528e, 633CSi & 733i 6-CYLINDER

ENGINE CODING

ENGINE IDENTIFICATION

Engine code is part of vehicle identification number. Number is stamped on a metal plate in the engine compartment. Metal plate is located on firewall.

ENGINE IDENTIFICATION CODES

Engine	Code
2693 cc (528e)	
M/T	4073
A/T	4083
3210 cc (633CSi)	
M/T	5236
A/T	5246
3210 cc (733i)	
M/T	6634
A/T	6644

ENGINE & CYLINDER HEAD

MANUAL TRANSMISSION

Removal

1) Remove exhaust system and support brackets from vehicle. Compress rubber coupling with compressing strap (26 1 012), then disconnect propeller shaft at rear of transmission.

2) Remove heat shield from center support bearing. Remove center support bearing bracket. Lower propeller shaft at center support bearing and pull propeller shaft from transmission.

3) Remove clutch slave cylinder, leaving line connected. Remove speedometer cable and disconnect plug from back-up light switch.

4) Pull up boot from floor shift lever, remove circlip and pull shift lever up and out. Support transmission and remove crossmember. Remove transmission.

Installation

1) To install, reverse removal procedure. When installing propeller shaft, use new lock nuts at rubber coupling. Only tighten nuts (never bolts) to avoid stress on coupling.

2) When installing propeller shaft, push center support bearing forward .08" (2.0 mm) to preload bracket, then tighten nuts.

AUTOMATIC TRANSMISSION

Removal

1) Disconnect exhaust system and remove support brackets. Disconnect accelerator cable from transmission and disconnect bracket. Drain transmission oil. Remove filler tube and plug opening.

2) Disconnect oil cooler lines from transmission. Label and disconnect all wiring attached to transmission. Remove cover plate from transmission. If equipped, mark installed positions of speed and reference mark sensors, then remove.

3) Remove 4 bolts securing torque converter to drive plate. Disconnect shift rod from lever. Disconnect propeller shaft coupling at rear of transmission.

4) Remove heat shield, then remove center support bearing bracket. Lower propeller shaft at center support bearing and pull propeller shaft from transmission. Disconnect speedometer cable. Support transmission.

5) Remove crossmember, then lower transmission to rest on front axle carrier. Place transmission jack under transmission. Separate and remove transmission and torque converter from engine.

Installation

1) To install transmission and remaining components, reverse removal procedures while noting the following:

2) Before installing transmission, position torque converter so that a distance of 1/2" (1 13/64" for 528e models) exists between front face of threaded tabs (tabs for torque converter bolts) and front edge of transmission case.

3) When installing propeller shaft, push center support bearing forward .08" (2.0 mm) to preload bracket, then tighten nuts.

4) When installing sensors, note that black plug of speed sensor faces ring gear. Gray ring of reference mark sensor faces flywheel. If plugs are reversed, engine will not start.

ENGINE

Removal

1) Remove hood. Disconnect battery cables from battery. Remove transmission. Remove splash guard from under engine. Drain cooling system and remove radiator. Remove power steering pump (leaving hoses connected) and secure away from engine.

2) If equipped, remove A/C compressor (with hoses connected) and secure away from engine. Remove accelerator cable. If equipped, remove cruise control cable from engine.

3) Label and disconnect all electrical and ignition wiring that might interfere with engine removal. Be sure to disconnect wiring harness in glove box, and pull through hole in firewall.

4) Label and disconnect all coolant, ventilation, fuel and vacuum hoses (or lines) that might interfere with engine removal. Remove air cleaner with air flow sensor.

5) Remove nuts from engine mounts. Ensure no wiring, hoses or lines are attached to engine. Attach a lifting chain and hoist to engine. Carefully lift engine from vehicle.

Installation

To install engine, reverse removal procedures. Ensure that all hoses, lines and electrical connections are restored to original positions. Bleed cooling system.

CYLINDER HEAD

Removal

1) Disconnect battery ground cable. Drain cooling system. Remove splash guard from bottom of engine. Disconnect exhaust pipes from manifolds.

2) Disconnect accelerator and cruise control cables from throttle valve housing, including cable to automatic transmission (if equipped). Disconnect attached hoses and electrical wiring, then remove air cleaner with air flow sensor.

3) Label and disconnect all coolant hoses attached to cylinder head. Label and disconnect all fuel, ventilation and vacuum hoses (or lines) from cylinder head and intake manifold.

4) Label and disconnect all electrical and ignition wiring that might interfere with head removal. If

528e, 633CSi & 733i 6-CYLINDER (Cont.)

necessary, disconnect electrical plug in glove box, and pull wiring through hole in firewall.

5) Remove rocker cover. Remove upper engine front cover (or timing belt cover on 528e models). On 528e models, remove cover surrounding distributor.

6) Set No. 1 piston on TDC at end of compression stroke. Timing pointer and mark on vibration damper should align, and valves of No. 6 cylinder should overlap.

7) On 633CSi and 733i models, remove timing chain tensioner plug, spring and piston. On 528e models, loosen timing belt tensioner bolts. Push tensioner sprocket inward, then tighten adjusting bolt.

8) On 528e models, remove timing belt from camshaft sprocket. On other models, remove camshaft sprocket. Remove cylinder head bolts. Install locating pins in bolt holes to keep rocker arm shafts from turning. Remove cylinder head.

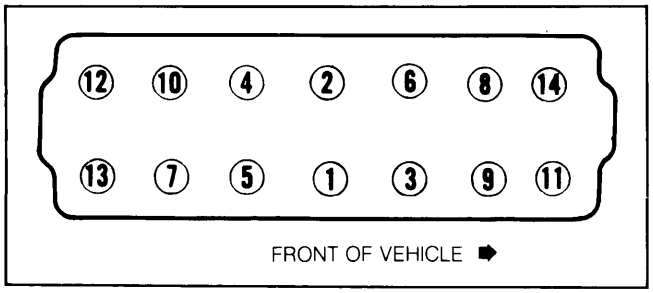
Installation

1) Clean all gasket mating surfaces. Remove oil from head bolt threaded holes in cylinder block.

