

CYLINDER HEAD

SERVICE TOOLS

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SERVICE TOOLS – OTHER SUPPLIER

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SERVICE PRODUCTS

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GENERAL

NOTE: When diagnosing an engine problem, always perform an engine leak test. This will help pin-point a problem. Refer to *ENGINE LEAK TEST* in this subsection for procedures.

When disassembling parts that are duplicated in the engine, (e.g.: valves, bushings), it is strongly recommended to note their position and to keep them as a “group”. If you find a defective component, it will be much easier to find the cause of the failure. Since parts were break-in together during the engine operation, they will keep their matched fit when parts are reassemble together within their “group”.

INSPECTION

ENGINE LEAK TEST

The procedure has to be done when engine operating temperature of approximately 70°C (158°F) is reached.



WARNING

Be careful to burns when working on a hot engine.

Preparation

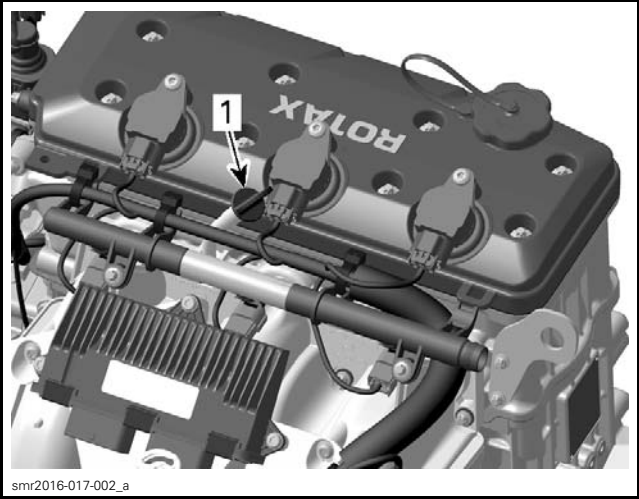
- 1. Remove any required parts to give access to engine.
- 2. Remove the tether cord.
- 3. Remove jet pump (refer to *JET PUMP* subsection).
- 4. Remove coolant pressure cap.



WARNING

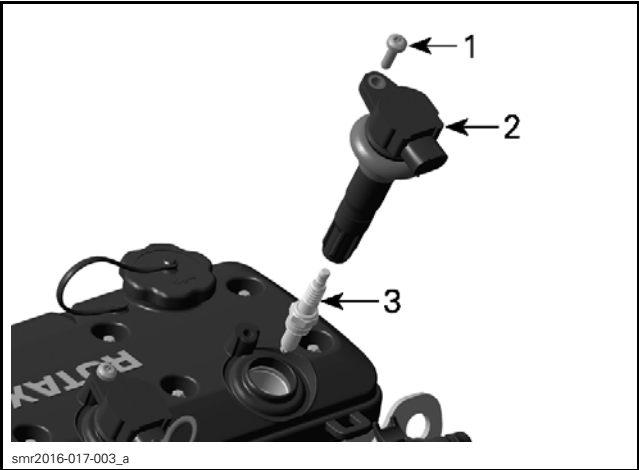
To avoid potential burns, only remove the coolant pressure cap by wearing the appropriate safety equipment.

- 5. Remove oil dipstick.



1. Oil dipstick

- 6. Unplug and remove ignition coils.
- 7. Remove spark plugs.



1. Retaining screw
2. Ignition coil
3. Spark plug

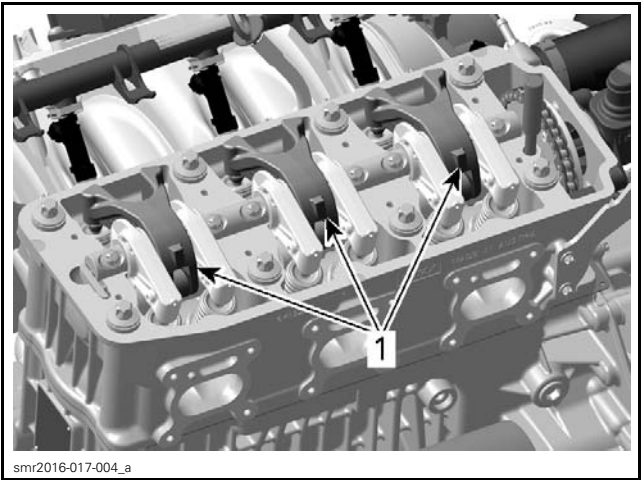
- 8. Remove *VALVE COVER*, see procedure in this subsection.
- 9. Install the drive shaft adapter and an appropriate wrench lever on drive shaft end.

REQUIRED TOOL	
DRIVE SHAFT ADAPTER (P/N 529 035 985)	

Leak Test Procedure

NOTE: Cylinder numbers are molded on valve cover.

- 1. Rotate engine crankshaft counterclockwise until the cylinder 1 is at Top Dead Center (TDC) compression stroke.
 - 1.1 As the engine crankshaft is turned over, observe the movement of intake rocker arm of the cylinder to be checked.
 - 1.2 After piston completes its cycle and the intake valve closes, observe the piston.
 - 1.3 When it reaches its uppermost position this is TDC compression stroke.



1. Intake rocker arms

- 2. Secure the wrench lever, at the end of the drive shaft, against hull to prevent further crankshaft rotation.
- 3. Install the leak down test tool.

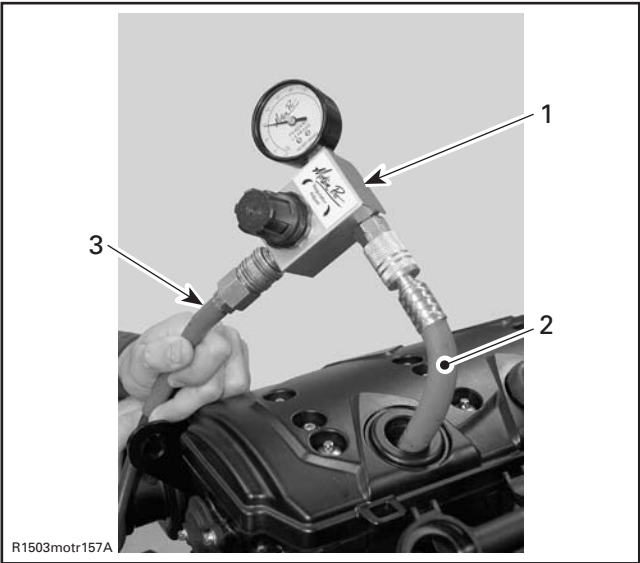
REQUIRED TOOL
ENGINE LEAK DOWN TEST KIT (P/N 529 035 661)



- 3.1 Install the appropriate gauge adapter into spark plug hole.
- 3.2 Connect the leak down tester gauge to the gauge adapter.
- 3.3 Connect to an adequate pressurized air supply.
- 3.4 Set needle of measuring gauge to zero (0).

NOTE: Each tester will have specific instruction on the gauge operation and required pressure. Refer to manufacturer's instructions.

- 4. Supply combustion chamber with air.



TYPICAL
1. Leak down tester gauge
2. Gauge adapter
3. Air supply hose

- 5. Note the amount of leaking or percentage (depending on tester).

LEAKAGE PERCENTAGE	ENGINE CONDITION
Up to 15%	Excellent condition
16% to 25%	Good condition
26% to 40%	Fair condition; engine will run and performance might be down in some cases
41% and higher	Poor condition, diagnose and repair engine

- 6. Proceed the same way with remaining cylinders.

Diagnostic

Pressurize area to be tested, spray soap/water solution at the indicated location and look and/or listen for air bubbles.

OBSERVATION	CAUSE
Air escaping on intake port	Leaking intake valve(s)
Air escaping on exhaust port	Leaking exhaust valve(s)
Air escaping into crankcase	Excessively worn and/or broken piston rings
Air bubbles out of coolant tank	Leaking cylinder head gasket

OBSERVATION	CAUSE
Air/water escaping from cylinder-block/head	Damaged gasket and/or loosened screws
Coolant escaping from water pump housing	Damaged gasket and/or loosened screws (refer to <i>COOLING SYSTEM</i>)
Coolant escaping from leak indicator hole	Damaged rotary seal on water pump shaft (refer to <i>COOLING SYSTEM</i>)
Oily contamination on leak indicator hole	Damaged oil seal on water pump shaft

Reassembly

For reassembly, reverse the preparation procedure. Use torque values and service products from the exploded views (refer to proper *ENGINE* subsections).

Properly install ignition coils. Refer to *IGNITION COILS AND SPARK PLUGS* subsection.

TROUBLESHOOTING

The following is provided to help in diagnosing the probable source of problems. It is a guideline and it should not be assumed to list all possible problems.

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* section.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. **Incorrect camshaft timing adjustment**
- Replace damaged components and readjust camshaft timing.
2. **Camshaft timing gear screws got loose**
- Retighten screws with the recommended torque.
3. **Rocker arm(s) hydraulic element is broken or worn out (improper valve adjustment).**
- Replace faulty rocker arm(s).
4. **Rocker arm screw not properly tightened**
- Retighten screws with recommended torquing procedure.
5. **Faulty chain tensioner**
- Replace chain tensioner.
6. **Chain guide is worn out**
- Replace chain guide.

7. **Stretched timing chain or worn out sprocket**
- Replace timing chain and sprocket.
8. **Camshaft is worn out**
- Check if camshaft radial clearance is out of specification.

OIL LEAKAGE FROM CYLINDER HEAD

1. **Valve cover gasket is leaking**
- Replace valve cover gasket and retighten screws with recommended torque.
- Check valve cover for cracks or other damage. Replace if necessary.
2. **Valve cover screws are leaking**
- Replace valve cover screws.
3. **Spark plug tube gasket is leaking**
- Remove valve cover and replace spark plug tube gasket.
- Clean spark plug area from oil spillage.
4. **Blow by valve is leaking**
- Replace blow by valve O-ring.
5. **Camshaft sensor O-ring is leaking**
- Replace camshaft sensor O-ring.
6. **Cylinder head gasket is leaking**
- Remove cylinder head and check for damage.
- Replace cylinder head gasket and retighten screws with recommended torquing procedure.

