 ft-lbs.

(1) Record on "Data" Sheet 13, Sheet 5.

h. Again check that the governor coupling adaptor shaft is not being forced against the top of the governor drive vertical shaft.

(1) There should be at least 1/16 inch gap (i.e., coupling adaptor shaft should be able to be moved vertically by hand).

i. */* Check governor drive housing to ensure nothing has fallen inside.

j. */* Replace inspection cover and torque the ten cap screws to 144 inch-lbs.

(1) Record on "Data" Sheet 13, Sheet 5.

k. */* Flush the booster servo with clean oil and then install the booster servo on the governor drive housing and torque the four cap screws per Table 1.

(1) Record on Data Sheet 13, Sheet 5.

l. Connect the air supply tubing to the booster servo.

m. Install the governor oil lines between the booster servo and governor.

n. Connect the jacket water supply and return lines to the governor oil cooler.

o. Connect the electrical cable to the governor.

p. Connect extensible link and fuel rack actuator arm to governor actuator terminal shaft ensuring that some over travel on each end, from no-load to full-load fuel position, exists to provide positive fuel rack control.

q. Ensure that linkage is free of binding and without backlash.

r. Drain the oil from the governor.

s. Clean the top of the governor assembly including the oil filler cup cap area.

t. */* Flush governor using Mobilgard 412 or approved equal.

u. */* Refill governor to proper level with Mobilgard 412 or approved equal.

4.28.18 */* Complete overspeed governor and accessory drive inspection of Step 4.15.

4.28.19 **Install overspeed governor drive as follows (Commitment 9183)**

a. */* Install and check the overspeed governor drive coupling as follows:

(1) Remove the adaptor plate from the gear case.

(2) Clean the mating surfaces of the adaptor plate and the overspeed governor drive.

(3) Install the overspeed governor drive with new gasket on the adaptor plate.

(4) */* Torque the five cap screws to 30 ft-lbs.

(a) Record on "Data" Sheet 14, Sheet 3.

(5) Clean the overspeed governor drive coupling, key and shaft.

(6) Check mating surfaces of coupling, key and shaft.

(7) Measure outside diameter of shaft and inside diameter of coupling.

(a) Interference fit should be below 0.0005 inch, if interference fit exists.

(8) Prepare mating surfaces of coupling, key taper pin and shaft with Loctite Safety Solvent No. 745 or equivalent.

(9) Coat mating surfaces of shaft, coupling and key with Loctite 609.

(10) Install coupling and key on shaft.

(11) Coat taper pin with Loctite 609, install and stake in two places.

b. Verify overspeed governor drive coupling location as follows:

(1) Temporarily install the overspeed governor and adaptor plate to gear case with spider between coupling halves (accessory drive half and governor drive half).

(2) Verify coupling halves are snug against spider (7/8 inch separation between hub faces).

(3) Remove the overspeed governor drive and adaptor plate assembly from gear case.

(4) Install the accessory drive coupling shield on the backside of the adaptor plate.

(5) */* Torque the seven cap screws in accordance with Table 1.

(a) Lock wire in accordance with Appendix A.

(b) Record on "Data" Sheet 14, Sheet 3.

c. Install the overspeed governor drive as follows:

(1) Discard used spider.

(2) Install the overspeed governor and adaptor plate assembly to gear case with new spider between coupling halves. (Commitment 9183)

(3) */* Torque the twelve cap screws to 30 ft-lbs.

(a) Record on "Data" Sheet 14, Sheet 4.

d. */* Connect the magnetic pickup wiring (two circuits).

e. */* Disassemble and replace o-rings or replace overspeed trip vent valves connect the pneumatic tubing to the overspeed trip valve.

f. Connect the lube oil supply and drain tubing on the overspeed governor.

g. Install the fuel oil booster pump suction and discharge tubing.

h. */* Install the two inch lube oil line (lube oil supply to turbochargers and rocker arm header).

(1) Torque bolts in accordance with Table 1.

(a) Record on "Data" Sheet 14, Sheet 5.

4.28.20 Install fuel injectors as follows:

a. Remove rag from injector hole in cylinder head and ensure that the hole is clear.

b. Install new gasket for nozzle in place.

CAUTION

Extreme care should be taken not to damage injector tip during installation.

c. Visually check injector nozzle for cleanliness and then carefully insert into place and hand tighten the two 1 1/8" nuts on retainer plate studs.

d. */* Torque the nuts to 75 to 80 ft-lbs.

(1) Record on "Data" Sheet 22, Sheet 8.

e. */* Re-torque nuts after every 8 hours of engine operation until no change in torque is observed.

(1) Record on "Data" Sheet 25, Sheets 1 and 2.

f. Blow out and then install 5/8" fuel supply line from injector to the pump and install clamp. Visually inspect elastomer insert for deterioration or degradation.

g. Blow out and then install the injection line-to-burst header tubing.

h. Blow out and then install the 1/4" line from the injector to the drip header and install clamp.

NOTE

Fuel injection pumps inspected are not to be reinstalled on engine but are to be returned to vendor for refurbishing and calibration unless vendor performed inspection.

4.28.21 Install new fuel injection pump(s) for the pump(s) inspected as follows:

a. Use care to keep the smallest particle of dust or dirt entering pump or fuel inlet line.

b. Keep plugs or caps on pump and line openings until pump is installed.

c. Remove covers placed over fuel injection pump seating surface on engine.

d. Check opening and fuel tappet for cleanliness.

(1) Clean as necessary.

e. Set pump shims on the top of the fuel injector pump base assembly.

f. Install pin-and-deflector (TDI Part No. 02-345-05-AD) into the top of the fuel tappet assembly.

g. Before mounting pump on engine, and with the fuel tappet roller on the base circle of the fuel cam (see Figure 26), measure distance from the fuel pump mounting surface on the base assembly to the tappet with a depth micrometer.

(1) Add or remove shims from the top of the base assembly to obtain a measurement of approximately 0.197 inch.

h. */* Place injector pump on base assembly and install nuts on studs.

(1) Record pump serial number on "Data" Sheet 10, Sheet 1.

i. */* Torque nuts to 80 ft-lbs.

(1) Document torquing of nuts on "Data" Sheet 10, Sheet 1.

j. Timing mark on plunger follower should appear near bottom of timing window.

k. Prior to barring of the engine, lubricate the engine main bearings and cylinder liners in accordance with Step 2.17.

k. Bar engine over in the direction of normal rotation until the flywheel pointer is aligned with the fuel injection point (21° BTDC for right bank, 22° BTDC for left bank) for the cylinder served by the fuel pump being installed.

CAUTION

For fuel injection pumps manufactured prior to March 1982, the timing mark on the plunger follower must never go beyond the upper or lower edge of the timing window. If it does, the pump may be severely damaged.

For fuel injection pumps manufactured since March 1982, the timing mark must never go beyond the upper edge of the timing window, if it does, the pump may be severely damaged. The timing mark on the plunger will fall below the bottom of the window opening when the fuel tappet roller is on the cam base circle, the fuel pump will have to be loosened and checked to ensure that the fuel injection pump internal spring is still under compression. If not, the fuel pump plunger follower is bottoming out against the snap ring and the timing must be rechecked.

m. Observe plunger follower timing mark in pump timing window.

(1) IF the plunger follower timing mark does not line up with the index mark on the timing window, remove pump and add or remove shims between the pump and the pump base assembly as necessary so that the marks will line up.

(2) Reinstall pump.

(3) Re-torque nuts to 80 ft-lbs.

(4) Document torquing of nuts on "Data" Sheet 10, Sheet 1 if re-torquing was required.

n. Bar engine through one complete injection cycle to ensure that marks align at the fuel injection point.

o. Connect fuel control rack to linkage.

p. Blow out and then install 5/8" fuel supply line from injector to the pump and install clamp.

q. Blow out and then install the injection line-to-burst header tubing.

r. Blow out and then install the 1/4" line for the fuel recirculation line from the pump to the header.

s. Blow out and then install the fuel supply line from supply header to fuel injection pump.

(1) IF flexible lines are installed, ensure clamp end is at header.

4.28.22 Adjust cylinder head intake and exhaust valves.

a. Prior to barring of the engine, lubricate the engine main bearings and cylinder liners in accordance with Step 2.17.

b. Adjust the intake and exhaust valve clearance as
/ follows (reference Figure 27):

(1) Bar engine until piston is at TDC on the compression stroke (all valves closed).

(2) Loosen the jam nut on the adjusting screw for the valve to be adjusted.

(3) Turn adjusting screw until a 0.040 inch feeler gauge can be inserted between valve stem and swivel pad.

(4) Tighten adjusting screw until valve begins to open.

(5) Loosen adjusting screw just until feeler gauge can be removed.

(6) Hold adjusting screw and tighten jam nut.

(7) Adjust all four valves, intake and exhaust, to 0.040 inch clearance.

(8) Continue to next cylinder in firing order (1L, 8F, 4L, 5R, 7L, 2R, 3L, 6R, 8L, 1R, 5L, 4R, 2[illegible] 7R, 6L, and 3R).

c. Install the six cylinder head cover mounting studs in subcover.

d. */* Ensure that all tools have been removed from engine.

e. */* Install cylinder head covers.

4.28.23 Ensure turbocharger installation complete.

4.28.24 Ensure jacket water and lube oil heat exchangers are assembled.

4.28.25 Fill jacket water system.

4.28.26 */* Check jacket water piping and components for leaks as follows:

a. Cylinder head jacket water outlet pipes at cylinder heads.

b. Cylinder head jacket water outlet pipes at 90 degree dresser couplings.

c. Turbocharger jacket water inlet piping dresser couplings (below turbochargers).

d. Turbocharger jacket water outlet piping dresser couplings and flanges.

e. Engine driven jacket water pump mechanical seal.

f. Governor heat exchanger tubing.

4.28.27 */* Inform Chemistry Department that engine jacket water system has been drained and refilled.

4.29 FUEL OIL PUMP LINKAGE ASSEMBLY AND BEARINGS (02-371B)

4.29.1 */* Grease swivel link and lubricate all fuel oil pump assemblies. (Commitment 9000)

a. Inject grease into the hole provided in the sixteen spring loaded fuel pump rack control levers attached to fuel control shafts.

b. Coat fuel rack (part of fuel injection pumps) on the sixteen fuel injection pumps with oil and work racks back and forth to check freedom of movement (spring loaded fuel pump rack control levers will move independently of shaft).

c. Add oil to the ten (five per shaft) fuel pump control shaft bearing oil cups.

(1) Ensure there is an oil wick in oil hole.

(2) Ensure oil hole cover cap is intact.

(3) Inject oil under the seals around the shafts with a pointed tip nozzle oil can, taking care not to damage seal.

4.30 GOVERNOR LINKAGE AND BEARINGS (02-413A)

4.30.1 */* Lubricate the rod end fittings and lubricate oil wicks of the cross shaft bearings on governor linkage. (Commitment 9013)

a. Add oil to the four fuel control cross shaft bearing oil cups.

(1) Ensure there is an oil wick in oil hole.

(2) Ensure oil hole cover cap is intact.

(3) Inject oil under the seals around the shafts with a pointed tip nozzle oil can, taking care not to damage seal.

4.30.2 */* Inspect the "Heim" rod ends of the governor-to-cross shaft extensible link assembly.

a. Ensure that the rod ends rotate freely and no binding exists.

b. Lubricate the rod ends with oil.

4.30.3 */* Inspect for loose parts on the governor cross shaft assembly.

a. Check that lever arm cap screws are torqued to 12 ft-lbs.

b. Install positive locking hardware on the lever arm clamp bolt heads and shaft roll pins if bolts or roll pins are found loose during inspection. (To be performed as necessary after tightening governor linkage hardware to design torque specifications.) (Commitment 9010, 13753)

4.31 CRANKCASE VACUUM FANS (02-387A)

4.31.1 Open crankcase vacuum fan 120V AC breakers at 1NBI (1NBO) 1NYI1-03, 1NYI1-04 (1NY02-03, 1NY02-04).

4.31.2 Disconnect wiring at crankcase vacuum fans.

4.31.3 Remove crankcase vacuum fan and oil separators.

4.31.4 */* Disassemble as required to inspect and clean fan and separator.

4.31.5 */* Rotate fan and motor by hand to check bearings for roughness.

4.31.6 Reassemble fan and separator.

4.31.7 */* Install crankcase vacuum fan and oil separators.

4.31.8 Connect wiring at crankcase vacuum fans.

4.31.9 Close crankcase vacuum fan breakers at 1NBI (1NBO) 1NYI1-03, 1NYI1-04 (1NY02-03, 1NY02-04).

4.32 BARRING DEVICE AIR FILTER (02-525C)

4.32.1 */* Replace filter element.

4.33 AIR FILTER TO STARTING AIR DISTRIBUTOR (02-441B)

4.33.1 */* Replace or clean filter elements. (Commitment 9023)

4.33.2 */* Clean and check air start admission valve strainer(s). (Commitment 9023)

NOTE

Step 4.34 is not required at present time, if satisfactory oil analysis is obtained from Maintenance Engineering and Maintenance Supervisor opt to perform later.

4.34 INTAKE AIR FILTER (02-805B)

4.34.1 Drain oil from intake air filter per Reference 6.1.3.1 Bulletin 160-X12-A.

4.34.2 */* Clean air filter oil reservoir per Reference 6.1.3.1 Bulletin 160-X12-A. (Commitment 9079, 13771)

4.34.3 */* Refill air filter oil reservoir with oil per Reference 6.1.3.1 Bulletin 160-X12-A, to middle of bulls eye sight glass.

4.35 FOUNDATION BOLTS (02-550)

4.35.1 */* Visually check foundation for breaks in the bond between the sole plates and grout. (Commitment 9041)

4.36 */* DIESEL STARTING AIR COMPRESSORS (02-835B)

4.36.1 Clean fins on intercoolers and aftercoolers. (Commitment 9082)

4.36.2 Check intake filter element and replace as necessary. (Commitment 9082)

4.36.3 Change compressor oil. (Commitment 9082)

4.36.4 Check belt tension. (Commitment 9082)

4.36.5 Check pulley clamp bolts and set screws are tight. (Commitment 9082)

4.37 AIR DRYERS AND MOISTURE TRAPS (02-835I)
/

4.37.1 Inspect and service moisture traps as follows (Commitment 9088):

a. Disassemble

(1) Open petcock at bottom of air dryer to release any residual air pressure.

(2) Disconnect drain line(s).

(3) Remove ten shell bolts and detach bottom shell assembly from separator.

(4) Remove seal ring retainer and case seal ring.

(5) Remove six screws from piston cylinder and remove cylinder.

(6) Remove nut and lock washer from bottom of valve stem assembly.

(7) Remove piston discs, piston seal, and key washer from valve stem assembly.

(8) Remove valve stem assembly from valve body by lifting valve stem assembly upward.

(9) Remove retainer clip and pivot pin and lift float arm assembly off of valve stem assembly.

(10) Remove pilot valve screw assembly from float arm assembly.

b. Checkout

(1) Pilot Valve Screw Assembly

(a) Visually check assembly for damage.

(b) Repair or replace as necessary.

(2) Valve Disc

(a) Visually check for damage.

(b) Replace as necessary.

(3) Sleeve Seal and Piston Seal

NOTE

Figure 28, Detail A and B show the correct positioning of seals.

(a) Visually check for damage.

(b) Replace as necessary.

(4) Float Assembly

(a) Check for evidence of leakage.

(b) Repair or replace as necessary.

c. Reassembly

(1) Install pilot valve screw assembly onto float arm assembly.

(2) Reassemble float arm assembly to valve stem assembly using pivot pin and retainer clip.

(3) Install sleeve seal on valve sleeve referring to Figure 28, Detail A for proper orientation.

(4) Install valve disc onto valve sleeve.

(5) Reassemble valve sleeve to valve stem assembly.

(6) Lubricate sleeve seal and insert complete valve stem assembly into valve body. Lubricant supplied in repair kit.

(7) Reassemble piston discs and piston seal referring to Figure 28, Detail B for proper orientation.

(8) Reassembly key washer, piston assembly, lock washer and nut to valve stem assembly.

(a) Ensure that key washer is in the hole directly opposite discharge connection on valve body.

(9) Lubricate piston seal and piston cylinder wall. Lubricate supplied in repair kit.

(10) Reassemble piston cylinder to valve body with six screws.

(11) Place seal ring retainer into bottom shell assembly so that end of float arm assembly with counterweight is positioned in open area of seal ring retainer.

(12) Position case seal ring ABOVE the small lip on the seal ring retainer.

(13) Reassemble bottom shell to separator assembly.

(14) Reconnect drain line(s) and close petcock.

4.37.2 Clean fins on air dryer condensing unit.

4.37.3 Measure air dew point ($\leq 50^{\circ}F$).

4.38 GENERATOR

4.38.1 */* Measure generator vibration and check against baseline data. (Maintenance Engineering to perform this step.)

a. Include "Data" Sheet in package. (Commitment 9045)

4.38.2 */* Clean and check all accessible parts of the generator. (Commitment 9045)

4.38.3 */* Megger Diesel Generator using Procedure 25740-C, "Megger Testing The Diesel Generator".

a. Include "Data" Sheet in package. (Commitment 9045)

4.39 GENERATOR PEDESTAL BEARING (02-650C)

4.39.1 */* Drain, flush and refill generator pedestal bearing housing. (See Lubrication Manual for proper oil.) (Commitment 9049)

4.39.2 */* Thoroughly clean the pedestal bearing housing, housing-to-pedestal insulating plates and pedestal.

NOTE

IF the bolted joint between the bearing housing and pedestal has been disturbed, or if directed by the Maintenance Supervision it will be necessary to perform Procedure 27602-C.

4.39.3 */* Measure resistance for the following pedestal bearing components (see Figure 29), resistance should be greater than one megaohm at 500 volts. (Commitment 9049)

a. Check resistance between bearing housing and steel shim.

b. Check resistance between pedestal and steel shim.

c. Check resistance between the four bearing housing-to-pedestal bolts and the steel shim.

4.40 ENGINE CONTROL CABINET (02-500A, C, G, J AND N) (Commitment 9034, 9035, 9036, 9037, 9038)

4.40.1 */* Check cabinet for cleanliness and clean as required.

4.40.2 */* Visually check wiring for insulation degradation.

4.40.3 */* Visually check instrument tubing for leaks.

4.40.4 */* Replace O-rings, gaskets and filter in control air pressure regulator/filter.

a. Inspect filter surfaces for foreign matter to determine if problems may exist down stream.

4.40.5 */* Check circuit breakers and contact blocks for cleanliness, tightness and for wiring degradation.

4.40.6 */* Inspect control valves.

4.40.7 */* Clean accessible relays, terminal boards and switch contacts.

a. Visually check wire insulation and terminals for tightness and degradation.

b. Inspect for arcing and overheating.

NOTE

Control air pressure must be at 60 ± 2 psig prior to performing the following step.

4.40.8 */* De-energize control circuit A and B by placing CB1-2 (Ganged) and CB3-4 (Ganged) to the off position.

a. Verify no audible leakage on the following Humphrey solenoid valves: 202-1A through 202-7A, 202-1B through 202-7B, 201-1B through 201-3B and 3B. [Reference Drawings 1X4AK01-457, 46, 47 for circuit schematic and location.]

4.40.9 */* Perform "Generator And Engine Control Panel Functional Test" per Procedure 27563-C.

4.41 EMERGENCY GENERATOR CONTROL PANEL (CP-102)

4.41.1 */* Check panel for cleanliness and clean as required. (Commitment 9047)

4.41.2 */* Check terminal boards for loose wiring. (Commitment 9047)

4.41.3 */* Visually check condition of wire insulation for degradation. (Commitment 9047)

4.41.4 */* Clean and inspect accessible relay contacts. (Commitment 9047)

4.41.5 */* Check automatic voltage regulator potentiometers which have glyptol applied to side of adjustment screws for signs of relative motion. (Commitment 9187, 15001)

4.41.6 */* Check printed circuit boards for cleanliness and proper mounting of components. (Commitment 9187, 15001)

4.42 FUEL OIL FILTER (02-455A)

4.42.1 */* Clean, inspect and replace fuel oil duplex filter for the section that had been in service as follows:

a. */* Ensure that the filter that is to be replaced is taken out of service (top of selection handle points to filter in service).

b. */* Slowly remove 1/4" drain plug from the bottom of the casing of the filter that is to be replaced.

(1) Drain fuel oil from casing into suitable container.

(2) IF the volume of fuel oil drained is greater than expected and it continues to drain, this indicates that the selection valve is not fully isolating the out of service filter.

(a) Replace the drain plug.

(b) */* A maintenance work order should be written to correct valve when the activity can be scheduled and parts are available.

c. Loosen the nuts on the U-bolt securing the filter casing to the mounting plate.

(1) Remove U-bolt if necessary.

d. Remove center post nut and gasket from top of filter assembly head.

e. Remove casing, center tube and filter element as a unit.

f. Remove filter element from casing.

(1) */* Inspect filter element to determine nature of material caught and record in "Comments" section of "Completion" Sheet.

(2) Discard filter element.

g. Remove the center tube with spring assembly from O-ring is available.

(1) Discard the center post O-ring if replacement is required.

h. */* Clean casing and center tube assembly with clean fuel oil.

(1) */* Apply thread sealant to drain plug and install plug securely into casing.

i. */* Install center post O-ring and center tube with spring assembly into the casing (see Reference 6.2.20).

j. */* Install new filter element in casing.

k. Install casing onto filter assembly head.

(1) Perforated center tube pilots into head.

(2) Center rod and casing for proper alignment.

(3) */* Inspect the canister gasket(s) replace if any signs of deterioration is noted.

l. */* Install center post nut and gasket.

(1) */* Torque center post nut to 60 - 70 ft-lbs. (See Reference 6.2.20)

m. */* Install U-bolt which secures the filter casing to mounting plate.

(1) Tighten the two nuts evenly and snugly (over tightening can cause the casing-to-head gasket to leak).

NOTE

Remove the 1/4" vent plug from the top of the filter assembly head above the casing for which the filter element was replace.

o. */* IF the day tank was isolated, open the day tank isolation valve.

CAUTIONS

a. The following steps must be performed slowly if the engine is in operation to prevent introduction of air into the fuel oil system.

b. If the engine is in operation, fuel oil pressure will be 50 psig.

c. Safety equipment (e.g., eye goggles) should be worn as necessary.

p. Slowly move the filter selection handle toward the filter that is to be vented until the filter is only partially selected.

(1) This can be detected by feeling pressure build up at the vent hole.

q. */* When fuel oil discharges from vent hole, return selection handle to original position so that filter being serviced is no longer selected.

r. */* Apply thread sealant to vent plug and install plug securely into fuel filter assembly head.

s. Slowly move the filter selection handle toward the filter that was replaced until the filter is fully selected.

(1) */* IF the engine is in operation, record the clean filter differential pressure.

t. Check the following areas for leakage and take
/ corrective action as required.

(1) Casing-to-head gasket.

(2) Center post nut to head gasket.

(3) Casing drain plug.

(4) Casing vent plug.

u. Slowly move the filter selection handle toward the
/ filter that was originally in service until the filter is fully selected.

v. IF the filter selection valve did not fully
/ isolate the filter in Step 4.42.1b(2) and fuel oil was lost from the fuel oil system piping during filter element replacement, it will be necessary to back fill the engine fuel oil headers, through the fuel oil return to day tank vent valve located at the north end of the engine, prior to attempting an engine start.

(1) An engine start should be performed to verify
/ fuel oil headers are full prior to returning engine to operable status.

4.43 FUEL OIL STRAINER (02-455B)

4.43.1 Clean and inspect fuel oil duplex strainer for the
/ section that had been in service as follows:

a. Ensure that the strainer that is to be cleaned is
/ taken out of service (top of selection handle points to strainer in service).

b. Slowly open the drain valve on the bottom of the strainer housing of the strainer that is to be cleaned.

(1) Drain fuel oil from housing into suitable container.

(2) IF the volume of fuel oil drained is greater than expected and it continues to drain or if the engine is operating and a suction (negative pressure) is noted at the drain, this indicates that the selection valve is not fully isolating the out of service strainer.

(a) Close the drain valve.

(b) A maintenance work order should be written to correct valve when the activity can be scheduled and parts are available. */*

c. Loosen the bolt on the strainer support bar.

(1) Remove bolt and bar if necessary.

d. Remove nut from strainer housing.

e. Remove strainer element and housing.

NOTES

a. It is not necessary to disassembly strainer element to clean.

b. Plug open ends of strainer during cleaning.

f. Clean strainer element using cleaning solvent and a stiff bristled non-metallic brush. */*

(1) Rinse thoroughly in clean hot water.

(2) Blow off with dry, filtered low pressure (less than 30 psi) compressed air.

(3) Install new screen if required. (See Reference 6.2.20)

g. Clean strainer housing using cleaning solvent and a stiff bristled non-metallic brush. */*

(1) Rinse thoroughly in clean hot water.

(2) Blow off with dry, filtered low pressure (less than 30 psi) compressed air.

h. Install cleaned or new strainer element into housing with new seals. */*

i. Install strainer housing with new seals. */*

j. */* Torque strainer housing nut to 120 - 150 inch-lbs.

k. */* Install the support bar which secures the strainer housing to mounting plate.

(1) Tighten bolt securely (over tightening could damage housing and could cause strainer to leak.

CAUTION

IF the engine is in operation, do not perform the following steps since the strainer would be under negative pressure and air would be introduced into the fuel oil system.

l. */* IF the day tank was isolated, open the day tank isolation valve.

m. Open the strainer drain valve on the strainer that was cleaned.

n. Move the strainer selection handle toward the strainer that is to be filled.

o. */* When fuel oil discharges from the drain valve, close the drain valve.

p. Move the strainer selection handle toward the strainer that was cleaned until it is fully selected.

q. */* Check the following areas for leakage and take corrective action as required.

(1) Strainer housing to strainer body.

(2) Strainer housing nut.

(3) Strainer housing drain valve.

r. */* Reposition the strainer selection handle to select the strainer that was originally in service.

e. */* IF the strainer selection valve did not fully isolate the strainer in Step 4.43.1b(2) and fuel oil was lost from the fuel oil system piping during strainer cleaning, it will be necessary to back fill the engine fuel oil headers, through the fuel oil return to day tank vent valve located at the north end of the engine, prior to attempting an engine start.

(1) */* An engine start should be performed to verify fuel oil headers are full prior to returning engine to operable status.

4.44 AIR BUTTERFLY VALVE (02-475B)

4.44.1 */* Lubricate valve shaft via grease fittings. (Commitment 9032)

4.44.2 */* Verify that associate locking devices (jam nuts and lock washers) are tight. (Commitment 9033)

4.45 INSTRUMENTATION

4.45.1 Ensure all instrument calibrations and inspections have been completed for the following:

a. */* Generator Control Panel Meters - Calibration (Commitment 9047 and 14999)

b. */* Overspeed Trip Vent Valve - Replace O-rings or valves. (Commitment 9007)

c. */* Engine Control Panel Instrument Tubing - Check for leakage. (Commitment 9034)

d. */* Engine Control Panel Space Heater - Functionally check. (Commitment 9034)

e. */* Lube Oil Sump Tank Level Switch - Calibrate. (Commitment 9189, 13783)

f. */* Thermocouples - Sixteen Cylinder Exhaust and two turbocharger stack.

(1) Verify thermocouples read ambient when engine is cold. (Commitment 9042, 13761)

(2) Remove thermocouples and visually check. (Commitment 9043)

(3) Apply heat (between 500°F to 1000°F) to each thermocouple to check accurate reading at digital indicator at engine control panel.

(4) Check wiring at conduit junction box and terminal boards. (Commitment 9044)

g. */* Engine Control Pneumatic Trip Switches (Commitment 9052, 13764)

(1) Low Pressure Lube Oil (F-573-156) - Qty. 3

(2) Low Pressure Turbo Oil (F-573-156) - Qty. 1

(3) Low Press Jacket Water (F-573-156) - Qty. 1

(4) High Vibration (F-573-171) - Qty. 4 - (Functional Only)

(5) High Crankcase Pressure (F-573-359) - Qty. 1

(6) High Temp Jacket Water (F-573-330) - Qty. 3

(7) High Temp Lube Oil (F-573-330) - Qty. 1

(8) High Temp Main Bearings (F-573-271) - Qty. 10

(a) Remove one detector and check setpoint (228°F) per Steps 3.4, 3.9 and 3.10 of Reference 6.6.7.

(b) Replace tested detector with new detector which has been tested per Step 3.11.1 of Reference 6.6.7.

h. */* Jacket Water Heater Thermostat - Calibration (Commitment 9062)

i. */* Lube Oil Heater Thermostat - Calibration (Commitment 9063)

j. */* Full Flow Lube Oil Filter Duplex Differential Pressure Gauges - Calibration (Commitment 9072, 13768)

(1) Engine Control Panel Mounted Gauge

(2) Engine Skid Gauge Panel Mounted Gauge

k. */* Lube Oil Full Pressure Strainer Differential Pressure Gauges - Calibration (Commitment 8975, 14881)

(1) Left Bank Strainer - Engine Skid Gauge Panel Mounted Gauge

(2) Right Bank Strainer - Engine Skid Gauge Panel Mounted Gauge

l. */* Air Start Receiver Pressure Gauge - Calibration (Commitment 9086)

(1) Air Receiver No. 1

(a) Engine Control Panel Mounted Gauge

(b) Air Receiver Mounted Gauge

(2) Air Receiver No. 2

(a) Engine Control Panel Mounted Gauge

(b) Air Receiver Mounted Gauge

m. */* Air Start Receiver Pressure Switch - Calibration (Commitment 9086)

(1) Air Start Receiver No. 1

(a) Low Pressure Switch

(b) High Pressure Switch

(2) Air Start Receiver No. 2

(a) Low Pressure Switch

(b) High Pressure Switch

n. */* Overspeed Trip Pressure Regulator (located under right bank turbo bracket) - Inspection

o. */* STOP/RUN Valve Pressure Regulator (located under left bank turbo bracket) - Inspection

4.46 PREPARING ENGINE FOR OPERATION

NOTE

The following steps are to be performed after the engine has been inspected and is ready to be placed in service.

4.46.1 Ensure that Steps 4.1 through 4.45 have been completed.

4.46.2 Ensure that the Fuel Oil Day Tank to engine isolation valve U4-031(U4-032) is OPEN.

4.46.3 */* Back fill fuel oil system through fuel oil return header vent valve X4-050 (X4-052).

a. Check fuel oil system for leaks including fuel oil filter gaskets. (Commitment 9027, 13758)

4.45.4 */* With the lube oil keepwarm pump operating, check lube oil sump tank level to be within +/- 1/2" of the MAX STATIC mark on the dipstick.

a. Add oil as required.

4.46.5 Ensure LOCAL/REMOTE switch on the Generator Control Panel 1-2403-P5-DG1(3) is in the LOCAL position.

4.46.6 Have tags on air receiver isolation valves U4-765 and U4-769 (U4-722 and U4-729) removed.

4.46.7 */* Ensure valve lineup of Procedure 13145-1 has been performed.

4.46.8 */* Check air butterfly valve movement as follows:

a. Station personnel at the air butterfly valves.

NOTES

a. Valve movement can be verified by observing the exposed top surface of the valve shaft. The mark on the top of the shaft reflects position of valve.

b. Ensure red stop light on Engine Control Panel 1-2403-P5DG2(4) is OFF.

b. Place the engine in MAINTENANCE MODE by depressing the MAINTENANCE MODE pushbutton on the Engine Control Panel 1-2403-P5-DG2(DG4).

c. Observe that the butterfly valves close with no apparent binding. (Mark on top of shaft should be perpendicular with the axis of the intake manifold when valve is closed.) (Commitment 9033)

4.46.9 */* With the shutdown cylinder extended, check tail rod vent on fuel pump linkage automatic shutdown cylinder and verify it is not leaking. (Commitment 9012)

4.47 OPERATION OF ENGINE

4.47.1 */* Ensure engine is ready for LOCAL operation per Procedure 13145-1, but that it is in the MAINTENANCE MODE and LOCAL.

4.47.2 Check response time of the overspeed trip shutdown logic as follows:

a. Station a person (with stopwatches at the first three locations) at each of the following positions.

(1) Left bank air butterfly valve. (Stopwatch)

(2) Right bank air butterfly valve. (Stopwatch)

(3) Governor control cross shaft shutdown cylinder. (Stopwatch)

(4) Engine control panel 1-2403-P5-DG2(DG4).

(5) Overspeed trip switch at overspeed governor.

b. Place engine in the OPERATIONAL MODE by depressing the OPERATIONAL MODE pushbutton on the engine control panel.

c. Manually trip the overspeed trip switch by lifting up both of the small levers on the trip switch.

d. */* Measure the time it takes for the butterfly valves to fully stroke from the initiation of the trip switch. (Maximum acceptable time is 1.5 seconds.)

e. */* Measure the time it takes for the shutdown cylinder rod to fully extend from the initiation of the trip switch. (Maximum acceptable time is 1.5 seconds.)

f. At the engine control panel observe the following:

(1) The OVERSPEED TRIP and NON RESET OF EMERGENCY TRIP annunciators are actuated.

(2) The EMERGENCY STOP and STOPPING lights are ON.

g. Reset both levers on the overspeed trip switch.

h. At the engine control panel perform or observe the following:

(1) Depress the EMERGENCY STOP RESET pushbutton.

(2) Reset and verify reset annunciators OVERSPEED TRIP and NON RESET OF EMERGENCY TRIP.

(3) The EMERGENCY STOP and STOPPING lights are OFF or go OFF after a 2 minute time delay.

4.47.3 Place the engine in the MAINTENANCE MODE by depressing the MAINTENANCE MODE pushbutton on the engine control panel.

NOTES

a. The following steps require operation of the engine.

b. If break in run is required, perform Step 4.47.4 concurrent with Step 4.47.6.

4.47.4 Vent the governor as follows:

a. */* Place diesel generator in LOCAL control at generator control panel. (Operation's responsibility, Maintenance check.)

b. */* Place diesel generator in MAINTENANCE MODE at engine control panel. (Operation's responsibility, Maintenance check.)

c. */* Open the D.C. breaker in the generator control panel to disable generator field excitation circuits and electronic governor. (Operation's responsibility, Maintenance check.)

NOTE

Figure 30 is a drawing of governor components.

d. Open cylinder head indicator cocks on all sixteen cylinder heads.

e. Bar engine over two revolutions per Procedure 13145-1, "Diesel Generators". (Operation's responsibility, Maintenance check.)

f. */* Record governor settings as "As Found" on "Completion" Sheet (Droop, Speed and Load Limit).

g. */* Verify fuel rack shutdown cylinder is extended and fuel pumps are at approximately 3 mm.

h. Perform several air rolls of 3 - 5 second duration adding oil after each roll as required to maintain sight glass level near the top, when engine is stopped.

i. */* When oil level no longer decreases on air rolls, close the cylinder head indicator cocks.

j. Reduce load limit on governor to less than 25%.

k. Reduce speed setting on governor to approximately half of that recorded in Step f.

l. Set droop setting on governor to zero.

m. Establish communications between the governor and operator at engine control panel.

CAUTION

DO NOT increase load limit above the mid position.

n. Start diesel locally per Procedure 13145-1 and quickly increase engine speed to 450 rpm using the speed and load limit knobs, at the governor. (Operation's responsibility.)

(1) Add oil as required to maintain governor oil level at full mark on sight glass.

(2) Set load limit to mid position and ensure governor is controlling speed at 450 rpm. Use the speed knob on governor to adjust speed.

o. On the right (east) side of the governor unscrew and remove the cover for the mechanical actuator needle valve.

CAUTION

DO NOT turn needle valve more than 2-1/2 turns open (counterclockwise).

(1) Using a screw driver turn needle valve counterclockwise until engine starts to hunt (surge). (Commitment 14063)

(a) Monitor oil level in governor.

(b) Add oil to maintain proper level.

(c) Do not fill above the full mark when engine is running.

(2) Allow engine to hunt for 45 to 60 seconds. (Commitment 14063)

(3) Turn needle valve clockwise until engine just stops hunting (surging). (Commitment 14063)

(4) Turn load limit knob to zero and allow engine speed to drop to 350 rpm and then quickly return load limit to mid position. Observe engine and governor response. (Commitment 14063)

(a) IF engine speed is unstable turn needle valve clockwise until engine is stable.

(b) IF engine speed response is too sluggish turn needle valve counterclockwise to give more response.

(5) Repeat Step (4) until engine response is */* satisfactory. (Commitment 14067)

(6) Increase load limit knob to Max. (Commitment 14063)

(7) Set droop knob to 2.5. (Commitment 14063)

(8) Increase speed knob until speed is at 470 rpm. (Commitments 14063, 10035, 13655)

(9) Turn load limit knob to zero and allow engine speed to drop to 300 rpm and quickly return load limit to Max. Observe engine and governor response. (Commitment 14063)

(10) Replace the mechanical actuator needle valve cover on the right side of the governor.

p. When response is satisfactory, close the DC breaker in generator control panel to enable the excitation circuits and electronic governor to function. (Operation's responsibility, Maintenance check.)

q. Momentarily depress the EXCITER ENABLE pushbutton on the generator control panel and observe that the generator voltage builds up to approximately 4160V AC and that frequency stabilizes at approximately 60 Hz.

(1) Adjust, if required, using the local automatic voltage regulator control switch and speed control switch on the generator control panel. (Operations' responsibility.)

→r.

(2) Using the speed knob on the governor, adjust speed until frequency is 62.7 Hz.

(3) Using the speed control switch on the generator control panel, reduce speed to 60 Hz. IT RNG 2/23

r. Increase speed by going to RAISE with the speed control switch on generator control panel. (Operations responsibility.)

(1) Continue to raise with the speed control switch until speed no longer increases. (Do Not exceed64 HZ).

s. Stop the unit. (Operations' responsibility.)

t. */* Record all governor settings (Droop, Speed and Load Limit) on "Completion" Sheet as "As Left" column.

u. */* Torque seal knobs on governor in this position.

NOTE

If breakin run is required, perform steps 4.47.6a through 4.47.6p prior to performing the overspeed test of step 4.47.5

4.47.5 Perform overspeed trip setpoint test per Engineering Procedure 54719-1(54720-1) as follows:

a. */* In addition to the chart recorder channels specified in Step 5.1.6 of 54719-1(54720-1), add Channel 5 as follows:

(1) Connect Channel 5 of the recorder to terminals 7(+) and 8(-) of the tachometer transmitter located in the "A" (north) side of the engine control panel and ensure there is a 250 ohm resistor installed across terminals 7 and 8 of the tachometer.

(2) Span Channel 5 for an Input Signal of 1 - 5VDC full scale (1VDC suppressed) which corresponds to 00-600 rpm (assuming 50 mm chart paper: 12 rpm/mm).

b. */* Perform the overspeed setpoint test per Procedure 54719-1(54720-1). (Commitment 9117, 13778)

(1) In Step 5.2.1 of 54719-1(54720-1), verify from Channel 5 of the chart recorder that engine speed overshoot did not exceed 484 rpm during the engine start transient. (Commitment 9185)

c. */* Remove circuit added for Channel 5 in Step 4.47.5a

4.47.6 **Perform** engine break in run if any pistons were removed **as** follows:

a. Verify that Emergency Diesel Generator has been */* aligned for LOCAL start.

NOTE

Perform only those steps deemed necessary based on the extent of maintenance performed on the engine. It is suggested that following the ten year overhaul that all steps be performed, however, IF the maintenance performed, removed only two pistons then performance of Steps 4.47.6a through 4.47.6aa may be adequate.

NOTE

New piston rings must be seated in the liner as quickly as is practical in order to assure a good gas seal, and an acceptable lubricating oil consumption rate.

b. Open the DC breaker in the Generator Control Panel to disable generator field excitation circuits and electric governor.

NOTE

If governor is to be vented, perform Steps 4.47.4d through 4.47.4m at this time.

c. Remove the cylinder head covers.

d. Start the diesel generator locally per Procedure 13145-1 and quickly increase engine speed to 300 rpm using the speed and Load Limit knobs at the governor. (Perform Step 4.47.4n(1) concurrently, if required.)

e. */* Run engine at 300 rpm for 15 minutes. During the run, inspect rocker arms, valves, push rods, fuel injection lines, and drip return header to be sure all are secure, functioning properly and that there are no fuel leaks.

f. Stop engine locally by depressing STOP pushbutton, per Procedure 13145-1.

g. Place diesel generator in MAINTENANCE mode.

h. Close starting air header isolation valves. Secure lube oil keepwarm pump.

i. Remove crankcase side door covers.

j. */* Feel connecting rod bearing boxes, main bearing caps, crank webs, cylinder liners and pistons (including areas adjacent to piston pins) to be sure there are no indications of excessive heat.

k. Replace crankcase side door covers and the cylinder head covers.

l. Open starting air header isolation valves and start lube oil keepwarm pump.

m. Place diesel generator in OPERATIONAL mode.

n. Start the diesel generator locally per Procedure 13.45-1 and quickly increase engine speed to 300 rpm using the speed and Load Limit knobs at the governor.

o. Increase speed to 470 rpm. (Perform Steps 4.47.4r(2) through 4.47.4r(3) and 4.47.4t at this time, if required.)

p. */* Close the DC breaker in the generator control panel to enable the excitation circuits and electronic governor.

NOTE

Perform overspeed test of step 4.47.5 prior to preceding to step 4.47.6g.

q. Parallel the diesel to off-site power per Procedure 13427-1.

r. */* Load the diesel generator to 20% (1400 kw) and run for one hour.

s. Unload the diesel generator per Procedure 13145-1.

t. Place the LOCAL/REMOTE switch to LOCAL.

u. Place diesel generator in MAINTENANCE mode.

v. Close starting air header isolation valves and secure the lube oil keepwarm pump.

w. Remove crankcase side door covers and cylinder head covers.

x. */* Bar engine over to place each piston in turn at top center. Inspect the lower part of the liner bore.

y. */* Bar engine over to place each piston in turn at bottom center. Inspect the piston skirt.

z. */* Inspect rocker arms, rocker shafts, nozzle holders, high pressure fuel injection lines, and drip return header connections, and all other mechanisms under the cylinder head cover to be sure all is in good order and that there are no fuel leaks.

aa. Replace crankcase side door covers and the cylinder head covers.

bb. Open starting air header isolation valves and start lube oil keepwarm pump.

cc. Place diesel generator in OPERATIONAL mode.

dd. Place LOCAL/REMOTE switch on the generator control panel in the REMOTE position.

ee. */* Start and load the diesel generator, from the Control Room, to 35% load (2450 kw) per Procedure 13145-1 and 13427-1 for one hour.

ff. */* Increase load to 50% (3500 kw) and run for two hours.

gg. */* Increase load to 75% (5250 kw) and run for two hours.

hh. */* Reduce load to 25% (1750 kw) and run for one hour.

ii. */* Increase load to 100% (7000 kw) and run for two hours.

jj. */* Increase load to 110% (7700 kw) and run for 15 minutes.

kk. Unload and stop the diesel generator per Procedure 13145-1.

ll. Place the LOCAL/REMOTE switch to LOCAL.

mm. Place diesel generator in MAINTENANCE mode.

nn. Close starting air header isolation valves and secure the lube oil keepwarm pump.

oo. Remove crankcase side door covers.

pp. */* Perform a hot crankcase web deflection per Step 4.5.3.

qq. */* Check crankshaft thrust per Step 4.5.7.

rr. Allow engine to cool.

ss. */* Repeat the instructions of Steps x through z.

tt. */* Replace the crankcase side covers.

uu. Open starting air header isolation valves and start the lube oil keepwarm pump.

vv. Place diesel generator in OPERATIONAL mode.

ww. Start the diesel generator locally per Procedure 13145-1.

xx. */* Take and record cold compression pressures at 450 rpm per Step 4.5.1.

yy. Stop the diesel generator per Procedure 13145-1.

zz. */* Torque crankcase side cover cap screws per Table 1.

4.48 POST RUN INSPECTIONS

4.48.1 Lube Oil Regulating Valve (00-420)

a. */* During initial startup after a major reassembly of lube piping, the lube oil regulating valve should be disassembled and cleaned (if abnormal pressure changes occur) until abnormal lube oil pressure excursions subside. (Commitment 8979)

4.48.2 Governor Coupling

a. Re-torque the coupling fasteners after 24 hours of operation or at first stop after at least one hour of operation, whichever comes first as follows:

CAUTIONS

a. Do not disconnect tubing between the governor and the governor booster (which is mounted on the governor housing inspection plate) as this will cause loss of governor oil.

b. IF during the following steps any governor oil is lost, ensure oil is added and the governor vented per step 4.47.4 (engine overspeed could result if this is not done).

(1) Remove the capscrews which secure the governor booster to the governor drive housing inspection plate but do not disconnect tubing to booster or governor.

(2) Remove the governor drive coupling inspection plate.

(3) Torque the coupling fasteners to 48 inch-lbs.
/

(a) Record on Data Sheet 26.

(4) Replace inspection cover and torque the tan
/ cap screws to 144 inch-lbs.

(a) Record on Data Sheet 26.

(5) Install and torque cap screws, which secure
/ governor booster to inspection plate, per Table 1.

(a) Record on Data Sheet 26.

4.48.3 Turbocharger Bolting

a. After a turbocharger installation, inspect the
/ turbocharger cap screws per Step 4.7.8 after each of the first three engine operations (where engine operated loaded for at least one hour). (Commitments 9143, 13781)

4.48.4 Air Start Valve Cap Screws

a. Re-torque air start valve cap screws after every 8
/ hours of engine operation until no change in torque is observed per Step 4.28.3g.

4.48.5 Fuel Injector Nuts

a. Re-torque injector nuts after every 8 hours of
/ engine operation until no change in torque is observed per Step 4.28.20e.

4.48.6 Turbocharger Tie Plate

a. Retorque tie plate bolts to 30 ft./lbs. when
/ turbocharger is hot.

5.0 ACCEPTANCE CRITERIA

5.1 Maintenance performed using this procedure is acceptable when:

5.1.1 The "Completion"/"Data" Sheet is properly filled out.

5.1.2 Deviations from the procedure data and recommended settings have been reviewed on a case-by-case basis with the Maintenance Foreman.

5.1.3 Deviations have been identified in the "Comments" section of the "Completion" Sheet.

5.1.4 The "Completion" Sheet has been approved.

5.1.5 Maintenance Work Orders have been written and submitted for conditions evaluated as needing attention.

5.2 Acceptance Criteria for NDE (PT, MT, UT, RT, and ET) results should be in accordance with Reference 6.20 is not stated in procedure.

