GROUP 11B

ENGINE OVERHAUL

CONTENTS

SPECIAL TOOLS ...................... 11B-2
GENERATOR AND DRIVE BELT ... 11B-4
  REMOVAL AND INSTALLATION .... 11B-4
INTAKE MANIFOLD PLENUM AND
THROTTLE BODY ASSEMBLY .... 11B-6
  INTAKE MANIFOLD PLENUM REMOVAL AND
  INSTALLATION .................... 11B-6
IGNITION SYSTEM ............... 11B-8
  REMOVAL AND INSTALLATION .... 11B-8
TIMING BELT ...................... 11B-10
  REMOVAL AND INSTALLATION .... 11B-10
  INSPECTION ...................... 11B-15
INTAKE MANIFOLD AND FUEL
PARTS ............................ 11B-17
  REMOVAL AND INSTALLATION .... 11B-17
EXHAUST MANIFOLD ............. 11B-21
  REMOVAL AND INSTALLATION .... 11B-21
ROCKER ARMS AND CAMSHAFT .. 11B-22
  REMOVAL AND INSTALLATION .... 11B-22
  INSPECTION ...................... 11B-24
CYLINDER HEAD AND VALVES .... 11B-28
  REMOVAL AND INSTALLATION .... 11B-28
  INSPECTION ...................... 11B-31
OIL PAN AND OIL PUMP ......... 11B-35
  REMOVAL AND INSTALLATION .... 11B-35
  INSPECTION ...................... 11B-39
PISTON AND CONNECTING ROD .. 11B-40
  REMOVAL AND INSTALLATION .... 11B-40
  INSPECTION ...................... 11B-46
CRANKSHAFT AND CYLINDER
BLOCK ........................... 11B-48
  REMOVAL AND INSTALLATION .... 11B-48
  INSPECTION ...................... 11B-52
BRACKET .......................... 11B-54
  REMOVAL AND INSTALLATION .... 11B-54
SPECIFICATIONS ................ 11B-55
  FASTENER TIGHTENING
  SPECIFICATIONS .................. 11B-55
  GENERAL SPECIFICATIONS ....... 11B-57
  SERVICE SPECIFICATIONS ....... 11B-58
  SEALANTS AND ADHESIVES ....... 11B-60
## SPECIAL TOOLS

<table>
<thead>
<tr>
<th>TOOL</th>
<th>TOOL NUMBER AND NAME</th>
<th>SUPERSESSION</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flywheel stopper</td>
<td>MD998781</td>
<td>General service tool</td>
<td>Loosening and tightening crankshaft bolts</td>
</tr>
<tr>
<td>End yoke holder Use with MD998715</td>
<td>MB990767</td>
<td>MB990767-01</td>
<td>Holding camshaft sprocket when loosening or torquing bolt.</td>
</tr>
<tr>
<td>Pin</td>
<td>MD998715</td>
<td>MIT308239</td>
<td></td>
</tr>
<tr>
<td>Crankshaft spacer</td>
<td>MD998769</td>
<td>General service tool</td>
<td>Rotation of crankshaft when installing piston and timing belt</td>
</tr>
<tr>
<td>Tensioner wrench</td>
<td>MD998767</td>
<td>MD998752-01</td>
<td>Adjustment of timing belt tension</td>
</tr>
<tr>
<td>Lash adjuster holder (8)</td>
<td>MD998443</td>
<td>MD998443-01</td>
<td>Supporting of the lash adjuster to prevent it from falling when rocker shaft assembly is removed or installed</td>
</tr>
<tr>
<td>Camshaft oil seal installer</td>
<td>MD998713</td>
<td>MD998713-01</td>
<td>Installation of camshaft oil seal</td>
</tr>
<tr>
<td>Camshaft oil seal installer adaptor</td>
<td>MB991559</td>
<td>–</td>
<td>Installation of camshaft oil seal (left bank) (use with MD998713)</td>
</tr>
<tr>
<td>TOOL</td>
<td>TOOL NUMBER AND NAME</td>
<td>SUPERSESSION</td>
<td>APPLICATION</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------------</td>
<td>----------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td></td>
<td>MD998442 Air bleed wire</td>
<td>General service tool</td>
<td>Air bleeding of auto lash adjuster</td>
</tr>
<tr>
<td></td>
<td>MD998051 Cylinder head bolt wrench</td>
<td>MD998051-01 or</td>
<td>Loosening and tightening cylinder</td>
</tr>
<tr>
<td></td>
<td></td>
<td>General service tool</td>
<td>head bolts</td>
</tr>
<tr>
<td></td>
<td>MD998772 Valve spring compressor</td>
<td>General service tool</td>
<td>Compression of valve spring</td>
</tr>
<tr>
<td></td>
<td>MD998774 Valve stem seal installer</td>
<td>MD998774-01</td>
<td>Installation of valve stem seal</td>
</tr>
<tr>
<td></td>
<td>MD998717 Crankshaft front oil seal installer</td>
<td>MD998717-01</td>
<td>Installation of crankshaft front oil seal</td>
</tr>
<tr>
<td></td>
<td>MD998718 Crankshaft rear oil seal installer</td>
<td>MD998718-01</td>
<td>Installation of crankshaft rear oil seal</td>
</tr>
</tbody>
</table>
**REMOVAL STEPS**

1. COOLING FAN
2. FAN CLUTCH
3. COOLING FAN BRACKET
4. COOLING FAN PULLEY
5. IDLER PULLEY
6. IDLER PULLEY
7. AUTO TENSIONER
8. GENERATOR

**REMOVAL STEPS (Continued)**

9. ACCESSORY MOUNT STAY
10. TIMING INDICATOR BRACKET
11. ACCESSORY MOUNT
12. POWER STEERING PUMP BRACKET
13. CRANKSHAFT BOLT
14. CRANKSHAFT PULLEY WASHER
15. DAMPER PULLEY

---

**Required Special Tool:**

- MD998781: Flywheel Stopper
REMOVAL SERVICE POINT

<<A>> CRANKSHAFT BOLT LOOSENING
1. Using special tool MD998781, hold the drive plate or flywheel.
2. Remove the crankshaft bolt.

INSTALLATION SERVICE POINT

>>A<< CRANKSHAFT BOLT TIGHTENING
1. Using special tool MD998781, hold the drive plate or flywheel.
2. Clean the bolt hole in crankshaft bolt and damper pulley’s seating surface.
3. Degrease the cleaned seating surface of the damper pulley.
4. Install the damper pulley.
5. Apply oil to the threads of crankshaft bolt and the outer surface of washer.
6. Tighten the crankshaft bolt to the specified torque.
   
   **Tightening torque: 185 ± 5 N·m (137 ± 3 ft-lb)**
REMOVAL STEPS
1. VACUUM HOSE
2. VACUUM HOSE
3. VACUUM TANK
4. SOLENOID VALVE
5. PURGE HOSE
6. SOLENOID VALVE
7. FUEL HOSE
8. FUEL RETURN PIPE
9. BREATHER HOSE
10. BREATHER HOSE
11. VACUUM PIPE AND HOSE
12. BREATHER AND WATER HOSE

REMOVAL STEPS (Continued)
13. EXHAUST GAS RECIRCULATION VALVE
14. EXHAUST GAS RECIRCULATION VALVE GASKET
15. MANIFOLD DIFFERENTIAL PRESSURE SENSOR
16. O-RING
17. EXHAUST GAS RECIRCULATION PIPE
18. EXHAUST GAS RECIRCULATION PIPE GASKET
19. INTAKE MANIFOLD PLENUM STAY
20. WATER OUTLET FITTING BRACKET
REMOVAL STEPS (Continued)
21. PURGE HOSE BRACKET
22. THROTTLE BODY
23. THROTTLE BODY GASKET
24. INTAKE MANIFOLD PLENUM
25. INTAKE MANIFOLD PLENUM VALVE GASKET
26. INTAKE MANIFOLD PLENUM VALVE ASSEMBLY
27. INTAKE MANIFOLD PLENUM GASKET

INSTALLATION SERVICE POINT

THROTTLE BODY GASKET INSTALLATION
Install the gasket so that the tab is positioned as shown in the illustration.

[Diagram of throttle body gasket installation]
IGNITION SYSTEM
REMOVAL AND INSTALLATION

REMOVAL STEPS
1. SPARK PLUG CABLES
2. IGNITION COIL
3. SPARK PLUGS
4. SPARK PLUG CABLE SUPPORT
5. SPARK PLUG CABLE SUPPORT
6. SPARK PLUG CABLE SUPPORT

REMOVAL STEPS (Continued)
7. CAMSHAFT POSITION SENSOR
8. O-RING
9. CAMSHAFT POSITION SENSOR SUPPORT
10. CAMSHAFT POSITION SENSING CYLINDER

TSB Revision
REMOVAL SERVICE POINT

<<A>> CAMSHAFT POSITION SENSING CYLINDER REMOVAL
1. Using special tool MD998781, hold the drive plate or flywheel.
2. Loosen the camshaft position sensing cylinder bolt.

INSTALLATION SERVICE POINT

>>A<< CAMSHAFT POSITION SENSING CYLINDER INSTALLATION
1. Using special tool MD998781, hold the drive plate or flywheel.
2. Tighten the camshaft position sensing cylinder bolt to the specified torque.
   
   **Tightening torque: 22 ± 4 N·m (16 ± 3 ft-lb)**

>>B<< CAMSHAFT POSITION SENSOR SUPPORT INSTALLATION

Apply a 3 mm (0.12 inch) diameter bead of sealant Mitsubishi Genuine Parts number MD970389, or equivalent to the camshaft position sensor support.
TIMING BELT

REMOVAL AND INSTALLATION

 Required Special Tool:
• MB990767: End Yoke Holder
• MD998767: Tensioner Pulley Wrench
• MD998769: Crankshaft Spacer
• MD998715: Pins

REMOVAL STEPS
1. TIMING BELT FRONT UPPER COVER, RIGHT
2. TIMING BELT FRONT UPPER COVER, LEFT
3. TIMING BELT FRONT LOWER COVER
4. TIMING BELT
5. CRANKSHAFT POSITION SENSOR
6. AUTO-TENSIONER
7. TENSIONER PULLEY

REMOVAL STEPS (Continued)
8. TENSIONER ARM
9. SHAFT
10. IDLER PULLEY
11. IDLER PULLEY SPACER
12. CRANKSHAFT SPROCKET
13. CRANKSHAFT SENSING BLADE
14. CRANKSHAFT SPACER
15. CAMSHAFT SPROCKET BOLT
16. CAMSHAFT SPROCKET
17. TIMING BELT REAR COVER

AK201074 AB
REMOVAL SERVICE POINTS

<<A>> TIMING BELT REMOVAL

⚠️ CAUTION

Water or oil on the belt shortens its life drastically, so the removed timing belt, sprocket, and tensioner must be kept free from oil and water. Do not immerse parts in cleaning solvent.