ENGINE LACKS ACCELERATION OR POWER

1. **Incorrect camshaft timing adjustment**
- Replace damaged components and readjust camshaft timing.
2. **Intake or exhaust valves are leaking**
- Perform *ENGINE LEAK TEST*.
- Check if valve seats properly in valve seat.
- Repair or replace damaged components.
3. **Broken valve spring(s)**
- Replace defective parts.
4. **Broken rocker arm(s)**
- Replace defective parts.

PROCEDURES

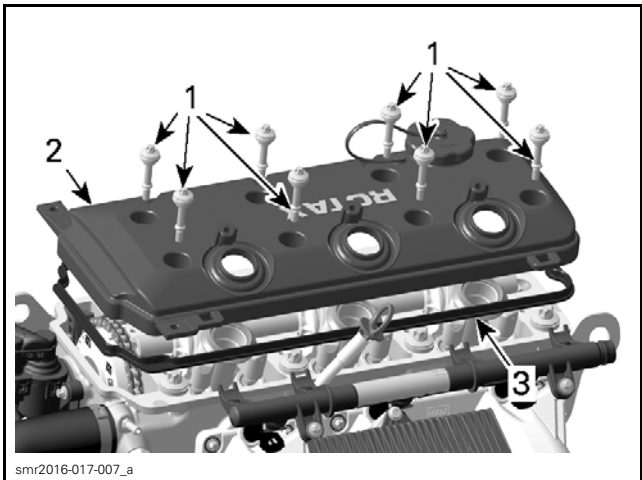
VALVE COVER

Removing the Valve Cover

1. Remove the ignition coils. Refer to *IGNITION COILS AND SPARK PLUGS* subsection.

Subsection 09 (CYLINDER HEAD)

2. Remove:
- Valve cover screws
 - Valve cover
 - Gasket (discard it).



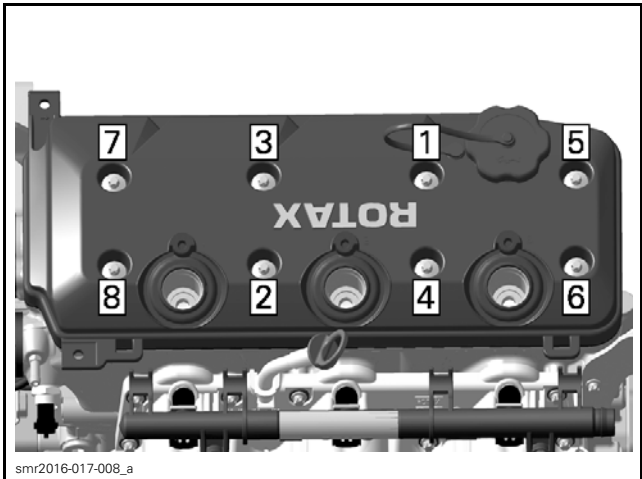
1. Valve cover screws
2. Valve cover
3. Gasket

Inspecting the Valve Cover

Check the valve cover for cracks or other damage.
Check if rubber bushing on the valve cover screws are brittle, cracked or hard. If so, replace valve cover screw accordingly.

Installing the Valve Cover

The installation is the reverse of the removal procedure. However, pay attention to the following.
Properly seat **NEW** gasket in the cover groove.
Install the valve cover screws according to following sequence.



TIGHTENING SEQUENCE

NOTICE Tighten screws 1 - 4 twice.

TIGHTENING TORQUE	
All valve cover screws (Step A)	9 N•m ± 1 N•m (80 lbf•in ± 9 lbf•in)
Valve cover screws (1 - 4) (Step B)	9 N•m ± 1 N•m (80 lbf•in ± 9 lbf•in)

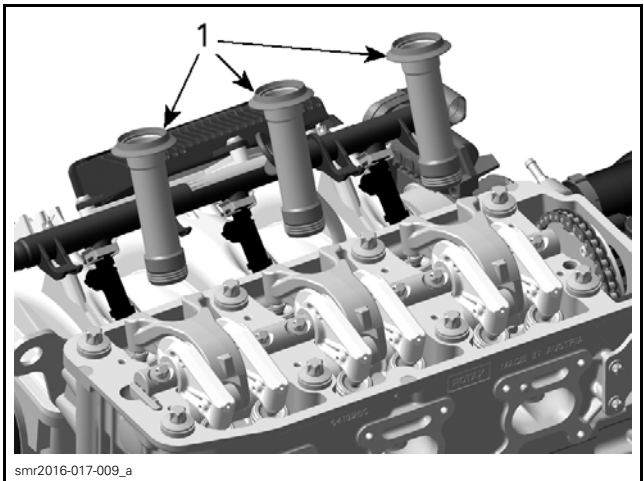
Install ignition coils, refer to *IGNITION COILS AND SPARK PLUGS* subsection.

Install all other removed parts. Refer to proper subsection for procedure.

SPARK PLUG TUBES

Removing the Spark Plug Tube

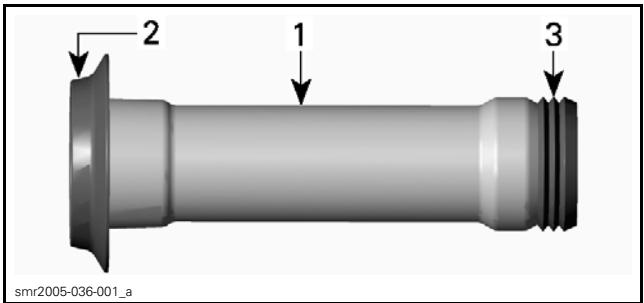
Remove the *VALVE COVER*, see procedure in this subsection.
Pull spark plug tubes to remove them.



1. Spark plug tubes

Inspecting the Spark Plug Tube

Check seals on spark plug tube. If seals are brittle, cracked or hard, replace spark plug tube.



TYPICAL
1. Spark plug tube
2. Seal to the valve cover
3. Seal to the cylinder head

Installing the Spark Plug Tube

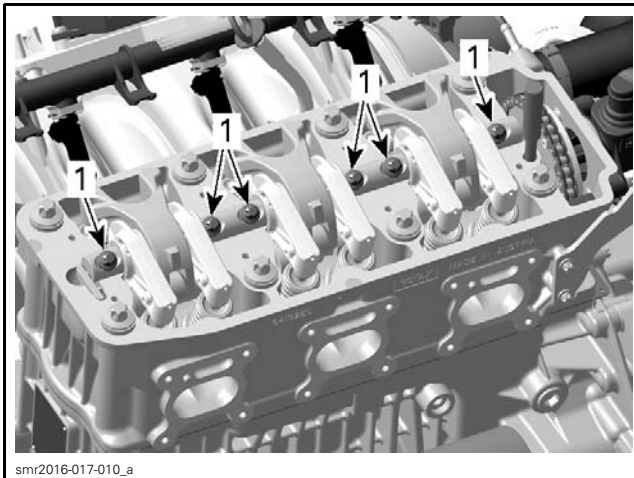
The installation is the reverse the removal procedure. However, pay attention to the following detail.

Apply engine oil on seals.

ROCKER ARMS

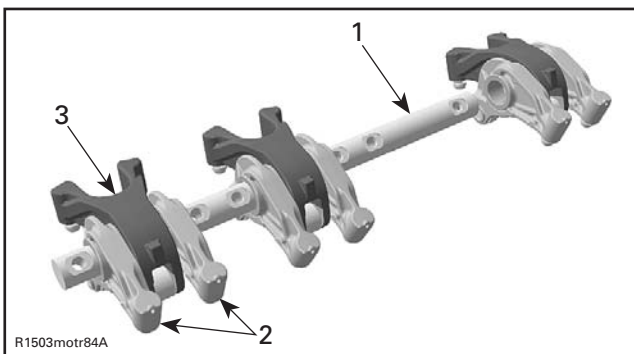
Removing the Rocker Arm

- See procedure in this subsection to remove:
 - Valve cover
 - Spark plug tubes.
- Remove and discard rocker arm shaft screws.



1. Rocker arm shaft screws

- Remove rocker arm shaft with rocker arms.

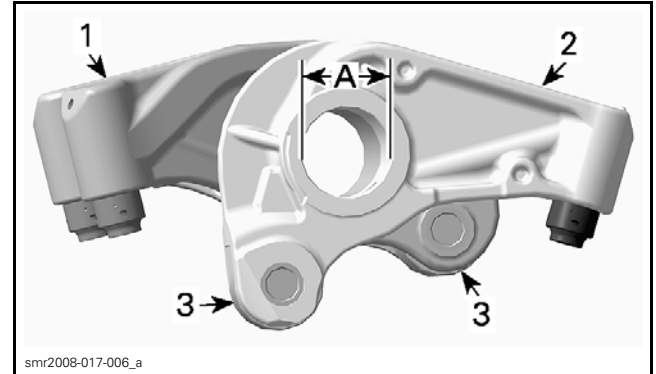


1. Rocker arm shaft
2. Rocker arms (exhaust side)
3. Rocker arm (intake side)

Inspecting the Rocker Arm

Inspect each rocker arm for cracks and scored friction surfaces. If so, replace rocker arm assembly.

Check the rocker arm rollers for free movement, wear and excessive radial play. Replace rocker arm assembly as necessary.



1. Rocker arm (intake side)
2. Rocker arm (exhaust side)
3. Rollers
A. Rocker arm inside diameter

Measure rocker arm inside diameter. If diameter is out of specification, change the rocker arm assembly.

