

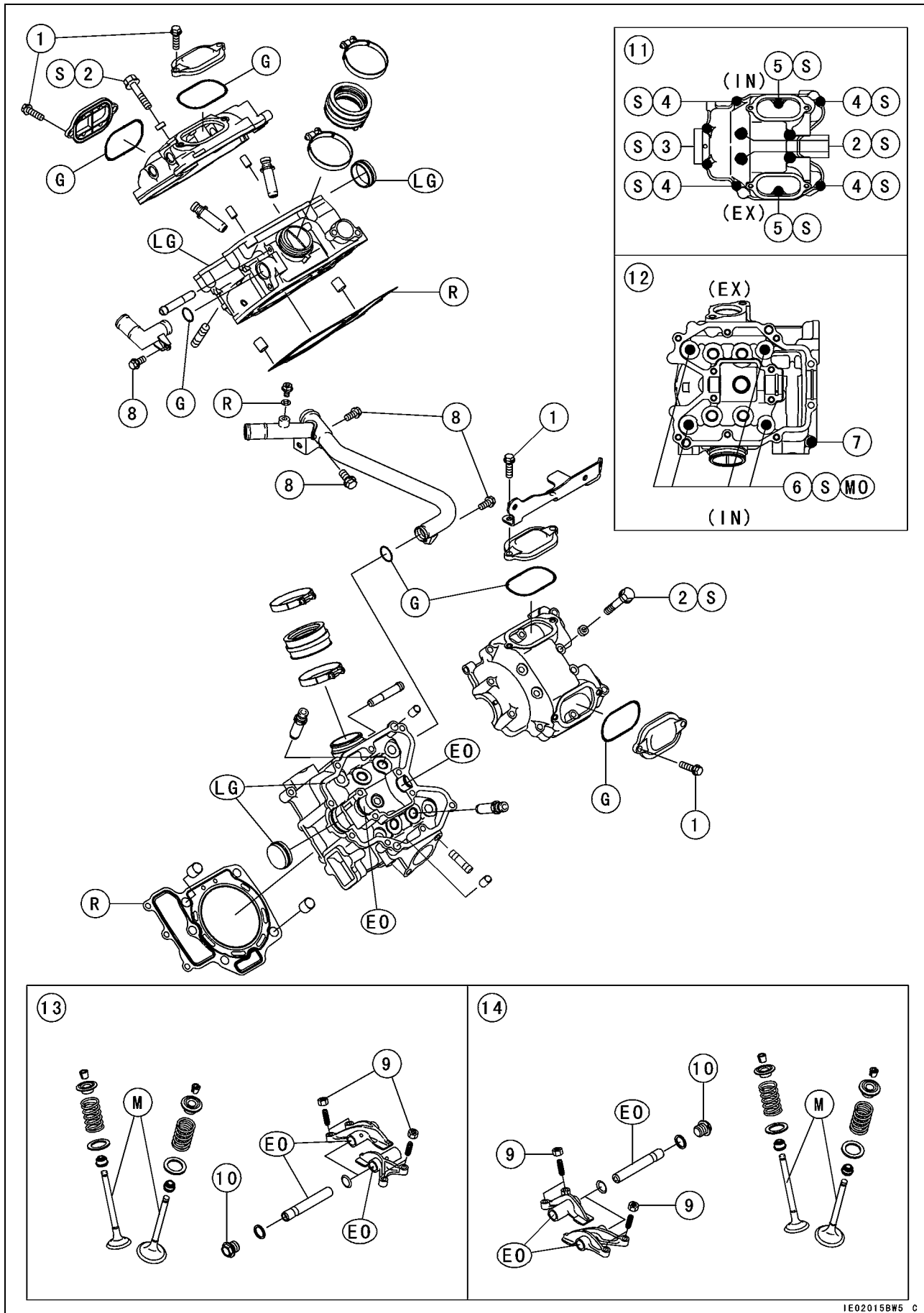
Engine Top End

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5-2 ENGINE TOP END

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Valve Adjusting Cap Bolts	8.8	0.90	78 in·lb	
2	Rocker Case Bolts, L= 55 mm (2.2 in.)	8.8	0.90	78 in·lb	S
3	Rocker Case Bolts, L= 130 mm (5.1 in.)	9.8	1.0	87 in·lb	S
4	Rocker Case Bolts, L= 30 mm (1.2 in.)	9.8	1.0	87 in·lb	S
5	Rocker Case Bolts, L= 25 mm (1.0 in.)	9.8	1.0	87 in·lb	S
6	Cylinder Head Bolts (M10), first torque	25	2.5	18	S, MO
6	Cylinder Head Bolts (M10), final torque	49	5.0	36	S
7	Cylinder Head Bolts (M6)	9.8	1.0	87 in·lb	
8	Water Pipe Mounting Bolts	8.8	0.90	78 in·lb	
9	Valve Adjusting Screw Locknuts	12	1.2	104 in·lb	
10	Rocker Shaft Bolts	22	2.2	16	

11. Rocker Case

12. Cylinder Head

13. Front

14. Rear

EO: Apply engine oil.

G: Apply grease.

LG: Apply liquid gasket (Kawasaki Bond: 92104-1063 or Three Bond 1216).

M: Apply molybdenum disulfide grease.

MO: Apply molybdenum disulfide oil solution

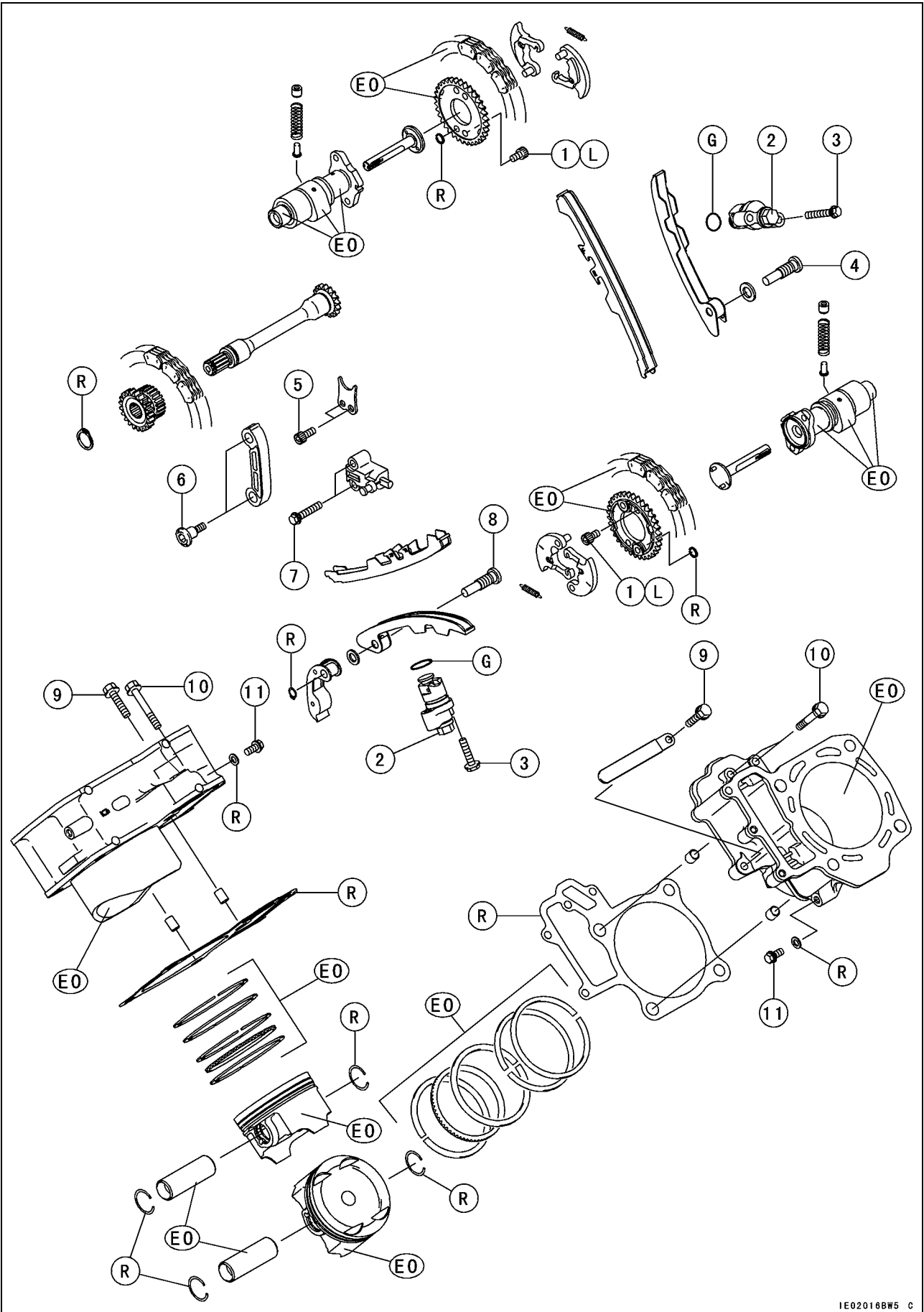
(mixture of the engine oil and molybdenum disulfide grease in a weight ratio 10:1).

R: Replacement Parts

S: Follow the specific tightening sequence.

5-4 ENGINE TOP END

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Camshaft Sprocket Bolts	12	1.2	104 in·lb	L
2	Chain Tensioner Cap Bolt	22	2.2	16	
3	Chain Tensioner Mounting Bolts	8.8	0.90	78 in·lb	
4	Front Cylinder Camshaft Chain Guide Bolt	20	2.0	14	
5	Position Plate Bolts	8.8	0.90	78 in·lb	
6	Intermediate Shaft Chain Guide Bolts	8.8	0.90	78 in·lb	
7	Intermediate Shaft Chain Tensioner Bolts	8.8	0.90	78 in·lb	
8	Rear Cylinder Camshaft Chain Guide Bolt	20	2.0	14	
9	Cylinder Bolts, L= 30 mm (1.2 in.)	9.8	1.0	87 in·lb	
10	Cylinder Bolts, L= 40 mm (1.6 in.)	9.8	1.0	87 in·lb	
11	Coolant Drain Plug (Cylinder)	8.8	0.90	78 in·lb	

EO: Apply engine oil.

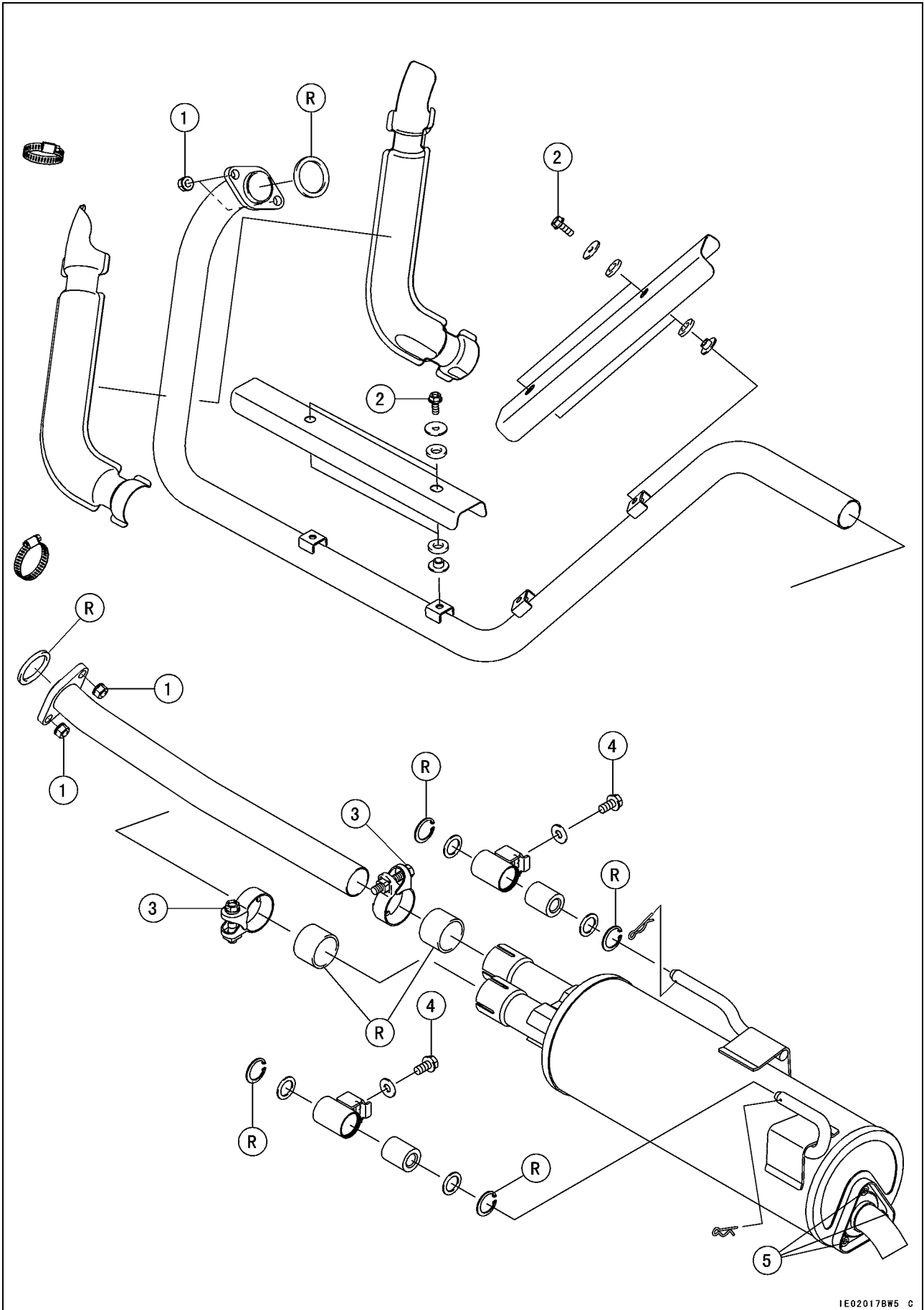
G: Apply grease for oil seal and O-ring.

L: Apply a non-permanent locking agent.

R: Replacement Parts

5-6 ENGINE TOP END

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Exhaust Pipe Nuts	17	1.7	12	
2	Exhaust Pipe Cover Bolts	8.8	0.90	78 in·lb	
3	Muffler Clamp Bolts	15	1.5	11	
4	Muffler Mounting Bolts	28	2.8	21	
5	Spark Arrester Mounting Bolts	8.8	0.90	78 in·lb	

R: Replacement Parts

5-8 ENGINE TOP END

Specifications

Item	Standard	Service Limit
Rocker Case		
Rocker Arm Inside Diameter	12.000 ~ 12.018 mm (0.4724 ~ 0.4731 in.)	12.05 mm (0.474 in.)
Rocker Shaft Diameter	11.983 ~ 11.994 mm (0.4718 ~ 0.4722 in.)	11.96 mm (0.471 in.)
Camshafts		
Cam Height:		
Exhaust	35.363 ~ 35.477 mm (1.3922 ~ 1.3967 in.)	35.26 mm (1.388 in.)
Inlet	35.622 ~ 35.736 mm (1.4024 ~ 1.4069 in.)	35.52 mm (1.398 in.)
Camshaft Bearing Clearance:		
$\phi 18$	0.016 ~ 0.052 mm (0.0006 ~ 0.0020 in.)	0.14 mm (0.0055 in.)
$\phi 22$	0.020 ~ 0.062 mm (0.0008 ~ 0.0024 in.)	0.15 mm (0.0059 in.)
Camshaft Journal Diameter:		
$\phi 18$	17.966 ~ 17.984 mm (0.7073 ~ 0.7080 in.)	17.94 mm (0.706 in.)
$\phi 22$	21.959 ~ 21.980 mm (0.8645 ~ 0.8654 in.)	21.93 mm (0.863 in.)
Camshaft Bearing Inside Diameter:		
$\phi 18$	18.000 ~ 18.018 mm (0.7087 ~ 0.7094 in.)	18.08 mm (0.712 in.)
$\phi 22$	22.000 ~ 22.021 mm (0.8661 ~ 0.8670 in.)	22.08 mm (0.869 in.)
Camshaft runout	TIR 0.02 mm (0.0008 in.) or less	TIR 0.1 mm (0.0039 in.)
KACR (Kawasaki Automatic Compression Release):		
KACR Operating Engine Speed	760 \pm 30 r/min (rpm)	— — —
Cylinder Head		
Cylinder Compression (Usable Range)		
Electric Starter	251 ~ 456 kPa (2.56 ~ 4.65 kgf/cm ² , 36 ~ 66 psi) @380 r/min (rpm)	— — —
Cylinder head warp	— — —	0.05 mm (0.002 in.)
Valve		
Valve Clearance:		
Exhaust	0.20 ~ 0.25 mm (0.0079 ~ 0.0098 in.)	— — —
Inlet	0.10 ~ 0.15 mm (0.0039 ~ 0.0059 in.)	— — —
Valve Head Thickness:		
Exhaust	0.8 mm (0.031 in.)	0.5 mm (0.020 in.)
Inlet	0.5 mm (0.020 in.)	0.3 mm (0.012 in.)
Valve Stem Bend	TIR 0.01 mm (0.0004 in.) or less	TIR 0.05 mm (0.002 in.)

