CATERPILLAR®

SENR6593-03
September 2002

Systems Operation Testing and Adjusting

C-10 and C-12 Truck Engines

1YN1-Up (Engine)
2PN1-Up (Engine)

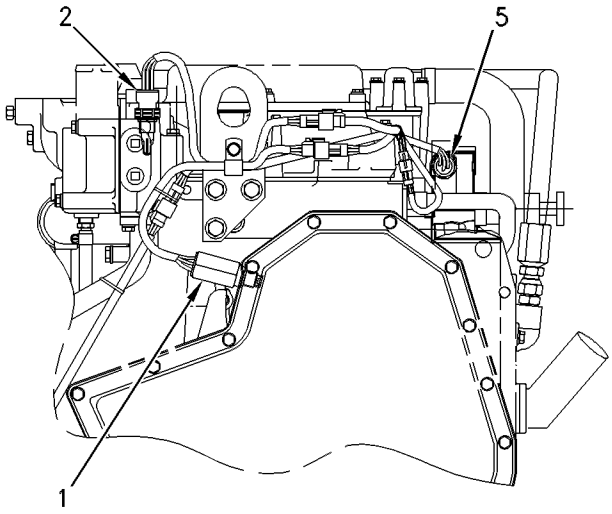

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Illustration 4

Front View

(1) Speed sensor or timing sensor
(2) Coolant temperature sensor
(5) Fuel temperature sensor

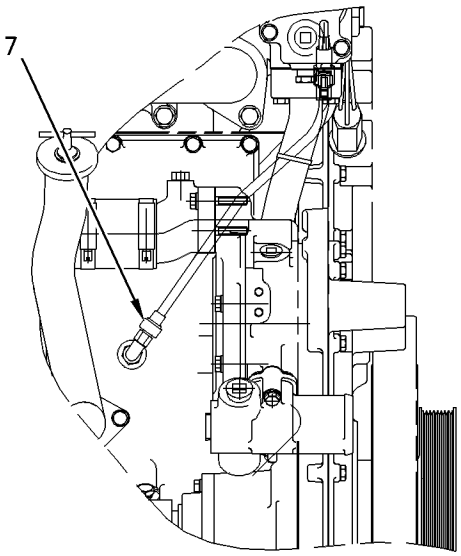

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Illustration 5

Right Side View

(7) Oil pressure sensor

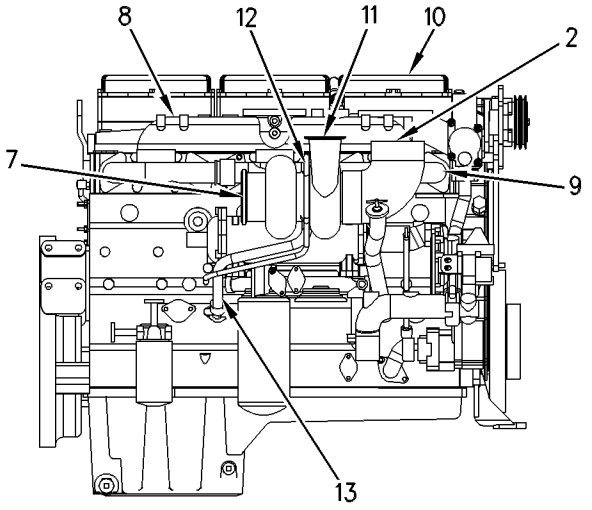

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Illustration 15

Air inlet and exhaust system components

(2) Air inlet
(7) Exhaust outlet
(8) Inlet manifold
(9) Exhaust manifold
(10) Valve mechanism cover
(11) Turbocharger
(12) Oil inlet line
(13) Oil drain line

The components of the air inlet and exhaust system control the quality of the air that is available for combustion. These components also control the amount of the air that is available for combustion. The system includes all the components in the illustrations plus an air cleaner.

Inlet air is pulled through the air cleaner into air inlet (2) by turbocharger compressor wheel (3). The air is compressed. The compression of the air heats the air. The air is pushed through the aftercooler (1). The temperature of the air is lowered while the air flows through the aftercooler. Cooling of the inlet air increases combustion efficiency. Increased combustion efficiency helps to lower fuel consumption. Also, increased combustion efficiency helps to increase the horsepower output.

