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TOOL OPERATING MANUAL

9U-5132 Timing and Fuel System Setting Tool Group

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9U-5132 Timing Tool Group

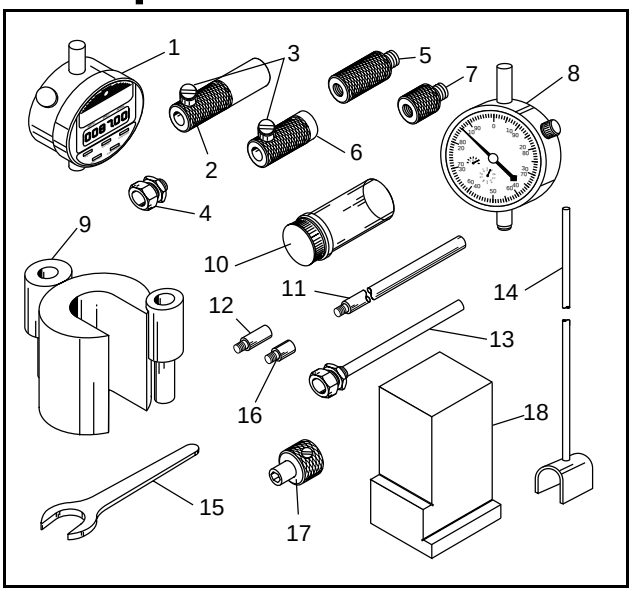

Illustration 1. 9U-5132 Timing Tool Group

9U-5132 Timing Tool Group		
Item	**Part No.**	**Description**
1	1U-8869[3]	Digital Dial Indicator
2	9U-6273[3]	Rod Sleeve Extension
3	9U-6272[3]	Nylon Screw
4	5P-8414[3]	Clamp Collet
5	136-4588[3]	Collet Extension
6	122-0449[3]	Rod Sleeve Extension
7	136-4587[3]	Collet Extension
8	6V-3075	Dial Indicator, Metric
9	9U-5137[2]	Timing Fixture
10	5P-7276	Container
11	5P-7263	Contact Point, 76.2 mm (3.00 in)
12	9S-8883	Contact Point, 12.7 mm (.50 in)
13	4C-8753	Extended Collet
14	8T-2684	Rack Synchronization Gauge, 12.7 mm (.50 in)
15	6V-7918	Wrench (5/8)
16	8S-3675	Contact Point, 3 mm (.12 in)
17	129-8602	Solenoid Driver
18	9U-5138	Set Gauge
19	9U-5736[1]	Foam Insert
20	6V-3072[1]	Plastic Case
21	5P-4160[1, 3]	Contact Point, 19.0 mm (.75 in)
22	9S-9802[1, 3]	Engine Turning Tool
23	122-0451[1, 3]	Extension Rod Assembly

[1] Not shown.

[2] Part of 9U-5233 Magnetic Fixture Group.

[3] Additional tooling required, but not part of 9U-5132.

Crankshaft Positions for Unit Injector Lash and Valve Lash Settings

Chart A. Standard Rotation (Counterclockwise) As Viewed From Flywheel End				
Cylinders to Check/Adjust				
Engine	Correct Stroke for No. 1 Piston at Top Center Position[1]	Intake 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
Chart B. Reverse Rotation (Clockwise) As Viewed From Flywheel End				
Cylinders to Check/Adjust				
3508	Compression	1-3-4-8	1-2-7-8	2-5-6-7
	Exhaust	2-5-6-7	3-4-5-6	1-3-4-8
3512	Compression	1-3-4-6-7-12	1-4-5-8-9-12	2-5-8-9-10-11
	Exhaust	2-5-8-9-10-11	2-3-6-7-10-11	1-3-4-6-7-12
3516	Compression	1-2-5-6-7-8-13-14	1-2-3-4-5-6-9-10	3-4-9-10-11-12-15-16
	Exhaust	3-4-9-10-11-12-14-15-16	7-8-11-12-13-14-15-16	1-2-5-6-7-8-13-14

[1] Put No. 1 piston at top center (TC) position and make identification for the correct stroke. After top center position for a particular stroke is found and adjustments are made for the correct cylinders, remove timing bolt and turn the flywheel 360 degrees in the direction of normal engine rotation. This will put No. 1 piston at top center (TC) position on the other stroke. Install the timing bolt in the flywheel and complete the adjustments for the cylinders that remain.

Chart C. Dial Indicator Setting Chart[1]	
Fuel Timing Dimension in Millimeters	Dial Indicator Setting in Millimeters
88.28	+1.28
88.07	+1.07
87.85	+0.85
87.64	+0.64
87.43	+0.43
87.21	+0.21
87.00	+0.00
86.79	-0.21
86.57	-0.43
86.36	-0.64
86.15	-0.84
85.93	-1.07
85.72	-1.28

[1] Refer to Fuel Setting and Related Information Fiche for the correct fuel timing dimension to use.

Section 1, Mechanical Unit Injector Engines

This section provides all the testing and adjustment procedures for mechanical unit injector (MUI) engines. For testing and adjusting electronic unit injectors (EUI) engines, refer to Section 2 of this manual.

Start-Up Procedure

After any repair work is done on the fuel system or governor of mechanical unit injector engines, use this procedure before starting an engine for the first time.

1. Disconnect the air inlet system from the turbochargers.

2. Have a person in position near each turbocharger air inlet with a piece of steel plate, large enough to completely cover the turbocharger air inlet.

⚠ WARNING

Be careful when plate is put against air inlet opening. Due to excessive suction, the plate can be pulled quickly against the air inlet opening. To avoid crushed fingers, do not put fingers between plate and air inlet opening.

3. Start the engine. If the engine starts to run too fast or runs out of control, immediately put the steel plates against the turbocharger air inlets. This will stop the air supply to the engine, and the engine will stop.

4. If the engine runs correctly, it is ready to be installed in the machine. If the engine did not run correctly, recheck the settings made using this manual, beginning with the fuel setting adjustments.

Tooling

All tools listed are included with 9U-5132 Tool Group, except as noted.

Chart A.
9U-5132 Timing and Fuel System Setting Tool Group For MUI Engines

Part No.	Description
5P-4160[1]	Contact Point, 19 mm (for digital indicator)
8S-3675	Contact Point, 3 mm
9S-9082[1]	Engine Turning Tool
1U-8869[1]	Digital Dial Indicator (used in preferred method)
9U-5137	Timing Fixture
9U-5138	Set Gauge
9U-5220	Rod Assembly
9U-6272	Nylon Screw
9U-6273	Rod Sleeve Extension (refer to the note below for alternate parts)
6V-3075	Dial Indicator, Metric (used in alternate method)

[1] Not included in 9U-5132.

NOTE: Because some technicians prefer to secure the dial indicator with the 5P-4814 Clamp Collet, instead of the nylon screw, parts have been made available for this purpose. In place of 9U-6273 Rod Sleeve Extension, order and use 136-4587 Collet Extension. This extension accepts the 5P-4814 Clamp Collet. Use two 6V-7918 Wrenches (or 5/8 inch open-end wrenches) to tighten the collet on the indicator stem.

General Set-up Information

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 result.

Refer to the "Crankshaft Positions For Unit Injector Lash and Valve Lash Setting" chart in this manual and put the engine in time. With the two crankshaft positions given in the chart, all of the injectors can be checked or adjusted. This will make sure the pushrod lifters are off the lobes and on the base circles of the camshafts.

Refer to the "Fuel Setting And Related Information" fiche for the correct fuel timing dimension to use. The range of timing dimensions are given in the "Dial Indicator Setting" chart in this manual.

