

2001-2005 ENGINE**Engine Mechanical - Repair Instructions - S64****ENGINE, GENERAL****00 00 250 BMW ENGINE OIL SERVICE INCL. SUPPLEMENTARY SERVICE (S54)**

NOTE: Work step 00 00 250 comprises the engine oil and supplementary services.

Only the engine oil service will be described in these repair instructions.

For the supplementary service work steps, refer to the vehicle-specific inspection sheet.

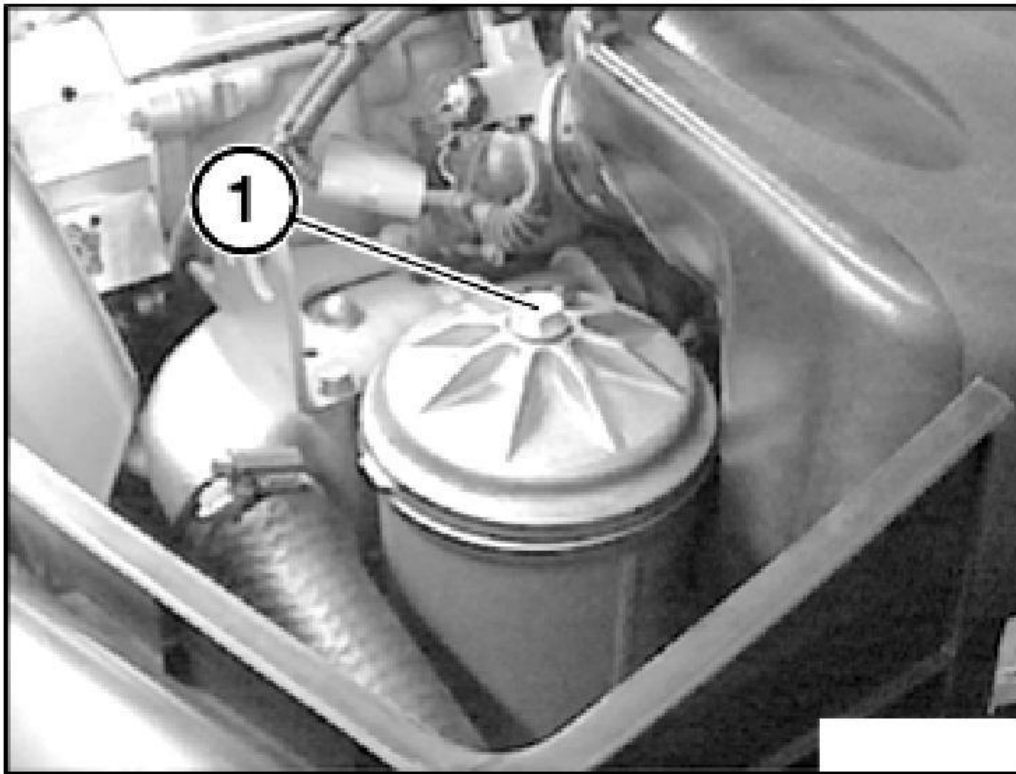
Engine Oil Service:

NOTE: When the main flow oil-filter cover is released, the oil flows from the oil-filter housing back into the sump.

Unfasten oil filter cover.

Installation:

Tightening torque, refer to 11 42 2AZ in **ENGINE - TIGHTENING TORQUES** .



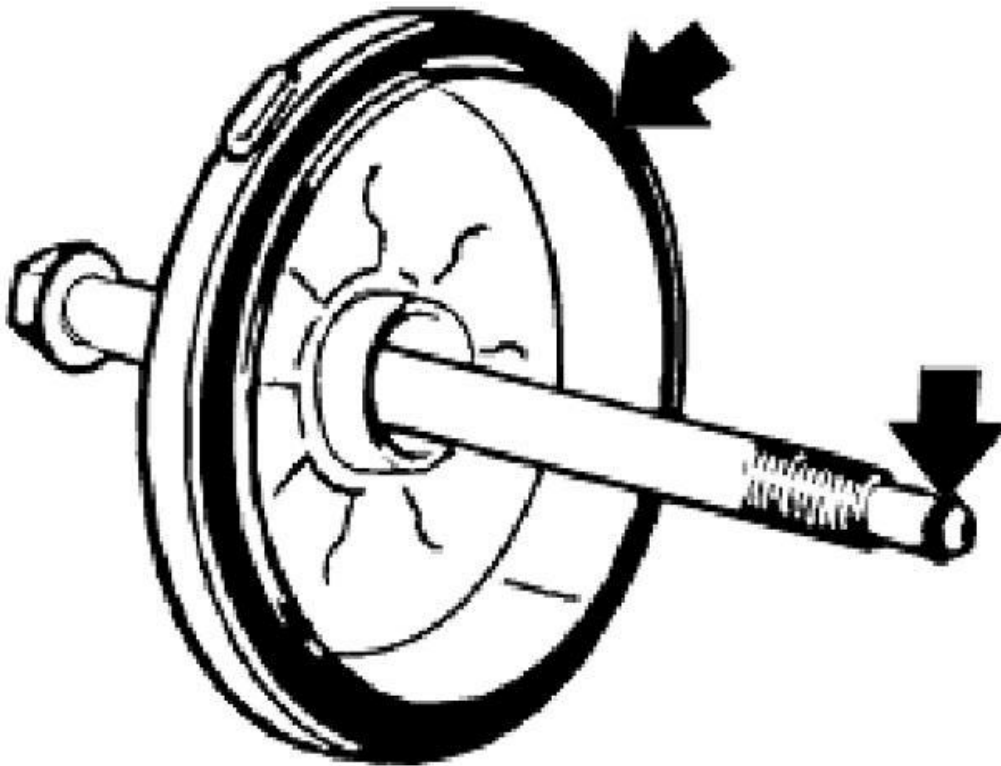
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Fig. 1: Locating Oil Filter Cover

Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

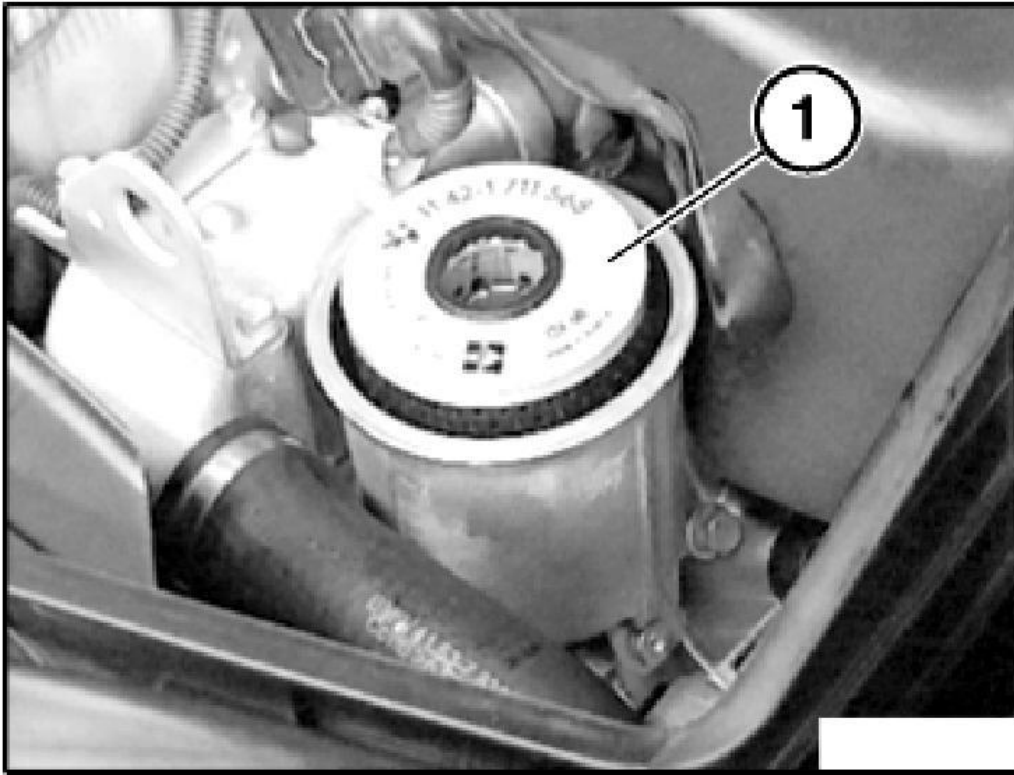
Replace sealing ring in oil-filter cover and sealing ring on bolt.



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Fig. 2: Locating Sealing Rings In Oil-Filter Cover
Courtesy of BMW OF NORTH AMERICA, INC.

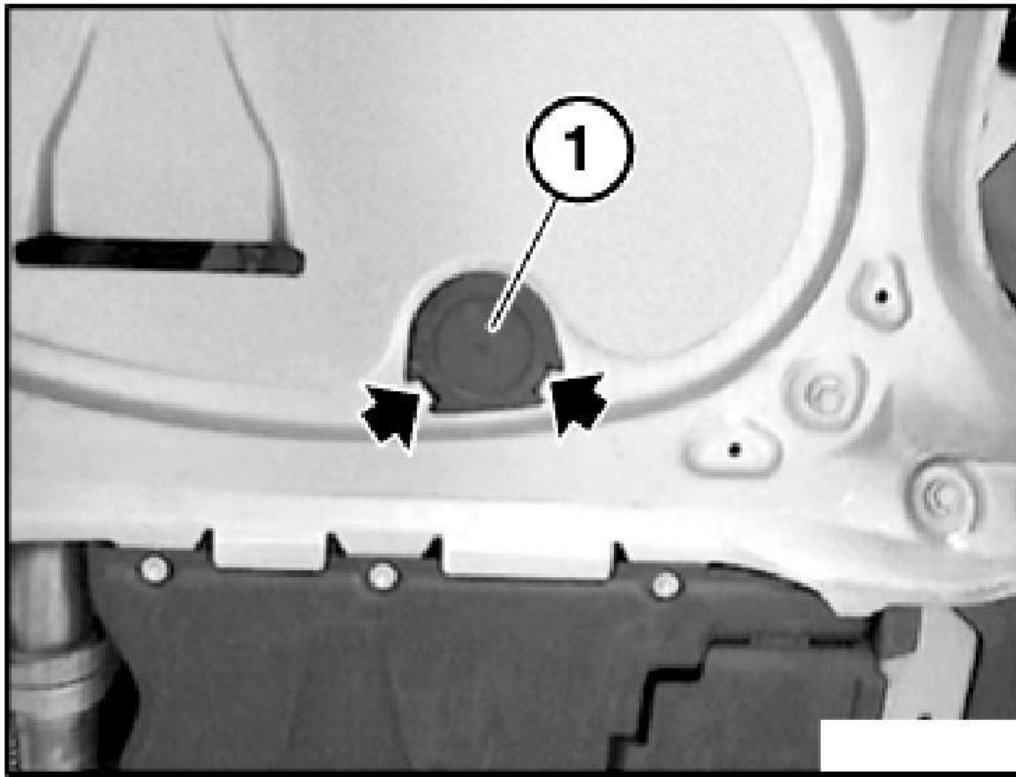
Replace oil filter element (1).

**G03117666****Fig. 3: Locating Oil Filter Element****Courtesy of BMW OF NORTH AMERICA, INC.**

Drain or draw off engine oil. If engine oil is drained:

E46 Only:

Lever out cover (1) on side with a screwdriver.



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Fig. 4: Locating Cover (E46 Only)

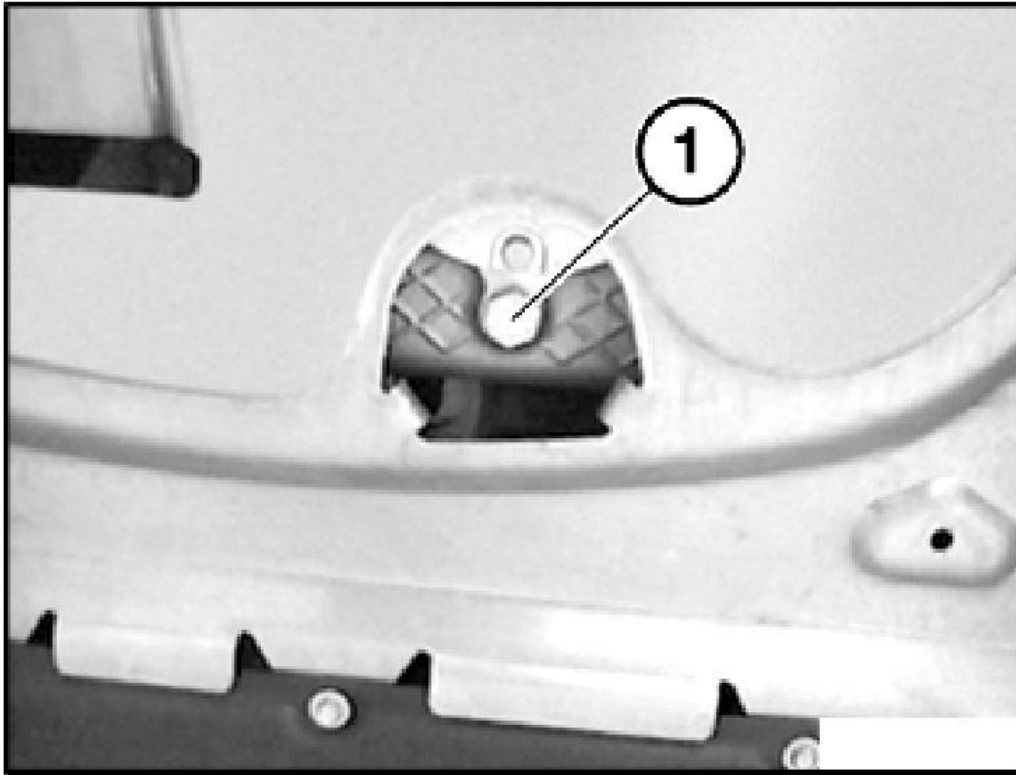
Courtesy of BMW OF NORTH AMERICA, INC.

Open oil drain plug and drain off engine oil.

Installation:

Replace sealing ring.

Tightening torque, refer to 11 13 1AZ in **ENGINE - TIGHTENING TORQUES** .

**G03117668****Fig. 5: Locating Oil Drain Plug****Courtesy of BMW OF NORTH AMERICA, INC.**

Complete vehicle and set in horizontal position. Top up engine oil.

Start engine and run at idle until oil indicator lamp goes out. Switch off engine, wait approx. 5 minutes and then check engine oil level.

Top up engine oil if necessary.

Supplementary Service:

Refer to vehicle-specific inspection sheet.

11 00 039 CHECKING COMPRESSION OF ALL CYLINDERS (S54)

NOTE: For Special Tool identification, see **SPECIAL TOOLS - M3** .

Special Tools Required:

- 11 0 224
- 11 0 235
- Read out fault memory of DME control unit.
- Check stored faults.
- Rectify faults.
- Clear fault memory.

Disconnect fuel pump relay or fuel pump fuse. Start engine and allow remaining fuel to escape. This prevents fuel from being injected, the catalytic converter from being damaged and the test result from being distorted during the compression pressure check.

CAUTION: High tension - danger!

Disconnect all supply leads from ignition coils (interrupt power supply to ignition coils).

- Remove lower microfilter section (E46 only).
- Remove ignition coil cover.
- Remove ignition coils. See **12 13 511 REPLACING IGNITION COIL (S54)**
- Remove all spark plugs. See **12 12 011 REPLACING ALL SPARK PLUGS (S54)**

NOTE: **Check that sealing ring is in perfect condition on special tool 11 0 235.**

Screw special tool 11 0 235 by hand into spark plug thread and connect special tool 11 0 224.

Depress accelerator and actuate starter until compression stops rising.

Compression pressure, refer to **ENGINE - TECHNICAL DATA** .

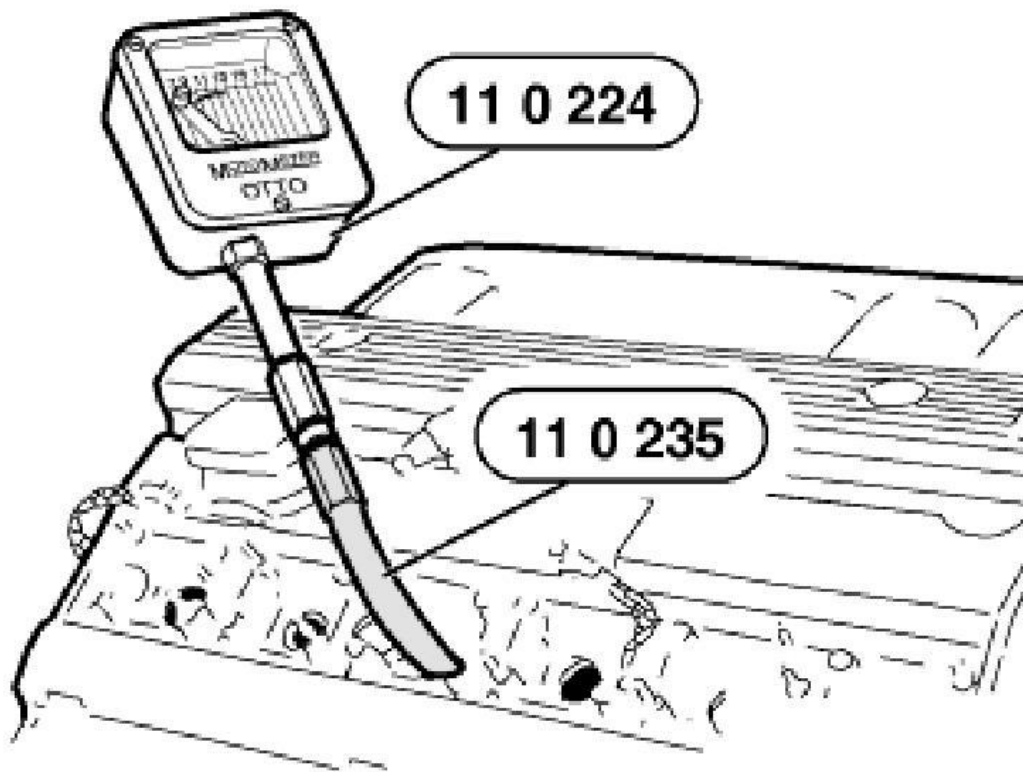
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Fig. 6: Checking Compression Of All Cylinders (S54)
Courtesy of BMW OF NORTH AMERICA, INC.

Now clear the fault memory.

11 00 045 CHECKING ABSOLUTE COMPRESSION OF ALL CYLINDERS

With BMW Diagnosis Information System (DIS).



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Fig. 7: Identifying BMW Diagnosis Information System (DIS)
Courtesy of BMW OF NORTH AMERICA, INC.

- Connect DIS tester.

- BMW measuring technology.
- Preset measurements.
- Absolute compression.
 - The further procedure is described in:
 - Help.
 - Help on preset measurements.
 - Adaptation of "Absolute compression".
- Clear fault memory.

11 00 050 REMOVING AND INSTALLING ENGINE (S54)

Special Tools Required:

- 11 0 000
- 51 2 160

Instructions for disconnecting and connecting battery. Refer to **12 00... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY** .

Disconnect negative battery lead.

Move engine hood to assembly position:

NOTE: **The following work must be carried out with a second person assisting. Work instruction applies to left and right sides.**

Gently raise retaining clip and simultaneously push upwards.

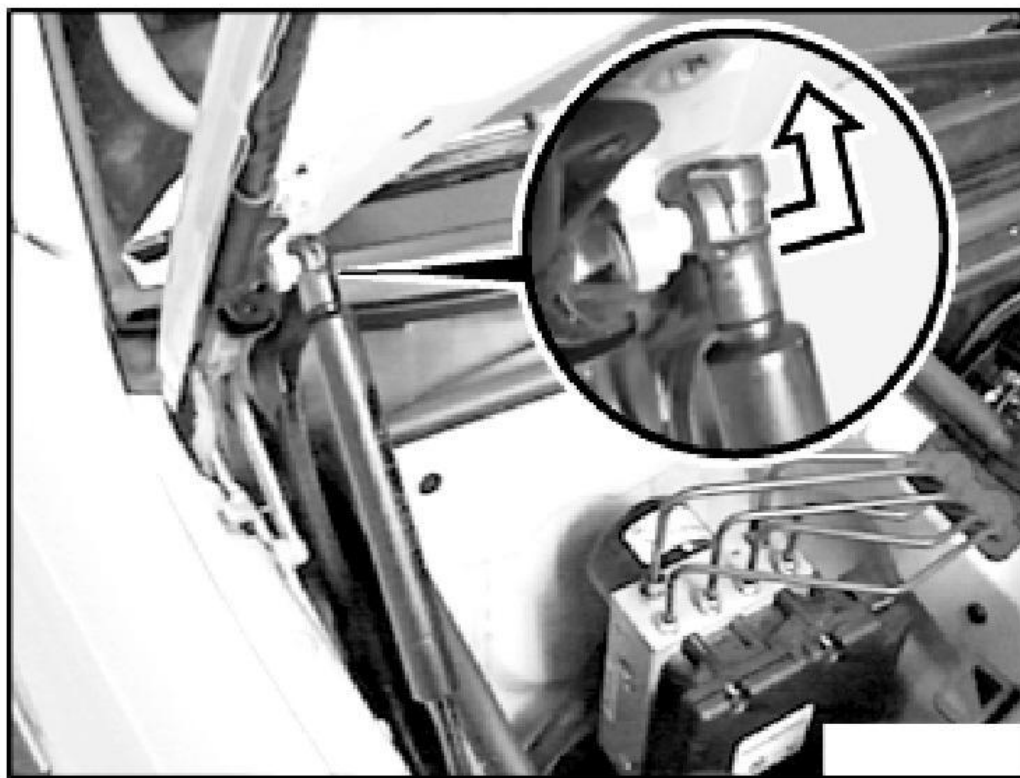
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Fig. 8: Moving Engine Hood To Assembly Position
Courtesy of BMW OF NORTH AMERICA, INC.

Hold engine hood, unhook damper on hood.

Slide special tool 51 2 160 over damper.

Open engine hood completely and reconnect damper with special tool 51 2 160 to hood.

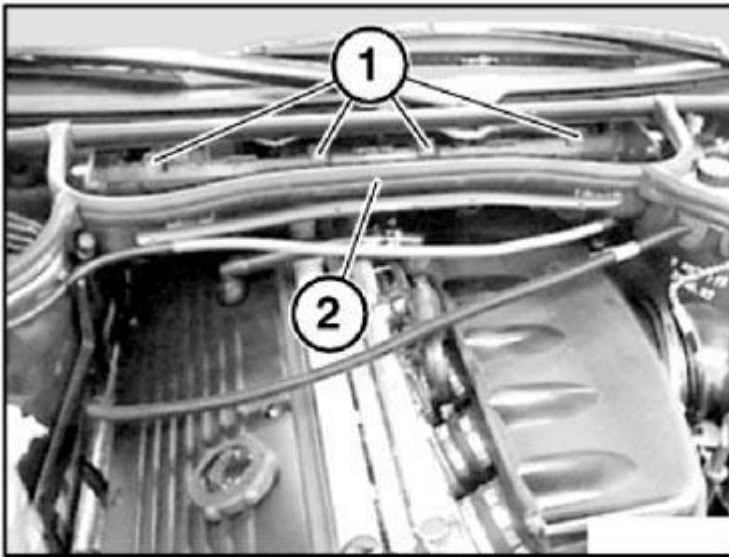
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Fig. 9: Sliding Hood/Bonnet Stay Over Damper
Courtesy of BMW OF NORTH AMERICA, INC.

Remove microfilter.

Open cable duct on lower section of microfilter housing (2) and feed out cable(s).

Release screws (1) and remove lower section of microfilter Housing (2)



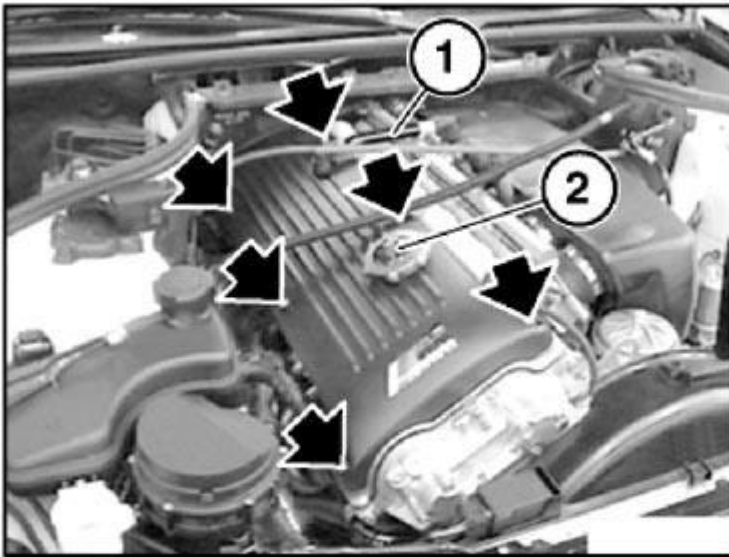
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Fig. 10: Identifying Cable Duct On Microfilter Housing
Courtesy of BMW OF NORTH AMERICA, INC.

Remove engine vent (1).

Remove oil filler cap (2).

Remove engine cover.



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Fig. 11: Removing Engine Vent And Oil Filler Cap
Courtesy of BMW OF NORTH AMERICA, INC.

Remove engine splash guard.

Remove reinforcement plate.

CAUTION: The article 51 71 374 REMOVING AND INSTALLING / REPLACING REINFORCEMENT PLATE ON FRONT AXLE SUPPORT (M3) , contains important installation instructions.

Remove A/C compressor drive belt. Refer to 11 28 050 REPLACING A/C COMPRESSOR DRIVE BELT (S54).

Remove A/C compressor from bearing block and tie back to one side.

NOTE: Lines remain connected.

Drain and dispose of coolant.

NOTE: The water drain plug is located on the exhaust side on cylinder 2 in the engine block.

Installation:

Replacing sealing ring on water drain plug.

Tightening torque, (25 N.m.).

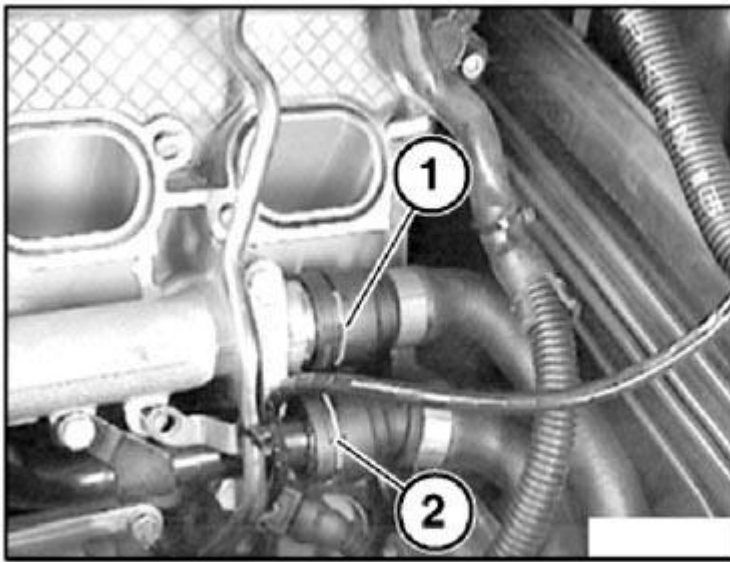
Remove intake air manifold. Refer to **11 61 050 REMOVING AND INSTALLING INTAKE AIR MANIFOLD (S54)**.

Remove throttles. Refer to **13 54 030 REMOVING AND INSTALLING/SEALING THROTTLE ASSEMBLY (S54)**.

Pull lock and detach water hoses (1 and 2).

Installation:

Refer to **17 00... INSTRUCTIONS FOR WORKING ON COOLING SYSTEM.**



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Fig. 12: Detaching Water Hoses
Courtesy of BMW OF NORTH AMERICA, INC.

Drain power steering supply tank, detach from left carrier bracket and tie to one side.

NOTE: **Lines remain connected.**

Remove fan clutch with fan impeller from water pump. Refer to **11 52 020 REMOVING AND INSTALLING/REPLACING FAN CLUTCH (S52 / S54 / M52 / M52TU / M54 / M56)**.

Remove engine oil cooler.

Remove radiator. Refer to **17 11 000 REMOVING AND INSTALLING RADIATOR (S54)** .

Remove alternator drive belt. Refer to **11 28 010 REPLACING ALTERNATOR DRIVE BELT (S54)**.

Remove vane pump for power steering and tie back to one side.

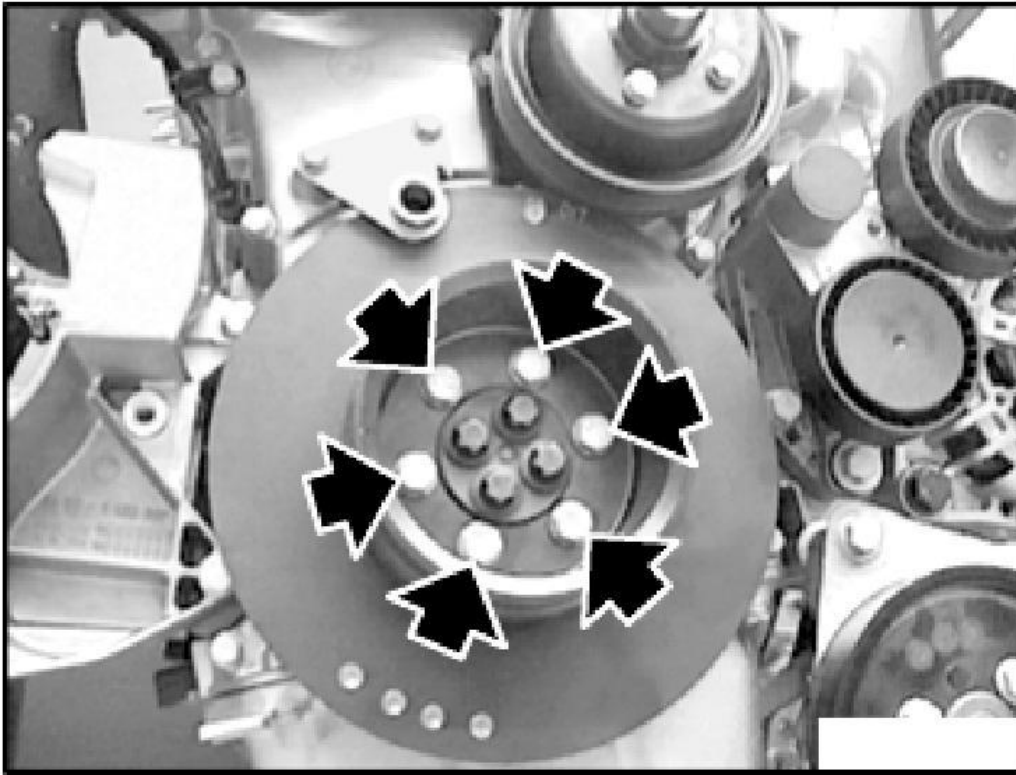
NOTE: **Lines remain connected.**

NOTE: **Wiring harness section for engine is disconnected from car and removed with engine.**

Disconnect plug connections on DME control unit. Disconnect wiring harness section from car and lay to engine.

NOTE: **When the engine is being lifted out, there is the danger that the belt pulley may be damaged.**

Unfasten screws. Remove belt pulley

**G03117676****Fig. 13: Locating Belt Pulley Screws****Courtesy of BMW OF NORTH AMERICA, INC.**

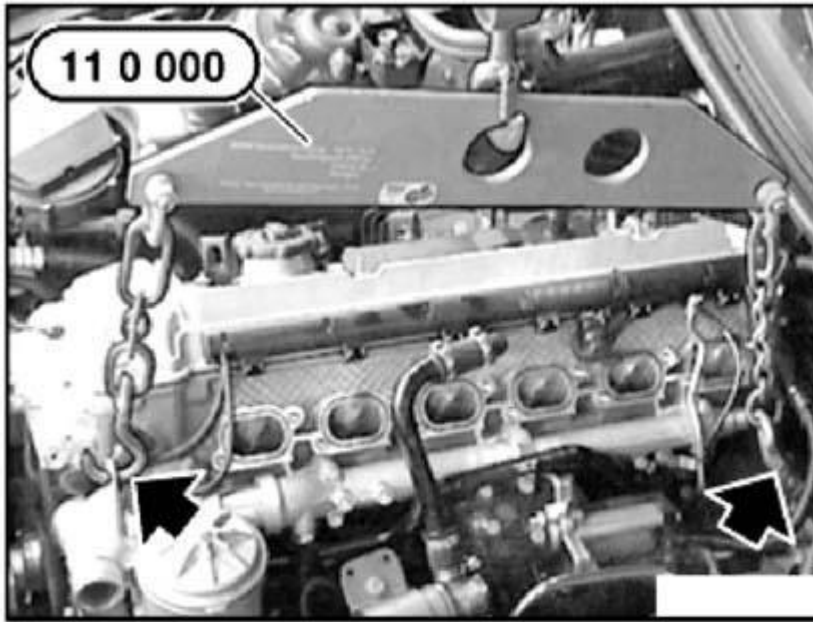
Remove transmission. See **REMOVAL & INSTALLATION - M3 (S6S 420G SMG)**

Remove starter motor. See **STARTER**

Detach steering spindle from steering gear. Refer to **POWER STEERING GEAR** .

CAUTION: Only raise engine on locating lugs provided for this purpose.

Fit engine to special tool 11 0 000.



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Fig. 14: Fitting Engine To Engine Lifter
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten right ground wire.

Unscrew left and right engine mounts.

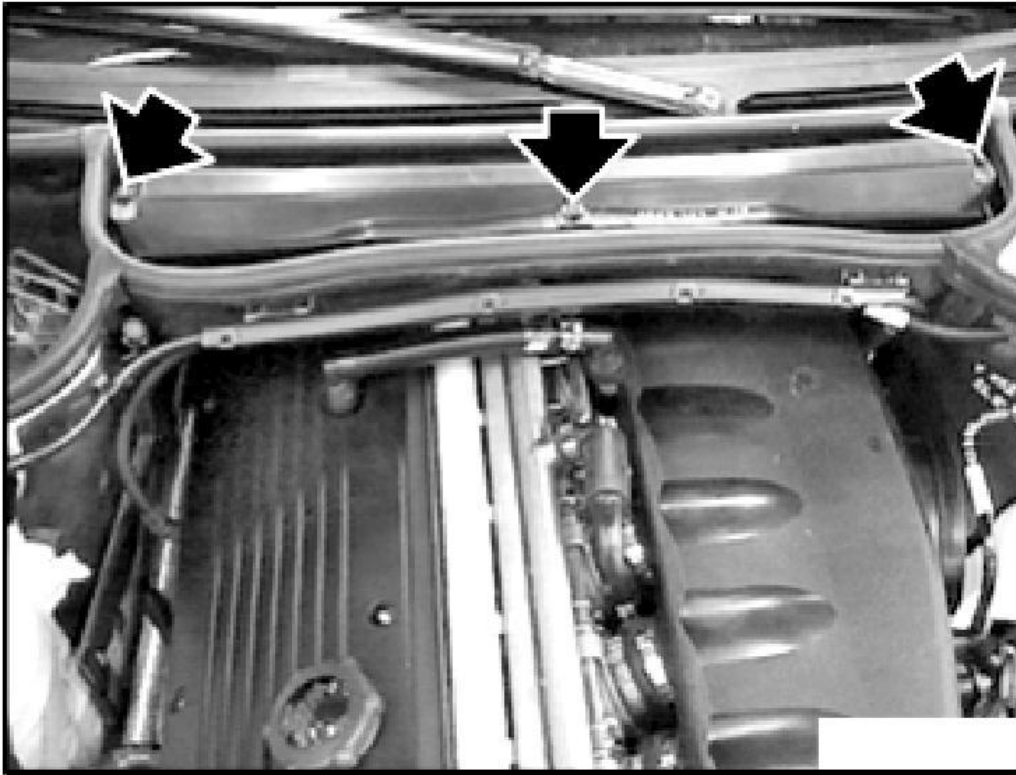
Carefully lift out engine.

CYLINDER HEAD WITH COVER

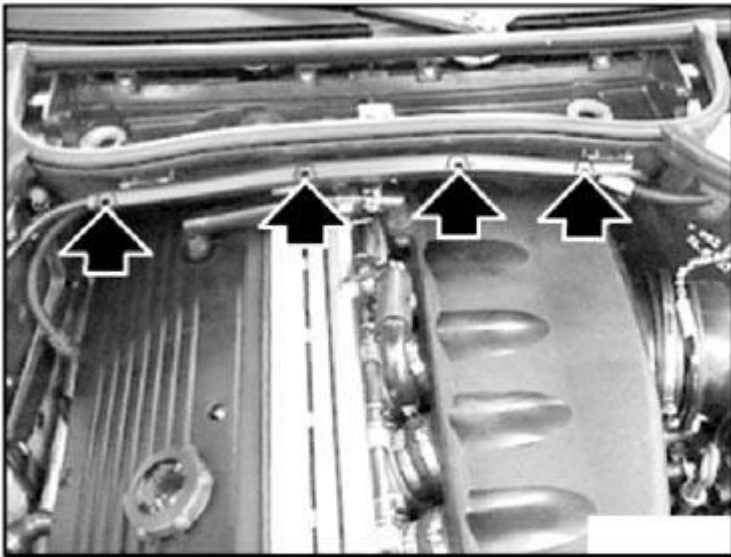
11 12 000 REMOVING AND INSTALLING, SEALING CYLINDER HEAD COVER (S54)

E46 Only:

Remove microfilter

**G03117678****Fig. 15: Removing Microfilter (E46)****Courtesy of BMW OF NORTH AMERICA, INC.****E46 Only:**

Open cable duct on lower section of microfilter housing and feed out cable(s).

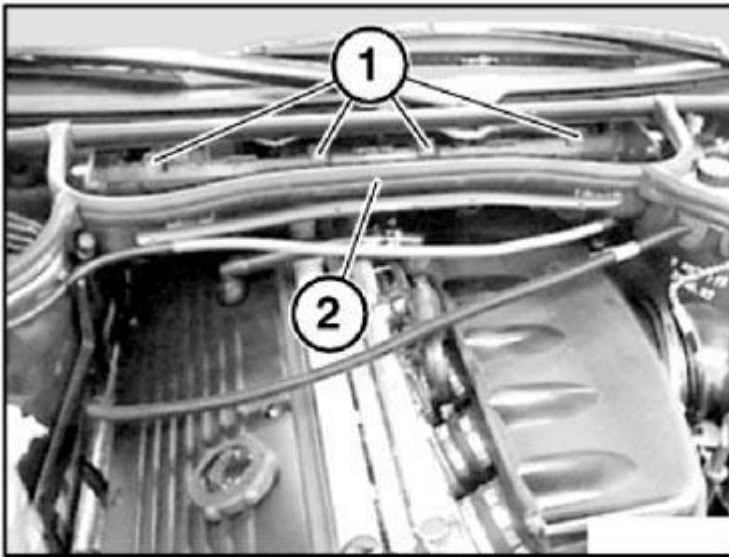


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Fig. 16: Locating Cable Duct On Lower Section Of Microfilter
Courtesy of BMW OF NORTH AMERICA, INC.

E46 Only:

Release screws (1) and remove lower section of microfilter housing (2)

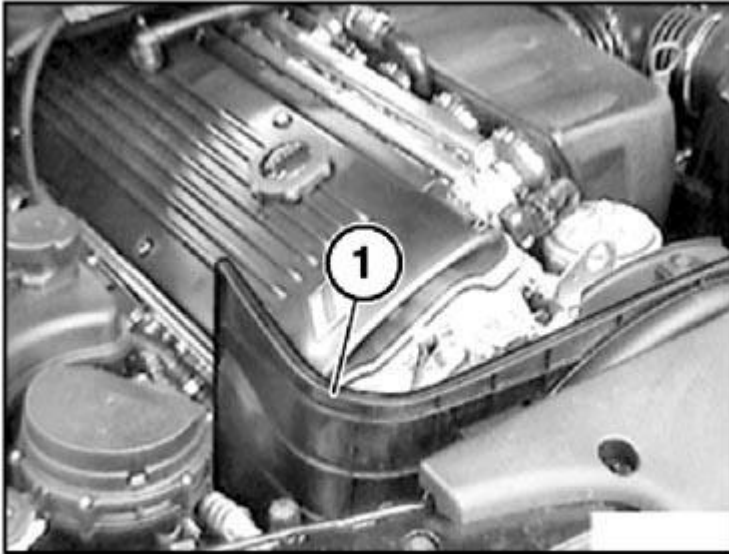


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Fig. 17: Identifying Lower Section Of Microfilter Housing (E46)
Courtesy of BMW OF NORTH AMERICA, INC.

E46 Only:

Remove expansion rivets. Remove air duct (1).



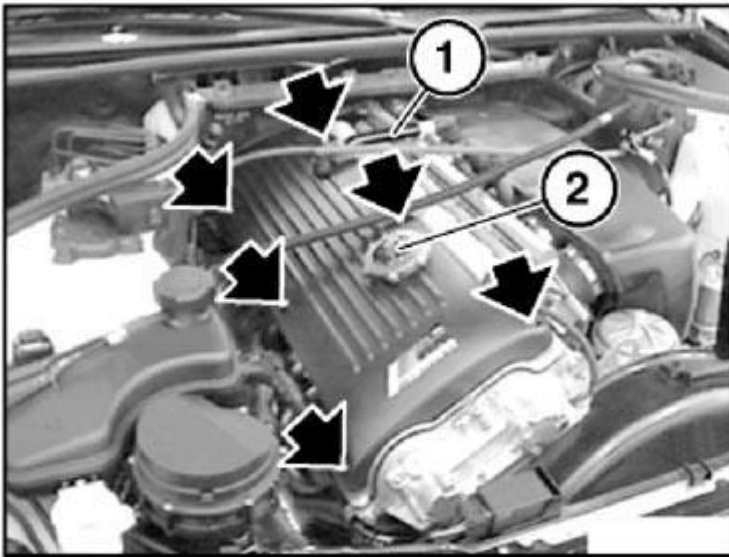
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Fig. 18: View Of Air Duct (E46)**Courtesy of BMW OF NORTH AMERICA, INC.**

Remove hose (1) for engine vent.

Remove sealing cap (2).

Remove ignition coil cover.

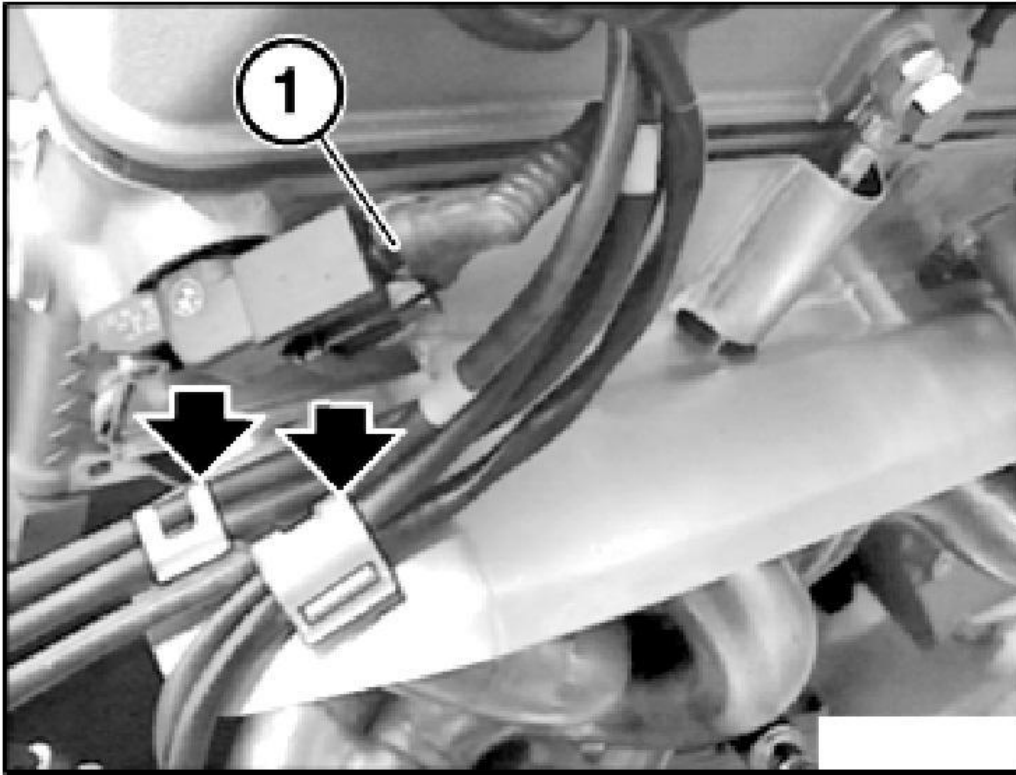


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Fig. 19: Locating Hose For Engine Vent And Sealing Cap
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (1) on sensor of exhaust camshaft.

NOTE: **Illustration shows: US version.**



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Fig. 20: Disconnecting Exhaust Camshaft Sensor Plug Connection
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

The cables of the oxygen sensors are clipped into mounts on the shield plate of the exhaust manifold.

CAUTION: Ensure cables are exactly routed.

CAUTION: It is very easy for the sealing ring between the cylinder head cover and the return line to drop into the engine.

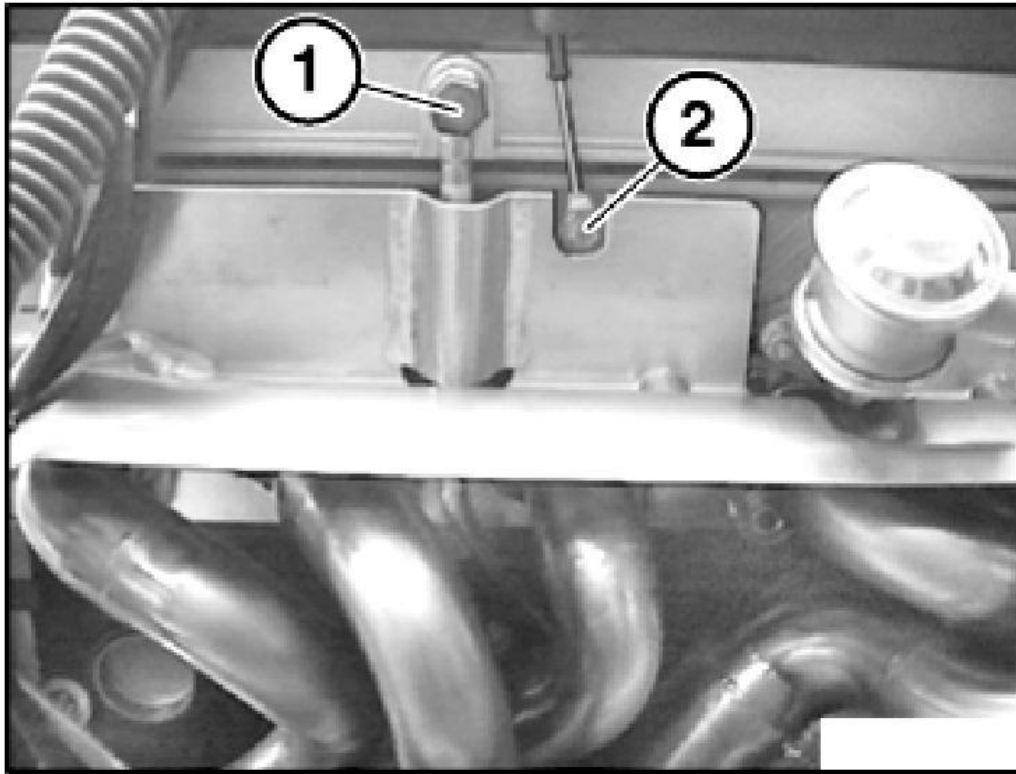
Carefully release hollow screw (1) and remove sealing ring between cylinder head cover and return line.

Installation:

Replace sealing rings.

Tightening torque 25 N.m.

Detach grounding strap (2) for ignition coils from cylinder head.



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Fig. 21: Identifying Hollow Screw And Grounding Strap

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: The plug housings of the oxygen sensors for cylinders 1 to 3 and 4 to 6 are different.

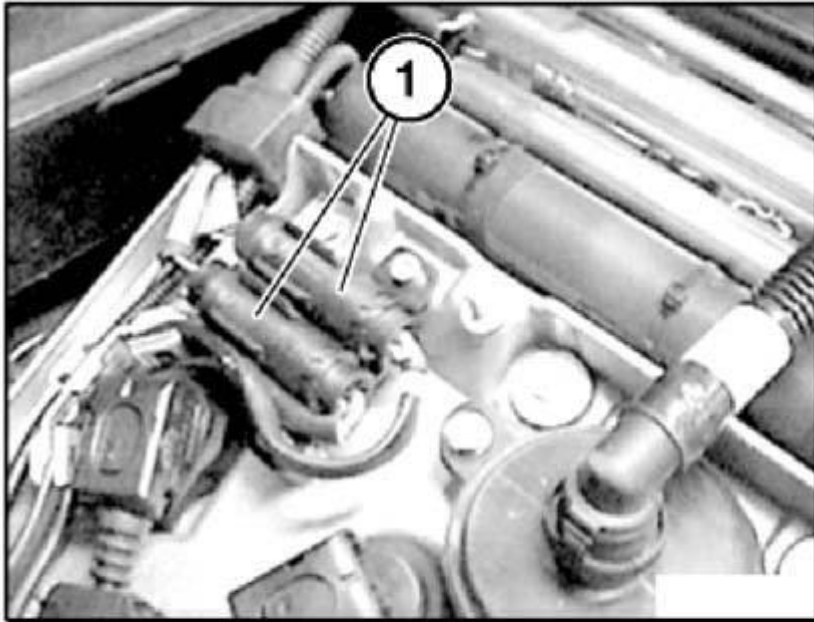
Unclip plug housing (1) from mounting.

Disconnect plug connections of oxygen sensors.

Feed oxygen sensor cables out of cable guide and lay to one side.

Remove ignition coils. Refer to **12 13 511 REPLACING IGNITION COIL (S54)** .

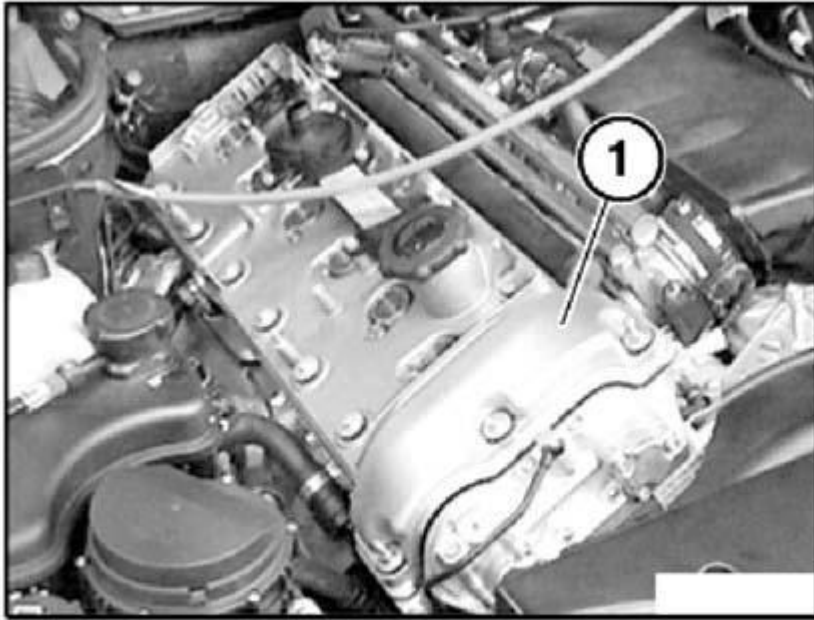
Lay ignition coil and oxygen sensor cables to one side.



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Fig. 22: Unclipping Plug Housing
Courtesy of BMW OF NORTH AMERICA, INC.

Remove cylinder head cover (1)



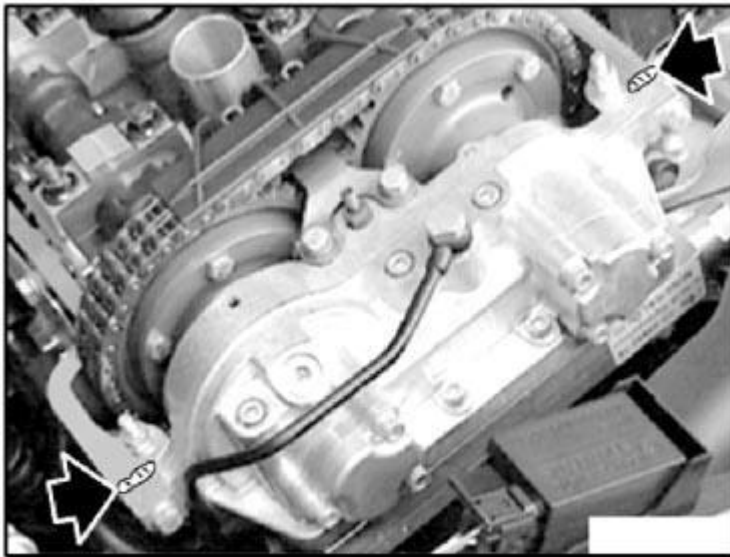
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Fig. 23: Removing Cylinder Head Cover
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Remove sealing debris from sealing faces of cylinder head and cylinder head cover.

Apply a sealing bead of Drei Bond 1209 on left and right sides at transition between cylinder head and VANOS adjustment unit.



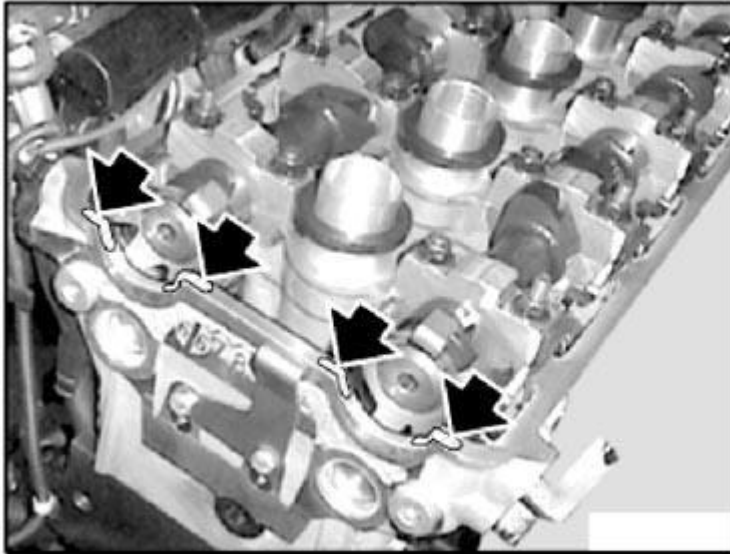
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Fig. 24: Identifying Sealant Area Between Cylinder Head And VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Illustration with engine removed.

Installation:

Apply a thin and even sealing bead of Drei Bond 1209 at transition to half-moon sections at rear of cylinder head.

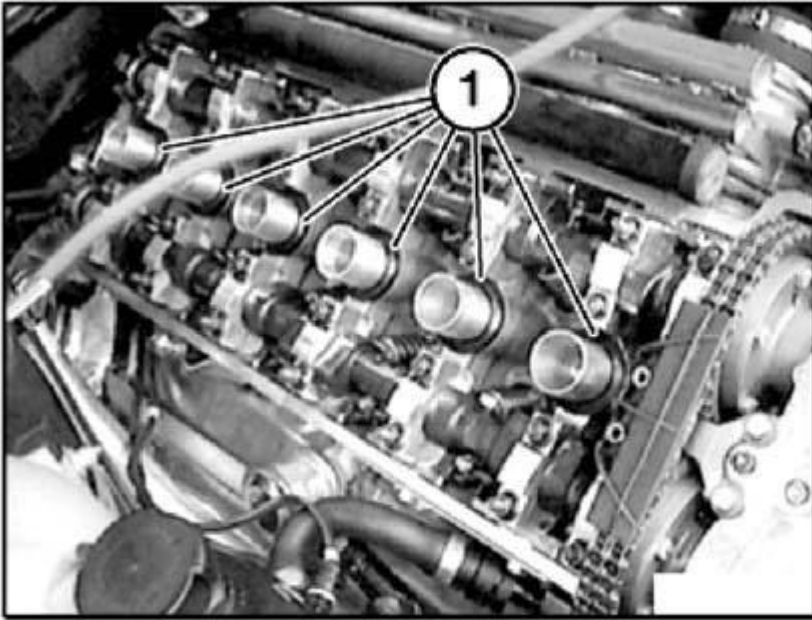


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Fig. 25: Applying Sealant To Half-Moon Sections On Cylinder Head
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Replace sealing rings (1).



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Fig. 26: Replacing Sealing Rings

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: The gasket of the cylinder head cover is secured with guide pins on the cylinder head and on the VANOS adjustment unit.

Installation:

Replace gasket of cylinder head cover. Preassemble gasket of cylinder head cover on cylinder head.

CAUTION: The guide pins may buckle very slightly during installation. Make sure that guide pins are exactly fed into bore holes.

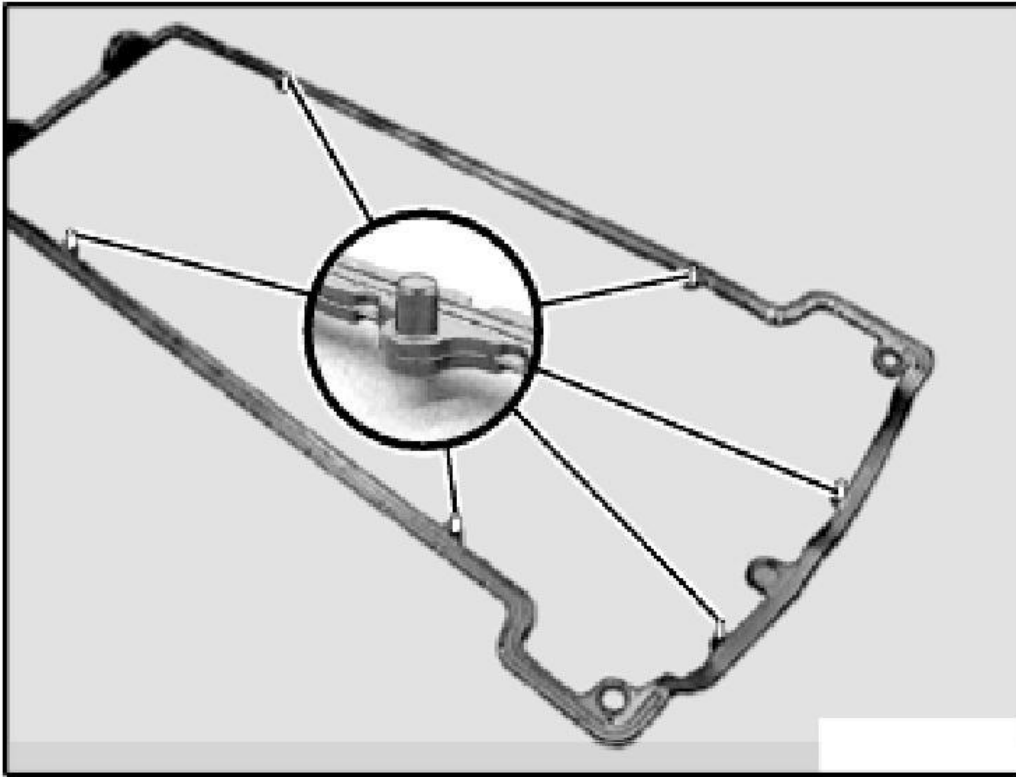
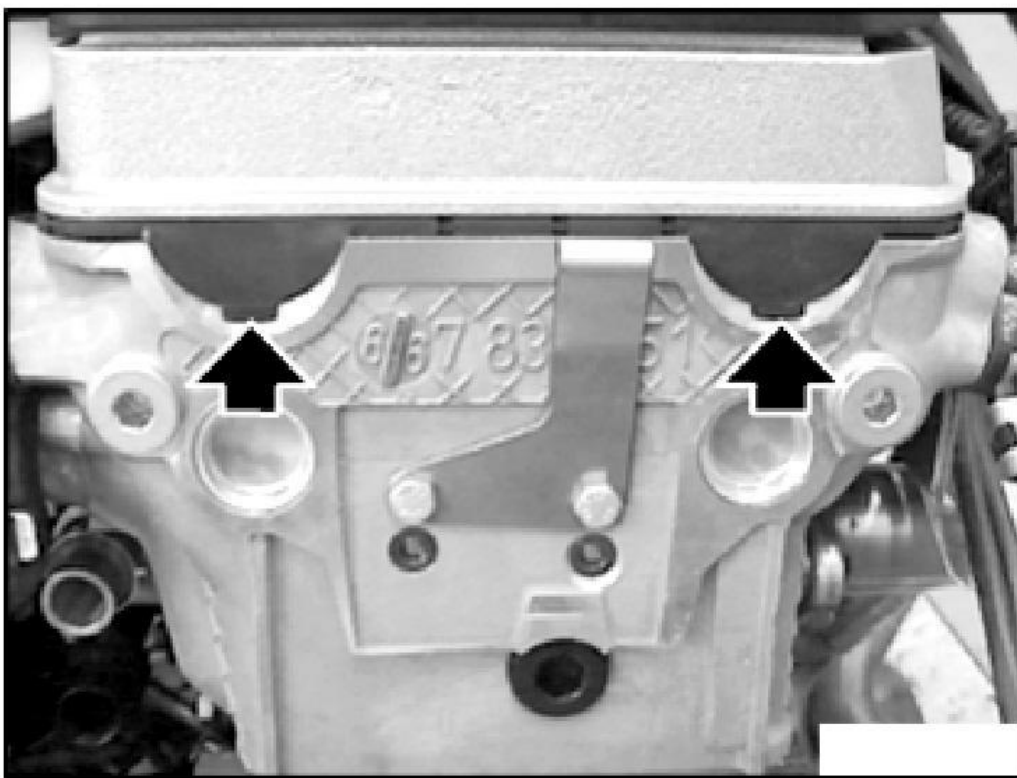
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Fig. 27: Identifying Cylinder Head Cover Gasket Guide Pins
Courtesy of BMW OF NORTH AMERICA, INC.

Illustration with engine removed.

Installation:

Make sure gasket is correctly seated on rear and front ends of cylinder head.



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Fig. 28: View Of Cylinder Head Gasket
Courtesy of BMW OF NORTH AMERICA, INC.

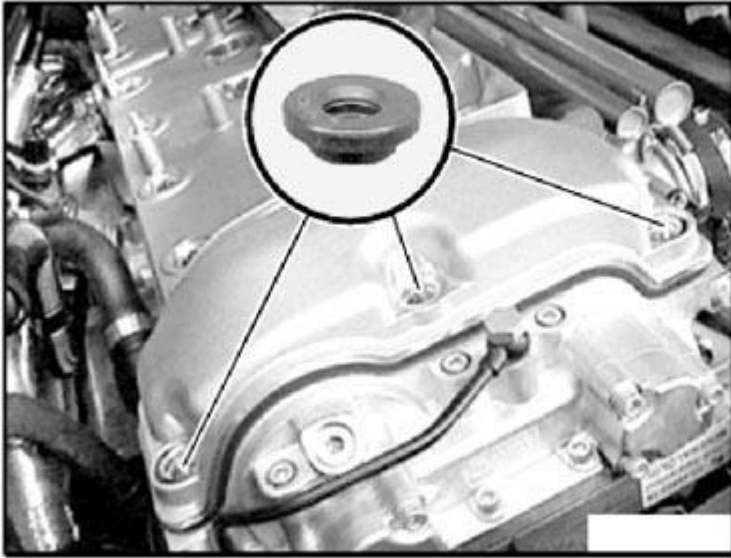
CAUTION: Different rubber gaskets: Front low version.

Installation:

Replace rubber gaskets.

Install all cap nuts and align cylinder head cover.

Fit all cap nuts without pretension. Tighten down cap nuts in diagonal sequence from inside to outside.



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Fig. 29: Identifying Front Low Rubber Gaskets
Courtesy of BMW OF NORTH AMERICA, INC.

11 12 100 REMOVING AND INSTALLING/SEALING CYLINDER HEAD (S54)

NOTE: For Special Tool identification, see **SPECIAL TOOLS - M3** .

Special Tools Required:

- 11 4 400
- 12 1 120

Remove both exhaust manifolds. Refer to **11 62 140 REMOVING AND INSTALLING, SEALING/REPLACING BOTH EXHAUST MANIFOLDS (S54)**.

Remove intake filter housing with air-mass flow sensor. Refer to **13 71 000 REMOVING AND INSTALLING INTAKE FILTER HOUSING (S54)** .

Remove cylinder head cover. Refer to **11 12 000 REMOVING AND INSTALLING, SEALING CYLINDER HEAD COVER (S54)**.

Remove all spark plugs. See **12 12 011 REPLACING ALL SPARK PLUGS (S54)**

Remove intake air manifold. Refer to **11 61 050 REMOVING AND INSTALLING INTAKE AIR MANIFOLD (S54)**.

Remove coolant drain plug in engine block. Drain and dispose of coolant.

Installation:

Tightening torque, (25 N.m.).

Vent cooling system and check for leaks. Refer to **17 00 039 VENTING COOLING SYSTEM AND CHECKING FOR LEAKS (S54)** .

Removal

Removal of cylinder head is described separately from installation.

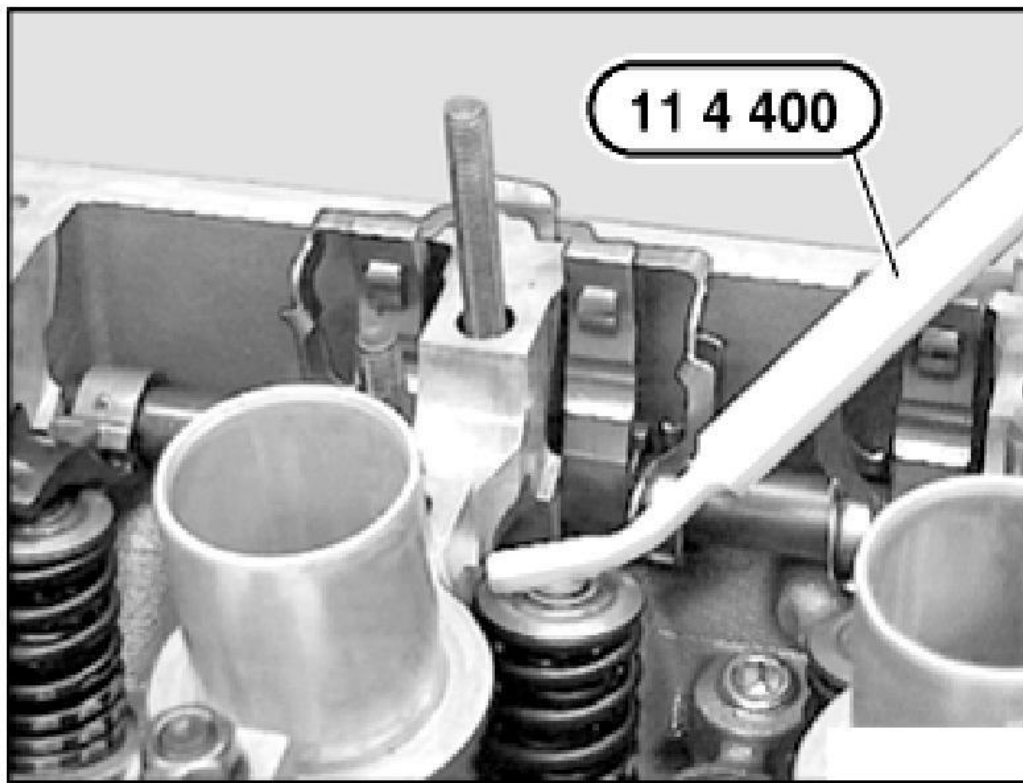
Remove camshafts. Refer to **11 31 019 REPLACING CAMSHAFTS (S54)**.

CAUTION: It is very easy for the adjustment plates to fall down.

Raise rocker arm.

NOTE: Special tool 11 4 400 is magnetic.

Remove all adjustment plates with special tool 11 4 400 and set to one side in order.



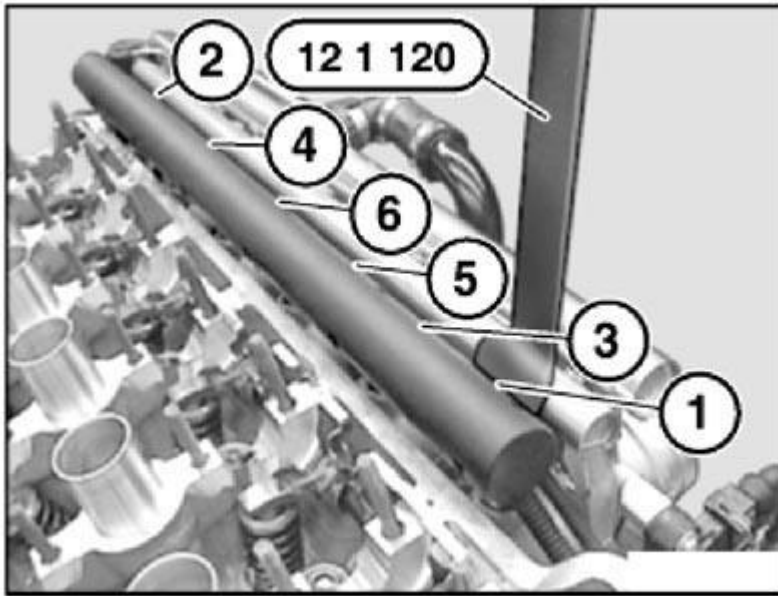
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Fig. 30: Raising Rocker Arm

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: The connector strip may break if it is removed without special tool 12 1 120.

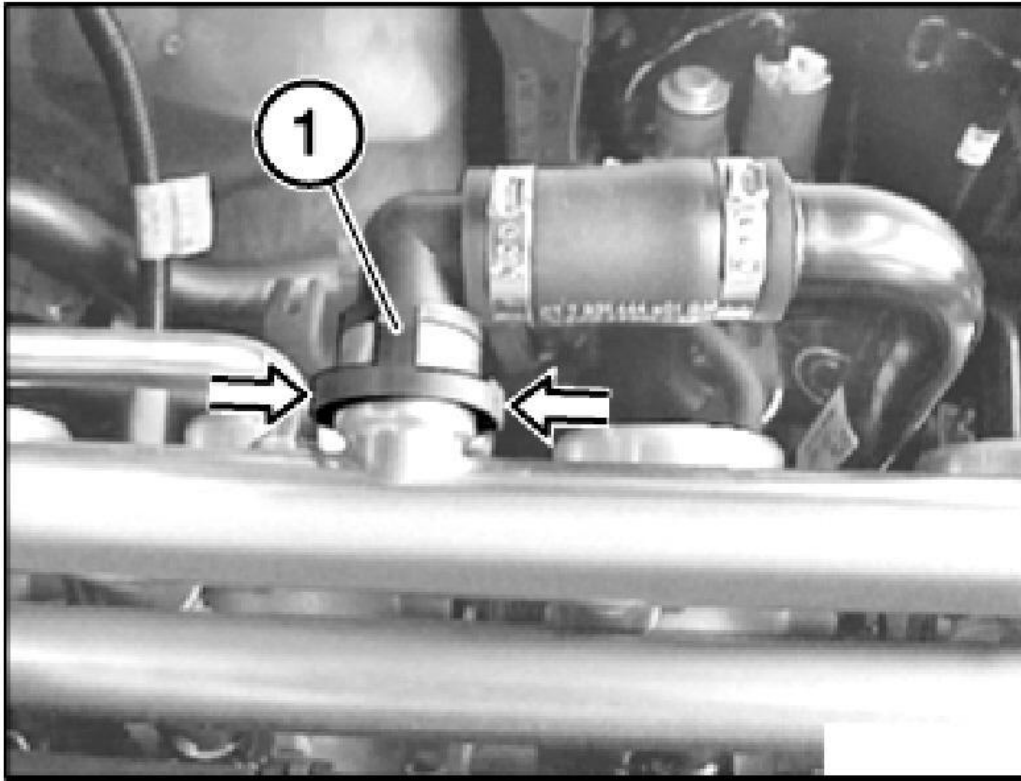
Unlock connector strip with special tool 12 1 120 in sequence 1 to 6.



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Fig. 31: Identifying Connector Strip Removal Sequence
Courtesy of BMW OF NORTH AMERICA, INC.

Press lock and detach hose from supplementary air line.



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Fig. 32: Detaching Hose From Supplementary Air Line
Courtesy of BMW OF NORTH AMERICA, INC.

Detach bracket for idle-speed control valve from return line and lay with hoses to one side.

Disconnect plug connection (1) to temperature sensor.



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Fig. 33: Disconnecting Plug Connection To Temperature Sensor
Courtesy of BMW OF NORTH AMERICA, INC.

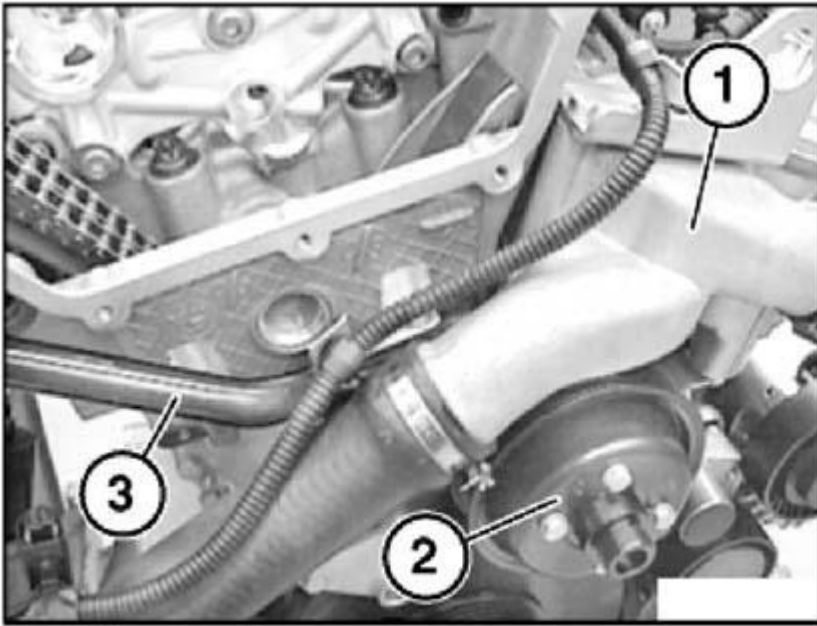
Remove thermostat housing (1).

Installation:

Replace sealing rings.

Remove belt pulley (2).

Remove pipe (3).



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Fig. 34: Removing Thermostat Housing And Belt Pulley
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Illustration with engine removed.

Pull off vacuum hose (1).

Feed out upper cover section (2) towards top.

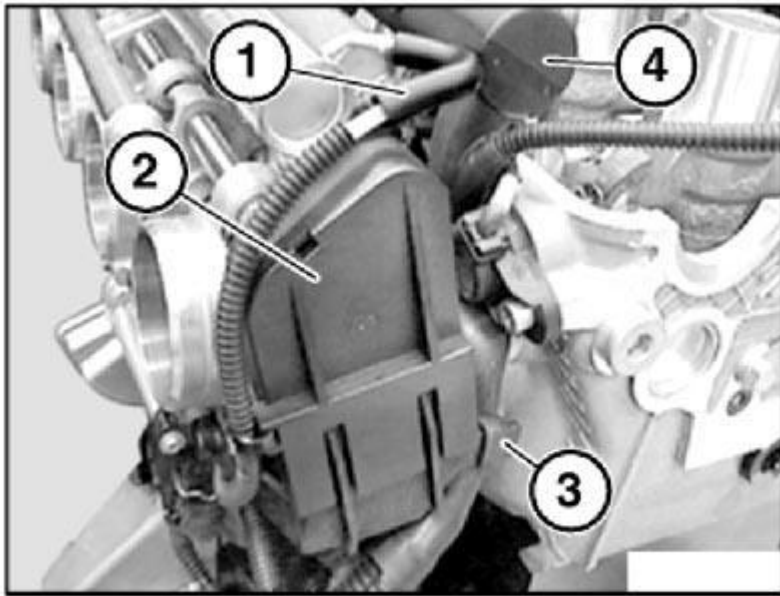
Detach wiring harness from retaining lug (3).

Pull connector strip (4) upwards.

Disconnect plug connection to camshaft sensor of inlet and exhaust camshafts.

Disconnect plug connection to throttle actuator.

Lay connector strip (4) to one side.



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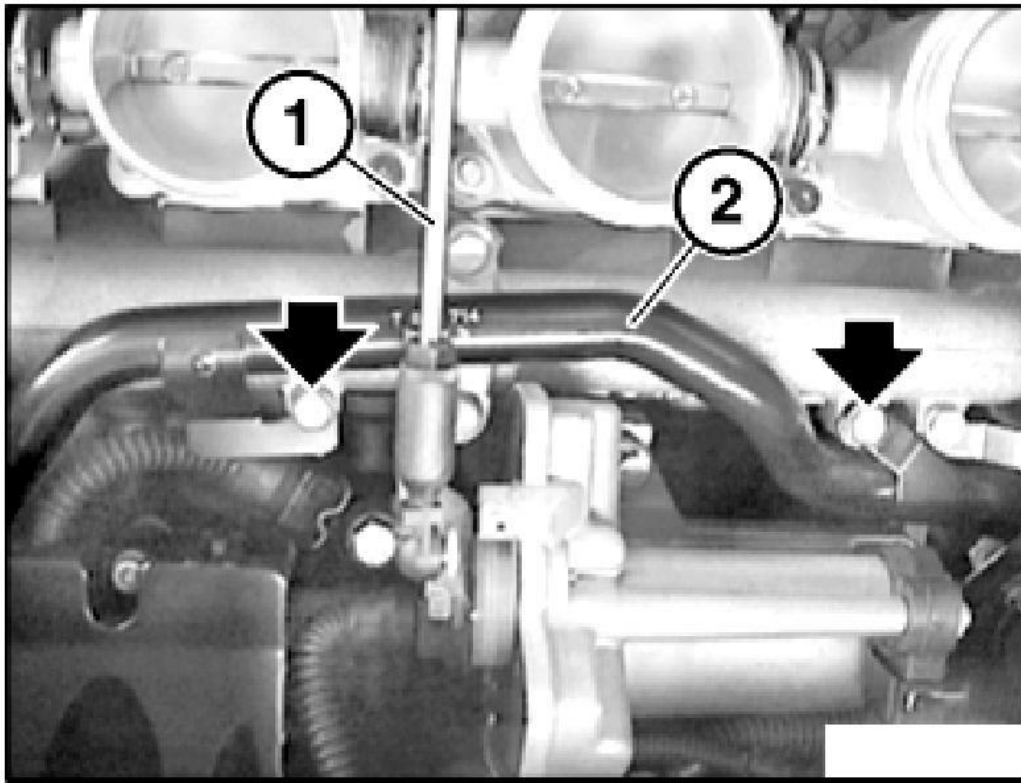
Fig. 35: View Of Upper Cover Section

Courtesy of BMW OF NORTH AMERICA, INC.

Remove pull rod (1).

Unfasten screws.

NOTE: Do not remove pipe (2).

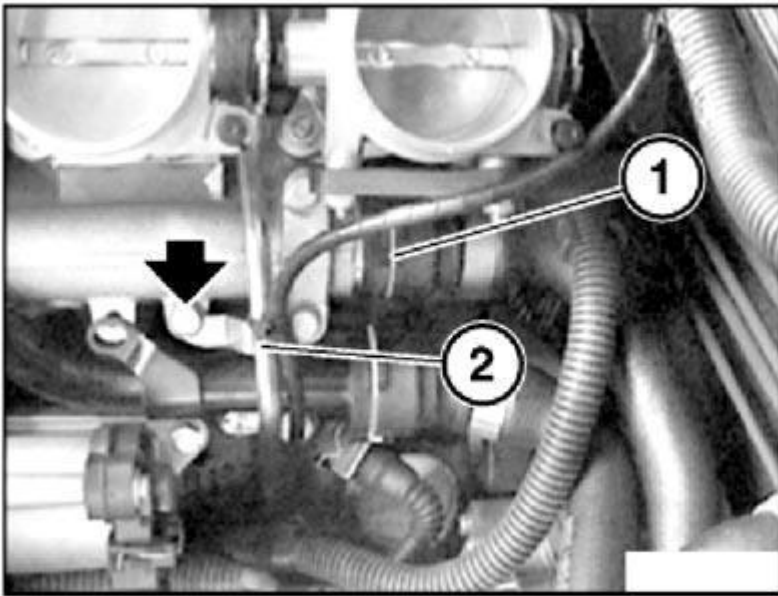


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Fig. 36: Identifying Pull Rod**Courtesy of BMW OF NORTH AMERICA, INC.**

Unlock water hose (1) and detach from return line.

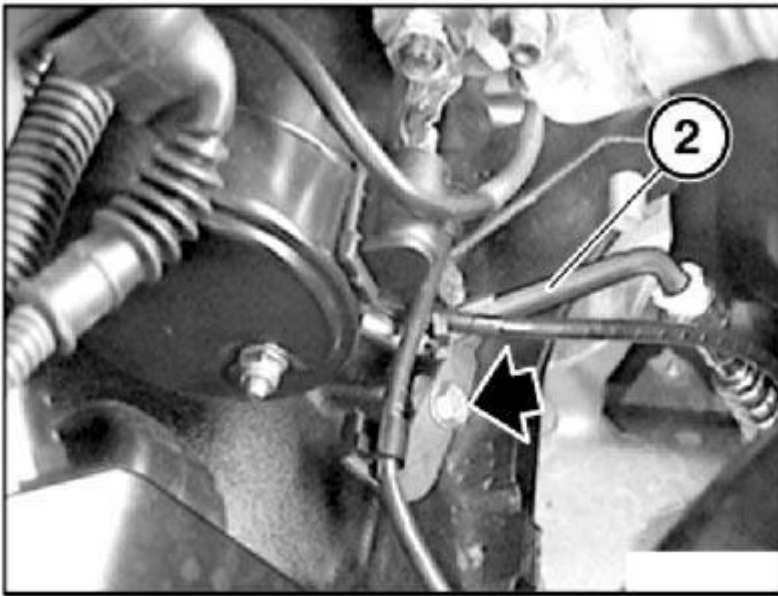
Release upper screw of fuel feed line (2) from return line.



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Fig. 37: Locating Upper Screw Of Fuel Feed Line
Courtesy of BMW OF NORTH AMERICA, INC.

Release lower screw of fuel feed line (2) from engine block.



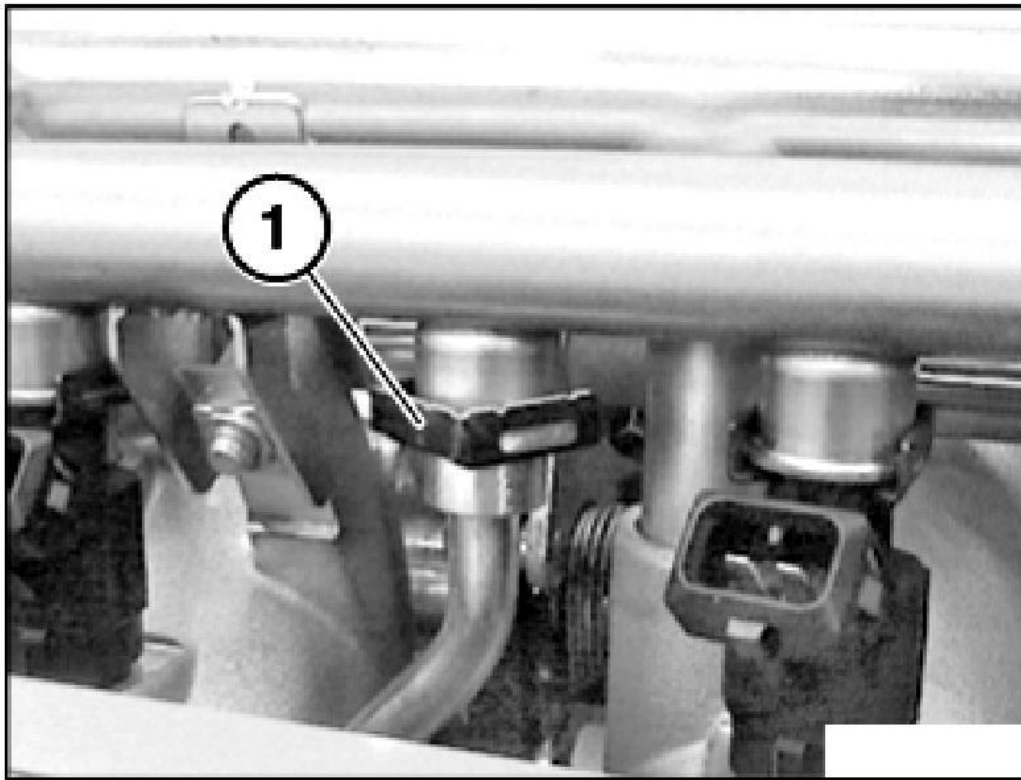
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Fig. 38: View Of Lower Screw Of Fuel Feed Line From Engine Block
Courtesy of BMW OF NORTH AMERICA, INC.

Detach retaining clip (1) of fuel feed line.

NOTE: **Catch and dispose of escaping fuel.**

Pull fuel feed line downwards.

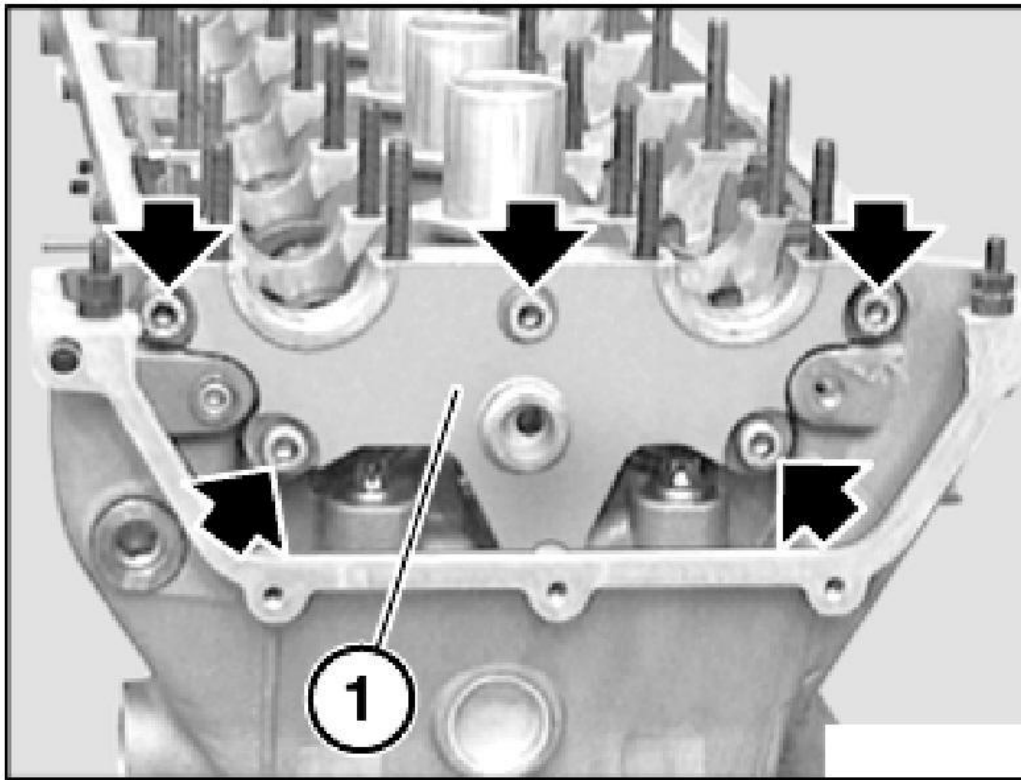


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Fig. 39: Identifying Retaining Clip Of Fuel Feed Line
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: The thrust bearing flange (1) and the cylinder head are machined as a single unit and must not be replaced individually.

Remove thrust bearing flange (1).

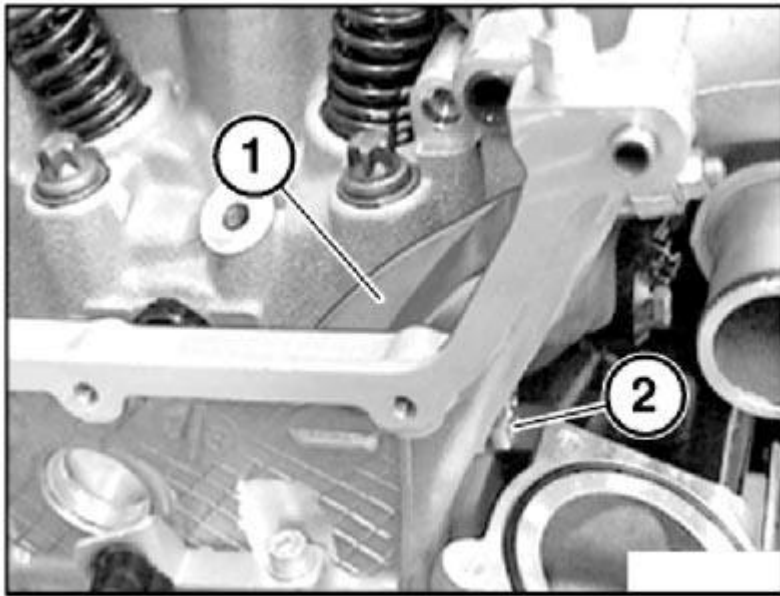


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Fig. 40: Removing Thrust Bearing Flange
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Sliding rail (1) is screwed to cylinder head.

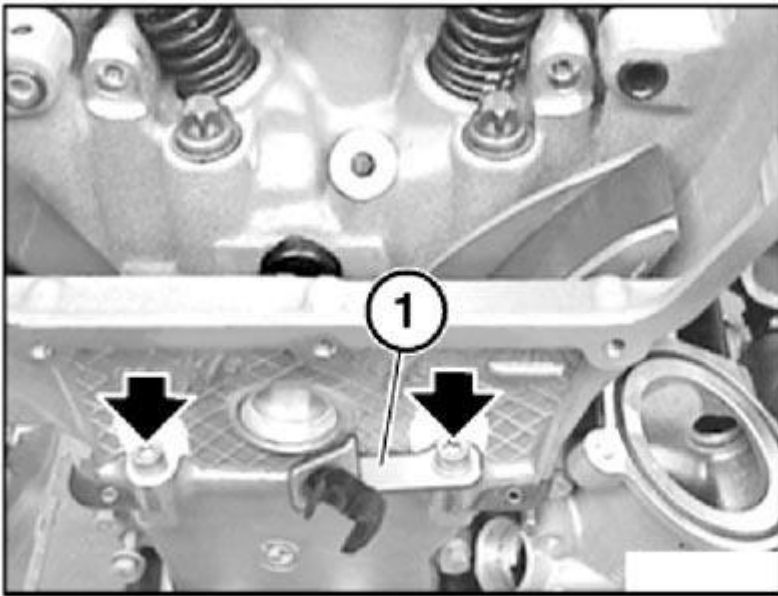
Release screw (2).



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Fig. 41: View Of Sliding Rail**Courtesy of BMW OF NORTH AMERICA, INC.**

Release screws between cylinder head and timing case cover. Remove cable holder (1).

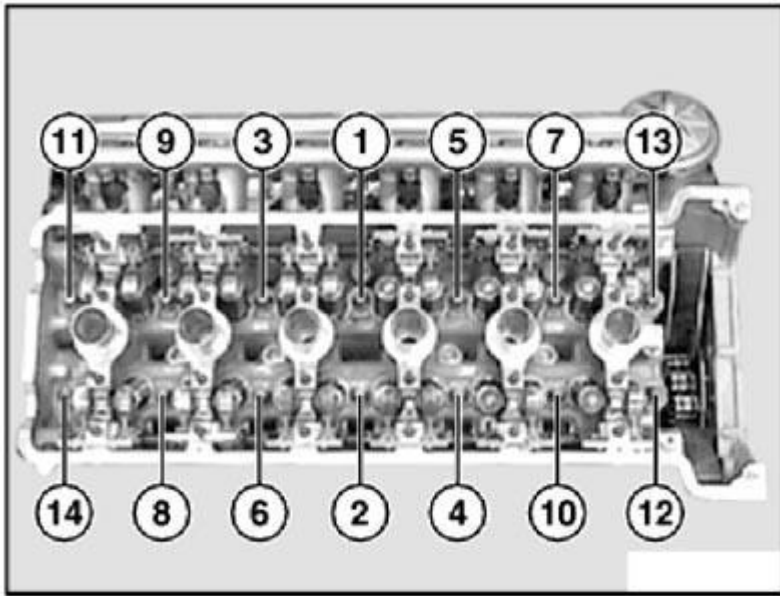


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Fig. 42: Removing Cable Holder**Courtesy of BMW OF NORTH AMERICA, INC.**

Release cylinder head bolts from outside to inside in sequence 14 to 1.

Lift off cylinder head.



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Fig. 43: Identifying Sequence Of Releasing Cylinder Head Bolts
 Courtesy of BMW OF NORTH AMERICA, INC.

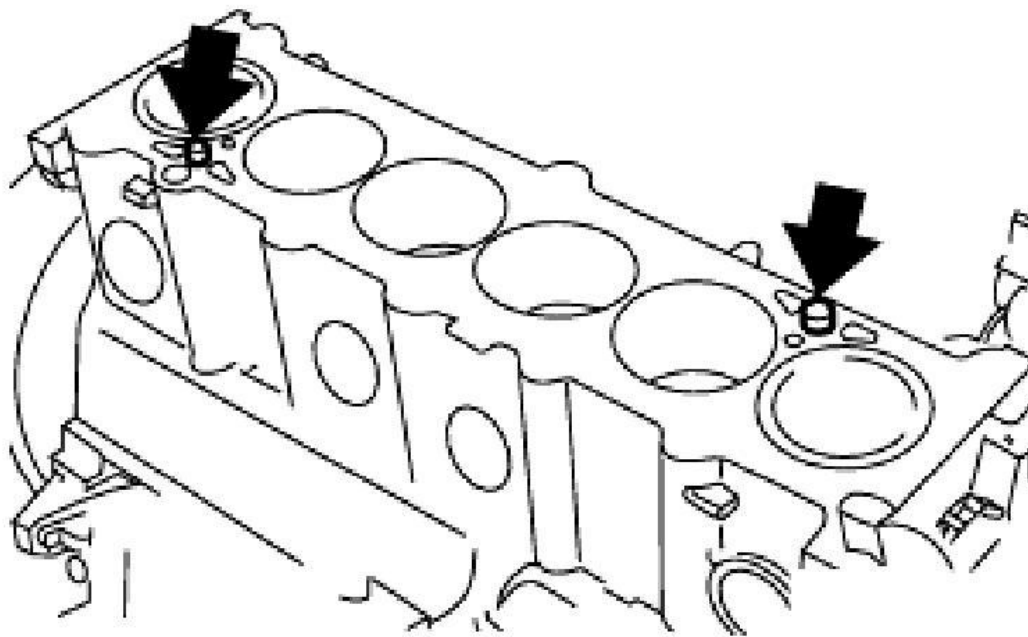
Installation

Installation of cylinder head is described separately from removal.

Clean sealing faces of cylinder head and engine block; if necessary, remove traces of gasket with hardwood spatula. Make sure no gasket remnants drop into oil and cooling channels.

Check dowel sleeves for damage and correct installation position.

Apply permanently elastic sealing compound Drei Bond 1209 to joints to timing case cover. Replace cylinder head gasket.



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Fig. 44: Locating Dowel Sleeves

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Use cylinder head bolts only once. There must be no oil in the tapped holes of the engine block and the timing case cover. Risk of cracking and distorted tightening values.

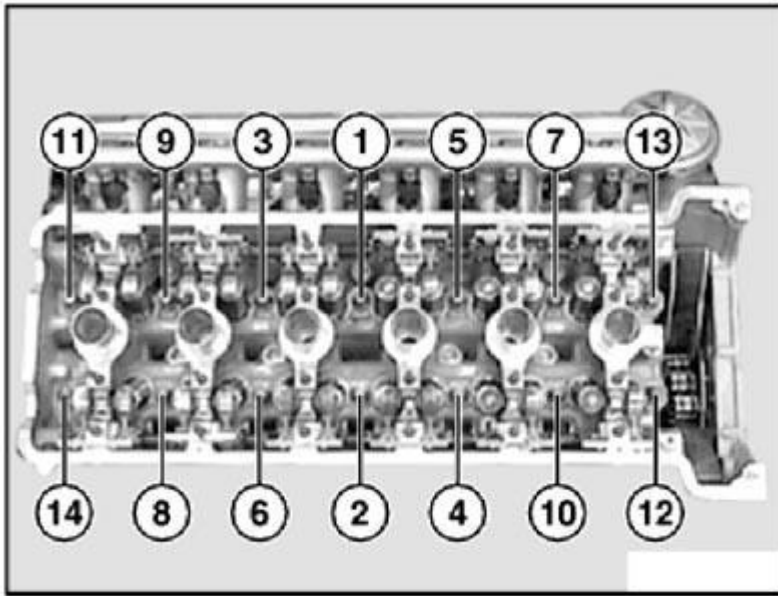
Put the cylinder head on.

Apply a light coat of oil to washer contact area and thread of new cylinder head bolts.

Tighten down cylinder head bolts in sequence 1 to 14.

Tightening torque, refer to 11 12 6AZ in **ENGINE - TIGHTENING TORQUES** .

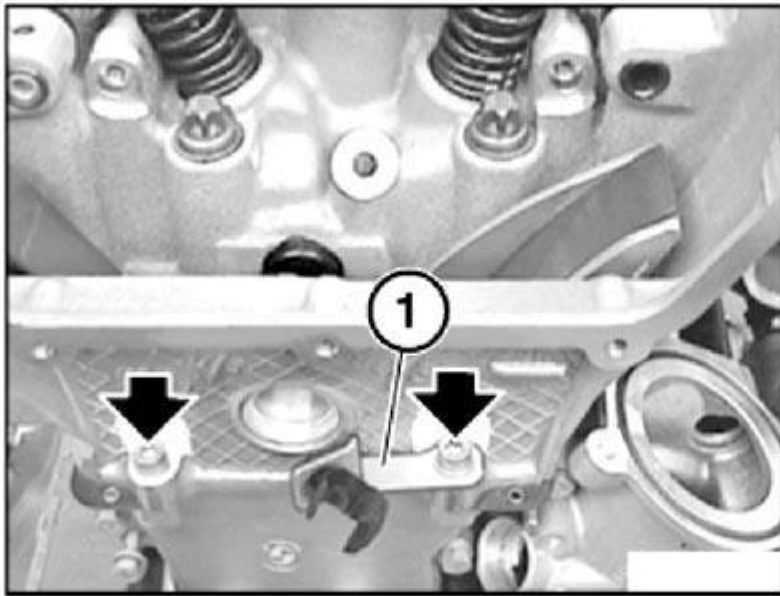
NOTE: Use special tool 00 9 120 for torsion angle tightening.



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Fig. 45: Tightening Sequence Of Cylinder Head Bolts
 Courtesy of BMW OF NORTH AMERICA, INC.

Install cable holder (1) and screws. Tighten down screws.

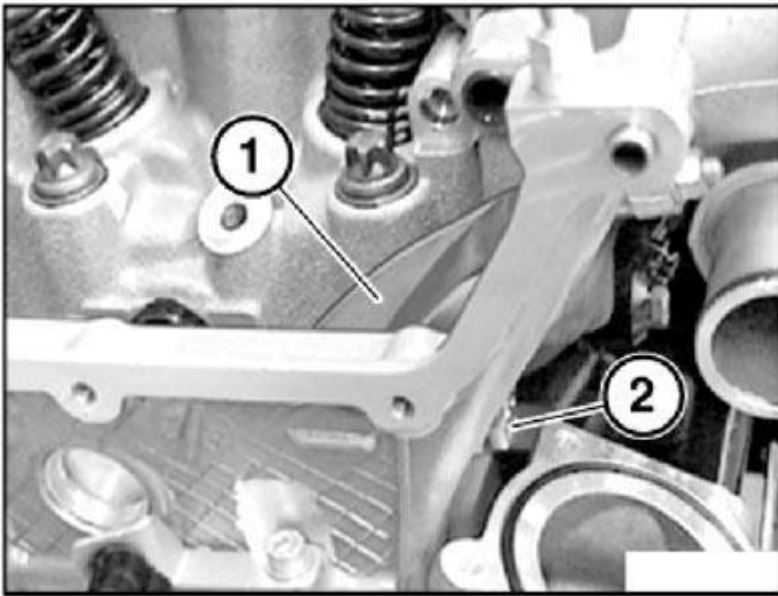


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Fig. 46: Installing Cable Holder**Courtesy of BMW OF NORTH AMERICA, INC.**

Replace sealing washer for screw (2).

Screw down sliding rail (1) with screw (2).



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Fig. 47: Installing Sliding Rail**Courtesy of BMW OF NORTH AMERICA, INC.**

Check dowel sleeves (1) for damage and correct installation position.

Replace sealing ring (2).

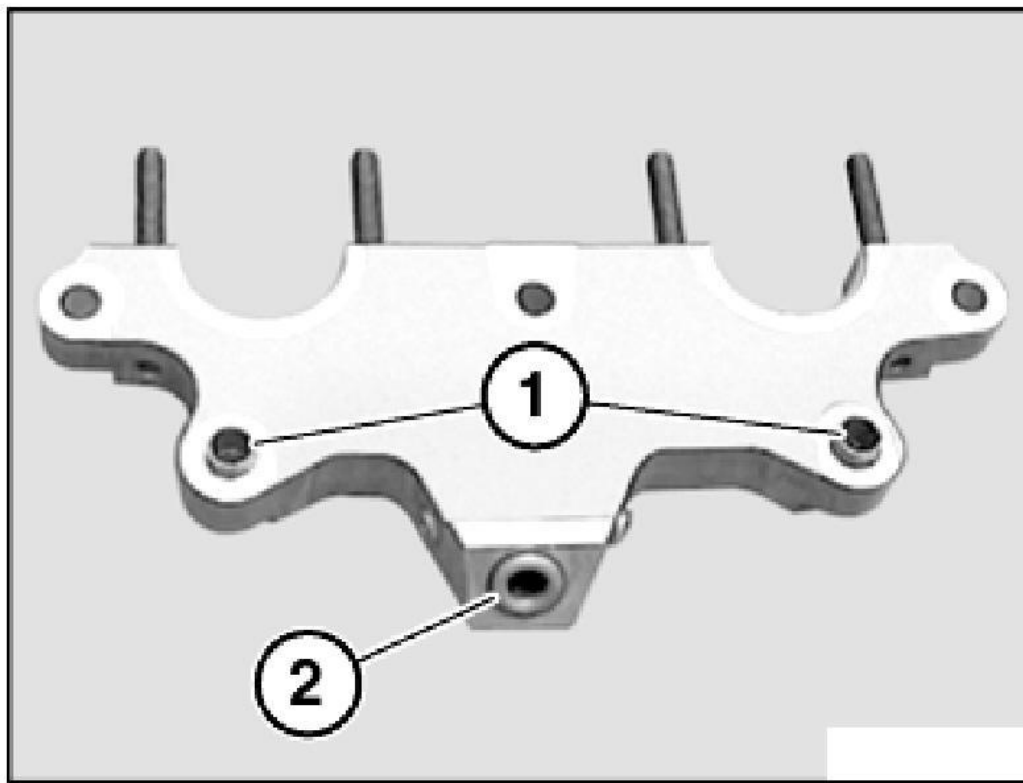
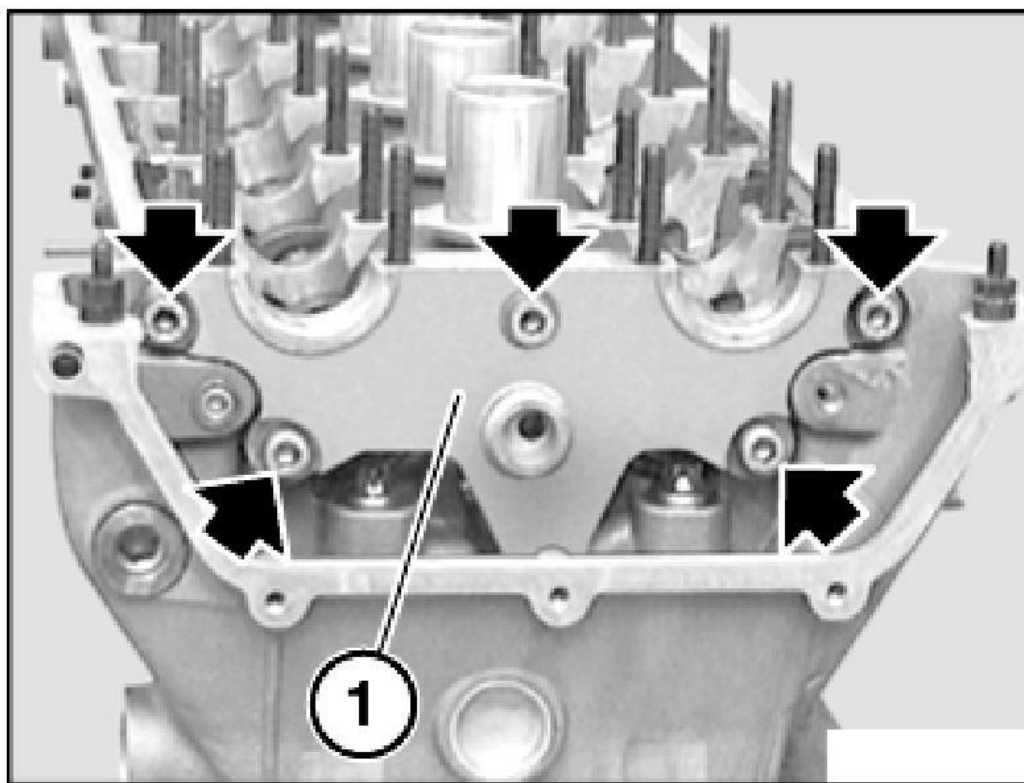
**G03117711**

Fig. 48: Replacing Sealing Ring
Courtesy of BMW OF NORTH AMERICA, INC.

Install thrust bearing flange (1).

Install and tighten down screws.



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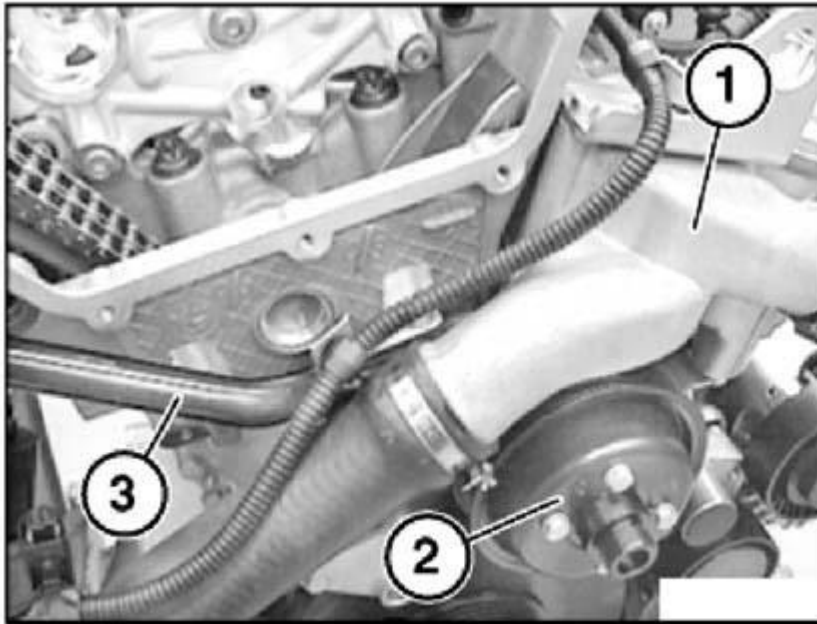
Fig. 49: Installing Thrust Bearing Flange
Courtesy of BMW OF NORTH AMERICA, INC.

Replace O-ring on pipe (3). Install pipe (3).

Install belt pulley (2).

Replace O-ring between thermostat housing (1) and water pump.

Replace O-ring between thermostat housing (1) and return pipe. Install thermostat housing (1) with thermostat.



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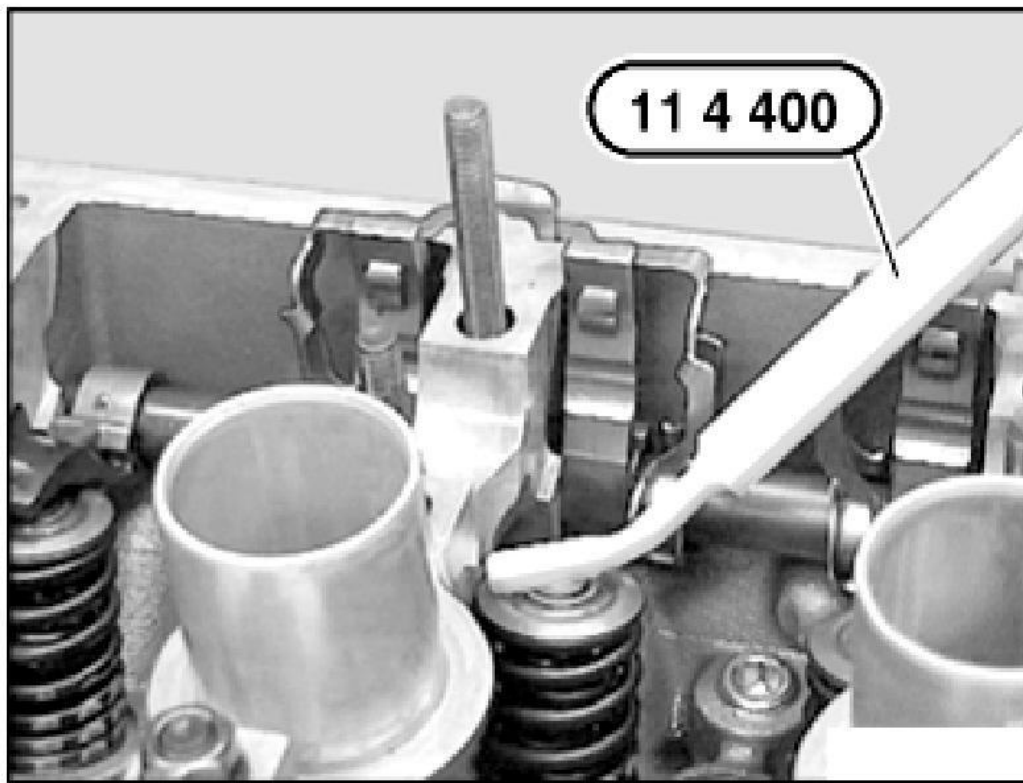
Fig. 50: Installing Belt Pulley And Thermostat Housing
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: It is very easy for the adjustment plates to fall down.

Raise rocker arm.

NOTE: Special tool 11 4 400 is magnetic.

Install all adjustment plates with special tool 11 4 400.

**G03117714****Fig. 51: Raising Rocker Arm****Courtesy of BMW OF NORTH AMERICA, INC.**

Install camshafts. Refer to **11 31 019 REPLACING CAMSHAFTS (S54)**.

Adjust valve clearance. Refer to **11 34 004 ADJUSTING VALVE CLEARANCE (S54)**.

Assemble engine.

11 12 101 REPLACING CYLINDER HEAD GASKET (S50 S54)

Operation is identical to **11 12 100 REMOVING AND INSTALLING/SEALING CYLINDER HEAD (S54)**.

11 12 503 DISASSEMBLING AND ASSEMBLING CYLINDER HEAD - CYLINDER HEAD REMOVED (S54)**Special Tools Required:**

- 00 1 490
- 11 0 192
- 11 0 342
- 11 0 343
- 11 0 345
- 11 1 045
- 11 1 065
- 11 1 067
- 11 1 071
- 11 3 411
- 11 3 412

Provide special tools for removing valve springs.

Secure special tool 11 1 065 to special tool 00 1 490.

- Special tool 11 1 071
- Special tool 11 1 067
- Special tool 11 0 192
- Special tool 11 1 045

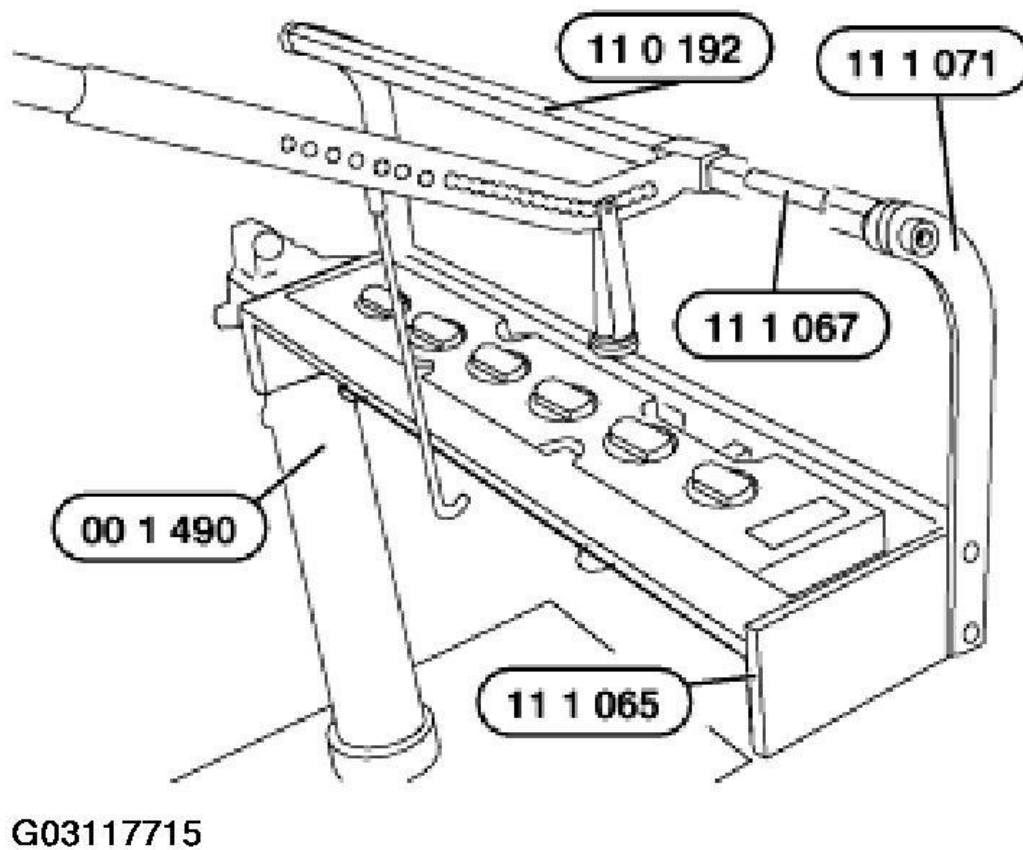
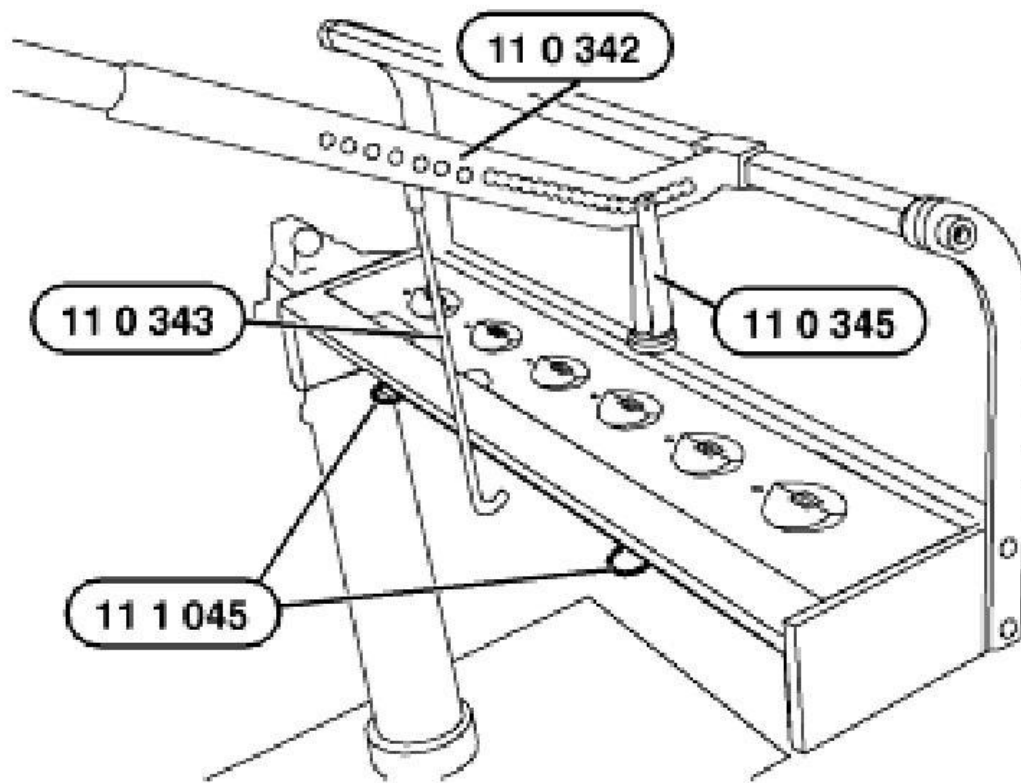


Fig. 52: Identifying Special Tools For Removing Valve Springs
Courtesy of BMW OF NORTH AMERICA, INC.

- Special tool 11 0 345
- Special tool 11 0 342
- Special tool 11 0 343
- Special tool 11 3 411

Secure special tool 11 3 411 with special tool 11 1 045 in special tool 11 1 065.

Assemble special tools.

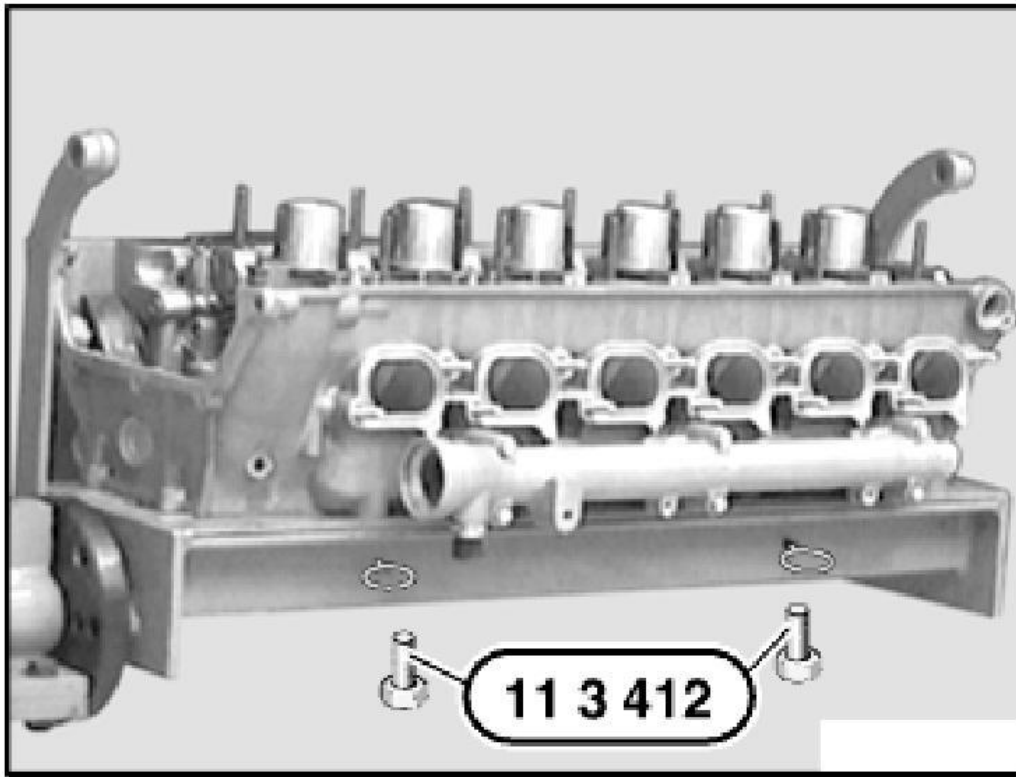


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Fig. 53: View Of Special Tools For Removing Valve Springs
Courtesy of BMW OF NORTH AMERICA, INC.

Secure cylinder head to special tool 11 1 065.

NOTE: Secure cylinder head from below through locating board with special tool 11 3 412 in spark plug threads.



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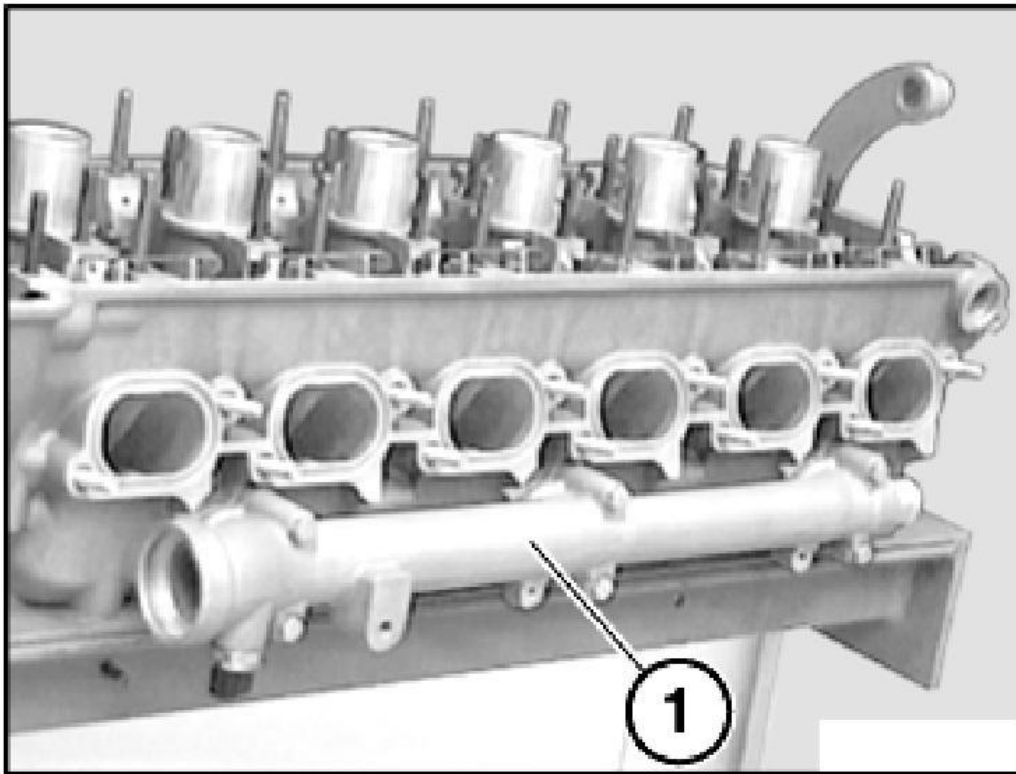
Fig. 54: Securing Cylinder Head To Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

Remove coolant pipe (1).

Installation:

Clean sealing surface.

Replace O-rings.

**G03117718****Fig. 55: Removing Coolant Pipe****Courtesy of BMW OF NORTH AMERICA, INC.**

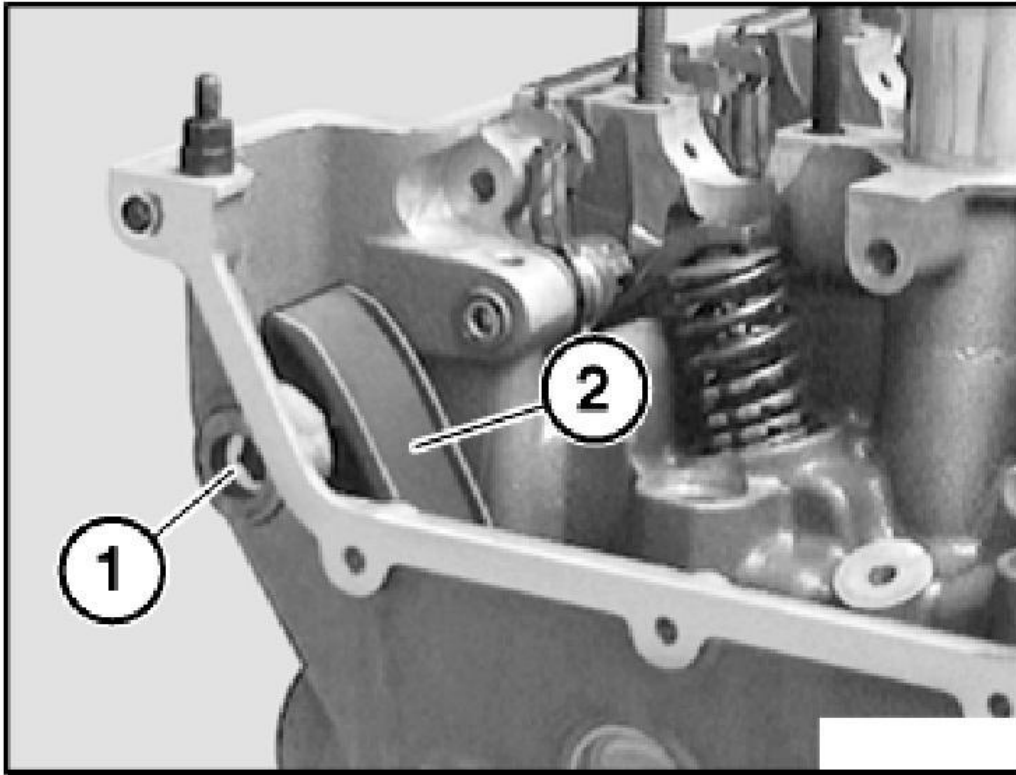
Release bearing pin (1) for tensioning rail (2).

Remove tensioning rail (2).

Installation:

Replace sealing ring.

Tightening torque of bearing pin (1) 13 N.m.



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Fig. 56: Removing Tensioning Rail

Courtesy of BMW OF NORTH AMERICA, INC.

Remove exhaust and inlet rocker arm shafts. Refer to **11 33 545 REMOVING AND INSTALLING/REPLACING ROCKER ARM SHAFT (S54)**.

Remove all valve springs. Refer to **11 34 715 REPLACING ALL VALVE SEALS - CYLINDER HEAD REMOVED (S54)**.

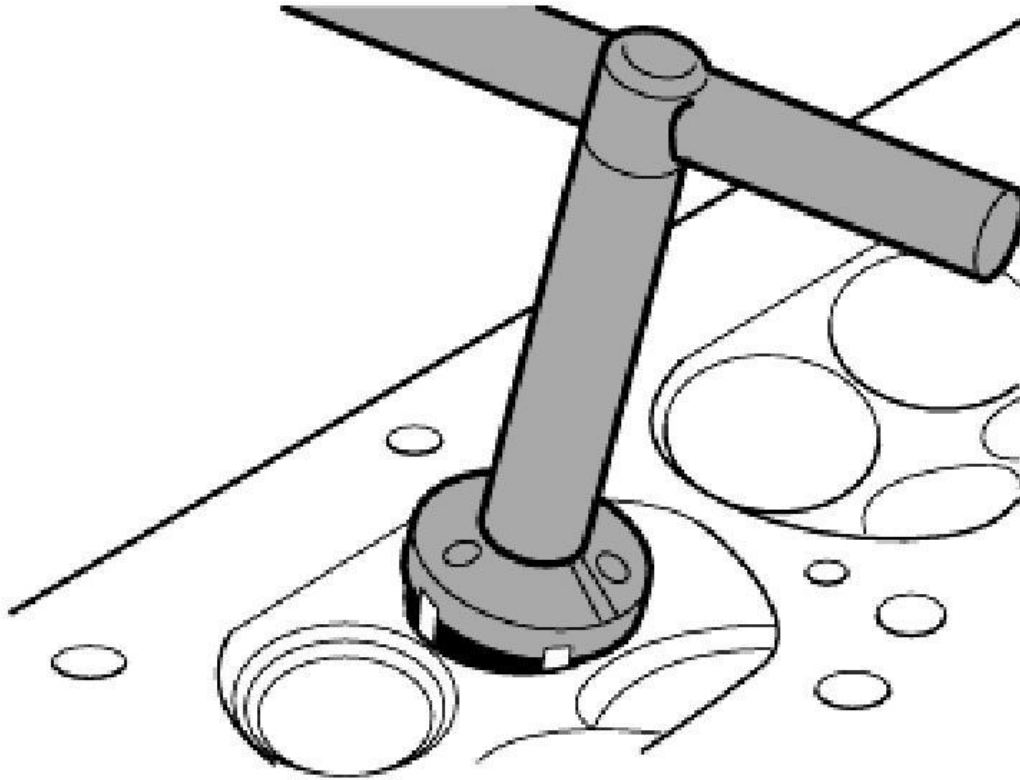
Replace all stem seals. Refer to **11 34 560 REPLACING ALL VALVE STEM SEALS - CYLINDER HEAD REMOVED (S50 / S54)**.

Remove all valves. Refer to **11 34 552 REMOVING AND INSTALLING OR REPLACING ALL VALVES - CYLINDER HEAD REMOVED (S54)**.

11 12 527 REMACHINING A VALVE SEAT - CYLINDER HEAD DISASSEMBLED (S50/S54)

Machine valve seat surface with special tool 00 3 520 or with 00 3 580 in accordance with tool manufacturer's

instructions.



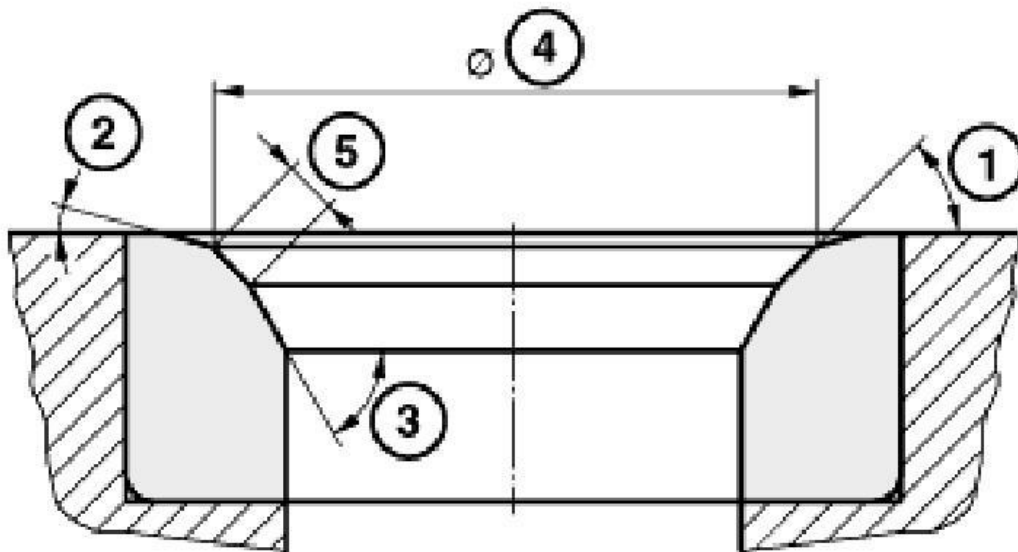
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Fig. 57: Machining Valve Seat Surface With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: After machining valve-seat surface: Remachine outside and inside diameters with correction milling tool to the) specified diameters until you obtain valve seat width (5).

1. Valve-seat angle.
2. Correction angle, outside.
3. Correction angle, inside.
4. Outside diameter of seat face.
5. Valve-seat width.

Items (1) to (5). Refer to **ENGINE - TECHNICAL DATA** .



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Fig. 58: Sectional View Of Valve Seat
Courtesy of BMW OF NORTH AMERICA, INC.

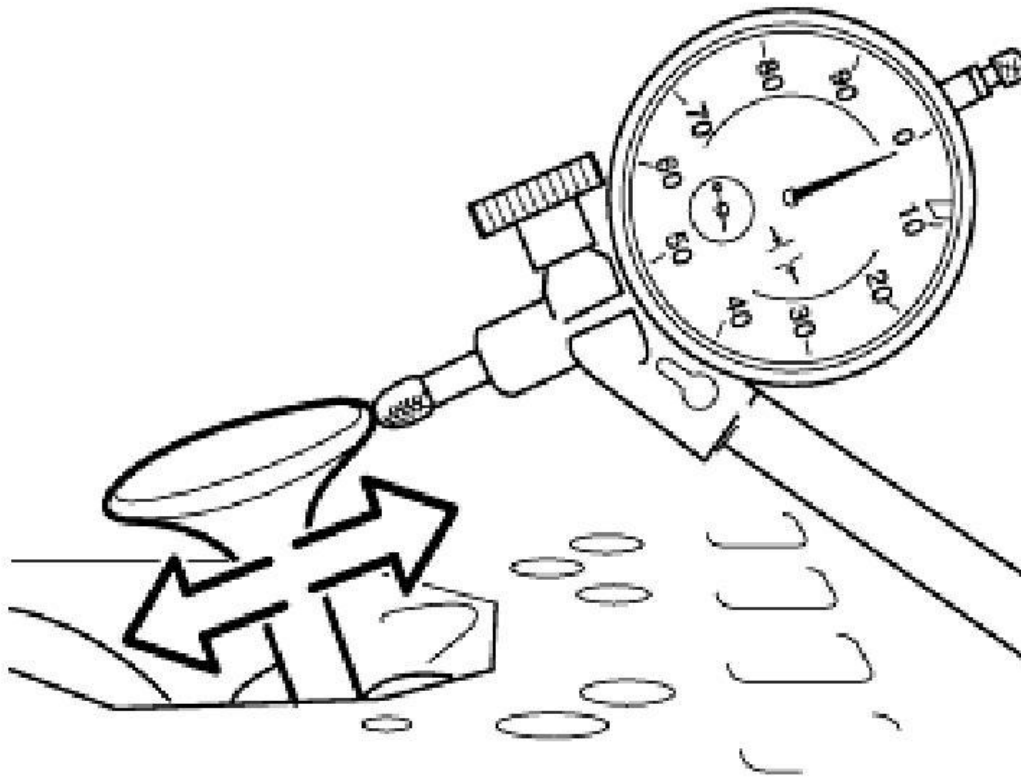
11 12 595 CHECKING A VALVE GUIDE FOR WEAR - VALVE REMOVED (S50/S54)

Measure tilt clearance.

For measurement, install a new valve in such a way that the end of the valve shaft seals the valve guide.

Mount dial gauge and measure tilt clearance.

Max. permissible tilt clearance, refer to **ENGINE - TECHNICAL DATA** .



G03117722

Fig. 59: Measuring Tilt Clearance

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Repair valves of larger stem diameters are "not" supplied.

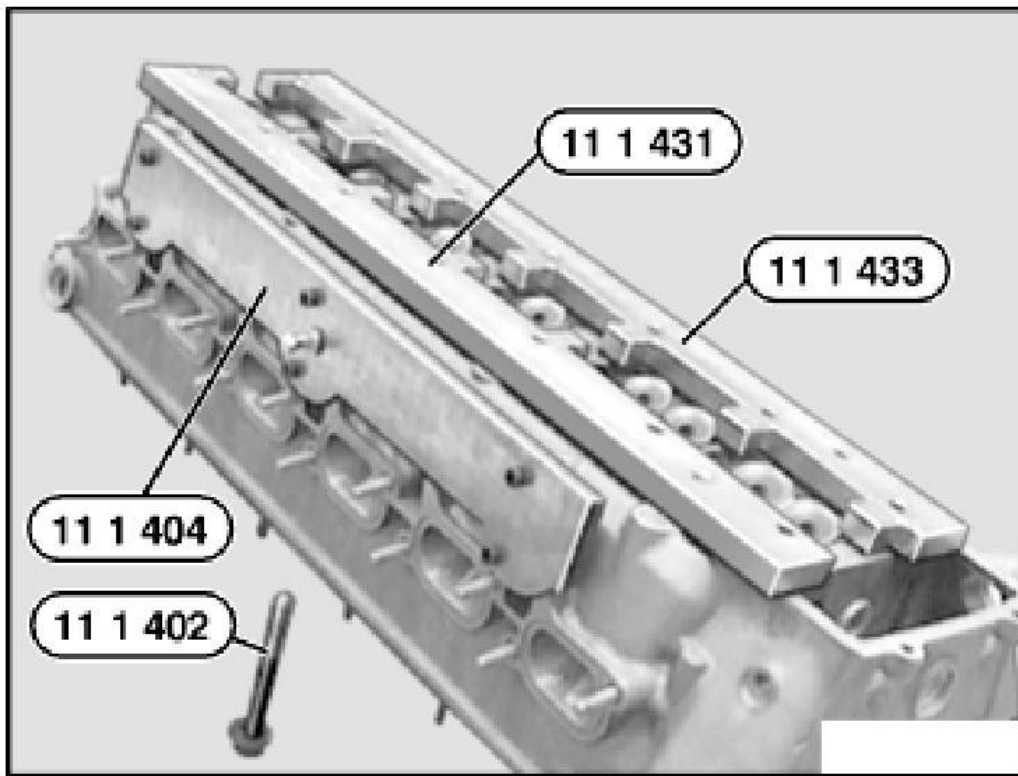
In event of excessive tilt clearance: replace cylinder head.

11 12 729 CHECKING CYLINDER HEAD FOR LEAKS - CYLINDER HEAD REMOVED (S54)**Special Tools Required:**

- 11 1 402
- 11 1 404
- 11 1 431
- 11 1 433

Seal off coolant openings with following special tools.

- Special tool 11 1 431
- Special tool 11 1 433
- Special tool 11 1 402
- Special tool 11 1 404



G03117723

Fig. 60: Sealing Off Coolant Openings With Special Tools
Courtesy of BMW OF NORTH AMERICA, INC.

Connect compressed air supply to special tool 11 1 404.

Immerse cylinder head in a water bath.

Test pressure: 4.5 bar.

Check cylinder head for escaping air (cracks).

NOTE: If necessary, soften the bath water with a cleaning agent.



G03117724

Fig. 61: Connecting Compressed Air Supply To Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

OIL SUMP

11 13 000 REMOVING AND INSTALLING, SEALING OR REPLACING OIL SUMP (S54)

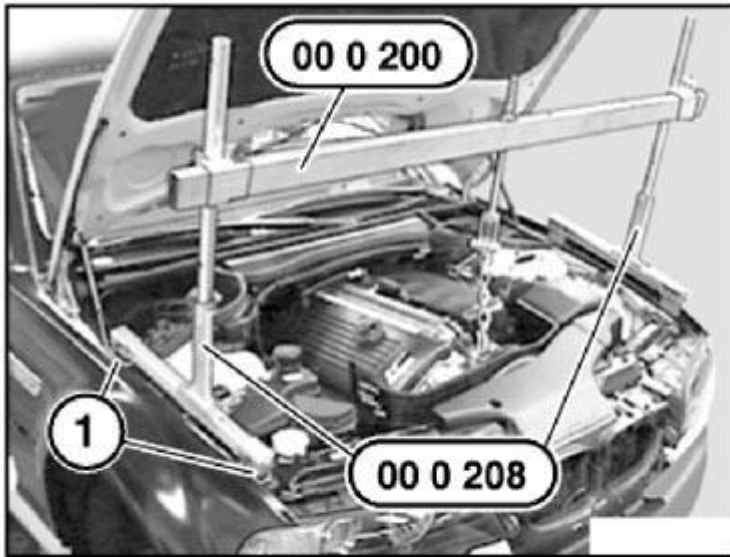
NOTE: To remove the oil sump, you must lower the front axle support. There is no need to perform a front axle alignment check.

Fit special tool 00 0 200 to special tool 00 0 201 / 202 / 204 / 208 and attach.

Secure special tool 00 0 200 to the front suspension lug on the engine.

NOTE: The supports (1) of special tool 00 0 208 must rest on the bolt connection of

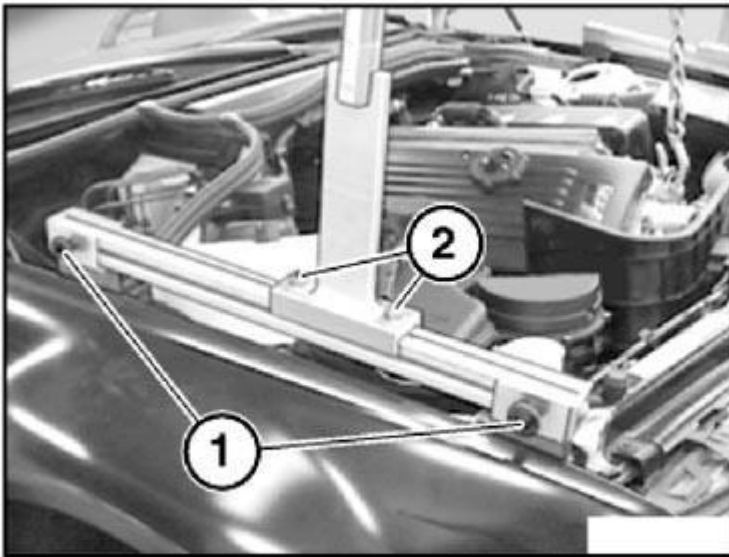
both side walls.



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Fig. 62: Securing Special Tool To Front Suspension Lug On Engine
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten the screws (1 and 2).



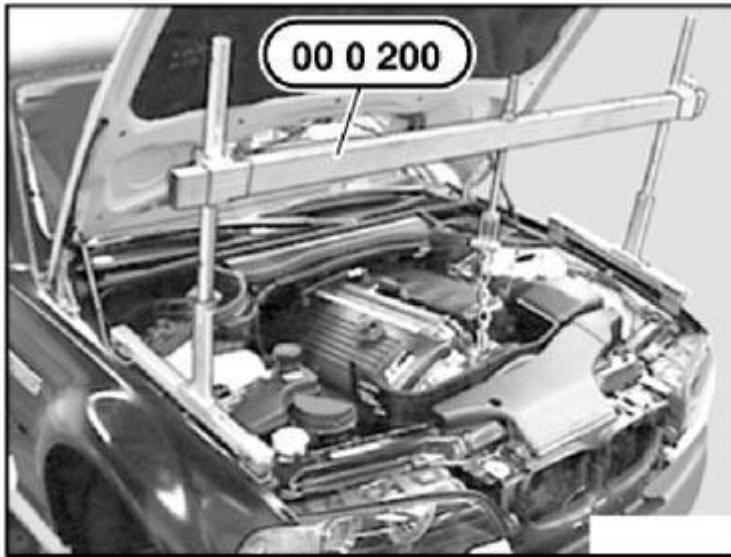
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Fig. 63: Locating Screws Of Special Tool

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Do not damage fan cowl. If necessary, release fan cowl and remove fan with fan clutch.

Raise engine with special tool 00 0 200 approx. 10 mm.



G03117727

Fig. 64: Raising Engine With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

Remove suction-filter housing. Refer to **13 71 000 REMOVING AND INSTALLING INTAKE FILTER HOUSING (S54)** .

Detach guide tube (1) for oil dipstick from intake air manifold.

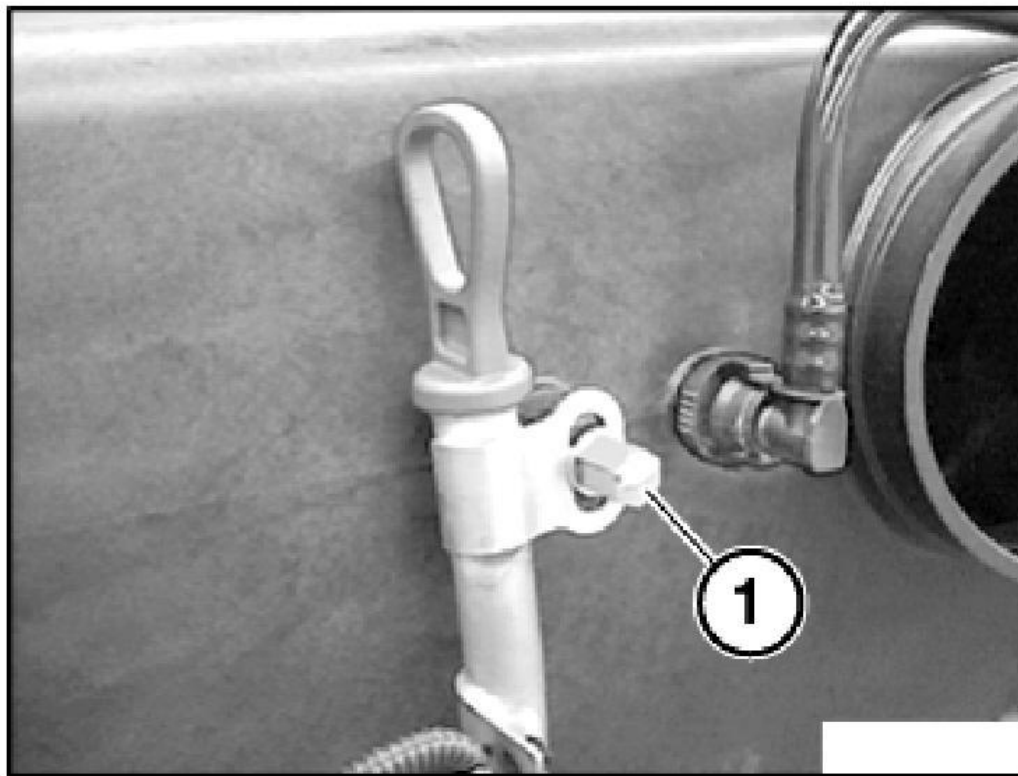
**G03117728**

Fig. 65: Detaching Guide Tube For Oil Dipstick From Intake Air Manifold
Courtesy of BMW OF NORTH AMERICA, INC.

Remove engine splash guard.

Remove reinforcement plate.

CAUTION: The article **51 71 374 REMOVING AND INSTALLING / REPLACING REINFORCEMENT PLATE ON FRONT AXLE SUPPORT (M3)** contains important installation instructions.

Drain engine oil. Refer to **00 00 250 BMW ENGINE OIL SERVICE INCL. SUPPLEMENTARY SERVICE (S54)**.

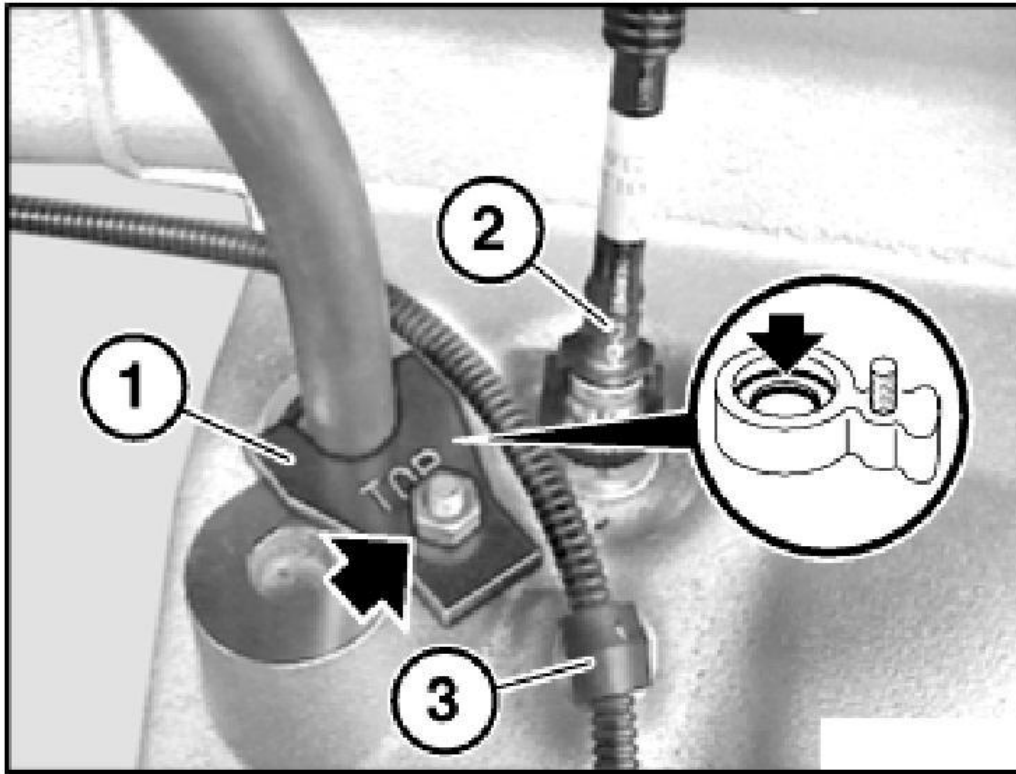
Unfasten nut. Unscrew holder (1).

Press side locks and detach condensate return (2).

Open cable holder (3).

Installation:

Replace O-ring. Insert O-ring and washer in oil sump.



G03117729

Fig. 66: Removing Cable Holder

Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten steering spindle from steering gear. Refer to **POWER STEERING GEAR** .

Detach oil lines from vane pump bracket.

Remove drive belt from belt pulley of power steering vane pump. See **POWER STEERING VANE PUMP (M52/M54)**

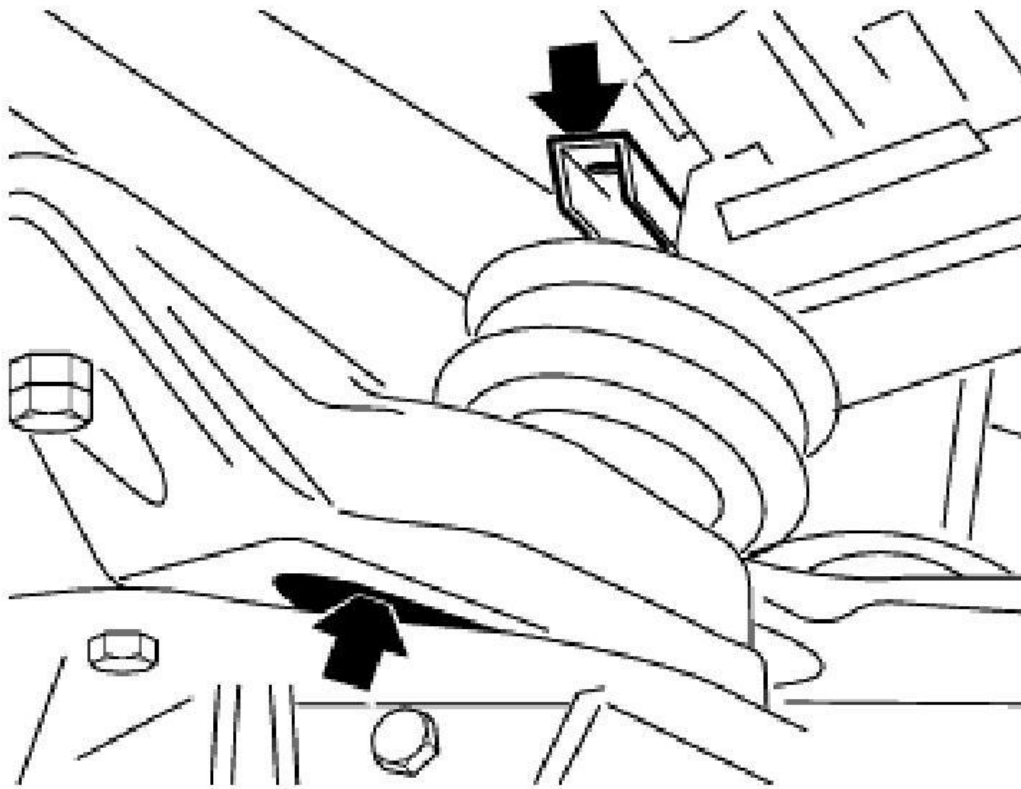
Remove vane pump for power steering. See **POWER STEERING VANE PUMP (M52/M54)**

NOTE: Lines remain connected.

