

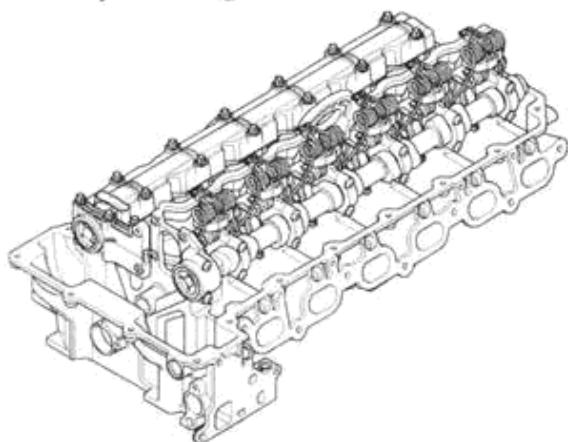
113 Cylinder Head Removal and Installation

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113-2 Cylinder Head Removal and Installation

Engine identification

Cylinder head:
N52 6-cylinder engine



B510113007

GENERAL

- ◀ This repair group provides removal and installation procedures for the cylinder head and associated components.

The cylinder head is equipped with variable camshaft timing (sometimes referred to as VANOS, from the German words *V*ariable *N*ockenwellen *S*teuerung). Special tools and procedures are required to remove and install camshaft adjustment units and to time camshafts. Be sure to read each procedure through before starting work.

See also:

- **020 Maintenance**
- **100 Engine-General** for engine code and application information.
- **117 Camshaft Timing Chain** for camshaft timing chain and camshaft adjuster (VANOS) service
- **130, 131, 132, 133 Fuel Injection** for air filter housing and intake manifold removal
- **170 Radiator and Cooling System**

Engine identification

Engine applications and specifications are detailed in **100 Engine-General**.

Table a. Engine identification

Engine designation	Year, model	Identifying feature
M54	2004 - 2005 525i, 530i	2 upper engine covers
N52	2006 - 2007 525i, 525xi 530i, 530xi 530xi Sports Wagon	Aluminum-magnesium cylinder head cover
N52KP	2008 - 2010 528i, 528xi 530i, 530xi 528i xDrive 530i xDrive	Black plastic cylinder head cover
N54	2008 - 2010 535i, 535xi 535xi Sports Wagon 535i xDrive 535i Sports Wagon 535i xDrive Sports Wagon	Twin-turbo chargers
N62	2004 - 2005 545i 2006 - 2010 550i	V-style engine with two valvetronic motors

Fasteners and fastener torques differ among the versions. Read torque specifications carefully.

Warnings and Cautions**WARNING—**

- To avoid personal injury, be sure the engine is cold before beginning work on engine components.
- Use extreme caution when draining and disposing of engine coolant. Coolant is poisonous and lethal to humans and pets. Pets are attracted to coolant because of its sweet smell and taste. Seek medical attention immediately if coolant is ingested.
- The fuel system is designed to retain pressure even when the ignition is OFF. When working with the fuel system, loosen fuel lines slowly to allow residual fuel pressure to dissipate. Avoid spraying fuel. Use shop towels to capture leaking fuel.
- Before beginning work on the fuel system, place a fire extinguisher in the vicinity of the work area.
- Fuel is highly flammable. When working around fuel, do not disconnect wires that could cause electrical sparks. Do not smoke or work near heaters or other fire hazards.
- Wear eye protection and protective clothing to avoid injuries from contact with fuel.
- Unscrew the fuel tank cap to release pressure in the tank before working on fuel lines.
- Do not use a work light with an incandescent bulb near fuel. Fuel may spray on the hot bulb causing a fire.
- Make sure the work area is properly ventilated.

CAUTION—

- To avoid electrochemical corrosion to engine components made of aluminum-magnesium alloy, do not use steel fasteners. Use aluminum fasteners only.
- The end faces of aluminum fasteners are usually painted blue. For reliable identification, test fasteners for aluminum composition with magnet.
- Replace aluminum bolts each time they are loosened.
- Follow torque instructions, including angle of rotation specifications, when installing aluminum fasteners.

113-4 Cylinder Head Removal and Installation

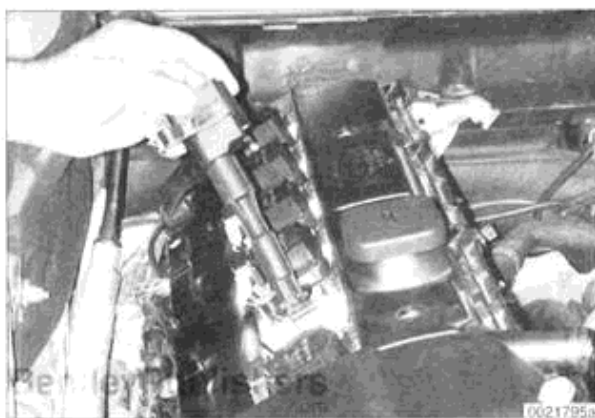
Cylinder head cover, removing and installing (M54 engine)



CYLINDER HEAD (M54 ENGINE)

Cylinder head cover, removing and installing (M54 engine)

- Make sure ignition is OFF. Remove ignition key.
- Remove air intake hood above radiator.
- Remove upper engine covers. See **020 Maintenance**.
- Working at left front of cylinder head cover, pinch crankcase breather hose clip (**arrows**). Detach hose from cover.



- Remove ignition coils:
 - Disconnect ignition coil harness connectors.
 - Remove coil mounting fasteners.
 - Remove coils.
 - Remove ground straps.
 - Set coil harness to side of engine compartment.

CAUTION—

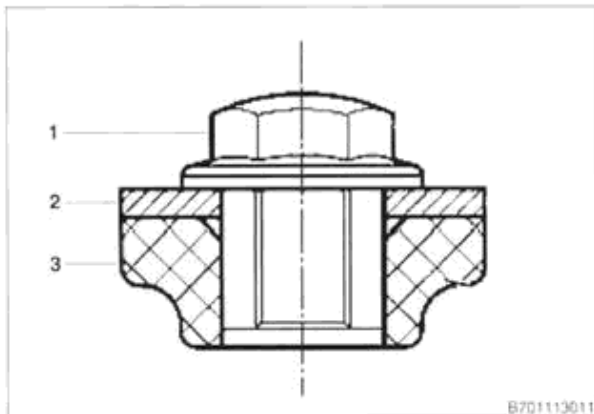
- Note location of all ground wires. Failure to reinstall grounds can result in permanent damage to engine control module or ignition system components.

- Remove cylinder head cover mounting fasteners and remove cylinder head cover.

NOTE—

- Make note of arrangement of fasteners during removal so that they can be reinstalled in their original locations.

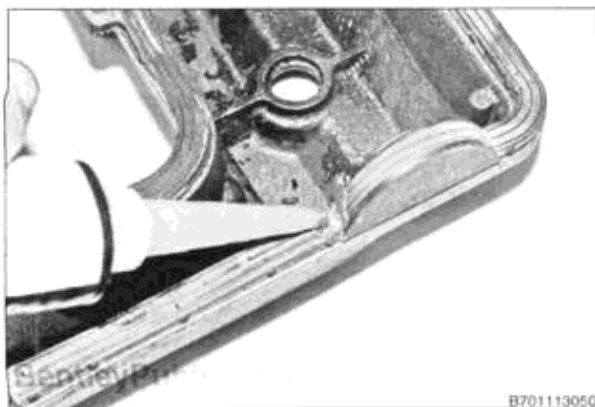
- Inspect cylinder head cover fasteners. Replace as necessary.
 1. Cap nut
 2. Washer
 3. Rubber seal



- Clean gasket residue from cylinder head sealing surface. Apply thin beads of 3-Bond 1209® or equivalent sealer at timing chain cover seams.
- Remove inner and outer gaskets from cylinder head cover and clean gasket residue from grooves.

- Coat cylinder head cover grooves with thin layer of anti-friction compound such as glycerine. Press inner and outer gaskets in place, making sure gaskets are not stretched at any point.

- Use a small amount of 3-Bond 1209® or equivalent sealer at corners of half-moon seals.



- Reinstall cylinder head cover.
 - Coat cylinder head and gasket contact surfaces with thin layer of anti-friction compound such as glycerine.
 - Check for correct seating of half-moon seals in back of cylinder head cover.
 - Install cylinder head cover fasteners and tighten gradually in crisscross pattern, starting with inside fasteners.
- Remainder of assembly is reverse of removal.

CYLINDER HEAD REMOVAL AND INSTALLATION (M54 ENGINE)

The 6-cylinder engine cylinder head is equipped with double VANOS. To remove the cylinder head, special tools and procedures are required for removing the VANOS unit. Read the entire procedure before beginning the repair.

CAUTION—

- *Disassembly, removal and assembly of camshafts or cylinder head without special tools poses the risk of damage or breakage. The valves may be bent by contact with the piston crown; camshafts may break if stressed incorrectly during removal or installation.*

NOTE—

- VANOS or variable camshaft timing is from the German words Variable NOckenwellen Steuerung.
- VANOS service is covered in **117 Camshaft Timing Chain**.

Cylinder head removal and installation procedures are described separately. Remove the intake manifold before removing the cylinder head. See **130 Fuel Injection**.

If you remove a cylinder head and determine that it requires significant reconditioning work, a remanufactured cylinder head is available from an authorized BMW dealer.

Cylinder head, removing (M54 engine)

WARNING—

- *Due to risk of personal injury, be sure the engine is cold before beginning the removal procedure.*

- Disconnect negative (–) cable from battery.

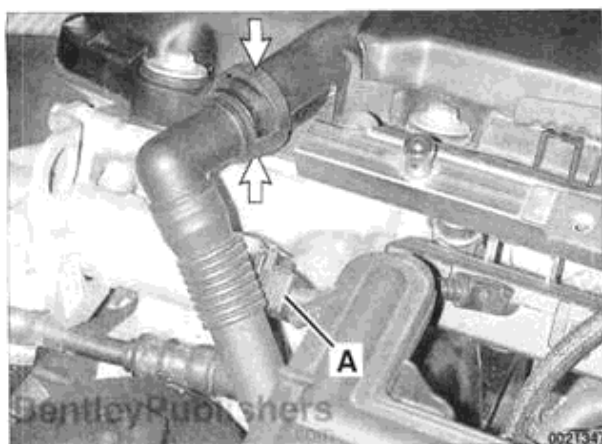
CAUTION—

- *Prior to disconnecting the battery, read the battery disconnection cautions in **001 Warnings and Cautions**.*

- Remove air intake hood above radiator.
- Remove upper engine covers. See **020 Maintenance**.
- Detach air hose and vacuum line from secondary air valve on right side of cylinder head.

113-6 Cylinder Head Removal and Installation

Cylinder head, removing (M54 engine)



- Working above engine, disconnect the following:
- Vent line from cylinder head cover. To remove, pinch clip (**arrows**).
 - Electrical harness connector from VANOS solenoid valve (**A**).
- Remove both exhaust manifolds. See **180 Exhaust System**. After removing exhaust manifolds, reinstall engine support arm and engine mount.
- Remove air filter housing and ducts. See **130 Fuel Injection**.
- Remove cylinder head cover. See **Cylinder head cover, removing and installing (M54 engine)** in this repair group.
- Remove spark plugs. Plug spark plug bores to prevent debris from falling into engine.
- Remove intake manifold. See **130 Fuel Injection**. Plug cylinder head intake ports to prevent debris from falling into engine.

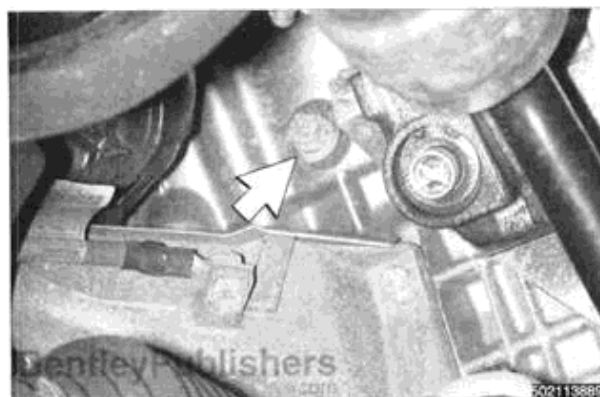
WARNING —

- Unscrew the fuel tank cap to release pressure in the tank before working on the fuel line.
- Wrap shop towels around fuel line fitting before disconnecting.
- Plug open fuel lines and fittings.

- Raise car and support safely.

WARNING —

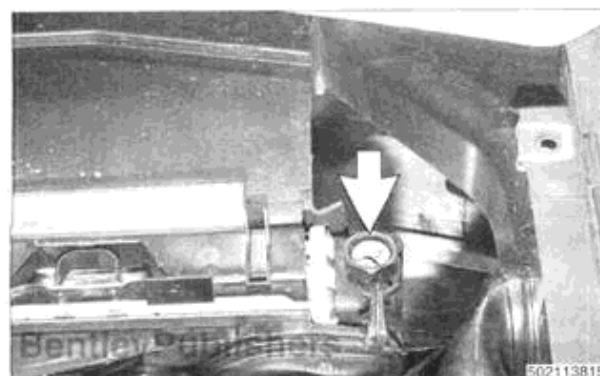
- Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.



- Drain engine coolant:
- Remove expansion tank cap on radiator.
 - Place a 3 gallon pail underneath engine to capture coolant.
 - Remove coolant drain plug (**arrow**) located on exhaust side of cylinder 2 on engine block.

- Drain radiator into a 3 gallon pail by removing plastic drain plug (**arrow**) completely.

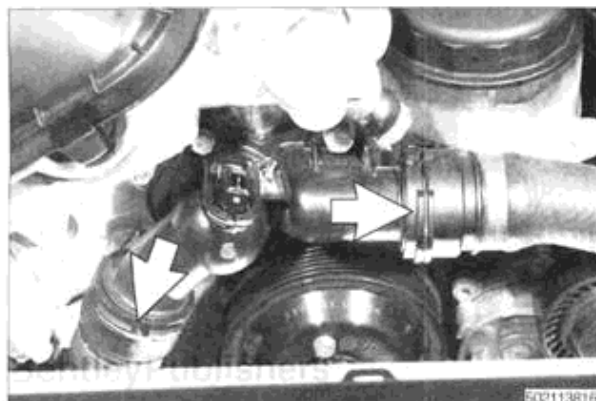
- Remove engine cooling fan and radiator. See **170 Radiator and Cooling System**.



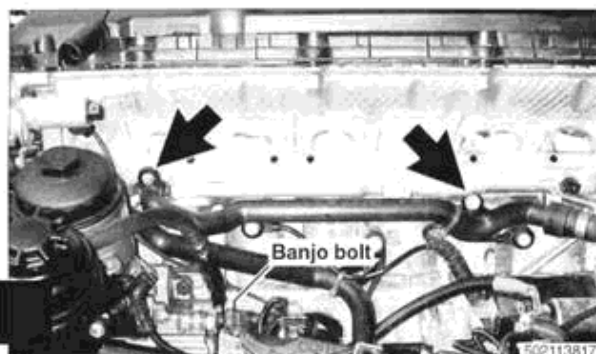
Cylinder Head Removal and Installation 113-7

Cylinder head, removing (M54 engine)

113



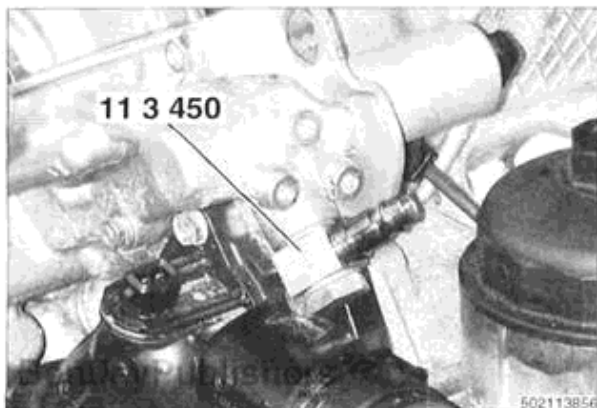
- Remove thermostat housing:
 - Disconnect electrical harness connector at thermostat housing.
 - Remove hoses from thermostat housing by releasing locks (**arrows**).
 - Unbolt (4 bolts) and remove thermostat housing.



- Remove fasteners (**arrows**) from heater bypass tube. Pull tube out of cylinder head and set to side, leaving heater hose connected.
- If necessary, loosen oil pressure line banjo bolt and carefully push oil line aside.



- Remove oil baffle cover from above intake camshaft.



- Remove banjo bolt from VANOS unit oil pressure line. Use banjo bolt to attach BMW special tool 11 3 450 (compressed air fitting) to VANOS unit.
- Be prepared to catch dripping oil. Do not allow oil to contaminate accessory belts.

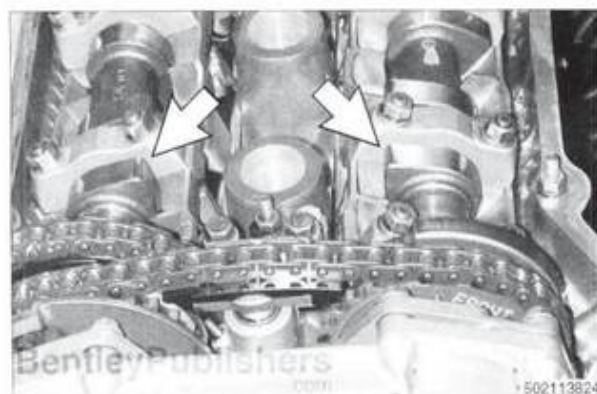
113-8 Cylinder Head Removal and Installation

Cylinder head, removing (M54 engine)



➤ Cover oil bore (**arrow**) in VANOS unit with shop towel to capture oil which sprays when compressed air is applied.

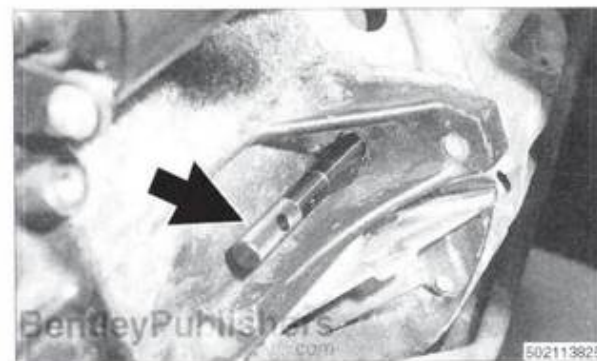
— Connect compressed air line to air fitting. Apply air pressure set to 2 – 8 bar (30 – 115 psi).



➤ With compressed air line connected, use crankshaft vibration damper bolt to rotate engine in direction of rotation (clockwise) at least twice, until cylinder 1 intake and exhaust camshaft lobes face each other (**arrows**) in top dead center (TDC) position for cylinder 1.

CAUTION—

• Do not rotate engine counterclockwise to reach TDC. If engine rotates past TDC, complete another two complete rotations.



➤ Remove sealing plug from special tool bore on lower left side of engine block near flywheel. Secure crankshaft in TDC position with BMW special tool 11 2 300 (**arrow**).



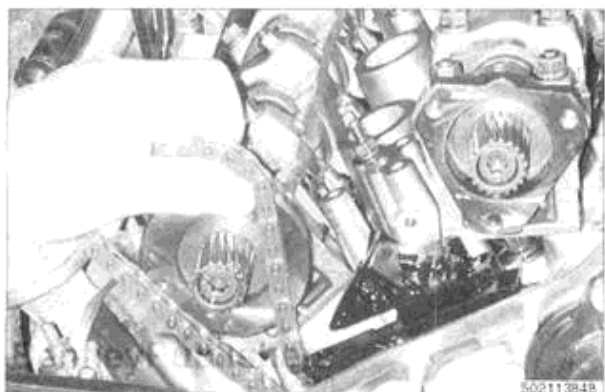
➤ Unscrew and remove two cylinder head cover studs (**arrows**) at rear of cylinder head.

Cylinder Head Removal and Installation 113-9

Cylinder head, removing (M54 engine)



- Secure camshafts in TDC position using BMW special tool set 11 3 240 (includes 11 3 241 and 11 3 244).
- Remove VANOS unit from front of cylinder head. See **117 Camshaft Timing Chain**.
- Remove crankshaft locking tool from transmission bell housing.



- Lift primary chain and hold under tension. Use crankshaft vibration damper bolt to rotate engine in direction opposite to normal rotation (counterclockwise) approximately 30°.

CAUTION—

• By turning crankshaft 30° counterclockwise, pistons are moved away from TDC. This prevents piston-to-valve interference during camshaft servicing.

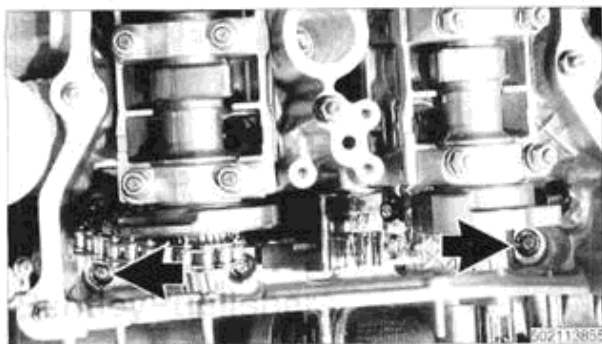
- Remove camshaft locking tools (BMW special tool set 11 3 240) from rear of cylinder head.
- Remove camshafts and camshaft bearing carriers. See **117 Camshaft Timing Chain**.
- Remove intake camshaft sensor (arrow) from side of cylinder head.



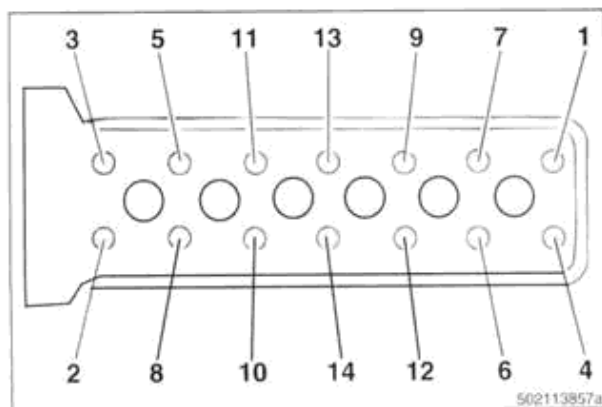
- Remove secondary chain lower guide bolts (arrow). Remove chain guide.

113-10 Cylinder Head Removal and Installation

Cylinder head, installing (M54 engine)



- Remove bolts (**arrows**) holding timing chain cover to cylinder head. (Photo shows camshafts and camshaft bearing caps in place).



- Using BMW special tool 11 2 250 or equivalent, loosen cylinder head bolts in several stages, in sequence shown. Discard head bolts.

NOTE—

- BMW special tool 11 2 250 is a thin-walled Torx E12 socket with an extended reach. The cylinder head bolts are recessed into the head below the camshaft carriers with little working space.

- Lift off cylinder head.