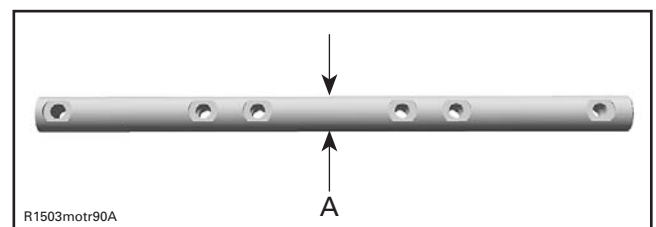
ROCKER ARM INSIDE DIAMETER	
New	20.007 mm to 20.020 mm (.7877 in to .7882 in)
Service limit	20.050 mm (.7894 in)

Press the hydraulic lifter with your thumb. If the hydraulic lifter can be fully pressed in, replace rocker arm. Lifter must turn freely in rocker arm bore. Otherwise, replace.

Rocker Arm Shaft

Check for scored friction surfaces, if so, replace parts.

Measure rocker arm shaft diameter.

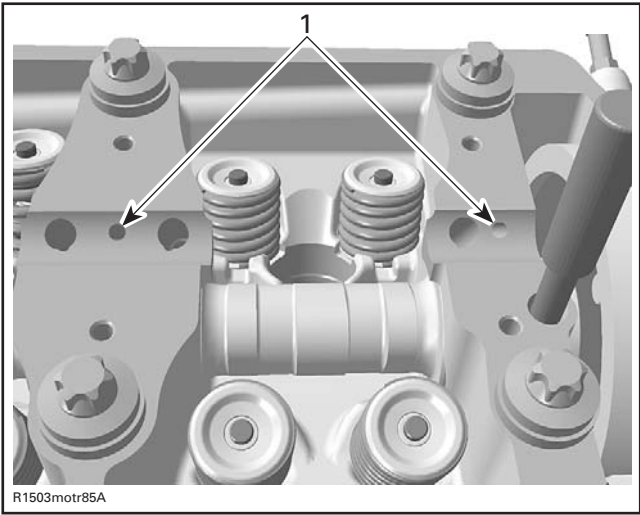


A. Measure rocker arm shaft diameter here

ROCKER ARM SHAFT DIAMETER	
New	19.980 mm to 19.993 mm (.7866 in to .7871 in)
Service limit	19.970 mm (.7862 in)

Any area worn excessively will require parts replacement.

Verify and clean oil orifices to ensure a good rocker arm shaft lubrication.



1. Oil orifices from the camshaft to the rocker arm shaft, then to the rocker arms and finally to the valve adjustment

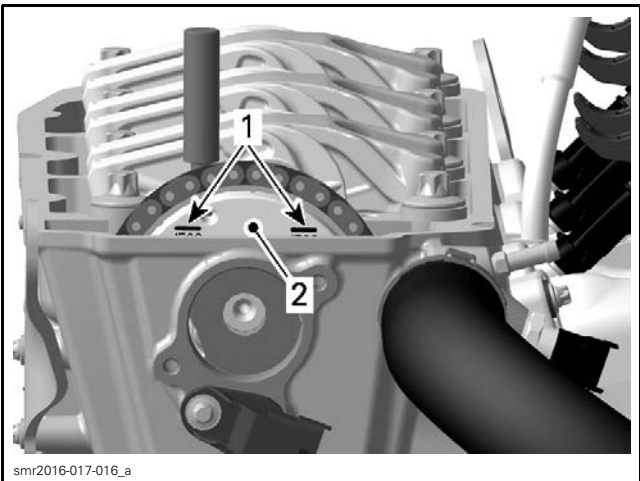
Installing the Rocker Arm

The installation is the reverse of the removal procedure. However, pay attention to the following details.

NOTE: The rocker arm shaft can only be installed in one specific position. Therefore strictly adhere to following procedure.

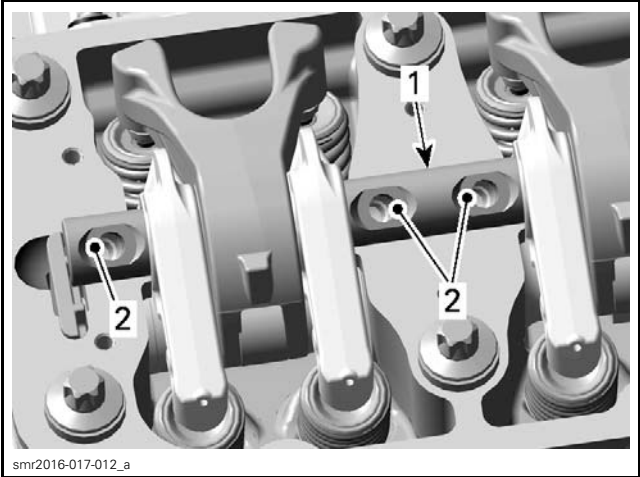
- 1. Lock camshaft. Refer to *CAMSHAFT* in this subsection.

NOTICE Make sure the printed marks on oil separator cover are parallel to the cylinder head base.



1. Printed marks
2. Oil separator cover

- 2. Apply engine oil on rocker arm shaft.
- 3. Position the rocker arm shaft with the notches on top.



1. Rocker arm shaft
2. Rocker arm shaft notches

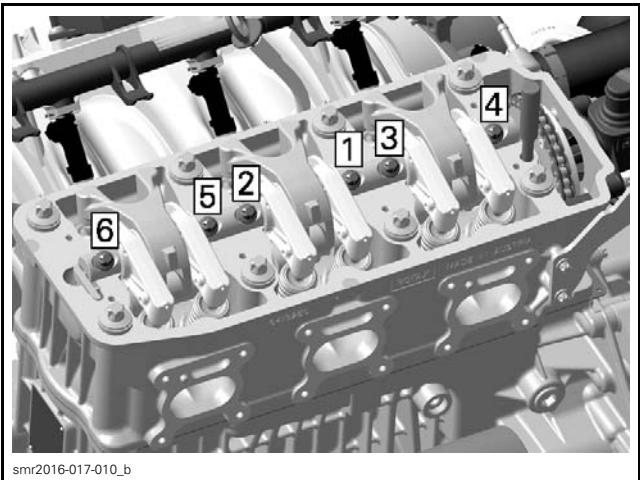
- 4. Install **NEW** rocker arm shaft screws.

NOTICE This assembly uses stretch screws. Always use **NEW** screws and strictly adhere to the tightening procedure.

- 5. Tighten screws according to following sequence.

NOTE: Always perform a step on **ALL** rocker arm shaft screws before going to the next step.

TIGHTENING PROCEDURE		
Rocker arm shaft screws	Step A	20 N•m ± 2 N•m (15 lbf•ft ± 1 lbf•ft)
	Step B	Additional 90° ± 5°



TIGHTENING SEQUENCE

CAMSHAFT TIMING GEAR

Removing the Camshaft Timing Gear

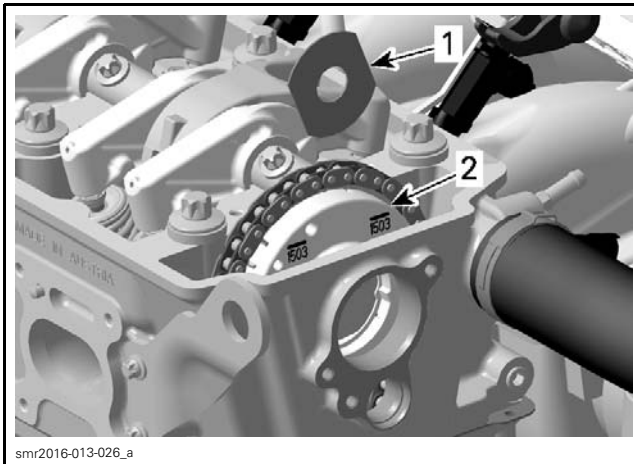
Lock crankshaft, refer to *CYLINDER BLOCK* subsection.

Remove *VALVE COVER*, see procedure in this subsection.

Remove camshaft position sensor. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.

Lock camshaft. Refer to *CAMSHAFT* in this subsection.

Remove thrust washer from oil separator cover.

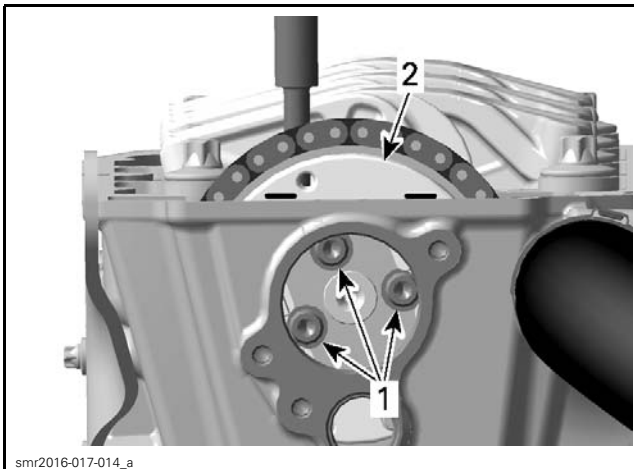


1. Thrust washer
2. Oil separator cover

Remove the chain tensioner. Refer to *CYLINDER BLOCK* subsection.

Remove:

- Chain guide
- Camshaft timing gear with oil separator cover.



1. Timing gear screws
2. Camshaft timing gear with oil separator cover

NOTE: Secure timing chain with a retaining wire.

Inspecting the Camshaft Timing Gear

Check camshaft timing gear for wear or deterioration.

If gear is worn or damaged, replace it as a set (camshaft timing gear and timing chain).

NOTE: For crankshaft timing gear replacement, refer to *CYLINDER BLOCK* subsection.

