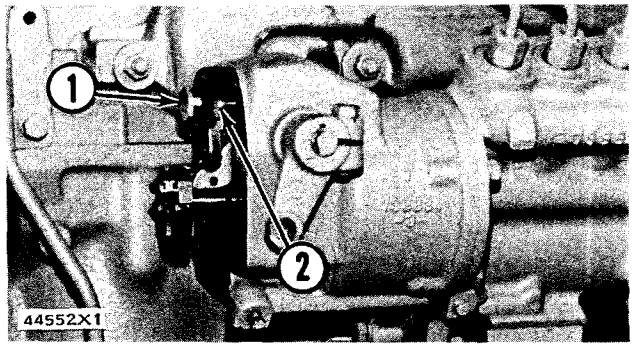
NOTE: If the fuel injection pump housing is removed from the engine the fuel rack setting can be checked with 7S7113 Rack Setting Gauge but, FT960 Adapter Assembly must also be used.

GOVERNOR ADJUSTMENTS

CAUTION: Only competent personnel should attempt to adjust the low and high idle rpm. The low and high idle rpm, and the rack setting dimensions for this engine, are listed in the RACK SETTING INFORMATION.

Engine rpm should be checked with an accurate tachometer.



GOVERNOR ADJUSTMENTS
(Typical Example)

1. Low idle adjusting screw. 2. High idle adjusting screw.

Low and high rpm can be adjusted by removing the cover at the rear of the governor, and turning the high idle and low idle adjusting screws. Turning either adjusting screw in a clockwise direction will decrease the respective high and low idle rpm. The retainer holes in the cover are shaped to prevent the screws from turning, after the adjustment has been made.

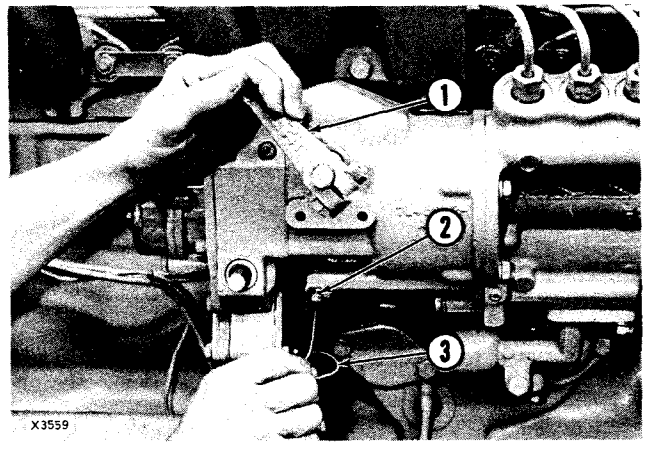
After setting the idle rpm, move the governor control lever to change the engine rpm. Return it to the idle position and recheck the idle rpm. Repeat the adjustment procedure until the specified idle rpm is obtained.

Fuel Ratio Control Setting (Six Cylinder Engines Only)

Tools Needed: 9S240 Rack Positioning Tool Group, 4B9820 Wrench.

The fuel rack must be set correctly before setting the fuel ratio control.

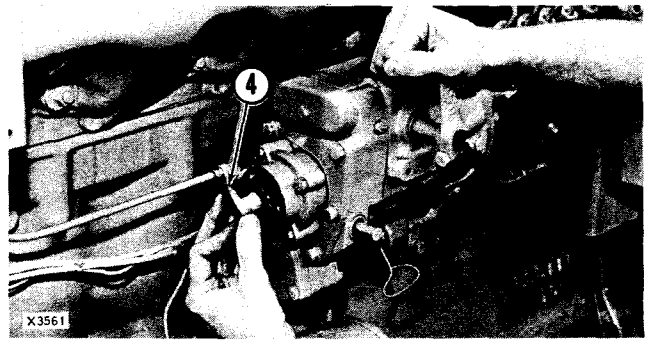
1. Remove the rack cover from the front of the fuel injection pump housing, and cover (4) from the rear of the fuel ratio control.
2. Engage slot in cover (4) with cross-dowel in adjusting bolt and turn the adjusting bolt in as far as possible. This prevents the head of the bolt from limiting the travel of the fuel rack.
3. Install 9S238 Rack Positioning Bracket Group over the front end of the fuel rack and 9S215 Dial Indicator in the bracket.
4. Remove the plug from the bottom of the governor and install plug (2). Through opening in plug (2) use rod (3) to push in (retract) the speed limiter plunger. Tighten plug (2) just enough to hold rod (3) in place (speed limiter depressed).



RETRACTING SPEED LIMITER PLUNGER

1. Governor control lever. 2. 9S8518 Plug. 3. 9S8521 Rod.

5. Center the rack and set the dial indicator on zero. Remove the spacer.
6. With the speed limiter plunger held in, move governor control lever (1) to FULL LOAD position. Hold the lever in the FULL LOAD position while making the adjustment.
7. Turn adjusting bolt out with cover (4) until the proper dial indicator reading is obtained. The proper reading is listed in the RACK SETTING INFORMATION.



SETTING FUEL RATIO CONTROL
(Typical Example)

4. Cover.

8. Turn cover (4) clockwise the amount necessary to align the bolt holes and install cover (4).
9. Remove the 9S238 Rack Positioning Bracket Group, 9S215 Dial Indicator and install the rack cover.

10. Install the standard plug in place of plug (2).

NOTE: Before starting the engine, make certain the governor control lever will move the governor to the SHUTOFF position and that all parts operate freely.

With the above initial adjustment made, a further adjustment while the engine is running can be made if necessary to improve engine performance. To reduce exhaust smoke during acceleration, turn cover (4) out (less fuel) ½ turn at a time until satisfactory. When exhaust smoke is acceptable but acceleration is sluggish, turn cover (4) in (more fuel) ½ turn at a time until satisfactory.

NOTE: Some exhaust smoke is likely to appear at maximum acceleration.

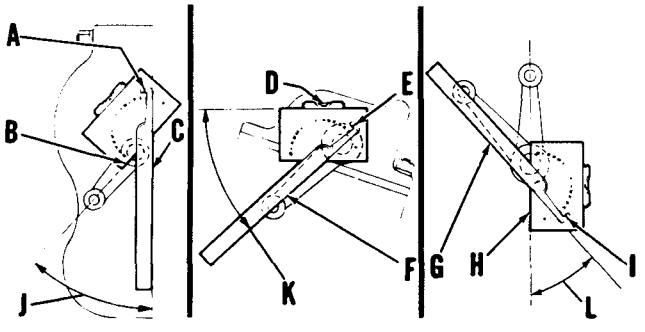
NOTE: If acceleration is sluggish and full engine power seems to be lost, inspect the air line to the cover and the cover gasket for air leaks. If no air leaks are apparent, inspect the diaphragm. A damaged diaphragm will not allow the fuel rack to open completely, acceleration will be sluggish and full engine power cannot be obtained.

GOVERNOR CONTROL AND DECELERATOR LINKAGE ADJUSTMENTS

(Six Cylinder Engines Only)

Tools Needed: 1P2385 Protractor Assembly

Three basic uses of the 1P2385 Protractor tools are shown here.



1P2385 PROTRACTOR TOOL USE

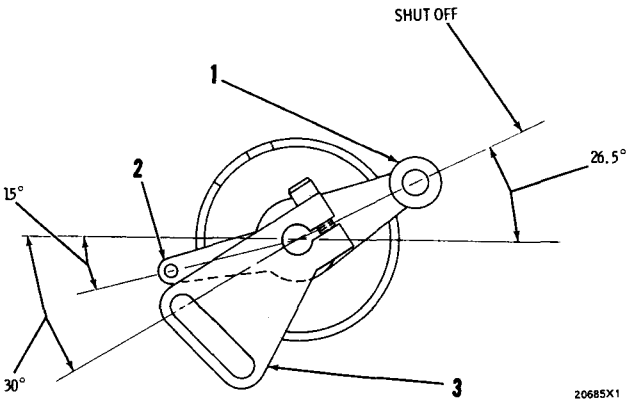
A. Inducator used for angle setting. B. Protractor plate edge in alignment with lever. C. Vertical housing face and extension arm are in alignment. D. Bubble in level. E. Indicator used for angle setting. F. Extension arm in alignment with lever. G. Extension arm in alignment with lever. H. Plate edge in alignment with second lever. I. Indicator used for angle setting. J. Angle between lever and vertical face of housing. K. Angle between level and lever. L. Angle between levers.

32231-1X1

All adjustments should be made when governor control shaft is in shutoff position. Disconnect all linkage and turn lever (1) clockwise to force governor control shaft to shutoff position.

Engage the nearest serration tooth to obtain lever positions closest to approximate angles indicated. 1P2385 Protractor Assembly should be used to establish these angles.

1. Install lever (1) at 26.5° from horizontal as shown.



GOVERNOR AND DECELERATOR LEVERS INSTALLATION

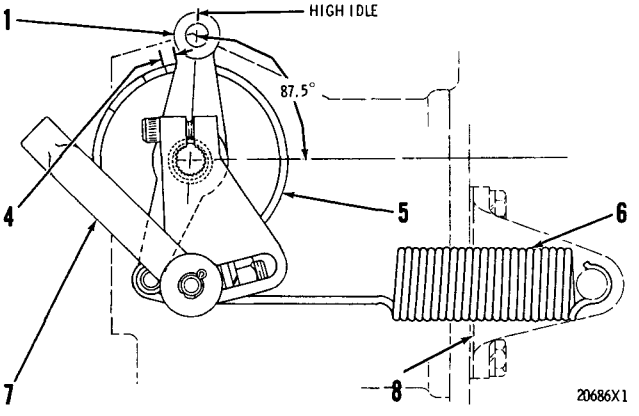
1. Governor control lever. 2. Decelerator control spring lever. 3. Decelerator cable control lever.

2. Install spring lever (2) at 15° angle from horizontal.

3. Install lever (3) with rear of its slot at 30° angle from horizontal as shown.

4. Force lever (3) on the shaft to remove clearance between the levers and tighten the clamp bolt.

5. Move the governor control shaft to high idle position. This will be when lever (1) makes angle of 87.5° from horizontal as shown.



DECELERATOR LINKAGE ADJUSTMENT

1. Governor control lever high idle position. 4. Stop clearance .12 in. (3.05 mm). 5. Clamp. 6. Decelerator control spring. 7. Decelerator cable yoke end. 8. Bracket.

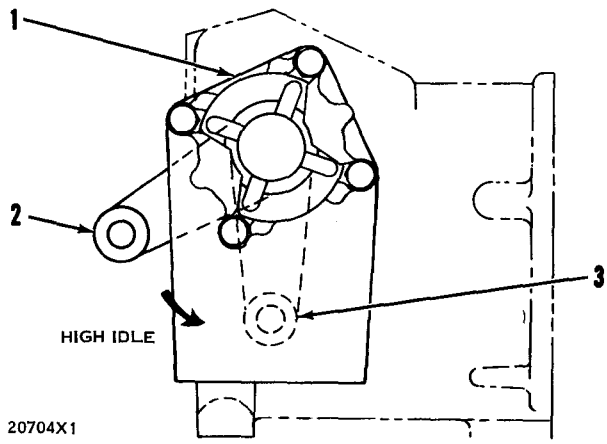
6. Move clamp (5) so there is .12 in. (3.0 mm) clearance at (4) between lever (1) and the stop on the clamp.

7. Adjust yoke end (7) so connecting pin will be at rear of slot in lever (3).
8. Attach decelerator control spring (6) to lever (2) and bracket (8).

DECELERATION CONTROL ADJUSTMENT (Six Cylinder Engines Only)

With proper adjustment the dashpot (1) retards the motion of the governor shaft and control lever which is used to reduce the possibility of engine stall upon rapid deceleration.

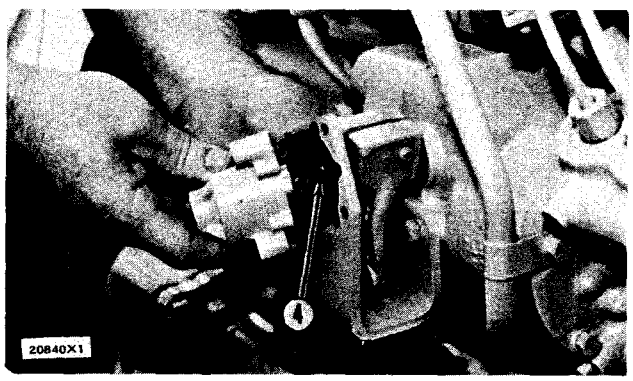
1. Position governor shaft and control lever (2) in high idle position as shown at (3). The lever is keyed to the shaft so lever to shaft relationship is non-adjustable.
2. Install coupling assembly (4) so pin engages slots in lever (2).
3. With the governor control lever held in high idle position, engage dashpot and coupling serrations.



DASHPOT INSTALLATION

1. Dashpot. 2. Governor control lever. 3. High idle speed position.

4. Rotate dashpot clockwise to limit of dashpot shaft travel.
5. Remove dashpot from coupling and align dashpot mounting holes.



DASHPOT ADJUSTMENT

4. Coupling assembly.

AIR INLET AND EXHAUST SYSTEM

RESTRICTION OF AIR INLET AND EXHAUST

There will be a reduction of horsepower and efficiency of the engine if there is a restriction in the air inlet or exhaust system.

Air flow through the air cleaner must not have a restriction of more than 30 in. (762 mm) of water difference in pressure.

Back pressure from the exhaust (pressure difference measurement between exhaust outlet elbow and atmosphere) must not be more than 20 in. (508 mm) of water.

ENGINES WITH TURBOCHARGERS	ENGINES WITHOUT TURBOCHARGERS
27" H_2O (686 mm)	34" H_2O (864 mm)

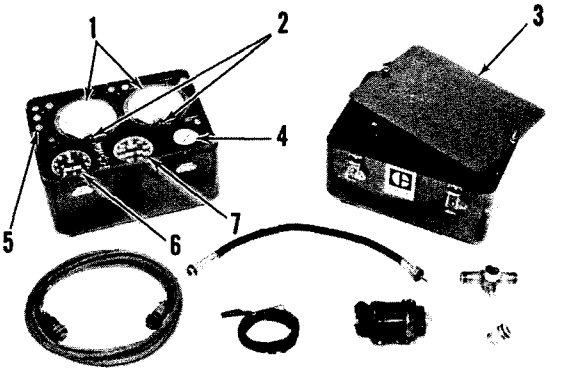
MEASUREMENT OF PRESSURE IN INLET MANIFOLD

By checking the pressure in the inlet manifold the efficiency of an engine can be checked by making a comparison with the information given in the book RACK SETTING INFORMATION. This test is used when there is a decrease of horsepower from the engine, yet there is no real sign of a problem with the engine.