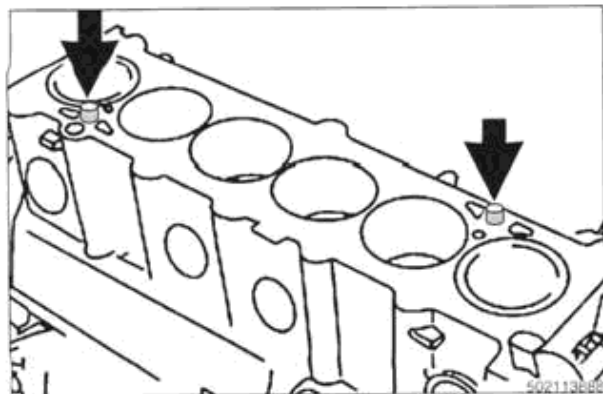
Cylinder head, installing (M54 engine)

- Clean cylinder head and gasket surfaces of cylinder block and timing chain covers.

CAUTION—

- Remove foreign matter and liquid from bolt holes. Trapped oil or coolant in bolt holes can cause damage to the engine block.
- Do not use a metal scraper or wire brush to clean the aluminum cylinder head or pistons. If necessary, use a hard wooden or plastic scraper. Also available are abrasive discs to be used in conjunction with an electric drill. Be sure to use the correct disc for the type of metal being cleaned.

- If the cylinder head is machined, use a special cylinder head gasket available from an authorized BMW dealer. The gasket is 0.3 mm (0.011 in) thicker than standard and is marked accordingly.
- Lubricate camshafts, camshaft carriers, bearing caps, hydraulic lifters and friction washers with assembly lubricant before installation.
- Check that two cylinder head aligning sleeves (**arrows**) are correctly positioned in block and are not damaged.
- Apply elastic sealing compound 3-Bond 1209® to corner joints and seam on cylinder block to timing chain cover.
- Place new cylinder head gasket on cylinder block.



Cylinder Head Removal and Installation 113-11

Cylinder head, installing (M54 engine)

NOTE—

- The word "OBEN" or "TOP", printed on the gasket, faces up. The cylinder head gasket fits correctly in only one orientation.

- Set cylinder head in position, guiding primary chain through cylinder head opening.
- Prior to installing cylinder head bolts, keep in mind the following:
 - Do not reuse cylinder head bolts. They are stretch-type bolts and are replaced whenever loosened.
 - Cylinder head bolt length for aluminum engine block = 110 mm.
 - Check that head bolt washers are in place before installing the bolts. Some washers are staked to the cylinder head.
- Lightly lubricate **new** cylinder head bolts and washers with oil. Install cylinder head bolts and bolts for cylinder head to lower timing chain cover finger tight.

- Tighten cylinder head bolts in correct sequence (1 – 14).

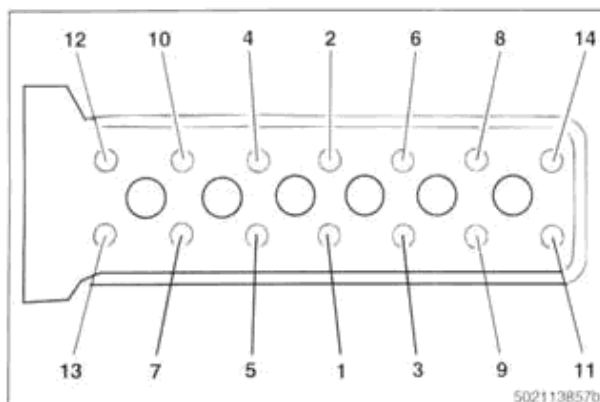
CAUTION—

- Tighten the bolts in three stages, as listed below. The final stages require the use of a BMW special tool 11 2 110 or a suitable protractor to tighten the bolts to a specified torque angle.

Tightening torque

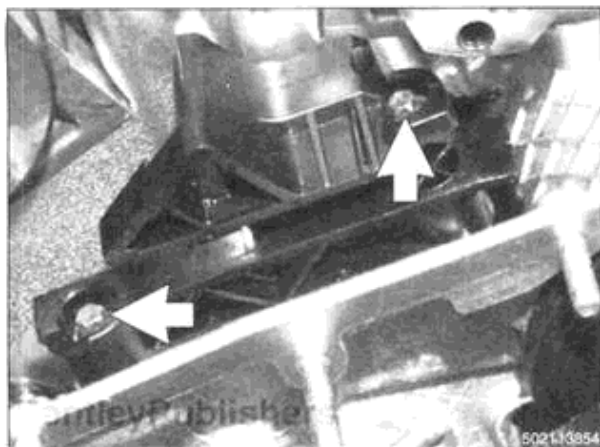
Cylinder head to engine block	
• Stage 1	40 Nm (30 ft-lb)
• Stage 2	+90°
• Stage 3	+90°

- Install intake camshaft sensor (arrow).



113-12 Cylinder Head Removal and Installation

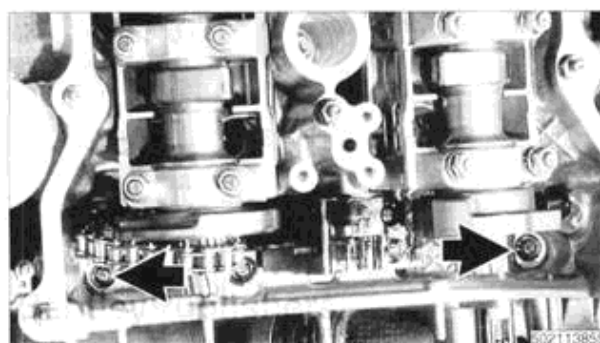
Cylinder head, installing (M54 engine)



- Install lower secondary chain guide. Tighten torx bolts (**arrows**) to specifications. Bolt on intake camshaft side is long and extends into engine block.

Tightening torque

Secondary chain guide to cylinder head (M6)	10 Nm (89 in-lb)
---	------------------



- Tighten bolts (**arrows**) for cylinder head to lower timing chain cover. (Photo shows camshafts in place).

Tightening torque

Cylinder head to lower timing chain cover (M6)	10 Nm (89 in-lb)
--	------------------

- Reinstall camshafts. See **117 Camshaft Timing Chain**.

CAUTION—

- Make sure the crankshaft, which was rotated approximately 30° opposite the direction of engine rotation from TDC, is still in that position before reinstalling the camshafts. This ensures that pistons are out of TDC position and prevents piston-valve interference when the camshafts are installed.
- After the camshafts are installed, a minimum waiting time is required for the hydraulic lifters to bleed down before bringing the crankshaft and pistons back to TDC. When the camshafts are removed, the hydraulic lifters may expand. This expansion can cause increased valve lift when the camshafts are bolted down, possibly resulting in piston-valve interference.

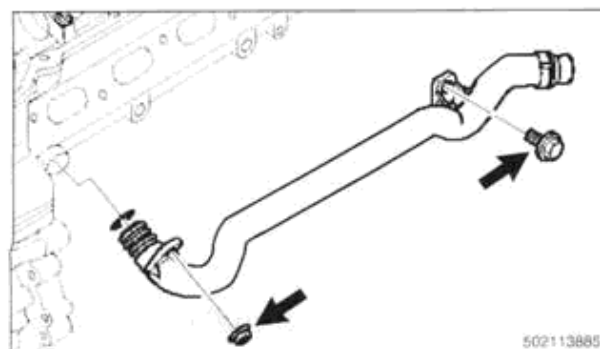
- Reinstall double VANOS unit. See **117 Camshaft Timing Chain**.

- Install coolant pipe fasteners at base of cylinder head and tighten fasteners (**arrows**).

NOTE—

- Use new sealing O-ring on coolant pipe.

- Attach oil line to VANOS unit using banjo bolt with new seals.



Tightening torque

Oil line to VANOS unit (banjo bolt)	32 Nm (24 ft-lb)
-------------------------------------	------------------

Cylinder Head Removal and Installation 113-13

Cylinder head, installing (M54 engine)

- Install intake camshaft cover and cylinder head cover. See **Cylinder head cover, removing and installing (M54 engine)** in this repair group.

Tightening torque

Cylinder head cover to cylinder head (M6)	10 Nm (89 in-lb)
---	------------------

- Install exhaust manifolds using new gaskets and nuts. Coat manifold studs with copper paste prior to installing nuts. See **180 Exhaust System**.

Tightening torque

Exhaust manifold to cylinder head (M7)	20 Nm (15 ft-lb)
--	------------------

- Install electrical harness connectors for oil pressure sender and coolant temperature sensor before installing intake manifold.
- Reinstall intake manifold. See **130 Fuel Injection**.

CAUTION—

- When reattaching throttle assembly harness connector, connector is fully tightened when arrows on connector and plug line up.

- Installation of the remaining parts is reverse or removal, noting the following:
 - Refill and bleed cooling system. See **170 Radiator and Cooling System**.
 - Change engine oil and filter. See **020 Maintenance**.
 - Reconnect battery.

CAUTION—

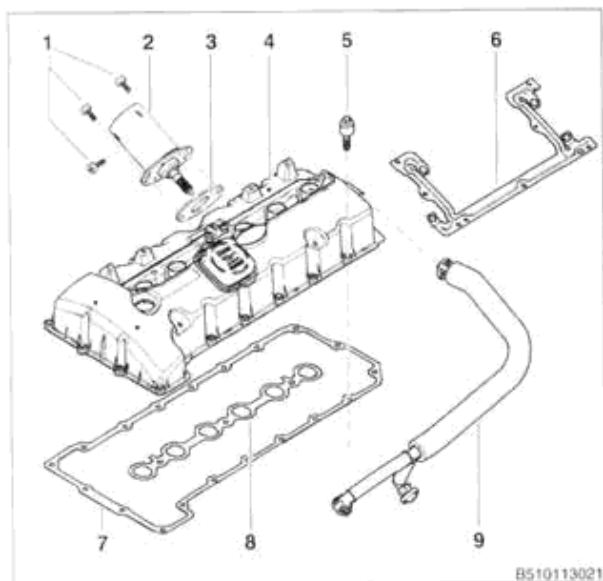
- To prevent damaging engine electronic systems, install ground wires previously removed, including the ground wires for the ignition coils.
- Prior to starting engine, be sure to remove crankshaft lock tool.

Tightening torque

Coolant drain plug to cylinder block	25 Nm (18 ft-lb)
Radiator cooling fan to coolant pump	40 Nm (30 ft-lb)
Radiator drain screw to radiator	2.5 Nm (22 in-lb)
Spark plug to cylinder head	25 Nm (18 ft-lb)

113-14 Cylinder Head Removal and Installation

Cylinder head cover components (N52 engine)



CYLINDER HEAD (N52 ENGINE)

Cylinder head cover components (N52 engine)

Cylinder head cover for 2006 N52 engine is made of aluminum-magnesium alloy. Aluminum stretch bolts and fasteners are used. Replace them whenever the cover is removed.

Cylinder head cover for 2007 and later N52 engine is made of plastic. Steel fasteners may be used and they can be reused.

1. Valvetronic motor mounting bolt (M6 x 16 mm)
 - Tighten to 10 Nm (7 ft-lb)
2. Valvetronic motor
3. Gasket
4. Cylinder head cover
5. Cylinder head cover fastener
6. Bracket (N52 engine only)
7. Cylinder head cover gasket-outer
8. Cylinder head cover gasket-inner (spark plug holes)
9. Crankcase breather hose

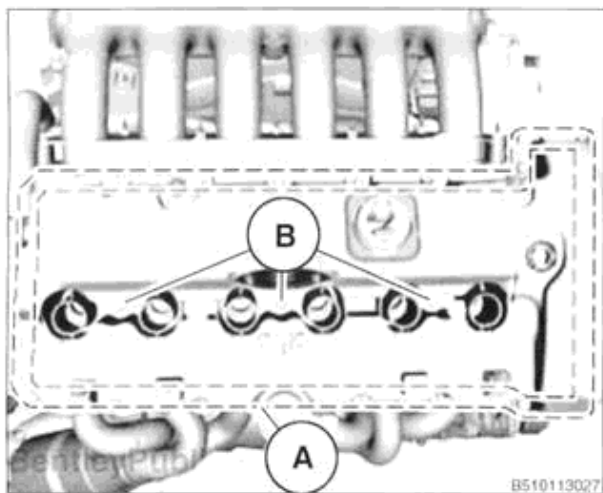
Cylinder head cover, removing and installing (N52 engine)

- Use scan tool to read out and record ECM fault memory.
 - Switch ignition OFF and remove key.
 - Remove cabin microfilter upper and lower housings. See **640 Heating and Air-conditioning**.
 - Remove right strut tower brace.
 - Remove ignition coil cover (upper engine cover). See **020 Maintenance**.
 - Detach ignition coil connectors. Unclip ignition coil harness from cylinder head cover and lift aside.
 - Remove ignition coils. See **120 Ignition System**.
- ◀ Working at cylinder head cover:
- Detach crankcase breather hose.
 - If applicable: Pull off metal bracket.
 - Remove valvetronic motor mounting bolts (A). To disengage valvetronic motor, see **131 Fuel Injection**.



Cylinder Head Removal and Installation 113-15

Cylinder head cover, removing and installing (N52 engine)



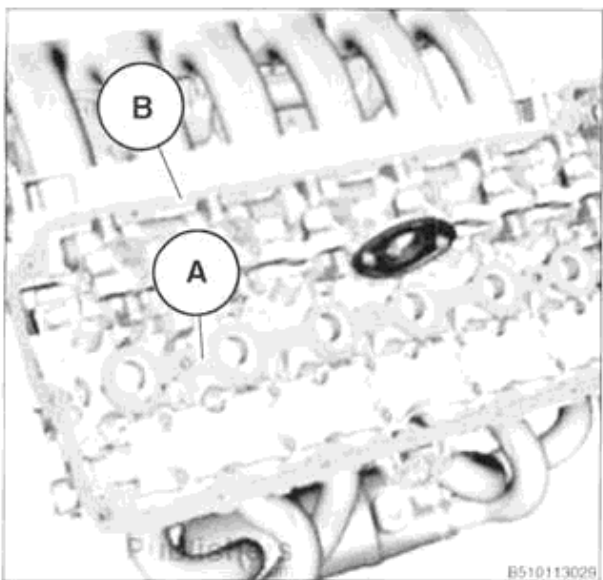
- Remove cylinder head cover fasteners (A, B). Discard if aluminum (blue head).

- Measure and record lengths and positions of bolts and studs. Different fastener lengths are determined by shapes of bushings.

NOTE—

- The end faces of aluminum fasteners are usually painted blue. For reliable identification, test fasteners for aluminum composition with magnet.

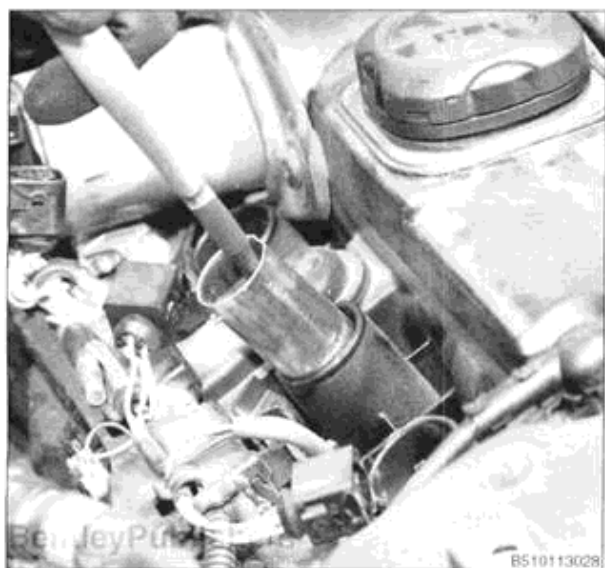
- Lift off cylinder head cover and discard old gaskets.



- Clean gasket residue from cylinder head and cylinder head cover sealing surfaces (A, B).

CAUTION—

- To avoid gouging the cover, do not use metal scraping tool.



- Remove and replace slotted ignition coil sleeves in cylinder head cover.

- Coat cylinder head cover grooves with thin layer of anti-friction compound such as glycerine. Press gaskets in place, making sure they are not stretched at any point.

113-16 Cylinder Head Removal and Installation

Cylinder head cover, removing and installing (N52 engine)

- Reinstall cylinder head cover.
 - Coat cylinder head contact surfaces with thin layer of anti-friction compound such as glycerine.
 - Place small quantity of silicone sealant at metal-to-metal seams (such as timing cover to engine block) and half moon gasket area.
 - Replace aluminum fasteners. Install in correct locations as noted previously.
 - Tighten gradually in crisscross pattern, starting with inside fasteners.

Tightening torques	
N52 engine cylinder head cover to cylinder head (aluminum-magnesium alloy cover, use new aluminum M7 fasteners) • Stage 1 • Stage 2	7 Nm (63 in-lb) additional 90°
N52KP or N51 engine cylinder head cover to cylinder head (plastic cover, steel M7 fasteners)	9 Nm (7 ft-lb)

N52 engine cylinder head cover to cylinder head (aluminum-magnesium alloy cover, use new aluminum M7 fasteners) • Stage 1 • Stage 2	7 Nm (63 in-lb) additional 90°
N52KP or N51 engine cylinder head cover to cylinder head (plastic cover, steel M7 fasteners)	9 Nm (7 ft-lb)

- Reinstall valvetronic motor.

Tightening torque	
Valvetronic motor to cylinder head cover (M6 x 16 mm bolts)	10 Nm (7 ft-lb)

Valvetronic motor to cylinder head cover (M6 x 16 mm bolts)	10 Nm (7 ft-lb)
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- Remainder of assembly is reverse of removal. Make sure cabin microfilter housing seals correctly.

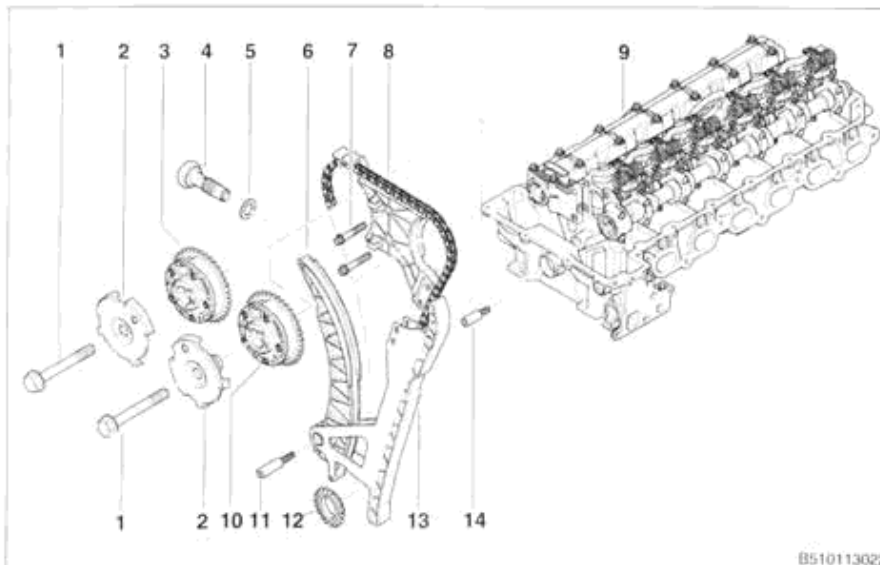
Tightening torques	
Ignition coil cover to cylinder head cover (M6)	4 Nm (35 in-lb)

Ignition coil cover to cylinder head cover (M6)	4 Nm (35 in-lb)
---	-----------------

Cylinder Head Removal and Installation 113-17

Cylinder head and timing chain (N52 engine)

Cylinder head and timing chain (N52 engine)



1. Camshaft adjustment unit mounting bolt (M10 x 94 mm)
 - Replace with new
 - Tighten in 2 stages
Stage 1: 20 Nm (15 ft-lb)
Stage 2: Additional 180°
2. Camshaft impulse wheel
3. Exhaust camshaft adjustment unit
4. Chain tensioner (M22 x 1.5)
 - Tighten to 55 Nm (41 ft-lb)
5. Sealing O-ring
 - Install new
6. Chain tensioner rail
7. Chain module mounting bolts (M6 x 35 mm Torx)
 - Tighten to 8.5 Nm (6 ft-lb)
8. Timing chain
9. Cylinder head with camshafts
10. Intake camshaft adjustment unit
11. Chain tensioner rail mounting bolt (M8)
 - Tighten to 20 Nm (15 ft-lb)
12. Crankshaft sprocket
13. Chain guide
14. Chain guide mounting bolt (M7)
 - Tighten to 14 Nm (10 ft-lb)

Cylinder head, removing and installing (N52 engine)

When removing and installing the cylinder head, special tools and procedures are required to remove and install camshaft adjustment units and valvetronic eccentric shaft and to time camshafts. Read the entire procedure before beginning repairs.

CAUTION—

- Disassembly, removal and assembly of camshafts, camshaft adjustment units or cylinder head without special tools poses the risk of damage or breakage: Valves may be bent by contact with the piston crowns.

NOTE—

- Camshaft timing is covered in **117 Camshaft Timing Chain**.

Cylinder head removal and installation procedures are described separately.

If you remove a cylinder head and determine that it requires significant reconditioning work, a remanufactured cylinder head is available from an authorized BMW dealer.

113-18 Cylinder Head Removal and Installation

Cylinder head, removing (N52 engine)

Cylinder head, removing (N52 engine)

The cylinder head stretch bolts are aluminum. Replace them any time they are removed. Use angle protractor to torque.

WARNING—

- To avoid personal injury, be sure the engine is cold before beginning the removal procedure.

- Disconnect negative (–) cable from battery.

CAUTION—

- Prior to disconnecting the battery, read the battery disconnection cautions in **001 Warnings and Cautions**.

- Raise vehicle and support safely.

WARNING—

- Make sure the vehicle is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove engine compartment splash shield. See **020 Maintenance**.
- With exhaust system fully cooled off, remove exhaust system and both exhaust manifolds. See **180 Exhaust System**.
- Drain engine coolant. See **170 Radiator and Cooling System**.
- Drain engine oil. See **020 Maintenance**.
- Remove ignition coil cover (upper engine cover). See **020 Maintenance**.
- Remove air filter housing, engine air intake ducts and intake manifold. See **131 Fuel Injection**.

WARNING—

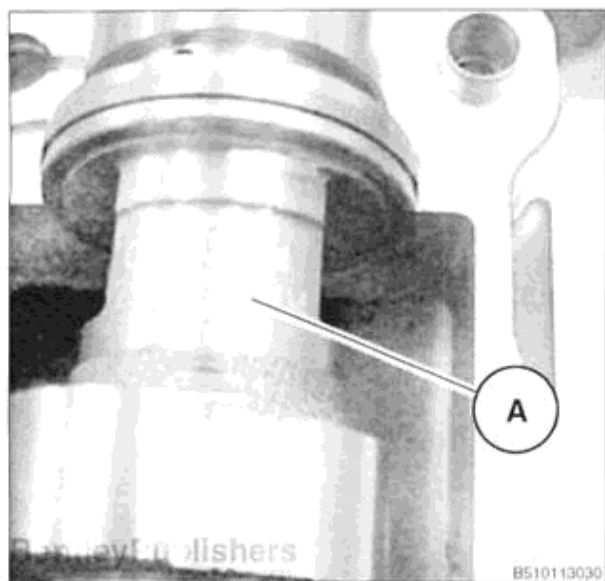
- Unscrew the fuel tank cap to release pressure in the tank before working on fuel lines.

