

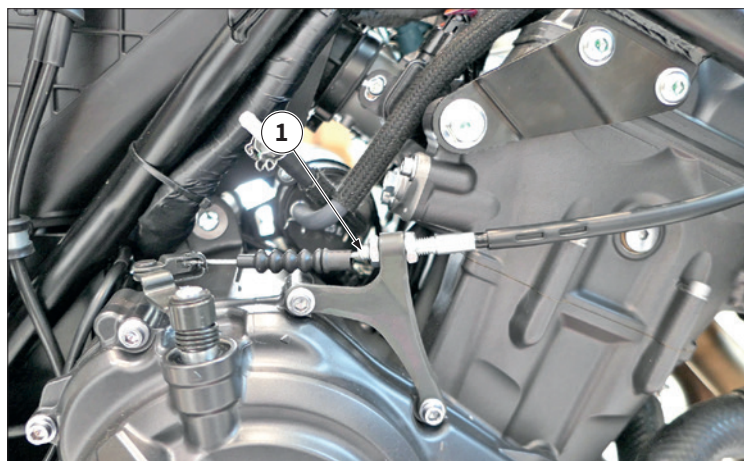
13.1 COMPLETE ENGINE REMOVAL



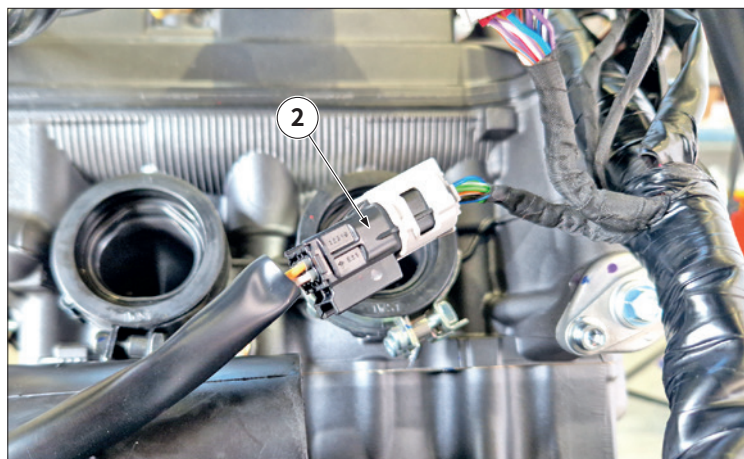
Position the vehicle on a central stand and support its rear weight with straps and hoist.

Preliminary operations:

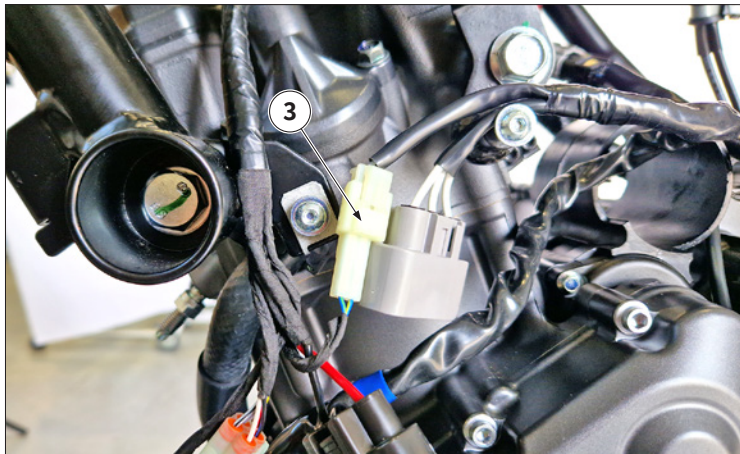
- Remove the complete tank (as described on page 106);
- Remove the exhaust system (as described on page 136);
- Remove the Chain (as described on page 121);
- Remove the Conveyors (as described on page 106);
- Remove the coils and tubes (as described on page 45);
- Remove the Regulator and its bracket (as described on page 45);
- Remove the Side panels (as described on page 104);
- Remove the Radiator (as described on page 138);
- Remove the throttle body complete with pipes (as described on page 245);
- Remove the filter canister and its support (as described on page 254);
- Remove the petrol injectors (as described on page 249);
- Remove the clutch lever (as described on page 145);
- Remove the rear brake lever (as described on page 128).



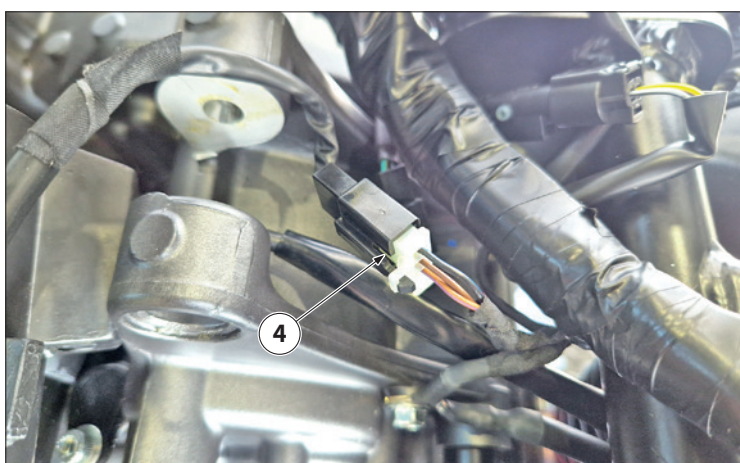
- Remove the clutch cable "1".



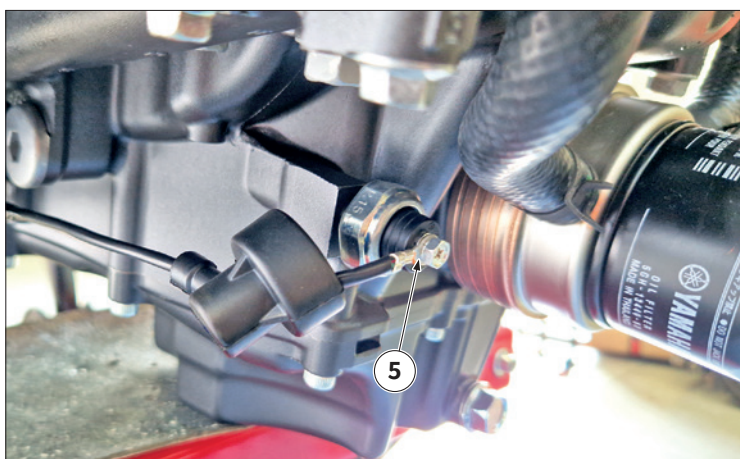
- Disconnect connector "2" of the gear position sensor.



- Disconnect the Pickup "3" connector.



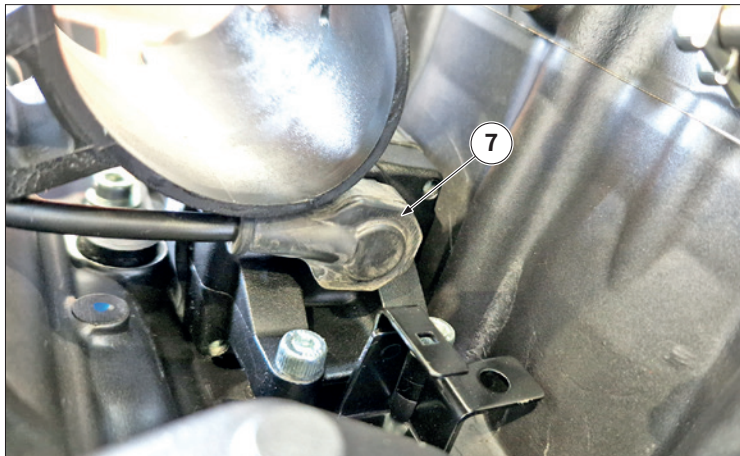
- Disconnect the kickstand sensor connector "4".



- Remove the oil pressure bulb connector "5".



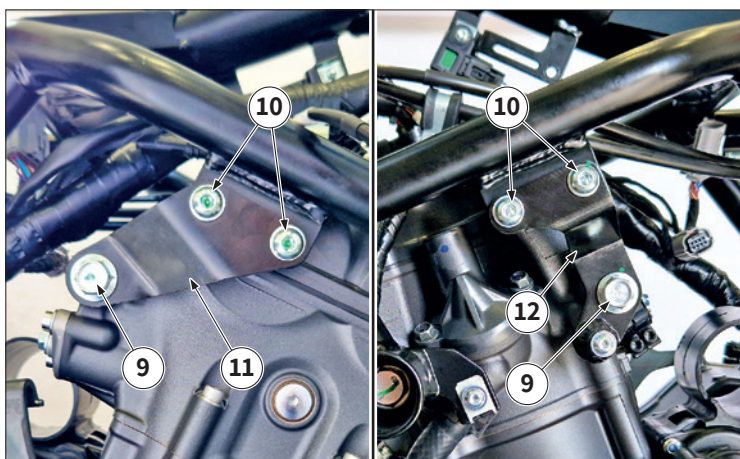
- Remove the two ground cables "6".



- Disconnect connector "7" of the positive starter motor cable.



- Remove connections "8" to the starting relay.

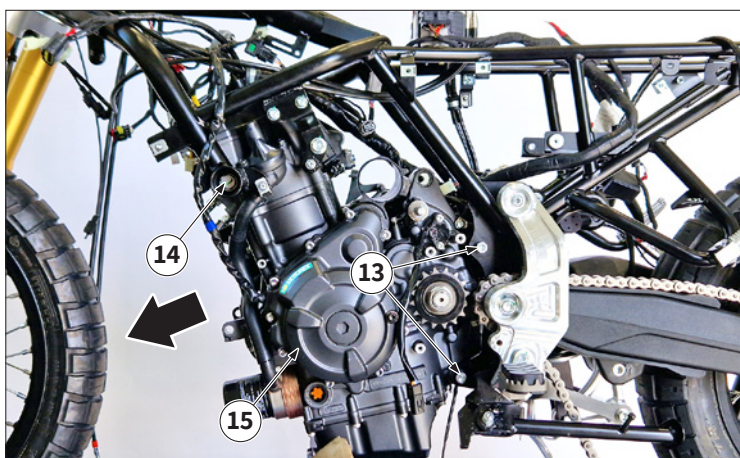


- Remove the two screws "9".
- Tightening torques**
Engine fastening screws (fastening to upper support bracket) M10X30 : 50 Nm (5 kgf, 36.9 lbf).

- Apply copper grease to the two "9" screws.**
- Remove the four screws "10".

- Tightening torques**
Screws fastening engine mounts to frame M8X20 : 23 Nm (2.3 kgf, 17.0 lbf).

- Remove the right engine mount "11" and the left engine mount "12" from the vehicle.



- Remove the two nuts "13" and related screws.
- Tightening torques**
Engine fastening nuts (fastening on frame centre plate) M10 : 50 Nm (5 kgf, 36.9 lbf).

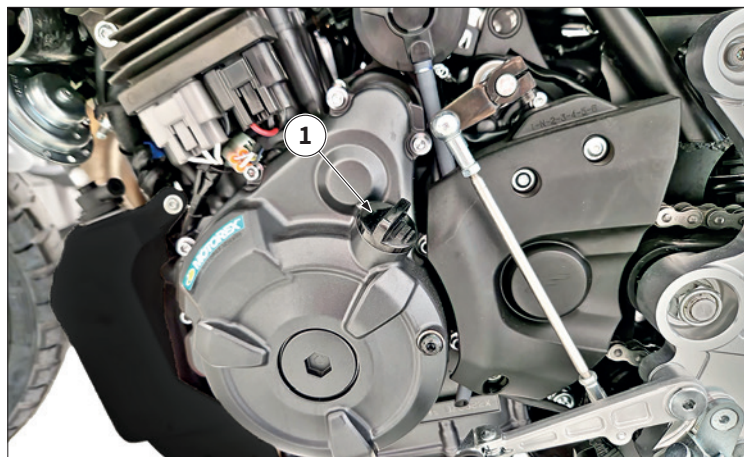
- Remove the two screws "14" (one on each side).

- Tightening torques**
Engine fastening screw (upper front fastening) M12X35 : 60 Nm (6 kgf, 44.2 lbf).

- Apply copper grease to the two "14" screws.**

- Remove engine "15" from the vehicle.

- Proceed in the reverse order for reassembly.**

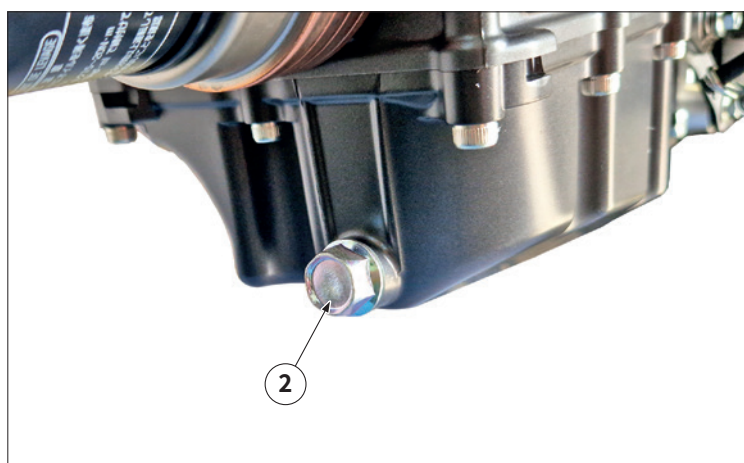


13.2 ENGINE OIL AND FILTER CHANGE

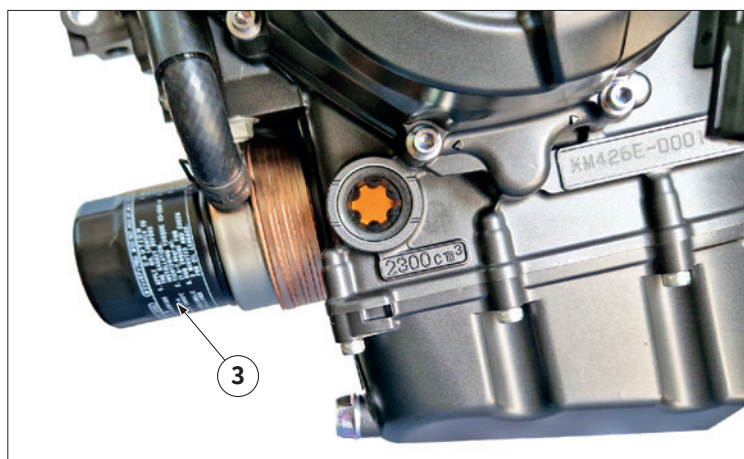
- Start the engine, warm it up for a few minutes, then turn it off.

i Wait until the engine reaches a temperature of at least 80°C.

- Place a container under the oil drain bolt.
- Remove the engine oil level dipstick cap "1".



- Remove oil drain bolt "2" (together with gasket).
- Completely drain the engine oil from the oil sump.



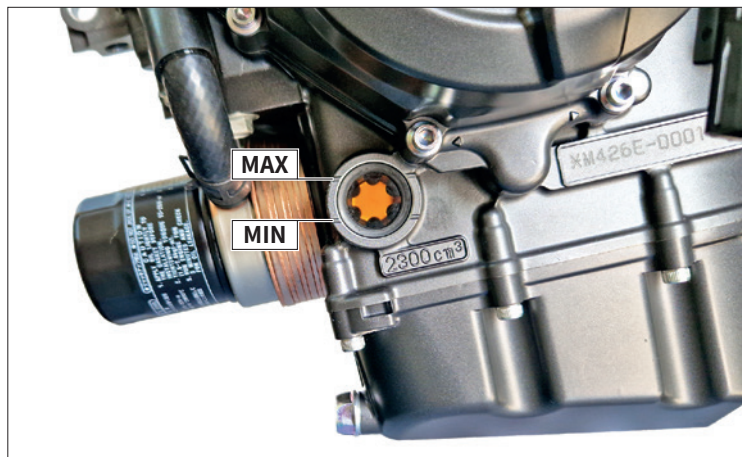
- Remove oil filter cartridge "3" with an oil filter spanner.
- Lubricate the O-ring of the new oil filter cartridge with a thin layer of engine oil.

! Make sure that the O-ring is correctly positioned in the groove of the oil filter cartridge.

- Tighten the new oil filter cartridge as prescribed with an oil filter spanner.
- Install the oil drain bolt "B" (together with a new gasket).
- Fill the oil sump with the recommended amount of engine oil (see specific quantities at "6.2 Engine technical data" on page 21).
- Install the engine oil level dipstick cap "A" (together with a new O-ring).
- Start the engine, warm it up for a few minutes, then turn it off.

i Wait until the engine reaches a temperature of at least 80°C.

- Check the engine for engine oil leaks.
- Check the engine oil level.



13.3 ENGINE OIL LEVEL CHECK

- Place the vehicle on a level surface.
- i** Place the vehicle on a suitable stand, making sure that the vehicle is upright.
- Start the engine, warm it up for a few minutes, then turn it off.
- The engine oil level must be between the "MIN" and "MAX" level reference.
- If the level is below the "MIN" level reference, top up with the recommended engine oil up to the correct level.
- i** Before checking the engine oil level, wait a few minutes until the oil has settled.

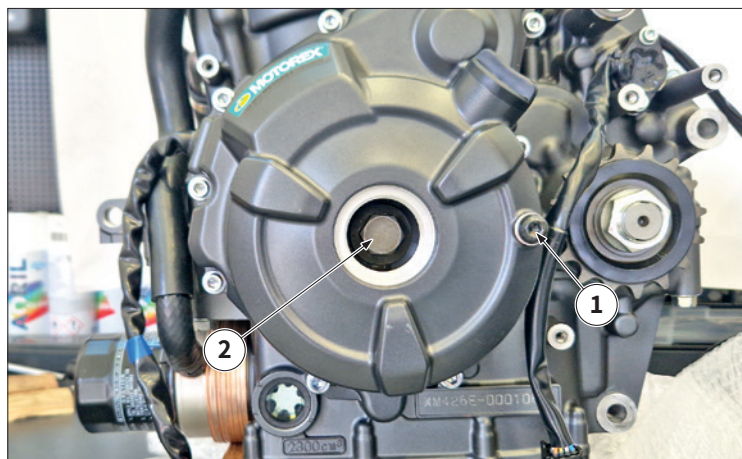
13.4 VALVE CLEARANCE ADJUSTMENT

The following procedure applies to all valves.

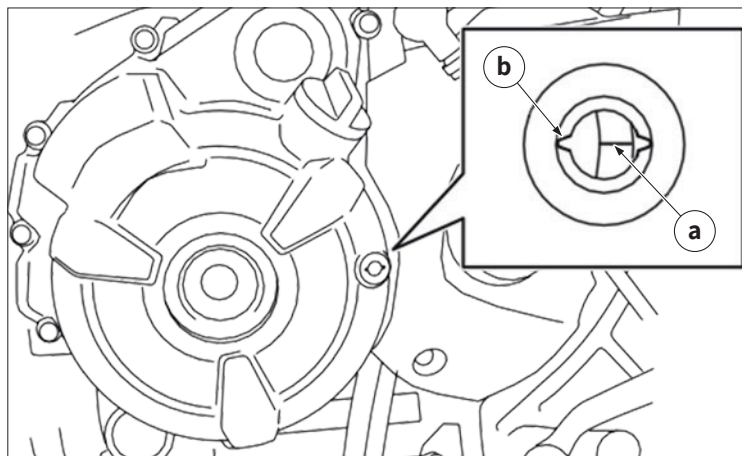
- i** The valve clearance adjustment must be performed with the engine cold, at room temperature.
- i** When it is necessary to measure or adjust the valve clearance, the piston must be at the top dead center (TDC) of the compression phase.

Remove:

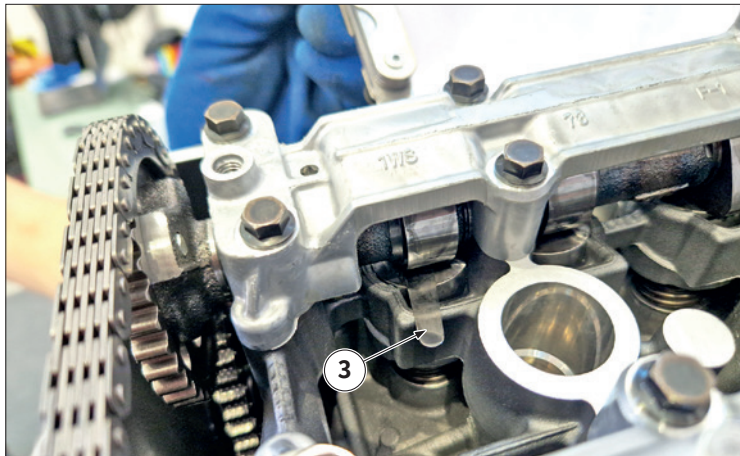
- Remove the complete engine (as described on page 150).



- With the engine on the bench, remove the cylinder head cover and cylinder head cover gasket ("13.5 Camshafts" on page 158);
- Remove timing reference access bolt "1" and crankshaft end cover "2".



- Turn the crankshaft counter-clockwise.
- With piston No. 1 at top dead centre of the compression phase, align top dead centre reference "a" on the generator rotor with notch "b" on the generator rotor cover.



– Measure the valve clearance with a "3" thickness gauge.



Valve clearance (cold):

- Intake: 0.11-0.20 mm (0.0043–0.0079 in)
- Exhaust: 0.24-0.30 mm (0.0094–0.0118 in)

If the valve clearance is incorrect, record the measured reading and measure the valve clearance in the following order:

Valve clearance measurement sequence Cylinder No. 1 and No. 2

A. Front

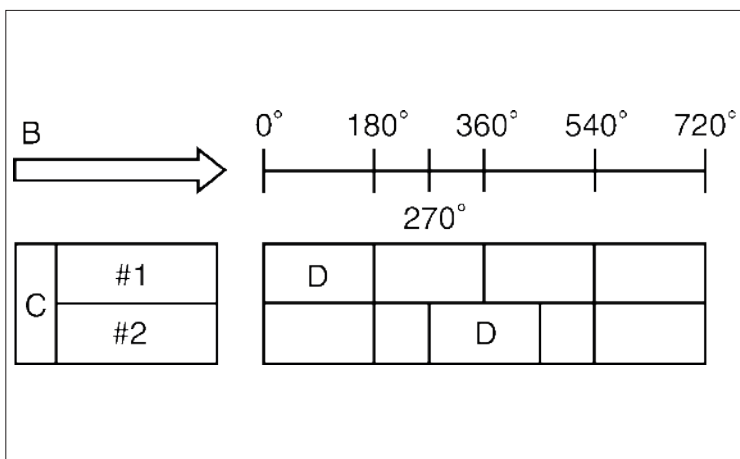
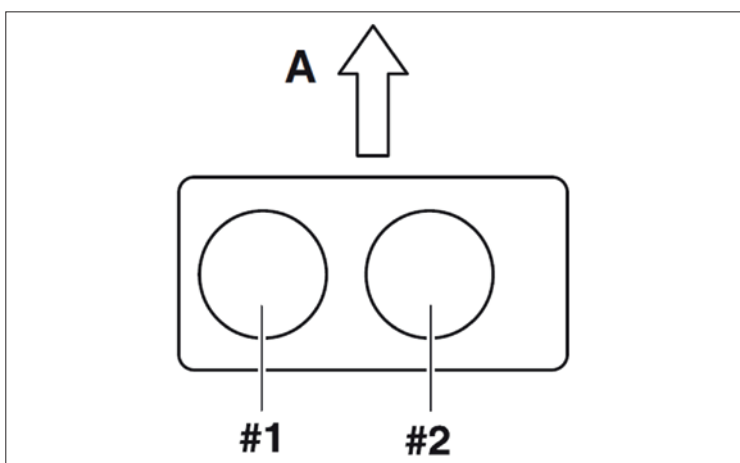


To measure the valve clearance of cylinder No. 2, turn the crankshaft 270° anticlockwise.

B. Indicates how many degrees the crankshaft is rotated anticlockwise

C. Cylinder

D. Combustion cycle



– Remove the camshaft.



When removing the timing chain and camshafts, secure the timing chain with a wire to prevent it from falling into the crankcase.

Adjust the valve clearance:

- Remove the valve lifter and valve bearing with a valve lapping machine.



Cover the timing chain opening with a rag to prevent the valve bearing from falling into the crankcase.

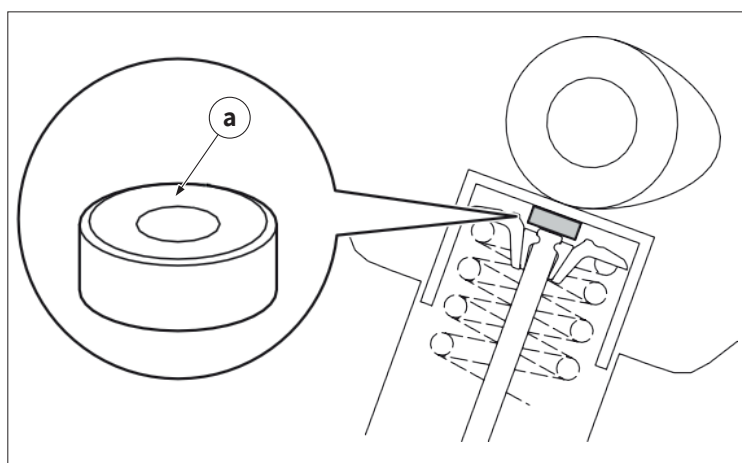


Note the position of each valve lifter and valve bearing so that they can be installed in the correct position.

- Calculate the difference between the prescribed valve clearance and the measured valve clearance.

Example:

 **Prescribed valve clearance:**
0.11-0.20 mm (0.0043-0.0079 in)
Measured valve clearance:
0.25 mm (0.0098 in) - 0.20 mm (0.0079 in) = 0.05 mm
(0.0020 in)



i **The thickness "a" of each valve bearing is indicated in hundredths of a millimetre on the side in contact with the valve lifter.**

Example:

If the valve bearing is marked with the number "158", the bearing thickness is

 **1.58 mm (0.0622 in)**

- Calculate the sum of the values obtained in steps (b) and (c) to determine the prescribed valve bearing thickness and valve bearing number.

Example:

 **1.58 mm (0.0622 in) + 0.05 mm (0.0020 in) = 1.63 mm**
(0.0641 in)

The valve bearing number is 163.

- Round off the valve bearing number according to the table below, then select the appropriate valve bearing.

Last digit	Rounded value
0, 1, 2	0
3, 4, 5, 6	5
7, 8, 9	10

i **Refer to the table below for available valve bearings.**

Valve bearing range	N. 150-240
Valve bearing thickness	1.50-2.40 mm (0.0590-0.0944 in)
Available valve bearings	19 thicknesses in 0.05 mm (0.0020 in) increments

Example:

Valve bearing number = 163

Rounded value = 165

New valve bearing number = 165

- Install the new valve bearing and valve lifter.

(i) Lubricate the valve bearing with molybdenum disulphide oil.

(i) Lubricate the valve lifter with engine oil.

(i) Install the valve lifter and valve bearing in the correct position.

(i) It must be possible to turn the valve lifter easily by hand.

- Install the exhaust and intake camshafts, timing chain and camshaft caps (refer to "13.5 Camshafts" on page <?>).

** Tightening torques - exhaust camshaft cap bolt:
 10 N·m (1.0 kgf·m, 7.4 lb·ft); - Intake camshaft cap bolt:
 10 N·m (1.0 kgf·m, 7.4 lb·ft)**

(i) Lubricate the camshaft lobes and journals with molybdenum disulphide oil.

(i) First install the exhaust camshaft.

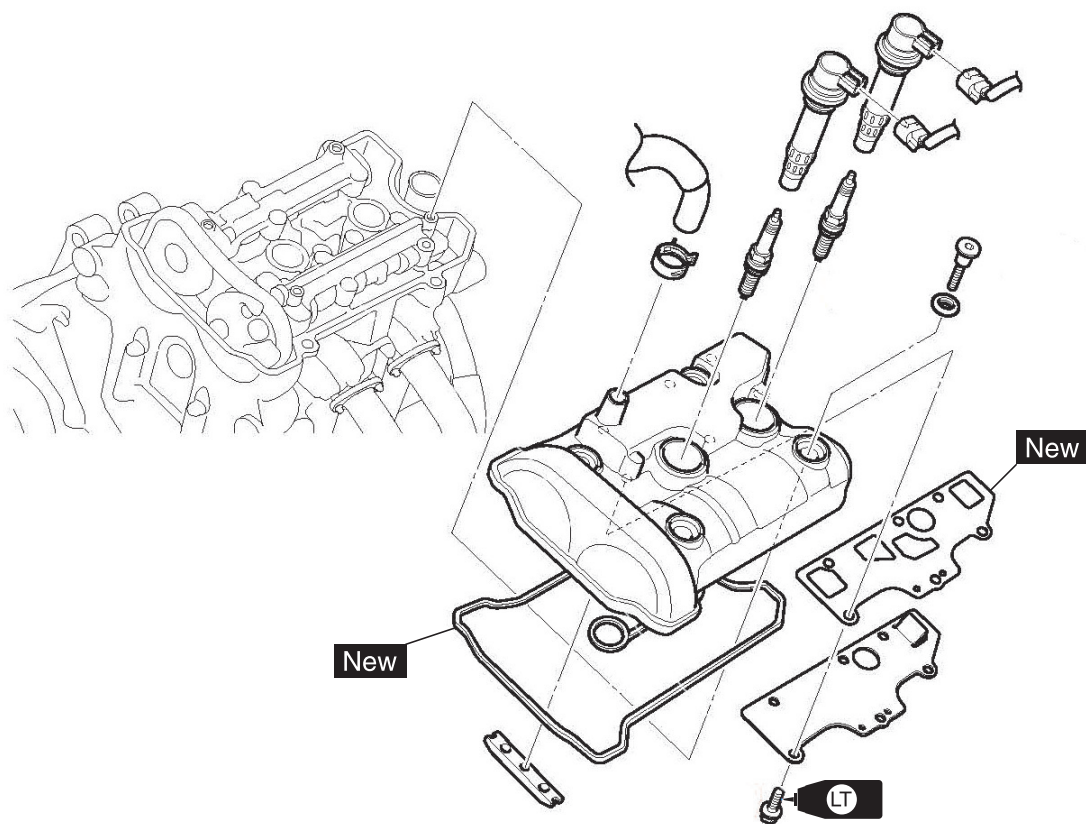
(i) Align the references on the camshaft sprockets with the edge of the cylinder head.

(i) Turn the engine shaft anti-clockwise several full turns to fit the components in their housings.

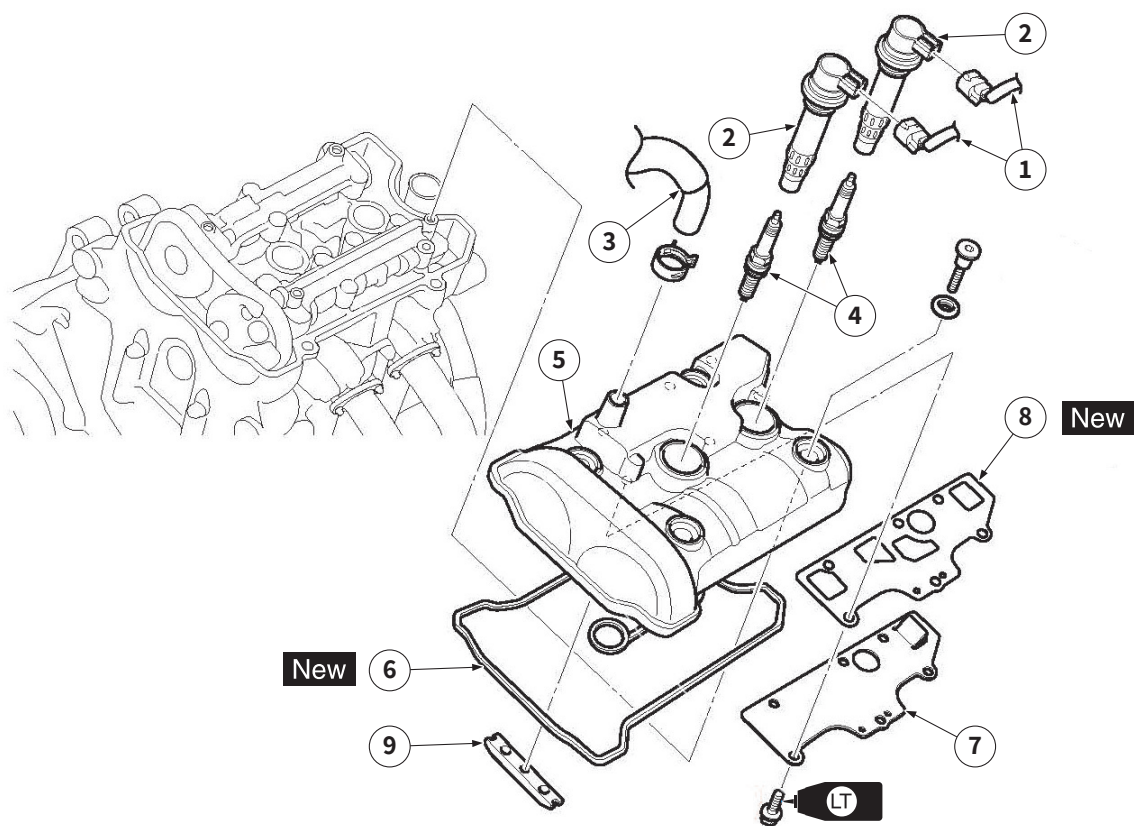
- Measure the valve clearance again.
- If the valve clearance still does not comply with the prescribed values, repeat all the valve clearance adjustment operations until the prescribed clearance is achieved.
- Install the all removed components, proceeding in the reverse direction of disassembly.

13.5 CAMSHAFTS

Valve cover removal: preliminary operations

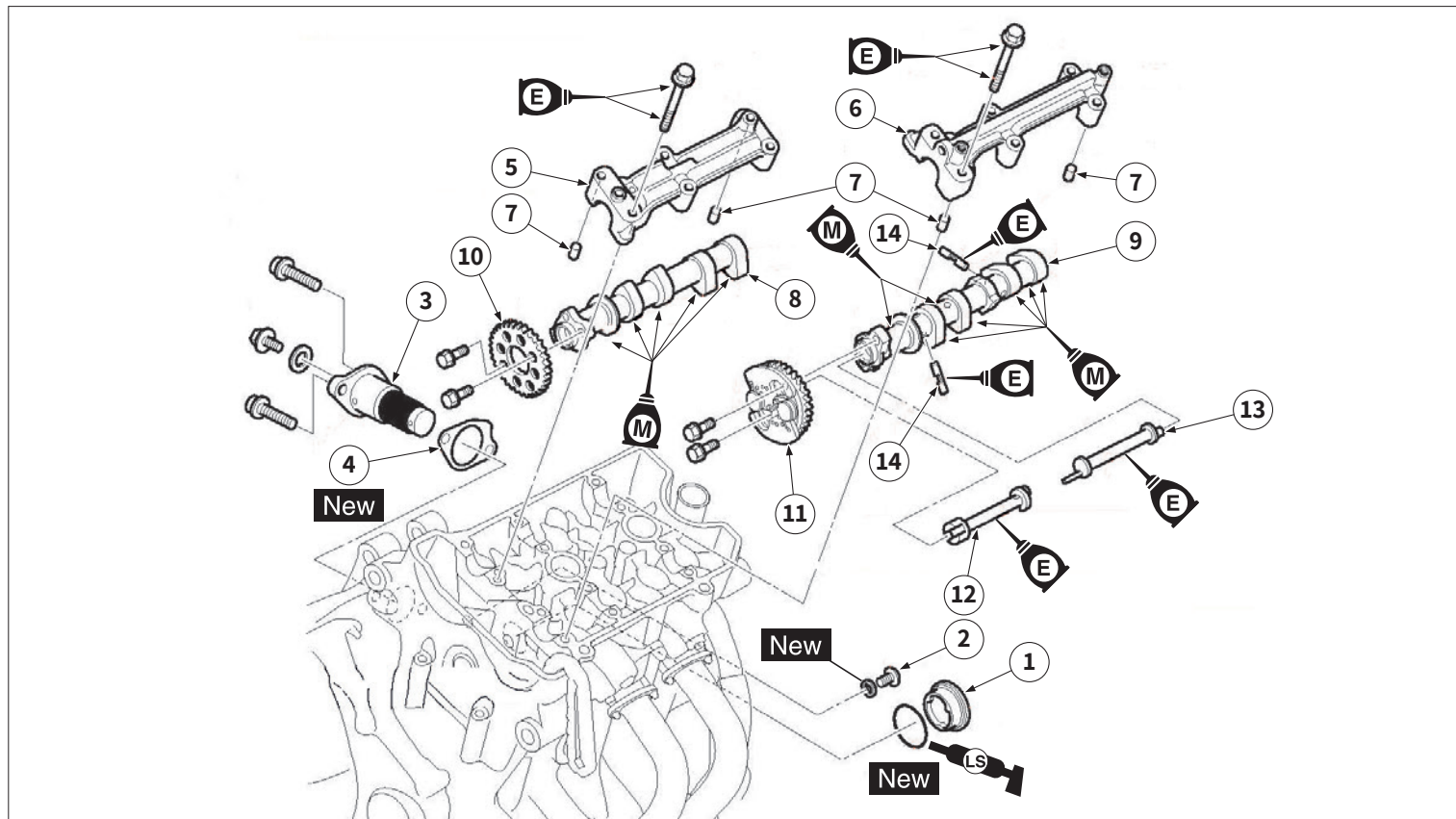


Sequence	Components to be removed	References to operations
1	Seat	"12.1 Seat" on page 102
2	Side conveyors	"12.6 Fairings and conveyors" on page 106
3	Fuel tank	"12.7 Fuel tank" on page 106
4	Right side panel	"12.4.2 Right side panel." on page 104
5	Drain the coolant	"12.20.5 Coolant change." on page 141
6	Expansion tank	"12.20.4 Expansion tank." on page 140
7	Radiator	"12.20.2 Radiator" on page 138
8	Clutch cable guide	"12.23 Clutch lever" on page 145

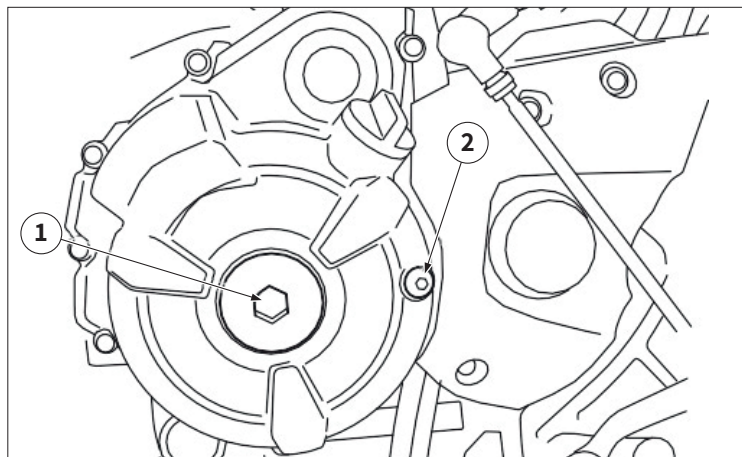
Valve cover removal


Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Ignition coil connector	2	Disconnect.
2	Ignition coil	2	
3	Cylinder head breather pipe	1	Disconnect.
4	Spark plug	2	13 N•m (1.3 kgf•m, 9.6 lb•ft)
5	Valve cover	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
6	Valve cover gasket	1	
7	Vent plate	1	4.0 N•m (0.40 kgf•m, 3.0 lb•ft)
8	Vent plate gasket	1	
9	Timing chain guide (upper side)	1	

Camshaft removal

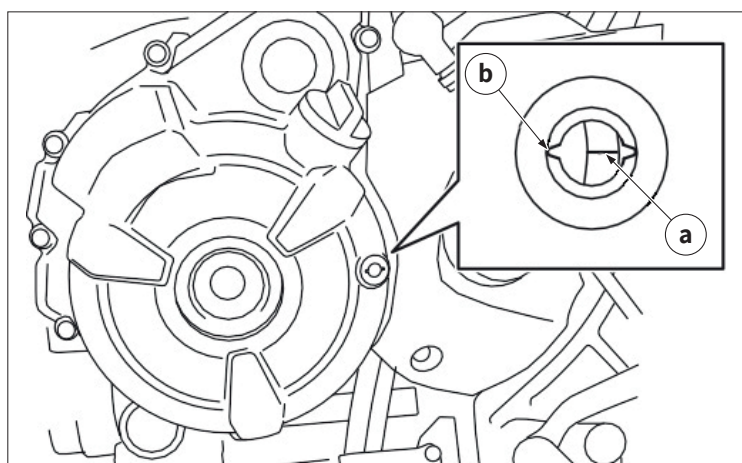


Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Crankshaft end cover	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
2	Access bolt to reference for timing	1	15 N•m (1.5 kgf•m, 11 lb•ft)
3	Timing chain tensioner	1	Tensioner fastening = 10 N•m (1.0 kgf•m, 7.4 lb•ft) Cap bolt = 7 N•m (0.7 kgf•m, 5.2 lb•ft)
4	Timing chain tensioner gasket	1	
5	Intake camshaft cover	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
6	Exhaust camshaft cover	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
7	Centering pin	4	
8	Intake camshaft	1	
9	Exhaust camshaft	1	
10	Intake camshaft sprocket	1	24 N•m (2.4 kgf•m, 18 lb•ft)
11	Exhaust camshaft sprocket	1	24 N•m (2.4 kgf•m, 18 lb•ft)
12	Decompressor lever No. 2	1	
13	Decompressor lever No. 1	1	
14	Decompressor lever pin	2	



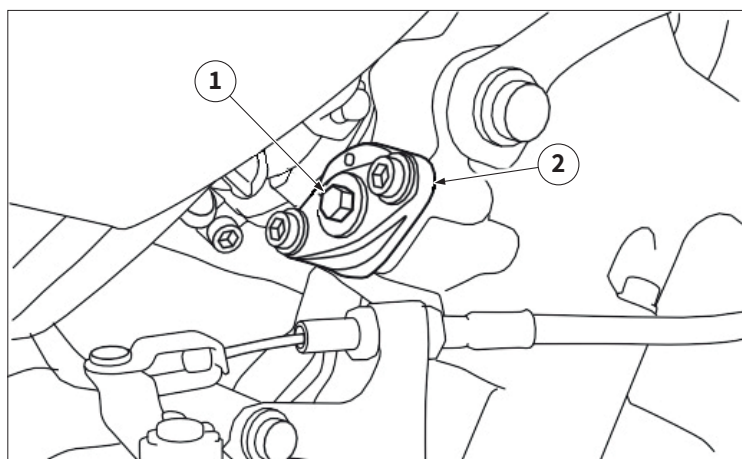
13.5.1 Camshaft removal

- Remove crankshaft end cover "1" and timing reference access bolt "2".

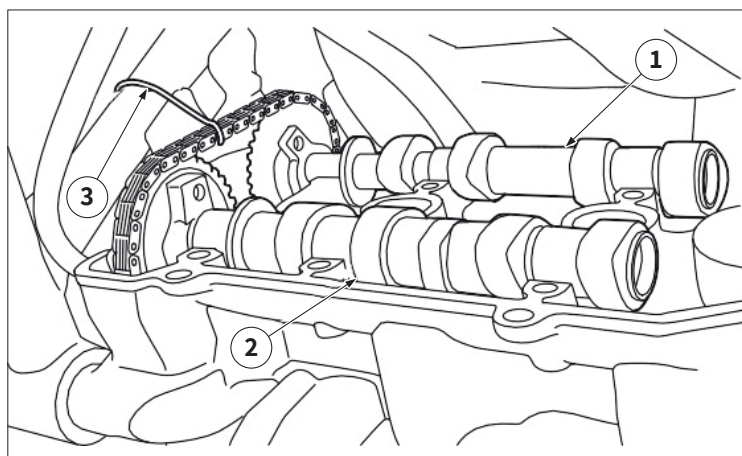


- Turn the crankshaft anti-clockwise, then with piston No. 1 at PMS of the exhaust phase, align PMS mark "a" on the generator rotor with mark "b" on the generator rotor cover.

i TDC = Top Dead Centre.



- Insert hexagon spanner "1" into the timing chain tensioner and remove timing chain tensioner "2" and gasket.

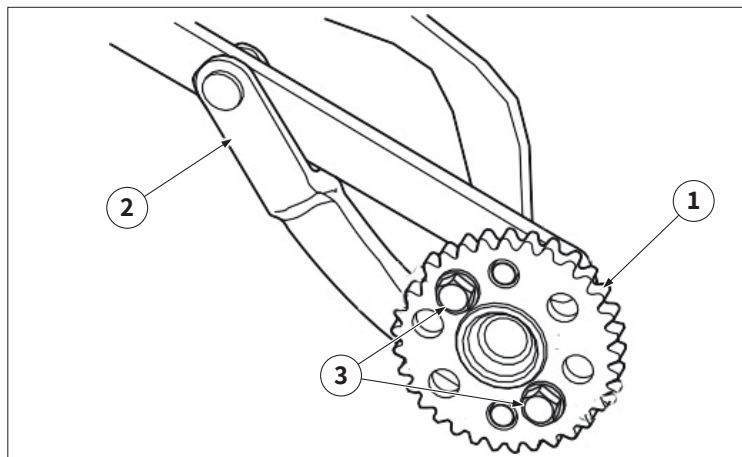


- Remove intake and exhaust camshaft covers.

! To avoid damage to cylinder heads, camshafts or camshaft caps, loosen the bolts in stages and work diagonally from the outside inwards.

- Remove the intake camshaft "1" and exhaust camshaft "2".

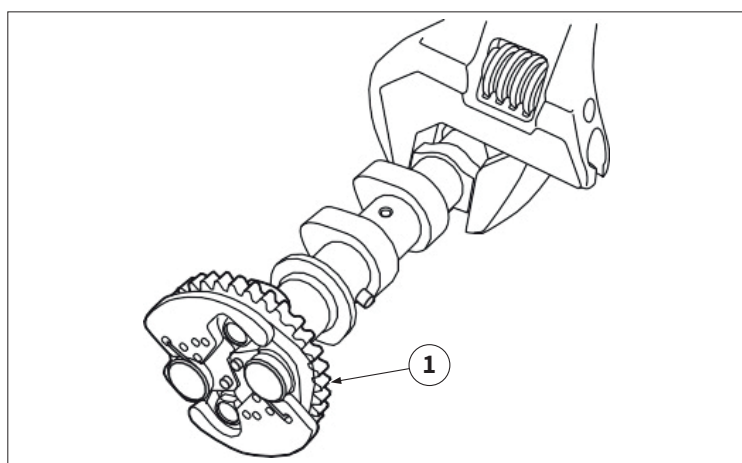
i To prevent the timing chain from falling into the crankcase, fix it with an iron wire "3".



– Remove the intake camshaft sprocket "1".

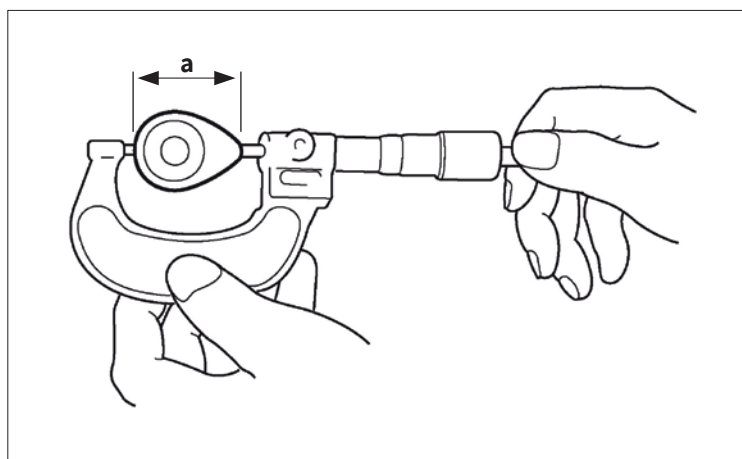
(i) Hold the intake camshaft sprocket with the rotor holding tool "2" to loosen the retaining bolts "3".

✕ - Rotor locking tool; - Universal magnet and rotor support.



– Remove the exhaust camshaft sprocket "1".

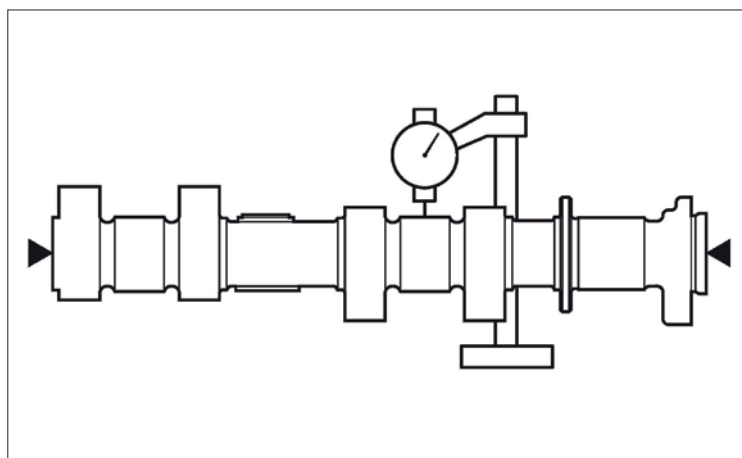
(i) Hold the exhaust camshaft sprocket with a suitable tool to loosen the fastening bolts.



13.5.2 Camshafts check

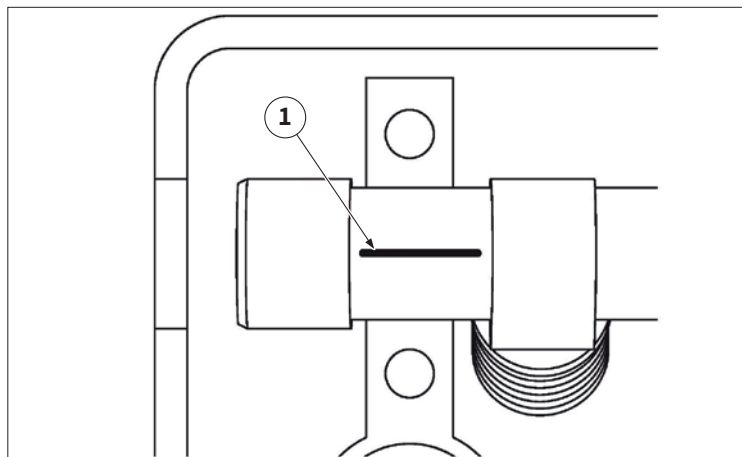
- Check the camshaft lobe: in case of blue discolouration, pitting or scratches, replace the camshaft.
- Measure the size of the camshaft lobe "a": if it does not comply with the prescribed values, replace the camshaft.

✕ **Camshaft lobe size - lobe height limit (intake): 35.510 mm (1.3980 in);**
– Lobe height limit (exhaust): 35,610 mm (1.4020 in).



- Measure the camshaft offset: if it does not comply with the prescribed values, replace the camshaft.

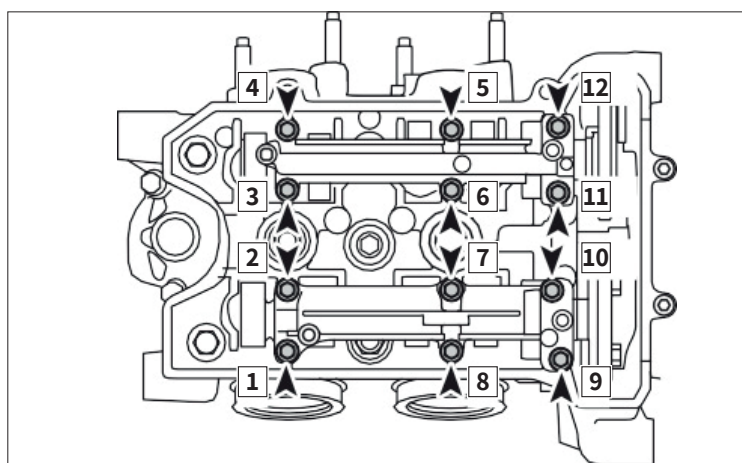
✕ **Camshaft misalignment limit:**
0.030 mm (0.0012 in).



- Measure the clearance of the camshaft journal - camshaft cap: if not in accordance with the prescribed values, measure the camshaft journal diameter.

✂ Camshaft journal-camshaft cap clearance limit: 0.080 mm (0.0032 in).

- Install the camshafts in the cylinder head without the caps;
- Place a strip of Plastigauge® "1" on the camshaft journal, as illustrated;
- Install the centring pins and camshaft caps.

