

113-20 Cylinder Head Removal and Installation

Cylinder Head Removal and Installation (Cooper S)

CYLINDER HEAD REMOVAL AND INSTALLATION (COOPER S)

Cylinder head removal and installation is a complicated job and requires special tools.

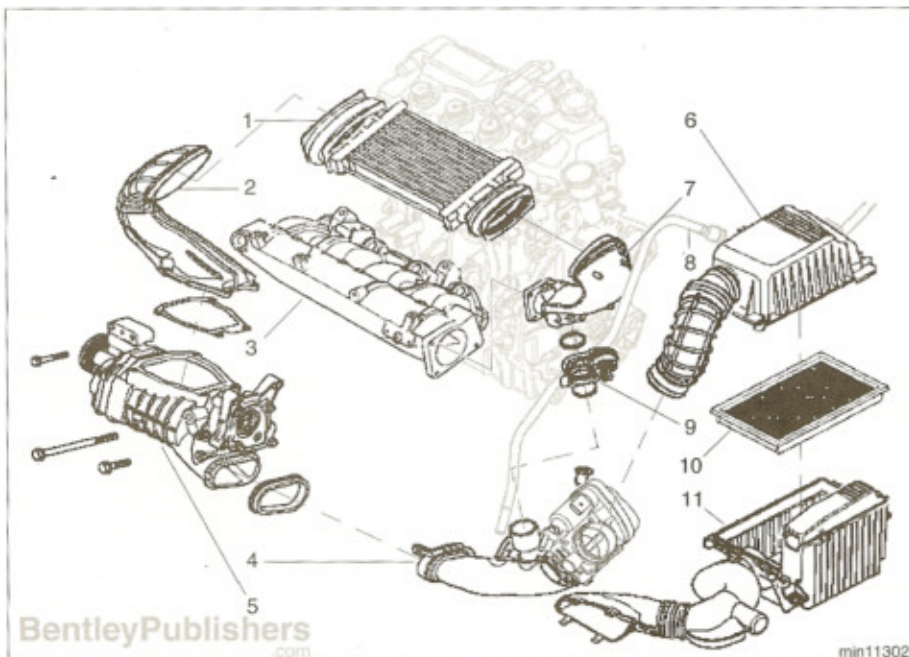
The job has been divided up into several procedures. Read the procedures before beginning the repair. If necessary, refer to **Cooper S air intake components** graphic for component locations.

WARNING—

Due to risk of personal injury, be sure the engine is cold before beginning any of the procedures.

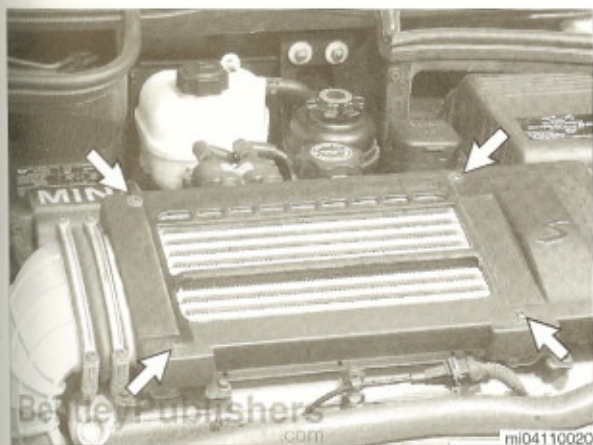
CAUTION—

Cover all painted surfaces before beginning the removal procedure. As an aid to installation, label all components, wires, and hoses before removing them. Do not reuse gaskets, O-rings or seals during reassembly.



Cooper S air intake components

1. Intercooler
2. Supercharger output air duct
3. Intake manifold
4. Supercharger intake air duct with throttle housing
5. Supercharger
6. Air filter cover
7. Intercooler output air duct
8. Brake booster vacuum hose
9. Air intake bypass valve
10. Air filter element
11. Air filter housing

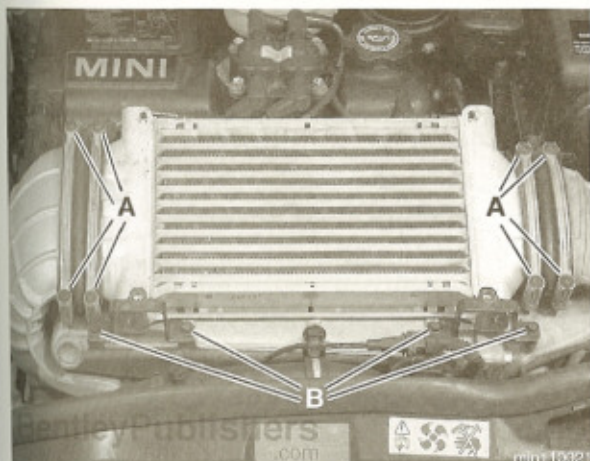


Intercooler, removing and installing

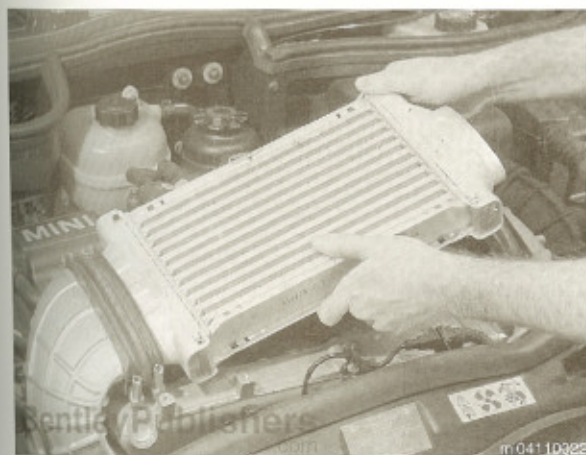
- Make sure ignition is OFF.
- Remove intercooler cover retaining screws (arrows). Remove cover.

CAUTION—

Intercooler fins are easily damaged. Be careful working on or around intercooler. Use intercooler protector (BMW special tool 11 8 480) when working in the engine compartment.



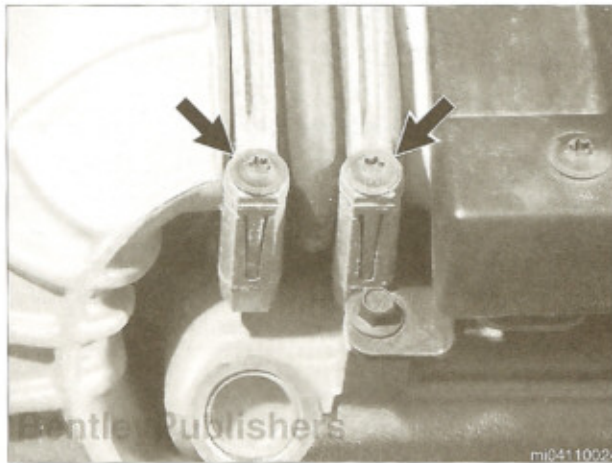
- Remove intercooler sealing bellows clamping bolts (A). Remove upper clamps.
- Remove intercooler cover mounting bracket bolts (B). Remove brackets.



- Detach sealing bellows and tilt intercooler to right to remove.

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- Before reinstalling intercooler, check intercooler sealing bellows splits or cracks. Replace if necessary.

- ◀ Note positioning of intercooler sealing bellows clamps with bolt heads (**arrows**) pointing up.

CAUTION—

Make sure sealing bellows are clean, dry and correctly located. Do not lubricate.

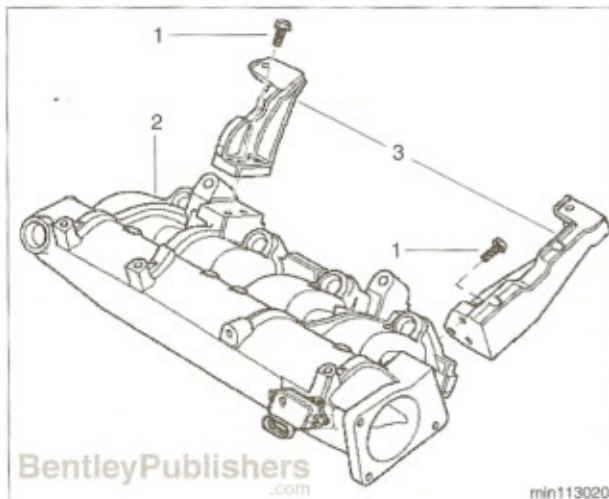
- Remainder of intercooler installation is reverse of removal.