2) Clean and lubricate bolt heads and threads of head bolts. Using new head gasket, install cylinder head and bolts.

3) On 528e models, tighten head bolts in 2 steps. *See Fig. 1.* On all other models, tighten in 3 steps. *See Fig. 2.*

Fig. 1: 528e Cylinder Head Tightening Sequence

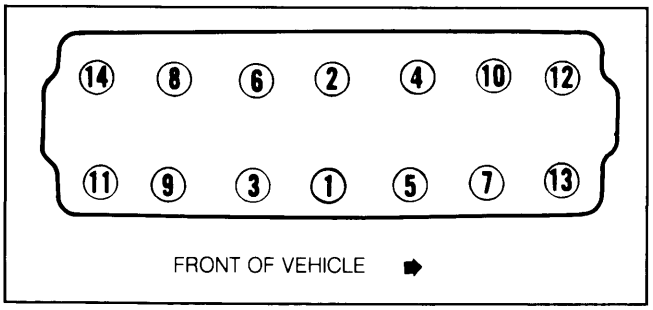


Tighten head bolts in 2 steps. Use angle-calibrated torque wrench for final tightening (engine warm).

4) On all models, retighten head bolts after engine has been warmed to operating temperature. Using special torque wrench (11 2 110), retighten head bolts to torque angle of 20-30°.

5) Check head bolt torque (except 528e) at 600 miles after cylinder head service. If necessary, retighten with engine cold. Never loosen bolts during tightening sequence; turn only in tightening direction.

Fig. 2: 633CSi & 733i Cylinder Head Tightening Sequence



Tighten head bolts in 3 steps. Use angle-calibrated torque wrench for final tightening (engine warm).

6) On all models, install camshaft sprocket and timing chain (or timing belt). Ensure valve timing is correct. Install remaining components in reverse order of removal, using new gaskets where required. Adjust valves.

CAMSHAFT

TIMING BELT COVER

Removal (528e)

1) Remove radiator. Remove all drive belts. Remove pulley and vibration damper. Hold crankshaft in place and remove center bolt from vibration damper hub.

2) Using puller, remove vibration damper hub from crankshaft. Remove crankshaft sprocket from crankshaft using a puller. Hold intermediate shaft sprocket in place and remove attaching bolt, washer and sprocket.

3) Remove 3 oil pan-to-cover bolts, then loosen remaining oil pan bolts. Remove remaining attaching bolts, then remove timing belt cover.

Installation

1) Clean gasket mating surfaces. Coat oil pan-to-cover gasket with gasket sealer. Install centering tool (11 2 211) on crankshaft and centering tool (11 2 212) on intermediate shaft to align front cover.

2) Using new gasket, install and tighten timing belt cover. Note that lettering on crankshaft sprocket must face forward when installing. Install remaining components in reverse order of removal procedures.

UPPER ENGINE FRONT COVER

Removal (633CSi & 733i)

1) Remove rocker cover. Remove distributor. If equipped, remove fan shroud. Remove cover plate above air injection pipe, then disconnect and remove air injection pipe from exhaust manifold and smog pump air hose.

2) Remove thermostat housing and thermostat. Remove upper front cover attaching bolts. Remove upper front cover with distributor drive.

Installation

1) Clean gasket mating surfaces. Fill holes in lower front cover (at junction of lower front cover-to-cylinder block) with sealer. Replace cord seal around distributor drive.

2) Using new gasket, install front cover with distributor drive. Install attaching bolts. Tighten bolts to lower cover first, then tighten remaining cover bolts. Install remaining components in reverse order of removal.

LOWER ENGINE FRONT COVER

Removal (633CSi & 733i)

1) Remove upper engine front cover. Remove timing chain tensioner plug, spring and piston. Remove fan. Remove drive belts from crankshaft and fan pulleys.

2) Hold crankshaft in place and remove vibration damper and hub. Remove TDC position sensor and bracket from cover. Remove oil pan-to-front cover attaching bolts.

3) Loosen remaining oil pan bolts. Remove remaining cover attaching bolts. Carefully separate lower front cover from oil pan.

Installation

1) Clean gasket mating surfaces. Apply gasket sealer to oil pan gasket and to oil pan-to-cylinder block junction. Install lower engine front cover.

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2) Install remaining components in reverse order of installation. Adjust TDC position sensor after installing.

TIMING BELT COVER OIL SEALS

Removal & Installation (528e)

Remove timing belt cover. Remove crankshaft and intermediate shaft oil seals from cover. Using seal installing tool, install new seals until flush. Coat seal lips with oil prior to installing cover.

FRONT COVER OIL SEAL

NOTE: Using seal installing tool (11 1 280), front cover oil seal can be replaced without removing lower engine front cover.

Removal (633CSi & 733i)

Remove fan shroud. Remove all drive belts. Remove nut on crankshaft, then remove vibration damper and hub. Remove oil seal.

Installation

Pack lips of new oil seal with grease. Using seal installing tool (11 1 280), press in seal. Install remaining components in reverse order of removal.