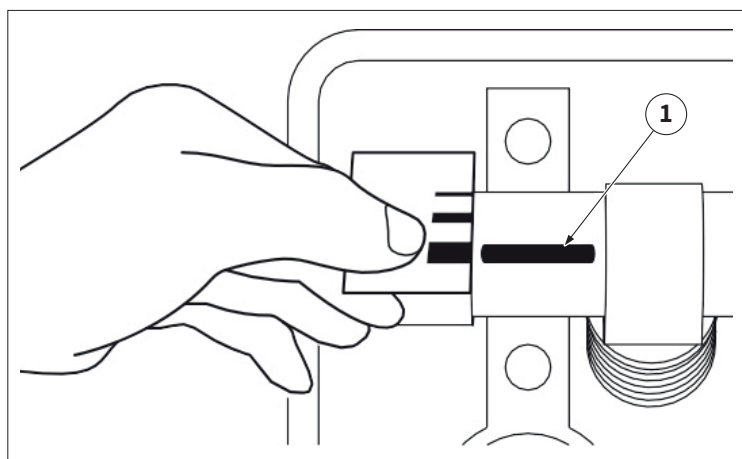


ⓘ Tighten the camshaft cap bolts in the correct sequence, as illustrated.

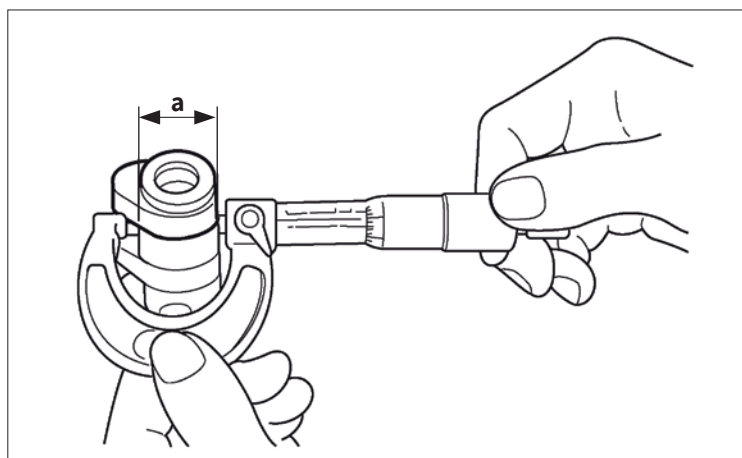
⚠ Camshaft cap bolts must be tightened evenly to avoid damage to the cylinder head, caps and camshafts.

ⓘ Do not rotate the camshaft when measuring clearance after applying the Plastigauge® strip.

✂ Tightening torques - exhaust camshaft cap bolt: 10 N·m (1.0 kgf·m, 7.4 lb·ft); - Intake camshaft cap bolt: 10 N·m (1.0 kgf·m, 7.4 lb·ft).

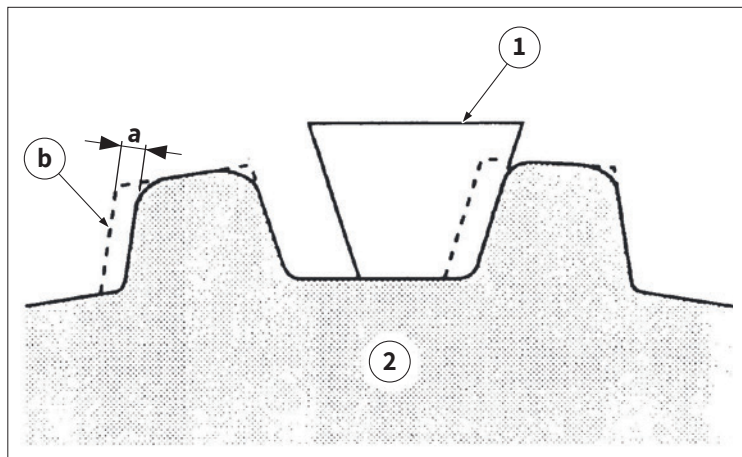


- Remove the camshaft caps, then measure the width of the Plastigauge® "1" strip.



- Measure the diameter of the camshaft journal "a": if it does not comply with the prescribed values, replace the camshaft; if it does comply, replace the cylinder head and camshaft caps en bloc.

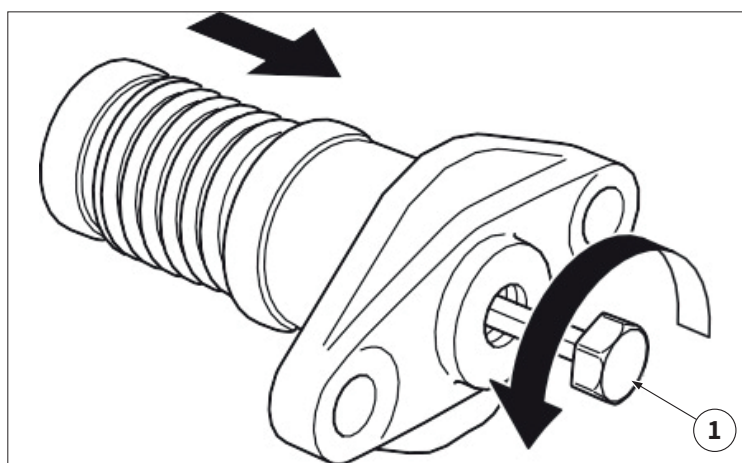
✂ Camshaft journal diameter: 21.959-21.972 mm (0.8645- 0.8650 in).



13.5.3 Camshaft sprockets check

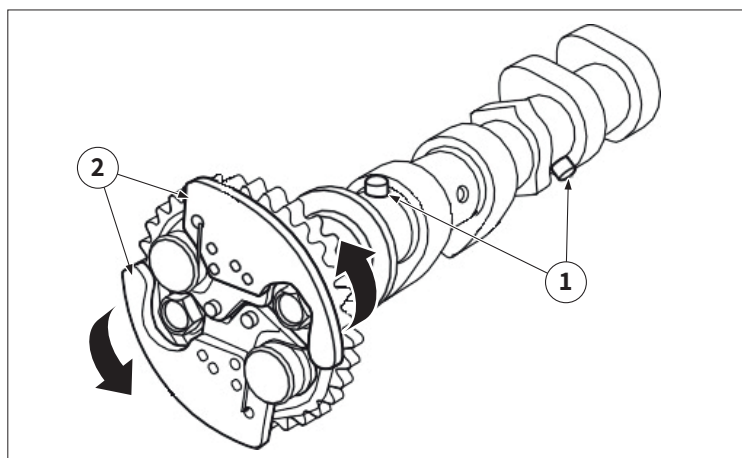
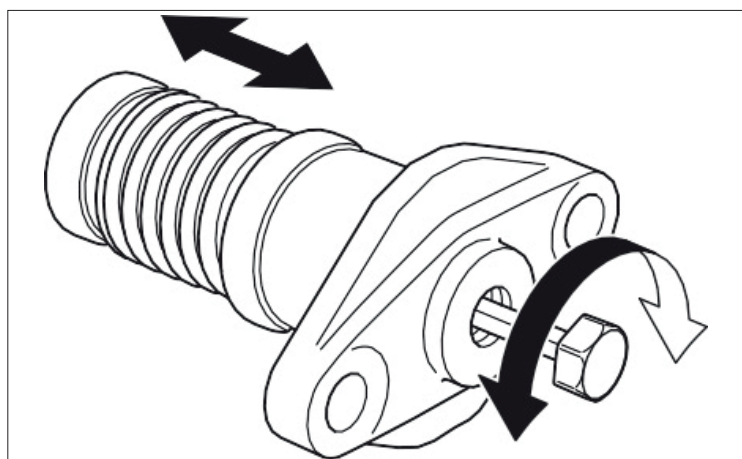
- Check the camshaft sprocket: if the wear on tooth "a" is greater than 1/4, replace the camshaft sprockets and timing chain as a whole.

a	1/4 of a tooth
b	Correct
1	Timing chain
2	Camshaft sprocket



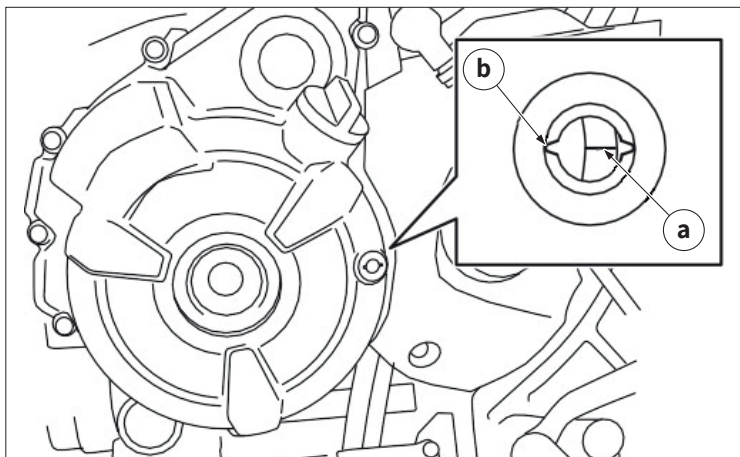
13.5.4 Timing chain tensioner check

- Check the timing chain tensioner: if it shows cracks, damage or irregular movement, replace it.
 - Press the timing chain tensioner rod lightly by hand into its housing and turn it anti-clockwise with a hexagon spanner "1" until it stops;
- Make sure that the timing chain tensioner rod slides in and out of its housing smoothly: if the movement is irregular, replace the timing chain tensioner.



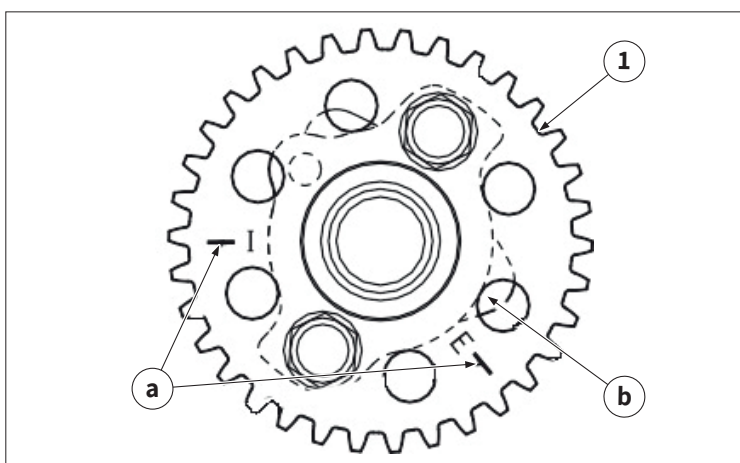
13.5.5 Decompression system check

- Check the decompression system.
 - ① Check that the decompressor lever pins "1" protrude from the camshaft.
 - ① Check that decompression cams "2" and the decompression lever pins move smoothly.



13.5.6 Camshafts installation

- Turn the crankshaft anti-clockwise, then with piston No. 1 at PMS, align PMS mark "a" on the generator rotor with mark "b" on the generator rotor cover.

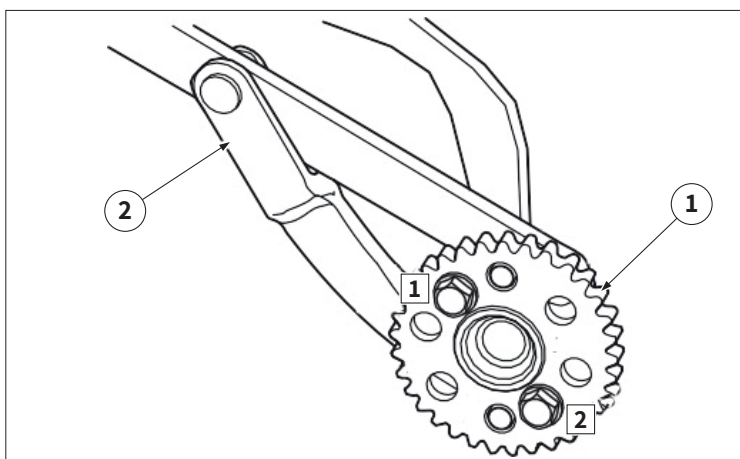


- Install the intake camshaft sprocket "1".

Tightening torque
 Intake camshaft sprocket bolt:
 24 N·m (2.4 kgf·m, 18 lb·ft).

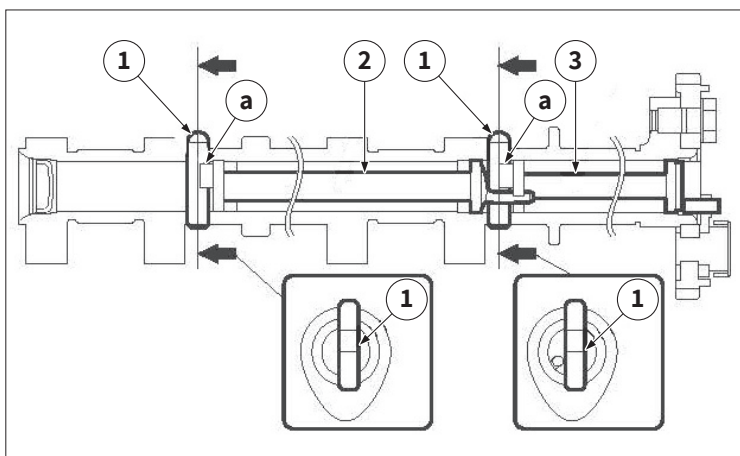
! Tighten the bolts to the specified torque to prevent them from loosening and damaging the engine.

i Ensure that the references "a" on the intake camshaft sprocket are aligned with cam lobe No. 1 "b", as illustrated.



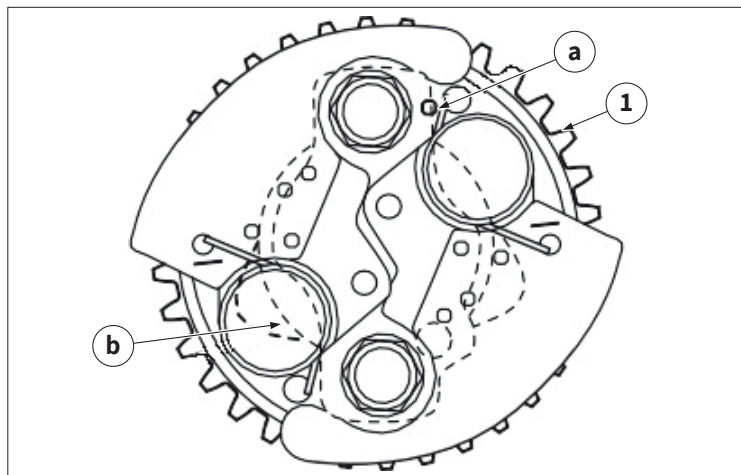
i While holding the intake camshaft sprocket with the rotor holding tool "2", tighten the bolts in the correct sequence, as illustrated.

X - Rotor locking tool; - Universal magnet and rotor support.



- Install the decompressor lever pin "1", decompressor lever No. 1 "2" and decompressor lever No. 2 "3" into the exhaust camshaft as shown.

i Turn notch "a" in each decompressor lever pin towards the exhaust camshaft sprocket.

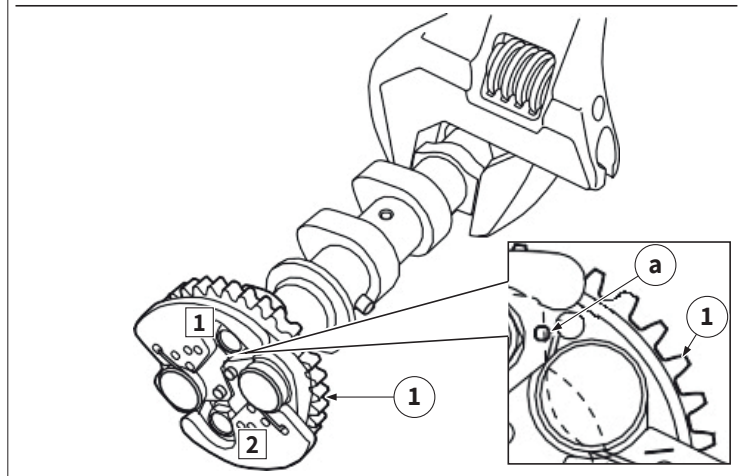


- Install the exhaust camshaft sprocket "1" by holding it with a suitable tool, then tighten the bolts in the correct sequence as illustrated.

 **Tightening torque**
 Exhaust camshaft sprocket bolt:
 24 N·m (2.4 kgf·m, 18 lb·ft).

-  **Be sure to tighten the camshaft sprocket bolts to the specified torque to prevent them from loosening and damaging the engine.**

-  **Ensure that the reference "a" on the exhaust camshaft sprocket is aligned with cam lobe No. 1 "b", as illustrated.**

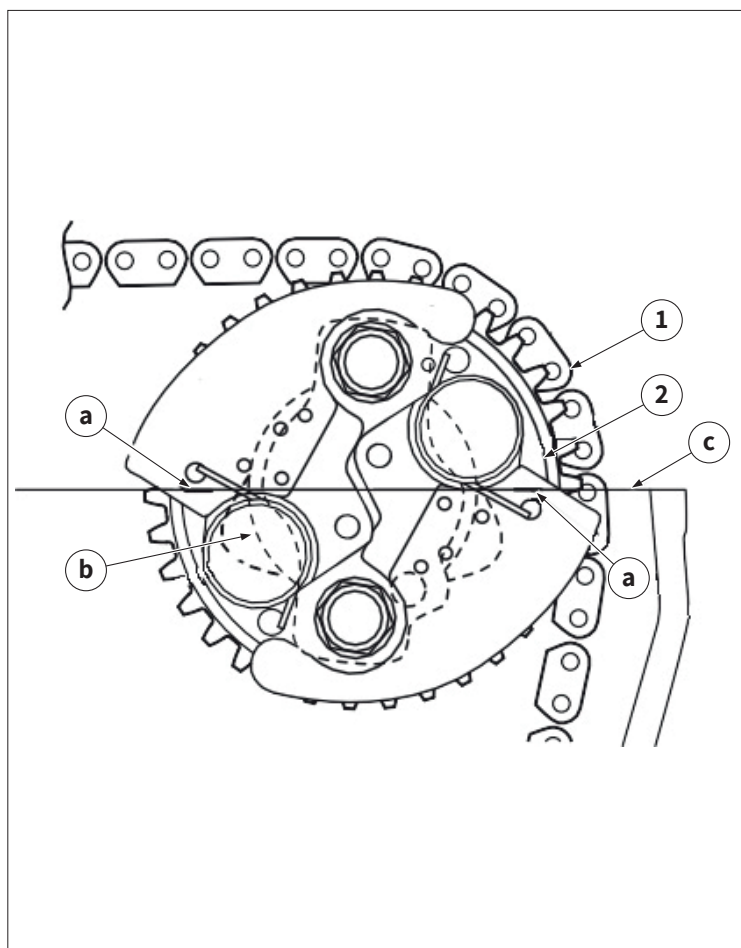


- Install the timing chain "1" on exhaust camshaft sprocket "2", exhaust camshaft and exhaust camshaft cap.

 **Lubricate the bolts with engine oil.**

-  **Camshaft cap bolts must be tightened evenly to avoid damage to the cylinder head, caps and camshafts.**

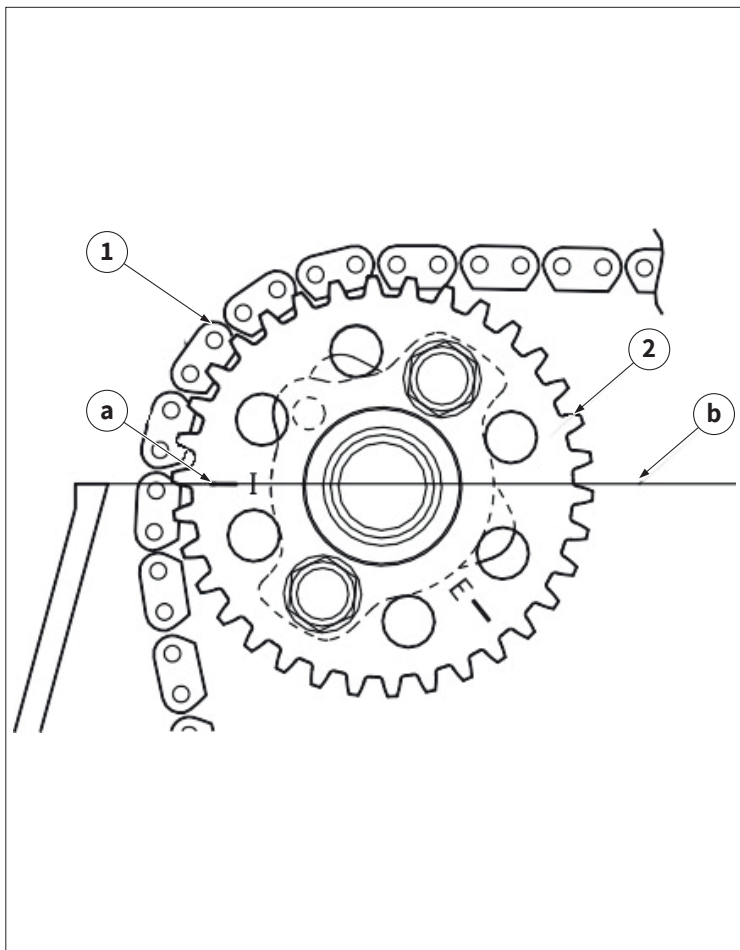
-  **Do not turn the crankshaft when installing the camshaft to avoid damage or valve adjustment errors.**



-  **When installing the timing chain, start at the exhaust camshaft and keep the timing chain as taut as possible on the exhaust side.**

-  **Ensure that the coupling references "a" on the exhaust camshaft sprocket and cam lobe No. 1 "b" are aligned with the edge of the cylinder head "c", as illustrated.**

-  **Provisionally tighten the exhaust camshaft cap bolts.**



- Install the timing chain "1" on intake camshaft sprocket "2", intake camshaft and intake camshaft cap.

Lubricate the bolts with engine oil.

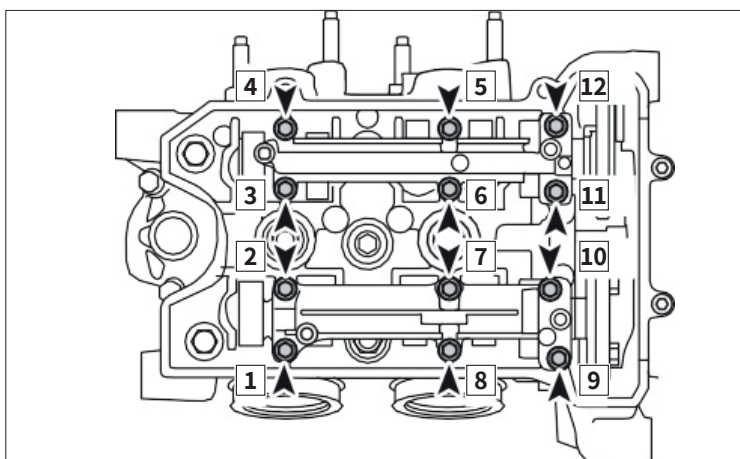
Camshaft cap bolts must be tightened evenly to avoid damage to the cylinder head, camshaft caps and camshafts.

Do not turn the crankshaft when installing the camshaft to avoid damage or valve adjustment errors.

- Install the timing chain on the sprocket of the intake camshaft, then place the intake camshaft on the cylinder head;

Ensure that the coupling reference "a" on the intake camshaft sprocket is aligned with the edge of the cylinder head "b".

- Provisionally tighten the bolts of the intake camshaft cap.

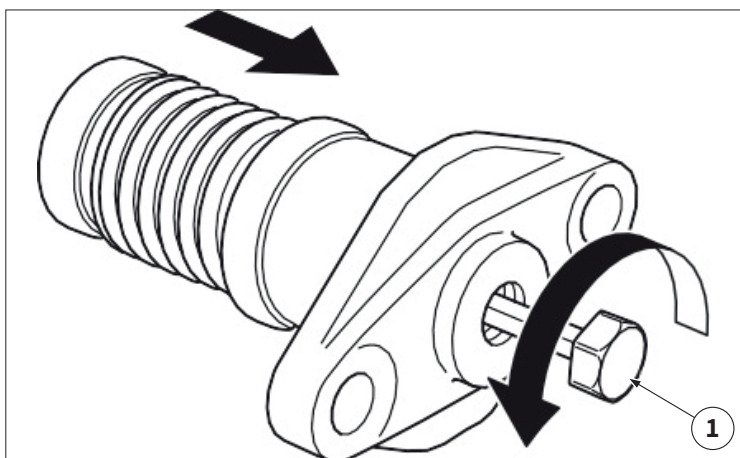


- Tighten exhaust and intake camshaft cap bolts.

Camshaft cap bolts must be tightened evenly to avoid damage to the cylinder head, camshaft caps and camshafts.

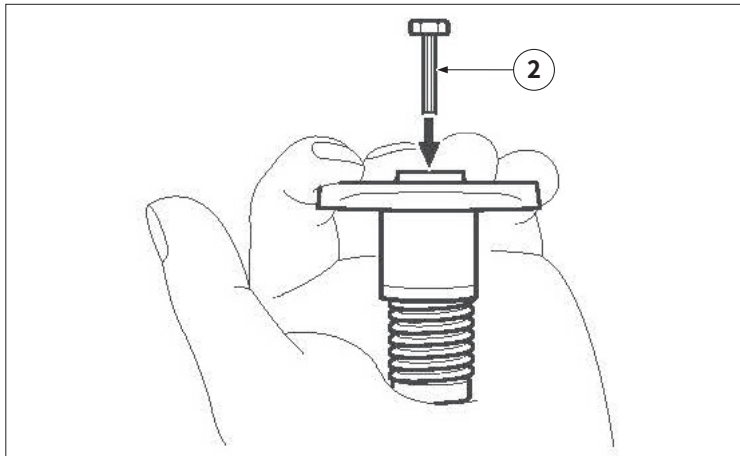
Tighten the bolts in the correct sequence, as illustrated.

Tightening torques - exhaust camshaft cap bolt:
 10 N·m (1.0 kgf·m, 7.4 lb·ft); - Intake camshaft cap bolt:
 10 N·m (1.0 kgf·m, 7.4 lb·ft).

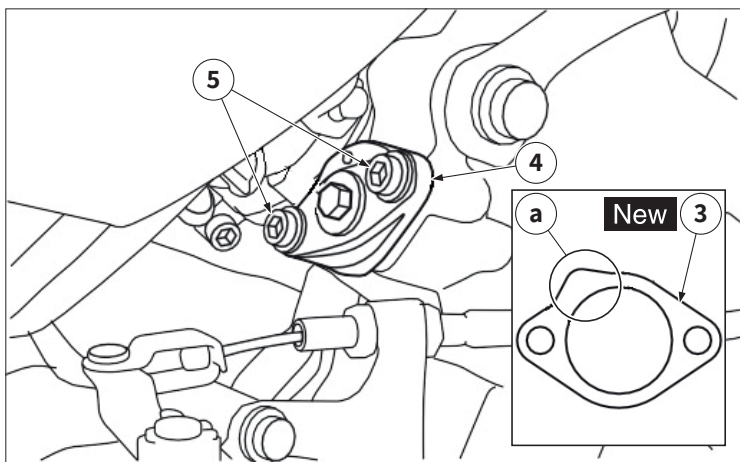


- Install the timing chain tensioner and timing chain tensioner gasket.

- While lightly pressing the timing chain tensioner rod by hand, turn it anti-clockwise with a hexagonal spanner "1";

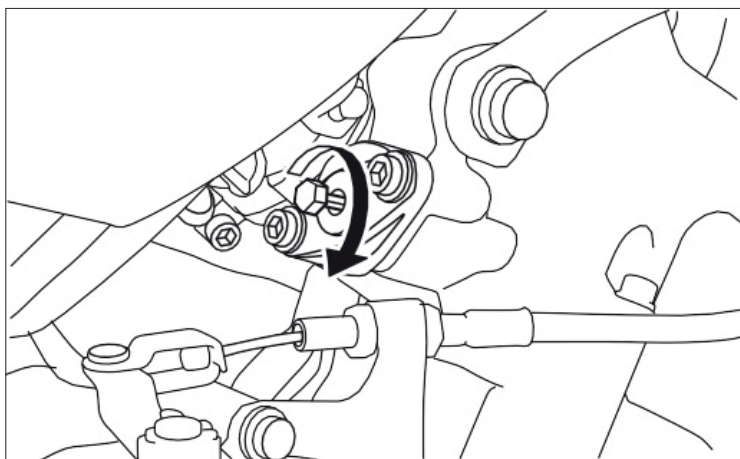


- While continuing to push the timing chain tensioner rod by hand, remove the hexagonal spanner and insert the hexagonal spanner "2";



- Install the a new timing chain tensioner gasket "3", timing chain tensioner "4" and timing chain tensioner bolts "5" on the cylinder block;

i Be sure to install the timing chain tensioner gasket so that part "a" of the gasket protrudes from the upper inner side of the timing chain tensioner.



- Tighten the timing chain tensioner bolts to the prescribed values;



Tightening torque
Timing chain tensioner bolt:
10 N·m (1.0 kgf·m, 7.4 lb·ft).

- Hand-tighten the hexagonal spanner until the timing chain tensioner rod touches the timing chain guide and tighten 1/4 turn with a tool;

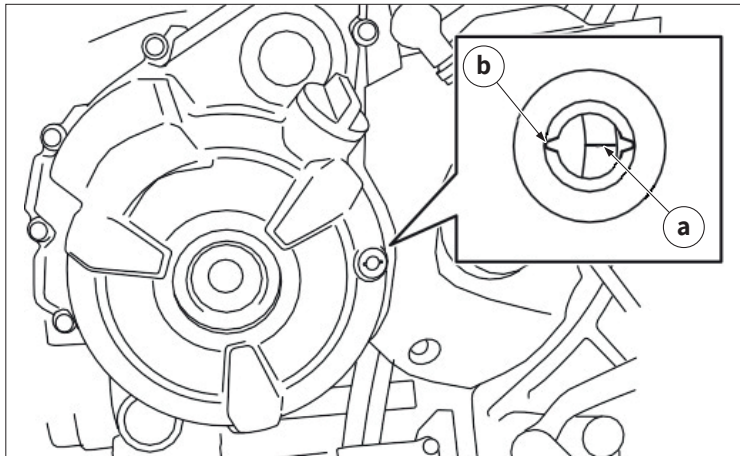


By turning the hexagonal spanner clockwise, the timing chain tensioner rod extends.

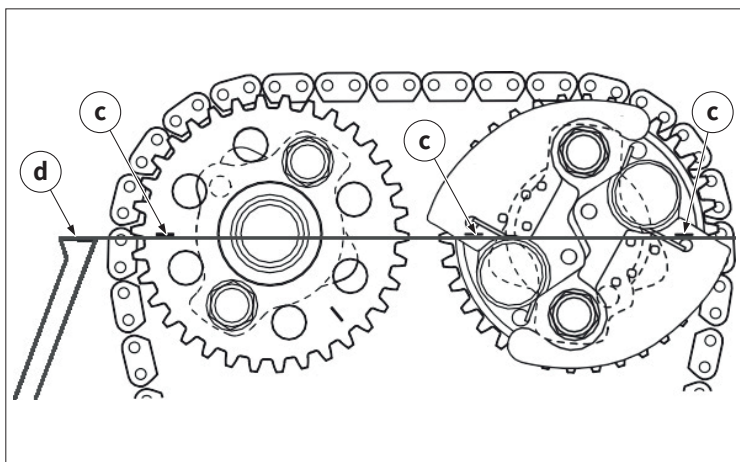
- Remove the hexagonal spanner;
- Install the timing chain tensioner cap gasket and bolt, then tighten the bolt to the prescribed values.



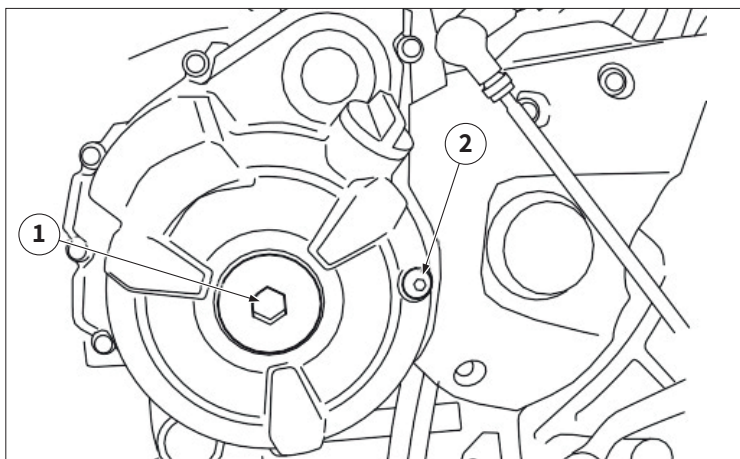
Tightening torque
Timing chain tensioner cap bolt:
7 N·m (0.7 kgf·m, 5.2 lb·ft).



- Rotate the engine shaft anti-clockwise and carry out the following checks:
 - Reference "a" on the generator rotor must be aligned with notch "b" on the generator rotor cover;

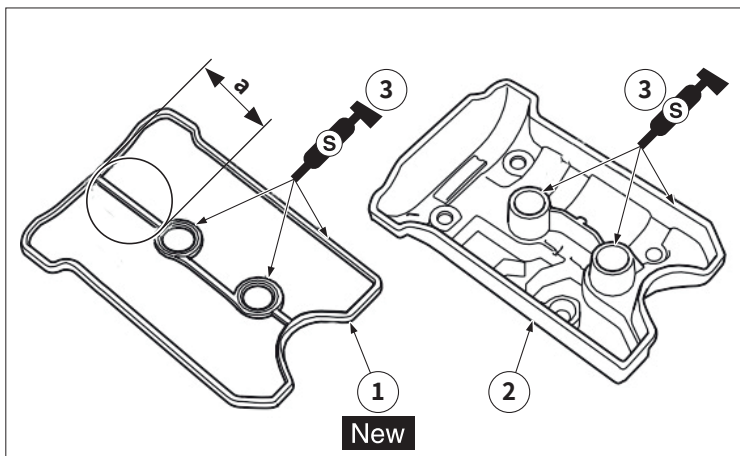


- The references "c" on the camshaft sprockets must be aligned with the mating surface of the cylinder head "d": in the event of misalignment, adjust them by referring to the installation operations above.



- Measure the valve clearance: if it does not comply with the prescribed values, adjust it. Refer to "13.7.2 Valves and valve guides check" on page 177.
- Install the timing reference access bolt "1" and crankshaft end cover "2".

-  **Tightening torques**
- Access bolt for timing reference:
15 N·m (1.5 kgf·m, 11 lb·ft);
 - Engine shaft end cover:
10 N·m (1.0 kgf·m, 7.4 lb·ft).



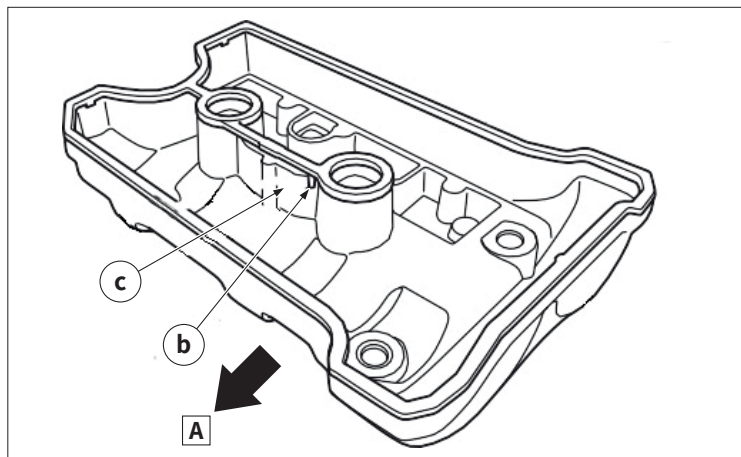
13.5.7 Valve cover installation

- Install the upper guide for the timing chain inside the valve cover.
- Install the a new gasket "1" on valve cover "2".

-  **Tightening torque**
- Valve cover bolt:**
10 N·m (1.0 kgf·m, 7.4 lb·ft).

-  **Apply Three bond No.1215® "3" sealant to the mating surfaces of the valve cover gasket and cylinder head.**

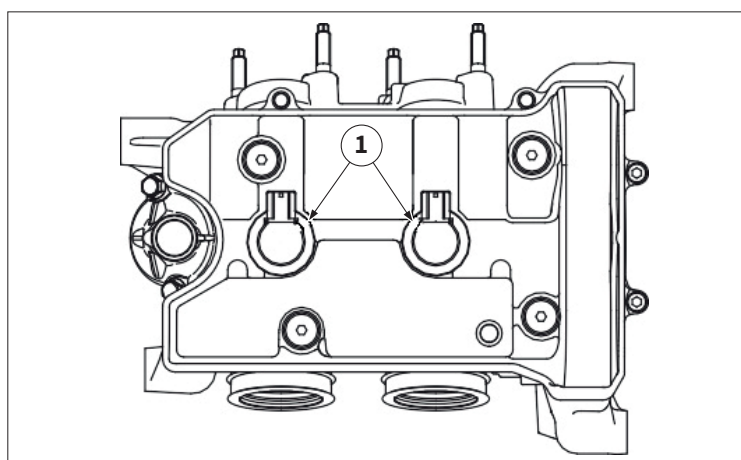
-  **After installing valve cover gasket "1" on the cover, cut section "a".**



- ① Ensure that the protrusion "b" of the valve cover gasket is positioned on the exhaust side of rib "c" of the cover.

♻️ Apply Three-bond sealant No.1215®.

A	Exhaust side
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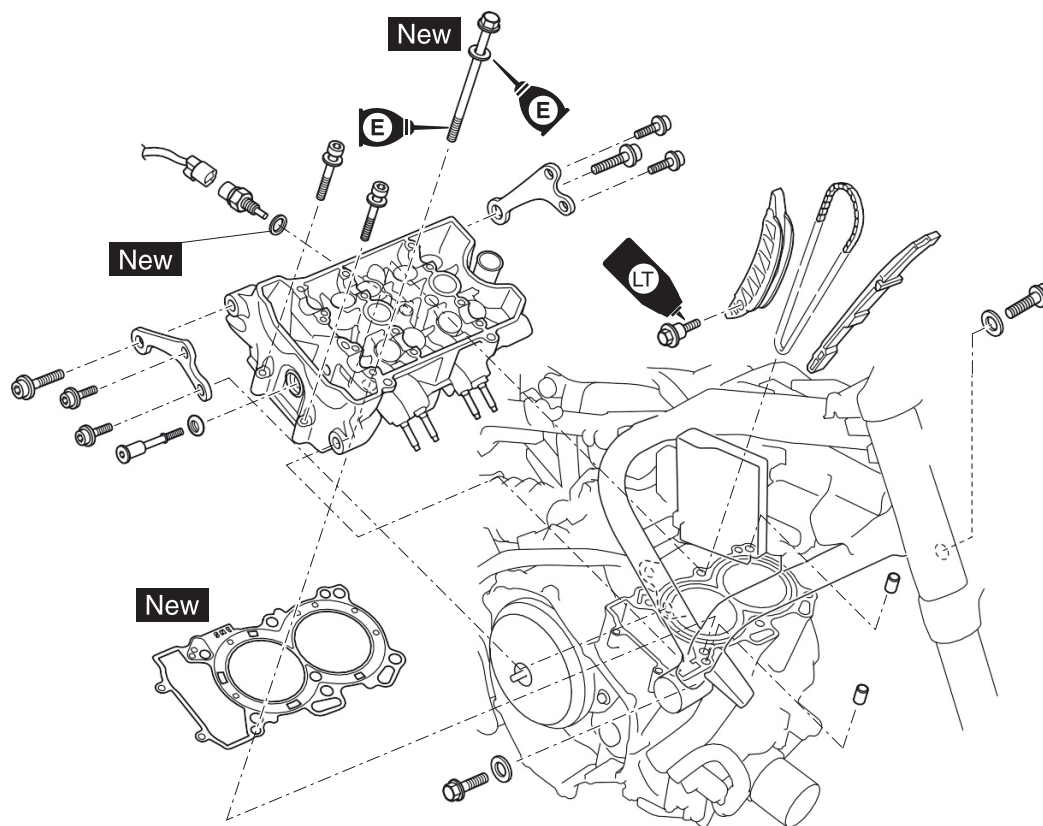
– Install the spark plug and ignition coils "1".

⚙️ **Tightening torque**
 Spark plug: 13 N·m (1.3 kgf·m, 9.6 lb·ft).

- ① Install the ignition coils "1" in the direction shown in the figure.

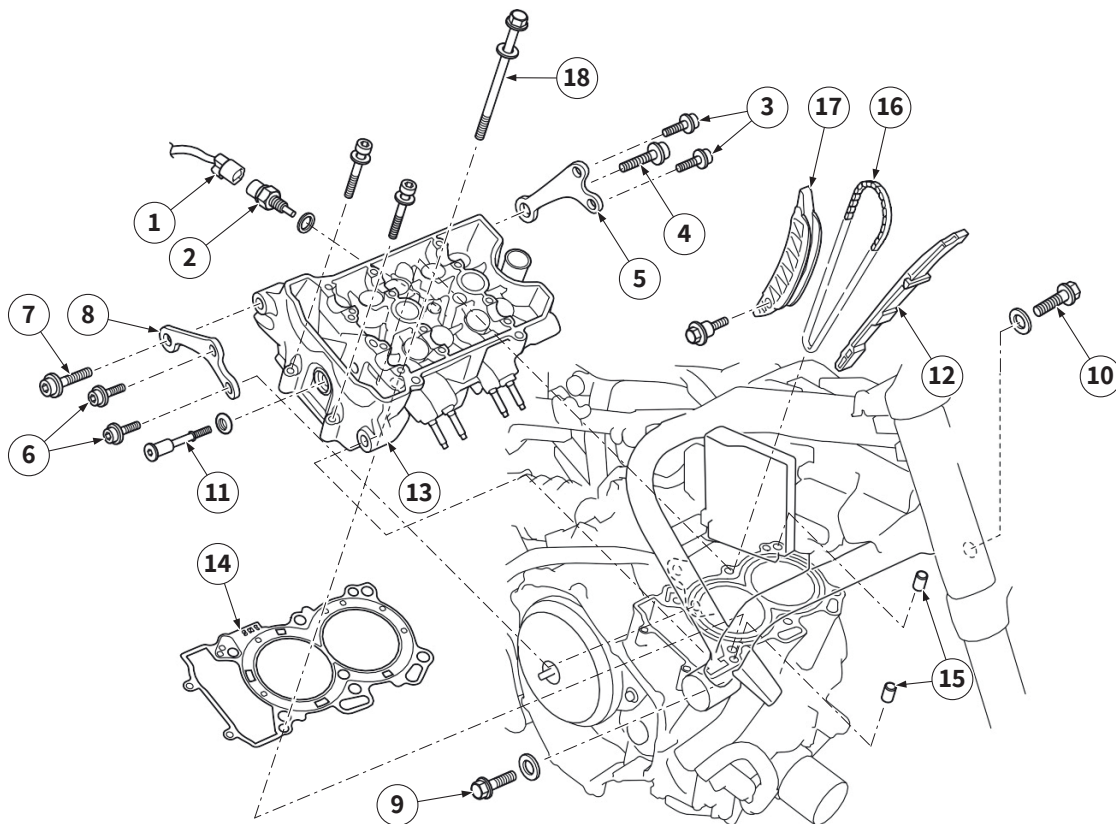
13.6 CYLINDER HEAD

Cylinder head removal: preliminary operations

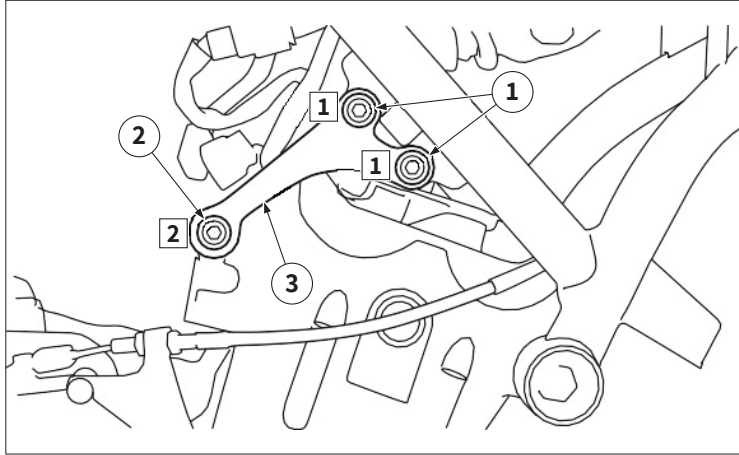


Sequence	Components to be removed	References to operations
1	Seat	"12.1 Seat" on page 102
2	Side conveyors	"12.6 Fairings and conveyors" on page 106
3	Fuel tank	"12.7 Fuel tank" on page 106
4	Right side panel	"12.4.2 Right side panel." on page 104
5	Drain the coolant	"12.20.5 Coolant change." on page 141
6	Expansion tank	"12.20.4 Expansion tank." on page 140
7	Radiator Disconnect the oil cooler inlet tube	"12.20.2 Radiator" on page 138
8	Filter casing and air ducts	"12.27 Filter casing" on page 147
9	Throttle bodies	"13.20 Throttle bodies" on page 245
10	Right frame plate	"12.15.4 Frame plate for right rider pedal" on page 125
11	Silencer	"12.19.1 Silencer" on page 136
12	Cylinder head cover Intake camshaft Exhaust camshaft	"13.5 Camshafts" on page 158
13	Clutch crankcase	"13.10 Clutch" on page 192
14	Thermostat	"13.18 Thermostat" on page 238

Cylinder head removal

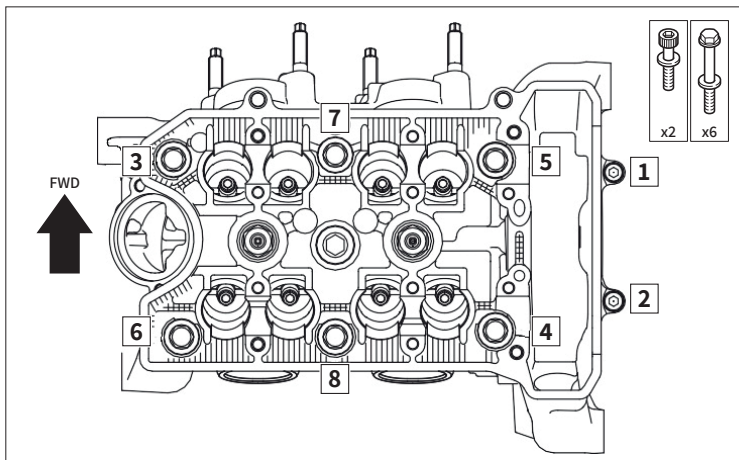


Sequence	Component	Q.ty	Remarks and data
1	Coolant temperature sensor connector	1	Disconnect.
2	Coolant temperature sensor	1	15 N•m (1.5 kgf•m, 11 lb•ft)
3	Engine bracket bolt (left)	2	25 N•m (2.5 kgf•m, 18 lb•ft)
4	Engine mounting bolt (upper left side)	1	55 N•m (5.5 kgf•m, 41 lb•ft)
5	Engine bracket (left)	1	
6	Engine bracket bolt (right)	2	25 N•m (2.5 kgf•m, 18 lb•ft)
7	Engine mounting bolt (upper right side)	1	55 N•m (5.5 kgf•m, 41 lb•ft)
8	Engine bracket (right)	1	
9	Engine mounting bolt (front right side)	1	75 N•m (7.5 kgf•m, 55 lb•ft)
10	Engine mounting bolt (front left side)	1	75 N•m (7.5 kgf•m, 55 lb•ft)
11	Timing chain bolt (right side of cylinder head)	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
12	Timing chain guide (exhaust side)	1	
13	Cylinder head	1	
14	Cylinder head gasket	1	
15	Centering pin	2	
16	Timing chain	1	
17	Timing chain guide (intake side)	1	
18	Cylinder head bolt	2 (M6) 6 (M10)	1st tightening = 10 N•m (1.0 kgf•m, 7.4 lb•ft) 2nd tightening = 20 N•m (2.0 kgf•m, 15 lb•ft) 3rd tightening = 40 N•m (4.0 kgf•m, 30 lb•ft), with specific angle of 90°



13.6.1 Cylinder head removal

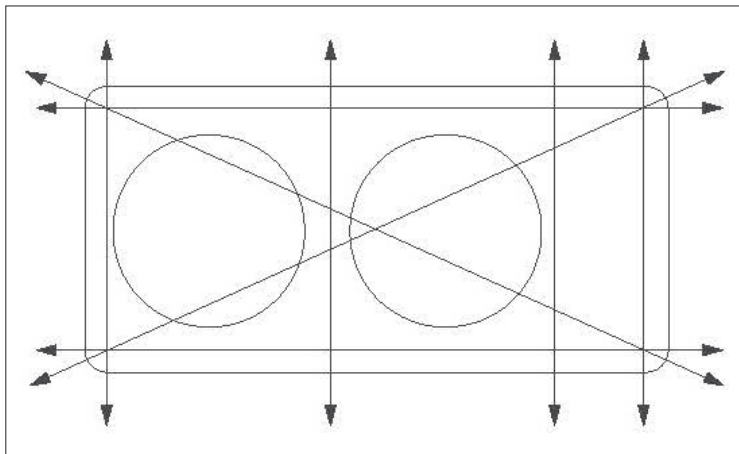
- i** The following procedure applies to both engine brackets.
- Remove the engine bracket bolts "1", engine mounting bolt "2" and engine bracket "3".
- i** Place a suitable support under the engine.
- i** Loosen bolts in the sequence indicated.



- Remove the M6 and M10 cylinder head bolts.
- i** Loosen bolts in the sequence indicated.
- i** Loosen each bolt 1/2 turn at a time. After completely loosening all the bolts, remove them.
 - M6 x 45 mm: "1", "2";
 - M10 x 100 mm: "3" - "8".

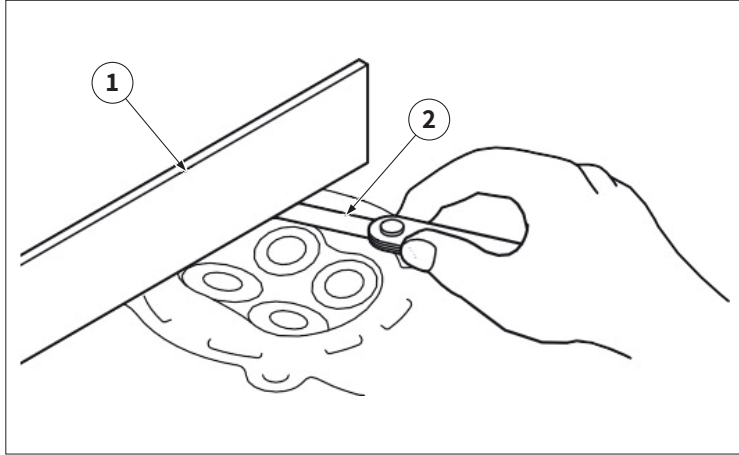
13.6.2 Timing chain guides check

- Check the timing chain guides on the exhaust and intake side: if they are damaged or show signs of wear, replace them.



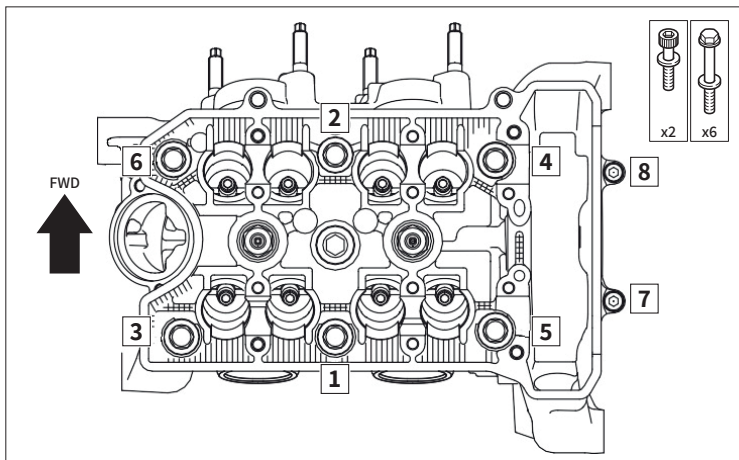
13.6.3 Cylinder head check

- Remove the carbon deposit in the combustion chamber with a rounded scraper.
- i** Do not use a sharp tool to avoid damaging or scratching the threads of the spark plug seats and valve seats.
- Check the cylinder head: if it is damaged or scratched, replace it.
- Measure the cylinder head deformation: if it does not comply with the prescribed values, flatten the cylinder head.
- ⚠ Deformation limit: 0.10 mm (0.0039 in).**



- Place a feeler gauge "1" and a feeler gauge "2" transversely on the cylinder head and measure the deformation: if the limit is exceeded, flatten the cylinder head as follows:
 - Place 400-600 grit wet sandpaper on a countertop and level the cylinder head in a figure-of-eight motion.

i To obtain a uniform surface, rotate the cylinder head several times.