Specifications

Item	Standard	Service Limit
Valve Stem Diameter:		
Exhaust	4.955 ~ 4.970 mm (0.1951 ~ 0.1957 in.)	4.94 mm (0.1945 in.)
Inlet	4.975 ~ 4.990 mm (0.1959 ~ 0.1965 in.)	4.96 mm (0.1953 in.)
Valve Guide Inside Diameter:		
Exhaust	5.000 ~ 5.012 mm (0.1969 ~ 0.1973 in.)	5.08 mm (0.20 in.)
Inlet	5.000 ~ 5.012 mm (0.1969 ~ 0.1973 in.)	5.08 mm (0.20 in.)
Valve/Valve Guide Clearance (Wobble Method):		
Exhaust	0.09 ~ 0.17 mm (0.0035 ~ 0.0067 in.)	0.37 mm (0.0146 in.)
Inlet	0.03 ~ 0.11 mm (0.0012 ~ 0.0043 in.)	0.31 mm (0.0122 in.)
Valve Seat Cutting Angle	45°, 32°, 60°	— — —
Valve Seating Surface:		
Outside Diameter:		
Exhaust	25.2 ~ 25.4 mm (0.992 ~ 1.000 in.)	— — —
Inlet	29.4 ~ 29.6 mm (1.157 ~ 1.165 in.)	— — —
Width:		
Exhaust	0.5 ~ 1.0 mm (0.02 ~ 0.04 in.)	— — —
Inlet	0.5 ~ 1.0 mm (0.02 ~ 0.04 in.)	— — —
Valve Spring Free Length:		
Exhaust	41.3 mm (1.626 in.)	39.5 mm (1.555 in.)
Inlet	41.3 mm (1.626 in.)	39.5 mm (1.555 in.)
Cylinder, Piston		
Cylinder Inside Diameter	84.994 ~ 85.006 mm (3.3462 ~ 3.3467 in.)	85.09 mm (3.3500 in.)
Piston Diameter	84.964 ~ 84.979 mm (3.3450 ~ 3.3456 in.)	84.81 mm (3.3390 in.)
Piston/Cylinder Clearance	0.015 ~ 0.042 mm (0.0006 ~ 0.0017 in.)	— — —
Piston Ring/Groove Clearance:		
Top	0.04 ~ 0.08 mm (0.0016 ~ 0.0031 in.)	0.18 mm (0.0071 in.)
Second	0.03 ~ 0.07 mm (0.0012 ~ 0.0028 in.)	0.17 mm (0.0067 in.)

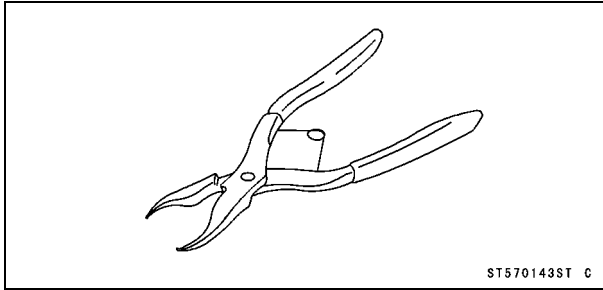
5-10 ENGINE TOP END

Specifications

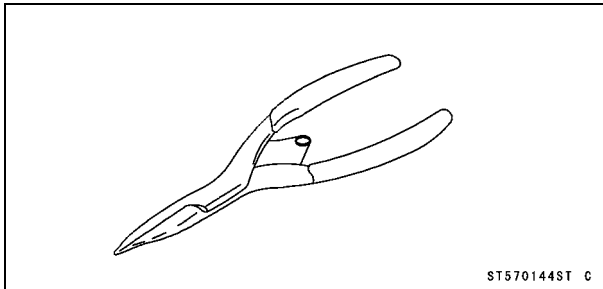
Item	Standard	Service Limit
Piston Ring Groove Width:		
Top	1.03 ~ 1.05 mm (0.0406 ~ 0.0413 in.)	1.13 mm (0.0445 in.)
Second	1.02 ~ 1.04 mm (0.0402 ~ 0.0409 in.)	1.12 mm (0.0441 in.)
Piston Ring Thickness:		
Top	0.97 ~ 0.99 mm (0.0382 ~ 0.0390 in.)	0.90 mm (0.0354 in.)
Second	0.97 ~ 0.99 mm (0.0382 ~ 0.0390 in.)	0.90 mm (0.0354 in.)
Piston Ring End Gap:		
Top	0.20 ~ 0.30 mm (0.0079 ~ 0.0118 in.)	0.60 mm (0.0236 in.)
Second	0.30 ~ 0.45 mm (0.0118 ~ 0.0177 in.)	0.75 mm (0.0295 in.)
Oil	0.20 ~ 0.70 mm (0.0079 ~ 0.0276 in.)	1.00 mm (0.0394 in.)

Special Tools and Sealant

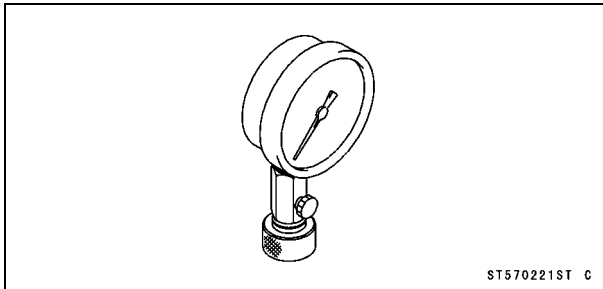
Inside Circlip Pliers:
57001-143



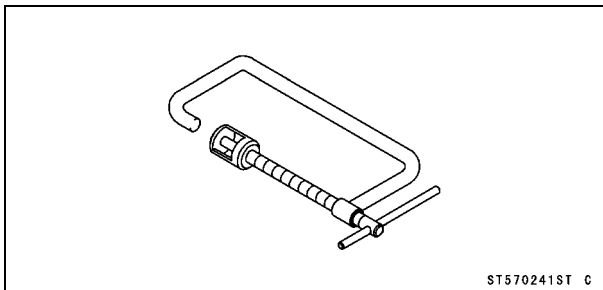
Outside Circlip Pliers:
57001-144



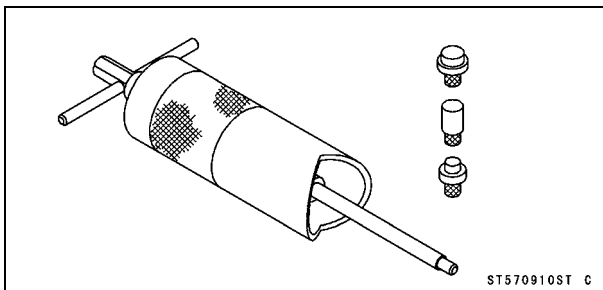
Compression Gauge, 20 kgf/cm²:
57001-221



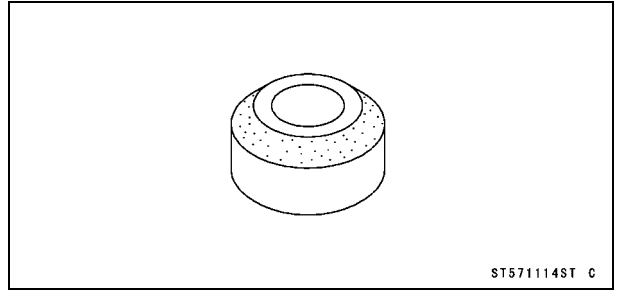
Valve Spring Compressor Assembly:
57001-241



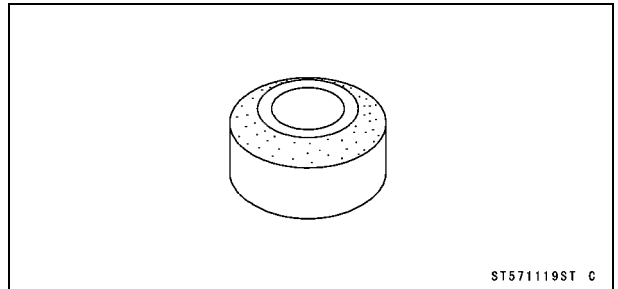
Piston Pin Puller Assembly:
57001-910



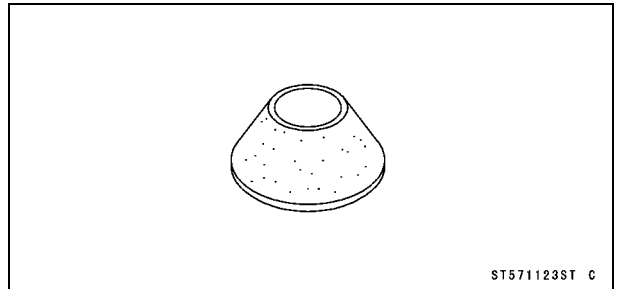
Valve Seat Cutter, 45° - $\phi 27.5$:
57001-1114



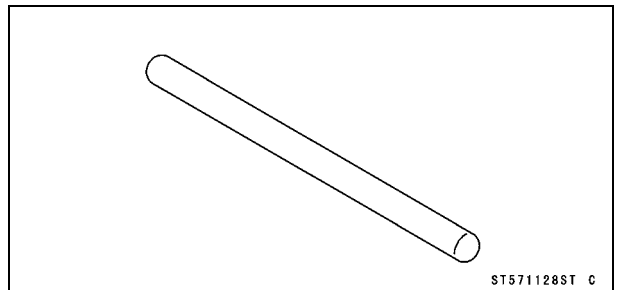
Valve Seat Cutter, 32° - $\phi 28$:
57001-1119



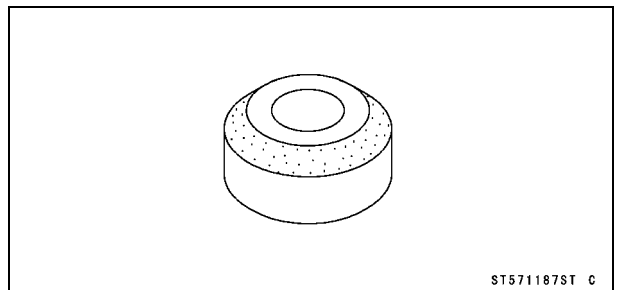
Valve Seat Cutter, 60° - $\phi 30$:
57001-1123



Valve Seat Cutter Holder Bar:
57001-1128



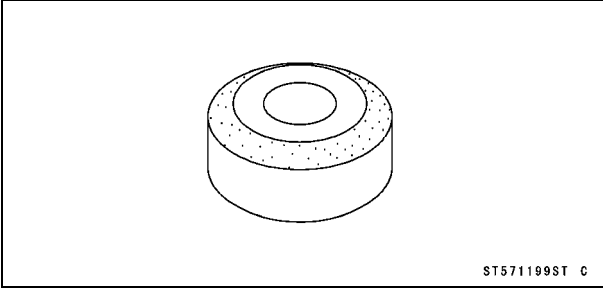
Valve Seat Cutter, 45° - $\phi 30$:
57001-1187



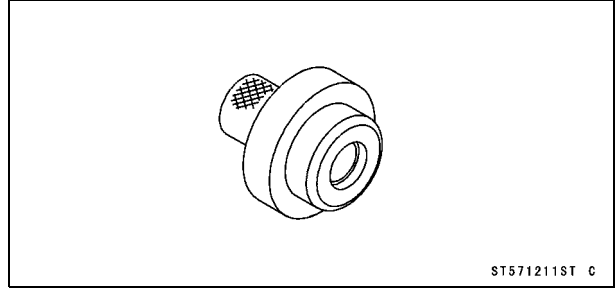
5-12 ENGINE TOP END

Special Tools and Sealant

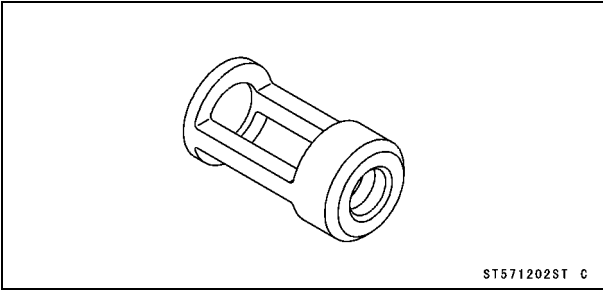
Valve Seat Cutter, 32° - ϕ 33:
57001-1199



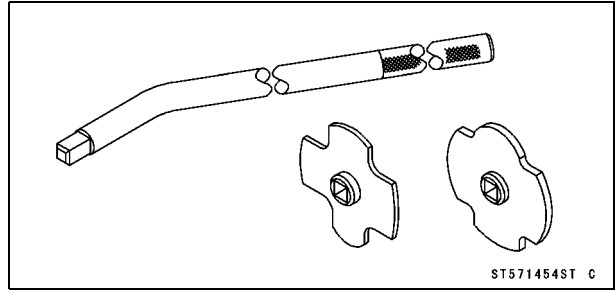
Piston Pin Puller Adapter, ϕ 14:
57001-1211



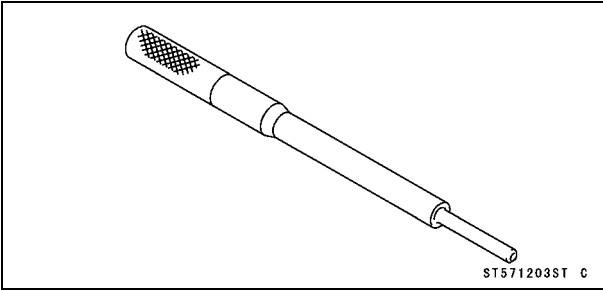
Valve Spring Compressor Adapter, ϕ 22:
57001-1202



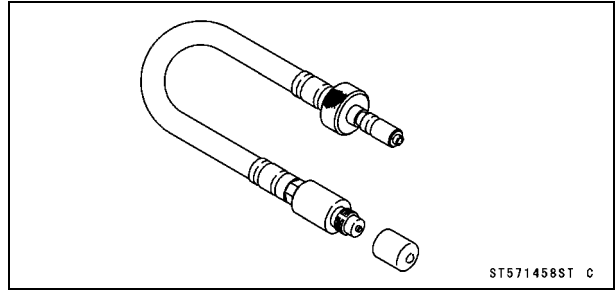
Filler Cap Driver:
57001-1454



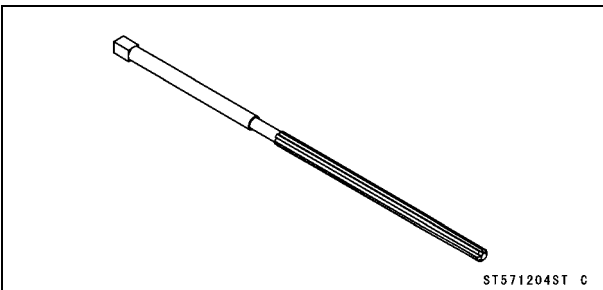
Valve Guide Arbor, ϕ 5:
57001-1203



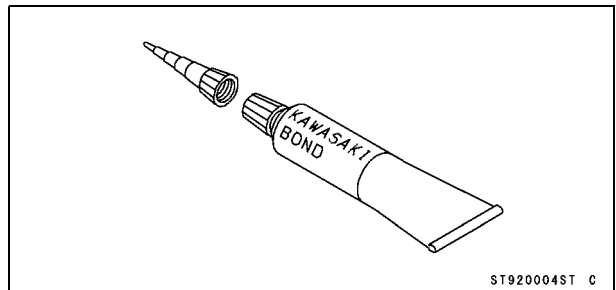
Compression Gauge Adapter, M10 × 1.0:
57001-1458



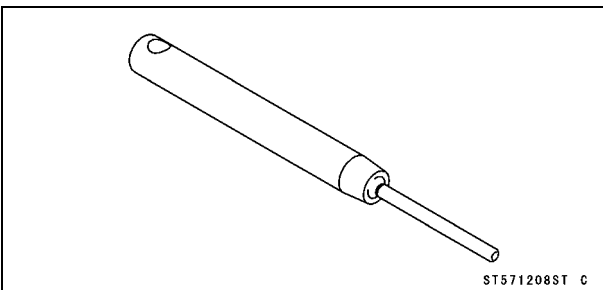
Valve Guide Reamer, ϕ 5:
57001-1204



Kawasaki Bond (Silicone Sealant):
92104-1063



Valve Seat Cutter Holder, ϕ 5:
57001-1208



Camshaft Chain Tensioner

Camshaft Chain Tensioner Removal

CAUTION

This is a non-return type cam chain tensioner. The push rod does not return to its original position once it moves out to take up cam chain slack. Observe all the rules listed below:

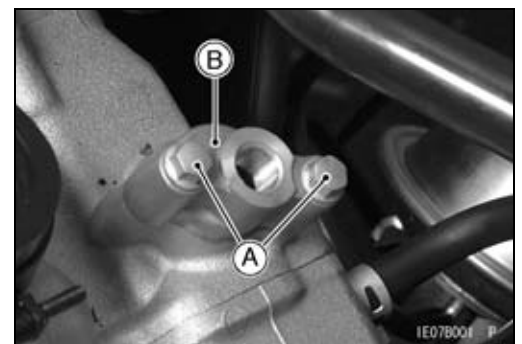
When removing the tensioner, do not take out the mounting bolts only partway. Retightening the mounting bolts from this position could damage the tensioner and the camshaft chain. Once the bolts are loosened, the tensioner must be removed and reset as described in "Camshaft Chain Tensioner Installation".

Do not turn over the crankshaft while the tensioner is removed. This could upset the cam chain timing, and damage the valves.