Disconnect plug connection to oil level sensor.

Disconnect plug connection to level sensor.

Loosen top and unfasten bottom of left and right engine mounts.



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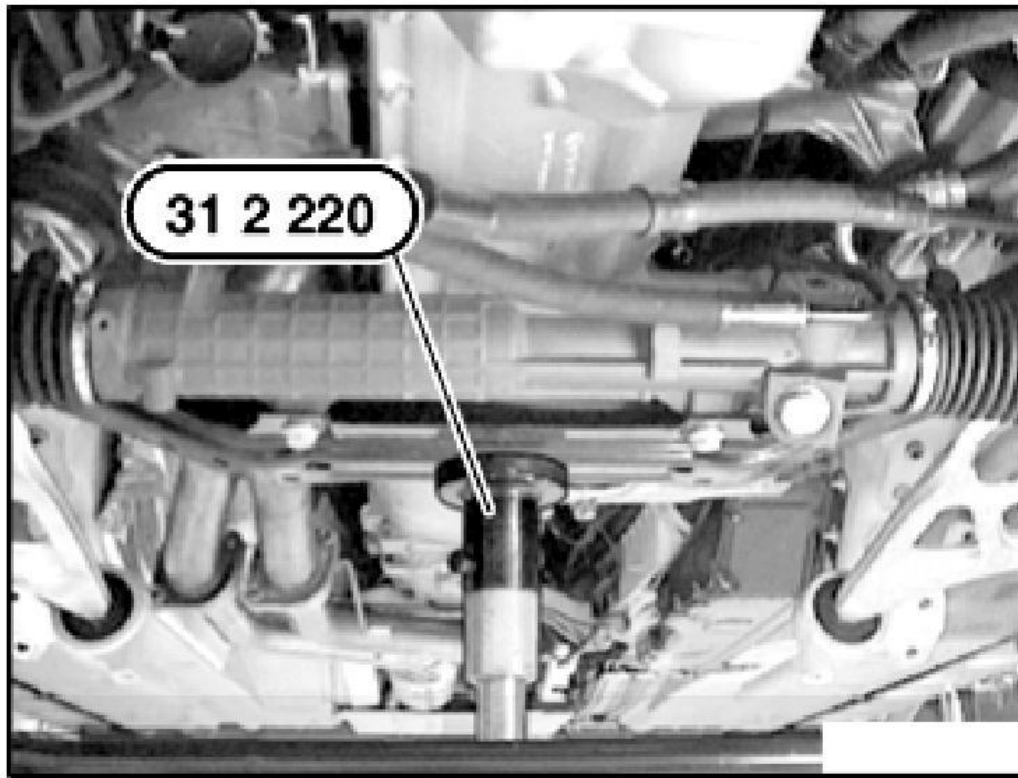
Fig. 67: Locating Left And Right Engine Mounts
Courtesy of BMW OF NORTH AMERICA, INC.

Detach brackets for left and right control arms from engine carrier. Release retaining brackets for left and right stabilizer bars.

Support front axle support with special tool 31 2 220 in conjunction with special tool 00 2 030.

Release front axle support bolt connection and lower front axle support approx. 100 mm.

These operations are described in **DRIVE AXLE SHAFTS & SEAL (FRONT, ALL WHEEL DRIVE)** .



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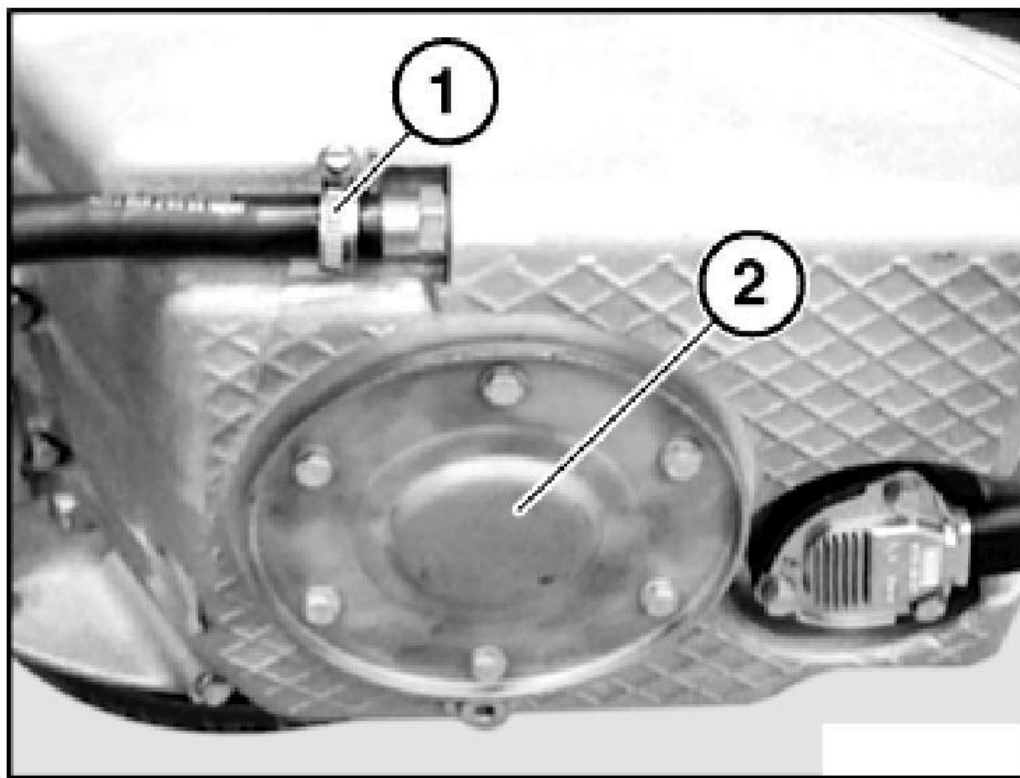
Fig. 68: Supporting Front Axle Support With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: There is no need to detach the steering gear from the front axle support.

Detach return hose (1) of oil separator from oil sump.

CAUTION: A residual amount of oil will emerge after the screws on the cover (2) are released. Have cleaning cloths and container ready.

Remove cover (2) from oil sump.



G03117732

Fig. 69: Locating Oil Return Hose And Oil Sump Cover
Courtesy of BMW OF NORTH AMERICA, INC.

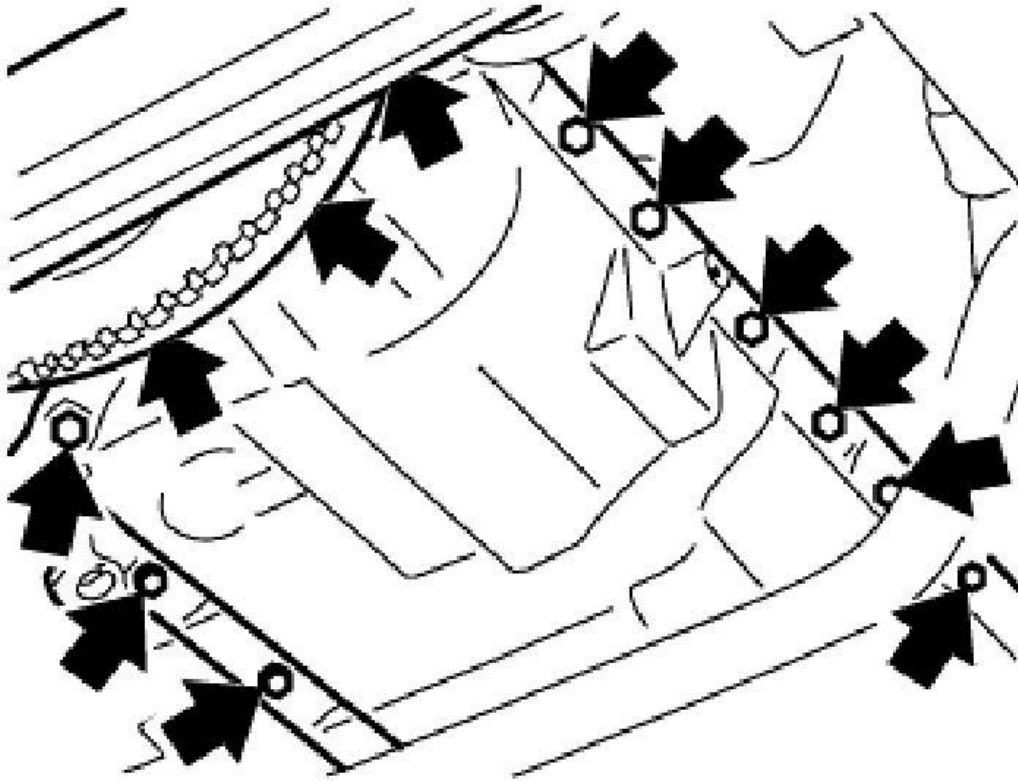
Installation:

Replace gasket on cover (2).

Unfasten oil sump screws at transmission and engine ends.

CAUTION: A residual amount of oil remains in front section of oil sump. Have cleaning cloths and container ready.

Lower and remove oil sump.



G03117733

Fig. 70: Removing Oil Sump
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Sealing faces clean and free of seal debris. Check seal, replace if necessary.

Apply Drei Bond 1209 sealing compound to area around joint: approx. 3 mm wide and 2 mm high.

Installation:

1. Install oil sump.
2. Install all oil pan screws.
3. Insert screws in transmission end without preload at this stage.
4. Tighten down screws in engine end.
5. Tighten down screws in transmission end.

HOUSING COVER

11 14 110 REMOVING AND INSTALLING, SEALING OR REPLACING TIMING CASE COVER (S50 / S54)

Special Tools Required:

- 00 0 200

NOTE: Illustrations show the S50. The procedure is identical for the S54.

Unscrew oil sump. Refer to **11 13 000 REMOVING AND INSTALLING, SEALING OR REPLACING OIL SUMP (S54)**.

NOTE: After removing oil sump, reinstall front axle support provisionally and remove special tool 00 0 200.

Remove cylinder head. Refer to **11 12 100 REMOVING AND INSTALLING/SEALING CYLINDER HEAD (S54)**.

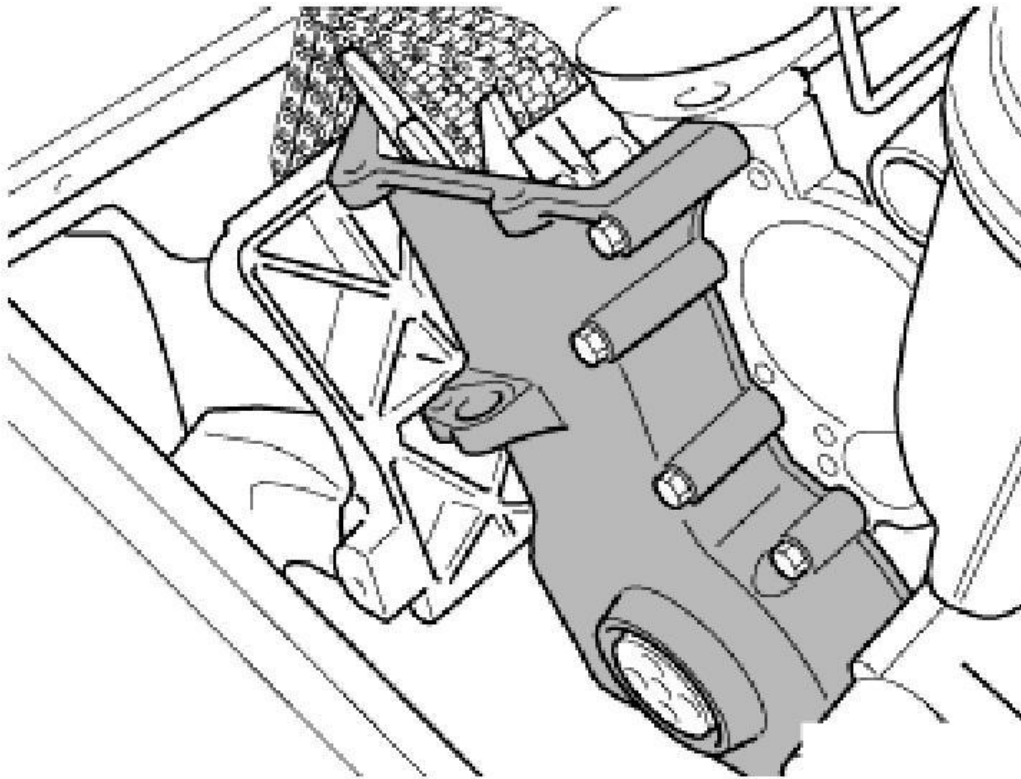
Remove vibration damper. Refer to **11 23 010 REMOVING AND INSTALLING/REPLACING VIBRATION DAMPER (S54)**.

Remove radial seal. Refer to **11 14 141 REPLACING RADIAL SEAL IN LOWER TIMING CASE COVER (S50 / S54)**.

NOTE: Install new radial seal only after installing timing case cover.

Remove vane pump from timing case cover (lines remain connected).

Unfasten screws and remove timing case cover.

**G03117735****Fig. 71: Removing Timing Case Cover****Courtesy of BMW OF NORTH AMERICA, INC.**

NOTE: Dowel pins for location purposes are pressed into the timing case cover.

Installation:

Keep sealing faces clean and free of oil. Check dowel pins for damage and correct installation position.

Replace seals.

Apply a thin coat of Drei Bond 1209 sealing compound to ends of seals at front and rear.

Position seals on dowel pins in timing case cover.

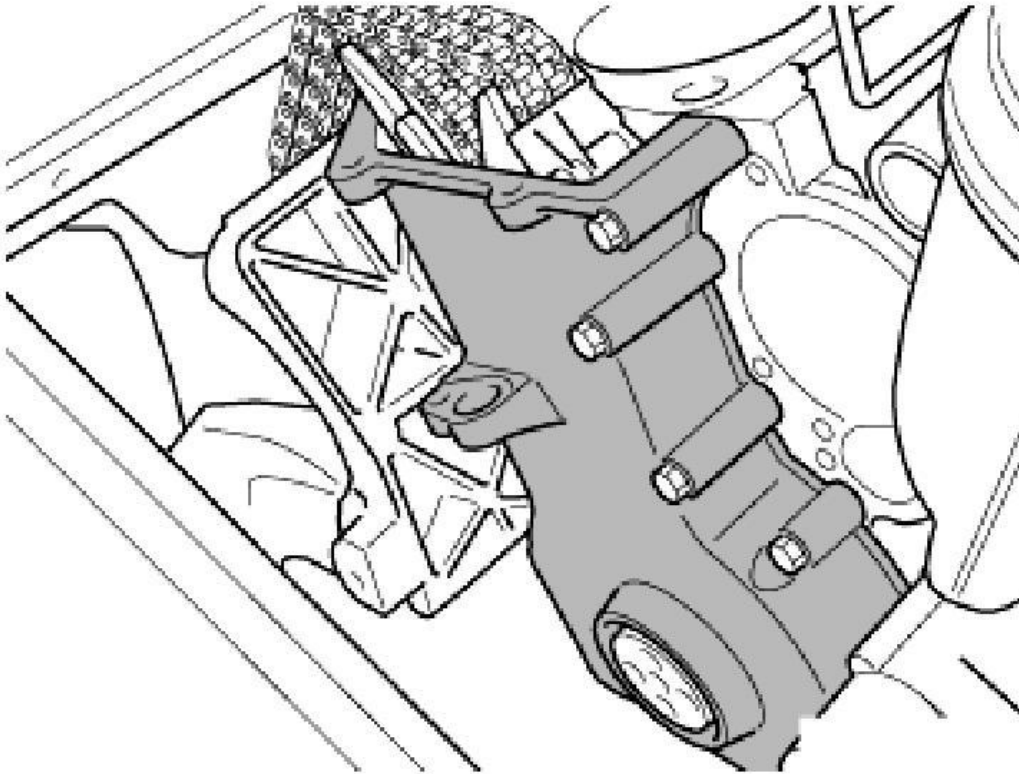
Installation:

Fit timing case cover with seals, insert all screws and pretighten to approx. 5 N.m.

Fully tighten all screws in alternate sequence.

Tightening torque, refer to 11 14 1AZ in **ENGINE - TIGHTENING TORQUES** .

CAUTION: Once all screws have been tightened down, retighten them in a second operation.



G03117736

Fig. 72: Installing Timing Case Cover
Courtesy of BMW OF NORTH AMERICA, INC.

Replace radial sealing ring. Refer to **11 14 141 REPLACING RADIAL SEAL IN LOWER TIMING CASE COVER (S50 / S54)**.

Assemble engine.

11 14 141 REPLACING RADIAL SEAL IN LOWER TIMING CASE COVER (S50/S54)

Special Tools Required:

- 11 1 220
- 11 2 380
- 11 2 384
- 11 5 090
- 11 7 240

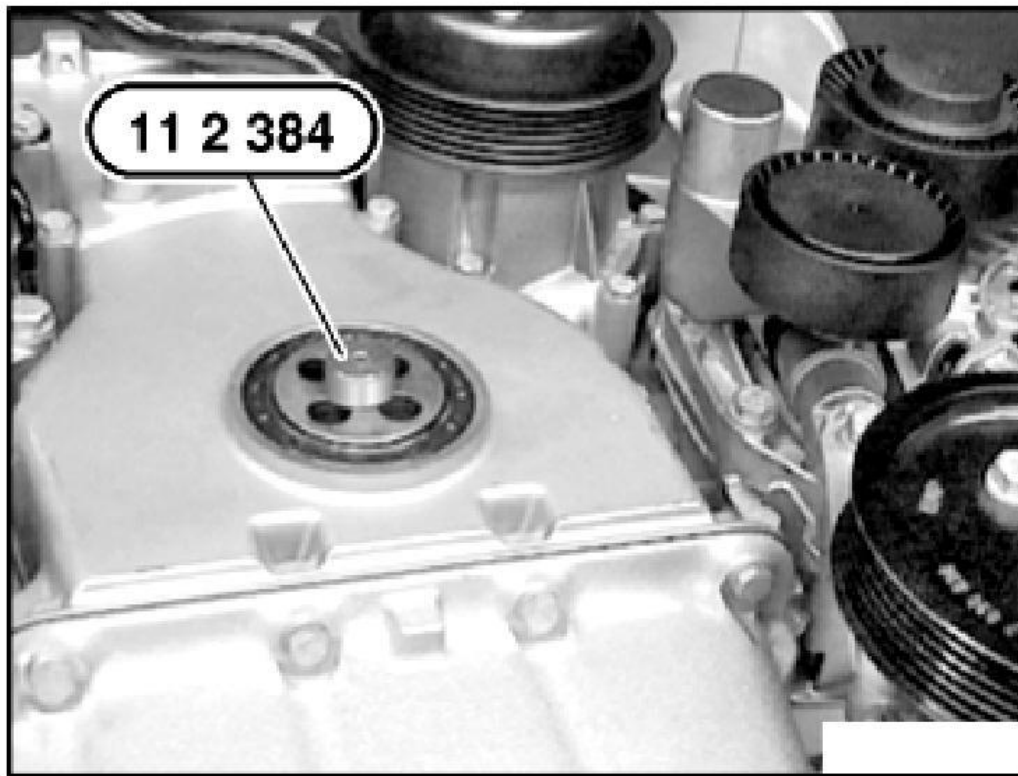
Remove vibration damper. Refer to **11 23 010 REMOVING AND INSTALLING/REPLACING VIBRATION DAMPER (S54)**.

NOTE: Illustrations show the S54.

The special tools and the actual procedure are identical for the S50.

Removal:

Fit special tool 11 2 384 on crankshaft.

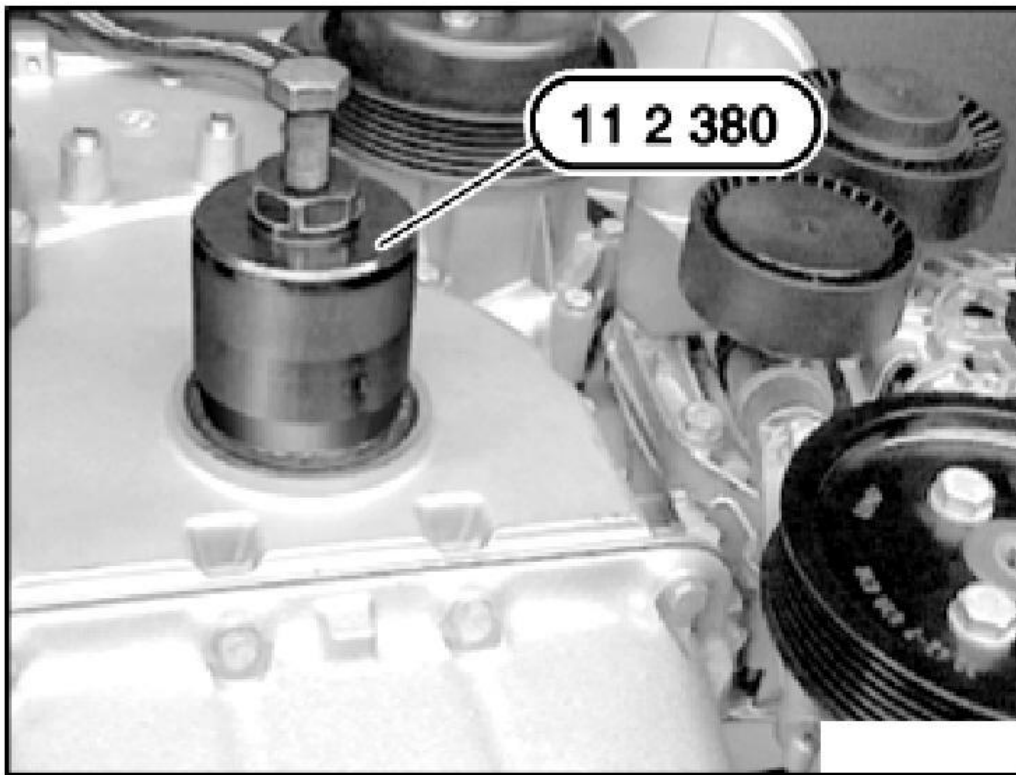


G03117737

Fig. 73: Installing Special Tool On Crankshaft
Courtesy of BMW OF NORTH AMERICA, INC.

Screw in special tool 11 2 380 until it is firmly connected to the radial seal.

Remove radial seal by tightening in the screw.



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Fig. 74: Removing Radial Seal
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

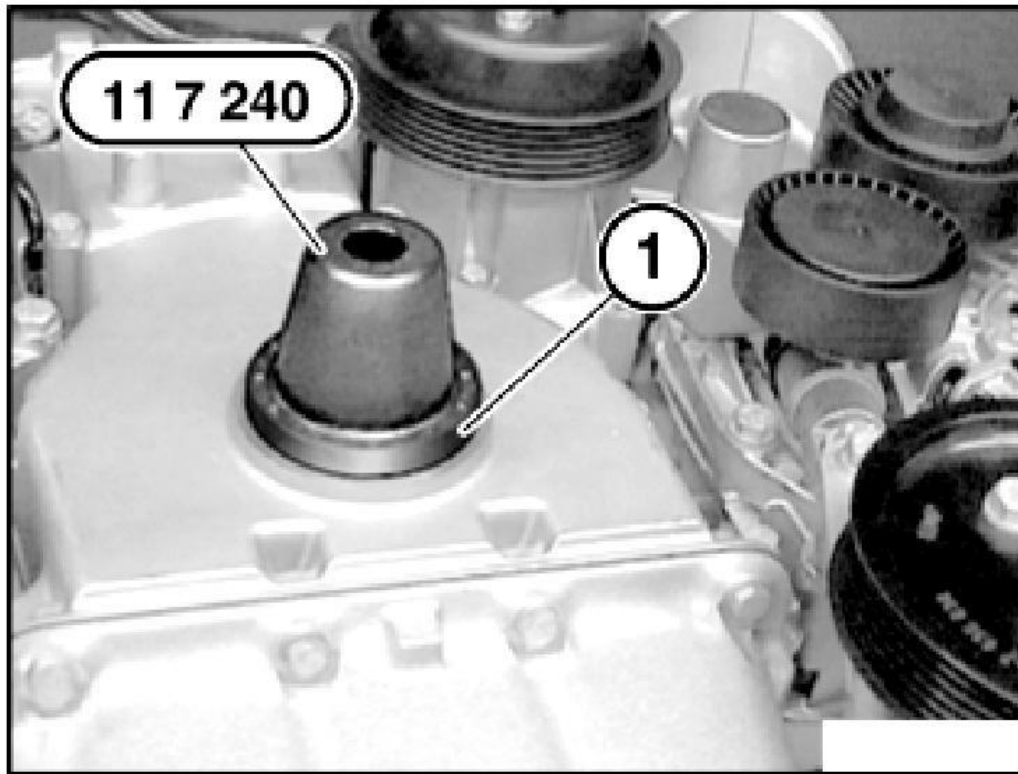
CAUTION: Do not touch sealing lip of new radial seal with your fingers.

Fit special tool 11 7 240 on sprocket wheel.

Oil sealing lips of new radial seal (1).

Push radial seal (1) over special tool 11 7 240 until it rests against timing case cover.

Remove special tool 11 7 240.



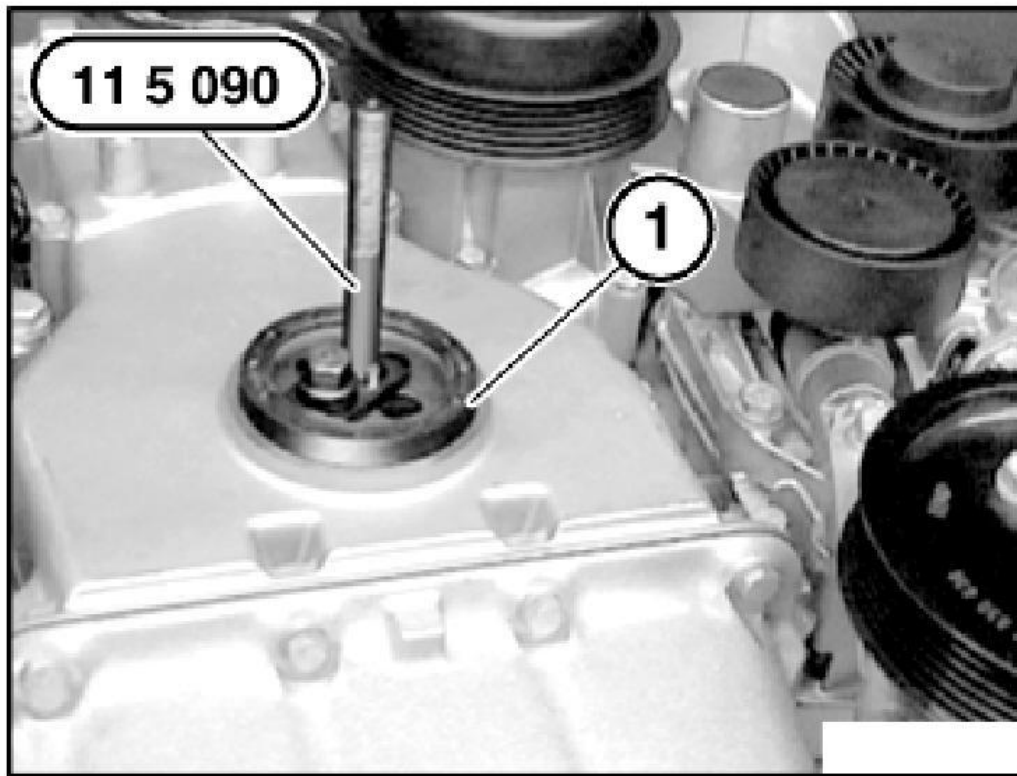
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Fig. 75: Identifying Fixture For Installing Rotary Shaft Seal

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Do not touch sealing lip of new radial seal (1) when installing special tool 11 5 090.

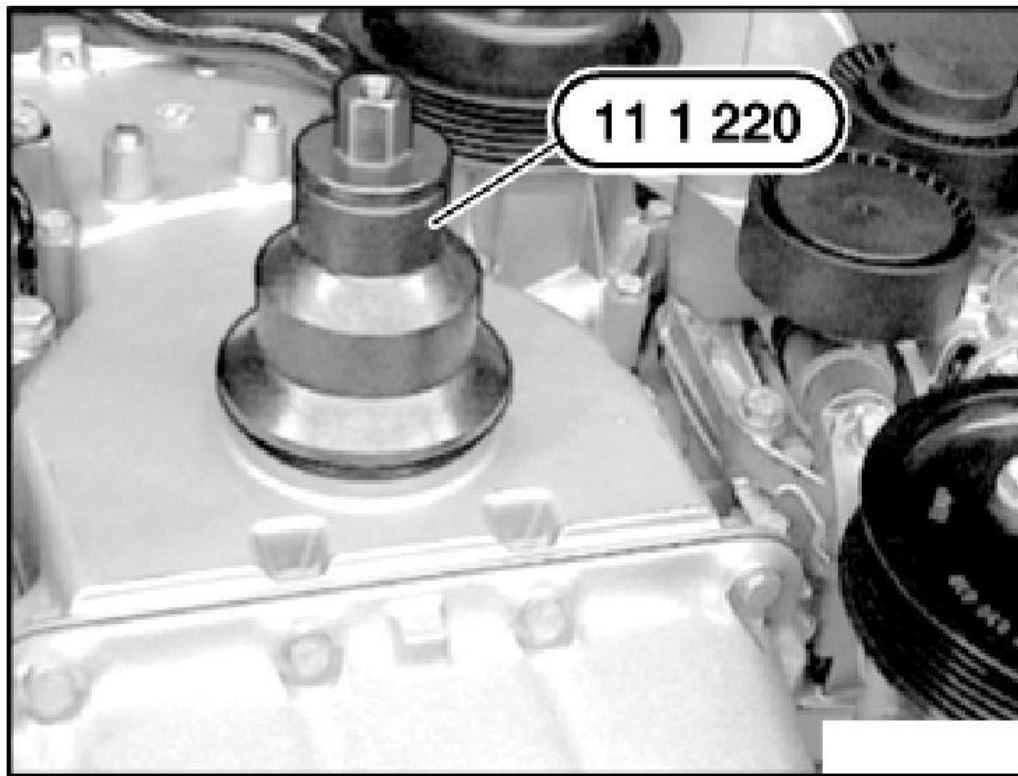
Install special tool 11 5 090 and tighten down.



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Fig. 76: View Of Fixture In Timing Case Cover
Courtesy of BMW OF NORTH AMERICA, INC.

Draw in new radial seal with special tool 11 1 220 until it is flush with timing case cover.



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Fig. 77: View Of Installation Bushing

Courtesy of BMW OF NORTH AMERICA, INC.

11 14 151 REPLACING CRANKSHAFT RADIAL SEAL (TRANSMISSION SIDE)

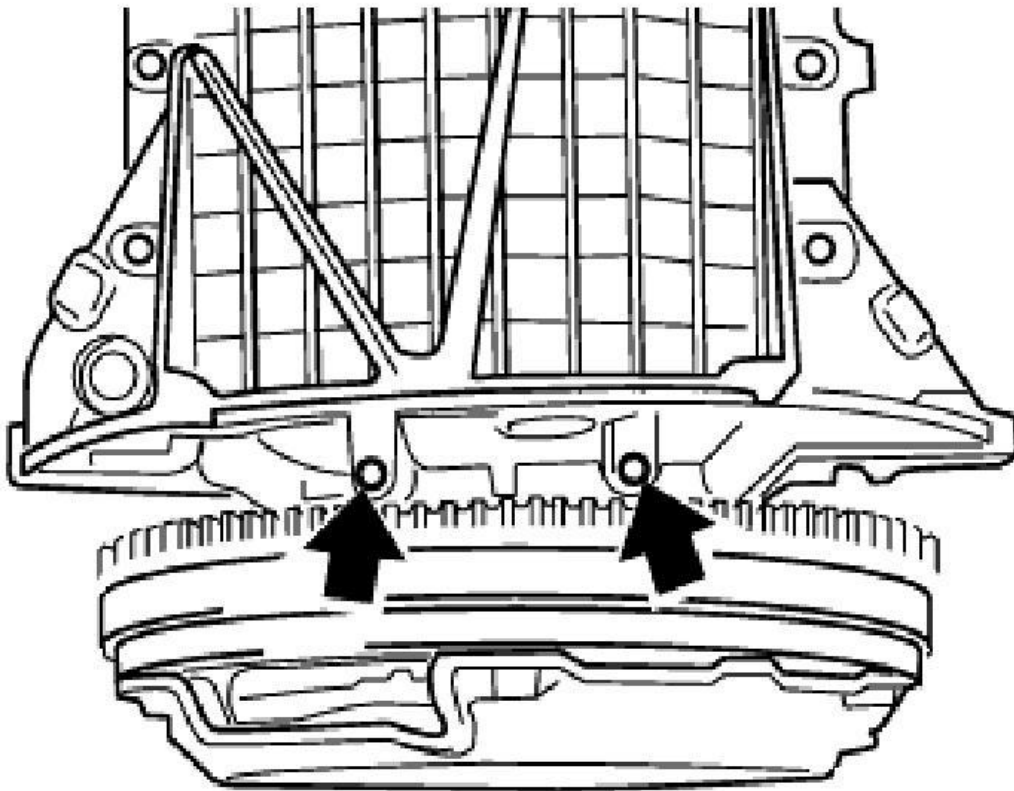
NOTE: This repair instruction is valid for the following engines:

- M40 / M42 / M43 / M43TU / M44
- M50 / M52 / M52TU / M54 / M56
- S52/S54

Necessary Preliminary Tasks:

- Remove gearbox.
- Drain off engine oil.
- Remove flywheel. See **11 22 500 Removing And Installing Or Replacing Flywheel (M52/S52/M52TU/M54/S54)**

Unfasten oil sump screws on transmission end. Loosen oil pan.



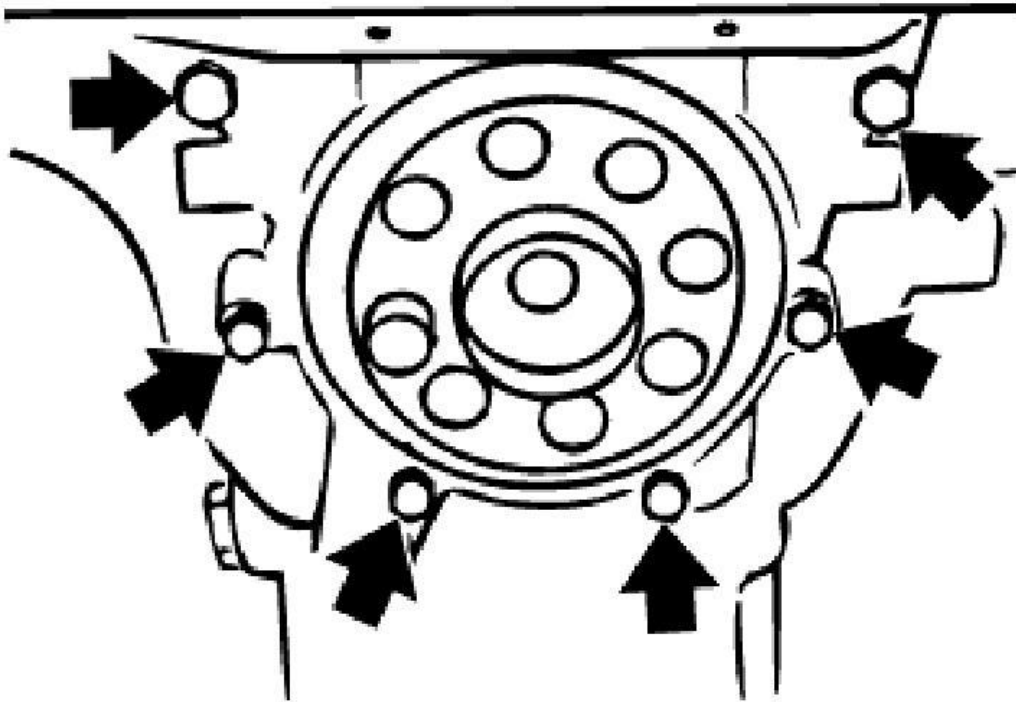
G03117742

Fig. 78: Unfastening Oil Sump Screws On Transmission End
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws in end cover at rear.

Carefully detach oil sump gasket from end cover, remove end cover.

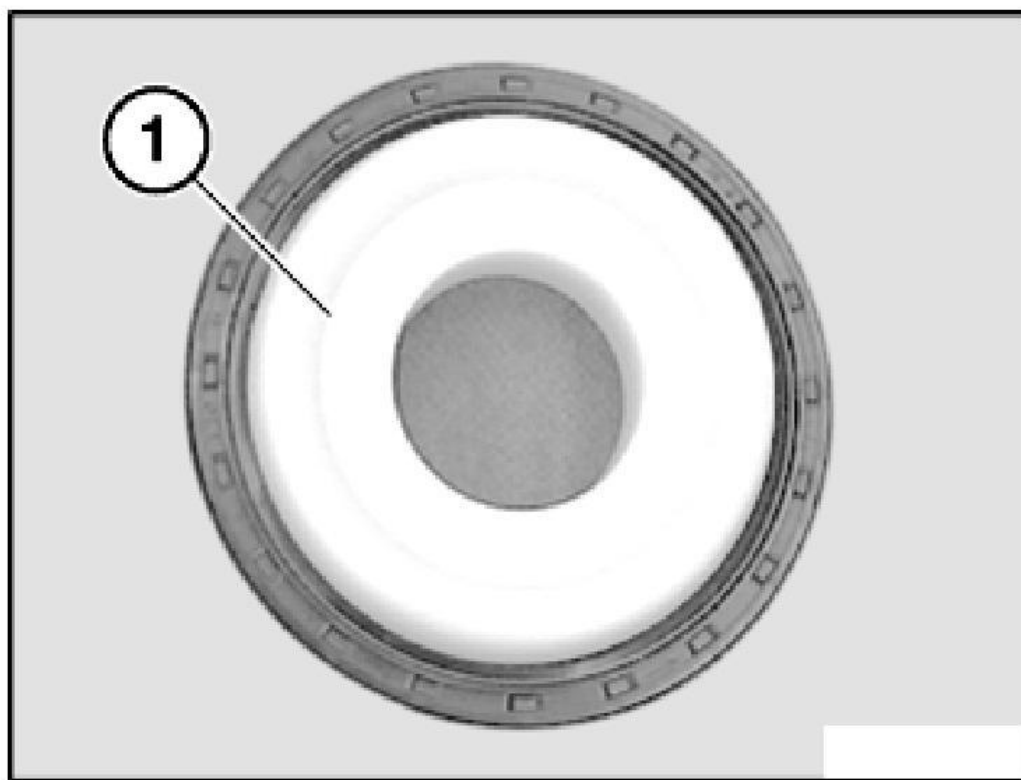
NOTE: After removing end cover: check oil sump gasket for damage. If necessary, remove oil sump and replace oil sump gasket.



G03117743

Fig. 79: Releasing Screws In End Cover At Rear
Courtesy of BMW OF NORTH AMERICA, INC.

- NOTE:** As from 4/98, a new type of radial seal is used in the Series and as a replacement. This radial seal may only be supported with a "support bushing".
- NOTE:** If the radial seal is supported without the support bushing (1) for more than six months, operational reliability will no longer be assured and the radial seal must not be used any further.



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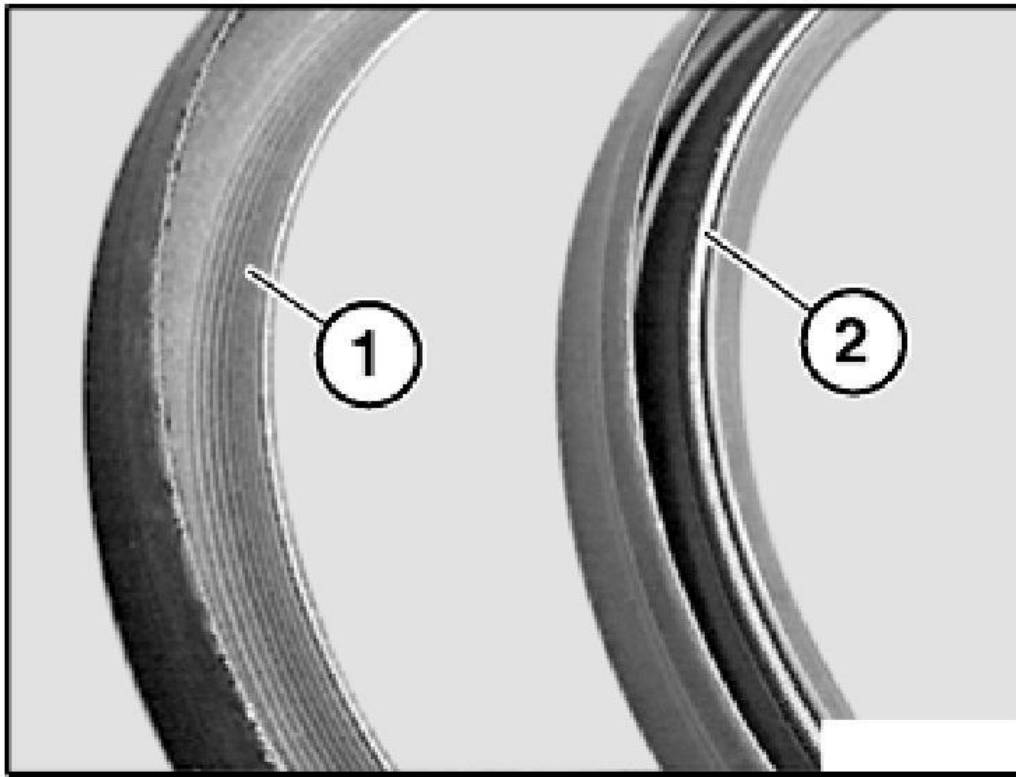
Fig. 80: Identifying Radial Seal

Courtesy of BMW OF NORTH AMERICA, INC.

Distinguishing feature:

- (1) New version "without hose spring".
- (2) Old version "with hose spring".

IMPORTANT: The sealing lip of the new version (1) is very sensitive and must not be kinked under any circumstances. Do not touch the sealing lip with your fingers.



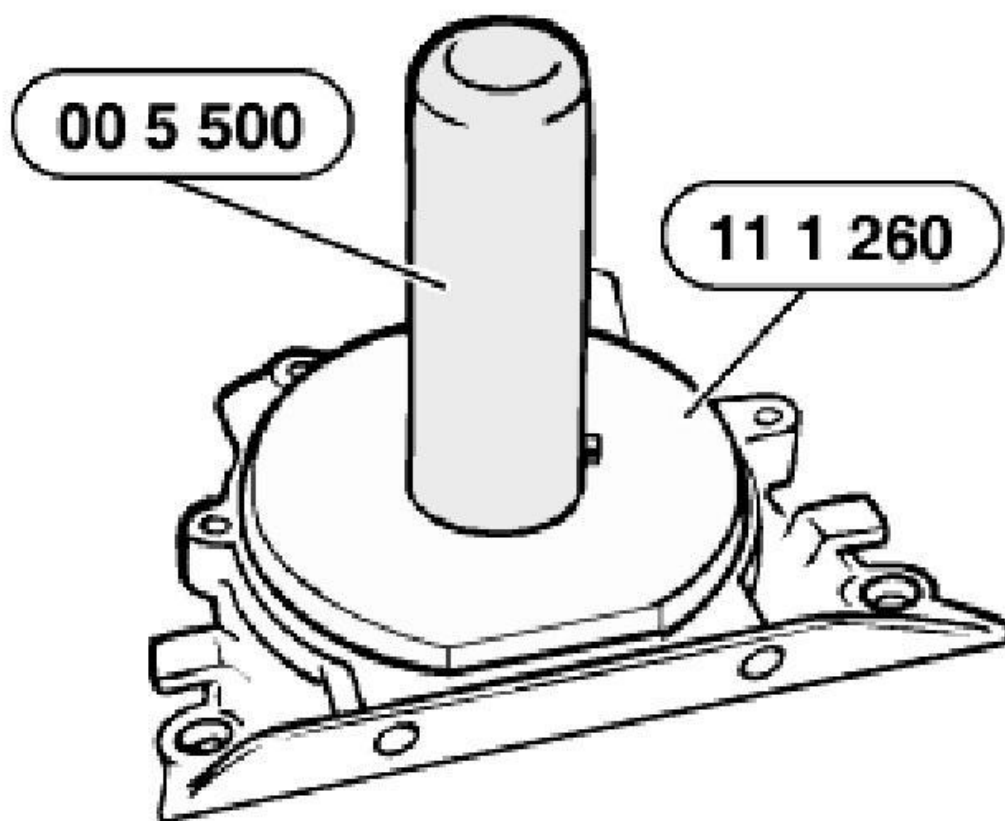
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Fig. 81: View Of Radial Seal Types

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: The end cover is offered in the kit with a radial seal.

If necessary, lift out the radial sealing ring and drive in new sealing ring using special tool 11 1 260 in conjunction with special tool 00 5 500.



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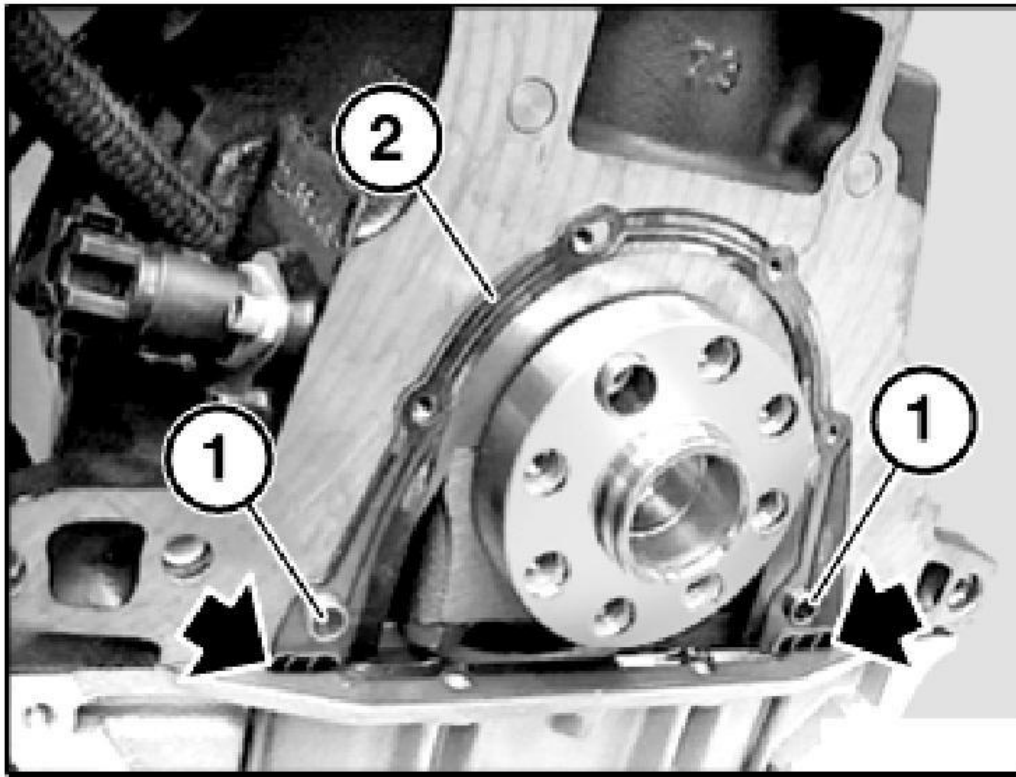
Fig. 82: Removing Radial Seal

Courtesy of BMW OF NORTH AMERICA, INC.

Check dowel sleeves (1) for damage and correct installation position.

Replace seal (2).

Apply thin, uniform coat of Drei Bond 1209 sealing compound to edges of joint on oil pan.

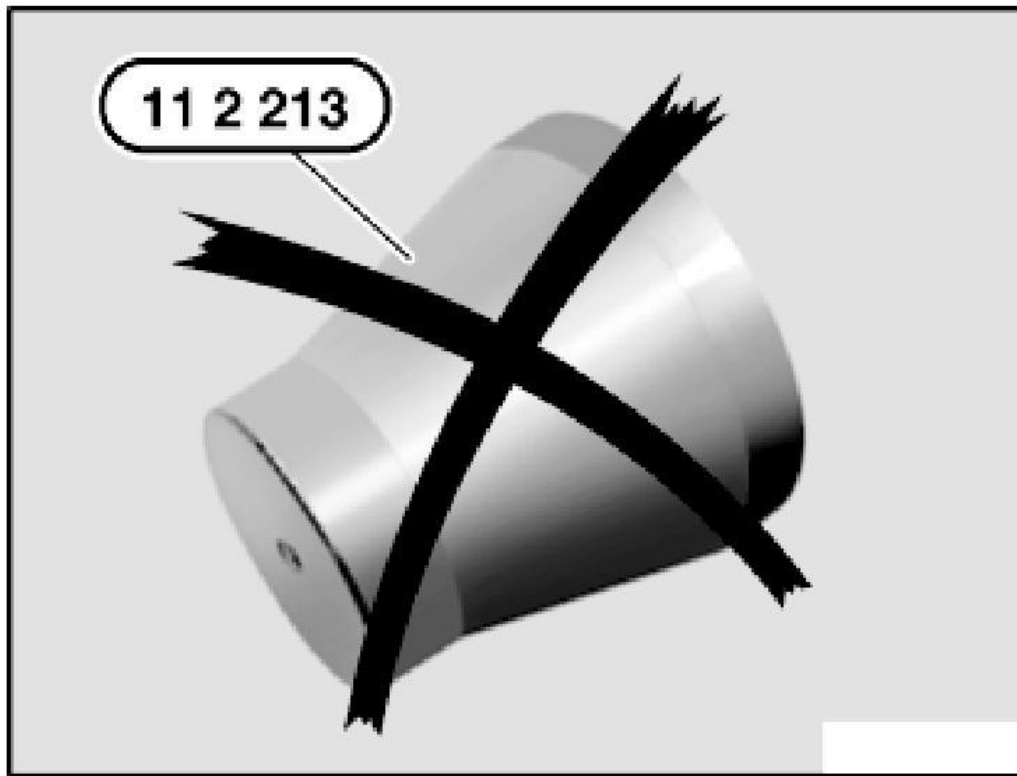


G03117747

Fig. 83: Locating Dowel Sleeves

Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Do not use special tool 11 2 213 for the new radial seal version.



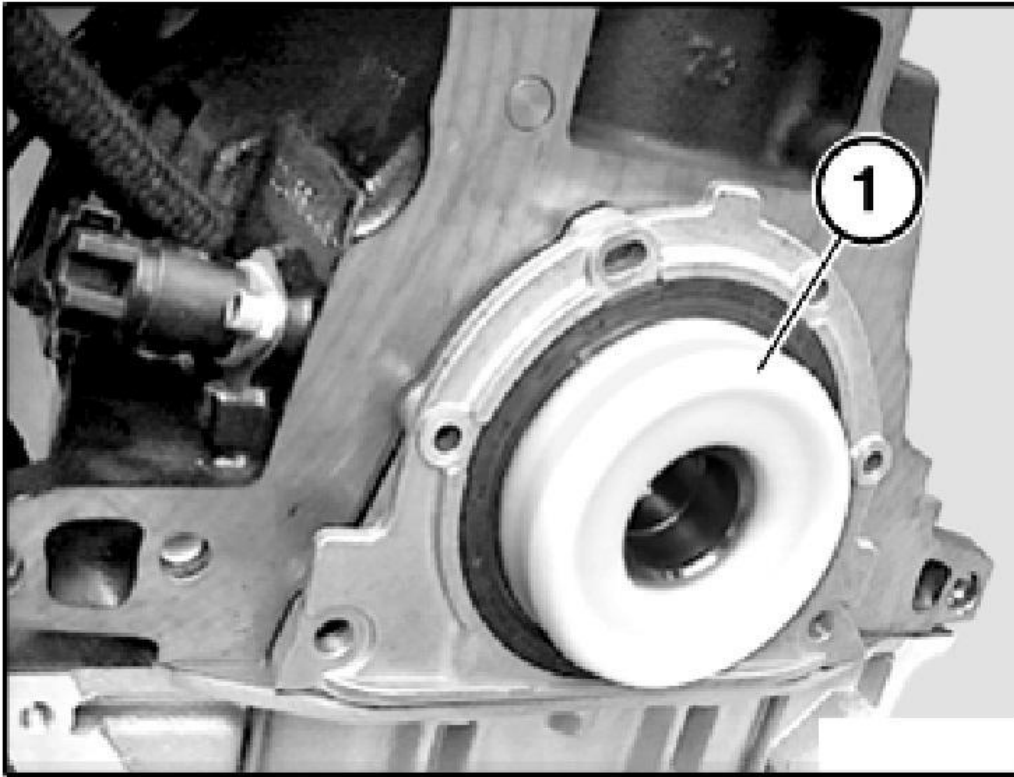
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Fig. 84: Identifying Special Tool

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: When fitting the end cover with radial seal on the crankshaft, it is only permitted to use the "support bushing (1)" as an installation tool.

Lubricate contact face of crankshaft.



G03117749

Fig. 85: Installing Radial Seal

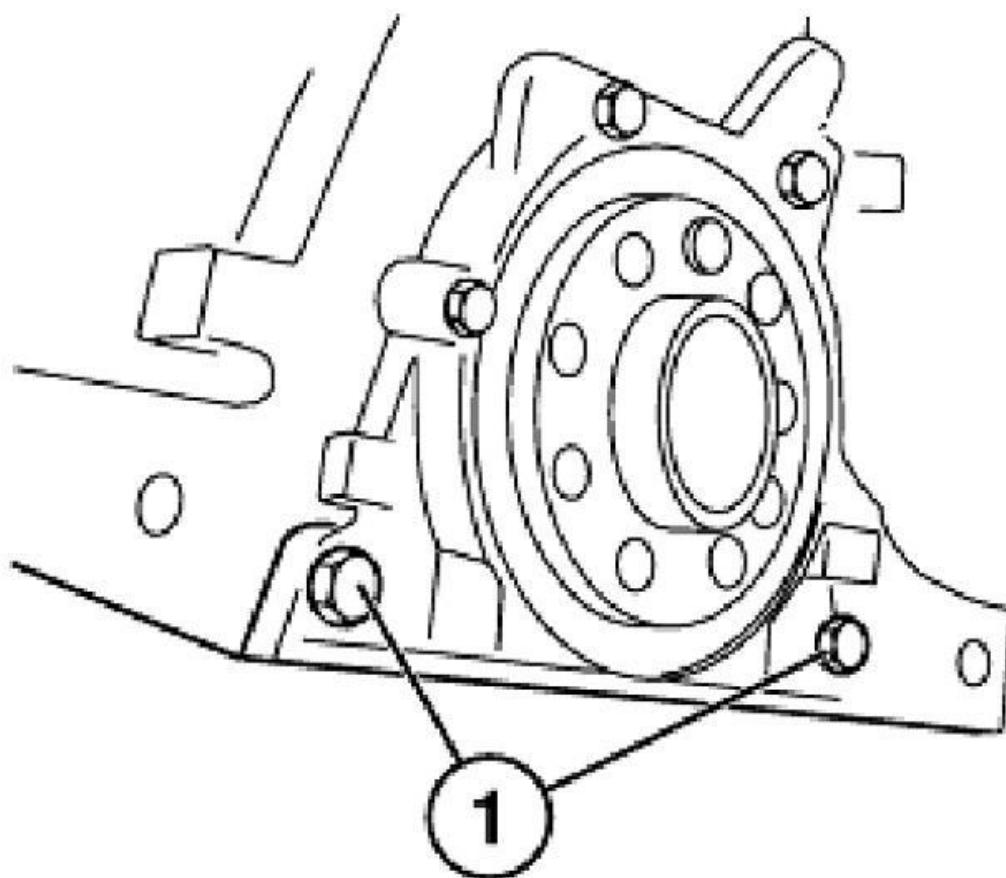
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Push on end cover with support bushing (1) straight and without tilting sideways.

NOTE: Screw threads (1) are coated with sealing compound.

Replace screws (1).

Insert all screws and tighten down end cover.

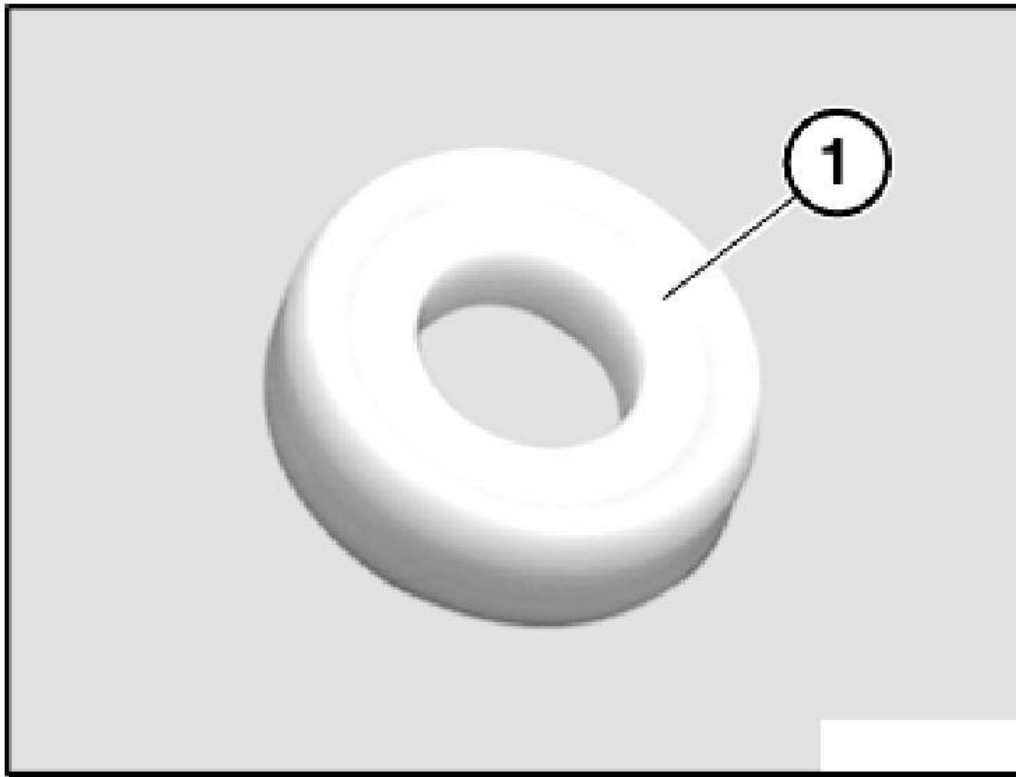


G03117750

Fig. 86: Identifying Screws In End Cover
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Keep the support bushing (1) of the new radial seal version as a "special tool", then render the special tool 11 2 213 unusable and dispose of it.

The old and new radial seal versions can be installed with the support bushing (1).



G03117751

Fig. 87: Identifying Support Bushing Of New Radial Seal Version
Courtesy of BMW OF NORTH AMERICA, INC.

CRANKSHAFT WITH BEARING

11 21 500 REPLACING CRANKSHAFT (S54)

(Engine removed)

Remove cylinder head. Refer to **11 12 100 REMOVING AND INSTALLING/SEALING CYLINDER HEAD (S54)**.

Remove lower timing case cover.

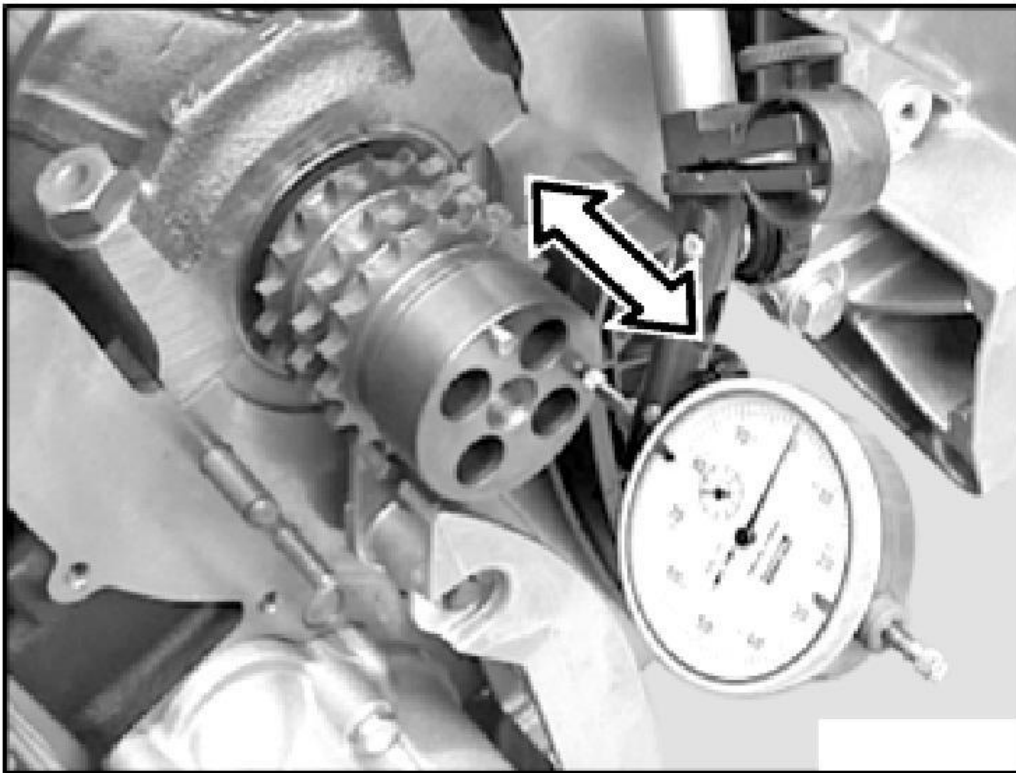
Remove pistons. Refer to **11 25 530 REMOVING AND 530 INSTALLING/REPLACING ALL PISTONS (S54)**.

Remove flywheel. See **11 22 500 Removing And Installing Or Replacing Flywheel (M52/S52/M52TU/M54/S54)**

Remove end cover at rear. This task is described in the article "Replacing crankshaft radial seal".

Checking axial clearance:

If permitted end float is exceeded, check crankshaft, guide bearing shells and engine block, replacing if necessary. Refer to **ENGINE - TECHNICAL DATA** .



G03117752

Fig. 88: Checking Axial Clearance

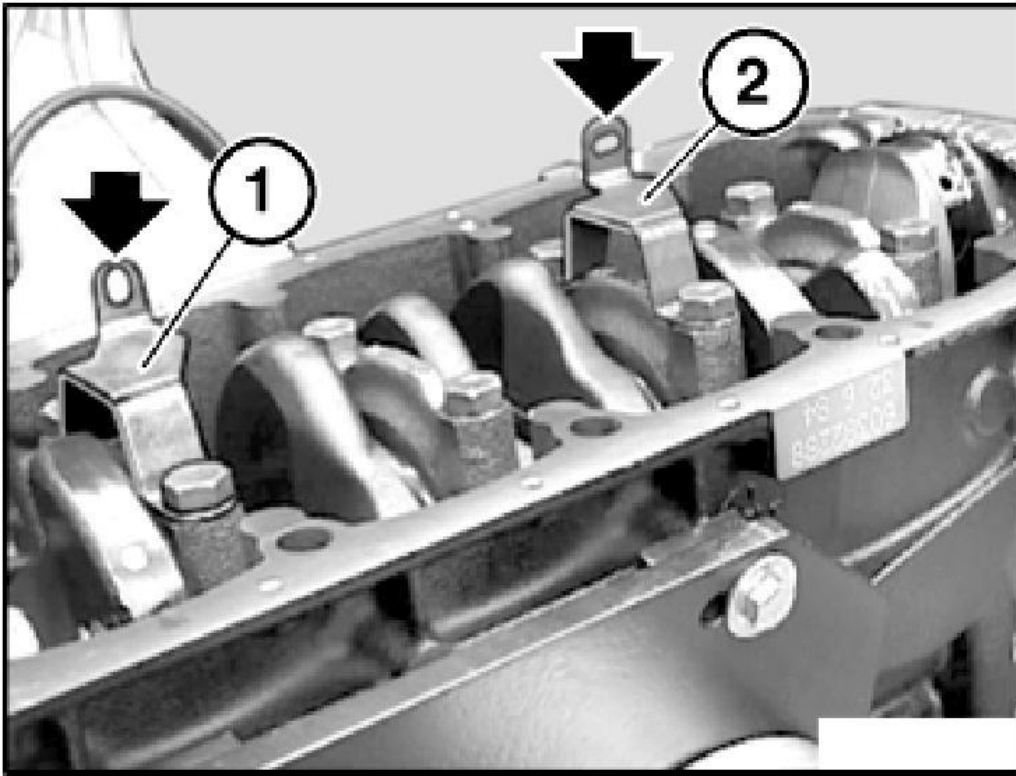
Courtesy of BMW OF NORTH AMERICA, INC.

Holders for oil lines are fitted on main bearing caps 3 and 5.

CAUTION: Holders (1 and 2) are different.

Holder (1) with elongated hole in vertical direction.

Holder (2) with elongated hole in horizontal direction.



G03117753

Fig. 89: Locating Holders For Oil Lines On Main Bearing Caps
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Main bearing caps 1 to 5 are marked on exhaust side.

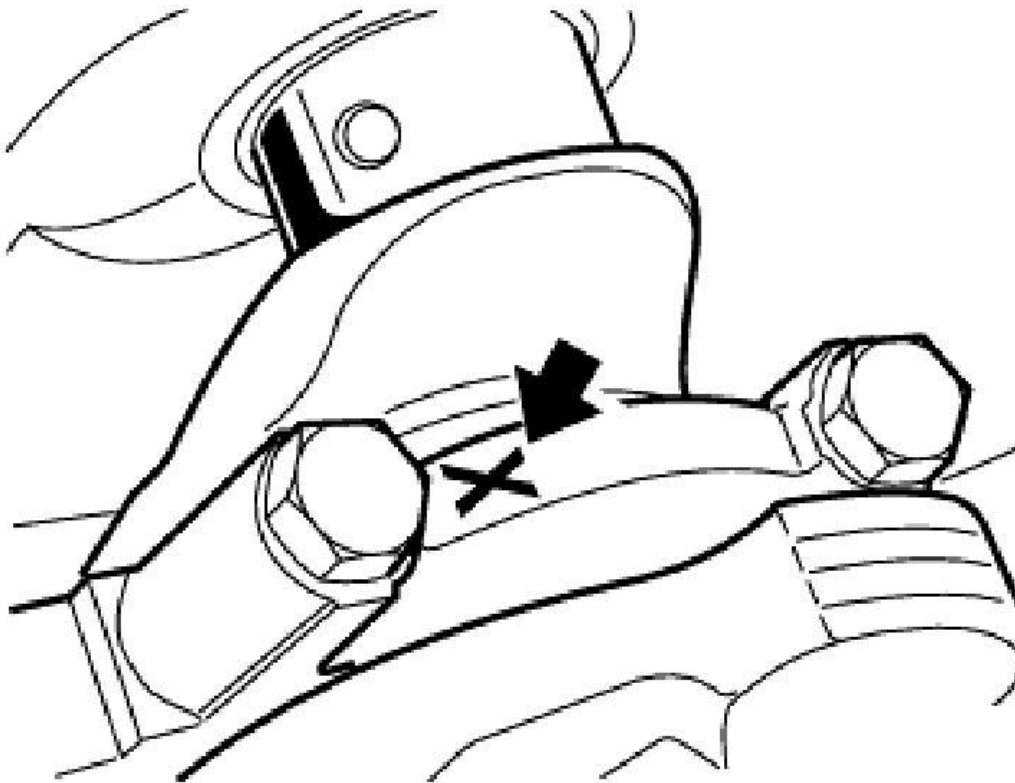
Main bearing caps 6 and 7 are not marked.

Main bearing cap 6 is guide bearing.

Remove screws securing main bearing caps.

Remove main bearing caps 1 to 7.

Lever out crankshaft.



G03117754

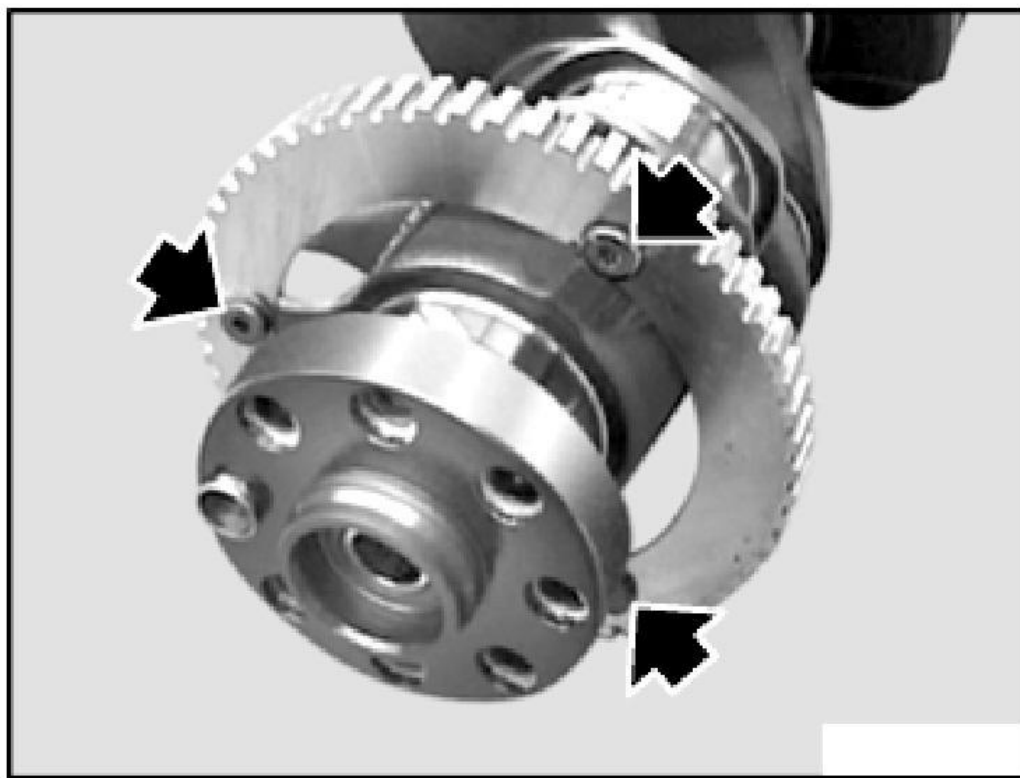
Fig. 90: Locating Mark On Main Bearing Cap
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: The increment gear cannot be released without the screws being damaged or destroyed.

A crankshaft with fitted increment gear is available. If in an exceptional case increment gear has to be removed:

CAUTION: Protect crankshaft against damage.

Release screws, drill out screw heads if necessary.



G03117755

Fig. 91: Identifying Increment Gear

Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Replace increment gear and screws.

Tighten down screws to 5 N.m.

Mark 45° angle on screw head and sensor gear.

CAUTION: Screws can be tightened down to max. 45°.

Tighten down with 40° to 45° torsion angle.

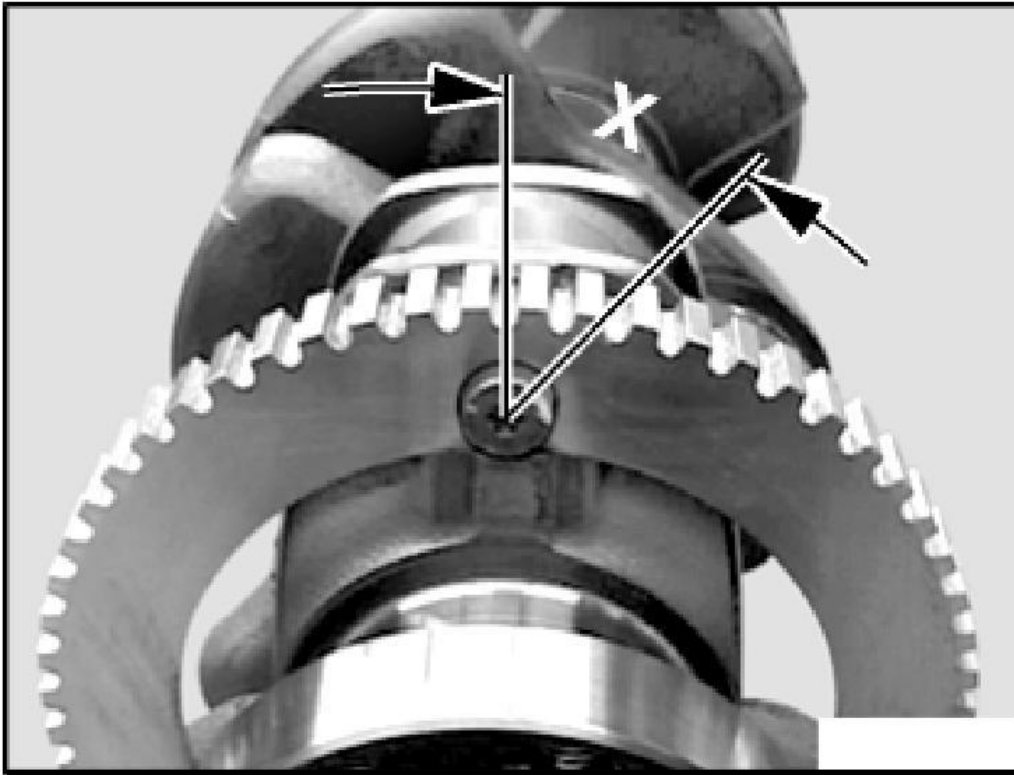
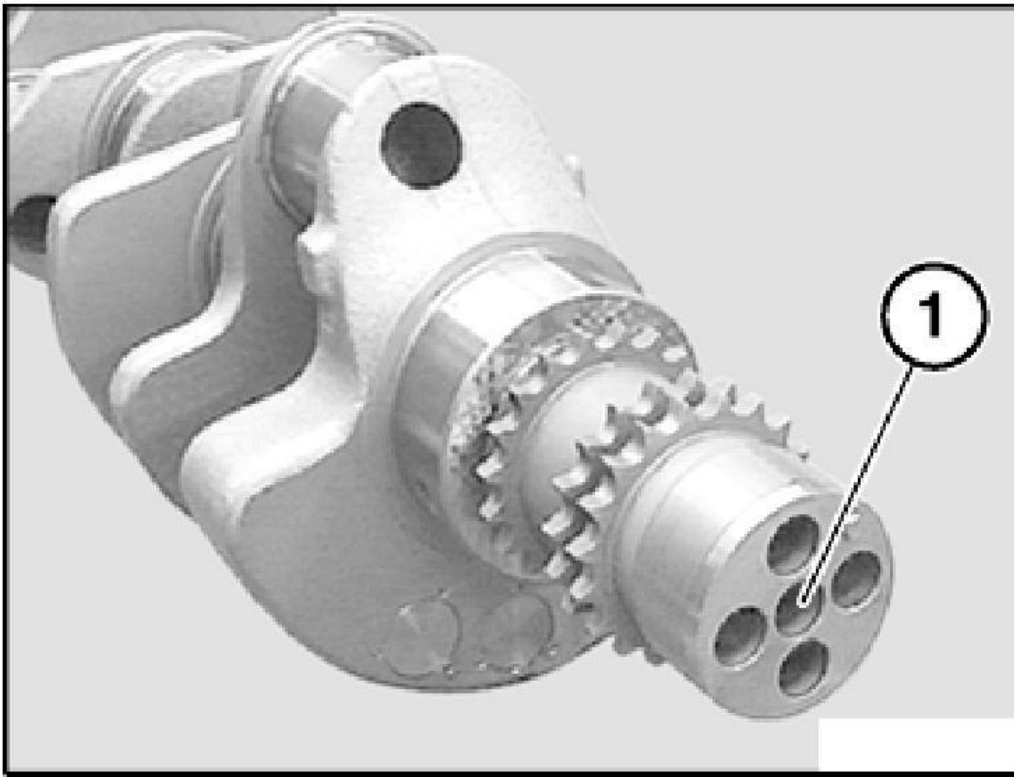
**G03117756**

Fig. 92: View Of Increment Gear
Courtesy of BMW OF NORTH AMERICA, INC.

If necessary, remove sprocket wheel:

Release screw in bore (1).

Detach sprocket wheel from crankshaft.



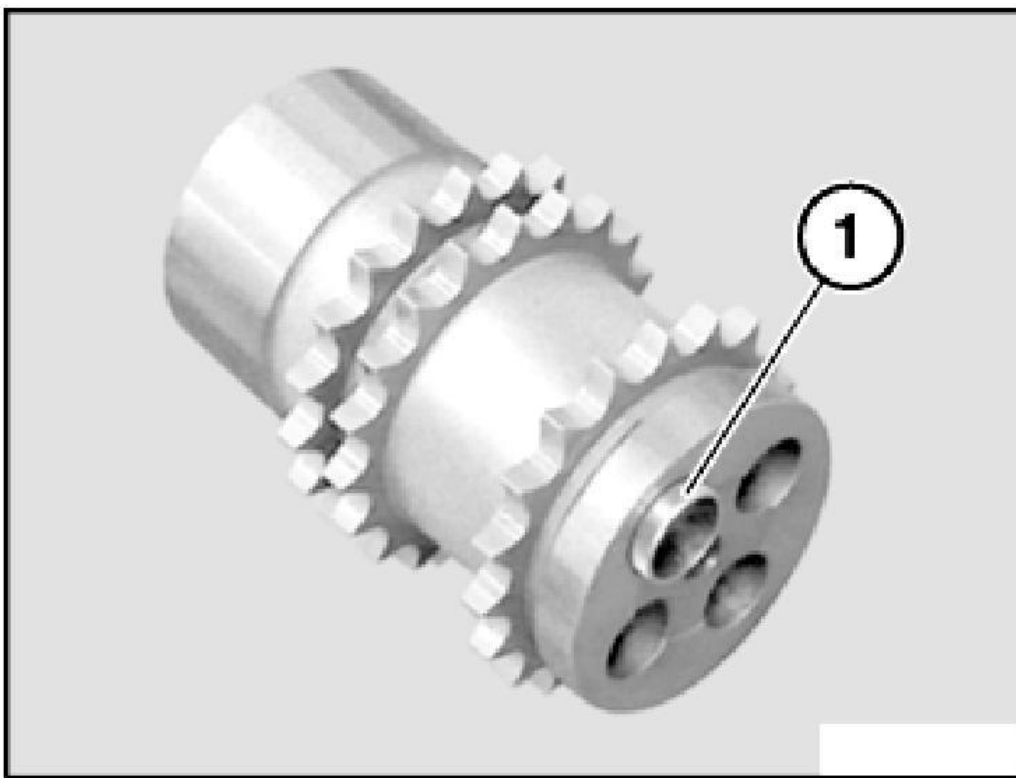
G03117757

Fig. 93: Identifying Screw In Sprocket Wheel Bore
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Sprocket wheel is secured with an adapter sleeve (1) to crankshaft.

Installation:

Check adapter sleeve (1) for damage and correct installation position.

**G03117758****Fig. 94: Locating Adapter Sleeve****Courtesy of BMW OF NORTH AMERICA, INC.****Installation:**

Align adapter sleeve of sprocket wheel to locating bore of crankshaft and fit sprocket wheel.

Apply a thin coat of screw retaining compound to screw thread (1).

Insert screw.

Tighten down crankshaft sprocket wheel to 10 N.m.

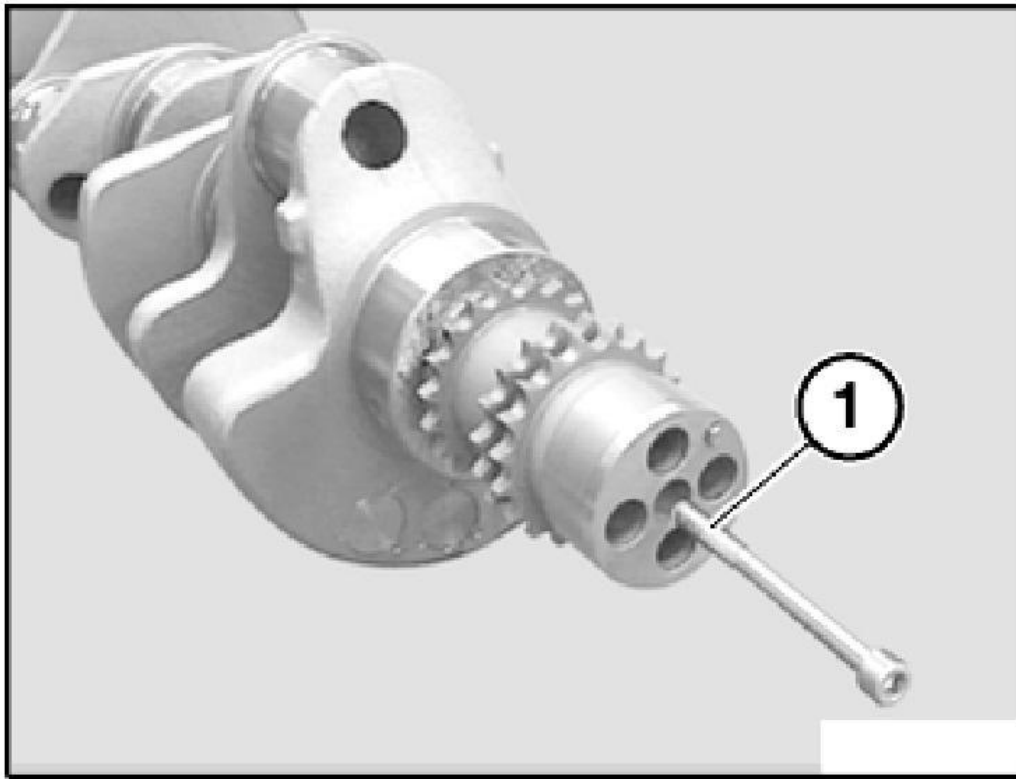
**G03117759**

Fig. 95: Installing Sprocket Wheel

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Observe grinding stage of crankshaft. Refer to **ENGINE - TECHNICAL DATA** .

Replace main crankshaft bearing shells. Refer to **11 21 531 REPLACING ALL CRANKSHAFT MAIN BEARING SHELLS (S54)**.

Replace conrod bearing shells. Refer to **11 24 571 REPLACING ALL CONROD BEARINGS (S54)**.

Replace grooved ball bearings in crankshaft. Refer to **11 21 571 REPLACING GROOVED BALL BEARING IN CRANKSHAFT (M52 / S52 / M52TU / M54 / S50 / S54)**.

11 21 531 REPLACING ALL CRANKSHAFT MAIN BEARING SHELLS (S54)

Special Tools Required:

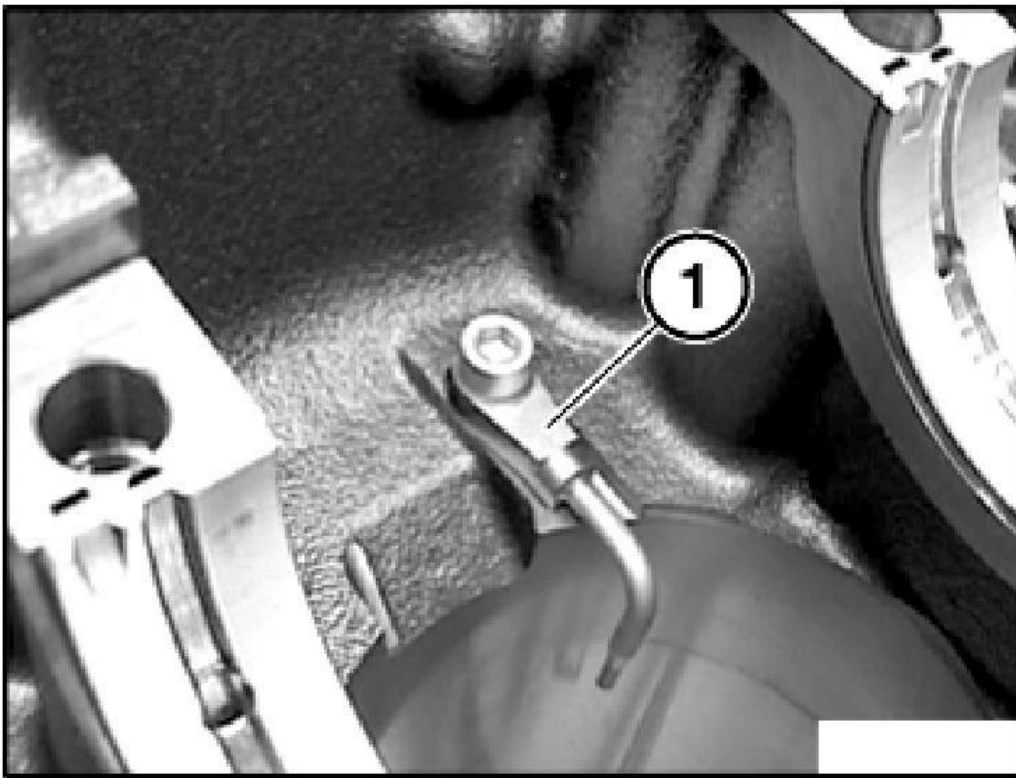
- 00 2 590
- 00 9 120

(Engine dismantled)

The preliminary operations are described in **11 21 500 REPLACING CRANKSHAFT (S54)**.

NOTE: **Piston cooling spray nozzles are installed between the bearing seats.**

Check spray nozzles for damage.



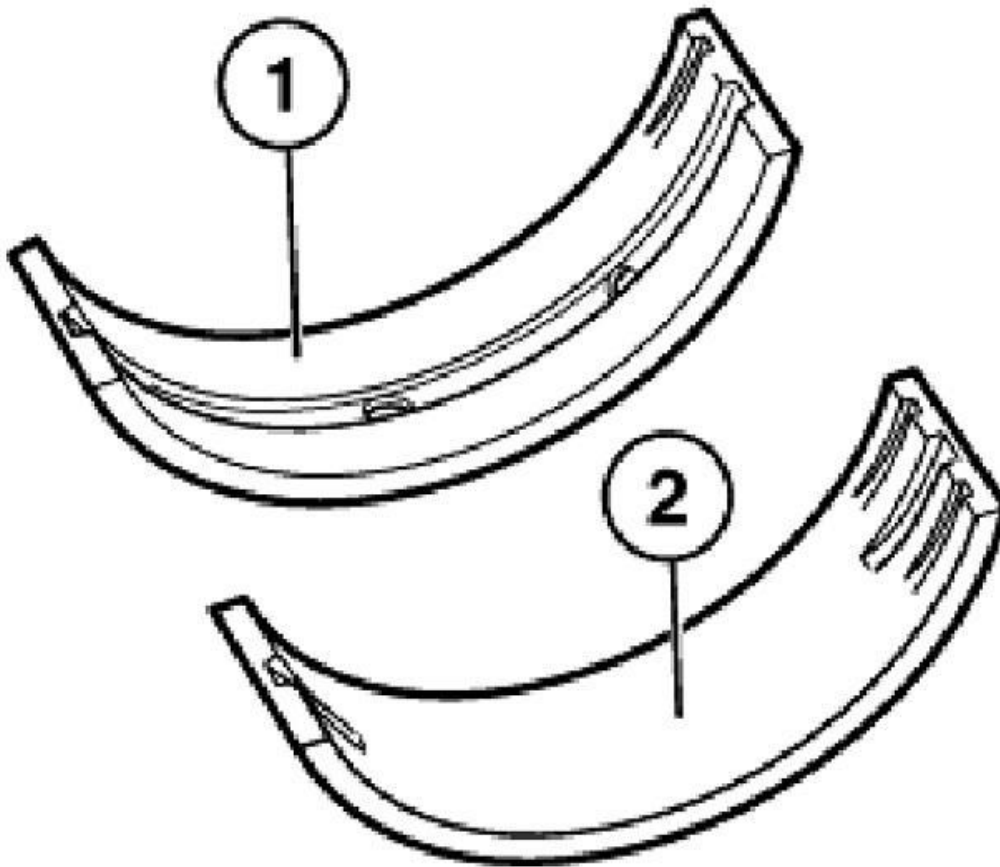
G03117760

Fig. 96: Identifying Spray Nozzles

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: **1. Install bearing shells with continuous lubricant groove and one retaining lug in engine block.**

2. Fit bearing shells without continuous lubricant groove and two retaining lugs in bearing cover.



G03117761

Fig. 97: Identifying Bearing Shells

Courtesy of BMW OF NORTH AMERICA, INC.

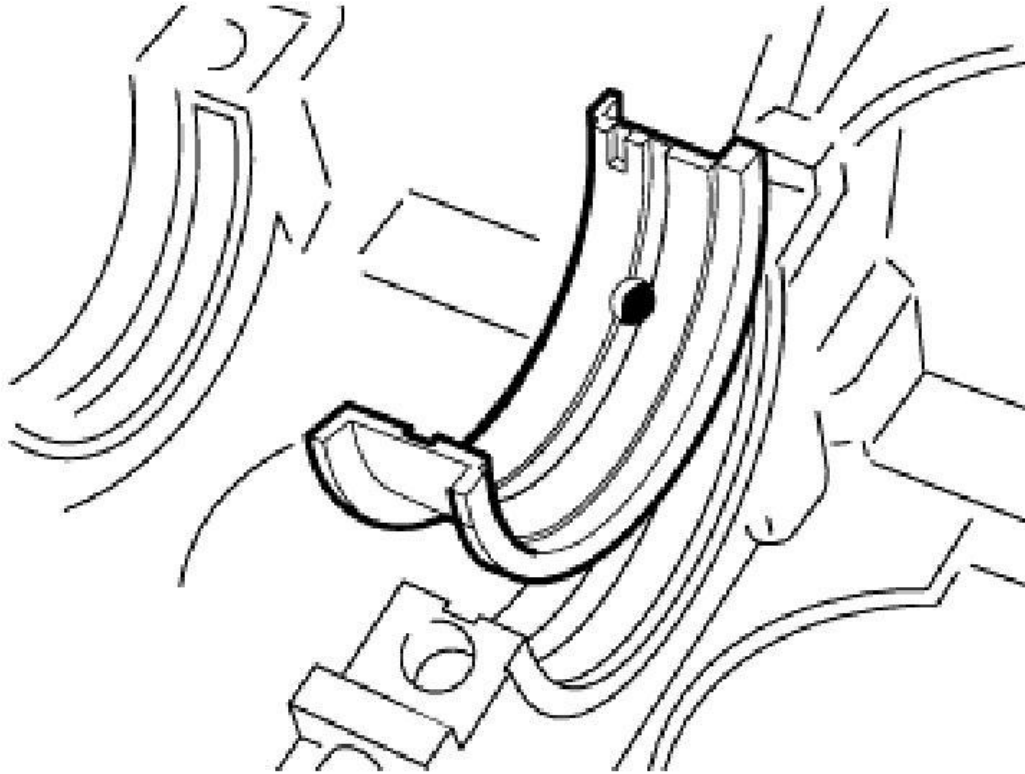
Installation:

When the bearing shells or the crankshaft are replaced, the classification for bearing shell arrangement in the engine block is eliminated.

Only install yellow bearing shells in the engine block.

NOTE: The axial guide on the crankshaft is fitted to bearing point 6.

Insert pilot bearing shell in the engine block.

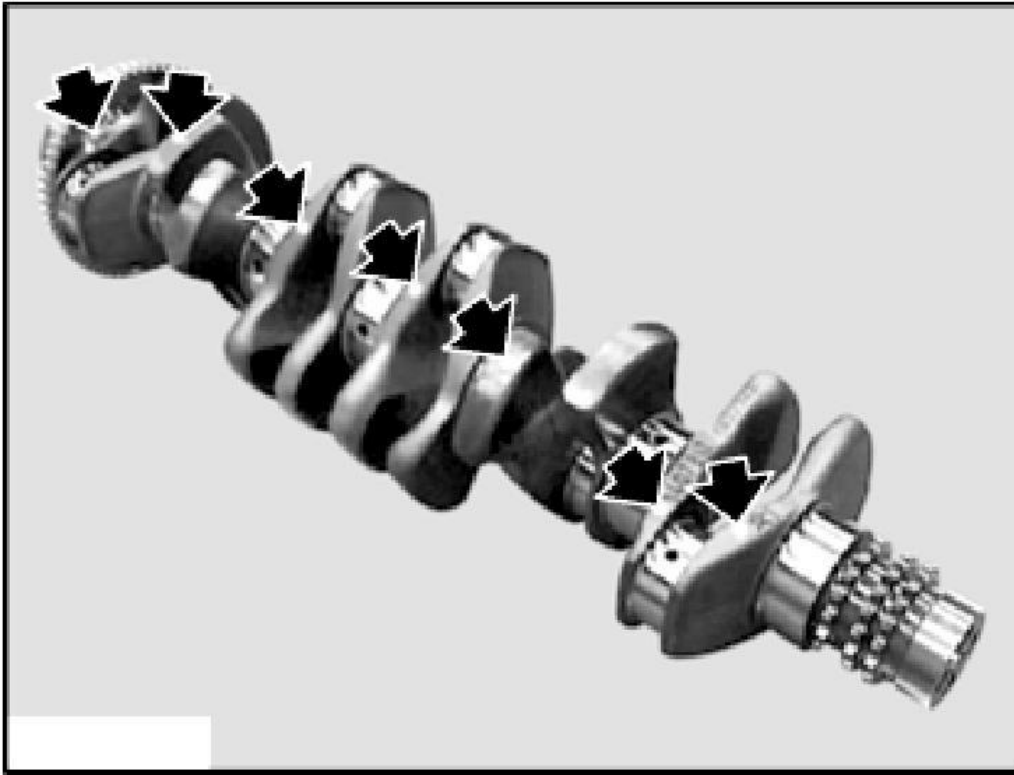


G03117762

Fig. 98: Inserting Pilot Bearing Shell In Engine Block
Courtesy of BMW OF NORTH AMERICA, INC.

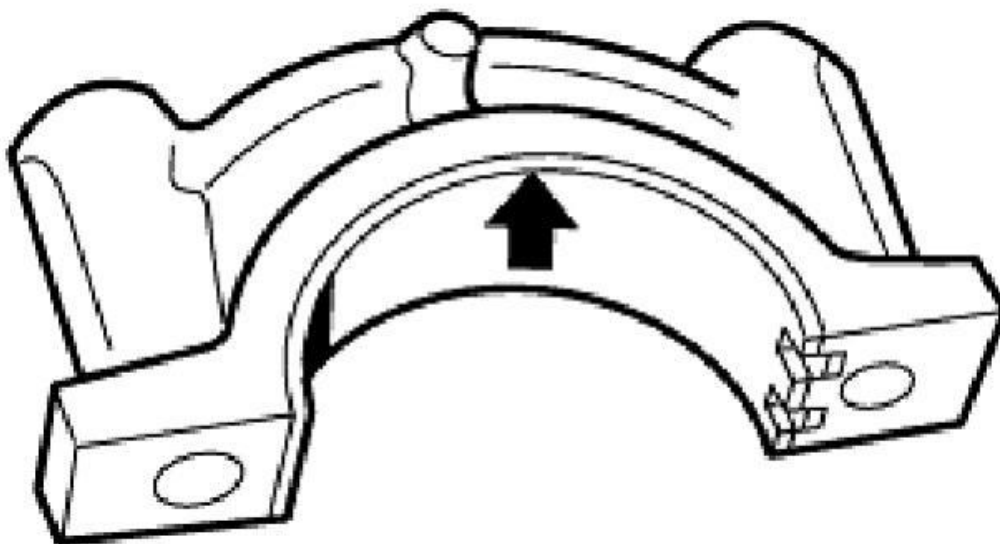
NOTE: The crankshaft is marked with yellow, green or white paint according to the tolerance of the main journal.

Insert crankshaft in engine block.

**G03117763****Fig. 99: Identifying Crankshaft****Courtesy of BMW OF NORTH AMERICA, INC.****Installation:**

The bearing shell classification for the bearing cover is marked on the crankshaft in yellow, green or white paint.

Place main bearing shells with same color code as that of crankshaft in main bearing caps.



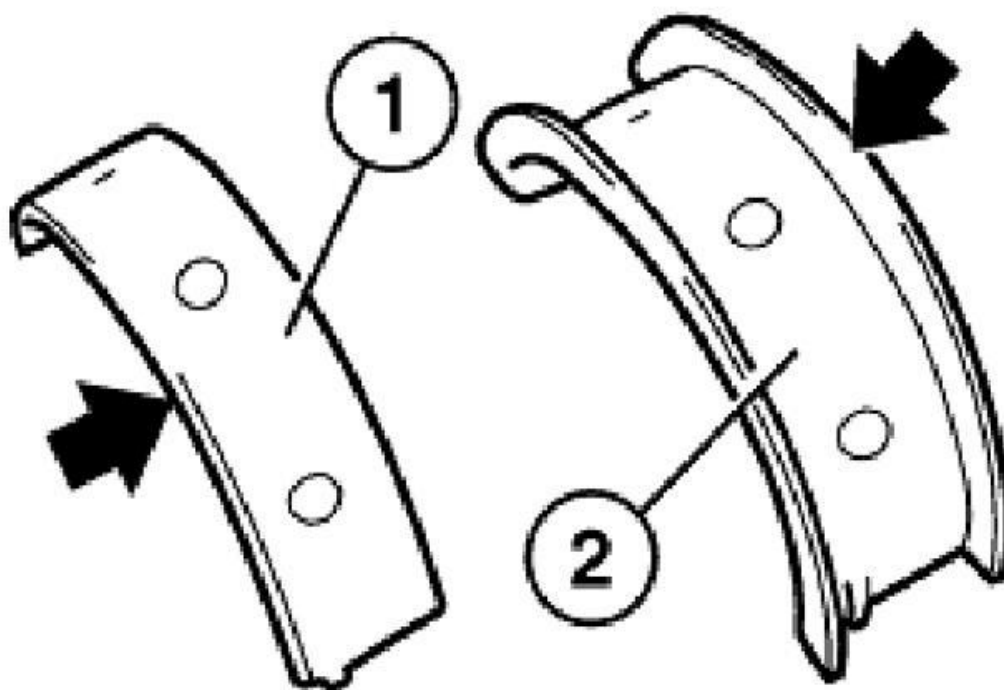
G03117764

Fig. 100: Placing Main Bearing Shells In Main Bearing Caps
Courtesy of BMW OF NORTH AMERICA, INC.

The bearing shells are marked with yellow, green or white paint.

1. Bearing shell.
2. Guide bearing.

Observe grinding stage of main bearing journals. Refer to **ENGINE - TECHNICAL DATA** .



G03117765

Fig. 101: Identifying Bearing Shell And Guide Bearing
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Main bearing caps 1 to 5 are marked on exhaust side. Main bearing caps 6 and 7 are not marked. Main bearing cap 6 is thrust bearing.

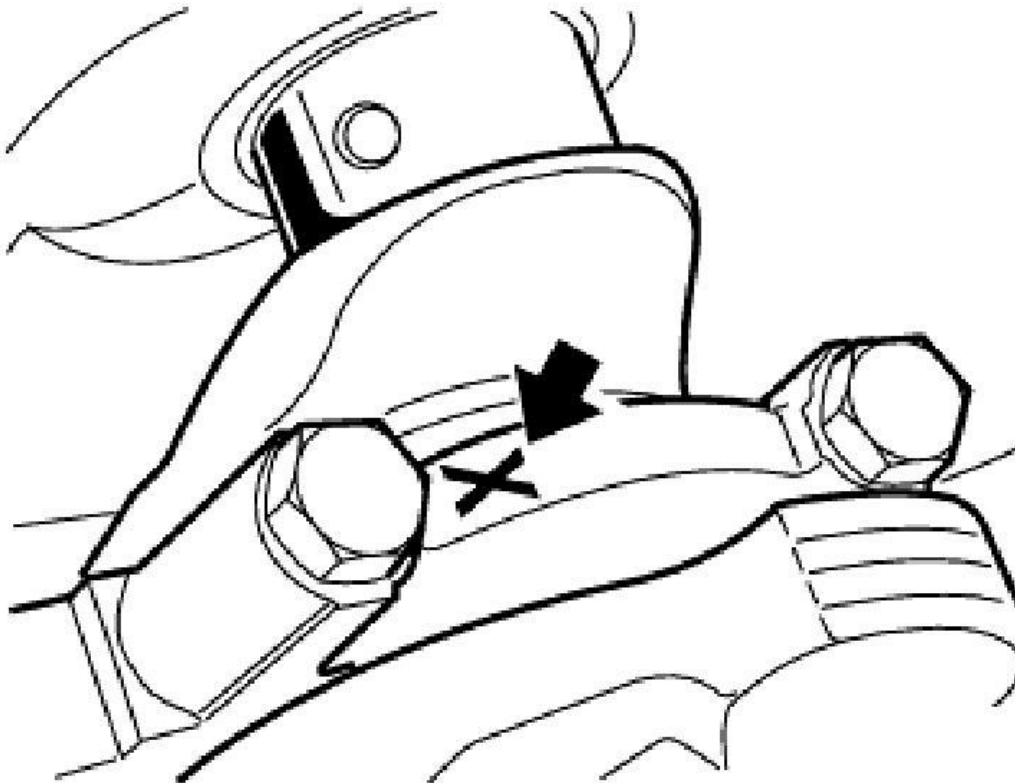
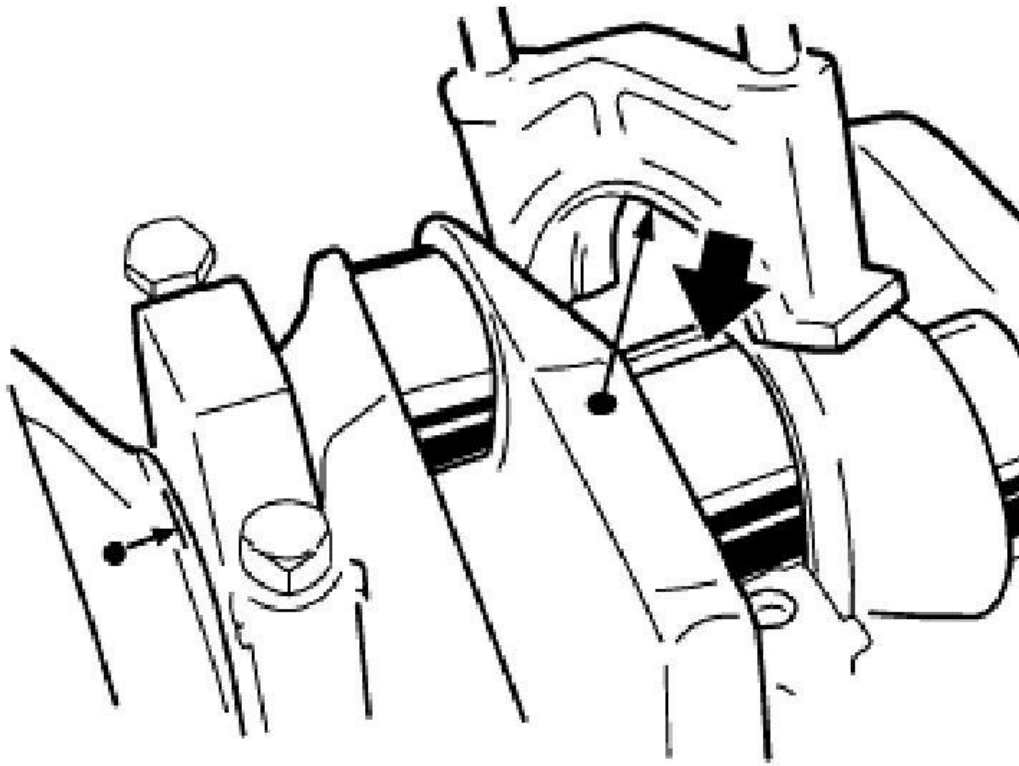
**G03117766**

Fig. 102: Locating Mark On Main Bearing Cap
Courtesy of BMW OF NORTH AMERICA, INC.

Check clearance on main crankshaft bearing.

Install crankshaft and place special tool 00 2 590 (Plastigage Type PG1) on oil-free crankshaft.

Do not twist crankshaft.

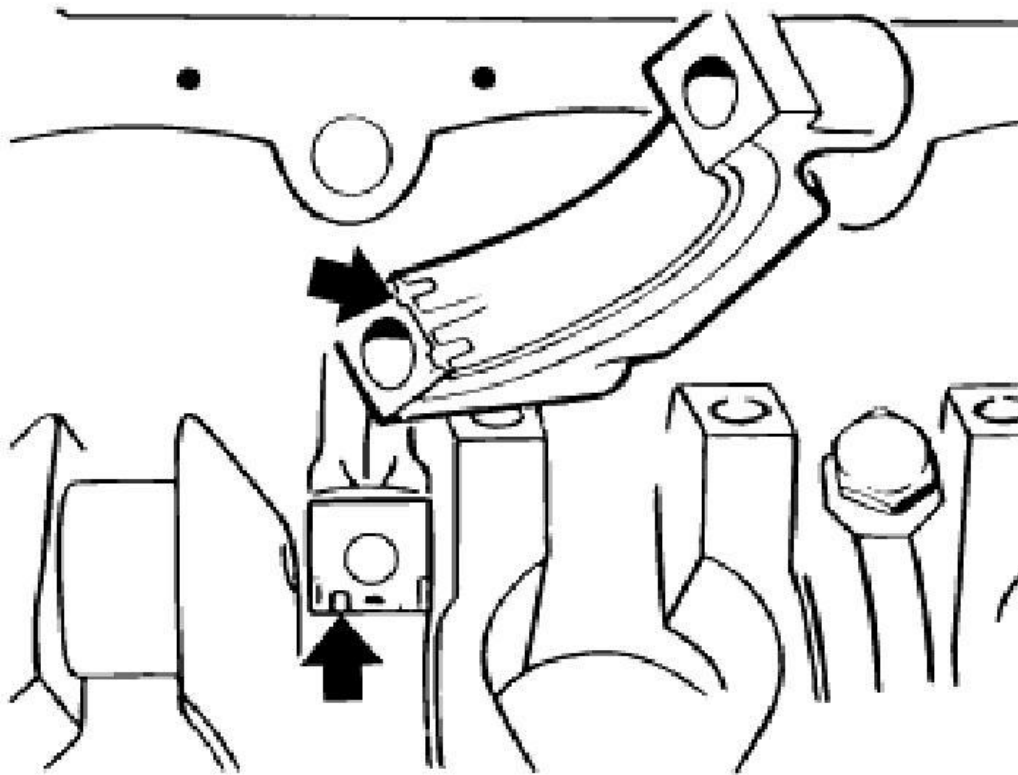


G03117767

Fig. 103: Checking Clearance On Main Crankshaft Bearing
Courtesy of BMW OF NORTH AMERICA, INC.

Insert main bearing caps in such a way that guide grooves of main bearing shells lie on one side.

Align main bearing cap flush with side of bearing seat.



G03117768

Fig. 104: Aligning Main Bearing Cap With Side Of Bearing Seat
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

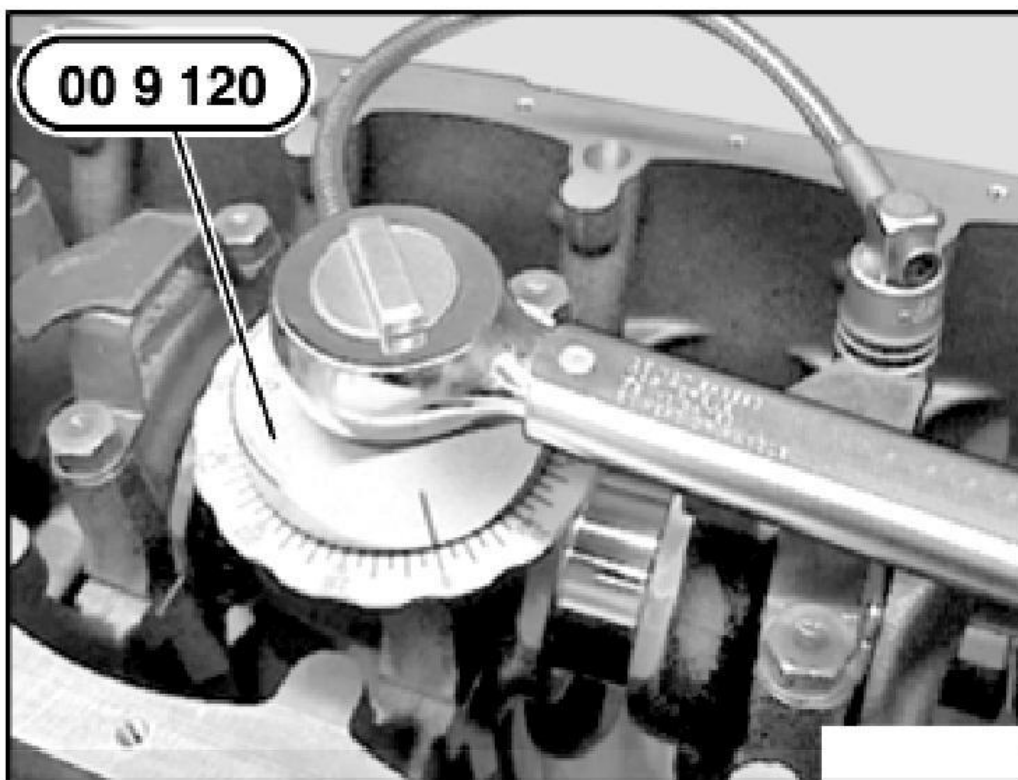
To check main bearing clearance, use the old main bearing screws.

There must be no oil in the blind holes (risk of cracking).

NOTE: Wash and oil main bearing bolts.

1. Tighten down main bearing screws with jointing torque.
2. Tighten down main bearing screws using special tool 00 9 120 and torsion angle.

Tightening torque, refer to 11 11 1AZ in **ENGINE - TIGHTENING TORQUES** .



G03117769

Fig. 105: Identifying Torque Angle Measurement Dial
Courtesy of BMW OF NORTH AMERICA, INC.

Remove main bearing cap and read off bearing clearance at width of pinched plastic thread on measuring scale.

Crankshaft bearing clearance radial, refer to **ENGINE - TECHNICAL DATA** .

If necessary, fit new bearing shells with a different color code to correct bearing clearance.



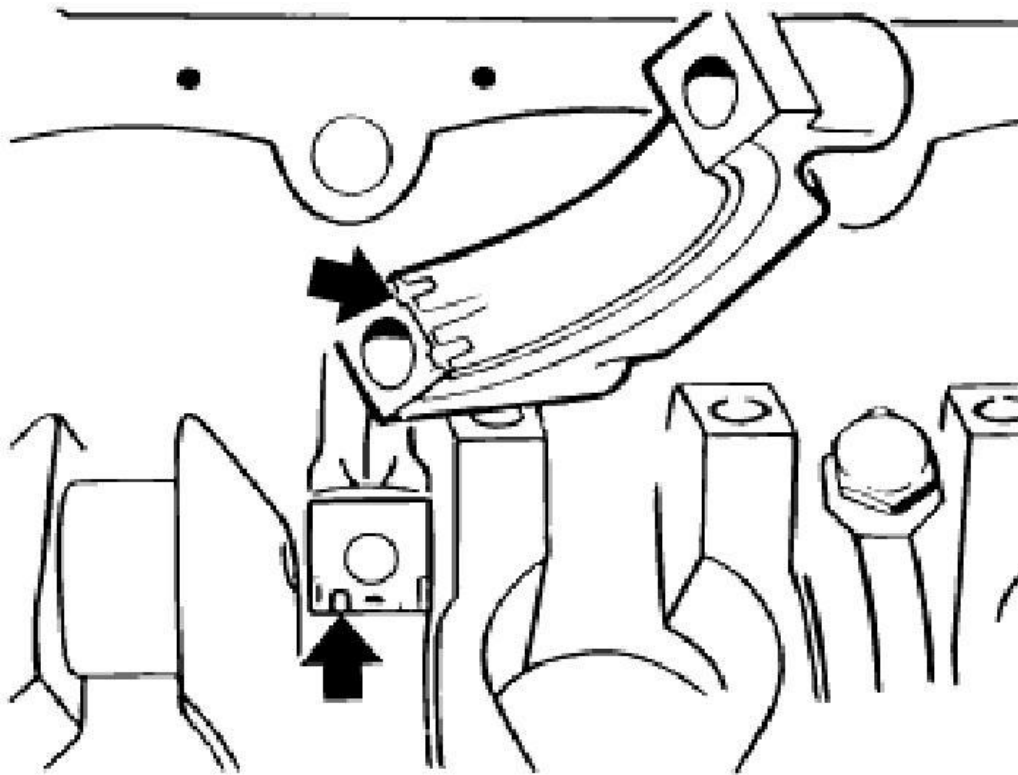
G03117770

Fig. 106: Checking Bearing Clearance Using Measuring Scale
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Remove plastic thread. Coat main bearing shells and crankshaft with engine oil.

Insert main bearing cap in such a way that grooves of main bearing shell guide lie on one side.

Align main bearing cap flush with side of bearing seat.



G03117771

Fig. 107: Aligning Main Bearing Cap With Side Of Bearing Seat
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Always replace screws of main bearing caps with new ones.
There must be no oil in the blind holes (risk of cracking).

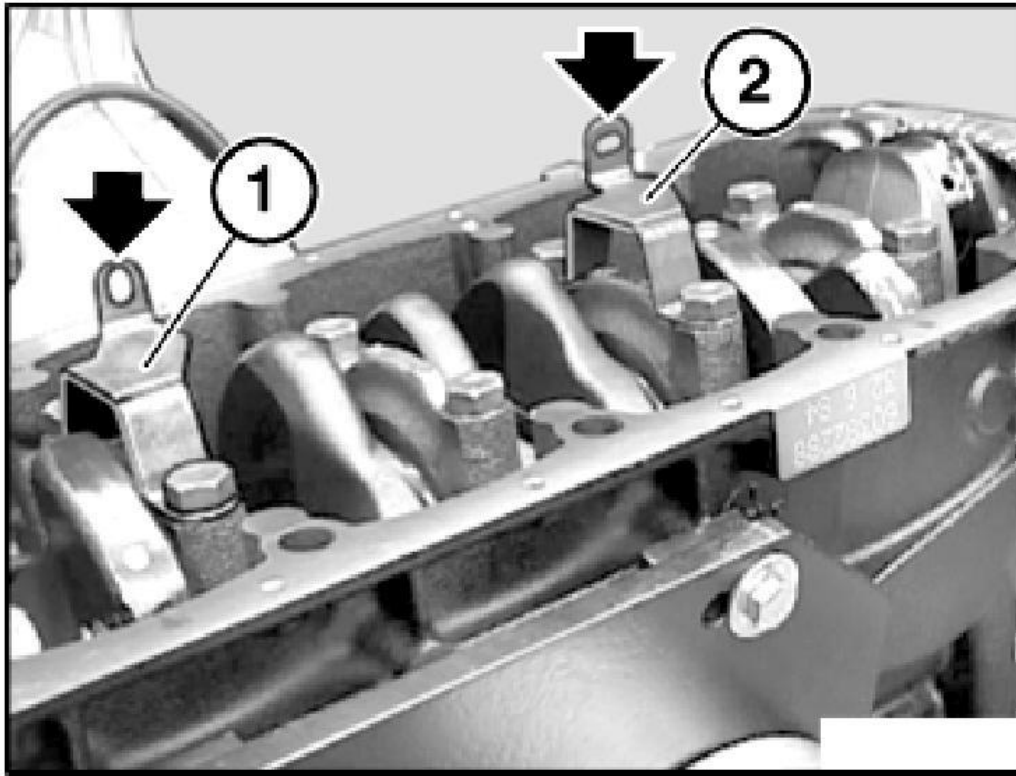
NOTE: Wash and oil main bearing bolts.

Holders for oil lines are fitted on main bearing caps 3 and 5.

CAUTION: Holders (1 and 2) are different.

Holder (1) with elongated hole in vertical direction.

Holder (2) with elongated hole in horizontal direction.



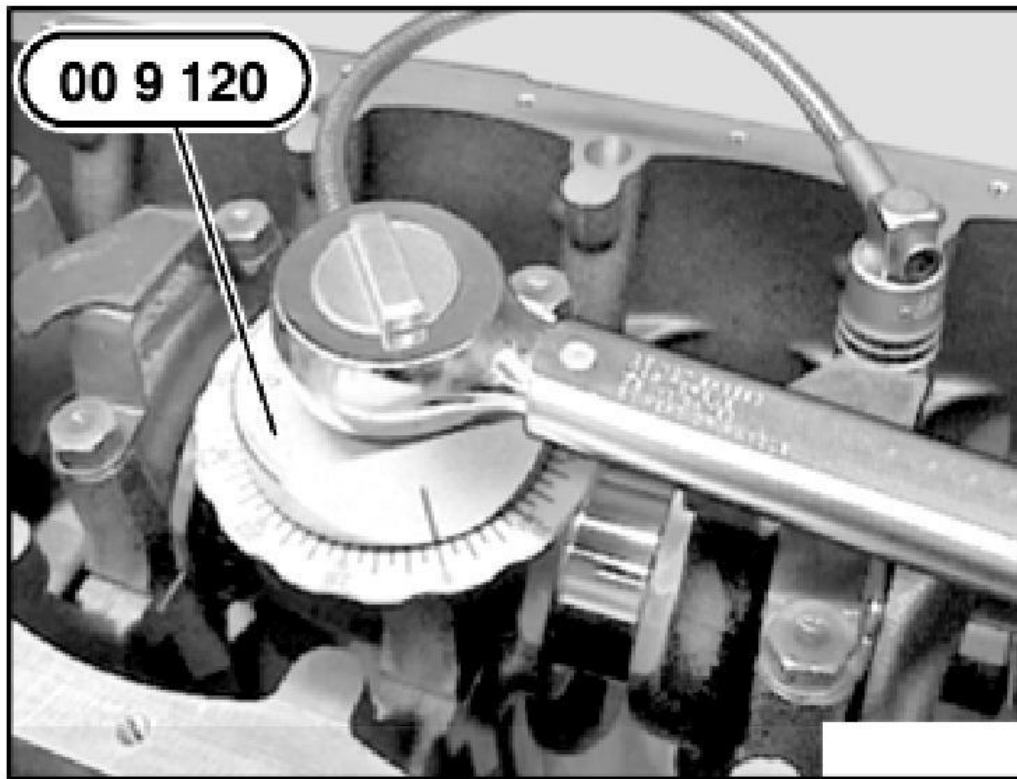
G03117772

Fig. 108: Locating Holders For Oil Lines On Main Bearing Caps
Courtesy of BMW OF NORTH AMERICA, INC.

Tightening specifications for main bearing:

1. Tighten all screws on main bearing cover with jointing torque.
2. Unfasten screws on main bearing cover 6.
3. Strike back and front of crankshaft with plastic hammer to center thrust bearing (do not damage crankshaft).
4. Tighten screws of main bearing cover 6 with jointing torque.
5. Tighten down all screws on main bearing caps with special tool 00 9 120 and torsion angle.

Tightening torque, refer to 11 11 1AZ in **ENGINE - TIGHTENING TORQUES** .

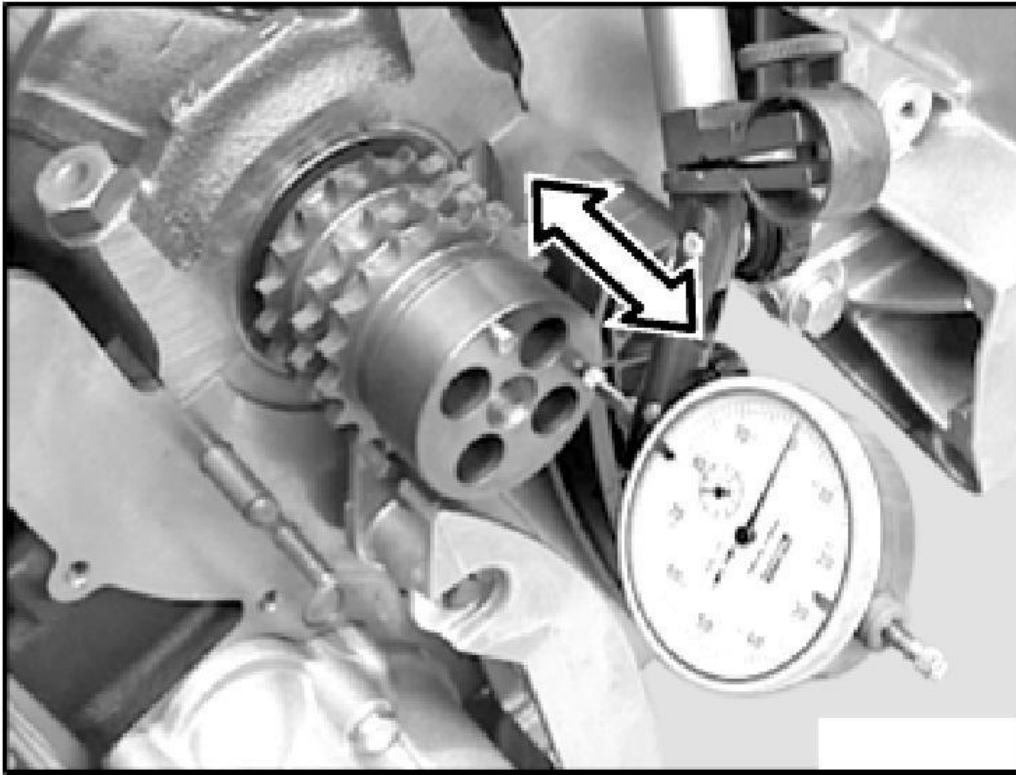


G03117773

Fig. 109: View Of Torque Angle Measurement Dial
Courtesy of BMW OF NORTH AMERICA, INC.

Check axial play.

If permitted end float is exceeded, check crankshaft, guide bearing shells and engine block, replacing if necessary. Refer to **ENGINE - TECHNICAL DATA** .



G03117774

Fig. 110: Checking Axial Play

Courtesy of BMW OF NORTH AMERICA, INC.

**11 21 571 REPLACING GROOVED BALL BEARING IN CRANKSHAFT
(M52/S52/M52TU/M54/S50/S54)**

Special Tools Required:

- 00 5 500
- 11 2 340
- 11 2 350

(Clutch removed)

IMPORTANT: In version with needle bearing (1) in dual-mass flywheel (2), no grooved ball bearing may be fitted in the crankshaft.

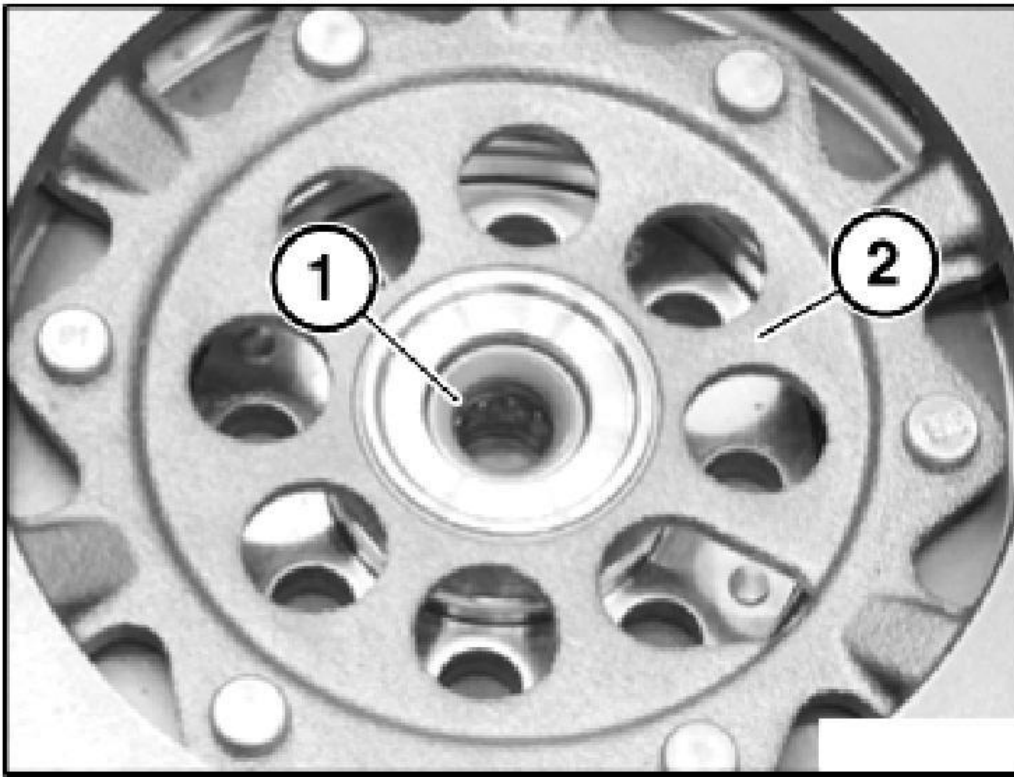
**G03117775**

Fig. 111: Locating Needle Bearing In Dual-Mass Flywheel
Courtesy of BMW OF NORTH AMERICA, INC.

Version With Grooved Ball Bearing:

Remove guide bearing with special tool 11 2 340.

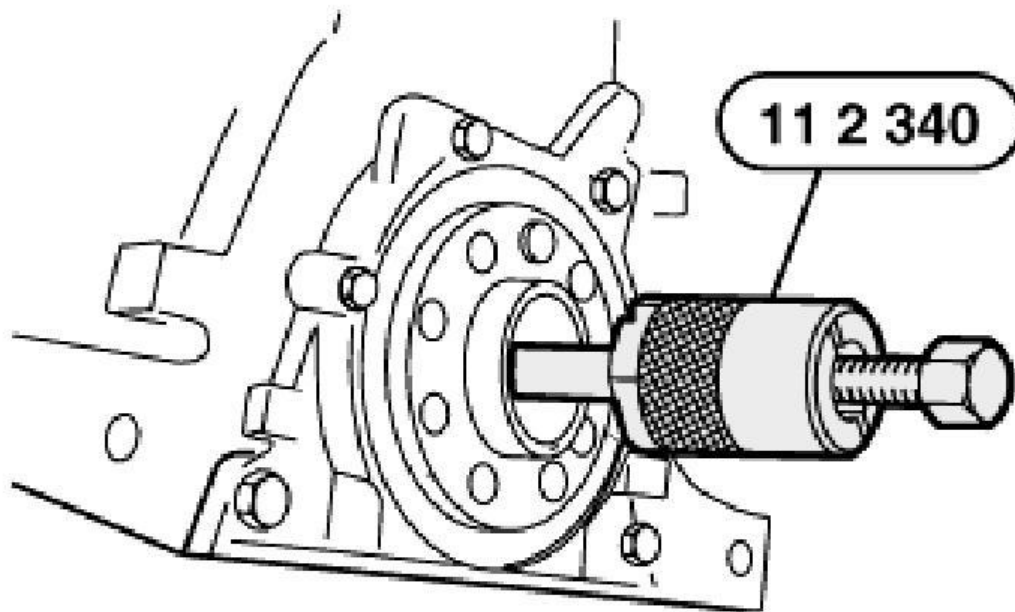
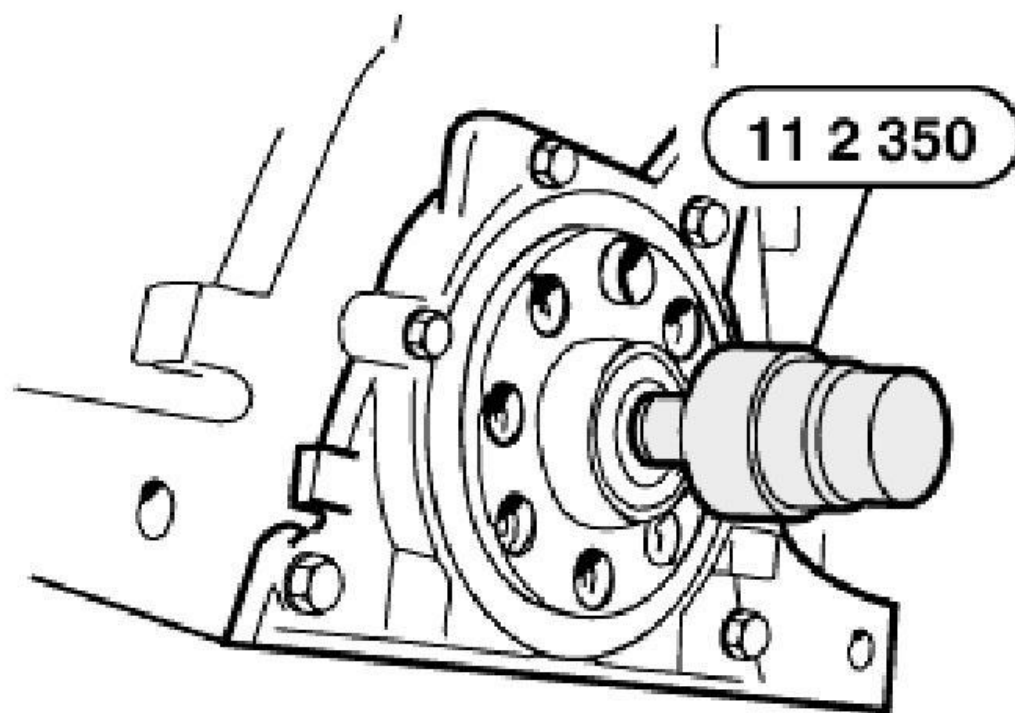
**G03117776**

Fig. 112: Removing Guide Bearing With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

Install new thrust bearing and drive firmly home with special tool 11 2 350 in conjunction with special tool 00 5 500.



G03117777

Fig. 113: Installing New Thrust Bearing
Courtesy of BMW OF NORTH AMERICA, INC.

FLYWHEEL

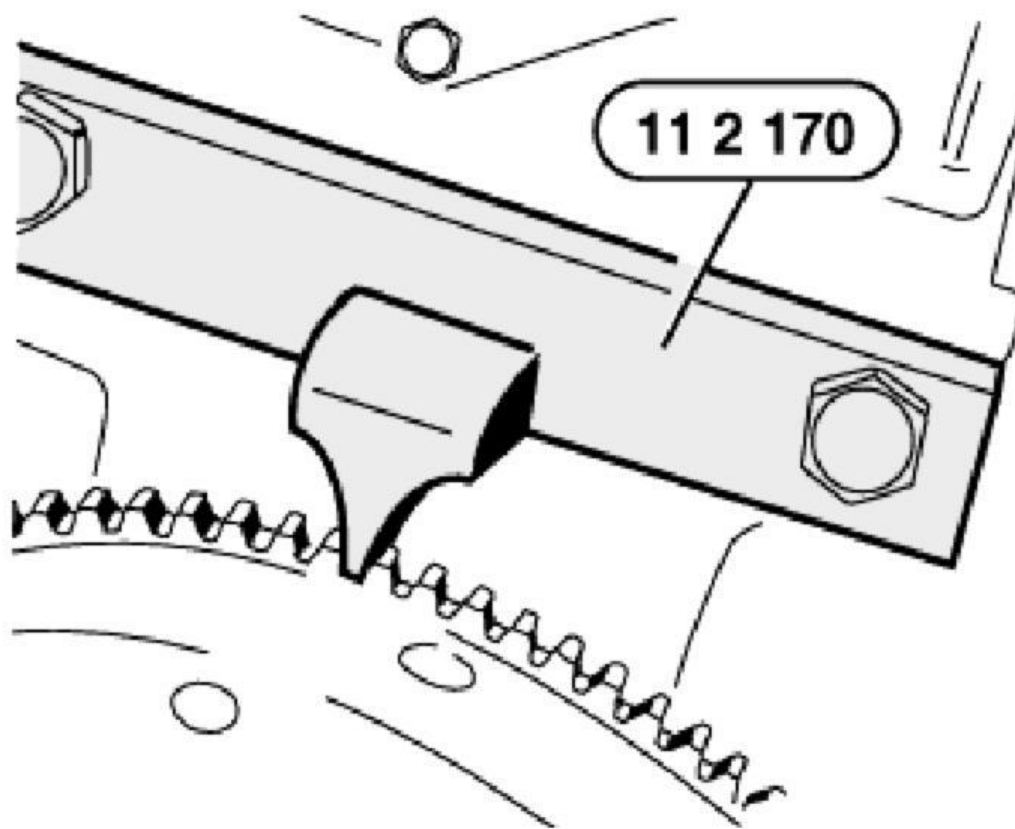
11 22 500 REMOVING AND INSTALLING OR REPLACING FLYWHEEL (M52/S52/M52TU/M54/S54)

Special Tools Required:

- 11 2 170

(Clutch removed)

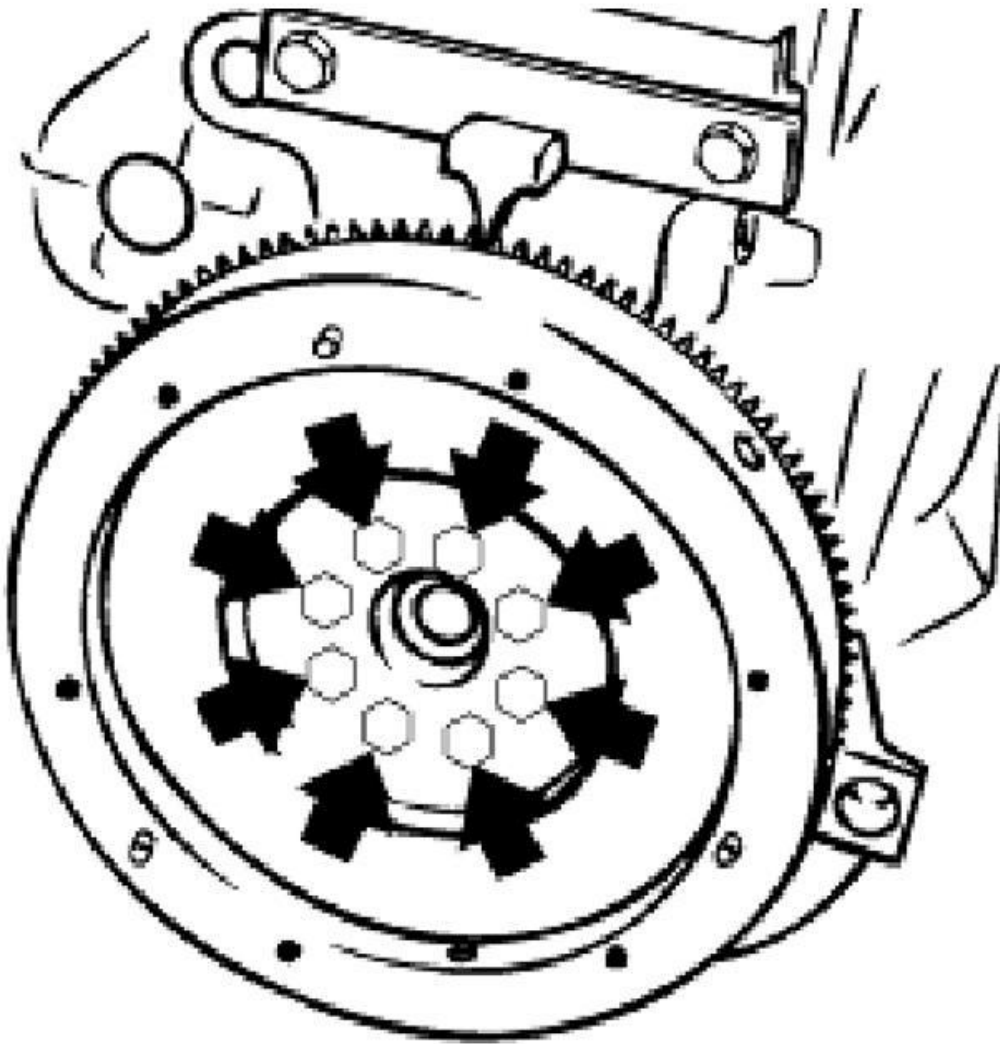
Lock flywheel with special tool 11 2 170.



G03117778

Fig. 114: Securing Flywheel With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten screws and remove flywheel.

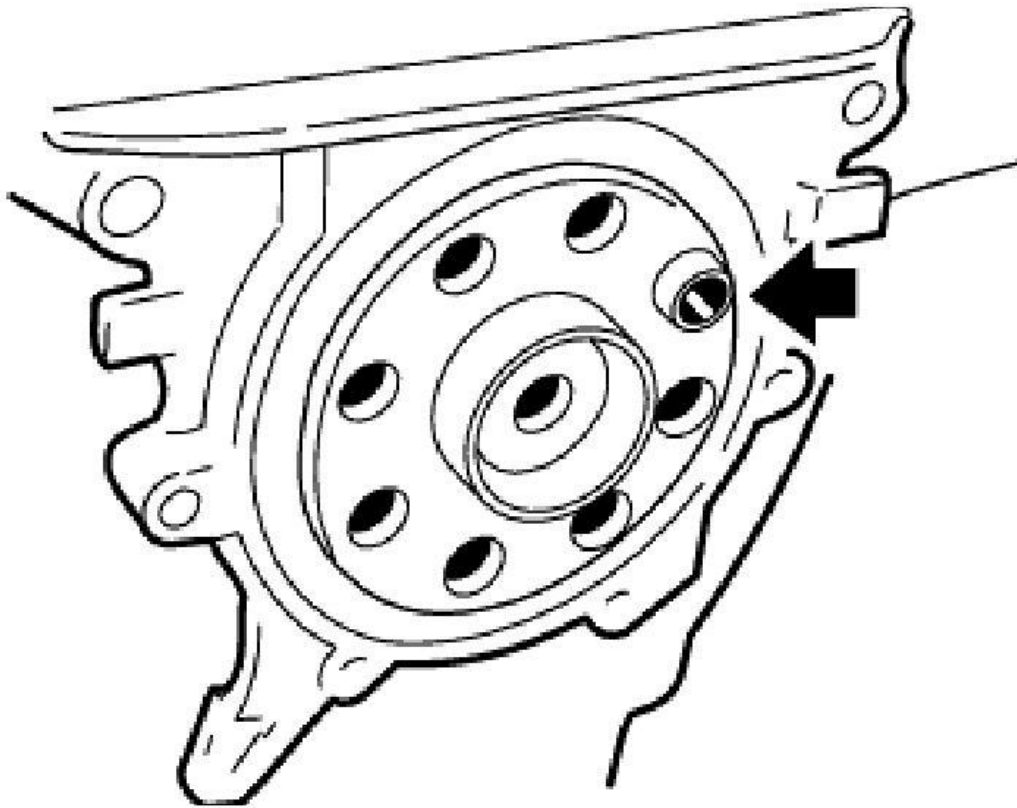


G03117779

Fig. 115: Identifying Flywheel Screws
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Check dowel sleeve for damage and correct installation position.



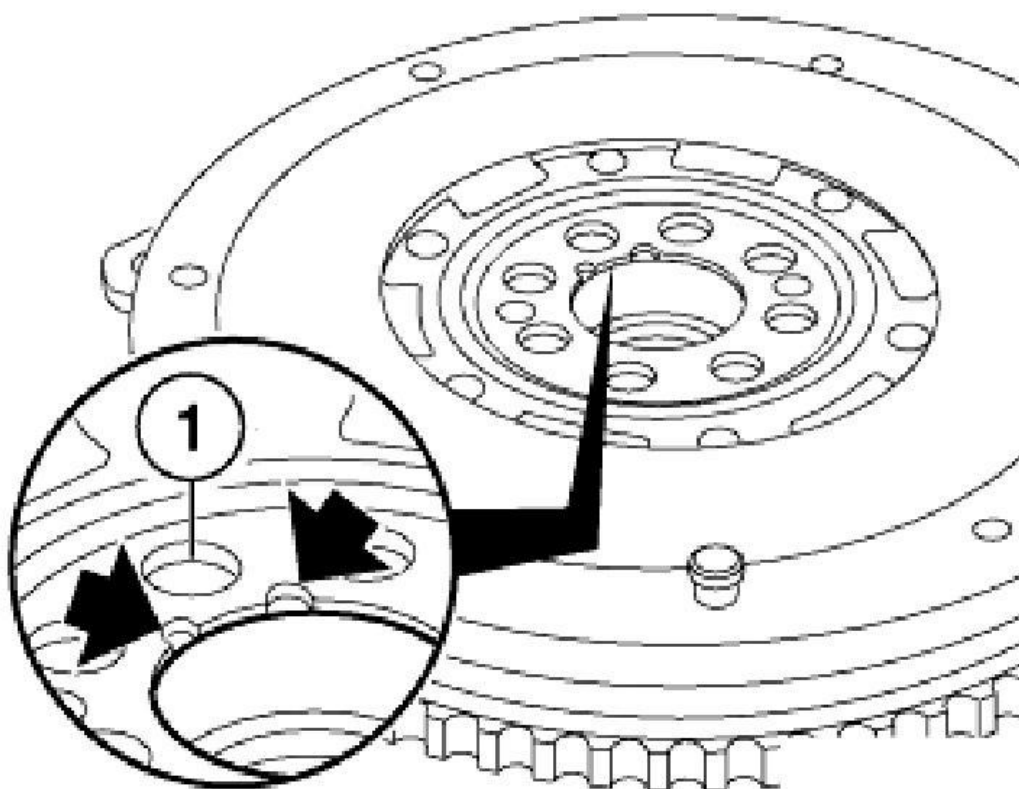
G03117780

Fig. 116: Locating Dowel Sleeve

Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Position of dowel sleeve (1) in dual-mass flywheel is identified by two notches next to associated bolt hole.



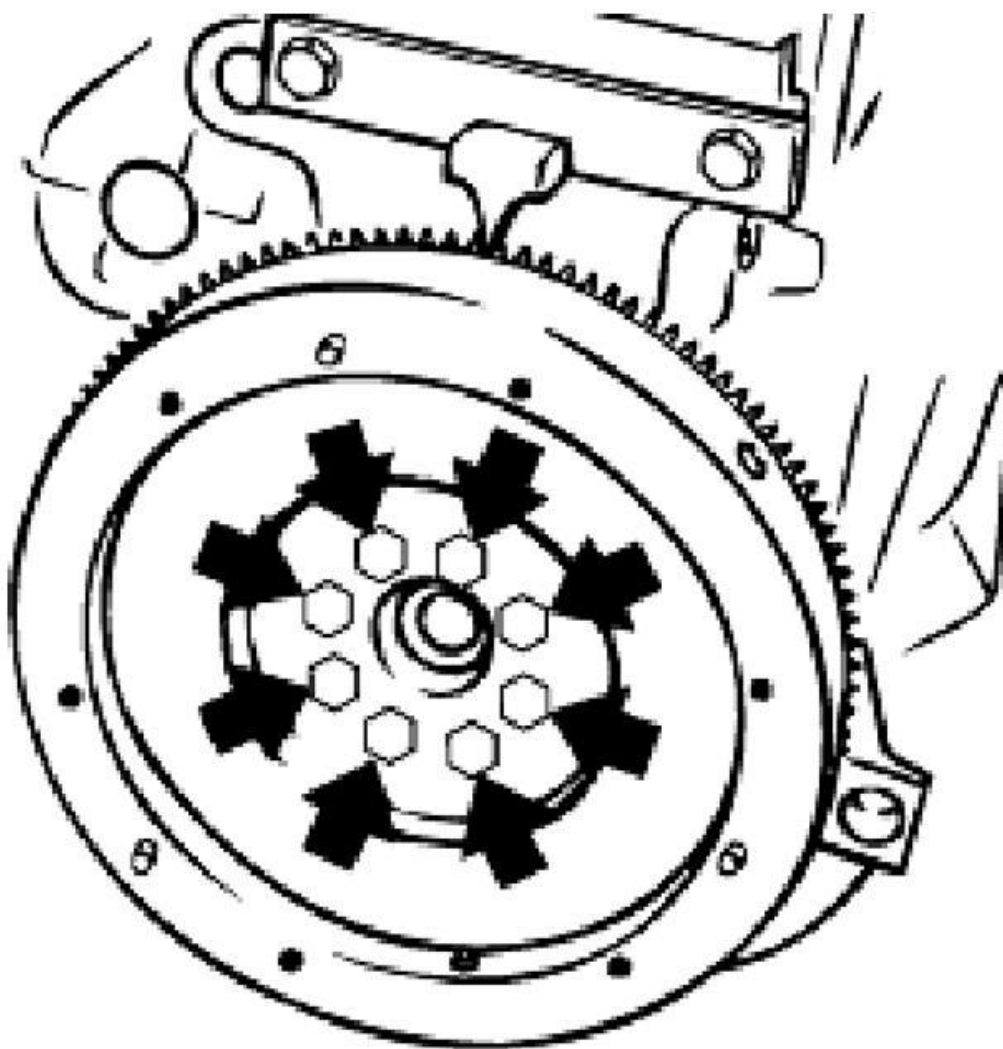
G03117781

Fig. 117: Locating Position Of Dowel Sleeve In Dual-Mass Flywheel
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Clean thread and install new micro-encapsulated screws.

Tightening torque, refer to 11 22 1AZ in **ENGINE - TIGHTENING TORQUES** .



G03117782

Fig. 118: Identifying Flywheel Retaining Screws
Courtesy of BMW OF NORTH AMERICA, INC.

VIBRATION DAMPER

11 23 010 REMOVING AND INSTALLING/REPLACING VIBRATION DAMPER (S54)

Special Tools Required:

- 00 9 120
- 11 0 280

Remove engine underguard.

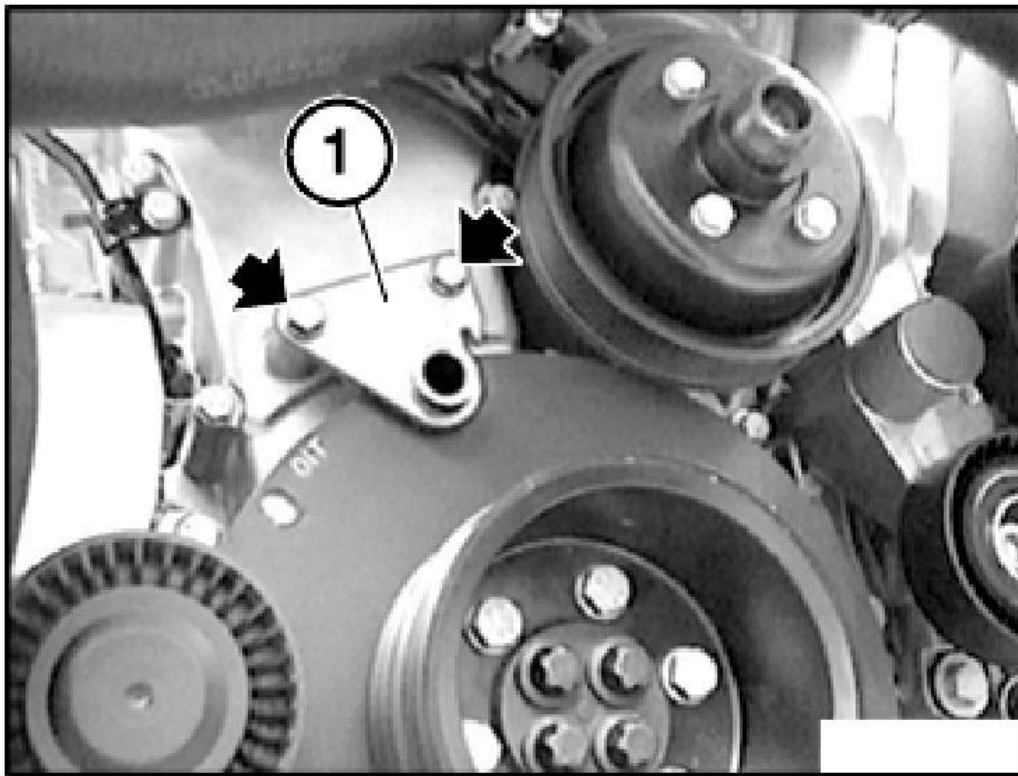
Remove fan cowl. Refer to **17 11 031 REPLACING FAN COWL (S54)** .

Remove A/C compressor drive belt. Refer to **11 28 050 REPLACING A/C COMPRESSOR DRIVE BELT (S54)**.

Remove alternator drive belt. Refer to **11 28 010 REPLACING ALTERNATOR DRIVE BELT (S54)**.

Unfasten screws.

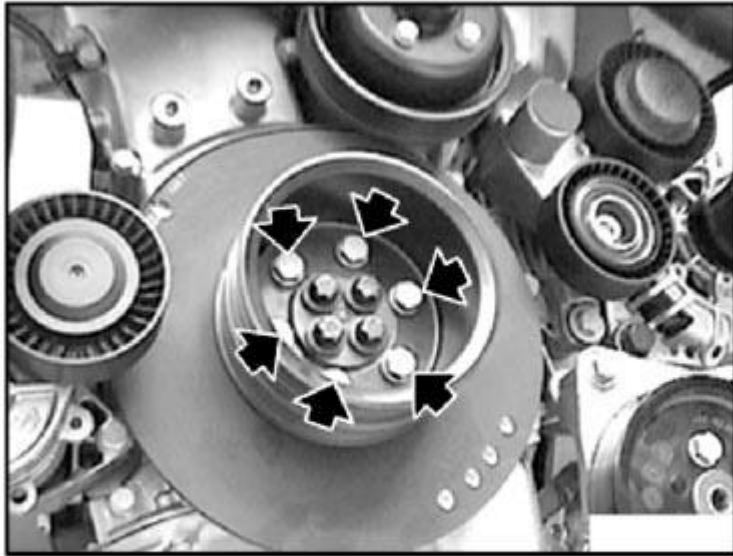
Remove plate (1) for TDC marking.



G03117783

Fig. 119: Identifying Plate For TDC Marking
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten screws. Remove belt pulley.



G03117784

Fig. 120: Locating Belt Pulley Retaining Screws
Courtesy of BMW OF NORTH AMERICA, INC.

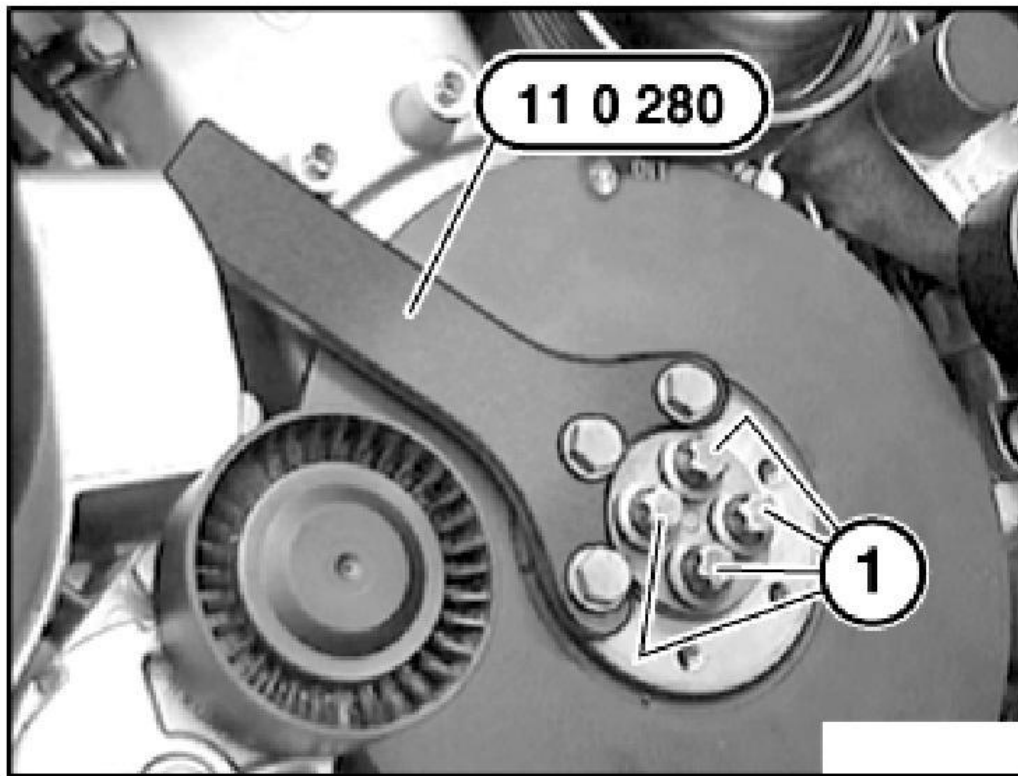
Mount special tool 11 0 280 on vibration damper.