13.6.4 Cylinder head installation

- Install the cylinder head and M10 and M6 bolts.

i Pass the timing chain through the timing chain recess.

♻️ Lubricate M10 bolt threads and mating surfaces with engine oil.

- Tighten the cylinder head bolts in 4 stages, in the correct sequence, as illustrated.
- Follow the tightening sequence; loosen the bolts one by one and retighten them to the prescribed torques.
 - M10 x 100 mm: "1" - "6";
 - M6 x 45 mm: "7", "8".



Tightening torque

- Cylinder head bolt ("1" - "6"):

1st stage: 10 N·m (1.0 kgf·m, 7.4 lb·ft)

2nd stage: 40 N·m (4.0 kgf·m, 30 lb·ft)

3rd stage: 20 N·m (2.0 kgf·m, 15 lb·ft)

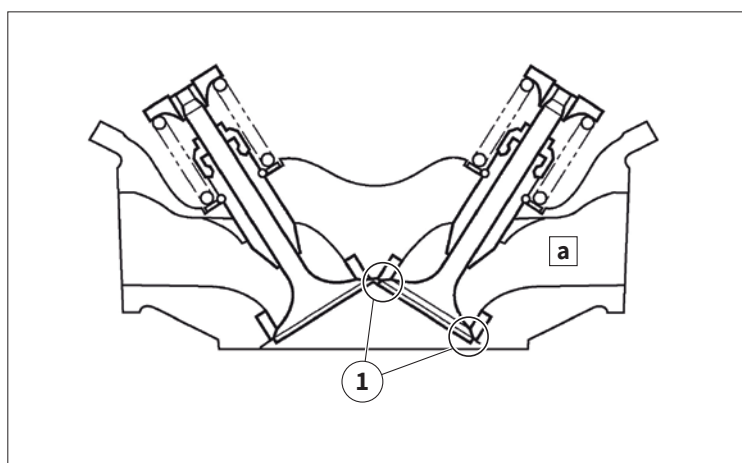
4th stage: tightening at a prescribed angle of 90°;

- Cylinder head bolt ("7", "8"):

10 N·m (1.0 kgf·m, 7.4 lb·ft).

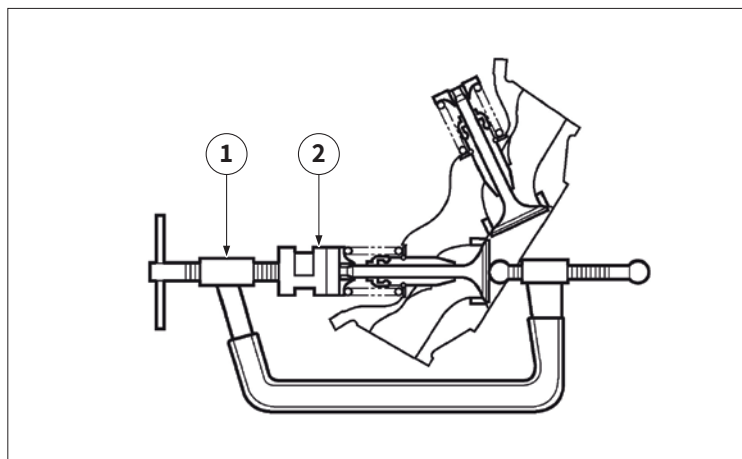
13.7.1 Valve removal

- ① The following procedure applies to all valves and related components.
- ① Before removing internal cylinder head components (e.g. valves, springs and seats), check that the valves are sealed properly.
 - Remove the valve lifter and valve bearing.
- ① Note the position of each valve lifter and bearing so that they can be installed in their original position.



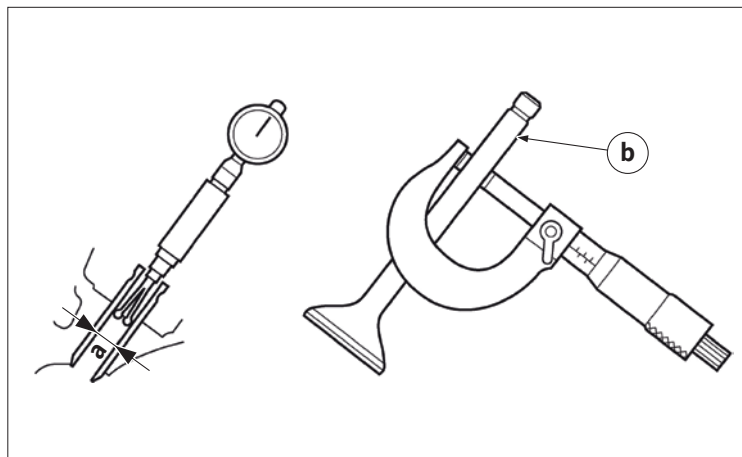
- Check the tightness of the valves: in the event of leakage from the seat, check the face, seat and width of the valve seat, referring to “13.7.3 Valve seats check” on page 178.
 - Pour clean solvent "a" into the intake and exhaust ports;
 - Check the valves for correct tightness.

- ① There must be no leakage from valve seats "1".



- Remove the valve cotter.
- ① Remove the valve cottes by compressing the valve spring with compressor "1" and compressor adapter "2".
- ✂ - Compressor for valve springs;
 - Adapter for valve spring compressor $\varnothing 26$.

- Remove valve spring retainer, spring, valve, stem seal and spring seat.
- ① Identify the position of each component very carefully, so that it can be installed again in its original location.



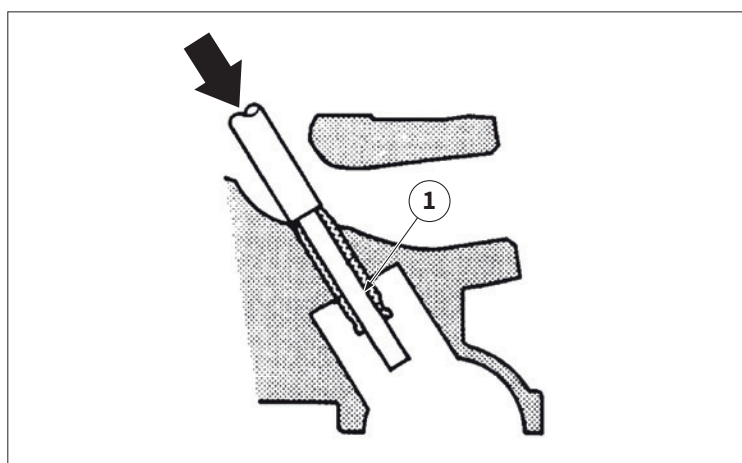
13.7.2 Valves and valve guides check

i The following procedure applies to all valves and valve guides.

- Measure the valve stem-valve guide clearance: if it does not comply with the prescribed values, replace the valve guide.

Valve stem clearance = inside diameter of valve guide "a" - stem diameter "b".

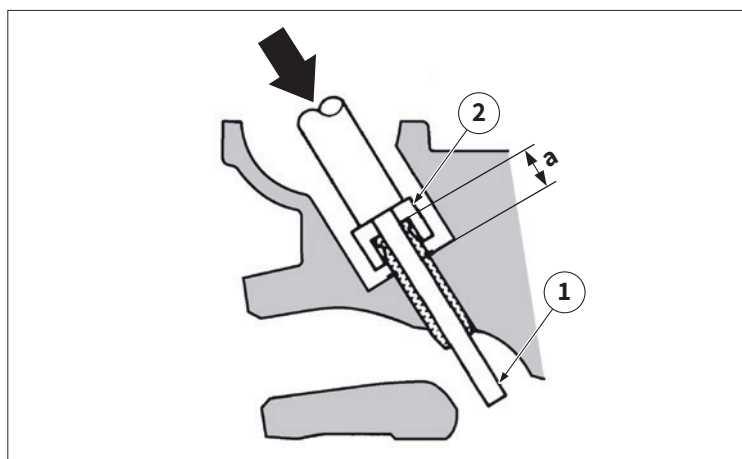
- Valve stem-valve guide clearance limit (intake)
0.080 mm (0.0032 in);
- Valve rod-valve guide clearance limit (exhaust):
0.100 mm (0.0039 in).



- Replace the valve guide.

i To facilitate removal and installation of the valve guide and to maintain proper coupling, heat the cylinder head in an oven at 100 °C (212 °F).

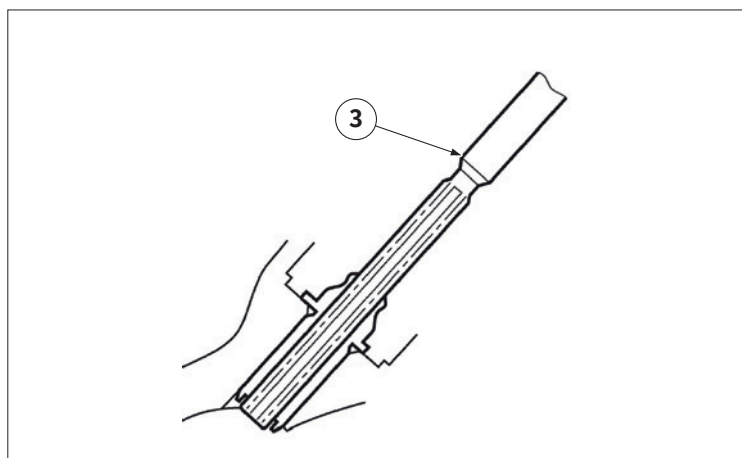
- Remove the valve guide with the appropriate extractor "1".



- Install the new valve guide with the appropriate installer "2" and extractor "1";

Valve guide position: 14.8–15.2 mm (0.58–0.60 in).

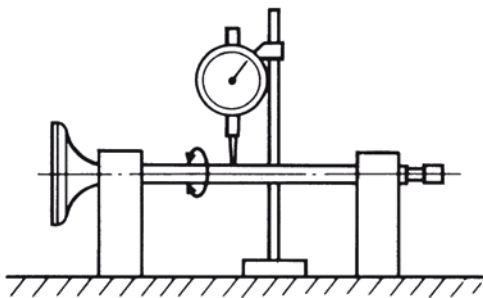
a	Valve guide position
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- After installation, ream the valve guide with reamer "3" to obtain the correct clearance.

i After replacing the valve guide, grind the valve seat.

- Valve-guide extractor ø4.5;
- Valve-guide installer ø4.5;
- Valve-guide reamer ø4.5.

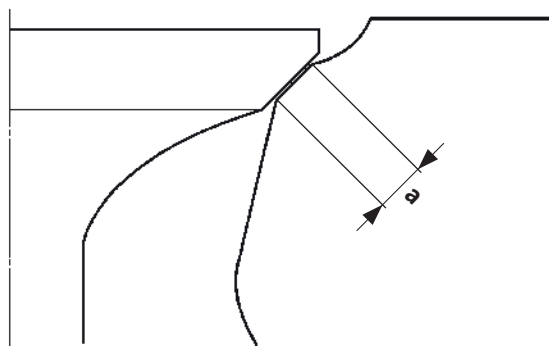


- Remove carbon deposits from the valve face and seat.
- Check the valve face: if it shows pitting or signs of wear, ream it.
- Check the valve stem end: if it is mushroom-shaped or the diameter is larger than the stem body, replace the valve.
- Measure the valve stem misalignment: if it does not comply with the prescribed values, replace the valve.

i When installing a new valve, always replace the valve guide.

i If the valve is removed or replaced, always replace also the valve stem gasket.

✂ Valve stem misalignment: 0.010 mm (0.0004 in).



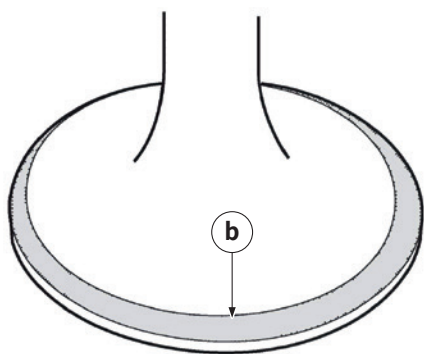
13.7.3 Valve seats check

i The following procedure applies to all valves and valve seats.

- Remove carbon deposits from the valve face and seat.
- Check the valve seat: if there is pitting or signs of wear, replace the cylinder head.
- Measure the width of the valve seat "A": if it does not comply with the prescribed values, replace the cylinder head.

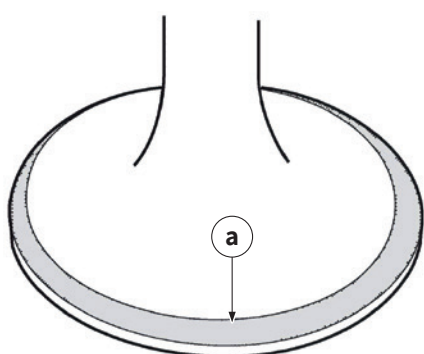
✂ - Valve seat contact width limit (intake)
1.6 mm (0.06 in);

- Valve seat contact width limit (exhaust):
1.6 mm (0.06 in).



- Apply Blue Layout Fluid "b" to the valve face;
- Install the valve in the cylinder head;
- Press the valve through the valve guide and on the valve seat to produce a clear impression.
- Measure the width of the valve seat.

i Where the valve seat and valve face have touched, the blue colouring will be removed.

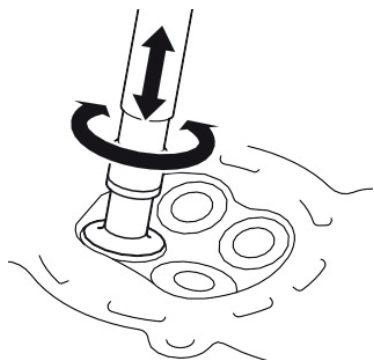


- Lap the valve face and seat.

i After replacing the cylinder head or valve and valve guide, the valve seat and valve face must be lapped.

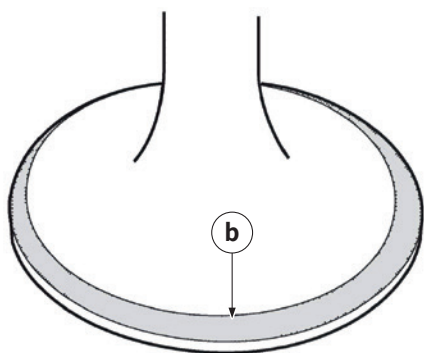
- Apply a coarse-grained abrasive lapping agent "a" on the valve face.

⚠ Do not allow the penetration of the abrasive lapping agent into the clearance between valve stem and valve guide.

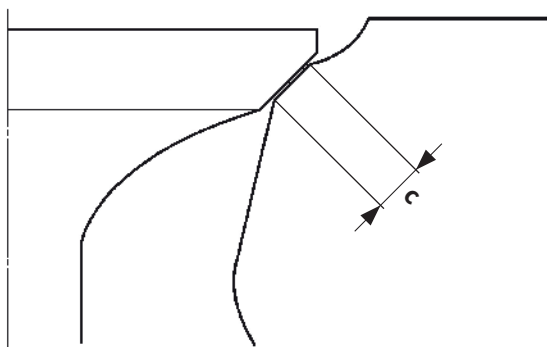


- Apply molybdenum disulphide oil to the valve stem;
- Install the valve in the cylinder head.
- Rotate the valve until the valve face and seat are evenly polished, then remove the abrasive lapping agent.

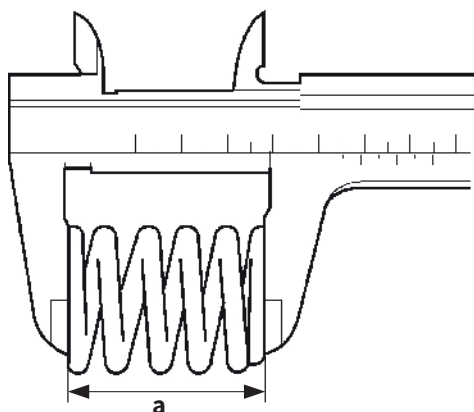
i To obtain an excellent lapping, lightly tap the valve seat turning the valve back and forth between the hands.



- Apply a fine-grained lapping abrasive agent to the valve face and repeat the above steps.
- After each lapping process, remove the lapping abrasive agent from the valve face and seat;
- Apply Blue Layout Fluid "b" to the valve face;



- Install the valve in the cylinder head.
- Press the valve through the valve guide and on the valve seat to produce a clear impression.
- Measure the width of the valve seat "c" again: if it does not conform to the prescribed values, rectify and lapped the valve seat.



13.7.4 Valve springs check

i The following procedure applies to all valve springs.

- Measure the free length of the valve spring "a": if it does not comply with the prescribed values, replace it.

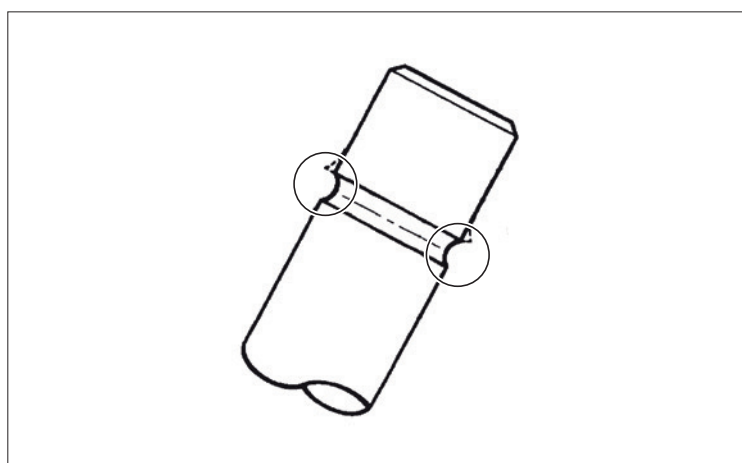


- Free length limit (intake) 38.29 mm (1.51 in);
- Free length limit (exhaust): 39.32 mm (1.55 in).

13.7.5 Valve lifter check

i The following procedure applies to all valve lifters.

- Check the valve lifter: if it is damaged or scratched, replace the valve lifters and cylinder head.

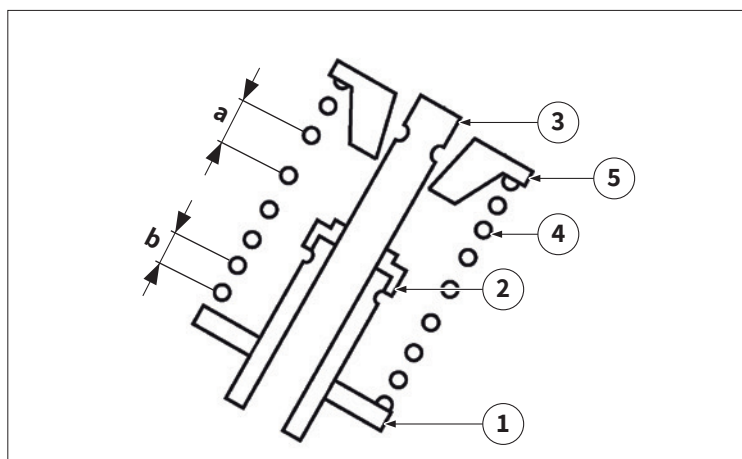


13.7.6 Valve installation

i The following procedure applies to all valves and related components.

- Deburr the valve stem with a sharpening stone.
- Lubricate the valve stem and stem end with the recommended lubricant.

Recommended lubricant: molybdenum disulphide oil.

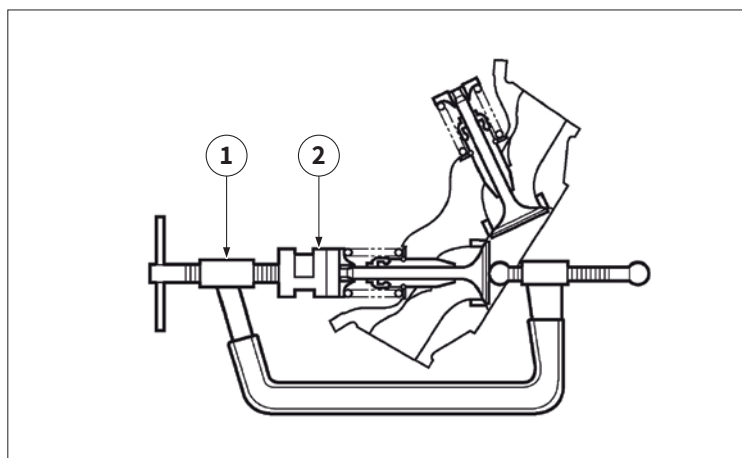


- Install the valve spring seat "1" in the cylinder head, valve stem seal "2", valve "3", valve spring "4", valve spring retainer "5".

i Make sure that each valve is installed in its original position.

i Install the valve springs with the largest pitch "a" facing upwards.

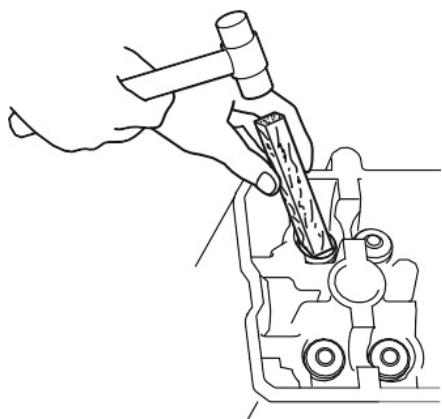
b	Smaller pitch
---	---------------



- Install the valve cotters.

i Install the valve cotters by compressing the spring with the appropriate compressor "1" and spring compressor adapter "2".

- Compressor for valve springs;
- Adapter for valve spring compressor $\varnothing 26$.



- To fasten the valve cotteners on the stem, lightly tap with a soft hammer on the valve tip.

⚠ If valve tip is hit with too much force, there is a risk of damaging it.

- Lubricate the valve lifter with the recommended lubricant.

🔄 Recommended lubricant: engine oil.

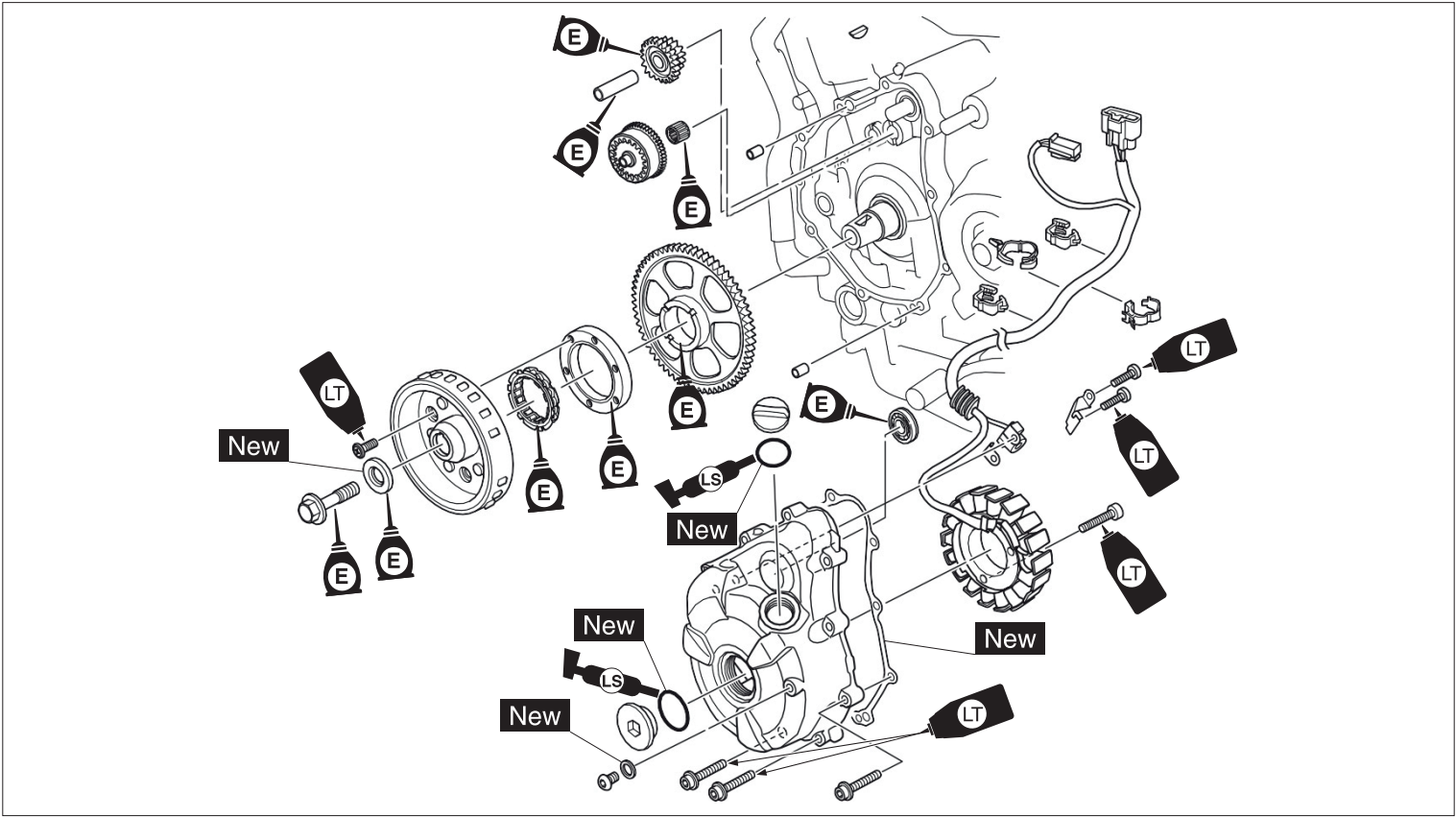
- Install the valve bearing and valve lifter.

ⓘ The valve lifter must move smoothly when rotated with a finger.

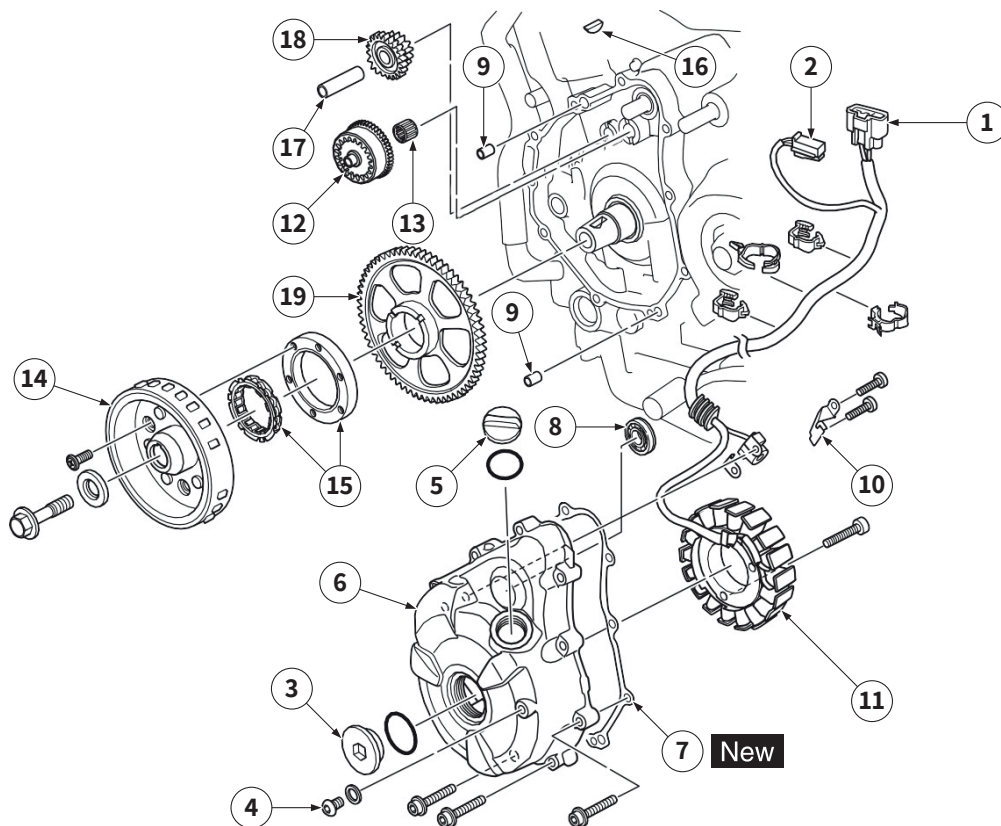
ⓘ Each valve lifter and bearing must be reinstalled in its original position.

13.8 UNIDIRECTIONAL GENERATOR AND STARTER

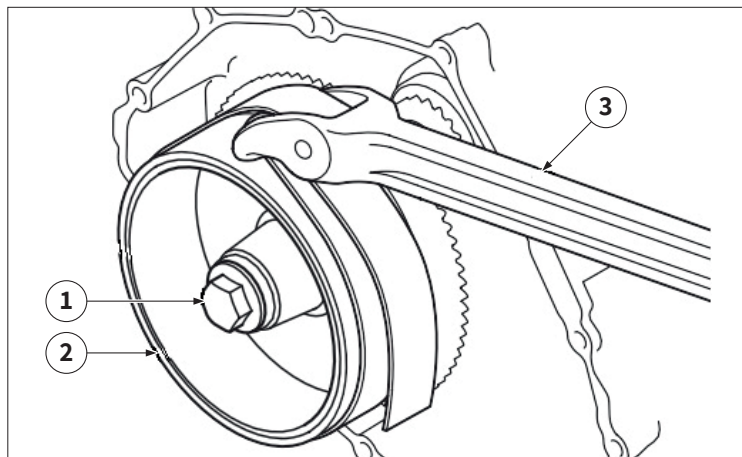
Removal of stator coil, generator rotor and unidirectional starter: preliminary operations



Sequence	Components to be removed	References to operations
1	Drain the Coolant	"12.20.5 Coolant change." on page 141
2	Expansion tank	"12.20.4 Expansion tank." on page 140
3	Voltage regulator	"10.4.3 Voltage regulator removal" on page 45
4	Sprocket guard	"12.13.4 Sprocket removal" on page 122
5	Drain the Engine Oil	"13.2 Engine oil and filter change" on page 153

Removal of stator coil, generator rotor and unidirectional starter


Sequence	Component to be removed	Q.ty	Remarks and data
1	Stator coil connector	1	Disconnect.
2	Crankshaft position sensor connector	1	Disconnect.
3	Crankshaft end cover	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
4	Access bolt to reference for timing	1	15 N•m (1.5 kgf•m, 11 lb•ft)
5	Oil filler cap	1	
6	Generator cover	1	12 N•m (1.2 kgf•m, 8.9 lb•ft)
7	Generator cover gasket	1	
8	Bearing	1	
9	Centering pin	2	
10	Stator coil cable support	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
11	Stator coil unit (Stator coil/Engine shaft position sensor)	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
12	Torque limiter	1	
13	Bearing	1	
14	Generator rotor	1	70 N•m (7.0 kgf•m, 52 lb•ft)
15	Unidirectional start-up	1	32 N•m (3.2 kgf•m, 24 lb•ft)
16	Woodruff key	1	
17	Unidirectional starter idler gear shift shaft	1	
18	Unidirectional starter idler gear	1	
19	Unidirectional starter gear	1	

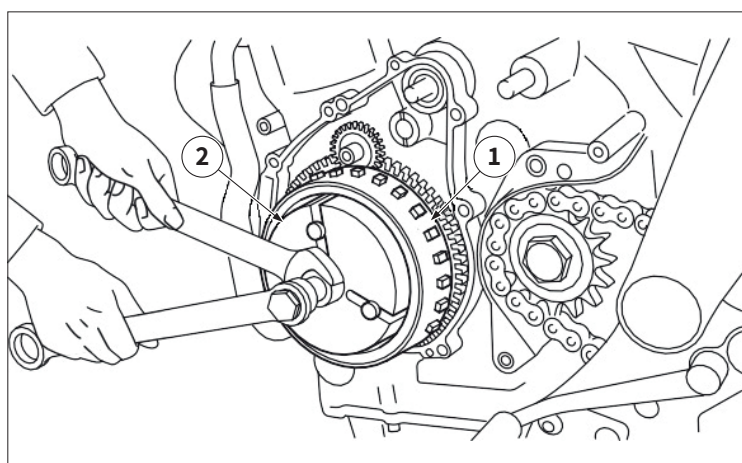


13.8.1 Generator removal

- Remove generator rotor bolt "1" and washer.

i While holding the generator rotor "2" with the rotor locking tool "3", loosen the generator rotor bolt.

- ✕ - Pulley locking tool;
- Primary clutch locking tool.



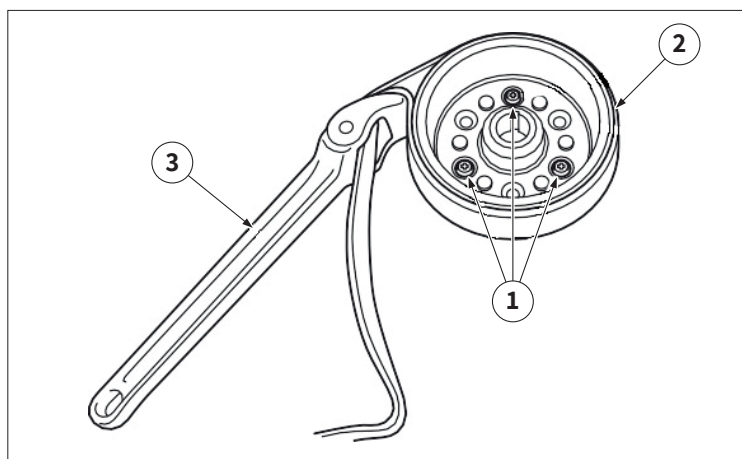
- Remove the generator rotor "1" with flywheel extractor "2" and Woodruff tab.

! To protect the end of the crankshaft, place a suitably sized socket wrench between the flywheel puller centering bolt and the crankshaft.

i Install the flywheel extractor bolts in the threaded holes of the unidirectional starter.

i Make sure that the flywheel puller is centered over the generator rotor.

- ✕ - Flywheel puller;
- Puller for heavy work.



13.8.2 Unidirectional starter removal

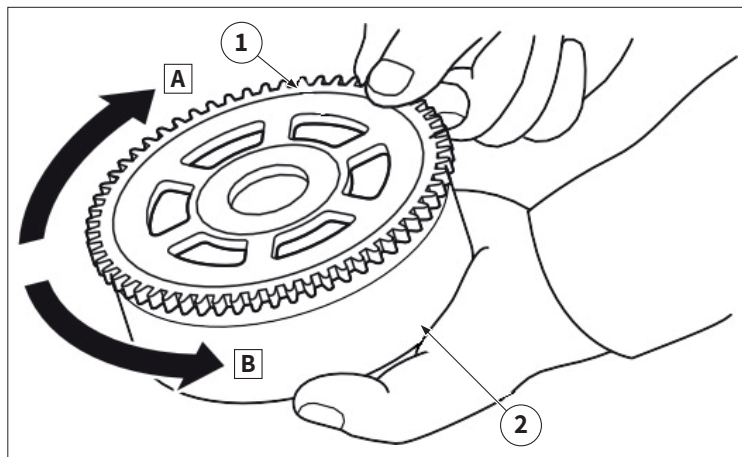
- Remove the bolts of the unidirectional starter "1" and the unidirectional starter.

i While holding the generator rotor "2" with the rotor locking tool "3", loosen the bolts.

- ✕ - Pulley locking tool;
- Primary clutch locking tool.

13.8.3 Unidirectional start-up control

- Check the unidirectional starter roller: if it shows damage or signs of wear, replace it.
- Check the unidirectional starting idler gear and the unidirectional starting gear: if they show burrs, chips, roughness or signs of wear, replace the defective component(s).
- Check the contact surface of the unidirectional starting gear: if it shows damage, pitting or wear, replace the unidirectional starting gear.

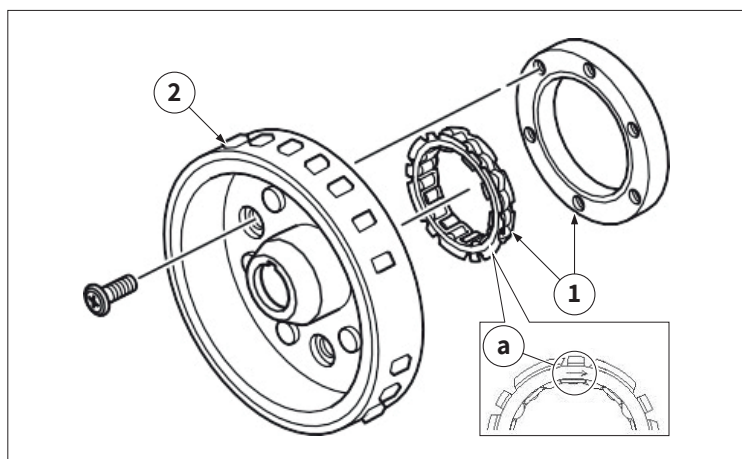


- Check the unidirectional starter operation:
 - Install the unidirectional starting gear "1" on the generator rotor "2" and hold the rotor in place;
 - When turning the unidirectional starting gear "A" clockwise, it must engage with the unidirectional starter. Otherwise, the unidirectional starter is faulty and must be replaced;
 - When turning the unidirectional starter gear "B" counter-clockwise, it must rotate freely, otherwise the unidirectional starter is faulty and must be replaced.

13.8.4 Torque limiter control

- Check the torque limiter: if it shows damage or signs of wear, replace it.

i Do not disassemble the torque limiter.



13.8.5 Unidirectional starter installation

- Install the unidirectional starter "1".

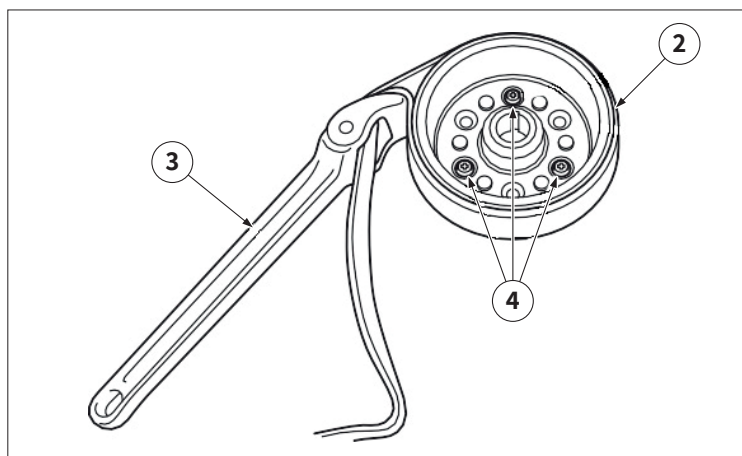
Tightening torque
 Unidirectional starter bolts:
 32 N·m (3.2 kgf·m, 24 lb·ft)

Apply **LOCTITE®** threadlock to the fastening bolts of the unidirectional starter.

i Install the unidirectional starter so that the side of the unidirectional starter roller unit with the reference arrow "a" is facing the generator rotor "2".

i Hold the generator rotor "2" in place with the rotor locking tool "3" to tighten the unidirectional starter bolts "4".

- X** - Pulley locking tool;
- Primary clutch locking tool.



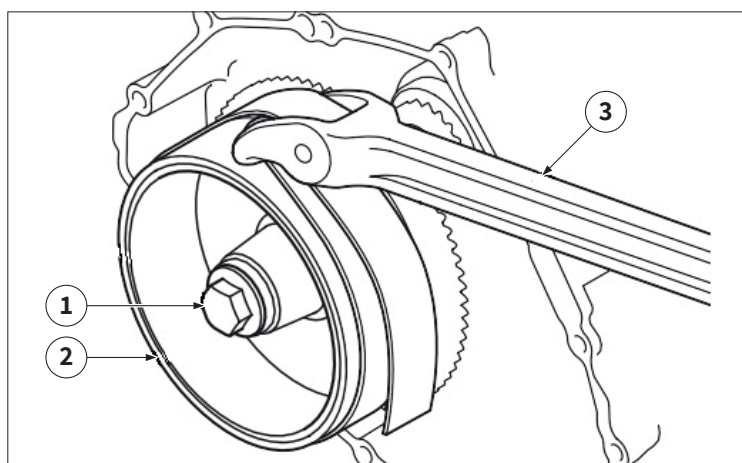
13.8.6 Generator installation

- Install the Woodruff tab, generator rotor, washer and generator rotor bolt.

i Clean the tapered part of the crankshaft and the generator rotor hub.

i When installing the generator rotor, make sure that the Woodruff tab is properly installed in the keyway of the crankshaft.

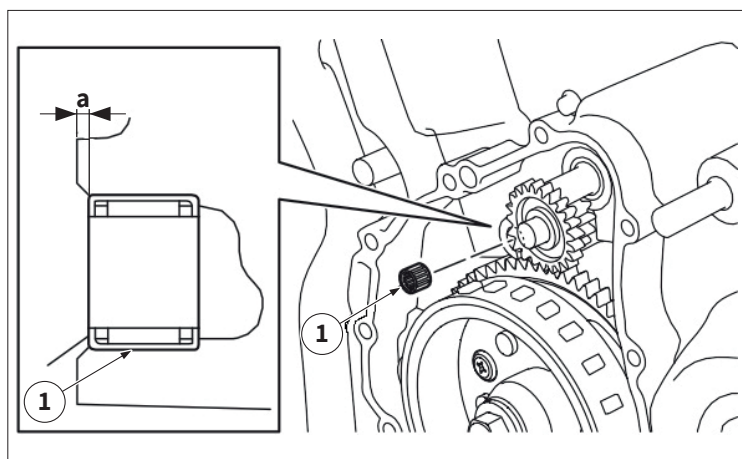
 Lubricate bolt threads and washer damping surfaces with engine oil.



- Tighten the generator rotor bolt "1".

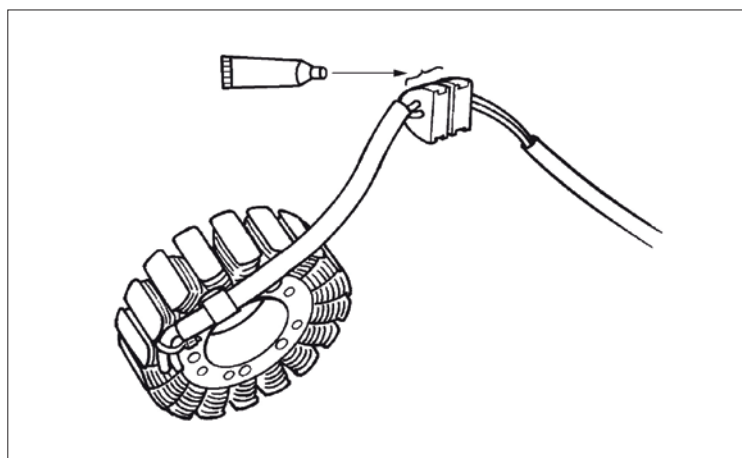
 **Tightening torque**
 Generator rotor bolt: 70 N·m (7.0 kgf·m, 52 lb·ft).

i Hold the generator rotor "2" with the rotor locking tool "3" to tighten the bolt.



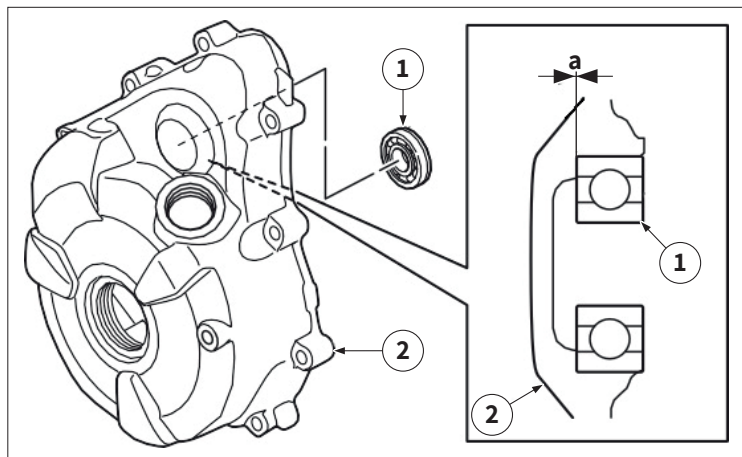
- Install bearing "1".

i Ensure that the bearing does not protrude beyond the "a" surface of the cylinder.



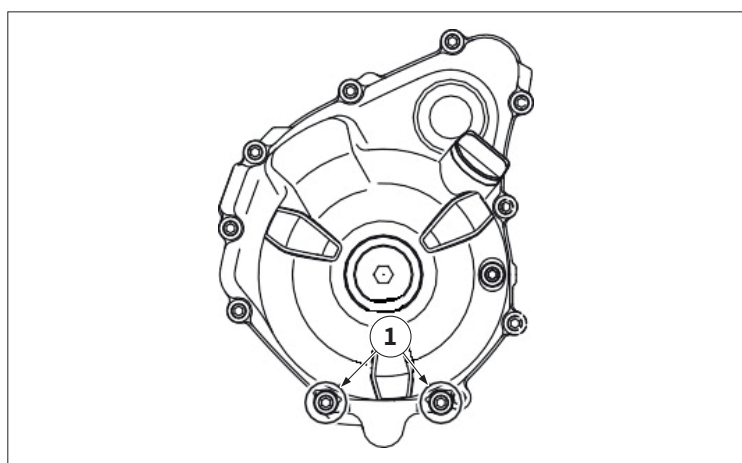
- Apply sealant to the stator coil cable grommet.

 **Sealant: Three bond No.1215®**



– Install bearing "1".

- i** Ensure that the bearing touches surface "a" of the generator cover "2".



– Install the generator cover gasket and generator cover.



Tightening torques

- Generator cover bolt:
12 N·m (1.2 kgf·m, 8.9 lb·ft) LOCTITE®;
- Generator cover bolt:
12 N·m (1.2 kgf·m, 8.9 lb·ft).

- i** Tighten the bolts in stages and crosswise.

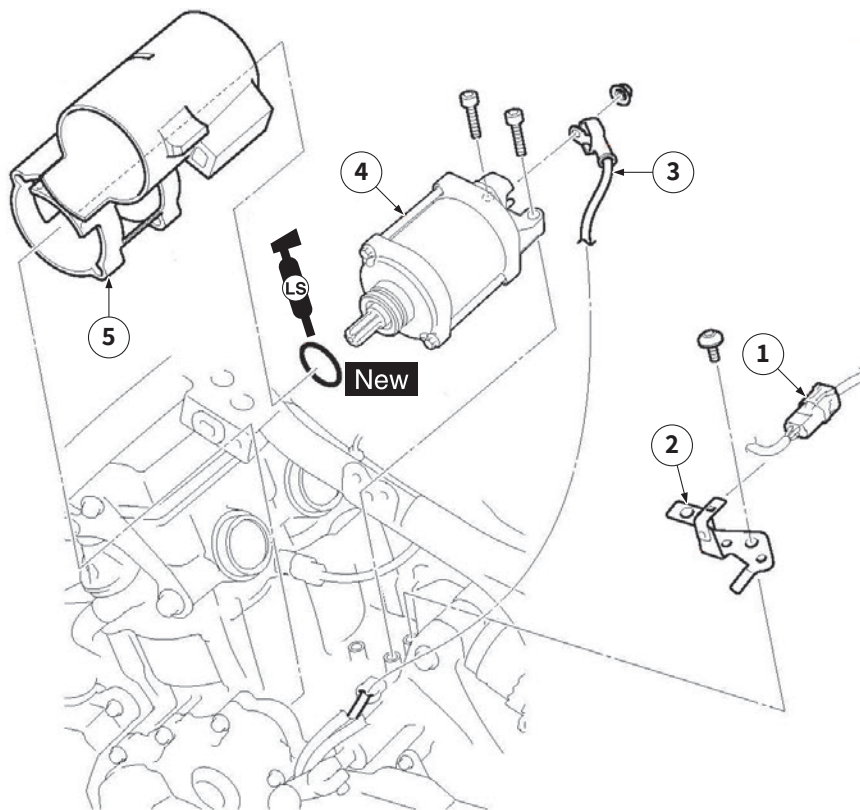


- Apply LOCTITE® to the threads of bolts "1" shown in the figure only.

– Connect the stator coil connector and the crankshaft position sensor connector.

13.9 ELECTRIC STARTER

Removing the starter motor



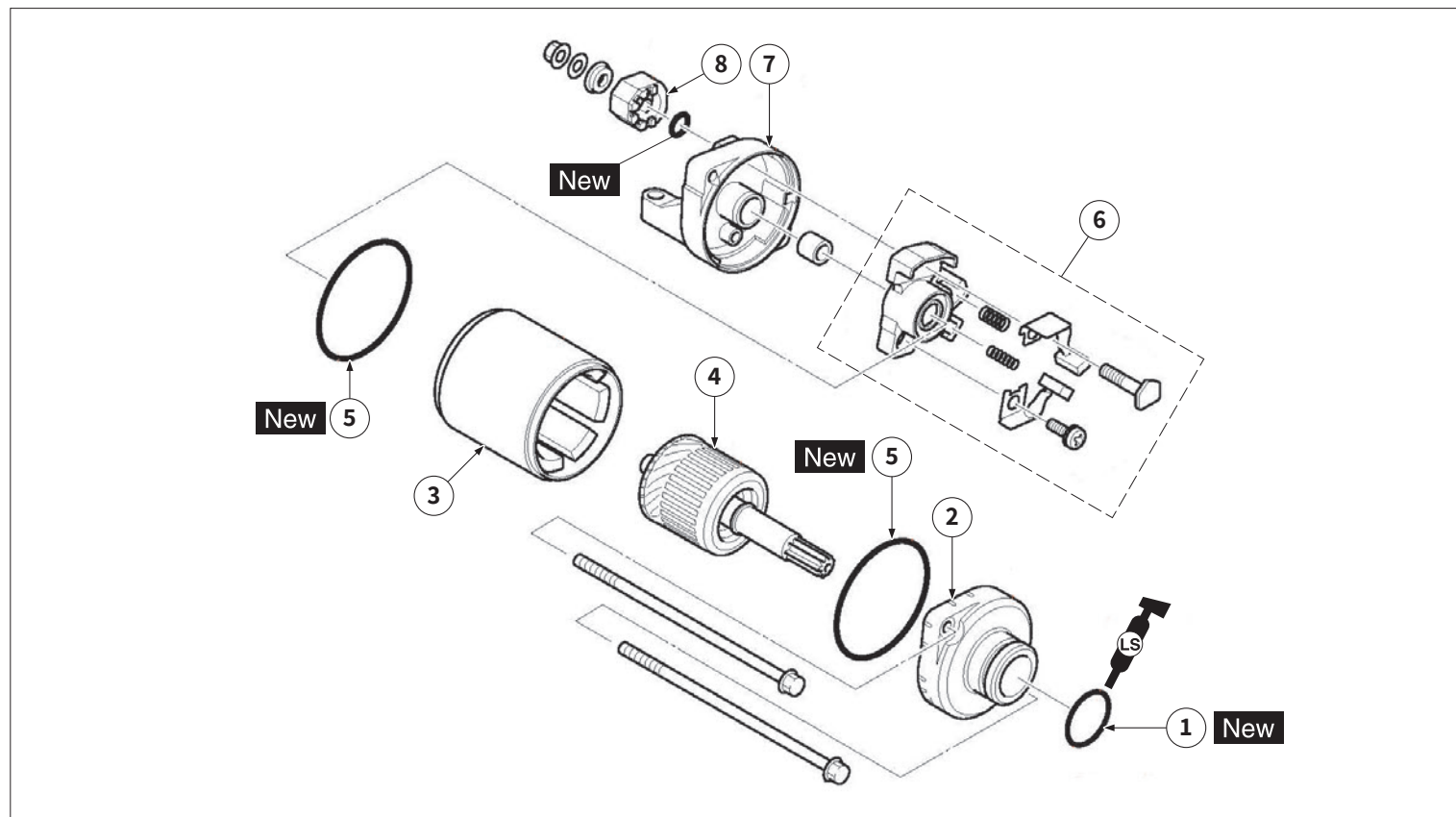
Preliminary operations:

Sequence	Components to be removed	References to operations
1	Seat	"12.1 Seat" on page 102
2	Upper tank cover	"12.7.3 Upper tank cover" on page 107
3	Tank side covers	"12.7.4 Tank side covers" on page 108
4	Canister filter	"13.22 Canister filter removal" on page 254
5	Air ducts and filter casing	"12.27 Filter casing" on page 147
6	Throttle bodies	"13.20 Throttle bodies" on page 245

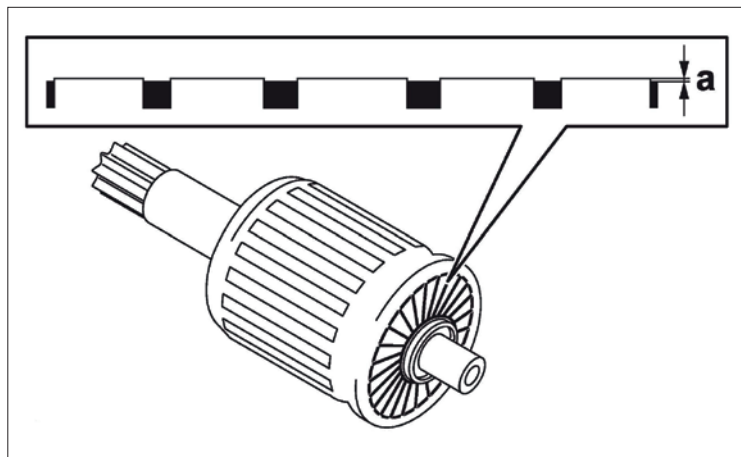
Procedure:

Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Gear position switch connector	1	
2	Connector and hose support	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
3	Starter motor cable	2	Disconnect. 7 N•m (0.7 kgf•m, 5.2 lb•ft)
4	Starter motor	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
5	Activated carbon filter holder	1	

Starter motor disassembly



Sequence	Component to be removed	Q.ty	Remarks and data
1	O-ring	1	
2	Starter motor front cover	1	5 N•m (0.5 kgf•m, 3.7 lb•ft)
3	Starter motor fork	1	
4	Induced group	1	
5	Gasket	2	
6	Brush holder set	1	
7	Starter rear cover	1	
8	Cable guide	1	11 N•m (1.1 kgf•m, 8.1 lb•ft)

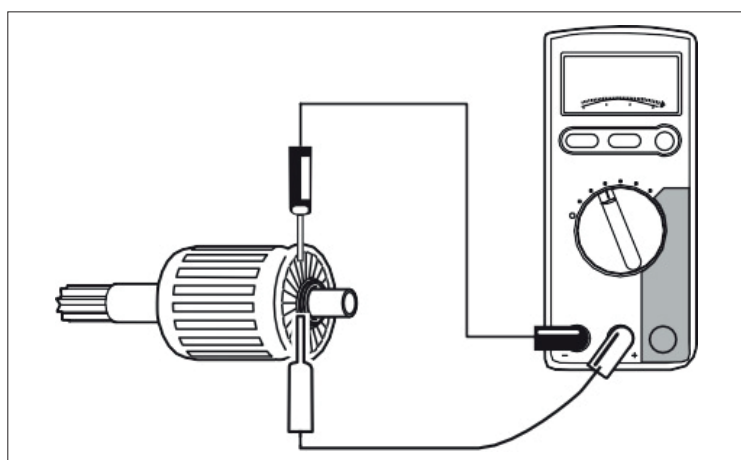


13.9.1 Starter motor check

- Check the commutator: if it has impurities, clean it with 600-grit sandpaper.
- Measure the mica coating "a": if it does not conform to the prescribed values, cut the coating to the correct size using a hacksaw blade connected to ground to fit the tap changer.