Tightening torques

Intercooler cover to intercooler	9 Nm (7 ft-lb)
Intercooler cover bracket to intercooler	9 Nm (7 ft-lb)
Upper sealing bellows clamp to lower clamp	9 Nm (7 ft-lb)

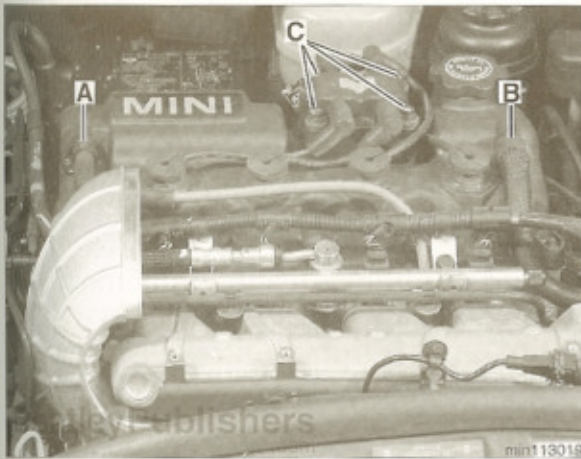
Valve cover, removing and installing (Cooper S)

- Make sure ignition is OFF.
- Remove intercooler. See **Intercooler, removing and installing** this repair group.
- ◀ Remove left and right intercooler bracket mounting bolts from intake manifold. Remove brackets.
 1. Intercooler bracket mounting bolt, M6 -tighten to 9 Nm (7 ft-lb)
 2. Intake manifold
 3. Intercooler mounting brackets

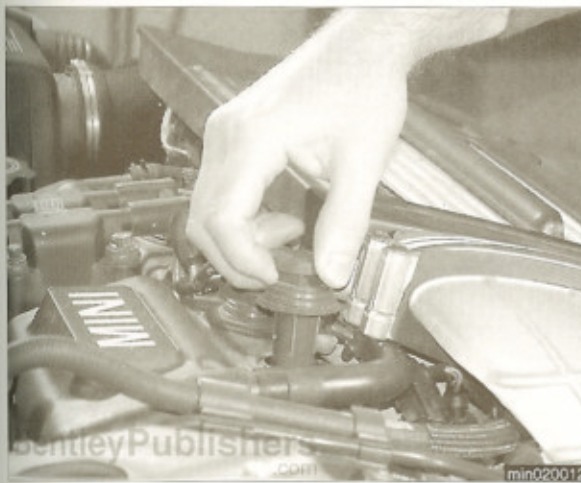


- ◀ Working at top of valve cover, disconnect electrical harness connector to ignition coil pack.
 - Press securing clip in direction of **white arrow**.
 - Pull off coil pack connector in direction of **black arrow**.

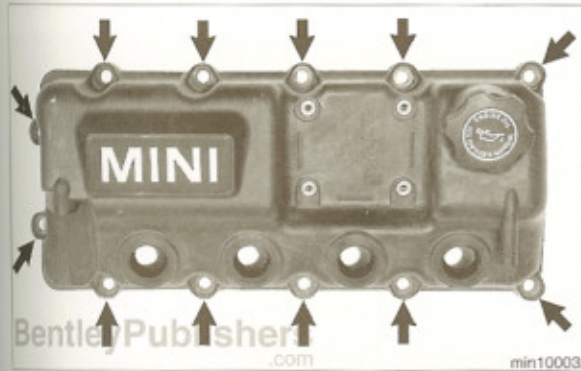
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- Working at top of engine:
- Disconnect crankcase ventilation hoses (A, B).
 - Remove coil pack mounting bolts (C).



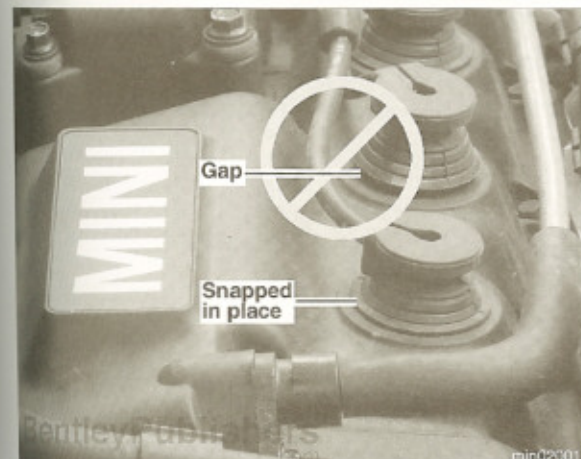
- Pull up on each spark plug wire connector while gently twisting from side to side.
- Remove harness clips from valve cover studs.
 - Remove coil pack and spark plug wires from valve cover.



- Remove 12 valve cover bolts (arrows).
- Remove valve cover.
 - Valve cover installation is reverse of removal. Note the following:
 - Replace valve cover gasket.
 - Replace spark plug hole sealing grommets in valve cover.
 - Clean gasket mating faces. Coat lightly with oil.
 - Replace valve cover mounting bolts or insulators if damaged.
 - Tighten valve cover mounting bolts in sequence, from inside to outside.
 - Inspect ignition coil pack insulators. Replace if damaged.

Tightening torques

Valve cover to cylinder head (M6)	12 Nm (9 ft-lb)
Ignition coil pack to valve cover (M6)	12 Nm (9 ft-lb)



- When reinstalling ignition wires, make sure that they snap securely into place.

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Cylinder Head Removal and Installation (Cooper S)

- Reinstall left and right intercooler brackets on intake manifold.

Tightening torque

Intercooler bracket to intake manifold (M6)	9 Nm (7 ft-lb)
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- Reinstall intercooler.

Intake manifold, removing and installing (Cooper S)

- Working in cargo compartment, lift floor trim cover. Disconnect negative (-) cable from battery. See **121 Battery, Starter, Alternator** for more information.

CAUTION —

Disconnecting the battery may erase fault code(s) stored in memory. Check for fault codes prior to disconnecting the battery cables.

- Remove intercooler. See **Intercooler, removing and installing** in this repair group.



Detach air filter housing from throttle housing:

- Pull up on battery positive connection point (Batt+) (arrows) to release from right side of air filter housing.
- Loosen or remove hose clamp (A) and detach outlet duct from air filter housing.
- Remove air filter housing retaining bolt (B).

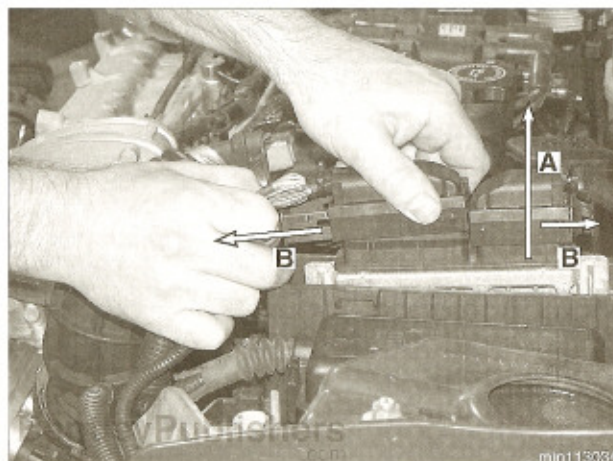


Remove DME control module:

- Remove control module container cover and lift control unit upward (A).
- Pull connector locking sliders outward (B).
- Disconnect control module connectors.
- Place control module in safe storage location.

NOTE —

There are 2 control module harness connectors.



