Perkins®

SENR9833-02
May 2006

# Specifications

## 800C Industrial Engine

**UE (Engine)**
**UF (Engine)**

# Important Safety Information

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

**Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.**

**Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.**

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons.

The hazards are identified by the "Safety Alert Symbol" and followed by a "Signal Word" such as "DANGER", "WARNING" or "CAUTION". The Safety Alert "WARNING" label is shown below.

**⚠ WARNING**

The meaning of this safety alert symbol is as follows:

**Attention! Become Alert! Your Safety is Involved.**

The message that appears under the warning explains the hazard and can be either written or pictorially presented.

Operations that may cause product damage are identified by "NOTICE" labels on the product and in this publication.

**Perkins cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all inclusive. If a tool, procedure, work method or operating technique that is not specifically recommended by Perkins is used, you must satisfy yourself that it is safe for you and for others. You should also ensure that the product will not be damaged or be made unsafe by the operation, lubrication, maintenance or repair procedures that you choose.**

The information, specifications, and illustrations in this publication are on the basis of information that was available at the time that the publication was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service that is given to the product. Obtain the complete and most current information before you start any job. Perkins dealers or Perkins distributors have the most current information available.

**⚠ WARNING**

**When replacement parts are required for this product Perkins recommends using Perkins replacement parts.**

**Failure to heed this warning can lead to premature failures, product damage, personal injury or death.**

# Table of Contents

## Specifications Section



## Index Section

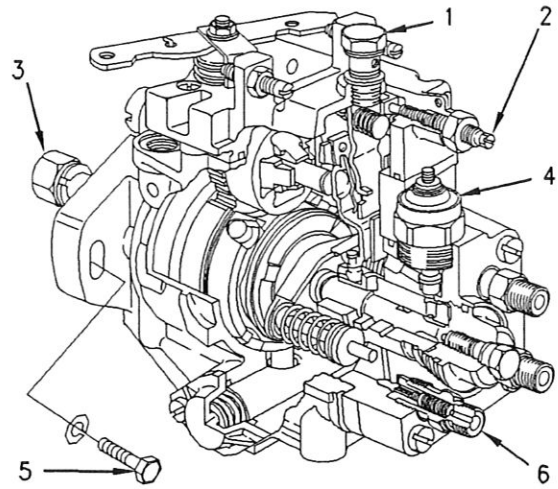



Illustration 3 g00993641

(1) Tighten the overflow valve for the fuel injection pump to the following torque. ..... 22 to 31 N·m (16 to 23 lb ft)

(2) Screw for adjusting the full load setting

(3) Tighten the nut for the fuel injection pump gear to the following torque.

Naturally aspirated engines ..... 59 to 69 N·m (43 to 51 lb ft)
Turbocharged engines ..... 83 to 98 N·m (62 to 72 lb ft)

(4) Fuel shutoff solenoid

(5) Bolt for attaching to the gear case cover

(6) Delivery valves for the fuel

i02506427

# Fuel Injectors

## Naturally Aspirated Engines

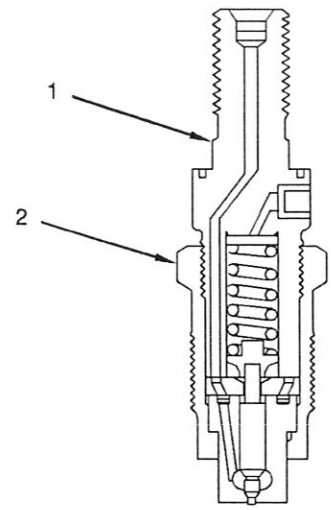



Illustration 4 g01010241

(1) Tighten the body in the retaining nut to the following torque. ..... 34 to 39 N·m (25 to 29 lb ft)

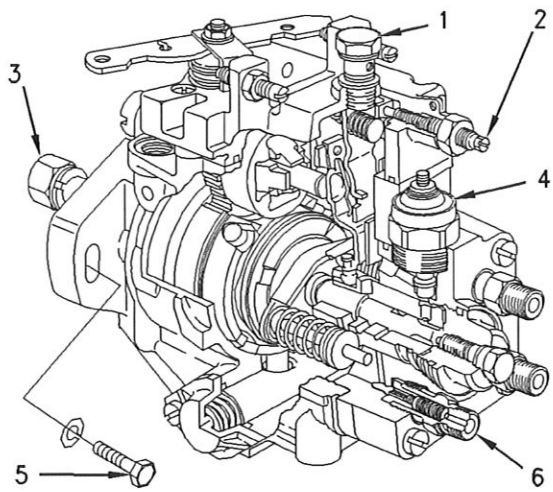
**Note:** The fuel injector should only be disassembled and assembled by personnel with the proper training.

(2) Tighten the fuel injector in the engine to the following torque. ..... 53 to 65 N·m (39 to 48 lb ft)

Type of fuel injector ..... single orifice

Injection pressure

Standard at assembly ..... 11.77 to 12.75 MPa (1707 to 1849 psi)

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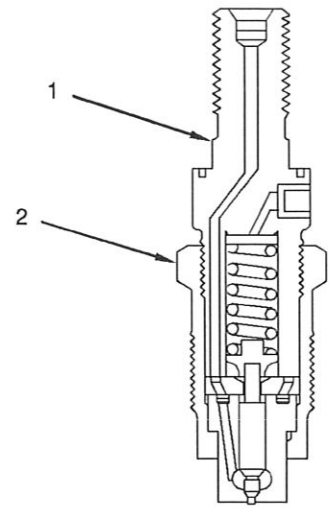
i02506427

# Fuel Injectors

## Naturally Aspirated Engines

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Type of fuel injector ..... single orifice

Injection pressure

Standard at assembly ..... 11.77 to 12.75 MPa (1707 to 1849 psi)

Repair limit ..... 0.08 mm (0.0031 inch)

i02509351

# Rocker Shaft

**Part No.:** 233-5501

Table 1

| Required Tools | | | |
|---|---|---|---|
| **Tool** | **Part Number** | **Part Description** | **Qty** |
| A | 21825617 | Dial Indicator Group | 1 |
| B | - | V Block | 2 |

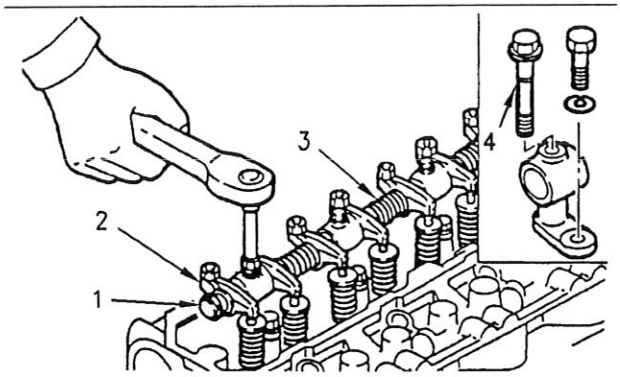


Illustration 8 g00984738

(1) Rocker shaft

Diameter of the rocker shaft ..... 18.980 to 19.000 mm (0.7472 to 0.7480 inch)

(2) Rocker arm

Inside diameter of the rocker arm bushings ..... 19.010 to 19.030 mm (0.7484 to 0.7492 inch)
Clearance between the rocker arm bushing and the rocker shaft ..... 0.010 to 0.050 mm (0.0004 to 0.0020 inch)
Maximum permissible clearance between the rocker arm bushing and the rocker shaft ..... 0.070 mm (0.0028 inch)

(3) Spring

(4) Tighten the bolts evenly. Tighten the long bolt first. Tighten the bolts to the following torque. ..... 10 to 20 N·m (7 to 15 lb ft)

