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ENGINE—FD620D, K SERIES

Page

SPECIFICATIONS

TEST AND ADJUSTMENT SPECIFICATIONS

Engine

Oil Pressure Sensor Activates	98 kPa (14.2 psi)
Oil Pressure While Cranking (Minimum)	28 kPa (4 psi)
Oil Pressure	138—272 kPa (20—40 psi)
Oil Filter Bypass Valve Opening Pressure	78.5—117.5 kPa (11.4—17.1 psi)
Cylinder Compression Pressure (Minimum)	1171 kPa (170 psi)
Maximum Compression Pressure Variation Between Cylinders	97 kPa (14 psi)
Crankcase Vacuum (Minimum)	25 mm (1 in.) water
Intake and Exhaust Valve Clearance (Cold)	0.25 mm (0.01 in.)
Intake and Exhaust Valve Adjustment Interval	300 hrs
Valve Clearance Adjusting Nut Torque	9 N•m (79 lb-in.)

Fuel/Air System

Fuel Pump

Minimum Flow—425	300 mL (10 oz) in 10 seconds
Minimum Pressure (Carburetor—425)	10 kPa (1.5 psi)
Minimum Pressure (Fuel Injection—445)	172—186 kPa (25—27 psi)

Carburetor

SLOW Idle Mixture Screw Initial Setting	1 turn counterclockwise after lightly seating
SLOW Idle Stop Screw Setting	50 rpm less than throttle control arm SLOW idle stop screw setting
Throttle Lever Friction Disks	18—35 N (4—8 lb force)

Throttle Cable

Throttle Control Arm SLOW Idle Stop Screw Setting	1500 ± 100 rpm
Throttle Control Arm FAST Idle Stop Screw Setting	3600 ± 100 rpm
Air Restriction Indicator	(optional)

Fuel Tank

Check Valve Opening Pressure (Maximum)	3 kPa (0.4 psi)

Cooling System

Radiator

Maximum Test Pressure	117 kPa (17 psi)
Minimum Hold Pressure	90 kPa (13 psi)

Radiator Cap

Opening Pressure	83–96 kPa (12–14 psi)
Minimum Pressure	76 kPa (11 psi)

Thermostat

Begin-to-Open Temperature	63—66°C (145—150°F)
Full-Open Temperature	80°C (176°F)
Full-Closed Temperature	63—66°C (145—150°F)

Fan Belt

Fan Belt Tension	12—19 mm (0.472—0.748 in.) deflection with 245—391 N (55—88 lb force) applied force

REPAIR SPECIFICATIONS

Engine

Mounting Bolts Torque	80 N•m (60 lb-ft)
Drive Shaft Coupler Screws Torque	40 N•m (30 bl-ft)

Carburetor—425

Throttle Shaft Retaining Screw Torque	2.0 N•m (17 lb-in.)
Drain Screw Torque	1.2 N•m (10 lb-in.)
Choke and Throttle Plate Screws Torque	0.88 N•m (7.8 lb-in.)
Solenoid Valve Torque	9.8 N•m (87 lb-in.)
Main Jet and Main Air Jet Torque	1.0 N•m (8.9 lb-in.)
Air Horn Mounting Screws Torque	2.9 N•m (26 lb-ft)

Throttle Body—445

Throttle Shaft Retaining Screw Torque	2.0 N•m (17 lb-in.)
Throttle Plate Screws Torque	0.88 N•m (7.8 lb-in.)
Mounting Stud Nuts Torque	17 N•m (12 lb-ft)

Plain Bearings

Maximum Crankcase Cover ID	34.07 mm (1.341 in.)
Maximum Crankcase ID	34.11 mm (1.343 in.)

Crankcase

Oil Capacity	1.5 L (3.2 pt)
Cover Cap Screw Torque	21 N•m (186 lb-in.)
Drain Plug Torque	23 N•m (204 lb-in.)
Breather Reed Valve Clearance	0.2 mm (0.008 in.)

Fuel System

Carburetor Mounting Nuts Torque	17 N•m (12 lb-ft)

Intake Manifold

Cap Screw Torque	6 N•m (53 lb-in.)
Pressure Relief Plug Torque	15 N•m 133 lb-in.)

Cylinder Head and Valves

Valve Clearance	0.25 mm (0.010 in.)

Rocker Arm

Minimum Shaft OD	11.95 mm (0.470 in.)
Maximum Bearing ID	12.07 mm (0.475 in.)
Adjuster Screw Lock Nut Torque	9 N•m (79 lb-in.)
Push Rod Maximum Bend	0.80 mm (0.031 in.)

REPAIR SPECIFICATIONS—(continued)

Valves and Springs

Valve Clearance at 16—27°C (60—80°F)	0.25 mm (0.010 in.)
Spring Free Length	29.70 mm (1.170 in.)
Minimum Valve Stem OD	
Intake	5.94 mm (0.234 in.)
Exhaust	5.92 mm (0.233 in.)
Maximum Valve Guide ID	6.05 mm (0.238 in.)
Maximum Valve Stem Bend	0.03 mm (0.001 in.)
Standard Valve Seating Surface	0.80 mm (0.031 in.)
Valve Seating Width Tolerance	0.50—1.10 mm (0.020—0.043 in.)
Valve Seat and Face Angle	45°
Minimum Valve Margin	0.60 mm (0.024 in.)
Valve Narrowing Angle	30°

Push Rods

Maximum Run-Out	0.8 mm (0.03 in.)

Cylinder Head

Cylinder Head Flatness	0.06 mm (0.002 in.)
Cap Screw Torque in Sequence (Lubricated)	
Initial Torque	13 N•m (115 lb-in.)
Final Torque	21 N•m (186 lb-in.)
Spark Plug Torque	25 N•m (221 lb-in.)

Flywheel

Flywheel Nut Torque	108 N•m (80 lb-ft)
Flywheel Sheave Torque	15 N•m (130 lb-in.)
Fan Belt Tension Adjustment	
Increase	Remove shim(s)
Decrease	Add shim(s)
Fan Belt Drive Sheave Screw Torque	15 N•m (133 lb-in.)

Camshaft

Bearing Journals OD (Minimum)	15.91 mm (0.626 in.)
Minimum Lobe OD (Intake)	25.21 mm (0.993 in.)
Minimum Lobe OD (Exhaust)	25.46 mm (1.002 in.)
Minimum Fuel Pump Lobe	19.50 mm (0.760 in.)
Maximum Cover and Crankcase Bearing ID	16.07 mm (0.633 in.)

REPAIR SPECIFICATIONS—(continued)

Piston

Maximum Top Ring Groove Clearance	0.15 mm (0.006 in.)
Maximum Second Ring Groove Clearance	0.12 mm (0.005 in.)
Maximum Oil Ring Groove Clearance	Not measured
Maximum Ring End Gap	1.20 mm (0.050 in.)
Minimum Pin O.D	16.98 mm (0.668 in.)
Maximum Pin Bore ID	17.04 mm (0.671 in.)
Distance from Bottom of Piston Skirt to Measure Piston OD	11 mm (0.433 in.)
Piston OD	75.935—75.950 mm (2.989—2.990 in.)
Piston-to-Cylinder Bore Clearance	0.030—0.170 mm (0.00118—0.00670 in.)

Connecting Rod

Maximum Crankshaft Bearing ID	34.06 mm (1.341 in.)
Maximum Piston Pin Bearing ID	17.05 mm (0.671 in.)
End-Cap Screw Torque	21 N•m (186 lb-in.)

Crankshaft

Minimum Bearing Journal OD	33.91 mm (1.335 in.)
Minimum Connecting Rod Journal	33.93 mm (1.336 in.)
Maximum T.I.R. (Bend)	0.05 mm (0.002 in.)

Crankshaft Plain Bearings

Maximum Crankcase Cover ID	34.07 mm (1.341 in.)
Maximum Crankcase ID	34.11 mm (1.343 in.)

Cylinder Bore

Standard ID	75.98—76.00 mm (2.994—2.995 in.)
Maximum ID	76.07 mm (2.997 in.)

Cylinder Block Reboring

Oversize Diameter 0.50 mm	76.46—76.48 mm (3.012—3.013 in.)

REPAIR SPECIFICATIONS—(continued)

Oil Pump

Cover Cap Screws Torque	7.8 N•m (69 lb-in.)
Minimum Rotor Shaft OD	10.92 mm (0.430 in.)
Maximum Rotor Shaft Bearing ID	11.07 mm (0.436 in.)
Minimum Outer Rotor OD	40.43 mm (1.592 in.)
Maximum Outer Rotor Bearing ID	40.80 mm (1.606 in.)
Minimum Relief Valve Spring Free Length	19.50 mm (0.770 in.)
Maximum Inner and Outer Rotor Clearance	0.3 mm (0.012 in.)
Maximum Pump Housing Depth	10.230 mm (0.403 in.)
Maximum Outer Rotor Thickness	9.830 mm (0.3870 in.)

Coolant Pump

Minimum Shaft OD	9.94 mm (0.391 in.)
Maximum Pump and Crankcase Housing Bore ID	10.09 mm (0.397 in.)
Cap Screw Torque	9—11 N•m (79—96 lb-in.)
Crankcase Cover Cap Screw Torque	23—28 N•m (17—20 lb-ft)

Over-flow Reservoir

Mounting Cap Screw Torque	4 N•m (31 lb-in.)

Governor

Governor Arm Nut Torque	7.88 N•m (69 lb-in.)
Shaft Oil Seal	1.0 mm (0.004 in.) below crankcase surface

Charging System

Capacity	20 amps
Unregulated Stator Output	26 VAC @ 3000 rpm
Regulated Stator Output	15 VDC @ 3000 rpm

Injector

Resistance at 20°C (68°F)	13.8 ohms

Ignition System

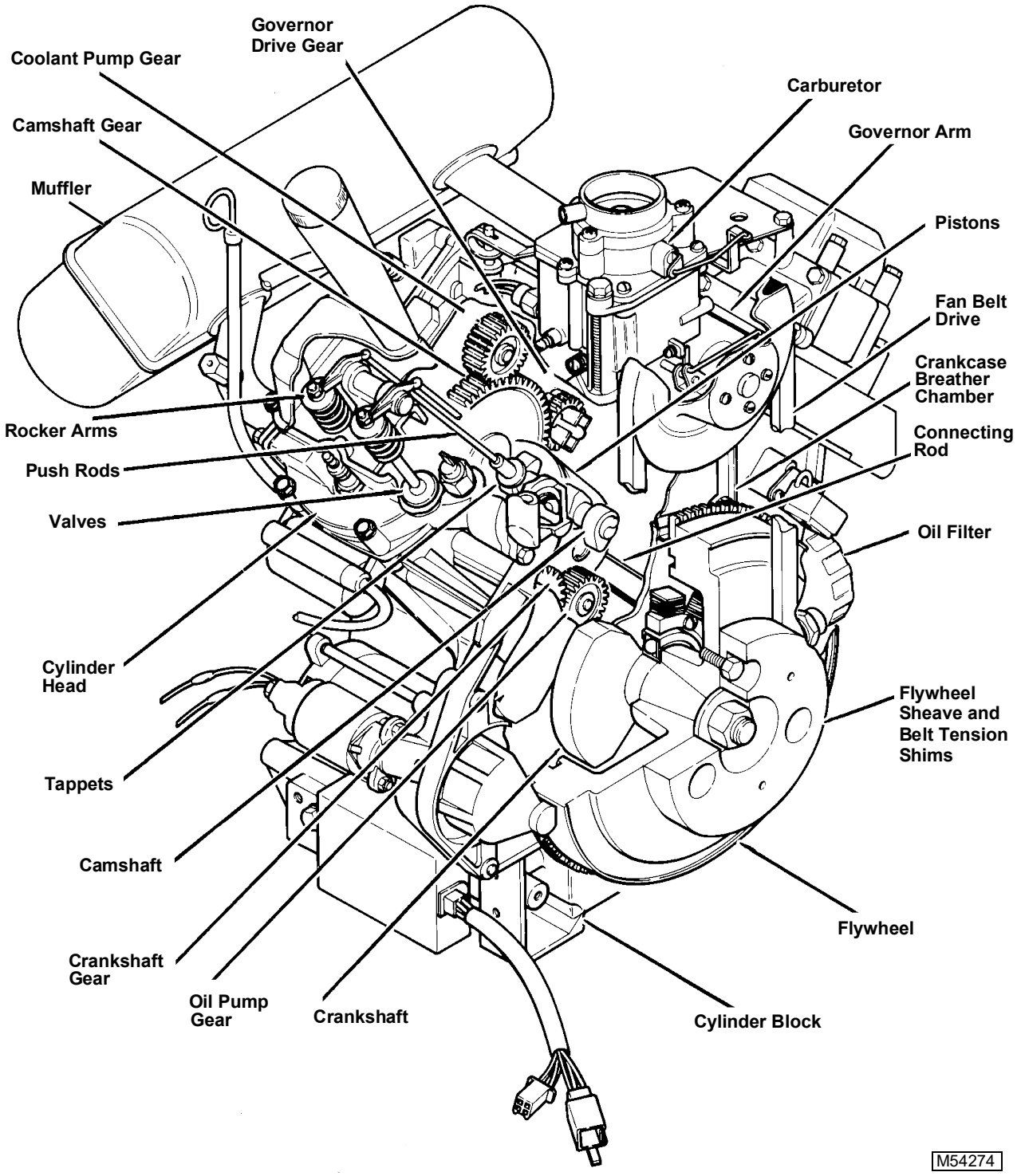
Pulser Output	0.1—1.0 VAC

Electric Starter

Minimum Brush Length	6 mm (0.240 in.)
Maximum No Load Starter Draw	30 amps at 6000 rpm (min)

COMPONENT LOCATION

ENGINE—FD620D



Cutaway—FD620D

THEORY OF OPERATION

COOLING SYSTEM OPERATION

Function:

The coolant pump circulates coolant through the cooling system, drawing hot coolant from the engine block, and circulating it through the radiator for cooling.

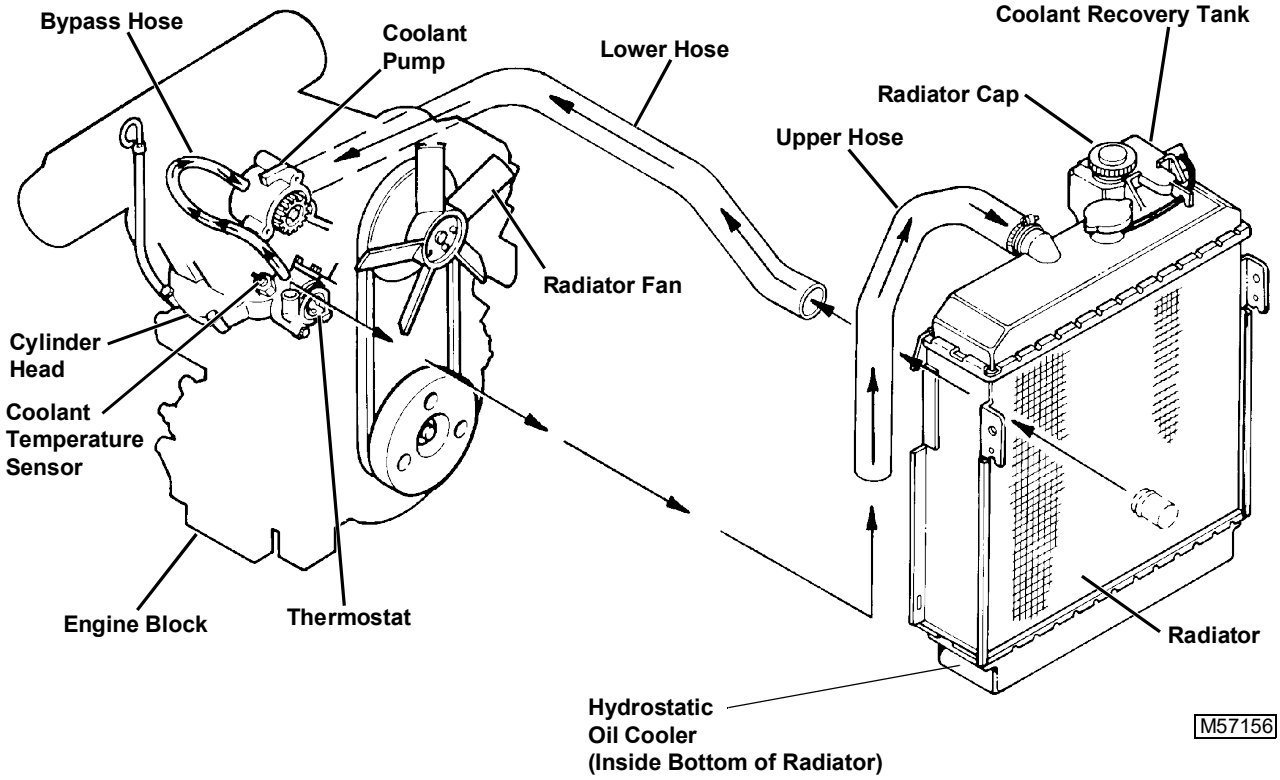
System Operation:

The impeller-type coolant pump draws coolant from the bottom of the radiator when the thermostat is open or from the bypass when the thermostat is closed. Coolant from the water pump flows to the water jackets in block, up through cylinder heads, intake manifold, past the coolant temperature sensor and thermostat.

When the engine temperature is below approximately 66°C (150°F), the thermostat is closed and coolant is directed back to the water pump through bypass hose to be recirculated. This allows the engine to warm up to operating temperature quickly.

When the engine temperature is approximately 66°C (150°F), the thermostat begins to open and is fully open at 80°C (176°F). Coolant from the water jackets and cylinder heads now flow through the thermostat to the radiator, which is cooled by the radiator fan. The fan is driven by a belt off the crankshaft pulley.

The radiator cap maintains a constant pressure of 90 kPa (13 psi) inside the radiator which actually raises the boiling point of the coolant. The radiator cap contains a pressure valve and a vacuum valve. When the coolant is hot and pressure is above 90 kPa (13 psi), the pressure valve opens allowing some coolant to flow to the recovery tank. After the engine is stopped, the coolant cools and the pressure inside the radiator decreases. The pressure difference between the radiator and recovery tank forces the vacuum valve open and some coolant from the recovery tank flows back to the radiator.



CARBURETED ENGINE FUEL AND AIR SYSTEM OPERATION—425

Function:

The fuel system supplies pressurized fuel to the carburetor for combustion. The air intake system filters air needed for combustion.

System Operation:

An electric fuel pump mounted inside the fuel tank provides pressurized fuel to the carburetor. The fuel pump uses the fuel for lubrication and cooling. The fuel pump draws fuel through the fuel pump filter. Low pressure fuel from the fuel pump flows through the fuel shut-off valve and in-line fuel filter to the carburetor. Fuel pressure is maintained at the carburetor inlet needle until the float allows more fuel in the bowl. The fuel tank relief/check valve prevents gas fumes from escaping into the air for emission control. When the fuel tank starts to create a vacuum, the check valve opens and allows air into the tank, but closes for air trying to escape from the tank. The tank will pressurize up to 3 kPa (0.4 psi) before the relief valve opens and allows the air pressure out. The fuel tank cap is NOT vented (carburetor vent solenoid only).

IMPORTANT: Model (S.N. —033626) use a carburetor vent solenoid. Model (S.N. 033627—) use a fuel shut-off solenoid. System operation remains the same expect for the following differences. Lower, upper and inlet vent hoses are removed. Air restriction indicator is removed. Fuel shut-off solenoid shuts off the main jet not atmospheric pressure (vacuum), which eliminates the need for vent hoses. Fuel cap is vented instead of vent hoses with fuel tank relief/check valve.

The carburetor vent solenoid connects both sides of the carburetor venturi through lower and upper vent hoses when the solenoid is de-energized. In this condition, no vacuum is present in the carburetor to draw fuel out of the main nozzle, so the fuel flow is stopped very quickly. The ignition delay module is used with the carburetor vent/fuel shut-off solenoid to prevent backfire. The ignition delay module allows the spark plugs to fire for one additional second after the key switch is turned off to burn any remaining fuel in the cylinder. When the key switch is turned off, the carburetor vent/fuel shut-off solenoid is de-energized. When the key switch is turned on, the carburetor vent solenoid closes the venturi vent tubes, so a vacuum can be created for fuel flow.

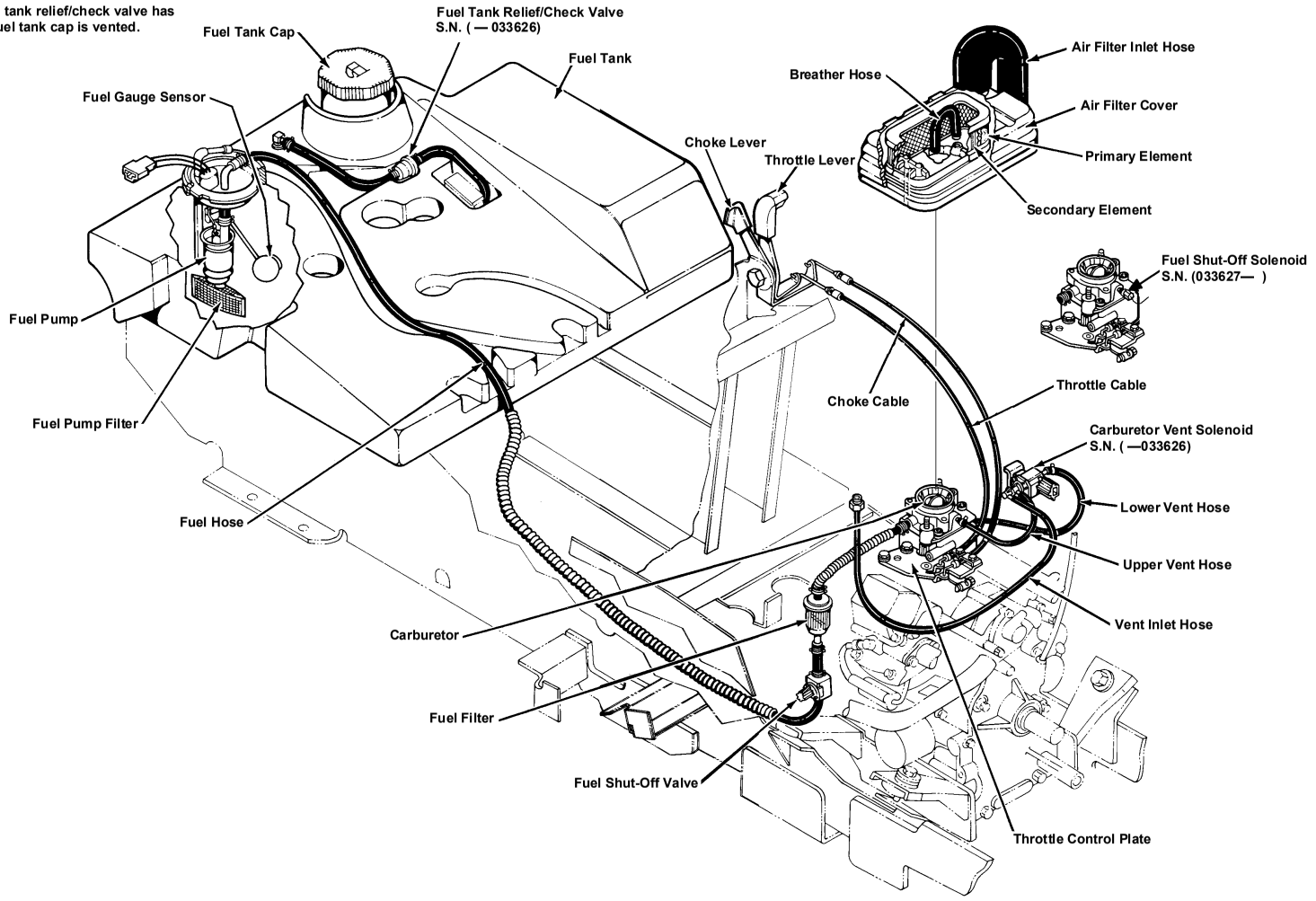
Air enters the air filter through the side panel screen and air filter inlet hose. The primary and secondary elements filter the air before entering the carburetor. The breather hose vents crankcase fumes into the carburetor for burning to decrease emissions. An air restriction indicator alerts the operator when the filters need servicing. The air restriction indicator senses the amount of vacuum in the intake system.

NOTE: Air restriction indicators are removed for model (S.N. 033627—).

A small amount of air restriction is always present due to some restriction of air movement through the filter elements. The vacuum increases as the filter elements become plugged. The indicator moves to the highest vacuum rating and holds that position until the operator resets it. An air intake leak will prevent the air restriction from operating properly.

CARBURETED ENGINE FUEL AND AIR SYSTEM COMPONENTS AND OPERATION—425

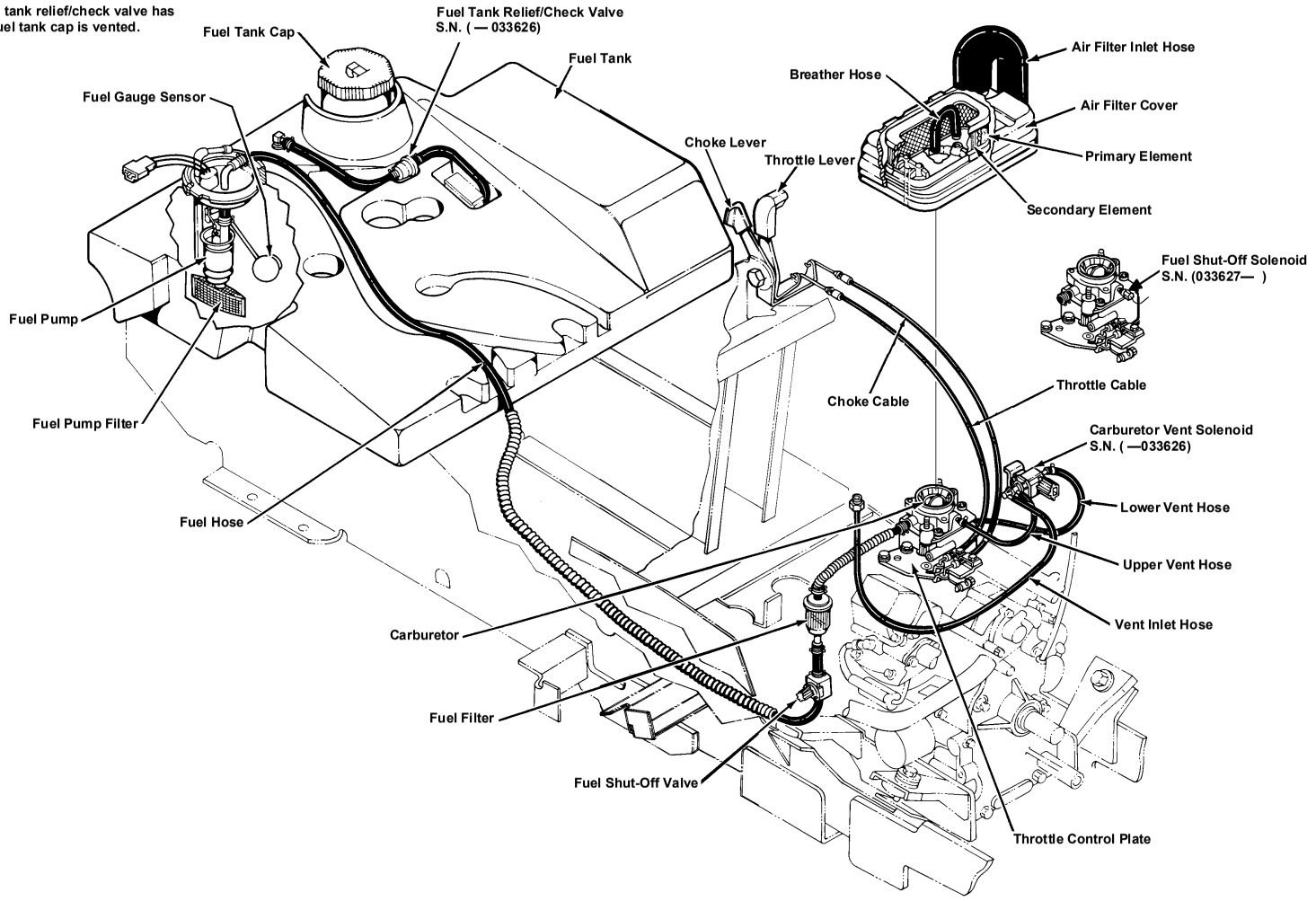
Important: Model S.N. (033627—) have fuel shut-off solenoid instead of carburetor vent solenoid and vent hoses. Air restiction indicator and fuel tank relief/check valve has been removed. Fuel tank cap is vented.