5.3 Acceptance Criteria standard is ASME SA-613, Section 19 for a Magnetic Particle test.

5.4 Acceptance Criteria for liquid penetrant is ASME SA-613, Section 20.

6.0 REFERENCES

6.1 VENDOR MANUALS

6.1.1 AX4AK01-509, "Instruction Manual" Diesel Generator

6.1.2 AX4AK01-510, "Parts Manual" Diesel Generator

6.1.3 AX4AK01-563, "Associated Publications Manual, Book 1 Diesel Generator - Vendors "A" through "H"

6.1.3.1 AX4AK01-563, American Air Filter Company Publication C "Bulletin 160-X12-A - Operating Instructions

6.1.4 AX4AK01-564 "Associated Publications Manual, Book 2" Diesel Generator - Vendors "I" through "Z"

6.2 PROCEDURES

6.2.1 00304-C, "Equipment Clearance And Tagging"

6.2.2 13143-1, "Diesel Generators"

6.2.3	20427-C,	"Maintenance Cleanliness And Housekeeping Control"
6.2.4	25740-C,	"Megger Testing The Diesel Generator"
6.2.5	27220-C,	"Ingersoll-Rand Generator Air Start Compressor Maintenance"
6.2.6	27245-C,	"Emergency Diesel Air Dryer Condensate Discharge Trap Maintenance"
6.2.7	27562-C,	"Emergency Diesel Generator Maintenance"
6.2.8	27563-C,	"IMO Generator And Engine Control Panel Functional Test"
6.2.9	27570-C,	"Diesel Generator Turbocharger Maintenance"
6.2.10	27577-C,	"Diesel Generator Governor Oil Change"
6.2.11	27590-C,	"Emergency Diesel Generator Governor Flexible Coupling Replacement"
6.2.12	27591-C,	"Emergency Diesel Generator Fuel Injector Maintenance"
6.2.13	27592-C,	"Emergency Diesel Generator Gear Train Inspection And Backlash"
6.2.14	27593-C,	"Emergency Diesel Generator Fuel Injection Pump And Control Linkage Maintenance"
6.2.15	27594-C,	"Emergency Diesel Generator Governor And Governor Drive Maintenance"
6.2.16	27595-C,	"Emergency Diesel Generator Overspeed Governor And Accessory Drive Maintenance"
6.2.17	27596-C,	"Emergency Diesel Generator Engine Driven Jacket Water Pump Maintenance"
6.2.18	27597-C,	"Emergency Diesel Generator Crankshaft Thrust And Web Deflection"

6.2.19	27598-C,	"Emergency Diesel Generator Air Start Valve (02-359) Maintenance"
6.2.20	27599-C,	"Emergency Diesel Generator Fuel Oil Filter And Strainer Maintenance"
6.2.21	27600-C,	"Emergency Diesel Generator Lube Oil Filter And Strainer Maintenance"
6.2.22	27601-C,	"Emergency Diesel Generator Air Start Distributor Maintenance"
6.2.23	27602-C,	"Emergency Diesel Generator - Generator Pedestal Bearing Maintenance"
6.2.24	27603-C,	"Emergency Diesel Generator Break In Run"
6.2.25	54168-C,	"Diesel Generator Commitment Tracking"
6.2.26	54169-C,	"Diesel Generator Miscellaneous Trending And Evaluation"
6.2.27	54170-C,	"Diesel Generator Lube Oil Analysis, Trending And Evaluation"
6.2.28	25250-C,	"General Rigging And Lifting"
6.3	TDI Diesel Generator Design Review and Quality Revalidation (DR/QR) Report - VEGP	
6.4	NUREG-1216	"Safety Evaluation Report Related To The Operability and Reliability of Emergency Diesel Generators Manufactured By Transamerica Delaval, Inc.
6.5	VEGP Lube Oil Manual	
6.6	Service Information Memo (SIM)	
6.6.1	TDI Service Information Memo 164 - Safety Wiring of Fastners.	
6.6.2	TDI Service Information Memo 250 - Cylinder Head Overhaul.	
6.6.3	TDI Service Information Memo 346 - Product Change Notice Bendix FDEX Fuel Injection Pump.	

6.6.4 TDI Service Information Memo 349 - Connecting Rod Assembly.

6.6.5 TDI Service Information Memo 360 - Air Start Valve Capscrews Bottoming in Cylinder Head.

6.6.6 TDI Service Information Memo 363 - Overspeed Governor/Fuel Booster Pump Drive Coupling.

6.6.7 IMO Delaval Service Information Memo 371 - High Temperature Bearing Detectors.

6.6.8 IMO Delaval Service Information Memo 372 - Removal of Spring Pins From R4 Subcover Assemblies.

6.6.9 IMO Delaval Service Information Memo 373 - Installation of Connecting Rod Bearing Shell Dowels.

6.7 Letters and Memos from Transamerica Delaval Incorporation (TDI).

6.7.1 Telex from TDI dated March 26, 1984,
Subject: Oiling of Engine During Disassembly.

6.7.2 Letter from TDI to M. Malcom dated April 4, 1984,
Subject: Dimensions for Cylinder Liners.

6.7.3 Letter from TDI to M. Malcom dated April 29, 2984,
Subject: Dimensions for Cylinder Liners.

6.7.4 Telex from TDI dated May 7, 1984,
Subject: Pre-stressor Hose Rating,

6.7.5 Memo from TDI dated May 7, 1984,
Subject: Interchangeability (upper versus lower) of Bearing Shells.

6.7.6 Memo from TDI dated May 9, 1984,
Subject: Protrusion of Connecting Rod Indexing Pins.

6.7.7 Telex from TDI's Robert Johnson dated May 21, 1984,
Subject: Belleville Spotface Depth.

6.7.8 Telecopy from TDI dated June 11, 1984.
Subject: Tolerance of Torque Values ± 3%.

6.7.9 Telecopy from TDI dated September 7, 1984,
Subject Piston Pin to Bushing Clearance.

6.7.10 Telecopy from TDI dated January 7, 1985,
Subject: Incremental Torquing of Fastners.

6.7.11 Letter from TDI to Larry Eppler dated August 15, 1985,
Subject: Engine Gear Backlash.

6.7.12 Letter from TDI to Steve Phillips dated May 27, 1986,
Subject: Miscellaneous Engine Component Manufacturing Tolerances.

6.7.13 Letter from TDI to George Bockhold dated August 13, 1986,
Subject: Connecting Rod Bolts.

6.7.14 Memo from TDI to Don Kinnsch dated June 2, 1987 (OB-12598),
Subject: Torque Values For 1/4" and 5/16" capscrews.

6.8 MISCELLANEOUS

6.8.1 Letter from Duke Power Company to TDI Diesel Generator Owners Group Executive Committee (OGTP-736-0-449) dated January 11, 1985,
Subject: Design Review of TDI Cylinder Blocks.

6.8.2 Letter from George Bockhold to J. A. Bailey, Log: NOM-00340, dated September 4, 1986,
Subject: Diesel Generator-Generic SER.

6.8.3 Letter from George Bockhold to J. A. Bailey, Log: NOM-00360, dated September 11, 1986,
Subject: Response to Safety Evaluation Report on the Diesel Generators.

6.8.4 Letter from George Bockhold to J. A. Bailey, Log: NOM-00428, dated October 28, 1986,
Subject: Response to NRC Staff Questions Concerning VEGP SER on TDI Diesel Generators.

6.8.5 ASME Standard SA-613-Specifications for Special Requirements for steel castings for Nuclear and Other Special Applications.

6.8.6 Unit 2 Operations Deficiency Report ODR T-2-88-223,
Subject: Engine Driven Jacket Water Pump Impeller Installation.

6.8.7 Failure Analysis Associates Report FaAA-9409011.1, dated December 1984, "Design Review of TDI R.4 and RV-4 Series Emergency Diesel Generator Cylinder Blocks".

6.8.8 TDI Drawing 03-341-7116, Revision E, "Piston Assembly".

6.8.9 TDI Drawing 102673, "Cylinder Head Studs".

6.9 COMMITMENTS

6.9.1 8993

6.9.2 8983

6.9.3 9189

6.9.4 8985

6.9.5 9100

6.9.6 9116

6.9.7 9066

6.9.8 14938

6.9.9 14941

6.9.10 9069

6.9.11 9068

6.9.12 14939

6.9.13 14940

6.9.14 8946

6.9.15 9106

6.9.16 9107

6.9.17 13775

6.9.18 8996

6.9.19 8995

6.9.20	9354
6.9.21	9096
6.9.22	9304
6.9.23	9105
6.9.24	9108
6.9.25	9143
6.9.26	13781
6.9.27	9002
6.9.28	9003
6.9.29	8989
6.9.30	9169
6.9.31	9049
6.9.32	9088
6.9.33	9179
6.9.34	9356
6.9.35	9011
6.9.36	9009
6.9.37	9006
6.9.38	2222
6.9.39	9098
6.9.40	9358
6.9.41	9361
6.9.42	9059
6.9.43	9314

6.9.44	9306
6.9.45	9103
6.9.46	8985
6.9.47	9045
6.9.48	9369
6.9.49	9004
6.9.50	14393
6.9.51	9005
6.9.52	8980
6.9.53	8982
6.9.54	9110
6.9.55	9015
6.9.56	9183
6.9.57	9000
6.9.58	13753
6.9.59	9013
6.9.60	9023
6.9.61	9079
6.9.62	13771
6.9.63	9041
6.9.64	9082
6.9.65	9049
6.9.66	9034
6.9.67	9035

6.9.68	9036
6.9.69	9037
6.9.70	9038
6.9.71	9047
6.9.72	9187
6.9.73	15001
6.9.74	9032
6.9.75	9033
6.9.76	9007
6.9.77	13783
6.9.78	13761
6.9.79	9043
6.9.80	9042
6.9.81	9044
6.9.82	9189
6.9.83	9062
6.9.83	9062
6.9.84	9063
6.9.85	9072
6.9.86	13768
6.9.87	8975
6.9.88	14[illegible]
6.9.89	90[illegible]
6.9.90	9027

6.9.91	13758
6.9.92	9012
6.9.93	9033
6.9.94	9117
6.9.95	13778
6.9.96	9185
6.9.97	8979
6.9.98	9143
6.9.99	13781
6.9.100	14999
6.9.101	9176
6.9.102	9363

END OF PROCEDURE TEXT

APPENDIX A

SUBJECT: SAFETY WIRING OF FASTNERS

DESCRIPTION:

1. Fastners such as bolts, nuts and capscrews which fasten rotating or rediprocating parts together must be secured with safety wire, cotters, locking clips or locking plates.

   1.1 Safety wire and/or locking devices prevent the fastners loosening or falling out while the machinery is in operation.

2. Safety wiring must be done correctly to be effective.

   2.1 Wire must be wrapped around the fastner in the direction to tighten the fastner.

   2.2 Wire must be pulled tight but not overstressed.

   2.3 Wire must be twisted between adjacent fastners and at the cut off end.

      2.3.1 Wire between adjacent fastners should be twisted clockwise in a continuous twist. No eye in the middle.

      2.3.2 Wire at cut off end should be twisted counter-clockwise.

   2.4 Wire must not interfere with rotating parts.

   2.5 Cut ends of wire must be bent to a position where it will not injure personnel.

   2.6 Correct size and type of wire must be used.

      2.6.1 Stainless steel wire is recommended for many applications. See Reference 6.3 for correct wire.

3. See Sheet 2 of this Appendix for illustration of correct method of applying and twisting safety wire.

APPENDIX A

ILLUSTRATION OF CORRECT METHOD OF APPLYING AND TWISTING SAFETY WIRE

BEND OUT OF WAY

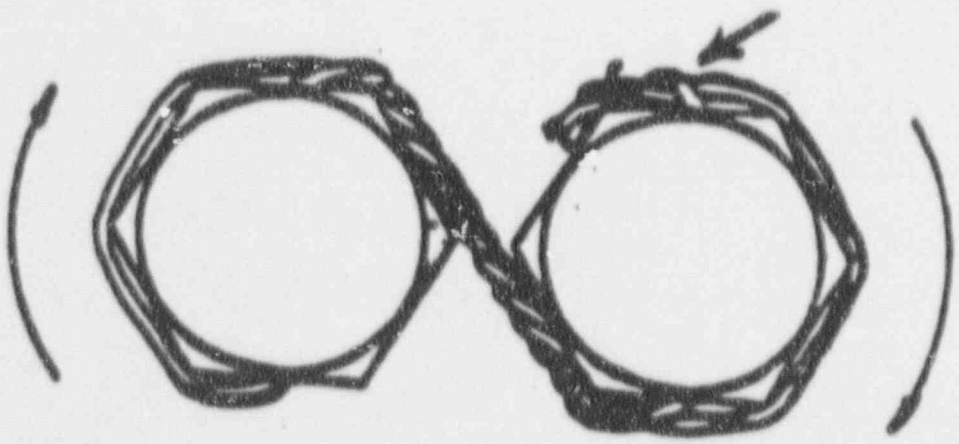


TABLE 1

GENERAL TORQUE VALUES

Bolt Size And No. Threads	Torque (ft-lb)	Kg-m)
3/8-16	12	1.66
3/8-24	15	2.08
1/2-13	30	4.15
1/2-20	35	4.74
5/8-11	60	8.29
5/8-18	70	9.68
3/4-10	100	13.83
3/4-16	115	15.90
7/8-9	160	22.13
7/8-14	180	24.89
8-8	245	33.78
1-14	290	40.11
1-1/87	335	46.33
1-1/8-8	355	48.00
1-1/8-12	395	54.53
1-1/4-7	480	66.38
1-1/4-8	500	69.15
1-1/4-12	620	85.75
1-3/8-8	680	94.04
1-3/8-12	745	103.03
1-1/2-6	735	101.65
1-1/2-8	800	110.64
1-1/2-12	865	119.63

1/4-20	47 inch-lbs
1/4-28	57 inch-lbs
5.16-18	96 inch-lbs
5/16-24	108 inch-lbs

TABLE 2

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GPC STOCK NO.

NOTE

The following parts list is in two categories:

(1) Required Part - Those parts required to perform disassembly, inspection and reassembly with no anticipated problems.

(2) Recommend On Hand - Those parts that may be required under worse case conditions.

4.7 TURBOCHARGER -

NOTE

Quantities shown assumes rotor float check for two turbos and removal/ inspection of one turbocharger.

	Required Parts:		
2	Gasket - Turbo To Air Inlet Adaptor	00-491-01-QJ	11010-05289
4	Gasket - Exhaust Inlet Adaptor To Turbo	F-057-010	29080-26234
9	Multiseal - Adaptor To Exhaust Manifold	JA-037-000	29090-15910
1	Gasket - Turbo To Exhaust Outlet Adaptor	00-495-03-AG	29080-08118
1	Gasket - Intercooler Inlet Adaptor To Turbo	02-475-08-AH	11010-05288
1	Gasket - Intercooler Inlet Adaptor To Inter	02-475-02-QP	29080-07118
2	Gasket - Turbo Lube Oil Drain Lines	20-465-01-QS	29080-08132
1	Gasket - Intermediate Casing	390654-1	29080-24941

TABLE 2 (CONT'D.)

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GPC STOCK NO.
		Recommended On Hand:		
	2	Oil Seal - Turbine End	380756-3	29080-24942
	2	Oil Seal - Blower End	380757-3	29080-24944
	2	Bearing - Turbine End	380632-2	31010-5783
	2	Bearing - Blower End	380631-1	29130-8258
	2	Rotor Assembly	370697-28	29150-21570
	4	Snap Ring	P27C73	29030-24943
	2	Stop Nut	P14G25	29070-24945
	2	Joint Compound	B-6099-008	29200-24946
	2	Thread Compound	B-6099-010	29100-24948
	2	Shaft Compound	B-6099-009	29050-24947
	1	Lock Wire	36054028	29100-7126
	2	Nozzle Ring	370692-10390	29030-26657
			370692-10	29080-7127
	16	Nozzle Ring Bolts	3908472	53020-5787
	16	Nozzle Ring Washers	P25D585	53030-5771
4.7.7		INTERCOOLER		
		Recommended On Hand:		
	2	Gasket Set - Intercooler End Plates	F-068-077-01	
	2	Gasket - Intercooler To Inlet Adaptor	02-475-02-CP	29080-07118
	2	Gasket - Intercooler To Outlet Adaptor	02-475-02-CP	29080-07118
	2	Gasket - Turbo To Intercooler Inlet Adaptor	02-475-08-AH	11010-05288
	2	Gasket - Intercooler Outlet Adaptor To Spool	02-475-19-AE	11010-05241
	4	Gasket - Jacket Water Piping Flanges	93375	11010-05293
	3	Gasket - Jacket Water Dresser Coupling	CG-005-012	29080-24881
	1	Gasket - Jacket Water Dresser Coupling	CG-019-014	29080-24768
4.7.8		TURBOCHARGER BRACKET BOLTS		
		Recommended On Hand:		
	24	Cap Screw - Bracket-To-Engine	GB-001-143	
	8	Cap Screw - Bracket-To-Turbo	GB-001-120	

TABLE 2 (CONT'D.)

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GPC STOCK NO.
4.8		FUEL INJECTORS		
		Recommended on Hand:		
	2	Body	F-075-108	N/A
	16	Shim .005	F-075-117	29070-07115
	16	Shim .006	F-075-116	29070-07116
	16	Shim .008	F-075-115	53170-05256
	16	Shim .010	F-075-114	29070-07117
	16	Shim .031	F-075-113	53170-05257
	2	Spring Seat	B-8341-006	53160-0576C
	2	Spring	B-8341-011	53160-05798
	2	Rod	F-075-112	29200-24822
	2	Stop Plate	B-8341-009	29200-24823
	2	Nozzle Valve Assembly	B-8342	29070-07133
	16	Spray Trip	HD-004-000	29070-07125 29060-05762
	2	Assembly Nut	F-075-127	N/A
	2	Retainer, Nozzle Holder	03-365-01-GB	N/A
	16	Nozzle Holder	F-075-105	29060-06511
4.9		SUBCOVER		
		Recommended On Hand:		
	2	Subcover Assembly	1A-5529	29060-06487
	4	Push Rod - Intake and Exhaust	02-390-06-AB	29060-06515
	2	Push Rod - Connector	02-390-07AG	29060-06488
	2	Bushing - Intake Rocker Arm	03-390-01-GC	29020-06489
	2	Bushing - Exhaust Rocker Arm	03-390-01-GG	29020-06490
	2	Bushing - Intermediate Rocker Arm	03-390-01-GE	29020-06492
	2	Push Rod Socket	05-390-01-GF	29060-06505
4.10		AIR START VALVES		
		Required Parts:		
	16	Roll Pin - Air Start Valve	GC-001-060	29070-07123
		Recommended On Hand:		
	2	Air Start Valve Assembly	1A-6249	29060-06512
	2	Valve	02-359-03-AJ	29060-06513
	2	Spring	02-359-03-AP	29070-24805
	4	Ring	JC-[illegible]2-000	29030-10349
	2	Piston	02-[illegible]9-03-AH	29010-26124
	32	Cap Screws	GB-032-113	29070-07265

TABLE 2 (CONT'D.)

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GPC STOCK NO.
4.11		CYLINDER HEADS		
		Required Parts: (If three heads removed)		
	6	Wiper - Inlet Valve	JA-048-000	29070-07273
		Recommended On Hand:		
	3	Cylinder Head	1A-6446	29060-05770
	6	Valve - Exhaust and Intake	03-360-02-CD	29060-06507
	6	Spring - Valve	03-360-02-CM	53160-05780
	12	Wedge (Halves)	7669-002	29060-05763
	6	Rotator - Valve	F-108-033	59120-06508
	6	Oil Shield - Inlet Valve	JA-040-000	29060-05309
	3	Stud - Injector	03-360-03-CD	29070-24809
	3	Lock Washer - Injector Stud	GA-002-009	N/A
	3	Indicator Cock (Kiene)	F-160-032	29060-06514
4.12		FUEL INJECTION PUMP		
		Required Parts:		
	1	Tool - Delivery Valve Puller	11-57-35	N/A
4.13		CAMSHAFT AND TAPPETS (If Inspected)		
		Required Parts:		
	40	Cap Screw - Camshaft Cover Bridge	GD-011-018	29070-07530
	20	Seal - Cam Side Cover To Bridge	08-395-04-AM	31040-05344
	16	Gasket - Cam Side Cover To Block	02-385-01-AL	11010-05290
	64	Cap Screw - Cam Side Cover	GB-001-095	29070-08112
	16	Stud - Cam Side Cover	423	29070-07089
		Recommended On Hand:		
	200	Cap Screw - Cam Side Cover	GB-001-095	29070-08112
	4	Shell - Cam Front Bearing - Thrust	02-350-01-CN	29200-24790
	1	Tappet and Guide - Intake and Exhaust	1A-4225	29070-08259
	1	Tappet and Guide - Fuel	1A-6165	29020-08257
	1	Tappet - Fuel	1A-6166	29200-24780
	1	Bushing - Roller - Intake and Exhaust	08-345-03-AB	29020-24784
	1	Bushing - Pin - Intake and Exhaust	08-345-03-AC	29020-24783

TABLE 2 (CONT'D.)

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GRC STOCK NO.
	1	Pin - Roller - Intake and Exhaust	08-345-03-AD	29030-24782
	1	Bushing - Pin - Fuel	02-345-01-CE	29020-24785
	1	Bushing - Roller - Fuel	02-345-01-CF	29020-24787
	1	Roller - Cam - Fuel	02-345-01-CB	29200-24786
	1	Pin - Roller - Fuel	02-345-03-AB	29030-26123
	1	Guide - Tappet - Intake and Exhaust	02-345-03-AC	29200-24788
	1	Guide - Tappet - Fuel	02-345-03-AD	29200-24789
4.14		GOVERNOR DRIVE, COUPLING AND GOVER. R		
		Required Parts:		
	1	Taper Pin - #4 X 2-1/4"L	GC-003-100	53070-05781
	4	Dowel - 1/4" X 2-1/4"L	GC-004-057	29070-21564
	6	Clip - Nut Lock	180-010	29060-11626
	2	Dowel - Governor Drive Bracket To Crankcase	109-002	29070-08136
	2	Dowel - Support Housing To Gear Case	106-002	
	1	Gasket - Housing To Generator	97326	29080-07250
		Recommended On Hand:		
	1	Governor Drive Assembly	1A-7015	N/A
	2	Bushing - Horizontal Drive Shaft	02-411-02-AP	29020-21549
	2	Bushing - Vertical Drive Shaft	02-411-02-AN	29020-21566
	1	Shaft - Governor Drive Gear Drive	02-411-02-AD	29050-21565
	1	Gear - Horizontal Shaft Drive	02-411-01-CA	29130-22082
	1	Gear - Horizontal Shaft Drive	02-411-01-CB	29130-21553
	2	Key - Woodruff #21	GD-001-031	29030-21563
	1	Shaft - Governor Drive Gear (Vertical)	02-411-03-AA	
	1	Gear - Vertical Shaft Drive	02-411-02-AB	
	1	Key - Woodruff #13	GD-001-013	29030-21552
	1	Collar - Vertical Shaft Retainer	95701	
	1	Coupling - Vertical Shaft Flexible	AK-007-000	
	1	Adaptor - Coupling	02-411-06-AA	29060-05802
	2	Key - Flexible Coupling	98164	
	1	Coupling - Governor	03-402-04-AB	29060-05792

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GPC STOCK NO.
4.15		OVERSPEED GOVERNOR AND ACCESSORY DRIVE AND COUPLING		
		Required Parts:		
	1	Pin - Groove - 1/4" X 2-1/4"L	GC-005-085	29030-21560
	1	Pin - Groove - 1/4" X 2-3/4"L	GC-005-087	29030-21562
	1	Pin - Groove - 5/32" X 2"L	GC-005-049	29030-21561
	4	Clip - Lock	180-010	29060-11626
	2	Dowel - Drive To Block	109-002	29070-08136
	1	Gasket - Plate To Gear Case	97326	29080-07250
	2	Dowel - Plate To Gear Case	107-003	
		Recommended On Hand:		
	2	Drive Coupling (Half)	F-034-061	29060-07120
	7	Cap Screw - Drilled Head	F-014-121	29070-07108
	2	Bushing	02-411-02-AP	29020-21549
	1	Key - No. 21 Woodruff	GD-001-031	29030-21563
	1	Key - No. 9 Woodruff	GD-001-009	
4.16		GEAR TRAIN		
		Required Parts:		
		None		
4.17		LUBE OIL SUMP TANK		
		Required Parts:		
	1	Gasket - Manhole Cover	02-540-06-AE	29080-26630
	6	Filter Elements - L.O. Keepwarm	76021-115-01	14000-17018
	1	O-ring - L.O. K.W. Filter Cover	76021-114-02	29080-30159
	1	Gasket - L.O. K.W. Strainer Cover	SE-031-002	29080-27349
	1	Packing - L.O. K.W. Strainer	SE-031-001	29080-27348
	1	O-ring - L.O. Duplex Filter	76021-115-02	29080-30160
	27	Filter Elements - L.O. Filter	76021-115-01	14000-17018
		Recommended On Hand:		
	1	Screen - Sump Tank Strainer 16 X 16 Mesh 0.018 Dia. Brass Wire	R-3577	
	1	Copper Wire #20 Gauge X 12'	N/A	
	1	Gasket - Sump Tank Strainer	R-2929	

TABLE 2 (CONT'D.)

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GPC STOCK NO.
	16	Nut - Hex - Elastic Stop	B-8239	
	1	Foot Valve	KF-003-000	
	1	Gasket - 6" - For Foot Valve	101223	
	1	Lube Oil Heater	76021-112	
	1	Gasket - Lube Oil Heater 8" - 150#	16890 or 101231	
4.18.2		PISTONS		
		Recommended On Hand:		
	2	Skirt - Piston	03-341-04-AE	29040-07096
	8	Washer - Belleville	FA-033-000	53110-06509
	8	Groove Pins	GC-023-000	53070-05765
	8	Nut - Piston Stud	03-341-02-AF	54030-05768
	8	Stud - Piston	03-341-04-AB	29070-07258
	2	Crown - Piston	03-340-04-AE	29070-10354
	4	O-Ring	JF-023-000	31020-05334
	8	Collar	03-341-04-AC	29060-07259
	8	Lok Tab	03-341-04-AD	29070-07248
	2	Dowel	105-002	29030-06510
	2	Pin - Piston Assembly	1A-1707	29030-06519
	4	Ring - Piston Pin Retainer	GE-003-067	29030-07101
	2	Ring Set - Piston	JC-039-002	29030-05319
	8	Spring Guide	03-341-04-AF	29060-12774
4.18.3		CONNECTING RODS		
		Recommended On Hand:		
	2	Dowel - Connecting Rod Bearing	R-3216	29070-07267
	4	Bushing - Conn Rod Piston Pin	R-3195	29020-08165
	4	Setscrew - Conn Rod Bushing, Locking	02-340-03-AP	29070-10348
	4	Nut - Conn Rod Bolt	R-132	53040-05259
	4	Bolt - Conn Rod to Box 19"L	02-340-11-AF	29070-07271
	12	Washer - Conn Rod Bolt	R-1317	53030-05324
	8	Bolt - Conn Rod 11-3/16"L	02-340-10-AJ	53020-06756
	2	Bushing - Conn Rod Box	02-340-03-AT	29020-24774
	2	Locking Clip	180-015	29070-08123
	2	Pin - Box Bushing Lock	R-1013	29030-24776

TABLE 2 (CONT'D.)

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GPC STOCK NO.
4.19		CONNECTING ROD BEARINGS		
		Recommended On Hand:		
	4	Bearing Shell - Conn Rod	02-340-04-AG	31010-05346
	4	Retainer Ring - Conn Rod	02-340-01-CH	29030-05311
4.20		CRANKSHAFT AND MAIN BEARINGS		
		Recommended On Hand:		
	4	Dowel - Crankshaft Bearing Cap	03-305-02-BM	53070-05277
	4	Bearing Shell - Main, Intermediate	R-3315	31010-05345
	4	Bearing Shell - Main, Rear	R-3317	31010-05347
	4	Locking Ring - Main Bearing Shell	R-3155	29030-05255
	4	Oil Ring (16 Gauge)	R-3149	10020-06730
	2	Thrust Ring	R-3319	29030-06496
	8	Cap Screw - Button Head - Mylock	F-014-064	29070-06255
	2	Trip - Main Bearing Temperature	F-573-271	59200-06494
4.21		CYLINDER LINER		
		Recommended On Hand:		
	1	Cylinder Liner	02-315-02-CG	29170-15933
	2	Ring - Cylinder Liner Seal	JF-019-000	29030-07274
	1	Glaze Breaker - Bottle Brush	AR-053-000	29150-26660
4.22		CYLINDER BLOCK		
		Required Parts: None		
4.23		EXHAUST MANIFOLD		
		Required Parts: None		

TABLE 2 (CONT'D.)

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GPC STOCK NO.
4.24		CRANKCASE RELIEF VALVES		
		Required Parts:		
	8	Repair Kit - Relief Valve Assembly	F-152-052-01	29200-24832
		Recommended On Hand:		
	1	Relief Valve Assembly	F-152-052	29110-24831
4.25		ENGINE BASE AND CRANKCASE		
		Required Parts:		
		None		
4.26		JACKET WATER HEAT EXCHANGER		
		Required Parts: (If disassembled)		
	1	Gasket Kit Without Packing	76021-104-07	11010-09330
	1	Gasket - 8" - 150# J.W. Outlet	19195	11010-05269
		Recommended On Hand:		
	1	Gasket Kit With Packing	76021-104-06	29080-25350
	1	Lantern Ring	76021-104-08	31020-09311
	4	Gasket - For 8" Dresser Coupling	ZC-068-015	29080-24928
4.27		LUBE OIL HEAT EXCHANGER		
		Required Parts: (If disassembled)		
	2	Gasket - Cover	76021-107-01	29080-30147
	1	Gasket - 8" 150# L.O. Inlet	101231	29080-07988
		Recommended On Hand:		
	1	Packing - Channel To Tube Sheet	76021-107-02	29080-30148
	1	Packing - Shell To Tube Sheet	76021-107-03	29080-30149
	2	Gasket - For 6" Dresser Coupling	ZC-068-014	29080-24929

TABLE 2 (CONT'D.)

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GPC STOCK NO.
4.28		ENGINE REASSEMBLY		
4.28.1		Piston And Connecting Rods (If two sets removed)		
		Required Parts:		
	1	Lock Wire - 0.063" Diameter Stainless	F-161-001-01	29060-05807
	4	Cotter Pin - 1/4" X 3"L	GC-022-055	29070-07124
4.28.2		CYLINDER HEADS		
		Required Parts: (If four heads removed)		
	4	Cylinder Head Gasket Set	1A-7363	11010-05805
		Recommended On Hand:		
	10	Ferrule - Push Rod Tube Seal	03-360-03-CB	29060-06493
	20	Ferrule - Head To Water Block Passage	95782	29080-07093
	37	Ferrule - Head To Water Block Passage	95781	2960-06506
	16	Cylinder Head Gasket Set	1A-7363	11010-05805
4.28.3		AIR START VALVES		
		Required Parts:		
	*16	Gasket - Air Start Valve To Head	03-359-01-CE	11010-05310
	*16	O-ring - Air Start Valve	JF-022-334	29080-22340
	*	O-ring - Air Start Valve	JF-022-228	31020-05260
4.28.4		SUBCOVERS		
		Recommended On Hand:		
	11	Cap Screws - Subcover To Cylinder Head	GB-011-121	29070-26529
	4	Bolt Rocker Arm	02-390-06-AA	29070-07266
4.28.7		LUBE OIL SUMP TANK		
		Required Parts: (If lube oil removed)		
	1	Gasket - Manhole Cover	02-540-06-AE	29080-26630

* Contained in cylinder head gasket set also.

TABLE 2 (CONT'D.)

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GPC STOCK NO.
4.28.8		LUBE OIL		
		Required Parts: (If lube oil removed)		
	1500	Oil - Mobil 412	412	91030-03373
4.28.11		CRANKCASE SIDE COVER		
		Required Parts:		
	16	Gaskets - Side Cover To Crankcase	02-386-01-AF	
		Recommended On Hand:		
	160	Cap Screws	GB-001-095	29070-08112
	32	Stud	423	29070-07089
4.28.13		GEAR INSPECTION COVERS, JACKET WATER PUMP, LUBE OIL PUMP		
		Required Parts:		
	2	Gasket - Cam Gear Cover	97363	11010-05244
	2	Gasket - Cam Gear Cover	02-385-01-AJ	11010-05268
	1	Gasket - J.W. Pump Adaptor Plate	02-425-06-AG	29080-07256
	2	Dowel - J.W. Pump Adaptor Plate	GC-004-132	29070-08116
	1	Gasket - J.W. Pump To Adaptor Plat	02-425-03-AM	11010-05242
	2	Gasket - J.W. Pump Discharge	19195	11010-05269
	1	Gasket - J.W. Pump Suction	08-717-01-BF	29080-07985
	2	Dresser Coupling Gasket	ZC-088-016	29080-24934
	1	Gasket - L.O. Pump Adaptor Plate	02-420-02-CH	29060-05341
	1	Gasket - Lube Oil Pump To Adaptor Plate	08-420-04-CH	29080-21550 29080-07254
	1	Gasket - Elbow To Lube Oil Pump	04-420-04-CG	11010-05292
	1	Gasket - Elbow To Suction Piping	101223	29080-17299
	2	Dowel - Adaptor Plate To Gear Case	GC-004-136	29030-06495
	1	Gasket - Pump Discharge	13452	11010-05297
	2	Dresser Coupling Gasket	ZC-088-014	29080-24929
	1	Gasket - To Regulator Valves - 4"	18532	11010-05278

TABLE 2 (CONT'D.)

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GPC STOCK NO.
4.28.16		GOVERNOR COUPLING		
		Required Parts:		
	1	Coupling Elastomeric	AR-007-001	29060-05803
4.28.17		GOVERNOR		
		Required Parts:		
	1	Gasket - Governor To Adaptor	94652	29080-07253
	1	Gasket - Cover To Housing	02-411-03-AG	11010-05800
4.28.19		OVERSPEED GOVERNOR DRIVE		
		Required Parts:		
	1	Gasket - O.S. Trip Drive To Manufacturing Plate	02-410-04-OQ	29080-07251
	1	Spider - O.S. Trip Drive Coupling	F-034-062	29060-07109
	A/R	Wire - Locking - No. 19 Gauge Iron	GA-005-020	29060-05286
		Recommended On Hand:		
	1	Coupling - Fuel Oil Booster Pump	F-034-064	29060-07121
	1	Coupling - Fuel Oil Booster Pump	F-034-062	29060-07122
	1	Spider - Fuel Oil Booster Pump Coupling	F-034-065	29060-06503
	1	Pin - Taper No. 2 X 1-5/8"L	GC-003-208	29030-10442
	2	Gasket - Lube Oil Line 1-1/2" - 150#	78663	29080-24897
	2	Gasket - Lube Oil Line 2" - 150#	08-545-02-AD	
	1	Pin - Taper No. 4 X 2"L	GC-003-009	29030-28951
4.28.20		FUEL INJECTORS		
		Required Parts:		
	*16	Gasket - Nozzle Holder To Head	R-2322	11010-05761

TABLE 2 (CONT'D.)

PARTS LIST

SECT NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GEC STOCK NO.
4.28.21		FUEL INJECTION PUMPS		
		Required Parts:		
	1	Fuel Injection Pump	F-099-180	29090-07095
	2	Shim - Pump To Base (.003")	R-1437	29200-26231 53170-05758
	2	Shim - Pump To Base (0.010")	R-1438	29200-26232 53170-05757
	2	Shim - Pump To Base (0.062")	03-345-01-CD	29200-24811
		Recommended On Hand:		
	16	Fuel Injection Pump	F-099-180	29090-07095
4.31		CRANKCASE VACUUM FAN		
		Required Parts:		
	2	Gasket	02-387-06-AQ	
	2	Gasket	02-387-04-AB	
		Recommended On Hand:		
	1	Fan - Crankcase Vacuum	EJ-002-000	29200-26548
4.32		BARRING DEVICE AIR FILTER		
		Required Parts:		
	1	Filter - Element		
4.33		STARTING AIR DISTRIBUTOR AIR FILTER		
		Required Parts:		
	2	Elements - Air Filter	SB-006-002	29150-22712
	2	O-ring - Air Filter	SB-006-004	31020-23005
4.34		INTAKE AIR FILTER		
		Required Parts:		
	A/R	Oil		

TABLE 2 (CONT'D.)

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GPC STOCK NO.
4.36		AIR COMPRESSORS		
		Required Parts:		
	2	Elements - Filter	76021-12721	14000-17053
	A/R	Oil		
		Recommended On Hand:		
	2	Belts	76021-127-25	
4.37		AIR DRYERS AND MOISTURE TRAPS		
		Required Parts		
	2	Repair Kits	05.7501-03	29200-23205
		Recommended On Hand:		
	A/R	Refrigerant - R12	R12	91060-09936
	1	Air Dryer Assembly	76021-129	29150-24524
	1	Trap - Air Dryer	76021-129-21	
4.38		GENERATOR		
		Required Parts:		
		None		
4.39		GENERATOR PEDESTAL BEARING		
		Required Parts:		
	A/R	Oil		
		Recommended On Hand:		
	1	Seal - Dust	76021-101-17	29080-21095
	1	Seal - Shaft To Bearing	76021-101-18	29080-21094
	1	Gasket - Housing	76021-101-19	29080-21093
4.40		ENGINE CONTROL PANEL		
		Required Parts:		
	1	Filter - Control Air	F-527-002-03	29160-26617
	1	O-ring - Filter	F-527-002-02	29080-24908
	1	Regulator Repair Kit	F-579-061-01	29190-35350
	1	Regulator - Control Air	F-579-061	29190-35350

TABLE 2 (CONT'D.)

PARTS LIST

STEP NO.	QTY.	PART DESCRIPTION	VENDOR PART NO.	GPC STOCK NO.
4.41		GENERATOR CONTROL PANEL		
		Required Parts:		
		None		
4.42		FUEL OIL FILTER		
		Required Parts:		
	1	Element - Fuel Filter	F-044-120	14000-06504
	1	Gasket - Fuel Filter	SC-011-001	29080-24892
	1	Gasket - Cover	SC-011-002	11010-14543
	1	O-ring - Center Post	SC-011-005	29080-26610
		Recommend On Hand:		
	1	Casing Subassembly - F.O. Filter	SC-011-007	
	1	Center Post Nut - F.O. Filter	SC-011-008	
4.43		FUEL OIL STRAINER		
		Required Parts:		
	1	Seal - F.O. Strainer	F-044-117-02	
	1	O-ring - F.O. Strainer	F-044-117-06	
	1	O-ring - F.O. Strainer	F-044-117-07	
		Recommended On Hand:		
	1	Kit - Complete Seal F.O. Strainer	F-044-108	29080-24894
	1	Element - F.O. Strainer	F-039-058	29160-26611
4.44		AIR BUTTERFLY		
		Recommended On Hand:		
	1	Kit - Cylinder Repair	AJ-009-001	29180-27964
	1	Cylinder	AJ-009-000	29180-24902
4.45		INSTRUMENTATION		
		Required Parts:		
	1	Fuse Rod - Main Bearing Temp Detector	F-573-271-01	29200-27541
	2	Valve - Overspeed Trip Vent	F-153-009	29110-21559
	1	Kit - Stop/Run Valve Regulator	F-573-013-05	
	1	Kit - Overspeed Trip Regulator	F-079-079-01	

Sheet 1 of 1

TABLE 3

TABLE OF CLEARANCES

Item Requiring Clearance Check	Design Clearance	Acceptable Wear Limits
Rotor Float	0.008" - 0.018"	0.00." - 0.020"
Journal Bearings-Shaft O.D. -Bearing I.D.	2.4935"-2.4940" 2.5000"-2.5005"	2.5000"-2.5015" 2.5000"-2.5015"
Radial Clearance Between Turbine Blade O.D. and Inlet Casing	0.30"-0.35"	0.025"-0.050"
Nozzle Ring to Inlet Casing (Radial)	0.015"-0.020"	0.005"-0.030"
Oil Seal Turbine End - Seal I.D. Matching Shaft Diameter O.D. Clearances on Diameter	 5.7500"-5.7520" 5.7410"-5.7420" 0.008"- 0.011"	 5.7500"-5.7540" No Wear 0.008"- 0.013"
Oil Seal Blower End - Seal I.D. Matching Shaft Diameter O.D. Clearance on Diameter	 3.7500"-3.7520" 3.7410"-3.7420" 0.008"- 0.011;	 3.7500"-3.7540" No Wear 0.008"- 0.0013"

TABLE 4

COMPONENT ISOLATION MINIMUM REQUIREMENTS

STEP NO.	DESCRIPTION	DG1A COMPONENT	POS	DG1B COMPONENT	POS	DG2A COMPONENT	POS	DG2B COMPONENT	POS
3.3.1	Air Hdr Iso	1-2403-U4-765	CL	1-2403-U4-722	CL	2-2403-U4-765	CL	2-2403-U4-722	CL
	Air Hdr Iso	1-2403-U4-769	CL	1-2403-U4-729	CL	2-2403-U4-769	CL	2-2403-U4-729	CL
	Air Hdr Drain	1-2403-X4-038	OP	1-2403-X4-044	OP	2-2403-X4-038	OP	2-2403-X4-044	OP
	Air Hdr Drain	1-2403-X4-035	OP	1-2403-X4-040	OP	2-2403-X4-035	OP	2-2403-X4-040	OP
3.3.2	DG Brkr	1AA0219	RO	1BA0319	RO	2AA0219	RO	2BA0319	RO
3.4	J.W. Pump	1NBI-12	OP	1NBO-12	OP	2NBI-12	OP	2NBO-12	OP
	J.W. Heater	1NBI-13	OP	1NBO-13	OP	2NBI-13	OP	2NBO-13	OP
3.5	Standpipe Drain	1-2403-X4-755	OP	1-2403-X4-715	OP	2-2403-X4-755	OP	2-2403-X4-715	OP
	Block Drain	1-2403-X4-401	OP	1-2403-X4-403	OP	2-2403-X4-401	OP	2-2403-X4-403	OP
	Block Drain	1-2403-X4-402	OP	1-2403-X4-404	OP	2-2403-X4-402	OP	2-2403-X4-404	OP
	L.O. Hx	1-2403-X4-101	OP	1-2403-X4-111	OP	2-2403-X4-101	OP	2-2403-X4-111	OP
3.6	L.O. Pump	1NBI-15	OP	1NBO-15	OP	2NBI-15	OP	2NBO-15	OP
	L.O. Heater	1NBI-16	OP	1NBO-16	OP	2NBI-16	OP	2NBO-16	OP
3.8	Fuel Oil Iso	1-2403-U4-031	CL	1-2403-U4-032	CL	2-2403-U4-031	CL	2-2403-U4-032	CL

Sheet 1 of 1

DATA SHEET 1

STEP NO.	4.5.1g	4.5.2g	4.5.2i	4.5.2i
Cylinder No.	Cold Comp (psi)	Firing Press (psi)	Fuel Pump (mm)	Exh Temp (°F)
1L				
2L				
3L				
4L				
5L				
6L				
7L				
8L				
1R				
2R				
3R				
4R				
5R				
6R				
7R				
8R				

M&TE SERIAL NO. _____ _____ _____

CAL DUE DATE _____ _____ _____

COMPLETED BY: _____ / _____

SIGNATURE DATE

DATA SHEET 2

CRANKSHAFT WEB DEFLECTION

COMPONENT GROUP TITLE: CRANKSHAFT	PARTS GROUP NO. 02-310
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.5.3

DEFLECTION READINGS (Steps 4.5.3h(4) and 4.5.3h(5).
Deflection checks should be made while the engine is hot, i.e., within 4 hours after the unit has been shut down. Record the temperature of the oil in the engine lube oil sump tank or engine base.

When an engine in which the connecting shaft is solidly coupled to the flywheel is grouted on a concrete foundation, the desired deflection at crank position No. 3 is zero to plus (+) 1 mil (one thousandth) in all cranks except the crank adjacent to the flywheel which should be (-) 1/2 mil, This deflection allows thermal distortion of the concrete foundation.

If the deflection in any crank in an engine in service exceeds 3 mils, corrective action must be taken. Also, if the total deflection value in any two adjacent crank exceeds 3 mils, corrective action must be taken. Example, a +2 mils in any crank with a -2 mils in the next adjacent crank adds up to a total of 4 mils deflection between these adjacent cranks.

In engines with solidly coupled connecting shafting, excessive deflection at positions No. 2, 3 or 4 in the crank adjacent to the external shafting usually indicated misalignment between the connecting shafting and the engine crankshaft.

Set the deflection gauge at zero at position No. 1 and turn the crankshaft in the direction of normal rotation.

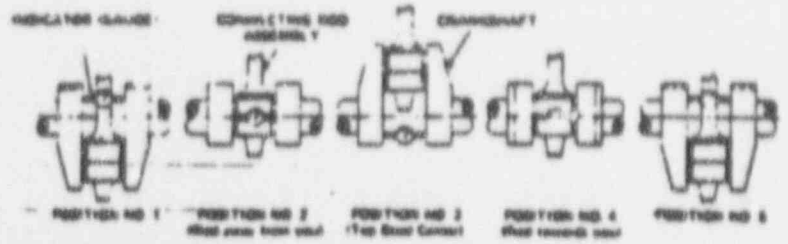
Position No. 1 for placing the deflection gauge is 52 degrees AFTER VERTICAL BOTTOM CENTER.

Sheet 2 of 2

DATA SHEET 2

CRANKSHAFT WEB DEFLECTION

ENGINE TAG NO._____ DATE _____



DATE	EGP TANK TEMP	THRUST CLEAR.	SIGNATURE

Record readings in phsi (+) or minus (-) thousandths of an inch. Example: +0.003 in. write as +3. Write - 0.002 in. as -2, etc.