- Remove:
 - Engine Upper Cover (see Engine Upper Cover Removal in the Frame chapter)
 - Cap Bolt [A] and Washer
 - Pin and Spring

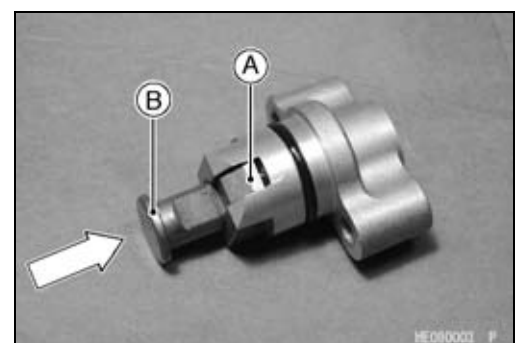


- Remove:
 - Tensioner Mounting Bolts [A]
 - Camshaft Chain Tensioner [B]



Camshaft Chain Tensioner Installation

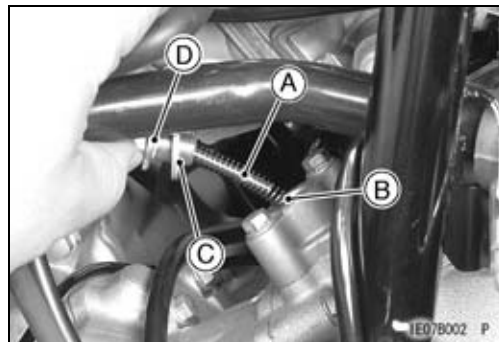
- Push the stopper [A] to release the ratchet and push the push rod [B] into the tensioner body.



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Camshaft Chain Tensioner

- Tighten:
Torque - Chain Tensioner Mounting Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)
- Install:
Pin [A] and Spring [B]
Washer [C] and Chain Tensioner Cap Bolt [D]
- Tighten:
Torque - Chain Tensioner Cap Bolt: 22 N·m (2.2 kgf·m, 16 ft·lb)

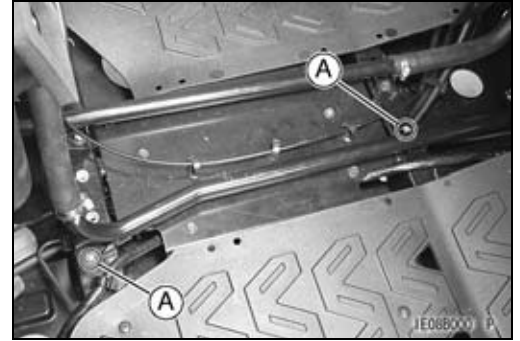


Rocker Case

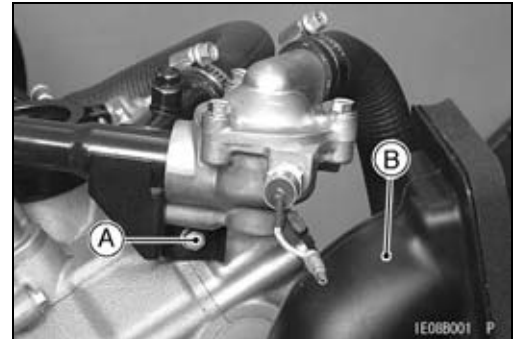
Rocker Case Removal

Front Rocker Case

- Remove:
 - Center Bracket (see Center Bracket Removal in the Frame chapter)
 - Right Water Pipe Bolts [A]



- Remove:
 - Water Pipe Bolt [A]
 - Air Inlet Duct [B]



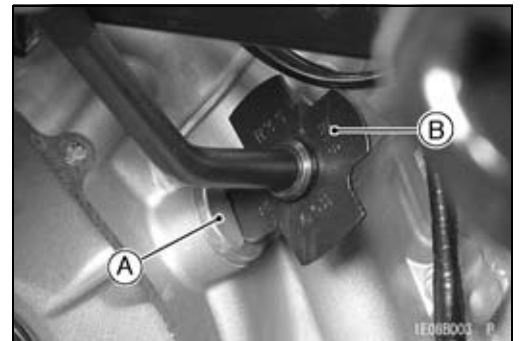
- Remove:
 - Left Cover (see Left Cover Removal in the Frame chapter)
 - Bolts [A] and Engine Left Cover [B]



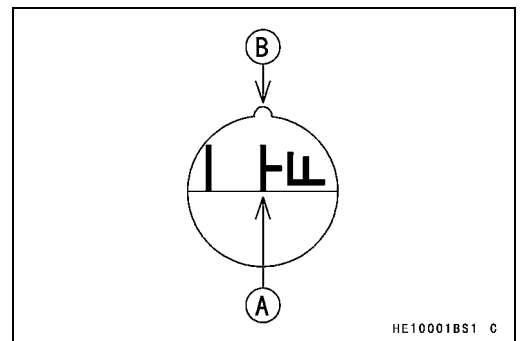
- Remove:
 - Timing Inspection Plug [A]

Special Tool - Filler Cap Driver [B]: 57001-1454

- Remove:
 - Front Camshaft Chain Tensioner (see Camshaft Chain Tensioner Removal)
 - Valve Adjusting Caps



- Using a wrench on the alternator bolt, turn the crankshaft counterclockwise until "T-F" mark [A] is aligned with the notch [B] in the inspection window, and the cam lobes are pointing away from the rocker arms: the end of the compression stroke.

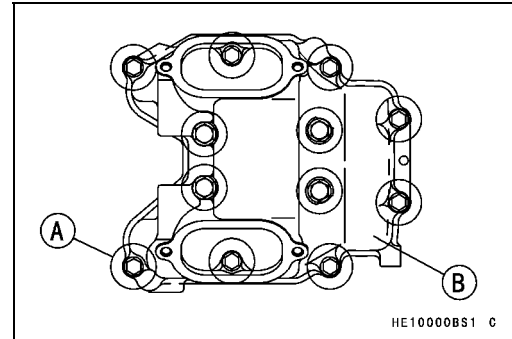


CAUTION
<p>Be sure to position the crankshaft at TDC of the end of the compression stroke when removing or installing the rocker case. The rocker arms could bend the valves.</p>

5-16 ENGINE TOP END

Rocker Case

- Remove:
 - Rocker Case Bolts [A]
- Lift the rocker case to clear of the dowel pins in the cylinder head and remove the front rocker case [B].



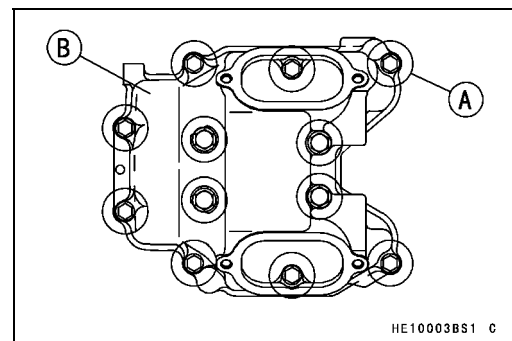
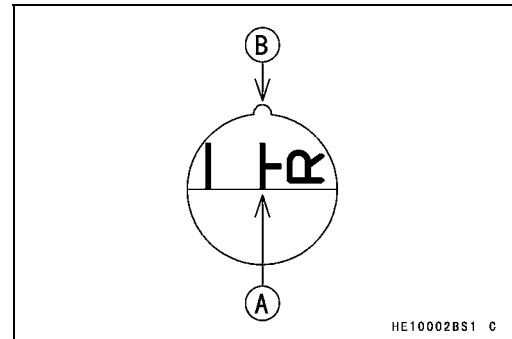
Rear Rocker Case

- Remove:
 - Front Rocker Case
- Using a wrench on the alternator bolt, turn the crankshaft **counterclockwise** (270°) until "T-R" mark [A] is aligned with the notch [B] in the inspection window, and the cam lobes are pointing away from the rocker arms: the end of the compression stroke.

CAUTION

Be sure to position the crankshaft at TDC of the end of the compression stroke when removing or installing the rocker case. The rocker arms could bend the valves.

- Remove:
 - Rear Camshaft Chain Tensioner (see Camshaft Chain Tensioner Removal)
 - Rocker Case Bolts [A]
 - Rear Rocker Case [B]
- Lift the rocker case to clear of the dowel pins in the cylinder head and remove the rocker case.



Rocker Case Installation

- Check that the crankshaft is positioned at TDC and at the end of the compression stroke.

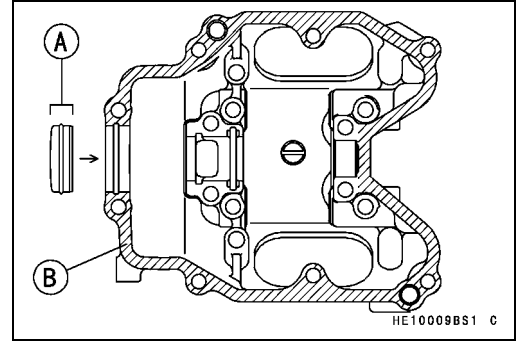
CAUTION

Be sure to position the crankshaft is at TDC of the end of the compression stroke. The rocker arms could bend the valves.

Rocker Case

- Apply liquid gasket to the outer surface of the cap [A] and the cylinder head upper surface [B] as shown in the figure.

Sealant - Kawasaki Bond: 92104-1063 or Three Bond: TB1216



- Tighten the rocker case bolts following the tightening sequence as shown in the figure.

Torque - Rocker Case Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)

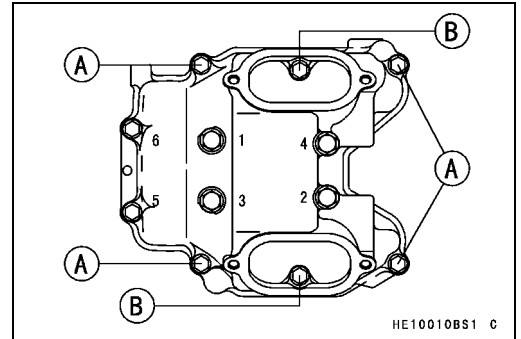
[1, 2, 3, 4] L = 55 mm (2.2 in.) with washers

Rocker Case Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)

[5, 6] L = 130 mm (5.1 in.)

[A] L = 30 mm (1.2 in.)

[B] L = 25 mm (1.0 in.)

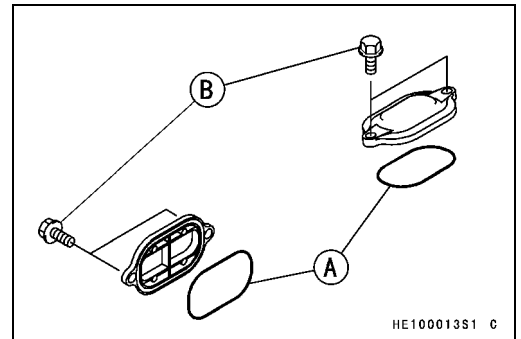


- Check the valve clearance and adjust it if necessary.

- Apply grease to the O-ring [A].

- Tighten:

Torque - Valve Adjusting Cap Bolts [B]: 8.8 N·m (0.90 kgf·m, 78 in·lb)

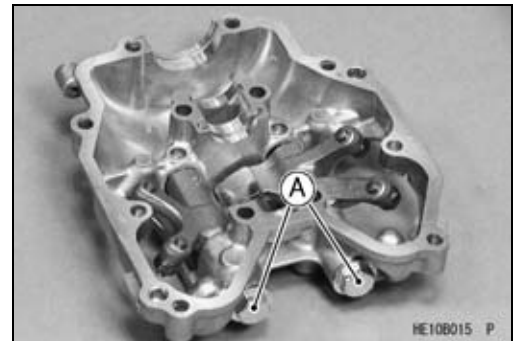


Rocker Arm Removal

- Remove:

Rocker Case (see Rocker Case Removal)

Rocker Shaft Bolts [A]



- Using a M8 bolt [A], remove the rocker shaft [B].

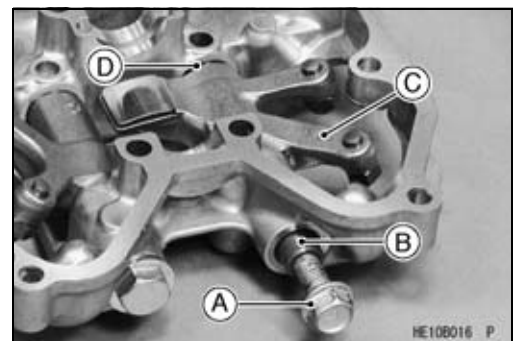
- Remove:

Rocker Arm [C]

Washers [D]

○ Mark and record the rocker arm location so it can be installed in the original position.

○ The rocker arms come off with the rocker shafts.

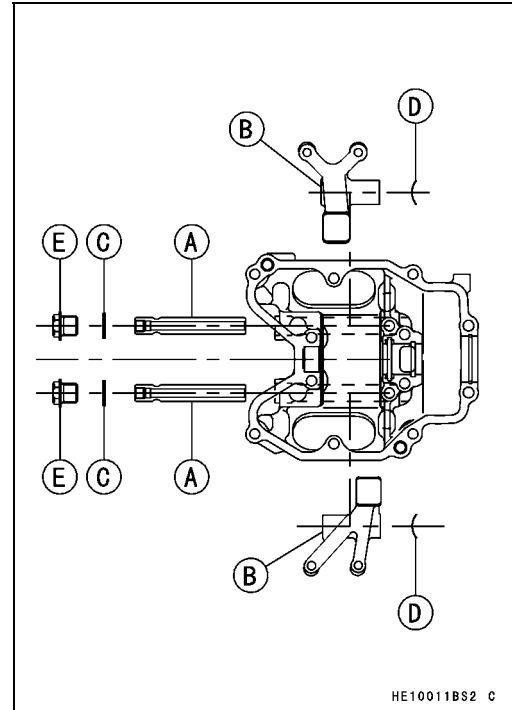


5-18 ENGINE TOP END

Rocker Case

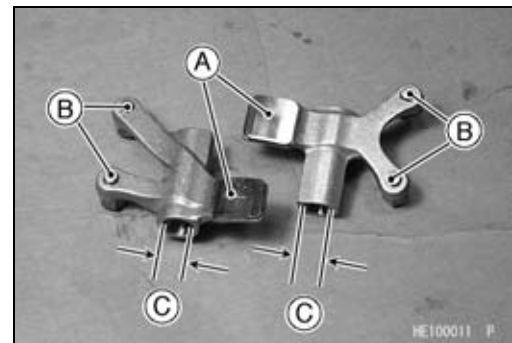
Rocker Arm Installation

- Apply engine oil:
 - Rocker Shafts [A]
 - Hole in Rocker Arms [B]
- Replace the copper washers [C] with new ones.
- Install:
 - Wave Washers [D] (as shown)
 - Rocker Arms (as shown)
 - Rocker Shafts and Copper Washers
- Tighten:
 - Torque - Rocker Shaft Bolts [E]: 22 N·m (2.2 kgf·m, 16 ft·lb)**



Rocker Arm Inspection

- Inspect the area [A] on the rocker arm where the cam rubs.
- ★ If the rocker arm is scored, discolored or otherwise damaged, replace it. Also inspect the camshaft lobes.
- Inspect the end of the valve clearance adjusting screws [B] where it contacts the valve stem.
- ★ If the end of the adjusting screw is mushroomed or damaged in any way, or if the screw will not turn smoothly, replace it. Also inspect the end of the valve stem.
- Measure the inside diameter [C] of the rocker arm with a dial bore gauge.
- ★ If the rocker arm inside diameter is larger than the service limit, replace it. Also check the rocker shaft diameter (see Rocker Shaft Diameter Measurement).



Rocker Arm Inside Diameter

Standard: 12.000 ~ 12.018 mm (0.4724 ~ 0.4731 in.)

Service Limit: 12.05 mm (0.474 in.)

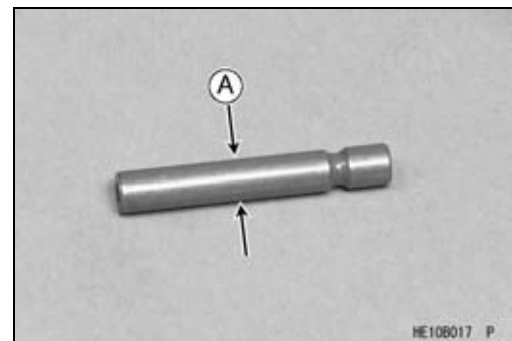
Rocker Shaft Diameter Measurement

- Measure the diameter [A] of the rocker shaft where the rocker arm pivots on it with a micrometer.
- ★ If the rocker shaft diameter is smaller than the service limit, replace it. Also check the rocker arm inside diameter (see Rocker Arm Inspection).

Rocker Shaft Diameter

Standard: 11.983 ~ 11.994 mm (0.4718 ~ 0.4722 in.)

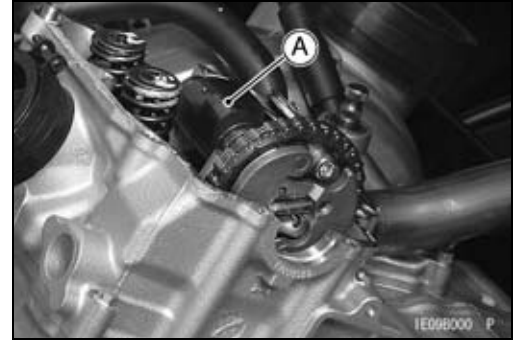
Service Limit: 11.96 mm (0.471 in.)



Camshaft

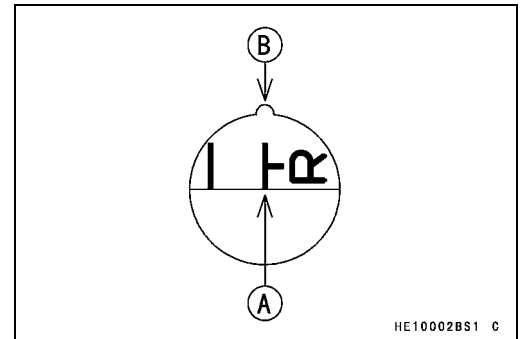
Camshaft Removal

- Remove:
 - Camshaft Chain Tensioners (see Camshaft Chain Tensioner Removal)
 - Rocker Cases (see Rocker Case Removal)
 - Camshafts [A]
- Support the chain using a suitable tool.