TIMING BELT & SPROCKET

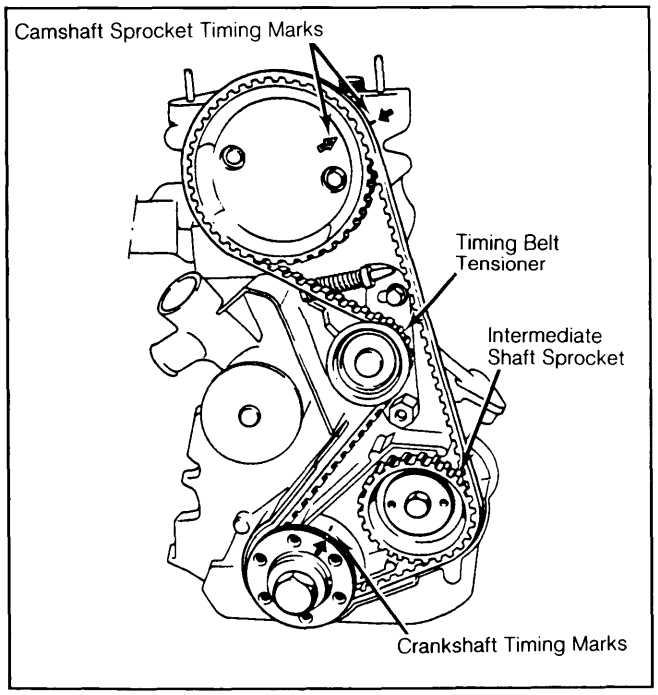
Removal (528e)

1) Remove distributor cap and rotor, then remove cover surrounding distributor. Turn crankshaft to position No. 1 piston on TDC at end of compression stroke.

2) Ensure timing marks on vibration damper and pointer are aligned. Arrow on camshaft must be aligned with timing mark on cylinder head. *See Fig. 3.*

3) Remove timing belt cover. Loosen tensioner and position away from timing belt to relieve tension.

Fig. 3: 528e Timing Sprockets Alignment



If installing same timing belt, mark direction of rotation prior to removing.

Tighten tensioner adjusting bolt to keep tensioner in retracted position.

4) If installing same timing belt, mark normal direction of rotation on timing belt before removing. Remove timing belt.

Installation

1) Ensure arrow on camshaft sprocket is still aligned with timing mark on cylinder head. Check that timing mark on crankshaft sprocket is aligned with notch in cover (approximatey 1 o'clock position). *See Fig. 3.*

2) Install timing belt on sprockets. Loosen tensioner adjusting bolt to allow tension on timing belt. Turn crankshaft in direction of normal rotation until timing belt tightens. Tighten tensioner bolts. Install remaining components in reverse order of removal.

TIMING CHAIN & SPROCKETS

Removal (633CSi & 733i)

1) Remove distributor. Remove upper engine front cover. Rotate crankshaft until No. 1 cylinder is on TDC at end of compression stroke. Timing mark on front cover should align with notch in vibration damper.

2) Remove camshaft sprocket with timing chain attached. Remove chain from camshaft and crankshaft sprockets.

3) If crankshaft sprocket removal is necessary, remove oil pan. Remove oil pump sprocket and drive chain. Remove Woodruff key from crankshaft. Using a puller, remove crankshaft sprocket.

Installation

1) Install components in reverse order of removal. Oil pump drive chain has correct tension if chain gives under slight thumb pressure midway between sprockets. Adjusting shims are available for adjusting oil pump drive chain tension.

2) Make sure No. 1 piston is still on TDC at end of compression stroke. When installing timing chain and camshaft sprocket, be sure camshaft flange is correctly positioned. *See Fig. 5.*

VALVE TIMING

For 528e models, valve timing procedures are covered in Timing Belts & Sprockets. For all other models, use procedures explained in Timing Chain & Sprockets.

TIMING BELT TENSIONER

Removal & Installation (528e)

Remove timing belt cover. Place piston of No. 1 cylinder on TDC at end of compression stroke. Remove timing belt tensioner. To install, reverse removal procedures.

TIMING CHAIN TENSIONER

CAUTION: Timing chain tensioner piston assembly is under high spring pressure. Use care when unscrewing tensioner plug.

Removal & Disassembly (633CSi & 733i)

Carefully remove tensioner plug. Remove spring and piston assembly. Remove piston, check ball and metering disc from piston sleeve. *See Fig. 4.* Clean all parts thoroughly and blow out with compressed air.

Reassembly & Installation

1) Reassemble piston parts in reverse order of disassembly. Ensure that metering disc does not block bleed slots in piston. Remove rocker cover.

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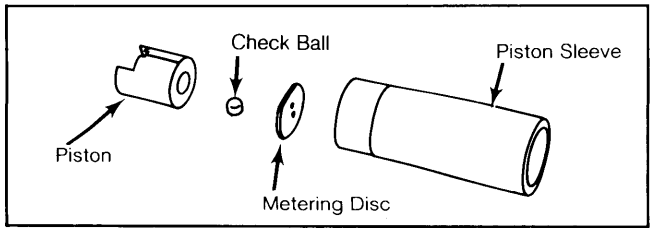
Fig. 4: 633CSi & 733i Tensioner Components



Piston assembly must be purged of air after installing.

2) Install piston assembly and spring in lower front cover. Tapered end of spring must face tensioner plug. Install plug and lightly tighten. Fill tensioner piston oil pocket (in lower front cover) with engine oil.

3) Piston must be purged of air. Using a screwdriver, move tensioning rail back and forth against piston until oil runs out around tensioner plug threads. Tighten tensioner plug. Install remaining components.

CAMSHAFT

Removal (528e)

Remove cylinder head. Remove rocker arm shaft assemblies. Remove thrust plate. Pull out camshaft.

Installation

Install camshaft in reverse order of removal. When installing thrust plate, use aligning tool (11 2 212) to properly align. Install remaining components in reverse order of removal.

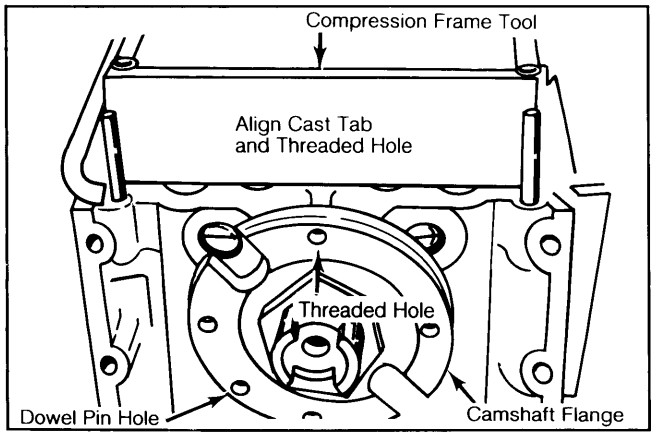
Removal (633CSi & 733i)

1) Remove cylinder head from engine. In vicinity of EGR valve, remove coolant hose and pipe from side of head. Remove EGR valve. Remove 2 hollow attaching bolts, then remove oil distribution pipe from top of head.