POSITION	CYLINDER NUMBER STARTING AT GEARCASE END										DATE
	1	2	3	4	5	6	7	8	9	10	

M&TE Serial NO. _____ _____

Cal. Due Date: _____ _____

Corrective Actions If Required (Step 4.5.3h(7)): _____

_____

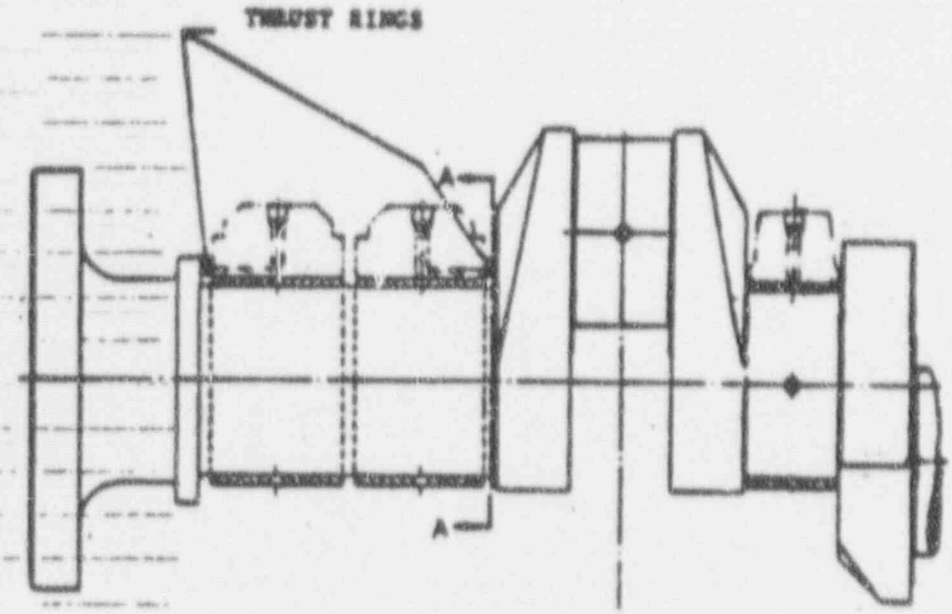
_____

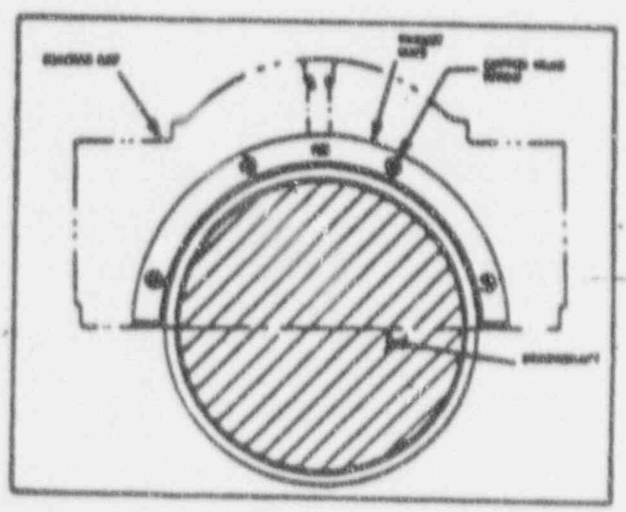
Sheet 1 of 2

DATA SHEET 3

CRANKSHAFT WEB DEFLECTION

COMPONENT GROUP TITLE: CRANKSHAFT	PARTS GROUP NO. 02-310
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.5.3





DATA SHEET 3

CRANKSHAFT THRUST CLEARANCE

ENGINE NO. _____ _____

	Step	Clearance	Results Sat	Unsat	Performed By
As Found	4.5.11				
Final	4.5.11				

Clearance: Expected - 0.022" - 0.030"
Replace at least one thrust ring if greater than 0.040"

M&TE Serial No. _____ _____ _____ _____
Cal. Due Date _____ _____ _____ _____

If crankshaft thrust clearance is required to be adjusted:

Bearing Cap Removed (Step 4.5.12a): _____
Thrust Ring Replaced or Shims Added (Step 4.5.12(g)): _____
If shims Added, Thickness of Shims (Step 4.5.12(g)): _____

VISUAL INSPECTION

1.) Thrust Ring on No. 9 Bearing Cap (Step 4.5.12(c)): _____
Sat ( ) Unsat ( ) Performed By/Date: _____ /

2.) Thrust Ring on No. 10 Bearing Cap (Step 4.5.12(c)): _____
Sat ( ) Unsat ( ) Performed By/Date: _____ _____ /

Sheet 1 of 1

DATA SHEET 4

ENGINE BASE AND CRANKSHAFT INSPECTION

COMPONENT GROUP TITLE: ENGINE BASE AND CRANKSHAFT	PARTS GROUP NO. 02-305/02-311
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.6.1, 4.24.2, 4.25.1

VISUAL INSPECTIONS

1) Clean and inspect crankcase relief valves (Step 4.24.2a(6) and (7).

Relief Valve	Cleaned	Seat & Disc Inspection Sat	Unsat	Performed By:
1L	_____	_____	_____	_____
2L	_____	_____	_____	_____
3L	_____	_____	_____	_____
4L	_____	_____	_____	_____
5L	_____	_____	_____	_____
6L	_____	_____	_____	_____
7L	_____	_____	_____	_____
8L	_____	_____	_____	_____

2) Inspect engine base (internals) including area adjacent to the main bearing stud nut pockets for the presence of cracks (Step 4.25.1a): _____

Sat ( ) Unsat ( ) Performed By/Date: _____ /_____

3) Inspect engine crankcase (internals) including the vertical crankcase arch wall and the crankcase-to-base nut pocket area for the presence of cracks (Step 4.25.1b): _____

Sat ( ) Unsat ( ) Performed By/Date: _____ /_____

4) Perform an overall inspection of engine internals for: any abnormal conditions, presence of babbit flakes, presence of excessive water or sludge, dents in lube oil tubing or pneumatic tubing (Step 4.6.1): _____

Sat ( ) Unsat ( ) Performed By/Date: _____ /_____

Sheet 1 of 1

DATA SHEET 5

TURBOCHARGER INSPECTION

Turbocharger Tag No. _____

Turbocharger Serial No. _____

Left Bank or Right Bank _____

STEP NUMBER	ATTRIBUTE TO VERIFY	MEASURED VALUE	M&TE SER. NO.	M&TE CAL. NO.	PERFORMED BY/DATE	Q/C BY/DATE
4.7.2c	Rotor Axial Float					
4.7.6h	Rotor Axial Float					
4.7.7d	Thrust Bearing Sat or Unsat					
4.7.7f	Shaft O.D.-Turbine End					
	Shaft O.D.-Blower End					
	Bearing I.D.-Turbine End					
	Bearing I.D.-Blower End					
4.7.7h(1)	Oil Seal I.D.-Turbine End					
	Oil Seal I.D.-Blower End					
4.7.7h(2)	Thrust Collar O.D.-Turbine End (Active)					
	Thrust Collar O.D.-Blower End (Inactive)					
4.7.8b(3)	Nozzle Ring Bolt Torque					
4.7.8e(4)	Intermediate Casing Bolt Torque					
4.7.8f(13)	Elastic Stop Nut Torque					
4.7.8f(14)	Rotor Axial Float					
4.7.8g(2)	Blower Inlet Casing Bolt Torque					
4.7.8h(3)	Turbine Inlet Casing Bolt Torque					

Sheet 1 of 4

DATA SHEET 6

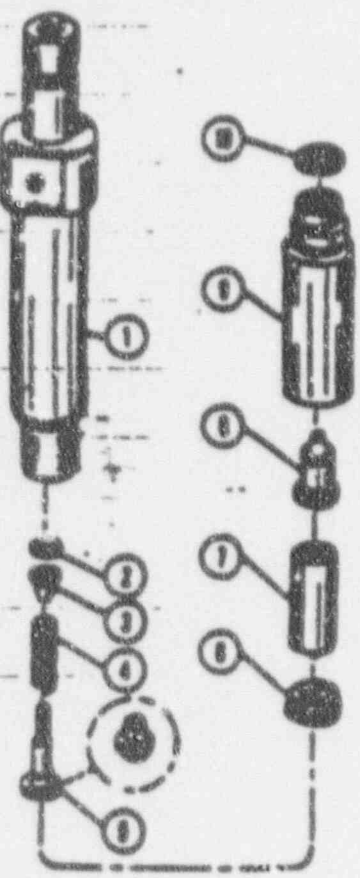
FUEL INJECTION INSPECTION

COMPONENT GROUP TITLE: FUEL INJECTION EQUIPMENT	PARTS GROUP NO. 02-365
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.8.4

FUEL INJECTION NOZZLE HOLDER

TYPE [illegible]

ENTERPRISE PART NO. F-875-105



[illegible]

ITEM NO.	ENTERPRISE PART NO.	DESCRIPTION OF PART	QTY. REQ.
1	F-875-105	BODY**	1
2	F-875-117	SHIM [illegible]	[illegible]
2	F-87[illegible]	SHIM [illegible]	[illegible]
2	F-875-115	SHIM [illegible]	[illegible]
2	F-875-114	SHIM [illegible]	[illegible]
2	F-875-113	SHIM [illegible]	[illegible]
3	[illegible]	SPRING SEAT	1
4	[illegible]	SPRING	1
5	F-875-112	ROD	1
6	[illegible]	STOP PLATE	1
7	*	NOZZLE VALVE ASSEMBLY	1
8	*	SPRAY TIP	1
9	F-875-127	ASSEMBLY NUT**	1
10	[illegible]	COPPER GASKET	1

*Not included with Nozzle Holder Assembly. Refer to the fuel injection parts list in the Engine Parts Manual for part number.

**Cadmium Plated.

DATA SHEET 6

FUEL INJECTION INSPECTION

ENGINE TAG NO. _____ DATE: _____

1) Step 4.8.4 - Fuel Injector Initial Test (As Found Conditions)

Step 4.8.4c		4.8.4e	4.8.4f		4.8.4g		4.8.4i	
Pop Action		As Found	Leakage		Pattern		Spray Trip	
Inj.	Sat Unsat	Opening Press.	Sat	Unsat	Sat	Unsat	Sat Unsat	Performed By
1R								
1L								
2R								
2L								
3R								
3L								
4R								
4L								
5R								
5L								
6R								
6L								
7R								
7L								
8R								
8L								

Required Opening Pressure: 3000 - 32000 psi

Comments: (Step 4.8.4i)

M&TE Serial No. _____ _____ _____

Cal. Due Date _____ _____ _____

Sheet 3 of 4

DATA SHEET 6

FUEL INJECTION INSPECTION

2) Step 4.8.5 - Fuel Injector Spray Tip Inspection

Step 4.8.4i Spray Trip Unl. Sat Unsat	Disposition If Unsat	4.8.5a Torque	Performed By:	Witnessed
1R				
1L				
2R				
2L				
3R				
3L				
4R				
4L				
5R				
5L				
6R				
6L				
7R				
7L				
8R				
8L				

Required Opening Pressure: 3000 - 32000 psi

Comments: (Step 4.8.4j)

M&TE Serial No. _____ _____ _____

Cal. Due Date _____ _____ _____

Sheet 4 of 4

DATA SHEET 6

FUEL INJECTION INSPECTION

ENGINE TAG NO.: _____ DATE: _____

3) Step 4.8.6 - Injector I. Opening Pressure Adjustment

Step	4.8.6e	4.8.6g	4.8.6k(1)		
Injector	Shims Added	Torque	Final Opening Press	Performed By	Witnessed By

Required Opening Pressure: 3000 - 32000 psi

M&TE Serial No._____ _____ _____

Cal. Due Date _____ _____ _____

Comments: _____

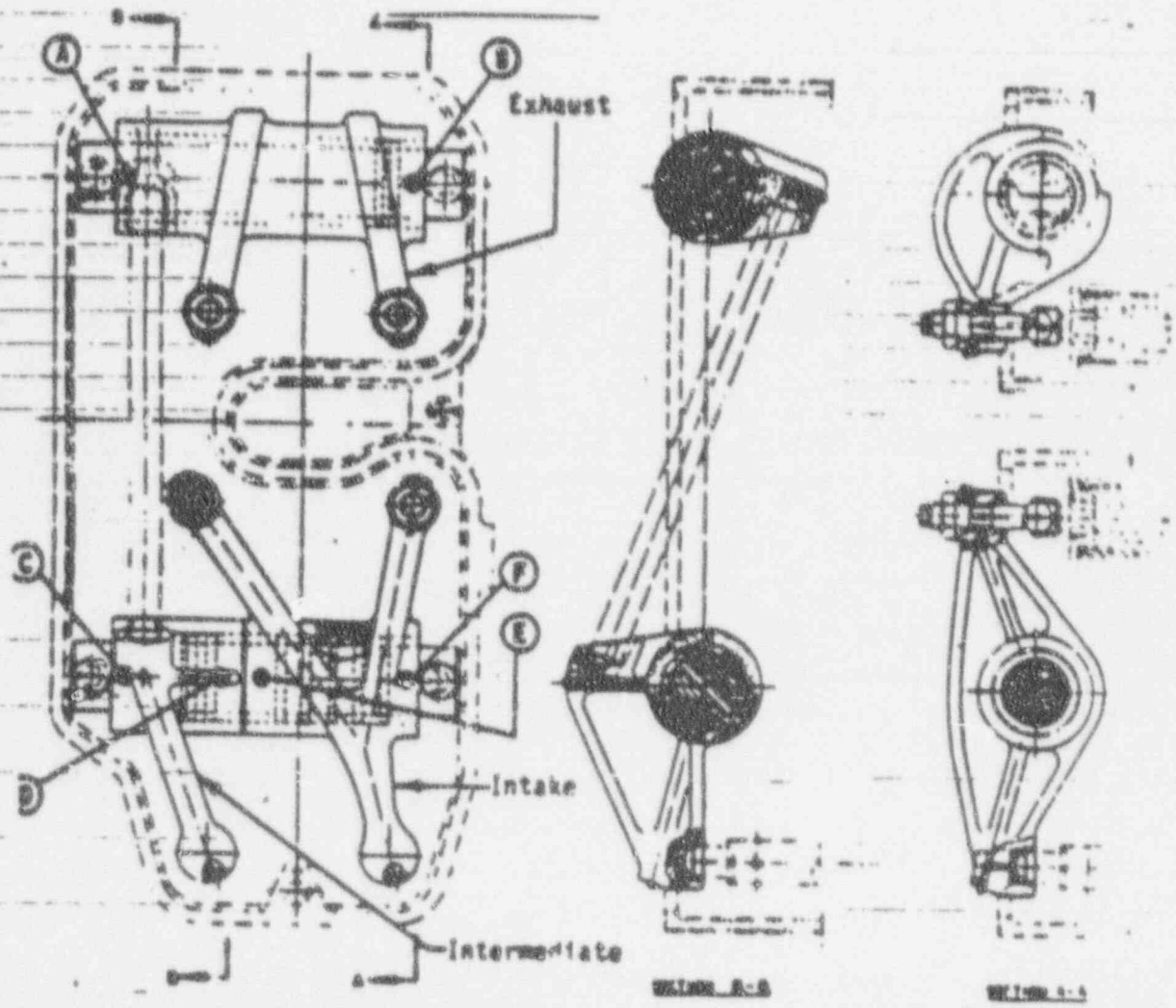
Sheet 1 of 3

DATA SHEET 7

SUBCOVER AND ROCKER ARM ASSEMBLY INSPECTIONS

COMPONENT GROUP TITLE: SUBCOVER AND ROCKER ARM ASSEMBLIES	PARTS GROUP NO. 02-362/02-390
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.9.14

CYLINDER NO./BANK _____



Sheet 2 of 3

DATA SHEET 7

SUBCOVER AND ROCKER ARM ASSEMBLY INSPECTIONS

ENGINE TAG NO. ____________ DATE: ____________

CYLINDER/BANK: ____________

INSPECTIONS

1) Inspect subcover for evidence of valve guide blowby, soot (Step 4.9.14a):

Sat ( ) Unsat ( ) Performed By/Date: ________ / ________

2) Inspect subcover in web area for cracks (Step 4.9.14c):

Sat ( ) Unsat ( ) Performed By/Date: ________ / ________

3) Inspect intake & intermediate pushrod cups for linear indications or chipped pieces in outer lips (Step 4.9.15a): ____________

Sat ( ) Unsat ( ) Performed By/Date: ________ / ________

4) Inspect exhaust pushrod cup for linear indications or chipped pieces in the outer lip (Step 4.9.15b): ____________

Sat ( ) Unsat ( ) Performed By/Date: ________ / ________

5) Intake and exhaust pushrods are free of cracks (Step 4.9.15c): ____________

Sat ( ) Unsat ( ) Performed By/Date: ________ / ________

6) Connector pushrod is free of cracks (Step 4.9.15d): ____________

Sat ( ) Unsat ( ) Performed By/Date: ________ / ________

7) Rocker arm drive studs (pop rivets or allen screws) are tight and intact (Step 4.9.15f(1)): ____________

Sat ( ) Unsat ( ) Performed By/Date: ________ / ________

DATA SHEET 7

SUBCOVER AND ROCKER ARM ASSEMBLY INSPECTIONS

ENGINE TAG NO. _____

CYLINDER/BANK _____

8) Rocker arm capscrews torque (ft-lbs) (Step 4.9.15f(2) and 4.28.4o)

	Capscrew					
	Exh-Left	Exh-Right	Int-Left	Int-Right	Performed	Witnessed
M&TE Serial No.						
Cal. Due Date:						

* NOTE: Document inspection of component removed even if it is to be replaced. Use additional data sheets for any replacement components.

Position (Step)	Rocker Shaft Bushing X-X	Rocker Shaft Bushing Y-Y	Rocker Shaft X-X	Rocker Shaft Y-Y	Clearance Sat Unsat	Performed
A 4.9.15e(5)(c)						
B 4.9.15e(5)(c)						
C 4.9.15e(5)(b)						
D 4.9.15e(5)(b)						
E 4.9.15e(5)(b)						
F 4.9.15e(5)(b)						

Clearance: When new - 0.004" - 0.006"
Replace - 0.010"

M&TE Serial No.				
Cal. Due Date				

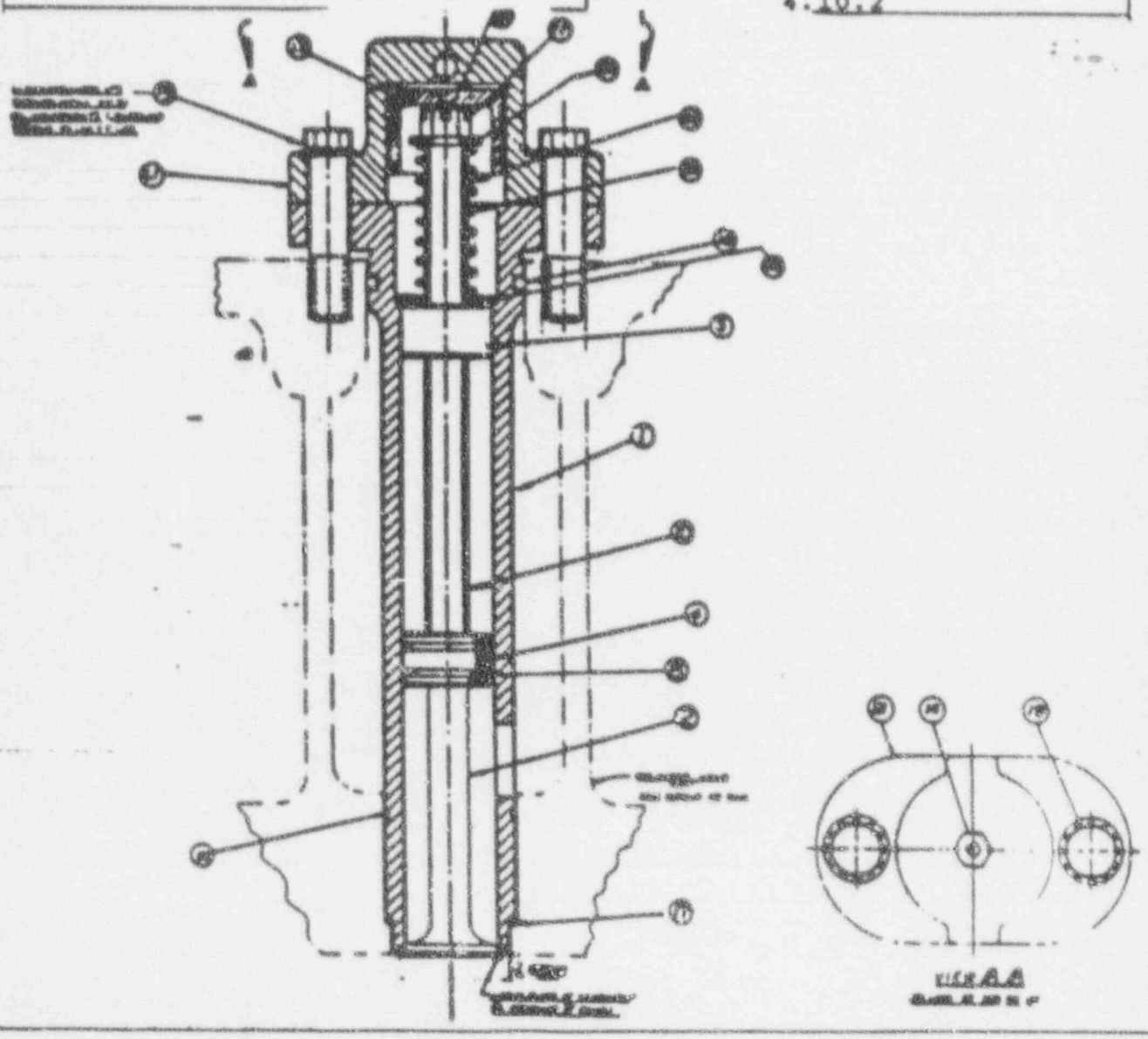
* NOTE: Document inspection of rocker arms removed even if it is to be replaced. Use additional data sheets for any replacement rocker arm assemblies.

Sheet 1 of 4

DATA SHEET 8

AIR START VALVE INSPECTION

COMPONENT GROUP TITLE: AIR START VALVE	PARTS GROUP NO. 02-359/
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.10.2



DATA SHEET 8

AIR START VALVE INSPECTION

ENGINE TAG NO.: _____ DATE: _____

1) Step 4.10.2b(2), (3) and (4): Cap to Piston Clearance

	CAP		PISTON			
Valve	X-X	Y-Y	X-X	Y-Y	Clearance Sat Unsat	Performed By:
1R						
1L						
2R						
2L						
3R						
3L						
4R						
4L						
5R						
5L						
6R						
6L						
7R						
7L						
8R						
8L						

M&TE Serial No. _____ _____ _____
Cal. Due Date _____ _____ _____
Clearance When New: 0.001/0.003" Replace When Over 0.009"

2) Step 4.10.2b(5): Valve Internals Inspection

Valve	Comments	Sat	Unsat	Performed By/Date
1R				
1L				
2R				
2L				
3R				
3L				
4R				
4L				
5R				
5L				
6R				
6L				
7R				
7L				
8R				
8L				

DATA SHEET 8

AIR START VALVE INSPECTIONS

ENGINE TAG NO. _____ DATE: _____

3) Step 4.10.2b(6) and (8): Valve Seat Inspection

Valve	Valve/Seat Inspection Bluing	Sat	Unsat	Performed By/Date
1R				
1L				
2R				
2L				
3R				
3L				
4R				
4L				
5R				
5L				
6R				
6L				
7R				
7L				
8R				
8L				

4) Step 4.28.3: Air start valve capscrews. ENGINE HOURS _____

Cylinder	Capscrew = 2-3/4" Torque 1	2	1	2	Performed	Witnessed
1R						
2R						
3R						
4R						
5R						
6R						
7R						
8R						
1L						
2L						
3L						
4L						
5L						
6L						
7L						
8L						

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

DATA SHEET 8

ENGINE TAG NO. _____ DATE: _____

5) Step 4.28.4.0: Rocker Arm Capscrew Torque

Cylinder	Rocker Arm 1	Capscrew 2	Performed	Witnessed
1R				
2R				
3R				
4R				
5R				
6R				
7R				
8R				
1L				
2L				
3L				
4L				
5L				
6L				
7L				
8L				

M&TE Serial No. _____ _____ _____ _____
Cal. Due Date _____ _____ _____ _____

DATA SHEET 9

CYLINDER HEAD INSPECTIONS

COMPONENT GROUP TITLE:	PARTS GROUP NO.
CYLINDER HEAD	02-360
LOCATION:	UNIT NO.
VOGTLE ELECTRIC GENERATING PLANT	
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.11.2

CYLINDER NO./BANK _____

1) Record the following information for the cylinder head removed from engine per Step 4.11.1n.

Foundry Number _____
Casting Date _____
Stress Relief Date (If Applicable) _____
Recorded By/Date _____ / _____

2) Record the following information for the cylinder head installed on engine per Step 4.28.2d.

Foundry Number _____
Casting Date _____
Stress Relief Date (If Applicable) _____
Recorded By/Date _____ / _____

If cylinder head installed in this position is not the one that was removed, state reason for replacement:

_____

_____

_____ / _____

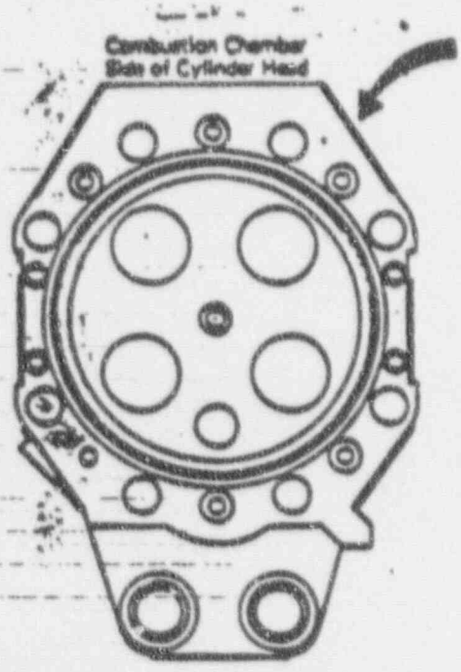
DATA SHEET 9

CYLINDER HEAD INSPECTIONS

ENGINE TAG NO. _____

CYLINDER NO./BANK _____ DATE _____

Visually inspect cylinder head combustion surfaces and valve seats. If no indications noted, state so. (Step 4.11.2e)



Use diagram at left to sketch any abnormalities appearing on the cylinder head combustion surfaces and valve seats. Record comments relative to condition of cylinder head in spaces below.

Combustion Surfaces
Valve Seat Condition
Gasket Surfaces
Other (specify)

Results: Sat ( ) Unsat ( )
Performed By: _____
If Unsat, resolution: _____

Ensure cylinder head does not have a through wall weld repair at injector nozzle (step 4.11.2f(5)):

Sat ( ) Unsat ( )

Performed By: _____
If Unsat, resolution: _____

DATA SHEET 9

CYLINDER HEAD INSPECTIONS

ENGINE TAG NO. _____

CYLINDER NO./BANK _____ DATE _____

Valve-To-Guide Clearance (Steps 4.11.2a(6) and (7)):
Measure by noting deflection on valve head while rocking valve in its guide. Remove wedges, retainer (or rotators) and springs. Lay cylinder head on its side with valve axis in the horizontal plane. Leave a wedge on valve stem and push valve out until stopped by wedge hitting guide (See Figure 2).

Position a dial indicator as shown in Figures 1 and 2 so that spindle of indicator is bearing against side of valve head on the A-A axis (See Figure 3). Zero the indicator, then apply sufficient pressure by hand at a point diametrically opposite the spindle to move the valve in the guide. Record this deflection. Repeat the process in the B-B axis and record all readings in the space provided below. See Figure 1 for valve identification (EX-1, IN-1, etc.)

Axis/Valve	EX-1	EX-2	IN-1	IN-2
A-A				
B-B				
Performed				
Witnessed				

Clearance When New: 0.012"/0.017"
Replace when greater than or equal to 0.045"

M&TE Serial No. _____ _____ _____ _____
Cal Due Date _____ _____ _____ _____

DATA SHEET 9

CYLINDER HEAD INSPECTIONS

ENGINE TAG NO. _____

CYLINDER NO./BANK _____ DATE _____

2) Valve Head Thickness (Step 4.11.2b(3))

Valve	EX-1	EX-2	IN-1	IN-2
Thickness				
Performed				
Witnessed				

Minimum valve head thickness to be greater than 3/32"

M&TE Serial No. _____ _____ _____ _____
Cal Due Date _____ _____ _____ _____

3) Inspect intake and exhaust valve, disc, stems and seats (Step 4.11.2c): _____

Sat ( ) Unsat ( ) Performed By/Date: _____ /

4) Inspect valve springs (Step 4.11.2d(1) and (2)): _____

Sat ( ) Unsat ( ) Performed By/Date: _____ /

DATA SHEET 9

CYLINDER HEAD INSPECTIONS

ENGINE TAG NO. _____

CYLINDER NO./BANK _____ DATE _____

CYLINDER HEAD STUD TORQUING AND FREE LENGTH (Step 4.28.2a(2))

STUD	TORQUE	FREE LENGTH	PERFORMED	WITNESSED
1				
2				
3				
4				
5				
6				
7				
8				

M&TE Serial No. _____ _____ _____ _____

Cal Due Date: _____ _____ _____ _____

CYLINDER HEAD NUT TORQUE (Step 4.28.2i)

STUD	TORQUE	PERFORMED	WITNESSED
1			
2			
3			
4			
5			
6			
7			
8			

M&TE Serial No. _____ _____ _____ _____

Cal Due Date: _____ _____ _____ _____

DATA SHEET 10

FUEL INJECTION PUMP INSPECTIONS

COMPONENT GROUP TITLE:	PARTS GROUP NO.
FUEL INJECTION PUMP	02-365
LOCATION:	UNIT NO.
VOGTLE ELECTRIC GENERATING PLANT	
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.12.2

Fuel Pump Location	Fuel Pump Serial No. 4.12.2i		Injection Pump Stud Nuts Torque 4.28.21h		4.28.21i	4.28.21m
	Removed	Installed	Performed	Witnessed	Performed	Witnessed
1R						
1L						
2R						
2L						
3R						
3L						
4R						
4L						
5R						
5L						
6R						
6L						
7R						
7L						
8R						
8L						

M&TE Serial No. _____ _____ _____ _____

Cal Due Date: _____ _____ _____ _____

Sheet 2 of 2

DATA SHEET 10

FUEL INJECTION PUMP INSPECTIONS

FUEL PUMP SERIAL NO.	DELIVERY FLANGE SCREWS TORQUED (Step 4.12.5Z)	
	PERFORMED	WITNESSED

M&TE Serial No. ________ ________ ________ ________

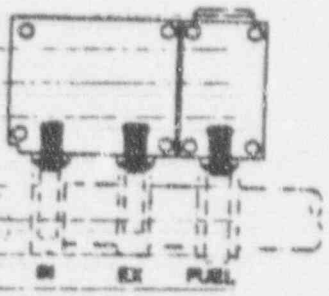
Cal Due Date: ________ ________ ________ ________

Sheet 1 of 1

DATA SHEET 11

CAM AND TAPPET ASSEMBLY INSPECTION

COMPONENT GROUP TITLE: CAM AND TAPPET ASSEMBLIES	PARTS GROUP NO. 02-365
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.13.1



4.13.1b

CAM LOBE CONDITION (Number 1 cylinder at governor end)

CODE:

4.13.2a and b

TAPPET ROLLER CONDITION (Number 1 cylinder at governor end)

CODE:

4.13.2c

TAPPET ROLLER PIN CONDITION (As indicated using a dial indicator)

CODE:

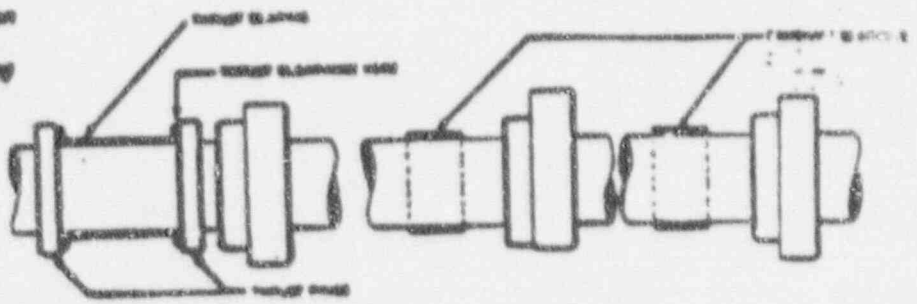
Sheet 1 of 1

DATA SHEET 12

CAMSHAFT BEARING INSPECTION

COMPONENT GROUP TITLE: CAMSHAFT	PARTS GROUP NO. 02-350
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.13.4

For purposes of recording information on this form, bearings are numbered in sequence, starting with the thrust bearing at the gearcase end and proceeding towards the flywheel end.



THRUST CLEARANCE (Step 4.13.4b)

Move camshaft all the way aft with a bar then measure thrust clearance

Bank	Clearance	Perform	Witness
Left			
Right			

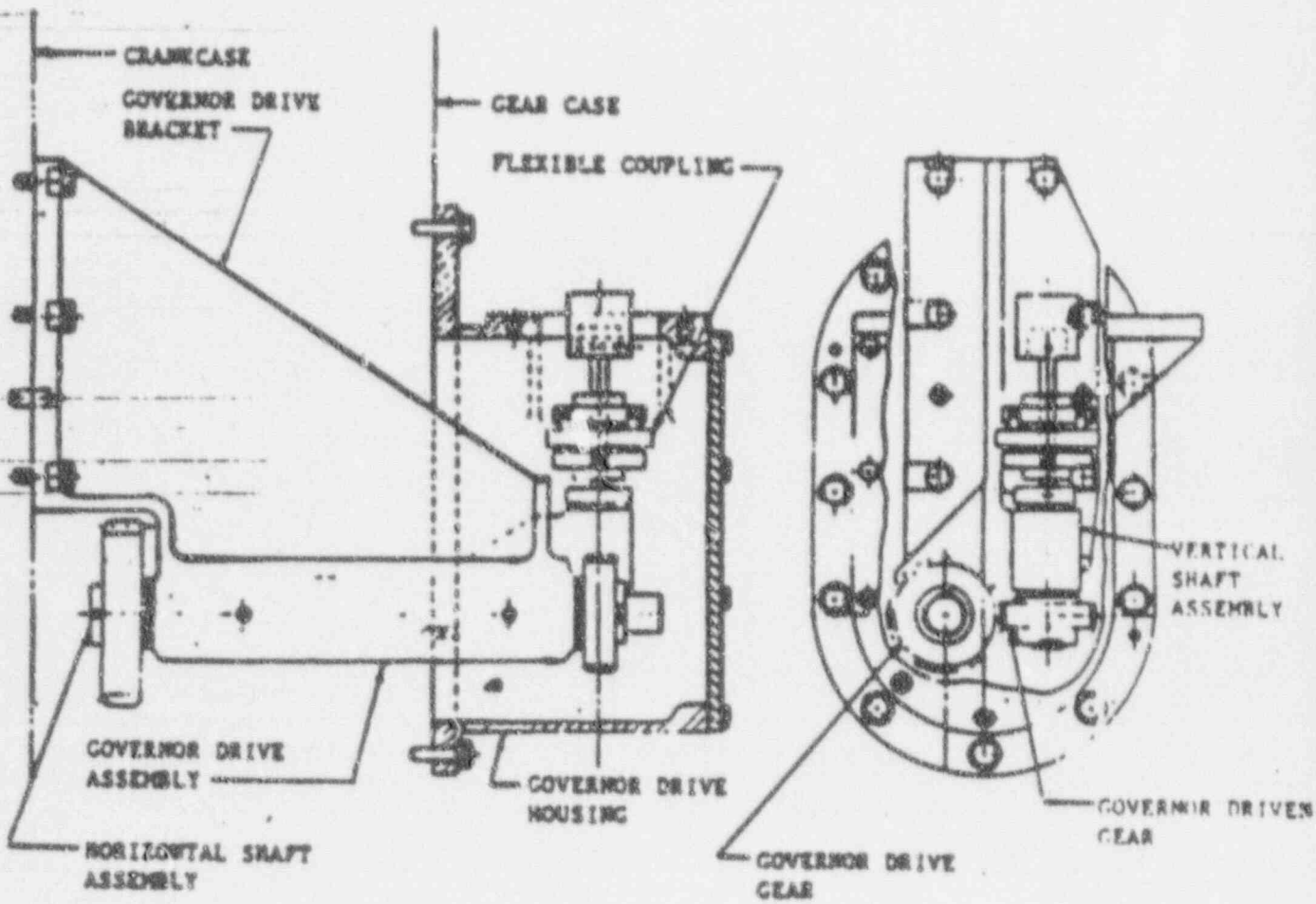
Clearance: Expected - 0.004"-0.007"
Adjust - 0.012"

M&TE Serial No. _____ _____
Cal. Due Date _____ _____

DATA SHEET 13

GOVERNOR DRIVE AND COUPLING INSPECTION

COMPONENT GROUP TITLE: GOVERNOR DRIVE	PARTS GROUP NO. 02-411
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.14



DATA SHEET 13

GOVERNOR DRIVE AND COUPLING INSPECTION

ENGINE TAG NO.: _____ DATE: _____

Governor Drive Horizontal Shaft

1) Step 4.14.2b(2), 4.14.2f(7): End Play

	End Play	Sat	Unsat	Performed By
As Found (4.14.2b(2))				
Final (4.14.2f(7))				

M&TE Serial No.: _____ _____ _____

Cal. Due Date: _____ _____ _____

2) Step 4.14.2b(8): Shaft, Bushing, Gear Inspection: _____

_____

Sat ( ) Unsat ( ) Performed By/Date: _____/_____

3) Step 4.14.2b(11): Shaft-To-Bushing Clearance

Position	Bushing X-X	Bushing Y-Y	Shaft X-X	Shaft Y-Y	Clearance	Sat	Unsat	Performed By
Large Gear End								
Small Gear End								

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

Governor Drive Vertical Shaft

1) Step 4.14.2b(4), 4.14.2f(14): End Play

	End Play	Sat	Unsat	Performed By
As Found (4.14.2b(4))				
Final (4.14.2f(14))				

M&TE Serial No.: _____ _____ _____

Cal. Due Date: _____ _____ _____

2) Step 4.14.2b(15): Shaft, Bushing, Gear Inspection: _____

_____

Sat ( ) Unsat ( ) Performed By/Date: _____/_____

3) Step 4.14.2b(17): Shaft-To-Bushing Clearance

Position	Bushing X-X	Bushing Y-Y	Shaft X-X	Shaft Y-Y	Clearance	Sat	Unsat	Performed By
Large Gear End								
Small Gear End								

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

DATA SHEET 13

GOVERNOR DRIVE AND COUPLING INSPECTION

ENGINE TAG NO.: _____ DATE: _____

1) Step 4.14.2g(4): Governor Drive Installation Torque

Capscrews	Torque	Lock Tabs Secured	Performed By	Witnessed By
1	_____	_____	_____	_____
2	_____	_____	_____	_____
3	_____	_____	_____	_____
4	_____	_____	_____	_____
5	_____	_____	_____	_____
6	_____	_____	_____	_____

M&TE Serial No.: _____ _____ _____

Cal. Due Date: _____ _____ _____

2) Step 4.142h(5): Governor Housing Installation Torque

Capscrews	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
9	_____	_____	_____
10	_____	_____	_____
11	_____	_____	_____
12	_____	_____	_____

M&TE Serial No.: _____ _____ _____

Cal. Due Date: _____ _____ _____

3) Step 4.14.2i(1)(e), 4.14.2j(5): Governor Adaptor To Housing Torque

Capscrews	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____

M&TE Serial No.: _____ _____ _____

Cal. Due Date: _____ _____ _____

DATA SHEET 13

GOVERNOR DRIVE AND COUPLING INSPECTION

ENGINE TAG NO.: _____ DATE: _____

4) Step 4.14.2i(5) & (7): Governor Drive to Adaptor Plate Angular Alignment

	POSITION							
	12	3	6	9	TIR	Sat	Unsat	Perform
As Found (4.14.2i(5)								
Final (4.14.2i(7))								

TIR should not exceed 0.006"
M&TE Serial No.: _____ _____ _____
Cal. Due Date: _____ _____ _____

5) Step 4.14.2j(3) & (7): Governor Drive To Adaptor Plate Axial Alignment

	POSITION							
	12	3	6	9	TIR	Sat	Unsat	Perform
As Found (4.14.2j(3))								
Final (4.14.2i(7))								

TIR should not exceed 0.010"
M&TE Serial No.: _____ _____ _____
Cal. Due Date: _____ _____ _____

1) Step 4.28.16h: Governor flexible coupling torqued

Fasteners	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____

M&TE Serial No.: _____ _____ _____
Cal. Due Date: _____ _____ _____

Sheet 5 of 5

DATA SHEET 13

Step 4.28.17g: Governor Base.

