

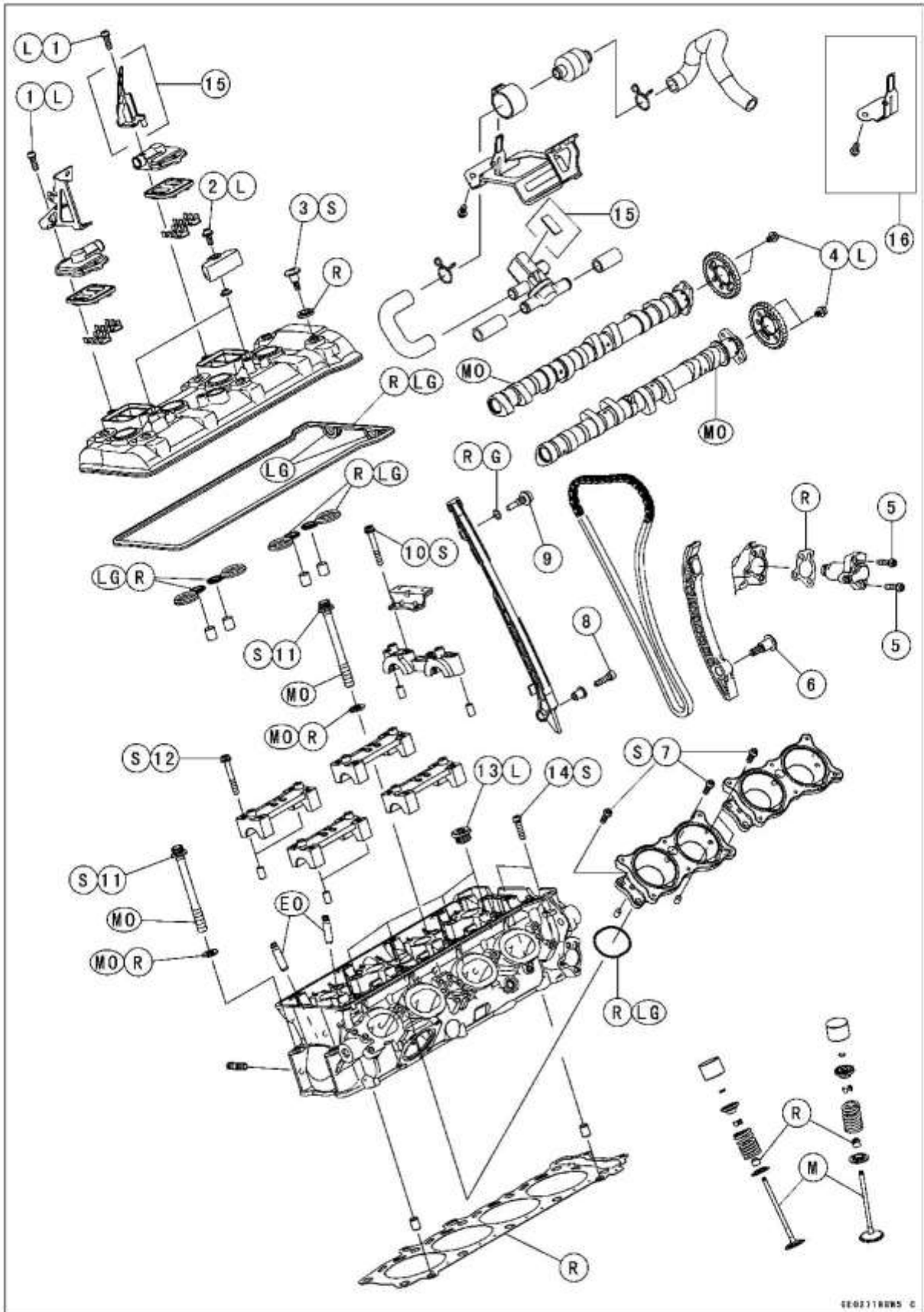
Engine Top End

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5-2 ENGINE TOP END

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Air Suction Valve Cover Bolts	10	1.0	89 in·lb	L
2	Sub Cover Bolts	10	1.0	89 in·lb	L
3	Cylinder Head Cover Bolts	10	1.0	89 in·lb	S
4	Camshaft Sprocket Bolts	15	1.5	11	L
5	Camshaft Chain Tensioner Mounting Bolts	10	1.0	89 in·lb	
6	Rear Camshaft Chain Guide Bolt	25	2.5	18	
7	Throttle Body Assy Holder Bolts	10	1.0	89 in·lb	S
8	Front Camshaft Chain Guide Bolt (Lower)	12	1.2	106 in·lb	
9	Front Camshaft Chain Guide Bolt (Upper)	25	2.5	18	
10	Upper Camshaft Chain Guide Bolts	12	1.2	106 in·lb	S
11	Cylinder Head Bolts (M10), First	30	3.1	22	MO, S
	Cylinder Head Bolts (M10), Final	67	6.8	49	MO, S
12	Camshaft Cap Bolts	12	1.2	106 in·lb	S
13	Cylinder Head Plugs	20	2.0	15	L
14	Cylinder Head Bolts (M6)	12	1.2	106 in·lb	S

15. Other than US and CA Models

16. US and CA Models

EO: Apply engine oil.

G: Apply grease.

L: Apply a non-permanent locking agent.

LG: Apply liquid gasket.

M: Apply molybdenum disulfide grease.

MO: Apply molybdenum disulfide oil solution.

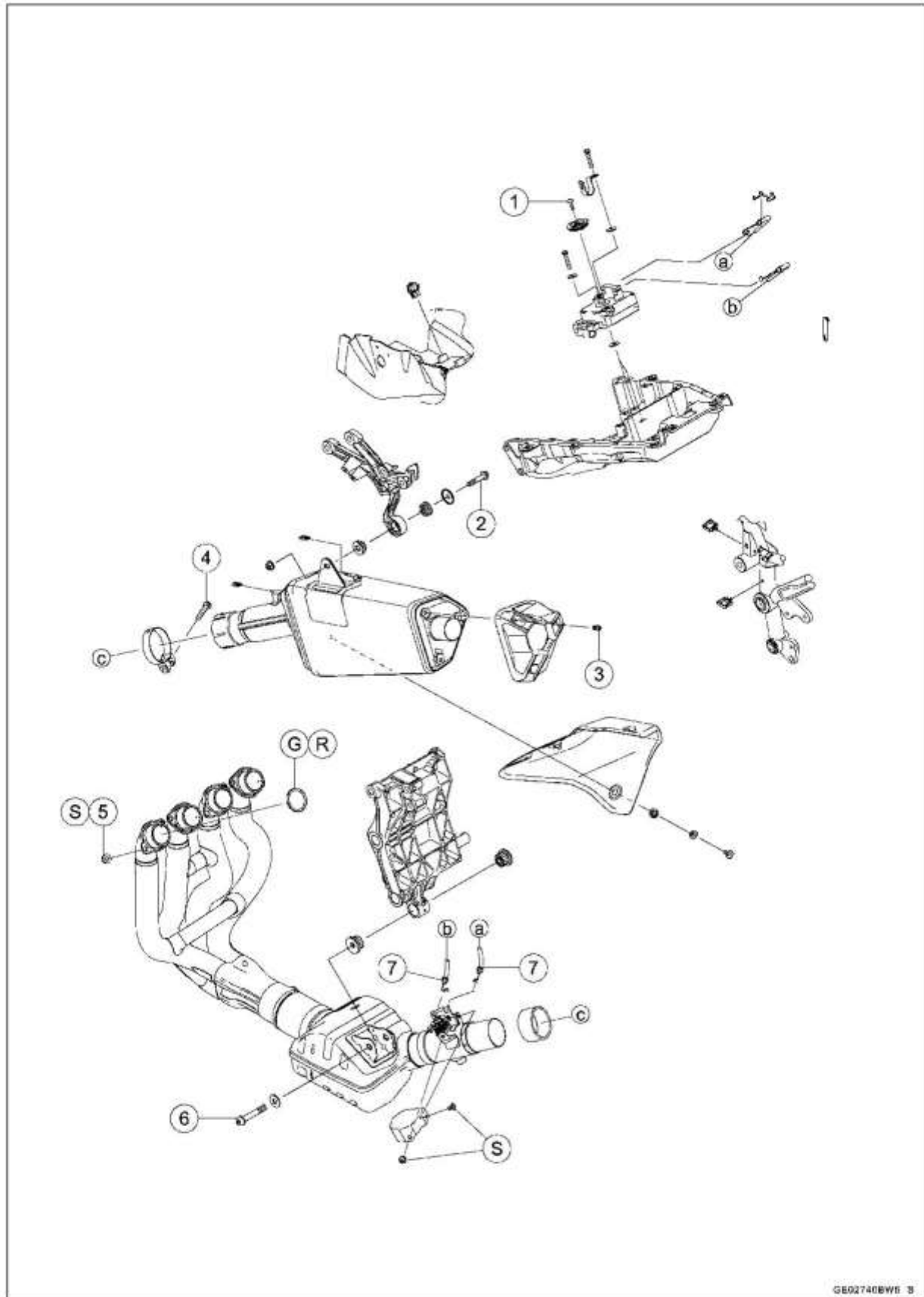
(mixture of the engine oil and molybdenum disulfide grease in a weight ratio 10:1)

R: Replacement Parts

S: Follow the specified tightening sequence.

5-4 ENGINE TOP END

Exploded View



Exploded View

No.	Fastener	Torque			Remarks
		N·m	kgf·m	ft·lb	
1	Exhaust Butterfly Valve Actuator Pulley Bolt	5.0	0.51	44 in·lb	
2	Muffler Body Mounting Bolt	25	2.5	18	
3	Muffler Body End Cover Bolts	10	1.0	89 in·lb	
4	Muffler Body Clamp Bolt	17	1.7	13	
5	Exhaust Pipe Holder Nuts	20	2.0	15	S
6	Exhaust Pipe Mounting Bolt	34	3.5	25	
7	Exhaust Butterfly Valve Cable Locknuts	5.5	0.56	49 in·lb	

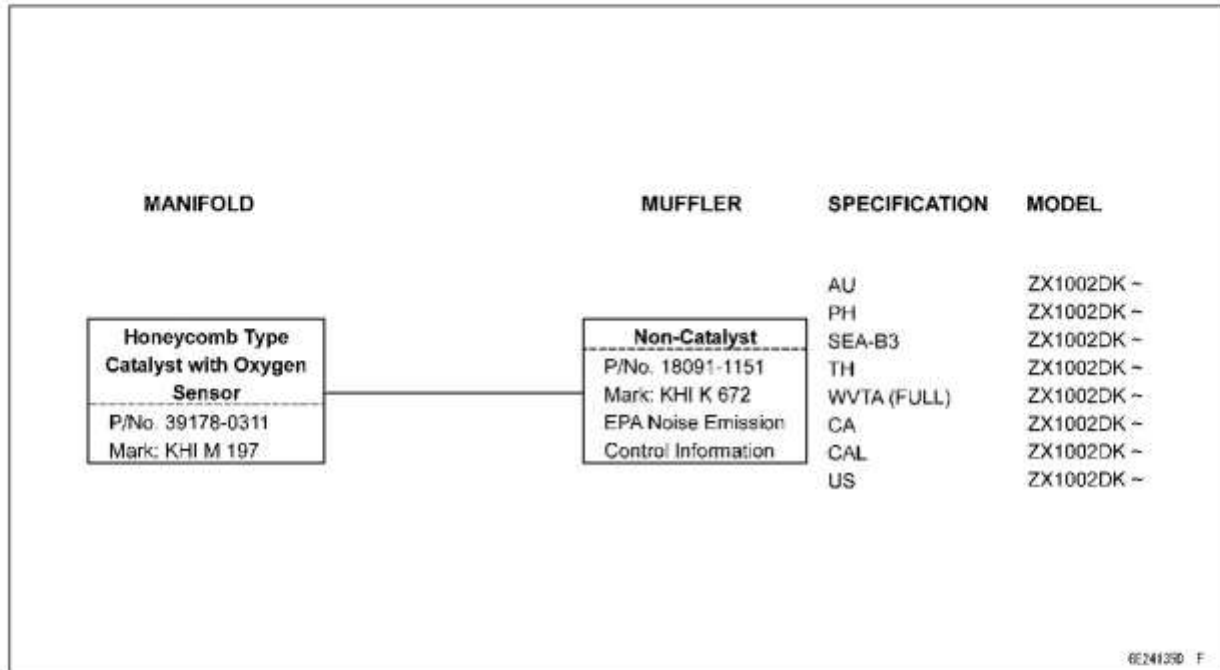
G: Apply grease.

R: Replacement Parts

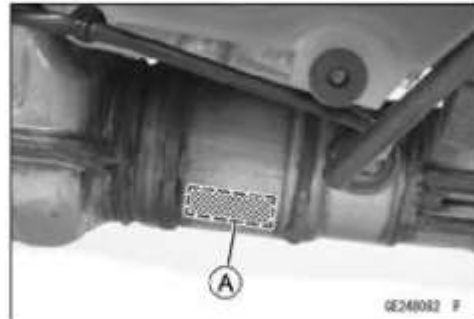
S: Follow the specified tightening sequence.

5-6 ENGINE TOP END

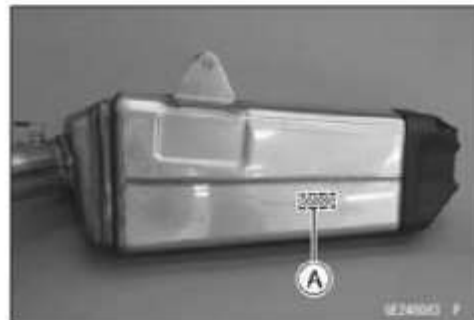
Exhaust System Identification



Exhaust Pipe Mark Position [A]

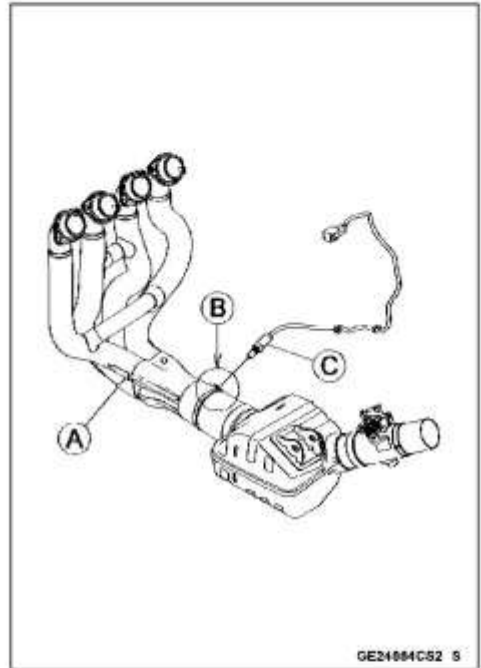


Muffler Mark Position [A]

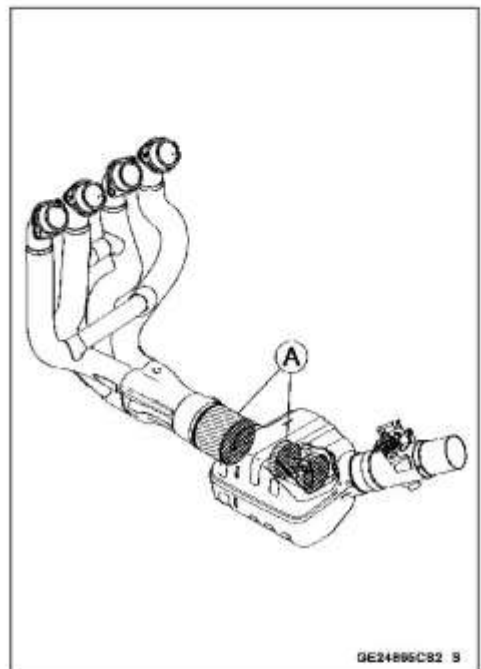


Exhaust System Identification

Exhaust Pipe [A] with Hole [B] for Oxygen Sensor [C]



