Product: GEN SET ENGINE
Model: 3516 GEN SET ENGINE 25Z
Configuration: 3516 Generator Set Engine 25Z02189-UP

Testing and Adjusting
3500 Generator Set Engines
Media Number -SENR2362-01 **Publication Date -01/07/2002** **Date Updated -15/07/2002**

i02206665

Crankshaft Position for Fuel Injector Adjustment and Valve Lash Setting

SMCS - 1202

Table 1

Standard Rotation (Counterclockwise) As Viewed From Flywheel End				
Cylinders To Check/Adjust				
Engine	Correct Stroke For No. 1 Piston At Top Center Position (1)	Inlet Valves	Exhaust Valves	Injectors
3508	Compression	1-2-6-8	1-2-3-7	3-4-5-7
	Exhaust	3-4-5-7	4-5-6-8	1-2-6-8
3512	Compression	1-3-6-7-10-12	1-4-5-6-9-12	2-4-5-8-9-11
	Exhaust	2-4-5-8-9-11	2-3-7-8-10-11	1-3-6-7-10-12
3516	Compression	1-2-5-7-8-12-13-14	1-2-3-4-5-6-8-9	3-4-6-9-10-11-15-16
	Exhaust	3-4-6-9-10-11-15-16	7-10-11-12-13-14-15-16	1-2-5-7-8-12-13-14

(1) Put the No. 1 Piston at the top center (TC) position and identify the correct stroke. Refer to Testing and Adjusting, "Finding the Top Center Position for the No. 1 Piston". Find the top center position for a particular stroke and make the adjustment for the correct cylinders. Remove the timing bolt. Turn the flywheel by 360 degrees in the direction of normal engine rotation. This will put the No. 1 piston at the top center (TC) position on the other stroke. Install the timing bolt in the flywheel and complete the adjustments for the cylinders that remain.

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i02126811

Valve Lash Check

SMCS - 1105-535

WARNING

The Electronic Control Module produces high voltage. To prevent personal injury make sure the Electronic Control Module is not powered and do not come in contact with the fuel injector solenoid terminals while the engine is running.

Valve lash is measured between the rocker arm and the bridge for the valves. All of the clearance measurements and the adjustments must be made with the engine stopped. **The valves must be fully closed.**

If the measurement of the valve lash is in the acceptable range, no adjustments are necessary. The range is given in Table 1.

Table 1

Valve Lash Check: Engine Stopped	
Valves	Acceptable Valve Lash Range
Inlet	0.42 to 0.58 mm (0.017 to 0.023 inch)
Outlet	0.92 to 1.08 mm (0.036 to 0.043 inch)

.020 INTAKE

.040 EXHAUST

If the measurement is not within this range, adjustment is necessary. Refer to Testing And Adjusting, "Valve Lash and Valve Bridge Adjustment".

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i02013998

Valve Lash and Valve Bridge Adjustment

SMCS - 1102-036

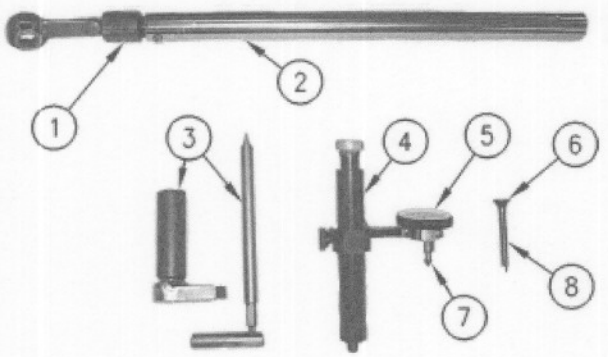

Illustration 1 g00286271

(1) 147-2060 Wrench

(2) 147-2059 Torque Wrench

(3) 148-7211 Bridge Nut Socket

(4) 145-5191 Gauge Support

(5) 147-2056 Dial Indicator

(6) 147-5536 Indicator Contact Point

(7) 147-2057 Indicator Contact Point

(8) 147-2058 Indicator Extension

Table 1

Tools Needed	Quantity
147-2060 Wrench	1
147-2059 Torque Wrench	1
148-7211 Bridge Nut Socket	1
145-5191 Gauge Support	1
147-2056 Dial Indicator	1
147-5536 Indicator Contact Point	1
147-2057 Indicator Contact Point	1
147-2058 Indicator Extension	1
147-5537 Dial Indicator (not shown)	1

Note: The **145-5191** Gauge Support (4), the **147-2057** Indicator Contact Point (7), the **147-2058** Indicator Extension (8), and the **147-5536** Indicator Contact Point (6) are included in the **147-5482** Valve Lash Gauge Group .

Note: The **147-2056** Dial Indicator or the **147-5537** Dial Indicator (Metric, not shown) can be used with the **147-5482** Valve Lash Gauge Group .

There are two different design of valve bridges that are used. If the engine is equipped with an adjustable valve bridge (Illustration 2), proceed to the "Valve Bridge Adjustment". If the engine is equipped with a nonadjustable valve bridge (Illustration 3), proceed to the "Valve Lash Adjustment".