The correct pressure for the inlet manifold is given in the book RACK SETTING INFORMATION. Development of this information is done with these conditions: 29.4 in. (746.76 mm) of mercury barometric pressure, 60°F (15.5°C) outside air temperature and 35 API rated fuel. Any change from these conditions can change the pressure in the inlet manifold. Outside air that has higher temperature and lower barometric pressure than given above will cause a lower horsepower and inlet manifold pressure measurement, than given in the book RACK SETTING INFORMATION. Outside air that has a lower temperature and higher barometric pressure will cause a higher horsepower and inlet manifold pressure measurement.

A difference in fuel rating will also change horsepower and the pressure in the inlet manifold. If the fuel is rated above 35 API, pressure in the inlet manifold can be less than given in the book RACK SETTING INFORMATION. If the fuel is rated below 35 API, the pressure in the inlet manifold can be more than given in the book RACK SETTING INFORMATION. BE SURE THAT THE AIR INLET AND EXHAUST DO NOT HAVE A RESTRICTION WHEN MAKING A CHECK OF PRESSURE IN THE INLET MANIFOLD.

Use the 4S6553 Instrument Group to check engine rpm, the pressure in the inlet manifold and pressure in the exhaust system. Special Instruction (FE036044) is with the tool group and gives instructions for the test procedure.



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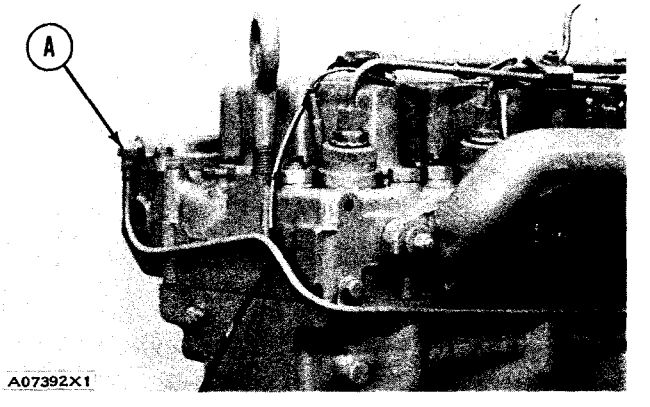
4S6553 INSTRUMENT GROUP

1. 4S6992 Differential Pressure gauges. 2. Zero adjustment screw. 3. Lid. 4. 8M2743 Gauge. 5. Pressure tap fitting. 6. 4S6991 Tachometer. 7. 4S6997 Manifold Pressure Gauge.



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POSITION FOR PRESSURE TEST

A. Remove elbow and install a tee for testing.

CHECKING INLET MANIFOLD PRESSURE AT TORQUE CONVERTER STALL SPEED

Inlet manifold pressure at torque converter stall speed provides a convenient engine performance test.

The torque converter stalling capacity, and the hydraulic system can be used to temporarily load the engine.

1. On engine equipped with air compressor, disconnect the air compressor air inlet line at the diesel engine cylinder head.

2. Connect the inlet manifold pressure gauge to the opening in the cylinder head and connect the rest of the 4S6553 Instrument Group components.

NOTE: The air compressor will be operative, but unfiltered air will be entering the air system. Avoid prolonged operation with unfiltered air.

3. With the torque converter at operating temperature, load the hydraulic system. This can be accomplished by driving the bucket into a dirt bank.

4. Shift to the highest forward gear and move the governor control to the HIGH IDLE position. Engine speed will increase until the hydraulic system and the torque converter stall. At this point, engine speed stabilizes.

NOTE: It may be necessary to reduce the load on the hydraulic system to maintain FULL LOAD SPEED.

CAUTION: Do not leave the converter in a stall condition for a prolonged period of time; only that necessary to record engine speed and boost pressure. Observe the temperatures of the torque converter oil and cooling system. Do not allow to overheat.

5. Record the engine speed and inlet manifold pressure.

6. Return the governor control to LOW IDLE position, move transmission control lever to NEUTRAL and lower the bucket.

7. Compare the recorded engine speed and inlet manifold pressure with the values in the RACK SETTING INFORMATION book. If both values are within their specified limits engine output is within expected limits.

8. If stall speed is within limits, but boost is not, determine why and correct.

9. If boost and/or stall speed are outside their limits, determine cause as either a converter or engine malfunction and correct.

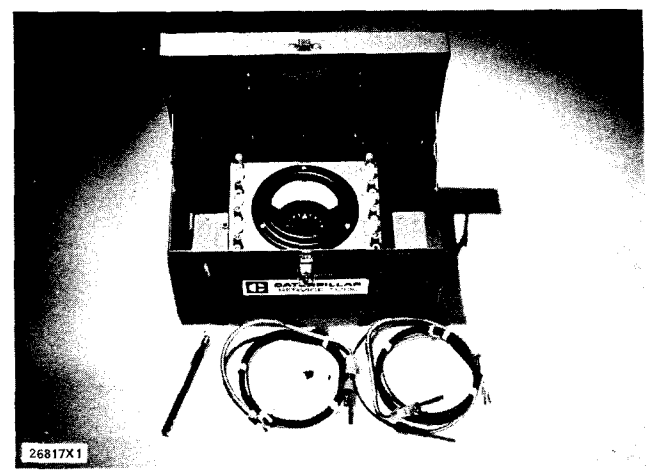
CRANKCASE (CRANKSHAFT COMPARTMENT) PRESSURE

Pistons or piston rings that have damage can be the cause of too much pressure in the crankcase. This condition will cause the engine to run rough. There will also be more than the normal amount of fumes coming from the crankcase breather. This crankcase pressure can also cause the element for the crankcase breather to have a restriction in a very short time. It can also be the cause of oil leakage at gaskets and seals that would not normally have leakage.

Normal crankcase pressure with a clean crankcase breather is 2 in. (50.8 mm) of H_2O or less.

MEASUREMENT OF EXHAUST TEMPERATURES

Use the 1P3060 Pyrometer Group to check exhaust temperature. Special Instruction (GMG00697) is with the tool group and gives instructions for the test procedure.



1P3060 PYROMETER GROUP

CYLINDER CONDITION

Tools Needed:

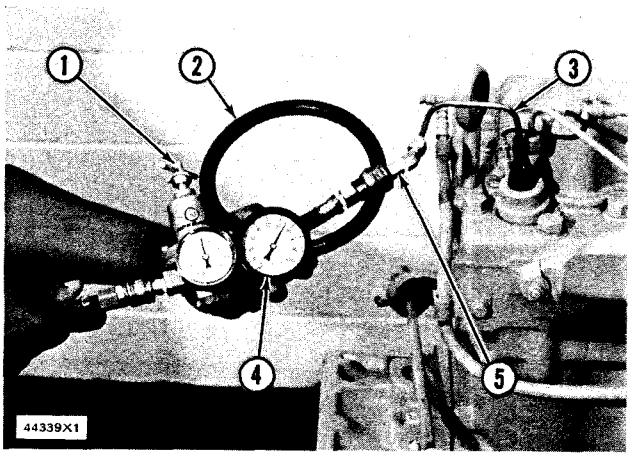
3B7762 Tee.	**7S8890 Adapter.**
3B7767 Nipple.	**7S8895 Adapter.**
6K5875 Hose Assembly.	**8S2268 Tube Assembly.**
8M2744 Gauge.	**9S7341 Adapter.**
1P5569 Tip.	**Air pressure regulator.**

An engine that runs rough can have a leak at the valves, or valves that need adjustment. Run the engine at the speed that gives rough running. To find a cylinder that has low compression or does not have good fuel ignition, loosen a fuel line nut at a fuel injection pump. This will stop the flow of fuel to that cylinder. Do this for each cylinder until a loosened fuel line is found that makes no difference in engine rough running. Be sure to tighten each fuel line nut after the test before the next fuel line nut is loosened. This test can also be an indication that the fuel injection is wrong, so more checking of the cylinder will be needed. This test is just a fast method of finding the cause of compression loss in a cylinder. Removal of the head

and inspection of the valves and valve seats is necessary to find those small defects that do not normally cause a problem. Repair of these problems is normally done when reconditioning (overhaul) the engine.

The procedure that follows will give a better indication of the condition of the valves and valve seats.

1. Remove the fuel injection valve from the precombustion chamber or adapter.
2. Using a threaded fitting or rubber adapter, connect an air hose to the precombustion chamber or adapter.
3. Turn the crankshaft until the piston for the cylinder to be tested is at top center (TC) compression position. The valves for the cylinder will be closed.
4. Put air in the cylinder with force and check for air leakage. An air leak at the exhaust outlet is an indication of exhaust valve leakage. An air leak at the inlet of the air cleaner is an indication of intake valve leakage. An air leak at the crankcase breather is an indication that there can be a problem with the piston, piston rings or the cylinder liner. It may be necessary to remove inlet and outlet connections on both sides of turbocharger to find leakage.

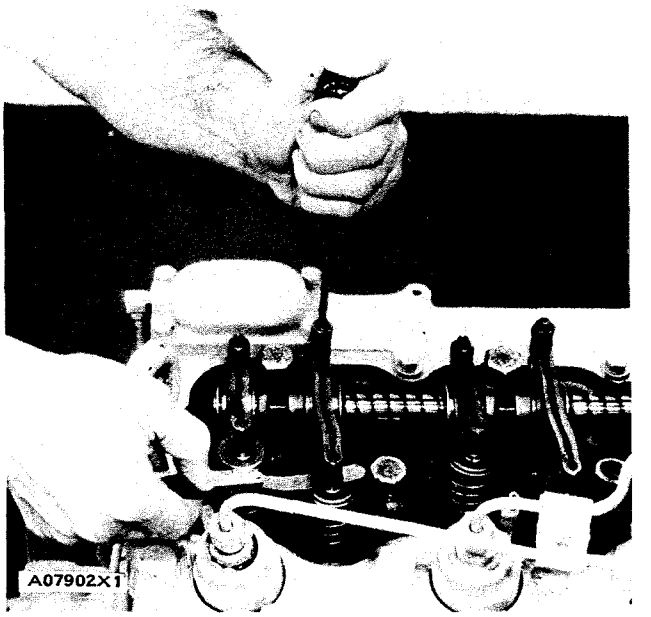


MEASURING AIR FLOW

1. Air regulator. 2. 6K6875 Hose Assembly and 7S8895 Adapter. 3. 8S2268 Tube Assembly and 9S7341 Adapter. 4. 8M2744 Gauge (0 to 100 psi). 5. 7S8890 Adapter. Parts not shown: 3B7762 Tee, 3B7767 Nipple, 1P5569 Tip.

Engine cylinder condition can be analyzed with controlled pressure air through the engine cylinder precombustion chamber. Special Instruction (GMG00694) explains the procedure.

VALVE CLEARANCE SETTING

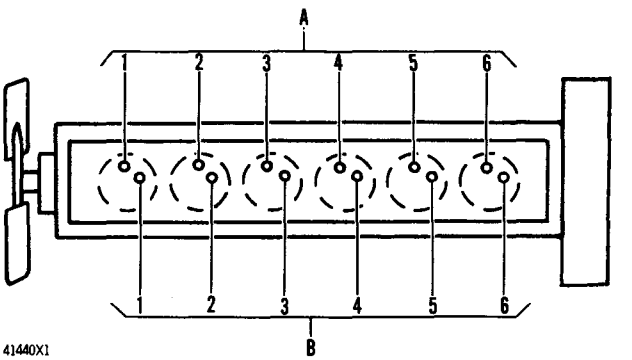


VALVE ADJUSTMENT

NOTE: Valve clearance is measured between the rocker arm and the valves.

VALVE CLEARANCE SETTING WITH ENGINE STOPPED	
Exhaust	.025" (0.64 mm)
Intake	.015" (0.38 mm)

3306 Engine



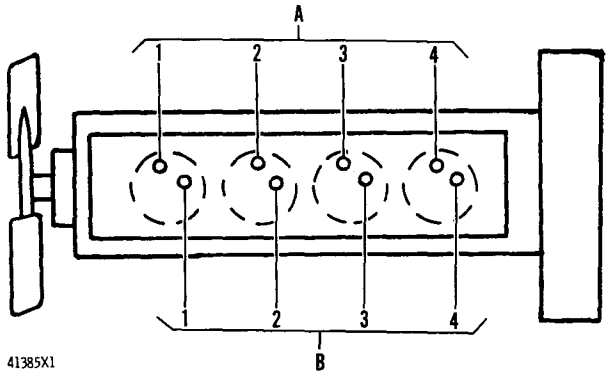
CYLINDER AND VALVE IDENTIFICATION

A. Exhaust valves. B. Intake valves.

1. Put No. 1 piston at top center (TC) on the compression stroke. Make reference to FINDING TOP CENTER COMPRESSION POSITION FOR NO. 1 PISTON.

2. Make an adjustment to the valve clearance on the intake valves for cylinders 1, 2, and 4. Make an adjustment to the valve clearance on the exhaust valves for cylinders 1, 3, and 5.
3. Turn the flywheel 360° in the direction of engine rotation. This will put No. 1 piston at top center (TC) on the exhaust stroke.
4. Make an adjustment to the valve clearance on the intake valve for cylinder 3, 5, and 6. Make an adjustment to the valve clearance on the exhaust valves for cylinders 2, 4, and 6.
5. After valve adjustment is correct, tighten the nuts for the valve adjustment screws to 22 ± 3 lb.ft. (3.0 ± 0.4 mkg).

3304 Engines



CYLINDER AND VALVE IDENTIFICATION

A. Exhaust valves. B. Intake valves.

1. Put No. 1 piston at top center (TC) on the compression stroke. Make reference to FINDING TOP CENTER COMPRESSION POSITION FOR NO. 1 PISTON.
2. Make an adjustment to the valve clearance on the intake valves for cylinders 1 and 2. Make an adjustment to the valve clearance on the exhaust valves for cylinders 1 and 3.
3. Turn the flywheel 360° in the direction of engine rotation. This will put No. 1 piston at top center (TC) on the exhaust stroke.
4. Make an adjustment to the valve clearance on the intake valves for cylinders 3 and 4. Make an adjustment to the valve clearance on the exhaust valves for cylinders 2 and 4.
5. After valve adjustment is correct, tighten the nuts for the valve adjustment screws to 22 ± 3 lb.ft. (3.0 ± 0.4 mkg).