2) Loosen all valve adjustments to maximum permissible clearance. Turn camshaft to position camshaft flange as shown in *Fig. 5*. Now rotate camshaft flange approximately 9/16 - 5/8" toward intake side.

3) Install rocker arm compression tool (11 1 060) to relieve tension on camshaft. Tighten nuts on exhaust valve side of tool. Next, tighten nuts on intake valve side of tool. Remove bolts from camshaft thrust plate. Remove camshaft.

Fig. 5: 633CSi & 733i Camshaft Flange Position for Compression Tool Installation and Removal



Position flange as shown when removing and installing camshaft sprocket.

Installation

1) Install camshaft in head and tighten thrust plate bolts. Cam must turn easily. Turn camshaft to position camshaft flange as shown in *Fig. 5* (valves of No. 6 cylinder overlap). Remove compression tool.

2) Install oil pipe so that oil bores will give off spray between rocker arms and cams of intake and exhaust valves. Use new seals between oil pipe and rocker supports as well as under head of attaching bolts. Continue assembly in reverse order of removal.

CAMSHAFT OIL SEAL

Removal (528e)

Place No. 1 cylinder on TDC and align ignition timing and valve timing marks. Remove timing belt. Remove camshaft sprocket. Remove thrust plate. Remove oil seal and round cord seal from thrust plate.

Installation

Lubricate oil seals with engine oil. Replace oil seal and round cord seal on thrust plate. Use aligning tool (11 2 212) when installing thrust plate. Install remaining components in reverse order of removal.

CAMSHAFT END THRUST

Insert feeler gauge between thrust plate and camshaft flange (or sprocket on 528e). Maximum end thrust is .008" (.20 mm). Replace camshaft thrust plate if end thrust is excessive. Recheck end thrust.

INTERMEDIATE SHAFT

Removal & Installation (528e)

Remove timing belt cover. Remove guide plate and pull out intermediate shaft. To install, reverse removal procedures. Bearings in cylinder block are not replaceable.

VALVES

VALVE ARRANGEMENT

Intake valves (Left side)
Exhaust valves (Right side)

ROCKER ARM SHAFT ASSEMBLY

Removal (528e)

1) Remove cylinder head from engine. Remove camshaft sprocket. Adjust valve clearance of all valves to maximum value. Remove front and rear rubber plugs on either side of rocker shafts.

2) Remove thrust plate from rocker shafts (at front of head). Remove spring clips from rockers. Turn camshaft so valves of cylinder No. 6 overlap.

3) Rotate camshaft 1/4 turn against normal direction of rotation, and at the same time push rockers for cylinders 3 and 4 to the rear. Push all remaining rockers toward the front of the head.

4) When the camshaft is clear of the rockers, both rocker shafts can be removed. Be sure to keep all rockers in order for later installation in their original locations.

Installation

Install rocker arm shaft assembly in reverse order of removal. Install rocker shafts with large oil holes facing downward. Ensure small oil holes and thrust plate grooves in rocker shafts face inward. Straight surface of retaining clips are installed in rocker shaft grooves.

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Removal (633CSi & 733i)

1) Remove camshaft. Push rocker arms and thrust rings against springs and remove circlips from front rocker arm shafts.

2) Remove countersunk slotted bolts from front of cylinder head. Thread special slide hammer tool (11 3 060) into end of rocker shaft, and pull shaft from cylinder head. Keep rocker arms, thrust rings, springs and washers in correct order for reassembly.

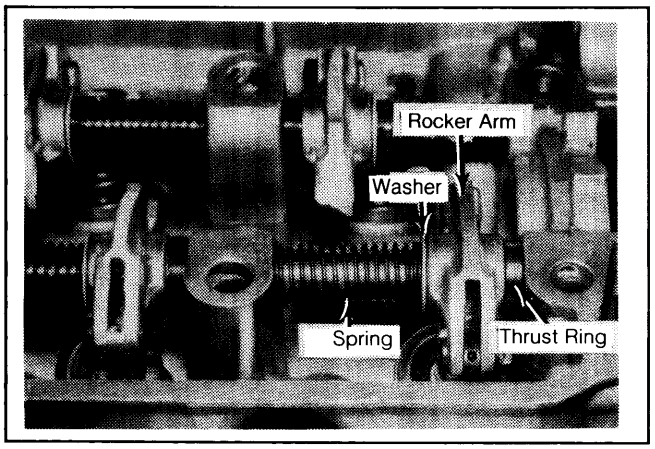
3) To remove rear rocker arm shafts, remove cover from rear of cylinder head. Use same tool and procedures used for removing front rocker arm shafts.

4) Check cam follower pads on rocker arms for wear. If pads are worn or loose on rocker arms, replace rocker arms.

Installation

Install rocker arm shaft components in original locations. *See Fig. 6.* Use locating pins to align cutout notches in rocker arm shafts for cylinder head bolts. Use Loctite on countersunk bolts (front and rear of head).

Fig. 6: 633CSi & 733i Rocker Arm Assembly



When removing, keep all components in order for later reassembly.

VALVE GUIDE SERVICING

528e

1) Measure valve-to-guide clearance. If guide is worn, drive out guide toward combustion chamber side of head.

2) Check size of valve guide bore in cylinder head. Install oversize guides if bore size in head is excessive.

3) When boring head for installation of guides, allow for shrink fit. Heat cylinder head to 430-480°F (220-250°C) before installing guides.

4) Using driver, drive guide into cylinder head from top until top of guide protrudes .552-.591" (14.02-15.01 mm). Ream guide until correct valve-to-guide clearance is obtained.