- Remove cylinder head cover. See **Cylinder head cover, removing and installing (N52 engine)** in this repair group.
- Detach coolant hoses from cylinder head.
- ◀ Using vibration damper bolt, rotate crankshaft to place cylinder 1 in TDC firing position. In this position, cylinder 1 intake camshaft lobe points upward at an angle.

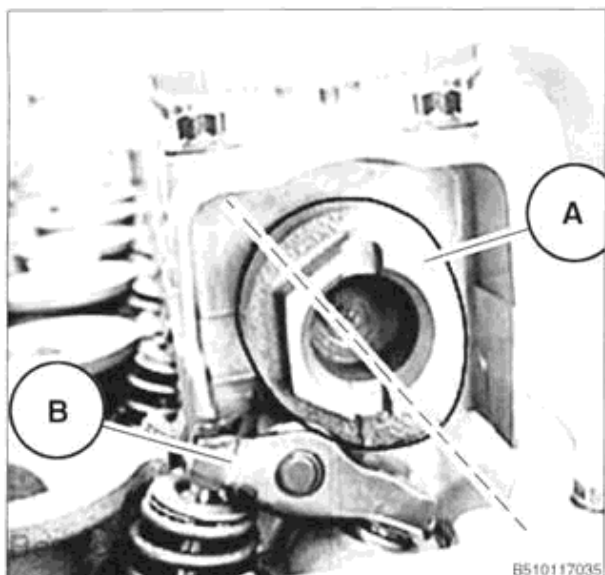


Cylinder Head Removal and Installation 113-19

Cylinder head, removing (N52 engine)



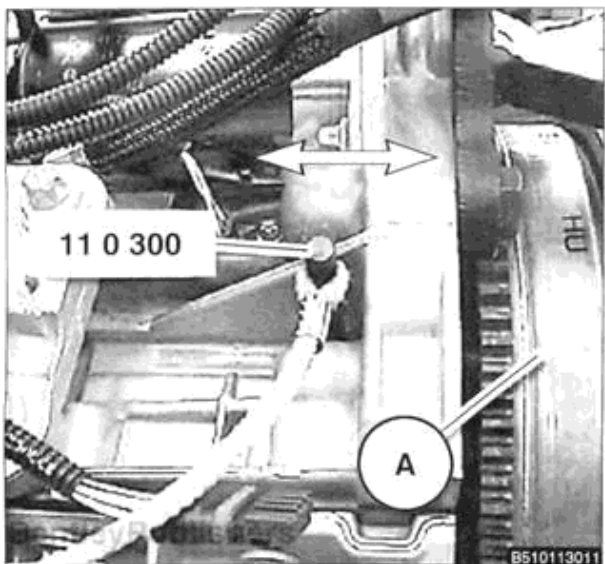
Make sure intake and exhaust camshaft part numbers (A) point up.



Cylinder 1 in TDC firing position: Cylinder 6 exhaust camshaft lobe (A) points downward at an angle (dashed line). Cam follower (B) is not actuated.

NOTE—

- Use a mirror to check exhaust camshaft lobe position.



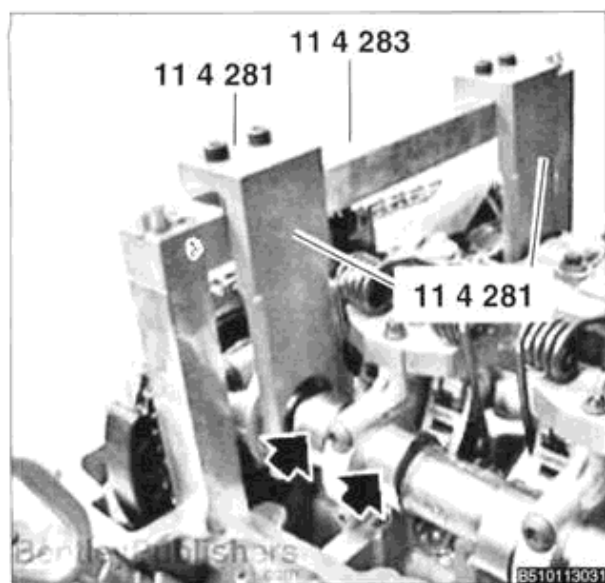
Working underneath engine, slide out protective plug at lower left of engine bell housing flange. Install BMW special tool 11 0 300 (crankshaft locking tool) through bell housing flange port into flywheel (A) hole. If necessary, rock flywheel slightly back and forth to line up holes with tool. This locks crankshaft at TDC.

CAUTION—

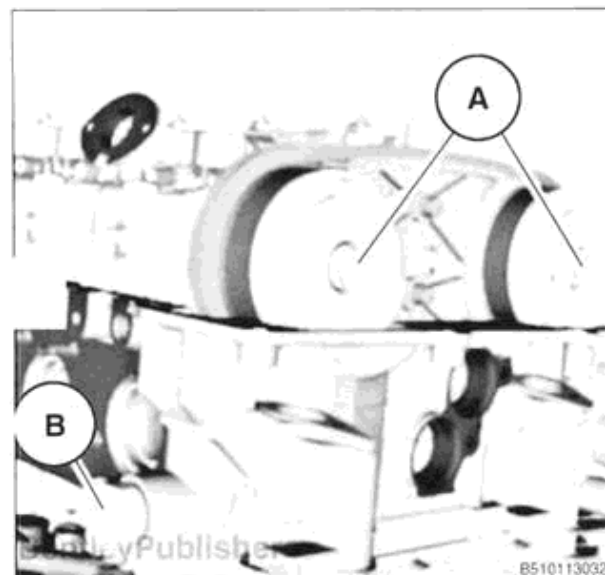
- Automatic transmission model: A short distance before the flywheel special tool bore for TDC position, there is a large bore which can be confused with the special tool bore. If the flywheel is locked using the correct bore, the engine can no longer be rotated at the vibration damper bolt.

113-20 Cylinder Head Removal and Installation

Cylinder head, removing (N52 engine)



Using BMW special tool set 11 4 280, lock down camshafts.

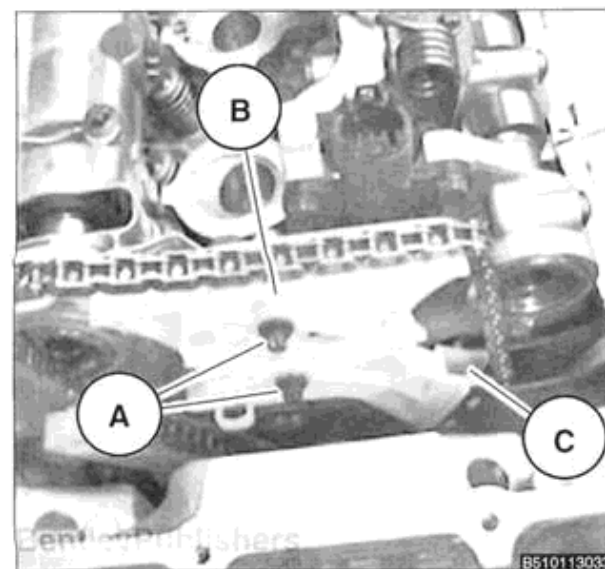


Remove intake and exhaust camshaft adjustment units:

- Loosen and remove adjustment unit mounting bolts (A). Discard bolts.
- Remove timing chain tensioner (B). Be prepared to catch dripping oil with a shop towel. Do not allow oil to contaminate accessory belt.
- Disengage timing chain from camshaft adjustment unit sprockets. Remove adjustment units and set aside.

NOTE—

- Illustration does not show special tool set 11 4 280 in place.



Working at front of cylinder head:

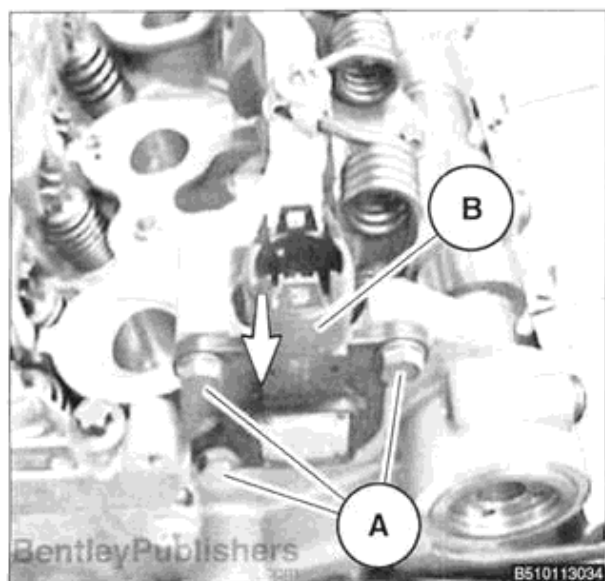
- Remove timing chain module mounting bolts (A).
- Unclip chain module (B) at junction (C) and lift out.
- Place timing chain in cylinder head opening.

CAUTION—

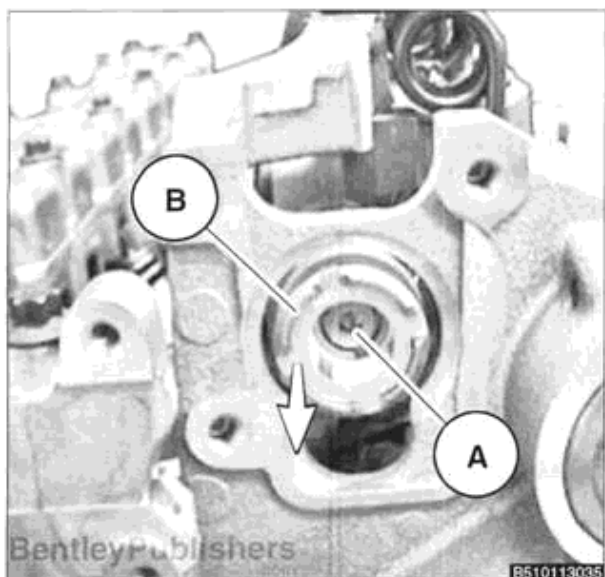
- Do not remove crankshaft locking tool. Rotating crankshaft may cause the timing chain to jam or jump teeth.

Cylinder Head Removal and Installation 113-21

Cylinder head, removing (N52 engine)



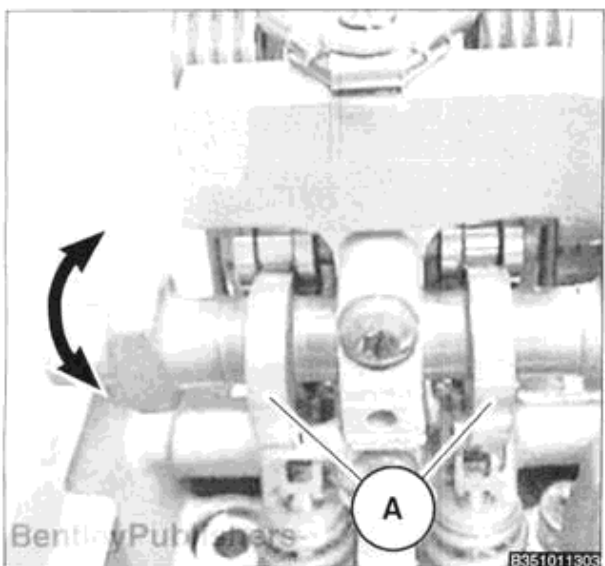
- ◀ Unbolt and remove valvetronic eccentric shaft sensor mounting bolts (A). Slide sensor (B) forward (arrow) to remove.



- ◀ Remove eccentric shaft magnet wheel mounting bolt (A). Slide magnet wheel (B) forward (arrow) to remove.

CAUTION—

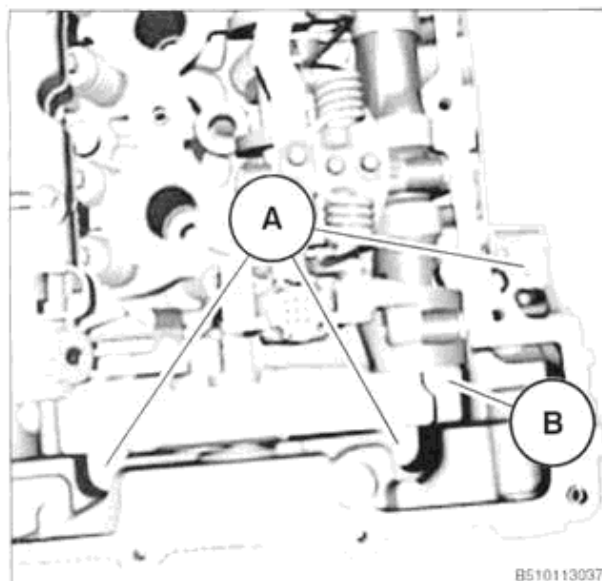
- Magnet wheel mounting bolt is non-magnetic. Do not allow it to fall into engine.
- Magnet wheel is highly magnetic. Protect against metal filings by storing in sealed plastic bag.



- ◀ Pretension eccentric shaft (arrow). Remove stop screw between cylinders 1 and 2 (A).

113-22 Cylinder Head Removal and Installation

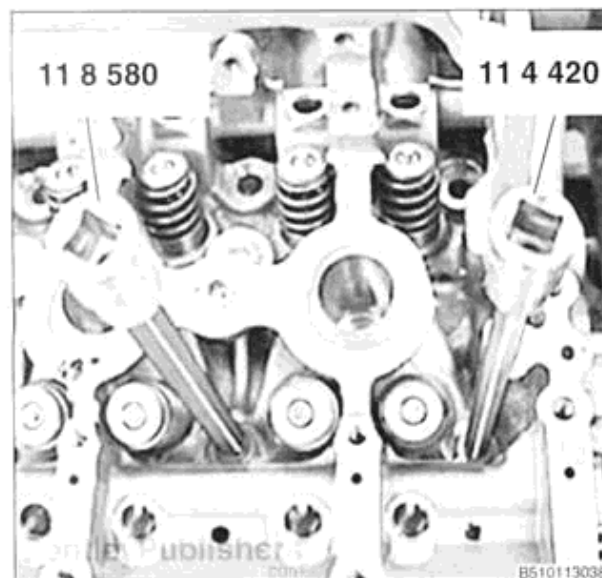
Cylinder head, installing (N52 engine)



- Remove cylinder head bolts (A, B) to timing chain housing. Press timing chain rail forward slightly to remove bolt B. Discard aluminum bolts.

CAUTION—

- Use mechanical gripper to prevent lower bolt(s) from falling down inside crankcase.
- Measure and note down different bolt lengths for correct reinstallation.



- Use BMW special tools 11 4 420 (Torx T50) and 11 8 580 (Torx T60) to loosen and remove M9 and M10 cylinder head bolts. (Intake and exhaust camshafts removed for purpose of illustration.)

- Loosen M9 bolts first.
- Loosen M10 bolts in crisscross pattern, starting with outside bolts.
- Note different bolt lengths.
- Discard aluminum bolts.

- Bolt lifting handles to cylinder head. Lift off head with help of assistant.

CAUTION—

- Cylinder head weighs approx. 40 kg (88 lb).
- Place cylinder head on work bench on its side. Putting it down on sealing surface risks damage to the valves.
- Be sure to clean antifreeze out of cylinder head bolt holes in crankcase immediately.

Cylinder head, installing (N52 engine)

- Before cleaning engine block sealing surface, insert plugs (BMW special tools 11 4 430 or equivalent) into oil passages.

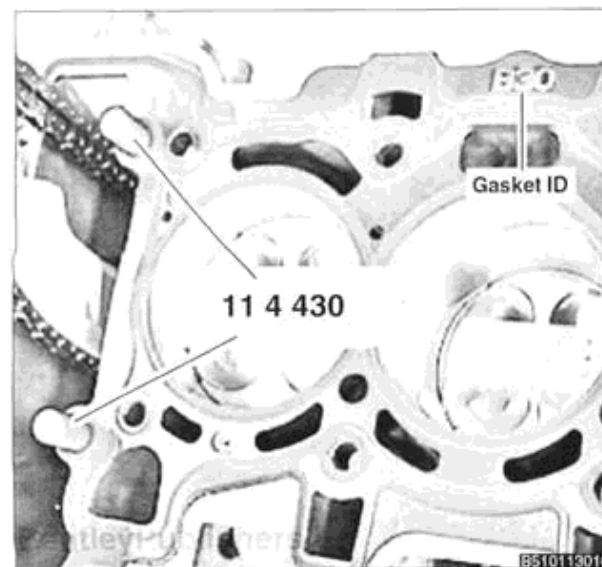
- Note cylinder head gasket ID at right front edge of gasket.

- Clean cylinder head and gasket surfaces of engine block and timing chain housing.

CAUTION—

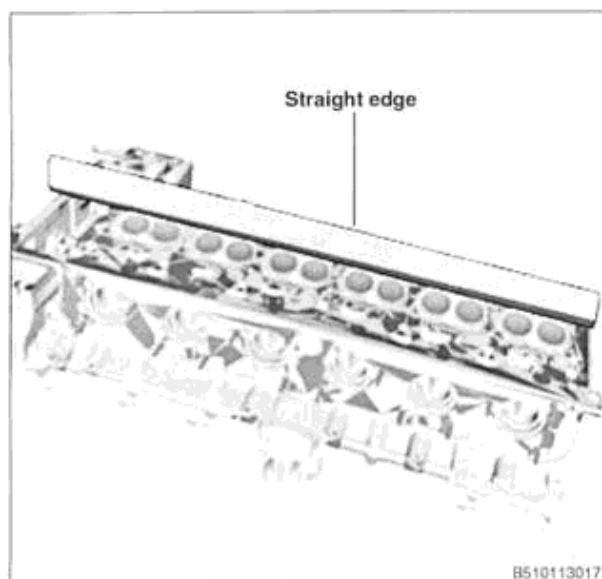
- Remove foreign matter and liquid from bolt holes. Trapped oil or coolant in bolt holes can cause damage to the engine block.
- Do not use a metal scraper or wire brush to clean sealing surfaces. If necessary, use a hard wooden or plastic scraper. Also available are abrasive discs to be used in conjunction with an electric drill. Be sure to use the correct disc for the type of metal being cleaned.

- Inspect cylinder head for visible cracks or other defects.

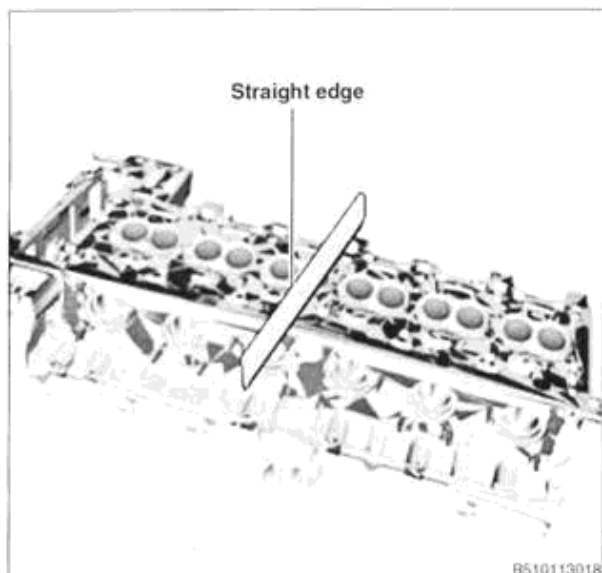


Cylinder Head Removal and Installation 113-23

Cylinder head, installing (N52 engine)



B510113017



B510113018

- To check cylinder head for warpage:
 - Remove intake and exhaust camshafts and intermediate intake levers.

CAUTION—

- Keep components in separate compartments and mark them for reassembly in their original positions.

- Use straight edge to check evenness of cylinder head sealing surface in longitudinal direction.

- Use straight edge to check evenness of cylinder head sealing surface in transverse direction.

Cylinder head warpage specifications

Maximum warpage allowed	
• Longitudinal	0.10 mm (0.0039 in)
• Transverse	0.05 mm (0.0020 in)

- Have cylinder head tested for coolant leaks and cracks.
- If cylinder head is warped but otherwise sound, machine a maximum of 0.3 mm (0.011 in) off sealing surface.
- Reassemble cylinder head, or use reconditioned BMW cylinder head. See **117 Camshaft Timing Chain**.

Tightening torques

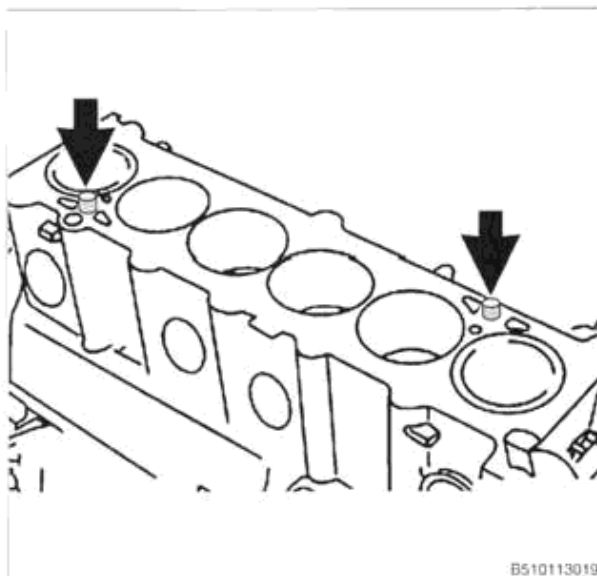
Oil spray nozzle to valvetronic guide block (M6 x 30 mm bolt)	10 Nm (7 ft-lb)
Valvetronic guide block to timing chain housing (M6 x 23 mm bolt)	10 Nm (7 ft-lb)
Valvetronic torsion spring to cylinder head (M6 x 20 bolt)	10 Nm (7 ft-lb)
Camshaft bearing strip to camshaft (M7 x 70 mm 10.9 steel bolt)	
• Stage 1	8 Nm (71 in-lb)
• Stage 2	additional 60°

CAUTION—

- Once assembled with valves and camshafts, place cylinder head down on work bench on its side. Putting it down on sealing surface risks damage to the valves.

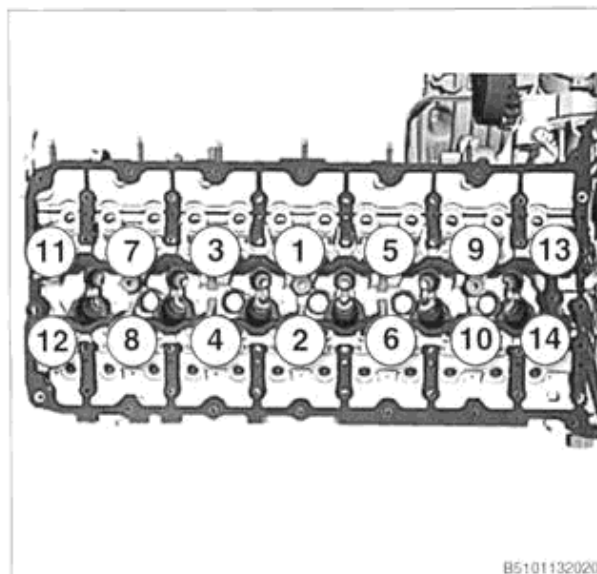
113-24 Cylinder Head Removal and Installation

Cylinder head, installing (N52 engine)



Check that two cylinder head aligning sleeves (**arrows**) are correctly positioned in engine block and are not damaged.