CYLINDER HEAD

The cylinder head has valve seat inserts and valve guides that can be removed when they are worn or have damage. Replacement of these components can be made with the following tools.

Valves

Valve removal and installation is easier with use of 5S1330 Valve Spring Compressor Assembly and 5S1322 Valve Keeper Inserter.

Valve Seat Inserts

Tools needed to remove and install valve seat inserts are in the 9S3080 Valve Insert Puller Group. Special Instruction GMG02114 gives an explanation to this procedure. The insert can be more easily installed by lowering the temperature of the insert before installing it in the head.

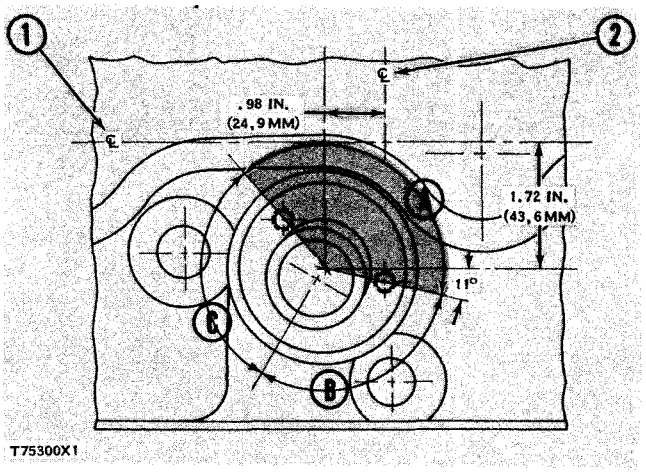
Valve Guides

Tools needed to install valve guides are: 7S8858 Driver Bushing and 7S8859 Driver. The counterbore in the driver bushing installs the guide to the correct height. Use a 1P7450 Honing Arrangement to make a finished bore in the valve guide after installing the guide in the head. Special Instruction GMG00966 gives an explanation of this procedure. Grind the valves after installing new valve guides.

PRECOMBUSTION CHAMBER POSITION

Use 5F8353 Wrench to remove and install chamber.

Put 5M2667 Gasket, with "2C" on it, on the precombustion chamber. Put 9M3710 or 4S9416 Anti-Seize Compound on the threads of the precombustion chamber. Install the precombustion chamber. Install the precombustion chamber in the cylinder head and tighten to 150 ± 10 lb.ft. (20.7 ± 1.4 mkg). If the opening for the glow plug is not in the "A range", remove the precombustion chamber and 5M2667 Gasket. If the opening for the glow plug was in the "B range" use 2S8959 Gasket with "2S" on it. If the opening for the glow plug was in the "C range" use 2S8960 Gasket with "2X" on it. Put 9M3710 or 4S9416 Anti-Seize Compound on the threads of the precombustion chamber. Install the precombustion chamber with the correct gasket and tighten the precombustion chamber to 150 ± 10 lb.ft. (20.7 ± 1.4 mkg).



PRECOMBUSTION CHAMBER POSITIONING DIAGRAM

1. Center line of engine. 2. Center line of cylinder. A. Correct range for glow plug opening. B. Use "2S" gasket. C. Use "2X" gasket.

LUBRICATION SYSTEM

One of the problems in the following list will generally be an indication of a problem in the lubrication system for the engine.

TOO MUCH OIL CONSUMPTION
OIL PRESSURE IS LOW
OIL PRESSURE IS HIGH
TOO MUCH BEARING WEAR

TOO MUCH OIL CONSUMPTION

Oil Leakage on Outside of Engine

Check for leakage at the seals at each end of the crankshaft. Look for leakage at the oil pan gasket and all lubrication system connections. Check to see if oil is coming out of the crankcase breather. This can be caused by combustion gas leakage around the pistons. A dirty crankcase breather will cause high pressure in the crankcase, and this will cause gasket and seal leakage.

Oil Leakage Into Combustion Area of Cylinders

Oil leakage into the combustion area of the cylinders can be the cause of blue smoke. There are four possible ways for oil leakage into the combustion area of the cylinders:

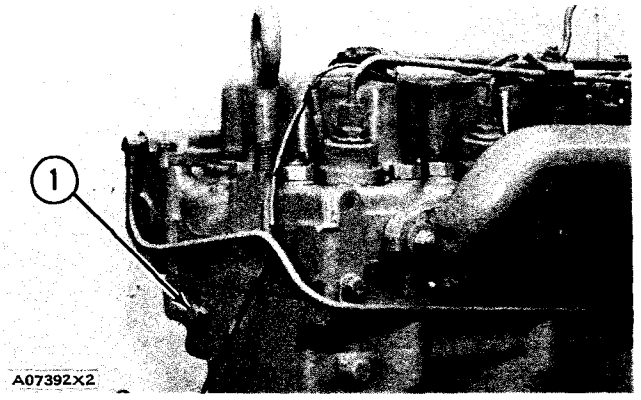
1. Oil leakage between worn valve guides and valve stems.
2. Worn or damaged piston rings or dirty oil return holes.
3. Compression ring not installed correctly.
4. Oil leakage past the seal rings in the impeller end of the turbocharger shaft.

Too much oil consumption can also be the result of using oil with the wrong viscosity. Oil with a thin viscosity can be caused by fuel getting in the crankcase, or by the engine getting too hot.

OIL PRESSURE IS LOW

An oil pressure gauge that has a defect may give an indication of low oil pressure.

Connect an 8M2744 Gauge to the engine oil manifold at pressure test location (1). Install a test thermometer or thermocouple in the crankcase. Run the engine until the oil temperature is 210 ± 10° F (99 ± 6° C).



OIL MANIFOLD

1. Pressure Test Location.

If the engine has SAE 10 oil, the correct engine oil pressure at full load speed is 48 ± 12 psi (3.37 ± 0.84 kg/cm^2).

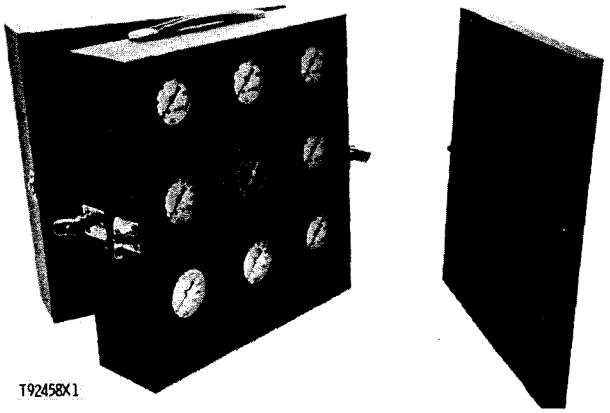
If the engine has SAE 30 oil, the correct engine oil pressure at full load speed is 58 ± 12 psi (4.08 ± 0.84 kg/cm^2).

At lower speeds, lower engine oil pressure is normal. The minimum engine oil pressure is 12 psi (0.84 kg/cm^2).

The 8M2744 Gauge, in the 7S8875 Hydraulic Test Box, can be used for checking pressure in the system.

NOTE: If the clearance between the oil pan and the suction bell is too small, there will be a decrease in oil pressure. This can be because of a dent in the oil pan.

CAUTION: There are holes in the bores for the main bearings, between cylinders land 2, 3 and 4, and 5 and 6 (six cylinder engines), for piston cooling orifices. These holes must have either orifices or plugs installed. Find this information in OIL LINES in the parts book for your engine arrangement.



7S8875 HYDRAULIC TEST BOX

Crankcase Oil Level

Check the level of the oil in the crankcase. Add oil if needed. It is possible for the oil level to be too far below the oil pump supply tube. This will cause the oil pump to not have the ability to supply enough lubrication to the engine components.

Oil Pump Does Not Work Correctly

The inlet screen of the supply tube for the oil pump can have a restriction. This will cause cavitation (the sudden making of low pressure bubbles in liquids by mechanical forces) and a loss of oil pressure. Air leakage in the supply side of the oil pump will also cause cavitation and loss of oil pressure. If the bypass valve for the oil pump is held in the open (unseated) position, the lubrication system can not get to maximum pressure. Oil pump gears that have too much wear will cause a reduction in oil pressure.

Oil Filter and Oil Cooler Bypass Valves

If the bypass valve for the oil filter or oil cooler is held in the open position (unseated) and the oil filter or oil cooler has a restriction, a reduction in oil pressure can be result. To correct this problem, install a new Caterpillar oil filter.

Too Much Clearance at Engine Bearings Or Open (Broken or Disconnected Oil Line or Passage) Lubrication System

Components that are worn and have too much bearing clearance can cause oil pressure to be low. Low oil pressure can also be caused by an oil line or oil passage that is open, broken or disconnected.

Oil Cooler

Look for a restriction in the oil passages of the oil cooler. If the oil cooler has a restriction, the oil temperature will be higher than normal when the engine is running. The oil pressure of the engine will not get low just because the oil cooler has a restriction.

OIL PRESSURE IS HIGH

Oil pressure will be high if the bypass valve for the oil pump can not move from the closed position.

TOO MUCH BEARING WEAR

When some components of the engine show bearing wear in a short time, the cause can be a restriction in an oil passage. A broken oil passage can also be the cause.

If the gauge for oil pressure shows enough good oil pressure, but a component is worn because it is not getting enough lubrication, look at the passage for oil supply to that component. A restriction in a supply passage will not let enough lubrication get to a component and this will cause early wear.

COOLING SYSTEM

The engine has a pressure type cooling system. A pressure type cooling system gives two advantages. The first advantage is that the cooling system can operate safely at a temperature that is higher than the normal point where water changes to steam. The second advantage is that this type system prevents cavitation (air in inlet of pump) in the water pump. With this type system it is more difficult for an air or steam pocket to form in the cooling system.

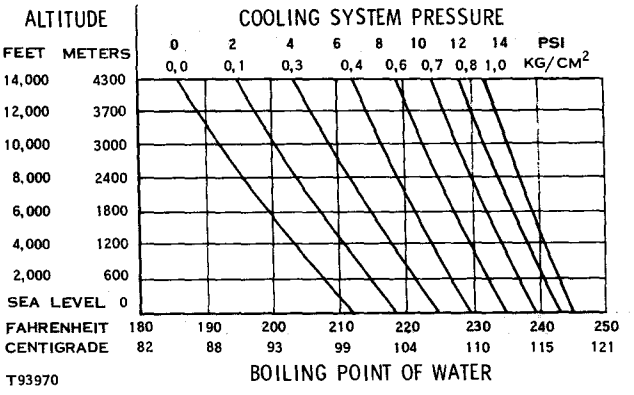
The cause for an engine getting too hot is generally because regular inspections of the cooling system were not done. Make a visual inspection of the cooling system before testing with testing equipment.

VISUAL INSPECTION OF THE COOLING SYSTEM

1. Check coolant level in the cooling system.
2. Look for leaks in the system.
3. Look for bent radiator fins. Be sure that air flow through the radiator does not have a restriction.
4. Inspect the drive for the fan.
5. Check for damage to the fan blades.
6. Look for air or combustion gas in the cooling system.
7. Inspect the pressure cap and the sealing surface for the cap. The sealing surface must be clean.
8. Look for large amounts of dirt in the radiator core and on the engine.

TESTING THE COOLING SYSTEM

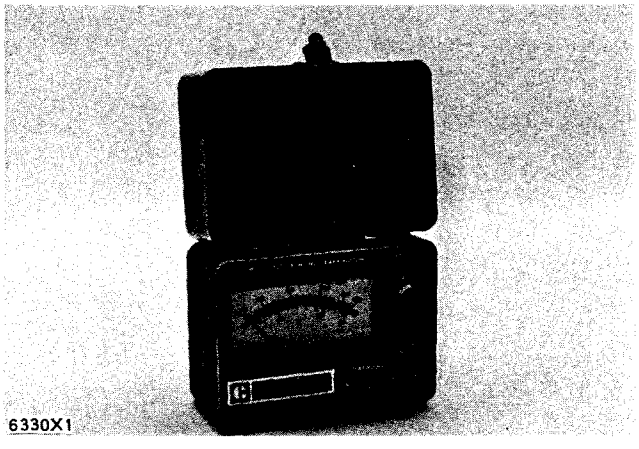
Remember that temperature and pressure work together. When making a diagnosis of a cooling system problem, temperature and pressure must both be checked. Cooling system pressure will have an effect on cooling system temperatures. For an example, look at the chart to see the effect of pressure and the height above sea level on the boiling point (steam) of water.



Checking Coolant Temperatures

Tools Needed: 9S9102 Thermistor Thermometer Group.

The 9S9102 Thermistor Thermometer Group is used in the diagnosis of overheating (engine running too hot) or overcooling (engine running too cool) problems. This group can be used to check the different parts of the cooling system. The complete testing procedure is in Special Instruction GMG00450.



9S9102 THERMISTOR THERMOMETER GROUP

The locations for making the temperature checks with probe are listed below:

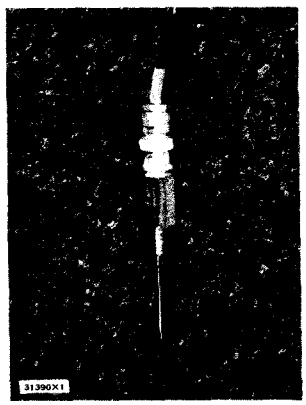


Fig. 1

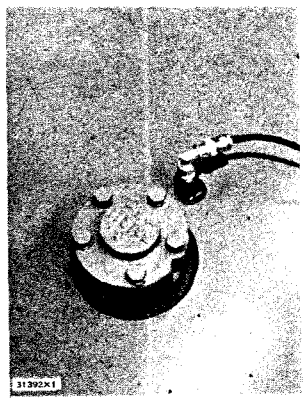


Fig. 2

(Typical Illustration)

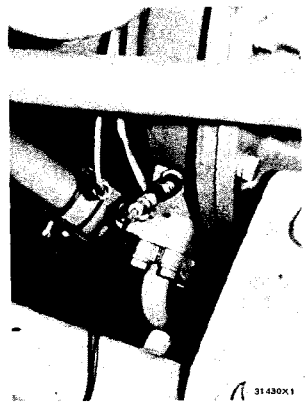


Fig. 3

(Typical Illustration)

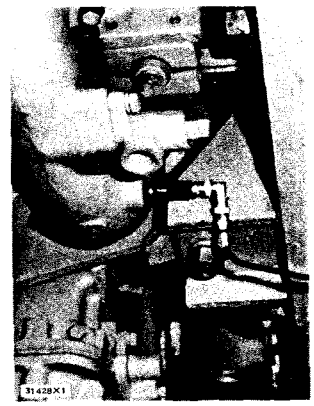


Fig. 4

(Typical Illustration)

Fig. 1. Ambient (air temperature away from the machine and not in direct sunlight).
Fig. 2. Top tank (in a pipe plug location in the top tank of the radiator and in the housing for the regulators or in the water manifold).