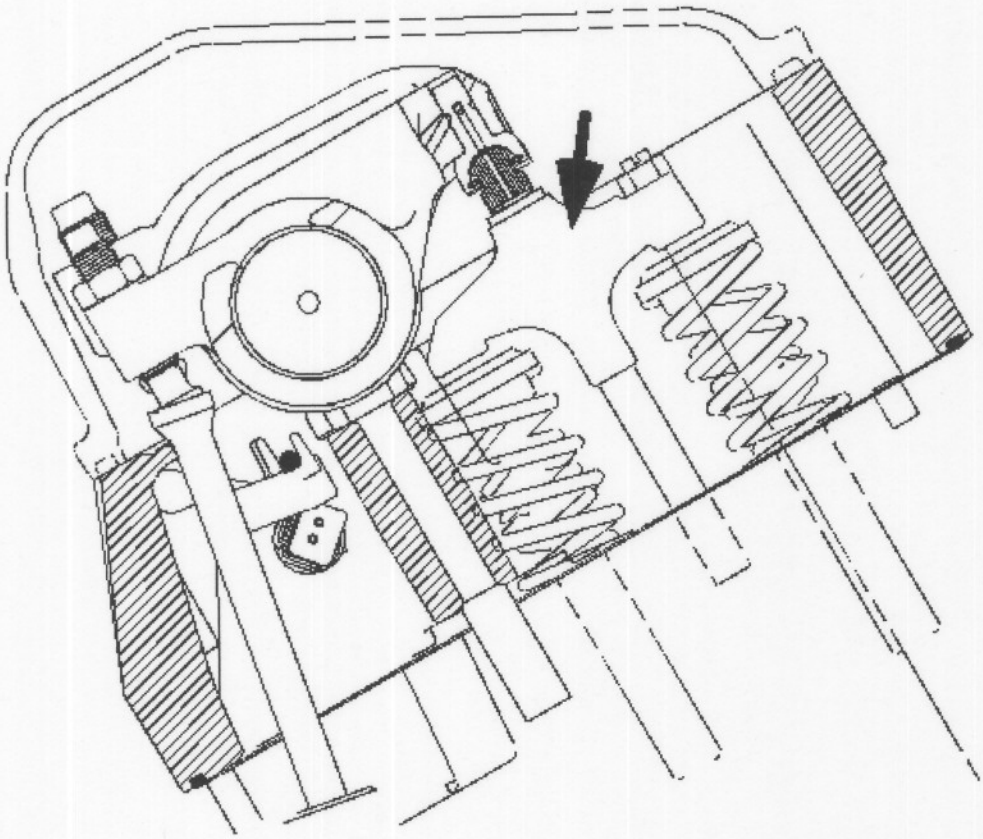

Illustration 2 g01034327
Adjustable valve bridge

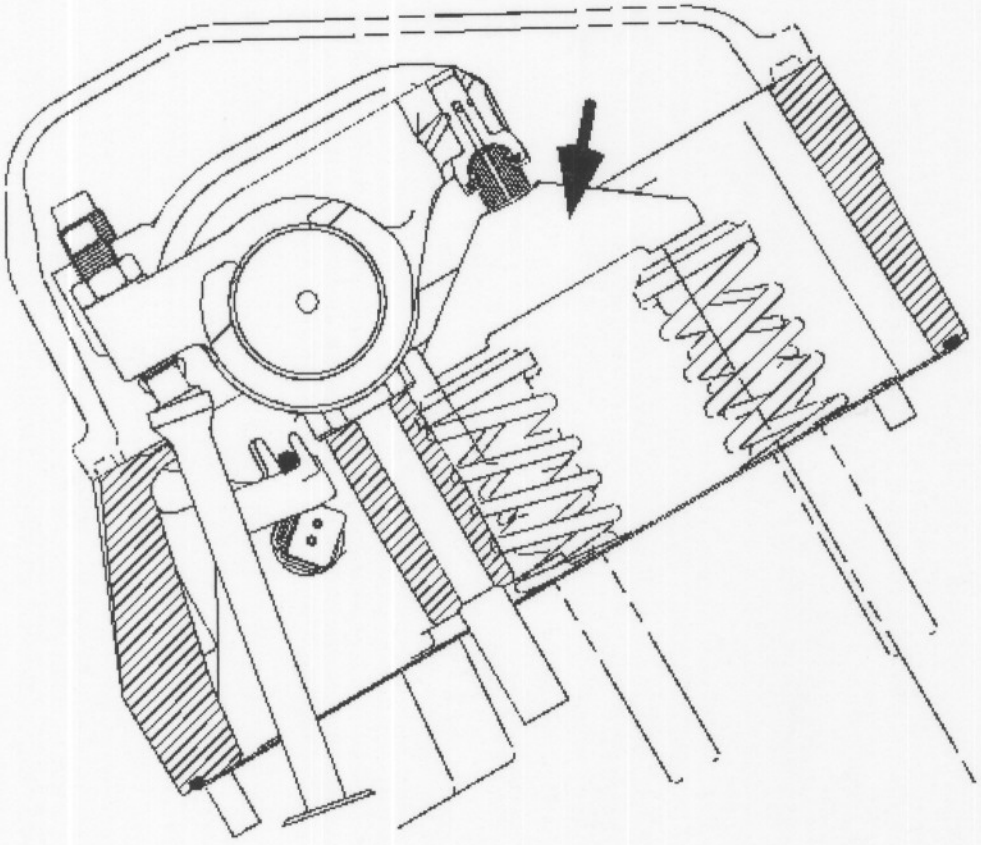

Illustration 3 g01034328
Nonadjustable valve bridge

Valve Bridge Adjustment

WARNING

The Electronic Control Module produces high voltage. To prevent personal injury make sure the Electronic Control Module is not powered and do not come in contact with the fuel injector solenoid terminals while the engine is running.

Note: When the **147-5482** Valve Lash Gauge Group is used, it is not necessary for you to remove the rocker arm shaft assemblies. The valves must be fully closed when the adjustment is made. Refer to Testing and Adjusting, "Finding the Top Center Position for the No. 1 Piston".

Installation

1. Assemble the **147-2058** Indicator Extension and the **147-5536** Indicator Contact Point on the **147-2056** Dial Indicator or on the **147-5537** Dial Indicator .