M46319

CARBURETED ENGINE FUEL AND AIR SYSTEM COMPONENTS AND OPERATION—425

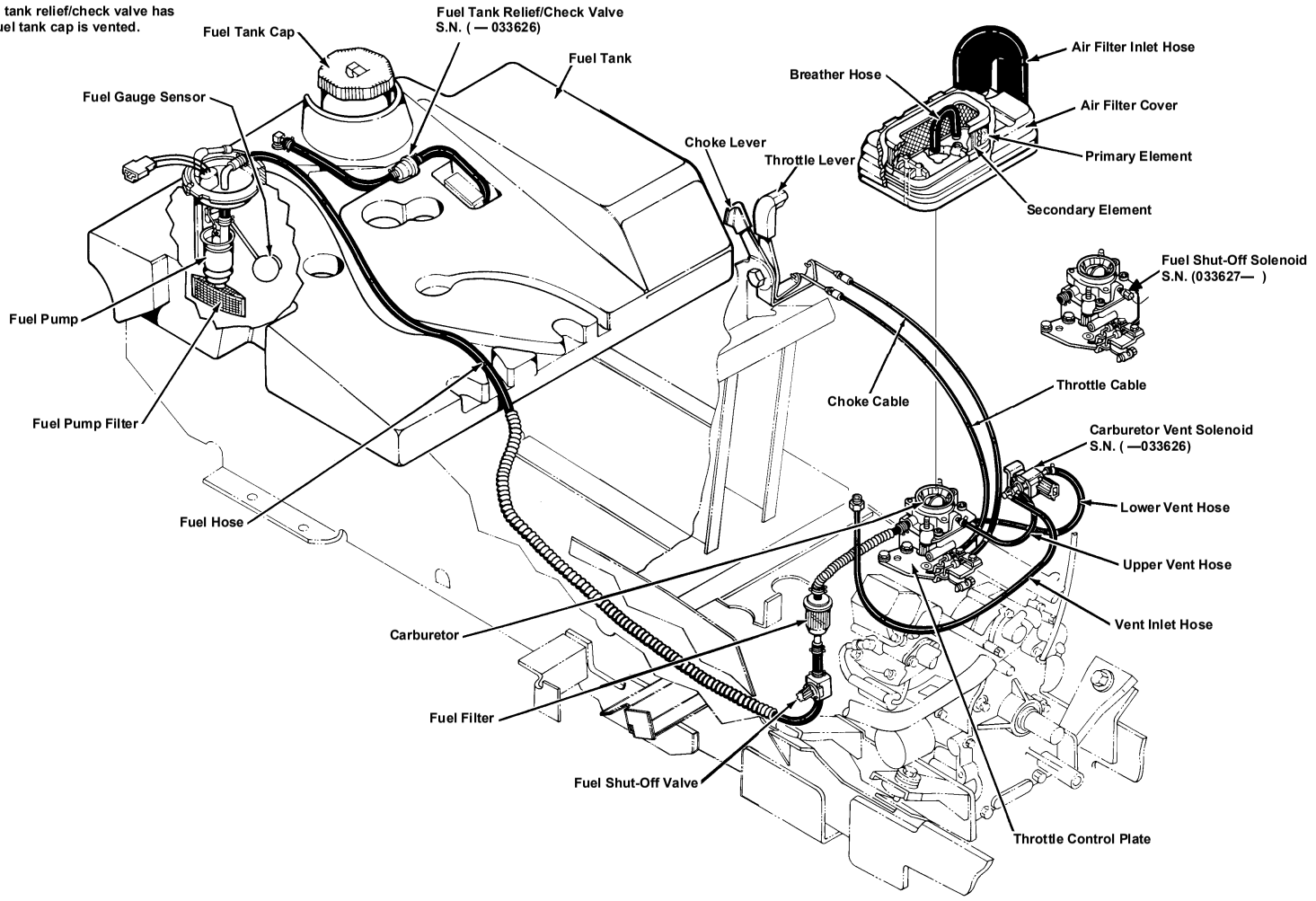
Important: Model S.N. (033627—) have fuel shut-off solenoid instead of carburetor vent solenoid and vent hoses. Air restiction indicator and fuel tank relief/check valve has been removed. Fuel tank cap is vented.



M46319

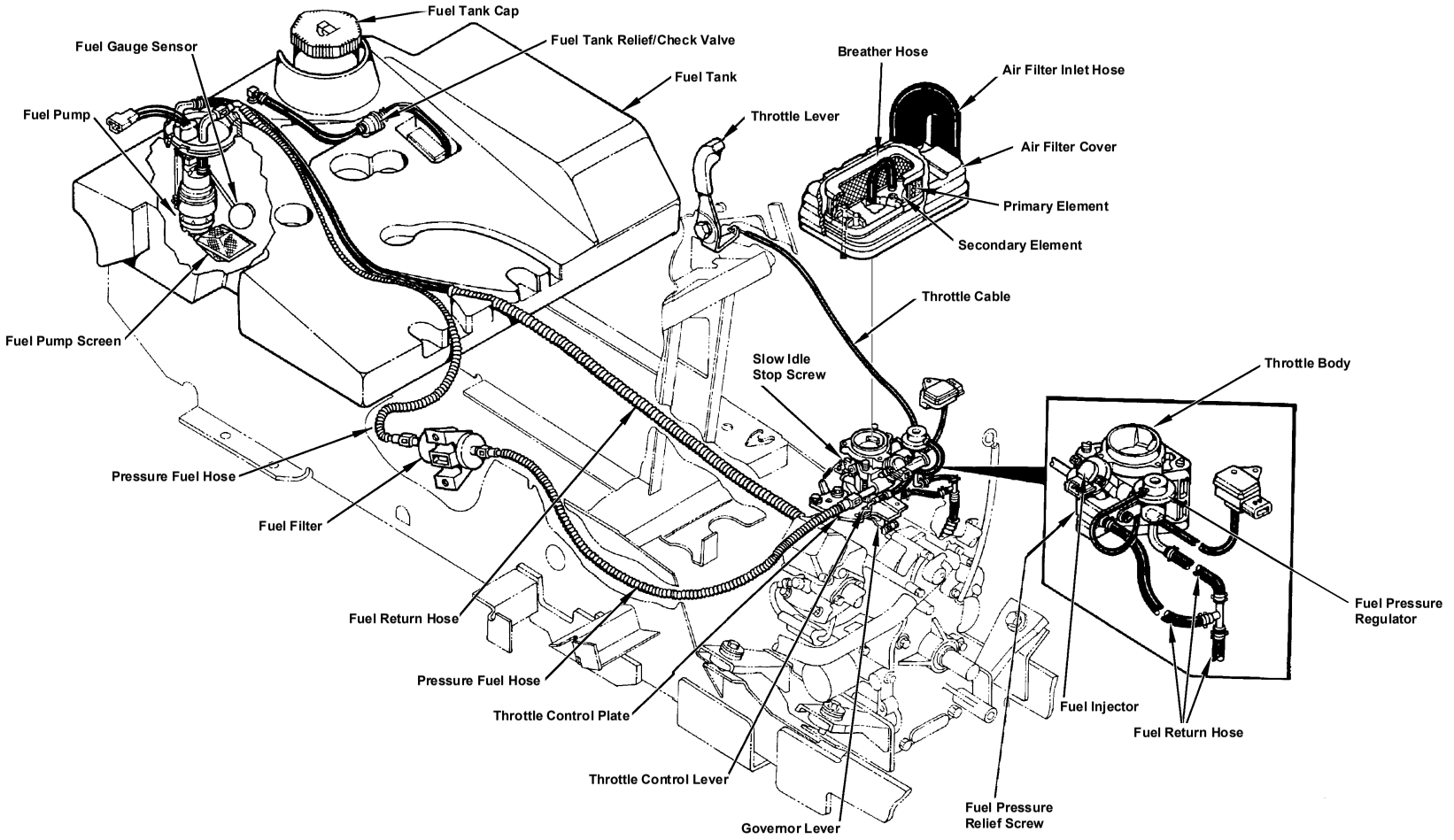
CARBURETED ENGINE FUEL AND AIR SYSTEM COMPONENTS AND OPERATION—425

Important: Model S.N. (033627—) have fuel shut-off solenoid instead of carburetor vent solenoid and vent hoses. Air restiction indicator and fuel tank relief/check valve has been removed. Fuel tank cap is vented.



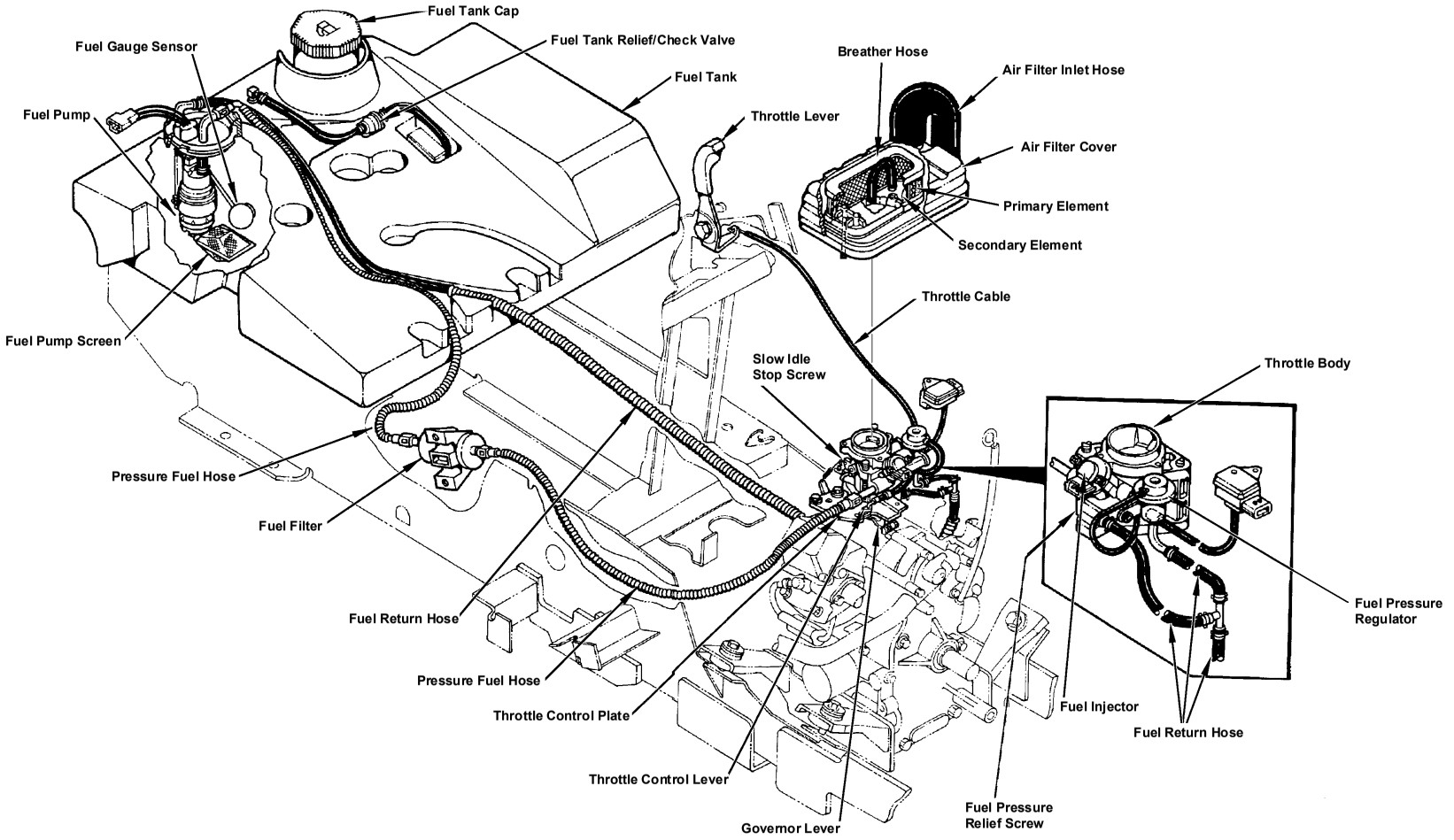
M46319

FUEL INJECTION AND AIR SYSTEM COMPONENTS AND OPERATION—445



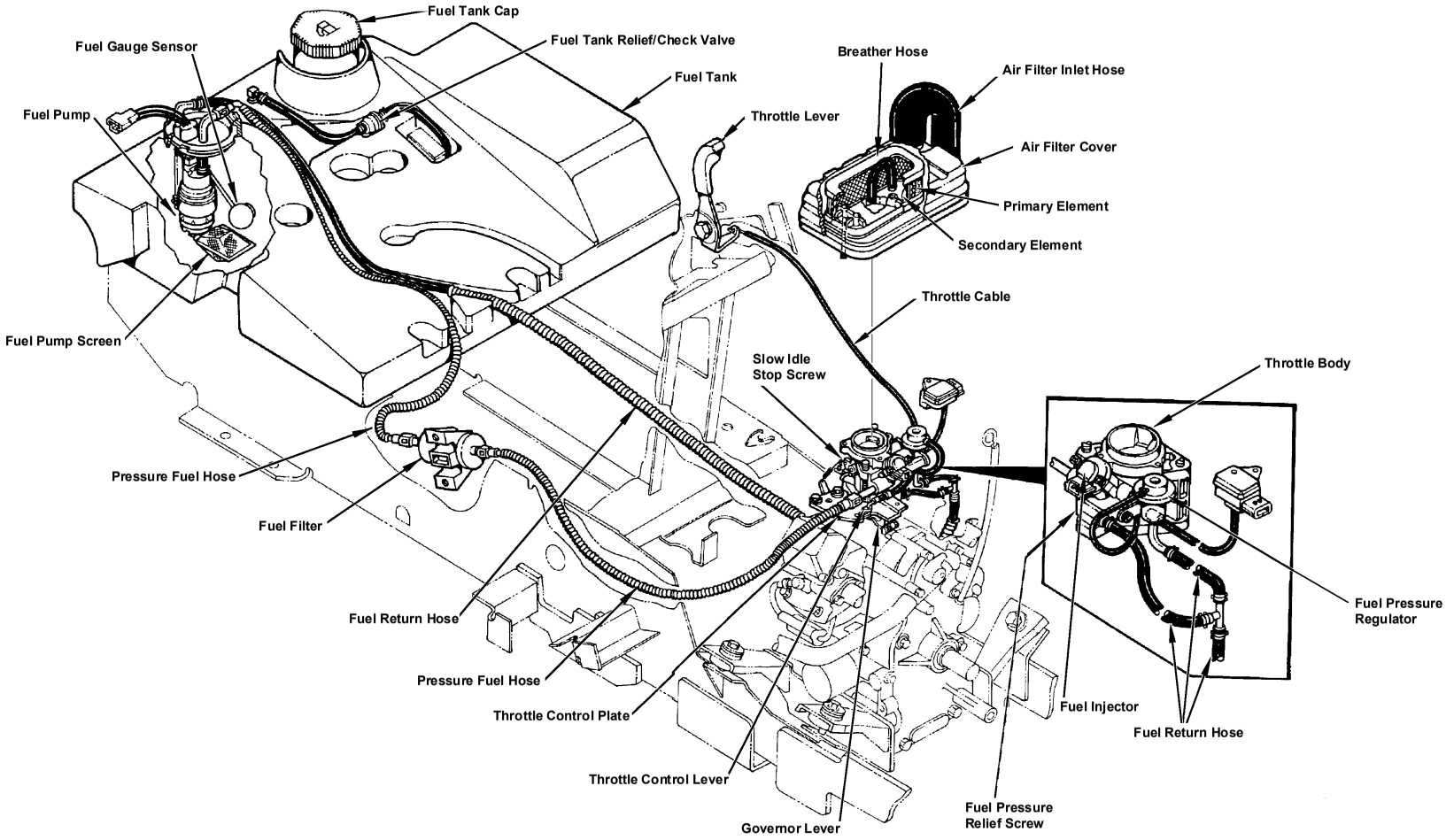
M55612

FUEL INJECTION AND AIR SYSTEM COMPONENTS AND OPERATION—445



M55612

FUEL INJECTION AND AIR SYSTEM COMPONENTS AND OPERATION—445



M55612

FUEL INJECTION AIR SYSTEM COMPONENTS AND OPERATION—445

Function:

The fuel injection system supplies pressurized fuel to the fuel injector for combustion. The air intake system filters air needed for combustion.

System Operation:

An electric fuel pump mounted inside the fuel tank provides pressurized fuel to the fuel injector. The fuel pump uses the fuel for lubrication and cooling.The fuel pump and fuel injector are controlled by the fuel injection module computer. The computer monitors engine operating and environmental conditions to calculate the amount of fuel to inject. The fuel pump draws fuel through the fuel pump screen. High pressure fuel from the fuel pump flows through the in-line fuel filter to the fuel injector and fuel pressure regulator. The fuel injector is a solenoid operated type valve with single point injection. Fuel is injected into the throttle body when the solenoid is energized by the computer. Fuel pressure is controlled by the fuel pressure regulator. The regulator is an overflow type regulator that maintains fuel pressure at the fuel injector at a constant 175 kPa (25 psi). Excess fuel flows through the regulator valve and fuel return hose to the fuel tank. The fuel tank relief/check valve prevents gas fumes from escaping into the air for emission control. When the fuel tank starts to create a vacuum, the check valve opens and allows air into the tank, but closes for air trying to escape from the tank. The tank will pressurize up to 3 kPa (0.4 psi) before the relief valve opens and allows the air pressure out. The fuel tank cap is NOT vented.

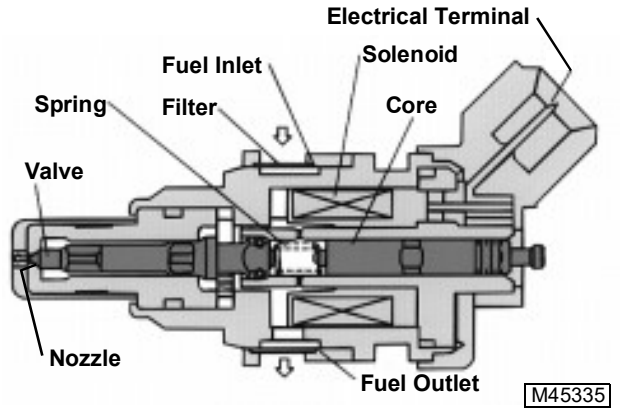
The throttle control lever, which is connected to the throttle lever and the governor lever, controls engine rpm. The governor lever is connected to the throttle valve inside the throttle body. Slow idle is adjusted by turning the slow idle stop screw and fast idle is adjusted by moving the throttle control plate.

Air enters the air filter through the side panel screen and air filter inlet hose. The primary and secondary elements filter the air before entering the throttle body. The breather hose vents crankcase fumes into the throttle body for burning to decrease emissions. An air restriction indicator alerts the operator when the filters need servicing. The air restriction indicator senses the amount of vacuum in the intake system. A small amount is always present due to some restriction of air movement through the filter elements. The vacuum increases as the filter elements become plugged. The indicator moves to the highest vacuum rating and holds that position until the operator resets it. An air intake leak will prevent the air restriction indicator from operating properly.

FUEL INJECTOR OPERATION—445

Function:

Injects fuel into the throttle body at the correct time and duration.



System Operation:

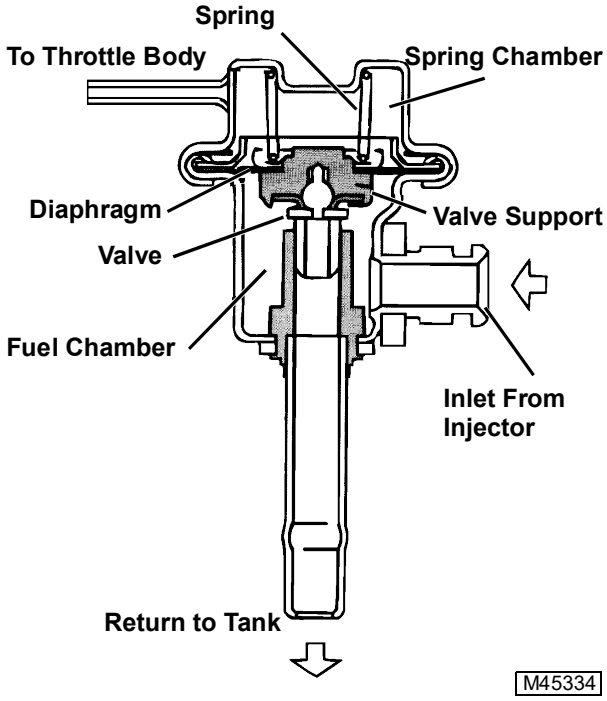
The fuel injector is a solenoid operated type valve with single point injection. Fuel is injected into the throttle body when the solenoid is energized by the computer. The amount of fuel injected depends on the length of time the injector valve is open and on fuel pressure.

High pressure fuel from the fuel pump flows through filter to the inlet passage. High pressure fuel also flows out the outlet passage to the pressure regulator. The pressure regulator maintains the correct fuel pressure needed for injection. When the solenoid is energized, the solenoid core pulls the valve open against spring tension. High pressure fuel is injected in the throttle body through the nozzle. After a precise amount of fuel is injected, the computer de-energizes the solenoid. Spring tension closes valve quickly to prevent additional leakage.

FUEL PRESSURE REGULATOR OPERATION—445

Function:

Maintains a constant differential in pressure between fuel pressure at the injector and air pressure in the throttle body. Therefore, the amount of fuel injected is determined by the opening time of the injector.



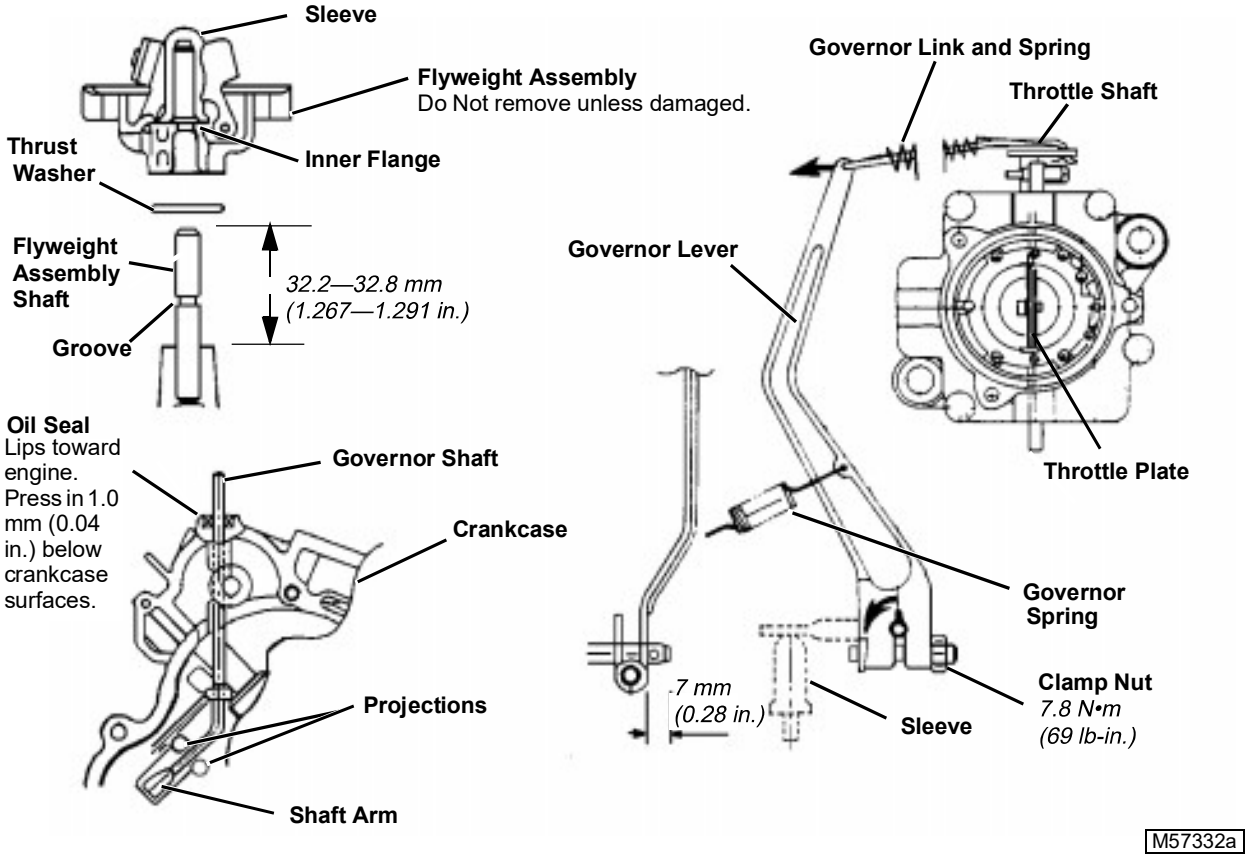
System Operation:

The pressure regulator is an overflow type regulator. The spring chamber is connected to the throttle body to insure that they are operating at the same air pressure. High pressure fuel from the injector flows to the pressure regulator inlet and fills the fuel chamber. A hose from the vacuum inlet is connected to the intake manifold. This allows the air pressure in the spring chamber and intake manifold to be equal.

When intake manifold vacuum increases, the spring chamber vacuum also increases and overcomes spring tension allowing the diaphragm to move upward. With the valve connected to the diaphragm, the valve moves upward and allows more fuel to flow out the outlet and return to the fuel tank. This lowers the fuel pressure. As intake manifold vacuum decreases, the spring chamber vacuum decreases and the spring returns the diaphragm to the original position. The valve restricts fuel flow to return and fuel pressure increases.

GOVERNOR OPERATION

IMPORTANT: Do not remove flyweight assembly or shaft unless damaged. Removal damages the assembly.

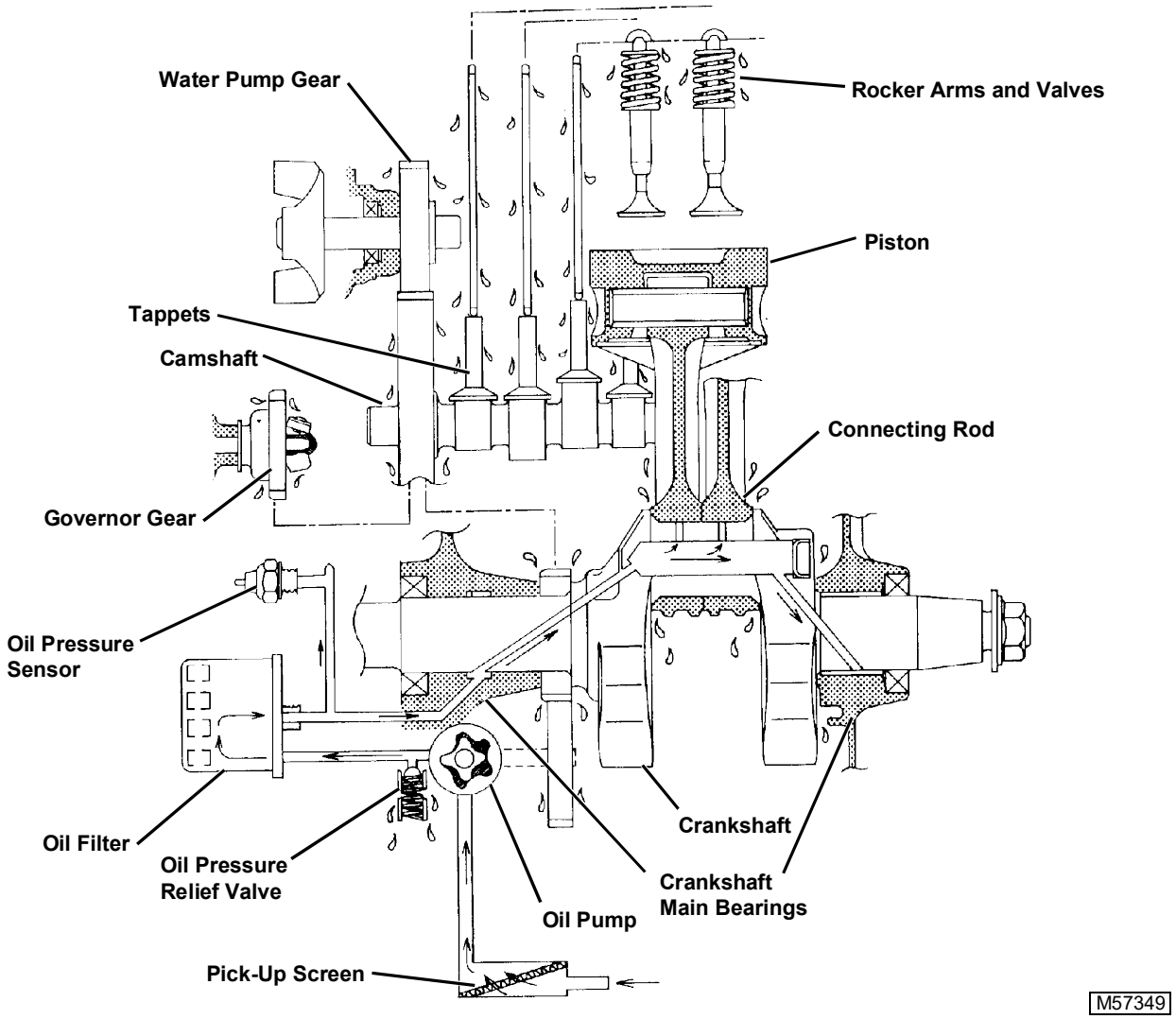


System Operation:

The governor controls engine speed. Governed engine speed is a balance between governor spring tension, set by the throttle control, and actual engine speed, countered by centrifugal force of the governor flyweights. As tension is applied to governor spring, governor linkage opens carburetor throttle shaft and plate, increasing engine rpm. As engine speed increases, flyweight assembly (driven by the crankshaft gear) pushes on governor arm, rotating governor shaft and lever, moving throttle shaft, closing throttle plate slightly and reducing rpm to governed operating speed. If a heavy load is encountered, engine speed drops, as does the governor assembly speed. Flyweights retract and allow shaft arm to move governor shaft and lever in opposite direction to open throttle plate and allow more air into venturi to draw in more fuel until engine peak operating speed is recovered. Springs provide a smooth yet responsive transitional control.