NOTE: Special tool 11 0 280 is supported on mounting bracket for A/C system.

CAUTION: Do not damage mounting bracket for A/C system.

Loosen screws (1).

Remove special tool 11 0 280.

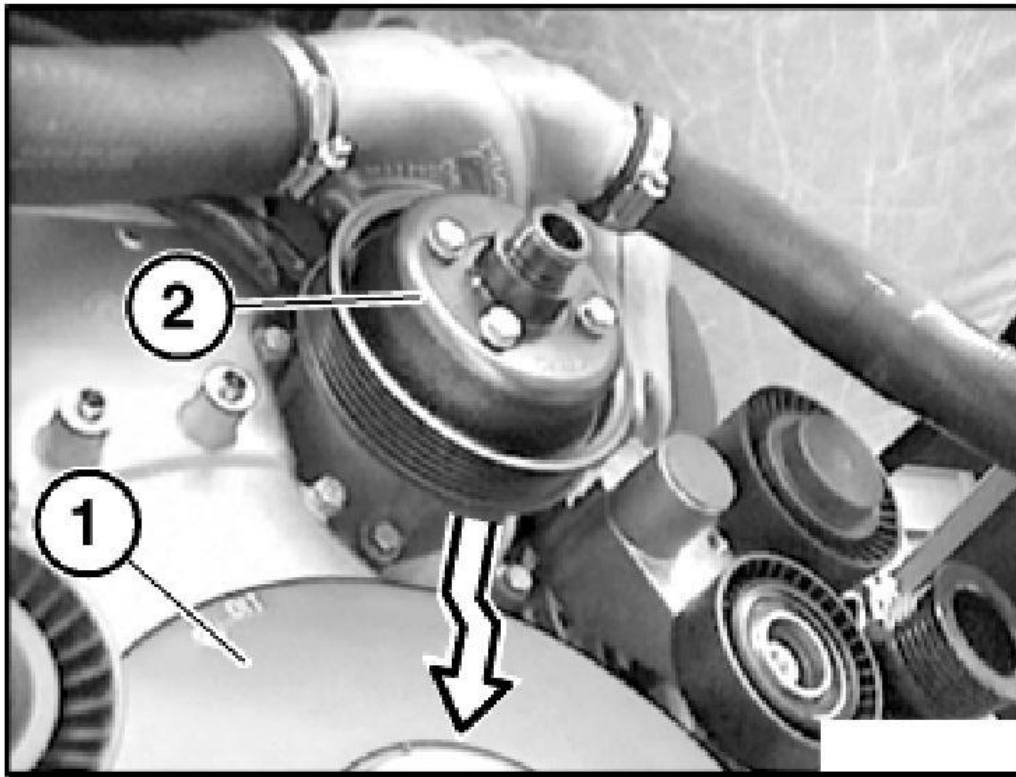


G03117785

Fig. 121: Mounting Holder On Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Do not damage belt pulley of water pump.

Remove vibration damper from crankshaft and feed out below belt pulley of water pump.

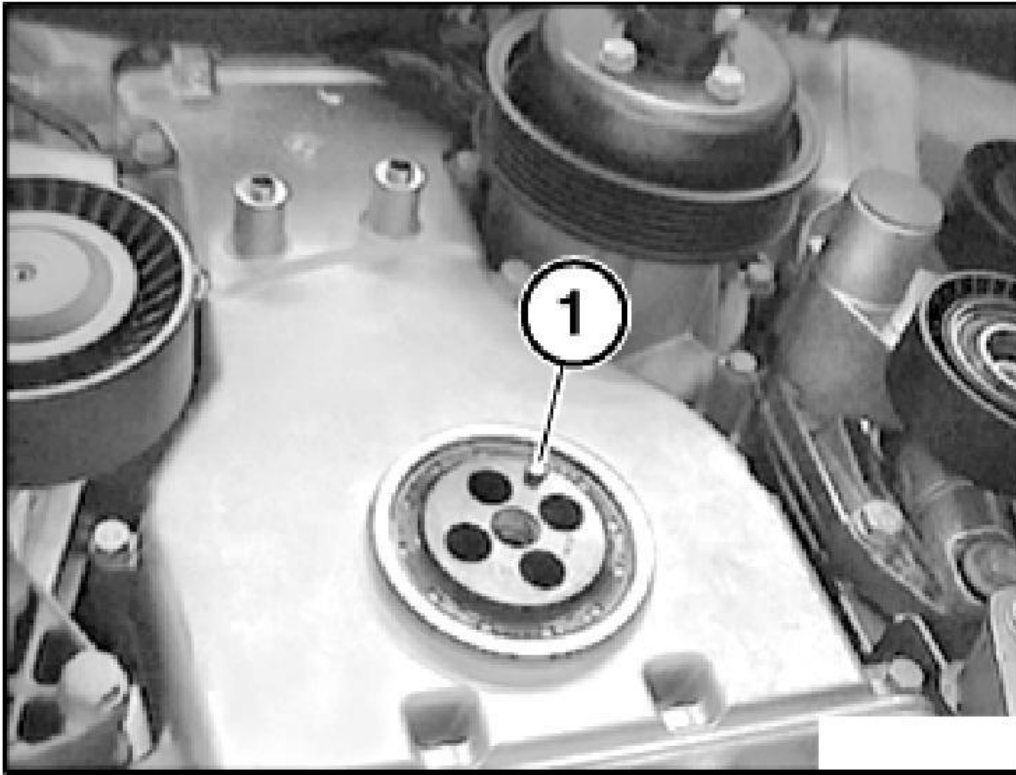


G03117786

Fig. 122: Removing Vibration Damper From Crankshaft
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

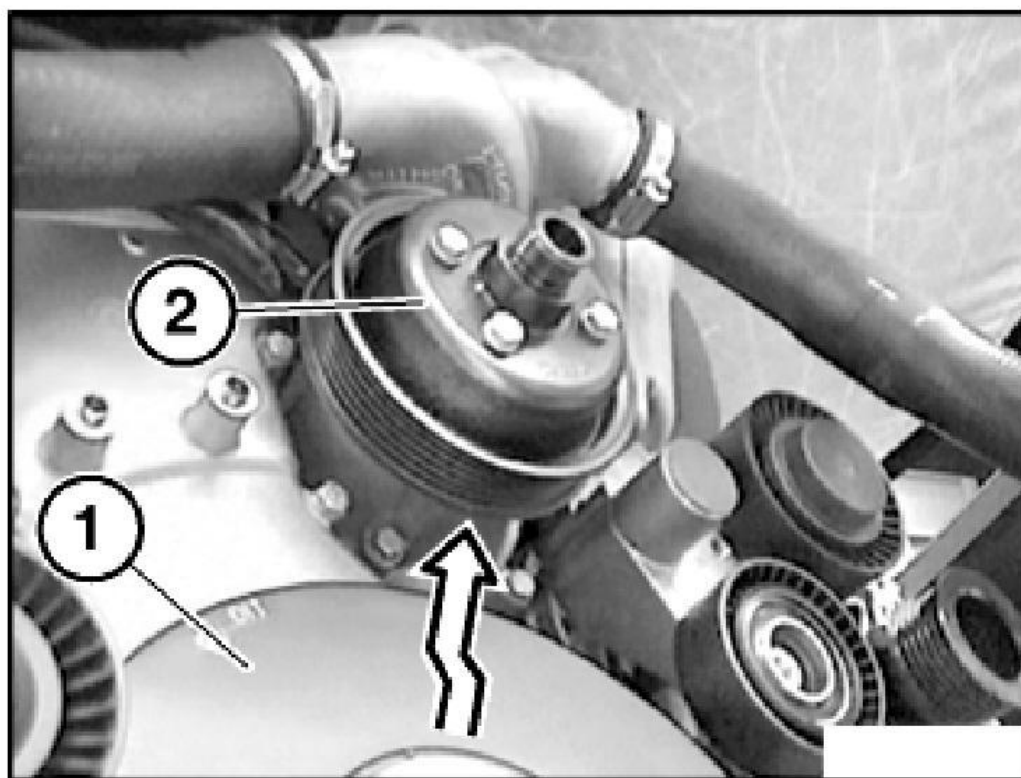
Align locating bore in vibration damper to dowel pin (1).



G03117787

Fig. 123: Aligning Locating Bore In Vibration Damper To Dowel Pin
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Feed in vibration damper (1) behind belt pulley (2) of water pump.



G03117788

Fig. 124: Feeding In Vibration Damper Behind Belt Pulley Of Water Pump
Courtesy of BMW OF NORTH AMERICA, INC.

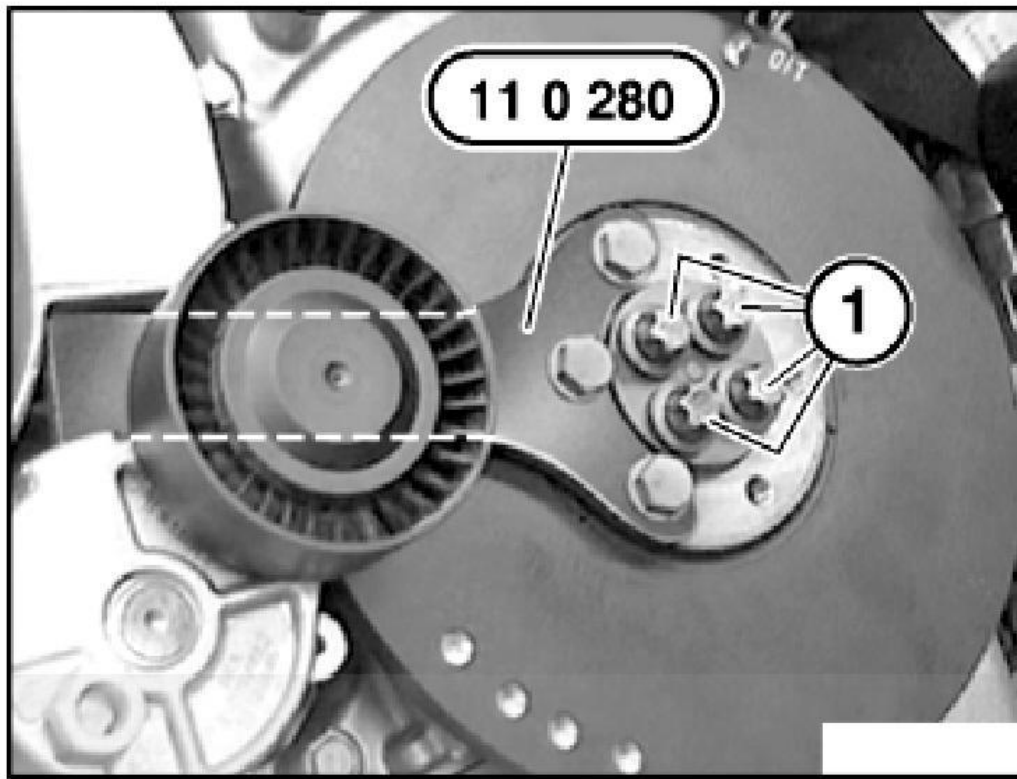
Installation:

Attach vibration damper and align to dowel pin.

NOTE: A washer is installed under screws (1).

Replace screws (1).

NOTE: Feed in special tool 11 0 280 behind tensioning roller and support on mounting bracket of A/C system.



G03117789

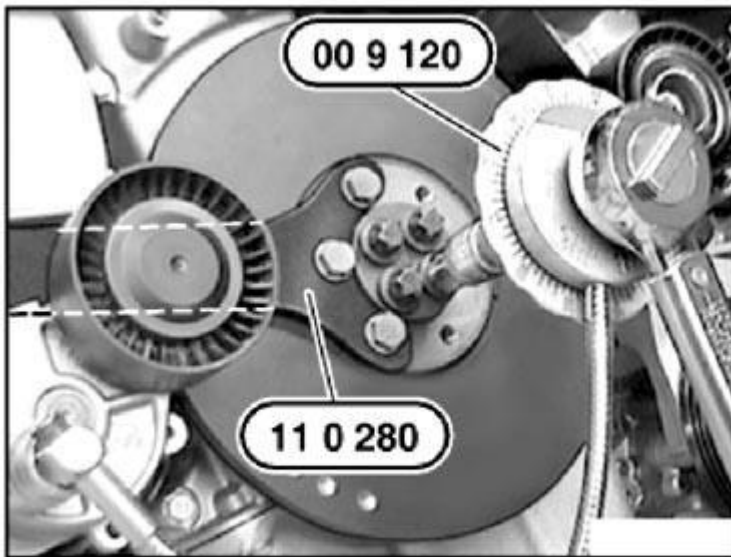
Fig. 125: Attaching Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

Mount special tool 11 0 280 on vibration damper.

Installation:

Tighten down screws on vibration damper with special tool 00 9 120.

Tightening torque, refer to 11 23 2AZ in **ENGINE - TIGHTENING TORQUES**.



G03117790

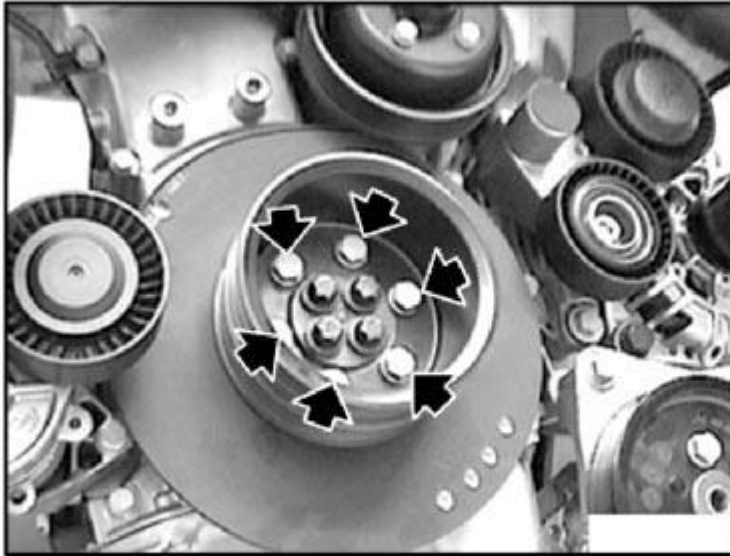
Fig. 126: Mounting Special Tool On Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Install belt pulley.

Tighten down screws.

Tightening torque, refer to 11 23 3AZ in **ENGINE - TIGHTENING TORQUES** .

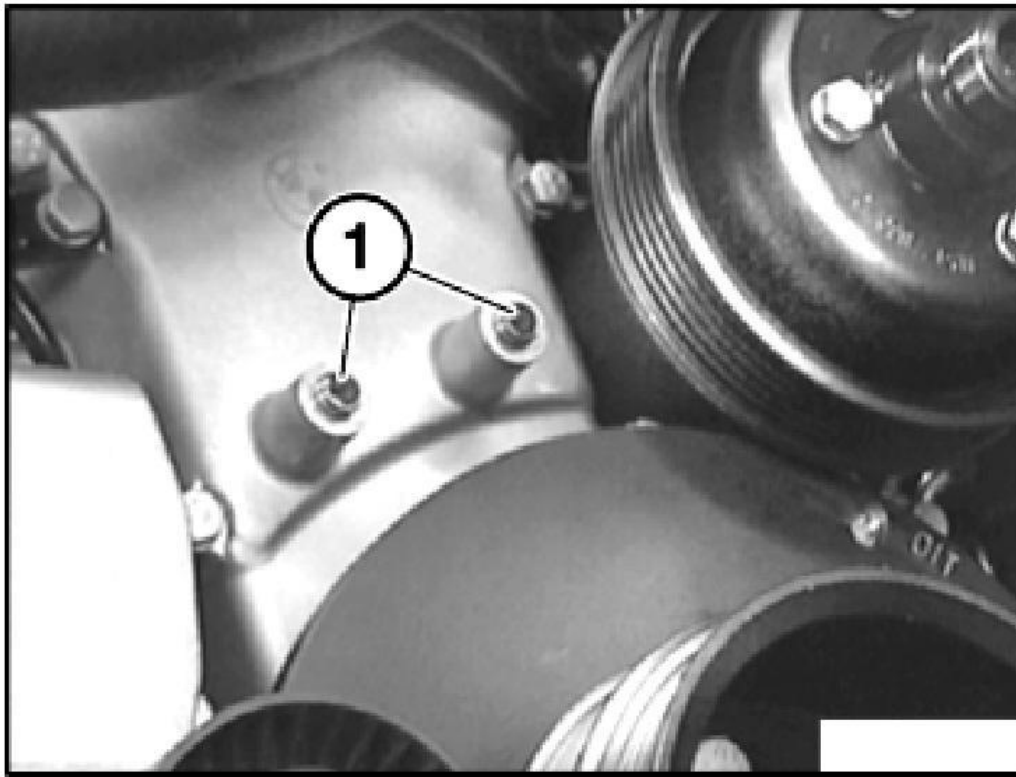


G03117791

Fig. 127: Installing Belt Pulley
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Check dowel sleeves (1) for damage and correct installation



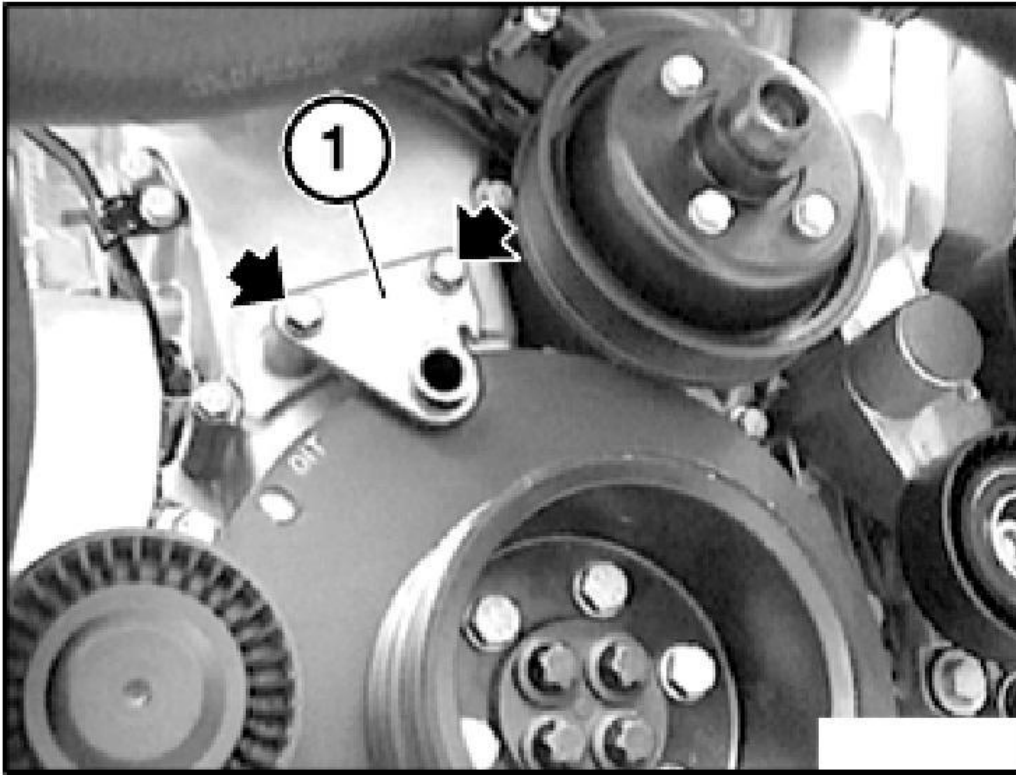
G03117792

Fig. 128: Checking Dowel Sleeves

Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Install plate (1) for TDC marking.



G03117793

Fig. 129: Installing Plate For TDC Marking
Courtesy of BMW OF NORTH AMERICA, INC.

CONNECTING ROD WITH BEARING

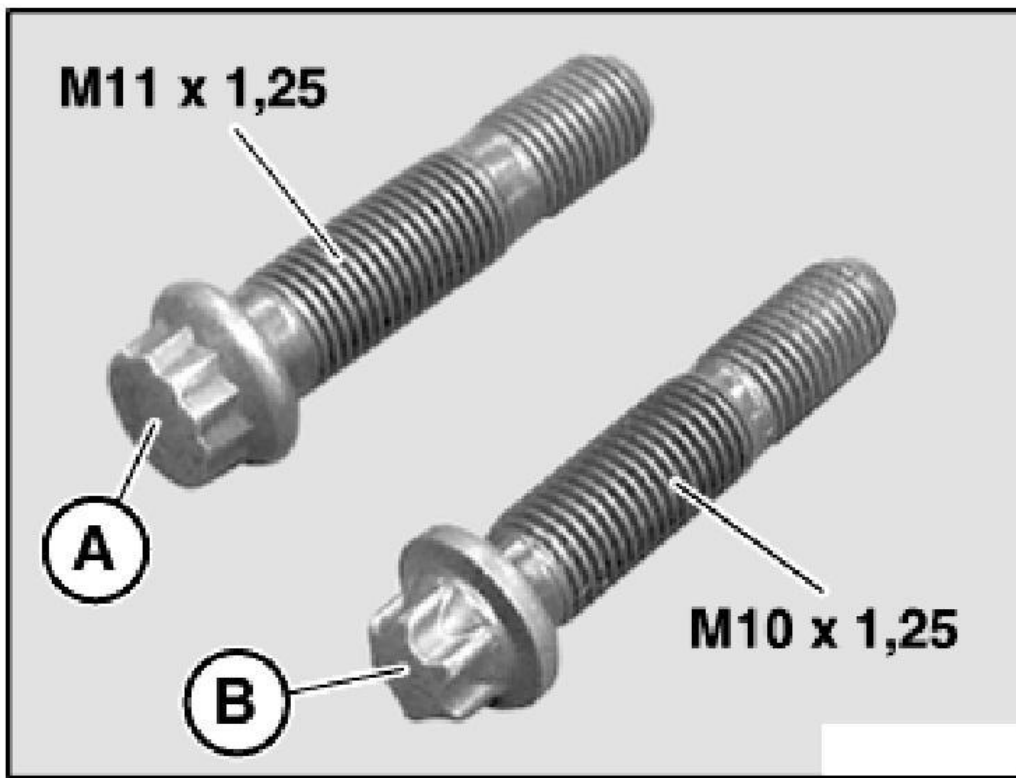
11 24 571 REPLACING ALL CONROD BEARINGS (S54)

(Piston removed)

CAUTION: The S54 engine has two types of conrod with different conrod bolts.

Differentiating Features:

- A. Conrod bolt with M11x1.25 thread. Bolt head: bihexagonal 12 mm A/F.
- B. Conrod bolt with M10x1.25 thread. Bolt head: Torx E12.



G03117794

Fig. 130: Identifying Conrod Bolts

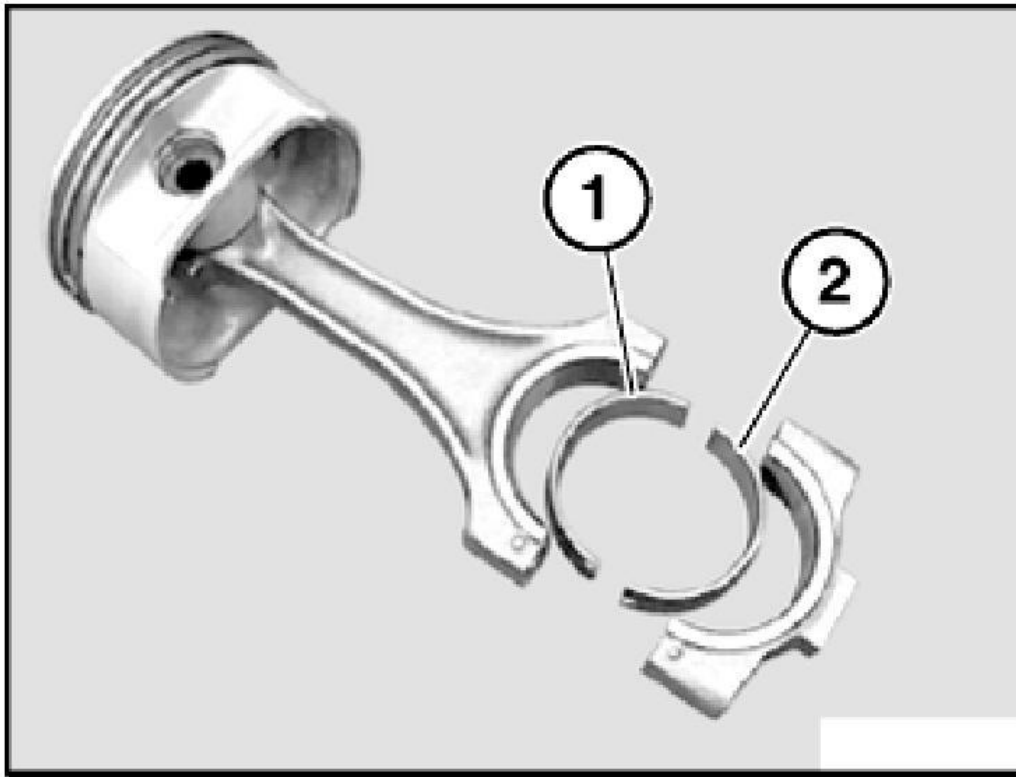
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: The procedure for replacing the conrod bolts and the tightening specifications are different. Mixing up the procedure for replacing the conrods and conrod bolts and the tightening specifications will result in serious engine damage.

CAUTION: Note grinding stages on crankshaft. Refer to ENGINE - TECHNICAL DATA .

NOTE: Classified conrod bearing shells color-coded "Yellow and Green" are installed in the model series.

The classification is removed when the conrod bearing shells are replaced.



G03117795

Fig. 131: Installing Conrod Bearing Shells In Conrod
Courtesy of BMW OF NORTH AMERICA, INC.

- Install conrod bearing shells (1) color-coded "Blue" in conrod at top.
- Install conrod bearing shells (2) color-coded "Red" in conrod at top.

Install piston. Refer to **11 25 530 REMOVING AND 530 INSTALLING/REPLACING ALL PISTONS (S54)**.

PISTON WITH RINGS AND PIN

11 25 530 REMOVING AND INSTALLING/REPLACING ALL PISTONS (S54)

(Engine removed)

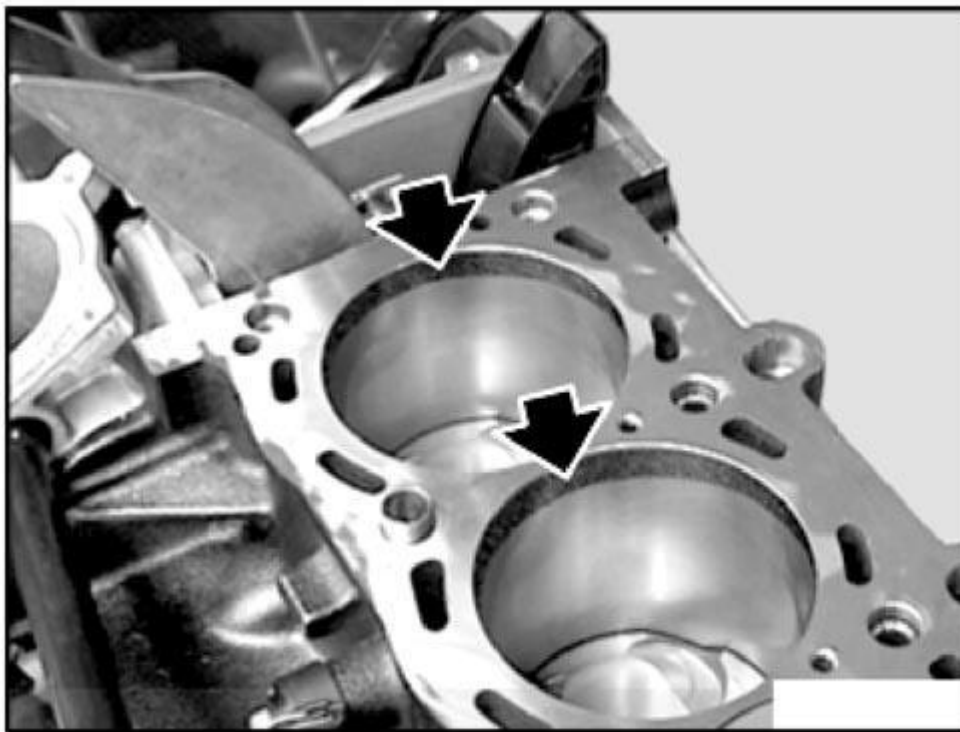
Fit engine to special tool 00 1 450.

- Removing cylinder head.

- Removing oil pan.
- Removing oil pump.

CAUTION: Re-install piston, conrod and bearing shells back in the same position and in the same installation location. Conrod and conrod bearing cover are designated with same pair number: do not interchange/confuse.

In event of heavy oil carbon residue: Carefully remove oil carbon residue from cylinder wall.

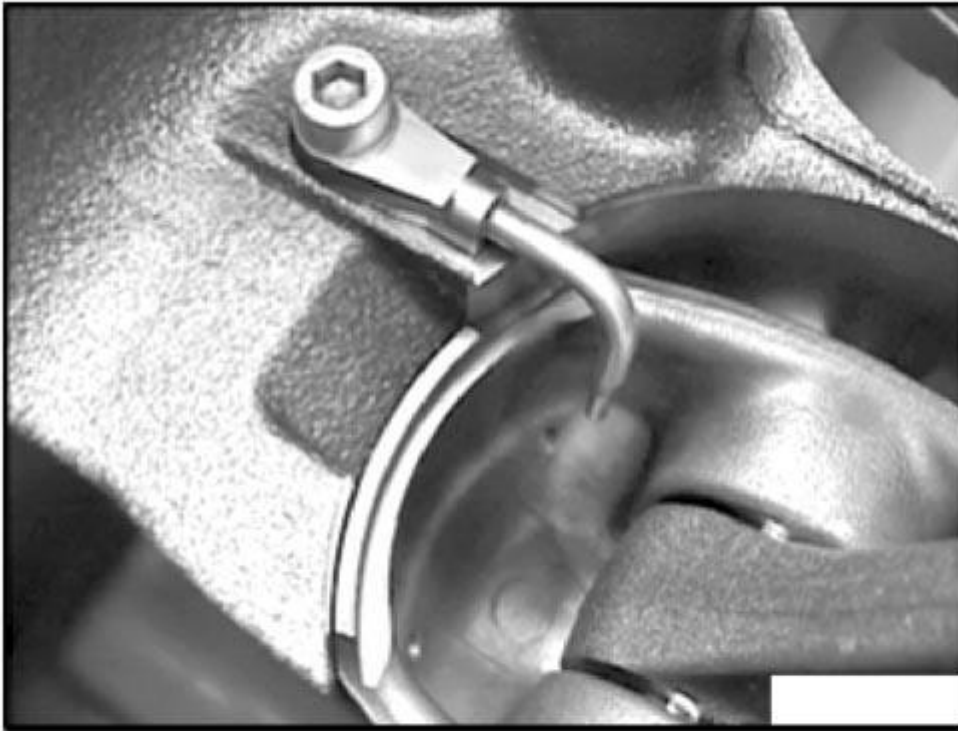


G03117796

Fig. 132: Identifying Oil Carbon Residue On Cylinder Wall
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Piston cooling spray nozzles are installed between the bearing seats.

Check spray nozzles for damage. If necessary, remove piston-cooling spray nozzles.



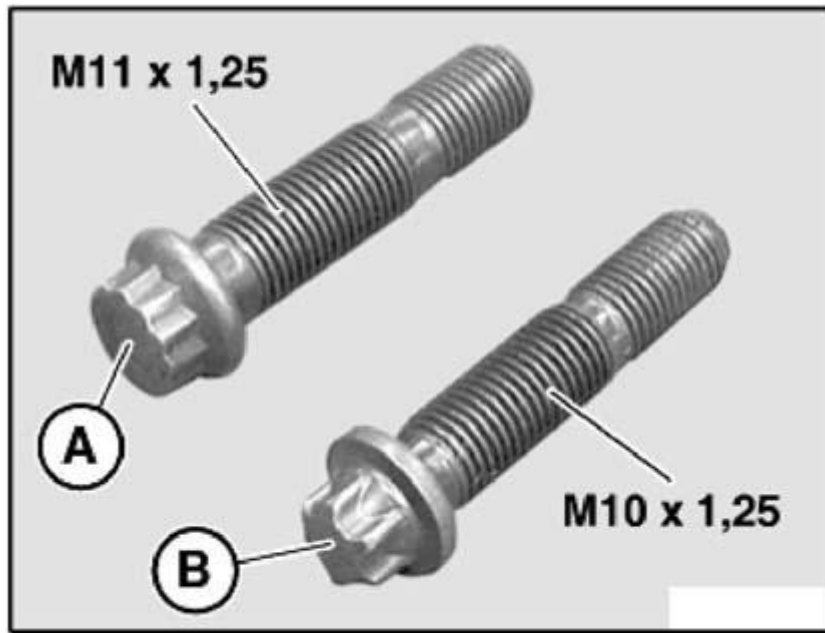
G03117797

Fig. 133: Checking Spray Nozzles For Damage
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: The S54 engine has two types of conrod with different conrod bolts.

Differentiating Features:

- A. Conrod bolt with M11x1.25 thread.
Bolt head: bihexagonal 12 mm A/F.
- B. Conrod bolt with M10x1.25 thread.
Bolt head: Torx E12.



G03117798

Fig. 134: Identifying Conrod Bolts
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: The procedure for replacing the conrod bolts and the tightening specifications are different. Mixing up the procedure for replacing the conrods and conrod bolts and the tightening specifications will result in serious engine damage.

Removal And Installation:

Removal and installation of pistons and conrods with M11x1.25 conrod bolt and M10x1.25 conrod bolt are described separately.

Remove and install piston (M11x1.25 conrod bolt, refer to **11 25 530 REMOVING AND INSTALLING/REPLACING ALL PISTONS (S54 WITH M11X1.25 CONROD BOLT)**).

Remove and install piston (M10x1.25 conrod bolt), refer to **11 25 530 REMOVING AND INSTALLING/REPLACING ALL PISTONS (S54 WITH M10X1.25 CONROD BOLT)**).

11 25 530 REMOVING AND INSTALLING/REPLACING ALL PISTONS (S54 WITH M11X1.25 CONROD BOLT)

Special Tools Required:

- 00 2 590

- 00 9 120
- 11 3 480
- 11 9 120

(Engine removed)

Removal:

Removal of pistons is described separately from installation. Assembly sequence for removal and installation is different.

Fit engine to special tool 00 1 450.

- Removing cylinder head.
- Removing oil pan.
- Removing oil pump.

CAUTION: Re-install piston, conrod and bearing shells back in the same position and in the same installation location. Conrod and conrod bearing cover are designated with same pair number: do not interchange/confuse.

In event of heavy oil carbon residue:

Carefully remove oil carbon residue from cylinder wall.

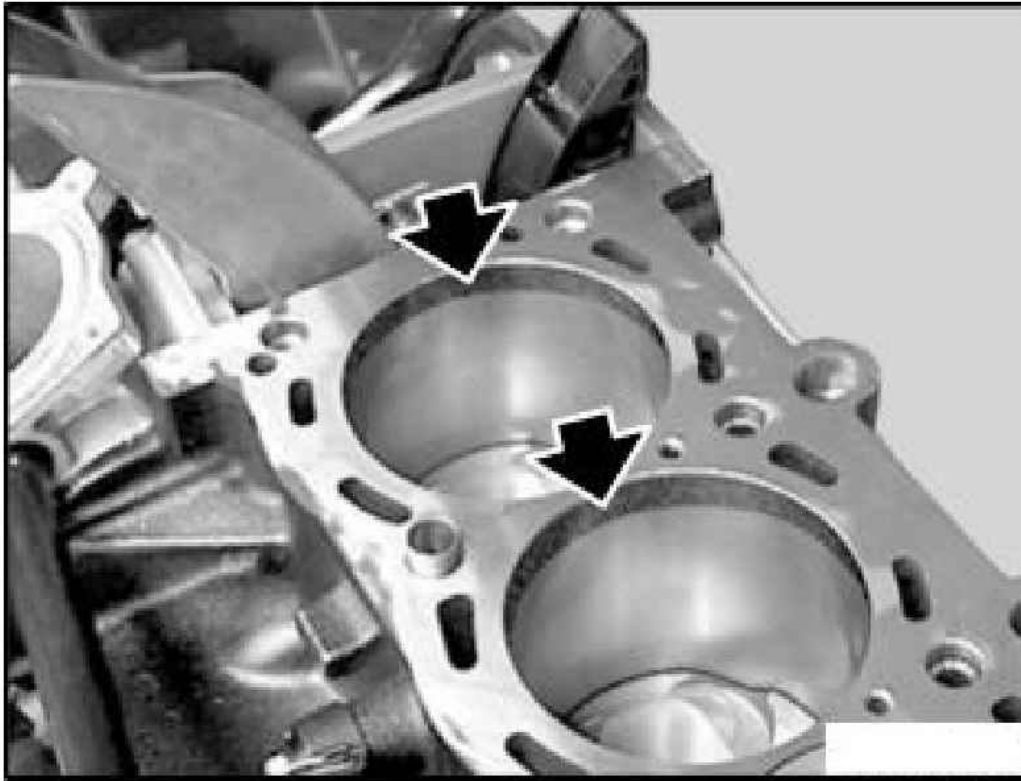
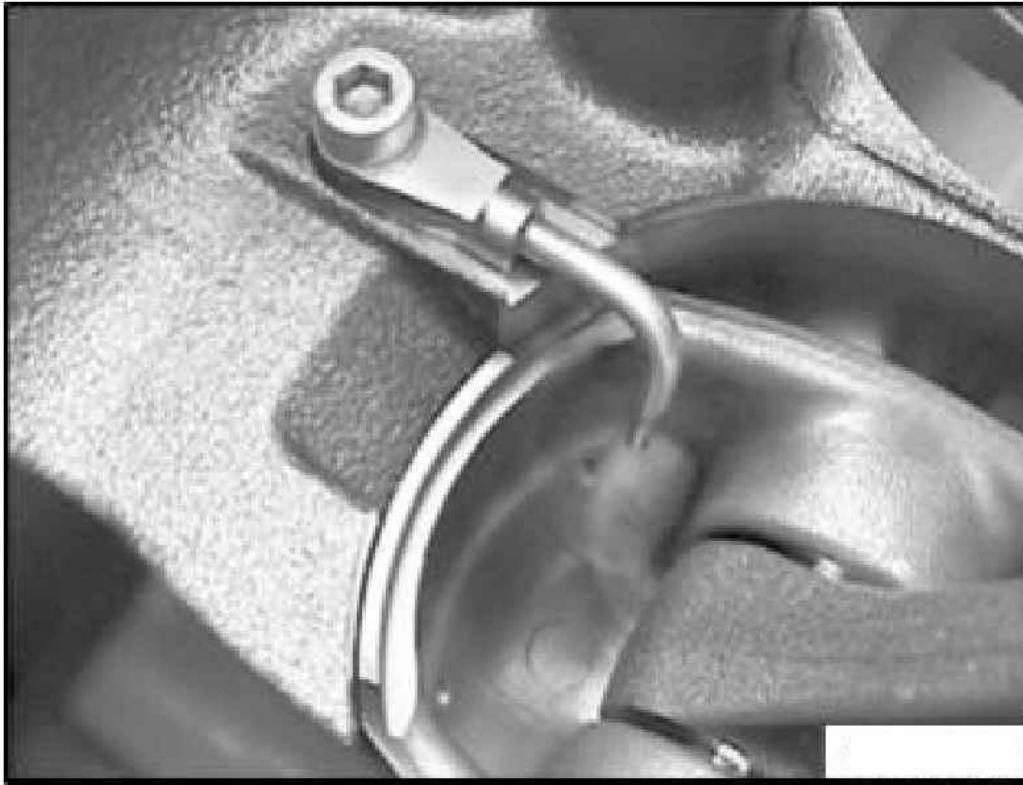
**G03190713**

Fig. 135: Identifying Oil Carbon Residue On Cylinder Wall
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: **Piston cooling spray nozzles are installed between the bearing seats.**

Check spray nozzles for damage.

If necessary, remove piston-cooling spray nozzles.



G03190714

Fig. 136: Identifying Piston Cooling Spray Nozzles
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: The S54 engine has two types of conrod with different conrod bolts.

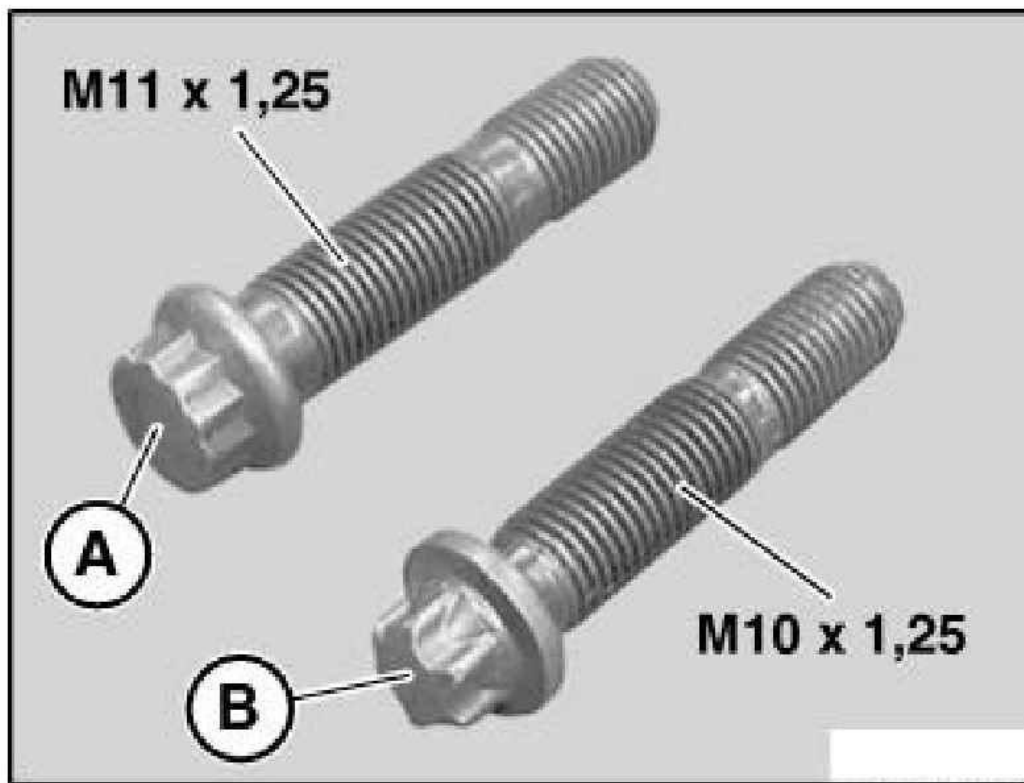
Differentiating Features:

A Conrod bolt with M11x1.25 thread. Bolt head: bihexagonal 12 mm A/F.

B Conrod bolt with M10x1.25 thread. Bolt head: Torx E12.

The procedure for replacing the conrod bolts and the tightening specifications are different.

Mixing up the procedure for replacing the conrods and conrod bolts and the tightening specifications will result in serious engine damage.

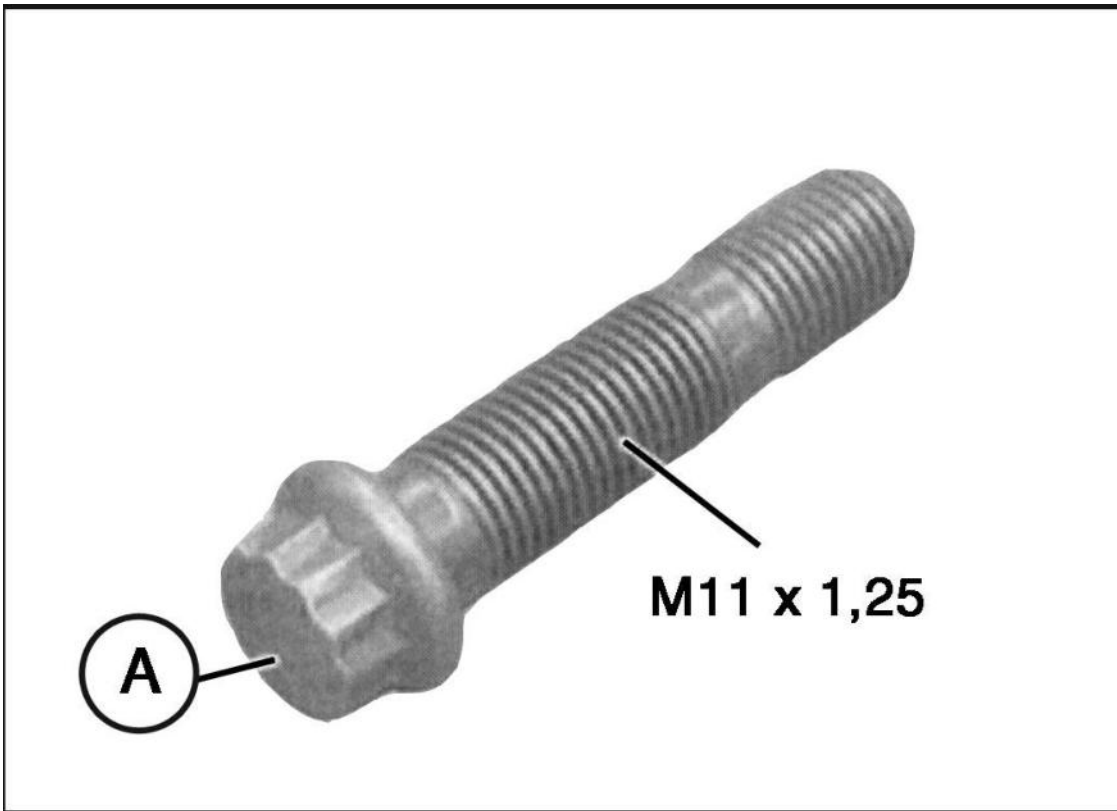


- A** Conrod bolt with M11x1.25 thread
Bolt head: bihexagonal 12 mm A/F
- B** Conrod bolt with M10x1.25 thread
Bolt head: Torx E12

G03190715

Fig. 137: Identifying Types Of Conrod Bolts
Courtesy of BMW OF NORTH AMERICA, INC.

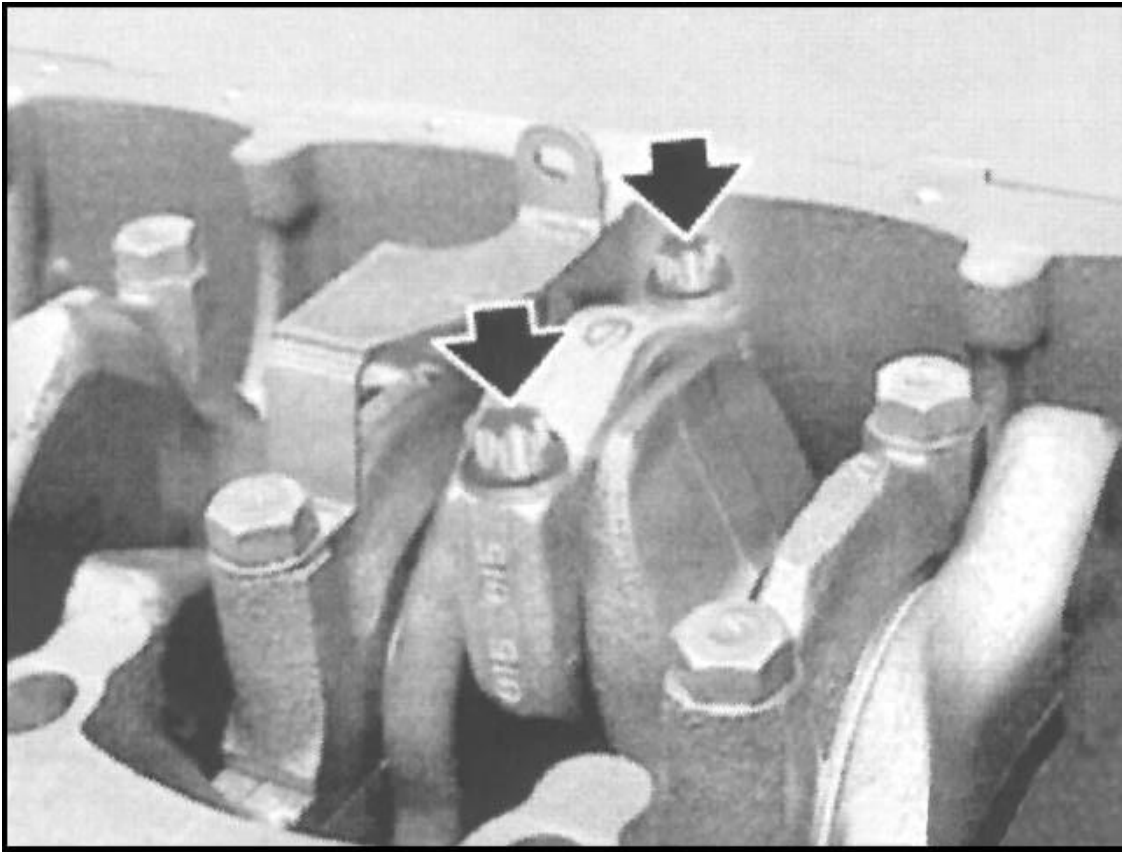
CAUTION: Contrary to the instructions for all other BMW engines, the conrod bolts must not be replaced in the S54 engine with the M11x1.25 conrod bolt. The M11x1.25 may only be reused in the same conrod thread. Conrods with M11x1.25 conrod bolts are no longer supplied as replacements. If a conrod or a conrod bolt with M11x1.25 thread is damaged: replace the conrods with a complete set of conrods with M10X1.25 Conrod Bolts. .



G00397775

Fig. 138: Identifying M11x1.25 Conrod Bolt
Courtesy of BMW OF NORTH AMERICA, INC.

- Release conrod bolts.
- Remove conrod bearing cap.
- Set conrod bolts and conrod bear caps down in neat order.

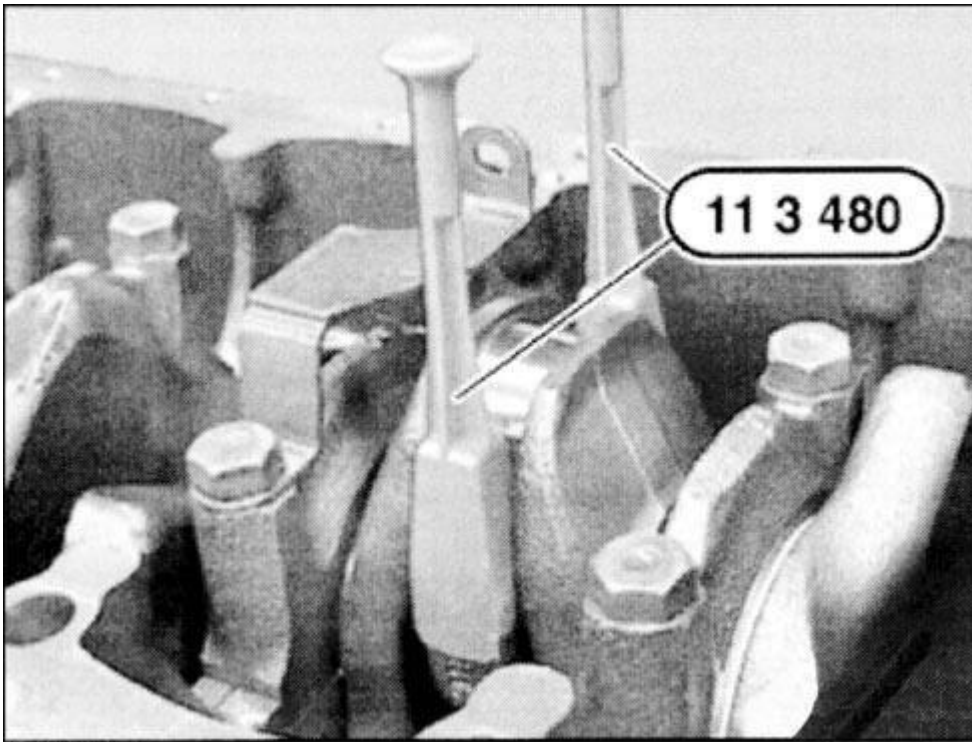


G00397774

Fig. 139: Locating Conrod Bolt
Courtesy of BMW OF NORTH AMERICA, INC.

Insert special tool 11 3 480 in conrod.

Remove connecting rod with piston from cylinder-head side.

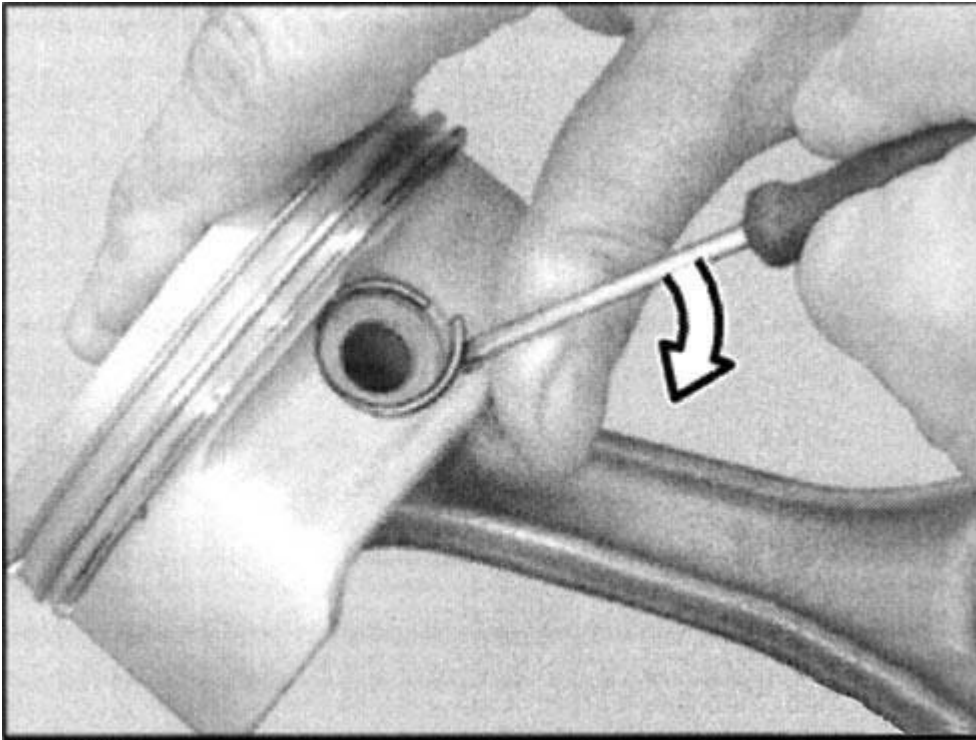


G00397778

Fig. 140: View Of Special Tool 11 3 480 In Connecting Rod
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Piston and piston bolts are paired and must not be fitted individually.

Lift out retaining ring and press out piston pin.



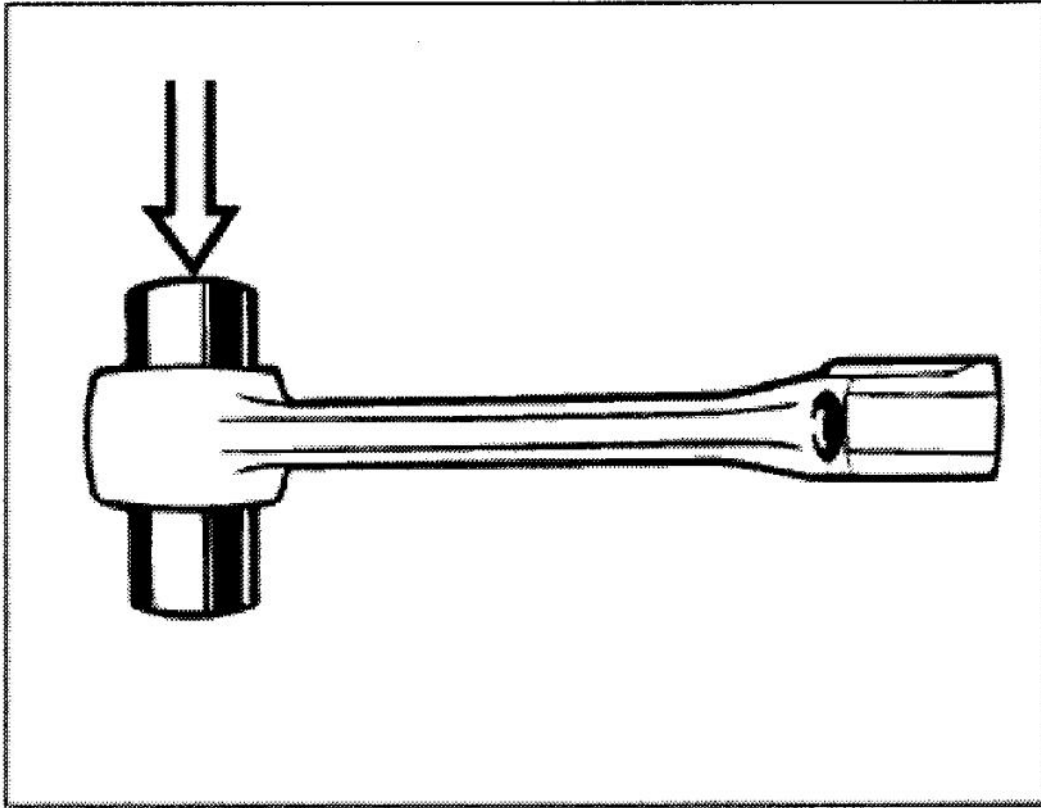
G00397779

Fig. 141: Removing Retaining Ring & Piston Pin
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Installation of pistons is described separately from removal. The assembly sequence for removal and installation is different.

The piston pin must be able to be pressed through the liner by hand with little force and must not display any significant play. If necessary, replace connecting rods.



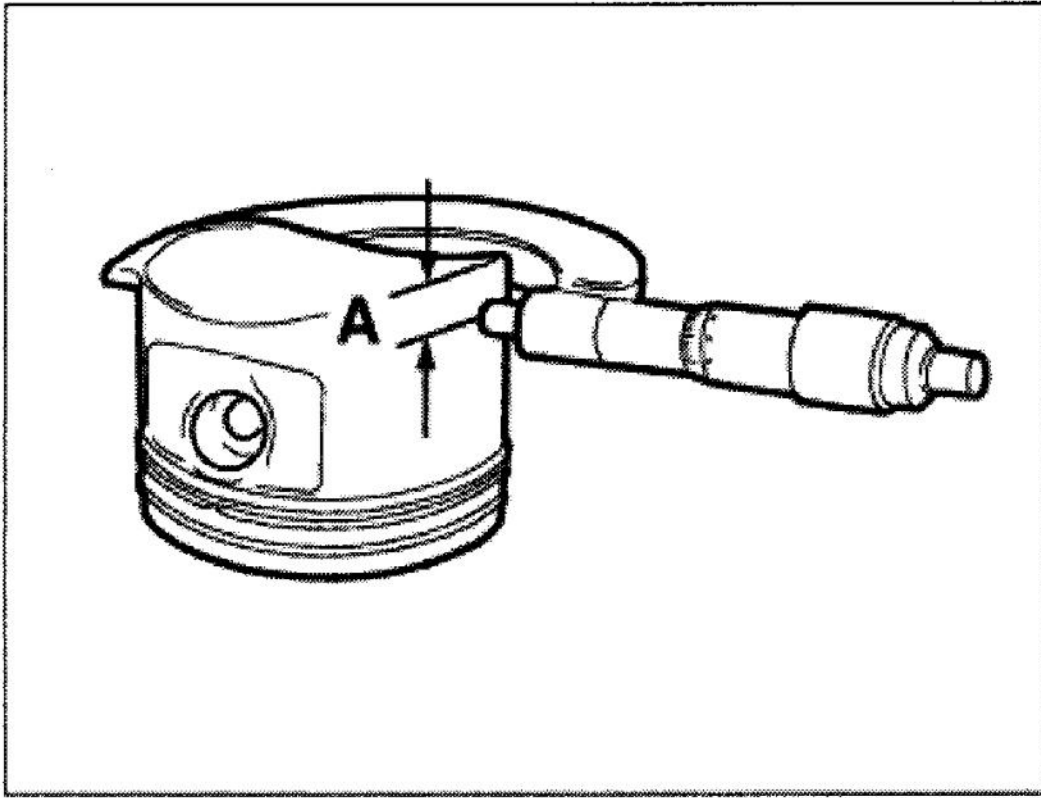
G00397780

Fig. 142: Locating Piston Pin

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Only conrods of the same weight group are allowed to be installed inside an engine. Connecting rods are only supplied in complete sets.

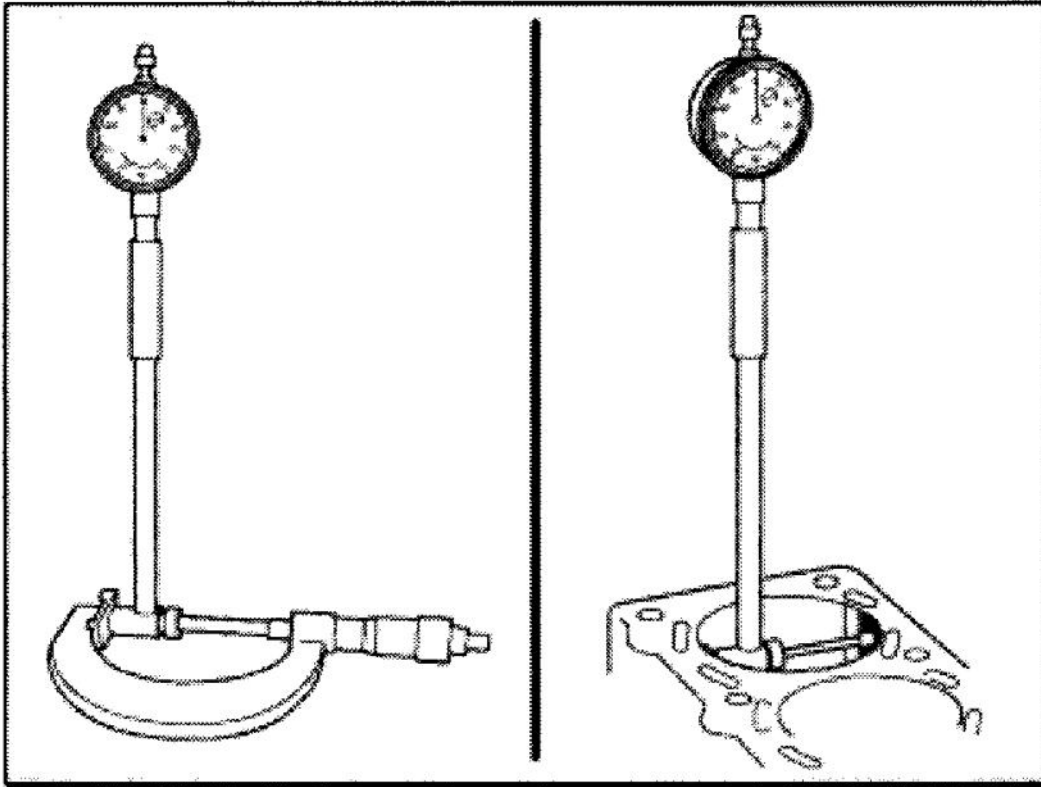
Prior to installation, measure piston installation clearance: Measure piston diameter with micrometer at measuring point A from bottom edge of piston and offset at 90° to the axis of the piston pin. For measuring point A, refer to 11 25 Pistons With Rings And Pins S54, in **ENGINE - TECHNICAL DATA** .



G00397781

Fig. 143: Locating Measuring Point**Courtesy of BMW OF NORTH AMERICA, INC.**

Adjust micrometer to cylinder bore of engine block. Set internal caliper on micrometer to zero. Measure bottom, center and top of cylinder bore in direction of travel and direction of engine rotation.



G00397793

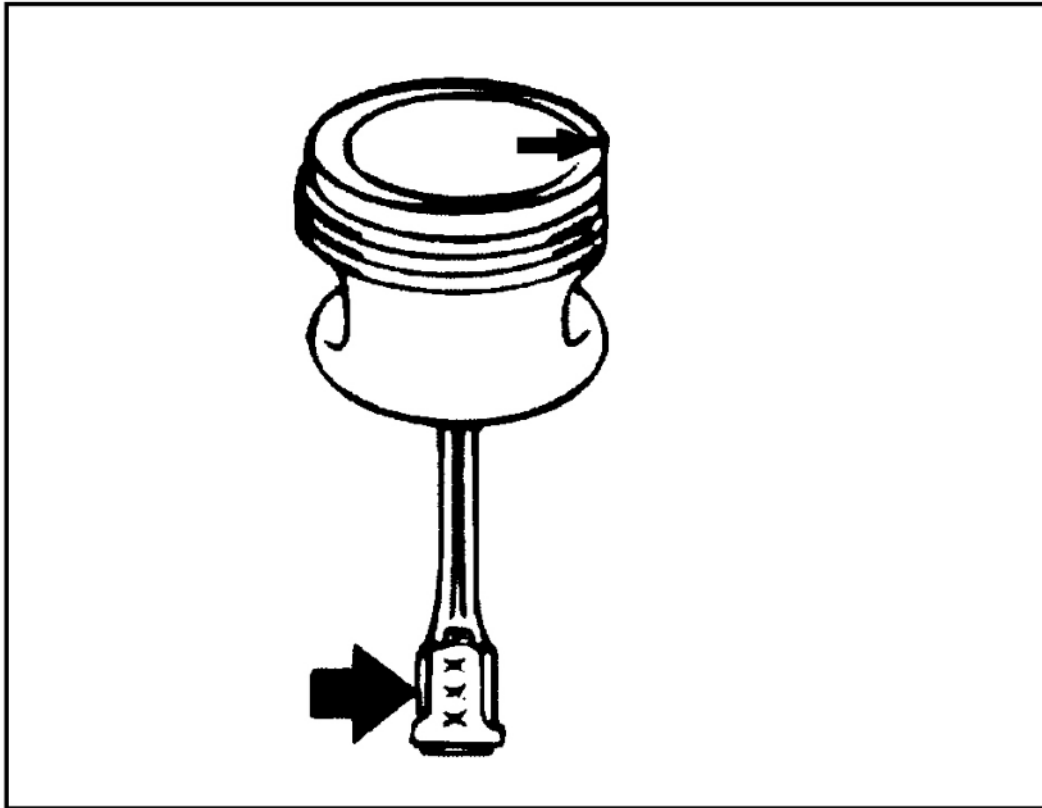
Fig. 144: Measuring Cylinder Bore

Courtesy of BMW OF NORTH AMERICA, INC.

- Diameter of cylinder bore, refer to 11 00 Engine In General S54 in **ENGINE - TECHNICAL DATA** .
- Piston installation clearance, refer to 11 25 Pistons With Rings And Pins S54 in **ENGINE - TECHNICAL DATA** .
- Permitted total wear clearance, refer to 11 25 Pistons With Rings And Pins S54 in **ENGINE - TECHNICAL DATA** .

CAUTION: Piston and piston pins are paired and must not be fitted individually.

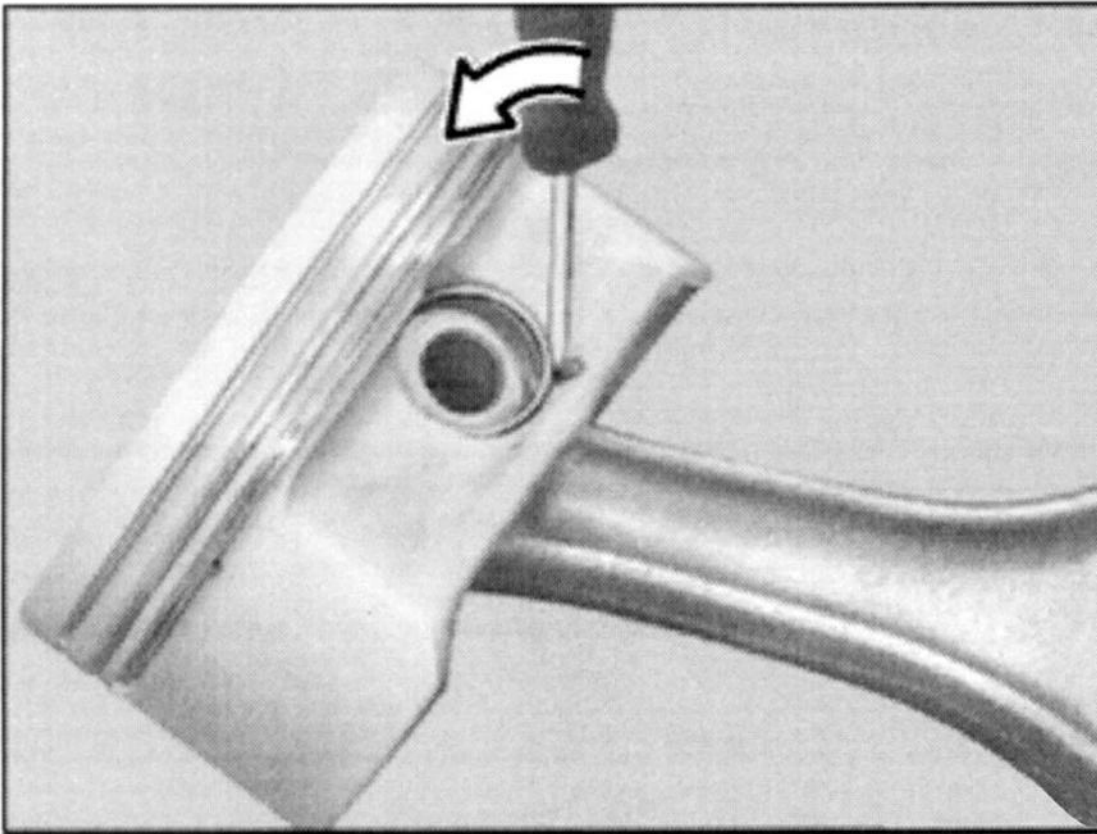
Fit conrod with piston pin to piston in such a way that both of the visible pair numbers on the installation direction arrow on the piston point to the right.



G00397782

Fig. 145: Identifying Pair Numbers
Courtesy of BMW OF NORTH AMERICA, INC.

Install retaining ring.



G00397783

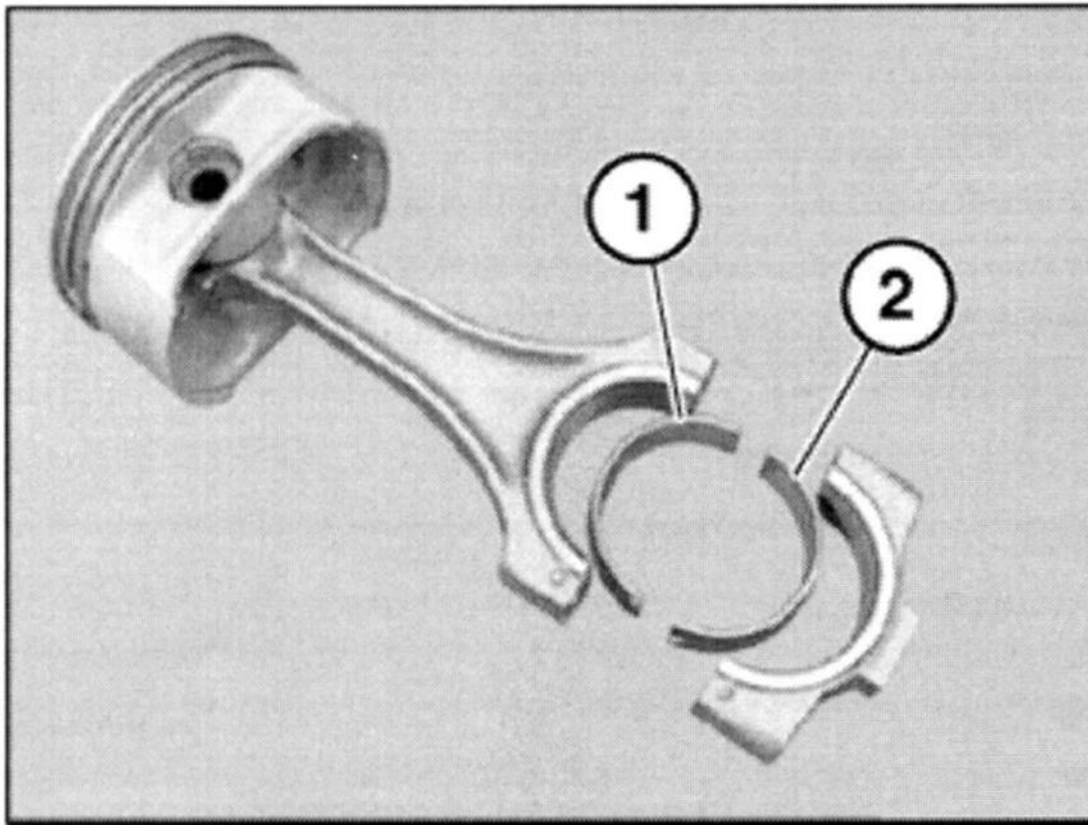
Fig. 146: View Of Retaining Ring

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Note grinding stages on crankshaft. Refer to 11 21 Crankshaft And Bearings S54 in ENGINE - TECHNICAL DATA .

NOTE: Classified conrod bearing shells color-coded "Yellow and Green" are installed in the model series. The classification is removed when the conrod bearing shells are replaced.

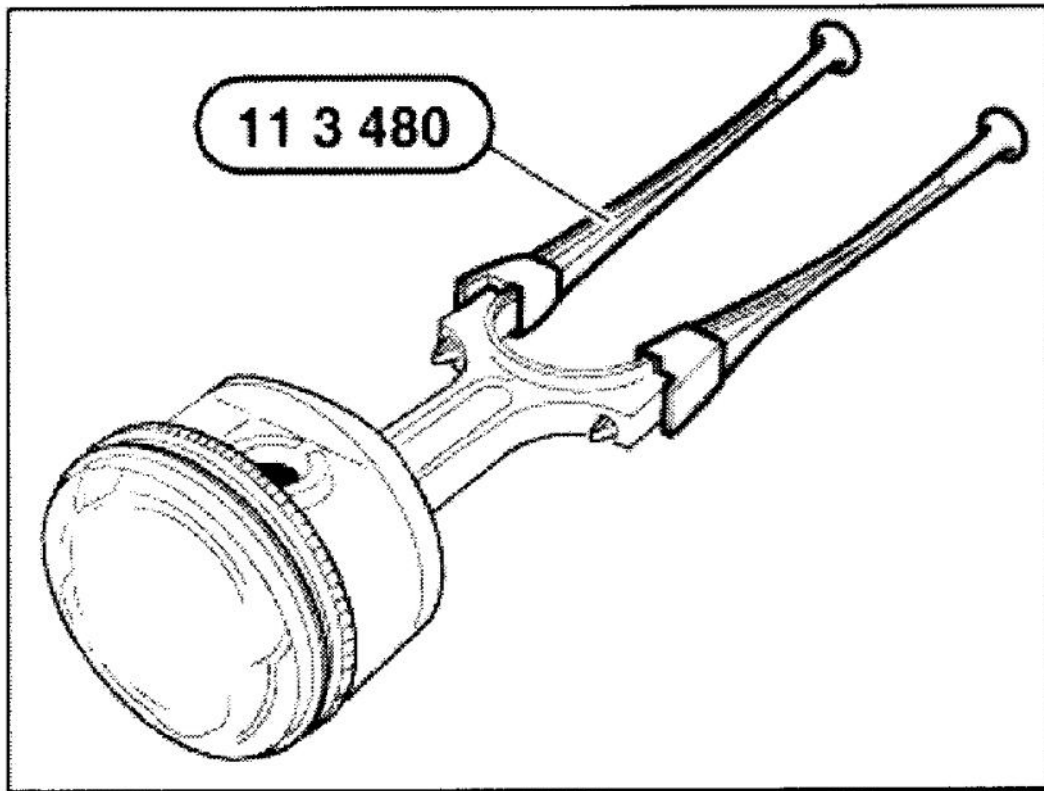
- Install conrod bearing shells (1) color-coded "Blue" in conrod at top.
- Install conrod bearing shells (2) color-coded "Red" in conrod at top.



G00397784

Fig. 147: Identifying Conrod Bearing Shells
Courtesy of BMW OF NORTH AMERICA, INC.

Insert special tool 11 3 480 in conrod.



G00397786

Fig. 148: Inserting Special Tool 11 3 480
Courtesy of BMW OF NORTH AMERICA, INC.

Lightly coat pistons and piston rings with oil.

Offset the contact points of the piston rings by approx. 120° to each other but do not position above the piston pin boss.

Compress piston rings with special tool 11 9 120.

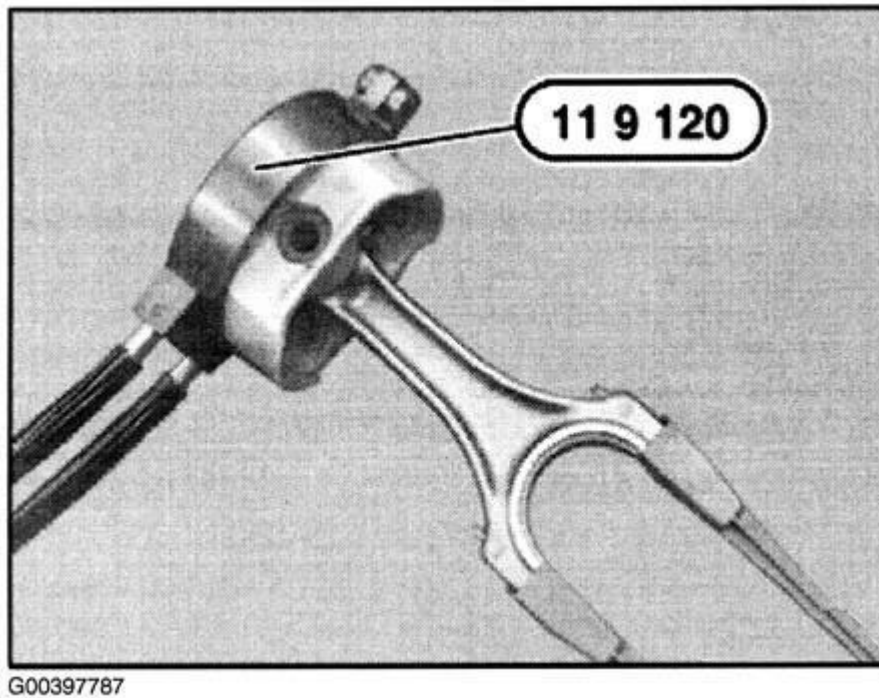
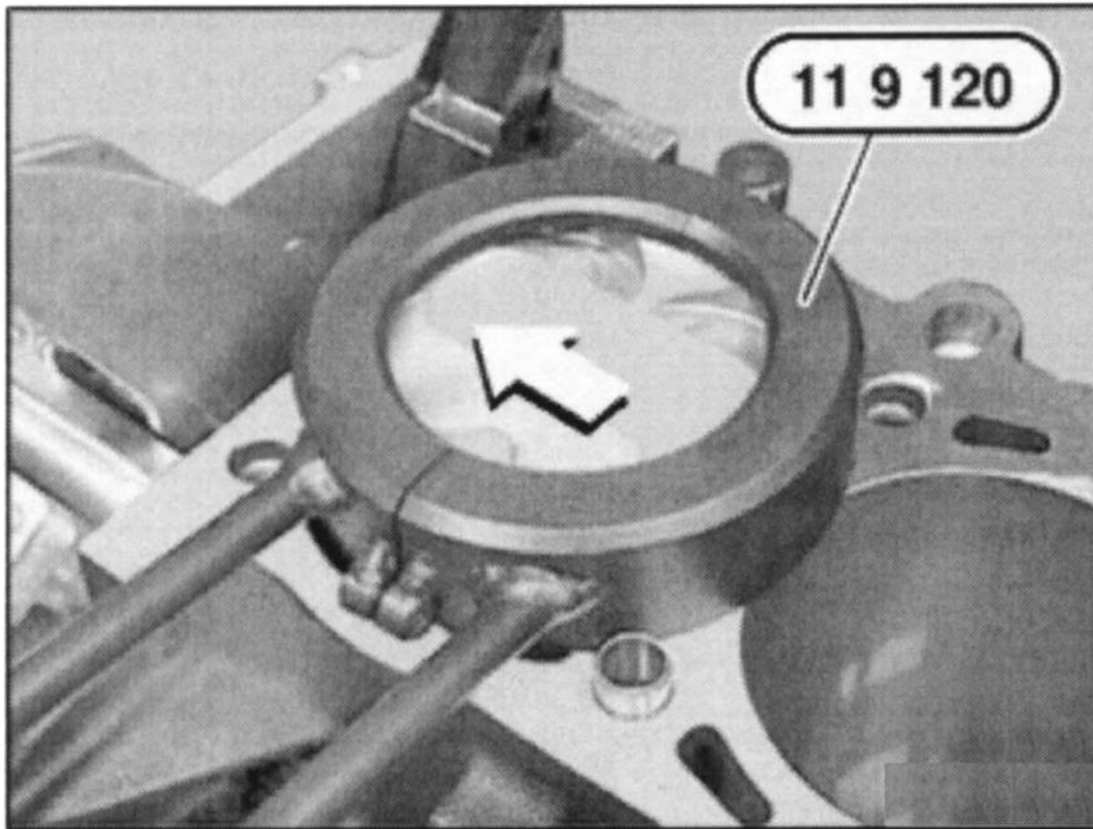


Fig. 149: Compressing Piston Rings

Courtesy of BMW OF NORTH AMERICA, INC.

Keep piston rings pressed with special tool 11 9 120. Install piston so that arrow points to camshaft drive.



G00397788

Fig. 150: Installing Piston

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Danger of piston ring failure. Only press pistons into place with finger force - do not knock in!

Attach crankpin to connecting rod.

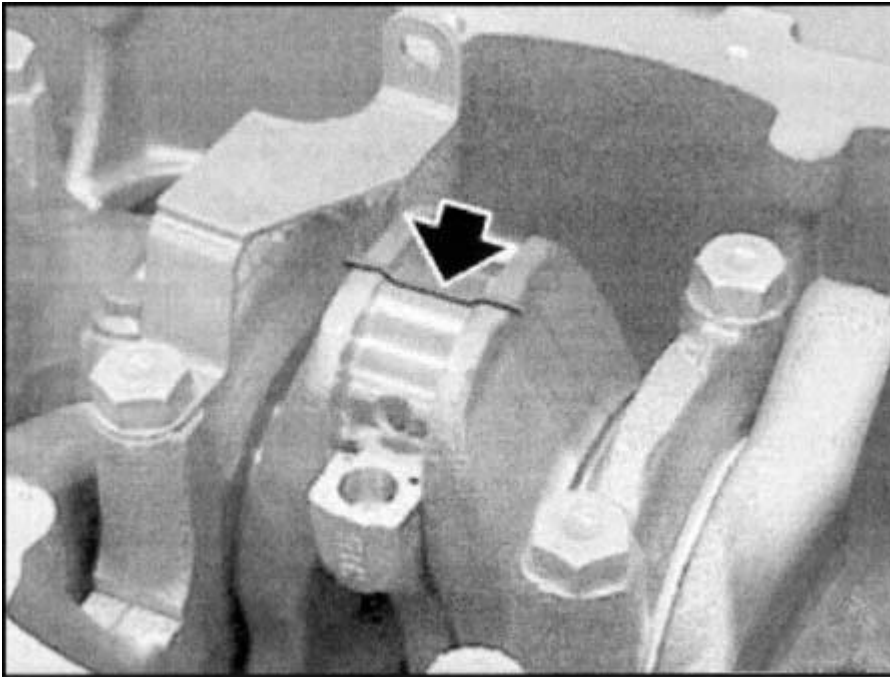
Remove special tool 11 3 480.



G00397778

Fig. 151: View Of Special Tool 11 3 480**Courtesy of BMW OF NORTH AMERICA, INC.**

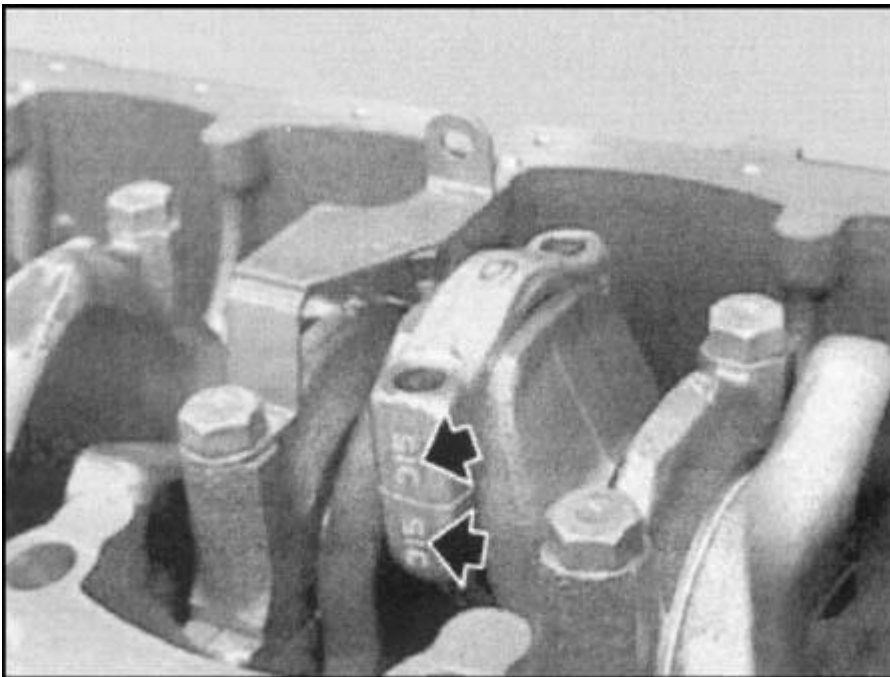
Check connecting rod bearing clearance: Piston in BDC position. Fit special tool 00 2 590 (Plastigage Type PG 1) to the oil-free crankshaft.



G00397789

Fig. 152: Checking Connection Rod Bearing Clearance
Courtesy of BMW OF NORTH AMERICA, INC.

Fit bearing caps so that pair numbers match up.



G00397790

Fig. 153: View Of Bearing Cap Pair Numbers

Courtesy of BMW OF NORTH AMERICA, INC.

Conrod With M11X1.25 Conrod Bolt:

CAUTION: Contrary to the instructions for all other BMW engines, the conrod bolts must not be replaced in the S54 engine with the M11x1.25 conrod bolt. The M11x1.25 may only be reused in the same conrod thread.

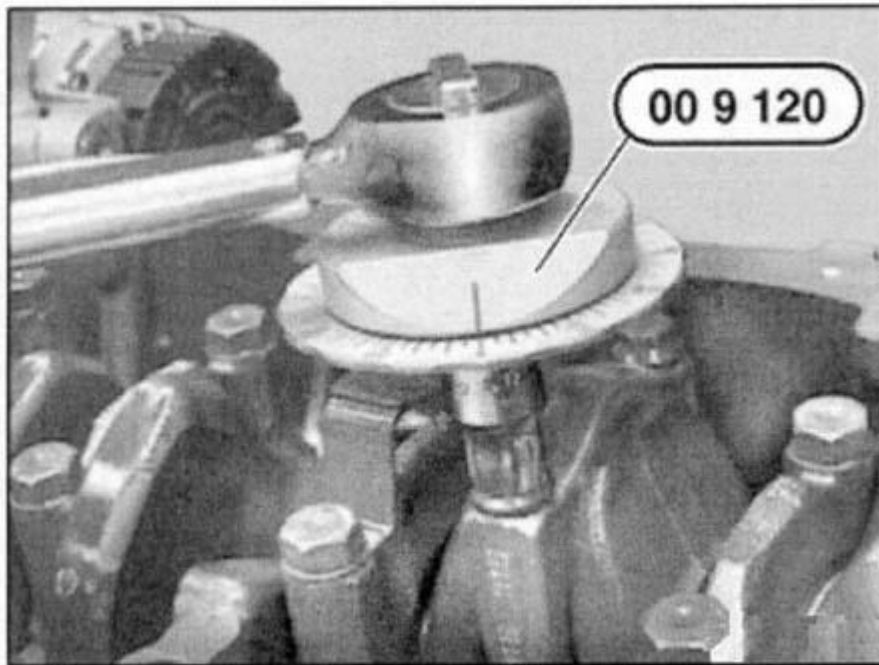
Conrod With M11X1.25 Conrod Bolt:

CAUTION: Do not distort conrods or crankshaft

Tighten down conrod bolts with special tool 00 9 120.

Tightening torque:

- Application torque 5 N.m.
- Joining torque 30 N.m.
- Angle of rotation 70°.



G00397791

Fig. 154: Tightening Conrod Bolts

Courtesy of BMW OF NORTH AMERICA, INC.

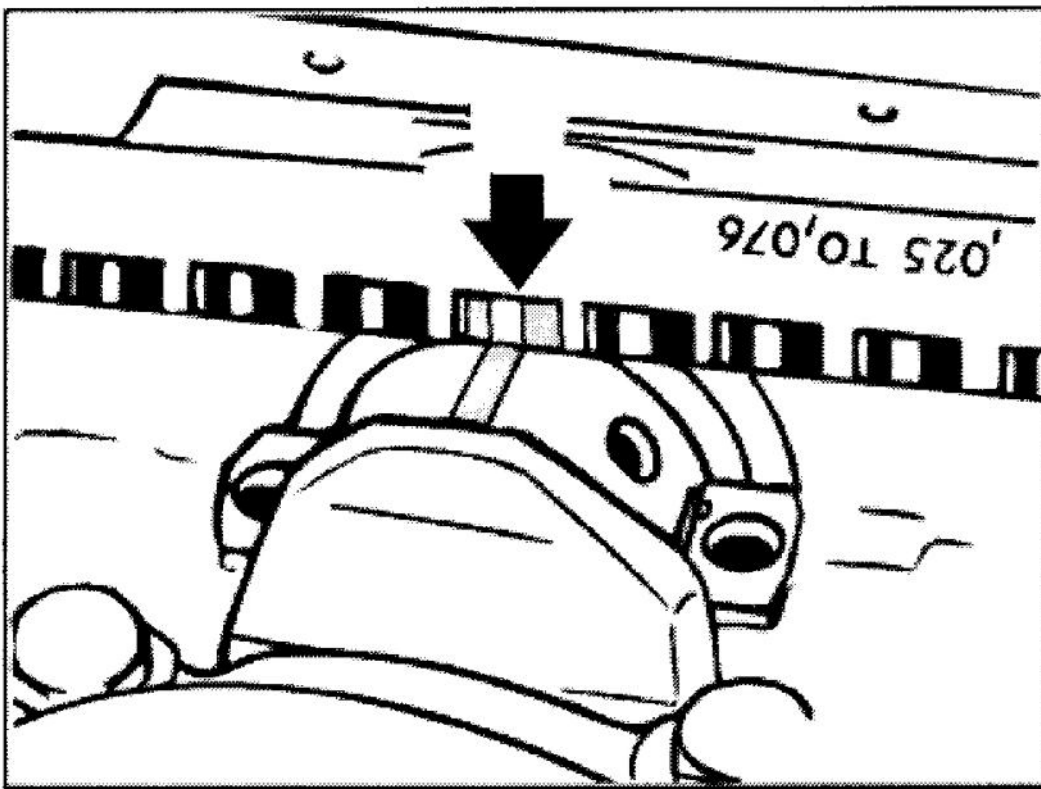
Remove bearing cap and read off bearing play at width of flattened plastic thread with assistance of measurement scale.

Conrod Bearing Clearance: 0.030 To 0.070 mm.

CAUTION: If a bearing clearance of below 0.030 mm is measured: Replace Conrod Bearing Shells.

If a bearing clearance of below 0.030 mm is measured with the new conrod bearing shells:

Replace the conrods with a complete set of conrods with **M10X1.25 Conrod Bolts**.



G00397792

Fig. 155: Measuring Bearing Clearance
Courtesy of BMW OF NORTH AMERICA, INC.

- Remove plastic thread.
- Coat crankshaft and bearing shells with oil.
- Fit bearing caps so that the pair numbers match up.

CAUTION: The M11x1.25 may only be reused in the same conrod thread.

- Insert conrod bolts.

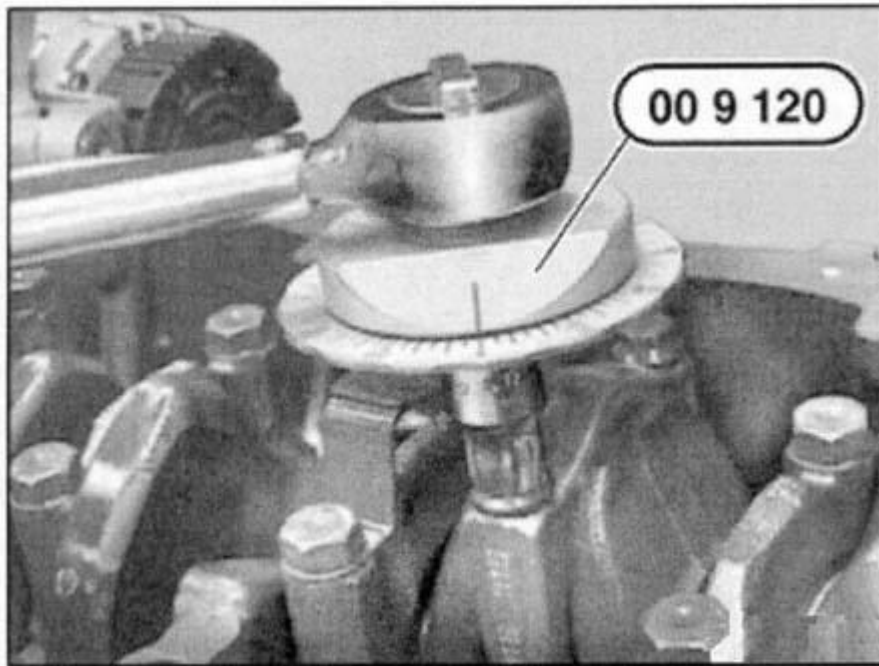
Conrod With M11X1.25 Conrod Bolt:

Tighten down conrod bolts with special tool 00 9 120.

CAUTION: The tightening torque only applies to conrod bolts with M11x1.25 threads.

Tightening torque:

- Application torque 5 N.m.
- Joining torque 30 N.m.
- Angle of rotation 70°.



G00397791

Fig. 156: Tightening Conrod Bolts

Courtesy of BMW OF NORTH AMERICA, INC.

Install spray nozzles for piston cooling, tighten down screw.

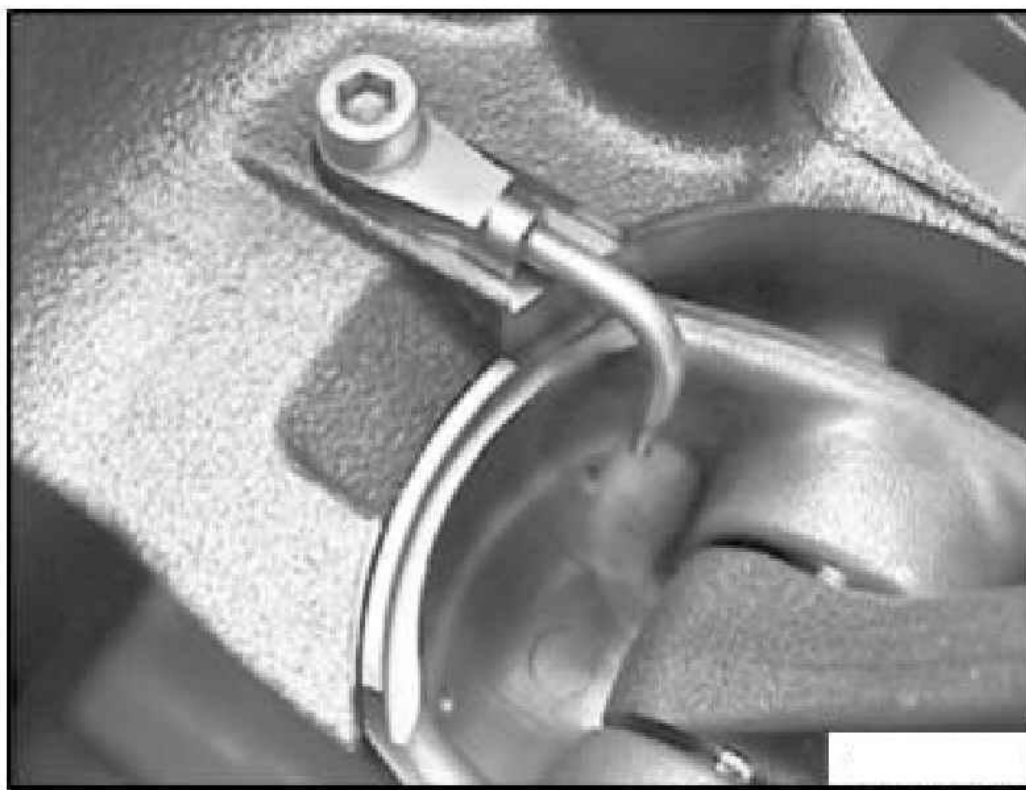
**G03190714**

Fig. 157: Identifying Piston Cooling Spray Nozzles
Courtesy of BMW OF NORTH AMERICA, INC.

Tightening torque, 11 11 7AZ. Refer to **ENGINE - TIGHTENING TORQUES** .

11 25 530 REMOVING AND INSTALLING/REPLACING ALL PISTONS (S54 WITH M10X1.25 CONROD BOLT)

Special Tools Required:

- 00 2 590
- 00 9 120
- 11 2 050
- 11 9 120

(Engine removed)

Removal:

Removal of pistons is described separately from installation. Assembly sequence for removal and installation is different.

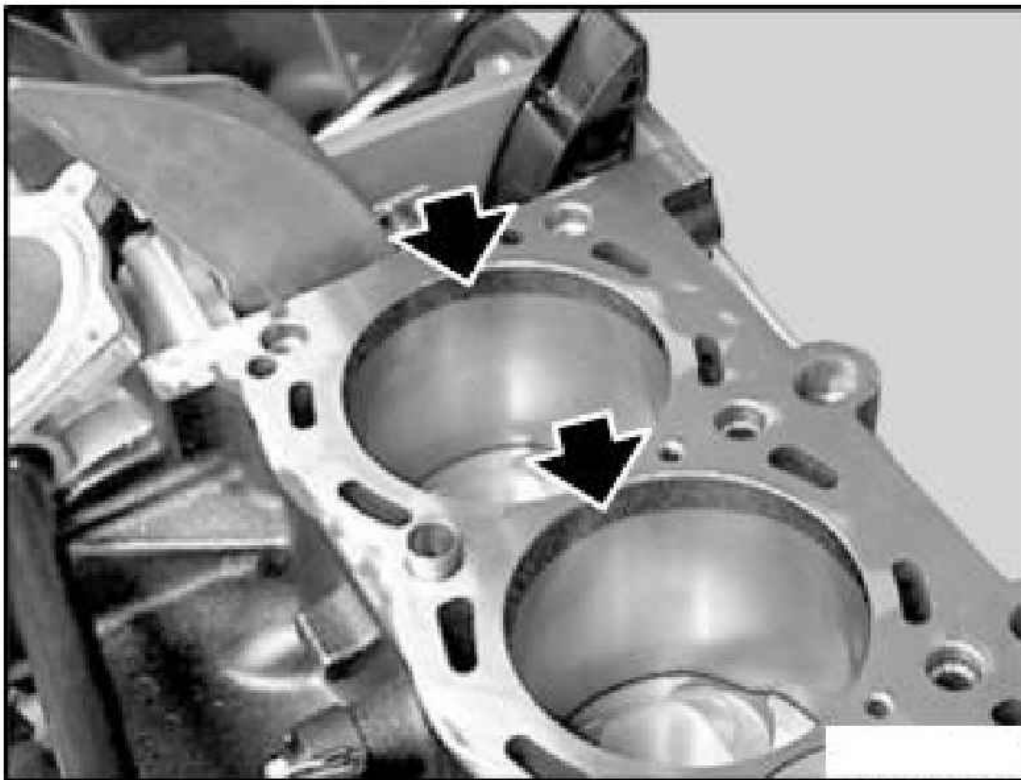
Fit engine to special tool 00 1 450.

- Removing cylinder head.
- Removing oil pan.
- Removing oil pump.

CAUTION: Re-install piston, conrod and bearing shells back in the same position and in the same installation location. Conrod and conrod bearing cover are designated with same pair number: do not interchange/confuse.

In event of heavy oil carbon residue:

Carefully remove oil carbon residue from cylinder wall.



G03190713

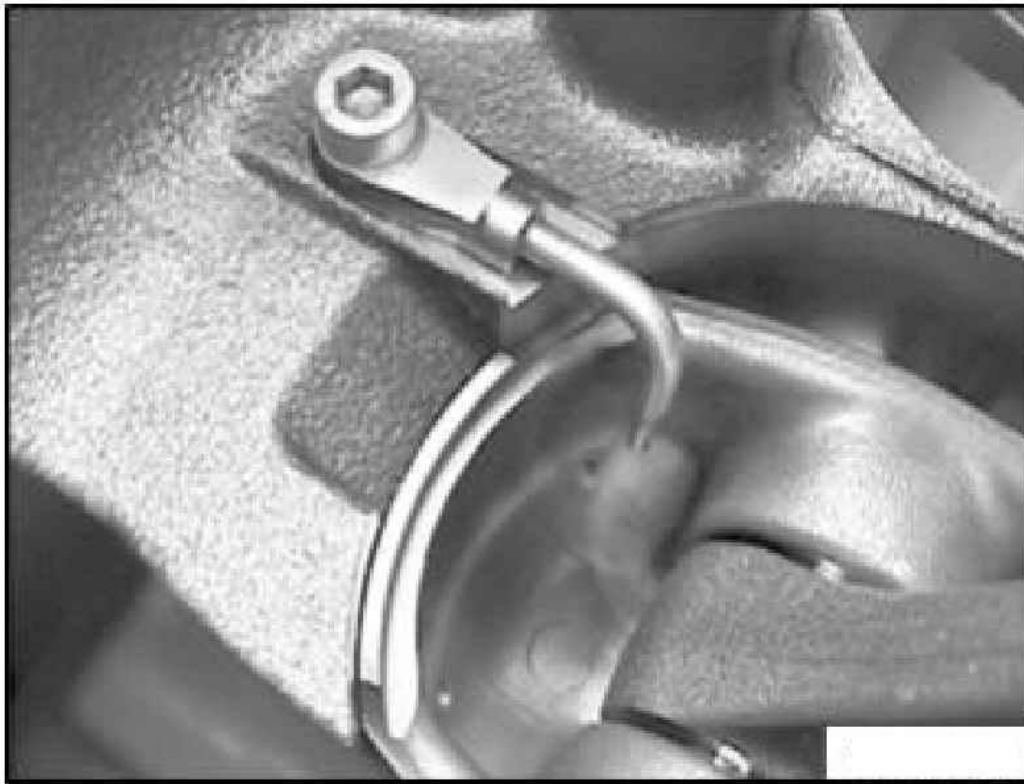
Fig. 158: View Of Oil Carbon Residue From Cylinder Wall

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Piston cooling spray nozzles are installed between the bearing seats.

Check spray nozzles for damage.

If necessary, remove piston-cooling spray nozzles.



G03190714

Fig. 159: Identifying Piston Cooling Spray Nozzles

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: The S54 engine has two types of conrod with different conrod bolts.

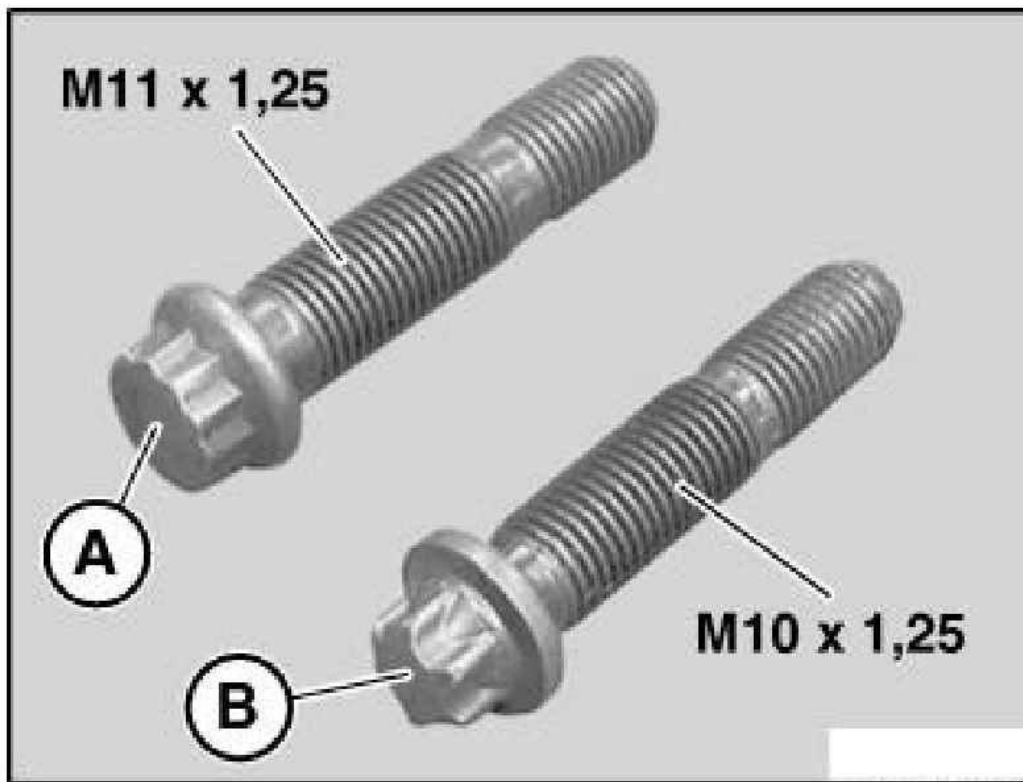
Differentiating Features:

A Conrod bolt with M11x1.25 thread. Bolt head: bihexagonal 12 mm A/F.

B Conrod bolt with M10x1.25 thread. Bolt head: Torx E12.

The procedure for replacing the conrod bolts and the tightening specifications are different.

Mixing up the procedure for replacing the conrods and conrod bolts and the tightening specifications will result in serious engine damage.



- A** Conrod bolt with M11x1.25 thread
Bolt head: bihexagonal 12 mm A/F
- B** Conrod bolt with M10x1.25 thread
Bolt head: Torx E12

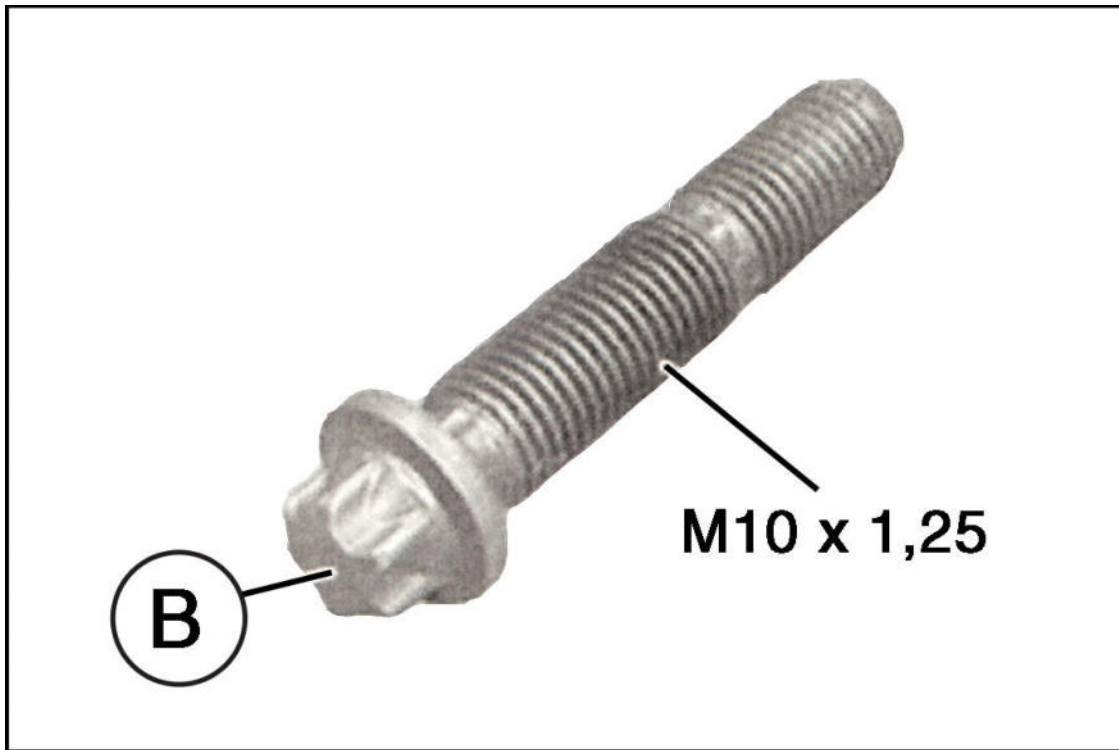
G03190715

Fig. 160: Identifying Types Of Conrod Bolts
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: In the S54 engine with the M10x1.25 conrod bolt (B) the conrod bolts must be replaced.

Conrod bolts (B) are made from a material which only reaches its maximum tensile strength after they have been tightened three times.

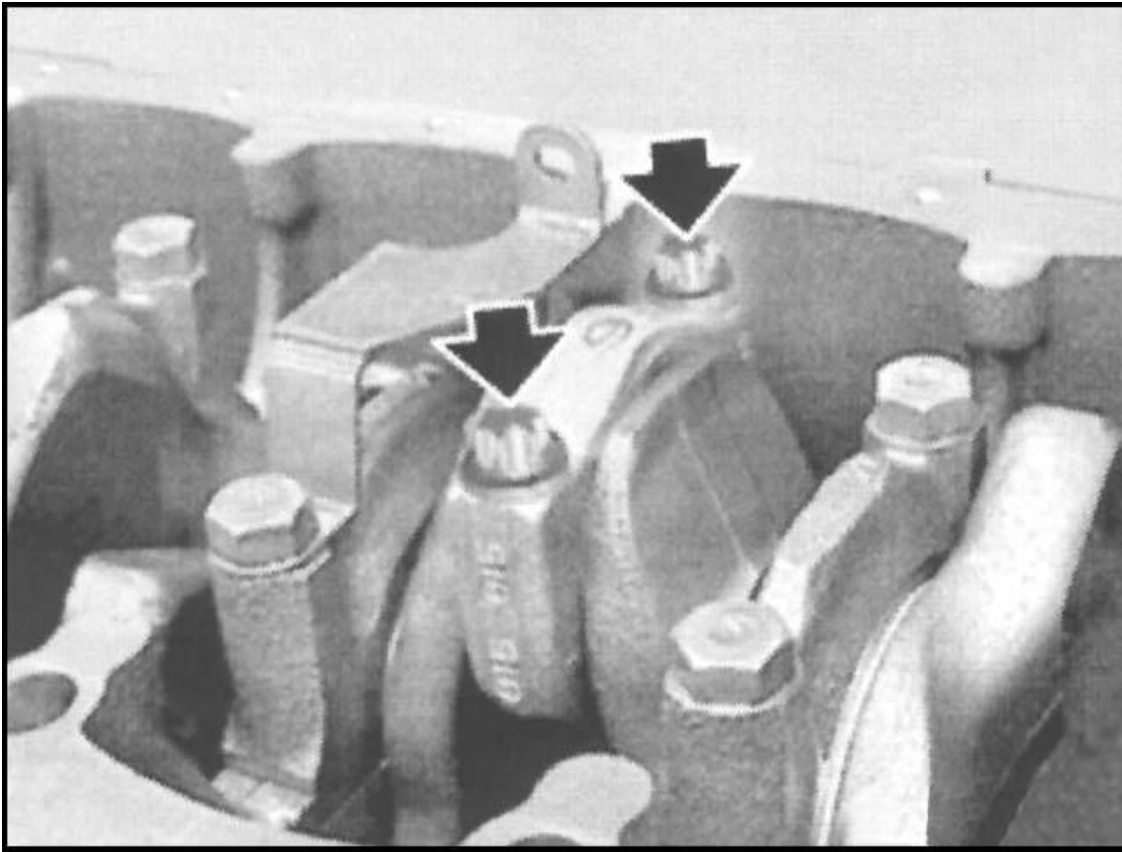
Connecting rod bolts (B) must be tightened at least three times but no more than five times.



G00397773

Fig. 161: Identifying M10x1.25 Conrod Bolt
Courtesy of BMW OF NORTH AMERICA, INC.

- Release conrod bolts.
- Remove conrod bearing cap.
- Set conrod bolts and conrod bear caps down in neat order.

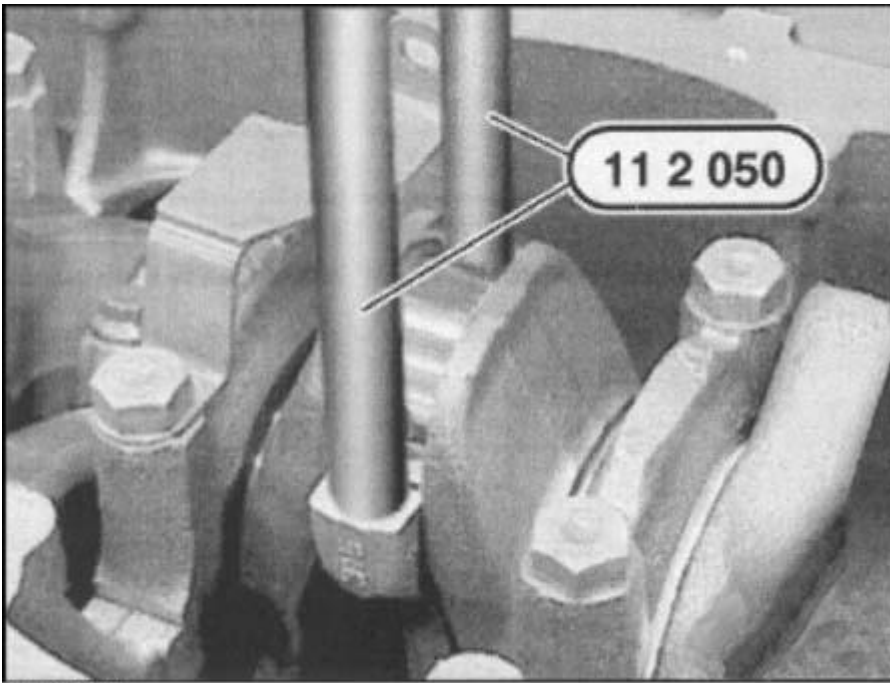


G00397774

Fig. 162: Locating M10x1.25 Conrod Bolt
Courtesy of BMW OF NORTH AMERICA, INC.

Insert special tool 11 2 050 in conrod.

Remove connecting rod with piston from cylinder-head side.

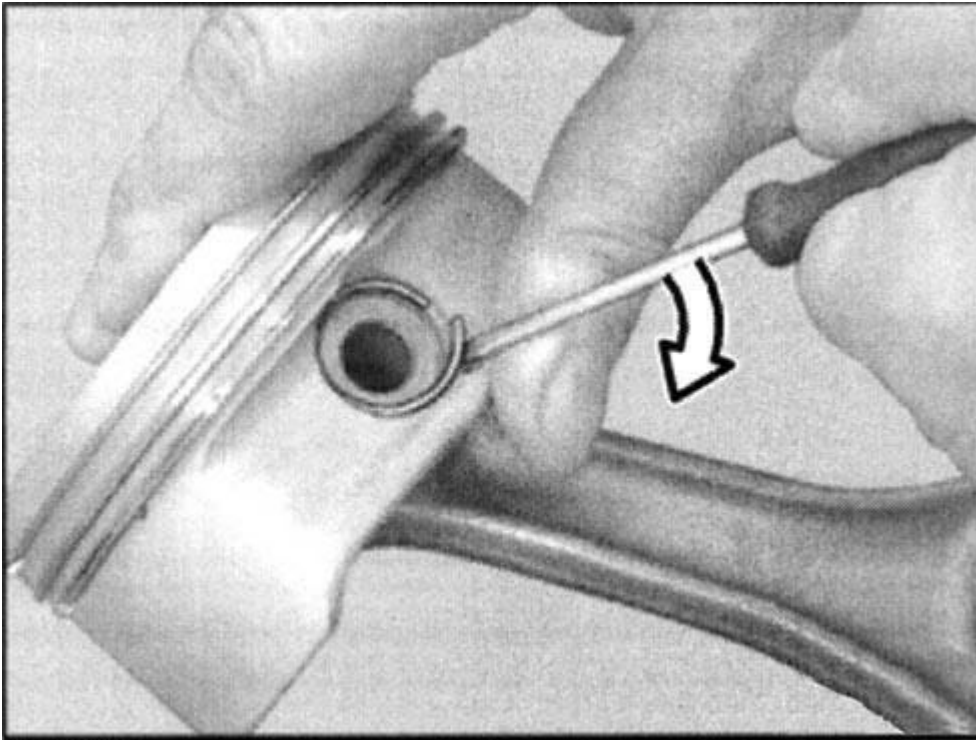


G00397777

Fig. 163: Identifying Special Tool 11 2 050 In Conrod
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Piston and piston bolts are paired and must not be fitted individually.

Lift out retaining ring and press out piston pin.



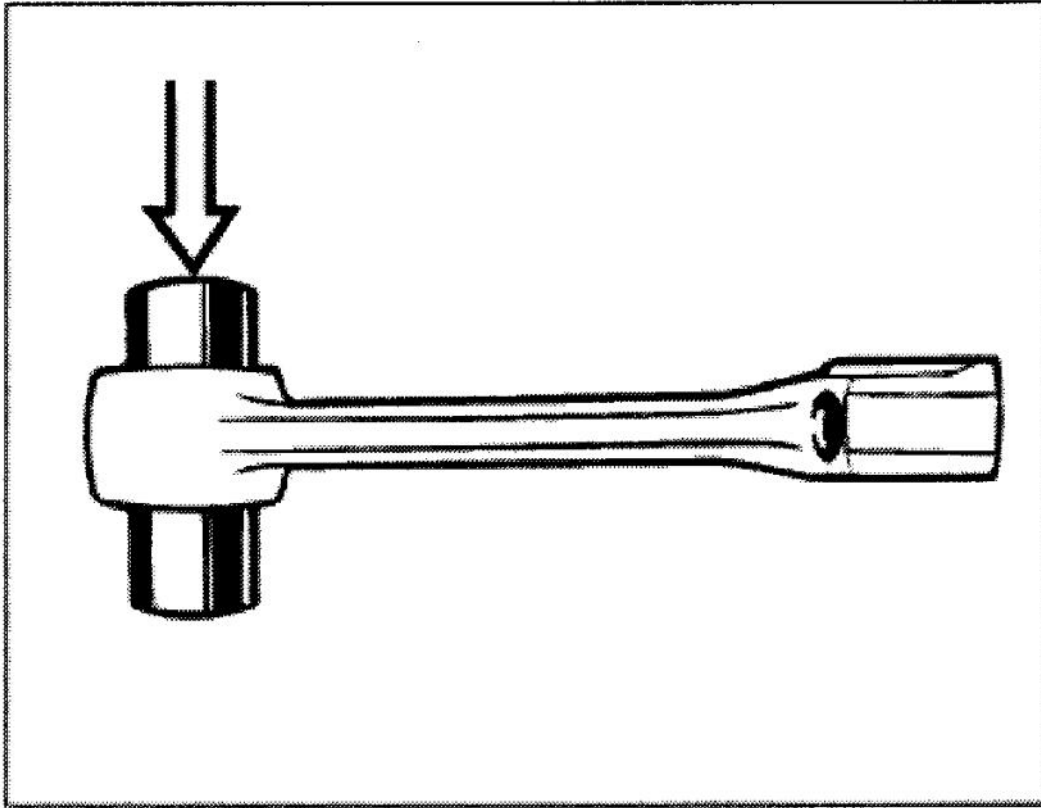
G00397779

Fig. 164: Removing Retaining Ring & Piston Pin
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Installation of pistons is described separately from removal. The assembly sequence for removal and installation is different.

The piston pin must be able to be pressed through the liner by hand with little force and must not display any significant play. If necessary, replace connecting rods.



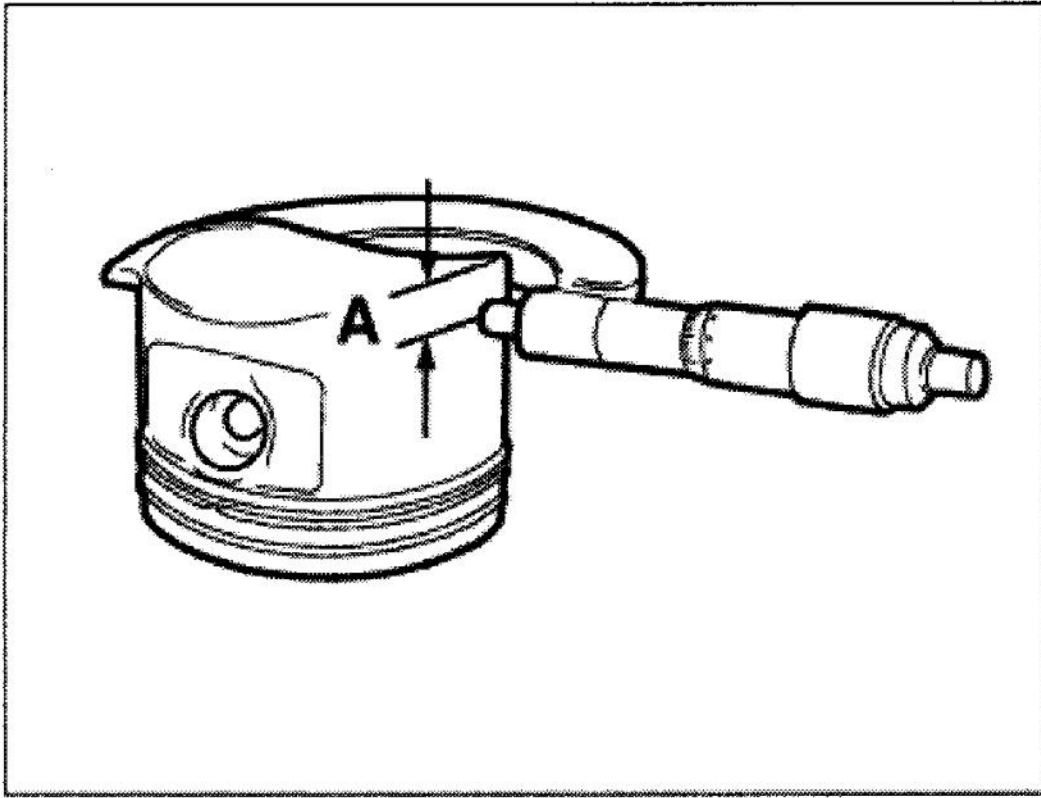
G00397780

Fig. 165: Identifying Piston Pin

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Only conrods of the same weight group are allowed to be installed inside an engine. Connecting rods are only supplied in complete sets.

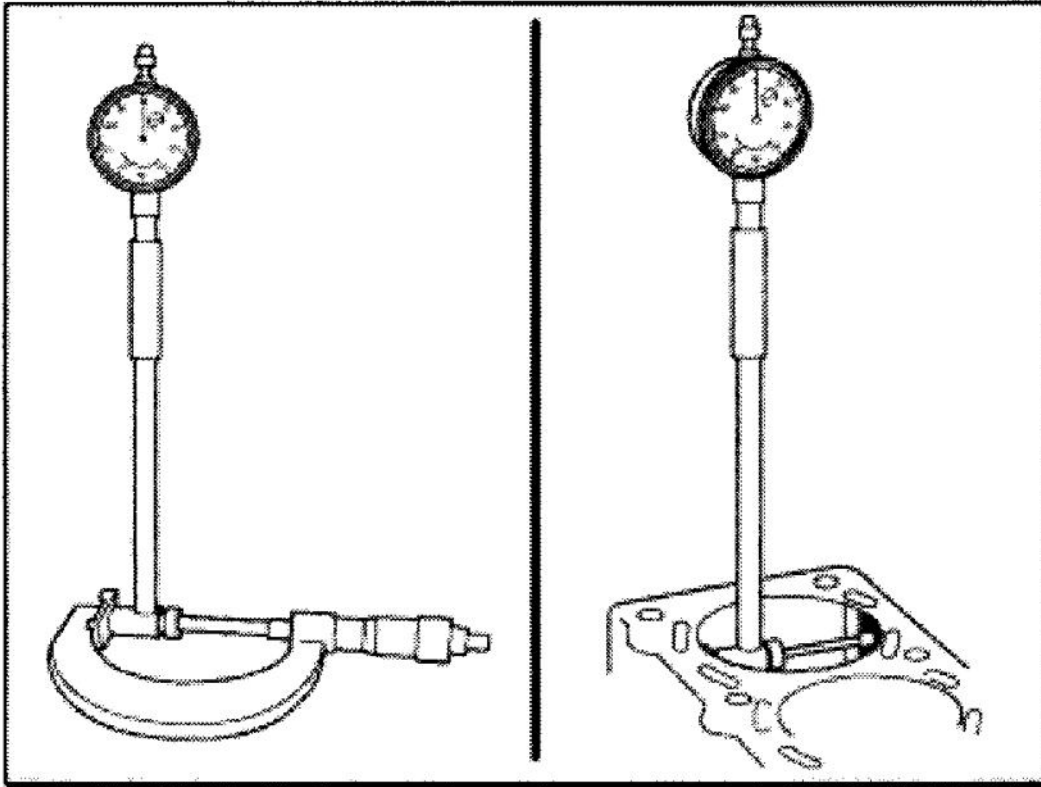
Prior to installation, measure piston installation clearance: Measure piston diameter with micrometer at measuring point A from bottom edge of piston and offset at 90° to the axis of the piston pin. For measuring point A, refer to 11 25 Pistons With Rings And Pins S54, in **ENGINE - TECHNICAL DATA** .



G00397781

Fig. 166: Locating Measuring Point**Courtesy of BMW OF NORTH AMERICA, INC.**

Adjust micrometer to cylinder bore of engine block. Set internal caliper on micrometer to zero. Measure bottom, center and top of cylinder bore in direction of travel and direction of engine rotation.



G00397793

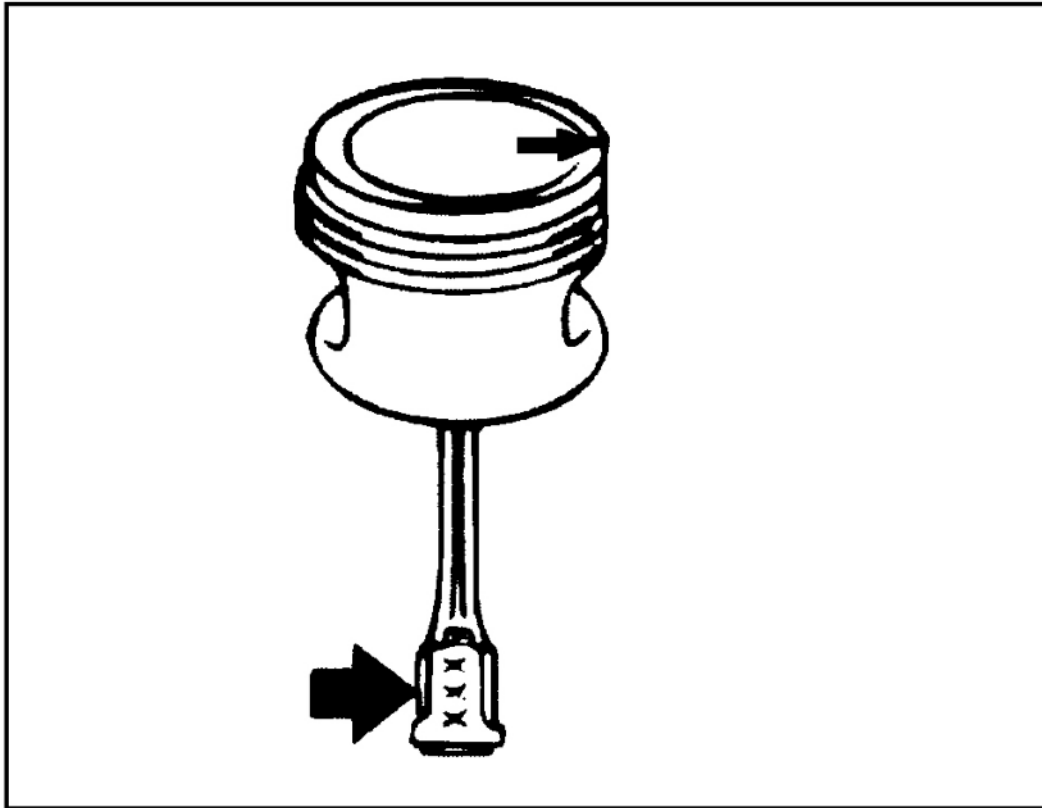
Fig. 167: Measuring Cylinder Bore

Courtesy of BMW OF NORTH AMERICA, INC.

- Diameter of cylinder bore, refer to 11 00 Engine In General S54 in **ENGINE - TECHNICAL DATA** .
- Piston installation clearance, refer to 11 25 Pistons With Rings And Pins S54 in **ENGINE - TECHNICAL DATA** .
- Permitted total wear clearance, refer to 11 25 Pistons With Rings And Pins S54 in **ENGINE - TECHNICAL DATA** .

CAUTION: Piston and piston pins are paired and must not be fitted individually.

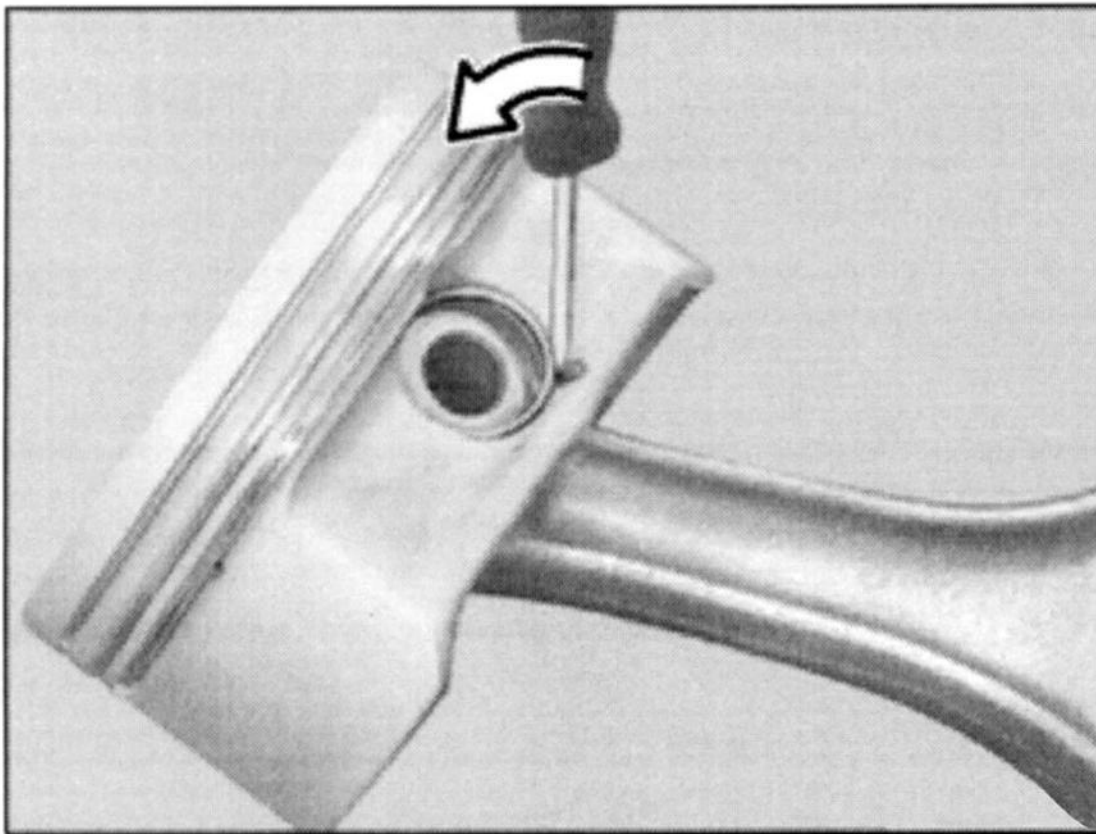
Fit conrod with piston pin to piston in such a way that both of the visible pair numbers on the installation direction arrow on the piston point to the right.



G00397782

Fig. 168: Identifying Conrod Pair Numbers
Courtesy of BMW OF NORTH AMERICA, INC.

Install retaining ring.



G00397783

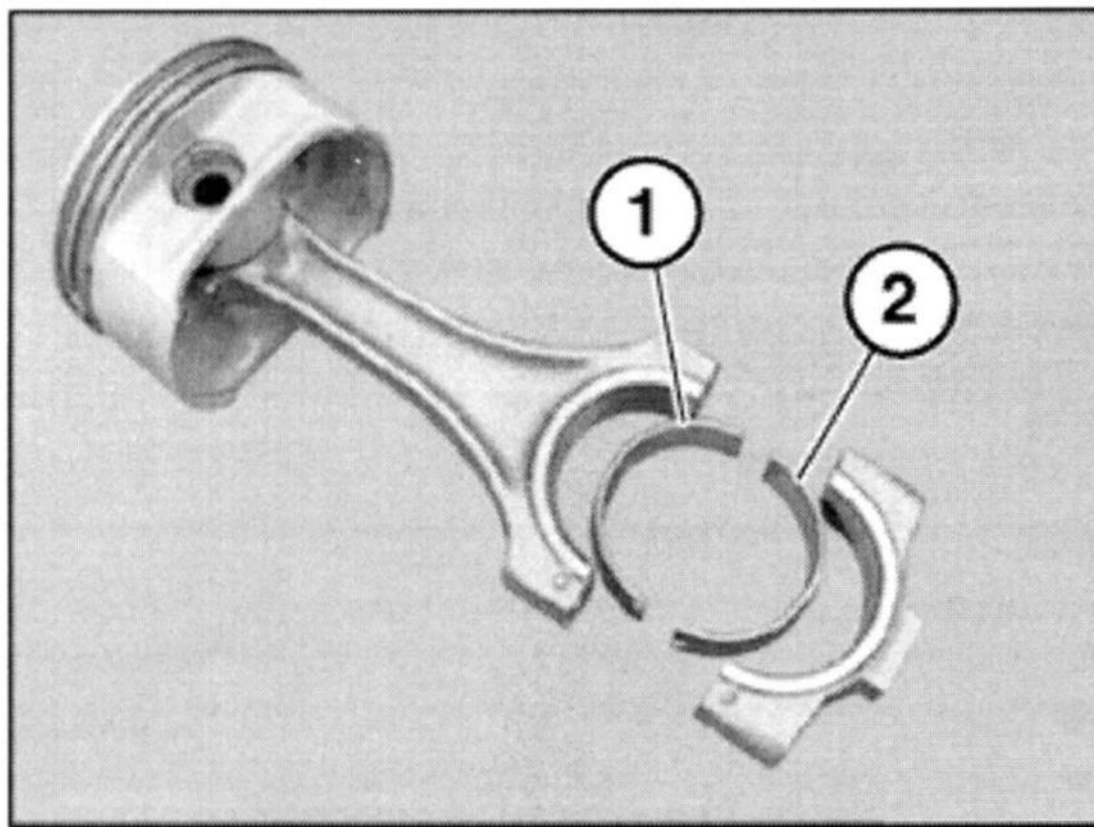
Fig. 169: Installing Retaining Ring

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Note grinding stages on crankshaft. Refer to 11 21 Crankshaft And Bearings S54 in ENGINE - TECHNICAL DATA .

NOTE: Classified conrod bearing shells color-coded "Yellow and Green" are installed in the model series. The classification is removed when the conrod bearing shells are replaced.

- Install conrod bearing shells (1) color-coded "Blue" in conrod at top.
- Install conrod bearing shells (2) color-coded "Red" in conrod at top.



G00397784

Fig. 170: Identifying Conrod Bearing Shells
Courtesy of BMW OF NORTH AMERICA, INC.

Insert special tool 11 2 050 in conrod.

Lightly coat pistons and piston rings with oil.

Offset the contact points of the piston rings by approx. 120° to each other but do not position above the piston pin boss.

Compress piston rings with special tool 11 9 120.

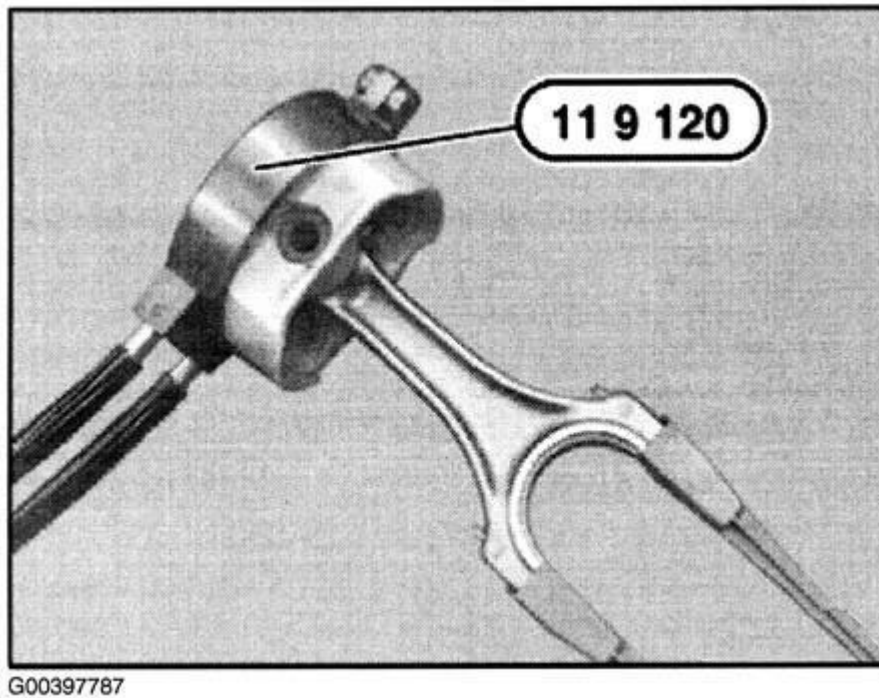
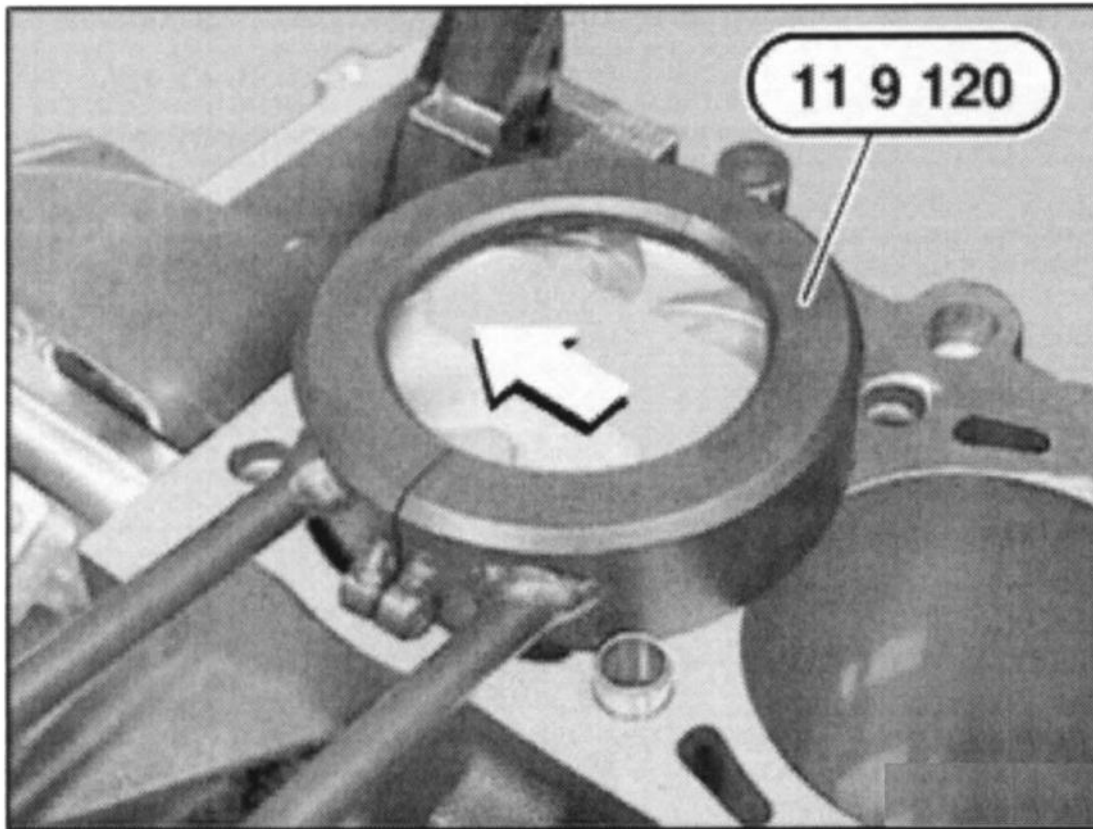


Fig. 171: Compressing Piston Rings

Courtesy of BMW OF NORTH AMERICA, INC.

Keep piston rings pressed with special tool 11 9 120. Install piston so that arrow points to camshaft drive.

CAUTION: Danger of piston ring failure. Only press pistons into place with finger force - do not knock in!



G00397788

Fig. 172: Installing Piston**Courtesy of BMW OF NORTH AMERICA, INC.**

Attach crankpin to connecting rod.

Remove special tool 11 2 050.

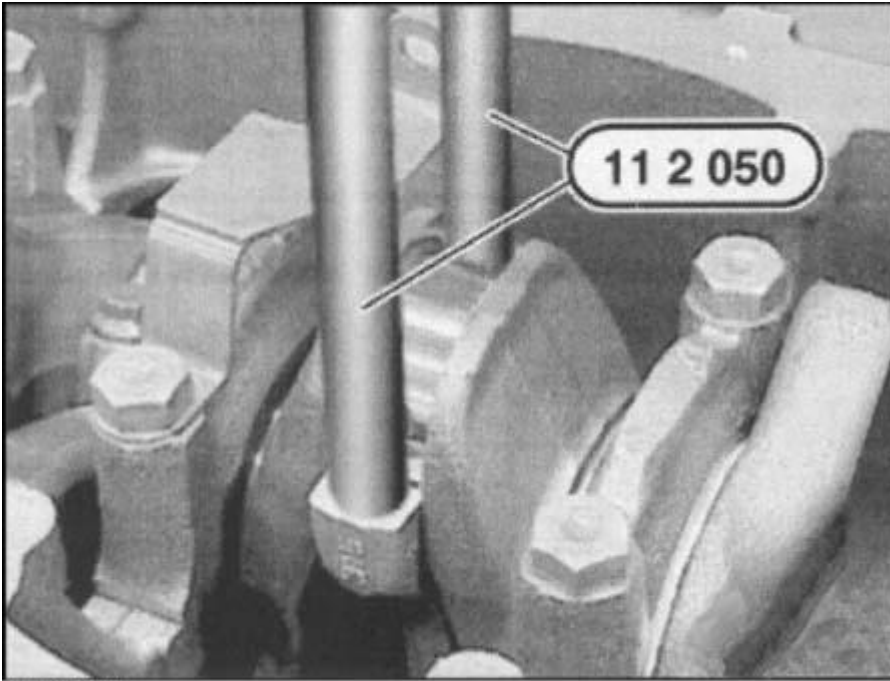
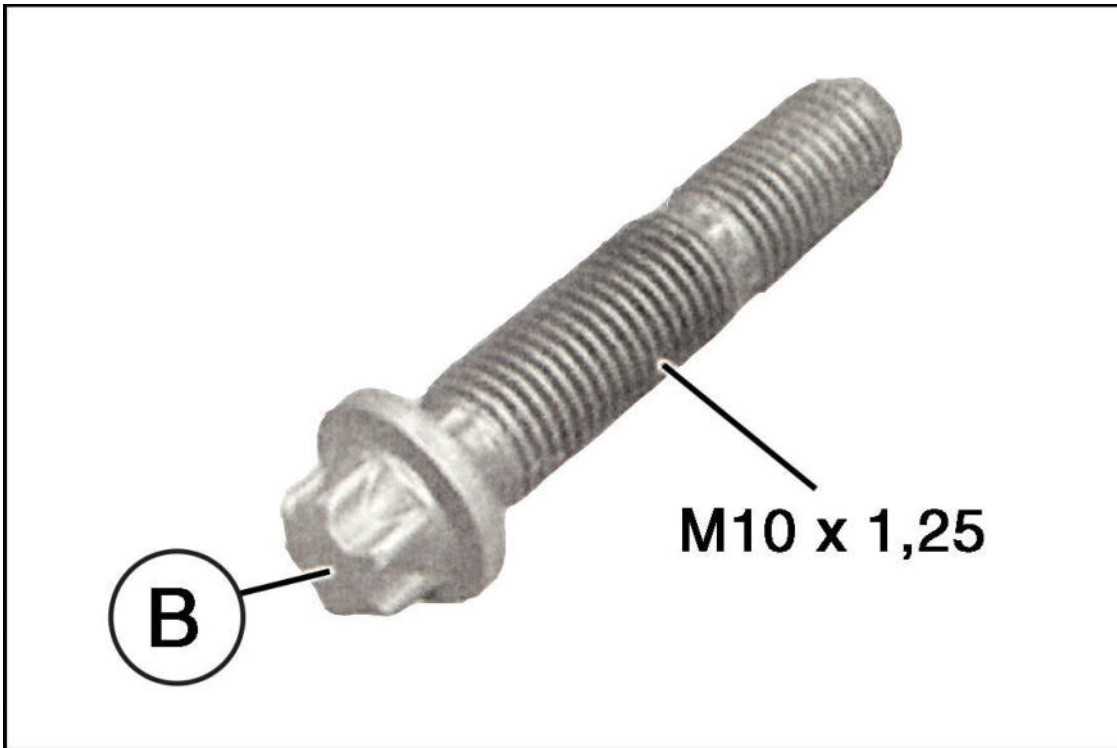


Fig. 173: Removing M10x1.25 Conrod Bolt Connecting Rod
Courtesy of BMW OF NORTH AMERICA, INC.

Conrod With M10X1.25 Conrod Bolt:

CAUTION: Conrod bolts (B) are made from a material which only reaches its maximum tensile strength after they have been tightened three times. Connecting rod bolts (B) must be tightened at least three times but no more than five times. The tightening specifications detailed in the following must be observed exactly. Mixing up the procedure for replacing the conrods and conrod bolts and the tightening specifications will result in serious engine damage.



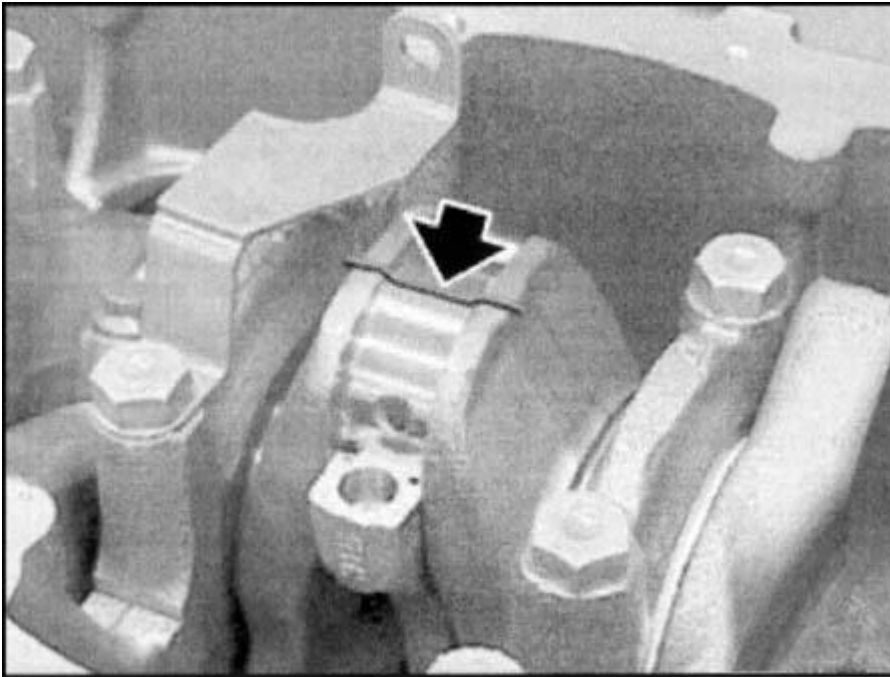
G00397773

Fig. 174: Identifying M10x1.25 Conrod Bolt
Courtesy of BMW OF NORTH AMERICA, INC.

Check connecting rod bearing clearance:

Piston in BDC position.

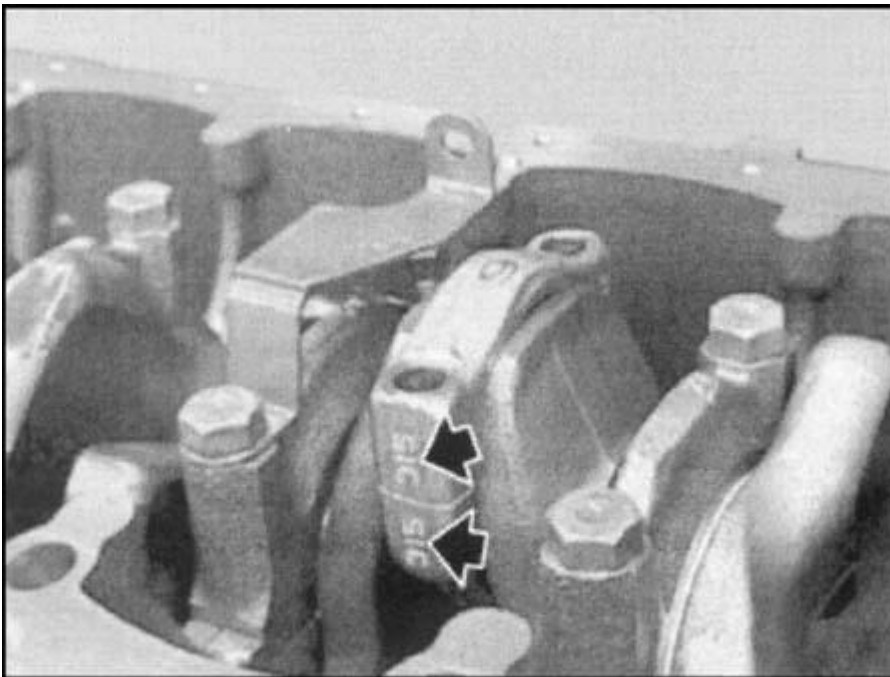
Fit special tool 00 2 590 (Plastigage Type PG 1) to the oil-free crankshaft.



