Technician
Service
Receptionist
Body
Specialist

Training Manual

Powertrain (NTOM)

CT-L1001.4

ZOOM-ZOOM

Notes:

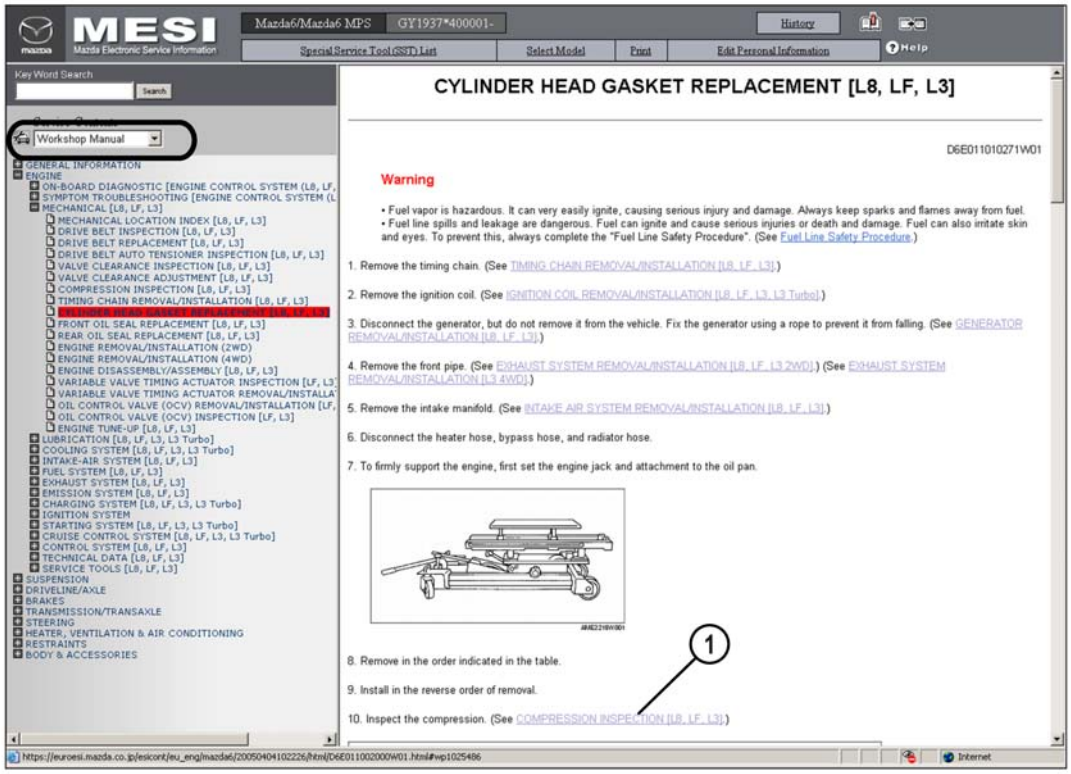
Introduction

- The training course “Powertrain” introduces the various engines and transmissions of the current Mazda models with the main focus on the mechanical system.
- It is one part of the **NTOM** (**N**ew-**T**o-**M**azda) course, which is addressed to entry-level Mazda technicians. Successful attendance of the NTOM course is a prerequisite for participation in any technical courses of the Mazda Masters program.
- Anyone associated with the diagnosis and repair of Mazda vehicles **must** have the knowledge to deliver a “Fix it right first time” repair. Therefore, the Mazda Masters development and qualification path provides the following training courses required for servicing Mazda vehicles:
  - Introduction To Mazda (NTOM) CT-L1001.1
  - Mazda Modular Diagnostic System (NTOM) CT-L1001.2
  - Chassis and Body (NTOM) CT-L1001.3
  - Powertrain (NTOM) CT-L1001.4
- The ranking of this course within the Mazda Masters educational system is Level 1 – ‘Mazda Technician’. It is intended for technicians without Mazda experience, who already have started their new job at a Mazda dealer.
- The training manual “Powertrain” is divided into the following main chapters:
  - Engines
  - Transmissions

Notes:

MESI for Engine Service and Repairs

- For engine service and repairs MESI provides two different types of information within the Service Contents menu.
- The chapter “Engine” of the workshop manual contains information about the various engine systems such as cooling system, exhaust system etc. but also about certain mechanical repairs on the engine.
- The “Engine Workshop Manual” contains detailed information about mechanical overhauling of the engine. It explains the disassembly, inspection, repair and reassembly procedures on the engine. It also contains specifications (like tightening torques, standard values and limit values) for the various overhaul and repair procedures.
- The chapter “Engine” of the workshop manual can be found by choosing the “Workshop Manual” from the Service Contents menu and then selecting “Engine”. If you have to replace a cylinder head gasket for example, select “Mechanical” and then “Cylinder Head Gasket Replacement” to get information about the procedure.



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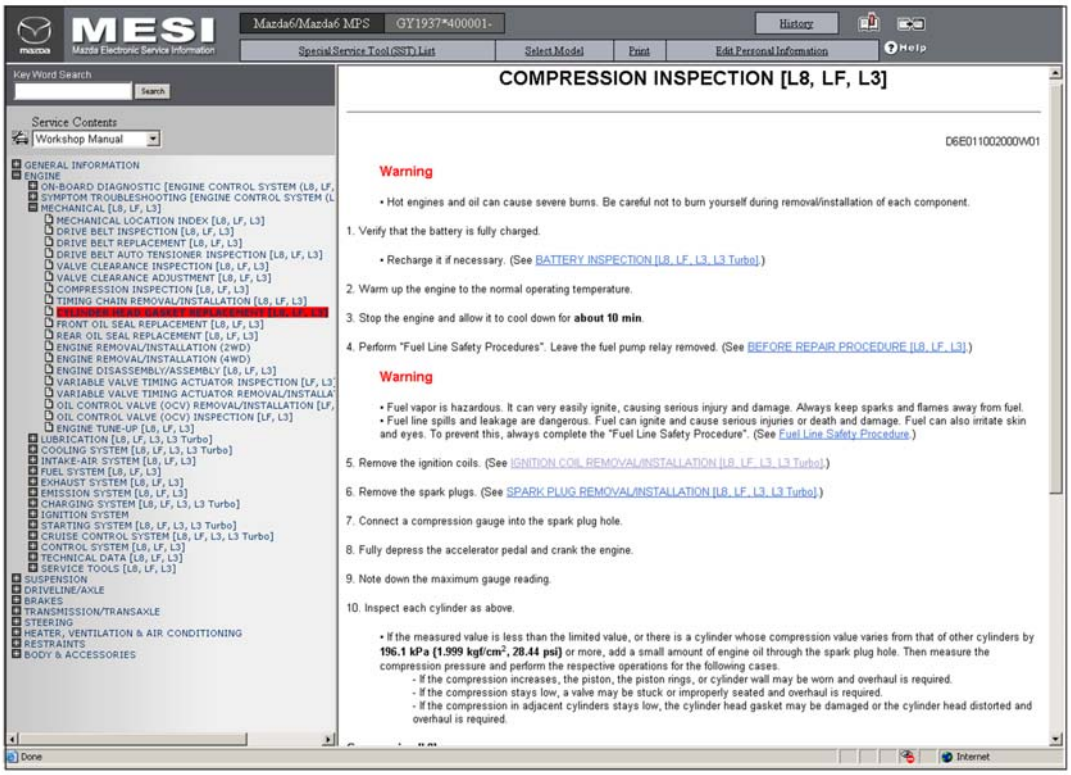
1 Hyperlink

- Clicking a Hyperlink (e.g. compression inspection) provides the technician with additional information, which is essential for the repair in question.



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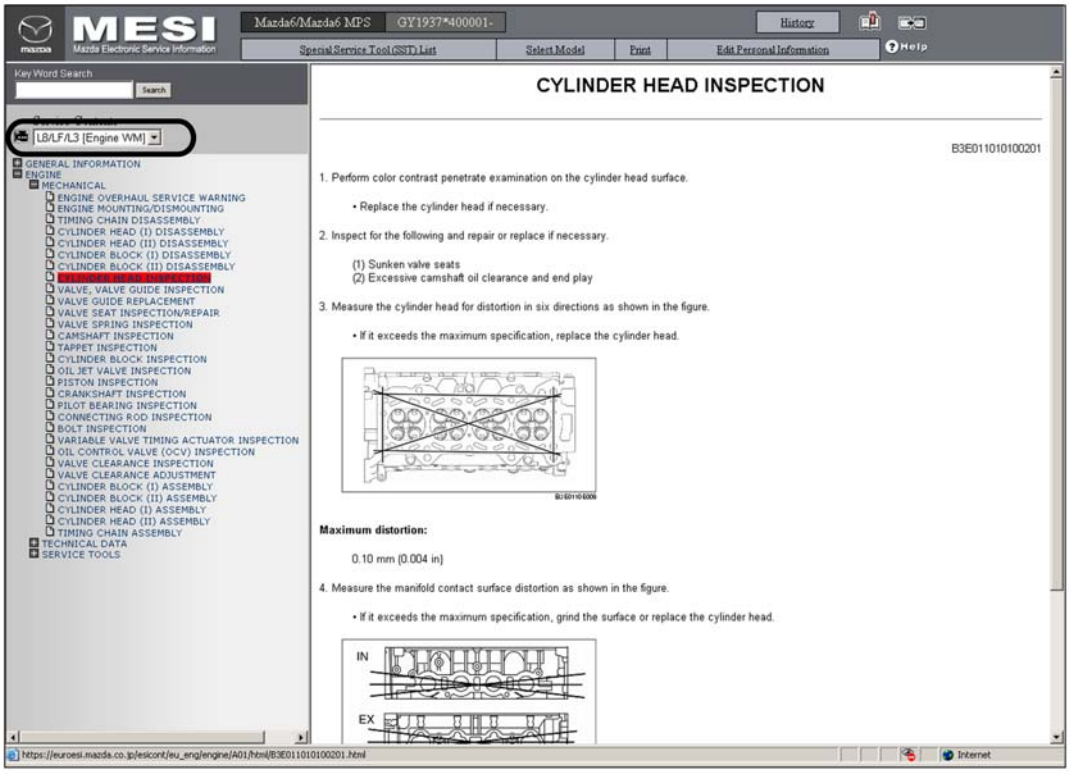
- The Engine Workshop Manual can be found by choosing “Engine WM” of the Service Contents menu and then selecting “Engine). See example below. If you have to inspect a cylinder head for example, select “Mechanical” and then “Cylinder Head Inspection” to get information about the procedure.



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Notes:

Petrol Engines

- The following petrol engine types are fitted in the current Mazda models:

Model / Engine	1.25 MZI	1.4 MZI	1.6 MZI	ZJ	Z6	L8	LF	L3	L3-T
Mazda2 (DY)	X	X	X						
Mazda3				X	X		X		
Mazda3 MPS									X
Mazda5						X	X		
Mazda6						X	X	X	
Mazda6 MPS									X
Mazda CX-7									X
Mazda MX-5						X	X		

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L-type Engines

- In the L-type engine line-up the following engines are available:
  - L8 engine with 1.8 L displacement (also termed as 1.8 L MZR engine)
  - LF engine with 2.0 L displacement (also termed as 2.0 L MZR engine)
  - L3 engine with 2.3 L displacement (also termed as 2.3 L MZR engine)
  - L3-T engine with 2.3 L displacement, direct injection and turbocharger (also termed as 2.3 L MZR **DISI** (**D**irect **I**njection **S**park **I**gnition) Turbo engine)

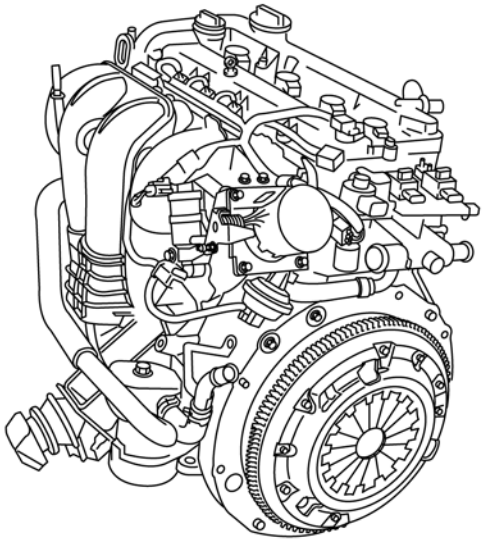
- The L8 and the LF engine are fitted in the Mazda5, Mazda6 and Mazda MX-5 models. In addition, the LF engine is available in the Mazda3 models. The L3 engine is fitted in the Mazda6 models only. All engines are equipped with a multipoint manifold injection system and a distributorless ignition system (direct ignition coils).
- The L3-T engine is available in the Mazda3 MPS, Mazda6 MPS and Mazda CX-7 models. It is equipped with a direct injection system, a **FGT** (**F**ixed **G**eometry **T**urbine) turbocharger and a distributorless ignition system (direct ignition coils).

Mechanical (L8, LF, L3 Engine)

Features

- The mechanical system of the L8, LF and L3 engine has the following features:
  - Chain driven 16 valve **DOHC** (**D**ouble **O**ver**h**ead **C**amshaft) engine
  - Balancer shafts (only L3 engine)
  - Valve train with automatic timing chain tensioner and mechanical bucket tappets
  - Variable valve timing system for the intake camshaft (except L8 engine)
  - V-ribbed belt drive with automatic tensioner

Overview



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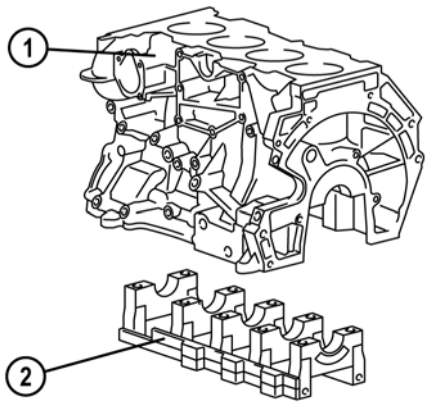
Cylinder Block

- The cylinder block features a bearing support frame, in which the main bearing caps are integrated. Cylinder block and bearing support frame are matched to each other, i.e. they cannot be replaced separately. If one of the components exceeds the specification, the cylinder block must be replaced as a complete unit.
- The main bearing cap bolts are torque-to-yield bolts, which must be tightened in several stages (refer to the workshop manual for details).



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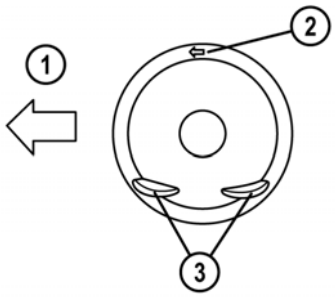
1 Cylinder block

2 Bearing support frame

Pistons

- The piston skirt is coated to reduce friction between the piston and the cylinder.
- Piston, piston pin and connecting rod are shrinkage fitted and cannot be disassembled. If one of the components exceeds the specification, the piston/ connecting rod assembly has to be replaced as a complete unit.



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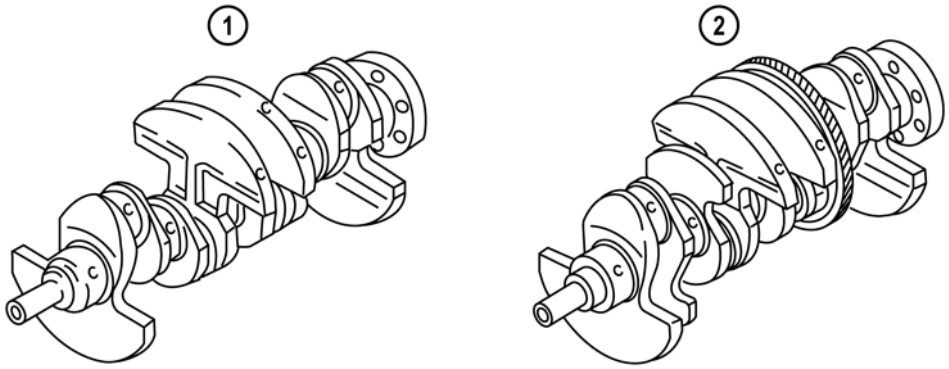
1 Engine front side
2 Arrow indicating the installation direction
3 Valve recesses

Crankshaft

- The crankshaft for the L8 and LF engine has four counterweights, while the crankshaft for the L3 engine has eight counterweights.
- In addition, the crankshaft for the L3 engine is equipped with a drive gear for the balancer shafts.
- The crankshaft features no key for the installation of the crankshaft sprocket and the crankshaft pulley, i.e. solely the clamping force of the lock bolt secures both components on the crankshaft.
- The crankshaft pulley has a pulse wheel for the **CKP** (**C**ran**k**shaft **P**osition) sensor signals. For this reason, the crankshaft pulley must be fixed to the engine front cover using a detent bolt (M6 x 1.0) before tightening the crankshaft pulley lock bolt.
- The crankshaft pulley lock bolt is a torque-to-yield bolt, which must be tightened in several stages (refer to the workshop manual for details).

NOTE: The crankshaft pulley lock bolt must not be re-used.



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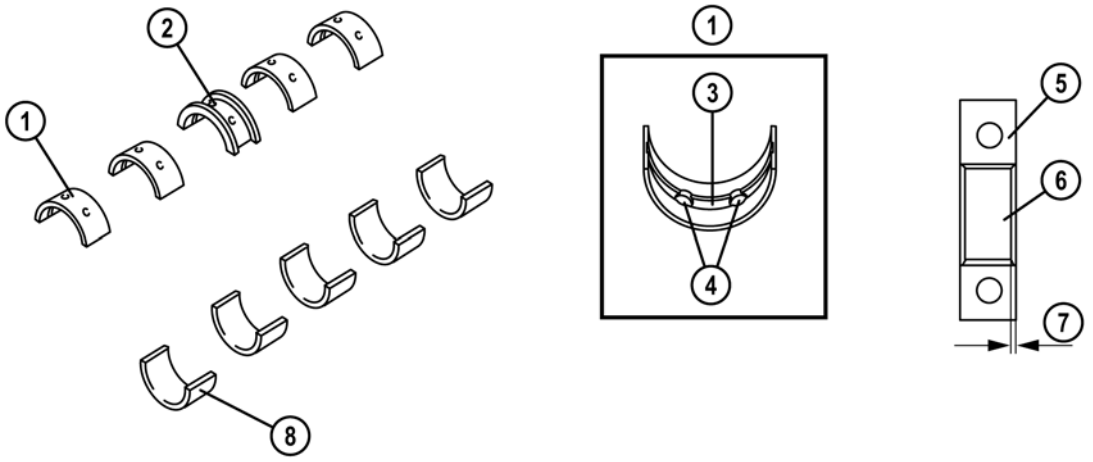
1 Crankshaft (L8, LF engine)

2 Crankshaft (L3 engine)

- There is no positioning tab for locating the upper and lower bearing in the main journal. For installing the main bearing shells (upper and lower), they have to be measured and attached so that they are positioned in the center of the main bearing cap (refer to the workshop manual for details).



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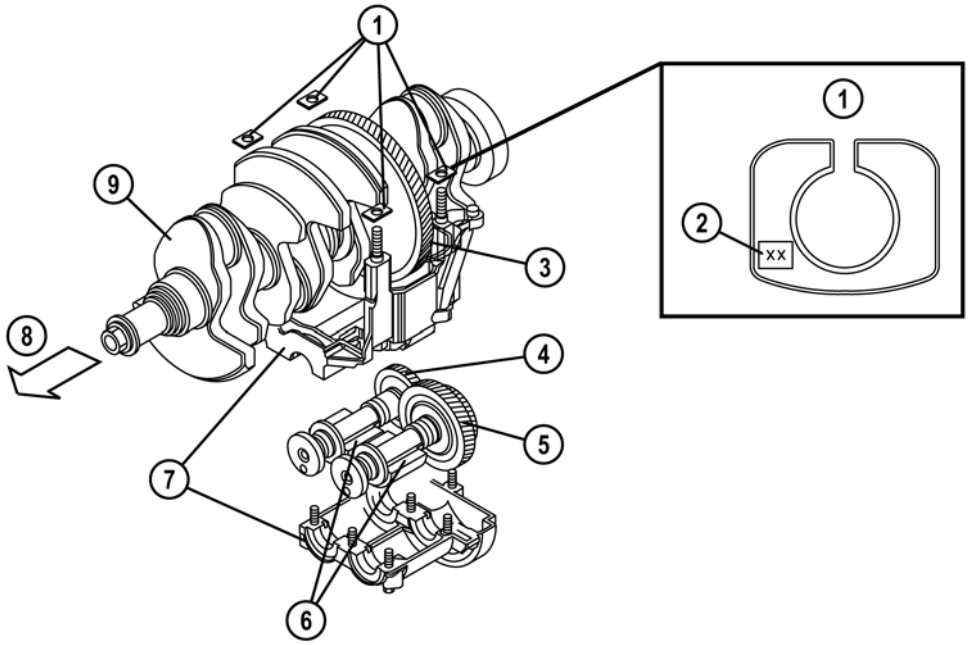
1 Upper main bearing shell
2 Thrust bearing
3 Upper main bearing oil groove
4 Oil holes
5 Main bearing cap
6 Main bearing shell
7 Specified measurement
8 Lower main bearing shell

Balancer Shaft Unit

- The balancer shafts minimize the engine vibrations by rotating at twice the speed of the crankshaft.
- The balancer shaft unit features a two-piece housing, which is fixed to the cylinder block by four bolts.

NOTE: The balancer shaft unit cannot be repaired due to its precise interior construction, i.e. it must be replaced as a complete unit.

- If the cylinder block, crankshaft, crankshaft main bearing, or balancer shaft unit have been replaced, the backlash between the drive gear of the crankshaft and the driven gear of the balancer shaft unit must be adjusted using shims (refer to the workshop manual for details).



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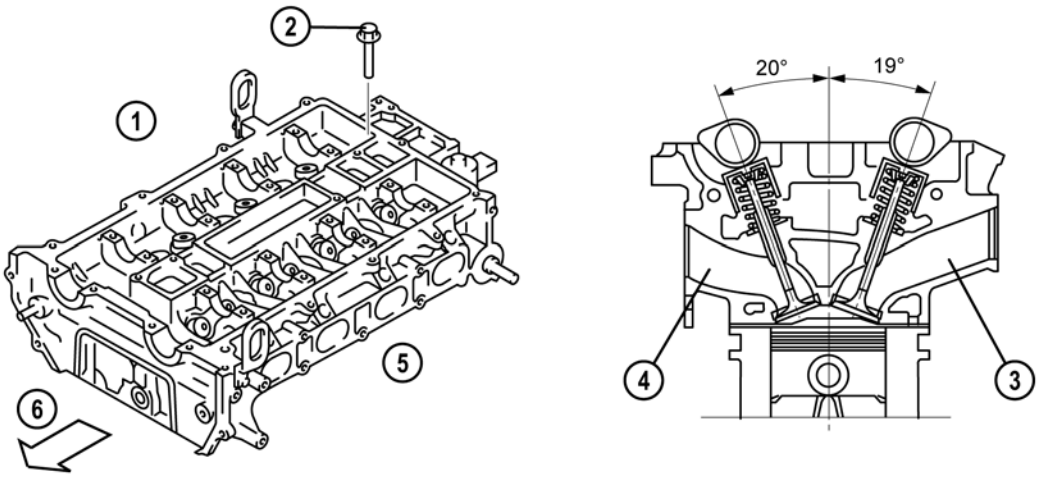
1 Adjustment shim
2 Engraved identification mark
3 Drive gear
4 Balancer shaft no.2
5 Balancer shaft no.1 with driven gear
6 Counter weights
7 Balancer shaft unit housing
8 Engine front side
9 Crankshaft

Cylinder Head

- The cylinder head is a conventional construction with separate camshaft bearing caps.
- The cylinder head bolts are torque-to-yield bolts, which must be tightened in several stages (refer to the workshop manual for details).

NOTE: The cylinder head bolts must not be re-used if their length exceeds the specification (refer to the workshop manual for details).



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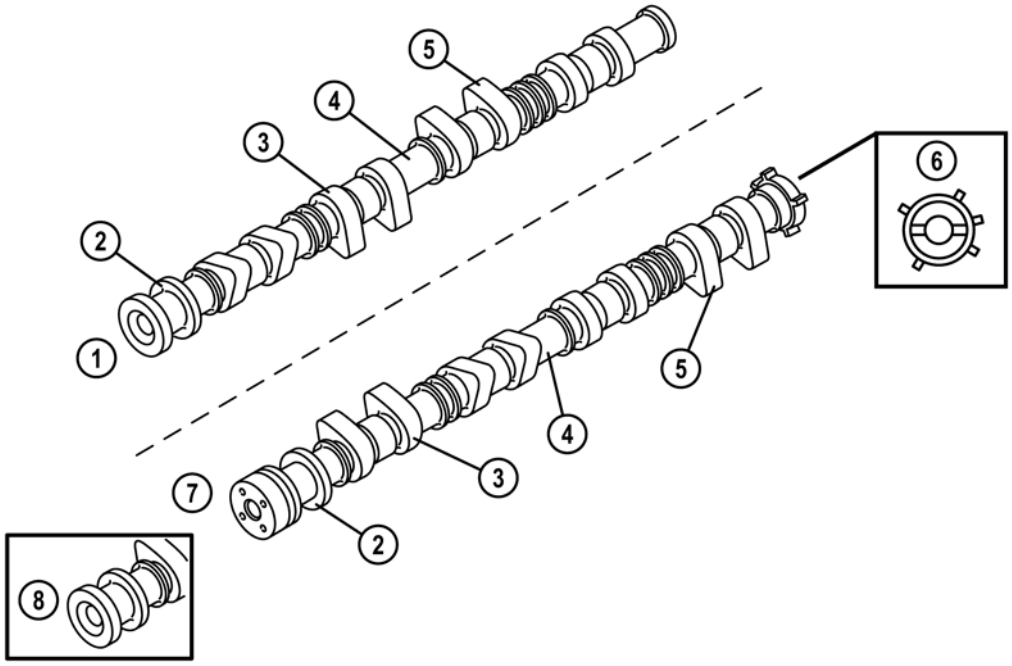
1 Exhaust side
2 Cylinder head bolt
3 Intake port
4 Exhaust port
5 Intake side
6 Engine front side

Camshafts

- The camshafts feature no key for the installation of the camshaft sprockets, i.e. solely the clamping force of the lock bolt secures the sprocket on the camshaft.
- The intake camshaft of the LF and L3 engine is equipped with an oil line supplying oil to the camshaft actuator of the variable valve timing system.
- The intake camshaft has a pulse wheel for the **CMP** (**C**a**m**shaft **P**osition) sensor signals.



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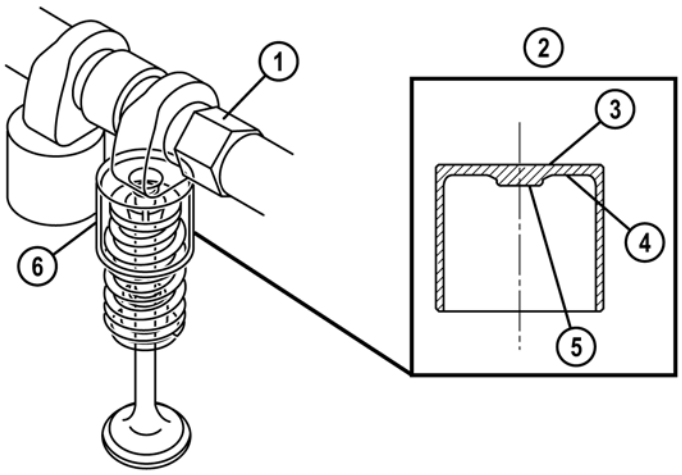
1 Exhaust camshaft
2 Thrust collar
3 Cam heel
4 Cam journal
5 Cam nose
6 Pulse wheel for CMP sensor
7 Intake camshaft (with variable valve timing system)
8 Intake camshaft front end (without variable valve timing system)

Valve Actuation

- The camshafts actuate the valves via mechanical bucket tappets without adjustment shims.
- The valve clearance is adjusted by the different thickness of the bucket tappets. The tappet thickness can be determined by the engraved number (e.g. number “402” means a thickness of 3.402 mm). In order to replace the tappets the camshafts have to be removed (refer to the workshop manual for details).
- The valve clearance has to be audibly inspected (and if noisy adjusted) every 120,000 km.



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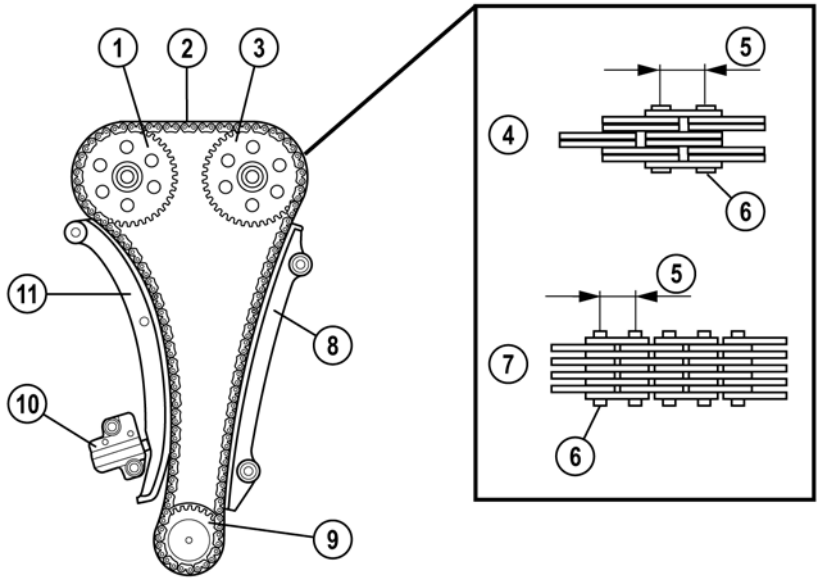
1 Camshaft
2 Tappet cross-sectional view
3 Cam lobe contact surface
4 Tappet thickness
5 Valve stem contact surface
6 Bucket tappet

Valve Train

- The camshafts are driven by a maintenance-free pinned link timing chain.