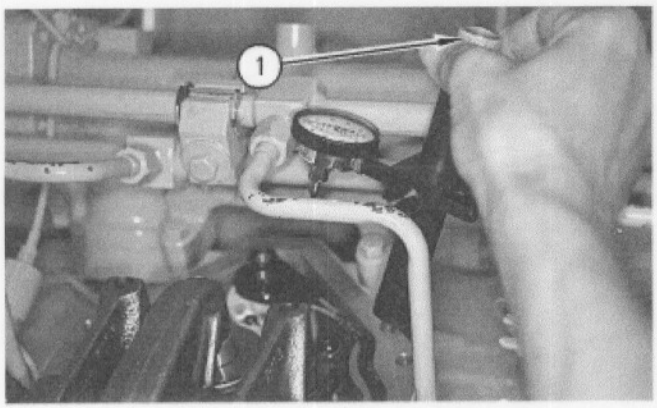

Illustration 4 g00286279
145-5191 Gauge Support

(1) Knurled knob

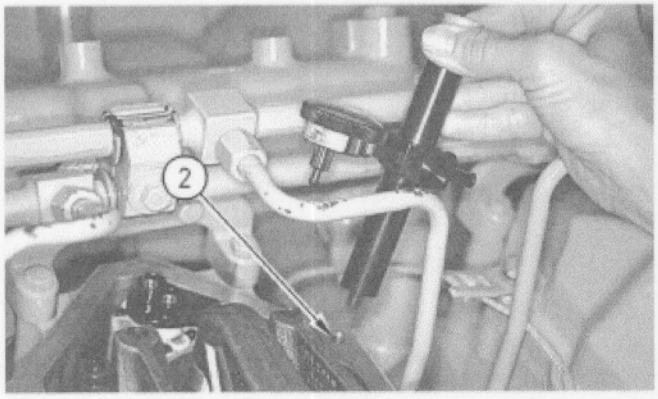

Illustration 5 g00286280
(2) Valve cover base rear bolt hole

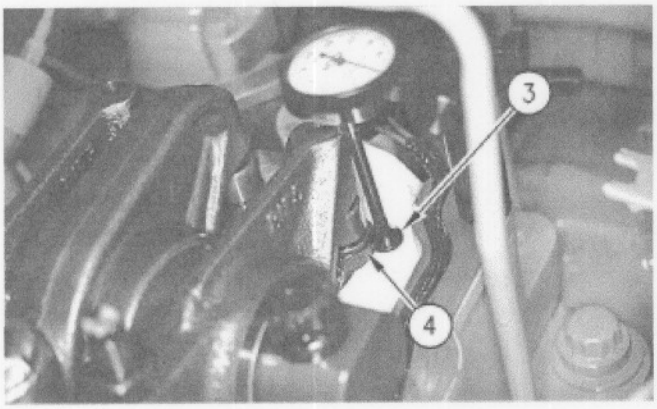

Illustration 6 g00286281
(3) 147-5536 Indicator Contact Point

(4) Top edge of the valve bridge

2. Install the **145-5191** Gauge Support in the rear bolt hole (2). The rear bolt hole is located in the valve cover base. Adjust contact point (3) on the top edge of valve bridge (4) .

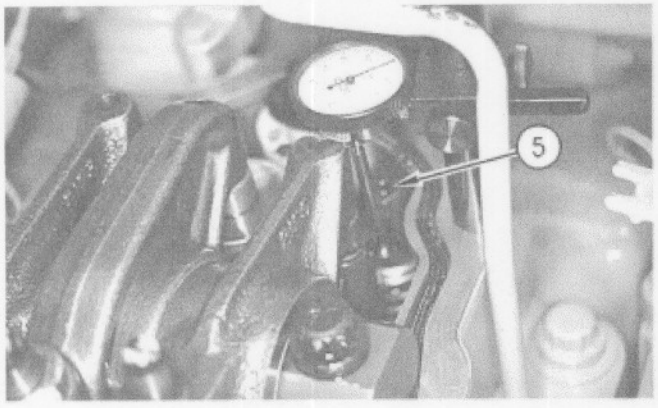

Illustration 7 g00286283
(5) Adjustment screw

3. Loosen the locknut for the adjustment screw. Loosen the adjustment screw (5) by several turns.

4. Apply a force of 5 N (1 lb) to 45 N (10 lb). Push down on the top contact surface of the valve bridge. Zero the indicator.

5. Turn adjustment screw (5) in the clockwise direction until the dial indicator reads 0.038 mm (0.0015 inch). This measurement is equal to turning the adjustment screw 20 to 30 degrees clockwise after the screw contacts the end of the valve.

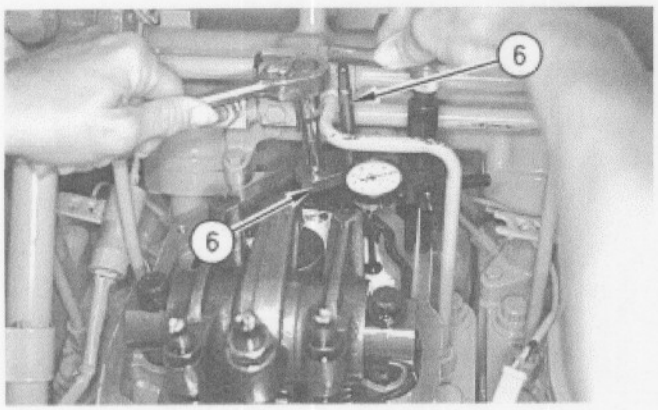

Illustration 8 g00286364
(6) 148-7211 Bridge Nut Socket

6. Hold the adjustment screw with the **148-7211** Bridge Nut Socket (6) in order to tighten the locknut to 30 ± 4 N·m (22 ± 3 lb ft). You may use a sliderule torque computer in order to determine the torque wrench dial reading for the different extensions. Refer to Special Instruction, SEHS7150, "Snap On Torque Computer".

Valve Lash Adjustment

WARNING

The Electronic Control Module produces high voltage. To prevent personal injury make sure the Electronic Control Module is not powered and do not come in contact with the fuel injector solenoid terminals while the engine is running.

Note: Adjust the valve bridges before you make the valve lash adjustments.