G00397789

Fig. 175: Checking Connection Rod Bearing Clearance
Courtesy of BMW OF NORTH AMERICA, INC.

Fit bearing caps so that pair numbers match up.



G00397790

Fig. 176: View Of Bearing Cap Pair Numbers

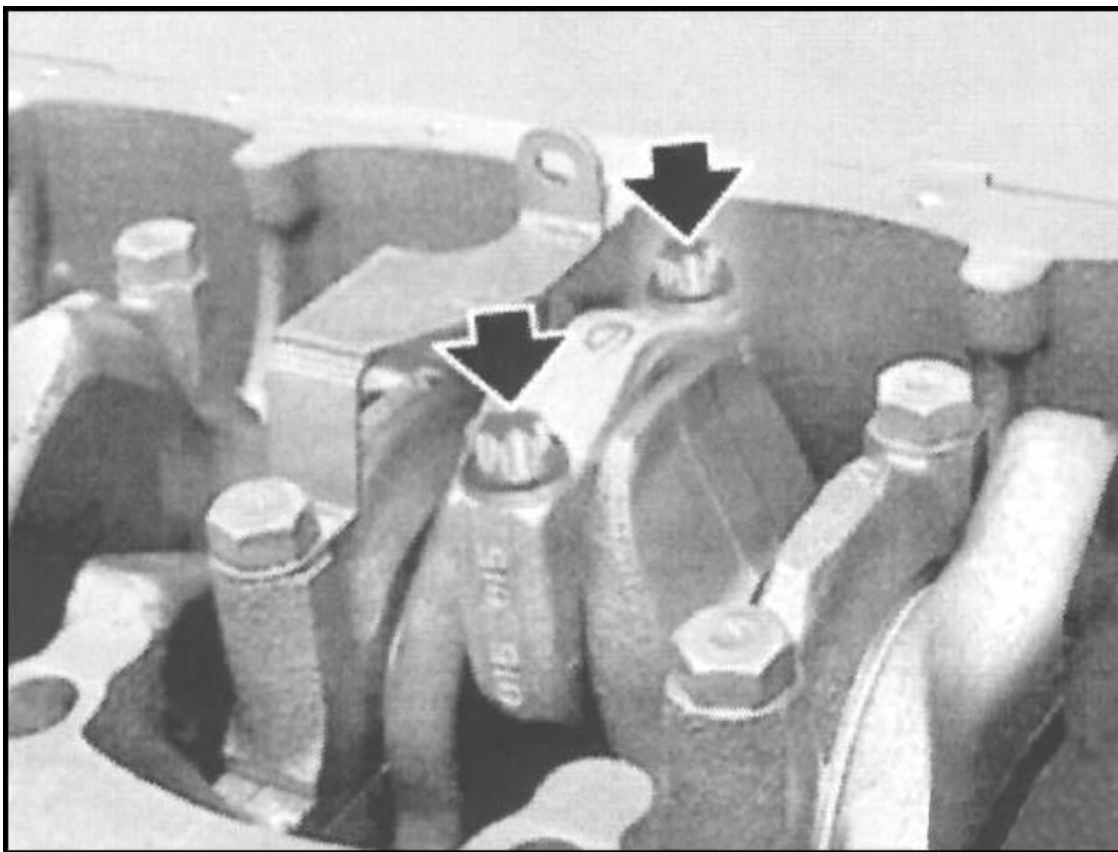
Courtesy of BMW OF NORTH AMERICA, INC.

Conrod With M10X1.25 Conrod Bolt:**If A New Set Of Conrods Has Been Installed:**

Use the conrod bolts used in the new set of conrods.

If The Conrods Already Used Have Been Installed:

Install new conrod bolts.



G00397774

Fig. 177: View Of M10x1.25 Conrod Bolt

Courtesy of BMW OF NORTH AMERICA, INC.

Conrod With M10X1.25 Conrod Bolt:

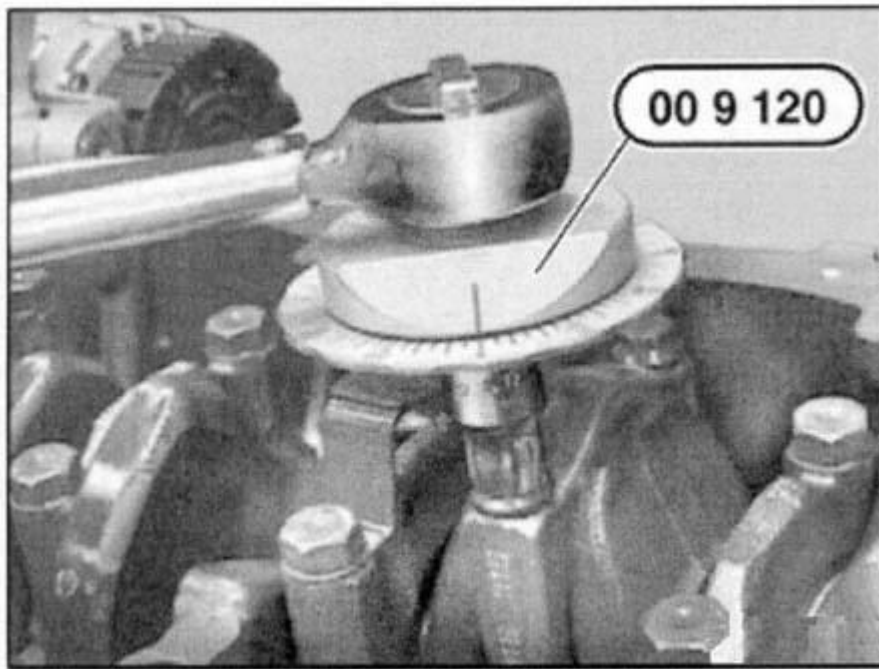
CAUTION: Do not distort conrods or crankshaft.

First Tightening Of Conrod Bolts:

Tighten down conrod bolts with special tool 00 9 120.

Tightening torque:

- Application torque 5 N.m.
- Joining torque 30 N.m.
- Angle of rotation 105°.



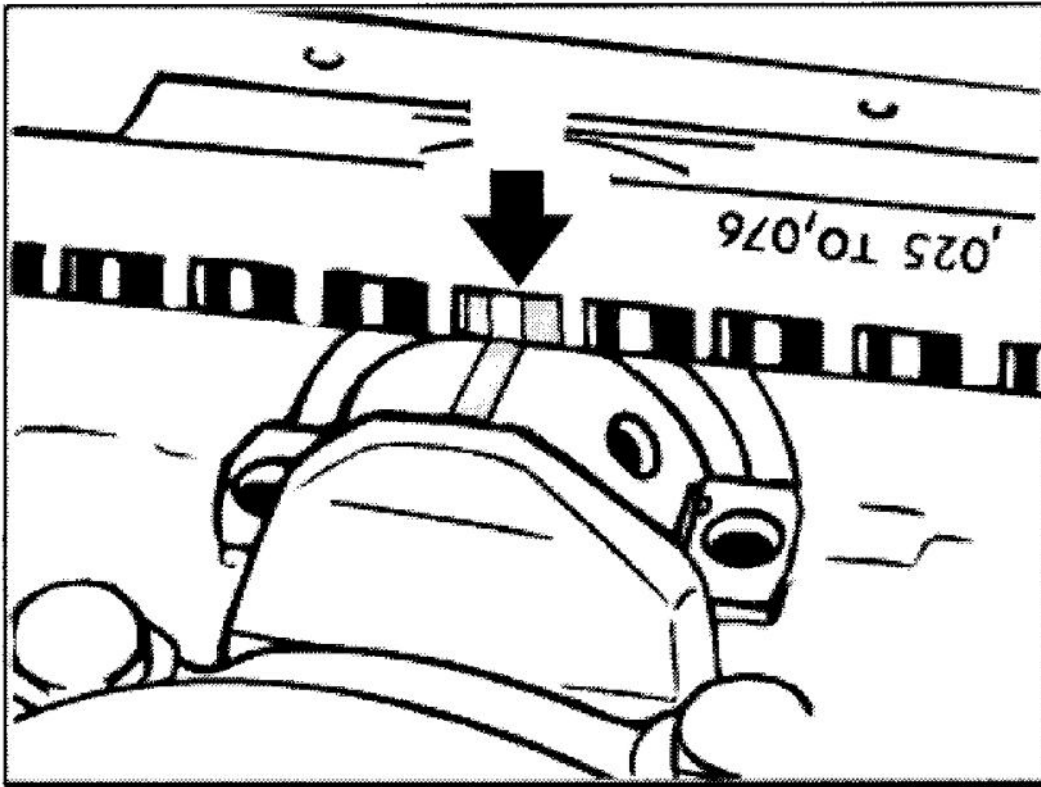
G00397791

Fig. 178: Tightening Conrod Bolts

Courtesy of BMW OF NORTH AMERICA, INC.

Remove bearing cap and read off bearing play at width of flattened plastic thread with assistance of measurement scale.

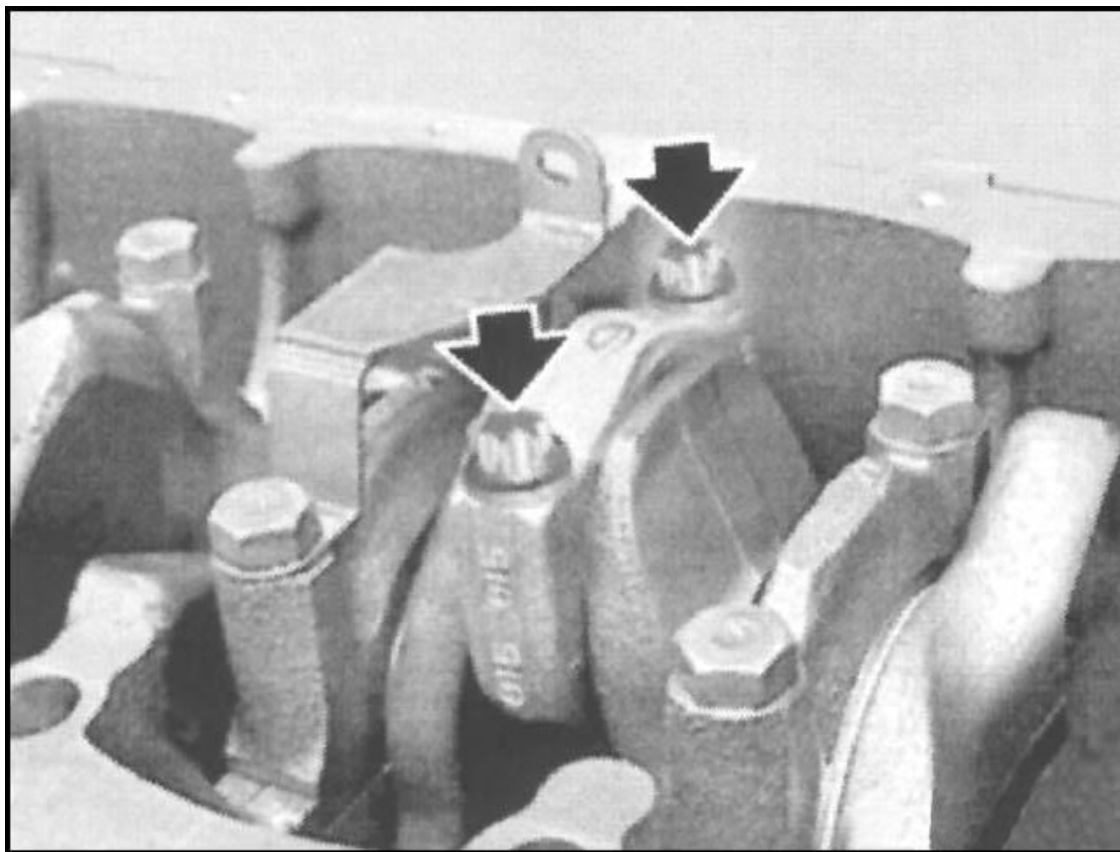
Conrod Bearing Clearance: 0.030 To 0.070 mm.



G00397792

Fig. 179: Measuring Bearing Clearance
Courtesy of BMW OF NORTH AMERICA, INC.

- Remove plastic thread.
- Coat crankshaft and bearing shells with oil.
- Fit bearing caps so that the pair numbers match up.
- Fit the conrod bolts used for the bearing clearance.



G00397774

Fig. 180: View Of M10x1.25 Conrod Bolt
Courtesy of BMW OF NORTH AMERICA, INC.

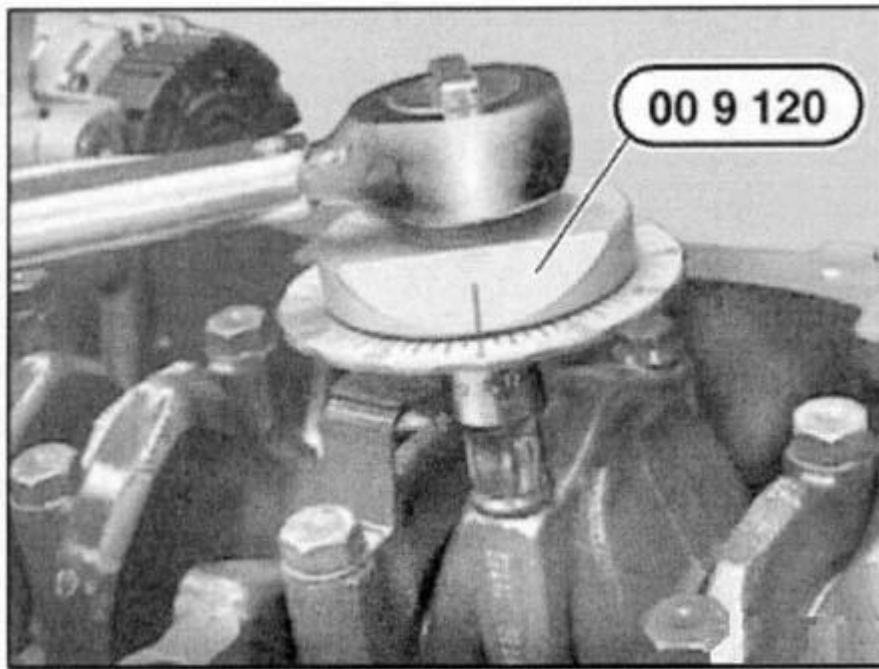
Conrod With M10X1.25 Conrod Bolt:

Second Tightening Of Conrod Bolts:

Tighten down conrod bolts with special tool 00 9 120.

Tightening torque:

- Application torque 5 N.m.
- Joining torque 30 N.m.
- Angle of rotation 105°.



G00397791

Fig. 181: Tightening Conrod Bolts

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: The following work step differs depending on whether a new set of conrods has been fitted or only the conrod bolts have been replaced. If A New Set Of Conrods Has Been Installed: The conrod bolts must not be tightened down again as they have already been screwed down three times when the conrod was machined and have reached their maximum tensile strength. If The Conrods Are Reused And Only The Conrod Bolts Have Been Replaced: The conrod bolts must be slackened again and brought to maximum tensile strength by the third tightening operation. If the conrod bolts have not been tightened at least three times or have been tightened more than five times, this will result in serious engine damage.

If necessary, back off conrod bolts by approx. one turn.

Third Tightening Of Conrod Bolts:

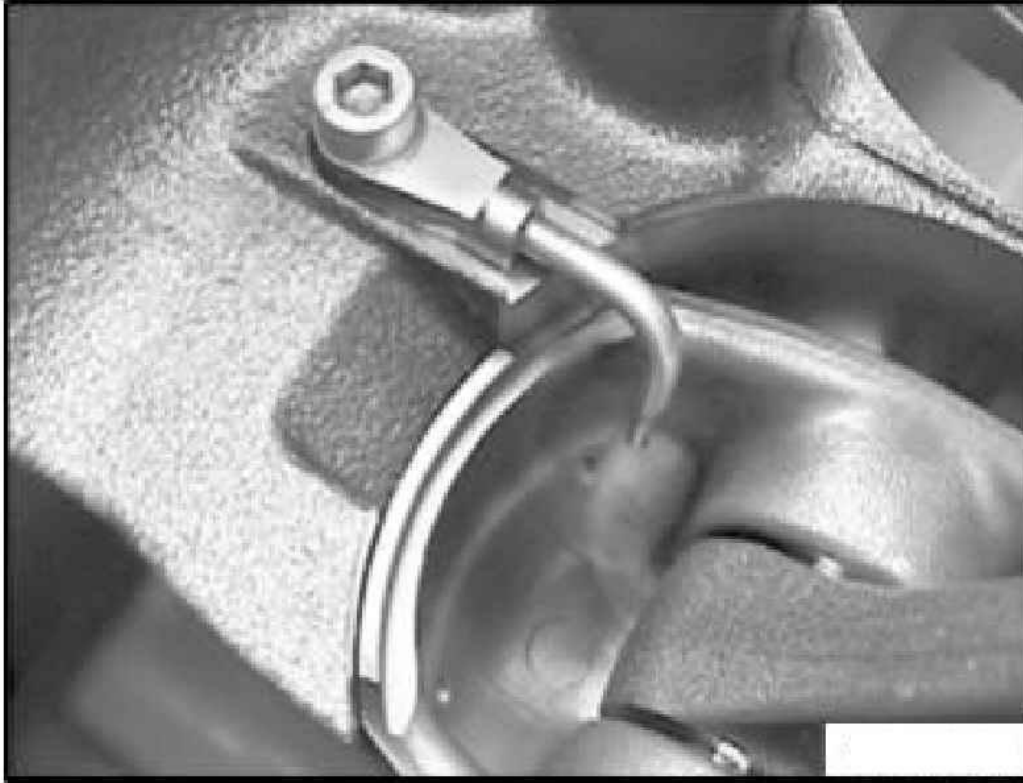
Tighten down conrod bolts with special tool 00 9 120.

Tightening torque:

- Application torque 5 N.m.
- Joining torque 30 N.m.
- Angle of rotation 105°.

Install spray nozzles for piston cooling, tighten down screw.

Tightening torque, 11 11 7AZ. Refer to **ENGINE - TIGHTENING TORQUES** .



G03190714

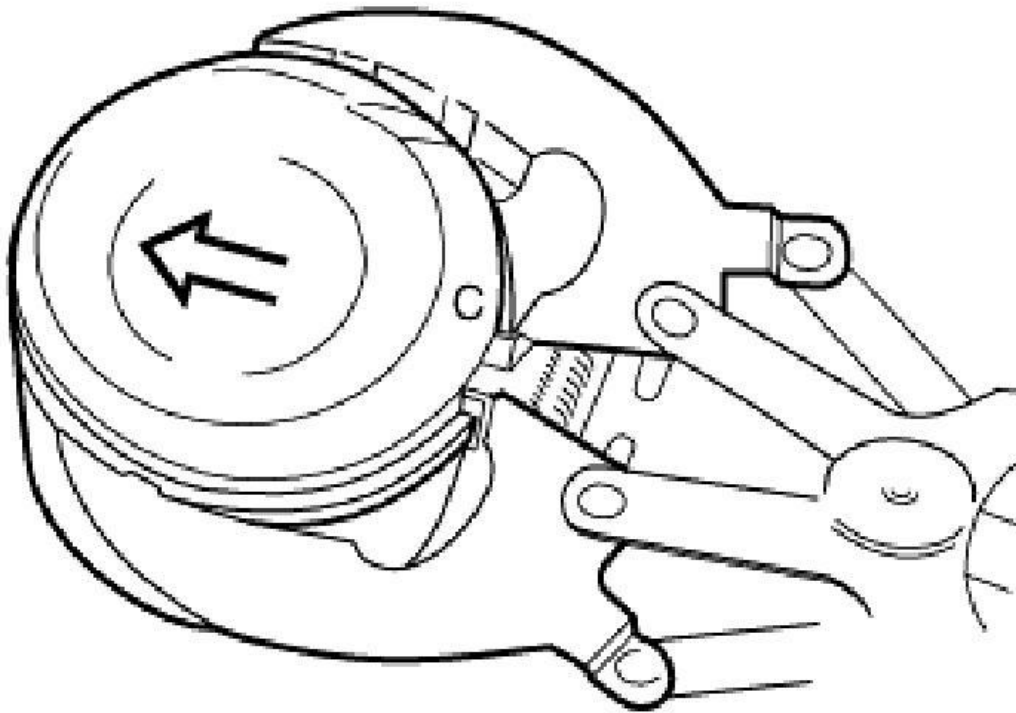
Fig. 182: Identifying Piston Cooling Spray Nozzles
Courtesy of BMW OF NORTH AMERICA, INC.

11 25 671 REPLACING PISTON RINGS ON ALL PISTONS (S62/S54)

(Piston removed)

Remove piston rings with piston-ring compressing pliers.

NOTE: It might not be possible to find the identification on used piston rings. Put aside piston rings in correct sequence and installation position.



G03117799

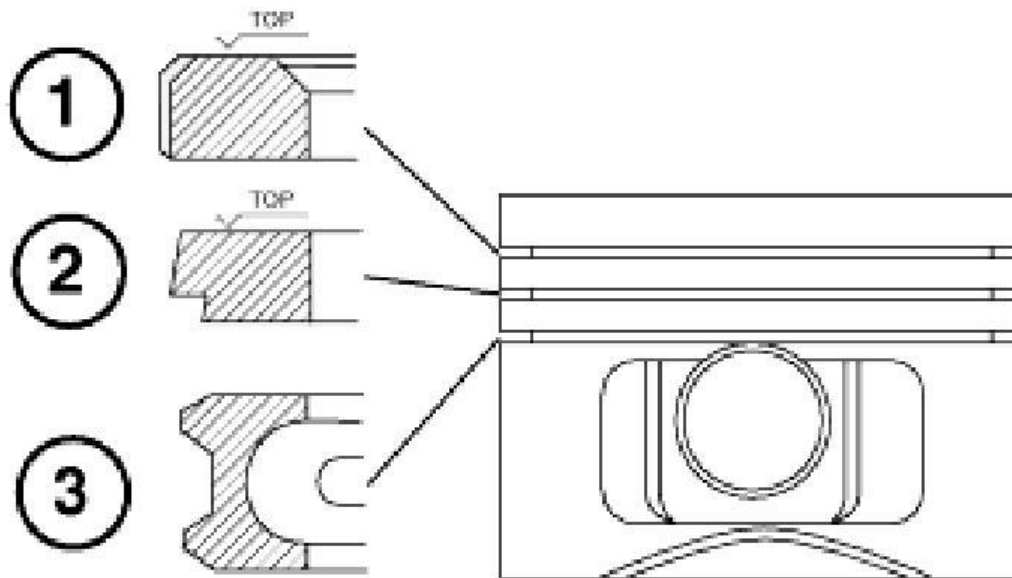
Fig. 183: Removing Piston Rings With Piston-Ring Compressing Pliers
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Insert piston rings with the word "TOP" facing piston crown.

1. Plain compression ring "TOP".
2. Tapered compression ring "TOP".
3. Slotted oil-scraper ring with rubber-lined spring.

Offset the contact points of the piston rings by approx. 120° to each other but do not position above the piston pin boss.



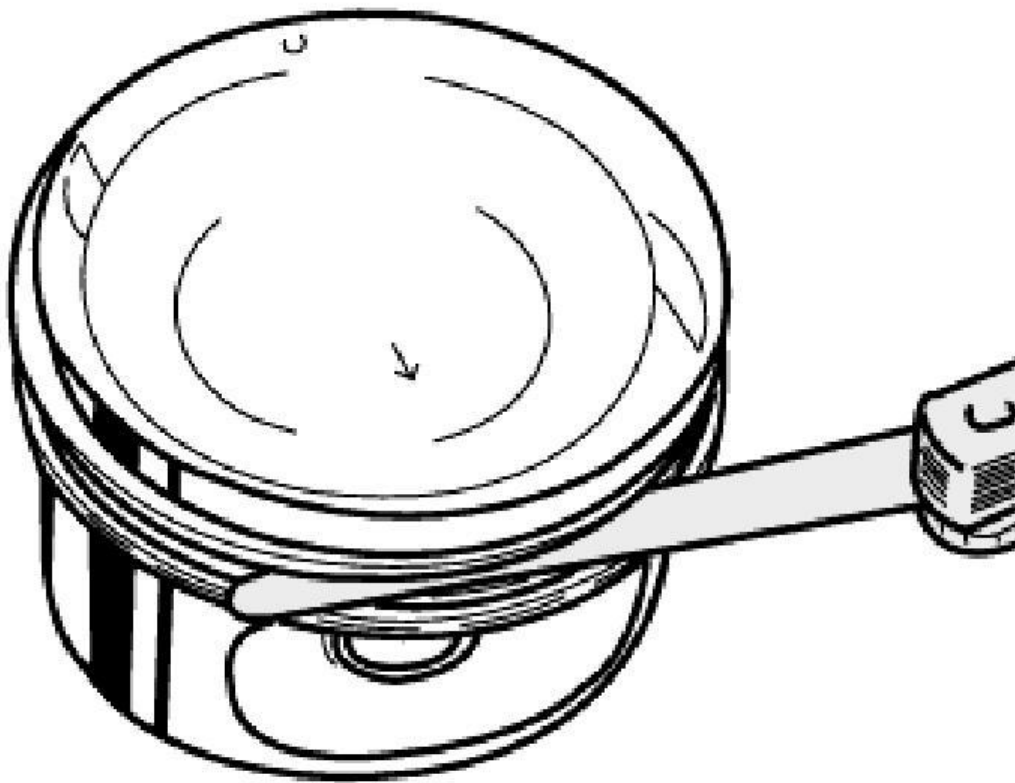
G03117800

Fig. 184: Inserting Piston Rings

Courtesy of BMW OF NORTH AMERICA, INC.

Measure axial play.

Axial clearance, refer to **ENGINE - TECHNICAL DATA** .

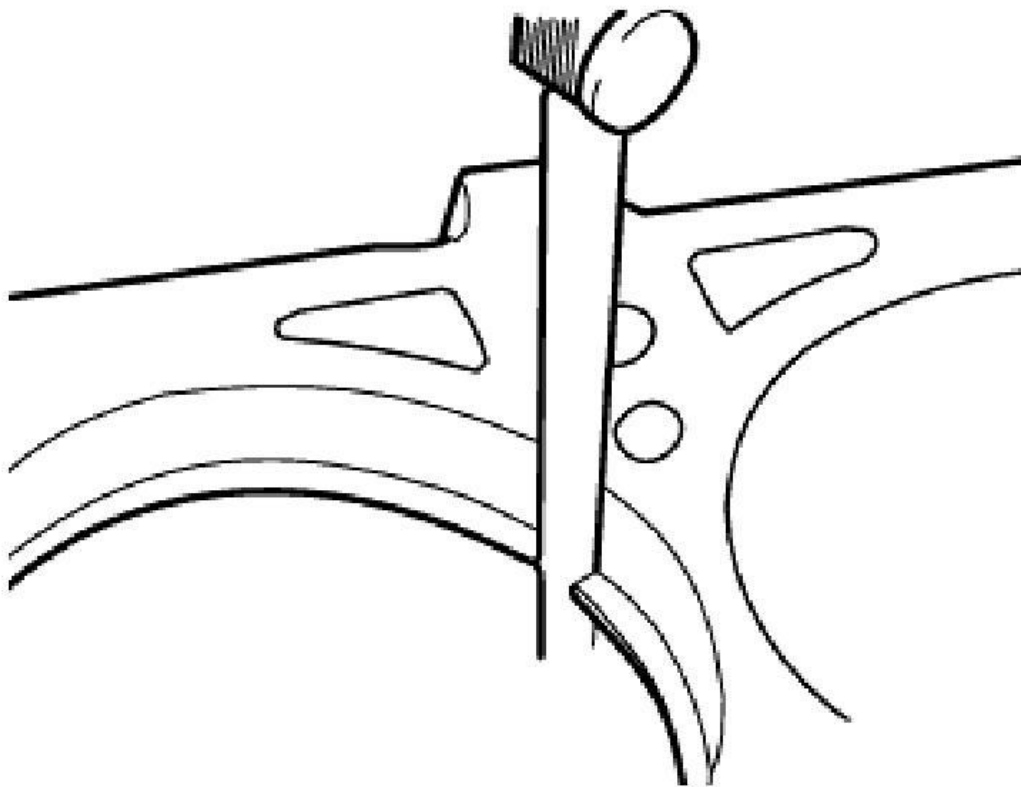


G03117801

Fig. 185: Measuring Axial Play
Courtesy of BMW OF NORTH AMERICA, INC.

Measure end clearance.

End clearance, refer to **ENGINE - TECHNICAL DATA** .



G03117802

Fig. 186: Measuring End Clearance

Courtesy of BMW OF NORTH AMERICA, INC.

V RIBBED BELT W/TENSION DEFLECT ELEMENT

11 28 010 REPLACING ALTERNATOR DRIVE BELT (S54)

NOTE: If the drive belt is to be subsequently reused: Mark direction of travel and reinstall drive belt in same direction of travel.

Remove fan clutch with fan impeller. Refer to **11 52 020 REMOVING AND INSTALLING/REPLACING FAN CLUTCH (S52 / S54 / M52 / M52TU / M54 / M56)**.

Remove A/C compressor drive belt. Refer to **11 28 050 REPLACING A/C COMPRESSOR DRIVE BELT (S54)**.

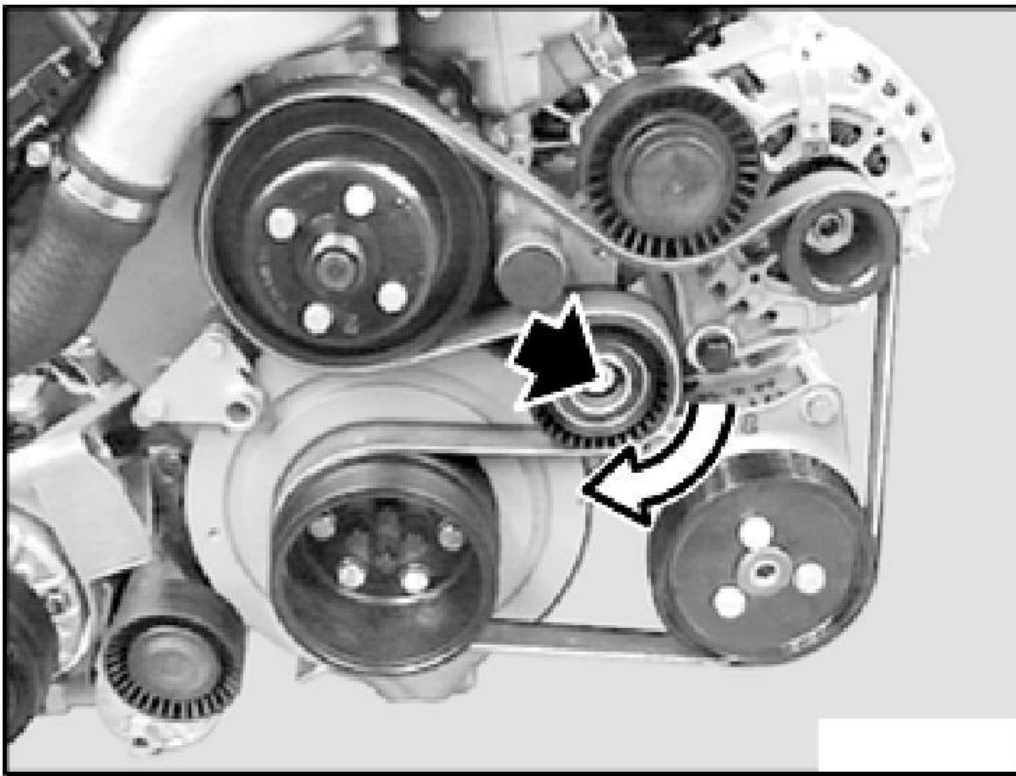
Place on screw connection of tensioning wheel and compress belt tensioner slowly and carefully.

Hold belt tensioner under tension, remove drive belt.

CAUTION: If contaminated with hydraulic fluid: Replace drive belt.

Installation:

Check drive belt for coolant and oil residue and replace if necessary.



G03117803

Fig. 187: Removing Alternator Drive Belt
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Fit drive belt and check if it is correctly located on pulleys.

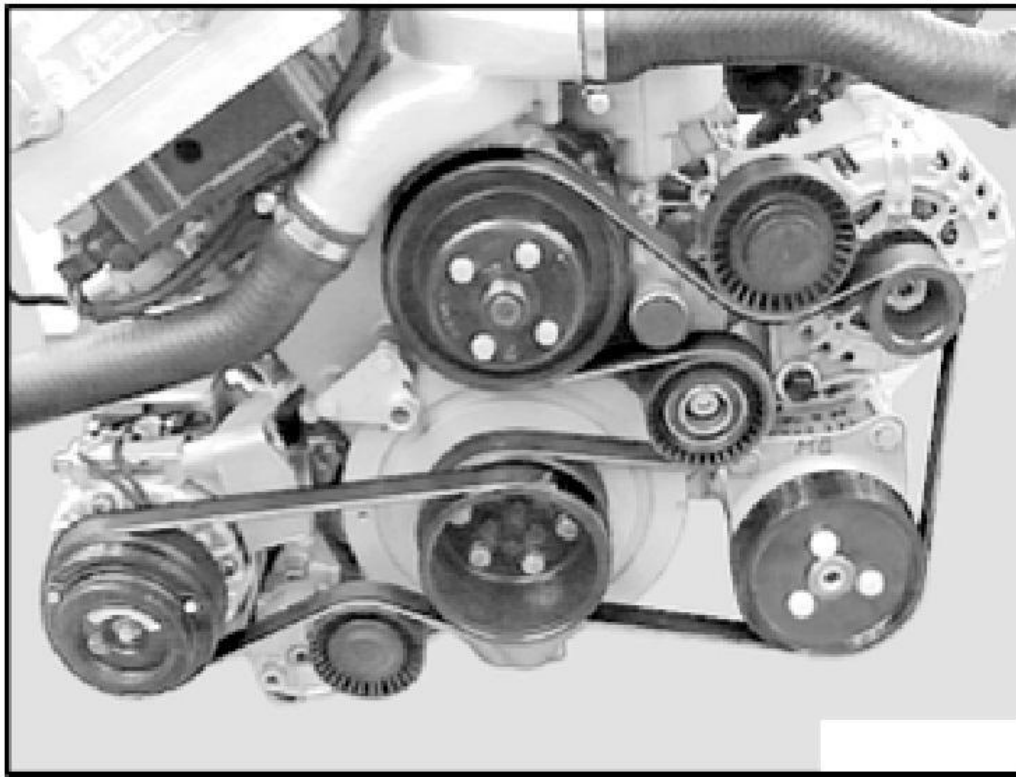
**G03117804**

Fig. 188: Installing Alternator Drive Belt

Courtesy of BMW OF NORTH AMERICA, INC.

11 28 050 REPLACING A/C COMPRESSOR DRIVE BELT (S54)

NOTE: If the drive belt is to be subsequently reused: Mark direction of travel and reinstall drive belt in same direction of travel. Remove engine splash guard.

Push back belt tensioner at hexagon head and remove drive belt.

CAUTION: If contaminated with hydraulic fluid: Replace drive belt.

Installation:

Check drive belt for coolant and oil residue and replace if necessary.

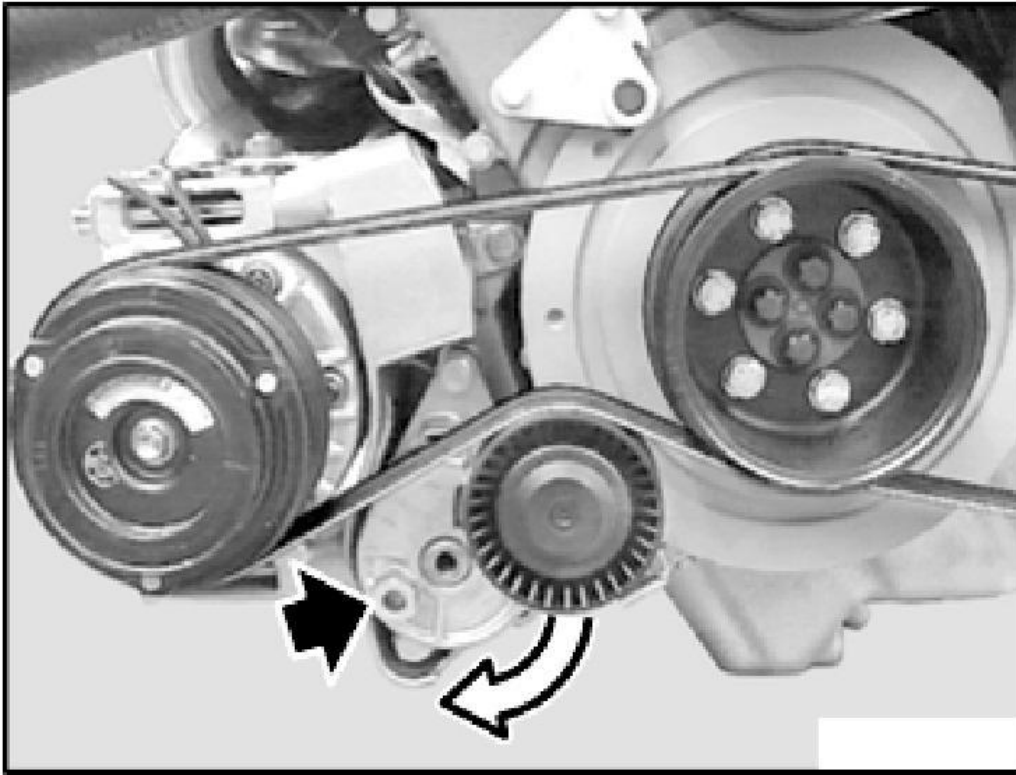
**G03117805**

Fig. 189: Removing A/C Compressor Drive Belt
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Fit drive belt and check if it is correctly located on pulleys.

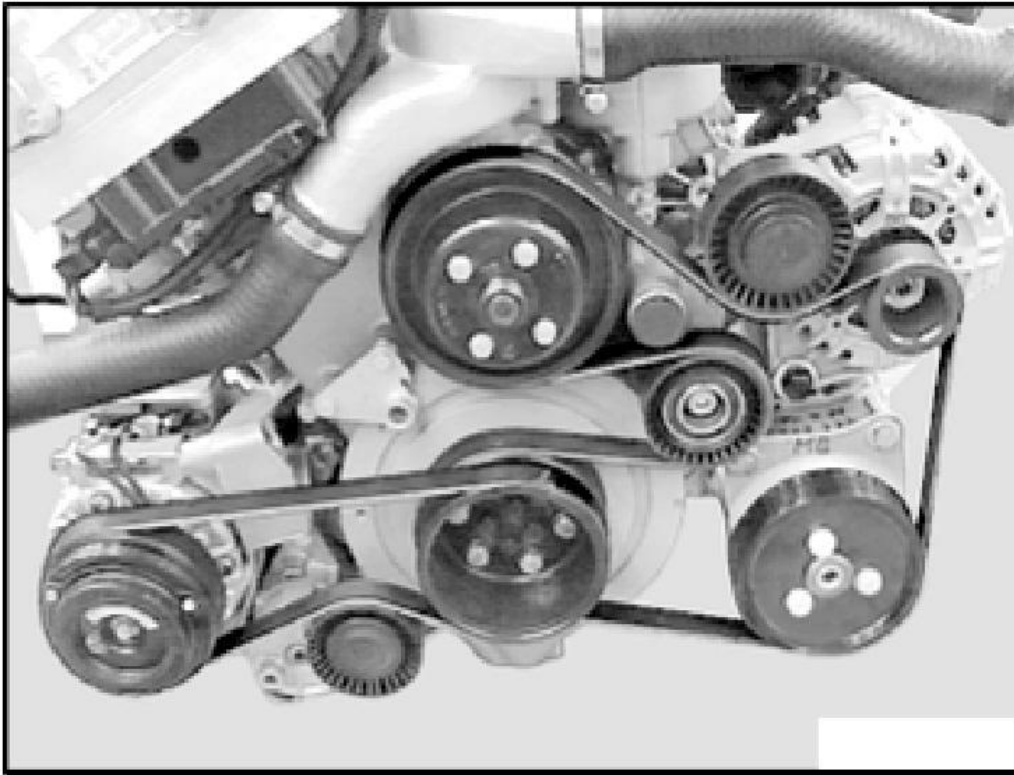
**G03117806**

Fig. 190: Installing A/C Compressor Drive Belt
Courtesy of BMW OF NORTH AMERICA, INC.

CAMSHAFT

11 31 005 CHECKING CAMSHAFT TIMING (S54)

Special Tools Required:

- 11 2 300
- 11 5 100
- 11 7 130
- 11 9 140
- 12 6 050
- 12 6 410
- 12 6 411

Remove fan clutch with fan cowl. Refer to **11 52 020 REMOVING AND INSTALLING/REPLACING FAN CLUTCH (S52 / S54 / M52 / M52TU / M54 / M56)**.

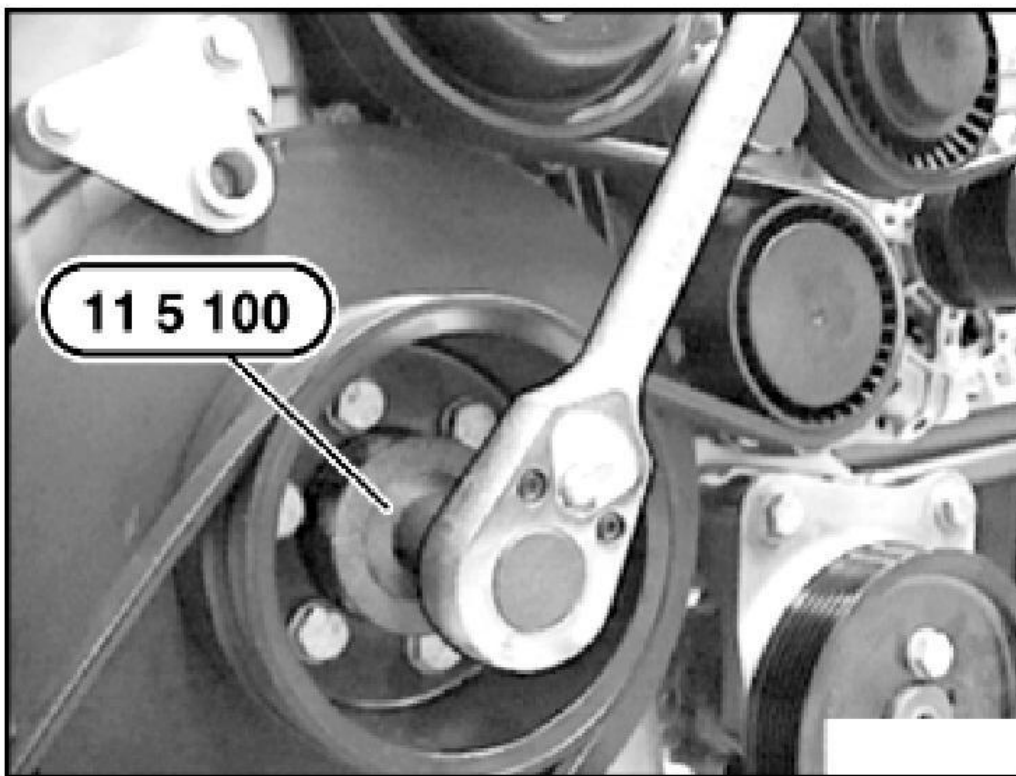
Remove cylinder head cover. Refer to **11 12 000 REMOVING AND INSTALLING, SEALING CYLINDER HEAD COVER (S54)**.

Remove all spark plugs.

When the engine is switched off, VANOS moves the camshafts to a position which is advantageous to engine starting.

CAUTION: The timing must "not" be checked in this position. The camshafts must first be turned back to their initial position.

Attach special tool 11 5 100 to four screws of crankshaft hub.

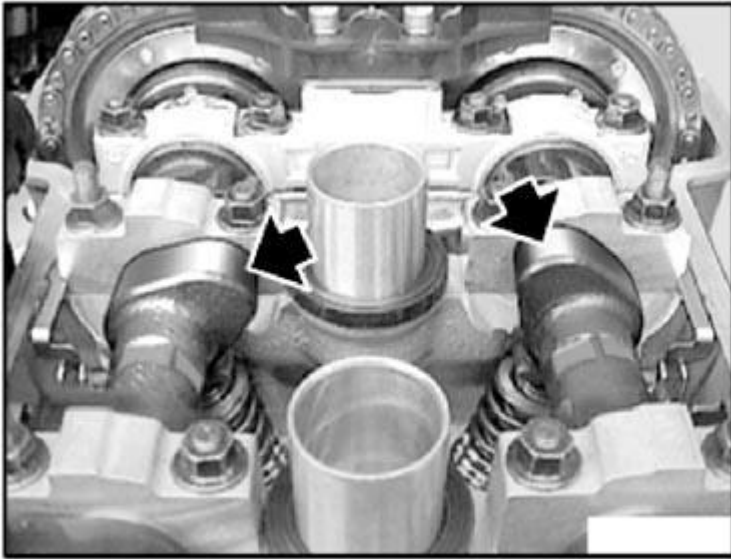


G03117807

Fig. 191: Attaching Adapter With Socket Wrench To Crankshaft Hub

Courtesy of BMW OF NORTH AMERICA, INC.

Rotate crankshaft in direction of rotation as far as firing TDC position of 1st cylinder.

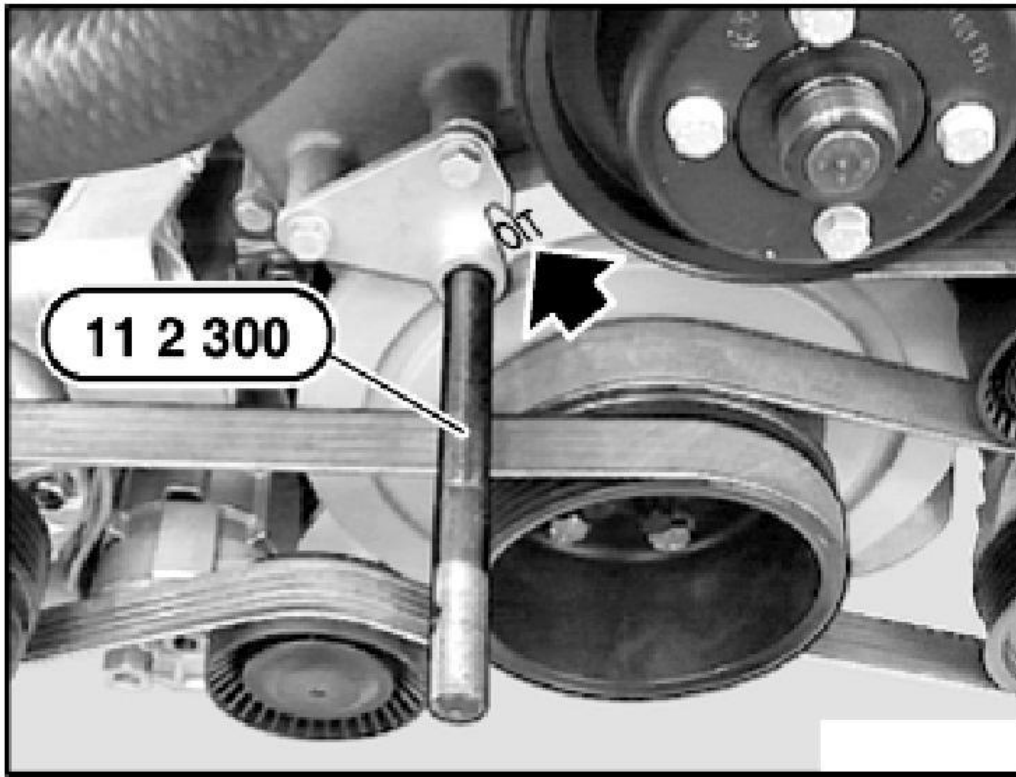


G03117808

Fig. 192: Aligning Crankshaft To Firing TDC Position Of 1st Cylinder
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Do not turn the engine back.

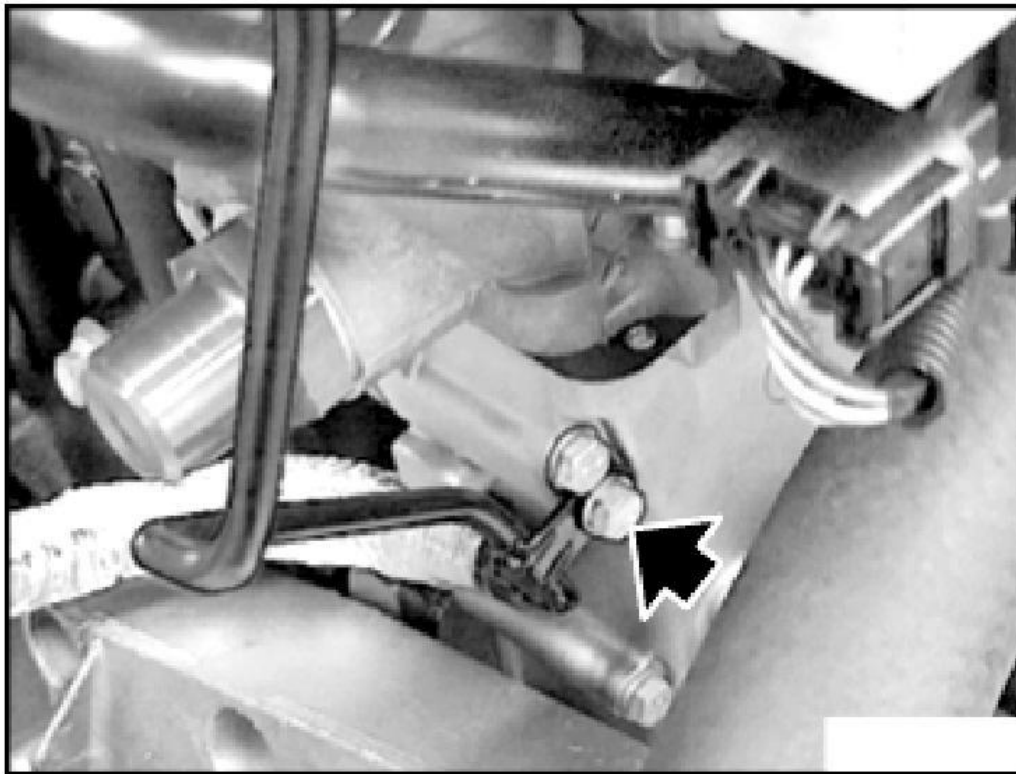
Rotate crankshaft in direction of rotation as far as ignition TDC-J position of cylinder 1. Secure vibration damper in position with special tool 11 2 300.



G03117809

Fig. 193: Securing Vibration Damper In Position With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

Detach bracket of oil line from timing case cover.



G03117810

Fig. 194: Identifying Oil Line Bracket
Courtesy of BMW OF NORTH AMERICA, INC.

Remove oil line from VANOS adjustment unit.

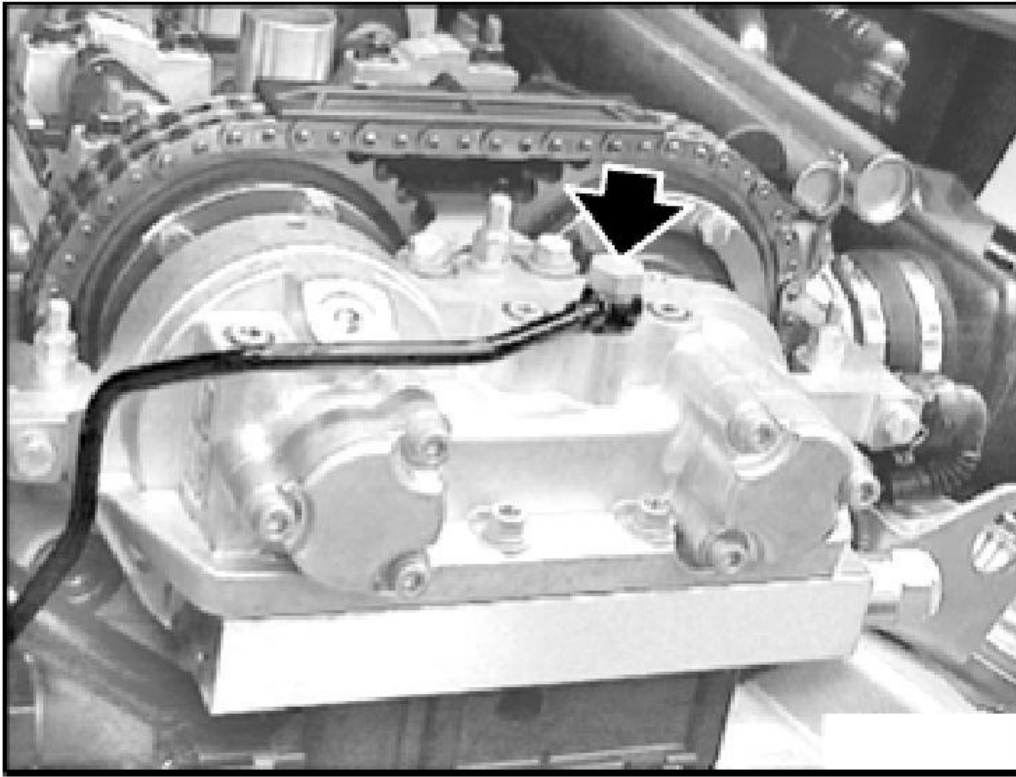
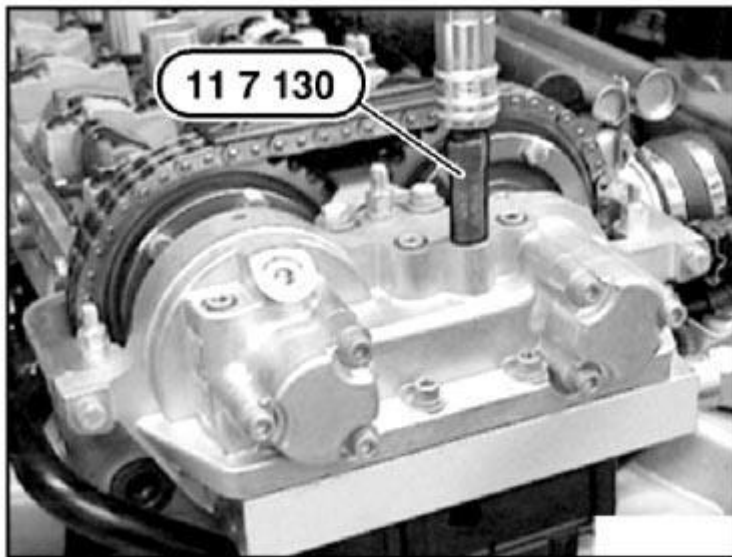
**G03117811**

Fig. 195: View Of Oil Line From VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Fit special tool 11 7 130 to VANOS adjustment unit.

Connect compressed air (2 to 8 bar).



G03117812

Fig. 196: Installing Special Tool To VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection on solenoid valve.

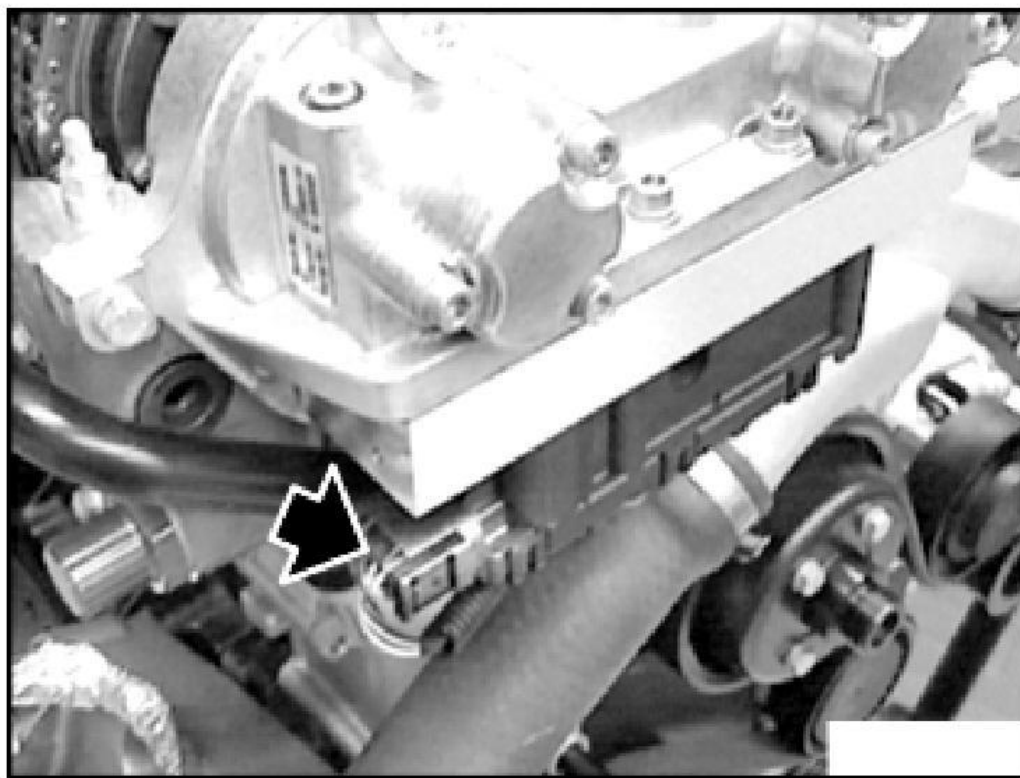
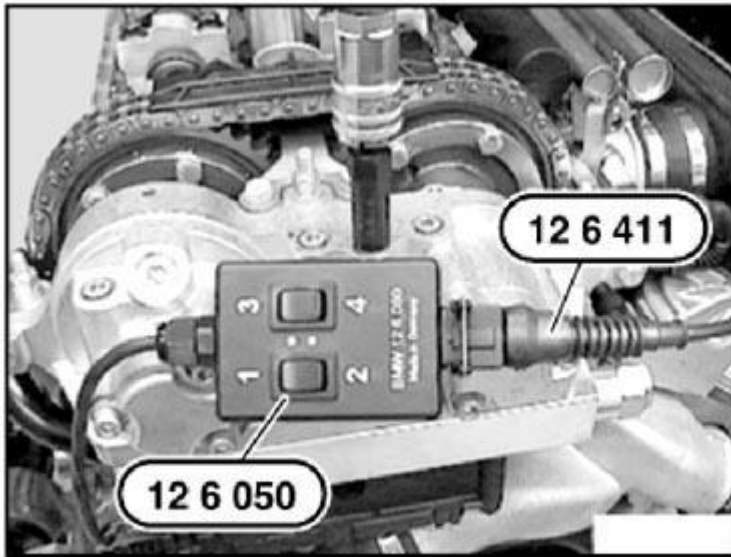
**G03117813**

Fig. 197: Disconnecting Plug Connection On Solenoid Valve
Courtesy of BMW OF NORTH AMERICA, INC.

Connect special tool 12 6 050 in conjunction with special tool 12 6 411 (from special tool kit 12 6 410) to solenoid valves. Connect special tool 12 6 411 to correct terminals on car battery.

Alternately press toggle switch buttons 1 and 2 several times on special tool 12 6 050.

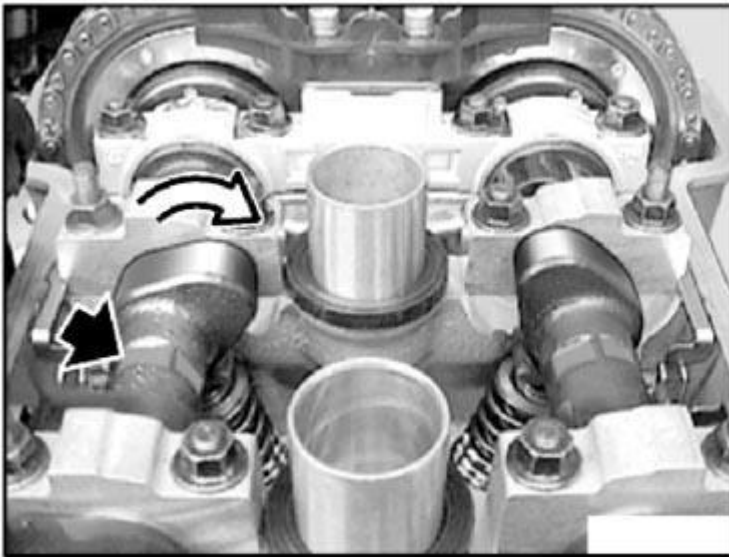


G03117814

Fig. 198: View Of Switching Unit**Courtesy of BMW OF NORTH AMERICA, INC.**

Press and hold down toggle switch button 1 on special tool 12 6 050.

At same time, rotate inlet camshaft at hexagon drive against direction of rotation as far as it will go.



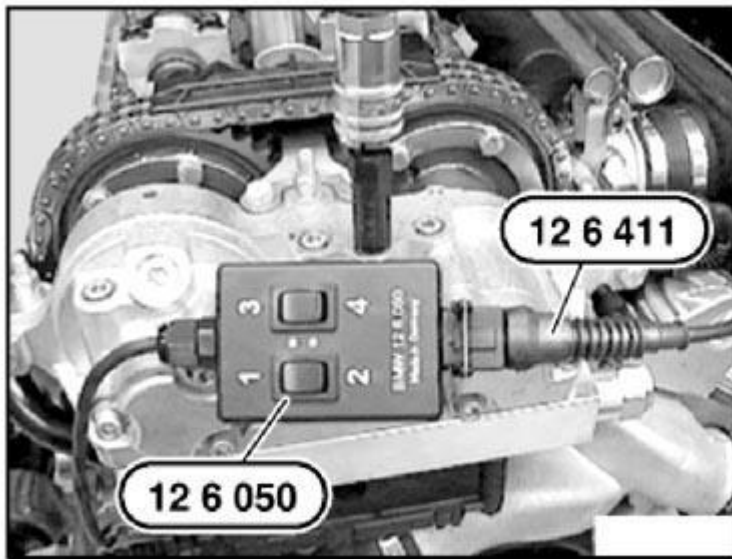
G03117815

Fig. 199: Identifying Inlet Camshaft

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Spline teeth in VANOS gear are engaged; and inlet camshaft cannot be rotated further.

Alternately press toggle switch buttons 3 and 4 several times on special tool 12 6 050.

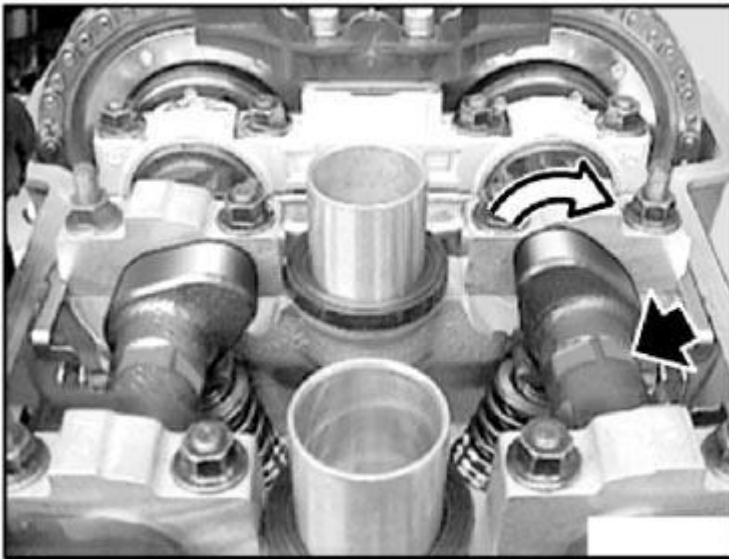


G03117816

Fig. 200: Locating Toggle Switch Buttons On Switching Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Press and hold down toggle switch button 3 on special tool 12 6 050.

At same time, rotate exhaust camshaft at hexagon drive against direction of rotation as far as it will go.



G03117817

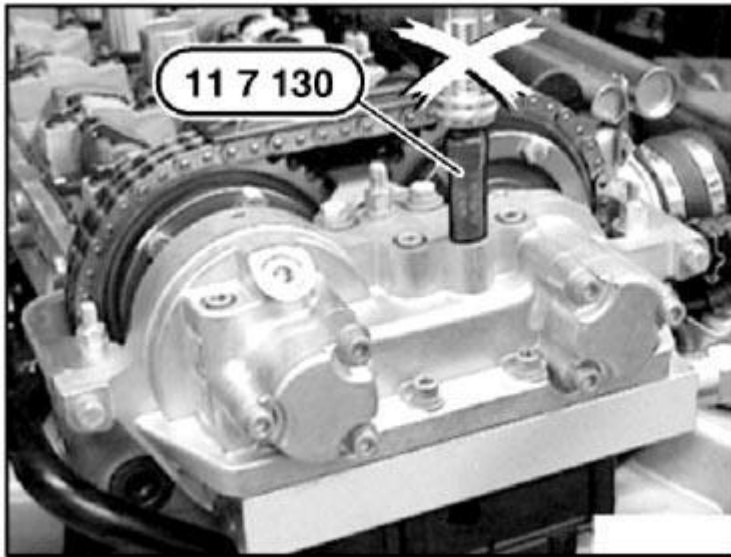
Fig. 201: View Of Exhaust Camshaft

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Spline teeth in VANOS gear are engaged; and exhaust camshaft cannot be rotated further.

Disconnect compressed air from special tool 11 7 130.

Remove special tool 11 7 130.



G03117818

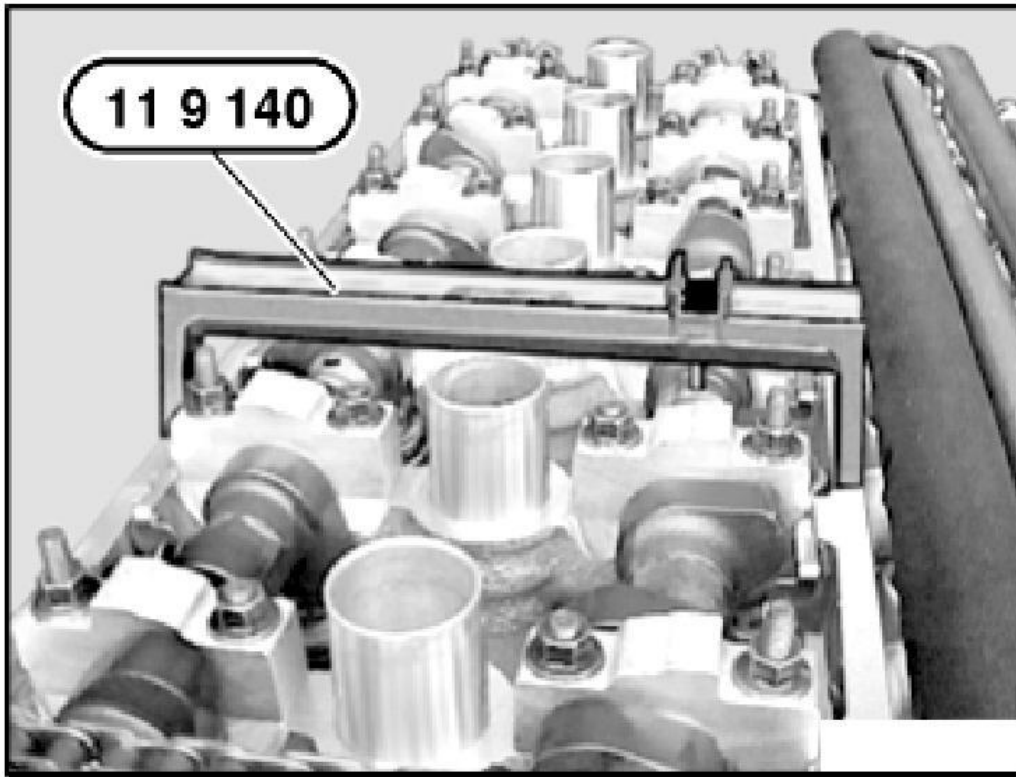
Fig. 202: Identifying Connection Piece In VANOS Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Check camshaft setting:

Attach special tool 11 9 140 and join in locating bore of inlet camshaft.

NOTE: The inlet camshaft is correctly adjusted when special tool 11 9 140 rests flat on the cylinder head or protrudes by max. 0.5 mm to the exhaust side.

If the special tool 11 9 140 protrudes to the inlet side, the timing must be readjusted.



G03117819

Fig. 203: Identifying Gauge (Special Tool 11 9 140)
Courtesy of BMW OF NORTH AMERICA, INC.

Join special tool 11 9 140 in locating bore of exhaust camshaft.

NOTE: The exhaust camshaft is correctly adjusted when special tool 11 9 140 rests flat on the cylinder head or protrudes by max. 0.5 mm to the exhaust side.

If the special tool 11 9 140 protrudes to the inlet side, the timing must be readjusted.

If necessary, adjust camshaft timing. Refer to **11 31 505 ADJUSTING CAMSHAFT TIMING (S54)**.

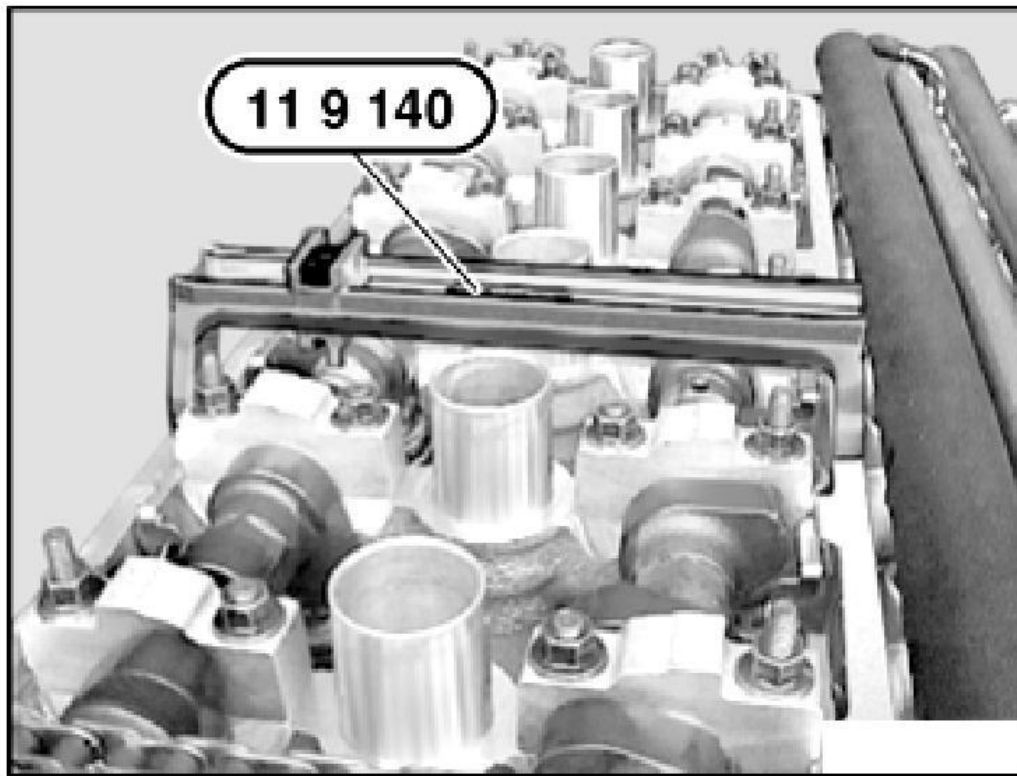
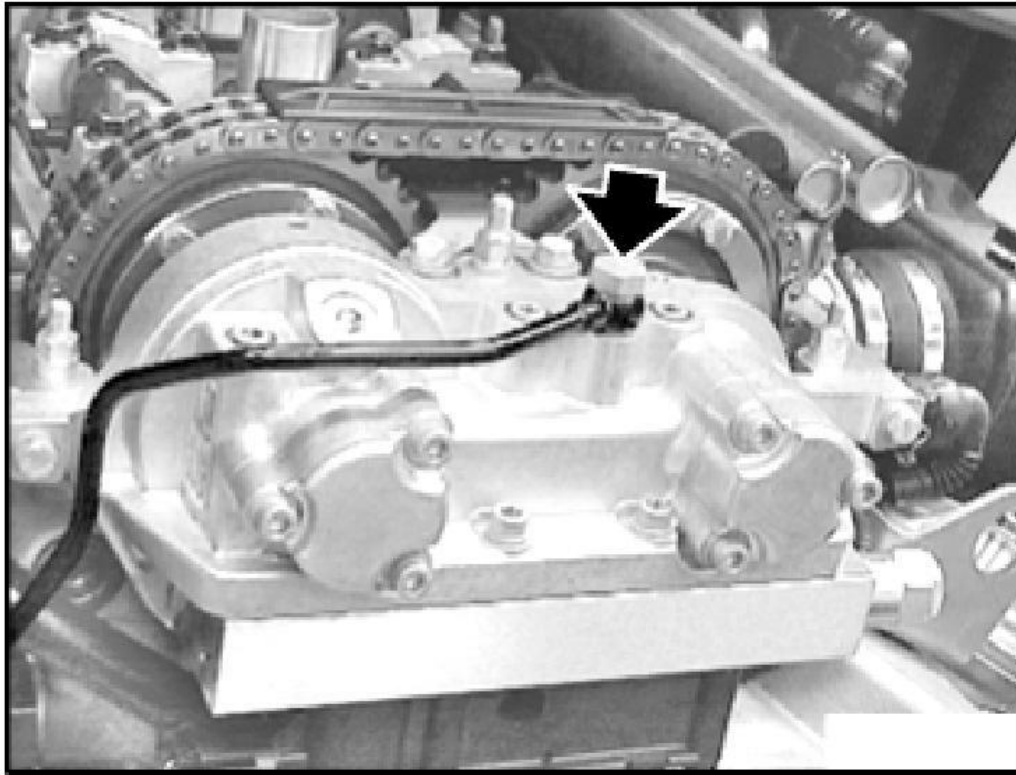
**G03117820**

Fig. 204: View Of Gauge In Locating Bore Of Exhaust Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

Replace sealing rings of banjo bolt.

Install banjo bolt but do not tighten down yet.



G03117821

Fig. 205: Installing Banjo Bolt
Courtesy of BMW OF NORTH AMERICA, INC.

Install bracket of oil line. Install screw and tighten down.

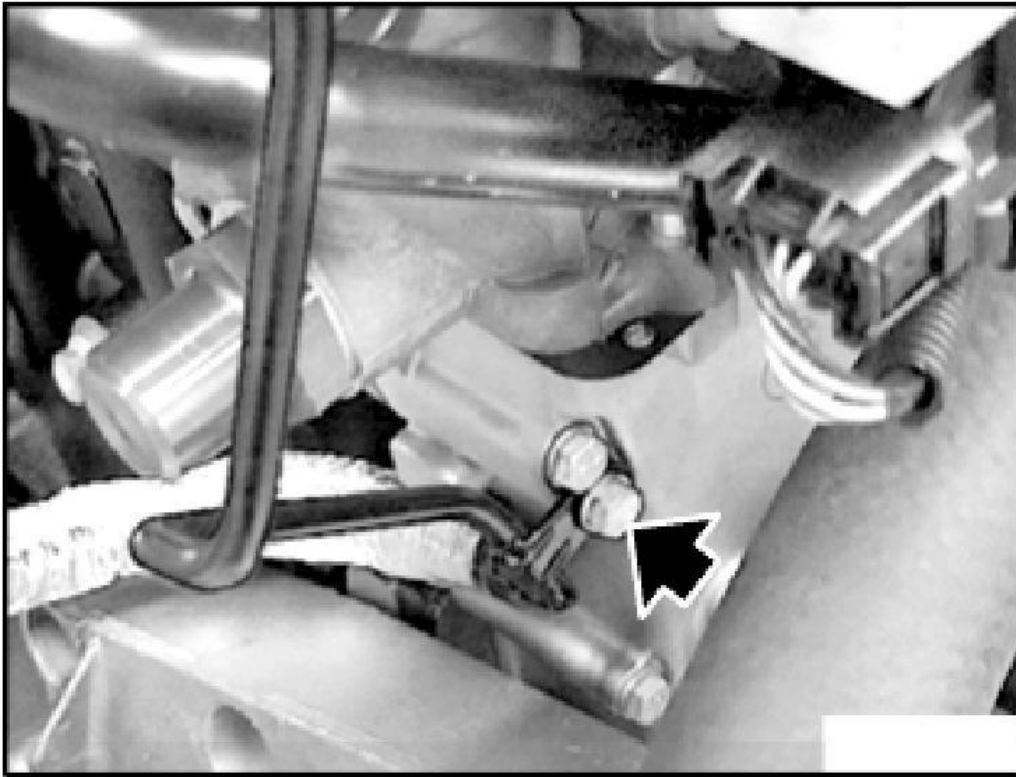
**G03117822**

Fig. 206: Installing Bracket Of Oil Line
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down banjo bolt of oil line.

Tightening torque, refer to 11 36 9AZ in **ENGINE - TIGHTENING TORQUES** .

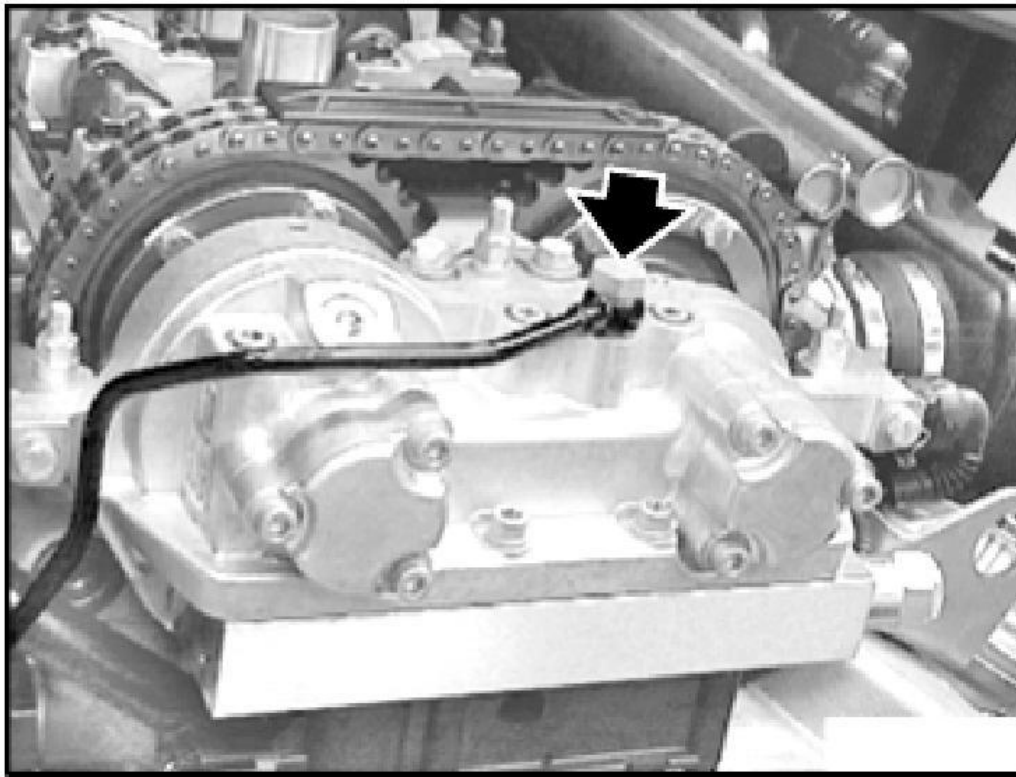
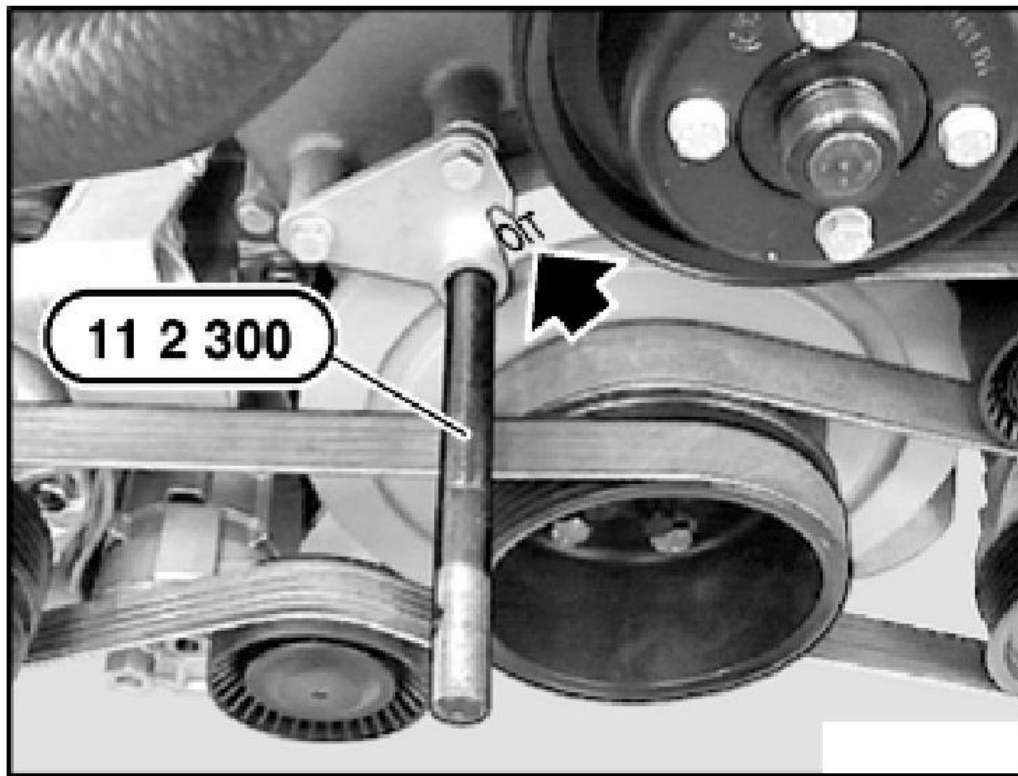
**G03117823**

Fig. 207: Identifying Banjo Bolt Of Oil Line
Courtesy of BMW OF NORTH AMERICA, INC.

Remove special tool 11 2 300.

Assemble engine.



G03117824

Fig. 208: Removing Special Tool From Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: There is air in the VANOS system once it is opened. In the first few seconds after startup this results in a clearly discernible "rattling noise". This rattling noise does "not" indicate incorrect assembly. The rattling noise will disappear as soon as the oil pressure has built up and the system has vented.

11 31 019 REPLACING CAMSHAFTS (S54)

Special Tools Required:

- 11 2 300
- 11 4 380
- 11 5 100
- 11 7 130

- 11 7 160
- 11 7 200
- 11 7 342
- 11 9 130
- 11 9 140
- 11 9 170
- 12 6 050
- 12 6 410
- 12 6 411

Read fault memory and make a documentary record.

Remove cylinder head. Refer to **11 12 100 REMOVING AND INSTALLING/SEALING CYLINDER HEAD (S54)**.

Remove all spark plugs.

Remove fan clutch with fan impeller and fan cowl. Refer to **11 52 020 REMOVING AND INSTALLING/REPLACING FAN CLUTCH (S52 / S54 / M52 / M52TU / M54 / M56)** and **17 11 031 REPLACING FAN COWL (S54)** .

Removal:

Removal of the VANOS adjustment unit and the camshafts is described separately from installation. The assembly sequence for removal and installation is different.

Fit special tool 11 5 100 to four screws on crankshaft hub.

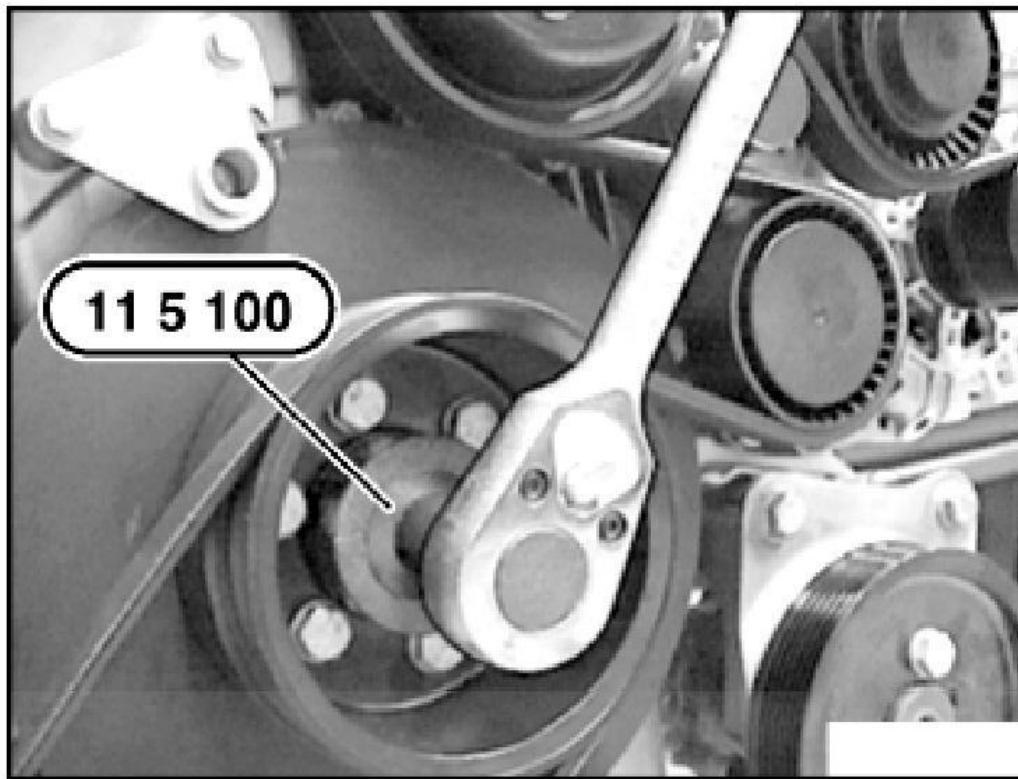
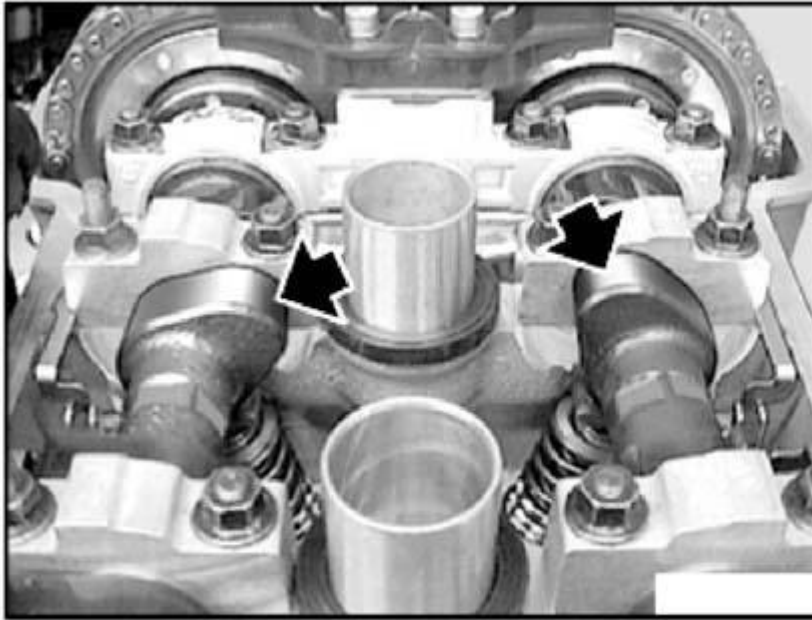
**G03117825**

Fig. 209: View Of Adapter With Socket On Crankshaft Hub
Courtesy of BMW OF NORTH AMERICA, INC.

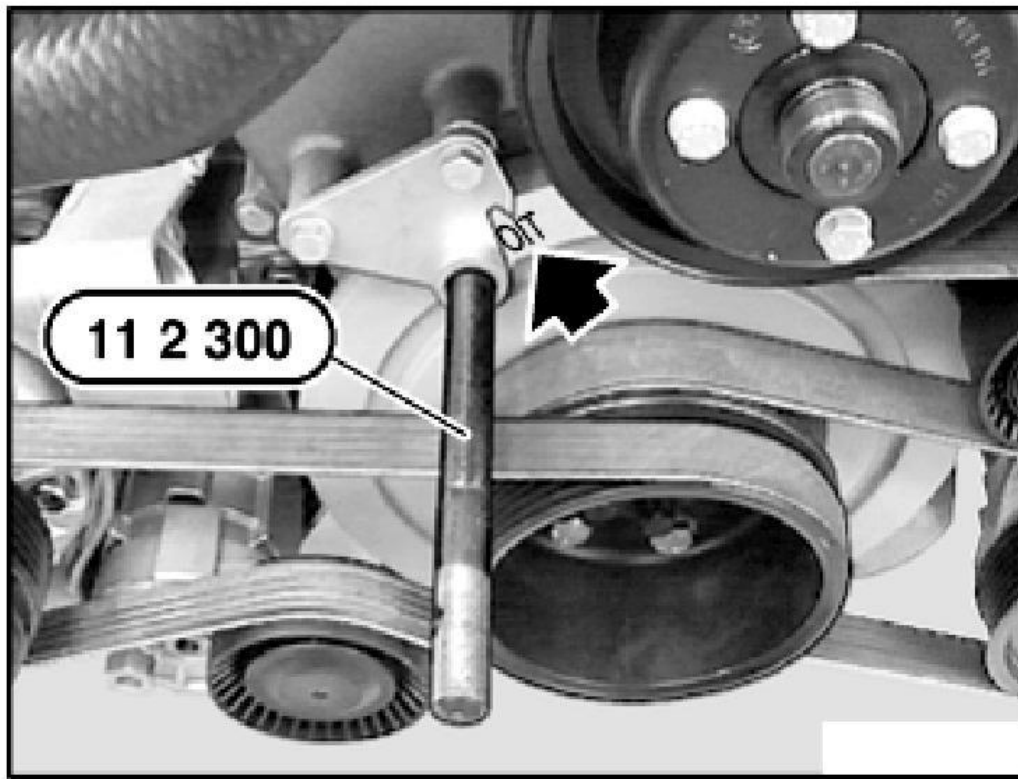
Rotate crankshaft in direction of rotation as far as firing TDC position of 1st cylinder.



G03117826

Fig. 210: Rotating Crankshaft As Far As Firing TDC Position Of 1st Cylinder
Courtesy of BMW OF NORTH AMERICA, INC.

Secure vibration damper with special tool 11 2 300 in firing TDC position of 1st cylinder.

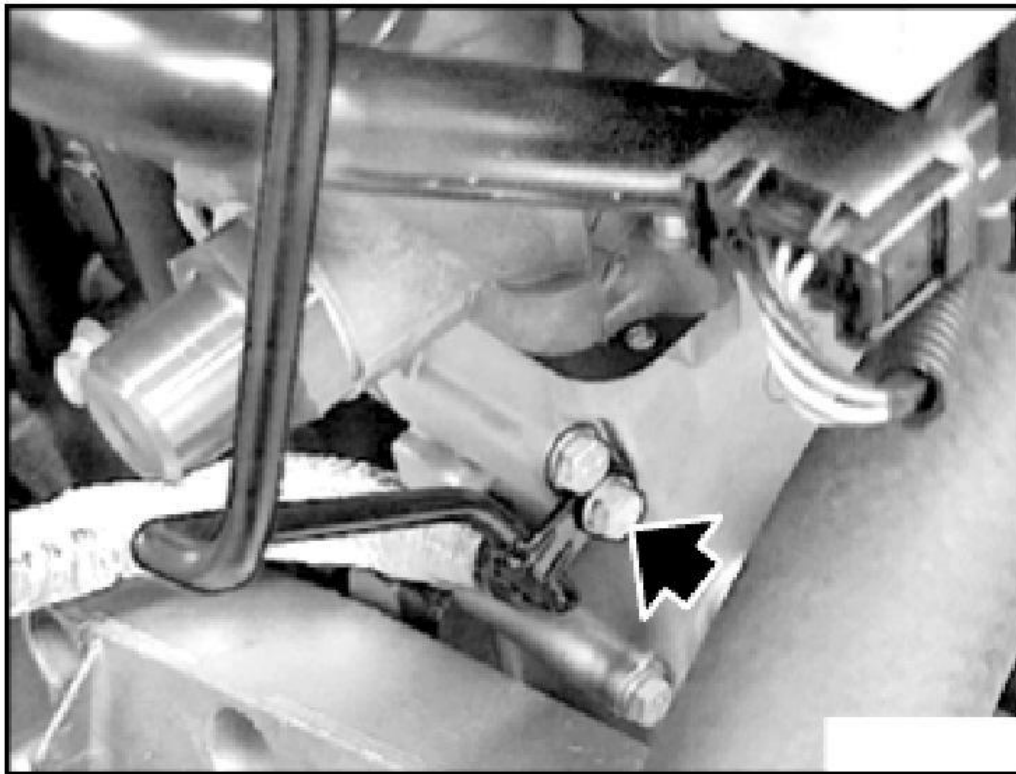


G03117827

Fig. 211: Securing Vibration Damper With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: When the engine is switched off, VANOS moves the camshafts to a position which is advantageous to engine starting. The camshafts and the VANOS adjustment unit must be placed in the installation position before the VANOS adjustment unit is removed.

Detach bracket of oil line from timing case cover.



G03117828

Fig. 212: View Of Oil Line Bracket
Courtesy of BMW OF NORTH AMERICA, INC.

Remove oil line from VANOS adjustment unit.

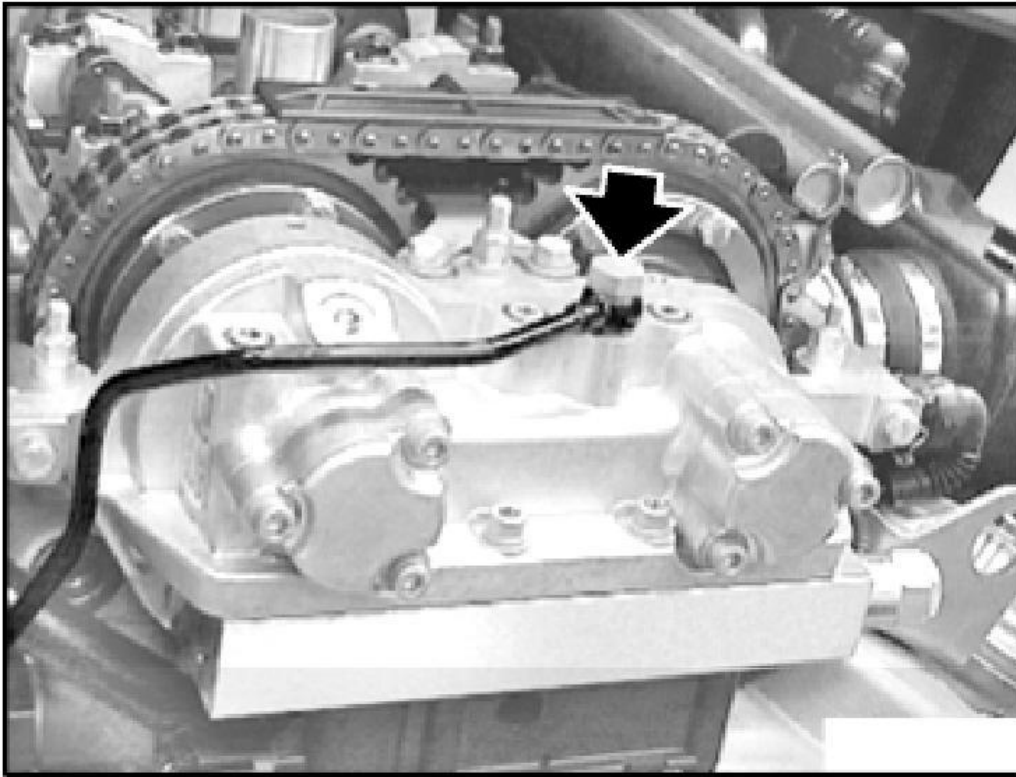
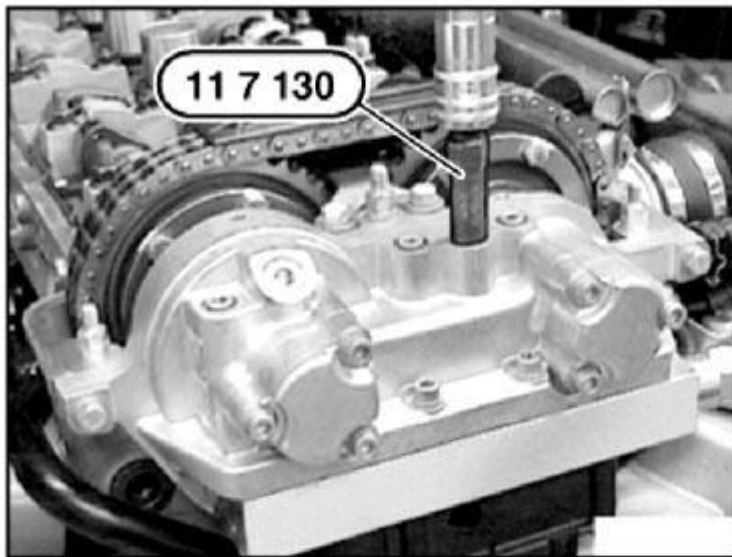
**G03117829**

Fig. 213: Identifying Oil Line From VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Fit special tool 11 7 130 to VANOS adjustment unit. Connect compressed air (2 to 8 bar).



G03117830

Fig. 214: View Of Connection Piece In VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection on solenoid valve.

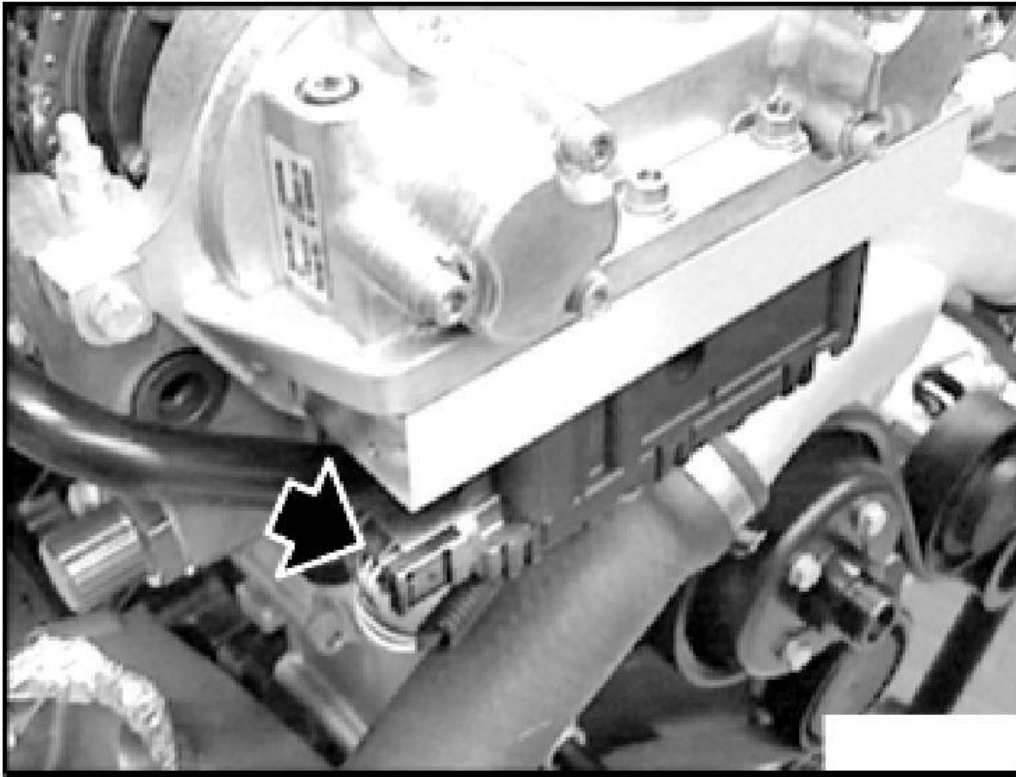
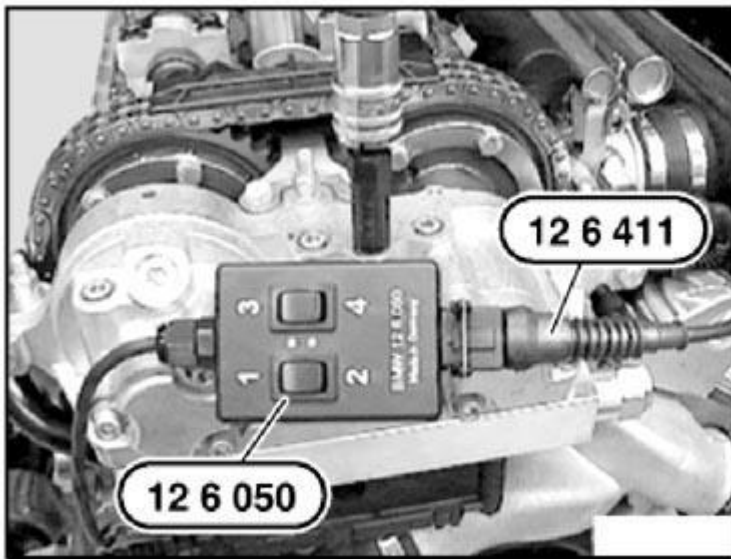
**G03117831**

Fig. 215: Disconnecting Plug Connection On Solenoid Valve
Courtesy of BMW OF NORTH AMERICA, INC.

Connect special tool 12 6 050 in conjunction with special tool 12 6 411 (from special tool kit 12 6 410) to solenoid valves. Connect special tool 12 6 411 to correct terminals on car battery.

Alternately press toggle switch buttons 1 and 2 several times on special tool 12 6 050.

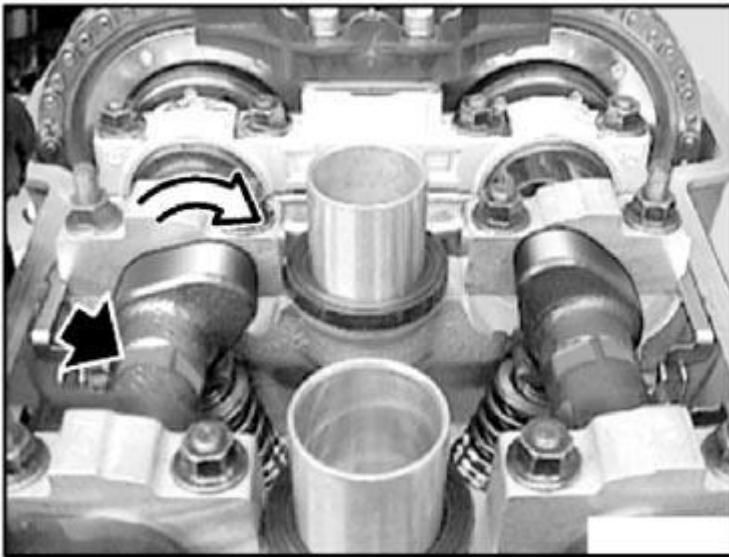


G03117832

Fig. 216: View Of Switching Unit**Courtesy of BMW OF NORTH AMERICA, INC.**

Press and hold down toggle switch button 1 on special tool 12 6 050.

At same time, rotate inlet camshaft at hexagon drive against direction of rotation as far as it will go.



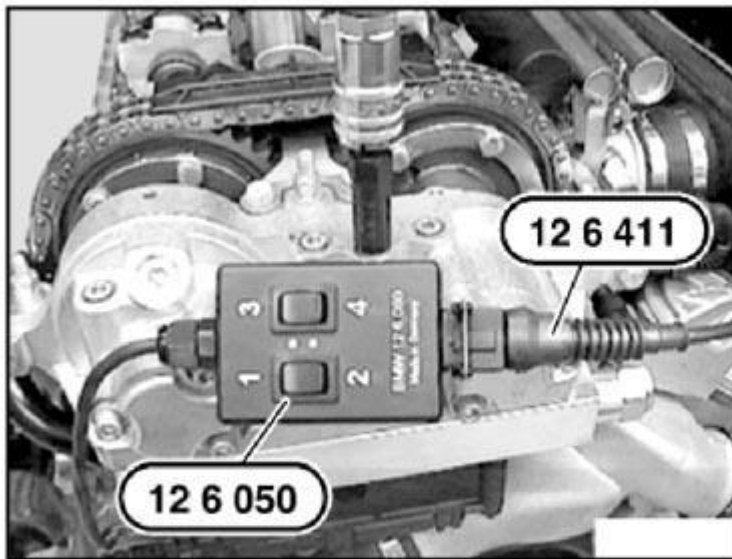
G03117833

Fig. 217: Identifying Inlet Camshaft

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Spline teeth in VANOS gear are engaged; and inlet camshaft cannot be rotated further.

Alternately press toggle switch buttons 3 and 4 several times on special tool 12 6 050.

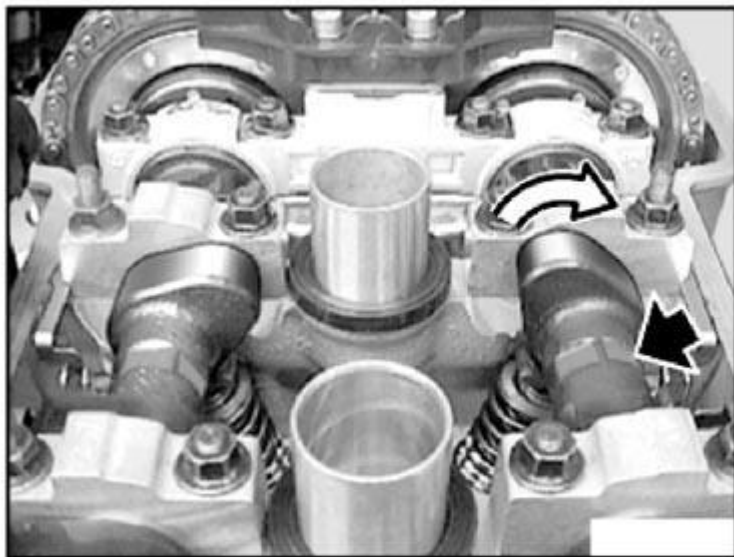


G03117834

Fig. 218: Locating Toggle Switch Buttons 3 And 4 On Switching Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Press and hold down toggle switch button 3 on special tool 12 6 050.

At same time, rotate exhaust camshaft at hexagon drive against direction of rotation as far as it will go.



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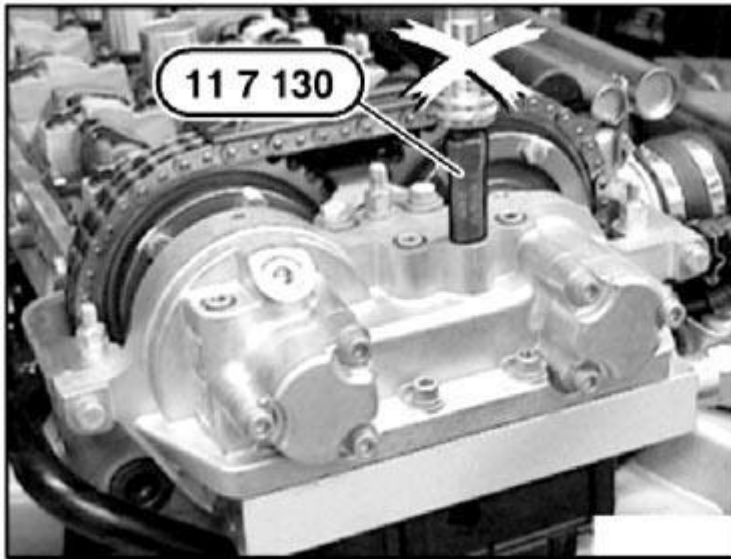
Fig. 219: View Of Exhaust Camshaft

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Spline teeth in VANOS gear are engaged; and exhaust camshaft cannot be rotated further.

Disconnect compressed air from special tool 11 7 130.

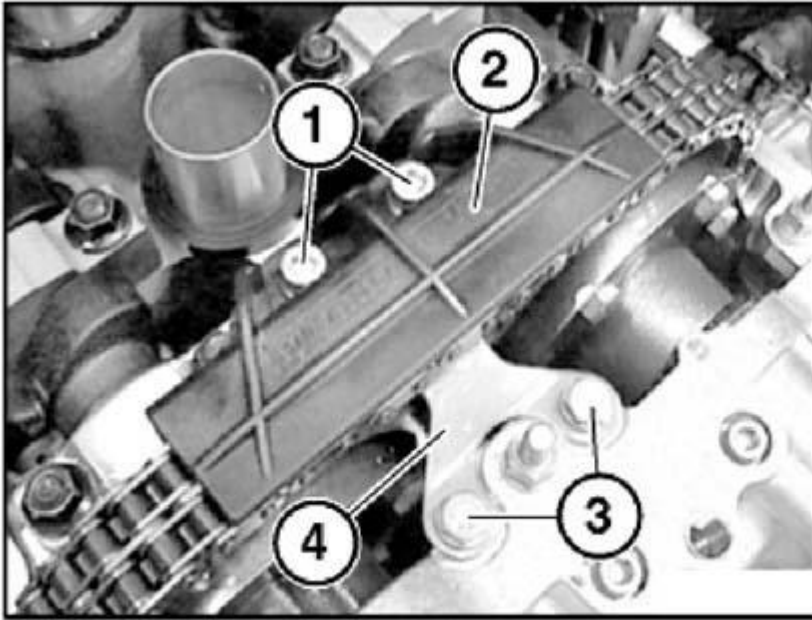
Remove special tool 11 7 130.



G03117836

Fig. 220: Disconnecting Compressed Air From Connection Piece
Courtesy of BMW OF NORTH AMERICA, INC.

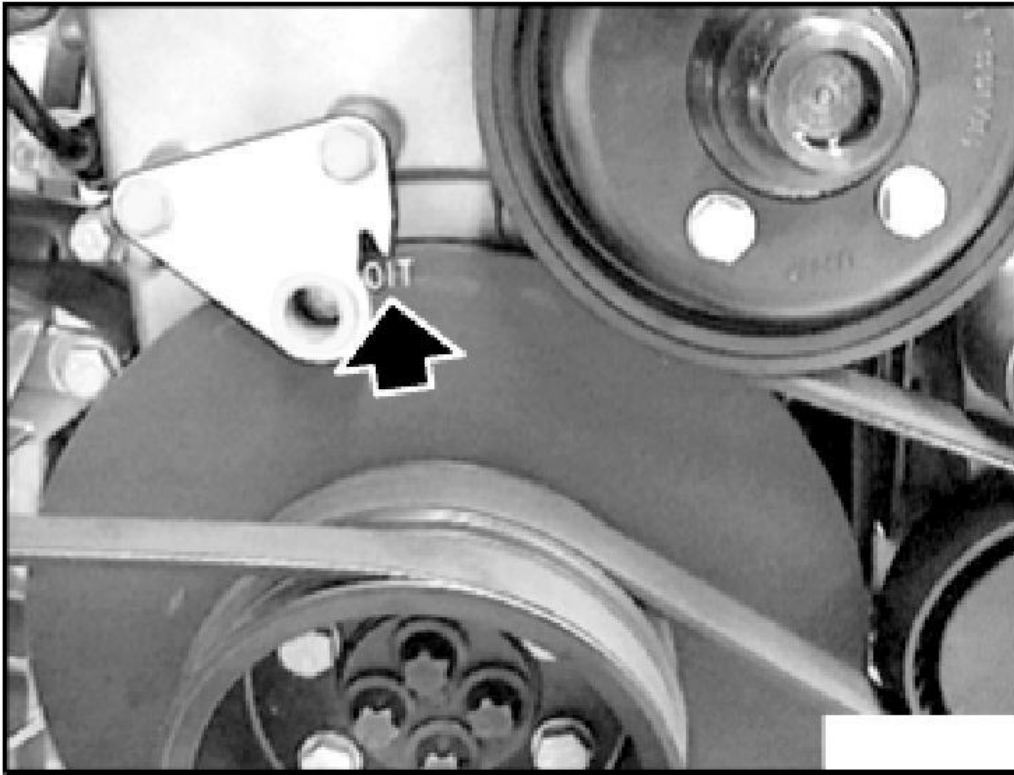
- Release screws (1).
- Remove sliding rail (2).
- Release screws (3).
- Remove holder (4).



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Fig. 221: Removing Sliding Rail**Courtesy of BMW OF NORTH AMERICA, INC.**

Remove special tool 11 2 300. Rotate crankshaft in direction of rotation a further revolution up to overlap TDC position.

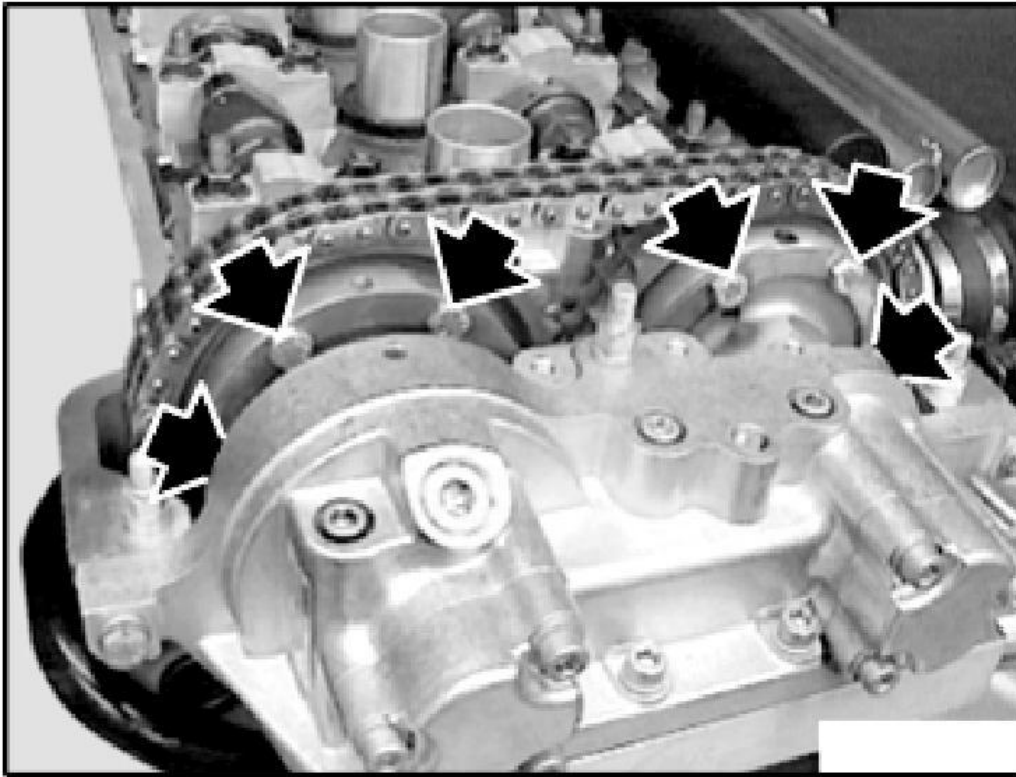


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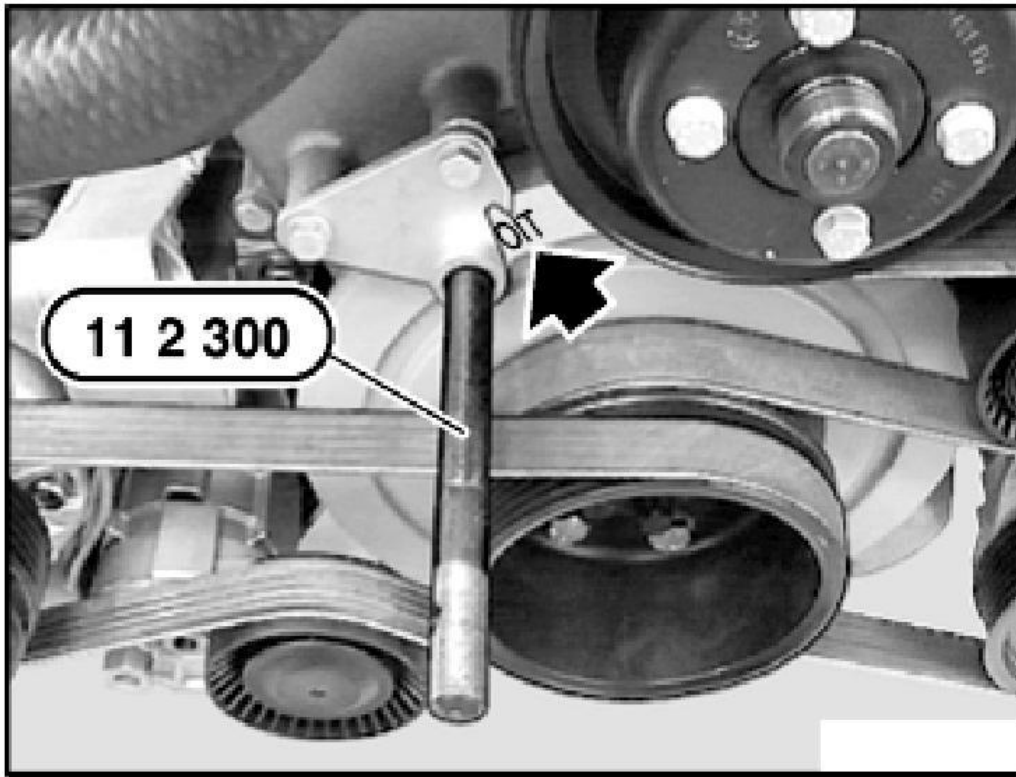
Fig. 222: Removing Special Tool From Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: TDC allocation above marking on vibration damper is sufficient.

Slacken six accessible bolts two turns.

**G03117839****Fig. 223: Locating Accessible Bolts****Courtesy of BMW OF NORTH AMERICA, INC.**

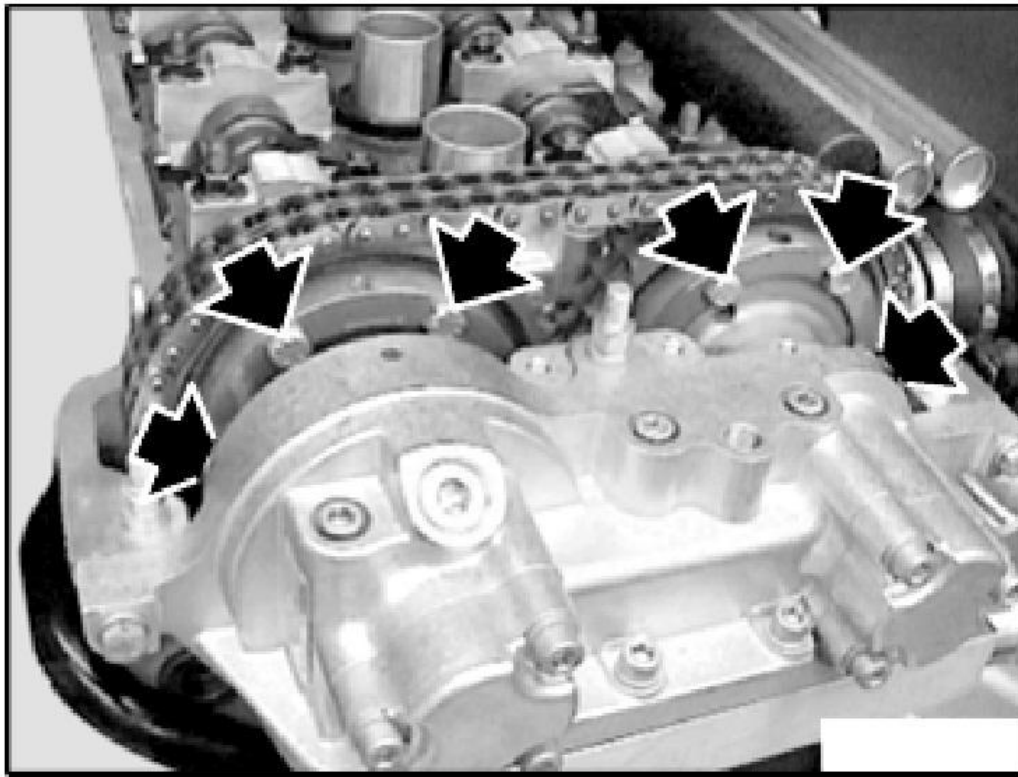
Crank engine at central bolt in direction of rotation until 1st cylinder is at TDC firing position. Secure vibration damper in position with special tool 11 2 300.



G03117840

Fig. 224: Securing Vibration Damper In Position With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

Slacken remaining six bolts two turns.

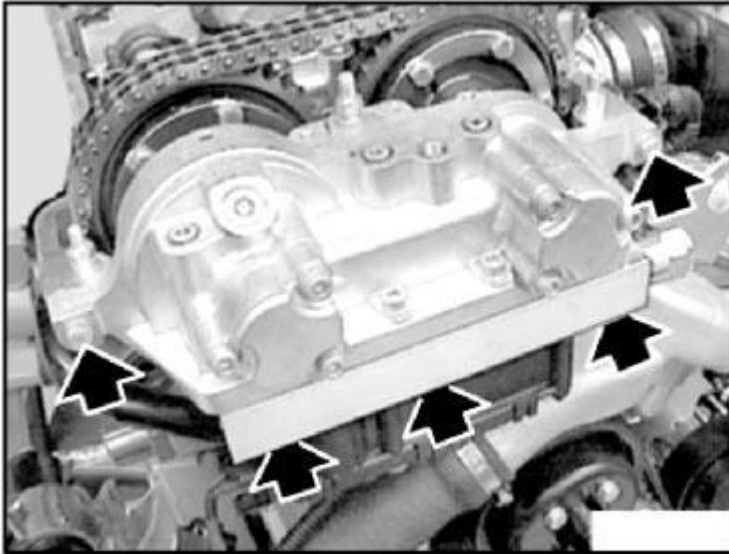


G03117841

Fig. 225: View Of Accessible Bolts

Courtesy of BMW OF NORTH AMERICA, INC.

Release screws on VANOS adjustment unit.

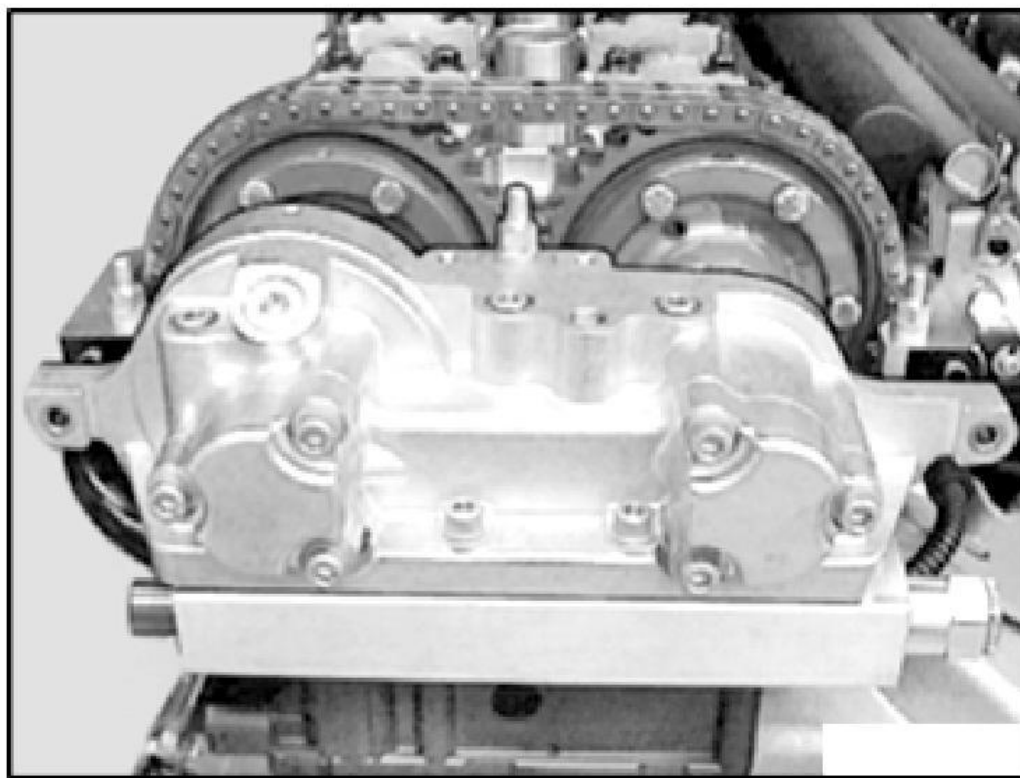


G03117842

Fig. 226: Releasing Screws On VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Do not damage VANOS adjustment unit.

Carefully detach VANOS adjustment unit.



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Fig. 227: Detaching VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

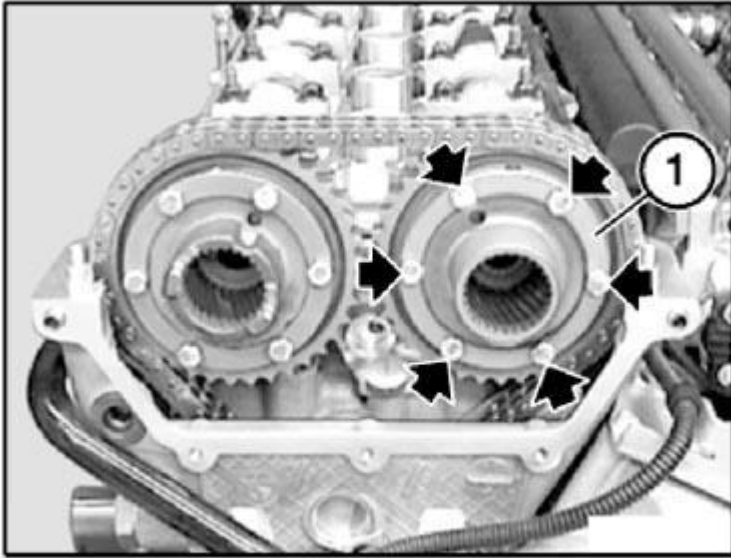
Inlet side:

NOTE: **The spline hub (1) accommodates a plate spring and a supporting ring.**

Take care: the supporting ring can easily fall out when removed.

Remove slackened screws on inlet side.

Remove spline hub (1) with plate spring and supporting ring.



G03117844

Fig. 228: Locating Spline Hub Retaining Screws On Inlet Side
Courtesy of BMW OF NORTH AMERICA, INC.

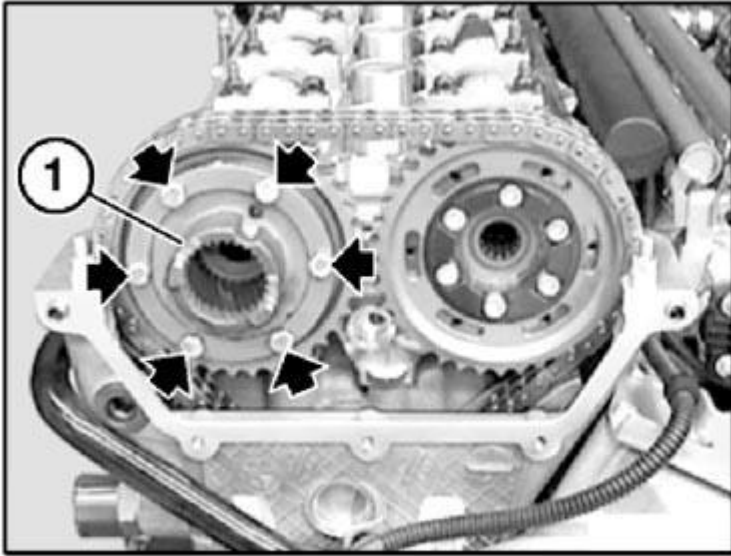
Exhaust side:

NOTE: The spline hub (1) accommodates a plate spring and a supporting ring.

Take care: the supporting ring can easily fall out when removed.

Remove slackened screws on exhaust side.

Remove spline hub (1) with plate spring and supporting ring.



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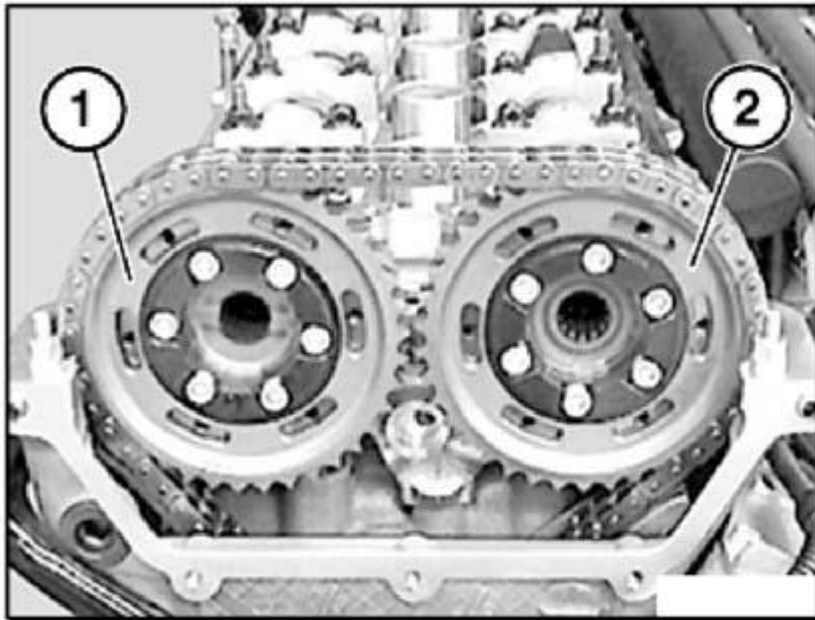
Fig. 229: Locating Spline Hub Retaining Screws On Exhaust Side
Courtesy of BMW OF NORTH AMERICA, INC.

Remove chain tensioning piston. Refer to **11 31 090 REMOVING AND INSTALLING/REPLACING CHAIN TENSIONING PISTON (S54)**.

Detach sprocket wheel (1 and 2) from centering sleeve.

Hold timing chain under tension.

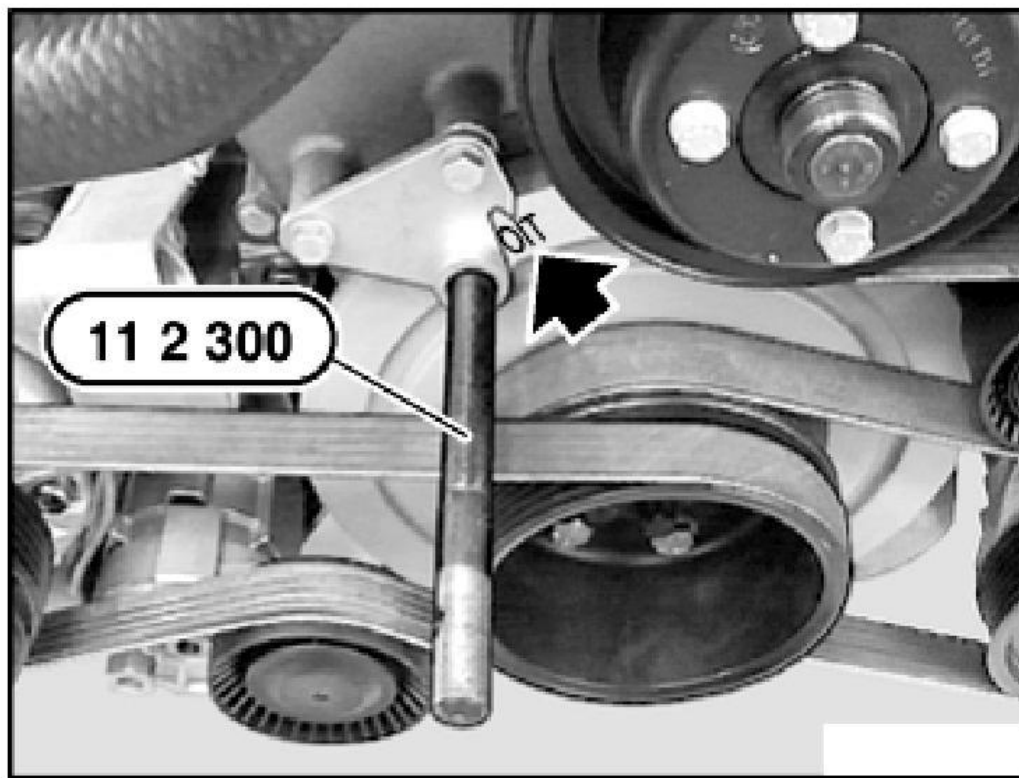
Feed out sprocket wheel (1 and 2). Secure timing chain against slipping down.



G03117846

Fig. 230: Detaching Sprocket Wheel From Centering Sleeve
Courtesy of BMW OF NORTH AMERICA, INC.

Remove special tool 11 2 300.



G03117847

Fig. 231: Removing Plug Mandrel From Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: No piston must be in the TDC position when the camshafts are removed.

Lift timing chain and hold under tension.

Crank engine at central bolt against direction of rotation to 30° before TDC position.

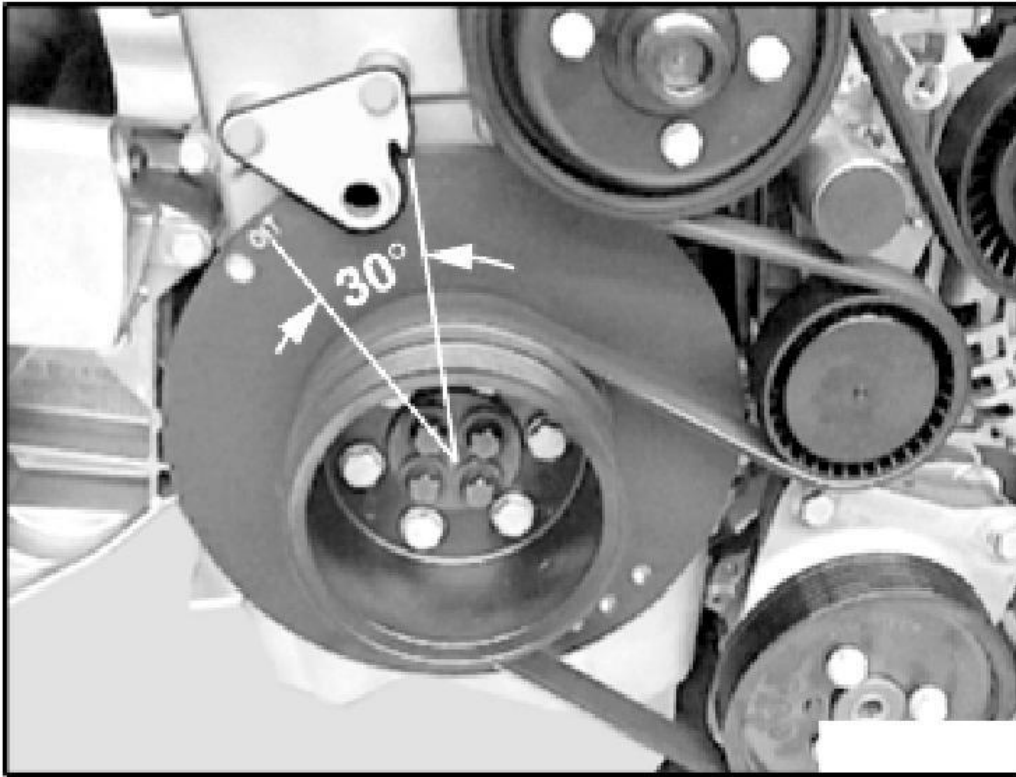
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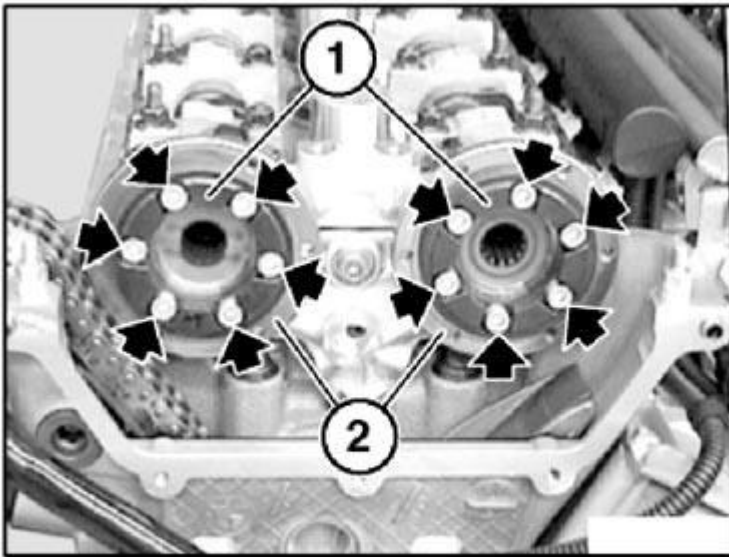
Fig. 232: Identifying 30° Before TDC Position.
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: This work step is only necessary if the camshafts are to be replaced at a later stage.

Grip camshafts at hexagon head.

Release bolts on centering sleeves (1).

Remove centering sleeves (1) on exhaust and inlet sides with thrust washers (2)

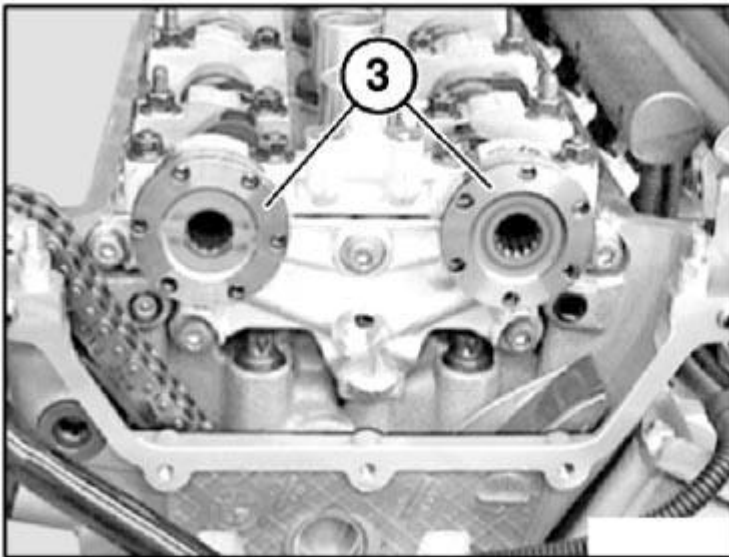


G03117849

Fig. 233: Locating Centering Sleeves Retaining Bolts
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: This work step is only necessary if the camshafts are to be replaced at a later stage.

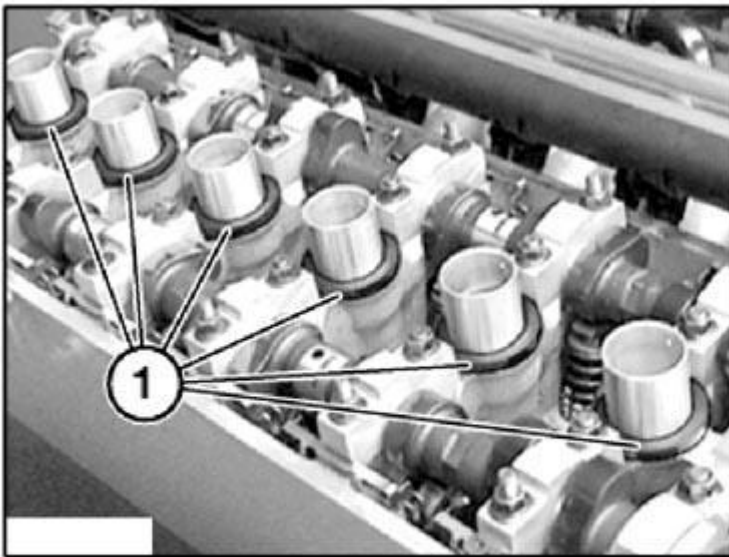
Withdraw toothed sleeves (3) from exhaust and inlet camshafts.



G03117850

Fig. 234: View Of Toothed Sleeves For Exhaust And Inlet Camshafts
Courtesy of BMW OF NORTH AMERICA, INC.

Remove profile seal (1)



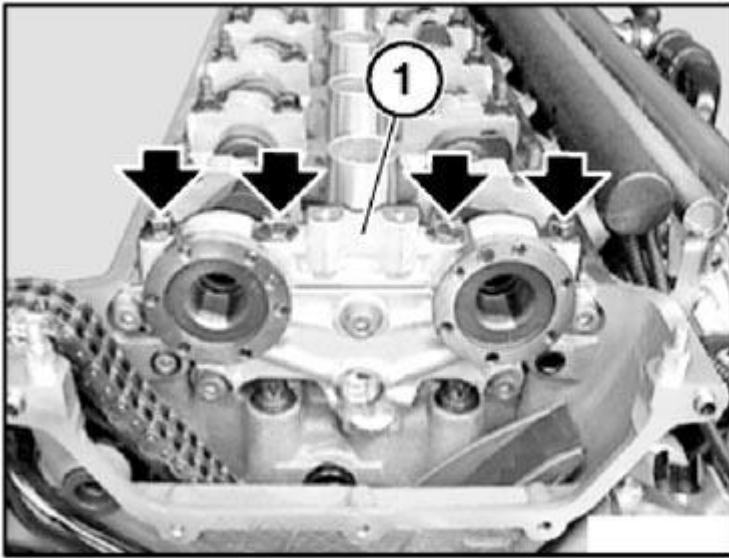
G03117851

Fig. 235: Locating Profile Seal

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Inlet and exhaust camshafts have a joint thrust bearing flange at 1st bearing seat. Thrust bearing flange is secured with adapter sleeves.

Release nuts and remove thrust bearing flange (1).



G03117852

Fig. 236: Identifying Thrust Bearing Flange Retaining Nuts

Courtesy of BMW OF NORTH AMERICA, INC.

Removing inlet camshaft:

CAUTION: Note direction and angle of rotation.

Rotate inlet camshaft at hexagon inwards until cam tips on 1st cylinder are horizontal.

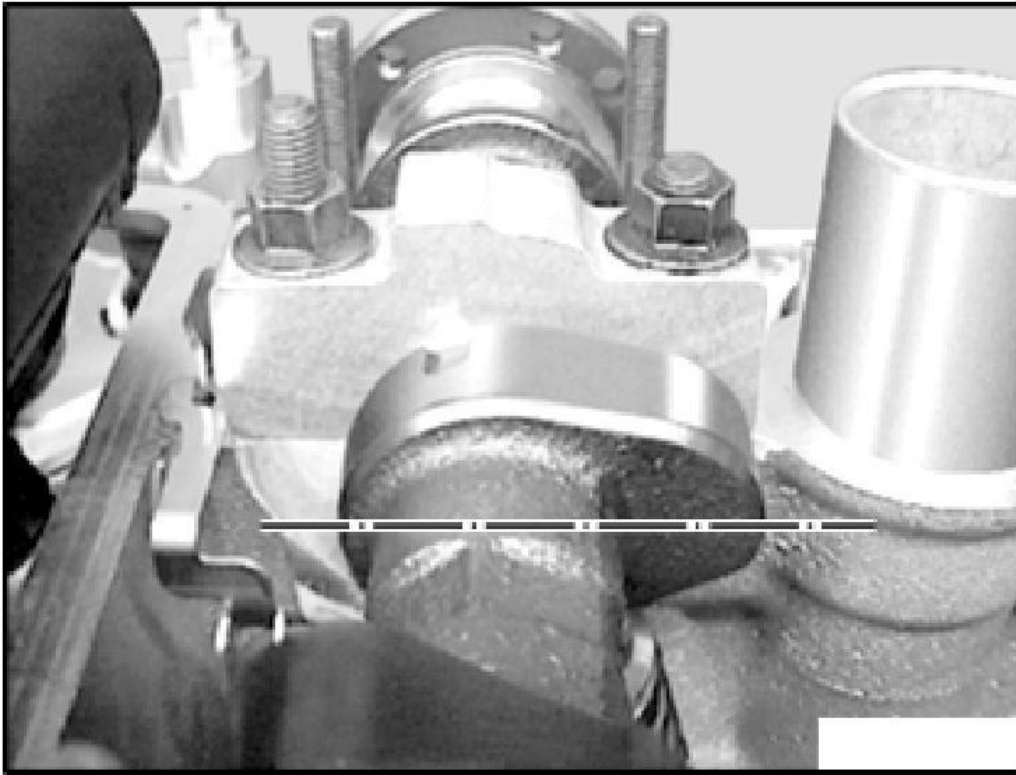
**G03117853**

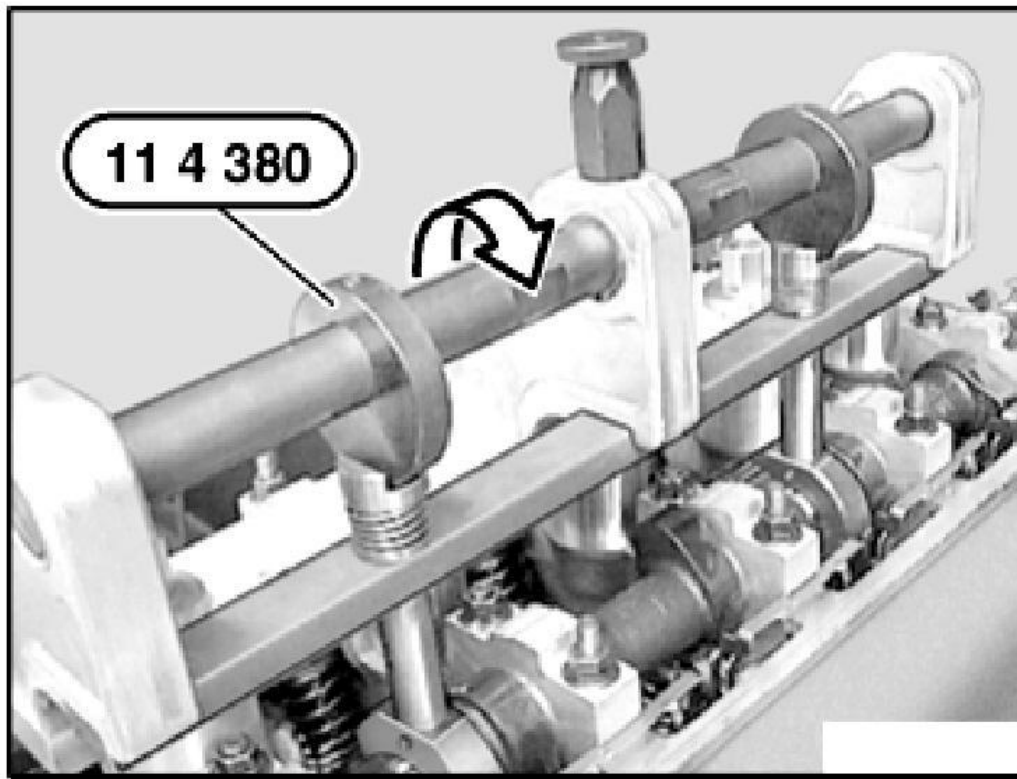
Fig. 237: Identifying Inlet Cam Tips Aligned Horizontally
Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

CAUTION: Incorrect removal/installation without a special tool exposes the camshaft to the risk of preliminary damage or breakage.

Fit special tool 11 4 380 on inlet camshaft and screw into spark plug threads of cylinders 2 and 5.

Pretension inlet camshaft by rotating eccentric shaft. Release all nuts of bearing caps on inlet camshaft.



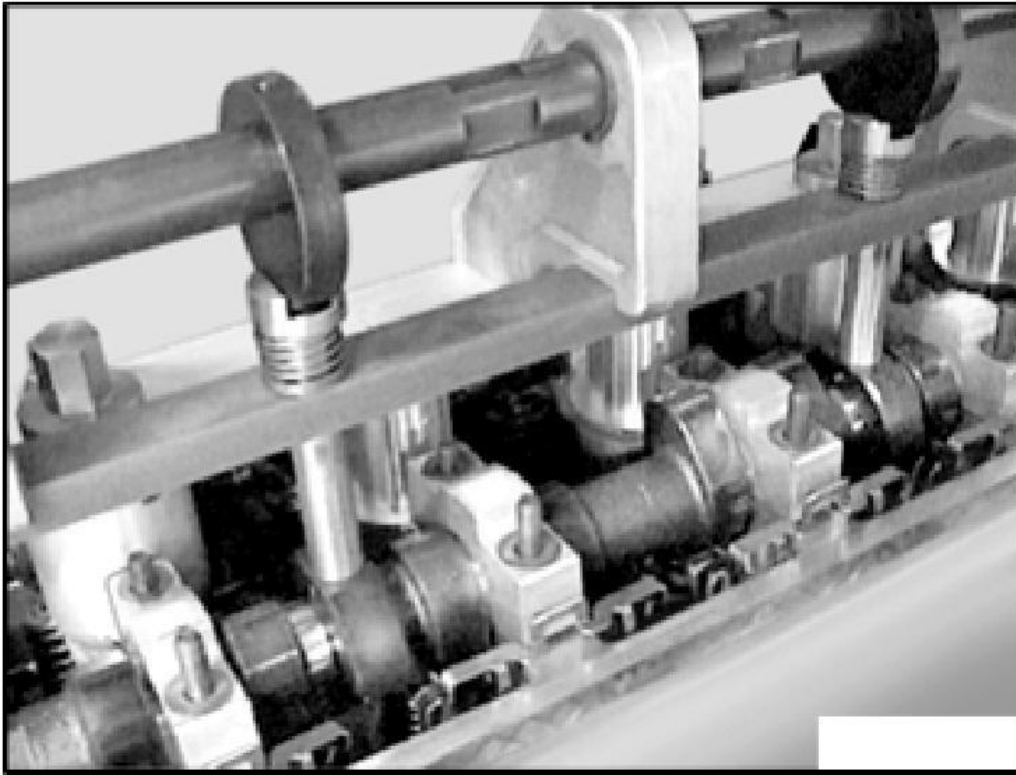
G03117854

Fig. 238: View Of Press-Down Device On Inlet Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

NOTE: Bearing caps are secured with adapter sleeves. Bearing caps are marked E2 to E7.

Feed out bearing caps E2 to E7 and set down in order.