IMPORTANT: Flyweight assembly shaft is pressed into crankcase cover and is <u>not serviceable</u>. Therefore, if it is damaged or pulled loose, the crankcase cover MUST BE replaced.

LUBRICATION SYSTEM OPERATION



System Operation

A positive displacement gerotor pump is used to pressurize the lubrication system. The lubrication system is protected by an oil pressure relief valve, low oil pressure switch, and an oil filter with bypass.

The oil pump draws oil from the sump through screen. Pressure oil from the pump flows to the oil pressure relief valve. If oil pressure exceeds 296 kPa (43 psi), the relief valve opens allowing oil to return to sump. Relief valve is not adjustable.

Pressure oil from the relief valve flows to the oil filter. The filter contains a bypass valve which opens if the element becomes plugged to insure engine lubrication.

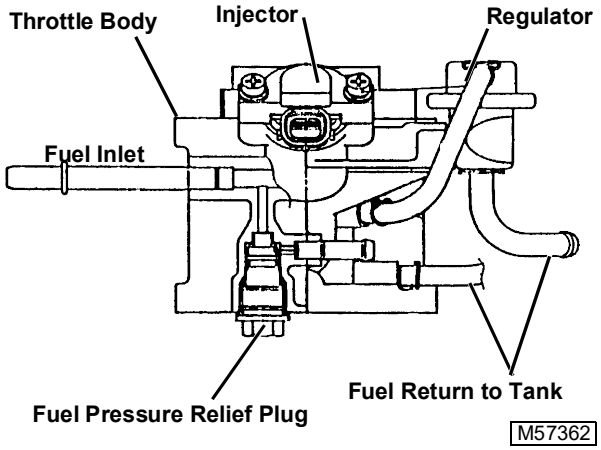
An oil pressure switch mounted above the oil filter turns on a warning light if oil pressure is below 28 kPa (4 psi). Filtered pressure oil flows through a passage in the oil sump to the crankshaft main bearing (PTO side).

Drilled passages in the crankshaft distribute oil from the main bearing to the connecting rod journals and crankshaft main bearing (flywheel side). A drilled passage in the connecting rods allows oil from the connecting rod journal to lubricate the piston and cylinder walls.

THROTTLE BODY OPERATION—445

Function:

Injects and atomizes the fuel into the intake air for the proper combustion.



System Operation:

An electric fuel pump, controlled by the computer, supplies fuel to the inlet of the throttle body to the injector. The fuel pressure regulator holds the fuel under pressure in the injector. The computer receives signals from the throttle sensor and other sensors then controls the time the injector is open. The injector injects the atomized fuel into the throat of the throttle body.

Excess fuel not used by the injector flows through the pressure regulator back to the fuel tank.

The FD620 has an extra passage in the throttle body that allows for a means to relieve the fuel pressure in the fuel lines before any work is done on the system.

TROUBLESHOOTING—425 CARBURETED ENGINES

NOTE: See Electrical Section for fuel injection chart.

Problem or Symptom / Check or Solution	Engine cranks but will not start.	Loss of power.	Engine runs erratically.	Engine misses at high rpm.	Engine misses at low rpm.	Excessive fuel consumption.	Excessive oil consumption.	Engine backfires.	Engine knocks.	Coolant leakage.	Engine overheats.
Worn or burned valves or improper clearance.											
Worn valve stem(s) or valve guide(s).											
Warped cylinder head.											
Broken valve spring.											
Defective head gasket.											
Low oil level.											
Too much oil in crankcase.											
Carburetor out of adjustment.											
Air/fuel passages clogged.											
Carbon deposits in exhaust pipe/ muffler.											
Carbon deposits in combustion chamber.											
Lack of coolant.											
Governor linkage out of adjustment.											
Faulty governor spring.											
Governor gear assembly binding or broken.											
Air being drawn through carburetor or intake manifold flanges.											
Incorrect timing gear alignment.											

TROUBLESHOOTING—425 CARBURETED ENGINES (continued)

Problem or Symptom / Check or Solution	Engine cranks but will not start.	Loss of power.	Engine runs erratically.	Engine misses at high rpm.	Engine misses at low rpm.	Excessive fuel consumption.	Excessive oil consumption.	Engine backfires.	Engine knocks.	Coolant leakage.	Engine overheats.
Plugged oil ring groove.											
Check spark—see Electrical Section.											
Incorrect oil viscosity.											
Carburetor flange loose or leaking at gasket.											
Carburetor body and throttle shaft worn.											
Intake valve burned or sticking.											
Excessive engine load.											
Fan belt slippage.											
Defective radiator hose or clamp.											
Broken or missing fan shroud.											
Defective radiator.											
Cracked or porous casting.											
Loose stud bolts and cap screw.											
Engine overheating.											
Damaged water pump seals.											
Improperly installed gasket.											
Improper or defective radiator cap.											

TROUBLESHOOTING—425 CARBURETED ENGINES (continued)

Problem or Symptom / Check or Solution	Engine cranks but will not start.	Loss of power.	Engine runs erratically.	Engine misses at high rpm.	Engine misses at low rpm.	Excessive fuel consumption.	Excessive oil consumption.	Engine backfires.	Engine knocks.	Engine rpm low or engine stalls.
Battery weak or discharged.	●									
Drain-back in breather chamber plugged.							●			
Oil leakage along governor shaft.			●							
Defective oil seal.			●							
Weak or faulty spark plug.	●	●	●	●	●					
Faulty high tension leads.	●	●	●	●	●	●				
Faulty ignition module.	●	●	●	●	●	●			●	
Faulty ignition coil.	●	●	●	●	●	●				
Faulty pulser coil.	●	●	●	●	●	●				
Contaminated fuel or faulty fuel supply system.	●	●	●						●	
Fuel shut-off solenoid not allowing fuel into main jet.	●									
Defective fuel pump.	●	●	●	●						
Air being drawn in through a hole in the fuel line(s).	●	●	●					●		

TROUBLESHOOTING—425 CARBURETED ENGINES (continued)

Problem or Symptom / Check or Solution	Engine cranks but will not start.	Loss of power.	Engine runs erratically.	Engine misses at high rpm.	Engine misses at low rpm.	Excessive fuel consumption.	Excessive oil consumption.	Engine backfires.	Engine knocks.	Coolant leakage.
Fuel shut-off valve closed (In-line valve).	●									
Clogged fuel line or filter.	●	●	●							
Fuel tank vent line clogged.	●	●	●	●						
Vapor lock.		●	●							
Improper use of choke.	●					●				
Air filter restricted.	●	●				●				
Defective breather valve.		●					●			
Float level too high.	●					●				
Poor compression. Worn piston/piston rings stuck or not seated. Worn cylinder bore.	●	●				●	●			
Cylinder head loose.	●	●						●		●

TROUBLESHOOTING—425 CARBURETED ENGINES

Problem or Symptom / Check or Solution	Engine is sluggish.	Black smoky Exhaust.	Runs worse when warm.	Spark plug fouled black.	Runs better without air cleaner.	Engine will not start, plug wet.	Spark plug burned white.	Engine speed unstable (surging).	Loss of power.	Engine overheats.	Engine is hard to start when cold.
Mixture too rich.											
Mixture too lean.											
Check and clean air cleaner.											
Clean under engine shrouding.											
Adjust Idle mixture and check engine performance.											
Choke is not completely open Adjust.											
Inlet needle and seat leaking.											
Choke is not completely shut Adjust.											
Clean Carburetor.											
Check spark plug gap and spark. See Electrical Section.											
Water pump nylon impeller.											

TROUBLESHOOTING—445 FUEL INJECTED ENGINES

See Electrical Section for fuel injection chart.

Problem or Symptom / Check or Solution	Engine cranks but will not start.	Loss of power.	Engine runs erratically.	Engine misses at high rpm.	Engine misses at low rpm.	Excessive fuel consumption.	Excessive oil consumption.	Engine backfires.	Engine knocks.	Coolant leakage.	Engine overheats.
Worn or burned valves or improper clearance.											
Worn valve stem(s) or valve guide(s).											
Warped cylinder head.											
Broken valve spring.											
Defective head gasket.											
Low oil level.											
Too much oil in crankcase.											
Air/fuel passages clogged.											
Carbon deposits in exhaust pipe/ muffler.											
Carbon deposits in combustion chamber.											
Lack of coolant.											
Governor linkage out of adjustment.											
Faulty governor spring.											
Governor gear assembly binding or broken.											
Air being drawn through throttle body or intake manifold flanges.											
Incorrect timing gear alignment.											

TROUBLESHOOTING—445 FUEL INJECTED ENGINES (continued)

Problem or Symptom / Check or Solution	Engine cranks but will not start.	Loss of power.	Engine runs erratically.	Engine misses at high rpm.	Engine misses at low rpm.	Excessive fuel consumption.	Excessive oil consumption.	Engine backfires.	Engine knocks.	Coolant leakage.	Engine overheats.
Plugged oil ring groove.											
Check spark—See Electrical Section.											
Incorrect oil viscosity.											
Throttle body flange loose or leaking at gasket.											
Throttle body and throttle shaft worn.											
Intake valve burned or sticking.											
Excessive engine load.											
Fan belt slippage.											
Defective radiator hose or clamp.											
Broken or missing fan shroud.											
Defective radiator.											
Cracked or porous casting.											
Loose stud bolts and cap screw.											
Engine overheating.											
Damaged water pump seals.											
Improperly installed gasket.											
Improper or defective radiator cap.											

TROUBLESHOOTING—445 FUEL INJECTED ENGINES (continued)

Problem or Symptom / Check or Solution	Engine cranks but will not start.	Loss of power.	Engine runs erratically.	Engine misses at high rpm.	Engine misses at low rpm.	Excessive fuel consumption.	Excessive oil consumption.	Engine backfires.	Engine knocks.	Engine rpm low or engine stalls.
Battery weak or discharged.	●									●
Drain-back in breather chamber plugged.							●			
Oil leakage along governor shaft.			●							
Defective oil seal.			●							
Weak or faulty spark plug.	●	●	●	●	●	●				
Faulty high tension leads.	●	●	●	●	●	●				
Faulty fuel injection module.	●	●	●	●	●	●			●	
Faulty ignition coil.	●	●	●	●	●	●				
Faulty pulser coil.	●	●	●	●	●	●		●		
Contaminated fuel or faulty fuel supply system.	●	●	●						●	
Fuel shut-off solenoid not allowing fuel into fuel injectior.	●									
Defective fuel pump.	●	●	●	●						
Air being drawn in through a hole in the fuel line(s).	●	●	●					●		

TROUBLESHOOTING—445 FUEL INJECTED ENGINES (continued)

Problem or Symptom / Check or Solution	Engine cranks but will not start.	Loss of power.	Engine runs erratically.	Engine misses at high rpm.	Engine misses at low rpm.	Excessive fuel consumption.	Excessive oil consumption.	Engine backfires.	Engine knocks.	Coolant leakage.
Fuel shut-off valve closed (In-line valve).	●									
Clogged fuel line or filter.	●	●	●	●						
Fuel tank vent line clogged.	●	●	●							
Vapor lock.		●	●							
Improper use of choke.	●					●				
Air filter restricted.	●	●								
Defective breather valve.		●					●			
Poor compression. Worn piston/piston rings stuck or not seated. Worn cylinder bore.	●	●					●			
Cylinder head loose.	●	●				●				●

TROUBLESHOOTING—445 FUEL INJECTED ENGINES

Problem or Symptom / Check or Solution	Engine is sluggish.	Black smoky Exhaust.	Runs worse when warm.	Spark plug fouled black.	Runs better without air cleaner.	Engine will not start, plug wet.	Spark plug burned white.	Engine speed unstable (surging).	Loss of power.	Engine overheats.	Engine is hard to start when cold.
Mixture too rich.											
Mixture too lean.											
Check and clean air cleaner.											
Clean under engine shrouding.											
Check spark plug gap and spark See Electrical Section.											
Water pump nylon impeller .											

DIAGNOSIS—425

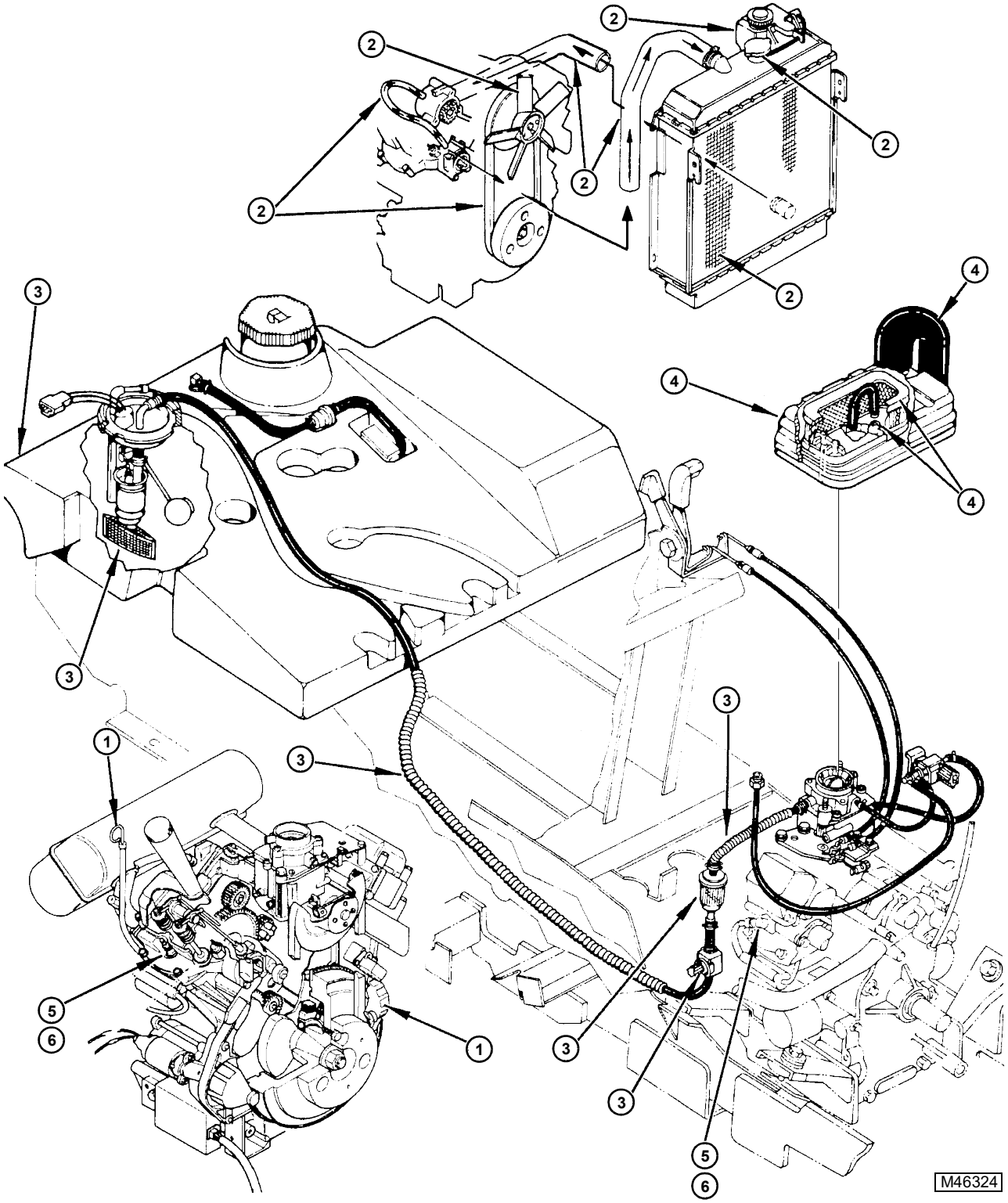
ENGINE SYSTEM DIAGNOSIS—425 CARBURETED ENGINES

Test Conditions:

- Machine parked on level surface.
- Park brake locked.
- PTO switch off.
- Key switch off.
- Spark plug connected to D-05351ST Spark Tester.

Test/Check Point	Normal	If Not Normal
1. Engine dipstick and exterior engine surface—ENGINE OIL DIPSTICK. See engine oil dipstick in this section.	Oil level between "L" and "H" marks. Oil not burnt, or contaminated with metal particles or coolant. (A small amount of fuel is acceptable.) No external leakage, filter clean.	Change oil and inspect for source of contamination. Check gaskets, seals, plugs, cylinder head, block, and intake manifold. Change oil filter.
2. Coolant tank and radiator—cooling system check.	Coolant level between marks on tank when engine is warm. Coolant in radiator full to top. Coolant not contaminated with oil or fuel or discolored brown. Radiator/screen free of debris. Hoses not cracked or leaking, clamps and radiator cap tight. Fan belt tight, not glazed or cracked. Fan blades not damaged or warped.	Add proper coolant mix. Drain and flush system. Check for source of contamination. Clean or replace hoses. Pressure test radiator and cap. Replace and adjust belt tension. Replace fan.
3. Fuel tank, pump, lines, filters and shutoff valve—fuel system check.	Fuel level correct, not contaminated or stale smelling, no water in fuel. Fuel pump filter and in-line filter free of debris. Fuel shutoff valve in on position. Fuel hoses not cracked or leaking. Fuel hose clamps tight. Fuel tank does not have vacuum.	Drain and clean fuel tank. Add fresh fuel. Replace filters. Move to on position Replace or tighten. Replace fuel tank check valve.
4. Air filter, side screen.	Side panel air intake screen free of debris. Air filter hose not cracked, clamps tight. Primary and secondary elements not plugged. Air filter housing sealed, no dirt tracking inside filter element.	Clean intake screen. Replace and tighten clamps. Replace elements or housing. Replace air restriction indicator.
5. Spark plug (key switch in start position).	Steady blue spark. Engine must crank.	If spark is weak (yellow) or no spark, install new spark plug and test again. If still weak or no spark, see IGNITION CIRCUIT DIAGNOSIS—425 in ELECTRICAL section. See CRANKING CIRCUIT DIAGNOSIS. in the ELECTRICAL section.
6. Spark plug (key switch off).	Plug dry.	Check carburetor inlet needle for debris, choke, and mixture adjustment.

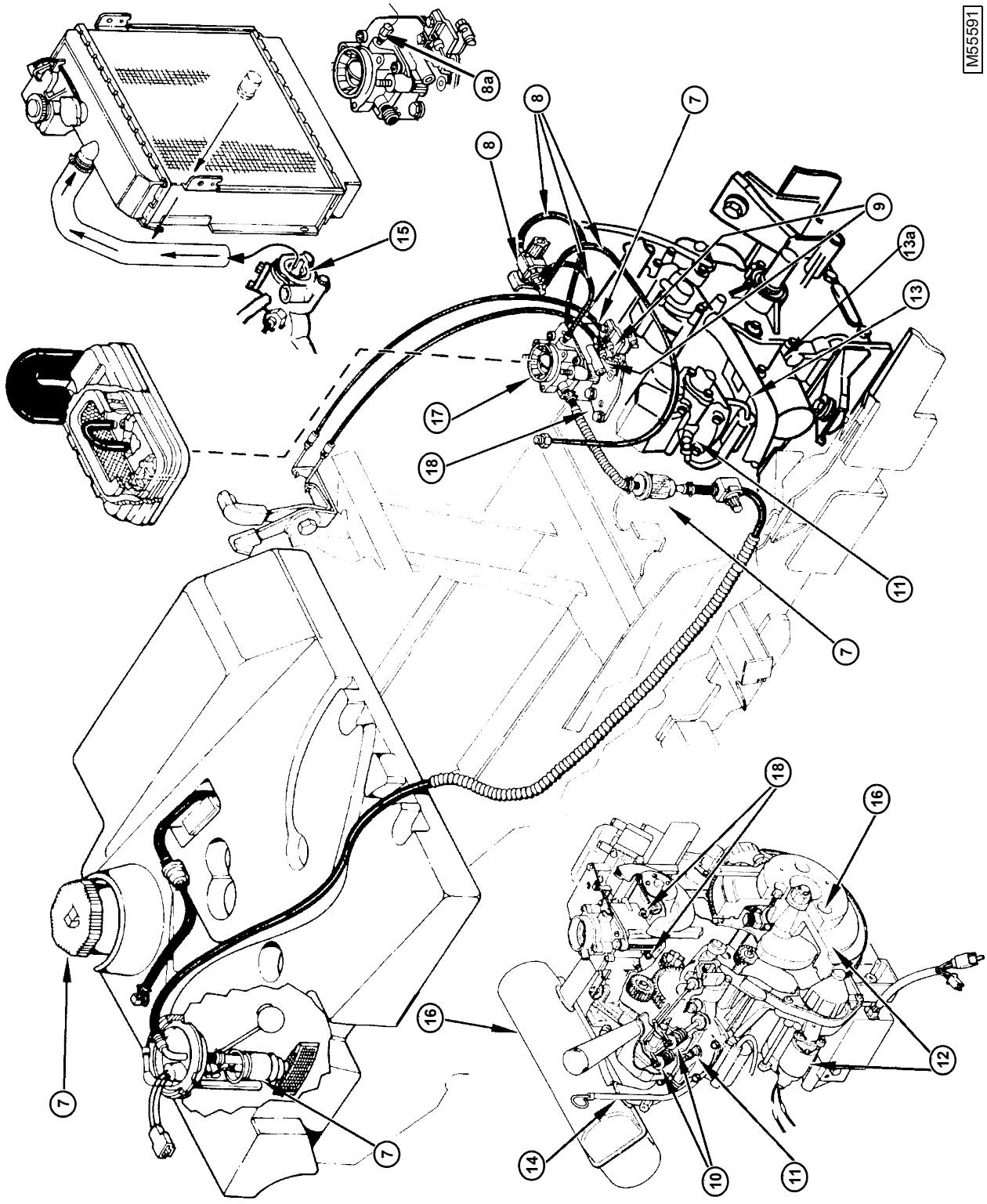
ENGINE SYSTEM TEST POINTS—425 CARBURETED ENGINES



ENGINE SYSTEM DIAGNOSIS—425 CARBURETED ENGINES (continued)

Test/Check Point	Normal	If Not Normal
7. Carburetor—fuel filter, fuel pump, and carburetor bowl drain screw (key switch on).	Fuel level increases in filter. Fuel pump operating—listen for humming sound near fuel tank cap. Fuel present in float bowl when screw is opened.	See FUEL PUMP AND FUEL SHUTOFF SOLENOID CIRCUIT DIAGNOSIS in the ELECTRICAL section. Test fuel pump pressure and flow. Check carburetor for debris.
8. Carburetor vent solenoid (S.N. —033626). 8a. Fuel shut-off solenoid (S.N. 033627—).	Solenoid must “click” when key is turned on. Vent hoses not cracked, and clamps tight. Solenoid must “click” when key is turned on.	See FUEL PUMP AND CARBURETOR VENT/FUEL SHUT-OFF SOLENOID CIRCUIT DIAGNOSIS in the ELECTRICAL section. Replace hoses and clamp. See FUEL PUMP AND CARBURETOR VENT/FUEL SHUT-OFF SOLENOID CIRCUIT DIAGNOSIS in the ELECTRICAL section.
9. Carburetor choke, governor linkage, and mixture screw (key off).	Linkage not binding and adjusted correctly.	Repair, replace or adjust linkage and mixture screw.
10. Intake and exhaust valves.	Cold engine valve clearance of 0.25 mm (0.010 in.). Valves not sticking.	Adjust—See Valve Clearance Adjustment. Check valve guides and stems.
11. Spark plug hole (key switch start).	Minimum compression of 1171 kPa (170 psi) with a 97 kPa (14 psi) maximum difference between cylinders.	Perform compression test.
12. Flywheel and starter.	Minimum cranking rpm—300 rpm.	Check starter amp draw.

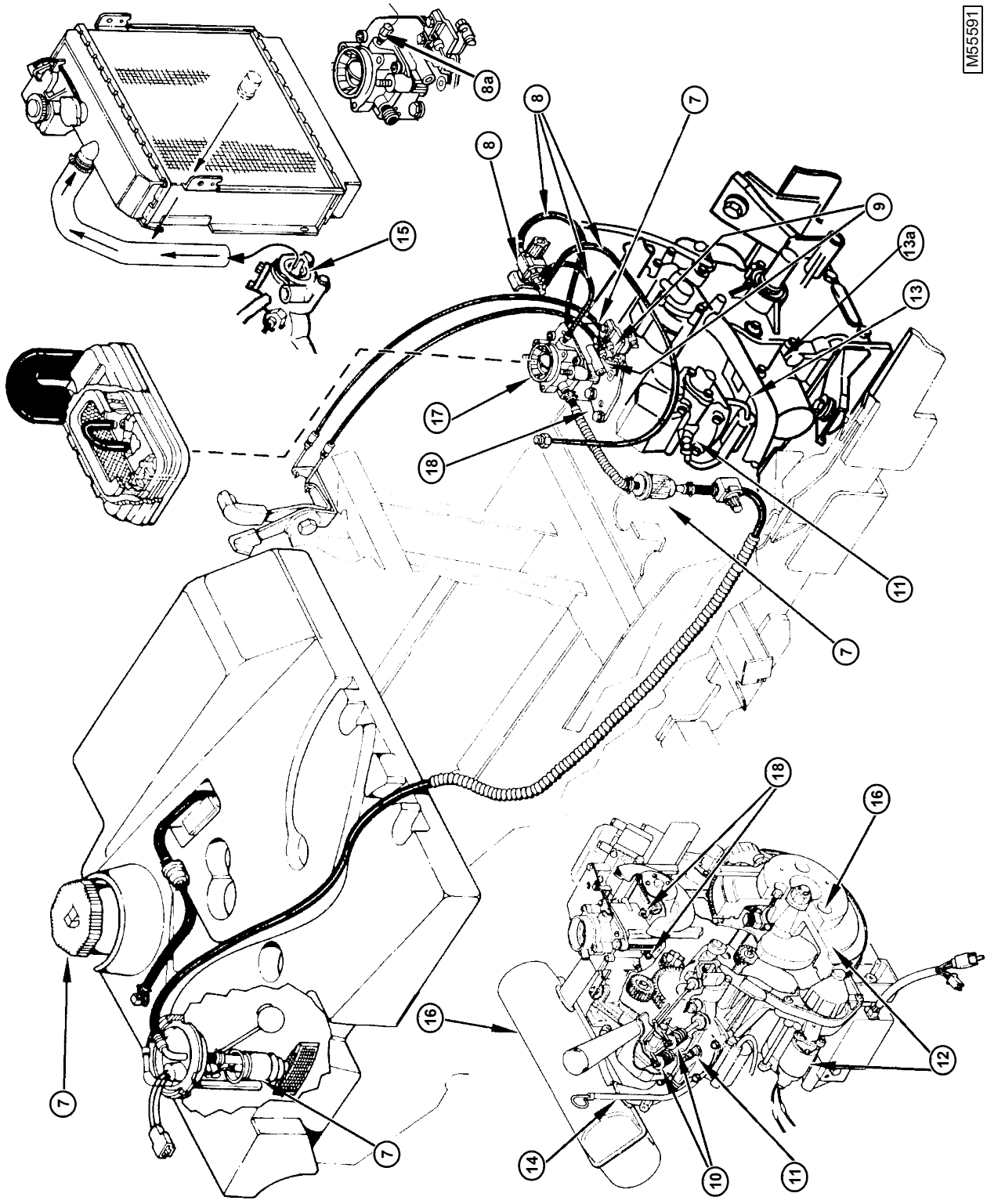
ENGINE SYSTEM TEST POINTS—425 CARBURETED ENGINES (continued)



ENGINE SYSTEM DIAGNOSIS—425 CARBURETED ENGINES (continued)

Test/Check Point	Normal	If Not Normal
13. Oil pressure switch port (on engines with test ports). 13a. Oil filter base (on machines without test ports).	Minimum oil pressure at 3600 rpm—276 kPa (40 psi). Oil pressure at slow and fast idle—138—272 kPa (20—40 psi).	See ENGINE OIL PRESSURE TEST. (Engines Without Oil Pressure Switch Ports) See ENGINE OIL PRESSURE TEST. (Engines Without Oil Pressure Switch Ports)
14. Dipstick tube.	Minimum crankcase vacuum—25 mm (1 in.) water at 3600 rpm.	See CRANKCASE VACUUM TEST.
15. Thermostat.	Clean from corrosion, rust, or debris. Opening temperature—66°C (150°F).	Replace thermostat.
16. Internal components, muffler, and driveshaft.	Wear within limits, all hardware tight, not bent or vibrating.	Repair or replace components.
17. Carburetor internal inspection (key off).	Needle valve, passages, and jets free from varnish or debris. Main jet correct for elevation.	Clean or replace carburetor. Replace jet with correct size.
18. Carburetor (engine running).	Slow idle at 1500 ± 100 rpm. Fast idle at 3600 ± 100 rpm.	Adjust slow idle mixture screw and slow idle rpm. Adjust fast idle.