Using the 1U-8869 Digital Dial Indicator (preferred method)

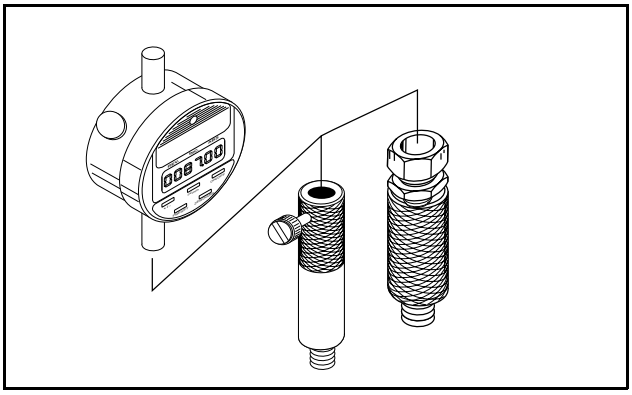

Illustration 1. 1U-8869 Digital Dial Indicator

1. The digital dial indicator needs to be programmed to read 87.00 mm, since this is the correct dimension for setting 3500 Mechanical Unit Injectors. The following steps show how to program the indicator to read 87.00 mm.

   a. Turn the indicator ON by pushing the "ON/OFF" button.

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

   c. A negative (–) sign should be in the display window under REV. If that space is blank, push the +/- button so the display shows (–). When this is done, plunger movement into the indicator will show on the display as negative (–) movement, and plunger movement out of the indicator as positive (+) movement.

   d. Push and hold the preset button down until there is a flashing (P) in the upper right corner of the display, and then release the button.

   e. Push 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, and then release. Momentarily pushing the preset button will cause a minus sign to appear or disappear above the flashing indicator. Use the preset button so that this position is blank.

   f. Push and hold the preset button down until flashing indicator begins flashing under the first number position (fourth position to the left of the decimal), then release. 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 and hold the preset button until the flashing (P) is shown in the upper right corner of the display, and then release. Momentarily push the preset button so the flashing (P) and the zeros to the left of 87.00 mm disappear.

   h. The indicator can now be turned OFF, if desired. The indicator will retain the preset number in memory (only one preset number is retained). To recall the preset number, repeat Steps 1a through 1d.

2. Install a 5P-4160 Contact Point, 19 mm (.75 in) long, in the indicator stem.

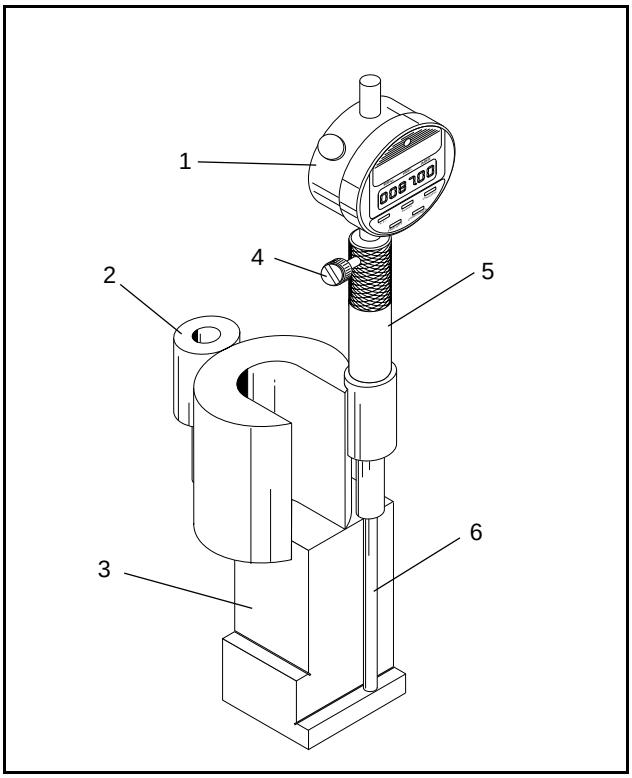

Illustration 2. Fuel Timing Adjustment Tools
(1) 1U-8869 Digital Dial Indicator. (2) 9U-5137 Timing Fixture. (3) 9U-5138 Set Gauge. (4) 9U-6272 Nylon Screw. (5) 9U-6273 Rod Sleeve Extension. (6) 9U-5520 Rod Assembly.

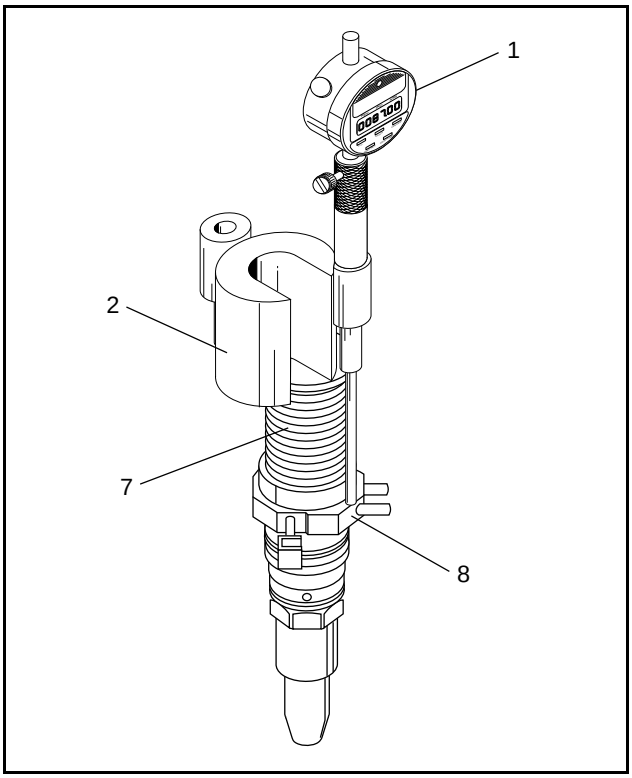

Illustration 3. Fuel Timing Tools In Position
(1) 1U-8869 Digital Dial Indicator. (2) 9U-5137 Timing Fixture. (7) Injector follower. (8) Shoulder on injector body.

3. Install the 9U-6273 Rod Sleeve Extension (5, Illustration 2) in the smaller diameter tube of 9U-5137 Timing Fixture (2). Install the 9U-5520 Rod Assembly (6) in the rod sleeve extension (5).

4. Install the indicator in the rod sleeve extension (5). Do not tighten the nylon screw (4), but be careful not to drop the indicator.

5. Place the fixture and indicator on 9U-5138 Set Gauge (3), with the extension rod of the bracket on the bottom (87.00 mm) step of the gauge. Position the indicator in the bracket so the indicator plunger has adequate travel and tighten the nylon screw.

6. Repeat Steps 1a through 1d.

7. Momentarily push the "preset" button on the digital dial indicator to stop the (P) in the upper right hand corner from flashing. The display should show 87.00 mm. Place the 1U-8869 Digital Dial Indicator and the 9U-5137 Timing Fixture in position on the injector to be checked. Make sure that the magnetic base of the timing fixture is on the top surface of injector follower (7, Illustration 3) and the extension rod is on the top surface of injector shoulder (8).

NOTE: To ensure an accurate fuel timing dimension, make sure the top surfaces of injector follower (7) and shoulder (8) are clean and dry.

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

9. If the dial indicator reads the correct fuel timing dimension, as determined from the "Fuel Setting And Related Information" fiche for the engine being checked, then no adjustment is necessary. Proceed to Step 13.

10. If the dial indicator does not read the correct and/or desired fuel timing dimension, as determined from the "Fuel Setting And Related Information" fiche for the engine being checked, proceed with Steps 11 through 14.

11. With digital dial indicator (1) and timing fixture (2) in position on the injector to be adjusted, loosen the push rod adjustment screw locknut for the injector to be adjusted.