Table 2

Valve Lash Setting: Engine Stopped	
Valves	Gauge Dimension
Inlet	0.50 mm (0.020 inch)
Exhaust	1.00 mm (0.040 inch)

1. Ensure that the number 1 piston is at the top center position. Refer to Testing and Adjusting,

"Finding the Top Center Position for the No. 1 Piston".

2. The number 1 piston should be at the top center position of the correct stroke. Make adjustments to the valves according to the chart: Refer to Testing and Adjusting, "Crankshaft Positions for Fuel Injector Adjustment and Valve Lash Setting".

   Note: Tap each rocker arm on the top of the adjustment screw before you make any adjustments. Use a soft hammer. Make sure that the lifter roller is seated against the base circle of the camshaft.

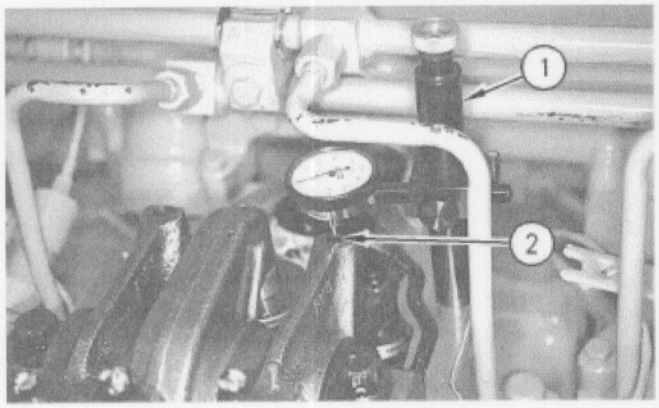

Illustration 9 g00286365

(1) 145-5191 Gauge Support

(2) 147-2057 Indicator Contact Point

3. Install the **145-5191** Gauge Support (1). Use the **147-2056** Dial Indicator or use the **147-5537** Dial Indicator. Use the **147-2057** Indicator Contact Point (2). Install the tool in the rear bolt hole. The rear bolt hole is located on the valve cover base.

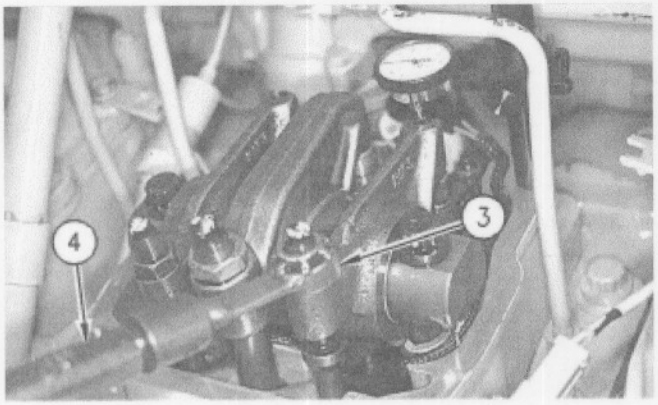

Illustration 10 g00286366
(3) 147-2060 Wrench

(4) 147-2059 Torque Wrench

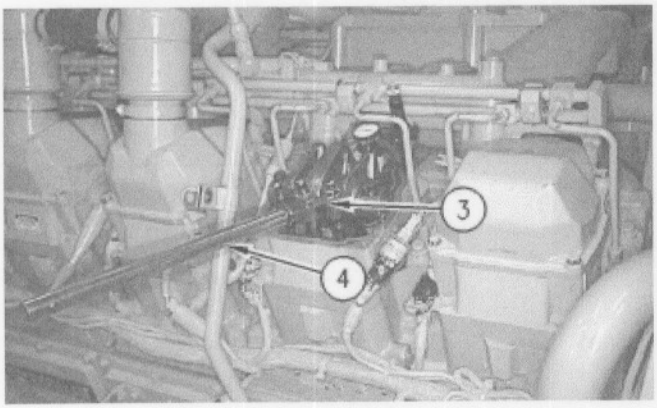

Illustration 11 g00286367
(3) 147-2060 Wrench

(4) 147-2059 Torque Wrench

4. Move the rocker assembly upward and move the rocker arm assembly downward. Move the rocker assembly several times. The oil film is removed in order to get a true zero reading on the dial indicator. Use the **147-2060** Wrench (3) and use the **147-2059** Torque Wrench (4). Install the socket wrench and install the torque wrench on the nut of the rocker arm. Apply upward pressure to the front of the rocker assembly. Set the dial indicator to zero. The weight of the torque wrench (4) allows the valve lash to be read. Do not apply any pressure on the torque wrench.

5. Loosen the locknut. The locknut is located on the adjustment screw of the pushrod. Turn the adjustment screw until the valve lash is set to specifications. Tighten the nut for the adjustment screw to 70 ± 15 N·m (50 ± 11 lb ft). The **147-2059** Torque Wrench is preset to the torque that is required. Check the adjustment again.

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i01374252

Fuel Injector Synchronization

SMCS - 1290-025

Table 1

Tools Needed	
8T-2684 Rack Synchronization Gauge	1

Injector synchronization is the setting of all fuel injector racks to a reference position so each injector gives the same amount of fuel to each cylinder. Injector synchronization is done by setting each fuel injector rack to the same position while the control linkage is in a fixed position. Use the following procedure for the adjustment of injector synchronization:

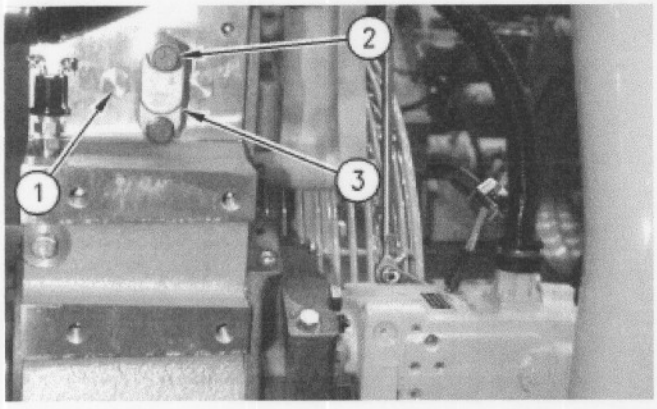

Illustration 1 g00323443

Location of fuel setting cover and synchronization pin (typical example)

(1) Plug

(2) Synchronization pin

(3) Cover

1. The top bolt that holds cover (3) in position is synchronization pin (2). Remove synchronization pin (2) and plug (1) from the front drive housing. DO NOT destroy the seal or remove cover (3) .