Cylinder Head Removal and Installation (Cooper S)



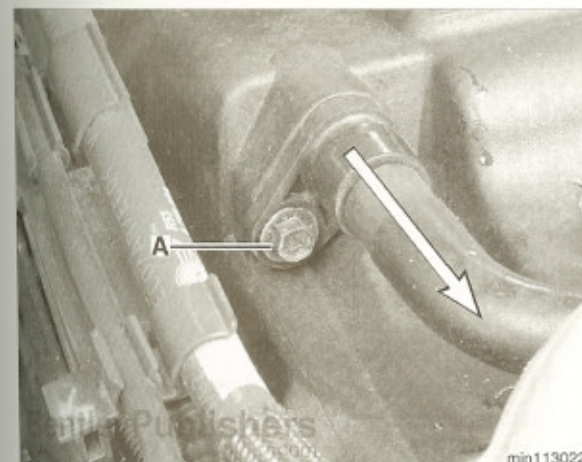
◀ Unclip air filter inlet duct from modular front end. Wriggle duct while pulling it toward front of car to detach from air filter housing.

— Remove air filter housing from engine compartment.



◀ Remove throttle valve assembly:

- Loosen or remove air duct clamp at throttle assembly. Detach air duct (A).
- Disconnect electrical harness connector (B).
- Detach fuel tank vent line (B).
- Loosen and remove throttle assembly mounting screws.
- Lift throttle assembly off supercharger intake duct.



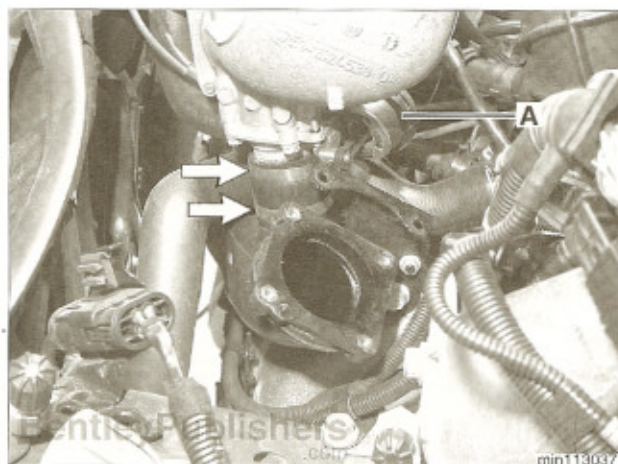
◀ Working at top right of valve cover, remove PCV valve and hose:

- Remove valve retaining screw (arrow).
- Pull valve out of valve cover.

— Detach crankcase ventilation hose from left end of valve cover.

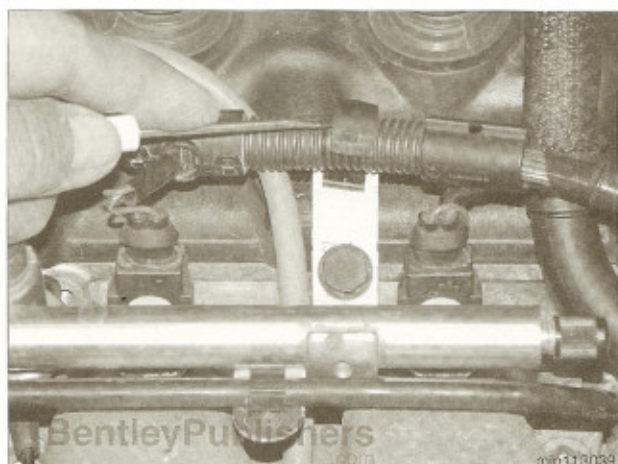
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Cylinder Head Removal and Installation (Cooper S)



◀ Working below left end of intake manifold, loosen or remove hose clamps (**arrows**) from air intake bypass hose. Detach hose from air bypass valve (**A**).

- Detach knock sensor electrical harness connector from fuel rail wiring harness.
- Detach electrical harness connectors from intake manifold.



◀ Unhook fuel injector electrical harness from fuel rail mounting brackets.

- Disconnect top fuel tank vent line and unclip at fuel rail.

WARNING —

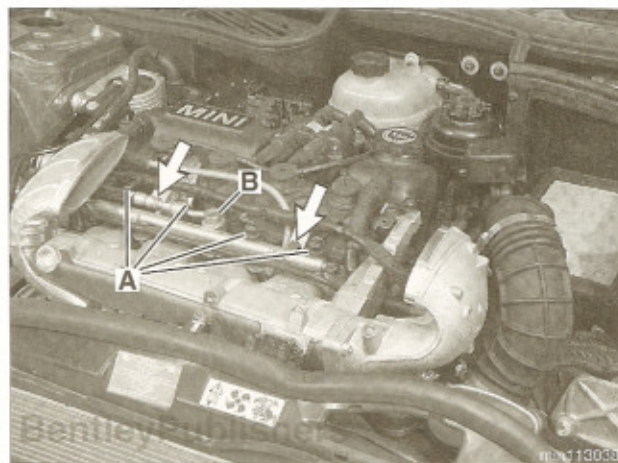
- If disconnecting fuel line, fuel will be expelled under pressure. Loosen fuel filler cap to release fuel tank pressure.
- Do not smoke or work near heaters or other fire hazards.
- Keep a fire extinguisher handy.
- Before disconnecting fuel hose, wrap a cloth around hose to absorb any leaking fuel.
- Plug all open fuel connections.

CAUTION —

Do not allow fuel to drip on alternator.

NOTE —

- Follow the procedure below to avoid disconnecting the fuel hose from the fuel rail.
- If it becomes necessary to disconnect the fuel hose from the fuel rail, follow the procedure in **130 Fuel Injection**. Be sure to read the warnings and cautions regarding working with fuel.



◀ Detach fuel rail from top of engine:

- Disconnect fuel injector electrical harness connectors (**A**).
- Working at fuel rail, unclip hoses and ducts. Cut wire ties as needed.
- Disconnect vacuum line at base of fuel pressure regulator (**B**).
- Remove fuel rail mounting bolts (**arrows**).

CAUTION —

Use compressed air to blow away accumulated debris at the base of each fuel injector.

Cylinder Head Removal and Installation (Cooper S)

- Remove fuel rail together with fuel injectors from intake manifold.
 - Unclip fuel line from engine vibration damper bracket.
 - Carefully fold fuel hose to right and rear of engine. Protect fuel rail and injectors by storing in plastic bag.

CAUTION—

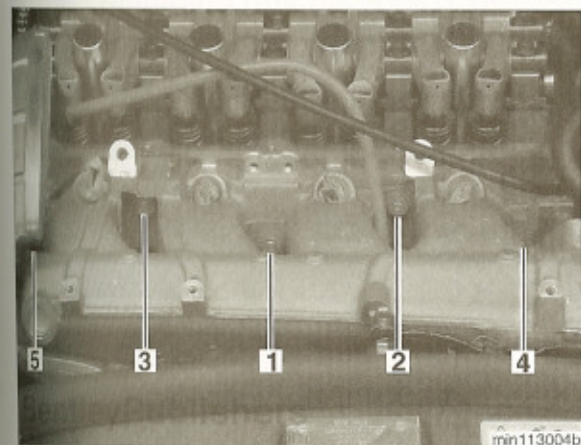
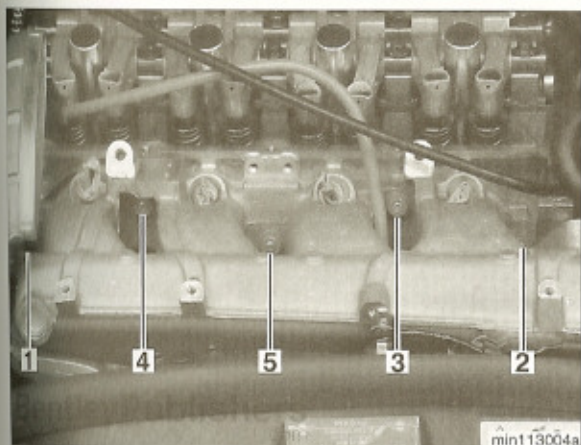
Plug fuel injector bores in intake manifold.

