NOTE: Put a layer of graphite grease on lobes of camshaft when installing.

1. Width of groove in camshaft for thrust washer (new) .................. 190 ± .002 in. (4.83 ± 0.05 mm)
   Thickness of thrust washer (new) .................. .183 ± .001 in. (4.65 ± 0.03 mm)
   End play of the camshaft (new) .................. .007 ± .003 in. (0.18 ± 0.08 mm)
   Maximum permissible end play (worn) .................. .025 in. (0.64 mm)

2. Diameter of camshaft bearing surface (journal) (new) .................. 2.3110 ± .0005 in. (58.699 ± 0.013 mm)

3. Bore in bearing for camshaft (new) .................. 2.3150 ± .0005 in. (58.601 ± 0.013 mm)
   Clearance between bearing and bearing surface (journal) (new) .................. .002 to .005 in. (0.05 to 0.15 mm)
   Maximum permissible clearance between bearing and bearing surface (journal) (worn) .................. .008 in. (0.20 mm)

NOTE: Make reference to CYLINDER BLOCK for installation dimensions.

5. Height of camshaft lobes.
   To find lobe lift, use the procedure that follows:
   A. Measure camshaft lobe height (5).
   B. Measure base circle (6).
   C. Subtract base circle (STEP B) from lobe height (STEP A). The difference is actual lobe lift (4).
   D. Specified camshaft lobe lift (4) is ............ .3300 in. (8.382 mm)
   Maximum permissible difference between actual lobe lift (STEP C) and specified lobe lift (STEP D) is ............ .010 in. (0.25 mm)

VALVE ROCKER ARMS AND LIFTERS

1. Bore in bearing for shaft (new) .................. 7263 ± .0005 in. (184.448 ± 0.013 mm)
   Diameter of shaft (new) .................. 7245 ± .0005 in. (184.122 ± 0.013 mm)
   Maximum permissible clearance between bearing and shaft (worn) .................. .008 in. (0.20 mm)

2. Torque for locknut on valve adjustment screw .................. 21 ± 5 lb. ft. (26 ± 7 N·m)

3. Clearance for valves:
   Intake valves .................. .015 in. (0.38 mm)
   Exhaust valves .................. .025 in. (0.64 mm)

4. Diameter of valve lifter (new) .................. 1.3105 ± .0005 in. (33.287 ± 0.013 mm)
   Bore in block for valve lifter (new) .................. 1.3145 ± .0010 in. (33.388 ± 0.025 mm)
   Maximum permissible clearance between lifter and bore for valve lifter (worn) .................. .012 in. (0.30 mm)
# 3304 VEHICULAR ENGINE