Honeycomb Type Catalyst Positions [A]



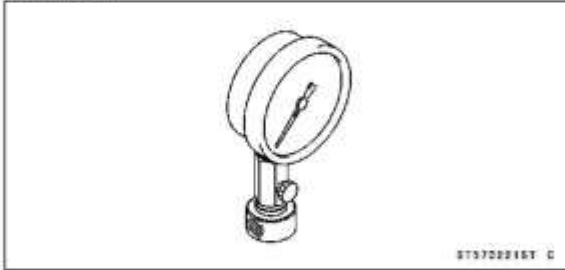
5-8 ENGINE TOP END

Specifications

Item	Standard	Service Limit
Camshafts		
Cam Height:		
Exhaust	33.143 ~ 33.257 mm (1.3048 ~ 1.3093 in.)	33.04 mm (1.301 in.)
Intake	33.143 ~ 33.257 mm (1.3048 ~ 1.3093 in.)	33.04 mm (1.301 in.)
Camshaft Journal/Cap Clearance	0.038 ~ 0.081 mm (0.0015 ~ 0.0032 in.)	0.17 mm (0.0067 in.)
Camshaft Journal Diameter	23.940 ~ 23.962 mm (0.94252 ~ 0.94338 in.)	23.91 mm (0.9413 in.)
Camshaft Bearing Inside Diameter	24.000 ~ 24.021 mm (0.94488 ~ 0.94571 in.)	24.08 mm (0.9480 in.)
Camshaft Runout	TIR 0.02 mm (0.0008 in.) or less	TIR 0.1 mm (0.004 in.)
Cylinder Head		
Cylinder Compression	(Usable Range) 1 064 ~ 1 618 kPa (10.85 ~ 16.50 kgf/cm ² , 154.3 ~ 234.6 psi) @230 r/min (rpm)	---
Cylinder Head Warp	---	0.05 mm (0.002 in.)
Valves		
Valve Clearance:		
Exhaust	0.33 ~ 0.38 mm (0.0130 ~ 0.0150 in.)	---
Intake	0.15 ~ 0.22 mm (0.0059 ~ 0.0087 in.)	---
Valve Head Thickness:		
Exhaust	0.8 mm (0.031 in.)	0.4 mm (0.02 in.)
Intake	0.5 mm (0.020 in.)	0.3 mm (0.01 in.)
Valve Stem Bend	TIR 0.01 mm (0.0004 in.) or less	TIR 0.05 mm (0.002 in.)
Valve Stem Diameter:		
Exhaust	4.455 ~ 4.470 mm (0.1754 ~ 0.1760 in.)	4.44 mm (0.175 in.)
Intake	4.475 ~ 4.490 mm (0.1762 ~ 0.1768 in.)	4.46 mm (0.176 in.)
Valve Guide Inside Diameter:		
Exhaust	4.500 ~ 4.512 mm (0.1772 ~ 0.1776 in.)	4.58 mm (0.180 in.)
Intake	4.500 ~ 4.512 mm (0.1772 ~ 0.1776 in.)	4.58 mm (0.180 in.)
Valve/Valve Guide Clearance (Wobble Method):		
Exhaust	0.09 ~ 0.16 mm (0.0035 ~ 0.0063 in.)	0.36 mm (0.014 in.)
Intake	0.03 ~ 0.11 mm (0.0012 ~ 0.0043 in.)	0.30 mm (0.012 in.)
Valve Seat Cutting Angle	32°, 45°, 60°	---
Valve Seating Surface:		
Outside Diameter:		
Exhaust	25.2 ~ 25.4 mm (0.99 ~ 1.00 in.)	---
Intake	29.4 ~ 29.6 mm (1.16 ~ 1.17 in.)	---
Width:		
Exhaust	1.6 ~ 2.0 mm (0.063 ~ 0.079 in.)	---
Intake	0.5 ~ 1.0 mm (0.020 ~ 0.039 in.)	---
Valve Spring Free Length:		
Exhaust	36.6 mm (1.44 in.)	35.4 mm (1.39 in.)
Intake	37.6 mm (1.48 in.)	36.3 mm (1.43 in.)

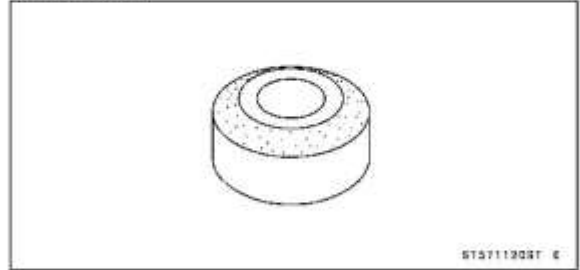
Special Tools and Sealants

Compression Gauge, 20 kgf/cm²:
57001-221



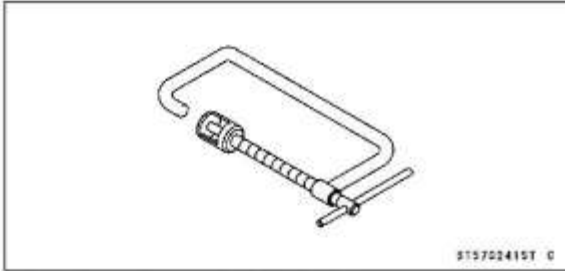
57002415T ©

Valve Seat Cutter, 32° - φ30:
57001-1120



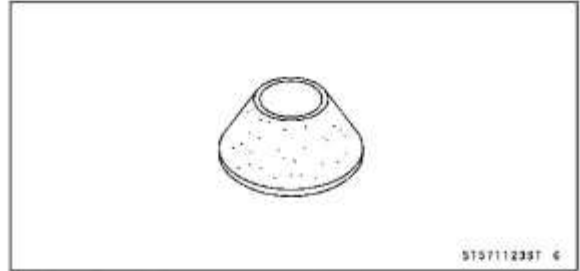
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Valve Spring Compressor Assembly:
57001-241



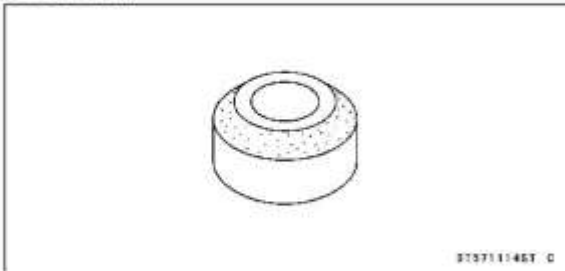
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Valve Seat Cutter, 60° - φ30:
57001-1123



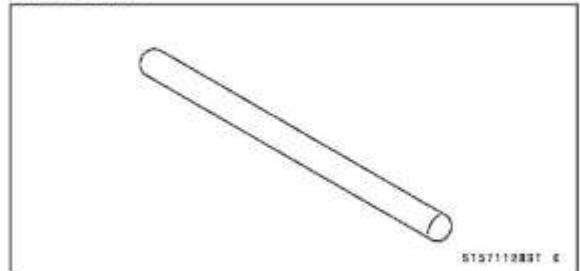
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Valve Seat Cutter, 45° - φ27.5:
57001-1114



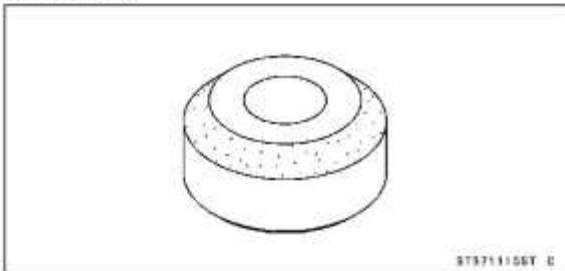
57011145T ©

Valve Seat Cutter Holder Bar:
57001-1128



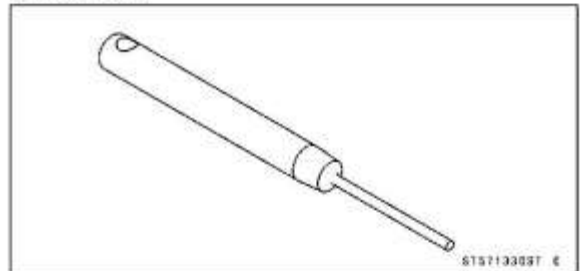
57011285T ©

Valve Seat Cutter, 45° - φ32:
57001-1115



57011155T ©

Valve Seat Cutter Holder, φ4.5:
57001-1330



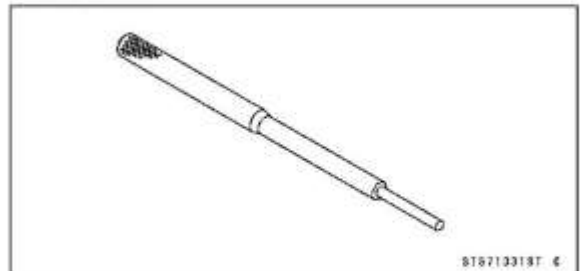
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Valve Seat Cutter, 32° - φ28:
57001-1119



57011195T ©

Valve Guide Arbor, φ4.5:
57001-1331



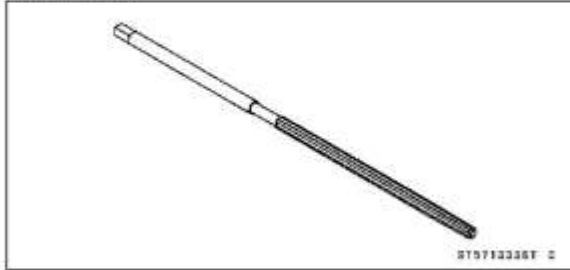
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5-10 ENGINE TOP END

Special Tools and Sealants

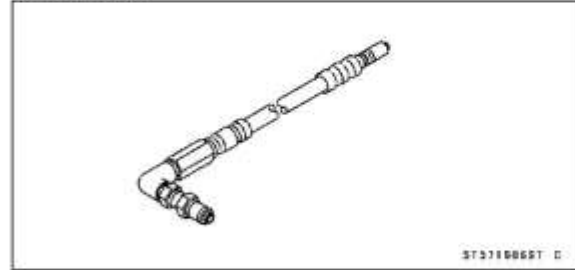
Valve Guide Reamer, $\phi 4.5$:

57001-1333



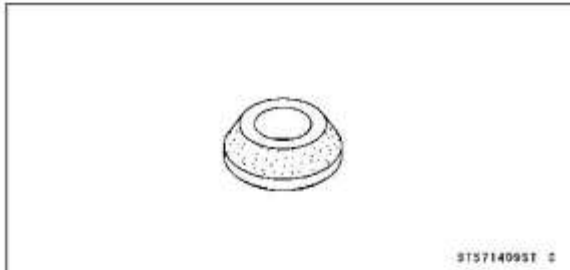
L-Shape Hose:

57001-1606



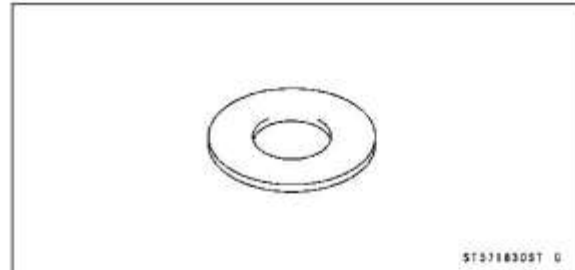
Valve Seat Cutter, 60° - $\phi 27$:

57001-1409



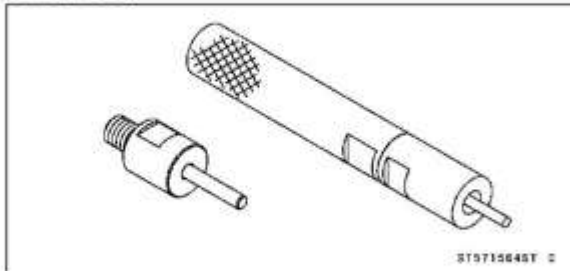
Spacer, $\phi 9.6$:

57001-1830



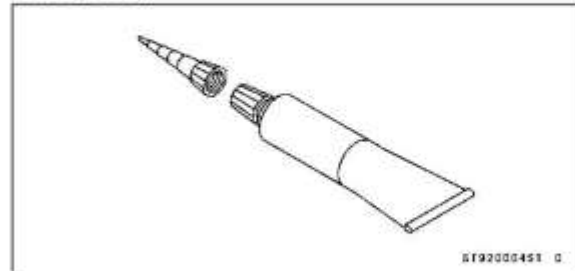
Valve Guide Driver:

57001-1564



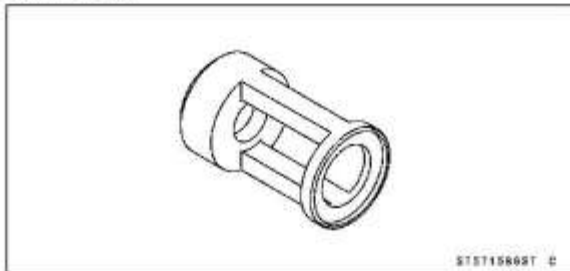
Liquid Gasket, TB1211F:

92104-0004



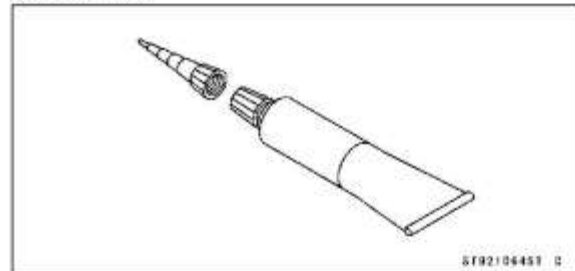
Valve Spring Compressor Adapter, $\phi 24$:

57001-1586



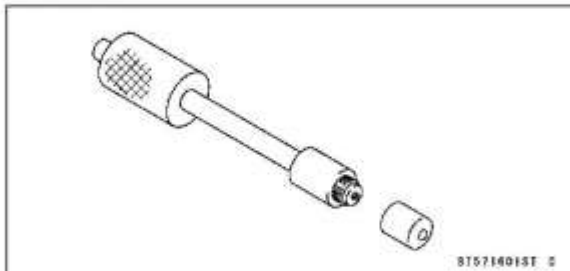
Liquid Gasket, TB1216B:

92104-1064



Compression Gauge Adapter, M10 x 1.0:

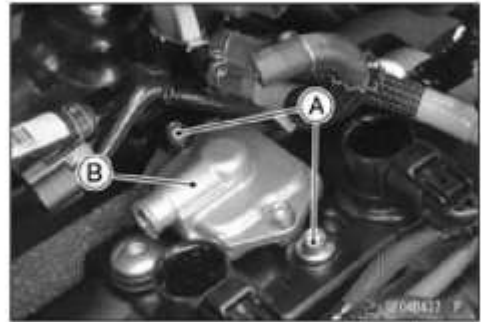
57001-1601



Clean Air System

Air Suction Valve Removal

- Remove:
 - Air Switching Valve (see [Air Switching Valve Removal\(5-12\)](#))
 - Purge Valve (for Supercharger) (see [Purge Valve \(for Supercharger\) Removal\(17-112\)](#))
 - Air Suction Valve Cover Bolts [A] (Both Sides)
 - Air Suction Valve Cover [B] (Both Sides)



- Remove the air suction valve [A] on both sides.