- Detach radiator upper hose support clamp from intake manifold.
- Remove intake manifold mounting nuts in sequence, working from outside to inside (1 to 5). Remove manifold.

CAUTION—

Stuff clean rags in cylinder head intake ports.

- When reinstalling intake manifold, replace intake manifold gasket.



- Tighten down intake manifold mounting bolts in sequence, working from inside to outside (1 - 5).

Tightening torque

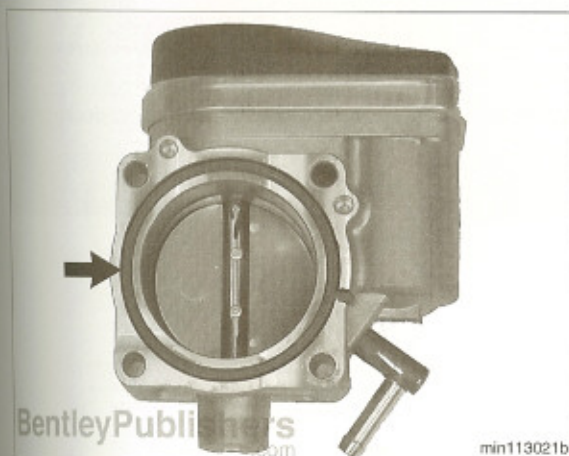
Intake manifold to cylinder head (M8)	26 Nm (19 ft-lb)
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- When reinstalling fuel rail, coat fuel injector sealing O-rings with anti-seize agent.

Tightening torque

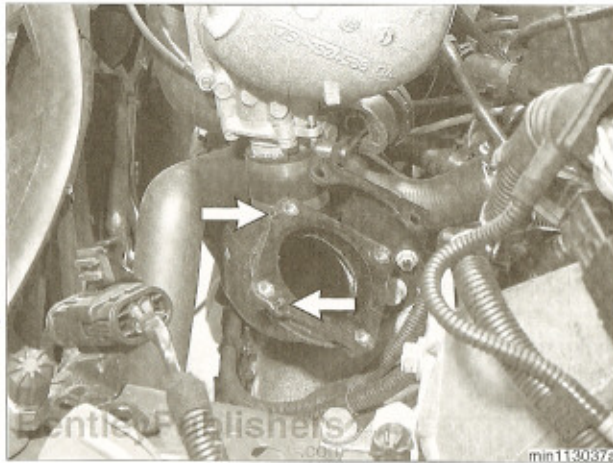
Fuel rail to intake manifold (M8)	25 Nm (18 ft-lb)
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- When reinstalling throttle valve assembly, replace sealing O-ring (arrow).



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Cylinder Head Removal and Installation (Cooper S)



- Make sure locating pins (**arrows**) on supercharger intake duct align with corresponding bores on throttle valve assembly. Check locating pins for damage. Replace if necessary.

Tightening torque

Throttle valve assembly to supercharger intake duct (M6)	9 Nm (7 ft-lb)
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- Reinstall air filter housing.

Tightening torque

Air filter housing to body (M6)	7 - 10 Nm (5 - 7 ft-lb)
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- Reinstall ECM and attach connectors.
- Reattach air duct using new clamps.
- Reinstall intercooler.

NOTE—

If throttle valve assembly is replaced, be sure to reset DME control unit adaptation values using BMW scan tool.

Cylinder head, removing and installing (Cooper S)

- Working in cargo compartment, lift floor trim cover. Disconnect negative (-) cable from battery. See **121 Battery, Starter, Alternator** for more information.

CAUTION—

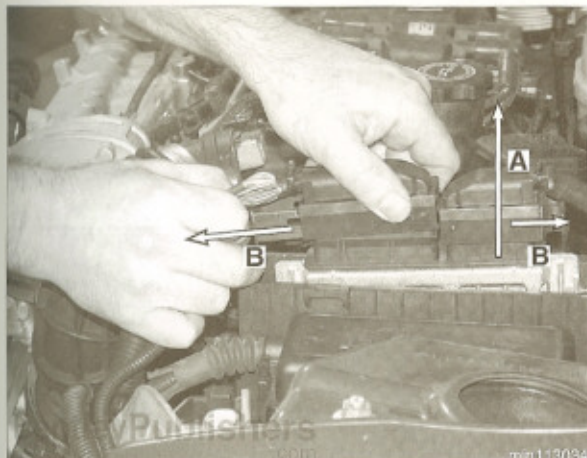
Disconnecting the battery may erase fault code(s) stored in memory. Check for fault codes prior to disconnecting the battery cables.

- Remove intercooler. See **Intercooler, removing and installing** in this repair group.

- Detach air filter housing from throttle housing:
 - Pull up on battery positive connection point (Batt+) (**arrows**) to release from right side of air filter housing.
 - Loosen or remove hose clamp (**A**) and detach outlet duct from air filter housing.
 - Remove air filter housing retaining bolt (**B**).



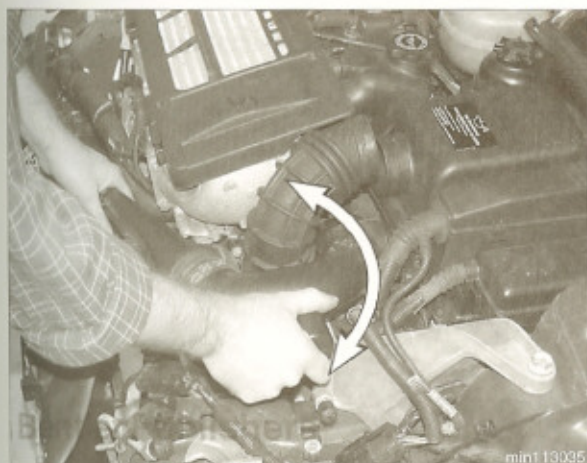
Cylinder Head Removal and Installation (Cooper S)



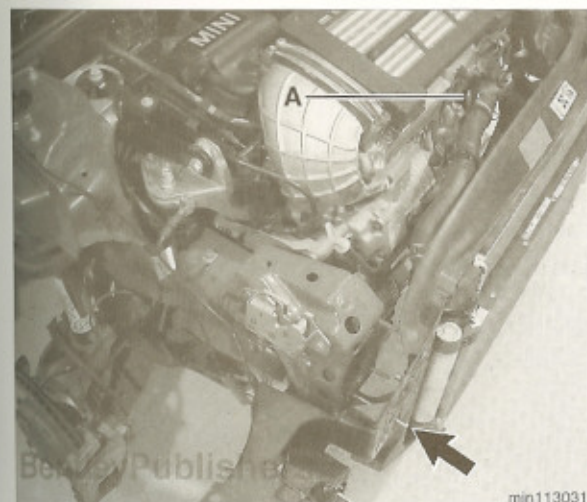
- Remove DME control module:
 - Remove control module container cover and lift control unit upward (A).
 - Pull connector locking sliders outward (B).
 - Disconnect control module connectors.
 - Place control module in safe storage location.

NOTE—

There are 2 control module harness connectors.



- Unclip air filter inlet duct from modular front end. Wiggle duct while pulling it toward front of car to detach from air filter housing.
- Remove air filter housing from engine compartment.
- Drain coolant. Begin by releasing pressure at coolant reservoir cap. See 170 Cooling System.



- Loosen modular front end (MFE):
 - Remove right front wheel housing liner.
 - Detach left front wheel housing liner from front bumper cover trim.
 - Remove front bumper cover trim.
 - Remove bumper.
 - Detach radiator upper hose support clamp (A) from intake manifold.
 - Remove MFE mounting bolts. Install two 100 mm (4 in) M8 bolts (arrow) in left and right bumper support members. Slide MFE forward, supported on long bolts.