Capscrews	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____

M&TE serial No. _____ _____ _____
Cal Due Date _____ _____ _____

Step 4.28.17j: Governor Housing Inspection Cover

Capscrews	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
9	_____	_____	_____
10	_____	_____	_____

M&TE serial No. _____ _____ _____
Cal. Due Date _____ _____ _____

Step 4.28.17k: Governor Booster

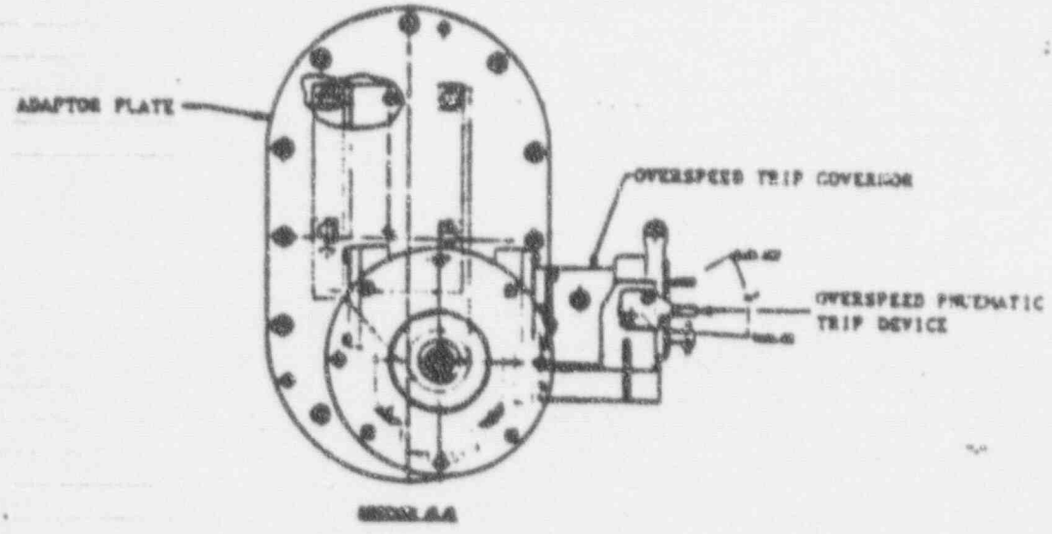
Capscrews	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____

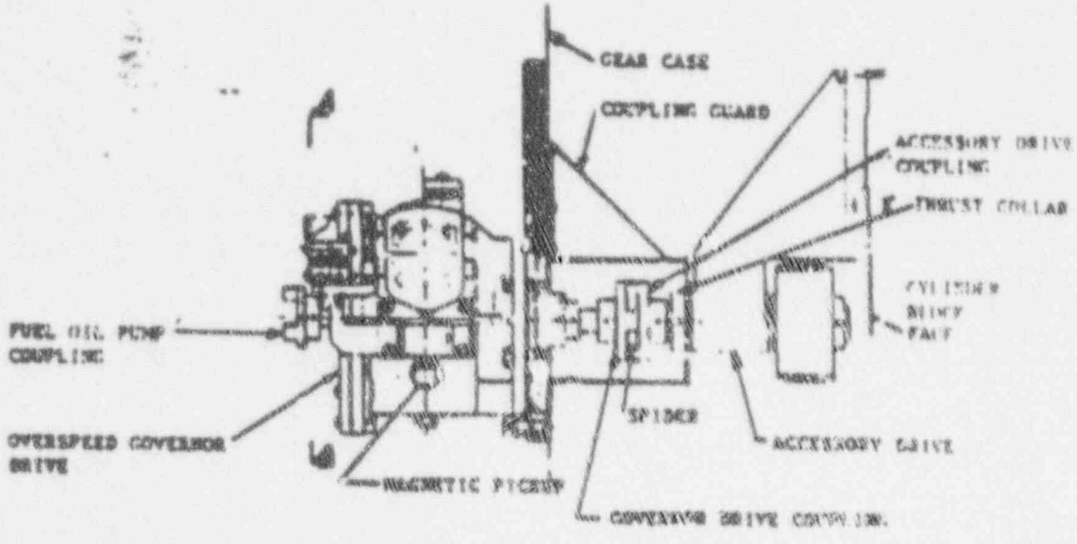
M&TE serial No.: _____ _____ _____
Cal. Due Date: _____ _____ _____

DATA SHEET 14

ACCESSORY DRIVE, OVERSPEED GOVERNOR DRIVE COUPLING

COMPONENT GROUP TITLE:	PARTS GROUP NO.
OVERSPEED TRIP	02-410
LOCATION:	UNIT NO.
VOGTLE ELECTRIC GENERATING PLANT	
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.15





DATA SHEET 14

ACCESSORY DRIVE, OVERSPEED GOVERNOR DRIVE COUPLING AND FUEL OIL BOOSTER PUMP COUPLING INSPECTIONS

ENGINE TAG NO.: _____ DATE _____

1) Step 4.15.3e & 4.15.4f: Accessory drive end play

	End Play	Sat	Unsat	Performed By
As Found (4.15.3e)				
Final (4.15.4f)				

M&TE Serial No.: _____ _____ _____
Cal. Due Date: _____ _____ _____

2) Step 4.15.3j: Accessory Drive Inspection: _____

Sat ( ) Unsat ( ) Performed By/Date: _____/_____

3) Step 4.15.3n: Accessory drive shaft-to-bushing clearance

Position	Drive Bushing		Drive Shaft		Clearance	Sat	Unsat	Performed By
	X-X	Y-Y	X-X	Y-Y				
Gear End								
Coupl. End								

M&TE Serial No. _____ _____ _____ _____
Cal. Due Date _____ _____ _____ _____

4) Step 4.15.5e: Accessory Drive Installation Torque

Capscrew	Torque	Lock Tabs Secured	Performed By	Witnessed By
1				
2				
3				
4				

M&TE Serial No. _____ _____ _____ _____
Cal. Due Date _____ _____ _____ _____

5) Step 4.15.6f: Inspect overspeed governor drive for magnetic particles:

Sat ( ) Unsat ( ) Performed by/Date: _____/_____

DATA SHEET 14

ACCESSORY DRIVE, OVERSPEED GOVERNOR DRIVE COUPLING AND FUEL OIL BOOSTER PUMP COUPLING INSPECTIONS

ENGINE TAG NO.: _____ DATE _____

1) Step 4.15.7f and h: Accessory drive to adaptor plate Angular Alignment

	POSITION							
	12	3	6	9	TIR	Sat	Unsat	Performed
As Found (4.15.7f)								
Final (4.15.7h)								

TIR should not exceed 0.006"

M&TE Serial No. _____ _____ _____

Cal. Due Date: _____ _____ _____

2) Step 4.15.8c and g: Accessory drive to Adaptor Plate Axial Alignment

	POSITION							
	12	3	6	9	TIR	Sat	Unsat	Performed
As Found (4.15.8c)								
Final (4.15.8g)								

TIR should not exceed 0.010"

M&TE Serial No. _____ _____ _____

Cal. Due Date: _____ _____ _____

3) Step 4.28.19a(4): Overspeed Governor Drive To Adaptor Plate Torque

Capscrews	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____

M&TE Serial No.: _____ _____ _____

Cal. Due Date: _____ _____ _____

4) Step 4.28.19b(5): Accessory Drive Coupling Shield Torque

Capscrews	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____

M&TE Serial No.: _____ _____ _____

Cal. Due Date: _____ _____ _____

DATA SHEET 14

ACCESSORY DRIVE, OVERSPEED GOVERNOR DRIVE COUPLING AND FUEL OIL BOOSTER PUMP COUPLING INSPECTIONS

ENGINE TAG NO.: _____ DATE: _____

5) Step 4.28.1.c(3): Overspeed Governor Drive Adaptor Plate Torque

Capscrews	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
9	_____	_____	_____
10	_____	_____	_____
11	_____	_____	_____
12	_____	_____	_____

M&TE Serial No.: _____ _____ _____

Cal. Due Date: _____ _____ _____

DATA SHEET 14

ACCESSORY DRIVE, OVERSPEED GOVERNOR DRIVE COUPLING AND FUEL OIL BOOSTER PUMP COUPLING INSPECTIONS

ENGINE TAG NO.: _____ DATE: _____

1) Step 4.28.19h: Lube Oil Line To Turbo/Rocker Arm Header Torque

Bolts	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
9	_____	_____	_____
10	_____	_____	_____
11	_____	_____	_____
12	_____	_____	_____
M&TE Serial No.:	_____	_____	_____
Cal. Due Date:	_____	_____	_____

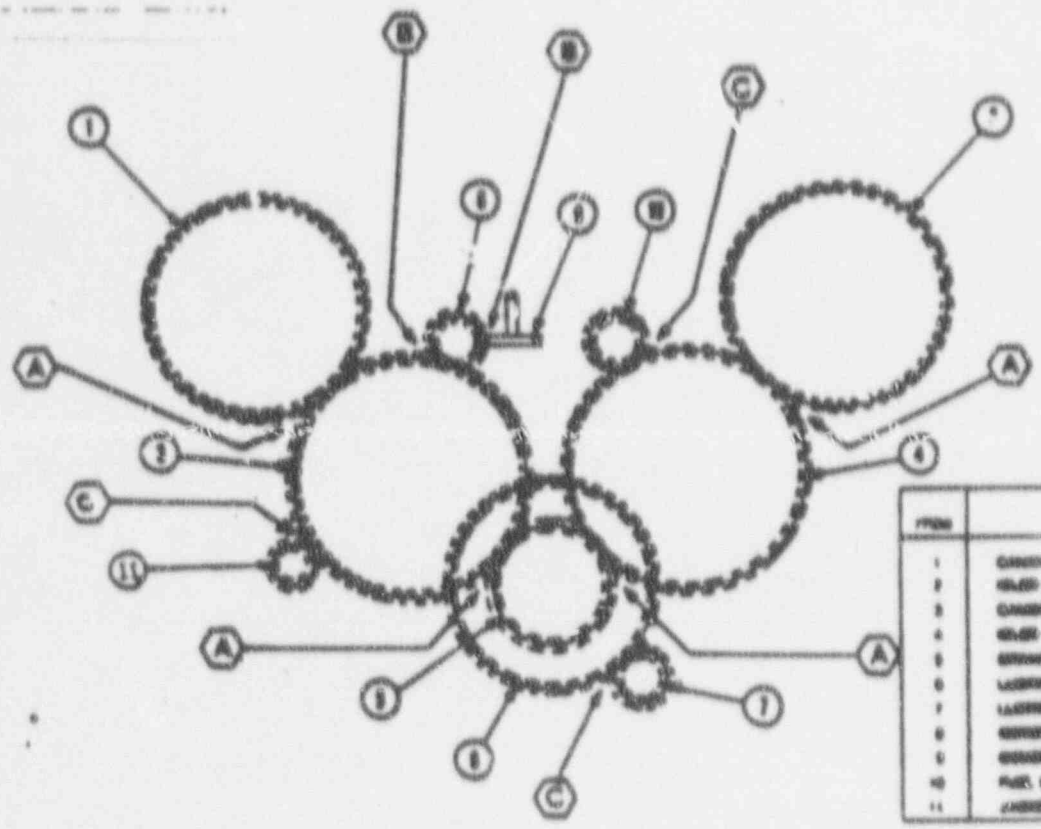
Sheet 1 of 3

DATA SHEET 15

GEARSET INSPECTION

COMPONENT GROUP TITLE:	PARTS GROUP NO.
TIMING GEARS	02-355
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.16.8

GEAR SET AND BACKLASH CLEARANCES
MODEL 8V ENGINE



ITEM	DESCRIPTION
1	CAMSHAFT GEAR, RIGHT HAND
2	IDLER GEAR, RIGHT HAND
3	CAMSHAFT GEAR, LEFT HAND
4	IDLER GEAR, LEFT HAND
5	CRANKSHAFT GEAR
6	LUBRICATING OIL PUMP DRIVE GEAR
7	LUBRICATING OIL PUMP DRIVEN GEAR
8	GOVERNOR AND TACHOMETER DRIVE GEAR
9	GOVERNOR DRIVEN GEAR AND DRIVEN PG GEAR
10	FUEL OIL PUMP & GOVERNOR DRIVE GEAR
11	JACKET WATER PUMP DRIVE GEAR

DATA SHEET 15

GEARSET INSPECTION

ENGINE TAG NO: _____ DATE: _____

VISUAL INSPECTION (Step 4.16.8)

Inspect the following gears for chipped or broken teeth, pitting, excessive wear or other abnormal conditions:

Item	Description	Sat	Unsat	Performed By/Date
1	Camshaft Gear Right Hand	____	____	____/____
2	Idler Gear Right Hand	____	____	____/____
3	Camshaft Gear Left Hand	____	____	____/____
4	Idler Gear Left Hand	____	____	____/____
5	Crankshaft Gear	____	____	____/____
6	Lubricating Oil Pump Drive Gear	____	____	____/____
7	Lubricating Oil Pump Driven Gear	____	____	____/____
8	Governor Drive Gear	____	____	____/____
9	Governor Driven and Drive Gear	____	____	____/____
10	Fuel Oil Pump & Overspeed Trip Drive Gear	____	____	____/____
11	Jacket Water Pump Drive Gear	____	____	____/____

Remarks: _____

DATA SHEET 15

GEARSET INSPECTION

ENGINE TAG NO.: _____ DATE: _____

Gear Mesh Lube Oil Spray Pattern Inspection (Step 4.16.9, 4.28.10):

Location	Description	Sat	Unsat	Performed
1	R.B. Cam To R.B. Idler Gears	____	____	____
2	L.B. Cam To L.B. Idler Gears	____	____	____
3	L.B. Idler to Crankshaft Gears	____	____	____
4	R.B. Idler to Crankshaft Gears	____	____	____
5	Water Pump to R.B. Idler Gears	____	____	____
6	Oil Pump to R.B. Idler Gears	____	____	____
7	Governor Drive to R.B. Idler Gears	____	____	____
8	Overspeed Trip to L.B. Idler Gears	____	____	____
9	Governor Drive to Driven Gears	____	____	____

Remarks: _____

Sheet 1 of 9

DATA SHEET 16

CONNECTING ROD INSPECTIONS

COMPONENT GROUP TITLE:	PARTS GROUP NO.
CONNECTING RODS	02-340
LOCATION:	UNIT NO.
VOGTLE ELECTRIC GENERATING PLANT	
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.18

1) Step 4.24.4 & 4.25.5 - Rod Eye To Bushing Interference

Step	4.24.4				4.24.5	
	Rod Eye		Bushing			
Rod	x-x	y-y	x-x	y-y	Interference	Performed By

Interference Fit To Be: 0.004/0.006:

M&TE Serial No. _____ _____ _____

Cal. Due Date _____ _____ _____

2) Step 4.24.6 - Rod Eye And Bushing Width

Step	4.24.6			
Rod	Rod Eye	Bushing	Difference	Performed By

M&TE Serial No. _____ _____ _____

Cal. Due Date _____ _____ _____

DATA SHEET 16

CONNECTING ROD INSPECTIONS

ENGINE TAG NO. _____

CYLINDER NO./BANK _____ DATE _____

1) Record the following information for the connecting rod removed from engine per Step 4.18.2cc and 4.18.3r.

Link Rod ID No. _____
Master Rod ID No. _____
Recorded By/Date _____/_____

2) Record the following information for the connecting rod installed in engine per Step 4.28.1b(6)(b) or 4.28.1c(5)(b).

Link Rod ID No. _____
Master Rod ID No. _____
Recorded By/Date _____/_____

If connecting rod installed in this position is not the one that was removed, state reason for replacement: _____

_____

_____

_____/_____

3) LINK ROD-TO-LINK PIN BOLT TORQUE (ft-lbs)

STEP	4.18.5a(2)(a)			4.18.5h(3)(a) and 4.18.5h(4)			
BOLT	TORQUE DISASSEMBLY	PERFORMED	WITNESSED	TORQUE ASSEMBLY	CLEARANCE SATISFACTORY	PERFORMED	WITNESSED
1							
2							
3							
4							

	Disassembly		Assembly	
M&TE Serial No.	_____	_____	_____	_____
Cal. Due Date	_____	_____	_____	_____

DATA SHEET 16

CYLINDER NO./BANK _____ DATE _____

* Note: Document inspections of connecting rods removed even if it is to be replaced. Use additional data sheets for any replacement rods.

1) Piston Pin Bushings (Step 4.18.5B)
Measure inside diameter of link rod piston pin bushing with micrometer. Measure in vertical (A-A) and horizontal (B-B) planes, 90½ apart. Measure on both ends (gearcase and flywheel), two inches from end of bushing. Take same measurements on master rod piston pin bushing.

	LINK ROD		MASTER ROD	
	A-A	B-B	A-A	B-B
Gearcase Rod				
Flywheel Rod				
Performed By				
Witnessed By				

M&TE Serial No. _____ _____ _____ _____
Cal Due Date _____ _____ _____ _____

2) Link Pin and Bushings (Step 4.18.5C(1), (2) and (3))
Measure inside diameter of link pin bushing with micrometer. Take measurements in vertical (A-A) and horizontal (B-B) planes, 90½ apart. Measure on both ends (gearcase and flywheel), one inch from end of bushing. Measure outside diameter of link pin with micrometer. Measure on both ends, one inch in from end of pin in both vertical (A-A) and horizontal (B-B) planes.

	Link Pin Bushing ID		Link Pin OD		Clearance	Perform	Witness
	A-A	B-B	A-A	B-B			
Gearcase End							
Flywheel End							

Clearance - When New: 0.006"/0.011"

Replace when greater than or equal to 0.015"

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

DATA SHEET 16

CONNECTING ROD INSPECTIONS

ENGINE TAG NO. _____

CYLINDER NO./BANK _____ DATE _____

3) Connecting Rod Bearing Bore (Step 4.18.5d(3))
Reassemble connecting rod box to measure for out-of-round conditions at connecting rod bearing bore. Do not install bearings. Torque nuts to full value. Measure connecting rod bearing bore inside diameter at 45½ intervals on both ends, one inch in from outer edge.

	Connecting Rod Bearing Bore ID				Performed	Witnessed
	A-A	B-B	C-C	D-D		
Gearcase End						
Flywheel End						
M&TE Serial No.						
Cal. Due Date						

VISUAL INSPECTIONS:

4) Rack Teeth Inspection - Note any abnormalities (Step 4.18.5f):

_____

_____

Sat ( ) Unsat ( ) Performed By/Date: _____/_____

5) Connecting rod bolt washers, nuts and bolt contact surface inspection (Step 4.18.5g(3) and (5): _____

_____

_____

_____

Sat ( ) Unsat ( ) Performed By/Date: _____/_____

* Note: Document inspections of connecting rods removed even if it is to be replaced. Use additional data sheets for any replacement rods.

DATA SHEET 16

CONNECTING ROD INSPECTIONS

ENGINE TAG NO. _____

CYLINDER NO./BANK _____ DATE _____

NOTE

There is a licensing requirement to verify that the two pair of connecting rod bolts above the crankpin (nos. 1, 3, 5 and 6) have not lost bolt tension since last connecting rod assembly. This is accomplished by measuring the connecting rod bolt length ultrasonically prior to untorquing of bolts and comparing this value with the bolt length measured during last assembly and to the bolt's free (untorqued) length. The bolt should not have lost more than 7% of its tension. For example, if the bolt's free length is 11.1875 inches and during the connecting rod's last assembly this bolt was stretched the required .0225 inch to a length of 11.2100 inches. If the length of the bolt prior to disassembly is found to be between 11.2084 and 11.2100 inches the bolt is acceptable (ie., 93% of 0.0225 is 0.0209 inch and when added to free length of 11.1875 inches equals to 11.2084 inches).

1) Connecting rod bolt length during last assembly

BOLT	BOLT LENGTH (A)	RECORDED BY
1		/
3		/
5		/
6		/

DATA SHEET 16

CONNECTING ROD INSPECTIONS

ENGINE TAG NO. _____

CYLINDER NO. _____ DATE _____

2) Connecting rod bolt length prior to disassembly. See Sheet 1 of this "Data" Sheet for bolt identification number. Measure to nearest 1/2 thousandth. (Steps 4.18.2f):

BOLT	BOLT LENGTH (B)	PERFORMED BY	WITNESSED BY
1		/	/
2		/	/
3		/	/
4		/	/
5		/	/
6		/	/

M&TE Serial No. _____ _____ _____

Cal Due Date _____ _____ _____

3) Bolt free (untorqued) length determined ultrasonically (Step 4.18.5g(1))

BOLT	BOLT LENGTH (B)	PERFORMED BY	WITNESSED BY
1			
2			
3			
4			
5			
6			

M&TE Serial No. _____ _____ _____

Cal Due Date _____ _____ _____

DATA SHEET 16

CONNECTING ROD INSPECTIONS

ENGINE TAG NO. _____

CYLINDER NO. _____ DATE _____

4) Verify bolt preload (stretch) has not decreased by more than 7% for rod-to-box bolts 1, 3, 5 and 6. (Step 4.18.5g(2))

BOLT	BOLT LENGTH AT LAST ASSEMBLY (A)	BOLT FREE LENGTH (C)	AMOUNT OF STRETCH (D)	(E) = Dx 0.93
1				
3				
5				
6				

BOLT	BOLT LENGTH PRIOR TO DISASSEMBLY (B)	BOLT FREE LENGTH (C)	AMOUNT OF STRETCH (F)	Is (F) greater than or equal to (E)?
1				
3				
5				
6				

BOLT NO. 1: Sat ( ) Unsat ( )
BOLT NO. 3: Sat ( ) Unsat ( )
BOLT NO. 5: Sat ( ) Unsat ( )
BOLT NO. 6: Sat ( ) Unsat ( )

Performed By _____

Resolution if any unsat: _____

DATA SHEET 16

CONNECTING ROD INSPECTIONS

ENGINE TAG NO. _____

CYLINDER NO. _____ DATE _____

1) Measure untorqued bolt length (Step 4.28.1c(16)(b))

BOLT	BOLT LENGTH (A)	PERFORMED BY	WITNESSED BY
1		/	/
2		/	/
3		/	/
4		/	/
5		/	/
6		/	/

M&TE Serial No. _____ _____ _____

Cal Due Date _____ ___

2) Determine length to which bolts must be stretched to provide proper preload (Step 4.28.1c(16)(d)) Bolts 2 and 4 must be stretched 38 mils (þ1 mil). Bolts 1, 3, 5, 6 must be stretched 22.5 mils (þ .5 mil). (Determine by adding stretch required and Dimension (A) above.)

BOLT	MINIMUM STRETCHED LENGTH	MAXIMUM STRETCHED LENGTH	CALCULATED BY
1	(A) + 0.022 =	(A) + 0.023 =	
2	(A) + 0.037 =	(A) + 0.039 =	
3	(A) + 0.022 =	(A) + 0.023 =	
4	(A) + 0.037 =	(A) + 0.039 =	
5	(A) + 0.022 =	(A) + 0.023 =	
6	(A) + 0.022 =	(A) + 0.023 =	

DATA SHEET 16

CONNECTING ROD INSPECTIONS

ENGINE TAG NO. _____

CYLINDER NO. _____ DATE _____

3) Record final bolt length and torque applied: (Step 4.28.1c(16)(d))

BOLT	FINAL BOLT LENGTH	FINAL TORQUE*	PERFORMED BY	WITNESSED BY
1				
2				
3				
4				
5				
6				

* DO NOT EXCEED 2000 Ft-lbs

M&TE Serial No. _____ _____ _____
Cal. Due Date _____ _____ _____

Sheet 1 of 4

DATA SHEET 17

PISTON INSPECTIONS

COMPONENT GROUP TITLE: PISTON-TWO PIECE	PARTS GROUP NO. 02-341
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.18

CYLINDER/BANK NO. _____

1) Record the following information for the piston removed from engine per Step 4.18.2bb and 4.18.3g.

Skirt ID No. _____ Orientation: _____
Crown ID No. _____
Recorded By/Date _____/_____

2) Record the following information for the piston installed in engine per Step 4.28.1b(6)(a) and 4.28.1c(5)(a).

Skirt ID No. _____ Orientation: _____
Crown ID No. _____
Recorded By/Date _____/_____

If piston installed in this position is not the one that was removed, state reason for replacement:_____
_____
_____

_____/_____

DATA SHEET 17

PISTON INSPECTIONS

ENGINE TAG NO. _____
CYLINDER/BANK _____ DATE _____

1. Measure piston ring side clearance in groove with feeler gauge. Measure each ring in three locations, 120 degrees apart. Record results below (Step 4.18.4b
2. Remove rings from piston for cleaning (Step 4.18.4c)
3. Measure ring end gap (Step 4.18.4e(3))
4. Record percent ring face contact (Step 4.18.4e(4))
5. If new rings are installed, note reasons in "Remarks" below. (Step 4.18.4e(5))
6. If new rings are installed, record end gap and side clearance in grooves. (Step 4.13.4e(6))

	Old (Removed) Rings					New (Replacement) Rings					
	Side Clearance			End	% Face	Side Clearance			End	Performed	Witnessed
Ring	A	B	C	Gap	Contact	A	B	C	Gap	By	By
1 Top Compression											
2 Top Compression											
3 Intermediate Compression											
4 Intermediate Compression											
5 Oil Control											
6 Oil Control											

Replace rings if the following criteria is exceeded:

	Side Clearance	End Gap
Top Compression Ring (No. 1)	0.020	0.155
Compression Ring (No. 2)	0.020	0.155
Compression Ring (No. 3)	0.020	0.150
Compression Ring (No. 4)	0.030	0.150
Oil Control Ring (Upper)	0.020	0.110
Oil Control Ring (Lower)	0.020	0.110

M&TE Serial No. _____ _____ _____ _____
Cal. Due Date _____ _____ _____ _____
Remarks: _____

DATA SHEET 17

PISTON INSPECTIONS

ENGINE TAG NO. _____
CYLINDER/BANK _____ DATE _____

1) Record piston skirt outside diameter (Step 4.18.4g(1) and (2)):

Position	A-A	B-B	C-C	D-D	Perform	Witn
Upper				N/A		
Lower						
M&TE Serial No.						
Cal. Due Date						

2) Record piston pin outside diameter (Step 4.18.4h(1)):

Position	A-A	B-B	Performed	Witnessed
Forward End				
Alt End				
M&TE Serial No.				
Cal. Due Date				

3) Record piston pin bore in skirt (Step 4.18.4h(2)):

Position	A-A	B-B	Performed	Witnessed
Forward End				
Alt End				
M&TE Serial No.				
Cal. Due Date				

* Note: Document inspections of pistons removed even if is to be replaced. Use additional data sheets for any replacement pistons.

DATA SHEET 17

PISTON INSPECTIONS

ENGINE TAG NO. _____
CYLINDER/BANK _____ DATE _____

4) Determine Pin-To-Bushing Clearance (Step 4.18.4i(1)) And Pin-To-Piston Clearance (Step 4.18.4i(2))

	Clearance	Performed
Pin-To-Bushing		
Pin-To-Piston		

Clearances:	Pin-to-Bushing	Pin-to-Piston
When New-	0.009"/0.015"	0.002"/0.004"
Replace -	0.020"	0.005"

VISUAL INSPECTIONS:

1) Inspect piston for wear and other abnormal conditions such as scuffing, scratches, etc. (Step 4.18.4f). _____

Sat ( ) Unsat ( ) Performed By/Date: _____/_____

2) Inspect piston pin for chrome damage: chipped or blistered (Step 4.18.4j(1)): _____

3) Inspect piston pin end plugs to ensure they are tight (Step 4.18.4j(2)) _____

Sat ( ) Unsat ( ) Performed By/Date: _____/_____

DATA SHEET 18

CONNECTING ROD BEARING SHELL INSPECTIONS

COMPONENT GROUP TITLE: CONNECTING ROD BEARING SHELLS	PARTS GROUP NO. 02-340
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.19

CYLINDER/BANK NO. _____

1) For Connecting Rod Bearing Shells Removed From Engine (Step 4.19.1d)

UPPER SHELL
ID No.: _____ Manuf. Info.: _____
Disassembly Position: _____ Recorded By/Date: _____/_____

LOWER SHELL
ID No.: _____ Manuf. Info.: _____
Disassembly Position: _____ Recorded By/Date: _____/_____

2) For Connecting Rod Bearing Shells Installed In Engine (Step 4.28.1b(12)(e)):

UPPER SHELL
ID No.: _____ Manuf. Info.: _____
Reassembly Position: _____ Recorded By/Date: _____/_____

LOWER SHELL
ID No.: _____ Manuf. Info.: _____
Reassembly Position: _____ Recorded By/Date: _____/_____

DATA SHEET 18

CONNECTING ROD BEARING SHELL INSPECTIONS

CYLINDER NO. _____
ENGINE TAG NO. _____ DATE _____

3) Visual Inspection (Step 4.19.2a(1))
Note any indications on Figures at left.
a) TOP SHELL: _____
_____
Sat ( ) Unsat ( )
Performed By/Date: _____/_____
b) BOTTOM SHELL: _____
_____
Sat ( ) Unsat ( )
Performed By/Date: _____/_____

4) Dimensional Check (Step 4.19.2b(1))
Record measurement in boxes at left.
Thickness when New: 0.619/0.618"
Replace when less than or equal to 0.613"
a) TOP SHELL: Sat ( ) Unsat ( )
Performed By/Date: _____/_____
M&TE Serial No. _____
Cal. Due Date _____
b) BOTTOM SHELL: Sat ( ) Unsat ( )
Performed By/Date: _____/_____
M&TE Serial No. _____
Cal. Due Date _____

* Note: Document inspections of connecting rod bearings removed even if it is to be replaced. Use additional data sheets for any replacement bearings.

Sheet 1 of 2

DATA SHEET 19

MAIN BEARING SHELL INSPECTIONS

COMPONENT GROUP TITLE:	PARTS GROUP NO.
MAIN BEARING SHELLS	02-310
LOCATION:	UNIT NO.
VOGTLE ELECTRIC GENERATING PLANT	
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFFRENCE STEPS: 4.20

BEARING NO. _____

1) For Main Bearing Shells Removed From Engine (Step 4.20.1u and 4.20.1w(3))

UPPER SHELL
ID No.: _____ Manuf. Info.: _____
Disassembly Position: _____ Recorded By/Date: _____/_____

LOWER SHELL
ID No.: _____ Manuf. Info.: _____
Disassembly Position: _____ Recorded By/Date: _____/_____

2) For Main Bearing Shells Installed In Engine (Step 4.20.7b and 4.20.9)

UPPER SHELL
ID No.: _____ Manuf. Info.: _____
Reassembly Position: _____ Recorded By/Date: _____/_____

LOWER SHELL
ID No.: _____ Manuf. Info.: _____
Reassembly Position: _____ Recorded By/Date: _____/_____

DATA SHEET 19

MAIN BEARING SHELL INSPECTIONS

ENGINE TAG NO. _____
BEARING NO, _____ DATE _____

3) Visual Inspection (Step 4.20.4a(1))
Note any indications on Figures at left.
a) TOP SHELL: _____
_____
Sat ( ) Unsat ( )
Performed By/Date: _____/_____
b) BOTTOM SHELL: _____
_____
Sat ( ) Unsat ( )
Performed By/Date: _____/_____

4) Dimensional Check (Step 4.20.4a(2))
Record measurement in boxes at left.
Thickness when New: 0.619/0.618"
Replace when less than or equal to 0.613"
a) TOP SHELL: Sat ( ) Unsat ( )
Performed By/Date: _____/_____
M&TE Serial No. _____
Cal. Due Date _____
b) BOTTOM SHELL: Sat ( ) Unsat ( )
Performed By/Date: _____/_____
M&TE Serial No. _____
Cal. Due Date _____

* Note: Document inspections of main bearing removed even if it is to be replaced. Use additional data sheets for any replacement bearings.

Sheet 1 of 2

DATA SHEET 20

CRANKSHAFT INSPECTIONS

COMPONENT GROUP TITLE: CRANKSHAFT	PARTS GROUP NO. 02-310
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS:

DIMENSIONAL CHECK (Step 4.20.2b)

Measure diameter of crank journals, one inch in from web at either end (Flywheel end and gearcase end). Measure four different diameters (A-A, B-B, C-C and D-D) at each location. Record measurements in spaces below.

	Flywheel End				Gearcase End				Results		Performed
Journal No.	A-A	B-B	C-C	D-D	A-A	B-B	C-C	D-D	Sat	Unsat	By
1											
2											
3											
4											
5											
6											
7											
8											

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

DATA SHEET 20

CRANKSHAFT INSPECTIONS

ENGINE TAG NO. _____ DATE _____

VISUAL INSPECTIONS

1) Inspect crankshaft crankpin (4.20.2a(1)) _____

Sat ( ) Unsat ( ) Performed By/Date: _____/_____

2) Inspect crankshaft main journals (Step 4.20.2a(2)) _____

Sat ( ) Unsat ( ) Performed By/Date: _____/_____

3) Inspect crankshaft oil hole plugs (Step 4.20.2c): _____

Sat ( ) Unsat ( ) Performed By/Date: _____/_____

Sheet 1 of 2

DATA SHEET 21

MAIN BEARING CAP INSPECTIONS

COMPONENT GROUP TITLE:	PARTS GROUP NO.
MAIN BEARING CAP	02-305
LOCATION: VOGTLE ELECTRIC GENERATING PLANT	UNIT NO.
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.20

VISUAL INSPECTIONS:

1) Inspect mating surface of bearing cap for evidence of fretting (Step 4.20.4b(1))

Cap No.	1	2	3	4	5	6	7	8	9	10
Sat/Unsat										
Performed										
Witnessed										

2) Inspect engine base bearing pedestal cap mating surface for evidence of fretting (Step 4.20.4b(2)):

Pedestal	1	2	3	4	5	6	7	8	9	10
Sat/Unsat										
Performed										
Witnessed										

DATA SHEET 21

MAIN BEARING CAP INSPECTIONS

ENGINE TAG NO. _____ DATE _____

MAIN BEARING BOLT ELONGATION, OR TORQUE APPLIED WITH TORQUE WRENCH. [If torque multiplier used with torque wrench, record multiplier ratio.] Bearing caps are numbered starting from gearcase end. Record elongation in thousandths of an inch.
M&TE Serial No. _____ _____
Cal. Due Date _____ _____
Required Elongation: 0.051"-0.056"

INITIAL STUD HEIGHT (Step 4.20.13k(4) and 4.20.13o(2))

STUD/CAP	1	2	3	4	5	6	7	8	9	10
A										
B										
C										
D										
E		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

PERFORMED _____
WITNESSED _____

STRETCHED HEIGHT (Step 4.20.13k(a), 4.20.13o(4))

STUD/CAP	1	2	3	4	5	6	7	8	9	10
A										
B										
C										
D										
E		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

PERFORMED _____
WITNESSED _____

DISTANCE STRETCHED (Step 4.20.13j(6)(7)(8), 4.20.13k(11), 4.20.13o(6))

STUD/CAP	1	2	3	4	5	6	7	8	9	10
A										
B										
C										
D										
E		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

PERFORMED _____
WITNESSED _____

Sheet 1 of 22

DATA SHEET 22

MISCELLANEOUS TORQUING

COMPONENT GROUP TITLE:	PARTS GROUP NO.
MISC.	MISC.
LOCATION:	UNIT NO.
VOGTLE ELECTRIC GENERATING PLANT	
TAG NUMBER:	ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.20

1) Step 4.20.14: Crankshaft rear seal upper half.

Capscrew	Torque	Performed By	Witnessed By
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
M&TE Serial No.			
Cal. Due Date			

DATA SHEET 22

MISCELLANEOUS TORQUING

ENGINE TAG NO.: _____ DATE: _____

3) Step 4.28.2k: RIGHT BANK Intake air elbows

Elbow-to-Head

	Cylinder Head							
Capscrew	1R	2R	3R	4R	5R	6R	7R	8R
1								
2								
3								
4								
5								
6								
Performed								
Witnessed								

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

Elbow-to-Intake Manifold

	Cylinder Head							
Capscrew	1R	2R	3R	4R	5R	6R	7R	8R
1								
2								
3								
4								
5								
6								
7								
8								
Performed								
Witnessed								

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

DATA SHEET 22

MISCELLANEOUS TORQUING

ENGINE TAG NO.: _____ DATE: _____

3) Step 4.28.2k: LEFT BANK Intake air elbows

Elbow-to-Head

	Cylinder Head							
Capscrew	1L	2L	3L	4L	5L	6L	7L	8L
1								
2								
3								
4								
5								
6								
Performed								
Witnessed								
M&TE Serial No.								
Cal. Due Date								

Elbow-to-Intake Manifold

	Cylinder Head							
Capscrew	1L	2L	3L	4L	5L	6L	7L	8L
1								
2								
3								
4								
5								
6								
7								
8								
Performed								
Witnessed								
M&TE Serial No.								
Cal. Due Date								

DATA SHEET 22

MISCELLANEOUS TORQUING

ENGINE TAG NO.: _____ DATE: _____

4) Step 4.28.21: Exhaust elbows.

RIGHT BANK

	Cylinder Head							
Capscrew	1R	2R	3R	4R	5R	6R	7R	8R
1								
2								
3								
4								

Performed _____

Witnessed _____

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

LEFT BANK

	Cylinder Head							
Capscrew 1L		2L	3L	4L	5L	6L	7L	8L
1								
2								
3								
4								

Performed _____

Witnessed _____

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

DATA SHEET 22

MISCELLANEOUS TORQUING

ENGINE TAG NO.: _____ DATE: _____

5) Step 4.28.3d & f: Air start valve capscrews. Engine Hours _____

Cylinder	Capscrew = 2-3/4" Torque 1	2	1	2	Performed	Witnessed
1R						
2R						
3R						
4R						
5R						
6R						
7R						
8R						
1L						
2L						
3L						
4L						
5L						
6L						
7L						
8L						

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

DATA SHEET 22

MISCELLANEOUS TORQUING

ENGINE TAG NO.: _____ DATE: _____

6) Step 4.28.2m: Jacket water piping to head.

RIGHT BANK

	Cylinder Head							
Capscrew	1R	2R	3R	4R	5R	6R	7R	8R
1								
2								
3								
4								
Performed								
Witnessed								
M&TE Serial No.								
Cal. Due Date								

LEFT BANK

	Cylinder Head							
Capscrew	1L	2L	3L	4L	5L	6L	7L	8L
1								
2								
3								
4								
Performed								
Witnessed								
M&TE Serial No.								
Cal. Due Date								

DATA SHEET 22

MISCELLANEOUS TORQUING

ENGINE TAG NO.: _____ DATE: _____

7) Step 4.28.2o: Starting air piping to head.

RIGHT BANK

	Cylinder Head							
Capscrew	1R	2R	3R	4R	5R	6R	7R	8R
1								
2								
3								
4								

Performed _____

Witnessed _____

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

LEFT BANK

	Cylinder Head							
Capscrew	1L	2L	3L	4L	5L	6L	7L	8L
1								
2								
3								
4								

Performed _____

Witnessed _____

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

Sheet 8 of 12

DATA SHEET 22

MISCELLANEOUS TORQUING

ENGINE TAG NO.: _____ DATE: _____

8) Step 4.28.20d: Fuel injector nuts. Engine Hours _____

Cylinder	Nuts 1	2	Performed	Witnessed
1R				
2R				
3R				
4R				
5R				
6R				
7R				
8R				
1L				
2L				
3L				
4L				
5L				
6L				
7L				
8L				
M&TE Serial No.	_____	_____	_____	_____
Cal. Due Date	_____	_____	_____	_____

DATA SHEET 22

MISCELLANEOUS TORQUING

ENGINE TAG NO.: _____ DATE: _____

9) Step 4.28.4i: Subcover assembly.

RIGHT BANK

Capscrew	Cylinder Head 1R	2R	3R	4R	5R	6R	7R	8R
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								

Performed _____

Witnessed _____

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

LEFT BANK

Capscrew	Cylinder Head 1L	2L	3L	4L	5L	6L	7L	8L
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								

Performed _____

Witnessed _____

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

DATA SHEET 22

MISCELLANEOUS TORQUING

ENGINE TAG NO.: _____ DATE: _____

10) Step 4.28.13(b)(3): Jacket Water Pump Adaptor Plate.

Capscrew	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
9	_____	_____	_____
10	_____	_____	_____
11	_____	_____	_____
12	_____	_____	_____
M&TE Serial No.		_____	_____
Cal. Due Date		_____	_____

11) Step 4.28.13(b)(6): Jacket Water Pump.

Capscrew	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
M&TE Serial No.		_____	_____
Cal. Due Date		_____	_____

12) Step 4.28.13(b)(8): Jacket Water Pump Suction Piping.

Bolt	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
9	_____	_____	_____
10	_____	_____	_____
11	_____	_____	_____
12	_____	_____	_____
M&TE Serial No.		_____	_____
Cal. Due Date		_____	_____

DATA SHEET 22

MISCELLANEOUS TORQUING

ENGINE TAG NO.: ______________ DATE: ______________

13) Step 4.28.13b(10): Jacket Water Pump Discharge Piping.

Bolt	Torque	Performed By	Witnessed By
1			
2			
3			
4			
5			
6			
7			
8			

M&TE Serial No. ______ ______ ______ ______
Cal. Due Date ______ ______ ______ ______

14) Step 4.28.13c(3): Lube Oil Pump Adaptor Plate.

Capscrew	Torque	Performed By	Witnessed By
1			
2			
3			
4			
5			
6			
7			
8			
1			
2			
3			
4			
5			
6			
7			

M&TE Serial No. ______ ______ ______
Cal. Due Date ______ ______ ______

15) Step 4.28.13c(5): Lube Oil Pump.

Capscrew	Torque	Performed By	Witnessed By
1			
2			
3			
4			
5			
6			
7			
8			

M&TE Serial No. ______ ______ ______
Cal. Due Date ______ ______ ______

DATA SHEET 22

MISCELLANEOUS TORQUING

ENGINE TAG NO.: _____ DATE: _____

16) Step 4.28.13c(6): Lube Oil Pump Discharge Piping

Bolts	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
M&TE Serial No.	_____	_____	_____ _____
Cal. Due Date	_____	_____	_____ _____

17) Step 4.28.13c(8): Lube Oil Pump Suction Elbow.

Capscrews	Torque	Performed By	Witnessed By
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
9	_____	_____	_____
10	_____	_____	_____
11	_____	_____	_____
12	_____	_____	_____
M&TE Serial No.	_____	_____	_____ _____
Cal. Due Date	_____	_____	_____ _____

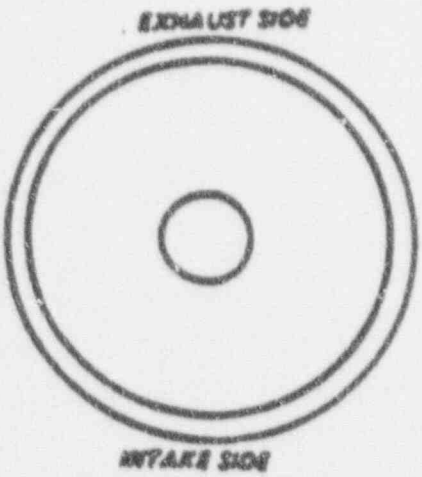
Sheet 1 of 2

DATA SHEET 23

CYLINDER LINER INSPECTIONS

COMPONENT GROUP TITLE: CYLINDER LINER	PARTS GROUP NO. 02-315
LOCATION: VOGTLE ELECTRIC GENERATING PLANT TAG NUMBER:	UNIT NO. ENGINE SERIAL NO.
TOTAL ENGINE HOURS:	HOURS SINCE LAST INSPECTION:
DATE THIS INSPECTION:	REFERENCE STEPS: 4.21

CYLINDER NO./BANK_____



Indicate blemishes on interior surface of cylinder liner as seen from above.

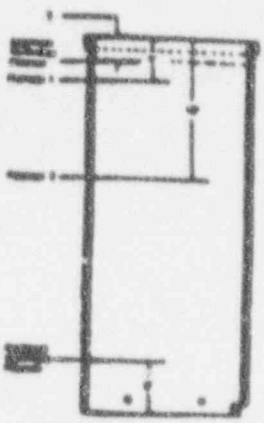
NORMAL CROSSHATCH

SCRATCHES – Long narrow grooves usually caused by foreign material. Crosshatch pattern runs through.

SCUFFING – Caused by piston and/or rings. Can start below oil ring and run up through upper compression ring travel area. Crosshatch pattern cannot be seen.

BRIGHT SPOT – Bearing through crosshatch. Can appear anywhere. Probable cause: Heavy bearing by buildup above top ring land.

A= Inboard (exhaust) side
B= Flywheel End



DATA SHEET 23

CYLINDER LINER INSPECTIONS

ENGINE TAG NO.: _____ DATE: _____

CYLINDER/BANK : _____

1) VISUAL INSPECTION (Step 4.21.2a)
Indicate any indications in figure on sheet 1: _____

_____

_____

Sat ( ) Unsat ( ) Performed By/Date: _____/_____

2) DIMENSIONAL CHECK (Step 4.21.2b and 4.21.2d)
DIRECTIONS FOR TAKING MICROMETER READINGS:

a) Establish reference measurement and record. If piston is out of liner, or if liner is removed from block, use PREFERRED REFERENCE POSITION. If piston is installed in liner, use ALTERNATE REFERENCE POSITION. Take two readings. 90 degrees apart (A and B).
b) Take readings at Position 1 and record.
c) Take readings at Position 2 and record.

Liner Bore: When New - 17.000" - 17.001"
Replace - 17.060" or Out of Round = 0.020"

Step 4.21.2b	(Before Honing)			Results		Performed
Position	A	B	Out of Round	Sat	Unsat	By
Reference						
1						
2						

M&TE Serial No. _____ _____ _____
Cal. Due Date _____ _____ _____

Step 4.21.2d	(After Honing)			Results		Performed
Position	A	B	Out of Round	Sat	Unsat	By
Reference						
1						
2						

M&TE Serial No. _____ _____ _____
Cal. Due Date _____ _____ _____

* Note: Document inspections of liner removed even if it is to be replaced. Use additional data sheets for any replacement liners.

Sheet 1 of 2

DATA SHEET 24

AIR START VALVE CAPSCREW TORQUING

ENGINE TAG NO.: _____ DATE: _____

Step 4.28.3g

Engine Hours _____

Cylinder	Capscrew 1	Capscrew 2	Did Screw Move?	Performed	Witnessed
1R					
2R					
3R					
4R					
5R					
6R					
7R					
8R					
1L					
2L					
3L					
4L					
5L					
6L					
7L					
8L					

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

Step 4.28.3g

Engine Hours _____

Cylinder	Capscrew 1	Capscrew 2	Did Screw Move?	Performed	Witnessed
1R					
2R					
3R					
4R					
5R					
6R					
7R					
8R					
1L					
2L					
3L					
4L					
5L					
6L					
7L					
8L					

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

Sheet 2 of 2

EVD. SHEET 24

AIR START VALVE CAPSCREW TORQUING

ENGINE TAG NO.: _____ DATE: _____

Step 4.28.3g Engine Hours _____

Cylinder	Capscrew 1	Capscrew 2	Did Screw Move?	Performed	Witnessed
1R					
2R					
3R					
4R					
5R					
6R					
7R					
8R					
1L					
2L					
3L					
4L					
5L					
6L					
7L					
8L					

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

Step 4.28.3g Engine Hours _____

Cylinder	Capscrew 1	Capscrew 2	Did Screw Move?	Performed	Witnessed
1R					
2R					
3R					
4R					
5R					
6R					
7R					
8R					
1L					
2L					
3L					
4L					
5L					
6L					
7L					
8L					

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

DATA SHEET 25

MISCELLANEOUS TORQUING

ENGINE TAG NO.: _____ DATE: _____

Step 4.28.20e: Fuel injector nuts. ENGINE HOURS _____

Cylinder	Nuts Did nut(s) 1	2	Move	Performed	Witnessed
1R					
2R					
3R					
4R					
5R					
6R					
7R					
8R					
1L					
2L					
3L					
4L					
5L					
6L					
7L					
8L					

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

ENGINE TAG NO.: _____ DATE: _____

Step 4.28.20e: Fuel injector nuts. ENGINE HOURS _____

Cylinder	Nuts Did nut(s) 1	2	Move	Performed	Witnessed
1R					
2R					
3R					
4R					
5R					
6R					
7R					
8R					
1L					
2L					
3L					
4L					
5L					
6L					
7L					
8L					

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

DATA SHEET 25

FUEL INJECTOR NUT TORQUING

ENGINE TAG NO.: _____ DATE: _____

Step 4.28.20e: Fuel injector nuts. ENGINE HOURS _____

Cylinder	Nuts 1	Nuts 2	Did nut(s) move	Performed	Witnessed
1R					
2R					
3R					
4R					
5R					
6R					
7R					
8R					
1L					
2L					
3L					
4L					
5L					
6L					
7L					
8L					

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

ENGINE TAG NO.: _____ DATE: _____

Step 4.28.20e: Fuel injector nuts. ENGINE HOURS _____

Cylinder	Nuts 1	Nuts 2	Did nut(s) move	Performed	Witnessed
1R					
2R					
3R					
4R					
5R					
6R					
7R					
8R					
1L					
2L					
3L					
4L					
5L					
6L					
7L					
8L					

M&TE Serial No. _____ _____ _____ _____

Cal. Due Date _____ _____ _____ _____

Sheet 1 of 1

DATA SHEET 26
GOVERNOR COUPLING FASTENER TORQUING

Step 4.48.2a(3): Governor flexible coupling torqued

Fasteners	Torque	Performed By	Witnessed By
1			
2			
3			
4			
5			
6			
M&TE serial No.			
Cal. Due Date			

Step 4.28.2a(4): Governor Coupling Inspection Cover

Capscrews	Torque	Performed By	Witnessed By
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
M&TE serial No.			
Cal. Due Date			

Step 4.48.2a(5): Governor Booster To Inspection Cover

Capscrews	Torque	Performed By	Witnessed By
1			
2			
3			
4			
M&TE serial No.:			
Cal. Due Date:			

POWER AND SIGNAL REMOVAL/REPLACEMENT DATA SHEET

Sheet 1 of 1

[ ] Safety Related/QC Holdpoints [ ] Non-Safety Related

NOTES

a. To install jumpers and/or lift wires, other than those directly associated with the equipment tag(s)/scheme number(s) listed on the Work Order, notify the Shift Supervisor and comply with his instructions.

b. Ensure that each lead (wire) is marked so it can be uniquely identified with its termination point.

c. Independent verification is only required on safety related equipment. Place N/A in independent verification block for non-safety related equipment.

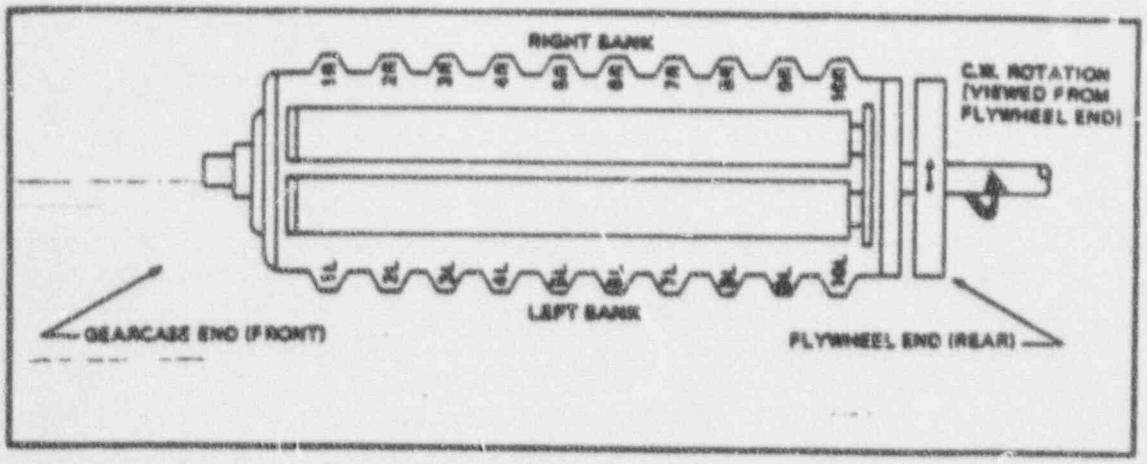
d. If the worker leaves the immediate proximity of the work or the work is interrupted, complete and install a "Jumper and Lifted Wire" tag per 00306-C, "Temporary Jumper And Lifted Wire Control". Instead of Control Number use the Procedure number on the tag.

e. If holdpoints do not apply, NA QC Verification block.

f. If applicable, tags shall remain intact and will only be removed by the independent verifier.