Mark the belt running direction for reference in reinstallation.

NOTE: If there is oil or water on any part, check the front case oil seal, camshaft oil seal, and water pump for leaks.

<<B>> CAMSHAFT SPROCKET BOLT REMOVAL

Use special tools MB990767 and MD998715 to prevent the camshaft sprocket from turning, and then loosen the camshaft sprocket bolt.

INSTALLATION SERVICE POINTS

>>A<< CAMSHAFT SPROCKET BOLT INSTALLATION

Use special tools MB990767 and MB998715 to prevent the camshaft sprocket from turning, and then tighten the camshaft sprocket bolt.

Tightening torque: 88 ± 10 N·m (65 ± 7 ft·lb)
>>B<< CRANKSHAFT SENSING BLADE/CRANKSHAFT SPACER/CRANKSHAFT SPROCKET INSTALLATION
1. Clean the hole in the crankshaft sprocket.
2. Clean and degrease the mating surfaces of the crankshaft sprocket; sensing blade; and spacer.

*NOTE: Degreasing is necessary to prevent decrease in friction between the mating surface due to presence of oil.*

>>C<< AUTO-TENSIONER INSTALLATION
If the auto-tensioner rod is fully extended, set it in the retracted position with the following procedure.
1. Set the auto-tensioner in a vice.
2. Slowly close the vice to force the rod in until the set hole (A) of the rod is lined up with the set hole (B) of the cylinder.
3. Insert a wire [1.4 mm (0.06 inch) in diameter] into the set holes.
4. Remove the auto-tensioner from the vice.

>>D<< TIMING BELT INSTALLATION

**CAUTION**
If the camshaft sprocket is rotated with the piston at the top dead center on the compression stroke of the number 1 cylinder, the valve and piston might interfere.
1. Move the timing mark of the crankshaft sprocket three teeth to slightly lower the piston below the top dead center on the compression stroke of the number 1 cylinder.
2. Line up the timing marks of the left bank camshaft sprockets.
3. Line up the timing marks of the right bank camshaft sprockets.

4. Line up the timing marks of the crankshaft sprockets.
5. Install the timing belt on each sprocket in the following sequence.
   (1) Install the timing belt on the crankshaft sprocket and then on the idler pulley, while tightening it to prevent slackness.
   (2) Line up the timing marks of the left bank camshaft sprockets.
   (3) Install the timing belt on the water pump pulley, while taking up the slack.
   (4) Install the timing belt on the right bank camshaft sprocket.
   (5) Install the timing belt on the tensioner pulley.
6. Lightly press the tensioner pulley against the belt and temporarily tighten the center bolt.
7. Check to see that the timing marks of all the sprockets are in alignment.

8. Using special tool MD998769, rotate the crankshaft a quarter of a turn counterclockwise. Then rotate it back clockwise to verify that all the timing marks are in alignment.
9. Mount special tool MD998767 and torque wrench on the tensioner pulley.

10. Torque it to 4.4 N·m (39 in-lb) with the torque wrench.

11. While holding the tensioner pulley in position, tighten the center bolt to the specified torque.

   **Tightening torque: 48 ± 6 N·m (35 ± 4 ft-lb)**

12. Rotate the crankshaft two turns clockwise and leave it alone for approximately five minutes.
13. Check to see whether the metal wire inserted when the auto-tensioner was installed can be removed without any resistance.

If the metal wire can be removed without any resistance, it means that the belt has a proper tension. Therefore, remove the metal wire. In this condition, check that the projection of the rod of the auto-tensioner is within the standard value.

**Standard value:** $4.8 - 5.5$ mm ($0.19 - 0.21$ inch)

14. If the metal wire offers resistance when removed, repeat the previous steps (9) through (12) until a proper belt tension is obtained.

**INSPECTION**

**TIMING BELT**

Replace the belt if any of the following conditions exist.

1. Hardening of rubber backing.
   
   Back side is glossy without resilience and leaves no indent when pressed with fingernail.

2. Cracks on rubber back
3. Cracks or peeling of canvas
4. Cracks on tooth bottom
5. Cracks on belt

6. Abnormal wear of belt sides. Normal wear is indicated if the sides are sharp as if cut by a knife. Abnormal wear is indicated if the sides are ragged.
7. Abnormal wear on teeth.
8. Missing tooth.

**TENSIONER PULLEY AND IDLER PULLEY**

Turn the pulley. If it does not rotate smoothly, or develops noise or excessive play, replace the pulley.

**AUTO-TENSIONER**

1. Check for oil leaks. If oil leaks are evident, replace the auto-tensioner.
2. Check the rod end for wear or damage and replace the auto-tensioner if necessary.
3. Measure the rod protrusion. If it is out of specification, replace the auto-tensioner.
   
   **Standard value:** 12 mm (0.5 inch)

4. Press the rod with a force of 98 to 196 N (22 to 44 pounds) and measure the movement of the rod.

   If the measured value is out of the standard value, replace the auto-tensioner.
   
   **Standard value:** 1.0 mm (0.03 inch) or less
REMOVAL STEPS

>>G<< 1. ENGINE COOLANT TEMPERATURE GAUGE UNIT
2. ENGINE COOLANT TEMPERATURE SENSOR
3. WATER OUTLET FITTING
4. WATER OUTLET FITTING GASKET
5. BLOW-BY HOSE
6. WATER OUTLET PIPE
7. O-RING
8. WATER HOSE
9. WATER INLET FITTING

>>F<< 10. THERMOSTAT
11. THERMOSTAT CASE
12. THERMOSTAT CASE GASKET
13. FITTING
14. FITTING GASKET
15. WATER HOSE
16. WATER PASSAGE
17. WATER PASSAGE GASKET
18. WATER HOSE

>>D<< 19. WATER PIPE
20. O-RING

REMOVAL STEPS (Continued)
REMOVAL STEPS

21. INJECTOR HARNESS
22. INJECTOR AND FUEL RAIL
23. INSULATOR

>>C<<
24. FUEL PRESSURE REGULATOR
25. O-RING
26. INSULATOR

>>B<< 27. INJECTOR

REMOVAL STEPS (Continued)

28. O-RING
29. GROMMET
30. FUEL PIPE
31. O-RING
32. FUEL RAIL

>>A<< 33. INTAKE MANIFOLD
34. INTAKE MANIFOLD GASKET
INSTALLATION SERVICE POINTS

>>A<< INTAKE MANIFOLD INSTALLATION
1. Tighten the nuts on the right bank to 6.4 N·m (56 in-lb).
2. Tighten the nuts on the left bank to the specified torque.
   
   Tightening torque: 22 ± 1 N·m (16 ± 1 ft-lb)

3. Tighten the nuts on the right bank to the specified torque.
   
   Tightening torque: 22 ± 1 N·m (16 ± 1 ft-lb)

4. Tighten the nuts on the left bank and those on the right bank again in that order.
   
   Tightening torque: 22 ± 1 N·m (16 ± 1 ft-lb)

>>B<< INJECTOR INSTALLATION

⚠️ CAUTION
Use care not to let engine oil enter the fuel rail.

1. Before installing the pressure regulator, lubricate the O-ring with a drop of new engine oil for easy installation.

2. Insert the injector top end into the fuel rail. Be careful not to damage the O-ring during installation.

>>C<< FUEL PRESSURE REGULATOR INSTALLATION

⚠️ CAUTION
Do not let engine oil enter the fuel rail.

Before installing the pressure regulator, lubricate the O-ring with a drop of new engine oil for easy installation.

>>D<< O-RING AND WATER PIPE INSTALLATION

⚠️ CAUTION
Keep the O-ring free of oil or grease.

Wet the O-ring (with water) to ease assembly.
>>E<< THERMOSTAT INSTALLATION
Install the thermostat in the thermostat case with its jiggle valve located at the top position.

>>F<< SEALANT APPLICATION TO ENGINE COOLANT TEMPERATURE SENSOR
Apply 3M™ AAD Part number 8731 or equivalent to the engine coolant temperature sensor.

>>G<< SEALANT APPLICATION TO ENGINE COOLANT TEMPERATURE GAUGE UNIT
Apply 3M™ AAD Part number 8672 or equivalent to the engine coolant temperature gauge unit.
REMOVAL STEPS
1. OIL DIPSTICK
2. O-RING
3. OIL DIPSTICK GUIDE
4. O-RING
5. ENGINE HANGER
6. HEAT PROCTOR, RIGHT
7. EXHAUST MANIFOLD, RIGHT

REMOVAL STEPS (Continued)
8. EXHAUST MANIFOLD GASKET
9. HEAT PROCTOR, LEFT
10. EXHAUST MANIFOLD, LEFT
11. EXHAUST MANIFOLD GASKET
12. WATER PUMP
13. WATER PUMP GASKET
REMOVAL STEPS
1. OIL FILLER CAP
2. PCV VALVE
3. PCV VALVE GASKET
4. ROCKER COVER
5. ROCKER COVER GASKET
6. OIL SEAL
7. CAMSHAFT OIL SEAL
8. ROCKER ARMS AND SHAFT
9. ROCKER ARMS AND SHAFT
10. ROCKER ARM A

REMOVAL STEPS (Continued)
11. ROCKER ARM B
12. ROCKER ARM SHAFT
13. LASH ADJUSTER
14. ROCKER ARM C
15. ROCKER ARM SHAFT
16. LASH ADJUSTER
17. THRUST CASE
18. O-RING (RIGHT BANK ONLY)
19. CAMSHAFT

APPLY ENGINE OIL TO ALL MOVING PARTS BEFORE INSTALLATION.
Required Special Tools:
- MB991559: Camshaft Oil Seal Installer Adapter
- MD998442: Air Bleed Wire
- MD998443: Lash Adjuster Holder
- MD998713: Camshaft Oil Seal Installer

REMOVAL SERVICE POINT

<<A>> ROCKER ARMS AND SHAFT REMOVAL

**CAUTION**
If the lash adjuster is re-used, clean the lash adjuster.
(Refer to lash adjuster inspection P.11B-24.)
Set special tool MB998443 to prevent the lash adjuster coming free and falling to the floor.