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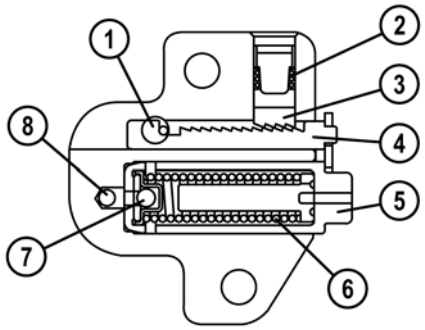
1	Exhaust camshaft sprocket	7	L3 engine
2	Timing chain	8	Chain guide
3	Intake camshaft sprocket	9	Crankshaft sprocket
4	L8, LF engine	10	Chain tensioner
5	Pitch size	11	Chain tensioner arm
6	Pin		

Timing Chain Tensioner

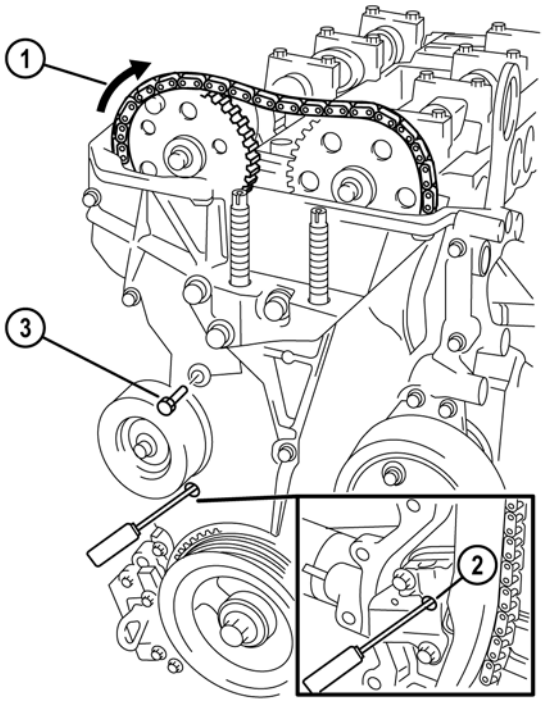
- An automatic timing chain tensioner is fitted to ensure optimum chain tension over the service life of the engine.
- The timing chain tensioner operates using engine oil pressure. The ratchet and the rack hold the piston in place when the engine is started.



L1001.4_01011

1 Hole for a ratchet lock
2 Ratchet spring
3 Ratchet
4 Rack
5 Plunger
6 Plunger spring
7 Check valve
8 Oil supply hole

- The timing chain tension can be released as following (refer to the workshop manual for details):
  1. Using a suitable screwdriver or equivalent tool, unlock the chain tensioner ratchet.
  2. Turn the exhaust camshaft clockwise using a suitable wrench on the cast hexagon, and loosen the timing chain.
  3. Placing a bolt (M6 x 1.0) in the engine front cover upper blind plug hole, secure the chain tensioner arm in the position where the tension is released.



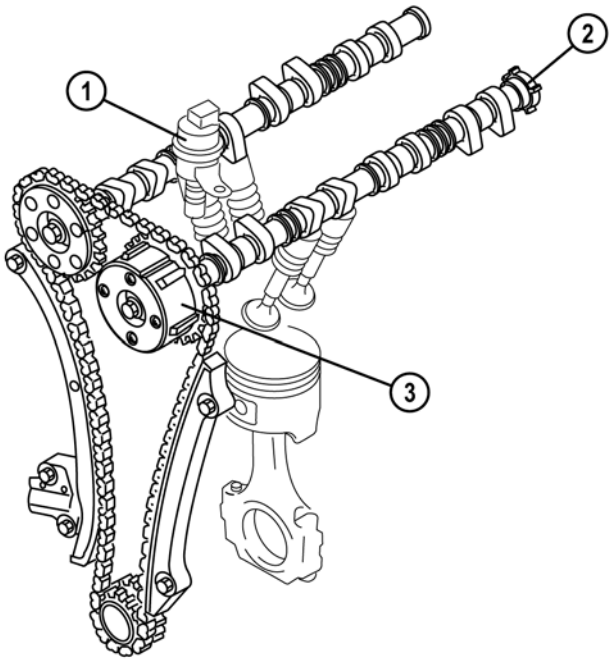
L1001.4_01012

1 Direction of rotation
2 Unlocking the chain tensioner ratchet
3 Detent bolt

Variable Valve Timing System

- The variable valve timing system continuously varies the valve timing of the intake valves, controlling the cylinder charge.
- The camshaft actuator is attached to the camshaft sprocket and varies the position of the intake camshaft in relation to the sprocket. The intake camshaft position is controlled by the oil control valve using engine oil pressure.

NOTE: The camshaft actuator cannot be repaired due to its precise interior construction, i.e. it must be replaced as a complete unit.



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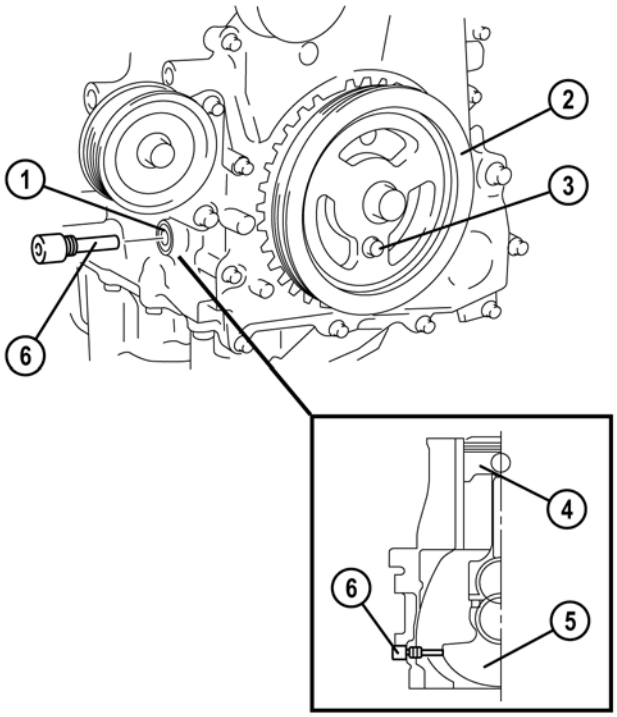
1 Oil control valve
2 Intake camshaft
3 Camshaft actuator

Valve Timing

- For verifying or adjusting the valve timing a timing peg (SST) has to be installed in the blind plug hole, which is located at the rear of the cylinder block. Then turn the crankshaft clockwise until the crankshaft counterweight of cylinder no. 1 touches the timing peg (refer to the workshop manual for details).

NOTE: To prevent damage to the timing peg do not use it to lock the crankshaft in position.



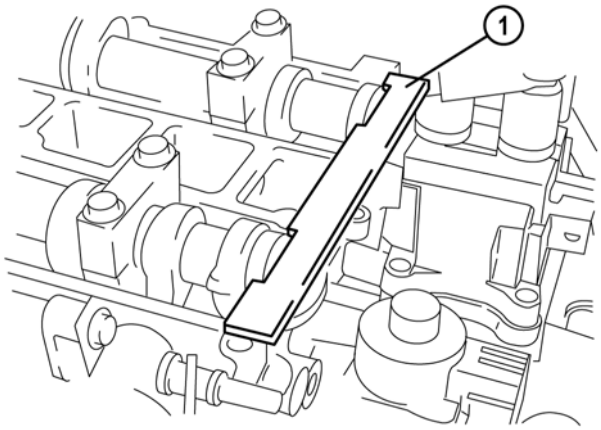
L1001.4_01013

1 Service hole
2 Crankshaft pulley
3 Detent bolt for crankshaft pulley
4 TDC position
5 Crankshaft counterweight of cylinder no.1
6 Timing peg (SST)

- For verifying or adjusting the valve timing a timing plate (SST) has to be installed in the camshafts.

NOTE: Never use the timing plate to hold the camshafts while loosening or tightening the camshaft pulleys. Hold the camshafts using a wrench on the camshaft´s cast hexagon.

NOTE: From a certain build date on specially coated washers are installed between the camshaft sprockets and the camshaft to increase the friction. These washers must be replaced (or installed if not equipped), if the camshaft sprockets have been removed.



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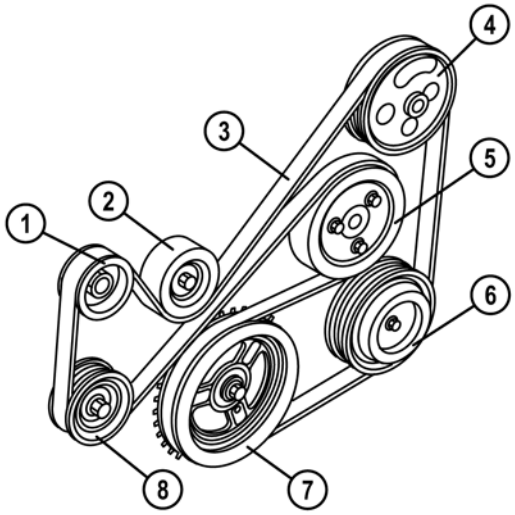
1 Timing plate (SST)

Accessory Drive Belt

- A V-ribbed drive belt is fitted to drive the engine accessories.
- An automatic tensioner provides constant drive belt tension.



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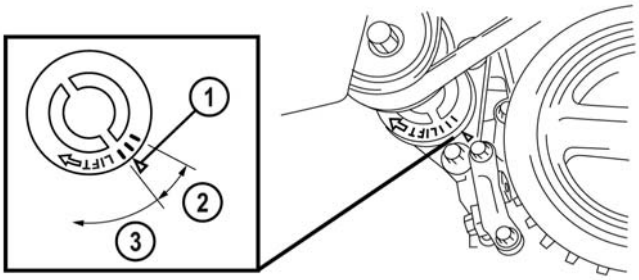
1 Generator pulley
2 Idler pulley
3 Drive belt
4 Power steering pump pulley
5 Water pump pulley
6 A/C compressor pulley
7 Crankshaft pulley
8 Drive belt tensioner pulley

- In order to check the drive belt for wear, verify that the automatic tensioner indicator mark does not exceed the specification.



L1001.4_01016

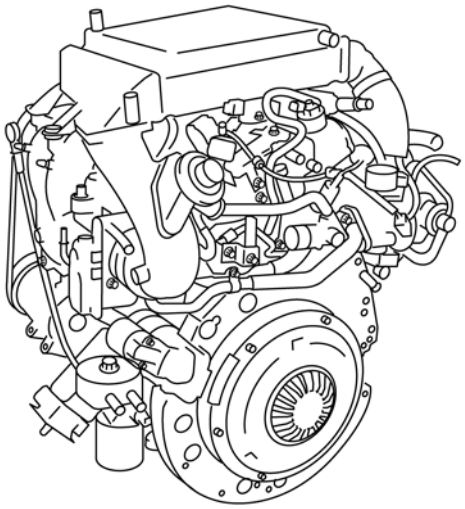
1 Indicator mark
2 Normal
3 Worn

Mechanical (L3-T Engine)

Features

- The mechanical system of the L3-T engine has the following features:
  - Chain driven 16 valve DOHC engine
  - Balancer shaft unit
  - Valve train with automatic timing chain tensioner and mechanical bucket tappets
  - Variable valve timing system for the intake camshaft
  - V-ribbed belt drive with automatic tensioner

Overview



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NOTE: Some of the components of the L3-T engine are very similar in construction and operation to those of the L3 engine. Therefore, this section only describes the components which are new or differ from those of the L3 engine.

Pistons

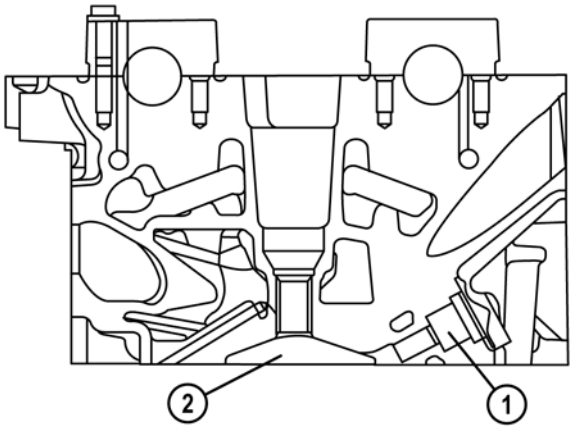
- The shape of the pistons has been adapted to the requirements of the direct injection system, i.e. the piston top is recessed to improve the mixture formation.
- The piston skirt is redesigned due to the modified oil jet valves. In addition, it features a coating to reduce friction between the piston and the cylinder.
- Piston, piston pin and connecting rod are not shrinkage fitted, i.e. the components can be replaced separately.

L1001.4_01018

1 Oil jet release width

Cylinder Head

- Due to the adoption of the direct injection system the cylinder head is equipped with installation holes for the fuel injectors.



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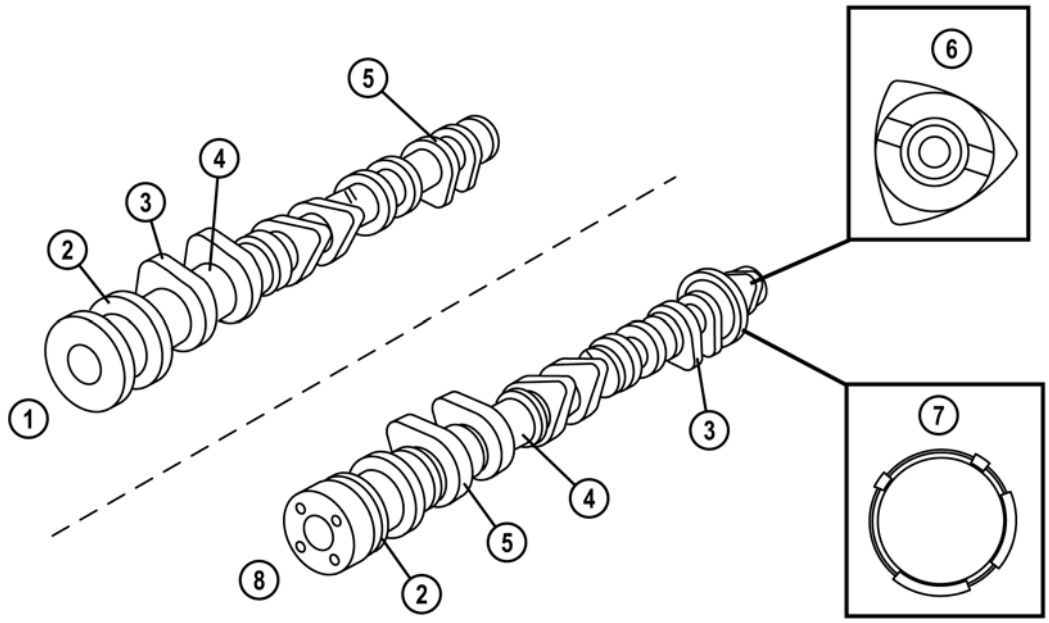
1 Fuel injector installation hole

2 Combustion chamber

Camshafts

- The intake camshaft features a trochoid shaped cam, which drives the high-pressure pump of the direct injection system.

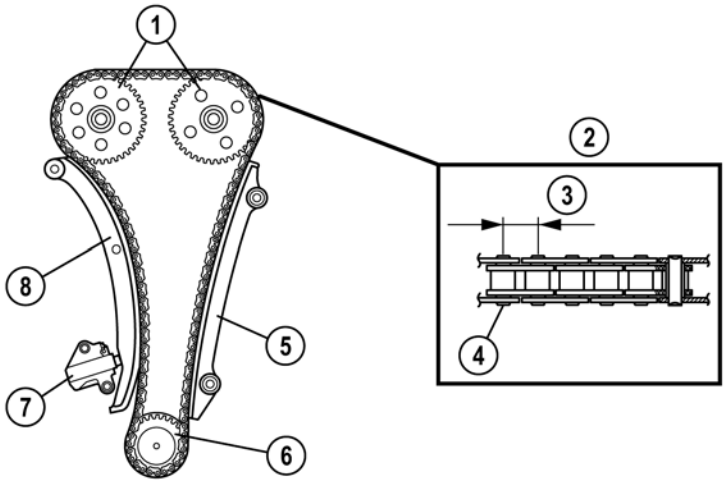


L1001.4_01020

1	Exhaust camshaft	5	Cam heel
2	Thrust collar	6	High-pressure pump drive cam
3	Cam nose	7	Pulse wheel for CMP sensor
4	Cam journal	8	Intake camshaft

Valve Train

- The valve train is equipped with a roller chain and respective sprockets to improve durability.

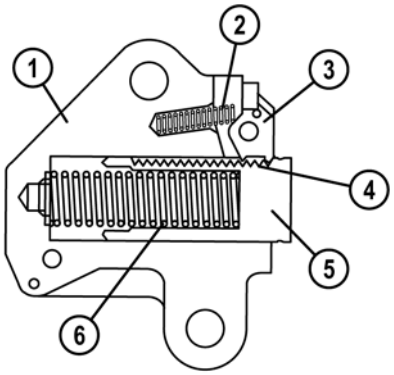


L1001.4_01021

1 Camshaft sprockets
2 Timing chain
3 Pitch size
4 Pin
5 Chain guide
6 Crankshaft sprocket
7 Chain tensioner
8 Chain tensioner arm

Timing Chain Tensioner

- The L3-T engine features a modified automatic timing chain tensioner. However, the operating principle is the same as on the L3 engine.

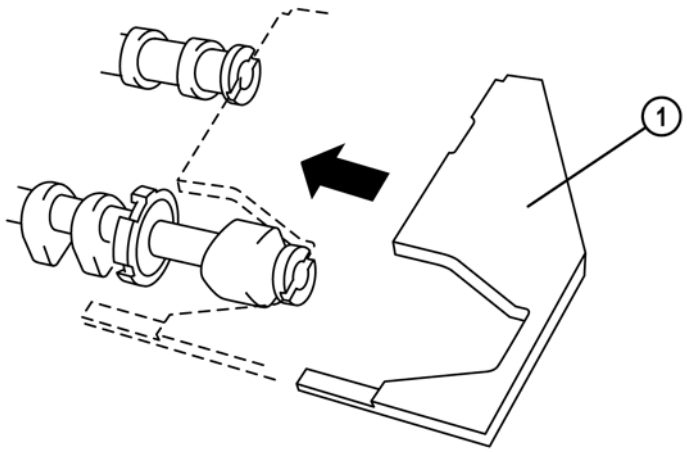


L1001.4_01022

1 Housing
2 Ratchet spring
3 Ratchet
4 Rack
5 Plunger
6 Plunger spring

Valve Timing

- Due to the modified intake camshaft a different timing plate (SST) is required to verify or adjust the valve timing.



L1001.4_01023

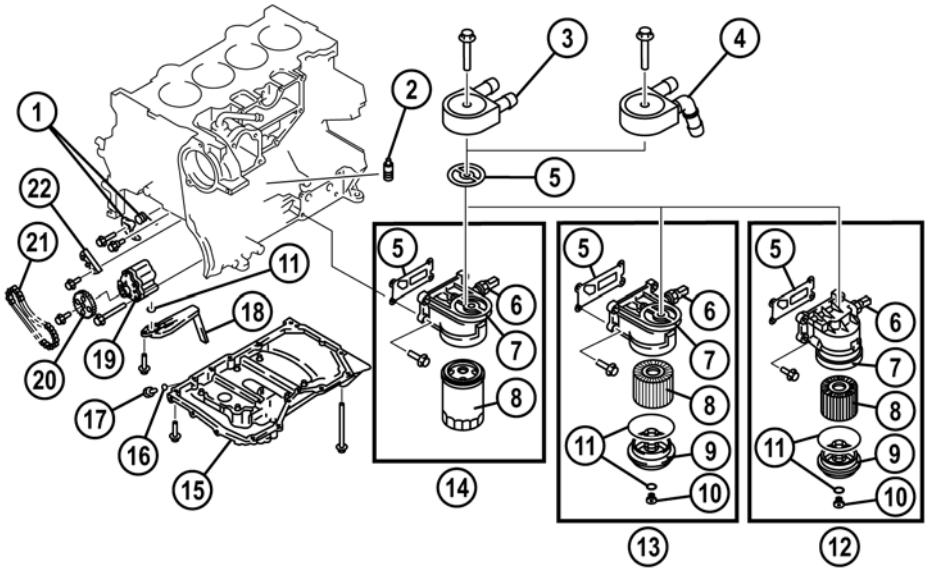
1 Timing plate (SST)

Lubrication

Features

- The lubrication system of the L-type engines has the following features:
  - Chain driven trochoid gear type oil pump
  - Water-cooled type oil cooler (L8 engine only if equipped)
  - Spin-on type or cartridge type oil filter
  - Oil jet valves

Parts Location



L1001.4_01024

Mazda6 GG/GY

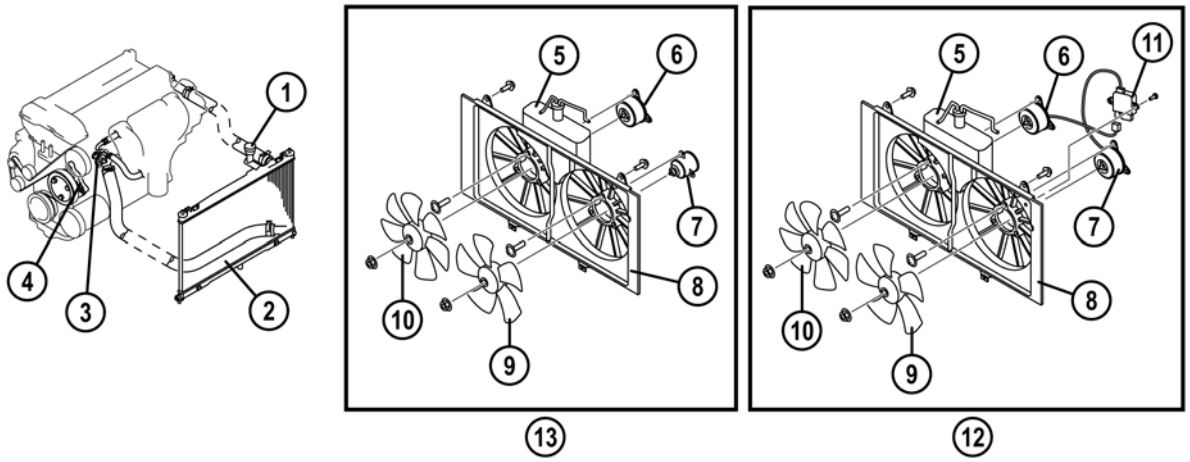
1	Oil pump chain tensioner	12	Cartridge type oil filter without oil cooler (only L8 engine)
2	Oil jet valve	13	Cartridge type oil filter with oil cooler
3	Oil cooler (L8, LF and L3 engine)	14	Spin-on type oil filter
4	Oil cooler (L3-T engine)	15	Oil pan
5	Gasket	16	Washer
6	Oil pressure switch	17	Oil pan drain plug
7	Oil filter adapter	18	Oil strainer
8	Oil filter	19	Oil pump
9	Oil filter cover	20	Oil pump sprocket
10	Oil filter drain plug	21	Oil pump chain
11	O-ring	22	Oil pump chain guide

Cooling System

Features

- The cooling system of the L-type engines has the following features:
  - Water pump driven by the accessory drive belt
  - Unpressurized or pressurized type coolant reserve tank (depending on model)
  - FL22 longlife engine coolant
  - Cooling fan controlled by relays or by a fan control module (depending on model)

Parts Location



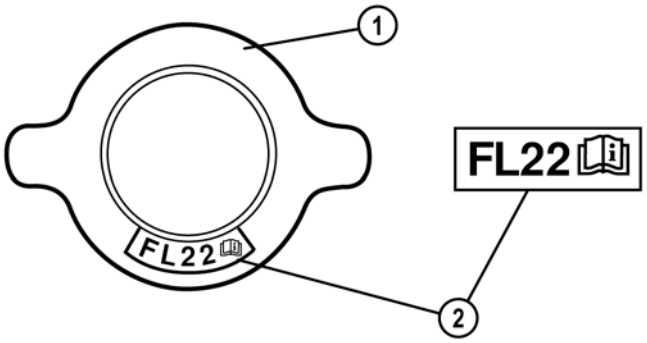
L1001.4_01025

Mazda6 GG/GY

1 Cooling system cap
2 Radiator
3 Thermostat
4 Water pump
5 Coolant reserve tank
6 Cooling fan motor no.2
7 Cooling fan motor no.1
8 Radiator cowling
9 Cooling fan no.1
10 Cooling fan no.2
11 Fan control module
12 Cooling fan component (L3-T engine)
13 Cooling fan component (L8, LF, L3 engine)

Engine Coolant

- For all current Mazda vehicles except for Mazda2 (DY) Mazda has developed a special engine coolant called ‘FL22’. This coolant has a significantly longer replacement interval than conventional coolant. Whereas conventional coolant must replaced at first every 100,000 km or 4 years (whichever occurs first) and after that every 2 years, FL22 coolant must be replaced every 200,000 km or 11 years (whichever occurs first). The only exception are models with L3-T engine (Mazda3 MPS, Mazda6 MPS and Mazda CX-7), which have a coolant replacement interval of 195,000 km or 11 years (whichever occurs first).
- FL22 coolant and conventional coolant are both ethylene glycol-based and can be mixed. They are both green, making them impossible to distinguish visually. For this reason, vehicles designated for use with FL22 coolant have a corresponding label on the radiator cap itself or on the surrounding area.



L1001.4_01142

1 Radiator cap 2 Label

- If the engine coolant on a vehicle designated for use with conventional coolant is replaced by FL22 coolant, the replacement interval changes to 100,000 km or 5 years (whichever occurs first). In order to indicate the new replacement interval, a sticker has to be applied next to the coolant reserve tank (refer to the respective service information for details).

NOTE: When replacing the coolant, the cooling system has to be flushed (refer to the workshop manual for details).

Z-type Engines

- In the Z-type engine line-up the following engines are available:
  - ZJ engine with 1.3 L displacement (also termed as 1.3 MZR engine)
  - Z6 engine with 1.6 L displacement (also termed as 1.6 MZR engine)

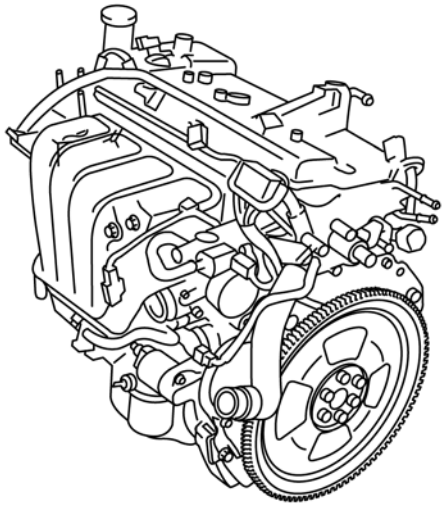
- Both engines are fitted in the Mazda3 models. They are equipped with a multipoint manifold injection system and a distributorless ignition system (direct ignition coils).

Mechanical

Features

- The mechanical system of the Z-type engines has the following features:
  - Chain driven 16 valve DOHC engine
  - Valve train with automatic timing chain tensioner and mechanical bucket tappets
  - Variable valve timing system for the intake camshaft
  - V-ribbed belt drive with automatic tensioner

Overview

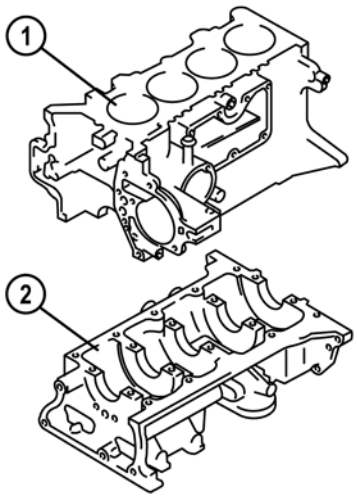


L1001.4_01026

NOTE: Some of the components of the Z-type engine are very similar in construction and operation to those of the L-type engines. Therefore, this section only describes the components which are new or differ from those of the L-type engines.

Cylinder Block

- The cylinder block is equipped with cylinder liners, the coolant jackets of which are open towards the top.
- The cylinder block is composed of an upper and a lower part, in which the main bearing caps are integrated. Upper and lower cylinder block are matched to each other, i.e. they cannot be replaced separately. If one of the components exceeds the specification, the cylinder block must be replaced as a complete unit.



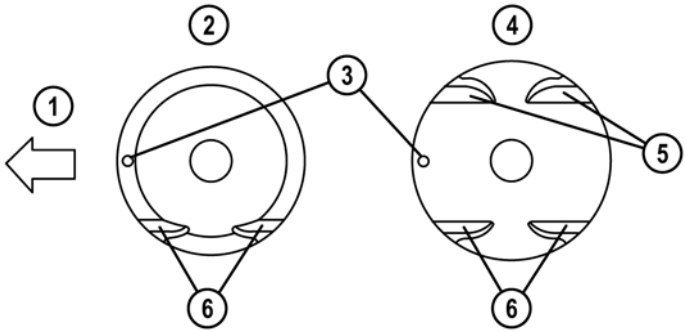
L1001.4_01027

1 Upper cylinder block

2 Lower cylinder block

Pistons

- The pistons of the ZJ engine only have valve recesses on the intake side, whereas the pistons of the Z6 engine have valve recesses on the intake and exhaust side.
- Piston, piston pin and connecting rod are not shrinkage fitted, i.e. the components can be replaced separately.

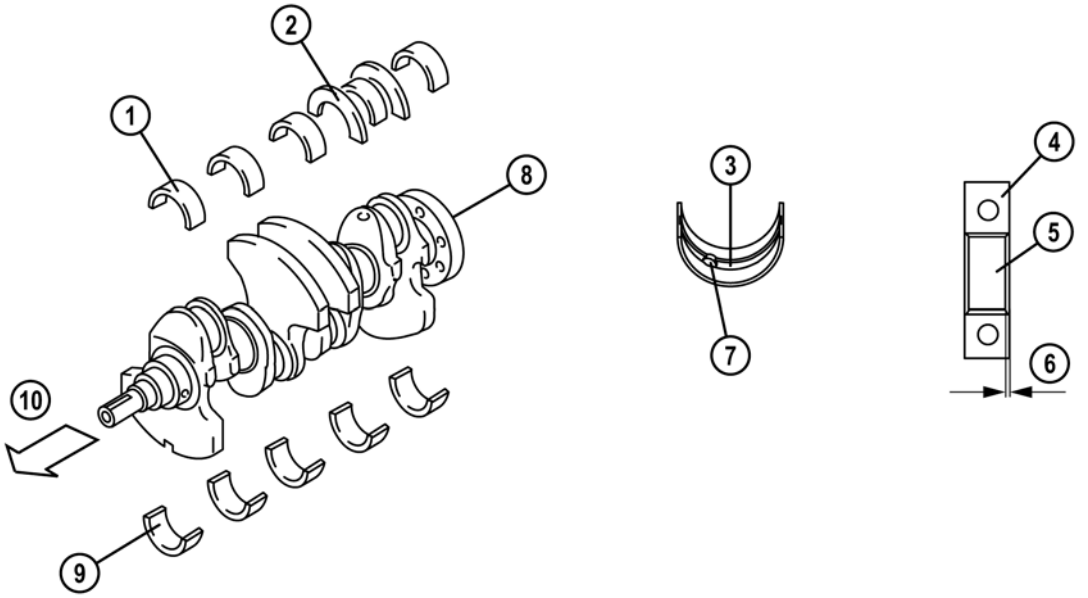


L1001.4_01028

1 Engine front side
2 ZJ engine
3 Dot indicating the installation direction
4 Z6 engine
5 Valve recesses (exhaust side)
6 Valve recesses (intake side)

Crankshaft

- The crankshaft is equipped with a key for the installation of the crankshaft sprocket and the crankshaft pulley.
- The installation procedure for the main bearing shells is the same as on the L-type engines.