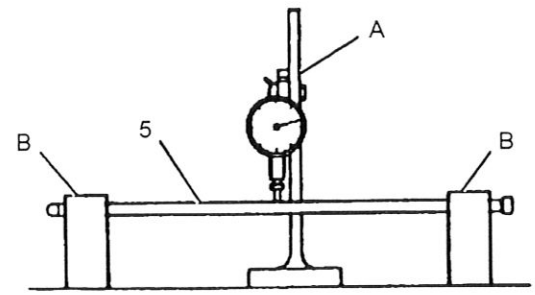


Illustration 9 g01256133

(5) Pushrods

Place the pushrod in Tooling (B). Use Tooling (A) in order to check all pushrods for runout. Replace the pushrod if the runout exceeds the following value. ..... 0.30 mm (0.0118 inch)

i01892068

# Valve Mechanism Cover

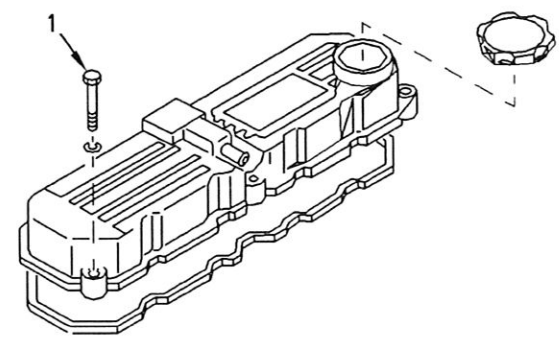


Illustration 10 g00984870

(1) Tighten the bolts for the valve mechanism cover to the following torque. ..... 10 to 13 N·m (7 to 10 lb ft)

Repair limit ..... 0.08 mm (0.0031 inch)

i02509351

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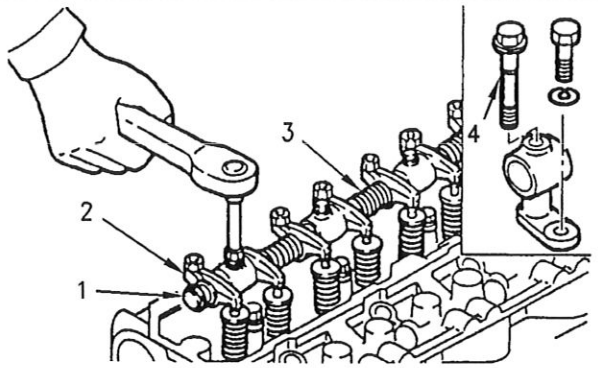


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(2) Rocker arm

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(3) Spring

(4) Tighten the bolts evenly. Tighten the long bolt first. Tighten the bolts to the following torque. ..... 10 to 20 N·m (7 to 15 lb ft)

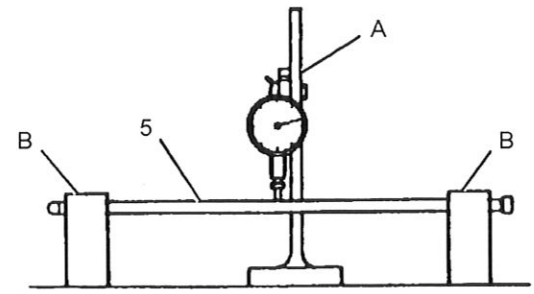


Illustration 9 g01256133

(5) Pushrods

Place the pushrod in Tooling (B). Use Tooling (A) in order to check all pushrods for runout. Replace the pushrod if the runout exceeds the following value. ..... 0.30 mm (0.0118 inch)

i01892068

# Valve Mechanism Cover

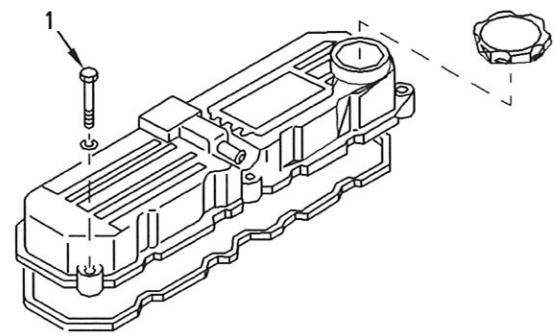


Illustration 10 g00984870

(1) Tighten the bolts for the valve mechanism cover to the following torque. ..... 10 to 13 N·m (7 to 10 lb ft)

D ..... 8 ± 0.1 mm (0.315 ± 0.004 inch)

Bore for the exhaust valve seat

A ..... 45 degrees
B ..... 37 to 37.0025 mm (1.457 to 1.458 inch)
C ..... 2 ± 0.1 mm (0.079 ± 0.004 inch)
D ..... 8 ± 0.1 mm (0.315 ± 0.004 inch)

i01892090

# Cylinder Head

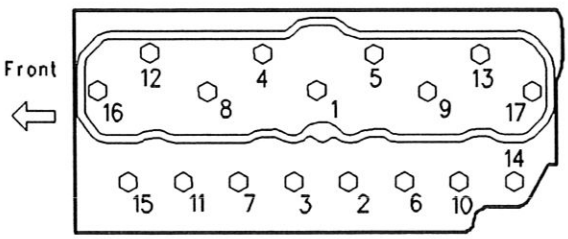


Illustration 13 g00984896

Tighten the cylinder head bolts in the sequence that is shown to the following torque. ..... 113 to 123 N·m (83 to 91 lb ft)

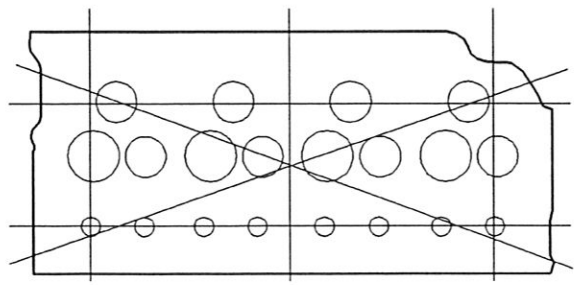

Illustration 14 g00984909

The permissible distortion of the cylinder head is given below.

Maximum at assembly .... 0.05 mm (0.0020 inch)
Repair limit ..... 0.20 mm (0.0079 inch)

i01892688

# Exhaust Manifold

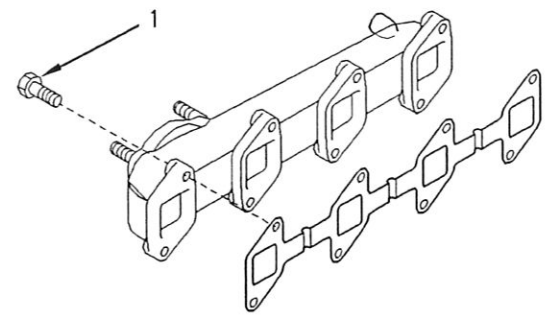


Illustration 15 g00985166

(1) Bolt

Tighten the exhaust manifold bolts to the following torque.

Naturally aspirated engines ..... 15 to 22 N·m (11 to 16 lb ft)
Turbocharged engines ..... 28 to 33 N·m (21 to 24 lb ft)

Maximum warpage of the flange for the exhaust manifold ..... 0.20 mm (0.008 inch)

i02506460

# Camshaft

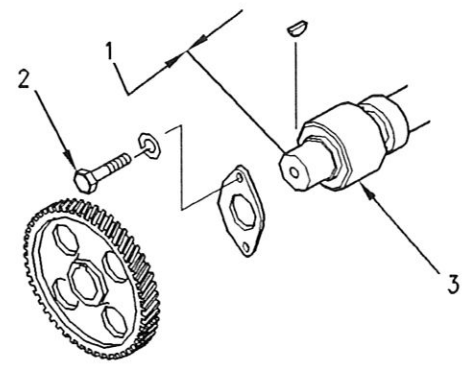


Illustration 16 g00988290

(1) End play of a new camshaft ..... 0.10 ± 0.25 mm (0.0039 ± 0.0098 inch)

Maximum permissible end play of a worn camshaft ..... 0.30 mm (0.0118 inch)

D ..... 8 ± 0.1 mm (0.315 ± 0.004 inch)

Bore for the exhaust valve seat

A ..... 45 degrees
B ..... 37 to 37.0025 mm (1.457 to 1.458 inch)
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i01892090

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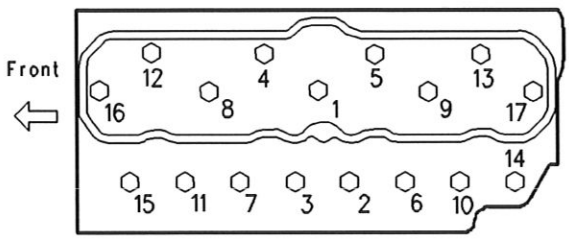