INSTALLATION SERVICE POINTS

>>A<< CAMSHAFT INSTALLATION

**CAUTION**
Use care to prevent confusion of the right and left bank camshafts.

1. Apply engine oil to the camshaft journals and cams and then install the camshafts.

   *NOTE: The right bank camshaft is identified by a slit 4 mm (0.16 inch) wide at the rear end of the camshaft.*

2. Check to see that the dowel pin of the camshaft is located at the position shown.
>>B<< LASH ADJUSTER INSTALLATION

**CAUTION**
If the lash adjuster is re-used, clean the lash adjuster.
(Refer to lash adjuster inspection P.11B-24.)
Fit the lash adjuster onto the rocker arm without allowing diesel fuel to spill out. Fit special tool MD998443 to prevent the lash adjuster coming free and falling to the floor.

>>C<< CAMSHAFT OIL SEAL INSTALLATION
Use special tools MD998713 and MB991559 to install the camshaft oil seal.

INSPECTION

ROCKER ARM SHAFT
Check the rocker arm mounting areas of the rocker arm shafts for wear or damage. Replace as necessary.
ROCKER ARM
1. Check the roller surface and replace the rocker arm if recesses, damage or heat seizure is observed.
2. Check roller rotation and replace the rocker arm if uneven rotation or roller backlash of the roller is observed.
3. Check the inside diameter and replace the rocker arm if damage or seizure is observed.

CAMSHAFT
1. Check the camshaft bearing journals for damage and binding. If the journals are binding, check the cylinder head for damage. Also check the cylinder head for clogged oil holes.
2. Check the tooth surface of the distributor drive gear teeth of the camshaft and replace if abnormal wear is evident.
3. Check the cam surface for abnormal wear and damage and replace if necessary. Also measure the cam height and replace if out of minimum limit.

   Standard value:
   Intake 37.39 mm (1.472 inches)
   Exhaust 37.14 mm (1.462 inches)
   Minimum limit:
   Intake 36.89 mm (1.452 inches)
   Exhaust 36.64 mm (1.443 inches)

LASH ADJUSTERS

CAUTION
- The lash adjusters are precision-engineered mechanisms. Do not allow them to become contaminated by dirt or other foreign substances.
- Do not attempt to disassemble the lash adjusters.
- Use only fresh diesel fuel to clean the lash adjusters.

1. Prepare three containers and approximately 5 dm³ (30.5 quart) of diesel fuel. Into each container, pour enough diesel fuel to completely cover a lash adjuster when it is standing upright. Then, perform the following steps with each lash adjuster.
2. Place the lash adjuster in container A and clean its outside surface.  

   *NOTE:* Use a nylon brush if deposits are hard to remove.

   **CAUTION**
   The steel ball spring is extremely weak, so the lash adjuster's functionality may be lost if the air bleed wire is pushed in hard.

3. While gently pushing down the internal steel ball using wire [0.5 mm (0.020 inch) in diameter] or special tool MD998442, move the plunger through five to ten strokes until it slides smoothly. In addition to eliminating stiffness in the plunger, this operation will remove dirty oil.  
   
   *NOTE:* If the plunger remains stiff or the mechanism appears otherwise abnormal, replace the lash adjuster.

4. Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.

   **CAUTION**
   The steel ball spring is extremely weak, so the lash adjuster's functionality may be lost if the air bleed wire is pushed in hard.

5. Place the lash adjuster in container B. Then, gently push down the internal steel ball using a wire [0.5 mm (0.020 inch) in diameter] or special tool MD998442 and move the plunger through five to ten strokes until it slides smoothly. This operation will clean the lash adjuster's pressure chamber.

6. Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.
CAUTION
Do not use container C for cleaning. If cleaning is performed in container C, foreign matter could enter the pressure chamber when the chamber is filled with diesel fuel.

7. Place the lash adjuster in container C. Then, gently push down the internal steel ball using a wire [0.5 mm (0.020 inch) in diameter] or special tool MD998442.

8. Stand the lash adjuster with its plunger at the top, then push the plunger downward firmly until it moves through its greatest possible stroke. Return the plunger slowly, then release the steel ball and allow the pressure chamber to fill with diesel fuel.

9. Remove the lash adjuster from the container, then stand the lash adjuster with its plunger at the top. Push the plunger firmly and check that it does not move.

NOTE: If the lash adjuster contracts or moves, perform the operations (7) through (9) again to fill it with diesel fuel completely. Replace the lash adjuster if it still contracts or moves after performing these steps.

10. Stand the lash adjuster upright to prevent diesel fuel from spilling out. Do not allow the lash adjuster to become contaminated by dirt or other foreign matter. Fit the lash adjuster onto the engine as soon as possible.
APPLY ENGINE OIL TO ALL MOVING PARTS BEFORE INSTALLATION.

REMOVAL STEPS

<<A>>  
1. CYLINDER HEAD BOLT
2. WASHER
3. CYLINDER HEAD ASSEMBLY
4. CYLINDER HEAD GASKET

<<B>>  
5. RETAINER LOCK
6. VALVE SPRING RETAINER

>>B<<  
7. VALVE SPRING
8. INLET VALVE
9. RETAINER LOCK
10. VALVE SPRING RETAINER

>>B<<  
11. VALVE SPRING

REMOVAL STEPS (Continued)

>>A<<  
12. EXHAUST VALVE
13. VALVE STEM SEAL
14. VALVE SPRING SEAT

>>A<<  
15. VALVE STEM SEAL
16. VALVE SPRING SEAT
17. INLET VALVE GUIDE
18. SNAP RING
19. EXHAUST VALVE GUIDE
20. INLET VALVE SEAT
21. EXHAUST VALVE SEAT
22. CYLINDER HEAD
Required Special Tools:
- MD998051: Cylinder Head Bolt Wrench
- MD998772: Valve Spring Compressor
- MD998774: Valve Stem Seal Installer

REMOVAL SERVICE POINTS

<<A>> CYLINDER HEAD BOLT REMOVAL
Use special tool MD998051 to loosen the cylinder head bolt.

<<B>> RETAINER LOCK REMOVAL
1. Using special tool MD998772, compress the spring.
2. Remove the retainer locks.

INSTALLATION SERVICE POINTS

>>A<< VALVE STEM SEAL INSTALLATION
1. Install the valve spring seat.

\[\text{CAUTION}\]
- Valve stem seals for intake valves and for exhaust valves are different. Be sure to install the correct ones.
- Valve stem seal identification color
  - Intake: GRAY
  - Exhaust: GRAY GREEN
**CAUTION**
Always use the special tool to install the valve stem seal. Improperly installed valve stem seals may leak oil.
2. Using special tool MD998774, install a new stem seal to the valve guide.

**>>B<< VALVE SPRING INSTALLATION**
Install the valve spring end with its identification color toward the spring retainer.

**>>C<< RETAINER LOCK INSTALLATION**
Using special tool MD998772, compress the valve spring and insert the retainer lock into position.
>>D<< CYLINDER HEAD BOLT INSTALLATION

**CAUTION**

Attach the head bolt washer in the direction shown in the figure.

1. Tighten the bolts in two three stages in the illustrated sequence.

   **Tightening torque:** 108 ± 5 N·m (80 ± 4 ft-lb)

2. Back off the bolts once and tighten them to the specified torque in the same procedure as shown in step (1).

---

**INSPECTION**

**CYLINDER HEAD**

1. Check the cylinder head gasket surface for flatness by using a straightedge in the directions of A through G shown in the illustration.

   **Standard value:** 0.03 mm (0.0012 inch)
   **Limit:** 0.2 mm (0.007 inch)

2. If the service limit is exceeded, correct to meet the specification.

   **Grinding limit:** *0.2 mm (0.007 inch)*

3. *If the service limit is exceeded, correct to meet the specification.

   **Cylinder head height (specification when new):**
   120 mm (4.7 inches)
VALVE
1. Check the valve face for correct contact. If incorrect, reface using a valve refacer. The valve should make a uniform contact with the seat at the center of the valve face.

2. If the margin exceeds the service minimum limit, replace the valve.
   - **Standard value:**
     - **Intake** 1.0 mm (0.04 inch)
     - **Exhaust** 1.2 mm (0.05 inch)
   - **Minimum limit:**
     - **Intake** 0.5 mm (0.02 inch)
     - **Exhaust** 0.7 mm (0.03 inch)

3. Measure the valve's total length. If the measurement is less than specified, replace the valve.
   - **Standard value:**
     - **Intake** 110.30 mm (4.343 inches)
     - **Exhaust** 114.11 mm (4.493 inches)
   - **Minimum limit:**
     - **Intake** 109.80 mm (4.323 inches)
     - **Exhaust** 113.61 mm (4.473 inches)

VALVE SPRINGS
1. Measure the free height of the spring and, if it is smaller than the minimum limit, replace the spring.
   - **Standard value:** 51.0 mm (2.01 inches)
   - **Minimum limit:** 50.0 mm (1.97 inches)

2. Measure the squareness of the spring and, if the limit is exceeded, replace the spring.
   - **Standard value:** 2° or less
   - **Limit:** 4°

VALVE GUIDES
Measure the clearance between the valve guide and valve stem. If the limit is exceeded, replace the valve guide, valve, or both.

- **Standard value:**
  - **Intake** 0.02 – 0.05 mm (0.0008 – 0.0019 inch)
  - **Exhaust** 0.04 – 0.07 mm (0.0016 – 0.0027 inch)
- **Limit:**
  - **Intake** 0.10 mm (0.003 inch)
  - **Exhaust** 0.15 mm (0.005 inch)
VALVE SEAT
Assemble the valve, then measure the valve stem projection between the end of the valve stem and the spring seating surface. If the measurement exceeds the specified limit, replace the valve seat.

**Standard value:**
- **Intake** 48.30 mm (1.9021 inches)
- **Exhaust** 51.71 mm (2.039 inches)

**Limit:**
- **Intake** 48.80 mm (1.921 inches)
- **Exhaust** 52.01 mm (2.048 inches)

### VALVE SEAT RECONDITIONING PROCEDURE

**CAUTION**
Before correcting the valve seat, check for the clearance between the valve guide and valve and, if necessary, replace the valve guide.