Fig. 3. Bottom tank (in the drain outlet for the radiator or the pipe plug location in the lower elbow of the radiator).
Fig. 4. Torque converter (in a pipe plug location of the oil outlet for the torque converter).

PROBE LOCATIONS	TEMPERATURES	PROBLEM	CHECK FOR
Top Tank (Fig. 2) and Ambient (Fig. 1)	Maximum 110° F (43° C) difference.	Overheating	Wrong Gear Selection. Radiator Core with Restriction to Air Flow. Bent Radiator Fins. Low Fan Speed. Damaged Fan Guard. Wrong Blade Position.
Top Tank (Fig. 2) and Bottom Tank (Fig. 3)	Maximum 15° F (9° C) difference.	Not enough Water Flow	Defect in Water Pump. Collapsed Hoses. Restriction in Radiator Core Tubes. Low Coolant Level.
Top Tank (Fig. 2) and Torque Converter Oil Outlet (Fig. 4)	Under normal conditions, temperature difference maximum 40° F (4° C). At stall conditions, normal temperature of torque converter oil 270°F (132°C) for any extended period of time.	Overheating	Wrong Gear Selection. Engine Operated with too Great a Load. Leakage Inside Torque Converter. Low Oil Flow From Torque Converter to Cooler.
Top Tank (Fig. 2) and Regulator Housing (Fig. 2)	Maximum 2°F (1°C) difference with regulators open.	Overcooling Overheating	Temperature Regulator will not Close. Regulator Seals Leaking. Coolant Flow Past the Regulator Flange. Low Ambient Temperature with Light Loads. Temperature Regulators will not Open.

Be sure the probe is installed in the liquid of the system being tested.

CAUTION: Do not tighten the probe more than 30 lb.ft. (4.1 mkg) torque.

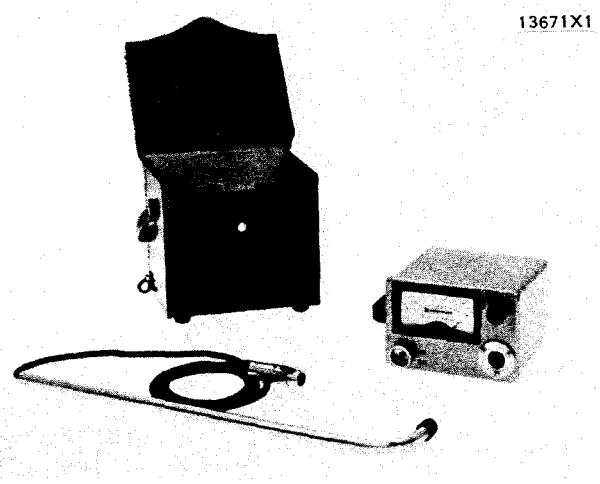
Check temperatures in the locations listed in the chart and make a comparison of these temperatures. Look at the chart to see if these comparisons are within the range in the chart. Make the needed checks if the temperatures are not within the ranges.

NOTE: To get the correct reading make a measurement of the temperatures during working conditions.

Checking Radiator Air Flow

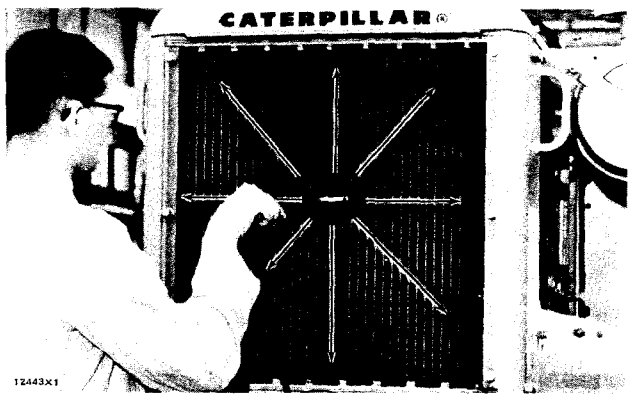
Tools Needed: 9S7373 Air Meter Group.

The 9S7373 Air Meter Group is used to check the air flow through the radiator core. Overheating can be caused by installing the wrong fan guard, low fan speed, or a restriction in the radiator core (clogging). The meter will give aid in finding a restriction in the core. The testing procedure and the correct readings are in Special Instruction GMG00203.



9S7373 AIR METER GROUP

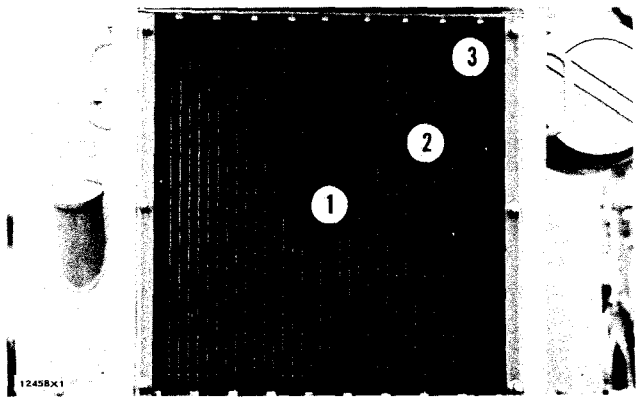
⚠ WARNING: When making the checks fasten the transmission in neutral, put the parking brakes on and lower all equipment. Make all checks at engine LOW IDLE and on the side of the radiator opposite the fan. Wear eye protection.



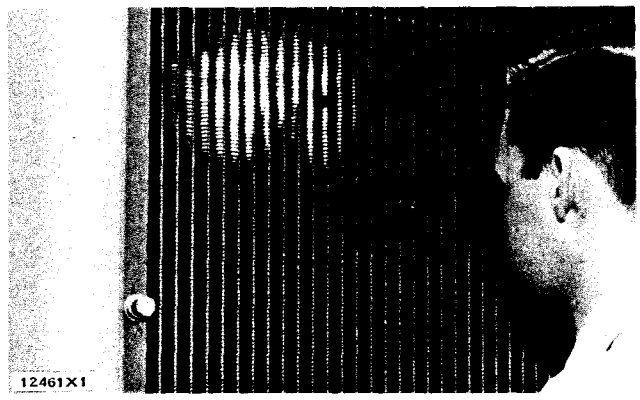
CHECKING AIR FLOW IN CROSS AND DIAGONAL LINES
(Typical Illustration)

Take readings in a cross and diagonal pattern. Make a comparison of the readings in each line the same distance from the center of the fan. Permit differences for restrictions such as guards, braces and engine components which will cause a change in the rate of air flow.

NOTE: All readings are taken at engine LOW IDLE.



AIR FLOW
(Typical Illustration)
1. Fan hub area. 2. Fan blade area. 3. Area outside fan blade.



INSPECTING RADIATOR CORE FOR RESTRICTION
(Typical Illustration)

If the readings are not within the ranges, stop the engine, put a strong light behind the core and inspect for a restriction. If the restriction is from dirt remove by steam cleaning. If the restriction is from bent fins use 2H1822 Radiator Fin Comb to make the fins straight.

Checking Fan Speed

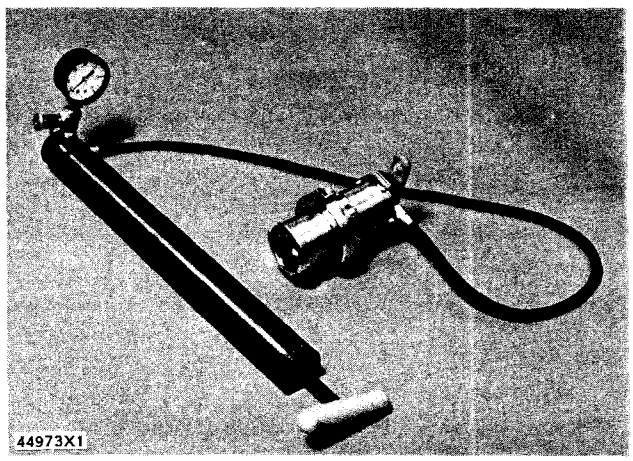
Tools Needed: 1P5500 Portable Phototach Group.

If the radiator core does not have a restriction, check the fan speed with the 1P5500 Portable Phototach Group. The complete testing procedure is in Special Instruction GMG00819.

1P5500 PORTABLE PHOTOTACH GROUP

Checking Pressure Cap or Relief Valve

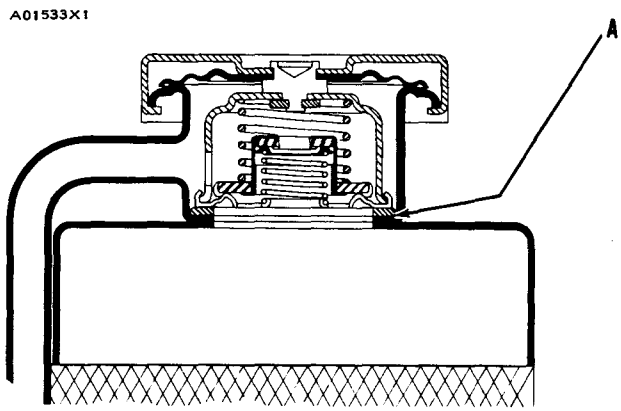
The 9S8140 Cooling System Pressurizing Pump Group is used to test pressure caps and pressure relief valves, and to pressure check the cooling system for leaks.



9S8140 COOLING SYSTEM PRESSURIZING PUMP GROUP

Pressure Cap

One cause for a pressure loss in the cooling system can be a bad seal on the pressure cap of the system. Inspect the pressure cap carefully. Look for damage to the seal or the sealing surface. Any foreign material or deposits on the cap, seal or sealing surface must be removed.

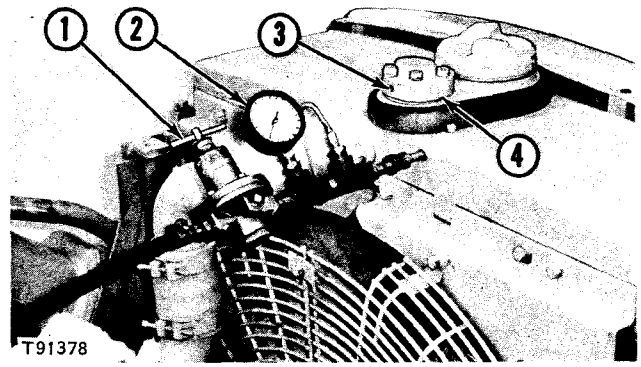


SCHEMATIC OF PRESSURE CAP

A. Sealing surface of cap and radiator.

Pressure Relief Valve

Stop the engine. Tighten the radiator cap to seal the cooling system. Install suitable fittings and a pressure test gauge into the radiator top tank. Install a suitable air pressure regulating valve as illustrated.



TESTING PRESSURE RELIEF VALVE

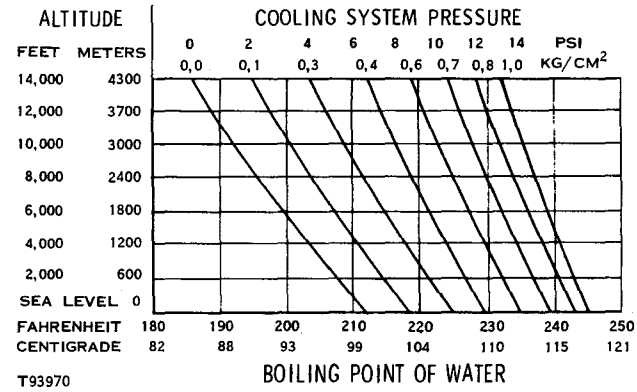
1. Pressure regulating valve. 2. Pressure gauge. 3. Overflow port in cover. 4. Pressure relief valve.

Slowly pressurize the radiator top tank. The highest pressure indicated on the gauge is the point the relief valve opens. The pressure that makes the pressure relief valve open is 13 to 16 psi (0.9 to 1.1 kg/cm^2). The vacuum that makes the vacuum relief valve open is 1 psi (0.1 kg/cm^2) less than ambient pressure.

A leakage check can be performed by attaching a length of hose to the overflow device. Submerge the opposite end of the hose in a container of water. Pressurize the top tank to a pressure just below the relief valve opening pressure. A steady stream of bubbles from the submerged hose indicates a leak in the relief valve.

If both the radiator cap and pressure relief valve are functioning properly and still the system will not hold pressure, a thorough inspection of the entire cooling system will be necessary. Correct any leaks detected by the inspection and repeat the pressure test.

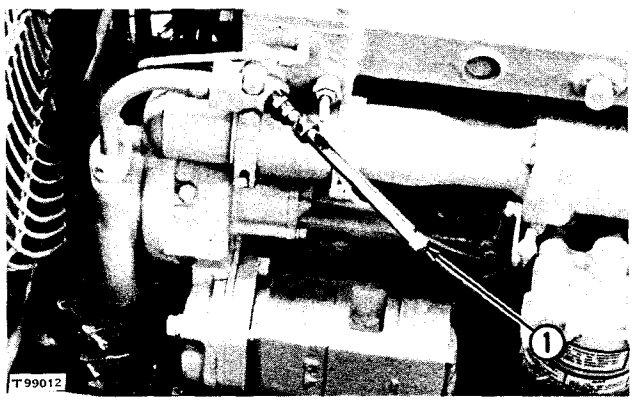
Remember that temperature and pressure go hand-in-hand and neither one can be tested logically without considering the other. For example, the effect of pressurization and altitude on the boiling point of water is shown in the chart.



Gauge for Water Temperature

Tools Needed: 9S9102 Thermistor Thermometer Group.
or
2F7112 Thermometer and 6B5072 Bushing.