2. Remove the washer from the synchronization pin. Remove the plug and install the synchronization pin into the threaded hole. Tighten the synchronization pin.

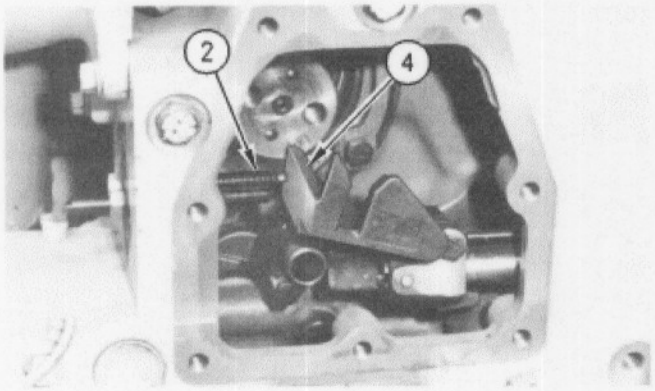

Illustration 2 g00323444
Position of the synchronization pin (typical example)

(2) Synchronization pin

(4) Fuel stop lever

3. Turn the governor or the actuator terminal shaft to the fuel ON position until the flat face of fuel stop lever (4) contacts synchronization pin (2). This is the synchronizing position or zero reference point. Hold the control linkage in this position when the injectors are adjusted.

4. Remove the valve covers.

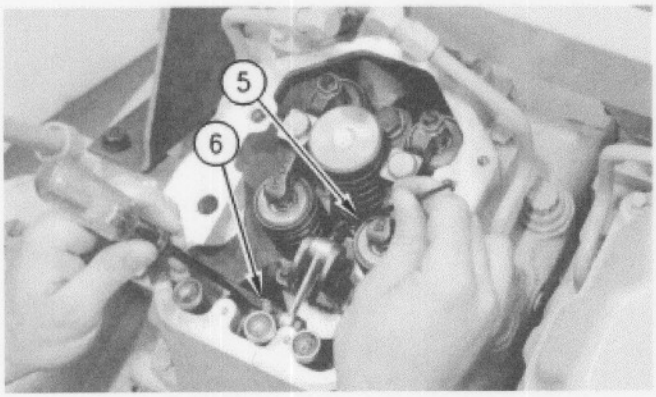

Illustration 3 g00323446
Location for gauge and control rod adjustment (typical example)

(5) 8T-2684 Rack Synchronization Gauge

(6) Control rod

5. With the fuel stop lever against the synchronization pin, put the **8T-2684** Rack Synchronization Gauge (5) on the round part of the fuel injector rack between the fuel injector body and the end of the rack. Use a screwdriver and make an adjustment of control rod (6). Turn the screw that is located on the control rod one click at a time until the **8T-2684** Rack Synchronization Gauge fits between the fuel injector body and the shoulder at the end of the rack. Remove the screwdriver from the control rod so that no pressure remains on the linkage. Check the setting with the rack synchronization gauge. Any pressure on the linkage with the screwdriver will not give a correct indication when the setting is checked with the rack synchronization gauge. Ensure that the linkage is free and that the linkage is giving an accurate setting by moving the linkage. Check the setting again. Put the box end of a combination wrench over the nut and the bolt. The nut and the bolt connect control rod (6) and the bellcrank. Pull upward on the control rod three times. Check the setting again.

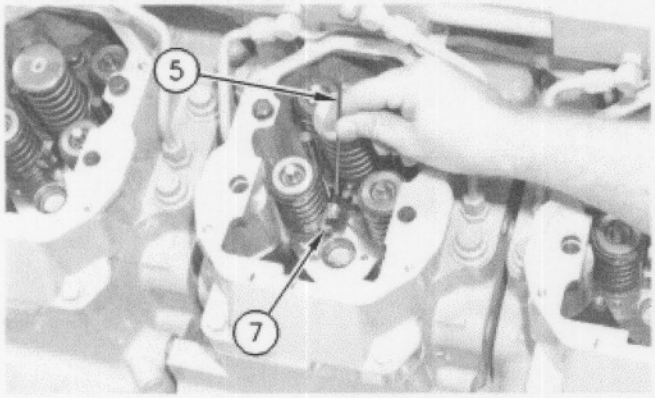

Illustration 4 g00323448
Gauge in place on the fuel injector rack (typical example)

(5) 8T-2684 Rack Synchronization Gauge

(7) Fuel injector rack

6. If the other injectors need to be adjusted, use rack synchronization gauge (5). When all adjustments have been made, release the actuator terminal shaft.

Illustration 5 g00323450
Adjustment of fuel control rod (typical example)

(5) 8T-2684 Rack Synchronization Gauge .

7. Install the valve covers.

8. Check the fuel setting and perform any necessary adjustments. Refer to Testing And Adjusting, "Fuel Setting" for this procedure.

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i01374151

Fuel Injector Timing

SMCS - 1290-025

NOTICE

The camshafts must be correctly timed with the crankshaft before an adjustment of fuel timing is made. The timing pins must be removed from the camshafts before the crankshaft is turned or damage to the cylinder block will be the result.

Note: Ensure that the engine is in time. Refer to Testing And Adjusting, "Camshaft Timing".

Note: Refer to Testing and Adjusting, "Crankshaft Position for Fuel Injector Adjustment and Valve Lash Setting". All of the injectors can be checked or adjusted with the crankshaft positions that are given in the chart. This check will make sure that the pushrod lifters are off the lobes and on the base circles of the camshafts.