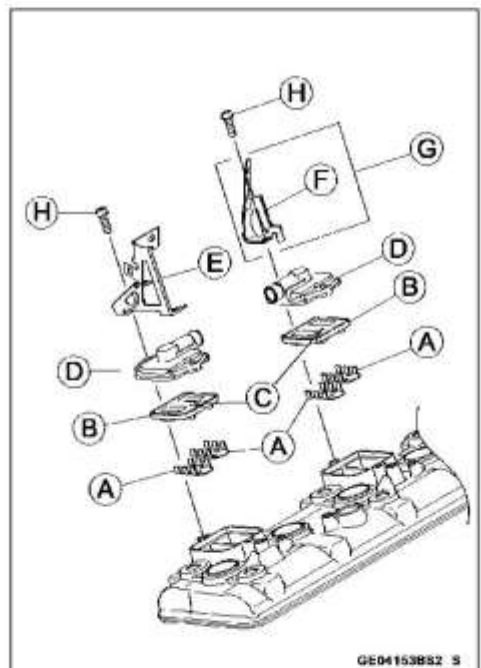


- Remove the plates [A] on both sides.



Air Suction Valve Installation

- Install:
 - Plates [A]
 - Air Suction Valve [B] (with White Mark [C])
 - Air Suction Valve Covers [D]
 - Bracket [E]
 - Bracket [F]
 - Other than US and CA Models [G]
- Apply a non-permanent locking agent to the threads of the air suction valve cover bolts [H].
 - Torque - Air Suction Valve Cover Bolts: 10 N·m (1.0 kgf·m, 89 in·lb)**
- Install the air switching valve (see [Air Switching Valve Installation\(5-13\)](#)).



5-12 ENGINE TOP END

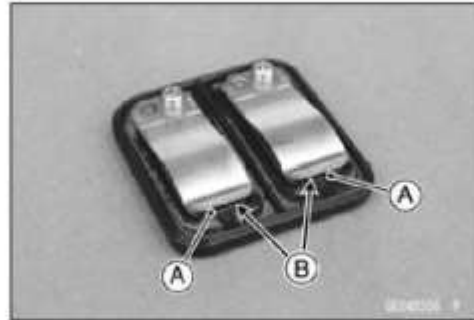
Clean Air System

Air Suction Valve Inspection

- Remove the air suction valve (see [Air Suction Valve Removal\(5-11\)](#)).
- Visually inspect the reeds [A] for cracks, folds, warps, heat damage or other damage.
- ★ If there is any doubt as to the condition of the reeds, replace the air suction valve as an assembly.
- Check the reed contact areas [B] of the valve holder for grooves, scratches, any signs of separation from the holder or heat damage.
- ★ If there is any doubt as to the condition of the reed contact areas, replace the air suction valve as an assembly.
- ★ If any carbon or other foreign particles have accumulated between the reed and the reed contact area, wash the valve assembly clean with a high flash-point solvent.

NOTICE

Do not scrape off the deposits with a scraper as this could damage the rubber, requiring replacement of the suction valve assembly.

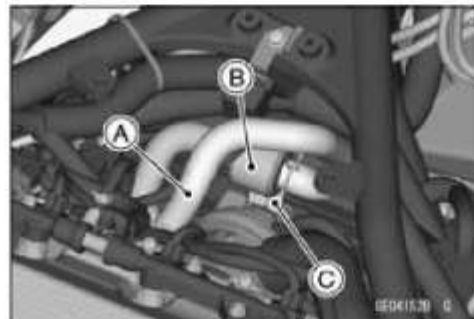


Air Switching Valve Removal

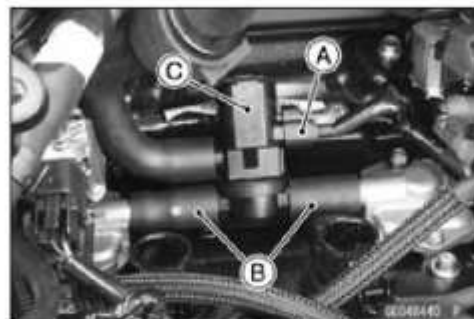
NOTICE

Never drop the air switching valve especially on a hard surface. Such a shock to the air switching valve can damaged it.

- Remove:
 - Fuel Tank (see [Fuel Tank Removal\(3-75\)](#))
- Other than US and CA models, remove the canister bracket (see [Evaporative Emission Control System Inspection \(Other than US and CA Models\)\(2-25\)](#)).
- Disconnect the air switching valve hose [A] from the bracket.
- For US and CA models, remove the air switching valve filter [B] from the bracket [C].



- Disconnect the connector [A].
- Disconnect the hoses [B] from the air suction valve covers, and remove the air switching valve [C].



Clean Air System

Air Switching Valve Installation

- Installation is the reverse of removal.
- Install the air switching valve and hoses (see Cable, Wire, and Hose Routing section (18-2)).

Air Switching Valve Operation Test

- Refer to the Air Suction System Damage Inspection (see Air Suction System Damage Inspection(2-36)).

Air Switching Valve Unit Test

- Refer to the Air Switching Valve Unit Test (see Air Switching Valve Unit Test(16-64)).

Clean Air System Hose Inspection

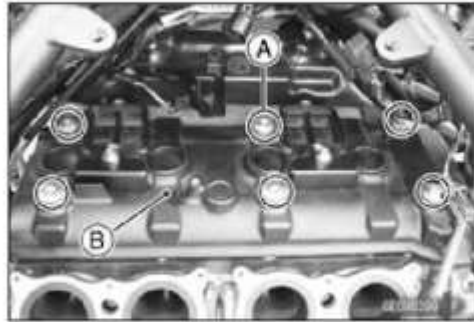
- Be certain that all the hoses are routed without being flattened or kinked, and are connected correctly to the air cleaner housing, air switching valve and air suction valve covers.
- ★ If they are not, correct them. Replace them if they are damaged.

5-14 ENGINE TOP END

Cylinder Head Cover

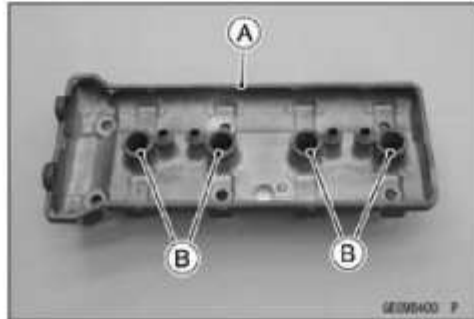
Cylinder Head Cover Removal

- Remove:
 - Air Suction Valves (see Air Suction Valve Removal(5-11))
 - Throttle Body Assy (see Throttle Body Assy Removal(3-59))
 - Stick Coils (see Stick Coil Removal(16-44))
 - Cylinder Head Cover Bolts [A] with Rubber Washers
 - Cylinder Head Cover [B]



Cylinder Head Cover Installation

- Replace the cylinder head cover gasket [A] and plug hole gaskets [B] with new ones.
- Using a high flash-point solvent, clean off any oil or dirt that may be on the mating surface. Dry them with a clean cloth.

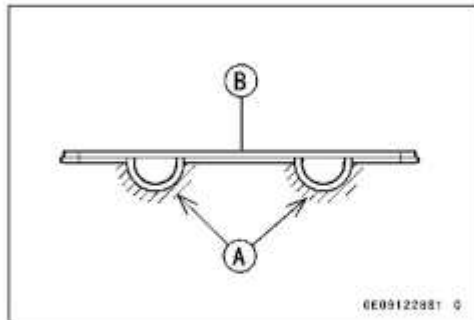


- Apply liquid gasket [A] to the cylinder head cover gasket [B] as shown.

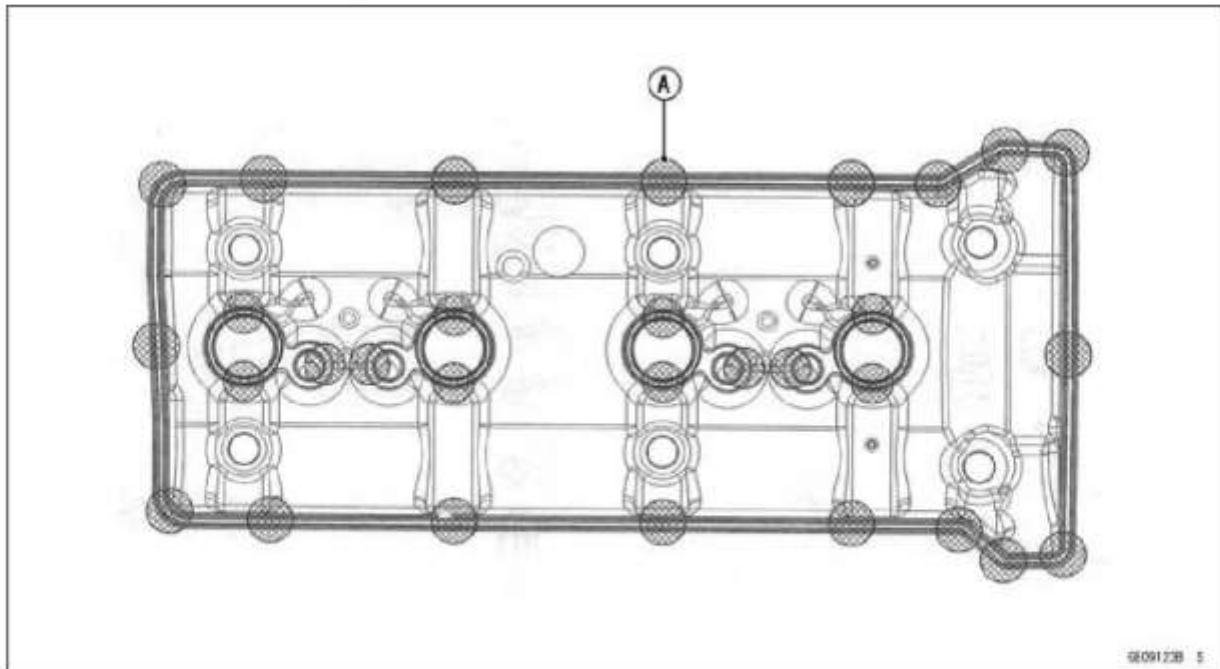
Sealant - Liquid Gasket, TB1216B: 92104-1064

NOTE

○When the liquid gasket is applied to the parts, finish the part assembling before the liquid gasket starts curing (within 20 minutes after the liquid gasket is applied).



- Apply liquid gasket [A] to the cylinder head cover.
 - Sealant - Liquid Gasket, TB1211F: 92104-0004
- Install the gaskets to the cylinder head cover.



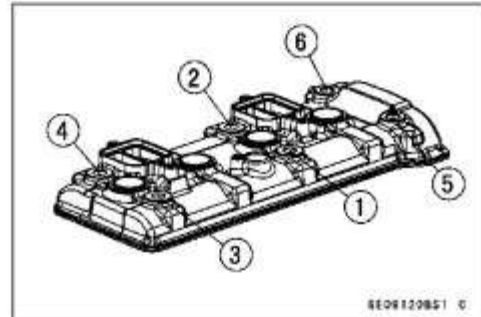
Cylinder Head Cover

- Install the cylinder head cover with the gaskets.
- Replace the rubber washers [A] with new ones.
- Install the rubber washers with the metal side [B] faces upward.



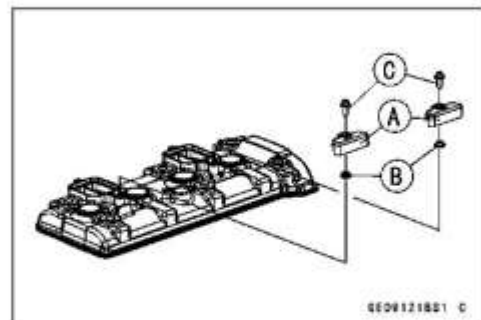
- Tighten the cover bolts following the specified tightening sequence [1 ~ 6].

Torque - Cylinder Head Cover Bolts: 10 N·m (1.0 kgf·m, 89 in·lb)



- When installing the sub covers [A], note the following.
- Install:
 - Collars [B]
 - Sub Covers
- Apply a non-permanent locking agent to the threads of the sub cover bolts [C], and tighten them.

Torque - Sub Cover Bolts: 10 N·m (1.0 kgf·m, 89 in·lb)



- Install the removed parts.

5-16 ENGINE TOP END

Camshaft Chain Tensioner

Camshaft Chain Tensioner Removal

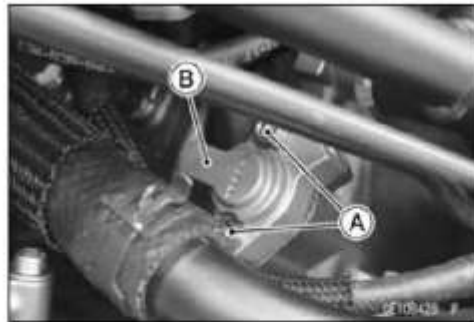
NOTICE

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

When removing the tensioner, do not take out the mounting bolts only halfway. 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 camshaft chain timing, and damage the valves.

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



Camshaft Chain Tensioner Installation

- Opening the snap ring [A], release it and turn the tensioner body [B] clockwise while holding the push rod [C].



Camshaft Chain Tensioner

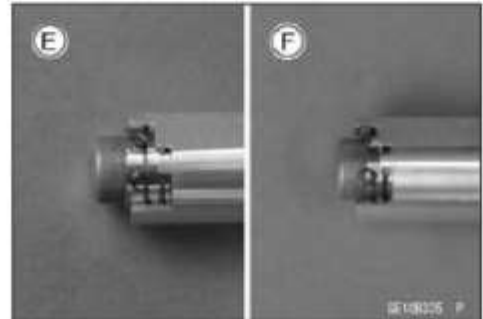
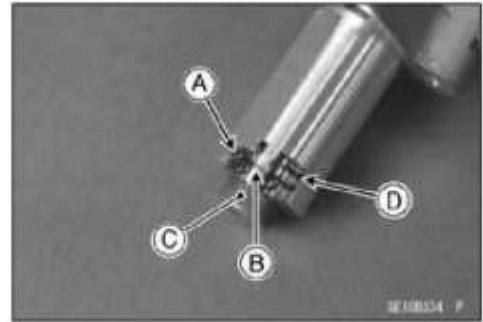
- Turning the tensioner body clockwise, slide the stopper [A] into the groove [B] of the push rod [C].

NOTE

○ Be careful not to fit the snap ring [D] into the groove.

Good [E]

Bad [F]



- Replace the gasket [A] with a new one.
- Install the tensioner body so that the plug [B] faces upward.
- Tighten:

Torque - Camshaft Chain Tensioner Mounting Bolts: 10 N·m (1.0 kgf·m, 89 in·lb)

- Turn the crankshaft 2 turns clockwise to allow the tensioner to expand and recheck the camshaft chain timing.

NOTE

○ You hear the sound from which the push rod moves out.

○ If you do not hear the sound, reassemble the camshaft chain tensioner.



NOTICE

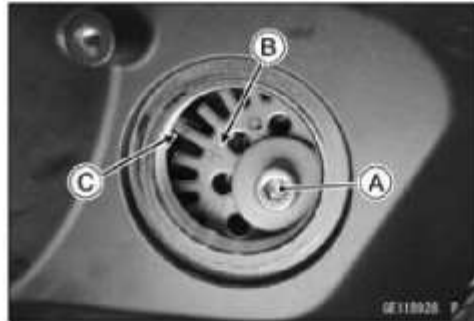
If you start the engine in case that the sound can not be heard, the engine may be damaged.