Installing the Camshaft Timing Gear

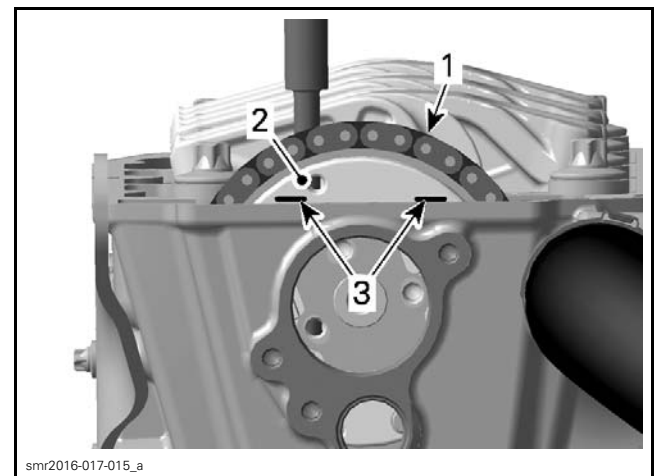
The installation is reverse of the removal procedure. However, pay attention to the following details.

Install oil separator cover on camshaft timing gear.

NOTICE Crankshaft and camshaft must be locked on TDC position.

Place camshaft timing gear along with timing chain on the camshaft.

NOTE: The printed marks on the oil separator cover must be parallel to the cylinder head base.



1. Timing chain
2. Oil separator cover
3. Printed marks

Ensure chain guides are properly installed.

Loosely install timing gear screws.

Install chain tensioner.

NOTE: There can be 2 different positions to install the timing gear on the camshaft. To find best position strictly follow the procedure.

Check if timing gear screws are still loose. If screws are squeezed by the timing gear, remove the chain tensioner again and rotate timing gear by one tooth clockwise.

Install the chain tensioner again.

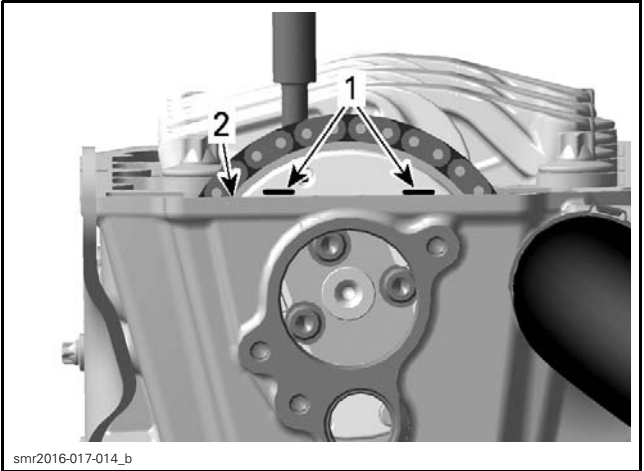
Remove timing gear screws and apply thread locker on threads.

Tighten timing gear screws to specification.

Subsection 09 (CYLINDER HEAD)

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Camshaft timing gear screws	16 N•m ± 2 N•m (142 lbf•in ± 18 lbf•in)

NOTICE Printed marks on the oil separator cover must be parallel to the cylinder head surface.



1. Printed marks
2. Cylinder head surface

Remove crankshaft and camshaft locking tools.
Install all other removed parts.

CAMSHAFT

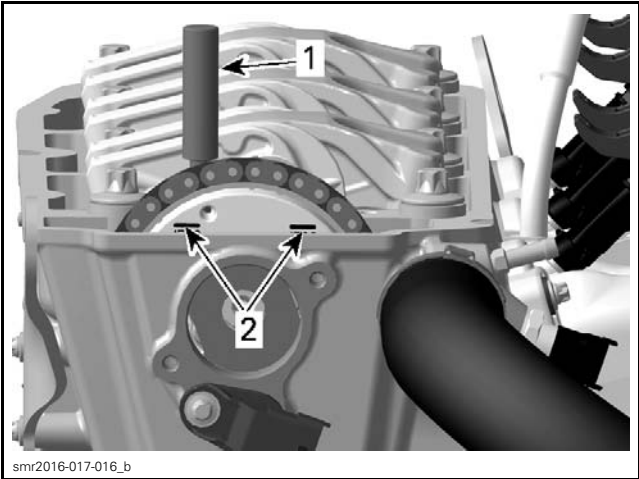
Camshaft Locking Procedure

1. Remove *VALVE COVER*, see procedure in this subsection.
2. Lock crankshaft, refer to procedure in *CYLINDER BLOCK* subsection.

NOTE: Make sure that printed marks on oil separator cover are parallel to the cylinder head base.

3. Insert the camshaft locking tool into the hole behind the camshaft timing gear to lock camshaft.

REQUIRED TOOL	
CAMSHAFT LOCKING TOOL (P/N 529 035 839)	



1. Camshaft locking tool
2. Printed marks

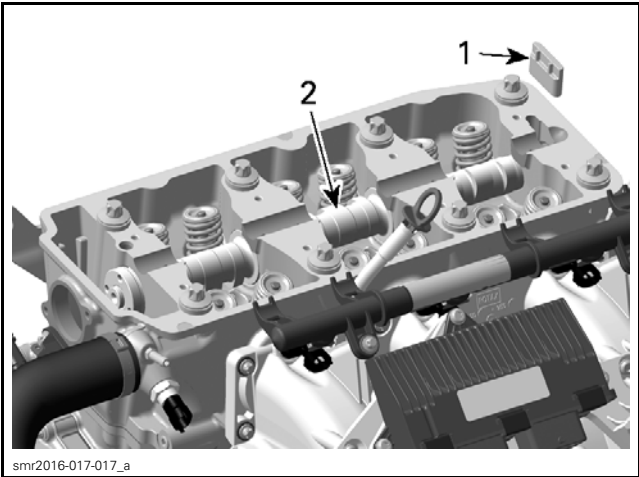
Removing the Camshaft

See procedure in this subsection and remove:

- Camshaft timing gear
- Rocker arm.

Remove:

- Camshaft lock
- Camshaft.



1. Camshaft lock
2. Camshaft

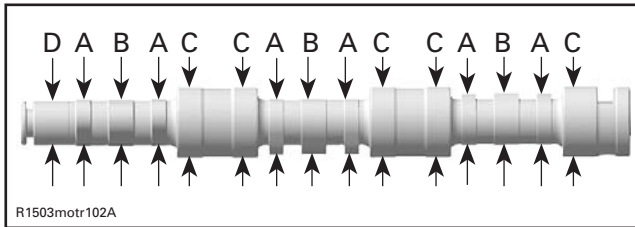
Inspecting the Camshaft

Check each lobe and bearing journal of camshaft for:

- Scoring
- Scuffing
- Cracks
- Other signs of wear.

Measure camshaft bearing journal and lobe height using a micrometer.

Measure clearance between both ends of camshaft and cylinder head.



- A. Camshaft lobe (exhaust valves)
 B. Camshaft lobe (intake valves)
 C. Camshaft bearing journal
 D. Camshaft bearing journal — engine front

CAMSHAFT LOBE HEIGHT — EXHAUST VALVE	
New	31.430 mm to 31.630 mm (1.2374 in to 1.2453 in)
Service limit	31.380 mm (1.2354 in)

CAMSHAFT LOBE HEIGHT — INTAKE VALVE	
New	31.540 mm to 31.740 mm (1.2417 in to 1.2496 in)
Service limit	31.500 mm (1.2402 in)

CAMSHAFT BEARING JOURNAL	
New	39.892 mm to 39.905 mm (1.5706 in to 1.5711 in)
Service limit	39.880 mm (1.5701 in)

CAMSHAFT BEARING JOURNAL (ENGINE FRONT)	
New	24.919 mm to 24.940 mm (.9811 in to .9819 in)
Service limit	24.890 mm (.9799 in)

CAMSHAFT BEARING INNER DIAMETER	
New	40.000 mm to 40.020 mm (1.5748 in to 1.5756 in)
Service limit	40.050 mm (1.5768 in)

CAMSHAFT BEARING INNER DIAMETER (ENGINE FRONT)	
New	25.000 mm to 25.013 mm (.9843 in to .9848 in)
Service limit	25.050 mm (.9862 in)

Replace parts that are not within specifications.

Installing the Camshaft

The installation is the reverse of the removal procedure. However, pay attention to the following details.

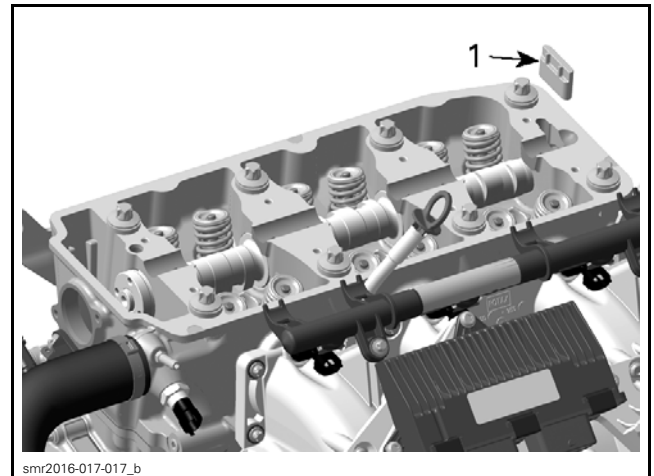
Lubricate the camshaft bearing journals.

CAMSHAFT BEARING JOURNALS

Service product

ISOFLEX GREASE
 TOPAS NB 52 (P/N 293
 550 021)

Install camshaft then turn and check if it moves freely. Place the camshaft lock in its slot.



1. Camshaft lock

For other parts, refer to the proper installation procedures in this subsection.

CYLINDER HEAD

Removing the Cylinder Head

Lock crankshaft, refer to *CYLINDER BLOCK* subsection.