1. Using the special tool or a seat grinder, correct to obtain the specified seat width and angle.
2. After correcting the valve seat, lap the valve and valve seat using lapping compound. Then, check the valve stem projection.

### VALVE SEAT REPLACEMENT PROCEDURE

**CAUTION**
Before replacing the valve seat, check the valve guide and, if necessary, replace the valve guide.

1. Cut the valve seat from the inside to thin the wall thickness. Then, remove the valve seat.
2. Rebore the valve seat hole in the cylinder head to a selected oversize valve seat diameter.

**Seat ring hole diameter:**
- **Intake valve**
  - 0.3 oversize 37.80 – 37.83 mm (1.4882 – 1.4894 inches)
  - 0.6 oversize 38.10 – 38.13 mm (1.5000 – 1.5012 inches)
- **Exhaust valve**
  - 0.3 oversize 34.80 – 34.83 mm (1.3701 – 1.3713 inches)
  - 0.6 oversize 35.10 – 35.13 mm (1.3819 – 1.3831 inches)
3. Before fitting the valve seat, either heat the cylinder head up to approximately 250°C (482°F) or cool the valve seat in liquid nitrogen, to prevent the cylinder head bore from galling.
4. Using a valve seat cutter, correct the valve seat to the specified width and angle. Using a valve seat cutter, correct the valve seat to the specified width and angle. See "VALVE SEAT RECONDITIONING PROCEDURE" on the previous page.

VALVE GUIDE REPLACEMENT PROCEDURE
1. Remove the snap ring from the exhaust valve guide.
2. Using a press, remove the valve guide toward the cylinder head gasket surface.
   
   **CAUTION**
   Do not install a valve guide of the same size again.
3. Re bore the valve guide hole of the cylinder head so that it fits the press-fitted oversize valve guide.
   
   **Valve guide hole diameter:**
   0.05 oversize 11.05 – 11.07 mm (0.4350 – 0.4358 inch)
   0.25 oversize 11.25 – 11.27 mm (0.4429 – 0.4457 inch)
   0.50 oversize 11.50 – 11.52 mm (0.4528 – 0.4535 inch)
4. Install the new snap ring into the groove of exhaust valve guide.
5. Press-fit the valve guide until it protrudes 14 mm (0.55 inch) from the cylinder head top surface as shown in the illustration.

**NOTE:** When press-fitting the valve guide, work from the cylinder head top surface.

**NOTE:** After installing the valve guides, insert new valves in them to check for sliding condition.
REMOVAL STEPS

>>F<< 1. ENGINE OIL PRESSURE SWITCH
2. OIL COOLER BY-PASS VALVE
>>E<< 3. OIL FILTER
4. OIL FILTER BRACKET
5. OIL FILTER BRACKET GASKET
6. DRAIN PLUG
>>D<< 7. DRAIN PLUG GASKET
8. COVER
<<A>> >>C<< 9. OIL PAN
10. BAFFLE PLATE
11. OIL SCREEN

REMOVAL STEPS (Continued)

12. OIL SCREEN GASKET
13. RELIEF PLUG
14. RELIEF SPRING
15. RELIEF PLUNGER
>>B<< 16. CRANKSHAFT OIL SEAL
17. OIL PUMP CASE
18. OIL PUMP CASE GASKET
19. OIL PUMP COVER
<<B>> >>A<< 20. OIL PUMP OUTER ROTOR
<<B>> >>A<< 21. OIL PUMP INNER ROTOR

Required Special Tool

- MD998717: Crankshaft Front Oil Seal Installer
REMOVAL SERVICE POINTS

<<A>> OIL PAN REMOVAL
1. Remove the bolts A shown in the illustration first.
2. Remove all other bolts.

⚠️ CAUTION
Do not use a scraper or special tool to remove the oil pan.
3. Remove the oil pan.
4. Thread the bolt into the illustrated bolt hole to remove the oil pan.

<<B>> OUTER ROTOR/INNER ROTOR REMOVAL
Make alignment dots on the outer and inner rotors for assembly.

INSTALLATION SERVICE POINTS

>>A<< INNER ROTOR/OUTER ROTOR INSTALLATION
Apply engine oil to the rotors. Then, install the rotors ensuring that the alignment dots made at disassembly are properly aligned.
>>B<< CRANKSHAFT OIL SEAL INSTALLATION
1. Install the guide of special tool MD998717 to the front end of the crankshaft.
2. Apply engine oil to the lip area of a new oil seal and push it in until it contacts the oil pump case.
3. Using special tool MD998717, press-fit the oil seal into the oil pump case.

>>C<< OIL PAN INSTALLATION
1. Clean the gasket surfaces of the cylinder block and upper oil pan.
2. Apply a 4 mm (0.2 inch) diameter bead of sealant Mitsubishi Genuine Parts number MD970389, or equivalent to the oil pan. Be sure to install the oil pan quickly while the sealant is wet (within 15 minutes).

CAUTION
When installing the upper oil pan, be sure not to expel the sealant from the oil pan flange at portion A in the illustration.
3. Tighten the upper oil pan bolts in the sequence shown. **Tightening torque: 9 ± 3 N·m (80 ± 26 in-lb)**
4. After installation, keep the sealed area away from the oil and coolant for approximately one hour.
**CAUTION**
If the gasket is installed in the wrong direction, oil leaks will be occurred.
Install the drain plug gasket as illustrated.

**>>E<< OIL FILTER INSTALLATION**
1. Clean the installation surface of the filter bracket.
2. Apply engine oil to the O-ring of the oil filter.
3. Screw the oil filter on until the O-ring contacts the bracket.
   Then tighten 3/4 turn [14 ±1 N·m (124 ± 9 in-lb)]

**>>F<< SEALANT APPLICATION TO ENGINE OIL**
**CAUTION**
Keep the end of threaded portion clear of sealant. Avoid an overtightening.
Apply 3M™ ATD Part number 8672 or equivalent to the engine oil pressure switch.
INSPECTION

OIL PUMP
1. Check the tip clearance.
   Standard value: 0.06 – 0.18 mm (0.003 – 0.007 inch)

2. Check the side clearance.
   Standard value: 0.04 – 0.10 mm (0.002 – 0.003 inch)

3. Check the body clearance.
   Standard value: 0.10 – 0.18 mm (0.004 – 0.007 inch)
   Limit: 0.35 mm (0.013 inch)

OIL COOLER BYPASS VALVE
1. Make sure that valve moves smoothly.
2. Ensure that the dimension L measures the standard value under normal temperature and humidity.
   Standard value: 34.5 mm (1.358 inches)
3. The dimension must be the standard value when measured after the valve has been dipped in 97 to 103°C (207 to 217°F) oil.
   Standard value: 40.0 mm (1.575 inches)
APPLY ENGINE OIL TO ALL MOVING PARTS BEFORE INSTALLATION.

REMOVAL STEPS

1. CONNECTING ROD CAP NUT
2. CONNECTING ROD CAP
3. CONNECTING ROD BEARING, LOWER
4. PISTON AND CONNECTING ROD ASSEMBLY
5. CONNECTING ROD BEARING, UPPER
6. PISTON RING NO.1
7. PISTON RING NO.2
8. OIL RING
9. SNAP RING
10. PISTON PIN
11. SNAP RING
12. PISTON
13. CONNECTING ROD
14. BOLT
REMOVAL SERVICE POINTS

<<A>> CONNECTING ROD CAP REMOVAL
1. Mark the cylinder number on the side of the connecting rod big end for correct reassembly.
2. Keep the removed connecting rods, caps, and bearings in order according to the cylinder number.

<<B>> PISTON PIN REMOVAL
1. Remove the snap rings.

**CAUTION**
The clearance between the piston and the piston pin is an almost tight fit at room temperature. Therefore, be sure the heat the piston before pulling out the piston pin. In addition, note that the piston is hot after heating.
2. Heat the piston approximately 70°C (158°F) and pull out the piston pin.

INSTALLATION SERVICE POINTS

>>A<< PISTON PIN INSTALLATION
1. When replacing the piston pin, read off the cylinder bore size mark on the cylinder block as illustrated, and select a piston according to the flowing table.

<table>
<thead>
<tr>
<th>CYLINDER BORE SIZE MARK</th>
<th>PISTON CLASS</th>
<th>PISTON SIZE MARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>II</td>
<td>B</td>
<td>None</td>
</tr>
<tr>
<td>III</td>
<td>C</td>
<td>C</td>
</tr>
</tbody>
</table>

**NOTE:** The piston size mark shows on the top of the piston.
2. Set the snap ring into one side of the piston pin hole.
CAUTION
Apply ample coat of engine oil to the periphery of the piston pin and the hole of the connecting rod small end. The clearance between the piston and the piston pin is an almost tight fit at room temperature. Therefore, be sure to heat the piston before inserting the piston pin. In addition, note that the piston is hot after heating.

3. Heat the piston to approximately 70°C (158°F).

4. With the front mark of the connecting rod and that of the piston located on the same side, insert the piston pin.

5. Set the snap ring into the other side of the piston pin hole.

6. Check that the piston moves smoothly.
>>B<< OIL RING INSTALLATION

1. Fit the oil ring spacer into the piston ring groove.

   NOTE: The side rails and spacer may be installed in either direction.

2. Install the upper side rail.
   To install the side rail, first fit one end of the rail into the piston groove, then press the remaining portion into the position by finger. See illustration.
   Use of a ring expander to expand the side rail end gap can break the side rail, unlike other piston rings.

3. Install the lower side rail in the same procedure as described in step (2).

4. Make sure that the side rails move smoothly in either direction.

>>C<< PISTON RING NO.2/PISTON RING NO.1 INSTALLATION

1. To prevent wrong installation, check the identification mark of each piston ring. The identification mark is stamped near the ring gap:

   Identification mark
   Number 1 ring: 1T
   Number 2 ring: 2T

   NOTE: Size marks on piston rings are as follows.

<table>
<thead>
<tr>
<th>SIZE</th>
<th>SIZE MARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard (0.00 mm oversize)</td>
<td>None</td>
</tr>
<tr>
<td>0.25 mm (0.010 in) oversize</td>
<td>25</td>
</tr>
<tr>
<td>0.50 mm (0.020 in) oversize</td>
<td>50</td>
</tr>
</tbody>
</table>

2. Using a piston ring expander, fit the number 2 piston ring into the number 2 groove of piston.
   NOTE: Install the piston rings with their identification mark facing up, to the piston crown side.