L1001.4_01029

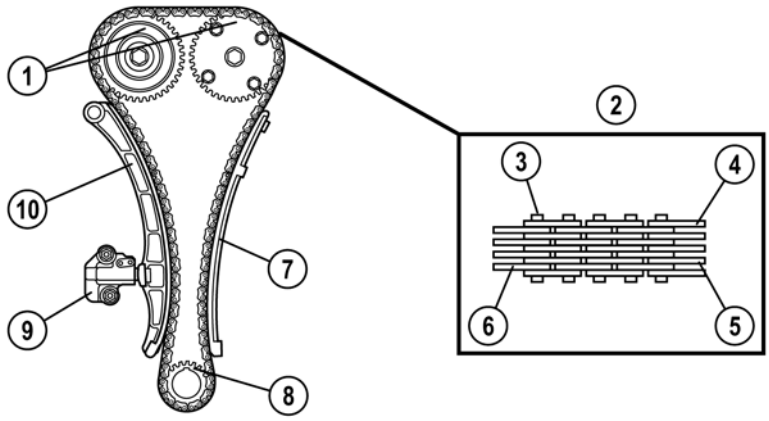
1	Upper main bearing shell	6	Specified measurement
2	Thrust bearing	7	Oil bore
3	Upper main bearing oil groove	8	Crankshaft
4	Main bearing cap	9	Lower main bearing shell
5	Main bearing shell	10	Engine front side

Camshafts

- The camshafts are equipped with a pin for the installation of the camshaft pulleys.
- The intake camshaft is equipped with an oil line supplying oil to the camshaft actuator of the variable valve timing system.
- The intake camshaft has a pulse wheel for the CMP sensor signals.

Valve Train

- The valve train is similar to that of the L-type engines. In addition, the procedure for releasing the timing chain tension is the same as on the L-type engines.

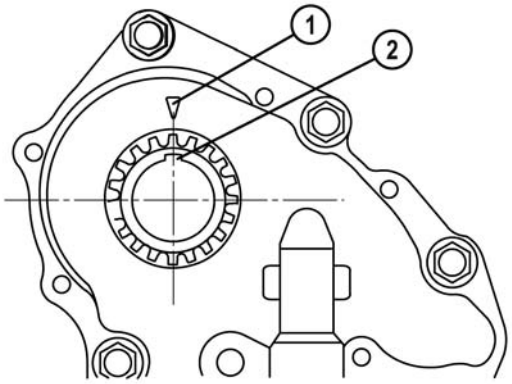


L1001.4_01032

1	Camshaft sprocket	6	Inner plate
2	Timing chain	7	Chain guide
3	Pin	8	Crankshaft sprocket
4	Guide plate	9	Chain tensioner
5	Middle plate	10	Chain tensioner arm

Valve Timing

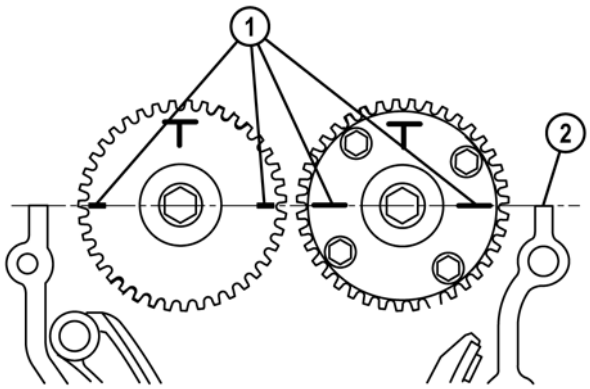
- For verifying or adjusting the valve timing, the crankshaft sprocket key has to be aligned with the timing mark on the oil pump housing.



L1001.4_01034

1 Timing mark
2 Crankshaft sprocket key

- For verifying or adjusting the valve timing, the timing marks on the camshaft sprockets have to be aligned, so that they form a straight line with the upper horizontal surface of the cylinder head.



L1001.4_01035

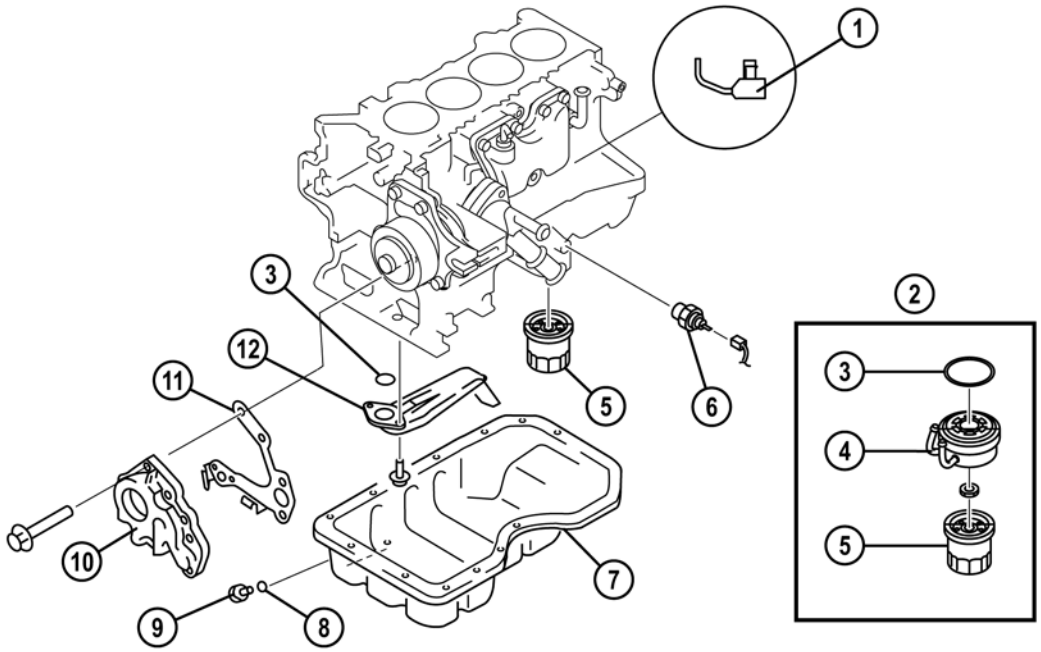
1 Timing marks
2 Cylinder head upper surface

Lubrication

Features

- The lubrication system of the Z-type engines has the following features:
  - Trochoid gear type oil pump, directly driven by the crankshaft
  - Water-cooled type oil cooler (depending on model)
  - Spin-on type oil filter
  - Oil jet valves

Parts Location



L1001.4_01038

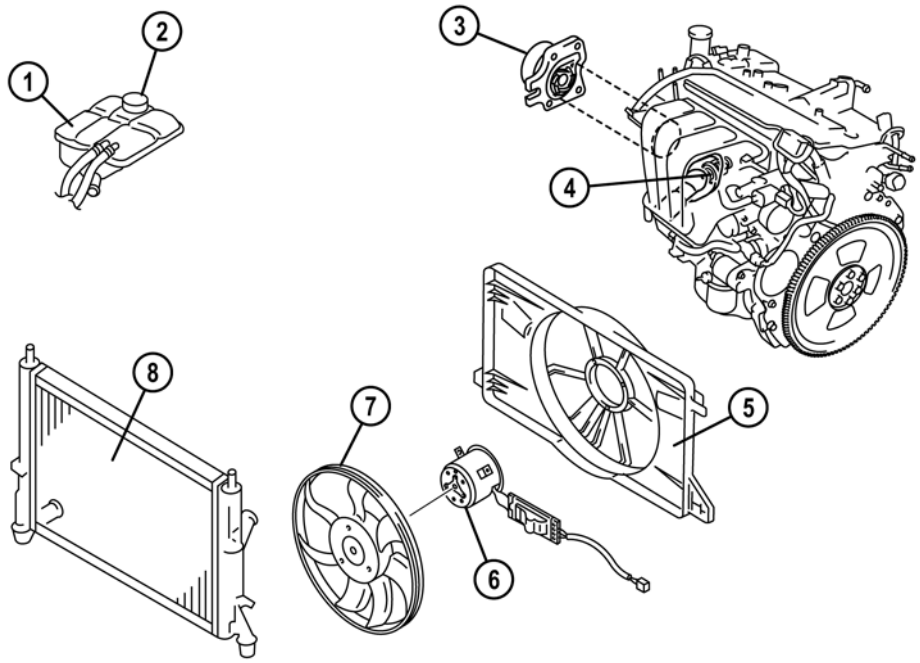
1 Oil jet valve
2 With oil cooler
3 O-ring
4 Oil cooler
5 Oil filter
6 Oil pressure switch
7 Oil pan
8 Washer
9 Oil pan drain plug
10 Oil pump
11 Gasket
12 Oil strainer

Cooling System

Features

- The cooling system of the Z-type engines has the following features:
  - Water pump driven by the accessory drive belt
  - Pressurized type coolant reserve tank
  - FL22 longlife engine coolant
  - Cooling fan with cooling fan motor and integrated fan control module

Parts Location



L1001.4_01039

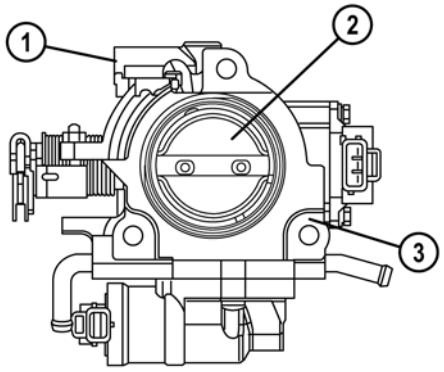
1 Coolant reserve tank
2 Cooling system cap
3 Water pump
4 Thermostat
5 Radiator cowling
6 Cooling fan motor with fan control module
7 Cooling fan
8 Radiator

Service Procedures

Adjusting the Idle Speed

- On the Mazda3 with ZJ and Z6 engine the idle speed must be adjusted at specified service intervals using M-MDS. To perform the procedure select the PIDs **RPM** (Rpm) and **test#** (Mode) in the M-MDS Datalogger, and set the PID test# to ON. Now the **PCM** (**P**owertrain **C**ontrol **M**odule) uses a fixed value for the ignition timing control, so that the idle speed can be adjusted on the air adjusting screw of the throttle body.

NOTE: The throttle body is equipped with a stop screw, which is used by the manufacturer to adjust the fully closed throttle position. Any adjustment of the stop screw is prohibited and can cause malfunctions such as sticking of the throttle valve.



L1001.4_01152

1 Air adjusting screw
2 Throttle valve
3 Throttle body

MZI-type Engines

- In the MZI engine line-up the following engines are available:
  - 1.25 MZI engine with 1.25 L displacement
  - 1.4 MZI engine with 1.4 L displacement
  - 1.6 MZI engine with 1.6 L displacement

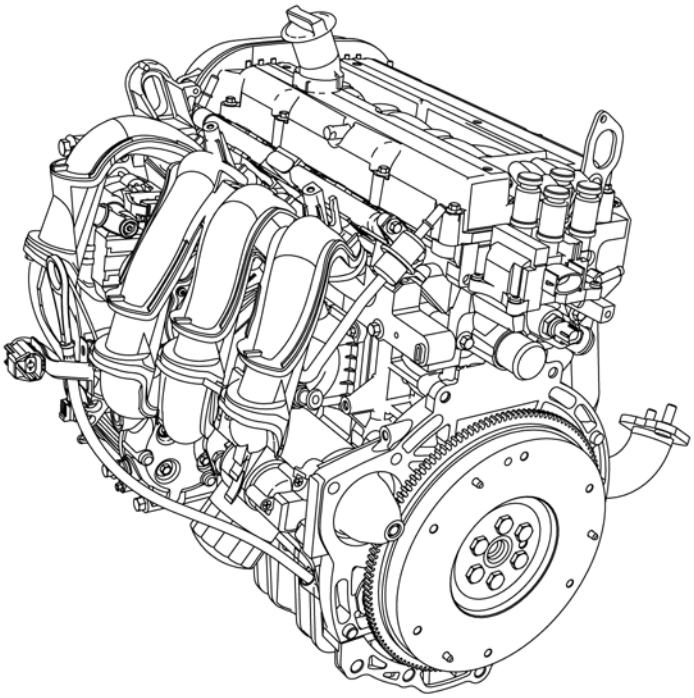
- The MZI-type engines are fitted in the Mazda2 (DY) models. They are equipped with a multipoint manifold injection system and a distributorless ignition system (ignition coil unit).

Mechanical

Features

- The mechanical system of the MZI-type engines has the following features:
  - Belt driven 16 valve DOHC engine
  - Valve train with manual or automatic timing belt tensioner, and mechanical bucket tappets
  - No variable valve timing system
  - V-ribbed belt drive with elastic belts

Overview



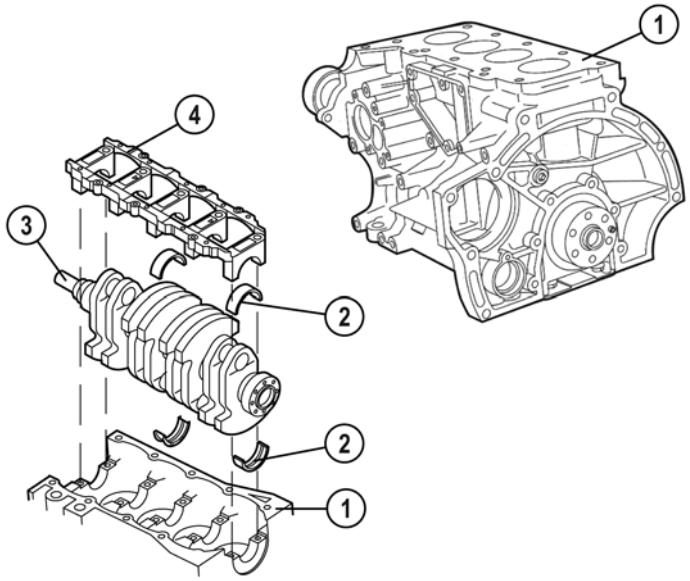
L1001.4_01040

NOTE: Some of the components of the MZI-type engine are very similar in construction and operation to those of the L-type engines. Therefore, this section only describes the components which are new or differ from those of the L-type engines.

Cylinder Block

- The cylinder block features a bearing support frame, in which the main bearing caps are integrated. The bearing support frame is matched to the cylinder block and is not located by means of guide sleeves, i.e. the components of the crank train (crankshaft, connecting rod and piston) cannot be replaced separately. If one of the components exceeds the specification, the cylinder block must be replaced as a complete unit.
- For this reason, a remanufactured cylinder block is available for the MZI-type engines, which is delivered completely with crankshaft, connecting rods, pistons, all oil passage blanking plugs and water drain plugs.

NOTE: Thread repairs on the cylinder block using thread inserts are not permitted.



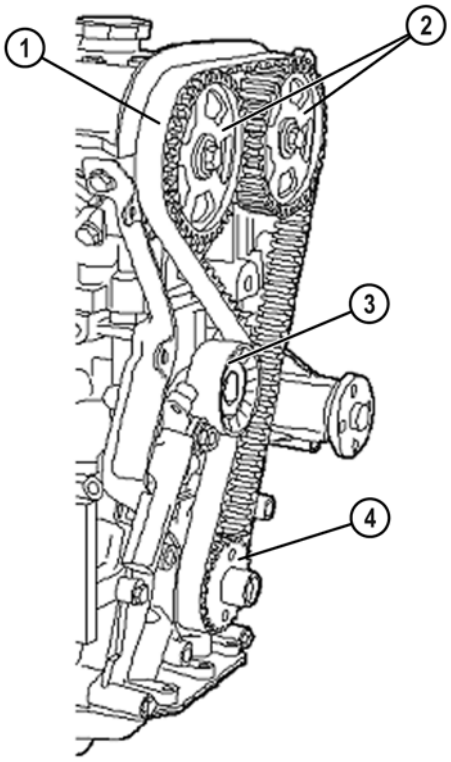
L1001.4_01041

1 Cylinder block
2 Main bearing shells
3 Crankshaft
4 Bearing support frame

Valve Train

- The camshafts are driven by a timing belt, which has to be replaced every 160,000 km or 10 years (whichever occurs first). In addition, the valve clearance must be inspected (and if necessary adjusted) at the same service interval.
- The procedure for verifying or adjusting the valve timing is the same as on the L-type engines.

NOTE: In order to prevent damage to the plastic camshaft pulleys when loosening or tightening the lock bolts, use the pulley holder (SST) with a suitable piece of hose installed to the SST studs.



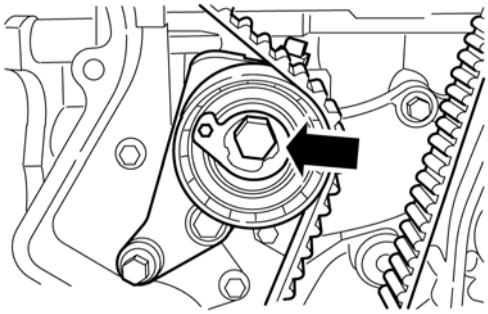
L1001.4_01043

1 Timing belt
2 Camshaft pulleys
3 Timing belt tensioner
4 Crankshaft pulley

Timing Belt Tensioner

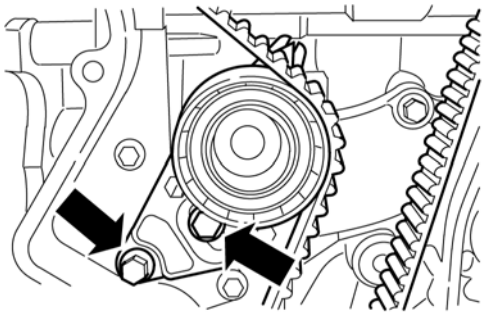
- Depending on the build date of the vehicle different manual or automatic timing belt tensioners are fitted (refer to the workshop manual for details).

NOTE: On vehicles with automatic tensioner do not remove the locking pin (SST), until the timing belt is correctly positioned. Failure to follow this instruction may result in personal injury, or damage to the timing belt tensioner.



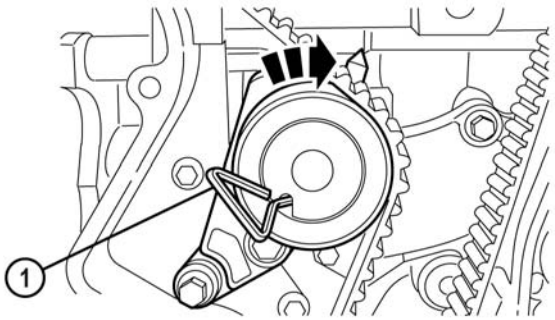
L1001.4_01044

Manual timing belt tensioner with eccentric cam



L1001.4_01045

Manual timing belt tensioner with slotted bracket



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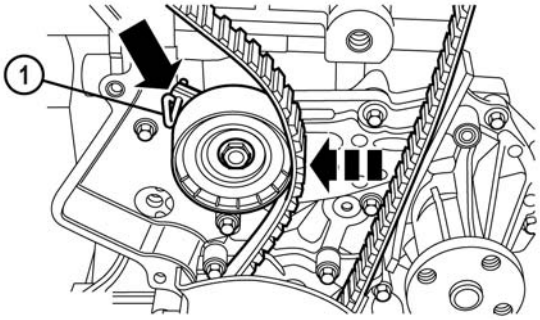
Automatic timing belt tensioner (vehicles built from 09/2003 onwards)

1 Locking pin (SST)



L1001.4_01047

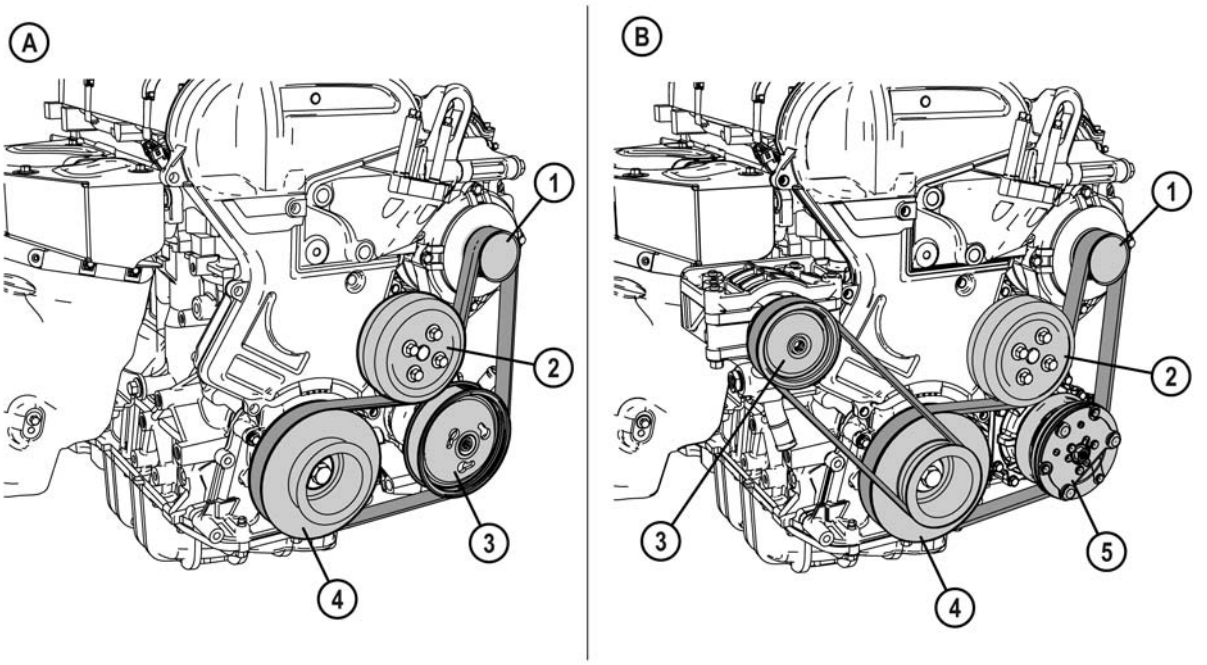
Automatic timing belt tensioner (vehicles built from 04/2005 onwards)

1 Locking pin (SST)

Accessory Drive Belts

- A V-ribbed drive belt is fitted to drive the engine accessories. There are two variants of the accessory belt drive:
  - Vehicles without A/C have one drive belt
  - Vehicles with A/C have two drive belts

- Both variants have elastic drive belts (also termed as stretchy belt), i.e. they do not need a tensioner. Since retensioning is not possible, the drive belt must not be re-used.

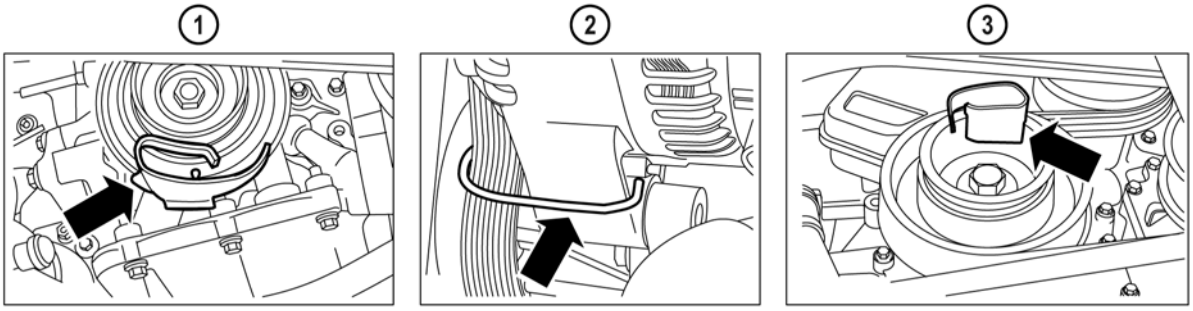


L1001.4_01050

A Vehicles without A/C
B Vehicles with A/C
1 Generator pulley
2 Water pump pulley
3 Power steering oil pump pulley
4 Crankshaft pulley
5 A/C compressor pulley

- In order to remove the drive belt cut it through with a knife. New drive belts are supplied in a service kit, which also contains the SSTs (installation tool and guide tool) required for installation (refer to the workshop manual for details).

NOTE: The SSTs in the service kit are designed for single use only.



L1001.4_01051

1 Installation tool attached to the crankshaft pulley

2 Guide tool attached to the generator bracket

3 Installation tool attached to the crankshaft pulley (for installing the power steering oil pump drive belt on vehicles with A/C)

Lubrication

Features

- The lubrication system of the MZI-type engines has the following features:
  - G-rotor type oil pump, directly driven by the crankshaft
  - Spin-on type oil filter
  - No oil jet valves

Cooling System

Features

- The cooling system of the MZI-type engines has the following features:
  - Water pump driven by the accessory drive belt
  - Pressurized type coolant reserve tank
  - Cooling fan controlled by relays

13B-MSP Rotary Engine

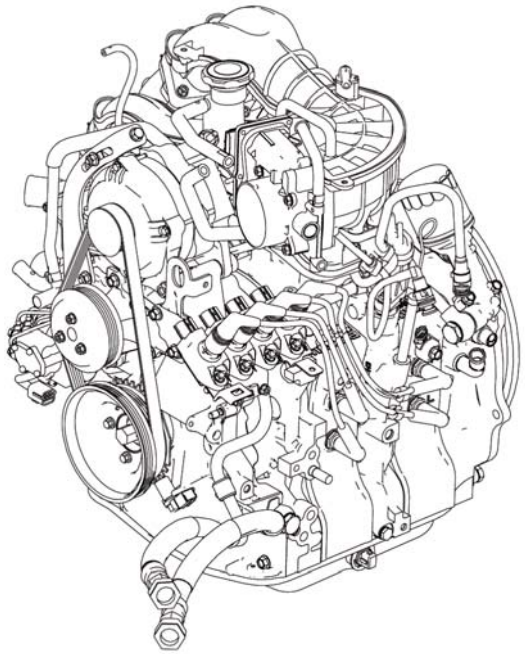
- The 13B-**MSP** (**M**ulti **S**ide **P**ort) rotary engine is fitted in the Mazda RX-8 models, and is available as a standard and a high-power version. It is equipped with a manifold injection system (two injectors per rotor on the standard power engine, and three injectors per rotor on the high-power engine) and a distributorless ignition system (two direct ignition coils per rotor).

Mechanical

Features

- The mechanical system of the 13B-MSP engine has the following features:
  - Rotor housings with side intake and side exhaust ports
  - Rotors with bathtub shaped combustion chambers
  - V-ribbed belt drive with two belts and two manual tensioners

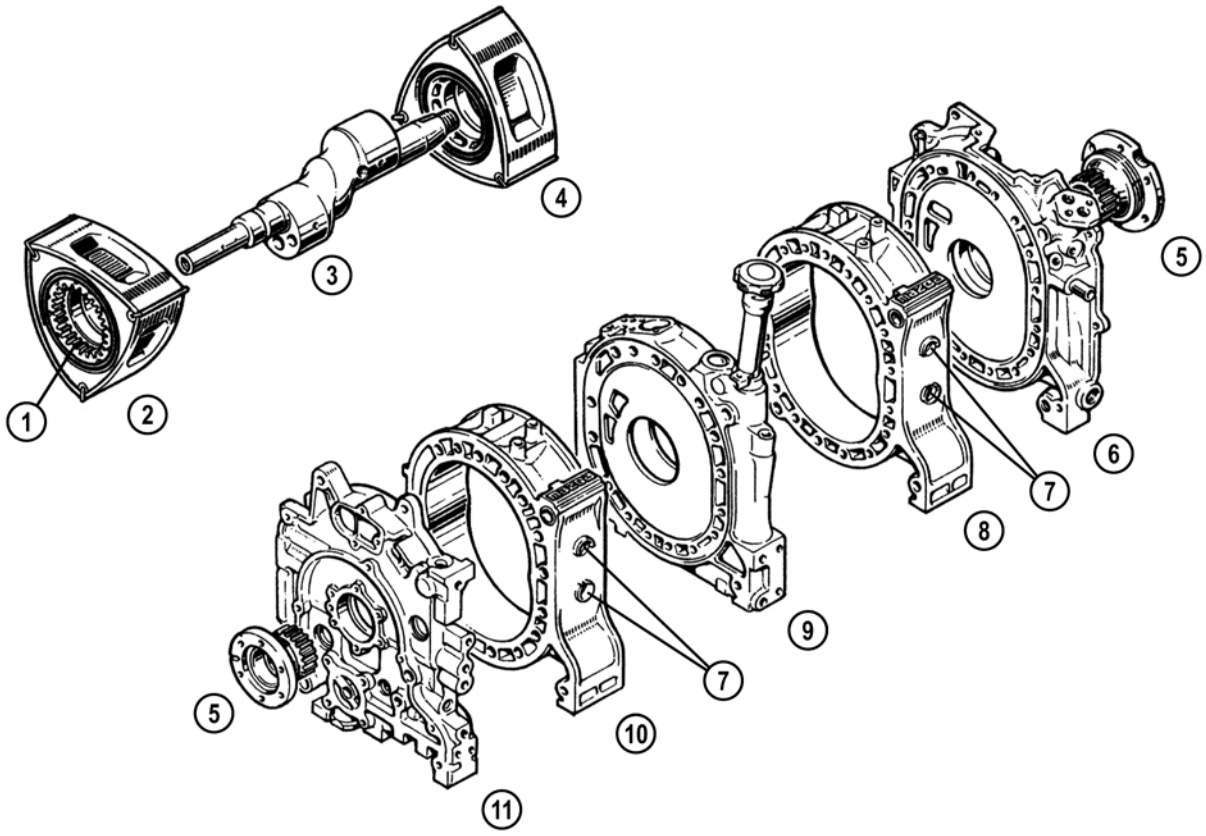
Overview



L1001.4_01114

Construction

- The main components of the rotary engine are the rotors, the eccentric shaft, the rotor housings, the front, rear and intermediate housings.
- The rotor rotates within the rotor housing, which is sandwiched between the intermediate housing on one side, and the front or rear housing on the other, forming a sealed chamber.
- The eccentric shaft transfers the rotational force of the rotors to the transmission.
- The path of the rotor within the rotor housing is determined by the internal and stationary gears, which are phased, so that for every rotation of the rotor, the eccentric shaft rotates three times.



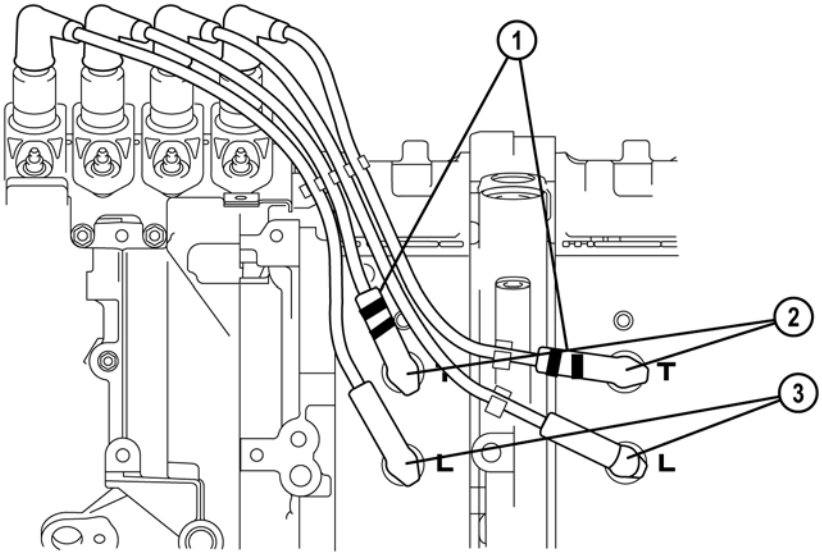
L1001.4_01115

1 Internal gear
2 Front rotor
3 Eccentric shaft
4 Rear rotor
5 Stationary gear
6 Rear housing
7 Spark plug bores
8 Rear rotor housing
9 Intermediate housing
10 Front rotor housing
11 Front housing

- Due to the large bathub shaped combustion chambers the rotary engine is equipped with two spark plugs per rotor housing, improving combustion efficiency and exhaust emissions

NOTE: Two different spark plugs (leading and trailing) with different lengths are mounted in each rotor housing. If a wrong spark plug is used the engine may be damaged (e.g. a spark plug which is too long may contact the rotor).