12. Turn the adjustment screw until the desired fuel timing dimension is read on the digital dial indicator. Turning the adjustment screw clockwise (CW) will lower the fuel timing dimension (advance timing). Turning the adjustment screw counterclockwise (CCW) will increase the fuel timing dimension.

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

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

15. Rotate engine, re-pin the flywheel, and repeat the procedure for other half.

Using the 6V-3075 Dial Indicator (alternate method)

Refer to the "Fuel Setting And Related Information" fiche for the correct fuel timing dimension to use.

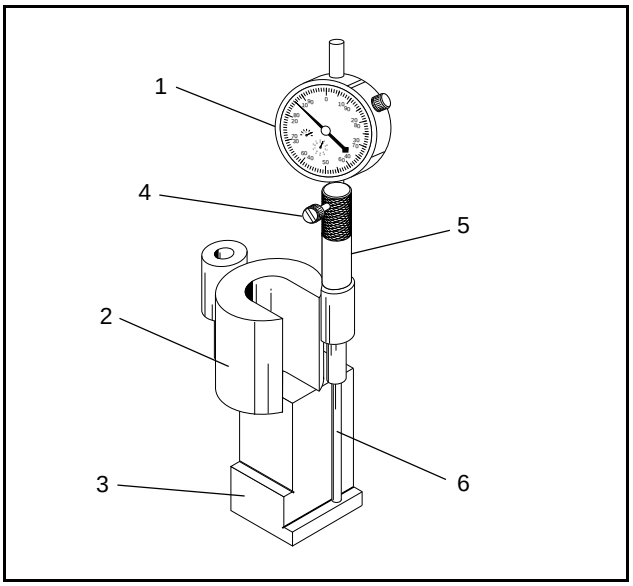

Illustration 4. Fuel Timing Adjustment Tools
(1) 6V-3075 Dial Indicator. (2) 9U-5137 Timing Fixture. (3) 9U-5138 Set Gauge. (4) 9U-6272 Nylon Screw. (5) 9U-6273 Rod Sleeve Extension. (6) 9U-5220 Rod Assembly.

1. Install the 8S-3675 Contact Point (3.0 mm) on the dial indicator stem.

2. Install 9U-6273 Rod Sleeve Extension (5) in smaller diameter tube of 9U-5137 Timing Fixture (2). Place 9U-5220 Rod Assembly (6) in rod sleeve extension (5).

3. Install 6V-3075 Dial Indicator (1) in rod sleeve extension.

4. Put the dial indicator and timing fixture assembly on 9U-5138 Set Gauge (3). The timing fixture should be on the top surface of the gauge, with the rod assembly on the bottom (87.00 mm) step.

5. Move the dial indicator in the rod sleeve extension until both needles indicate zero. Tighten nylon screw. At this point, the dial indicator has been zeroed to a standard fuel timing dimension of 87.00 mm using the gauge (gauge height is 87.00 mm).

NOTE: Some 6V-3075 Dial Indicators have a 0.25 mm (.010 in) smaller diameter extending about 4 mm (.2 in) up from the end of their stems. When zeroing these indicators in the bore of the 122-0449 Rod Sleeve Extension, the nylon screw will contact the indicator stem on this step. This can cause the indicator to cock in the bore and result in incorrect readings. It is recommended that the 136-4587 Collet Extension and 5P-4814 Clamp Collet be used with these "stepped" indicators, or that the 1U-8869 Digital Dial Indicator be used.

6. Subtract 87.00 mm (gauge dimension) from the desired fuel timing dimension (obtained from the "Fuel Setting And Related Information" fiche).

NOTE: To obtain a positive indicator setting, move the indicator downward. This will move the large needle clockwise (CW), or in the positive direction, increasing the fuel timing dimension from 87.00 mm.

To obtain a negative indicator setting, move the indicator upward. This will move the large needle counterclockwise (CCW), or in the negative direction, decreasing the fuel timing dimension from 87.00 mm.

a. Example 1: Desired fuel timing dimension is 87.50 mm.

Subtract 87.00 mm from the desired fuel timing dimension (87.50 mm).

87.50 mm - 87.00 mm = +0.50 mm

In this case, loosen the nylon screw, and move the dial indicator downward until the indicator reads a positive 0.50 mm. Then tighten the nylon screw again.

b. Example 2: Desired fuel timing dimension is 86.20 mm.

Subtract 87.00 from the desired fuel timing dimension (86.20 mm).

86.20 mm – 87.00 = –0.80 mm

In this case, loosen the nylon screw, and move the dial indicator upward until the indicator reads a negative 0.80 mm. Then tighten the nylon screw again.

7. Make sure the top surfaces of injector follower (7) and shoulder (8) are clean and dry.

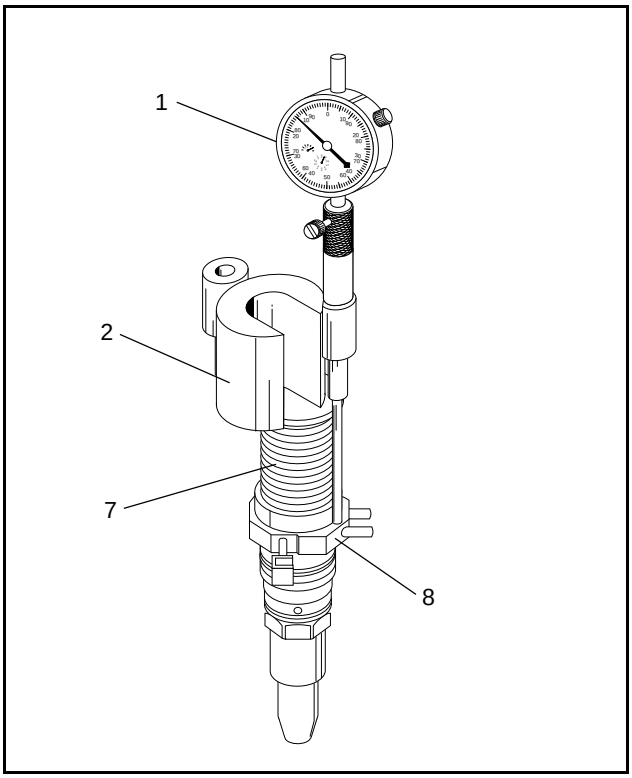

Illustration 5. Fuel Timing Tools In Position
(1) 6V-3075 Dial Indicator. (2) 9U-5137 Timing Fixture.
(7) Injector follower. (8) Shoulder on injector body.

8. Put dial indicator (1) and timing fixture (2) in position on the injector to be checked. Make sure the magnetic base of the timing fixture is on the top surface of injector follower (7, Illustration 5) and the extension rod is on the top surface of injector shoulder (8).

9. The dial indicator pointers must indicate 0.00 ± 0.20 mm.

10. If the dial indicator pointers indicate zero, or are within the tolerance given in Step 9, no adjustment is necessary. Proceed to Step 14.

11. If the dial indicator pointers do not indicate 0.00 ± 0.20 mm, continue with Steps 12 through 14.

12. Loosen the push rod adjustment screw locknut for the injector to be adjusted.

13. Turn the adjustment screw until zero is read on the dial indicator.

NOTE: If the dial indicator reading is greater than 0.00 ± 0.20 mm, then the timing is too far advanced. Turn adjustment screw counterclockwise (CCW). If the dial indicator reading is less than 0.00 ± 0.20 mm, then the timing is too far retarded. Turn the adjustment screw clockwise (CW).