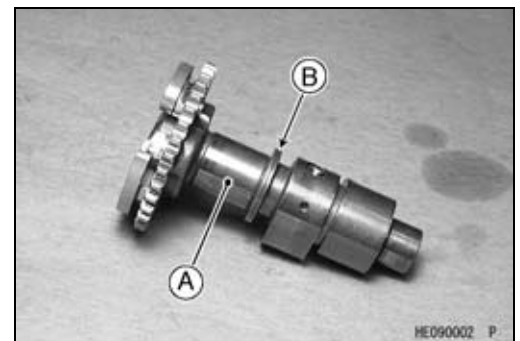


Camshaft Installation

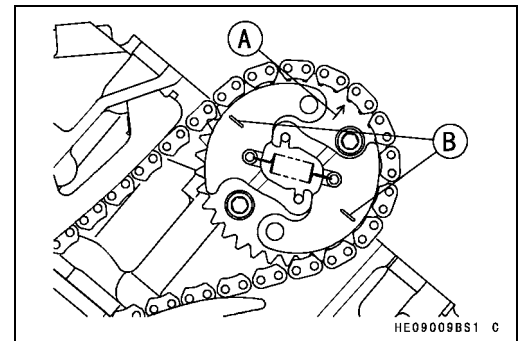
- Using a wrench on the alternator bolt, turn the crankshaft **clockwise** until "T-R" mark [A] is aligned with the notch [B] in the inspection window.



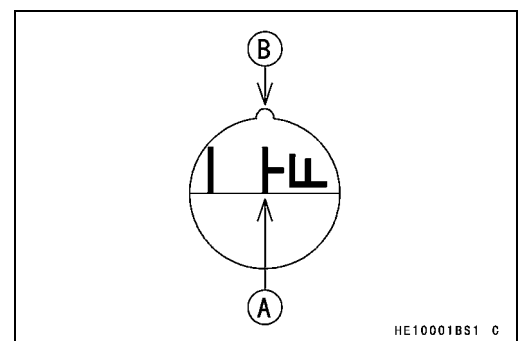
- The rear camshaft [A] has a groove [B].
- First, install the rear camshaft.



- Face the arrow [A] of the rear camshaft sprocket upward (left side view).
- Engage the rear camshaft chain with the rear camshaft sprocket.
- Align the marks [B] on the weights with the rear cylinder head upper surface.



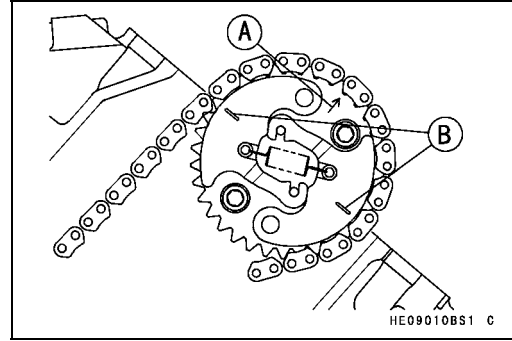
- Using a wrench on the alternator bolt, turn the crankshaft **clockwise** 270°.
- Align the "T-F" mark [A] with the notch [B] in the inspection window.



5-20 ENGINE TOP END

Camshaft

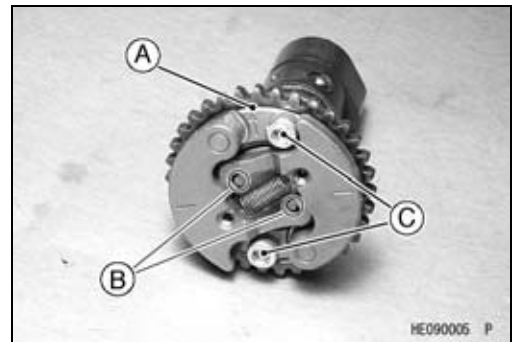
- Face the arrow [A] of the front camshaft sprocket upward (right side view).
- Engage the front camshaft chain with the front camshaft sprocket.
- Align the marks [B] on the weights with the front cylinder head upper surface.



- Install:
 - Rocker Cases (see Rocker Case Installation)
 - Camshaft Chain Tensioners (see Camshaft Chain Tensioner Installation)
- Check the valve clearance (see Valve Clearance Inspection).

Camshaft Assembly

- Install the KACR unit [A] (sprocket) on the camshaft so that the unit fits onto the camshaft pins [B].
- Apply a non-permanent locking agent to the camshaft sprocket bolts [C].
- Tighten:
 - Torque - Camshaft Sprocket Bolts: 12 N·m (1.2 kgf·m, 104 in·lb)



Cam Wear Inspection

- Remove the camshaft.
- Measure the height [A] of the cam with a micrometer.
- ★ If the cams are worn past the service limit, replace the camshaft.

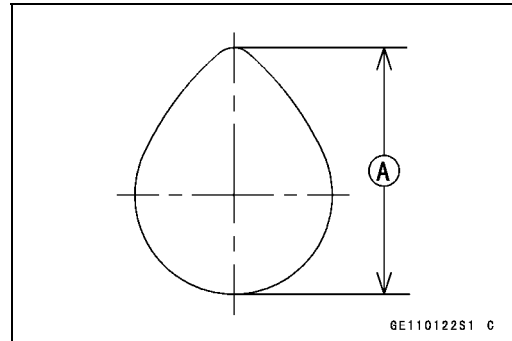
Cam Height

Standard:

Exhaust	35.363 ~ 35.477 mm (1.3922 ~ 1.3967 in.)
Inlet	35.622 ~ 35.736 mm (1.4024 ~ 1.4069 in.)

Service Limit:

Exhaust	35.26 mm (1.388 in.)
Inlet	35.52 mm (1.398 in.)



Camshaft

Camshaft Bearing Wear Inspection

- The journal wear is measured using plastigage (press gauge), which is inserted into the clearance to be measured. The plastigage indicates the clearance by the amount it is compressed and widened when the parts are assembled.
- Cut strips of plastigage to journal width. Place a strip on each journal parallel to the camshaft with the camshaft installed in the correct position so that the plastigage will be compressed between the journal and rocker case.
- Install the rocker case, tightening the bolts in the correct sequence to the specified torque (see Rocker Case Installation).

NOTE

- Do not turn the camshaft when the plastigage is between the journal and rocker case.

- Remove the rocker case and measure the plastigage width [A] to determine the clearance between the journal and the rocker case. Measure the widest portion of the plastigage.

Camshaft Bearing Clearance ($\phi 18$)

Standard: 0.016 ~ 0.052 mm (0.0006 ~ 0.0020 in.)

Service Limit: 0.14 mm (0.0055 in.)

Camshaft Bearing Clearance ($\phi 22$)

Standard: 0.020 ~ 0.062 mm (0.0008 ~ 0.0024 in.)

Service Limit: 0.15 mm (0.0059 in.)

- ★ If any clearance exceeds the service limit, measure the diameter of the camshaft journal.

Camshaft Journal Diameter ($\phi 18$)

Standard: 17.966 ~ 17.984 mm (0.7073 ~ 0.7080 in.)

Service Limit: 17.94 mm (0.706 in.)

Camshaft Journal Diameter ($\phi 22$)

Standard: 21.959 ~ 21.980 mm (0.8645 ~ 0.8654 in.)

Service Limit: 21.93 mm (0.863 in.)

- ★ If the camshaft journal diameter is less than the service limit, replace the camshaft with a new one and measure the clearance again.
- ★ If the clearance still remains out of the limit, replace the cylinder head and the rocker case.



CAUTION

The cylinder head and rocker case are machined as a set, and must be replaced as a set.

5-22 ENGINE TOP END

Camshaft

KACR Inspection

The Kawasaki Automatic Compression Release (KACR) momentarily opens the exhaust valves on the compression stroke at very low speeds. This allows some of the compression pressure to escape, making it easy to turn over the engine during starting.

Due to the simplicity of the mechanism, no periodic maintenance is needed. There are only two symptoms of problems with the KACR mechanism [A]: compression is not released during starting, and compression is released during running.

(1) If compression is not released during starting, the weights are not returning to their rest position.

- Remove the camshaft (see Camshaft Removal).
- Remove the KACR unit.
- Visually inspect the spring.
- ★ If damaged, deformed, or missing, replace the spring.
- Remove the spring and move the weights back and forth.
- ★ If the weights do not move smoothly, replace the KACR unit. Also inspect the exhaust rocker arm for any damage, and replace the rocker arm if necessary.

[A] Rest Position (compression is released)

[B] Weights

[C] Spring

(2) If compression is released while the engine is running, the weights are not swinging out.

- Remove the spring and move the weights back and forth.
- ★ If the weights do not move easily from the retracted position, replace the KACR unit. Also inspect the exhaust rocker arm for any damage, and replace the rocker arm if necessary.

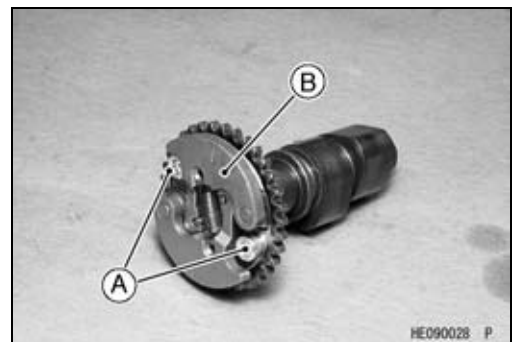
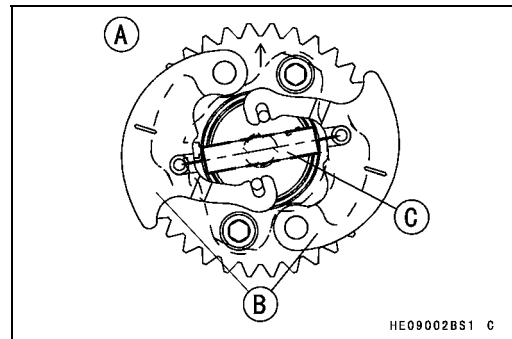
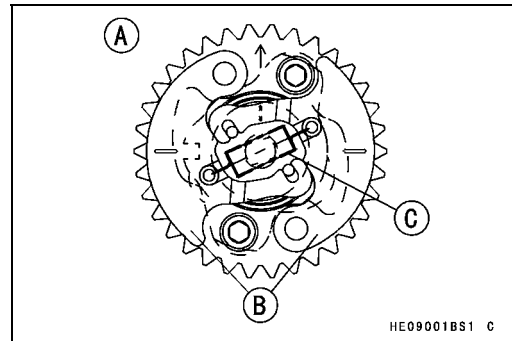
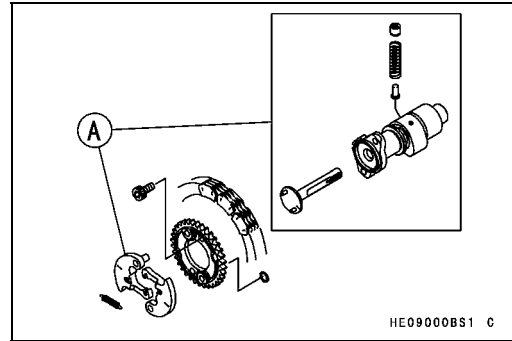
[A] Running Position (compression is not released)

[B] Weights

[C] Spring

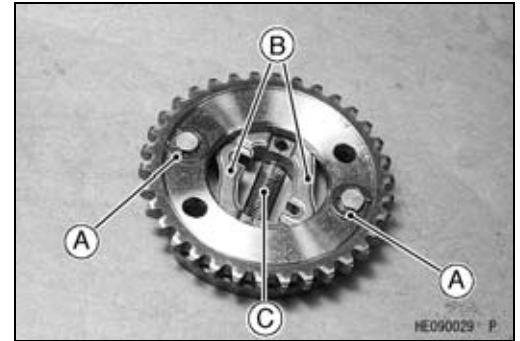
KACR Removal

- Remove:
 - Camshaft (see Camshaft Removal)
 - Camshaft Sprocket Bolts [A]
 - KACR Unit [B]



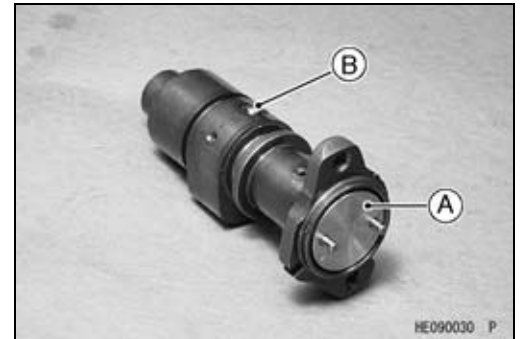
Camshaft

- Remove:
 - Circlips [A]
 - Weights [B]
 - Spring [C]



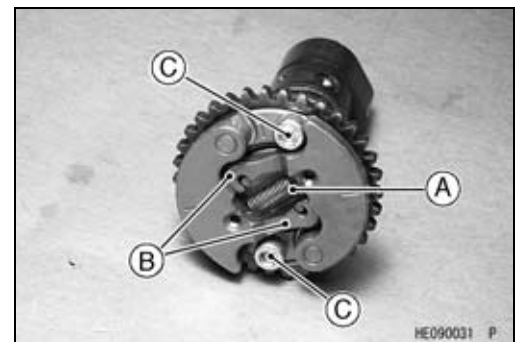
NOTE

- Do not remove the shaft [A] and pin [B].
- If the parts are removed, they cannot be reinstalled.



KACR Installation

- Install:
 - Weights
 - Circlips
 - Spring [A]
- Hook the spring from the outside with the open side of the hook inwards.
- Install:
 - KACR Unit
- Hook the arms [B] on the pins.
- Apply a non-permanent locking agent to the camshaft sprocket bolts [C] and tighten them.



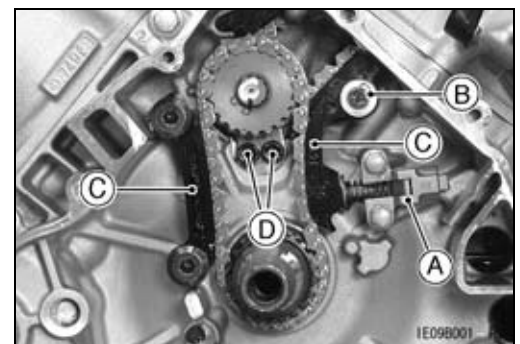
Torque - Camshaft Sprocket Bolts: 12 N·m (1.2 kgf·m, 104 in·lb)

Camshaft Chain Removal

- Remove (left side view):
 - Rear and Front Camshafts (see Camshaft Removal)
 - Alternator Rotor (see Alternator Rotor Removal in the Electrical System chapter)
 - Oil Pump (see Oil Pump Removal in the Engine Lubrication System chapter)
 - Intermediate Shaft Chain Tensioner [A]
 - Circlip [B] and Washer

Special Tool - Outside Circlip Pliers: 57001-144

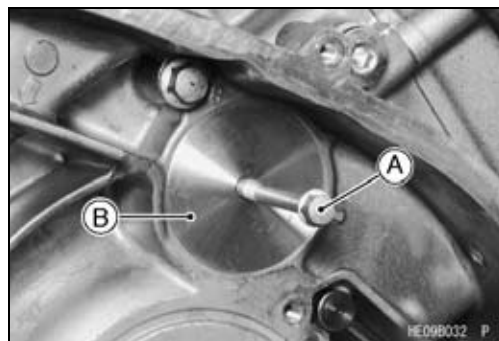
- Remove:
 - Intermediate Shaft Chain Guides [C]
 - Position Plate Bolts [D] and Position Plate



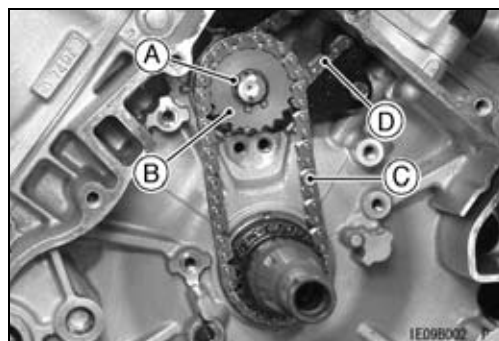
5-24 ENGINE TOP END

Camshaft

- Remove (right side view):
Torque Converter Cover (see Torque Converter Cover Removal in the Converter System chapter)
- Using a M6 bolt [A], pull out the cover [B].



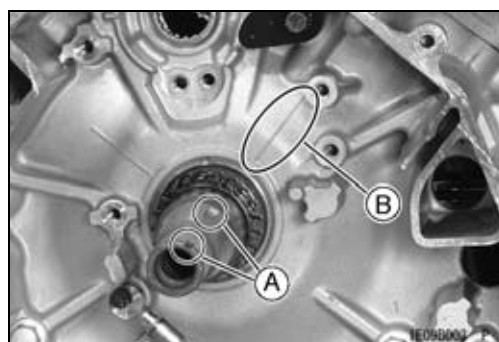
- Remove (left side view):
Circlip [A]
Special Tool - Outside Circlip Pliers: 57001-144
- Remove:
Intermediate Shaft Sprocket [B]
Intermediate Shaft Drive Chain [C]
Rear Camshaft Chain [D]
Front Camshaft Chain (right side)



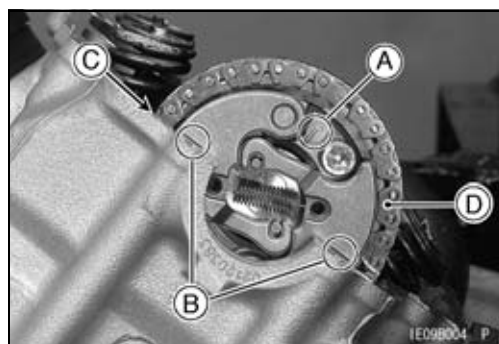
Camshaft Chain Installation

Rear Camshaft Chain

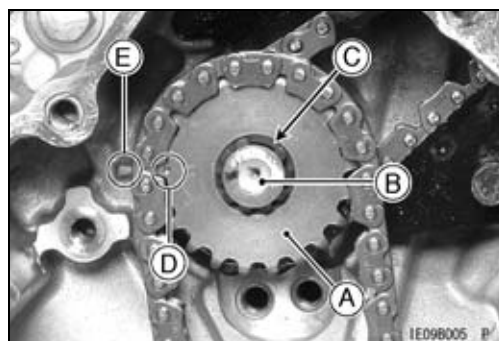
- Align the key grooves [A] on the crankshaft with the embossed line [B] on the crankcase (left side view).