## INDEX

### SYSTEMS OPERATION

<table>
<thead>
<tr>
<th>Component</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Inlet and Exhaust System</td>
<td>31</td>
</tr>
<tr>
<td>Timing Gears</td>
<td>33</td>
</tr>
<tr>
<td>Turbocharger</td>
<td>32</td>
</tr>
<tr>
<td>Valves and Valve Mechanism</td>
<td>33</td>
</tr>
<tr>
<td>Basic Block</td>
<td>40</td>
</tr>
<tr>
<td>Crankshaft</td>
<td>40</td>
</tr>
<tr>
<td>Cylinder Block and Liners</td>
<td>40</td>
</tr>
<tr>
<td>Pistons, Rings, and Connecting Rods</td>
<td>40</td>
</tr>
<tr>
<td>Cooling System</td>
<td>38</td>
</tr>
<tr>
<td>Coolant for Air Compressor</td>
<td>39</td>
</tr>
<tr>
<td>Electrical System</td>
<td>41</td>
</tr>
<tr>
<td>Charging System Components</td>
<td>41</td>
</tr>
<tr>
<td>Electrical System Schematic</td>
<td>45</td>
</tr>
<tr>
<td>Other Components</td>
<td>44</td>
</tr>
<tr>
<td>Starting System Components</td>
<td>43</td>
</tr>
<tr>
<td>Fuel System (Scroll-DI)</td>
<td>27</td>
</tr>
<tr>
<td>Fuel Injection Pump</td>
<td>27</td>
</tr>
<tr>
<td>Fuel System Timing</td>
<td>27</td>
</tr>
<tr>
<td>Governor (Hydraulic-Mechanical)</td>
<td>28</td>
</tr>
<tr>
<td>Injection Nozzles</td>
<td>30</td>
</tr>
<tr>
<td>Introduction</td>
<td>27</td>
</tr>
<tr>
<td>Fuel System (Scroll-PC)</td>
<td>24</td>
</tr>
<tr>
<td>Fuel Injection Pump</td>
<td>24</td>
</tr>
<tr>
<td>Fuel System Timing</td>
<td>24</td>
</tr>
<tr>
<td>Glow Plugs</td>
<td>26</td>
</tr>
<tr>
<td>Governor Operation</td>
<td>25</td>
</tr>
<tr>
<td>Introduction</td>
<td>24</td>
</tr>
<tr>
<td>Fuel System (Sleeve Metering)</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Component</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustments To The Sleeve Metering Fuel System</td>
<td>18</td>
</tr>
<tr>
<td>Fuel Flow After Engine Stops Running</td>
<td>16</td>
</tr>
<tr>
<td>Fuel Flow Using the Priming Pump and Bleed Valve</td>
<td>15</td>
</tr>
<tr>
<td>Fuel Flow With Engine Running</td>
<td>15</td>
</tr>
<tr>
<td>System With Constant Bleed Valve</td>
<td>9</td>
</tr>
<tr>
<td>System With Siphon Break</td>
<td>7</td>
</tr>
<tr>
<td>System With Siphon Break and Constant Bleed Valve</td>
<td>13</td>
</tr>
<tr>
<td>System Without Siphon Break or Constant Bleed Valve</td>
<td>11</td>
</tr>
<tr>
<td>Fuel Injection Pump Operation</td>
<td>17</td>
</tr>
<tr>
<td>Fuel Injection Valve—PC</td>
<td>23</td>
</tr>
<tr>
<td>Fuel Injection Valve</td>
<td>6</td>
</tr>
<tr>
<td>Fuel Priming Pump</td>
<td>15</td>
</tr>
<tr>
<td>Fuel Ratio Control</td>
<td>22</td>
</tr>
<tr>
<td>Fuel System Operation</td>
<td>8</td>
</tr>
<tr>
<td>Fuel System Timing</td>
<td>6</td>
</tr>
<tr>
<td>Fuel Transfer Pump</td>
<td>15</td>
</tr>
<tr>
<td>Glow Plugs—PC</td>
<td>23</td>
</tr>
<tr>
<td>Governor</td>
<td>20</td>
</tr>
<tr>
<td>Injection Nozzle—DI</td>
<td>23</td>
</tr>
<tr>
<td>Introduction</td>
<td>6</td>
</tr>
<tr>
<td>Non-Adjustable Dashpot Governor</td>
<td>21</td>
</tr>
<tr>
<td>Siphon Break</td>
<td>15</td>
</tr>
<tr>
<td>Water Separator</td>
<td>6</td>
</tr>
<tr>
<td>General Information</td>
<td>5</td>
</tr>
<tr>
<td>Engine Design</td>
<td>5</td>
</tr>
<tr>
<td>Fuel System Usage Chart</td>
<td>5</td>
</tr>
<tr>
<td>Lubrication System</td>
<td>34</td>
</tr>
<tr>
<td>Oil Flow In The Engine</td>
<td>36</td>
</tr>
<tr>
<td>Oil Flow Through The Oil Filter and Oil Cooler</td>
<td>36</td>
</tr>
</tbody>
</table>