		REMOVAL			RECONNECTION		
IDENTIFY LEADS LIFTED, JUMPERS INSTALLED, LINES OPEN, ETC.	LOCATION PANEL OR JUNCTION BOX	PERFORMED BY/DATE	INDEPENDENT VERIFICATION BY/DATE	QC VERIF. BY/DATE	PERFORMED BY/DATE	INDEPENDENT VERIFICATION BY/DATE	QC VERIF. BY/DATE

Sheet 1 of 1



ENGINE ROTATION AND CYLINDER DESIGNATION

FIGURE 1

Sheet 1 of 1

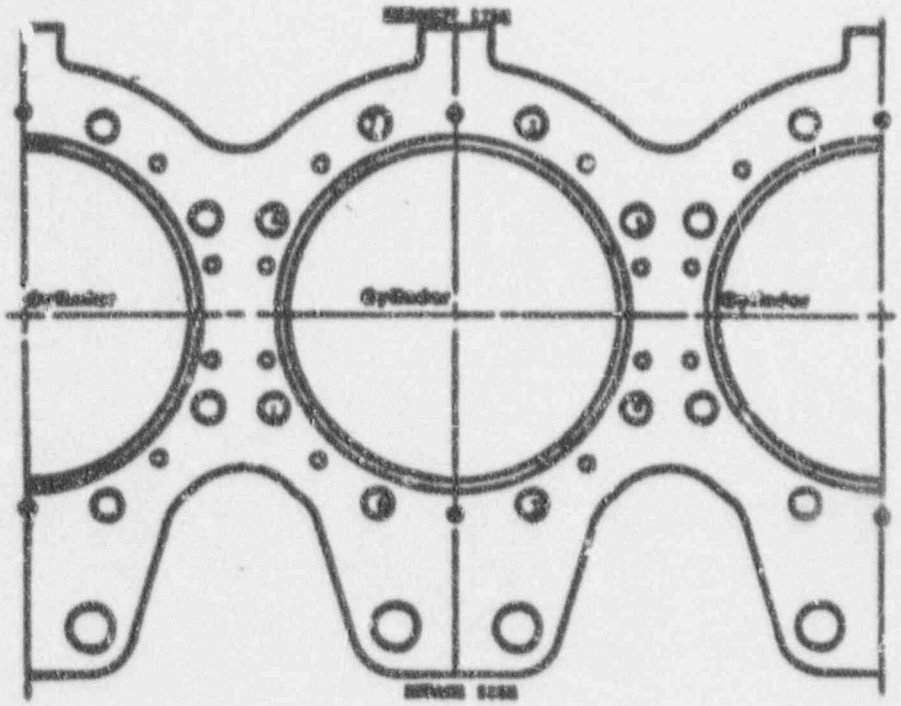
Improperly Cleaned Tip with Orifices Eroded by the Use of a Wire Brush

Properly Cleaned Tip with Sharp Square Orifice

INJECTOR SPRAY TIP

FIGURE 2

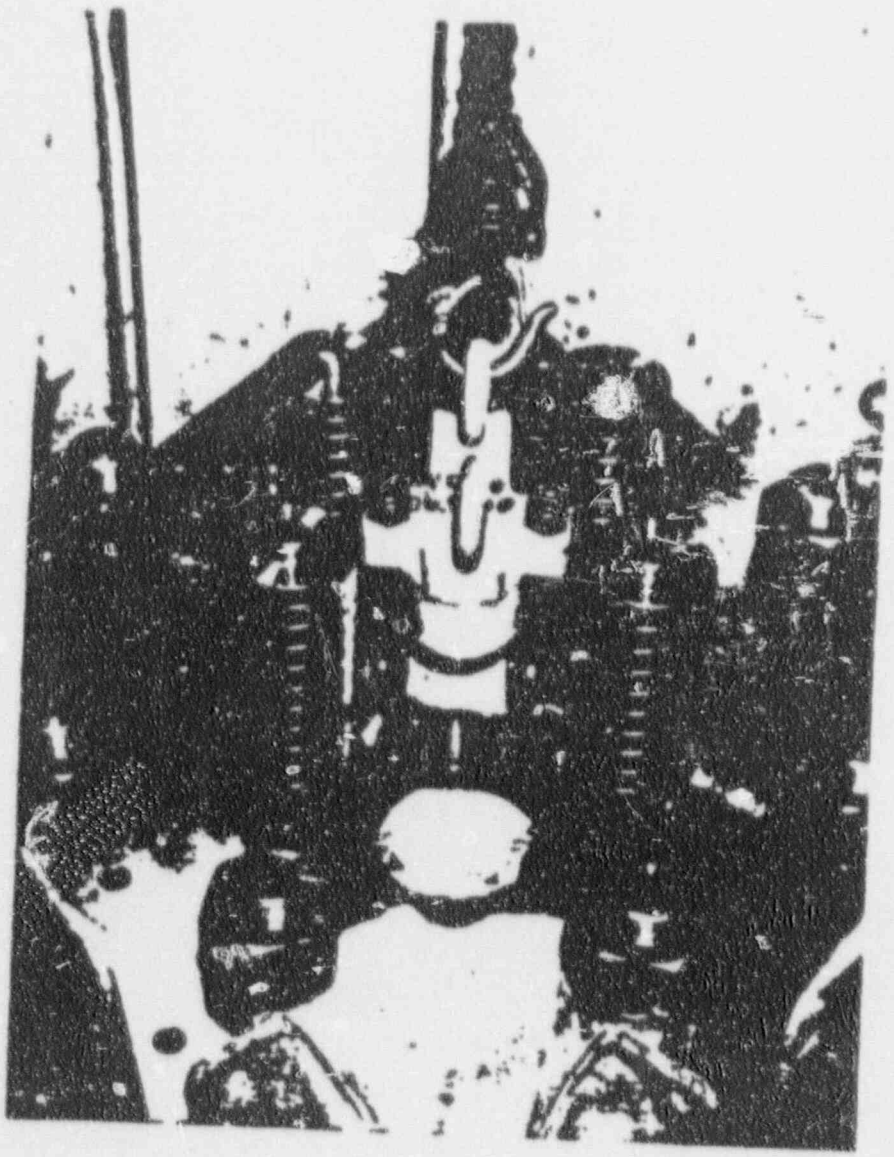
Sheet 1 of 1



TIGHTENING SEQUENCE FOR CYLINDER HEAD STUD NUTS

FIGURE 3

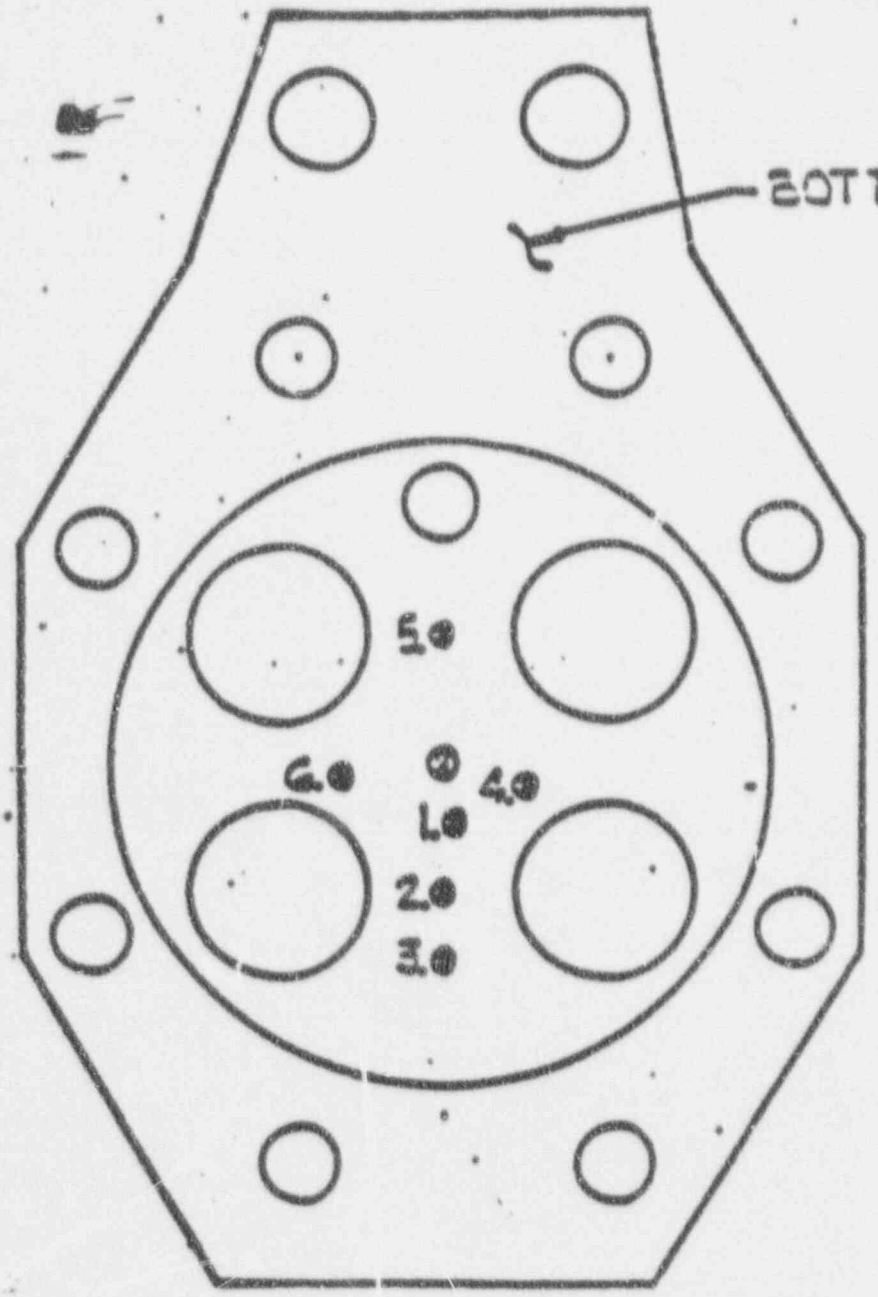
Sheet 1 of 1



CYLINDER HEAD LIFTING FIXTURE INSTALLATION

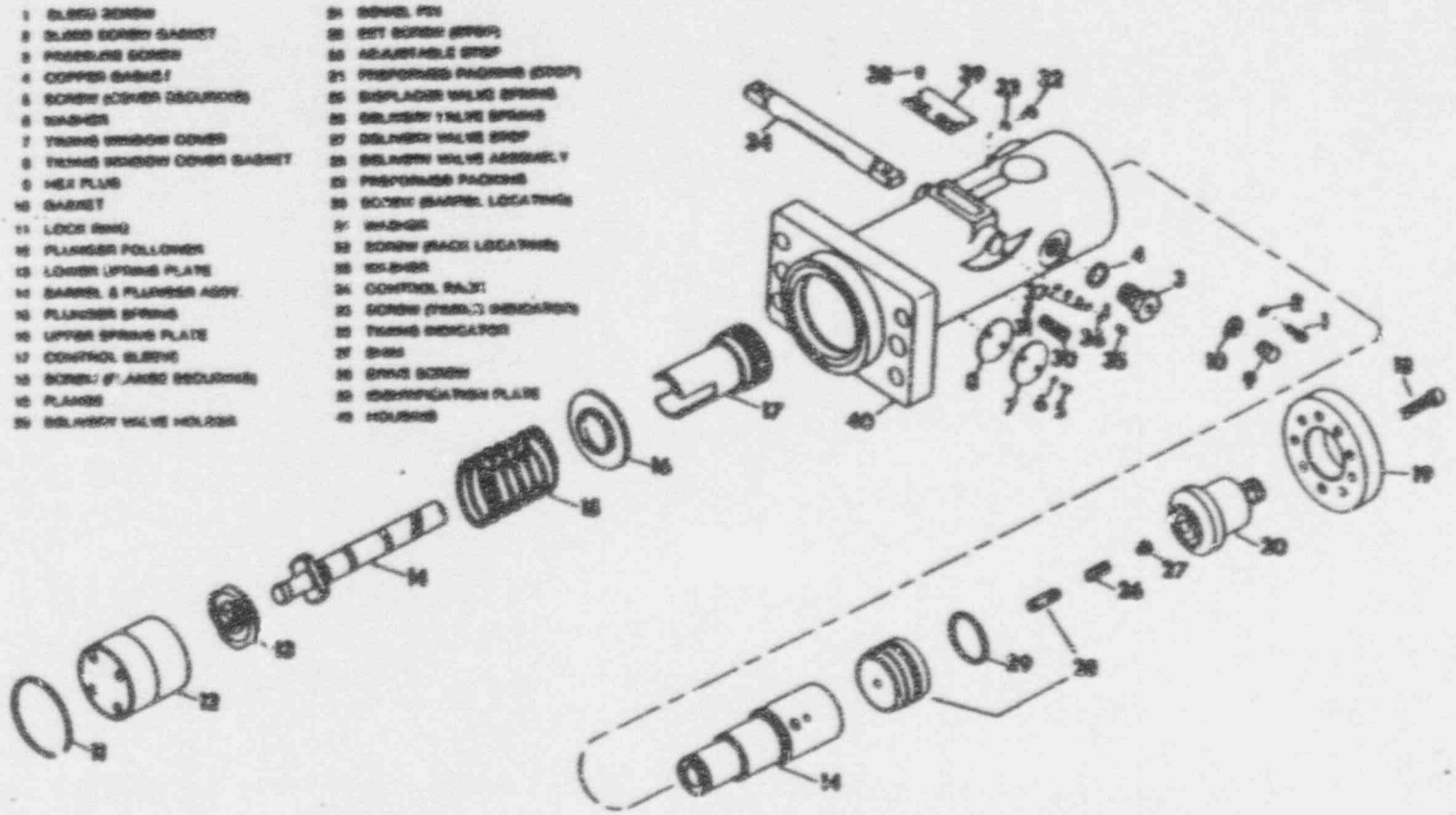
FIGURE 4

Sheet 1 of 1



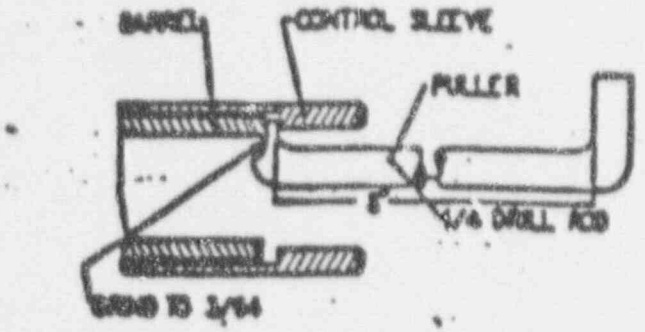
THIS SKETCH SHOWS THE SIX LOCATIONS WHERE A U.T. IS TO BE PERFORMED TO DETERMINE THE THICKNESS OF THE FIRE DECK.

FIGURE 5

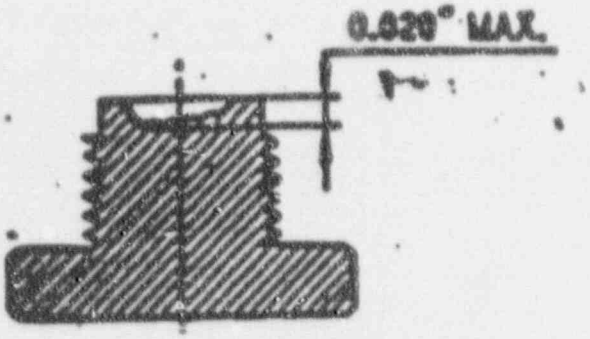


EXPLODED VIEW OF TYPICAL FDX TYPE PUMP

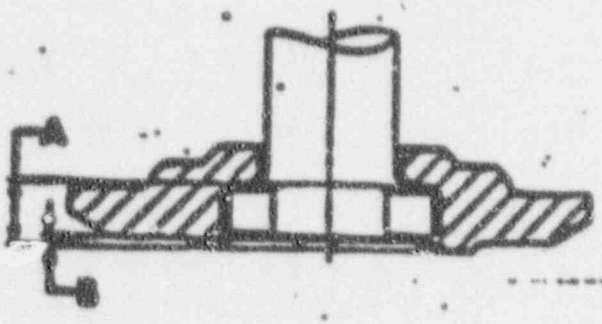
FIGURE 6



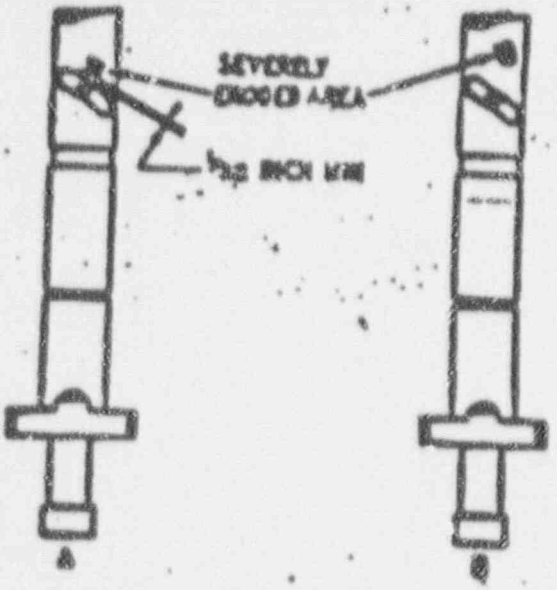
DIMENSION AND APPLICATION OF PULLER
FIGURE 7