633CSi & 733i

1) Measure valve-to-guide clearance. If guide is worn, drive out guide toward combustion chamber side of head.

2) Check size of valve guide bore in cylinder head. Install oversize guides if bore size in head is excessive.

3) When boring head for installation of guides, allow for shrink fit. Valve guide shrink fit specification is .0006-.0017" (.015-.043 mm). Heat cylinder head to 430-480°F (220-250°C) before installing guides.

4) Using driver, drive guide into cylinder head from top until top of guide protrudes .512-.551" (13.00-14.00 mm). Ream valve guide until correct valve-to-guide clearance is obtained.

VALVE STEM OIL SEALS

Remove valve springs and pull off old seal. When replacing valve stem oil seals, use protective sleeve over valve stem to avoid damage to new seals. Lubricate seal with oil and install.

VALVE SEAT INSERTS

1) When replacing valve seat, remove old seat by turning out with cutting tool. When cutting bore for valve seat inserts, allow for shrink fit. Valve seat insert shrink fit specification is .004"-.006" (.10-.15 mm).

2) When installing new seat, heat head to approximately 430-480°F (220-250°C) and chill valve seat to approximately -94°F (-70°C). Oversize replacement seats are available.

VALVE SPRING

Removal

Remove cylinder head. Remove rocker arms and shafts. Compress valve spring with spring compressor and remove keepers. Remove valve spring and retainer.

Inspection

Check spring free length. Check spring pressure in a valve spring tester. Replace defective springs with new springs of same color code.

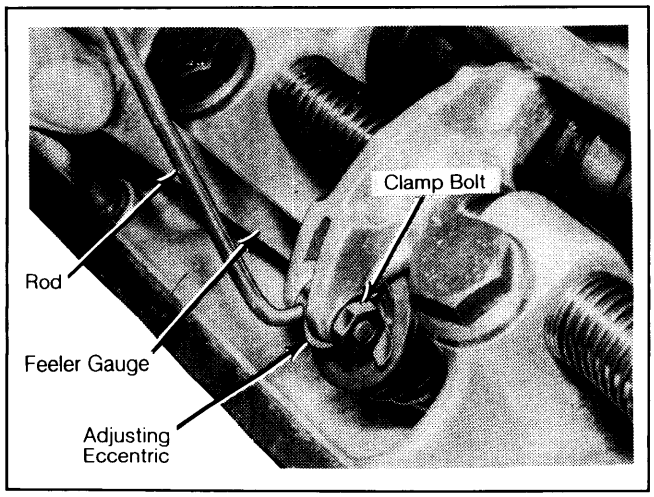
Installation

Install springs with paint stripe (tight coil end) against head. Install retainer and keepers. Install remaining components to complete installation.

VALVE CLEARANCE ADJUSTMENT

1) Adjust valves in firing order (1-5-3-6-2-4), with piston of cylinder concerned on TDC at end of compression stroke. Use a feeler gauge to measure clearance between rocker arm eccentric and tip of valve.

Fig. 7: Adjusting Valve Clearance



Adjust clearance to .010-.012" (.25-.30 mm) with engine cold, or .012-.014" (.30-.36 mm) with engine warm.

528e, 633CSi & 733i 6-CYLINDER (Cont.)

2) Valve clearance for intake and exhaust valves is .010-.012" (.25-.30 mm) with engine cold, or .012-.014" (.30-.36 mm) with engine at operating temperature.

3) To adjust valve clearance, loosen nut on rocker arm and insert a rod in eccentric hole. Rotate eccentric until proper clearance is obtained, then tighten lock nut. *See Fig. 7.*

PISTONS, PINS & RINGS

OIL PAN

Removal (528e)

Remove splash guard. Disconnect electrical plug from side of block and remove flywheel cover. Remove oil pan bolts. Remove oil pump and oil pan.

Installation

Clean gasket mating surfaces and coat with gasket sealer. Using new gasket, install oil pump and pan in reverse order of removal. Install remaining components to complete installation.

Removal (633CSi)

1) Drain engine oil and remove wire from oil level switch (if equipped). Remove steering stabilizer. Remove power steering pump with hoses connected. Remove mounting bracket attached to oil pan and front cover.

2) Remove oil pan bolts. Lower pan and move toward front of engine. Turn crankshaft until No. 6 connecting rod is above crankcase sealing surface.

3) Move oil pan toward right side of engine and remove. If necessary, raise engine at clutch housing with a jack to allow clearance for pan removal.

Installation

Clean gasket mating surfaces and coat with gasket sealer. Using new gasket, install oil pan in reverse order of removal. Install remaining components to complete installation.

Removal (733i)

1) Drain engine oil. Remove wire from oil level switch and detach from oil pan. Remove power steering pump with hoses connected. Remove mounting bracket attached to oil pan and front cover.

2) Remove nuts from left and right engine mounts. Remove engine damper. Remove fan housing from radiator. Install engine hoist and chain to engine. Raise engine to provide clearance for oil pan removal. Remove oil pan.

Installation

Clean gasket mating surfaces and coat with gasket sealer. Using new gasket, install oil pan in reverse order of removal. Install remaining components to complete installation.

PISTON & ROD ASSEMBLY

Removal

1) Remove cylinder head, oil pan and oil pump. If necessary, mark rod and rod cap for cylinder identification, then remove rod cap.

2) Remove ridge at top of cylinder bore. Push piston and rod assembly out top of block. Install rod cap on connecting rod from which removed.

3) If replacing pistons or rods, be sure they are in the same weight class as existing piston or rods.

Installation

1) Install rings on piston and space end gaps 120° apart. Coat piston and cylinder walls with engine oil. Install ring compressor on piston.

2) Install piston and rod assembly with arrow on piston head toward front of engine. Install rod bearings. Using new rod bolts and nuts, install and tighten rod caps.

FITTING PISTONS

528e Models

1) Arrow on piston heads indicate direction of installation. Weight class is indicated by a "+" or "—" sign. All pistons must be in same weight class.