3. Install the number 1 piston ring in the same manner as step 2.
**>>D<< CONNECTING ROD BEARING INSTALLATION**

1. Measure the crankshaft pin diameter and confirm its classification from the following table. In the case of a crankshaft supplied as a service part, identification colors/marks of its pins are painted/stamped at the positions shown in the illustration.

2. From the following table, select a bearing whose size is appropriate for the crankshaft pin outside the diameter. If the crankshaft pin outside diameter Identification color is "yellow" and the connecting rod Identification mark is "2," for example, select a bearing whose Identification color is "green."

   If there is no Identification color paint on the crankshaft, measure the pin outside diameter and select bearing appropriate for the measured value.

3. Install the selected bearing in the big end and in the cap of the connecting rod.

### CRANKSHAFT PIN OUTSIDE DIAMETER

<table>
<thead>
<tr>
<th>IDENTIFICATION COLOR</th>
<th>SIZE mm (in)</th>
<th>IDENTIFICATION MARK</th>
<th>IDENTIFICATION COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>54.994 – 55.000</td>
<td>0</td>
<td>Pink</td>
</tr>
<tr>
<td></td>
<td>(2.1651 – 2.1654)</td>
<td>1</td>
<td>Red</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>Green</td>
</tr>
<tr>
<td>None</td>
<td>54.988 – 54.994</td>
<td>0</td>
<td>Red</td>
</tr>
<tr>
<td></td>
<td>(2.1649 – 2.1651)</td>
<td>1</td>
<td>Green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>Black</td>
</tr>
<tr>
<td>White</td>
<td>54.982 – 54.988</td>
<td>0</td>
<td>Green</td>
</tr>
<tr>
<td></td>
<td>(2.1646 – 2.1649)</td>
<td>1</td>
<td>Black</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>Brown</td>
</tr>
</tbody>
</table>
**<<E>> PISTON AND CONNECTING ROD INSTALLATION**

1. Liberally coat the circumference of the piston, piston ring, and oil ring with engine oil.

2. Arrange the piston ring and oil ring gaps (side rail and spacer) as shown in the illustration.

3. Rotate the crankshaft so that the crank pin is on the center of the cylinder bore.

4. Insert the piston and connecting rod assembly into the cylinder with the front mark on the piston crown pointing to the timing belt side.

5. Using a suitable piston ring compressor tool, install the piston and connecting rod assembly into the cylinder block.

**<<F>> CONNECTING ROD CAP INSTALLATION**

1. Verifying the mark made during disassembly, install the bearing cap to the connecting rod. If the connecting rod is new with no index mark, make sure that the bearing locking notches are on the same side as shown.
2. Make sure that the connecting rod big end side clearance meets the specification.

   **Standard value:** 0.10 – 0.25 mm (0.004 – 0.009 inch)
   **Limit:** 0.4 mm (0.02 inch)

>>G<< CONNECTING ROD CAP NUT INSTALLATION

1. The connecting rod bolts should be examined before reuse.
   If the bolt threads are damaged, the bolt should be replaced.
   Hand-thread the nut to the full length of the bolt threads. If the nut does not run down smoothly, the bolt should be replaced.

2. Before installation of each nut, apply engine oil to the threaded portion and bearing surface of the nut.

3. Loosely tighten each nut to the bolt.

4. Then tighten the nuts alternately to a torque of 27 ± 2 N·m (20 ± 1 ft-lb) to install the cap properly.

5. Make a paint mark on the head of each nut.

6. Make a paint mark on the bolt end at the position 90 degree angle (1/4 turn) to 94 degree angle from the paint mark made on the nut in the direction of tightening the nut.

   **CAUTION**
   - If the nut is turned less than 90 degree angle (1/4 turn), proper fastening performance may not be achieved. Be careful to tighten the nut exactly 90 degree angle (1/4 turn).
   - If the nut is overtightened (exceeding 94 degree angle), loosen the nut completely and then retighten it by repeating the tightening procedure from step 3.

7. Turn the nut further 90 degree angle (1/4 turn) to 94 degree angle and make sure that the paint marks on the nut and bolt are aligned.

INSPECTION

PISTON
Replace the piston if scratches or seizure is evident on its surfaces (especially the thrust surface). Replace the piston if it is cracked.

PISTON PIN

1. Insert the piston pin into the piston pin hole with a thumb.
   You should feel a slight resistance. Replace the piston pin if it can be easily inserted or there is an excessive play.
2. The piston and piston pin must be replaced as an assembly.
PISTON RING

1. Check the piston ring for damage, excessive wear, and breakage and replace if defects are evident. If the piston has been replaced with a new one, the piston rings must also be replaced with new ones.

2. Check for clearance between the piston ring and ring groove. If the limit is exceeded, replace the ring or piston, or both.
   
   **Standard value:**
   
   Number 1: 0.03 – 0.07 mm (0.0012 – 0.0027 inch)  
   Number 2: 0.02 – 0.06 mm (0.0008 – 0.0023 inch)  
   Limit: 0.1 mm (0.003 inch)

3. Insert the piston ring into the cylinder bore. Force the ring down with a piston, the piston crown being in contact with the ring, to correctly position it at right angles to the cylinder wall. Then, measure the end gap with a feeler gauge.

   If the ring gap is excessive, replace the piston ring.

   **Standard value:**
   
   Number 1: 0.25 – 0.40 mm (0.010 – 0.016 inch)  
   Number 2: 0.35 – 0.50 mm (0.014 – 0.020 inch)  
   Oil: 0.10 – 0.35 mm (0.004 – 0.014 inch)  
   Limit:  
   Number 1, Number 2: 0.8 mm (0.03 inch)  
   Oil: 1.0 mm (0.03 inch)

CRANKSHAFT PIN OIL CLEARANCE

**<PLASTIC GAUGING MATERIAL METHOD>**

The crankshaft oil clearance can be measured easily by using plastic gauging material, as follows:

1. Remove oil from the crankshaft pin and the bearing inner surface.
2. Cut plastic gauging material to the same length as the width of the bearing and place it on the pin in parallel with its axis.
3. Install the connecting rod cap carefully and tighten the nuts to the specified torque.
4. Carefully remove the connecting rod cap.
5. Measure the width of the smashed plastic gauging material at its widest section by using a scale printed on the plastic gauging material bag.

   **Standard value:** 0.02 – 0.04 mm (0.0008 – 0.0016 inch)  
   **Limit:** 0.1 mm (0.003 inch)
REMOVAL STEPS

1. ADAPTER PLATE
2. DRIVE PLATE
3. CRANKSHAFT ADAPTOR
4. REAR PLATE
5. OIL SEAL CASE
6. CRANKSHAFT REAR OIL SEAL
7. BAFFLE PLATE
8. BEARING CAP BOLT
9. BEARING CAP
10. CRANKSHAFT BEARING, LOWER
11. CRANKSHAFT
12. THRUST BEARING
13. CRANKSHAFT BEARING, UPPER
14. KNOCK SENSOR
15. KNOCK SENSOR BRACKET
16. CYLINDER BLOCK

Required Special Tool:
- MD998718: Crankshaft Rear Oil Seal Installer
INSTALLATION SERVICE POINTS

>>A<< KNOCK SENSOR BRACKET INSTALLATION
Check that the bracket is in proper contact with the cylinder block boss and tighten to the specified torque in the order shown.

Tightening torque: 28 ± 2 N·m (21 ± 1 ft-lb)

>>B<< CRANKSHAFT BEARING INSTALLATION
1. Measure the crankshaft journal diameter and confirm its classification from the following table. In the case of a crankshaft supplied as a service part, identification colors/marks of its journals are painted/stamped at the positions shown in the illustration.

2. The cylinder block bearing bore diameter identification marks are stamped at the position shown in the illustration from left to right, beginning at No.1.

<table>
<thead>
<tr>
<th>CRANKSHAFT JOURNAL OUTSIDE DIAMETER</th>
<th>CYLINDER BLOCK BEARING BORE</th>
<th>CRANKSHAFT BEARING</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDENTIFICATION COLOR</td>
<td>SIZE mm (in)</td>
<td>IDENTIFICATION MARK</td>
</tr>
<tr>
<td>Yellow</td>
<td>63.994 – 64.000</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>(2.5194 – 2.5197)</td>
<td>II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
</tr>
<tr>
<td>None</td>
<td>63.988 – 63.994</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>(2.5192 – 2.5194)</td>
<td>II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
</tr>
</tbody>
</table>
From the following table, select a bearing whose size is appropriate for the crankshaft journal outside diameter. If the crankshaft journal outside diameter ID color is “yellow” and the cylinder block bearing bore ID mark is "III", for example, select a bearing whose ID color is "green". If there is no ID color paint on the crankshaft, measure the journal outside diameter and select a bearing appropriate for the measured valve.

4. Install bearings with a groove to the cylinder block.
5. Install the bearings having no groove to the bearing cap.

**>>C<< CRANKSHAFT THRUST BEARING INSTALLATION**
1. Install the thrust bearing in the No.3 bearing bore in the cylinder block and in the bearing cap. For easier installation, apply engine oil to the bearings; this will help hold them in position.
2. The thrust bearings must be installed with their groove toward the crankshaft web.
>>D<< BEARING CAP/BEARING BOLT INSTALLATION

1. Attach the bearing cap on the cylinder block as shown in the illustration.
2. Tighten the bearing cap bolts to specified torque in the sequence shown in the illustration.
   **Tightening torque:** 74 ± 4 N·m (54 ± 3 ft-lb)
3. Check that the crankshaft rotates smoothly.
4. Check the end play. If it exceeds the limit value, replace the thrust bearing.
   **Standard value:** 0.05 – 0.25 mm (0.002 – 0.009 inch)
   **Limit:** 0.3 mm (0.01 inch)

>>E<< CRANKSHAFT REAR OIL SEAL INSTALLATION
Using special tool MD998718, press-fit a new crankshaft rear oil seal into the oil seal case.
>>F<< OIL SEAL CASE INSTALLATION
1. Apply the sealant Mitsubishi Genuine Part number MD970389 or equivalent to the oil seal case.
2. Apply a small amount of engine oil to the entire circumference of the oil seal lip section, and place the oil seal case on the cylinder block.

**NOTE:** Install the oil seal case within 15 minutes after applying liquid gasket.
**NOTE:** Then wait at least one hour. Never start the engine or let engine oil or coolant touch the adhesion surface during that time.