- The high tension leads for the trailing spark plugs are marked with blue and green tape to prevent incorrect installation.

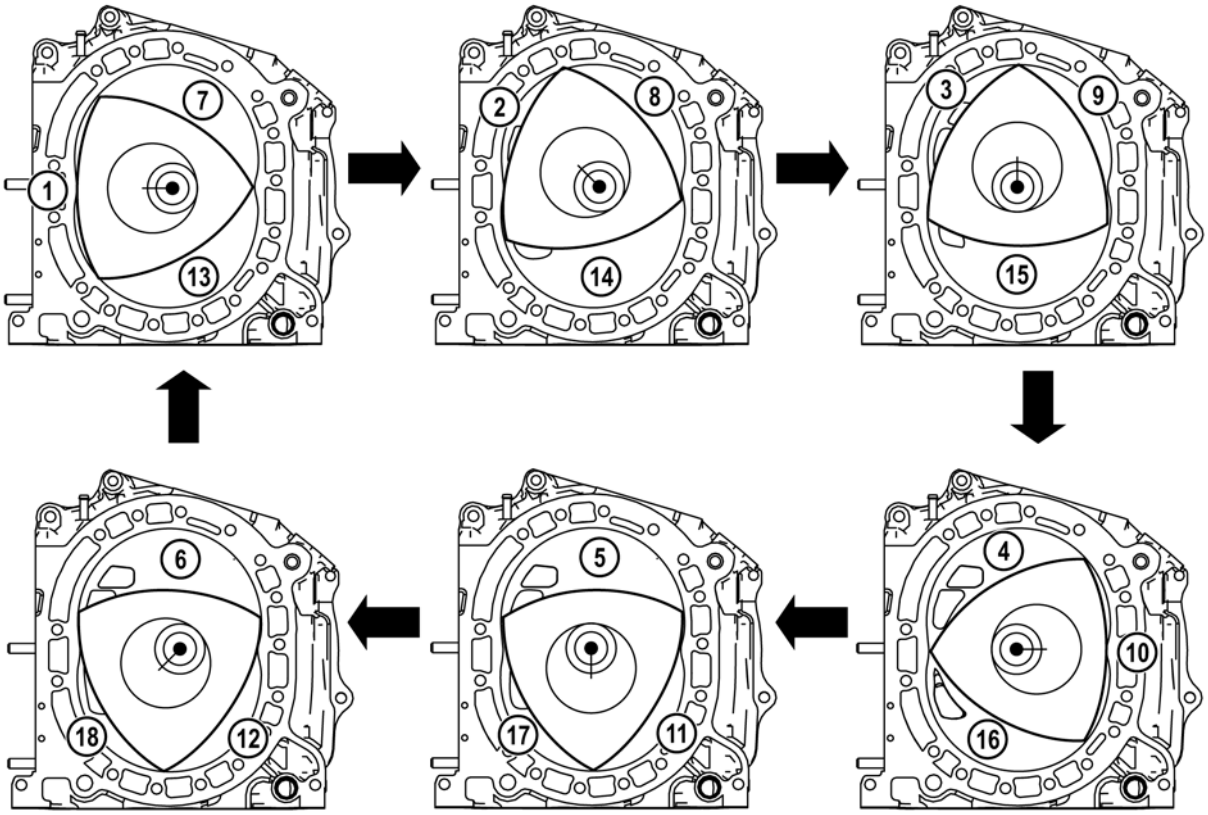


L1001.4_01137

1 Blue and green tape
2 Trailing spark plugs
3 Leading spark plugs

Operating Principle

- In the rotary engine, each of the three faces of the rotor forms a chamber. These three chambers are not interconnected and their combustion cycles vary as described below.
- In much the same way as the four-stroke reciprocating engine, the air/fuel mixture in a rotary engine is subjected to combustion and expansion within the engine, thus converting heat energy to output power.
- However, while the reciprocating engine uses the vertical movement of the pistons and a complex valve mechanism to allow gas exchange, a rotary engine uses the rotation of the rotor to open and close intake and exhaust ports on either side of it.
- Because each rotor has three working chambers, this means that for every single rotation of the rotor three full working cycles (intake, compression, combustion, exhaust) are completed, resulting in three power pulses being delivered to the eccentric shaft for one rotation of the rotor (see explanation on following pages).



L1001.4_01116

Intake Stroke

- The volume of the operating chamber in position 1 is at its minimum, thus corresponding with intake **TDC** (**T**op **D**ead **C**enter) of a reciprocating engine. As the rotor continues to turn from 2 through to 4, the intake ports become increasingly larger and draw in the air/fuel mixture as the intake stroke begins. At the same time, the intake operating chamber increases in capacity, reaching its maximum at 5. At this time, the rotor position corresponds with **BDC** (**B**ottom **D**ead **C**enter) of the intake stroke on a reciprocating engine.

Compression Stroke

- After 5, the intake ports are covered by the rotor, ending the intake stroke. The operating chamber's capacity gradually becomes smaller, compressing the air/fuel mixture as the compression stroke begins. As the rotor turns, the operating chamber capacity becomes smaller and smaller from 6 through to 9, and at 10 when the compression is almost complete, the mixture is ignited by the spark plugs. At 10, the operating chamber's capacity is at its minimum. This is TDC of the compression stroke.

Combustion Stroke

- The mixture ignited at 10 is burnt, pressure and volume increase, and expansion in the operating chamber continues from 11 through to 13. During this time, the combustion energy of the air/fuel mixture is applied to the rotor's surface, and via the eccentric shaft it is converted to rotational energy and used as motive power. At 15, the operating chamber's capacity reaches its maximum as it approaches BDC of the combustion stroke.

Exhaust Stroke

- After completion of combustion, burnt gases are expelled from the exhaust ports as the capacity of the operating chamber decreases from 15 through 18. This is the exhaust stroke, and when this stroke ends there is a return to 1, from where the cycle starts again.

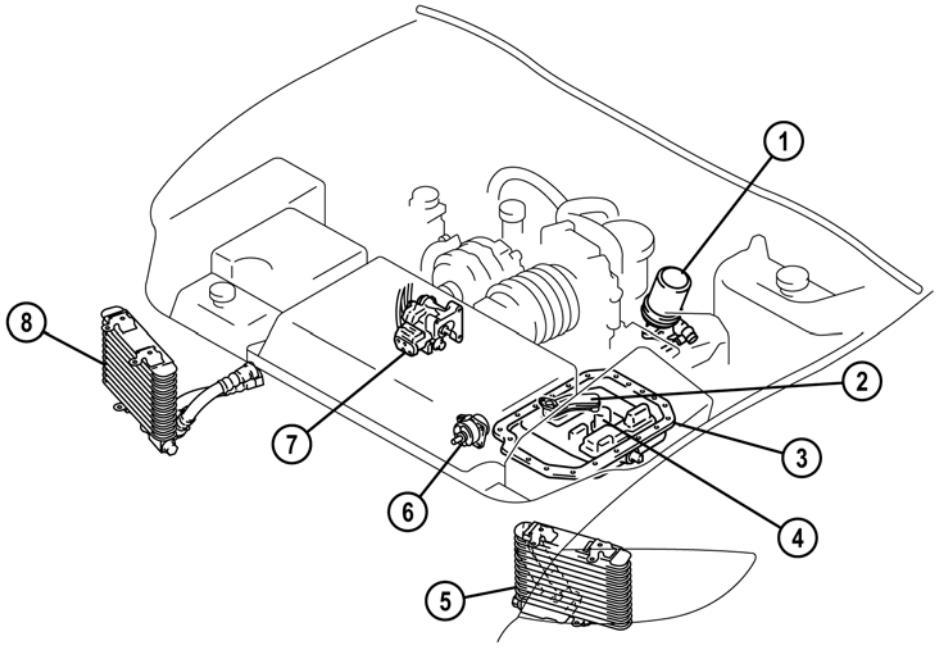
- The above is a description for only one chamber; the other two operate in exactly the same way. As a result of these actions by only one chamber, the rotor makes one rotation (during which the eccentric shaft turns three times), resulting in an intake of the gas mixture followed by compression, combustion and exhaust. Also, because there are three chambers on one rotor, there are three combustion (output) cycles for each revolution of the rotor. In other words, one combustion cycle takes place for each revolution of the eccentric shaft.
- Concerning gas exchange, the cycles of the rotary engine are the same as those of a four-stroke reciprocating engine, but combustion cycles per revolution of the output shaft are the same as on a two-stroke reciprocating engine. Consequently, the rotary engine is a special type of engine that neither falls into the four-stroke nor two-stroke category.

Lubrication

Features

- The lubrication system of the 13B-MSP engine has the following features:
  - Chain driven trochoid gear type oil pump
  - Air-cooled type oil cooler
  - Spin-on type oil filter
  - Metering oil pump with oil nozzles
  - Mazda Dexelia Ultra engine oil

Parts Location



L1001.4_01138

1 Oil filter
2 Oil strainer
3 Oil pan
4 Oil level switch
5 Oil cooler
6 Oil pump
7 Metering oil pump
8 Additional oil cooler (with twin oil cooler)

Engine Oil

- For the rotary engine, Mazda specifies the use of mineral engine oil. If synthetic or semi-synthetic engine oil is used for the rotary engine, carbon deposits may get accumulated in the intake ports and in the combustion chamber. This can cause misfire, knocking and/or power loss as a long-term effect.
- The only semi-synthetic oil released by Mazda for use in rotary engines is ‘Mazda Dexelia Ultra’ engine oil with the specification ACEA A5/B5 (refer to the respective service information for details).

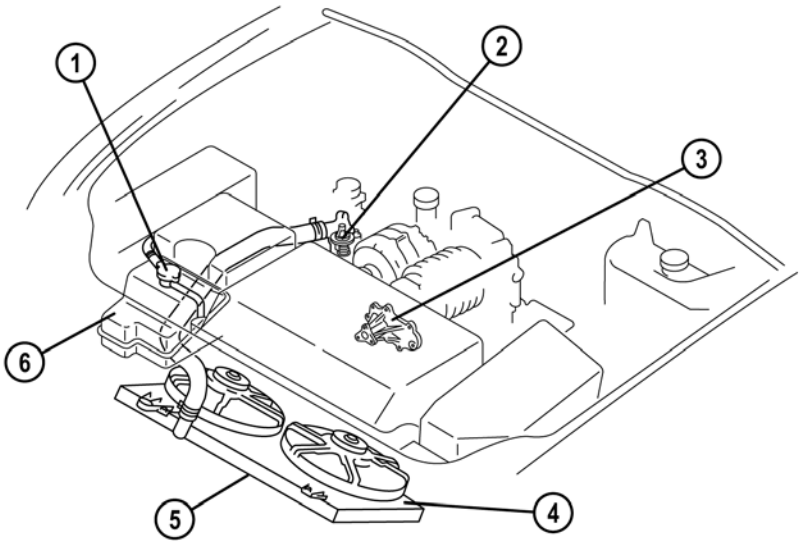
NOTE: Using other than the specified oil (especially synthetic or semi-synthetic oil) could result in engine damage.

Cooling System

Features

- The cooling system of the 13B-MSP engine has the following features:
  - Water pump driven by the accessory drive belt
  - Pressurized type coolant reserve tank
  - FL22 longlife engine coolant
  - Cooling fan controlled by relays

Parts Location



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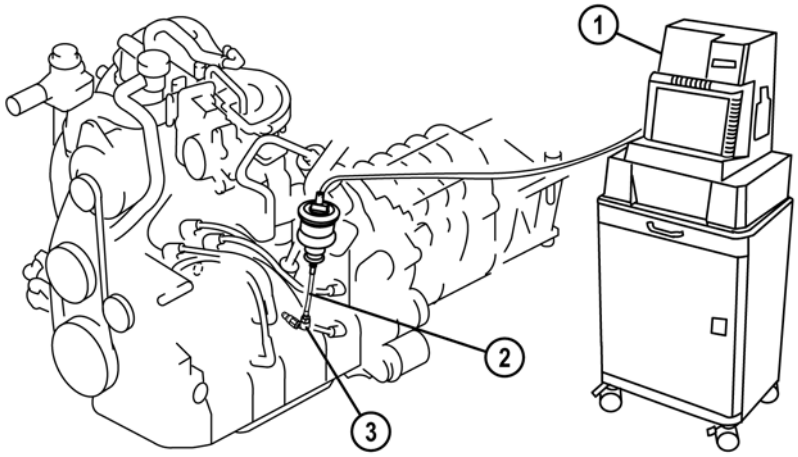
1 Cooling system cap
2 Thermostat
3 Water pump
4 Cooling fan component
5 Radiator
6 Coolant reserve tank

Service Procedures

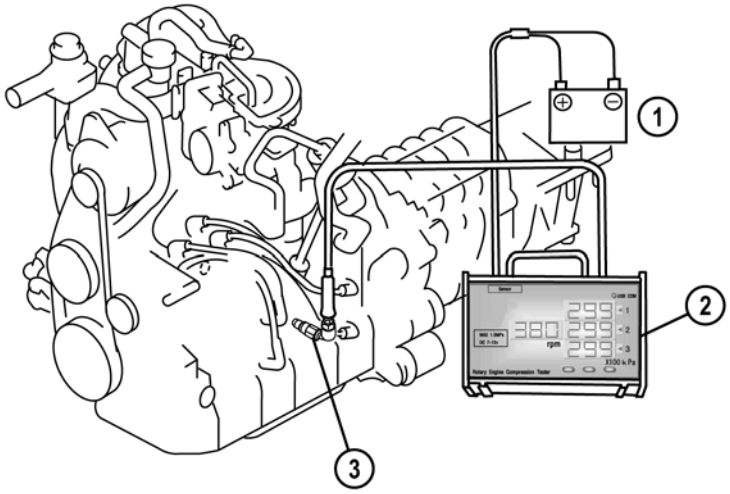
Compression Test

- Since the operation of the rotary engine is different to that of a reciprocating engine, a compression test cannot be performed using a conventional compression tester. For this reason, **WDS** (**W**orldwide **D**iagnostic **S**ystem) or a special rotary engine compression tester (SST) in conjunction with an adapter (SST) must be used (refer to the workshop manual for details).



L1001.4_01136

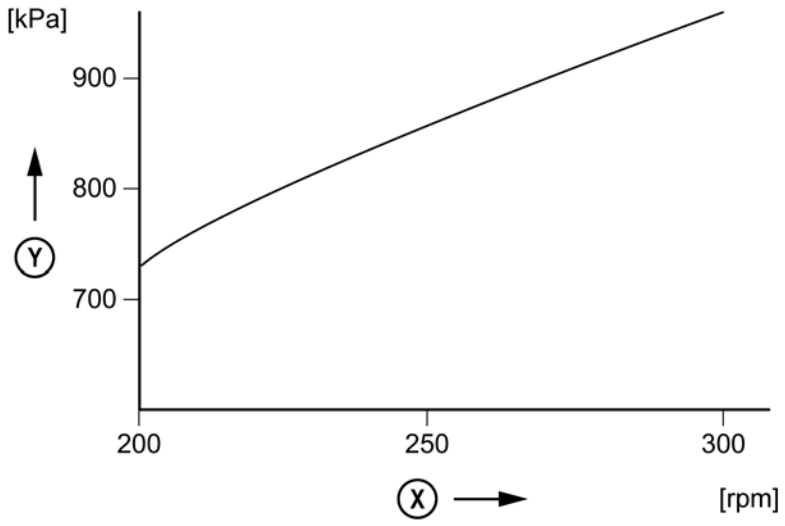
1 WDS
2 Adapter hose (SST)
3 Adapter (SST)



L1001.4_01118

1 Vehicle battery
2 Rotary engine compression tester (SST)
3 Adapter (SST)

NOTE: If the cranking speed during the compression test differs from the specification, the indicated pressure values must be evaluated using the diagram below.



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X Cranking speed
Y Compression pressure

Notes:

Diesel Engines

- The following diesel engine types are fitted in the current Mazda models:

Model / Engine	Y4	Y6	RF-T	WL-C
Mazda2 (DY)	X			
Mazda3		X	X	
Mazda5			X	
Mazda6			X	
Mazda BT-50				X

L1001.4_T01001b

RF-T Engine

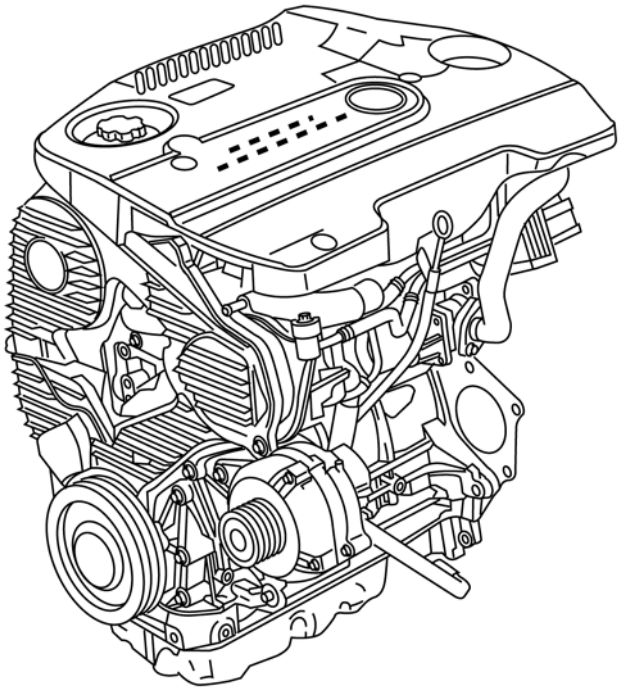
- The RF-T engine with 2.0 L displacement (also termed as 2.0 MZR-CD engine) is fitted in the Mazda3 F/L, the Mazda5 and the Mazda6 models, and is available as a standard and a high-power version. It is equipped with a common rail direct injection system and a **VGT** (**V**ariable **G**eometry **T**urbine) turbocharger.

Mechanical

Features

- The mechanical system of the RF-T engine has the following features:
  - Belt driven 16 valve **SOHC** (**S**ingle **O**ver**h**ead **C**amshaft) engine
  - Valve train with automatic timing belt tensioner, and adjustable roller rocker arms and rocker bridges
  - Vacuum pump and power steering oil pump driven by the camshaft
  - V-ribbed belt drive with automatic tensioner

Overview



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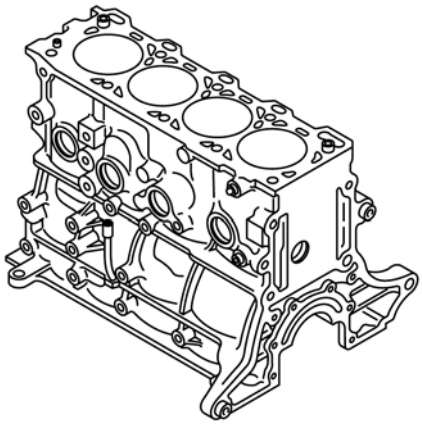
Cylinder Block

- The cylinder block is a conventional construction with separate main bearing caps.



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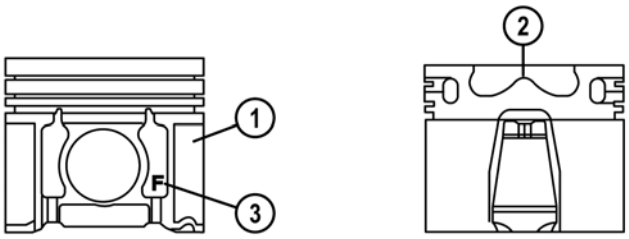
Pistons

- The piston shape meets the requirements of the common rail direct injection system, i.e. the combustion chamber is integrated in the piston head.
- The piston skirt is coated to reduce friction between the piston and the cylinder.

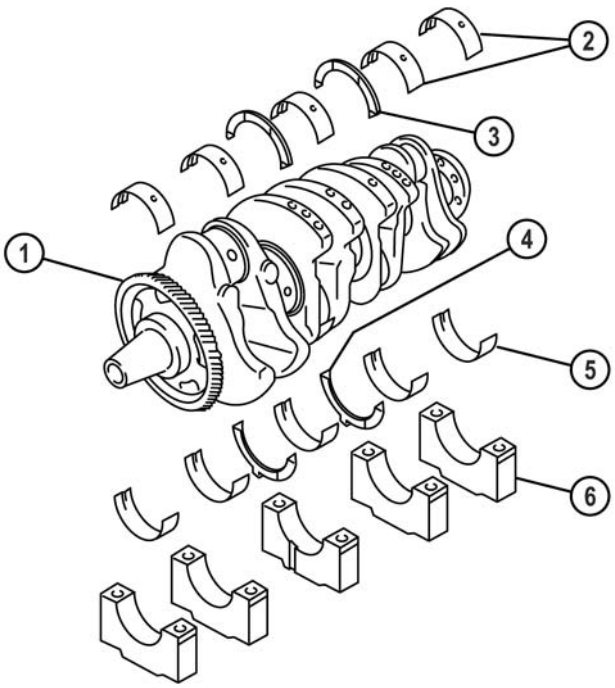


L1001.4_01062

1 Anti-friction coating
2 Combustion chamber
3 F-mark (engine front)

Crankshaft

- The crankshaft is equipped with a key for the installation of the crankshaft timing pulley and the crankshaft pulley.
- In addition, the crankshaft features a drive gear for the oil pump.



L1001.4_01063

1 Oil pump drive gear
2 Upper main bearing shells
3 Upper thrust bearing
4 Lower thrust bearing
5 Lower main bearing shell
6 Main bearing cap

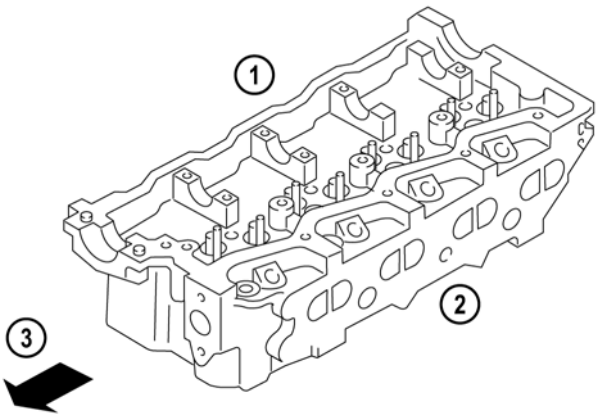
Cylinder Head

- The cylinder head is a conventional construction with separate camshaft bearing caps.
- The cylinder head bolts are torque-to-yield bolts, which must be tightened in several stages (refer to the workshop manual for details).

NOTE: The cylinder head bolts must not be re-used if their length exceeds the specification (refer to the workshop manual for details).

- The leak-off lines for the fuel injectors are integrated in the cylinder head.

NOTE: Always replace the gaskets of the injector leak-off lines when removing them. As the leak-off lines are located under the cylinder head cover, fuel leaking from the lines can contaminate the engine oil. This results in oil dilution and hence in engine damage.



L1001.4_01064

1 Exhaust side
2 Intake side
3 Engine front side

Camshaft

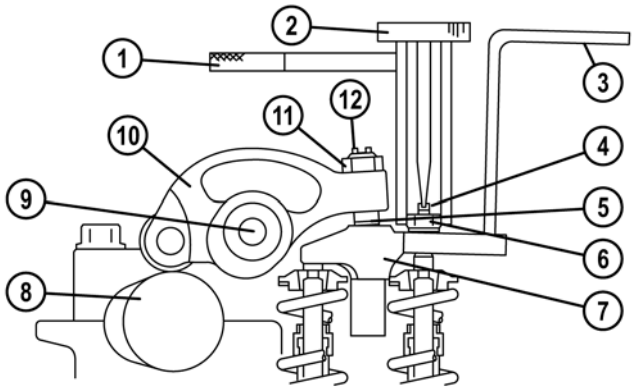
- The camshaft is equipped with a key for the installation of the camshaft pulley.
- The camshaft drives the vacuum pump directly, and the power steering oil pump via a helical gear.

Valve Actuation

- The camshaft actuates the valves via roller rocker arms and rocker bridges.
- The valve clearance has to be measured between roller rocker arm and rocker bridge, and is adjusted through the adjustment screws of roller rocker arm and rocker bridge (refer to the workshop manual for details).

NOTE: In order to prevent damage to the rocker bridge an adjustment wrench set (SST) is required to hold the rocker bridge while loosening or tightening the locknut.

- The valve clearance has to be checked (and adjusted if necessary) for the first time after 20,000 km or 12 months (whichever occurs first). After that it has to be checked (and if necessary adjusted) every 120,000 km or 6 years (whichever occurs first).
- For checking and adjusting of the valve clearances refer to the workshop manual.

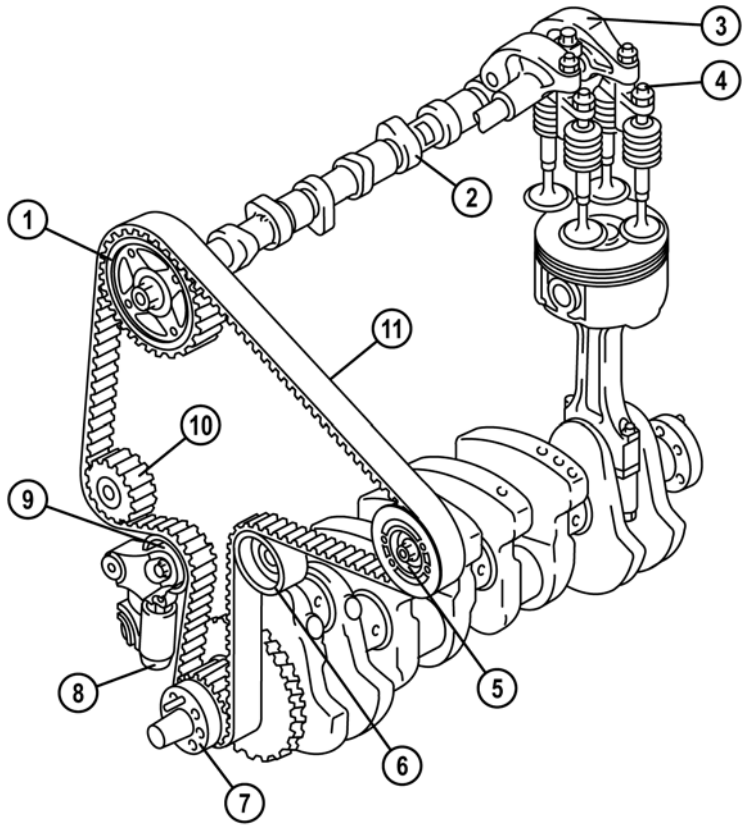


L1001.4_01065

1	SST (for loosening / tightening the locknut)	7	Rocker bridge
2	SST (for adjusting)	8	Camshaft
3	SST (for holding the rocker bridge)	9	Rocker arm shaft
4	Adjusting screw (rocker bridge)	10	Roller rocker arm
5	Measuring point for valve clearance	11	Locknut (rocker arm)
6	Locknut (rocker bridge)	12	Adjusting screw (rocker arm)

Valve Train

- The camshaft is driven by a timing belt, which has to be replaced every 120,000 km.

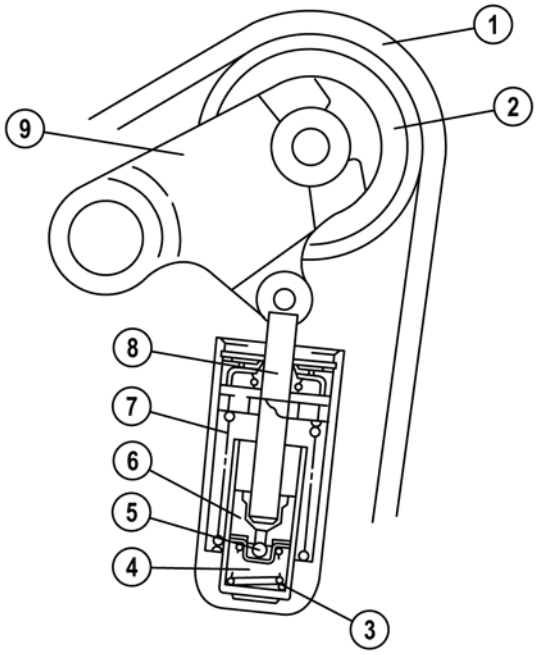


L1001.4_01066

1	Camshaft pulley	7	Crankshaft pulley
2	Camshaft	8	Timing belt tensioner
3	Rocker arm	9	Tensioner pulley
4	Rocker bridge	10	Water pump pulley
5	Fuel high-pressure pump pulley	11	Timing belt
6	Idler pulley		

Timing Belt Tensioner

- An automatic timing belt tensioner is fitted to ensure optimum belt tension over the service life of the engine.
- The timing chain tensioner operates using a hydraulic mechanism, which also compensates the increased belt tension due to heat expansion of the engine components.



L1001.4_01120

1 Timing belt
2 Tensioner pulley
3 Plunger spring
4 Pressure chamber
5 Check valve
6 Plunger
7 Spring
8 Tensioner rod
9 Tensioner arm

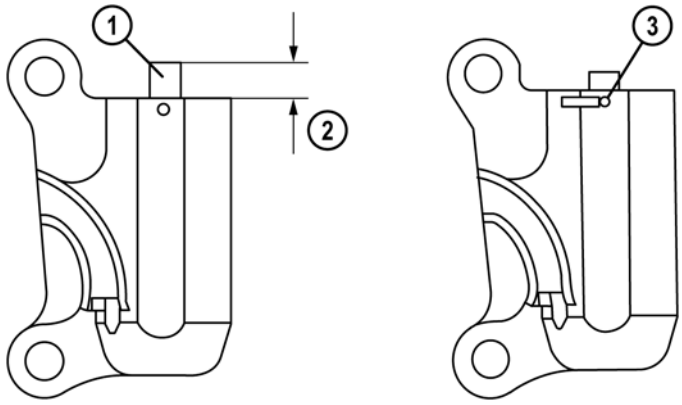
- When replacing the timing belt, the timing belt tensioner has to be checked as following (refer to the workshop manual for details):
  - Measure the tensioner rod projection length.
  - Inspect the tensioner for oil leakage.
  - Verify the thrust/resistance of the tensioner.

NOTE: If the tensioner rod projection length and/or tensioner thrust/resistance exceeds the specification and/or there is an oil leakage, replace the timing belt tensioner.

- Before installing the timing belt tensioner, the tensioner rod has to be pushed down and secured by inserting a locking pin with 1.5 mm diameter (refer to the workshop manual for details).

NOTE: Placing the timing belt tensioner horizontally while pushing the tensioner rod can cause oil leakage and damage the automatic tensioner.