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

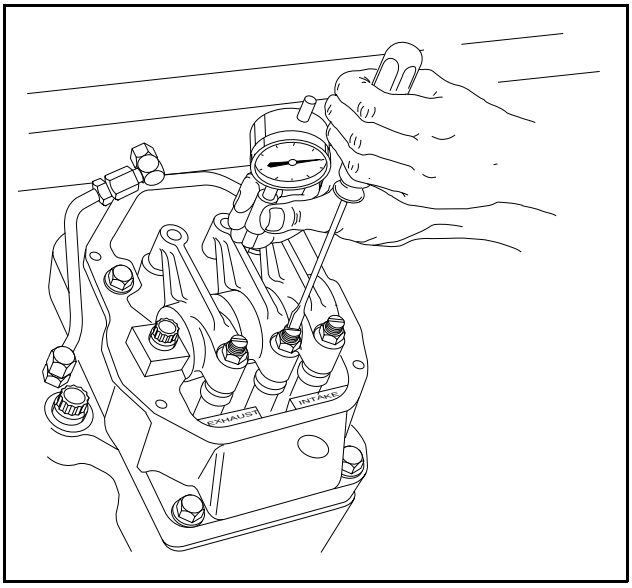

Illustration 6. Typical Example Of Adjusting Fuel Timing

15. Rotate engine, re-pin the flywheel, and repeat the procedure for other half.

Injector Synchronization Procedure

Chart B. Injector Synchronization Tools		
Part No.	**Title/Description**	**Qty**
8T-2684	Rack Synchronizing Gauge	1

Injector synchronization is the setting of all injector racks to a reference position, so each injector gives the same amount of fuel to each cylinder. This is done by setting each injector rack to the same position, while the control linkage is in a fixed position (called the synchronizing position). The procedure for adjustment of injector synchronization is as follows:

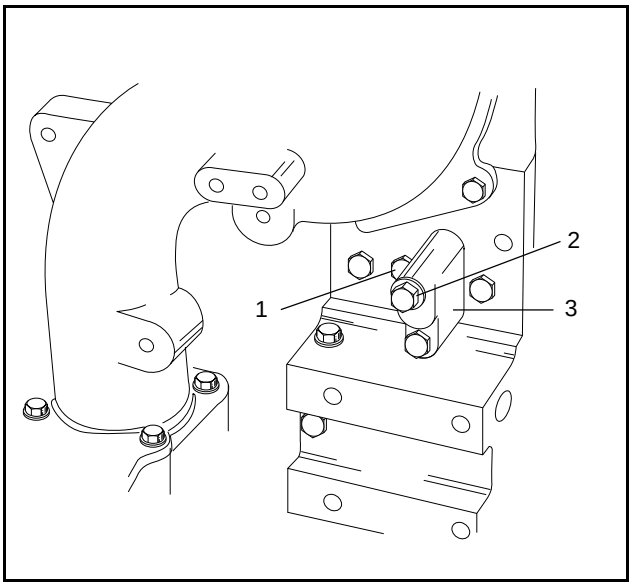

Illustration 7. Location Of Fuel Setting Cover And Synchronizing Pin (Typical Example)
(1) Plug. (2) Synchronizing pin. (3) Cover.

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

2. Remove the washer from synchronizing pin (2) and install it into the threaded hole where plug (1) was removed. Tighten synchronizing pin (2).

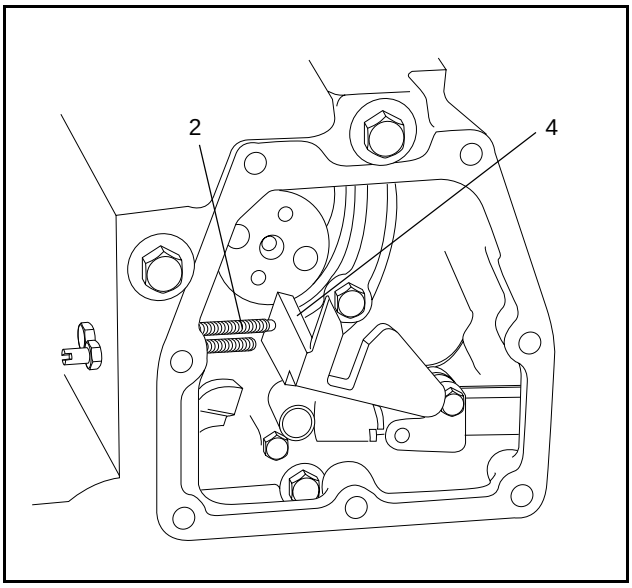

Illustration 8. Typical Example Of Synchronizing Position (Governor Fastener Cover Removed Only For Illustration)
(2) Synchronizing pin. (4) Fuel stop lever.

3. Turn the governor, or actuator terminal shaft, to the fuel "ON" position until the flat face of fuel stop lever (4) contacts synchronizing 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.

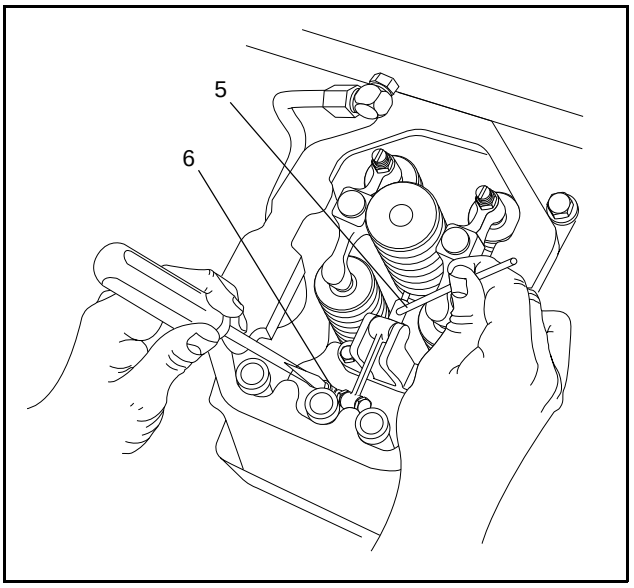

Illustration 9. Typical Example Of Location For Gauge And Control Rod Adjustment (Rocker Shaft Removed For Illustration)
(5) 8T-2684 Rack Synchronizing Gauge [12.7 mm (.50 in)]. (6) Control rod.

5. Adjust synchronization.

   a. With the fuel stop lever against the synchronizing pin, put 8T-2684 Rack Synchronizing Gauge (5) on the round part of the injector rack between the injector body and the end of the rack.

   b. Use a screwdriver and make an adjustment of control rod (6). Turn the screw on control rod (6) one "click" at a time, until rack synchronizing gauge (5) just fits between the injector body and the shoulder at the end of the rack.

   c. Remove the screwdriver from control rod (6) so no pressure is on the linkage while the setting is checked with rack synchronizing gauge (5). Any pressure on the linkage with the screwdriver will not give a correct indication when the setting is checked with the rack synchronizing gauge.

   d. To make sure the linkage is free and giving the correct setting, move (flip) the linkage and check the setting again. Put the box end of a 9/16 or 5/8 inch combination wrench over the nut and bolt that holds control rod (6) and the bellcrank together. Pull up on the control rod two or three times; then check the setting again.

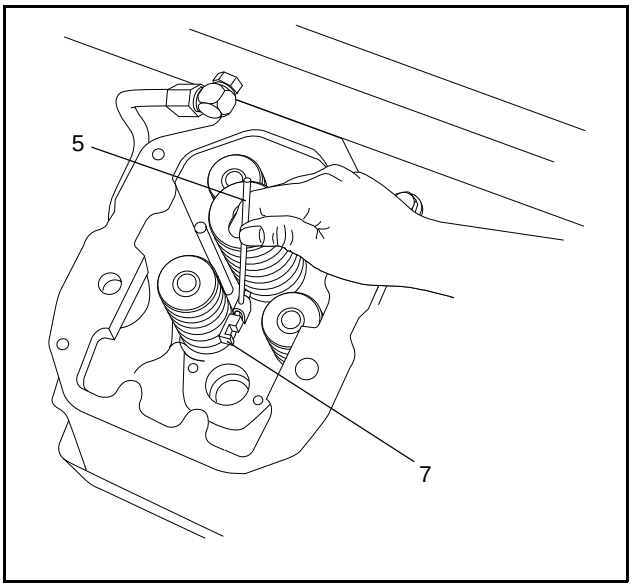

Illustration 10. Typical Example Of Gauge In Position On Injector Rack (Rocker Shaft Removed For Illustration)
(5) 8T-2684 Rack Synchronizing Gauge [12.7 mm (.50 in)]. (7) Fuel injector rack.