From the aftercooler, air is forced into inlet manifold (8). Air flow from the inlet chambers into the cylinders is controlled by inlet valves (4). There are two inlet valves and two exhaust valves (5) in the cylinder head for each cylinder. Inlet valves open when the piston moves down on the intake stroke. When the inlet valves open, cooled compressed air from the inlet chamber within the inlet manifold is pulled into the cylinder. The inlet valves close and the piston begins to move up on the compression stroke. The air in the cylinder is compressed. When the piston is near the top of the compression stroke, fuel is injected into the cylinder. The fuel mixes with the air and combustion starts. During the power stroke, the combustion force pushes the piston downward. The exhaust valves open and the exhaust gases are pushed through the exhaust port into exhaust manifold (9).

After the piston makes the exhaust stroke, the exhaust valves close and the cycle starts again. The complete cycle consists of four stages:

- inlet stroke
- compression stroke
- power stroke
- exhaust stroke

Exhaust gases from the exhaust manifold enter the turbine side of the turbocharger in order to turn the turbocharger turbine wheel (6). The turbine wheel is connected to the shaft that drives the compressor wheel. Exhaust gases from the turbocharger pass through exhaust outlet (7), a muffler and an exhaust stack.

Turbocharger

The turbocharger is mounted to the exhaust manifold of the engine. All the exhaust gases go from the exhaust manifold through the turbocharger.

The exhaust gases go into the turbocharger. The exhaust gases then push the blades of the turbocharger turbine wheel. This causes the turbocharger turbine wheel to spin. Because the turbocharger turbine wheel is connected by a shaft to the turbocharger compressor wheel, the compressor wheel can turn at very high speeds. Clean air from the air cleaner is pulled through the compressor housing air inlet by rotation of the compressor wheel. The action of the compressor wheel blades causes a compression of the inlet air. This compression gives the engine more power by allowing the engine to burn more air and fuel during combustion.

The element has a specific amount of inhibitor for acceptable cooling system protection. As the coolant flows through the element, the corrosion inhibitor, which is a dry material, disperses into the coolant. The coolant and the inhibitor are mixed to the correct concentration. Two basic types of elements are used for the cooling system, the precharge and the maintenance elements. Each type of element has a specific use. Each type of element must be used correctly to get the necessary concentration for the cooling system protection. The elements also contain a filter. Even after the conditioner material is dispersed, the elements should be left in the system so the coolant flows through the filter.

The precharge element has an excess amount of inhibitor. The precharge element is used when a system is first filled with new coolant. This element must add enough inhibitor in order to bring the complete cooling system up to the correct concentration.

The maintenance elements have a normal amount of inhibitor and the maintenance elements are installed at the first change interval. The maintenance elements provide enough inhibitor in order to keep the corrosion protection at an acceptable level. After the first change interval, only the maintenance elements are installed at the specified intervals in order to give the protection to the cooling system.

Coolant for Air Compressor

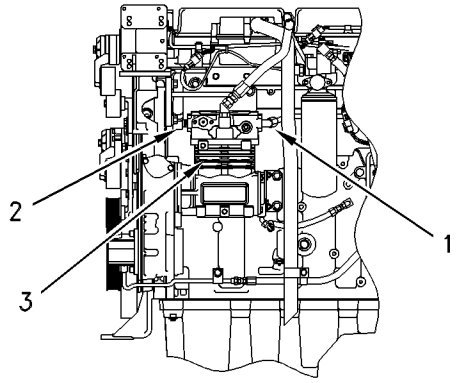

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Illustration 30

Coolant Flow for Air Compressor

(1) Inlet hose
(2) Outlet hose
(3) Air compressor

The coolant that is used for the air compressor (3) comes from the cylinder head through the inlet hose (1). The coolant exits the air compressor through outlet hose (2) and flows back to the cylinder head.

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Basic Engine

SMCS Code: 1200

Cylinder Block

The cylinder block is a unique design with a deep counterbore that supports the cylinder liner. The cylinder block also forms the coolant jacket. Two oil manifolds are provided in the cylinder block for engine lubrication. The manifold on the lower right side of the cylinder block provides oil to the following components:

- Piston cooling jets
- Crankshaft bearings
- Oil filter base

The manifold on the upper left side of the cylinder block provides oil to the following components:

- Camshaft bearings
- Valve mechanism

The manifold on the right supplies oil to the manifold on the left. The oil travels through the cut above the number one main bearing and the cut above the number four main bearing.