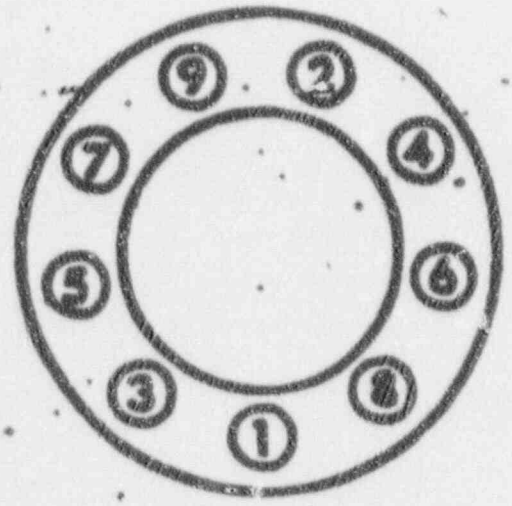
MAXIMUM PRESSURE SCREW EROSION
FIGURE 8



MEASURING PLUNGER BUTTON THICKNESS
FIGURE 9

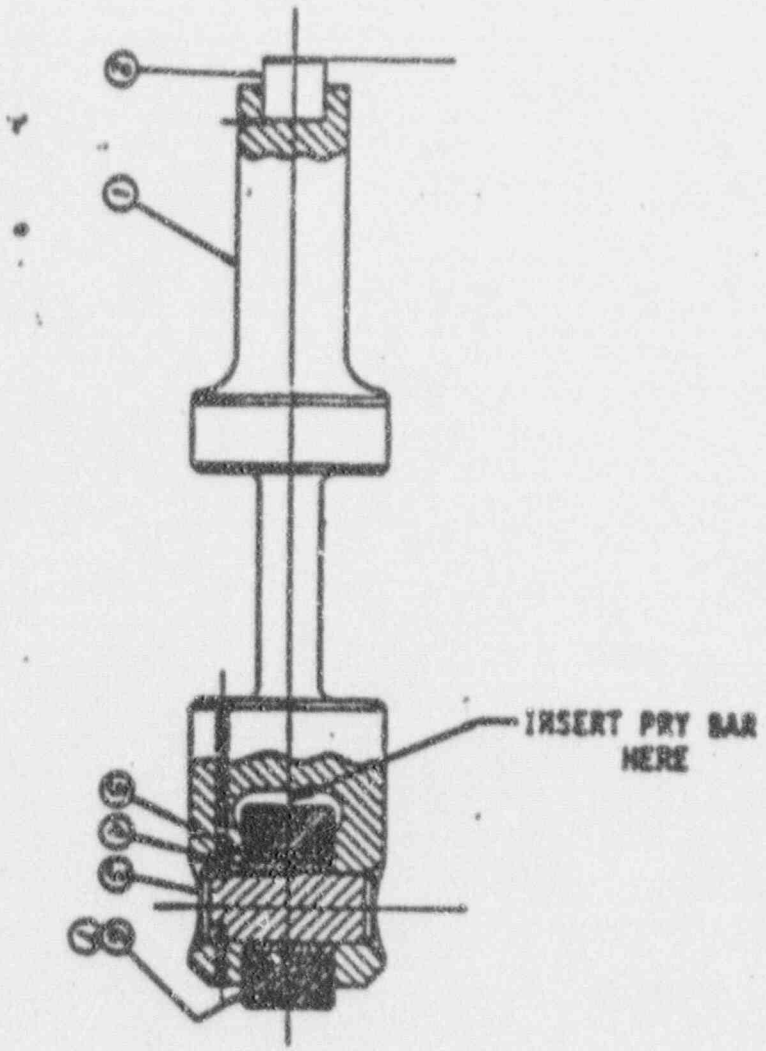


PLUNGER EROSION
FIGURE 10



SEQUENCE FOR TIGHTENING FLANGE SCREWS
FIGURE 11

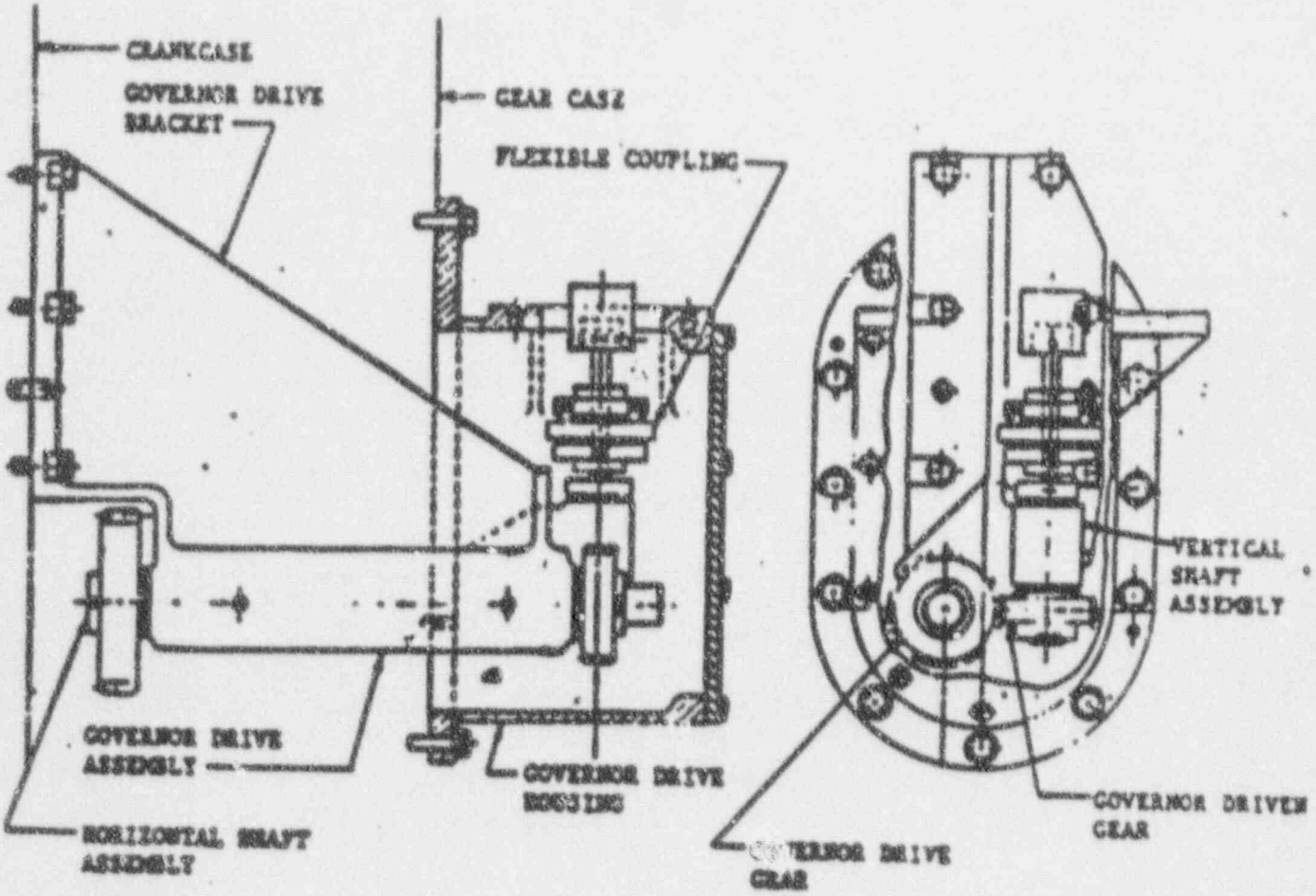
Sheet 1 of 1



TAPPET ROLLER CLEARANCE CHECK

FIGURE 12

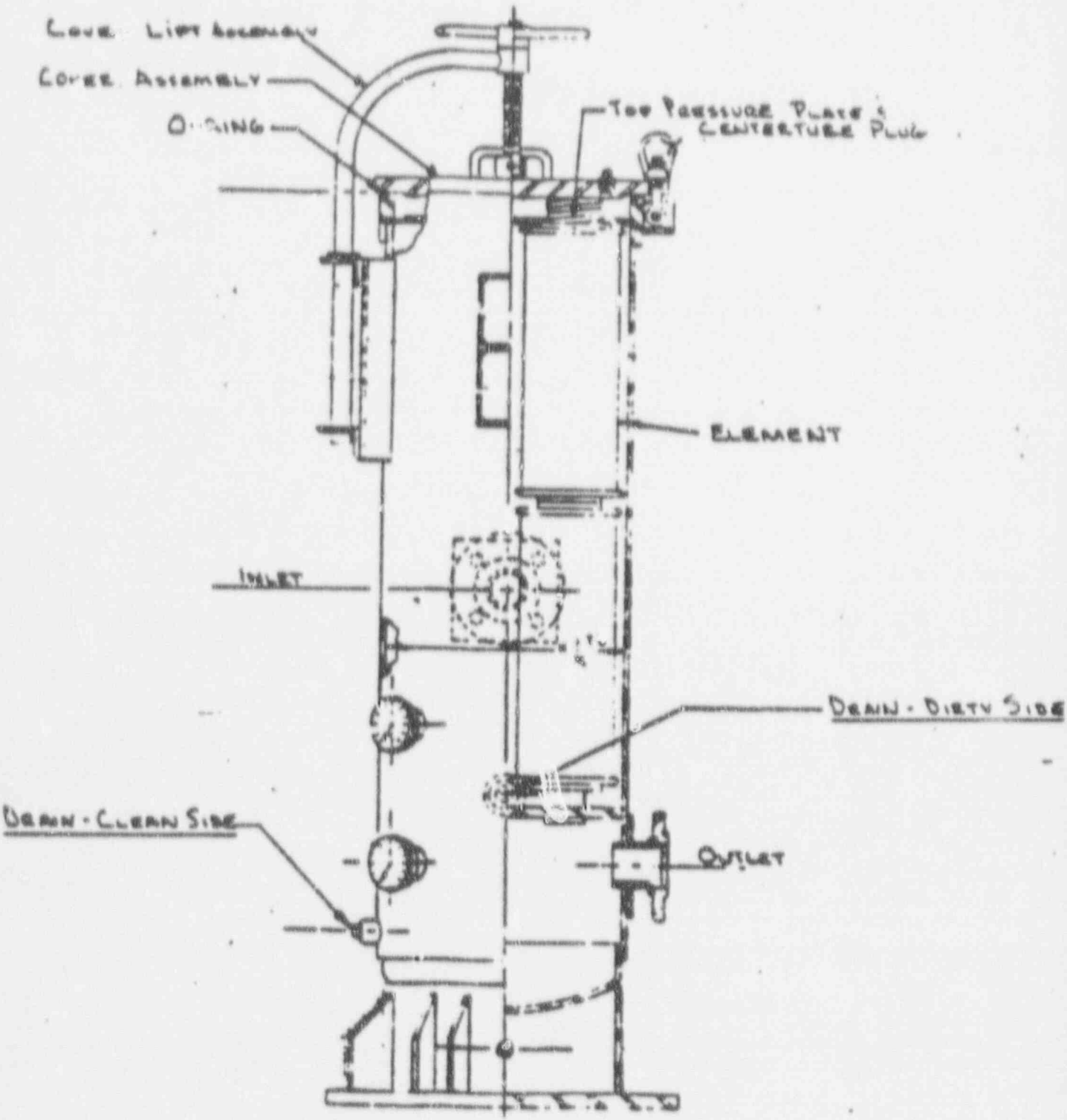
Sheet 1 of 1



GOVERNOR DRIVE ASSEMBLY

FIGURE 13

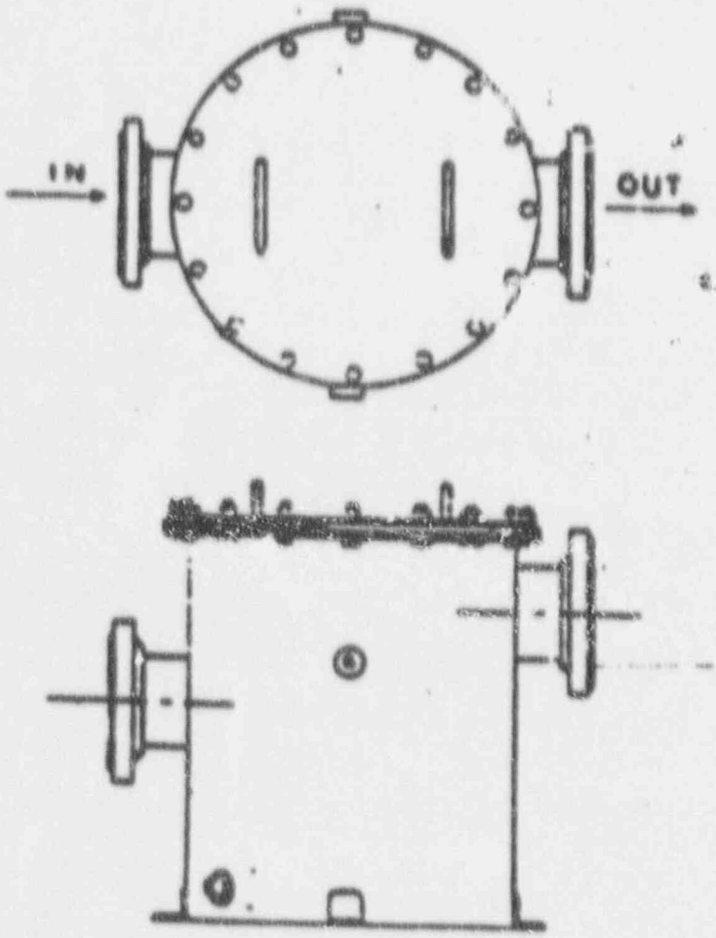
Sheet 1 of 1



LUBE OIL KEEPWARM FILTER

FIGURE 14

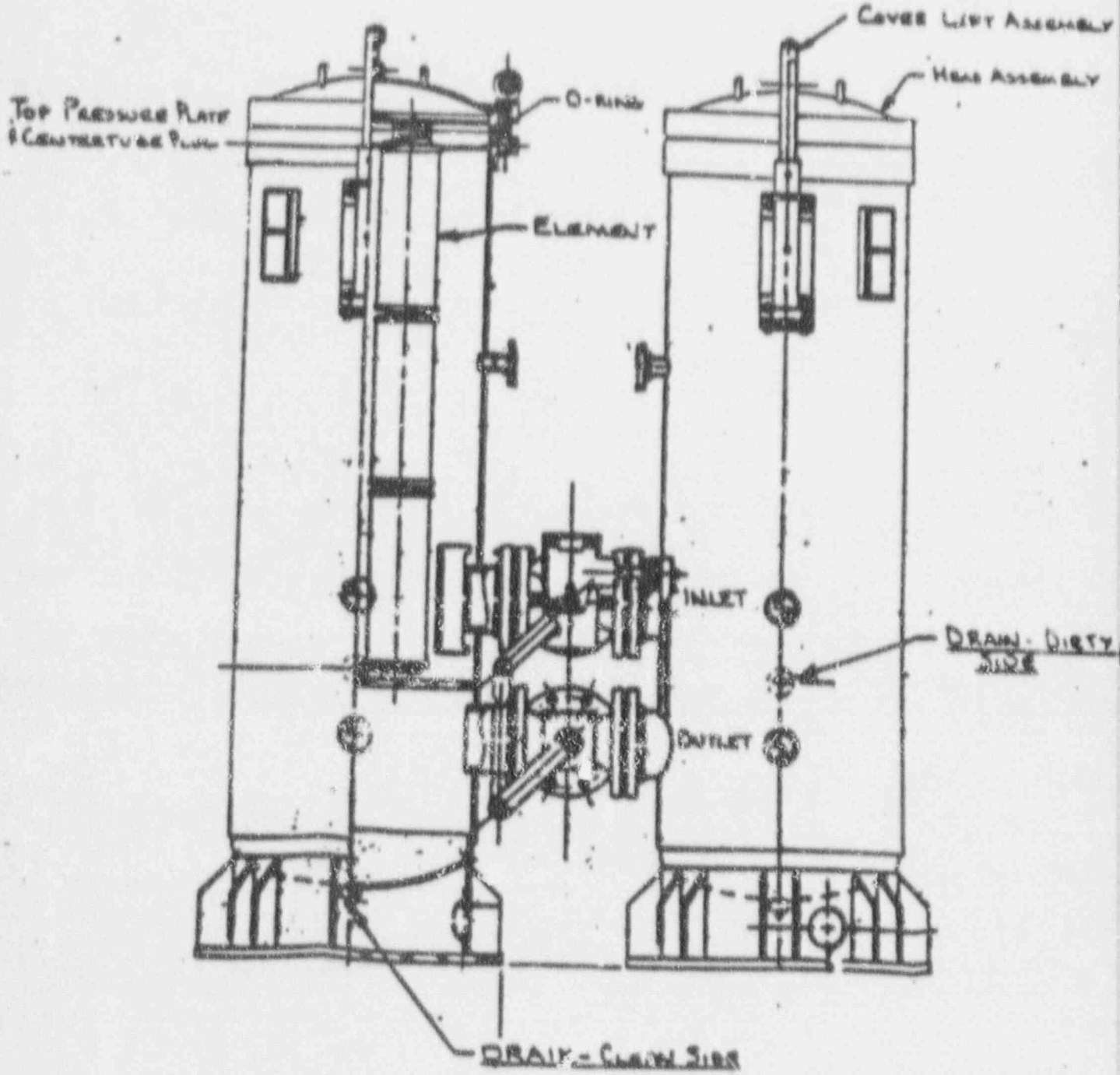
Sheet 1 of 1



LUBE OIL PRELUBE STRAINER

FIGURE 15

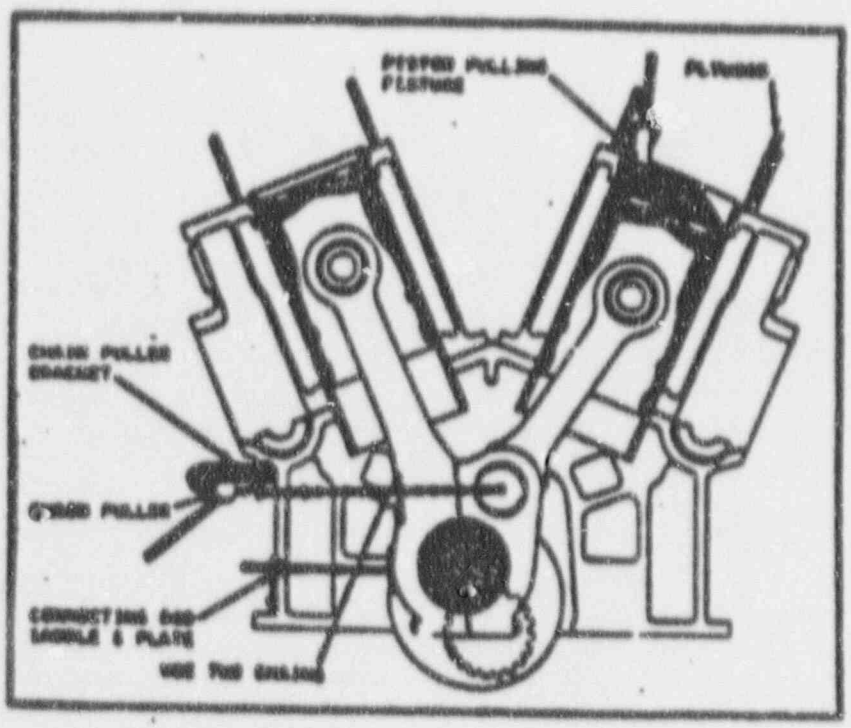
Sheet 1 of 1



LUBE OIL FULL FLOW DUPLEX FILTER

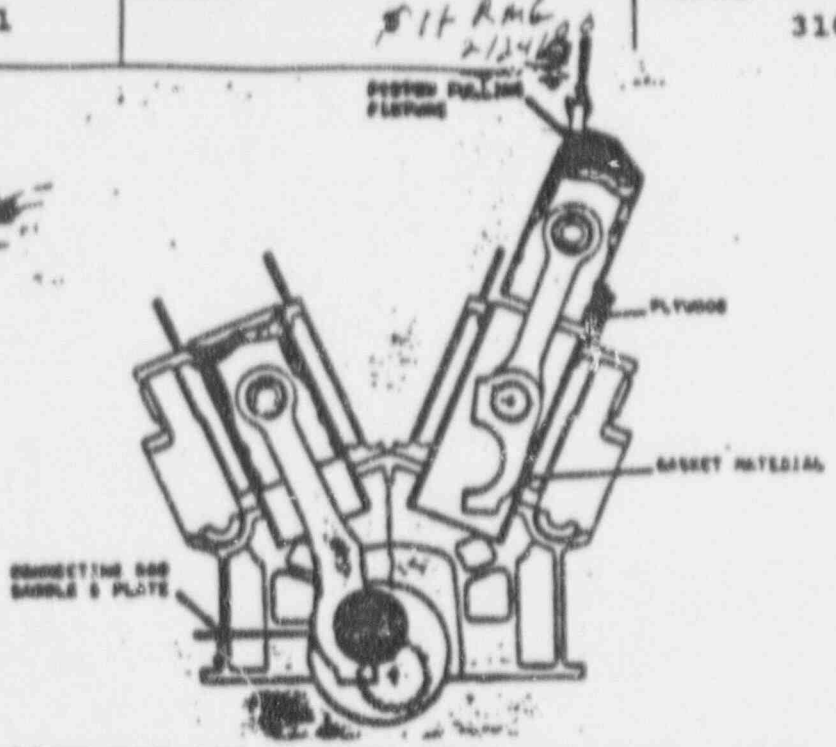
FIGURE 16

Sheet 1 of 1



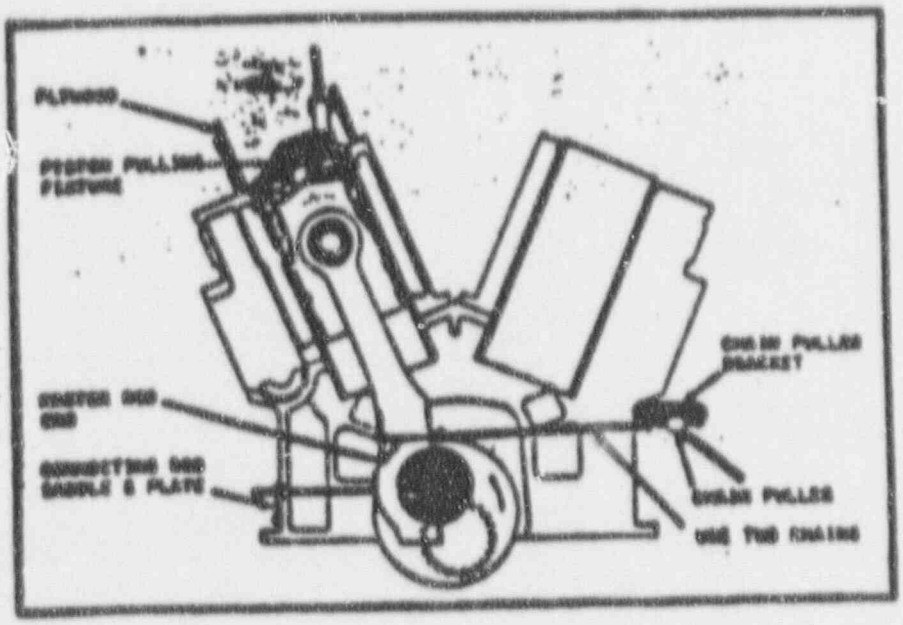
TOOLS INSTALLED FOR REMOVING PISTON AND LINK ROD

FIGURE 17



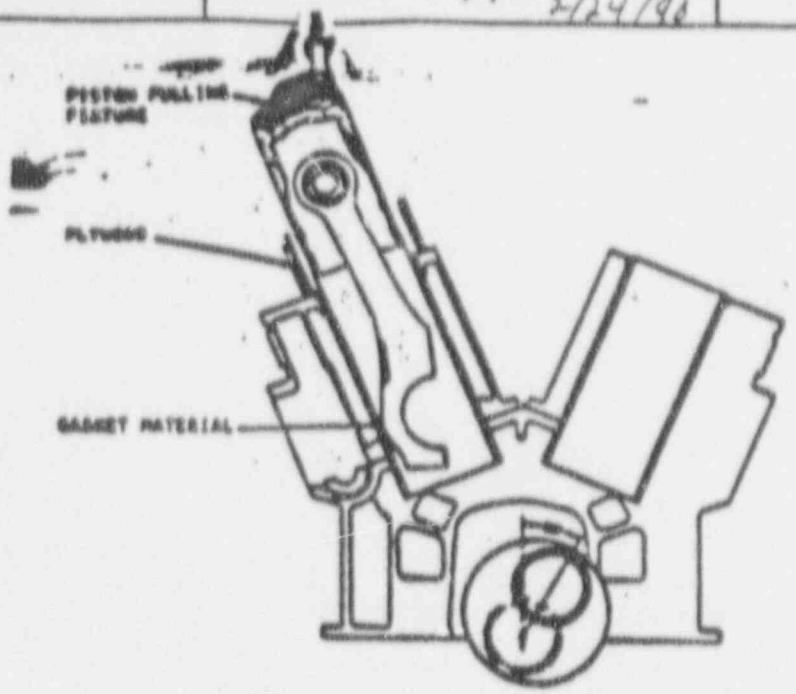
LIFTING LINK ROD AND PISTON FROM CYLINDER LINER

FIGURE 18



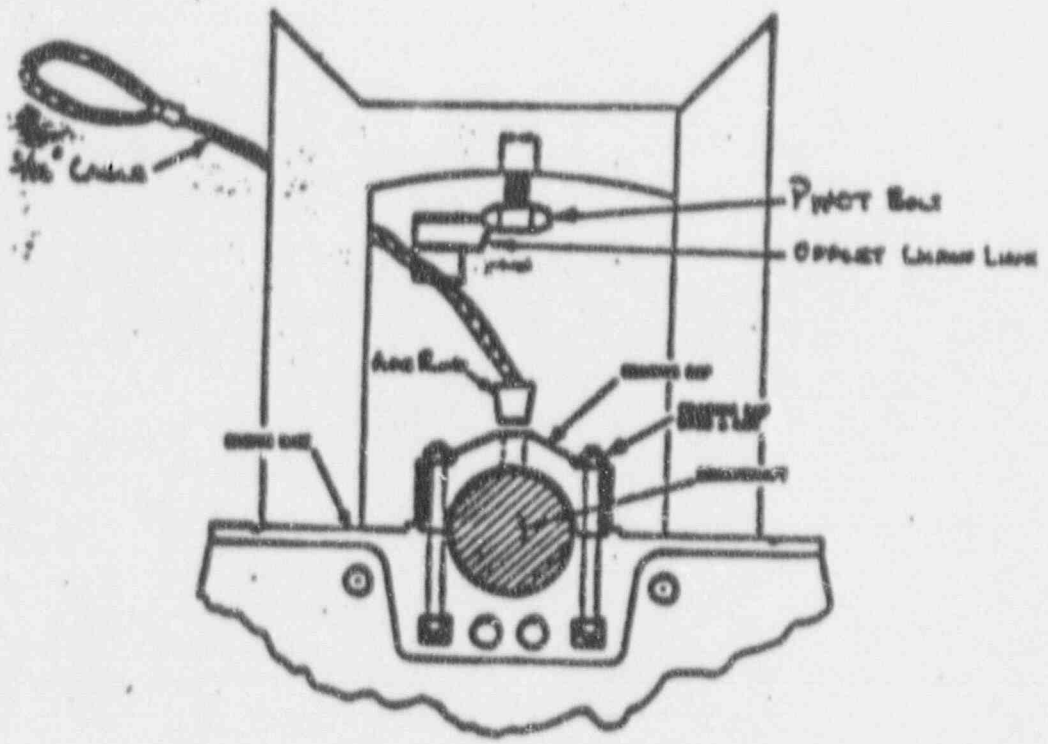
TOOLS INSTALLED FOR MASTER ROD AND PISTON REMOVAL

FIGURE 19



[illegible] ROD AND PISTON FROM CYLINDER

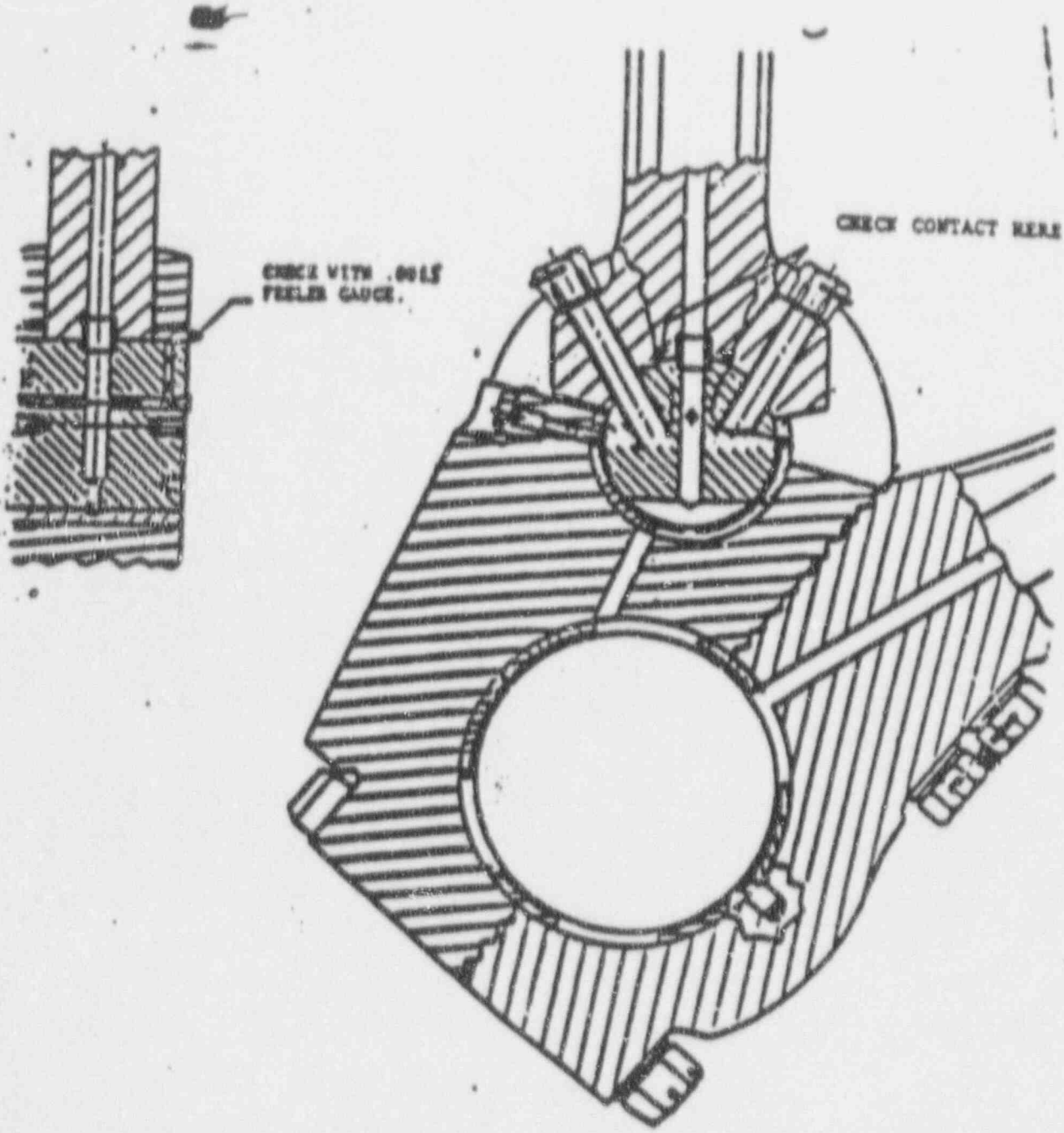
FIGURE 20



BEARING CAP LIFTING INSTALLATION

FIGURE 21

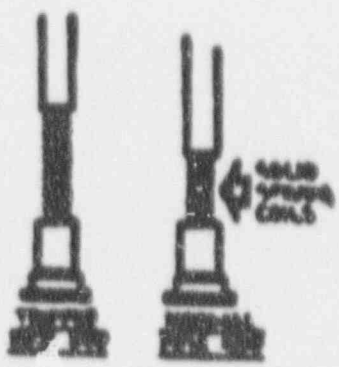
Sheet 1 of 1



BUSHING CLEARANCE CHECK

FIGURE 22

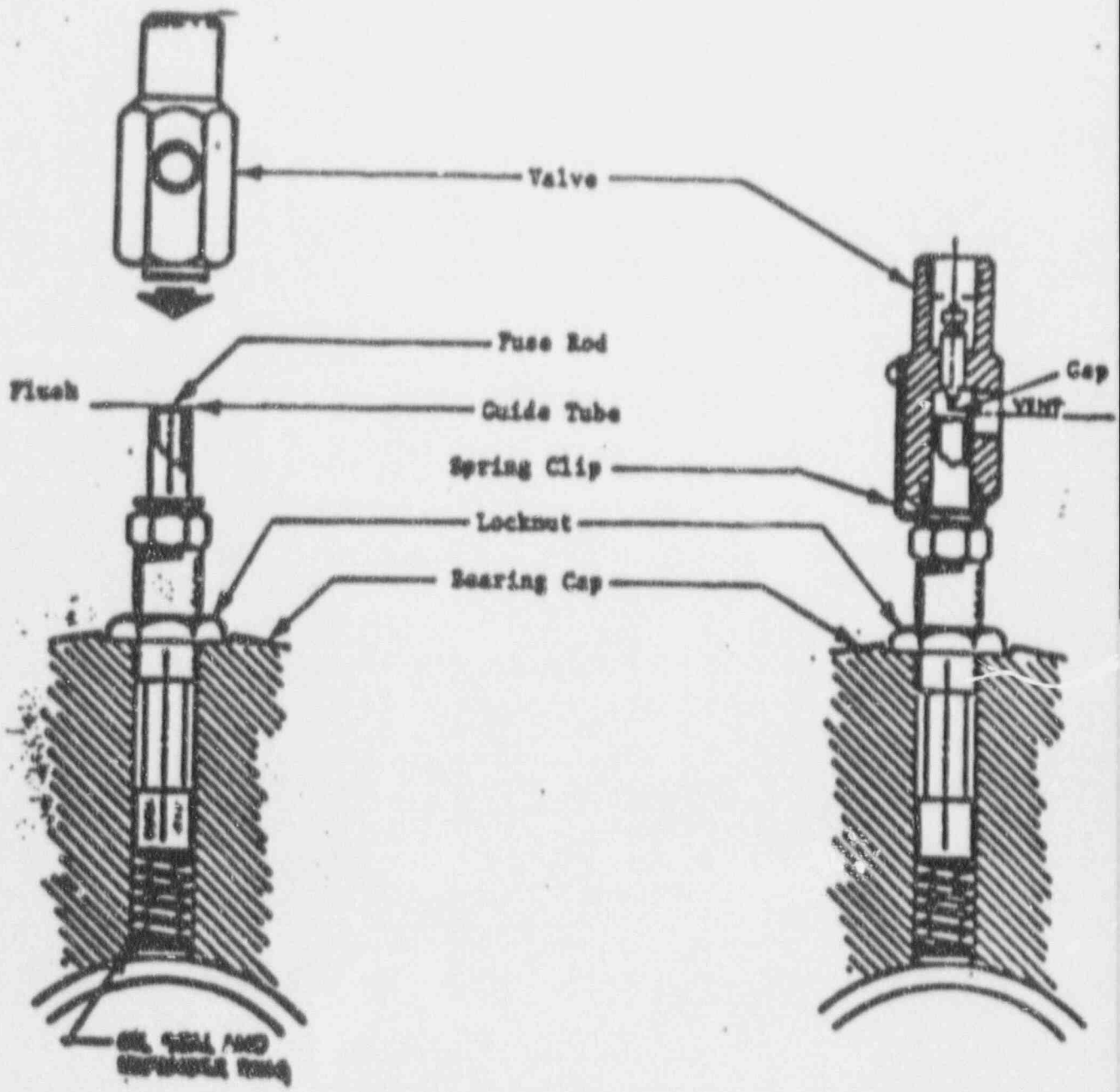
Sheet 1 of 1



FUSE ROD CHECK

FIGURE 23

Sheet 1 of 1



HIGH TEMPERATURE TRIP VALVE CHECK

FIGURE 24

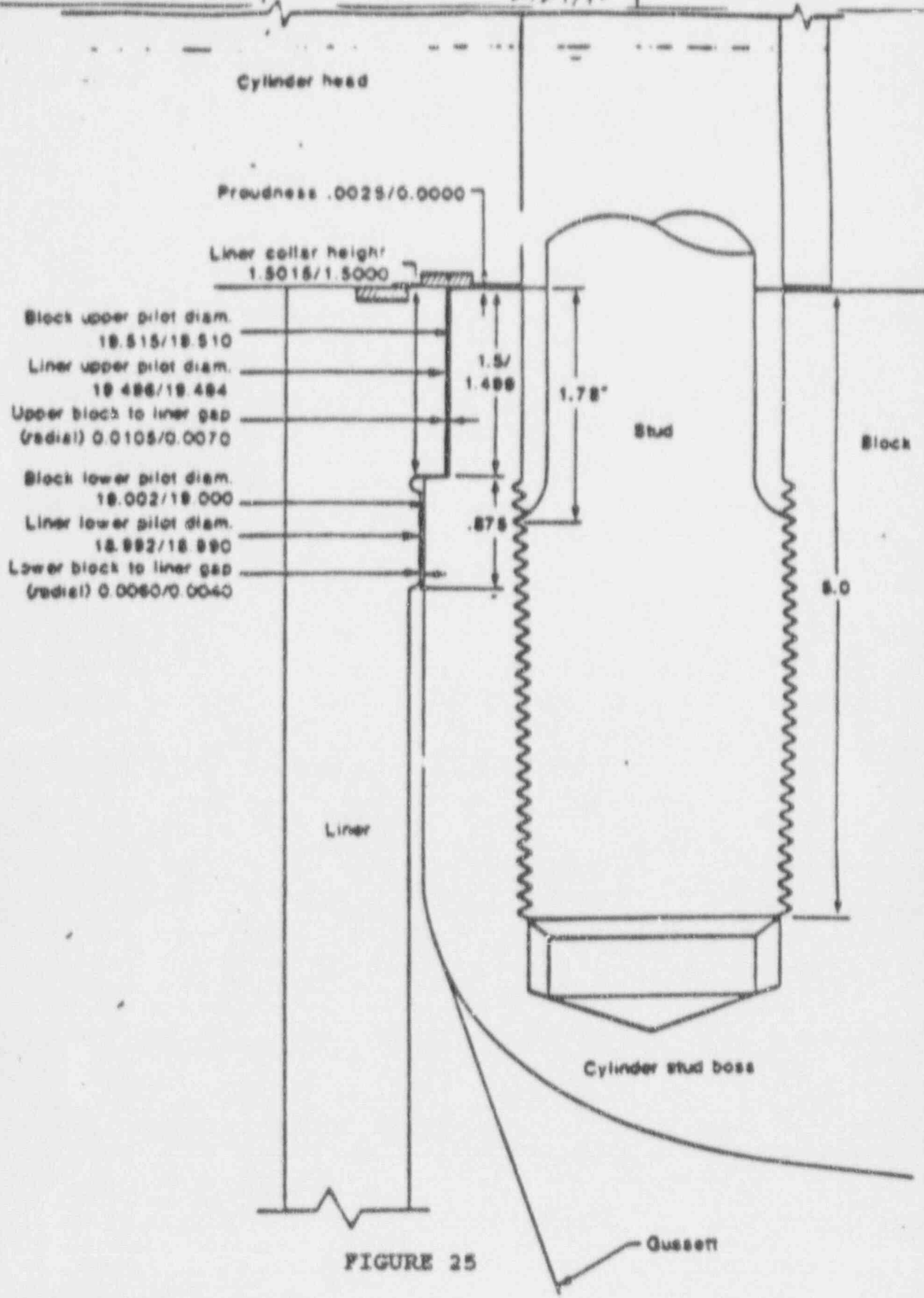
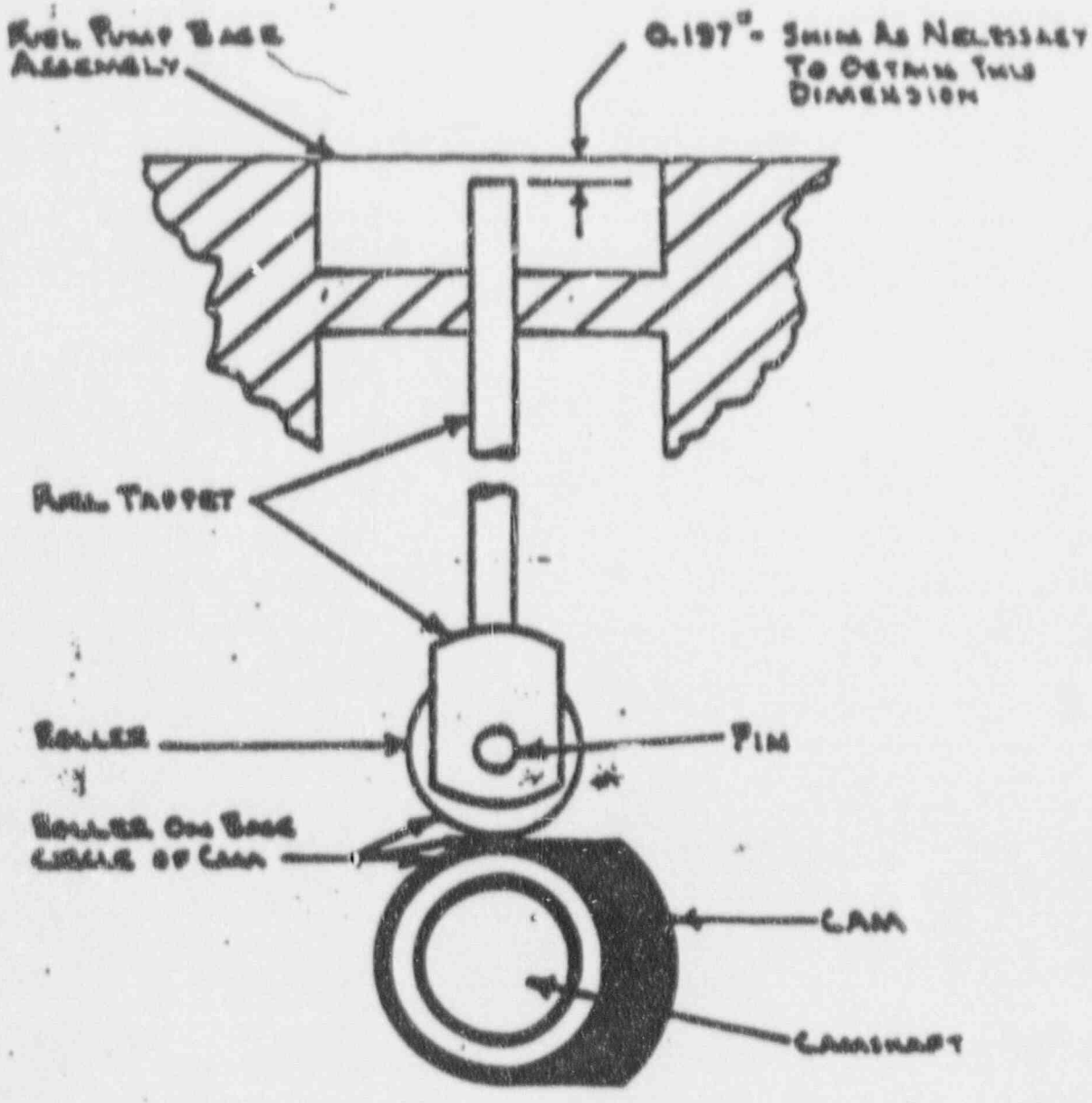

Cylinder head
Proudness .0025/0.0000
Liner collar height
1.5015/1.5000
Block upper pilot diam.
18.515/18.510
Liner upper pilot diam.
18.496/18.494
Upper block to liner gap
(radial) 0.0105/0.0070
Block lower pilot diam.
18.002/18.000
Liner lower pilot diam.
18.992/18.990
Lower block to liner gap
(radial) 0.0060/0.0040
1.5/
1.498
.875
1.78"
Stud
Block
8.0
Liner
Cylinder stud boss
Gusset

FIGURE 25

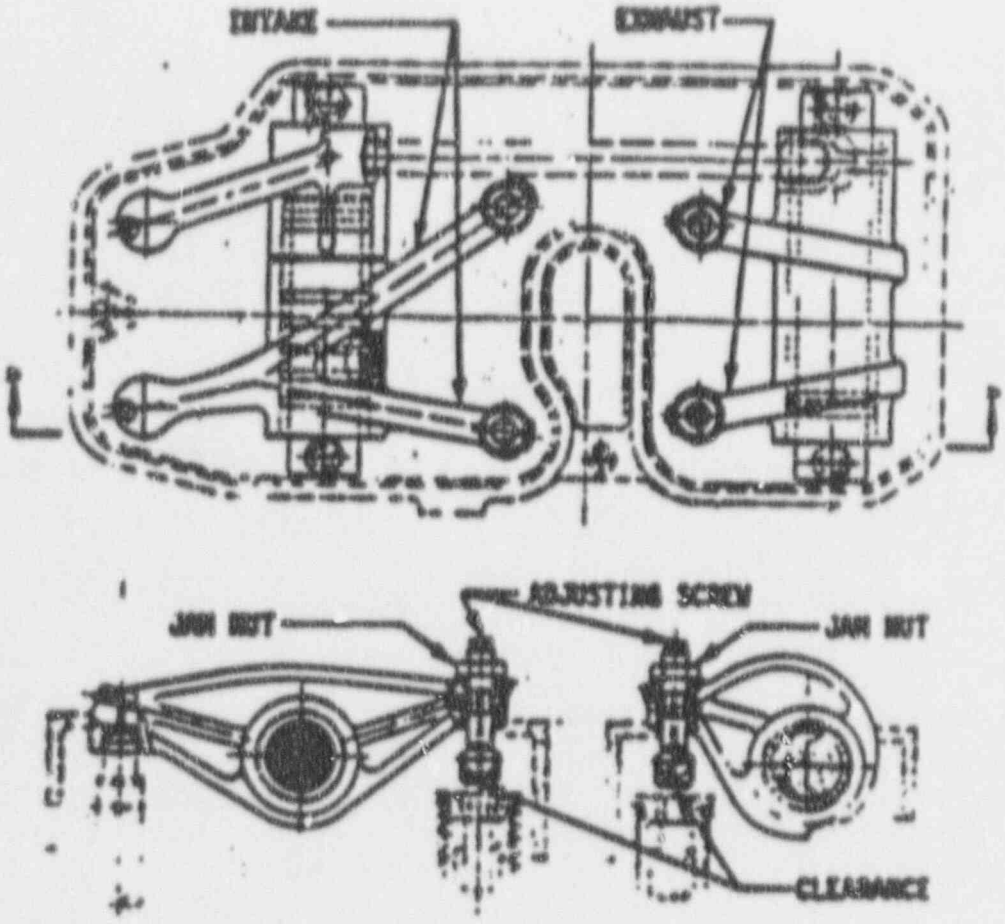
Sheet 1 of 1



FUEL INJECTION PUMP BASE TO TAPPET ADJUSTMENT

FIGURE 26

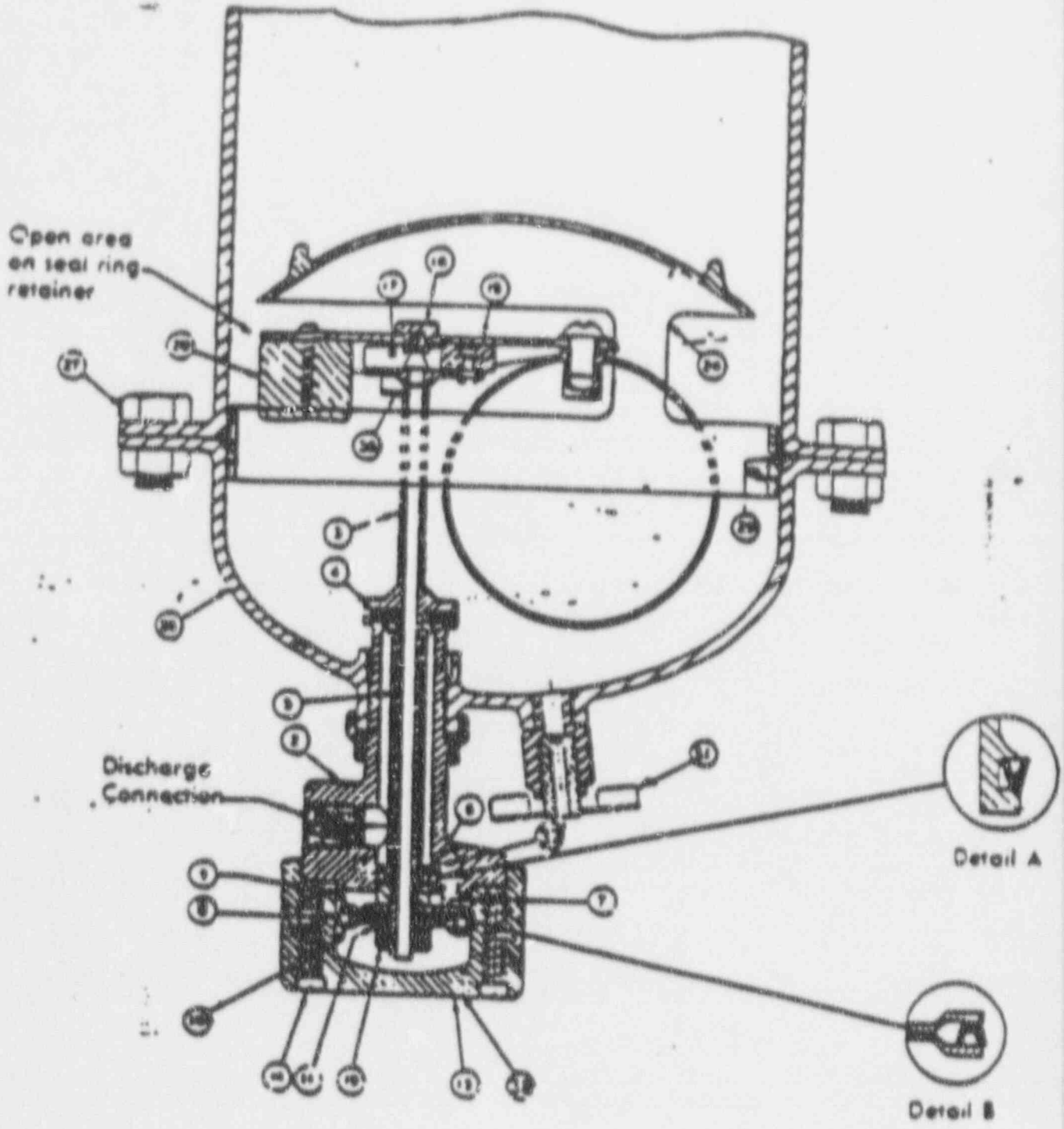
Sheet 1 of 1



INTAKE AND EXHAUST VALVE CLEARANCES

FIGURE 27

Sheet 1 of 2



SECTIONAL DRAWING OR AIR DRYER

FIGURE 28

Sheet 2 of 2

REPLACEMENT PARTS FOR AUTOMATIC DRAIN TAP

PC NO.	NAME
1	Float
2	Valve Body
3, 22, 23	Valve Stem Assembly
* 4	Valve Disc
5	Valve Sleeve
* 6	Sleeve Seal
7	Key Washer
* 8	Piston Seal
* 9	Piston Disc Female
*10	Piston Disc Male
11	Lock Washer
13	Piston Cylinder
14	Cylinder Screws
15	Float Arm
16	Float Screw
*17	Pivot Pin
*18	Pilot Valve Screw Assembly
19	Hexagon Nut
20	Counterweight
21	Counterweight Screw
24	Baffle and Seal Ring Retainer
26	Shell Case Assembly (Bottom)
27	Flange Bolt
28	Flange Bolt Nut
*29	Case Seal Ring
31	Draincock
33	Thread Shield
*36	Retainer Clip

* Included in Repair Parts Kit

PARTS LIST FOR AIR DRYER

FIGURE 28 (CONT'D)

Sheet 1 of 1

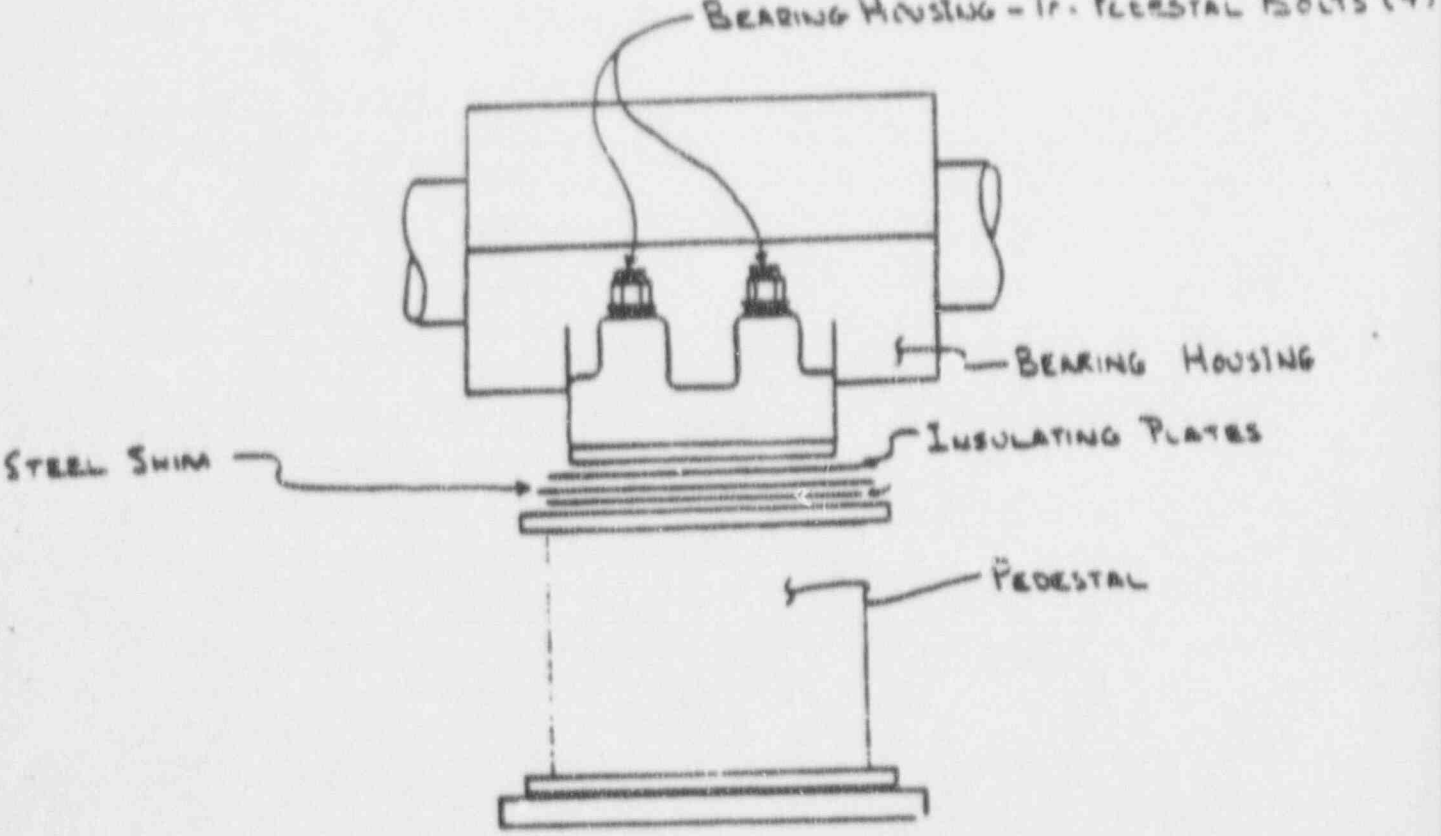
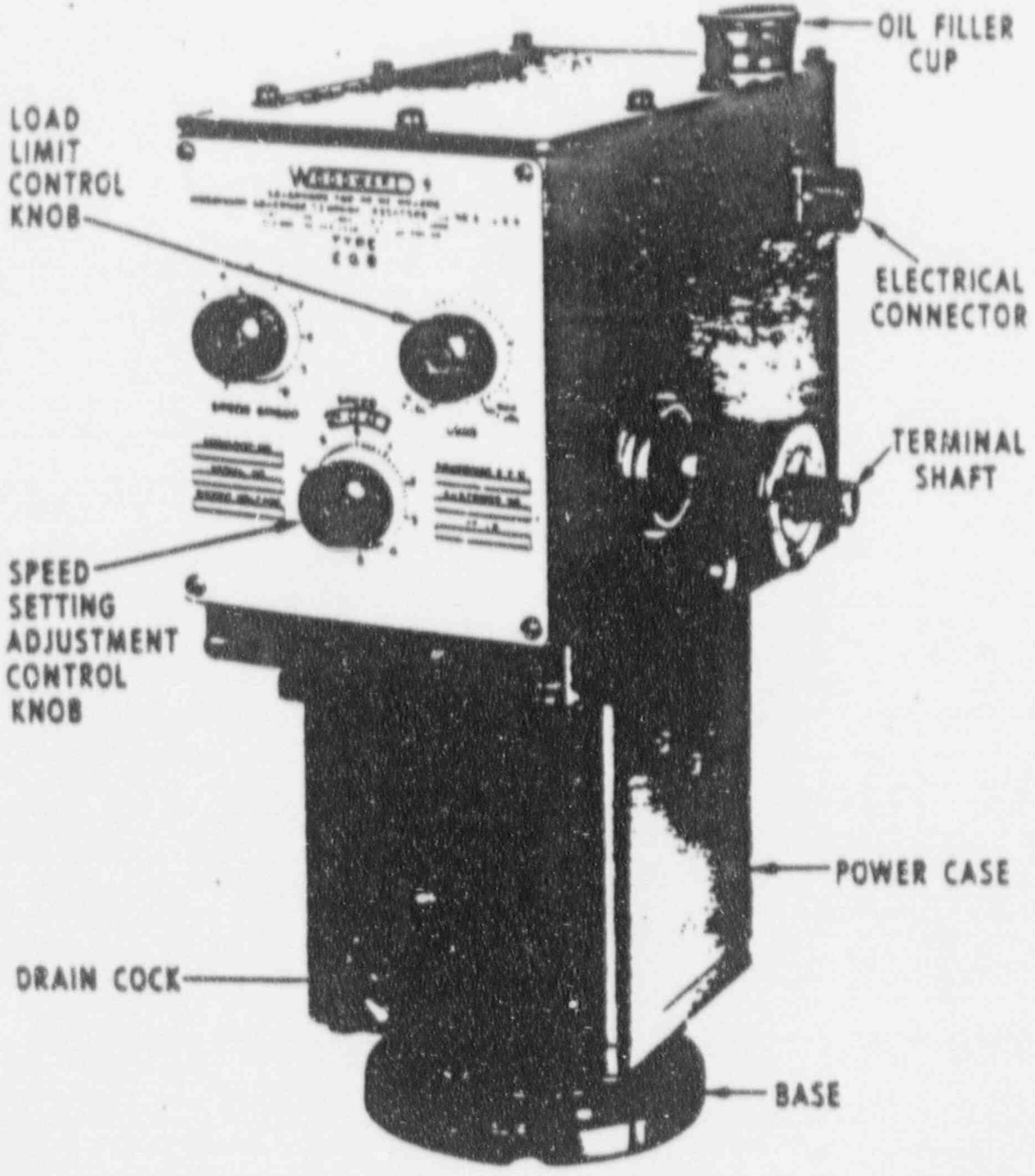


FIGURE 29

Sheet 1 of 1



GOVERNOR/BASE

FIGURE 30

COMPLETION SHEET

PROCEDURE	REVISION	SHEET
	0 / 1 RMG 2/14/80	1 of 70
TAG NO.	DESCRIPTION	
	EOC Diesel Generator Checkout	
SERIAL NO.	MANUFACTURER	MODEL
TEST EQUIPMENT USED	M&TE #	[ ] Safety Related QC Hold Points [ ] Non-Safety Related

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.1	Verify Prerequisites met	/		/
4.2	Notify Shift Supervisor	/		/
4.3	Verify isolated and tagged	/		/
4.4	Ensure procedures attached	/		/
4.5.1g	Cold Compression Recorded On Data Sheet 1	/		/
4.5.1j	Linkage Torqued At Fuel Pump:			
	1L	/		/
	2L	/		/
	3L	/		/
	4L	/		/
	5L	/		/
	6L	/		/

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
	7L	/_____	_____	/_____
	8L	/_____	_____	/_____
	1R	/_____	_____	/_____
	2R	/_____	_____	/_____
	3R	/_____	_____	/_____
	4R	/_____	_____	/_____
	5R	/_____	_____	/_____
	6R	/_____	_____	/_____
	7R	/_____	_____	/_____
	8R	/_____	_____	/_____
4.5.1n	Analyze Cold Compression Data	/_____	_____	/_____
4.5.2g	Firing Pressures Recorded On Data Sheet 1	/_____	_____	/_____
4.5.2i	Fuel Pump Rack mm Recorded On Data Sheet 1	/_____	_____	/_____
4.5.2j	Cylinder Exhaust Temperatures Recorded on Data Sheet 1	/_____	_____	/_____
4.5.2n	Analyze Firing Pressure Data	/_____	_____	/_____
4.5.3e	Air Storage Tanks Isolated	/_____	_____	/_____
4.5.3H(4)	Crankshaft Web Deflection "Data" Sheet 2, Sheet 2	*/_____	_____	/_____
4.5.3H(5)	Crankshaft Web Deflection "Data" Sheet 2, Sheet 2	*/_____	_____	/_____

* Document on Referenced "Data" Sheet

Sheet 3 of 70

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.5.3h(7)	Record Corrective Action if required "Data" Sheet 2, Sheet 2	*/		/
4.5.3h	Crankshaft Web Deflection Completed	/		/
4.5.3i	Crankcase Side Covers Replaced And Cap Screws Torqued	/		/
4.5.3j	Deflection Readings Analyzed Sat _____ Unsat _____	/		/
4.5.4a	Lube Oil Samples Reviewed Sat _____ Unsat _____	/		/
4.5.4b	Equivalent Engine Hours Since Last Block Top Inspection: _____ hours	/		/
4.5.4c	Jacket Water Heat Exchanger Trend Data Analyzed Sat _____ Unsat _____	/		/
4.5.4d	Lube Oil Heat Exchanger Trend Data Analyzed Sat _____ Unsat _____	/		/
4.5.4e	Intercooler Trend Data Analyzed Sat _____ Unsat _____	/		/
4.5.4f	Turbocharger Non-Prelubed Starts Since Last Inspection Left Bank _____ starts Right Bank _____ starts	/		/

Sheet 4 of 70

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.5.4g	Were Anomalies Found At Previous Turbocharger Inspection Left Bank (Yes/No) _____ Right Bank (Yes/No) _____	____/____	____	____/____
4.5.4h	Cylinder Exhaust Temperatures Analyzed Sat _____ Unsat _____ Problem Cylinders _____ _____	____/____	____	____/____
4.5.4i	Pistons Removed At Previous Outage Cylinder Nos. _____ _____	____/____	____	____/____
4.5.4j	Engine base cracks exist (Yes/No) _____	____/____	____	____/____
4.5.4k	Lube Oil Keepwarm Pump Discharge Pressure Trend Data Analyzed Sat ___ Unsat ___	____/____	____	____/____
4.5.4l	Engine Operation While Severely Unbalanced (Yes/No) _____	____/____	____	____/____
4.5.4m	New Or Reworked Cylinder Heads Which Have Been In Operation 500-600 Hours _____ _____	____/____	____	____/____
4.5.5	Lube Oil Keepwarm Heater Meggered	____/____	____	____/____

* Document on Referenced "Data" Sheet

Sheet 5 of 70

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.5.6	Jacket Water Keepwarm Heater Meggered	/		/
4.5.11h	Record Crankshaft Thrust (As Found) "Data" Sheet 3 Sheet 2	*/		/
4.5.11i	Record Crankshaft Thrust (Final) "Data" Sheet 3 Sheet 2	*/		/
4.5.12a	Bearing Cap Removed "Data" Sheet 3, Sheet 2	*/		/
4.5.12c	Inspect Crankshaft Thrust Bearings - "Data" Sheet 3, Sheet 2	*/		/
4.5.12g	Thrust Ring Replaces Or Shims Added "Data" Sheet 3, Sheet 2	*/		/
4.5.7	Crankshaft Thrust Clearance Checked	/		/
4.6.1	Engine Internals Checked	/		/
4.7.1	Turbocharger Vibration Measured Left Bank _____ Right Bank _____	/ /		/ /
4.7.2	Turbocharger Rotor End Play Measured Left Bank _____ Right Bank _____	/ /		/ /

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.7.2f	Turbocharger Bearing Inspection Required Left Bank (Yes/No) ____ Right Bank (Yes/No)____	/ /	____ ____	/ /
4.7.2g	Intake Air Adapter Torqued Left Bank (Yes/No) ____ Right Bank (Yes/No)____	/ /	____ ____	/ /
4.7.3	Visual And Blue Check Performed On Turbocharger With 40 Or More Non-Prelubed Starts Left Bank (Yes/No ____ Right Bank (Yes/No____	/ /	____ ____	/ /
4.7.4	Nozzle Ring Components Checked Left Bank (Yes/No) ____ Right Bank (Yes/No)____	/ /	____ ____	/ /
4.7.6h	Check and record rotor float - "Data" Sheet 5	/	____	/
4.7.7d	Check thrust bearing for wear "Data" Sheet 5	/	____	/
4.7.7e	Check bearing surface	/	____	/
4.7.7f	Measure and record shaft and bearing diameters - "Data" Sheet 5	/	____	/
4.7.7h(1)	Measure and record seal inside diameter "Data" Sheet 5	/	____	/
4.7.7h(2)	Measure and record thrust collar outside diameter "Data" Sheet 5	/	____	/

Sheet 7 of 70

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.7.7i	Check impeller and turbine wheel	/		/
4.7.7j	Check nozzle ring	/		/
4.7.8a	Parts cleaned	/		/
4.7.8b(3)	Bolts torqued - "Data" Sheet 5	/		/
4.7.8c(3)	Check turbine side bearing pull-up	/		/
4.7.8c(5)	Check turbine side bearing alignment	/		/
4.7.8d(3)	Check blower side bearing pull-up	/		/
4.7.8e(4)	Intermediate casing bolts torqued - "Data" Sheet 5	/		/
4.7.8f(2)	Turbine end oil seal installed	/		/
4.7.8f(5)	Blower and thrust collar installed	/		/
4.7.8f(7)	Blower end oil seal installed	/		/
4.7.8f(13)	Torqued stop nut - "Data" Sheet 5	/		/
4.7.8f(14)	Check and record rotor float - "Data" Sheet 5	/		/
4.7.8g(2)	Torqued bolts "Data" Sheet 5	/		/
4.7.8h(2)	Torqued bolts "Data" Sheet 5	/		/
	Lockwire installed	/		/

Sheet 8 of 70

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.7.9e	Torqued flange _____ ft/lbs	/		/
4.7.9i	Torqued flange _____ ft/lbs	/		/
4.7.9j	Torque tie plate bolts _____ ft/lbs	/		/
4.7.9k	Torque base bolts _____ ft/lbs	/		/
4.7.9l	Ensure no air gaps	/		/
4.7.9m	Bolts torqued _____ ft/lbs	/		/
4.7.9p	Bolts torqued _____ ft/lbs	/		/
4.7.9r	Reconnect tubing	/		/
4.7.10	Left Bank Intercooler Inlet Adaptor Checked For Cracks	/		/
4.7.11	Intercooler Tube Fins Inspected Left Bank (Yes/No) ____ Right Bank (Yes/No) ____	/ /		/ /
4.7.12	Intercooler Cleaned As Result Of Trend Data Left Bank (Yes/No) ____ Right Bank (Yes/No) ____	/ /		/ /
4.7.13	Turbocharger Cap Screws Inspected Left Bank Right Bank	/ /		/ /

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.8.4c	Check Injector Popping Action "Data" Sheet 6, Sheet 2	*/		*/
4.8.4e	Record Injector Opening Pressure "Data" Sheet 6, Sheet 2	*/		*/
4.8.4f	Check Injector For Leakage "Data" Sheet 6, Sheet 2	*/		*/
4.8.4g	Check Injector Spray Pattern "Data" Sheet 6, Sheet 2	*/		*/
4.8.4i	Check Spray Tip "Data" Sheet 6, Sheet 2	*/		*/
4.8.4j	Analyze deposits. Check for zinc "Data" Sheet 6, Sheet 2	*/		*/
4.8.5k	Inspect Spray Tip "Data" Sheet 6, Sheet 2	*/		*/
4.8.5m	Torque Assembly Nut "Data" Sheet 6, Sheet 2	*/		*/
4.8.6e	Shims Added To Injector "Data" Sheet 6, Sheet 3	*/		*/
4.8.6g	Torque Assembly Nut "Data" Sheet 6, Sheet 3	*/		*/
4.8.6k	Record Final Injector Opening Pressure - "Data" Sheet 6, Sheet 3	*/		*/

* Document on Referenced "Data" Sheet

Sheet 10 of 70

PROCEDURE STEP	DESCRIPTION		MAINT. - INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.8.8	Fuel Injectors Tested Cylinder	1L	/		/
		2L	/		/
		3L	/		/
		4L	/		/
		5L	/		/
		6L	/		/
		7L	/		/
		8L	/		/
		1R	/		/
		2R	/		/
		3R	/		/
		4R	/		/
		5R	/		/
		6R	/		/
		7R	/		/
		8R	/		/
4.9.10a	Subcovers Removed Cylinder	_____	/		/
		_____	/		/
		_____	/		/
		_____	/		/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
	____	____/____	____	____/____
	____	____/____	____	____/____
	____	____/____	____	____/____
	____	____/____	____	____/____
4.9.14a	Inspect Subcover For Blow-by "Data" Sheet 7, Sheet 2	*/____	____	*/____
4.9.14c	Inspect Subcover For Cracking "Data" Sheet 7, Sheet 2	*/____	____	*/____
4.9.14d	PT Report Subcover Attached	*/____	____	*/____
4.9.15a	Inspect Intake/Interm. Pushrod Cups - "Data" Sheet 7, Sheet 2	*/____	____	*/____
4.9.15b	Inspect Exhaust Pushrod Cups - "Data" Sheet 7, Sheet 2	*/____	____	*/____
4.9.15c	Inspect Intake/Exhaust Pushrod "Data" Sheet 7, Sheet 2	*/____	____	*/____
4.9.15c(4)	PT Report Intake/Exhaust Pushrods Attached	*/____	____	*/____
4.9.15d	Inspect Connecting Pushrods "Data" Sheet 7, Sheet 2	*/____	____	*/____
4.9.15d(4)	PT Report Connecting Pushrods Attached	*/____	____	*/____
4.9.15e(5)(a)	Inspect Intake Rocker Arm Bushing "Data" Sheet 7, Sheet 3	*/____	____	*/____

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.9.15e(5)(b)	Inspect Intermediate Rocker Bushing - "Data" Sheet 7, Sheet 3	*/		*/
4.9.15e(5)c	Inspect Exhaust Rocker Arm Bushing - "Data" Sheet 7, Sheet 3	*/		*/
4.9.15f(1)	Inspect Rocker Arm Drive Studs "Data" Sheet 7, Sheet 3	*/		*/
4.9.15f(2)	Torque Rocker Arm Capscrews "Data" Sheet 7, Sheet 3	*/		*/
4.9.15	Rocker Arms And Push Rods Inspected			
	Cylinder ____	/		/
	____	/		/
	____	/		/
	____	/		/
	____	/		/
	____	/		/
	____	/		/
	____	/		/

* Document on Referenced "Data" Sheet

Sheet 13 of 70

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.9.17	Intermediate/Intake Rocker Arms And Push Rods Inspected			
	Cylinder 1L	/		/
	2L	/		/
	3L	/		/
	4L	/		/
	5L	/		/
	6L	/		/
	7L	/		/
	8L	/		/
	1R	/		/
	2R	/		/
	3R	/		/
	4R	/		/
	5R	/		/
	6R	/		/
	7R	/		/
	8R	/		/
4.10.2b(2) thru (4)	Measure Air Start Valve Cap To Piston Clearance "Data" Sheet 8, Sheet 2	*/		*/
4.10.2b(5)	Inspect Air Start Valve Internals "Data" Sheet 8, Sheet 2	*/		*/

* Document on Referenced "Data" Sheet

Sheet 14 of 70

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.10.2b(6)	Inspect Air Start Valve Seat For Pitting "Data" Sheet 8, Sheet 3	*/		*/
4.10.2b(8)	Blue Air Start Valve "Data" Sheet 8, Sheet 3	*/		*/
4.10.2c	Air Start Valves Reassembled			
	1R	/		/
	2R	/		/
	3R	/		/
	4R	/		/
	5R	/		/
	6R	/		/
	7R	/		/
	8R	/		/
	1L	/		/
	2L	/		/
	3L	/		/
	4L	/		/
	5L	/		/
	6L	/		/
	7L	/		/
	8L	/		/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. - INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.11.1m	Cylinder Heads Removed			
	Cylinder ____	____/____	____	____/____
	____	____/____	____	____/____
	____	____/____	____	____/____
	____	____/____	____	____/____
	____	____/____	____	____/____
	____	____/____	____	____/____
	____	____/____	____	____/____
	____	____/____	____	____/____
4.11.1n	Record Head Foundary Number/Casting Date "Data" Sheet 9, Sheet 1	*/____	____	*/____
4.11.2a(6)	Record Valve Deflection (A-A Axis) "Data" Sheet 9, Sheet 3	*/____	____	*/____
4.11.2a(7)	Record Valve Deflection (B-B Axis) "Data" Sheet 9, Sheet 3	*/____	____	*/____
4.11.2b(3)	Record Valve Head Thickness "Data" Sheet 9, Sheet 4	*/____	____	*/____
4.11.2c	Inspection Intake/Exhaust Valves "Data" Sheet 9, Sheet 4	*/____	____	*/____
4.11.2d(1)	Inspect Valve Springs For Cracks "Data" Sheet 9, Sheet 4	*/____	____	*/____

* Document on Referenced "Data" Sheet

Sheet 16 of 70

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.11.2d(2)	Inspect Valve Springs For Type "Data" Sheet 9, Sheet 4	*/		*/
4.11.2e	Inspect Cylinder Head "Data" Sheet 9, Sheet 2	*/		*/
4.11.2f(1)	PT Report Of Valve Seat Attached	*/		*/
4.11.2f(2)	MT Report Of Fire Deck Attached	*/		*/
4.11.2f(3)	UT Report Of Fire Deck Attached	*/		*/
4.11.2f(4)	PT Report Of Blended Radius Of Valve Stems Attached	*/		*/
4.11.2f(5)	Inspect Cylinder Head For Weld Repair - "Data" Sheet 9, Sheet 2	*/		*/
4.11.2g	Cylinder Heads Reassembled			
	Cylinder ____	/		/
	____	/		/
	____	/		/
	____	/		/
	____	/		/
	____	/		/
	____	/		/
4.12.2i	Record Pump Serial Number On "Data" Sheet 10, Sheet 1	*/		*/