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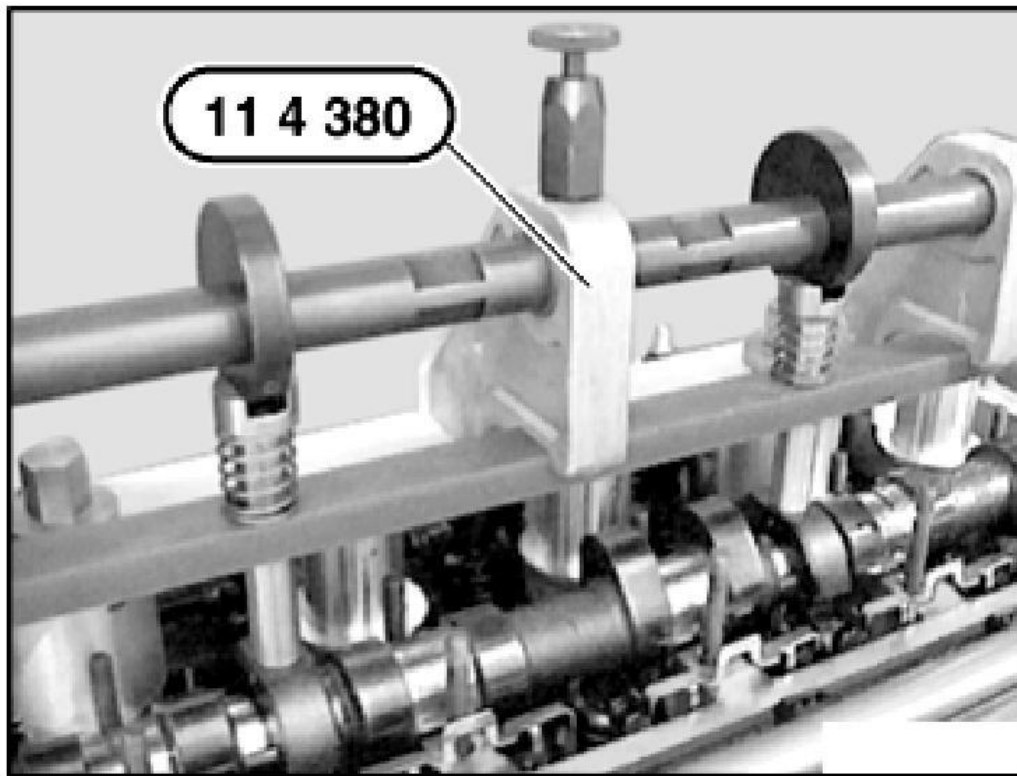
Fig. 239: Locating Bearing Caps

Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

CAUTION: Inlet camshaft must not tilt when tension is relieved on special tool 11 4 380.

Relieve tension on special tool 11 4 380 and remove. Lift out inlet camshaft.



G03117856

Fig. 240: Removing Inlet Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

Removing exhaust camshaft:

CAUTION: Note direction and angle of rotation.

Rotate exhaust camshaft at hexagon inwards until cam tips on 1st cylinder are horizontal.

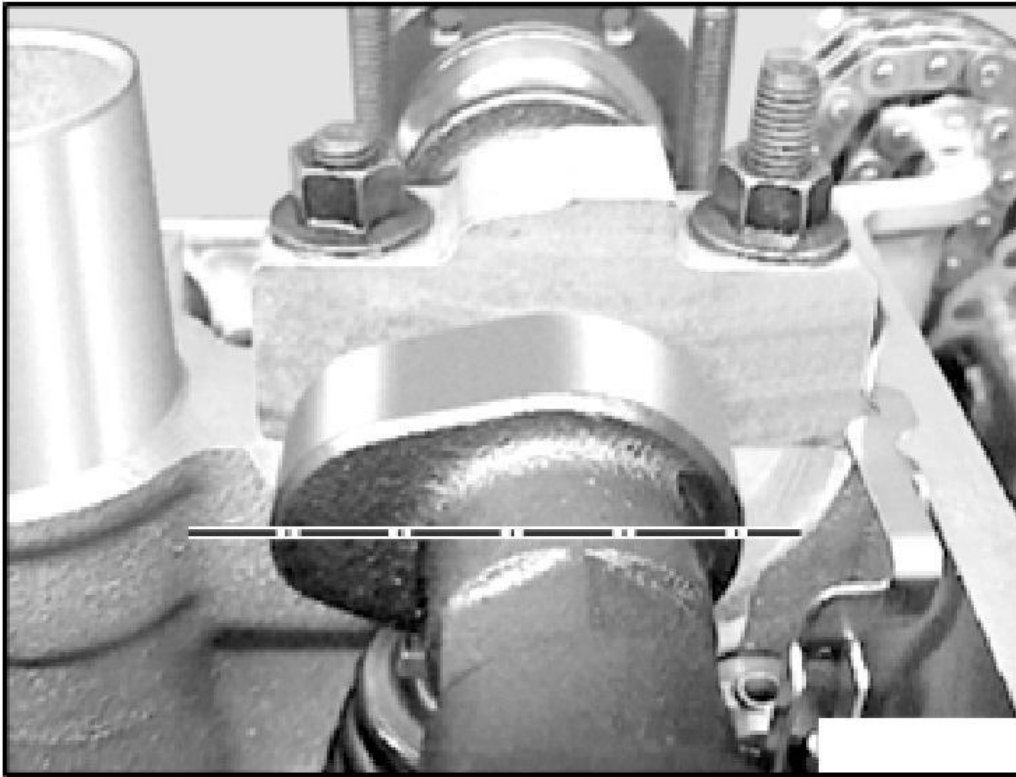
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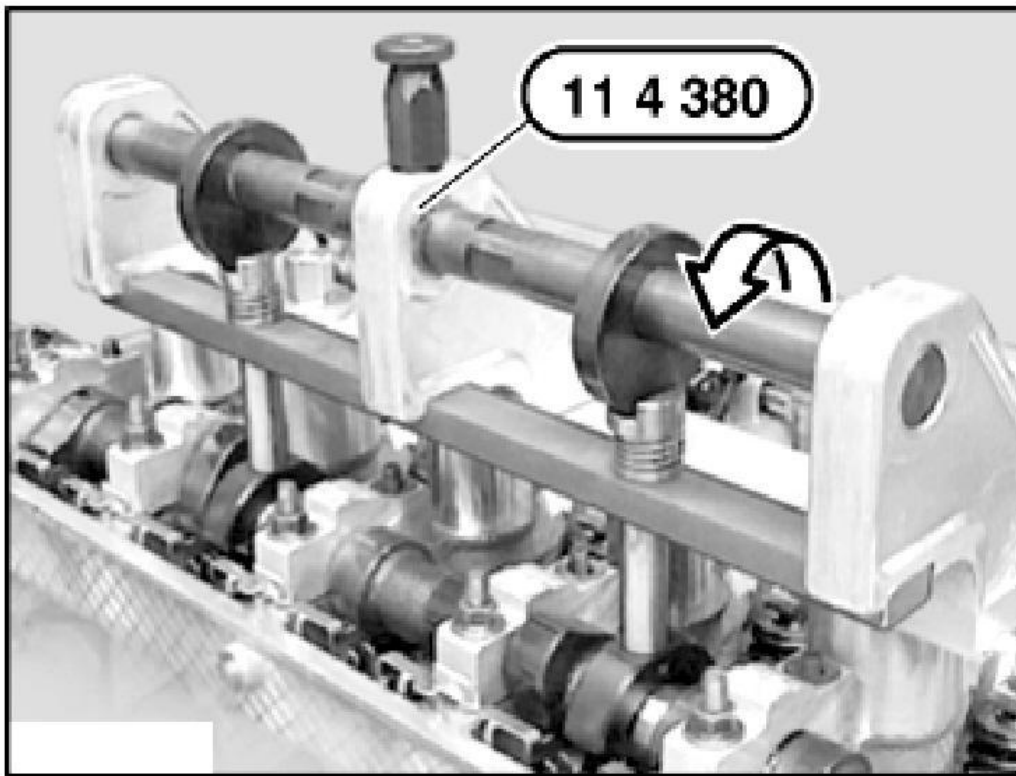
Fig. 241: Identifying Exhaust Camshaft Tips Aligned Horizontally
Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

CAUTION: Incorrect removal/installation without a special tool exposes the camshaft to the risk of preliminary damage or breakage.

Fit special tool 11 4 380 on exhaust camshaft and screw into spark plug threads of cylinders 2 and 5.

Pretension exhaust camshaft by rotating eccentric shaft. Release all nuts of bearing caps on exhaust camshaft.



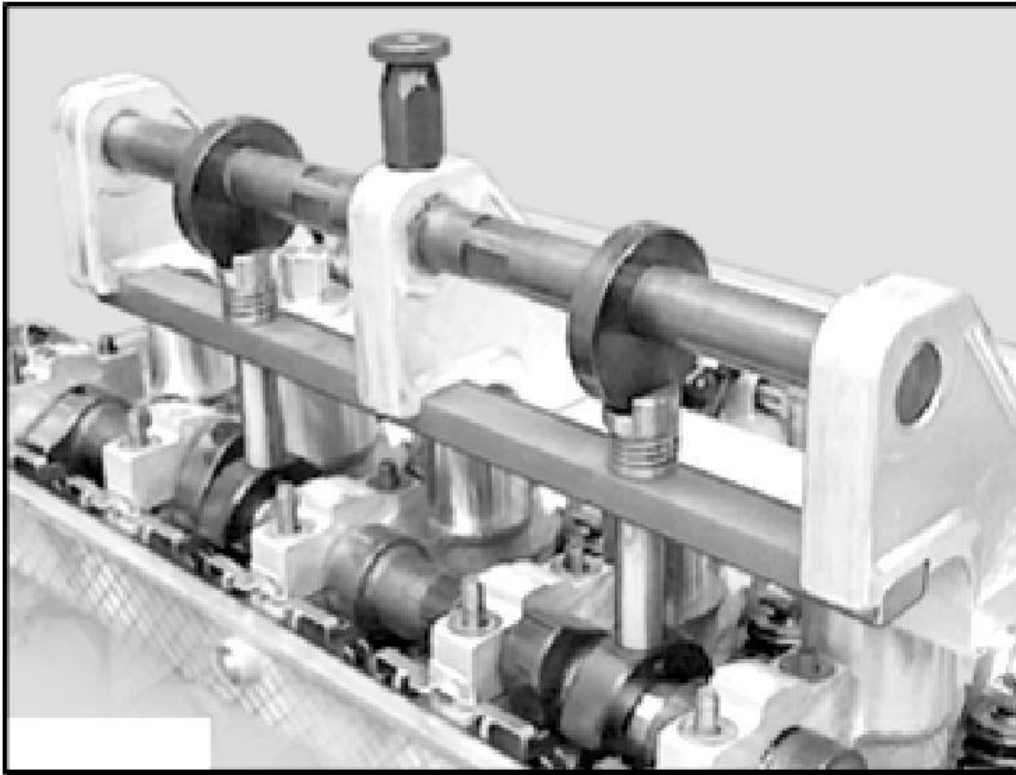
G03117858

Fig. 242: Installing Press-Down Device On Exhaust Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

NOTE: Bearing caps are secured with adapter sleeves. Bearing caps are marked A2 to A7.

Feed out bearing caps A2 to A7 and set down in order.



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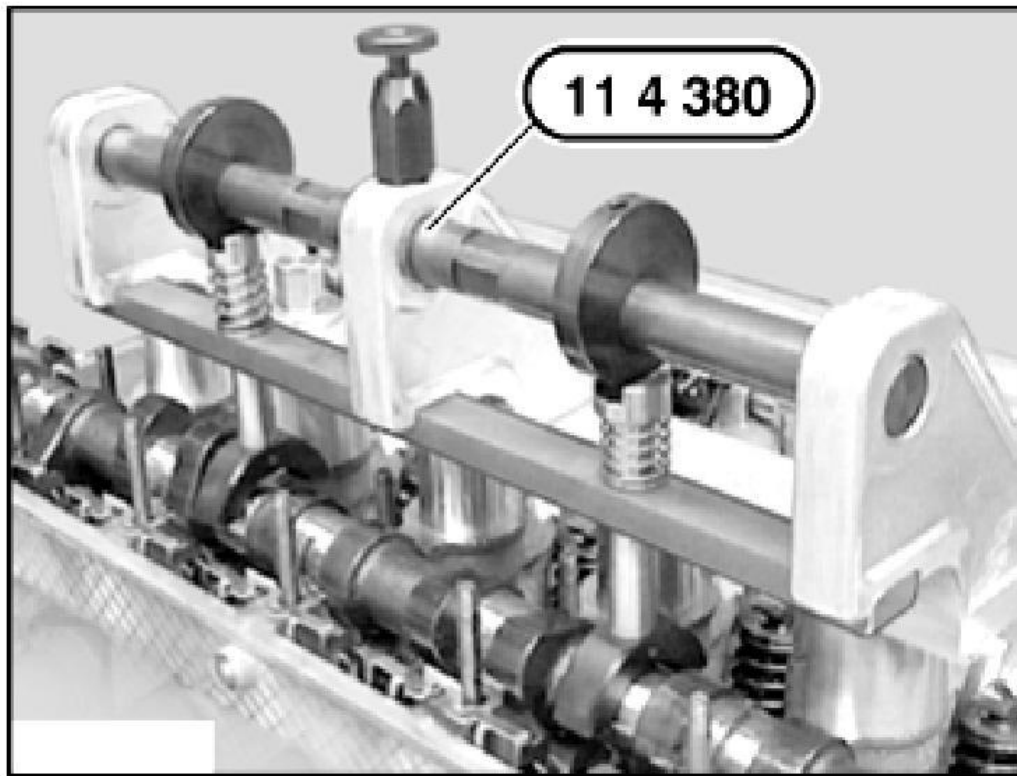
Fig. 243: Locating Bearing Caps

Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

CAUTION: Exhaust camshaft must not tilt when tension is relieved on special tool 11 4 380.

Relieve tension on special tool 11 4 380 and remove. Lift out exhaust camshaft.



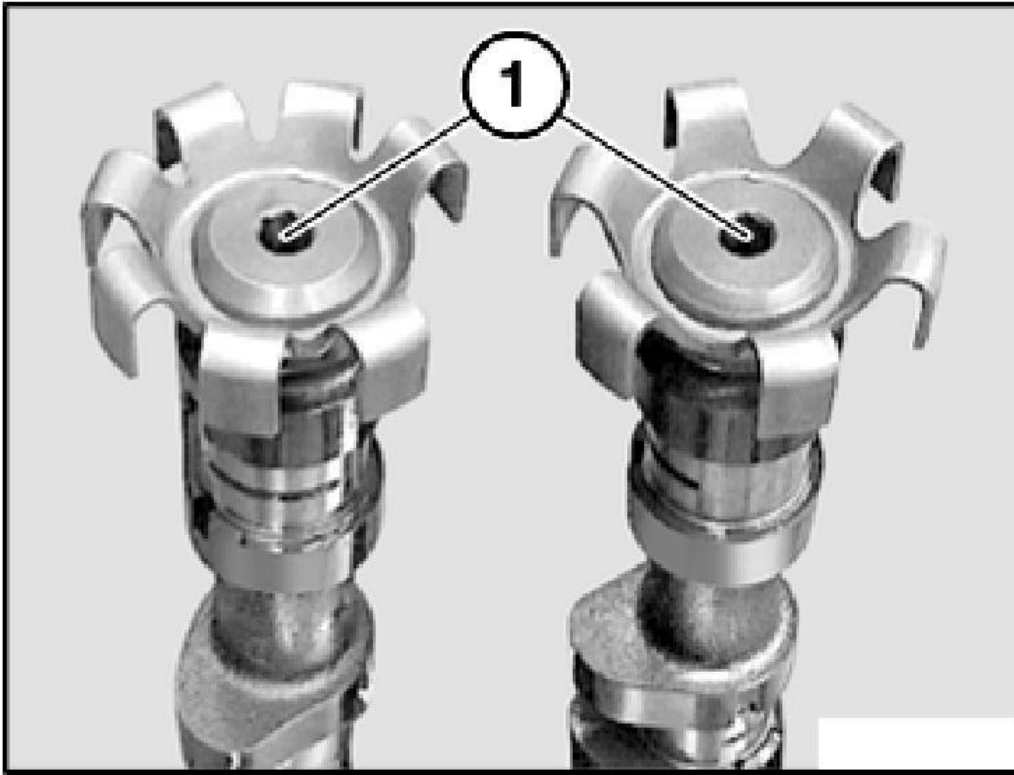
G03117860

Fig. 244: Removing Exhaust Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

If necessary, removing signal disk of exhaust and inlet camshafts:

CAUTION: Do not damage camshafts. Use protective vise jaws.

Grip camshaft at hexagon in a vise and release banjo bolt (1).



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Fig. 245: Releasing Banjo Bolt

Courtesy of BMW OF NORTH AMERICA, INC.

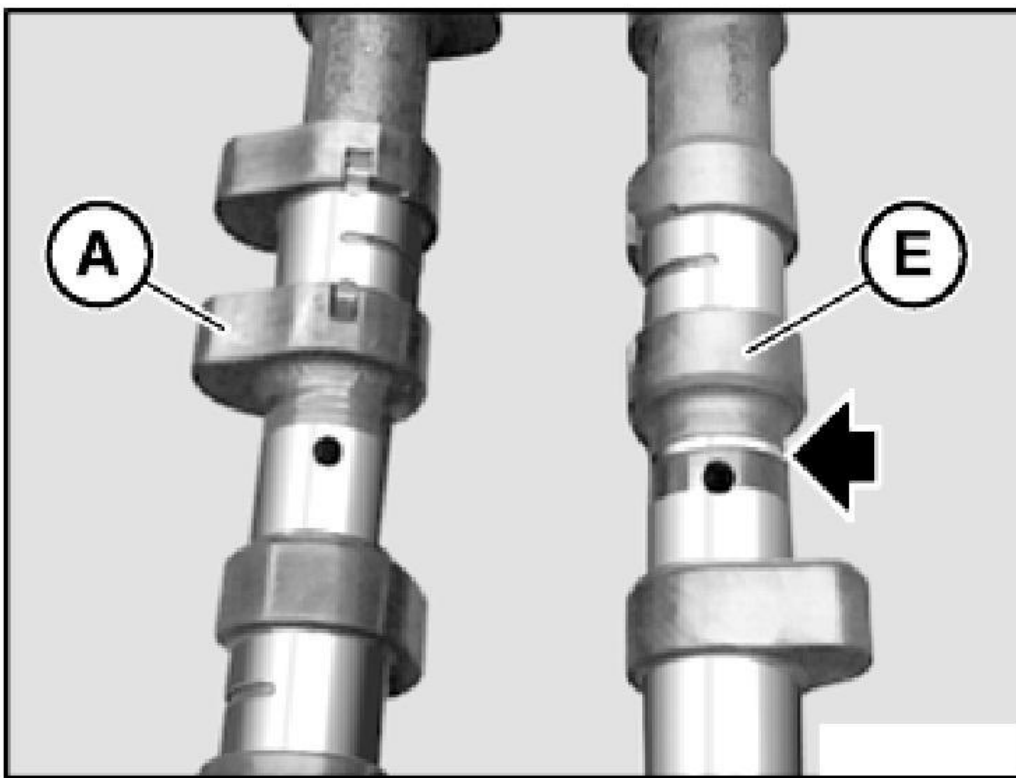
Installation:

Installation of camshafts and the VANOS adjustment unit is described separately from removal. The assembly sequence for removal and installation is different.

CAUTION: Danger of mixing up

The inlet camshaft has an identifying groove behind the locating bore.

- (A) Exhaust camshaft without groove.
- (E) Inlet camshaft with groove.



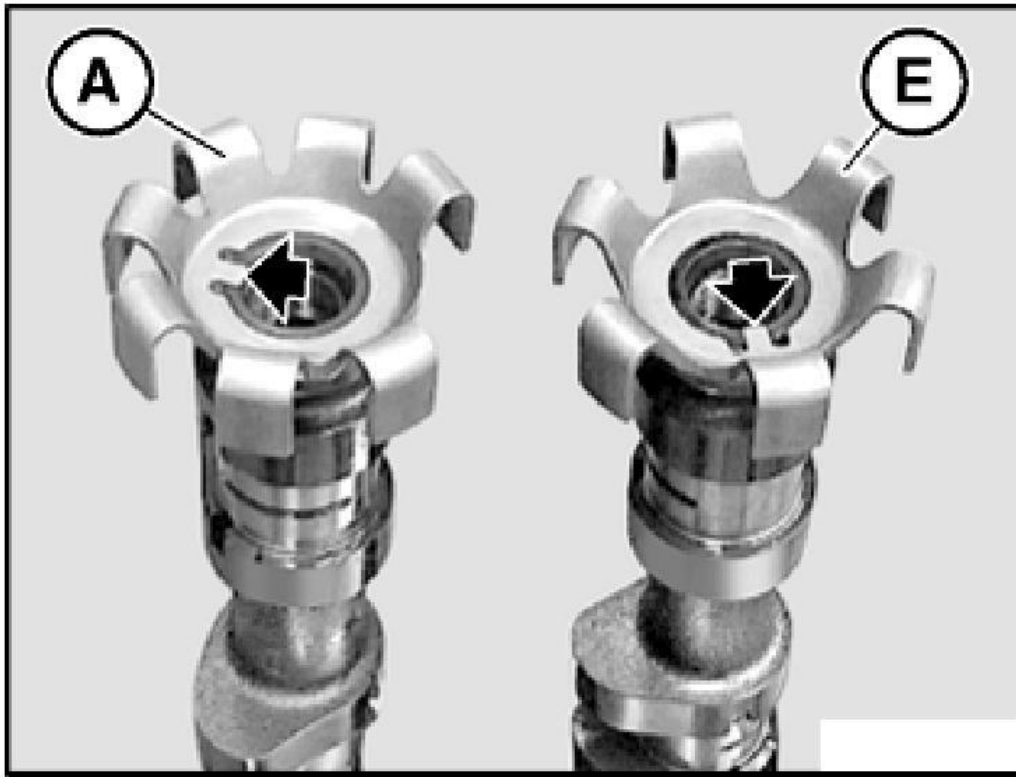
G03117862

Fig. 246: Identifying Exhaust Camshaft And Inlet Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Signal rings of inlet and exhaust camshafts are different.

(A) Signal disk of exhaust camshaft with seven blades.

(E) Signal disk of inlet camshaft with six blades. Fit signal disks, align locating lug to groove.

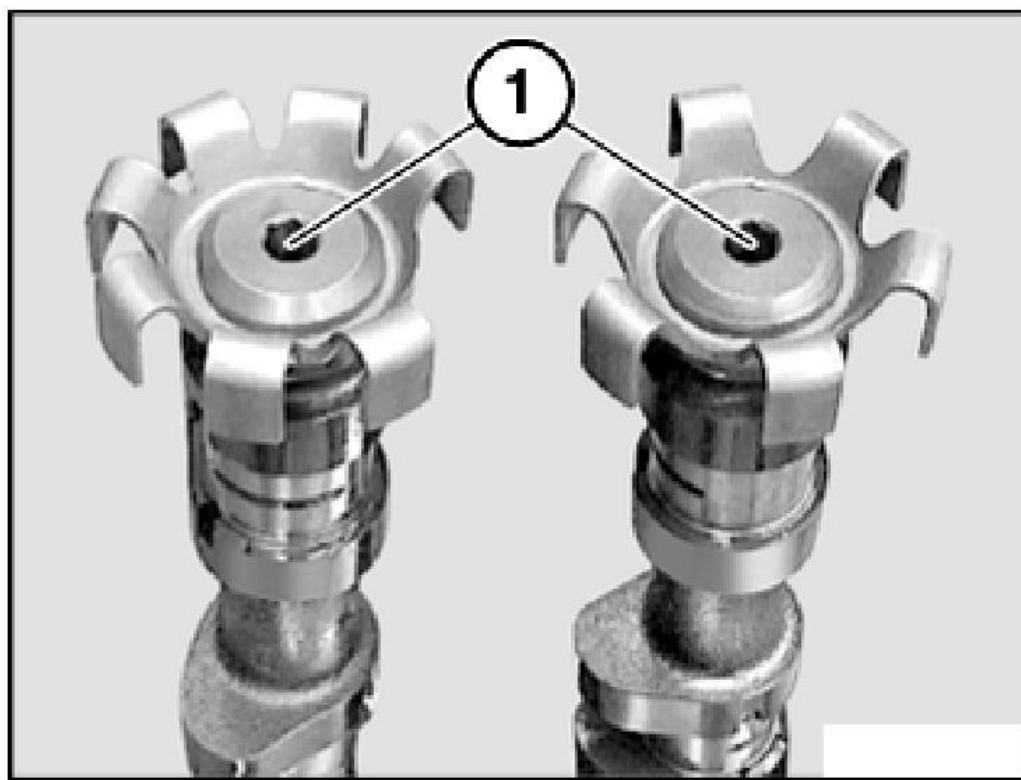


G03117863

Fig. 247: Identifying Signal Rings Of Inlet And Exhaust Camshafts
Courtesy of BMW OF NORTH AMERICA, INC.

Install banjo bolt (1) and tighten down.

Tightening torque, refer to 11 31 13AZ in **ENGINE - TIGHTENING TORQUES** .



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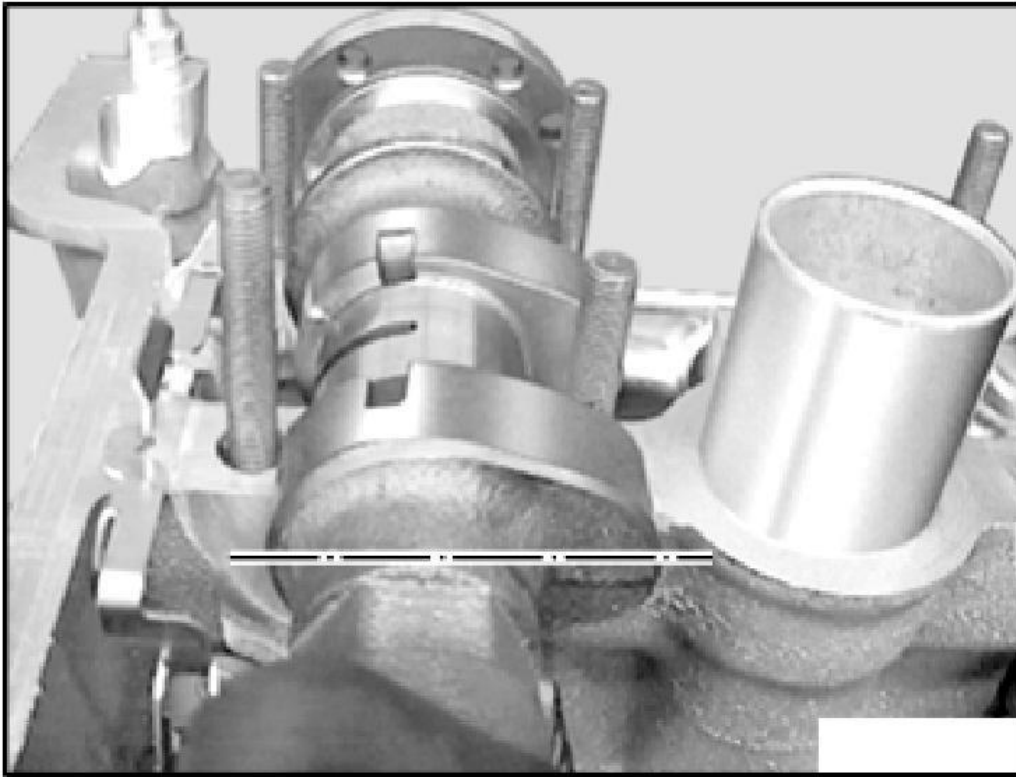
Fig. 248: Installing Banjo Bolt And Tightening Down
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Clean dirty parts. Oil following parts before installation:

- Contact faces of camshafts in cylinder head.
- Rocker arm.
- Cams and contact faces of camshafts.
- Bearing cover.

Installing inlet camshaft:

Install inlet camshaft in such a way that cams on cylinder 1 point horizontally inwards.



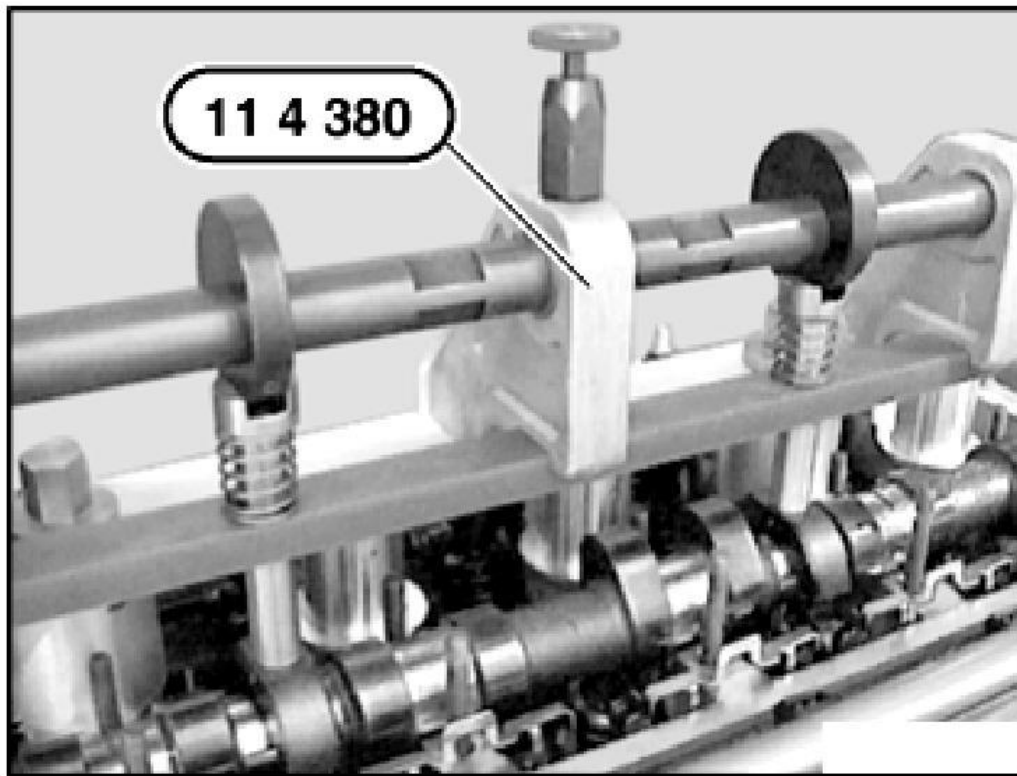
G03117865

Fig. 249: Installing Inlet Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

CAUTION: Incorrect removal/installation without a special tool exposes the camshaft to the risk of preliminary damage or breakage.

Fit special tool 11 4 380 on inlet camshaft and screw into spark plug threads of cylinders 2 and 5.

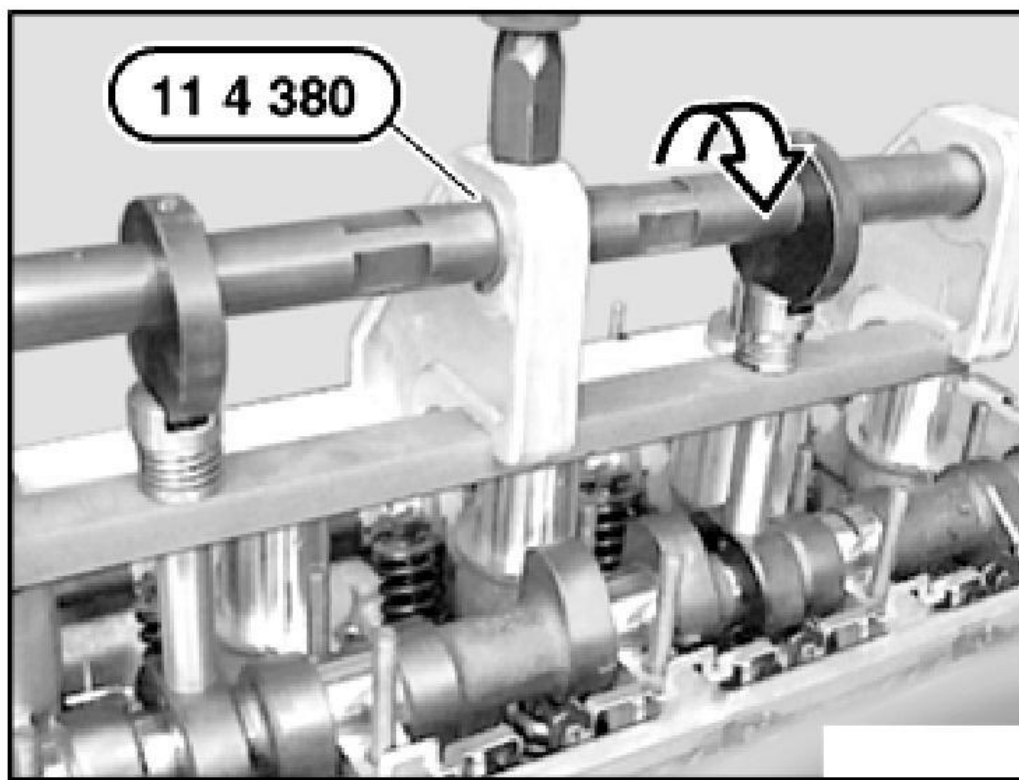


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Fig. 250: Installing Press-Down Device On Inlet Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

Pretension inlet camshaft by rotating eccentric shaft.



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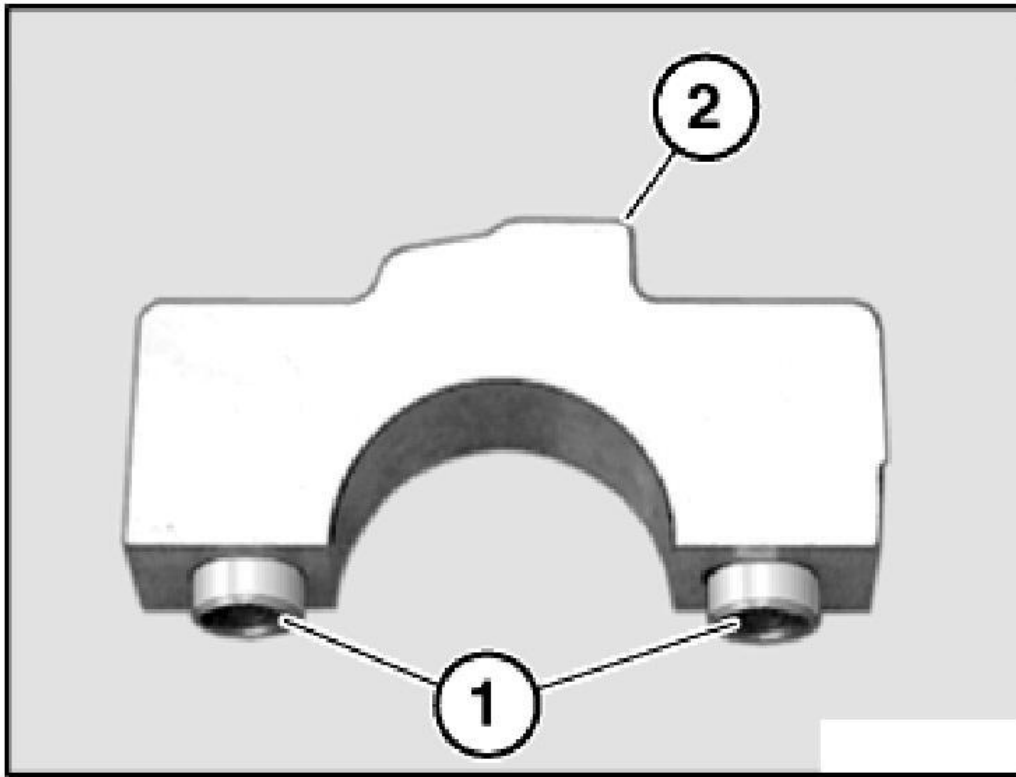
Fig. 251: Pretensioning Inlet Camshaft By Rotating Eccentric Shaft
Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

CAUTION: Risk of mixing up parts. Fit inlet side bearing caps so that lug (2) points outwards to inlet side.

NOTE: Bearing caps are secured with adapter sleeves (1).

Check dowel sleeves (1) for damage and correct installation position.



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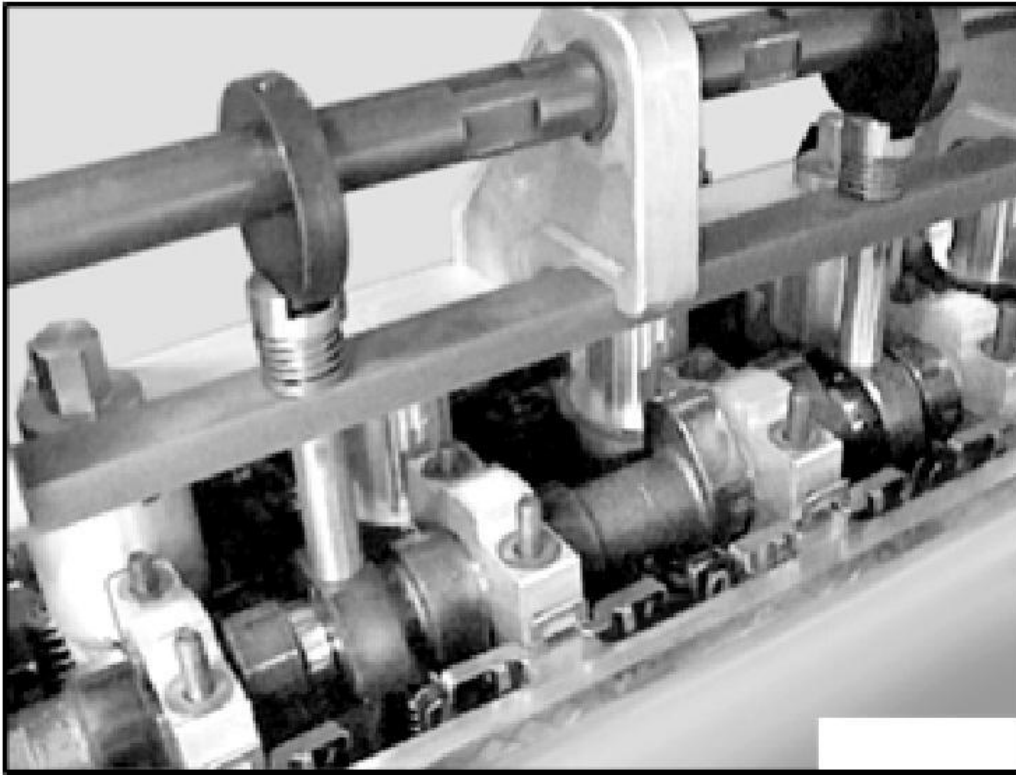
Fig. 252: Locating Dowel Sleeves

Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

NOTE: Bearing caps are marked E2 to E7.

Install bearing caps E2 to E7.



G03117869

Fig. 253: Installing Bearing Caps

Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

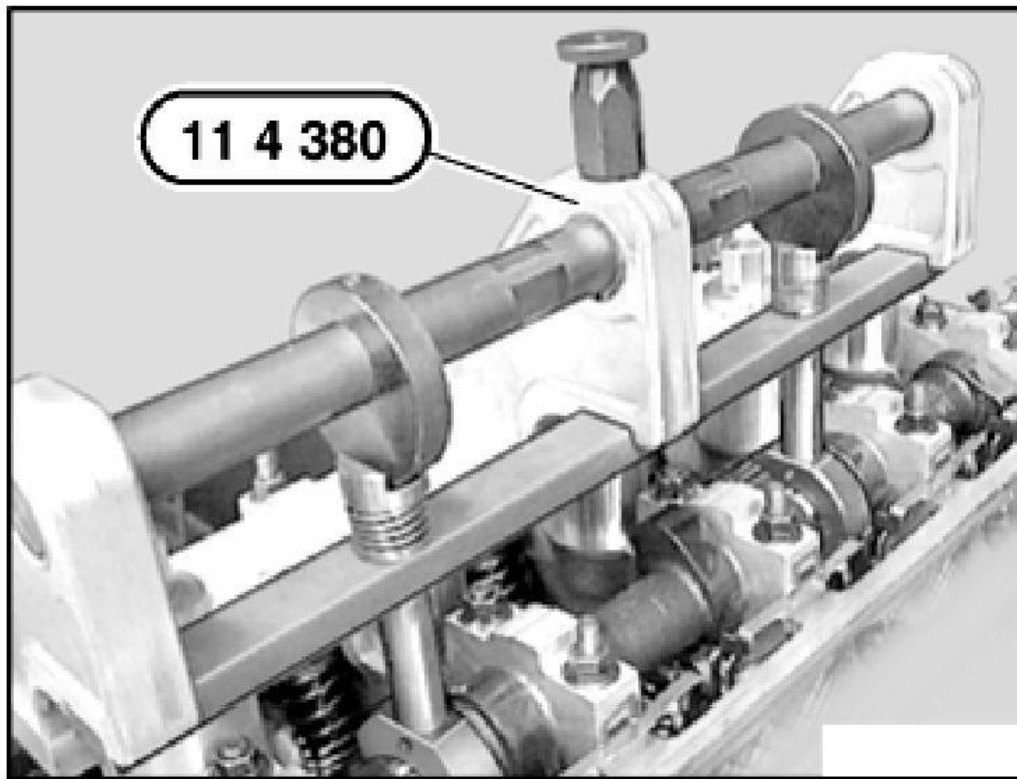
Align bearing caps by hand until they are secured by means of adapter sleeves.

Insert all nuts of bearing caps on inlet camshaft.

Manually tighten bearing cap nuts and then tighten down from inside to outside in 1/2 turn increments.

Tightening torque, refer to 11 31 1AZ in **ENGINE - TIGHTENING TORQUES** .

Remove special tool 11 4 380.



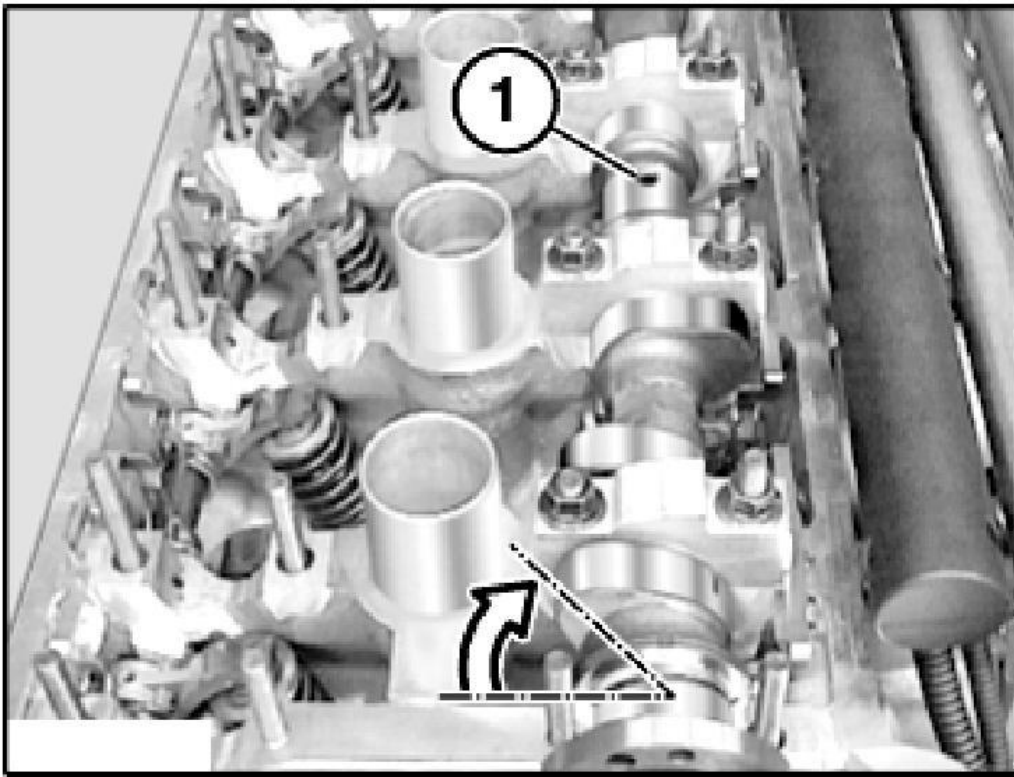
G03117870

Fig. 254: Removing Press-Down Device
Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

CAUTION: Note direction and angle of rotation.

Rotate inlet camshaft at hexagon from horizontal position upwards until locating bore (1) in camshaft is vertical.



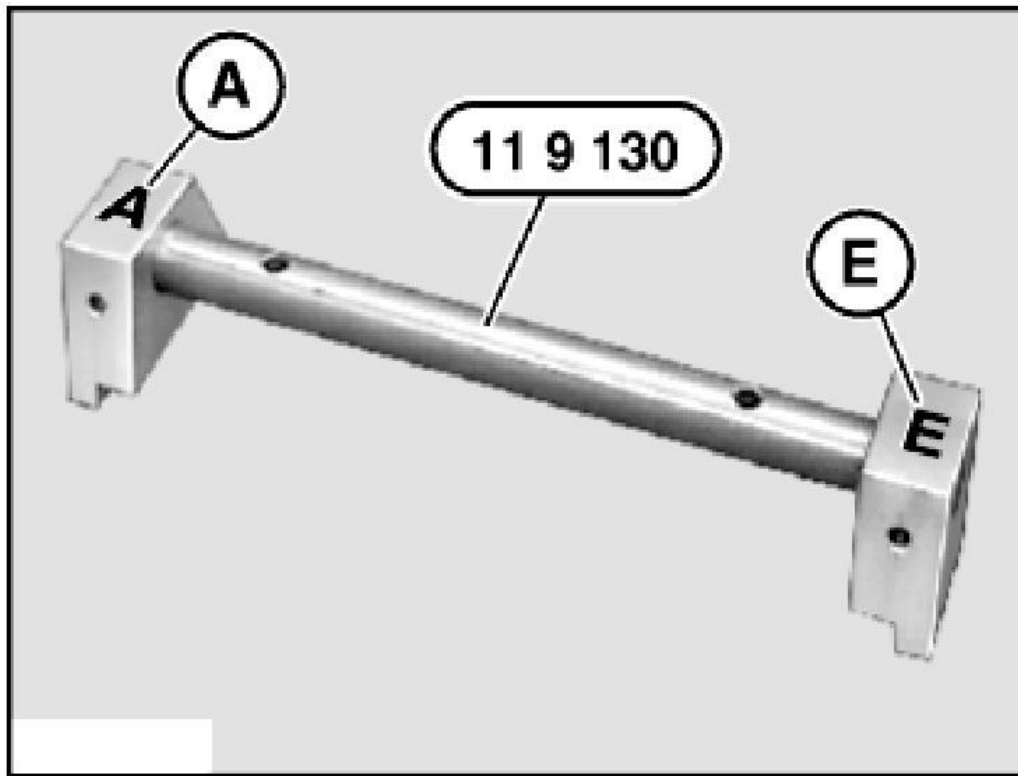
G03117871

Fig. 255: Aligning Locating Bore In Inlet Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Pay attention to installation direction of special tool 11 9 130.

(A) Exhaust side.

(E) Inlet side.



G03117872

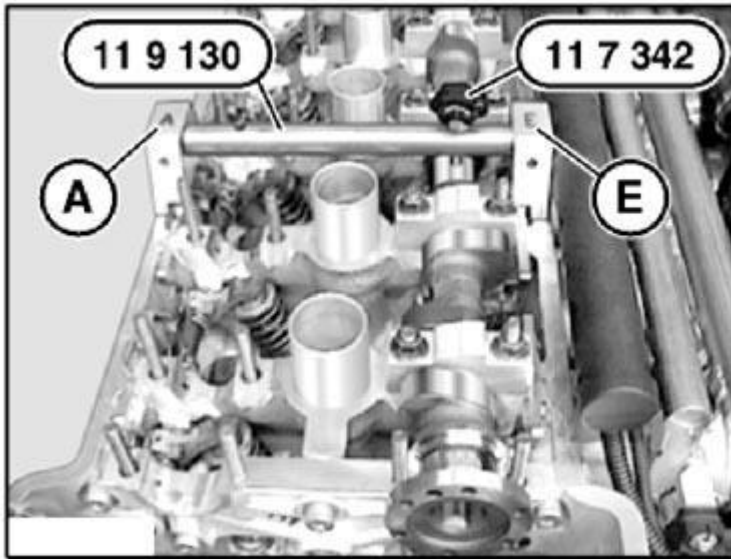
Fig. 256: Identifying Setting Gauge (Special Tool 11 9 130)
Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

Attach special tool 11 9 130 to cylinder head.

Align inlet camshaft at hexagon until special tool 11 7 342 can be joined by means of special tool 11 9 130 in locating bore.

Special tool 11 9 130 must rest flat on cylinder head. Remove special tool 11 9 130 and special tool 11 7 342.



G03117873

Fig. 257: Attaching Setting Gauge To Cylinder Head
Courtesy of BMW OF NORTH AMERICA, INC.

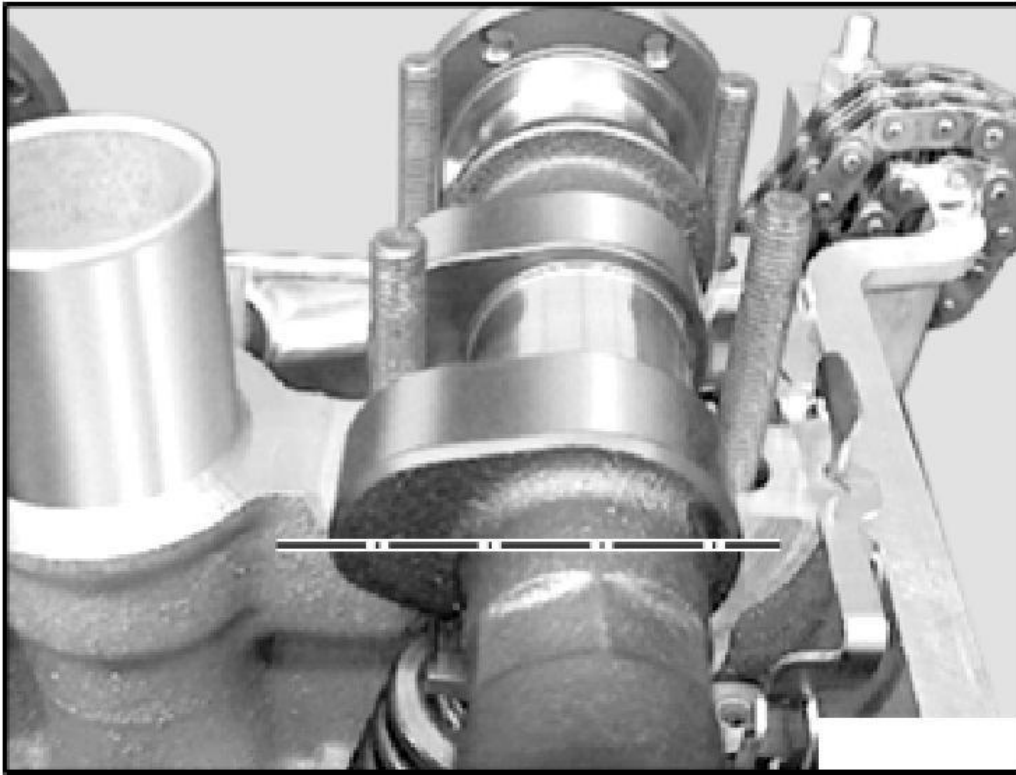
Installing exhaust camshaft:

Clean dirty parts.

Oil following parts before installation:

- Contact faces of camshafts in cylinder head.
- Rocker arm.
- Cams and contact faces of camshafts.
- Bearing cover.

Install exhaust camshaft in such a way that cams on cylinder 1 point horizontally inwards.



G03117874

Fig. 258: Aligning Exhaust Camshaft Cams On Cylinder 1
Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

CAUTION: Incorrect removal/installation without a special tool exposes the camshaft to the risk of preliminary damage or breakage.

Fit special tool 11 4 380 on exhaust camshaft and screw into spark plug threads of cylinders 2 and 5.

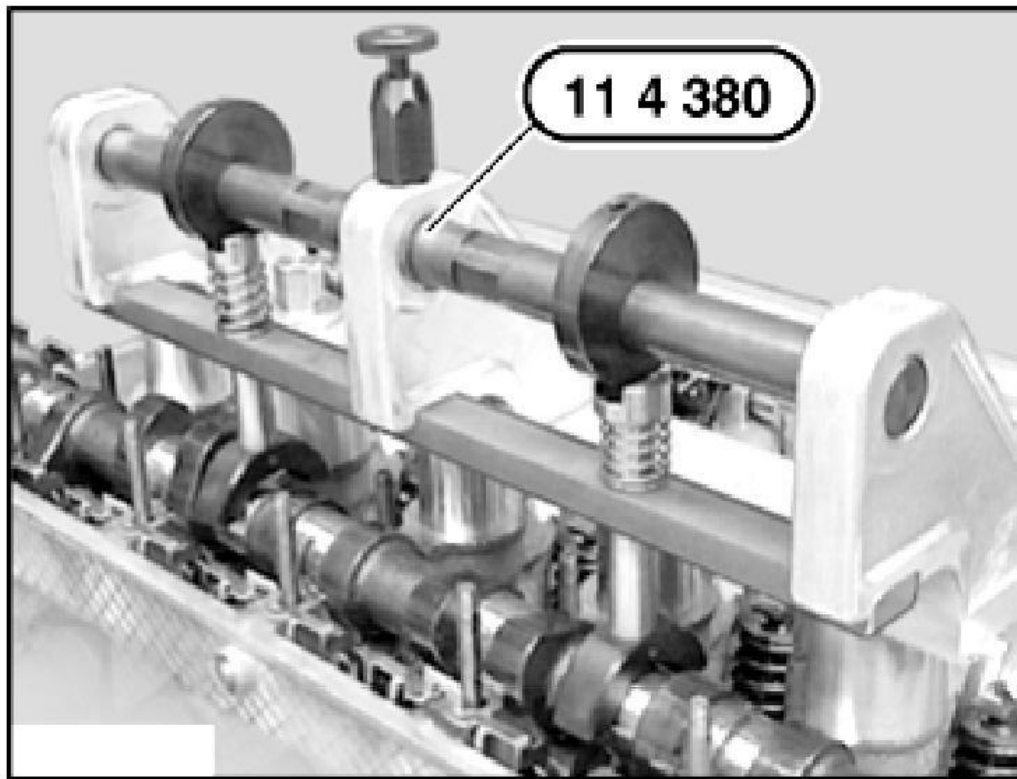
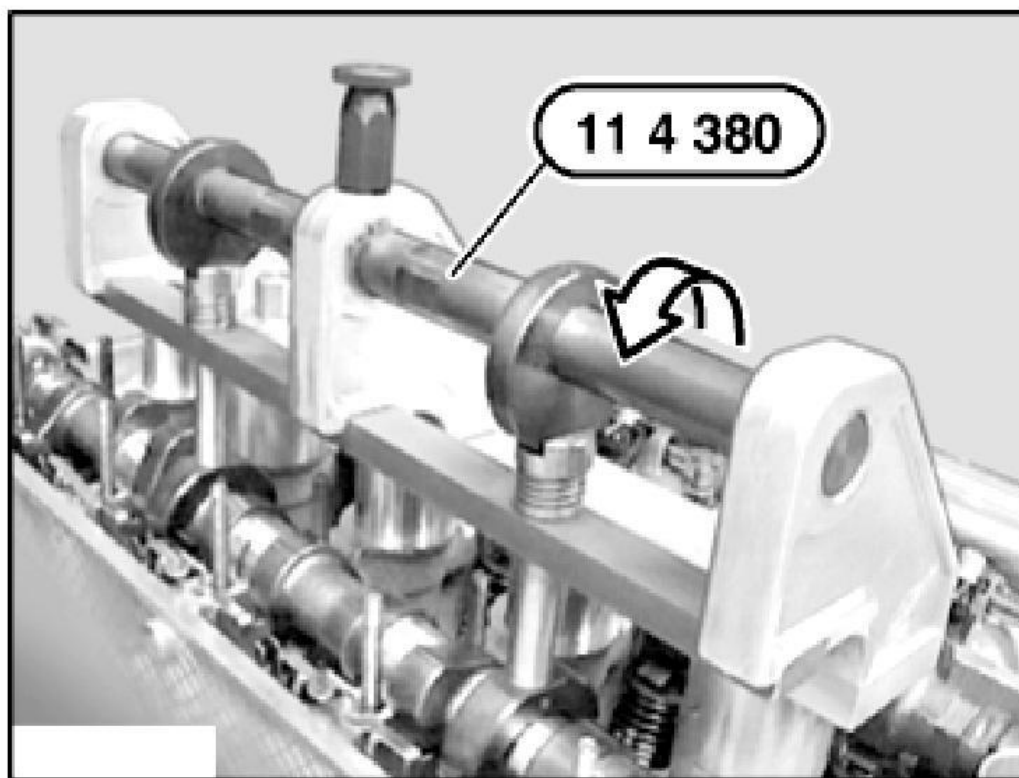
**G03117875**

Fig. 259: Installing Special Tool On Exhaust Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

Pretension exhaust camshaft by rotating eccentric shaft.



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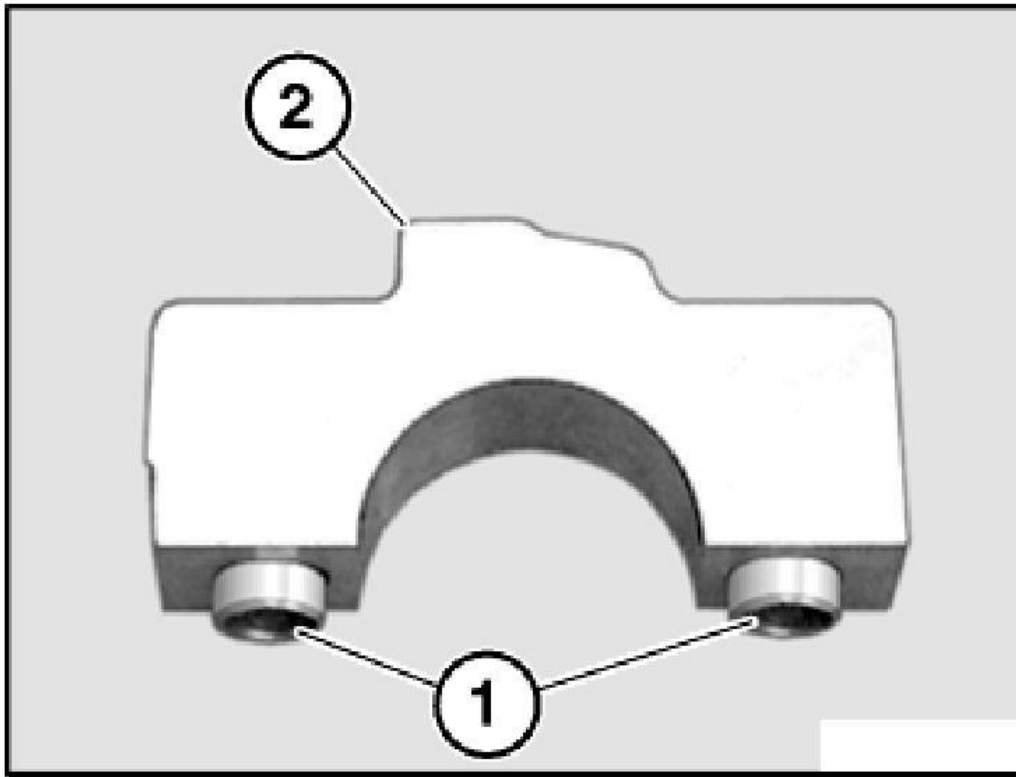
Fig. 260: Pretensioning Exhaust Camshaft By Rotating Eccentric Shaft
Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

CAUTION: Risk of mixing up parts. Fit exhaust side bearing caps so that lug (2) points outwards to exhaust side.

NOTE: Bearing caps are secured with adapter sleeves (1).

Check dowel sleeves (1) for damage and correct installation position.



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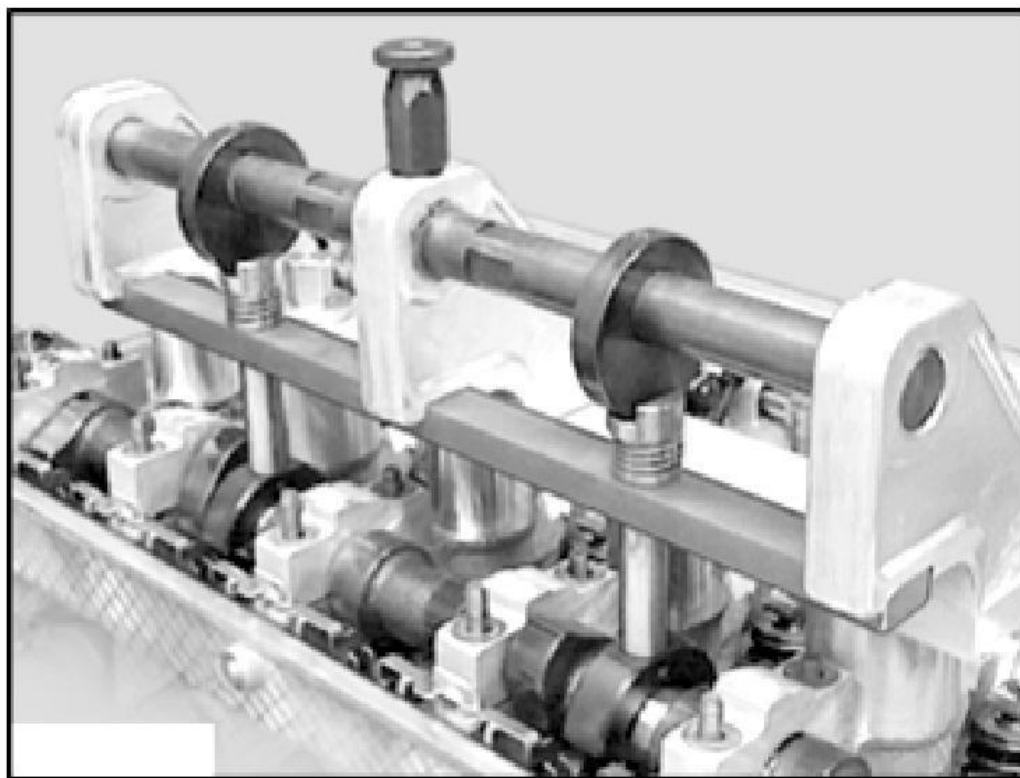
Fig. 261: Checking Dowel Sleeves

Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

NOTE: Bearing caps are marked A2 to A7.

Install bearing caps A2 to A7.

**G03117878****Fig. 262: Installing Bearing Caps****Courtesy of BMW OF NORTH AMERICA, INC.**

Exhaust side:

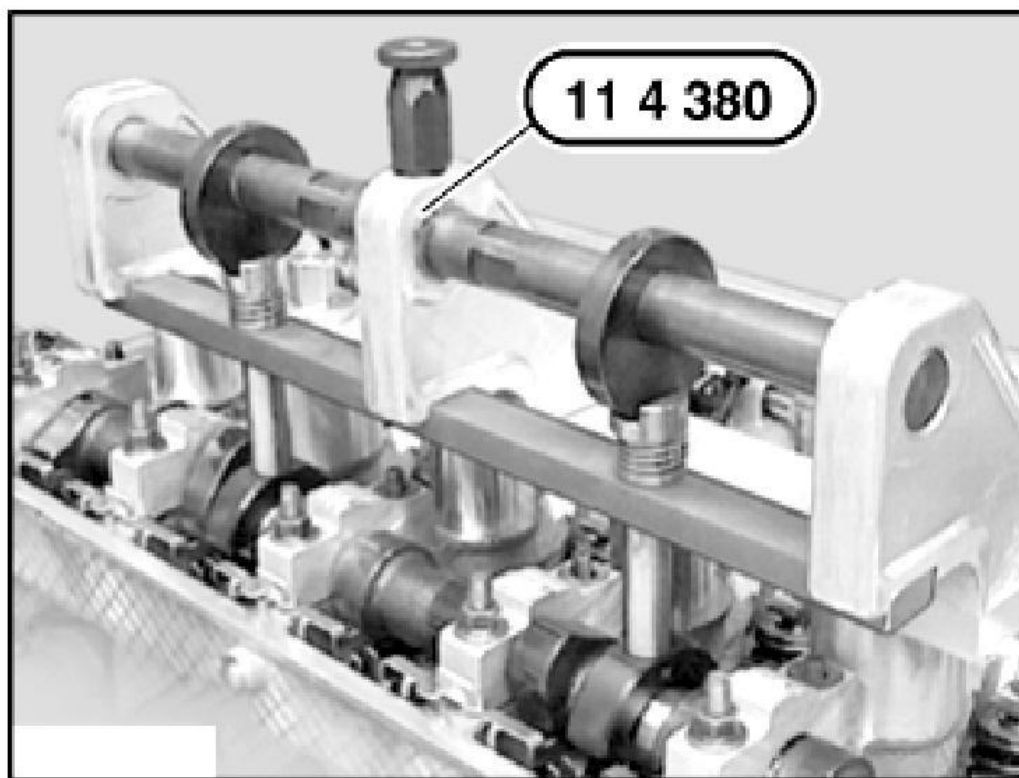
Align bearing caps by hand until they are secured by means of adapter sleeves.

Insert all nuts of bearing caps on exhaust camshaft.

Manually tighten bearing cap nuts and then tighten down from inside to outside in 1/2 turn increments.

Tightening torque, refer to 11 31 1AZ in **ENGINE - TIGHTENING TORQUES** .

Remove special tool 11 4 380.



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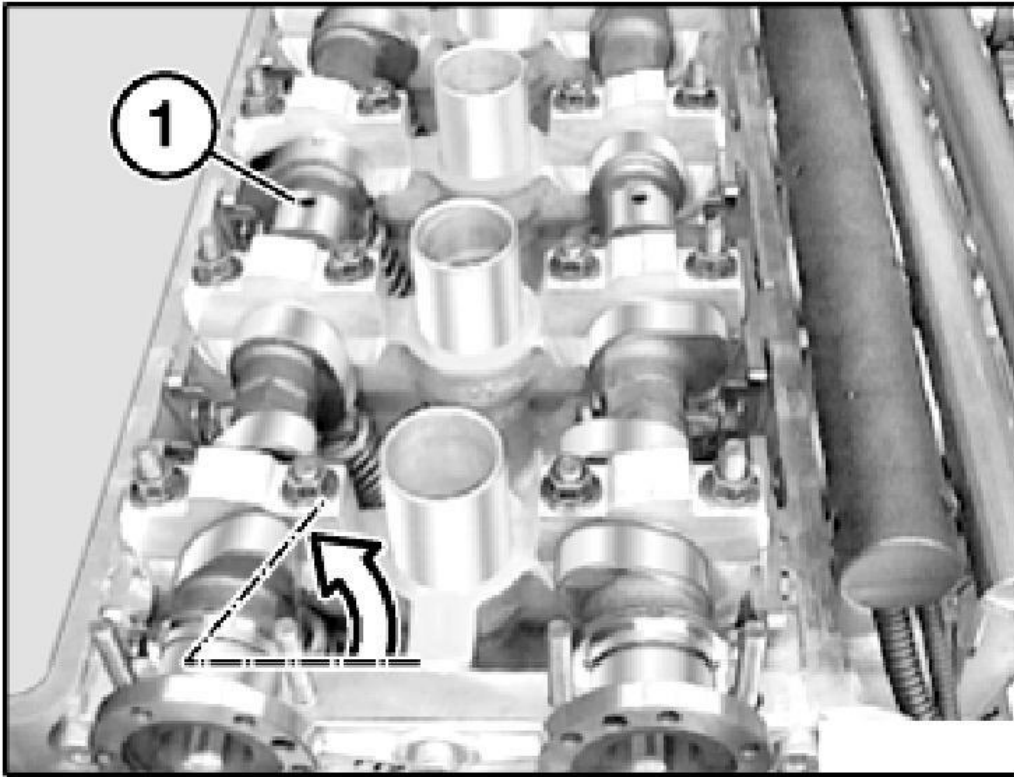
Fig. 263: Removing Special Tool

Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

CAUTION: Note direction and angle of rotation.

Rotate exhaust camshaft at hexagon from horizontal position upwards until locating bore (1) in camshaft is vertical.

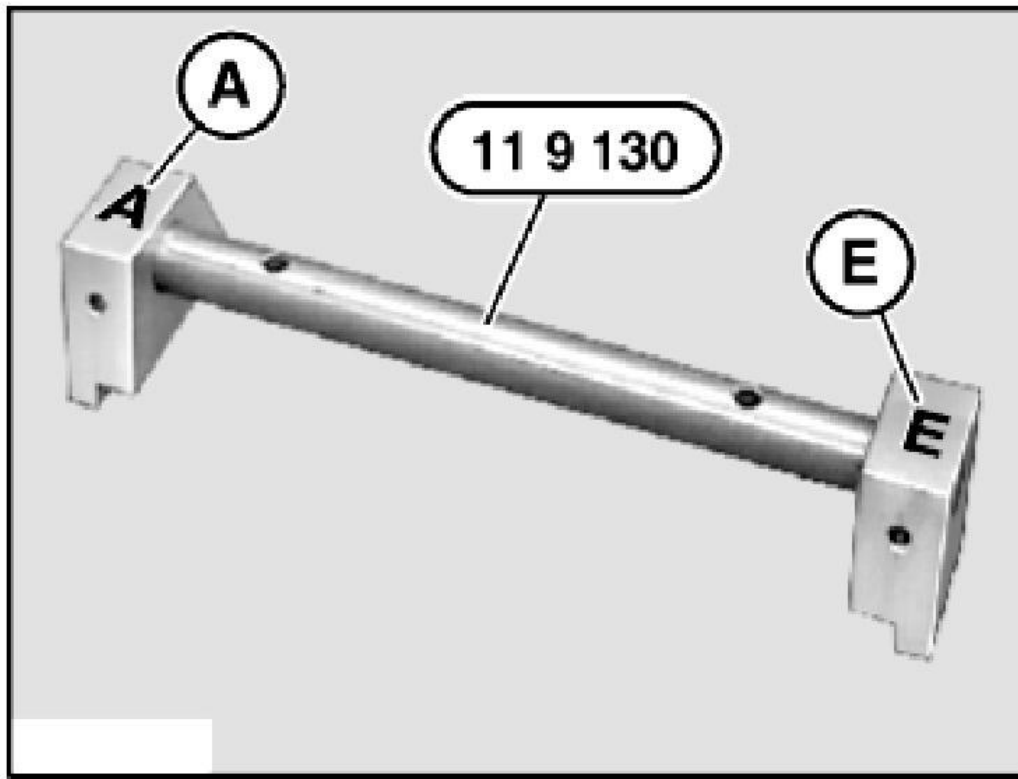


G03117880

Fig. 264: Aligning Locating Bore In Exhaust Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Pay attention to installation direction of special tool 11 9 130.

- (A) Exhaust side.
- (E) Inlet side.



G03117881

Fig. 265: Identifying Setting Gauge**Courtesy of BMW OF NORTH AMERICA, INC.**

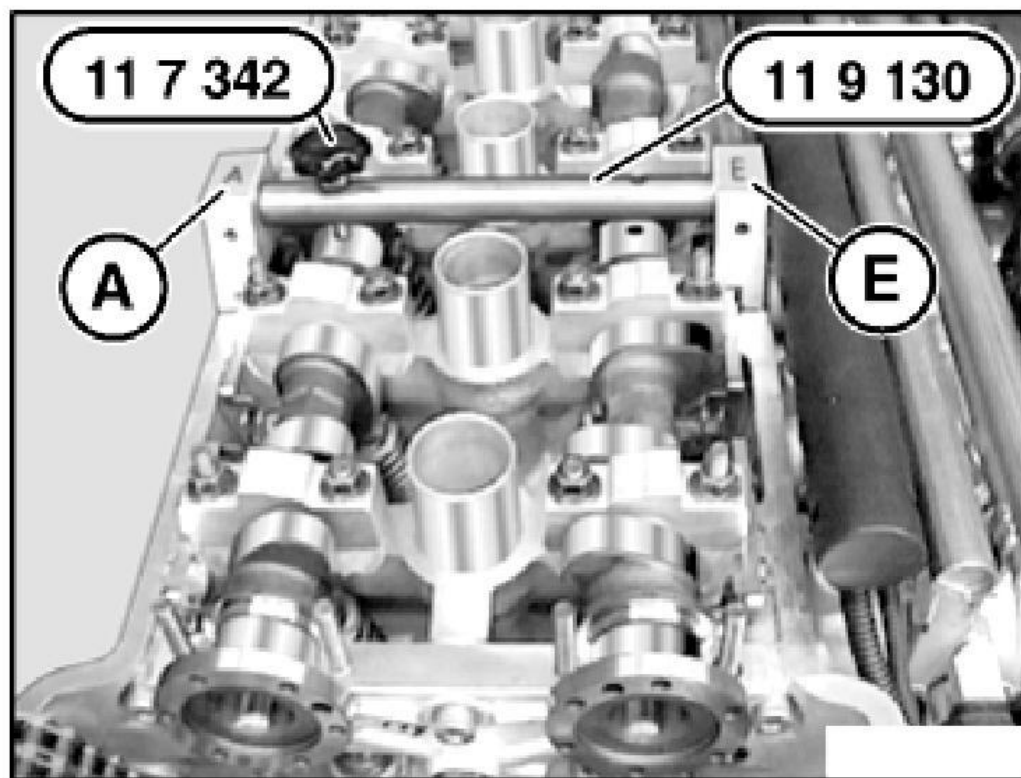
Exhaust side:

Attach special tool 11 9 130 to cylinder head.

Align exhaust camshaft at hexagon until special tool 11 7 342 can be joined by means of special tool 11 9 130 in locating bore.

Special tool 11 9 130 must rest flat on cylinder head.

Remove special tool 11 9 130 and special tool 11 7 342.



G03117882

Fig. 266: Attaching Special Tool To Cylinder Head
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Inlet and exhaust camshafts have a joint thrust bearing flange (1) at 1st bearing seat.

Check adapter sleeves (2) for damage and correct installation position.

Observing installation direction:

Fit thrust bearing flange (1) as shown in illustration.

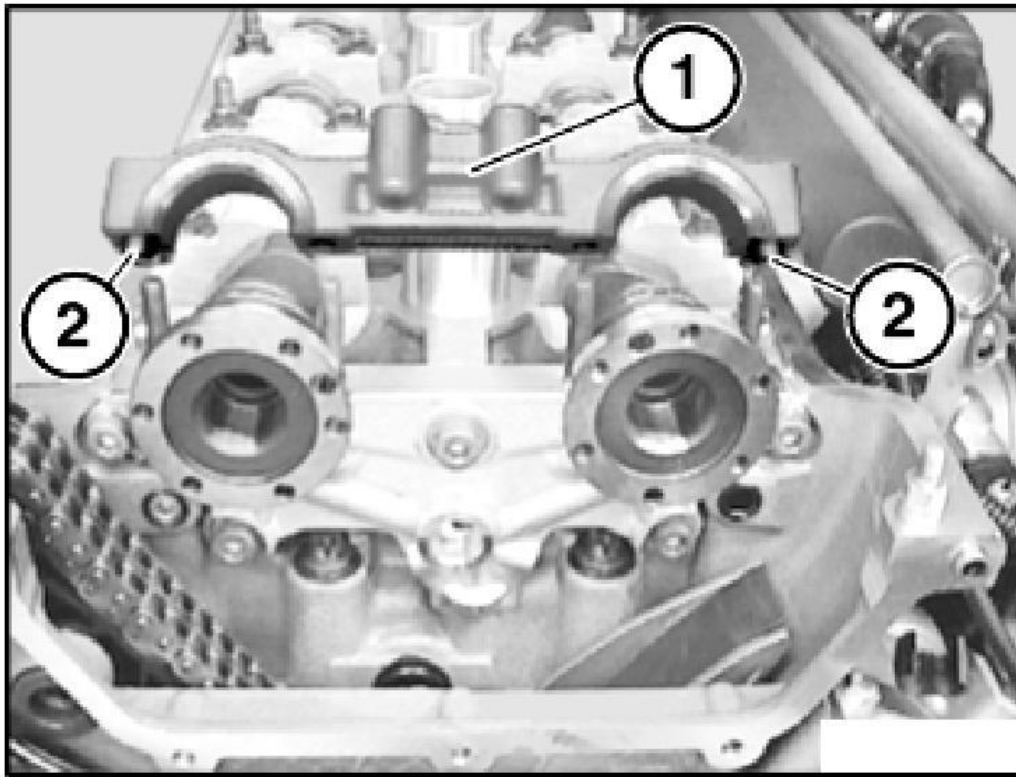
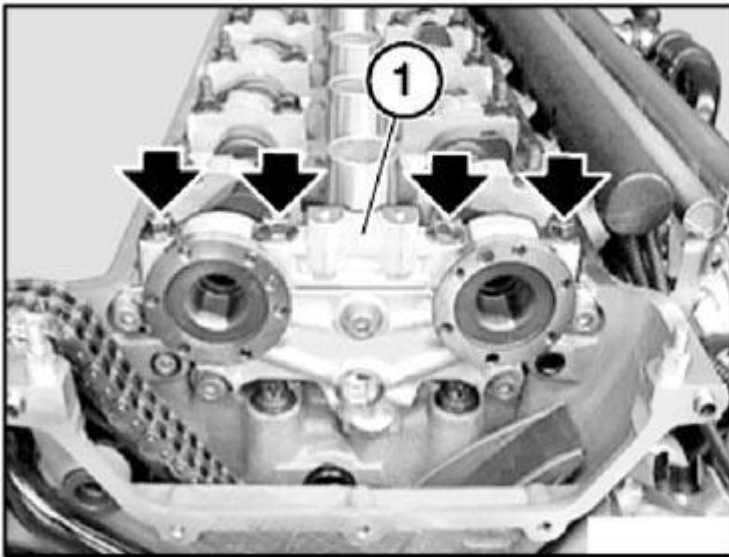
**G03117883**

Fig. 267: Identifying Thrust Bearing Flange
Courtesy of BMW OF NORTH AMERICA, INC.

Align thrust bearing flange (1) by hand until it is secured to cylinder head by means of adapter sleeves.

Install nuts of thrust bearing flange (1).

Manually tighten nuts and then tighten down from in 1/2 turn increments.

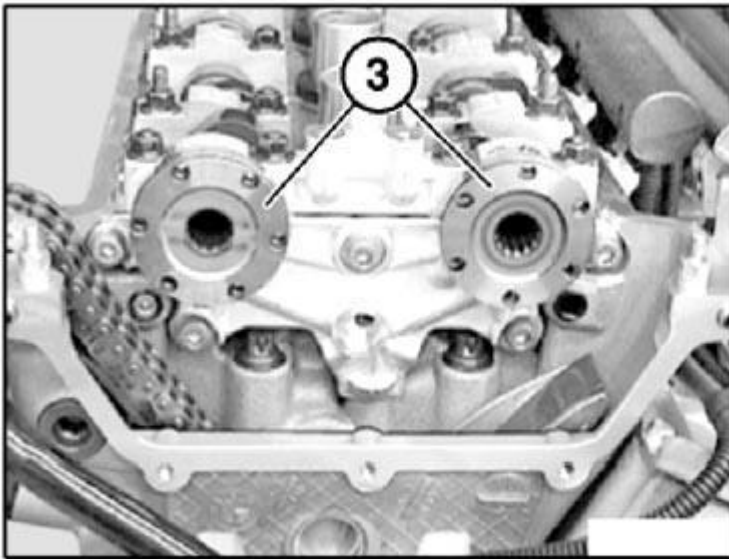


G03117884

Fig. 268: Locating Nuts Of Thrust Bearing Flange
Courtesy of BMW OF NORTH AMERICA, INC.

Coat tothing of toothed sleeves (3) with engine oil as antiseize agent.

Install toothed sleeves (3) of exhaust and inlet camshafts. Align bores in toothed sleeves (3) to tapped holes in camshafts.



G03117885

Fig. 269: View Of Toothed Sleeves Of Exhaust And Inlet Camshafts

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Note installation direction of thrust washers (2). Large chamfer points to camshaft.

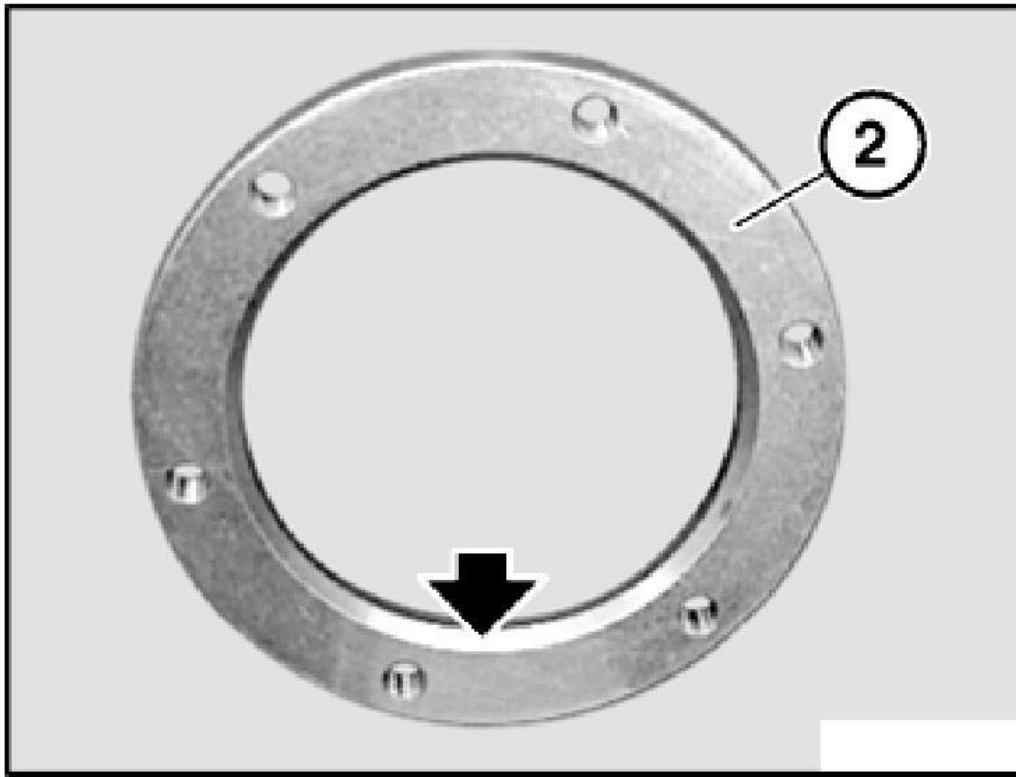
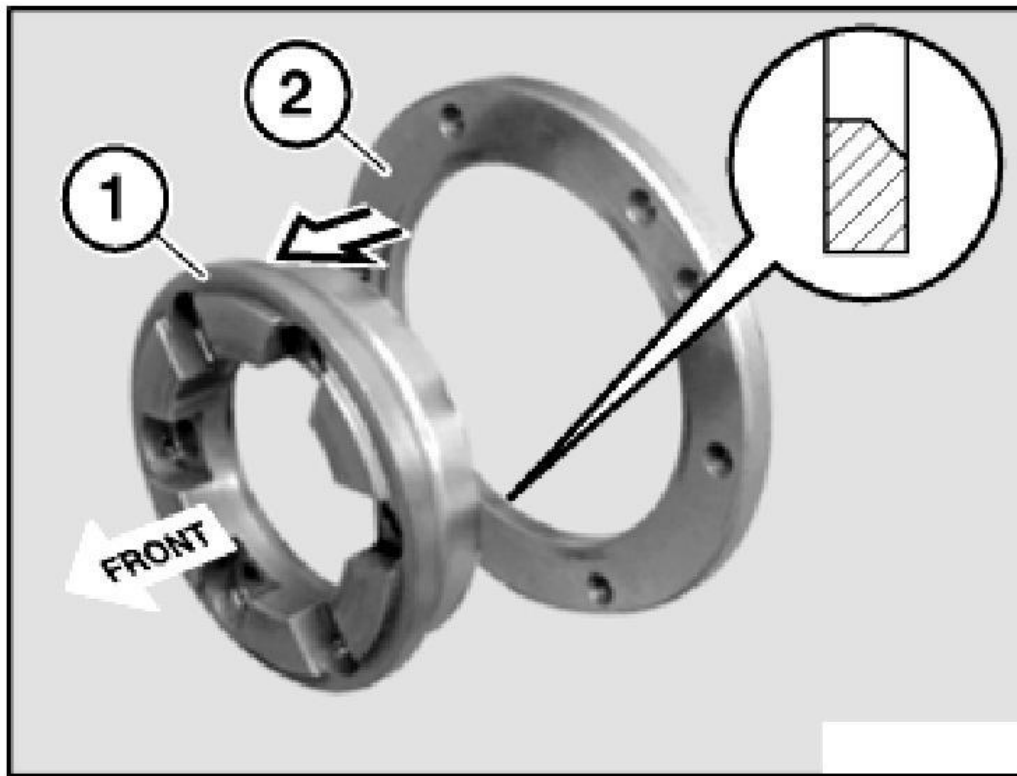
**G03117886**

Fig. 270: Identifying Installation Direction Of Thrust Washers
Courtesy of BMW OF NORTH AMERICA, INC.

Note installation direction of thrust washers (2).

Fit thrust washers (2) on centering sleeves (1) in such a way that large chamfer points towards rear to camshaft.



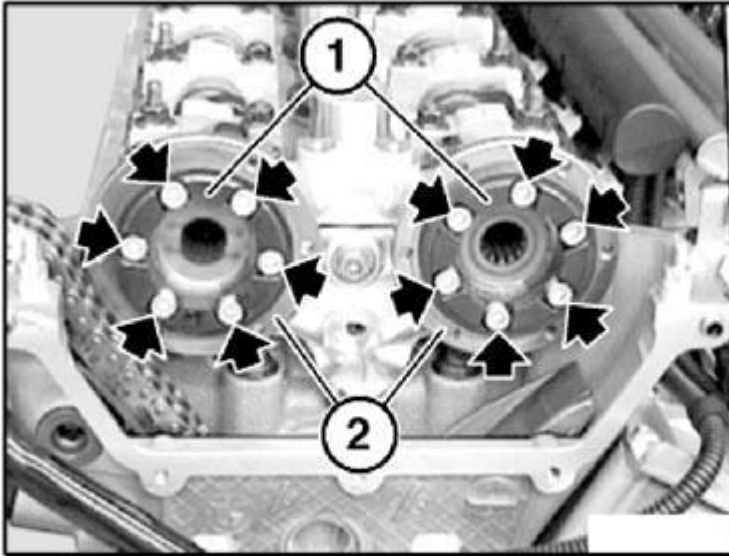
G03117887

Fig. 271: Aligning Thrust Washers On Centering Sleeves
Courtesy of BMW OF NORTH AMERICA, INC.

Fit centering sleeve (1) on exhaust and inlet sides with thrust washer (2).

Grip camshafts at hexagon head.

Tighten down bolts on centering sleeves (1).



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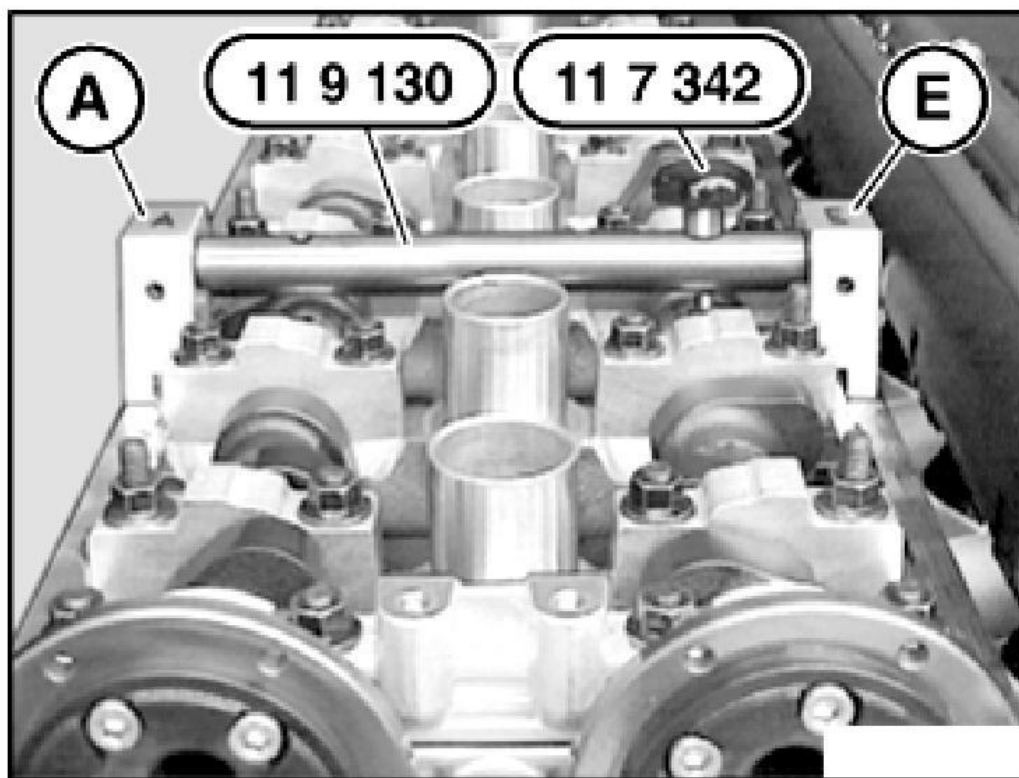
Fig. 272: Locating Centering Sleeve Retaining Bolts
 Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

CAUTION: Pay attention to installation direction of special tool 11 9 130.

Attach special tool 11 9 130 to cylinder head. Align inlet camshaft at hexagon until special tool 11 7 342 can be joined by means of special tool 11 9 130 in locating bore.

Special tool 11 9 130 must rest flat on cylinder head. Remove special tool 11 7 342.



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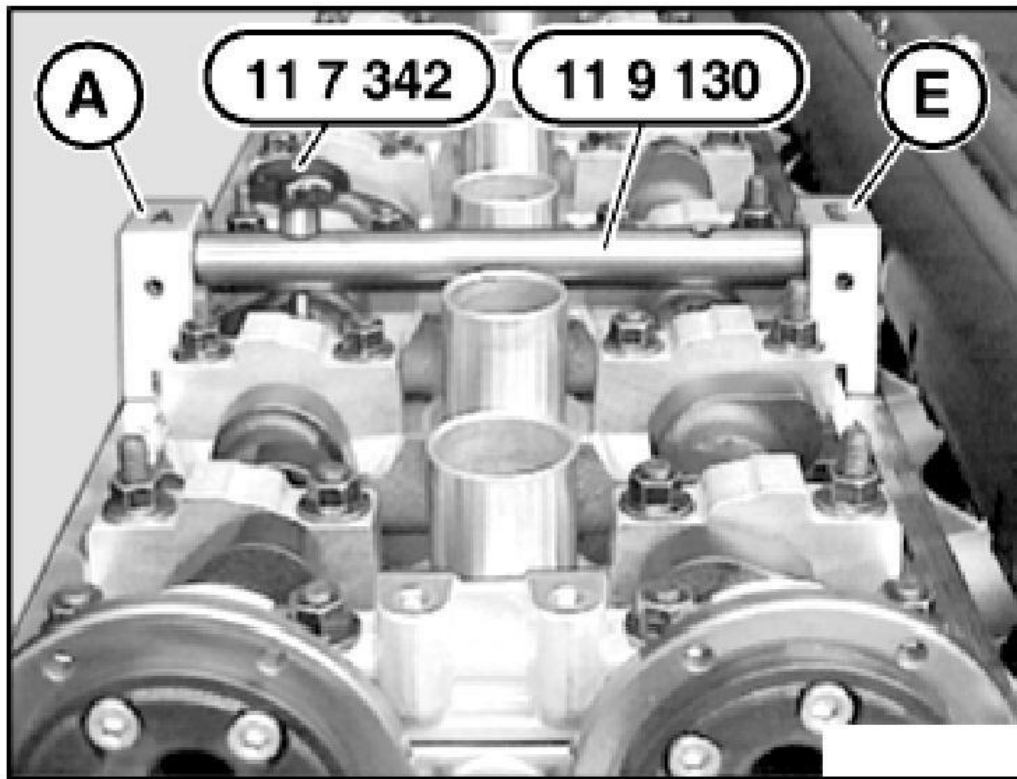
Fig. 273: Attaching Setting Gauge To Cylinder Head
Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

Align exhaust camshaft at hexagon until special tool 11 7 342 can be joined by means of special tool 11 9 130 in locating bore.

Special tool 11 9 130 must rest flat on cylinder head.

Remove special tool 11 9 130 and special tool 11 7 342.

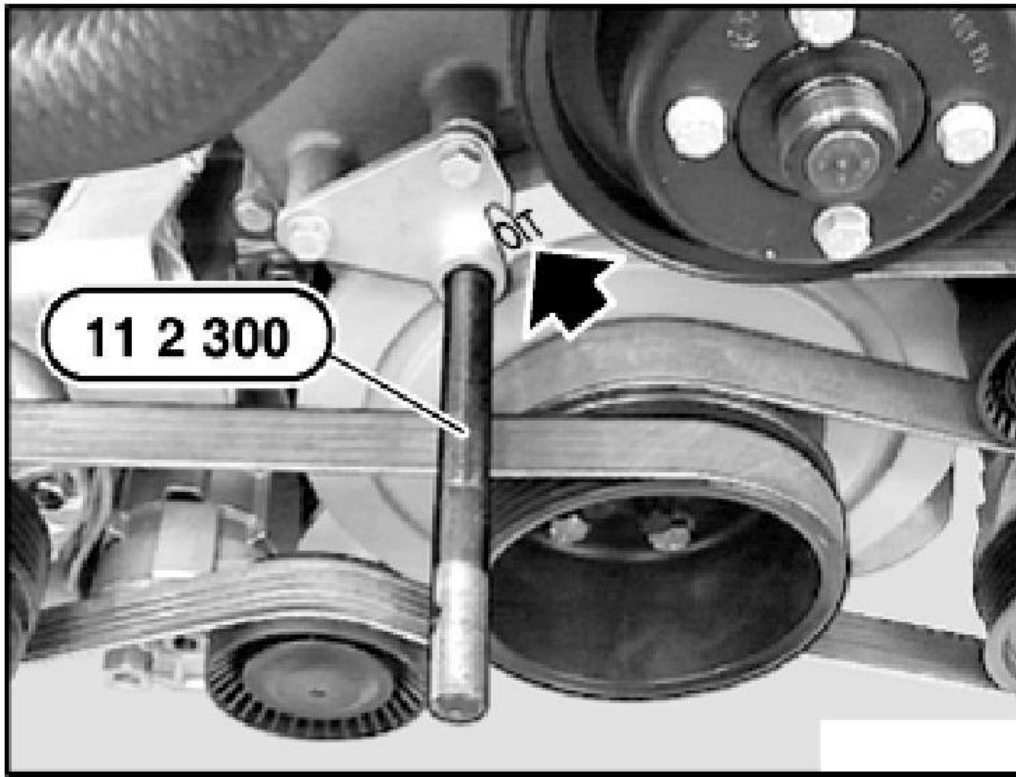


G03117890

Fig. 274: Aligning Exhaust Camshaft At Hexagon
Courtesy of BMW OF NORTH AMERICA, INC.

Lift timing chain and hold under tension.

Rotate crankshaft from 30° before TDC position in direction of rotation as far as firing TDC position. Secure vibration damper in position with special tool 11 2 300.



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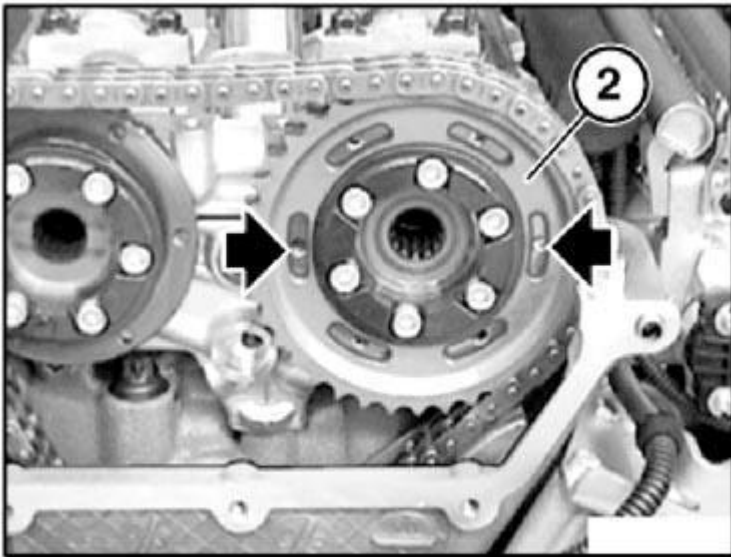
Fig. 275: Securing Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

Hold timing chain under tension.

Position tapped holes of thrust washer horizontally as shown in illustration.

Install sprocket wheel (2) on inlet side on centering sleeves in such a way that elongated holes are centrally located.

NOTE: The position of the elongated holes is only important in terms of accessibility to the screws and does not affect operation in any way.



G03117892

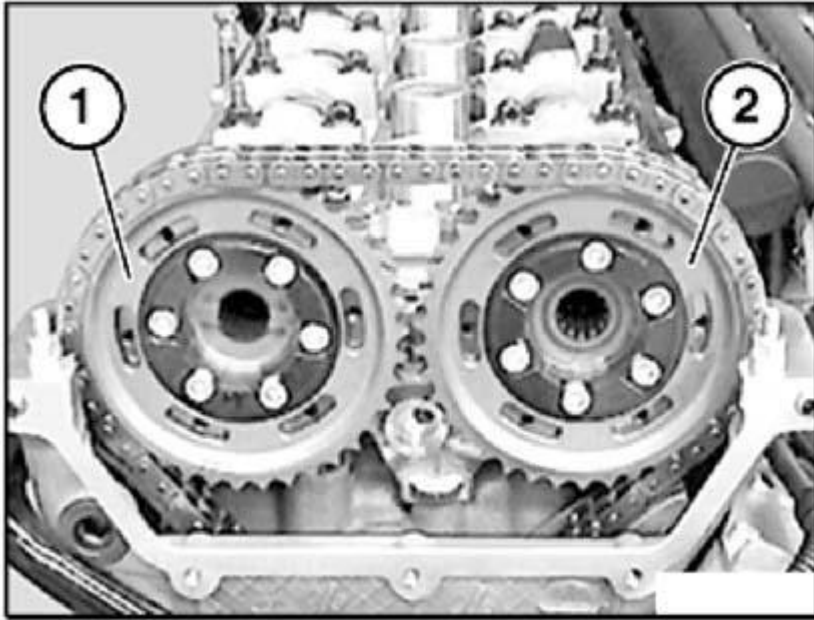
Fig. 276: Aligning Tapped Holes Of Thrust Washer
Courtesy of BMW OF NORTH AMERICA, INC.

Hold timing chain under tension and feed on sprocket wheel (1).

Install sprocket wheel (1) on exhaust side on centering sleeves in such a way that elongated holes of sprocket wheels (1 and 2) are centrally located.

Press tensioning rail against timing chain and check position of elongated holes.

NOTE: **The position of the elongated holes is only important in terms of accessibility to the screws and does not affect operation in any way.**



G03117893

Fig. 277: View Of Sprocket Wheels On Exhaust Side
Courtesy of BMW OF NORTH AMERICA, INC.

Install chain tensioning piston. Refer to **11 31 090 REMOVING AND INSTALLING/REPLACING CHAIN TENSIONING PISTON (S54)**.

NOTE: Coat all sliding surfaces on VANOS gear with engine oil as antiseize agent.

Exhaust side:

NOTE: The small support diameter of the plate spring (2) points in the direction of the supporting ring (3). Supporting ring is supported with retaining lugs in spline hub (1).

Insert plate spring (2) and supporting ring (3) in spline hub (1).

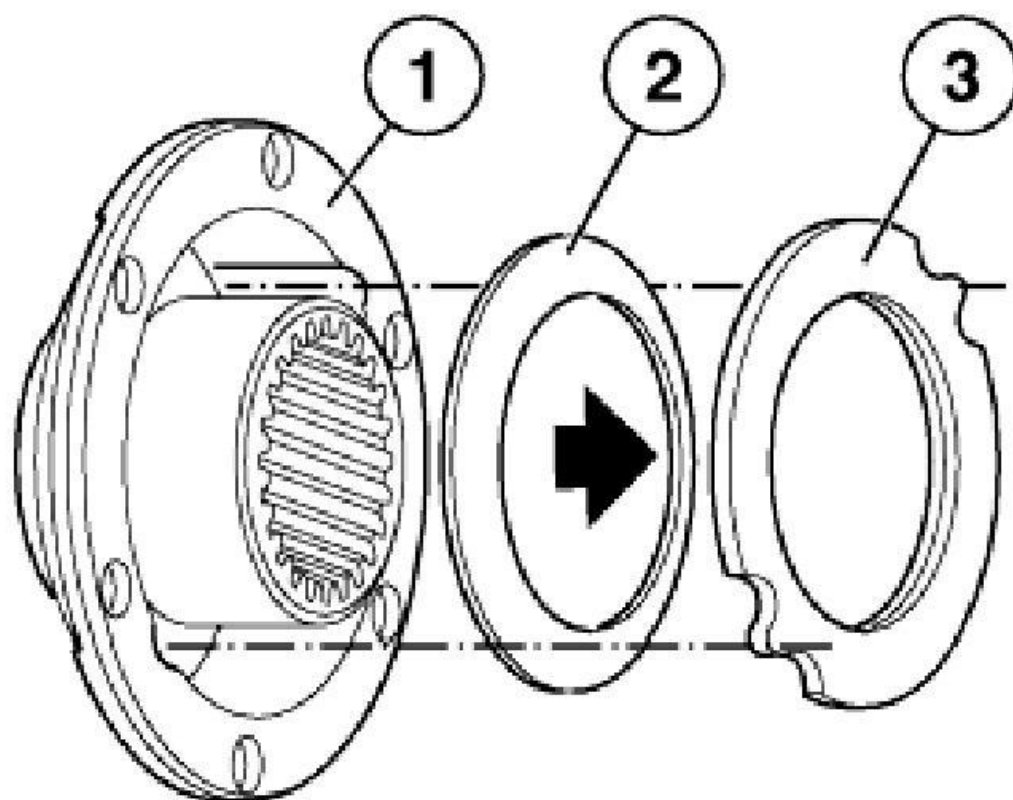
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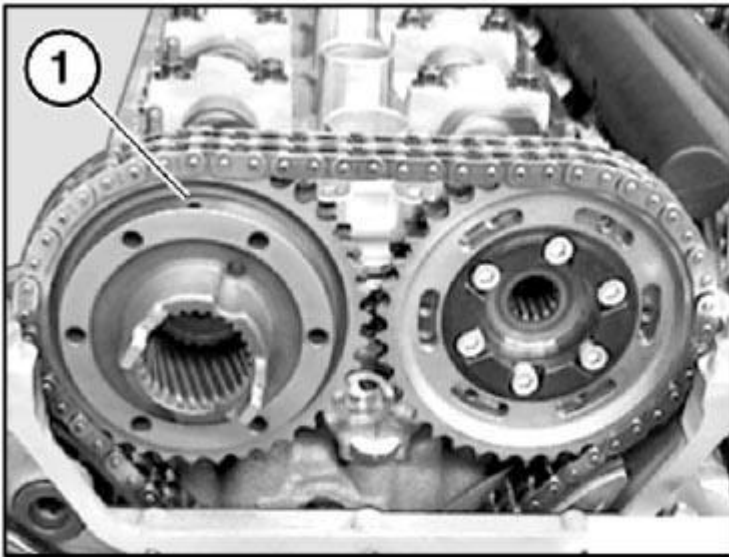
Fig. 278: Inserting Plate Spring And Supporting Ring In Spline Hub
Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

Take care: the supporting ring can easily fall out.

Remove spline hub with plate spring and supporting ring.

Bore hole (1) must point upwards as shown in illustration.



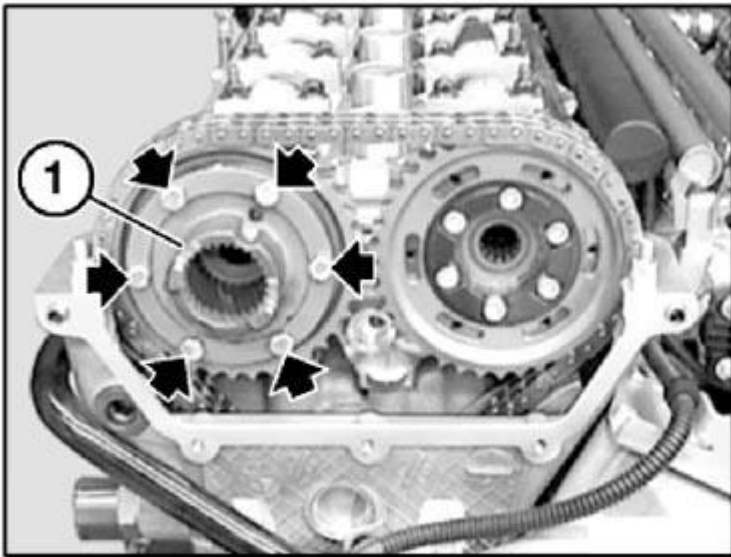
G03117895

Fig. 279: Aligning Bore Hole On Exhaust Side
Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

Insert all screws of spline hub (1) and tighten by hand until free of play.

Then slacken screws again until spline hub (1) can be moved with fingers.



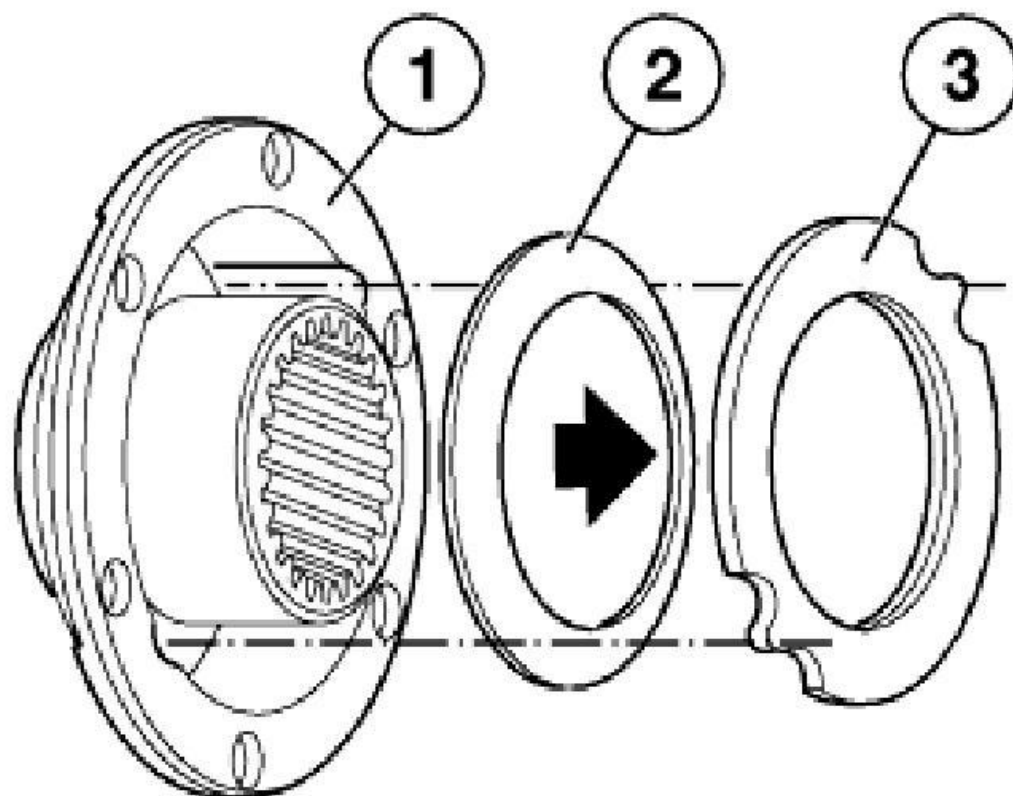
G03117896

Fig. 280: Identifying Screws Of Spline Hub
Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

NOTE: The small support diameter of the plate spring (2) points in the direction of the supporting ring (3). Supporting ring is supported with retaining lugs in spline hub (1).

Insert plate spring (2) and supporting ring (3) in spline hub (1).



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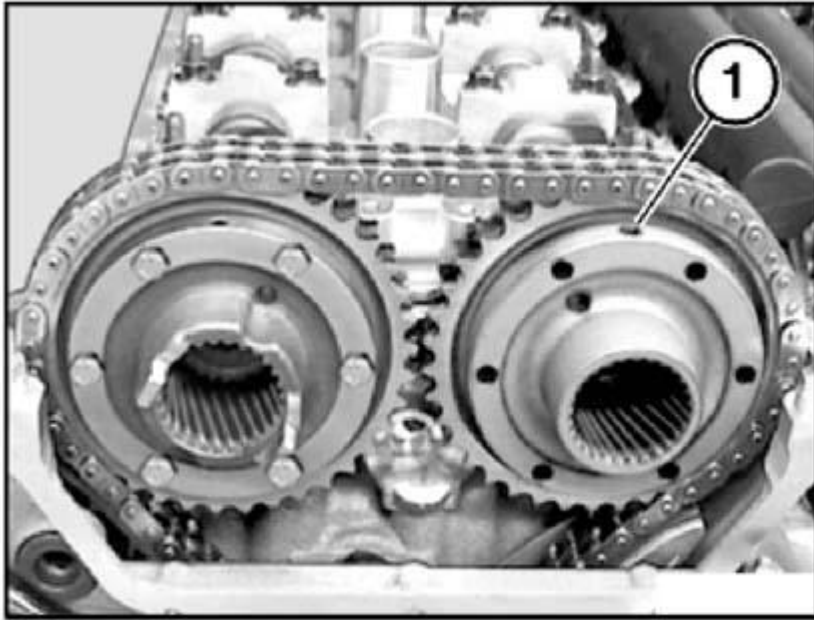
Fig. 281: Inserting Plate Spring And Supporting Ring In Spline Hub
Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

Take care: the supporting ring can easily fall out.

Remove spline hub with plate spring and supporting ring.

Bore hole (1) must point upwards as shown in illustration.



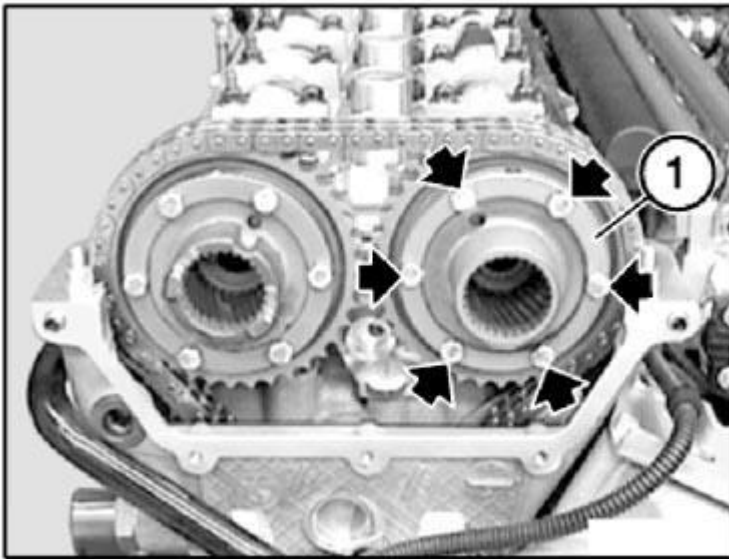
G03117898

Fig. 282: Aligning Bore Hole On Inlet Side
Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

Insert all screws of spline hub (1) and tighten by hand until free of play.

Then slacken screws again until spline hub (1) can be move with fingers.



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Fig. 283: Identifying Screws Of Spline Hub
Courtesy of BMW OF NORTH AMERICA, INC.

Detach control valve (1) from VANOS adjustment unit.

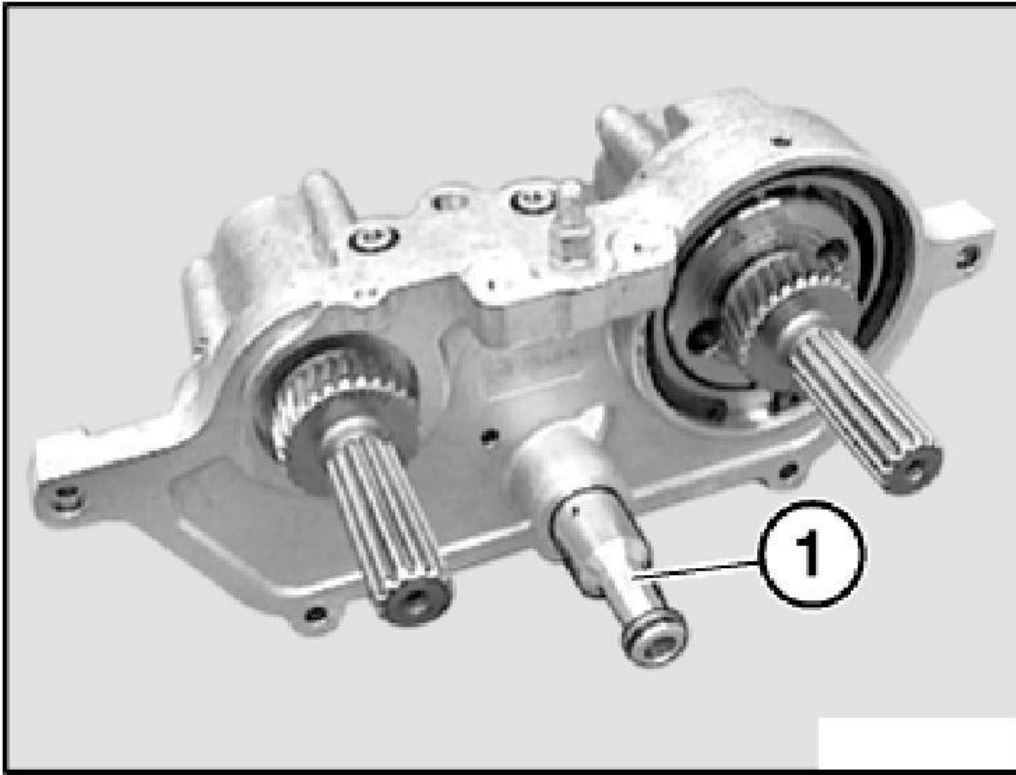
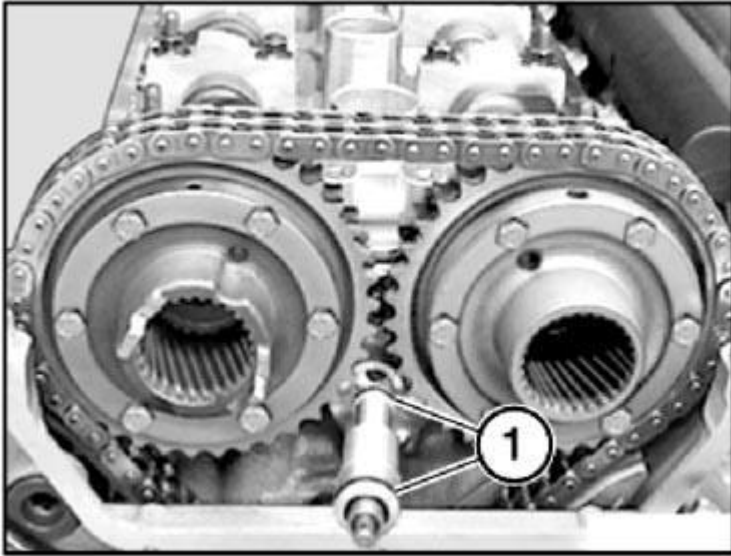
**G03117900**

Fig. 284: View Of Control Valve On VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: **A filter is integrated in the control valve.**

The control valve must be replaced after any engine damage which suggests that the filter is fouled with filings/shavings.

Replace sealing rings (1) and coat with oil as antiseize agent. Preassemble control valve in cylinder head.



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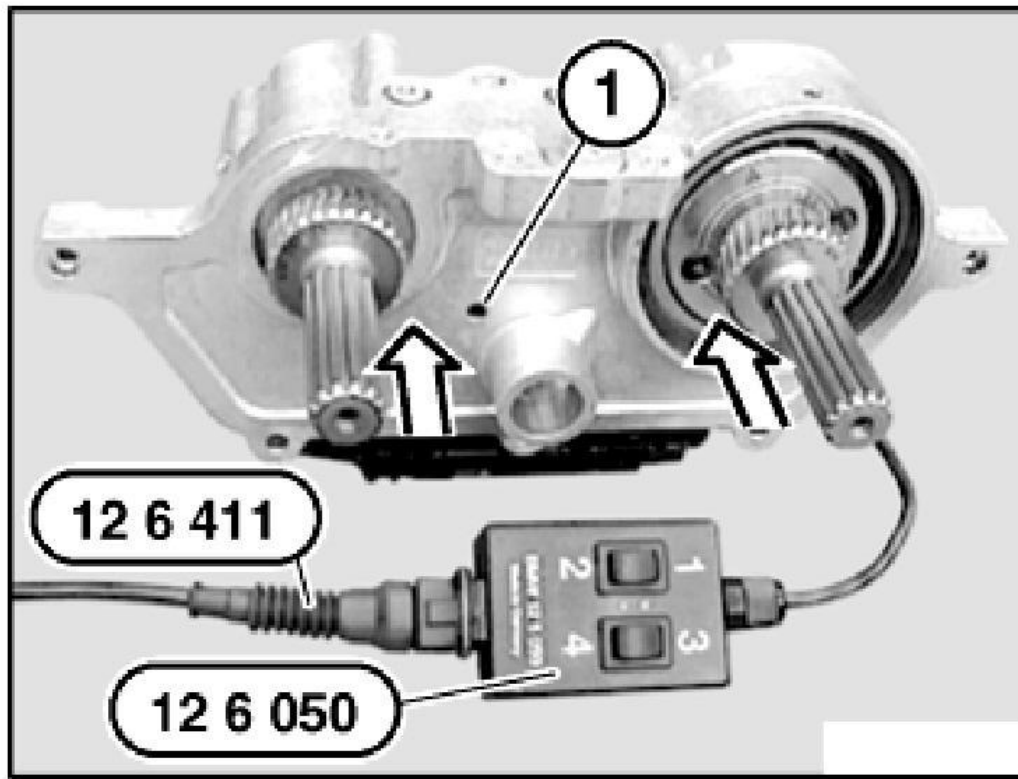
Fig. 285: Replacing Sealing Rings**Courtesy of BMW OF NORTH AMERICA, INC.**

Oil is sprayed when splined shafts are pressed back. Cover bore (1) with a cloth.

Connect special tool 12 6 050 in conjunction with special tool 12 6 411 (from special tool kit 12 6 410) to solenoid valves of VANOS adjustment unit. Connect special tool 12 6 411 to correct terminals on car battery.

Press buttons 1 and 3 on special tool 12 6 050 simultaneously. Solenoid valves are actuated.

Press splined shafts by hand up to stop into initial position.

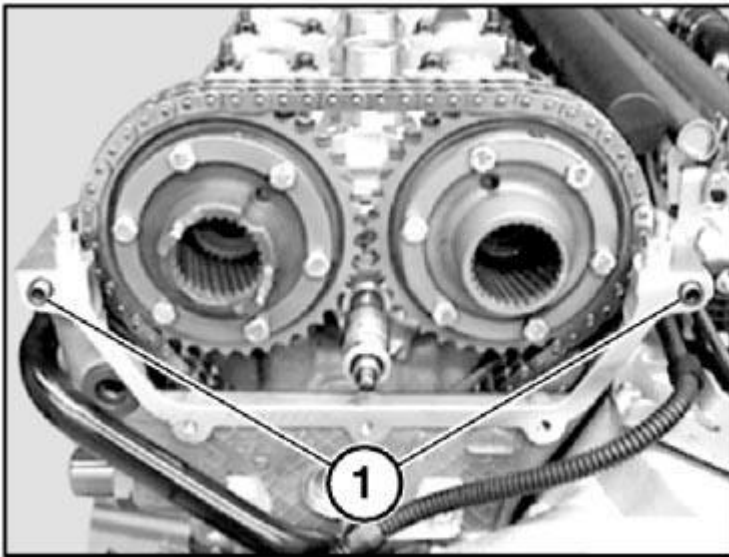


G03117902

Fig. 286: View Of Switching Unit

Courtesy of BMW OF NORTH AMERICA, INC.

Check dowel sleeves (1) for damage and correct installation position.



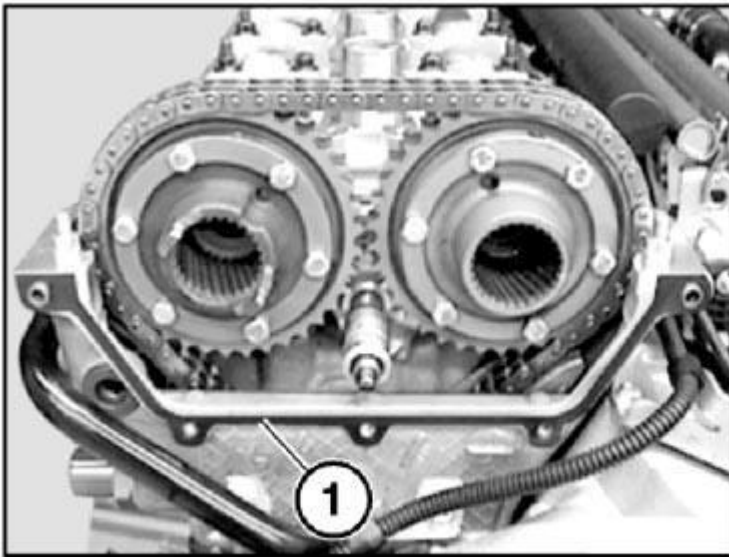
G03117903

Fig. 287: Locating Dowel Sleeves

Courtesy of BMW OF NORTH AMERICA, INC.

Replace gasket (1).

CAUTION: Note direction of installation of gasket. Install gasket (1) in such a way that beading points to VANOS adjustment unit. Secure gasket (1) with sealing compound on adapter sleeves.

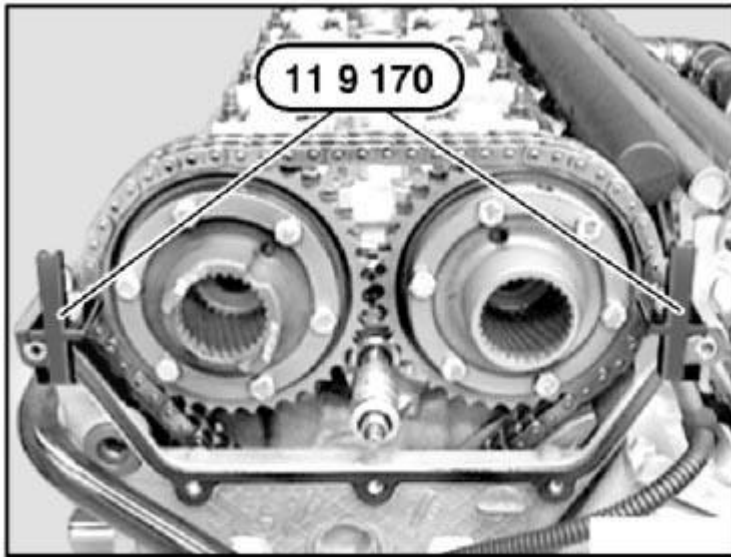


G03117904

Fig. 288: Aligning Gasket For VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Secure special tool 11 9 170 as shown in illustration by means of stud bolt.

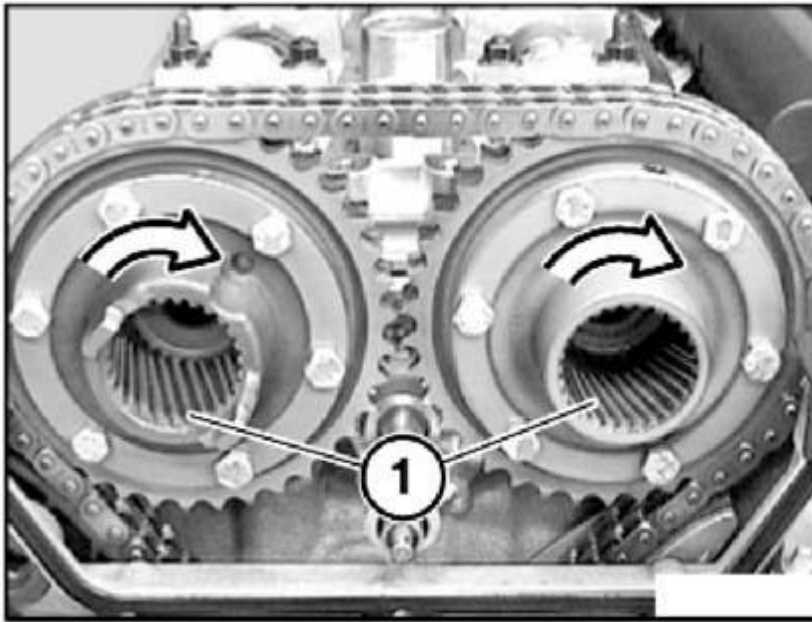
NOTE: The special tool 11 9 170 serves to maintain a prespecified distance during the below-mentioned installation of the VANOS adjustment unit.



G03117905

Fig. 289: Securing Spacer For Installation Of VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Turn spline hubs (1) of inlet and exhaust camshafts to right limit position.

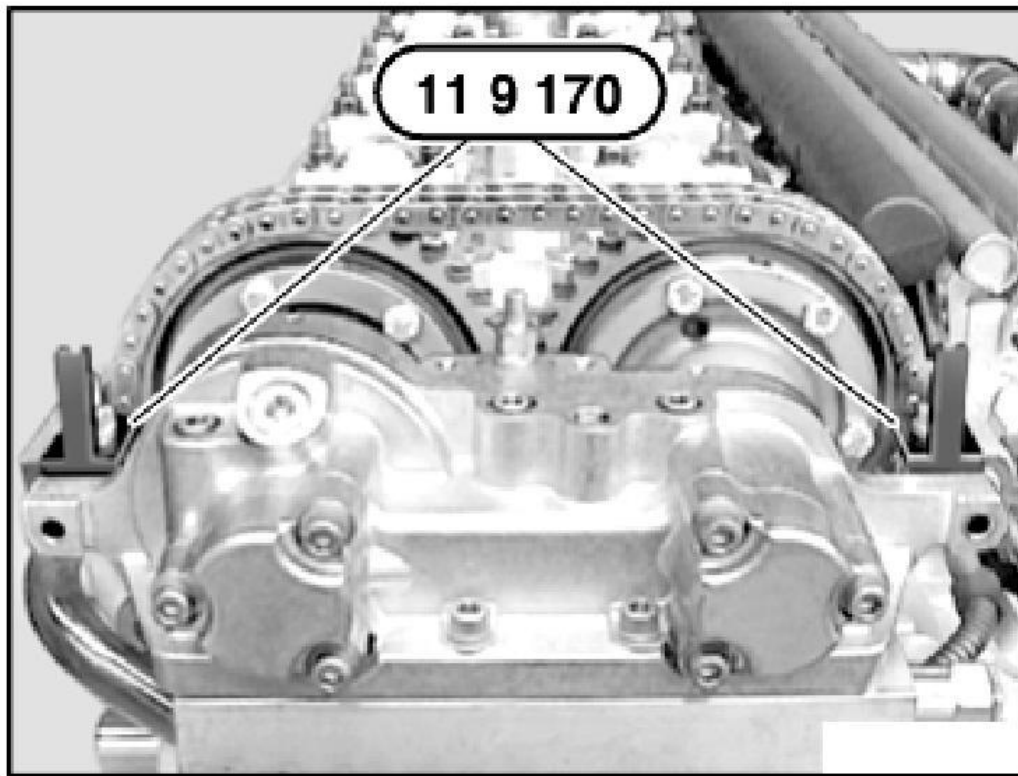


G03117906

Fig. 290: Aligning Spline Hubs To Right Limit Position
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Special tool 11 9 170 remains as a spacer element between cylinder head and VANOS adjustment unit.

Attach VANOS adjustment unit.



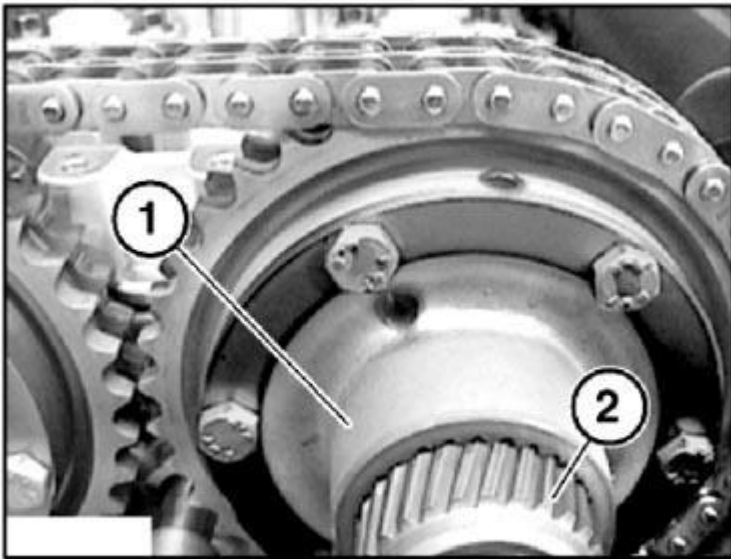
G03117907

Fig. 291: Attaching VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Make sure both VANOS splined shafts remain in initial position during installation.

Rotate splined shafts of inlet and exhaust sides until spur toothing is engaged.

Push VANOS adjustment unit with splined shaft into VANOS gear until helical cut splines (2) are positioned shortly before meshing with spline hub (1).



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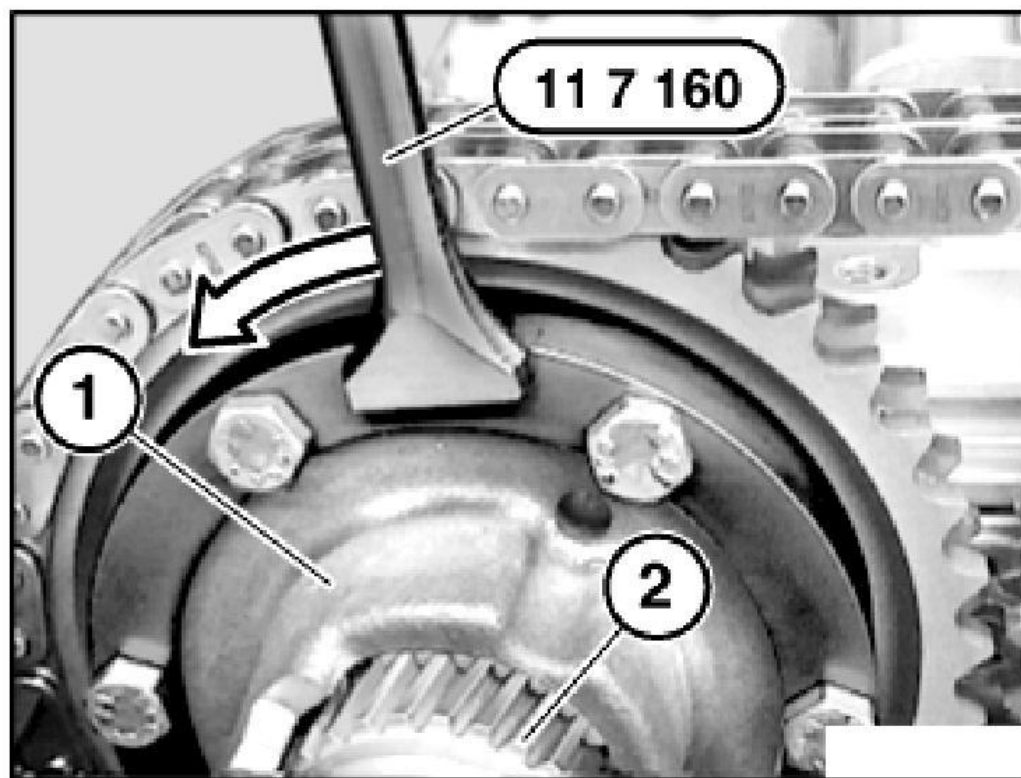
Fig. 292: Pushing VANOS Adjustment Unit Into VANOS Gear
Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

If the helical cut splines cannot be pushed into the spline hub (1):

Place special tool 11 7 160 on bore in spline hub (1). Rotate spline hub (1) against direction of rotation until splined shaft (2) is positioned with spline hub (1) exactly "tooth-to-tooth gap".

CAUTION: The "first" matching tooth must engage.



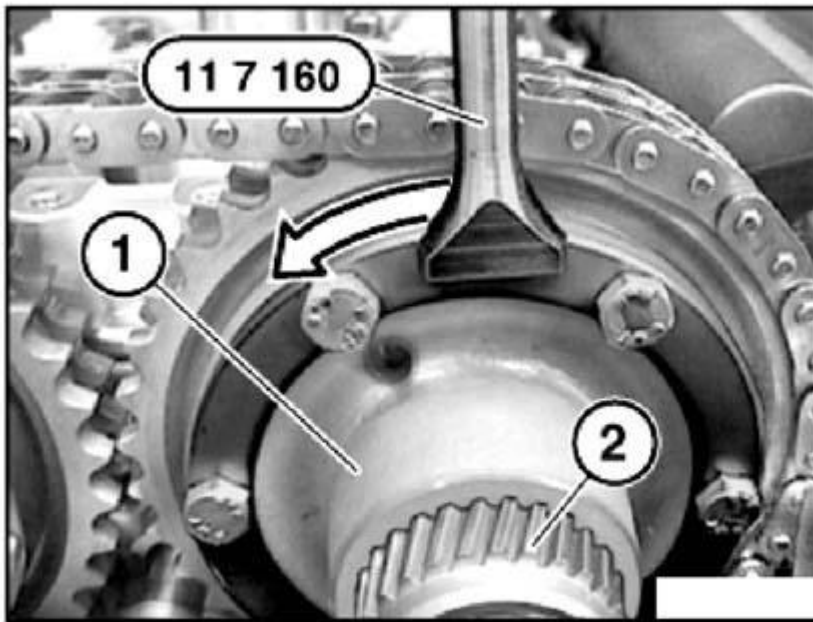
G03117909

Fig. 293: Placing Special Tool On Bore In Spline Hub (Exhaust)
Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

Place special tool 11 7 160 on bore in spline hub (1). Rotate spline hub (1) against direction of rotation until splined shaft (2) is positioned with spline hub (1) exactly "tooth-to-tooth gap".

CAUTION: The "first" matching tooth must engage.



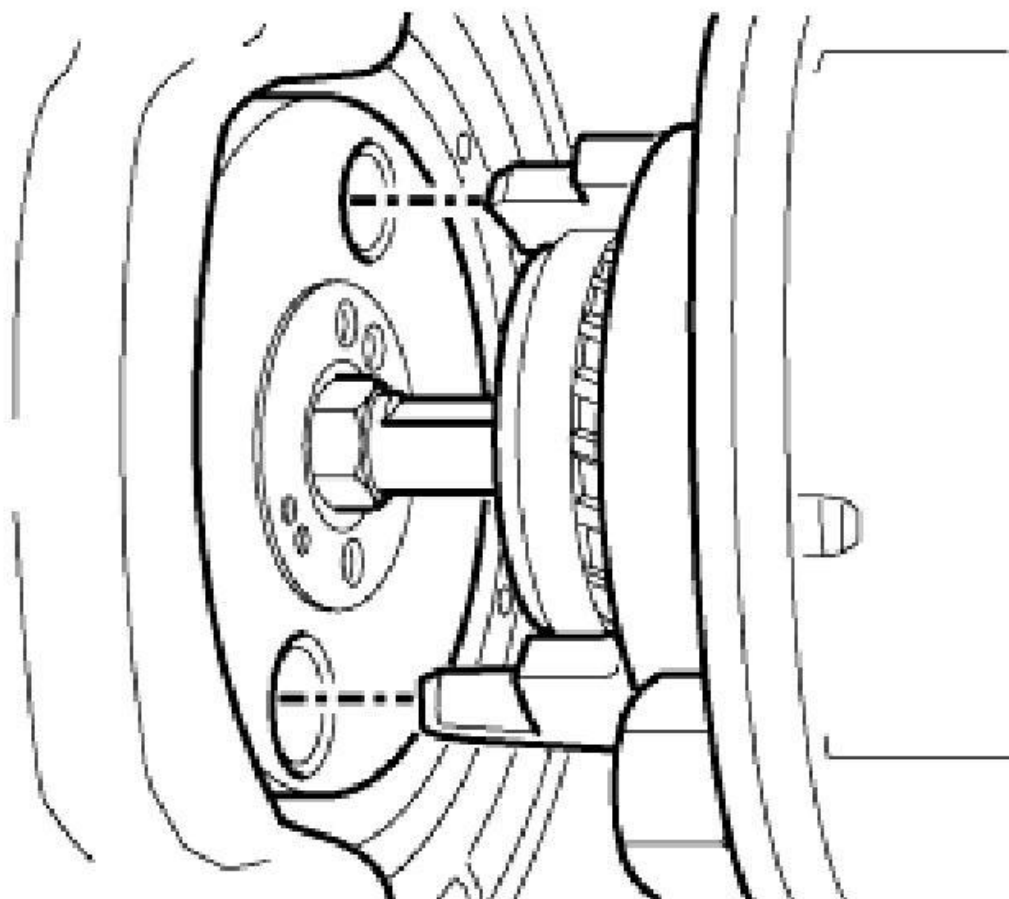
G03117910

Fig. 294: Placing Special Tool On Bore In Spline Hub (Inlet)
 Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

Align radial piston pump to driver on spline hub.

NOTE: Picture shows a schematic representation.

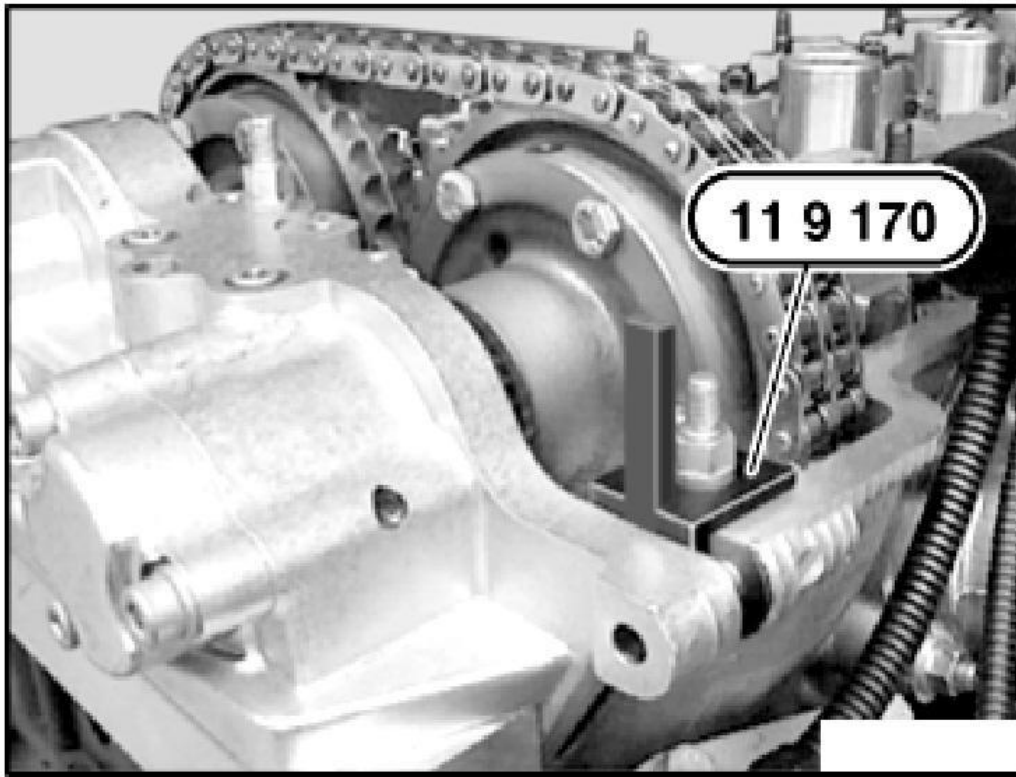


G03117911

Fig. 295: Aligning Radial Piston Pump To Driver On Spline Hub (Exhaust)
Courtesy of BMW OF NORTH AMERICA, INC.

Push on VANOS adjustment unit until it contacts special tool 11 9 170.

CAUTION: If this position is not reached, realign position of radial piston pump to driver.



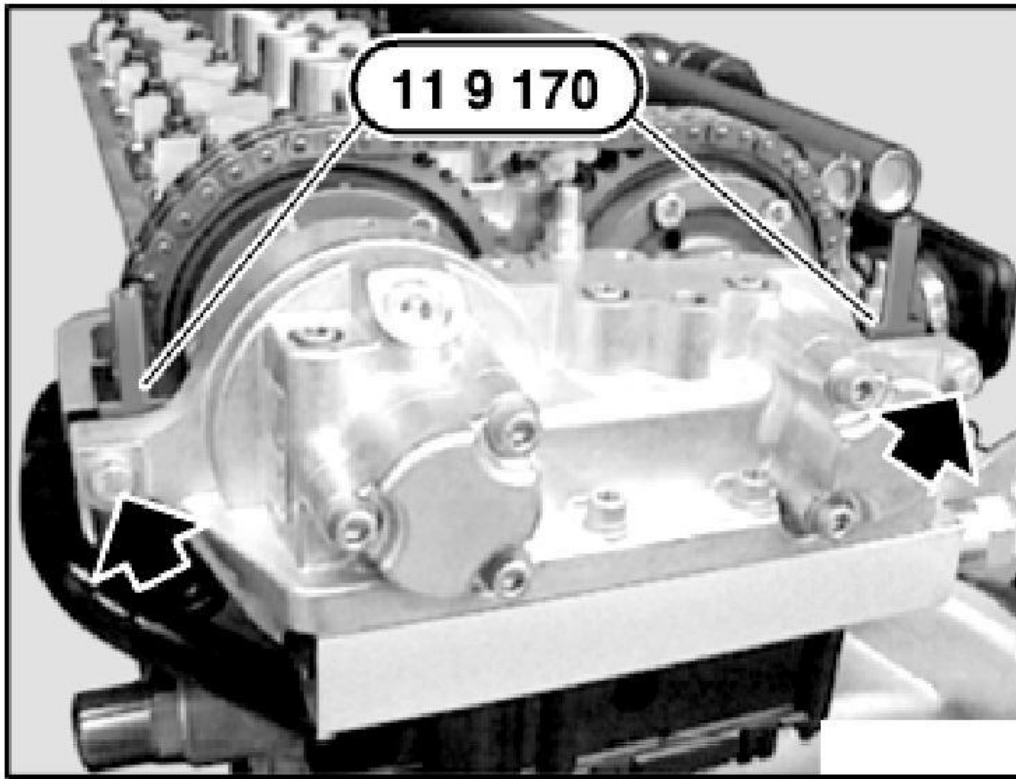
G03117912

Fig. 296: Installing VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Do not tighten down screws.

NOTE: Screw on left and right serves to secure the VANOS adjustment unit.

Insert a screw on left and right and tighten by hand until free of play.



G03117913

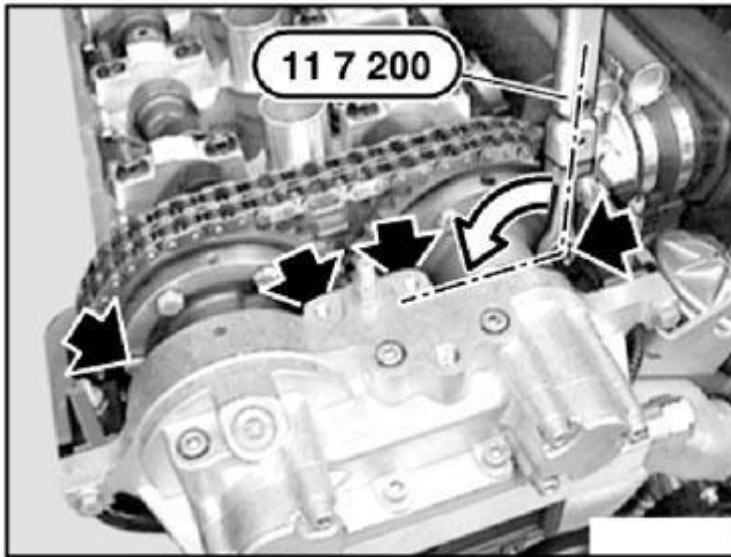
Fig. 297: Securing VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: The procedure described below helps to provide compensation for play. Only with this compensation for play is the timing diagram correctly set.

NOTE: To tighten down screws on VANOS gear: Use special tool 11 7 200.

Tighten down the two opposing screws on the inlet and exhaust sides of the VANOS gear to 10 N.m.

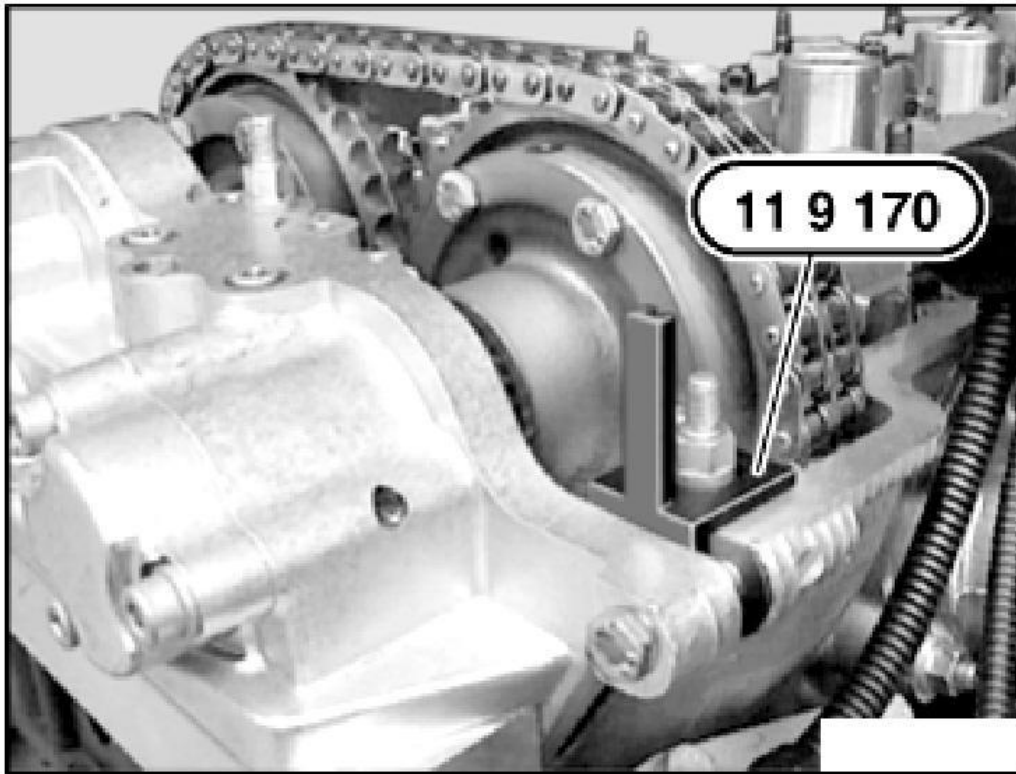
Then slacken all four screws by a 1/4 turn.



G03117914

Fig. 298: Locating Screws On VANOS Gear
Courtesy of BMW OF NORTH AMERICA, INC.

Remove special tool 11 9 170 on left and right sides.

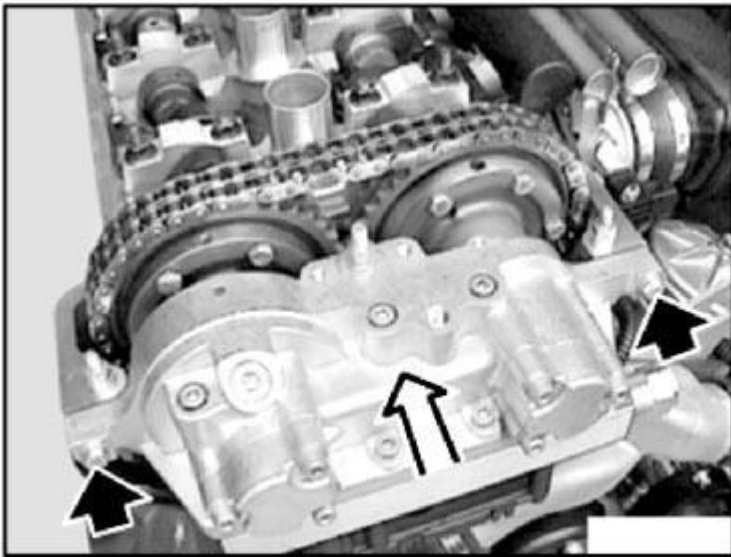


G03117915

Fig. 299: Identifying Special Tool On Left And Right Sides
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Make sure that radial piston pump is aligned to driver on spline hub. When the left and right screws are tightened down alternately, the exhaust and inlet camshafts must not rotate. If the camshafts do rotate, this means that the screws on the VANOS gear were not previously released correctly.

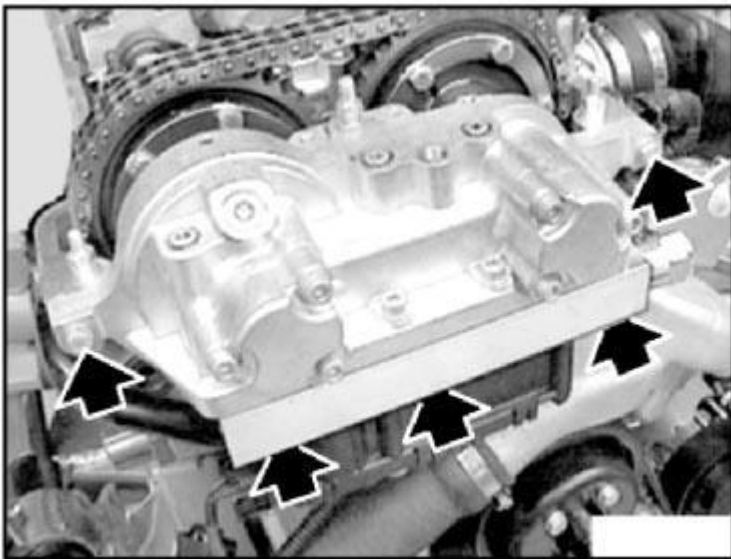
Alternately tighten down bolts in 1/2 turn increments carefully and evenly until VANOS adjustment unit rests against timing P case cover.



G03117916

Fig. 300: Aligning Radial Piston Pump To Driver On Spline Hub
Courtesy of BMW OF NORTH AMERICA, INC.

Insert remaining screws and tighten down.