Drain coolant, refer to *COOLING SYSTEM* subsection.

Remove blow-by valve from cylinder head. Refer to *LUBRICATION SYSTEM* subsection.

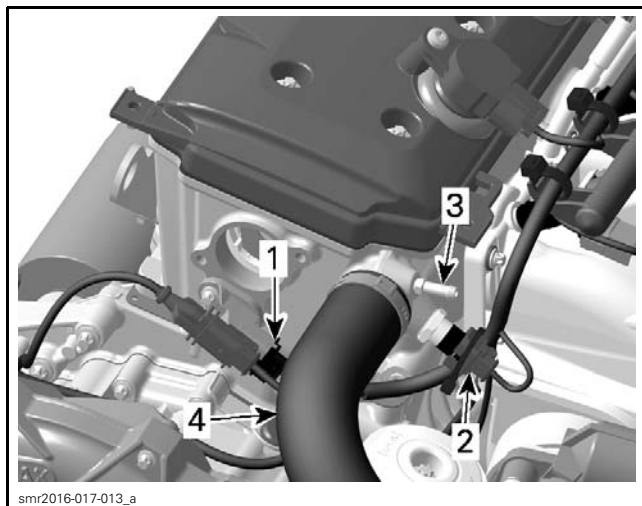
Unplug:

- Camshaft position sensors (CAPS)
- Coolant temperature sensor (CTS).

Disconnect:

- Bleeding hose
- Cylinder head outlet hose.

Subsection 09 (CYLINDER HEAD)



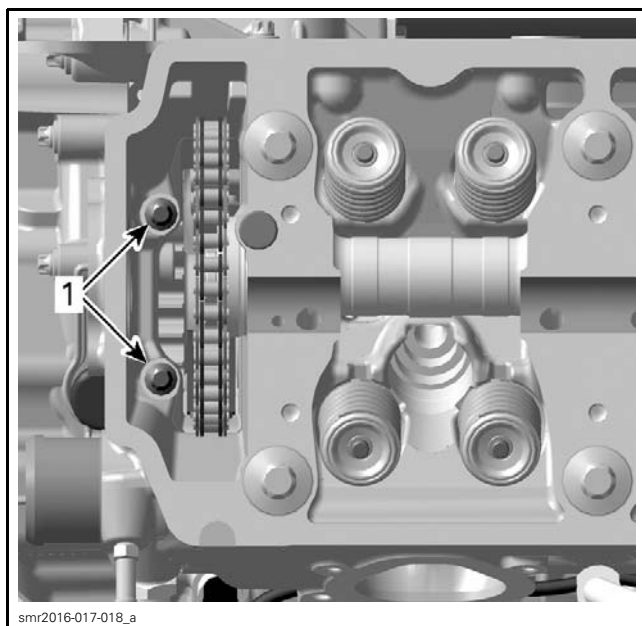
1. Camshaft position sensors (CAPS) connector
2. Coolant temperature sensor (CTS) connector
3. Bleeding nipple
4. Cylinder head outlet hose

Remove the intake manifold. Refer to *INTAKE MANIFOLD* subsection.

Remove the exhaust manifold. Refer to *EXHAUST SYSTEM* subsection.

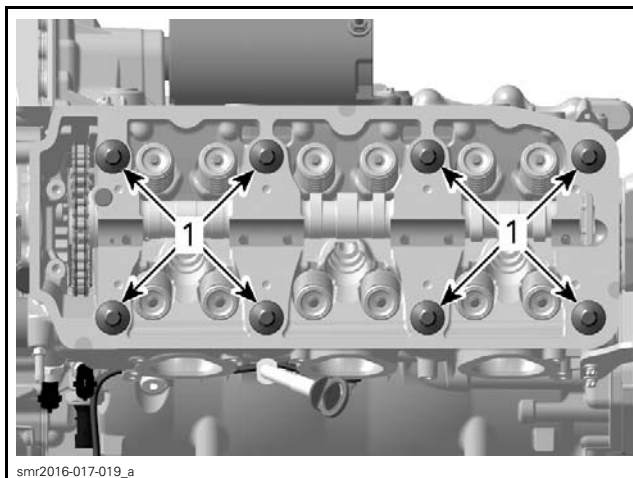
Remove the *CAMSHAFT TIMING GEAR*, see procedure in this subsection.

Remove the M6 cylinder head screws.



1. M6 cylinder head screws

Remove and discard the M11 cylinder head screws.



1. M11 cylinder head screws

Remove:

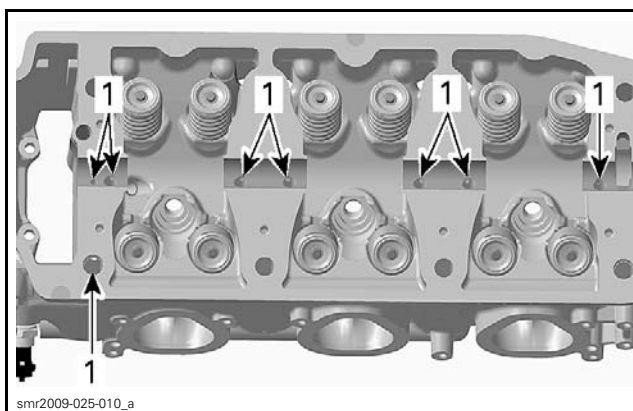
- Cylinder head
- Cylinder head gasket (discard it).

Cleaning the Cylinder Head

Remove carbon deposits from combustion chamber, exhaust port and piston top.

Clean cylinder head, especially cylinder head screw surface from oil spillage.

Blow out the oil orifices and check if they are not clogged.

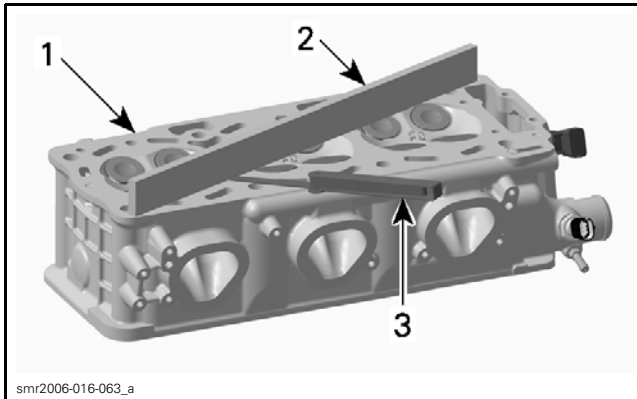


1. Oil orifices

Inspecting the Cylinder Head

Check for cracks between valve seats or other damages, if so, replace cylinder head.

Check cylinder head mating surface for flatness, using a straight edge.



1. Cylinder head
2. Flat bar
3. Feeler gauge

Check cylinder head warpage.

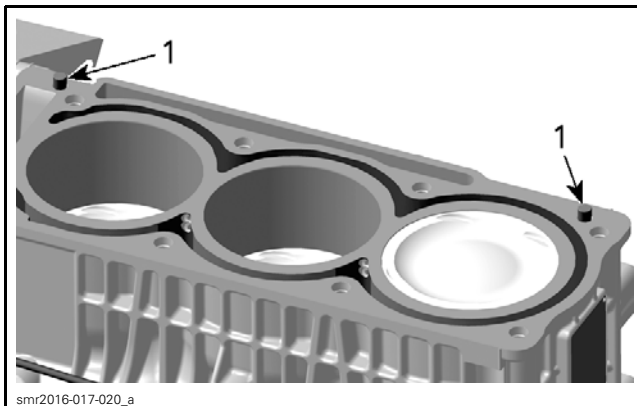
CYLINDER HEAD WARPAGE	
Maximum	0.100 mm (.004 in)

If warpage exceeds specification, replace cylinder head.

Installing the Cylinder Head

The installation is the reverse of the removal procedure. However, pay attention to the following details.

Ensure dowel pins are in place.



1. Dowel pins

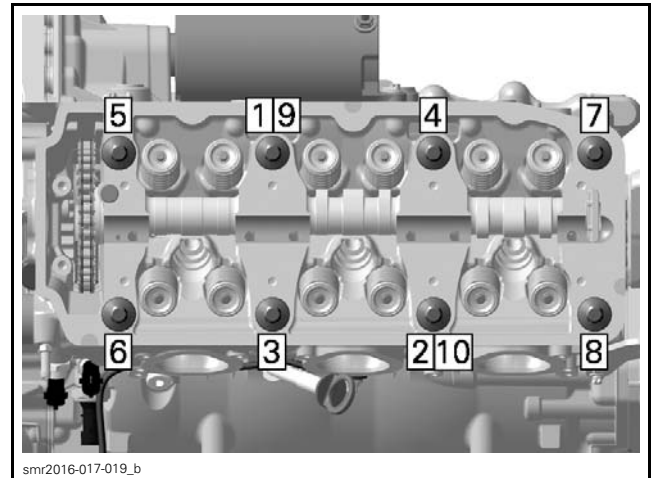
Install **NEW** cylinder head gasket.

NOTICE Each installation of the cylinder head requires a new cylinder head gasket. Using a gasket twice will cause engine damage.

Install **NEW** M11 cylinder head screws and tighten as per following procedure.

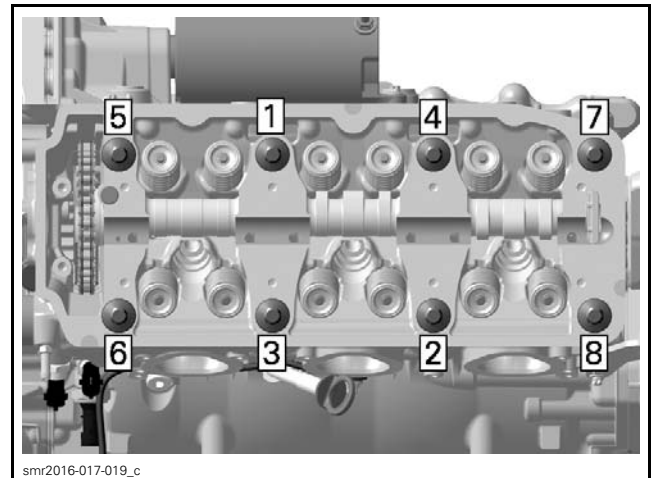
NOTICE This assembly uses stretch screws. Always use **NEW** screws and strictly adhere to the tightening procedure.