5-18 ENGINE TOP END

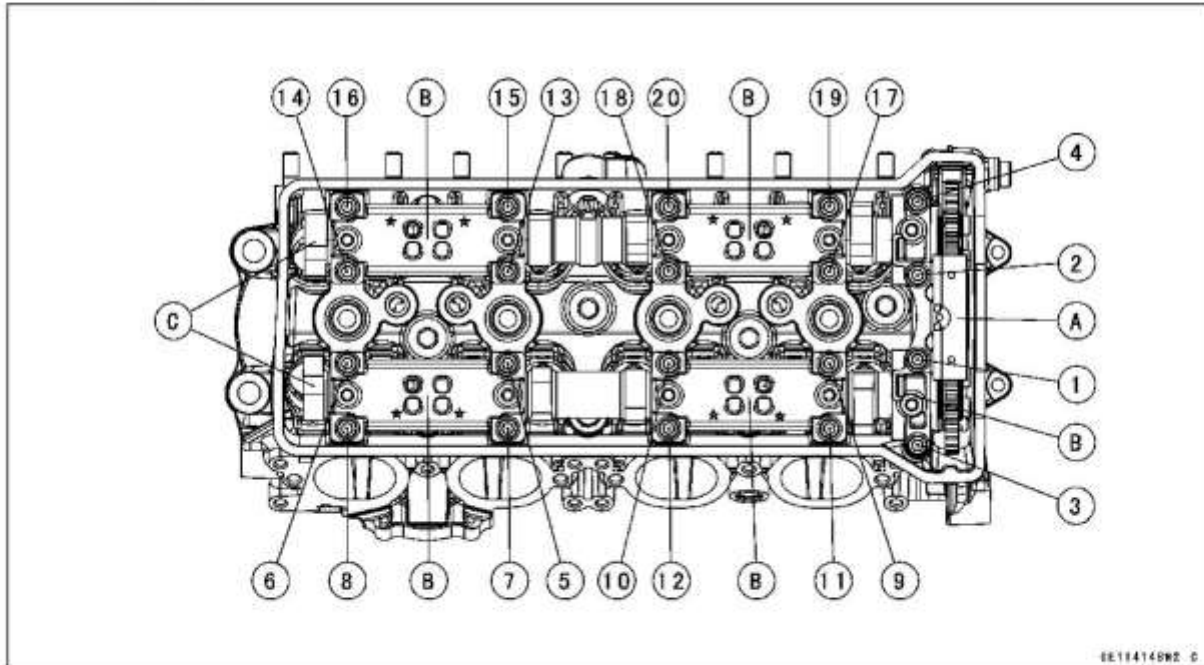
Camshaft, Camshaft Chain

Camshaft Removal

- Remove:
 - Cylinder Head Cover (see [Cylinder Head Cover Removal\(5-14\)](#))
 - Coolant Reserve Tank (see [Coolant Reserve Tank Removal\(4-10\)](#))
- Remove the crankshaft timing plug [A] on the clutch cover.
- Using a wrench on the timing rotor bolt [A], turn the crankshaft clockwise until the line [B] (TDC mark for #1,4 pistons) on the timing rotor is aligned with the mating surface [C] of the crankcase.



- Remove the camshaft chain tensioner (see [Camshaft Chain Tensioner Removal\(5-16\)](#)).
- Loosen the upper camshaft chain guide bolts and camshaft cap bolts gradually and evenly as shown sequence [1 ~ 20], and remove them.
- Remove:
 - Upper Camshaft Chain Guide [A]
 - Camshaft Caps [B]
 - Camshafts [C]
- Stuff a clean cloth into the chain tunnel to keep any parts from dropping into the crankcase.



Camshaft, Camshaft Chain

- Remove:
 - Camshaft Sprocket Bolts [A]
 - Camshaft Sprockets

NOTICE

The crankshaft may be turned while the camshafts are removed. Always pull the chain taut while turning the crankshaft. This avoids kinking the chain on the lower (crankshaft) sprocket. A kinked chain could damage both the chain and the sprocket.

Camshaft Installation

NOTE

○The intake camshaft has the identification groove [A].

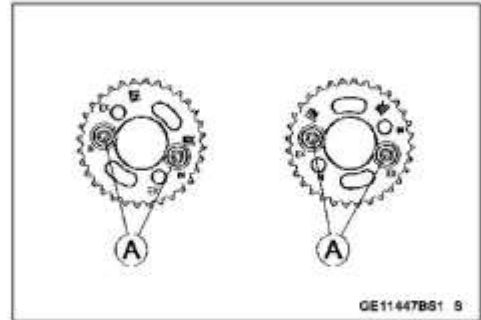
- Install the camshaft sprockets as shown.
 - Intake Camshaft Sprocket [A]
 - Exhaust Camshaft Sprocket [B]
- The intake camshaft sprocket and exhaust camshaft sprocket are identical.
- Apply a non-permanent locking agent to the threads of the camshaft sprocket bolts and tighten them.

Torque - Camshaft Sprocket Bolts: 15 N·m (1.5 kgf·m, 11 ft·lb)

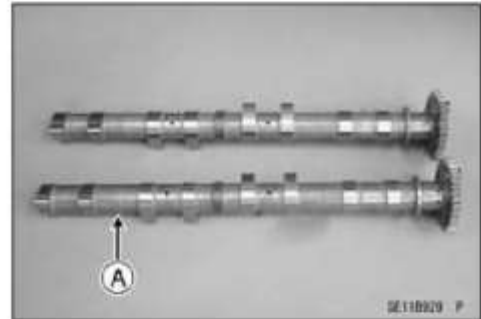
- Apply molybdenum disulfide oil solution to all cam parts, journals and tappets.
- ★If a new camshaft is to be used, apply a thin coat of molybdenum disulfide grease to the cam surfaces.
- Using a wrench on the timing rotor bolt [A], turn the crankshaft clockwise until the line [B] (TDC mark for #1,4 pistons) on the timing rotor is aligned with the mating surface [C] of the crankcase.

NOTICE

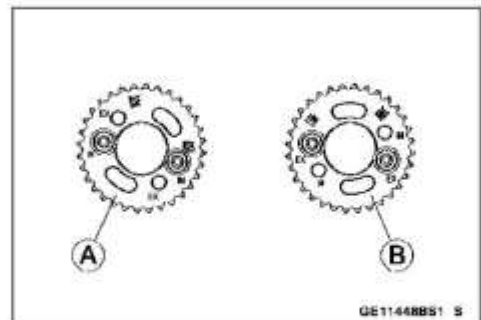
The crankshaft may be turned while the camshafts are removed. Always pull the chain taut while turning the crankshaft. This avoids kinking the chain on the lower sprocket. A kinked chain could damage both the chain and the sprocket.



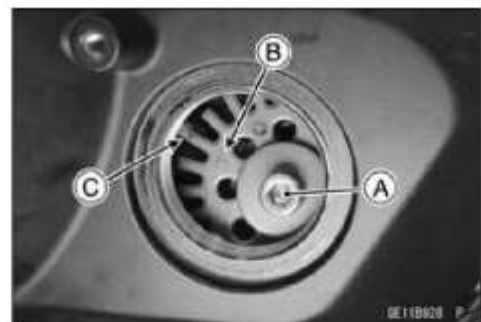
GE11447BS1 8



GE118929 P



GE11448BS1 8

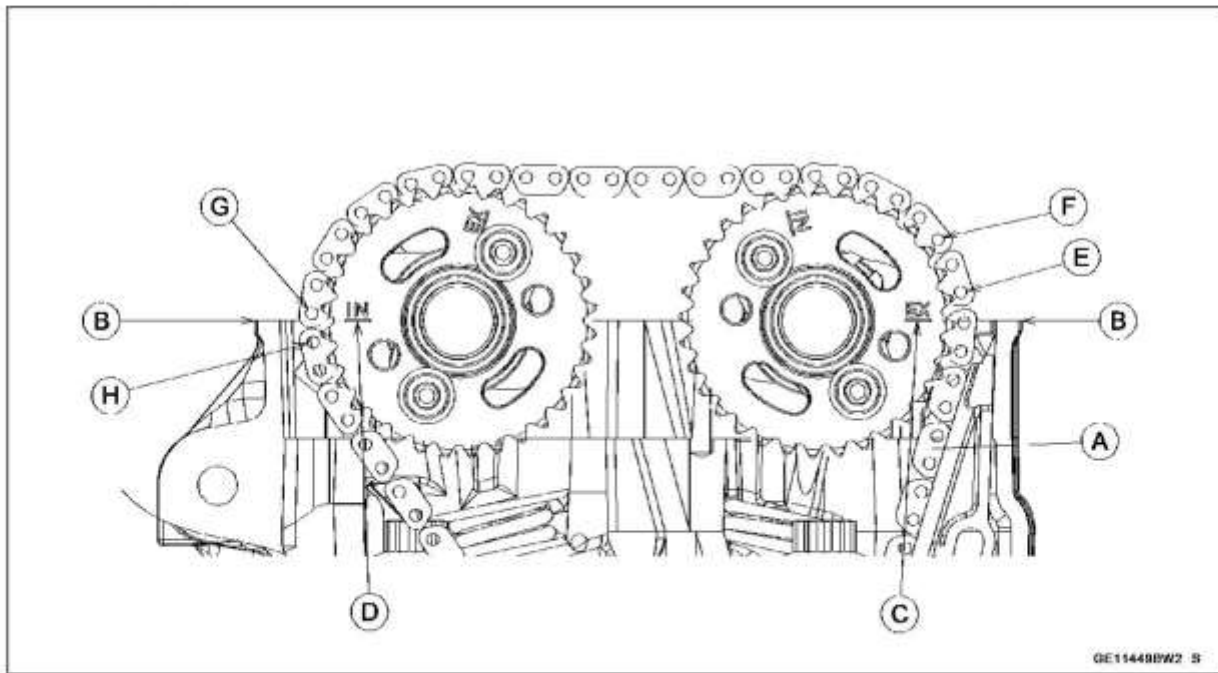


GE118929 P

5-20 ENGINE TOP END

Camshaft, Camshaft Chain

- Pull the tension side (exhaust side) [A] of the chain taut to install the chain.
- Engage the camshaft chain with the sprockets so that timing marks on the sprockets are positioned as shown.
- The timing marks must be aligned with the cylinder head upper surface [B].
 - "EX" Mark [C]
 - "IN" Mark [D]
 - #1 Pin [E]
 - #3 Pin [F]
 - #28 Pin [G]
 - #29 Pin [H]



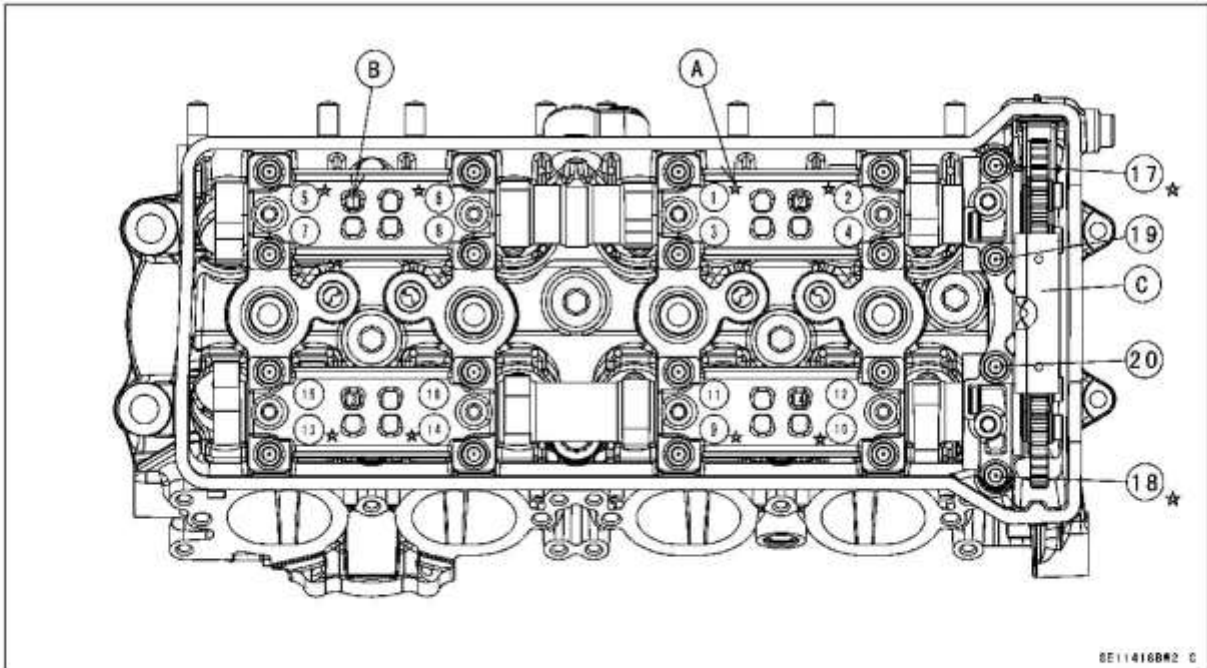
- Apply molybdenum disulfide oil solution to all cam lobes, journals and thrust journals.

Camshaft, Camshaft Chain

- Install the ten dowel pins on the ★ marks [A].
- Install the camshaft cap, following the identification No. [B] and upper camshaft chain guide [C].
- First tighten the all camshaft cap bolts evenly to seat the camshaft in place, then tighten all bolts following the specified tightening sequence [1 ~ 20].

Torque - Camshaft Cap Bolts [1 ~ 18]: 12 N·m (1.2 kgf·m, 106 in·lb)

Upper Camshaft Chain Guide Bolts [19, 20]: 12 N·m (1.2 kgf·m, 106 in·lb)



- Install the camshaft chain tensioner (see [Camshaft Chain Tensioner Installation\(5-16\)](#)).
- Turn the crankshaft 2 turns clockwise to allow the tensioner to expand and recheck the camshaft chain timing.
- Replace the O-ring on the crankshaft timing plug with a new one.
- Apply grease to the O-ring.
- Tighten:

Torque - Crankshaft Timing Plug: 25 N·m (2.5 kgf·m, 18 in·lb)

- Install the removed parts.

5-22 ENGINE TOP END

Camshaft, Camshaft Chain

Camshaft, Camshaft Cap Wear Inspection

- Remove the camshaft caps (see [Camshaft Removal\(5-18\)](#)).
- Cut the strips of plastigage (press gauge) to journal width. Place a strip on each journal parallel to the camshaft installed in the correct position.
- Tighten the camshaft cap bolts and upper camshaft chain guide bolts to the specified torque (see [Camshaft Installation\(5-19\)](#)).

NOTE

○ Do not turn the camshaft when the plastigage is between the journal and camshaft cap.

- Remove the camshaft cap again, measure each clearance between the camshaft journal and the camshaft cap using plastigage [A].

Camshaft Journal/Cap Clearance

Standard: 0.038 ~ 0.081 mm (0.0015 ~ 0.0032 in.)

Service Limit: 0.17 mm (0.0067 in.)

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

Camshaft Journal Diameter

Standard: 23.940 ~ 23.962 mm (0.94252 ~ 0.94338 in.)

Service Limit: 23.91 mm (0.9413 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 service limit, replace the cylinder head unit.

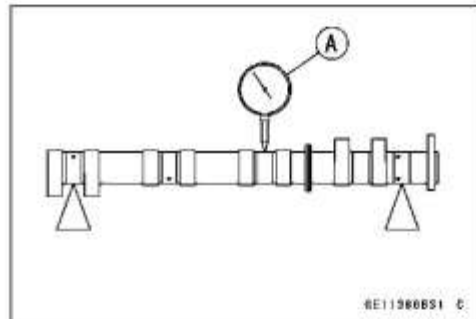
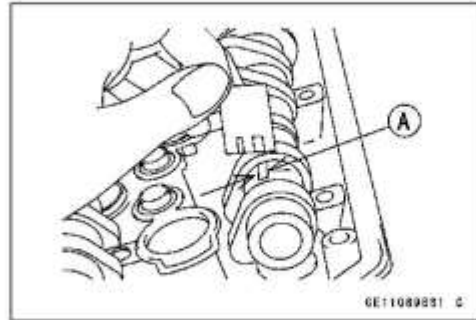
Camshaft Runout Inspection

- Remove the camshafts (see [Camshaft Removal\(5-18\)](#)).
- Set the camshaft in a camshaft alignment jig or on V blocks.
- Measure the runout with a dial gauge [A] at the specified place as shown.
- ★ If the runout exceeds the service limit, replace the camshaft.

Camshaft Runout

Standard: TIR 0.02 mm (0.0008 in.) or less

Service Limit: TIR 0.1 mm (0.004 in.)