6. Use rack synchronizing gauge (5) and, if necessary, make the adjustment to the other injectors. When all adjustments have been made, release the actuator terminal shaft.

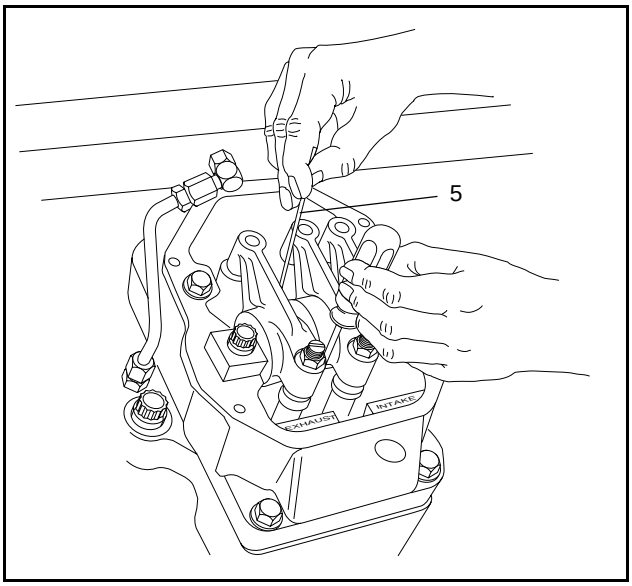

Illustration 11. Typical Example Of Adjustment Of Fuel Control Rod
(5) 8T-2684 Rack Synchronizing Gauge.

7. Install the valve covers.

8. Make a check of the fuel setting and make adjustments, if necessary. Refer to the subject, Fuel Setting, for this procedure.

Fuel Setting Procedure

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 injector racks.

All tools listed in Chart C are included with 9U-5132 Timing and Fuel System Setting Tool Group.

Chart C. Chart Fuel Setting Tools		
Part No.	**Title Description**	**Qty**
5P-7263	Contact Point, 76.2 mm (3.00 in)	1
8T-2684	Rack Synchronization Gauge, 12.7 mm (.50 in)	1
9U-6272	Nylon Screw	1
4C-8753	Extended Collet	1
6V-3075	Dial Indicator (Metric)	1

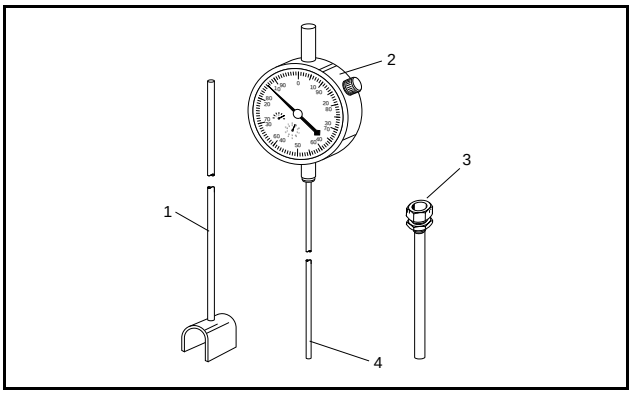

Illustration 12. Synchronization And Fuel Setting Tools
(1) 8T-2684 Rack Synchronizing Gauge. (2) 6V-3075 Dial Indicator (metric). (3) 4C-8753 Extended Collet. (4) 5P-7263 Contact Point, 76.2 mm (3.00 in) long.

Fuel Setting Check

Before the fuel setting is checked, the injectors must be correctly synchronized. Refer to the "Injector Synchronization Procedure" in this manual. After the injectors are synchronized correctly, leave the synchronizing pin in place for this procedure.

1. Put 6V-3075 Dial Indicator (metric) (2) and 5P-7263 Contact Point (4) in 4C-8753 Extended Collet (3). Remove the plug from the right side of fuel setting cover (8, Illustration 15).

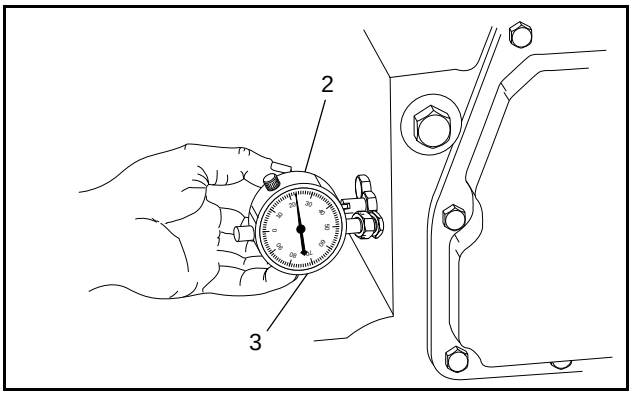

Illustration 13. Typical Example Of Installing A Dial Indicator
(2) 6V-3075 Dial Indicator (metric) with 5P-7263 Contact Point attached. (3) 4C-8753 Extended Collet.

2. Move the governor or actuator terminal shaft in the fuel "ON" direction until the flat face of fuel stop lever (6) contacts synchronizing pin (5). Hold the linkage in this position.

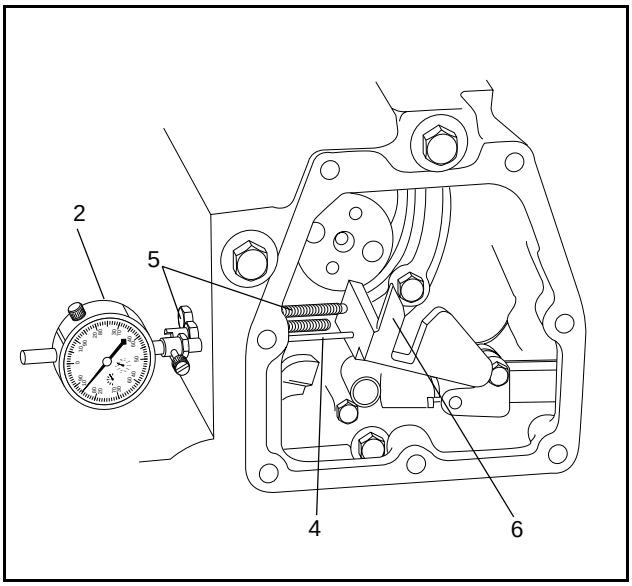

Illustration 14. Typical Example Of A Dial Indicator In Position (Cover Removed Only For Illustration)
(2) 6V-3075 Dial Indicator (metric). (4) 5P-7263 Contact Point, 76.2 mm (3.00 in) long. (5) Synchronizing pin. (6) Fuel stop lever.

3. Install dial indicator and collet (3) in the threaded hole as shown. When the contact point seats against fuel stop lever (6), slide the dial indicator in or out until the indicator reads zero. Now tighten nylon screw just enough to hold indicator at this position.