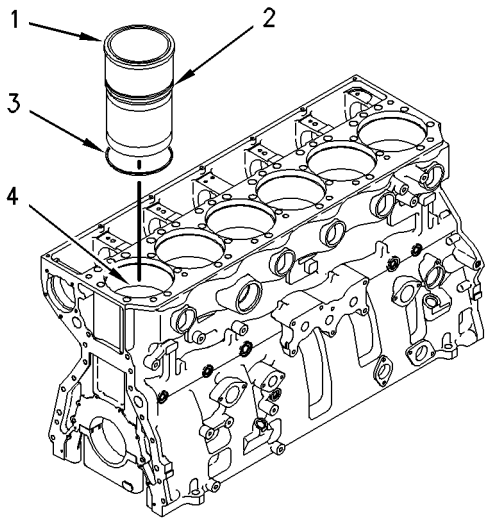

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Illustration 31

If the fuel pressure is low 517 kPa (75 psi) or less, stop the engine. Replace the fuel filter. Check the fuel lines in order to ensure that the fuel lines are not plugged. Make sure that the fuel lines are not damaged.

Start the engine and again check the fuel pressure. If the fuel pressure is still low, check the fuel regulator valve in the fuel transfer pump.

Stop the engine if the fuel pressure is at 690 kPa (100 psi) or above 690 kPa (100 psi). Remove the orificed valve from the connector. The valve is directly behind the return line fitting. Check for debris that is plugging the orifice holes near the tip. If the orifice holes are plugged, flush any remaining debris from the return passage. Then check the source of debris. If the orifice holes are not plugged, check for a plugged return fuel line. If the return fuel line is not plugged, check the regulator valve in the fuel transfer pump for debris or for rust.

Fuel Pressure

Table 2

Required Tools		
Part Number	**Part Name**	**Quantity**
1U-5470	Engine Pressure Group	1

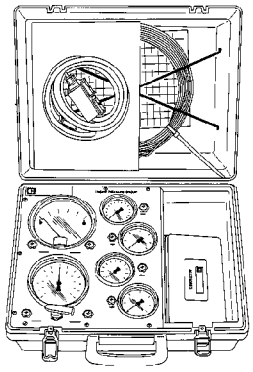

Illustration 45 g00293196

1U-5470 Engine Pressure Group

Refer to Special Instruction, SEHS8907, “Using The 1U-5470 Engine Pressure Group”.

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. Clean up fuel spills immediately.

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, “Caterpillar Tools and Shop Products Guide” for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

1. Use the following procedure to measure the fuel pressure after the secondary filter:

Note: Fuel pressure readings near the fuel supply manifold have pressure spikes. The pressure spikes are caused by excess fuel that is returning to the fuel system from the injectors. Excessive needle movement at the gauge may be present. Connect the gauge with a section of suitable hose. The air in the hose absorbs the spikes. This gives an average reading and a steady needle. Keep the gauge above the measuring point.

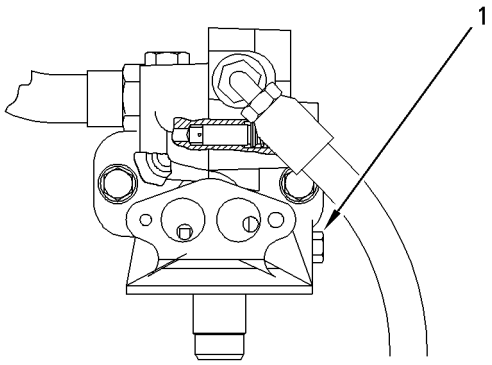

Illustration 46 g00824204

Standard Secondary Fuel Filter Base

(1) Proper Port

a. If the fuel filter base is mounted on the fuel supply manifold, install the 1U-5470 Engine Pressure Group into port (1). This port is the proper test port.

NOTICE
Do not use caustic cleaners to clean the air-to-air aftercooler core.

Caustic cleaners will attack the internal metals of the core and cause leakage.

Inlet Manifold Pressure

Normal inlet manifold pressure with high exhaust temperature can be caused by blockage of the aftercooler core fins. Clean the fins of the aftercooler core. Refer to “Visual Inspection” for the cleaning procedure.

Low inlet manifold pressure and high exhaust manifold temperature can be caused by any of the following conditions:

Plugged air cleaner – Clean the air cleaner or replace the air cleaner, as required. Refer to the Operation and Maintenance Manual.