- Face the arrow [A] of the rear camshaft sprocket upward.
- Align the marks [B] on the weights with the rear cylinder head upper surface [C].
- Place the rear camshaft chain [D] onto the rear camshaft sprocket.



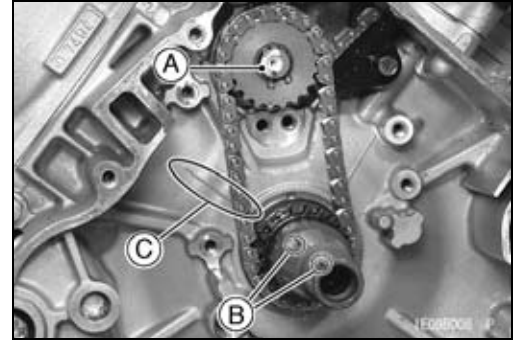
- Engage the camshaft and intermediate shaft chains on the intermediate shaft sprocket [A] and insert the intermediate shaft (left side view).
- Fit the splines of the intermediate shaft [B] and grooves [C] of the sprocket as shown.
- Align the punch mark [D] on the sprocket with the embossed mark [E] on the crankcase.



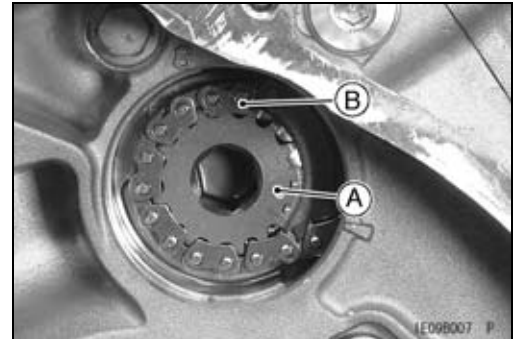
Camshaft

Front Camshaft Chain

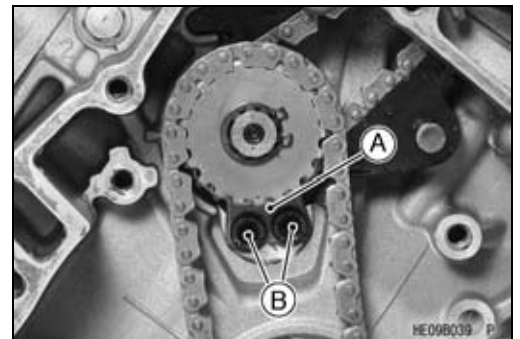
- Install the circlip [A].
Special Tool - Outside Circlip Pliers: 57001-144
- Rotate the crankshaft **clockwise** 270°.
- Align the key grooves [B] on the crankshaft with the embossed line [C] on the crankcase.



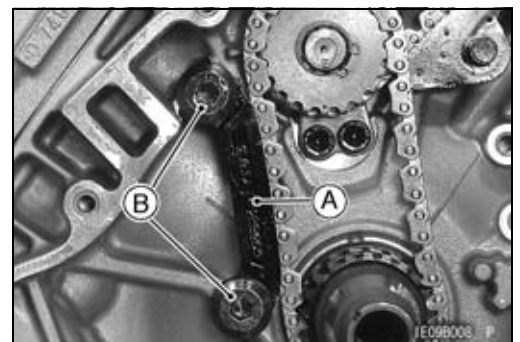
- Move the intermediate shaft [A] to the left side of the engine.
- Engage the front camshaft chain [B] with the sprocket on the intermediate shaft.



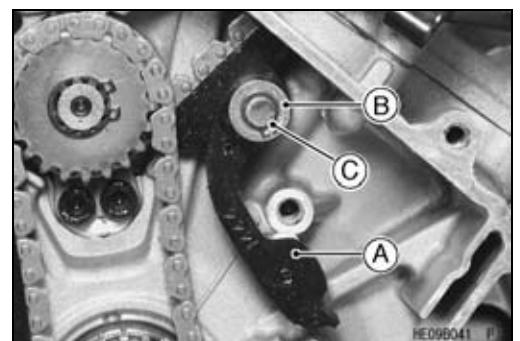
- Install (left side view):
 Position Plate [A]
- Tighten:
Torque - Position Plate Bolts [B]: 8.8 N·m (0.90 kgf·m, 78 in·lb)



- Install:
 Intermediate Shaft Chain Guide [A] (front)
- Tighten:
Torque - Intermediate Shaft Chain Guide Bolts [B]: 8.8 N·m (0.90 kgf·m, 78 in·lb)



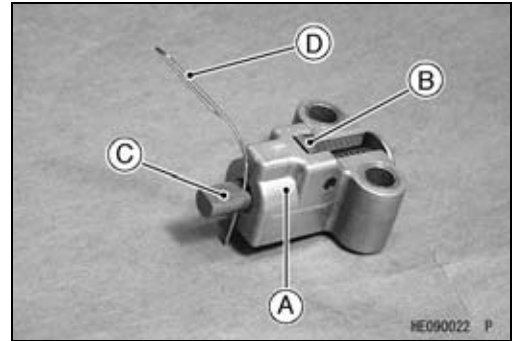
- Install:
 Intermediate Shaft Chain Guide [A] (Rear)
 Washer [B]
 Circlip [C]
- **Special Tool - Outside Circlip Pliers: 57001-144**



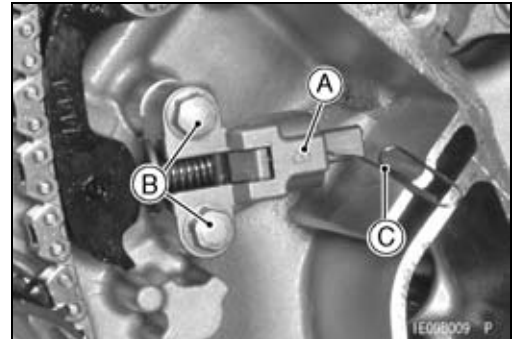
5-26 ENGINE TOP END

Camshaft

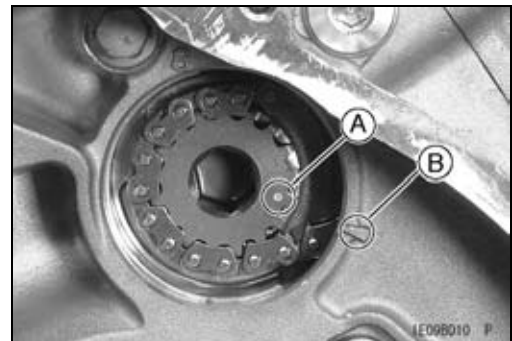
- Install the intermediate shaft chain tensioner [A] as follows:
- Release the stopper [B] and push the push rod [C] into the tensioner body.
- Insert a wire [D] into the rod hole to hold the rod in place.



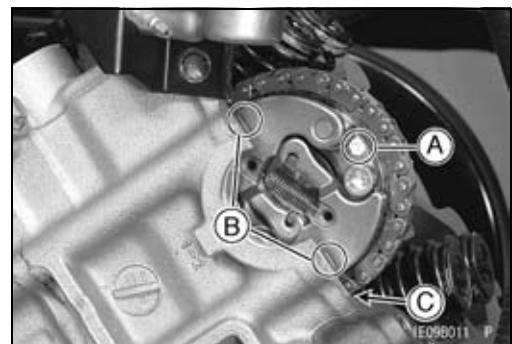
- Install:
Intermediate Shaft Chain Tensioner [A]
- Tighten:
Torque - Intermediate Shaft Chain Tensioner Bolts [B]: 8.8 N·m (0.90 kgf·m, 78 in·lb)
- Remove the wire [C] to free the push rod.



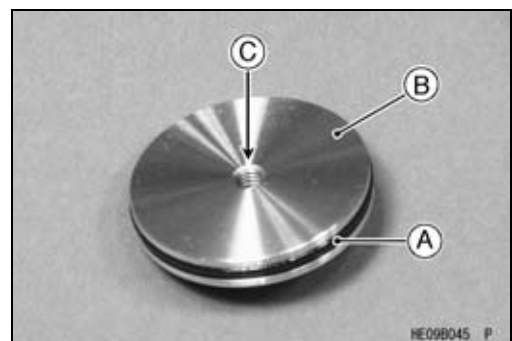
- Confirm that the punch mark [A] on the intermediate shaft sprocket (Right Side) is aligned with the embossed mark [B] on the crankcase.



- Face the arrow mark [A] upward.
- Align the marks [B] on the weights with the front cylinder head upper surface [C].
- Place the front camshaft chain on the front camshaft sprocket.



- Apply grease to the O-ring [A] and install the cover [B] into the right side of the crankcase so that the tapped hole [C] faces outward.



Camshaft

- Install:
 - Rocker Cases (see Rocker Case Installation)
 - Camshaft Chain Tensioners (see Camshaft Chain Tensioner Installation)
- Check the valve clearances (see Valve Clearance Inspection).

Camshaft Chain Guide Wear Inspection

- Visually inspect the rubber on the guides.
- ★ If the rubber is damaged, cut, or is missing pieces, replace the guide.

5-28 ENGINE TOP END

Cylinder Head

Cylinder Compression Measurement

NOTE

○ Use the battery which is fully charged.

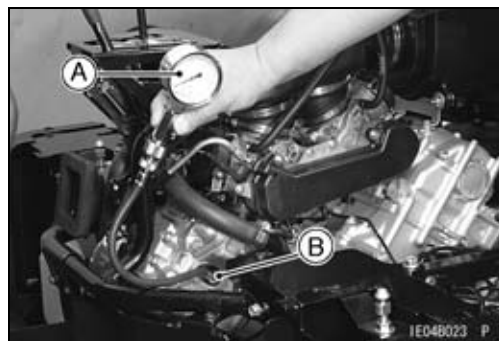
- Warm up the engine thoroughly, and stop the engine.
- Remove the spark plug (see Spark Plug Removal in the Electrical System chapter).
- Attach the compression gauge [A] and adapter [B] firmly into the spark plug hole.

Special Tools - Compression Gauge, 20 kgf/cm²: 57001-221
Compression Gauge Adapter, M10 × 1.0:
57001-1458

- Hold the throttle wide open and crank the engine with the electric starter or the recoil starter several times.
- When the gauge stops rising, stop cranking and read the gauge.

Cylinder Compression (Usable Range)

Electric Starter: 251 ~ 456 kPa (2.56 ~ 4.65 kgf/cm², 36 ~ 66 psi) @380 r/min (rpm)



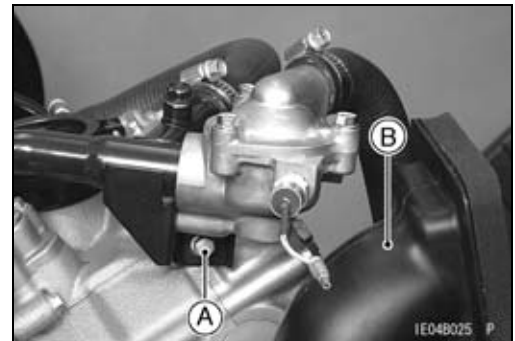
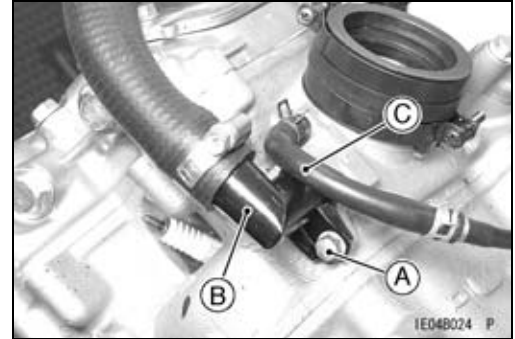
The following table should be consulted if the obtainable compression reading is not within the usable range.

Problem	Diagnosis	Remedy (Action)
Cylinder compression is higher than usable range.	Carbon accumulation on piston, cylinder head, and in combustion chamber possibly due to damaged valve stem oil seal and/or damaged piston oil rings (This may be indicated by white exhaust smoke).	Remove the carbon deposits and replace damaged parts if necessary.
	Incorrect cylinder head gasket thickness	Replace the gasket with a standard part.
	Damaged or missing compression release cam spring	Replace the spring.
	Compression release weights do not move smoothly.	Replace the compression release unit.
Cylinder compression is lower than usable range.	Gas leakage around cylinder head	Replace damaged gasket and check cylinder head warp.
	Bad condition of valve seating	Repair if necessary.
	Incorrect valve clearance	Adjust the valve clearance.
	Incorrect piston/cylinder clearance	Replace the piston and/or cylinder.
	Piston seizure	Inspect the cylinder and liner and replace/repair the cylinder and/or piston as necessary.
	Bad condition of piston ring and/or piston ring grooves	Replace the piston and/or the piston rings.
Compression release weights do not move smoothly.	Replace the compression release unit	

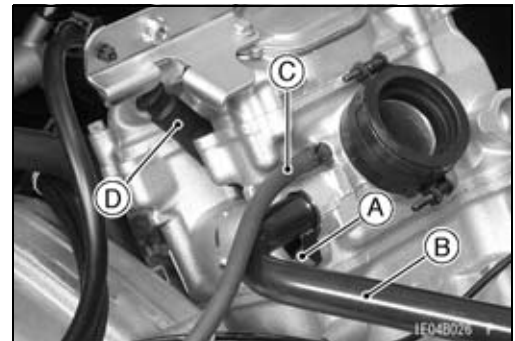
Cylinder Head

Cylinder Head Removal

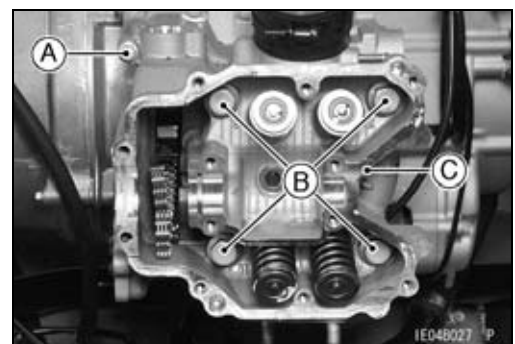
- Drain the coolant (see Coolant Change in the Periodic Maintenance chapter).
- Remove:
 - Carburetor (see Carburetor Removal in the Fuel System chapter)
 - Exhaust Pipe (see Muffler and Exhaust Pipe Removal)
 - Thermostat (see Thermostat Removal in the Cooling System chapter)
 - Spark Plug Cap
 - Water Pipe Bolt [A]
 - Left Water Pipe [B]
 - Vacuum Hose [C]
- Remove:
 - Water Pipe Bolt [A]
 - Air Inlet Duct [B]



- Remove:
 - Water Pipe Bolt [A]
 - Right Water Pipe [B]
 - Vacuum Hoses [C]
 - Spark Plug Cap [D]
 - Rocker Case (see Rocker Case Removal)
 - Camshaft (see Camshaft Removal)

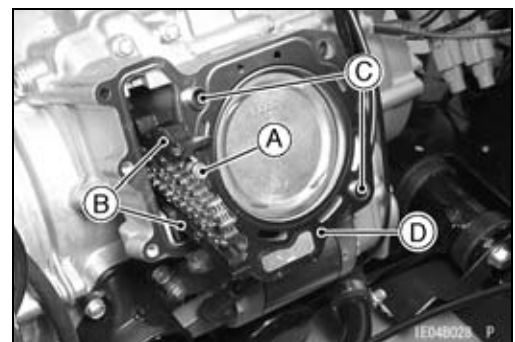


- Remove:
 - Cylinder Head Bolt (M6) [A]
 - Cylinder Head Bolts (M10) [B] and Washers
 - Cylinder Head [C] and Gasket
- Lift the cylinder head to clear the dowel pins in the cylinder.



Cylinder Head Installation

- Apply grease to the O-rings on the oil pipe [A], and insert the pipe.
- Install:
 - Camshaft Chain Guides [B]
 - Dowel Pins [C]
 - New Cylinder Head Gasket [D]
- Tighten:
 - Torque - Front Cylinder Camshaft Chain Guide Bolt: 20 N·m (2.0 kgf·m, 14 ft·lb)**



5-30 ENGINE TOP END

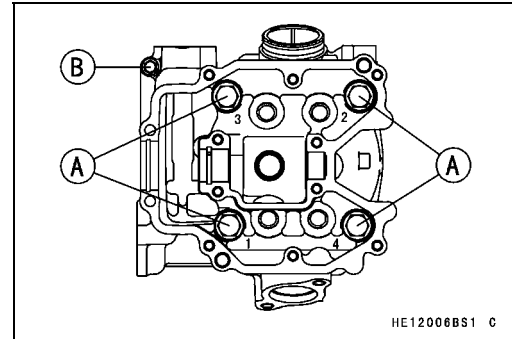
Cylinder Head

- Apply molybdenum disulfide oil to the threads and seating surface of the cylinder head bolts and both sides of the washers.
- Tighten the cylinder head bolts [A] following the tightening sequence as shown.

First Torque - Cylinder Head Bolts (M10): 25 N·m (2.5 kgf·m, 18 ft·lb)

Final Torque - Cylinder Head Bolts (M10): 49 N·m (5.0 kgf·m, 36 ft·lb)

- Tighten the cylinder head bolts (M6) [B].
Torque - Cylinder Head Bolts (M6): 9.8 N·m (1.0 kgf·m, 87 in·lb)



Cylinder Head Cleaning

- Remove the cylinder head (see Cylinder Head Removal).
- Scrape the carbon out of the combustion chamber and exhaust port with a suitable tool.
- Wash the head with a high-flash point solvent.
- Blow out any particles which may obstruct the oil passage in the cylinder head using compressed air.