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Tighten the cylinder head bolts in the sequence that is shown to the following torque. ..... 113 to 123 N·m (83 to 91 lb ft)

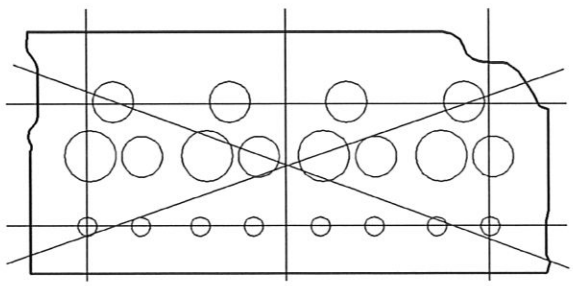


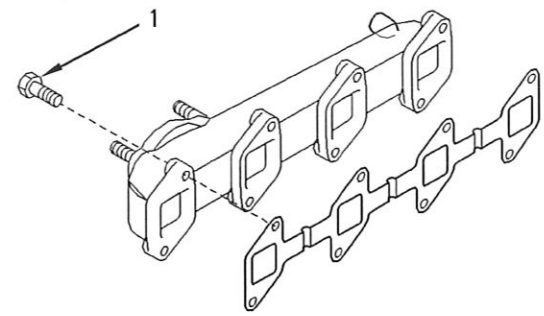
Illustration 14 g00984909

The permissible distortion of the cylinder head is given below.

Maximum at assembly .... 0.05 mm (0.0020 inch)
Repair limit ..... 0.20 mm (0.0079 inch)

i01892688

# Exhaust Manifold

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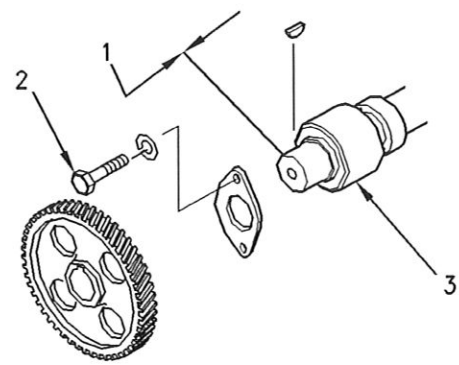
i02506460

# Camshaft

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(1) End play of a new camshaft ..... 0.10 ± 0.25 mm (0.0039 ± 0.0098 inch)

Maximum permissible end play of a worn camshaft ..... 0.30 mm (0.0118 inch)

i01893227

# Engine Oil Relief Valve

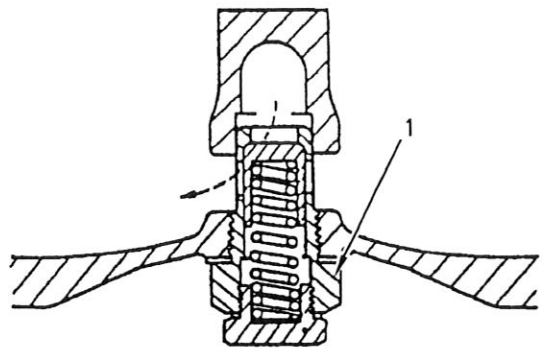



Illustration 19 g00987876

(1) Tighten the engine oil relief valve to the following torque. ..... 44 to 54 N·m (33 to 40 lb ft)

Opening pressure of engine oil relief valve ..... 350 ± 50 kPa (50 ± 7 psi)

**Note:** The engine oil relief valve is located on the left side of the cylinder block.

i02509468

# Engine Oil Pump

Table 3

| Required Tools | | | |
|---|---|---|---|
| **Tool** | **Part Number** | **Part Description** | **Qty** |
| A | - | Feeler Gauge | 1 |

Type ..... Gear-driven differential rotor

Number of lobes

Inner rotor ..... 4
Outer rotor ..... 5

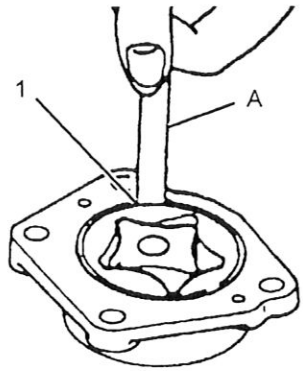



Illustration 20 g01256201

(1) Clearance between the outer rotor and the body

Standard ..... 0.20 to 0.30 mm (0.0079 to 0.0118 inch)
Service limit ..... 0.50 mm (0.0197 inch)

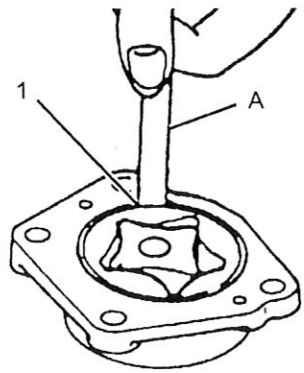


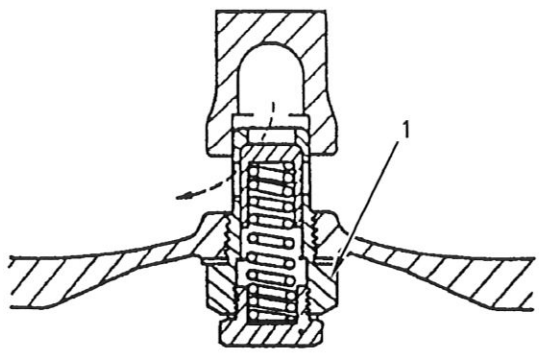

Illustration 21 g01256201

(2) Clearance between the outer rotor and the inner rotor

Standard ..... 0.13 to 0.15 mm (0.0051 to 0.0059 inch)
Service limit ..... 0.20 mm (0.0079 inch)

i01893227

# Engine Oil Relief Valve

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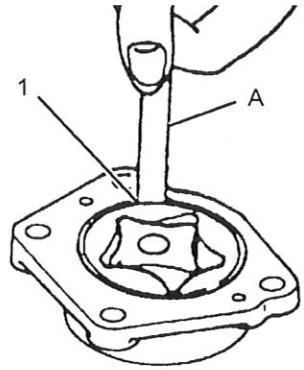


Illustration 20 g01256201

(1) Clearance between the outer rotor and the body

Standard ..... 0.20 to 0.30 mm (0.0079 to 0.0118 inch)
Service limit ..... 0.50 mm (0.0197 inch)

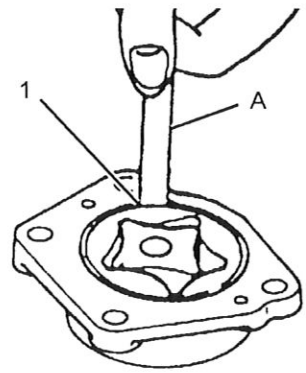


Illustration 21 g01256201

(2) Clearance between the outer rotor and the inner rotor

Standard ..... 0.13 to 0.15 mm (0.0051 to 0.0059 inch)
Service limit ..... 0.20 mm (0.0079 inch)

i02509965

# Engine Oil Pan

Table 5

| Required Tools | | | |
|---|---|---|---|
| Tool | Part Number | Part Description | Qty |
| A | 21826038 | POWERPART Silicone Sealant | 1 |
| B | 21826051 | POWERPART Sealing Compound | 1 |
| C | 21820117 | POWERPART Threadlock and Nutlock | 1 |

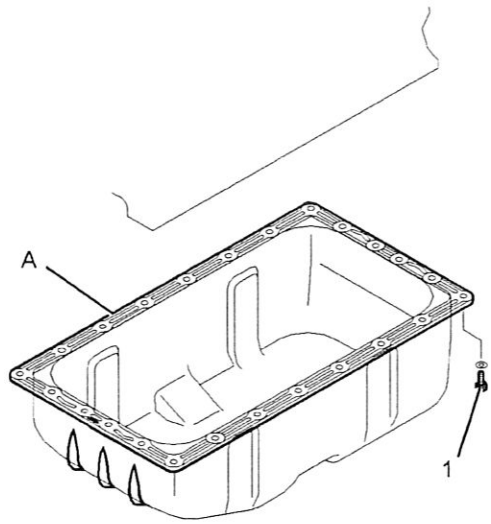


Illustration 25 g01256709

Apply tooling (A) or Tooling (B) to the flange of the oil pan. Refer to illustration 26.