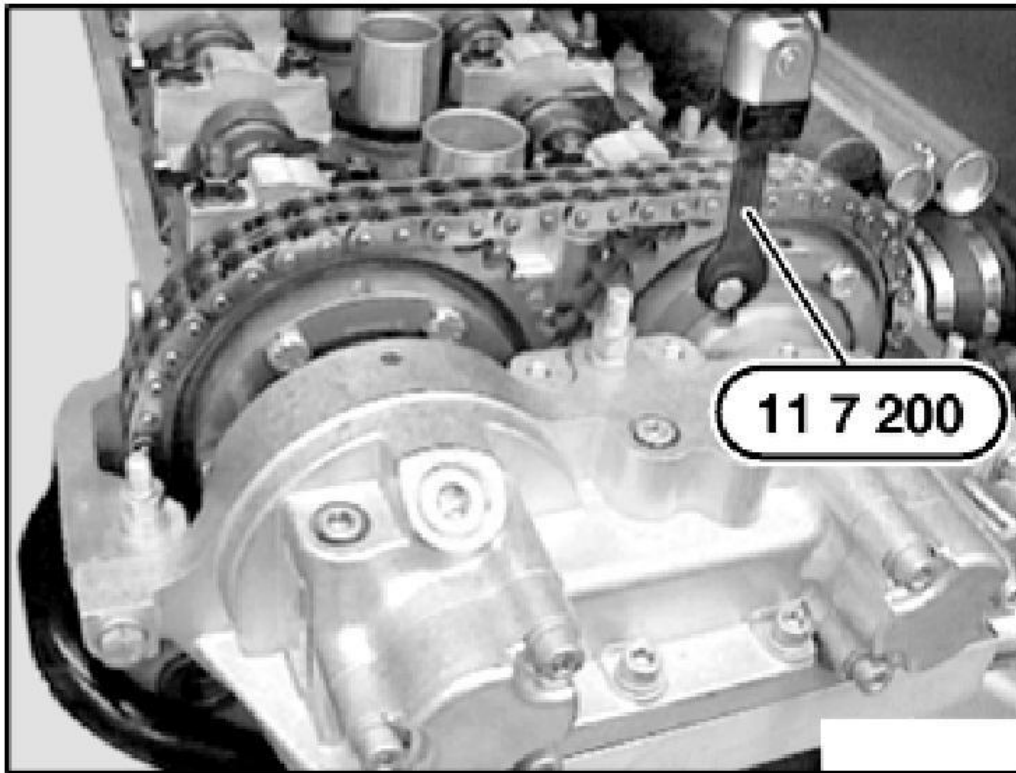


G03117917

Fig. 301: Identifying Retaining Screws On VANOS Adjustment Unit

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Use special tool 11 7 200 to tighten down bolts on VANOS gear.

**G03117918****Fig. 302: Installing Bolts On VANOS Gear**

Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down six accessible screws (three on exhaust side and three on inlet side) on VANOS gear to 10 N.m.

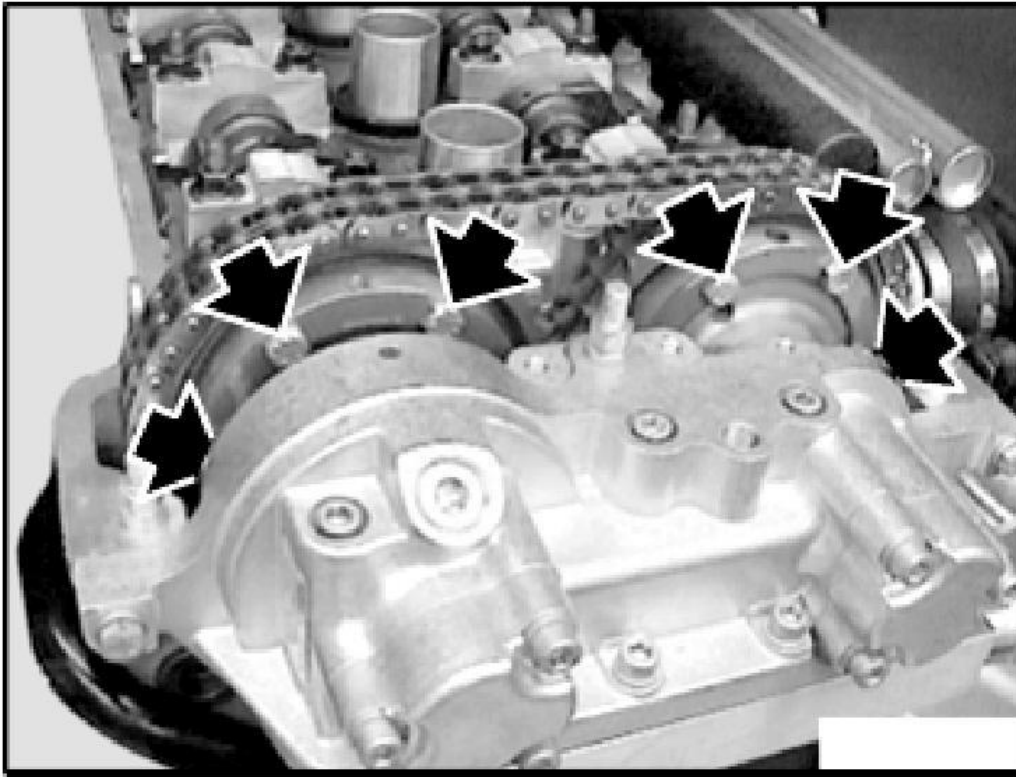
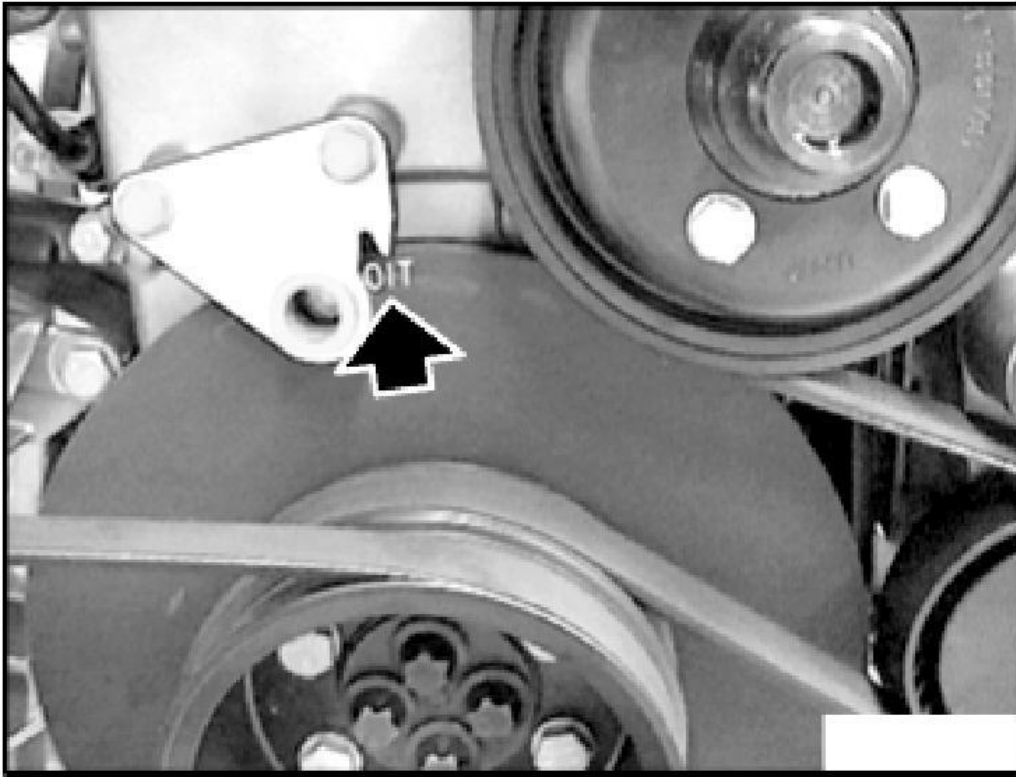
**G03117919**

Fig. 303: Locating Six Accessible Screws On VANOS Gear
Courtesy of BMW OF NORTH AMERICA, INC.

Remove special tool 11 2 300. Rotate crankshaft in direction of rotation a further revolution up to overlap TDC position.

NOTE: TDC allocation above marking on vibration damper is sufficient.



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Fig. 304: Rotating Crankshaft To Overlap TDC Position
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Use special tool 11 7 200 to tighten down bolts on VANOS gear.

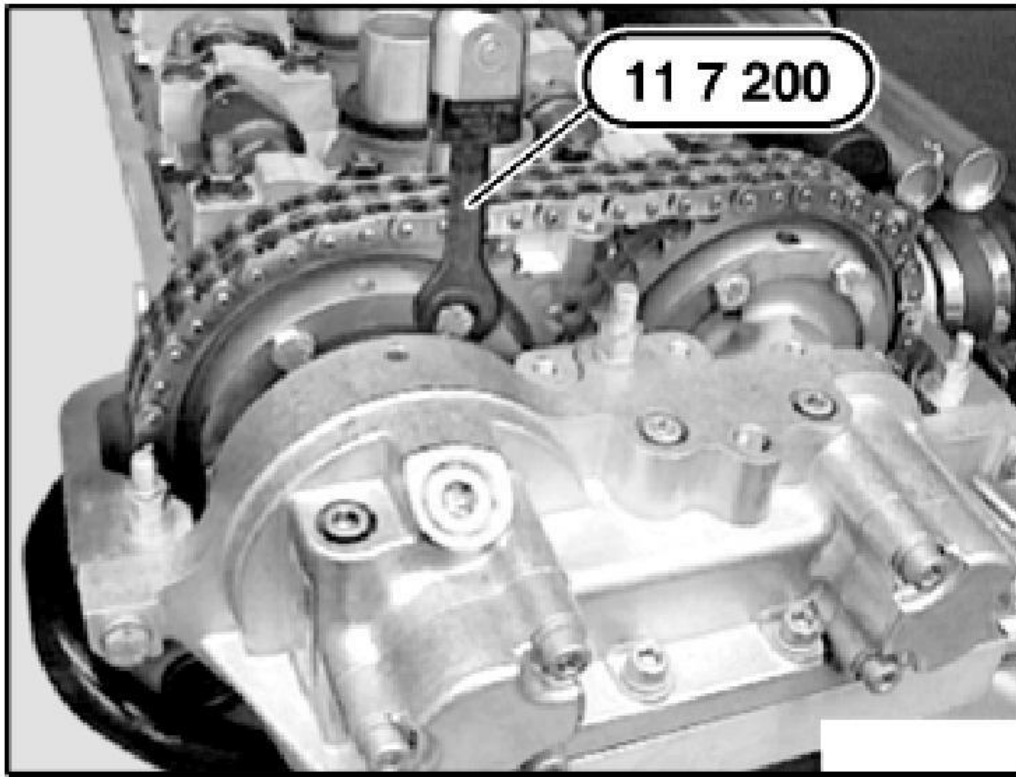
**G03117921**

Fig. 305: Installing Bolts On VANOS Gear
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down remaining six screws (three on exhaust side and three on inlet side) on VANOS gear 10 N.m.

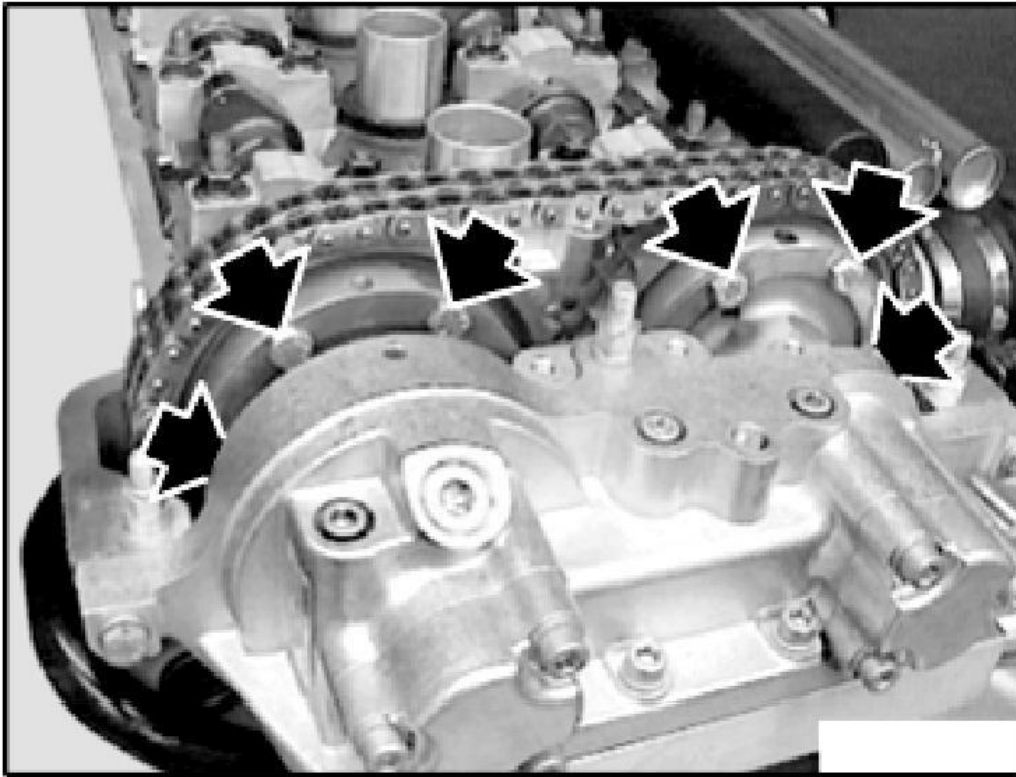
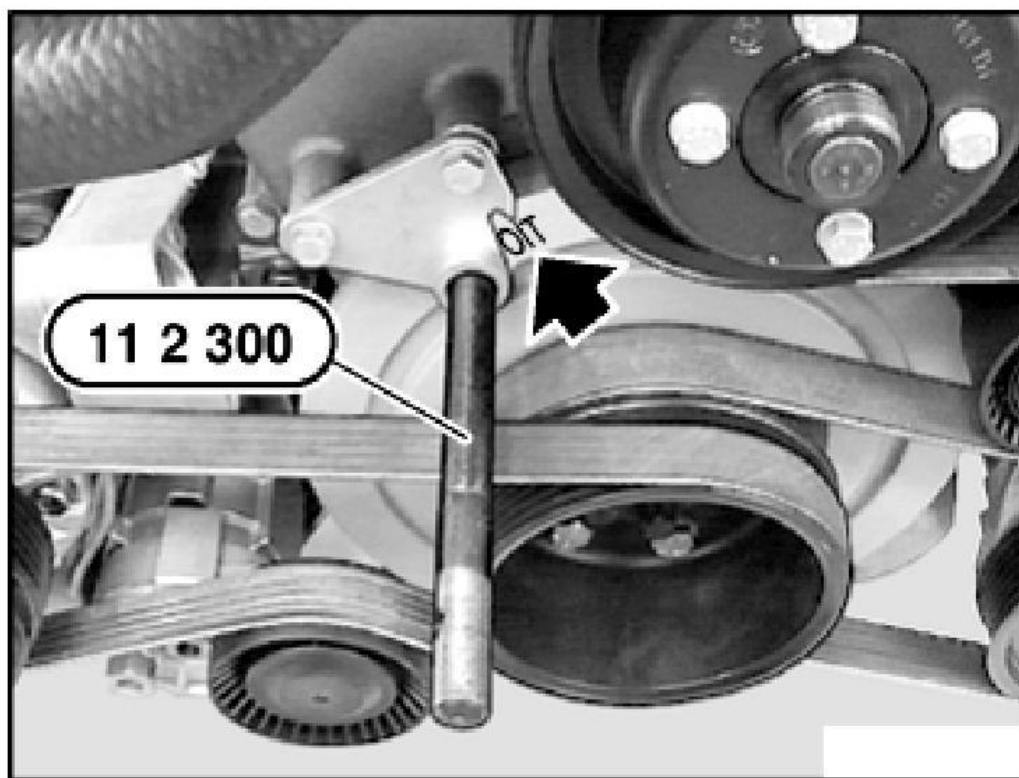
**G03117922**

Fig. 306: Installing Remaining Screws On VANOS Gear
Courtesy of BMW OF NORTH AMERICA, INC.

Then crank engine again in direction of rotation until 1st cylinder is at TDC firing position.

Secure vibration damper in position with special tool 11 2 300.



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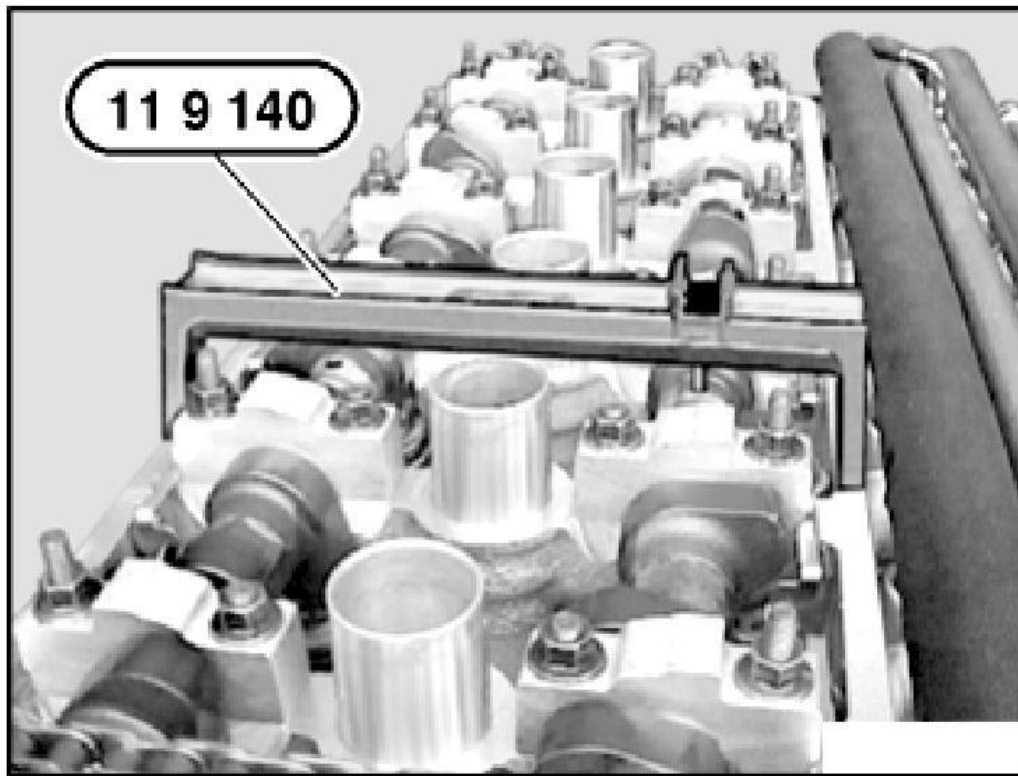
Fig. 307: Securing Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

Check camshaft setting:

Attach special tool 11 9 140 and join in inlet camshaft.

NOTE: The inlet camshaft is correctly adjusted when special tool 11 9 140 rests flat on the cylinder head or protrudes by max. 0.5 mm to the exhaust side.

If the special tool 11 9 140 protrudes to the inlet side, the timing must be readjusted.



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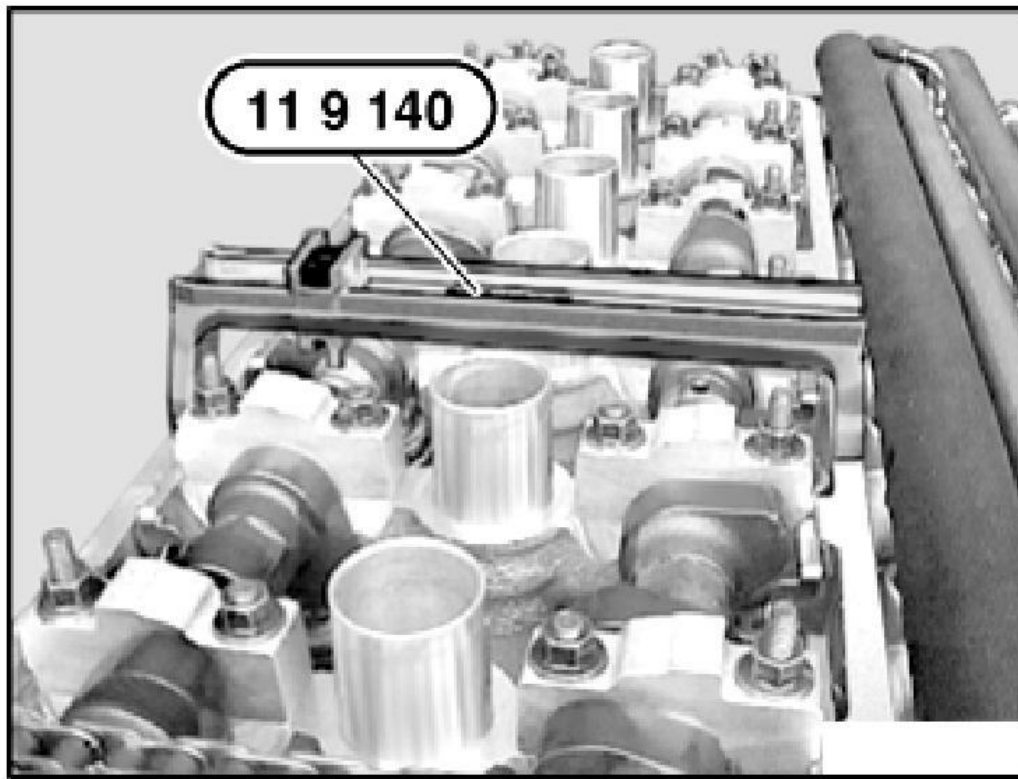
Fig. 308: Attaching Gauge To Inlet Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

Join special tool 11 9 140 in exhaust camshaft.

NOTE: The exhaust camshaft is correctly adjusted when special tool 11 9 140 rests flat on the cylinder head or protrudes by max. 0.5 mm to the exhaust side.

If the special tool 11 9 140 protrudes to the inlet side, the timing must be readjusted.

If necessary, adjust camshaft timing. Refer to **11 31 505 ADJUSTING CAMSHAFT TIMING (S54)**.

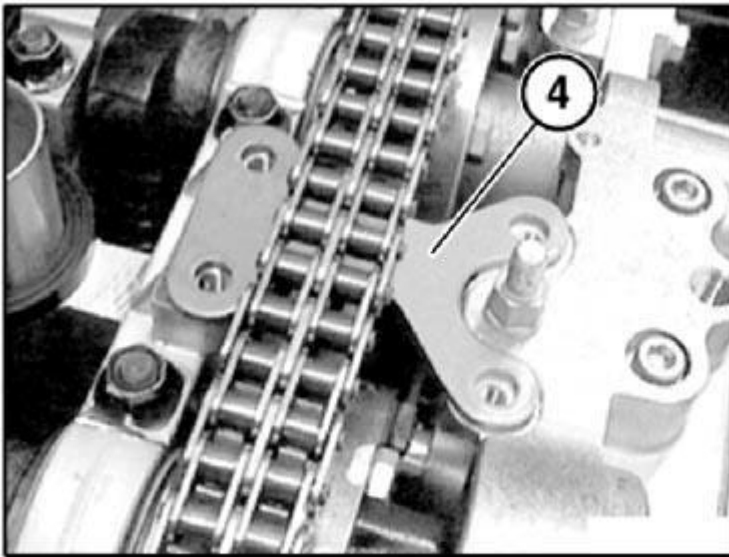


G03117925

Fig. 309: Attaching Gauge To Exhaust Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Check installed direction.

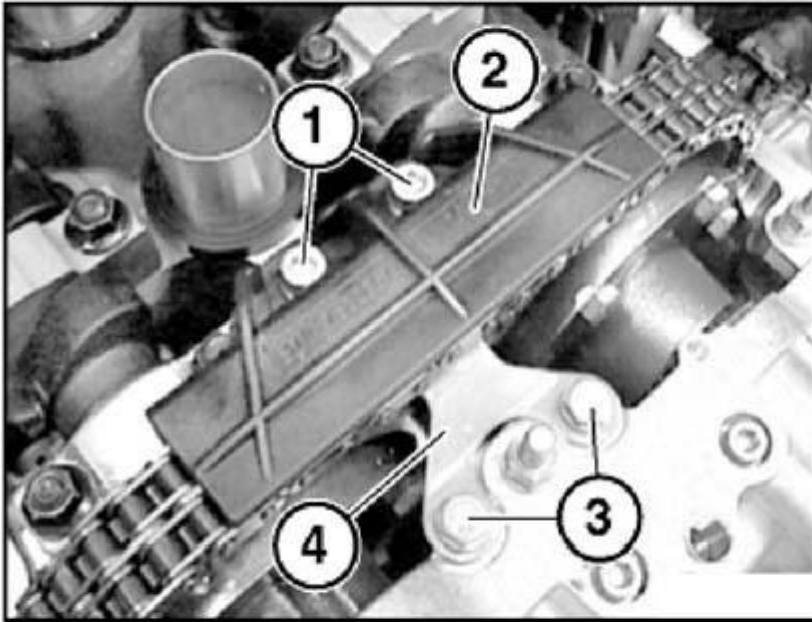
Install holder (4)



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Fig. 310: Installing Holder**Courtesy of BMW OF NORTH AMERICA, INC.**

- Insert screws (3) and secure holder (4) (do not tighten down screws (3) yet)
- Install sliding rail (2).
- Insert screws (1).
- Tighten down screws (1) and screws (3).

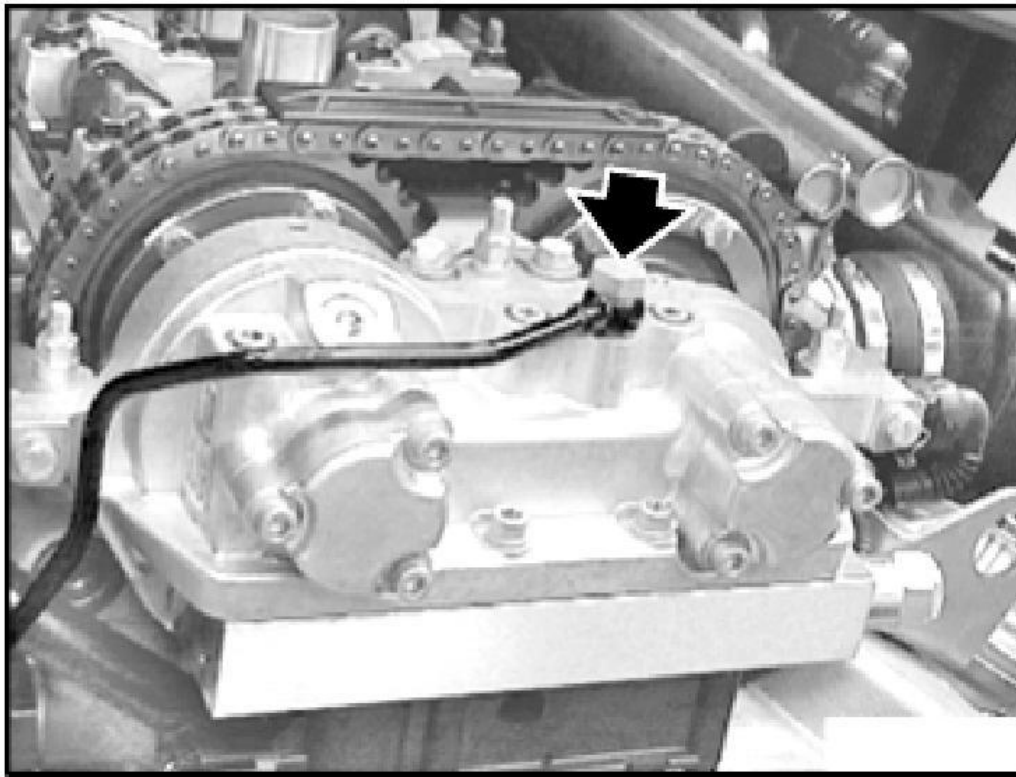


G03117927

Fig. 311: View Of Sliding Rail**Courtesy of BMW OF NORTH AMERICA, INC.**

Replace sealing rings of banjo bolt.

Insert banjo bolt but do not tighten down yet.



G03117928

Fig. 312: Locating Banjo Bolt

Courtesy of BMW OF NORTH AMERICA, INC.

Install bracket of oil line. Install screw and tighten down.

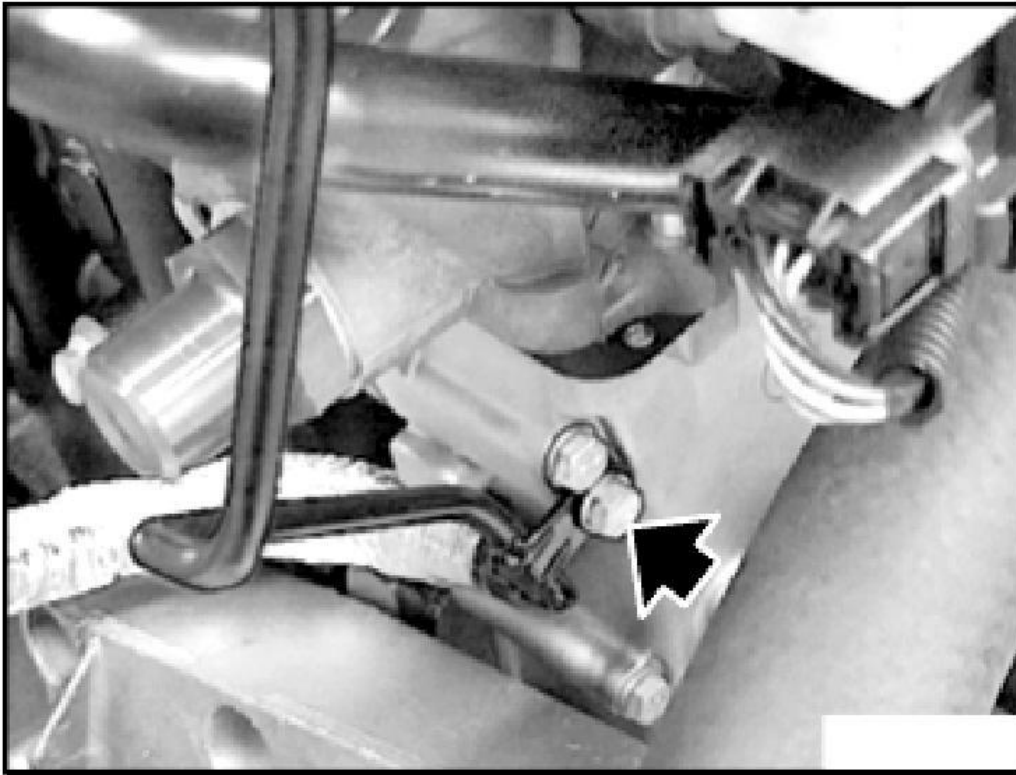
**G03117929**

Fig. 313: Identifying Bracket Of Oil Line
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down banjo bolt of oil line.

Tightening torque, refer to 11 36 9AZ in **ENGINE - TIGHTENING TORQUES** .

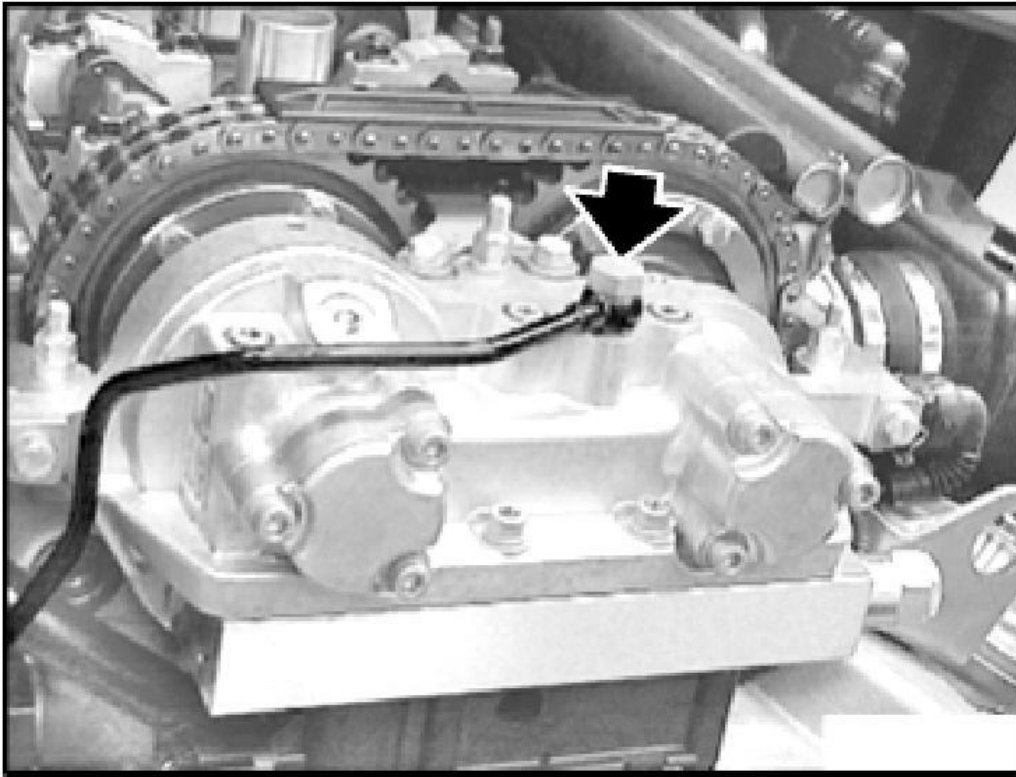
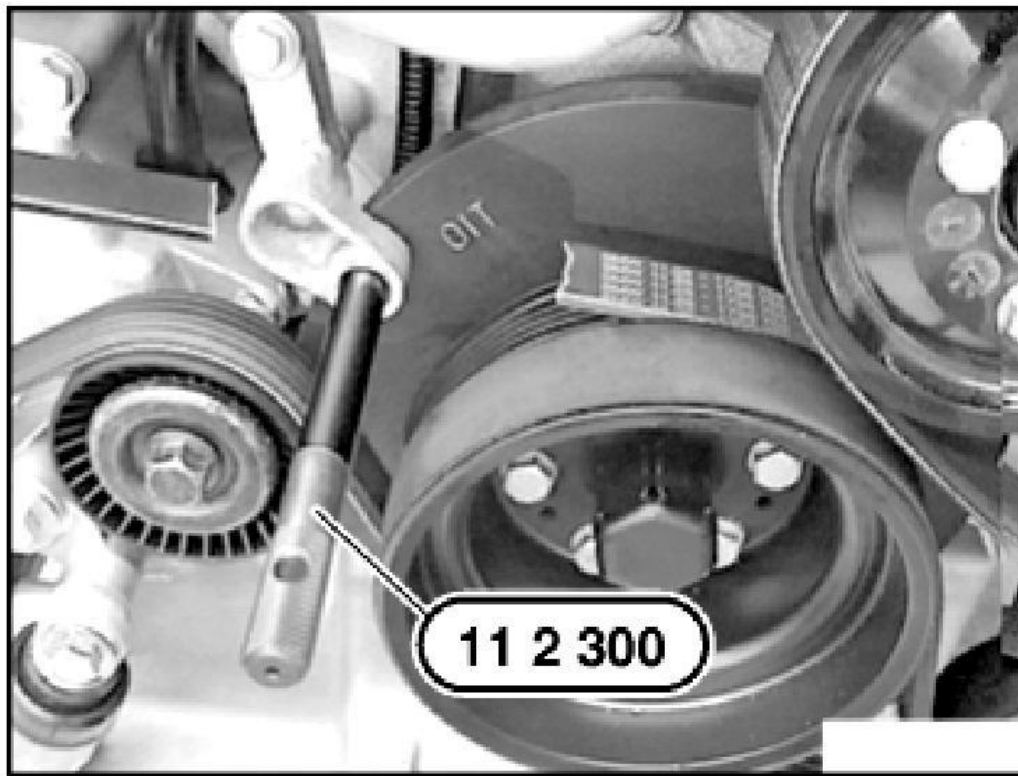
**G03117930**

Fig. 314: Tightening Down Banjo Bolt Of Oil Line
Courtesy of BMW OF NORTH AMERICA, INC.

Remove special tool 11 2 300.

Adjust valves. Refer to **11 34 004 ADJUSTING VALVE CLEARANCE (S54)**.

Assemble engine.



G03117931

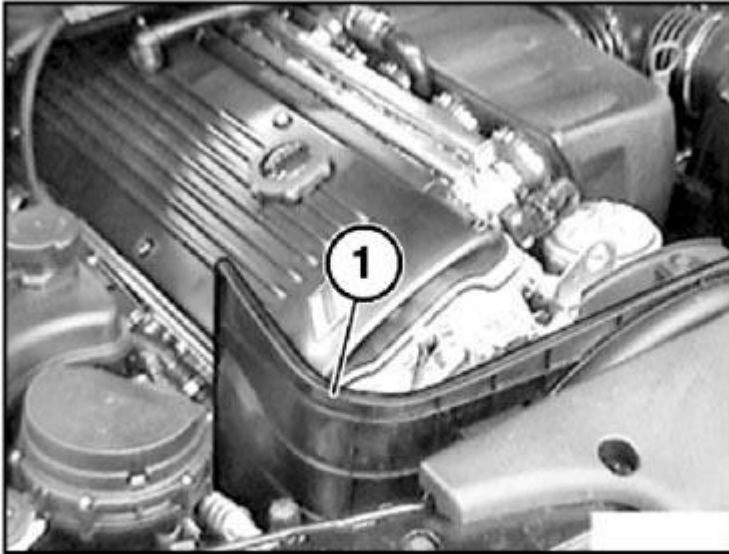
Fig. 315: Removing Plug Mandrel From Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: There is air in the VANOS system once it is opened. In the first few seconds after startup this results in a clearly discernible "rattling noise". This rattling noise does "not" indicate incorrect assembly. The rattling noise will disappear as soon as the oil pressure has built up and the system has vented.

11 31 090 REMOVING AND INSTALLING/REPLACING CHAIN TENSIONING PISTON (S54)

E46 Only:

Remove expansion rivet. Remove air duct (1).



G03117932

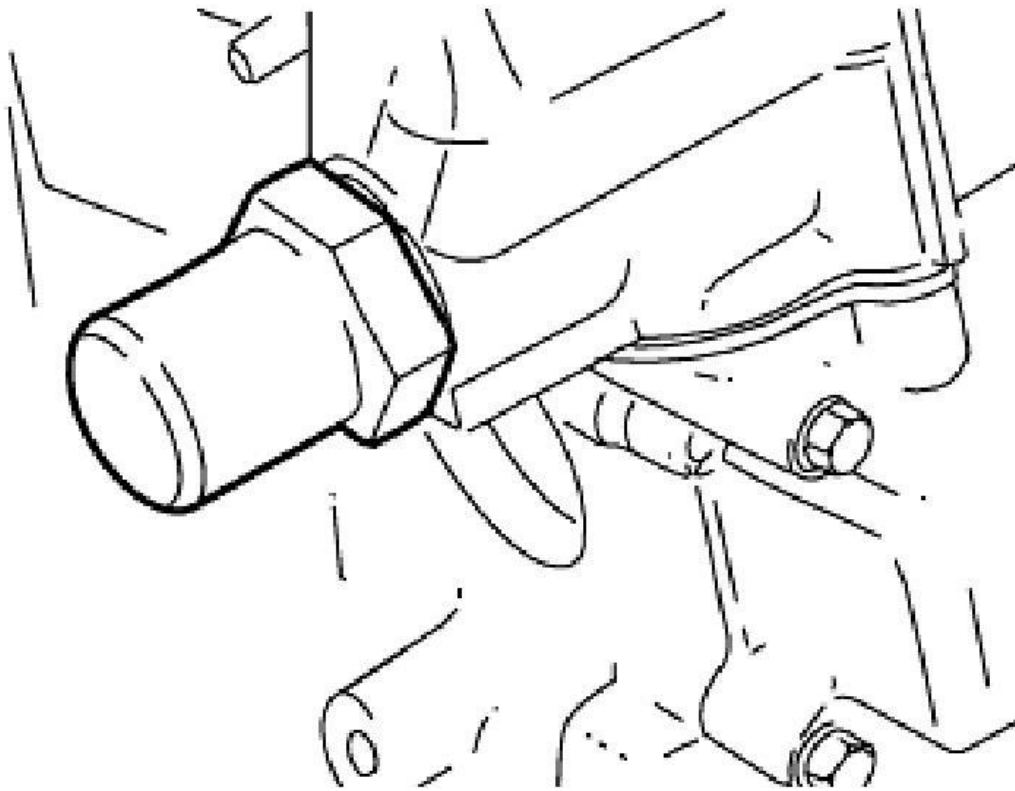
Fig. 316: View Of Air Duct

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Strong spring force. Have a cleaning cloth ready. A small quantity of oil will emerge after the screw connection has been released. Make sure no oil runs onto belt drive. Remove any remnants of oil immediately with cleaning cloth.

Unfasten screw connection.

Remove chain tensioning piston. Refer to **11 31 090 REMOVING AND INSTALLING/REPLACING CHAIN TENSIONING PISTON (S54)**.



G03117933

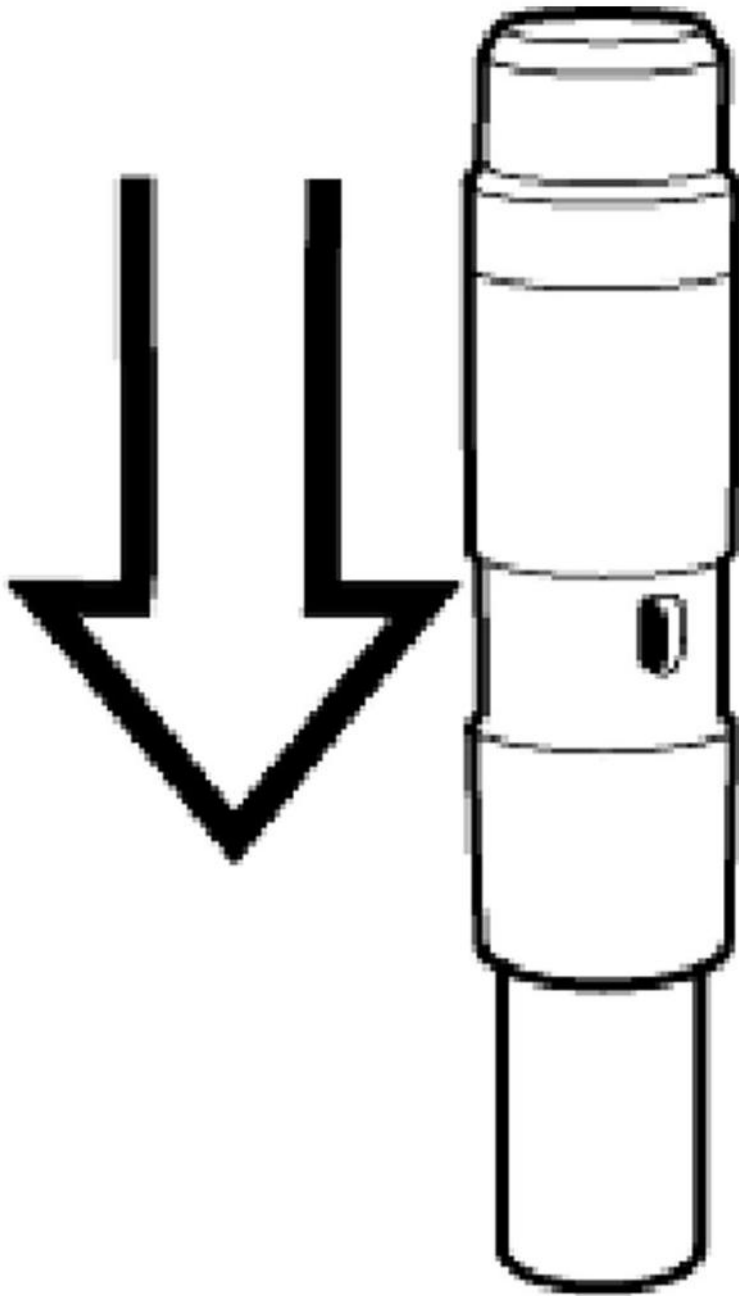
Fig. 317: Removing Chain Tensioning Piston
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

If a chain tensioner is reused, its oil chamber must be drained.

Place chain tensioner on a level surface and compress slowly and carefully.

Repeat this procedure twice.



G03117934

Fig. 318: Identifying Chain Tensioning Piston
Courtesy of BMW OF NORTH AMERICA, INC.

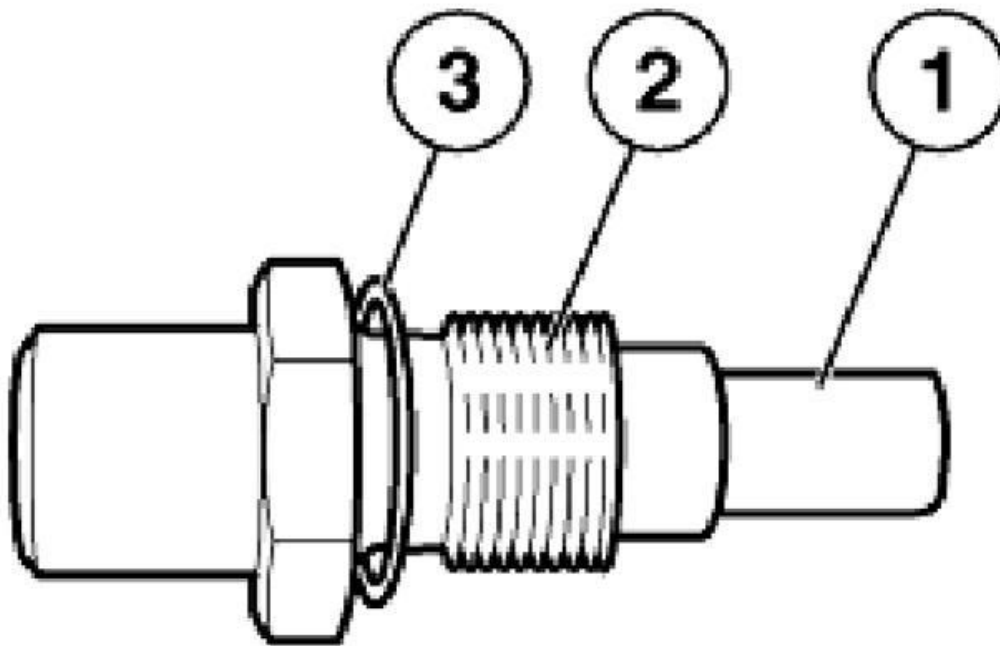
Installation:

Install hydraulic chain tensioner (1) in cylinder for chain tensioning piston (2).

Replace sealing ring (3).

Install and tighten down cylinder for chain tensioning piston (2).

Tightening torque, refer to 11 31 8AZ in **ENGINE - TIGHTENING TORQUES** .



G03117935

Fig. 319: Identifying Sealing Ring

Courtesy of BMW OF NORTH AMERICA, INC.

11 31 505 ADJUSTING CAMSHAFT TIMING (S54)

Special Tools Required:

- 11 2 300
- 11 5 100
- 11 7 160
- 11 7 200

- 11 7 342
- 11 9 130
- 11 9 140
- 11 9 170
- 12 6 050
- 12 6 410
- 12 6 411

(Refer to **11 31 005 CHECKING CAMSHAFT TIMING (S54).**)

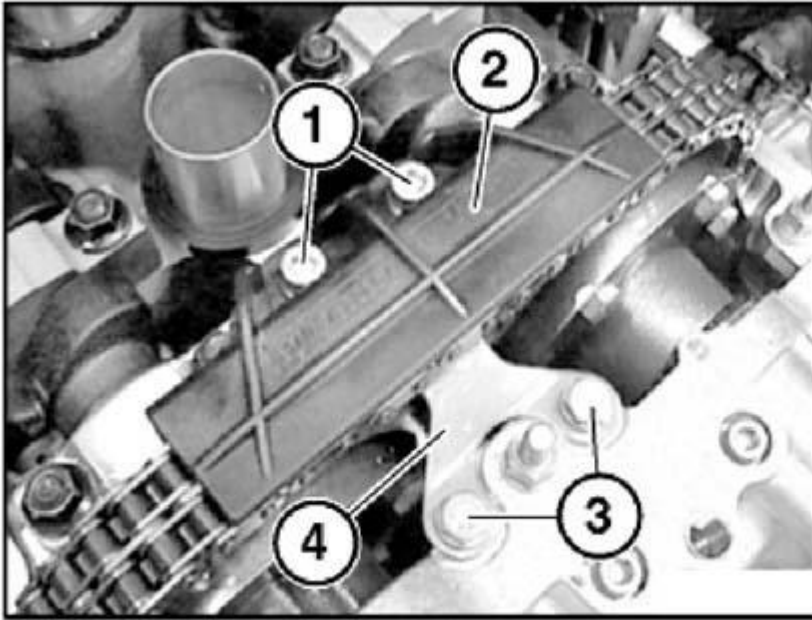
When the engine is switched off, VANOS moves the camshafts to a position which is advantageous to engine starting.

CAUTION: The timing must "not" be adjusted in this position. The camshafts must be rotated back to their initial position beforehand and the timing checked.

Check camshaft timing. Refer to **11 31 005 CHECKING CAMSHAFT TIMING (S54).**

If the timing check reveals an impermissible deviation, the VANOS adjustment unit must be removed and the camshaft timing readjusted.

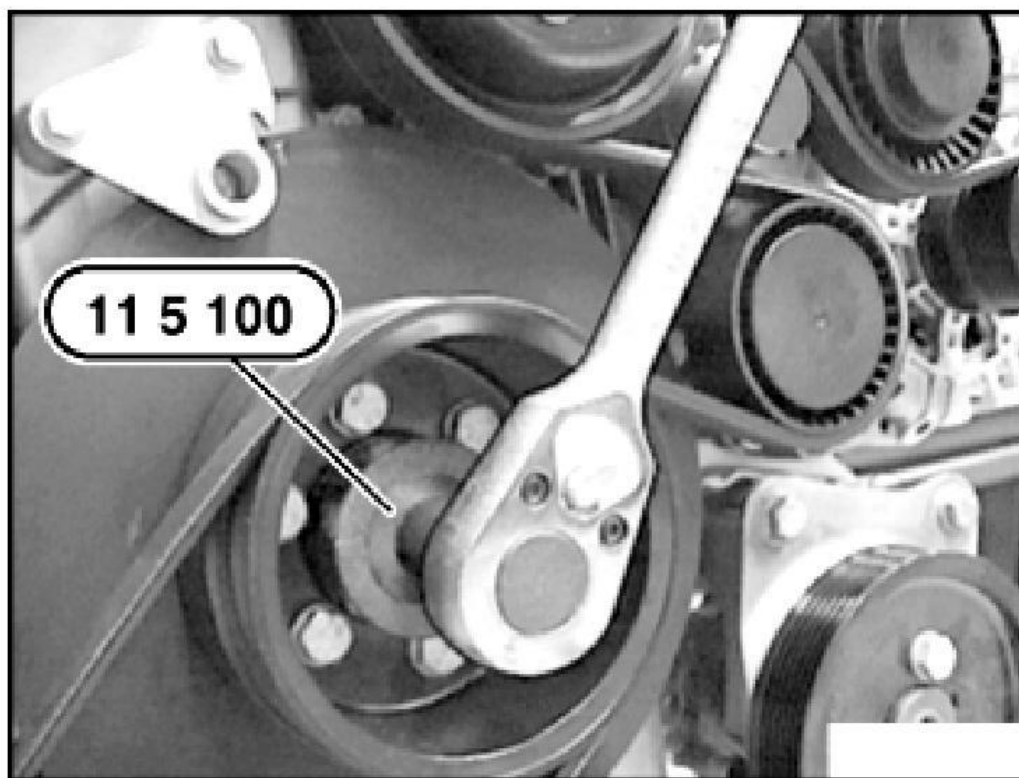
- Release screws (1).
- Remove sliding rail (2).
- Release screws (3).
- Remove holder (4).



G03117936

Fig. 320: Locating Sliding Rail**Courtesy of BMW OF NORTH AMERICA, INC.**

Attach special tool 11 5 100 to four screws of crankshaft hub.

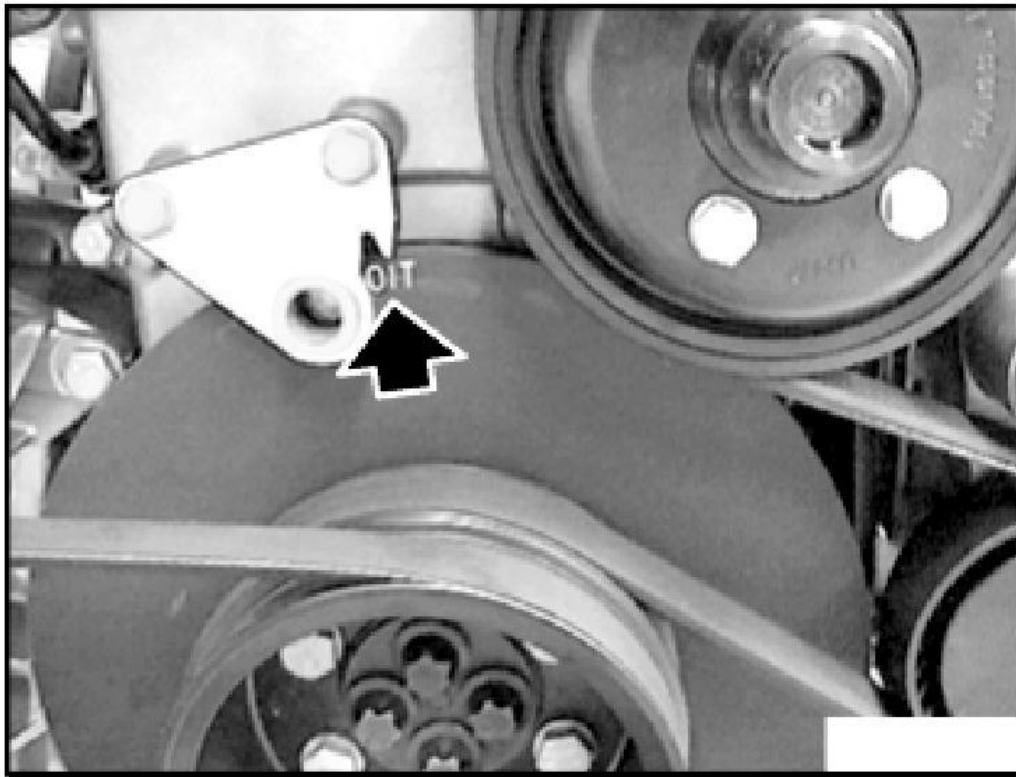


G03117937

Fig. 321: Attaching Adapter With Socket Wrench To Crankshaft Hub Screws
Courtesy of BMW OF NORTH AMERICA, INC.

Remove special tool 11 2 300. Rotate crankshaft in direction of rotation a further revolution up to overlap TDC position.

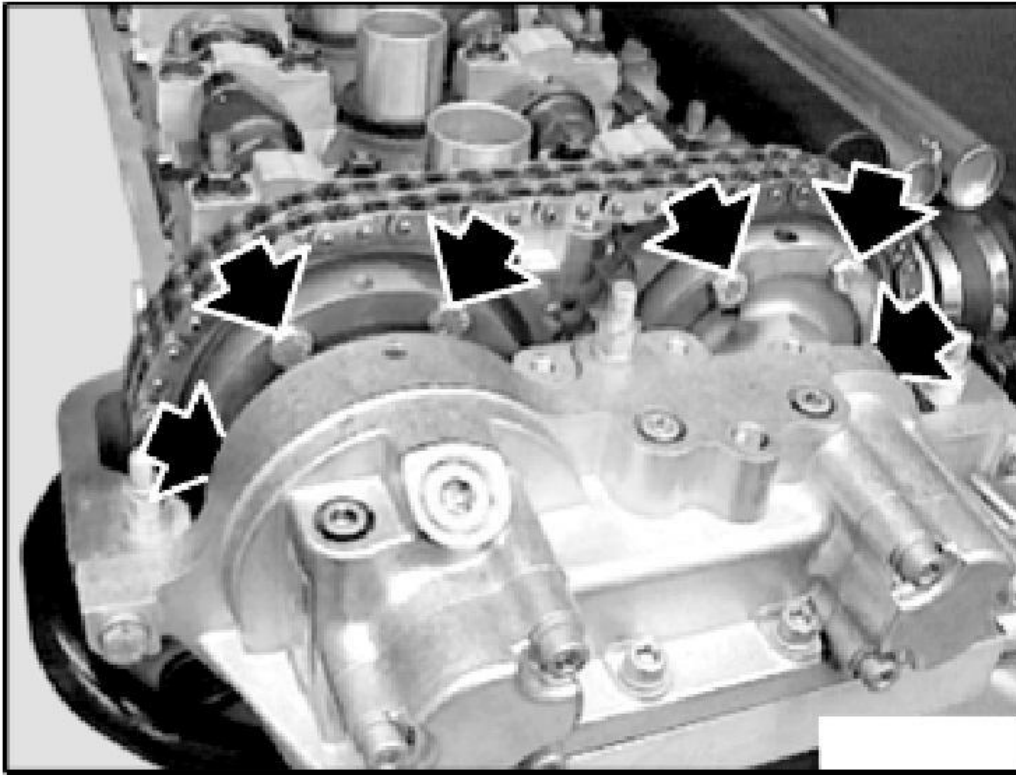
NOTE: TDC allocation above marking on vibration damper is sufficient.



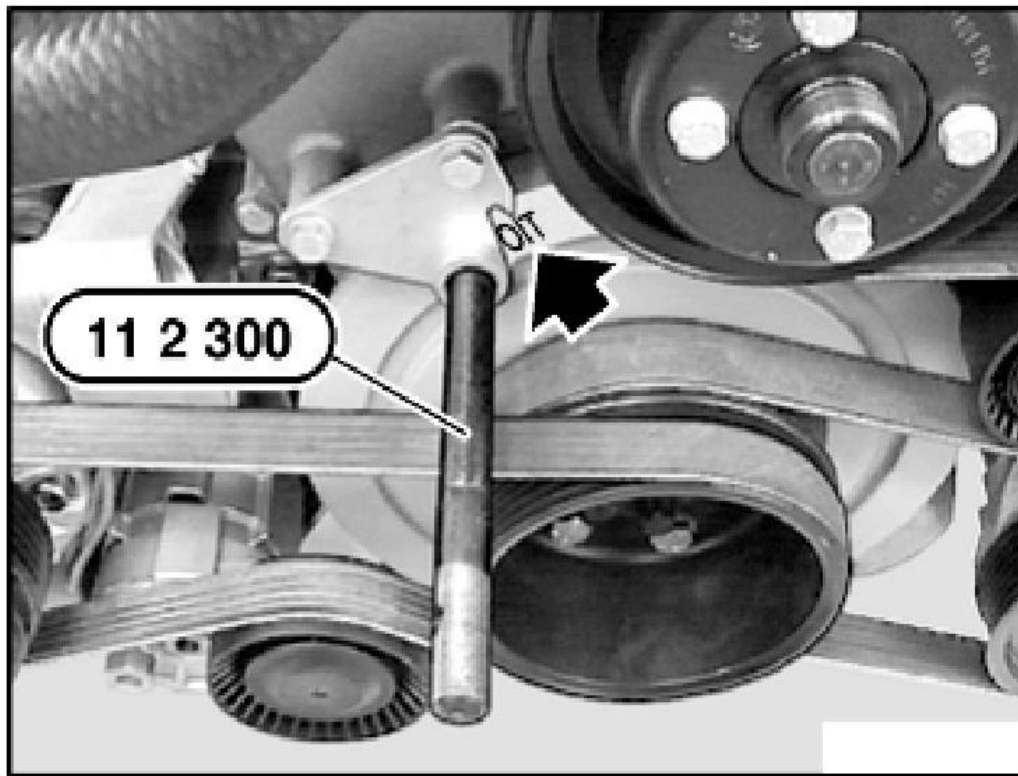
G03117938

Fig. 322: Removing Plug Mandrel From Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

Slacken six accessible bolts two turns.

**G03117939****Fig. 323: View Of Accessible Bolts****Courtesy of BMW OF NORTH AMERICA, INC.**

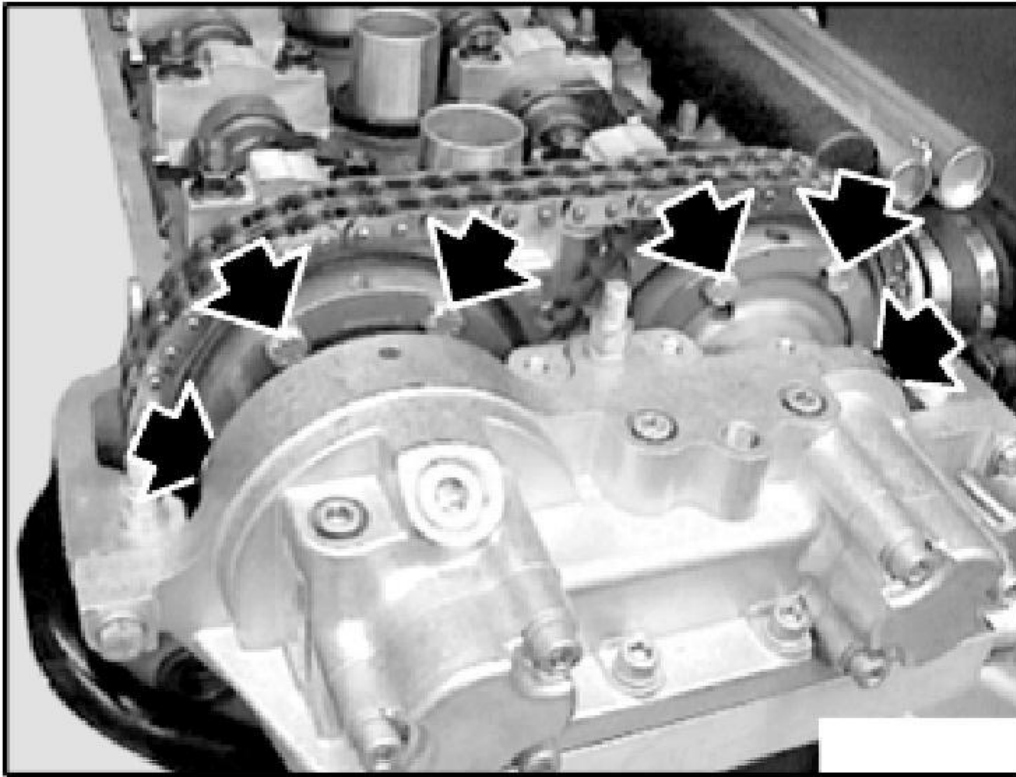
Crank engine at central bolt in direction of rotation until 1st cylinder is at TDC firing position. Secure vibration damper in position with special tool 11 2 300.



G03117940

Fig. 324: Securing Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

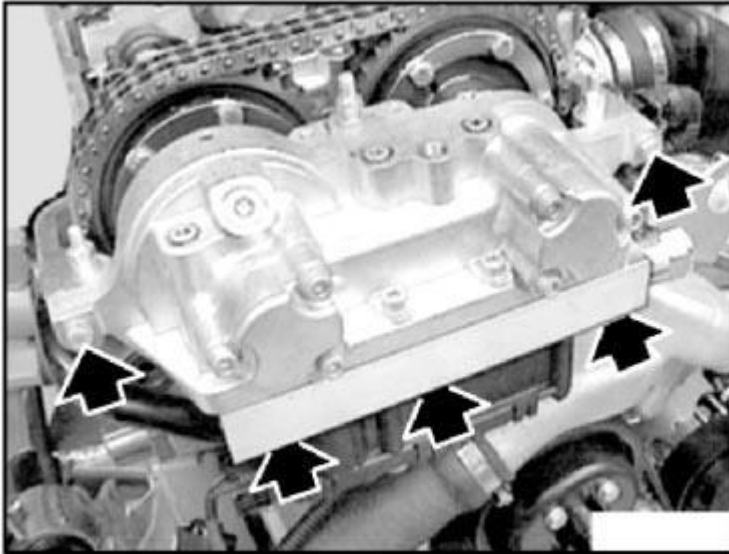
Slacken remaining six bolts two turns.



G03117941

Fig. 325: Identifying Remaining Bolts
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws on VANOS adjustment unit.

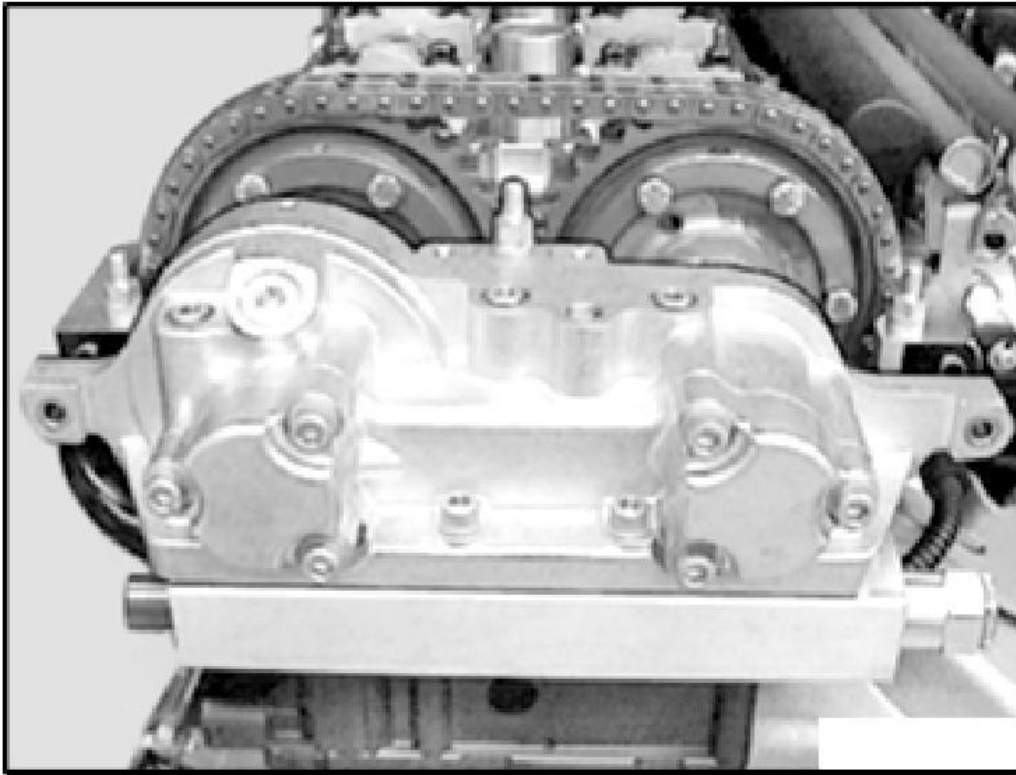


G03117942

Fig. 326: Releasing Screws On VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Do not damage VANOS adjustment unit.

Carefully detach VANOS adjustment unit.



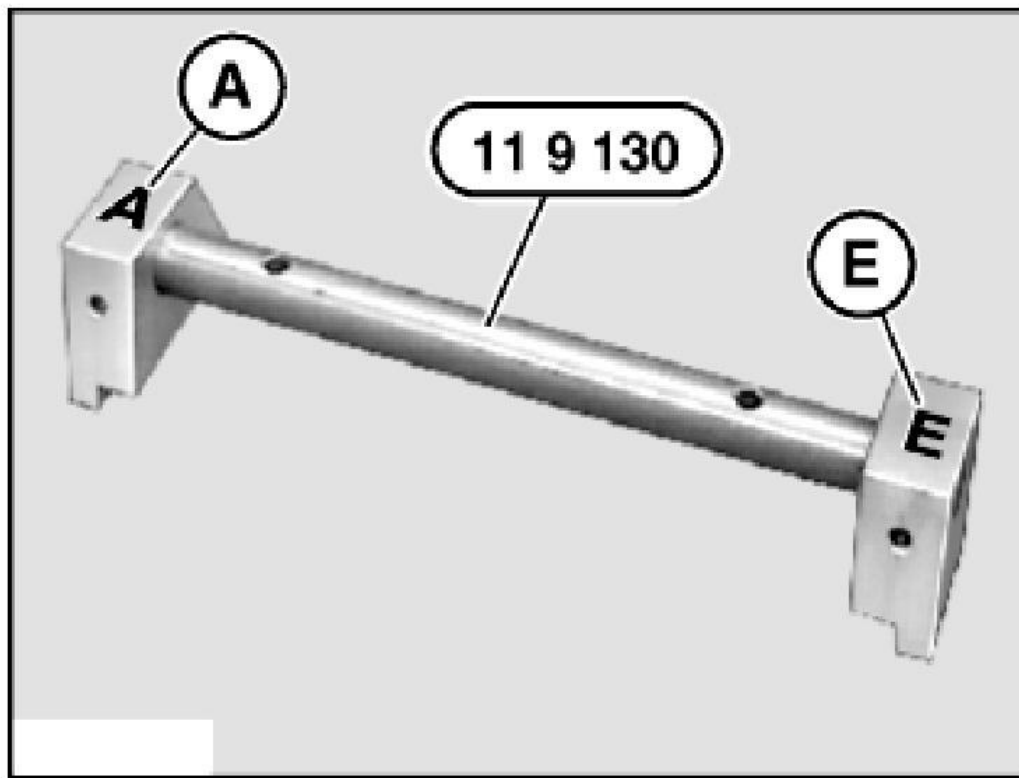
G03117943

Fig. 327: Detaching VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Pay attention to installation direction of special tool 11 9 130.

(A) Exhaust side.

(E) Inlet side.



G03117944

Fig. 328: Identifying Setting Gauge

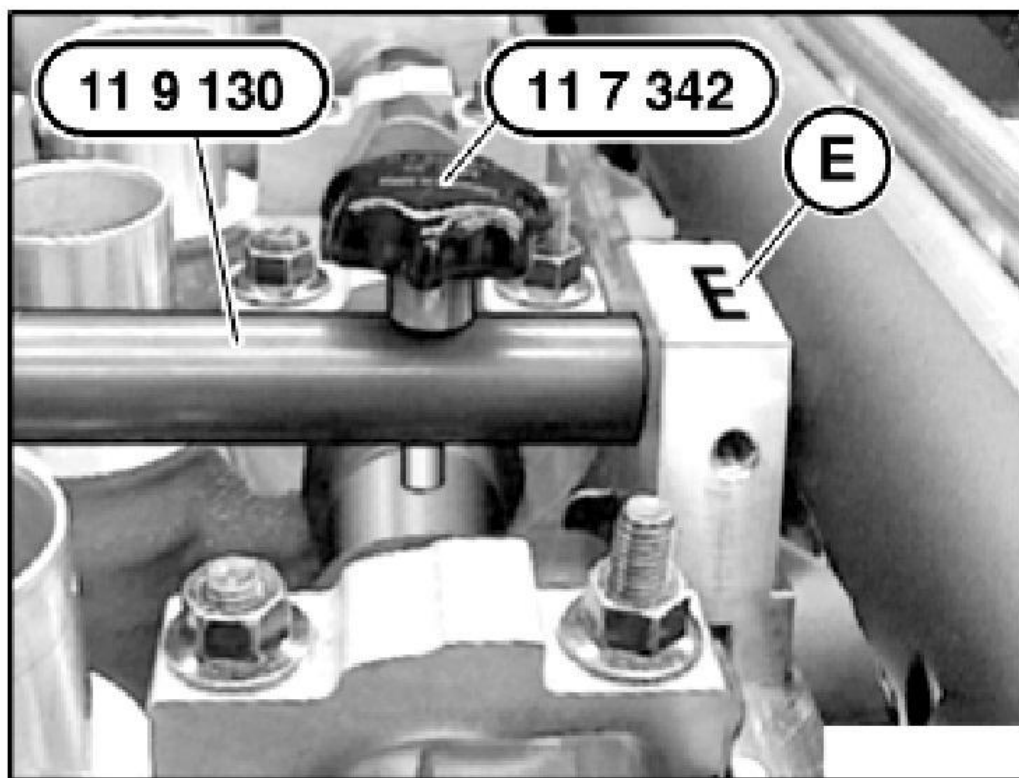
Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

CAUTION: Pay attention to installation direction of special tool 11 9 130.

Attach special tool 11 9 130 to cylinder head. Align inlet camshaft at hexagon until special tool 11 7 342 can be joined by means of special tool 11 9 130 in locating bore.

Special tool 11 9 130 must rest flat on cylinder head. Remove special tool 11 7 342.



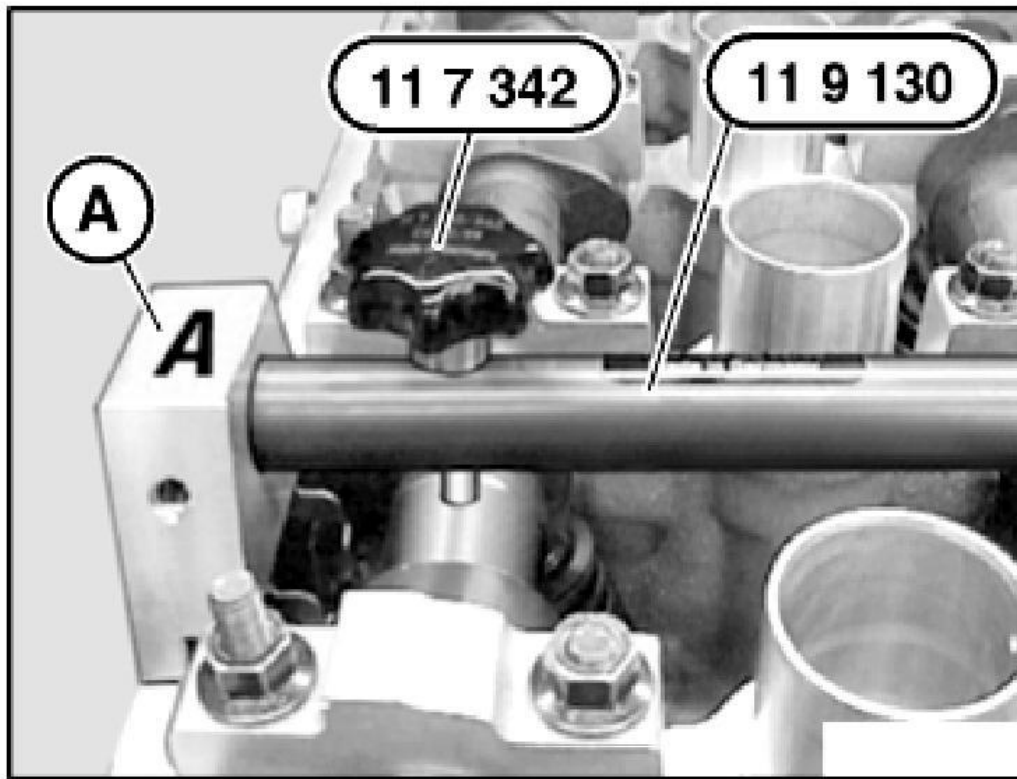
G03117945

Fig. 329: Attaching Setting Gauge To Cylinder Head
Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

Align exhaust camshaft at hexagon until special tool 11 7 342 can be joined by means of special tool 11 9 130 in locating bore.

Special tool 11 9 130 must rest flat on cylinder head. Remove special tool 11 9 130 and special tool 11 7 342.

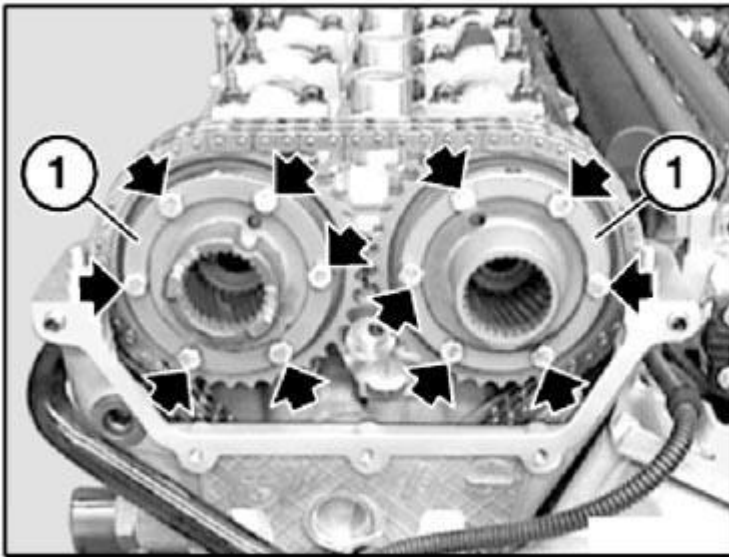


G03117946

Fig. 330: Aligning Exhaust Camshaft**Courtesy of BMW OF NORTH AMERICA, INC.**

Tighten all screws of spline hub (1) on inlet and outlet sides by hand until free from play.

Then slacken screws again until spline hubs (1) can be moved) with fingers.



G03117947

Fig. 331: Locating Screws Of Spline Hub On Inlet And Outlet Sides
Courtesy of BMW OF NORTH AMERICA, INC.

Detach control valve (1) from VANOS adjustment unit.

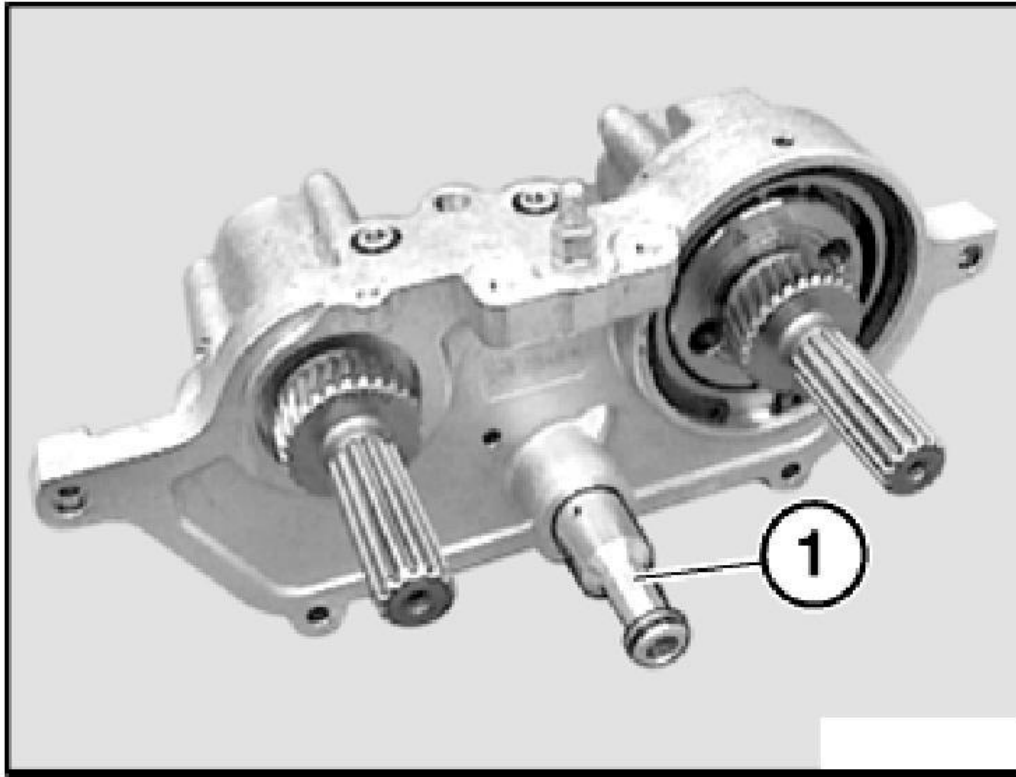
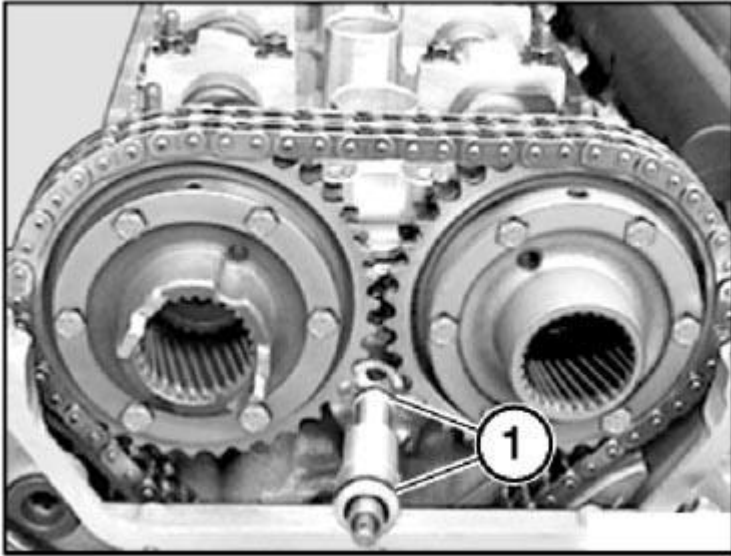
**G03117948**

Fig. 332: View Of Control Valve From VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: **A filter is integrated in the control valve.**

In the event of engine damage which suggests that the filter is contaminated with swarf/chips, it is essential to replace the control valve.

Replace sealing rings (1) and coat with oil as antiseize agent. Preassemble control valve in cylinder head.



G03117949

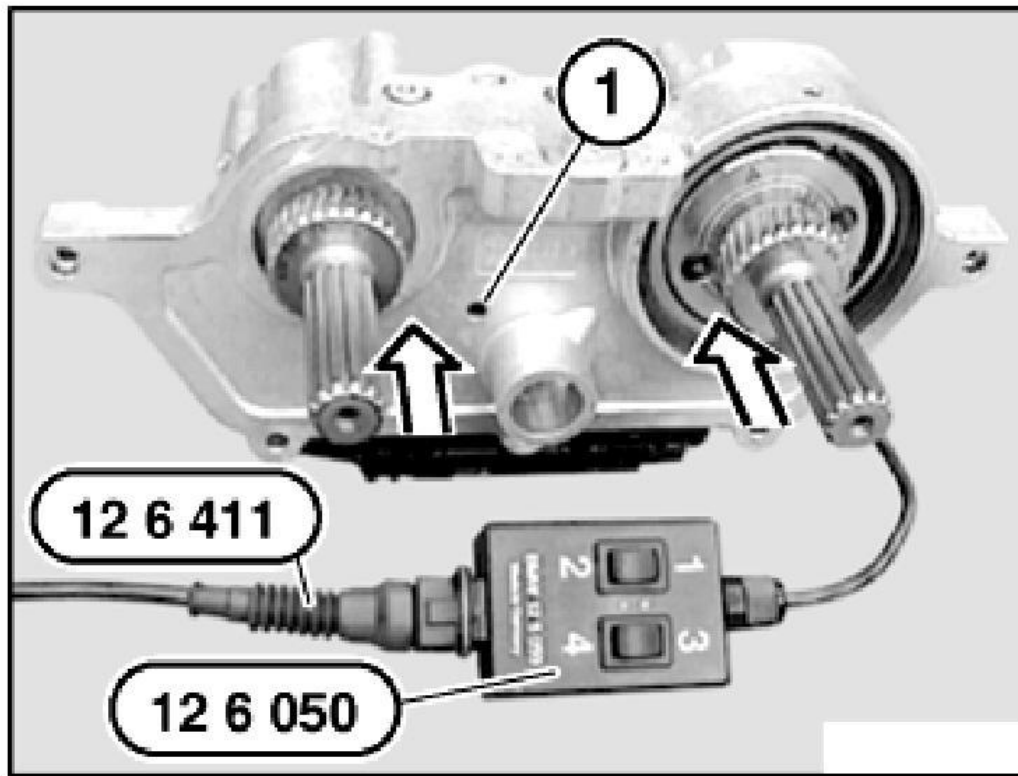
Fig. 333: Replacing Sealing Rings On Control Valve
Courtesy of BMW OF NORTH AMERICA, INC.

Oil is sprayed when splined shafts are pressed back. Cover bore (1) with a cloth.

Connect special tool 12 6 050 in conjunction with special tool 12 6 411 (from special tool kit 12 6 410) to solenoid valves of VANOS adjustment unit. Connect special tool 12 6 411 to correct terminals on car battery.

Press buttons 1 and 3 on special tool 12 6 050 simultaneously. Solenoid valves are actuated.

Press splined shafts by hand up to stop into initial position.

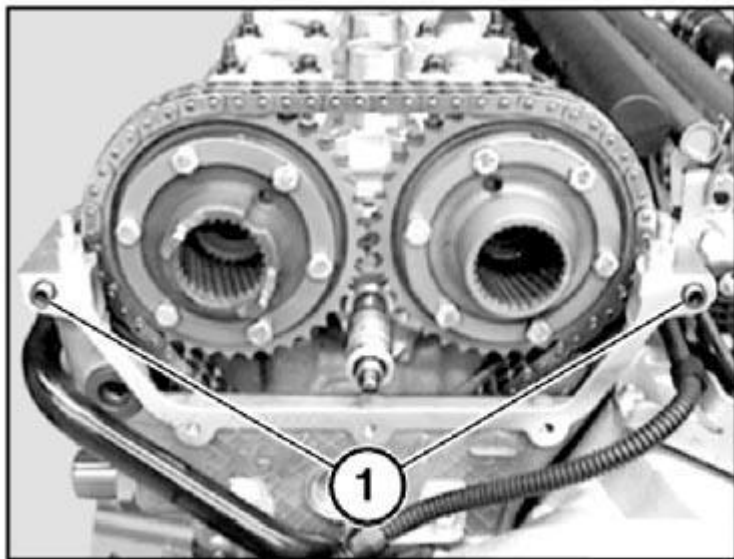


G03117950

Fig. 334: Identifying Switching Unit

Courtesy of BMW OF NORTH AMERICA, INC.

Check adapter sleeves (1) for damage and correct installation position.



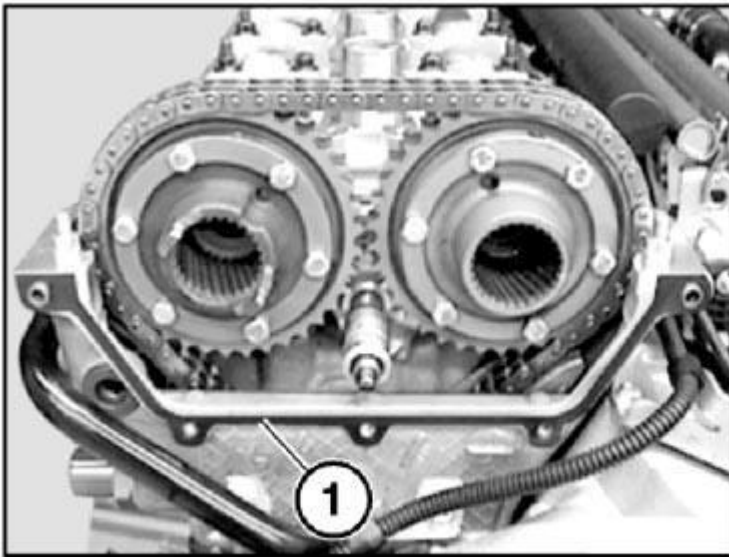
G03117951

Fig. 335: View Of Adapter Sleeves

Courtesy of BMW OF NORTH AMERICA, INC.

Replace gasket (1).

CAUTION: Note direction of installation of gasket. Install gasket (1) in such a way that beading points to VANOS adjustment unit. Secure gasket (1) with sealing compound on adapter H sleeves.

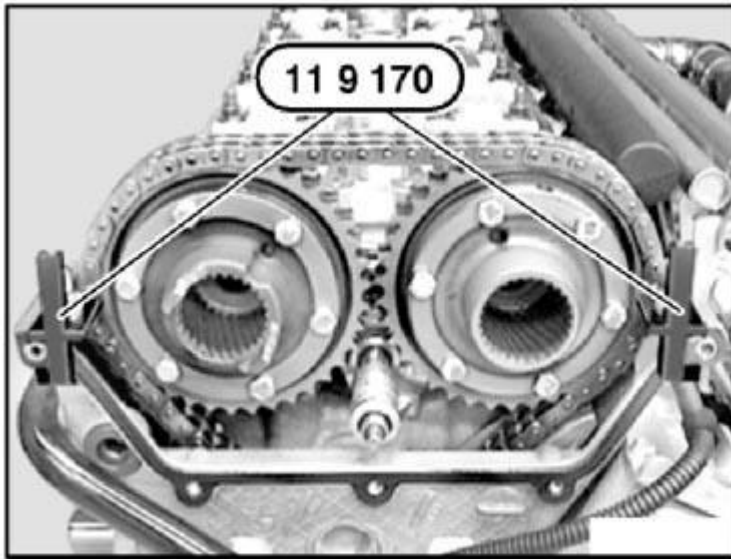


G03117952

Fig. 336: Replacing VANOS Adjustment Unit Gasket
Courtesy of BMW OF NORTH AMERICA, INC.

Secure special tool 11 9 170 - as shown in illustration - by means of stud bolt.

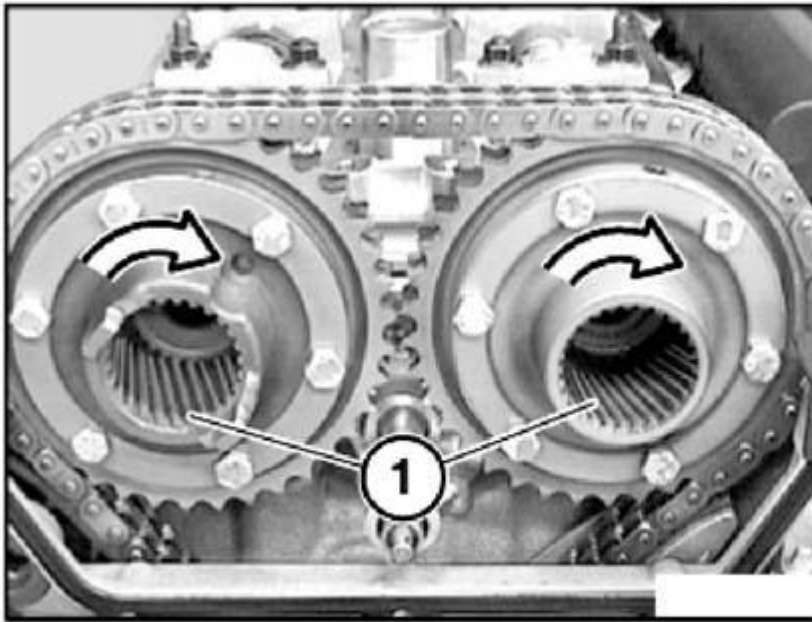
NOTE: **The special tool 11 9 170 serves to maintain a prespecified distance during the below-mentioned installation of the VANOS adjustment unit.**



G03117953

Fig. 337: Securing Spacer For Installation Of VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Turn spline hubs (1) of inlet and exhaust camshafts to right limit position

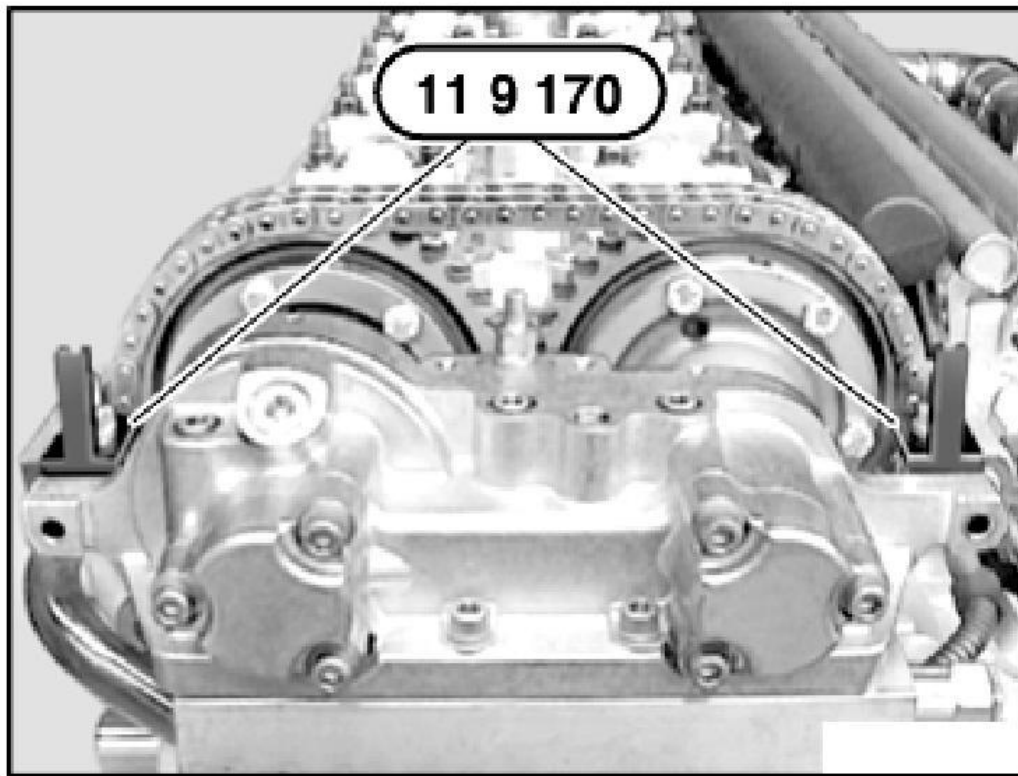


G03117954

Fig. 338: Turning Spline Hubs To Right Limit Position
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Special tool 11 9 170 remains as a spacer element between cylinder head and VANOS adjustment unit.

Attach VANOS adjustment unit.



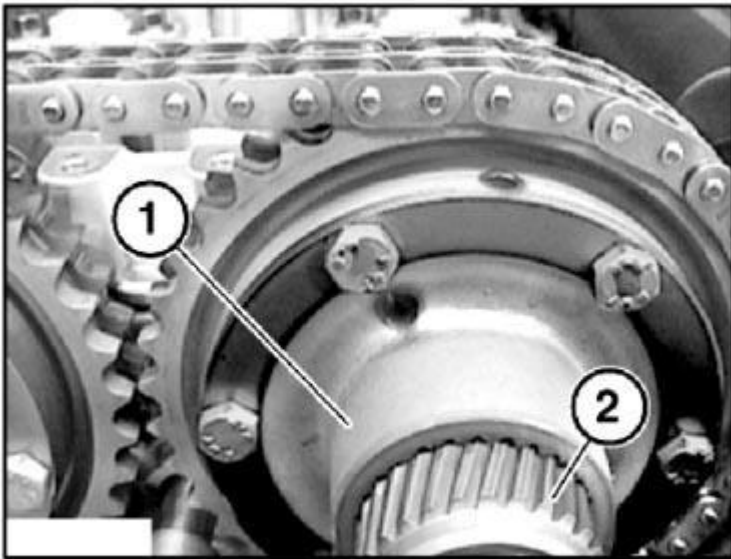
G03117955

Fig. 339: Attaching VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Make sure both VANOS splined shafts remain in initial position during installation.

Rotate splined shafts of inlet and exhaust sides until spur toothing is engaged.

Push VANOS adjustment unit with splined shaft into VANOS gear until helical cut splines (2) are positioned shortly before meshing with spline hub (1).



G03117956

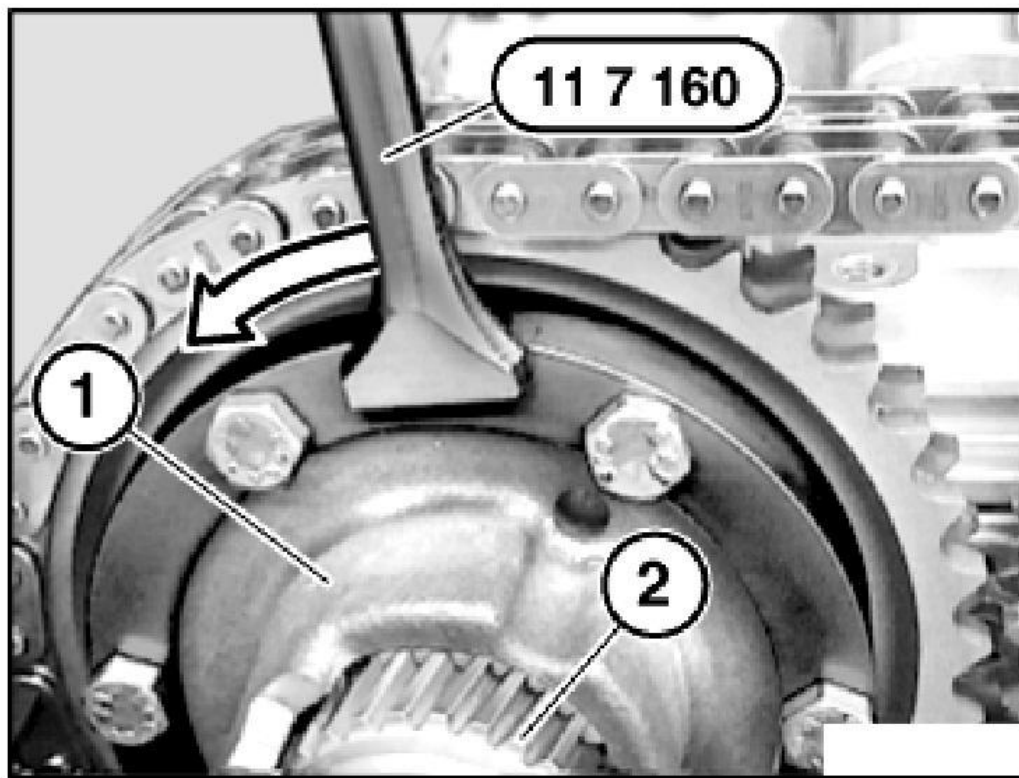
Fig. 340: Identifying Helical Cut Splines And Spline Hub
Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

If the helical cut splines cannot be pushed into the spline hub (1):

Place special tool 11 7 160 on bore in spline hub (1). Rotate spline hub (1) against direction of rotation until splined shaft (2) is positioned with spline hub (1) exactly "tooth-to-tooth gap".

CAUTION: The "first" matching tooth must engage.



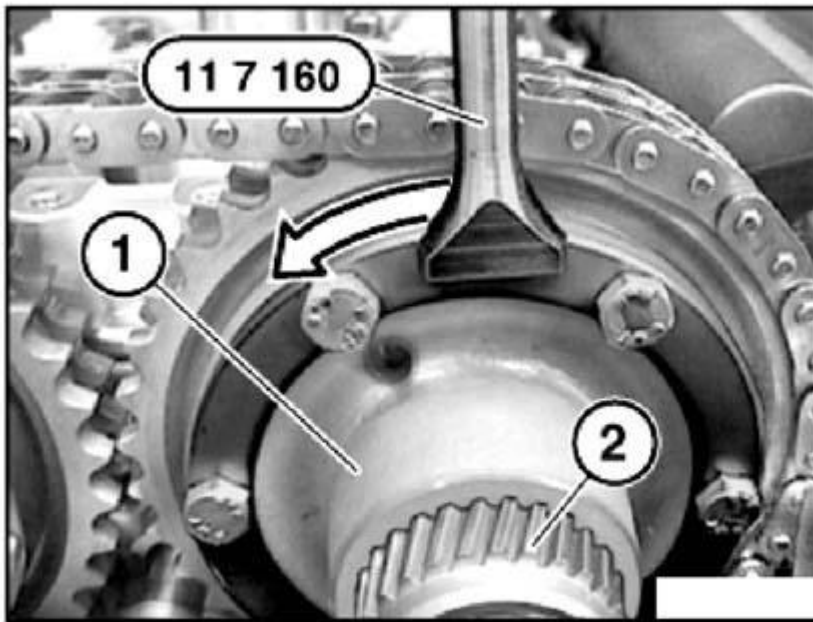
G03117957

Fig. 341: Placing Special Tool On Bore In Spline Hub (Exhaust)
Courtesy of BMW OF NORTH AMERICA, INC.

Inlet side:

Place special tool 11 7 160 on bore in spline hub (1). Rotate spline hub (1) against direction of rotation until splined shaft (2) is positioned with spline hub (1) exactly "tooth-to-tooth gap".

CAUTION: The "first" matching tooth must engage.



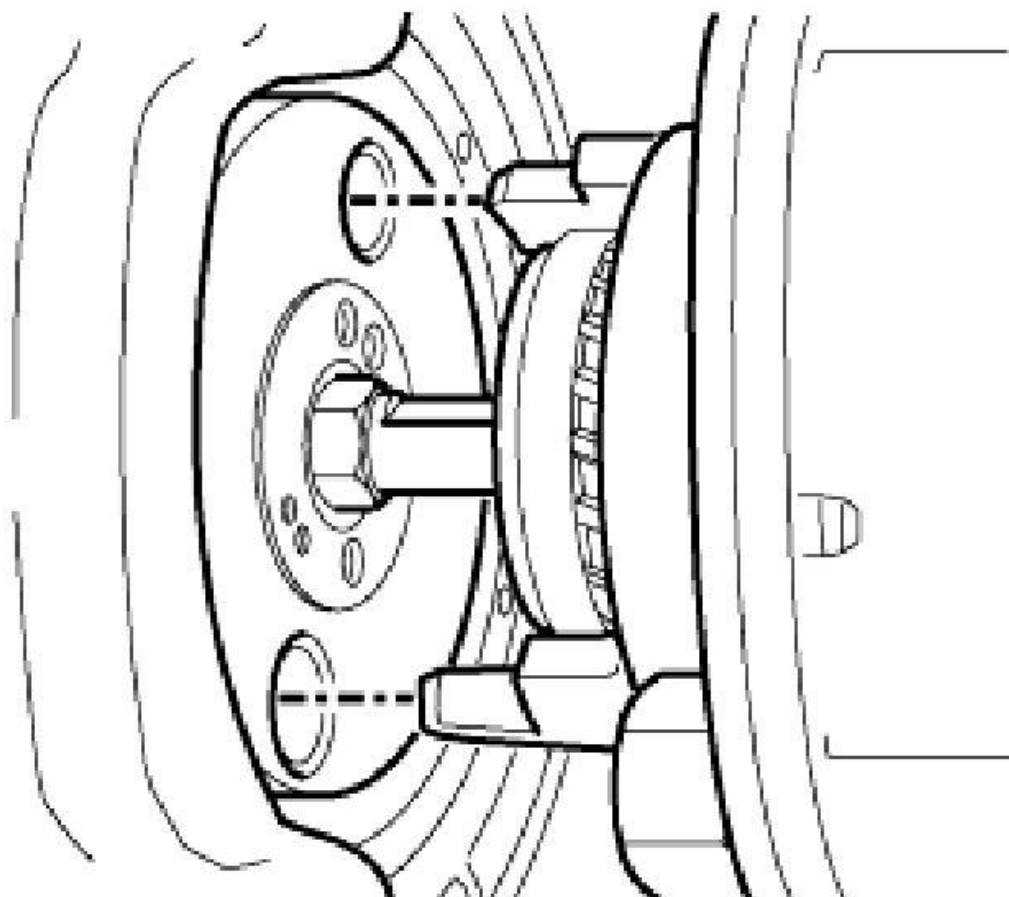
G03117958

Fig. 342: Placing Special Tool On Bore In Spline Hub (Inlet)
Courtesy of BMW OF NORTH AMERICA, INC.

Exhaust side:

Align radial piston pump to driver on spline hub.

NOTE: Picture shows a schematic representation.

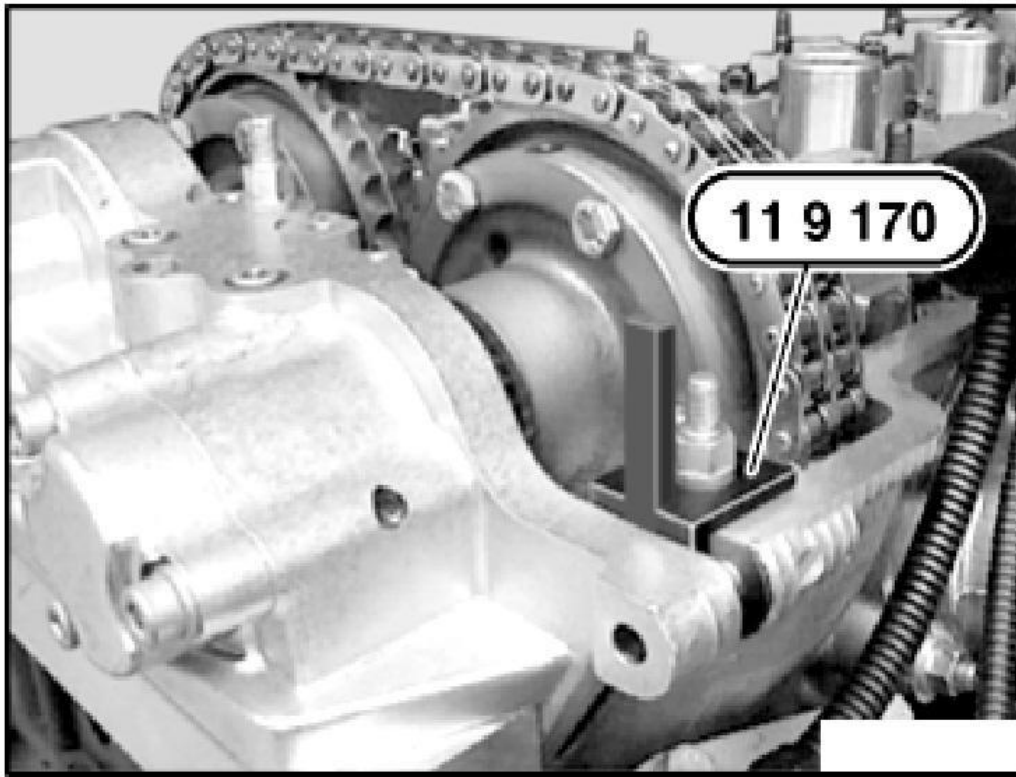


G03117959

Fig. 343: Aligning Radial Piston Pump To Driver On Spline Hub (Exhaust)
Courtesy of BMW OF NORTH AMERICA, INC.

Push on VANOS adjustment unit until it contacts special tool 11 9 170.

CAUTION: If this position is not reached, realign position of radial piston pump to driver.



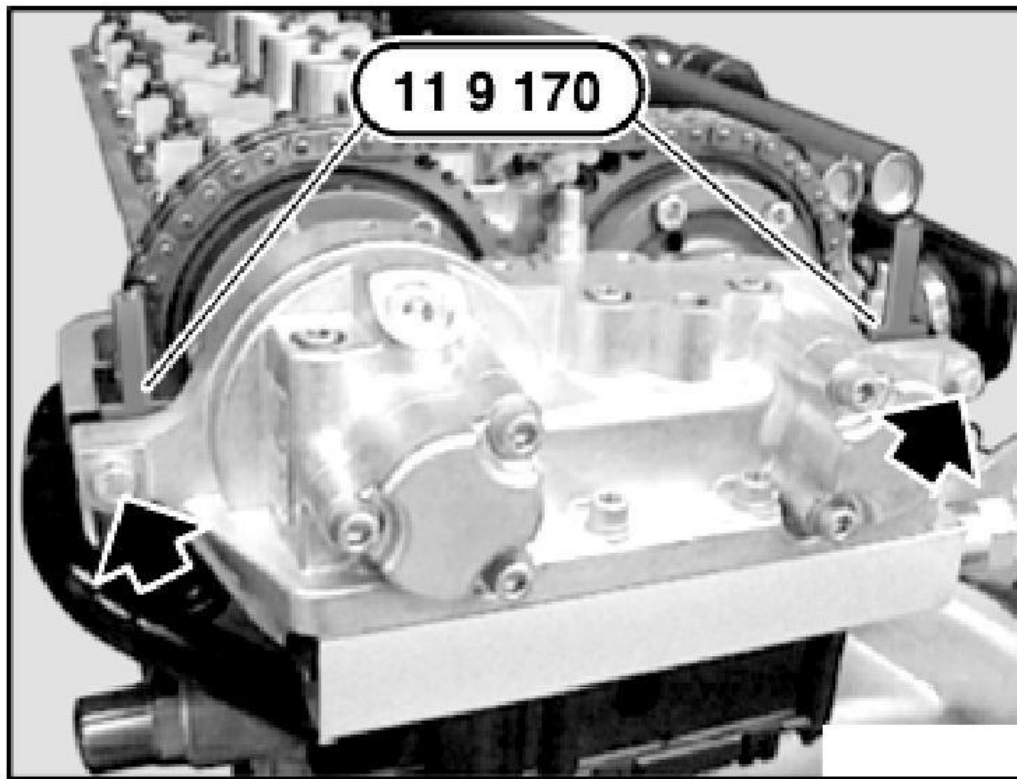
G03117960

Fig. 344: Installing VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Do not tighten down screws.

NOTE: Screw on left and right serves to secure the VANOS adjustment unit.

Insert a screw on left and right and tighten by hand until free of play.



G03117961

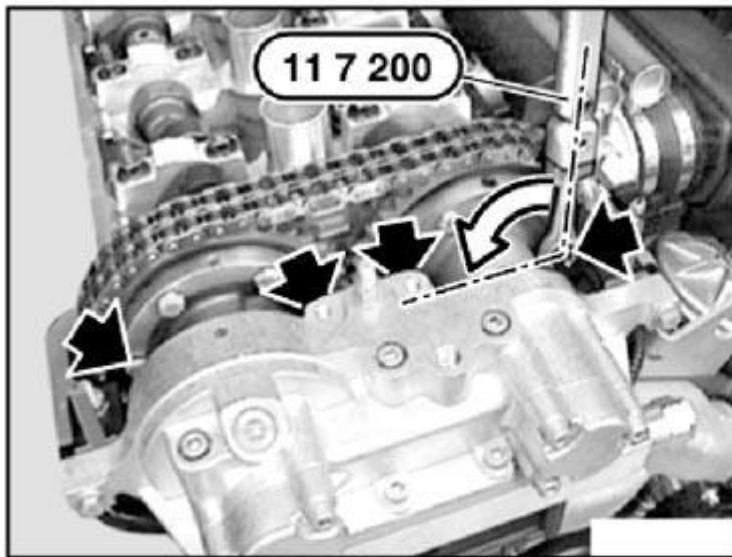
Fig. 345: Securing VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: The procedure described below helps to provide compensation for play. Only with this compensation for play is the timing diagram correctly set.

NOTE: To tighten down screws on VANOS gear: Use special tool 11 7 200.

Tighten down the two opposing screws on the inlet and exhaust sides of the VANOS gear to 10 N.m.

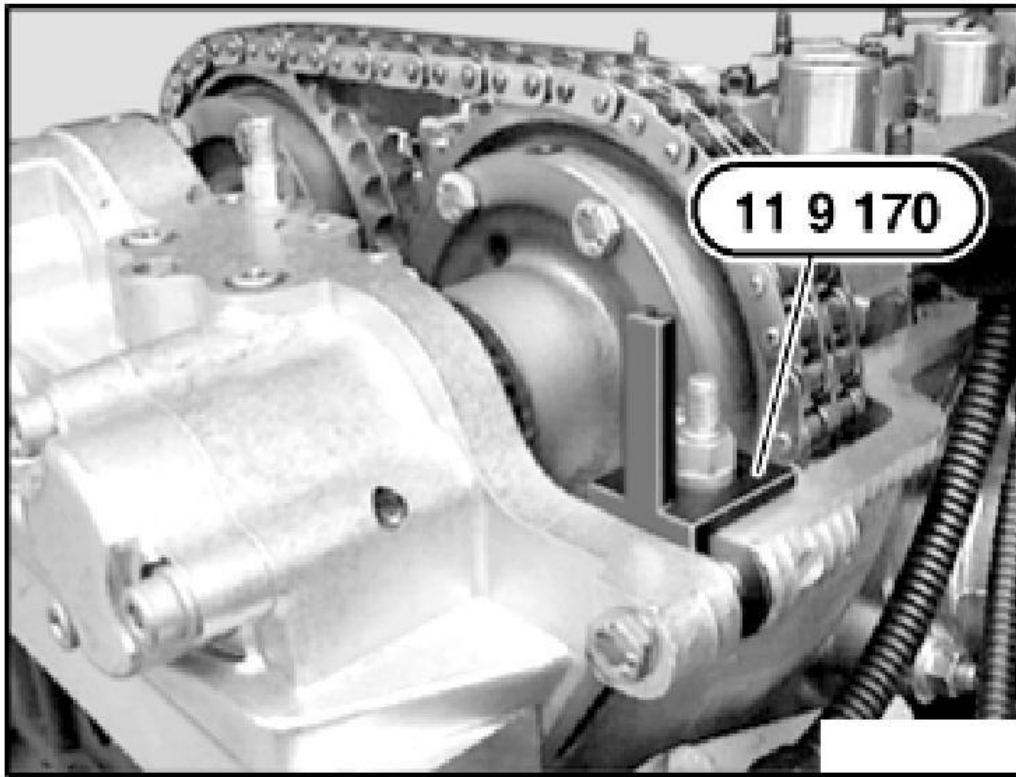
Then slacken all four screws by a 1/4 turn.



G03117962

Fig. 346: Locating Screws On VANOS Gear
Courtesy of BMW OF NORTH AMERICA, INC.

Remove special tool 11 9 170 on left and right sides.

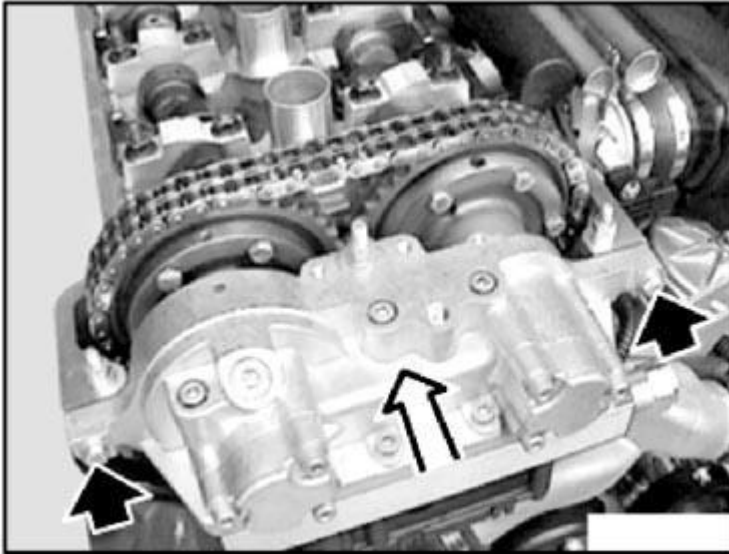


G03117963

Fig. 347: Removing Special Tool On Left And Right Sides
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Make sure that radial piston pump is aligned to driver on spline hub. When the left and right screws are tightened down alternately, the exhaust and inlet camshafts must not rotate. If the camshafts do rotate, this means that the screws on the VANOS gear were not previously released correctly.

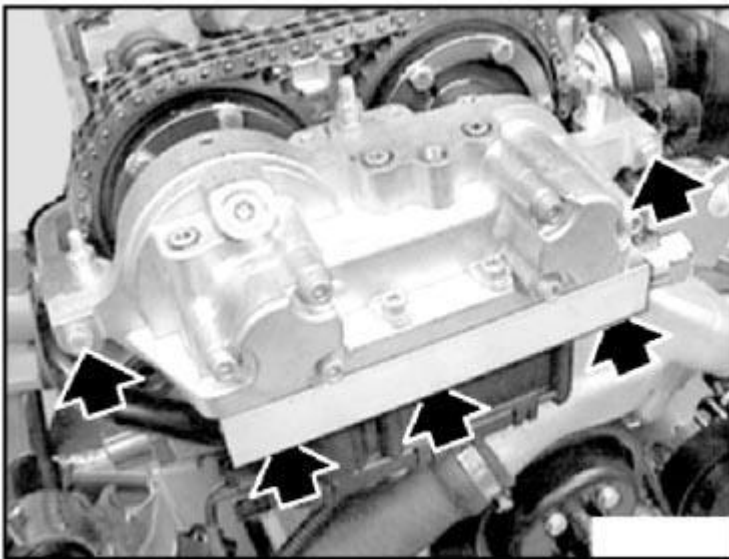
Alternately tighten down bolts in 1/2 turn increments carefully and evenly until VANOS adjustment unit rests against timing case cover.



G03117964

Fig. 348: Installing VANOS Adjustment Unit To Timing Case Cover
Courtesy of BMW OF NORTH AMERICA, INC.

Insert remaining screws and tighten down.

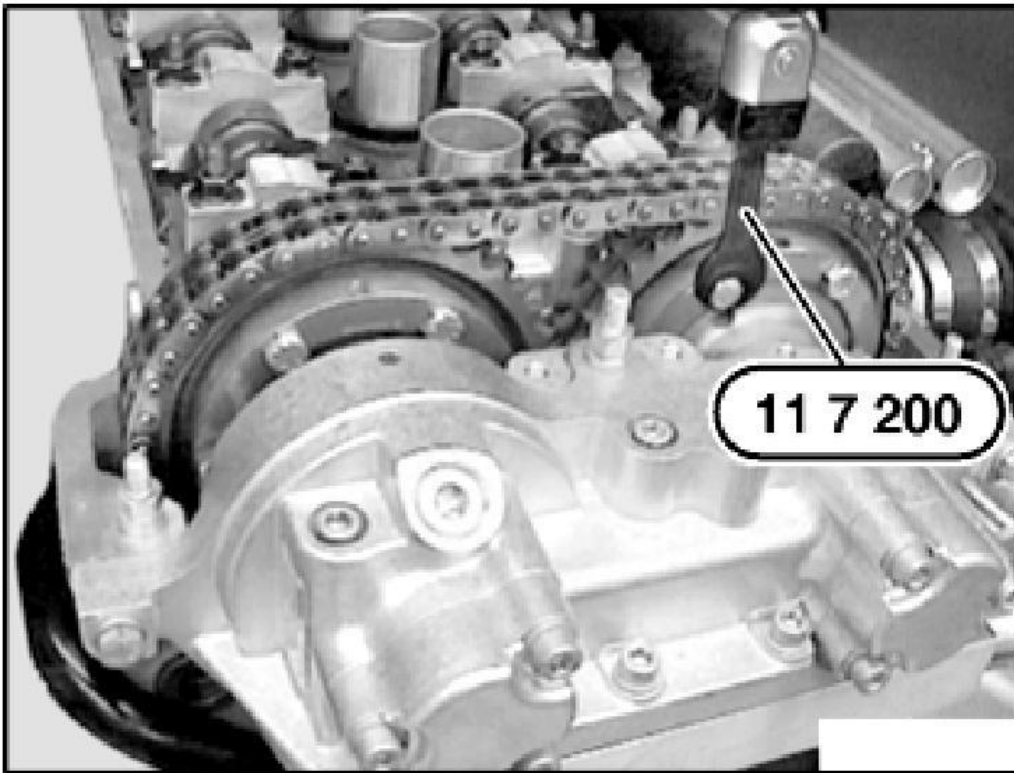


G03117965

Fig. 349: Inserting Remaining Screws

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Use special tool 11 7 200 to tighten down bolts on VANOS gear.

**G03117966****Fig. 350: Installing Bolts On VANOS Gear**

Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down six accessible screws (three on exhaust side and three on inlet side) on VANOS gear to 10 N.m.

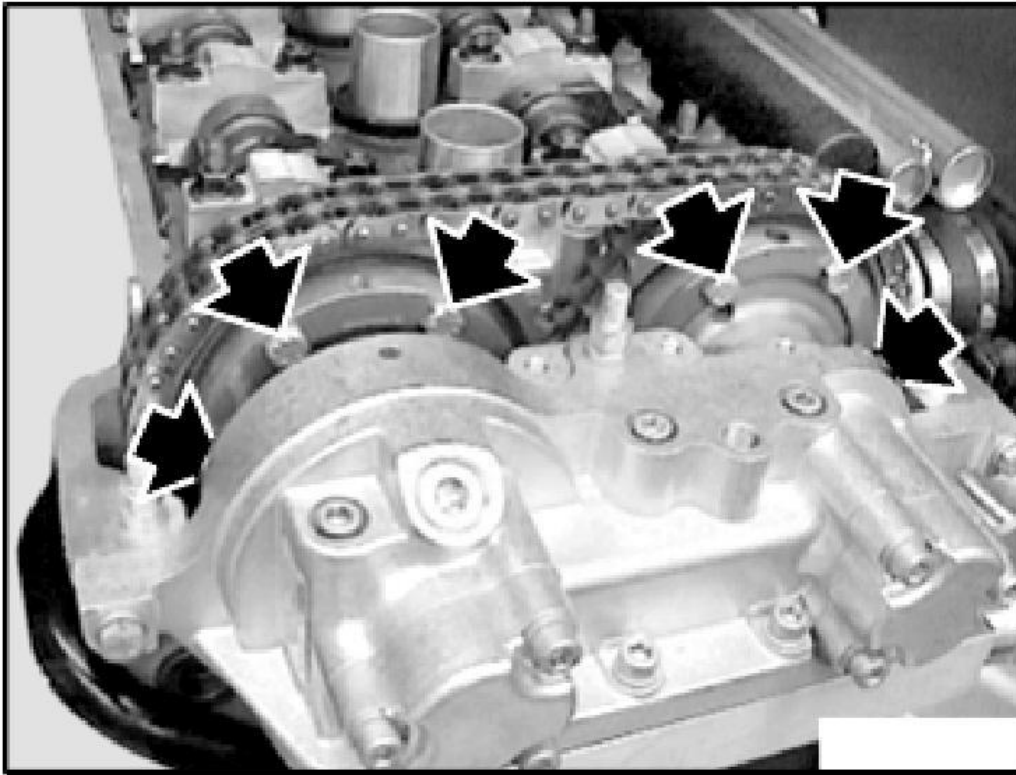
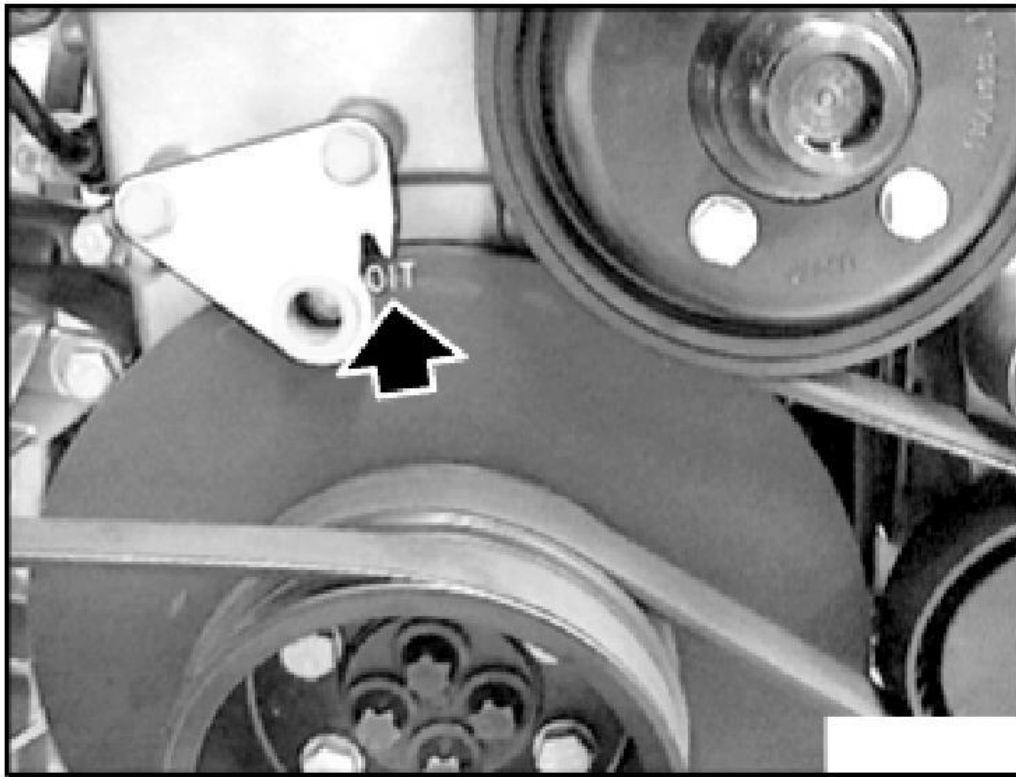
**G03117967**

Fig. 351: Securing Accessible Screws On VANOS Gear
Courtesy of BMW OF NORTH AMERICA, INC.

Remove special tool 11 2 300. Rotate crankshaft in direction of rotation a further revolution up to overlap TDC position.

NOTE: TDC allocation above marking on vibration damper is sufficient.



G03117968

Fig. 352: Removing Plug Mandrel From Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Use special tool 11 7 200 to tighten down bolts on VANOS gear.

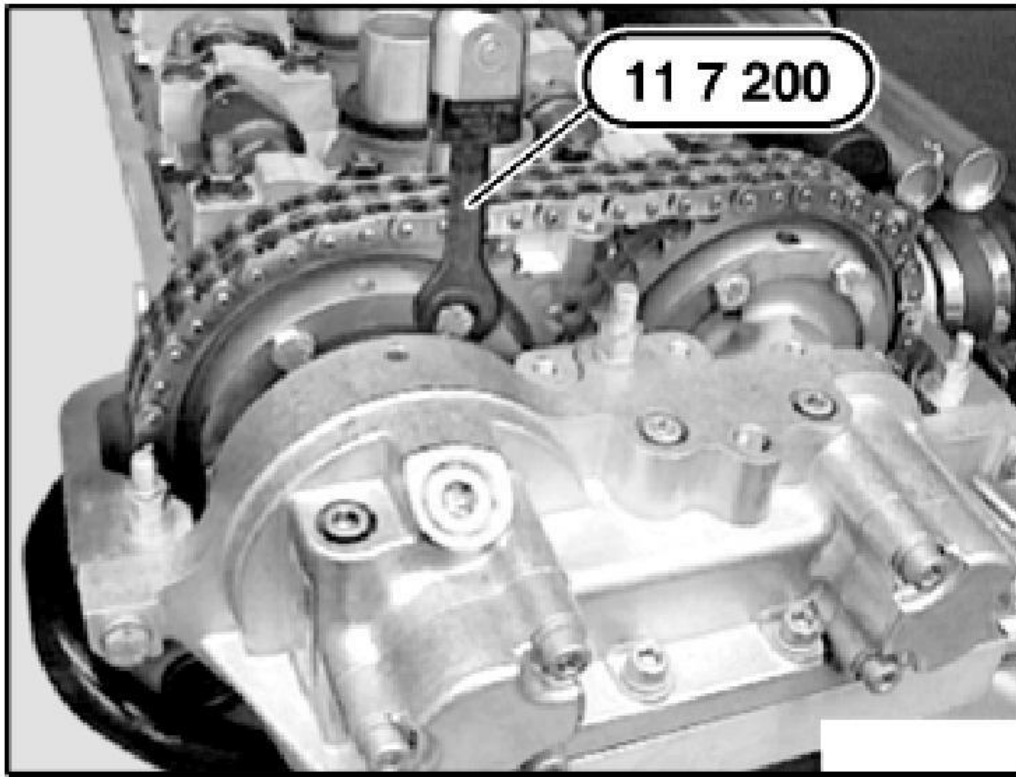
**G03117969**

Fig. 353: Securing Remaining Screws On VANOS Gear
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down remaining six screws (three on exhaust side and three on inlet side) on VANOS gear to 10 N.m.

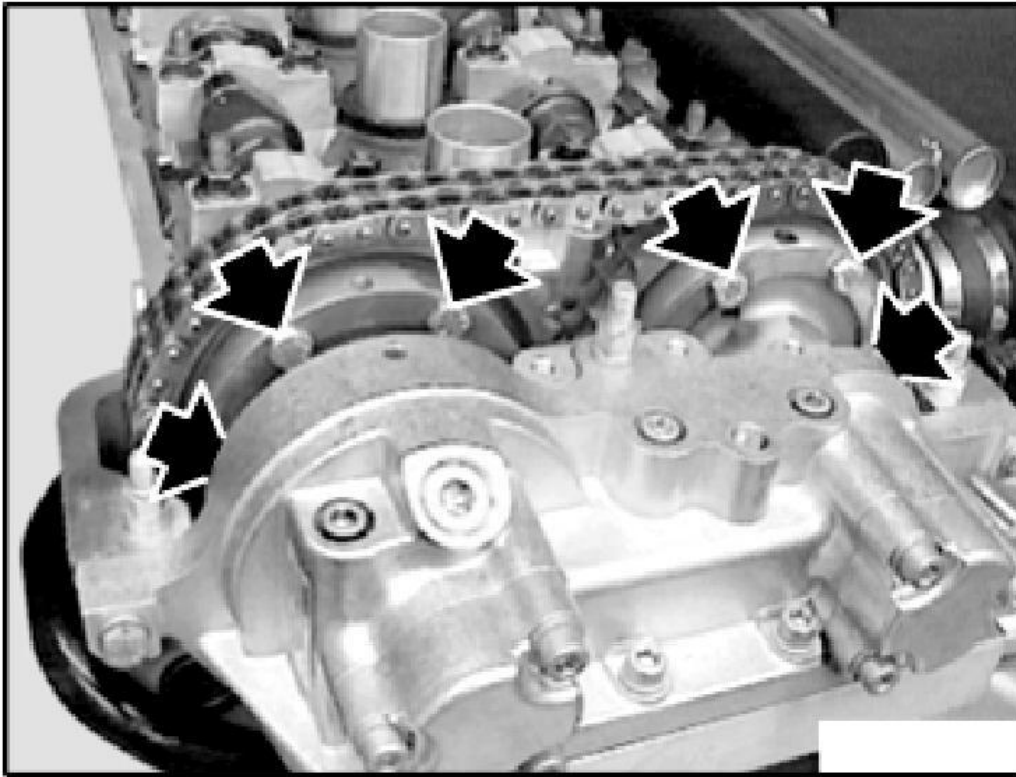
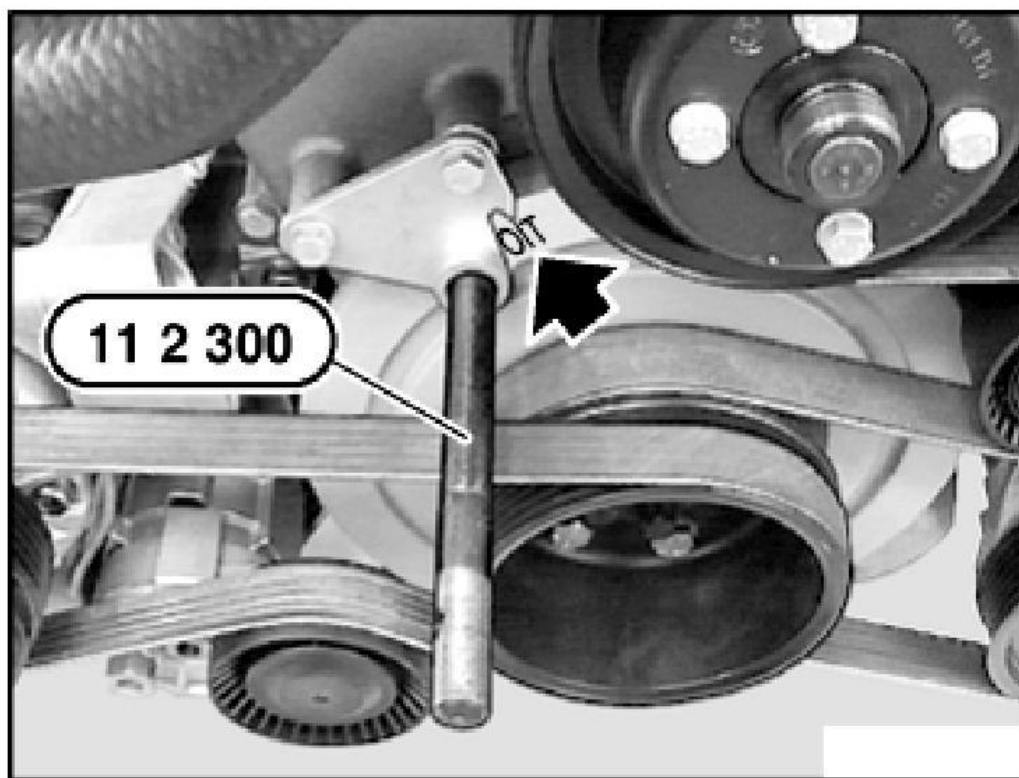
**G03117970**

Fig. 354: Tightening Down Six Accessible Screws On VANOS Gear
Courtesy of BMW OF NORTH AMERICA, INC.

Then crank engine again in direction of rotation until 1st cylinder is at TDC firing position.

Secure vibration damper in position with special tool 11 2 300.



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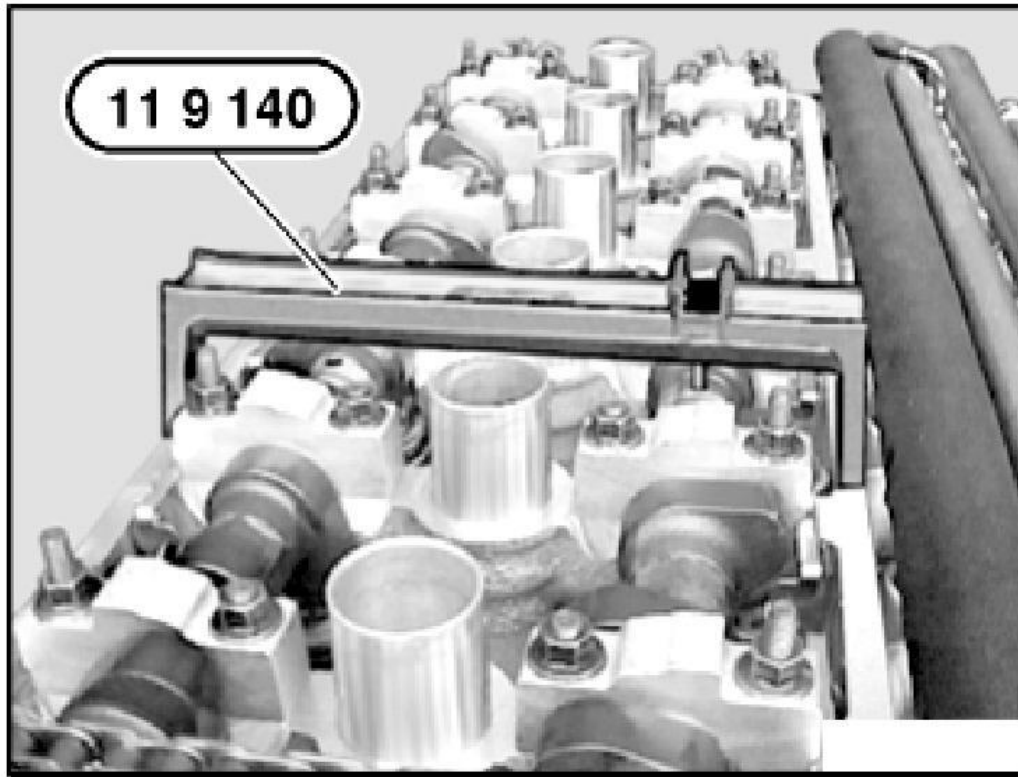
Fig. 355: Securing Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

Check camshaft setting:

Attach special tool 11 9 140 and join in inlet camshaft.

NOTE: The inlet camshaft is correctly adjusted when special tool 11 9 140 rests flat on the cylinder head or protrudes by max. 0.5 mm to the exhaust side.

If the special tool 11 9 140 protrudes to the inlet side, the timing must be readjusted.



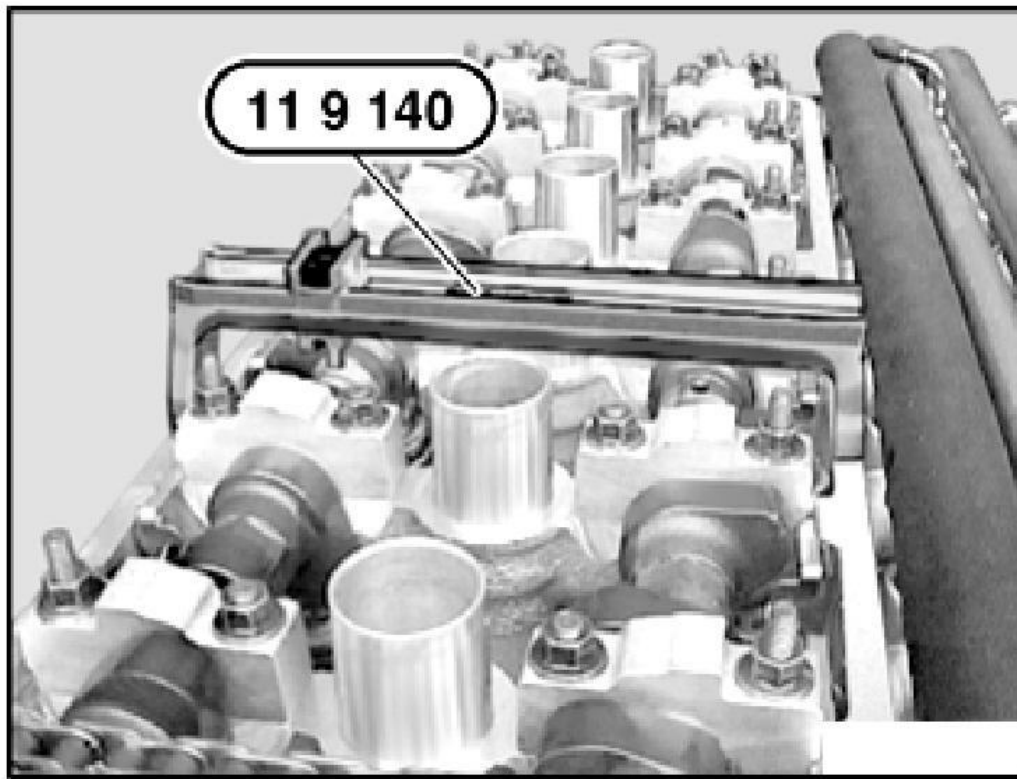
G03117972

Fig. 356: Attaching Gauge To Inlet Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

Join special tool 11 9 140 in exhaust camshaft.

NOTE: The exhaust camshaft is correctly adjusted when special tool 11 9 140 rests flat on the cylinder head or protrudes by max. 0.5 mm to the exhaust side.

If the special tool 11 9 140 protrudes to the inlet side, the timing must be readjusted.

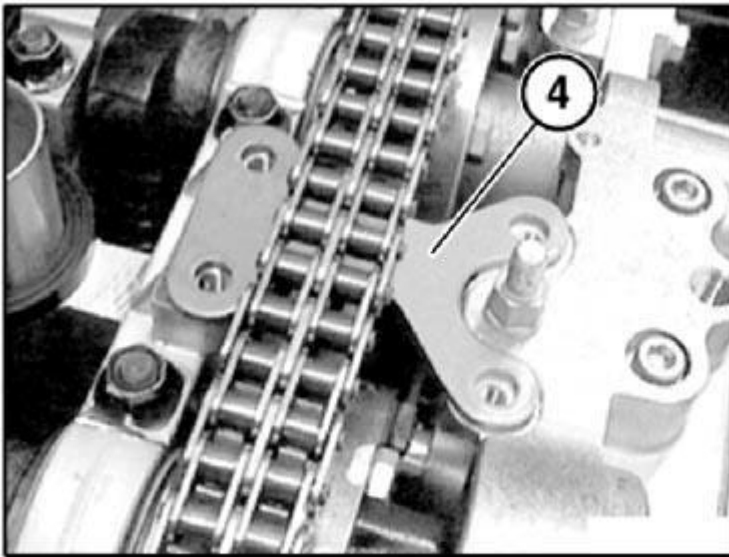


G03117973

Fig. 357: Attaching Gauge To Exhaust Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Check installed direction.

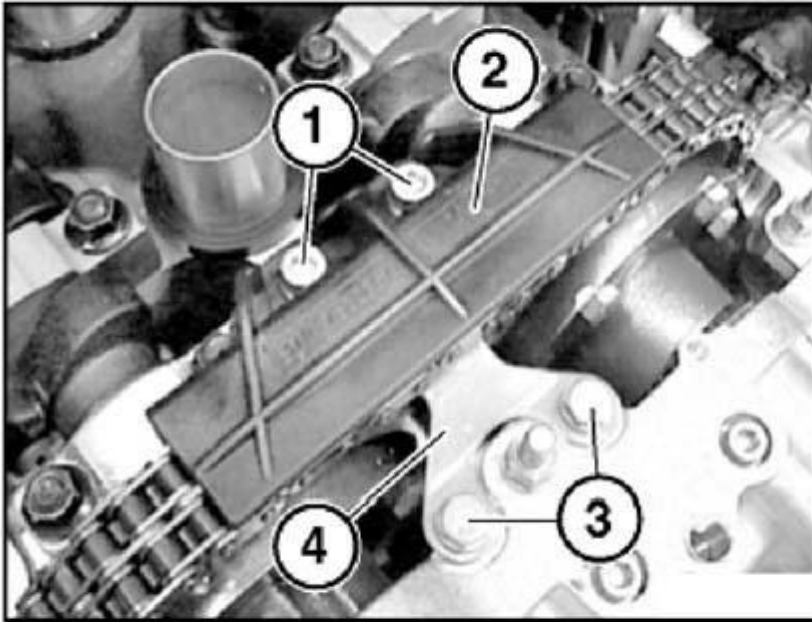
Install holder (4)



G03117974

Fig. 358: Installing Holder**Courtesy of BMW OF NORTH AMERICA, INC.**

- Insert screws (3) and secure holder (4) (do not tighten down screws (3) yet)
- Install sliding rail (2).
- Insert screws (1).
- Tighten down screws (1) and screws (3).

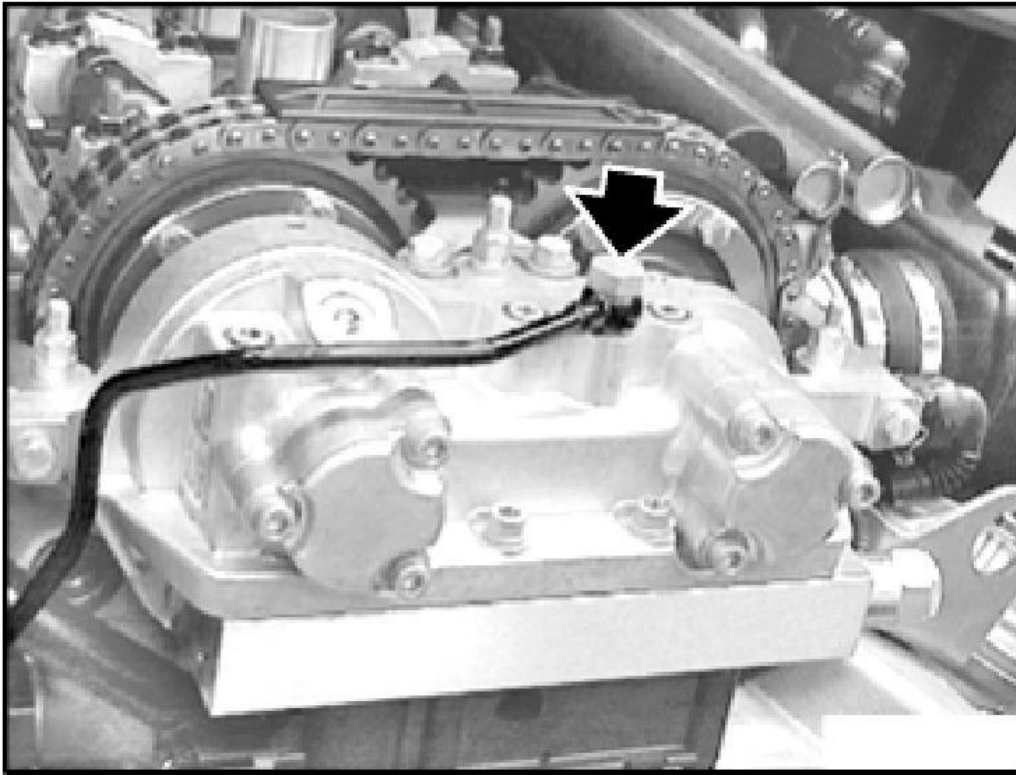


G03117975

Fig. 359: Identifying Sliding Rail**Courtesy of BMW OF NORTH AMERICA, INC.**

Replace sealing rings of banjo bolt.

Install banjo bolt do not tighten down yet



G03117976

Fig. 360: View Of Banjo Bolt

Courtesy of BMW OF NORTH AMERICA, INC.

Install bracket of oil line. Install screw and tighten down.

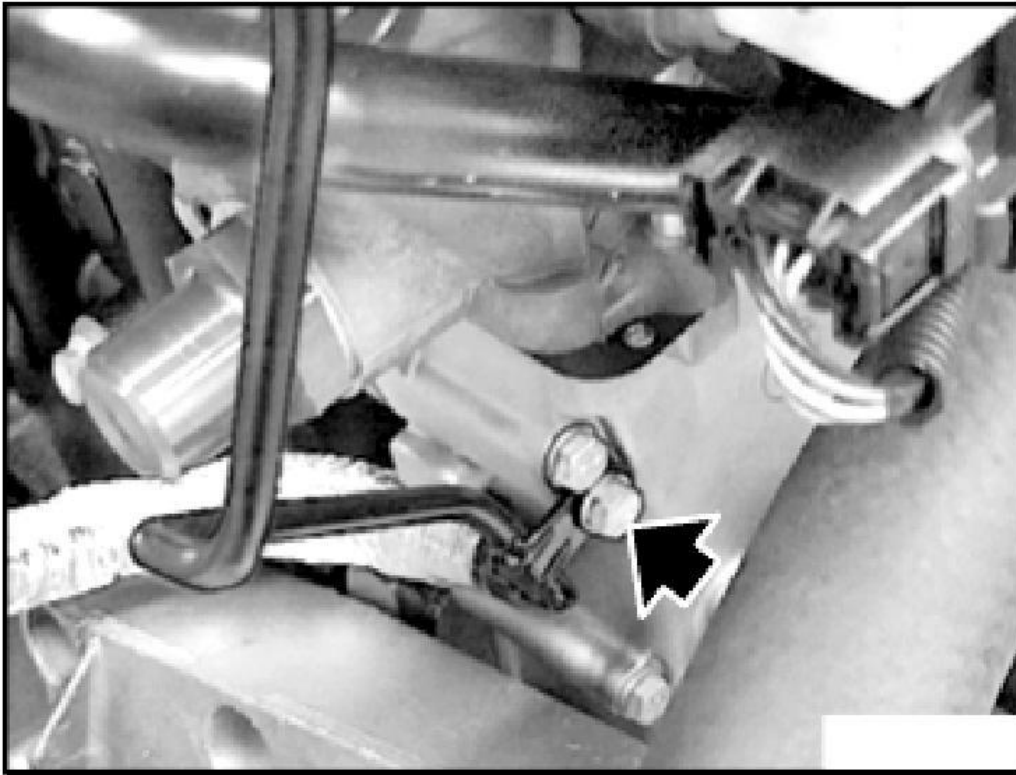
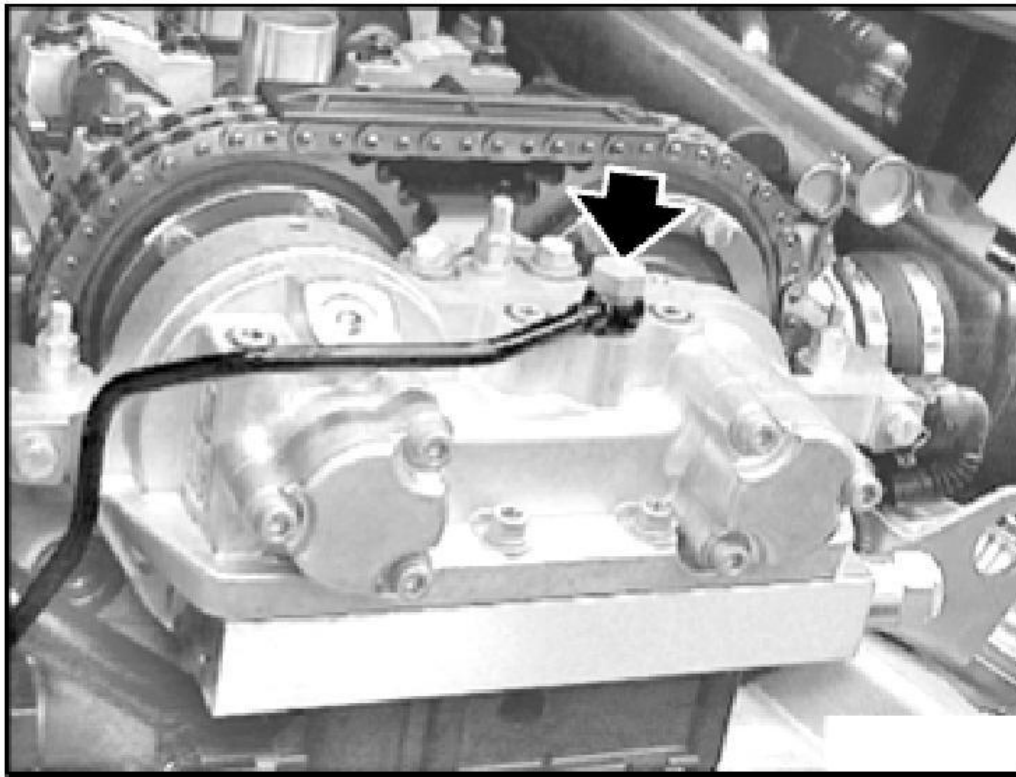
**G03117977**

Fig. 361: Locating Bracket Of Oil Line
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down banjo bolt of oil line.

Tightening torque, refer to 11 36 9AZ in **ENGINE - TIGHTENING TORQUES** .

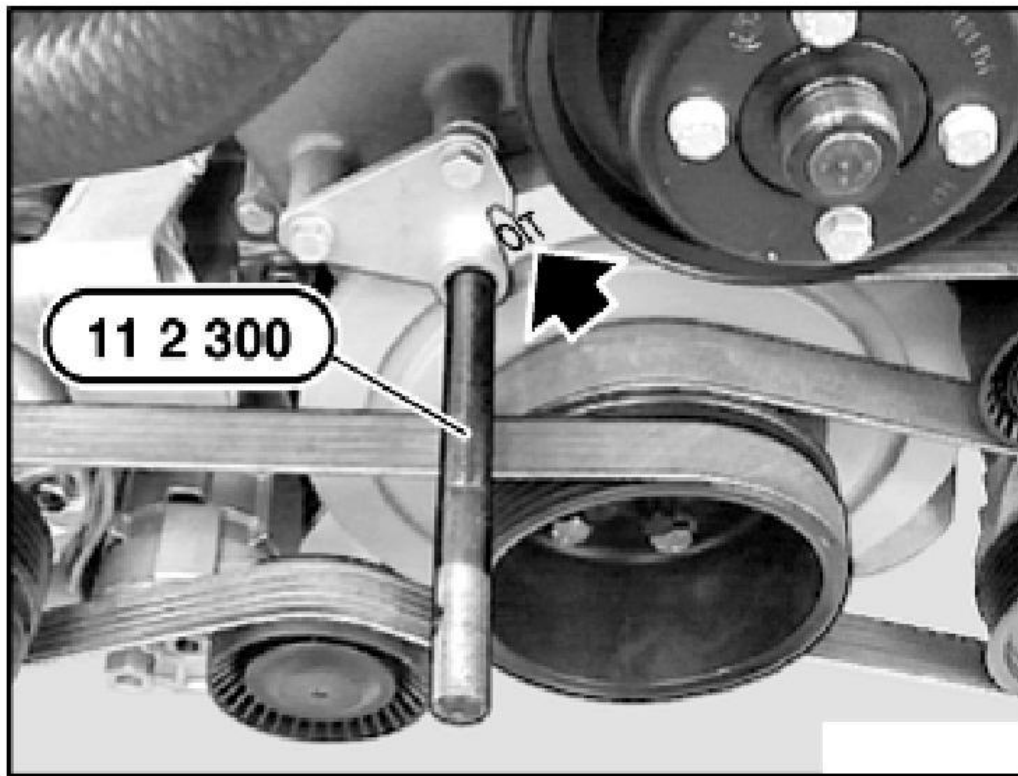


G03117978

Fig. 362: Locating Banjo Bolt Of Oil Line
Courtesy of BMW OF NORTH AMERICA, INC.

Remove special tool 11 2 300.