ENGINE SYSTEM TEST POINTS—425 CARBURETED ENGINES (continued)



DIAGNOSIS—425

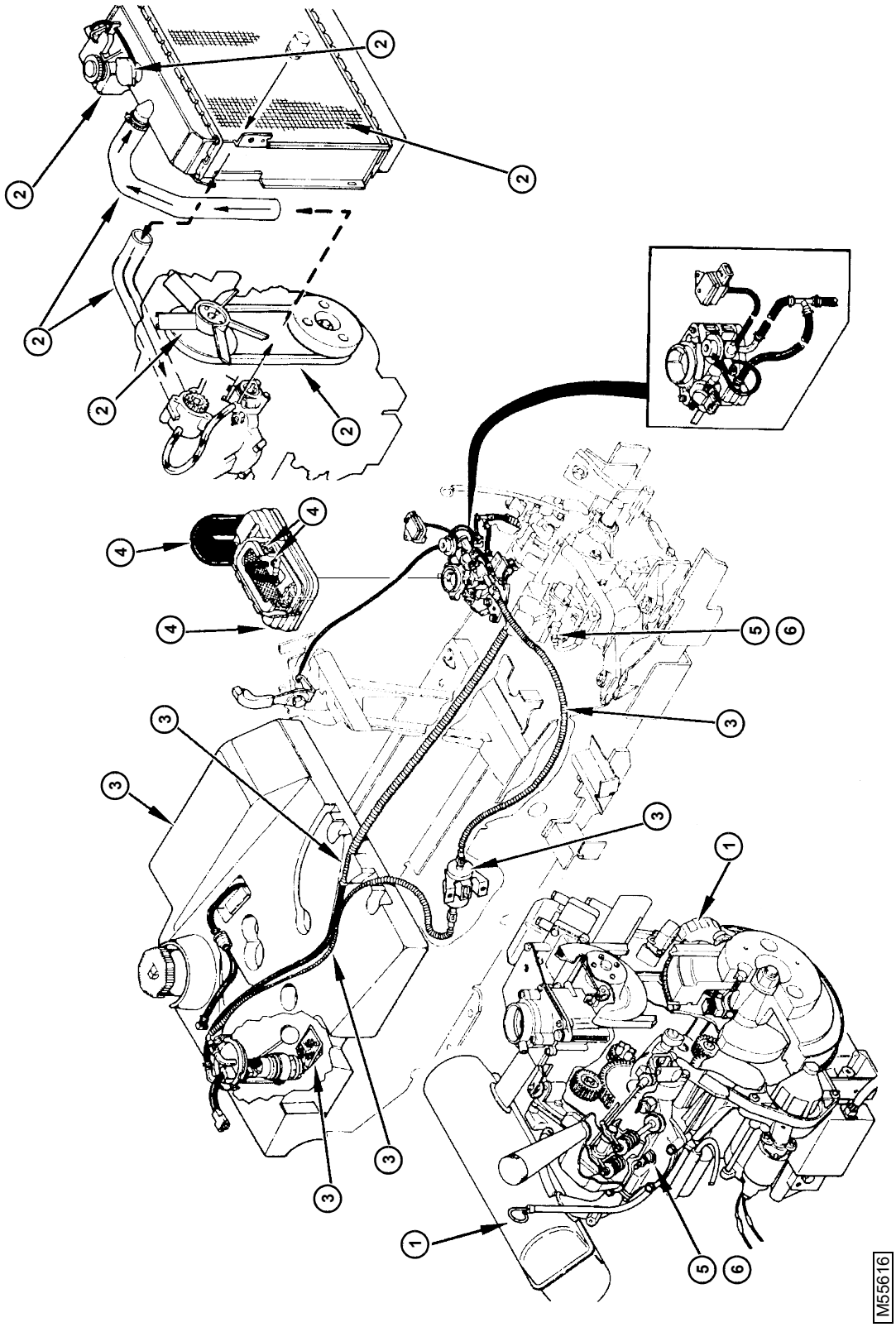
ENGINE SYSTEM DIAGNOSIS—445 FUEL INJECTED ENGINES

Test Conditions:

- Machine parked on level surface.
- Park brake locked.
- PTO switch off.
- Key switch off.
- Spark plug connected to D-05351ST Spark Tester.

Test/Check Point	Normal	If Not Normal
1. Engine dipstick and exterior engine surface—engine oil check. SEE ENGINE OIL DIPSTICK.	Oil level between "L" and "H" marks. Oil not burnt, or contaminated with metal particles or coolant. (A small amount of fuel is acceptable.) No external leakage, filter clean.	Change oil and inspect for source of contamination. Check gaskets, seals, plugs, cylinder head, block, and intake manifold. Change oil filter.
2. Coolant tank and radiator—cooling system check.	Coolant level between marks on tank when engine is warm. Coolant in radiator full to top. Coolant not contaminated with oil or fuel or discolored brown. Radiator/screen free of debris. Hoses not cracked or leaking, clamps and radiator cap tight. Fan belt tight, not glazed or cracked. Fan blades not damaged or warped.	Add proper coolant mix. Drain and flush system. Check for source of contamination. Clean or replace hoses. Pressure test radiator and cap. Replace and adjust belt tension. Replace fan.
3. Fuel tank, pump, lines, filters and shutoff valve—fuel system check.	Fuel level correct, not contaminated or stale smelling, no water in fuel. Fuel pump filter and in-line filter free of debris. Fuel shutoff valve in on position. Fuel hoses not cracked or leaking. Fuel hose clamps tight. Fuel tank does not have vacuum.	Drain and clean fuel tank. Add fresh fuel. Replace filters. Move to on position Replace or tighten. Replace fuel tank check valve.
4. Air filter, side screen.	Side panel air intake screen free of debris. Air filter hose not cracked, clamps tight. Primary and secondary elements not plugged. Air filter housing sealed, no dirt tracking inside filter element.	Clean intake screen. Replace and tighten clamps. Replace elements or housing. Replace air restriction indicator.
5. Spark plug (key switch in start position).	Steady blue spark. Engine must crank.	If spark is weak (yellow) or no spark, install new spark plug and test again. If still weak or no spark, see IGNITION CIRCUIT DIAGNOSIS—425 in ELECTRICAL section. See CRANKING CIRCUIT DIAGNOSIS. in the ELECTRICAL section.
6. Spark plug (key switch off).	Plug dry.	Check fuel injector needle for debris and test fuel injector operation.

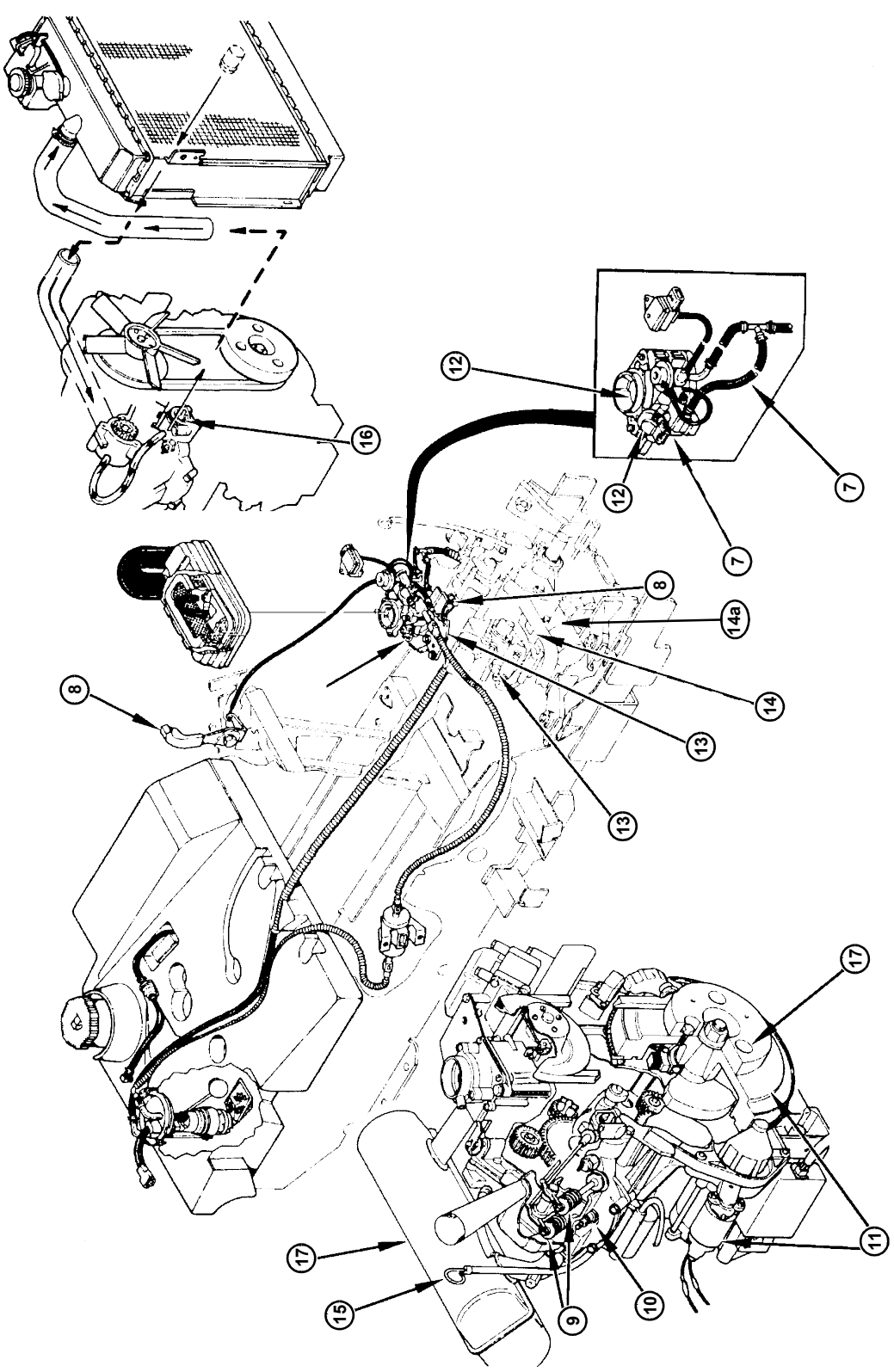
ENGINE SYSTEM TEST POINTS—445 FUEL INJECTED ENGINES



ENGINE SYSTEM DIAGNOSIS—445 FUEL INJECTED ENGINES (continued)

Test/Check Point	Normal	If Not Normal
7. Fuel Injection—pressure relief screw of throttle body (key switch on).	Fuel pump operating for 2 seconds —listen for humming sound near fuel tank cap. Fuel present in throttle body. Passage when screw is opened—fuel will flow through throttle body return hose.	See FUEL INJECTOR AND FUEL PUMP CIRCUIT DIAGNOSIS—445 in the ELECTRICAL section. Test fuel pump pressure and flow. Check fuel injector screen for debris and test fuel pump pressure and flow.
8. Fuel Injection—throttle lever, throttle control lever, and governor lever (key off).	Linkage not binding and adjusted correctly.	Repair, replace or adjust linkage.
9. Intake and exhaust valves.	Cold engine valve clearance of 0.25 mm (0.010 in.). Valves not sticking.	Adjust—See VALVE CLEARANCE ADJUSTMENT. Check valve guides and stems.
10. Spark plug hole (key switch start).	Minimum compression of 1171 kPa (170 psi) with a 97 kPa (14 psi) maximum difference between cylinders.	Perform compression test.
11. Flywheel and starter.	Minimum cranking rpm—300 rpm.	Check starter amp draw.
12. Fuel injector and throttle body valve plate wet (with key switch in start for 5 seconds, then off, then remove air filter cover).	Throttle body valve plate fuel.	Dry or can't tell if wet—check Fuel Injector Circuit Test Points.
13. Throttle body (engine running).	Slow idle at 1500 ± 100 rpm. Fast idle at 3600 ± 100 rpm.	Adjust slow idle stop screw. Adjust fast idle.

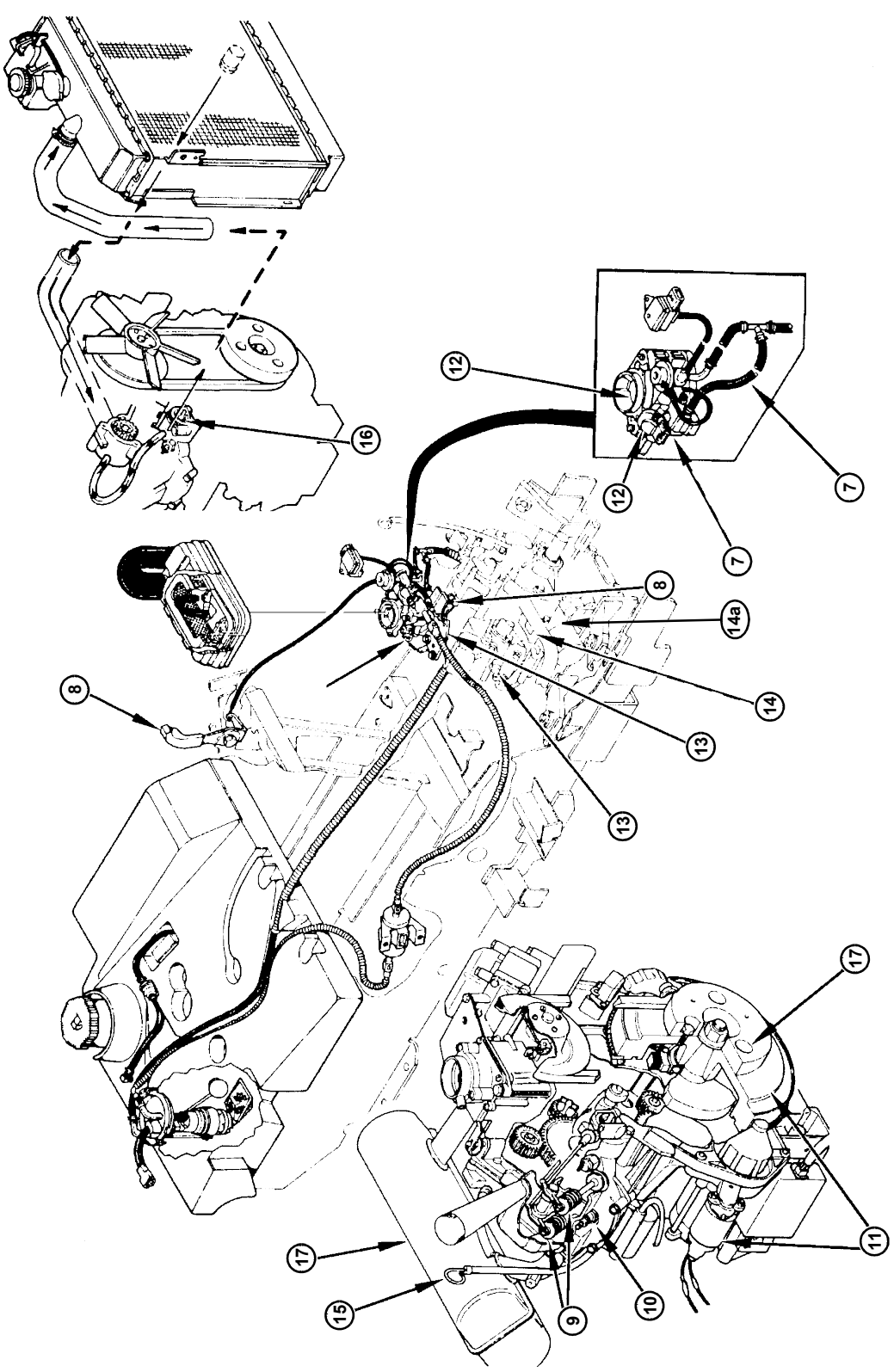
ENGINE SYSTEM TEST POINTS—445 FUEL INJECTED ENGINES (continued)



ENGINE SYSTEM DIAGNOSIS—445 FUEL INJECTED ENGINES (continued)

Test/Check Point	Normal	If Not Normal
14. Oil pressure switch port (on engines with test ports). 17a. Oil filter base (on machines without test ports).	Minimum oil pressure at 3600 rpm—276 kPa (40 psi). Oil pressure at slow and fast idle—138—272 kPa (20—40 psi).	See ENGINE OIL PRESSURE TEST. (Engines Without Oil Pressure Switch Ports) See ENGINE OIL PRESSURE TEST. (Engines Without Oil Pressure Switch Ports)
15. Dipstick tube.	Minimum crankcase vacuum—25 mm (1 in.) water at 3600 rpm.	See CRANKCASE VACUUM TEST.
16. Thermostat.	Clean from corrosion, rust, or debris. Opening temperature—66°C (150°F).	Replace thermostat.
17. Internal components, muffler, and driveshaft.	Wear within limits, all hardware tight, not bent or vibrating.	Repair or replace components.

ENGINE SYSTEM TEST POINTS—445 FUEL INJECTED ENGINES (continued)



TESTS AND ADJUSTMENTS

THROTTLE LEVER ADJUSTMENT

Reason:

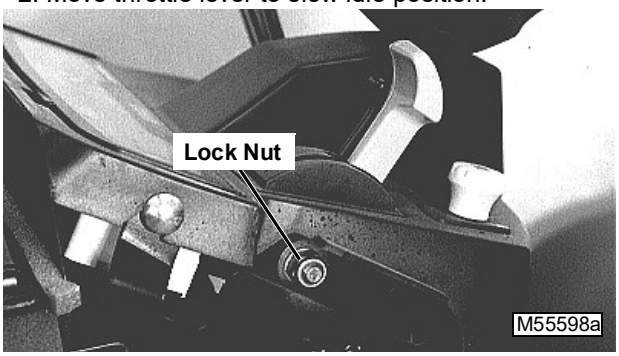
To achieve smooth throttle lever movement with enough tension to maintain throttle setting.

Test Equipment:

- Spring Scale

Procedure:

1. Connect a scale near the end of the throttle lever.
2. Move throttle lever to slow idle position.



3. Adjust friction disks by tightening or loosening lock nut until throttle lever movement in forward direction is **18—35 N (4—8 lb force)**.

NOTE: Make sure throttle cable is not binding or stuck.

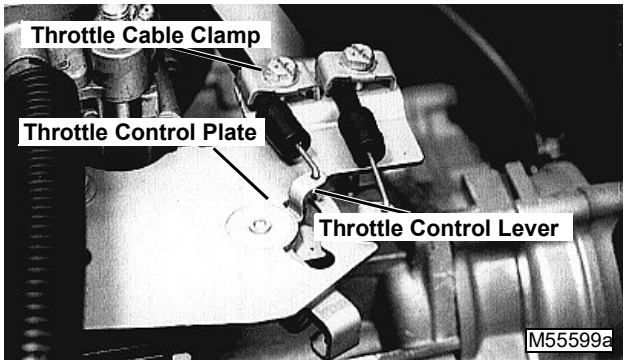
THROTTLE CABLE ADJUSTMENT

Reason:

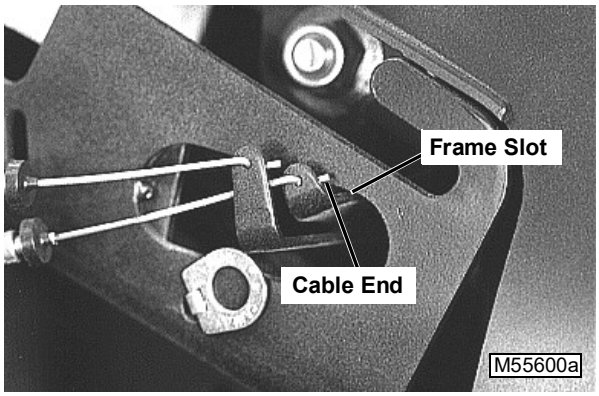
To insure that the throttle lever cable moves the governor linkage from slow to fast idle position.

Procedure:

NOTE: Air filter removed for clarity of photo. DO NOT remove air filter when making adjustment.



1. Loosen throttle cable clamp.



2. Move throttle lever on instrument panel towards fast idle position until the throttle lever cable end is 2—3 mm (0.080—0.120 in.) away from frame slot.
3. Pull throttle cable to hold throttle control lever tight against the throttle control plate. Tighten cable clamp.
4. Move throttle lever through full range to be sure linkage is not binding.

CHOKE ADJUSTMENT

ATTENTION!

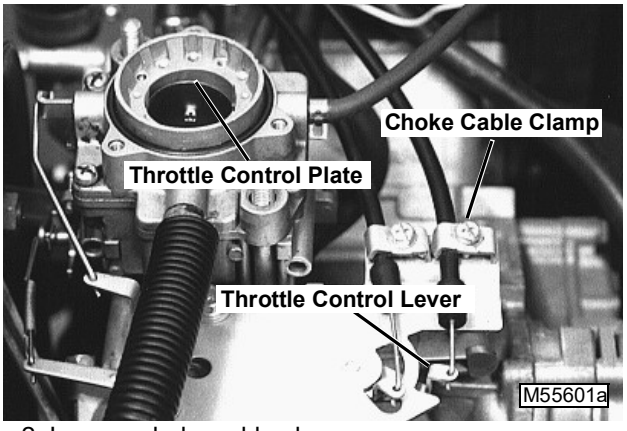
Do not attempt to rebuild or adjust carburetor unless you are a factory trained technician with authorization to service California Air Resources Board/Environmental Protection Agency (CARB/EPA) Certified engines.

Reason:

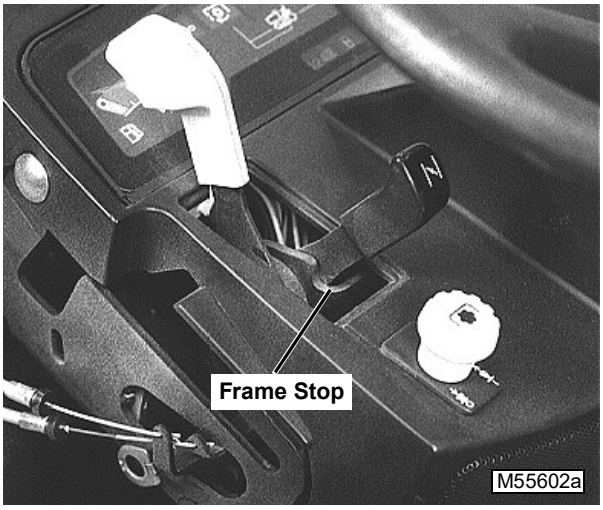
To obtain correct choke plate position.

Procedure:

1. Remove air filter cover.



2. Loosen choke cable clamp.



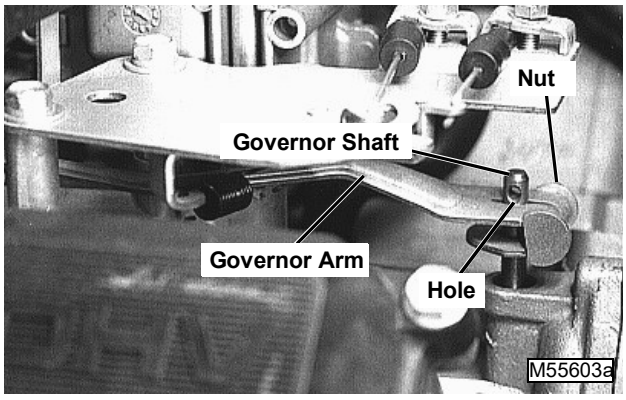
3. Move choke lever fully rearward. Be sure choke lever contacts the frame stop.
4. Push choke cable tight against the choke control lever. Be sure choke plate is fully open (straight up) in the carburetor. Tighten cable clamp.
5. Move choke lever fully forward. Be sure choke plate is fully closed.
6. Move choke lever through full range to be sure linkage is not binding.
7. Install air filter cover.

GOVERNOR ADJUSTMENT

Reason:

To correctly position governor arm against flyweight assembly for proper governor response.

Procedure:



1. Loosen nut.
2. Turn governor arm full counterclockwise and hold.
3. Turn governor shaft full counterclockwise using a small shaft through hole and hold.
4. Tighten nut.

SLOW IDLE ADJUSTMENT—425 NON-CARB/EPA ENGINES

*NOTE: For engines **WITHOUT** California Air Resources Board/Environmental Protection Agency (CARB/EPA) Emissions/Carburetors.*

Reason:

To achieve a smooth running engine at slow idle.

Test Equipment:

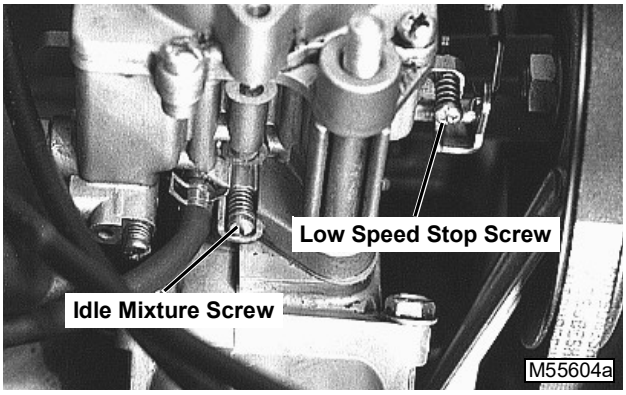
- JT05719 Digital Tachometer

Procedure:

NOTE: Air filter removed for clarity of photo. DO NOT remove air filter when making adjustment.

1. Put reflective tape on flywheel or front crankshaft to check engine rpm.

IMPORTANT: Do not turn idle mixture screw tight. Tightening screw will damage the needle and seat.

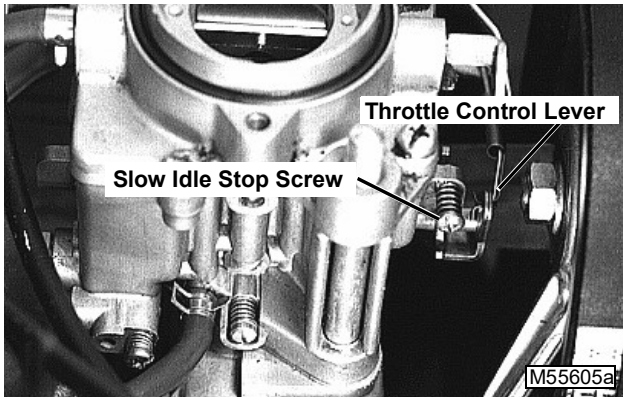


2. Turn idle mixture screw clockwise until lightly seated. Then turn counterclockwise 1-3/8 turns.
3. Lock park brake. Start engine and run for five minutes to operating temperature.
4. Move throttle lever to slow idle position.

c CAUTION

Engine will be HOT. Be careful not to burn hands. Keep hands away from fan belt and pulley.

5. Hold carburetor throttle lever against low speed stop screw.
6. Turn idle mixture screw clockwise until engine speed drops, then counterclockwise until engine speed increases and begins to drop again.
7. Adjust idle mixture screw for highest engine speed between drop points, then turn screw out an additional 1/4 turn.
8. Move throttle lever to slow idle position.



c CAUTION

Engine will be HOT. Be careful not to burn hands. Keep hands away from fan belt and pulley.