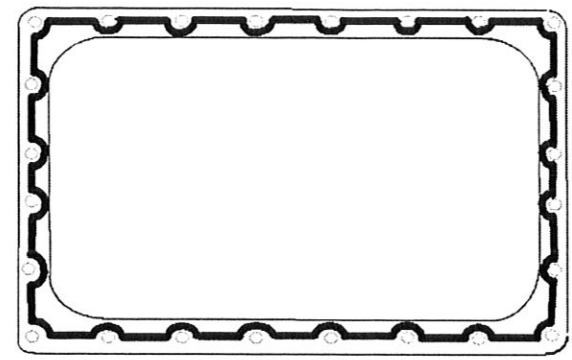

Illustration 26 g01020644

**Note:** Apply Tooling (C) in order to reuse the bolts for the oil pan. Apply Tooling (C) to the first 13 mm (0.5118 inch) of the thread.

(1) Tighten the oil pan bolts to the following torque. ..... 10 to 13 N·m (7 to 10 lb ft)

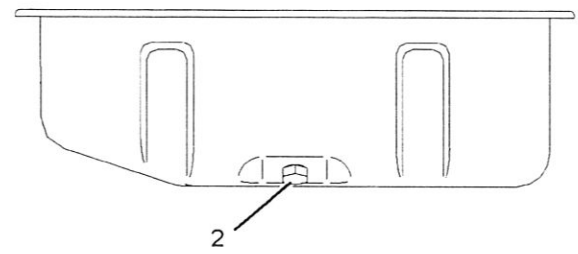


Illustration 27 g01256710

(2) Tighten the oil pan drain plug to the following torque. ..... 34 to 44 N·m (25 to 33 lb ft)

i02509965

# Engine Oil Pan

Table 5

| Required Tools | | | |
|---|---|---|---|
| Tool | Part Number | Part Description | Qty |
| A | 21826038 | POWERPART Silicone Sealant | 1 |
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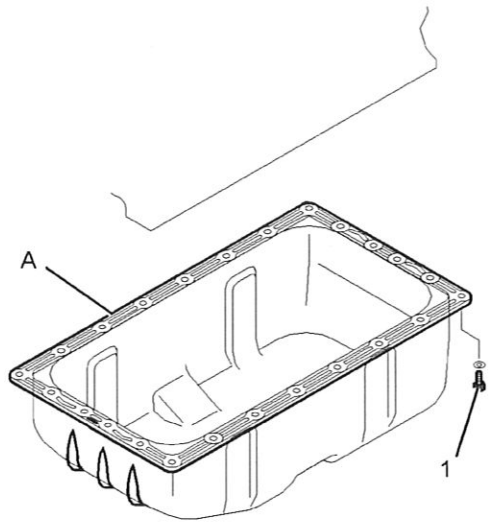


Illustration 25 g01256709

Apply tooling (A) or Tooling (B) to the flange of the oil pan. Refer to illustration 26.

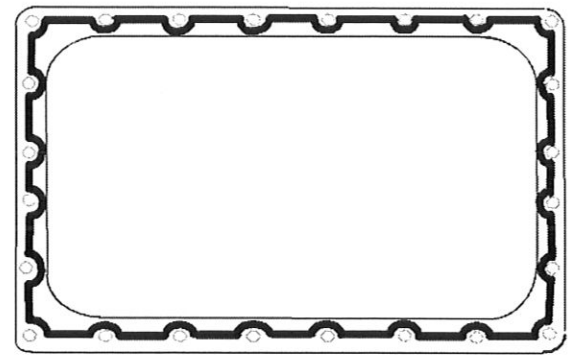

Illustration 26 g01020644

**Note:** Apply Tooling (C) in order to reuse the bolts for the oil pan. Apply Tooling (C) to the first 13 mm (0.5118 inch) of the thread.

(1) Tighten the oil pan bolts to the following torque. ..... 10 to 13 N·m (7 to 10 lb ft)

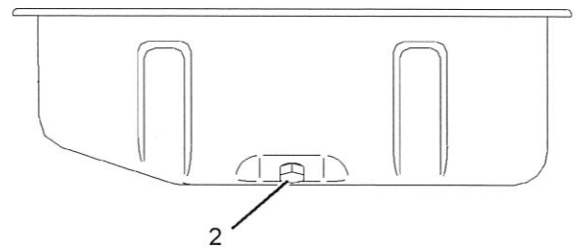


Illustration 27 g01256710

(2) Tighten the oil pan drain plug to the following torque. ..... 34 to 44 N·m (25 to 33 lb ft)

Repair limit ..... 0.20 mm (0.0079 inch)

(2) Main bearing cap bolts

Use the following procedure in order to install the main bearing cap bolts:

1. Apply engine oil to the bearings and install the bearings to the caps.

**Note:** Apply a small amount of Tooling (A) or Tooling (B) to the corners of the cylinder block for the rear main bearing cap. After the rear main bearing cap is installed, remove any excess sealant from the inside of the recess for the rear oil seal. Excess sealant prevents the correct seating of the rear oil seal.

2. Install the cap to the crankcase so that the rear face of the cap is even with the rear face of the crankcase.

3. Apply clean engine oil to the threads of the main bearing cap bolts.

   Tighten the main bearing cap bolts to the following torque. ..... 98 to 108 N·m (72 to 80 lb ft)

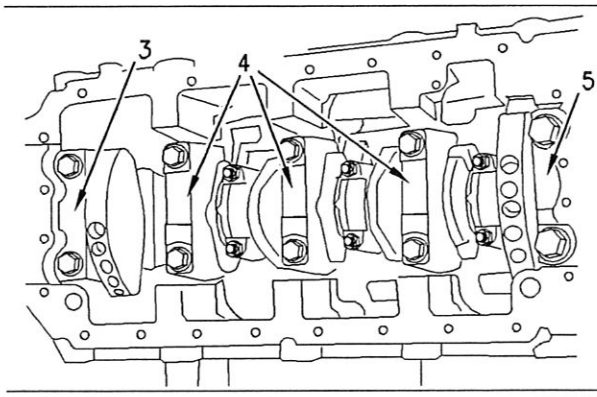


Illustration 30 g01007113

(3) Rear main bearing cap

(4) Main bearing caps should have a marking that indicates placement and orientation.

(5) Front main bearing cap

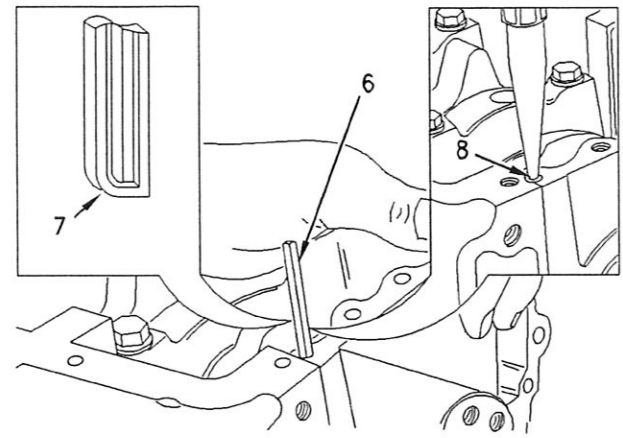


Illustration 31 g01007117

(6) Seal for the front and rear main bearing caps.

(7) The seals for the front and the rear main bearing caps have a curve at one end. The curved side must be installed toward the side of the engine. The curved end is inserted first into the hole.

**Note:** Use Tooling (C) in order to install the seal correctly.

(8) Before installing the seals, inject a small quantity of Tooling (A) or Tooling (B) in the holes for the seals.