INSPECTION

CRANKSHAFT JOURNAL OIL CLEARANCE
<PLASTIC GAUGING MATERIAL METHOD>
1. Remove oil from the crankshaft journal and crankshaft bearing inner surface.
2. Install the crankshaft.
3. Cut plastic gauging material to the same length as the width of the bearing and place it on the journal in parallel with its axis.
4. Install the crankshaft bearing cap carefully and tighten the bolts to the specified torque.
   **Tightening torque: 74 ± 4 N·m (54 ± 3 ft-lb)**
5. Carefully remove the crankshaft bearing cap.
6. Measure the width of the smashed plastic gauging material at its widest section by using a scale printed on the plastic gauging material bag.
   **Standard value: 0.02 – 0.04 mm (0.0008 – 0.0016 inch)**
   **Limit: 0.1 mm (0.003 inch)**

CRANKSHAFT REAR OIL SEAL
1. Check the oil seal lip for wear and damage.
2. Check the rubber for deterioration or hardening.
3. Check the oil seal case for cracks and damage.
CYLINDER BLOCK
1. Visually check for scratches, rust, and corrosion. Use also a flaw detecting agent for the check. If defects are evident, correct, or replace.
2. Using a straightedge and feeler gauge, check the block top surface for warpage. Make sure that the surface is free from gasket chips and other foreign matter.
   - **Standard value:** 0.05 mm (0.002 inch)
   - **Limit:** 0.1 mm (0.003 inch)
3. If the distortion is excessive, correct within the allowable limit or replace.
   - **Grinding limit:** *0.2 mm (0.008 inch)*
   *Includes/combined with cylinder head grinding.
Cylinder block height (when new):
227.9 – 228.1 mm (8.972 – 8.980 inches)
4. Check the cylinder walls for scratches and seizure. If defects are evident, correct (bored to an oversize) or replace.
5. Using a cylinder gauge, measure the cylinder bore and cylindricality. If worn badly, correct by boring the cylinders to an oversize and replace pistons and piston rings. Measure at the points shown in the illustration.
   - **Standard value:**  
     - Cylinder Inside Diameter: 95.0 mm (3.740 inches)
     - Cylindricality: 0.01 mm (0.0003 inch)

BORING CYLINDER
1. Oversize pistons to be used should be determined on the basis of the largest bore cylinder.

**Piston size identification**

<table>
<thead>
<tr>
<th>SIZE</th>
<th>IDENTIFICATION MARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25 mm (0.010 in) Oversize diameter</td>
<td>0.25</td>
</tr>
<tr>
<td>0.50 mm (0.020 in) Oversize diameter</td>
<td>0.50</td>
</tr>
</tbody>
</table>

**NOTE:** Size mark is stamped on the piston top.

2. Measure the outside diameter of the piston to be used. Measure it in the thrust direction as shown.
3. Based on the measured piston Outside Diameter (OD), calculate the boring finish dimension.
   - **Boring finish dimension = Piston OD + (clearance between piston OD and cylinder) – 0.02 mm (0.0008 inch) (honing margin)**

**CAUTION**
To prevent distortion that may result from temperature rise during honing, bore cylinders in the order of number 2, number 4, number 6, number 1, number 3 and number 5.
4. Bore all cylinders to the calculated boring finish dimension.
5. Hone to the final finish dimension (piston OD + clearance between piston OD and cylinder).

Standard value:
Cylinder Inside Diameter: 95.0 mm (3.740 inches)
Cylindricality: 0.01 mm (0.0003 inch)

6. Check the clearance between the piston and cylinder.

Clearance between piston and cylinder:
0.02 – 0.04 mm (0.0008 – 0.0015 inch)

NOTE: When boring cylinders, finish all six cylinders to the same oversize. Do not bore only one cylinder to an oversize.

**BRACKET**

**REMOVAL AND INSTALLATION**

**REMOVAL STEPS**
1. ENGINE SUPPORT BRACKET, RIGHT
2. ENGINE SUPPORT BRACKET, LEFT

M1113009000084

AKX01390AB
## FASTENER TIGHTENING SPECIFICATIONS

<table>
<thead>
<tr>
<th>ITEMS</th>
<th>SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator and drive belt</td>
<td></td>
</tr>
<tr>
<td>Accessory mount bolt M10 pitch 1.25</td>
<td>44 ± 10 N·m (33 ± 7 ft-lb)</td>
</tr>
<tr>
<td>Accessory mount bolt M10 pitch 1.5</td>
<td>41 ± 8 N·m (30 ± 6 ft-lb)</td>
</tr>
<tr>
<td>Accessory mount bolt M12</td>
<td>74 ± 9 N·m (54 ± 7 ft-lb)</td>
</tr>
<tr>
<td>Accessory mount stay bolt</td>
<td>24 ± 4 N·m (17 ± 3 ft-lb)</td>
</tr>
<tr>
<td>Auto tensioner bolt M10</td>
<td>44 ± 10 N·m (33 ± 7 ft-lb)</td>
</tr>
<tr>
<td>Auto tensioner bolt M8</td>
<td>24 ± 4 N·m (17 ± 3 ft-lb)</td>
</tr>
<tr>
<td>Cooling fan bolt</td>
<td>11 ± 1 N·m (97 ± 9 in-lb)</td>
</tr>
<tr>
<td>Cooling fan clutch bracket bolt</td>
<td>41 ± 8 N·m (30 ± 6 ft-lb)</td>
</tr>
<tr>
<td>Crankshaft bolt</td>
<td>185 ± 5 N·m (137 ± 3 ft-lb)</td>
</tr>
<tr>
<td>Fan clutch nut</td>
<td>11 ± 1 N·m (97 ± 9 in-lb)</td>
</tr>
<tr>
<td>Generator bolt M10</td>
<td>44 ± 10 N·m (33 ± 7 ft-lb)</td>
</tr>
<tr>
<td>Generator bolt M8</td>
<td>22 ± 4 N·m (16 ± 3 ft-lb)</td>
</tr>
<tr>
<td>Idler pulley bolt</td>
<td>44 ± 10 N·m (33 ± 7 ft-lb)</td>
</tr>
<tr>
<td>Power steering pump bracket bolt</td>
<td>44 ± 10 N·m (33 ± 7 ft-lb)</td>
</tr>
<tr>
<td>Timing indicator bolt</td>
<td>11 ± 1 N·m (97 ± 9 in-lb)</td>
</tr>
<tr>
<td><strong>Intake manifold plenum and throttle body</strong></td>
<td></td>
</tr>
<tr>
<td>Intake manifold plenum bolt M8</td>
<td>18 ± 2 N·m (13 ± 2 ft-lb)</td>
</tr>
<tr>
<td>Intake manifold plenum bolt and nut M6</td>
<td>9 ± 1 N·m (80 ± 9 in-lb)</td>
</tr>
<tr>
<td>Exhaust gas recirculation pipe bolt</td>
<td>18 ± 2 N·m (13 ± 2 ft-lb)</td>
</tr>
<tr>
<td>Exhaust gas recirculation pipe flare nut</td>
<td>59 ± 10 N·m (43 ± 7 ft-lb)</td>
</tr>
<tr>
<td>Exhaust gas recirculation valve bolt</td>
<td>24 ± 3 N·m (18 ± 2 ft-lb)</td>
</tr>
<tr>
<td>Fuel return pipe bolt</td>
<td>9 ± 1 N·m (80 ± 9 in-lb)</td>
</tr>
<tr>
<td>Intake manifold plenum stay bolt M10</td>
<td>36 ± 6 N·m (27 ± 4 ft-lb)</td>
</tr>
<tr>
<td>Intake manifold plenum stay bolt M8</td>
<td>18 ± 2 N·m (13 ± 2 ft-lb)</td>
</tr>
<tr>
<td>Intake manifold plenum valve assembly bolt</td>
<td>18 ± 2 N·m (13 ± 2 ft-lb)</td>
</tr>
<tr>
<td>Manifold differential pressure sensor bolt</td>
<td>5 ± 1 N·m (44 ± 9 in-lb)</td>
</tr>
<tr>
<td>Throttle body bolt</td>
<td>13 ± 2 N·m (113 ± 17 in-lb)</td>
</tr>
<tr>
<td>Solenoid valve bolt</td>
<td>9 ± 1 N·m (80 ± 9 in-lb)</td>
</tr>
<tr>
<td>Water outlet fitting bracket bolt</td>
<td>14 ± 1 N·m (124 ± 9 in-lb)</td>
</tr>
<tr>
<td><strong>Ignition system</strong></td>
<td></td>
</tr>
<tr>
<td>Camshaft position sensing cylinder bolt</td>
<td>22 ± 4 N·m (16 ± 3 ft-lb)</td>
</tr>
<tr>
<td>Camshaft position sensor bolt</td>
<td>11 ± 1 N·m (97 ± 9 in-lb)</td>
</tr>
<tr>
<td>Camshaft position sensor support bolt</td>
<td>14 ± 1 N·m (124 ± 9 in-lb)</td>
</tr>
<tr>
<td>Ignition coil bolt</td>
<td>10 ± 2 N·m (89 ± 17 in-lb)</td>
</tr>
<tr>
<td>Spark plugs</td>
<td>25 ± 5 N·m (18 ± 4 ft-lb)</td>
</tr>
<tr>
<td>Spark plug cable support M8</td>
<td>13 ± 2 N·m (115 ± 18 in-lb)</td>
</tr>
<tr>
<td>Spark plug cable support M6</td>
<td>10 ± 2 N·m (89 ± 17 in-lb)</td>
</tr>
<tr>
<td>ITEMS</td>
<td>SPECIFICATIONS</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td><strong>Timing belt</strong></td>
<td></td>
</tr>
<tr>
<td>Auto tensioner bolt</td>
<td>$24 \pm 3;\text{N}\cdot\text{m}$ ($17 \pm 2;\text{ft-lb}$)</td>
</tr>
<tr>
<td>Camshaft sprocket bolt</td>
<td>$88 \pm 10;\text{N}\cdot\text{m}$ ($65 \pm 8;\text{ft-lb}$)</td>
</tr>
<tr>
<td>Crankshaft position sensor bolt washer assembly</td>
<td>$8.5 \pm 0.5;\text{N}\cdot\text{m}$ ($76 \pm 4;\text{in-lb}$)</td>
</tr>
<tr>
<td>Crankshaft position sensor flange bolt</td>
<td>$11 \pm 1;\text{N}\cdot\text{m}$ ($97 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Idler pulley bolt</td>
<td>$44 \pm 10;\text{N}\cdot\text{m}$ ($33 \pm 7;\text{ft-lb}$)</td>
</tr>
<tr>
<td>Tensioner arm bolt</td>
<td>$44 \pm 10;\text{N}\cdot\text{m}$ ($33 \pm 7;\text{ft-lb}$)</td>
</tr>
<tr>
<td>Tensioner pulley bolt</td>
<td>$48 \pm 6;\text{N}\cdot\text{m}$ ($35 \pm 4;\text{ft-lb}$)</td>
</tr>
<tr>
<td>Timing belt front cover bolt M6</td>
<td>$11 \pm 1;\text{N}\cdot\text{m}$ ($97 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Timing belt front cover bolt M8</td>
<td>$14 \pm 1;\text{N}\cdot\text{m}$ ($124 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Timing belt rear cover bolt</td>
<td>$14 \pm 1;\text{N}\cdot\text{m}$ ($124 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td><strong>Intake manifold and fuel parts</strong></td>
<td></td>
</tr>
<tr>
<td>Engine coolant temperature gauge unit</td>
<td>$11 \pm 1;\text{N}\cdot\text{m}$ ($97 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Engine coolant temperature sensor</td>
<td>$29 \pm 10;\text{N}\cdot\text{m}$ ($22 \pm 7;\text{ft-lb}$)</td>
</tr>
<tr>
<td>Fitting bolt</td>
<td>$12 \pm 1;\text{N}\cdot\text{m}$ ($106 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Fuel pipe bolt</td>
<td>$9 \pm 1;\text{N}\cdot\text{m}$ ($80 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Fuel pressure regulator bolt</td>
<td>$9 \pm 1;\text{N}\cdot\text{m}$ ($80 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Injector and fuel rail bolt</td>
<td>$12 \pm 1;\text{N}\cdot\text{m}$ ($106 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Intake manifold nut</td>
<td>$22 \pm 1;\text{N}\cdot\text{m}$ ($16 \pm 1;\text{ft-lb}$)</td>
</tr>
<tr>
<td>Thermostat case bolt</td>
<td>$9 \pm 1;\text{N}\cdot\text{m}$ ($80 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Water inlet fitting bolt</td>
<td>$12 \pm 1;\text{N}\cdot\text{m}$ ($106 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Water outlet fitting bolt</td>
<td>$12 \pm 1;\text{N}\cdot\text{m}$ ($106 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Water outlet pipe bolt</td>
<td>$14 \pm 1;\text{N}\cdot\text{m}$ ($124 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Water passage bolt</td>
<td>$19 \pm 1;\text{N}\cdot\text{m}$ ($14 \pm 1;\text{ft-lb}$)</td>
</tr>
<tr>
<td>Water pipe bolt</td>
<td>$14 \pm 1;\text{N}\cdot\text{m}$ ($124 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td><strong>Exhaust manifold</strong></td>
<td></td>
</tr>
<tr>
<td>Oil dipstick guide bolt</td>
<td>$14 \pm 1;\text{N}\cdot\text{m}$ ($124 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Engine hanger bolt</td>
<td>$36 \pm 6;\text{N}\cdot\text{m}$ ($27 \pm 4;\text{in-lb}$)</td>
</tr>
<tr>
<td>Exhaust manifold nut</td>
<td>$44 \pm 5;\text{N}\cdot\text{m}$ ($33 \pm 4;\text{ft-lb}$)</td>
</tr>
<tr>
<td>Exhaust manifold cover bolt</td>
<td>$14 \pm 1;\text{N}\cdot\text{m}$ ($124 \pm 9;\text{in-lb}$)</td>
</tr>
<tr>
<td>Water pump bolt</td>
<td>$24 \pm 3;\text{N}\cdot\text{m}$ ($17 \pm 2;\text{ft-lb}$)</td>
</tr>
<tr>
<td><strong>Rocker arm and camshaft</strong></td>
<td></td>
</tr>
<tr>
<td>Rocker cover bolt</td>
<td>$3.4 \pm 0.5;\text{N}\cdot\text{m}$ ($26 \pm 4;\text{in-lb}$)</td>
</tr>
<tr>
<td>Rocker shaft bolt</td>
<td>$31 \pm 3;\text{N}\cdot\text{m}$ ($23 \pm 2;\text{ft-lb}$)</td>
</tr>
<tr>
<td>Thrust case bolt</td>
<td>$13 \pm 2;\text{N}\cdot\text{m}$ ($113 \pm 17;\text{in-lb}$)</td>
</tr>
<tr>
<td><strong>Cylinder head and valve</strong></td>
<td></td>
</tr>
<tr>
<td>Cylinder head bolt</td>
<td>$108 \pm 5;\text{N}\cdot\text{m}$ ($80 \pm 4;\text{ft-lb}$)</td>
</tr>
<tr>
<td>Oil pan and oil pump</td>
<td>$11 \pm 1;\text{N}\cdot\text{m}$ ($97 \pm 9;\text{in-lb}$)</td>
</tr>
</tbody>
</table>
## ENGINE OVERHAUL
### SPECIFICATIONS