CAUTION—

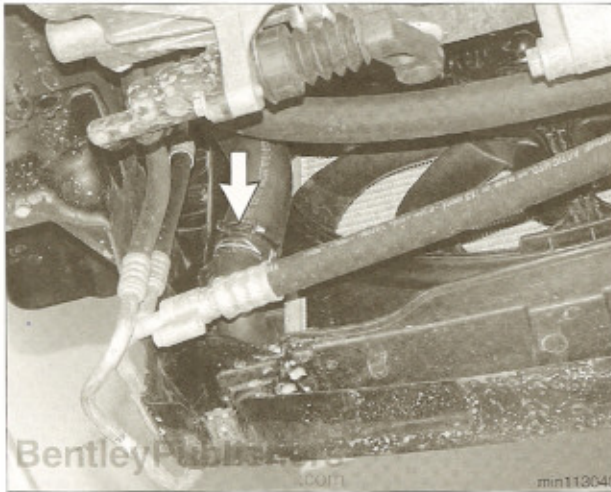
For ease of component alignment when reassembling front bumper assembly, do not loosen or remove bumper alignment bosses.

NOTE—

- If available, use BMW special tools 11 8 401 and 11 8 402 instead of long bolts to support MFE.
- Removal of MFE is a complicated job. It is covered in 510 Bumpers, External Trim.

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Cylinder Head Removal and Installation (Cooper S)



- ◀ Working below left side of engine compartment, loosen or remove lower radiator hose clamp (**arrow**). Detach hose from radiator.

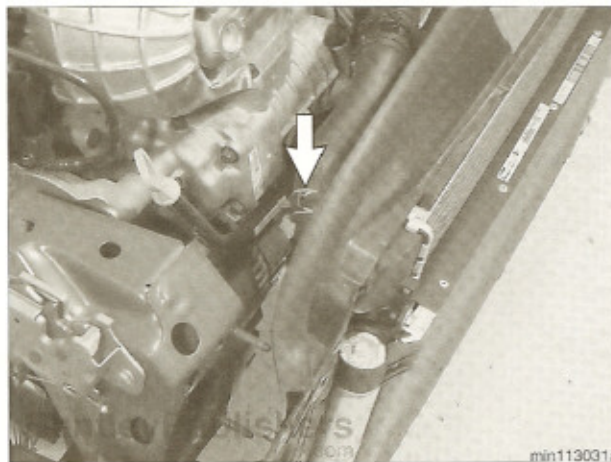
- Allow coolant to drain into suitable catch pan.

NOTE—

Save coolant and reuse, or dispose of properly.

WARNING—

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.

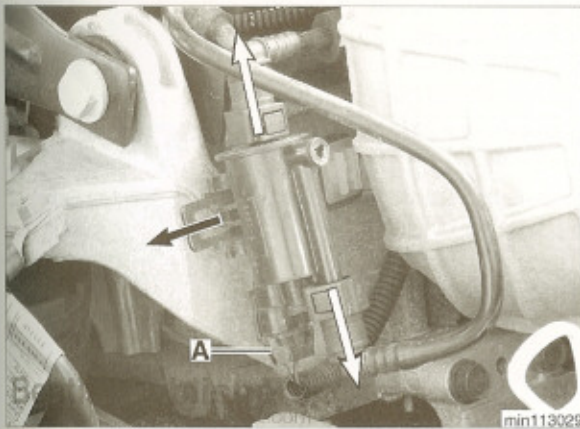


- ◀ Loosen or remove upper radiator hose clamp (**arrow**). Detach hose from radiator.



- ◀ Remove throttle valve assembly:
 - Loosen or remove air duct clamp at throttle assembly. Detach air duct (**A**).
 - Disconnect electrical harness connector (**B**).
 - Detach fuel tank vent line (**C**).
 - Loosen and remove throttle assembly mounting screws.
 - Lift throttle assembly off supercharger intake duct.
- Remove valve cover. See **Valve cover, removing and installing (Cooper S)** in this repair group.

Cylinder Head Removal and Installation (Cooper S)



- ◀ Remove fuel tank vent valve.
 - Disconnect vent hoses (**white arrows**) via quick fit connectors.
 - Straighten retaining tab and slide vent valve off bracket (**black arrow**).
 - Remove electrical harness connector (**A**).
- Remove intake manifold. See **Intake manifold, removing and installing (Cooper S)** in this repair group.
 - Detach brake booster vacuum line.
 - Remove fuel rail together with fuel injectors from intake manifold.
 - Unclip fuel line from engine vibration damper bracket.
 - Carefully fold fuel hose to right and rear of engine. Protect fuel rail and injectors by storing in plastic bag.
 - Unbolt and remove intake manifold.

WARNING—

- If disconnecting fuel line, fuel will be expelled under pressure. Loosen fuel filler cap to release fuel tank pressure.
- Do not smoke or work near heaters or other fire hazards.
- Keep a fire extinguisher handy.
- Before disconnecting fuel hose, wrap a cloth around hose to absorb any leaking fuel.
- Plug all open fuel connections.

CAUTION—

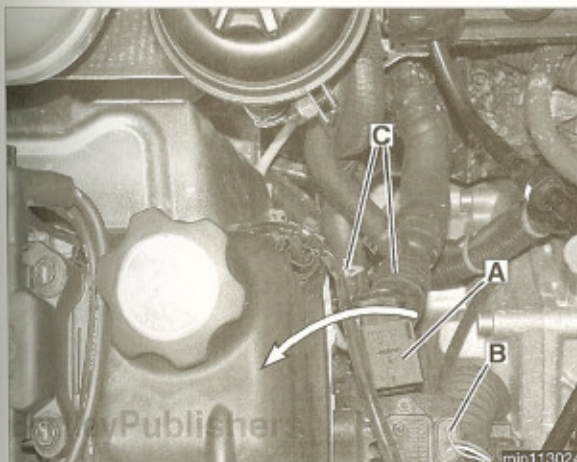
Do not allow fuel to drip on alternator.

NOTE—

- If the procedure for removing the fuel rail in **Intake manifold, removing and installing (Cooper S)** is followed, there is no need to disconnect the fuel hose from the fuel rail.
- If it becomes necessary to disconnect the fuel hose from the fuel rail, follow the procedure in **130 Fuel Injection**. Be sure to read the warnings and cautions regarding working with fuel.

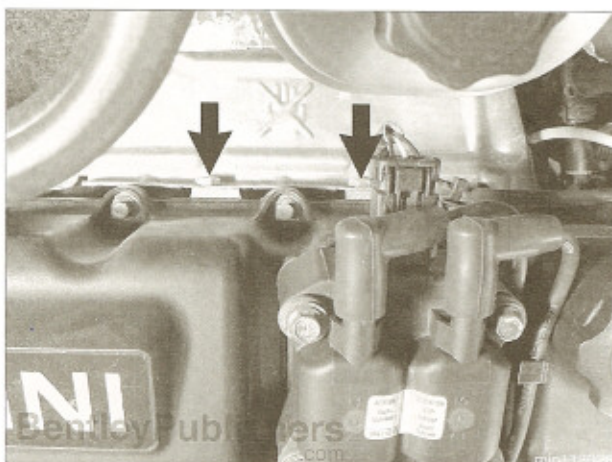
- Remove supercharger outlet pipe.

- ◀ Working at left end of cylinder head:
 - Disconnect oxygen sensor connector (**A**). Twist in direction of **arrow** to detach from support bracket.
 - Disconnect MAP sensor connector (**B**).
 - Loosen coolant hose clamps (**C**) and detach hoses from coolant manifold.



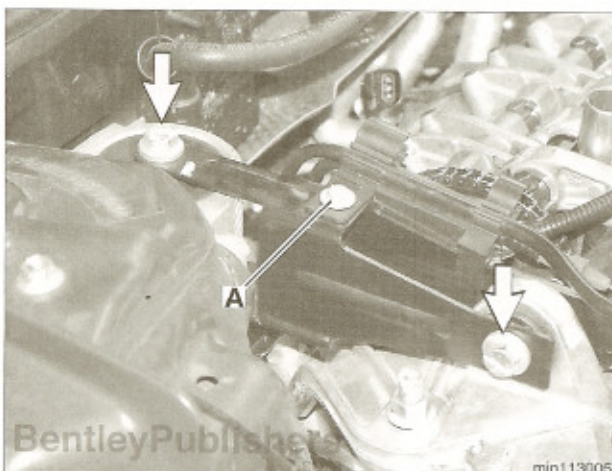
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Cylinder Head Removal and Installation (Cooper S)



Working in back of cylinder head, remove exhaust manifold heat shield fasteners (**arrows**).