Blockage in the air lines – Blockage in the air lines between the air cleaner and the turbocharger must be removed.

Aftercooler core leakage – Aftercooler core leakage should be pressure tested. Refer to the “Aftercooler Core Leakage” topic for the correct testing procedure.

Leakage of the induction system – Any leakage from the pressure side of the induction system should be repaired.

Inlet manifold leak – An inlet manifold leak can be caused by the following conditions: loose fittings and plugs, missing fittings and plugs, damaged fittings and plugs, and leaking inlet manifold gasket.

Aftercooler Core Leakage

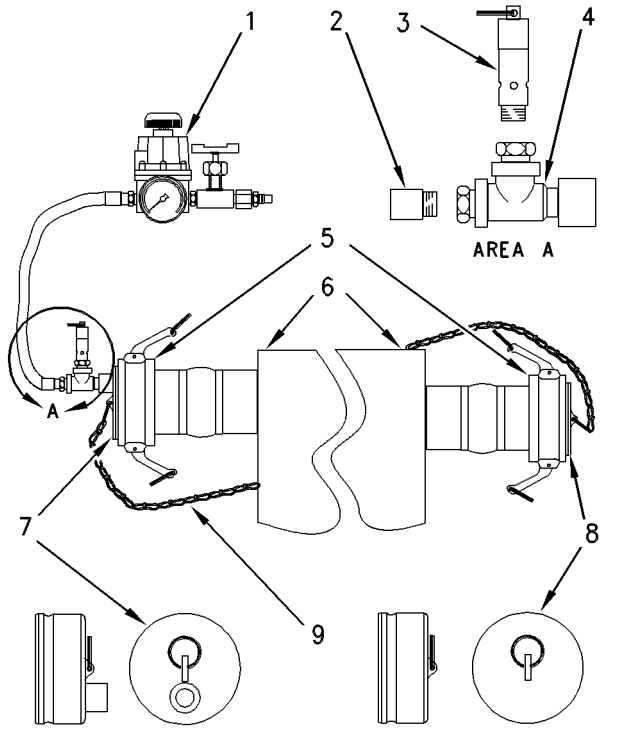

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Illustration 62

FT-1984 Aftercooler Testing Group

(1) Regulator and valve assembly
(2) Nipple
(3) Relief valve
(4) Tee
(5) Coupler
(6) Aftercooler
(7) Dust plug
(8) Dust plug
(9) Chain

A low power problem in the engine can be the result of aftercooler leakage. Aftercooler system leakage can result in the following problems:

- Low power
- Low boost pressure
- Black smoke
- High exhaust temperature

NOTICE
Remove all air leaks from the system to prevent engine damage. In some operating conditions, the engine can pull a manifold vacuum for short periods of time. A leak in the aftercooler or air lines can let dirt and other foreign material into the engine and cause rapid wear and/or damage to engine parts.

Remove any deposits that are found on these items, and remove any material that is found on these items.

2. Put the filler cap on the 9S-8140 Pressurizing Pump.

3. Check the gauge for the exact pressure that is required to open the filler cap.

4. Compare the gauge's reading with the specification of the filler cap:

5. If the filler cap is damaged, replace the filler cap.

Testing The Radiator And Cooling System For Leaks

Table 16

Tools Needed		
Part Number	**Part Name**	**Quantity**
9S-8140	Pressurizing Pump	1

Use the following procedure to check the cooling system for leaks:

⚠ WARNING

Personal injury can result from hot coolant, steam and alkali.

At operating temperature, engine coolant is hot and under pressure. The radiator and all lines to heaters or the engine contain hot coolant or steam. Any contact can cause severe burns.

Remove filler cap slowly to relieve pressure only when engine is stopped and radiator cap is cool enough to touch with your bare hand.

Cooling System Conditioner contains alkali. Avoid contact with skin and eyes.

1. After the engine cools, carefully loosen the filler cap. Slowly release the pressure from the cooling system and remove the filler cap.

2. Ensure that the coolant level is above the top of the radiator cores.

3. Put the 9S-8140 Pressurizing Pump onto the radiator.

4. Pressurize the cooling system to a pressure that is 20 kPa (3 psi) greater than the rated pressure of the filler cap.

5. Check the radiator for external leakage.

6. Check all cooling system hoses for cracking or stretching. Check all hose connections for leakage.

7. Check for indications of coolant leakage from the water pump seal.

8. Ensure that the water pump's weep hole is not plugged with debris.

The cooling system is not considered to have leakage if the following conditions exist:

- The cooling system retains a constant test pressure for at least five minutes.
- No external leakage is observed.