Refer to the TMI (Technical Marketing Information) for the correct fuel timing dimension to use.

Table 1

Tools Needed	
5P-4160 Indicator Contact Point	1
1U-8869 Dial Indicator	1
9U-5138 Setting Gauge	1
9U-5233 Magnetic Fixture Group	1
9S-9082 Engine Turning Tool	1

Illustration 1 g00322956
1U-8869 Dial Indicator

1. The digital dial indicator needs to be programmed to read actual timing dimensions. Since the **9U-5138** Setting Gauge in the timing and fuel setting tool group is 87.00 mm, set the digital dial indicator for 87.00 mm. Use the following steps in order to program the indicator to read 87.00 mm.

   a. Turn the indicator to the ON position by pushing the "on/off" button.

   b. Push the "in/mm" button so the display shows "mm".

   c. A negative "-" sign should be in the display window under "REV". If that space is blank, push the "+/-" button so the display shows a negative "-" sign. When this is done, the movement of the plunger into the indicator will be displayed. The display will be shown as a negative movement. The movement of the plunger out of the indicator will be displayed as a positive movement.

   d. Push the preset button and hold the preset button down until there is a flashing "P" in the upper right corner of the display. Then release the button.

   e. Push the preset button and hold the preset button down until the flashing "P" disappears and a flashing indicator bar is seen in the lower left corner of the display. Then release the button. Use the preset button so that this position is blank.

   f. Push the preset button and hold the preset button down until the flashing indicator begins flashing under the first number position. The first number position is located in the fourth position to the left of the decimal. Then release the button. Momentarily pushing the preset will cause the display number in that position to change. Use the preset until this position reads zero (0).

   g. Use the preset button to move the flashing indicator and change the display numbers until the display shows 0087.00 mm. Push the preset button and hold the preset button until the flashing "P" is shown in the upper right corner of the display. Release the preset button. Momentarily push the preset button so the flashing "P" and the zeroes to the left of 87.00

mm disappear.

h. The indicator can now be turned off. The indicator will retain the preset number in memory. To recall the preset number, repeat Steps 1.a through 1.d.

2. Install a **5P-4160** Indicator Contact Point in the indicator stem.

3. Install the indicator into the **9U-5233** Magnetic Fixture Group. Leave the collet loose.

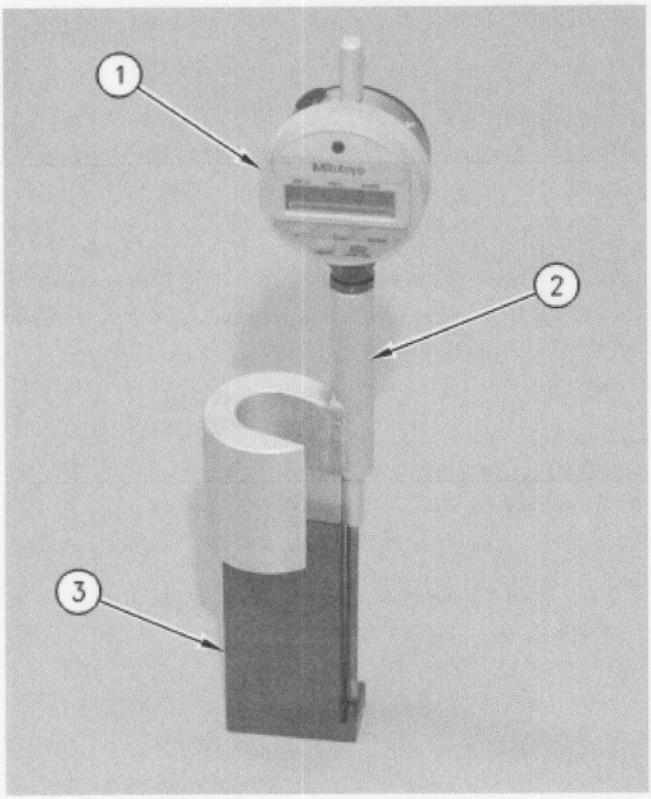

Illustration 2 g00323023
Adjustment of fuel timing tools

(1) 1U-8869 Dial Indicator

(2) 9U-5233 Magnetic Fixture Group

(3) 9U-5138 Setting Gauge

4. Place the fixture and the indicator on the **9U-5138** Setting Gauge with the extension rod of the bracket on the step of the gauge. Position the indicator in the bracket so that the indicator plunger can travel adequately. Tighten the collet.