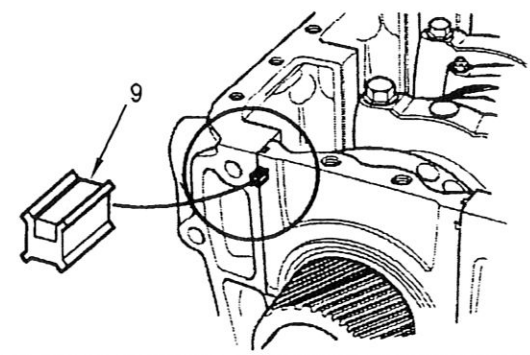


Illustration 32 g01007175

(9) Seal for the front main bearing cap.

Repair limit ..... 0.20 mm (0.0079 inch)

(2) Main bearing cap bolts

Use the following procedure in order to install the main bearing cap bolts:

1. Apply engine oil to the bearings and install the bearings to the caps.

**Note:** Apply a small amount of Tooling (A) or Tooling (B) to the corners of the cylinder block for the rear main bearing cap. After the rear main bearing cap is installed, remove any excess sealant from the inside of the recess for the rear oil seal. Excess sealant prevents the correct seating of the rear oil seal.

2. Install the cap to the crankcase so that the rear face of the cap is even with the rear face of the crankcase.

3. Apply clean engine oil to the threads of the main bearing cap bolts.

   Tighten the main bearing cap bolts to the following torque. ..... 98 to 108 N·m (72 to 80 lb ft)

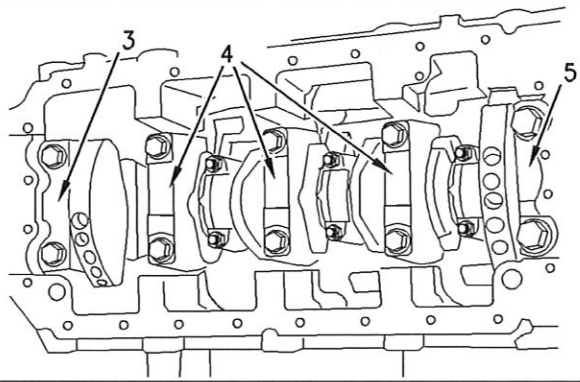


Illustration 30 g01007113

(3) Rear main bearing cap

(4) Main bearing caps should have a marking that indicates placement and orientation.

(5) Front main bearing cap

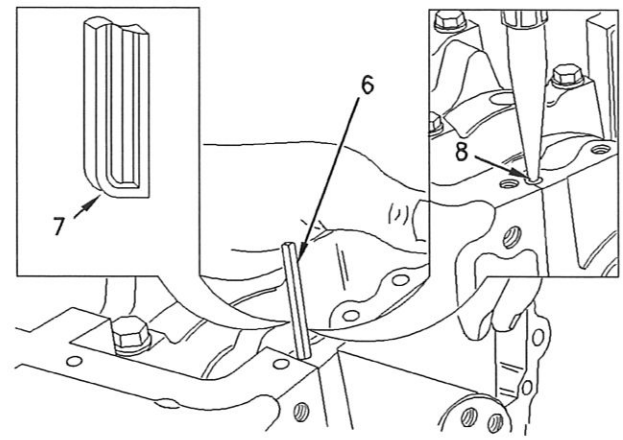


Illustration 31 g01007117

(6) Seal for the front and rear main bearing caps.

(7) The seals for the front and the rear main bearing caps have a curve at one end. The curved side must be installed toward the side of the engine. The curved end is inserted first into the hole.

**Note:** Use Tooling (C) in order to install the seal correctly.

(8) Before installing the seals, inject a small quantity of Tooling (A) or Tooling (B) in the holes for the seals.

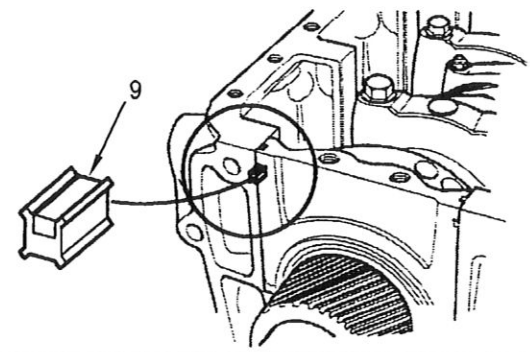


Illustration 32 g01007175

(9) Seal for the front main bearing cap.

i01059939

# Crankshaft Seals

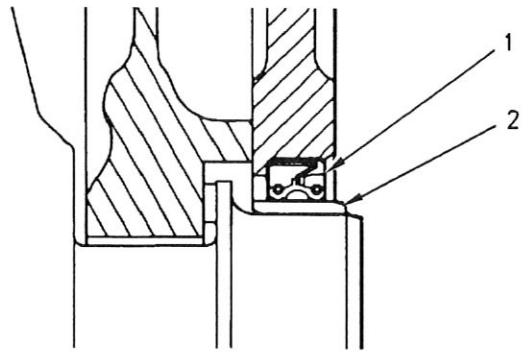


Illustration 36 g00554030

(1) Oil seal

(2) Oil seal sleeve

Inspect the contact surface between the oil seal and the crankshaft for wear. If the crankshaft is worn, replace the oil seal with an oil seal and a sleeve assembly.

i01907581

# Connecting Rod Bearing Journal

Table 10

| Diameter of Crankshaft Journal (Bearing Surface) For Connecting Rod Bearings | |
|---|---|
| Original Size Journal(1) | 57.955 to 57.970 mm (2.2817 to 2.2823 inch) |
| Undersize Journal 0.25 mm (0.010 inch) | 57.705 to 57.720 mm (2.2718 to 2.2724 inch) |
| Undersize Journal 0.50 mm (0.020 inch) | 57.455 to 57.470 mm (2.2620 to 2.2626 inch) |
| Undersize Journal 0.75 mm (0.030 inch) | 57.205 to 57.220 mm (2.2522 to 2.2528 inch) |

(1) Regrind the connecting rod bearing journals to the next undersize dimension if the repair limit of 57.800 mm (2.2756 inch) is exceeded.

The clearance between a new connecting rod bearing and a new connecting rod bearing journal is the following value. ..... 0.030 to 0.090 mm (0.0012 to 0.0035 inch)

Service limit for clearance between a connecting rod bearing and a connecting rod bearing journal ..... 0.200 mm (0.0079 inch)

i01907583

# Main Bearing Journal

Table 11

| Diameter of Crankshaft Journal (Bearing Surface) For Main Bearings | |
|---|---|
| Original Size Journal(1) | 77.955 to 77.970 mm (3.0691 to 3.0697 inch) |
| Undersize Journal 0.25 mm (0.010 inch) | 77.705 to 77.720 mm (3.0592 to 3.0598 inch) |
| Undersize Journal 0.50 mm (0.020 inch) | 77.455 to 77.470 mm (3.0494 to 3.0500 inch) |
| Undersize Journal 0.75 mm (0.030 inch)(2) | 77.205 to 77.220 mm (3.0396 to 3.0402 inch) |

(1) Regrind the main bearing journals to the next undersize dimension if the repair limit of 77.850 mm (3.0650 inch) is exceeded.

(2) Service limit 77.100 mm (3.0354 inch)

The clearance between a new main bearing and a new main bearing journal is the following value. ..... 0.050 to 0.110 mm (0.0020 to 0.0043 inch)

i01895665

# Connecting Rod

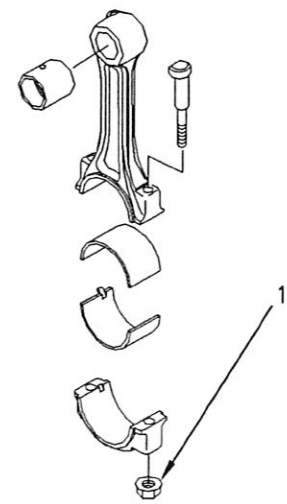


Illustration 37 g00987949

Prior to assembly, apply engine oil to the bearing.