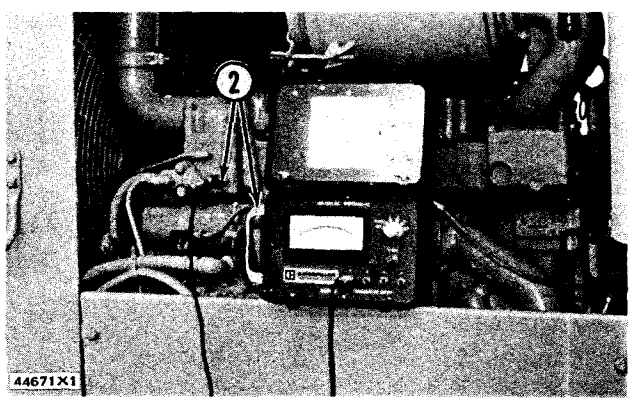
If the engine gets too hot and a loss of coolant is a problem, a pressure loss in the cooling system could be the cause. If the gauge for water temperature shows that the engine is getting too hot, look for coolant leakage. If a place can not be found where there is coolant leakage, check the accuracy of the gauge for water temperature. Use the 9S9102 Thermistor Thermometer Group or the 2F7112 Thermometer and 6B5072 Bushing.



THERMOMETER INSTALLED

1. 2F7112 Thermometer.

WARNING: Be careful when working around an engine if it is running.



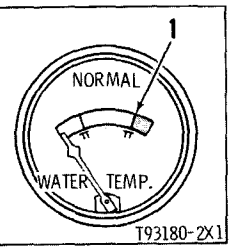
THERMISTOR THERMOMETER GROUP INSTALLED
(Typical Example)

2. 9S9102 Thermistor Thermometer Group.

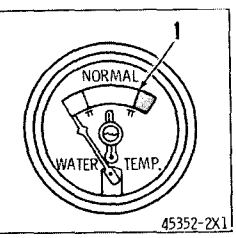
For Gauges with Color Temperature Ranges

Install the test thermometer. Get the coolant temperature at the test temperature according to the test thermometer. The pointer of the gauge on the instrument panel must be on the tolerance mark (TT).

POINTER POSITION	TEST THERMOMETER TEMPERATURE READING	
	F.°	C.°
1	209 TO 217	98, 2 TO 102, 8



POINTER POSITION	TEST THERMOMETER TEMPERATURE READING	
	F.°	C.°
1	219 TO 227	103, 8 TO 108, 2



For Direct Reading Gauges

Install the test thermometer. Get the coolant temperature at 200°F according to the test thermometer. The centerline of the pointer of the gauge on the instrument panel must be .030 in. (0.76 mm) or less on either side of the centerline for the 200° mark.

Water Temperature Regulators

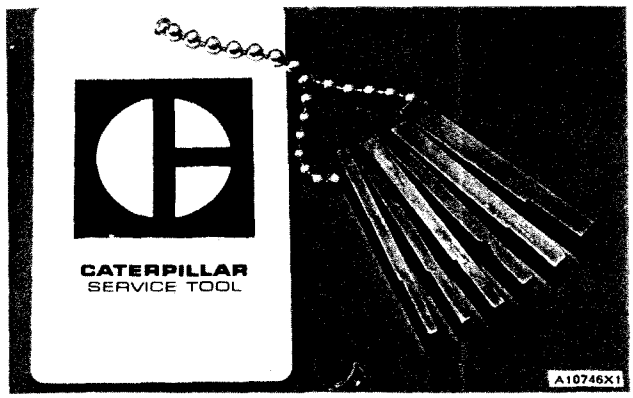
1. Remove the regulator from the engine.
2. Heat water in a pan until the temperature is correct for opening the regulator according to the chart. Move the water around in the pan to make it all be the same temperature.
3. Hang the regulator in the pan of water. The regulator must be below the surface of the water and it must be away from the sides and bottom of the pan.
4. Keep the water at the correct temperature for 10 minutes.
5. Remove the regulator from the water. Immediately make a measurement of the distance the regulator is open.
6. If the regulator is open to a distance less than given in the chart, install a new regulator.

WATER TEMPERATURE REGULATORS				
Part No.	Minimum Open Distance		Temperature	
	in.	mm	°F	°C
6L5851	.375	9.53	197°	92°
6N1848 2P3768	.375	9.53	195°	90°
9S9160	.375	9.53	187°	86°
4L7615	.375	9.53	180°	82°

BASIC BLOCK

PISTON RING GROOVE GAUGE

A 5P3519 Piston Ring Groove Gauge is available for checking ring grooves with straight sides. For instructions on the use of the gauge, see the GUIDELINE FOR REUSABLE PARTS; PISTONS AND CYLINDER LINERS, Form No. SEBF8001.



PISTON RING GROOVE GAUGE

CONNECTING RODS AND PISTONS

Use the 7S9470 Piston Ring Expander to remove or install piston rings.

Use the 7S9417 Piston Ring Compressor to install pistons into cylinder block.

Tighten the connecting rod bolts in the following step sequence:

1. Put crankcase oil on threads.
2. Tighten both nuts to 30 ± 3 lb.ft. (4.1 ± 0.4 mkg).
3. Put a mark on each nut and cap.
4. Tighten each nut 90° from the mark.

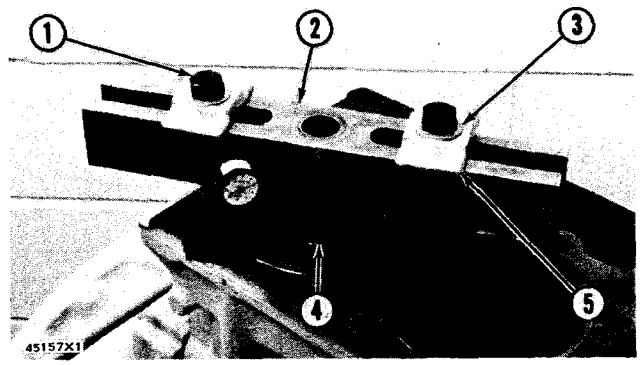
The connecting rod bearings should fit tightly in the bore in the rod. If bearing joints or backs are worn (fretted), check for bore size as this is an indication of wear because of looseness.

CONNECTING ROD AND MAIN BEARINGS

Bearings are available with .010 in. (0.254 mm), .020 in. (0.508 and .030 in. 0.762 mm) smaller inside diameter than the original size bearings. These bearings are for crankshafts that have been "ground" (made smaller) than the original size.

CYLINDER LINER PROJECTION

Tools Needed: **1P2394 Adapter Plate.**
Two 3H465 Plates.
Crossbar (from 8B7548 Push-Puller).
Two 5/8"–11 NC bolts, 5.5 in. (118.7 mm) long.
Two 4B4281 Washers.
1P5510 Liner Projection Tool Group.

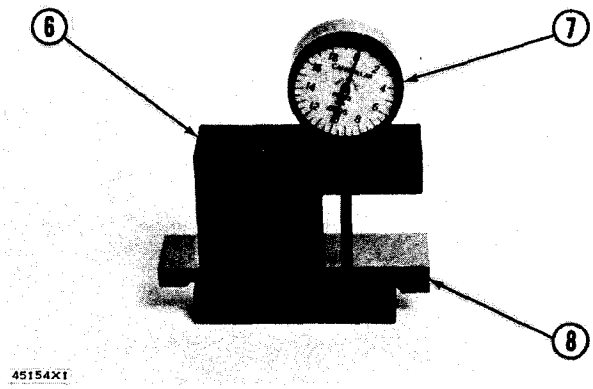


CHECKING LINER PROJECTION

1. Bolts (two). 2. Crossbar. 3. 4B4281 Washers (two). 4. 1P2394 Adapter Plate. 5. 3H465 Plates (two).

Check liner height projection as follows:

1. Make sure that the bore in block and the cylinder liner flange are clean.
2. Put adapter plate (4) on top the cylinder liner. Put crossbar (2) on the adapter plate. Using bolts (1), washers (3) and plates (5), install the crossbar to the cylinder block as shown. Tighten bolts (1) in four steps to: 5 lb.ft. (0.7 mkg), 15 lb.ft. (2.0 mkg), 25 lb.ft. (3.5 mkg) and then to 50 lb.ft. (6.9 mkg). Distance from



ZEROING INDICATOR

6. 1P2402 Block. 7. 1P2403 Dial Indicator. 8. 1P5507 Gauge.

bottom edge of crossbar, to top of cylinder block, must be the same on both sides of the cylinder liner.

3. Put the dial indicator (7) on zero using the back of gauge (8) with dial indicator (7) installed in block (6).

4. Use a 1P5510 Liner Projection Tool Group to get a measurement of liner projection. Special Instruction (GMG00623) is with the tool.

5. Make a measurement of the cylinder liner projection in at least four locations around the cylinder liner. Projection must be within .0020 to .0056 in. (0.051 to 0.142 mm) and the four measurements should not vary more than .001 in. (0.03 mm). The average projection between adjacent cylinders must not vary more than .001 in. (0.03 mm).

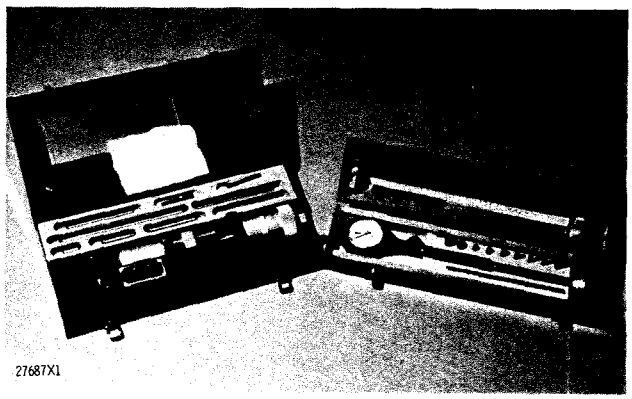
NOTE: If liner projection changes from point to point around the liner, turn the liner to a new position within the bore. If still not within specifications move liner to a different bore.

NOTE: When liner projection is correct, put a temporary mark on the liner and top plate so when seals and band are installed, the liner can be installed in the correct position.

6. Use the 8S3140 Counterboring Tool Arrangement to machine the contact face on block if needed. Special Instruction (FM055228) gives an explanation of the use of the 8S3140 Counterboring Tool Arrangement.

ADJUSTMENT SHIMS FOR LINER PROJECTION

SHIM THICKNESS AND PART NUMBER				
.007 in. (0.18 mm)	.008 in. (0.20 mm)	.009 in. (0.23 mm)	.015 in. (0.38 mm)	.030 in. (0.76 mm)
8S6045	8S6046	8S6047	8S6048	8S6049



1P3537 DIAL BORE GAUGE GROUP

CYLINDER BLOCK

The bore in the block for main bearings can be checked with the main bearing caps installed without bearings. Tighten the nuts holding the caps to the torque shown in the SPECIFICATIONS, Form No. REG01350. Alignment error in the bores must not be more than .003 in. (0.08 mm). Special Instruction (GMG00503) gives instructions for the use of 1P4000 Line Boring Tool Group for making alignment in the main bearing bores. 1P3537 Dial Bore Gauge Group can be used to check the size of the bores. Special Instruction (GMG00981) is with the group.

FLYWHEEL AND FLYWHEEL HOUSING

Installing Ring Gear

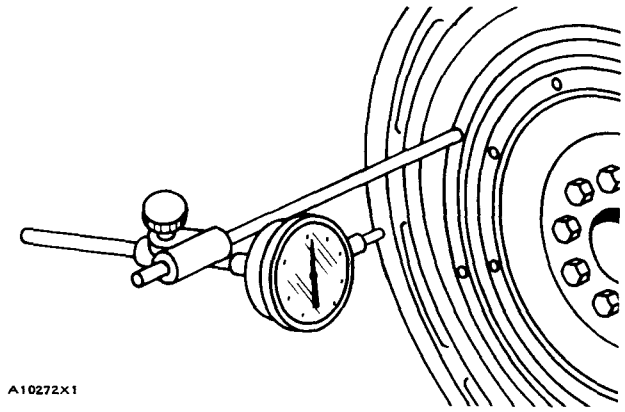
Heat the ring gear to install it. Do not heat to more than 600°F (315°C). Install the ring gear so the chamfer on the gear teeth are next to the starter pinion when the flywheel is installed.

Face Runout (axial eccentricity) of the Flywheel Housing

Tools Needed: 8S2328 Dial Indicator Group.

If any method other than given here is used, always remember bearing clearances must be removed to get correct measurements.

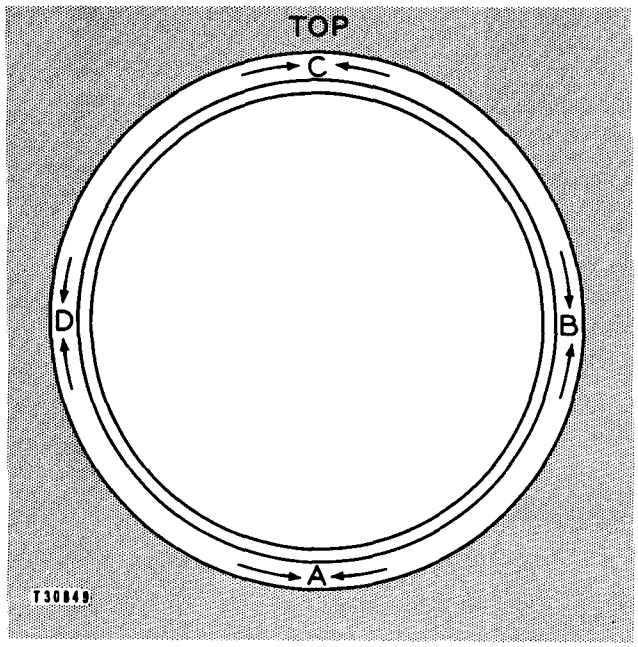
1. Fasten a dial indicator to the crankshaft flange so the anvil of the indicator will touch the face of the flywheel housing.



8S2328 DIAL INDICATOR GROUP INSTALLED

2. Put a force on the crankshaft toward the rear before reading the indicator at each point.

3. With dial indicator set at .000 in. (0.0 mm) at location (A), turn the crankshaft and read the indicator at locations (B), (C) and (D).