Camshaft, Camshaft Chain

Cam Wear Inspection

- Remove the camshafts (see [Camshaft Removal\(5-18\)](#)).
- Measure the height [A] of each cam with a micrometer.
- ★ If the cams are worn down past the service limit, replace the camshaft.

Cam Height

Standard:

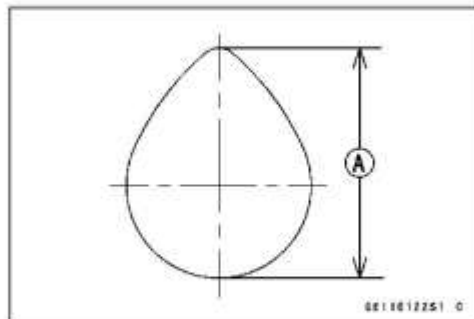
Exhaust 33.143 ~ 33.257 mm (1.3048 ~ 1.3093 in.)

Intake 33.143 ~ 33.257 mm (1.3048 ~ 1.3093 in.)

Service Limit:

Exhaust 33.04 mm (1.301 in.)

Intake 33.04 mm (1.301 in.)



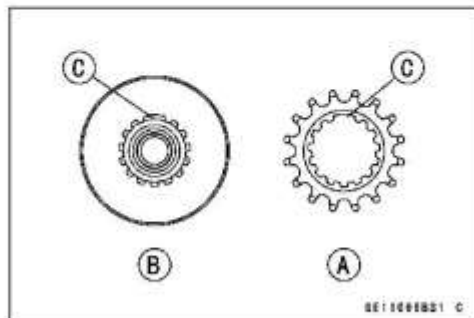
Camshaft Chain Removal

- Remove:
 - Camshaft (see [Camshaft Removal\(5-18\)](#))
 - Timing Rotor (see [Timing Rotor Removal\(16-43\)](#))
 - Rear Camshaft Chain Guide Bolt [A]
 - Rear Camshaft Chain Guide [B]
 - Crankshaft Sprocket [C]
 - Camshaft Chain [D]



Camshaft Chain Installation

- Install the camshaft chain from head side.
- Engage the camshaft chain with the crankshaft sprocket.
- Install the crankshaft sprocket [A] on the crankshaft [B] with their teeth [C] aligned.
- Install the removed parts.



5-24 ENGINE TOP END

Cylinder Head

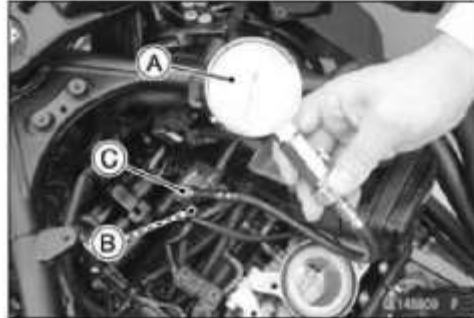
Cylinder Compression Measurement

NOTE

○Use the battery which is fully charged.

- Warm up the engine thoroughly.
- Stop the engine.
- Remove the spark plugs (see [Spark Plug Replacement\(2-73\)](#)).
- Attach the compression gauge [A] and adapter [B] firmly into the spark plug hole.
- Using the starter motor, turn the engine over with the throttle fully open until the compression gauge stops rising; the compression is the highest reading obtainable.

Special Tools - Compression Gauge, 20 kgf/cm²: 57001-221
Compression Gauge Adapter, M10 × 1.0: 57001-1601
L-Shape Hose [C]: 57001-1606



Cylinder Compression

Usable Range: 1 064~ 1 618 kPa (10.85 ~ 16.50 kgf/cm², 154.3 ~ 234.6 psi) @230 r/min (rpm)

- Repeat the measurement for the other cylinders.
- Install the spark plugs (see [Spark Plug Replacement\(2-73\)](#)).

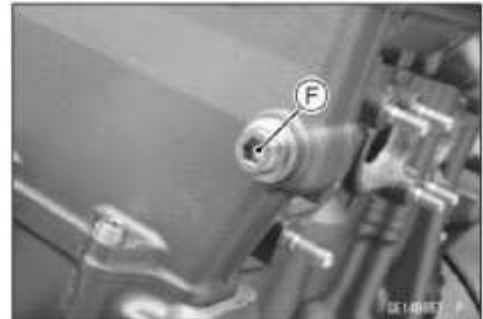
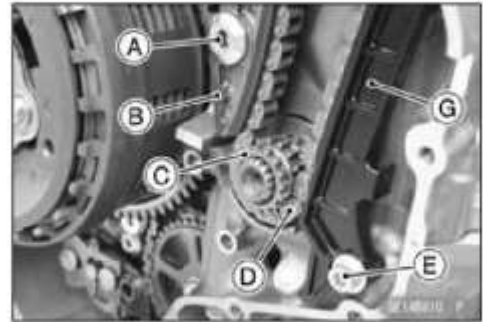
○The following table should be consulted if the obtainable compression reading is not within the usable range.

Problem	Diagnosis	Remedy (Action)
Cylinder compression is higher than usable range.	Carbon accumulation on piston 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.
Cylinder compression is lower than usable range.	Gas leakage around cylinder head	Replace damaged gasket and check the 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 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.

Cylinder Head

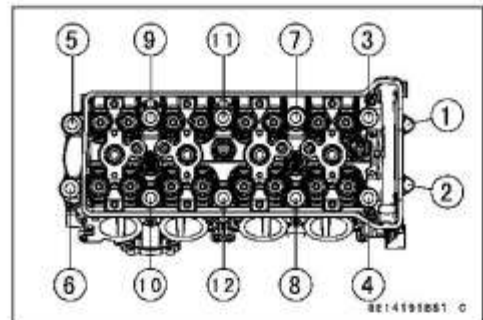
Cylinder Head Removal

- Remove the engine (see [Engine Removal\(8-4\)](#)).
- Set the engine on a clean surface and hold the engine steady while parts are being removed.
- Remove:
 - Cylinder Head Cover (see [Cylinder Head Cover Removal\(5-14\)](#))
 - Camshafts (see [Camshaft Removal\(5-18\)](#))
 - Timing Rotor (see [Timing Rotor Removal\(16-43\)](#))
 - Rear Camshaft Chain Guide Bolt [A]
 - Rear Camshaft Chain Guide [B]
 - Crankshaft Sprocket [C]
 - Camshaft Chain [D]
 - Front Camshaft Chain Guide Bolt (Lower) [E]
 - Front Camshaft Chain Guide Bolt (Upper) [F]
 - Front Camshaft Chain Guide [G]



- Remove:
 - Coolant Drain Bolt (Cylinder) [A]
 - Washer
- Drain the coolant.

- Loosen the M6 and M10 cylinder head bolts as shown sequence [1 ~ 12], and remove them and washers.
- Remove the cylinder head.



Cylinder Head Installation

NOTE

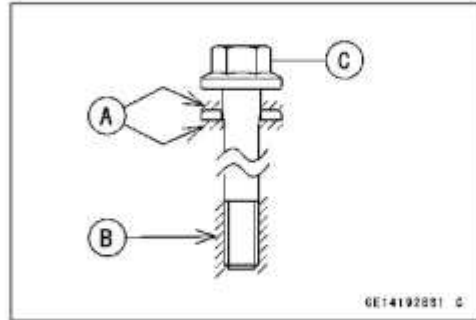
○The camshaft cap is machined with the cylinder head, so if a new cylinder head is installed, use the cap that is supplied with the new head.

- Install the dowel pins.
- Replace the cylinder head gasket with a new one.
- Install the cylinder head.

5-26 ENGINE TOP END

Cylinder Head

- Replace the cylinder head bolt washers with new ones.
- Apply molybdenum disulfide oil solution to both sides [A] of the cylinder head bolt washers and the threads [B] of the M10 cylinder head bolts [C].



- Tighten the M10 cylinder head bolts following the tightening sequence [1 ~10].

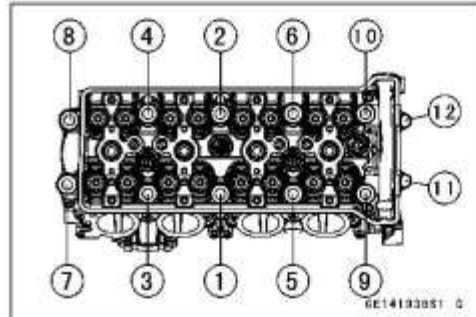
Torque - Cylinder Head Bolts (M10):

First: 30 N·m (3.1 kgf·m, 22 ft·lb)

Final: 67 N·m (6.8 kgf·m, 49 ft·lb)

- Tighten the M6 cylinder head bolts as shown sequence [11, 12].

Torque - Cylinder Head Bolts (M6): 12 N·m (1.2 kgf·m, 106 in·lb)



- Replace the O-ring [A].
- Apply grease to the O-ring.
- Install the front camshaft chain guide.
- Tighten:

Torque - Front Camshaft Chain Guide Bolt (Upper): 25 N·m (2.5 kgf·m, 18 ft·lb)



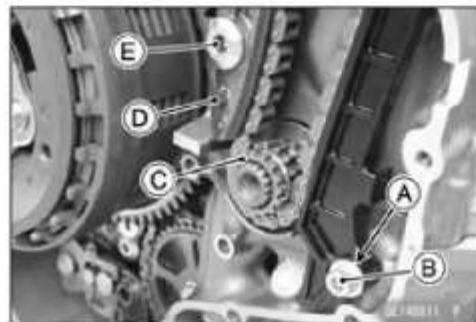
- Install the collar [A].
- Tighten:

Torque - Front Camshaft Chain Guide Bolt (Lower) [B]: 12 N·m (1.2 kgf·m, 106 in·lb)

- Install:
Camshaft Chain and Crankshaft Sprocket [C] (see Camshaft Chain Installation(5-23))
Rear Camshaft Chain Guide [D]

- Tighten:

Torque - Rear Camshaft Chain Guide Bolt [E]: 25 N·m (2.5 kgf·m, 18 ft·lb)



Cylinder Head

- Replace the washer with a new one.
- Tighten the coolant drain bolt (cylinder) [A] with washer.
- Install the removed parts.



Cylinder Head Warp Inspection

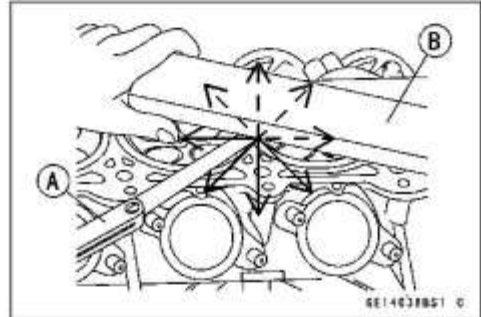
- Clean the cylinder head.
- Lay a straightedge across the lower surface of the cylinder head at several positions.
- Use a thickness gauge [A] to measure the space between the straightedge [B] and the head.

Cylinder Head Warp

Standard: ---

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 rubbing the lower surface on emery paper secured to a surface plate (first No. 200, then No. 400).



5-28 ENGINE TOP END

Valves

Valve Clearance Inspection

- Refer to the Valve Clearance Inspection (see Valve Clearance Inspection(2-31)).

Valve Clearance Adjustment

- Refer to the Valve Clearance Adjustment (see Valve Clearance Adjustment(2-32)).

Valve Removal

- Remove the cylinder head (see Cylinder Head Removal(5-25)).
- Remove the valve lifter and shim.

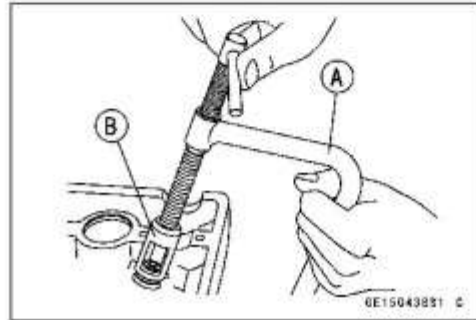
NOTE

○Keep the valve lifter and shim locations so they can be installed in their original positions.

- Using the valve spring compressor assembly, remove the valve.

Special Tools - Valve Spring Compressor Assembly [A]:
57001-241

Valve Spring Compressor Adapter, ϕ 24 [B]:
57001-1586



Valve Installation

- Replace the oil seal with a new one.
- Apply a thin coat of molybdenum disulfide grease to the valve stem before valve installation.
- Install the springs so that the closed coil end faces downwards.

Valve Stem [A]

Oil Seal [B]

Spring Seat [C]

Closed Coil End [D]

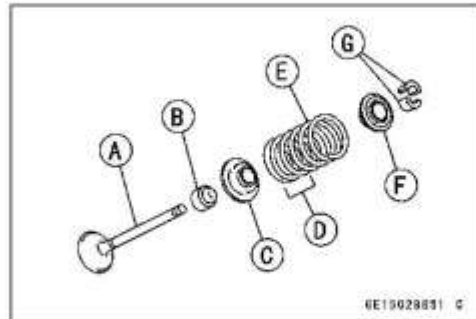
Valve Spring [E]:

EX - Green Paint

IN - Gray Paint

Retainer [F]

Split Keepers [G]



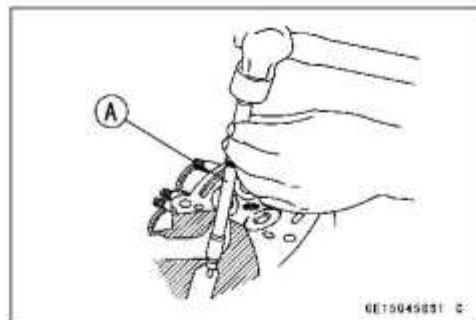
Valve Guide Removal

- Remove:
 - Valve (see Valve Removal(5-28))
 - Oil Seal
 - Spring Seat
- Heat the area around the valve guide to 120 ~ 150°C (248 ~ 302°F), and hammer lightly on the valve guide arbor [A] to remove the guide from the top of the head.

NOTICE

Do not heat the cylinder head with a torch. This will warp the cylinder head. Soak the cylinder head in oil and heat the oil.

Special Tool - Valve Guide Arbor, ϕ 4.5: 57001-1331



Valves

Valve Guide Installation

- Apply engine oil to the valve guide outer surface before installation.
- Heat the area around the valve guide hole to about 120 ~ 150°C (248 ~ 302°F).

NOTICE

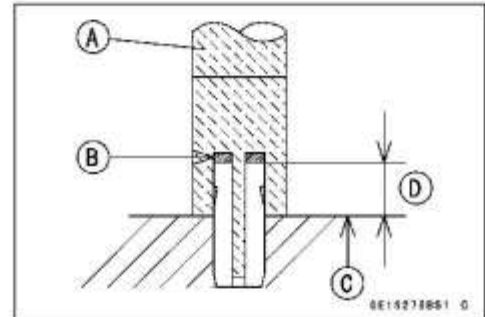
Do not heat the cylinder head with a torch. This will warp the cylinder head. Soak the cylinder head in oil and heat the oil.

- Using the valve guide driver [A] and spacer [B], press and insert the valve guide in until the attachment surface [C] touches the head surface.

13.3 ~ 13.5 mm (0.524 ~ 0.531 in.) [D]

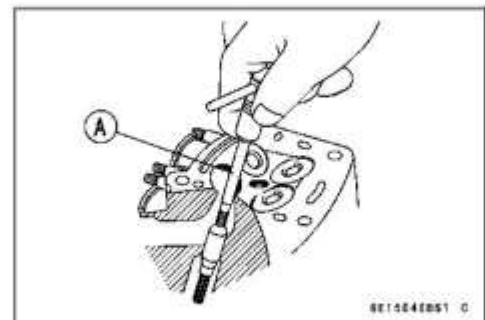
Special Tools - Valve Guide Driver: 57001-1564

Spacer ϕ 9.6: 57001-1830



- Ream the valve guide with valve guide reamer [A], even if the old guide is reused.