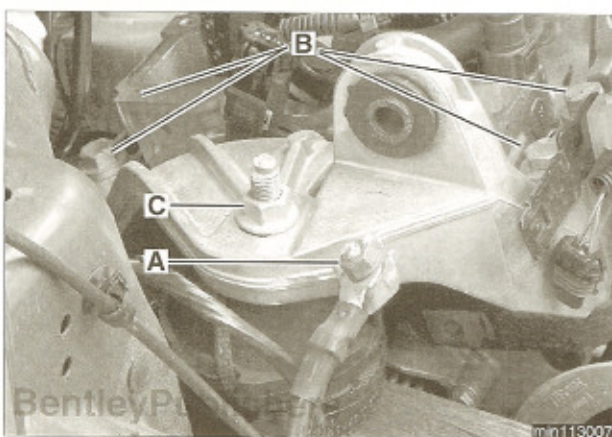
- Unbolt exhaust manifold from cylinder head:
 - Working underneath car, detach oxygen sensor harness connectors.
 - Detach exhaust system from exhaust manifold. See **180 Exhaust System**.
- Remove spark plugs.



- Remove engine vibration damper bracket:
 - Remove fuel line bracket mounting bolt (**A**). Detach any fuel lines still attached. Lift off bracket and set aside.
 - Remove engine vibration damper bracket bolts (**arrows**).
 - Remove bracket.
- Support engine under oil pan.

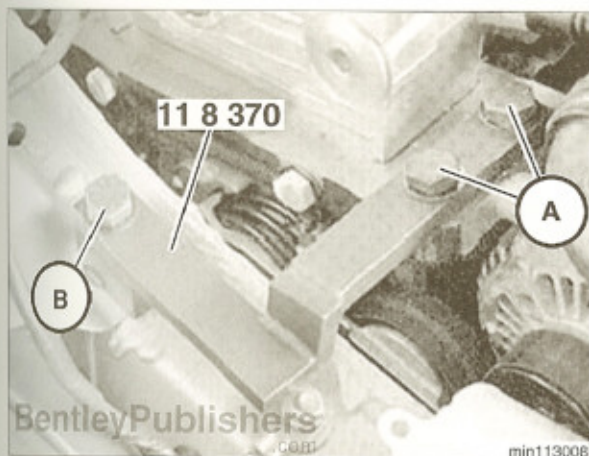
CAUTION—

To avoid damaging the oil pan, use a rubber pad on top of the engine supporting jack.

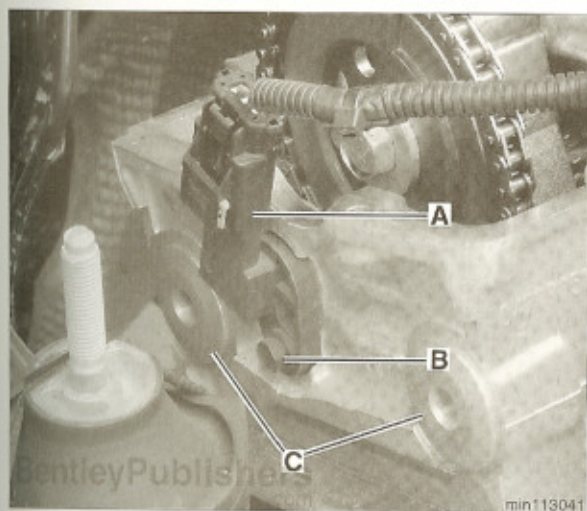


- Remove engine mounting bracket:
 - Remove engine ground cable mounting nut (**A**) from bracket. Detach ground cable.
 - Remove 4 engine mounting bolts (**B**) from engine block.
 - Unscrew mounting nut (**C**) from hydraulic front engine mount stud. Lift off engine mount bracket.
- Use special tool 11 8 380 to remove hydraulic engine mount. Counterhold Torx head mounting bolt from below.

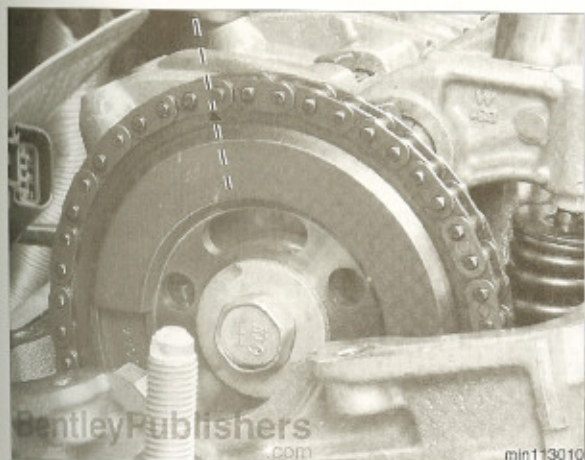
Cylinder Head Removal and Installation (Cooper S)



- ◀ Use BMW special tool 11 8 370 to support engine.
 - Attach tool to cylinder head using engine mount bracket bolts (A).
 - Use bolt (B) or long stud to secure tool to frame extension.
- Remove jack from underneath engine oil pan.



- ◀ Working at right end of cylinder head:
 - Disconnect electrical harness connector (A) at camshaft position sensor.
 - Remove sensor mounting bolt (B).
 - Remove sensor from cylinder head.
 - Remove threaded plugs (C) from cylinder head.



- ◀ Rotate crankshaft until triangular adjustment mark on camshaft sprocket (dashed line) is at 12 o'clock.

CAUTION—

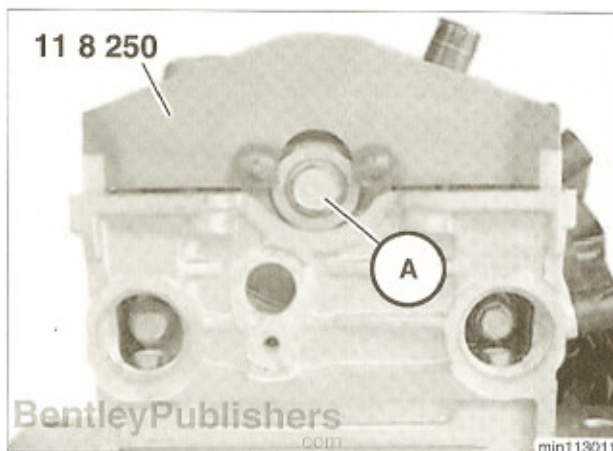
- For ease of assembly, mark timing chain at triangular adjustment mark (B) with paint.
- Mark crankshaft vibration damper and timing case cover with paint.

NOTE—

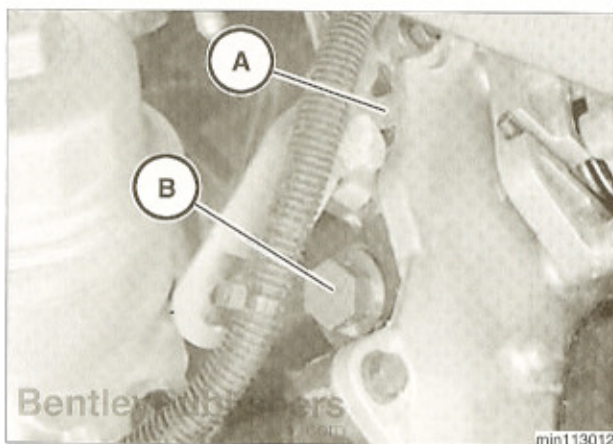
- Because the engine is tilted slightly toward the back of the car, 12 o'clock on the camshaft sprocket and crankshaft vibration damper is NOT straight up and down.
- The brass-colored timing chain links are of no importance to the timing.