- Replace cylinder head gasket.
- If cylinder head is machined, use a special cylinder head gasket available from an authorized BMW dealer. The gasket is 0.3 mm (0.011 in) thicker than standard and is marked accordingly.
- Place cylinder head on engine block and fit to aligning sleeves.



Insert new aluminum cylinder head bolts:

- Bolts 1 - 10: M10 x 125 mm
- Bolts 11 - 14: M9 x 95 mm and M9 x 125 mm. Insert correct length bolts, as marked previously.

NOTE—

- Graphic shows intake and exhaust camshafts removed.

- Use BMW special tool 11 8 850 (Torx T60) to tighten bolts 1 - 10 in sequence shown below.
- Use BMW special tool 11 4 420 (Torx T50) to tighten bolts 11 - 14 in sequence shown below.

Tightening torques and sequence

Cylinder head to engine block:

- Stage 1: All bolts, 1 - 14
- Stage 2: All bolts, 1 - 14
- Stage 3: Only bolts 1 - 10
- Stage 4: All bolts 1 - 14

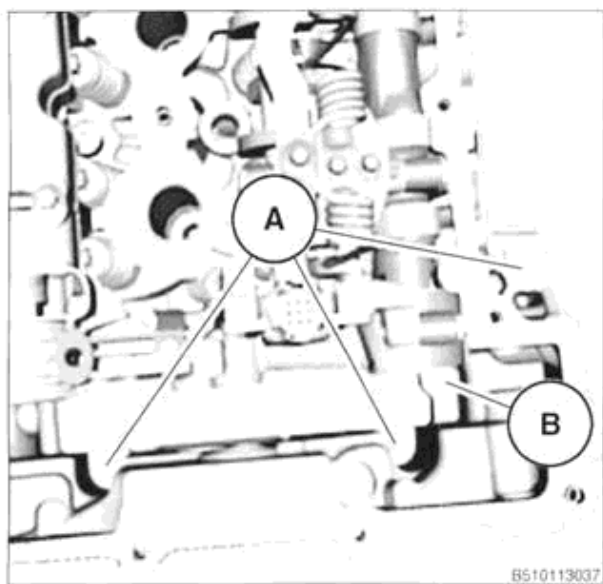
30 Nm (22 ft-lb)
additional 90°
additional 90°
additional 45°

CAUTION—

- Stage 3 applies to M10 bolts (1 - 10) only.

Cylinder Head Removal and Installation 113-25

Cylinder head, installing (N52 engine)



- Use new aluminum bolts (A, B) to attach cylinder head to timing chain housing. Press timing chain rail forward slightly to install lower bolt(s).

CAUTION—

- Use mechanical gripper to prevent lower bolt(s) from falling down inside crankcase.
- Place different bolt lengths in correct bores.

Tightening torques

N52 engine cylinder head to timing chain housing (M9 x 30 mm or M9 x 70 mm):	
• Stage 1	15 Nm (11 ft-lb)
• Stage 2	additional 90°
N52K engine cylinder head to timing chain housing (M9 x 30 mm):	
• Stage 1	10 Nm (7 ft-lb)
• Stage 2	additional 90°
N52K engine cylinder head to timing chain housing (M9 x 70 mm):	
• Stage 1	10 Nm (7 ft-lb)
• Stage 2	additional 135°

- Reinstall eccentric shaft stop screw.

Tightening torque

Eccentric shaft stop screw to cylinder head (M6)	10 Nm (7 ft-lb)
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- Replace eccentric shaft magnet wheel.
- Reinstall eccentric shaft sensor.
- Use wire hook to retrieve timing chain from inside timing chain housing. Place chain over chain module and clip module to lower chain rail. Reinstall chain module mounting bolts.

Tightening torque

Chain module to cylinder head (M6 x 35 mm Torx)	8.5 Nm (6 ft-lb)
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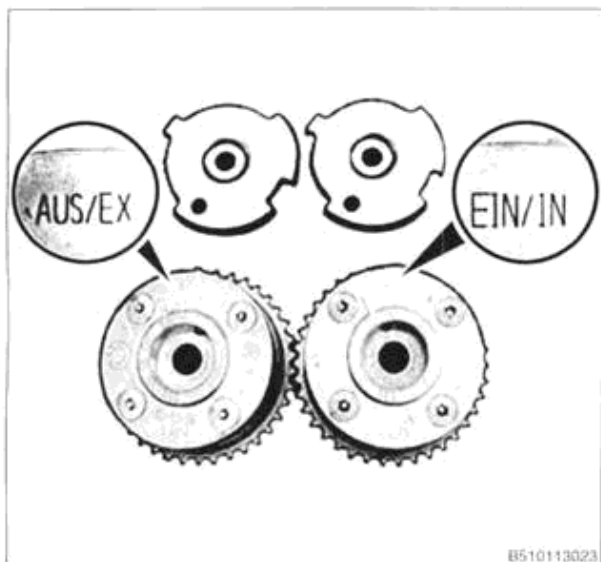
- Use new bolts to reattach camshaft adjustment (VANOS) units. Note that exhaust and intake units are different and so marked. Camshaft sensor impulse wheel for intake and exhaust are the same.

CAUTION—

- Use special tools shown in 117 Camshaft Timing Chain to lock down camshafts.

Tightening torque

Camshaft adjustment (VANOS) unit to camshaft (use new M10 x 94 mm bolt):	
• Stage 1	20 Nm (15 ft-lb)
• Stage 2	additional 180°



113-26 Cylinder Head Removal and Installation

Cylinder head, installing (N52 engine)

- Install chain tensioner and set camshaft timing. See **117 Camshaft Timing Chain**.

CAUTION—

- *If chain tensioner is reused, drain its oil chamber. Place tensioner on level working surface and compress slowly. Repeat twice.*
- *No sealing ring is fitted to chain tensioner at the factory. When reassembling engine, be sure to use new sealing O-ring.*

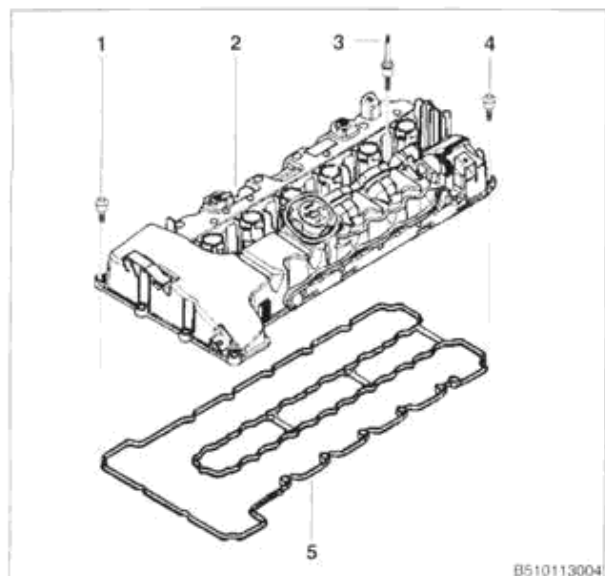
Tightening torque

Timing chain tensioner to cylinder head (M22 x 1.5) (use new sealing O-ring)	55 Nm (41 ft-lb)
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- Remainder of installation is reverse of removal. Remember to:
 - Remove camshaft and crankshaft locking tools.
 - Assemble cylinder head cover with new gasket.
 - Reattach and tighten any ground cables removed.
 - Reassemble fuel rail using new O-ring seals.
 - Change engine oil and filter. See **020 Maintenance**.
 - Fill and bleed cooling system. See **170 Radiator and Cooling System**.

Cylinder Head Removal and Installation 113-27

Cylinder head cover components (N54 engine)



CYLINDER HEAD (N54 ENGINE)

Cylinder head cover components (N54 engine)

1. Cylinder head cover bolt (M6 x 38 mm)
 - Quantity: 2
 - Tighten to 8.5 Nm (75 in-lb)
2. Cylinder head cover
3. Threaded stud
 - Quantity: 3
 - Remove using BMW special tool 11 8 620 or equivalent deep 10 mm socket wrench.
4. Cylinder head cover bolt (M6 x 32.5 mm)
 - Quantity: 26
 - Tighten to 8.5 Nm (75 in-lb)
5. Cylinder head cover gasket

Cylinder head cover, removing and installing (N54 engine)

- Disconnect negative (-) battery cable and cover battery terminal to keep cable from accidentally contacting terminal.

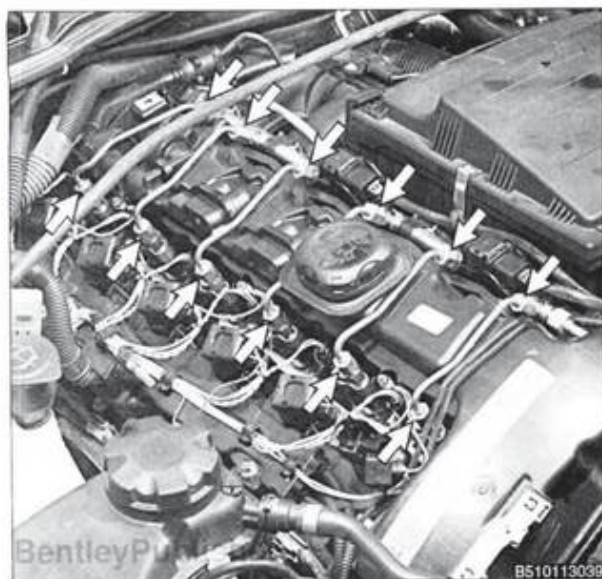
CAUTION—

- Prior to disconnecting the battery, read the battery disconnection cautions given in **001 Warnings and Cautions**.

- Use scan tool to read out and record ECM fault memory.
- Switch ignition OFF and remove key.
- Remove upper and lower cabin microfilter housings. See **640 Heating and Air-conditioning**.
- Remove right strut tower brace.
- Remove ignition coil cover (upper engine cover). See **020 Maintenance**.
- Remove ignition coils. See **120 Ignition System**.
- Unclip fuel injector and ignition coil wiring harness and set aside.

113-28 Cylinder Head Removal and Installation

Cylinder head cover, removing and installing (N54 engine)



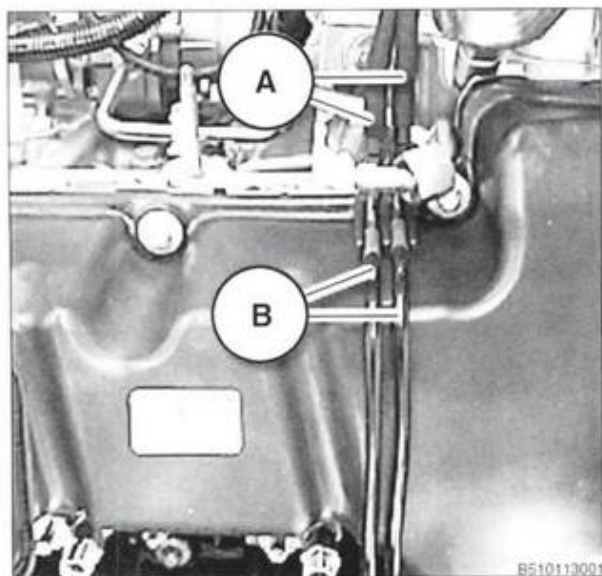
Loosen high pressure fuel line junctions (arrows).

WARNING—

- Fuel in the fuel line is under pressure (approx. 200 bar or 2900 psi) and may be expelled forcibly. Do not smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy.
- Work only on fuel system when engine temperature is below 40°C (104°F).
- Unscrew the fuel tank cap to release pressure in the tank before working on the fuel line.
- Plug open fuel lines and fittings.
- Wrap a clean shop towel around fitting before disconnecting. Residual fuel pressure is present in the fuel line.
- To reduce fuel pressure, place towel over injector and carefully tap with a wrench.

CAUTION—

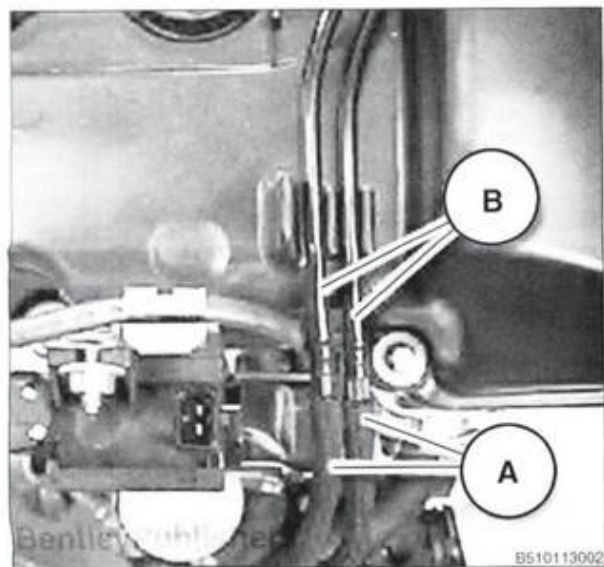
- Maintain a clean work area when servicing high pressure fuel system. Contaminants can cause a system malfunction.
- Fuel residue can break down the electrical resistance qualities of silicone used in ignition coil production, resulting in coil failure.
- Replace high pressure fuel lines if tightened 10 times.



- Remove injector lines and mark them in order.
- Remove injectors and mark them in order. Plug fuel injector bores to prevent debris from entering engine. See **132 Fuel Injection**.

Working at left front of cylinder head:

- Detach vacuum hoses (A) from vacuum lines.
- Unclip vacuum lines (B) from cylinder head cover.

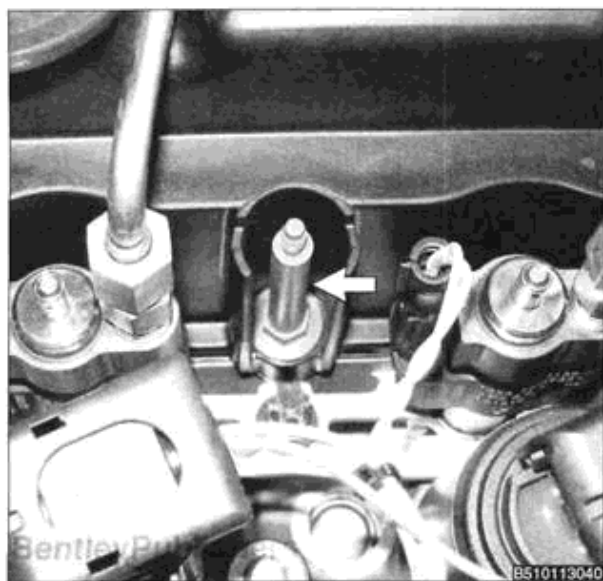


Working at right front of cylinder head:

- Detach vacuum hoses (A) from vacuum lines.
- Unclip vacuum lines (B) and set aside.

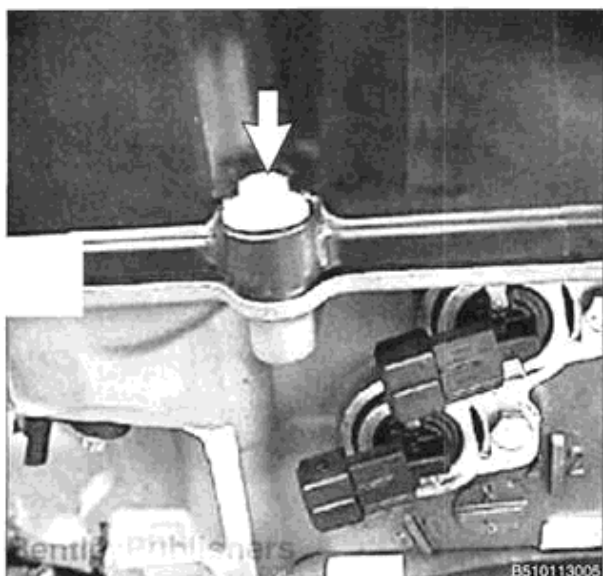
Cylinder Head Removal and Installation 113-29

Cylinder head cover, removing and installing (N54 engine)



- Use BMW special tool 11 8 620 or equivalent deep 10 mm socket wrench to loosen and remove threaded studs (**arrow**) in center of cylinder head cover valley.

- Quantity: 3 studs



- Remove cylinder head cover bolts (**arrow**).

- M6 x 38 mm bolts, quantity: 2
- M6 x 32.5 mm bolts, quantity: 26

NOTE —

- Make note of arrangement of fasteners during removal so that they can be reinstalled in their original locations.

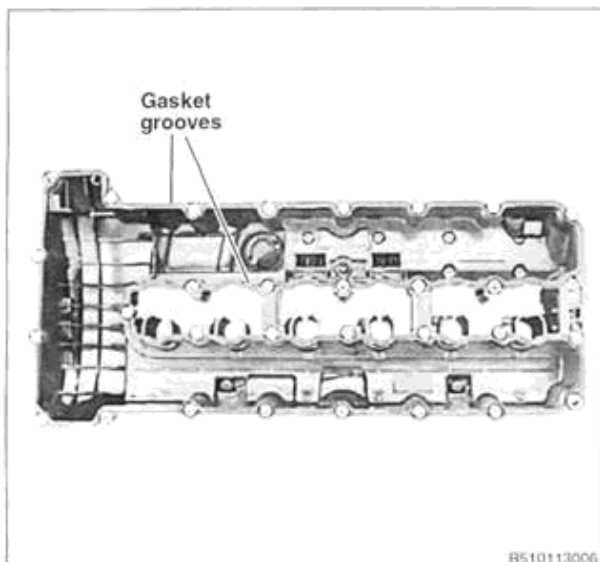
- Remove cylinder head cover and discard gasket.
- Inspect cylinder head cover fasteners. Replace as necessary.

- Clean gasket residue from cylinder head sealing surface and from cylinder head cover grooves.

CAUTION—

- To avoid gouging the cover, do not use metal scraping tool.

- Coat cylinder head cover grooves with thin layer of anti-friction compound such as glycerine. Press gasket in place, making sure it is not stretched at any point.



113-30 Cylinder Head Removal and Installation

Cylinder head cover, removing and installing (N54 engine)

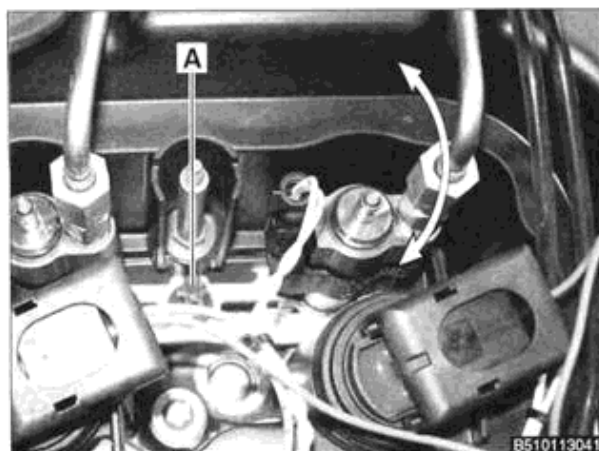
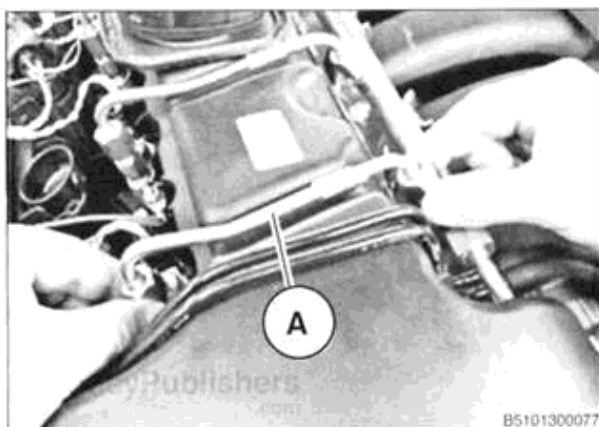
- Reinstall cylinder head cover.
 - Coat cylinder head and gasket contact surfaces with thin layer of anti-friction compound such as glycerine.
 - Place small quantity of silicone sealant at metal-to-metal seams (such as timing cover to engine block).
 - Install cylinder head cover fasteners in correct locations as noted previously.
 - Tighten gradually in crisscross pattern, starting with inside fasteners.
 - Replace fuel injector PTFE sealing rings. See **132 Fuel Injection**.

Tightening torque

Cylinder head cover to cylinder head (M6)	8.5 Nm (75 in-lb)
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- Reinstall high pressure fuel lines and injectors in correct locations, as marked previously. See **132 Fuel Injection**.

- Coat nut threads with gear oil.
- Connect high pressure line (A) finger tight.
- High pressure line may only be retightened 10 times.



- If fuel lines cannot be easily installed, rock injector (arrows) to allow fuel line nipple threads to be started by hand.

- Tighten hold-down bracket fastener (A).

Tightening torque

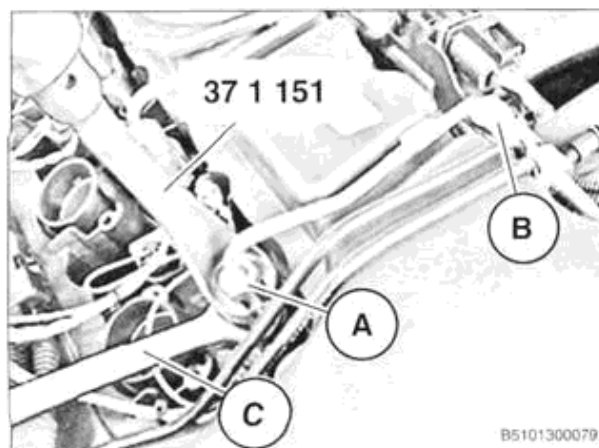
Hold-down bracket to cylinder head	13 Nm (9.5 ft-lb)
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- To tighten injector lines:

- Tighten nut (A) using special tool 37 1 151 while holding injector with wrench (C).
- Tighten nut (B) using special tool 37 1 151.

Tightening torque

High pressure line to injector	23 Nm (17 ft-lb)
High pressure line to fuel rail	23 Nm (17 ft-lb)



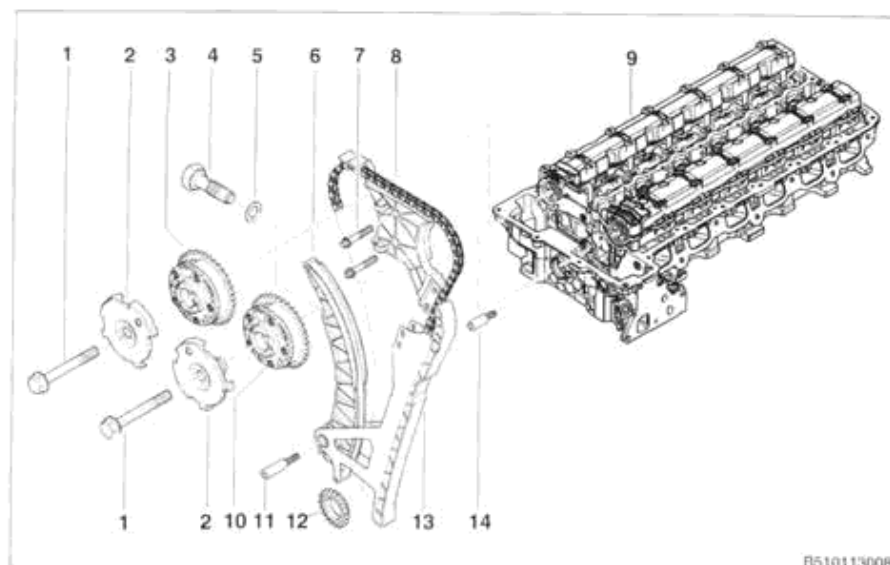
Cylinder Head Removal and Installation 113-31

Cylinder head and timing chain (N54 engine)

- Clean all fuel from ignition coil hole.
- Remainder of assembly is reverse of removal. Keep in mind the following:
 - Make sure cabin microfilter housing seals correctly.
 - Check fuel lines for leaks once engine starts.