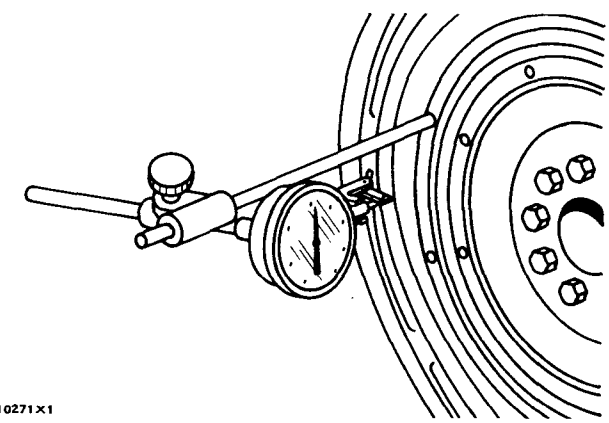
CHECKING FACE RUNOUT OF THE FLYWHEEL HOUSING

A. Bottom. B. Right side. C. Top. D. Left side.

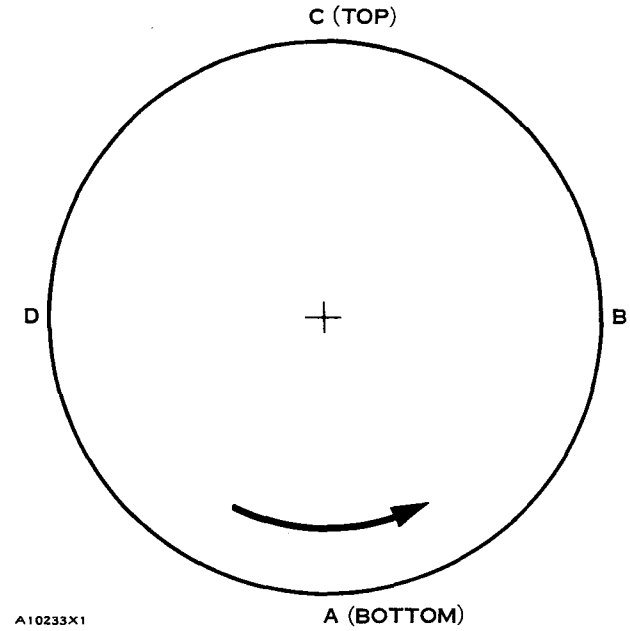
4. The difference between lower and higher measurements taken all four points must not be more than .012 in. (0.30 mm), which is the maximum permissible face run out (axial eccentricity) of the flywheel housing.

Bore Runout (radial eccentricity) of the Flywheel Housing

1. With the dial indicator in position at (C), adjust the dial indicator to "0" (zero). Push the crankshaft up against the top bearing. Write the measurement for bearing clearance on line 1 in column (C).



8S2328 DIAL INDICATOR GROUP INSTALLED



CHECKING BORE RUNOUT OF THE FLYWHEEL HOUSING

CHART FOR DIAL INDICATOR MEASUREMENTS

		Position of dial indicator			
	Line No.	A	B	C	D
Correction for bearing clearance	I	0			
Dial Indicator Reading	II	0			
Total of Line 1 & 2	III	0	**	*	**

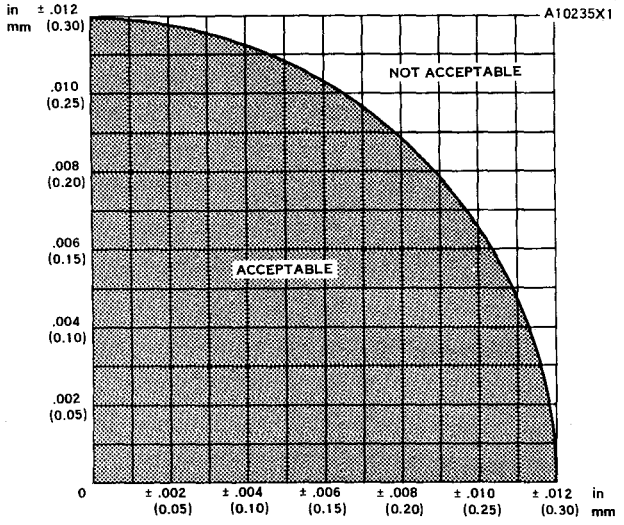
*Total Vertical eccentricity (out of round).
**Subtract the smaller No. from the larger No. The difference is the total horizontal eccentricity.

A10234X1

2. Divide the measurement from Step 1 by 2. Write this number on line 1 in columns (B) & (D).
3. Turn the crankshaft to put the dial indicator at (A). Adjust the dial indicator to "0" (zero).
4. Turn the crankshaft counterclockwise to put the dial indicator at (B). Write the measurement in the chart.
5. Turn the crankshaft counterclockwise to put the dial indicator at (C). Write the measurement in the chart.
6. Turn the crankshaft counterclockwise to put the dial indicator at (D). Write the measurement in the chart.
7. Add lines I & II by columns.
8. Subtract the smaller number from the larger number in line III in columns (B) & (D). The

result is the horizontal "eccentricity" (out of round). Line III, column (C) is the vertical eccentricity.

9. On the graph for total eccentricity find the point of intersection of the lines for vertical eccentricity and horizontal eccentricity.

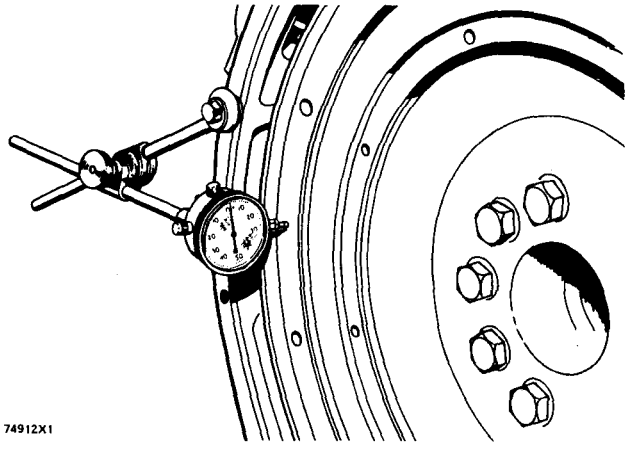


GRAPH FOR TOTAL ECCENTRICITY

10. If the point of intersection is in the range marked "Acceptable" the bore is in alignment. If the point of intersection is in the range marked "Not Acceptable" do Step 11.

11. Loosen the bolts holding the flywheel housing to the cylinder block. Hit the flywheel housing lightly with a hammer to put it in the correct position. Tighten the bolts holding the flywheel housing to the cylinder block and do Steps 1 through 10 again.

Face Runout (axial eccentricity) of the Flywheel



CHECKING FACE RUNOUT OF THE FLYWHEEL

1. Install the dial indicator as shown. Put a force on the crankshaft the same way before the indicator is read to the crankshaft end clearance (movement) is always removed.

2. Set the dial indicator to read .000 in. (0.0 mm).

3. Turn the flywheel and read the indicator every 90°.

4. The difference between the lower and higher measurements taken at all four points must not be more than .006 in. (0.15 mm), which is the maximum permissible face runout (axial eccentricity) of the flywheel.

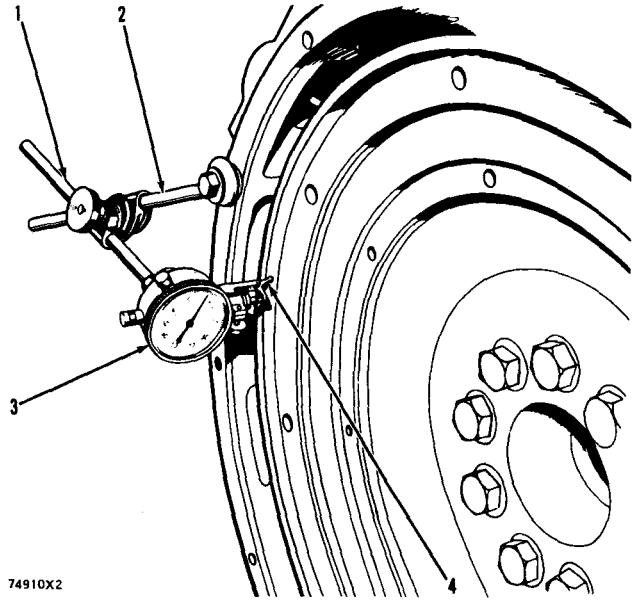
Bore Runout (radial eccentricity) of the Flywheel

1. Install the dial indicator (3) and make an adjustment of the universal attachment (4) so it makes contact as shown.

2. Set the dial indicator to read .000 in. (0.0 mm).

3. Turn the flywheel and read the indicator every 90°.

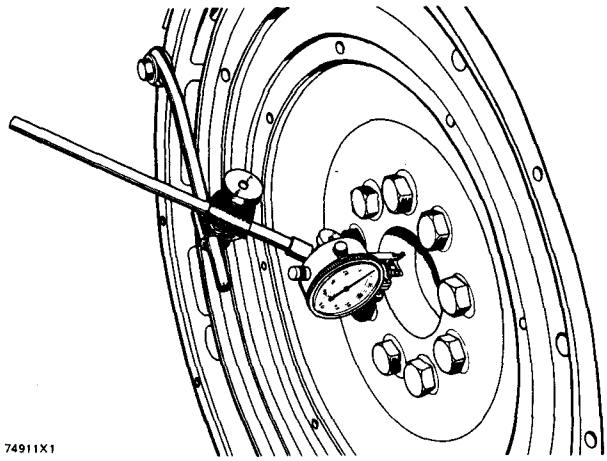
4. The difference between the lower and higher measurements taken at all four points must not be more than .006 in. (0.15 mm), which is the maximum permissible bore runout (radial eccentricity) of the flywheel.



CHECKING BORE RUNOUT OF THE FLYWHEEL

1. 7H1945 Holding Rod. 2. 7H1645 Holding Rod. 3. 7H1942 Indicator. 4. 7H1940 Universal Attachment.

5. Runout (eccentricity) of the bore for the pilot bearing for the flywheel clutch, must not exceed .005 in. (0.13 mm).



CHECKING FLYWHEEL CLUTCH PILOT BEARING BORE

VIBRATION DAMPER

Damage to or failure of the damper will increase vibrations and result in damage to the crankshaft. It will cause more gear train noise at variable points in the speed range.

ENGINE MOUNTING BOLTS

Make a reference to Specifications for the correct torques for the bolts which hold the engine supports to the frame.

OIL PUMP INSTALLATION
(Four Cylinder Engines Only)

The oil pump can be removed for inspection and service without removing the timing gear cover. With the cover in place, timing marks are not easy to see. Therefore, time both balancer shafts, with respect to No. 1 piston at TC or compression stroke, in the following steps.

1. Rotate the crankshaft to bring No. 1 piston to TC on compression stroke.

2. Drive dowel (7) back so it is flush with mounting face of oil pump mounting bracket.

3. Rotate both balancer shafts so the flat portion is away from the oil pan plate. Install bolts (6) so they enter in countersunk holes in balancer shafts and limit shaft movement. The bolts should not be tight against the shaft countersunk hole bottom.

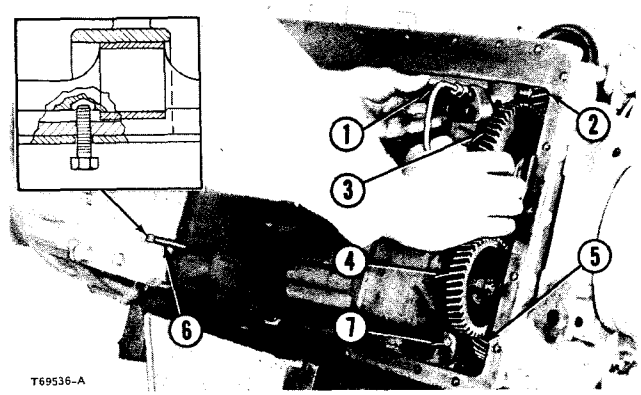
4. Position oil pump on bottom of engine block and install the mounting bolts loosely.

5. Install shims if necessary, between pump mounting pads and cylinder block to adjust backlash to .002 to .006 in. (0.05 to 0.15 mm) between gear (4) and (5) and between gears (2) and (3).

6. Drive dowel (7) back in place, through mounting bracket and into cylinder block. Tighten the mounting bolts.

7. Remove bolts (6) and check to see that the countersunk holes are aligned with holes in oil pan plate when No. 1 cylinder is in TC position.

Timing mark alignment information shown in the SPECIFICATIONS is to be used when the timing gear cover is removed.



OIL PUMP INSTALLATION
(Typical Example)

1. Right side balancer shaft. 2. Right side balancer shaft gear. 3. Idler gear. 4. Oil pump drive gear. 5. Left side balancer shaft gear. 6. Bolt. 7. Dowel.

FLEXIBLE DRIVE COUPLING

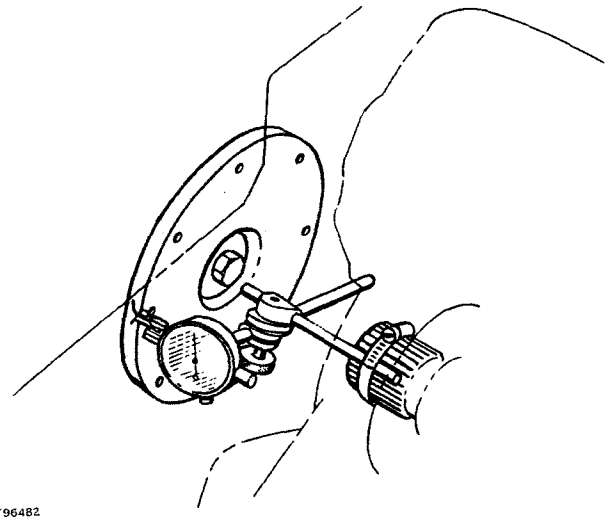
CHECKING FLEXIBLE DRIVE COUPLING ALIGNMENT

Position engine in mounting location within the main frame. Check for correct engine-to-transmission alignment as follows:

1. Remove the torque converter input flange.

2. Fasten a 7H1942 Indicator (with a 7H1940 Universal Attachment) to the torque converter input shaft using a 7H1948 Snug, 7H1945 Holding Rod, 3/8 in. (9.5 mm) diameter rod 3 in. (76.2 mm) long and a 1J9778 Hose Clamp.

3. Zero the indicator on the outside diameter of engine output flange as illustrated. Take an indicator reading every 90° while rotating the torque converter input shaft one complete turn.

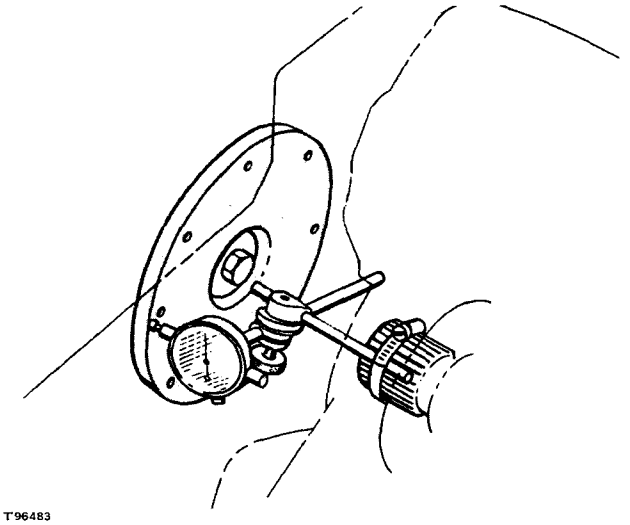


T96482

CHECKING VERTICAL AND HORIZONTAL ALIGNMENT
(Viewed from left side of machine).