2) Measure piston diameter 90° to pin bore near bottom of piston skirt. For Mahle type pistons, measure about 9/16" from bottom of piston skirt. For KS type pistons, measure about 5/16" from bottom of piston skirt.

3) Measure cylinder bore diameter in line with crankshaft centerline and 90° to crankshaft centerline, at top, middle and bottom of cylinder. Difference between corresponding measurements is out-of-round and must not exceed .0012" (.03 mm).

4) Difference between top cylinder bore measurement and bottom cylinder bore measurement is taper, and should not exceed .0008" (.02 mm).

5) Difference between maximum cylinder diameter measurement and piston diameter measurement is piston-to-cylinder bore clearance. If clearance is excessive, bore and hone cylinder block for installation of oversize pistons.

633CSi & 733i

1) Arrow on piston heads indicate direction of installation. Weight class is indicated by a "+" or "—" sign. All pistons must be in same weight class.

2) Measure piston diameter 90° to pin bore near bottom of piston skirt. For Mahle type pistons, measure about 1 1/32" from bottom of piston skirt. For KS type pistons, measure about 1 11/32" from bottom of piston skirt.

3) Measure cylinder bore diameter in line with crankshaft centerline and 90° to crankshaft centerline, at top, middle and bottom of cylinder. Difference between corresponding measurements is out-of-round and must not exceed .0004" (.010 mm).

4) Difference between top cylinder bore measurement and bottom cylinder bore measurement is taper, and should not exceed .0004" (.010 mm).

5) Difference between maximum cylinder diameter measurement and piston diameter measurement is piston-to-cylinder bore clearance. If clearance is excessive, bore and hone cylinder block for installation of oversize pistons.

FITTING RINGS

1) Place piston rings squarely into cylinder bore about 9/16" from bottom of bore. Use a feeler gauge to measure ring end gap.

2) With rings installed on piston, use a feeler gauge to measure ring side clearance. Take measurement around entire circumference of piston, between top of ring and ring land.

3) Install rings on piston with word "TOP" facing upward. Space ring end gaps 120° apart.

528e, 633CSi & 733i 6-CYLINDER (Cont.)

PISTON PIN REPLACEMENT

Removal

1) Remove circlip from pin bore groove. Push pin from piston and connecting rod. Piston pins and pistons must be replaced as matched set. All pistons must be in same weight class, as must all connecting rods.

2) Replacement piston pin bushings are available for 633CSi and 733i model engines. Replacement bushings may be used if pin is not worn. Connecting rods on 528e models cannot be machined.

3) Drill and deburr oil holes, and install bushing so that seam is 90° to oil hole in rod's small end. Ream bushing so pin slides through under slight pressure.

4) On 633CSi and 733i models, assemble connecting rod to piston with oil hole in rod's small end and arrow on piston head on same side. When installed, arrow on piston and rod's small end oil hole will face front of engine.

5) On 528e models, assemble connecting rod to piston so rod bearing locating lugs will be on exhaust side of engine, and arrow on piston head will face toward front of engine.

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

CRANKSHAFT MAIN BEARINGS

1) Use Plastigage method to measure main bearing clearances. Measure main bearing clearances 1 at a time. Wipe oil from surfaces to be checked. DO NOT allow crankshaft to turn once Plastigage is in place and bearing cap is tightened.

2) Remove bearing cap. Measure flattened width of Plastigage with scale furnished to determine clearance.

3) Standard crankshafts are marked with red or blue dots on side of counterweights. Factory ground crankshafts are identified by paint stripes marked on 1st counterweight. Bearings are also color coded.

4) If red and blue bearing shells are used in combination, be sure to install shells of same color on same side of crankshaft.

CONNECTING ROD BEARINGS

1) Use Plastigage method to measure connecting rod bearing clearances. Measure clearances 1 at a time.

2) Mark connecting rod and cap for cylinder identification before removing caps. Wipe oil from surfaces to be checked. DO NOT allow crankshaft to turn once Plastigage and cap is in place. Tighten cap to specification.

3) Remove rod cap. Measure flattened width of Plastigage with scale furnished to determine clearance. Whenever rod bearing caps are removed, rod cap bolts and nuts should be replaced.

CRANKSHAFT END THRUST

Attach a dial indicator to crankcase with indicator point contacting flywheel. Push flywheel forward and zero dial indicator. Pull flywheel rearward and record crankshaft end thrust. If end thrust is excessive, replace thrust bearing.

REAR MAIN BEARING OIL SEAL

Removal

1) Remove transmission and flywheel. Remove 2 rear oil pan bolts. Loosen remaining oil pan bolts. Carefully separate seal retainer from oil pan gasket.

2) Remove seal retainer from rear of crankcase. Remove oil seal from seal retainer.

Installation

1) Coat oil pan gasket at seal retainer contact surface with sealing compound. Install oil seal into retainer.

2) Install aligning tool (11 2 213) on crankshaft. Coat seal lips with oil and install retainer and seal. Install remaining components.

ENGINE OILING

CRANKCASE CAPACITY

528e

Capacity is 4.2 quarts (4.0L) without filter replacement; 4.5 quarts (4.3L) with filter replacement.

633CSi & 733i)

Capacity is 5.3 quarts (5.0L) without filter replacement; 6.1 quarts (5.8L) with filter replacement.

NORMAL OIL PRESSURE

528e

Oil pressure should be 7-14 psi (0.5-1.0 kg/cm²) at idle. Maximum oil pressure at top speed should be 72-87 psi (5.0-6.0 kg/cm²).

633CSi & 733i

Oil pressure should be 7-28 psi (0.5-2.0 kg/cm²) at idle. Maximum oil pressure at top speed should be about 70 psi (4.9 kg/cm²).

OIL PRESSURE RELIEF VALVE

For all models, oil pressure relief valve opens at approximately 68-74 psi (4.8-5.2 kg/cm²).