9. Hold carburetor throttle lever against slow idle stop screw. Check slow idle speed.

Results:

- If slow idle rpm is below 1500 ± 100 rpm, turn slow idle stop screw until idle speed is 1500 ± 100 rpm.

10. After idle speed adjustment, readjust throttle cable as necessary.

SLOW IDLE ADJUSTMENT—425 CARB/EPA ENGINES

*NOTE: For engines **WITH** California Air Resources Board/Environmental Protection Agency (CARB/EPA) Emissions/Carburetors.*

BEGINNING ENGINE SERIAL NUMBER:
FD620D-CS02 . . . . . (068728—)

ATTENTION!

Do not attempt to rebuild or adjust carburetor unless you are a factory trained technician with authorization to service California Air Resources Board/Environmental Protection Agency (CARB/EPA) Certified engines.

Reason:

To achieve a smooth running engine at slow idle while maintaining emissions specifications.

Test Equipment:

- JT05719 Digital Tachometer

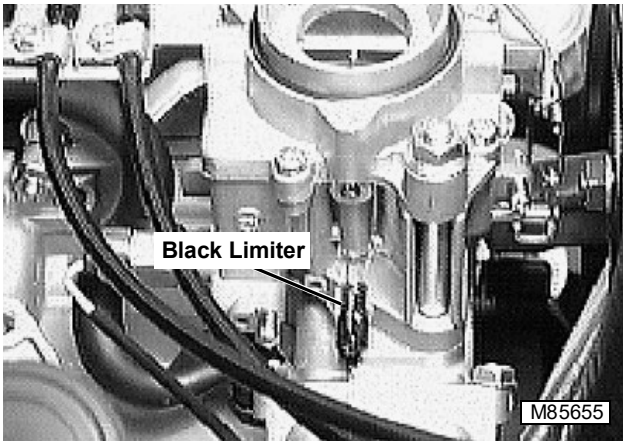
Procedure:

NOTE: Air filter removed for clarity of photo. DO NOT remove air filter when making adjustment.

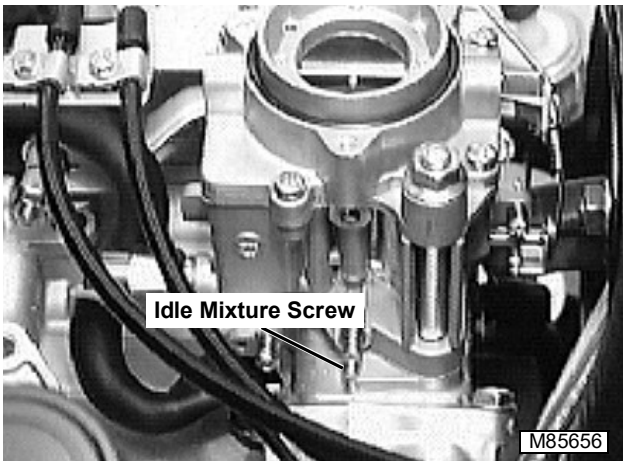
1. Put reflective tape on flywheel or front crankshaft to check engine rpm.

NOTE: Idle mixture screw on CARB/EPA engines can be adjusted 1/4 turn in either direction without removing black limiter.

IMPORTANT: Do not turn idle mixture screw tight. Tightening screw will damage the needle and seat.



2. Remove black limiter on idle mixture screw.



3. Turn idle mixture screw clockwise until lightly seated. Then turn counterclockwise 1-3/4 turns.
4. Lock park brake. Run engine for five minutes to operating temperature.

5. Move throttle lever to slow idle position.

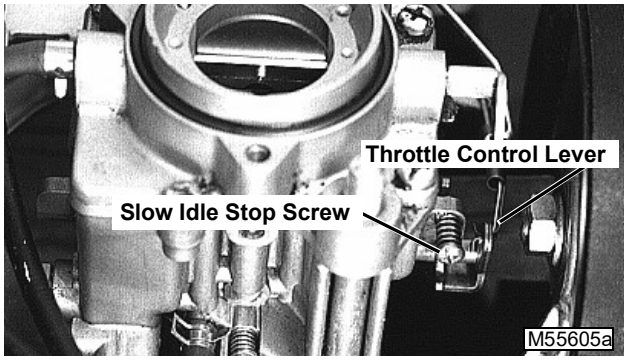
c CAUTION

Engine will be HOT. Be careful not to burn hands. Keep hands away from fan belt and pulley.

6. Hold carburetor throttle lever against slow speed stop screw—see photo below.
7. Turn idle mixture screw in until engine speed drops, then out until engine speed increases and begins to drop again.
8. Adjust idle mixture screw for highest engine speed between drop points.
9. Replace black limiter without turning idle mixture screw. Make sure limiter stop tab is centered between housing stops.

c CAUTION

Engine will be HOT. Be careful not to burn hands. Keep hands away from fan belt and pulley.



10. Hold carburetor throttle lever against slow idle stop screw. Check slow idle speed.

Results:

- If slow idle rpm is not 1500 ± 100 rpm, turn slow idle stop screw until idle speed is 1500 ± 100 rpm.

11. After slow idle speed adjustment, readjust throttle cable as necessary.

FAST IDLE ADJUSTMENT

ATTENTION!

Do not attempt to rebuild or adjust carburetor unless you are a factory trained technician with authorization to service California Air Resources Board/Environmental Protection Agency (CARB/EPA) Certified Engines.

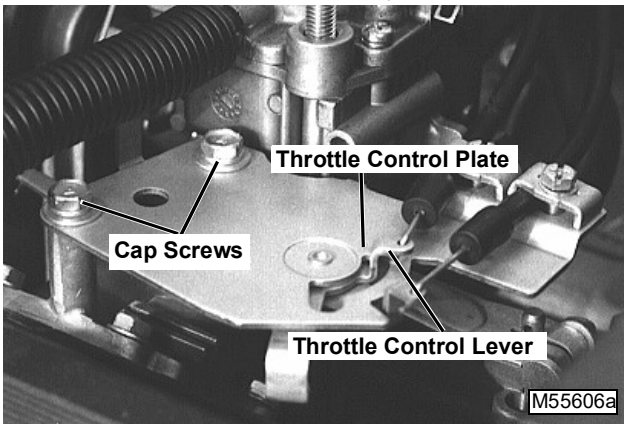
Reason:

To check and adjust the fast idle or operating range of the engine.

Procedure:

NOTE: Air filter removed for clarity of photo. DO NOT remove air filter when making adjustment.

1. Put reflective tape on flywheel or front crankshaft to check engine rpm.
2. Lock park brake. Start engine and run for five minutes (operating temperature).
3. Adjust carburetor idle mixture screw. (See SLOW IDLE ADJUSTMENT).
4. Move throttle lever to fast idle position.



c CAUTION

Engine will be HOT. Be careful not to burn hands. Keep hands away from fan belt and pulley.

5. Loosen cap screws.
6. Be sure the throttle control lever contacts the control plate.
7. Move control plate left or right until the tachometer reads 3600 ± 100 rpm.
8. Tighten cap screws.
9. Adjust choke. (See CHOKE ADJUSTMENT.)

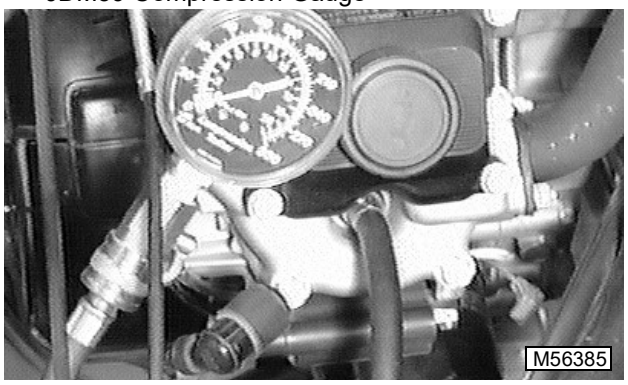
COMPRESSION TEST

Reason:

To determine the condition of pistons, rings, cylinder walls and valves.

Test Equipment:

- JDM59 Compression Gauge



1. Adjust valve clearance to 0.25 mm (0.010 in.) with engine at top dead center (TDC) compression stroke. Engine must be “cold” (shop temperature, about 60—85°F (16—30°C).
2. Run engine until it reaches operating temperature (thermostat opens, both radiator hoses hot).
3. Remove both spark plugs and ground leads to block or use spark testers.
4. Put throttle lever in fast idle (wide open) position. Choke must be properly adjusted and fully open. Air filter must be clean.

IMPORTANT: DO NOT overheat starting motor during test. Starter duty is 5 seconds on, 10 seconds off. Additionally, if throttle lever is left in slow idle position (air flow into carburetor restricted), compression could read up to 483 kPa (70 psi) below specification.

5. Crank hot engine until highest compression reading is obtained.
6. Record pressure readings for each cylinder.

Specifications:

Minimum Compression . . . . . 1171 kPa (170 psi)
Maximum Difference Between Cylinders . . . . . 97 kPa (14 psi)

Results:

- If pressure readings are above specification, adjust valves and check fuel and intake air systems. Check exhaust for restriction.
- If pressure readings are below specification, squirt clean engine oil into cylinders and repeat test.
- If pressure increases significantly, check piston rings and cylinder walls for wear or damage,
- If pressure does NOT increase after retest, check for leaking valves, valve seats or cylinder head gaskets.

7. Reconnect ignition coils and install spark plugs.

VALVE CLEARANCE ADJUSTMENT

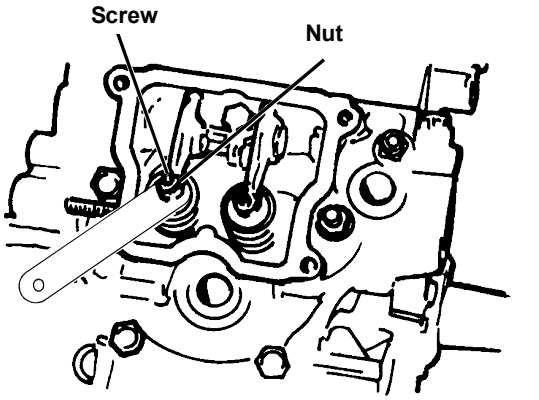
Reason:

Check and adjust valve clearance for proper engine operation.

IMPORTANT: Perform valve clearance measurement or adjustment when the engine is at 16—27°C (60—80°F). Proper valve clearance is essential for the engine to operate properly. Check valve clearance for each cylinder separately.

Procedure:

1. Remove spark plugs.
2. Remove valve covers.
3. Turn the crankshaft until piston, visible in the spark plug hole, is at TDC (top dead center) of the compression stroke. When the piston is at TDC, the "1" or "2" mark with a triangle embossed on the flywheel will align with the triangle on the engine crankcase directly above the flywheel at the 12 o'clock position. Both intake and exhaust valves will be closed and the rocker arms will be loose. If one rocker arm is tight, the piston is on the exhaust stroke and the crankshaft must be turned another revolution (360 degrees).



4. Use a feeler gauge to measure valve clearance. See specifications.
5. Repeat procedure for other cylinder.

Results:

- To adjust valve clearance, loosen nut and turn screw to correct clearance. Hold screw while tightening nut to specifications.

Specifications:

Valve Clearance at 16—27°C (60—80°F). . . . . 0.25 mm (0.010 in.)
Nut Torque . . . . . 9 N•m (79 lb-in.)
Spark Plug Torque . . . . . 25 N•m (221 lb-in.)

CRANKCASE VACUUM TEST

Reason:

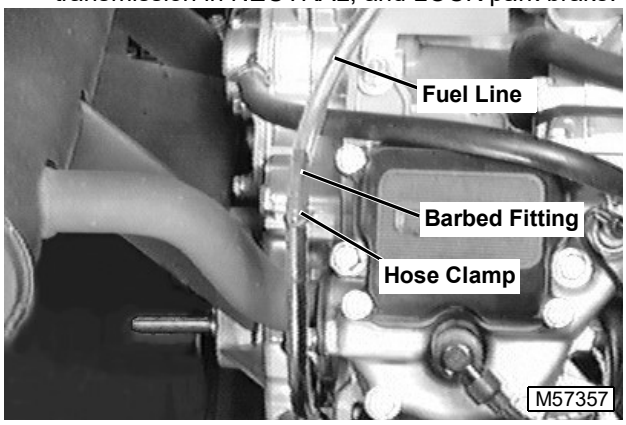
To check operation of breather and condition of seals, gaskets, rings, piston and cylinders walls.

Test Equipment:

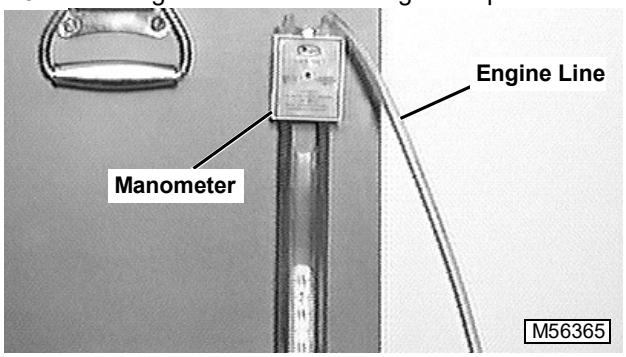
- JT05701 Hose Clamp
- JT05703 Barb Fitting
- JT05699 Line
- JT05698 U-Tube Manometer

Procedure:

1. Park machine on level surface, key switch OFF, transmission in NEUTRAL, and LOCK park brake.



2. Put small end of barbed fitting into line and fasten with hose clamp.
3. Install large end of barbed fitting into dipstick tube.



IMPORTANT: DO NOT make connection between manometer and engine line BEFORE engine is running or fluid in manometer could be drawn into crankcase. DO NOT turn engine OFF until line has been disconnected from manometer.

4. Start and run engine at SLOW idle.
5. Connect line to U-Tube Manometer Kit.
6. Run engine at fast idle.
7. Record crankcase vacuum reading. Manometer should show a **minimum vacuum of 25 mm (1.0 in.) of water**.
8. Run engine at SLOW idle. DO NOT TURN ENGINE OFF!
9. Disconnect clear tube from manometer.
10. Turn engine off.
11. Remove barbed fitting and install dipstick.

Results:

If crankcase vacuum is less than specification, check the following:

- Breather reed valve clearance is **0.2 mm (0.008 in.)** and is in good condition.
- Seals and gaskets for leakage.
- Valve cover gasket for leakage.
- Valve and valve seats for wear or damage.
- Head warpage.
- Rings, piston, and cylinder walls for wear or damage.

ENGINE OIL PRESSURE TEST (Engines With Oil Pressure Switch Ports)

Reason:

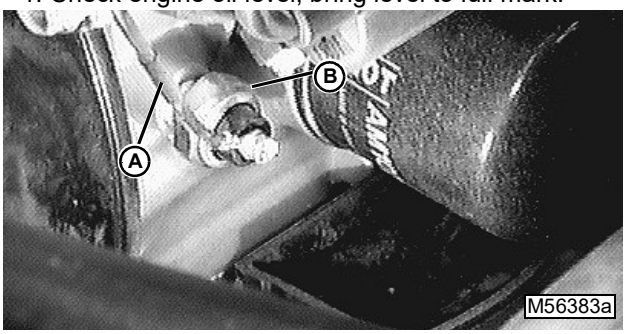
To determine condition of lubrication system.

Equipment:

- JT05577 Pressure Gauge Assembly
- JT03017 Hose Assembly
- JT03349 Connector

Procedure:

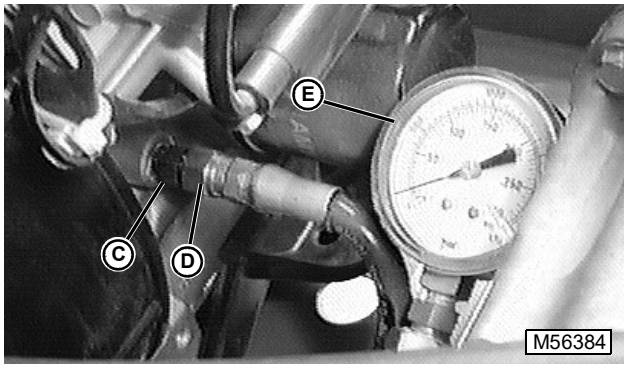
1. Check engine oil level, bring level to full mark.



c CAUTION

Engine components are HOT. Be careful not to touch, especially the exhaust pipe or muffler, while making adjustments. Wear protective eye glasses and clothing.

2. Disconnect oil pressure switch wiring lead (A).
3. Remove oil pressure switch (B).



4. Install JT03349 Connector (C).
5. Connect JT03017 Hose Assembly (D) and JT05577 Pressure Gauge Assembly (E).
6. Crank engine and check oil pressure. If no oil pressure, determine cause before starting engine.

IMPORTANT: If pressure reading is below 69 kPa (10 psi), STOP ENGINE IMMEDATELY and determine cause.

7. Run engine at FAST idle and check. **Minimum oil pressure is 276 kPa (40 psi).**
8. Run engine at FAST idle until at operating temperature.
9. Install oil pressure switch and switch wiring lead. Use John Deere Pipe Sealant with TEFLON (medium strength), or equivalent, on switch threads.

Results:

If oil pressure is BELOW specifications, inspect or replace the following:

- Oil pressure relief valve for broken or worn spring.
- Oil pressure relief valve for stuck or damaged valve.
- Worn or damaged oil pump.
- Oil pump suction screen or oil passages plugged.
- Excessive wear of connecting rod and main bearing journals.

ENGINE OIL PRESSURE TEST (Engines Without Oil Pressure Switch Ports)

Reason:

To verify that the engine has enough oil pressure to lubricate the internal engine components.

Equipment:

JT07262 Oil Presure Test Adapter w/ o-ring (required ONLY on engines without pressure switch ports)

JT05847 Connector

JT03017 Hose Assembly

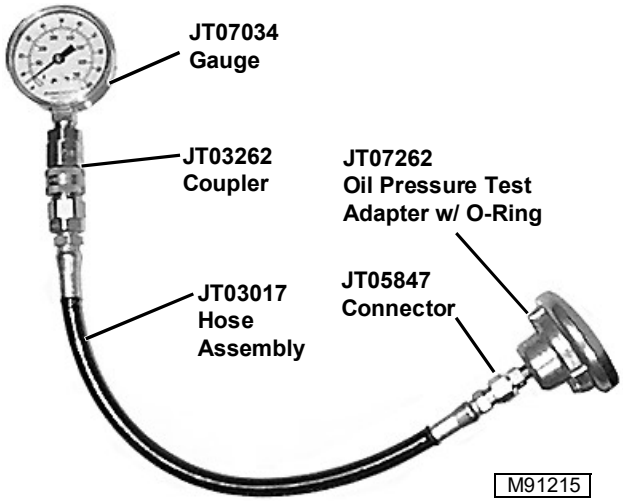
JT03262 Coupler

JT07034 Gauge, 0—700 kPa (0—100 psi)

NOTE: The connector, hose assembly, quick coupler, and gauge are found in other SERVICEGARD™ test kits. The connector pipe thread (NPT) also matches the oil pressure switch port on early Kohler engines.

Test Procedure at Oil Filter Base:

1. Perform test procedure with engine level.
2. Stop engine.
3. Disconnect spark plug wire and allow engine to cool.
4. Drain engine oil from oil filter.
5. Remove oil filter and wipe filter base clean.
6. Install preassembled adapter, connector, hose assembly, coupler, and gauge onto oil filter base. ONLY hand-tighten adapter to oil filter base.
7. Check crankcase oil level and adjust to full mark.



8. Monitor oil pressure during cranking, if oil pressure is **below 28 kPa (4 psi)—STOP engine immediately** and correct cause before continuing.
9. Connect spark plug wire.
10. Warm-up engine by running at MEDIUM idle for five minutes.

c CAUTION

Engine components are HOT. DO NOT touch with bare skin. Wear protective eye glasses and clothing.

11. Record oil pressure readings at SLOW and FAST idle.
12. Stop engine and allow to cool.
13. Remove adapter, connector, hose assembly, coupler, and gauge.
14. Install new oil filter.
15. Run engine for 30 seconds and stop engine.
16. Check crankcase oil level and adjust to full mark.

Results:

- If oil pressure readings are not within **138—272 kPa (20.0—40.0 psi)**, inspect or replace the following:
  –Oil pump assembly.
  –Oil suction screen.
  –Oil passages.

FUEL PUMP FLOW TEST FOR CARBURETOR—425

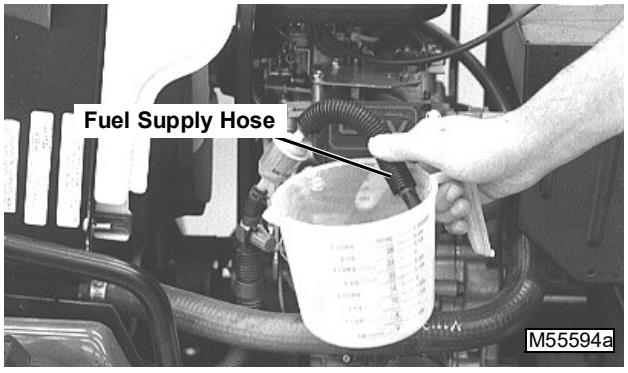
Reason:

To determine proper fuel flow from transfer pump.

Test Equipment:

- Graduated container

Procedure:



1. Disconnect fuel supply hose from carburetor and put end in a graduated container.
2. Turn key switch on for 10 seconds. DO NOT start engine.

Results:

- If fuel flow is **below 300 mL (10 oz)/10 seconds**, check fuel pump filter, in-line filter, hoses, and fuel shutoff valve for debris or restrictions. Replace filters, then test again.
- If fuel flow is still **below 300 mL (10 oz)/10 seconds**, replace fuel pump.

FUEL PUMP PRESSURE TEST FOR CARBURETOR—425

Reason:

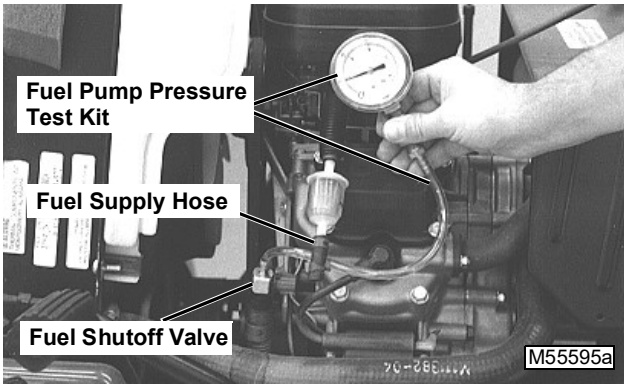
To check condition of fuel pump and determine fuel pressure.

Test Equipment:

- JDG356 Fuel Pump Pressure Test Kit

Procedure:

1. Engage park brake.



2. Disconnect fuel supply hose from fuel shutoff valve.
3. Connect Fuel Pump Pressure Test Kit to fuel shutoff valve outlet.
4. Turn key switch on. DO NOT start engine. Observe pressure reading.

Results:

- If fuel pressure is below **10 kPa (1.5 psi)**, check fuel pump filter, in-line filter, hoses, and fuel shutoff valve for debris or restrictions. Replace filters, then test again.
- If pressure is still below **10 kPa (1.5 psi)**, replace fuel pump.

FUEL PUMP PRESSURE TEST FOR FUEL INJECTION—445

Reason:

To check condition of fuel pump and fuel pressure regulator which determines fuel pressure.

Test Equipment:

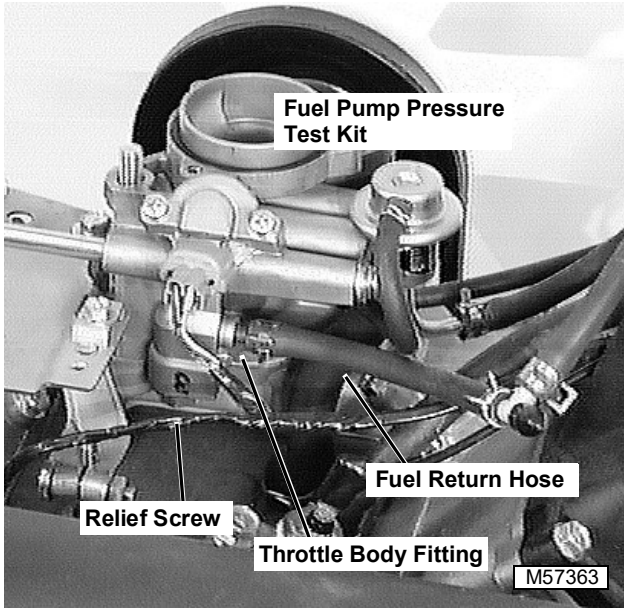
- JT07032 400 kPa (60 psi) Pressure Gauge
- JT03246 1/4 F NPT X 1/4 F NPT Coupler
- JDG41 1/4 M NPT X 1/8 ID Barbed Fitting
- Fuel Hose

Procedure:

c CAUTION

Release of fluids from pressurized fuel system can cause serious injuries. Relieve fuel system pressure before disconnecting fuel line.

1. Engage park brake. Put PTO in OFF position..



2. Disconnect and plug fuel return hose from throttle body fitting.
3. Connect pressure gauge, coupler, barbed fitting, and hose to throttle body fitting. Fasten hose with hose clamp.
4. Turn fuel pressure relief screw open 1/2 turn.

NOTE: Check fuel pressure quickly as fuel pump will run for only two seconds.

5. Turn key switch on. DO NOT start engine. Observe pressure reading.
6. After test is completed, turn fuel pressure relief screw closed.
7. Put a shop towel over end of test fuel hose.
8. Remove hose slowly and carefully to allow pressure to escape.

Results:

- If fuel pressure is below **172—186 kPa (25—27 psi)**, check fuel pump screen, in-line filter, and hoses for debris or restrictions. Replace filters, then test again.
- If pressure is still below specification, replace pressure regulator or fuel pump.
- If pressure is above specification, check fuel tank return line for restrictions and check the pressure regulator vacuum line for air leaks. If OK, replace the pressure regulator.

FAN BELT TENSION ADJUSTMENT

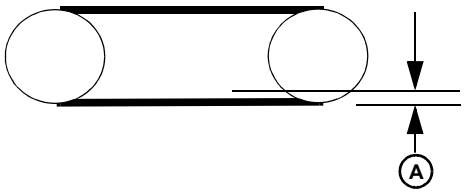
Reason:

To keep proper tension on belt to drive cooling fan.

Test Equipment:

- JDST28 Belt Tension Gauge

Procedure:



1. Use JDST28 Belt Tension Gauge to check belt deflection (A) midway between fan and drive sheaves. See specifications.

Specifications:

Applied Force . . . . . 245—391 N (55—88 lb force)
Deflection (A) . . . . . 12—19 mm (0.472—0.748 in.)

Results:

- If deflection is not within specifications, disconnect drive shaft and remove outer sheave half of fan drive pulley. Remove shim(s) to increase belt tension or add shim(s) to decrease tension.

RADIATOR BUBBLE TEST

Reason:

To determine if compression pressure is leaking past head gaskets and into cooling system.

Procedure:

1. With coolant at proper level and radiator cap tight, start and run engine to bring it to operating temperature.
2. Disconnect overflow hose from coolant recovery tank.

3. Put end of hose in a container of water.
4. Check for bubbles coming from hose.

Results:

- If bubbles are present, replace head gaskets.

RADIATOR CAP PRESSURE TEST

Reason:

To test radiator cap for operating in correct pressure range.

Test Equipment:

- D05104ST Cooling System Pressure Pump
- JDG692 Adapter

Procedure:

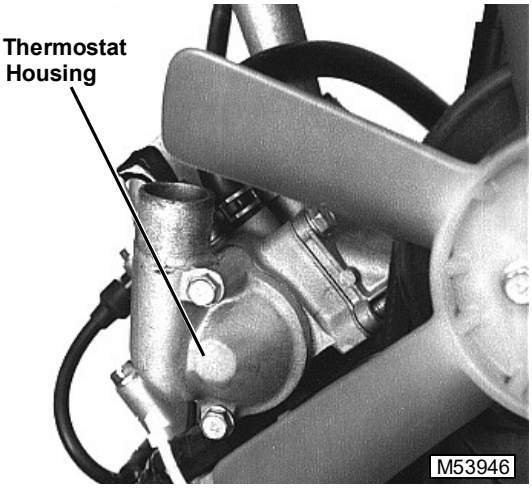
1. Install radiator cap on pressure pump.
2. Apply pressure and observe when cap relieves.

Specifications:
Opening Pressure . . . . . 83—96 kPa (12—14 psi)
Minimum Pressure . . . . . 76 kPa (11 psi)

Results:

- If cap leaks, retighten and test again. Replace cap if pressure is not according to specifications.