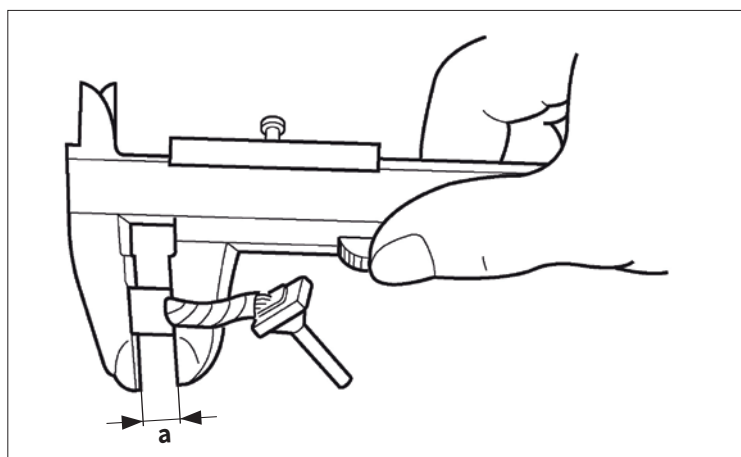
 **Mica coating (depth): 0.70 mm (0.03 in).**

 **The mica coating must be thinned out to ensure proper functioning of the switch.**



- Check the continuity of the induced group using a digital circuit tester: if there is no continuity, replace the starter motor.

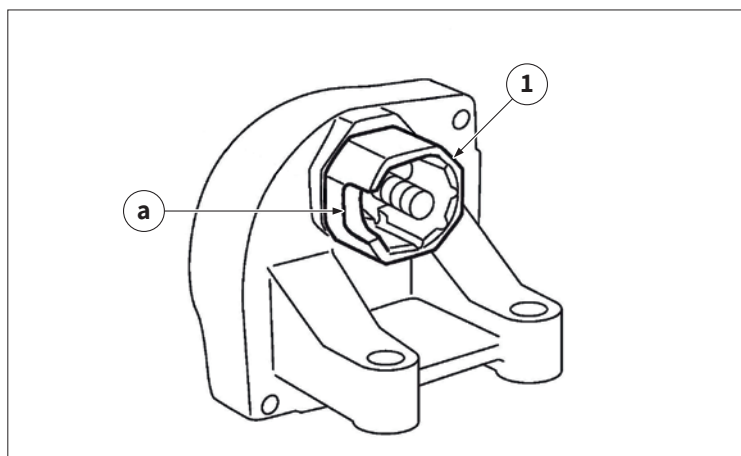
 - **Digital circuit tester;**
 - **Model 88 multimeter with tachometer. Measure:**



- Measure the length of the brush "a": if it does not comply with the prescribed values, replace the brush holder set.

 **Total brush length limit: 6.5 mm (0.26 in).**

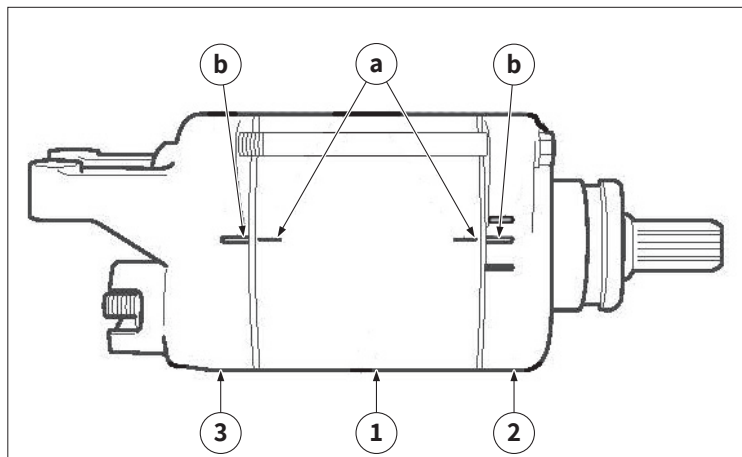
- Check the gear teeth: if they show damage or signs of wear, replace the starter motor.
- Check the bearing and oil seal: if they show damage or signs of wear, replace the front cover of the starter motor.



13.9.2 Starter motor assembly

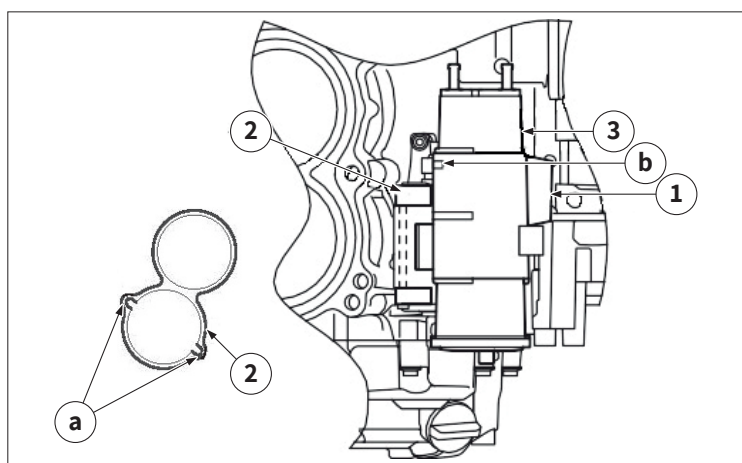
- Install the cable guide "1".

 **Ensure that notch "a" on the cable guide points in the direction shown in the figure.**



- Install the fork "1", front cover "2" and rear cover "3" of the starter motor.

i Align the coupling references "a" of the starter motor yoke with the coupling references "b" of the front and rear covers.

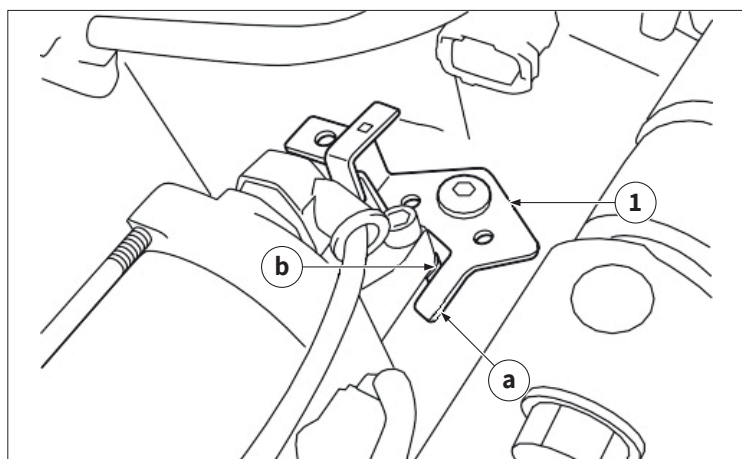


13.9.3 Starter motor installation

- Install the activated carbon filter holder "1", starter motor "2" and activated carbon filter "3".

i Pass the front cover bolts through notches "a" in the carbon filter holder to fasten it.

i Install the active carbon filter holder by aligning the moulded reference "2RC" "b" forwards.

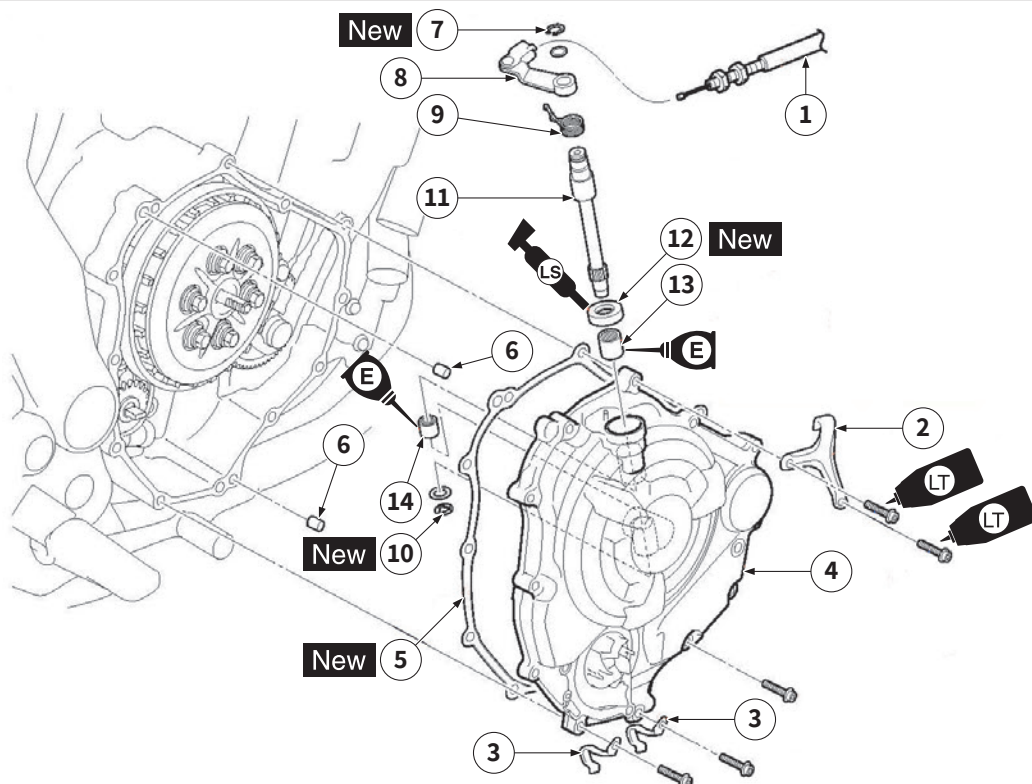


- Install the connector and tube support "1".

i Ensure that the tab "a" on the connector and tube bracket touches the protrusion "b" on the cylinder block.

13.10 CLUTCH

Removal of clutch housing and release lever shaft

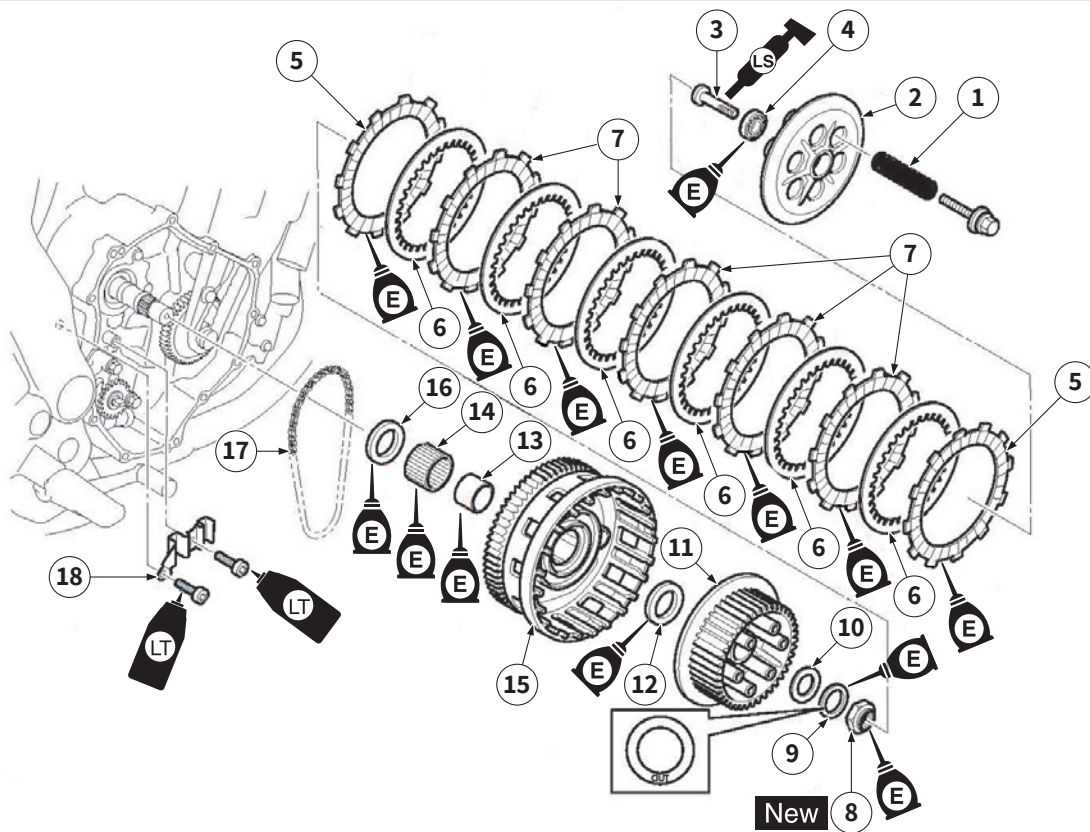


Preliminary operations:

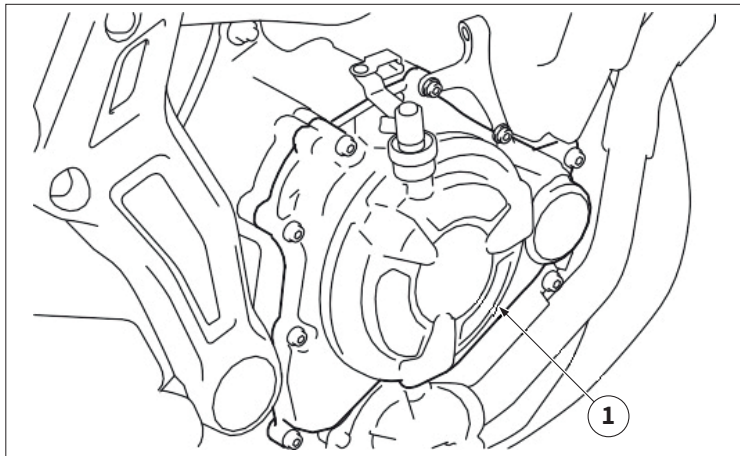
- Drain the engine oil (as described on page 153);
- Remove the water pump housing (as described on page 240).

Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Clutch cable	1	Disconnect. 7 N•m (0.7 kgf•m, 5.2 lb•ft)
2	Clutch cable support	1	12 N•m (1.2 kgf•m, 8.9 lb•ft)
3	O2 sensor cable holder and switch cable	2	12 N•m (1.2 kgf•m, 8.9 lb•ft)
4	Clutch crankcase	1	12 N•m (1.2 kgf•m, 8.9 lb•ft)
5	Clutch crankcase gasket	1	
6	Centering pin	2	
7	Retaining ring	1	
8	Release lever	1	
9	Release lever spring	1	
10	Retaining ring	1	
11	Release lever shaft	1	
12	Oil seal	1	
13	Bearing	1	
14	Bearing	1	

Clutch removal



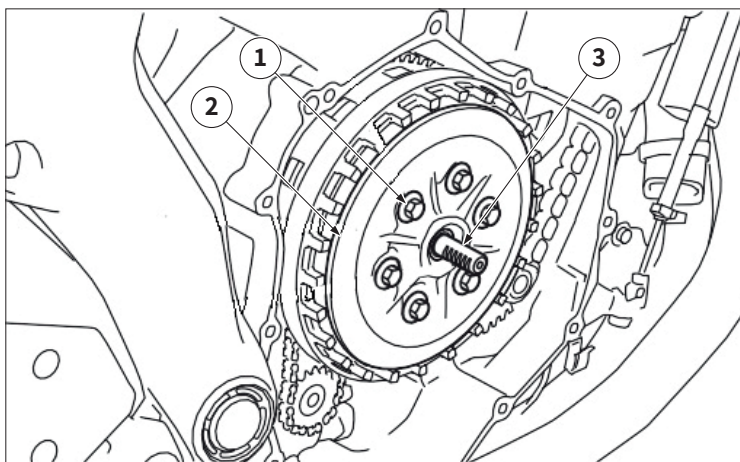
Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Clutch spring	6	
2	Pressure plate	1	8 N•m (0.8 kgf•m, 5.9 lb•ft)
3	Pull rod	1	
4	Bearing	1	
5	Friction disc 1	2	
6	Clutch plate	6	
7	Friction disc 2	5	Identification colour: violet
8	Clutch hub nut	1	95 N•m (9.5 kgf•m, 70 lb•ft)
9	Spring washer	1	
10	Washer	1	
11	Clutch hub	1	
12	Thrust plate	1	
13	Spacer	1	
14	Bearing	1	
15	Clutch housing	1	
16	Thrust plate	1	
17	Oil pump chain drive	1	
18	Oil pump chain drive guide	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)



13.10.1 Clutch removal

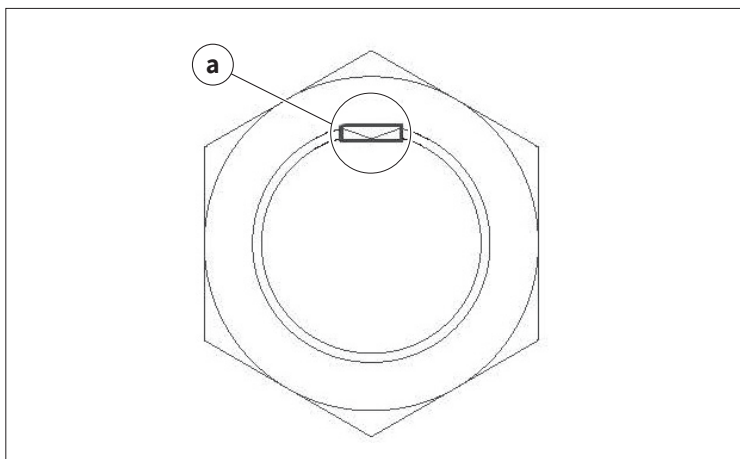
– Remove the clutch housing "1" and gasket.

- ① Loosen each bolt 1/4 of a turn at a time, gradually and in a crossed way. After completely loosening all the bolts, remove them.

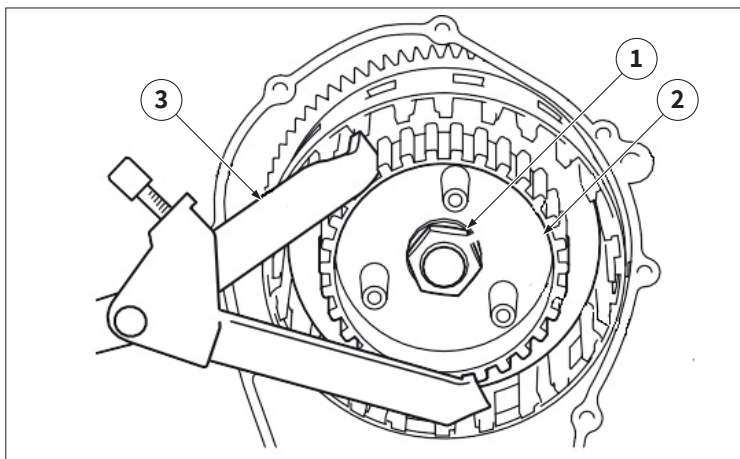


– Remove the clutch spring bolts "1", clutch spring, pressure plate "2" and pull rod "3".

- ① Loosen the bolts gradually and crosswise.

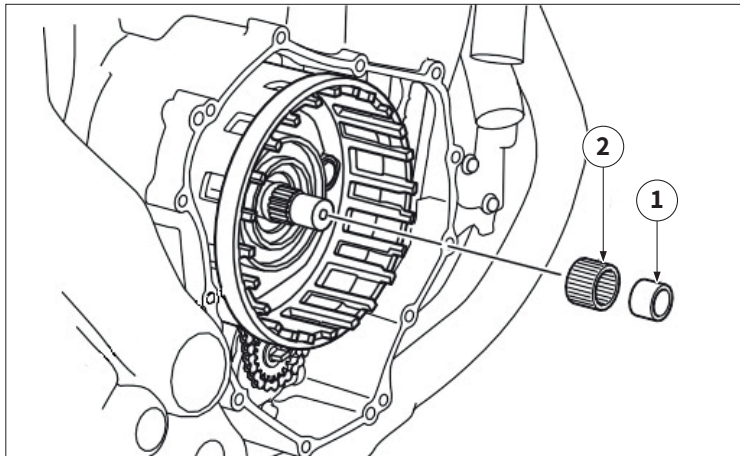


– Remove the friction disc 1, clutch plate and friction disc 2, then flatten the rib of the clutch hub nut "a".

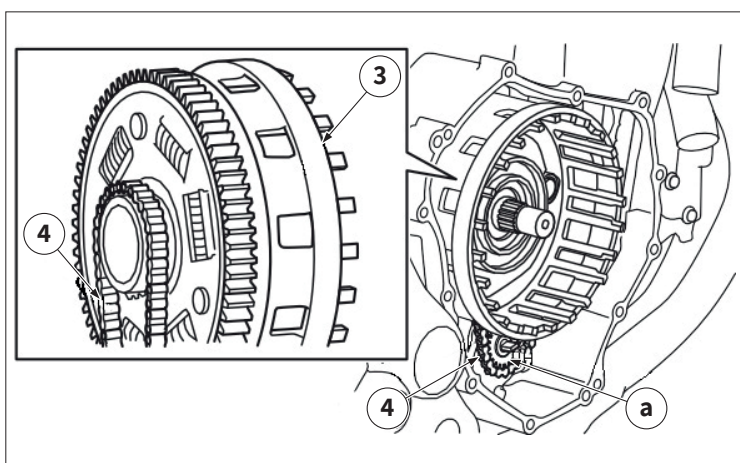


– Loosen clutch hub nut "1" while holding clutch hub "2" with universal clutch holder "3".

- ✘ Universal clutch locking tool.



- Remove the spacer "1" and bearing "2" from the clutch housing.



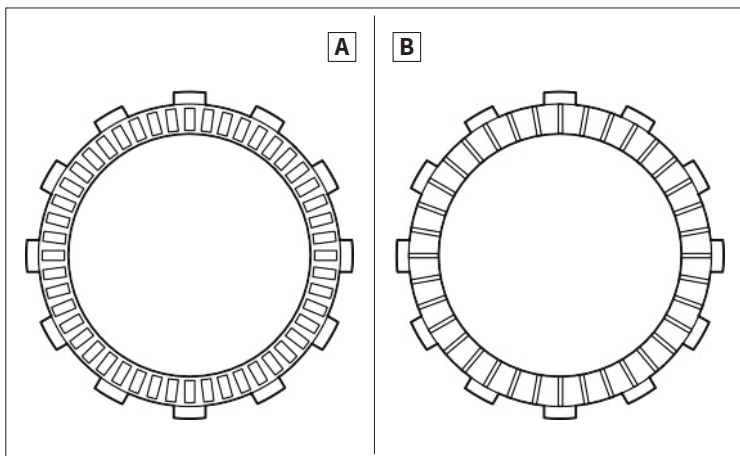
- Remove the oil pump chain drive "4" from oil pump sprocket "a" and remove the clutch housing "3".

13.10.2 Friction discs check

i The following procedure applies to all friction plates.

- Check the friction discs: if they show damage or signs of wear, replace them as a whole.
- Measure the thickness of the friction plates: if they do not comply with the prescribed values, replace them as a whole.

i Measure the friction discs in four different positions.



- **Friction disc thickness 1:**
2.90-3.10 mm (0.114-0.122 in);
- **Wear limit: 2.80 mm (0.110 in);**
- **Friction disc thickness 2:**
2.92-3.08 mm (0.115-0.121 in);
- **Wear limit: 2.82 mm (0.111 in).**

- A. Friction disc 1;
- B. Friction disc 2.

13.10.3 Clutch plates check

i The following procedure applies to all clutch plates.

- Check the clutch plates: if they are damaged, replace them as a whole.
- Measure the deformation of the friction discs with a gauge and feeler gauge: if they do not comply with the prescribed values, replace them as a whole.

✗ Thickness gauge set.

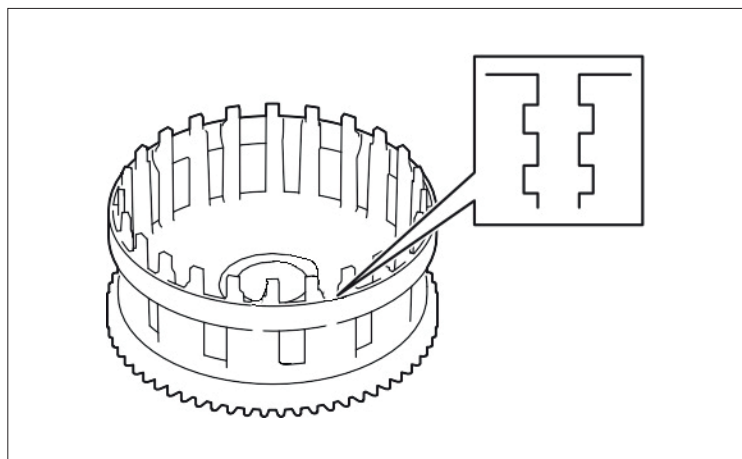
✗ Deformation limit: 0.10 mm (0.004 in).

13.10.4 Clutch springs check

i The following procedure applies to all clutch springs.

- Check the clutch springs: if they are damaged, replace them as a whole.
- Measure the free length of the clutch springs: if not in accordance with the prescribed values, replace them as a whole.

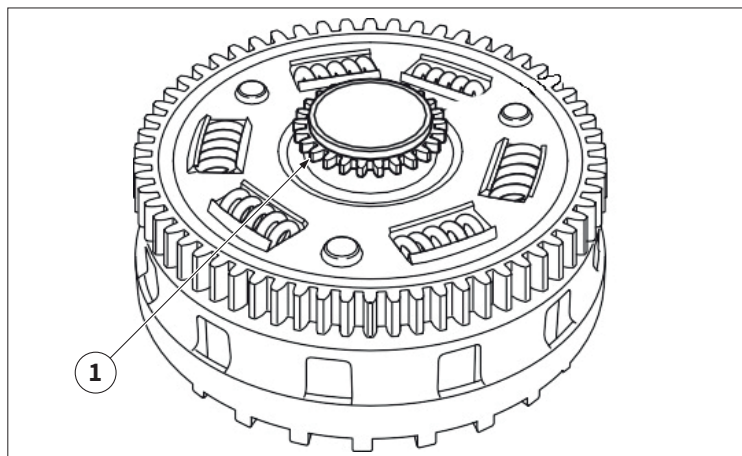
**✗ Clutch spring free length limit:
47.50 mm (1.87 in).**



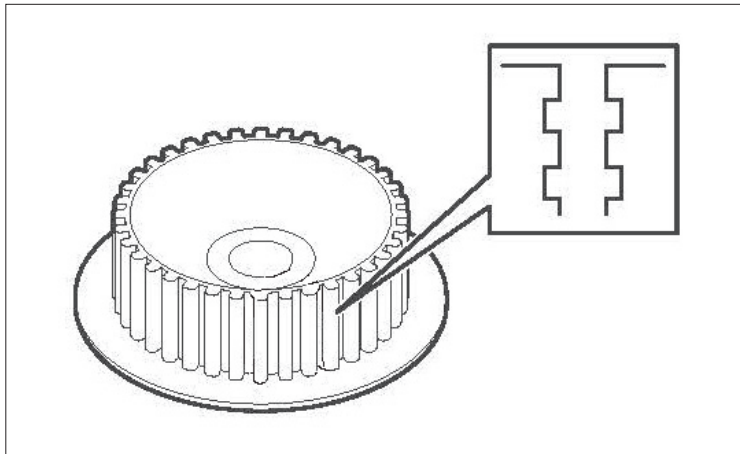
13.10.5 Clutch housing check

- Check the clutch housing teeth: if they show damage, pitting or wear, deburr them or replace the clutch housing.

i The presence of pitting on the teeth of the clutch housing will cause an irregular operation of the clutch.



- Check the oil pump sprocket "1": if it shows cracks, damage or signs of wear, replace it.
- Check the bearing: if it shows damage or signs of wear, replace the bearing and clutch housing.



13.10.6 Clutch hub check

Check the clutch hub splines: if it shows damage, pitting or signs of wear, replace the clutch hub.

- ❗ **The presence of pitting on the clutch hub splines will cause the clutch malfunction.**

13.10.7 Pressure plate check

- Check the pressure plate: if it is cracked or damaged, replace it.
- Check the bearing: if it shows damage or signs of wear, replace it.

13.10.8 Primary transmission gear check

- Check the transmission gear of the primary transmission: if it shows damage or wear, or if the noise during operation is excessive, replace the drive shaft and clutch housing as a whole.

13.10.9 Primary transmission driven gear check

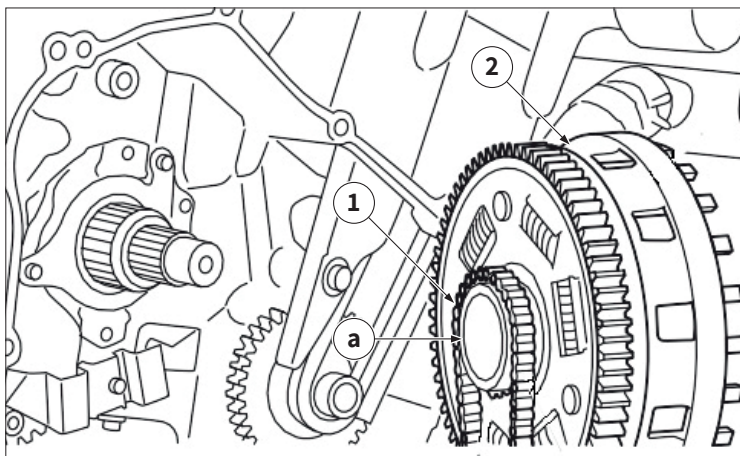
- Check the driven gear of the primary transmission: if it shows damage or wear, or if the noise during operation is excessive, replace the drive shaft and clutch housing as a whole.

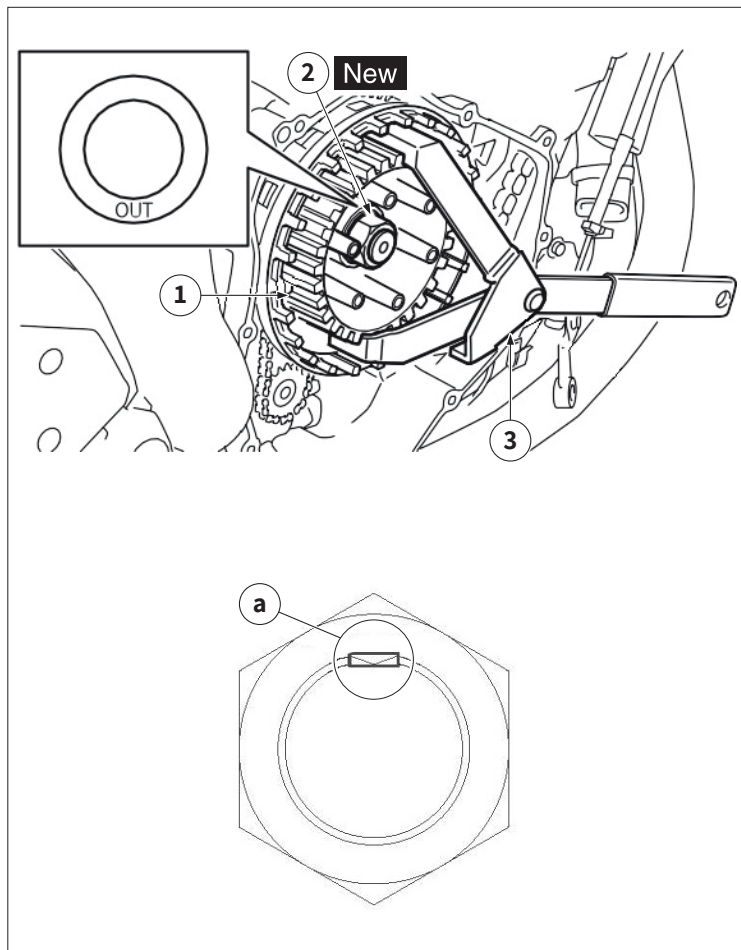
13.10.10 Release lever shaft and pull rod check

- Check the sprocket teeth of the release lever shaft and the pull rod: if they show damage or signs of wear, replace the pull rod and release lever as a whole.
- Check the pull rod bearing: if it shows damage or signs of wear, replace it.

13.10.11 Clutch installation

- Install the oil pump chain drive "1" on oil pump sprocket "a", thrust plate, clutch housing "2", bearing and spacer.





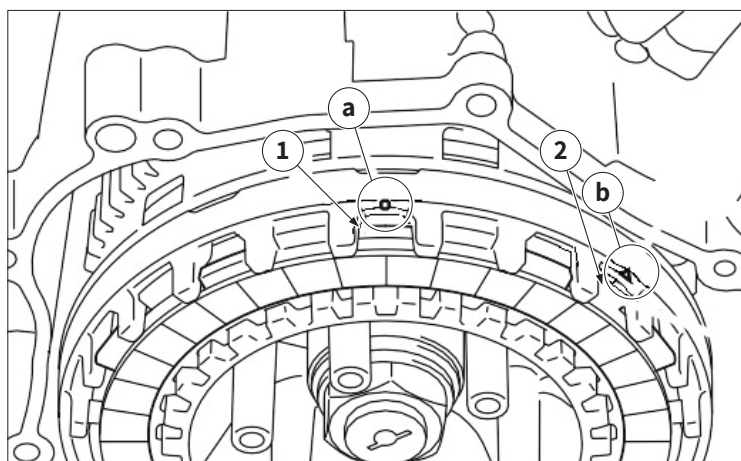
- Install the thrust plate, clutch hub "1", the washer on the primary shaft with the reference "OUT" pointing away from the vehicle, the spring washer and the clutch hub nut "2", locking it on the protruding part "a" of the primary shaft.

Lubricate the spring washer and the threads of the clutch hub nut with engine oil.

While holding clutch hub "1" with universal clutch holder "3", tighten the clutch hub nut.

Tightening torque:
Clutch hub nut 95 N·m (9.5 kgf·m, 70 lb·ft).

Universal clutch locking tool.



- Install the friction discs 1 "1" and friction discs 2 "2".

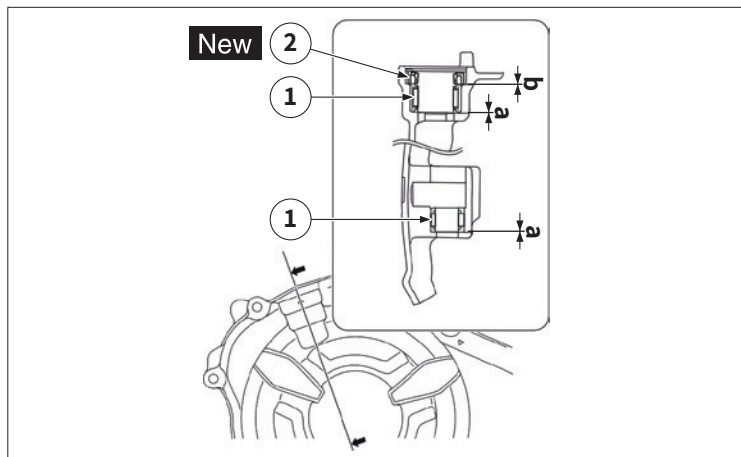
Install the a friction disc first and then alternate between a friction disc and a friction disc.

Align a projection of friction disc 1 to the punched reference "a" of the clutch housing and align a projection of friction disc 2 to the housing reference "b".

- Install the bearing, pull rod, pressure plate, clutch springs and clutch spring bolts, tightening them gradually and crosswise.

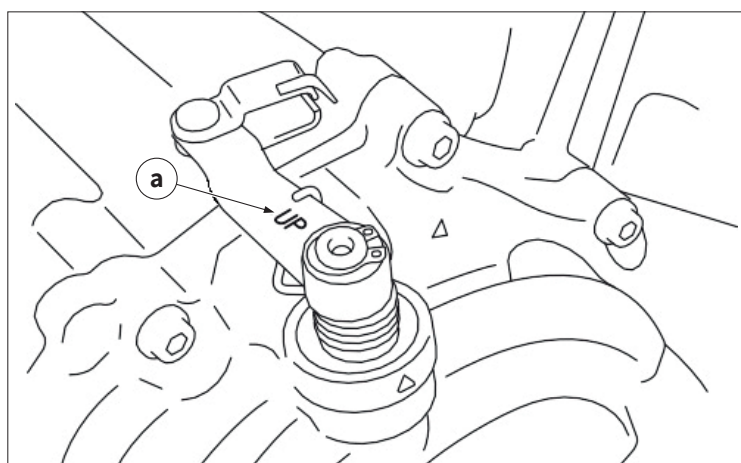
Tightening torque
• Clutch spring bolt: 8 N·m (0.8 kgf·m, 5.9 lb·ft).

Apply lithium soap grease to the pull rod.

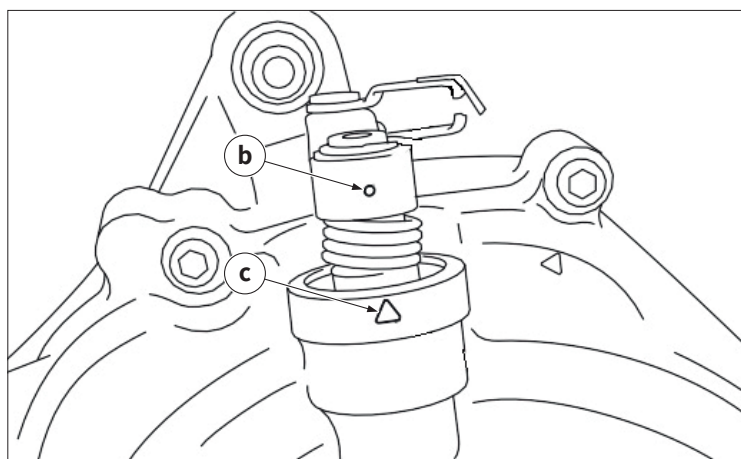


- Install the bearing "1" until it contacts surface "a", oil seal "2" to the clutch housing until it contacts surface "b", finally the clutch hub nut

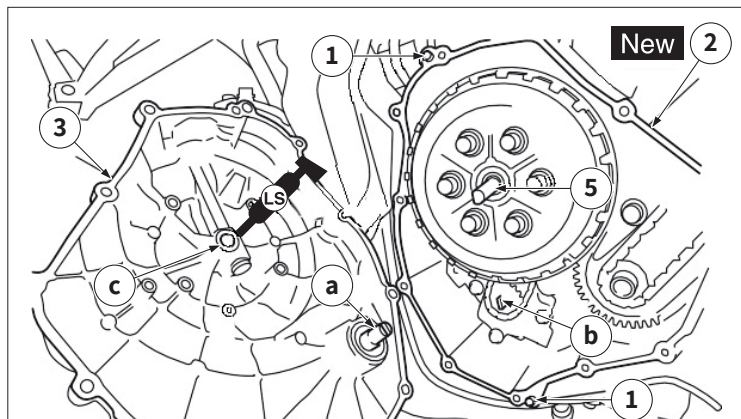
 **Lubricate the bearings with engine oil and the oil seal with lithium soap grease.**



- Install the release lever with the "UP" reference "a" facing upwards.



- i** When installing the release lever, press it in and check that the lever's punch "b" is aligned with the clutch housing reference "c".



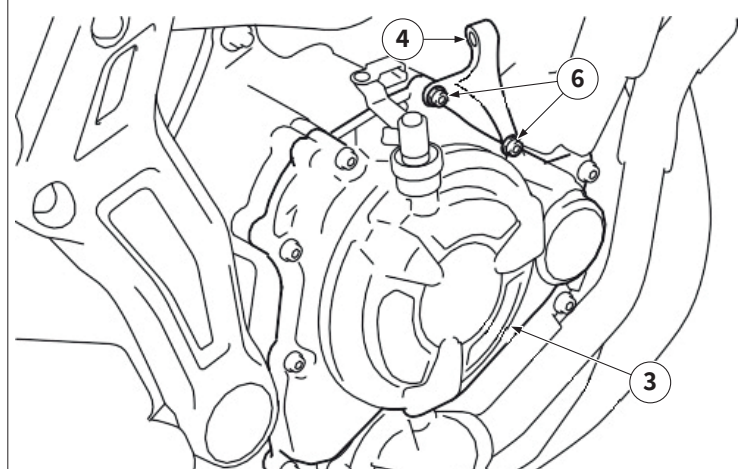
- Install the centring pins "1", clutch housing gasket "2", clutch housing "3" and clutch cable holder "4".

i Align slot "a" in the impeller shaft with protrusion "b" in the oil pump sprocket.

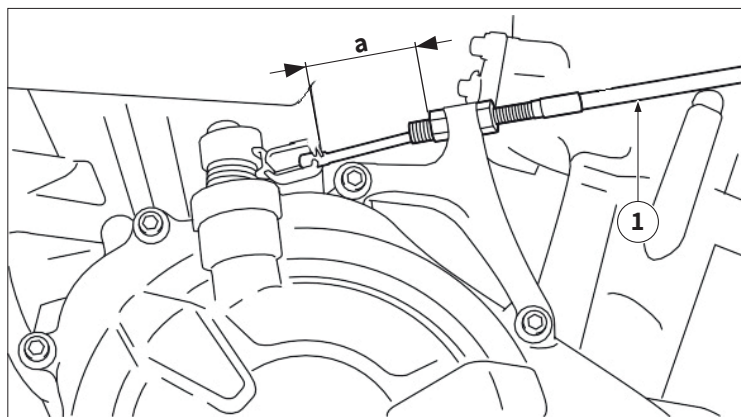
i Turn back the streaks on the clutch pull rod "5" and align the rod with hole "c" in the clutch housing.

i Ensure that the teeth of the pull rod and the sprocket of the release lever shaft are engaged.

 **Only apply LOCTITE® to the threads of the clutch cable holder bolts "6" shown in the illustration.**



i Tighten the bolts gradually and crosswise.



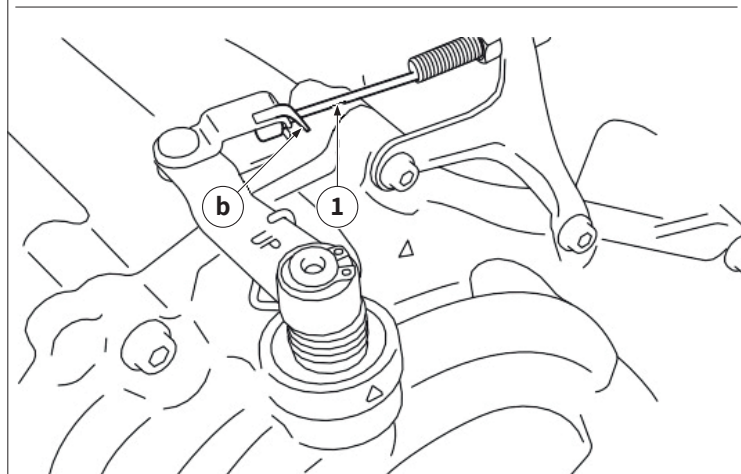
- Connect the clutch cable "1" making sure the length "a" is 51.6-62.2 mm (2.03-2.45 in).

i Ensure that the vehicle is positioned straight when measuring the clutch cable length.

- After installing the clutch cable, bend the projection "b" of the release lever.

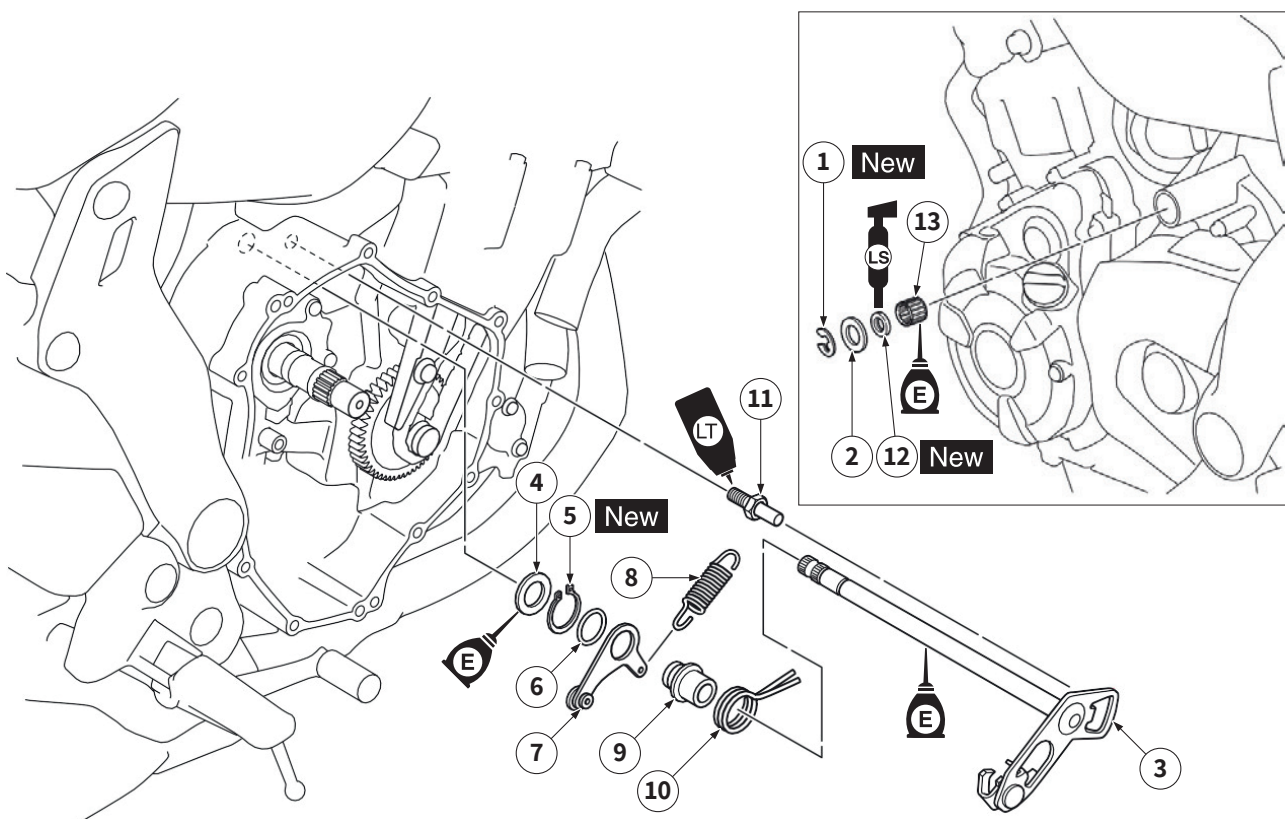
- Adjust the clutch lever clearance, referring to "12.23 Clutch lever" on page 145.

 **Clutch lever clearance: 5.0-10.0 mm (0.20-0.39 in).**



13.11 GEAR SHIFT SHAFT

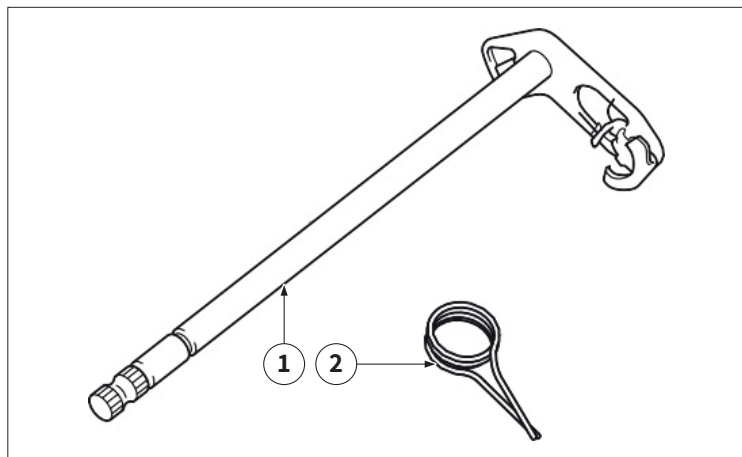
Gear shift shaft and cut off lever removal



Preliminary operations:

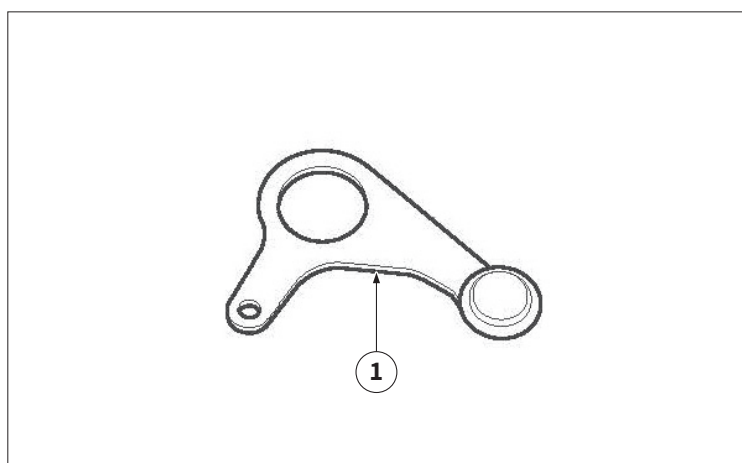
- Remove the clutch housing (as described on page 192).

Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Retaining ring	1	
2	Washer	1	
3	Gear shift shaft	1	
4	Washer	1	
5	Retaining ring	1	
6	Washer	1	
7	Cut off lever	1	
8	Stop lever spring	1	
9	Collar	1	
10	Gearshift shaft spring	1	
11	Gearshift shaft fastener	1	22 N•m (2.2 kgf•m, 16 lb•ft)
12	Oil seal	1	
13	Bearing	1	



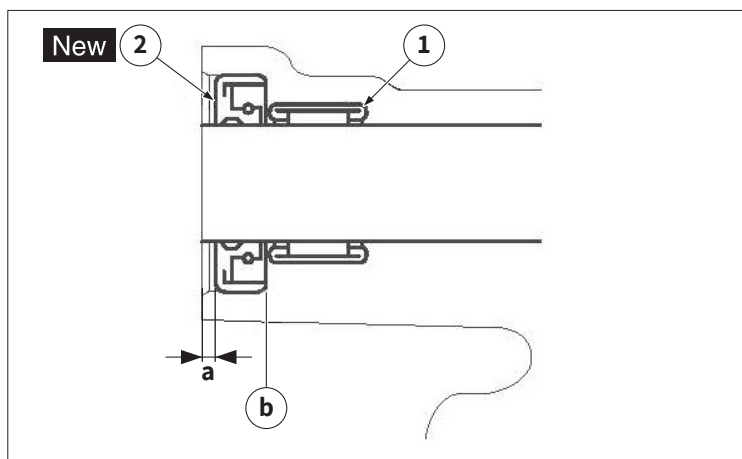
13.11.1 Gearshift shaft check

- Carry out the following checks:
 - If the gearshift shaft "1" shows bending, damage or wear, replace it;
 - If the collar shows damage or wear, replace it.
- Check the gearshift shaft spring "2".



13.11.2 Retainer lever check

- Check the reatiner lever "1": if it is bent, damaged or if rotation of the roller is difficult, replace it.

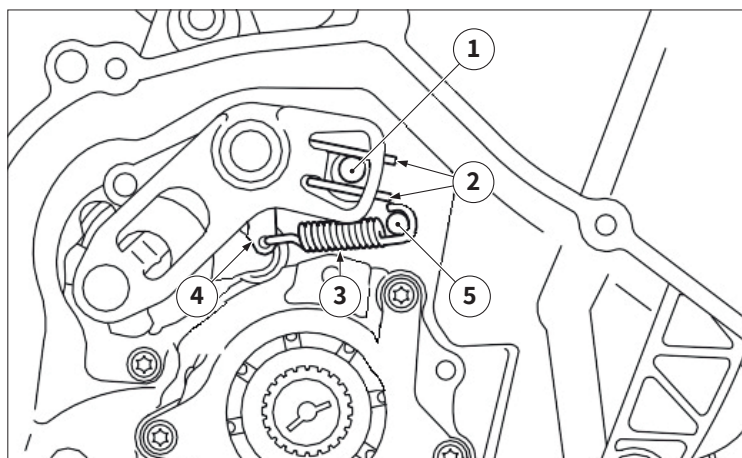


13.11.3 Gear shift shaft installation

- Install the bearing "1" by applying engine oil and ensuring that it does not protrude beyond line "b" shown in the figure.
- Install the oil seal "2" by lubricating the lips with lithium soap grease.

- Bearing lubricant "1": engine oil;
- Oil seal lubricant "2": lithium soap-based grease.

- Installation depth "a": 0.6–1.1 mm (0.02–0.04 in).



- Install the gearshift shaft spring retainer, washer, gearshift shaft unit and stop lever spring.

- Hook the end of the gearshift shaft spring "2" onto the spring retainer "1".

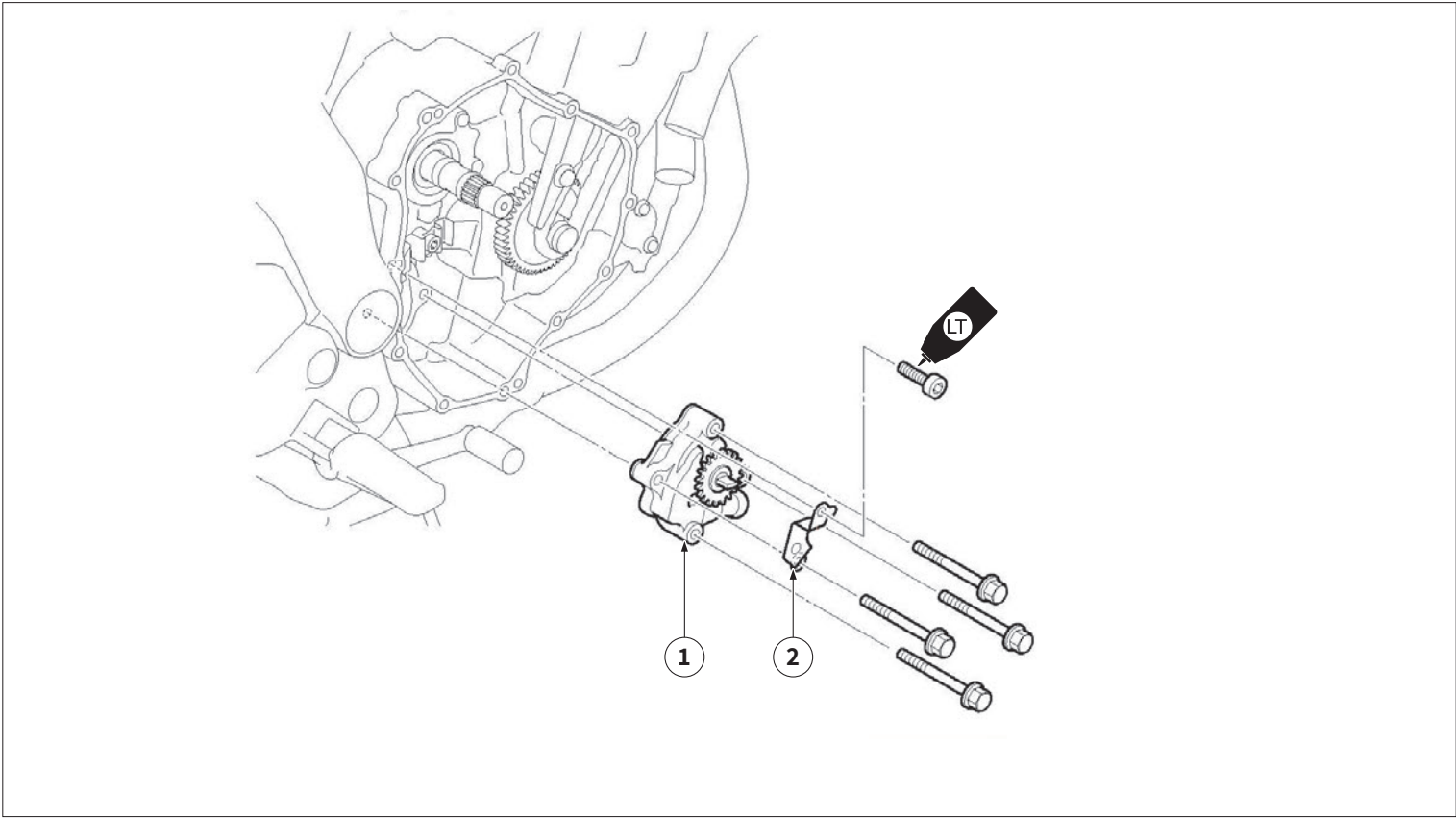
- Hook the spring ends of stop lever "3" onto stop lever "4" and the spring hook of stop lever "5".

- Engage the retainer lever with the gear selector drum piston ring unit.

- Tightening torque
 Shaft spring retainer:
 22 N·m (2.2 kgf·m, 16 lb·ft) LOCTITE®.

13.12 OIL PUMP

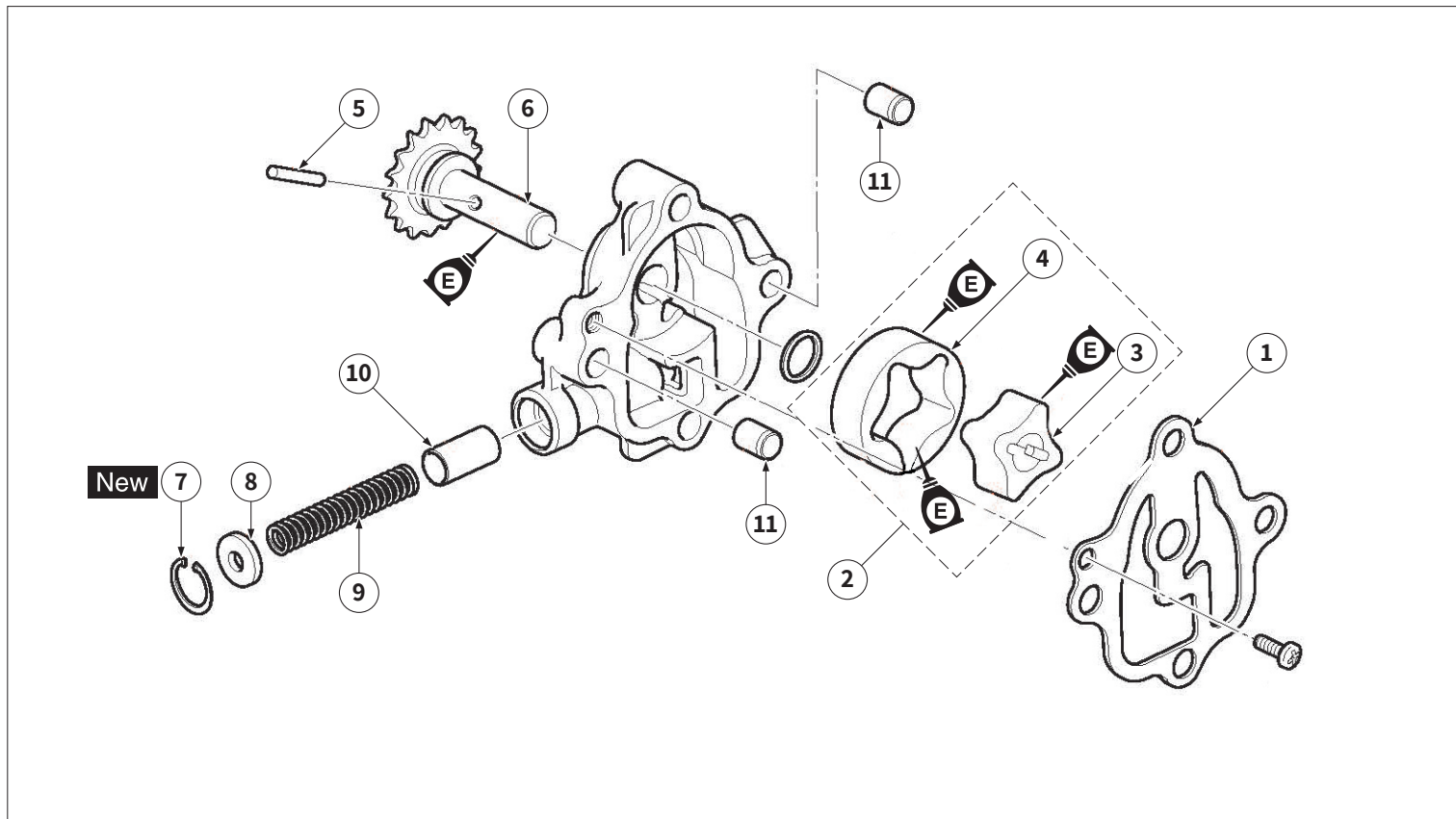
Removing the oil pump



Preliminary operations:
 – Remove the clutch housing (as described on page 192).

Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Oil pump unit	1	12 N•m (1.2 kgf•m, 8.9 lb•ft)
2	Support	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)

Oil pump disassembly

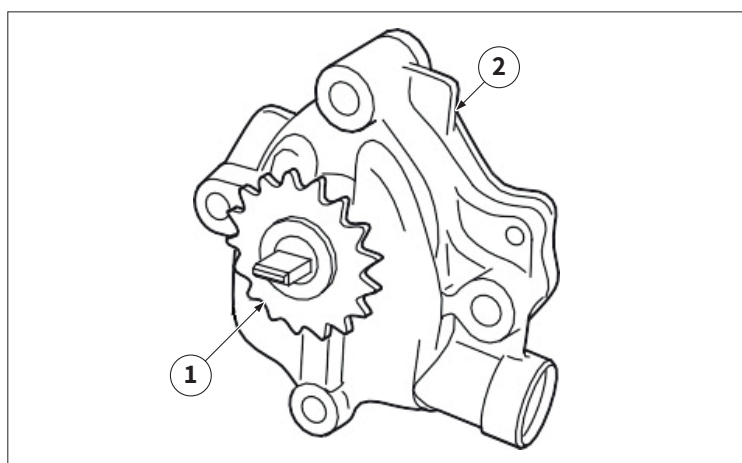


Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Oil pump cover	1	3.8 N•m (0.38 kgf•m, 2.8 lb•ft)
2	Oil pump rotor unit	1	
3	Oil pump internal rotor	1	
4	Oil pump external rotor	1	
5	Pin	1	
6	Oil pump sprocket	1	
7	Retaining ring	1	Hold washer "8" in place when removing the reatining ring.
8	Washer	1	
9	Spring	1	
10	Safety valve	1	
11	Centering pin	2	

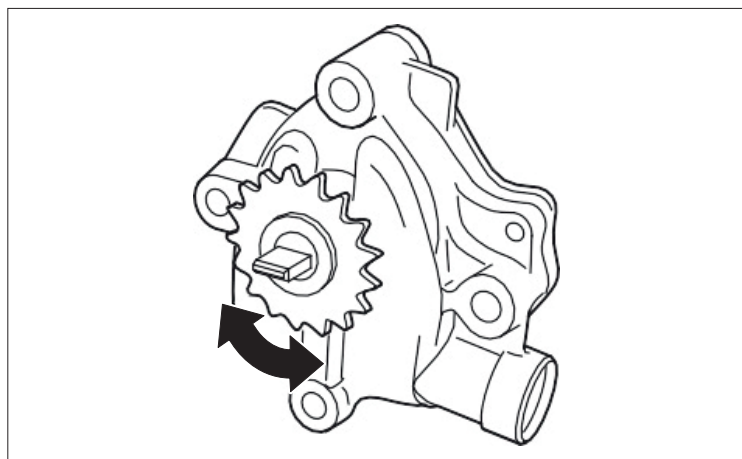
13.12.1 Sprocket and chain check

i To check the oil pump sprocket refer to "13.10.5 Clutch housing check" on page 196" and "13.12.2 Oil pump check" on page 205.

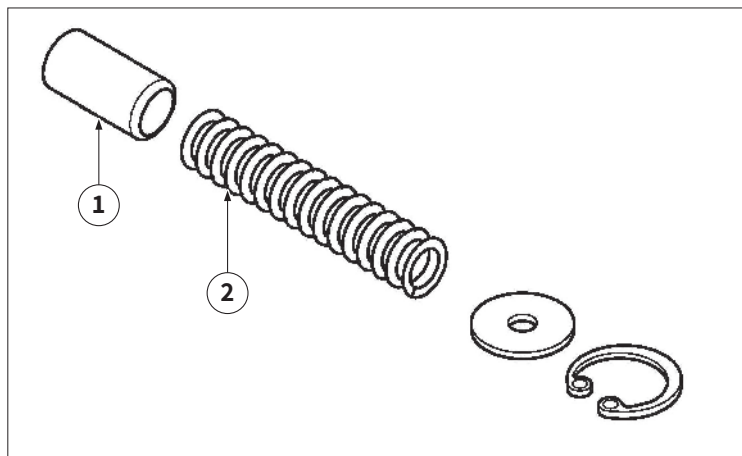
- Check the oil pump chain drive: if it is damaged or stiff, replace the complete oil pump chain drive.
- Check the oil pump sprocket and the integrity of the clutch housing sprocket.


13.12.2 Oil pump check

- Check the oil pump sprocket "1".
- Check the oil pump housing "2": if it shows cracks, damage or signs of wear, replace the oil pump unit.



- Check the functioning of the oil pump: if movement is difficult, repeat the previous operation or replace the oil pump unit.


13.12.3 Safety valve check

- Check safety valve "1".
- Check spring "2": if it shows damage or wear, replace the oil pump unit.

13.12.4 Oil pump assembly

- Lubricate the inner and outer rotors and the oil pump sprocket with the recommended lubricant.



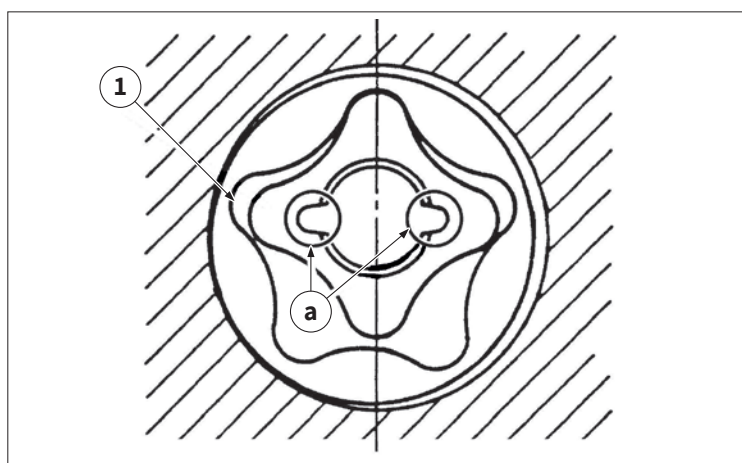
Recommended lubricant: engine oil.

- Install the oil pump sprocket, pin, outer and inner rotors, oil pump cover and oil pump cover screws.



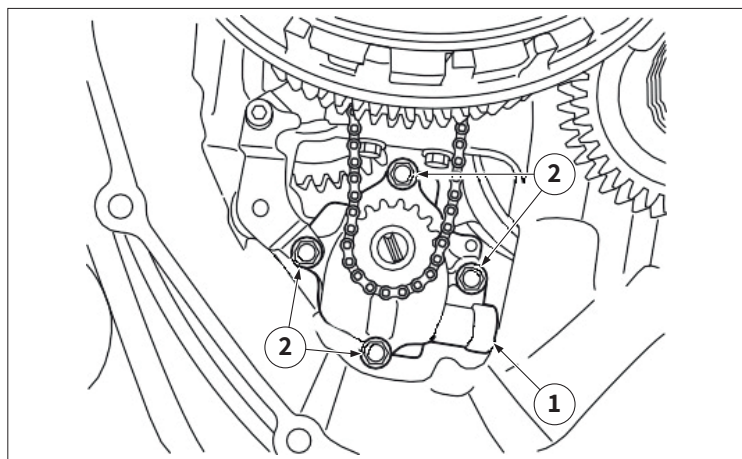
Tightening torque

Oil pump cover screw: 3.8 N·m (0.38 kgf·m, 2.8 lb·ft).



- i** Align the pin of the oil pump shaft with the grooves "a" of the inner rotor "1".

- Check the operation of the oil pump by referring to paragraph "13.12.2 Oil pump check" on page 205.



13.12.5 Oil pump installation

- Install the oil pump "1" and oil pump bolts "2".



Tightening torque

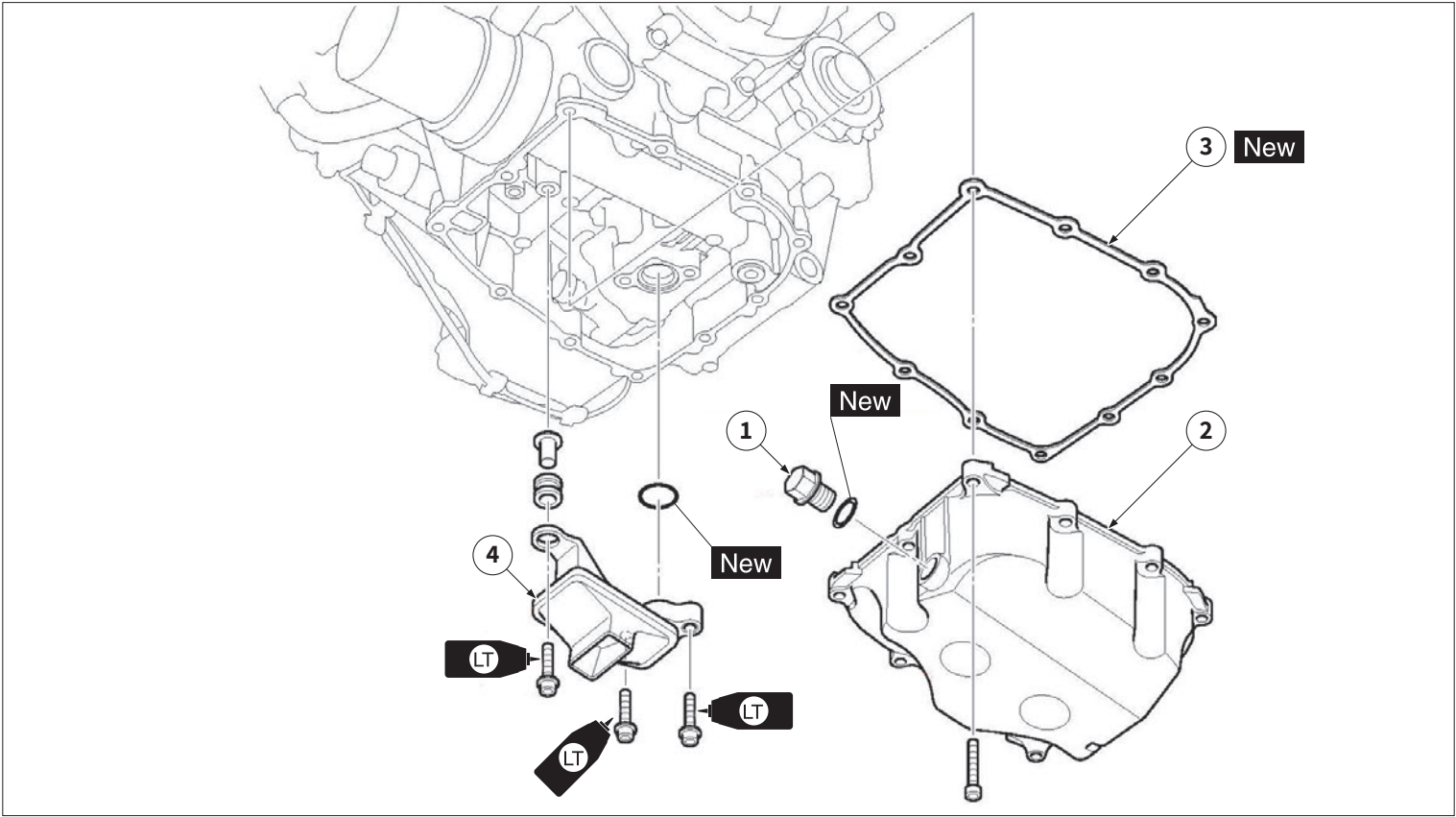
Oil pump bolt: 12 N·m (1.2 kgf·m, 8.9 lb·ft).



After correctly tightening the fastening bolts, ensure that the oil pump rotates unhindered.

13.13 OIL SUMP

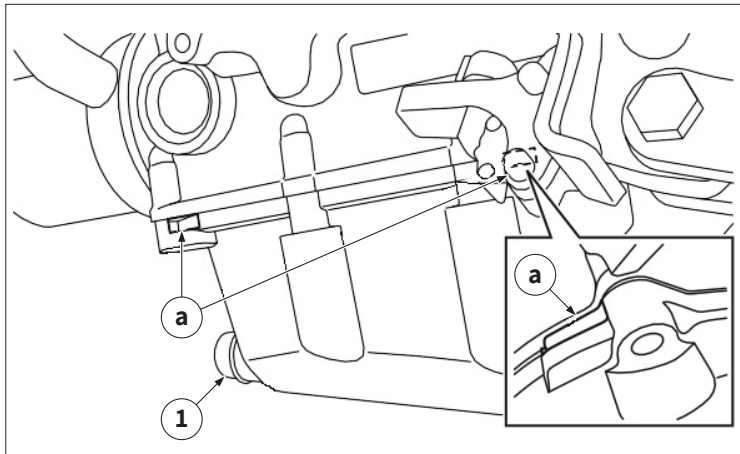
Oil sump removal



Preliminary operations:

- Remove the right footrest plate (as described on page 125);
- Remove the exhaust system (as described on page 136);
- Drain the engine oil (as described on page 153);
- Remove the oil pump (as described on page 203).

Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Oil drain bolt	1	43 N•m (4.3 kgf•m, 32 lb•ft)
2	Oil sump	1	
3	Oil sump gasket	1	
4	Oil filter	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)



13.13.1 Oil sump removal

- Remove the oil sump "1" and the oil sump gasket.

- ① Loosen each bolt 1/4 of a turn at a time, gradually and in a crossed way. After completely loosening all the bolts, remove them.
- ① Insert a flathead screwdriver into the notches "a" in the oil sump to remove it

13.13.2 Oil filter check

- Check the oil filter: if it is damaged, replace it; if it is contaminated, clean it with a solvent.

13.13.3 Oil sump installation

- Install the oil sump gasket and oil sump.



Tightening torque

Oil sump bolt: 10 N·m (1.0 kgf·m, 7.4 lb·ft).

- ① Tighten the oil sump bolts gradually and crosswise.

- Install the gasket and oil drain bolts.

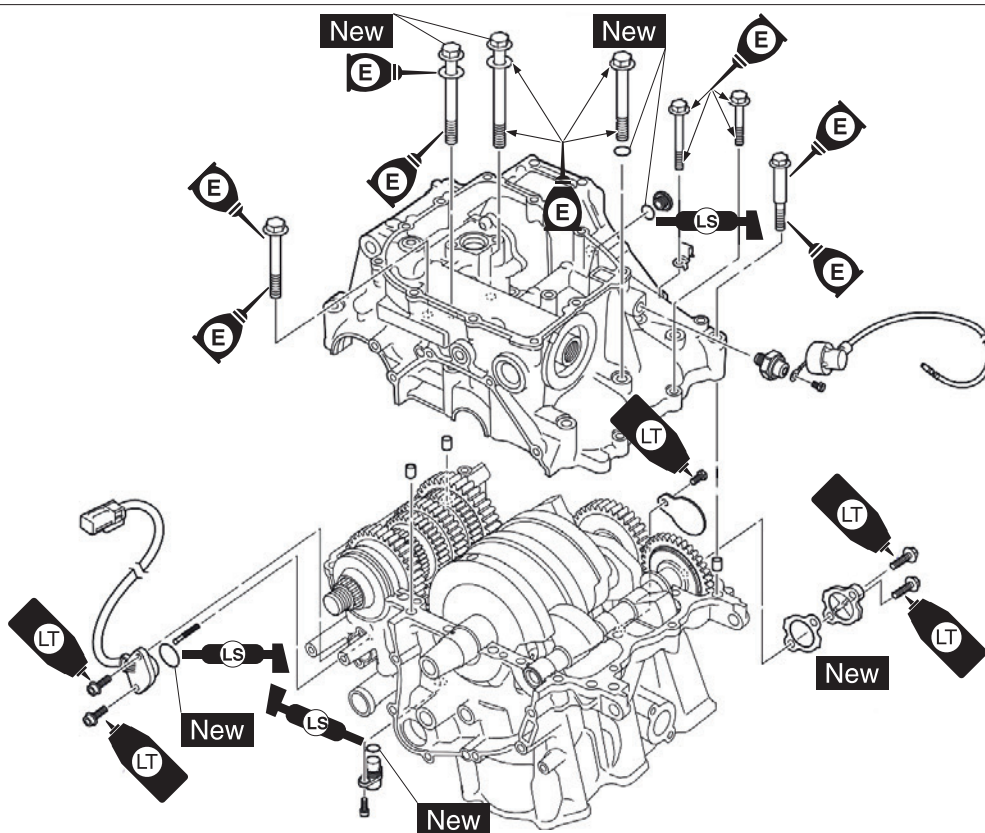


Tightening torque

Oil drain bolt: 43 N·m (4.3 kgf·m, 32 lb·ft).

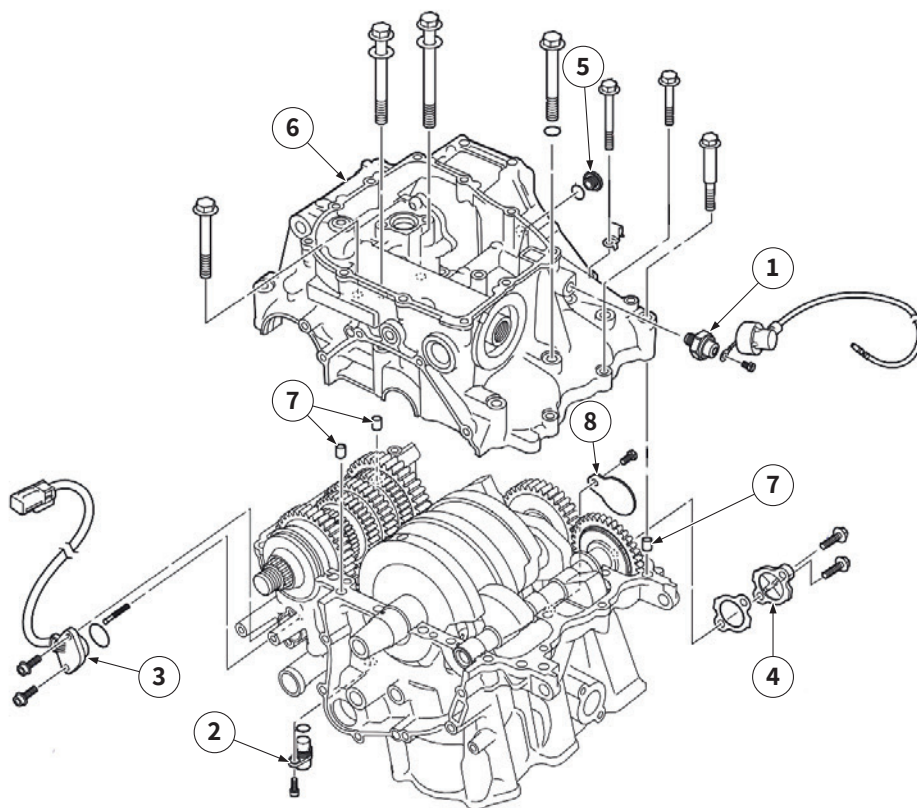
13.14 CRANKCASE

Crankcase separation: preliminary operations

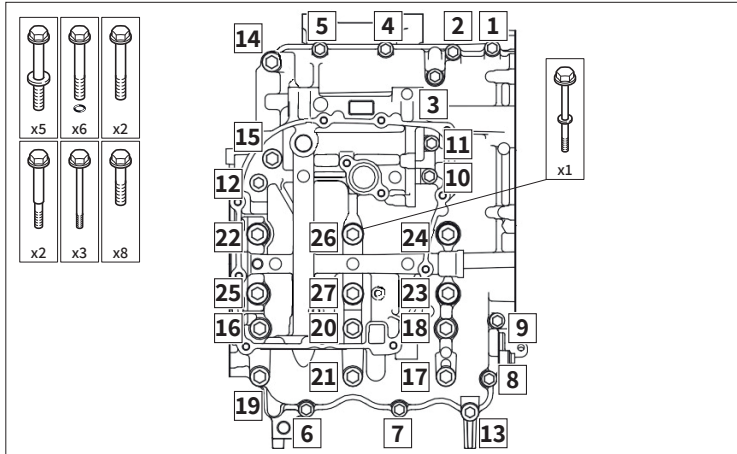


Sequence	Components to be removed	References to operations
1	Engine	"13.1 Complete engine removal" on page 150
2	Cylinder head cover	"13.5 Camshafts" on page 158
3	Cylinder head	"13.6 Cylinder head" on page 171
4	Unidirectional start-up	"13.8 Unidirectional generator and starter" on page 182
5	Starter motor	"13.9 Electric starter" on page 188
6	Clutch housing	"13.10 Clutch" on page 192
7	Oil filter	"13.13 Oil sump" on page 207
8	Oil radiator	"13.12 Oil pump" on page 203
9	Sprocket rim	"12.13.4 Sprocket removal" on page 122

Crankcase separation



Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Oil pressure switch	1	Hollow bolt = 1.8 N•m (0.18 kgf•m, 1.3 lb•ft) Oil pressure switch = 15 N•m (1.5 kgf•m, 11 lb•ft)
2	Cylinder cap	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
3	Gear position switch	1	4.0 N•m (0.40 kgf•m, 3.0 lb•ft)
4	Balacing countershaft access cover	1	12 N•m (1.2 kgf•m, 8.9 lb•ft)
5	Main duct bolt	1	8 N•m (0.8 kgf•m, 5.9 lb•ft)
6	Crankcase	1	For tightening, follow the sequence of page 212
7	Centering pin	3	
8	Blind plate	1	8 N•m (0.8 kgf•m, 5.9 lb•ft)



13.14.1 Crankcase disassembly

– Turn the engine over and remove the crankcase bolts, loosening each bolt 1/4 turn at a time in a gradual, crossed pattern. After completely loosening all the bolts, remove them.

- ❗ **Loosen bolts "1"- "11" in any sequence.**
- ❗ **Loosen bolts "12"- "27" in the appropriate sequence indicated.**
- ❗ **The numbers "1"- "16" embossed on the crankcase indicate the tightening sequence.**

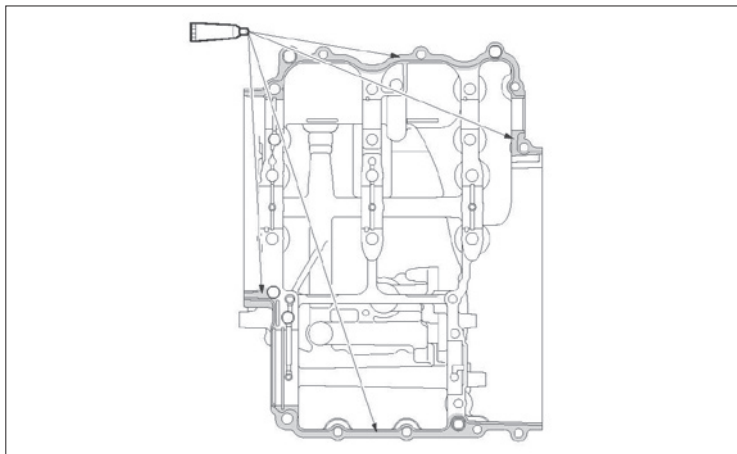
- Bolt M6 × 40 mm (× 8): "1", "2", "4"- "7", "10", "11";
- Bolt M6 × 60 mm (× 3): "3", "8", "9";
- Bolt M6 × 65 mm (× 2): "12", "13";
- Bolt M8 × 65 mm (× 2): "14", "15";
- Bolt M8 × 70 mm (× 6) (with O-ring): "16"- "21";
- Bolt M9 × 80 mm (× 5) (with washer): "22"- "25", "27";
- Bolt M9 × 90 mm (× 1) (with washer): "26".

Remove the crankcase and the centring pins by tapping on one side of the crankcase with a soft mallet.

⚠ **Only tap on the reinforced parts of the crankcase, not on the crankcase mating surfaces. Work slowly and carefully and make sure that the two half-crankcases are evenly separated.**

13.14.2 Crankcase check

- Wash the half-crankcases thoroughly with a non-aggressive solvent.
- Thoroughly clean the surfaces of all seals and crankcase mating surfaces.
- Carry out the following checks:
 - If the crankcase is cracked or damaged, replace it;
 - If the oil delivery passage is clogged, clean with compressed air.



13.14.3 Crankcase assembly

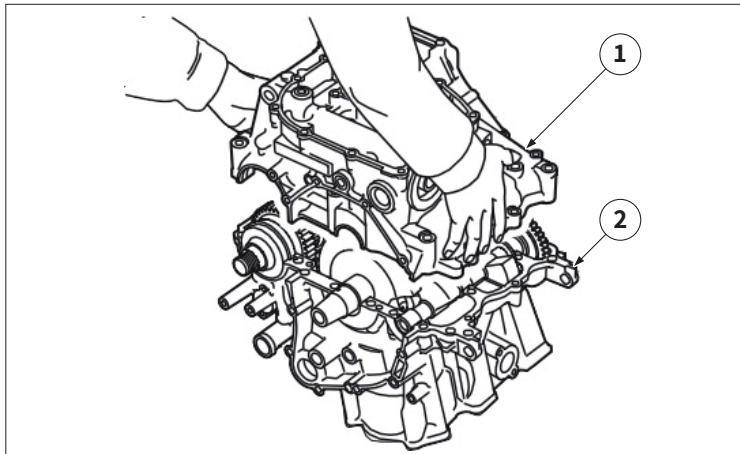
– Lubricate the inner surface of the crankshaft journal bearings with the recommended lubricant.

♻ **Recommended lubricant: engine oil.**

– Apply sealant to the mating surfaces of the crankcase.

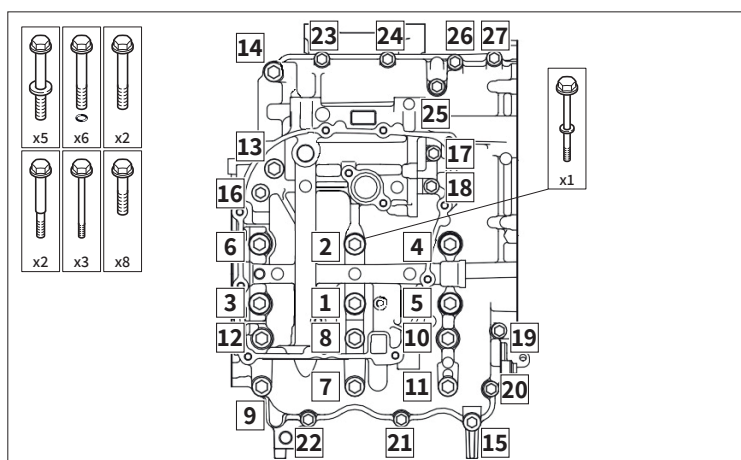
♻ **Sealant: Three bond No.1215®.**

⚠ **Do not allow the sealant to come into contact with the oil passage, crankshaft journal bearings or countershaft journal bearings.**



- Install the centring pins, move the gear selector drum unit and transmission gears to the neutral position, and then install crankcase "1" on cylinder "2".

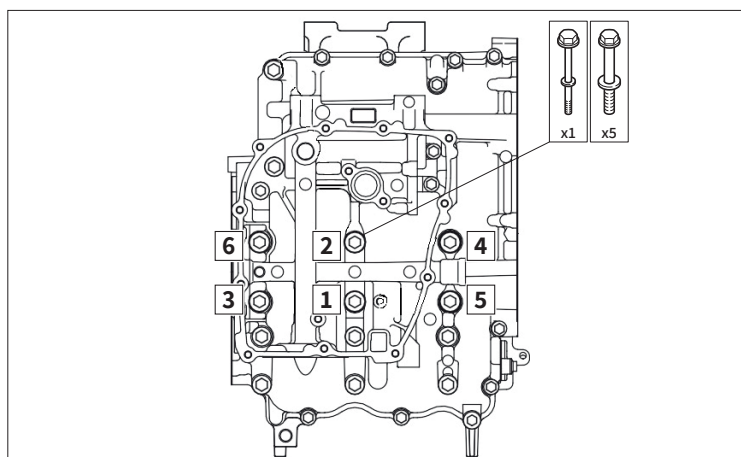
⚠ Before tightening the bolts, make sure that the transmission gears shift correctly when the gear selector drum unit is rotated manually.



- Install the crankcase bolts by lubricating the mating surfaces, washers and O-rings with engine oil.

i Tighten bolts "1"-"16" in the order of the numbers embossed on the crankcase.

- Bolt M9 x 80 mm (x 5) (with washer): "1", "3"-"6";
- Bolt M9 x 90 mm (x 1) (with washer): "2";
- Bolt M8 x 70 mm (x 6) (with O-ring): "7"-"12";
- Bolt M8 x 65 mm (x 2): "13", "14";
- Bolt M6 x 65 mm (x 2): "15", "16";
- Bolt M6 x 40 mm (x 8): "17", "18", "21"-"24", "26", "27";
- Bolt M6 x 60 mm (x 3): "19", "20", "25".

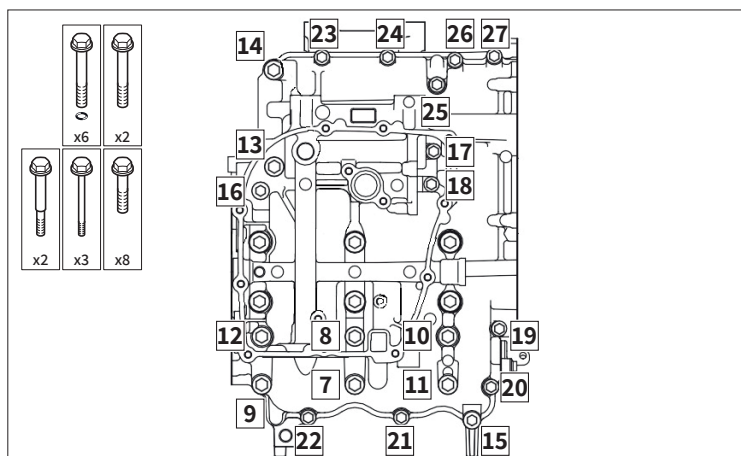


- Tighten bolts "1"-"6" in the sequence marked on the crankcase: loosen the bolts one by one and retighten them to the prescribed torques.

⚠ If the bolt is tightened beyond the prescribed angle, replace it and repeat the procedure.

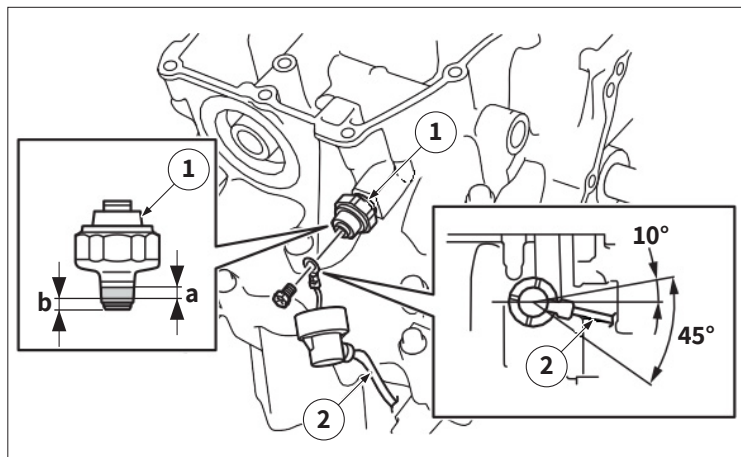
⚠ Do not use the torque spanner to tighten the bolt to the prescribed angle.

🔧 Tightening torques
Crankcase bolts (with washer):
 1st stage: 24 N·m (2.4 kgf·m, 18 lb·ft)
 2nd stage: 17 N·m (1.7 kgf·m, 13 lb·ft)
 3rd stage: clamping at a prescribed angle of 60°.



- Tighten bolts "7"-"16" in accordance with the tightening sequence stamped on the crankcase, then tighten bolts "17"-"27" in any sequence in a crossed pattern.

🔧 Tightening torques
 • Crankcase bolts "7"-"14": 24 N·m (2.4 kgf·m, 18 lb·ft);
 • Crankcase bolts "15"-"27": 10 N·m (1.0 kgf·m, 7.4 lb·ft).



13.14.4 Oil pressure switch installation

– Install the oil pressure switch "1" and switch cable "2".



Tightening torques

• Oil pressure switch:

15 N·m (1.5 kgf·m, 11 lb·ft);

• Oil pressure switch cable bolt:

1.8 N·m (0.18 kgf·m, 1.3 lb·ft)

– Apply sealant to the threads of the oil pressure switch



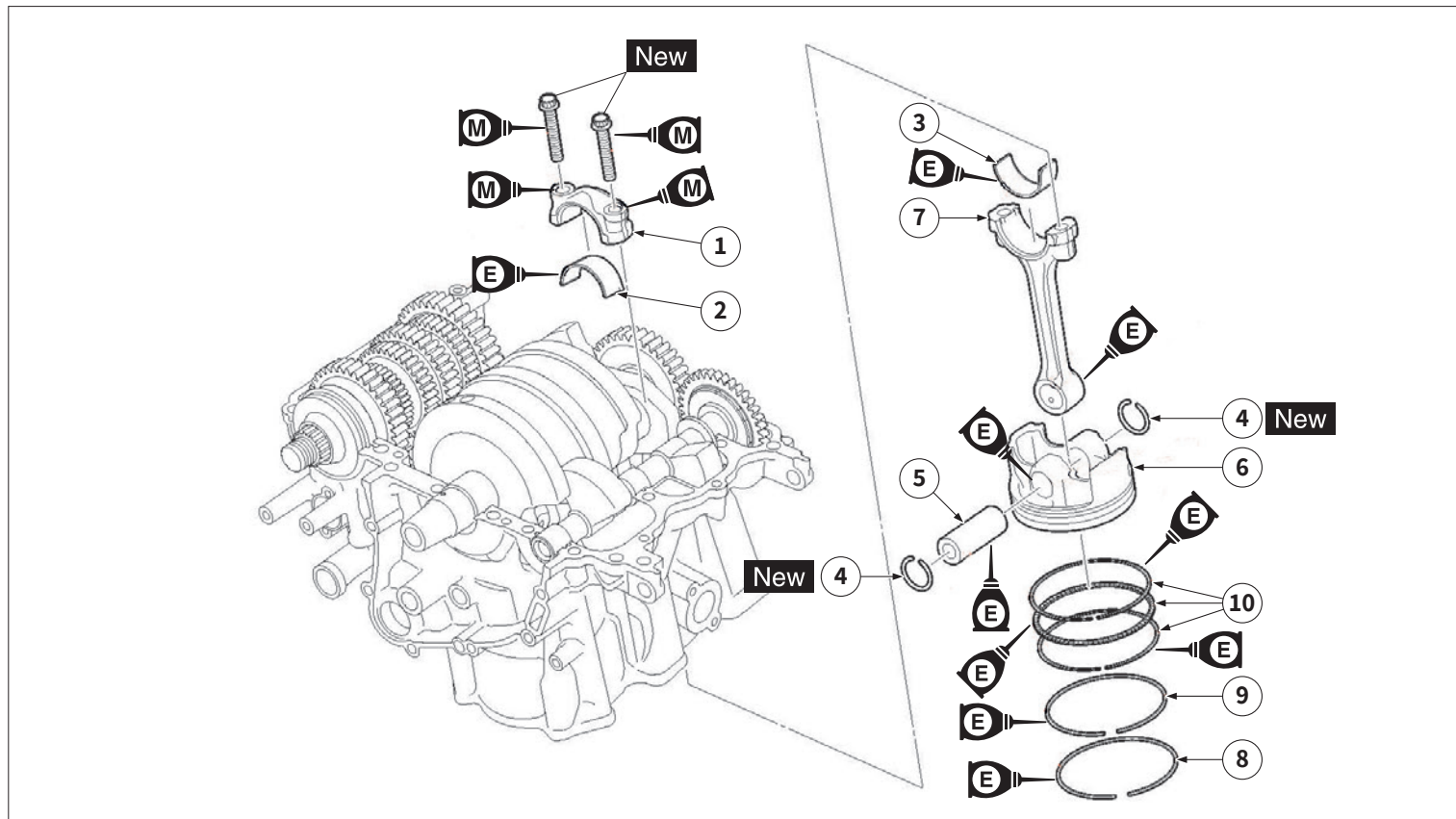
Sealant: Three bond No.1215®.

① Apply sealant to threads "a", taking care not to apply it to part "b" of the oil pressure switch.

① Install the cable so that it is arranged within the radius shown in the figure.

13.15 CONNECTING RODS AND PISTONS

Removal of connecting rods and pistons



Preliminary operations:

- Separate the engine crankcases (as described on page 209).

Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Connecting rod cap	1	1st tightening = 20 N•m (2.0 kgf•m, 15 lb•ft) 2nd tightening = Specific angle of 180°
2	Lower connecting rod big end bushing	1	
3	Upper connecting rod big end bushing	1	
4	Piston pin spring	2	
5	Piston pin	1	
6	Piston	1	
7	Connecting rod	1	
8	Upper piston ring	1	
9	2nd piston ring	1	
10	Oil scraper ring	1	

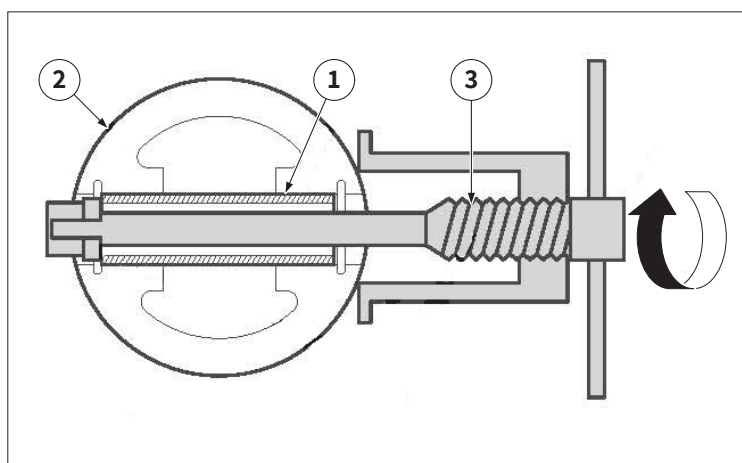
13.15.1 Removal of connecting rods and pistons

i The following procedure applies to all connecting rods and pistons.

– Remove the connecting rod cap, connecting rod and connecting rod big end bushing.

i Identify the position of each connecting rod cap so that it can be reinstalled in its original position.

i After removing the connecting rods and plugs, take care not to damage the mating surfaces of the connecting rods and plugs.



– Remove pin spring, pin "1", piston "2" and connecting rod.

! Do not use a hammer to release the piston pin.

i For reference during installation, place identification marks on the piston sprocket.

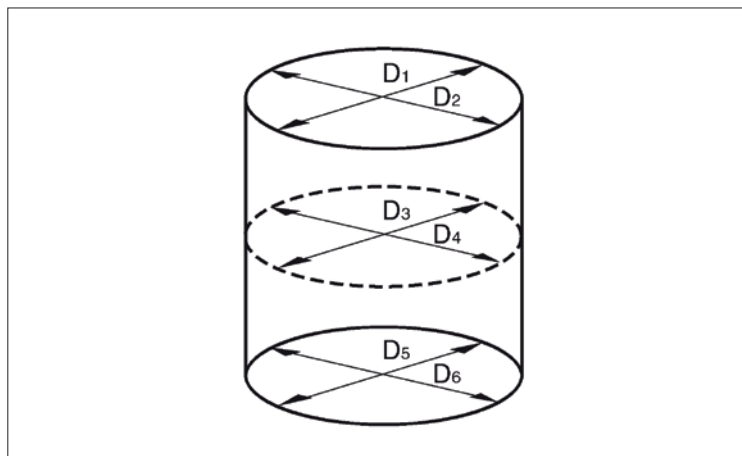
i Before removing the pin, deburr the piston pin spring groove and the piston pin hole area. If both areas are smudged and removing the pin continues to be difficult, remove the pin using the pin extractor kit "3".

✂ - Pin extractor kit;
 - Pin extractor.



– Remove the upper piston ring, the 2nd piston ring and the oil scraper ring.

i When removing a piston ring, widen the clearance between the ends with the fingers and lift the other side of the piston ring over the piston deck.



13.15.2 Cylinder and piston check

i The following procedure applies to all cylinders and pistons.

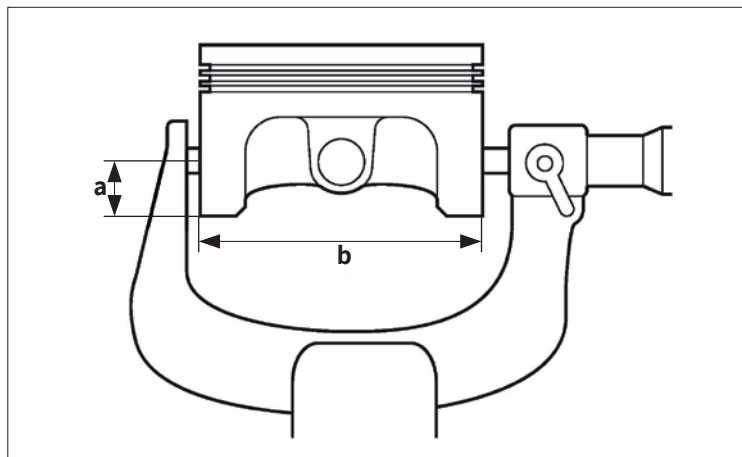
– Check the piston wall.

– Check the cylinder wall: if it has vertical scratches, replace the cylinder and the piston and piston rings as a whole.

– Measure the cylinder bore with a bore gauge: if it does not comply with the prescribed values, replace the cylinder and the piston and piston rings as a whole.