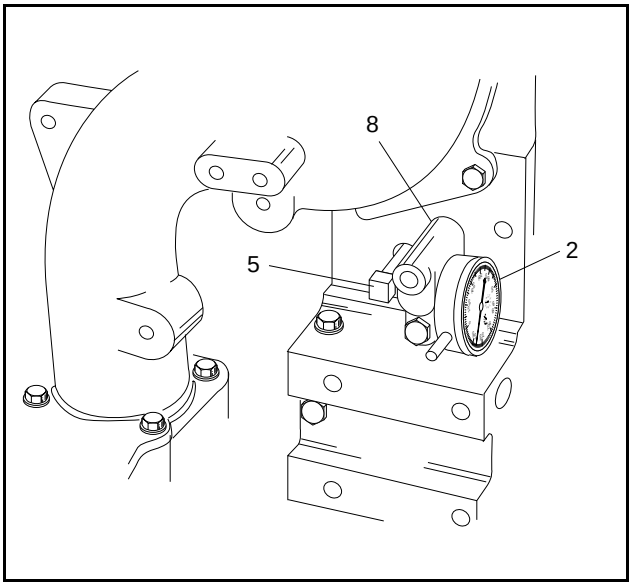

Illustration 15. Typical Example Of Checking Fuel Setting
(2) 6V-3075 Dial Indicator (metric). (5) Synchronizing pin. (8) Fuel setting cover.

4. Turn synchronizing pin (5) back out a minimum of 25 mm (1.0 in) (or remove it completely), and then slowly move the governor or actuator terminal shaft in the fuel "ON" direction until the flat face of the fuel stop lever is against the end of the fuel setting screw. With the linkage held in this position, the dial indicator reading will be the present fuel setting.

NOTE: Refer to "Fuel Setting And Related Information" fiche for the correct fuel setting.

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

6. If fuel setting needs adjustment, continue on to "Fuel Setting Adjustment".

Fuel Setting Adjustment

NOTICE

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

1. Cut the seal wire and remove fuel setting cover (8, Illustration 15) and the gasket. Loosen locknut (9, Illustration 16) and (with fuel stop lever still held against end of the fuel setting screw) turn the fuel setting screw in or out until the correct reading is on the dial indicator.

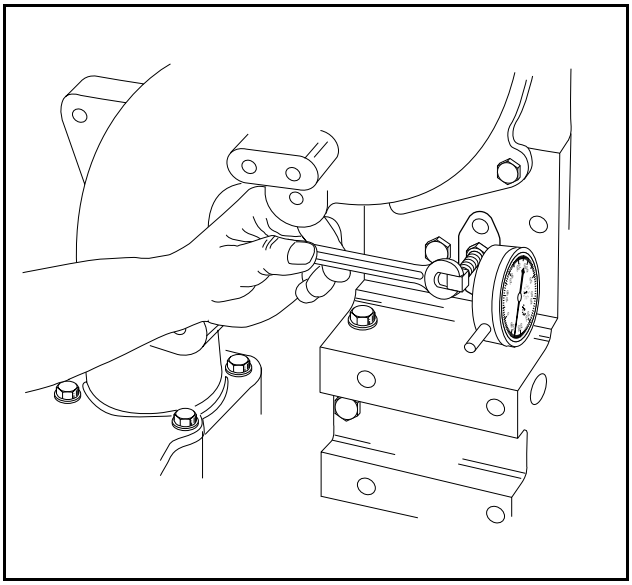

Illustration 16. Typical Example Of Adjustment Of The Fuel Setting Screw
(9) Locknut.

2. Now tighten locknut (9). Be sure that the fuel setting screw does not turn when locknut (9) is tightened. Release the fuel linkage and again move linkage all the way in the fuel "ON" direction. Check the dial indicator reading again to be sure that fuel setting is still correct.

3. Remove dial indicator (2, Illustration 15) and synchronizing pin (5, Illustration 15), then install two plugs (10).

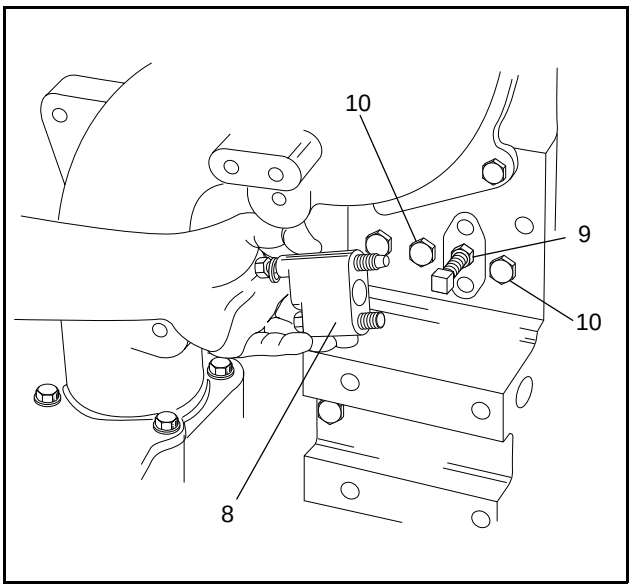

Illustration 17. Typical Example Of Installing The Cover
(8) Fuel setting cover. (9) Locknut. (10) Plugs.

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

Section 2, Electronic Unit Injector Engines

This section provides all the testing and adjustment procedures for electrical unit injector (EUI) engines. For testing and adjusting mechanical unit injectors (MUI) engines, refer to Section 1 of this manual.

Electronic Injection Timing Calibration is not required unless the timing wheel has been removed from the camshaft, or the Electronic Control Module (ECM) has been changed.

Tooling

All tools listed in Chart A are included in the 9U-5132 Timing and Fuel System Setting Tool Group, except as noted.

Chart A.
9U-5132 Timing and Fuel System Setting Tool Group For EUI Engines

Part No.	Description
5P-4160[1]	Contact Point, [19 mm (.75 in) (for use with digital indicator)]
8S-3675	Contact Point, 3.0 mm (.12 in)
9S-9082[1]	Engine Turning Tool
1U-8869[1]	Digital Dial Indicator (used with preferred method)
9U-5137	Timing Fixture
9U-5138	Set Gauge
9U-6272	Nylon Screw
6V-3075[3]	Dial Indicator, Metric (used with alternate method)
122-0449	Rod Sleeve Extension
122-0451[2]	Extension Rod Assembly

[1] Not included in 9U-5132.

[2] Some 122-0451 Extension Rod Assemblies were manufactured 10 mm (.4 in) too long. The correct length for the rod is 124.00 mm (4.882 in). If the rod included with the tool group measures 134.00 mm (5.276 in), remove 10 mm (.4 in) from the end closest to the retaining ring.

[3] Two dial indicators, each with their own procedure, are available to set fuel timing. Checking or setting fuel timing with the 1U-8869 Digital Dial Indicator is the preferred method.

NOTE: Because some technicians prefer to secure the dial indicator with the 5P-4814 Clamp Collet, instead of the nylon screw, parts have been made available for this purpose. In place of 122-0449 Rod Sleeve Extension, order and use 136-4588 Collet Extension. This extension accepts the 5P-4814 Clamp Collet. Use a 6V-7918 Wrench (or 5/8 inch open-end wrench) to tighten the collet on the indicator stem.

General Set-up Information

NOTICE

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

⚠ WARNING

The electronic control module (ECM) produces high voltage. To prevent personal injury make sure the ECM is not powered and the unit injector solenoids are disconnected.

Refer to "Crankshaft Positions For Unit Injector Lash and Valve Lash Setting" chart, in this manual, for the specifications to put the engine in time. With the two crankshaft positions given in the chart, all of the injectors can be checked or adjusted. This will make sure the pushrod lifters are off the lobes and on the base circles of the camshafts.

Refer to the "Fuel Setting And Related Information" fiche for the correct fuel timing dimension. The range of timing dimensions are given in the "Crankshaft Positions for Unit Injector Lash and Valve Lash Settings" chart in this manual.