<table>
<thead>
<tr>
<th>ITEMS</th>
<th>SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover bolt</td>
<td>$11 \pm 1 \text{ N\cdot m (97 \pm 9 in-lb)}$</td>
</tr>
<tr>
<td>Drain plug</td>
<td>$39 \pm 5 \text{ N\cdot m (29 \pm 4 ft-lb)}$</td>
</tr>
<tr>
<td>Engine oil pressure switch</td>
<td>$10 \pm 2 \text{ N\cdot m (87 \pm 17 in-lb)}$</td>
</tr>
<tr>
<td>Oil cooler by-pass valve</td>
<td>$54 \pm 5 \text{ N\cdot m (40 \pm 4 ft-lb)}$</td>
</tr>
<tr>
<td>Oil filter bracket bolt</td>
<td>$23 \pm 3 \text{ N\cdot m (17 \pm 2 ft-lb)}$</td>
</tr>
<tr>
<td>Oil pan bolt</td>
<td>$9 \pm 3 \text{ N\cdot m (80 \pm 20 in-lb)}$</td>
</tr>
<tr>
<td>Oil pump case bolt</td>
<td>$14 \pm 1 \text{ N\cdot m (124 \pm 9 in-lb)}$</td>
</tr>
<tr>
<td>Oil pump cover bolt</td>
<td>$10 \pm 2 \text{ N\cdot m (87 \pm 17 in-lb)}$</td>
</tr>
<tr>
<td>Oil screen bolt</td>
<td>$19 \pm 3 \text{ N\cdot m (40 \pm 4 ft-lb)}$</td>
</tr>
<tr>
<td>Oil screen stay bolt</td>
<td>$9 \pm 1 \text{ N\cdot m (79 \pm 7 in-lb)}$</td>
</tr>
<tr>
<td>Relief plug</td>
<td>$44 \pm 5 \text{ N\cdot m (33 \pm 4 ft-lb)}$</td>
</tr>
</tbody>
</table>

### Piston and connecting rod

- Connecting rod cap nut: $27 \pm 2 \text{ N\cdot m (20 \pm 1 ft-lb) + 90°}$

### Crankshaft and drive plate

- Baffle plate bolt: $9 \pm 2 \text{ N\cdot m (79 \pm 18 in-lb)}$
- Bearing cap bolt: $74 \pm 4 \text{ N\cdot m (54 \pm 3 ft-lb)}$
- Drive plate bolt: $74 \pm 2 \text{ N\cdot m (54 \pm 1 ft-lb)}$
- Knock sensor: $23 \pm 2 \text{ N\cdot m (17 \pm 1 ft-lb)}$
- Knock sensor bracket bolt: $28 \pm 2 \text{ N\cdot m (21 \pm 1 ft-lb)}$
- Oil seal case bolt: $11 \pm 1 \text{ N\cdot m (97 \pm 9 in-lb)}$
- Rear plate bolt: $11 \pm 1 \text{ N\cdot m (97 \pm 9 in-lb)}$

### Bracket

- Engine support bracket bolt M10: $41 \pm 8 \text{ N\cdot m (30 \pm 6 ft-lb)}$
- Engine support bracket bolt M12: $75 \pm 10 \text{ N\cdot m (55 \pm 7 ft-lb)}$

### GENERAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>DESCRIPTIONS</th>
<th>SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>$60°$ V, OHV, SOHC</td>
</tr>
<tr>
<td>Number of cylinders</td>
<td>6</td>
</tr>
<tr>
<td>Combustion chamber</td>
<td>Pentroof type</td>
</tr>
<tr>
<td>Total displacement cm$^3$ (cu in)</td>
<td>3,828 (233.6)</td>
</tr>
<tr>
<td>Cylinder bore mm (in)</td>
<td>95.0 (3.74)</td>
</tr>
<tr>
<td>Piston stroke mm (in)</td>
<td>90.0 (3.54)</td>
</tr>
<tr>
<td>Compression ratio</td>
<td>10.0</td>
</tr>
<tr>
<td>Valve timing</td>
<td>5°, 55°, 51°, 17°</td>
</tr>
<tr>
<td>Intake valve</td>
<td>Opens (BTDC), Closes (ABDC)</td>
</tr>
<tr>
<td>Exhaust valve</td>
<td>Opens (BBDC), Closes (ATDC)</td>
</tr>
<tr>
<td>Lubrication system</td>
<td>Pressure feed, full-flow filtration</td>
</tr>
<tr>
<td>Oil pump type</td>
<td>Trochoid type</td>
</tr>
</tbody>
</table>