5. Repeat Steps 1.a through 1.d.

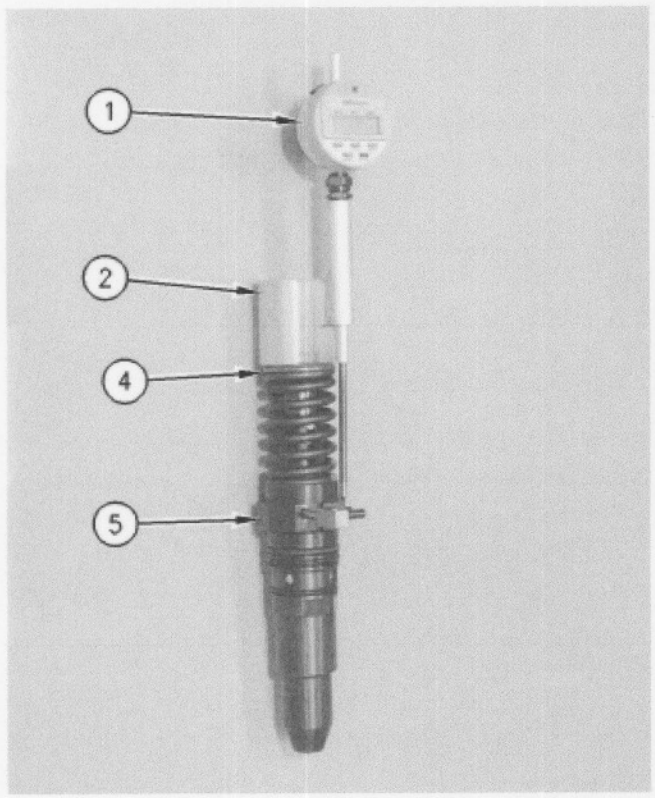

Illustration 3 g00323029
Fuel timing tools in position

(1) 1U-8869 Dial Indicator

(2) 9U-5233 Magnetic Fixture Group

(4) Injector follower

(5) Shoulder on fuel injector body

6. Momentarily push the preset button on the digital dial indicator in order to stop the "P" in the upper right hand corner from flashing. The display should show 87.00 mm. Place the **1U-8869** Dial Indicator and the **9U-5233** Magnetic Fixture Group in the correct position on the injector. Make sure that the magnetic base of the timing fixture is on the top surface of injector follower (4) and that the extension rod is on the top surface of shoulder on fuel injector body (5) .

   Note: In order to ensure an accurate fuel timing dimension, the top surfaces of injector follower (4) and shoulder on fuel injector body (5) must be clean and dry.

7. The digital dial indicator should now read the actual fuel timing dimension of the injector that is being checked.

8. No adjustment is necessary if the dial indicator reads the correct fuel timing dimension. Refer to

the TMI (Technical Marketing Information) for the engine that is being checked. Proceed to Step 12.

9. If the dial indicator does not read the correct fuel timing dimension or the desired fuel timing dimension, proceed with Steps 10 through 13.

10. Ensure that the **1U-8869** Dial Indicator and the **9U-5233** Magnetic Fixture Group are in the correct position on the injector. Loosen the locknut for the pushrod adjustment screw.

11. Turn the adjustment screw until the desired fuel timing dimension is read on the digital dial indicator.

    Note: Turning the adjustment screw clockwise will lower the fuel timing dimension. Turning the adjustment screw counterclockwise will increase the fuel timing dimension.

    Tighten the adjustment screw locknut to a torque of 70 ± 15 N·m (50 ± 11 lb ft) and check adjustment again. If necessary, repeat the procedure until the adjustment is correct.

12. Remove the timing bolt from the flywheel when the fuel timing check is completed.

13. Turn the flywheel by 360 degrees in the direction of normal engine rotation. Install the timing bolt for the flywheel. Repeat the procedure for the other half of the engine.

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i01549302

Fuel Setting

SMCS - 1257-025

Table 1

Tools Needed	
9U-5132 Engine Timing Tool Group	1
4C-8753 Extended Collet	1
6V-3075 Dial Indicator	1
5P-7263 Indicator Contact Point	1
8T-2684 Rack Synchronization Gauge	1

Refer to Special Instruction, SEHS9278 for the instructions on the use of the **4C-8753** Extended Collet .

Fuel setting is the adjustment of the fuel setting screw to a specified position. The fuel setting screw limits the power output of the engine by setting the maximum travel of all the fuel injector racks.

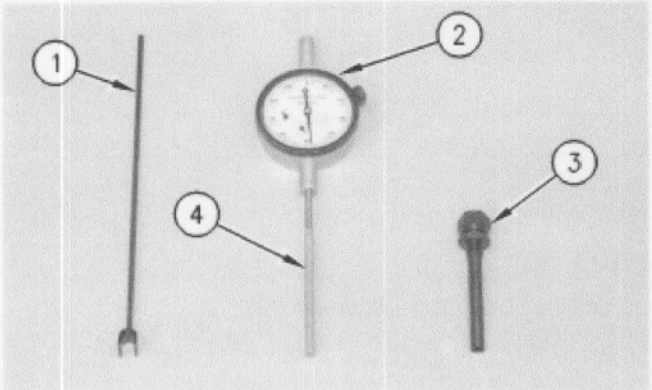

Illustration 1 g00323603
Synchronization and fuel setting tools

(1) 8T-2684 Rack Synchronization Gauge

(2) 6V-3075 Dial Indicator

(3) 4C-8753 Extended Collet

(4) 5P-7263 Indicator Contact Point

Before the fuel setting is checked, the injectors must be correctly synchronized. Refer to Testing And Adjusting, "Fuel Injector Synchronization". After the injectors are synchronized correctly, leave the synchronization pin in place for the procedure that follows.

1. Put **6V-3075** Dial Indicator (2) with **5P-7263** Indicator Contact Point Contact Point (4) in **4C-8753** Extended Collet (3). Remove the plug from the right side of fuel setting cover (8) .

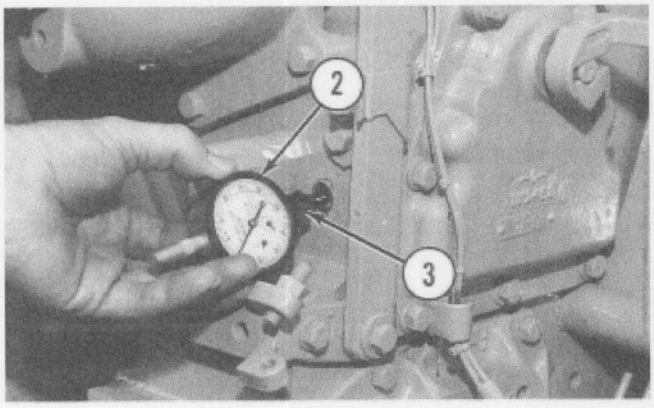

Illustration 2 g00323643
Installed dial indicator (typical example)

(2) 6V-3075 Dial Indicator with 5P-7263 Indicator Contact Point

(3) 4C-8753 Extended Collet

2. Move the governor or the actuator terminal shaft toward the ON position. The flat face of fuel stop lever (6) should make contact with synchronization pin (5). Hold the linkage in this position.