Purchase full manual at JENSALES.COM or Call 800-443-0625
Air Inlet and Exhaust System ................................................. 107
Checking Inlet Manifold Pressure At Torque .......................... 107
Converter Shaft Speed ....................................................... 108
Compression ................................................................. 109
Crankcase (Crankshaft Compartment) Pressure ......................... 109
Cylinder Head ........................................................................ 109
Glow Plug and Precombustion Chamber Removal and Installation ......................................................... 110
Measurement of Exhaust Temperatures ................................. 109
Measurement of Pressure in Inlet Manifold ......................... 107
Procedure for Measuring Camshaft Lobe Depression ............. 112
Restriction of Air Inlet and Exhaust ..................................... 107
Turbocharger ......................................................................... 108
Valve Clearance ..................................................................... 111
Basic Block .............................................................................. 122
Connecting Rod and Main Bearings ....................................... 122
Connecting Rods and Pistons ................................................. 122
Cylinder Block ........................................................................ 124
Cylinder Liner Projection ...................................................... 122, 123
Counterebored Block ............................................................ 122
Spacer Plate Block .................................................................. 123
Flywheel and Flywheel Housing .......................................... 124-127
Oil Pump Installation ............................................................ 121
Piston Ring Groove Gauge .................................................... 122
Cooling System ....................................................................... 115
Checking Coolant Temperature ............................................ 115
Checking Fan Speed ............................................................... 117
Checking Radiator Air Flow .................................................. 117
Filler Cap and Pressure Relief Valve .................................... 119
Gauge for Water Temperature .............................................. 119
Pressure Cap .......................................................................... 118
Testing Radiator and Cooling System for Leaks .................. 118
Testing the Cooling System .................................................. 115
V-belt Tension Chart .............................................................. 121
Visual Inspection of the Cooling System ................................ 115
Water Temperature Regulator .............................................. 120
Electrical System ................................................................... 129
Battery .................................................................................. 129
Charging System .................................................................... 128
Starting System ...................................................................... 132
Flexible Drive Coupling ......................................................... 128
Checking Flexible Drive Coupling Alignment ....................... 128
Fuel System ............................................................................ 60
Adjustment and Checking 7N449 Fuel Injection Nozzles ........ 70
Checking Engine Cylinders Separately ................................ 70
Checking Engine Timing With 6V3100 Diesel Engine Timing Indicator Group ......................................................... 74
Engine Speed Measurement .................................................. 73
Finding Top Center Compression Position for No. 1 Cylinder .... 75
Flow Checking Fuel Injection Pump Timing (PC Engines Only) ........ 73
Fuel Injection Lines ............................................................... 72
Fuel System Inspection .......................................................... 60
Start-Up Procedure .............................................................. 73
Test Sequence — Precombustion Chamber (PC) ...................... 73
Fuel Nozzle ............................................................................ 62
Testing 7N449 Fuel Injection Nozzles .................................. 63
Testing Capsule-Type Fuel Injection Nozzles ....................... 60
Troubleshooting of 7N449 Fuel Injection Nozzles .................. 69
Fuel System (Scroll-DI) .......................................................... 99
Checking the Fuel Injection Valves ...................................... 99
Checking the Plunger and Lifter Washer of an Injection Pump .......................................................... 99
Fuel Injection Pump Timing Dimension Setting ..................... 99
Foil Injection Timing Check (Timing Pin Method) .................... 99
Fuel Rack Setting .................................................................... 104
Fuel System Adjustments ...................................................... 101
Injection Pump (Install) .......................................................... 100
Injection Pump (Remove) ....................................................... 99
Fuel System (Scroll-PD) .......................................................... 91
Checking the Fuel Injection Valves ...................................... 91
Checking the Plunger and Lifter Washer of an Injection Pump .......................................................... 91
Fuel Injection Service ............................................................ 95
Accessory Drive Shaft Timing ............................................... 95
Checking With 854820 Gauge .............................................. 93
Checking With 857167 or 5P4158 Gauge ............................. 94
Fuel Injection Pump Timing Dimension Setting ..................... 94
Foil Injection System ................................. 94
Foil Injection System Setting ................................................ 91
Governor Adjustments .......................................................... 91
Governor Adjustments .......................................................... 97
Fuel Ratio Control Setting .................................................... 98
Fuel System (Sleeve Metering) .............................................. 79
Fuel Injection Service ............................................................ 79
Fuel Pump Calibration ........................................................... 86
Fuel Ratio Control Setting .................................................... 85
Fuel System Adjustments ...................................................... 80
Fuel System Setting ............................................................. 83
Governor Adjustments .......................................................... 82
Lubrication System .............................................................. 113
Oil Pressure is Low .............................................................. 114
Oil Pressure is High .............................................................. 114
Too Much Bearing Wear ...................................................... 46
Too Much Oil Consumption ................................................ 46
Troubleshooting ................................................................. 46-59

NOTE: This book has been completely changed from the former issue.

SPECIFICATIONS
NOTE: For Specifications with illustrations, make reference to SPECIFICATIONS for 3304 VEHICULAR ENGINE, Form No. SENR7590. If the Specifications in Form SENR7590 are not the same as in the Systems Operation and the Testing and Adjusting, look at the printing date on the back cover of each book. Use the Specifications given in the book with the latest date.
GOVERNOR OPERATION

The accelerator pedal is connected to the control lever on the engine governor. The governor controls the amount of fuel needed to keep the desired engine rpm.

The governor has governor weights (11) driven by the engine through drive gear (7). When the engine is running, the rotation of weights (11) makes a force. The difference in the force of weights (11) and spring (4) controls the movement of valve (12). Valve (12) sends engine oil to either side of piston (13). Piston (13) will move the rack to increase or decrease fuel to the engine.

When engine load increases, engine rpm decreases. The speed of rotation of weights (11) becomes less. Weights (11) move toward each other and make less force. Governor spring (4) can move valve (12) forward. As valve (12) moves forward, oil passage (6) around valve (12) opens to pressure oil. Oil is sent through passage (6) and fills the chamber behind piston (13). The pressure oil pushes piston (13) and the rack forward. This increases the amount of fuel to the engine. Engine rpm decreases until the force from the rotation of weights (11) makes a balance with the force of governor spring (4).