Tightening torque	
Ignition coil cover to cylinder head cover (M6)	4 Nm (35 in-lb)
Strut tower brace to bulkhead (replace M12 bolt)	100 Nm (74 ft-lb) additional 90°
• Stage 1	
• Stage 2	
Strut tower brace to strut tower (replace M10 bolt)	40 Nm (30 ft-lb) additional 60°
• Stage 1	
• Stage 2	

Cylinder head and timing chain (N54 engine)



1. Camshaft adjustment unit mounting bolt (M10 x 94 mm)
 - Replace with new
 - Tighten in 2 stages
 - Stage 1: 20 Nm (15 ft-lb)
 - Stage 2: Additional 180°
2. Camshaft impulse wheel
3. Exhaust camshaft adjustment unit
4. Chain tensioner (M22 x 1.5)
 - Tighten to 55 Nm (41 ft-lb)
5. Sealing O-ring
 - Install new
6. Chain tensioner rail
7. Chain module mounting bolts (M6 x 35 mm Torx)
 - Tighten to 8.5 Nm (6 ft-lb)
8. Timing chain
9. Cylinder head with camshafts
10. Intake camshaft adjustment unit
11. Chain guide mounting bolt (M8)
 - Tighten to 20 Nm (15 ft-lb)
12. Crankshaft sprocket
13. Chain guide
14. Chain guide mounting bolt (M7)
 - Tighten to 14 Nm (10 ft-lb)

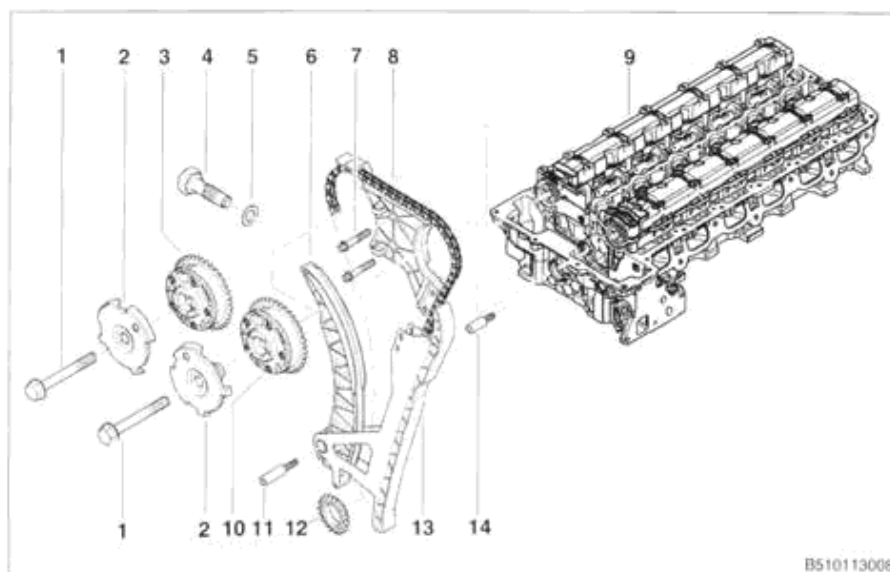
Cylinder Head Removal and Installation 113-31

Cylinder head and timing chain (N54 engine)

- Clean all fuel from ignition coil hole.
- Remainder of assembly is reverse of removal. Keep in mind the following:
 - Make sure cabin microfilter housing seals correctly.
 - Check fuel lines for leaks once engine starts.

Tightening torque	
Ignition coil cover to cylinder head cover (M6)	4 Nm (35 in-lb)
Strut tower brace to bulkhead (replace M12 bolt)	100 Nm (74 ft-lb) additional 90°
• Stage 1	
• Stage 2	
Strut tower brace to strut tower (replace M10 bolt)	40 Nm (30 ft-lb) additional 60°
• Stage 1	
• Stage 2	

Cylinder head and timing chain (N54 engine)



1. Camshaft adjustment unit mounting bolt (M10 x 94 mm)
 - Replace with new
 - Tighten in 2 stages
 - Stage 1: 20 Nm (15 ft-lb)
 - Stage 2: Additional 180°
2. Camshaft impulse wheel
3. Exhaust camshaft adjustment unit
4. Chain tensioner (M22 x 1.5)
 - Tighten to 55 Nm (41 ft-lb)
5. Sealing O-ring
 - Install new
6. Chain tensioner rail
7. Chain module mounting bolts (M6 x 35 mm Torx)
 - Tighten to 8.5 Nm (6 ft-lb)
8. Timing chain
9. Cylinder head with camshafts
10. Intake camshaft adjustment unit
11. Chain guide mounting bolt (M8)
 - Tighten to 20 Nm (15 ft-lb)
12. Crankshaft sprocket
13. Chain guide
14. Chain guide mounting bolt (M7)
 - Tighten to 14 Nm (10 ft-lb)

113-32 Cylinder Head Removal and Installation

Cylinder head, removing and installing (N54 engine)

Cylinder head, removing and installing (N54 engine)

To remove the turbo engine cylinder head, first remove the engine. Special tools and procedures are required to remove and install camshaft adjustment units and to time camshafts. Read the entire procedure before beginning repairs.

CAUTION—

- Disassembly, removal and assembly of camshafts, camshaft adjustment units or cylinder head without special tools poses the risk of damage or breakage:
 - Valves may be bent by contact with the piston crowns.
 - Camshaft may snap in two if bent by valve springs.

NOTE—

- Camshaft timing is covered in **117 Camshaft Timing Chain**.

Cylinder head removal and installation procedures are described separately.

If you remove a cylinder head and determine that it requires significant reconditioning work, a remanufactured cylinder head is available from an authorized BMW dealer.

Cylinder head, removing (N54 engine)

The cylinder head stretch bolts are aluminum. Replace them any time they are removed. Use angle protractor to torque.

WARNING—

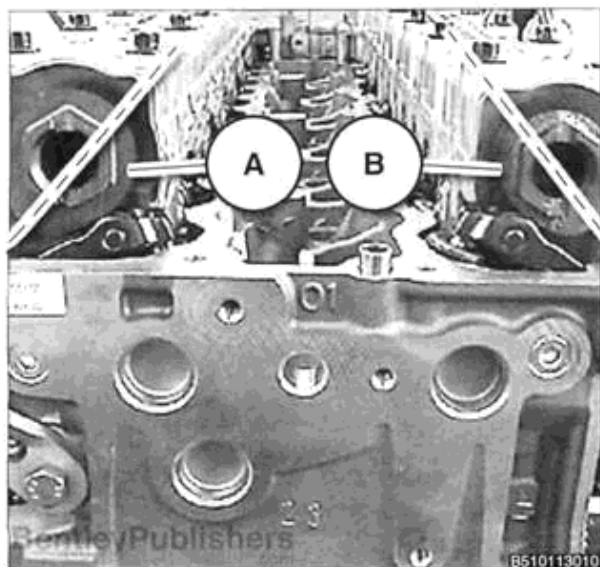
- To avoid personal injury, be sure the engine is cold before beginning the removal procedure.

- Disconnect negative (–) cable from battery.

CAUTION—

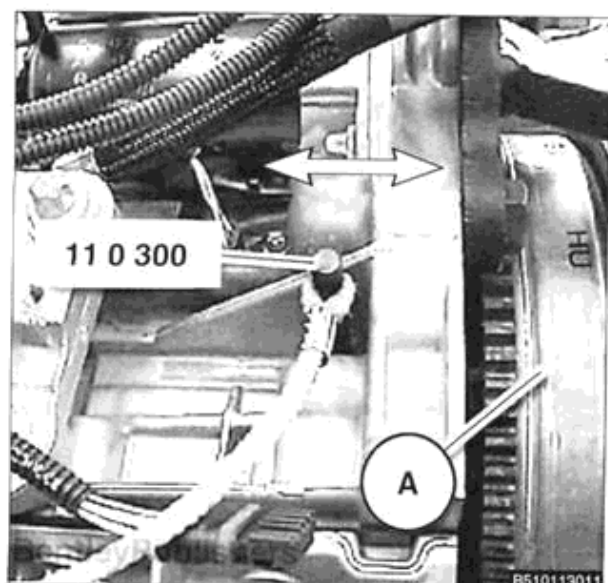
- Prior to disconnecting the battery, read the battery disconnection cautions in **001 Warnings and Cautions**.

- Remove ignition coil cover (upper engine cover). See **020 Maintenance**.
- With engine fully cooled off, drain engine coolant. See **170 Radiator and Cooling System**.
- Remove engine. See **110 Engine Removal and Installation**.
- Remove cylinder head cover. See **Cylinder head cover, removing and installing (N54 engine)** in this repair group.
- ◀ Using vibration damper bolt to rotate crankshaft, place cylinder 1 in TDC firing position. In this position, lobes for cylinder 6 (rear of engine) intake and exhaust camshafts (**A**, **B**) point away from each other and down. Cylinder 6 camshaft lobes do not contact roller cam followers.



Cylinder Head Removal and Installation 113-33

Cylinder head, removing (N54 engine)



NOTE—

- Use a mirror to check cylinder 6 cam lobe positions.

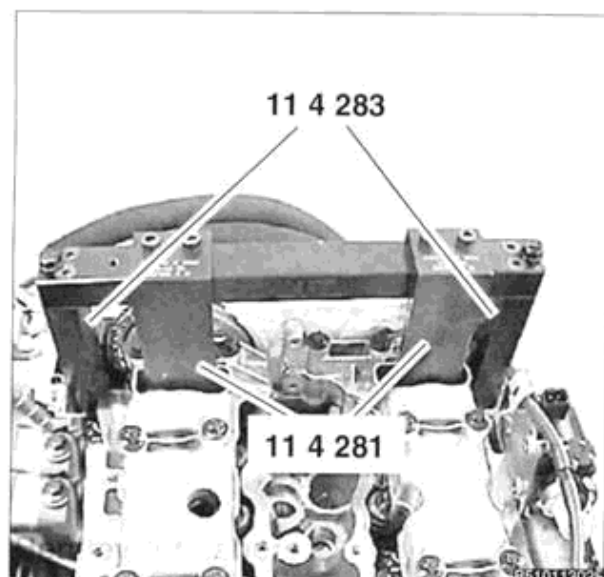
- ◀ Working underneath engine, slide out protective plug at lower left of engine bell housing flange. Install BMW special tool 11 0 300 (crankshaft locking tool) through bell housing flange port into flywheel (A) hole. If necessary, rock flywheel slightly back and forth to line up holes with tool. This locks crankshaft at TDC.

CAUTION—

- Automatic transmission model: A short distance before the flywheel special tool bore for TDC position, there is a large bore which can be confused with the special tool bore. If the flywheel is locked using the correct bore, the engine can no longer be rotated at the vibration damper bolt.

- Remove intake and exhaust camshaft adjustment units. See 117 Camshaft Timing Chain.

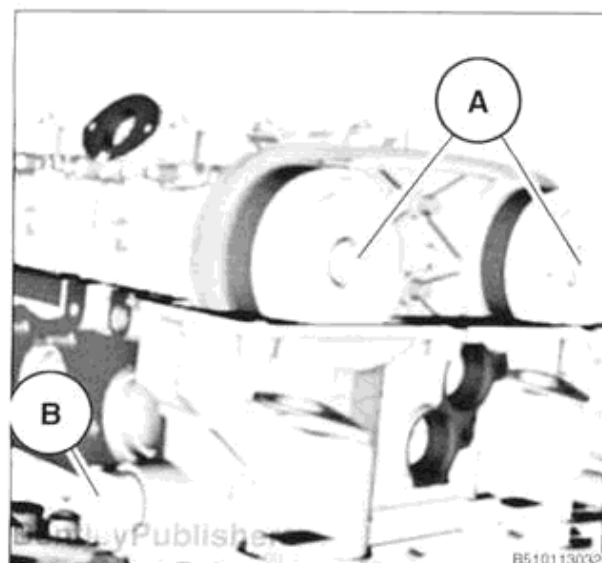
- ◀ Use BMW special tool set 11 4 280 to lock down camshafts.



- ◀ Remove intake and exhaust camshaft adjustment units:
 - Loosen and remove adjustment unit mounting bolts (1). Discard bolts.
 - Remove timing chain tensioner (2). Be prepared to catch dripping oil with a shop towel. Do not allow oil to contaminate accessory belt.
 - Disengage timing chain from camshaft adjustment unit sprockets. Remove adjustment units and set aside.

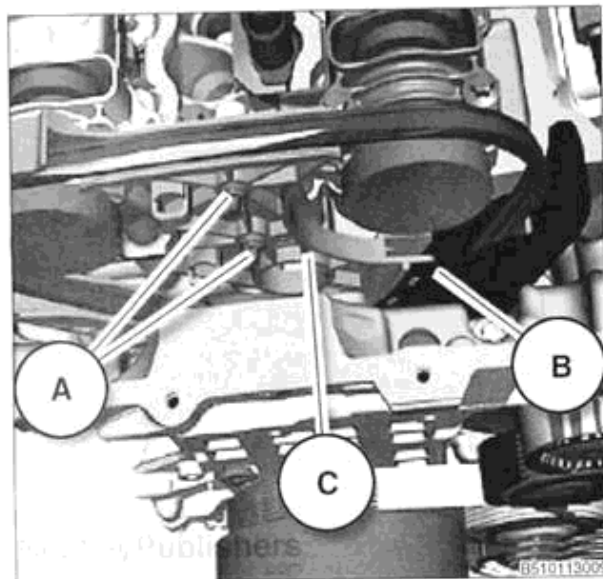
NOTE—

- Illustration does not show special tool set 11 4 280 in place.



113-34 Cylinder Head Removal and Installation

Cylinder head, removing (N54 engine)

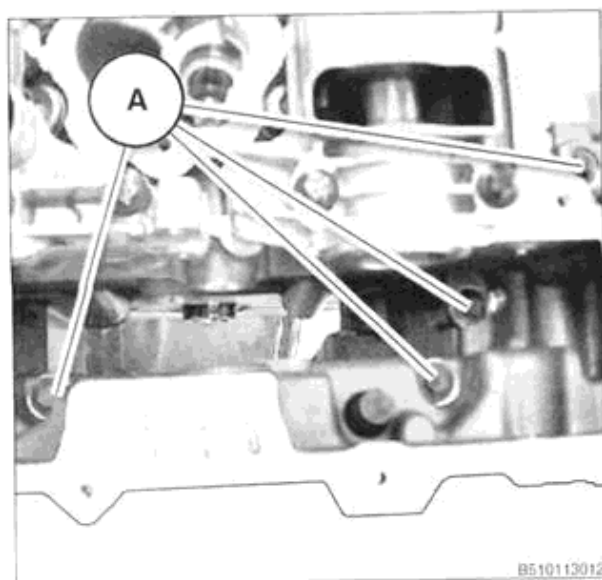


Working at front of cylinder head:

- Remove timing chain module mounting bolts (A).
- Unclip chain module (C) at junction (B) and lift out.
- Place timing chain in cylinder head opening.

CAUTION—

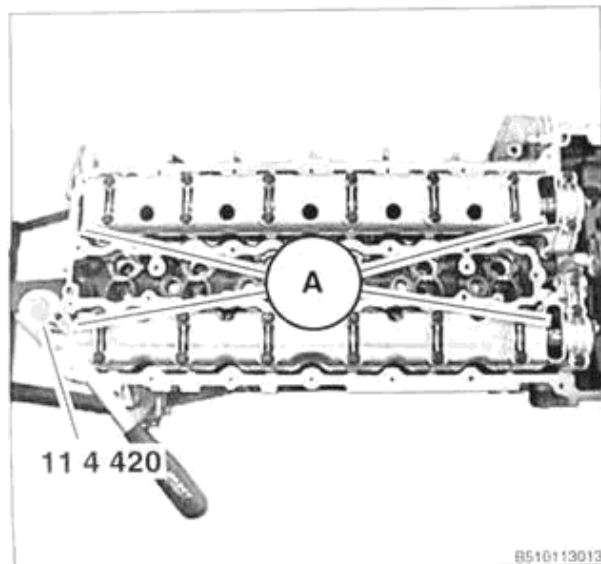
- Do not remove crankshaft locking tool. Rotating crankshaft may cause the timing chain to jam or jump teeth.



Remove cylinder head bolts (A) to timing chain housing. Press timing chain rail forward slightly to remove lower bolt(s).

CAUTION—

- Use mechanical gripper to prevent lower bolt(s) from falling down inside crankcase.
- Measure and note down different bolt lengths for correct reinstallation.

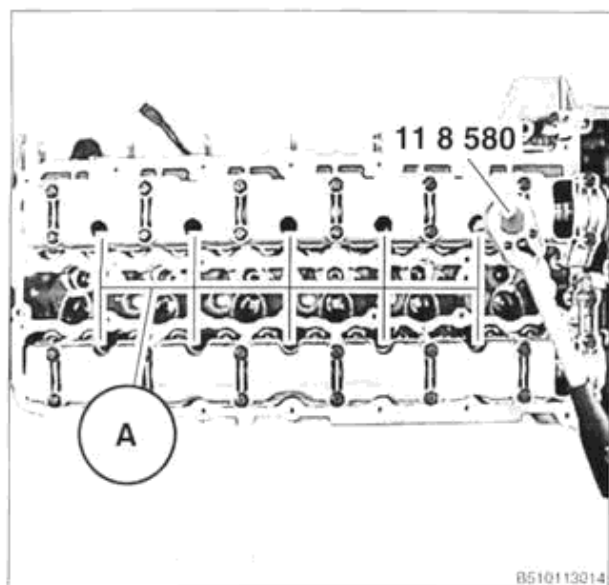


Use BMW special tool 11 4 420 (Torx T50) to loosen and remove M9 cylinder head bolts.

- Note different bolt lengths.
- Discard all aluminum bolts.

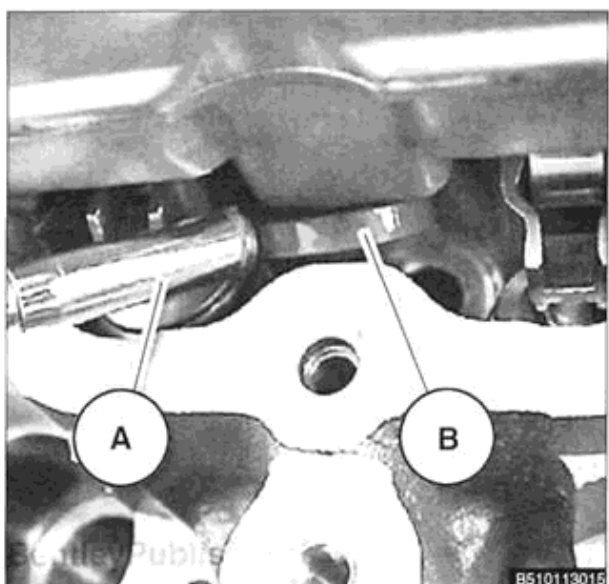
Cylinder Head Removal and Installation 113-35

Cylinder head, installing (N54 engine)



- Use BMW special tool 11 8 580 (Torx T60) to loosen and remove M11 cylinder head bolts (A).

- Start at outer corners and loosen bolts in crisscross pattern.
- Discard all aluminum bolts.

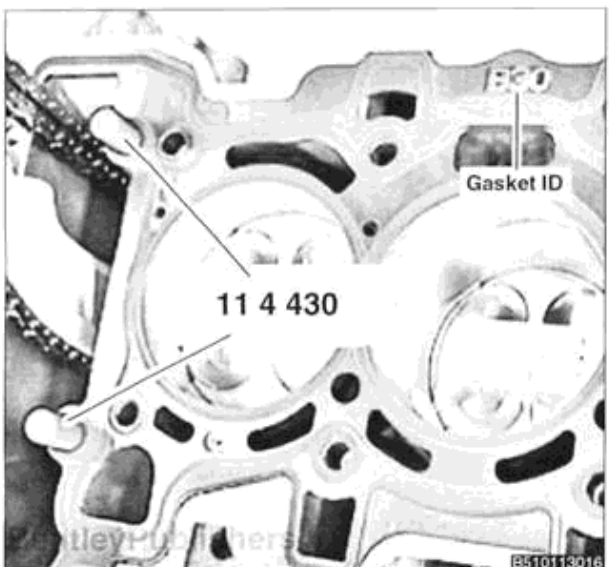


- Use magnet (A) to lift out cylinder head bolt washers (B) between surface of cylinder head and camshaft bearing strip.

- Bolt lifting handles to cylinder head. Lift off head with help of assistant.

CAUTION—

- Cylinder head weighs approx. 40 kg (88 lb).
- Place cylinder head down on work bench on its side. Putting it down on sealing surface risks damage to the valves.
- Be sure to clean antifreeze out of cylinder head bolt holes in crankcase immediately.



Cylinder head, installing (N54 engine)

- Before cleaning engine block sealing surface, insert plugs (BMW special tools 11 4 430 or equivalent) into oil passages.

- Clean cylinder head and gasket surfaces of engine block and timing chain housing.

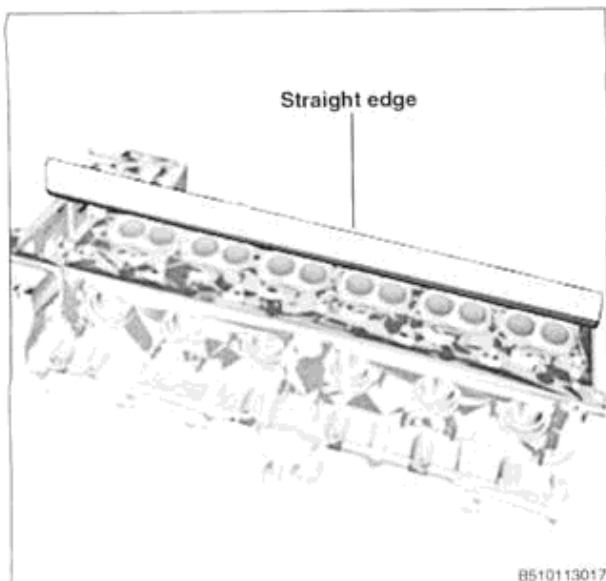
CAUTION—

- Remove foreign matter and liquid from bolt holes. Trapped oil or coolant in bolt holes can cause damage to the engine block.
- Do not use a metal scraper or wire brush to clean the aluminum cylinder head or pistons. If necessary, use a hard wooden or plastic scraper. Also available are abrasive discs to be used in conjunction with an electric drill. Be sure to use the correct disc for the type of metal being cleaned.

- Inspect cylinder head for visible cracks or other defects.