Using the 1U-8869 Digital Dial Indicator (preferred method)

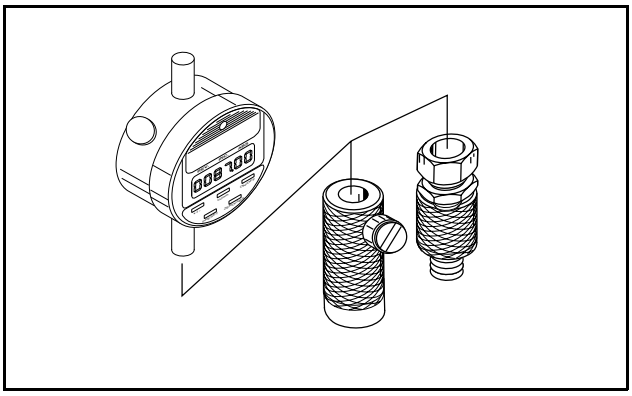

Illustration 1. 1U-8869 Digital Dial Indicator

1. The digital dial indicator needs to be programmed to read 64.34 mm, since this is the correct dimension for electronic unit injector engines. The following steps show how to program the indicator to read 64.34 mm.

a. Turn the indicator ON by pushing the "ON/OFF" button.

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

c. A negative (–) sign should be in the display window under REV. If that space is blank, push the +/- button so the display shows (–). When this is done, plunger movement into the indicator will show on the display as negative (–) movement, and plunger movement out of the indicator as positive (+) movement.

d. Push and hold the preset button down until there is a flashing (P) in the upper right corner of the display, and then release the button.

e. Push 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, and then release. Momentarily pushing the preset button will cause a minus sign to appear or disappear above the flashing indicator. Use the preset button so that this position is blank.

f. Push and hold the preset button down until flashing indicator begins flashing under the first number position (fourth position to the left of the decimal), then release. 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 0064.34 mm. Push and hold the preset button until the flashing (P) is shown in the upper right corner of the display, and then release. Momentarily push the preset button so the flashing (P) and the zeros to the left of 64.34 mm disappear.

h. The indicator can now be turned OFF, if desired. The indicator will retain the preset number in memory (only one preset number is retained). To recall the preset number, repeat Steps 1a through 1d.

2. Install a 5P-4160 Contact Point, 19 mm (.75 in) long, in the indicator stem.

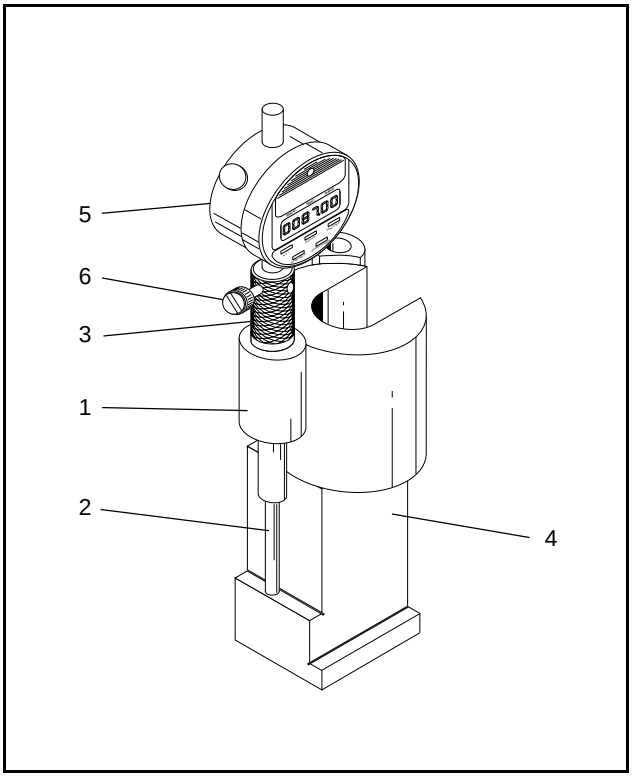

Illustration 2. Adjustment Of Fuel Timing Tools (64.34 mm fuel setting), Preferred Method
(1) 9U-5137 Timing Fixture. (2) 122-0451 Extension Rod Assembly. (3) 122-0449 Rod Sleeve Extension. (4) 9U-5138 Set Gauge. (5) 1U-8869 Digital Dial Indicator. (6) 9U-6272 Nylon Screw.

3. Install 122-0451 Extension Rod Assembly (2) and 122-0449 Rod Sleeve Extension (3) into larger diameter tube of 9U-5137 Timing Fixture (1). Place the timing fixture on 9U-5138 Set Gauge (4) with the rod assembly on the 64.34 mm step.

4. Install digital dial indicator (5) into rod sleeve extension (3). Position the indicator in the rod sleeve extension, so the indicator stem has adequate travel, and tighten the nylon screw (6).

5. Repeat Steps 1a through 1d.

6. Momentarily push the "preset" button on the digital dial indicator to stop the (P) in the upper right hand corner from flashing. The display should show 64.34 mm. Place the digital dial indicator and timing fixture in position on the injector to be checked. Make sure the magnetic base of the timing fixture is on the top surface of injector follower (7) and the extension rod is on the top surface of injector shoulder (8).

NOTE: To ensure an accurate fuel timing dimension, make sure the top surfaces of injector follower (7) and shoulder (8) are clean and dry.

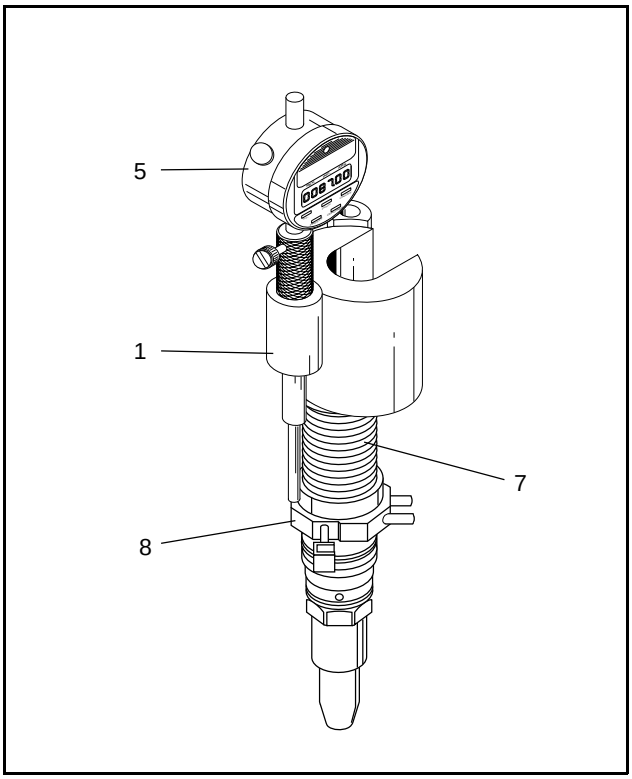

Illustration 3. Fuel Timing Tools in Position
(1) 9U-5137 Timing Fixture. (5) 1U-8869 Digital Dial Indicator. (7) Injector follower. (8) Shoulder on injector body.

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

8. If the dial indicator reads the correct fuel timing dimension, as determined from the "Fuel Setting And Related Information" fiche for the engine being checked, then no adjustment is necessary. Proceed to Step 12.

9. If the dial indicator does not read the correct and/or desired fuel timing dimension, as determined from the "Fuel Setting And Related Information" fiche for the engine being checked, continue with Steps 10 through 13.

10. With the 1U-8869 Digital Dial Indicator and the 9U-5137 Timing Fixture in position on the injector to be adjusted, loosen the push rod adjustment screw locknut for the injector to be adjusted.

11. Turn the adjustment screw until the desired fuel timing dimension is read on the digital dial indicator. Turning the adjustment screw clockwise (CW) will lower the fuel timing dimension (advance timing). Turning the adjustment screw counterclockwise (CCW) will increase the fuel timing dimension.

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

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

14. Rotate engine, re-pin the flywheel, and repeat procedure for other half.

Using the 6V-3075 Dial Indicator (alternate method)

Refer to the "Fuel Setting And Related Information" fiche for the correct fuel timing dimension to use.