When engine load decreases, engine rpm increases. The speed of rotation of weights (11) increases. Weights (11) move apart and make more force against governor spring (4). Valve (12) moves backwards and sends the oil behind piston (13) through a drain passage, opened at the rear of piston (13). The pressure oil in the chamber between sleeve (14) and piston (13) pushes piston (13) and the rack backwards. This decreases the amount of fuel to the engine. Engine rpm decreases until the force from the rotation of weights (11) makes a balance with the force of governor spring (4).

On earlier engines, when the engine is started, the speed limiter plunger restricts the movement of the governor control linkage. When operating oil pressure is reached, the plunger in the speed limiter retracts and the governor control can be moved to the HIGH IDLE position.

When engine rpm is at LOW IDLE, a spring-loaded plunger in lever assembly (2) comes in contact with a shoulder on the adjustment screw for low idle. To stop the engine, pull back on the governor control. This will let the spring-loaded plunger move over the shoulder on the low idle adjusting screw and move the fuel rack to the fuel OFF position. With no fuel to the engine cylinders, the engine will stop.

Oil from the engine lubrication system gives lubrication to the governor weight bearing. The other parts of the governor get lubrication from "splash-lubrication" (oil thrown by other parts). Oil from the governor runs down into the housing for the fuel injection pumps.
ALTERNATOR

REMOVE ALTERNATOR 1405-11

1. Remove panel assembly (1) from the left side of the machine.
2. Disconnect electric wires (2) and (3) from the alternator.
3. Loosen bolts (5) and (6) to remove vee belts (4) from the alternator pulley.
4. Remove bolts (5) and (6) and remove the alternator.

INSTALL ALTERNATOR 1405-11

1. If a new pulley has been installed on alternator (1), tighten the nut that holds it to a torque of 75 to 90 lb-ft. (100 to 120 N·m).
2. Put alternator (1) in position on the engine and install the bolts to hold it hand tight.
3. Put vee belts in position on the alternator pulley.
4. Use a belt tension gauge such as Borroughs Tool Company Part No. BT-33-72-4-15 or an equivalent and make an adjustment of vee belts (3). Measure the belt nearest the radiator. Tighten new belts until the gauge indication is 120 ± 5. Operate the engine at high idle for a minimum of 30 minutes after Step 5. Make another adjustment of the belt tension. The correct gauge indication for used belts is 90 ± 10. Tighten the bolts that hold the alternator in position.
5. Connect electric wires (2) and (4) to the alternator. Tighten the ground terminal nuts to a torque of 25 to 30 lb.in. (2.8 to 3.4 N·m). Tighten the positive terminal nuts to a torque of 225 to 250 lb.in. (25.4 to 28.3 N·m).
6. Install the panel assembly on the left side of the machine.
TORQUE CONVERTER CLEARANCE CHECKS

Tools Needed

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nut</td>
<td>599079</td>
<td>4</td>
</tr>
<tr>
<td>Dial Test Indicator Group</td>
<td>8S2328</td>
<td>1</td>
</tr>
</tbody>
</table>

There must be a minimum radial (running) clearance between the inside diameter of the rotating housing and turbine.

2. Check the clearance between the inside diameter of the rotating housing and the turbine as follows:

a) Install tooling (A) in four positions in the rotating housing as shown.

b) Put the rotating housing on a smooth flat surface. Install turbine (1) in the housing.

c) Put tooling (B) in the position shown.

d) Push turbine (1) toward tooling (B) until it makes contact with the inside diameter of the rotating housing. Adjust the dial indicator until it is on zero. Slide the turbine 180° away from tooling (B) until it makes contact with the other side of the rotating housing. Make a record of the dimension measured.

e) Make this check at several locations around the housing. Make a record of each of the dimensions measured. The largest dimension measured is used for the clearance between the two parts. The total clearance measured across the diameters must be .020 to .040 in. (0.51 to 1.02 mm) with a maximum permissible clearance of .045 in. (1.14 mm). The radial (running) clearance is half of the dimensions measured.
9. Put plate (4) in position on the machine and install two of the bolts that hold it 180° apart. Tighten the bolts to a torque of 15 lb-ft. (20 N·m).

10. Measure the distance between plate (4) and the frame (360° around the plate) with a feeler gauge. Make a note of the minimum measurement.

11. Remove plate (4) and install shims (5) that have a thickness of the minimum measurement taken in Step 10 minus .010 in. (.25 mm). Install the plate and tighten the seven bolts.

12. Connect oil lines (6) to the lift kickout and bucket positioner slave cylinders.

13. Connect air line (7) to the horn valve.

14. Connect hose assemblies (8), (9), (10) and (11) to their correct location on the front frame.