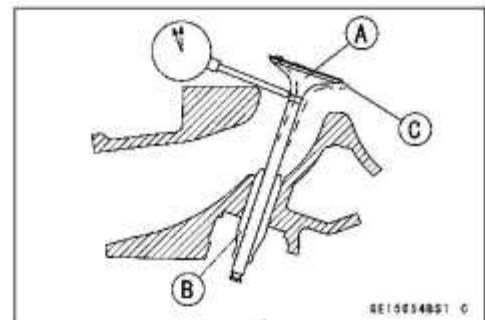
Special Tool - Valve Guide Reamer, ϕ 4.5: 57001-1333



Valve-to-Guide Clearance Measurement (Wobble Method)

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 the stem back and forth [C] 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.



5-30 ENGINE TOP END

Valves

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 ~ 0.16 mm (0.0035 ~ 0.0063 in.)
Intake	0.03 ~ 0.11 mm (0.0012 ~ 0.0043 in.)

Service Limit:

Exhaust	0.36 mm (0.014 in.)
Intake	0.30 mm (0.012 in.)

Valve Seat Inspection

- Remove the valve (see [Valve Removal\(5-28\)](#)).
- Check the valve seating surface [A] between the valve [B] and valve seat [C].
- Measure the outside diameter [D] of the seating pattern on the valve seat.
- ★ If the outside diameter is too large or too small, repair the seat (see [Valve Seat Repair\(5-30\)](#)).

Valve Seating Surface Outside Diameter

Standard:

Exhaust	25.2 ~ 25.4 mm (0.99 ~ 1.00 in.)
Intake	29.4 ~ 29.6 mm (1.16 ~ 1.17 in.)

- Measure the seat width [E] of the portion where there is no build-up carbon (white portion) of the valve seat with a vernier caliper.

Good [F]

- ★ If the width is too wide [G], too narrow [H] or uneven [J], repair the seat (see [Valve Seat Repair\(5-30\)](#)).

Valve Seating Surface Width

Standard:

Exhaust	1.6 ~ 2.0 mm (0.063 ~ 0.079 in.)
Intake	0.5 ~ 1.0 mm (0.020 ~ 0.039 in.)

Valve Seat Repair

- Repair the valve seat with the valve seat cutters [A].

Special Tools - Valve Seat Cutter Holder Bar [B]: 57001-1128

Valve Seat Cutter Holder, $\phi 4.5$ [C]: 57001-1330

[For Exhaust Valve Seat]

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

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

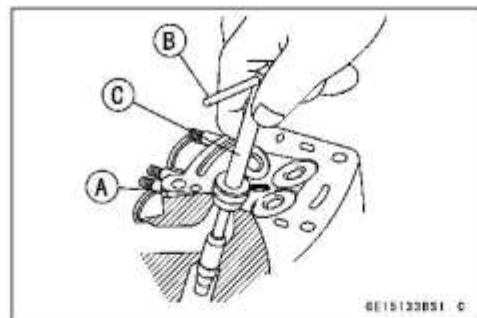
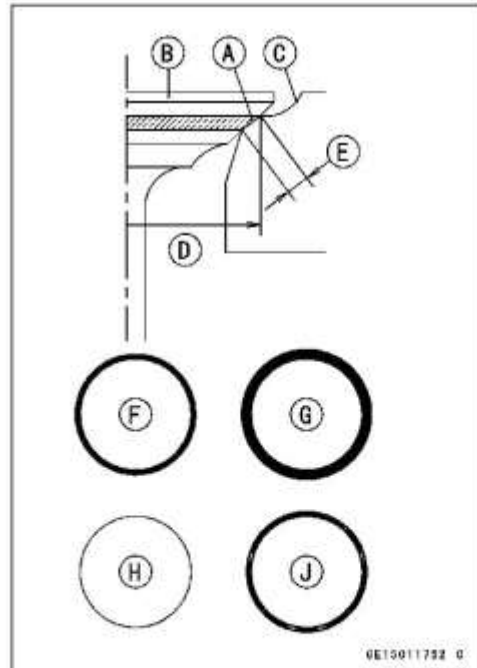
Valve Seat Cutter, 60° - $\phi 27$: 57001-1409

[For Intake Valve Seat]

Valve Seat Cutter, 45° - $\phi 32$: 57001-1115

Valve Seat Cutter, 30° - $\phi 33$: 57001-1120

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



Valves

Seat Cutter Operation Care

1. This valve seat cutter is developed to grind the valve 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.

NOTICE

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

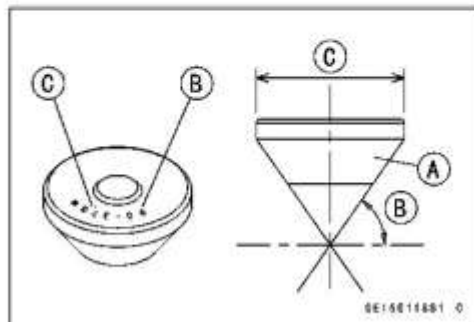
○Prior to grinding, apply engine oil to the cutter and during the operation, wash off any ground particles sticking to the cutter with washing oil.

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.

NOTICE

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.

5-32 ENGINE TOP END

Valves

- Measure the outside diameter of the seating surface with a vernier caliper.

★ If the outside diameter of the seating surface is too small, repeat the 45° grind until the diameter is within the specified range.

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

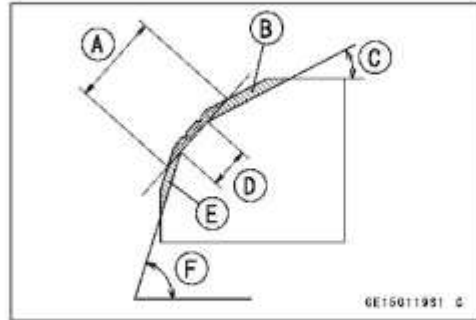
Ground Volume [B] by 32° cutter

32° [C]

Correct Width [D]

Ground Volume [E] by 60° cutter

60° [F]



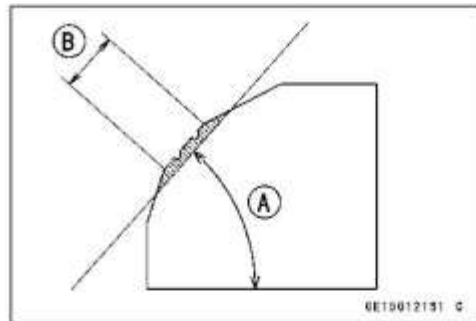
- Measure the outside diameter of the seating surface with a vernier caliper.

★ If the outside diameter of the seating surface is too small, repeat the 45° [A] grind 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.



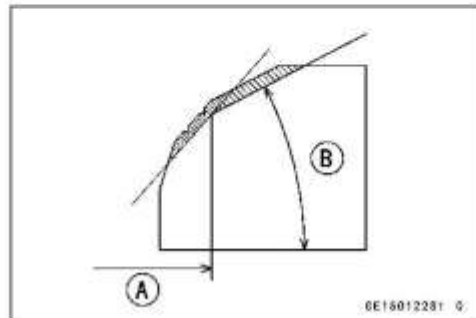
★ If the outside diameter [A] of the seating surface is too large, make the 32° [B] grind described below.

★ 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 until the seat outside diameter 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.



NOTICE

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

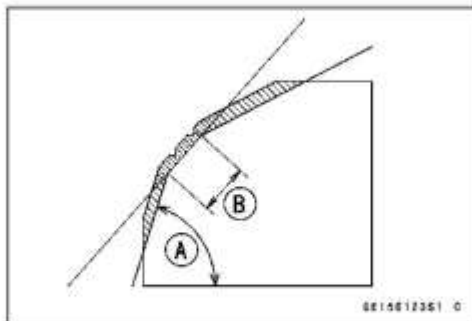
○ After making the 32° grind, return to the seat outside diameter measurement step above.

● To measure the seat width, use a vernier caliper 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 outside diameter measurement step above.

Valves

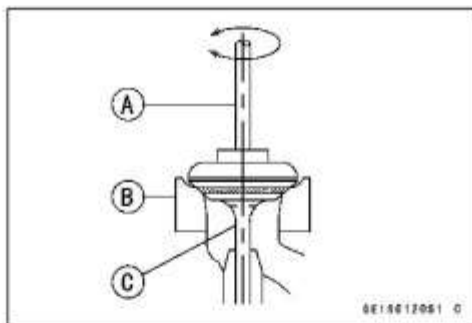
- ★ If the seat width is too wide, make the 60° [A] grind described below.
 - ★ If the seat width is within the specified range, lap the valve to the seat as described below.
 - Grind the seat at a 60° angle until the seat width is within the specified range.
 - To make the 60° grind, fit 60° cutter 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 valve seat, once the seat width and outside diameter 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.

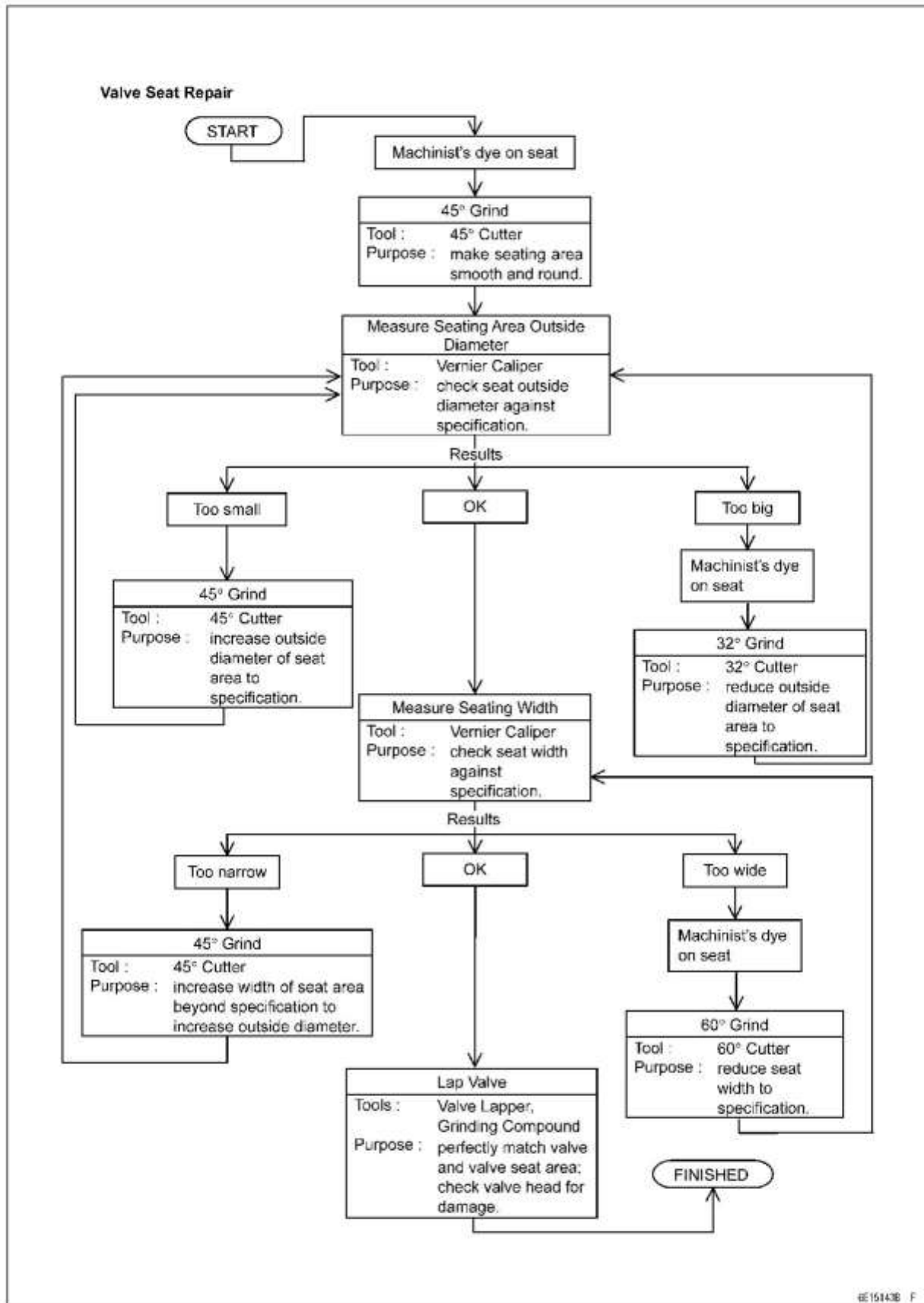
Lapper [A]
Valve Seat [B]
Valve [C]

- 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 Inspection\(2-31\)](#)).



5-34 ENGINE TOP END

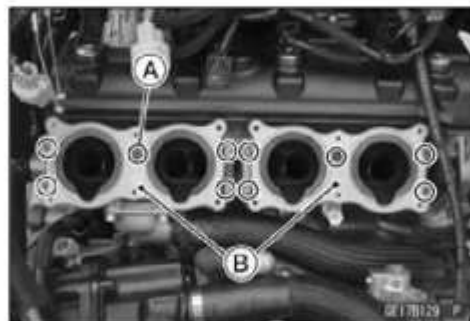
Valves



Throttle Body Assy Holder

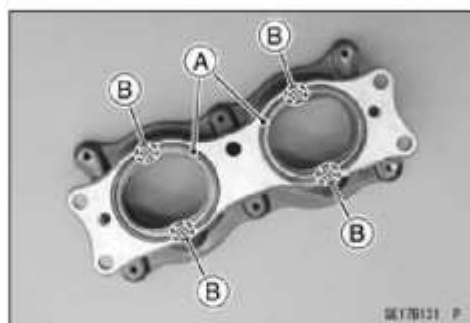
Throttle Body Assy Holder Removal

- Remove:
 - Throttle Body Assy (see Throttle Body Assy Removal(3-59))
 - Throttle Body Assy Holder Bolts [A]
 - Throttle Body Assy Holders [B]

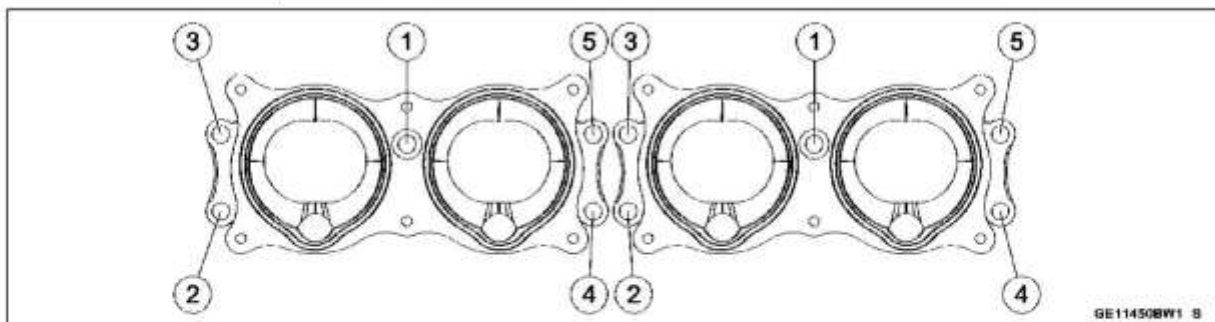


Throttle Body Assy Holder Installation

- Install the dowel pins [A].
 - Replace the O-rings [A] with new ones.
 - Apply liquid gasket to any two positions [B] of the O-rings to prevent it from coming off, and install them.
- Sealant - Liquid Gasket, TB1211F: 92104-0004**



- Install:
 - Throttle Body Assy Holders
 - Tighten the throttle body assy holder bolts following the specified tightening sequence [1 ~ 5].
- Torque - Throttle Body Assy Holder Bolts: 10 N·m (1.0 kgf·m, 89 in·lb)**
- Wipe of any excess liquid gasket.
 - Install the removed parts.