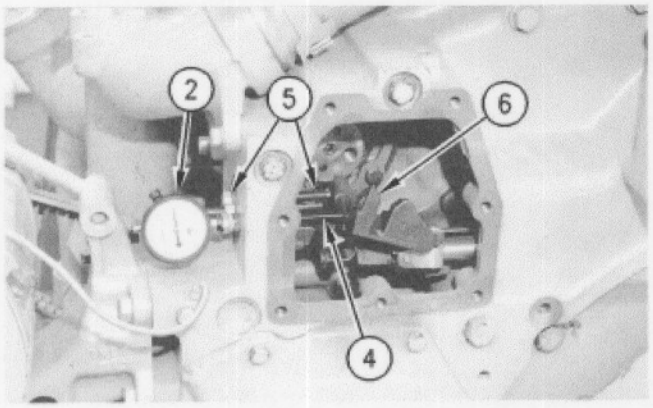

Illustration 3 g00323663

(2) 6V-3075 Dial Indicator

(4) 5P-7263 Indicator Contact Point

(5) Synchronization pin

(6) Fuel stop lever

3. Install dial indicator (2) and extended collet (3) in the threaded hole. After indicator contact point (4) touches fuel stop lever (6), slide dial indicator (2) until the indicator reads zero. Keep the dial indicator in this position by tightening collet (3) .

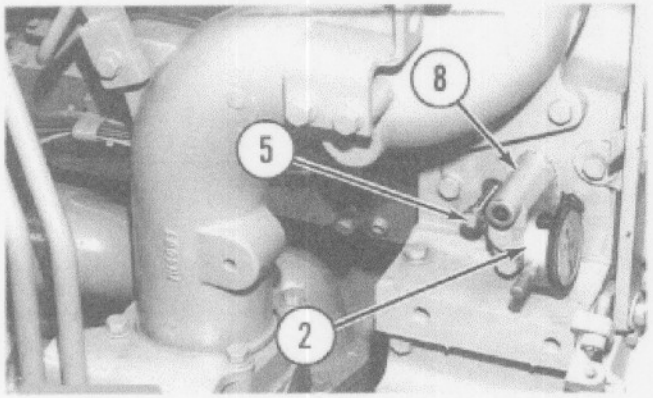

Illustration 4 g00805403

Checking fuel setting (typical example)

(2) 6V-3075 Dial Indicator

(5) Synchronization pin

(8) Fuel setting cover

4. Unscrew synchronization pin (5) by 25 mm (1 inch) or remove synchronization pin (5). Slowly move the governor or the actuator terminal shaft toward the fuel ON position until the flat face of the fuel stop lever is against the end of the fuel setting screw. The dial indicator reading will be the present fuel setting when the linkage is held in this position.

   Note: Refer to the TMI (Technical Marketing Information) for the correct fuel setting.

5. If the fuel setting is correct, remove the dial indicator and the synchronization pin. Install the two plugs, and install the synchronization pin back into cover (8) .

6. If the fuel setting needs adjustment, see "Fuel Setting Adjustment".

NOTICE

A mechanic with governor and fuel setting training is the ONLY one to make adjustments to the engine fuel setting.

Fuel Setting Adjustment

1. Cut the seal wire and remove fuel setting cover (8) and the gasket. Loosen locknut (7). Hold the fuel stop lever against the end of the fuel setting screw. Turn the fuel setting screw clockwise or counterclockwise until the correct reading is on the dial indicator.

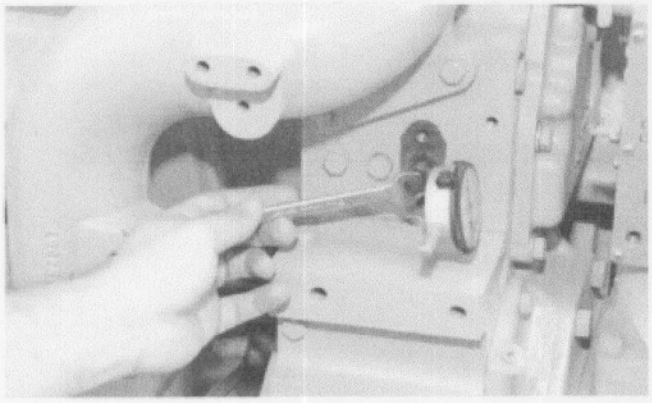

Illustration 5 g00323705
Adjustment of the fuel setting screw (typical example)

2. Now tighten locknut (7). Be sure that the fuel setting screw does not turn when the locknut is tightened. Release the fuel system linkage and move the linkage toward the fuel ON position. Check the dial indicator reading again in order to be sure that the fuel setting is still correct.

3. Remove dial indicator (2) and synchronization pin (5). Install the two plugs.

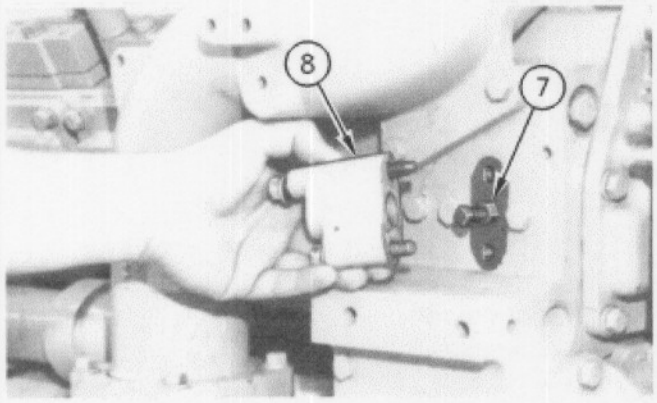

Illustration 6 g00323706
Installed cover (typical example)

(7) Locknut

(8) Fuel setting cover

4. Put fuel setting cover (8) and the gasket in position over the fuel setting screw. Install the bolt and synchronization pin (5) in the cover. Install a new seal wire.