THERMOSTAT TEST



Temperature gauge (on tractor) will read slightly higher than normal until thermostat opens. Check thermostat using a thermostat tester. Heat thermostat in water to check opening temperature. Replace, if not according to specifications.

Thermostat Specifications

Begin Opening . . . . . 66—66°C (145—150°F)
Fully Open. . . . . .80°C (176°F)

COOLING SYSTEM TEST

Reason:

Inspect cooling system for leaks.

Test Equipment:

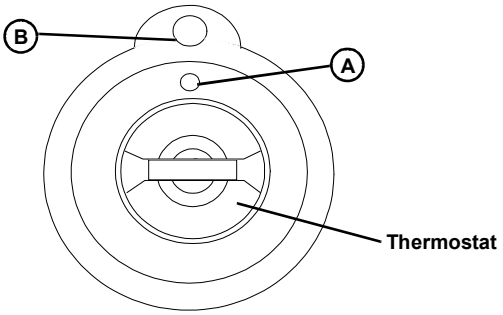
- D05104ST Cooling System Pressure Pump
- JDG692 Adapter

Procedure:

1. Remove cap and attach pressure pump to radiator.
2. Apply 117 kPa (17 psi) maximum pressure.
3. Check for leaks.

Results:

- Pressure should hold to **90 kPa (13 psi)**. If pressure decreases, check for leaks. Repair leaks or replace parts as necessary.
- If pressure test still indicates leakage and all external leaks have been stopped, a defective head gasket or cracked block may be the cause.
- If antifreeze level drops after changing, or drops to “add” several days later, air may be escaping.



- Install thermostat so “jiggle” pin (A) is in line with upper bolt hole (B) which will be 12 o’clock position on engine. Pin in this location allows air to escape allowing for full fill level of antifreeze.

ENGINE OIL DIPSTICK

IMPORTANT: The John Deere “K” series engine is designed to accept, without any engine damage, a 10% increase in the crankcase level caused by fuel. This could result in as much as 12 mm (1/2 in.) above the “H “mark on the dipstick. Fuel entering the crankcase (in small amounts) is a normal condition on all gasoline engines. Fuel will dissipate to atmosphere during hot engine operation.

1. Check oil level with dipstick handle facing toward engine side panel. Oil level is difficult to read on dipstick. After wiping dipstick clean, be sure it is completely straight before inserting back into tube. Any “curl” of dipstick will give inaccurate level readings.

NOTE: Do not try to read oil level from back side of dipstick. Use a scale to actually measure level of oil above full mark.

If crankcase level increases after repeated checks, and engine does not run properly, there may be excessive fuel in the crankcase.

Excessive fuel in the crankcase can be caused by the following conditions:

- Fouled spark plugs.
- Choke not properly adjusted.
- Air filter restricted.

REPAIR

ENGINE—REMOVAL/ INSTALLATION—425

c CAUTION

Release of fluids from pressurized fuel system can cause serious injuries. Relieve fuel system pressure and be sure engine is cool before servicing.

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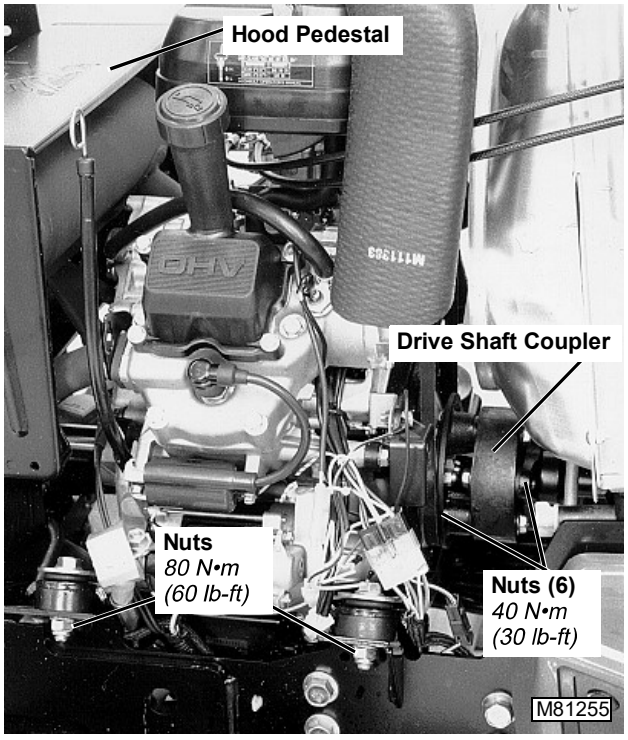

Left Side View

1. Remove side shields, grille, hood and hood pedestal.
2. Disconnect and remove battery.

NOTE: Cooling system capacity is approximately 2.8 L (3.0 qt).

3. Drain coolant and remove upper and lower radiator hoses.
4. Disconnect all hoses, wiring connectors and cables.
5. Remove muffler. (See MUFFLER REMOVAL/ INSTALLATION in the Miscellaneous Section.)
6. Disconnect throttle and choke cables.
7. Disconnect drive shaft coupler.
8. Install lift bracket to aid in engine removal/ installation.
9. Remove four mounting cap screws, washers and nuts, and right side ground cable.

IMPORTANT: When lifting engine, simultaneously move engine forward and away from radiator, so fan clears radiator shroud; otherwise, damage to radiator, cooling fan, or shroud may occur.

10. Safely attach overhead hoist and carefully remove engine making sure not to damage radiator, fan, or fan shroud.
11. Make repairs to engine as necessary.

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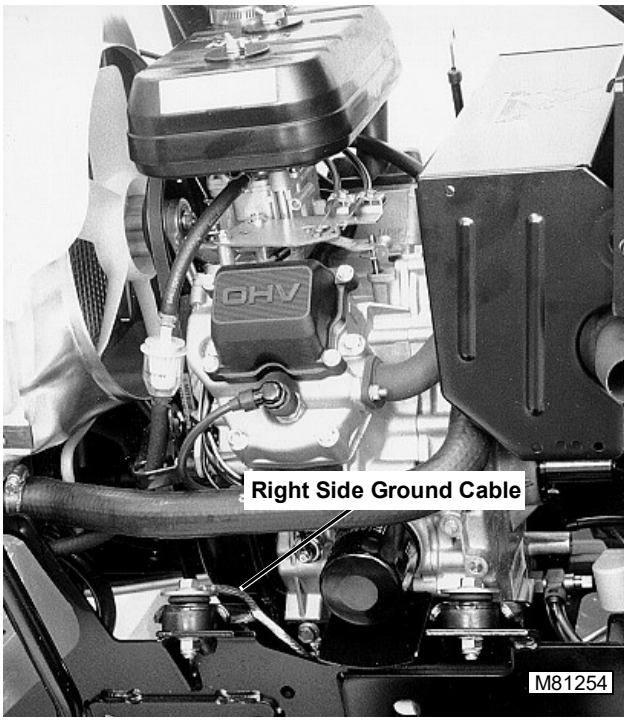


Right Side View

IMPORTANT: Ground cable must not be stretched tight after tightening engine mounting nut to prevent failure of cable from engine vibration.

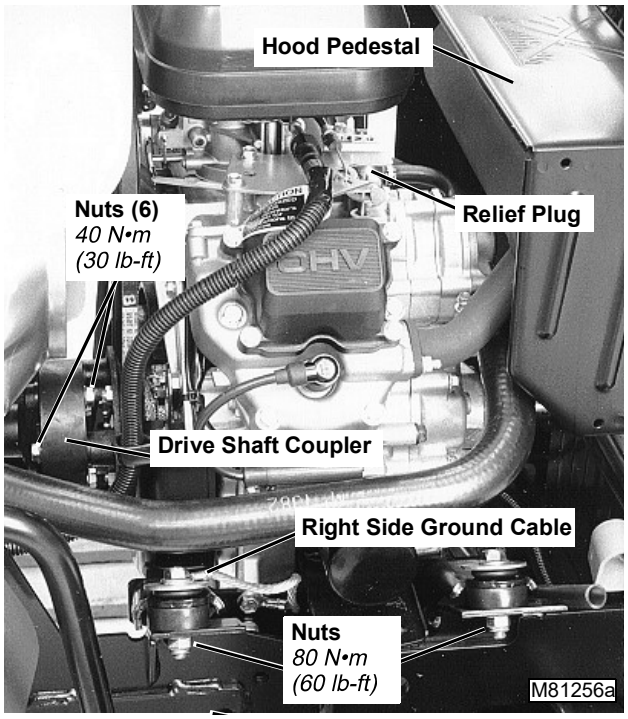
Installation is done in the reverse order of removal.

- Carefully install engine so damage is not caused to radiator, fan, or fan shroud.
- Install right side ground cable between head of rear engine mounting bolt and washer.
- Tighten engine mounting hardware to **80 N•m (60 lb-ft)**, drive shaft coupler hardware to **40 N•m (30 lb-ft)**, and hood pedestal hardware to standard torque specifications.
- Close drain valve and fill radiator with proper mixture of coolant to top of filler neck.
- Start engine and allow it to reach proper operating temperature.
- Visually check radiator, hoses, and connections for leaks. Adjust coolant level in recovery tank only.

ENGINE—REMOVAL/INSTALLATION (445)

c CAUTION

Release of fluids from pressurized fuel system can cause serious injuries. Relieve fuel system pressure and be sure engine is cool before servicing.



Right Side View

1. Remove side shields, grille, hood and hood pedestal.
2. Disconnect and remove battery.

NOTE: Cooling system capacity is approximately 2.8 L (3.0 qt).

3. Drain coolant and remove upper and lower radiator hoses.
4. Turn fuel pressure relief plug 1/2 turn to relieve pressure in fuel system.
5. Disconnect all hoses, wiring connectors and cables.
6. Remove muffler. (See MUFFLER REMOVAL/ INSTALLATION in the Miscellaneous Section.)
7. Disconnect throttle and choke cables.
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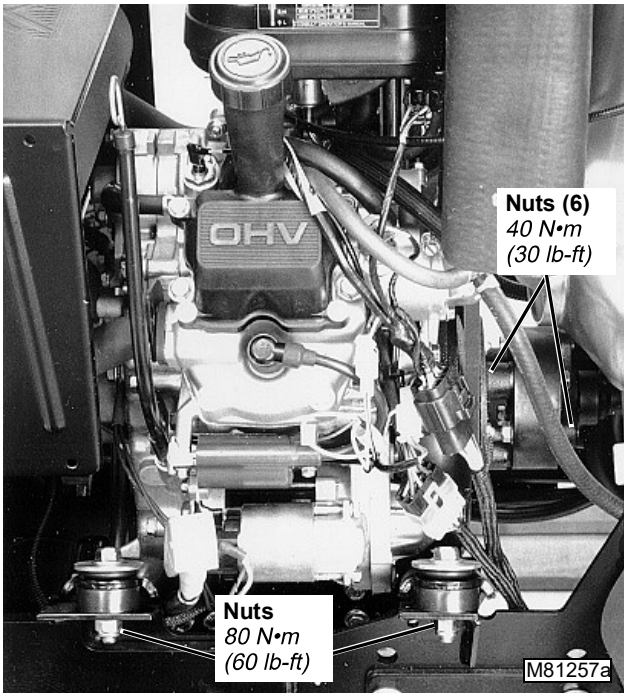

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IMPORTANT: Ground cable must not be stretched tight after tightening engine mounting nut to prevent failure of cable from engine vibration.

Installation is done in reverse order of removal.

- Carefully install engine so damage is not caused to radiator, fan, or fan shroud.
- Install right side ground cable between head of rear engine mounting bolt and washer.
- Tighten engine mounting hardware to **80 N•m (60 lb-ft)**, drive shaft coupler hardware to **40 N•m (30 lb-ft)**, and hood pedestal hardware to standard torque specifications and close fuel system relief plug to **15 N•m (133 lb-in.)**.
- Close drain valve and fill radiator with proper mixture of coolant to top of filler neck.
- Start engine and allow it to reach proper operating temperature.
- Visually check radiator, hoses, and connections for leaks.
- Adjust coolant level in recovery tank only.

CARBURETOR—EXPLODED VIEW

ATTENTION!

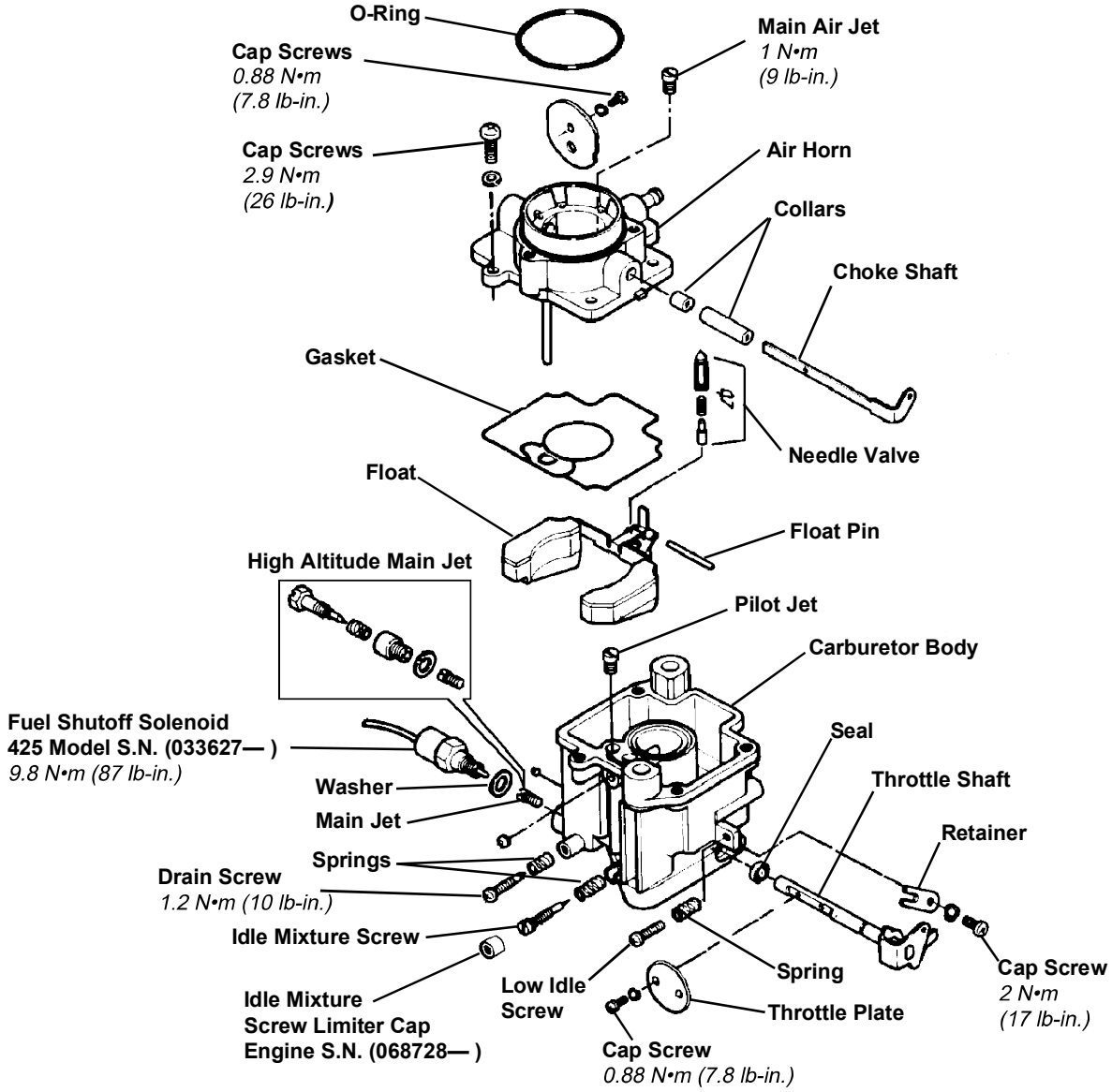
Do not attempt to rebuild or adjust carburetor unless you are a factory trained technician with authorization to service California Air Resources Board/Environmental Protection Agency (CARB/ EPA) Certified engines.

c CAUTION

Gasoline is extremely flammable. Do not smoke. Always work in a ventilated area away from open flame or spark producing equipment, this includes equipment that utilizes pilot lights.

Refer to the illustration and the following notes for disassembly and assembly.

NOTE: Late model 425 certified carburetors - Engine S.N: (068728—) have a limiter cap on the idle mixture screw . This capped idle mixture screw requires a special procedure for adjustment. 425 Model S.N. (033627—) use fuel shut-off solenoid. 425 Model S.N. (—033626) use carburetor vent tubes.



CARBURETOR—CLEAN AND REBUILD

There are a number of plates or boll plugs on/in the carburetor that should not be removed.

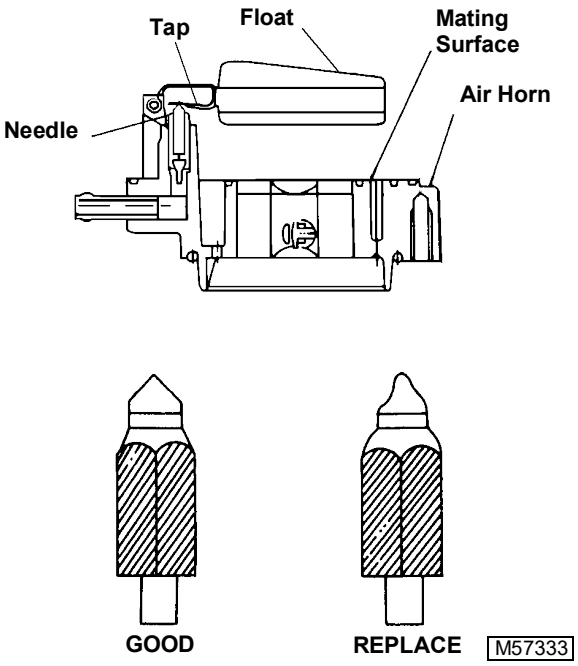
- Turn the idle mixture screw in and note the number of turns required to lightly seat it before removing it.

NOTE: If all rubber or plastic parts cannot be removed for cleaning, use a solvent with a high flash point that will not damage these parts when cleaning.

- Remove rubber or plastic parts from the carburetor. Immerse all the carburetor metal parts in a carburetor cleaning solution.
- Rinse the parts in water and dry with compressed air, do not use rags or paper to dry parts. Lint can plug the tiny passages in the carburetor.
- Inspect the carburetor body for damage. Ensure that the sealing surfaces and flanges are smooth and free of nicks and burrs.
- Turn the idle mixture screw in until lightly seated and back it out the same number of turns counted during disassembly.
- Install the choke valve with the metering hole towards the fuel inlet joint of the carburetor.
- Ensure that the float pin extends the same distance on both sides of the float hinge bracket when reassembling the carburetor.
- Ensure that the throttle and choke valves move freely and that the shaft bosses are not elongated or worn. If shaft bosses have any of these conditions, replace the carburetor.
- Inspect the inlet needle for wear or damage. The tip should be smooth, without any grooves, scratches or tears. If worn or damaged, replace the float assembly and carburetor body as a set.
- Inspect the idle mixture screw for wear or damage, replace it if necessary.

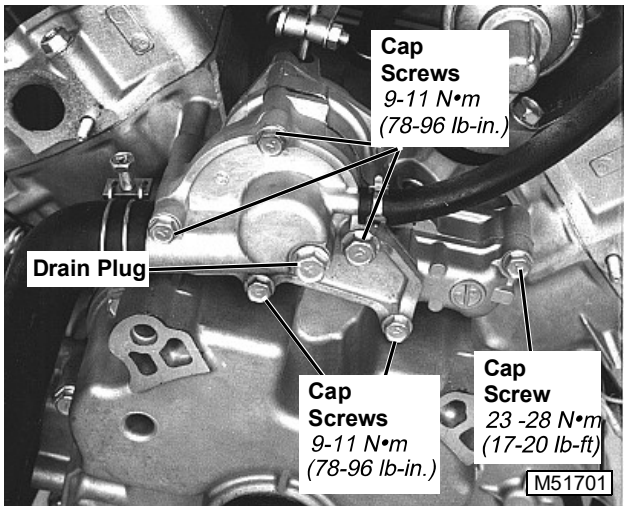
CARBURETOR—FLOAT LEVEL ADJUSTMENT

NOTE: Plastic floats are non-adjustable.



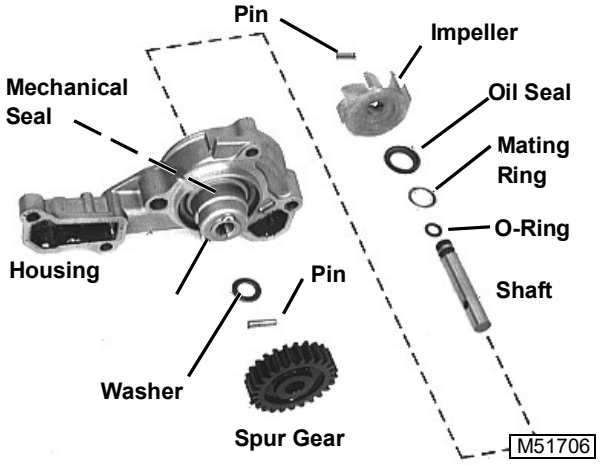
1. Hold air horn upside down at eye level with float assembly installed.
2. Gently support float with a finger and lower it slowly until the float arm tab just touches the float valve needle.
3. The float lower surface should be parallel with the body mating surface.
4. If necessary, bend float arm tab to adjust float level.

COOLANT PUMP—REMOVAL/ INSTALLATION



NOTE: Cap screw attaches crankcase cover to crankcase.

IMPORTANT: Leakage from water pump will drain into engine block and could cause engine damage. If there is any doubt of the condition of water pump, replace it as a complete assembly.



1. Remove gear with a puller.
2. Remove impeller assembly from shaft. Disassemble impeller assembly.

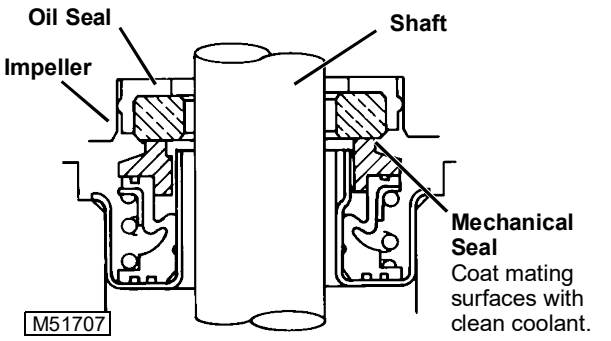
IMPORTANT: Check impeller for material breakdown or deterioration. Replace the complete coolant pump if impeller is damaged. Flush cooling system to remove debris and add new coolant.

3. Measure outside diameter of shaft. If less than specifications or if it shows any signs of corrosion, replace it.
4. Measure pump shaft bore in housing. Replace housing if greater than specifications.
5. Drive old mechanical seal from housing.

NOTE: Mechanic seal is sealed into place and will be difficult to remove.

When installing impeller assembly to housing, coat mating surfaces with clean water.

6. Install new mechanical seal.

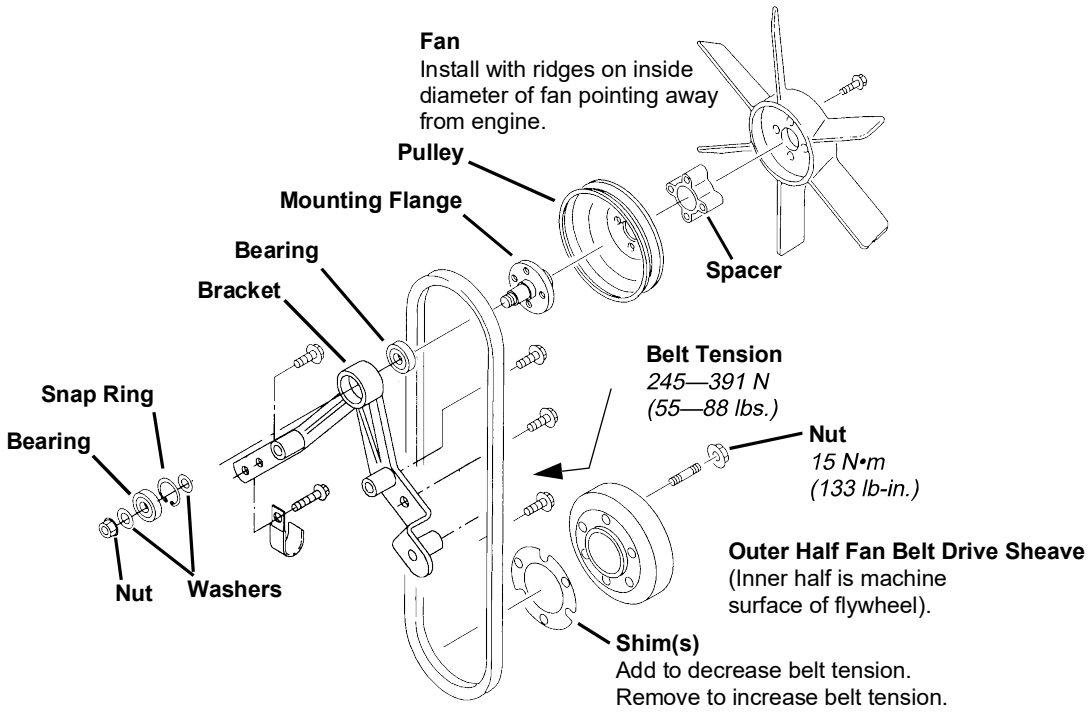


Pump Specifications

Shaft OD (Min) . . . . . 9.94 mm (0.391 in.)

Housing Shaft Bore/ ID (Max) . . . . . 10.09 mm (0.397 in.)

COOLING FAN AND BRACKET



IMPORTANT: Bearings are a press fit. Remove only if being replaced. To avoid pinching fan belt between flywheel and outer sheave half, rotate flywheel while tightening outer sheave half mounting cap screws.

c CAUTION

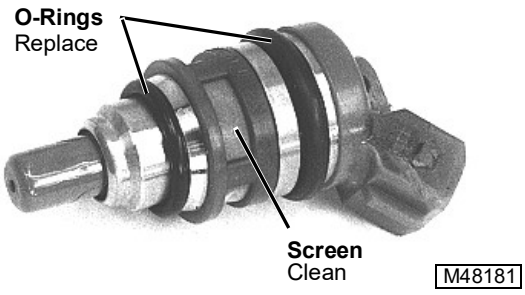
DO NOT heat oil over 182°C (360°F). Oil fumes or oil can ignite above 193°C (380°F). Use a thermometer. DO NOT allow a flame or heating element to come in direct contact with the oil. Heat the oil in a well-ventilated area.

1. Heat mounting bracket with bearings in hot oil to remove bearings. Tap bearings from mounting bracket.
2. Install bearings using a bushing, bearing and seal driver set and press.
3. Assemble fan, spacer, and belt sheave to mounting flange and install fan assembly to engine. Tighten hardware to standard torque specifications.
4. Install fan belt, shim(s), and outer sheave half to flywheel. Tighten flange nuts to specification.
5. Adjust belt tension. (See FAN BELT TENSION ADJUSTMENT.

FUEL INJECTOR—445

NOTE: See electrical system for electrical tests.

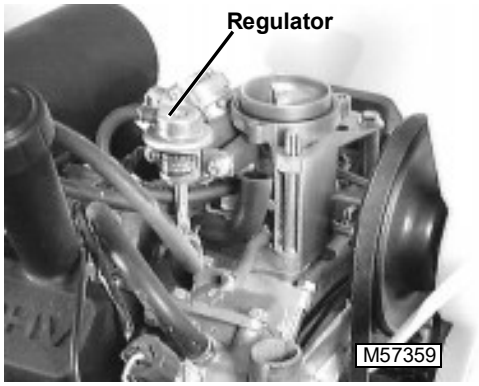
IMPORTANT: Do not drive against tip. Plastic cover can crack and nozzle will be damaged. Do not drop injector. Always install new O-rings.



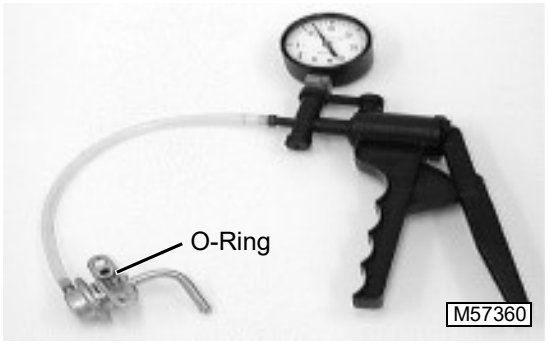
1. Remove injector retainer. Grip end of injector, twist and pull.
2. Replace injector O-rings and clean fuel screen.
3. Lubricate O-rings with clean engine oil.
4. Install injector in the same orientation as removed.