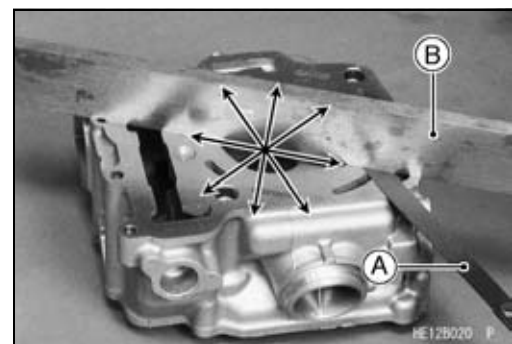
Cylinder Head Warp Inspection

- Clean the cylinder head (see Cylinder Head Cleaning).
- Lay a straightedge across the lower surface of the cylinder head.
- Use a thickness gauge [A] to measure the space between the straightedge [B] and the head at several locations.

Cylinder Head Warp

Service Limit: 0.05 mm (0.002 in.)

- ★ If the cylinder head is warped more than the service limit, replace it.
- ★ If the cylinder head is warped less than the service limit, repair the head by lapping the lower surface with emery paper secured to a surface plate (first No. 200, then No. 400).



Valves

Valve Clearance Inspection

- Refer to the Valve Clearance Inspection in the Periodic Maintenance chapter.

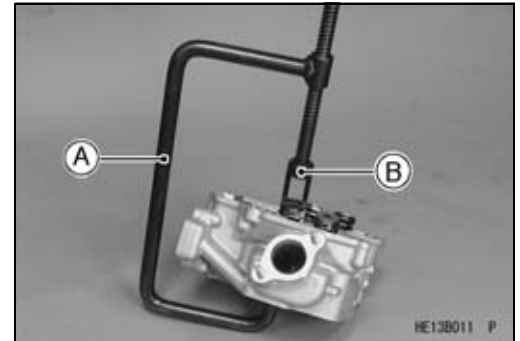
Valve Clearance Adjustment

- Refer to the Valve Clearance Adjustment in the Periodic Maintenance chapter.

Valve Removal

- Remove the cylinder head (see Cylinder Head Removal).
- Mark and record the valve location so it can be installed in the original position.
- Using the valve spring compressor assembly, remove the valve.

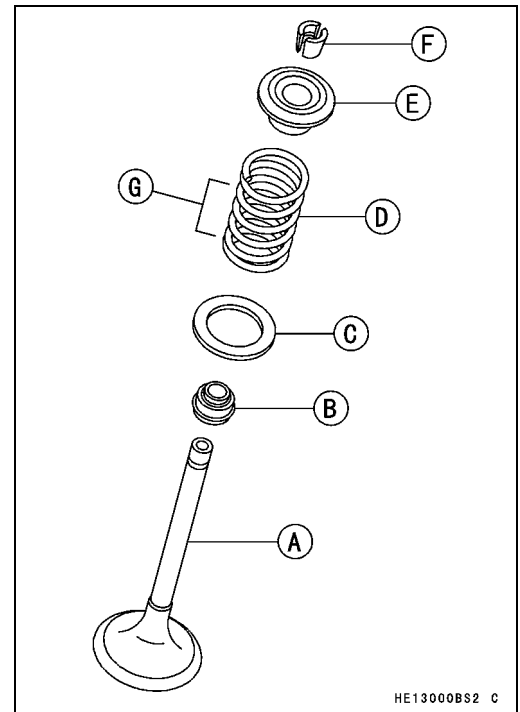
**Special Tools - Valve Spring Compressor Assembly: 57001-241 [A]
Valve Spring Compressor Adapter, ϕ 22: 57001-1202 [B]**



Valve Installation

- Install the spring seat.
- Replace the valve stem oil seal.
- ★ If a new valve is to be used, check the valve-to-guide clearance (see Valve-to-Guide Clearance Measurement).
- ★ If there is too little clearance, ream the valve guide (see Valve Guide Installation).
- ★ If there is too much clearance, install a new valve guide (see Valve Guide Removal and Valve Guide Installation).
- Check the valve seat (see Valve Seat Inspection).
- Apply a thin coat of molybdenum disulfide grease to the valve stem.
- Install each spring so that the closed coil end faces downwards.
- The white paint on the spring faces upwards.

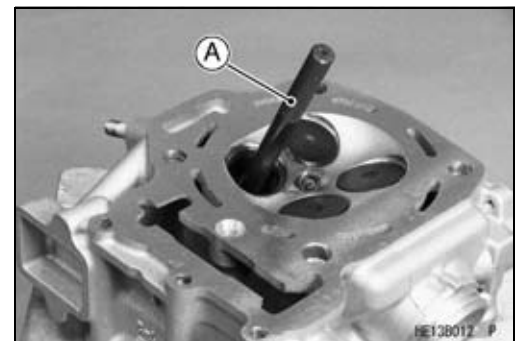
- Valve Stem [A]
- Oil Seal [B]
- Spring Seat [C]
- Spring [D]
- Retainer [E]
- Split Keepers [F]
- Closed Coil End [G]



Valve Guide Removal

- Remove:
 - Valve (see Valve Removal)
 - Valve Stem Oil Seal
- Hammer lightly on the valve guide arbor [A] to remove the guide from the top of the head.

Special Tool - Valve Guide Arbor, ϕ 5: 57001-1203



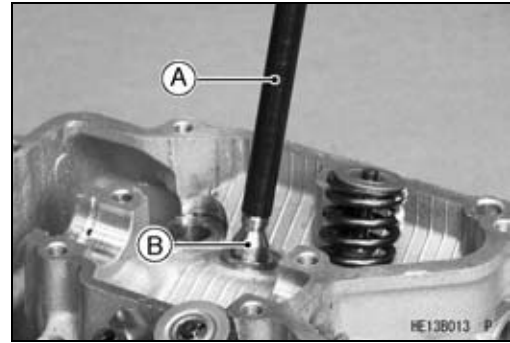
5-32 ENGINE TOP END

Valves

Valve Guide Installation

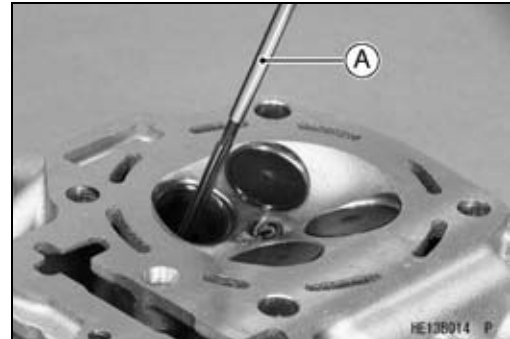
- Lightly oil the valve guide outer surface.
- Using the valve guide arbor [A], drive the valve guide [B] until its flange touches the cylinder head.

Special Tool - Valve Guide Arbor, ϕ 5: 57001-1203



- Ream the valve guide with the valve guide reamer [A], it may be necessary to ream the guide even if the old guide is reused.

Special Tool - Valve Guide Reamer, ϕ 5: 57001-1204

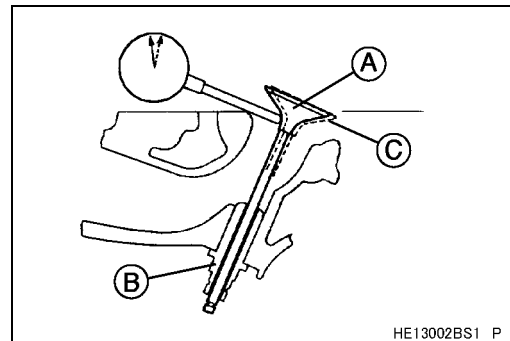


Valve-to-Guide Clearance Measurement

If a small bore gauge is not available, inspect the valve guide wear by measuring the valve to valve guide clearance with the wobble method as indicated below.

- Insert a new valve [A] into the guide [B] and set a dial gauge against the stem perpendicular to it as close as possible to the cylinder head mating surface.
- Move [C] the stem back and forth to measure valve/valve guide clearance.
- Repeat the measurement in a direction at a right angle to the first.

★ If the reading exceeds the service limit, replace the guide.



NOTE

○ The reading is not actual valve/valve guide clearance because the measuring point is above the guide.

Valve/Valve Guide Clearance (Wobble Method)

Standard:

Exhaust	0.09 ~ 0.17 mm (0.0035 ~ 0.0067 in.)
Inlet	0.03 ~ 0.11 mm (0.0012 ~ 0.0043 in.)

Service Limit:

Exhaust	0.37 mm (0.0146 in.)
Inlet	0.31 mm (0.0122 in.)

Valves

Valve Seat Inspection

- Remove the valve (see Valve Removal).
- Check the valve seating surface [A] between the valve [B] and valve seat [C].
- Coat the valve seat with machinist's dye.
- Push the valve into the guide.
- Rotate the valve against the seat with a lapping tool.
- Pull the valve out, and check the seating pattern on the valve head. It must be the correct width and even all the way around.
- Measure the outside diameter [D] of the seating pattern on the valve seat.
- ★ If the outside diameter of the valve seating pattern is too large or too small, repair the seat (see Valve Seat Repair).

Valve Seating Surface Outside Diameter

- Exhaust:** 25.2 ~ 25.4 mm (0.992 ~ 1.000 in.)
- Inlet:** 29.4 ~ 29.6 mm (1.157 ~ 1.165 in.)

NOTE

○ The valve stem and guide must be in good condition, or this check will not be valid.

- ★ If the valve seating pattern is not correct, repair the seat (see Valve Seat Repair).
- Measure the seat width [E] of the portion where there is no build-up carbon (white portion) of the valve seat with vernier calipers.
- ★ If the width is too wide, too narrow or uneven, repair the seat (see Valve Seat Repair).

- [F] Good
- [G] Too Wide
- [H] Too Narrow
- [J] Uneven

Valve Seating Surface Width

- Exhaust:** 0.5 ~ 1.0 mm (0.02 ~ 0.04 in.)
- Inlet:** 0.5 ~ 1.0 mm (0.02 ~ 0.04 in.)

Valve Seat Repair (Valve Lapping)

- Using the valve seat cutters [A], repair the valve seat.

Special Tools - Valve Seat Cutters:

Exhaust Valves:

- Valve Seat Cutter, 45° - ϕ 27.5: 57001-1114
- Valve Seat Cutter, 32° - ϕ 28: 57001-1119
- Valve Seat Cutter, 60° - ϕ 30: 57001-1123

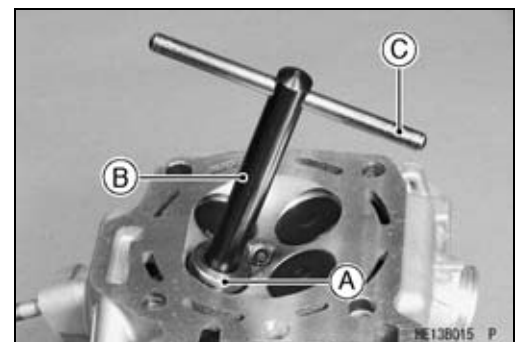
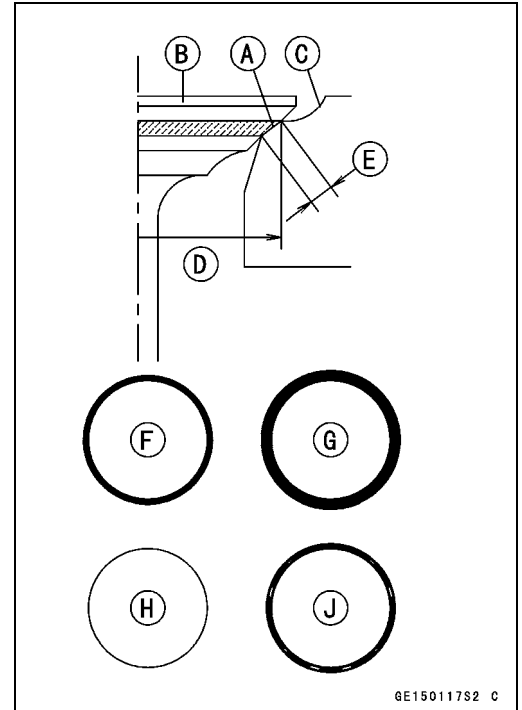
Inlet Valves:

- Valve Seat Cutter, 45° - ϕ 30: 57001-1187
- Valve Seat Cutter, 32° - ϕ 33: 57001-1199
- Valve Seat Cutter, 60° - ϕ 30: 57001-1123

Holder and Bar:

- Valve Seat Cutter Holder, ϕ 5: 57001-1208 [B]
- Valve Seat Cutter Holder Bar: 57001-1128 [C]

- ★ If the manufacturer's instructions are not available, use the following procedure.



5-34 ENGINE TOP END

Valves

Seat Cutter Operation Care

1. This valve seat cutter is developed to grind the valve seat for repair. Therefore the cutter must not be used for other purposes than seat repair.
2. Do not drop or shock the valve seat cutter, or the diamond particles may fall off.
3. Do not fail to apply engine oil to the valve seat cutter before grinding the seat surface. Also wash off ground particles sticking to the cutter with washing oil.

NOTE

○Do not use a wire brush to remove the metal particles from the cutter. It will take off the diamond particles.

4. Setting the valve seat cutter holder in position, operate the cutter in one hand. Do not apply too much force to the diamond portion.

NOTE

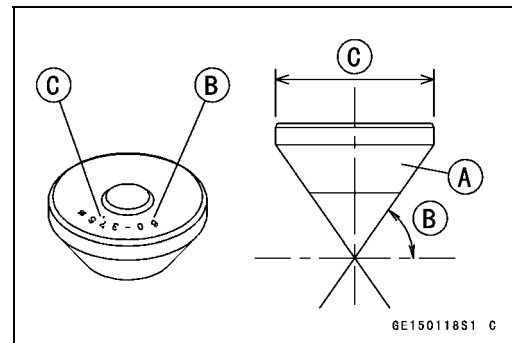
○Prior to grinding, apply engine oil to the cutter and during the operation, wash off any ground particles sticking to the cutter with washing oil.

5. After use, wash it with washing oil and apply thin layer of engine oil before storing.

Marks Stamped on the Cutter

The marks stamped on the back of the cutter [A] represent the following.

- 60° Cutter angle [B]
37.5φ Outer diameter of cutter [C]



Operating Procedures

- Clean the seat area carefully.
- Coat the seat with machinist's dye.
- Fit a 45° cutter into the holder and slide it into the valve guide.
- Press down lightly on the handle and turn it right or left. Grind the seating surface only until it is smooth.

CAUTION

Do not grind the seat too much. Overgrinding will reduce valve clearance by sinking the valve into the head. If the valve sinks too far into the head, it will be impossible to adjust the clearance, and the cylinder head must be replaced.

Valves

Widened Width [A] of engagement by machining with 45° cutter

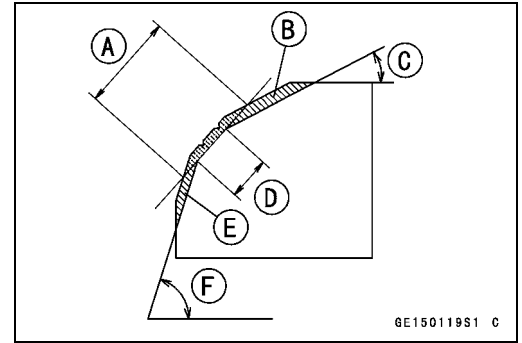
Ground Volume [B] by 32° cutter

32° [C]

Correct Width [D]

Ground Volume [E] by 60° cutter

60° [F]

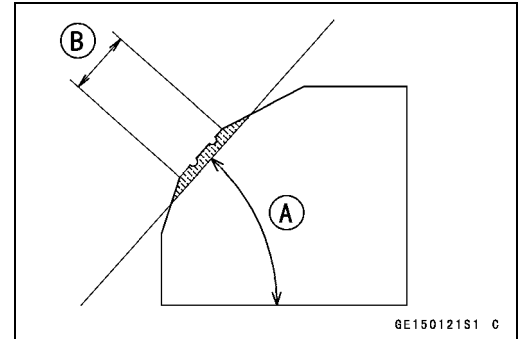


- Measure the outside diameter of the seating surface with vernier calipers.
- ★ If the outside diameter of the seating surface is too small, repeat the 45° grind [A] until the diameter is within the specified range.

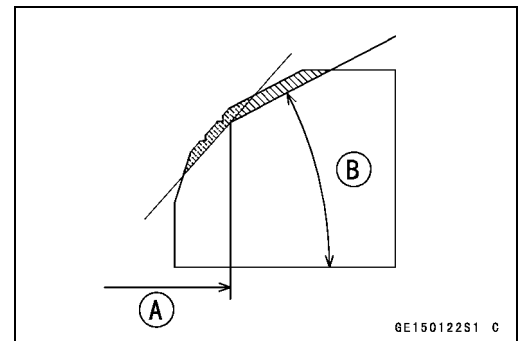
Original Seating Surface [B]

NOTE

- Remove all pittings or flaws from 45° ground surface.
- After grinding with 45° cutter, apply thin coat of machinist's dye to seating surface. This makes seating surface distinct and 32° and 60° grinding operation easier.
- When the valve guide is replaced, be sure to grind with 45° cutter for centering and good contact.