(M11130002000382)
## Service Specifications

<table>
<thead>
<tr>
<th>Items</th>
<th>Standard Value</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Timing belt</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto tensioner rod length mm (in)</td>
<td>4.8 – 5.5 (0.19 – 0.21)</td>
<td>–</td>
</tr>
<tr>
<td>Auto tensioner rod production length mm (in)</td>
<td>12 (0.5)</td>
<td>–</td>
</tr>
<tr>
<td>Auto tensioner rod pushed-in amount [when pushed with a force of 98 – 196 N (22 – 44 lb)] mm (in)</td>
<td>1.0 (0.03) or less</td>
<td>–</td>
</tr>
<tr>
<td><strong>Rocker arms and camshaft</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camshaft cam height mm (in) Intake</td>
<td>37.39 (1.472)</td>
<td>Minimum 36.89 (1.462)</td>
</tr>
<tr>
<td>Camshaft cam height mm (in) Exhaust</td>
<td>37.14 (1.462)</td>
<td>Minimum 36.64 (1.443)</td>
</tr>
<tr>
<td><strong>Cylinder head and valves</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder head flatness of gasket surface mm (in)</td>
<td>Less than 0.03 (0.001)</td>
<td>0.2 (0.007)</td>
</tr>
<tr>
<td>Cylinder head grinding limit of gasket surface mm (in) Total resurfacing depth of cylinder head and cylinder block</td>
<td>–</td>
<td>0.2 (0.007)</td>
</tr>
<tr>
<td>Cylinder head overall height mm (in)</td>
<td>120 (4.7)</td>
<td>–</td>
</tr>
<tr>
<td>Valve thickness of valve head (margin) mm (in) Intake</td>
<td>1.0 (0.04)</td>
<td>Minimum 0.5 (0.02)</td>
</tr>
<tr>
<td>Valve thickness of valve head (margin) mm (in) Exhaust</td>
<td>1.2 (0.05)</td>
<td>Minimum 0.7 (0.03)</td>
</tr>
<tr>
<td>Valve overall height mm (in) Intake</td>
<td>112.30 (4.421)</td>
<td>Minimum 111.80 (4.402)</td>
</tr>
<tr>
<td>Valve overall height mm (in) Exhaust</td>
<td>114.11 (4.493)</td>
<td>Minimum 113.61 (4.473)</td>
</tr>
<tr>
<td>Valve stem outside diameter mm (in) Intake</td>
<td>6.0 (0.24)</td>
<td>–</td>
</tr>
<tr>
<td>Valve stem outside diameter mm (in) Exhaust</td>
<td>6.0 (0.24)</td>
<td>–</td>
</tr>
<tr>
<td>Valve thickness to valve guide clearance mm (in) Intake</td>
<td>0.02 – 0.05 (0.0008 – 0.0019)</td>
<td>0.10 (0.003)</td>
</tr>
<tr>
<td>Valve thickness to valve guide clearance mm (in) Exhaust</td>
<td>0.04 – 0.07 (0.0016 – 0.0027)</td>
<td>0.15 (0.005)</td>
</tr>
<tr>
<td>Valve face angle mm (in)</td>
<td>45° – 45.5°</td>
<td>–</td>
</tr>
<tr>
<td>Valve spring free length mm (in)</td>
<td>51.0 (2.01)</td>
<td>50.0 (1.97)</td>
</tr>
<tr>
<td>Valve spring load/installed height N (lb)/mm (in)</td>
<td>267/44.2 (60.0/1.74)</td>
<td>–</td>
</tr>
<tr>
<td>Valve spring out-of-squareness</td>
<td>2° or less</td>
<td>4°</td>
</tr>
<tr>
<td>Valve seat valve contact width mm (in)</td>
<td>0.9 – 1.3 (0.04 – 0.05)</td>
<td>–</td>
</tr>
<tr>
<td>Valve guide inside diameter mm (in)</td>
<td>6.0 (0.32)</td>
<td>–</td>
</tr>
<tr>
<td>Valve guide projection from cylinder head upper surface mm (in)</td>
<td>14 (0.6)</td>
<td>–</td>
</tr>
<tr>
<td>Valve stem projection mm (in)</td>
<td>49.30 (1.941)</td>
<td>49.80 (1.960)</td>
</tr>
<tr>
<td>ITEMS</td>
<td>STANDARD VALUE</td>
<td>LIMIT</td>
</tr>
<tr>
<td>-------</td>
<td>----------------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>Oversize rework dimensions of valve guide hole mm (in)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.05 oversize diameter</td>
<td>11.05 – 11.07 (0.4351 – 0.4358)</td>
<td>–</td>
</tr>
<tr>
<td>0.25 oversize diameter</td>
<td>11.25 – 11.27 (0.4429 – 0.4437)</td>
<td>–</td>
</tr>
<tr>
<td>0.50 oversize diameter</td>
<td>11.50 – 11.52 (0.4528 – 0.4535)</td>
<td>–</td>
</tr>
<tr>
<td><strong>Intake oversize rework dimensions of valve seat hole mm (in)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.3 oversize diameter</td>
<td>34.30 – 34.33 (1.3504 – 1.3515)</td>
<td>–</td>
</tr>
<tr>
<td>0.6 oversize diameter</td>
<td>34.60 – 34.63 (1.3623 – 1.3633)</td>
<td>–</td>
</tr>
<tr>
<td><strong>Exhaust oversize rework dimensions of valve seat hole mm (in)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.3 oversize diameter</td>
<td>31.80 – 31.81 (1.2520 – 1.2531)</td>
<td>–</td>
</tr>
<tr>
<td>0.6 oversize diameter</td>
<td>32.10 – 32.13 (1.2638 – 1.2650)</td>
<td>–</td>
</tr>
<tr>
<td><strong>Oil pan and oil pump</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil pump tip clearance mm (in)</td>
<td>0.06 – 0.18 (0.003 – 0.007)</td>
<td>–</td>
</tr>
<tr>
<td>Oil pump side clearance mm (in)</td>
<td>0.04 – 0.10 (0.002 – 0.003)</td>
<td>–</td>
</tr>
<tr>
<td>Oil pump body clearance mm (in)</td>
<td>0.10 – 0.18 (0.004 – 0.007)</td>
<td>0.35 (0.013)</td>
</tr>
<tr>
<td>Oil cooler by-pass valve mm (in)</td>
<td>Dimension (Normal temperature)</td>
<td>34.5 (1.358)</td>
</tr>
<tr>
<td></td>
<td>By-pass hole closing temperature 97 to 103°C(207 to 217°F)</td>
<td>40.0 (1.575)</td>
</tr>
<tr>
<td>Oil pressure at curb idle speed kPa (psi) [oil temperature is 75 to 90°C(167 to 194°F)]</td>
<td>80 (11.6) or more</td>
<td>–</td>
</tr>
<tr>
<td><strong>Piston and connecting rod</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piston outside diameter mm (in)</td>
<td>93.0 (3.661)</td>
<td>–</td>
</tr>
<tr>
<td>Piston ring to ring groove clearance mm (in)</td>
<td>No.1</td>
<td>0.03 – 0.07 (0.0012 – 0.0027)</td>
</tr>
<tr>
<td></td>
<td>No.2</td>
<td>0.02 – 0.06 (0.0008 – 0.0023)</td>
</tr>
<tr>
<td>Piston ring end gap mm (in)</td>
<td>No.1</td>
<td>0.30 – 0.45 (0.012 – 0.017)</td>
</tr>
<tr>
<td></td>
<td>No.2</td>
<td>0.45 – 0.60 (0.018 – 0.023)</td>
</tr>
<tr>
<td></td>
<td>Oil ring side rail</td>
<td>0.20 – 0.60 (0.008 – 0.023)</td>
</tr>
<tr>
<td>Piston pin outside diameter mm (in)</td>
<td>22.0 (0.87)</td>
<td>–</td>
</tr>
<tr>
<td>Crankshaft pin oil clearance mm (in)</td>
<td>0.02 – 0.05 (0.0008 – 0.0019)</td>
<td>0.1 (0.003)</td>
</tr>
<tr>
<td>Connecting rod big end side clearance mm (in)</td>
<td>0.10 – 0.25 (0.003 – 0.009)</td>
<td>–</td>
</tr>
<tr>
<td><strong>Crankshaft and drive plate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crankshaft end play mm (in)</td>
<td>0.05 – 0.25 (0.002 – 0.009)</td>
<td>0.3 (0.01)</td>
</tr>
<tr>
<td>Crankshaft journal outside diameter mm (in)</td>
<td>64 (2.520)</td>
<td>–</td>
</tr>
<tr>
<td>Crankshaft pin outside diameter mm (in)</td>
<td>55 (2.165)</td>
<td>–</td>
</tr>
</tbody>
</table>
### ENGINE SPECIFICATIONS

<table>
<thead>
<tr>
<th>ITEMS</th>
<th>STANDARD VALUE</th>
<th>LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crankshaft journal oil clearance mm (in)</td>
<td>0.02 – 0.04 (0.0008 – 0.0015)</td>
<td>0.1 (0.003)</td>
</tr>
<tr>
<td>Piston to cylinder clearance mm (in)</td>
<td>0.02 – 0.04 (0.0008 – 0.0015)</td>
<td></td>
</tr>
<tr>
<td>Cylinder block flatness of gasket surface mm (in)</td>
<td>0.05 (0.02)</td>
<td>0.1 (0.003)</td>
</tr>
<tr>
<td>Cylinder block grinding limit of gasket surface mm (in) total resurfacing depth of both cylinder head and cylinder block</td>
<td></td>
<td>0.2 (0.008)</td>
</tr>
<tr>
<td>Cylinder block overall height mm (in)</td>
<td>227.9 – 228.1 (8.972 – 8.980)</td>
<td></td>
</tr>
<tr>
<td>Cylinder bore inside diameter mm (in)</td>
<td>93.0 (3.661)</td>
<td></td>
</tr>
<tr>
<td>Cylindricity mm (in)</td>
<td>0.01 (0.0003)</td>
<td></td>
</tr>
</tbody>
</table>

### SEALANTS AND ADHESIVES

<table>
<thead>
<tr>
<th>ITEMS</th>
<th>SPECIFIED SEALANT</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine coolant temperature sensor</td>
<td>3M™ AAD Part No. 8731 or equivalent</td>
<td>As required</td>
</tr>
<tr>
<td>Engine coolant temperature gauge unit</td>
<td>3M™ AAD Part No. 8672 or equivalent</td>
<td>As required</td>
</tr>
<tr>
<td>Engine Oil pressure switch</td>
<td>3M™ AAD Part No. 8672 or equivalent</td>
<td>As required</td>
</tr>
<tr>
<td>Oil pressure gauge unit</td>
<td>3M™ AAD Part No. 8672 or equivalent</td>
<td>As required</td>
</tr>
<tr>
<td>Oil pump case</td>
<td>MITSUBISHI genuine part No. MD970389 or equivalent</td>
<td>As required</td>
</tr>
<tr>
<td>Oil pan</td>
<td>MITSUBISHI genuine part No. MD970389 or equivalent</td>
<td>As required</td>
</tr>
</tbody>
</table>