The cooling system may have an internal leak if the following conditions exist:

- The cooling system does not hold the test pressure for the required five minutes.
- Coolant has not been observed leaking from the engine.

An internal leak can also be detected by regularly scheduled oil sampling. Internal leakage of engine coolant will be indicated by a scheduled oil sampling result that indicates a positive test result for ethylene glycol in the engine oil.

Investigate the cause of coolant that has been found in the engine oil by removing the engine oil pan and investigating the cause of the leakage.

Note: If the weep hole becomes obstructed, then coolant may be forced past the water pump's gasket into the crankcase.

If an internal leak is found, it is absolutely necessary that the cause of the leakage be investigated prior to engine repair. If the cause of the leak is not determined, repairing the leakage may not resolve the problem.

Ensure that the cause of any internal leakage is addressed prior to repairing the leak.

Make any repairs, as required.

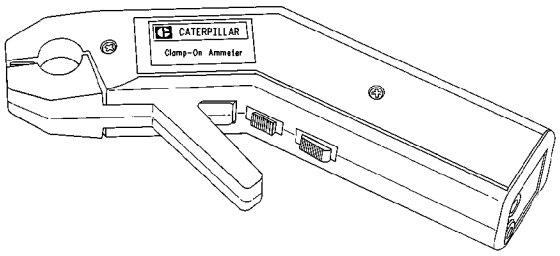

Illustration 93 g00296441

8T-0900 Ammeter

The 8T-0900 Ammeter is completely portable. This ammeter is a self-contained instrument that measures electrical currents without breaking the circuit and without disturbing the conductor's insulation.

The ammeter contains a digital display that is used to monitor current directly within a range between 1 ampere and 1200 amperes. If an optional 6V-6014 Cable is connected between this ammeter and a digital multimeter, current readings can be viewed directly from the display of the multimeter. This can be accomplished only if the current is less than one ampere.

A lever opens the ammeter's jaws over a conductor. The conductor's diameter cannot be larger than 19 mm (.75 inch).

The spring loaded jaws close around the conductor for measuring the current. A trigger switch controls the ammeter. The trigger switch can be locked into the ON position or into the OFF position.

After the trigger has been working and the trigger is turned to the OFF position, the reading appears in the digital display for five seconds. This accurately measures currents in areas with a limited access. For example, these areas include areas that are beyond the operator's sight. For DC operation, an ammeter contains a zero control, and batteries inside the handle supply the power.

Note: Refer to Special Instruction, SEHS8420 for more information about using the 8T-0900 Ammeter.

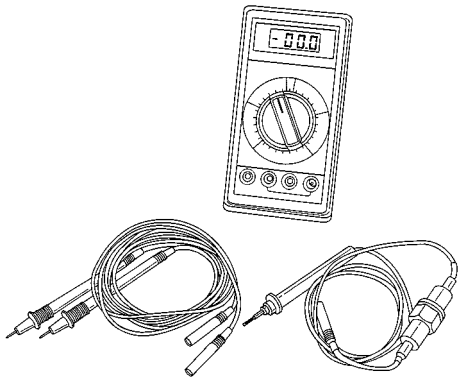

Illustration 94 g00283566

6V-7070 Digital Multimeter

The 6V-7070 Digital Multimeter is a completely portable, hand-held instrument with a digital display. This multimeter is built with extra protection against damage in field applications. The multimeter is equipped with 7 functions and 29 ranges. The 6V-7070 Digital Multimeter has an instant ohms indicator. This indicator permits checking continuity for a fast inspection of the circuits. The multimeter can also be used for troubleshooting capacitors that have small values.

Note: Refer to Special Instruction, SEHS7734 for complete information for the use of the 6V-7070 Digital Multimeter.

Battery

⚠ WARNING

Never disconnect any charging unit circuit or battery circuit cable from the battery when the charging unit is operated. A spark can cause an explosion from the flammable vapor mixture of hydrogen and oxygen that is released from the electrolyte through the battery outlets. Injury to personnel can be the result.

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.

NOTICE

The charging unit will be damaged if the connections between the battery and the charging unit are broken while in operation. Damage occurs because the load from the battery is lost and because there is an increase in charging voltage. High voltage will damage the charging unit, the regulator, and other electrical components.