- ★ If the outside diameter (O.D.) [A] of the seating surface is too large, make the 32° grind described below.
 - ★ If the outside diameter of the seating surface is within the specified range, measure the seat width as described below.
 - Grind the seat at a 32° angle [B] until the seat O.D. is within the specified range.
 - To make the 32° grind, fit a 32° cutter into the holder, and slide it into the valve guide.
- Turn the holder one turn at a time while pressing down very lightly. Check the seat after each turn.



CAUTION

The 32° cutter removes material very quickly. Check the seat outside diameter frequently to prevent overgrinding.

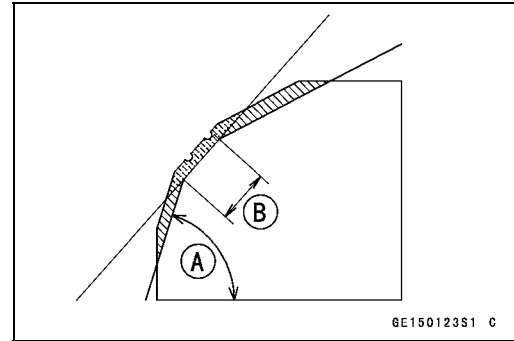
After making the 32° grind, return to the seat O.D. measurement step above.

- To measure the seat width, use vernier calipers to measure the width of the 45° angle portion of the seat at several places around the seat.
- ★ If the seat width is too narrow, repeat the 45° grind until the seat is slightly too wide, and then return to the seat O.D. measurement step above.

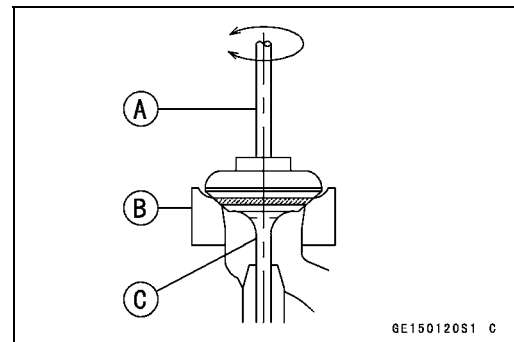
5-36 ENGINE TOP END

Valves

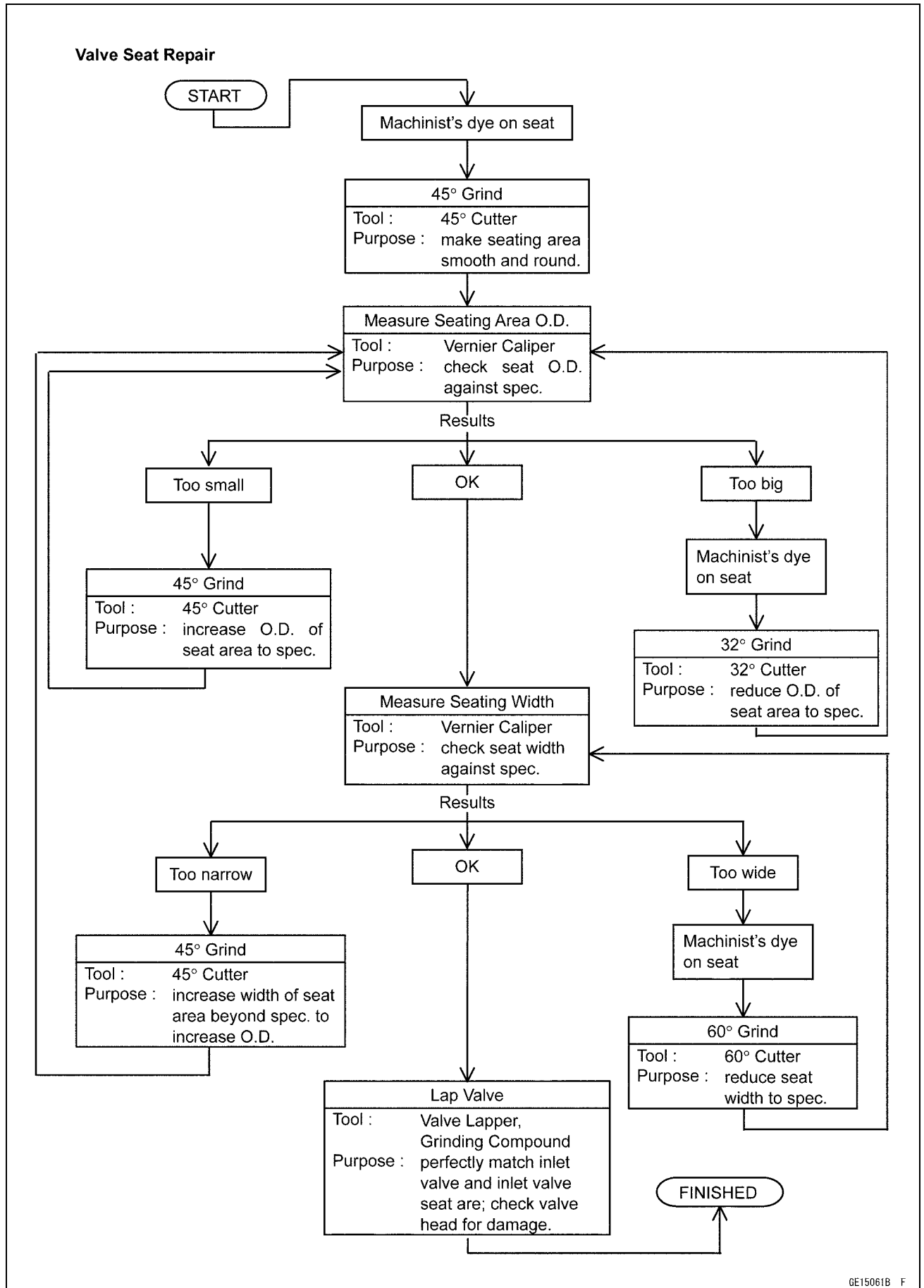
- ★ If the seat width is too wide, make the 60° [A] grind described below.
- ★ If the seat width is within the specified range, lap the valve to the seat as described below.
- Grind the seat at a 60° angle until the seat width is within the specified range.
- To make the 60° grind, fit 60° cutter into the holder, and slide it into the valve guide.
- Turn the holder, while pressing down lightly.
- After making the 60° grind, return to the seat width measurement step above.
Correct Width [B]



- Lap the valve to the seat, once the seat width and O.D. are within the ranges specified above.
- Put a little coarse grinding compound on the face of the valve in a number of places around the valve head.
- Spin the valve against the seat until the grinding compound produces a smooth, matched surface on both the seat and the valve.
- Repeat the process with a fine grinding compound.
 - [A] Lapper
 - [B] Valve Seat
 - [C] Valve
- The seating area should be marked about in the middle of the valve face.
- ★ If the seat area is not in the right place on the valve, check to be sure the valve is the correct part. If it is, it may have been refaced too much; replace it.
- Be sure to remove all grinding compound before assembly.
- When the engine is assembled, be sure to adjust the valve clearance (see Valve Clearance Adjustment in the Periodic Maintenance chapter).



Valves

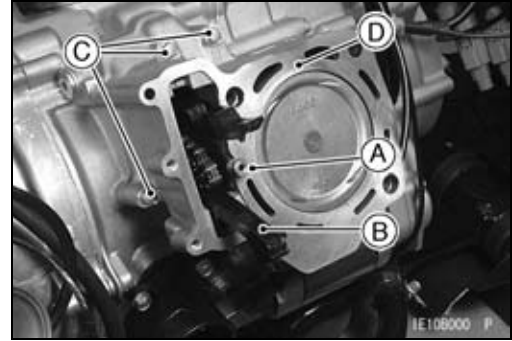


5-38 ENGINE TOP END

Cylinder and Piston

Cylinder Removal

- Remove:
 - Cylinder Head (see Cylinder Head Removal)
 - Oil Pipe [A]
 - Chain Guide [B]
 - Cylinder Bolts [C]
 - Cylinder [D]
 - Cylinder Base Gasket



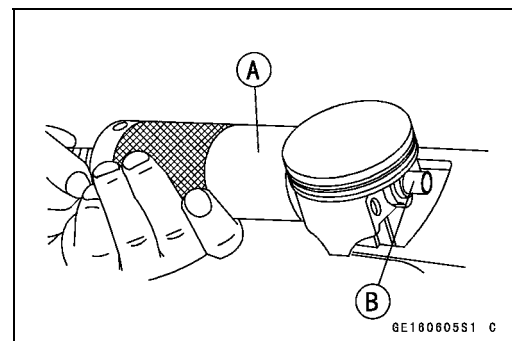
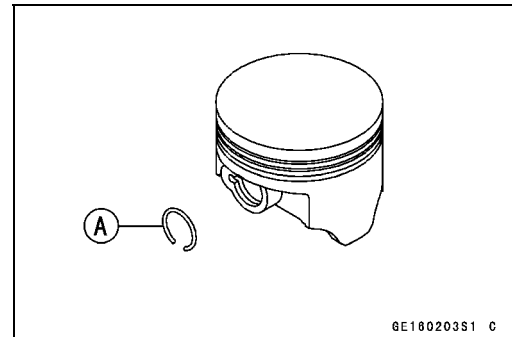
Piston Removal

- Remove the cylinder block (see Cylinder Removal).
- Place a piece of clean cloth under the piston and remove the piston pin snap rings [A] from the outside of each piston.

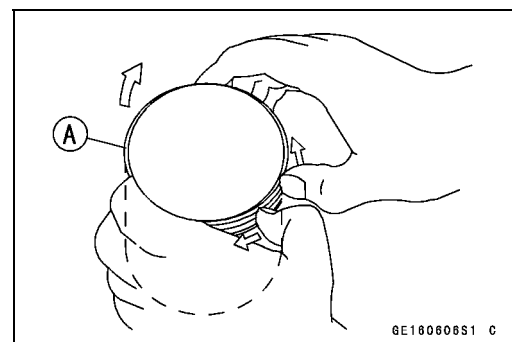
CAUTION

Do not reuse snap rings, as removal weakens and deforms them. They could fall out and score the cylinder wall.

- Using the piston pin puller assembly (special tool), remove the piston pins.
 - Special Tools - Piston Pin Puller Assembly [A]: 57001-910
 - Piston Pin Puller Adapter, $\phi 14$ [B]: 57001-1211
- Remove the piston.



- Carefully spread the ring opening with your thumbs and then push up on the opposite side of the ring [A] to remove it.
- Remove the 3-piece oil ring with your thumbs in the same manner.



Cylinder, Piston Installation

NOTE

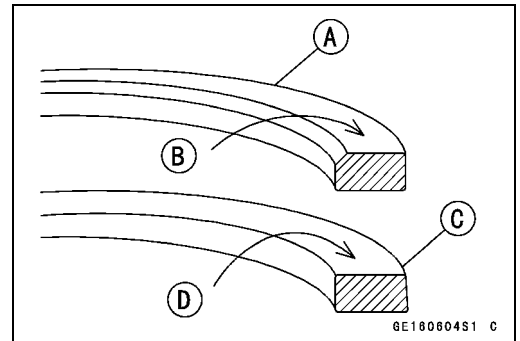
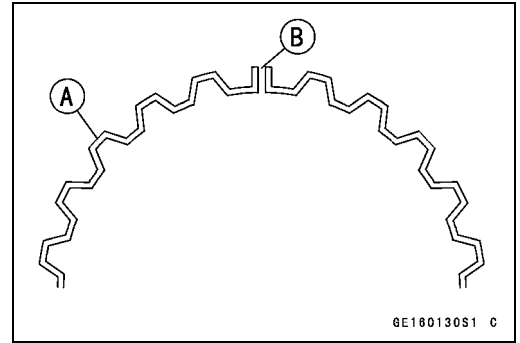
- If a new piston or cylinder is used, check piston to cylinder clearance (see Piston/Cylinder Clearance), and use new piston rings.

Cylinder and Piston

NOTE

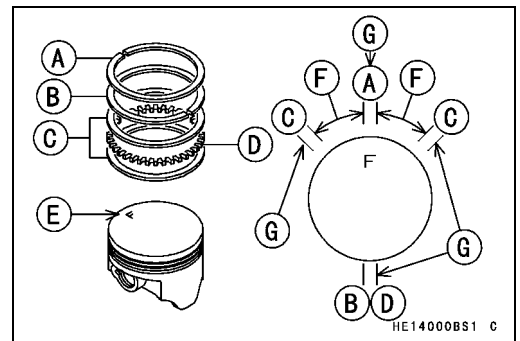
- The oil ring rails have no “top” or “bottom”.
- Install the oil ring expander [A] in the bottom piston ring groove so the ends [B] butt together.
- Install the oil ring steel rails, one above the expander and one below it.
- Spread the rail with your thumbs, but only enough to fit the rail over the piston.
- Release the rail into the bottom piston ring groove.

- Do not mix up the top ring and second ring.
- Install the top ring [A] so that the “R” mark [B] faces up.
- Install the second ring [C] so that the “RN” mark [D] faces up.

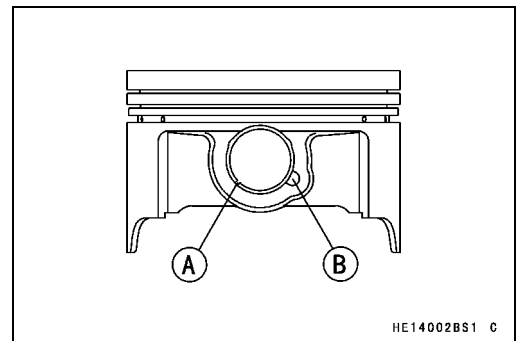


- The piston ring openings must be positioned as shown in the figure. The openings of the oil ring steel rails must be about 30 ~ 40° [F] of angle from the opening of the top ring.

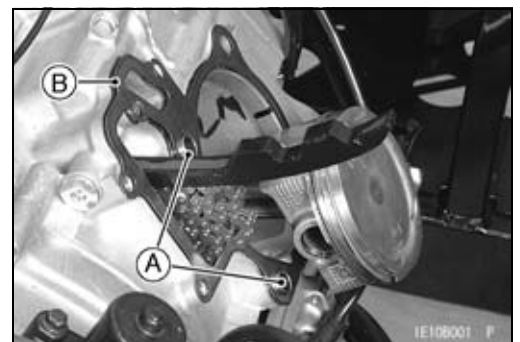
- Top Ring [A]
- Second Ring [B]
- Oil Ring Steel Rails [C]
- Oil Ring Expander [D]
- F mark [E] must be faced toward Front Side for front and rear pistons
- Opening Positions [G]



- Fit a new piston pin snap ring into the side of the piston so that the ring opening [A] does not coincide with the slit [B] of the piston pin hole.
- When installing the piston pin snap ring, compress it only enough to install it and no more.
- Apply engine oil to the cylinder bore and, piston skirt.



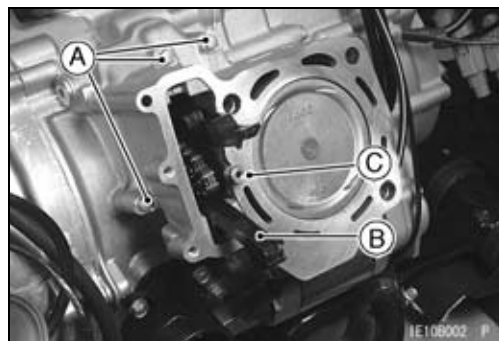
- Install:
 - Dowel Pins [A]
 - New Cylinder Base Gasket [B]



5-40 ENGINE TOP END

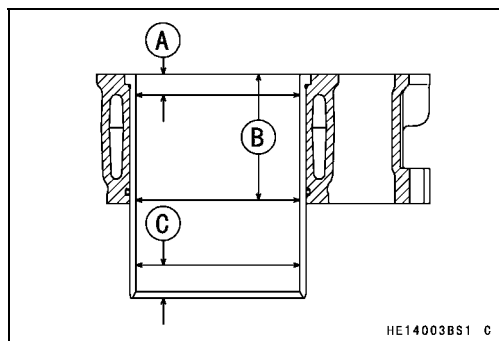
Cylinder and Piston

- Install:
Cylinder
- Tighten:
Torque - Cylinder Bolts [A]: 9.8 N·m (1.0 kgf·m, 87 in·lb)
- Install:
Chain Guide [B]
- Apply grease to the O-ring on the oil pipe [C], and insert the pipe.



Cylinder Wear Inspection

- Since there is a difference in cylinder wear in different directions, take a side-to-side and a front-to-back measurement at each of the three locations (total of six measurements) shown in the figure.
- ★ If any of the cylinder inside diameter measurements exceeds the service limit, replace the cylinder.
 - 10 mm (0.4 in.) [A]
 - 60 mm (2.4 in.) [B]
 - 20 mm (0.8 in.) [C]



Cylinder Inside Diameter

Standard: 84.994 ~ 85.006 mm (3.3462 ~ 3.3467 in.), and less than 0.01 mm (0.0004 in.) difference between any two measurements.

Service Limit: 85.09 mm (3.3500 in.), or more than 0.05 mm (0.0020 in.) difference between any two measurements.

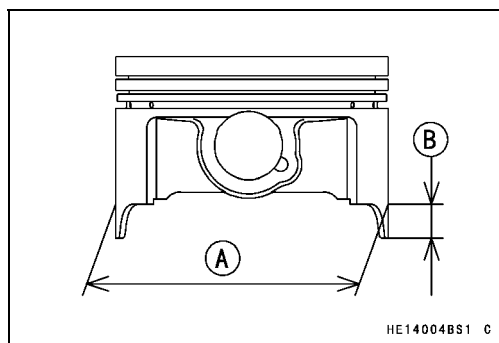
Piston Wear Inspection

- Measure the outside diameter [A] of each piston 5 mm (0.20 in.) [B] up from the bottom of the piston at a right angle to the direction of the piston pin.
- ★ If the measurement is under service limit, replace the piston.