Total indicator reading must not exceed .080 in. (2.03 mm). Correct any misalignment by adding or removing shims under engine rear supports.

4. Remove the 7H1940 Universal Attachment. Position the anvil of the dial indicator between the bolt holes and the outside diameter of engine output flange as illustrated.



T96483

CHECKING FACE ALIGNMENT
(Viewed from left side of machine).

Total indicator reading must not exceed .026 in. (0.66 mm). Move front of engine as necessary to obtain correct dimension.

5. Zero the dial indicator. Take an indicator reading every 90° while rotating the torque converter input shaft one complete turn.

6. Recheck both settings and adjust if necessary. When alignment is correct, tighten engine mounting bolts according to the specifications for the machine in ENGINE MOUNTING BOLTS in specifications.

Misalignment

If it is necessary to shift the engine from one side to the other in the frame, loosen the hold-down bolts and shift the engine accordingly.

If the holes for the hold-down bolts are enlarged, dowels should be installed to hold the engine in the proper location after it is bolted down.

Extreme misalignment is probably the result of bent main frame channels. They should be straightened. Extreme wear in the engine front support will also cause misalignment.

ELECTRICAL SYSTEM

Most of the testing of the electrical system can be done on the engine. The wiring insulation must be in good condition, the wire and cable connections clean and tight and the battery fully charged. If on the engine test shows a defect in a component, remove the component for more testing.

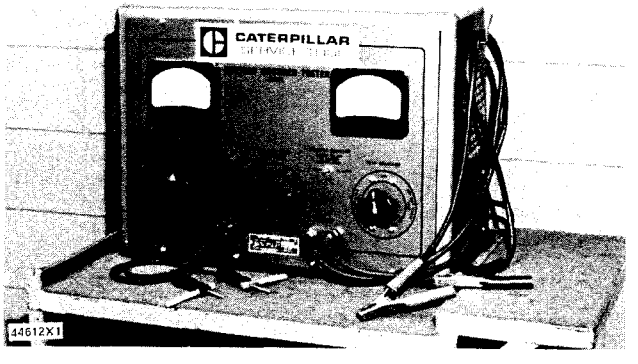
BATTERY

Tools Needed: 5P300 Electrical Tester.
9S1990 or 1P7470 Battery Charger Tester.
5P957 or 5P3414 Coolant and Battery Tester.

NOTE: Make reference to Special Instruction (GEG02276) and to the instructions inside of the cover of the tester, when testing with the 5P300 Electrical Tester.

The battery circuit is an electrical load on the charging unit. The load is variable because of the condition of the charge in the battery. Damage to the charging unit will result, if the connections, (either positive or negative) between the battery and charging unit are broken while the charging unit is charging. This is because the battery load is lost and there is an increase in charging voltage.

High voltage will damage, not only the charging unit but also the regulator and other electrical components.



9S1990 BATTERY CHARGER TESTER

CAUTION: Never disconnect any charging unit circuit or battery circuit cable from battery when the charging unit is charging.

Load test a battery that does not hold a charge when in use. To do this, put a resistance, across the battery main connections (terminals). For a 6 volt battery, put a resistance of two times the ampere/hour rating of the battery. For a 12 volt battery, put a resistance of three times the ampere/hour rating. Let the resistance remove the charge (discharge the battery) for 15 seconds. Immediately test the battery voltage. A 6 volt battery in good condition will test 4.5 volts; a 12 volt battery in good condition will test 9 volts.

The Special Instruction (GEG00058) with the 9S1990 Charger Tester gives the battery testing procedure.

CHARGING SYSTEM

Tools Needed: 5P300 Electrical Tester.

NOTE: Make reference to Special Instruction (GEG02276) and to the instructions inside of the cover of the tester, when testing with the 5P300 Electrical Tester.

The condition of charge in the battery at each regular inspection will show if the charging system is operating correctly. An adjustment is necessary when the battery is always in a low condition of charge or a large amount of water is needed (one ounce per cell per week or every 50 service hours).

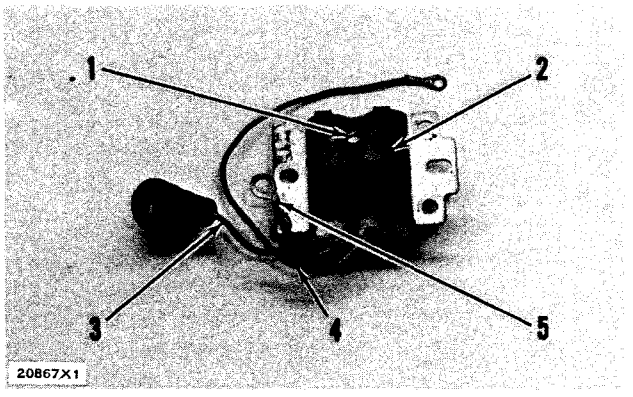
Test the charging units and voltage regulators on the engine, when possible, using wiring and components that are a permanent part of the system. Off the engine (bench) testing will give an operational test of the charging unit and voltage regulator. This testing will give an indication of needed repair. Final testing will give proof that the units are repaired to their original operating condition.

Before starting on the engine testing, the charging system and battery must be checked. See the following Steps.

1. Battery must be at least 75% (1.240 Sp. Gr.) full charged and held tightly in place. The battery holder must not put too much stress on the battery.
2. Cables between the battery, starter and engine ground must be the correct size. Wires and cables must be free of corrosion and have cable support clamps to prevent stress on battery connections (terminals).
3. Leads, junctions, switches and panel instruments that have direct relation to the charging circuit must give proper circuit control.
4. Inspect the drive components for the charging unit to be sure they are free of grease and oil and are able to drive the load of the charging unit.

Alternator Regulator (Prestolite)

The regulator components are sealed in an insulation of epoxy. The regulator is an electronic component with no moving parts (solid state) and has an adjustment screw (1) on the back. This voltage adjustment screw is used to meet different operating needs at different times of the year. An increase or decrease by .5 volts from the normal (N) setting is made by removing the regulator and changing the position of the adjustment screw and washer. An increase to the voltage will be made by moving the screw and washer to the "H" position (2).



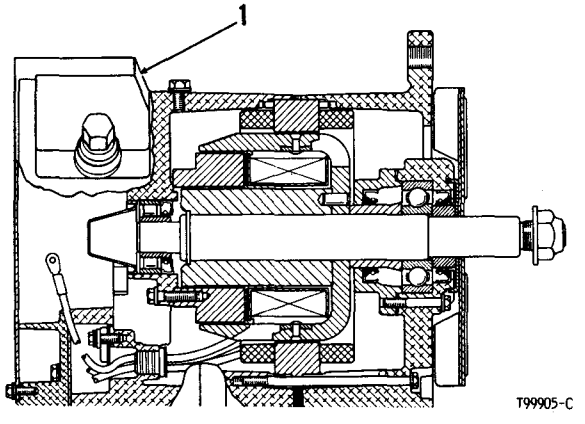
ALTERNATOR REGULATOR

1. Adjustment screw with washer. 2. High output position. 3. Green wire to field terminal of the alternator (F). 4. Orange wire to battery. 5. Black wire to ground.

Alternator Regulator Adjustment (Delco-Remy)

Set Screw Type

When an alternator is charging the battery too much or not enough, an adjustment can be made to the charging rate of the alternator. Remove the hollow head screw (1) from the alternator and use a screwdriver to turn the adjustment screw. Turn the adjustment screw one or two notches to increase or decrease the charging rate of the alternator.

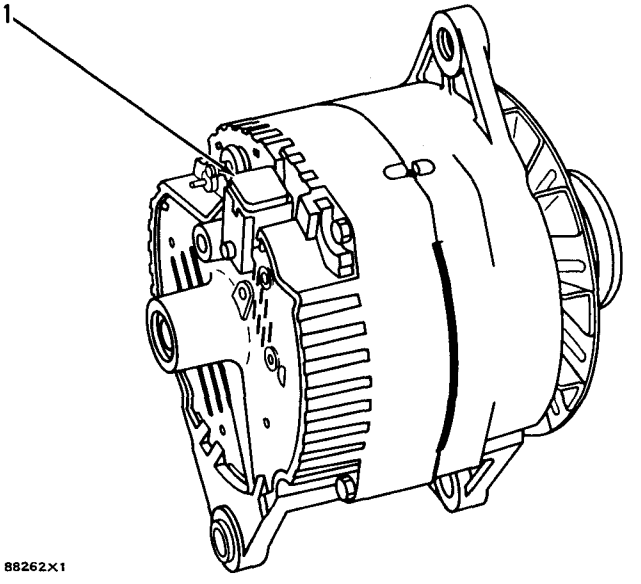


ALTERNATOR REGULATOR

1. Adjustment screw, on other side of alternator from output terminal.

Cap Type

When the alternator is either charging the battery too much or not enough, an adjustment can be made to the alternator charging rate. To make an adjustment to the voltage output, remove the voltage adjustment cap (1) from the alternator, turn the cap 90°, and install it again into the alternator. The voltage adjustment cap has four positions: HI, LO, and two positions between the high and the low setting.

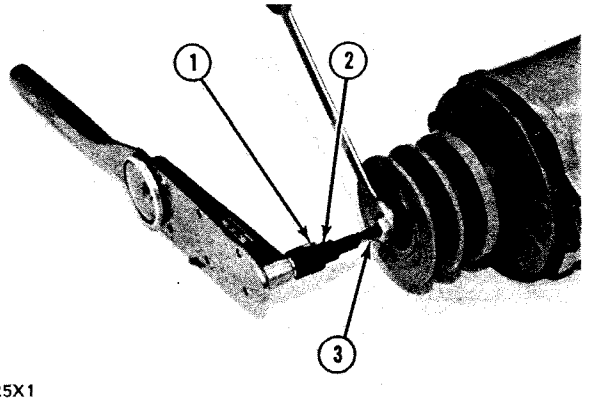


ALTERNATOR REGULATOR ADJUSTMENT

1. Voltage adjustment cap.

Delco-Remy Alternator; Pulley Nut Tightening

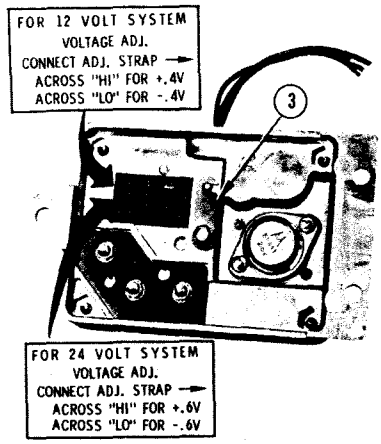
Tighten nut holding the pulley to a torque of 75 ± 5 lb.ft. (10.4 ± 0.7 mkg) with the tools shown.



ALTERNATOR PULLEY INSTALLATION

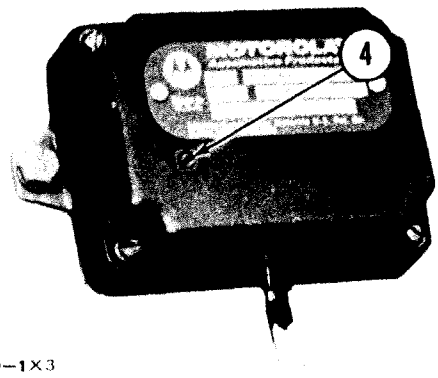
1. 8S1588 Adapter (1/2" female to 3/8" male). 2. 8S1590 Socket (5/16" with 3/8" drive). 3. 1P2977 Tool Group. 8H8555 Socket (15/16" with 1/2" drive) not shown.

Alternator Regulator (Motorola)



VOLTAGE ADJUSTMENT

3. Metal strap.



FINE VOLTAGE ADJUSTMENT

4. Cover screw.

NOTE: Total adjustment is one half a turn.

CAUTION: Do not let screwdriver make contact with cover.

When the alternator is either charging the battery too much or not enough, an adjustment can be made to the alternator charging rate. To make an adjustment to the voltage output, remove the cover from the voltage regulator and change the location of the metal strap (3).

To make an increase in the voltage (approximately .4 volt in a 12 volt system and .6 volt in a 24 volt system), remove the nuts from the two studs nearest to the word "HI". Install the metal strap on these studs and install the nuts.

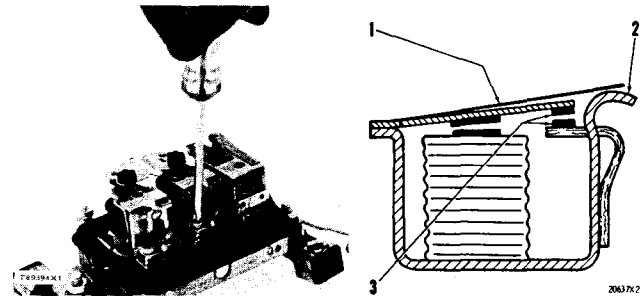
To make a decrease in the voltage (approximately .4 volt in a 12 volt system and .6 volt in a 24 volt system), remove the nuts from the two studs nearest to the word "LO". Install the metal strap on these studs and install the nuts.

A line adjustment can be made by removing cover screw (4) from the insulator and turning the adjustment screw with a Phillips screwdriver. Turn clockwise to make an increase in voltage.

Generator Regulator

When a generator is either overcharging or is not charging enough, a generator regulator tester can be used to determine whether the voltage regulator control, or the current limiter control, or both, require adjustment. To obtain an accurate test, the regulator cover must not be removed and the regulator must be warmed to operating temperature.

The voltage regulator and the current limiter controls in Delco-Remy regulators have spring tension adjustment screws. The Paris-Rhône control uses a spring tension adjustment stop. To increase generator voltage or current, increase the spring tension on the respective control. Decrease spring tension to decrease generator output. After a regulator has been adjusted always test the generator output with the regulator cover installed.



(Delco-Remy) (Paris-Rhône)
GENERATOR OUTPUT ADJUSTMENTS

1. Spring. 2. Stop (adjust by bending stop). 3. Points.

STARTING SYSTEM

Tools Needed: 5P300 Electrical Tester.