(1) Install the bearing cap to the connecting rod and tighten the cap nuts to the following torque. ..... 49 to 59 N·m (36 to 44 lb ft)

Inside diameter of the piston pin bearing

i01059939

# Crankshaft Seals

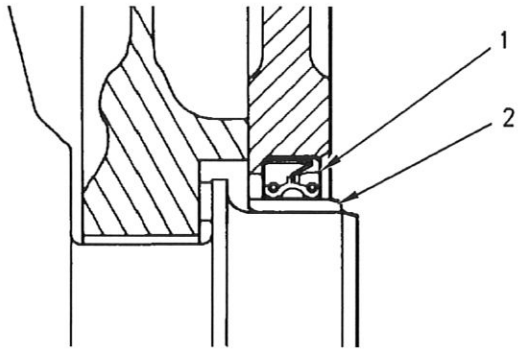


Illustration 36 g00554030

(1) Oil seal

(2) Oil seal sleeve

Inspect the contact surface between the oil seal and the crankshaft for wear. If the crankshaft is worn, replace the oil seal with an oil seal and a sleeve assembly.

i01907581

# Connecting Rod Bearing Journal

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| Diameter of Crankshaft Journal (Bearing Surface) For Connecting Rod Bearings | |
|---|---|
| Original Size Journal(1) | 57.955 to 57.970 mm (2.2817 to 2.2823 inch) |
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| Undersize Journal 0.50 mm (0.020 inch) | 57.455 to 57.470 mm (2.2620 to 2.2626 inch) |
| Undersize Journal 0.75 mm (0.030 inch) | 57.205 to 57.220 mm (2.2522 to 2.2528 inch) |

(1) Regrind the connecting rod bearing journals to the next undersize dimension if the repair limit of 57.800 mm (2.2756 inch) is exceeded.

The clearance between a new connecting rod bearing and a new connecting rod bearing journal is the following value. ..... 0.030 to 0.090 mm (0.0012 to 0.0035 inch)

Service limit for clearance between a connecting rod bearing and a connecting rod bearing journal ..... 0.200 mm (0.0079 inch)

i01907583

# Main Bearing Journal

Table 11

| Diameter of Crankshaft Journal (Bearing Surface) For Main Bearings | |
|---|---|
| Original Size Journal(1) | 77.955 to 77.970 mm (3.0691 to 3.0697 inch) |
| Undersize Journal 0.25 mm (0.010 inch) | 77.705 to 77.720 mm (3.0592 to 3.0598 inch) |
| Undersize Journal 0.50 mm (0.020 inch) | 77.455 to 77.470 mm (3.0494 to 3.0500 inch) |
| Undersize Journal 0.75 mm (0.030 inch)(2) | 77.205 to 77.220 mm (3.0396 to 3.0402 inch) |

(1) Regrind the main bearing journals to the next undersize dimension if the repair limit of 77.850 mm (3.0650 inch) is exceeded.

(2) Service limit 77.100 mm (3.0354 inch)

The clearance between a new main bearing and a new main bearing journal is the following value. ..... 0.050 to 0.110 mm (0.0020 to 0.0043 inch)

i01895665

# Connecting Rod

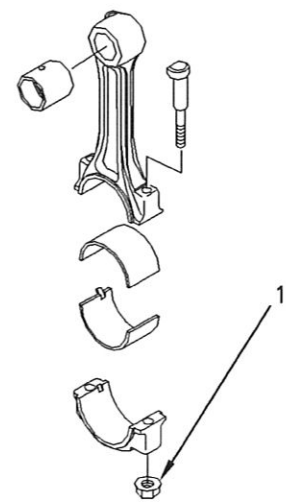


Illustration 37 g00987949

Prior to assembly, apply engine oil to the bearing.

(1) Install the bearing cap to the connecting rod and tighten the cap nuts to the following torque. ..... 49 to 59 N·m (36 to 44 lb ft)

Inside diameter of the piston pin bearing

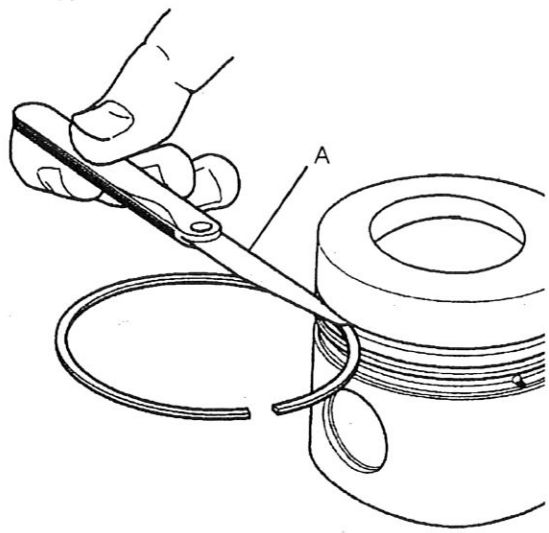


Illustration 40 g01256909

Use Tooling (A) in order to measure the clearance between the piston groove and a new piston ring.

No. 1 ring

Standard at assembly ..... 0.07 to 0.11 mm (0.0028 to 0.0043 inch)

Repair limit ..... 0.200 mm (0.0079 inch)

No. 2 ring

Standard at assembly ..... 0.045 to 0.085 mm (0.0018 to 0.0033 inch)

Repair limit ..... 0.150 mm (0.0059 inch)

Oil ring

Standard at assembly ..... 0.025 to 0.065 mm (0.0010 to 0.0026 inch)

Repair limit ..... 0.150 mm (0.0059 inch)

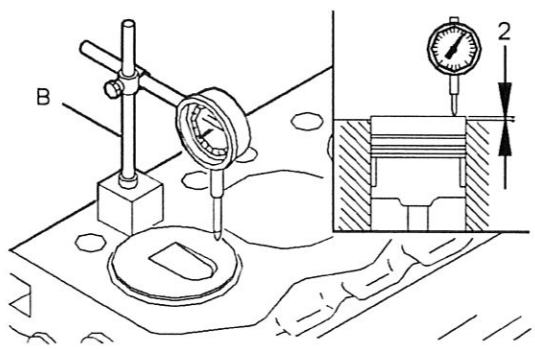


Illustration 41 g01256910

Use Tooling (B) in order to measure the protrusion of the piston (2).

Standard at Assembly

Naturally aspirated engines .... −0.25 to 0.15 mm (−0.0098 to 0.0059 inch)

Turbocharged engines ..... 0.05 to 0.45 mm (0.0020 to 0.0177 inch)

Compressed thickness of cylinder head gasket ..... 1.2 ± 0.05 mm (0.05 ± 0.002 inch)

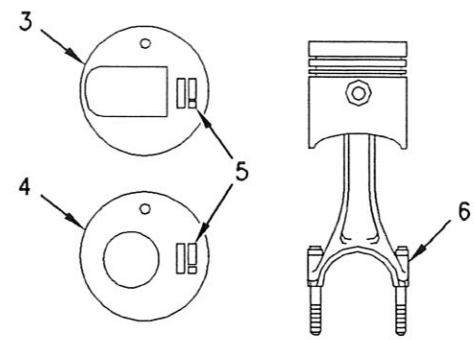


Illustration 42 g00987977

(3) Piston from naturally aspirated engines

(4) Piston from turbocharged engines

(5) "WEIGHT" mark

(6) "MATCHING" mark

**Note:** Assemble the piston and the connecting rod with the "WEIGHT" mark on the piston and with the "MATCHING" mark on the rod on the same side.