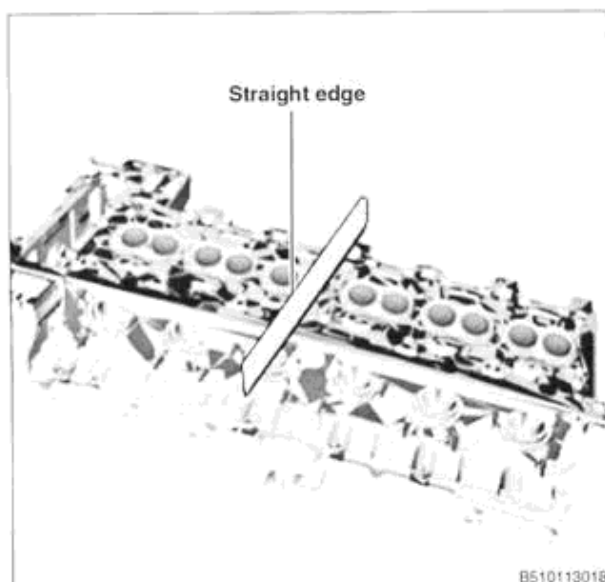
113-36 Cylinder Head Removal and Installation

Cylinder head, installing (N54 engine)



- To check cylinder head for warpage:
 - Remove intake and exhaust camshafts and roller cam followers.
 - Remove valve lifters and valves.

➤ Use straight edge to check evenness of cylinder head sealing surface in longitudinal direction.



➤ Use straight edge to check evenness of cylinder head sealing surface in transverse direction.

Cylinder head warpage specifications

Maximum warpage allowed	
• Longitudinal	0.10 mm (0.0039 in)
• Transverse	0.05 mm (0.0020 in)

- Have cylinder head tested for coolant leaks and cracks.
- If cylinder head is warped but otherwise sound, machine a maximum of 0.3 mm (0.011 in) off sealing surface.
- Reassemble cylinder head, or use reconditioned BMW cylinder head.

Tightening torque

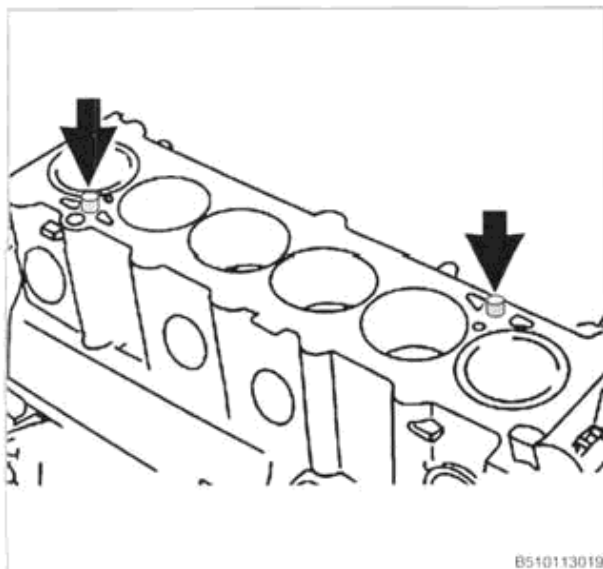
Camshaft bearing strip to camshaft (M7 x 70 mm 10.9 steel bolt)	
• Stage 1	8 Nm (71 in-lb)
• Stage 2	additional 60°

CAUTION—

- Once assembled with valves and camshafts, place cylinder head down on work bench on its side. Putting it down on sealing surface risks damage to the valves.

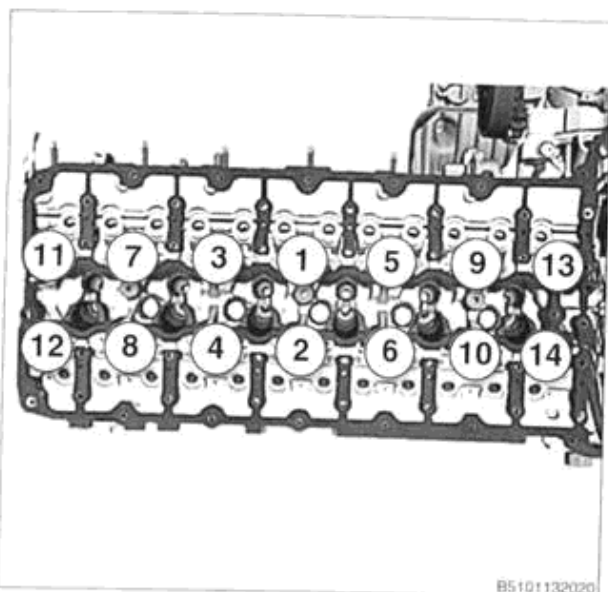
➤ Check that two cylinder head aligning sleeves (**arrows**) are correctly positioned in engine block and are not damaged.

- Replace cylinder head gasket.
- If cylinder head is machined, use a special cylinder head gasket available from an authorized BMW dealer. The gasket is 0.3 mm (0.011 in) thicker than standard and is marked accordingly.
- Place cylinder head on engine block and fit to aligning sleeves.



Cylinder Head Removal and Installation 113-37

Cylinder head, installing (N54 engine)



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- Insert new aluminum cylinder head bolts:
 - Bolts 1 - 10: M11 x 135 mm
 - Bolts 11 - 14: M9 x 95 mm and M9 x 125 mm. Insert correct length bolts, as marked previously.
 - Where necessary, use magnet to fit bolt washer.

NOTE—

- Graphic shows intake and exhaust camshafts removed.

- Use BMW special tool 11 8 850 (Torx T60) to tighten bolts 1 - 10 in sequence shown below.
- Use BMW special tool 11 4 420 (Torx T50) to tighten bolts 11 - 14 in sequence shown below.

Tightening torques and sequence

Cylinder head to engine block:

- Stage 1: All bolts, 1 - 14
- Stage 2: All bolts, 1 - 14
- Stage 3: Only bolts 1 - 10
- Stage 4: All bolts 1 - 14

30 Nm (22 ft-lb)
additional 90°
additional 90°
additional 45°

CAUTION—

- Stage 3 applies to M11 bolts (1 - 10) only.

- Install cylinder head bolts to timing chain housing (A). Press timing chain rail forward slightly to install lower bolt(s).

CAUTION—

- Use mechanical gripper to prevent lower bolt(s) from falling down inside crankcase.
- Place different bolt lengths in correct bores.

Tightening torque

Cylinder head to timing chain housing
(M9 x 30 mm or M9 x 70 mm)

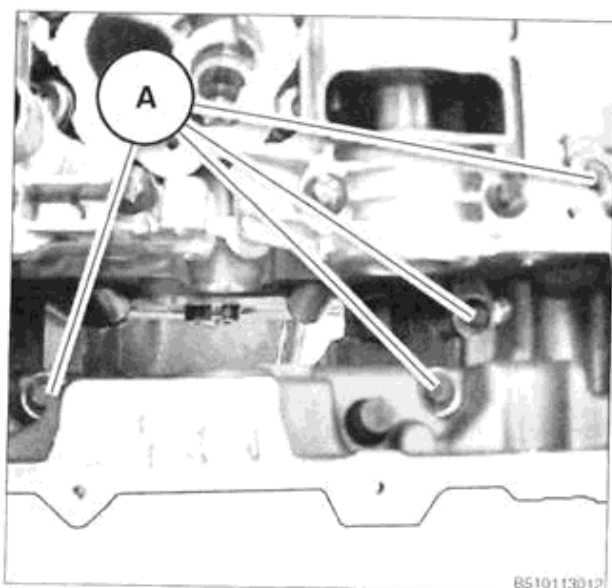
22 Nm (16 ft-lb)

- Use wire hook to retrieve timing chain from inside timing chain housing. Place chain over chain module and clip module to lower chain rail. Reinstall chain module mounting bolts.

Tightening torque

Chain module to cylinder head
(M6 x 35 mm Torx)

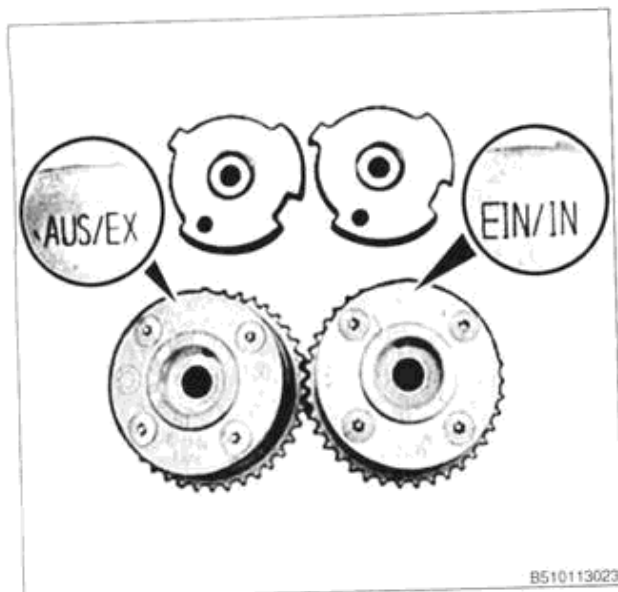
8.5 Nm (6 ft-lb)



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113-38 Cylinder Head Removal and Installation

Cylinder head, installing (N54 engine)



- Use new bolts to reattach camshaft adjustment units. Note that exhaust and intake units are different and so marked. Camshaft sensor impulse wheel for intake and exhaust are the same.

CAUTION—

- Use special tools shown in 117 Camshaft Timing Chain to lock down camshafts.

Tightening torque

Camshaft adjustment unit to camshaft (use new M10 x 94 mm bolt):

- Stage 1
- Stage 2

20 Nm (15 ft-lb)
additional 180°

- Install chain tensioner and set camshaft timing. See 117 Camshaft Timing Chain.

CAUTION—

- If chain tensioner is reused, drain its oil chamber. Place tensioner on level working surface and compress slowly. Repeat twice.
- No sealing ring is fitted to chain tensioner at the factory. When reassembling engine, be sure to use new sealing O-ring.

Tightening torque

Timing chain tensioner to cylinder head (M22 x 1.5) (use new sealing O-ring)

55 Nm (41 ft-lb)

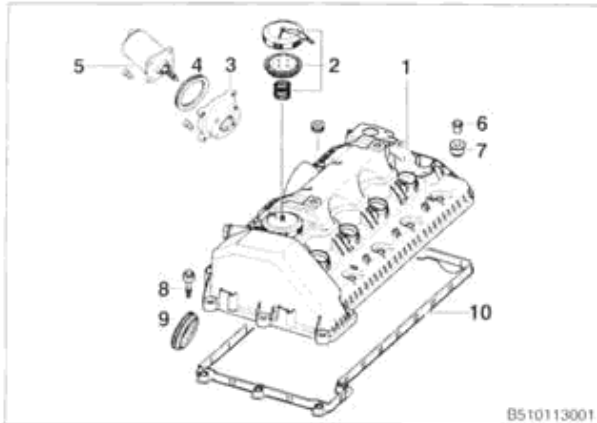
- Remainder of installation is reverse of removal. Remember to:
- Remove camshaft and crankshaft locking tools.
 - Assemble cylinder head cover with new gasket.
 - Reattach and tighten any ground cables removed.
 - Reassemble fuel rail using new O-ring seals.
 - Change engine oil and filter. See 020 Maintenance.
 - Fill and bleed cooling system. See 170 Radiator and Cooling System.

CYLINDER HEAD (V8 ENGINE)

Cylinder head cover components (V8 engine)

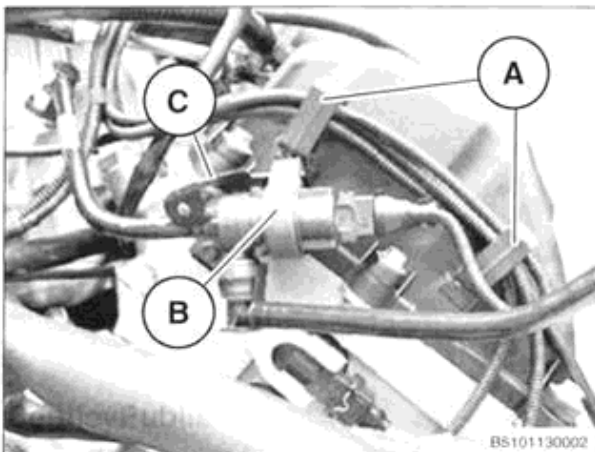
Cylinder head cover for V8 engines is made of plastic. Replace gaskets, seals and O-rings whenever the cover is removed.

1. Cylinder head cover
2. Pressure regulating valve
3. Valvetronic motor spacer
4. O-ring
5. Valvetronic motor
6. Cap nut
7. Rubber seal
8. Bolt
9. Gasket ring
10. Cylinder head cover gasket



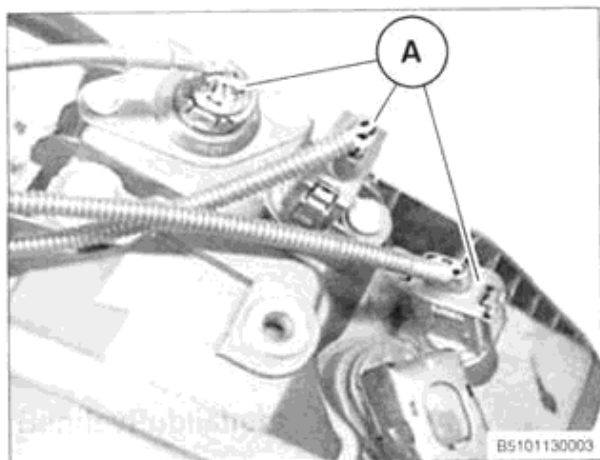
Cylinder head cover, removing and installing (V8 engine)

- Use scan tool to read out and record ECM fault memory.
- Switch ignition OFF and remove key.
- Remove upper engine cover. See **020 Maintenance**.
- Remove ignition coil cover. See **020 Maintenance**.
- Unclip wiring harness and holder from (A) from cylinder head cover. Remove fuel tank vent valve (B) off mounting bracket (C).

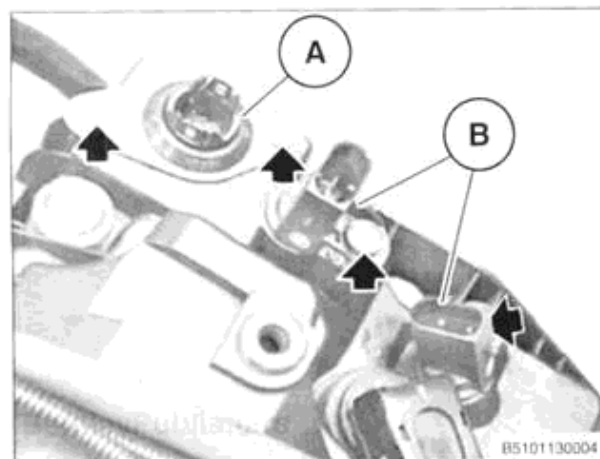


113-40 Cylinder Head Removal and Installation

Cylinder head cover, removing and installing (V8 engine)

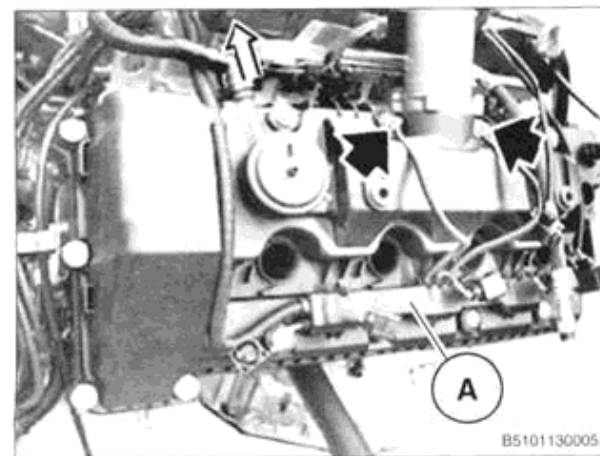


◀ Disconnect electrical connectors (A).



◀ Remove fasteners (arrows). Remove wiring harness bulkhead seal (A) and discard, remove sensors (B).

— Remove ignition coils. See **120 Ignition System**.

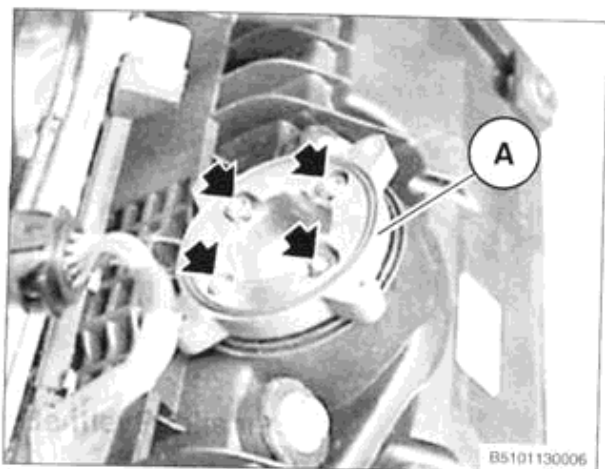


◀ Remove ground straps (arrows). Unclip and remove wiring harness duct (A).

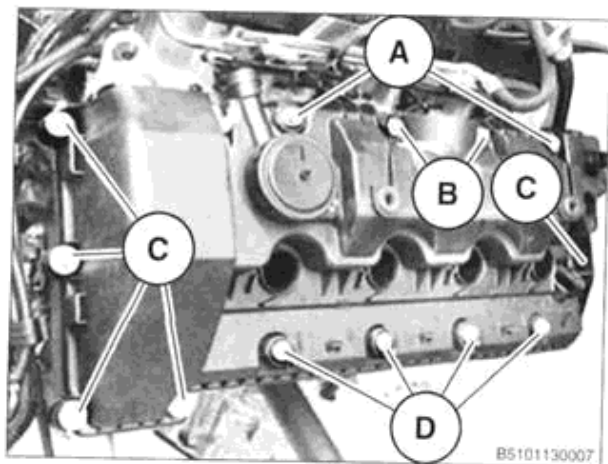
— Remove valvetronic motor. See **133 Fuel Injection**.

Cylinder Head Removal and Installation 113-41

Cylinder head cover, removing and installing (V8 engine)



- Remove valvetronic motor spacer fasteners (**arrows**) and spacer (**A**). Discard valvetronic motor spacer seal upon removal.
- Remove fuel injector rail. See **133 Fuel Injection**.



- Remove fasteners (**A, B, C and D**). If necessary remove dipstick. Lift and remove cylinder head cover.
- To reinstall cylinder head cover.
 - Coat cylinder head contact surfaces with thin layer of anti-friction compound such as glycerine.
 - Place small quantity of silicone sealant at metal-to-metal seams (such as timing cover to engine block) and half moon gasket areas.
 - Install spark plug domes in cylinder head cover before installation.
 - Replace cylinder head cover gaskets, seals and O-rings.
 - Reinstall valvetronic motor.
 - Tighten cylinder head cover bolts gradually in crisscross pattern, starting with inside fasteners.

Tightening torques

Cylinder head cover to cylinder head	
• M6 bolts	10 Nm (7 ft-lb)
• M7 bolts	15 Nm (11 ft-lb)
• M8 bolts	17 Nm (12.5 ft-lb)

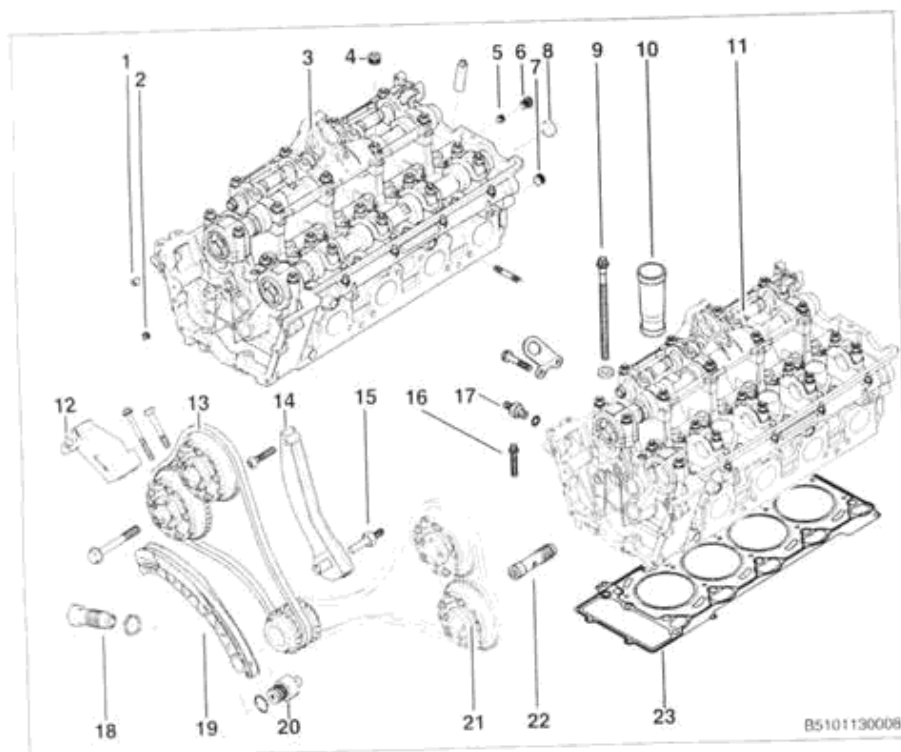
- Remainder of assembly is reverse of removal.

113-42 Cylinder Head Removal and Installation

Cylinder head and timing chain (V8 engine)

CYLINDER HEAD (V8 ENGINE)

Cylinder head and timing chain (V8 engine)



1. Dowel
2. Screw plug
3. Valvetronic motor flange
4. Screw plug
5. O-ring
6. Screw plug
7. Screw plug
8. Cover
9. Cylinder head bolt
10. Spark plug dome
11. Cylinder head assembly
12. Timing chain rail
13. Timing chain
14. Timing chain guide
15. Bearing bolt
16. Cylinder head bolt
17. Connector
18. Timing chain tensioner
19. Timing chain guide
20. Timing chain guide bearing
21. VANOS adjuster
22. Check valve
23. Cylinder head gasket

Cylinder head removal and installation (V8 engine)

V8 engine cylinder heads are equipped with VANOS. To remove the cylinder heads, special tools and procedures are required for removing the VANOS units. Read the entire procedure before beginning the repair.

CAUTION—

- Disassembly, removal and assembly of camshafts or cylinder head without special tools poses the risk of damage or breakage. The valves may be bent by contact with the piston crown; camshafts may break if stressed incorrectly during removal or installation.

NOTE—

- VANOS or variable camshaft timing is from the German words VArIable NOckenwellen Steuerung.
- VANOS removal is covered in 117 Camshaft Timing Chain.

Cylinder Head Removal and Installation 113-43

Right cylinder head, removing (V8 engine)

Right and left cylinder head removal and installation procedures are given separately. Remove the intake manifold before removing either cylinder head. See **133 Fuel Injection**.

If you remove a cylinder head and determine that it requires significant reconditioning work, a remanufactured cylinder head is available from an authorized BMW dealer.

Right cylinder head, removing (V8 engine)

WARNING—

- Due to risk of personal injury, be sure the engine is cold before beginning the removal procedure.

- Disconnect negative (-) battery cable.

CAUTION—

- Prior to disconnecting the battery, read the battery disconnection cautions in **001 Warnings and Cautions**.