NOTE: Always perform a step on **ALL** M11 cylinder head screws before going to the next step.



TIGHTENING SEQUENCE - STEP A

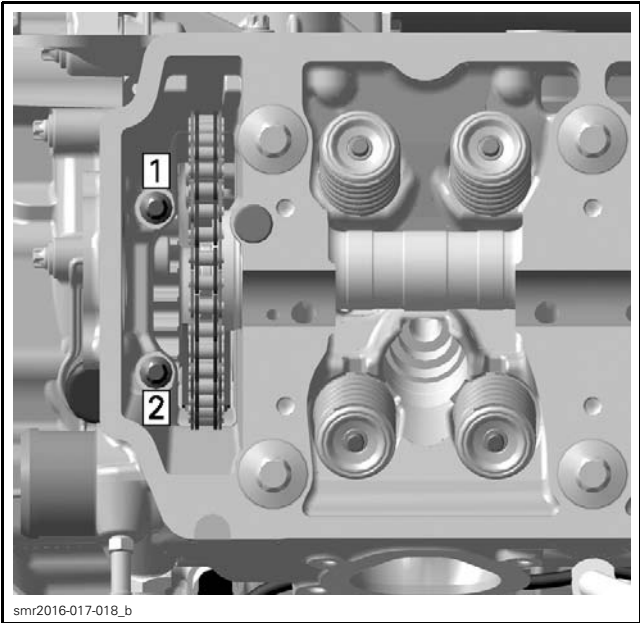
TIGHTENING PROCEDURE		
M11 cylinder head screws	Step A	40 N•m ± 3 N•m (30 lbf•ft ± 2 lbf•ft)



TIGHTENING SEQUENCE - STEP B AND C

TIGHTENING PROCEDURE		
M11 cylinder head screws	Step B	Additional 120° ± 5°
	Step C	Additional 90° ± 5°

Tighten M6 cylinder head screws to specification.



TIGHTENING SEQUENCE

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
M6 cylinder head screws	11 N•m ± 1 N•m (97 lbf•in ± 9 lbf•in)

Remove crankshaft and camshaft locking tools.
Install all removed parts.

VALVE SPRINGS

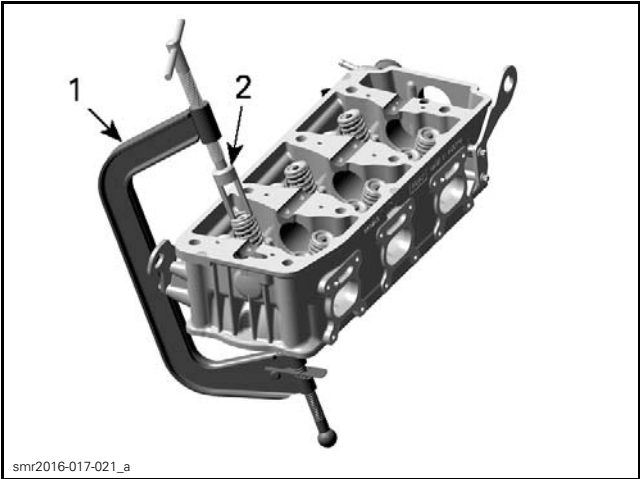
Removing the Valve Spring

See procedures in this subsection to remove:

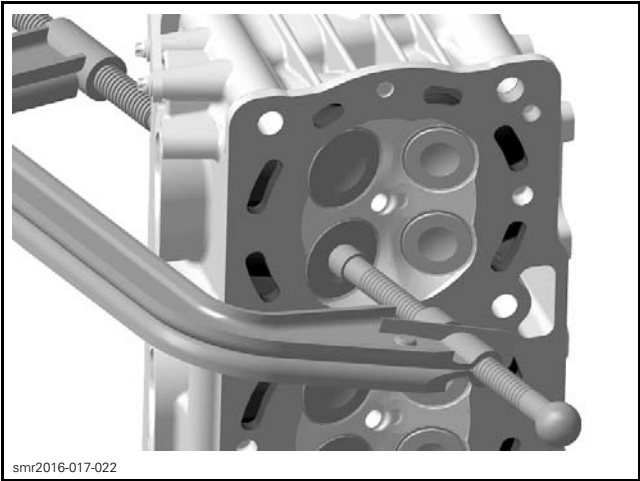
- *ROCKER ARM*
- *CYLINDER HEAD.*

Compress valve springs.

REQUIRED TOOL	
VALVE SPRING COMPRESSOR (P/N 529 035 724)	
VALVE SPRING COMPRESSOR CUP (P/N 529 036 073)	



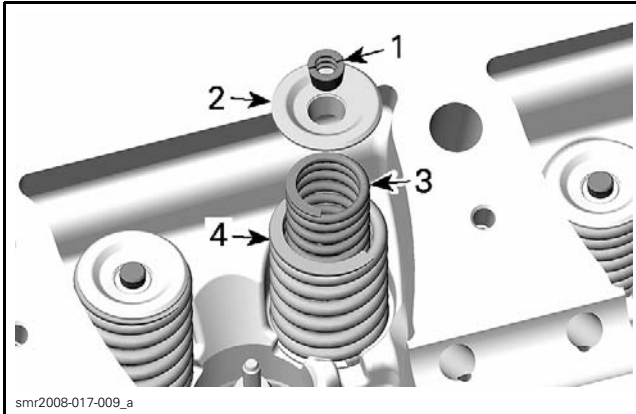
1. Valve spring compressor clamp
2. Valve spring compressor cup



LOCATE VALVE SPRING COMPRESSOR CLAMP IN CENTER OF THE VALVE

Remove valve cotters.
Withdraw valve spring compressor tools.
Remove:

- Valve spring retainer
- Outer valve springs
- Inner valve springs.



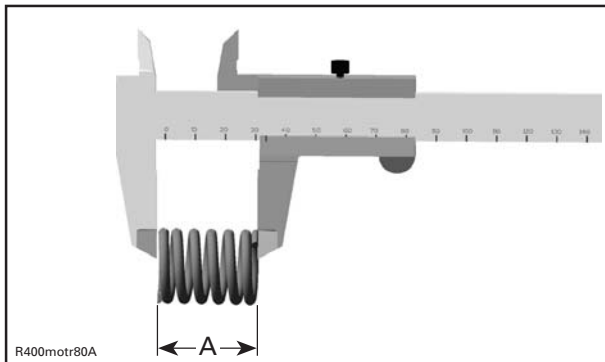
1. Valve cotter
2. Valve spring retainer
3. Inner valve spring
4. Outer valve spring

Inspecting the Valve Spring

Check valve springs for rust, corrosion or other visible damages. If so, replace faulty valve springs.

Check valve springs for free length and straightness.

Replace valve springs if not within specifications.



A. Valve spring length

OUTER VALVE SPRING FREE LENGTH	
New	45.45 mm (1.789 in)
Service limit	43.00 mm (1.693 in)

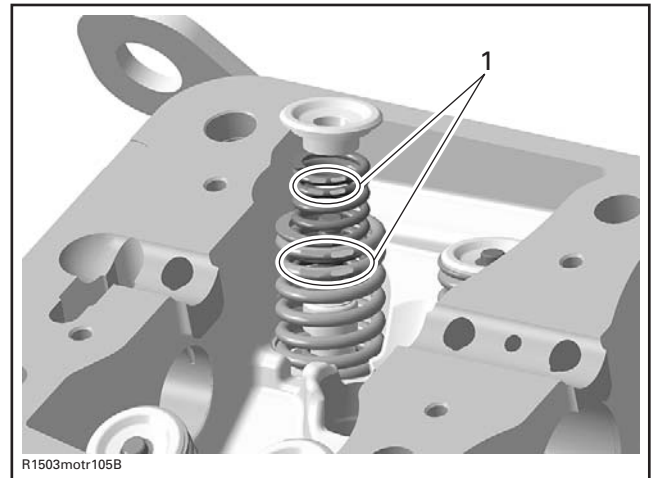
INNER VALVE SPRING FREE LENGTH	
New	41.02 mm (1.615 in)
Service limit	38.80 mm (1.528 in)

Installing the Valve Spring

The installation is the reverse of the removal procedure. However, pay attention to the following details.

Colored area of the valve spring must be placed on top.

NOTE: Valve cotters must be properly engaged in valve stem grooves.



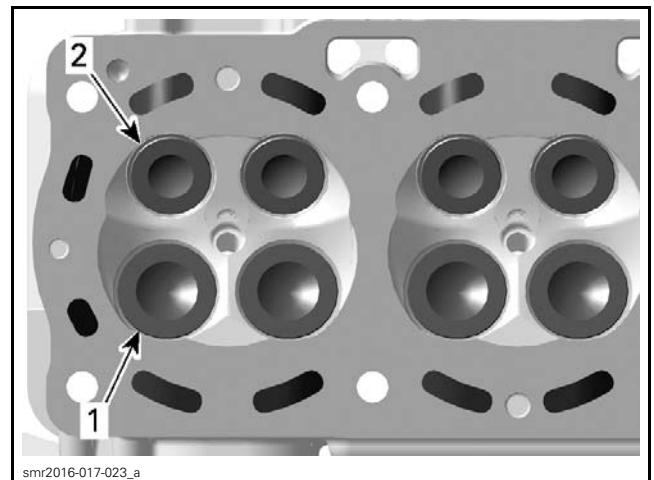
1. Position of the valve spring

VALVES

Removing the Valve

Remove valve spring.