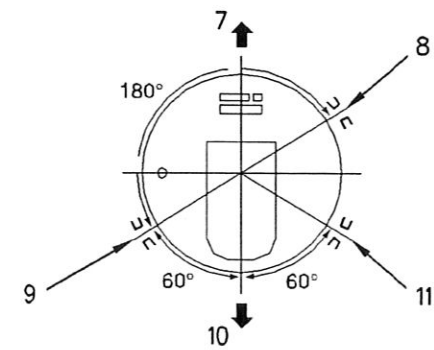


Illustration 43 g00987981

(7) Camshaft side

(8) End gap of No. 1 compression ring

(9) End gap of No. 2 compression ring

(10) Side with the inlet valve

(11) End gap of oil ring

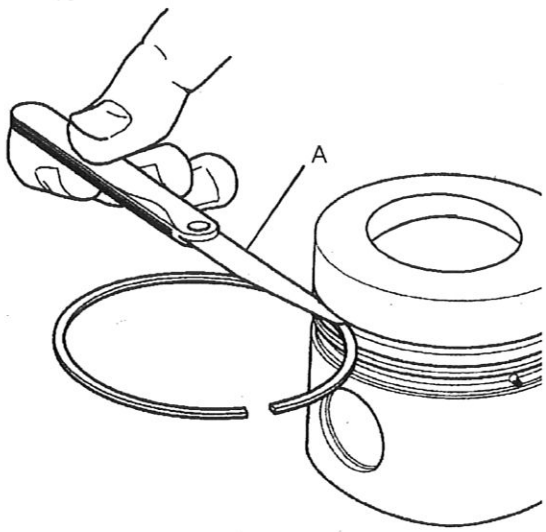


Illustration 40 g01256909

Use Tooling (A) in order to measure the clearance between the piston groove and a new piston ring.

No. 1 ring

Standard at assembly ..... 0.07 to 0.11 mm (0.0028 to 0.0043 inch)

Repair limit ..... 0.200 mm (0.0079 inch)

No. 2 ring

Standard at assembly ..... 0.045 to 0.085 mm (0.0018 to 0.0033 inch)

Repair limit ..... 0.150 mm (0.0059 inch)

Oil ring

Standard at assembly ..... 0.025 to 0.065 mm (0.0010 to 0.0026 inch)

Repair limit ..... 0.150 mm (0.0059 inch)

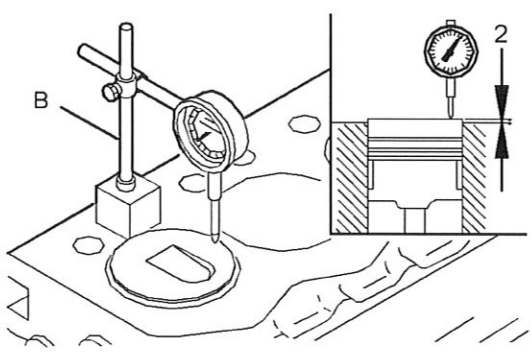


Illustration 41 g01256910

Use Tooling (B) in order to measure the protrusion of the piston (2).

Standard at Assembly

Naturally aspirated engines .... −0.25 to 0.15 mm (−0.0098 to 0.0059 inch)

Turbocharged engines ..... 0.05 to 0.45 mm (0.0020 to 0.0177 inch)

Compressed thickness of cylinder head gasket ..... 1.2 ± 0.05 mm (0.05 ± 0.002 inch)

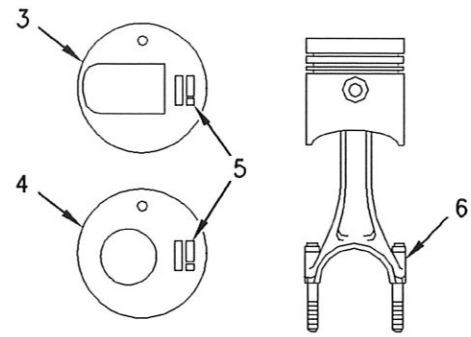


Illustration 42 g00987977

(3) Piston from naturally aspirated engines

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(5) "WEIGHT" mark

(6) "MATCHING" mark

**Note:** Assemble the piston and the connecting rod with the "WEIGHT" mark on the piston and with the "MATCHING" mark on the rod on the same side.

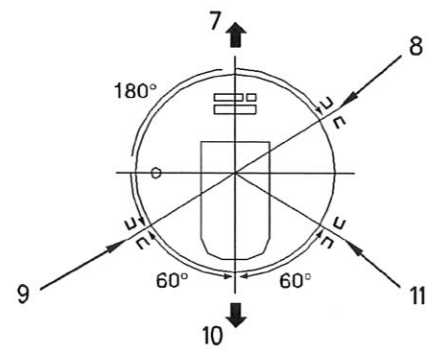


Illustration 43 g00987981

(7) Camshaft side

(8) End gap of No. 1 compression ring

(9) End gap of No. 2 compression ring

(10) Side with the inlet valve

(11) End gap of oil ring

(7) Tighten the locknut for the oil pump gear to the following torque. ..... 28 to 38 N·m (21 to 28 lb ft)

Backlash for gears

Helical gears at assembly ..... 0.03 to 0.18 mm (0.0012 to 0.0071 inch)
Spur gears at assembly ..... .03 to .20 mm (0.0012 to 0.0079 inch)
Service Limit ..... 0.25 mm (0.0098 inch)

## Engines that have a Balancer

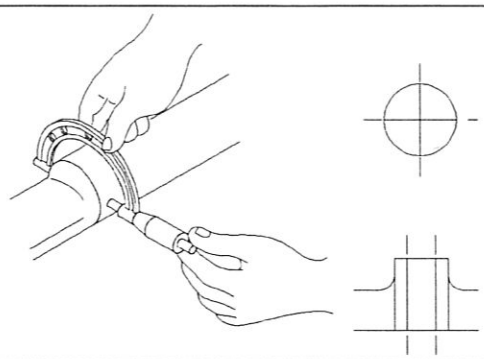

Illustration 47 g01152815

1. Measure the balancer shaft. Refer to illustration 47.

2. For information on the diameter of the balancer shaft, refer to table 14.

Table 14

| Balancer Shaft | |
|---|---|
| Shaft diameter 53.940 to 53.960 mm (2.1236 to 2.1244 inch) | Service limit 53.900 mm (2.1220 inch) |
| Clearance between balancer shaft and the bushing 0.04 to 0.09 mm (0.0016 to 0.0035 inch) | Service limit 0.15 mm (0.0059 inch) |

Backlash for the balancer gears

Backlash between left hand gear and the right hand gear ..... 0.07 to 0.14 mm (0.0028 ± 0.0055 inch)
Service Limit ..... 0.25 mm (0.0098 inch)
Backlash between right hand gear and the crankshaft gear ..... 0.03 to 0.17 mm (0.0012 to 0.0067 inch)
Service Limit ..... 0.25 mm (0.0098 inch)

i01896629

## Flywheel

Flatness of friction surface of the flywheel

Maximum at assembly .... 0.15 mm (0.0059 inch)
Repair limit ..... 0.50 mm (0.020 inch)

Face and bore runout's of flywheel

Maximum at assembly .... 0.15 mm (0.0059 inch)
Repair limit ..... 0.50 mm (0.020 inch)

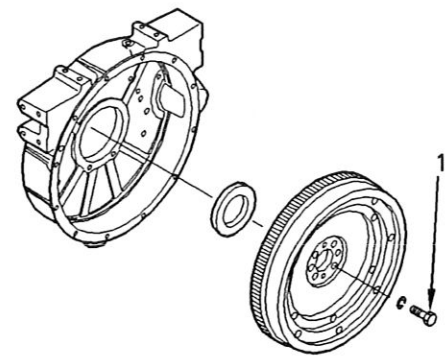


Illustration 48 g00988073

(1) Tighten the bolts for the flywheel to the following torque. ..... 79 to 88 N·m (58 to 65 lb ft)

i02510696

## Crankshaft Pulley

Table 15

| Required Tools | | | |
|---|---|---|---|
| Tool | Part Number | Part Description | Qty |
| A | 21826038 | POWERPART Silicone Sealant | 1 |

(7) Tighten the locknut for the oil pump gear to the following torque. ..... 28 to 38 N·m (21 to 28 lb ft)

Backlash for gears

Helical gears at assembly ..... 0.03 to 0.18 mm (0.0012 to 0.0071 inch)
Spur gears at assembly ..... .03 to .20 mm (0.0012 to 0.0079 inch)
Service Limit ..... 0.25 mm (0.0098 inch)