NOTE: To prevent damage to the timing belt tensioner, the tensioner rod has to be pushed slowly with a force not greater than the specified 235 N. The tensioner rod must not touch the bottom.



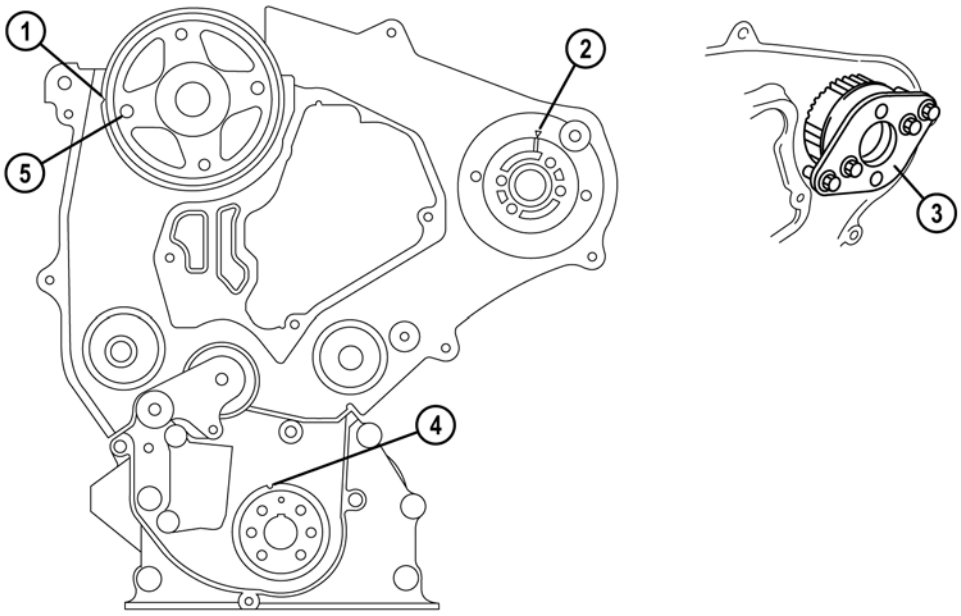
L1001.4_01067

1 Tensioner rod
2 Tensioner rod projection length
3 Locking pin

Valve Timing

- For verifying or adjusting the valve timing the timing marks have to be aligned as shown below (refer to the workshop manual for details).
- Before installing the timing belt the camshaft pulley must be fixed to the cylinder head using a bolt (M8 x 1.25). In addition, the fuel high-pressure pump pulley has to be locked against rotation with the aid of the **FIP** (**F**uel **I**njection **P**ump) repair kit (part no. RFY1-13-SMO).

NOTE: In order to prevent damage to the camshaft pulley, the detent bolts do not have to be fully tightened.

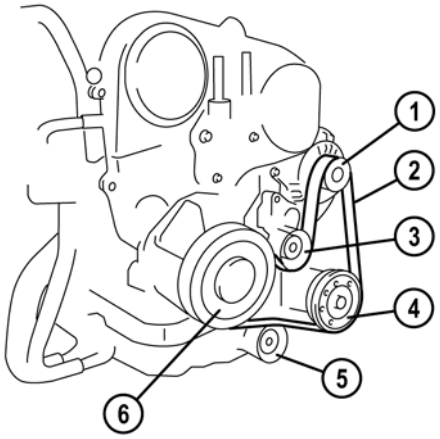


L1001.4_01068

1 Timing mark (camshaft pulley)
2 Timing mark (fuel high-pressure pump pulley)
3 FIP repair kit
4 Timing mark (crankshaft pulley)
5 Hole for detent bolt

Accessory Drive Belt

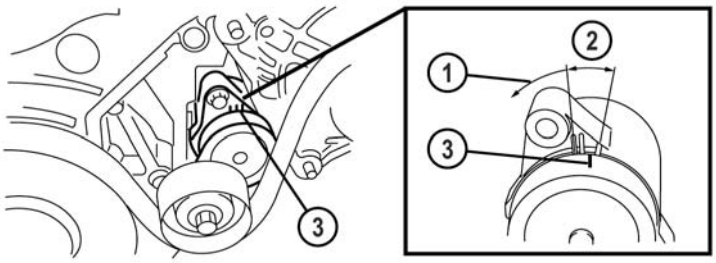
- A V-ribbed drive belt is fitted to drive the engine accessories.
- An automatic tensioner provides constant drive belt tension.



L1001.4_01069

1	Generator pulley	4	A/C compressor pulley
2	Drive belt	5	Idler pulley
3	Drive belt tensioner pulley	6	Crankshaft pulley

- In order to check the drive belt for wear, verify that the automatic tensioner indicator mark does not exceed the specification.



L1001.4_01070

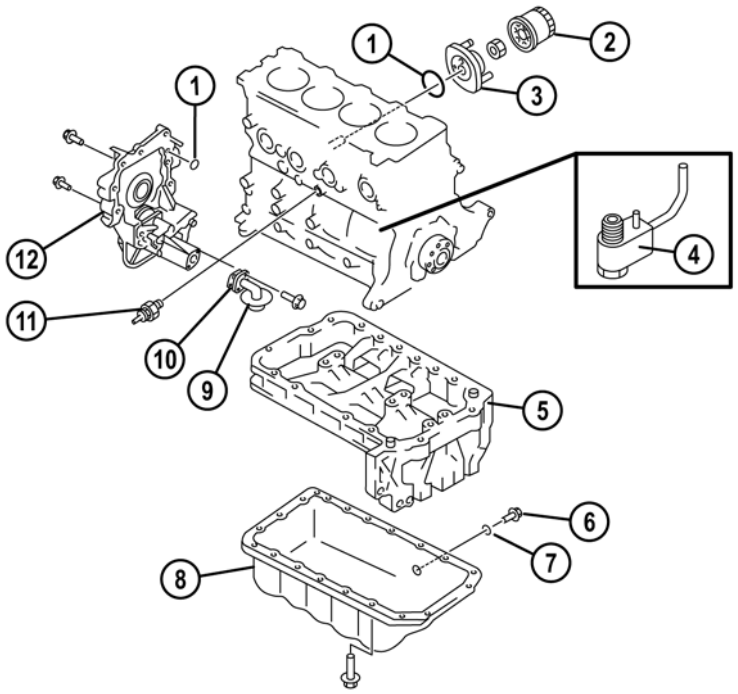
1	Worn	3	Indicator mark
2	Normal		

Lubrication

Features

- The lubrication system of the RF-T engine has the following features:
  - Trochoid gear type oil pump, directly driven by the crankshaft
  - Water-cooled type oil cooler
  - Spin-on type oil filter
  - Oil jet valves
  - Mazda Dexelia DPF engine oil

Parts Location



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1	O-ring	7	Washer
2	Oil filter	8	Oil pan
3	Oil cooler	9	Oil strainer
4	Oil jet valve	10	Gasket
5	Oil pan upper block	11	Oil pressure switch
6	Oil pan drain plug	12	Oil pump

Engine Oil

- For vehicles with RF-T engine and **DPF** (**D**iesel **P**articulate **F**ilter), Mazda has developed special engine oil called ‘Mazda Dexelia DPF’. This oil meets the specification ACEA C1, and has a significantly lower ash formation than normal engine oil. As a result of its very low ash formation in comparison to other engine oils, ‘Mazda Dexelia DPF’ guarantees lifetime performance of the DPF.

NOTE: If other than the specified oil is used, the service life of the DPF will be shortened.

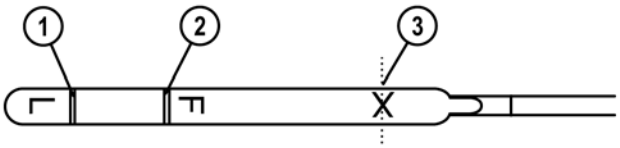
- In general, the ash forming additives in the engine oil protect the valve train against wear. Since oil with ACEA C1 specification has 62 % less ash forming additives than oil with ACEA A3/B4 specification, the RF-T engines on vehicles with DPF feature a modified valve train, ensuring durability of the engine.

NOTE: Engine oil with ACEA C1 specification must only be used for vehicles with RF-T engine and DPF. Since other engines (diesel as well as petrol) do not feature a modified valve train (even the Mazda6 pre-F/L and the Mazda MPV with RF-T engine), excessive wear would occur when engine oil with ACEA C1 specification is used, leading to severe engine damages (refer to the respective service information for details).

Oil Dipstick

- Since the multiple fuel injections required to regenerate the DPF can lead to an excessively high engine oil dilution, an “X” mark has been added to the oil dipstick to make the customer aware of this condition. If the oil level is close to or exceeds the “X” mark, the engine oil must be replaced.

NOTE: Every time the engine oil is replaced, the parameter “Calculated oil dilution” in the PCM must be reset (refer to the section “Service Procedures”).



L1001.4_01148

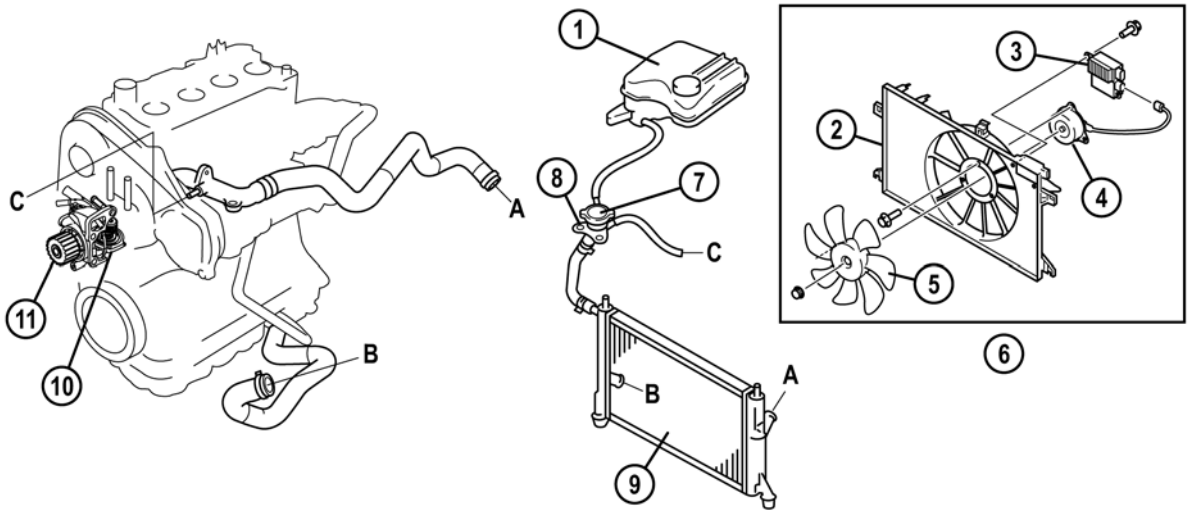
1 L mark (**L**ow)
2 F mark (**F**ull)
3 X mark (E**x**cessive)

Cooling System

Features

- The cooling system of the RF-T engine has the following features:
  - Timing belt driven water pump
  - Unpressurized or pressurized type coolant reserve tank (depending on model)
  - FL22 longlife engine coolant
  - Cooling fan controlled by relays or by a fan control module (depending on model)

Parts Location



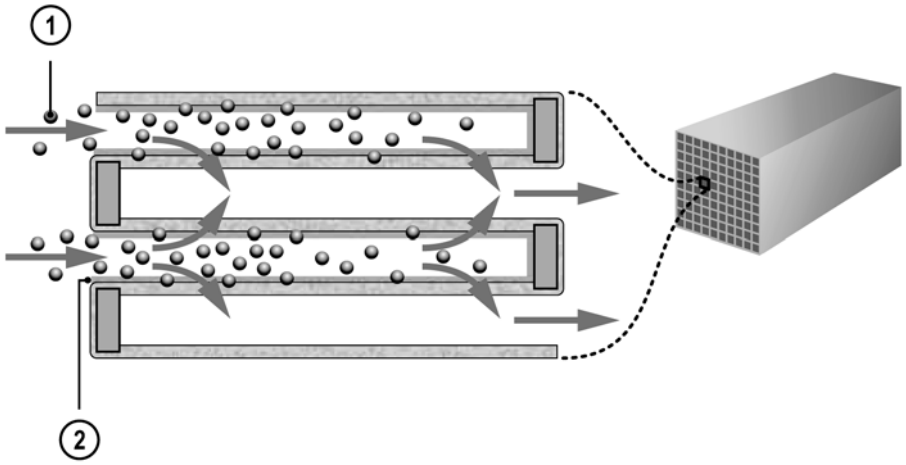
L1001.4_01072

Mazda5

1 Coolant reserve tank
2 Radiator cowling
3 Fan control module
4 Cooling fan motor
5 Cooling fan
6 Cooling fan component
7 Cooling system cap
8 Cooling system filler neck
9 Radiator
10 Thermostat
11 Water pump

Diesel Particulate Filter System

- The DPF is a honeycomb structure with many channels closed off at alternate ends. The soot particulates contained in the exhaust gas accumulate at the porous dividing walls, while gaseous components such as CO and HC pass through the filter with no problem.
- To prevent the filter becoming blocked with soot particulates, it must be ‘regenerated’ at certain intervals, i.e. the collected soot particulates are burnt off. In order to facilitate the regeneration process, the channels of the DPF feature a catalytic coating that lowers the temperature required to burn off the soot particulates.



L1001.4_01147

1 Soot 2 Catalytic coating

- Pressure and temperature sensors in the DPF detect when the soot accumulation capacity of the filter is reached. Then the engine control system increases the exhaust gas temperature by multiple fuel injections to burn off the particulates.

Service Procedures

Replacing the Engine Oil

- Every time the engine oil is replaced, the parameter “Calculated oil dilution” in the PCM must be reset with the aid of **M-MDS** (**M**azda-**M**odular **D**iagnostic **S**ystem). To perform the procedure select the option **Toolbox→Powertrain→Data Reset→Engine Oil** and follow the instructions of M-MDS.

Injection Amount Learning Function

- The injection amount learning function is used to compensate the deviations in the injection amount due to mechanical wear of the injectors, achieving a smooth engine operation. The injection amount correction function is carried out by the PCM under specific conditions. In addition, the injection amount learning function has to be carried out at specified service intervals by means of M-MDS. To perform the procedure select the option **Toolbox→Powertrain→Engine Checks→Learning→Injection Amount Correction** and follow the instructions of M-MDS.

NOTE: The injection amount learning function is performed several times at a pressure of 35 MPa, 65 MPa, 100 MPa and 140 MPa. As a result, slight changes in engine sound are normal.

NOTE: The injection amount learning function will be aborted, if the idle fluctuations of the engine are too high (e.g. due to a faulty injector).

DPF Manual Regeneration

- If the DPF indicator light is illuminated and the DPF is blocked due to an excessive soot amount accumulated, it must be manually regenerated with the aid of M-MDS. To perform the procedure select the option **Toolbox→Powertrain→DPF→DPF Regeneration** and follow the instructions of M-MDS.
- Depending on the amount of soot accumulated in the DPF the PCM automatically selects normal regeneration mode (34 min) or long regeneration mode (60 min).
- In order to cancel the manual regeneration process perform the following procedure:
  1. Depress the clutch pedal, shift to 1st gear and verify that the engine speed decreases to idle speed (manual regeneration is cancelled).
  2. Shift to Neutral and increase the engine speed to 3000 min^{-1} for 1 min (DPF is cooled).
  3. If the manual regeneration must be performed again, wait for approx. 5 min before re-starting the regeneration process.

NOTE: Always perform the manual regeneration in a well ventilated place and use an appropriate exhaust-gas extraction system. The vehicle should also not be stationed in front of any flammable or low heat resistant material, since high temperature exhaust gas is emitted during this process. In addition, the hood should be opened to prevent the engine from overheating. Do not apply electrical load (such as turning on the headlights or rear window defroster) during manual regeneration, since the post injection amount is changed and regeneration may not be performed correctly.

NOTE: If the exhaust gas temperature during manual regeneration exceeds a certain limit, the PCM stops the regeneration process and increases the engine speed to 2500 min^{-1} to cool the DPF.

NOTE: Depending on the amount of soot accumulated the PCM performs normal and long regeneration mode one after another, i.e. the regeneration process may take up to 94 min. If the DPF indicator light does not extinguish after the manual regeneration is finished, perform the regeneration process again.

WL-C Engine

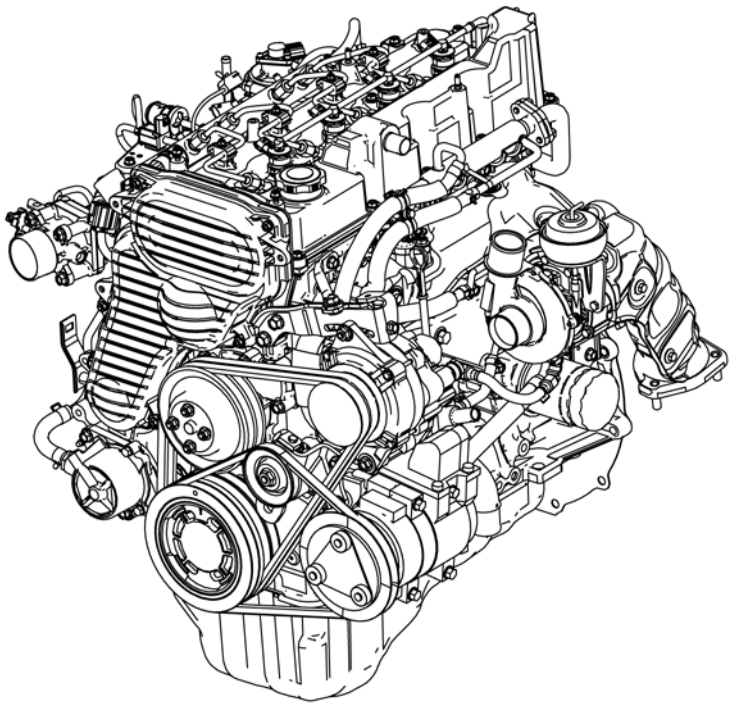
- The WL-C engine with 2.5 L displacement (also termed as 2.5 MZR-CD engine) is fitted in the BT-50 models. It is equipped with a common rail direct injection system and a VGT turbocharger.

Mechanical

Features

- The mechanical system of the WL-C engine has the following features:
  - Gear and belt driven 16 valve DOHC engine
  - Balancer shafts
  - Valve train with automatic timing belt tensioner and adjustable roller cam followers
  - Vacuum pump and power steering oil pump driven by the timing gears
  - V-belt drive with three belts and two manual tensioners

Overview



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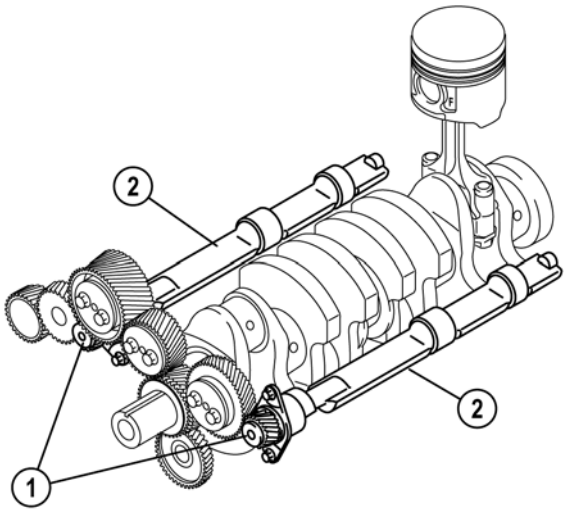
NOTE: Some of the components of the WL-C engine are very similar in construction and operation to those of the RF-T engine. Therefore, this section only describes the components which are new or differ from those of the RF-T engine.

Balancer Shafts

- The balancer shafts are directly fitted into the cylinder block. The crankshaft drives the balancer shafts via helical gears.



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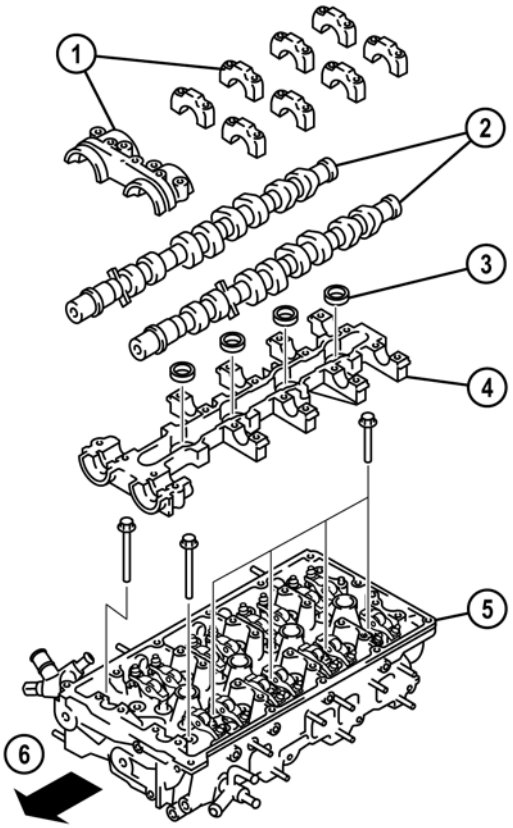
1 Balancer shaft gears

2 Balancer shaft

Cylinder Head

- The cylinder head features a bolted on camshaft bearing frame, which can be replaced separately.
- The cylinder head gasket is available in three different thicknesses depending on the piston protrusion. The gasket is marked respectively (refer to the workshop manual for details).
- The cylinder head bolts are torque-to-yield bolts, which must be tightened in several stages (refer to the workshop manual for details).

NOTE: The cylinder head bolts must not be re-used if their length exceeds the specification (refer to the workshop manual for details).

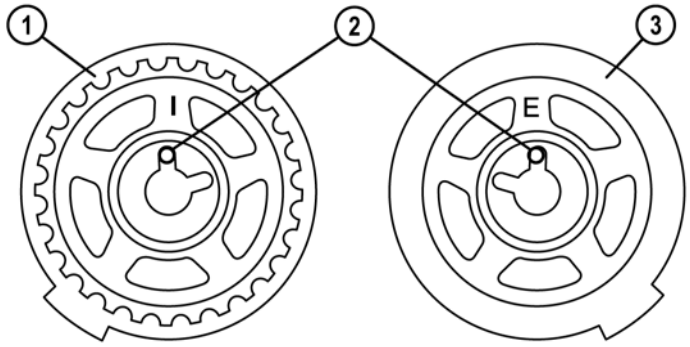


L1001.4_01076

1 Camshaft bearing caps
2 Camshafts
3 Injector sealing ring
4 Camshaft bearing frame
5 Cylinder head
6 Engine front side

Camshaft

- The camshafts are equipped with a pin for the installation of the camshaft pulleys.
- The camshaft pulleys for the intake and exhaust camshaft are identical. A letter (“I” for intake and “E” for exhaust) on the camshaft pulleys indicates the installation position, i.e. the letter on the camshaft pulley must be aligned with the pin on the camshaft.



L1001.4_01141

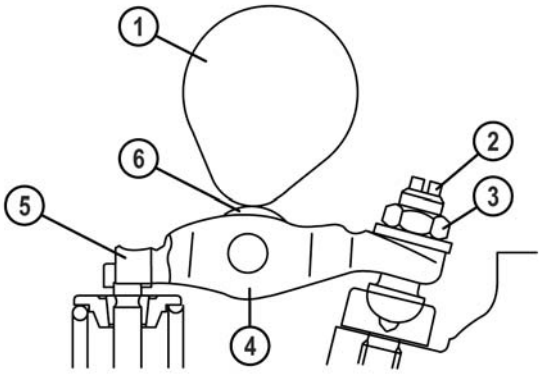
1 Intake camshaft pulley
2 Pin
3 Exhaust camshaft pulley

Valve Actuation

- The camshafts actuate the valves via roller cam followers.
- The valve clearance has to be measured between the roller cam follower and the cam lobe, and is adjusted through the adjusting screw of the roller cam follower (refer to the workshop manual for details).

NOTE: In order to prevent damage to the claw of the roller cam follower when loosening the locknut of the adjusting screw, the cam lobe must push down the roller cam follower firmly (refer to the illustration below).

- The valve clearance has to be checked (and if necessary adjusted) for the first time after 20,000 km or 12 months (whichever occurs first). After that it has to be checked (and if necessary adjusted) every 120,000 km or 6 years (whichever occurs first).

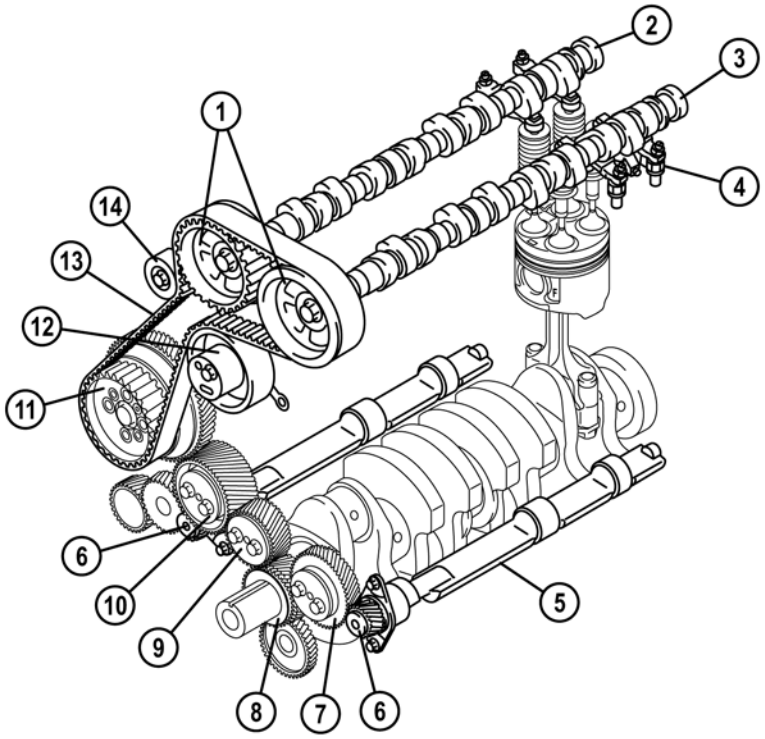


L1001.4_01077

1 Cam lobe
2 Adjusting screw
3 Locknut
4 Roller cam follower
5 Claw
6 Roller

Valve Train

- The camshafts are driven via a timing belt by the fuel high-pressure pump pulley/gear, which in turn is driven via helical gears by the crankshaft.
- The timing belt and the timing belt tensioner have to be replaced every 120,000 km.

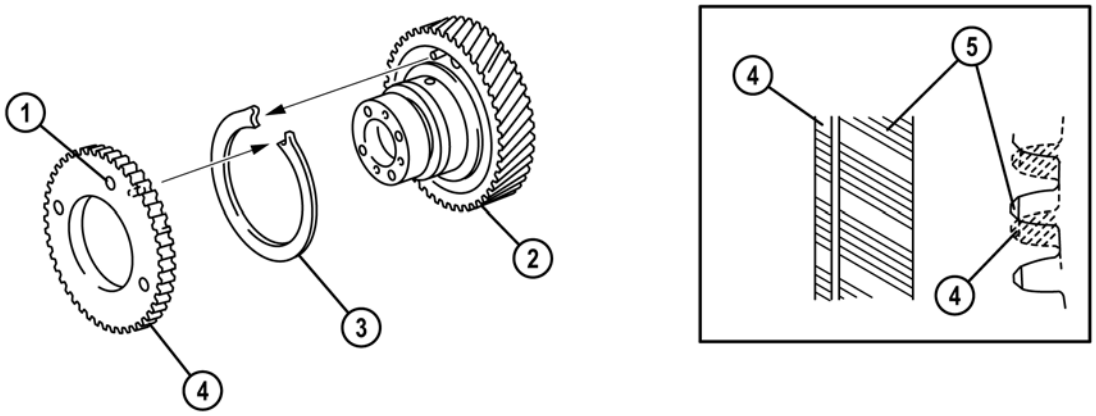


L1001.4_01078

1	Camshaft pulley	8	Crankshaft gear
2	Intake camshaft	9	Idler gear no.1
3	Exhaust camshaft	10	Idler gear no.2
4	Roller cam follower	11	Fuel high-pressure pump pulley/gear
5	Balancer shaft	12	Tensioner pulley
6	Balancer shaft gear	13	Timing belt
7	Idler gear no.3	14	Idler pulley

- The crankshaft gear and the fuel high-pressure pump gear are equipped with friction gears. The spring-loaded friction gears eliminate the backlash between the meshing gears, reducing gear noise.

NOTE: Before removing the fuel high-pressure pump gear, the friction gear must be fixed to the fuel high-pressure pump gear using a detent bolt (M6 x 1.0, length approx. 16 mm) to prevent it from rotating due to the spring force.

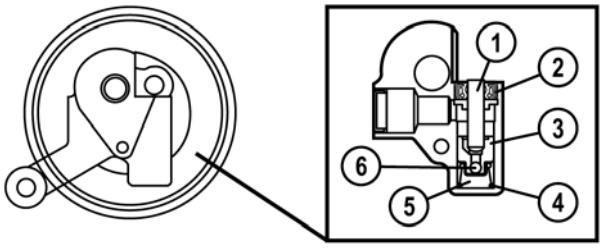


L1001.4_01153

1 Hole for detent bolt
2 Fuel high-pressure pump gear
3 Spring
4 Friction gear
5 Helical gear

Timing Belt Tensioner

- The WL-C engine features a modified automatic timing belt tensioner with integrated tensioner pulley. However, the operating principle is the same as on the RF-T engine.



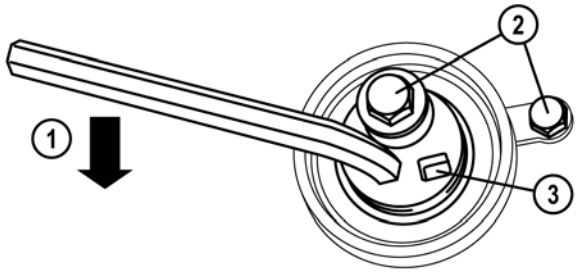
L1001.4_01080

1 Tensioner rod
2 Seal
3 Plunger
4 Plunger spring
5 Pressure chamber
6 Check valve

- For releasing the belt tension the timing belt tensioner has to be turned counterclockwise with an Allen key, and secured by inserting a locking pin with 6 mm diameter (refer to the workshop manual for details)..

NOTE: When removing the timing belt tensioner, the tensioner pulley must not be separated from the tensioner housing.

NOTE: In case air has entered the pressure chamber of the timing belt tensioner, it must be bled using a certain procedure (refer to the workshop manual for details).