5-36 ENGINE TOP END

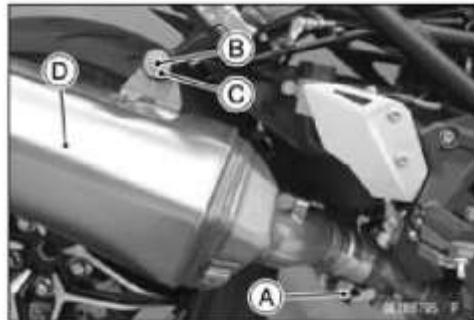
Muffler

WARNING

The muffler can become extremely hot during normal operation and cause severe burns. Do not remove the muffler while it is hot.

Muffler Body Removal

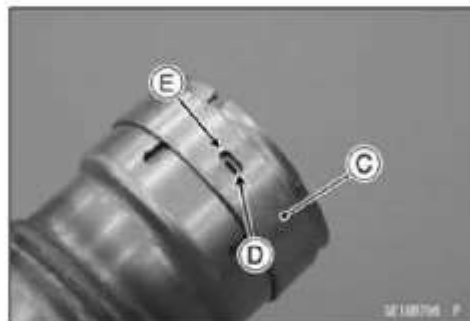
- Remove the bolt [A] and collar.
 - Remove the muffler body cover [B] forward.
-
- Loosen the muffler body clamp bolt [A].
 - Remove the muffler body mounting bolt [B], collar [C] and nut.
 - Remove the muffler body [D] backward.



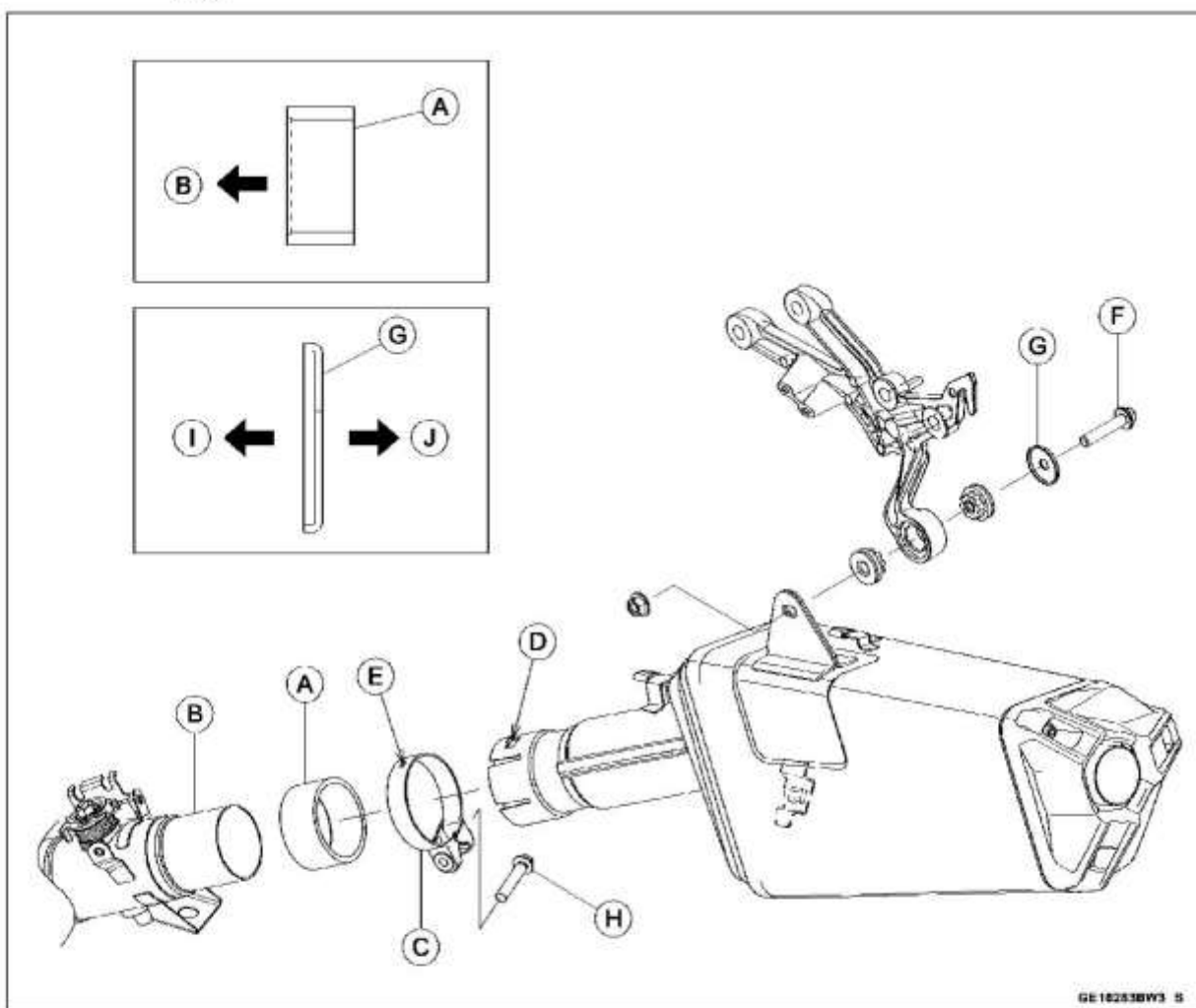
Muffler

Muffler Body Installation

- Replace the muffler body gasket [A] with a new one.
- Install the muffler body gasket to the exhaust pipe [B] until it is bottomed so that the chamfer side faces exhaust pipe.
- Install the muffler body clamp [C] as shown.
- Insert the projection [D] into the slot [E].
- Install the muffler body.
- Tighten the muffler body mounting bolt [F] with collar [G] and muffler body clamp bolt [H].
- Inside [I]
- Outside [J]



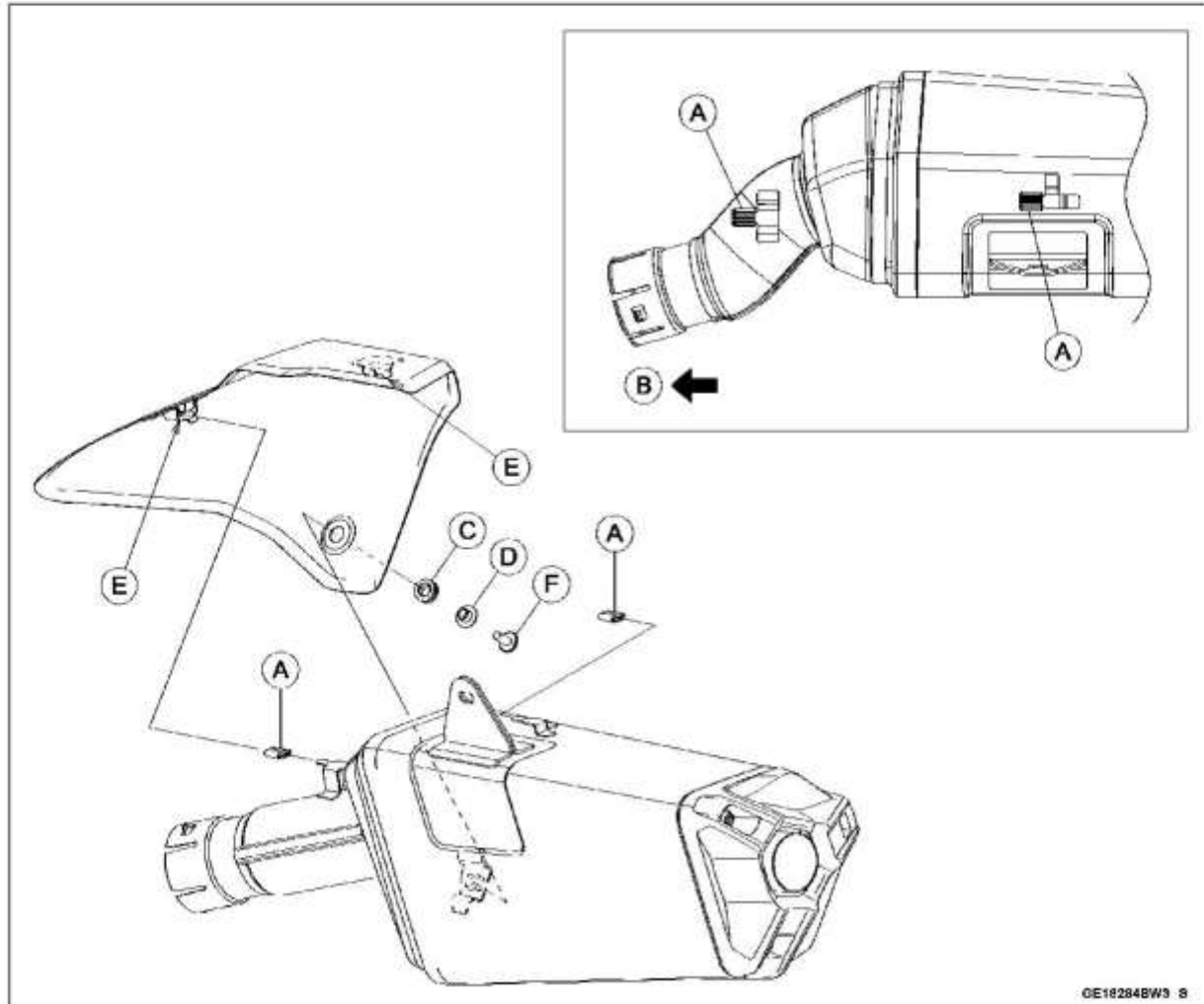
Torque - Muffler Body Mounting Bolt: 25 N·m (2.5 kgf·m, 18 ft·lb)
Muffler Body Clamp Bolt: 17 N·m (1.7 kgf·m, 13 ft·lb)



5-38 ENGINE TOP END

Muffler

- Install the dampers [A] as shown.
Front [B]
- Install:
Damper [C]
Collars [D]
- Fit the slots [E] of the muffler body cover onto the tabs.
- Tighten the bolt [F].



Exhaust Pipe Removal

- Remove:
Radiator (see [Radiator and Radiator Fan Removal\(4-15\)](#))
Fuel Tank (see [Fuel Tank Removal\(3-75\)](#))
Muffler Body (see [Muffler Body Removal\(5-36\)](#))
- Disconnect the oxygen sensor connector [A].
- Remove the lower ends of the exhaust butterfly valve cables from the pulley of the exhaust pipe (see [Exhaust Butterfly Valve Cable Removal\(5-41\)](#)).

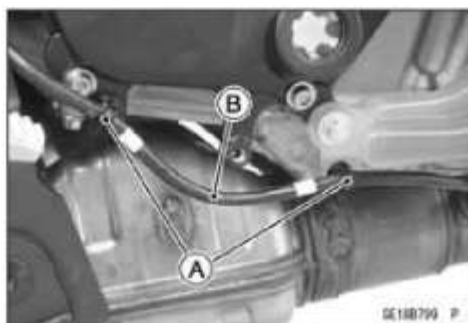


Muffler

- Free the oxygen sensor lead from the clamps [A].



- Remove the clamps [A] to free the oxygen sensor lead [B].



- Remove:
Exhaust Pipe Mounting Bolt [A]
Washer [B]



- Remove:
Exhaust Pipe Holder Nuts [A]
Exhaust Pipe



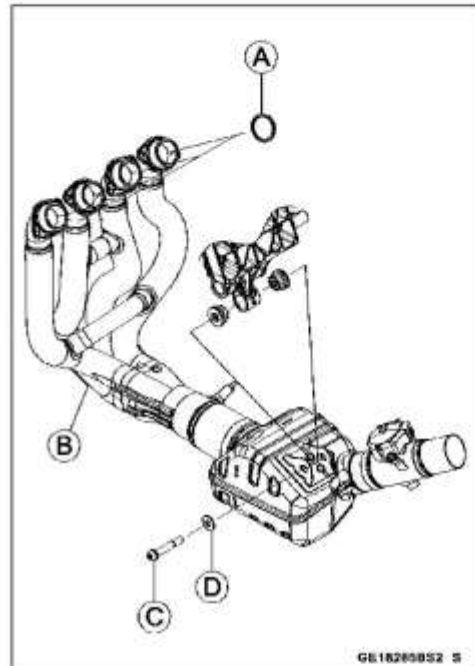
5-40 ENGINE TOP END

Muffler

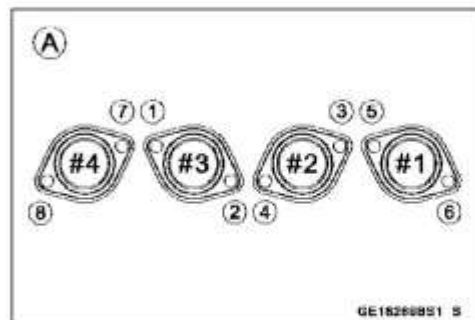
Exhaust Pipe Installation

- Replace the exhaust pipe gaskets [A] with new ones.
- Apply grease to the exhaust pipe gasket, and install them to engine.
- Install the exhaust pipe [B].
- Install the exhaust pipe mounting bolt [C] with washer [D].
- Tighten:

Torque - Exhaust Pipe Mounting Bolt: 34 N·m (3.5 kgf·m, 25 ft·lb)

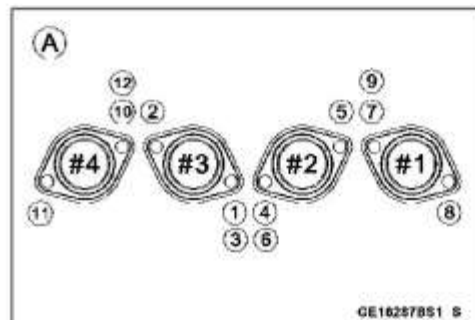


- Temporarily tighten the exhaust pipe manifold holder nuts following the tightening sequence [1 ~ 8].
View from Front [A]



- Tighten the exhaust pipe manifold holder nuts following the tighten sequence [1 ~ 12].
View from Front [A]

Torque - Exhaust Pipe Holder Nuts: 20 N·m (2.0 kgf·m, 15 ft·lb)



- Install the removed parts.
- Thoroughly warm up the engine, wait until the engine cools down, retighten all the bolts and nuts.

Muffler

Exhaust Butterfly Valve Cable Removal

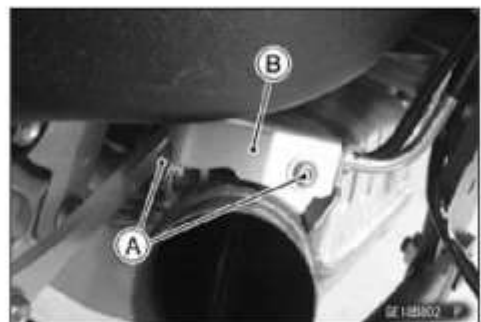
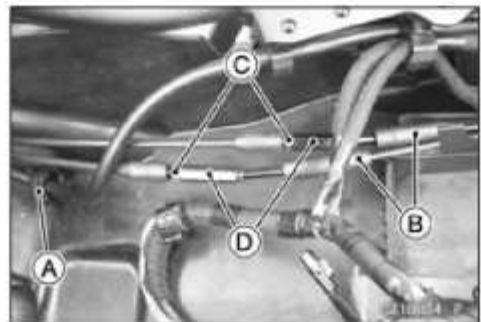
- Remove:
 - Battery (see [Battery Removal\(16-28\)](#))
 - Fuel Tank (see [Fuel Tank Removal\(3-75\)](#))
 - Muffler Body (see [Muffler Body Removal\(5-36\)](#))
 - Footpeg Bracket Bolts [A]
- Move the footpeg bracket backward.

- Take the KECS ECU [A] off the bracket.

- Remove the band [A].

- Open the clamp [A] to free the exhaust butterfly valve cables.
- Slide the dust covers [B].
- Loosen the locknuts [C], and turn the adjusters [D] to give the cable plenty of play.