ENGINE OILING SYSTEM

528e Models

A gear type oil pump is used. Pump shaft is driven by distributor shaft. The pump is attached to the bottom of the crankcase. A safety valve in the oil pump prevents oil pressure from becoming extremely excessive.

A pressure relief valve (screwed into the crankcase) is connected directly into the main oil gallery. When oil pressure reaches predetermined maximum value, valve opens to allow oil to return to crankcase.

Oil pump pressure feeds oil through drilled passages within the block to lubricate all internal engine parts. Upper valve train components are lubricated by drainage method.

633CSi & 733

A rotor type oil pump is used. Pump is chain driven off of crankshaft sprocket. Pressure regulating valve is integral with oil pump.

Oil pump pressure feeds oil to full-flow oil filter. From oil filter, oil is circulated through drilled passages to all moving parts of the engine. Upper valve train components and timing chain are lubricated through drainage or splash method.

528e, 633CSi & 733i 6-CYLINDER (Cont.)

OIL PUMP

NOTE: Disassembly and inspection procedures for 528e not available at time of printing.

Removal & Installation (528e)

Remove oil pan. Remove 3 attaching bolts and remove oil pump. Remove cover to gain access to oil screen. To install, reverse removal procedures. Ensure drive shaft engages with distributor shaft when installing.

Removal (633CSi & 733i)

Remove oil pan. Remove oil pump drive sprocket and detach from chain. Remove oil pump attaching bolts and nuts at bracket. Remove oil pump.

Disassembly

1) Unscrew union and remove relief valve spring and plunger from pump body. Remove pick-up tube and cover from pump body. Clean all parts and blow dry with compressed air.

2) If inner rotor replacement is required, remove pump sprocket hub from rotor shaft using a puller. Install new rotor in pump body and press hub onto rotor shaft to a distance of 1.740-1.748" (44.20-44.40 mm) between hub and rotor faces. *See Fig. 8.*

Inspection

1) Using a feeler gauge, measure clearance between outer rotor and pump body. If measurement exceeds specification, replace pump body.

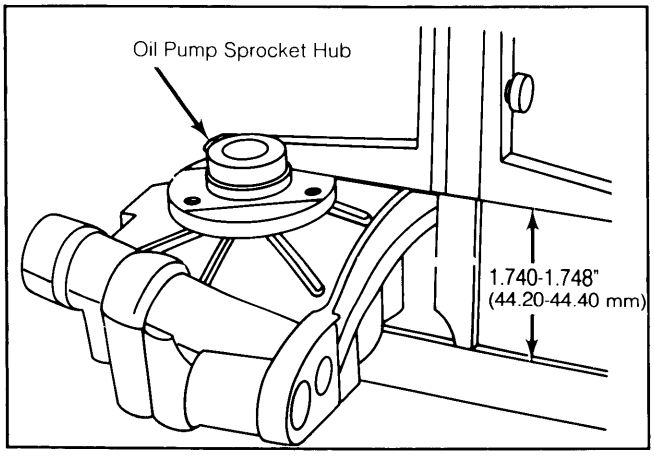
2) Using a feeler gauge, measure clearance between inner and outer rotor. If measurement exceeds specification, replace rotors.

3) Lay a straightedge over pump body. Insert a feeler gauge between straightedge and rotors and measure clearance over rotors. If clearance exceeds specification, replace pump body.

OIL PUMP SPECIFICATIONS

Application	Measurement In. (mm)
Rotor-to-Pump Body	.006-.011 (.15-.27)
Clearance Between Rotors	.0047-.0079 (.119-.200)
Clearance Over Rotors	.0014-.0037 (.035-.095)
Spring Free Length	2.677 (67.99)

Fig. 8: Measuring Distance Between Sprocket Hub and Rotor Face



Do not use arbor press to remove sprocket hub. Use a puller to remove hub.

4) Check free length of relief valve spring. If measurement is less than specified, replace spring.

Reassembly

Reassemble oil pump in reverse order of disassembly, using new parts where required.

Installation

1) Prime oil pump. To install, reverse removal procedure. Check oil pump drive chain tension.

2) Chain tension is correct if chain gives when slight thumb pressure is exerted midway between oil pump and crankshaft sprockets. Shims are available for tension adjustment.

3) Install shims between oil pump and crankcase mounting points. Front and rear shims must be of same thickness.

4) Ensure holes in shims align with corresponding holes in oil pump and crankcase. To install remaining components, reverse removal procedure.

ENGINE COOLING

THERMOSTAT

Thermostat begins opening at 176°F (80°C).

COOLANT CAPACITY

Coolant capacity (including heater system) is 12.7 quarts (12.0L)

RADIATOR CAP

Radiator cap pressure relief valve opens at 12.8-16.4 psi (0.9-1.2 kg/cm²).

WATER PUMP

Removal (528e)

1) Drain coolant. Remove distributor rotor and cap, then remove distributor cover. Remove fan and drive belt from pulley. Remove rubber guard and lift out cover from behind pulley.

2) Remove water pump pulley. Compress tensioner spring and pin near top of water pump and clamp in compressed position. Note installed position of pin to water pump. Remove coolant hoses from water pump. Remove water pump.

Installation

Using new gasket, install water pump. Adjust drive belt tension. Refill and bleed cooling system.

Removal & Installation (633CSi & 733i)

Loosen drive belts. Remove fan, spacer and pulley from water pump. Remove bar near top of water pump. Remove coolant hose from water pump, then remove pump. Using new gasket, install water pump in reverse order of removal.

528e, 633CSi & 733i 6-CYLINDER (Cont.)