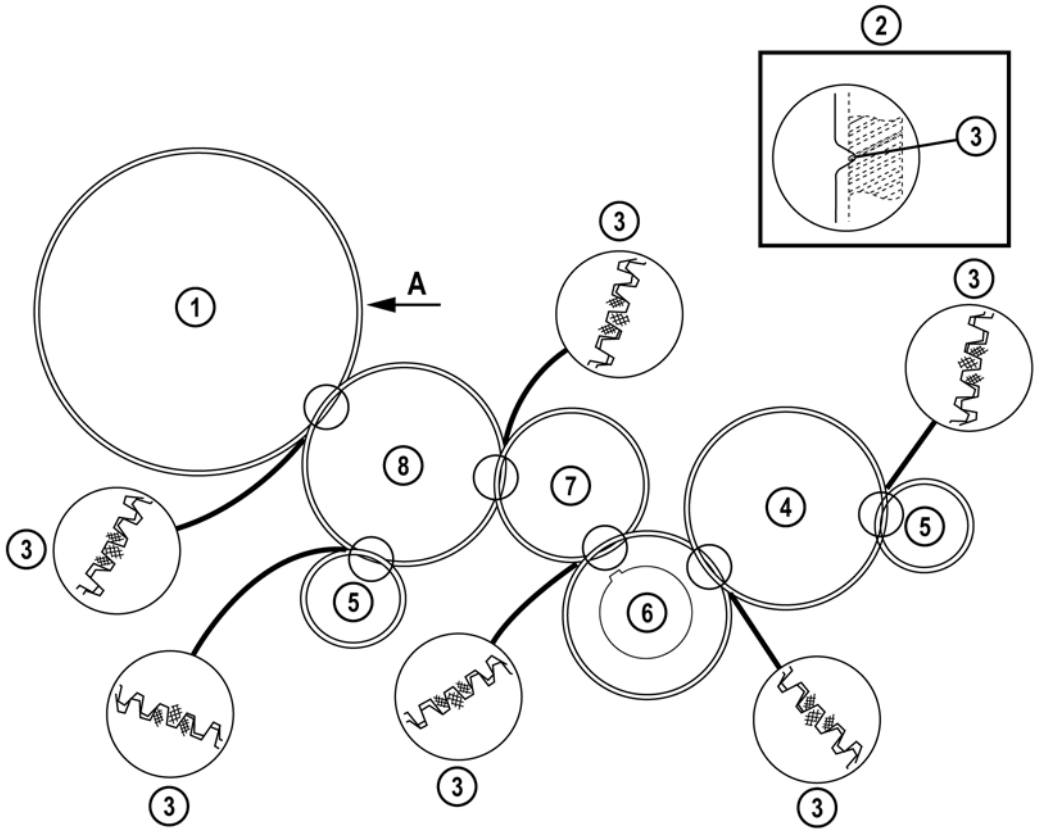
L1001.4_01079

1 Apply force (max. 39 Nm)
2 Mounting bolts
3 Hole for locking pin

Valve Timing

- For verifying or adjusting the valve timing of the gear drive the timing marks have to be aligned as shown below (refer to the workshop manual for details).
- All helical gears except for the fuel high-pressure pump gear have a punch mark as timing mark. However, the punch marks on the crankshaft gear and on the fuel-high-pressure pump gear can only be seen when the friction gears are removed.

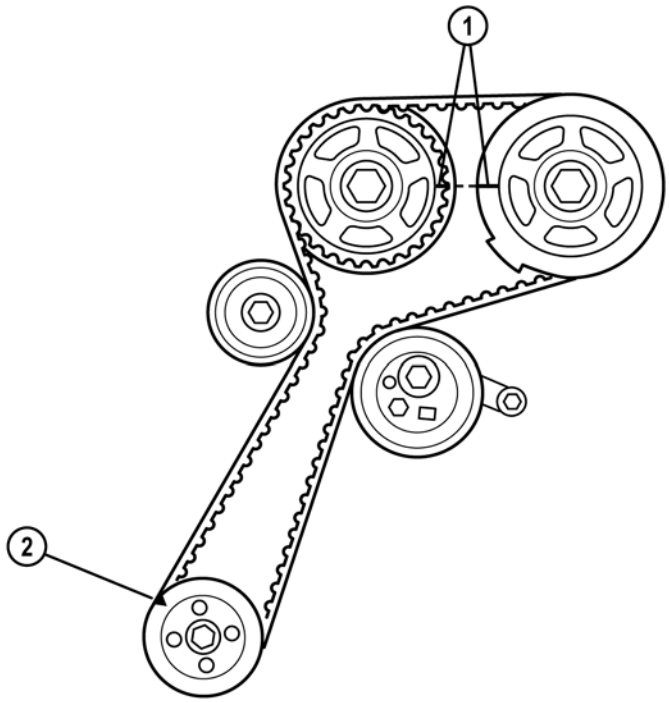
NOTE: The timing mark of each gear can be aligned easily, if paint is applied to the punch marks.



L1001.4_01082

1 Fuel high-pressure pump gear
2 View A
3 Timing mark
4 Idler gear no.3
5 Balancer shaft gear
6 Crankshaft gear
7 Idler gear no.1
8 Idler gear no.2

- For verifying or adjusting the valve timing of the belt drive, the timing marks have to be aligned as shown below (refer to the workshop manual for details).



L1001.4_01081

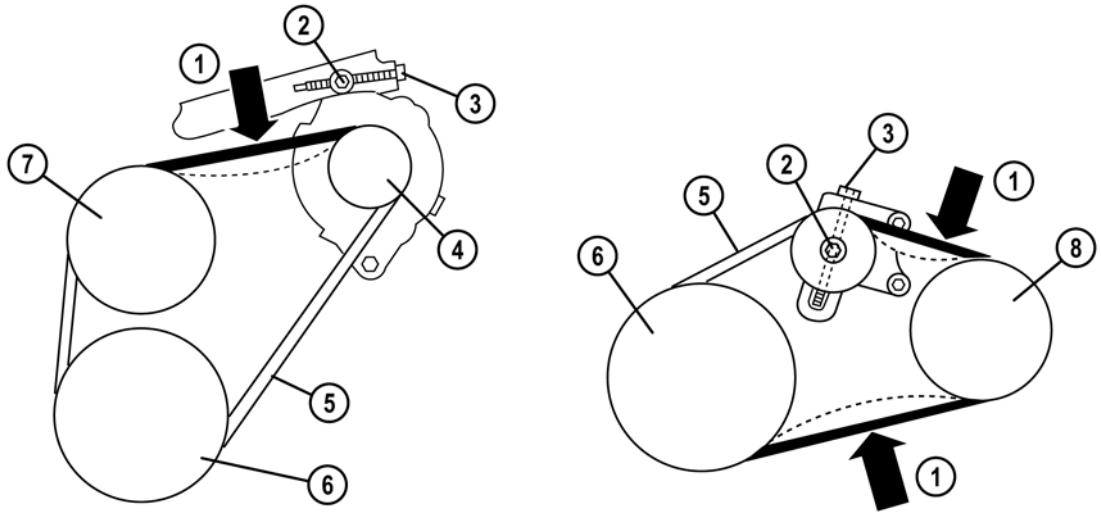
1 Timing marks (camshaft pulleys)

2 Timing mark (crankshaft pulley)

Accessory Drive Belt

- Three V-drive belts are fitted to drive the engine accessories, i.e. two belts drive the generator and one belt drives the A/C compressor.
- The drive belt tension can be adjusted via two manual tensioners (refer to the workshop manual for details).

NOTE: The belt deflection has to be checked when the engine is cold, or at least 30 minutes after the engine has been switched off.



L1001.4_01083

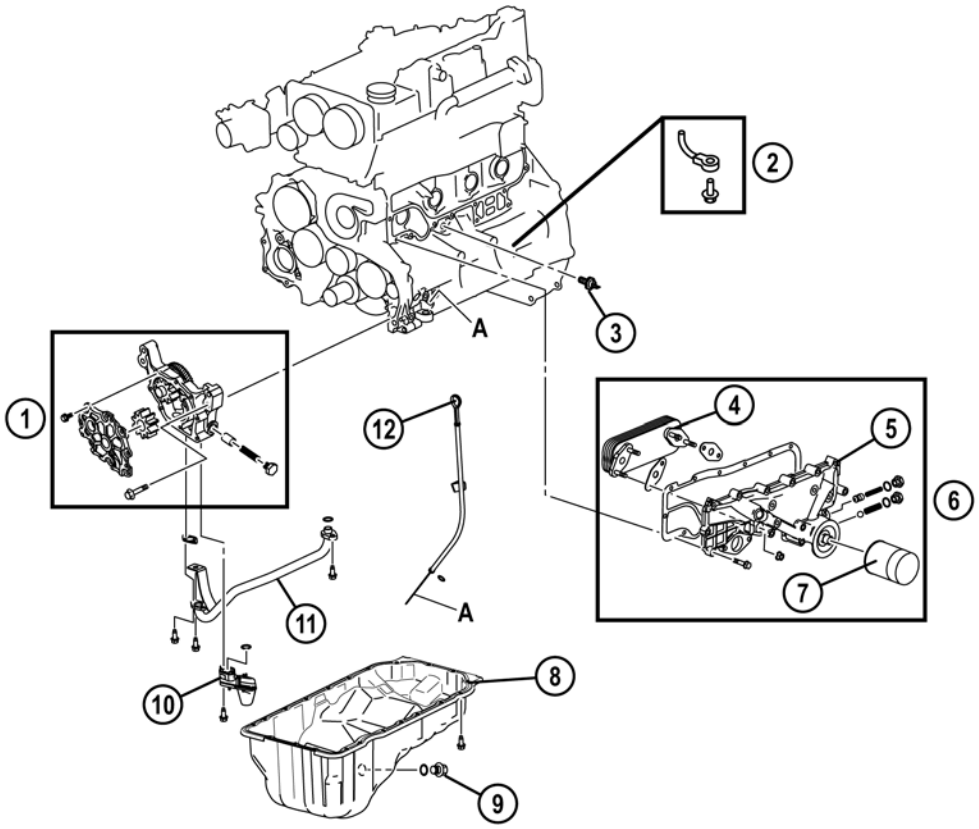
1 Measuring point
2 Locknut
3 Adjusting screw
4 Generator pulley
5 Drive belt(s)
6 Crankshaft pulley
7 Water pump pulley
8 A/C compressor pulley

Lubrication

Features

- The lubrication system of the WL-C engine has the following features:
  - Gear type oil pump, directly driven by the crankshaft
  - Water-cooled type oil cooler
  - Spin-on type oil filter
  - Oil jet valves

Parts Location



L1001.4_01084

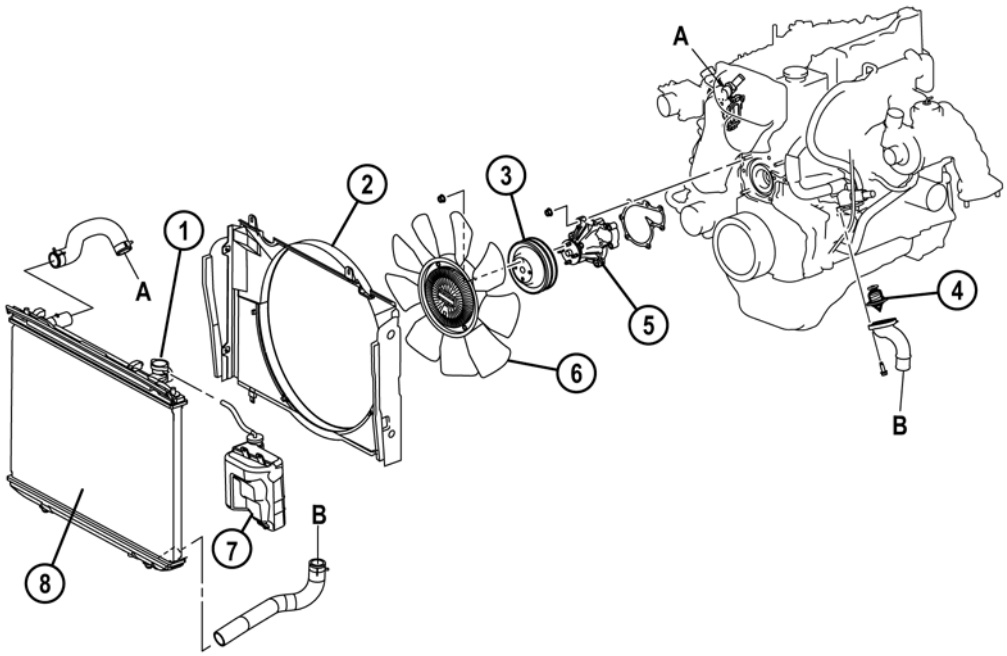
1	Oil pump	7	Oil filter
2	Oil jet valve	8	Oil pan
3	Oil pressure switch	9	Oil pan drain plug
4	Oil cooler	10	Oil strainer
5	Oil filter body	11	Oil outlet pipe
6	Oil cooler and oil filter body component	12	Oil dipstick

Cooling System

Features

- The cooling system of the WL-C engine has the following features:
  - Water pump driven by the accessory drive belts
  - Unpressurized type coolant reserve tank
  - FL22 longlife engine coolant
  - Thermo-modulation type cooling fan

Parts Location



L1001.4_01085

1 Cooling system cap
2 Radiator cowling
3 Water pump pulley
4 Thermostat
5 Water pump
6 Cooling fan
7 Coolant reserve tank
8 Radiator

Service Procedures

MAF Sensor Learning Function

- The MAF learning function is used to compensate the deviations of the amount due to measured intake air deterioration of the MAF sensor. It has to be carried out at specified service intervals by means of M-MDS. During this procedure the MAF learning function is performed at engine speeds of 750 min^{-1}, 1850 min^{-1}, and 2500 min^{-1}. To perform the procedure select the option **Toolbox→Powertrain→Engine Checks→Learning** and follow the instructions of M-MDS.

Y-type Engines

- In the Y-type engine line-up the following engines are available:
  - Y4 type with 1.4 L displacement (also termed as 1.4 MZ-CD engine)
  - Y6 type with 1.6 L displacement (also termed as 1.6 MZ-CD engine)

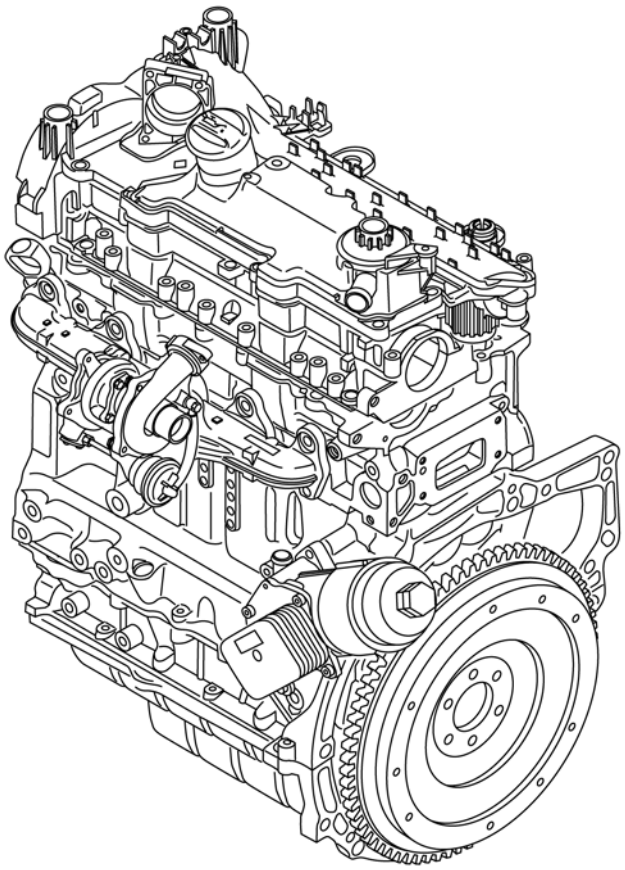
- The Y4 engine is fitted in the Mazda2 (DY) models. It is equipped with a common rail direct injection system and a FGT turbocharger
- The Y6 engine is fitted in the Mazda3 models, and is available as a standard and a high-power version. It is equipped with a common rail direct injection system and a turbocharger (FGT turbocharger on the standard power engine, and VGT turbocharger on the high-power engine).

Mechanical (Y4 Engine)

Features

- The mechanical system of the Y4 engine has the following features:
  - Belt driven 8 valve SOHC engine
  - Valve train with automatic timing belt tensioner, roller cam followers and hydraulic tappets
  - Vacuum pump driven by the camshaft
  - V-ribbed belt drive with automatic tensioner

Overview



L1001.4_01086

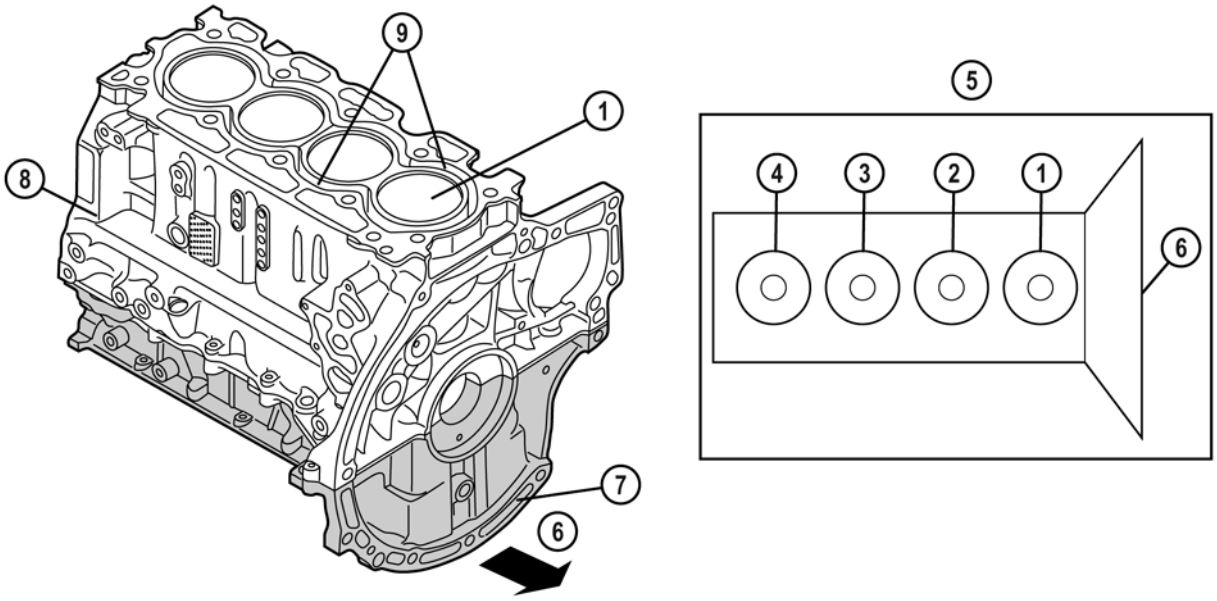
NOTE: Some of the components of the Y4 engine are very similar in construction and operation to those of the RF-T engine. Therefore, this section only describes the components which are new or differ from those of the RF-T engine.

Cylinder Block

- The cylinder block is equipped with cylinder liners, the coolant jackets of which are open towards the top.
- The cylinder block is composed of an upper and a lower cylinder block, in which the main bearing caps are integrated. Upper and lower cylinder block are matched to each other, i.e. they cannot be replaced separately. If one of the components exceeds the specification, the cylinder block must be replaced as a complete unit.

NOTE: Bolt and stud repairs using thread inserts in the area of the cylinder head bolts and main bearing bolts are not permitted.

- The cylinder no.1 is located on the transmission side (French-style cylinder numbering).

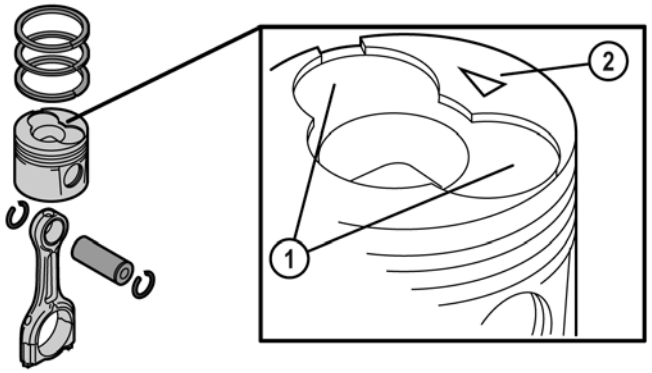


L1001.4_01087

1 Cylinder no.1
2 Cylinder no.2
3 Cylinder no.3
4 Cylinder no.4
5 French style cylinder numbering
6 Transmission side
7 Lower cylinder block
8 Upper cylinder block
9 Coolant jackets

Pistons

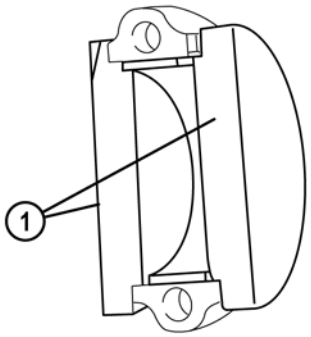
- The pistons have valve recesses for the intake and exhaust valves.
- The piston skirt is coated to reduce friction between the piston and the cylinder.
- The connecting rods are fracture-split on the big end to ensure a perfect fit between connecting rod and connecting rod bearing cap. For this reason, the pairs of connecting rods and connecting rod bearing caps must be kept together during removal.



L1001.4_01088

1 Valve recesses
2 Arrow indicating the installation direction

- There is no positioning tab for locating the lower bearing in the connecting rod big end. For installing the lower connecting rod bearing shell two alignment tools (SST) are required (refer to the workshop manual for details).



L1001.4_01144

1 Alignment tools (SST)

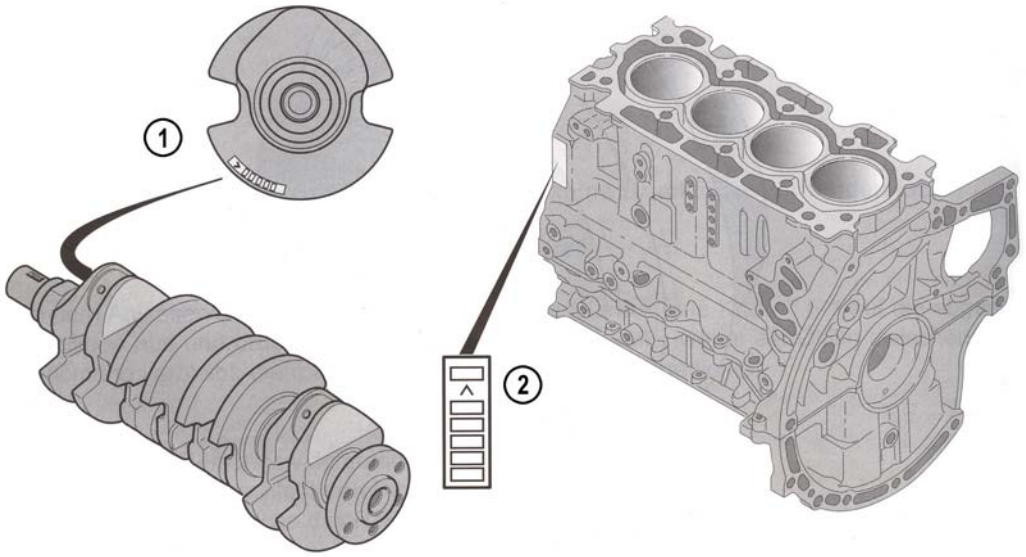
Crankshaft

- The crankshaft is equipped with a key for the installation of the crankshaft timing pulley and the crankshaft pulley.
- The crankshaft timing pulley has a magnetic pulse wheel for the CKP sensor signals.

NOTE: When removing or installing the crankshaft timing pulley care must be taken, since scratches or impacts can de-magnetize the magnetic pulse wheel.

- To ensure optimum bearing clearance of the crankshaft, main bearing shells with different thickness and hence different tolerance class are fitted in one engine. The upper main bearing shells are only available in one tolerance class and feature a black color coding on the edge.
- The lower main bearing shells are available in three different tolerance classes (A, B and C) and feature one of the following color codings on the edge:
  - Blue (tolerance class A)
  - Black (tolerance class B)
  - Green (tolerance class C)

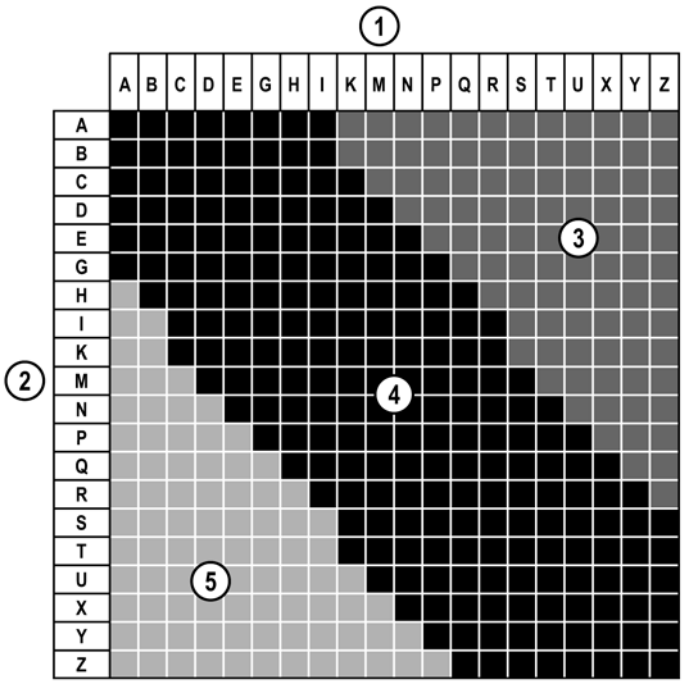
- To determine the tolerance class for the lower bearing shell of each main bearing, the diameter classes of the main bearings and of the main journals have to be verified.
- The diameter class of the main bearings can be verified by the engraved letters (A to Z) on the cylinder block, whereas the first letter is equivalent to the diameter class of main bearing no.5 (the symbol ^ locates the timing belt side).
- The diameter class of the main journals can be verified by the printed letters (A to Z) on the crankshaft, whereas the first letter is equivalent to the diameter class of main journal no.5 (the symbol ^ locates the timing belt side).



L1001.4_01090

1 Diameter classes of the main journals
2 Diameter classes of the main bearings

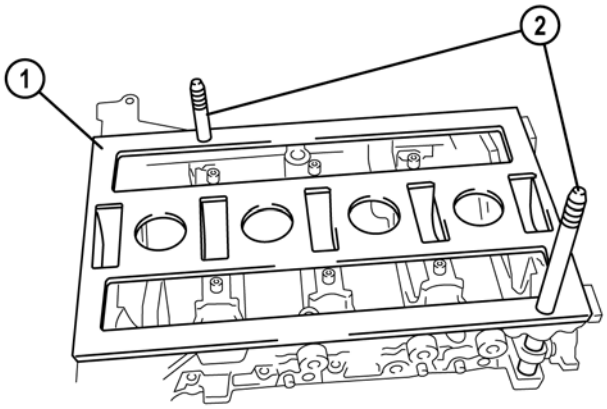
- The correct tolerance class for the lower bearing shell of each main bearing can be determined by the diagram shown below.



L1001.4_01091

1 Diameter class of main journal
2 Diameter class of main bearing
3 Blue (tolerance class A)
4 Black (tolerance class B)
5 Green (tolerance class C)

- There is no positioning tab for locating the lower bearings in the main journals. For installing the lower main bearing shells a guide (SST) and two guide studs (SST) are required (refer to the workshop manual for details).



L1001.4_01146

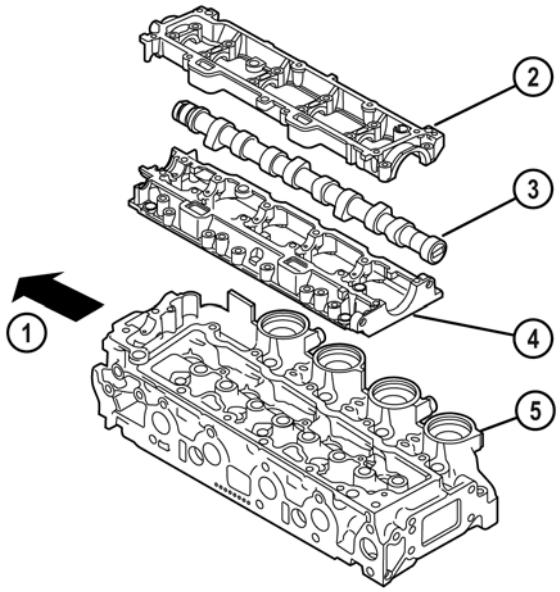
1 Guide (SST)

2 Guide studs (SST)

Cylinder Head

- The cylinder head features a bolted on camshaft housing, which comprises an upper and a lower part. Upper and lower camshaft housing as well as the cylinder head are matched to each other, i.e. they cannot be replaced separately. If one of the components exceeds the specification, the cylinder head must be replaced as a complete unit.
- There are no guide sleeves for locating the camshaft housing on the cylinder head. For this reason, two guide studs (SST) are required for the installation of the camshaft housing (refer to the workshop manual for details).
- The cylinder head gasket is available in five different thicknesses depending on the piston protrusion. The gasket is marked respectively (refer to the workshop manual for details).
- The cylinder head bolts are torque-to-yield bolts, which must be tightened in several stages (refer to the workshop manual for details).

NOTE: The cylinder head bolts must not be re-used.

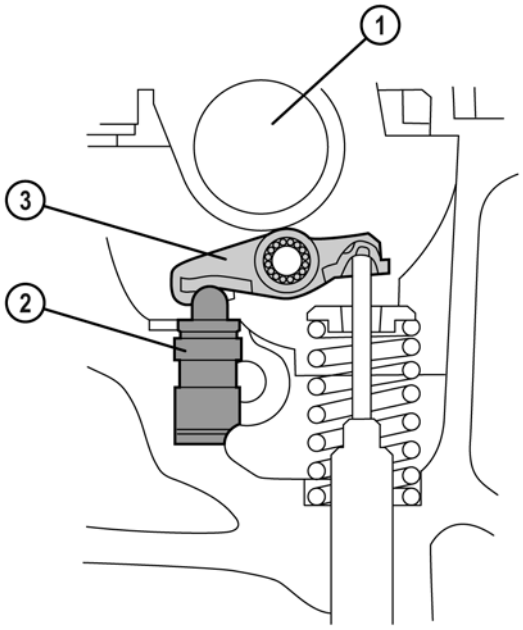


L1001.4_01092

1 Engine front side
2 Upper camshaft housing
3 Camshaft
4 Lower camshaft housing
5 Cylinder head

Valve Actuation

- The camshaft actuates the valves via roller cam followers.
- The adjustment of the valve clearance is performed via maintenance-free hydraulic tappets.