✂ - Reaming: 80.000–80.010 mm (3.1496–3.1500 in);
 - Wear limit: 80.060 mm (3.1520 in).

• Cylinder reaming = maximum of D1, D2, D3, D4, D5, D6.



- Measure the diameter of the piston shell "b" with a micrometer: if it does not comply with the prescribed values, replace the piston and piston rings as a whole.

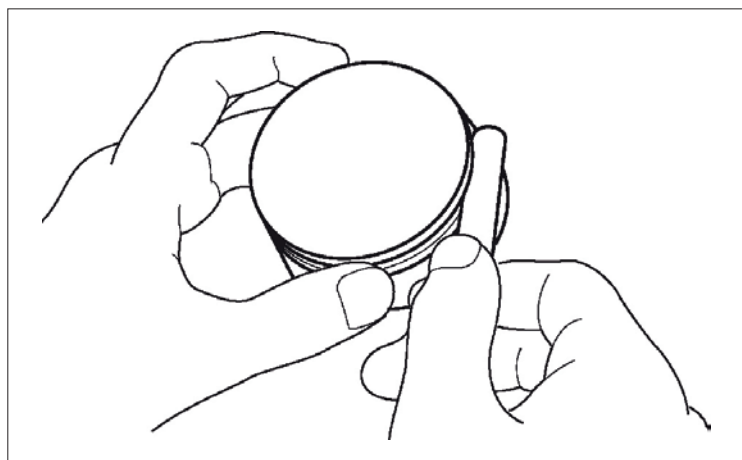
Diameter: 79,970–79,985 mm (3.1484–3.1490 in).

Calculate the clearance between piston and cylinder with the following formula:

Piston - cylinder clearance = cylinder bore - piston skirt diameter

If it does not comply with the prescribed values, replace the cylinder and the piston and piston rings as a whole.

- 8.0 mm (0.31 in) from the lower edge of the piston

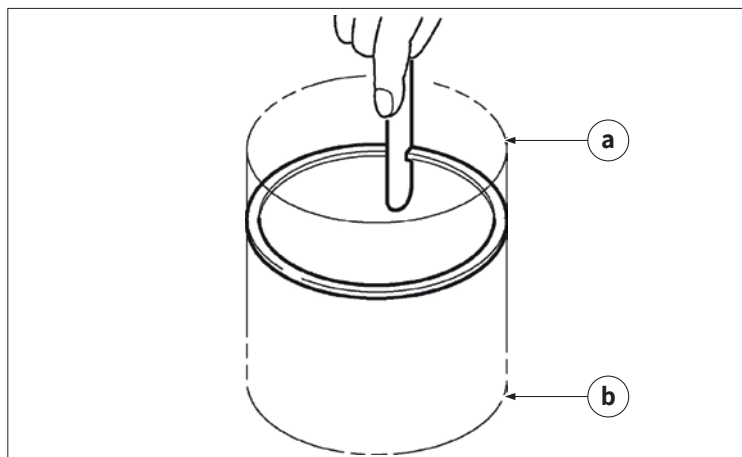


13.15.3 Piston rings check

- Measure the lateral clearance of the piston rings: if it does not comply with the prescribed values, replace the piston and the piston rings together.

i Before measuring the piston ring side clearance, remove any carbon deposits from the piston ring grooves and piston rings.

- **Upper piston ring side clearance limit:**
0.115 mm (0.0045 in);
- **2nd piston ring side clearance limit:**
0.115 mm (0.0045 in).

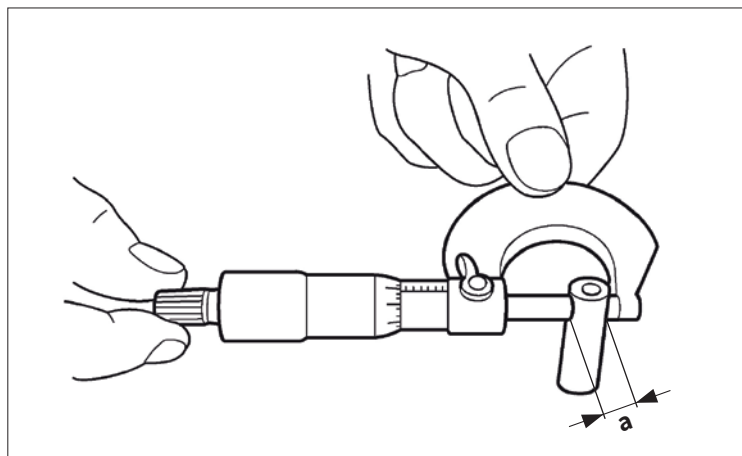


- Install the piston ring in the cylinder using the piston sprocket to level the piston ring near the underside of cylinder "a" where wear is minimal.
- Measure the clearance between the ends of the piston ring: it does not comply with the prescribed values, replace the piston ring.

i It is not possible to measure the clearance between the ends of the expander spacer of the oil scraper ring. If the gap is too large, replace the oil scraper ring as a whole.

- **Clearance limit between the ends of the upper piston ring:**
0.50 mm (0.0197 in);
- **Light limit between ends 2nd piston ring:**
0.80 mm (0.0315 in).

- a. Lower side of the cylinder;
- b. Upper side of the cylinder.

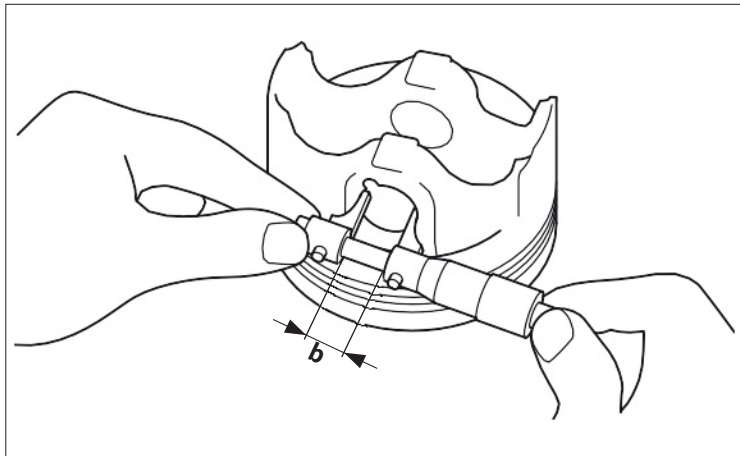


13.15.4 Pin check

i The following procedure applies to all pins.

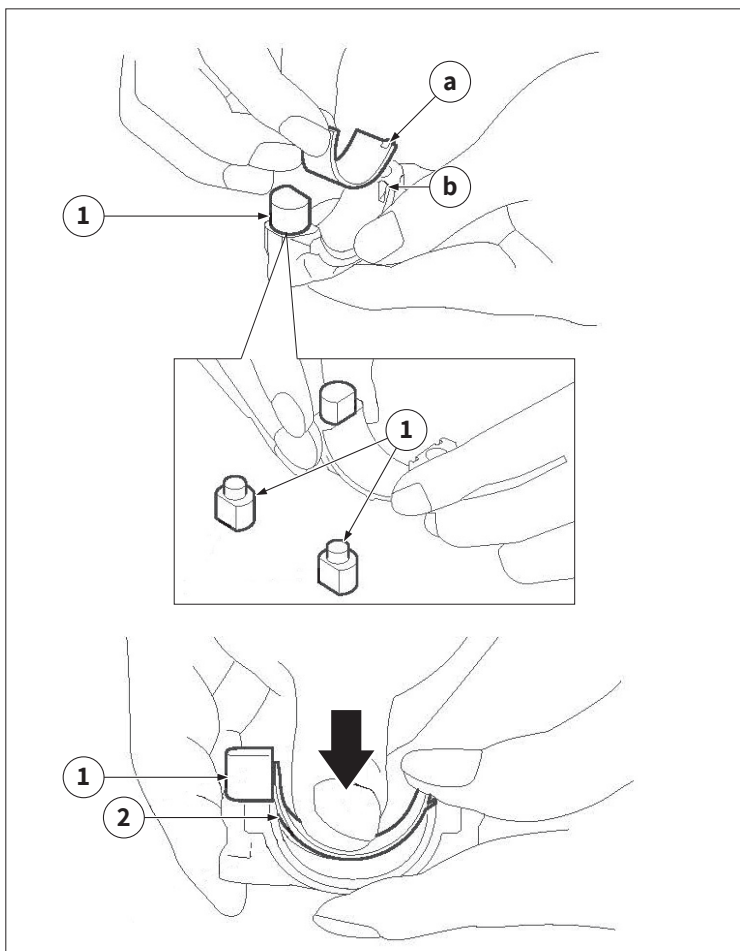
- Check the pin: if it shows blue discolouration or grooves, replace it and then check the lubrication system.
- Measure the outer diameter of pin "a": if it does not comply with the prescribed values, replace it.

Pin outside diameter limit: 17,970 mm (0.7075 in).



- Measure the internal diameter of the pin bore "b": if it does not comply with the prescribed values, replace the piston.

Pin hole inside diameter limit:
18,045 mm (0.7104 in).



13.15.5 Connecting rods check

i The following procedure applies to all connecting rods.

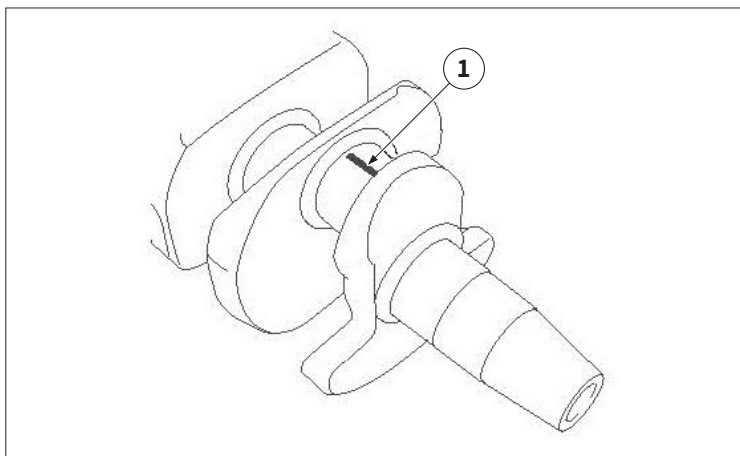
- Measure the connecting rod pin-connecting rod big end bushing clearance: if not in accordance with the prescribed values, replace the connecting rod big end bushings.

Oil height: 0.027-0.051 mm (0.0011-0.0020 in).

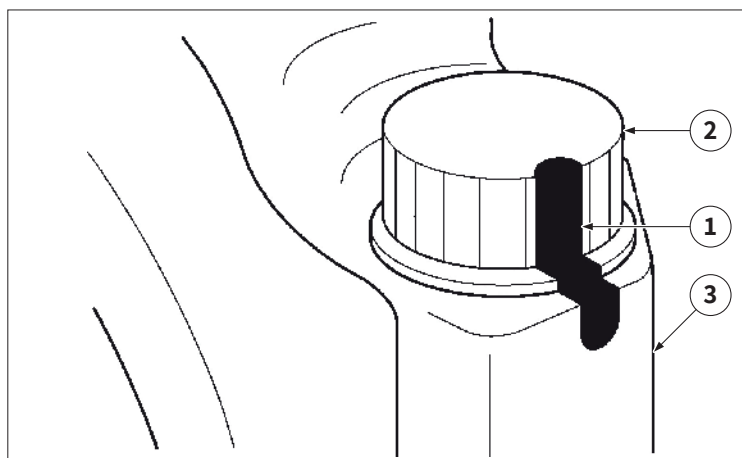
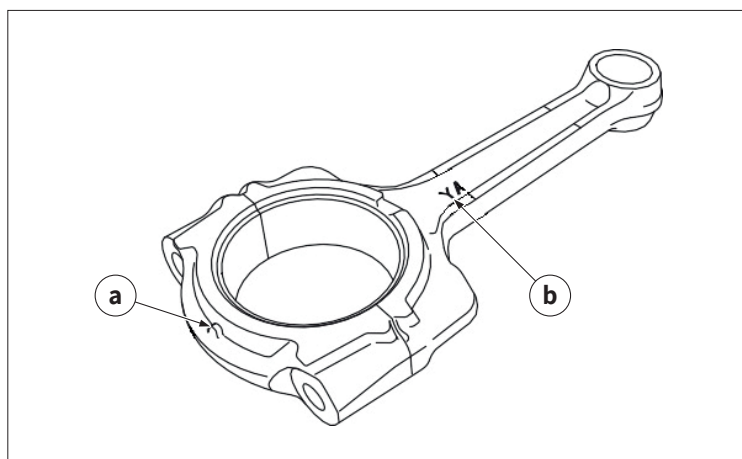
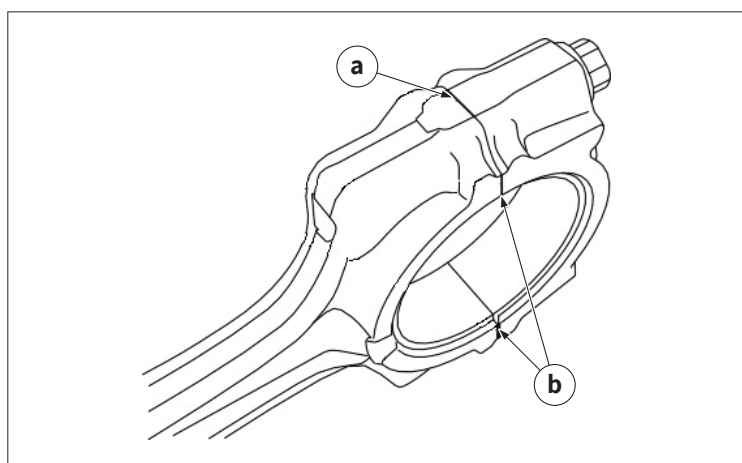
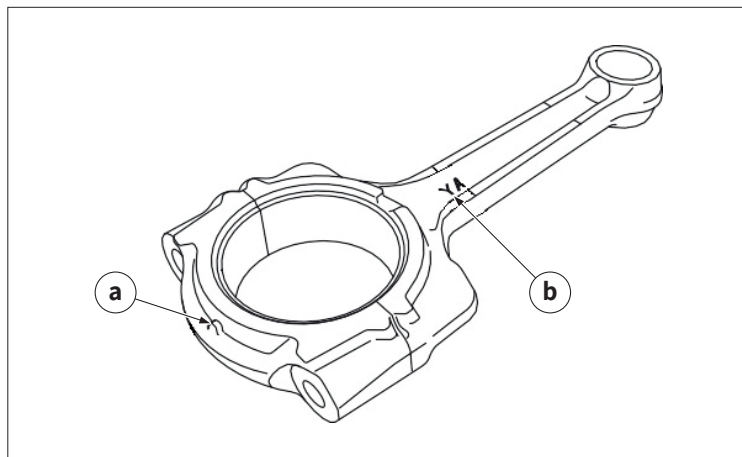
! Do not interchange connecting rod and connecting rod bushings. In order to achieve correct clearance between the connecting rod pin and the bushings and to avoid damage to the engine, the connecting rod big end bushings must be installed in their original positions.

- Clean the connecting rod big end bushings, connecting rod pins and the inside of both halves of the connecting rod.
- Install the bushing of the upper connecting rod big end in the connecting rod and the lower bushing of the upper connecting rod big end in the plug using the connecting rod big end bushing installation tool "1".
 - From the 3 types, choose the tool that fits perfectly and install it on the connecting rod and plug as illustrated;
 - Align the protrusions "a" on the connecting rod big end bushings with the recesses "b" on the connecting rod and plug;
 - Push connecting rod big end bushing "2" down and install it on the connecting rod and plug.

X Tool for installing bushings on connecting rod big end.



- Place a piece of Plastigauge® "1" on the connecting rod pin and assemble the two halves of the connecting rod.



⚠ Always install new bolts.

i Ensure that the protrusion "a" on the connecting rod cap is pointing in the same direction as the "Y" reference "b" on the connecting rod.

i Use the following procedures to carry out assembly under the most suitable conditions.

- Clean the connecting rod bolts and lubricate the threads and seats with molybdenum disulphide oil;
- After installing the connecting rod bushing, mount the connecting rod and plug without installing them on the crankshaft;

- Tighten the connecting rod bolts to a defined angle at the yield strength limit and at the same time check that sections "a" and "b" are flush with each other touching the surface;

i Ensure that the connecting rod bushing is not installed obliquely and that its position is not out of alignment.

🔧 Tightening torque
Connecting rod bolt: 30 N·m (3.0 kgf·m, 22 lb·ft).

- a. Machined side face;
- b. Thrust surfaces.

- Loosen the bolts, remove the connecting rod and cap, then install these components on the crankshaft, keeping the connecting rod big end bushing in its present condition.

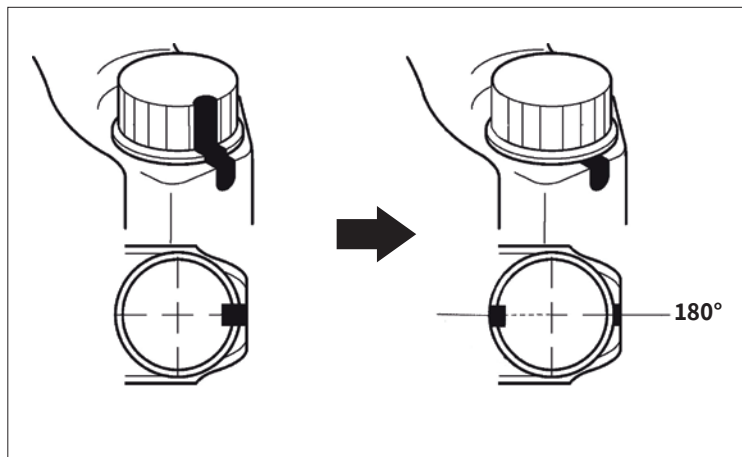
i Do not move the connecting rod or crankshaft until the clearance measurement has been completed.

i Ensure that the protrusion "a" on the cap faces the same direction as the "Y" reference "b" on the connecting rod.

i Make sure that the "Y" "b" marks on the connecting rods face the left side of the crankshaft.

- Tighten the bolts using a torque wrench.
- Place a reference "1" on bolt angle "2" and connecting rod cap "3".

🔧 Tightening torque
Connecting rod bolt (1°): 20 N·m (2.0 kgf·m, 15 lb·ft).



- Tighten the bolts further until the prescribed angle of 175°-185° is reached.


Tightening torque

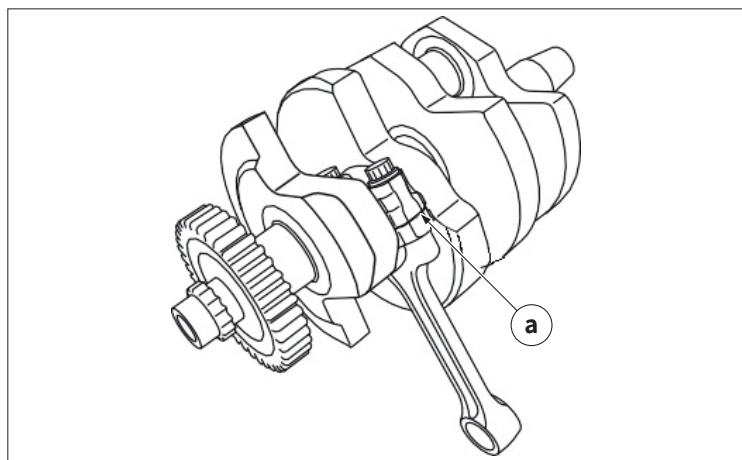
Connecting rod bolt (final): Prescribed angle 180°±5.



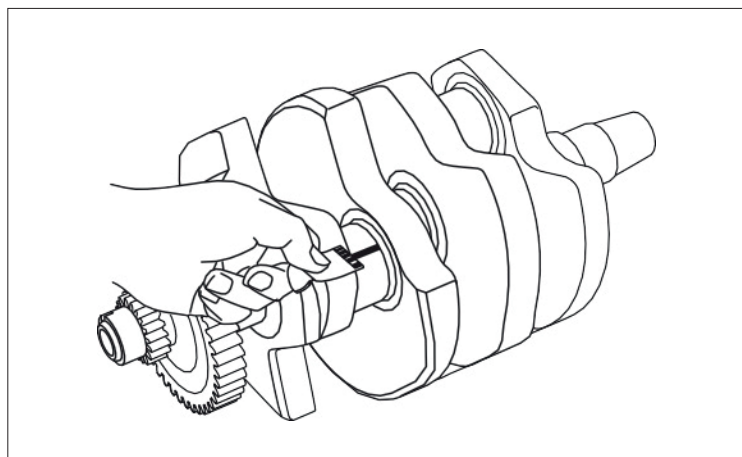
If the bolt is tightened beyond the prescribed angle, replace it and repeat the procedure.



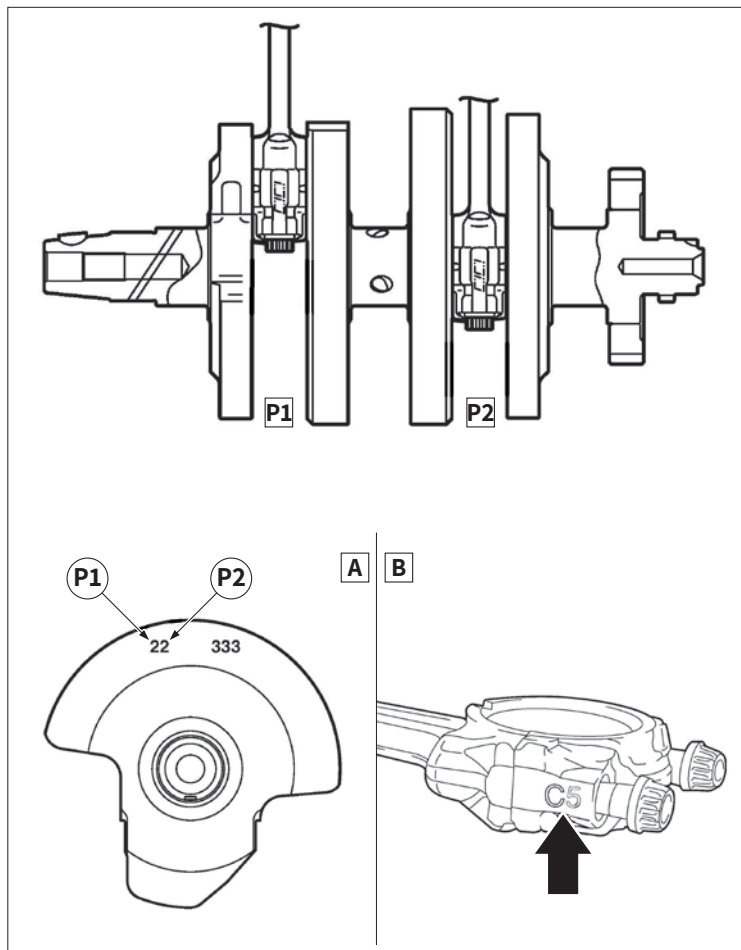
Do not use the torque spanner to tighten the bolt to the prescribed angle.



- After installation, check that section "a" is flush with the surface;
- Remove the connecting rod and connecting rod big end bushings;



- Measure the width of the compressed Plastigauge® on the crank pin; if the crank pin-connecting rod big end bushing clearance does not comply with the prescribed values, select replacement connecting rod big end bushings.

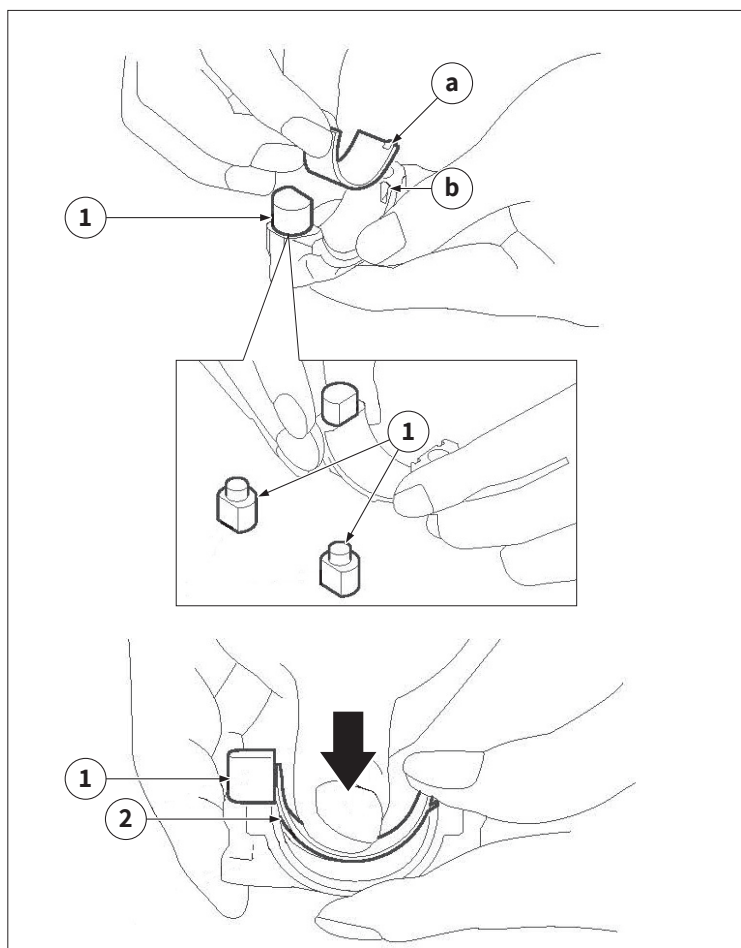


- Select the replacement connecting rod big end bushing "P1"- "P2" using the "A" numbers stamped on the crank arm and the "B" numbers on the connecting rods to determine its dimensions, according to the formula:

Bushing = "P1" (connecting rod) - "P1" (crank arm).

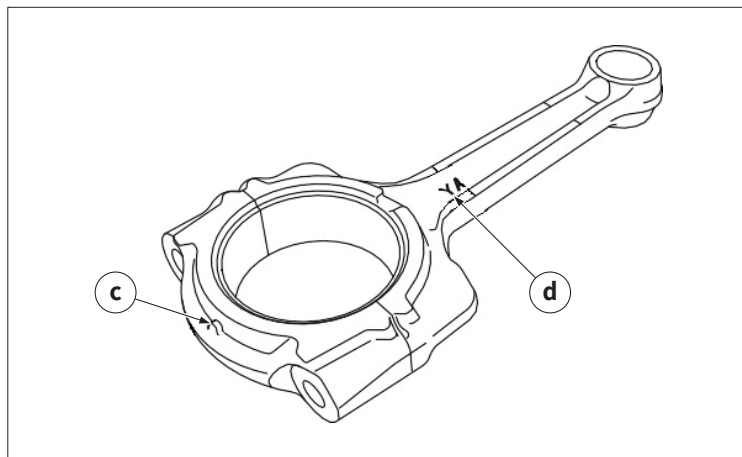
- ① For example, if the numbers on the connecting rod "P1" and crank arm "P1" are 5 and 2 respectively, the bushing size for "P1" is: 5 - 2 = 3 (brown)

- ✂ Bushings colour code
- Code 1: Blue;
Code 2: Black;
Code 3: Brown;
Code 4: Green.



13.15.6 Connecting rod and piston installation

- ① The following procedure applies to all connecting rods and pistons.
- Clean the connecting rod big end bushings, connecting rod pins and the inside of both halves of the connecting rod.
- Install the connecting rod big end bushing and plug on the connecting rod with the connecting rod big end bushing installation tool "1".
 - From the 3 types, choose the tool that fits perfectly and install it on the connecting rod and plug as illustrated;
 - Align the protrusions "a" on the connecting rod big end bushings with the recesses "b" on the connecting rod and plug;
 - Push connecting rod big end bushing "2" down and install it on the connecting rod and plug;

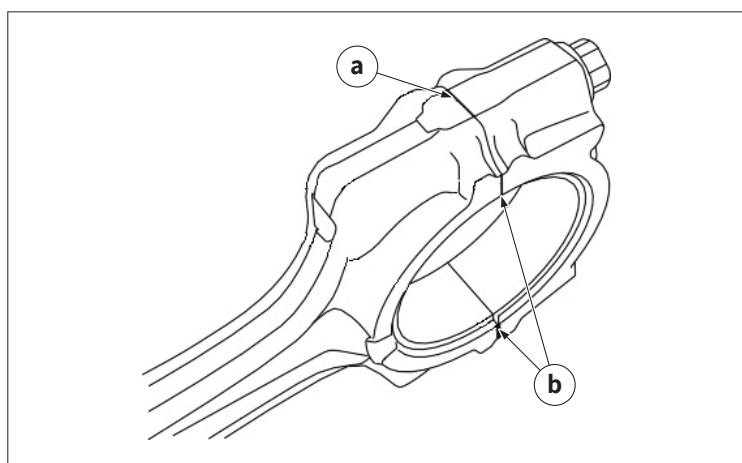


- Ensure that the protrusion "c" on the cap faces the same direction as the "Y" reference "d" on the connecting rod;

✂ Tool for installing bushings on connecting rod big end.

i Use the following procedures to carry out assembly under the most suitable conditions.

- Replace bolts with new ones;
- Clean the connecting rod bolts and lubricate the threads and seats with molybdenum disulphide oil;
- After installing the connecting rod bushing, mount the connecting rod and plug without installing them on the crankshaft;



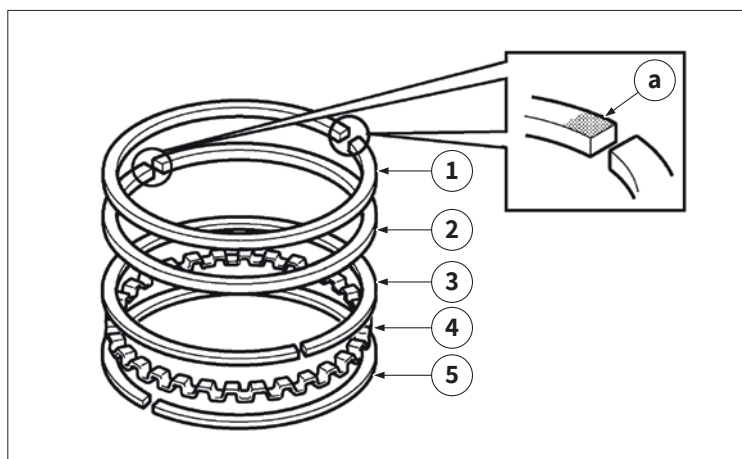
- Tighten the connecting rod bolts to a defined angle at the yield strength limit and at the same time check that sections "a" and "b" are flush with each other touching the surface;

i Ensure that the connecting rod bushing is not installed obliquely and that its position is not out of alignment.

⚠ Always install new bolts.

🔧 Tightening torque
Connecting rod bolt: 30 N·m (3.0 kgf·m, 22 lb·ft).

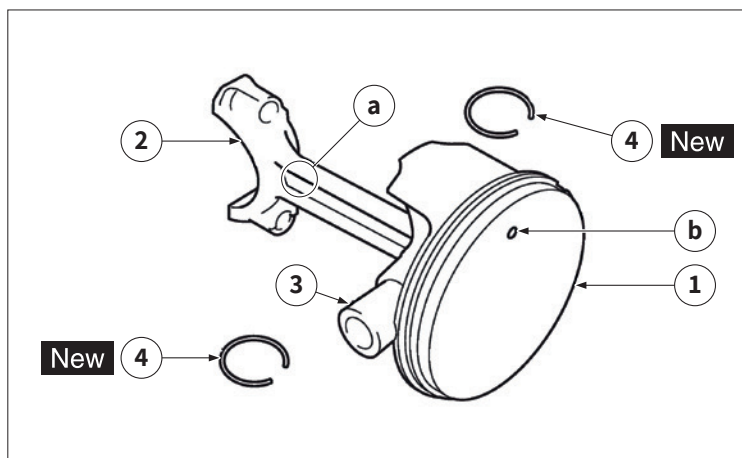
- a. Machined side face;
- b. Thrust surfaces.



- Loosen the bolts, remove the connecting rod and cap, then install these components on the crankshaft, keeping the connecting rod big end bushing in its present condition.

– Install the upper piston ring "1", 2nd piston ring "2", upper scraper ring piston ring "3" clearance, scraper piston ring expander "4" and lower scraper piston ring "5" clearance.

i Be sure to install the piston rings so that the manufacturer's references "a" are facing upwards.

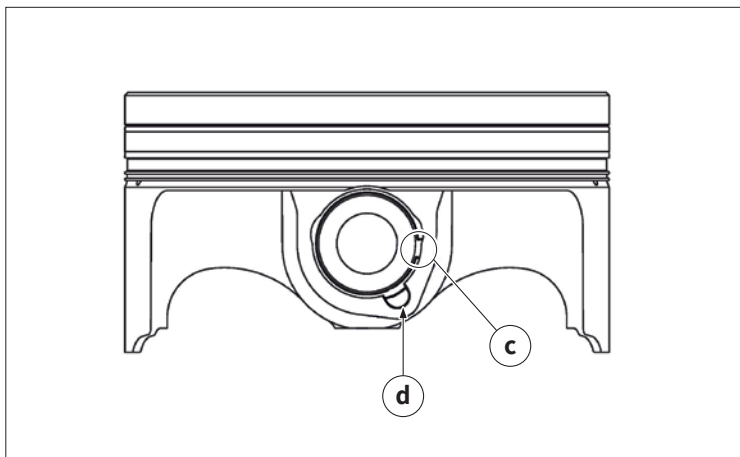


– Install the piston "1" on the respective connecting rod "2", pin "3" and pin spring "4".

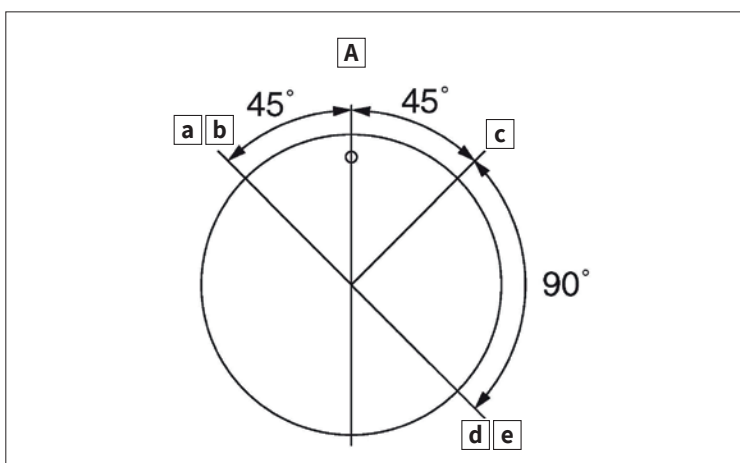
♻ Apply engine oil to the piston pin.

i Ensure that the "Y" reference "a" of the connecting rod faces to the left when the "b" punching of the piston faces upwards as illustrated.

i Reinstall each piston in the original cylinder.



- i** When installing a piston pin, ensure that the "c" ends are located away from piston notch "d" as shown.

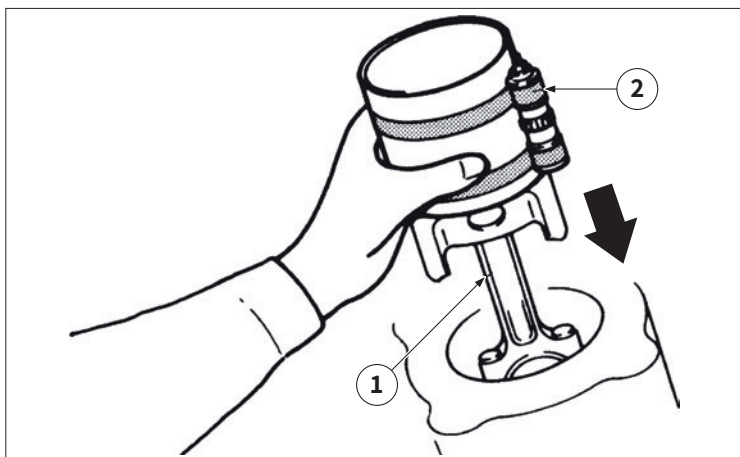


- Lubricate the piston, the piston ring and the cylinder with the recommended lubricant.

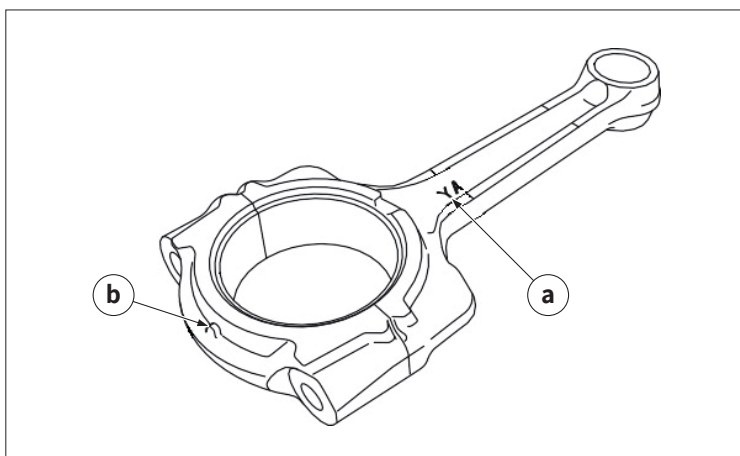
Recommended lubricant: engine oil.

- Misalignment of the clearances between the ends of the piston ring:
 - a. 2nd piston ring;
 - b. Lower oil scraper ring clearance;
 - c. Upper oil scraper ring clearance;
 - d. Upper piston ring;
 - e. Oil scraper ring expander;
 - A. Exhaust side.
- Lubricate the connecting rod pin and the inner surface of the connecting rod big end bushing with the recommended lubricant.

Recommended lubricant: engine oil.



- Install the connecting rod unit "1" into the cylinder and onto the connecting rod pin by compressing the piston ring with the connecting rod compressor "2" and the connecting rod cap.

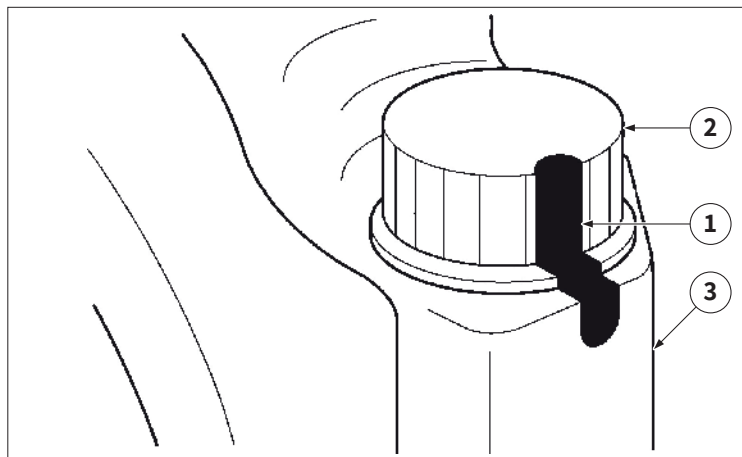


- i** Make sure that the "Y" references "a" on the connecting rods face the left side of the crankshaft.

- i** Ensure that the protrusion "b" on the connecting rod cap is pointing in the same direction as the "Y" reference "a" on the connecting rod.

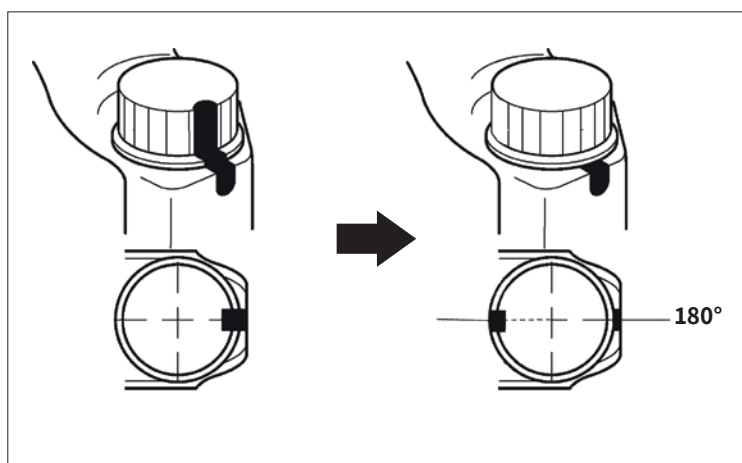
- Apply molybdenum disulphide oil to the threads and bolt housings.**

- ✗** Piston ring compressor for Ø80 mm pistons.



- Tighten bolts with a torque wrench.
- Place a reference "1" on bolt angle "2" and connecting rod cap "3".

 **Tightening torque**
 Connecting rod bolt (1°): 20 N·m (2.0 kgf·m, 15 lb·ft).

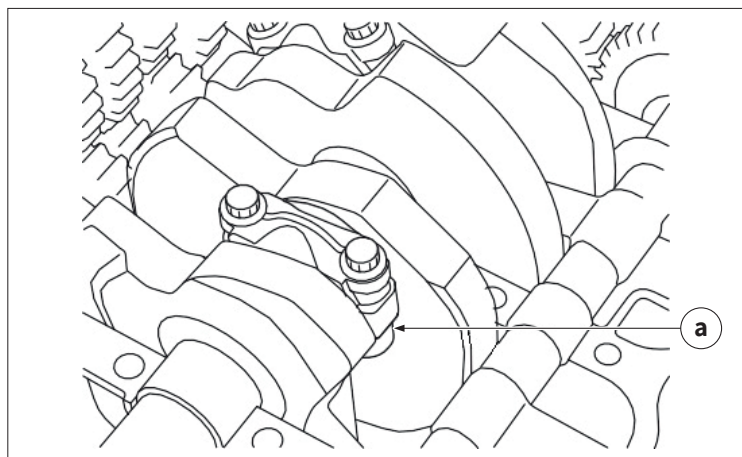


- Tighten the bolts further until the prescribed angle of 175°-185° is reached.

 **Tightening torque**
 Connecting rod bolt (final): Prescribed angle 180°±5.

 **If the bolt is tightened beyond the prescribed angle, replace it and repeat the procedure.**

 **Do not use the torque spanner to tighten the bolt to the prescribed angle.**

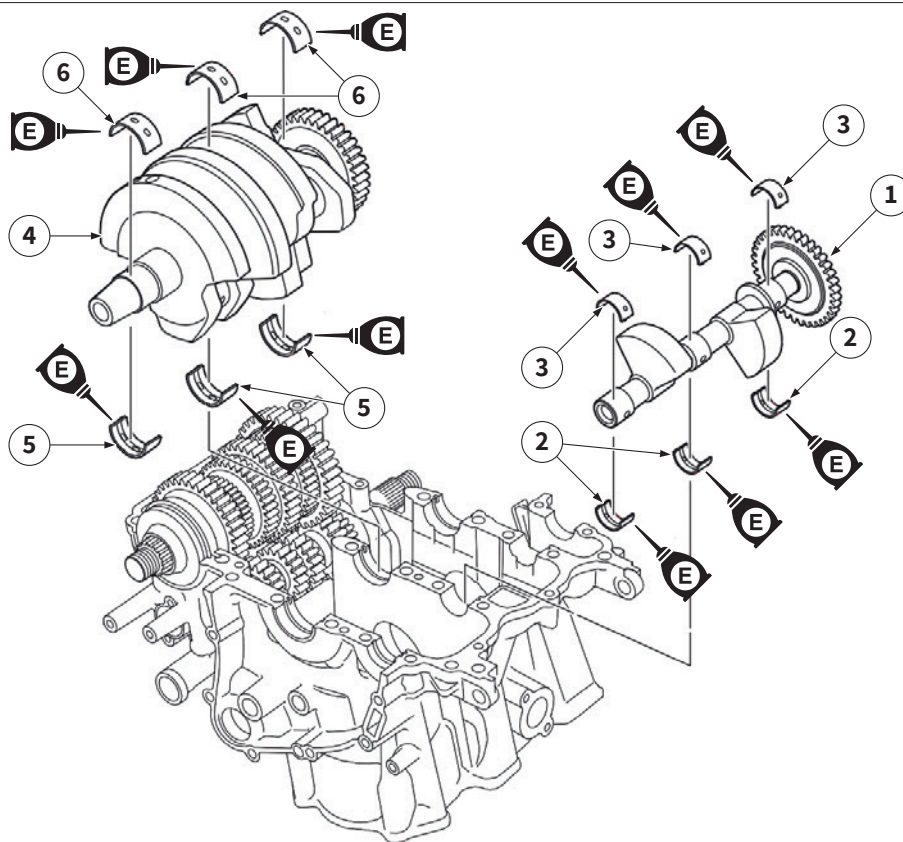


- After installation, check that section "a" is flush with the surface.

 **If they are not flush with each other, remove the bolts and the connecting rod big end bushing then repeat the entire procedure by replacing the bolts.**

13.16 CRANKSHAFT AND BALANCER COUNTERSHAFT

Removal of crankshaft and balancer countershaft



Preliminary operations:

- Separate the engine crankcases (as described on page 209);
- Remove the connecting rods (as described on page 214).

Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Balancer countershaft unit	1	
2	Balancer shaft lower journal bearing	3	
3	Balancer shaft upper journal bearing	3	
4	Crankshaft unit	1	
5	Crankshaft lower journal bearing	3	
6	Crankshaft upper journal bearing	3	

13.16.1 Removal of balancer countershaft journal bearings

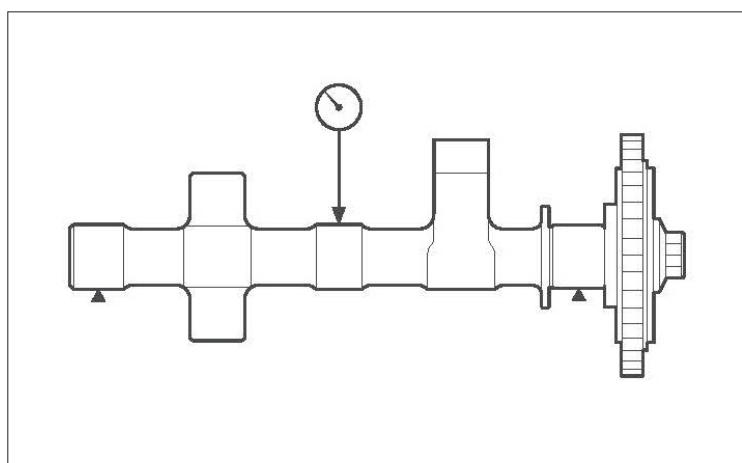
- Remove the countershaft lower journal bearings from the crankcase and the upper bearings from the cylinder.

i Identify the position of each bearing so that it can be reinstalled in its original position.

13.16.2 Removal of crankshaft journal bearings

- Remove the lower crankshaft journal bearings from the crankcase and the upper bearings from the cylinder.

i Identify the position of each bearing so that it can be reinstalled in its original position.


13.16.3 Balancer countershaft unit check

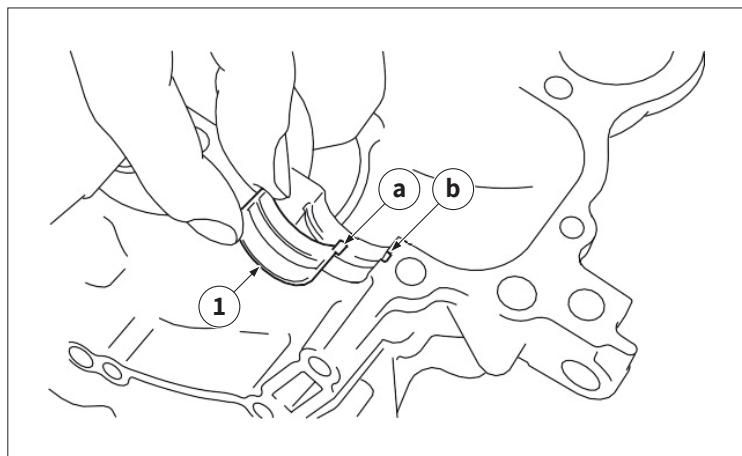
- Check the balancer drive gear: if it shows damage, signs of wear or if the noise during operation is excessive, replace the drive gear and balancer countershaft unit as a whole.
- Measure the offset of the balancer countershaft: if it does not comply with the prescribed values, replace the countershaft unit.

✂ Balancer countershaft misalignment limit
0.030 mm (0.0012 in).

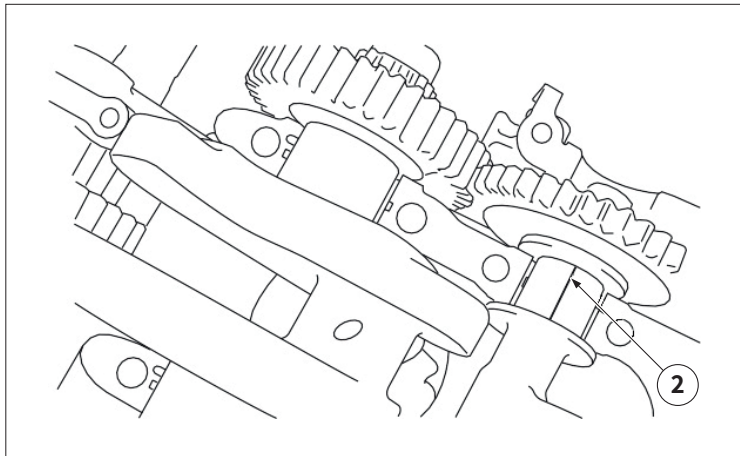
- Check the balancer countershaft unit: if it shows cracks, damage or signs of wear, replace the countershaft unit and the countershaft bushings; if it shows impurities, clean it.
- Check the bearings: if they show damage or signs of wear, replace them.
- Measure the countershaft journal-bearing clearance: if it does not comply with the prescribed values, replace the bearings.

✂ Balancer countershaft journal - bearings clearance:
0.020–0.054 mm (0.0008–0.0021 in).

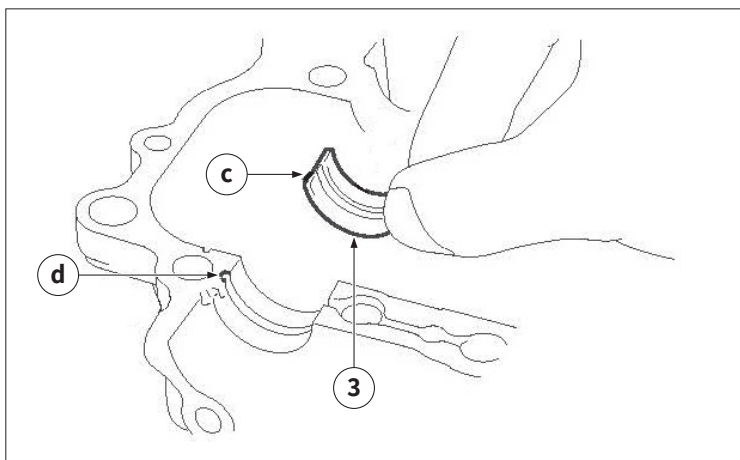
i Do not interchange bearings. To achieve the correct clearance and prevent damage to the engine, the bearings must be installed in their original positions.