- Raise car and support safely.

WARNING—

- Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove right exhaust manifold. See **180 Exhaust System**.

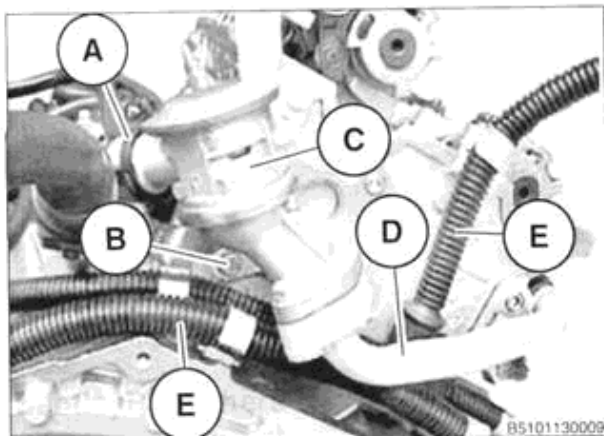
NOTE—

- To remove exhaust manifolds, secure engine in the installation position with special tool and lower front axle bracket. Once manifolds have been removed Reinstall front axle bracket and remove special tool for securing engine in installation position.

- Open engine coolant drain plug at right side of engine block. Be prepared to catch draining coolant. Drain remaining engine coolant from radiator. See **170 Radiator and Cooling System**.
- Remove ignition coil cover. See **020 Maintenance**.
- Remove ignition coils. See **120 Ignition System**.
- Remove valvetronic motor. See **133 Fuel Injection**.
- Remove right cylinder head cover. See **Cylinder head cover, removing and installing (V8 engine)** in this repair group.
- Remove intake manifold. Plug intake manifold ports to prevent debris from entering engine See **133 Fuel Injection**.
- Remove upper right timing cover. See **117 Camshaft Timing Chain**.
- Disconnect electrical connectors and lay engine wiring harness aside.
- Remove spark plugs. Plug spark plug bores to prevent debris from entering engine. See **020 Maintenance**.

113-44 Cylinder Head Removal and Installation

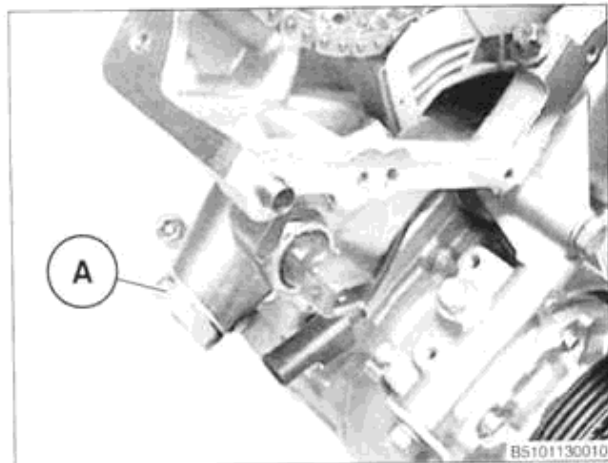
Right cylinder head, removing (V8 engine)



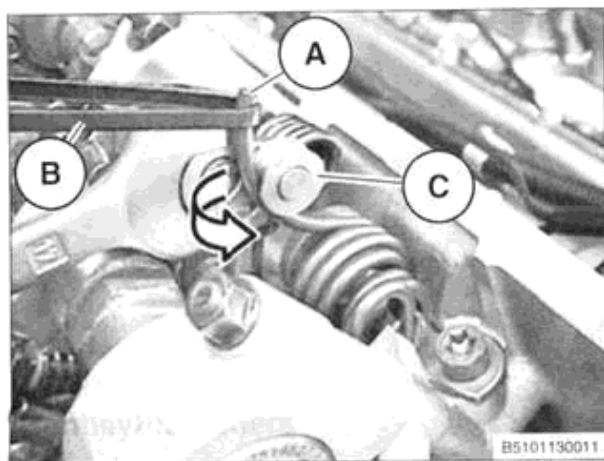
— Remove right cylinder head vent hose.

◀ Working at rear of right side cylinder head, remove secondary air hose (A). Remove check valve fasteners (B) and remove check valve (C) with tube (D). Unclip wiring harness (E) and lay aside.

— Remove intake and exhaust camshaft adjustment (VANOS) units. See 117 **Camshaft Timing Chain**.



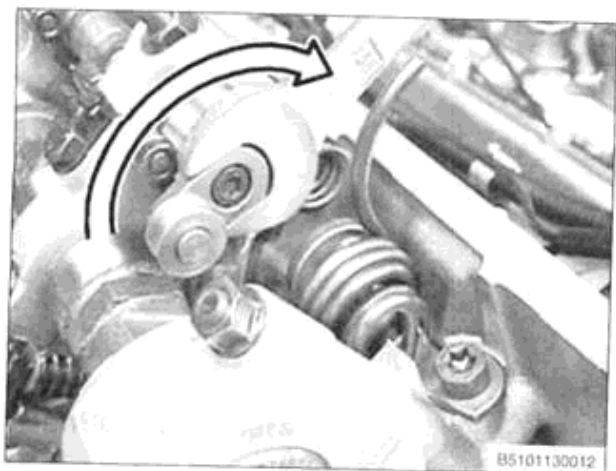
◀ Loosen timing chain tensioner (A) by 1 turn (360°).



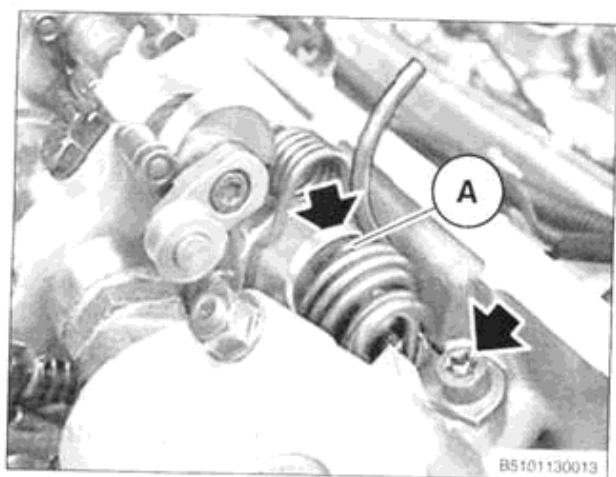
◀ Rotate eccentric shaft at dihedral head to reduce tension on torsion spring (A). Using a strap (B) carefully pull torsion spring (A) off roller (C) in direction of **arrow**.

Cylinder Head Removal and Installation 113-45

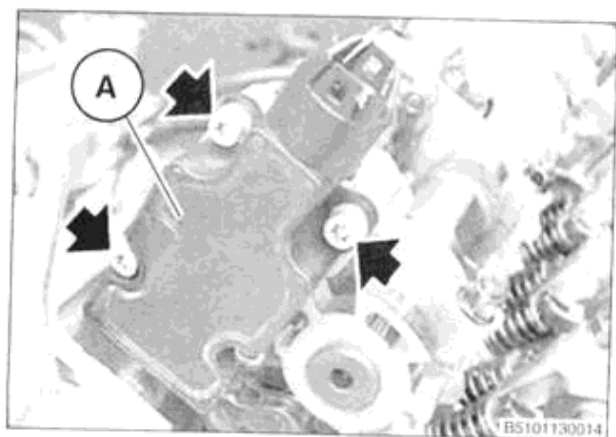
Right cylinder head, removing (V8 engine)



- Rotate eccentric shaft at dihedral head in direction of **arrow** to minimum stroke position.



- Remove spring mount fasteners (**arrows**) and feed spring mount (**A**) upwards out of locating pin.

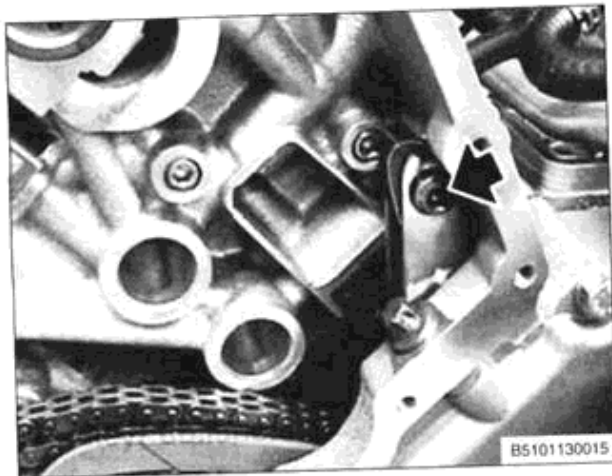


- Remove eccentric shaft sensor fasteners (**arrows**). Remove eccentric shaft sensor (**A**) from cylinder head.

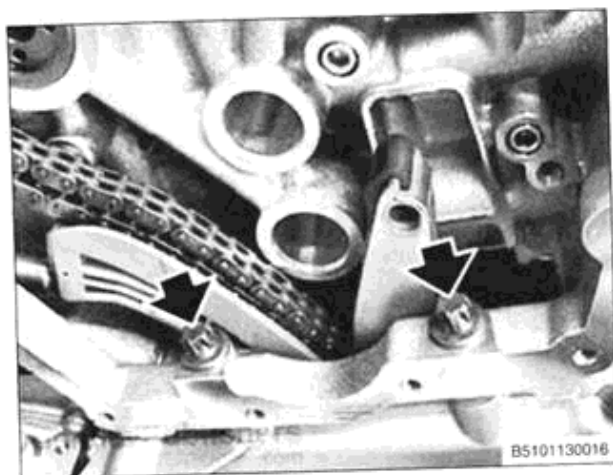
113-46 Cylinder Head Removal and Installation

Right cylinder head, removing (V8 engine)

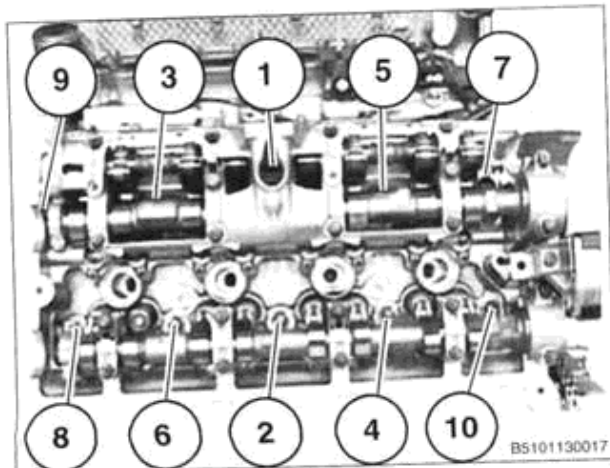
Remove timing chain guide fastener (**arrow**).



Remove cylinder head to timing cover fasteners (**arrows**).

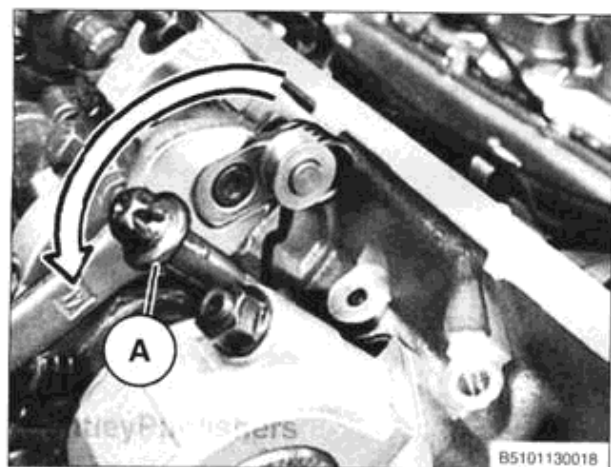


Loosen cylinder head fasteners 1 turn (360°) in sequence 10 - 1.



Cylinder Head Removal and Installation 113-47

Right cylinder head, installing (V8 engine)



- ⚡ Rotate eccentric shaft at dihedral head in direction of **arrow** to remove cylinder head bolt 7 (**A**) and discard.

- ⚡ Rotate eccentric shaft at dihedral head in direction of **arrow** to minimum stroke position.

- Remove remaining cylinder head fasteners and discard.
- Lift off cylinder head with help of assistant.

CAUTION—

- Cylinder head weighs approx. 40 kg (88 lb).
- Place cylinder head on work bench on its side. Putting it down on sealing surface risks damage to the valves.
- Be sure to clean antifreeze out of cylinder head bolt holes in crankcase immediately.

- Remove and discard cylinder head gasket.

Right cylinder head, installing (V8 engine)

- Clean cylinder head and gasket surfaces of engine block and timing chain housing.

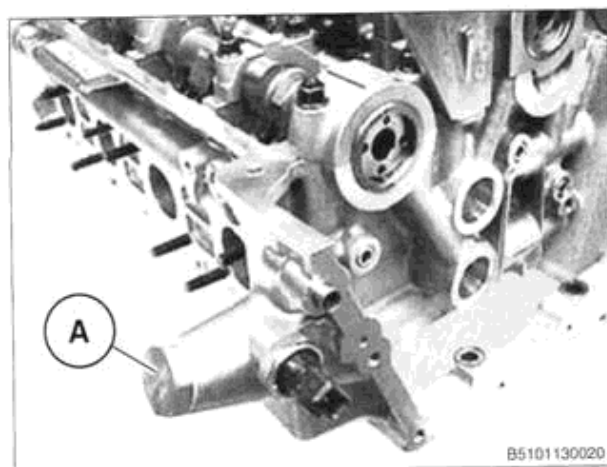
CAUTION—

- Remove foreign matter and liquid from bolt holes. Trapped oil or coolant in bolt holes can cause damage to the engine block.
- Do not use a metal scraper or wire brush to clean sealing surfaces. If necessary, use a hard wooden or plastic scraper. Also available are abrasive discs to be used in conjunction with an electric drill. Be sure to use the correct disc for the type of metal being cleaned.

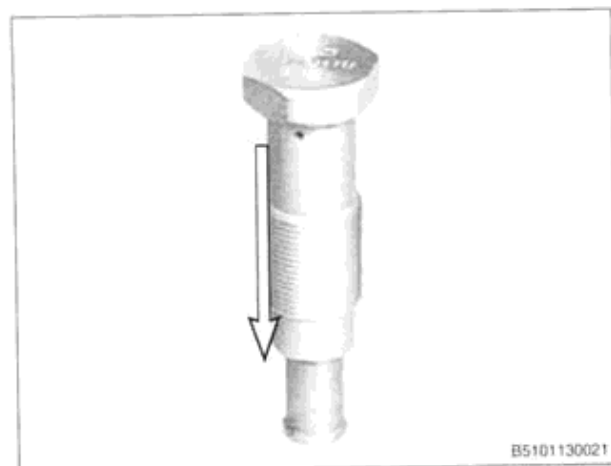
- Inspect cylinder head for visible cracks or other defects.

113-48 Cylinder Head Removal and Installation

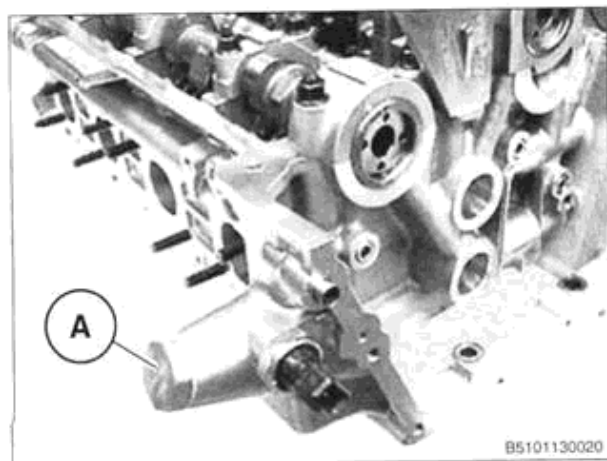
Right cylinder head, installing (V8 engine)



Remove timing chain tensioner (A) and discard tensioner seal.



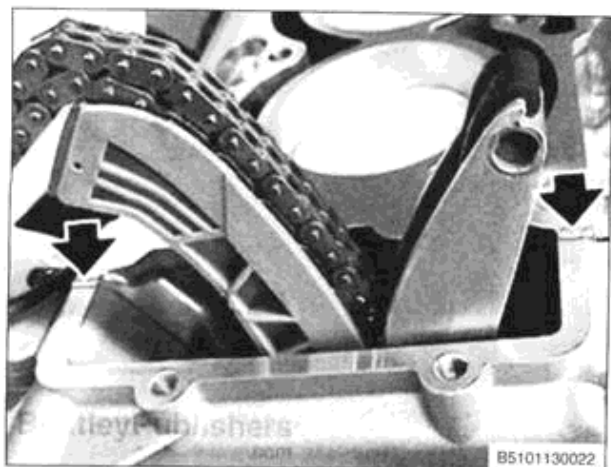
Slowly compress timing chain tensioner piston on a level surface. Repeat procedure two times.



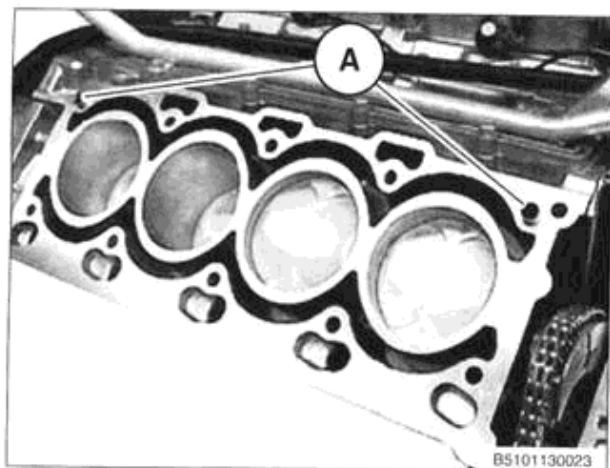
Install timing chain tensioner (A) with new seal finger tight.

Cylinder Head Removal and Installation 113-49

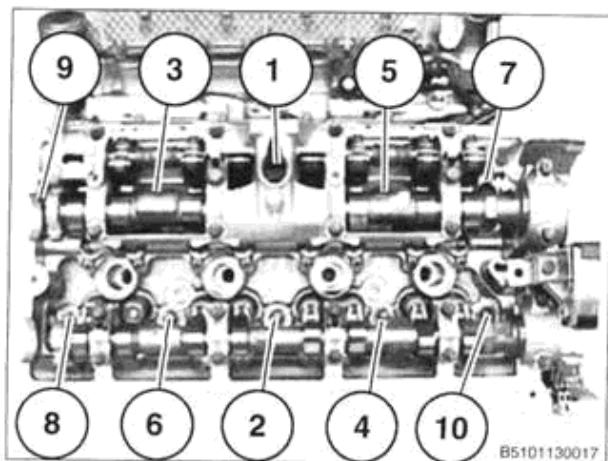
Right cylinder head, installing (V8 engine)



- ◀ Coat joint (**arrows**) between engine block and timing cover with 3-Bond 1209®.



- ◀ Inspect dowel sleeves (**A**) for damage, replace if necessary.
- Install new cylinder head gasket.
 - Place cylinder head onto engine block, being careful not to damage cylinder head gasket.



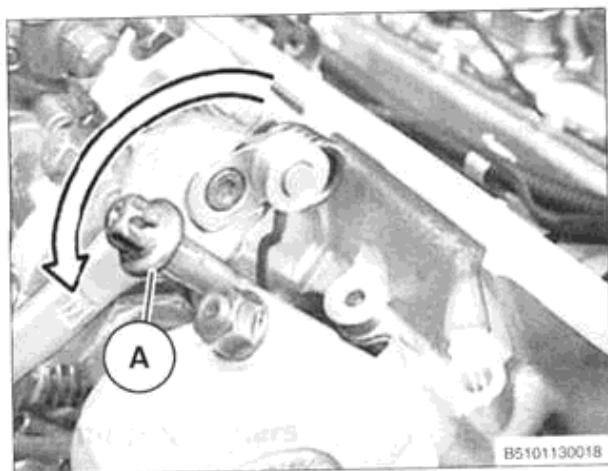
- ◀ Install new cylinder head fasteners finger tight. Do not wash coating on new cylinder head fasteners.

NOTE—

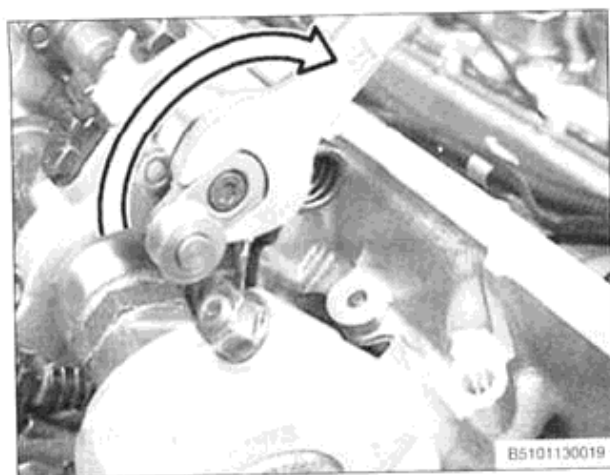
- Cylinder head fastener 7 will be installed in next step.

113-50 Cylinder Head Removal and Installation

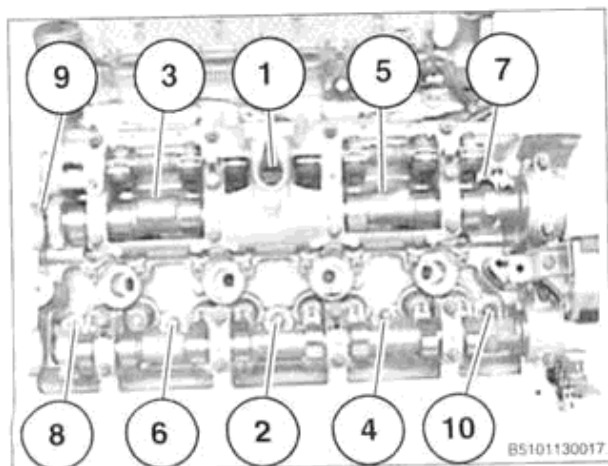
Right cylinder head, installing (V8 engine)



Rotate eccentric shaft at dihedral head in direction of **arrow** to install cylinder head bolt 7 (**A**).



Rotate eccentric shaft at dihedral head in direction of **arrow** to minimum stroke position.



Tighten cylinder head fasteners in sequence 1 - 10.