Piston Diameter

Standard: 84.964 ~ 84.979 mm (3.3450 ~ 3.3456 in.)

Service Limit: 84.81 mm (3.3390 in.)



Piston/Cylinder Clearance Inspection

- Subtract the piston diameter from the cylinder inside diameter to get the piston/cylinder clearance.

Piston/Cylinder Clearance

Standard: 0.015 ~ 0.042 mm (0.0006 ~ 0.0017 in.)

Cylinder and Piston

Piston Ring, Piston Ring Groove Wear Inspection

- Check for uneven groove wear by inspecting the ring seating.
- ★ The rings should fit perfectly parallel to groove surfaces. If not, replace the piston and all the piston rings.
- With the piston rings in their grooves, make several measurements with a thickness gauge [A] to determine piston ring/groove clearance.

Piston Ring/Groove Clearance

Standard:

Top	0.04 ~ 0.08 mm (0.0016 ~ 0.0031 in.)
Second	0.03 ~ 0.07 mm (0.0012 ~ 0.0028 in.)

Service Limit:

Top	0.18 mm (0.0071 in.)
Second	0.17 mm (0.0067 in.)

- ★ If the piston ring/groove clearance is greater than the service limit, measure the ring thickness and groove width as follows to decide whether to replace the rings, the piston or both.

Piston Ring Groove Width Inspection

- Measure the piston ring groove width.
- Use a vernier caliper at several points around the piston.

Piston Ring Groove Width

Standard:

Top	1.03 ~ 1.05 mm (0.0406 ~ 0.0413 in.)
Second	1.02 ~ 1.04 mm (0.0402 ~ 0.0409 in.)

Service Limit:

Top	1.13 mm (0.0445 in.)
Second	1.12 mm (0.0441 in.)

- ★ If the width of any of the two grooves is wider than the service limit at any point, replace the piston.

Piston Ring Thickness Inspection

- Measure the piston ring thickness.
- Use a micrometer to measure at several points around the ring.

Piston Ring Thickness

Standard:

Top	0.97 ~ 0.99 mm (0.0382 ~ 0.0390 in.)
Second	0.97 ~ 0.99 mm (0.0382 ~ 0.0390 in.)

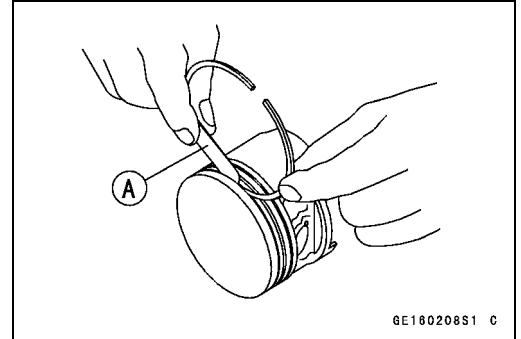
Service Limit:

Top	0.90 mm (0.0354 in.)
Second	0.90 mm (0.0354 in.)

- ★ If any of the measurements is less than the service limit on either of the rings, replace all the rings.

NOTE

- When using new rings in a used piston, check for uneven groove wear. The rings should fit perfectly parallel to the groove sides. If not, replace the piston.



5-42 ENGINE TOP END

Cylinder and Piston

Piston Ring End Gap Inspection

- Place the piston ring [A] inside the cylinder, using the piston to locate the ring squarely in place. Set it close to the bottom of the cylinder, where cylinder wear is low.
- Measure the gap [B] between the ends of the ring with a thickness gauge.

Piston Ring End Gap

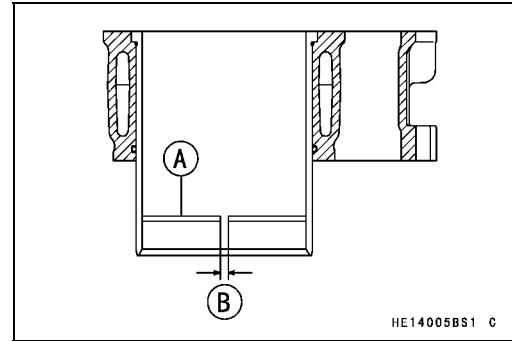
Standard:

Top	0.20 ~ 0.30 mm (0.0079 ~ 0.0118 in.)
Second	0.30 ~ 0.45 mm (0.0118 ~ 0.0177 in.)
Oil	0.20 ~ 0.70 mm (0.0079 ~ 0.0276 in.)

Service Limit:

Top	0.60 mm (0.0236 in.)
Second	0.75 mm (0.0295 in.)
Oil	1.00 mm (0.0394 in.)

- ★ If the end gap of either ring is greater than the service limit, replace all the rings.



Exhaust System

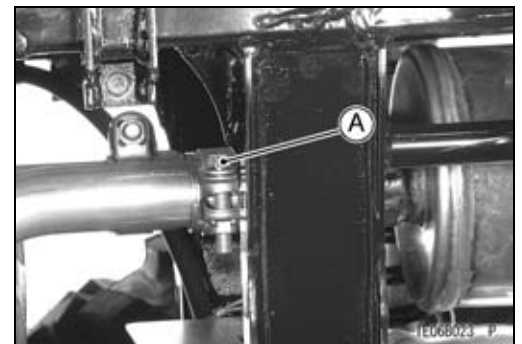
This vehicle is equipped with a spark arrester approved for off-road use by the United States Forest Service. It must be properly maintained to ensure its efficiency. In accordance with the Periodic Maintenance Chart, clean the spark arrester.

Spark Arrester Cleaning

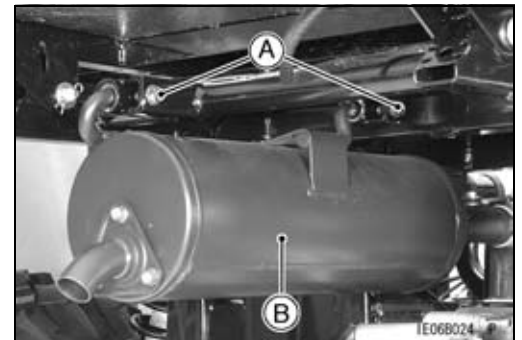
- Refer to the Spark Arrester Cleaning in the Periodic Maintenance chapter.

Muffler and Exhaust Pipe Removal

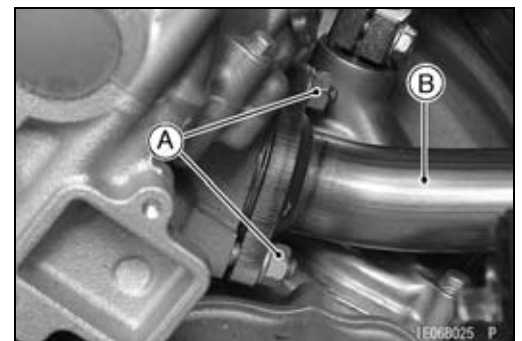
- Remove:
 - Seat Lower Cover (see Seat Lower Cover Removal in the Frame chapter)
 - Engine Bottom Cover (see Engine Bottom Cover Removal in the Frame chapter)
- Loosen:
 - Muffler Clamp Bolts [A] (both sides)



- Remove:
 - Muffler Mounting Bolts [A] and Washers
 - Muffler [B]



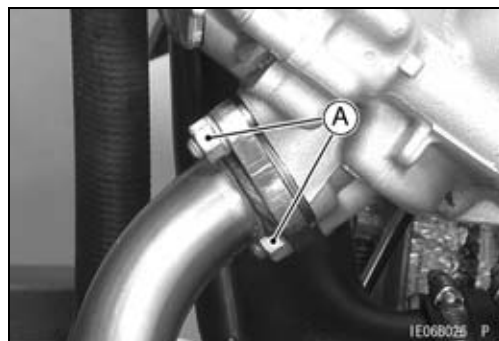
- Remove:
 - Rear Exhaust Pipe Nuts [A]
 - Rear Exhaust Pipe [B]



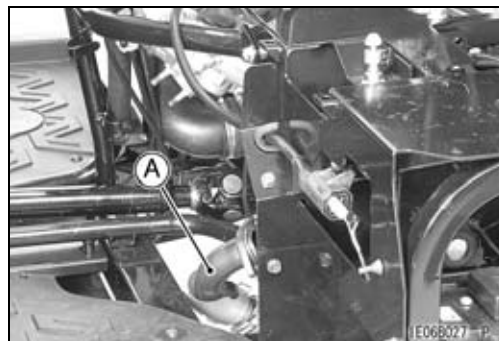
5-44 ENGINE TOP END

Exhaust System

- Remove:
Front Exhaust Pipe Nuts [A]

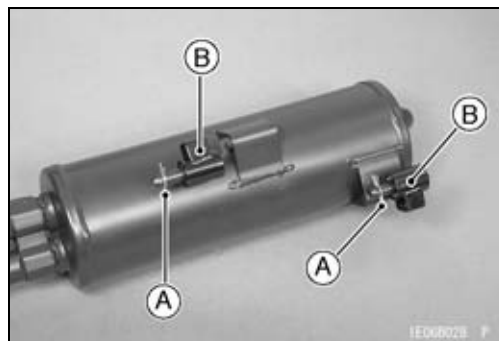


- Remove:
Front Exhaust Pipe [A]

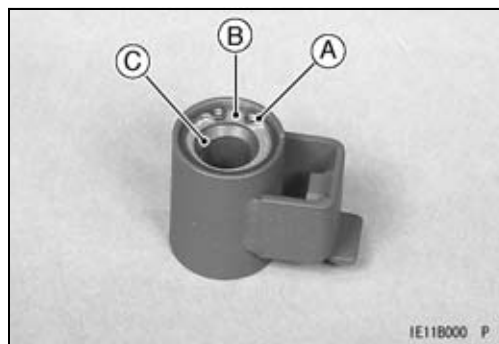


- When removing the muffler bracket dampers, do as follows.

- Remove:
Clips [A]
Bracket [B]



- Remove:
Circlips [A] and Washers [B] (both sides)
Damper [C]



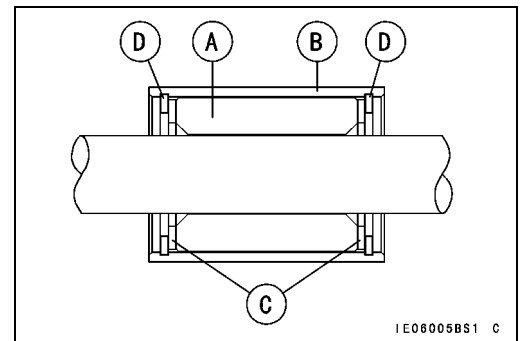
Exhaust System

Exhaust System Inspection

- Before removing the exhaust system, check for signs of leakage at the exhaust pipe gasket in the cylinder head and at the muffler clamp.
- ★ If there are signs of leakage around the exhaust pipe gasket, it should be replaced. If the muffler-to-exhaust pipe joint leaks, tighten the clamp.
- Remove the exhaust pipe and muffler (see Muffler and Exhaust Pipe Removal).
- Inspect the gasket for damage and signs of leakage.
- ★ If the gasket is damaged or has been leaking, replace it.
- Check the exhaust pipe and muffler for dents, cracks, rust and holes.
- ★ If the exhaust pipe or muffler is damaged or has holes, it should be replaced for best performance and least noise.

Muffler and Exhaust Pipe Installation

- When installing the muffler bracket dampers [A], do as follows.
- Install the following parts in the muffler bracket [B].
 - Muffler Bracket Damper
 - Washers [C]
 - New Circlips [D]
- Special Tool - Inside Circlip Pliers: 57001-143**
- Install the muffler brackets to the muffler.

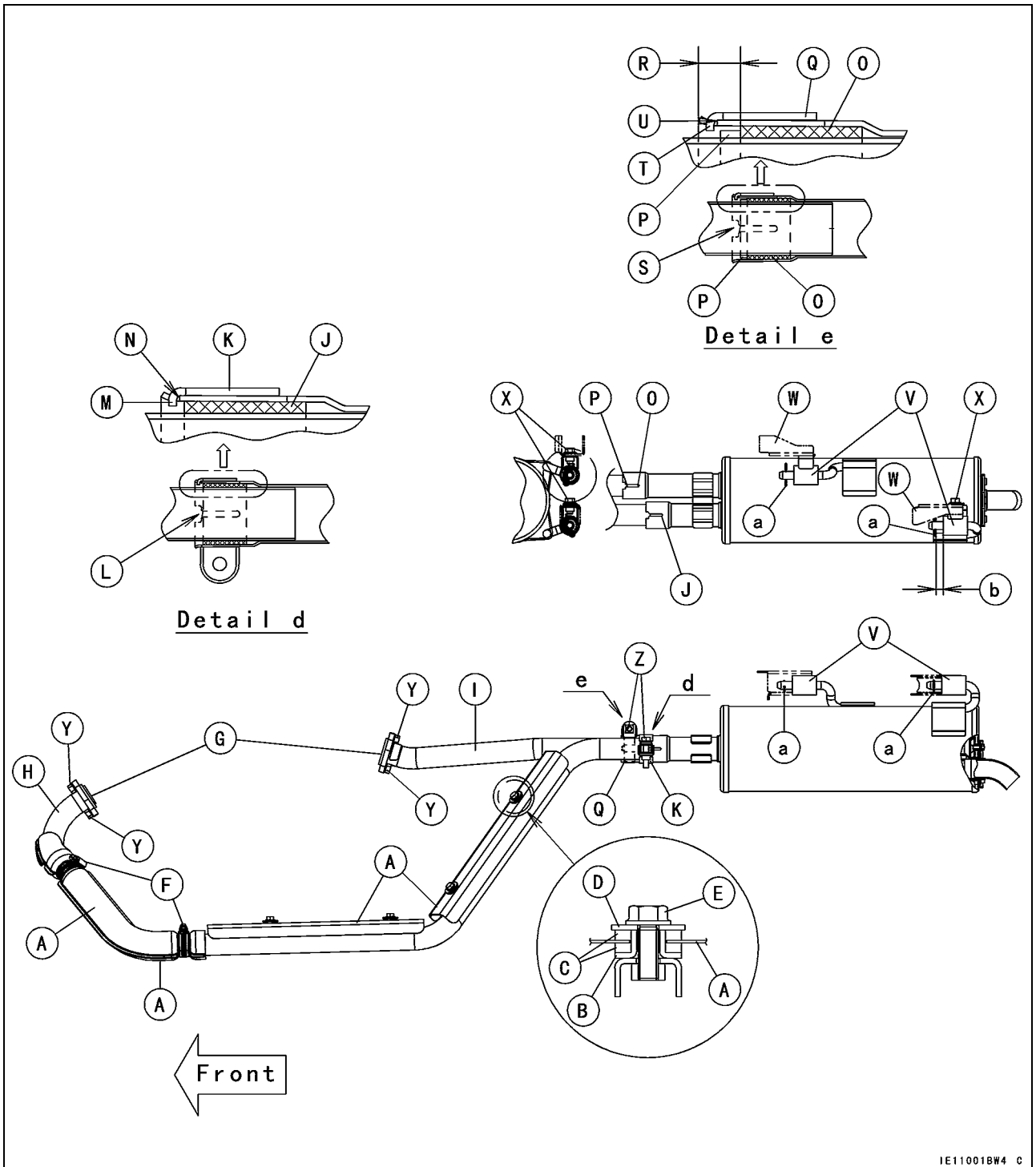


5-46 ENGINE TOP END

Exhaust System

- When installing the exhaust pipe covers [A], do as follows.
 - Install:
 - Exhaust Pipe Covers
 - Collars [B]
 - Dampers [C]
 - Washers [D]
 - Exhaust Pipe Cover Bolts [E]
 - Tighten:
 - Torque - Exhaust Pipe Cover Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)**
- Install the cover clamp screws [F] as shown in the figure.
- Replace the exhaust pipe gaskets [G] with new ones.
- Install:
 - New Exhaust Pipe Gaskets
 - Front Exhaust Pipe [H] and Exhaust Pipe Nuts (lightly)
 - Rear Exhaust Pipe [I] and Exhaust Pipe Nuts (lightly)
- Replace and muffler gasket with new ones.
- Install the new muffler gasket [J] and clamp [K] to the front side inlet pipe of the muffler as follows.
- Install the new muffler gasket more deeply than the first wide ditch [L] of the inlet pipe and contact the clamp claws [M] to the bottom [N] of the ditch.
- Install the new muffler gasket [O], collar [P] and clamp [Q] to the rear side inlet pipe of the muffler as follows.
- Install the new muffler gasket to the bottom of the inlet pipe.
- The distance [R] between the inlet pipe end and gasket end is 8 ± 0.5 mm (0.31 ± 0.02 in.).
- Install the collar more deeply than the first wide ditch [S] of the rear side inlet pipe and contact the clamp claws [T] to the bottoms [U] of the ditch.
- Install the muffler to the exhaust pipes.
- Install the muffler bracket [V] to the bracket [W] of the frame side.
- Install:
 - Washer and Muffler Mounting Bolts [X] (lightly)
- Tighten:
 - Torque - Exhaust Pipe Nuts [Y]: 17 N·m (1.7 kgf·m, 12 ft·lb)**
- Push the muffler to front, and then confirm that the gasket entered into the muffler.
- Tighten the muffler clamp bolts [Z] in the direction of the figure.
 - Torque - Muffler Clamp Bolts: 15 N·m (1.5 kgf·m, 11 ft·lb)**
- Tighten:
 - Torque - Muffler Mounting Bolts: 28 N·m (2.8 kgf·m, 21 ft·lb)**
- Install:
 - Snap Pins [a] (Reference Distance [b]: 10 mm (0.39 in.))
- After installation, thoroughly warm up the engine, wait until the engine cools down, and then retighten the exhaust pipe nuts, muffler clamp bolts and muffler mounting bolts.

Exhaust System



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