* Document on Referanced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.12.5z	Torque Delivery Flange Screws _____ ft/lbs. "Data" Sheet 10, Sheet 2	*/		*/
4.12.5dd	Fuel Injection Pump Inspected			
	Pump No. 1L (Yes/No)____	/		/
	Pump No. 2L (Yes/No)____	/		/
	Pump No. 3L (Yes/No)____	/		/
	Pump No. 4L (Yes/No)____	/		/
	Pump No. 5L (Yes/No)____	/		/
	Pump No. 6L (Yes/No)____	/		/
	Pump No. 7L (Yes/No)____	/		/
	Pump No. 8L (Yes/No)____	/		/
	Pump No. 1R (Yes/No)____	/		/
	Pump No. 2R (Yes/No)____	/		/
	Pump No. 3R (Yes/No)____	/		/
	Pump No. 4R (Yes/No)____	/		/
	Pump No. 5R (Yes/No)____	/		/
	Pump No. 6R (Yes/No)____	/		/
	Pump No. 7R (Yes/No)____	/		/
	Pump No. 8R (Yes/No)____	/		/
4.13.1b	Cams Inspected "Data" Sheet 11, Sheet 1			
	Left Bank	/		/
	Right Bank	/		/
4.13.2a	Inspect Tappet Assemblies "Data" Sheet 11, Sheet 1	*/		*/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.13.2b	Inspect Cam Rollers "Data" Sheet 11, Sheet 1	*/		*/
4.13.2c	Measure Tappet Roller Clearance "Data" Sheet 11, Sheet 1	*/		*/
4.13.3	Fuel Tappets Inspected Cyl. Nos. _____ _____	/		/
4.13.4b	Camshaft Thrust Clearance "Data" Sheet 12, Sheet 1			
	Left Bank	/		/
	Right Bank	/		/
4.13.5	Cam Covers Replaced	/		/
4.14.2a(1)	Backlash Checked	/		/
4.14.2b(2)	Record "As Found" Governor Drive Horizontal Shaft End Play - "Data" Sheet 13, Sheet 2	*/		*/
4.14.2b(4)	Record "As Found" Governor Drive Vertical Shaft End Play - "Data" Sheet 13, Sheet 2	*/		*/
4.14.2b(8)	Inspect Governor Drive Horizontal Shaft "Data" Sheet 13, Sheet 2	*/		*/
4.14.2b(11)	Record Governor Drive Horizontal Shaft To Bushing Clearance - "Data" Sheet 13, Sheet 2	*/		*/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.14.2b(15)	Check Governor Drive Vertical Shaft "Data" Sheet 13, Sheet 2	*/		*/
4.14.2b(17)	Record Governor Drive Horizontal Shaft To Bushing Clearance - "Data" Sheet 13, Sheet 2	*/		*/
4.14.2c	Vertical Shaft Flexible Coupling Inspected	*/		*/
4.14.2d	Coupling Lower Hub Installed	*/		*/
4.14.2e	Coupling Upper Hub Installed	*/		*/
4.14.2f(7)	Record "Final" Governor Drive Horizontal Shaft End Play "Data" Sheet 13, Sheet 2	*/		*/
4.14.2f(14)	Record "Final" Governor Drive Vertical Shaft End Play "Data" Sheet 13, Sheet 2	*/		*/
4.14.2g(4)	Governor Drive Installation Torque - "Data" Sheet 13, Sheet 3	*/		*/
4.14.2g(5)	Backlash Checked	/		/
4.14.2h(5)	Governor Drive Housing Installation Torque - "Data" Sheet 13, Sheet 3	*/		*/

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.14.2i(1)(e)	Governor Adapter Plate Torque - "Data" Sheet 13, Sheet 3	*/		*/
4.14.2i(5)	Record "As Found" Governor Drive Angular Alignment - "Data" Sheet 13, Sheet 4	*/		*/
4.14.2i(7)	Record "Final" Governor Drive Angular Alignment - "Data" Sheet 13, Sheet 4	*/		*/
4.14.2j(3)	Record "As Found" Governor Drive Axial Alignment - "Data" Sheet 13, Sheet 4	*/		*/
4.14.2j(5)	Governor Adaptor Plate Torque "Data" Sheet 13, Sheet 3	*/		*/
4.14.2j(7)	Record "Final" Governor Drive Axial Alignment - "Data" Sheet 13, Sheet 4	*/		*/
4.15.2	Accessory Drive Removed	/		/
4.15.3e	Record Drive End Play (As Found) "Data" Sheet 14, Sheet 2	*/		*/
4.15.3j	Check Drive Shaft, Gear Bushing "Data" Sheet 14, Sheet 2	*/		*/
4.15.3n	Record Shaft-To-Bushing Clearance "Data" Sheet 14, Sheet 2	*/		*/
4.15.4f	Record Drive End Play (Final) "Data" Sheet 14, Sheet 2	*/		*/

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.15.5	Accessory Drive Installation Complete	/		/
4.15.5e	Torque capscrews and record on "Data" Sheet 14, Sheet 2	/		/
4.15.6f	Inspect Inspect O.S. Governor Drive "Data" Sheet 14, Sheet 2	/		/
4.15.7f	Record "As Found" Accessory Drive Angular Alignment "Data" Sheet 14, Sheet 3	*/		*/
4.15.7h	Record "Final" Accessory Drive Angular Alignment "Data" Sheet 14, Sheet 3	*/		*/
4.15.8c	Record "As Found" Accessory Drive Axial Alignment "Data" Sheet 14, Sheet 3	*/		*/
4.15.8g	Record "Final" Accessory Drive Axial Alignment "Data" Sheet 14, Sheet 3	*/		*/
4.16.3	Overspeed Governor, Fuel Oil Booster Pump And Adapter Plate Removed	/		/
4.16.4	Governor Removed	/		/
4.16.5h	Lube Oil Pump Removed	/		/
4.16.5i	Lube Oil Pump Adaptor Plate Removed	/		/
4.16.6g	Jacket Water Pump Removed	/		/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.16.6h	Jacket Water Pump Adaptor Plate Removed	/		/
4.16.8	Inspect Gear Train Teeth "Data" Sheet 15, Sheet 2	*/		*/
4.16.9	Inspect Gear Lube Oil Spray Lines "Data" Sheet 15, Sheet 3	*/		*/
4.17.3	Lube Oil Sump Tank And Internal Strainer Cleaned And Inspected	/		/
4.17.4	Lube Oil Sump Tank Foot Valve Checked	/		/
4.17.5	Lube Oil Keepwarm Heater Checked	/		/
4.17.6	I&C Informed That Lube Oil Sump Tank Level Switch May Be Calibrated	/		/
4.17.7	Suction Side (East) of Lube Oil Sump Tank Closure	/		/
4.17.9a	Take Filter Out Of Service	/		/
4.17.9b	Drain Lube Oil Filter Clean Side	/		/
4.17.9c	Drain Lube Oil Filter Dirty Side	/		/

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.17.9h(1)	Inspect Filter Elements And Record Nature Of Material Caught on Comments	/		/
4.17.9i	Clean Filter Housing	/		/
4.17.9j	Install Drain Plug	/		/
4.17.9k	Close Drain Valve	/		/
4.17.9l	Install Filter Elements	/		/
4.17.9m	Clean Centerlube Plug And Top Pressure Plate Assemblies	/		/
4.17.9n	Install Centerlube Plugs And Top Pressure Plate Assemblies	/		/
4.17.9o	Inspect O-Ring And Replace If Required	/		/
4.17.9p	Fill Lube Oil Filter with Lube Oil	/		/
4.17.9r(1)	Center Head Assembly On Housing	/		/
4.17.9t	Tighten eyenuts To 75 ft/lbs	/		/
4.17.9u	Connect Vent Tubing	/		/
4.17.9v	Place Lube Oil Keepwarm Filter In Service	/		/
4.17.9v(3)	Record Clean Filter Differential Pressure _____ psid	/		/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.17.9w	Check Filter For Leakage	/		/
4.17.9x	Install Pipe Cap	/		/
4.17.10a	Take Strainer Out Of Service	/		/
4.17.10b	Drain Lube Oil Strainer	/		/
4.17.10b(2)(a)	MWO Issued To Correct Valve Leakage	/		/
4.17.10h	Clean Strainer Housing	/		/
4.17.10i	Clean Strainer Element	/		/
4.17.10j	Install New Preformed Package	/		/
4.17.10k	Install Strainer With Lube Oil	/		/
4.17.10l	Fill Strainer With Lube Oil	/		/
4.17.10m	Install New Cover Gasket	/		/
4.17.10n(2)	Torque Bolting Per Table 1 _____ ft/lbs	/		/
4.17.10o	Connect Vent Tubing	/		/
4.17.10p	Place Lube Oil Keepwarm Strainer In Service	/		/

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.17.10q	Check Strainer For Leakage	/		/
4.17.10r	Install Pipe Cap	/		/
4.17.11	Lube Oil Duplex Filter Cleaned			
	North Filter (Yes/No) ___	/		/
	South Filter (Yes/No) ___	/		/
4.17.11a	Take Filter To Be Cleaned Out Of Service	/		/
4.17.11b	Drain Lube Oil Filter Clean Side	/		/
4.17.11b(2)(b)	Issue MWO to correct valve leakage	/		/
4.17.11c	Drain Lube Oil Filter Dirty Side	/		/
4.17.11h(1)	Inspect Filter Elements and Record Nature of Material Caught on Comments	/		/
4.17.11i	Clean Filter Housing	/		/
4.17.11j	Install Drain Plug	/		/
4.17.11k	Close Drain Valve	/		/
4.17.11l	Install Filter Elements	/		/
4.17.11m	Clean Centerlube Plug And Top Pressure Plate Assemblies	/		/

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	INIT/DATE
4.17.11n	Install Centerlube Plugs And Top Pressure Plate Assemblies	/___	___	/___
4.17.11o	Inspect O-Ring and Replace If Required	/___	___	/___
4.17.11p	Fill Lube Oil Filter With Lube Oil	/___	___	/___
4.17.11r(1)	Center Head Assembly On Housing	/___	___	/___
4.17.11t	Tighten Eyenuts to 75 ft/lbs.	/___	___	/___
4.17.11u	Connect Vent Tubing	/___	___	/___
4.17.11x	Check Filter For Leakage	/___	___	/___
4.17.11y	Close Equalizing Valve	/___	___	/___
4.17.11z	Install Pipe Cap	/___	___	/___
4.17.12	Lube Oil Heat Exchanger Drained	/___	___	/___
4.18.2f	Connecting Rod Bolt Length "Data" Sheet 16, Sheet 6	*/___	___	*/___
4.18.2v	Piston 1L Removed	/___	___	/___
	Piston 2L Removed	/___	___	/___
	Piston 3L Removed	/___	___	/___
	Piston 4L Removed	/___	___	/___

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. - INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
	Piston 5L Removed	/___	___	/___
	Piston 6L Removed	/___	___	/___
	Piston 7L Removed	/___	___	/___
	Piston 8L Removed	/___	___	/___
4.18.2bb	Record Piston ID Number on "Data" Sheet 17, Sheet 1	*/___	___	*/___
4.18.2cc	Record Link Rod ID Number on "Data" Sheet 16, Sheet 2	/___	___	/___
4.18.3k	Piston 1R Removed	/___	___	/___
	Piston 2R Removed	/___	___	/___
	Piston 3R Removed	/___	___	/___
	Piston 4R Removed	/___	___	/___
	Piston 5R Removed	/___	___	/___
	Piston 6R Removed	/___	___	/___
	Piston 7R Removed	/___	___	/___
	Piston 8R Removed	/___	___	/___
4.18.3q	Record Piston ID Number on "Data" Sheet 17, Sheet 1	/___	___	/___
4.18.3r	Record Master Rod ID Number on "Data" Sheet 16, Sheet 2	/___	___	/___

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.18.4b	Measure Ring Side Clearance "Data" Sheet 17, Sheet 2	*/		*/
4.18.4e(3)	Measure Ring End Gap "Data" Sheet 17, Sheet 2	*/		*/
4.18.4e(4)	Determine Ring Face Contact "Data" Sheet 17, Sheet 2	*/		*/
4.18.4e(5)	Document Replacement Rings "Data" Sheet 17, Sheet 2	*/		*/
4.18.4e(f)	Measure Replacement Ring End Gap And Side Clearance "Data" Sheet 17, Sheet 2	*/		*/
4.18.4f	Inspect Piston "Data" Sheet 17, Sheet 4	*/		*/
4.18.4g(1)	Measure Piston Diameter (Top) "Data" Sheet 17, Sheet 3	*/		*/
4.18.4g(2)	Measure Piston Diameter (Bottom) "Data" Sheet 17, Sheet 3	*/		*/
4.18.4h(1)	Measure Piston Pin Outside Diameter "Data" Sheet 17, Sheet 3	*/		*/
4.18.4h(2)	Measure Piston Pin Bore Diameter "Data" Sheet 17, Sheet 3	*/		*/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.18.4i(1)	Determine Piston Pin-To Bushing Clearance - "Data" Sheet 17, Sheet 4	*/		*/
4.18.4i(2)	Determine Piston Pin-To Piston Clearance - "Data" Sheet 17, Sheet 4	*/		*/
4.18.4j(1)	Inspect Piston Pin Chrome "Data" Sheet 17, Sheet 4	*/		*/
4.18.4j(2)	Inspect Piston Pin Chrome "Data" Sheet 17, Sheet 4	*/		*/
4.18.4j(3)	PT or MT Report Of Replacement Piston Pins - Attached	*/		*/
4.18.5	Connecting Rods Inspected: Conn Rod ____	/		/
	____	/		/
	____	/		/
	____	/		/
	____	/		/
	____	/		/
	____	/		/
	____	/		/
4.18.5a(2)(a)	Record Link Pin Bolt Breakaway Torque "Data" Sheet 16, Sheet 2	*/		*/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.18.5b	Measure Rod Piston Pin Bushing "Data" Sheet 16, Sheet 3	*/		*/
4.18.5c(1)	Measure Link Pin Bushing "Data" Sheet 16, Sheet 3	*/		*/
4.18.5c(2)	Measure Link Pin "Data" Sheet 16, Sheet 3	*/		*/
4.18.5c(3)	Determine Pin-To-Bushing Clearance "Data" Sheet 16, Sheet 3	*/		*/
4.18.5d(3)	Measure Connecting Rod Bearing Bore - "Data" Sheet 16, Sheet 4	*/		*/
4.18.5e(1)	PT Report Piston Pin Bushing Attached	*/		*/
4.18.5e(2)	PT Report of Rod Box Attached	*/		*/
4.18.5e(3)	MT Report of Connecting Rod Bolts Attached	*/		*/
4.18.5e(4)	ET Reports Connecting Rod Box Bolt Holes Attached	*/		*/
4.18.5f	Inspect Connecting Rod Rack Teeth "Data" Sheet 16, Sheet 4	*/		*/
4.18.5g(1)	Measure Connecting Rod Bolt Free Length "Data" Sheet 16, Sheet 6	*/		*/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.18.5g(2)	Verify No Loss Of Connecting Rod Bolt Preload "Data" Sheet 16, Sheet 7	*/		*/
4.18.5g(3)	Inspect Connecting Rod Bolts, Washers, and Nuts "Data" Sheet 16, Sheet 4	*/		*/
4.18.5g(4)	Replace any Connecting Rod Washers that are not Nickel Plated Type	/		*/
4.18.5g(5)	Inspect Connecting Rod Surface at Bolt Contact Area "Data" Sheet 16, Sheet 4	*/		*/
4.18.5g(6)	Stone Rod And Bolt to remove any galling	/		/
4.18.5g(7)	Replace any Connecting Rod Bolt that is Damaged	/		/
4.18.5h(3a)	Torque Link Pin Bolts "Data" Sheet 16, Sheet 2	*/		*/
4.18.5h(4)	Check Link Rod-To-Pin Clearance "Data" Sheet 16, Sheet 2	*/		*/
4.18.5h(5)	Link Rod Cylinder 1 lockwire Installed	*/		*/
	Link Rod Cylinder 2 lockwire Installed	*/		*/
	Link Rod Cylinder 3 lockwire Installed	*/		*/
	Link Rod Cylinder 4 lockwire Installed	/		/

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
	Link Rod Cylinder 5 lockwire Installed	/		/
	Link Rod Cylinder 6 lockwire Installed	/		/
	Link Rod Cylinder 7 lockwire Installed	/		/
	Link Rod Cylinder 8 lockwire Installed	*/		*/
4.19.1b	Connecting Rod Bearings Cylinder 1 Removed	/		/
	Connecting Rod Bearings Cylinder 2 Removed	/		/
	Connecting Rod Bearings Cylinder 3 Removed	/		/
	Connecting Rod Bearings Cylinder 4 Removed	/		/
	Connecting Rod Bearings Cylinder 5 Removed	/		/
	Connecting Rod Bearings Cylinder 6 Removed	/		/
	Connecting Rod Bearings Cylinder 7 Removed	/		/
	Connecting Rod Bearings Cylinder 8 Removed	/		/
4.19.1d	Record Bearings ID Number ""Data" Sheet 18, Sheet 1	*/		*/
4.19.2a	Inspect Connecting Rod Bearing Shells "Data" Sheet 18, Sheet 2	*/		*/

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.19.2b	Measure Connecting Rod Bearing Shells "Data" Sheet 18, Sheet 2	*/		*/
4.19.2c	PT Report of Connecting Rod Bearing Shells Attached	/		/
4.19.2d	RT Report of Connecting Rod Bearing Shells Attached	/		/
4.20.1t	Top Main Bearing No. 5 Removed	/		/
	Top Main Bearing No. 7 Removed	/		/
4.20.1u	Record Bearing ID Number "Data" Sheet 19, Sheet 1	*/		*/
4.20.1w(2)	Bottom Main Bearing No. 5 Removed	/		/
	Bottom Main Bearing No. 7 Removed	/		/
4.20.1w(3)	Record Bearing ID Number on "Data" Sheet 19, Sheet 1	*/		*/
4.20.2a(1)	Inspect Crankshaft Crankpin Journals - "Data" Sheet 20, Sheet 2	*/		*/
4.20.2a(2)	Inspect Crankshaft Main Journals - "Data" Sheet 20, Sheet 2	*/		*/
4.20.2b	Measure Diameter Of Crank Pin Journals "Data" Sheet 20, Sheet 1	*/		*/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.20.2c	Inspect Crankshaft Oil Hole Plugs "Data" Sheet 20, Sheet 2	*/		*/
4.20.3a	PT Report Of Main Journals No. 4, 6 and 8 Fillets And Oil Holes Attached	/		/
4.20.3b	ET Report of Main Journals No. 4, 6 and 8 Fillet And Oil Holes Attached	/		/
4.20.3c	PT Report Of Crankpins No. 3 through 8 Fillets And Oil Holes Attached	/		/
4.20.3d	ET Report Of Crankpins No. 3 through 8 Fillets And Oil Holes Attached	/		/
4.20.4a(1)	Inspect Main Bearing Shells "Data" Sheet 19, Sheet 3	*/		*/
4.20.4a(2)	Measure Main Bearing Shells "Data" Sheet 19, Sheet 2	*/		*/
4.20.4a(3)	PT Report of Main Bearing Shells	*/		*/
4.20.4a(4)	RT Report of Main Bearing Shells	*/		*/
4.20.4b(1)	Check Bearing Cap Mating Surface "Data" Sheet 21, Sheet 1	*/		*/
4.20.4b(2)	Check Pedestal Mating Surface "Data" Sheet 21, Sheet 1	*/		*/
4.20.4c	Inspect Crankshaft Thrust Bearings	/		/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.20.6	Inspections of Section 4.20.4 Complete for Following Bearings:			
	No. 5 Bottom Main Bearing	/		/
	No. 7 Bottom Main Bearing	/		/
	No. 5 Top Main Bearing	/		/
	No. 7 Top Main Bearing	/		/
4.20.7	Main Journal is Clean and Free of Burrs; Bottom Shell Installed for the Following Bearings:			
	No. 5 Bottom Main Bearing	/		/
	No. 7 Bottom Main Bearing	/		/
4.20.7b	Record Bottom Bearing ID No. "Data" Sheet 19, Sheet 1	*/		*/
4.20.9	Record Top Bearing ID No. "Data" Sheet 19, Sheet 1	*/		*/
4.20.11	Bearing Cap Mating Surface is Clean for the Following Bearing Caps:			
	No. 5 Bearing Cap	/		/
	No. 7 Bearing Cap	/		/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.20.12	Main Journal is clean and Free of Burrs; Bearing Cap Installed for the Following Bearings:			
	No. 5 Bearing Cap	/		/
	No. 7 Bearing Cap	/		/
4.20.13j(6)	Record Distance Stretched "Data" Sheet 21, Sheet 2	*/		*/
4.20.13k(4)	Record Initial Stud Height "Data" Sheet 21, Sheet 2	*/		*/
4.20.13k(9)	Record Stretched Height "Data" Sheet 21, Sheet 2	*/		*/
4.20.13k(11)	Record Distance Stretched "Data" Sheet 21, Sheet 2	*/		*/
4.20.13o(2)	Record Initial Stud Height "Data" Sheet 21, Sheet 2	*/		*/
4.20.13o(4)	Record Stretched Height "Data" Sheet 21, Sheet 2	*/		*/
4.20.13o(6)	Record Distance Stretched "Data" Sheet 21, Sheet 2	*/		*/

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.20.13g	Inspect and Install the Following Main Bearing High Temperature Trip Valves:			
	No. 1 Bearing Trip Valve	/		/
	No. 2 Bearing Trip Valve	/		/
	No. 3 Bearing Trip Valve	/		/
	No. 4 Bearing Trip Valve	/		/
	No. 5 Bearing Trip Valve	/		/
	No. 6 Bearing Trip Valve	/		/
	No. 7 Bearing Trip Valve	/		/
	No. 8 Bearing Trip Valve	/		/
	No. 9 Bearing Trip Valve	/		/
	No. 10 Bearing Trip Valve	/		/
4.20.14	Install Rear Seal and Torque Bolts "Data" Sheet 22, Sheet 1	/		/
4.21.1	Cylinder Liners Inspected Cyl. No. _____ _____	/		/

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.21.2	Cylinder Liners Inspected Where Cylinder Heads Removed			
	Cyl. No. ____	✓	____	✓
	____	✓	____	✓
	____	✓	____	✓
	____	✓	____	✓
	____	✓	____	✓
	____	✓	____	✓
	____	✓	____	✓
	____	✓	____	✓
4.21.2a	Inspect Cylinder Liner "Data" Sheet 23, Sheet 2	*/	____	*/
4.21.2b(2)	Measure Liner ID at Reference "Data" Sheet 23, Sheet 2	*/	____	*/
4.21.2b(3)	Measure Liner ID at Position 2 "Data" Sheet 23, Sheet 2	*/	____	*/
4.21.2b(4)	Measure Liner ID at Position 2 "Data" Sheet 23, Sheet 2	*/	____	*/
4.21.2b(5)	Determine Liner Out-Of-Round "Data" Sheet 23, Sheet 2	*/	____	*/
4.21.2d	Repeat Step 4.21.2b "Data" Sheet 23, Sheet 2	*/	____	*/
4.21.2e	Dimensions of New Liners Checked	✓	____	✓

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. - INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.22.1	Block Top Inspection Complete Cyl. Heads _____	/		/
4.22.1a(1)	PT Report of Cylinder Block Top Attached	/		/
4.22.1a(2)	MT Report of Cylinder Block Top Attached	/		/
4.22.1a(3)	ET Report of Cylinder Head Stud Holes Attached	/		/
4.22.2	Inspection Results Sent To System Engineer	/		/
4.22.3	NRC Notified If Cracks Present	/		/
4.23.1	Exhaust Manifold Inspected	/		/
4.24.2	Crankcase Relief Valves Cleaned And Checked			
	No. 1	/		/
	2	/		/
	3	/		/
	4	/		/
	5	/		/
	6	/		/
	7	/		/
	8	/		/

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.25.1a	Check Engine Base Internals "Data" Sheet 4, Sheet 1	*/		*/
4.25.1b	Check Crankcase Internals "Data" Sheet 4, Sheet 1	*/		*/
4.25.2	If Cracks Exist, NDE Inspection Complete	/		/
4.26.1e(1)	Jacket Water Heat Exchanger Tube Checked And Cleaned	/		/
4.26.1e(2)	Jacket Water Heat Exchanger Epoxy Coating Inspected	/		/
4.26.1f	Jacket Water Heat Exchanger End Covers Installed	/		/
4.26.1g	Jacket Water Heat Exchanger Shell Side Checked And Cleaned	/		/
4.26.1h	Jacket Water Heat Exchanger Outlet Pipe Installed	/		/
4.27.1c(1)	Lube Oil Heat Exchanger Tubes Checked And Cleaned	/		/
4.27.1c(2)	Lube Oil Heat Exchanger Epoxy Coating Inspected	/		/
4.27.1d	Lube Oil Heat Exchanger End Covers Installed	/		/
4.27.1e	Lube Oil Heat Exchanger Shell Side Checked And Cleaned	/		/
4.27.1f	Lube Oil Heat Exchanger Inlet Pipe Installed	/		/

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.28.1a	Cylinder 1L Piston & Rod Assembled	/		/
	Cylinder 2L Piston & Rod Assembled	/		/
	Cylinder 3L Piston & Rod Assembled	/		/
	Cylinder 4L Piston & Rod Assembled	/		/
	Cylinder 5L Piston & Rod Assembled	/		/
	Cylinder 6L Piston & Rod Assembled	/		/
	Cylinder 7L Piston & Rod Assembled	/		/
	Cylinder 8L Piston & Rod Assembled	/		/
	Cylinder 1R Piston & Rod Assembled	/		/
	Cylinder 2R Piston & Rod Assembled	/		/
	Cylinder 3R Piston & Rod Assembled	/		/
	Cylinder 4R Piston & Rod Assembled	/		/
	Cylinder 5R Piston & Rod Assembled	/		/
	Cylinder 6R Piston & Rod Assembled	/		/
	Cylinder 7R Piston & Rod Assembled	/		/
	Cylinder 8R Piston & Rod Assembled	/		/

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.28.1b(6)(a)	Record Piston ID No. "Data" Sheet 17, Sheet 1	/		/
4.28.1b(6)(b)	Record Connecting Rod ID No. "Data" Sheet 16, Sheet 2	/		/
4.28.1b(10)(b)	Ensure Gaps Staggered For Piston:			
	Piston 1R	/		/
	Piston 2R	/		/
	Piston 3R	/		/
	Piston 4R	/		/
	Piston 5R	/		/
	Piston 6R	/		/
	Piston 7R	/		/
	Piston 8R	/		/
4.28.1b(11)	Cylinder 1R Piston & Rod Installed	/		/
	Cylinder 2R Piston & Rod Installed	/		/
	Cylinder 3R Piston & Rod Installed	/		/
	Cylinder 4R Piston & Rod Installed	/		/
	Cylinder 5R Piston & Rod Installed	/		/

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
	Cylinder 6R Piston & Rod Installed	/		/
	Cylinder 7R Piston & Rod Installed	/		/
	Cylinder 8R Piston & Rod Installed	/		/
4.28.1b(12)(a)	Inspections of Section 4.19.2 Complete for the Following Bearings:			
	No. 1 Top Connecting Rod Bearing	/		/
	No. 1 Bottom Connecting Rod Bearing	/		/
	No. 2 Top Connecting Rod Bearing	/		/
	No. 2 Bottom Connecting Rod Bearing	/		/
	No. 3 Top Connecting Rod Bearing	/		/
	No. 3 Bottom Connecting Rod Bearing	/		/
	No. 4 Top Connecting Rod Bearing	/		/
	No. 4 Bottom Connecting Rod Bearing	/		/
	No. 5 Top Connecting Rod Bearing	/		/
	No. 5 Bottom Connecting Rod Bearing	/		/

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
	No. 6 Top Connecting Rod Bearing	/		/
	No. 6 Bottom Connecting Rod Bearing	/		/
	No. 7 Top Connecting Rod Bearing	/		/
	No. 7 Bottom Connecting Rod Bearing	/		/
	No. 8 Top Connecting Rod Bearing	/		/
	No. 8 Bottom Connecting Rod Bearing	/		/
4.28.1b(12)(b)	Ensure that the Top Connecting Rod Bearing Shell is not Marked "BOTTOM ONLY":			
	No. 1 Top Connecting Rod Bearing	/		/
	No. 2 Top Connecting Rod Bearing	/		/
	No. 3 Top Connecting Rod Bearing	/		/
	No. 4 Top Connecting Rod Bearing	/		/
	No. 5 Top Connecting Rod Bearing	/		/
	No. 6 Top Connecting Rod Bearing	/		/
	No. 7 Top Connecting Rod Bearing	/		/
	No. 8 Top Connecting Rod Bearing	/		/

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.28.1b(12)(c)	Ensure Crankpin is Clean and Free of Burrs for the Following Crankpins:			
	No. 1 Crankpin	/_____	_____	/_____
	No. 2 Crankpin	/_____	_____	/_____
	No. 3 Crankpin	/_____	_____	/_____
	No. 4 Crankpin	/_____	_____	/_____
	No. 5 Crankpin	/_____	_____	/_____
	No. 6 Crankpin	/_____	_____	/_____
	No. 7 Crankpin	/_____	_____	/_____
	No. 8 Crankpin	/_____	_____	/_____
4.28.1b(12)(d)	Connecting Rod Bearing Cylinder 1 Installed	/_____	_____	/_____
	Connecting Rod Bearing Cylinder 2 Installed	/_____	_____	/_____
	Connecting Rod Bearing Cylinder 3 Installed	/_____	_____	/_____
	Connecting Rod Bearing Cylinder 4 Installed	/_____	_____	/_____
	Connecting Rod Bearing Cylinder 5 Installed	/_____	_____	/_____
	Connecting Rod Bearing Cylinder 6 Installed	/_____	_____	/_____
	Connecting Rod Bearing Cylinder 7 Installed	/_____	_____	/_____
	Connecting Rod Bearing Cylinder 8 Installed	/_____	_____	/_____

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.28.1b(12)(e)	Record Bearing ID No. "Data" Sheet 18, Sheet 1	*/		*/
4.28.1c(5)(a)	Record ID No. for Piston on "Data" Sheet 17, Sheet 1	*/		*/
4.28.1c(5)(b)	Record ID No. for Connecting Rod on "Data" Sheet 16, Sheet 2	*/		*/
4.28.1c(9)(b)	Ensure Ring Gap Staggered for Piston			
	Piston 1L	/		/
	Piston 2L	/		/
	Piston 3L	/		/
	Piston 4L	/		/
	Piston 5L	/		/
	Piston 6L	/		/
	Piston 7L	/		/
	Piston 8L	/		/
4.28.1c(10)	Cylinder 1L Piston & Rod Installed	/		/
	Cylinder 2L Piston & Rod Installed	/		/
	Cylinder 3L Piston & Rod Installed	/		/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
	Cylinder 4L Piston & Rod Installed	/		/
	Cylinder 5L Piston & Rod Installed	/		/
	Cylinder 6L Piston & Rod Installed	/		/
	Cylinder 7L Piston & Rod Installed	/		/
	Cylinder 8L Piston & Rod Installed	/		/
4.28.1c(16)(b)	Connecting Rod Bolt Length Measured "Data" Sheet 16, Sheet 8	*/		*/
4.28.1c(16)(d)	Connecting Rod Bolts Torqued "Data" Sheet 16, Sheet 8	*/		*/
4.28.1c(18)	Safety-Wire & Cotter Pins Installed on Cylinder 1 Connecting Rods	/		/
	Safety-Wire & Cotter Pins Installed on Cylinder 2 Connecting Rods	/		/
	Safety-Wire & Cotter Pins Installed on Cylinder 3 Connecting Rods	/		/
	Safety-Wire & Cotter Pins Installed on Cylinder 4 Connecting Rods	/		/
	Safety-Wire & Cotter Pins Installed on Cylinder 5 Connecting Rods	/		/

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
	Safety-Wire & Cotter Pins Installed on Cylinder 6 Connecting Rods	/		/
	Safety-Wire & Cotter Pins Installed on Cylinder 7 Connecting Rods	/		/
	Safety-Wire & Cotter Pins Installed on Cylinder 8 Connecting Rods	/		/
4.20.1c(19)	All Tools Removed From Crankcase	/		/
4.28.2a(2)	Head Studs Torqued/ Stud Free Length Measured "Data" Sheet 9, Sheet 5	*/		*/
4.28.2d(1)	Cylinder Head ID No. Recorded "Data" Sheet 9, Sheet 1	*/		*/
4.28.2D	Cylinder Head 1R Installed	/		/
	Cylinder Head 2R Installed	/		/
	Cylinder Head 3R Installed	/		/
	Cylinder Head 4R Installed	/		/
	Cylinder Head 5R Installed	/		/
	Cylinder Head 6R Installed	/		/
	Cylinder Head 7R Installed	/		/

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
	Cylinder Head 8R Installed	/		/
	Cylinder Head 1L Installed	/		/
	Cylinder Head 2L Installed	/		/
	Cylinder Head 3L Installed	/		/
	Cylinder Head 4L Installed	/		/
	Cylinder Head 5L Installed	/		/
	Cylinder Head 6L Installed	/		/
	Cylinder Head 7L Installed	/		/
	Cylinder Head 8L Installed	/		/
4.28.2i	Cylinder Head Nuts Torqued "Data" Sheet 9, Sheet 5	*/		*/
4.28.2k	Intake Elbow Torqued "Data" Sheet 22, Sheet 2 and 3	*/		*/
4.28.2l	Exhaust Elbow Torqued "Data" Sheet 22, Sheet 4	*/		*/
4.28.2m	Jacket Water Piping Torqued "Data" Sheet 22, Sheet 6	*/		*/

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.28.2(m)(3)	Tighten Jacket Water Piping Dresser Couplings:			
	Cylinder 1R	/___	___	/___
	Cylinder 2R	/___	___	/___
	Cylinder 3R	/___	___	/___
	Cylinder 4R	/___	___	/___
	Cylinder 5R	/___	___	/___
	Cylinder 6R	/___	___	/___
	Cylinder 7R	/___	___	/___
	Cylinder 8R	/___	___	/___
	Cylinder 1L	/___	___	/___
	Cylinder 2L	/___	___	/___
	Cylinder 3L	/___	___	/___
	Cylinder 4L	/___	___	/___
	Cylinder 5L	/___	___	/___
	Cylinder 6L	/___	___	/___
	Cylinder 7L	/___	___	/___
	Cylinder 8L	/___	___	/___
4.28.20	Air Start Piping Torqued "Data" Sheet 22, Sheet 7	*/___	___	*/___

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.28.20(3)	Tighten Air Start Piping Dresser Couplings:			
	Cylinder 1R	/		/
	Cylinder 2R	/		/
	Cylinder 3R	/		/
	Cylinder 4R	/		/
	Cylinder 5R	/		/
	Cylinder 6R	/		/
	Cylinder 7R	/		/
	Cylinder 8R	/		/
	Cylinder 1L	/		/
	Cylinder 2L	/		/
	Cylinder 3L	/		/
	Cylinder 4L	/		/
	Cylinder 5L	/		/
	Cylinder 6L	/		/
	Cylinder 7L	/		/
	Cylinder 8L	/		/
4.28.3b	Install New Valve To Head Gasket			
	1R	/		/
	2R	/		/
	3R	/		/
	4R	/		/

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
	5R	/		/
	6R	/		/
	7R	/		/
	8R	/		/
	1L	/		/
	2L	/		/
	3L	/		/
	4L	/		/
	5L	/		/
	6L	/		/
	7L	/		/
	8L	/		/
4.28.3d	Air Start Valve Capscrews Inspected "Data" Sheet 22, Sheet 5	*/		*/
4.28.3f	Air Start Valve Capscrews Torqued "Data" Sheet 22, Sheet 5	*/		*/
4.28.3g	Air Start Valve Capscrews Retorqued Every 8 hours of Engine Operation "Data" Sheet 24	*/		*/

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.28.4g	Subcover 1R Installed	/_____	_____	/_____
	Subcover 2R Installed	/_____	_____	/_____
	Subcover 3R Installed	/_____	_____	/_____
	Subcover 4R Installed	/_____	_____	/_____
	Subcover 5R Installed	/_____	_____	/_____
	Subcover 6R Installed	/_____	_____	/_____
	Subcover 7R Installed	/_____	_____	/_____
	Subcover 8R Installed	/_____	_____	/_____
	Subcover 1L Installed	/_____	_____	/_____
	Subcover 2L Installed	/_____	_____	/_____
	Subcover 3L Installed	/_____	_____	/_____
	Subcover 4L Installed	/_____	_____	/_____
	Subcover 5L Installed	/_____	_____	/_____
	Subcover 6L Installed	/_____	_____	/_____
	Subcover 7L Installed	/_____	_____	/_____
	Subcover 8L Installed	/_____	_____	/_____
4.28.4i	Subcover Bolts Torqued "Data" Sheet 22, Sheet 9	*/_____	_____	*/_____
4.28.4o	Rocker Arms Torqued	/_____	_____	/_____
4.28.6	Engine Internals Inspected	/_____	_____	/_____
4.28.7	Return Side Of Lube Oil Sump Tank Checked And Cover Installed	/_____	_____	/_____

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.28.8	Lube Oil System Filled	/		/
4.28.10	Gear Train Lube Oil Spray Nozzles Checked	/		/
4.28.11	Crankcase Side Covers Installed And Cap Screws Torqued	/		/
4.28.12	Gear Train Inspection Complete	/		/
4.28.13a	Gear Inspection Covers Installed and Bolts Torqued	/		/
4.28.13b(3)	Jacket Water Adaptor Plate Torqued - "Data" Sheet 22, Sheet 10	*/	-----	/
4.28.13b(6)	Jacket Water Pump "Data" Sheet 22, Sheet 10	*/		*/
4.28.13b(9)	Jacket Water Pump Suction Piping - "Data" Sheet 22, Sheet 10	*/		*/
4.28.13b(10)	Jacket Water Pump Discharge Piping - "Data" Sheet 22, Sheet 11	*/		*/
4.28.13b	Jacket Water Pump Installed	/		*/

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.28.13c(3)	Lube Oil Pump Adaptor Plate Torqued - "Data" Sheet 22, Sheet 11	*/		*/
4.28.13c(5)	Lube Oil Pump Torqued - "Data" Sheet 22, Sheet 11	*/		*/
4.28.13c(6)	Lube Oil Pump Discharge Piping - "Data" Sheet 22, Sheet 12	*/		*/
4.28.13c(8)	Lube Oil Pump Suction Elbow - "Data" Sheet 22, Sheet 12	*/		*/
4.28.13c	Lube Oil Pump Installed	/		/
4.28.14	Camshaft Inspection Complete	/		/
4.28.15	Governor Drive Inspection Complete	/		/
4.28.16c(1)	New Coupling Element Stamped "n"	*/		*/
4.28.16h	Governor Drive Flexible Element Torque - "Data" Sheet 13, Sheet 4	*/		*/
4.28.17g	Governor Base Torqued "Data" Sheet 13, Sheet 5	*/		*/

* Document on Referenced "Data" Sheet

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.28.17i	Ensure nothing has fallen into Governor housing	/___	___	/___
4.28.17j	Governor Housing Inspection Cover Torqued - "Data" Sheet 13, Sheet 5	*/___	___	*/___
4.28.17k	Governor Booster Torqued "Data" Sheet 13, Sheet 5	*/___	___	*/___
4.28.17t	Governor Flushed	/___	___	/___
4.28.17u	Governor Filled With Oil	/___	___	/___
4.28.18	Accessory Drive Inspection Complete	/___	___	/___
4.28.19a(4)	O.S. Governor Drive to Adaptor Plate Torque "Data" Sheet 14, Sheet 3	*/___	___	*/___
4.28.19a	O.S. Governor Drive Coupling Half Installed	/___	___	/___
4.28.19b(5)	O.S. Governor Drive Coupling Shield Torqued "Data" Sheet 14, Sheet 3	*/___	___	*/___
4.28.19c(3)	O.S. Governor Drive/ Adaptor Plate Torqued "Data" Sheet 14, Sheet 4	*/___	___	*/___
4.28.19d	Magnetic Pickup Wiring Connected	/___	___	/___
4.28.19e	O.S. Trip Vent Valves O-rings/valves replaces	/___	___	/___

* Document on Referenced "Data" Sheet

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.28.19h	Lube Oil Line to Turbo/Rocker Arm Header Torqued "Data" Sheet 14, Sheet 5	*/		*/
4.28.20d	Fuel Injector Nuts Torqued "Data" Sheet 22, Sheet 8	*/		*/
4.28.20e	Fuel Injector Nuts Retorqued Every 8 hours of Engine Operation Until no change is observed. "Data" Sheet 25, Sheets 1 and 2	*/		*/
4.28.21h	Record Fuel Pump Serial No. "Data" Sheet 10, Sheet 1	*/		*/
4.28.21i	Fuel Pump Nuts Torqued "Data" Sheet 10, Sheet 1	*/		*/
4.28.21m	Fuel Pump Nuts Torqued "Data" Sheet 10, Sheet 1	*/		*/
4.28.22b	Cylinder 1R Valve Clearances Adjusted	/		/
	Cylinder 2R Valve Clearances Adjusted	/		/
	Cylinder 3R Valve Clearances Adjusted	/		/
	Cylinder 4R Valve Clearances Adjusted	/		/
	Cylinder 5R Valve Clearances Adjusted	/		/

* Document on Referenced "Data" Sheets

PROCEDURE STEP	DESCRIPTION	MAINT. - INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
	Cylinder 6R Valve Clearances Adjusted	/		/
	Cylinder 7R Valve Clearances Adjusted	/		/
	Cylinder 8R Valve Clearances Adjusted	/		/
	Cylinder 1L Valve Clearances Adjusted	/		/
	Cylinder 2L Valve Clearances Adjusted	/		/
	Cylinder 3L Valve Clearances Adjusted	/		/
	Cylinder 4L Valve Clearances Adjusted	/		/
	Cylinder 5L Valve Clearances Adjusted	/		/
	Cylinder 6L Valve Clearances Adjusted	/		/
	Cylinder 7L Valve Clearances Adjusted	/		/
	Cylinder 8L Valve Clearances Adjusted	/		/
4.28.22d	Tools Removed From Engine	/		/
4.28.22e	Cylinder Head Covers Installed	/		/
4.28.26	Jacket Water System Check For Leaks	/		/
4.28.27	Chemistry Department Informed Jacket Water System Filled	/		/

* Document on Referenced "Data" Sheets

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.29.1	Fuel Pump Linkage And Bearings Lubricated			
	Left Bank	/		/
	Right Bank	/		/
4.30.1	Governor Control Cross Shaft Lubricated	/		/
4.30.2	"Heim" Rod Ends Checked And Lubricated	/		/
4.30.3	Cross Shaft Checked For Loose Parts	/		/
4.31.4	Crankcase Vacuum Fans Cleaned And Checked			
	Left Bank	/		/
	Right Bank	/		/
4.31.5	Crankcase Vacuum Fan Motor Bearings Checked			
	Left Bank	/		/
	Right Bank	/		/
4.31.7	Crankcase Vacuum Fans Installed			
	Left Bank	/		/
	Right Bank	/		/
4.32.1	Barring Device Air Filter Replaced	/		/
4.33.1	Air Distributor Air Filters Cleaned Or Replaced			
	Left Bank	/		/
	Right Bank	/		/
4.33.2	Air Start Admission Valve Strainers Cleaned			
	Left Bank	/		/
	Right Bank	/		/

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.34.2	Intake Air Filter Oil Reservoir Cleaned	/		/
4.34.3	Intake Air Filter Oil Reservoir Filled With Oil	/		/
4.35.1	Foundation Checked For Breaks In Grout	/		/
4.36	Air Compressor No. 1			
	Intercooler Fins Cleaned	/		/
	Air Filter Checked/ Replaced	/		/
	Compressor Oil Changed	/		/
	Belt Tension Checked	/		/
	Pulley Bolts/Screws Tight	/		/
	Air Aftercooler No. 1 Fins Cleaned	/		/
	Air Compressor No. 2			
	Intercooler Fins Cleaned	/		/
	Air Filter Checked/ Replaced	/		/
	Compressor Oil Changed	/		/
	Belt Tension Checked	/		/
	Pulley Bolts/Screws Tight	/		/
	Air Aftercooler No. 2 Fins Cleaned	/		/

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.37	Air Dryer No. 1			
	Moisture Traps Serviced	/		/
	Condenser Fins Cleaned	/		/
	Dew Point Checked	/		/
	Air Dryer No. 2			
	Moisture Traps Serviced	/		/
	Condenser Fins Cleaned	/		/
	Dew Point Checked	/		/
4.38.1	Generator Vibration Data Taken	/		/
4.38.2	Generator Cleaned	/		/
4.38.3	Generator Meggered	/		/
4.39.1	Generator Pedestal Bearing Flushed And Refilled	/		/
4.39.2	Generator Pedestal Bearing Housing Cleaned	/		/
4.39.3	Generator Pedestal Bearing Insulation Checked:			
	Bearing Housing To Shim	/		/
	Pedestal To Shim	/		/
	Bearing Housing Bolts:			
	No. 1	/		/
	No. 2	/		/
	No. 3	/		/
	No. 4	/		/
4.40.1	ECP Cleaned	/		/
4.40.2	ECP Wiring Checked	/		/
4.40.3	ECP Tubing Checked	/		/

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.40.4	Filter, O-rings And Gaskets Replaced In ECP Regulator/Filter	/		/
4.40.5	ECP Circuit Breakers And Contact Blocks Checked	/		/
4.40.6	ECP Valves Checked	/		/
4.40.7	ECP Relays, TB's And Switch Contacts Checked	/		/
4.40.8	ECP Solenoid Valves Checked For Leakage	/		/
4.40.9	ECP Functional Tested Completed	/		/
4.41.1	GCP Cleaned	/		/
4.41.2	GCP Wiring Checked	/		/
4.41.3	GCP Wire Insulation Checked	/		/
4.41.4	GCP Relay Contacts Checked	/		/
4.41.5	GCP Voltage Regulator Potentiometers Checked	/		/
4.41.6	GCP Circuit Boards Checked	/		/
4.42.1	Fuel Oil Duplex Filter Cleaned East Filter (Yes/No) ___ West Filter (Yes/No) ___	/ /		/ /
4.42.1a	Take Filter to be Replaced Out Of Service	/		/
4.42.1b	Fuel Filter Casing Drained	/		/

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PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.42.1b(2)(b)	MWO Written if Valve Leaks By	/		/
4.42.1f(1)	Record Nature of Material Caught in Filter in Comments	/		/
4.42.1h	Clean Casing and Center Tube	/		/
4.42.1h(1)	Install Drain Plug	/		/
4.42.1i	Install Center Post O-Ring and Center Tube Assembly	/		/
4.42.1j	Install Filter Element	/		/
4.42.1k(3)	Install Casing-to-Head Gasket	/		/
4.42.1l	Install Center Post Nut And Gasket	/		/
4.42.1l(1)	Torque Canter Post Nut	/		/
4.42.1m	U-Bolt Installed	/		/
4.42.1o	Open Day Tank Isolation Valve	/		/
4.42.1g	Vent Fuel Filter and Take Filter Out of Service	/		/
4.42.1r	Install Vent Plug	/		/
4.42.1s(1)	Record and Clean Filter Differential Pressure _____ psid	/		/
4.42.1t	Check Filter for Leakage	/		/

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.42.1u	Return Filter that was Replaced to Standby	/		/
4.42.1v	Backfill Fuel Oil Headers If Required	/		/
4.42.1v(1)	Perform Engine Start Prior to Returning Engine to Operable Status	/		/
4.43.1	Fuel Oil Duplex Strainer Cleaned North Strainer (Yes/No) South Strainer (Yes/No)	/ /		/ /
4.43.1a	Take Strainer to be Cleaned Out of Service	/		/
4.43.1b(2)(b)	MWO written if Valve Leaks by	/		/
4.43.1f	Clean Strainer Element	/		/
4.43.1g	Clean Strainer Housing	/		/
4.43.1h	Install Strainer Element	/		/
4.43.1i	Install Strainer Housing	/		/
4.43.1j	Torque Housing Nut	/		/
4.43.1k	Install Support Bar and Bolt	/		/
4.43.1l	Open Day Tank Isolation Valve	/		/
4.43.1o	Fill Strainer with Fuel Oil	/		/
4.43.1q	Check Strainer for Leakage	/		/
4.43.1r	Return Strainer that was Cleaned to Standby	/		/

Sheet 65 of 70

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.43.1s	Backfill Fuel Oil Headers If Required	/		/
4.43.1s(1)	Perform Engine Start Prior to Returning Engine to Operable Status	/		/
4.44.1	Air Butterfly Valve Shaft Greased			
	Left Bank	/		/
	Right Bank	/		/
4.44.2	Air Butterfly Valve Locking Devices Tight			
	Left Bank	/		/
	Right Bank	/		/
4.45.1	The Following Instrumentation Has Been Checked:			
4.45.1a	GCP Meters	/		/
4.45.1b	Overspeed Trip Vent Valve	/		/
4.45.1c	ECP Tubing	/		/
4.45.1d	ECP Space Heater	/		/
4.45.1e	Lube Oil Sump Tank Level Switch	/		/
4.45.1f	Exhaust Thermocouples	/		/
4.45.1g	Engine Trip Switches	/		/
4.45.1h	J.W. Heater Thermostat	/		/
4.45.1i	L.O. Heater Thermostat	/		/
4.45.1j	L.O. Filter dP Gauges	/		/
4.45.1k	L.O. Strainer dP Gauges	/		/

Sheet 66 of 70

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.45.1l	Air Receiver Press. Gauges	/_____	_____	/_____
4.45.1m	Air Receiver Press. Switches	/_____	_____	/_____
4.45.1n	Overspeed Air Regulator	/_____	_____	/_____
4.45.1o	STOP/RUN Valve Air Regulator	/_____	_____	/_____
4.46.3	Fuel Oil System Backfilled	/_____	_____	/_____
4.46.4	Lube Oil Sump Tank Level Checked	/_____	_____	/_____
4.46.7	System Valve Lineup Complete	/_____	_____	/_____
4.46.8	Air Butterfly Valve Movement Checked			
	Left Bank	/_____	_____	/_____
	Right Bank	/_____	_____	/_____
4.46.9	Shutdown Cylinder Checked For Leakage	/_____	_____	/_____
4.47.1	Engine In LOCAL and MAINTENANCE	/_____	_____	/_____
4.47.2d	Response Time For Air Butterfly Valves			
	Left Bank _____ sec	/_____	_____	/_____
	Right Bank _____ sec	/_____	_____	/_____
4.47.2e	Response Time For Shutdown Cylinder _____ sec	/_____	_____	/_____
4.47.4a	On LOCAL Control	/_____	_____	/_____
4.47.4b	In MAINTENANCE MODE	/_____	_____	/_____

Sheet 67 of 70

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.47.4c	DC Breaker in Control Panel Open	/		/
4.47.4f	Settings Recorded, "As Found" DROOP	/		/
	SPEED	/		/
	LOAD LIMIT	/		/
4.47.4g	Fuel Rack Cylinder Extended	/		/
4.47.4i	Cylinder Head Cocks Closed	/		/
4.47.4o(5)	Engine Response Satisfactory	/		/
4.47.4t	Governor Setting Recorded "As Left" DROOP	/		/
	SPEED	/		/
	LOAD LIMIT	/		/
4.47.4u	Knobs Sealed	/		/
4.47.5a	Chart Recorder Connected	/		/
4.47.5b	Overspeed Setpoint Checked	/		/
4.47.5c	Chart Recorder Disconnected	/		/
4.47.6a	Diesel Generator Aligned for LOCAL Start	/		/
4.47.6e	Run Engine At 300 rpm for 15 Minutes and Inspect	/		/
4.47.6j	Inspect Engine Internals	/		/
4.47.6p	Close DC Breaker In Generator Control Panel	/		/

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.47.6r	Run Engine at 20%, 1 hour	/		/
4.47.6x	Inspect Liners	/		/
4.47.6y	Inspect Pistons	/		/
4.47.6z	Inspect Rocker Arms and Injectors	/		/
4.47.6ee	Run Engine at 35%, 1 hour	/		/
4.47.6ff	Run Engine at 50%, 2 hours	/		/
4.47.6gg	Run Engine at 75%, 2 hours	/		/
4.47.6hh	Run Engine at 25%, 1 hour	/		/
4.47.6ii	Run Engine at 100%, 2 hours	/		/
4.47.6jj	Run Engine at 110%, 15 minutes	/		/
4.47.6pp	Perform Crankshaft Web Deflection	/		/
4.47.6qq	Perform Crankshaft Thrust	/		/
4.47.6ss	Reinspect Liners, Pistons, Rocker Arms and Injectors	/		/
4.47.6tt	Replace Crankshaft Side Covers	/		/
4.47.6xx	Take Cold Compression	/		/
4.47.6zz	Torque Crankcase Side Cover Capscrews	/		/

Sheet 69 of 70

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE
4.48.1a	Lube Oil Pressure Stable	/_____	_____	/_____
4.48.2a(3)	Retorque Governor Drive Flexible Element After 24 Hours of Engine Operation "Data" Sheet 26	*/_____	_____	*/_____
4.28.2a(4)	Torque Governor Inspection Cover Capscrews - "Data" Sheet 26	*/_____	_____	*/_____
4.28.2a(5)	Torque Booster Capscrews "Data" Sheet 26	*/_____	_____	*/_____
4.48.3a	Turbocharger Capscrews Checked	/_____	_____	/_____
	Following Run No. 1	/_____	_____	/_____
	Following Run No. 2	/_____	_____	/_____
	Following Run No. 3	/_____	_____	/_____
4.48.4a	Air Start Valve Cap Screws Re-torqued			
	After 1st 8 Hours	/_____	_____	/_____
	After 2nd 8 Hours	/_____	_____	/_____
	After 3rd 8 Hours	/_____	_____	/_____
4.48.5a	Fuel Injector Nuts Re-torqued			
	After 1st 8 Hours	/_____	_____	/_____
	After 2nd 8 Hours	/_____	_____	/_____
	After 3rd 8 Hours	/_____	_____	/_____
4.48.6a	Turbocharger Tie Plate Bolts Re-torqued when Hot, 30 ft/lbs.	/_____	_____	/_____
4.49	Notify Shift Supervisor checkout complete	/_____	_____	/_____
	Check complete	_____	_____	_____

Sheet 70 of 70

PROCEDURE STEP	DESCRIPTION	MAINT. INIT/DATE	HOLD POINT (Yes/No)	QC INIT/DATE

Comments/additional hold points: _____

_____

_____

_____

_____

_____

QC has reviewed this procedure for hold points _____
Signature

APPROVED ( ) DISAPPROVED ( )	
FOREMAN	DATE
_____	_____

COMPLETED BY	DATE
_____	_____

FOR INFO

CONTROL OF IN-PROCESS MATERIALS

1.0 PURPOSE

This procedure provides instructions for control of in-process materials, parts and equipment.