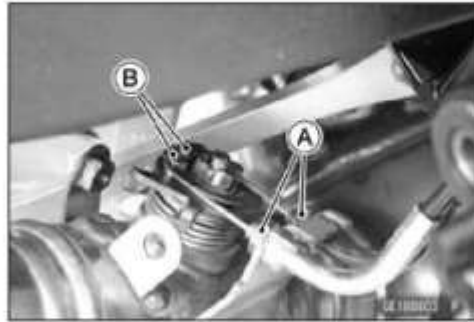
- Remove:
 - Bolts [A]
 - Exhaust Butterfly Valve Cover [B]



5-42 ENGINE TOP END

Muffler

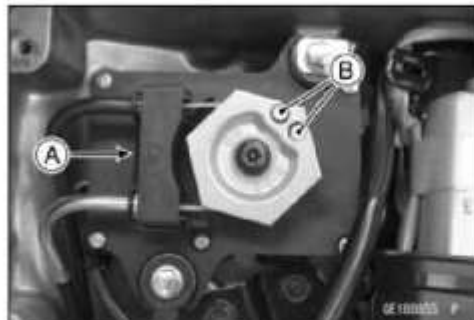
- Loosen the exhaust butterfly valve cable locknuts [A].
- Disconnect the exhaust butterfly valve cable lower ends [B].



- Free the exhaust butterfly valve cables from the clamps [A].

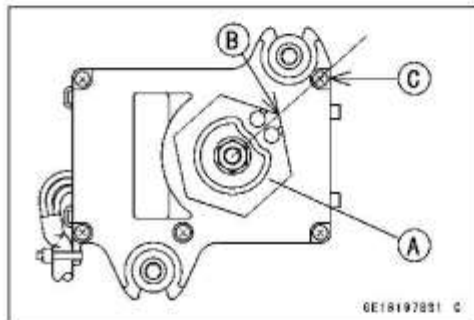


- Remove:
 - Seat Lock Bracket (see [Rear Frame Removal\(15-32\)](#))
 - Clamp [A]
- Disconnect the exhaust butterfly valve cable upper ends [B].
- Remove the exhaust butterfly valve cables.



Exhaust Butterfly Valve Cable Installation

- Before installing the exhaust butterfly valve cables, confirm that the exhaust valve actuator pulley [A] is in the original position as shown.
 - The pulley edge [B] and housing screw [C] are on the same line. This position is original position of the pulley.
 - ★If the pulley is not in the original position, adjust it (see [Exhaust Butterfly Valve Actuator Adjustment\(5-46\)](#)).

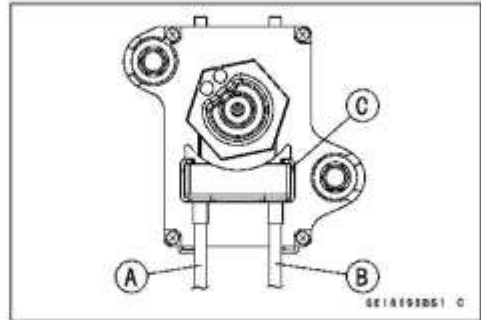


NOTICE

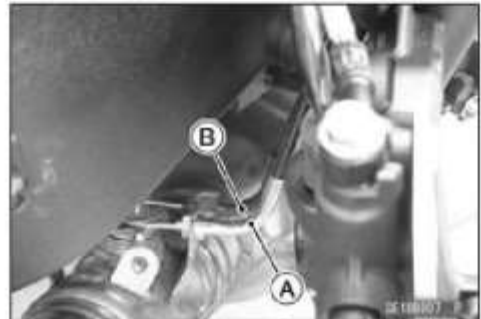
Do not attempt to move the pulley by hand or using a tool as internal actuator damage will occur.

Muffler

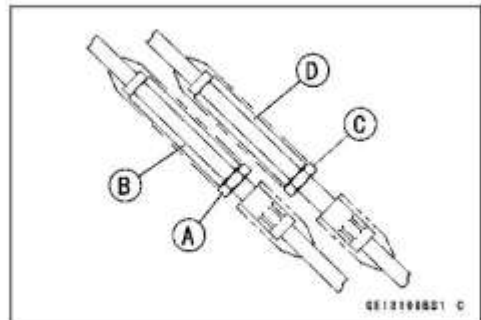
- Install the close cable (black) [A], and then install the open cable (silver) [B] to the exhaust valve actuator pulley.
- Install the clamp [C].



- Install the exhaust butterfly valve cables to the muffler body as shown.
 - Open Cable (Silver) [A]
 - Close Cable (Black) [B]
- Tighten:
 - Torque - Exhaust Butterfly Valve Cable Locknuts: 5.5 N·m (0.56 kgf·m, 49 in·lb)**



- Adjust the open cable (silver) first. Loosen the locknut [A] and turn the adjuster [B] until there is no play in the cable.
- Tighten the open cable locknut.
- Adjust the close cable (black). Loosen the locknut [C] and turn the adjuster [D] until there is no play in the cable.
- Turn the adjuster of the close cable clockwise by 1/2 to 1 rotation.
- Tighten the close cable locknut.



NOTICE

To keep the correct exhaust butterfly valve position, adjust the open cable first. Adjust the cables only until there is no play. If the cables are adjusted any further, the exhaust butterfly valve actuator will not operate correctly.

5-44 ENGINE TOP END

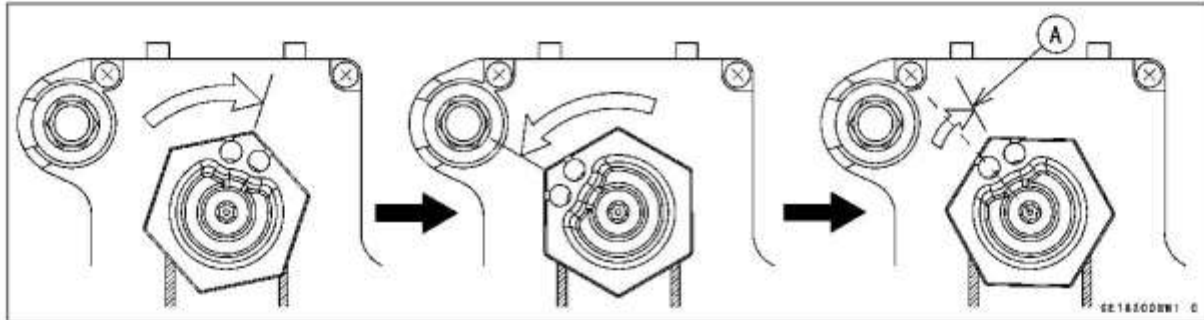
Muffler

- After adjusting the cables, turn the ignition switch on and make sure that the pulley turns clockwise, then counter-clockwise and then returns slightly clockwise as shown.

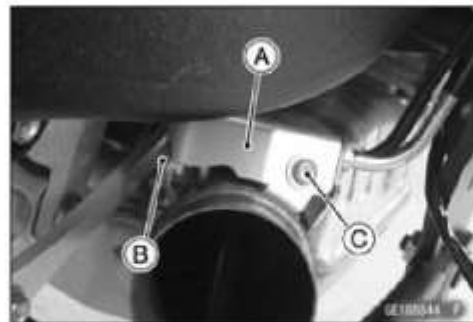
NOTE

○ The stop position [A] of the pulley is changed by the cables tension and the closed position of the exhaust butterfly valve.

- ★ If the pulley does not move smoothly, adjust the cables again.



- Install the exhaust butterfly valve cover [A].
- Tighten the bolt [B] first, and then the bolt [C].
- Install the removed parts.

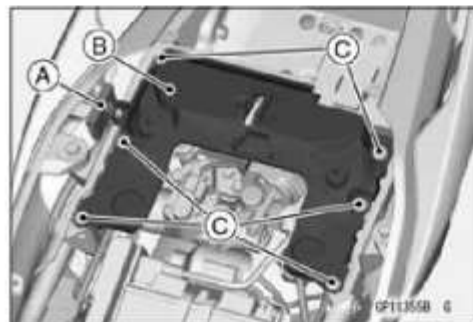


Exhaust Butterfly Valve Actuator Removal

NOTICE

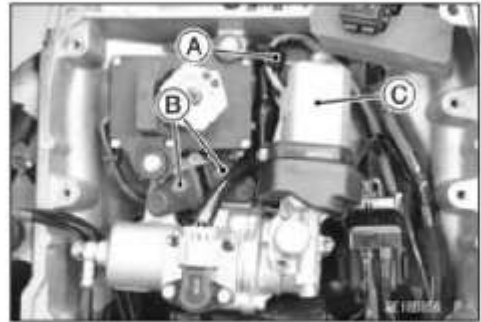
Never drop the exhaust butterfly valve actuator especially on a hard surface. Such a shock to the actuator can damage it.

- Remove:
 - Seat Sub Covers (see [Seat Cover Removal\(15-27\)](#))
- Free the fuse box [A] from the seat lock bracket [B].
- Remove:
 - Bolts [C]
 - Seat Lock Bracket
- Remove the upper ends of the exhaust butterfly valve cables from the pulley of the exhaust butterfly valve actuator (see [Exhaust Butterfly Valve Cable Removal\(5-41\)](#)).

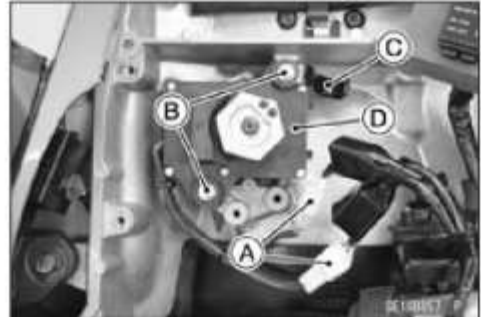


Muffler

- Open the clamp [A].
- Remove:
 - Rear Shock Absorber Preload Actuator Mounting Bolts [B]
 - Rear Shock Absorber Preload Actuator [C]



- Disconnect the exhaust butterfly valve actuator lead connectors [A]
- Remove:
 - Exhaust Butterfly Valve Actuator Mounting Bolts [B]
 - Clamp [C]
 - Washers
 - Exhaust Butterfly Valve Actuator [D]



- When replacing the pulley, note the following.
- Remove the pulley bolt while holding the pulley [A] with the suitable tool [B].

NOTICE

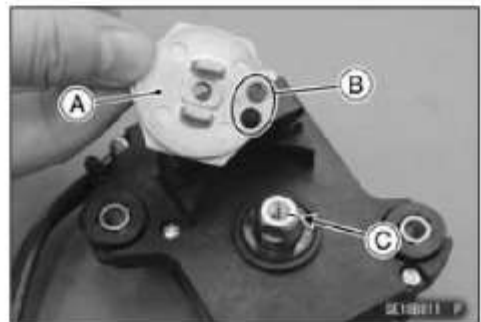
If the pulley bolt is removed without holding, the actuator damage will occur.

- Remove the pulley from the actuator.



Exhaust Butterfly Valve Actuator Installation

- When replacing the pulley, note the following.
- Install the pulley [A] on the actuator so that the holes side [B] aligns with the groove [C].

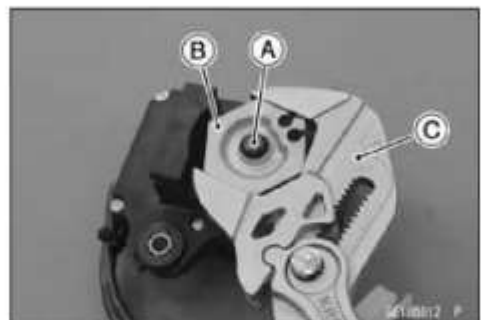


- Tighten the pulley bolt [A] while holding the pulley [B] with the suitable tool [C].

Torque - Exhaust Butterfly Valve Actuator Pulley Bolt: 5.0 N·m (0.51 kgf·m, 44 in·lb)

NOTICE

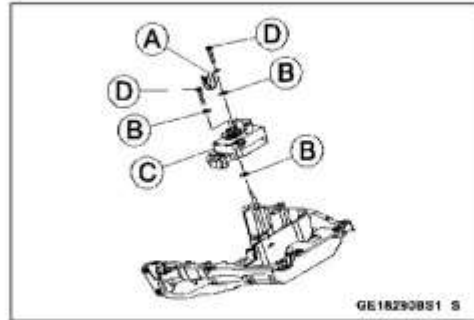
If the pulley bolt is tightened without holding, the actuator damage will occur.



5-46 ENGINE TOP END

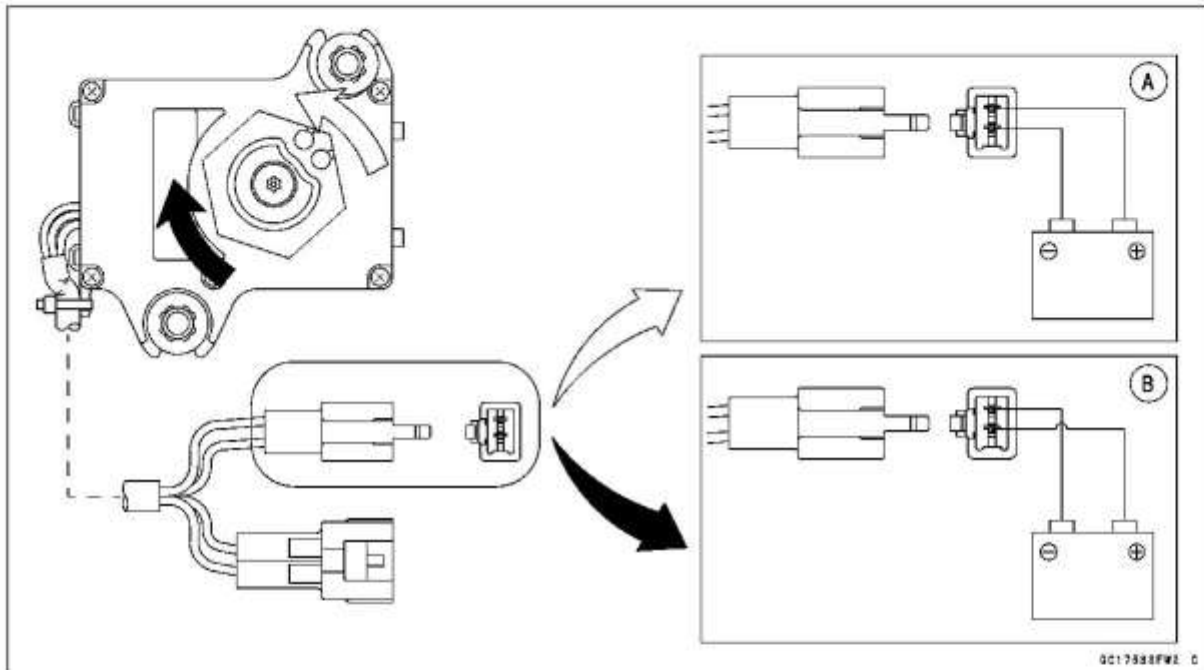
Muffler

- Install:
 - Clamp [A]
 - Washers [B]
 - Exhaust Butterfly Valve Actuator [C]
- Tighten the bolts [D].
- Install the exhaust butterfly valve cables (see [Exhaust Butterfly Valve Cable Installation\(5-42\)](#)).



Exhaust Butterfly Valve Actuator Adjustment Pulley Position Electrically Adjustment

- Turn the ignition switch off.
- Disconnect the exhaust butterfly valve actuator connectors.
- Connect the exhaust butterfly valve actuator connector (2 pins) to the battery to turn the pulley as follows.
 - Connection for counterclockwise [A]
 - Connection for clockwise [B]
- Adjust the pulley position until it returns to the original position.



- Confirm that the exhaust valve actuator pulley [A] is in the original position as shown.
- The pulley edge [B] and housing screw [C] are on the same line. This position is original position of the pulley.