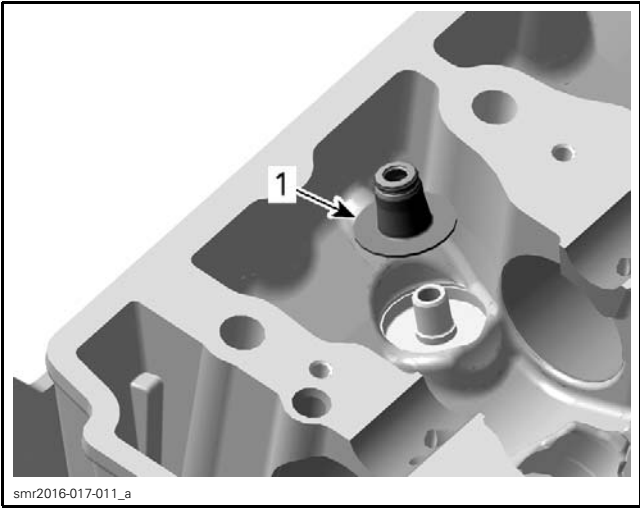
Push valve stem then pull valves out of valve guides.



1. Intake valve 38 mm
2. Exhaust valve 31 mm

Remove and discard valve stem seal.

REQUIRED TOOL
SNAP-ON VALVE STEM SEAL PLIERS (P/N YA8230)



1. Valve stem seal

Inspecting the Valve

Valve Stem Seal

Always install **NEW** seals whenever valves are removed.

Inspection of valve stem seals is not needed because **NEW** seals should always be installed whenever cylinder head is removed.

Valve

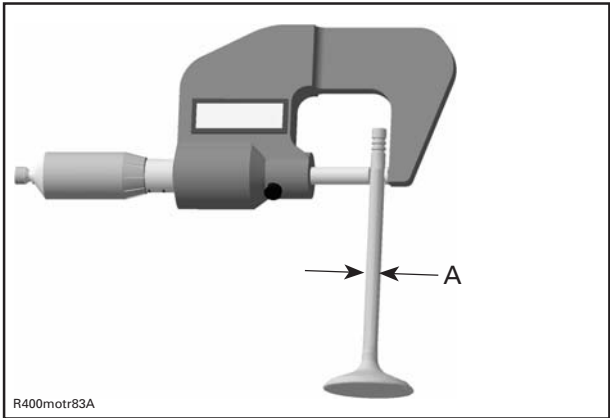
Inspect valve surface, check for abnormal stem wear and bending. If so, replace by a new one.

Valve Stem and Valve Guide Clearance

Measure valve stem and valve guide in three places, using a micrometer and a small bore gauge.

NOTE: Clean valve guide to remove carbon deposits before measuring.

Change valve if valve stem is out of specification or has other damages such as wear or friction surface.



A. Valve stem diameter

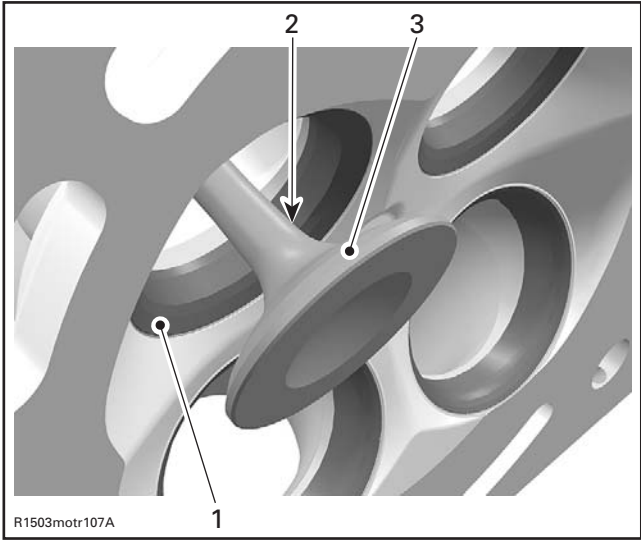
VALVE STEM DIAMETER - INTAKE VALVE	
New	5.961 mm to 5.975 mm (.2347 in to .2352 in)
Service limit	5.930 mm (.2335 in)

VALVE STEM DIAMETER - EXHAUST VALVE	
New	5.946 mm to 5.960 mm (.2341 in to .2346 in)
Service limit	5.930 mm (.2335 in)

Replace valve guide if it is out of specification or has other damages such as wear or friction surface. Refer to *VALVE GUIDE* in this subsection.

VALVE GUIDE INNER DIAMETER (INTAKE AND EXHAUST VALVE)	
New	5.994 mm to 6.018 mm (.236 in to .2369 in)
Service limit	6.060 mm (.2386 in)

Valve Face and Seat



- 1. Valve seat
- 2. Exhaust valve contaminated area
- 3. Valve face (contact surface to valve seat)

Check valve face and seat for burning or pittings and replace valve or cylinder head if there are signs of damage.

Ensure to seat valves properly. Apply some lapping compound on valve face and work valve on its seat with a lapping tool.

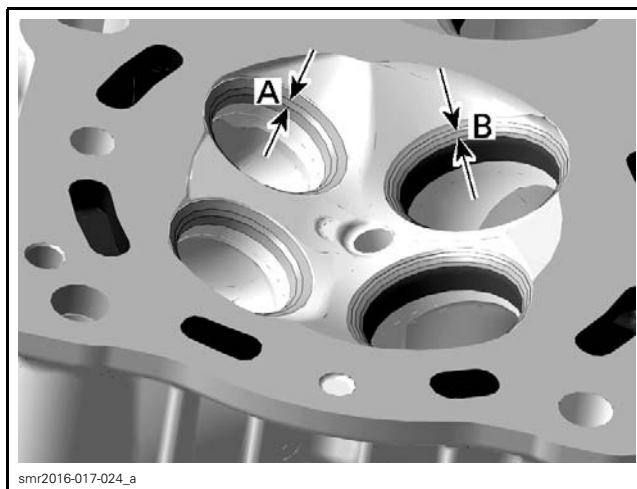
NOTE: The location of contact area should be in center of valve seat.

Measure valve seat width, using a caliper.

VALVE SEAT CONTACT WIDTH - INTAKE VALVE	
New	1.10 mm to 1.30 mm (.043 in to .051 in)
Service limit	1.60 mm (.063 in)

VALVE SEAT CONTACT WIDTH - EXHAUST VALVE	
New	1.25 mm to 1.55 mm (.049 in to .061 in)
Service limit	1.80 mm (.071 in)

If valve seat contact width is too wide or has dark spots, replace the cylinder head.

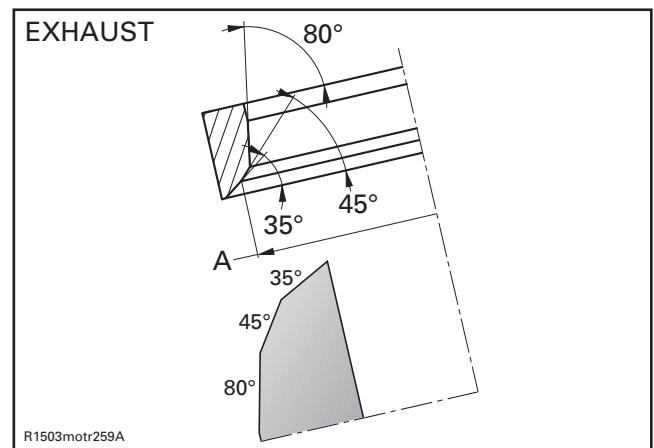


A. Valve seat contact width - Exhaust valve
B. Valve seat contact width - Intake valve

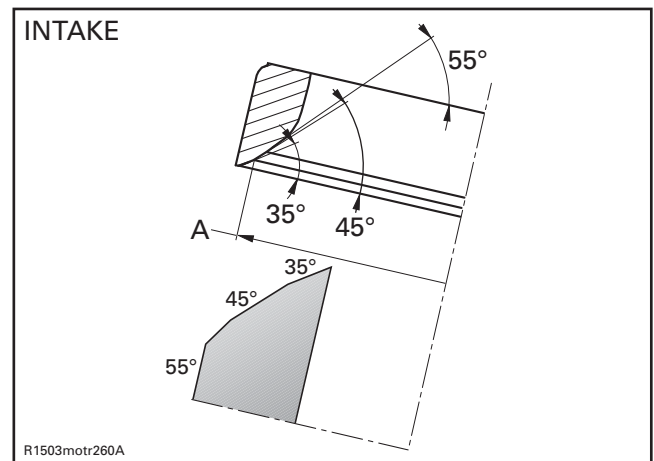
Valve Seat Grinding

NOTE: The valve seats may be reground with a valve seat grinder which centers on the valve guide.

1. Grind the valve seat at 45°. Remove no more material than absolutely necessary to clean the seat up.
2. Using a 35° stone, narrow the valve seat until the appropriate outer diameter is obtained.