- Clean the bearings and pins of the balancer shaft and the bearing parts of the crankcase and cylinder;
- Install the upper countershaft journal bearings "1" and countershaft unit into the cylinder, aligning bearing protrusions "a" with notches "b" on the cylinder;



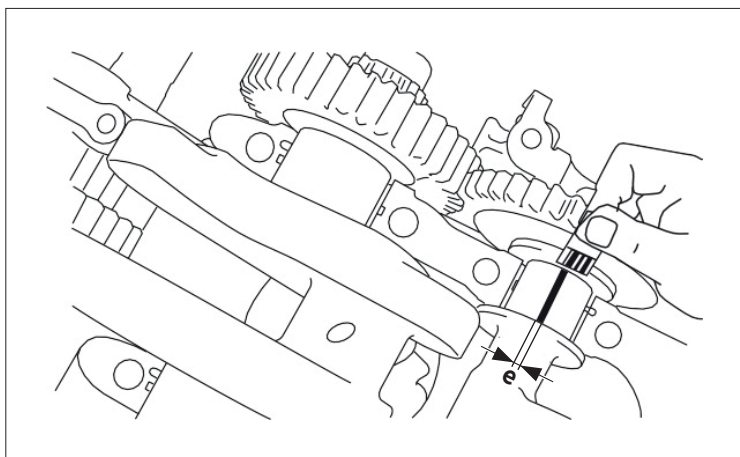
- Place a piece of Plastigauge® "2" on each balancer shaft pin, taking care not to place it over the oil hole;



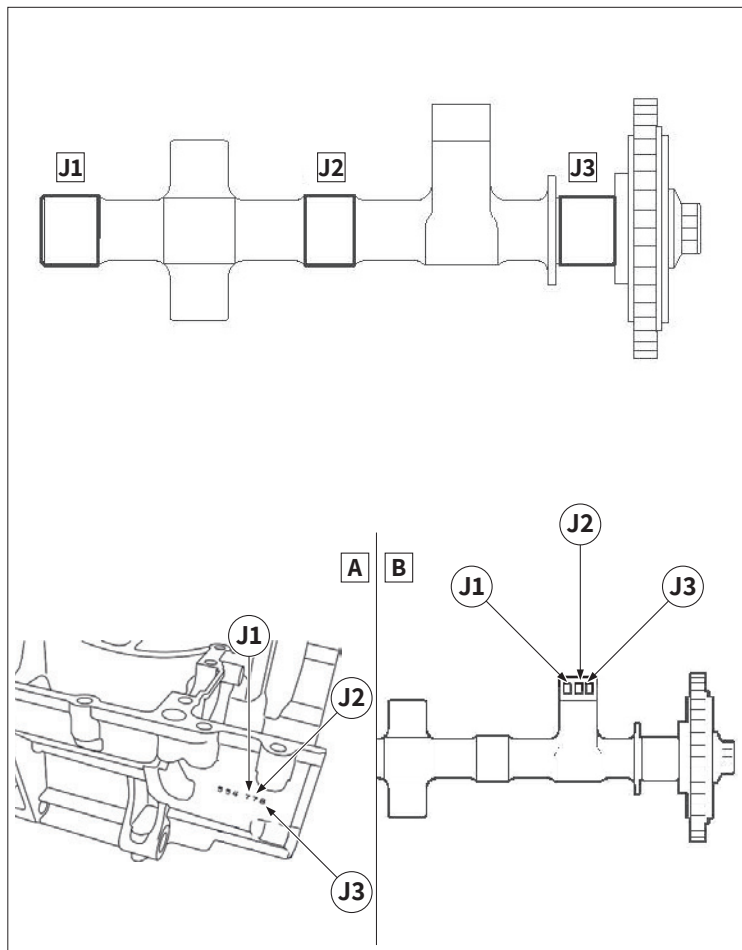
- Install the lower countershaft journal bearings "3" into the crankcase by aligning the bearing protrusions "c" with the notches "d" on the crankcase, then assemble the crankcase and cylinder;

i Do not move the balancer countershaft until the clearance measurement has been completed.

- Tighten the bolts to the prescribed values in accordance with the tightening sequence stamped on the crankcase, referring to "13.14 Crankcase" on page 209;
- Remove the crankcase and the lower bearings of the balancer shaft;



- Measure the width of the compressed Plastigauge® "e" on each countershaft journal: if the countershaft bearing journal clearance is out of specification, select replacement bearings.



- Select countershaft journal bearings "J1"- "J3" using the "A" numbers stamped on the crankcase and the "B" numbers stamped on the countershaft crank arm to determine their measurements, according to the formula:

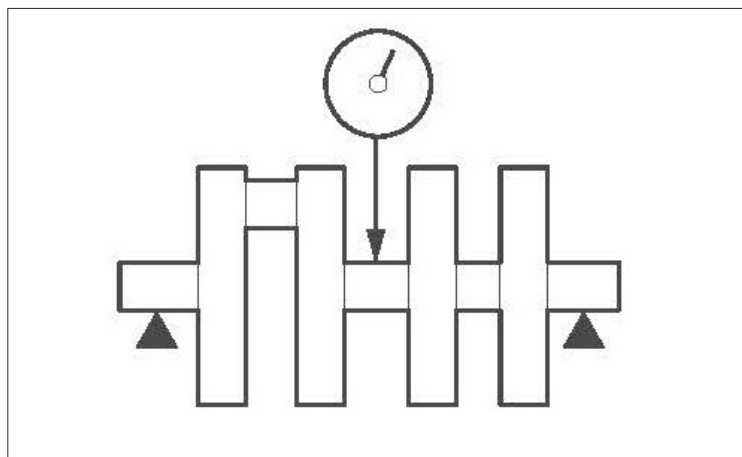
Bearing size = "J1" (crankcase) - "J1" (crank arm)

- i** For example, if the numbers on the crankcase "J1" and crank arm "J1" are 6 and 5 respectively, the bearing size for "J1" is: 6 - 5 = 1 (blue).



Bushings colour code

- Code 1: Blue;
- Code 2: Black;
- Code 3: Brown;
- Code 4: Green;
- Code 5: Yellow.



13.16.4 Crankshaft check

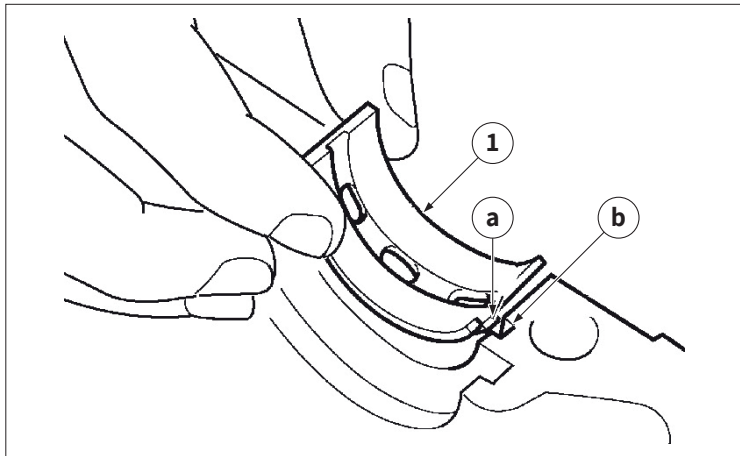
- Check the balancer drive gear: if it shows damage, signs of wear or if the noise during operation is excessive, replace the drive gear and balancer countershaft unit as a whole.
- Measure the offset of the crankshaft: if it does not comply with the prescribed values, replace it.
- Check the surface of the crankshaft journal and the surface of the connecting rod journal.
- Check the surface of the bearings: if they show scratches or wear, replace the crankshaft.

- Measure the crankshaft journal - bearings clearance : if it does not comply with the prescribed values, replace the bearings.

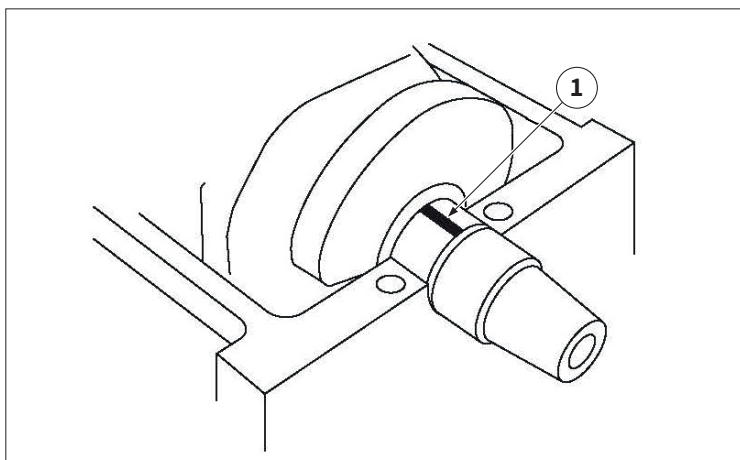


Axle oil height: 0.018-0.042 mm (0.0007-0.0017 in).

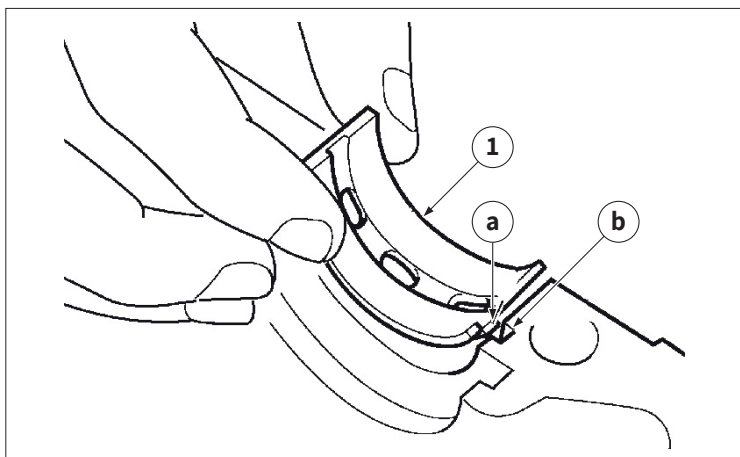
- i** Do not interchange bearings. To achieve the correct clearance and prevent damage to the engine, the bearings must be installed in their original positions.



- Clean crankshaft bearings and journals, crankcase and cylinder support parts;
- Install the upper crankshaft journal bearings "1" and the crankshaft into the cylinder, aligning the bearing protrusions "a" with the notches "b" on the cylinder;



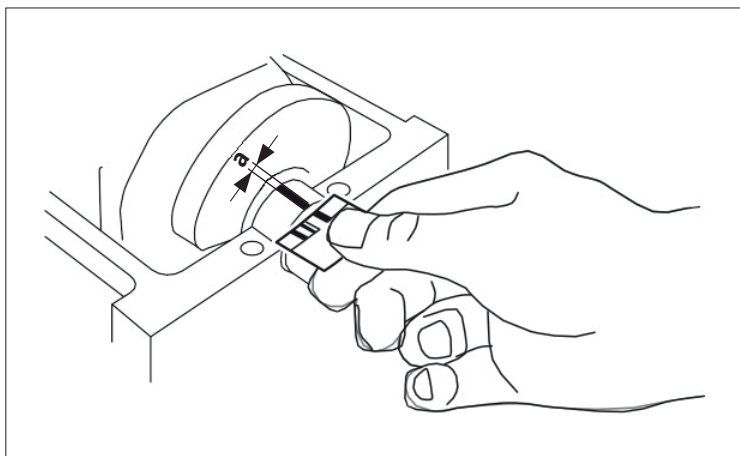
- Place a piece of Plastigauge® "1" on each crankshaft journal, taking care not to place it over the oil hole;



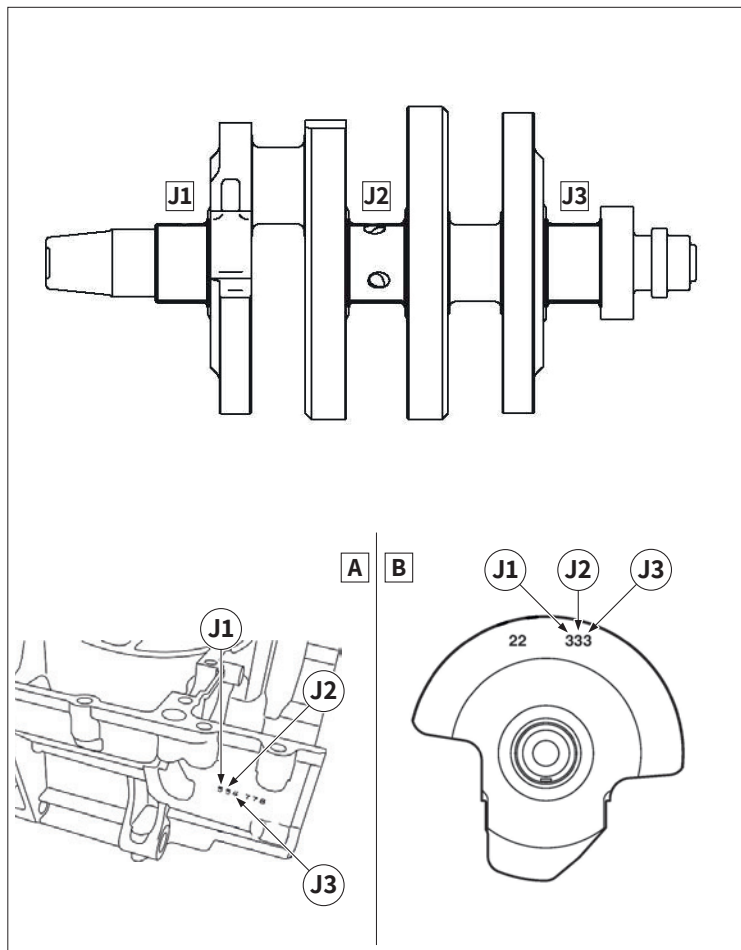
- Install the lower crankshaft journal bearings "1" into the crankcase by aligning the bearing protrusions "a" with the notches "b" on the crankcase, then assemble the crankcase and cylinder;

i Do not move the crankshaft until the clearance measurement has been completed.

- Tighten the bolts to the prescribed values in accordance with the tightening sequence stamped on the crankcase, referring to "13.14 Crankcase" on page 209;
- Remove the crankcase and lower crankshaft journal bearings;



- Measure the width of the compressed Plastigauge® "a" on each crankshaft journal: if the crankshaft-bearing journal clearance is out of specification, select replacement bearings.



- Select crankshaft journal bearings "J1"- "J3" using the "A" numbers stamped on the crankcase and the "B" numbers stamped on the crank arm of the crankshaft to determine their measurements, according to the formula:

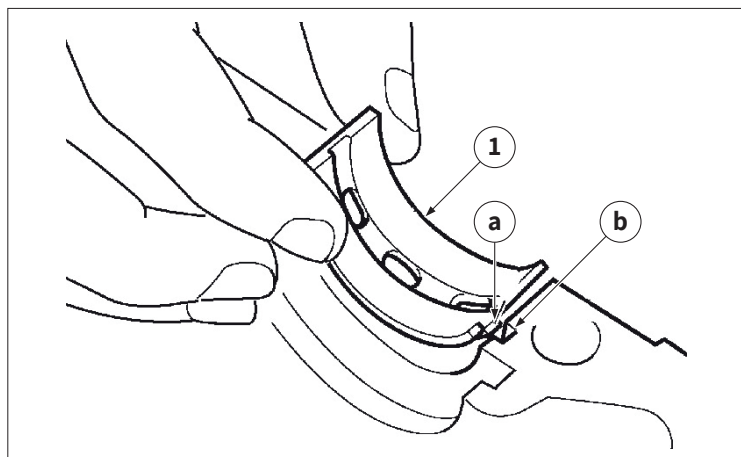
Bearing size = "J1" (crankcase) - "J1" (crank arm) - 2.

- ① For example, if the numbers on the crankcase "J1" and crank arm "J1" are 5 and 3 respectively, the bearing size for "J1" is: 5 - 3 - 2 = 0 (white-pink).



Bushing colour code

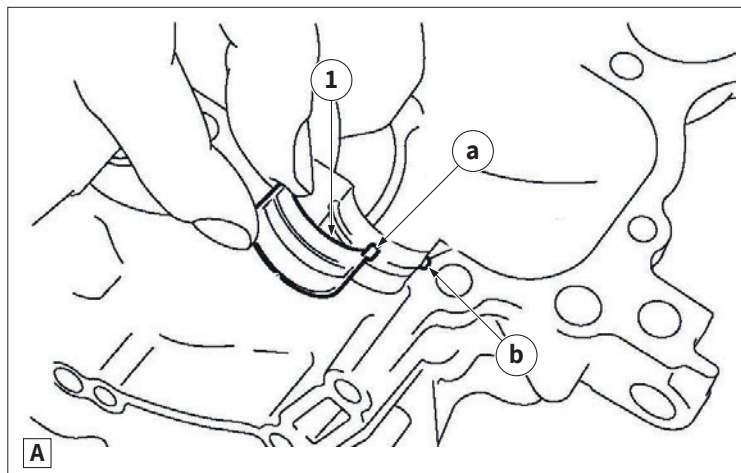
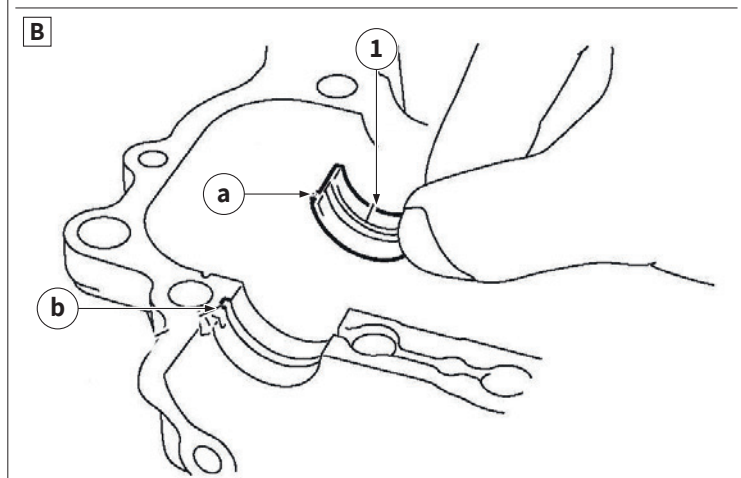
- Model identification colour: Pink;
- Code -1: Purple;
- Code 0: White;
- Code 1: Blue;
- Code 2: Black;
- Code 3: Brown.



13.16.5 Crankshaft installation

- Install the upper crankshaft journal bearings in the upper crankcase and the lower bearings in the lower crankcase, aligning bearing protrusions "a" to bearing notches "b" on the crankcase.

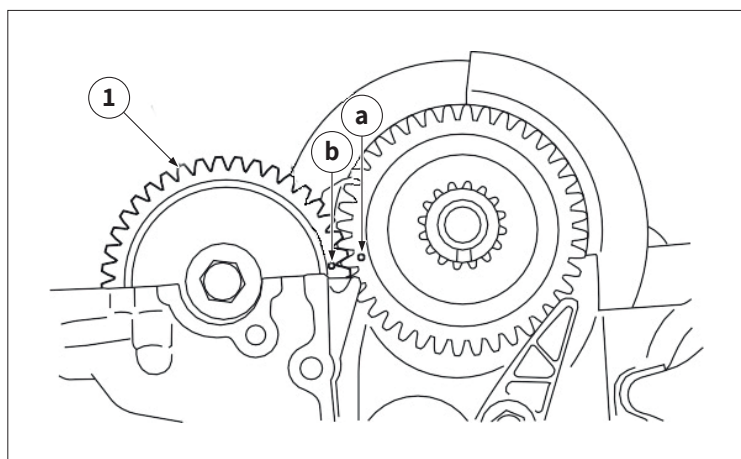
- ① Be sure to install each bearing in its original position.


A

B
13.16.6 Balancer countershaft unit installation

- Install the upper countershaft journal bearings in the upper crankcase and the lower bearings in the lower crankcase, aligning bearing protrusions "a" to bearing notches "b" on the crankcase.

i Be sure to install each bearing in its original position.

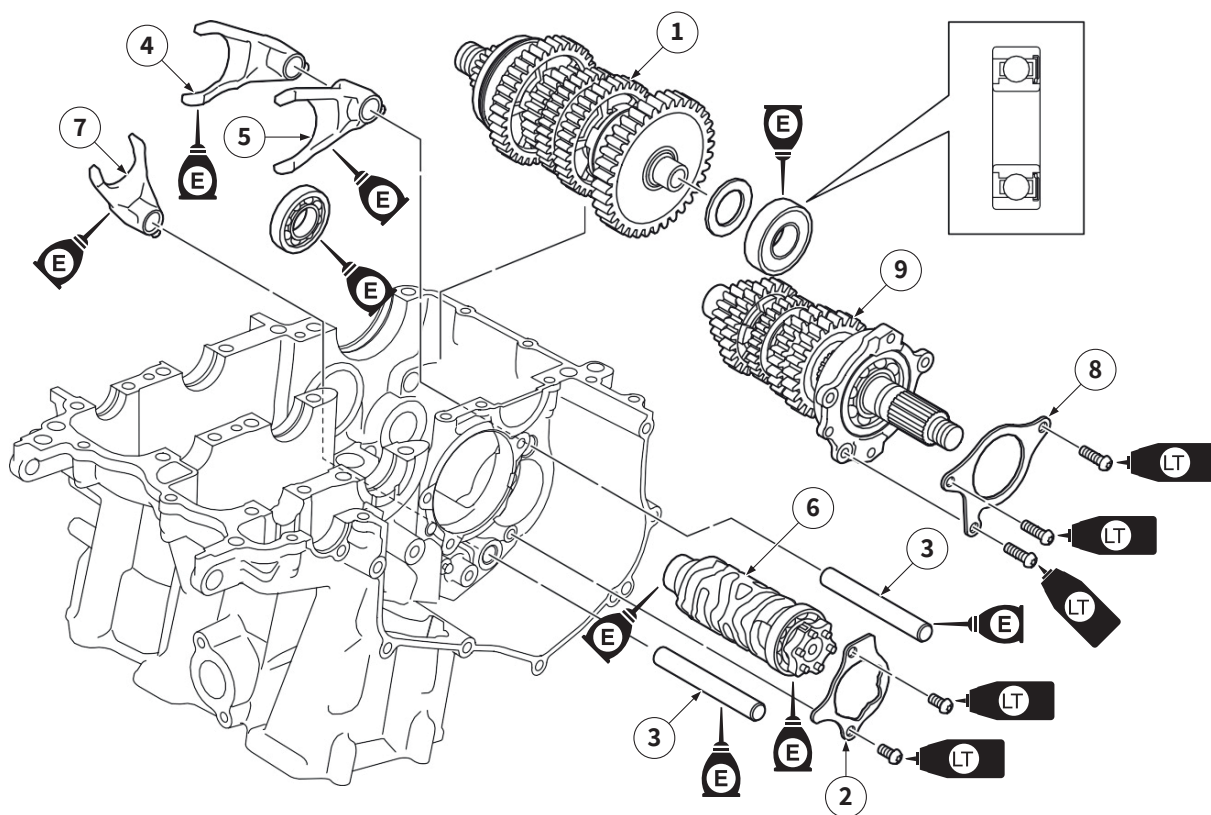
- A. Upper crankcase;
- B. Lower crankcase.



- Install the balancer countershaft "1" by aligning punch "a" on the balancer transmission gear with punch "b" on the balancer drive gear.

13.17 TRANSMISSION

Removal of transmission, gear selector drum unit and gear shift forks

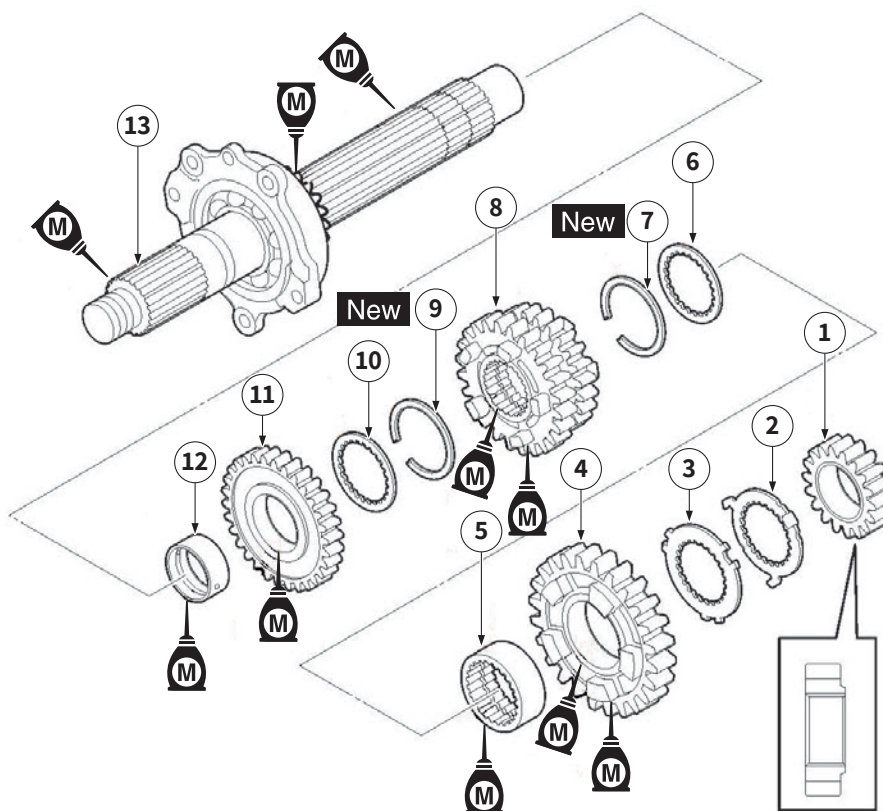


Preliminary operations:

- Separate the engine crankcases (as described on page 209).

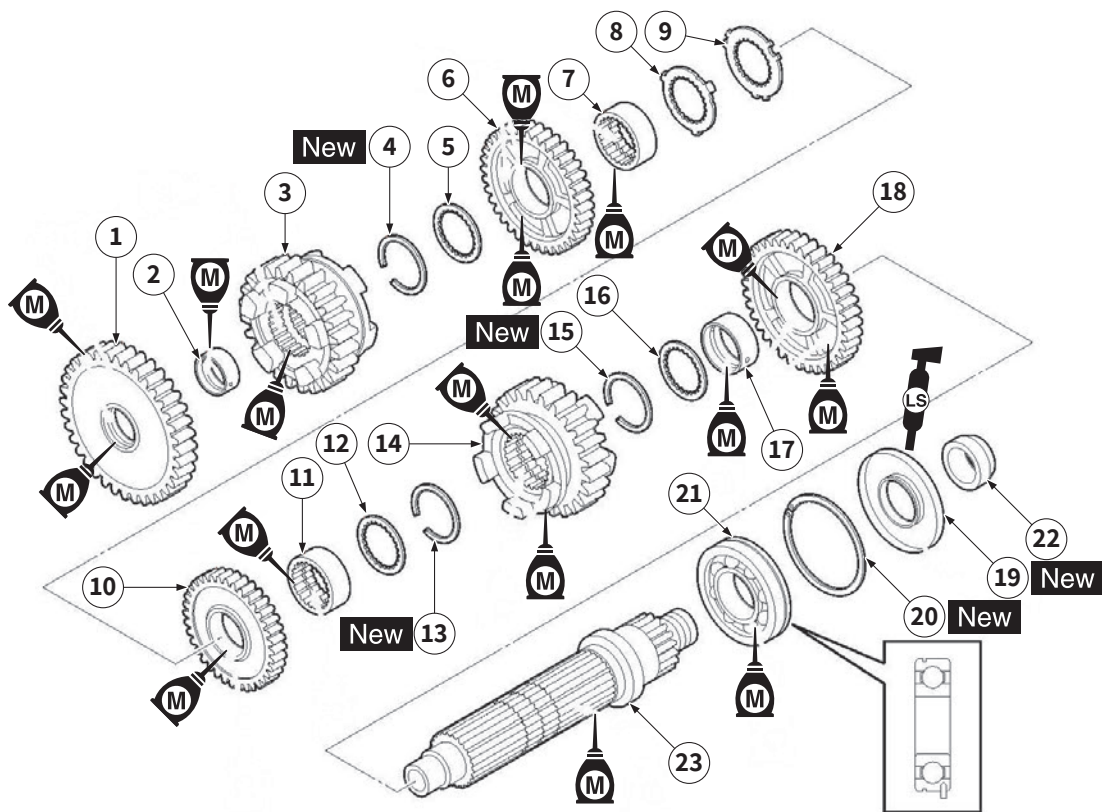
Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Secondary shaft unit	1	
2	Gear selector drum fastener	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
3	Shift fork guide bar	2	
4	Gear shift fork "L	1	
5	Gear shift fork "R	1	
6	Gear selector drum unit	1	
7	Gear shift fork "C	1	
8	Bearing retainer	1	12 N•m (1.2 kgf•m, 8.9 lb•ft)
9	Complete primary shaft	1	

Complete primary shaft disassembly

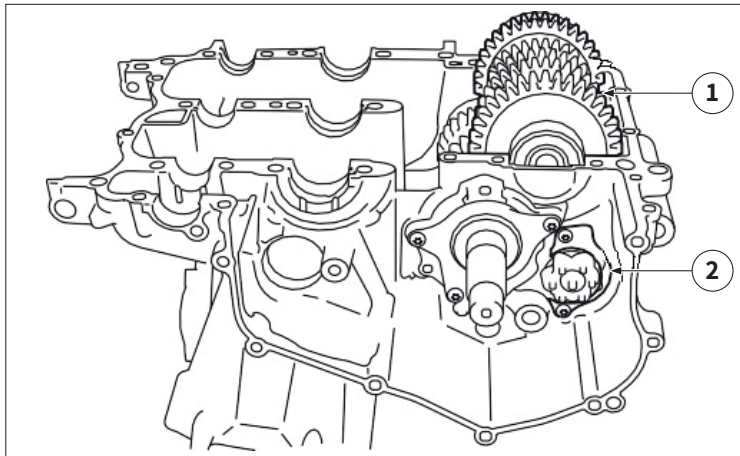


Sequence	Operation/Components to be removed	Q.ty	Remarks
1	2nd gear sprocket	1	
2	Toothed lock washer	1	
3	Toothed lock washer retainer	1	
4	6th gear sprocket	1	
5	Collar	1	
6	Washer	1	
7	Retaining ring	1	
8	3rd sprocket	1	
9	Retaining ring	1	
10	Washer	1	
11	5th gear sprocket	1	
12	Collar	1	
13	Primary shaft	1	

Secondary shaft unit disunit

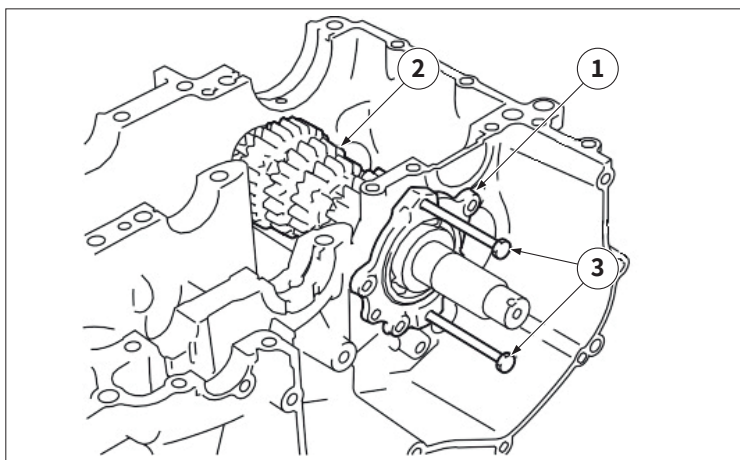


Sequence	Operation/Components to be removed	Q.ty	Remarks
1	1st gear shift	1	
2	Collar	1	
3	5th gear shift	1	
4	Retaining ring	1	
5	Washer	1	
6	3rd gear shift	1	
7	Collar	1	
8	Toothed lock washer	1	
9	Toothed lock washer retainer	1	
10	4th gear shift	1	
11	Collar	1	
12	Washer	1	
13	Retaining ring	1	
14	6th gear shift	1	
15	Retaining ring	1	
16	Washer	1	
17	Collar	1	
18	2nd gear shift	1	
19	Oil seal	1	
20	Retaining ring	1	
21	Bearing	1	
22	Collar	1	
23	Secondary shaft	1	



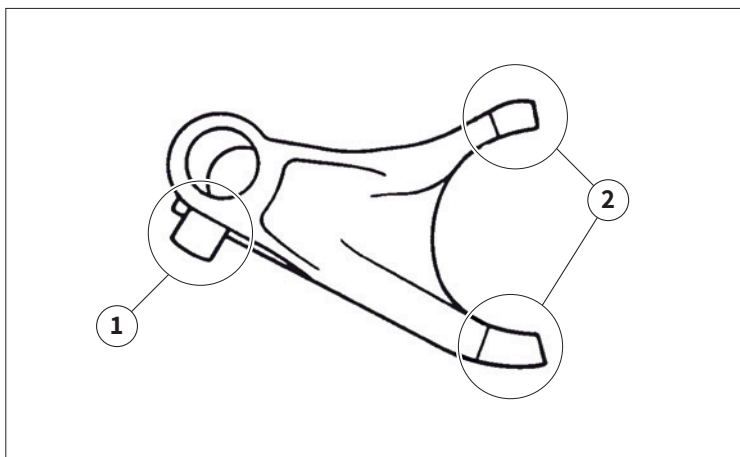
13.17.1 Transmission removal

- Remove the secondary shaft unit "1", gear selector drum retainer "2", gear selector fork guide rod, gear selector fork "L" and "R", gear selector drum unit and gear selector engagement fork "C".



- Remove the bearing retainer and bearing housing of the complete primary shaft "1".
- Remove the complete primary shaft "2" by inserting two bolts "3" of the correct size into the bearing housing and tightening them until it is completely free of the cylinder.

i Ensure that the bolts are in contact with the surface of the crankcase.

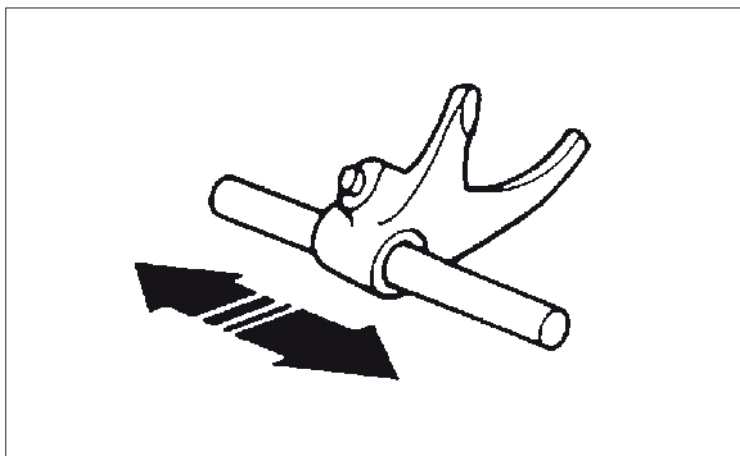


13.17.2 Gear shift forks check

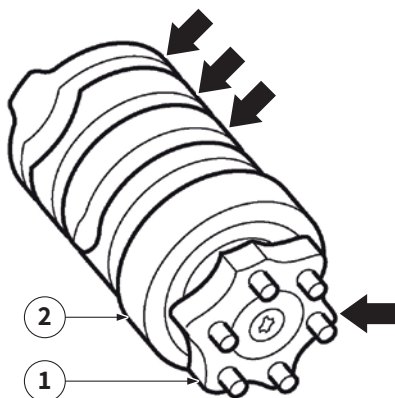
i The following procedure applies to all gear shift forks.

- Check the gear engagement cam roller "1".
- Check the gear engagement fork tooth "2": if it shows bending, damage, scoring or wear, replace the fork.
- Check the guide rod of the gearshift fork by rolling it on a flat surface: if bending is noticed, replace it.

! Do not attempt to straighten the guide rod of the gearshift fork if it is deformed.



- Check the movement of the shifting fork on the guide bar: if the movement is difficult, replace the shifting forks and the guide bar as a whole.



13.17.3 Gear selector drum unit check

- Check the gear selector drum and replace it if:
 - The groove shows damage, scratches or signs of wear;
 - Piston ring "1" shows damage or signs of wear;
 - Bearing "2" shows damage or pitting.



13.17.4 Transmission check

- Measure the misalignment of the primary shaft using a centering device and a comparator "1": if it does not comply with the prescribed values, replace the primary shaft.



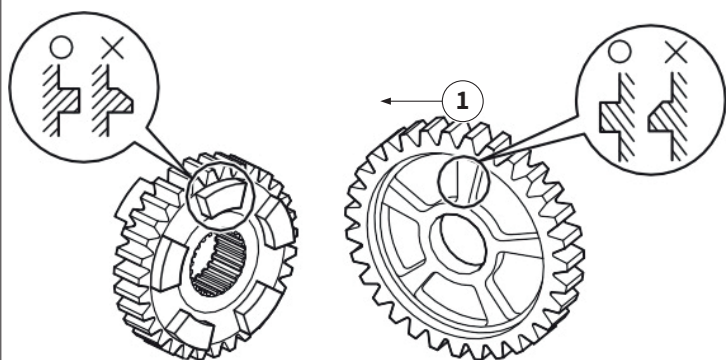
Primary shaft misalignment limit
0.08 mm (0.0032 in).



- Measure the misalignment of the secondary shaft using a centering device and a comparator "1": if it does not comply with the prescribed values, replace the secondary shaft.

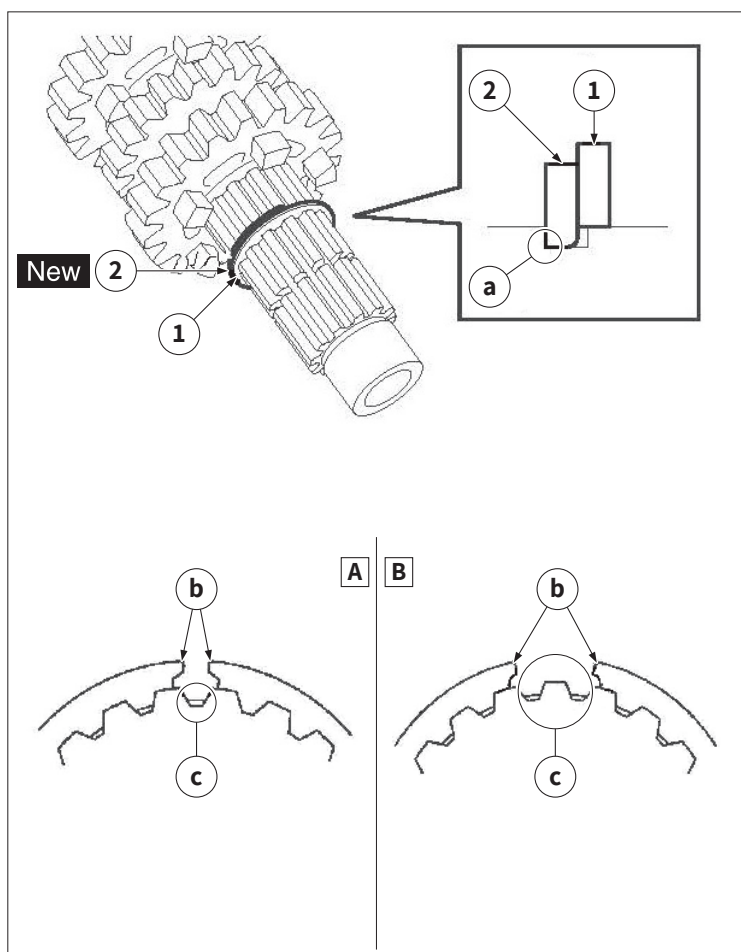


Secondary shaft misalignment limit:
0.08 mm (0.0032 in).



- Check the transmission gears: if they show blue discolouration, pitting or signs of wear, replace the defective gear(s).
- Check the tooth of the transmission gears: if they show cracks, damage or rounded edges, replace the defective gear(s).

- Check that the transmission gears of each sprocket gear are correctly engaged with respect to the respective gearing: if incorrect, reassemble the transmission shaft units.
- Check the movement of the transmission gears: if it is difficult, replace the defective component(s).
- Check the retaining ring: if it is bent, damaged or loose, replace it.

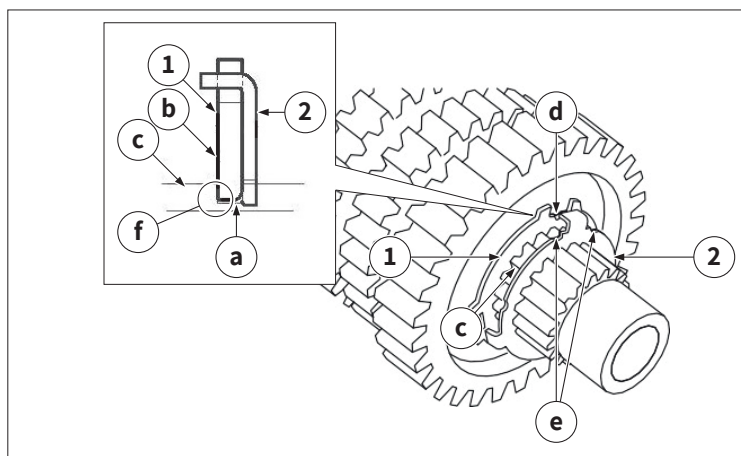


13.17.5 Primary and secondary shaft assembly

- Install the toothed washer "1" and retaining ring "2" by aligning the opening between the ends "b" of the ring with groove "c" of the shaft.

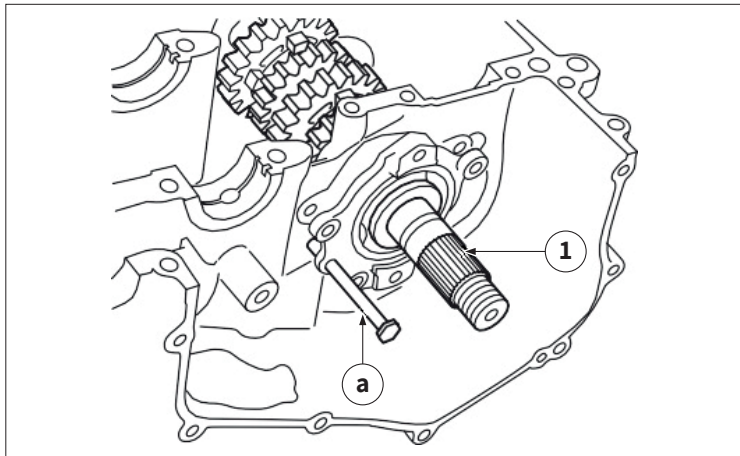
i Ensure that the sharp edge "a" of the retaining ring is positioned on the opposite side of the toothed washer and gear.

- A. Primary shaft
- B. Secondary shaft



- Install the toothed lock washer retainer "1" in groove "a" of the shaft, align projection "b" of the retainer with groove "c" of the shaft, then install toothed lock washer "2" by aligning the projection between alignment notches "e" with alignment notch "d" of the retainer.

i Ensure that the sharp edge of the toothed lock washer catch "f" is positioned on the opposite side of the washer.



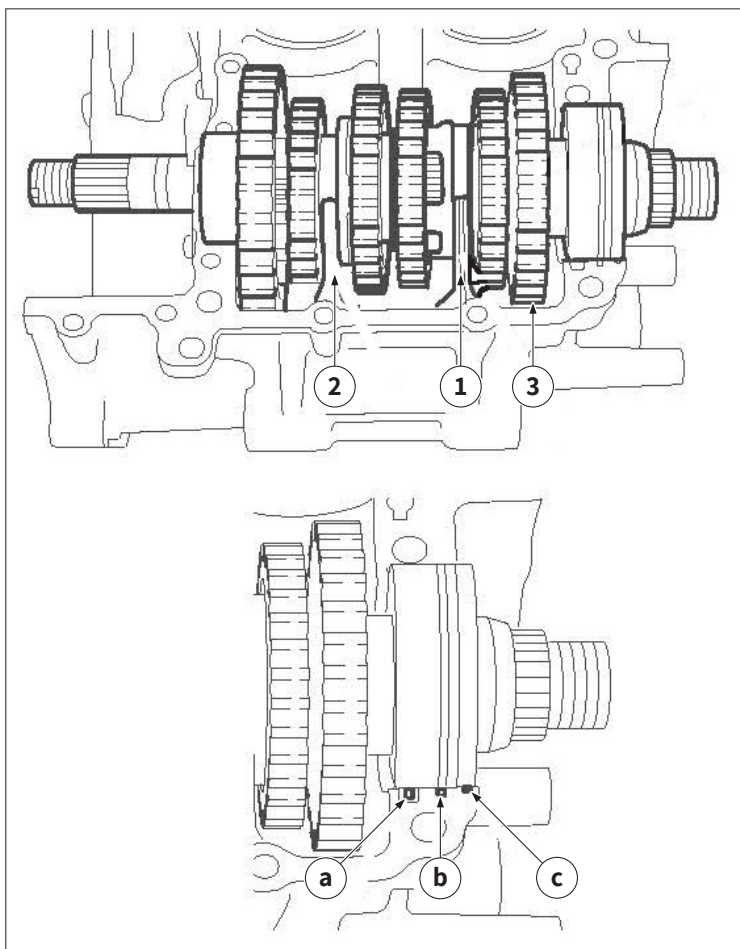
13.17.6 Transmission installation

- Install the complete primary shaft "1" and the bearing retainer.

 **Tightening torque**
Bearing retainer bolt:
 12 N·m (1.2 kgf·m, 8.9 lb·ft)

 **Apply LOCTITE® threadlock to the fastening bolts of the retainer.**

 **Use a suitable "a" pin to position the bearing housing and install it until it touches the cylinder.**



- Install the gearshift engagement fork "C" in the 3rd sprocket groove on the primary shaft, gear selector drum unit and gearshift fork guide bar.

 **The reference projections on the forks must face the right side of the engine.**

- Install the gearshift engagement fork "L" "1" in the 6th gear groove and gearshift engagement fork "R" "2" in the 5th gear groove of the output shaft.

- Install the gearshift fork guide bar, gear selector drum retainer and output shaft unit "3".

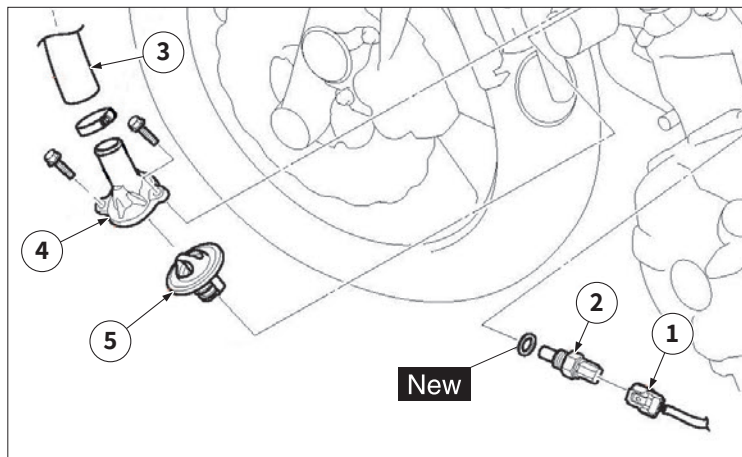
 **Ensure that the protrusion "a" of the output shaft unit is engaged in the notch of the cylinder.**

 **Ensure that the circlip "b" of the output shaft bearing and the flange "c" of the oil seal are inserted in the grooves of the cylinder.**

- Check the transmission: if the movement is irregular, repair it.

 **Thoroughly lubricate each gear, shaft and bearing.**

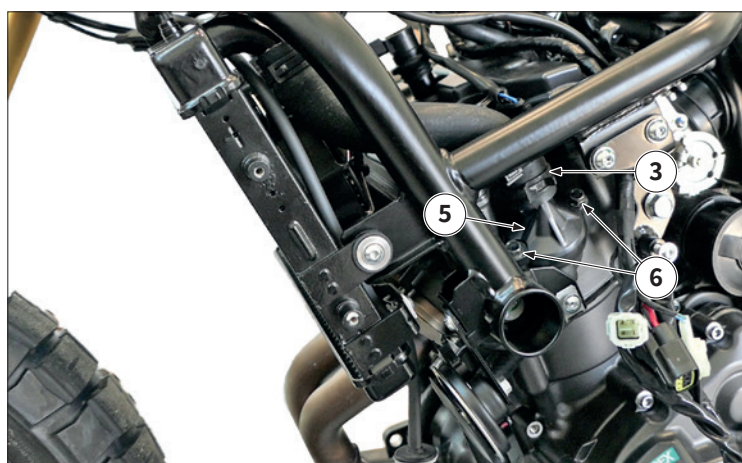
 **Recommended lubricant: engine oil.**



13.18 THERMOSTAT

13.18.1 Thermostat removal

- i** Before removing the thermostat, the engine cooling system must be drained (as described on page 141).



Disconnect sleeve "3";

Remove the two screws "6" and thermostat "5".

- i** Proceed in the reverse order for reassembly.

- Tightening torques**
Thermostat screws: 12 Nm (1.2 m·kgf, 8.9 ft·lbf);

13.18.2 Coolant temperature sensor removal

Preliminary operations:

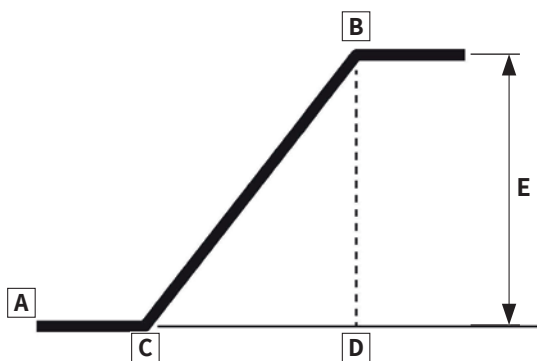
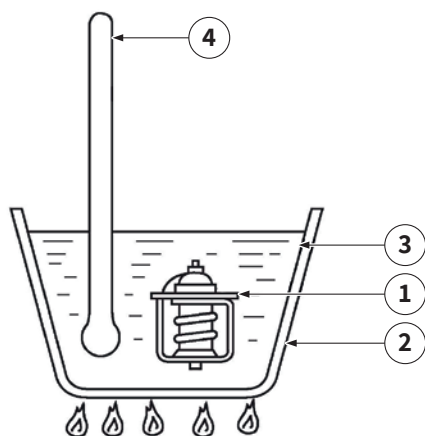
- Empty the engine cooling system (as described on page 141);
- Remove the tank (as described on page 106);
- Remove the canister filter (as described on page 254).

Disconnect the coolant temperature sensor connector "1";

Remove the coolant temperature sensor "2".

- i** Proceed in the reverse order for reassembly.

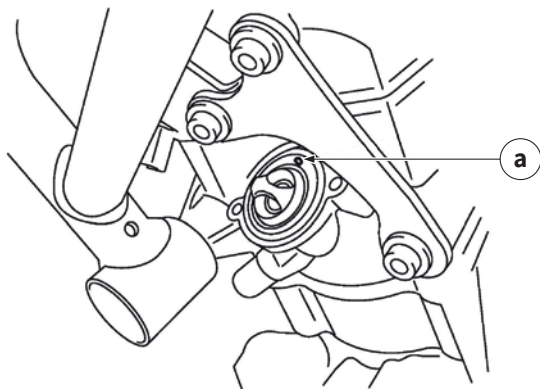
- Tightening torques**
Coolant temperature sensor: 15 Nm (1.5 m·kgf, 11 ft·lbf);



13.18.3 Thermostat check

- Check the thermostat "1" by carrying out the following procedure:
 - Keep it suspended in a container "2" filled with water;
 - Heat the water "3" slowly;
 - Dip a thermometer "4" into the water;
 - While stirring the water, observe the temperature indicated by thermometer and thermostat: if it does not open at 80-84 °C (176-183.2 °F), replace it.

A	Completely closed
B	Completely open
C	80–84 °C (176–183.2 °F)
D	95 °C (203 °F)
E	8 mm (0.31 in)



- i** If there are doubts about the accuracy of thermostat, replace it. A defective thermostat can cause dangerous overheating or excessive cooling.

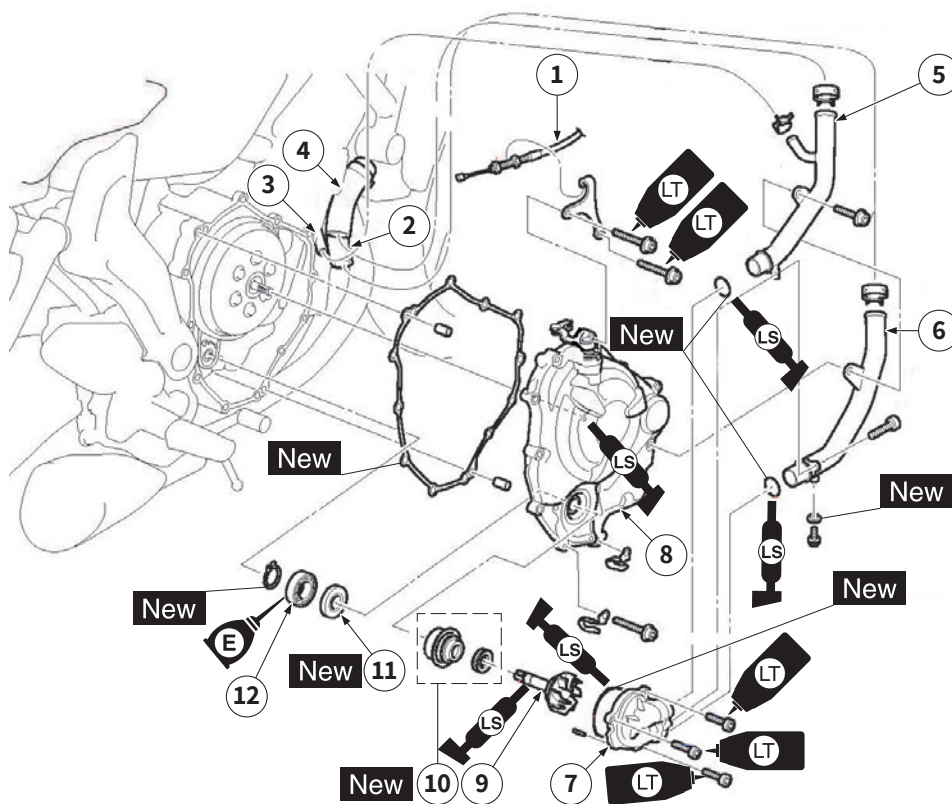
- Check thermostat cover: if it is cracked or damaged, replace it.