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

Year	Displacement Cu. In.	Displacement cc	Fuel System	HP@RPM	Torque Ft. Lbs.@RPM	Compr. Ratio	Bore In.	Bore mm	Stroke In.	Stroke mm
1982										
528e	164	2693	Fuel Inj.	121@4250	170@3250	9.0:1	3.30	84.0	3.19	81.0
633CSi	196	3210	Fuel Inj.	177@5500	192@4000	8.4:1	3.50	89.0	3.39	86.0
733i	196	3210	Fuel Inj.	177@5500	192@4000	8.4:1	3.50	89.0	3.39	86.0

VALVES

Engine Size & Valve	Head Diam. In. (mm)	Face Angle	Seat Angle	Seat Width In. (mm)	Stem Diameter In. (mm)	Stem Clearance In. (mm)	Valve Lift In. (mm)
2693 cc							
Intake	1.575 (40.0)	45.5°	45°	.051-.079 (1.3-2.0)	[1]	.006 Max. (.15)	.....
Exhaust	1.339 (34.0)	45.5°	45°	.051-.079 (1.3-2.0)	[1]	.006 Max. (.15)	.....
3210 cc							
Intake	1.811 (46.0)	45.5°	45°	.063-.079 (1.6-2.0)	.3134-.3140 (7.960-7.975)	.0010-.0022 (.025-.055)	.....
Exhaust	1.496 (38.0)	45.5°	45°	.079-.095 (2.0-2.4)	.3128-.3134 (7.945-7.960)	.0016-.0027 (.040-.070)	.....

[1] — Information not available from manufacturer.

PISTONS, PINS, RINGS

Engine	PISTONS Clearance In. (mm)	PINS Piston Fit In. (mm)	PINS Rod Fit In. (mm)	RINGS Ring No.	RINGS End Gap In. (mm)	RINGS Side Clearance In. (mm)
2693 cc	.0004-.0015 (.011-.039)	[1]	Push Fit	No. 1	.012-.020 (.30-.50)	.0016-.0028 (.040-.072)
				No. 2	.012-.020 (.30-.50)	.0012-.0024 (.030-.062)
				Oil	.010-.020 (.25-.50)	.0008-.0017 .020-.042)
3210 cc Mahle Pistons	.0018 Max. (.045)	.0002 Max. (.005)	Push Fit	No. 1	.012-.020 (.30-.50)	.0024-.0036 [2] (.060-.092)
				No. 2	.008-.016 (.20-.40)	.0020-.0032 [3] (.050-.082)
				Oil	.010-.016 (.25-.40)	.0008-.0020 [4] (.020-.052)

[1] — Piston and pin are replaced as matched set.
[2] — Clearance measurement is same for KS Pistons.
[3] — .0016-.0028" (.040-.072 mm) for KS Pistons.
[4] — .0012-.0024" (.030-.062 mm) for KS Pistons.

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

Engine	MAIN BEARINGS Journal Diam. In. (mm)	MAIN BEARINGS Clearance In. (mm)	MAIN BEARINGS Thrust Bearing	MAIN BEARINGS Crankshaft End Play In. (mm)	CONNECTING ROD BEARINGS Journal Diam. In. (mm)	CONNECTING ROD BEARINGS Clearance In. (mm)	CONNECTING ROD BEARINGS Side Play In. (mm)
2693 cc							
Red Code	2.3614-2.3618 (59.98-59.99)	.0012-.0028 (.030-.070)	No. 6	.0031-.0064 (.080-.163)	1.7707-1.7713 (44.975-44.991)	.0012-.0028 (.030-.070)	.....
Blue code	2.3610-2.3614 (59.97-59.98)						
3210 cc							
Red Code	2.3614-2.3618 (59.98-59.99)	.0012-.0028 (.030-.070)	No. 4	.0033-.0068 (.084-.173)	1.8888-1.8894 (47.975-47.991)	.0009-.0027 (.023-.069)	.....
Blue Code	2.3610-2.3614 (59.97-59.98)						

528e, 633CSi & 733i 6-CYLINDER (Cont.)

ENGINE SPECIFICATIONS (Cont.)

VALVE SPRINGS

Engine	Free Length In. (mm)	PRESSURE Lbs. @ In. (Kg @ mm)	
		Valve Closed	Valve Open
2963 cc 3210 cc	[1] 1.71 [2] (43.5)	[1] 64@1.48 (29@37.6)	[1] 154@1.12 (70@28.5)

[1] — Information not available from manufacturer.
[2] — Depending on spring manufacturer, some springs may be 1.811" (46.0 mm).

CAMSHAFT

Engine	Journal Diam. In. (mm)	Clearance In. (mm)	Lobe Lift In. (mm)
2693 cc [1]	[2]	[2]	[2]
3210 cc [3]			
No. 1	1.3764-1.3770 (34.960-34.975)	.0013-.0029 (.034-.074)	.2922 (7.422)
No. 2	1.7304-1.7310 (43.952-43.967)		
No. 3	1.7704-1.7710 (44.968-44.984)		
No. 4	1.8094-1.8100 (45.959-45.974)		

[1] — End play is .008" (.20 mm)
[2] — Information not available from manufacturer.
[3] — End play is .0012-.0071" (.030-.180 mm).

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Camshaft Sprocket	
528e Only	17 (23)
Camshaft Thrust Plate	100-106 (135-144)
Connecting Rod Caps	
528e	
Step 1	14 (19)
Step 2	[1]
633CSi & 733i	38-41 (51-56)
Cylinder Head Bolts	
528e	
Step 1	22-25 (30-34)
Step 2	43-47 (58-64)
Step 3	[2]
633CSi & 733i	
Step 1	26-32 (34-44)
Step 2	49-52 (67-71)
Step 3	56-59 (77-81)
Step 4	[2]
Exhaust Manifold	22-24 (30-32)
Flywheel Bolts (Use Loctite)	72-83 (98-113)
Intermediate Shaft	
Sprocket (528e Only)	29-32 (39-43)
Main Bearing Caps	
528e	43-48 (58-65)
633CSi & 733i	42-45 (57-62)
Vibration Damper Hub	
528e	289-318 (392-431)
633CSi & 733i	318-333 (431-451)

[1] — Using special (angle-calibrated) torque wrench (11 2 110), tighten bolts an additional 70°.
[2] — Using special (angle-calibrated) torque wrench (11 2 110), tighten bolts an additional 20-30°.