Assemble engine



G03117979

Fig. 363: Removing Plug Mandrel From Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: There is air in the VANOS system once it is opened. In the first few seconds after startup this results in a clearly discernible "rattling noise". This rattling noise does "not" indicate incorrect assembly. The rattling noise will disappear as soon as the oil pressure has built up and the system has vented.

ROCKER ARM WITH BEARING MOUNT

11 33 545 REMOVING AND INSTALLING/REPLACING ROCKER ARM SHAFT (S54)

(Cylinder head removed.)

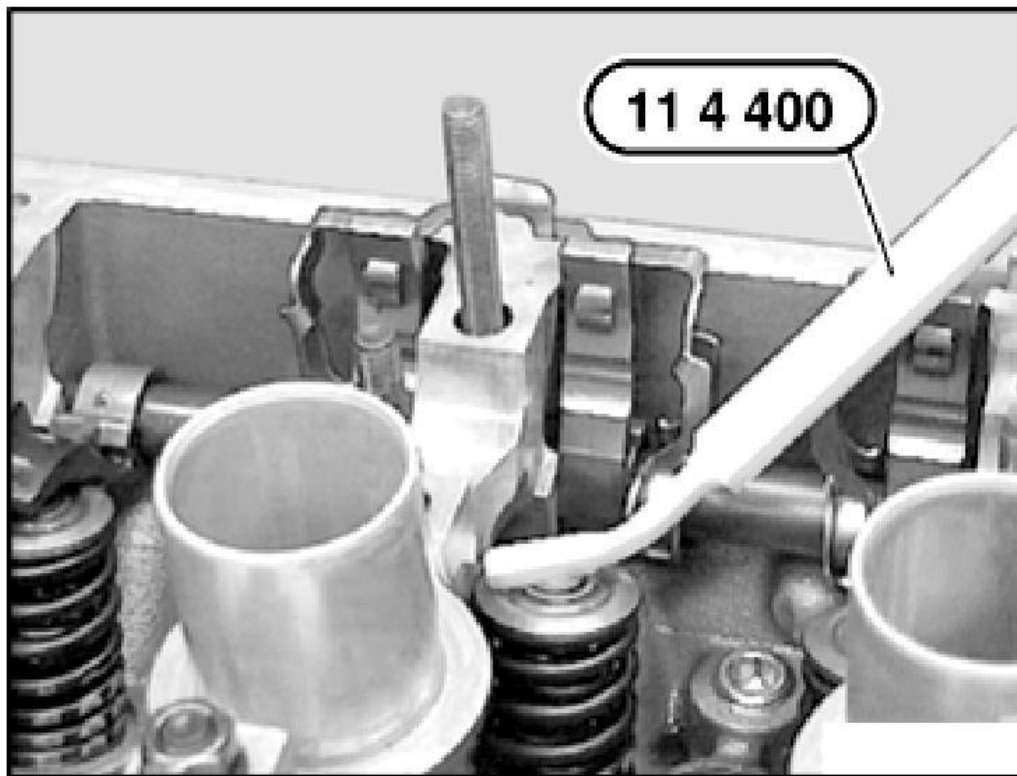
(If necessary inlet or exhaust side.)

CAUTION: It is very easy for the adjustment plates to fall down.

Raise rocker arm.

NOTE: The special tool 11 4 400 is magnetic.

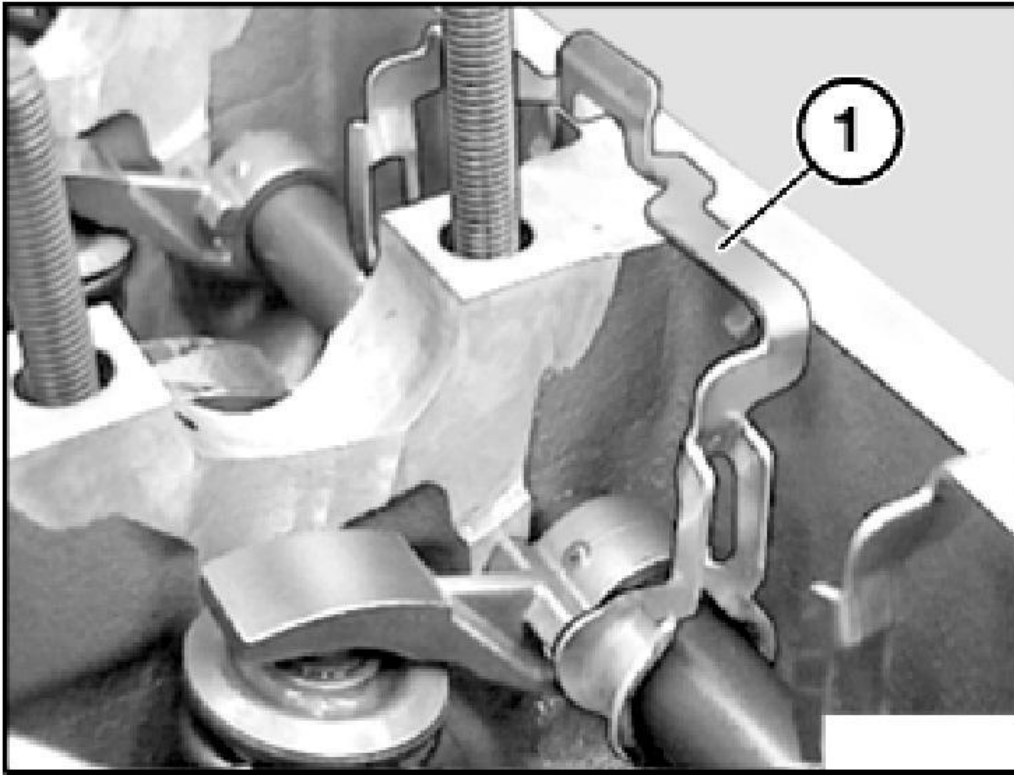
Remove all adjustment plates with special tool 11 4 400 and set to one side order



G03117980

Fig. 364: Removing Adjustment Plates With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

Detach spring clip (1).



G03117981

Fig. 365: Identifying Spring Clip

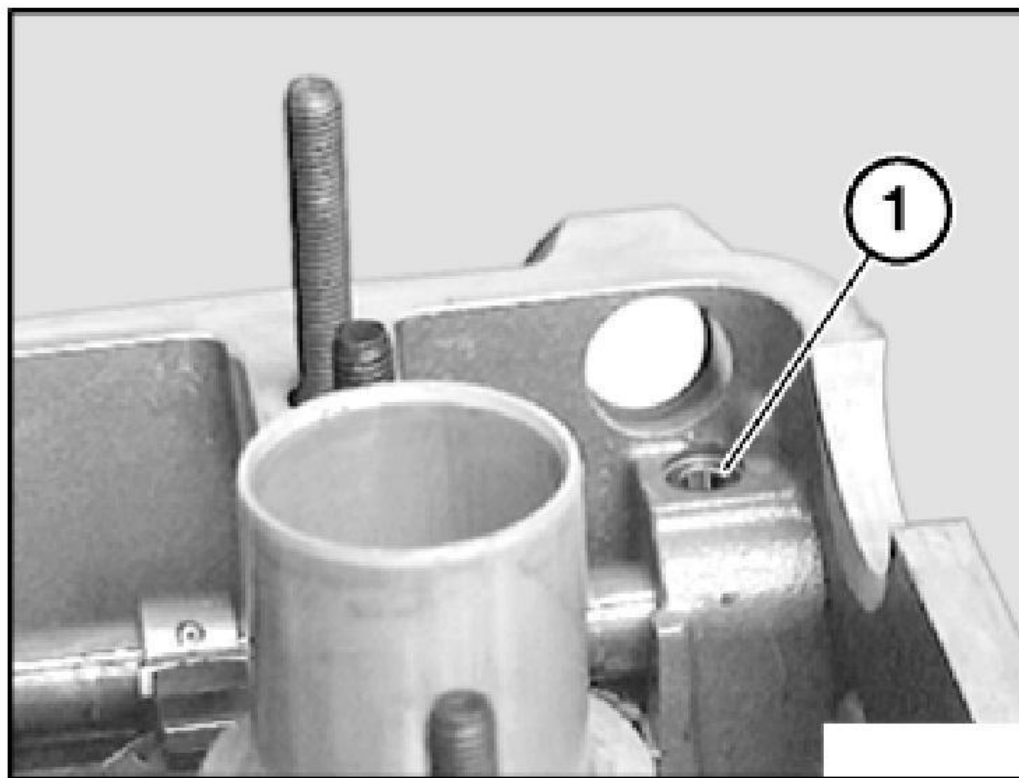
Courtesy of BMW OF NORTH AMERICA, INC.

Remove camshaft sensor.

Installation:

Replace O-ring and screw.

Release journal screw (1).

**G03117982****Fig. 366: View Of Journal Screw****Courtesy of BMW OF NORTH AMERICA, INC.**

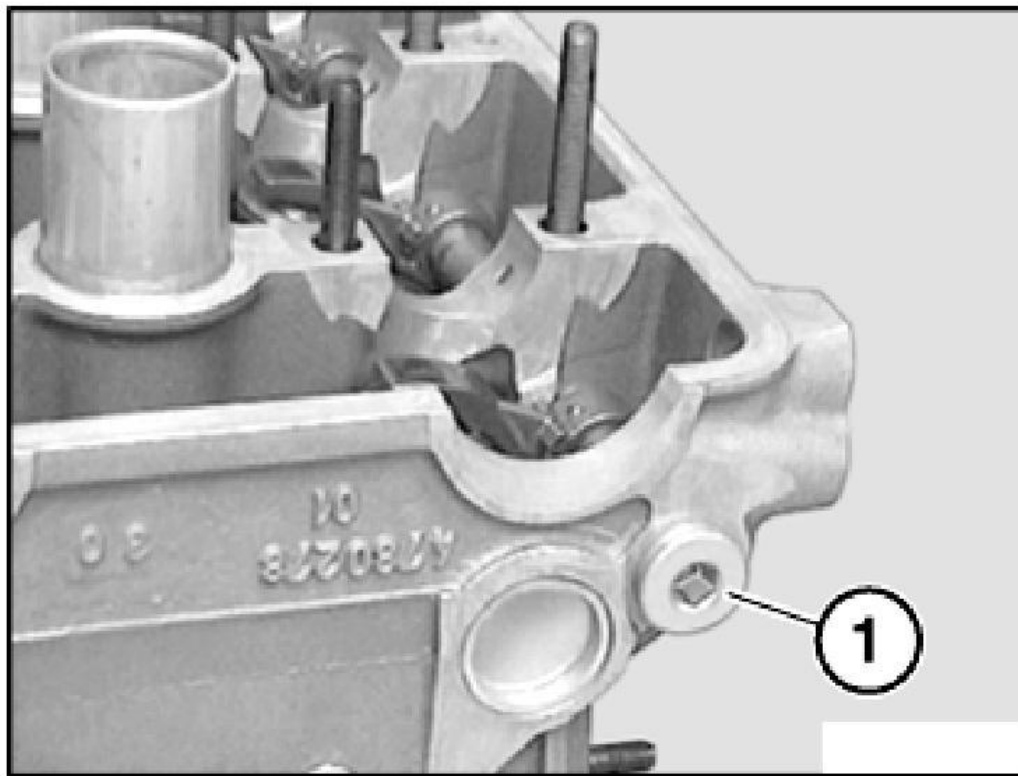
NOTE: If the rocker arm shaft cannot be removed by hand towards the front:

Open screw plug (1).

Installation:

Replace sealing ring on plug (1).

Tightening torque, refer to 11 33 2AZ in **ENGINE - TIGHTENING TORQUES** .



G03117983

Fig. 367: Removing Screw Plug

Courtesy of BMW OF NORTH AMERICA, INC.

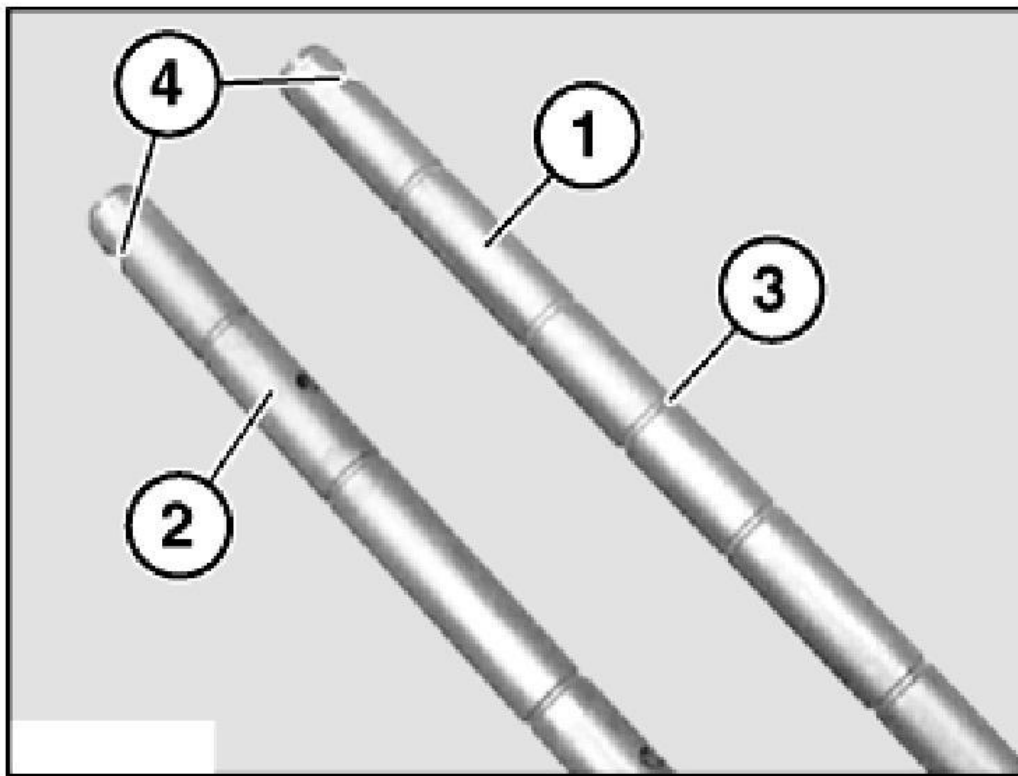
Slide out rocker arm shaft towards front.

NOTE: Place fingers to one side in orderly fashion. Worn rocker arms should only be reused at the same cam on the camshaft.

CAUTION: If the inlet and exhaust rocker arm shafts are mixed up: engine damage!

1. (1) Inlet rocker arm shaft.
2. (2) Exhaust rocker arm shaft.
3. (3) Groove for identifying inlet rocker arm shaft.
4. (4) Opening for journal screw.

The groove for identifying the inlet rocker arm shaft is located between the 5th and 6th cylinders.

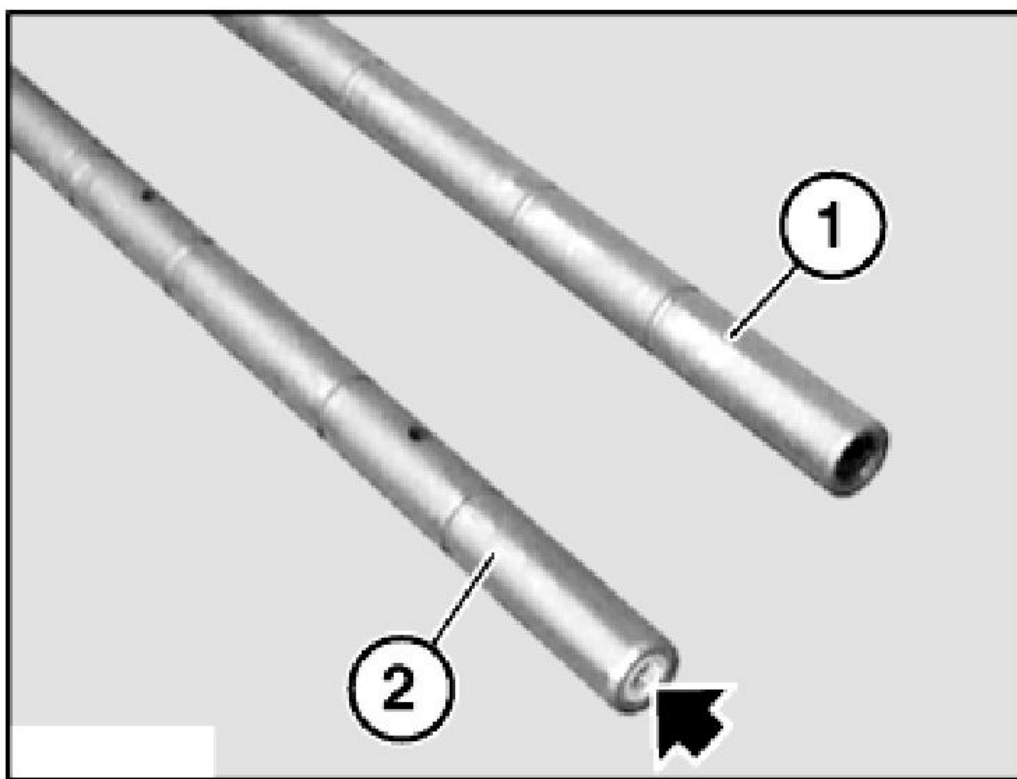


G03117984

Fig. 368: Identifying Inlet And Exhaust Rocker Arm Shafts
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: **Difference between inlet and exhaust rocker arm shafts, front.**

1. (1) Inlet rocker arm shaft, front, open.
2. (2) Exhaust rocker arm shaft, front, closed.



G03117985

Fig. 369: Identifying Inlet And Exhaust Rocker Arm Shafts Differences
Courtesy of BMW OF NORTH AMERICA, INC.

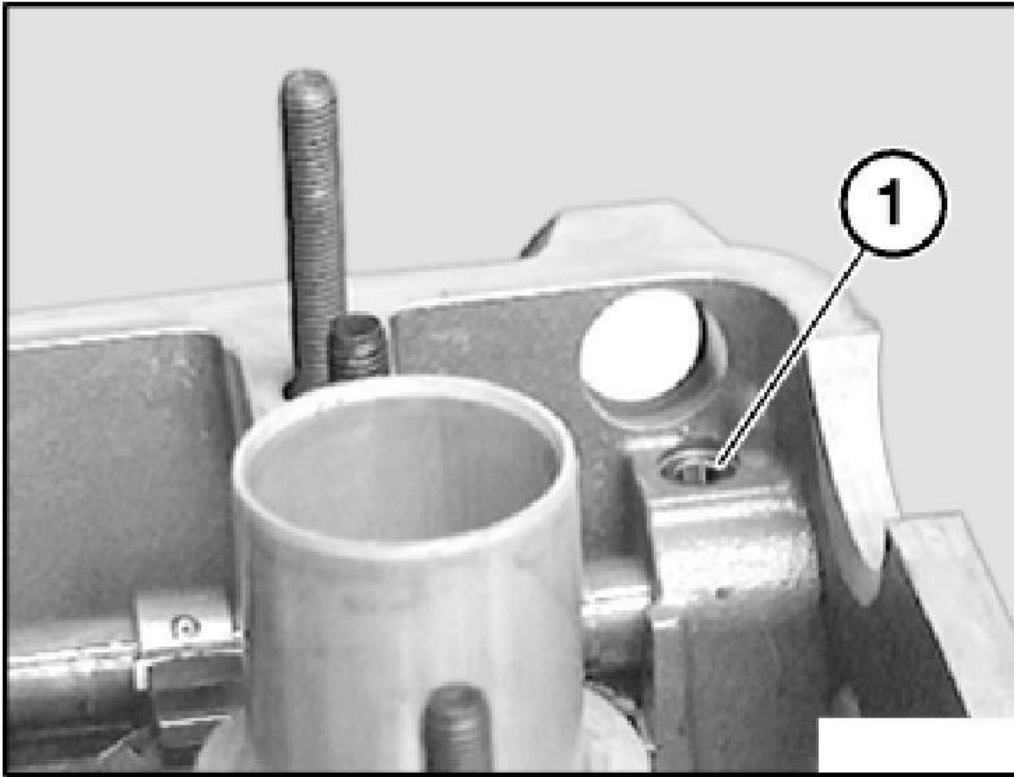
Installation:

Install rocker arm shaft and feed on rocker arm in so doing.

Align opening for journal screw precisely to cylinder head and insert journal screw (1).

Tighten down journal screw (1).

Tightening torque, refer to 11 33 3AZ in **ENGINE - TIGHTENING TORQUES** .



G03117986

Fig. 370: Inserting Journal Screw

Courtesy of BMW OF NORTH AMERICA, INC.

Align rocker arm to valve.

NOTE: Spring clip (1) must snap into place over rocker arm shaft.

Install spring clip (1).

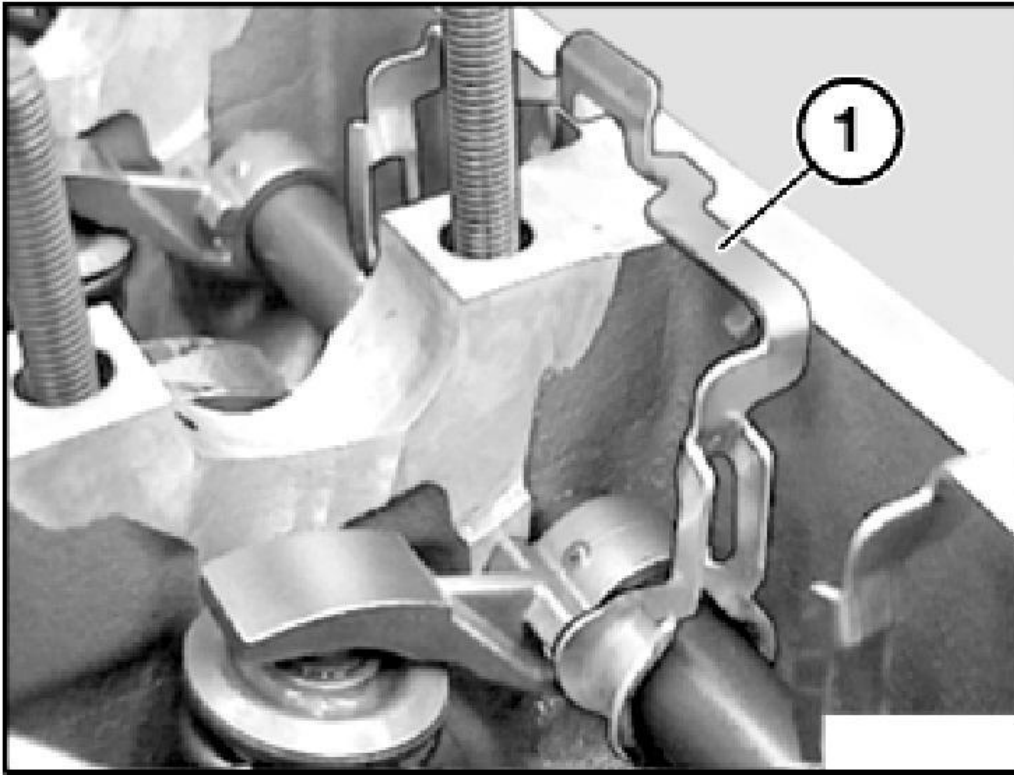
**G03117987**

Fig. 371: Installing Spring Clip

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: It is very easy for the adjustment plates to fall down.

Install adjustment plates for valve clearance only after cylinder head has been installed.

VALVES WITH SPRING

11 34 004 ADJUSTING VALVE CLEARANCE (S54)

Special Tools Required:

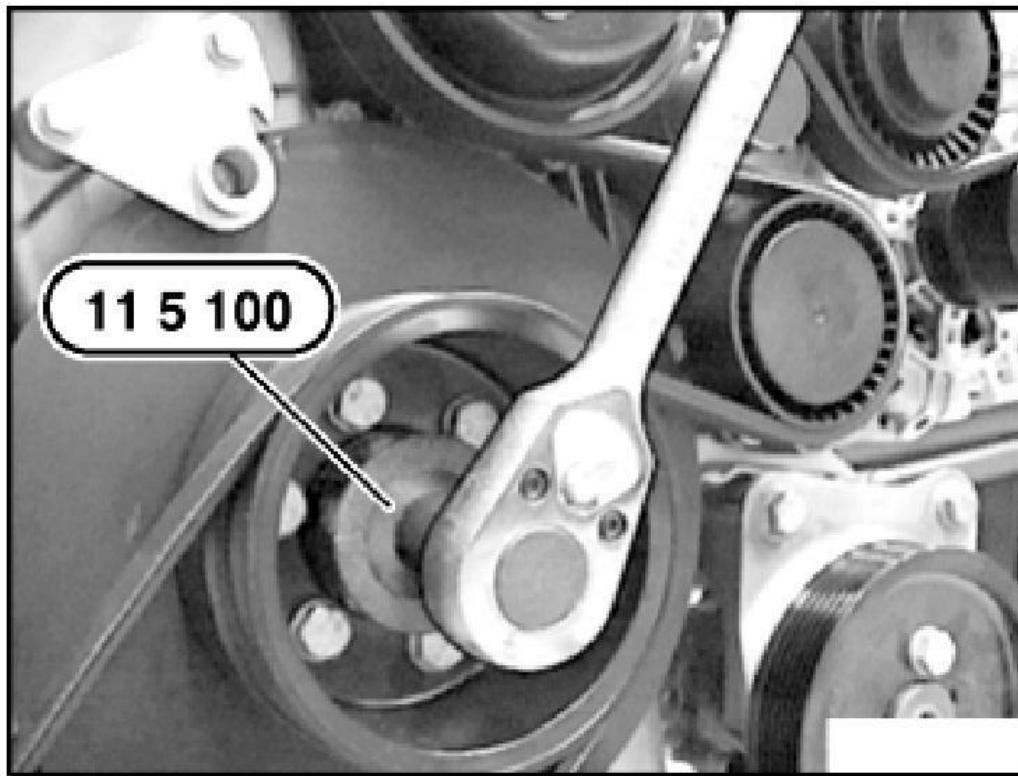
- 11 3 160
- 11 4 400
- 11 5 100

Remove cylinder head cover. Refer to **11 12 000 Removing And Installing, Sealing Cylinder Head Cover (S54)**.

Remove fan clutch with fan impeller and fan cowl. Refer to **11 52 020 REMOVING AND INSTALLING/REPLACING FAN CLUTCH (S52 / S54 / M52 / M52TU / M54 / M56)** and **17 11 031 REPLACING FAN COWL (S54)** .

Remove spark plugs. Refer to **12 12 011 REPLACING ALL SPARK PLUGS (S54)** .

NOTE: Fit special tool 11 5 100 on four screws on vibration damper and crank engine.



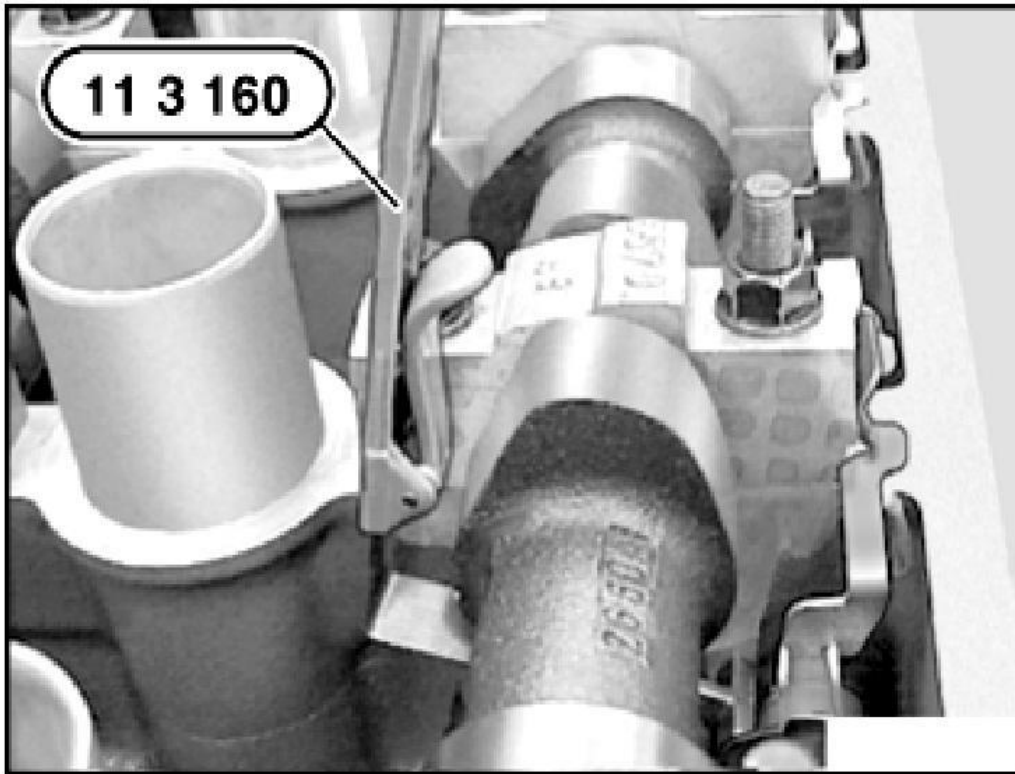
G03117988

Fig. 372: Identifying Adapter With Socket Wrench
Courtesy of BMW OF NORTH AMERICA, INC.

With cams pointing upwards, measure valve clearance with special tool 11 3 160.

Note down measured values.

Compare measured valve clearance with prespecified ventil clearance. Refer to ENGINE - TECHNICAL DATA .



G03117989

Fig. 373: Measuring Valve Clearance With Holder With Feeler Gauges
Courtesy of BMW OF NORTH AMERICA, INC.

If the measured valve clearance is outside the stipulated valve clearance tolerance:

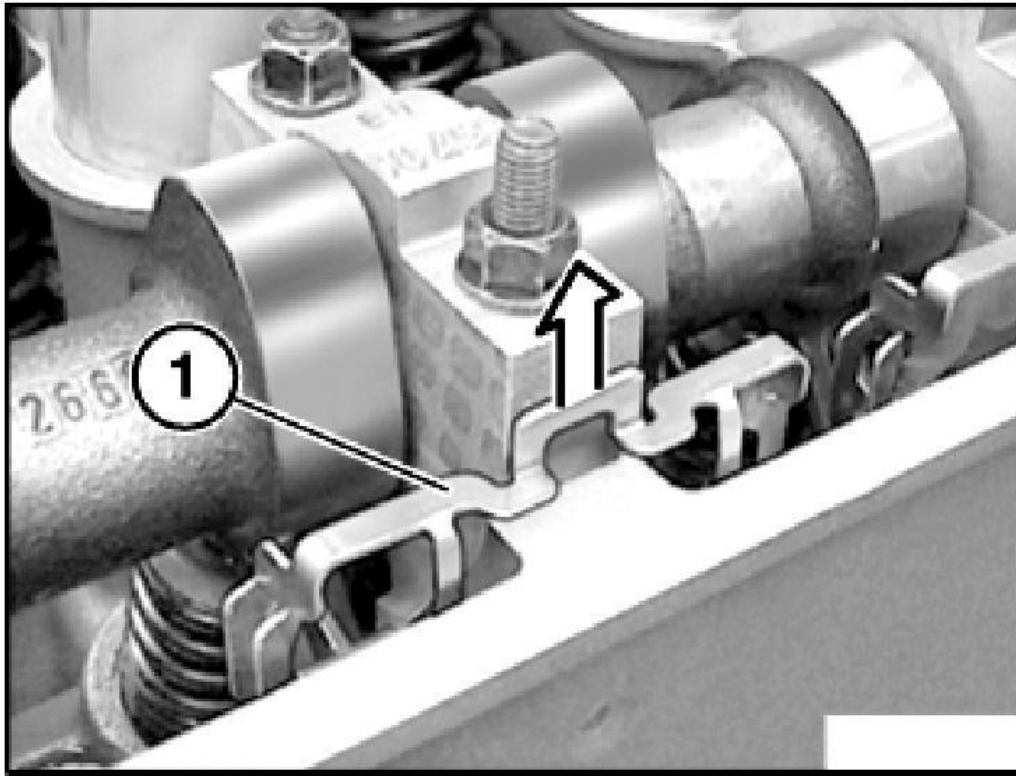
CAUTION: It is very easy for the adjustment plates to fall down.

Place a clean cloth underneath the valve to be adjusted. Seal oil return and vent holes.

Seal opening to timing case cover at first cylinder. Seal spark plug bores.

CAUTION: Do not damage sealing surface for cylinder head cover.

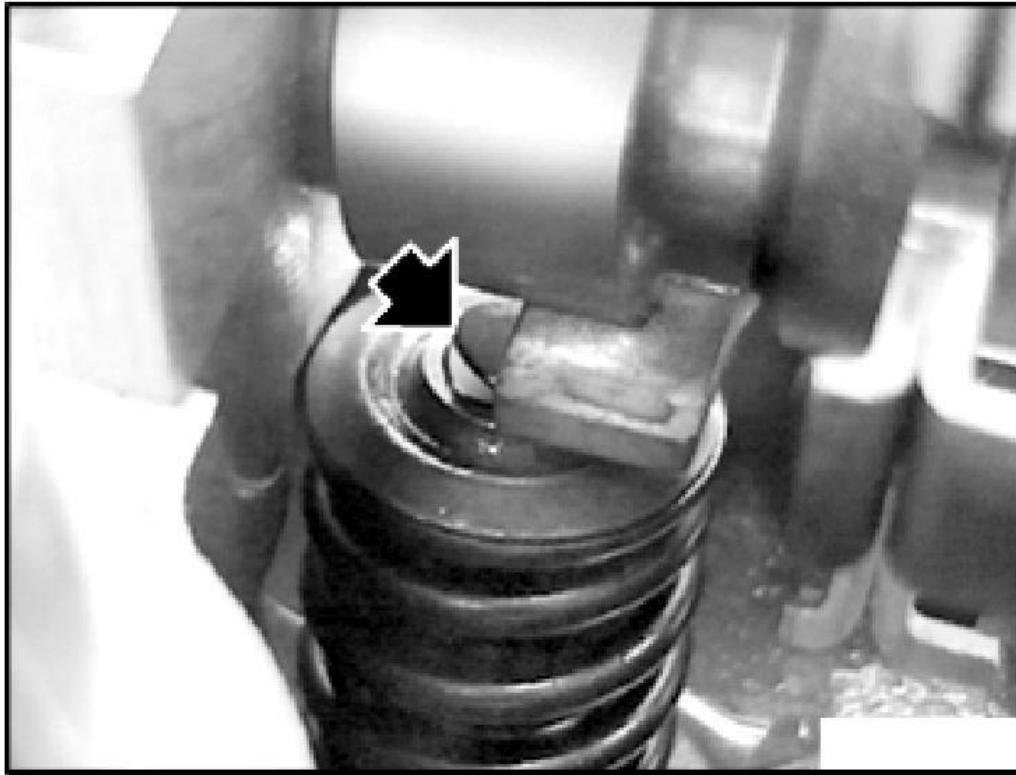
Carefully detach retaining clip (1) from rocker arm shaft.



G03117990

Fig. 374: View Of Retaining Clip From Rocker Arm Shaft
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: It is very easy for the adjustment plates to fall down. Carefully slide rocker arm to one side.



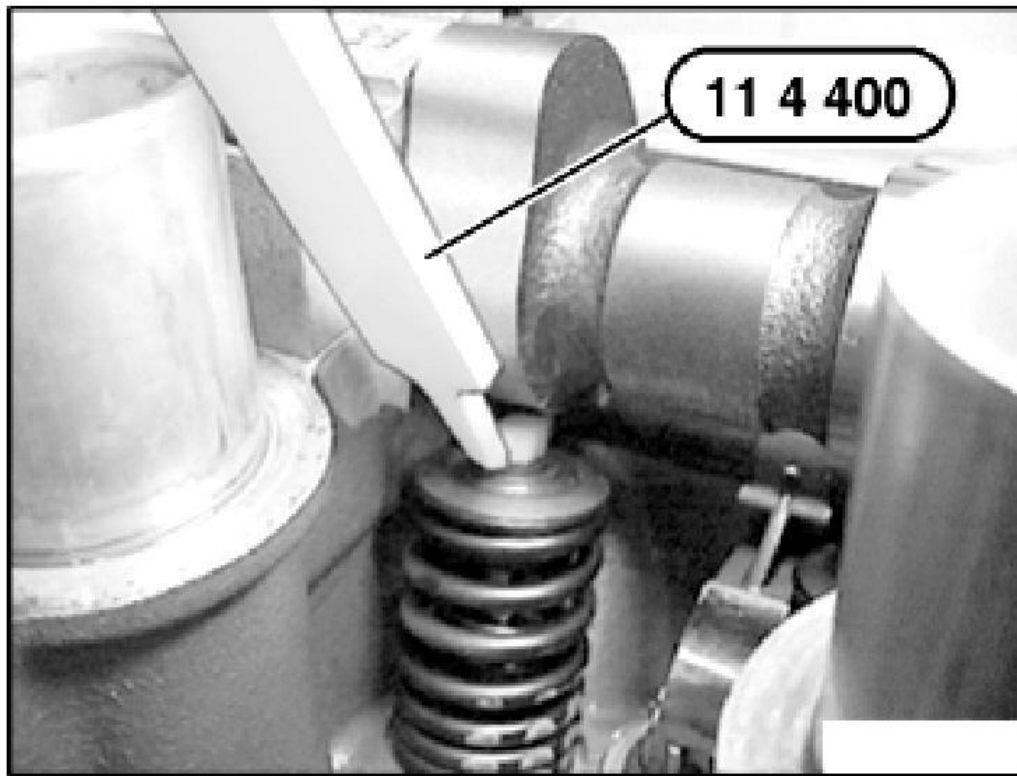
G03117991

Fig. 375: Aligning Rocker Arm

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Special tool 11 4 400 is magnetic.

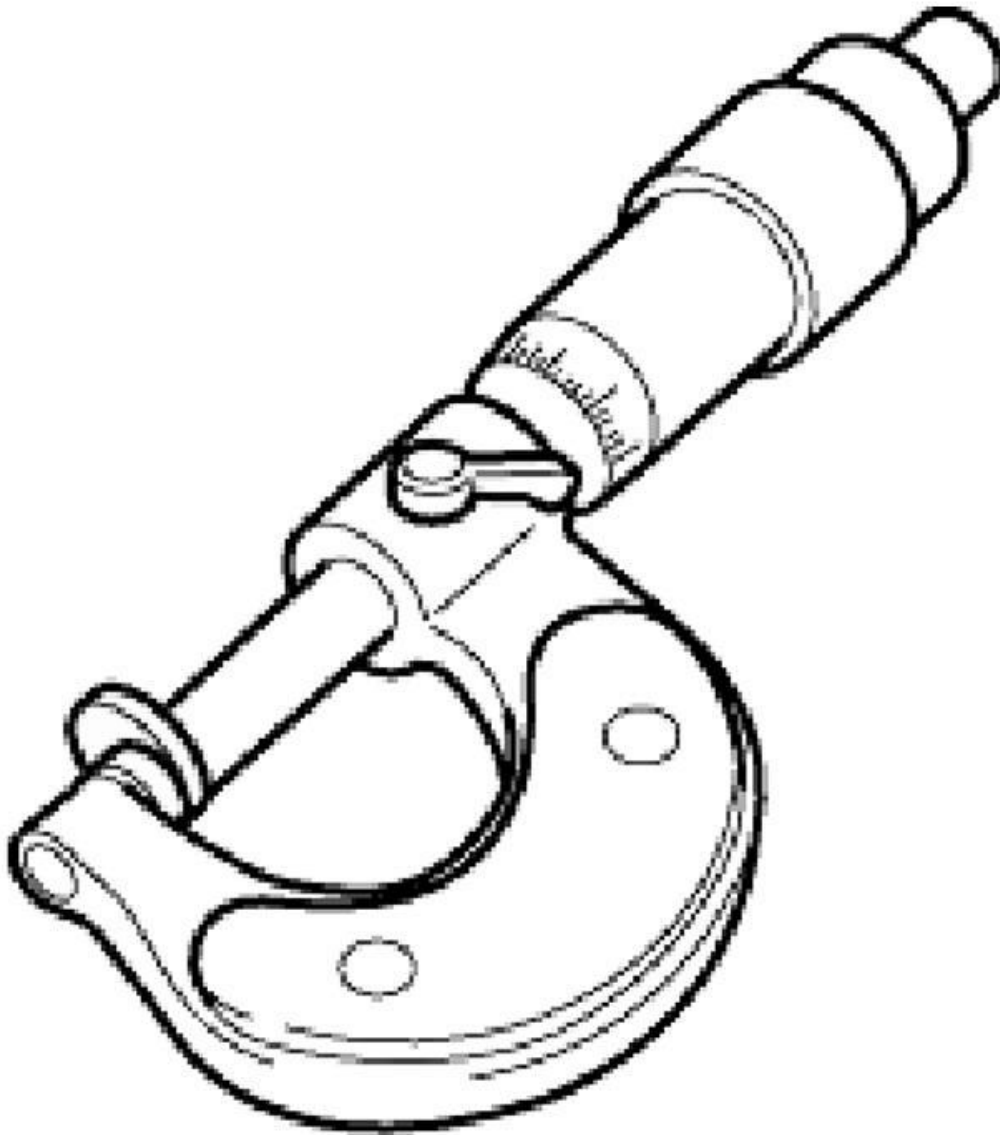
Remove adjustment plates with special tool 11 4 400.



G03117992

Fig. 376: Removing Adjustment Plates With Holder With Magnet
Courtesy of BMW OF NORTH AMERICA, INC.

Measure removed adjustment plates.

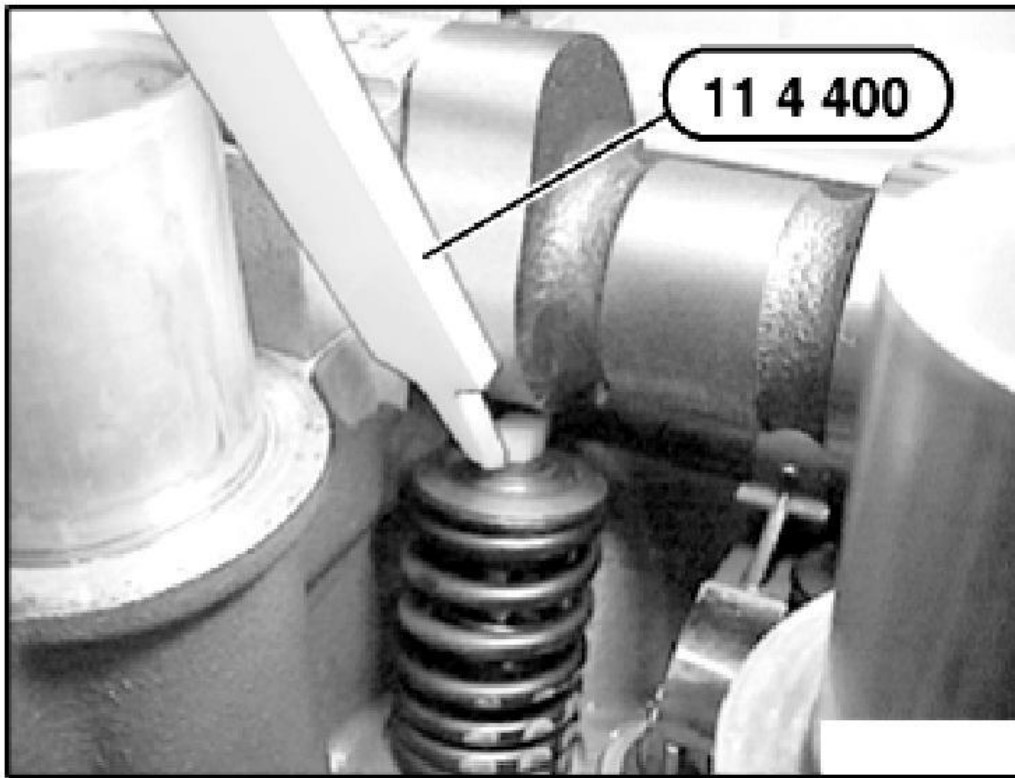


G03117993

Fig. 377: Measuring Removed Adjustment Plates
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: It is very easy for the adjustment plates to fall down.

Insert required adjustment plates with special tool 11 4 400.



G03117994

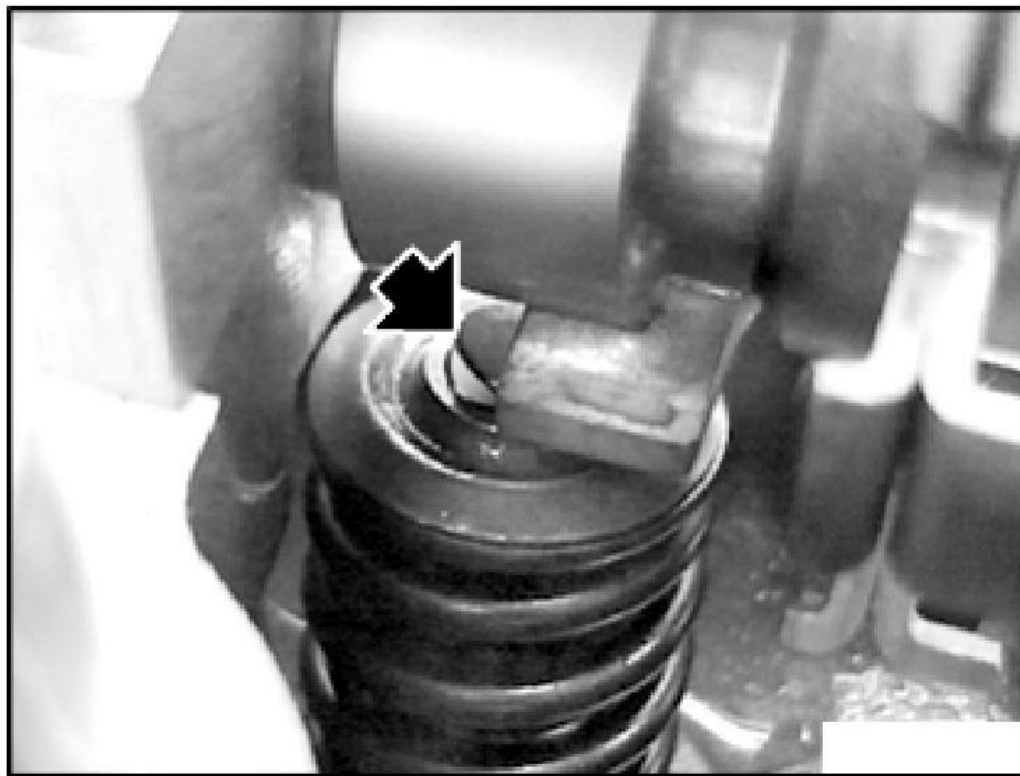
Fig. 378: Inserting Required Adjustment Plates With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Incorrect installation possible!

When the rocker arm is pushed back, there is the risk that the adjustment plate will also be pushed out.

Carefully push rocker arm back and check correct position of adjustment plates.

NOTE: If necessary, check correct position of adjustment plates with a mirror.



G03117995

Fig. 379: Aligning Rocker Arm

Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Do not damage sealing surface for cylinder head cover.

Install retaining clip (1).

CAUTION: Retaining clip (1) must snap into place on left and right over rocker arm shaft (2).

Check valve clearance. Refer to **ENGINE - TECHNICAL DATA** .



G03117996

Fig. 380: Installing Retaining Clip

Courtesy of BMW OF NORTH AMERICA, INC.

11 34 552 REMOVING AND INSTALLING OR REPLACING ALL VALVES - CYLINDER HEAD REMOVED (S54)

Preliminary tasks are described in **11 12 503 DISASSEMBLING AND ASSEMBLING CYLINDER HEAD - CYLINDER HEAD REMOVED (S54)**.

Replace valve stem seals. Refer to **11 34 560 REPLACING ALL VALVE STEM SEALS - CYLINDER HEAD REMOVED (S50 / S54)**.

Remove valves from cylinder head.

If necessary, check valve guide for wear. Refer to **11 12 595 CHECKING A VALVE GUIDE FOR WEAR - VALVE REMOVED (S50/S54)**.

If necessary, remachine valve seat. Refer to **11 12 527 REMACHINING A VALVE SEAT - CYLINDER**

HEAD DISASSEMBLED (S50/S54).

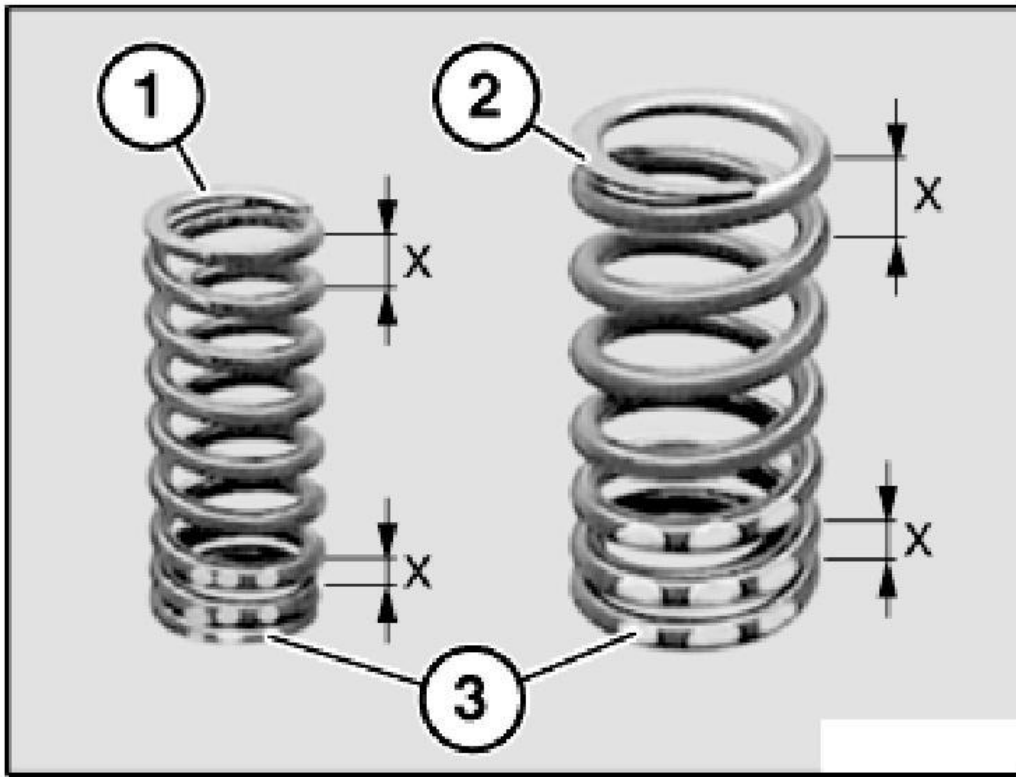
CAUTION: Incorrect installation possible. Incorrect installation will result in valve spring breakage.

The valve spring coils are narrower at the lower ends.

The color coding (3) is normally located at the lower end of the valve springs.

Only the position of the narrower coil is the decisive factor in correct installation of the valve springs (1 and 2).

Install valve springs (1 and 2) in such a way that lower coil points to spring plate at bottom.



G03117997

Fig. 381: Identifying Valve Springs

Courtesy of BMW OF NORTH AMERICA, INC.

Arrangement:

1. Valve.
2. Lower plate spring.
3. Valve-stem seal.
4. Outer spring.
5. Inner spring.
6. Top spring plate.
7. Valve tapers.

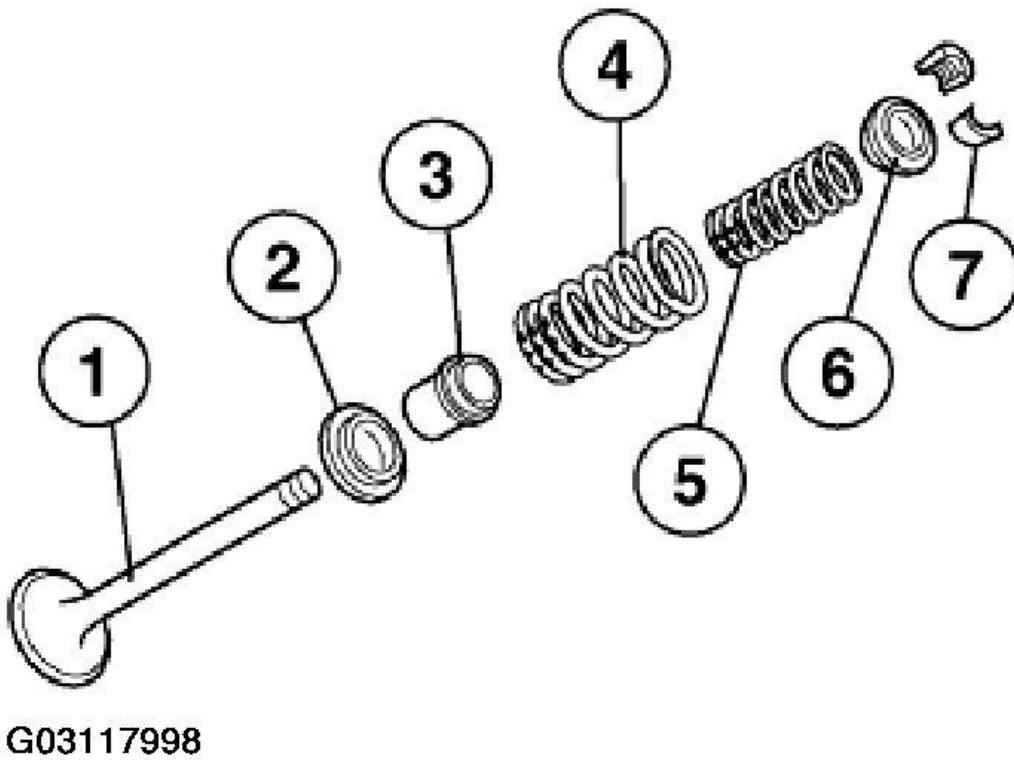


Fig. 382: View Of Valve Components
Courtesy of BMW OF NORTH AMERICA, INC.

11 34 560 REPLACING ALL VALVE STEM SEALS - CYLINDER HEAD REMOVED (S50/S54)

NOTE: For Special Tool identification, see **SPECIAL TOOLS - M3**.

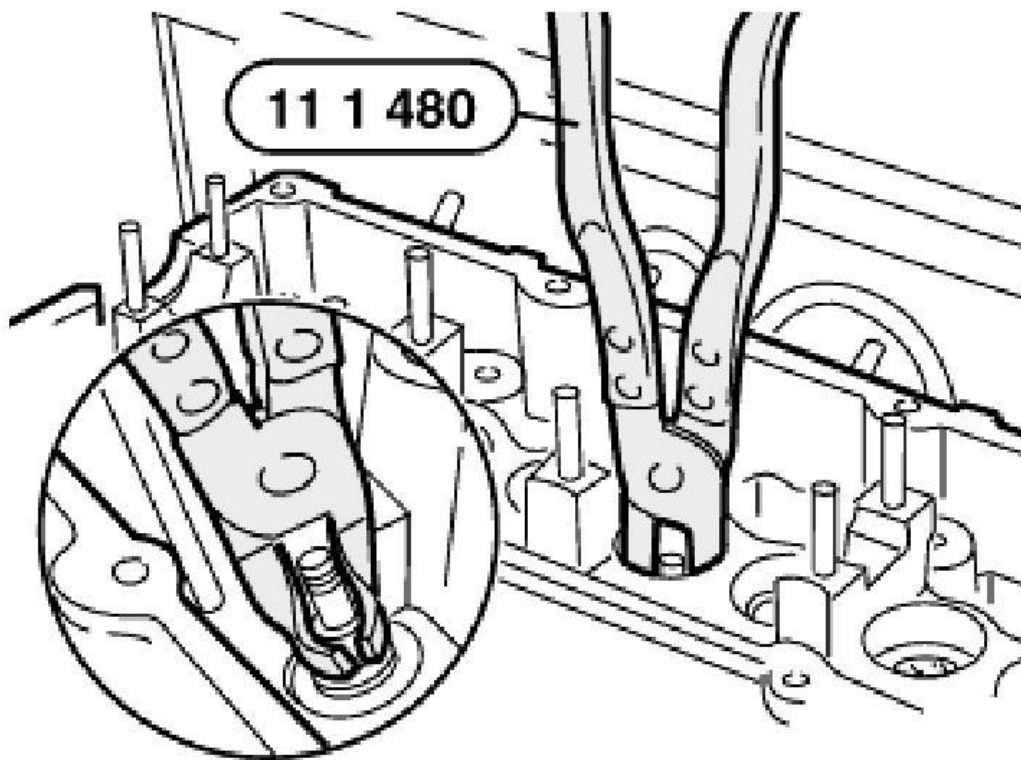
Special Tools Required:

- 11 1 200

- 11 1 380
- 11 1 480
- 11 1 960

Preliminary tasks are described in **11 12 503 DISASSEMBLING AND ASSEMBLING CYLINDER HEAD - CYLINDER HEAD REMOVED (S54).**

Remove valve stem seal with special tool 11 1 480.



G03117999

Fig. 383: Removing Valve Stem Seal With Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

S50 B32 And S54:

Valve stem diameter 6 mm:

Installation:

Lubricate valve stem with oil and insert valve.

Fit special tool 11 1 960.

Coat new valve stem seal (1) with oil and install.

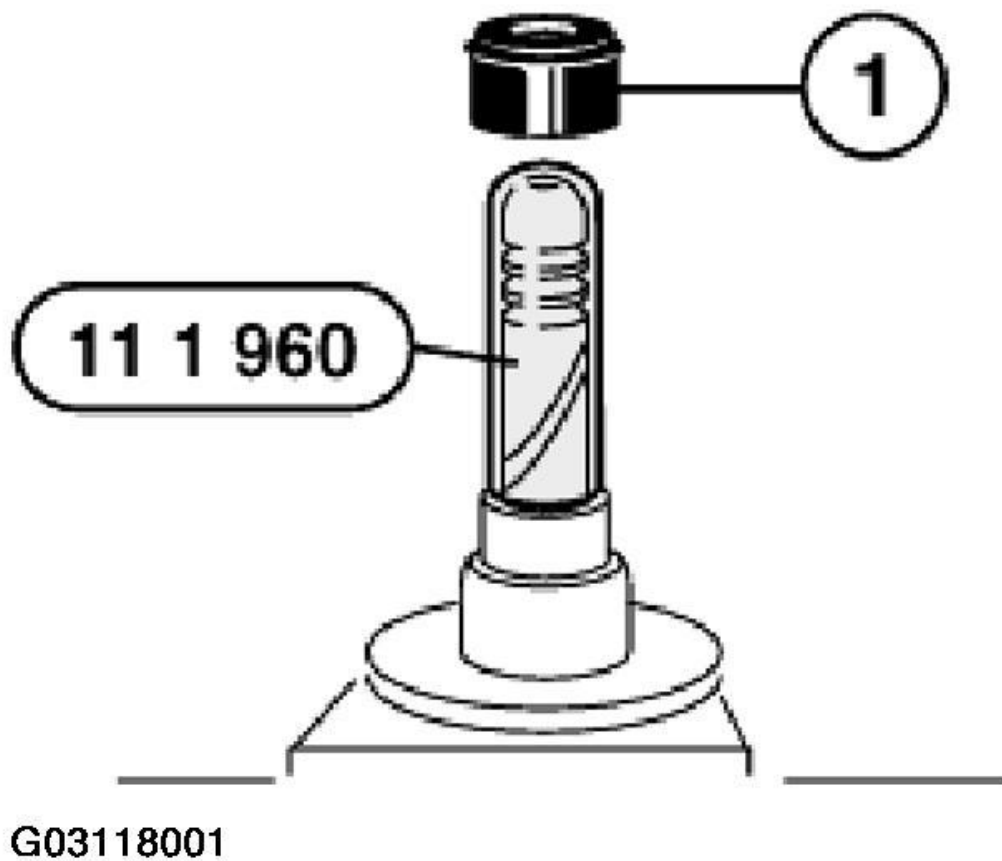
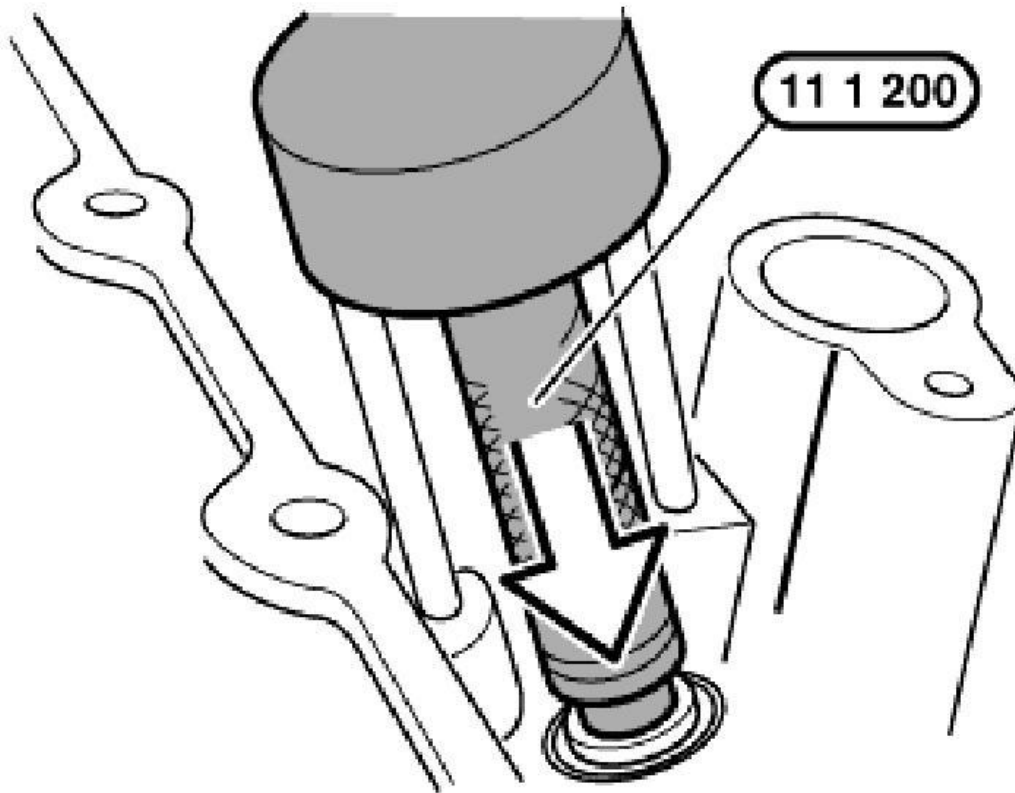


Fig. 384: Installing Assembly Sleeves (S50 B32 And S54)
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Special tool 11 1 200 is used for valve stem diameters 6 mm and 7 mm.

Installation:

Press valve stem seal firmly home by hand with special tool 11 1 200.



G03118002

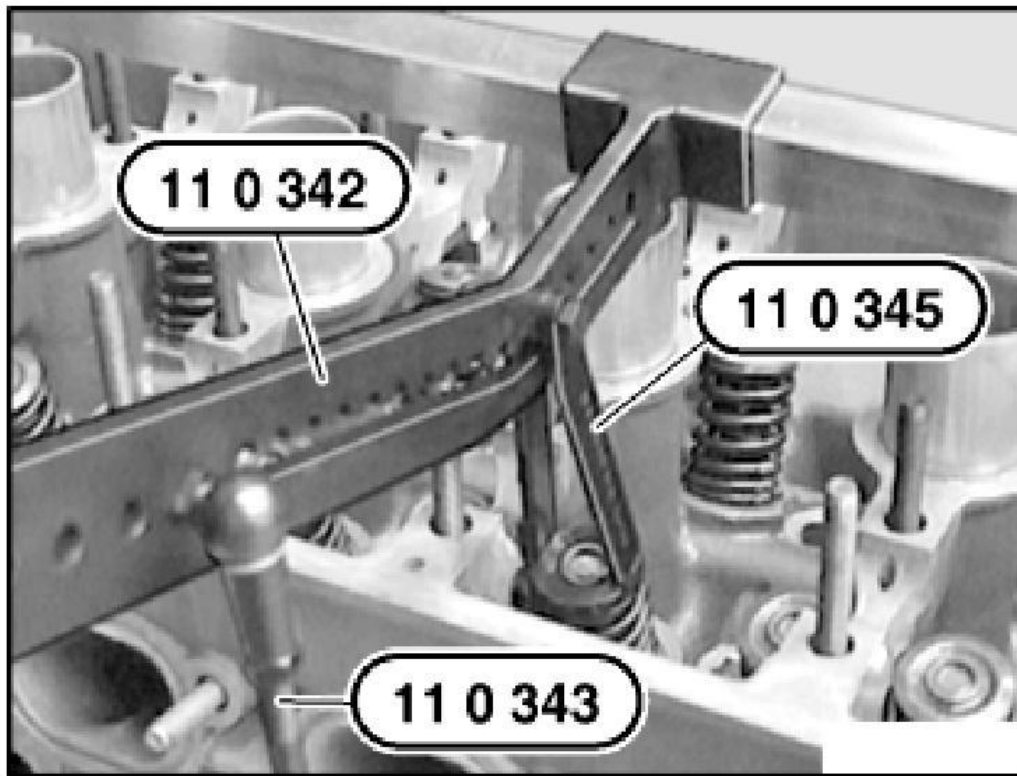
Fig. 385: Pressing Valve Stem Seal Using Drift
 Courtesy of BMW OF NORTH AMERICA, INC.

11 34 715 REPLACING ALL VALVE SEALS - CYLINDER HEAD REMOVED (S54)

Preliminary tasks are described in Disassembling and assembling cylinder head. Refer to **11 12 503**
DISASSEMBLING AND ASSEMBLING CYLINDER HEAD - CYLINDER HEAD REMOVED (S54).

Align special tool 11 0 345 in direction to valve shaft and select corresponding groove in special tool 11 0 342.

Press down valve spring on spring plate at top with special tool 11 0 342 and hook in special tool 11 0 343 to special tool 11 1 065.



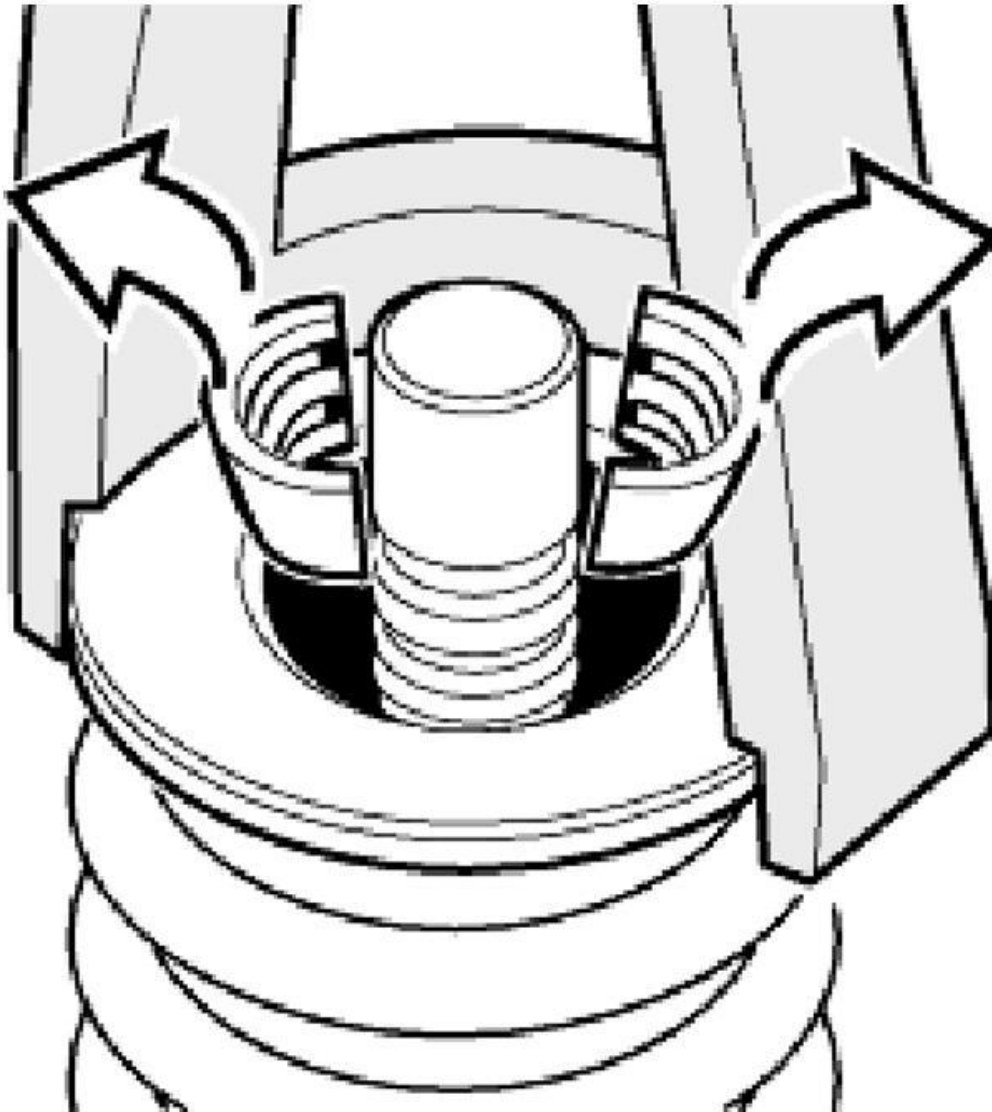
G03118003

Fig. 386: Compressing Valve Spring

Courtesy of BMW OF NORTH AMERICA, INC.

Remove valve cones.

Remove valve spring and spring plate.



G03118004

Fig. 387: Removing Valve Spring Tapers

Courtesy of BMW OF NORTH AMERICA, INC.

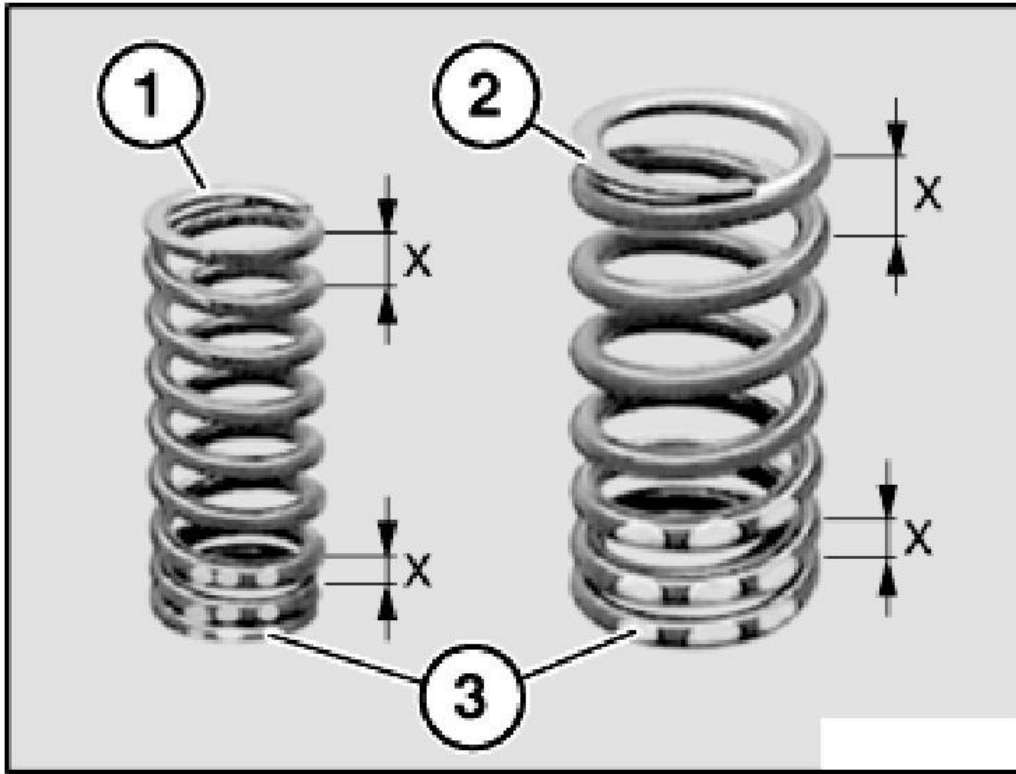
CAUTION: Incorrect installation possible. Incorrect installation will result in valve spring breakage.

The valve spring coils are narrower at the lower ends.

The color coding (3) is normally located at the lower end of the valve springs.

Only the position of the narrower coil is the decisive factor in correct installation of the valve springs (1 and 2).

Install valve springs (1 and 2) in such a way that lower coil points to spring plate at bottom.



G03118005

Fig. 388: Identifying Valve Springs

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: In event of damage to an inner or outer spring: replace inner and outer valve springs.

Arrangement:

1. Valve.
2. Lower plate spring.
3. Valve-stem seal.

4. Outer spring.
5. Inner spring.
6. Top spring plate.
7. Valve tapers.

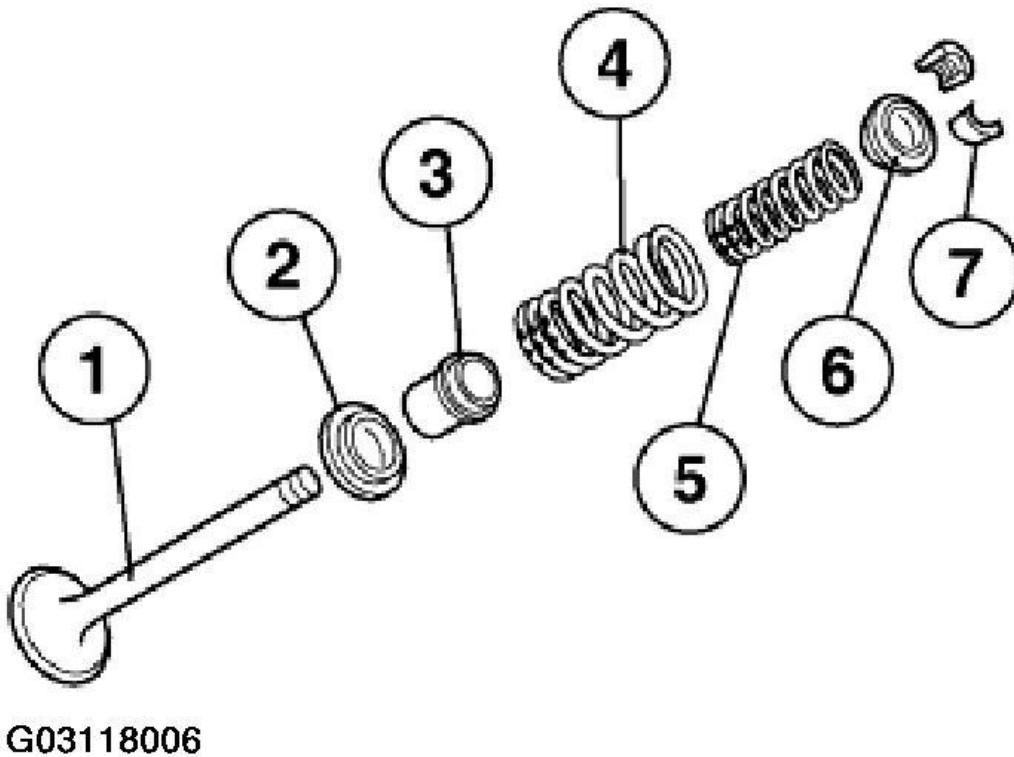


Fig. 389: View Of Valve Components
 Courtesy of BMW OF NORTH AMERICA, INC.

VARIABLE CAMSHAFT TIMING

11 36 010 REMOVING AND INSTALLING, SEALING/REPLACING VANOS ADJUSTMENT UNIT (S54)

Special Tools Required:

- 11 5 100
- 11 7 130
- 12 6 050

- 12 6 410
- 12 6 411

Read fault memory and make a documentary record.

Remove cylinder head. Refer to **11 12 100 REMOVING AND INSTALLING/SEALING CYLINDER HEAD (S54)**.

Remove all spark plugs. See **12 12 011 REPLACING ALL SPARK PLUGS (S54)**

Remove fan clutch with fan impeller and fan cowl. Refer to **11 52 020 REMOVING AND INSTALLING/REPLACING FAN CLUTCH (S52 / S54 / M52 / M52TU / M54 / M56)** and **17 11 031 REPLACING FAN COWL (S54)** .

Removal

Removal:

The removal of the VANOS adjustment unit is described separately from the installation. The assembly sequence for removal and installation is different.

Fit special tool 11 5 100 to four screws on crankshaft hub.

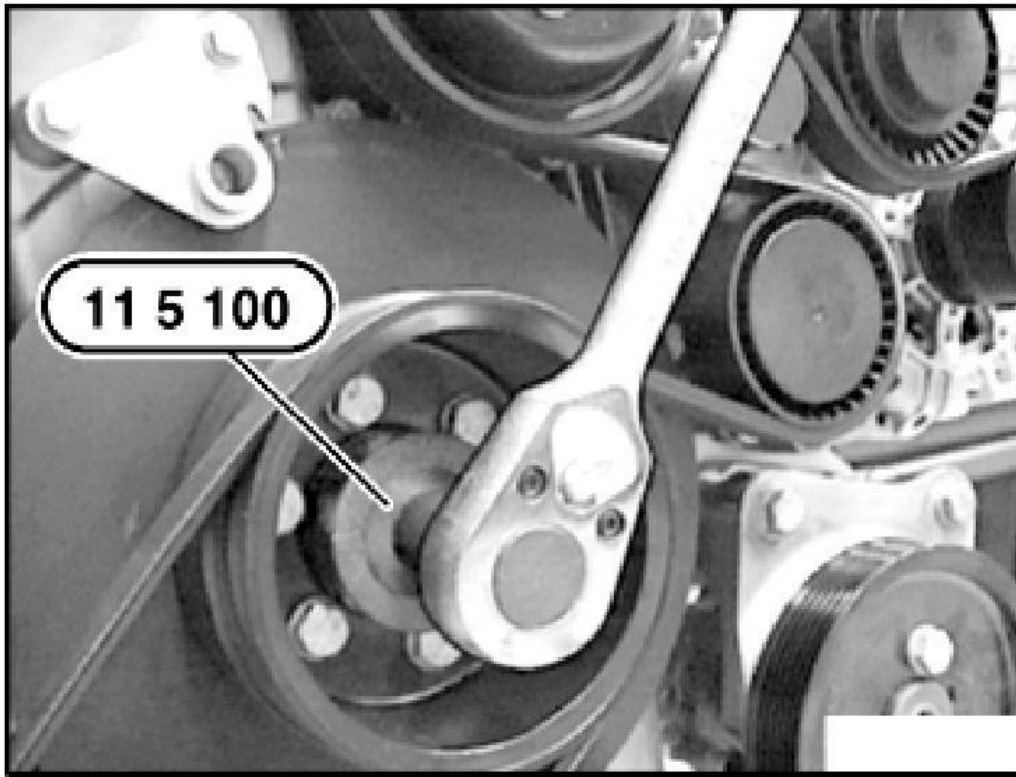
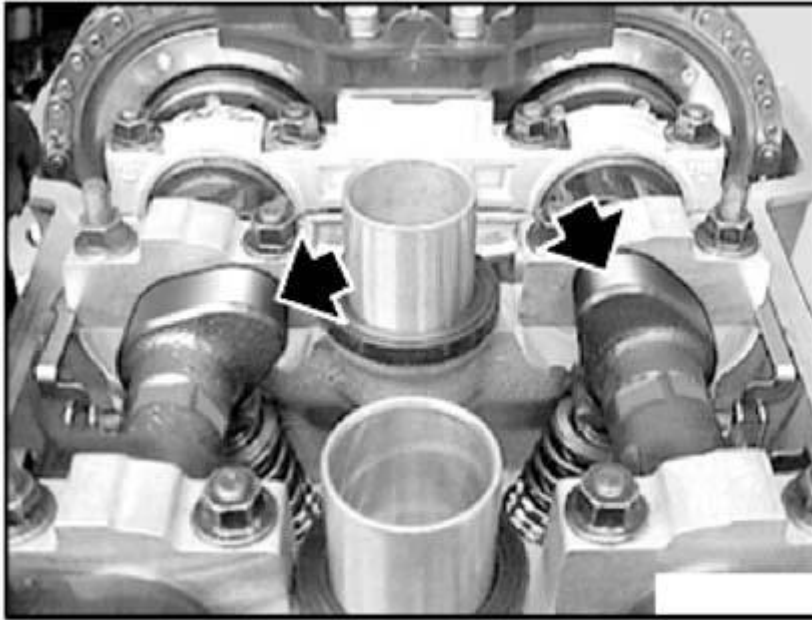
**G03118007**

Fig. 390: Identifying Adapter With Socket Wrench
Courtesy of BMW OF NORTH AMERICA, INC.

Rotate crankshaft in direction of rotation as far as firing TDC position of 1st cylinder.

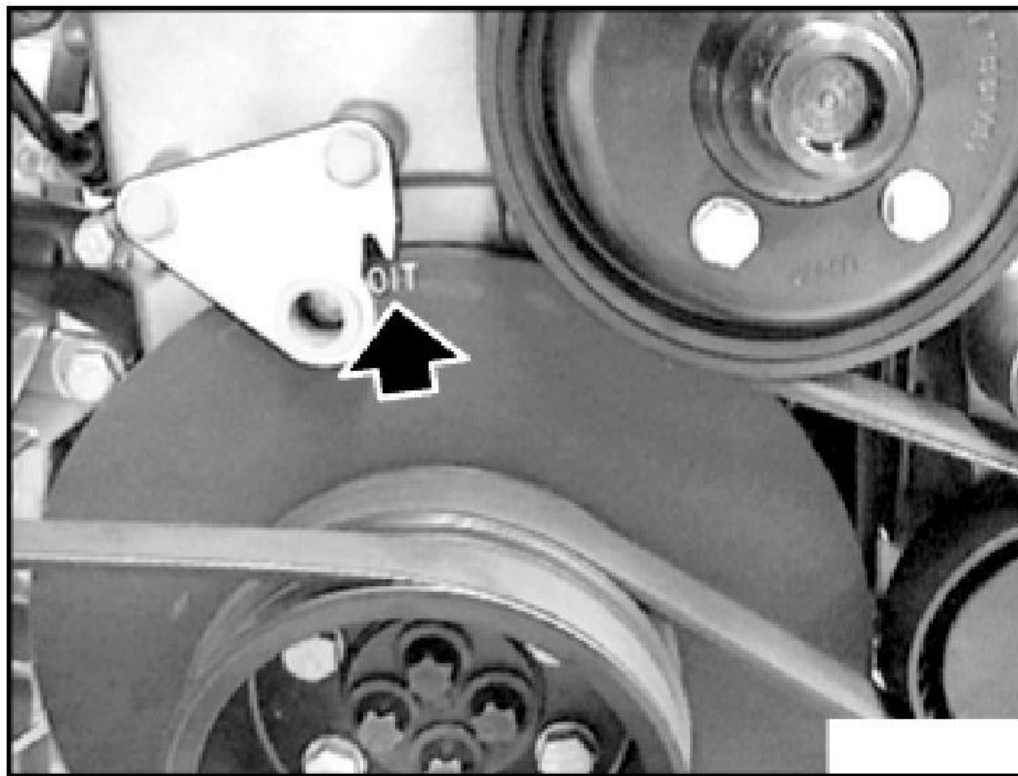


G03118008

Fig. 391: Rotating Crankshaft

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: TDC allocation above marking on vibration damper is sufficient.

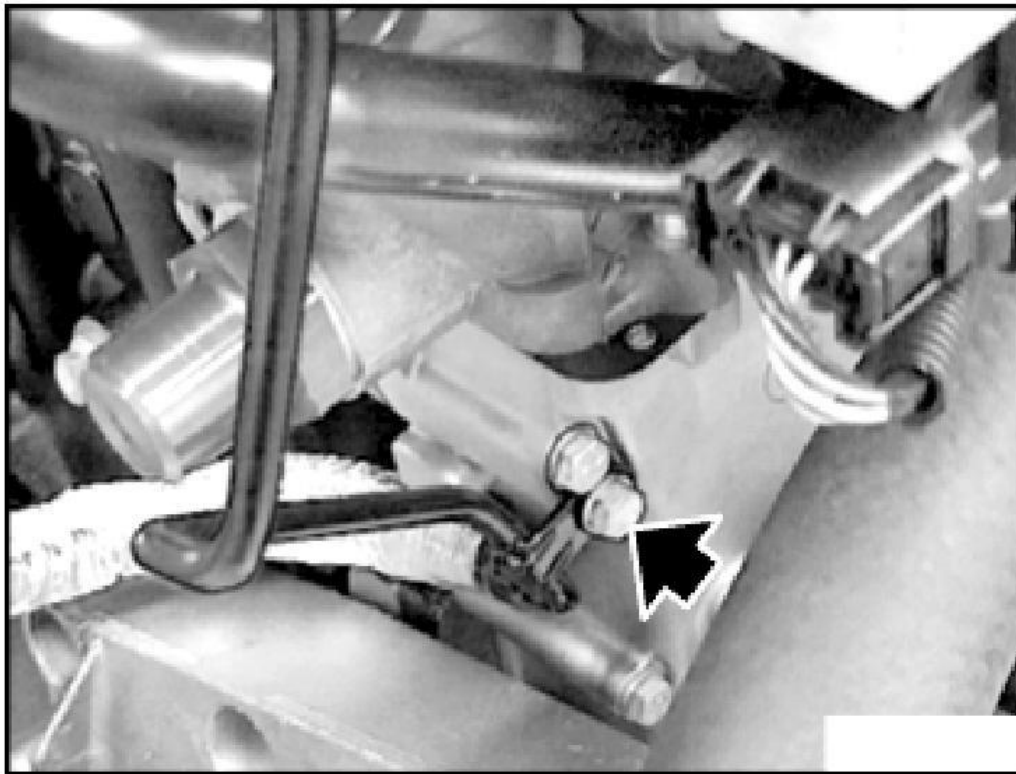


G03118009

Fig. 392: Identifying Marking On Vibration Damper
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: When the engine is switched off, VANOS moves the camshafts to a position which is advantageous to engine starting. The camshafts and the VANOS adjustment unit must be placed in the installation position before the VANOS adjustment unit is removed.

Detach bracket of oil line from timing case cover.



G03118010

Fig. 393: View Of Oil Line Bracket On Timing Case Cover
Courtesy of BMW OF NORTH AMERICA, INC.

Remove oil line from VANOS adjustment unit.

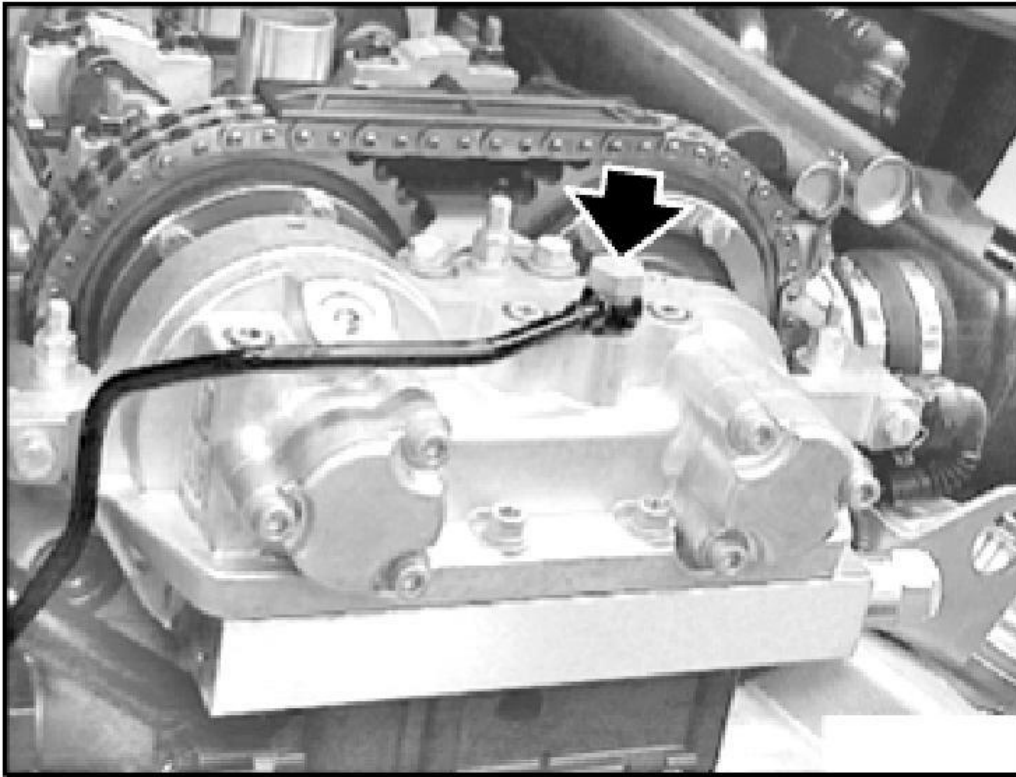
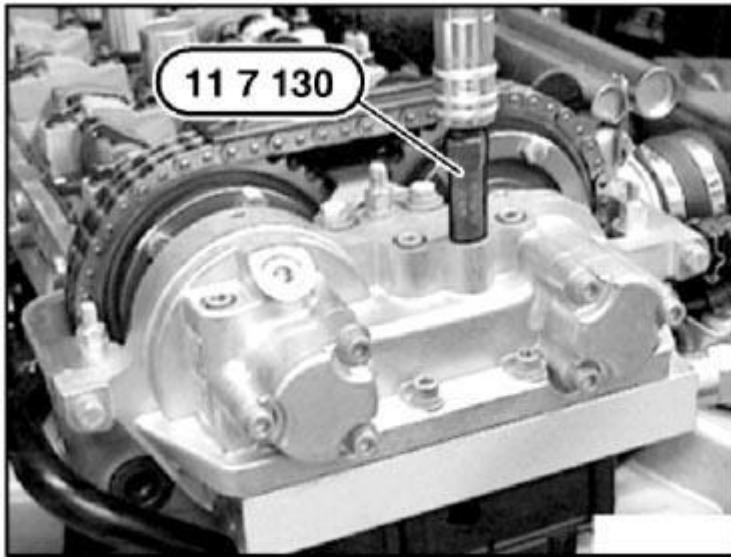
**G03118011**

Fig. 394: Identifying Oil Line On VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Fit special tool 11 7 130 to VANOS adjustment unit.

Connect compressed air (2 to 8 bar)



G03118012

Fig. 395: Installing Connection Piece To VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection on solenoid valve.

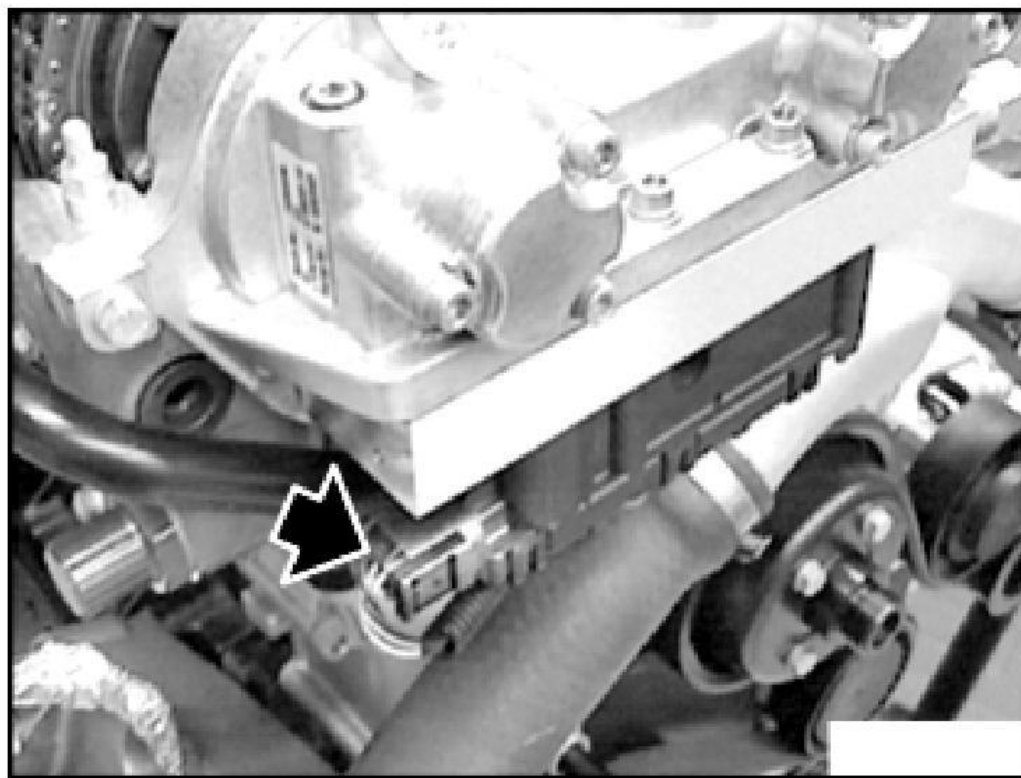
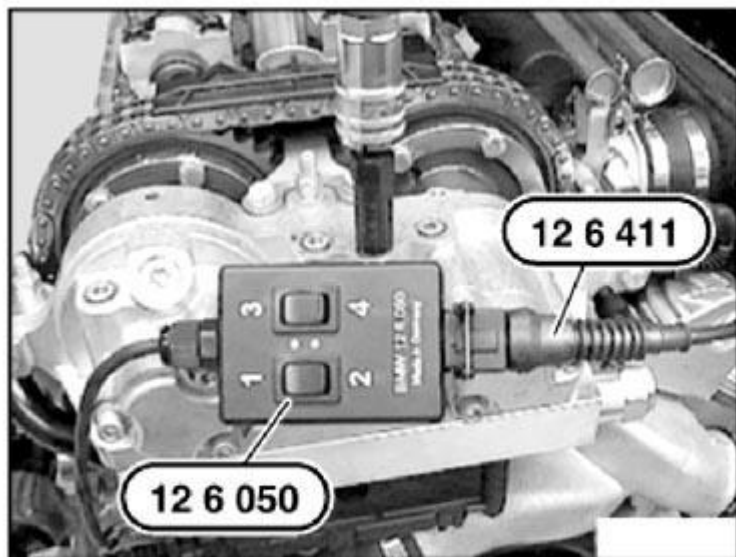
**G03118013**

Fig. 396: Disconnecting Plug Connection On Solenoid Valve
Courtesy of BMW OF NORTH AMERICA, INC.

Connect special tool 12 6 050 in conjunction with special 1 tool 12 6 411 (from special tool kit 12 6 410) to solenoid valves.

Connect special tool 12 6 411 to correct terminals on car battery.

Alternately press toggle switch buttons 1 and 2 several times on special tool 12 6 050.



G03118014

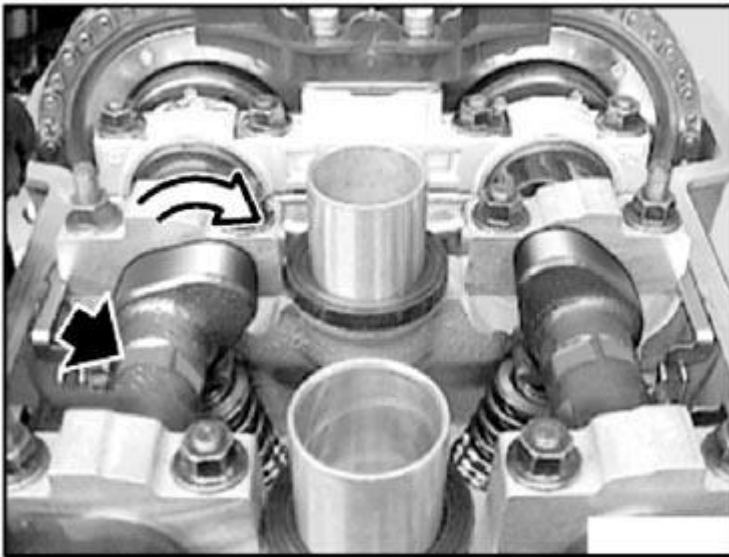
Fig. 397: View Of Switching Unit

Courtesy of BMW OF NORTH AMERICA, INC.

Press and hold down toggle switch button 1 on special tool 12 6 050.

At same time, rotate inlet camshaft at hexagon drive against direction of rotation as far as it will go.

NOTE: Spline teeth in VANOS gear are engaged; and inlet camshaft cannot be rotated further.

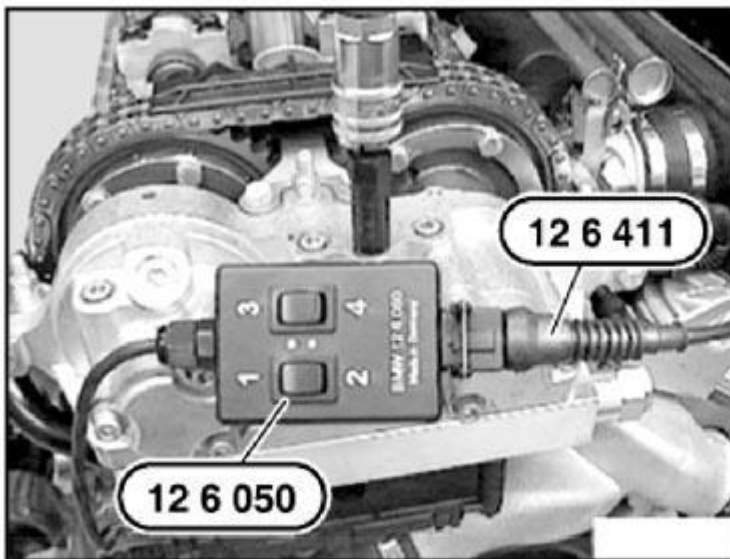


G03118015

Fig. 398: Rotating Inlet Camshaft

Courtesy of BMW OF NORTH AMERICA, INC.

Alternately press toggle switch buttons 3 and 4 several times on special tool 12 6 050.



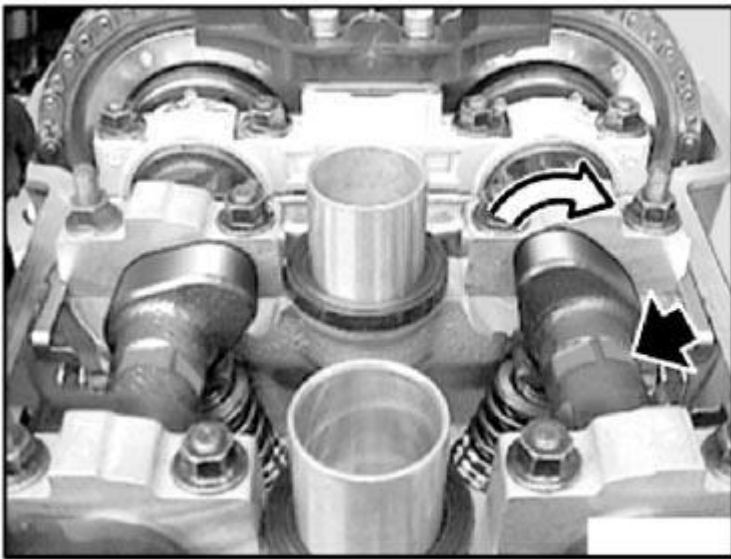
G03118016

Fig. 399: View Of Toggle Switch Buttons 3 And 4 On Switching Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Press and hold down toggle switch button 3 on special tool 12 6 050.

At same time, rotate exhaust camshaft at hexagon drive against direction of rotation as far as it will go.

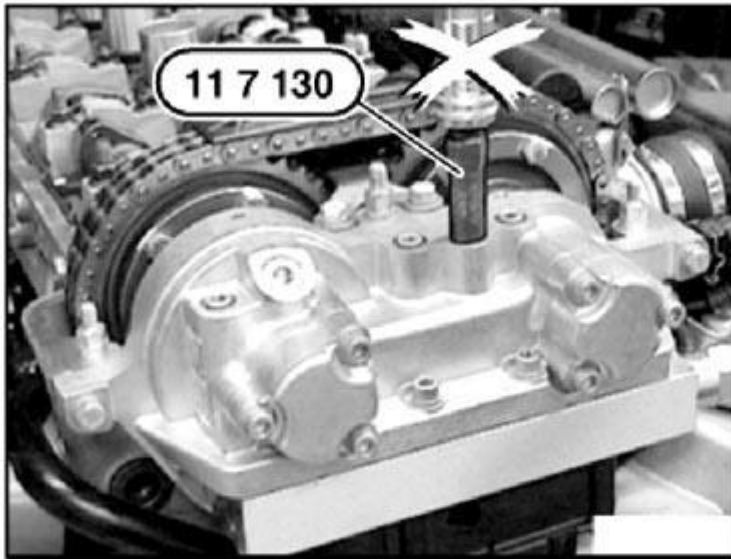
NOTE: Spline teeth in VANOS gear are engaged; and exhaust camshaft cannot be rotated further.



G03118017

Fig. 400: Rotating Exhaust Camshaft
Courtesy of BMW OF NORTH AMERICA, INC.

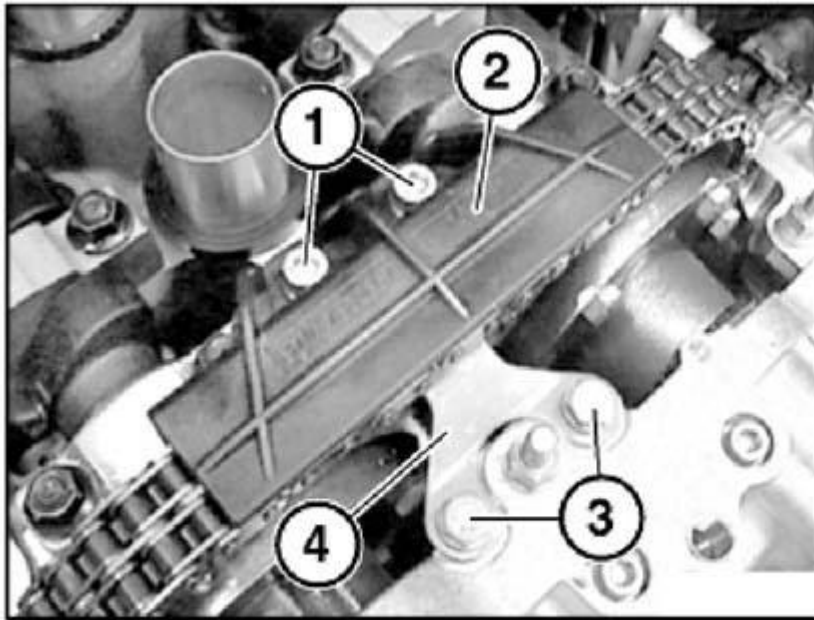
Disconnect compressed air from special tool 11 7 130.



G03118018

Fig. 401: Disconnecting Compressed Air From Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

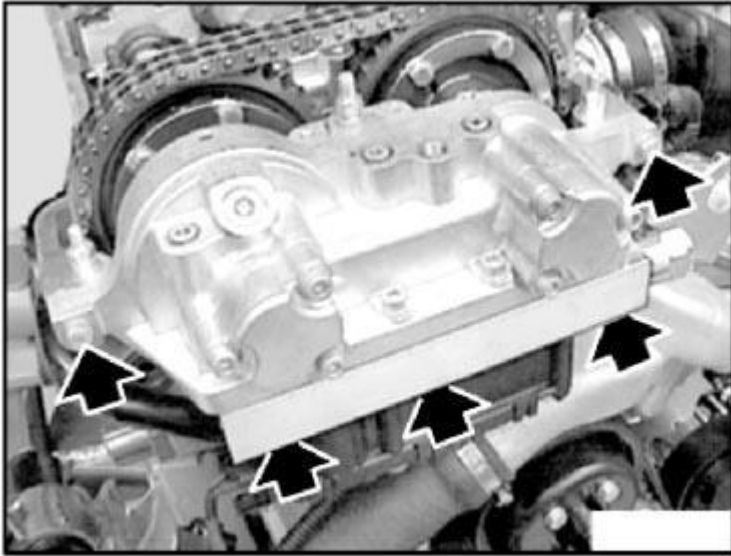
- Release screws (1).
- Remove sliding rail (2).
- Release screws (3).
- Remove holder (4).



G03118019

Fig. 402: Removing Sliding Rail**Courtesy of BMW OF NORTH AMERICA, INC.**

Release screws on VANOS adjustment unit.



G03118020

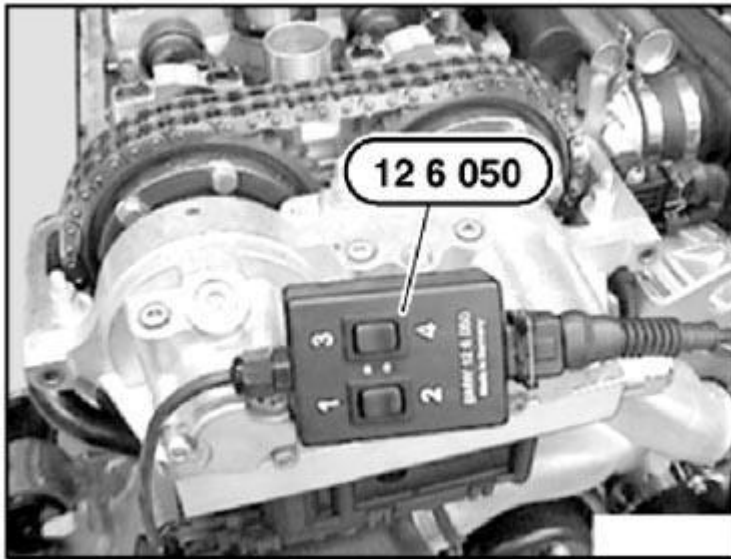
Fig. 403: Releasing Screws On VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Make sure that compressed air is "not" connected.

Press buttons 2 and 4 on special tool 12 6 050. The solenoid valves are activated and the oil chamber of the hydraulic piston is ventilated.

CAUTION: Do not damage VANOS adjustment unit.

Carefully detach VANOS adjustment unit from adapter sleeves in cylinder head.



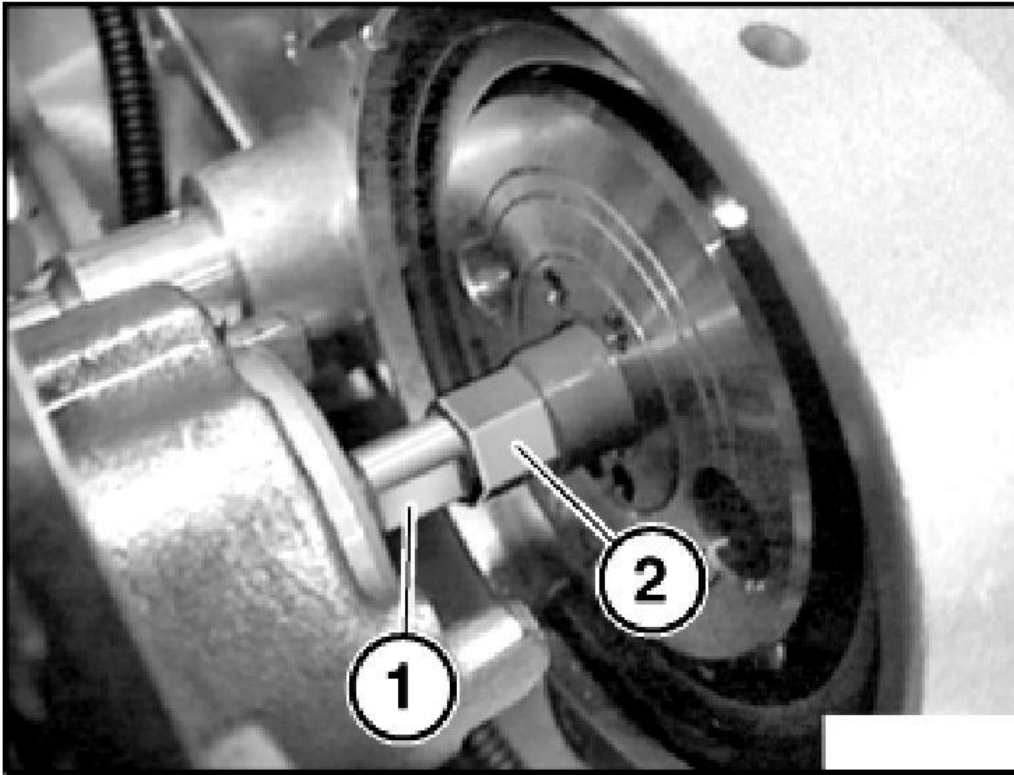
G03118021

Fig. 404: View Of Switching Unit**Courtesy of BMW OF NORTH AMERICA, INC.**

Detach VANOS adjustment unit until hydraulic pistons on exhaust and inlet sides are extended.

CAUTION: CCW thread! Brace against twin surface (1) and release hex head (2).

Release screw connection of toothed shaft on inlet and exhaust sides, supporting VANOS adjustment unit with your hand in the process.



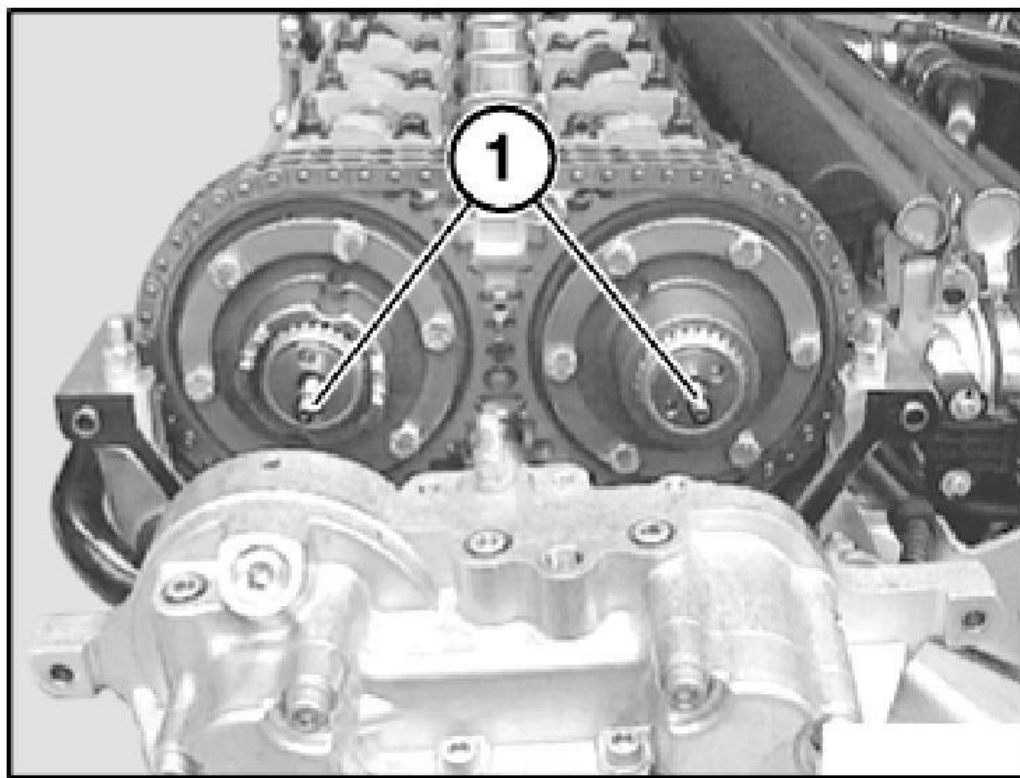
G03118022

Fig. 405: Releasing Hex Head

Courtesy of BMW OF NORTH AMERICA, INC.

Remove VANOS adjustment unit.

NOTE: The toothed shafts (1) remain in the VANOS gear on the engine.

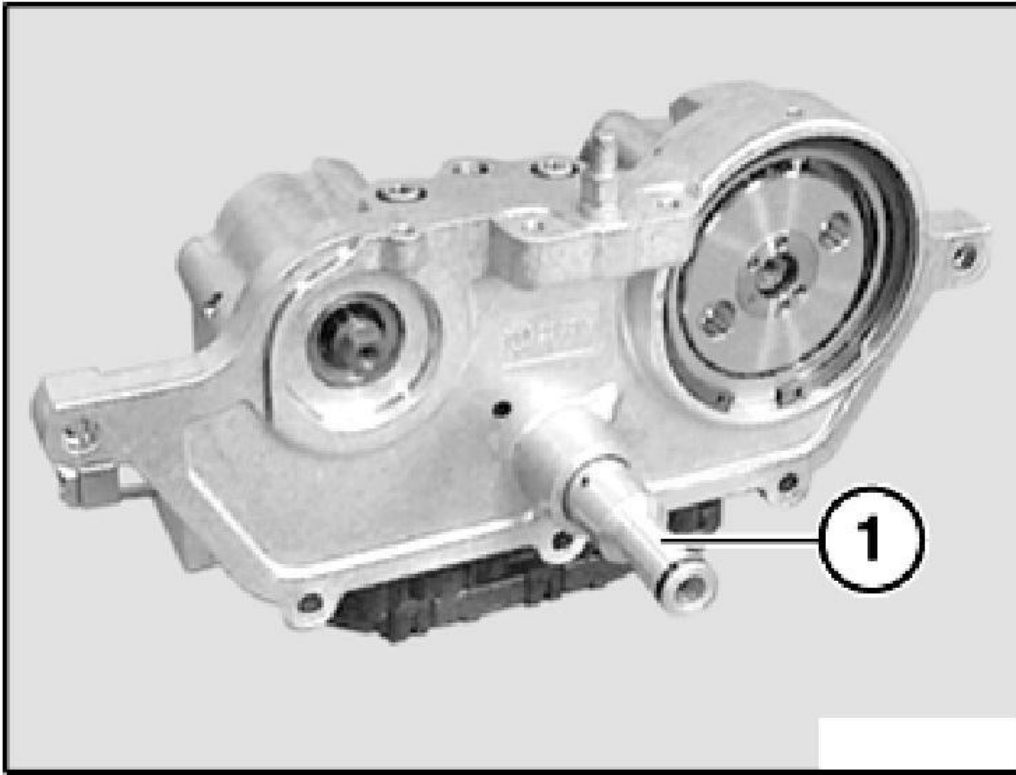


G03118023

Fig. 406: Removing VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: The engine must not be cranked while the VANOS adjustment unit is removed. The toothed shafts might displace and slip out of the spline teeth; the camshafts would no longer be non-positively connected and the valves could touch the piston.

Detach control valve (1) from VANOS adjustment unit.



G03118024

Fig. 407: Detaching Control Valve From VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

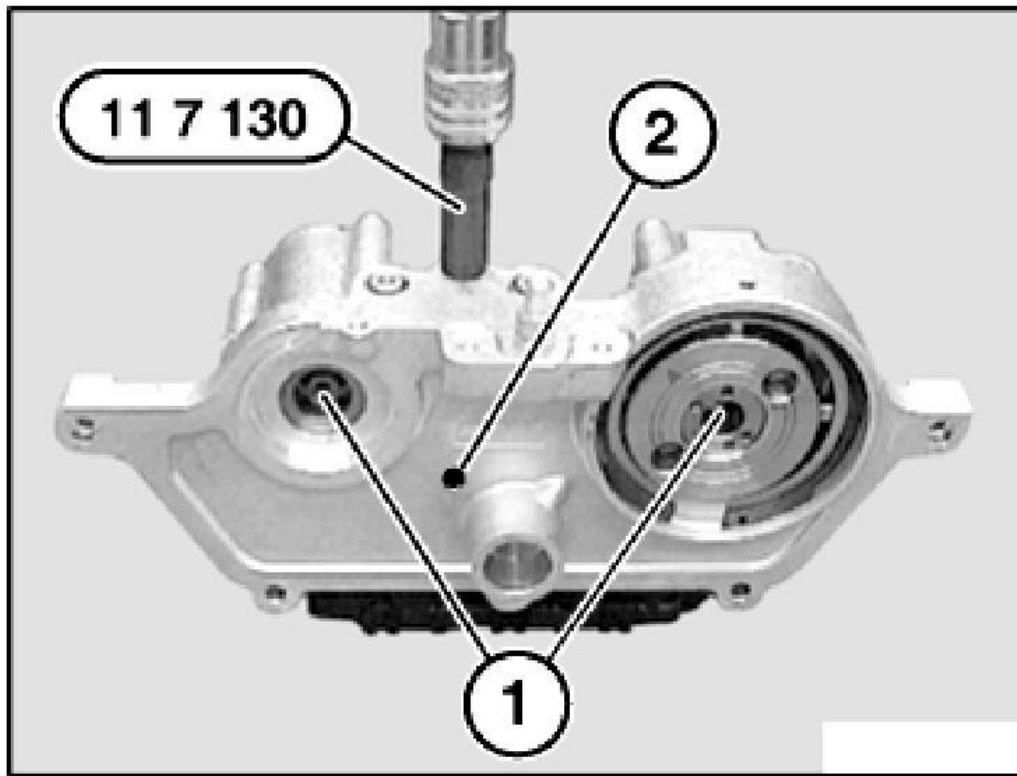
Installation

The installation of the VANOS adjustment unit is described separately from the removal. The assembly sequence for removal and installation is different.

NOTE: **Procedure for replacement or new parts: When delivered, the hydraulic pistons (1) of the VANOS adjustment unit are "retracted" and the hexagons are not accessible. Fit special tool 11 7 130 to VANOS adjustment unit.**

CAUTION: Oil is sprayed when compressed air is connected. Cover bore (2) with a cloth.

Connect compressed air (2 to 8 bar).



G03118025

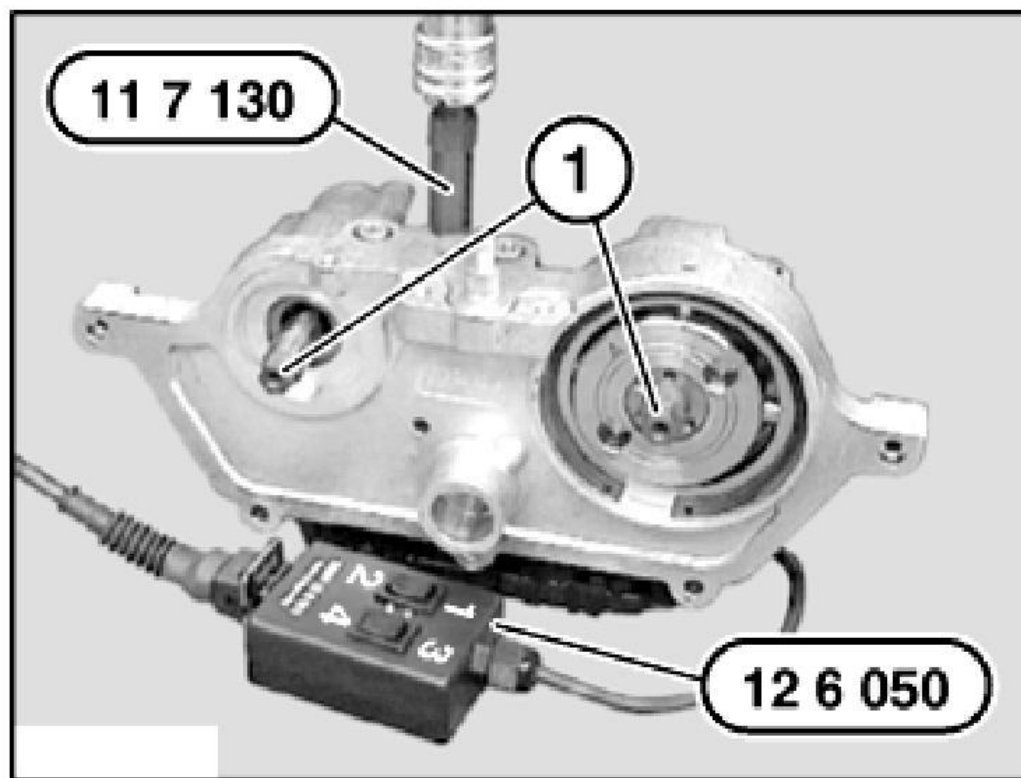
Fig. 408: Installing Special Tool To VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Connect special tool 12 6 050 in conjunction with special tool 12 6 411 to solenoid valves of VANOS adjustment unit.

Connect special tool 12 6 411 to correct terminals on car battery.

Press buttons 2 and 4 on special tool 12 6 050. The solenoid valves are activated and the oil chamber of the hydraulic piston is ventilated. The hydraulic pistons (1) extend.

Disconnect compressed air from special tool 11 7 130. Remove special tool 11 7 130 from VANOS adjustment unit.



G03118026

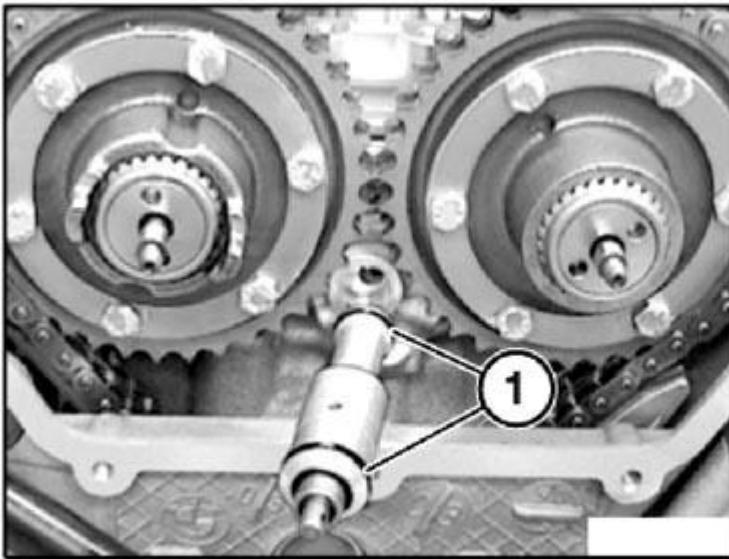
Fig. 409: Disconnecting Compressed Air From Switching Unit
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: A filter is integrated in the control valve.

In the event of engine damage which suggests that the filter is contaminated with swarf/chips, it is essential to replace the control valve.

Replace sealing rings (1) and coat with oil as antiseize agent.

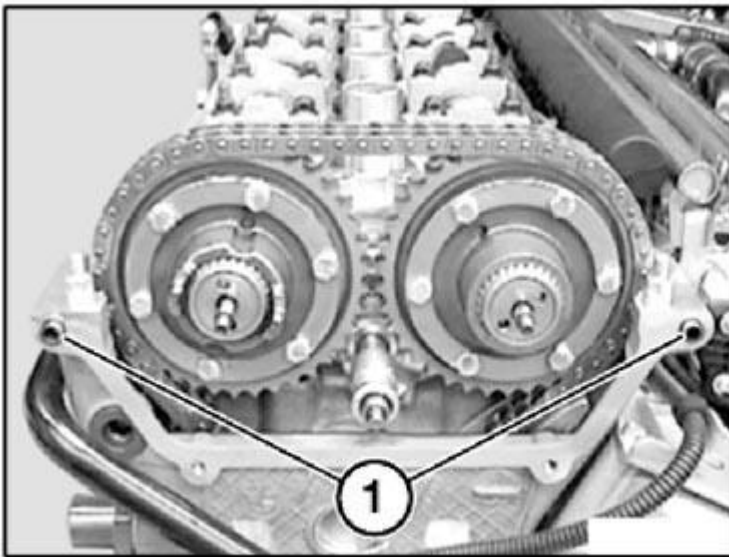
Preassemble controlled valve in cylinder head.



G03118027

Fig. 410: View Of Sealing Rings**Courtesy of BMW OF NORTH AMERICA, INC.**

Check dowel sleeves (1) for damage and correct installation position.



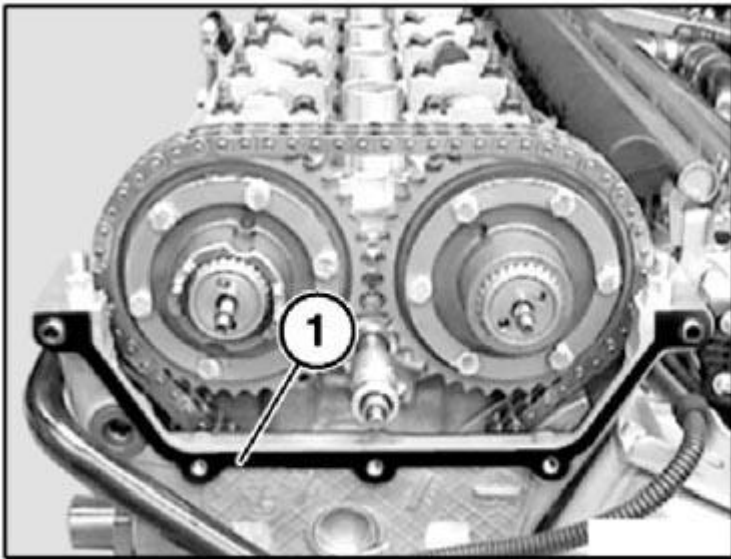
G03118028

Fig. 411: Checking Dowel Sleeves

Courtesy of BMW OF NORTH AMERICA, INC.

Replace gasket (1).

CAUTION: Note direction of installation of gasket. Install gasket (1) in such a way that beading points to VANOS adjustment unit. Secure gasket (1) with sealing compound on.

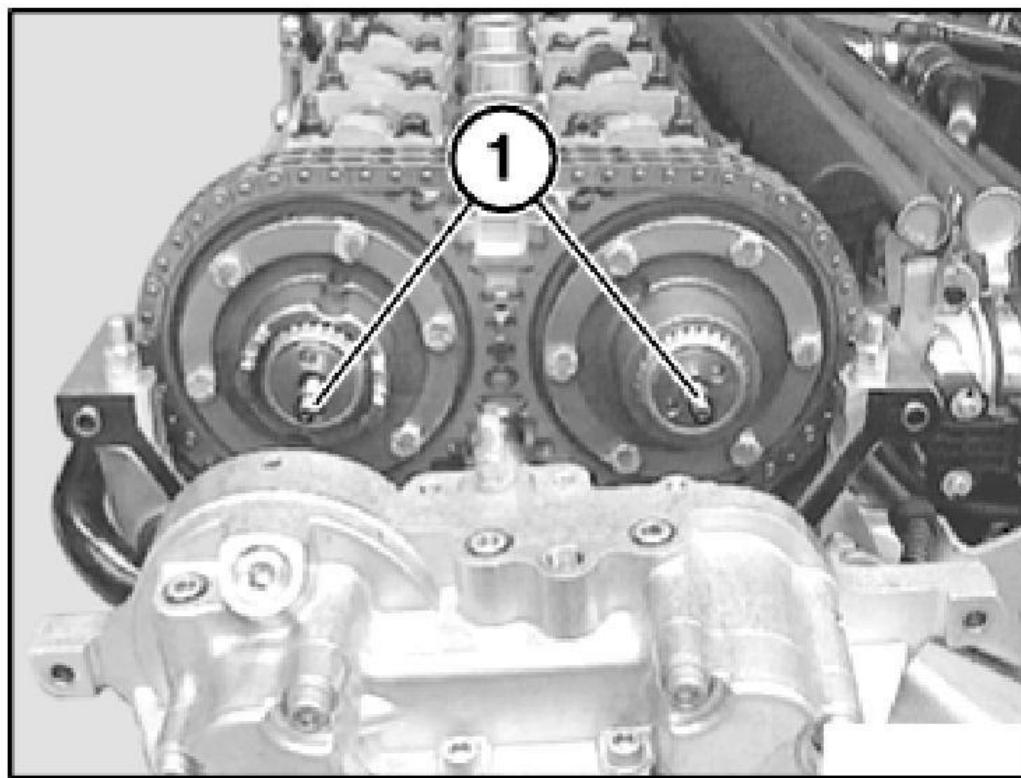


G03118029

Fig. 412: Replacing Gasket

Courtesy of BMW OF NORTH AMERICA, INC.

Place VANOS adjustment unit on toothed shafts (1).



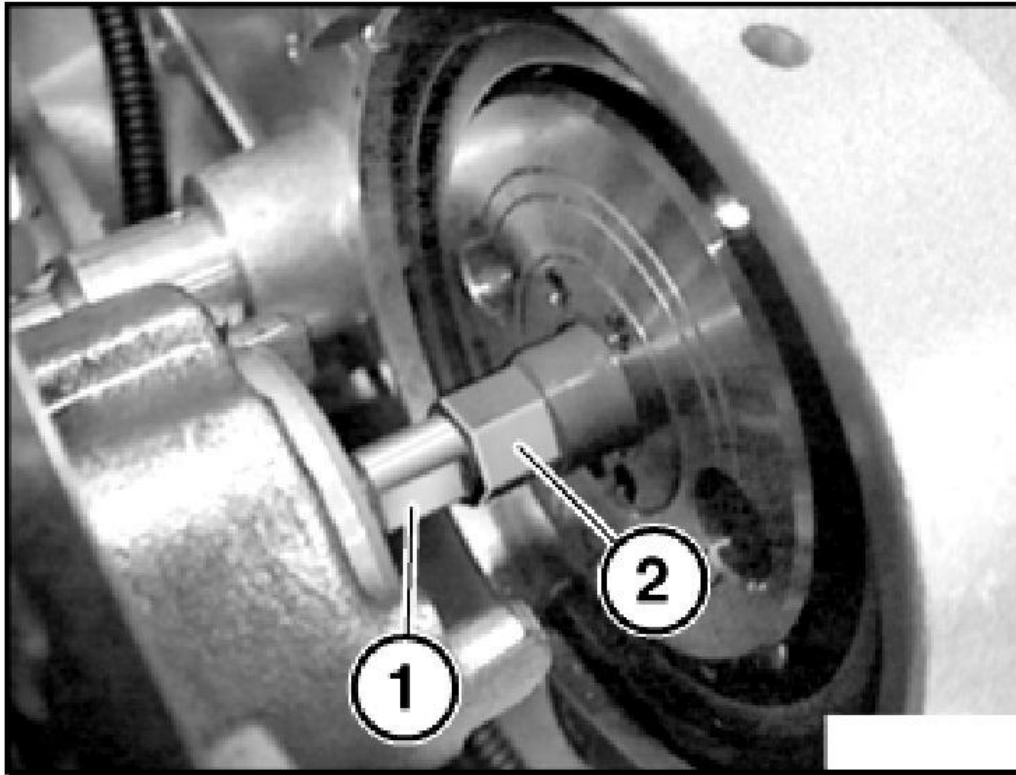
G03118030

Fig. 413: Placing VANOS Adjustment Unit On Toothed Shafts
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: CCW thread! When tightening down toothed shafts, support VANOS adjustment unit with your hand. Grip on dihedron (1) and screw together at hexagon (2) alternately between exhaust and inlet sides in 1/2 turn increments.

Tighten down screw connection of toothed shaft on inlet and exhaust sides.

Tightening torque 10 N.m.

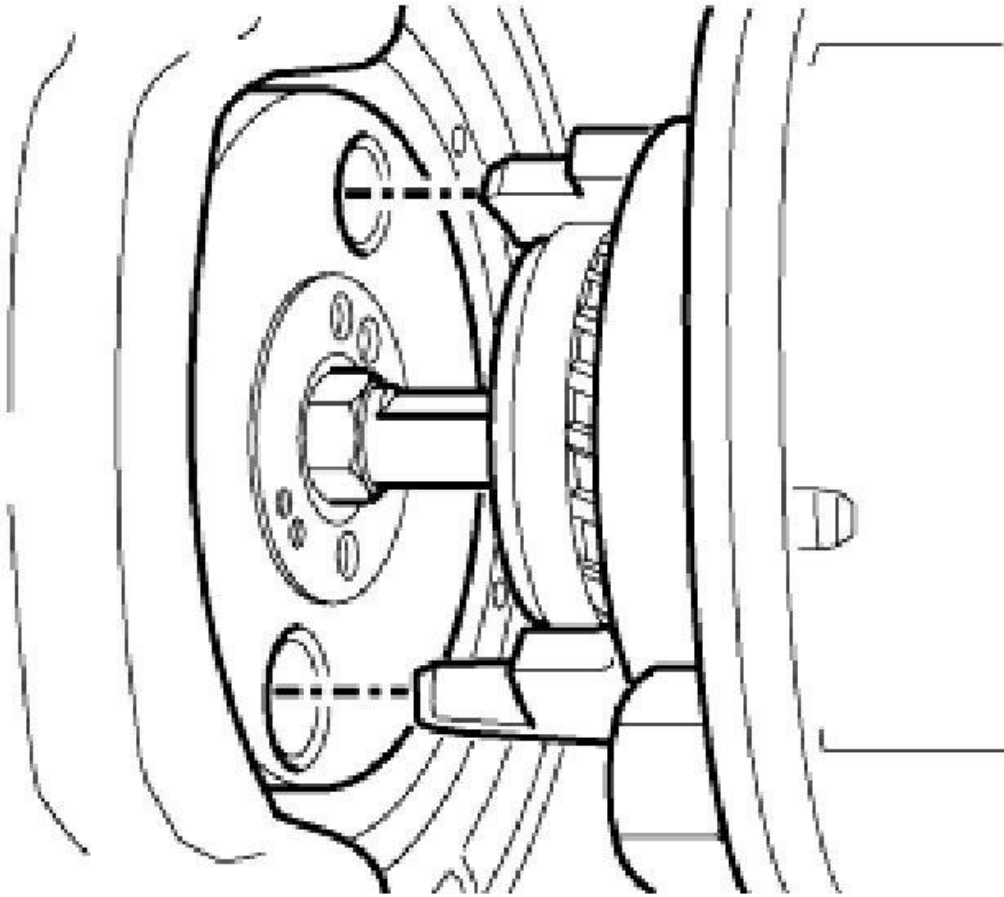


G03118031

Fig. 414: Locating Dihedron And Hexagon
Courtesy of BMW OF NORTH AMERICA, INC.

Align radial piston pump to driver on spline hub.

NOTE: Picture shows a schematic representation.



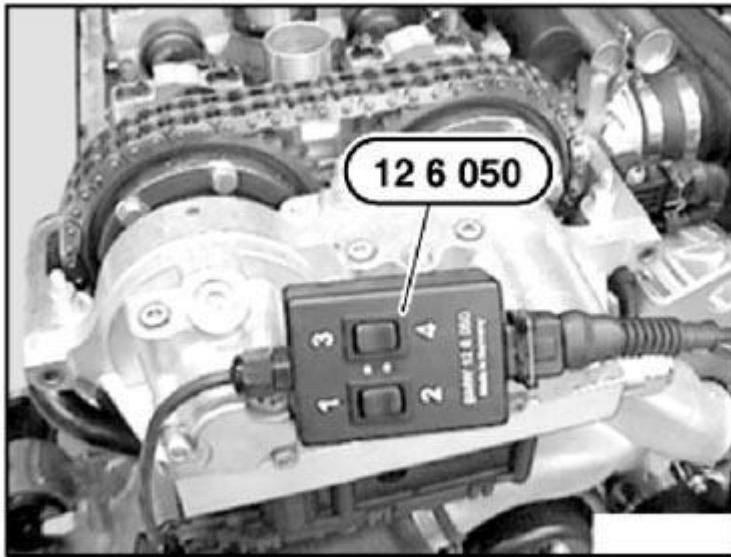
G03118032

Fig. 415: Aligning Radial Piston Pump To Driver On Spline Hub
Courtesy of BMW OF NORTH AMERICA, INC.

Press buttons 1 and 3 on special tool 12 6 050 simultaneously. The solenoid valves are activated and the air can escape from the hydraulic pistons of the VANOS adjustment unit.

Simultaneously push on VANOS adjustment unit until it rests on cylinder head.

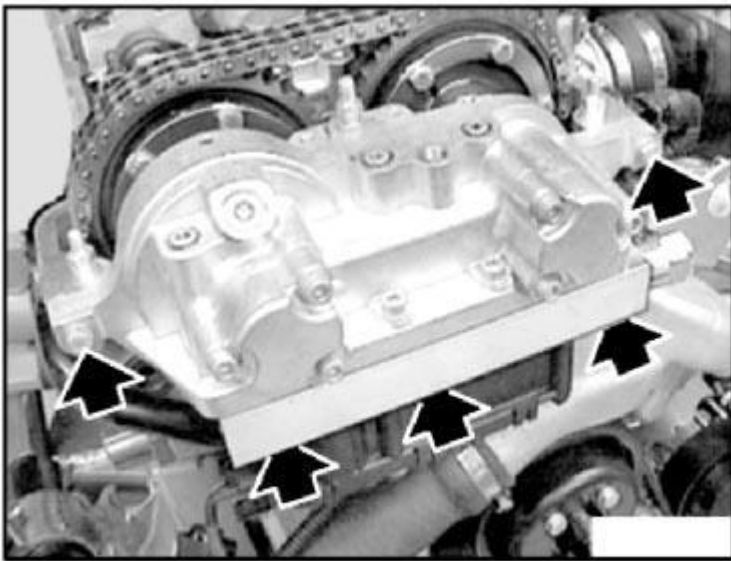
CAUTION: If this position is not reached, check position of radial piston pump to driver and realign if necessary.



G03118033

Fig. 416: Identifying Buttons 1 And 3 On Switching Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Insert screws of VANOS adjustment unit and tighten down.

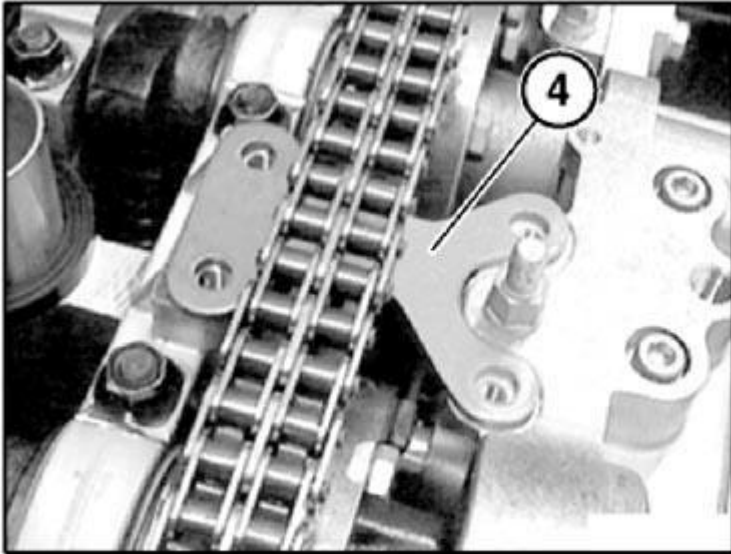


G03118034

Fig. 417: Locating Screws Of VANOS Adjustment Unit
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: Check installed direction.

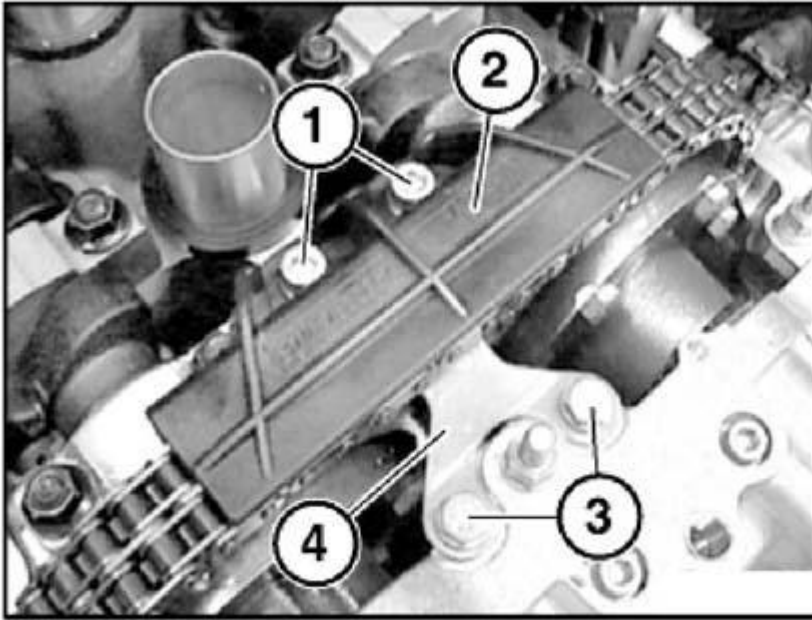
Install holder (4)



G03118035

Fig. 418: Installing Holder
Courtesy of BMW OF NORTH AMERICA, INC.

- Insert screws (3) and secure holder (4) (do not tighten down screws (3) yet)
- Install sliding rail (2).
- Insert screws (1).
- Tighten down screws (1) and screws (3).



G03118036

Fig. 419: Installing Sliding Rail**Courtesy of BMW OF NORTH AMERICA, INC.**

Disconnect special tool 12 6 050 and special tool 12 6 410 and remove.

Insert screw connections in solenoid valves.

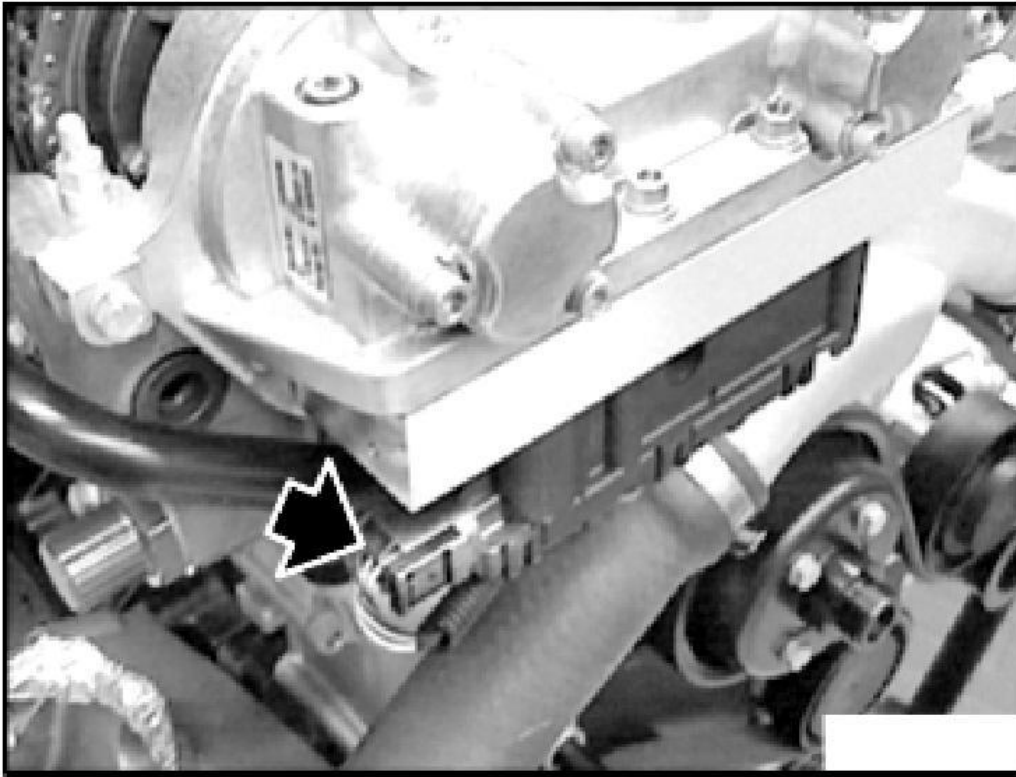
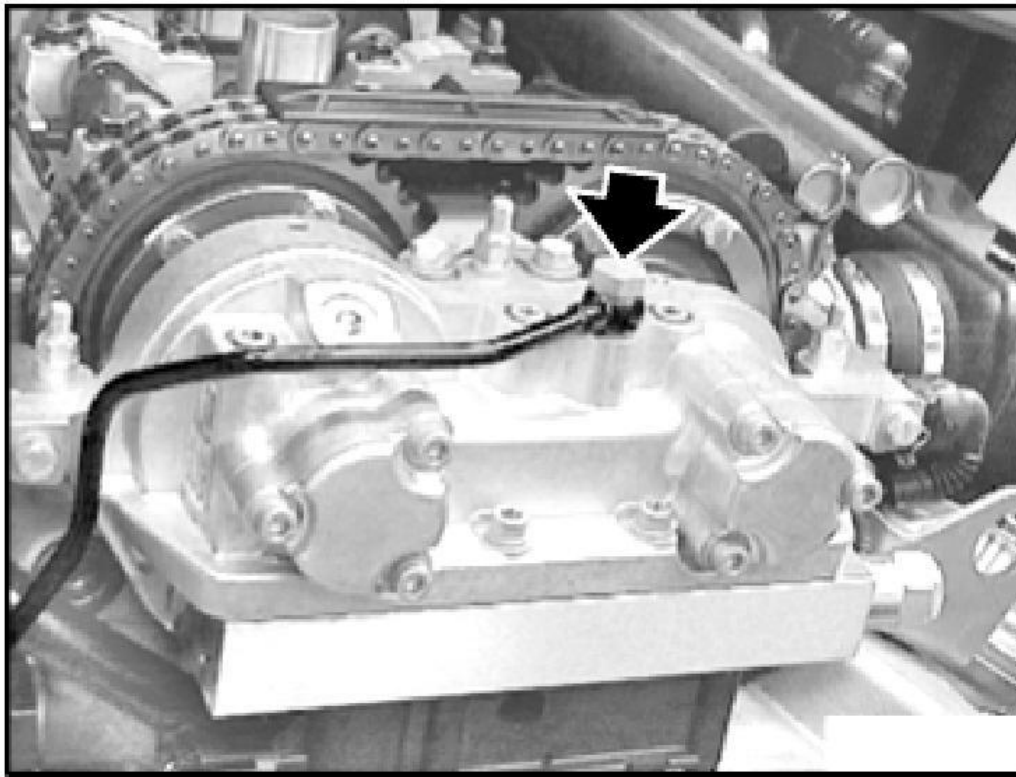
**G03118037**

Fig. 420: Inserting Screw Connections In Solenoid Valves
Courtesy of BMW OF NORTH AMERICA, INC.

Replace sealing rings of banjo bolt.

Insert banjo bolt but do not tighten down yet.



G03118038

Fig. 421: Inserting Banjo Bolt

Courtesy of BMW OF NORTH AMERICA, INC.

Install bracket of oil line. Install screw and tighten down.

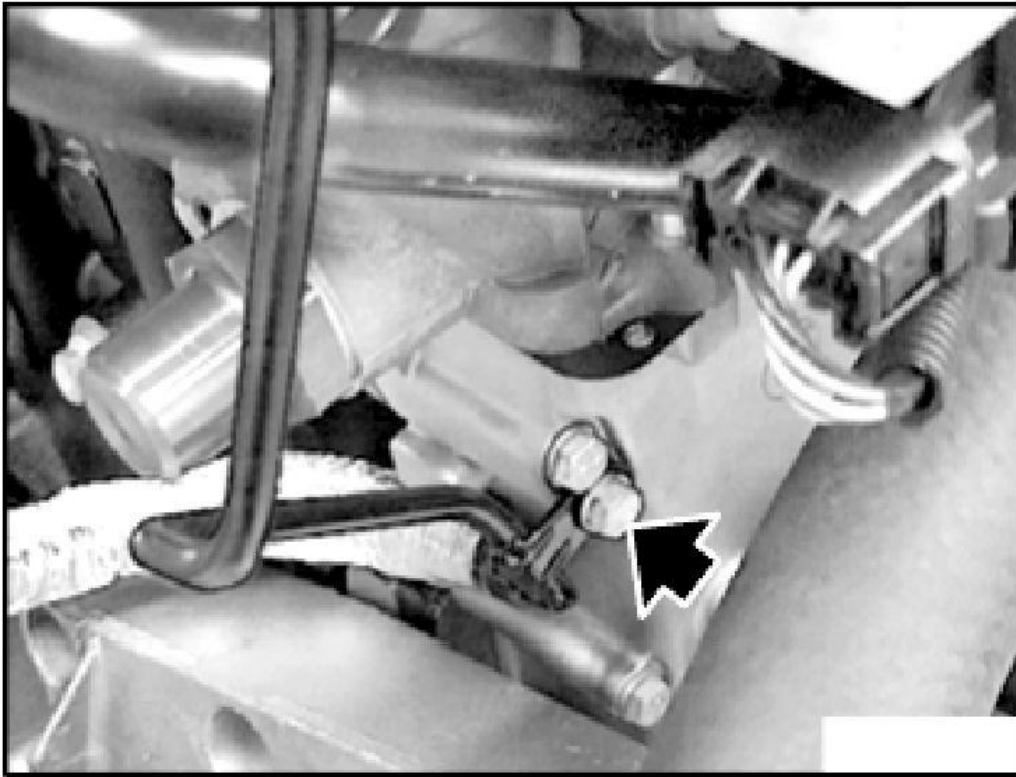
**G03118039**

Fig. 422: Installing Bracket Of Oil Line
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down banjo bolt of oil line.

Tightening torque, refer to 11 36 9AZ in **ENGINE - TIGHTENING TORQUES** .

Assemble engine.

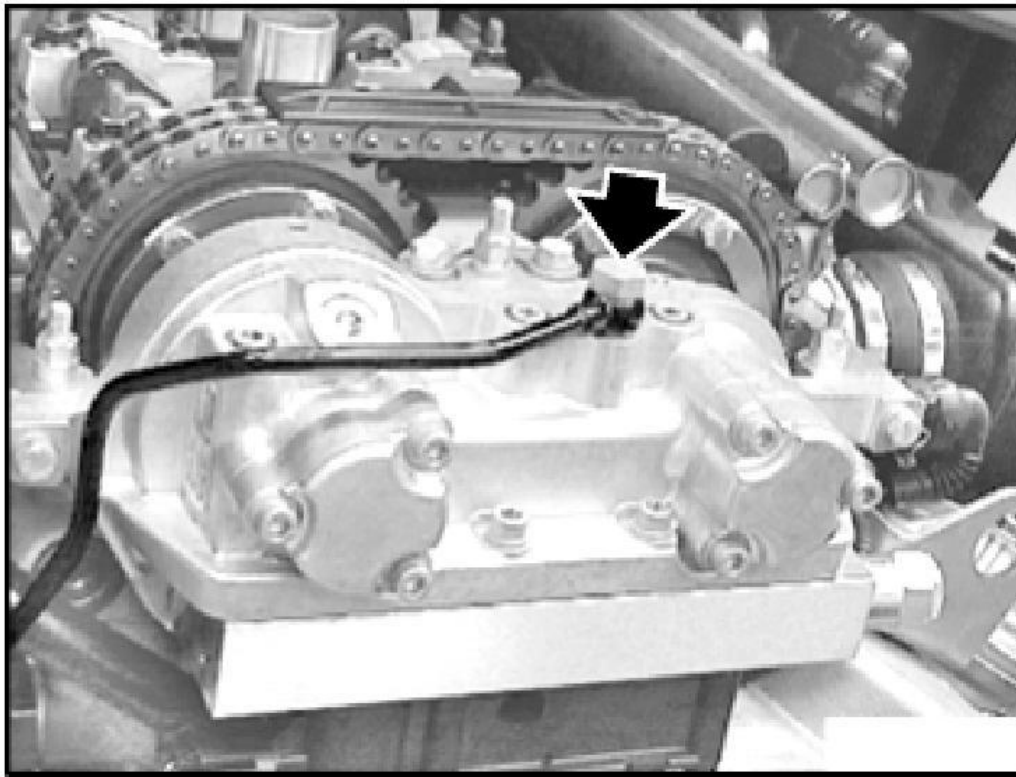
**G03118040**

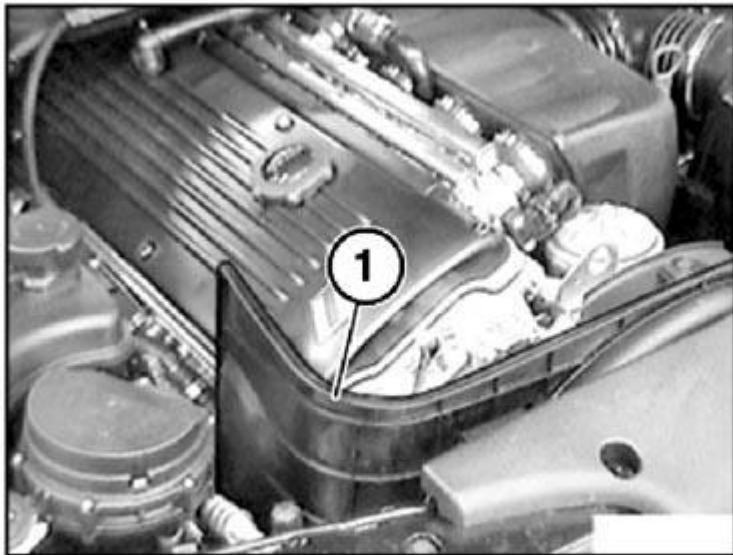
Fig. 423: Tightening Down Banjo Bolt Of Oil Line
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: There is air in the VANOS system once it is opened. In the first few seconds after startup this results in a clearly discernible "rattling noise". This rattling noise does "not" indicate incorrect assembly. The rattling noise will disappear as soon as the oil pressure has built up and the system has vented.