FUEL PRESSURE REGULATOR—445

IMPORTANT: Relieve fuel pressure before disconnecting fuel line.



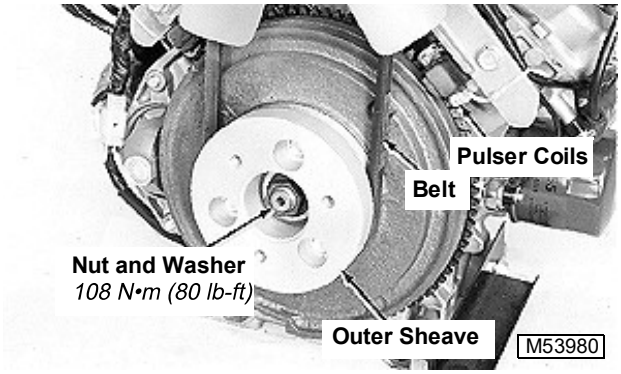
1. Remove fuel lines, vacuum line and regulator.



2. Apply vacuum to vacuum port of regulator. Regulator must hold vacuum.
3. Replace regulator if defective. Install new o-ring on regulator inlet and install regulator.

NOTE: Valve will not move without maximum fuel pressure on inlet.

FLYWHEEL—REMOVAL/ INSTALLATION



NOTE: Remove spark plugs to allow easy flywheel rotation during outer sheave half removal/ installtion.

1. Remove spark plugs.
2. Loosen and move pulser coils away from flywheel.
3. Remove outer sheave half with shim(s) and belt.
4. Hold flywheel with band wrench to remove flywheel nut and washer.
5. Use flywheel puller to remove flywheel.
6. Inspect stator (see Electrrical Section).
7. Inspect flywheel for cracks, chipped or broken teeth, and loose magnets.
8. Inspect flywheel magnets. Hold screwdriver blade close to magnet.

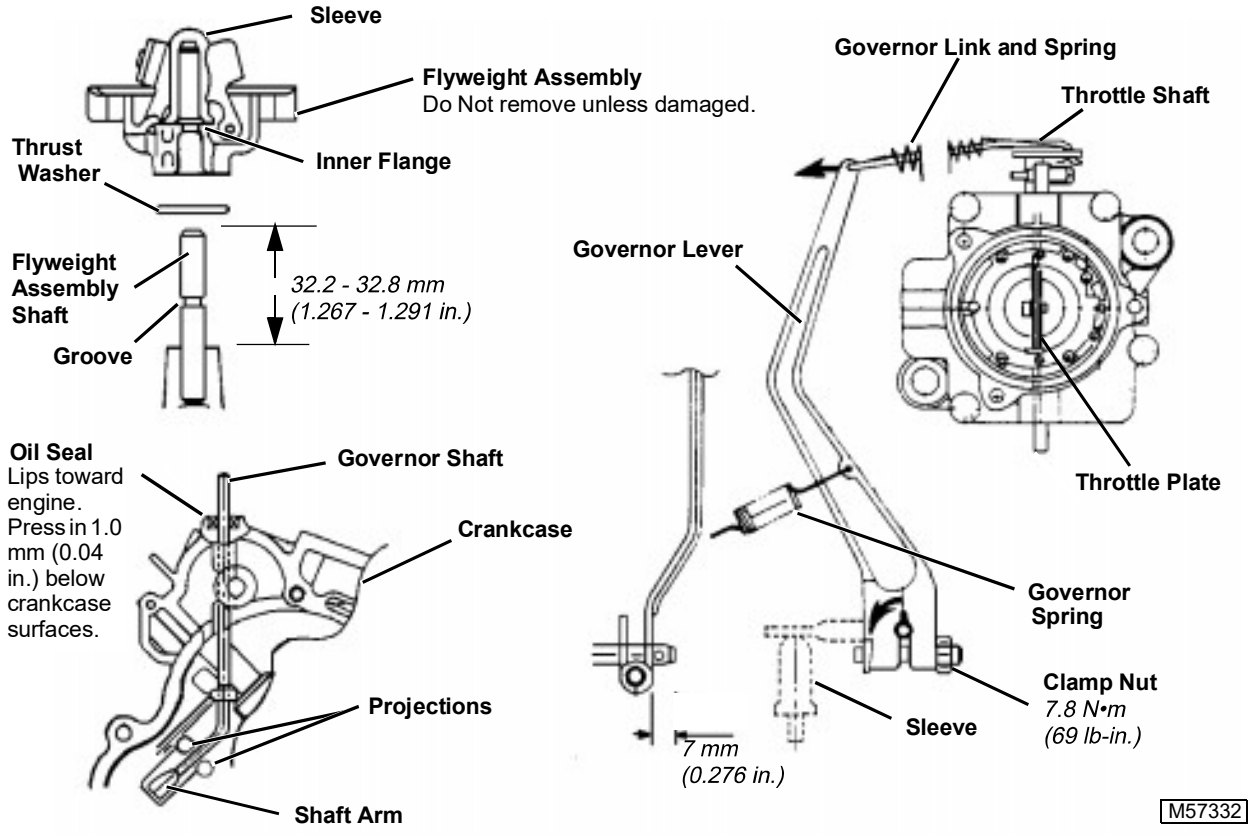
NOTE: Screwdriver blade should be drawn quickly and strongly to magnet.

9. Replace flywheel if necessary.

Installation is done in reverse order of removal.

- Install flywheel, washer, and nut and tighten nut to **108 N•m (80 lb-ft)**.
- Install belt, shim(s), outer sheave half and cap screws loosely then rotate flywheel while tightening cap screws to **15 N•m (130 lb-in.)**.
- Install spark plugs to **20 N•m (177 lb-in.)**.
- Install pulser coils.

GOVERNOR



1. Remove camshaft

IMPORTANT: DO NOT remove flyweight assembly or shaft unless damaged. Removal damages the assembly.

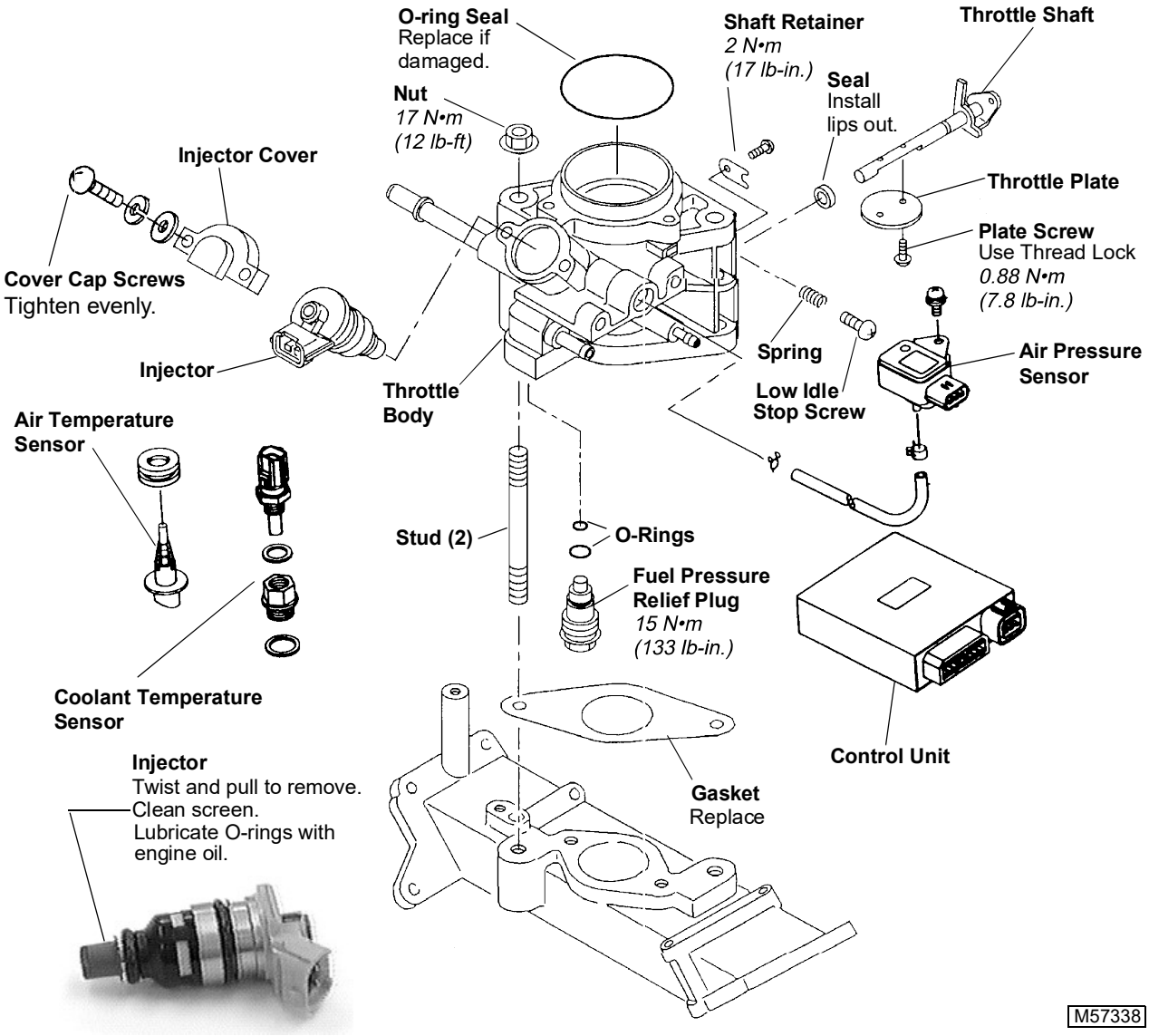
Flyweight assembly shaft is pressed into crankcase cover and is <u>not serviceable</u>. Therefore, if it is damaged or pulled loose, the crankcase cover MUST BE replaced.

2. Use two suitable pry bars to pry flyweight assembly from shaft. DO NOT damage crankcase cover sealing surfaces.
3. Unscrew governor lever clamp nut and remove governor lever.
4. Turn governor shaft **1/4 turn** clockwise to remove shaft.
5. Install new shaft oil seal. Press oil seal in to 1.0 mm (0.04 in) below crankcase surface.
6. Install governor shaft by properly positioning it between the two projections in crankcase.

NOTE: Install sleeve into governor flyweights and install as an assembly.

7. Push flyweight assembly onto shaft until it snaps into place. Check assembly for freedom of movement.
8. Loosely install governor lever on governor shaft.
9. Hold top of governor lever fully counterclockwise to fully open throttle plate.
10. Turn governor shaft fully counterclockwise to end of its travel. Check dimension from outside edge of lever to end of shaft; it should be **7 mm (0.276 in.)**.
11. Hold governor lever and shaft stationary (fully counterclockwise) while you tighten lever clamp nut to **7.8 N•m (69 lb-in.)**.

THROTTLE BODY REPAIR—445



c CAUTION

Relieve fuel pressure before removing any fuel line or components.
Loosen fuel pressure relief valve plug.

Do not remove throttle shaft unless it appears to be worn or damaged.

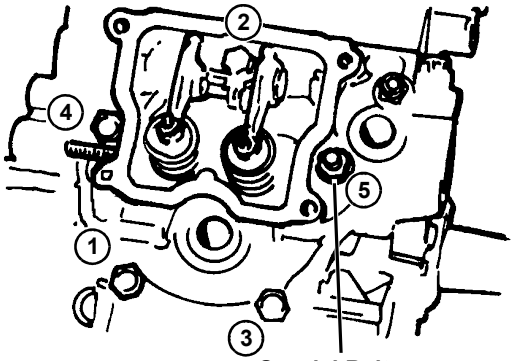
If throttle shaft is worn, check throttle body bushing. If worn, replace throttle body.

The throttle plate must be perfectly centered in bore when closed. It must also operate freely when plate screws are tightened.

CYLINDER HEAD—REMOVAL

IMPORTANT: Loosen cylinder head bolts 1/4 turn at a time, in the sequence shown, to avoid warping the cylinder head.

Mark position of all valve train parts so they can be reinstalled in their original position.

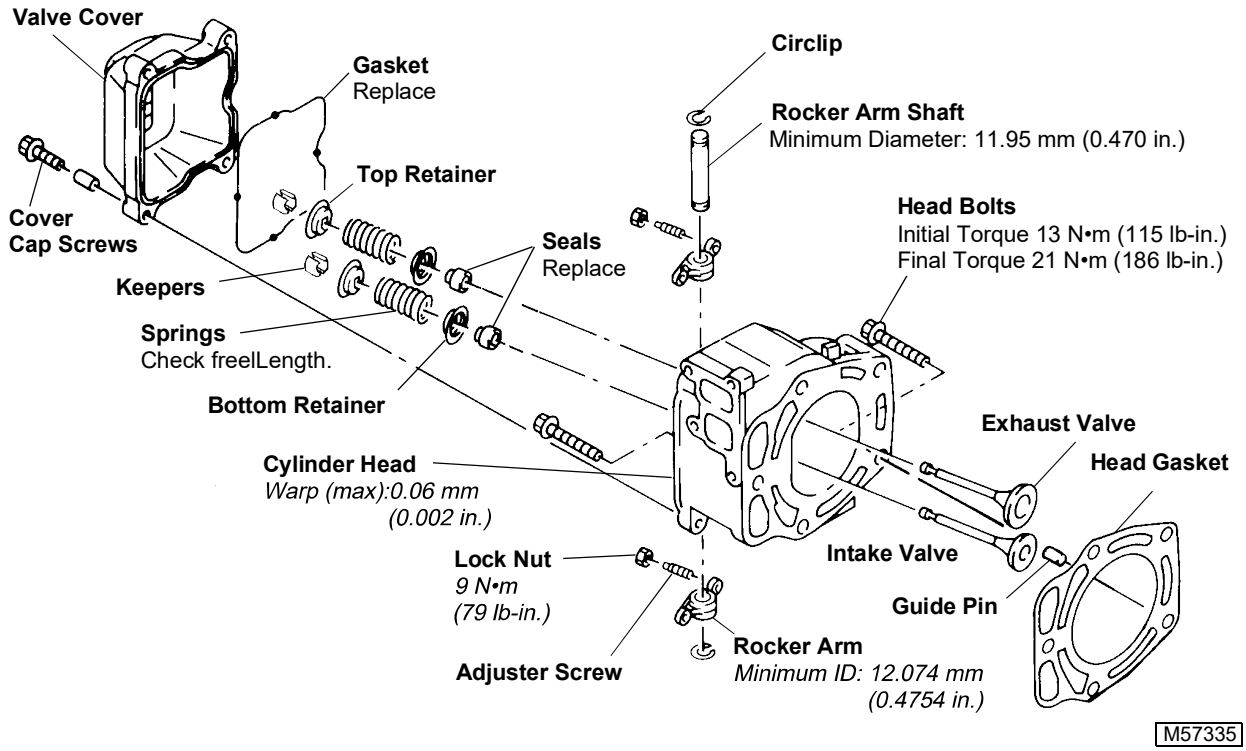


CYLINDER HEAD—CLEANING AND INSPECTION

NOTE: Use tools that will not gouge or damage the cylinder head.

1. Scrape heads to remove carbon deposits or use a de-carbonizing agent. Clean head with a suitable solvent and dry with compressed air.
2. Lay a straightedge along the sealing surface of head and measure warpage with a thickness gauge at several different points. If warpage exceeds service limit, repair or replace cylinder head.
3. Check cylinder head for cracks.
4. Apply clean engine oil to all contact surfaces and assemble cylinder head.

CYLINDER HEAD AND VALVE COMPONENTS

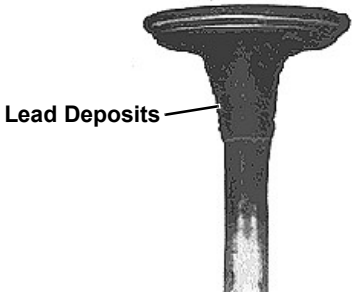


VALVE, VALVE SEAT, AND GUIDE—INSPECTION

Lead deposits on the intake valve are caused by exhaust gas leakage past the valve. This indicates that the valve is not seating properly.

Grind intake valve and reface the seat to correct this condition.

NOTE: Be sure to reset valve clearance after grinding valves.

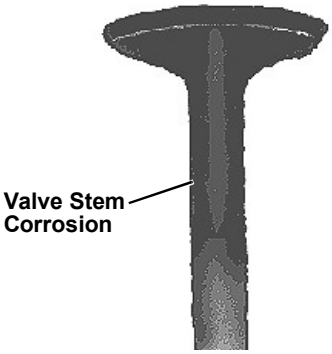


M29934

Valve stem corrosion is caused by moisture in the engine. Moisture in the fuel-air mixture can condense inside the engine when the engine is stopped and cools down.

Valve corrosion can also occur during storage. Fogging or pouring oil in the combustion chamber before storing helps prevent valve corrosion.

Corroded or pitted valves collect deposits and may cause sticking valves. Replace badly corroded or pitted valves.

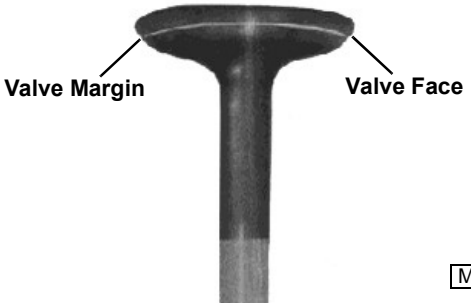


M5563

Exhaust valves are designed to function in temperatures exceeding 2760°C (5000°F). However, when operating at high temperatures for long periods of time, valve burning may occur.

Valves running too hot will show a dark discoloration of the valve stem into the area protected by the valve guide. Another indication is distortion of the valve margin and valve face. Valve inserts may also begin to burn away.

Other causes for valves running hot are worn valve guides or valve springs, incorrect valve clearance, lean fuel-air mixture and incorrect or overheated spark plug.



M30024

IMPORTANT: Do not run the engine with blower housing removed.

Poor engine cooling due to dirt or obstructions is a common cause for overheating an engine and the valves. Remove blower housing and clean the engine cooling fins.

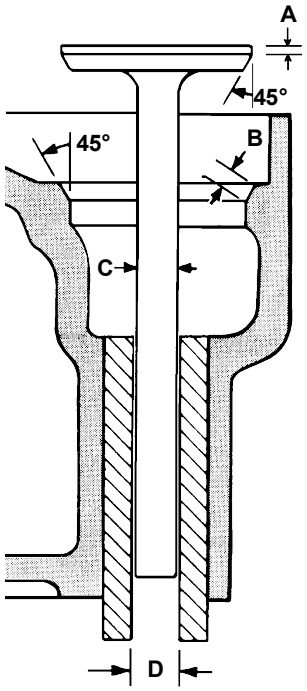
Other causes for valves running hot are worn valve guides or valve springs, incorrect valve clearance, lean fuel-air mixture and incorrect or overheated spark plug.

Using old or stale gasoline is a common cause for sticky valves.

This gummy deposit can be seen on the valve. When this condition exists, the carburetor may also contain gum deposits and will require a complete cleaning.

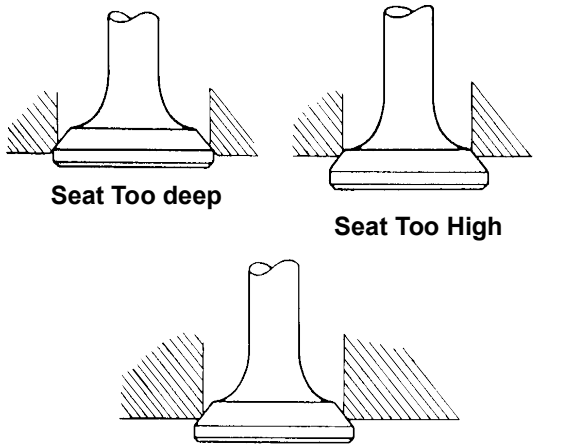
Always use fresh gasoline and drain fuel tank, lines, and carburetor before storing machine.

M29936



A - Valve Margin (Min) . . . . . 0.6 mm (0.024 in.)
B - Valve Seating Width . . . . . .
. . . . . 0.5—1.1 mm (0.02—0.043 in.)
C - Valve Stem Diameter (Min)
Intake: . . . . . 5.94 mm (0.234 in.)
Exhaust: . . . . . 5.92 mm (0.233 in.)
D - Guide ID (Max)
. . . . . 6.05 mm (0.238 in.)
Valve Stem Run-Out (Max.) . . . . 0.05 mm (0.002 in.)

- Valve guides are not replaceable. If worn, replace head.
- If grinding the valve and valve seat is necessary, follow tool manufacturer's instructions carefully.
- Lap valves after grinding with lapping compound and recheck valve seating surface for correct width and evenness of seating pattern.

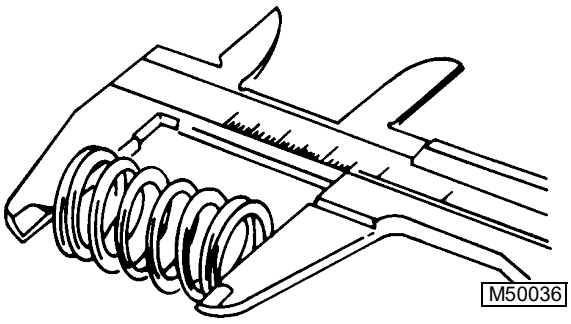


- If seats are warped or distorted beyond reconditioning, replace cylinder head.
- Check valve seating pattern for correct width and evenness all the way around.
- Clean and measure valve stem at three points along length of stem.

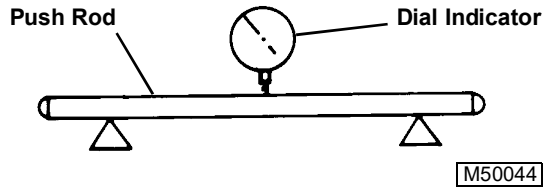
VALVE SPRING FREE LENGTH

1. Inspect valve spring for pitting, rust and burrs.

Free Length Specifications (Min)
FD620D . . . . . 29.70 mm (1.170 in.)



PUSH ROD—INSPECTION



1. Inspect push rods for straightness.

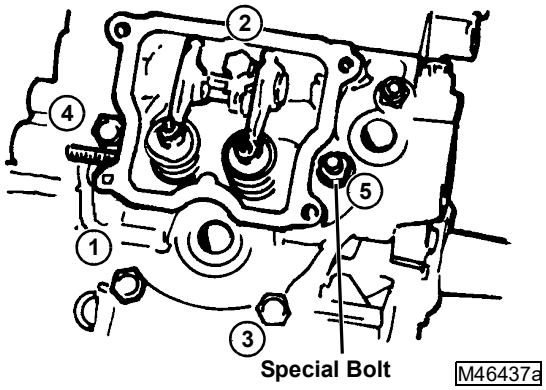
Specifications:
Maximum Run-Out . . . . . 0.8 mm (0.03 in.)

CYLINDER HEAD—INSTALLATION

IMPORTANT: Handle head gaskets carefully to avoid removing the sealing agents from the surface.

NOTE: For easier assembly turn flywheel until cam lobes are at their lowest position. Install the push-rods in their original positions. This will allow head to be installed without compressing valve springs.

*NOTE: Torque should be applied in **3 N•m (27 lb-in.)** increments.*



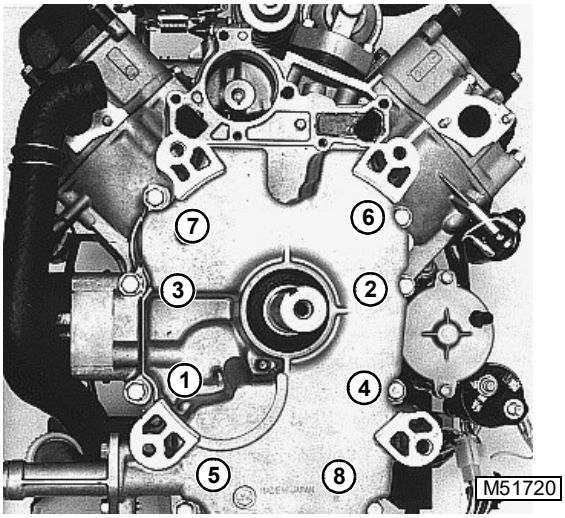
1. Tighten cylinder head bolts in sequence to initial torque of **13 N•m (115 lb-in.)**.
2. Install manifold before applying a final torque of **21 N•m (186 lb-in.)**.
3. Adjust valve clearance.

CRANKCASE COVER—DISASSEMBLY

1. Drain crankcase.
2. Remove coolant pump.

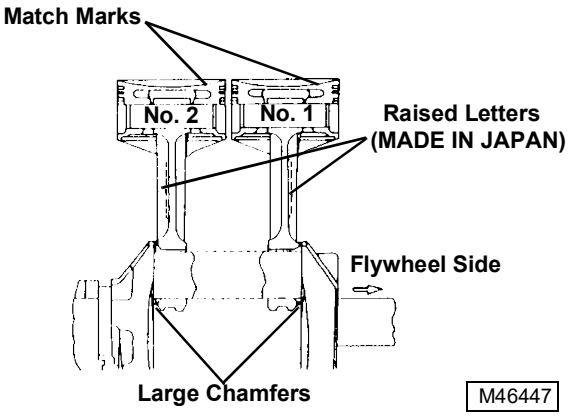
IMPORTANT: When installing crankcase cover, use bolt tightening sequence shown and tighten to 23—28 N•m (17—20 lb-ft).

NOTE: Crankcase is pinned by oil filter and opposite side. Do not force cover.



3. Remove crankcase cover and gasket.

PISTONS—REMOVAL



NOTE: Note location of the arrow match mark on the piston head in relation to "Made in Japan" on the connecting rod. No. 1 piston is opposite No. 2. Keep parts together as a set.

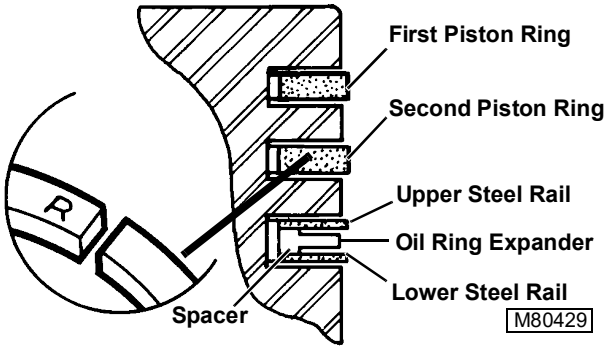
1. Turn the crankshaft to expose the connecting rod end caps. Mark the end caps for reassembly in the same position as removed.
2. Remove carbon and/or ridge from the top of the cylinder bore with a suitable ridge remover and remove the piston and connecting rod through the top of the cylinder bore.

PISTON RINGS—REMOVAL/ INSTALLATION

1. Remove piston rings with a piston ring expander.
2. Inspect piston for wear. Clean piston ring grooves. Check piston ring end gap.

IMPORTANT: Piston must be properly cleaned, inspected and the correct size rings and/or pistons obtained before proceeding with installation.

NOTE: FD620D engines are equipped with a second compression ring. Install ring with mark facing up.

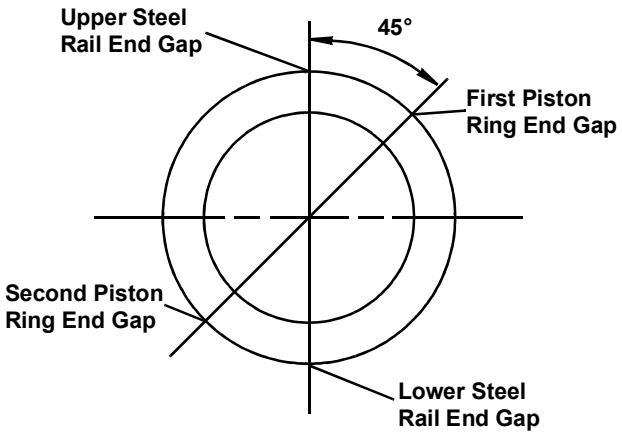


3. Install oil ring expander in the third piston oil ring groove.
4. Install upper and lower steel rails.

NOTE: There is no UP or DOWN position to the steel rails. They can be installed either way.

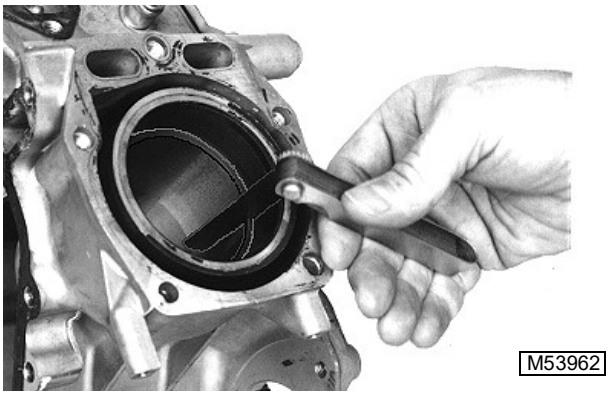
5. In second groove, install second piston ring (cast with no chrome edge) with the “Letter” mark, embossed dot, or any other mark facing up toward top of piston.