NOTE: Make reference to Special Instruction (GEG02276) and to the instructions inside of the cover of the tester, when testing with the 5P300 Electrical Tester.

Use a D. C. Voltmeter to find starting system components which do not function.

Move the starting control switch to activate the starter solenoid. Starter solenoid operation can be heard as the pinion of the starter motor is engaged with the ring gear on the engine flywheel.

If the solenoid for the starting motor will not operate, it is possible that the current from the

battery is not getting to the solenoid. Fasten one lead of the voltmeter to the connection (terminal) for the battery cable on the solenoid. Put the other lead to a good ground. No voltmeter reading shows there is a broken circuit from the battery. Further testing is necessary when there is a reading on the voltmeter.

The solenoid operation also closes the electric circuit to the motor. Connect one lead of the voltmeter to the solenoid connection (terminal) that is fastened to the motor. Put the other lead to a good ground. Activate the starter solenoid and look at the voltmeter. A reading of battery voltage shows the problem is in the motor. The motor must be removed for further testing. No reading on the voltmeter shows that the solenoid contacts do not close. This is an indication of the need for repair to the solenoid or an adjustment to be made to the starter pinion clearance.

Further test by fastening one voltmeter lead to the connection (terminal) for the small wire at the solenoid and the other lead to the ground. Look at the voltmeter and activate the starter solenoid. A voltmeter reading shows that the problem is in the solenoid. No voltmeter reading shows that the problem is in the magnetic switch, heat-start switch, or wiring.

Fasten one voltmeter lead to the connection (terminal) for the battery cable on the magnetic switch for the starter. Fasten the other lead to a good ground. No voltmeter reading shows there is a broken circuit from the battery.

Fasten one voltmeter lead to the connection (terminal) for the line from the heat-start switch. Fasten the other lead to a good ground.

Activate the magnetic switch. A voltmeter reading indicates the malfunction is in the magnetic switch. No voltmeter reading indicates a need for further testing.

Fasten one voltmeter lead to the heat-start switch at the connection (terminal) for the wire from the battery. Fasten the other lead to a good ground. No voltmeter reading indicates a broken circuit from the battery. Make a check of the circuit breaker and wiring. If there is voltmeter reading, the malfunction is in the heat-start switch or in the wiring.

Fasten one lead of the voltmeter to the battery wire connection of the starter switch and put the other lead to a good ground. A voltmeter reading indicates a failure in the switch.

A starting motor that operates too slow can have an overload because of too much friction in the engine being started. Slow operation of the starting motor can also be caused by shorts, loose connections, and/or dirt in the motor.

Pinion Clearance Adjustment (Prestolite)

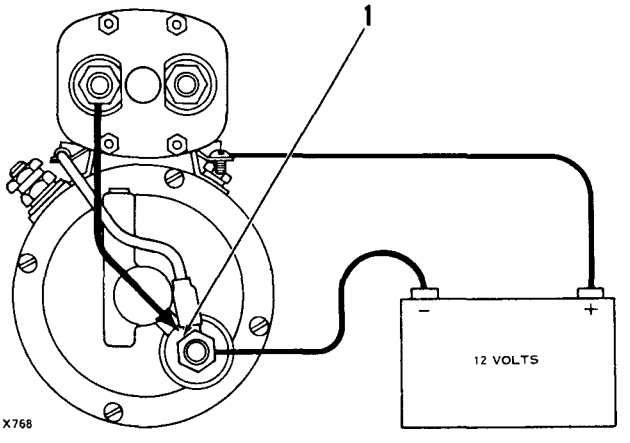
There are two adjustments on this type motor. Armature end play and pinion position.

Armature End Play

Adjust to .005 to .030 in. (0.13 to 0.76 mm) by adding or removing thrust washers on the commutator end of the armature shaft.

Pinion Position

This adjustment is accomplished in two steps.



CONNECTIONS FOR ADJUSTING THE PINION POSITION

1. Jumper lead flashing point.

1. To adjust the pinion distance, connect the solenoid to a 12 volt battery as shown.

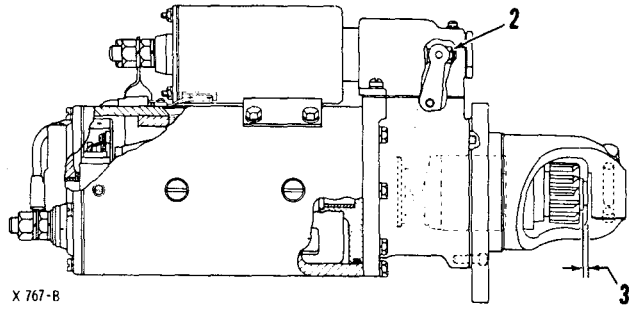
   Momentarily flash the jumper lead from the motor terminal stud of the solenoid to the terminal stud at (1) in the commutator end head to shift the solenoid and drive into the cranking position.

   Remove the jumper lead.

NOTE: The drive will remain in the cranking position until the battery is disconnected.

Push the drive toward the commutator end of the motor to eliminate any slack movement in the linkage and measure the distance between the outside edge of the drive sleeve and the thrust washer. The distance (3) must be .02 to .05 in. (0.51 to 1.27 mm).

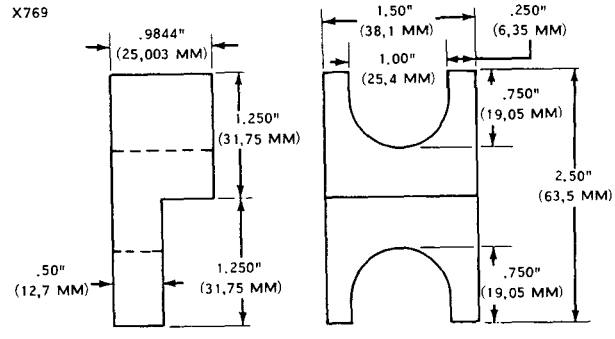
Adjust to this dimension by turning the adjusting nut (2) in or out as required.



PINION POSITION ADJUSTMENT

2. Adjusting nut. 3. Distance.

2. To test assembly of solenoid, it will be necessary to have an interference block cut to the dimensions shown.

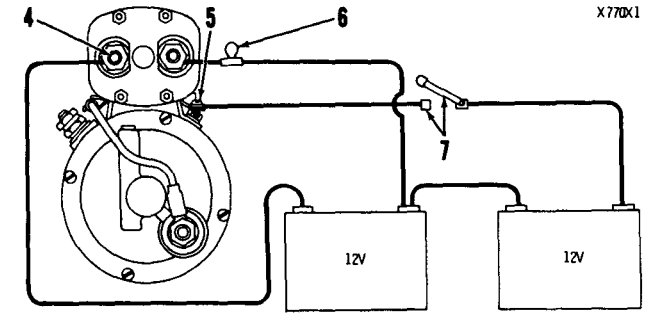


INTERFERENCE BLOCK DIMENSIONS

Connect the solenoid to 24 volts as shown.

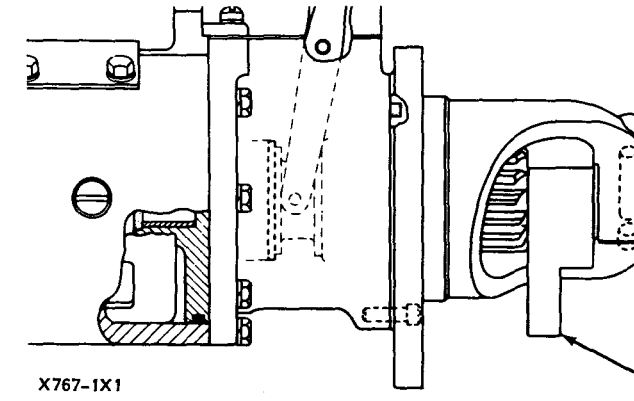
Position the .9844 in. (25.003 mm) side of the interference block against the pinion as shown and close the switch in the battery circuit.

With the switch closed and the .9844 in. (25.003 mm) side of the interference block in place, the test light must not light. Make sure the interference block is against the drive gear and not against the drive sleeve.



CONNECTIONS FOR TESTING SOLENOID

4. Solenoid motor terminal. 5. Solenoid control switch terminal. 6. 12V Test lamp. 7. Switch.



INTERFERENCE BLOCK IN POSITION

8. Interference block.

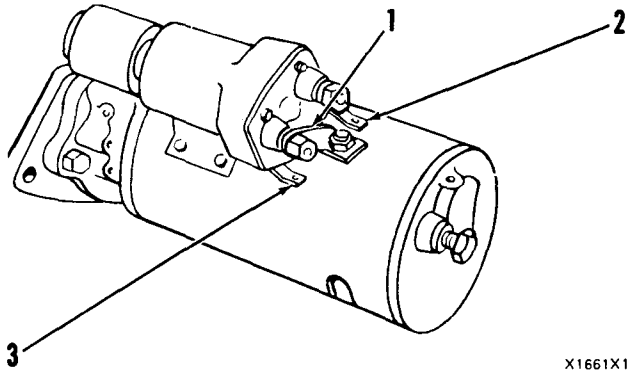
CAUTION: Due to the amount of current being passed through the solenoid series winding, these tests should be made as brief as possible.

If the test light lights, the solenoid has been assembled wrong. Remove the cover from the solenoid and check the contact component assembly. If the test light does not light, connect a carbon pile between the switch and battery and voltmeter to the terminals (4) and (5).

Position the .50 in. (12.7 mm) side of the interference block against the drive gear and adjust the voltage with the carbon pile. The test light must light before 16 volt reading. If the test light does not light, turn the adjusting nut (2) out until the light comes on. After all adjustments have been made, replace the plug and washer in the shift linkage cover.

Pinion Clearance Adjustment (Delco-Remy) (Paris-Rhône)

Whenever the solenoid is installed, the pinion clearance should be adjusted. The adjustment should be made with the starting motor removed.

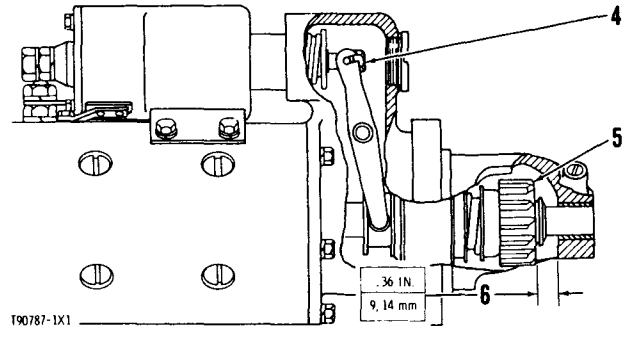


CONNECTIONS FOR CHECKING PINION CLEARANCE

1. Connector from MOTOR terminal on solenoid to motor.
2. SW terminal. 3. Ground terminal.

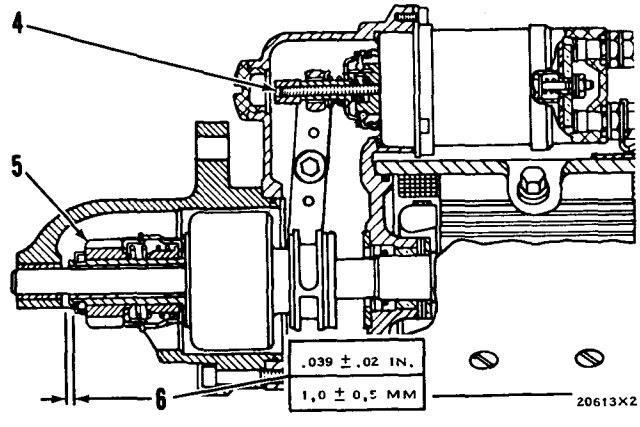
Bench test and adjust the pinion clearance at installation of solenoid as follows:

1. Install the solenoid without connector (1) from the MOTOR terminal on solenoid to the motor.
2. Connect a battery, of the same voltage as the solenoid, to the terminal (2), marked SW.
3. Connect the other side of battery to ground terminal (3).
4. MOMENTARILY flash a jumper wire from the solenoid terminal marked MOTOR to the ground terminal. The pinion will shift into cranking position and will remain there until the battery is disconnected.
5. Push pinion towards commutator end to eliminate free movement.
6. Pinion clearance (6) should be .36 in. (9.1 mm) for Delco-Remy motors and .039 ± .02 in. (1.0 ± 0.5 mm) for Paris-Rhone.
7. Adjust clearance by removing plug and turning shaft nut (4).



PINION CLEARANCE ADJUSTMENT (Delco-Remy)

4. Shaft nut. 5. Pinion. 6. Pinion clearance.



PINION CLEARANCE ADJUSTMENT (Paris-Rhone)

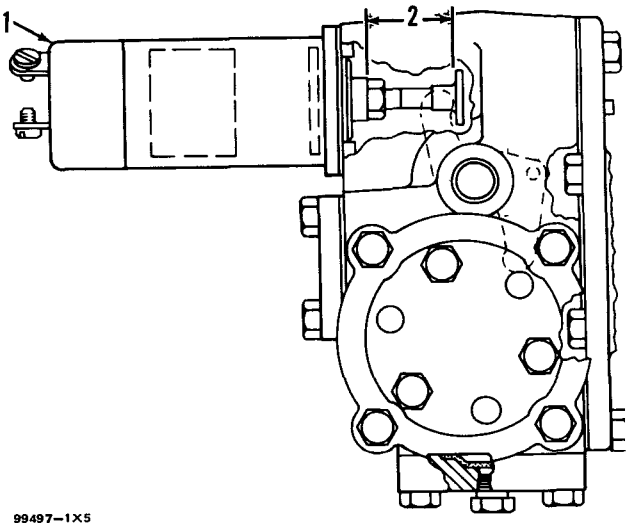
4. Shaft end. 5. Pinion. 6. Pinion clearance.

SHUTOFF SOLENOID

Two checks must be made on the engine to give proof that the solenoid adjustment is correct.

1. The adjustment must give the piston enough travel to move the sleeve control shaft to the shutoff position.

2. The adjustment must give the piston enough travel to cause only the "hold in" windings of the solenoid to be activated with the sleeve control shaft held in the fuel closed position. Use a thirty ampere ammeter to make sure the plunger is in the "hold in" position. Current needed must be less than one ampere.



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SHUTOFF SOLENOID

1. Shutoff solenoid. 2. Distance from face of piston to inside face of shaft.

APRIL 1975
FORM NO. REG01349-01

PRINTED IN U.S.A.