L1001.4_01093

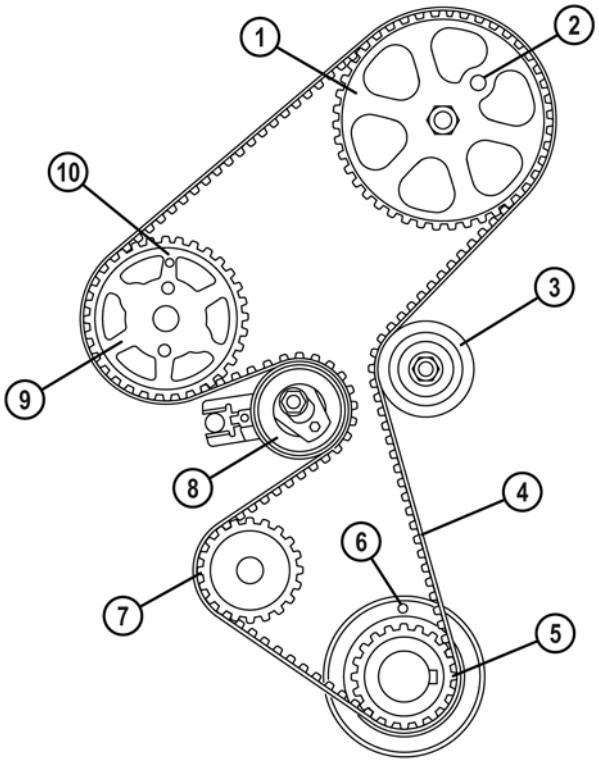
1 Camshaft
2 Hydraulic tappet
3 Roller cam follower

Valve Train

- The camshaft is driven by a timing belt, which has to be replaced every 240,000 km or 10 years (whichever occurs first).

NOTE: The timing belt must not be re-used.

NOTE: The timing belt has to be installed with the arrows pointing in the direction of engine rotation.

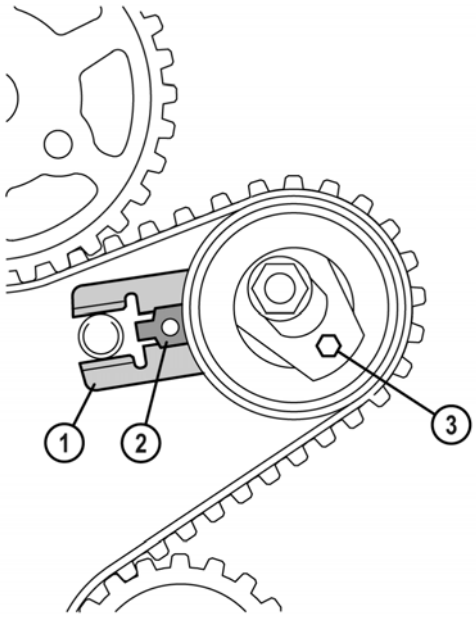


L1001.4_01094

1 Camshaft pulley
2 Hole for camshaft timing peg (SST)
3 Idler pulley
4 Timing belt
5 Crankshaft pulley
6 Hole for crankshaft timing peg (SST)
7 Water pump pulley
8 Tensioner pulley
9 Fuel high-pressure pump pulley
10 Hole for alignment of the fuel high-pressure pump pulley

Timing Belt Tensioner

- An automatic timing belt tensioner is fitted to ensure optimum belt tension over the service life of the engine.
- For tensioning the timing belt, turn the tensioner with an Allen key until the pointer is aligned with the corresponding mark on the housing, and tighten the bolt (refer to the workshop manual for details).

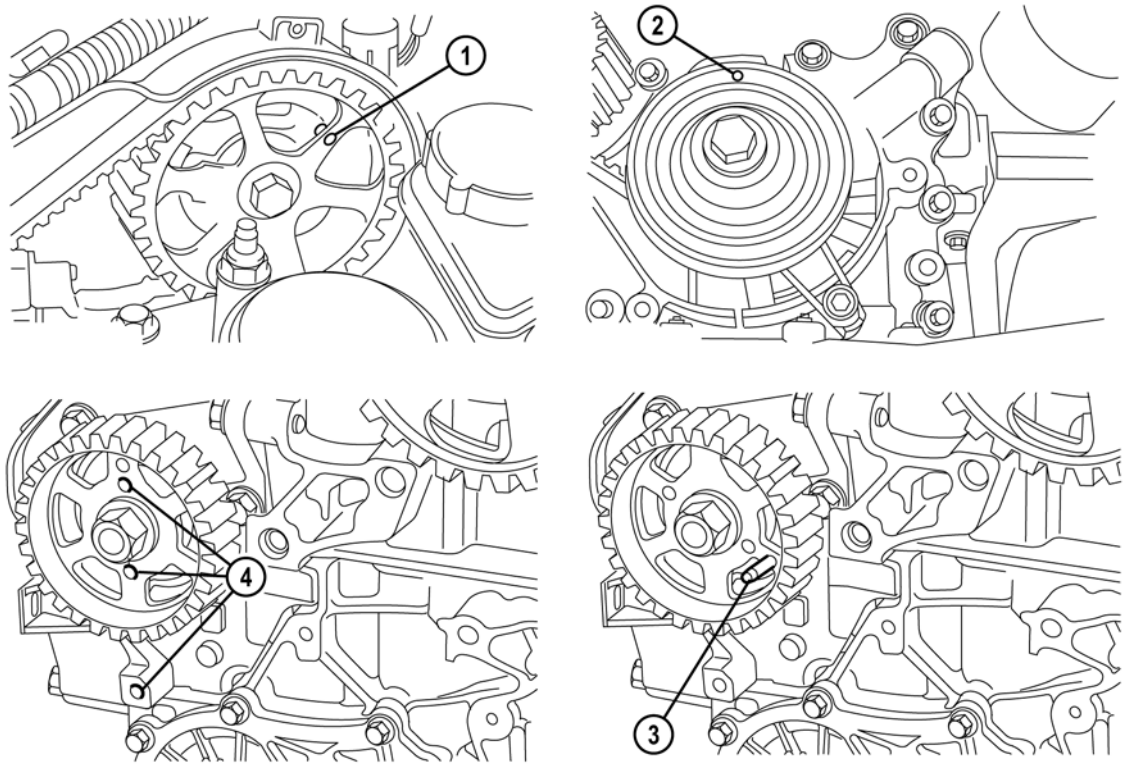


L1001.4_01095

1 Housing with mark
2 Pointer
3 Hexagonal hole for Allen key

Valve Timing

- For verifying or adjusting the valve timing, the crankshaft timing peg (SST) has to be installed in the cylinder block, and the camshaft timing peg (SST) in the cylinder head.
- Depending on whether or not there is a hole for the crankshaft timing peg (SST) in the bracket of the fuel high-pressure pump, the fuel high-pressure pump pulley must be aligned in either of the two ways shown below (refer to the workshop manual for details).



L1001.4_01096

1 Hole for camshaft timing peg (SST)

2 Hole for crankshaft timing peg (SST)

3 Fuel high-pressure pump pulley aligned with SST

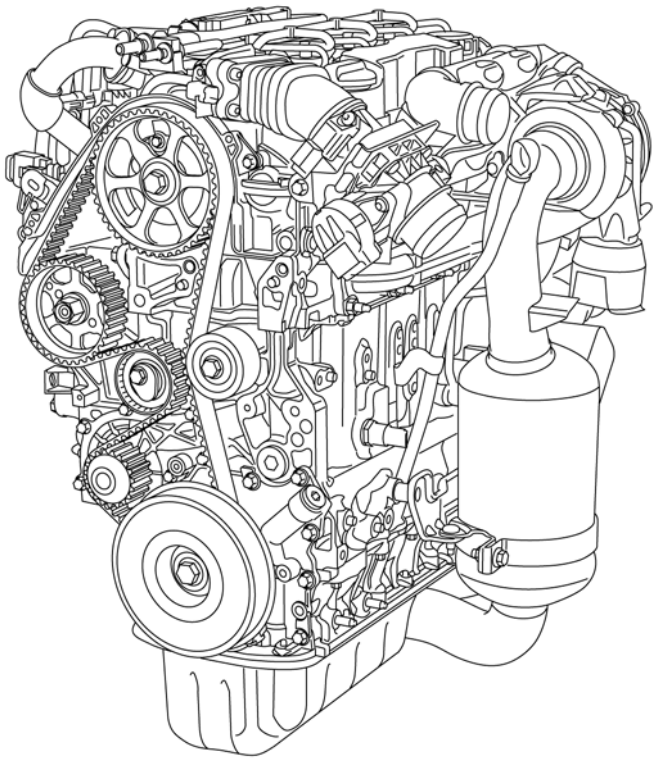
4 Fuel high-pressure pump aligned without SST

Mechanical (Y6 Engine)

Features

- The mechanical system of the Y6 engine has the following features:
  - Belt and chain driven 16 valve DOHC engine
  - Valve train with automatic timing belt tensioner, roller cam followers and hydraulic tappets
  - Vacuum pump driven by the exhaust camshaft
  - V-ribbed belt drive with automatic tensioner

Overview



L1001.4_01101

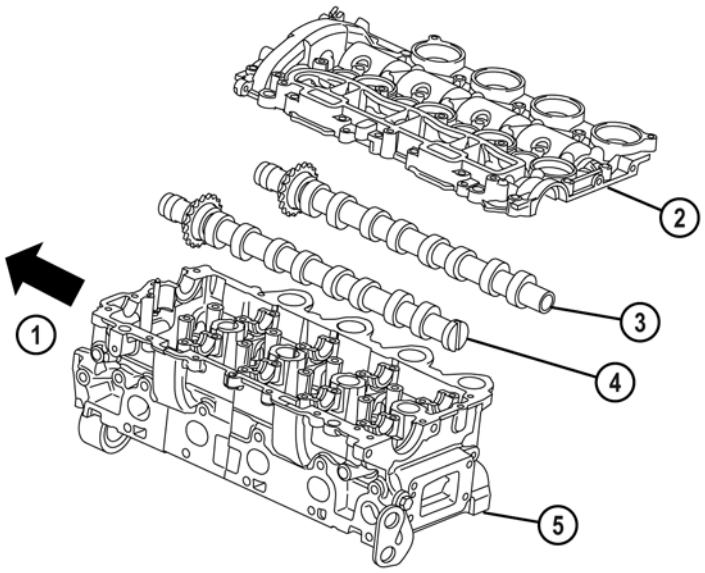
NOTE: Some of the components of the Y6 engine are very similar in construction and operation to those of the Y4 engine. Therefore, this section only describes the components which are new or differ from those of the Y4 engine.

Cylinder Head

- The cylinder head is composed of an upper and a lower part. Upper and lower cylinder head are matched to each other, i.e. they cannot be replaced separately. If one of the components exceeds the specification, the cylinder head must be replaced as a complete unit.
- There are no guide sleeves for locating the cylinder head upper part on the lower part. For this reason, two guide studs (SST) are required for the installation of the upper cylinder head (refer to the workshop manual for details).
- The cylinder head gasket is available in five different thicknesses depending on the piston protrusion. The gasket is marked respectively (refer to the workshop manual for details).
- The cylinder head bolts are torque-to-yield bolts, which must be tightened in several stages (refer to the workshop manual for details.

NOTE: The cylinder head bolts must not be re-used.

NOTE: When sealing the area between the upper and lower part of the cylinder head using silicon sealant, care must be taken that the oil supply bores are not blocked.

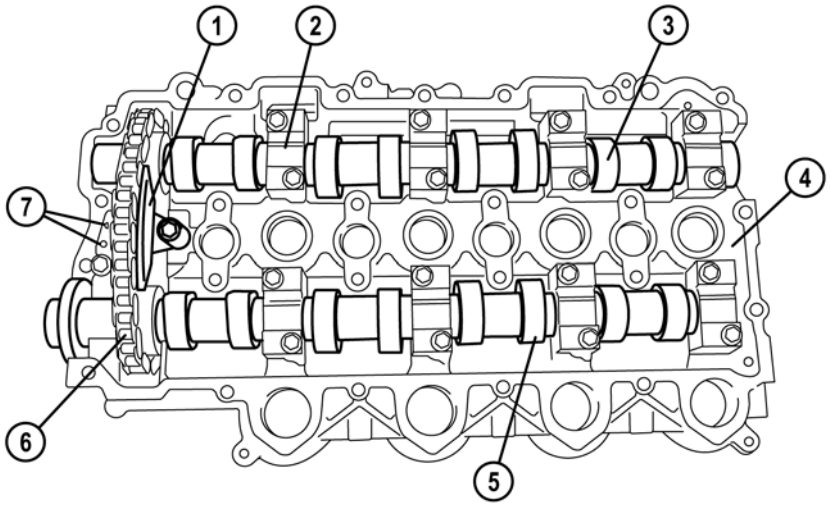


L1001.4_01103

1 Engine front side
2 Upper cylinder head
3 Intake camshaft
4 Exhaust camshaft
5 Lower cylinder head

Camshafts

- The camshafts are mounted hanging in the upper part of the cylinder head.
- The intake camshaft drives the exhaust camshaft by a timing chain.
- The intake camshaft is equipped with a key for the installation of the camshaft pulley.
- The exhaust camshaft drives the vacuum pump directly.

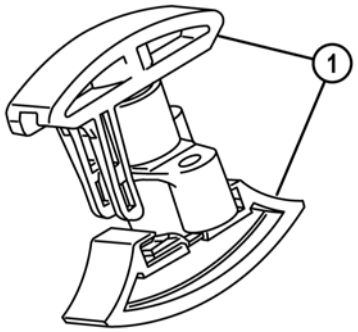


L1001.4_01104

1 Timing chain tensioner
2 Camshaft bearing cap
3 Exhaust camshaft
4 Upper cylinder head
5 Intake camshaft
6 Timing chain
7 Oil supply bores

- An automatic timing chain tensioner is fitted to ensure optimum chain tension over the service life of the engine.
- The timing chain tensioner operates using engine oil pressure.

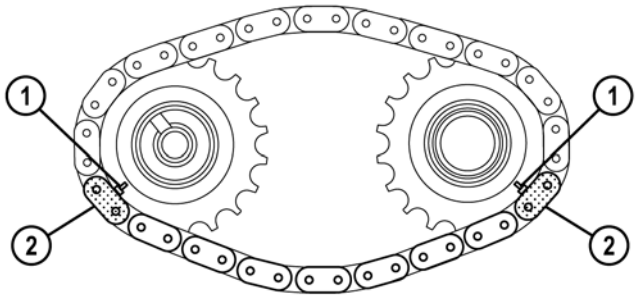
NOTE: The timing chain tensioner must be inserted together with the timing chain and the camshafts into the cylinder head upper part, as it is impossible to fit it afterwards.



L1001.4_01108

1 Chain guides

- For verifying or adjusting the valve timing the timing marks on the crankshaft sprockets have to be aligned with the gold-colored plates on the timing chain links.



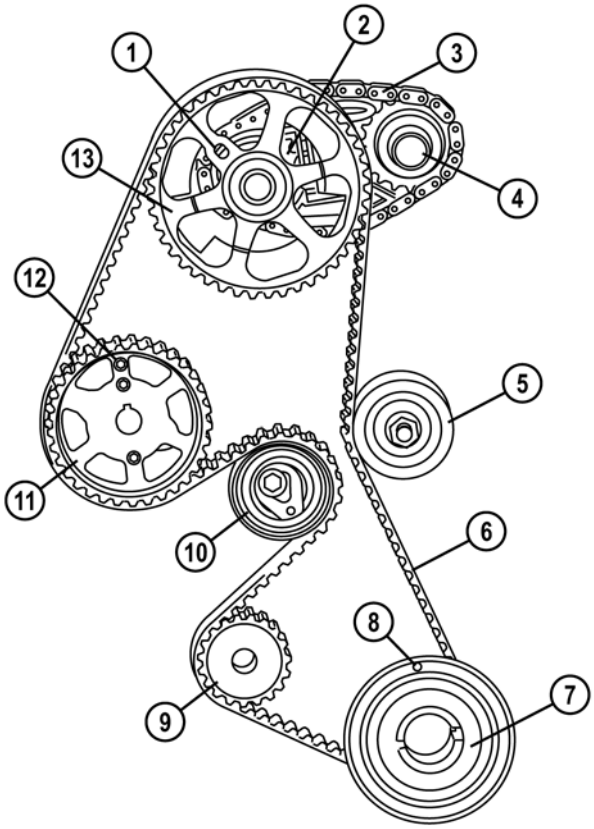
L1001.4_01107

1 Timing mark

2 Gold-colored plate

Valve Train

- The valve train is similar to that of the Y4 engine except for the additional chain drive of the exhaust camshaft. For this reason, the procedure for verifying or adjusting the valve timing is the same as on the Y4 engine.



L1001.4_01110

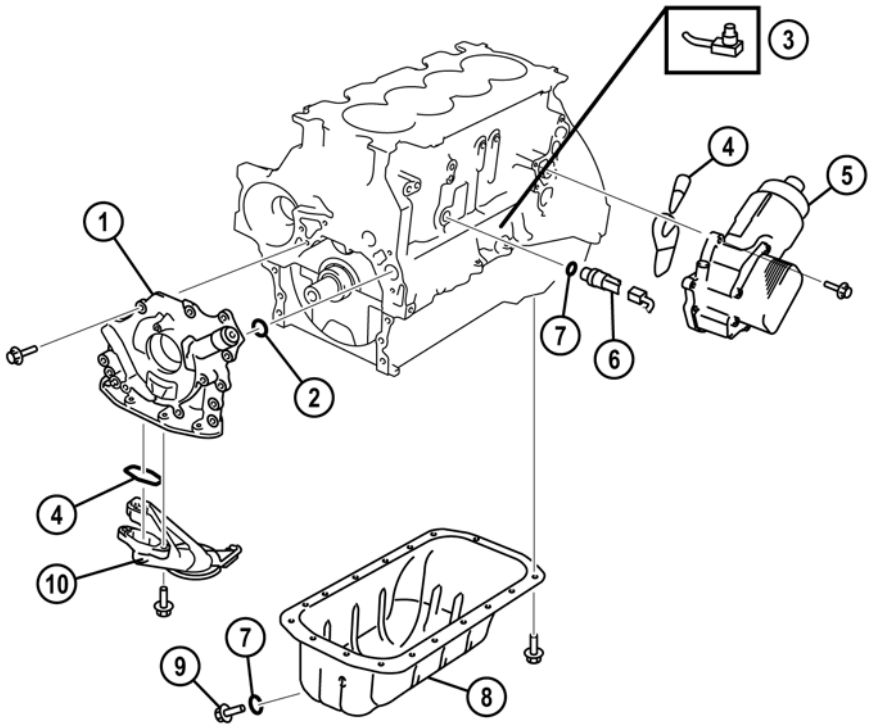
1 Hole for camshaft timing peg (SST)
2 Intake camshaft sprocket
3 Timing chain
4 Exhaust camshaft sprocket
5 Idler pulley
6 Timing belt
7 Crankshaft pulley
8 Hole for crankshaft timing peg (SST)
9 Water pump pulley
10 Tensioner pulley
11 Fuel high-pressure pump pulley
12 Hole for alignment of the fuel high-pressure pump pulley
13 Intake camshaft pulley

Lubrication

Features

- The lubrication system of the Y-type engines has the following features:
  - Trochoid gear type oil pump, directly driven by the crankshaft
  - Water-cooled type oil cooler
  - Cartridge type oil filter
  - Oil jet valves

Parts Location



L1001.4_01099

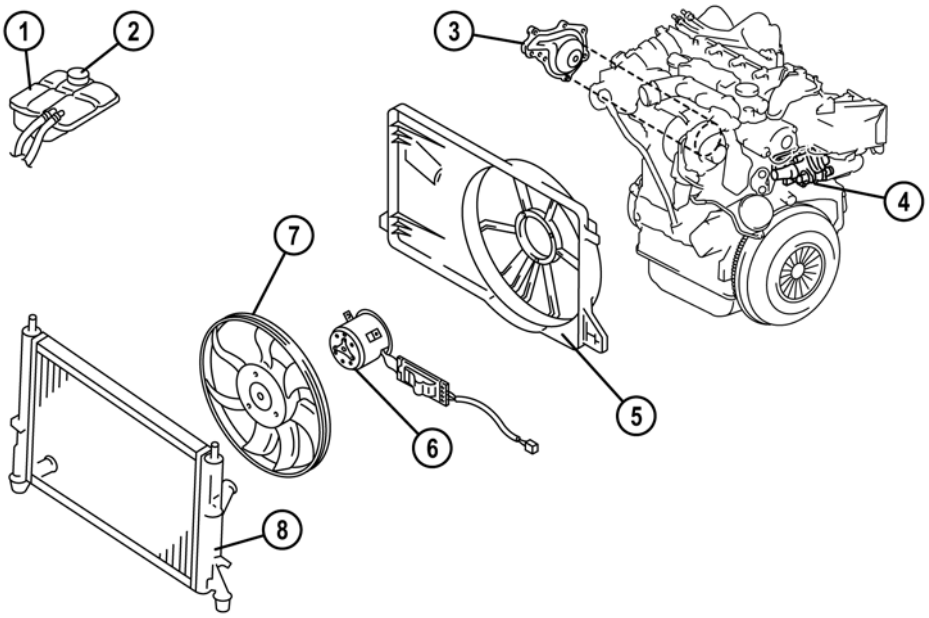
1	Oil pump	6	Oil pressure switch
2	Gasket	7	Washer
3	Oil jet valve	8	Oil pan
4	O-ring	9	Oil pan drain plug
5	Oil filter with oil cooler	10	Oil strainer

Cooling System

Features

- The cooling system of the Y-type engines has the following features:
  - Timing belt driven water pump
  - Pressurized type coolant reserve tank
  - FL22 longlife engine coolant (only Y6 engine)
  - Cooling fan controlled by relays or by a fan control module (depending on model)

Parts Location



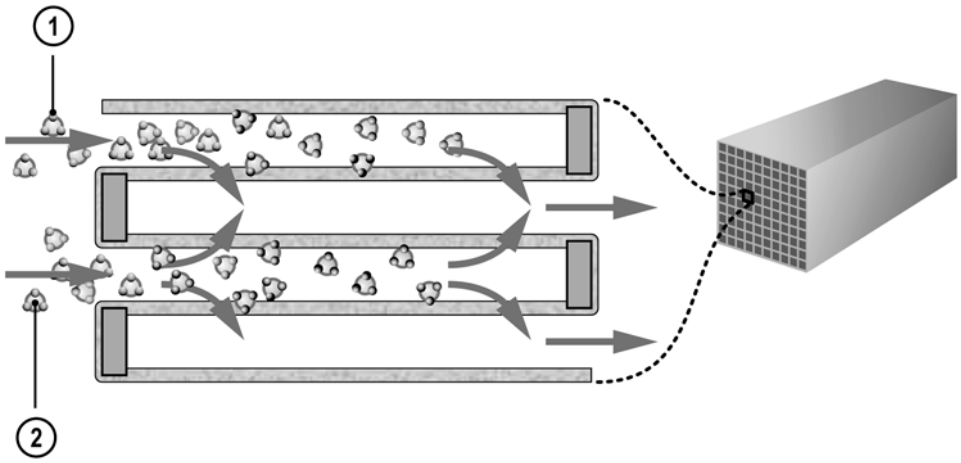
L1001.4_01113

Mazda3

1 Coolant reserve tank
2 Cooling system cap
3 Water pump
4 Thermostat
5 Radiator cowling
6 Cooling fan motor with fan control module
7 Cooling fan
8 Radiator

Diesel Particulate Filter System

- The Mazda3 with Y6 high-power engine features a DPF with a honeycomb structure, which must be regenerated at certain intervals. In order to facilitate the regeneration process, the Mazda3 uses a special fuel additive that is automatically injected into the fuel tank. During the combustion process the additive attaches itself to the soot particulates, which then accumulate in the filter. As a result, the temperature to burn off the particulates is lowered.



L1001.4_01145

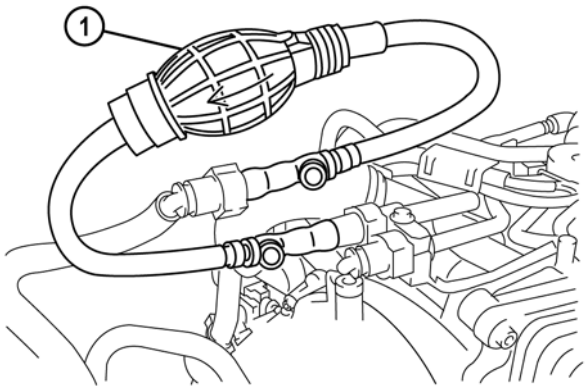
1 Fuel additive 2 Soot

- Pressure and temperature sensors in the DPF detect when the soot accumulation capacity of the filter is reached. The engine control system then increases the exhaust gas temperature by multiple fuel injections to burn off the particulates.
- After regeneration ash residues that have formed from the fuel additive and the engine oil remain in the DPF, clogging the filter pores. For this reason, the DPF must be replaced every 120,000 km.
- In addition, the fuel additive tank must be refilled every 60,000 km.

Service Procedures

Bleeding the Fuel System

- Since the Mazda3 with Y6 engine features no priming pump for the low-pressure fuel system, a hand pump (SST) must be used to bleed the system when the fuel filter has been replaced (refer to the workshop manual for details).



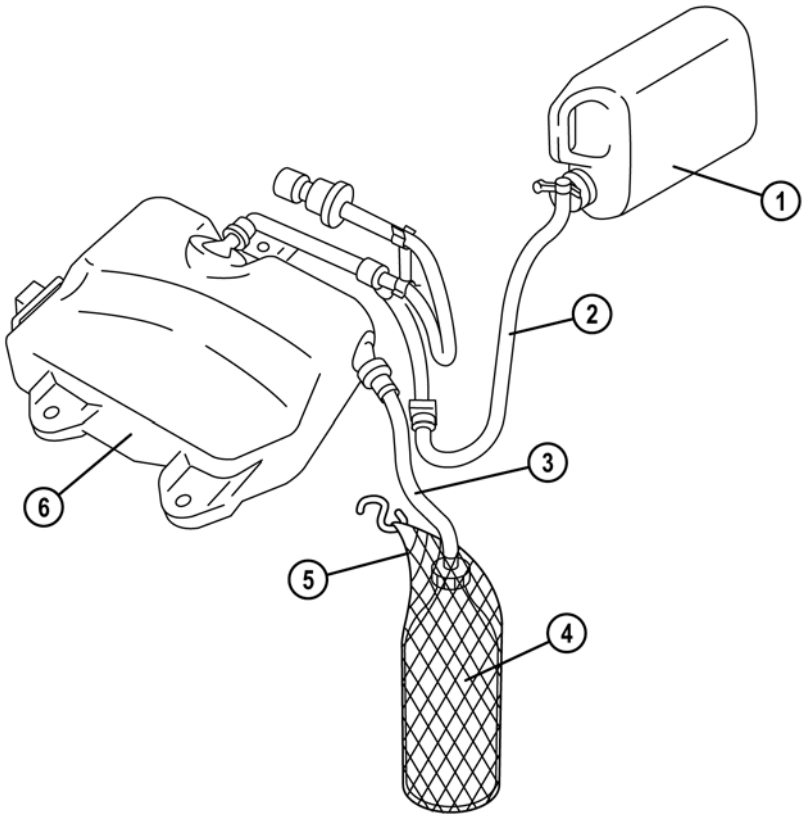
L1001.4_01133

1 Hand pump (SST)

Refilling the Fuel Additive Tank

- The fuel additive tank must be refilled every 60,000 km. Due to its installation position at the crossmember behind the fuel tank, a special fuel additive refill kit is available, which consists of the fuel additive container, filler hose with valve, overflow hose and overflow bottle (refer to the workshop manual for details).
- After refilling the fuel additive tank the parameter “Calculated additive level” in the **FACM** (**F**uel **A**dditive **C**ontrol **M**odule) must be reset with the aid of M-MDS. To perform the procedure select the option **Toolbox→Powertrain→Service Functions→FACM→ Refill FAT** and follow the instructions of M-MDS.

NOTE: Do NOT use the option “System Prime” when refilling the fuel additive tank. This will cause an excessive amount of fuel additive to be forced into the fuel tank, since the fuel additive injection line is already full.



L1001.4_01134

1 Fuel additive container
2 Filler hose with valve
3 Overflow hose
4 Overflow bottle
5 Net with hook
6 Fuel additive tank

Installing a New DPF

- The DPF must be replaced every 120,000 km Thereafter, the parameters for the regeneration control in the PCM and the parameter“ Total additive injection amount” in the FACM must be reset with the aid of M-MDS. To perform the procedure select the option **Toolbox→Powertrain→Service Functions→DPF Component/Parameter Commands→Reset Particulate Filter Learned Values** and follow the instructions of M-MDS.

DPF Manual Regeneration

- If the DPF is blocked due to an excessive soot amount accumulated, it must be manually regenerated with the aid of M-MDS. To perform the procedure select the option **Toolbox→Powertrain→Service Functions→DPF Component/Parameter Commands→Static Regeneration** and follow the instructions of M-MDS.

NOTE: Always perform the manual regeneration in a well ventilated place and use an appropriate exhaust-gas extraction system. In addition, the vehicle should not be stationed in front of any flammable or low heat resistant material, since high temperature exhaust gas is emitted during this process.

Notes:

Drive Train

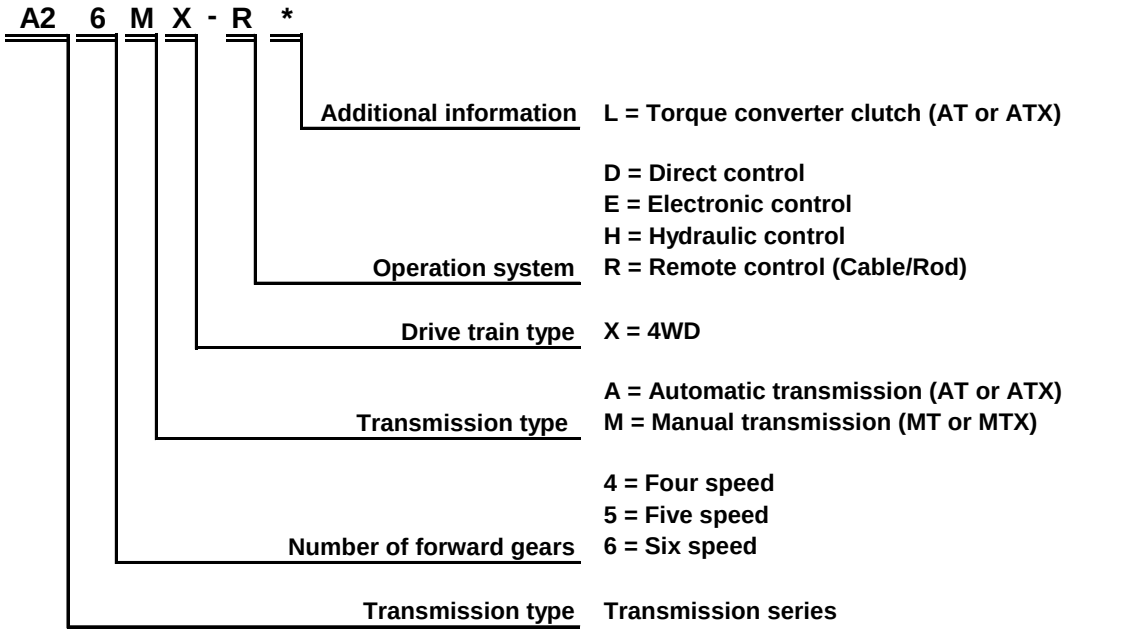
- The following drive train types are used on the current Mazda models:
  - **FWD** (**F**ront **W**heel **D**rive)
  - **RWD** (**R**ear **W**heel **D**rive)
  - **4WD** (**4 W**heel **D**rive)

Model / Drive train	FWD	RWD	4WD
Mazda2 (DY)	X		
Mazda3	X		
Mazda3 MPS	X		
Mazda5	X		
Mazda6	X		
Mazda6 MPS			X
Mazda CX-7			X
Mazda MX-5		X	
Mazda RX-8		X	
Mazda BT-50		X	X

L1001.4_T02006

Transmission Code

- The transmissions of the current Mazda models except for Mazda2 (DY) have a 5- or 6-digit alphanumerical code, which contains the information shown below.