Tightening torques and sequence

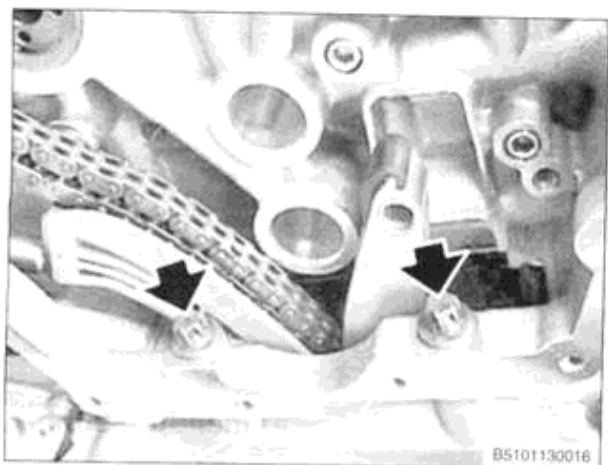
Cylinder head to engine block:

- Stage 1: All bolts, 1 - 10
- Stage 2: All bolts, 1 - 10
- Stage 3: All bolts 1 - 10

30 Nm (22 ft-lb)
additional 90°
additional 90°

Cylinder Head Removal and Installation 113-51

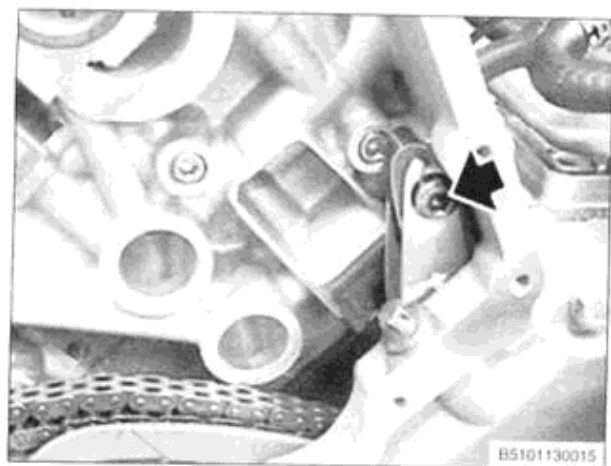
Right cylinder head, installing (V8 engine)



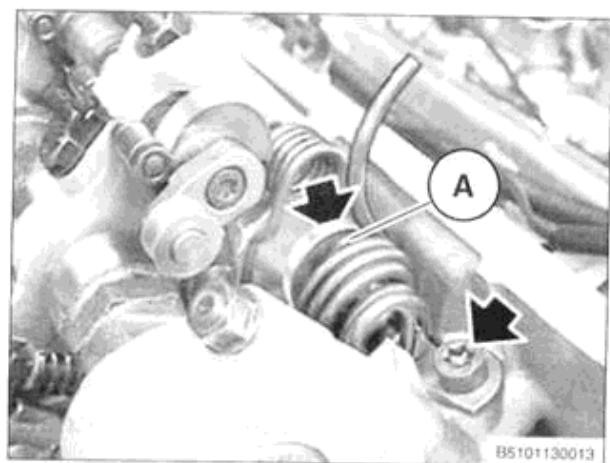
- Install and tighten cylinder head to timing cover fasteners (**arrows**).

Tightening torques and sequence

Cylinder head to timing cover:	10 Nm (7.3 ft-lb)
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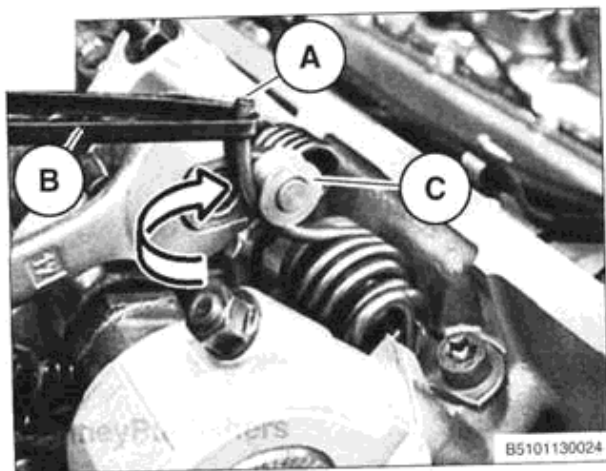
- Install and tighten timing chain guide fastener (**arrow**).



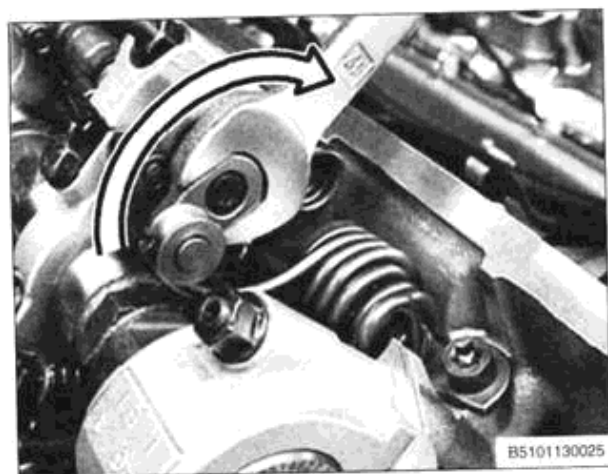
- Install eccentric shaft spring mount (**A**). Align locating pin with bore in cylinder head. Install and tighten fasteners (**arrows**).

113-52 Cylinder Head Removal and Installation

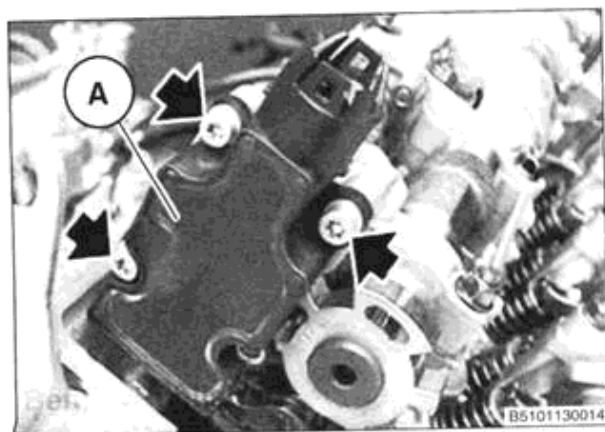
Right cylinder head, installing (V8 engine)



- Rotate eccentric shaft at dihedral head to reduce tension on torsion spring (A). Using a strap (B) carefully install torsion spring (A) onto roller (C) in direction of **arrow**.



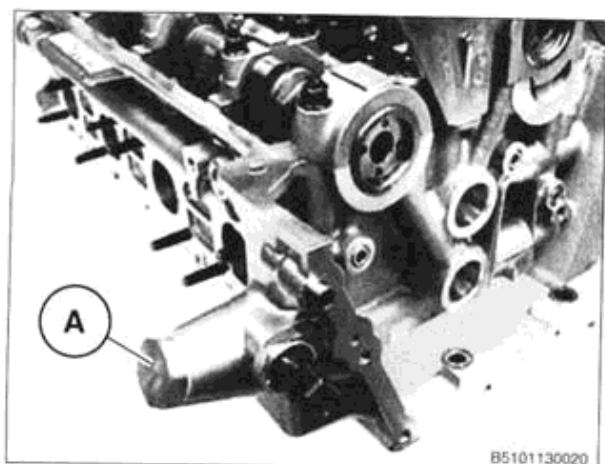
- Rotate eccentric shaft at dihedral head in direction of **arrow** to minimum stroke position.



- Install eccentric shaft sensor (A) onto cylinder head and tighten eccentric shaft sensor fasteners (**arrows**).

Cylinder Head Removal and Installation 113-53

Left cylinder head, removing (V8 engine)



- ⚡ Tighten timing chain tensioner (A).

Tightening torques and sequence

Timing chain tensioner to cylinder head	65 Nm (48 ft-lb)
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- Install intake and exhaust camshaft adjustment (VANOS) units. See **117 Camshaft Timing Chain**.
- Remainder of installation is reverse of removal. Remember to:
 - Remove camshaft and crankshaft locking tools.
 - Assemble cylinder head cover with new gasket.
 - Reattach and tighten any ground cables removed.
 - Reassemble fuel rail using new O-ring seals.
 - Change engine oil and filter. See **020 Maintenance**.
 - Fill and bleed cooling system. See **170 Radiator and Cooling System**.

Left cylinder head, removing (V8 engine)

WARNING—

- Due to risk of personal injury, be sure the engine is cold before beginning the removal procedure.

- Disconnect negative (-) battery cable.

CAUTION—

- Prior to disconnecting the battery, read the battery disconnection cautions in **001 Warnings and Cautions**.

- Raise car and support safely.

WARNING—

- Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove left exhaust manifold. See **180 Exhaust System**.

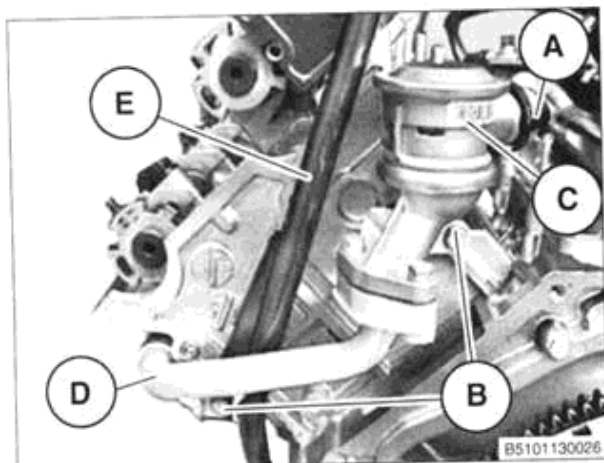
NOTE—

- To remove exhaust manifolds, secure engine in the installation position with special tool and lower front axle bracket. Once manifolds have been removed Reinstall front axle bracket and remove special tool for securing engine in installation position.
- Open engine coolant drain plug at left side of engine block. Be prepared to catch draining coolant. Drain remaining engine coolant from radiator. See **170 Radiator and Cooling System**.
- Remove ignition coil cover. See **020 Maintenance**.
- Remove ignition coils. Plug spark plug bores to prevent debris from entering engine. See **120 Ignition System**.
- Remove valvetronic motor. See **133 Fuel Injection**.
- Remove left cylinder head cover. See **Cylinder head cover, removing and installing (V8 engine)** in this repair group.

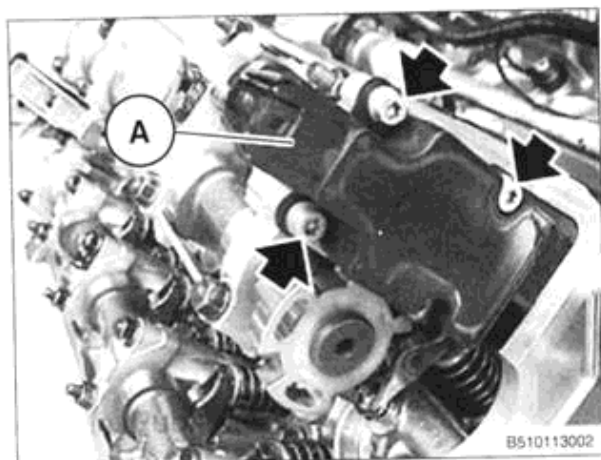
113-54 Cylinder Head Removal and Installation

Left cylinder head, removing (V8 engine)

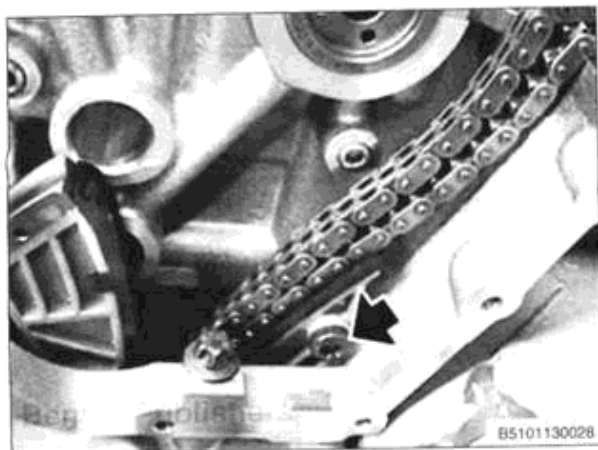
- Remove intake manifold. Plug intake manifold ports to prevent debris from entering engine. See **133 Fuel Injection**.
- Remove upper left timing cover. See **117 Camshaft Timing Chain**.
- Disconnect electrical connectors and lay engine wiring harness aside.
- Remove spark plugs. See **020 Maintenance**.
- Remove right cylinder head vent hose.
- ◀ Working at rear of left side cylinder head, remove secondary air hose (A). Remove check valve fasteners (B) and remove check valve (C) with tube (D). Do not remove dipstick tube (E).
- Remove intake and exhaust camshaft adjustment (VANOS) units. See **117 Camshaft Timing Chain**.



- ◀ Remove eccentric shaft sensor fasteners (arrows). Remove eccentric shaft sensor (A) from cylinder head.



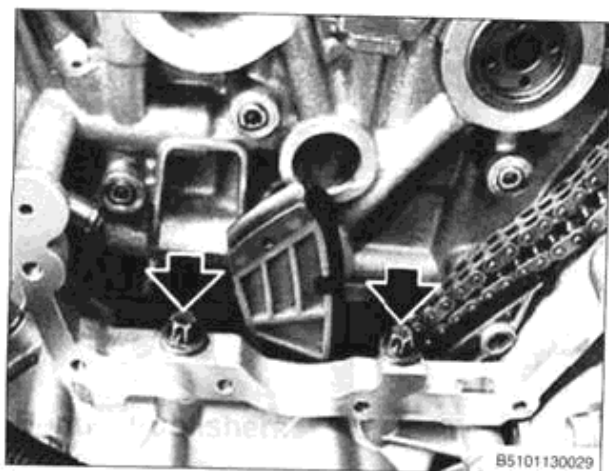
- ◀ Remove timing chain guide fastener (arrow).



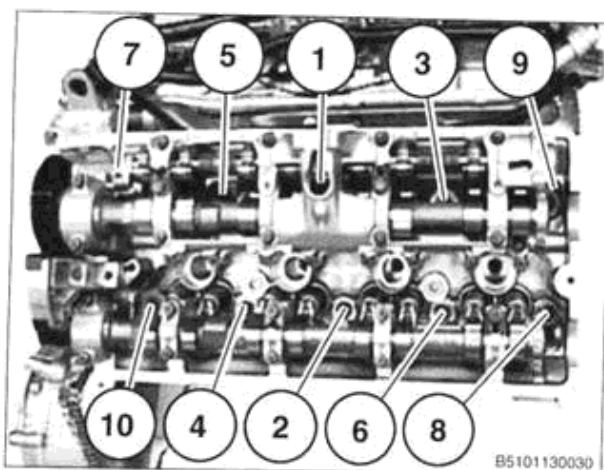
Cylinder Head Removal and Installation 113-55

Left cylinder head, installing (V8 engine)

113



- Remove cylinder head to timing cover fasteners (arrows).



- Remove and discard cylinder head fasteners in sequence 10 - 1.
- Lift off cylinder head with help of assistant.

CAUTION—

- Cylinder head weighs approx. 40 kg (88 lb).
- Place cylinder head on work bench on its side. Putting it down on sealing surface risks damage to the valves.
- Be sure to clean antifreeze out of cylinder head bolt holes in crankcase immediately.

- Remove and discard cylinder head gasket.

Left cylinder head, installing (V8 engine)

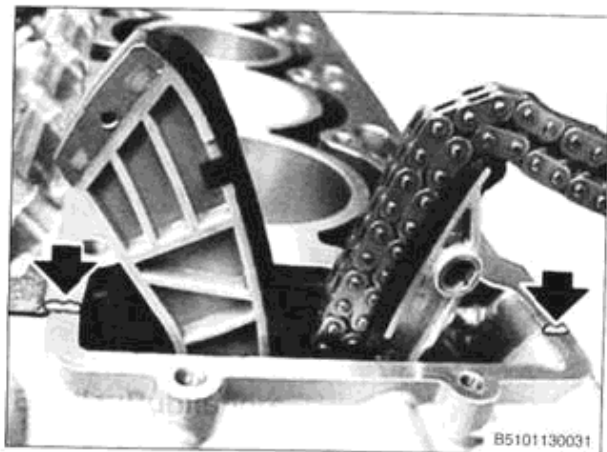
- Clean cylinder head and gasket surfaces of engine block and timing chain housing.

CAUTION—

- Remove foreign matter and liquid from bolt holes. Trapped oil or coolant in bolt holes can cause damage to the engine block.
- Do not use a metal scraper or wire brush to clean sealing surfaces. If necessary, use a hard wooden or plastic scraper. Also available are abrasive discs to be used in conjunction with an electric drill. Be sure to use the correct disc for the type of metal being cleaned.

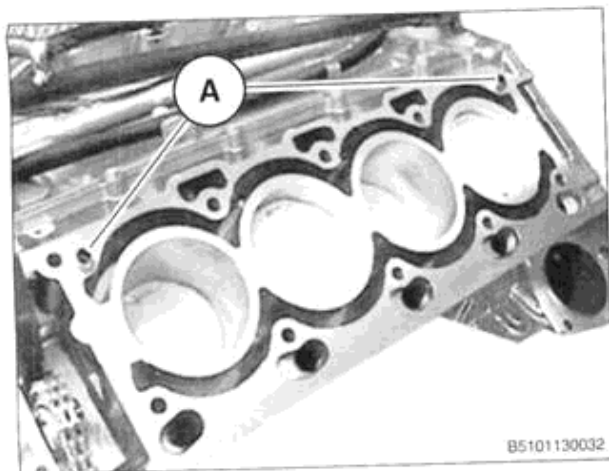
- Inspect cylinder head for visible cracks or other defects.

- Coat joint (arrows) between engine block and timing cover with 3-Bond 1209®.



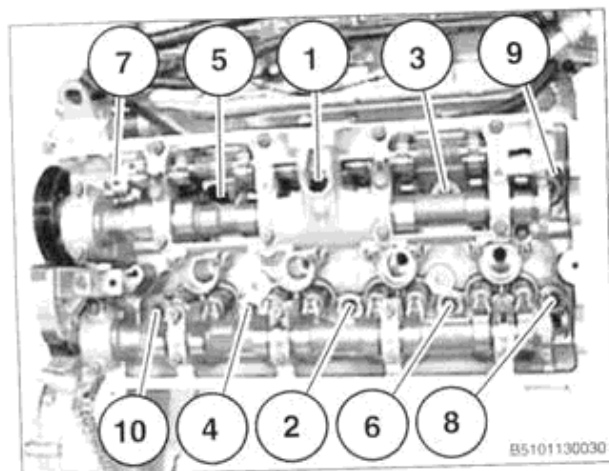
113-56 Cylinder Head Removal and Installation

Left cylinder head, installing (V8 engine)



◀ Inspect dowel sleeves (A) for damage, replace if necessary.

- Install new cylinder head gasket.
- Place cylinder head onto engine block, being careful not to damage cylinder head gasket.
- Install new cylinder head fasteners finger tight. Do not wash coating on new cylinder head fasteners.



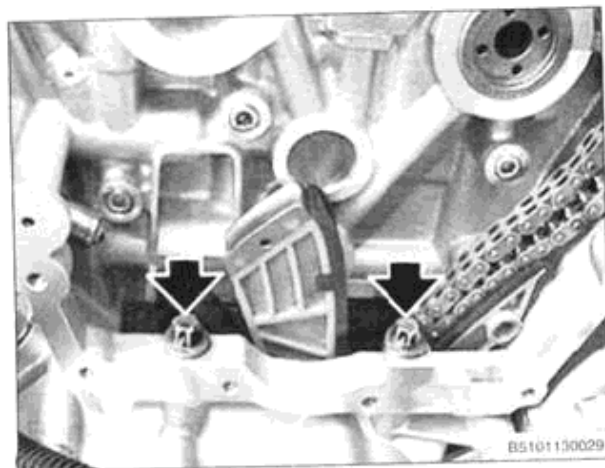
◀ Tighten cylinder head fasteners in sequence 1 - 10.

Tightening torques and sequence

Cylinder head to engine block:

- Stage 1: All bolts, 1 - 10
- Stage 2: All bolts, 1 - 10
- Stage 3: All bolts 1 - 10

30 Nm (22 ft-lb)
additional 90°
additional 90°



◀ Install and tighten cylinder head to timing cover fasteners (arrows).

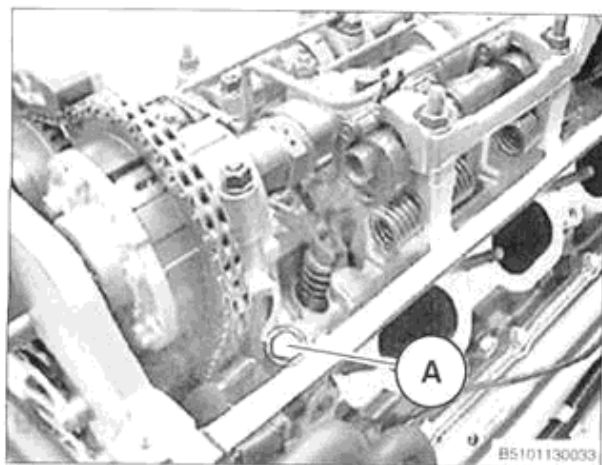
Tightening torques and sequence

Cylinder head to timing cover:

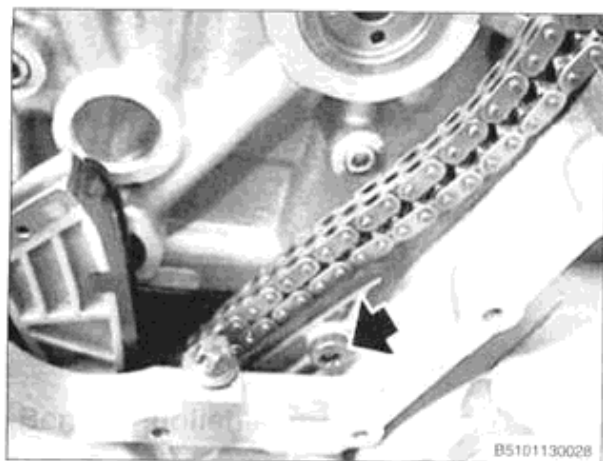
15 Nm (11 ft-lb)

Cylinder Head Removal and Installation 113-57

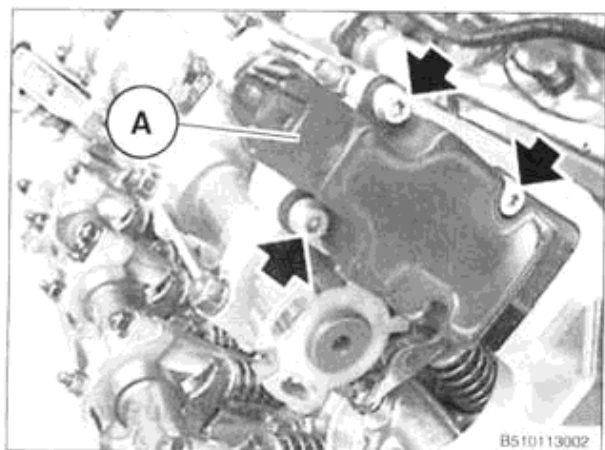
Left cylinder head, installing (V8 engine)



- ⚠ If replacing cylinder head, transfer screw plug (A) from old cylinder head to new. Failure to replace screw plug will result in a VANOS malfunction.



- ⚠ Install and tighten timing chain guide fastener (arrow).



- ⚠ Install eccentric shaft sensor (A) onto cylinder head and tighten eccentric shaft sensor fasteners (arrows).
- Install intake and exhaust camshaft adjustment (VANOS) units. See **117 Camshaft Timing Chain**.
 - Remainder of installation is reverse of removal. Remember to:
 - Remove camshaft and crankshaft locking tools.
 - Assemble cylinder head cover with new gasket.
 - Reattach and tighten any ground cables removed.
 - Reassemble fuel rail using new O-ring seals.
 - Change engine oil and filter. See **020 Maintenance**.
 - Fill and bleed cooling system. See **170 Radiator and Cooling System**.