A. Valve seat outer diameter EXHAUST



A. Valve seat outer diameter INTAKE

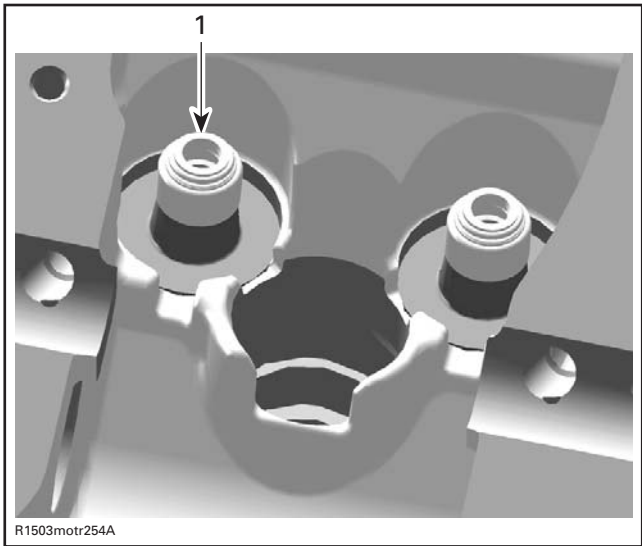
VALVE SEAT OUTER DIAMETER	
INTAKE	37.35 mm (1.4705 in)
EXHAUST	30.30 mm (1.1929 in)

3. Using a 55° stone for the intake and an 80° stone for the exhaust valve, reduce the valve seat contact width to the appropriate value mentioned above.
4. Finally, coat the valve seating surface with a fine paste of valve grinding compound using a manual valve grinding mandrel. Lightly grind the valves until a smooth, even, uniform sealing surface of the appropriate inside and outside diameter is obtained on both the valve and the seat. Use only a hand held valve grinding mandrel with a suction cup, rotating the valve back and forth through about 45°, and then advancing the valve 45° before repeating this operation.

Installing the Valve

The installation is the reverse of the removal procedure. however, pay attention to the following details.

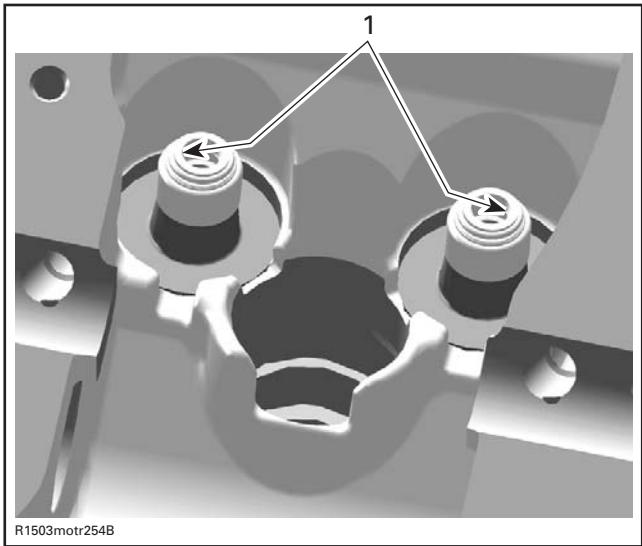
Install **NEW** valve stem seal.



1. Valve stem seal

Apply engine oil on valve stem and install valve.

NOTICE Be careful when valve stem is passed through sealing lips of valve stem seal.



1. Sealing lips of valve stem seal

To ease installation of cotters, apply oil or grease on them so that they remain in place while releasing the spring.

After springs are installed, ensure valve springs and valve spring retainer are properly locked by tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

NOTICE An improperly locked valve spring will cause engine damage.

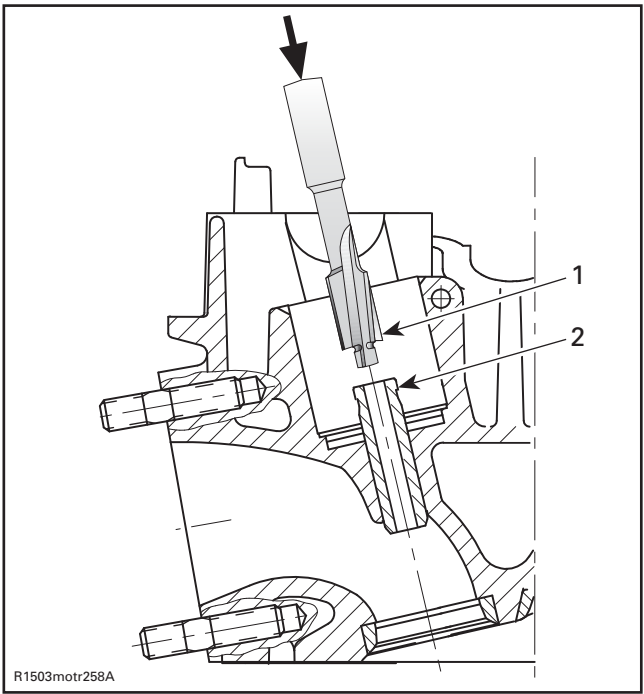
VALVE GUIDE

Valve Guide Replacement

NOTICE Do not heat cylinder head for this procedure.

NOTICE The sharp edge near the top of the valve guide must be machined away. Otherwise it will foul the valve guide hole in the cylinder head and destroy the cylinder head, as the valve guide is removed.

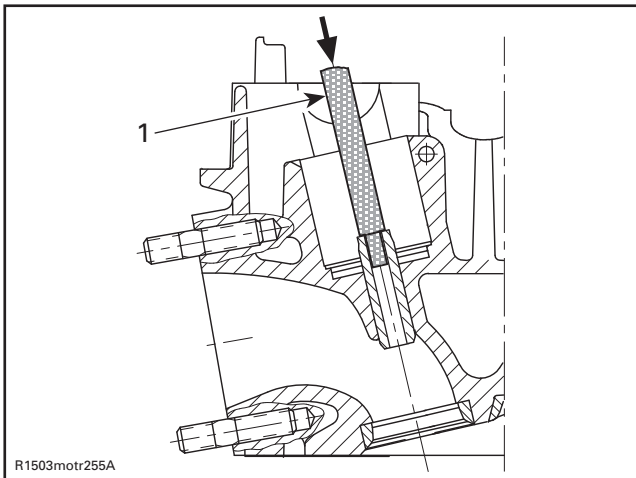
Use a special reamer as far as the top of the notch.



TYPICAL
1. Special reamer
2. Notch

Chase valve guide out of the cylinder head towards combustion chamber.

REQUIRED TOOL	
VALVE GUIDE REMOVER (6 MM) (P/N 529 036 086)	



TYPICAL
1. Punch

Check valve guide bore for abraded material. The inlet and exhaust valve guides have the same length and are interchangeable.

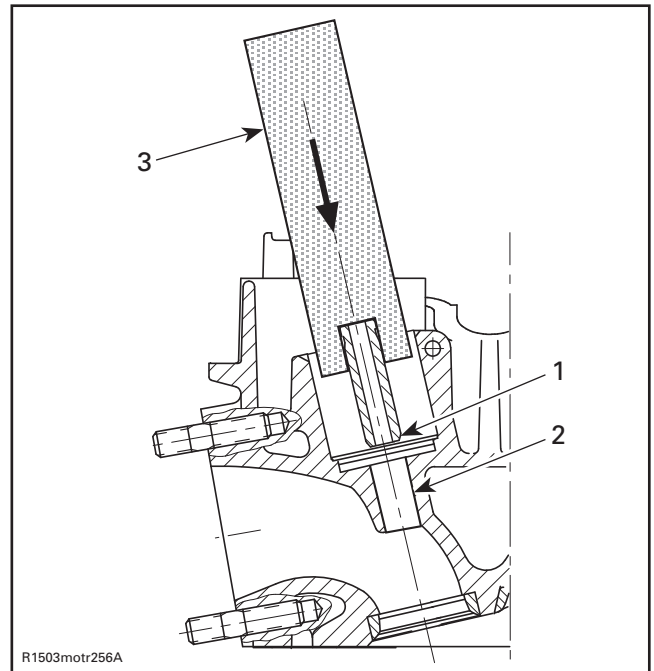
NOTE: If valve guide has caused scoring during extraction, replace the cylinder head.

Grease the bore in cylinder head and the leading end of valve guide with MOLYKOTE G-N (P/N 420 297 433).

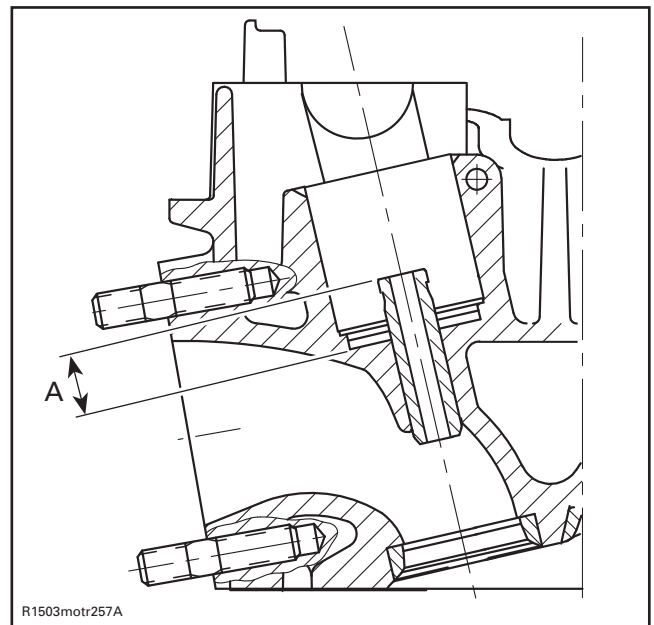
Press the valve guide into the **COLD** cylinder head as shown.

REQUIRED TOOL

VALVE GUIDE PUSHER (6 MM)
(P/N 529 036 087)



TYPICAL
1. Valve guide leading end
2. Cylinder head bore
3. Jig



TYPICAL
A. Protrusion

VALVE GUIDE PROTRUSION (MEASUREMENT "A")

12.4 mm to 12.8 mm (.488 in to .504 in)

NOTE: After installing new guides, they must be reamed with a standard 6 mm reamer tool. These are available from various tool suppliers.

Subsection 09 (CYLINDER HEAD)

Clean cylinder head carefully. Check that the valve seat is concentric with the new guide axis (check contact surface with engineer's blue).