IMPORTANT: Align the piston ring and steel rail end gaps as shown.



PISTON RING END GAP

Before installing rings on piston, check end gap in cylinder bore.



Install each pistion ring squarely in bore approximately 25.4 mm (1.0 in.) down from top of cylinder. Check end gap. Replace piston ring if end gap is more than **1.20 mm (0.050 in.) (Oil Rings—Not measured)**

PISTON RING WEAR

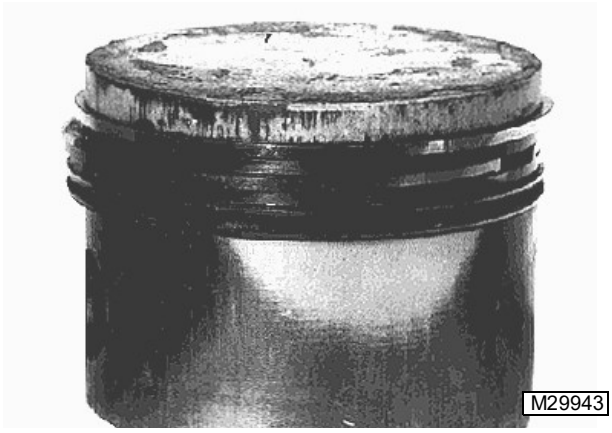
Rings of the wrong size or rings having improper end gap will not conform to the shape of the cylinder. This results in high oil consumption and excessive blow-by.

Ring end gaps should be staggered on the piston during installation. End gaps in alignment can also cause oil consumption and blow-by.

Light scuffing or scoring of both rings and piston occurs when unusually high friction and combustion temperatures approach the melting point of the piston material.

When this condition exists, it is due to one or more of the following probable causes:

- Dirty cooling shroud and cylinder head.
- Lack of cylinder lubrication.
- Improper combustion.
- Wrong bearing or piston clearance.
- Too much oil in crankcase causing fluid friction.

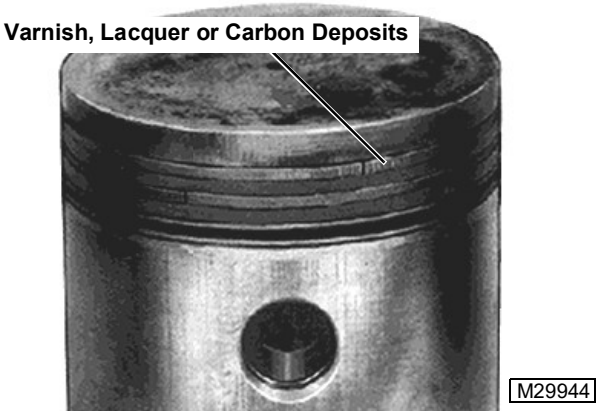


The engine operating at abnormally high temperatures

may cause varnish, lacquer or carbon deposits to form in the piston grooves making the rings stick. When this happens, excessive oil consumption and blow-by will occur.

Engine overheating and ring sticking is usually caused by one or more of the following:

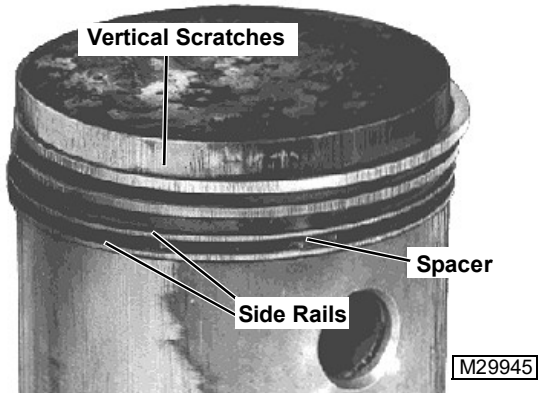
- Overloading
- Incorrect ignition timing
- Lean fuel mixture
- Dirty cooling fins
- Incorrect oil
- Low oil supply
- Stale fuel



Vertical scratches across the piston rings are due to an abrasive in the engine. Abrasives may be airborne, may have been left in the engine during overhaul or may be loose lead and carbon deposits.

When this condition exists, check for one or more of the following:

- Damaged, collapsed or improperly installed air filter.
- Loose connection or damaged gasket between air cleaner and carburetor.
- Air leak around carburetor-to-cylinder block gasket.
- Air leakage around throttle shaft.
- Failure to properly clean cylinder bore after reconditioning engine.



Abrasive particles in engine oil causes scratches on side rails of oil control ring. Inner spacer wear or distortion may cause:

- High oil consumption.
- Increased deposits in combustion chamber.
- Sticking compression rings.

Increased oil consumption may be caused by:

- Worn side rails with low tension.
- Worn or distorted inner spacer.

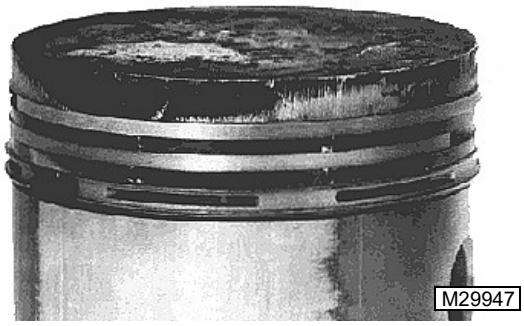
IMPORTANT: Do not use a caustic cleaning solution or a wire brush to clean piston.

PISTON—INSPECTION

Detonation, is abnormal combustion causing excessive temperature and pressure in the combustion chamber. Commonly called carbon knock, spark knock or timing knock, detonation occurs as the compressed fuel-air mixture ignites spontaneously to interrupt the normal ignition.

The following is a list of possible causes for detonation:

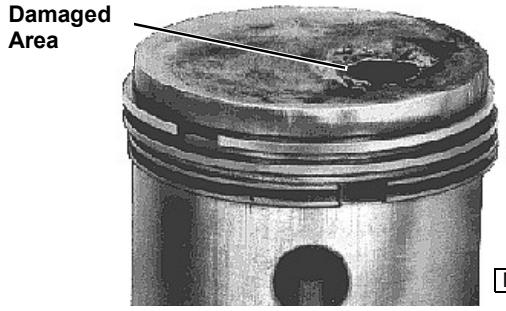
- Lean fuel mixture.
- Low octane fuel.
- Advanced ignition timing.
- Engine lugging.
- Build-up of carbon deposits on piston or cylinder head, causing excessive compression.
- Wrong cylinder head or milling of head increasing compression ratio.



Pre-ignition is the igniting of the fuel-air mixture prior to regular ignition spark. Pre-ignition causes internal shock, resulting in pings, vibration, detonation and power loss. Severe damage to piston rings and valves results from pre-ignition.

Check the following for causes of pre-ignition:

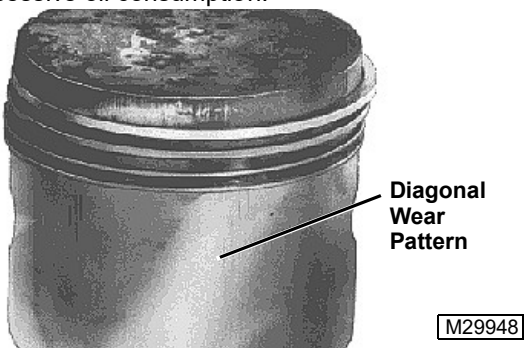
- Internal carbon deposits.
- Incorrect spark plug (high heat range).
- Broken ceramic in spark plug.
- Sharp edges on valves.



Check rod and piston alignment when piston shows a diagonal wear pattern extending across the skirt of the piston. Contact with the cylinder wall shows on bottom of skirt at left and ring lands on the right.

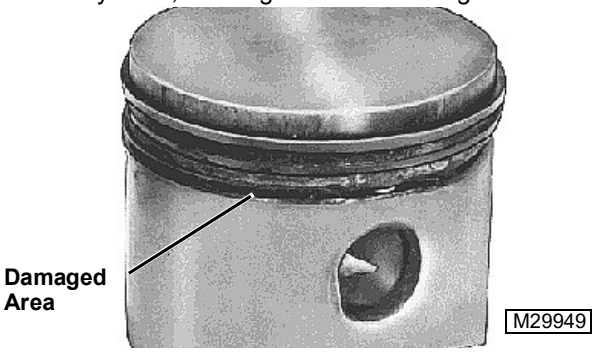
A cylinder bored at an angle to the crankshaft can also give improper ring contact with cylinder causing:

- Rapid piston wear.
- Uneven piston wear.
- Excessive oil consumption.

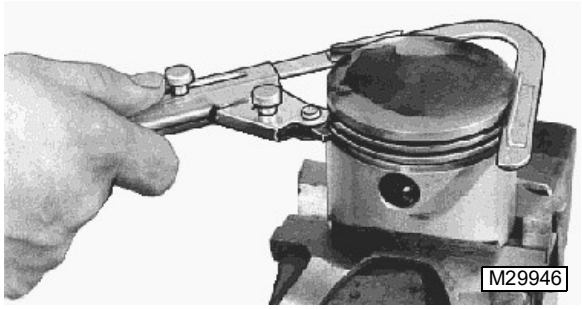


A broken retaining ring caused the damage shown. Retaining rings loosen or break due to:

- Rod misalignment.
- Excessive crankshaft end play.
- Crankshaft journal taper.
- Weak retaining rings.
- Incorrectly installed retaining rings. Inertia can cause a broken retaining ring to beat out the piston and cylinder, causing extensive damage.



1. Remove all deposits from the piston.



2. Clean carbon from piston ring grooves with a ring groove cleaner. If cleaning tool is not available, break an old ring and use it carefully to clean groove.
3. Check that oil return passages in grooves are open.
4. Inspect piston for scoring or fractures. Replace piston if damaged.

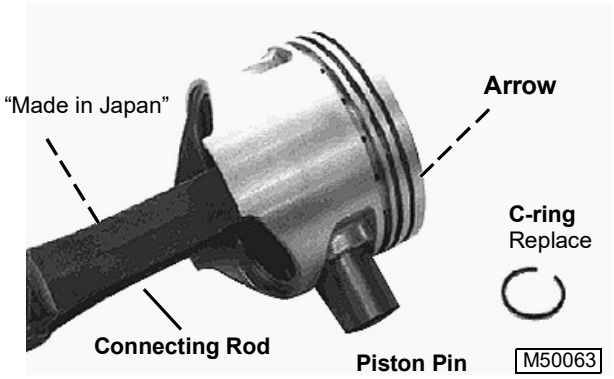
NOTE: Inspect clearance visually. Replace piston if clearance appears excessive.

5. Check ring grooves for wear at several points around piston. Replace piston if clearance is greater than specification.

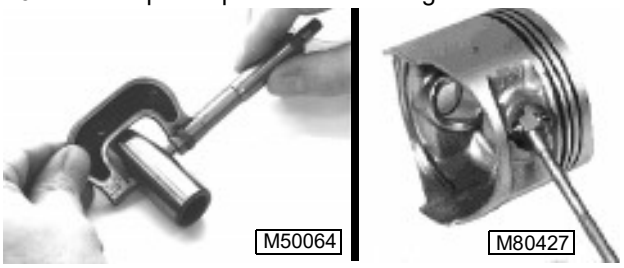
Ring Side Clearance Specification (Max):

Top Ring . . . . . 0.15 mm (0.006 in.)
Second Ring . . . . . 0.12 mm (0.005 in.)
Oil Rings . . . . . Not Measured

IMPORTANT: Note location of arrow match mark on piston head in relation to MADE IN JAPAN on connecting rod. No. 1 piston is opposite of No. 2 piston. Keep parts together as a set.



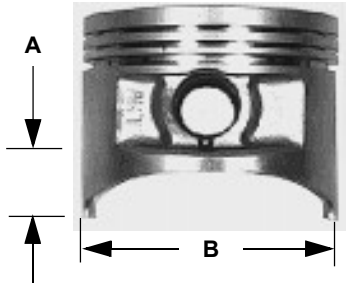
6. Remove piston pin and connecting rod.



7. Measure piston pin outer diameter and piston pin bore.

Piston And Piston Pin Specifications:

Piston Pin OD (Min) . . . . . 16.98 mm (0.668 in.)
Piston Pin Bore ID (Max) . . . . . 17.04 mm (0.671 in.)



8. Measure piston OD (B) perpendicular to piston pin bore at approximate specified distance (A) from bottom of piston skirt.
9. Subtract piston OD measurement (B) from cylinder bore measurement to determine piston-to-cylinder bore clearance.
10. Replace piston and/or rebore cylinder block if not within specifications.

Distance (A) . . . . . 11 mm (0.433 in.)
Piston OD (B) . . . . . 75.935—75.950 mm (2.989—2.990 in.)
Piston-to-Cylinder Bore Clearance. . . . . 0.030—0.170 mm (0.00118—0.0067 in.)

CONNECTING ROD—INSPECTION

CRANKSHAFT AND CONNECTING ROD WEAR

Check connecting rod and cap for damage or unusual wear patterns.

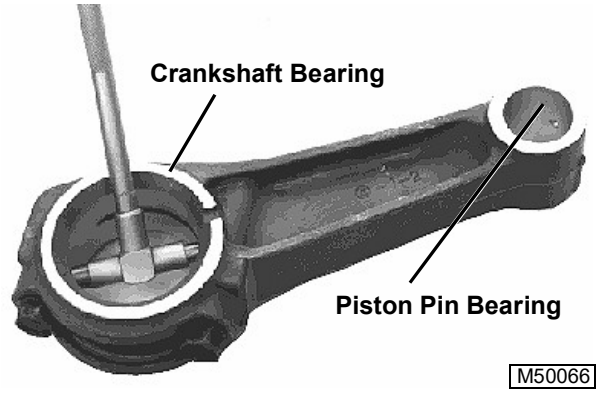
Lack of lubrication or improper lubrication can cause the connecting rod and cap to seize the crankshaft.

When the rod and cap seize to the crankshaft, the connecting rod and piston may both break causing other internal damage. Inspect block carefully before rebuilding engine.

Crankshaft and connecting rod damage can result from:

- Engine run low on oil or without oil.
- Oil not changed regularly.
- Bearing cap installed incorrectly.

1. Install connecting rod cap. Tighten to:
   21 N•m (186 lb-in.)
2. Clean and inspect rod. Replace if scored.



3. Measure connecting rod crankshaft bearing and piston pin bearing. Replace connecting rod if either measurement is greater than specifications.

Connecting Rod Bearing ID Specifications (Max)

Crankshaft Piston Bearing . . . 34.06 mm (1.341 IN.)
Piston Pin Bearing . . . . . 17.05 mm (0.671 in.)

CONNECTING ROD AND PISTON—ASSEMBLY

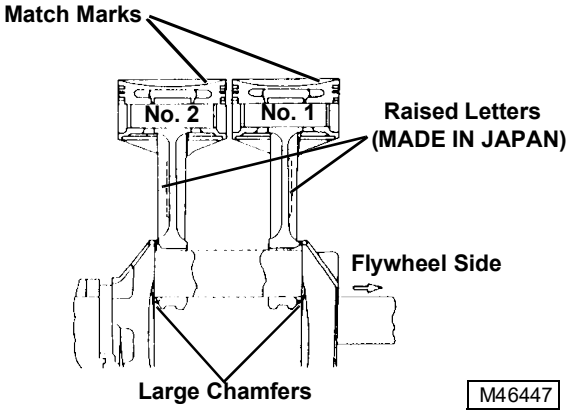
IMPORTANT: No. 1 piston is piston nearest flywheel. Install No. 1 piston with the large chamfer on connecting rod facing TOWARD the flywheel. The arrow match mark on piston head will be on the SAME side (toward flywheel) as the "Made in Japan" mark on the connecting rod.

No. 2 piston is piston farthest from flywheel. Install No. 2 piston with large chamfer on connecting rod facing AWAY from the flywheel.

The arrow match mark on piston head will be OPPOSITE the "Made in Japan" on connecting rod.

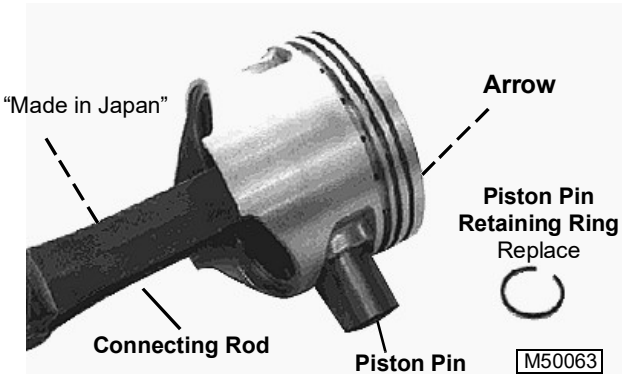
Use clean engine oil and apply on piston skirt, cylinder bore, and connecting rod bearing surface.

Use piston ring compressor to install piston in the cylinder bore.



1. Insert piston and connecting rod so arrow match mark on the top of the piston is facing the proper direction.

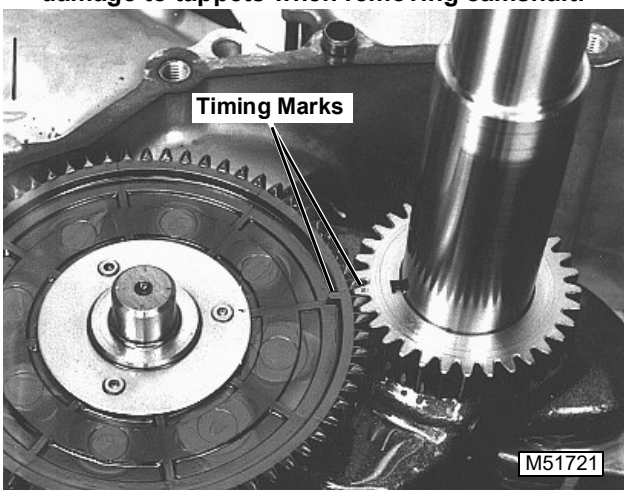
IMPORTANT: Do not reuse piston pin retaining rings.



2. Tighten connecting rod end caps to **21 N•m (186 lb-in.)**.

CAMSHAFT—REMOVAL/ INSTALLATION

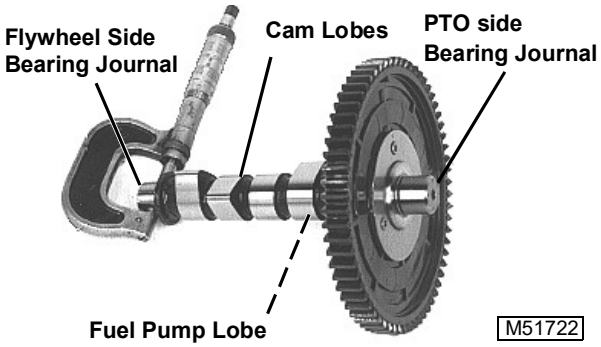
IMPORTANT: Align timing marks to prevent damage to tappets when removing camshaft.



1. Rotate crankshaft until timing marks align.
2. Remove and inspect camshaft.
3. Lubricate journals.
4. Align timing marks and install camshaft.

CAMSHAFT—INSPECTION

1. Inspect camshaft for worn or broken teeth and loose rivets holding gear to camshaft. Replace camshaft if loose.



2. Measure cam lobes. Replace camshaft if less than specifications.

Camshaft Specifications (Min)

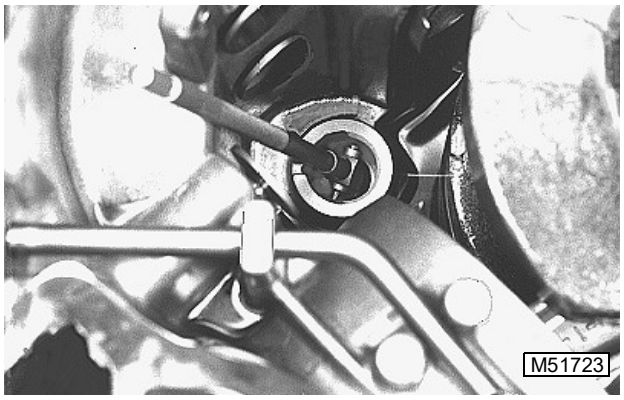
Bearing Journals OD . . . . . 15.91 mm (0.626 in.)

Cam Lobes

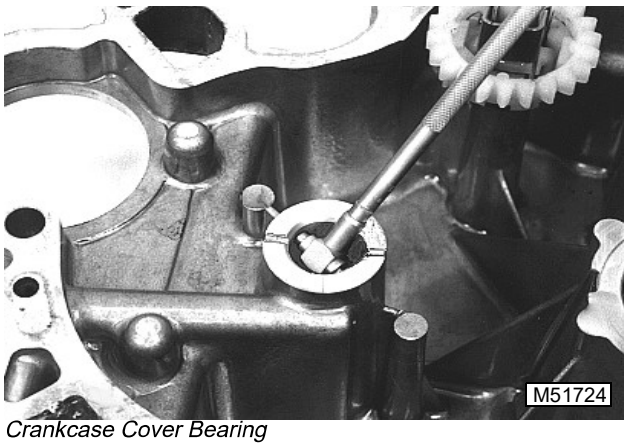
Intake. . . . . 25.21 (0.993 in.)
Exhaust . . . . . 25.46 mm (1.002 in.)
Fuel Pump Lobe . . . . . 19.50 mm (0.760 in.)

CAMSHAFT BEARINGS

1. Measure camshaft bearings in cylinder block and crankcase cover. Replace block or cover if diameter is greater than specification.



Cylinder Block Bearing



Crankcase Cover Bearing

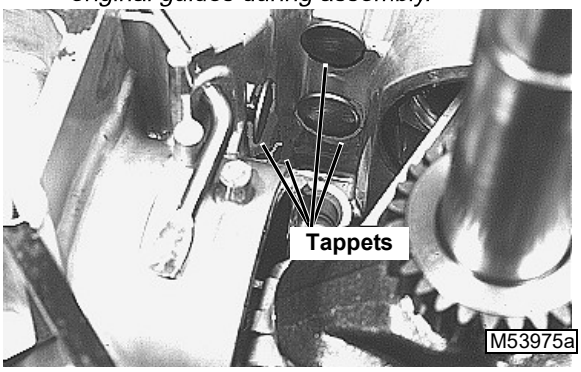
Camshaft Bearing ID Specifications (Max)

Cylinder Block Bearing . . . . . 16.07 mm (0.633 in.)
Crankcase Cover Bearing . . . . 16.07 mm (0.633 in.)

TAPPETS—REMOVAL/ INSTALLATION

1. Remove camshaft.

NOTE: Mark tappets so they can be installed in their original guides during assembly.

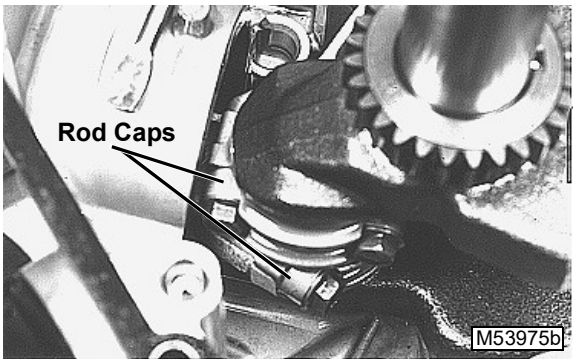


2. Remove tappets. Replace if scored.
3. Install tappets in original positions.

CRANKSHAFT—REMOVAL

1. Remove camshaft.

IMPORTANT: Mark connecting rod caps so they can be reinstalled in the same location.



2. Remove connecting rod caps and push pistons to top of cylinder. Remove crankshaft.

IMPORTANT: A bent crankshaft must be replaced; it cannot be straightened.

CRANKSHAFT—INSPECTION

CRANKSHAFT AND CONNECTING ROD WEAR

Check connecting rod and cap for damage or unusual wear patterns.

Lack of lubrication or improper lubrication can cause the connecting rod and cap to seize the crankshaft.

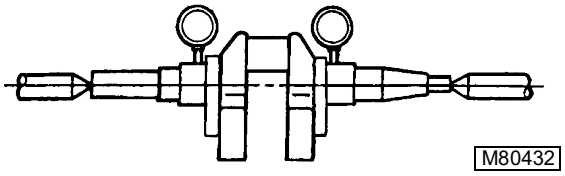
When the rod and cap seize to the crankshaft, the

connecting rod and piston may both break causing other internal damage. Inspect block carefully before rebuilding engine.

Crankshaft and connecting rod damage can result from:

- Engine run low on oil or without oil.
- Oil not changed regularly.
- Bearing cap installed incorrectly.

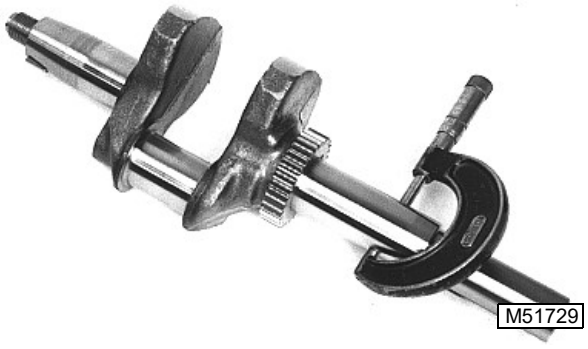
1. Check crankshaft alignment (T.I.R).
2. Place crankshaft into an alignment jig. Using dial indicators, rotate crankshaft slowly.



Maximum Crankshaft Bend

All . . . . . 0.05 mm (0.002 in.)

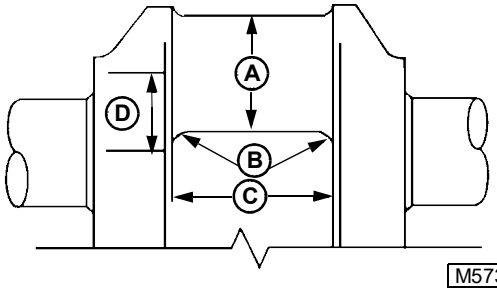
3. Clean and inspect crankshaft. Measure crankshaft main bearing journals and connecting rod journal.



NOTE: Connecting rod journal can be resized to accept under-sized rod. Have grinding done by a reliable repair shop. Before sending crankshaft for grinding, inspect journal radii for cracks.

Crankshaft Specifications (Min):

Main Bearing Journal . . . . . 33.91 mm (1.335 in.)
Connecting Rod Journal . . . . 33.91 mm (1.336 in.))



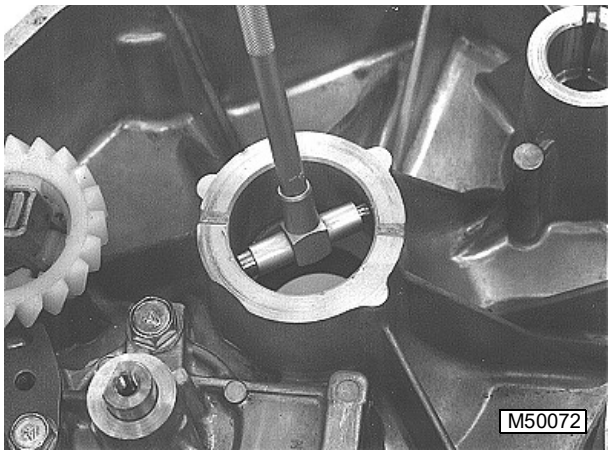
Resizing Specifications:

A . . . . . 33.48—33.47 mm (1.3181—1.3176 in.)
B . . . . . 2.30—2.70 mm (0.090—0.110 in.)
C . . . . . 44.50 mm Max 1.752 in.)
D . . . . . 34.00—33.95 mm (1.3386—1.3366 in.)

CRANKSHAFT—INSTALLATION

1. Cover keyway on flywheel end of crankshaft with tape to prevent seal damage when installing crankshaft.
2. Put a light film of oil on crankshaft bearing surfaces.
3. Pack grease in oil seals and install crankshaft.
4. Install connecting rod caps and torque to **21 N•m (186 lb-in.)**.

CRANKSHAFT PLAIN BEARINGS



1. Measure crankshaft bearings in crankcase and crankcase cover. Replace block, cover or shells, if equipped, if diameter is greater than specifications.

Bearing ID Specifications (Max):

Crankcase and Cover
Crankcase Cover. . . . . 34.07 mm (1.341 in.)
Crankcase . . . . . 34.11 mm (1.343 in.)