## Engines that have a Balancer

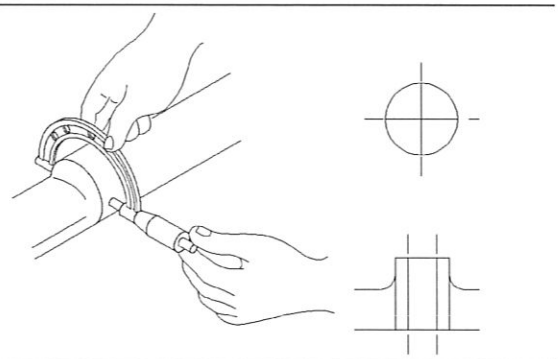

Illustration 47 g01152815

1. Measure the balancer shaft. Refer to illustration 47.

2. For information on the diameter of the balancer shaft, refer to table 14.

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| Balancer Shaft | |
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i01896629

## Flywheel

Flatness of friction surface of the flywheel

Maximum at assembly .... 0.15 mm (0.0059 inch)
Repair limit ..... 0.50 mm (0.020 inch)

Face and bore runout's of flywheel

Maximum at assembly .... 0.15 mm (0.0059 inch)
Repair limit ..... 0.50 mm (0.020 inch)

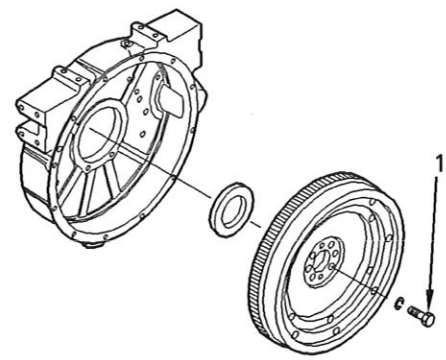


Illustration 48 g00988073

(1) Tighten the bolts for the flywheel to the following torque. ..... 79 to 88 N·m (58 to 65 lb ft)

i02510696

## Crankshaft Pulley

Table 15

| Required Tools | | | |
|---|---|---|---|
| Tool | Part Number | Part Description | Qty |
| A | 21826038 | POWERPART Silicone Sealant | 1 |

Table 16

| Belt Tension Chart | | |
|---|---|---|
| **Belt Type** | **Deflection** | **Applied Force for Specified Deflection** |
| Type B | 10 to 12 mm (0.4 to 0.6 inch) | 98 N (22 lb) |

i02535554

# Alternator and Regulator

**Note:** Apply a suitable Load to the battery in order to get the maximum alternator output.

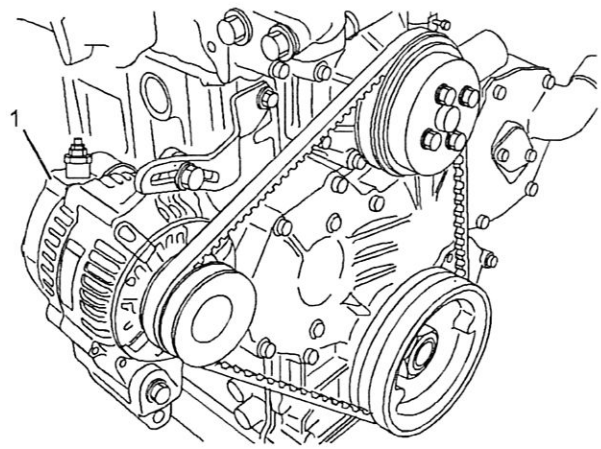


Illustration 51 g01268996

(1) Alternator and regulator

Voltage ..... 13.5 V

Output current at 1500 rpm ..... 20 amp or higher

Output current at 3000 rpm ..... 50 amp or higher

Output current at 5000 rpm ..... 60 amp or higher

Adjusting voltage of the regulator at 5000 rpm with a load of 5 amp or lower ..... 14.2 V to 14.8 V

i02506531

# Electric Starting Motor

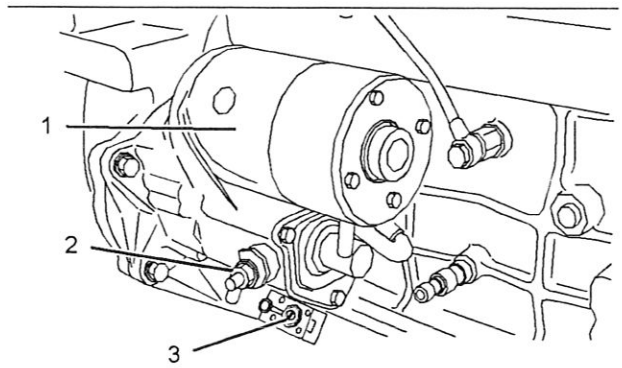


Illustration 52 g01024163

The starting motor

(1) Electric starting motor

(2) Tighten the nut on the starting motor terminal to the following torque. ..... 18 to 25 N·m (13.3 to 18.4 lb ft)

(3) Tighten the starting motor terminal to the following torque. ..... 2.6 to 4.6 N·m (23.0119 to 40.7134 lb in)

No load conditions at 25 °C (77 °F)

Speed ..... 3000 rpm minimum
Current draw ..... 200 amp maximum
Voltage ..... 11 V

When the electric starting motor is viewed from the drive end, the motor rotates in the following direction. ..... Clockwise

Table 16

| Belt Tension Chart | | |
|---|---|---|
| **Belt Type** | **Deflection** | **Applied Force for Specified Deflection** |
| Type B | 10 to 12 mm (0.4 to 0.6 inch) | 98 N (22 lb) |

i02535554

# Alternator and Regulator

**Note:** Apply a suitable Load to the battery in order to get the maximum alternator output.

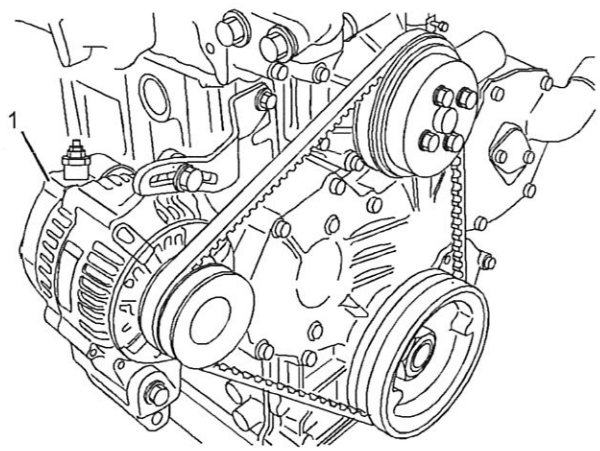


Illustration 51 g01268996

(1) Alternator and regulator

Voltage ..... 13.5 V

Output current at 1500 rpm ..... 20 amp or higher

Output current at 3000 rpm ..... 50 amp or higher

Output current at 5000 rpm ..... 60 amp or higher

Adjusting voltage of the regulator at 5000 rpm with a load of 5 amp or lower ..... 14.2 V to 14.8 V

i02506531

# Electric Starting Motor

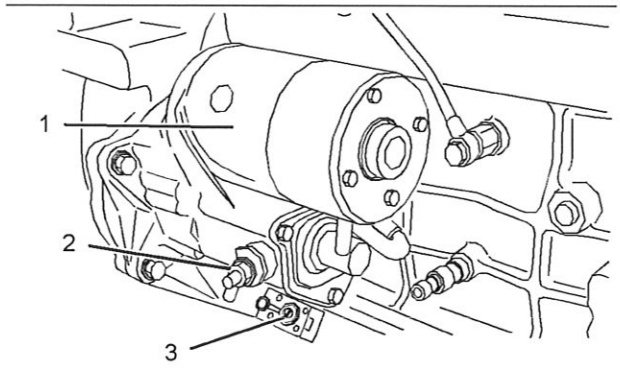


Illustration 52 g01024163

The starting motor

(1) Electric starting motor

(2) Tighten the nut on the starting motor terminal to the following torque. ..... 18 to 25 N·m (13.3 to 18.4 lb ft)

(3) Tighten the starting motor terminal to the following torque. ..... 2.6 to 4.6 N·m (23.0119 to 40.7134 lb in)

No load conditions at 25 °C (77 °F)

Speed ..... 3000 rpm minimum
Current draw ..... 200 amp maximum
Voltage ..... 11 V

When the electric starting motor is viewed from the drive end, the motor rotates in the following direction. ..... Clockwise

# Index

# Index