2.0 DEFINITIONS

2.1 IN-PROCESS MATERIAL

Material which has been removed from its permanent storage or installed location for the purpose of rework, repair, modification, calibration, testing or cleaning.

NOTES

a. Scaffolds are controlled under Procedure 20003-C, "Scaffolding Construction And Control" and are exempt from this procedure.

b. Health Physics air samplers, area radiation monitors, friskers and other surveying equipment are exempt from this procedure. Daily/weekly checks are performed on these items.

c. In-Process Material tags may be used to identify items (i.e. hoses, ladders, electrical cords heaters, pre-staged material ...) that should not be removed from its present location.

2.2 INTEGRITY

Assurance that the material, parts or equipment are not subjected to physical alterations which would reduce its quality, qualification, or serviceability to unacceptable levels.

FOR INFO

2.3 PURITY

Assurance that the material, parts or equipment are maintained at the correct level of cleanliness or that the correct level of cleanliness is restored prior to use. (Reference Regulatory Guide 1.37, March 1973, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants", and applicable system specifications for cleanliness class levels.)

2.4 TRACEABILITY

Assurance that the material, parts or equipment can be directly traced to the procurement source, qualification documentation, and in plant usage if required.

2.5 DESIGNATED STORAGE AREA

An area established for the purpose of staging materials for an outage or rooms designated for storage.

2.6 TEMPORARY STORAGE AREA

Any area where materials/equipment is located, which is not a permanent storage location or a designated storage area.

3.0 RESPONSIBILITIES

3.1 ALL PERSONNEL

3.1.1 All personnel performing safety-related activities are responsible for maintaining the integrity, purity, and traceability of the safety-related material, parts, or equipment.

3.1.2 Personnel leaving uninstalled safety-related material, parts, or equipment unattended are responsible for assuring their correct storage and protection.

3.1.3 Personnel observing deficient or nonconforming conditions are responsible for documenting and reporting those conditions in accordance with approved administrative procedures.

3.2 SUPERVISORS/FOREMEN

Work, or job, crew supervisors or foremen will ensure the following:

a. There is a valid need for the issuance of the "In-Process Material Control Tag".

b. Issuance of the In-Process Material Control Tag will not cause a violation of good housekeeping or safety practices.

c. In-Process Material Control Tags are legible and properly completed.

d. In-Process Material Control Tags are attached in a conspicuous place onto items being identified.

e. Once the associated work is completed and/or it is no longer necessary to keep the equipment in the plant, the equipment should be removed and the In-Process Macerial Control Tags detached and destroyed.

4.0 INSTRUCTIONS

The controls effected by these instructions are mandatory for safety-related items/components and will be used on non safety-related items/components. Equipment placed in an Instruments and Controls rebuild program per Procedure 20023-C, "I&C Rebuild Program", is not considered in-process material.

4.1 IN-PROCESS MATERIALS CONTROL

4.1.1 Control of in-process material will be applied at removal and remain in force until the material, part or equipment is ready to be re-installed in the plant and accepted or until the material, part or equipment is returned to the permanent storage location.

4.1.2 In process Material Control Tags are not required for bulk materials such as hoses, drop cords, oil cloth, and other supporting equipment when stored in designated storage areas.

4.1.3 When placing materials either in a designated storage area or In-process, consideration must be given to preserving the seismic qualification of safety-related equipment.

4.1.4 In-Process Material tags may be used to identify items (i.e. hoses, ladders, electrical cords heaters, pre-staged material, etc.) that should not be removed from its present location. Materials that are not tagged and their use, at their current location, is not obvious are subject to being removed.

4.2 TEMPORARY STORAGE

4.2.1 Temporary storage conditions shall be established for materials, parts, or equipment under the following conditions:

a. Permanent plant equipment has been disassembled and is to be left at the work site unattended.

b. Permanent plant equipment has been removed from its installed or permanent storage location for any purpose and is to be left unattended.

c. Bulk quantities of materials, parts, or equipment have been issued from the warehouse for the purpose of periodic in plant use or installation and are left unattended, outside of their designated storage location.

d. Raw material such as plates, structural steel, piping, etc., being used in a fabrication process which must be left unattended.

4.2.2 Designated and temporary storage areas shall meet the following minimum requirements:

a. The environmental conditions, such as temperature and humidity, are controlled to at least the level required for permanent storage of the material or adequate protection from the environment is provided when environmental conditions are not applicable.

b. Where practical, access to the material is limited to authorized personnel. Authorization may be granted by the foreman or supervisor responsible for the temporary storage area. Authorization during off-normal hours may be granted by the Shift Supervisor.

NOTE

Where permanent physical barriers are not present, access may be limited by the placement of signs and/or rope or similar barriers.

c. The material is protected from entry of foreign matter by wrapping, packaging or necessary means which will assure protection from cleanliness degradation.

d. The temporary storage areas are posted with signs identifying them as such, and the storage levels being maintained if applicable.

e. Fire protection measures commensurate with the type of storage area and the material involved are provided and maintained.

f. The use or storage of food, drinks, and salt tablet dispensers in controlled storage areas is not permitted.

g. Measures are taken, if necessary, to prevent entrance of rodents and other animals into indoor storage areas or equipment to minimize possible contamination and mechanical damage to temporarily stored material.

4.3 CLEANLINESS CONTROL

In-Process controls for material, parts, or equipment shall include provisions to protect the material from cleanliness degradation or provisions to restore the material to its required cleanliness level prior to in plant use. Cleanliness controls shall include:

4.3.1 Covering the openings of pipes or vessels with site approved materials whenever work is not in progress.

4.3.2 Wrapping or packaging with site approved materials of sub-assemblies of piping systems or equipment that will directly contact the fluid medium when installed.

4.3.3 Use of only approved solvents, or cleaning agents, for cleaning material and equipment. (Refer to Procedure 00262-C, "Control Of Chemicals/Fluids", 00853-C, "Material Identification, Control And Issue".

4.3.4 Subjecting accessible interior surfaces of piping, components or vessels to a cleanliness inspection prior to closure or reassembly, per Procedure 20427-C, "Maintenance Cleanliness And Housekeeping Control".

4.3.5 The storage area shall be cleaned as required to avoid the accumulation of trash, discarded packaging materials and other detrimental soil.

4.4 MATERIAL IDENTIFICATION

4.4.1 Material, parts, or equipment being left unattended for more than 1 shift or subjected to further fabrication or processing will be tagged with a tag similar to that shown in Figure 1.

4.4.2 Large components or complete assemblies being stored near the work site, that are easily identifiable as to their use or in plant location, need not be tagged.

4.4.3 Small safety-related components or sub-assemblies such as nuts, bolts, etc., will be bagged and tagged to help prevent loss.

4.4.4 Bulk materials such as fuses, fittings, packing, thermal overloads, etc., will be segregated by size, capacity, lot, batch, manufacturer, etc., and containerized and tagged, if necessary, to prevent loss of traceability. Figure 2 shows a sample of tag to use. Local reproduction of the tag is permitted. The tag will be affixed to the bulk material container. In no case will adhesive be used to attach the tag directly to the material.

4.4.5 During fabrication, processes which preclude the use of a tag and which may eradicate stamps or markings identifying the material, the personnel performing the process shall be responsible for maintaining traceability of the material. Quality Control will be notified prior to removal and prior to replacement of stamps or markings on safety-related material. At conclusion of the process, the tags, stamps or markings shall be reapplied to the material prior to leaving it unattended.

4.5 EQUIPMENT INTEGRITY

Work in-progress left unattended will be restored to a point where equipment integrity is maintained. Restoration of equipment includes, but is not limited to:

a. Reinstallation of exterior covers on equipment, where practical, if work is left unattended past one shift.

b. Where reinstallation of covers is not practical provision must be made to protect equipment.

4.6 LEAKAGE CONTROL

Collection buckets, catch basins, or other temporary leakage collection receptacles with hoses routed to drains do not require an In-Process Materials Control Tag.

5.0 REFERENCES

5.1 Regulatory Guides

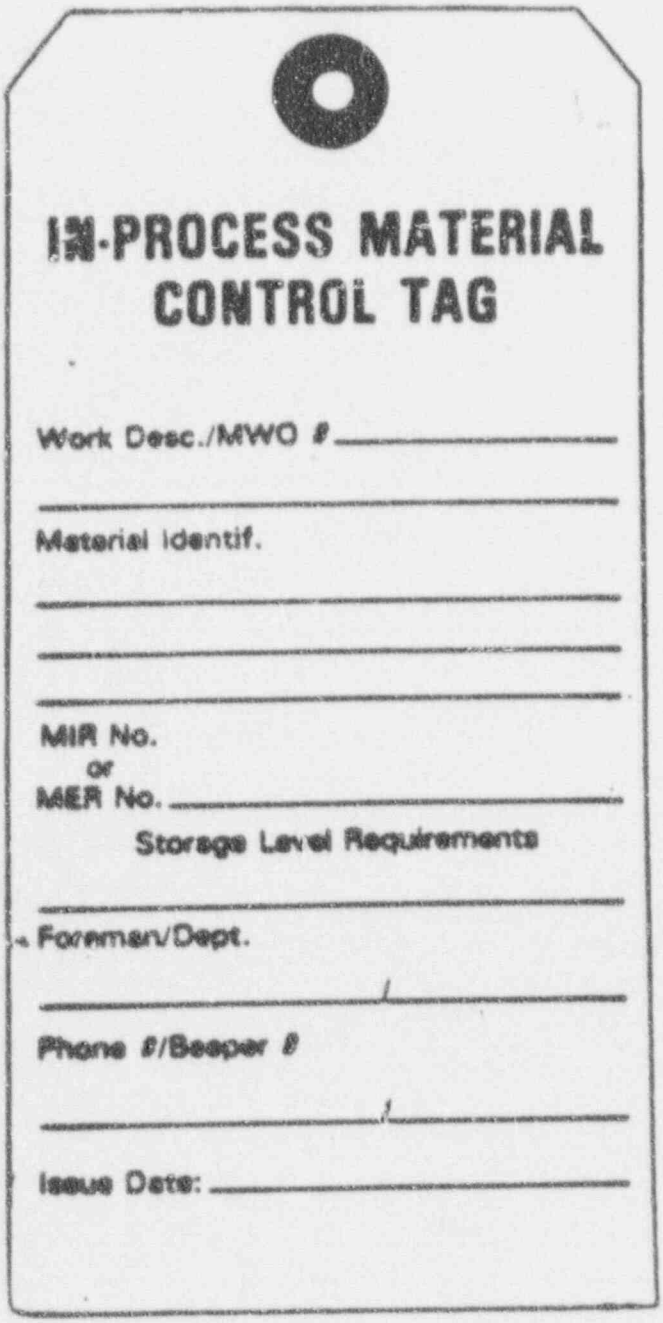
5.1.1	1.37, March 1973	"Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants"
5.1.2	1.38, Rev 2, May 1977	"Quality Assurance Requirements for Packaging, Shipping, Receiving and Handling of Items for Water-Cooled Nuclear Power Plants"
5.1.3	1.39, Rev 2, Sept 197/	"Housekeeping Requirements for Water-Cooled Nuclear Power Plants"

5.2 PROCEDURES

5.2.1 00262-C, "Control Of Chemicals/Fluids"

5.2.2	00853-C,	"Material Identification, Control And Issue"
5.2.3	20003-C,	"Scaffolding Construction And Control"
5.2.4	20023-C,	"I&C Equipment Rebuild Program"
5.2.5	20427-C,	"Maintenance Cleanliness And Housekeeping Control"

END OF PROCEDURE TEXT



IN-PROCESS MATERIAL CONTROL TAG

Work Desc./MWO # _____

_____

Material Identif.

_____

_____

_____

MIR No.
or
MER No. _____

Storage Level Requirements

_____

Foreman/Dept.

_____

Phone #/Beeper #

_____

Issue Date: _____

FIGURE 1
(EXAMPLE)

ONLY

BULK MATERIAL
IDENTIFICATION TAG

MWO No. _____

PART No. _____

MIR/MER No. _____

STORAGE LEVEL _____

DESCRIPTION
OF MATERIAL _____

FIGURE 2
(EXAMPLE)

** COPY ** COPY ** COPY ** COPY ** COPY ** COPY ** COPY ** COPY ** COPY ** COPY
NUCLEAR PLANT MAINTENANCE WORK ORDER NORMS (1 OF 2)

1.CONTROL NO. 19000439 00 2.DATE 01/25/90 3.UNIT 1 4.SYSTEM LIST
PL/TAG NO. LIST
PROB/ WORK REQ. REQUEST CALIBRATION ON ITEM IN BLOCK 5 TO SUPPORT PERFORMANCE OF MAINT PROCEDURE 28713-1 DURING 1R2.

CONT. N

ORIGINAL

INFO ONLY

7.INITIATOR FRANKLIN VETTER 615 8.SUPRV KEN STOKES LOC LIST
9.MWO CLASS N EQP CLASS LIST 10.UNIT STAT 1R2 11.FIRE PROTECT NO
12.DCR N 13.NCR/DR N 14.TYPE MAINT P 15.DURATION 33

16.CRAFT	MECH(EST/ACT)		ELEC(EST/ACT)		I&C(EST/ACT)		CONT(EST/ACT)		HP/OT(EST/ACT)	
CREW	0		0		2	MHG 1-29-90 2.0	0		0	
HRS.					66	40.0				
EXP.	0		0		0		0		0	
SCHED BEG	/ /		/ /		/ /		/ /		/ /	
SCHED END	/ /		/ /		/ /		/ /		/ /	
RESP FOREMAN										

17.CLR Y 18.WELD PERM N RWP PERM NA
19.QC HOLD PTS N 20.PROC 28820-C 22336-C, 22332-C, 22721-C, 20429-C
QC REVIEWED BY [signature] 1/29/90 21.PRI 44 22.LCO 1-26-1EC
23.WORK INST. Calibrate instruments listed in BLOCK 5. Rework or replace if necessary. MHG

CONT. N ref RER-88-0707, RER-88-0821 & ATTACHMENT 1
T.S. 3.8.1.1/3.8.2.2

------------ 24.INITIATE REVIEW ------------ 25.SPEC REV REQ N
OPS [initials] DATE 1/30/90 MNT MHG DATE 1/30/90 ---- 26.MWO RELEASE FOR WORK ------
HP [initials] DATE 1/29/90 ENG KSA DATE 1/29/90 SIG. [signature] DATE 3/1/90
27.ACT WORK PERFRMED obtained unit 1 s.s. permission to begin work. Calibrated 1TSH19110, 1TSH-19111, 1TSH19112 per proc. 22332C, attachment 1, and RER 88-707. Used VP 3082 due 4-22-90, 2079 due 4-22-90, and 2706 due 5-2-90. Reinstalled 1TSH 19110, 19111, 19112 in their wells. Current plant conditions are reflected [illegible] zone II cleanliness.

CONT. N

RECORD COPY

FOR INFO

[signature] 3/2/90

HIST SUM
28.MTRL REQD NA
29.PERSON PERFORMING WORK(NAME) DATE 30.MAINTENANCE FOREMAN DATE
[signature] G. Tochanter 3/10/90 Phillip [signature] 3/10/90
31.INSPECTION PERFORMED BY NA DATE NA
32.METHOD OF F.T. None required due to work performed. WJ 3/12/90
33.PROCEDURE # NA 34.PERFORMED BY See 29 35.DATE See 29
36.PROVES OPERABILITY NA 37.METHOD USED TO PROVE OPERABILITY NA
38.~~SATISFY.~~/UNSATISFY ✓ 39.IF UNSAT .CORR. ACTION NA
40.UNIT STATUS AT TIME OF FAILURE N 41.TYPE FAIL 42.MODE OF FAIL
43.CAUSE OF FAILURE N 44.DETECT BY N 45.EFFECT ON SYS N
46.EFF ON PLANT N 47.MWO STAT D 48.CAUSE 49.CORR ACT.
50.NEW MWO NA 51.OPER. ACCEPT BY Gary Moore DATE 3/13/90
52.OSOS APPROVAL NA DATE / /
53.SPEC REV COMP NA DATE / / 54.MEET.# NA DATE / /
55.CLOSE OUT APPROVAL BY QC [signature] 3-14-90

A TRAIN
[illegible]

NUCLEAR PLANT MAINTENANCE WORK ORDER (CONTINUED)

CONTROL NO. 19000439 00

MPL/TAG NO.	SYSTEM	EQP CLS	DESCRIPTION	LOCATION
1PSL19114	2403	61J	DSL GEN1 JACK WTR MAIN HD	1DB1
1TSH19111	2403	61J	DG1 JACK WTR MAIN HDR OUT	1DB1
1TSH19112	2403	61J	DSL GEN1 JACK WTR MAIN HD	1DB1
1TSH19110	2403	61J	DG1 JACK WTR HDR OUT	1DB1
1TSH19146	2403	61J	DSL GEN1 LUBE OIL ENGINE	X5DS5D01
1PDS19178	2403	61J	DIFF PRESS LUBE OIL FLTR	1DB1
1PDS19180	2403	61J	DIFF PRESS FUEL OIL FLTR	1DB1
1XS4745A	2403	61J	TRN A TURBO HI VIBRATION	1DB1-
1XS4745B	2403	61J	TRN A TURBO HI VIBRATION	1DB1-
1XS4746A	2403	61J	TRN A ENGINE HI VIBRATIO	1DB1-
1XS4746B	2403	61J	TRN A ENGINE HI VIBRATIO	1DB1-

TEST PROCEDURE FOR SETTING HIGH TEMPERATURE JACKET WATER TRIP SWITCHES (CALCON - P/N F-573-330)

1) Install temperature sensor in bath (See Temp. Bath requirements)

2) Hook-up Air Supply (60 PSI Thru .028 orifice and Test gauge) to Sensor "IN" Port.

3) Heat-up Temp. Bath to temperature at which sensors are to be Set and Stabilize.

4) Set temperature valves to trip by slowly turning split ring clockwise while watching pressure gauge. While adjusting or checking trip temperature setting, lightly tap continuously on the side of the sensor. This simulates engine vibration and will give a more accurate setting.
When valve begins to trip, the pressure gauge will drop. The temperature sensor is considered tripped when gauge drops to 20 psi.

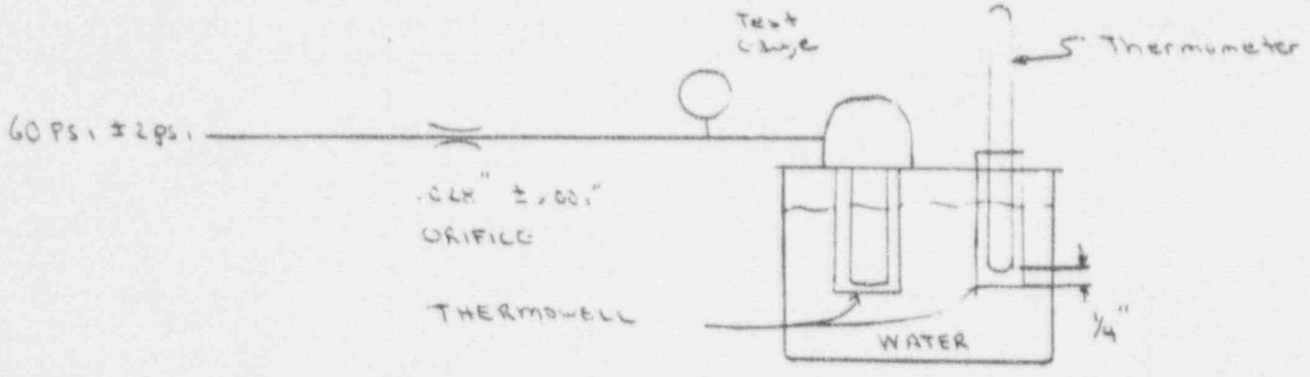
5) Cool temp. bath and note that temp. sensor Resets (40 psi on gauge) by 10°F below setpoint. Pressure gauge must Reset to within 1psi. of supply pressure by 20°F below setpoint.

6) Reheat bath (always starting 20°F below setpoint) and check trip setting.
Re-adjust as required to desired setting. A ± 2°F tolerance is acceptable.

7) Re-check settings until setting within tolerance is achieved two consecutive times.

ATTACHMENT 1 Pg 2

Temperature Bath Requirements



1) To test temperature valves accurately, a bath must have heating, cooling & circulating abilities.

2) Two Temp. Valve thermowells are required submerged 3" into the water.

3) Install Temp Sensor in one well and a Thermometer in the other. (Seal thermometer in well at the top to surpress heat loss. Thermometer should not touch sides or bottom of well.)

4) A 60 PSI Supply Pressure thru a 0.026" ± .001 Orifice thru a test gauge to the sensor is required.

FOR USE WITH CONTROL NO. 19000739

FOR INFO

Nuclear Plant Maintenance Work Order Continuation Sheet

MPL No. See pg. 2 list MWO No. 19000439

Work Description

Blk 26: SM [signature] 3/3/90

Block 27- Obtained unit 1 S.S. permission to begin work. calibrated 1TSH 19146 per proc. 22332-C, RER 88-707, and attachment #1. Used VP 2571 due 3-5-90 and VP 3092 due 4-22-90. Reinstalled 1TSH 19146.

Calibrated 1PDS 19180 and 1PDS 19178 per proc. 22336-C. Used VP 2556 due 5-13-90. Both switches satisfactorily returned to service.

Calibrated 1PSL 19114 per proc. 22721-C. Used VP 2552 due 5-16-90 and VP 2447 due 4-30-90. Returned switch to service. Maintained zone III cleanliness.

FOR INFO ONLY

[signature] 3/7/90

Block 2c) WC B3 - 3-[illegible]-90

Block 27- Obtained unit 1 S.S. permission to begin work. Functionally tested all SG 1A vibration valves per RER 88-821. The Right turbo was 14 turns to trip, left turbo was 13 turns to trip, the engine (rear) was 10 turns to trip, and the engine (front) was 7 turns to trip. All set point knobs returned to as-found condition and locked, all valves are reset and annunciator reflects current plant conditions.

Maintained zone III cleanliness. Did not use or need 23820-C

[signature] 3/10/90

SHEET 1 of ~~9~~ 10

REQUEST FOR ENGINEERING REVIEW

ORIGINAL

RER NO. 88-0707 UNIT 1

PART 1: Problem Identification

(1) System No. 2403 Component No. SEE ATTACHED

(2) Detailed Description of Problem: THERE IS NOT INSTRUMENT TOLERANCES AVAILABLE FOR CALCON SWITCHES USED ON DIESEL GENERATORS.

(3) Proposed Solution and Justification:

[ ] Personnel Safety [ ] Plant Safety [ ] Regulatory Requirement
[ ] ALARA* [X] Other

OBTAIN NECESSARY INFORMATION FROM VENDOR TO ALLOW CALIBRATION OF ASSOCIATED INSTRUMENTS.

(4) Requested Completion Date: ASAP Estimated Cost: ______

Point of Contact PHILLIP LINEBARGER Phone: 4075/BEEPER 260

Phillip Linebarger 10/10/88
Initiator / Date

M. [signature] 10/10/88
Department Superintendent / Date

Engr. Supv. Assigned Garrett Target Completion Date 12/3/88

* Copy to Manager Health Physics and Chemistry

FIGURE 1

SHEET 2 of 10

RER NO 88-0707

PART 2: Engineering Support Department Review

(5) Disposition: SHEETS 5, 6, & 7 OF THIS RER PROVIDE THE REQUIRED DATA FOR THE SPECIFIED INSTRUMENTS. TEST METHOD RECOMMENDATIONS ARE ALSO PROVIDED FOR SOME INSTRUMENTS AS NOTED. SHEETS 8, 9, & 10 ARE DUPLICATES OF INFORMATION CONTAINED IN SHEETS 5, 6, & 7 AND ARE FOR RECORD PURPOSES.

Safety Related No [ ] Yes [✓]

Document Generated No [✓] Yes [ ] No. N/A

Eng. Manhours Required for Review 20

Approvals:

Design Engr. N/A / (if applicable) Date

Responsible Engr. [signature] 10/15/88 Date

Engr. Supv. [signature] 10/15/88

Engr. Support Supt. [signature] 10/16/88 Date

ORIGINAL

FIGURE 1 (CONT'D.)

SHEET 3 of 10

RER CONTINUATION SHEET

RER NO. 88-0707

BLOCK NO.

MANUFACTURER: CALIFORNIA CONTROLS COMPANY (CALCON)

PUBLICATION(S)

A	DRAWING 1791	K	DRAWING B4417
B	DRAWING 3281	L	DRAWING B4446
C	DRAWING 3282	M	DRAWING B4449
D	DRAWING 3283	N	DRAWING J3406
E	DRAWING 3286	O	FORM 7173
F	DRAWING 3434	P	FORM 7673
G	DRAWING 3460	Q	FORM 100-2.5M-10/79
H	DRAWING 3461	R	FORM ENG-66
I	DRAWING A3500	S	FORM E4600
J	DRAWING B4400	T	FORM T3603
		U	DATA SHEET

ONLY

PART NUMBER	DESCRIPTION/REFERENCE
F-573-127	CHECK VALVE, MODEL 3460
F-573-133	MODEL J1791-.014, WITH 0.0145 INCH ORIFICE
F-573-141	ORIFICE/CHECK, PARALLEL, MODEL 3461, 0.028 INCH ORIFICE
F-573-144	ORIFICE/CHECK, PARALLEL, MODEL 3461, 0.006 INCH ORIFICE
(I) F-573-156	PRESSURE SENSOR, MODEL B4400, 2 WAY, NORMALLY OPEN, WITH MODEL 4499 BRACKET
(I) F-573-171	VIBRATION SENSOR, MODEL E4600, PNEUMATIC RESET TYPE
F-573-212	VALVE, 3-WAY, MODEL J1806 MK, DOUBLE PILOTED, MANUALLY OPERATED
F-573-217	CHECK VALVE PAC, MODEL 3283
F-573-222	ORIFICE PAC, MODEL 3281, WITH 0.028 INCH ORIFICE
F-573-228	ORIFICE/CHECK, PARALLEL, MODEL 3282, WITH 0.006 INCH ORIFICE
F-573-241	ORIFICE/CHECK, SERIES, MODEL 3286, WITH 0.020 INCH ORIFICE

[CONTINUED NEXT PAGE]

FIGURE 1 (CONT'D.)

ORIGINAL

SHEET 4 of 9/10

RER CONTINUATION SHEET

RER NO. 88-0707

BLOCK NO.		
	(I) F-573-271	TEMPERATURE DETECTOR, MODEL 3434,
	(I) F-573-330	TEMPERATURE SENSOR, MODEL A-3500-W3, NORMALLY CLOSED
	(I) F-573-359	PRESSURE SENSOR, MODEL B4417 WITH LATCH MECHANISM, WITH MODEL 4499 MOUNTING BRACKET
	(I) F-573-421	PRESSURE SENSOR, MODEL B4446, 50-200 PSI RANGE, NORMALLY OPEN
	KR-001-000	VALVE, BLOCKING, MODEL T3603, 3 INCH, 3000 FLANGED
	(I) F-594-043	SPEED INDICATOR # 6476K51065

ORIGINAL

FIGURE 1 (CONT'D.)

SHEET 5 of 10

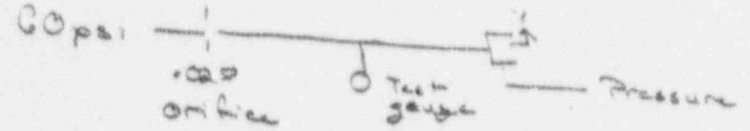
RER CONTINUATION SHEET

RER NO. 88-0707

BLOCK NO.

Imo Delaval F-573-421
Calcon model B444G Pressure Sensor

repeatable ± 5 psi of setpoint
reset up to 40psi above setpoint.

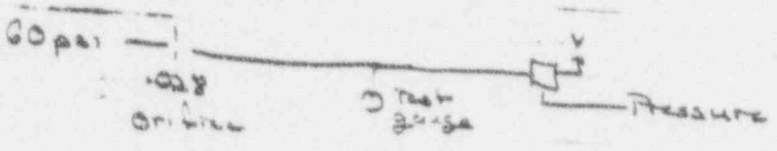


trip at 20psi or lower
reset at 40psi or higher

trip 3 times and average is setpoint

Imo Delaval F-573-156
Calcon model B4400 Pressure sensor

repeatable ± 2 psi
reset up to 8psi from setpoint



trip at 20psi or Lower
reset at 40psi or higher

Imo Delaval F-573-171
Calcon model E4600A

repeatable ± 0.2 G

FIGURE 1 (CONT'D.)

ORIGINAL

703446

SHEET 6 of 10

RER CONTINUATION SHEET

RER NO. 88-0707

BLOCK NO.

Imo Delaval part F-573-271
Calcon 3434

Temperature DETECTOR

repeatable ± 5% of setpoint

- Heat metal block until trips
- Hold manual reset and cool block
- trip 3 times and average vs setpoint

Imo Delaval part F-573-359
Calcon D4417

repeatable ± 3" H2O

Manual reset
(PNEUMATIC RESET SIGNAL REQ'D)

- SET using a water column.
- trips 3 times and average vs setpoint.

ORIGINAL

FIGURE 1 (CONT'D.)

SHEET 7 of 10

RER CONTINUATION SHEET

RER NO. 88-0707

BLOCK NO.

Delaval part F-573-330 temperature sensor
Calcon model T-3500-W2

repeatable ± .5% of setpoint temp.
requires • same heat-up rate
• same cool-down rate
• same starting temperature

reset ≥10% (MAX.) below setpoint

Test

60psi supply —— .028 orifice — test gauge — oil bath (agitating)

trip at 20psi or lower
reset at 40psi or higher

starting temperature ≥ 20° below

Operate switch 3 times and take average of the 3 for setpoint

DELAVAL PART F-594-043
GE D843

SPEED INDICATOR (TACHOMETER)

REPEATABLE ± 1%

ORIGINAL

FIGURE 1 (CONT'D.)

SHEET 8 of 10

RER CONTINUATION SHEET

RER NO. 88-0707

BLOCK NO.

OCT 13 '88 11:28 CALCON / UMI-SEAL 805 650-9318 P.1

California Controls Company

FAX NO. 805-650-9318

DATE: Oct 13, 1988

TO: VOGTLE ELECTRIC GENERATING PLANT

ATTN: PHILLIP ALEXANDER

FAX NO.: 404-554-7332

SUBJECT: CALCON PRODUCTS -

FROM: GARY HAZELWTT

COVER AND 1 PAGES

NOTES:

THIS FAX IS TO VERIFY INFORMATION GIVEN BY PHONE TO DAN HINES ON 10/12/88

Gary D. Hazlitt

ORIGINAL

FIGURE 1 (CONT'D.)

SHEET 9 of 10

RER CONTINUATION SHEET

RER NO. 88-0707

BLOCK NO.

OCT 13 '88 11:29 CALCON / UNI-SER 805 650-9318 P.2

California Controls Company

PAGE 1

1] CALCON B4446 PRESSURE SENSOR
(IMO #F-573-421)
REPEATABLE ± 5PSI OF SETPOINT
RESET UP TO 40 PSI ABOVE SET POINT

2] CALCON B4402 PRESSURE SENSOR
(IMO # F-573-156)
REPEATABLE ± 2 PSI
RESET 8 PSI MAX

3] CALCON E4600A VIBRATION SENSOR
(IMO F-573-171)
REPEATABLE ± 0.2 G

4] CALCON 3434 TEMP. DETECTOR (IMO F-573-271)
REPEATABLE ± 5% OF SETPOINT

5] CALCOD B4417 PRESSURE SENSOR
(IMO F-573-359)
REPEATABLE ± 3" H_2O
PNEUMATIC RESET SIGNAL REQ'D

6] CALCON A3500-W3 TEMP. SENSOR (IMO F-573-330)
REPEATABLE ± 2 % OF SETPOINT
RESET 10°F MAX. BELOW SETPOINT

1334 Callens Road, Ventura, California 93003 Telephone (805) 650-1597 A Tyton Company

ORIGINAL

FIGURE 1 (CONT'D.)

SHEET 10 of 10

RER CONTINUATION SHEET

RER NO. 88-0707

BLOCK NO.

Imo Delaval Inc
Enterprise Engine Division
Enterprise Way and 85th A
P. O. Box 2161
Oakland, CA 94621-0061
415-577-7400

IMO TELECOPY PHONE NUMBER: (415) 577-7524
TO VERIFY, CALL: (415) 577-7531

Date: OCTOBER 14, 1988

To: PHIL ALEXANDER, GEORGIA POWER S/N 76021

Fax No. (404) 554-7332

The published accuracy of the GE speed indicator, IMO P/N F-594-043, and of its current replacement, IMO P/N F-594-070, is ± 1% of full scale.

It should be noted that this is meter accuracy, in converting the 0-1 mA input signal to a meter needle position, and does not include the accuracy of the components providing the 0-1 mA input signal.

From: LANNY MCHUGH

Number Of Pages Attached To This Cover Sheet: ZERO

FIGURE 1 (CONT'D.)

ORIGINAL

NORMS

REQUEST FOR ENGINEERING REVIEW

SHEET 1 of

ORIGINAL

RER NO. 88-0831

UNIT 1

PART 1: Problem Identification

(1) System No. 2403 Component No. 1X5474S A+B, 4776 A+B 1X5485S A+B, 4856 A+B

(2) Detailed Description of Problem: Only PROCEDURE To CALIBRATE VIBRATION SENSORS REQUIRE STARTING AND TRIPPING Diesel FOR EACH SENSOR.

PM MWO 18806906

RECORD COPY

(3) Proposed Solution and Justification:

[ ] Personnel Safety [ ] Plant Safety [ ] Regulatory Requirement
[ ] ALARA* [X] Other

NEED ENGINEERING To PROVIDE ALTERNATE METHOD FOR CALIBRATING VIBRATION SENSORS.

FOR INFO

(4) Requested Completion Date: N/A Estimated Cost: N/A

Point of Contact Phil Linebarger Phone: 4075

Initiator / Date — Department Superintendent / Date

Engr. Supv. Assigned Garrett Target Completion Date 11/5/88

* Copy to Manager Health Physics and Chemistry

FIGURE 1

703445

SHEET 2 of 2

ORIGINAL

RER NO 88-0821

PART 2: Engineering Support Department Review

(5) Disposition:

The Calcon Vibration Trip Valves are set "slightly higher than highest Vibration level occurring in normal operation." This highest vibration level is at same power level, most likely 100 - 110 % of rated load. The engine SHOULD NOT be tripped at this load just for testing these valves. Engineering recommends a functional test of these vibration trip valves to be performed during the refueling outages. A procedure is attached on how to functional test the Calcon Vibration trip Valves model ~~E4500-B~~ E4500A.

Note: The Vibration trips are bypass during a SI.

FOR ONLY

Safety Related No [ ] Yes [X]

Document Generated No [X] Yes [ ] No. ____

Eng. Manhours Required for Review 10 hrs

Approvals:

Design Engr. NA / (if applicable) Date

Responsible Engr. Dan Hines 1/29-88 Date

Engr. Supv. 1/28/88 Date

Engr. Support Supt. 1/28/88 Date

FIGURE 1 (CONT'D.)

703645

Components for Pneumatic Control Systems

ORIGIN

Calcon

INSTALLATION AND ADJUSTMENT

E 4600
VIBRATION VALVE

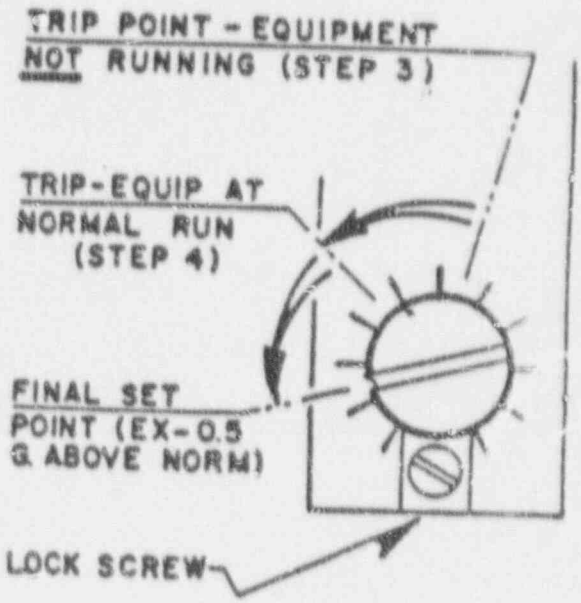
PART NUMBER(S)

LF-573-171

GENERAL INFORMATION: E4600 Vibration Valve should be installed rigidly to avoid any low frequency mounting resonance. Note direction of sensitivity to acceleration as marked on nameplate. Some experimentation may be necessary to secure proper placement on machinery so monitored vibration will be within the range (0-4g) of the unit. If normal equipment vibration is high mounting near equipment base could be proper location for the range of vibration and so on. See catalog data sheet for performance details. Port A, valve port, is vented to atmosphere when unit is tripped. Port B, reset port, requires a minimum of 25 psig to reset the unit.

ADJUSTMENT PROCEDURE: (Note: Manual reset button screwed into port B provides for ease of initial adjustment.)

1. Secure to machinery as indicated in General Information.
2. Set adjustment lock to point where the adjust knob turns with slight drag.
3. Back off adjust knob sufficiently to reset unit with manual reset button provided in port B. With equipment not running rotate adjust knob slowly clockwise (CW) until unit trips. Note this position on adjust scale.
4. Start equipment and rotate adjust knob counterclockwise (CCW) until unit resets. Rotate knob CW until unit trips and note this position on scale. This establishes normal running vibratory level.
5. Adjust knob is then rotated back CCW from the position in step 4 to required vibration trip level. Sensitivity adjustment per mark is stamped on name plate.
6. Final setting of adjust knob must not be more than 4g CCW of position established with equipment not running (as in step 3).
7. Tighten adjuster lock.
8. Consult CALCON with regard to pneumatic time delay circuit when fine adjustment desirable.



CALIFORNIA CONTROLS COMPANY, 2212 SIXTH ST., BERKELEY, CA 94710

FOR INFO

RER # 88-0821

PROCEDURE FOR TESTING CALCON E4500A VIBRATION VALVE AT EOC

PURPOSE

This procedure will functionally test the Calcon E4600A Vibration Trip Valves used on the Diesel Generators. There are four vibration trip valves per engine located at the front and back of the engine and one trip valve on each turbo-charger.These trip valves are all piped to a common alarm pressure switch (PS-26N) which will be monitored to verify the trip signal from the valve gets into the engine control panel.
The procedure's functional test method is to lower the set-point of the vibration trip valves,one at a time with the engine not running,until the common alarm pressure switch (PS-26N) operates.Then the vibration valve will be reset manually.
The engine will be out of service while performing this test.

PREFACE:

1) The engine air supply to the engine control panel is required to be in service.

2) The engine should be in "Maintenance Mode" which will take the engine out of service.

TEST : Functional Test Of All The Vibration Valves

1) Monitor with a VOM the contacts of PS-26N. PS-26N is the alarm pressure switch for all of the vibration trip valves that are being tested by this procedure.

2) Record "As-Found" setting of the vibration valves and mark on the valve the "As-Found" setting.

3) Loosen the lock screw for the vibration valve under test.

4) Turn set-point screw slowly clockwise until the vibration valve vents and PS-26N operate.

5) Turn set-point screw back to "As-Found" setting and tighten lock screw.

6) Press the manual reset push button on the vibration valve

7) Ensure PS-26N resets

8) Perform steps 2 through 7 for each Vibration valves on the engine.

9) After all vibration valves have been tested, remove VOM from PS-26N.

Trip Tag Numbers

DG1A	DG1B	DG2A	DG2B	LOCATION
1XS-4745A	1XS-4855A	2XS-4745A	2XS-4855A	TUBRO
1XS-4745B	1XS-4855B	2XS-4745B	2XS-4855B	TUBRO
1XS-4746A	1XS-4856A	2XS-4746A	2XS-4856A	ENGINE
1XS-4746B	1XS-4856B	2XS-4746B	2XS-4856B	ENGINE

References

Dwg CX5DT101-40H rev 1 set-point list
Letter from Dalaval dated 8-11-88, log VF-832
Dwg 1X4AK01-44-10 Control Drawing
Manual AX4AK01-563 Vender Manual