11 36 582 REPLACING SOLENOID VALVE ON VANOS ADJUSTMENT UNIT (S54)

E46 Only:

Remove expansion rivets. Remove air duct (1).



G03118041

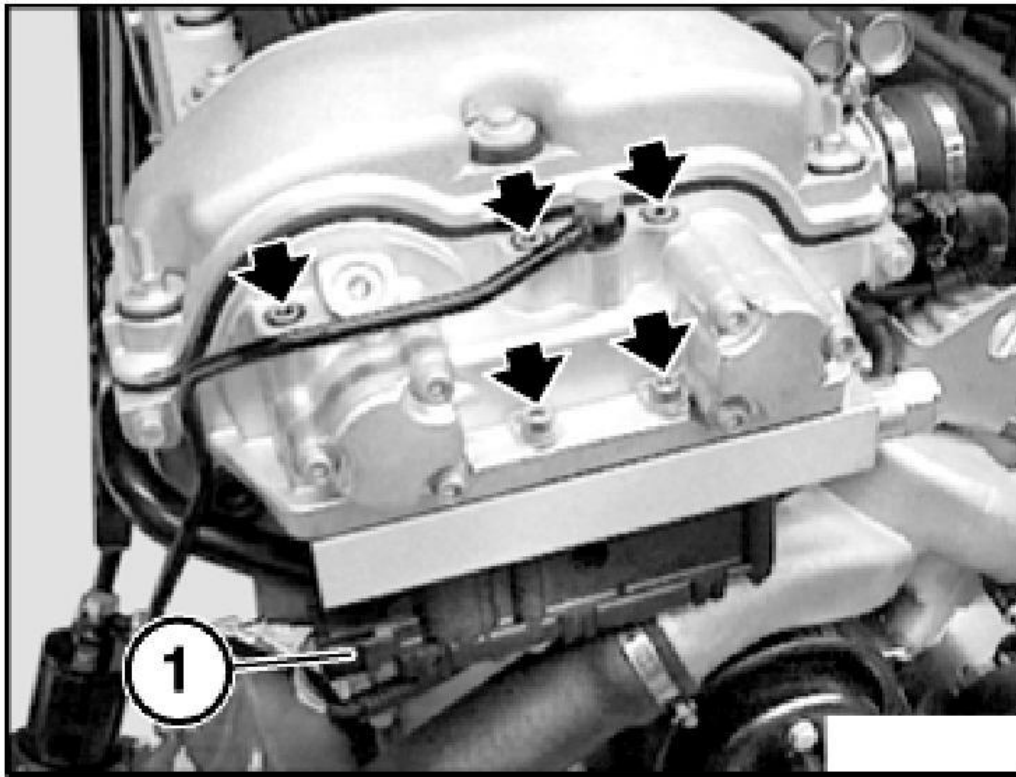
Fig. 424: Removing Air Duct

Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (1) on solenoid valve.

CAUTION: Have a cleaning cloth ready. A small quantity of oil will emerge after the screws have been released. Make sure no oil runs onto belt drive. Remove any remnants of oil immediately with cleaning cloth.

Release screws and remove solenoid valve with sealing plate.

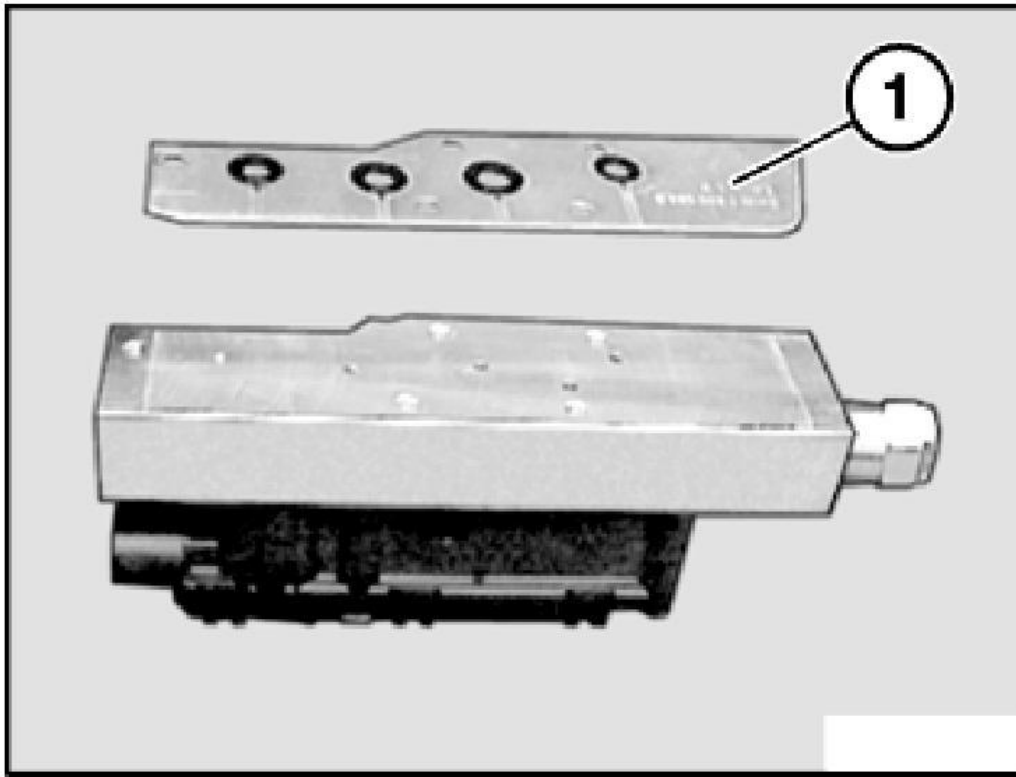


G03118042

Fig. 425: Disconnecting Plug Connection On Solenoid Valve
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Replace sealing plate (1). Sealing surfaces on solenoid valve and on VANOS adjustment unit clean and oil-free.



G03118043

Fig. 426: View Of Sealing Plate

Courtesy of BMW OF NORTH AMERICA, INC.

OIL SUPPLY

11 40 000 CHECKING ENGINE OIL PRESSURE (S50 / S54)

Special Tools Required:

- 11 4 390
- 13 3 061
- 13 3 063

NOTE: When the main flow oil-filter cover is released, the oil flows from the oil-filter housing back into the sump.

Unfasten oil filter cover.

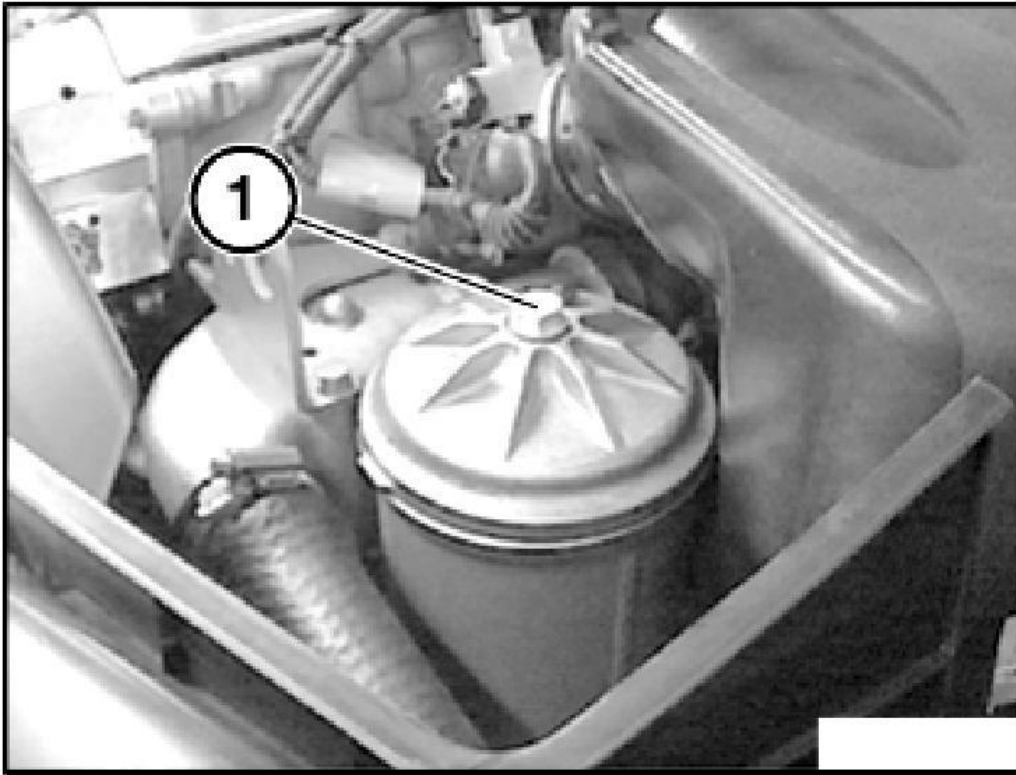
**G03118044**

Fig. 427: Unfastening Oil Filter Cover
Courtesy of BMW OF NORTH AMERICA, INC.

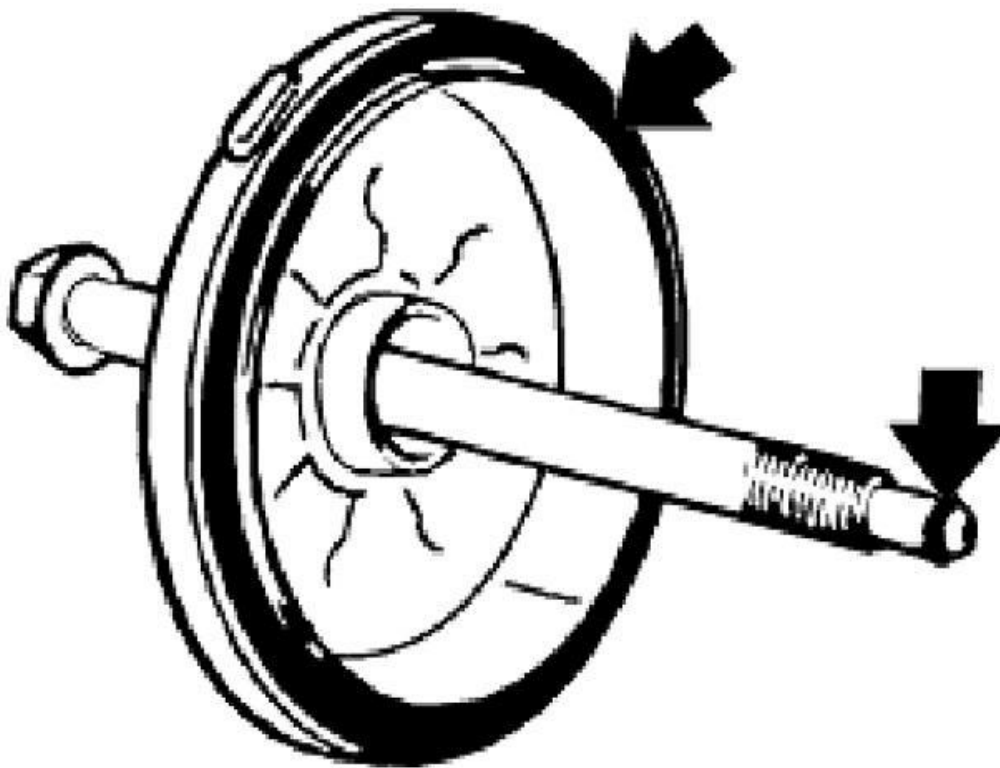
Installation:

Replace sealing ring.

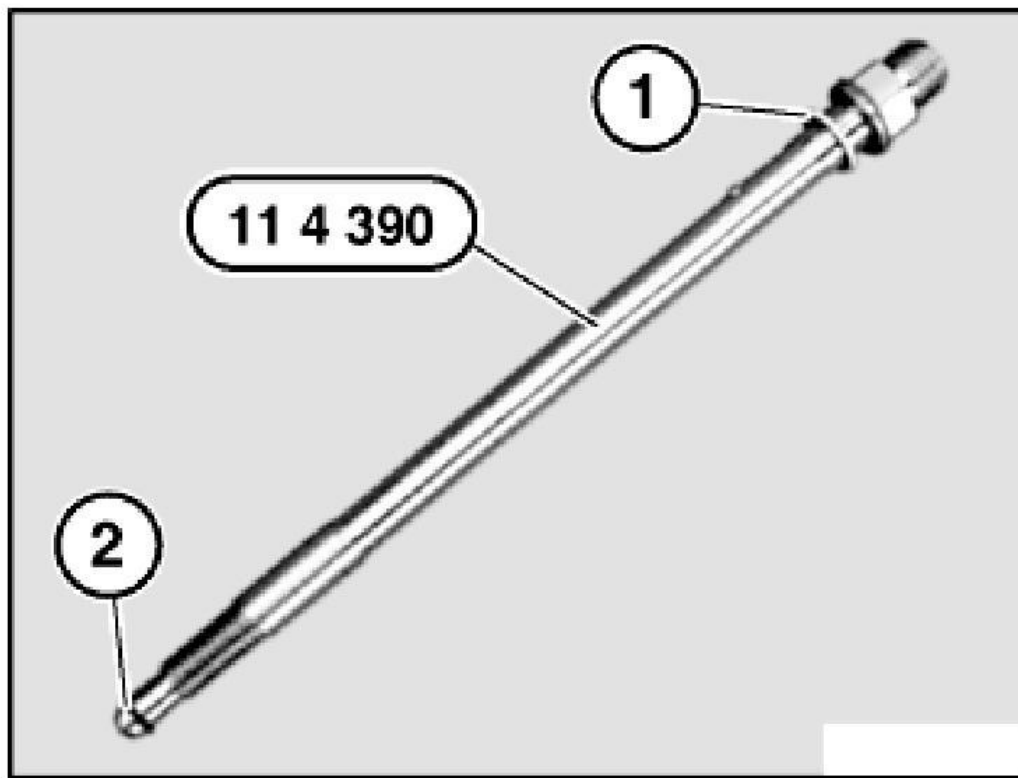
Tightening torque, refer to 11 42 2AZ in **ENGINE - TIGHTENING TORQUES** .

Installation:

Replace sealing ring in oil-filter cover and sealing ring on bolt.

**G03118045****Fig. 428: Locating Sealing Rings****Courtesy of BMW OF NORTH AMERICA, INC.**

Check sealing rings (1 and 2) on special tool 11 4 390, replace if necessary.



G03118046

Fig. 429: Identifying Sealing Rings On Special Tool
Courtesy of BMW OF NORTH AMERICA, INC.

Insert special tool 11 4 390 and tighten down oil filter cover.

**G03118047****Fig. 430: View Of Adapter Screw****Courtesy of BMW OF NORTH AMERICA, INC.**

Connect special tools 13 3 061/13 3 063.

Start engine and check engine oil pressure. Refer to **ENGINE - TECHNICAL DATA** .



G03118048

Fig. 431: Identifying Pressure Gauge

Courtesy of BMW OF NORTH AMERICA, INC.

OIL PUMP WITH FILTER

11 41 000 REMOVING AND INSTALLING/REPLACING OIL SUMP (S54)

Unscrew oil sump. Refer to 11 13 000 REMOVING AND INSTALLING, SEALING OR REPLACING OIL SUMP (S54).

CAUTION: Left-hand threads. Unscrew nut (1).

Installation:

Tightening torque, refer to 11 41 4AZ in ENGINE - TIGHTENING TORQUES.

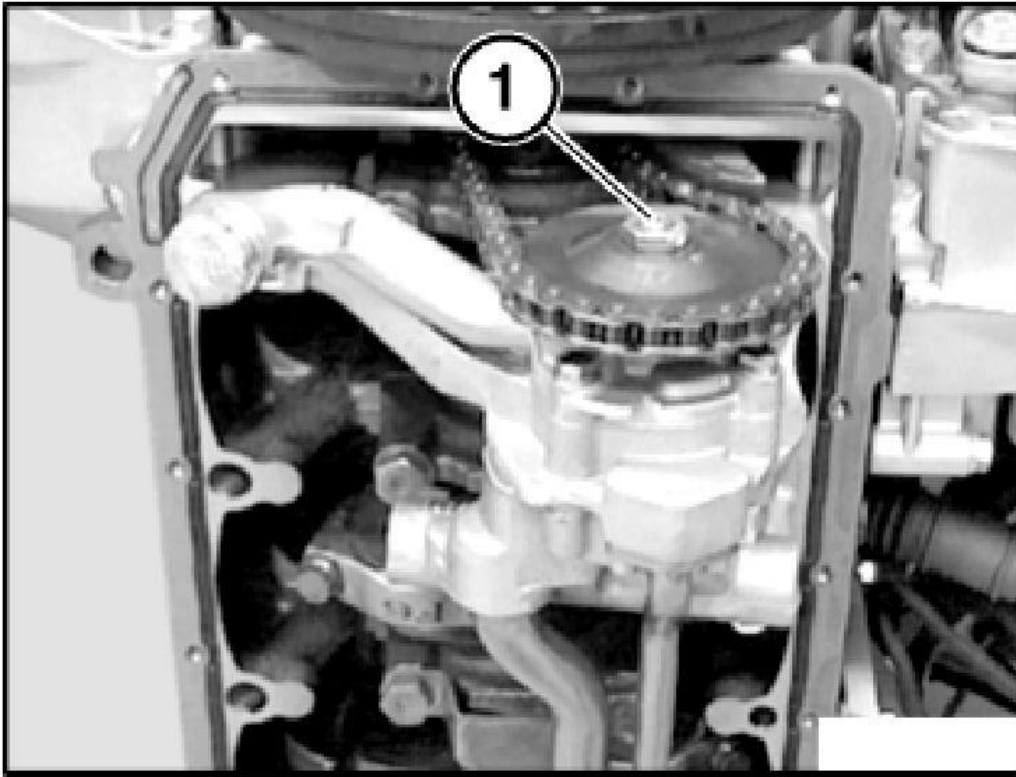
**G03118049**

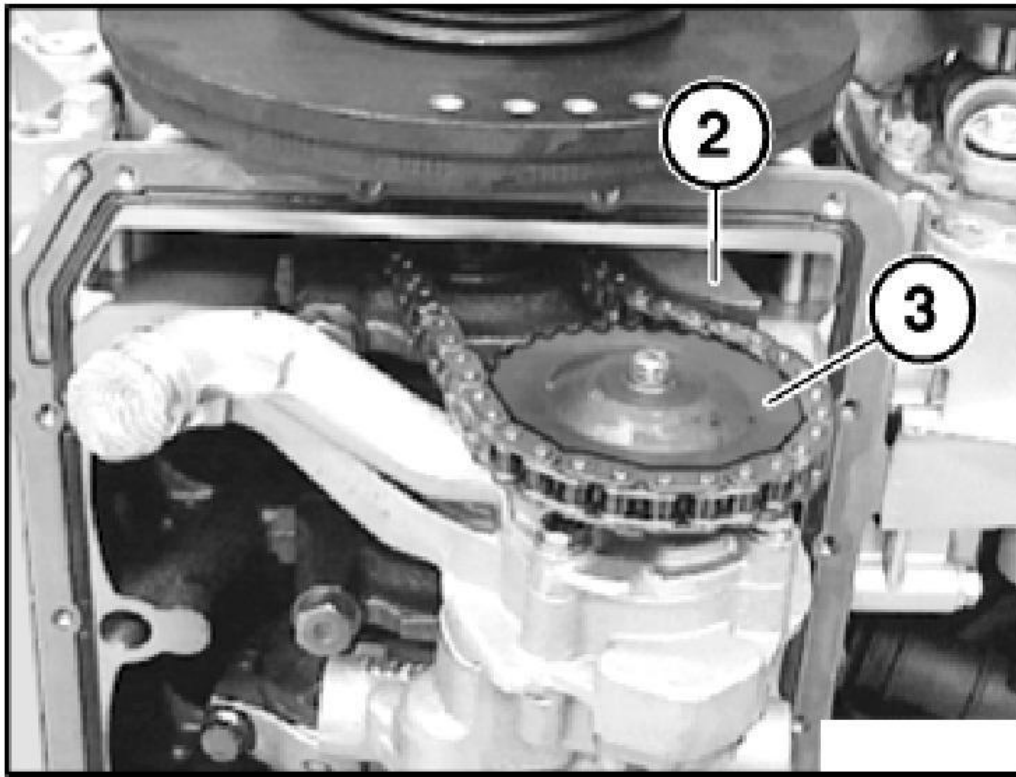
Fig. 432: View Of Sprocket Wheel Retaining Nut
Courtesy of BMW OF NORTH AMERICA, INC.

Press back chain tensioner (2).

Detach sprocket wheel (3) from teeth. Feed out sprocket wheel (3).

Installation:

Align teeth of sprocket wheel and oil pump shaft to each other.

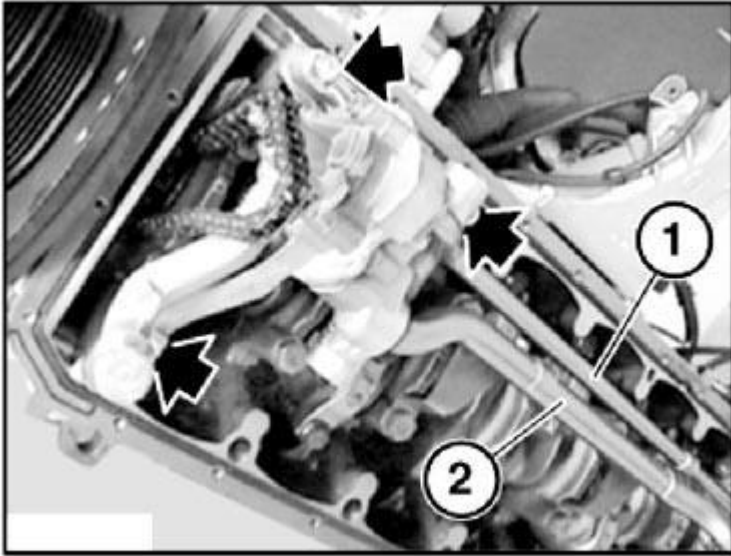
**G03118050****Fig. 433: Identifying Sprocket Wheel****Courtesy of BMW OF NORTH AMERICA, INC.**

Remove return pipe (1) and suction pipe (2).

Remove oil pump.

Installation:

Replace O-ring on suction pipe (2).

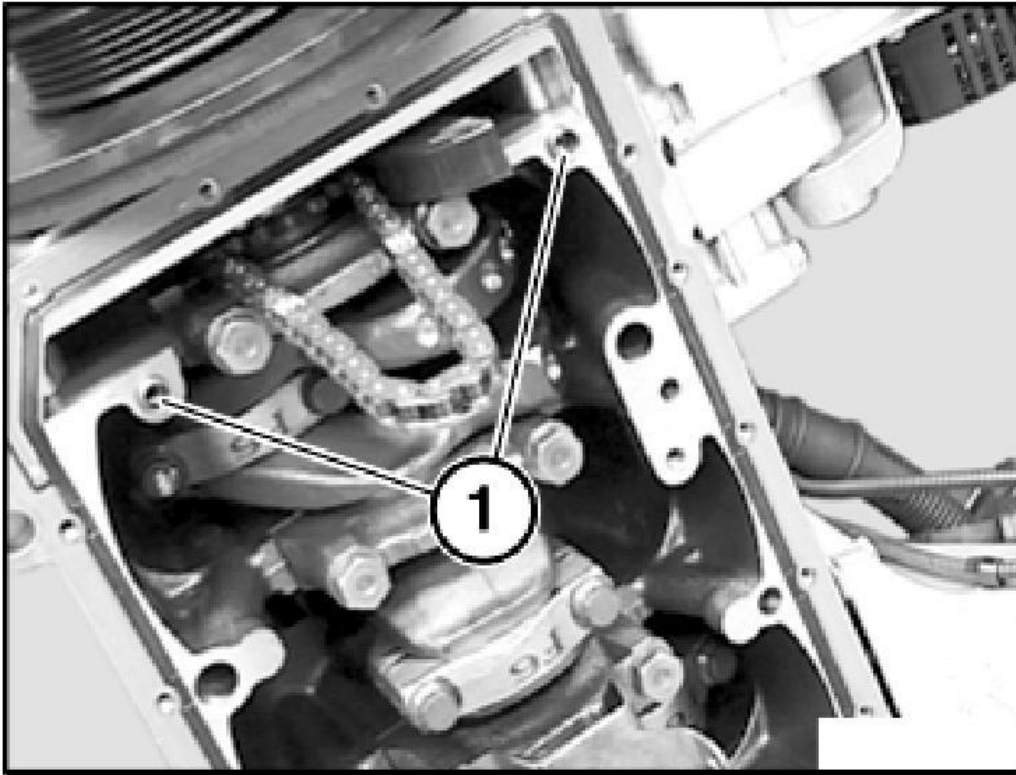


G03118051

Fig. 434: View Of Return Pipe And Suction Pipe
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Check dowel sleeves (1) for damage and correct installation position.

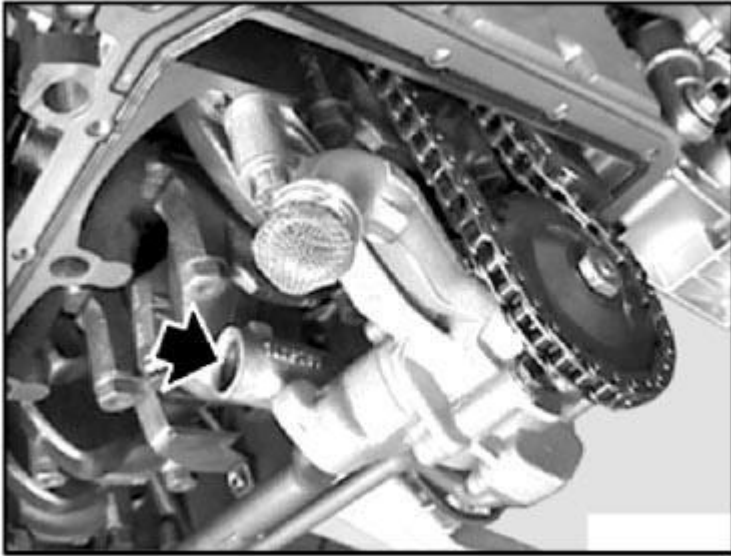
**G03118052****Fig. 435: Locating Dowel Sleeves****Courtesy of BMW OF NORTH AMERICA, INC.**

If necessary, remove control piston.

Press sleeve downwards with suitable drift.

CAUTION: The sleeve for the control plunger is under spring pressure.

Remove circlip.

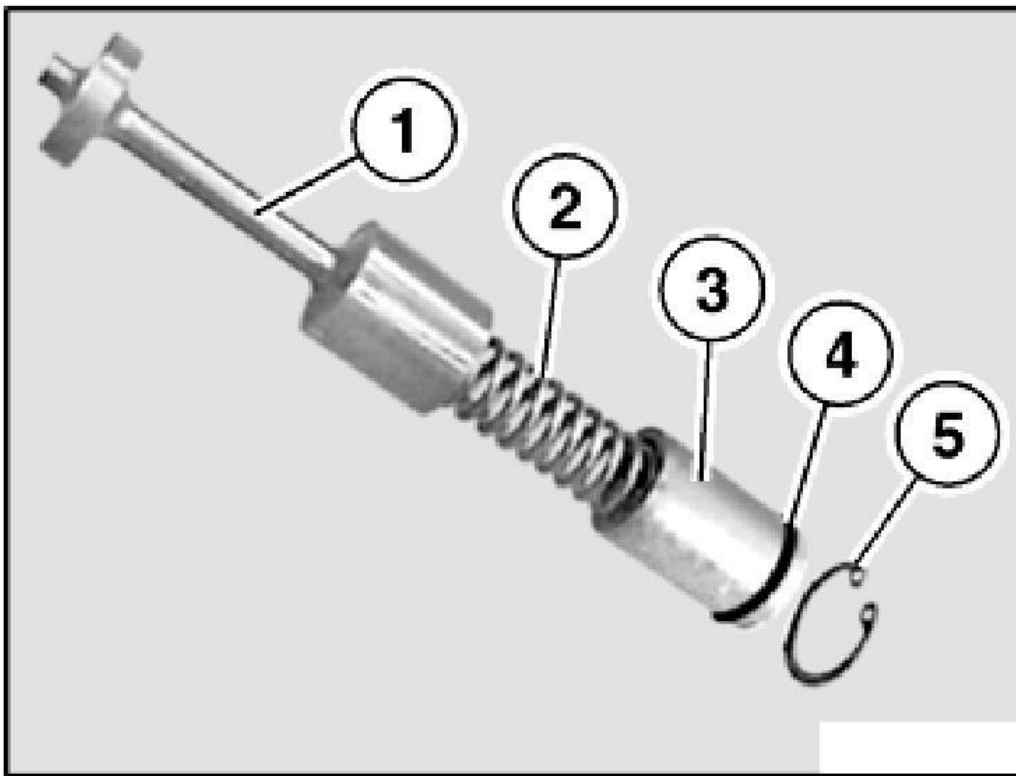


G03118053

Fig. 436: Identifying Circlip**Courtesy of BMW OF NORTH AMERICA, INC.**

Installation:

1. Control plunger.
2. Spring.
3. Sleeve.
4. O-ring (replace).
5. Circlip.



G03118054

Fig. 437: View Of Control Piston Components
Courtesy of BMW OF NORTH AMERICA, INC.

WATER PUMP WITH DRIVE

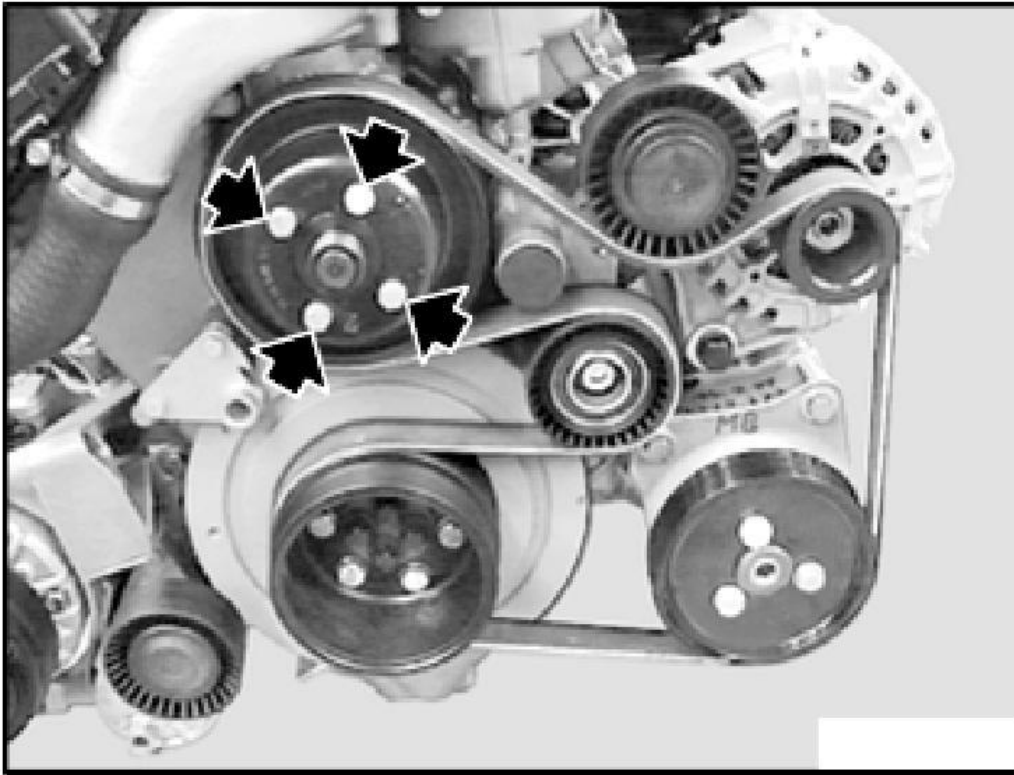
11 51 000 REMOVING AND INSTALLING/REPLACING WATER PUMP (S54)

Release water pump belt pulley.

Remove alternator drive belt. Refer to **11 28 010 REPLACING ALTERNATOR DRIVE BELT (S54)**.

Remove pulley from water pump.

Remove coolant thermostat. Refer to **11 53 000 REMOVING AND INSTALLING/REPLACING COOLANT THERMOSTAT (S54)**.



G03118055

Fig. 438: Identifying Water Pump Pulley Retaining Bolts
Courtesy of BMW OF NORTH AMERICA, INC.

E46 Only:

NOTE: Pipe (1) is also screwed on exhaust side to cylinder head.

Release screws and remove pipe (1).

Installation:

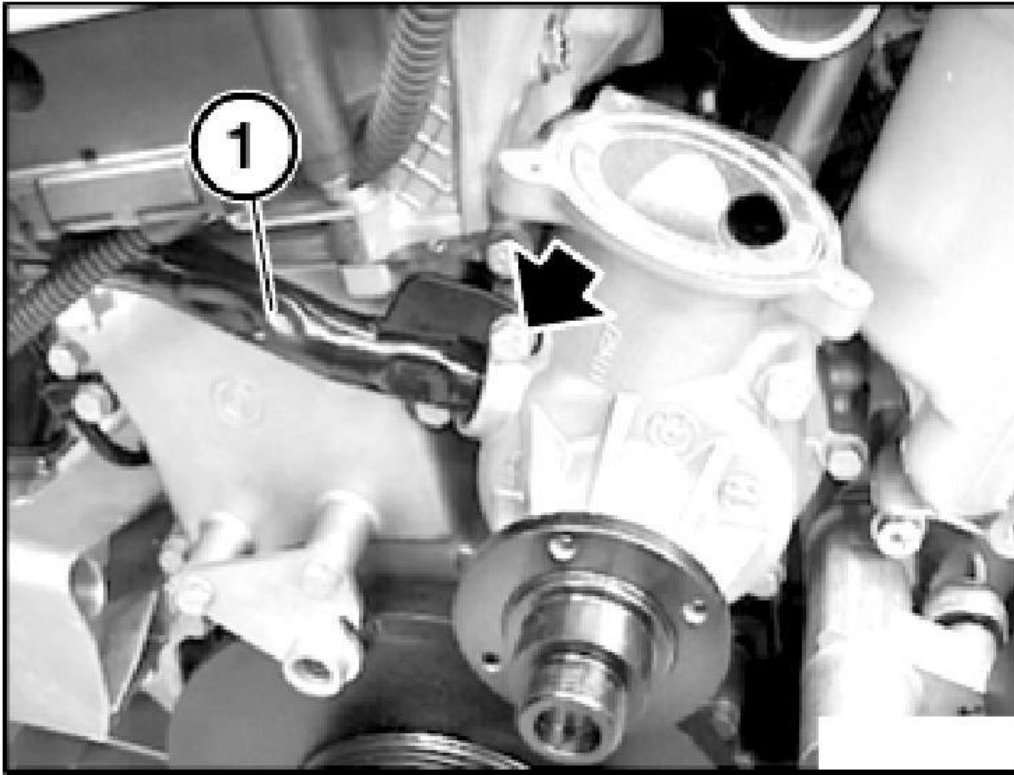
**G03118056**

Fig. 439: Releasing Screws And Removing Pipe
Courtesy of BMW OF NORTH AMERICA, INC.

Water pump is secured with 5 screws to engine block.

Release screw and remove water pump

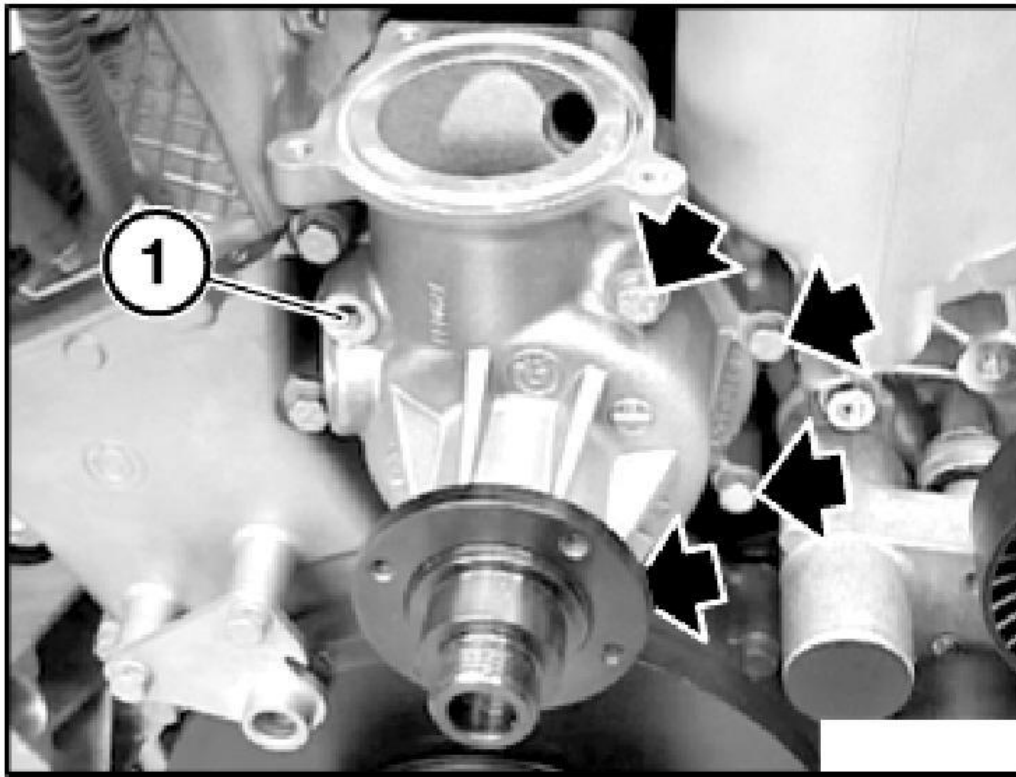
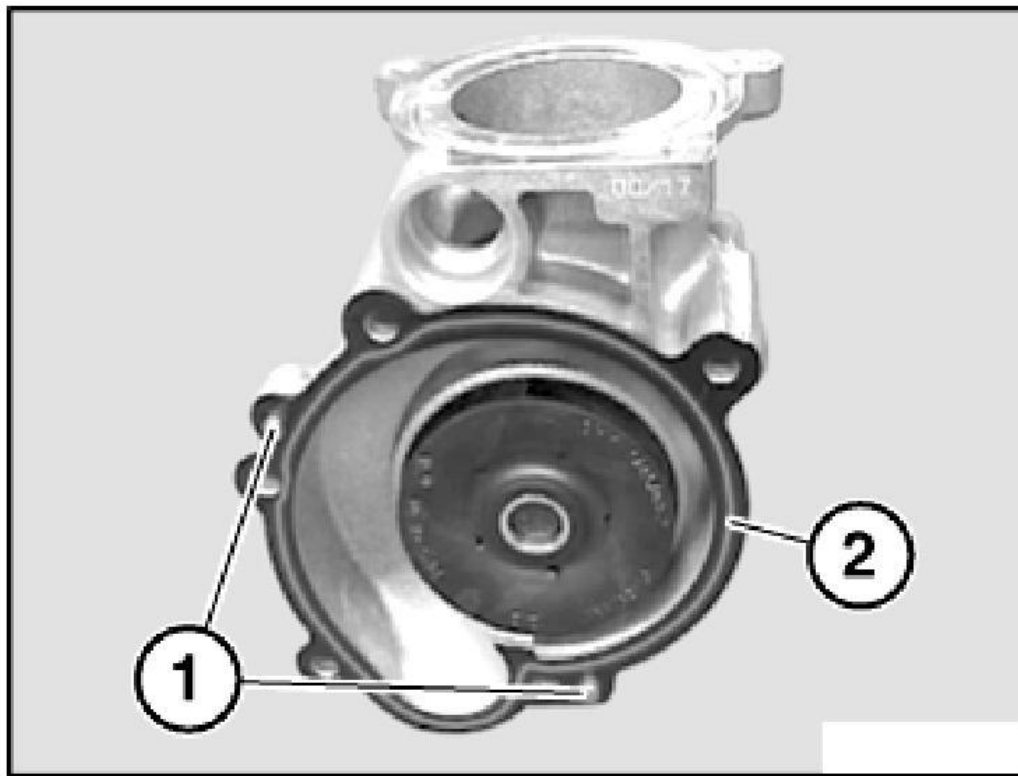
**G03118057**

Fig. 440: Releasing Screw And Removing Water Pump
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Check dowel pins (1) for damage and correct installation position.

Keep sealing faces clean and free of oil. Replace seal (2).



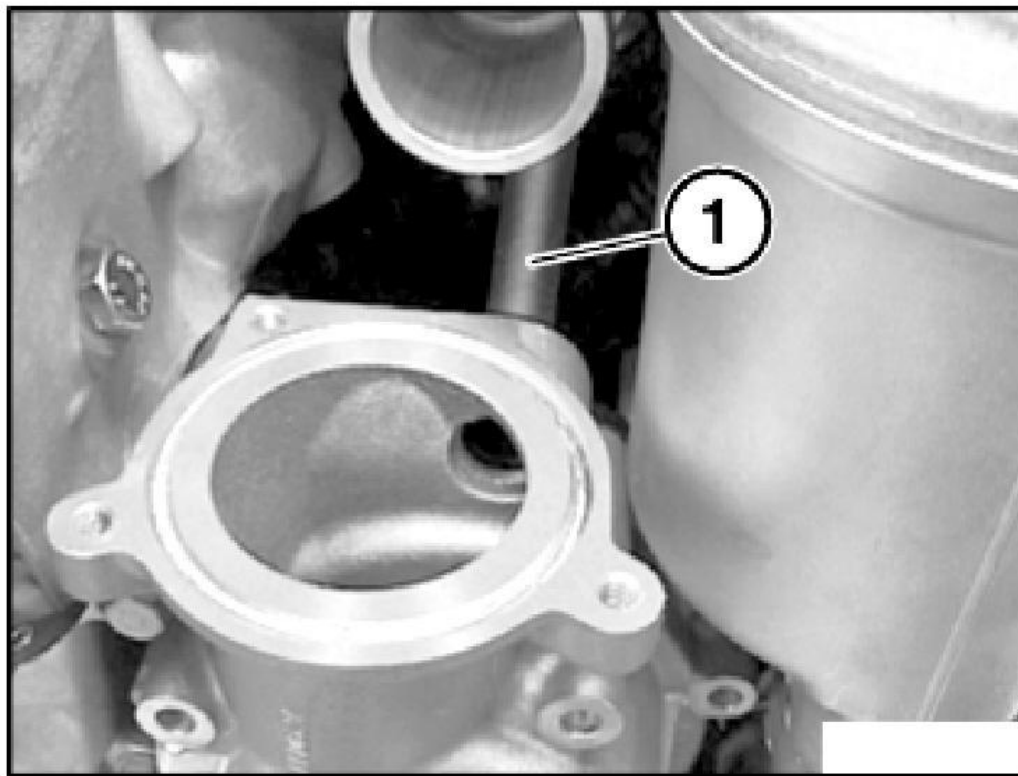
G03118058

Fig. 441: View Of Seal

Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Replace sealing ring on pipe (1).



G03118059

Fig. 442: Locating Sealing Ring On Pipe
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: O-ring on pipe (1) can very easily be shorn off when water pump is fitted.

Coat sealing ring with water acting as antiseize agent and carefully fit water pump.

FAN

11 52 020 REMOVING AND INSTALLING/REPLACING FAN CLUTCH (S52/S54/M52/M52TU/M54/M56)

Special Tools Required:

- 11 5 030
- 11 5 040

If necessary, remove air duct.

NOTE: S54:

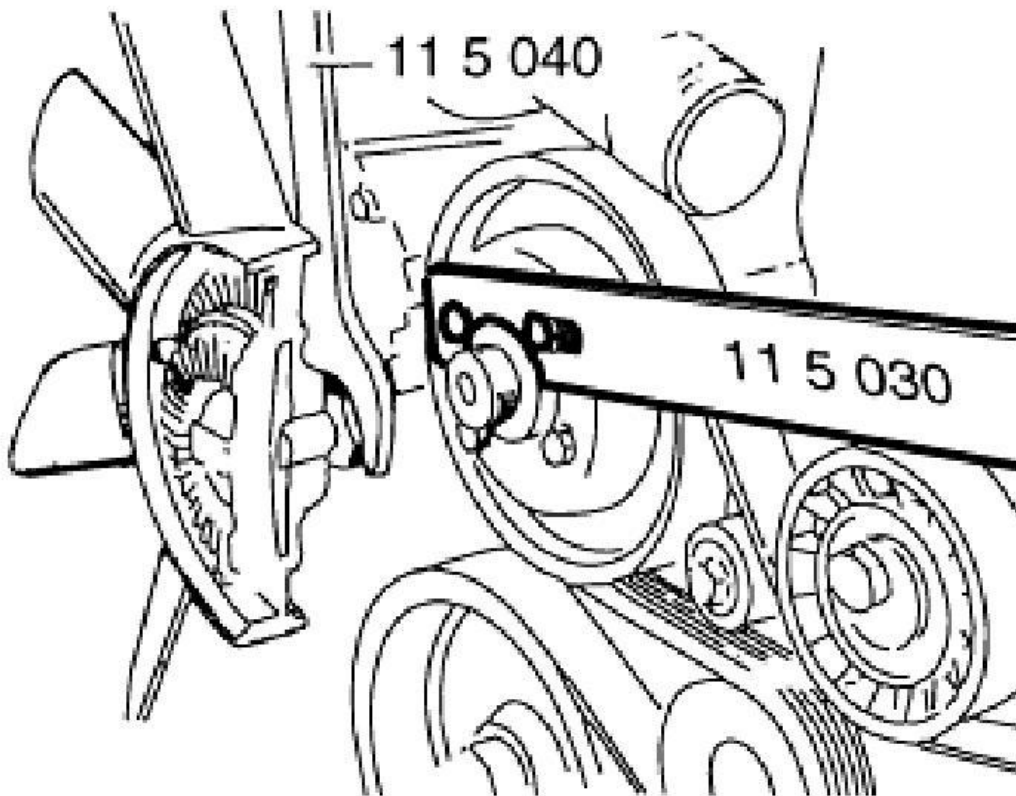
Remove engine underguard and release fan cowl.

IMPORTANT: Left-hand threads.

Using special tool 11 5 030, grip pulley and unfasten cap nut from water pump using special tool 11 5 040.

If necessary, unfasten fan cowl.

Take the fan wheel with fan coupling off the water pump and remove.



G03118060

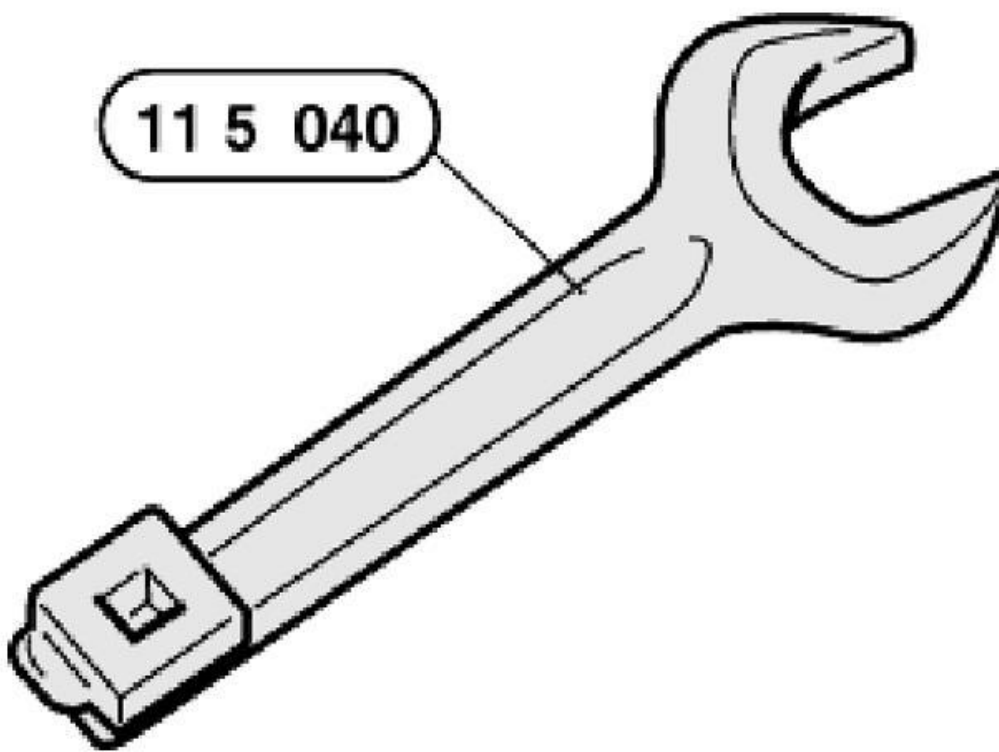
Fig. 443: Securing Pulley Using Holder (Special Tool 11 5 030)
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Tighten down fan impeller using special tool 11 5 040.

Tightening torque, refer to 11 52 1AZ in **ENGINE - TIGHTENING TORQUES**.

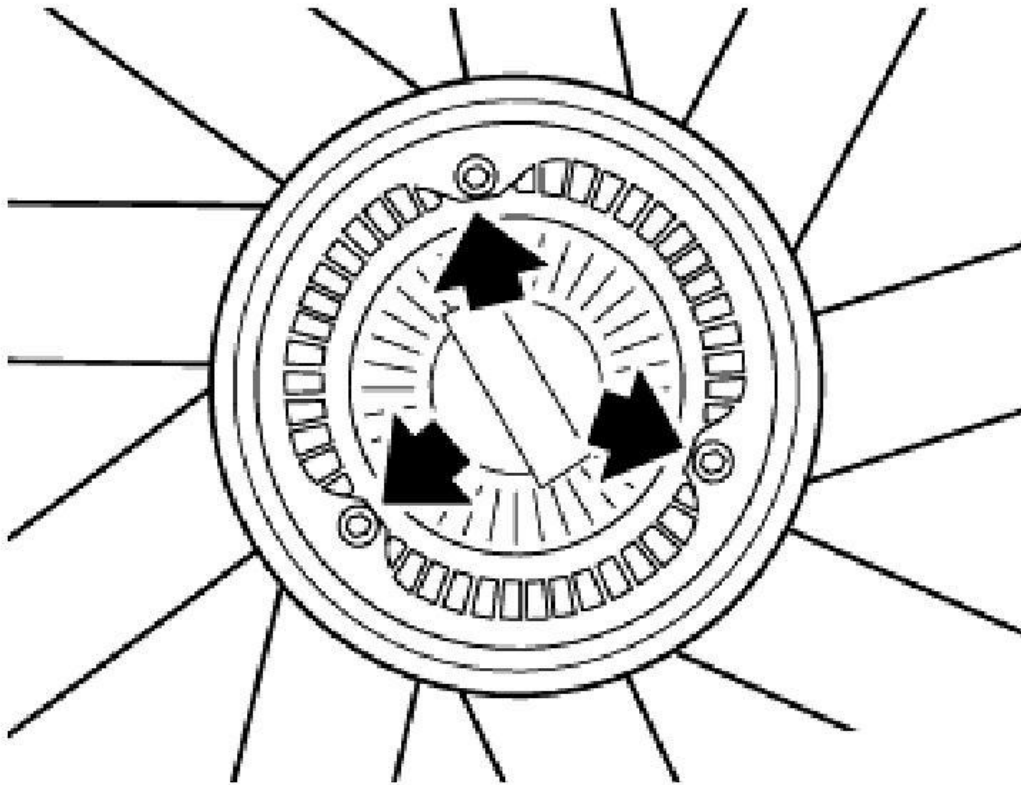
NOTE: When using special tool 11 5 040, 30 N.m. on the torque wrench scale are equivalent to a tightening torque of 40 N.m.



G03118061

Fig. 444: Identifying Open-Ended Spanner WAF 32
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten screws and detach fan from fan coupling.



G03118062

Fig. 445: Locating Fan To Fan Coupling Retaining Screws
Courtesy of BMW OF NORTH AMERICA, INC.

THERMOSTAT AND CONNECTIONS

11 53 000 REMOVING AND INSTALLING/REPLACING COOLANT THERMOSTAT (S54)

Remove fan clutch with fan impeller and fan cowl. Refer to **11 52 020 REMOVING AND INSTALLING/REPLACING FAN CLUTCH (S52 / S54 / M52 / M52TU / M54 / M56)** and **17 11 031 REPLACING FAN COWL (S54)** .

Remove coolant drain plug in engine block. Drain and dispose of coolant. See **17 11 509 FLUSHING RADIATOR**

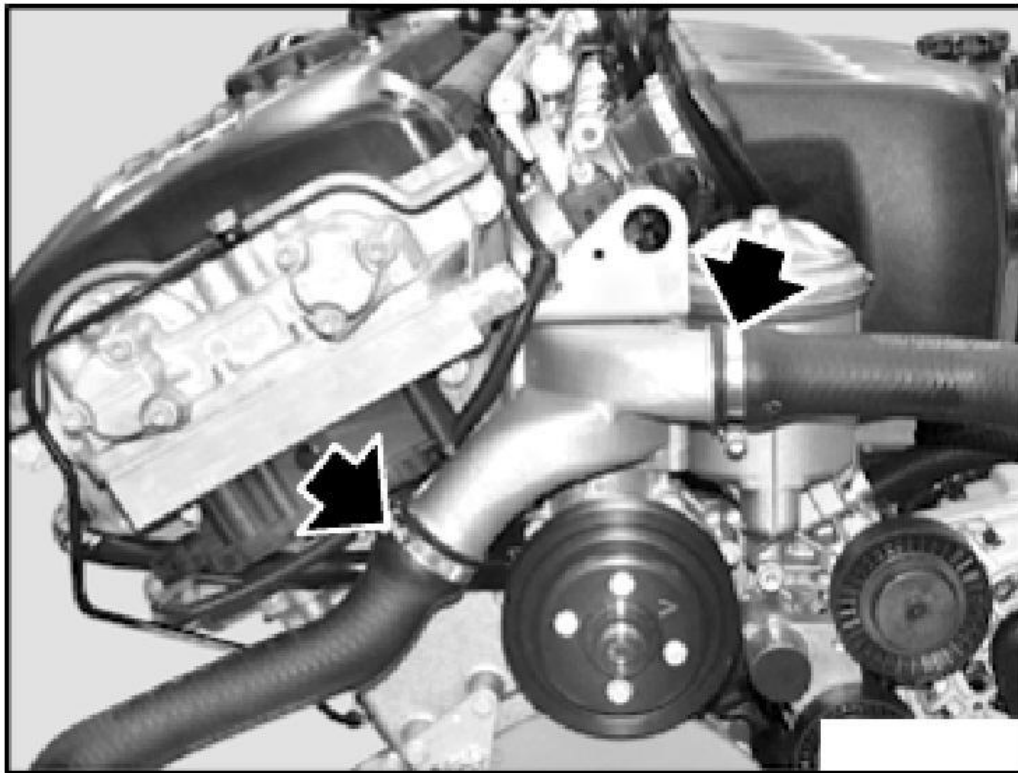
Installation:

Replace sealing ring on drain plug.

Tightening torque, refer to 11 11 5AZ in **ENGINE - TIGHTENING TORQUES** .

Vent cooling system and check for leaks. Refer to **17 00 039 VENTING COOLING SYSTEM AND CHECKING FOR LEAKS (S54)** .

Remove intake filter housing with air-mass flow sensor. Refer to **13 71 000 REMOVING AND INSTALLING INTAKE FILTER HOUSING (S54)** .



G03118063

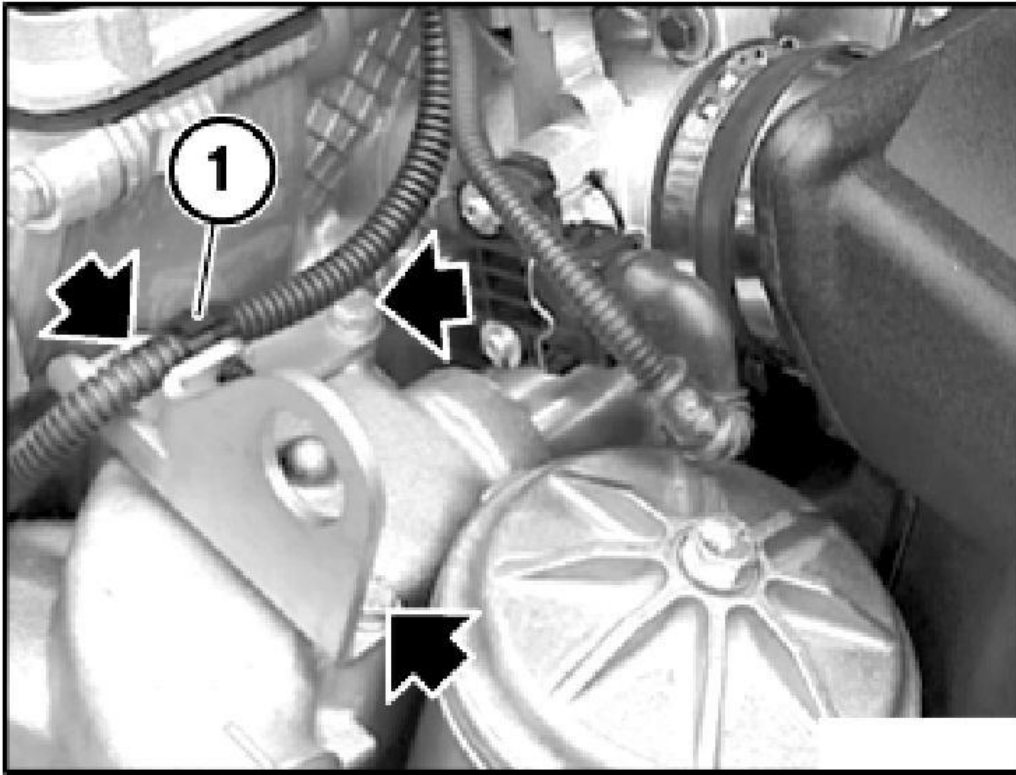
Fig. 446: Locating Water Hoses

Courtesy of BMW OF NORTH AMERICA, INC.

Remove water hoses.

Open cable clamp (1).

Release screws on thermostat housing. Remove thermostat housing and thermostat.



G03118064

Fig. 447: View Of Cable Clamp

Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Keep sealing faces clean and free of oil.

Replace O-ring (1) on water pump and O-rings on connecting tube (2).

Coat O-rings on connecting tube (2) with water acting as antiseize agent.

CAUTION: O-rings on connecting tube (2) can very easily be shorn off.

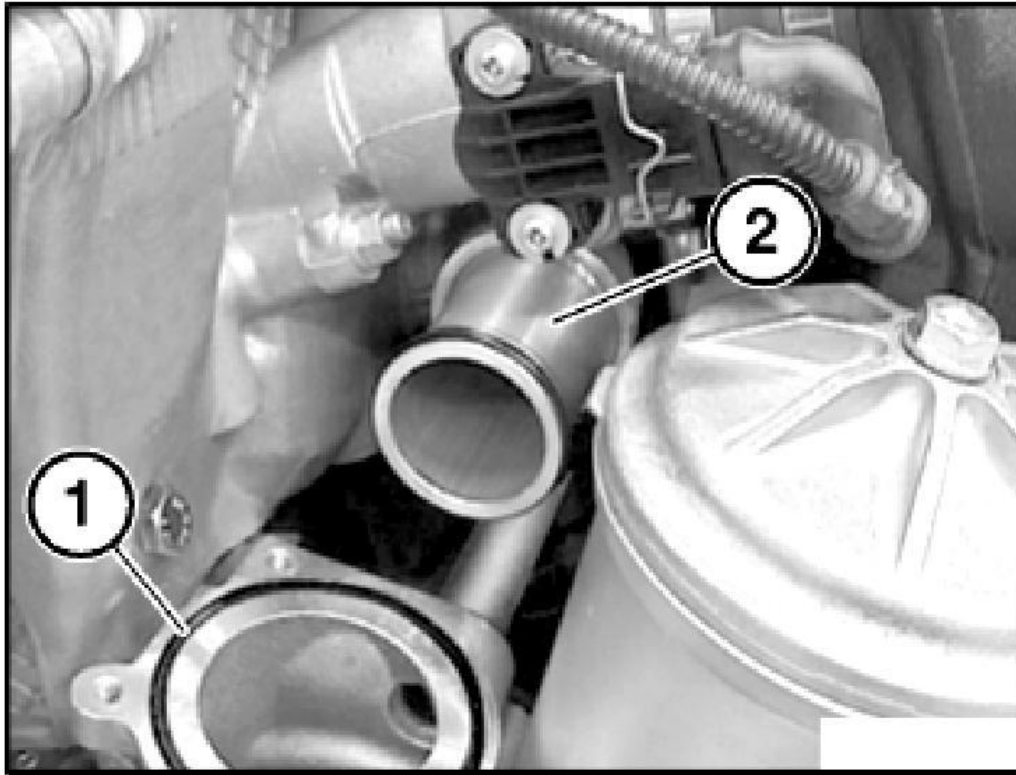
**G03118065**

Fig. 448: Replacing O-Rings On Water Pump And Connecting Tube
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Preassemble thermostat (1) as shown in illustration on water pump.

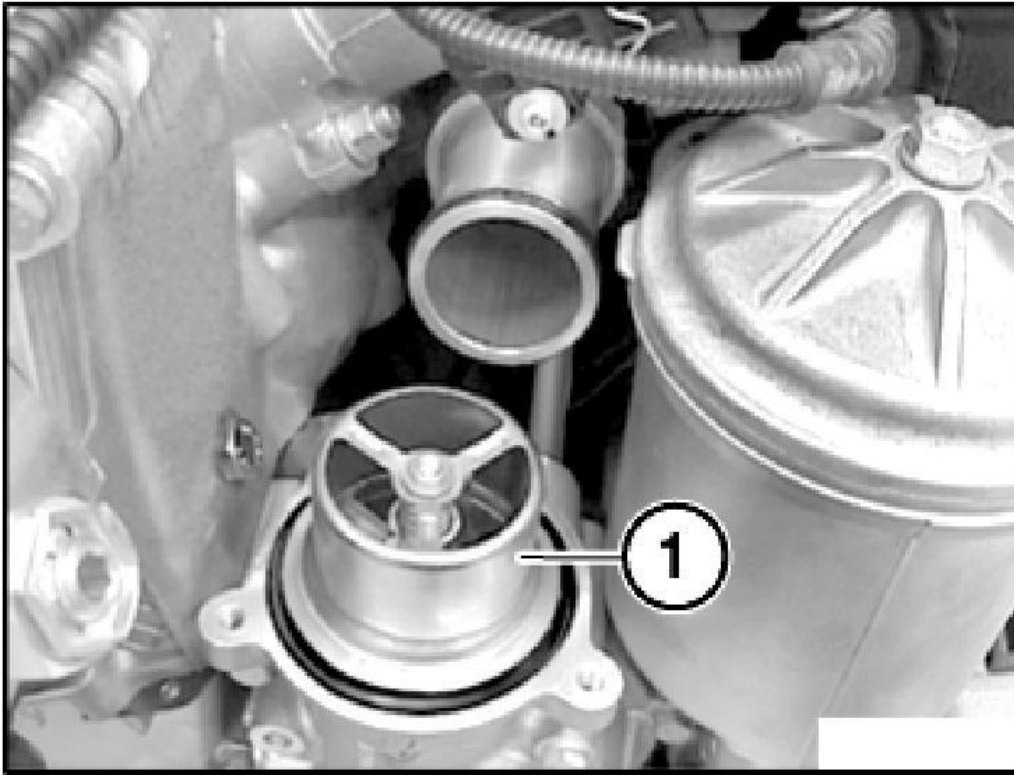
**G03118066**

Fig. 449: Identifying Thermostat

Courtesy of BMW OF NORTH AMERICA, INC.

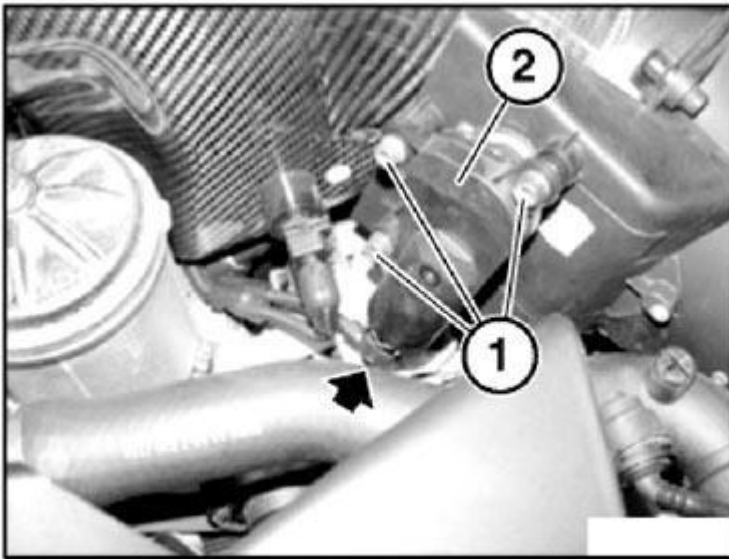
INTAKE MANIFOLD

11 61 REMOVING AND INSTALLING/REPLACING SERVOMOTOR FOR THROTTLE ON CONTROL UNIT (M3 CSL)

Unfasten plug connection and disconnect.

Release screws (1).

Detach servomotor (2) from fresh air housing.



G03118067

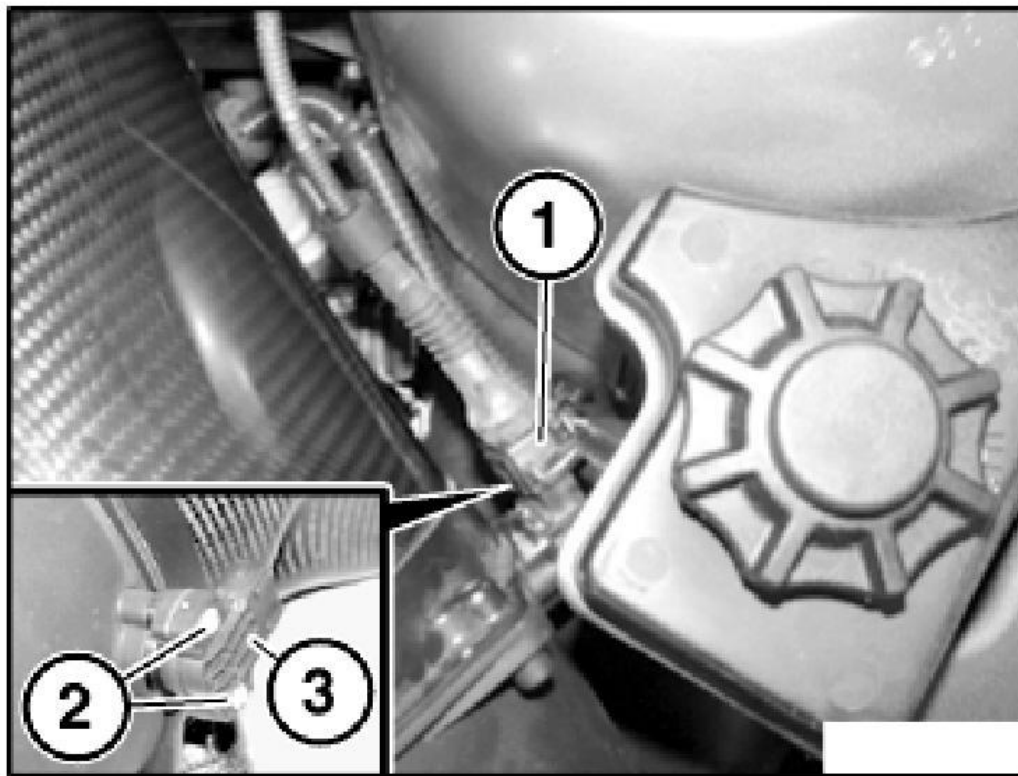
Fig. 450: View Of Servomotor And Fresh Air Housing
Courtesy of BMW OF NORTH AMERICA, INC.

11 61 REMOVING AND INSTALLING/REPLACING THROTTLE SWITCH ON CONTROL UNIT (M3 CSL)

Open retainer and disconnect plug (1).

Loosen screws (2).

Remove throttle switch (3) from raw air housing.



G03118068

Fig. 451: Locating Throttle Switch On Raw Air Housing
Courtesy of BMW OF NORTH AMERICA, INC.

11 61 050 REMOVING AND INSTALLING INTAKE AIR MANIFOLD (S54)

Special Tools Required:

- 11 9 160

Necessary preliminary tasks:

- Remove intake filter housing, refer to **13 71 000 REMOVING AND INSTALLING INTAKE FILTER HOUSING (S54)**.

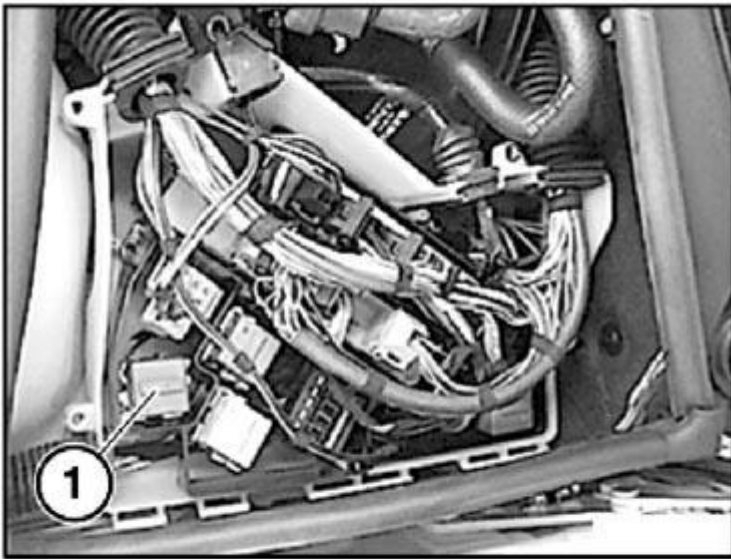
NOTE: Instructions for disconnecting and connecting battery. Refer to **12 00... INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY**.

Disconnect Negative Battery Lead.

Vehicles With SMG Transmissions Only:

- Open electronics box cover.
- Detach relay (1) of hydraulic pump.
- Disconnect line between expansion tank and hydraulic unit from intake manifold.

IMPORTANT: Reinstall relay (1) of hydraulic pump only after connecting j line between expansion tank and hydraulic unit.

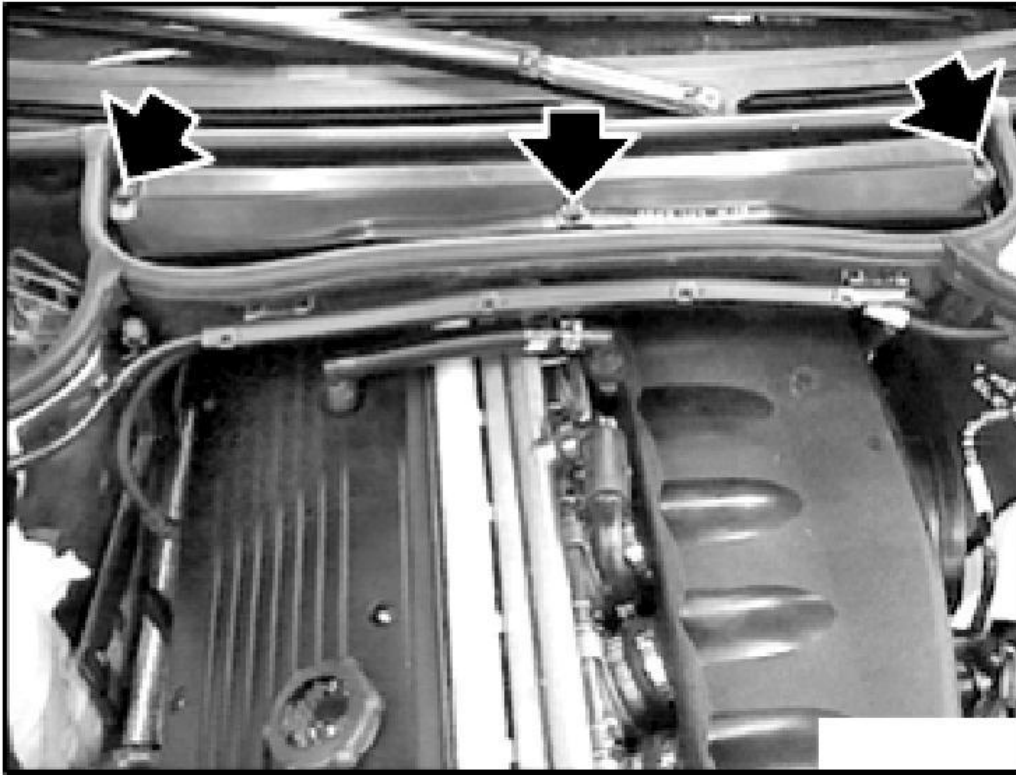


G03118069

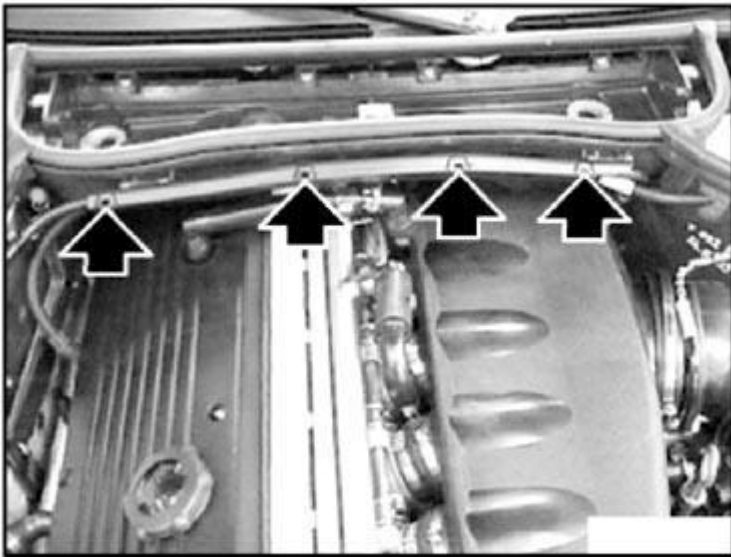
Fig. 452: Locating Relay Of Hydraulic Pump
Courtesy of BMW OF NORTH AMERICA, INC.

E46 Only:

Remove microfilter.

**G03118070****Fig. 453: Identifying Microfilter****Courtesy of BMW OF NORTH AMERICA, INC.****E46 Only:**

Open cable duct on lower section of microfilter housing and feed out cable(s).

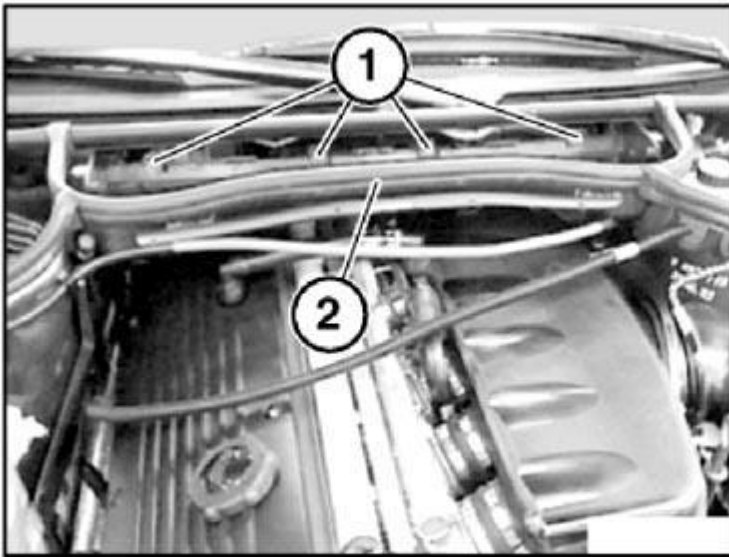


G03118071

Fig. 454: View Of Cable Duct On Lower Section Of Microfilter Housing
Courtesy of BMW OF NORTH AMERICA, INC.

E46 only:

Release screws (1) and remove lower section of microfilter housing (2).



G03118072

Fig. 455: Locating Screws For Lower Section Of Microfilter Housing
Courtesy of BMW OF NORTH AMERICA, INC.

Press locks.

Remove hose for engine vent.

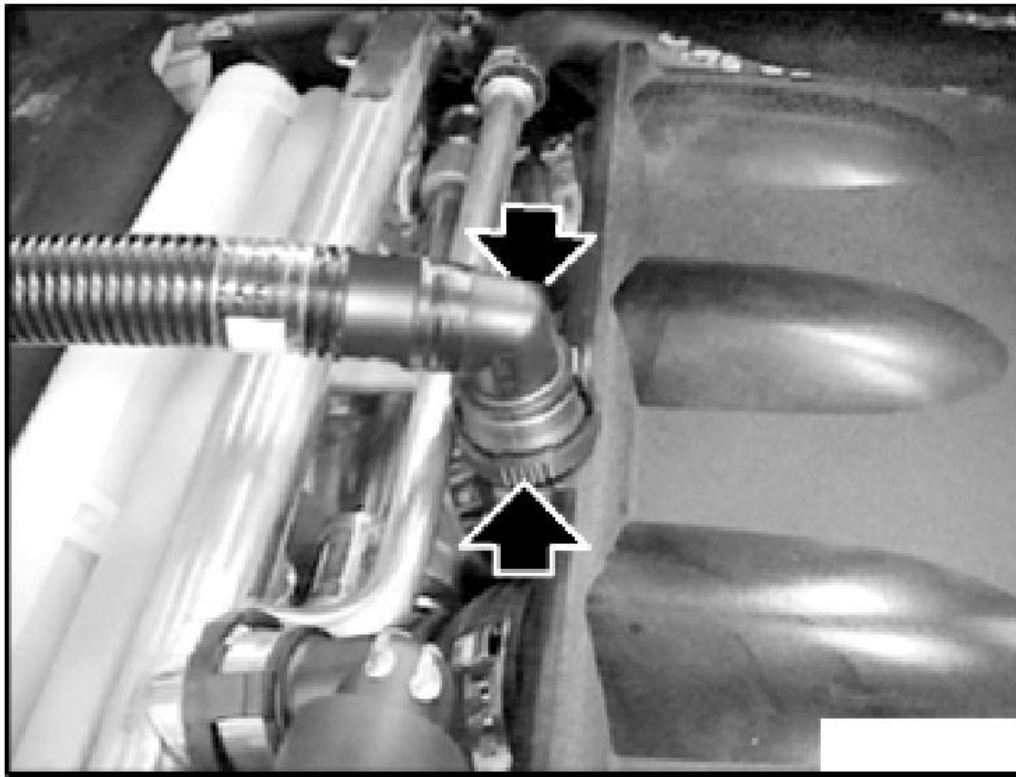
**G03118073**

Fig. 456: Identifying Engine Vent Hose
Courtesy of BMW OF NORTH AMERICA, INC.

Gently raise lug (1) and slide holder upwards.

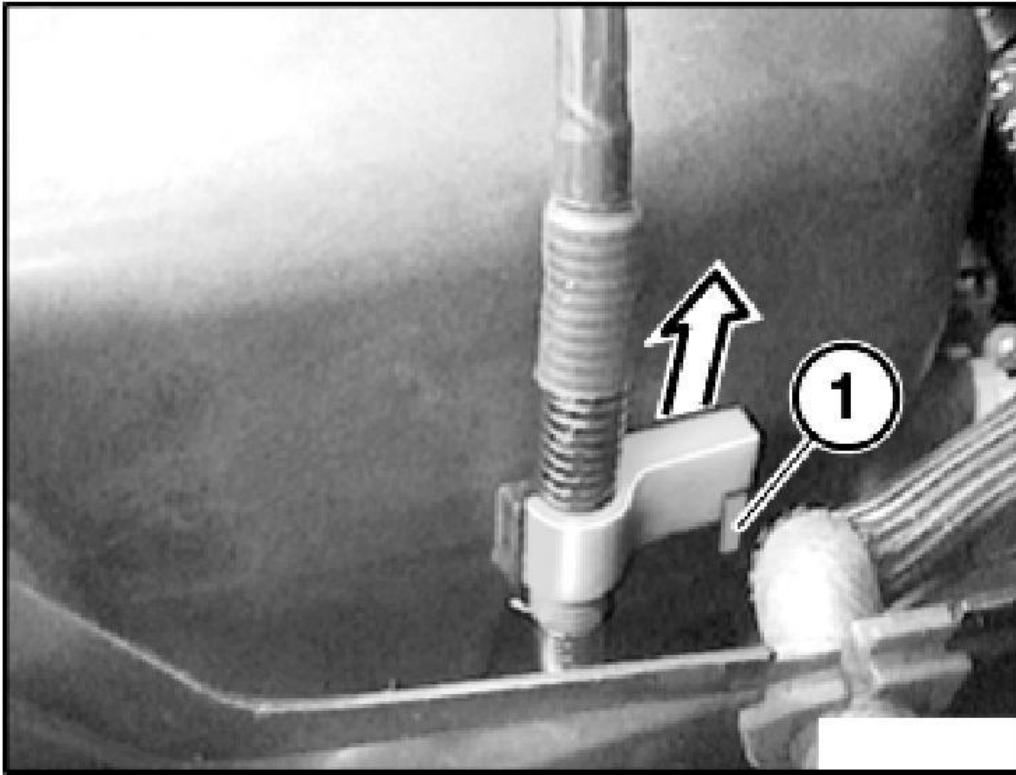
**G03118074**

Fig. 457: Raising Lug And Sliding Holder Upwards
Courtesy of BMW OF NORTH AMERICA, INC.

Not Applicable To M3 CSL:

Detach guide tube (1) for oil dipstick from intake air manifold.

Press locks on vacuum hose (2) and detach.

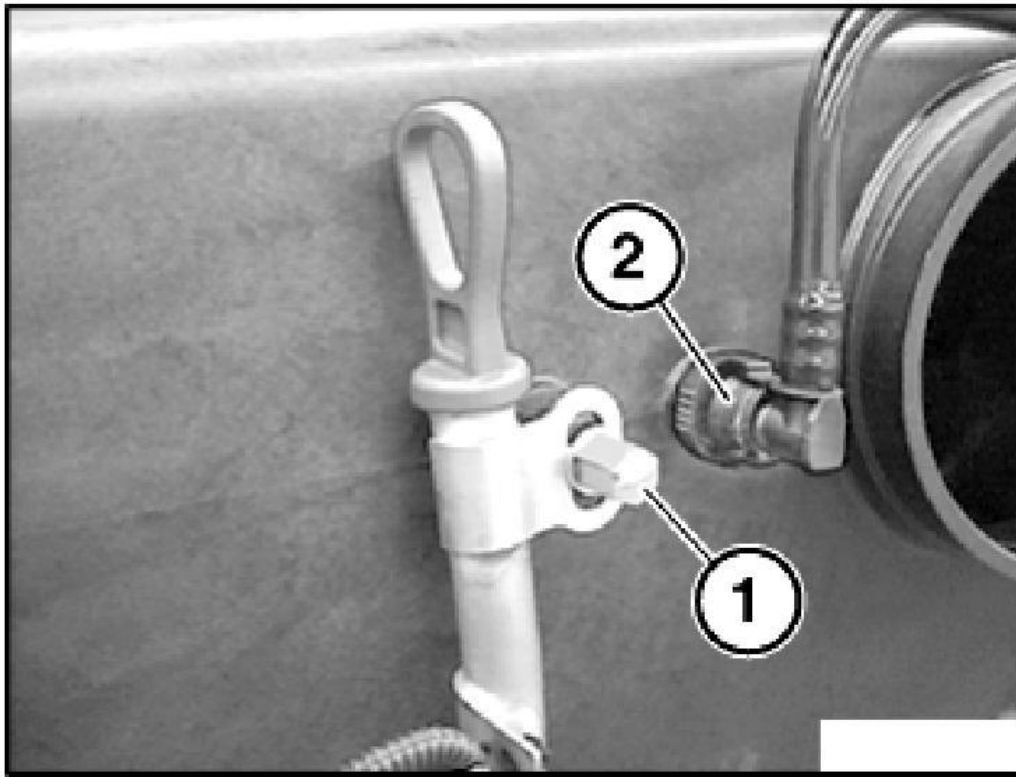
**G03118076**

Fig. 458: Locating Guide Tube For Oil Dipstick
Courtesy of BMW OF NORTH AMERICA, INC.

Detach tank venting valve (1) from holder on intake air manifold.

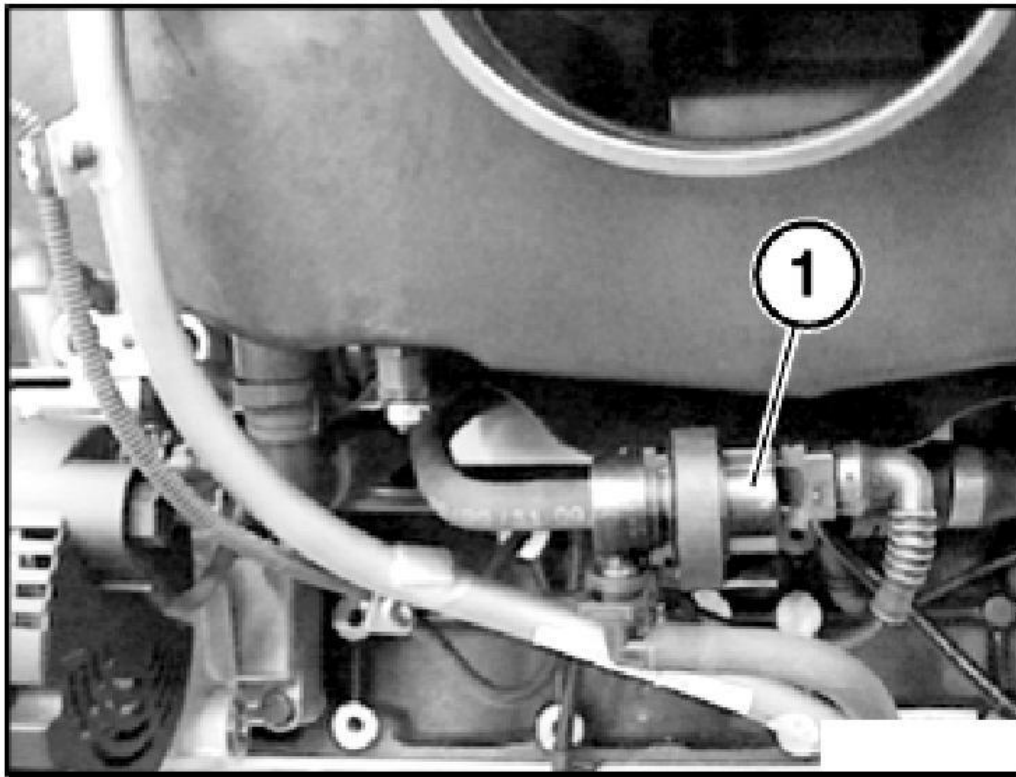
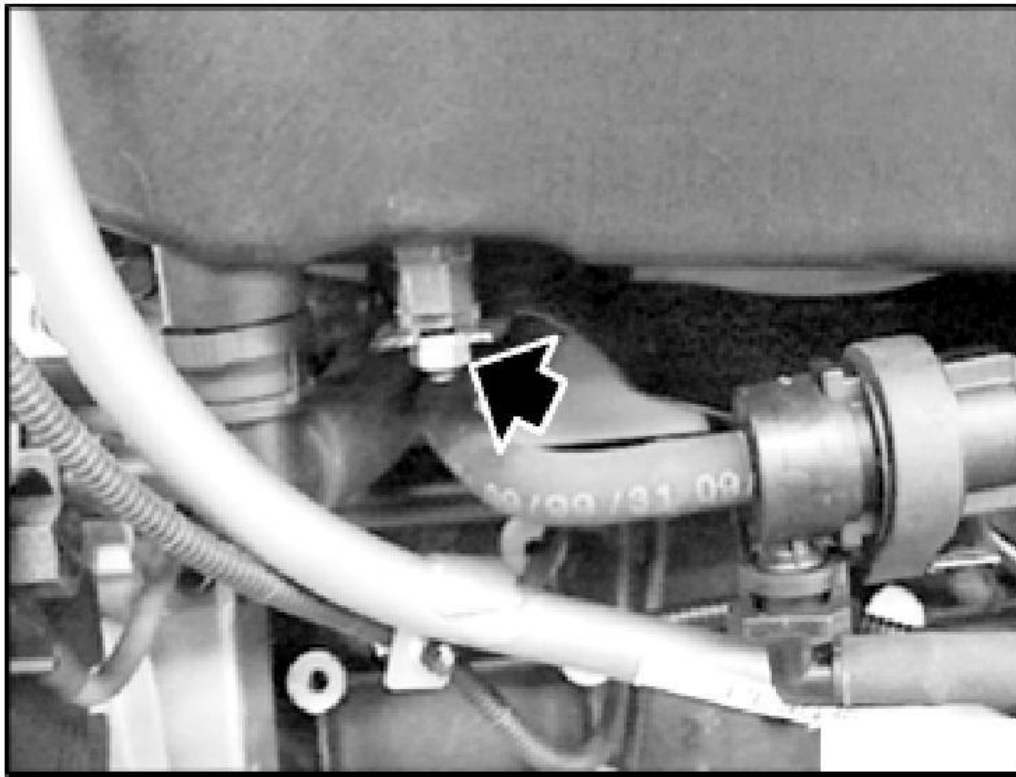
**G03118077**

Fig. 459: Identifying Tank Venting Valve
Courtesy of BMW OF NORTH AMERICA, INC.

Release support bracket at front and rear from intake air manifold.

**G03118078****Fig. 460: Releasing Support Bracket****Courtesy of BMW OF NORTH AMERICA, INC.**

Press lock. Detach hose (1) from intake air manifold.

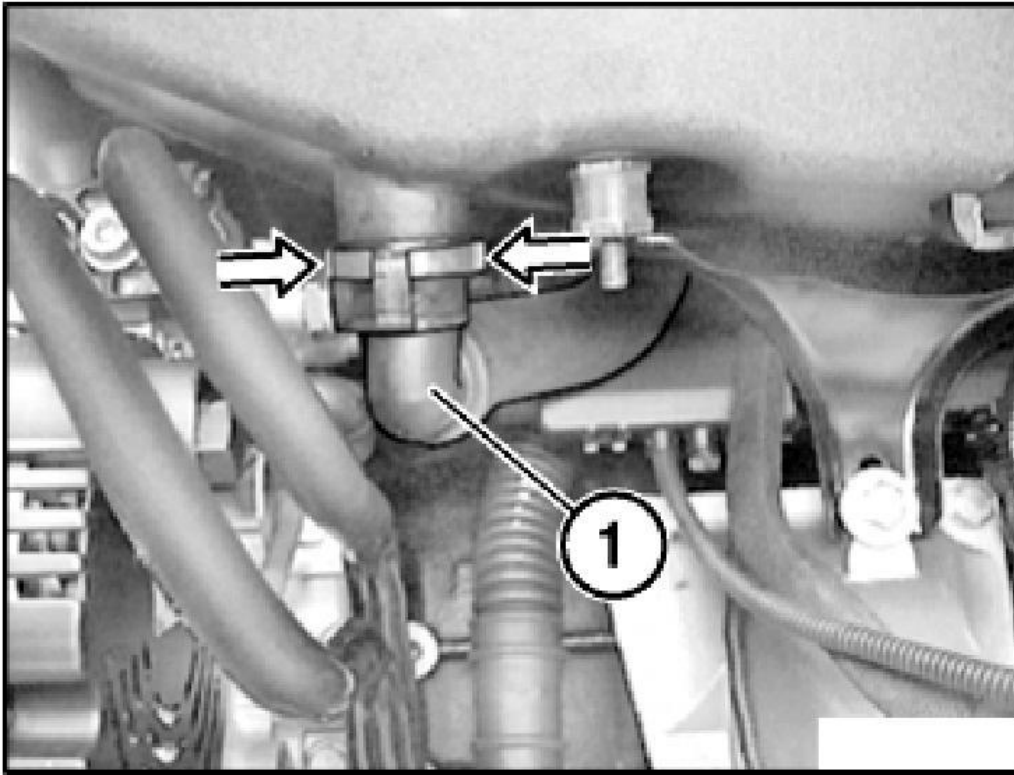
**G03118079**

Fig. 461: View Of Hose On Intake Air Manifold
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect hydraulic fluid connecting hose:

Press locks.

Detach connecting hose to hydraulic unit tank connection.

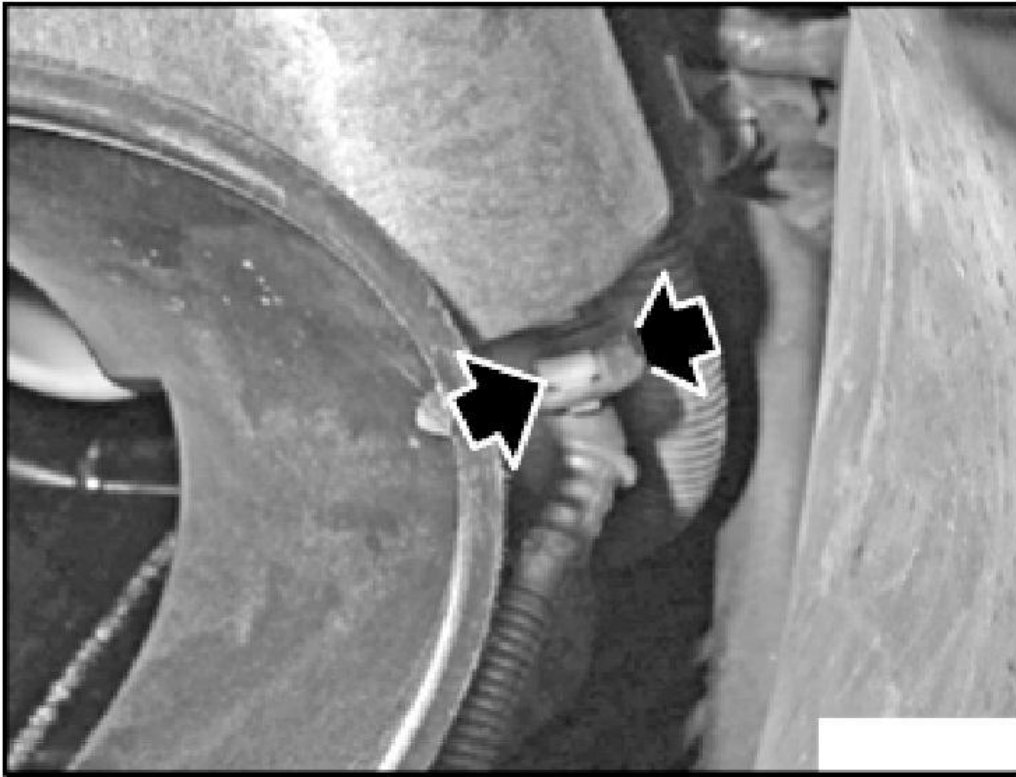
**G03118080**

Fig. 462: Identifying Hydraulic Fluid Connecting Hose Locks
Courtesy of BMW OF NORTH AMERICA, INC.

Place special tool 11 9 160 as shown in illustration on lugs of clamp.

Press clamp together until lock is opened.

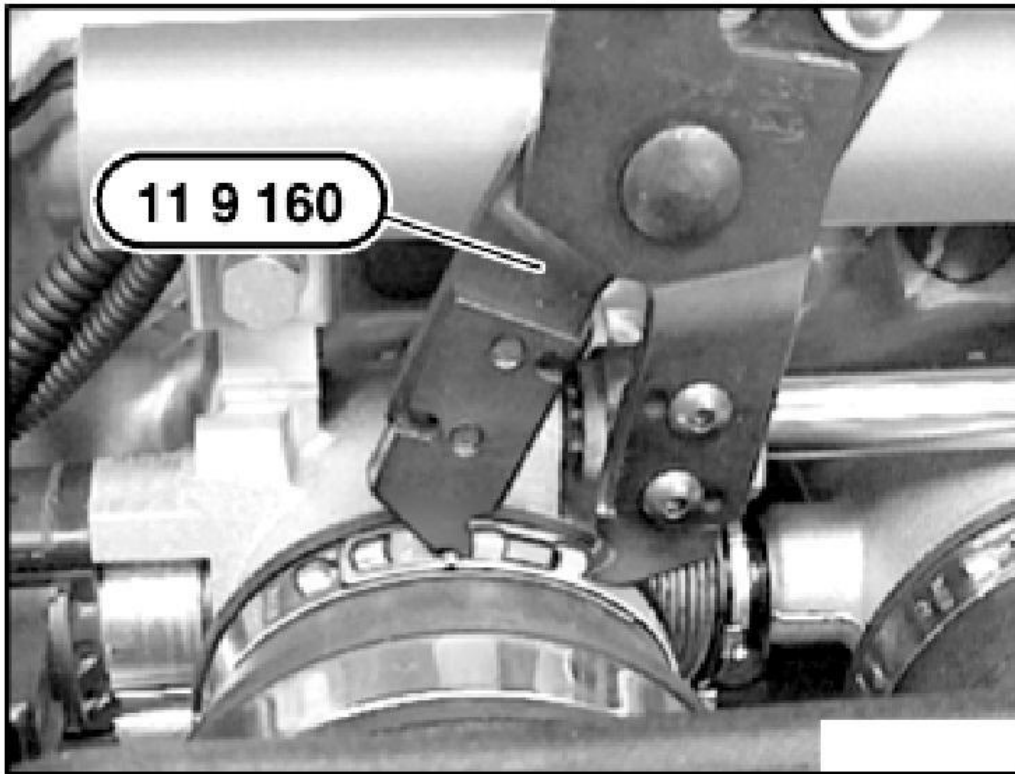
**G03118081**

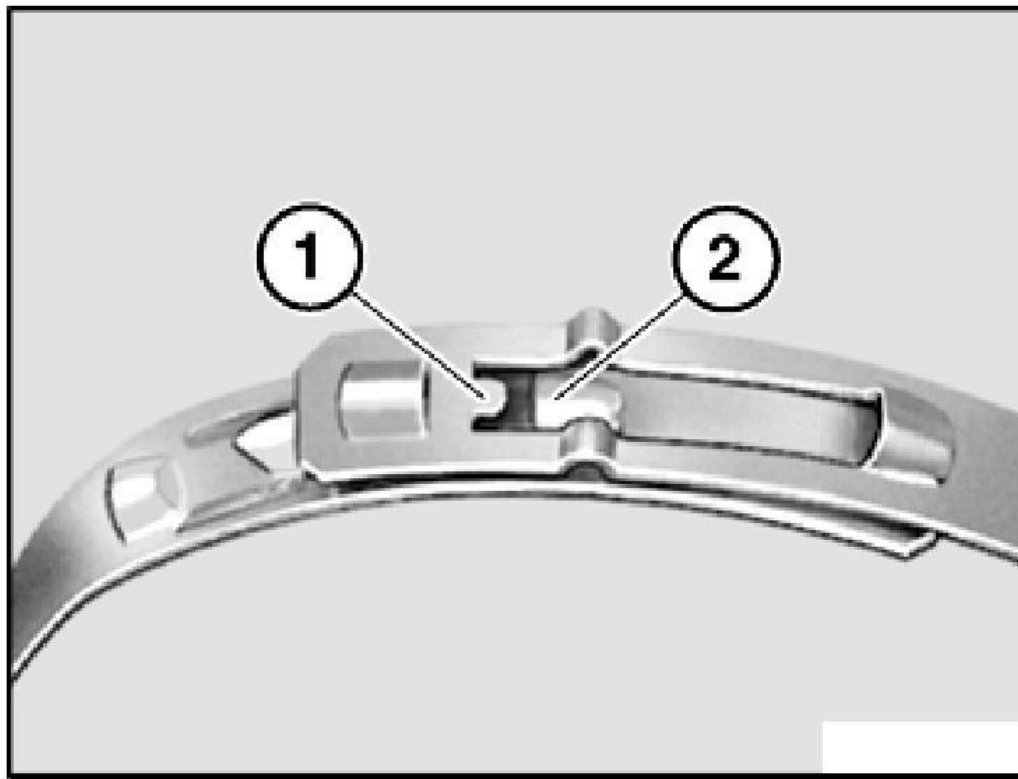
Fig. 463: Using Pliers On Lugs Of Clamp
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Replace clamps.

Preassemble clamps in installation position.

Catch (1) must be secured in lug (2).



G03118082

Fig. 464: View Of Preassembled Clamps In Installation Position
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Use only original clamps. If hose clamps are used, there is the risk that the throttle control linkage will stop or jam and no longer return to the idle position.

Installation:

Push intake air manifold with hose clamps (1) preassembled in installation position onto throttle assembly.

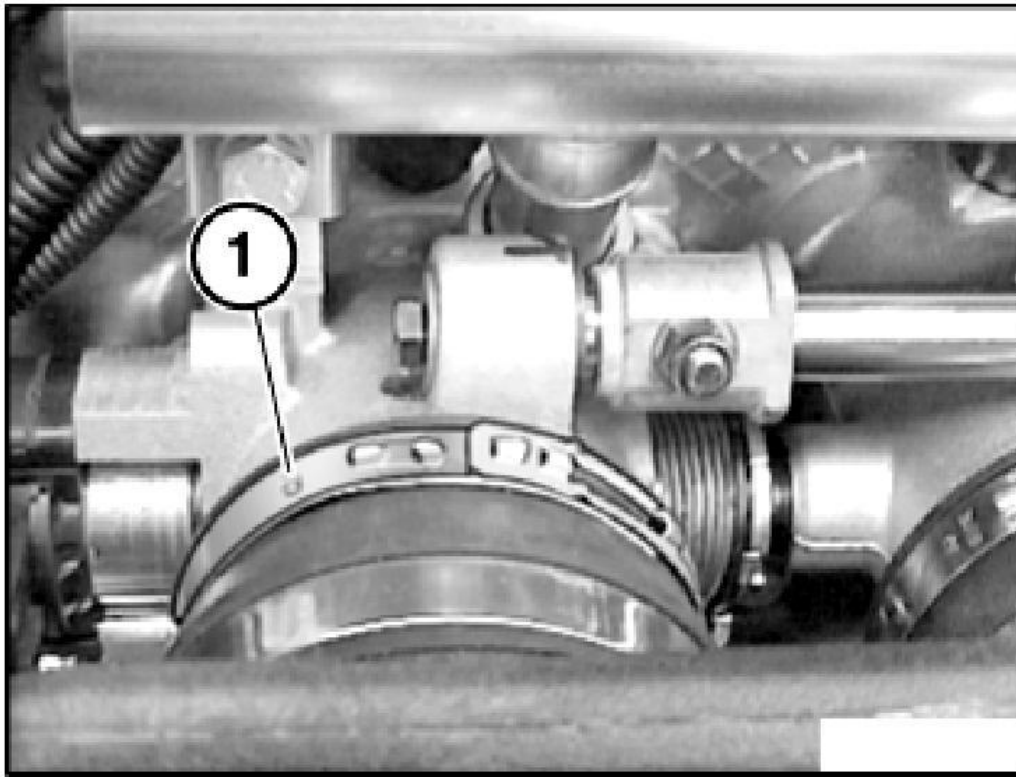
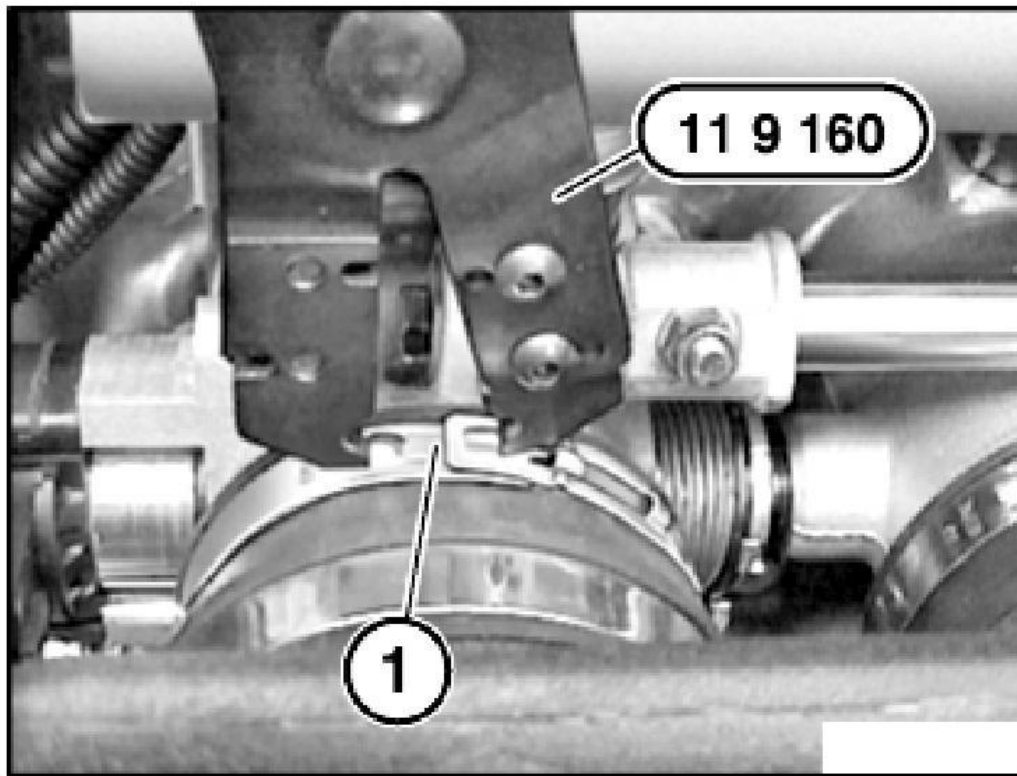
**G03118083**

Fig. 465: Identifying Intake Air Manifold With Hose Clamps
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

Place special tool 11 9 160 as shown in illustration on lugs of clamp.

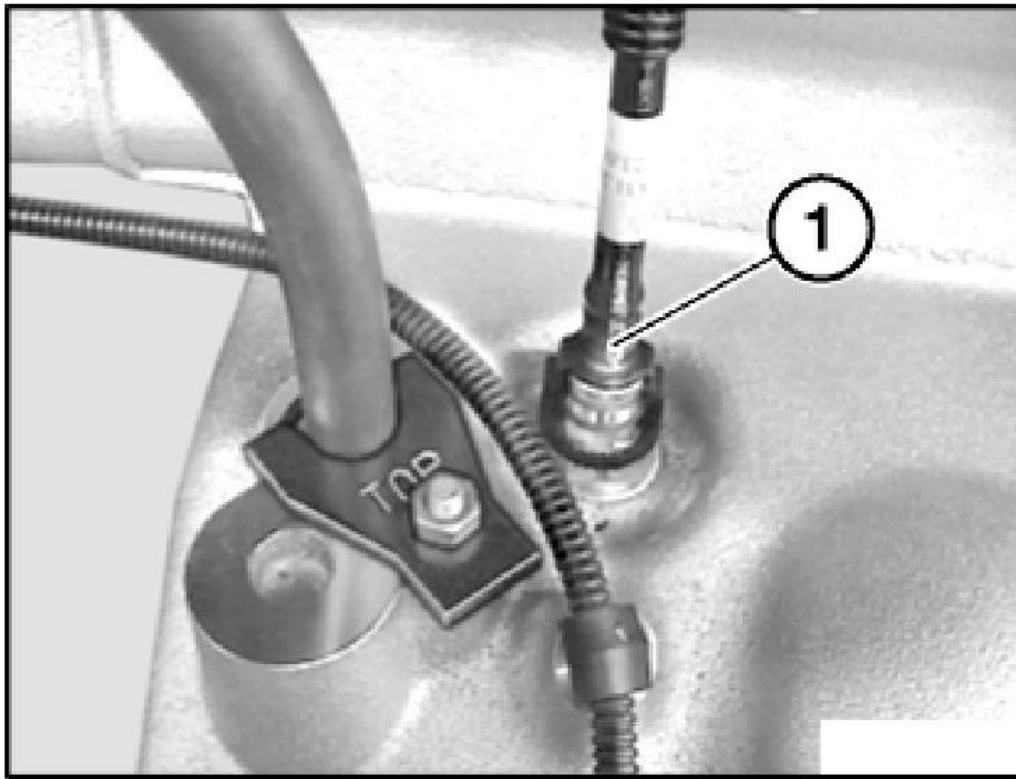
Press hose clamps together with special tool 11 9 160 until lock (1) engages.



G03118084

Fig. 466: Locking Lugs Of Clamp Using Pliers
Courtesy of BMW OF NORTH AMERICA, INC.

Press locks and detach condensate return (1).



G03118085

Fig. 467: View Of Condensate Return

Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: For purposes of clarity, shown on removed engine.

IMPORTANT: A vacuum line (1) and a wiring harness (2) are clipped into place on the reverse side of the intake air manifold.

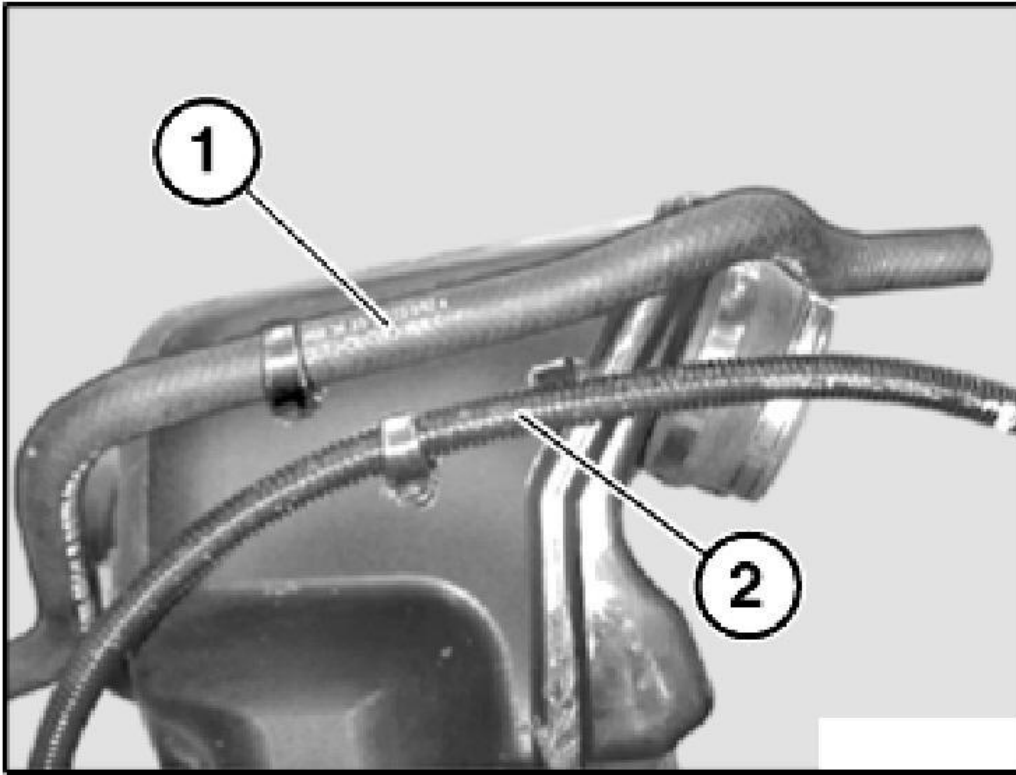
**G03118086**

Fig. 468: Identifying Vacuum Line And Wiring Harness
Courtesy of BMW OF NORTH AMERICA, INC.

Raise intake air manifold slightly and detach from throttle assembly.

Feed out vacuum line (1) and wiring harness (2).

Remove intake air manifold. Refer to **11 61 050 REMOVING AND INSTALLING INTAKE AIR MANIFOLD (S54)**.

EXHAUST MANIFOLD

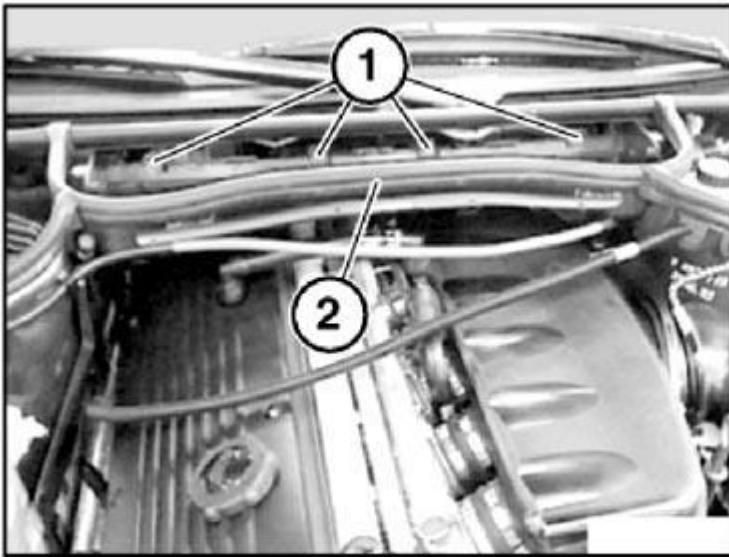
11 62 140 REMOVING AND INSTALLING, SEALING/REPLACING BOTH EXHAUST MANIFOLDS (S54)

E46 Only:

Remove microfilter.

Open cable duct on lower section of microfilter housing (2) and feed out cable(s).

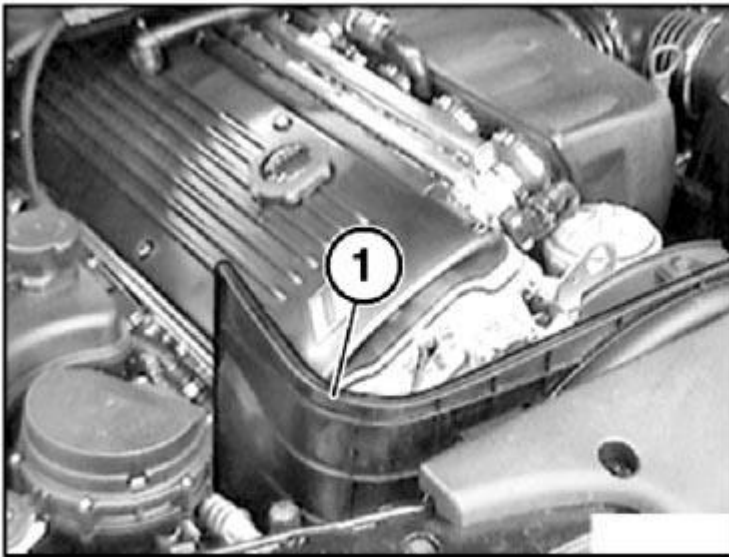
Release screws (1) and remove lower section of microfilter housing (2).



G03118087

Fig. 469: Locating Lower Section Of Microfilter Housing
Courtesy of BMW OF NORTH AMERICA, INC.

Remove expansion rivets. Remove air duct (1).



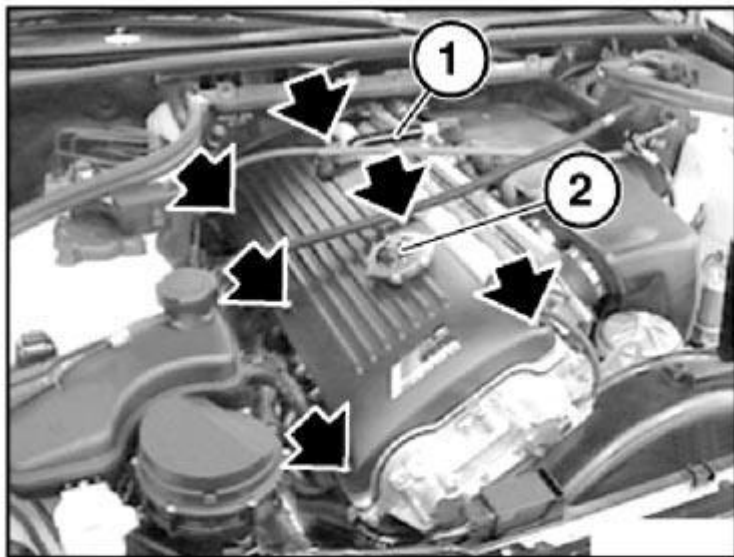
G03118088

Fig. 470: View Of Air Duct**Courtesy of BMW OF NORTH AMERICA, INC.**

Remove hose (1) for engine vent.

Remove sealing cap (2).

Remove ignition coil cover.



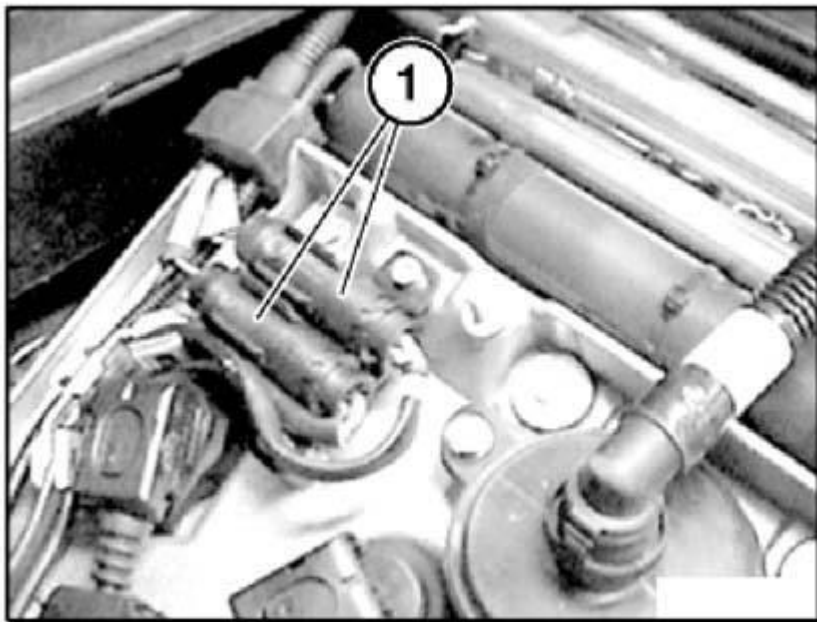
G03118089

Fig. 471: Identifying Engine Vent Hose And Sealing Cap
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: The plug housings of the oxygen sensors for cylinders 1 to 3 and 4 to 6 are different.

Unclip plug housing (1) from mounting.

Disconnect plug connections of oxygen sensors.



G03118090

Fig. 472: Unclipping Plug Housing From Mounting
Courtesy of BMW OF NORTH AMERICA, INC.

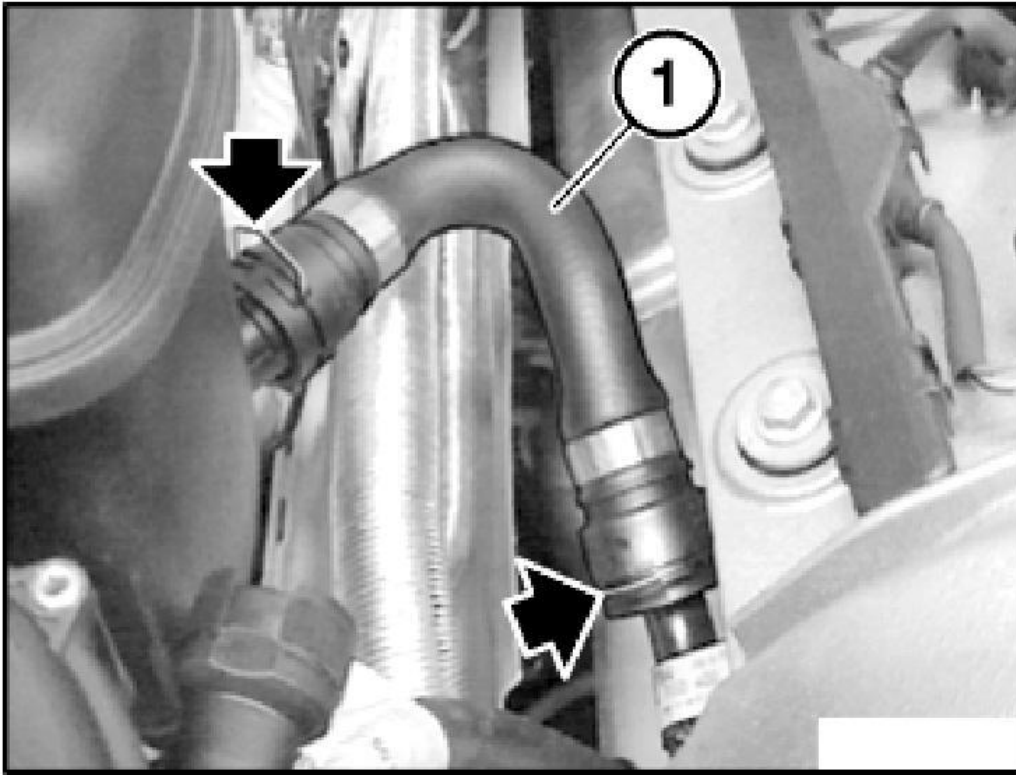
E46 Only:

Instructions for working on cooling system, refer to **17 00... INSTRUCTIONS FOR WORKING ON COOLING SYSTEM.**

Drain coolant.

Pull locks.

Remove hose (1).



G03118091

Fig. 473: Removing Coolant Hose

Courtesy of BMW OF NORTH AMERICA, INC.

Feed oxygen sensor cables out of shield plate of exhaust manifold.

NOTE: Fig. shows US version.

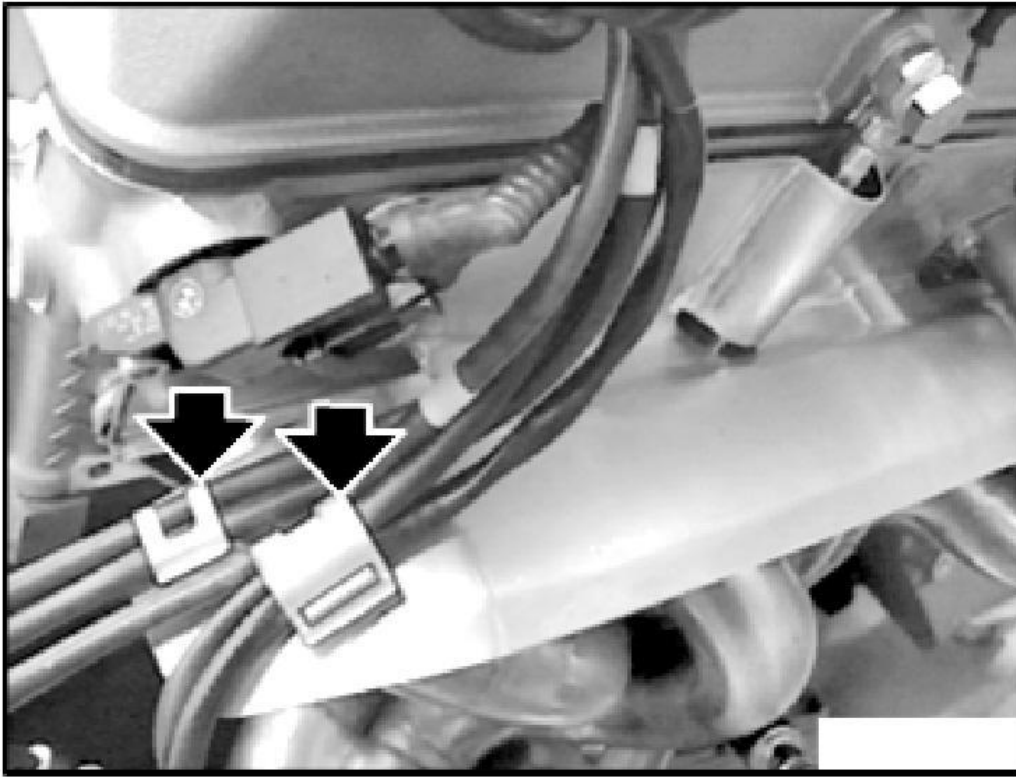
**G03118092**

Fig. 474: Feeding Oxygen Sensor Cables Out Of Shield Plate Of Exhaust Manifold
Courtesy of BMW OF NORTH AMERICA, INC.

Remove check valve from cylinder head.

Installation:

Replace the seal and nuts.

Remove exhaust manifold shield plate and A/C system hoses.

Remove engine splash guard.

E46 Only:

Remove reinforcement plate.

CAUTION: The article **51 71 374 REMOVING AND INSTALLING/REPLACING**

REINFORCEMENT PLATE ON FRONT AXLE SUPPORT (M3) contains important installation instructions.

ECE version:

Remove catalytic converter. Refer to **18 32 005 REMOVING AND INSTALLING/REPLACING CATALYTIC CONVERTER (S54)** .

US version:

Remove front exhaust system (front pipes).

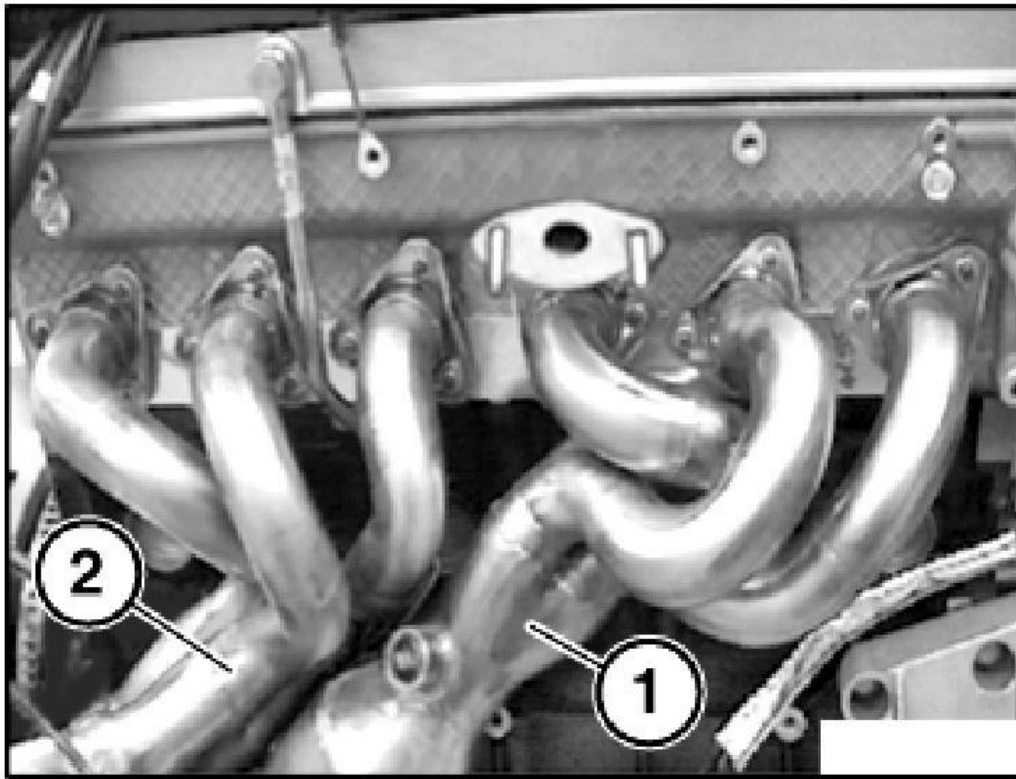
NOTE: **The oxygen sensors are in danger of being damaged when the exhaust manifolds are removed and installed.**

Remove oxygen sensors from exhaust manifolds.

NOTE: **Exhaust manifolds (1 and 2) cannot be removed individually.**

Detach exhaust manifold (1) from cylinder head and place on engine support arm.

Detach exhaust manifold (2) from cylinder head. Feed out exhaust manifolds (1 and 2) together.

**G03118093****Fig. 475: View Of Exhaust Manifolds****Courtesy of BMW OF NORTH AMERICA, INC.****Installation:**

Clean sealing faces, replace gaskets.

Coat threads with copper paste.

Replace nuts.

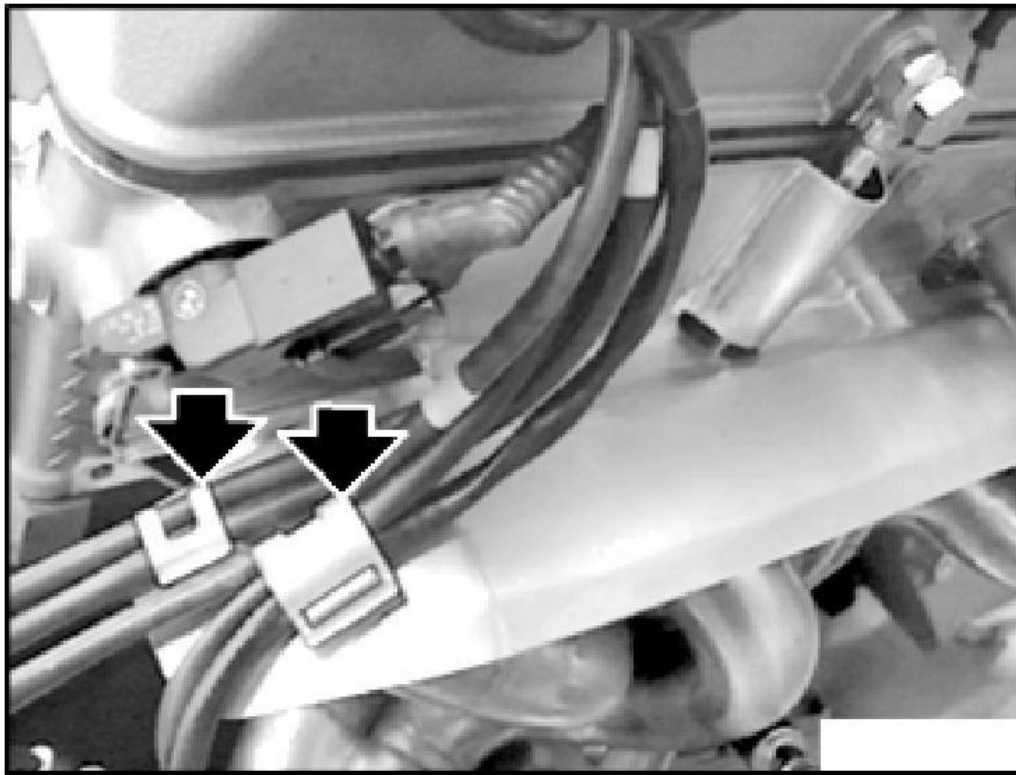
Tightening torque, refer to 11 62 1AZ in **ENGINE - TIGHTENING TORQUES** .

CAUTION: Ensure cables are exactly routed.

Installation:

Clip cables of oxygen sensors into mounts on shield plate of exhaust manifold.

NOTE: Fig. shows US version.



G03118094

Fig. 476: Locating Oxygen Sensor Cables

Courtesy of BMW OF NORTH AMERICA, INC.

EMISSION CONTROL, OXYGEN SENSOR

11 78 510 REPLACING BOTH OXYGEN CONTROL SENSORS (S54)

Special Tools Required:

- 11 7 030
- 11 9 150

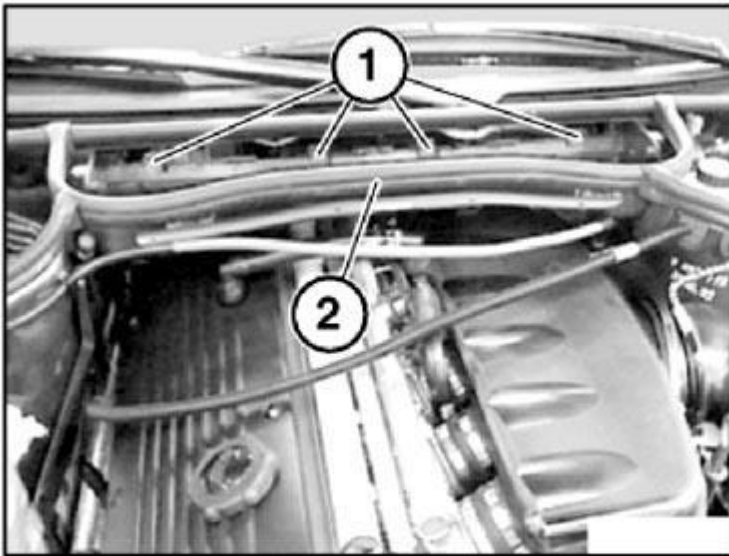
Read out fault memory, clear if necessary. Refer to **13 00 002 CHECKING FUNCTION OF DIGITAL**

ENGINE ELECTRONICS (DME) .**E46 Only:**

Remove microfilter.

Open cable duct on lower section of microfilter housing (2) and feed out cable.

Release screws (1) and remove lower section of microfilter housing (2).

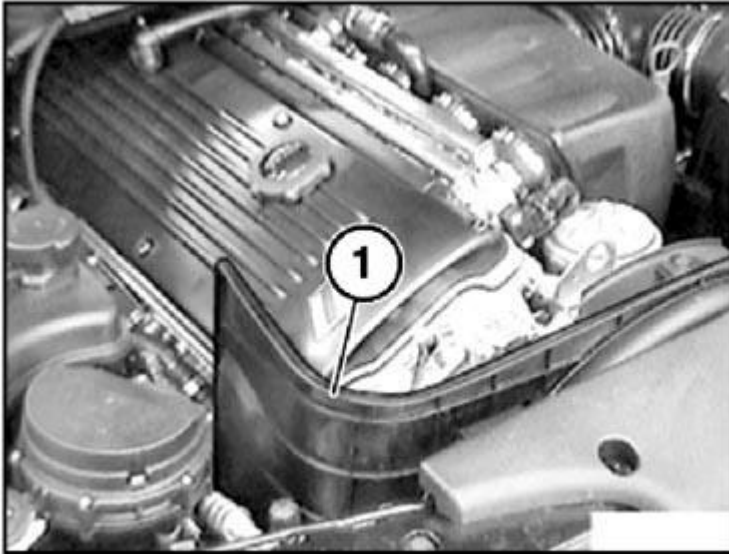


G03118095

Fig. 477: Identifying Lower Section Of Microfilter Housing
Courtesy of BMW OF NORTH AMERICA, INC.

E46 Only:

Lever out expansion rivets. Remove air duct (1).



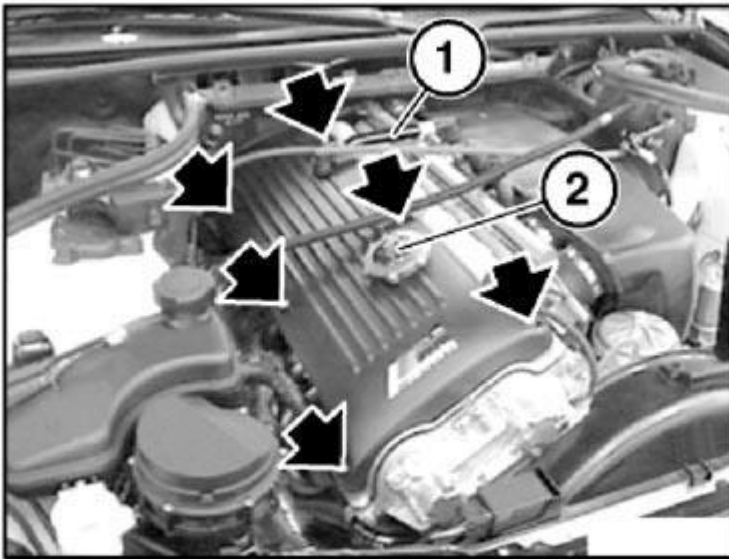
G03118096

Fig. 478: Locating Air Duct**Courtesy of BMW OF NORTH AMERICA, INC.**

Remove hose (1) for engine vent.

Remove sealing cap (2).

Remove ignition coil cover.



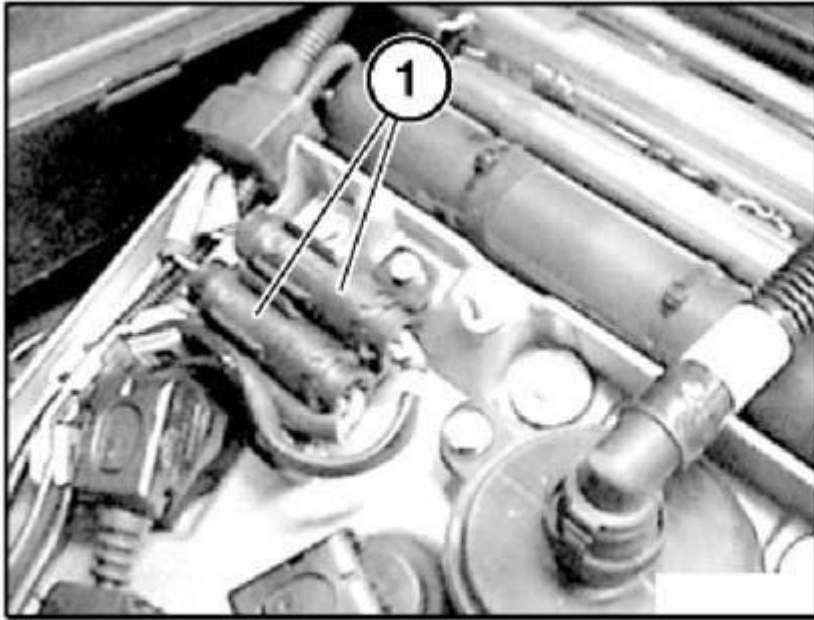
G03118097

Fig. 479: View Of Engine Vent Hose And Sealing Cap
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: The plug housings of the oxygen sensors for cylinders 1 to 3 and 4 to 6 are different.

Unclip plug housing (1) from mounting.

Disconnect plug connections of oxygen sensors.



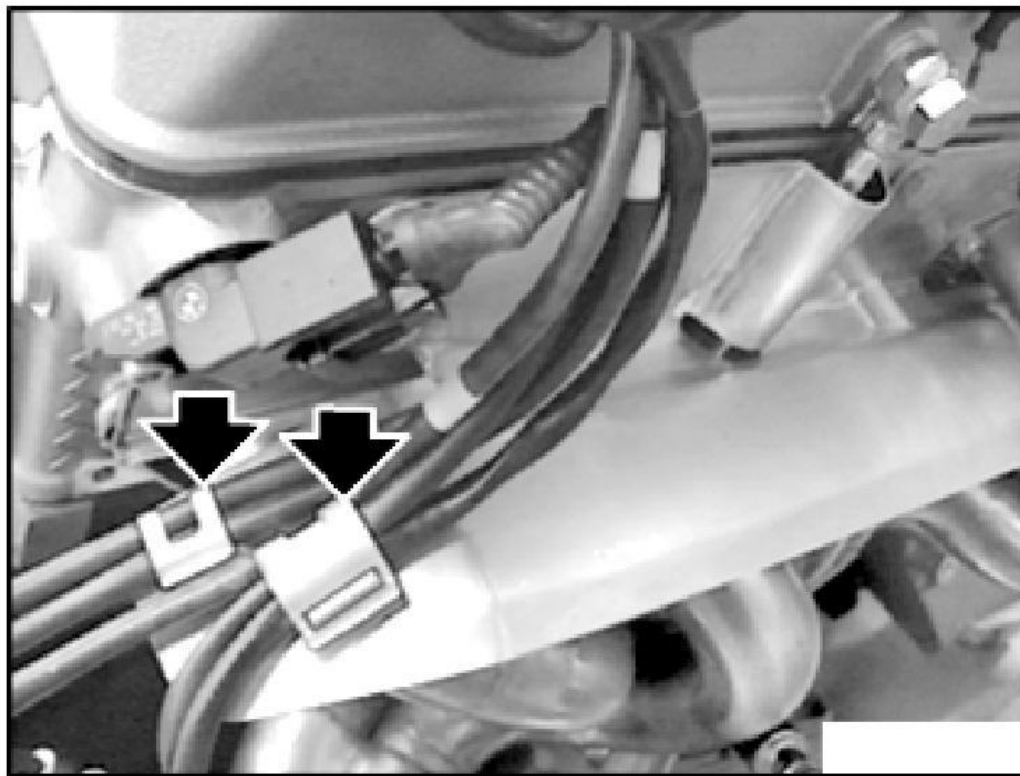
G03118098

Fig. 480: Unclipping Plug Housing From Mounting
Courtesy of BMW OF NORTH AMERICA, INC.

Feed oxygen sensor cables out of shield plate of exhaust manifold.

Installation:

Clip cables of oxygen sensors into mounts on shield plate of exhaust manifold.



G03118099

Fig. 481: View Of Oxygen Sensor Cables In Mounts
Courtesy of BMW OF NORTH AMERICA, INC.

CAUTION: Ensure cables are exactly routed.

NOTE: Fig. shows US version.

Remove underbody protection.

E46 Only:

Remove reinforcement plate.

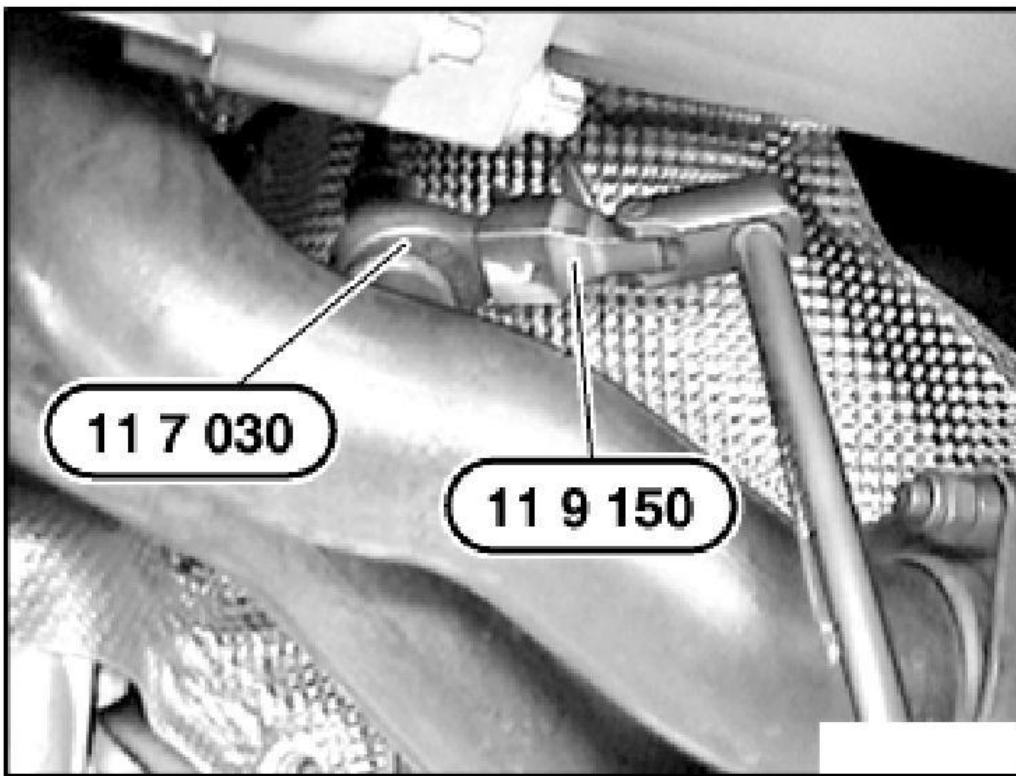
CAUTION: The article **51 71 374 REMOVING AND INSTALLING / REPLACING REINFORCEMENT PLATE ON FRONT AXLE SUPPORT (M3)** contains important installation instructions.

The oxygen sensors for cylinders 1 to 3 and 4 to 6 are different.

Mark oxygen sensors so as not to mix sensors up at a later J stage.

Detach oxygen sensors with special tool 11 7 030 in conjunction with special tool 11 9 150.

1. Remove oxygen sensor from cylinders 1 to 3.
2. Remove oxygen sensor from cylinders 4 to 6.



G03118100

Fig. 482: Removing Oxygen Sensors
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

The threads of new oxygen monitor sensors are already coated with Never Seez Compound.

If an oxygen monitor sensor is used again, apply a thin and even coat of Never Seez Compound to the thread only.

Do not clean that part of the oxygen sensor which projects into the exhaust system branch and do not allow it to come into contact with lubricants.

Installation:

When special tool 11 9 150 is used in conjunction with special tool 11 7 030, 47 N.m on the dial on the torque wrench corresponds to an actual tightening torque of 50 N.m.

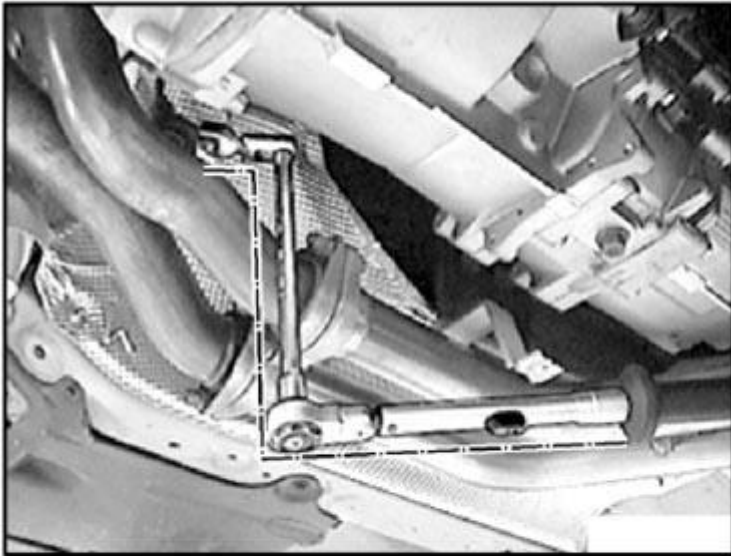
For final tightening of oxygen sensors, fit torque wrench and special tool (11 7 030/11 9 150) as illustrated.

Tightening torque, refer to 11 78 1AZ in **ENGINE - TIGHTENING TORQUES** .

1. Install oxygen sensor for cylinders 4 to 6 and tighten down.
2. Install oxygen sensor for cylinders 1 to 3 and tighten down.

Cover oxygen sensors when applying underseal.

Pay attention to cable routing for oxygen sensors.



G03118101

Fig. 483: Installing Oxygen Sensor

Courtesy of BMW OF NORTH AMERICA, INC.

11 78 613 REPLACING BOTH OXYGEN MONITOR SENSORS (S54)**Special Tools Required:**

- 11 7 020
- 11 7 030
- 11 9 150

Refer to **13 00 002 CHECKING FUNCTION OF DIGITAL ENGINE ELECTRONICS (DME)** .

US Version:

In the US version, the oxygen monitor sensors are installed in the exhaust manifolds.

Cylinders 1 to 3: Release monitor sensor with special

tool 11 9 150 in conjunction with special tool 11 7 030 and tighten down.

Installation:

When special tool 11 9 150 is used in conjunction with special tool 11 7 030, 47 N.m on the torque wrench dial corresponds to an actual tightening torque of 50 N.m.

Cylinders 4 to 6: Release monitor sensor with special tool 11 7 020 and tighten down.

Tightening torque, refer to 11 78 1AZ in **ENGINE - TIGHTENING TORQUES** .

ECE Version:

Remove catalytic converter. Refer to **18 32 005 REMOVING AND INSTALLING/REPLACING CATALYTIC CONVERTER (S54)** .

Unclip oxygen monitor sensor cable from holder.

To release and tighten down oxygen monitor sensors (1), use special tool 11 7 020 or special tool 11 7 030.

Tightening torque, refer to 11 78 1AZ in **ENGINE - TIGHTENING TORQUES** .

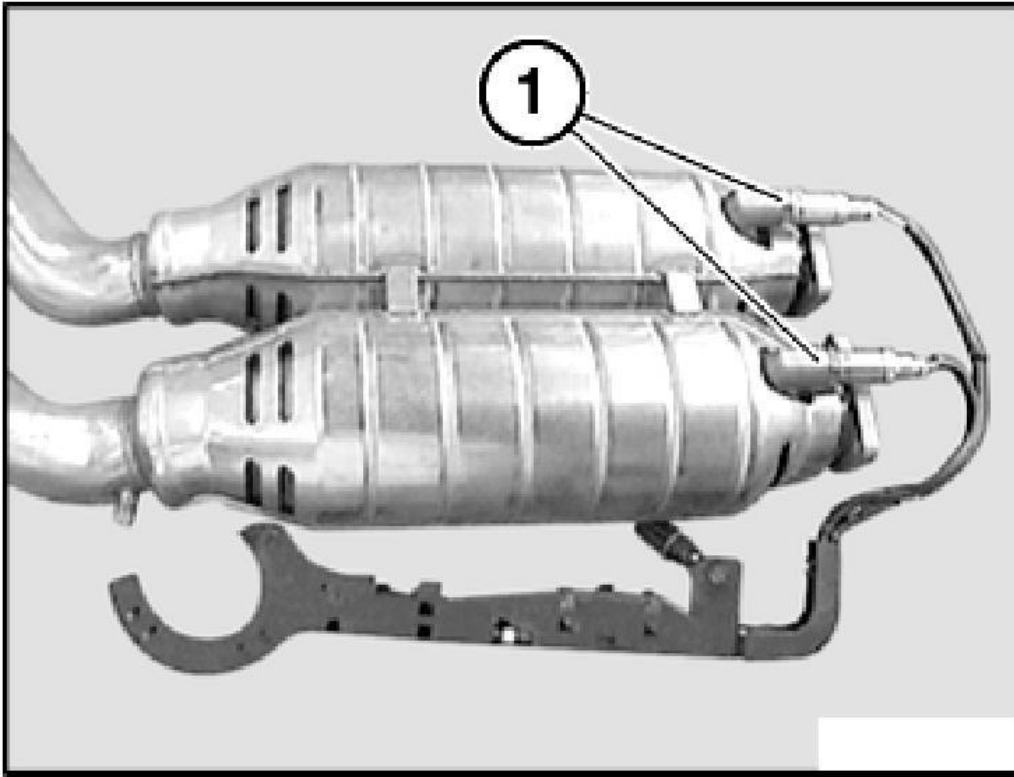
**G03118102**

Fig. 484: Locating Oxygen Monitor Sensors
Courtesy of BMW OF NORTH AMERICA, INC.

Installation:

The threads of new oxygen monitor sensors are already coated with Never Seez Compound.

If an oxygen monitor sensor is used again, apply a thin and even coat of Never Seez Compound to the thread only.

Do not clean that part of the oxygen sensor which projects into the exhaust system branch and do not allow it to come into contact with lubricants.

Cover oxygen monitor sensor when applying underseal. Pay attention to cable routing for oxygen monitor sensor.