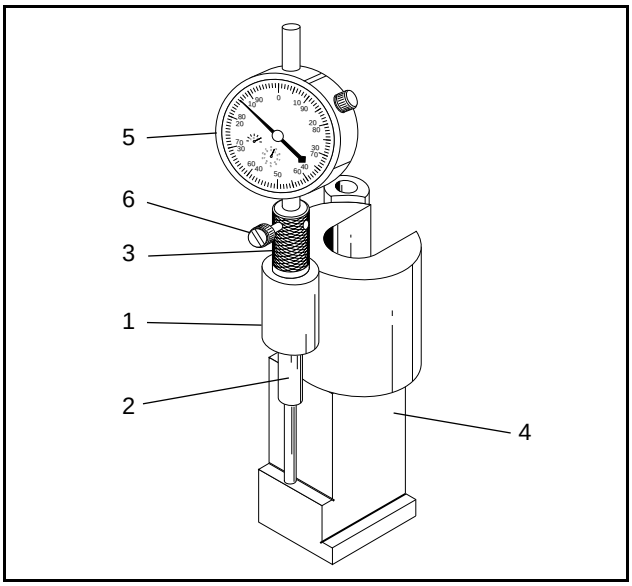

Illustration 4. Adjustment Of Fuel Timing Tools (64.34 mm Fuel Setting), Alternate Method
(1) 9U-5137 Timing Fixture. (2) 122-0451 Extension Rod Assembly. (3) 122-0449 Rod Sleeve Extension. (4) 9U-5138 Set Gauge. (5) 6V-3075 Dial Indicator (metric). (6) 9U-6272 Nylon Screw.

1. Install 8S-3675 Contact Point [3.0 mm (.12 in)] on 6V-3075 Dial Indicator (metric) (5).

2. Install 122-0449 Rod Sleeve Extension (3) in larger diameter tube of 9U-5137 Timing Fixture (1). Place rod assembly (2) into rod sleeve extension (3).

3. Place timing fixture (1) on 9U-5138 Set Gauge (4). The timing fixture should be on the top surface of the gauge, with the rod assembly resting on the upper 64.34 mm step.

4. Install dial indicator in rod sleeve extension. Move the indicator in the sleeve until both needles indicate zero, and tighten the nylon screw. At this point, the indicator has been zeroed to a standard fuel timing dimension of 64.34 mm.

NOTE: Some 6V-3075 Dial Indicators have a 0.25 mm (.010 in) smaller diameter turn extending about 4 mm (.2 in) up from the end of their stems. When zeroing these indicators in the bore of the 122-0449 Rod Sleeve Extension, the nylon screw will contact the indicator stem on this step. This can cause the indicator to cock in the bore and result in incorrect readings. It is recommended that the 136-4588 Collet Extension and 5P-4814 Clamp Collet be used with these "stepped" indicators, or that the 1U-8869 Digital Dial Indicator be used.

5. Make sure the top surfaces of injector follower (7) and shoulder (8) are clean and dry.

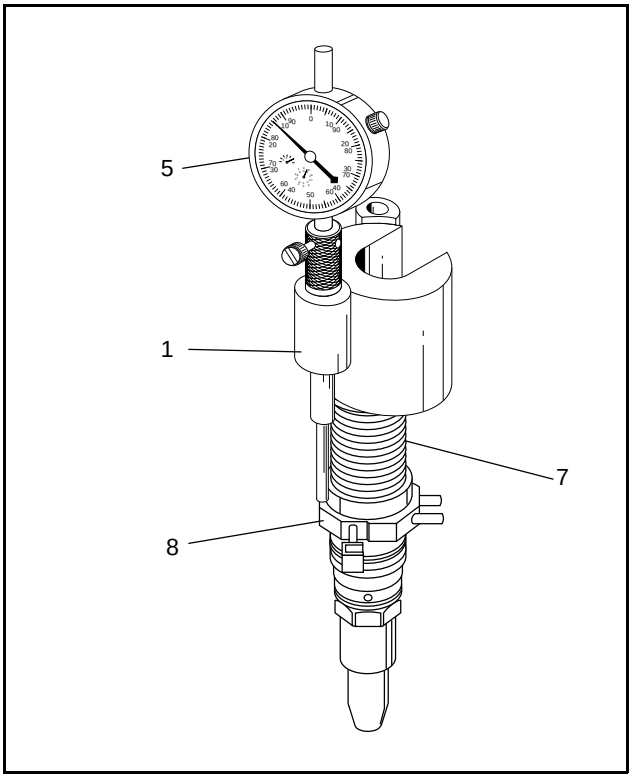

Illustration 5. Fuel Timing Tools In Position
(1) 9U-5137 Timing Fixture. (5) 6V-3075 Dial Indicator (metric). (7) Injector follower. (8) Shoulder.

6. Put the dial indicator (5) and timing fixture (1) in position on the injector to be checked. Make sure the magnetic base of the timing fixture is on the top surface of injector follower (7) and the extension rod assembly is on the top surface of shoulder (8), as shown in the illustration.

7. The dial indicator pointers must indicate 0.00 ± 0.20 mm.

8. If the dial indicator pointers indicate 0.00 ± 0.20 mm, no adjustment is necessary. Proceed to next injector to be checked and repeat procedure starting from Step 3. If the dial indicator pointers do not indicate 0.00 ± 0.20 mm, continue with Steps 9 and 10.

9. Loosen the push rod adjustment screw locknut for the injector to be adjusted.

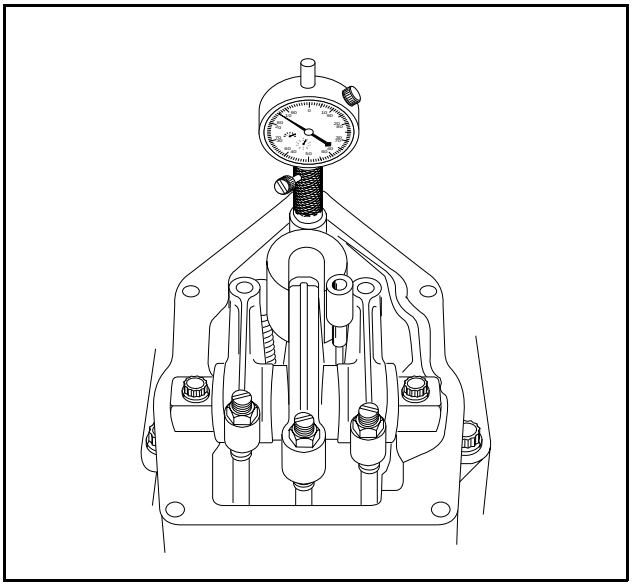

Illustration 6. Timing And Fuel Setting Tool Group Installed

10. Turn the adjustment screw until the dial indicator pointers indicate 0.00 ± 0.20 mm. Tighten the adjustment screw locknut to 160 ± 30 N·m (120 ± 22 lb ft). Check the adjustment to make sure it has not changed. If necessary, do this procedure again until the adjustment is correct. After adjustment is correct, proceed to the next injector to be checked and repeat procedure starting from Step 3.

NOTE: If the dial indicator reading is greater than 0.00 ± 0.20 mm, then the timing is too far advanced. Turn the adjustment screw counterclockwise (CCW). If the dial indicator reading is less than 0.00 ± 0.20 mm, then the timing is too far retarded. Turn the adjustment screw clockwise (CW).

11. After all injectors are checked/adjusted, remove the timing bolt from the flywheel.

12. Rotate engine, re-pin the flywheel, and repeat procedure for other half.

NOTES

For information on service tools or shop supplies
contact Caterpillar Service Technology Group on:

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1-800-542-8665 (USA)
1-800-541-8665 (Illinois)
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