113-34 Cylinder Head Removal and Installation

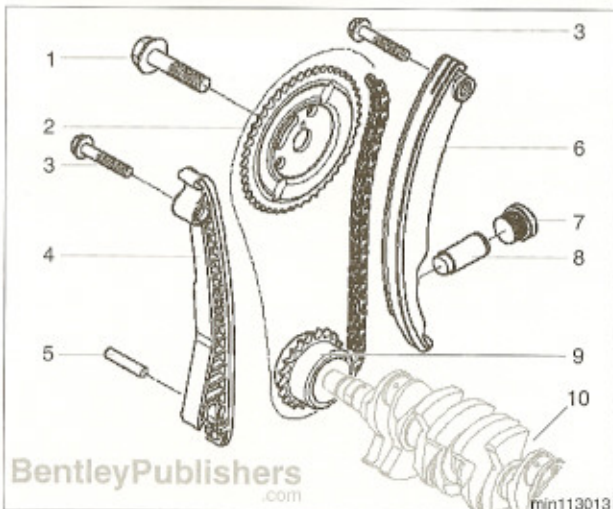
Cylinder Head Removal and Installation (Cooper S)



- ◀ Attach BMW special tool 11 8 250 to camshaft sprocket. Loosen but do not remove camshaft sprocket bolt (A).

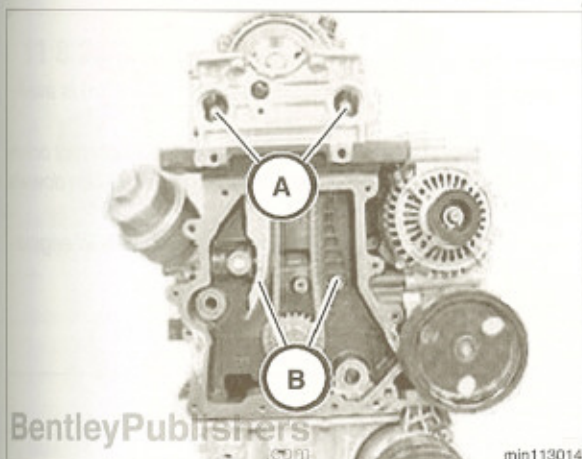


- ◀ Working in back of engine block, remove wiring harness bracket (A).
- Loosen and remove timing chain tensioner plug (B). Remove tensioner plunger from inside timing chain housing cover.



- ◀ Timing chain components:
 1. Bolt, M12
-tighten to 102 Nm (75 ft-lb)
 2. Camshaft sprocket
 3. Bolt, M8
-tighten to 28 Nm (21 ft-lb)
 4. Timing chain fixed guide
 5. Stud
 6. Timing chain tensioning guide
 7. Timing chain tensioner plug with sealing O-ring
 8. Timing chain tensioner plunger
 9. Crankshaft sprocket
 10. Crankshaft

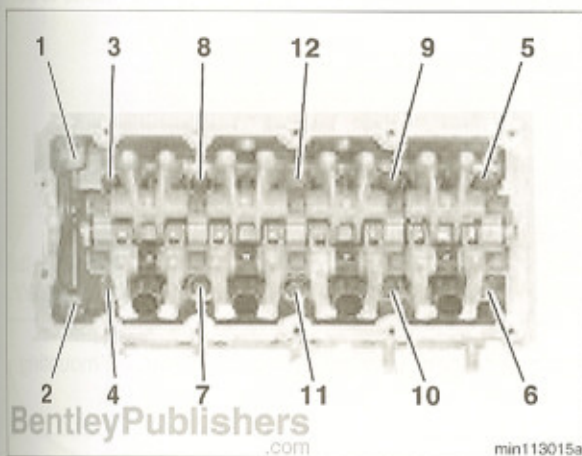
Cylinder Head Removal and Installation (Cooper S)



- ◀ Detach timing chain from camshaft:
 - Unscrew camshaft sprocket bolt.
 - Remove camshaft sprocket from timing chain and secure timing chain to prevent it from dropping down.
 - Remove timing chain fixed and tensioning guide mounting bolts (A and B).
 - Pull timing chain guides up out of timing chain housing.

CAUTION—

Do not rotate crankshaft. The timing chain cover is designed in such a way that the timing chain can remain on the crankshaft gear without gear teeth being skipped, as long as the crankshaft remains stationary.



- ◀ Remove cylinder head to timing chain housing mounting bolts 1 and 2.
- Loosen and remove cylinder head bolts 3 to 12, working from outside to inside. Discard bolts.
- Lift cylinder head off engine block.

CAUTION—

When placing cylinder head on work bench, do not rest on sealing surface. There is risk of damage to valves.

- Clean cylinder head and engine block mating surfaces.

CAUTION—

- Multilayer steel cylinder head gasket (MLS) requires scratch-free sealing surfaces.
- 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.

- Use straight edge to check diagonal and horizontal surface evenness of cylinder head.

Cylinder head distortion specification	
Maximum warpage allowed	0.1 mm (0.004 in)

- Clean engine block oil ducts.
- Check aligning dowel sleeves in engine block for damage. Replace if necessary.
- Thoroughly clean oil and coolant out of cylinder head bolt tapped holes in engine block. If necessary, clean out holes with compressed air.
- Replace cylinder head gasket.

113-36 Cylinder Head Removal and Installation

Cylinder Head Removal and Installation (Cooper S)

NOTE—

- The standard thickness of the cylinder head gasket is 0.65 mm (0.026 in). A thicker one of 0.95 mm (0.037in) is available.
- The gasket does not have any markings to indicate correct orientation. This is determined by visually lining up the location dowels and oil transfer gallery.
- Larger holes in head gasket slip over location dowels in engine block.

- Reinstall cylinder head. Insert new cylinder head bolts.

CAUTION—

Do not wash off coating on new bolts.

- ⚠ Tighten head bolts in sequence 1 to 10, working from inside to outside.

- Head bolt are tightened in 2 stages.
- Final (stage 2) torque is applied with special tool 00 9 120 or equivalent protractor.

Tightening torque

Cylinder head to engine block (use new)(M10):	40 Nm (30 ft-lb) rotate 90°
Stage 1	
Stage 2	

- Install and torque cylinder head to timing chain housing mounting bolts 11 and 12.

Tightening torque

Cylinder head to timing chain housing (M8)	28 Nm (21 ft-lb)
--------------------------------------------	------------------

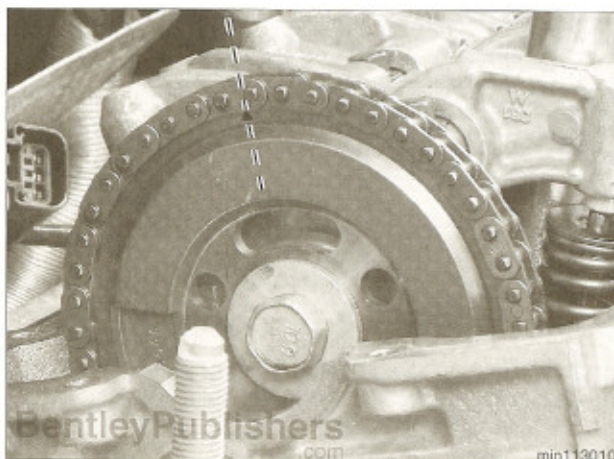
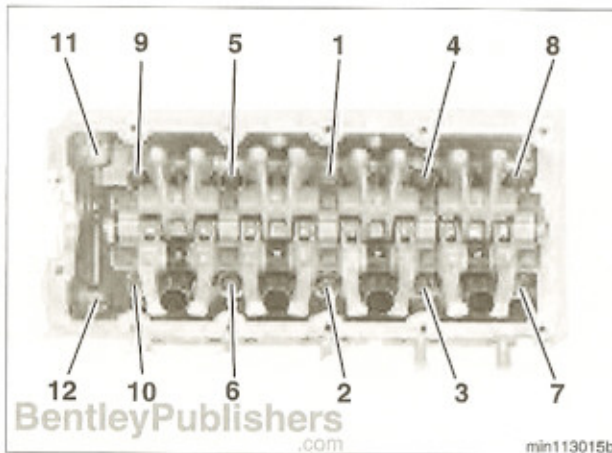
- Slide timing chain guides down into chain housing and reinstall mounting screws.