L1001.4_T02001

Manual Transmissions

- Depending on the installation position of the engine different types of manual transmissions are used. Vehicles with transversally installed engine feature a **MTX** (**M**anual **T**ransa**x**le) and vehicles with longitudinally installed engine a **MT** (**M**anual **T**ransmission). The basic difference between MTX and MT is that the MTX has a differential integrated in the transmission housing, while the MT has an external differential at the rear axle.
- The MTX and MT fitted in the current Mazda models have the following features:
  - Five or six speeds
  - Two shafts or three shafts (the latter ones in coaxial or non-coaxial arrangement)
  - Single-cone, double-cone or triple-cone synchronizer mechanism
  - Operated via cable or directly by shift lever
  - Hydraulic clutch actuation
  - Conventional or dual-mass flywheel

- The following MTX are fitted in the current Mazda models:

Model / MTX	iB5	F35M-R	G35M-R	J65M-R	G66M-R	A26M-R	A26MX-R
Mazda2 (DY)	X						
Mazda3		X		X	X	X	
Mazda3 MPS						X	
Mazda5			X			X	
Mazda6			X		X	X	
Mazda6 MPS							X
Mazda CX-7							X

L1001.4_T02002

- The following MT are fitted in the current Mazda models:

Model / MT	M15M-D	R15M-D	S15M-D	S15MX-D	P66M-D	Y16M-D
Mazda MX-5	X				X	
Mazda RX-8		X				X
Mazda BT-50			X	X		

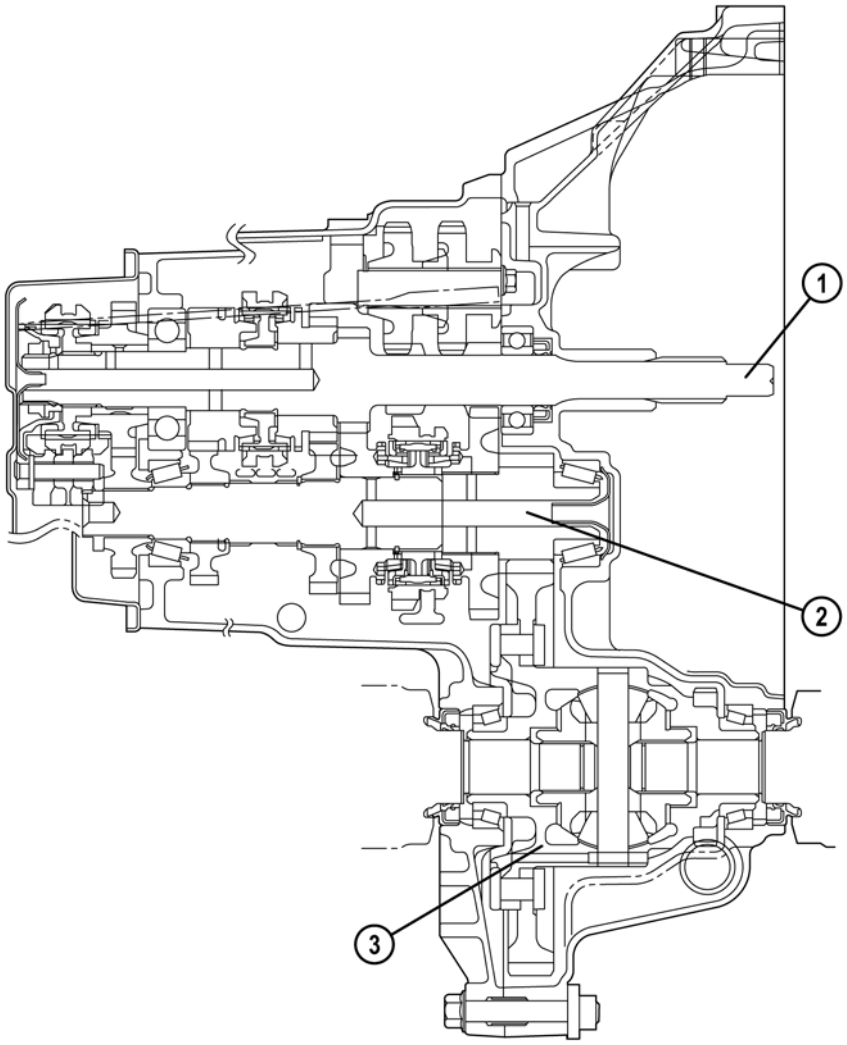
L1001.4_T02003

NOTE: All the manual transmissions are very similar in operation and servicing. Therefore, this section only shows some samples of current manual transmissions.

F35M-R Transmission

- The F35M-R transmission is a two-shaft five-speed MTX, which is operated via cables. It is only fitted in the Mazda3 models with Z-type engine.

Overview



L1001.4_02020

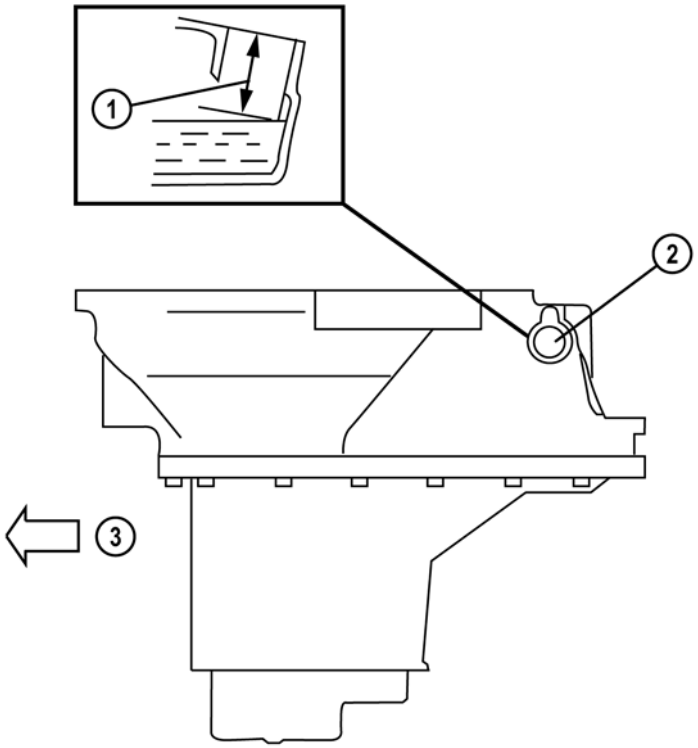
1 Input shaft
2 Output shaft
3 Differential

Service Procedures

Transmission Oil Inspection

- For transmission oil inspection on the F35M-R transmission the distance between upper edge of the hole in the transmission housing and oil level must be measured as shown below (refer to the workshop manual for details).

NOTE: Since the oil inspection and oil replacement procedures may differ depending on the transmission type or may be revised concerning the oil capacity and/or oil specification, always refer to the respective workshop manual.



L1001.4_02022

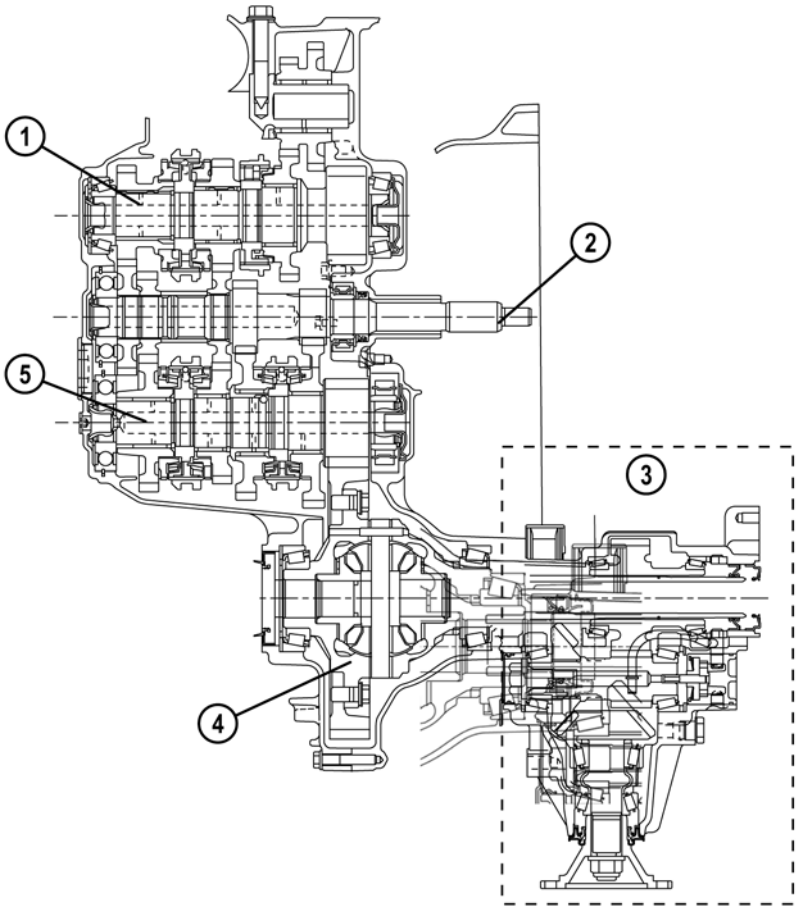
1 Distance
2 Hole in the transmission housing
3 Vehicle front

A26M(X)-R Transmission

- The A26M(X)-R transmission is a three-shaft (non-coaxial arranged) six-speed MTX, which is operated via cables.
- The A26M-R transmission is fitted in the Mazda3, Mazda5 and Mazda6 models with RF-T engine, and in the Mazda3 MPS models. The A26MX-R transmission with bolted-on transfer case is fitted in the Mazda6 MPS and Mazda CX-7 models.

NOTE: When replacing or refilling the transmission oil and/or the separate transfer oil only use the specified type of oil (refer to the workshop manual for details).

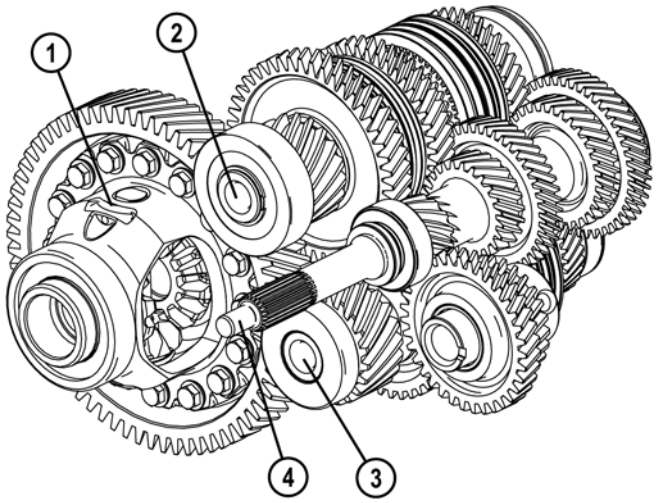
Overview



L1001.4_02021

1 Output shaft no. 2
2 Input shaft
3 Transfer case (A26MX-R)
4 Differential
5 Output shaft no. 1

- The three shaft design with one input shaft and two output shafts allows for a more compact construction, since each output shaft only carries three or four gears.
- As a result of this construction there are two different final gear ratios available, i.e. one for the first to fourth gear and another one for the fifth, sixth and reverse gear.



L1001.4_02003

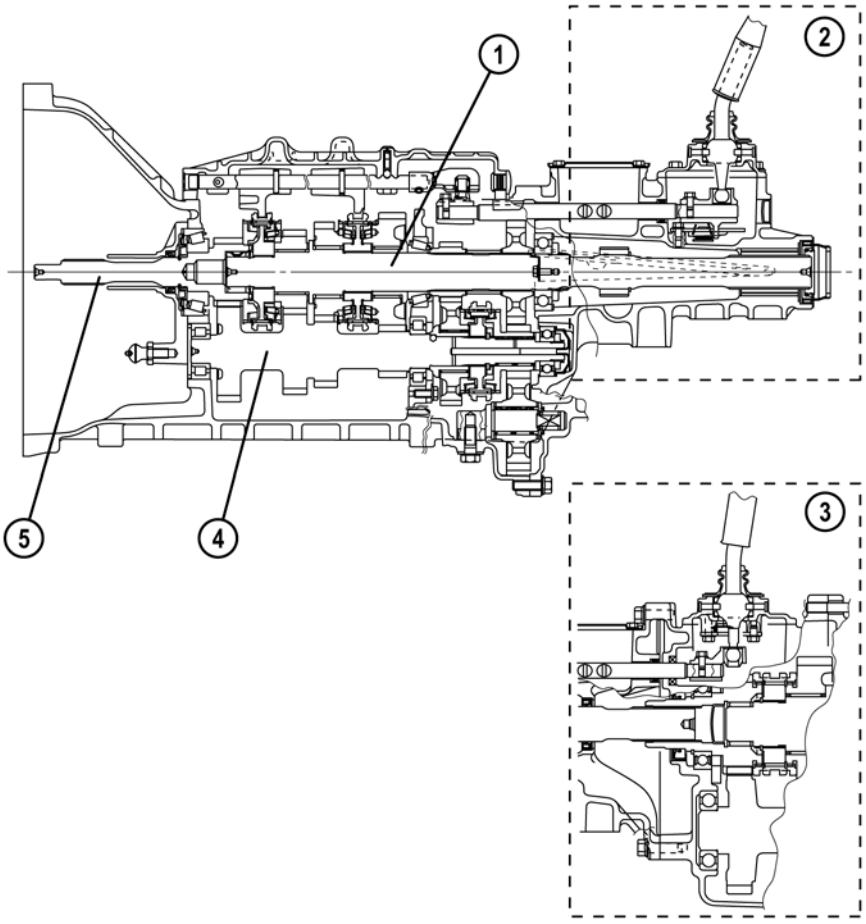
1 Differential
2 Output shaft no. 1
3 Output shaft no. 2
4 Input shaft

S15M(X)-D Transmission

- The S15M(X)-D is a three-shaft (coaxial arranged) five-speed MT, which is directly operated by the shift lever.
- The S15M-D transmission is fitted in the RWD version of the Mazda BT-50, while the S15MX-D transmission with bolted-on transfer case is fitted in the 4WD version.

NOTE: When replacing or refilling the transmission oil and/or the separate transfer oil only use the specified **MTF** (**M**anual **T**ransmission **F**luid) “Type A” (refer to the workshop manual for details).

Overview



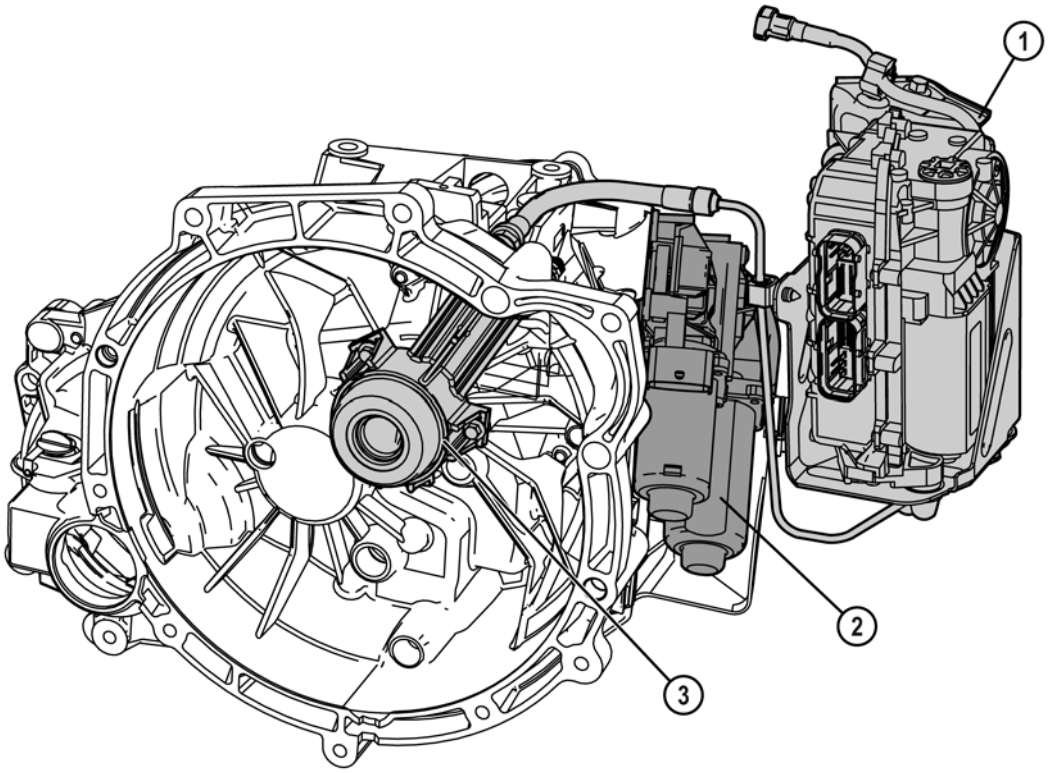
L1001.4_02006

1 Output shaft
2 Extension housing (S15M-D)
3 Transfer case (S15MX-D)
4 Counter shaft
5 Input shaft

Automated Shift Manual Transmission

- The automated shift manual transmission is based on the two-shaft five-speed MTX iB5. Compared to the cable operated version of the iB5 transmission the automated shift manual transmission features a bolted-on shift actuator, and a separate clutch actuator with integrated **TCM** (**T**ransmission **C**ontrol **M**odule). Depending on the signals from the TCM the clutch actuator operates the clutch via the clutch slave cylinder, and the shift actuator performs the gearshifts accordingly.
- The automated shift manual transmission is only fitted in the Mazda2 (DY) models with 1.4 MZI engine.

Overview



L1001.4_02011

1 Clutch actuator with integrated TCM
2 Shift actuator
3 Clutch slave cylinder

Service Procedures

Bleeding the Clutch System

- The hydraulic fluid of the clutch system should be replaced every two years, together with the hydraulic fluid of the brake system. Since the clutch system can only be bled in a certain position of the clutch master cylinder, the clutch actuator first needs to be driven to this position with the aid of M-MDS. To perform the procedure select the option **Toolbox→ Powertrain→ASM Service Functions→Shift Actuator Bleed** and follow the instructions of M-MDS.

Automatic Transmissions

- Depending on the installation position of the engine different types of automatic transmissions are used. Vehicles with transversally installed engine feature an **ATX** (**A**utomatic **T**ransa**x**le) and vehicles with longitudinally installed engine an **AT** (**A**utomatic **T**ransmission). The basic difference between ATX and AT is that the ATX has a differential integrated in the transmission housing, while the AT has an external differential at the rear axle. For the current European Mazda models only ATX are available.
- The ATX fitted in the current Mazda models have the following features:
  - Four, five or six speeds
  - Two or three single type planetary gear sets, or a single type planetary gear set in combination with a Ravigneaux planetary gear set
  - Hydraulically controlled clutches, brakes and brake bands
  - Torque converter with torque converter clutch
  - Electronic control system integrated in the PCM or in a separate TCM
- The following ATX are fitted in the current Mazda models:

Model / ATX	FN4A-EL	FS5A-EL	AW6AX-EL
Mazda3	X		
Mazda6		X	
Mazda CX-7			X

L1001.4_T02005

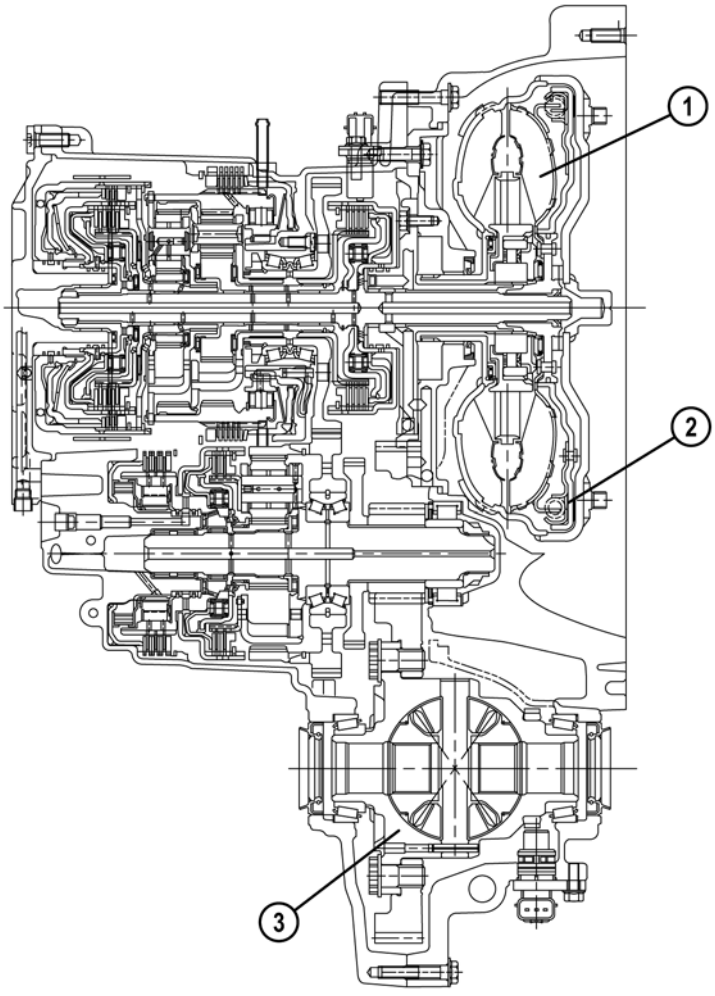
NOTE: All the automatic transmissions are very similar in operation and servicing. Therefore, this section only shows one sample of the current automatic transmissions.

FS5A-EL Transmission

- The FS5A-EL transmission is a five-speed ATX, which is controlled electronically by a TCM. It is only fitted in the Mazda6 models with LF and L3 engine.

NOTE: When replacing or refilling the **ATF** (**A**utomatic **T**ransmission **F**luid) and/or the separate transfer oil only use the specified type of oil (refer to the workshop manual for details).

Overview



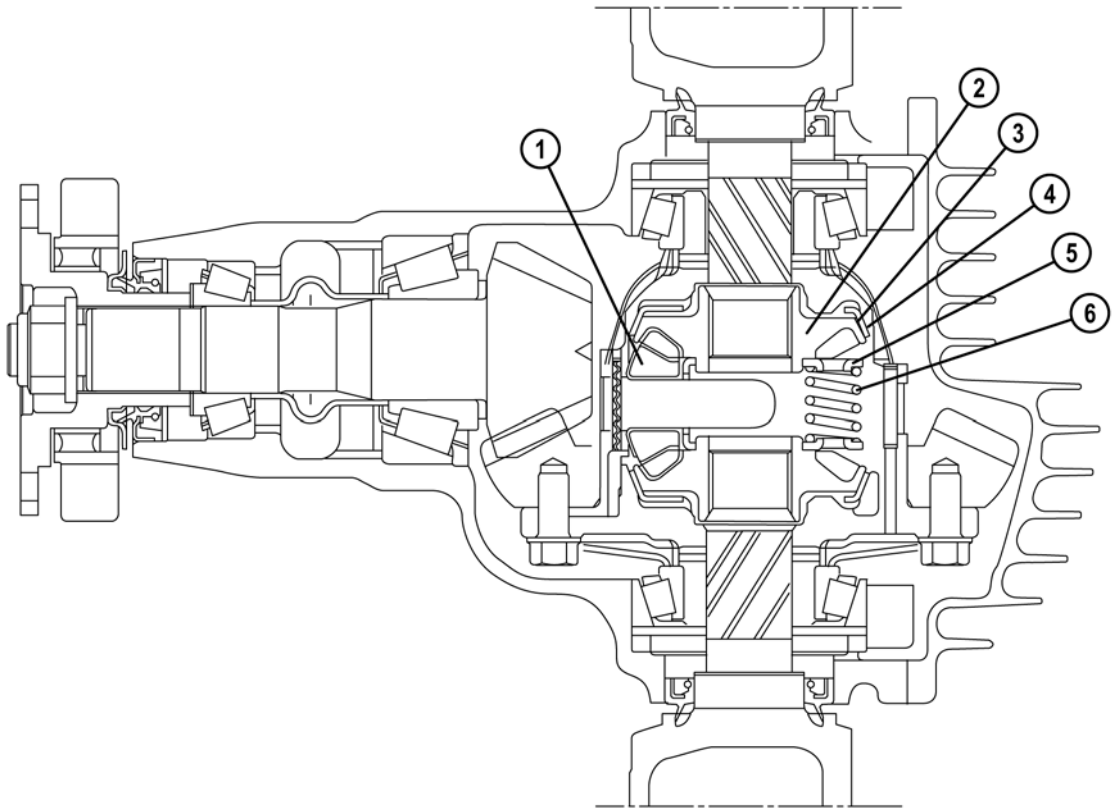
L1001.4_02013

1 Torque converter
2 Torque converter clutch
3 Differential

Limited Slip Differential

- For the current Mazda models a taper ring type **LSD** (**L**imited **S**lip **D**ifferential) is used (also termed as “Super LSD”). It is fitted to the rear axle of the Mazda6 MPS, Mazda MX-5, Mazda RX-8, Mazda BT-50, and to the MTX of the Mazda3 MPS.

Overview



L1001.4_02017

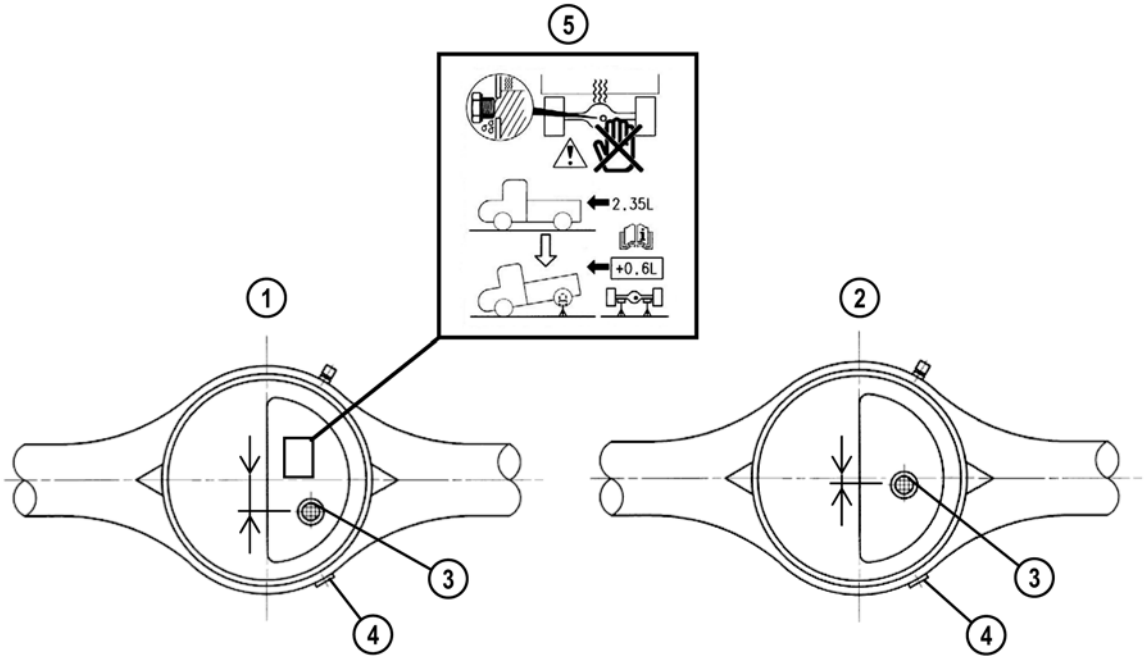
Mazda MX-5

1	Pinion gear	4	Taper ring
2	Side gear	5	Retainer
3	Cone	6	Spring

Service Procedures

Rear Differential Oil Inspection and Oil Replacement

- There are two different rear differentials (type A and type B) for the Mazda BT-50. The difference is the position of the oil filler hole due to a revised oil capacity. On the type A rear differential the oil level is higher than the oil filler hole, i.e. special measures are required for rear differential oil inspection and oil replacement. A caution label on the rear differential informs about this condition (refer to the respective service information for details).
- On the type B rear differential the oil level is flush with the oil filler hole, i.e. rear differential oil inspection and oil replacement can be performed as usual (refer to the workshop manual for details).



L1001.4_02019

1 Type A rear differential
2 Type B rear differential
3 Oil filler plug
4 Oil drain plug
5 Caution label

A/C	**A**ir **C**onditioning
ACEA	**A**ssociation des **C**onstructeurs **E**uropéens d'**A**utomobiles
API	**A**merican **P**etroleum **I**nstitute
AT	**A**utomatic **T**ransmission
ATF	**A**utomatic **T**ransmission **F**luid
ATX	**A**utomatic **T**ransa**x**le
AWD	**A**ll **W**heel **D**rive
BDC	**B**ottom **D**ead **C**enter
CKP	**C**ran**k**shaft **P**osition
CM	**C**ontrol **M**odule
CMP	**C**a**m**shaft **P**osition
DISI	**D**irect **I**njection **S**park **I**gnition
DOHC	**D**ouble **O**ver**h**ead **C**amshaft
DPF	**D**iesel **P**articulate **F**ilter
ECC	**E**lectronically **C**ontrolled **C**oupling
FACM	**F**uel **A**dditive **C**ontrol **M**odule
FGT	**F**ixed **G**eometry **T**urbine
FIP	**F**uel **I**njection **P**ump
F/L	**F**ace**l**ift
FWD	**F**ront **W**heel **D**rive
HC	**H**ydro **C**arbon
LCD	**L**iquid **C**rystal **D**isplay
LF	**L**eft **F**ront
LSD	**L**imited **S**lip **D**ifferential
MAF	**M**ass **A**ir **F**low
MESI	**M**azda **E**lectronic **S**ervice **I**nformation
M-MDS	**M**azda - **M**odular **D**iagnostic **S**ystem
MPS	**M**azda **P**erformance **S**eries
MSP	**M**ulti **S**ide **P**ort
MT	**M**anual **T**ransmission
MTF	**M**anual **T**ransmission **F**luid
MTX	**M**anual **T**ransa**x**le
PCM	**P**owertrain **C**ontrol **M**odule
RF	**R**ight **F**ront
RWD	**R**ea**r** **W**heel **D**rive

SAE	**S**ociety of **A**utomotive **E**ngineers
SOHC	**S**ingle **O**ver**h**ead **C**amshaft
SST	**S**pecial **S**ervice **T**ool
TCM	**T**ransmission **C**ontrol **M**odule
TEN	**T**est **EN**gine
TCM	**T**ransmission **C**ontrol **M**odule
TDC	**T**op **D**ead **C**enter
VGT	**V**ariable **G**eometry **T**urbocharger
WDS	**W**orldwide **D**iagnostic **S**ystem
W/M	**W**orkshop **M**anual
2WD	**2 W**heel **D**rive
4WD	**4 W**heel **D**rive