Tightening torque

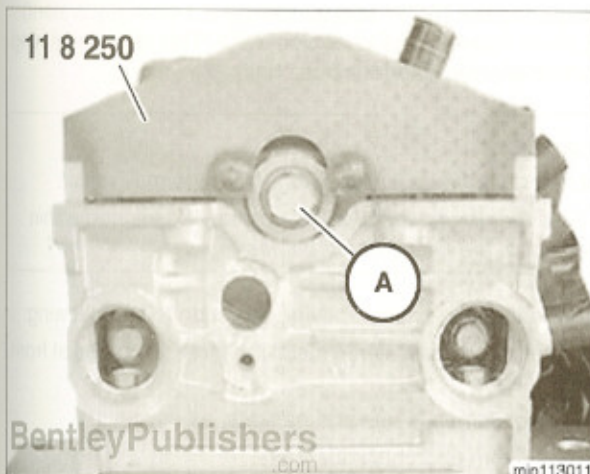
Timing chain guide to cylinder head (M8)	28 Nm (21 ft-lb)
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- ⚠ Place timing chain on camshaft sprocket. Use previously made paint mark to align sprocket and timing chain to each other.

- Place sprocket on camshaft and insert mounting bolt.



Cylinder Head Removal and Installation (Cooper S)



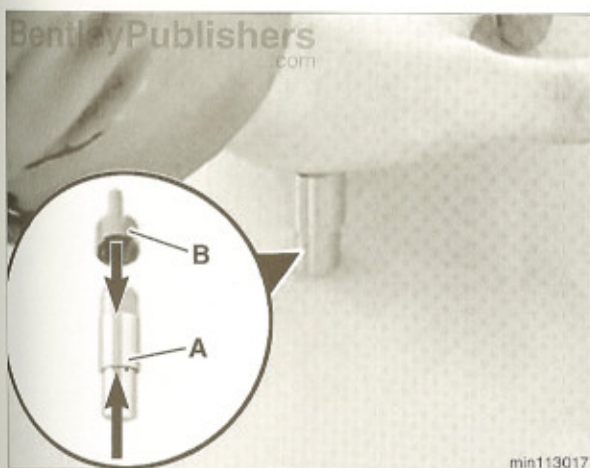
- Attach BMW special tool 11 8 250 to camshaft sprocket. Torque camshaft sprocket bolt (A).

CAUTION—

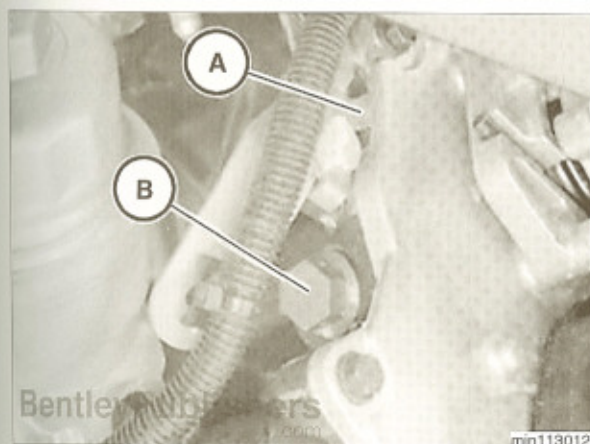
Be careful not to damage timing chain during this step.

Tightening torque

Camshaft sprocket to camshaft (M12)	102 Nm (75 ft-lb)
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- Squeeze timing chain tensioner plunger into retracted position.
 - Place plunger (A) on level surface.
 - Remove plunger cap (B).
 - Exert continuous hand pressure on plunger until it is completely compressed.
 - Replace cap.



- Working in back of engine block, install timing chain tensioner plunger. Install tensioner plug (B).

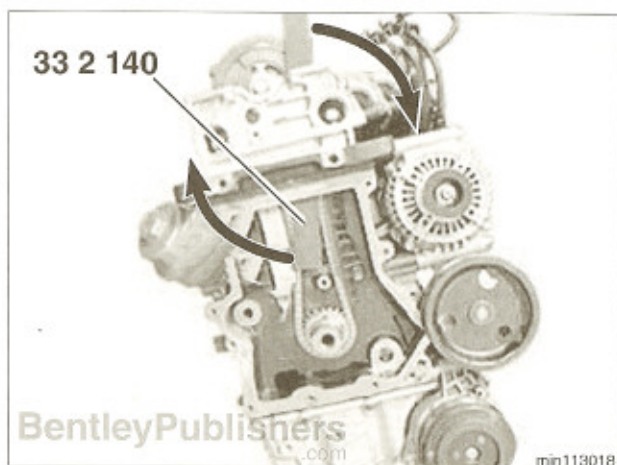
Tightening torque

Timing chain tensioner to engine block	63 Nm (46 ft-lb)
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- Install wiring harness bracket in back of engine block (A).

113-38 Cylinder Head Removal and Installation

Cylinder Head Removal and Installation (Cooper S)



- ◀ Insert large prying bar (BMW special tool 33 2 140 or equivalent) into timing chain housing and lever clockwise. This releases timing chain tensioner plunger and tensions chain.

CAUTION—

- Do not lever directly at timing chain. Damage may result.
- Make sure that the timing chain is properly positioned within the channel of the timing chain guides.

- Continue to reassemble engine, paying attention to the following:
 - Use new sealing washers when installing threaded plugs at front of cylinder head.
 - Use new hose clamps, seals and gaskets, as necessary.
 - Fill cooling system and check for leaks.
 - Fill engine with fresh oil.
 - Check DME control module adaptations using diagnostic scan tool. Check for fault codes and clear and reset control module memory.

Cylinder Head Removal and Installation 113-39

Cylinder Head Removal and Installation (Cooper S)

Tightening torques	
Air filter housing to body (M6)	7 - 10 Nm (5 - 7 ft-lb)
Battery cable (- or +) to battery (M6)	5 Nm (44 in-lb)
Camshaft position sensor to cylinder head (M6)	9 Nm (7 ft-lb)
Crush tube to subframe (M12 x 1.5 x 85 mm)	100 Nm (74 ft-lb)
Engine front mounting bracket to top of engine block (M12)	100 Nm (74 ft-lb)
Engine splash shield to modular front end (M6 x 16 mm)	6 Nm (53 in-lb)
Exhaust manifold to cylinder head (M8)	24 Nm (18 ft-lb)
Exhaust manifold heat shield to cylinder head (M8)	13 Nm (10 ft-lb)
Front bumper to crush tube or to bumper carrier (M8 x 30 mm)	22 Nm (16 ft-lb)
Front bumper to modular front end (M6 x 16 mm)	5 Nm (44 in-lb)
Hydraulic engine mount to body	100 Nm (74 ft-lb)
Hydraulic engine mount to body (replace bolt)	
Initial torque	56 Nm (41 ft-lb)
Torque angle	90°
Hydraulic engine mount to engine mounting bracket	68 Nm (50 ft-lb)
Ignition coil pack to valve cover (M6)	12 Nm (9 ft-lb)
Intake manifold to cylinder head (M8)	26 Nm (19 ft-lb)
Intercooler outlet pipe to intake manifold (M7)	16 Nm (12 ft-lb)
Modular front end to crush tube (M6)	5 Nm (44 in-lb)
Sealing plug to cylinder head	18 Nm (13 ft-lb)
Spark plug to cylinder head	27 Nm (20 ft-lb)
Supercharger outlet pipe to supercharger (M8)	25 Nm (18 ft-lb)
Throttle valve assembly to intake manifold (M6)	9 Nm (7 ft-lb)
Upper engine vibration damper bracket to damper or to engine mounting bracket (M12)	100 Nm (74 ft-lb)
Valve cover to cylinder head (M6)	12 Nm (9 ft-lb)