13.18.4 Thermostat installation

- Install the thermostat with vent valve "a" facing inwards.
- Fill the cooling system with the prescribed amount of recommended coolant, referring to "12.20.5 Coolant change." on page 141.
- Check the cooling system: if leaks or breaks are present, repair damaged parts or replace any defective components.
- Measure the opening pressure of the radiator cap: if it is below the prescribed pressure, replace the cap referring to "9.2 Coolant level check" on page 28.

13.19 WATER PUMP

Water pump removal



Preliminary operations:

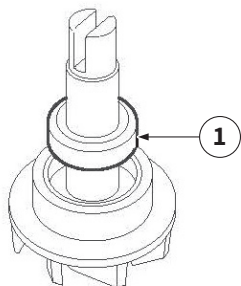
- Drain the coolant (as described on page 141);
- Drain the Engine Oil (as described on page 153).

Sequence	Operation/Components to be removed	Q.ty	Remarks
1	Clutch cable	1	Disconnect. 7 N•m (0.7 kgf•m, 5.2 lb•ft)
2	Water pump outlet tube	1	Disconnect.
3	Oil radiator outlet tube	1	Disconnect.
4	Radiator outlet coupling	1	Disconnect.
5	Water pump inlet tube	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
6	Water pump outlet tube	1	Tube fastening = 10 N•m (1.0 kgf•m, 7.4 lb•ft) Cap = 7 N•m (0.7 kgf•m, 5.2 lb•ft)
7	Water pump housing	1	10 N•m (1.0 kgf•m, 7.4 lb•ft)
8	Clutch crankcase	1	12 N•m (1.2 kgf•m, 8.9 lb•ft)
9	Impeller shaft	1	
10	Water pump gasket unit	1	
11	Oil seal	1	
12	Bearing	1	

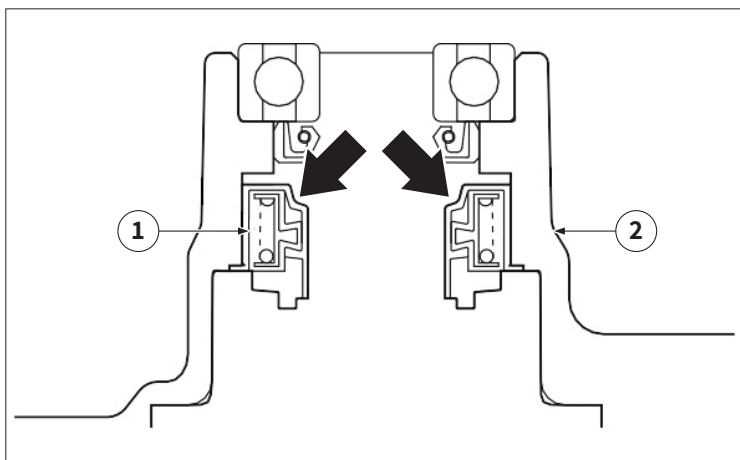
13.19.1 Water pump disassembly

- Remove the mechanical seal (impeller side) "1" from the impeller with a thin flathead screwdriver.

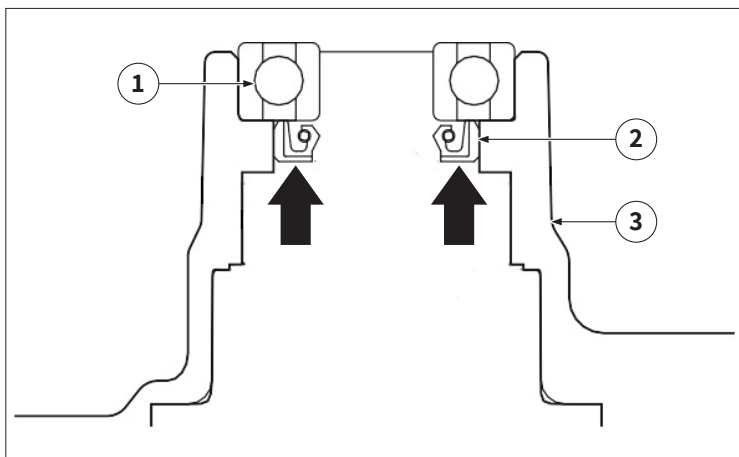
i Do not scratch the impeller shaft.



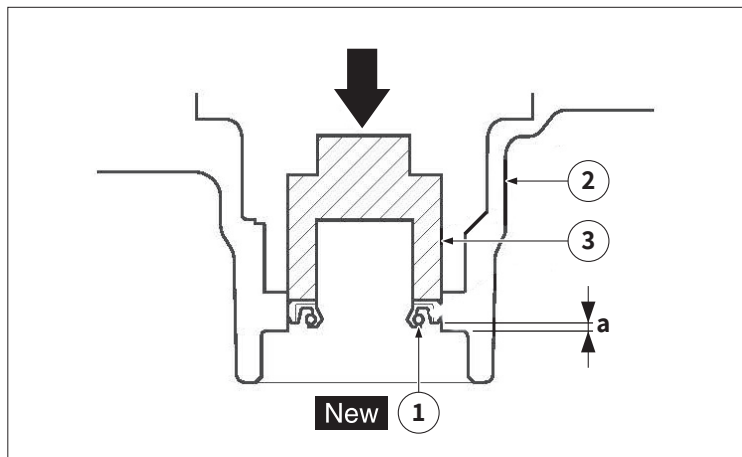
- Remove the mechanical seal (housing side) "1" from the inside of the clutch housing "2".



- Remove bearing "1" and oil seal "2" from the outside of clutch housing "3".


13.19.2 Water pump check

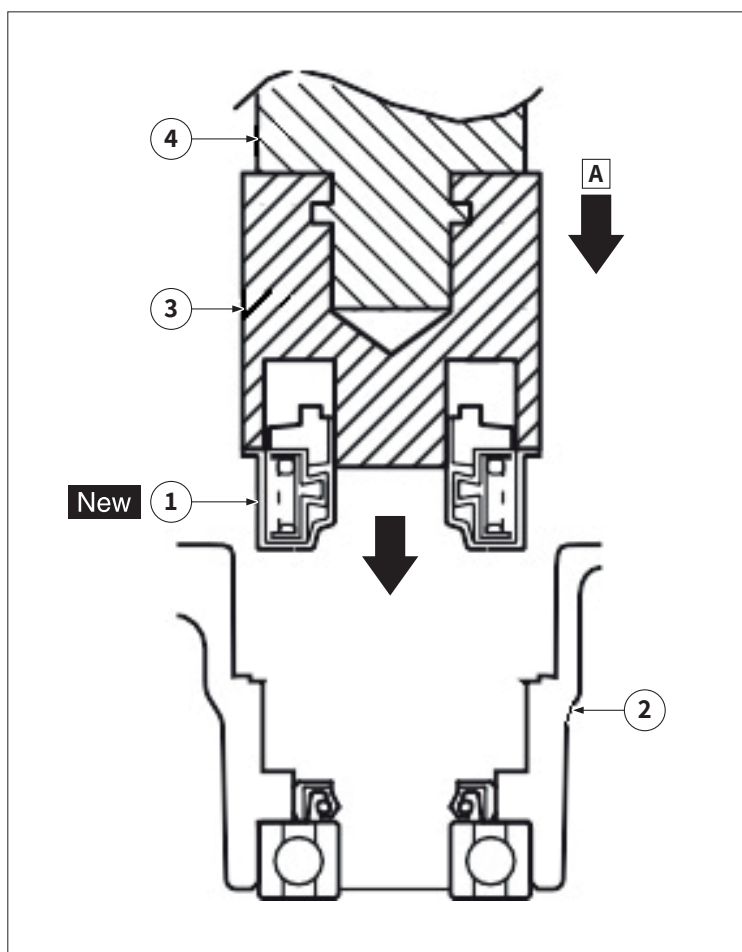
- Check the water pump housing, clutch housing and impeller shaft: if they show cracks, damage or wear, replace them.
- Check the movement of the bearing: if it is difficult, replace it.
- Check the water outlet and inlet tubes: if they are damaged or cracked, replace them.



13.19.3 Water pump assembly

- Install the oil seal "1" using a socket spanner "3" corresponding to its outer diameter and the bearing in the clutch housing "2".

✖ Installation depth of oil seal "a":
 0.5–1.3 mm (0.02–0.05 in).



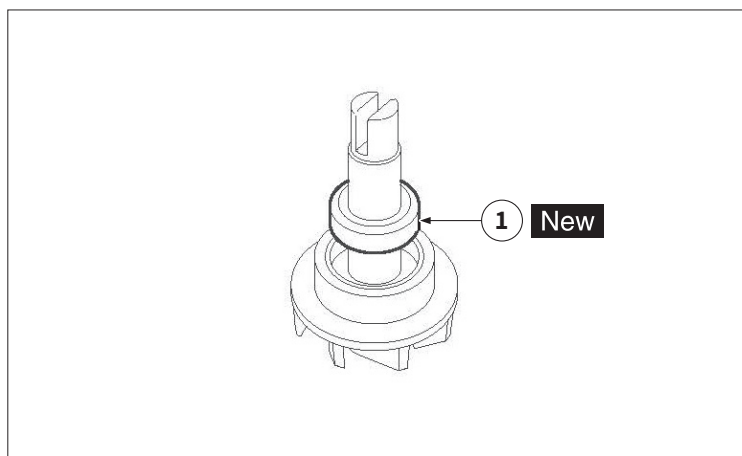
- Install the mechanical seal (housing side) "1" in the clutch housing "2".

⚠ Never lubricate the surface of the mechanical seal (housing side) with oil or grease.

ⓘ Use special tools and a press to press the mechanical seal (housing side) straight in until it touches the clutch crankcase.

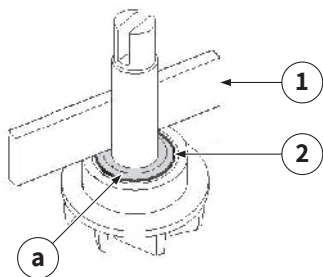
- ✖** - Mechanical seal installation tool (ø33);
- Centre duct shaft bearing installer;
- Centre duct bearing installer 40 & 50 mm.

- 3. Mechanical seals installer;
- 4. Central shaft bearing installer;
- A. Push down.



- Install the mechanical seals (impeller side) "1".

ⓘ Before installing the mechanical seal (impeller side), pour tap water or coolant onto its outer surface.



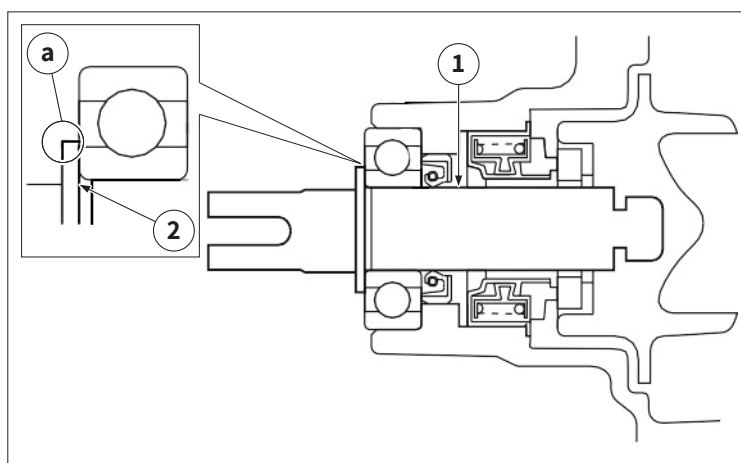
– Measure the mechanical seal (impeller side): if it does not comply with the prescribed values, install it again and then measure again.

⚠ Ensure that the mechanical seal (impeller side) is flush with the impeller.

i If surface "a" of the mechanical seal (impeller side) that is in contact with the mechanical seal (housing side) is dirty, clean it.

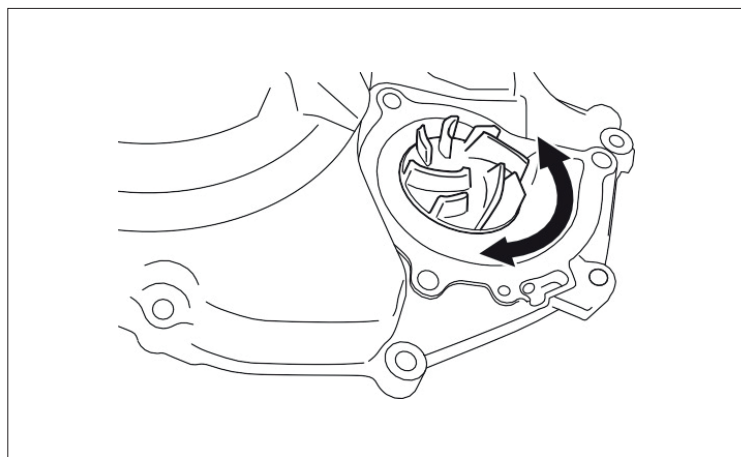
✂ Mechanical seal (impeller side): 0.15 mm (0.006 in).

- 1. Reference line;
- 2. Impeller.

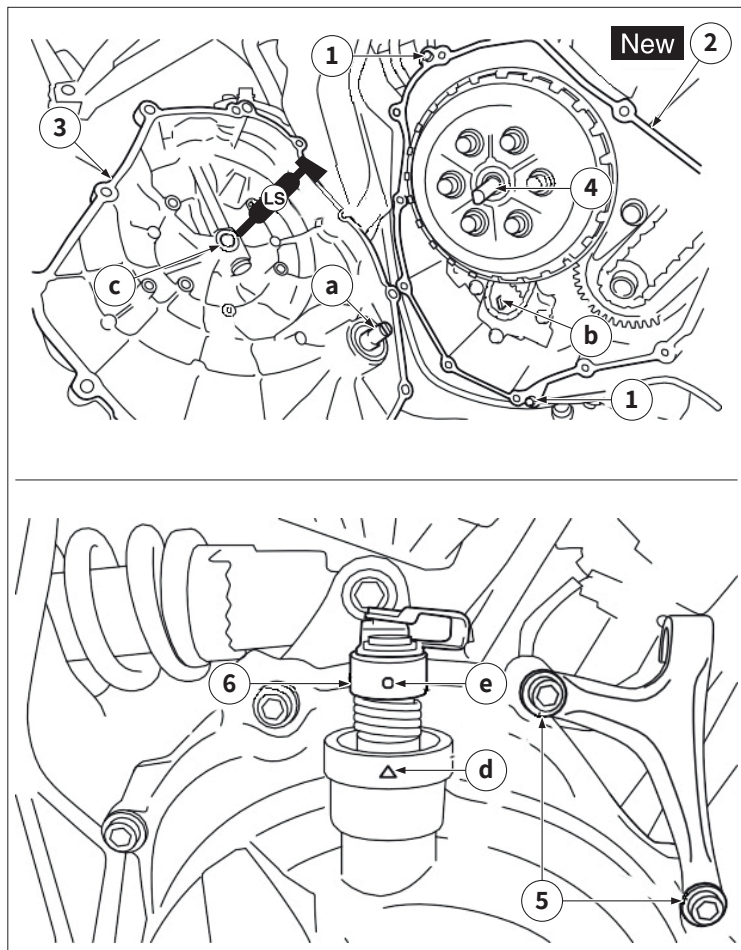


– Install the impeller shaft "1" and safety retaining ring "2".

i Ensure that the sharp edge of the retaining ring "a" is positioned on the opposite side of the bearing.



i After the installation, check that the impeller shaft rotates smoothly.



13.19.4 Clutch housing installation

- Install the centring pin "1", clutch housing gasket "2" and clutch housing "3".



Tightening torques

- Clutch housing bolt: 12 N·m (1.2 kgf·m, 8.9 lb·ft);
- Clutch cable support bolt: 12 N·m (1.2 kgf·m, 8.9 lb·ft)



- Only apply LOCTITE® threadlocker to the threads of the clutch cable support bolts "5".



- Align slot "a" in the impeller shaft with protrusion "b" in the oil pump sprocket.



- Turn back the streaks on the clutch pull rod "4" and align the rod with hole "c" in the clutch housing.

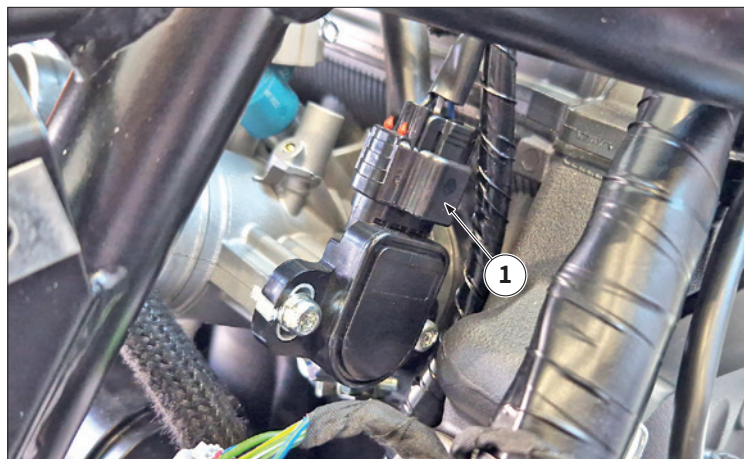


- Tighten the bolts gradually and crosswise.



- After installing the clutch housing, make sure that the alignment notch "d" on the housing is aligned with punch "e" on release lever "6".

- Fill the cooling system with the prescribed amount of recommended coolant, referring to paragraph "12.20.5 Coolant change." on page 141.
- Check the cooling system: if there are leaks, repair or replace the defective components, if any.
- Measure the opening pressure of the radiator cap: if it is below the prescribed pressure, replace the cap.
- Adjust the clutch lever clearance by referring to section "9.9 Clutch lever clearance" on page 31.

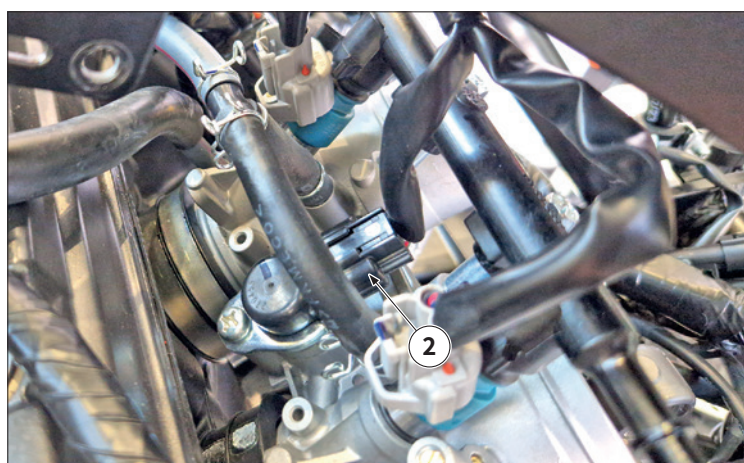


13.20 THROTTLE BODIES

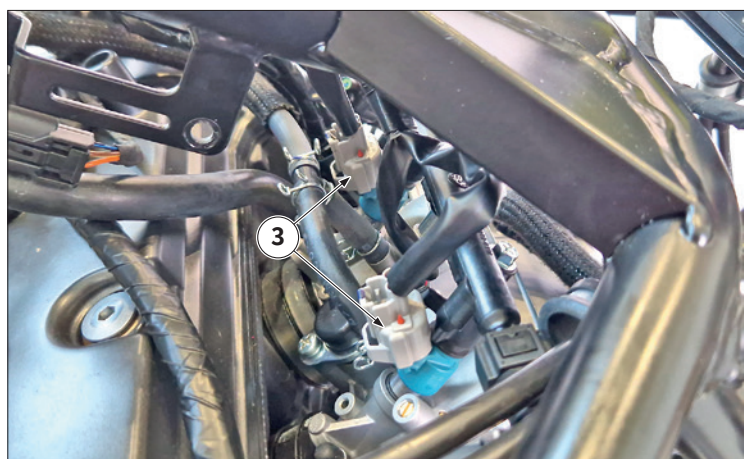
13.20.1 Throttle body removal

Remove:

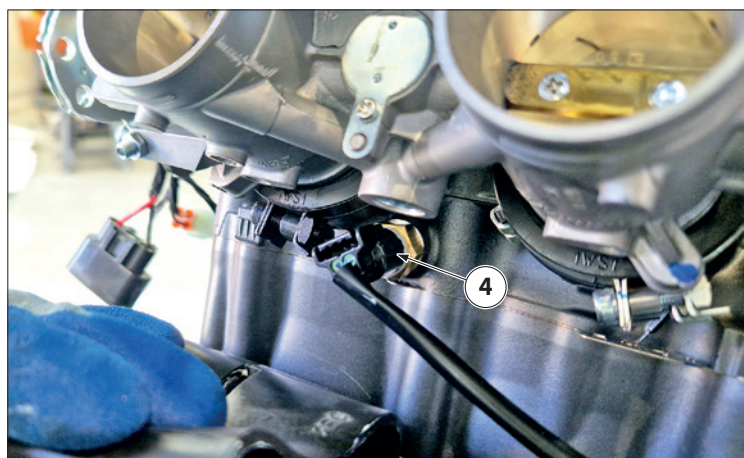
- Complete tank, refer to "12.8 Fuel tank removal" on page 202.
- Filter casing, refer to "12. Filter casing removal" on page 202.
- Canister filter, refer to "12. Canister filter removal" on page 202.
- Disconnect connector "1" of the TPS sensor.



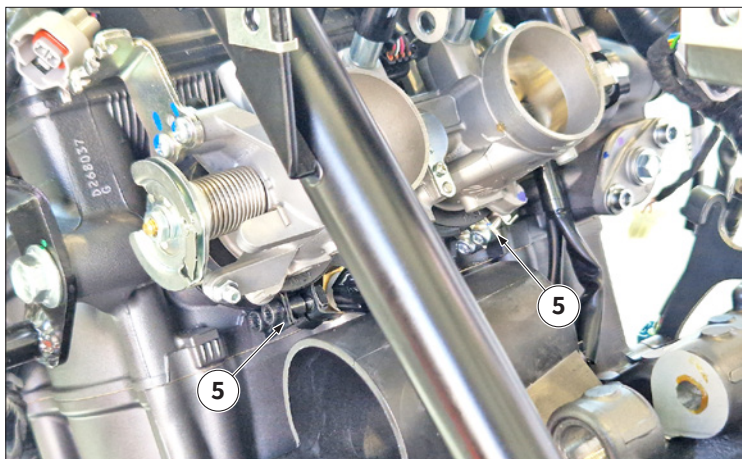
- Disconnect connector "2" of the ISC (idle speed regulation) valve.



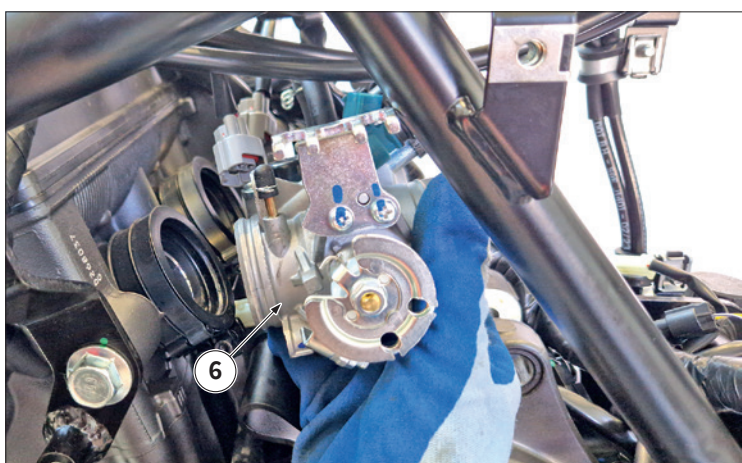
- Disconnect the "3" connectors of the two petrol injectors.



- Disconnect connector "4" engine temperature sensor.

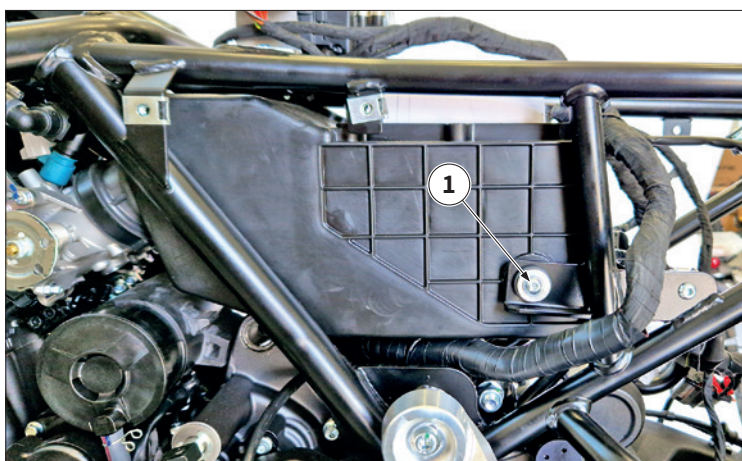


- Loosen the two screw clamps "5".



- Remove the throttle body "6" from the manifolds.

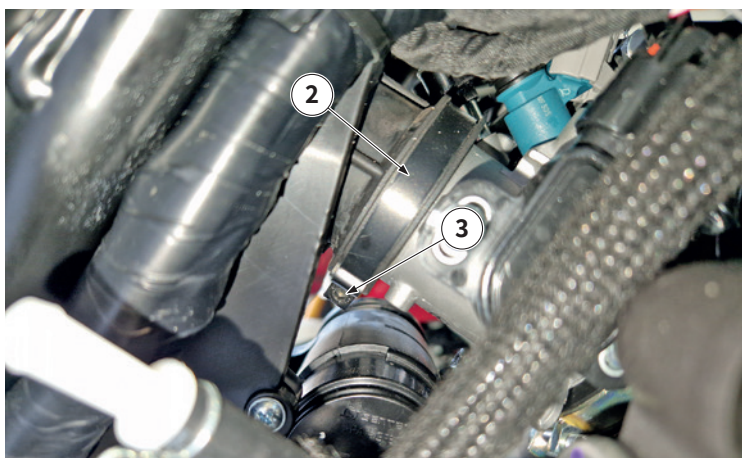
i Proceed in the reverse order for reassembly.



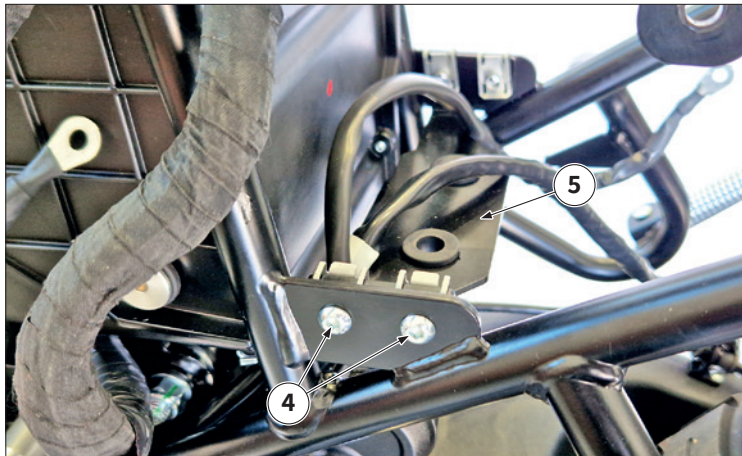
13.20.2 Filter casing removal

Preliminary operations:

- Remove the complete tank (as described on page 106);
- Remove the side panels (as described on page 104);
- Remove the battery compartment (as described on page 146);
- Remove the air filter (as described on page 105);
- Remove the two screws "1" with their washers (one on each side).



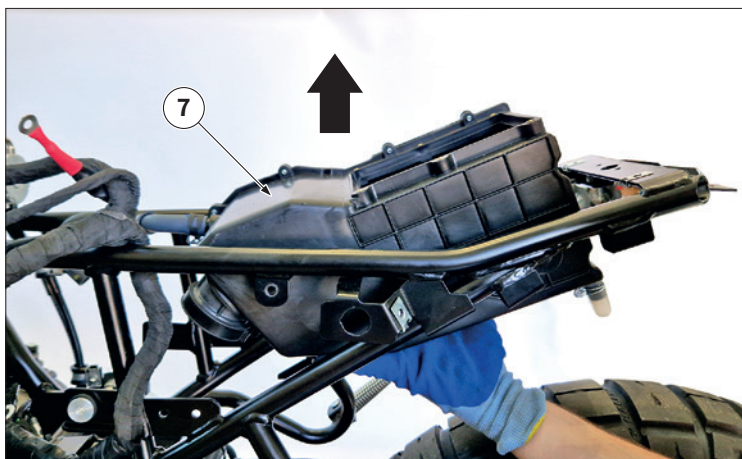
- Loosen the two intake manifold clamps "2" (one on each side) by unscrewing screws "3".



- Remove the four screws "4" (two on each side) and remove bracket "5" from the vehicle.



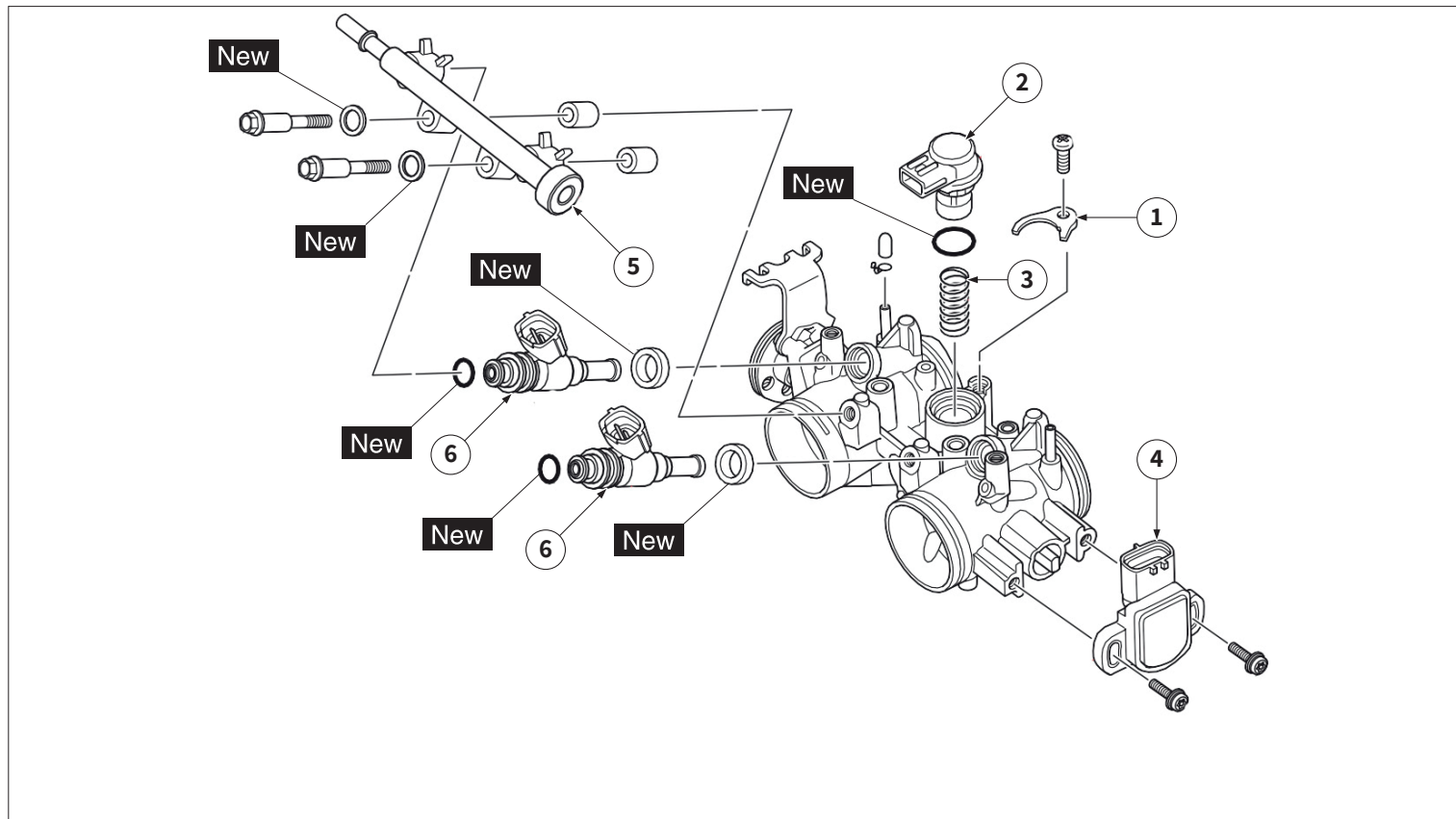
- Disconnect the vapour recovery tube of the head "6".



- Remove the filter casing "7" from the vehicle.

i Proceed in the reverse order for reassembly.

Fuel injectors removal



Sequence	Operation/Components to be removed	Q.ty	Remarks
1	ISC (idle speed control) valve plate	1	5 N•m (0.5 kgf•m, 3.7 lb•ft)
2	ISC valve (idle speed control)	1	
3	Spring	1	
4	Throttle valve position sensor	1	3.5 N•m (0.35 kgf•m, 2.6 lb•ft)
5	Fuel supply manifold	1	3.5 N•m (0.35 kgf•m, 2.6 lb•ft)
6	Fuel injector	2	

13.20.3 Injectors preliminary check

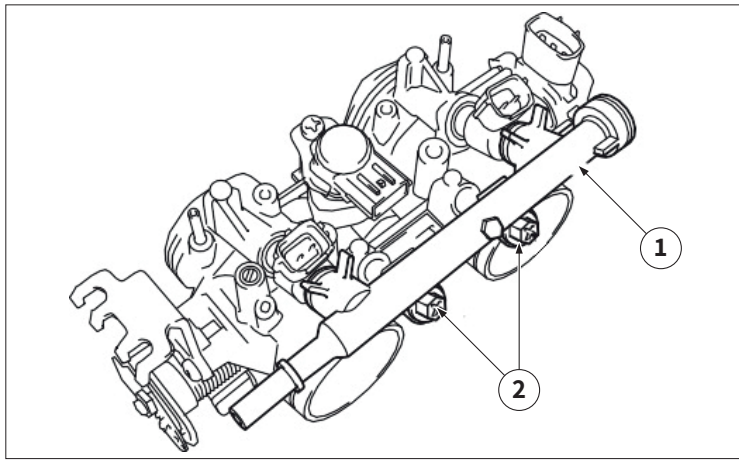
- Connect the diagnostic tool to the vehicle (as described on page 101);
- Disconnect the petrol pump connector beforehand;
- Perform the injector drive diagnostic tests (test numbers 36 and 37) using the diagnostic tool;
- Check that the injectors are working properly, then reconnect the petrol pump and disconnect the diagnostic tool.

i Check that each injector is operated five times, listening for the noise of operation.

13.20.4 Injector removal

! Check the injectors in a well-ventilated area free of combustible materials; ensure that there are no fumes and that no electric tools are used near the injectors.

! Turn the ignition switch to "OFF" and disconnect the negative battery cable from the terminal before removing the injectors.



! Be careful when disconnecting the petrol hose, any residual pressure could cause fuel sprays. Place a container or cloth under the hose to catch possible fuel spills. Clean up any fuel spills immediately.

- Remove bolts "1" and fuel supply manifold "2".

13.20.5 Injectors check

Check the injectors: if clogged, replace them and check the fuel pump and fuel system; if they have deposits or damage, replace them.

Check the resistance value of the injectors:

- Disconnect the petrol injector connectors;
- Connect the probes of a digital multimeter to the connector poles of each of the two injectors;
- Check that the value complies with the prescribed values, otherwise replace the fuel injector (as described on page 249).

✂ Fuel injector terminal resistance value : 12.0 Ω.

✂ Digital multimeter.

13.20.6 Throttle body check

! If throttle bodies are subjected to heavy impacts or fall to the ground during inspection, replace them.

i Before checking the throttle bodies, check the following items:

- Valve clearance;
- Spark plugs;
- Filter element;
- Throttle body couplings;
- Fuel tube;
- Exhaust system;
- Cylinder head breather tube;
- Vacuum tubes.

- Check throttle bodies: if they are cracked or damaged, replace them.

13.20.7 ISC (idle speed control) valve cleaning

– Remove the throttle bodies from the vehicle.

- ⓘ **Before removing the throttle bodies, disconnect all throttle cables and connectors.**

Throttle body cleaning

- ⚠ **Observe the following precautions to avoid malfunctioning throttle bodies.**

- ⚠ **Do not open throttle valves quickly.**

- ⚠ **Do not subject throttle bodies to excessive pressure.**

- ⚠ **Wash the throttle bodies with a petroleum-based solvent.**

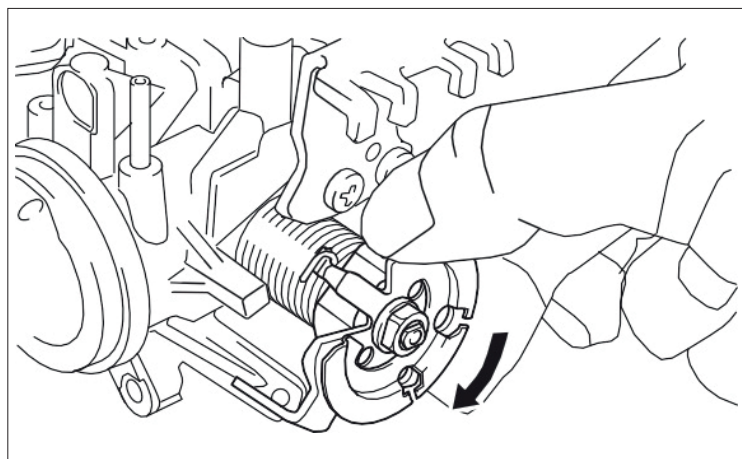
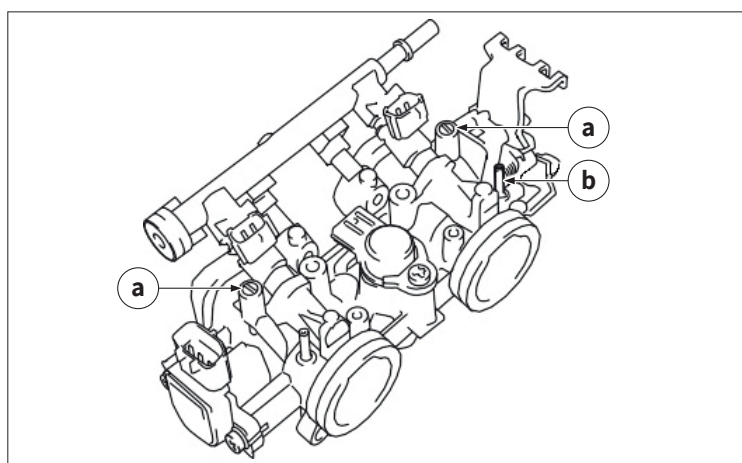
- ⚠ **Do not use corrosive carburettor cleaning solutions.**

- ⚠ **Do not apply cleaning solvent directly on plastic components, sensors or oil seals.**

- ⚠ **To open throttle valves, do not press them directly.**

- ⚠ **Do not turn bypass air screws "a". Failure to do so will adversely affect the synchronisation of the throttle bodies.**

- Place the throttle bodies on a flat surface with the filter casing side up;
- Install the cap on fitting "b";



- Push the lever in the direction shown in the figure to hold the throttle valves in the open position;

- ⚠ **When cleaning the throttle bodies, take care not to injure yourself with the throttle valves or other throttle body components.**

- ⚠ **Do not use tools to open throttle valves or to hold them in the open position.**

- ⚠ **Do not open throttle valves quickly.**

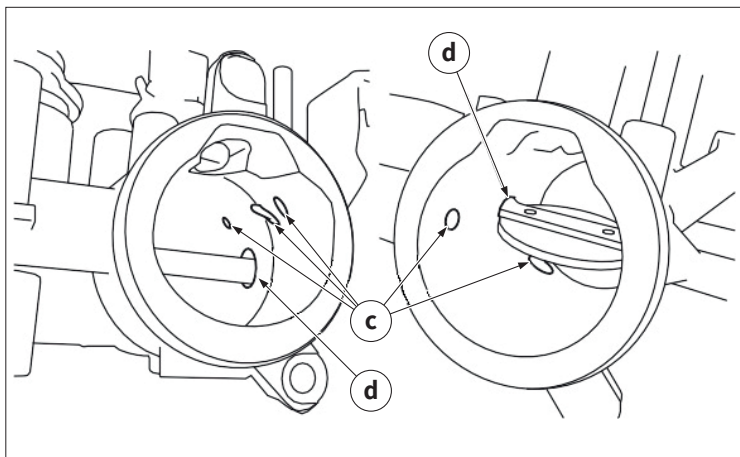
- Apply a petroleum-based solvent to the throttle valves and the inside of the throttle bodies to remove all carbon deposits;

- ⓘ **Ensure that petroleum-based solvent does not penetrate the injector opening.**

- ⓘ **Do not apply petroleum-based solvent to the throttle shaft components between the throttle bodies.**

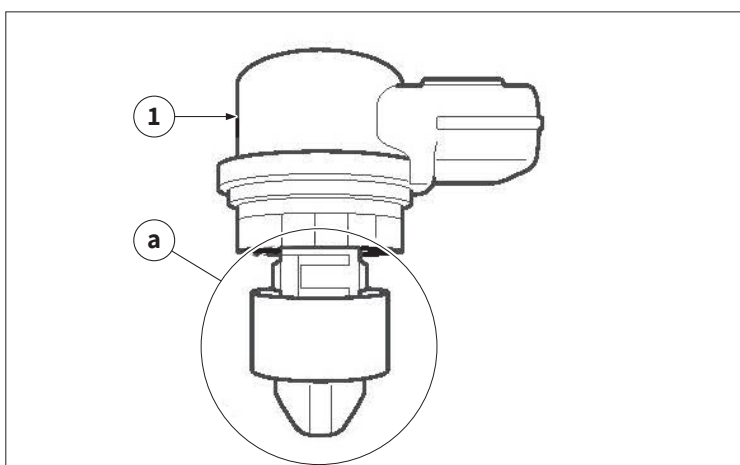
- Remove carbon deposits from the inside of each throttle body by proceeding downwards from the filter casing side of the throttle body to the engine side;

- ⚠ **Do not use tools such as wire brushes to remove carbon deposits. Otherwise, the inside of the throttle bodies could be damaged.**



⚠ **Do not allow carbon deposits or other foreign bodies to penetrate the ducts of each throttle body or the space between the throttle valve shaft and the throttle body.**

- Once the carbon deposits have been removed, clean the inside of the throttle bodies with a petroleum-based solvent, then dry the throttle bodies with compressed air;
- Make sure that no carbon deposits or other foreign bodies are present in any of the ducts "c" of each throttle body or in the space "d" between the throttle valve shaft and the throttle body.



Cleaning the ISC (idle speed control) valve

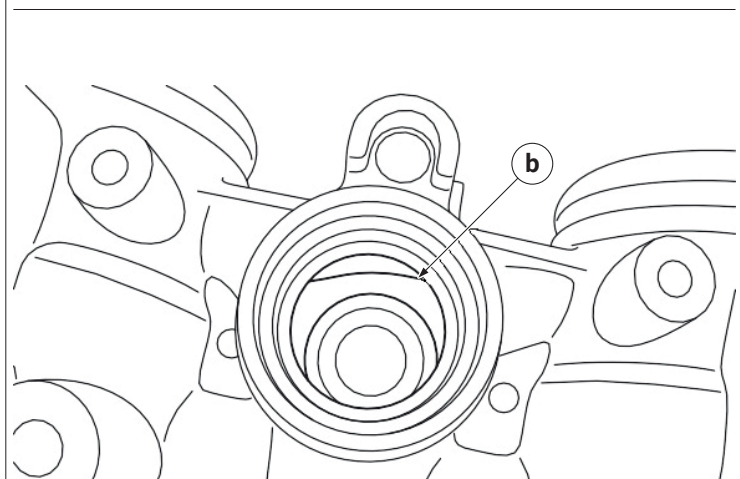
- Remove the plate, the ISC (idle speed control) valve "1" and the O-ring.
- Clean the valve area "a" and the installation hole "b".

♻ **Recommended cleaner: oil and brake cleaner.**

⚠ **Be sure to use the recommended detergent.**

⚠ **Do not spray the cleaner directly onto the ISC valve or throttle bodies or immerse them in it.**

⚠ **To avoid scratching components, do not use brushes, metal files or other abrasive tools.**

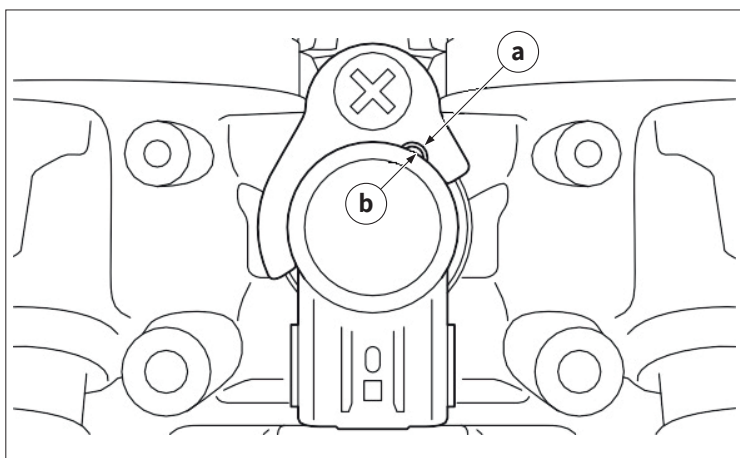


⚠ **Do not clean with compressed air.**

⚠ **Do not allow removed deposits or foreign bodies to adhere to the sealing surfaces of the O-ring.**

⚠ **Do not scratch or deform the ISC valve or air duct; otherwise, you risk impairing starting performance, destabilising the idle speed or throwing off the engine speed.**

⚠ **Clean only the areas indicated. If the cleaning agent sticks to the ISC valve or penetrates the throttle bodies, remove it completely.**



- Install the o-ring, ISC (idle speed control) valve and valve plate, aligning notch "a" on the ISC valve plate with protrusion "b" on the valve.

🔧 **Tightening torque**
ISC (idle speed control) valve plate screw:
5 N·m (0.5 kgf·m, 3.7 lb·ft).

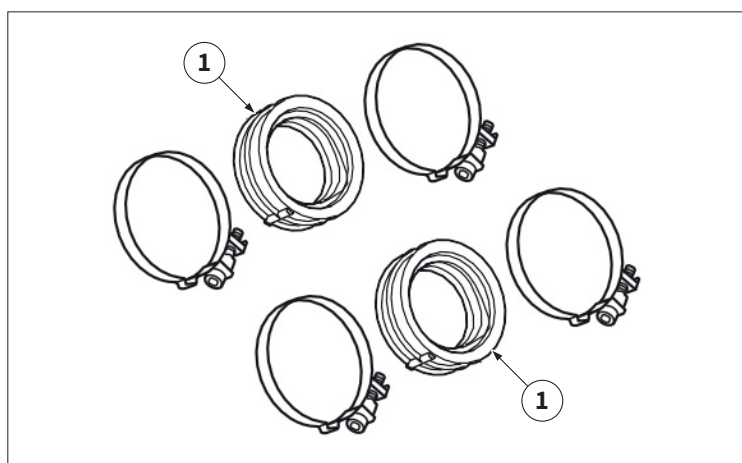
ISC learned values reset (idle speed control)

- Install the throttle body;
- Reset the ISC (idle speed control) learned values by actuating the engine stop switch from "X" to "C" three times within 5 seconds.

- Reset the learned feedback value for O₂_{by} actuating the engine stop switch from "X" to "O" three times in 5 seconds.



- USB diagnostic tool;
- Diagnostic tool (adapter interface).



13.20.8 Throttle body joint check

- Check throttle body joints "1": if they are cracked or damaged, replace them.

13.20.9 Throttle valve position sensor adjustment



Handle the throttle position sensor with extreme caution.



Never subject the throttle position sensor to severe stress. If the throttle position sensor falls down, replace it.

Check the resistance value of the TPS sensor:

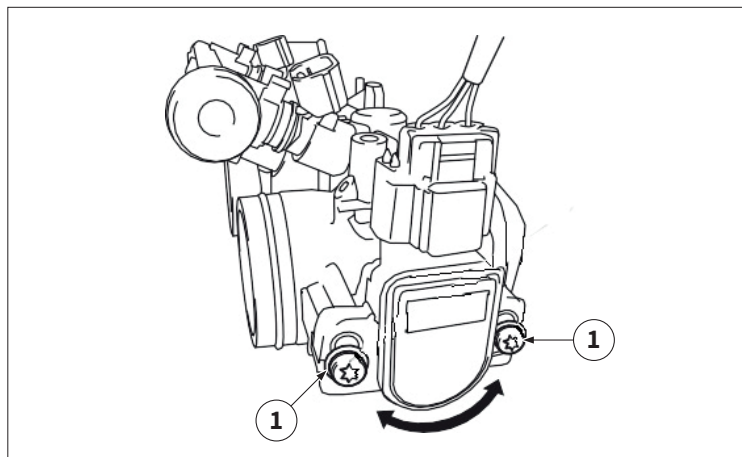
- Disconnect the TPS sensor connector;
- Connect the probes of a digital multimeter to poles 1 and 3 of the TPS sensor connector;
- Check that the value complies with the prescribed values, otherwise replace the fuel injector (as described on page 249).



TPS sensor terminal resistance range : 2.64 ÷ 6.16 Ω.



Digital multimeter.



- Adjust the angle of the throttle position sensor:
 - Provisionally tighten the sensor bolts;
 - Check that the throttle valves are completely closed;
 - Connect the sensor to the electrical wiring;

Digital multimeter.

- Connect the diagnostic tool to the vehicle's OBD port (located in the battery compartment under the seat);
- Run the TPS sensor calibration program;
- After adjusting the sensor angle, tighten bolts "1".

Tightening torque **Throttle valve position sensor screw:** **3.5 N·m (0.35 kgf·m, 2.6 lb·ft).**

13.20.10 Fuel injector installation

 **Always use new o-rings.**

 **When checking injectors, do not allow foreign bodies to adhere to or penetrate the injectors, fuel injection element or o-rings.**

 **Make sure not to twist and crush the o-rings.**

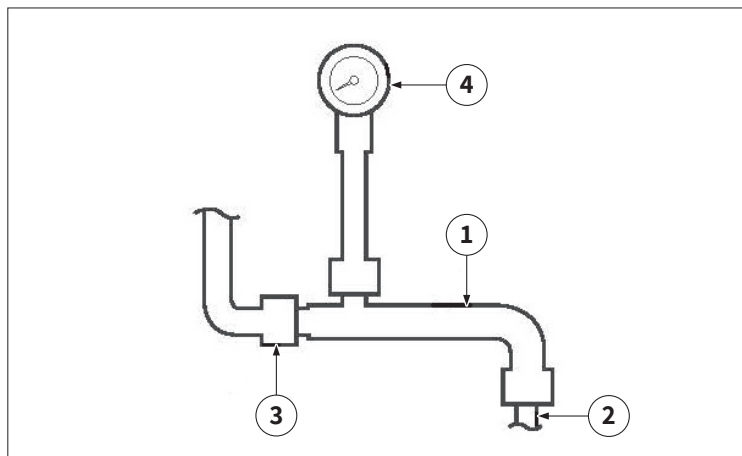
 **If the original fuel manifold and screws are installed, remove white paint marks with a cleaning solvent, as they may prevent the screws from being tightened to the prescribed torque.**

 **If an injector is subject to high stress or excessive force, replace it.**

- Install the new gasket on the end of each injector.
- Install the fuel injectors on the fuel manifold.

 **Tightening torque**
Fuel feed manifold bolt:
3.5 N·m (0.35 kgf·m, 2.6 lb·ft).

- Install the fuel injector units on the throttle bodies, then check the injector pressure by referring to "13.20.11 Injector pressure check" on page 253.



13.20.11 Injector pressure check

 **Do not allow foreign material to enter the fuel circuits.**

- After installing the fuel injectors, perform the following steps to check their pressure:
 - Connect the pressure adapter "1" to the fuel supply manifold "2", then connect an air compressor "3" to the adapter;
 - Connect pressure gauge "4" to the injector pressure adapter;

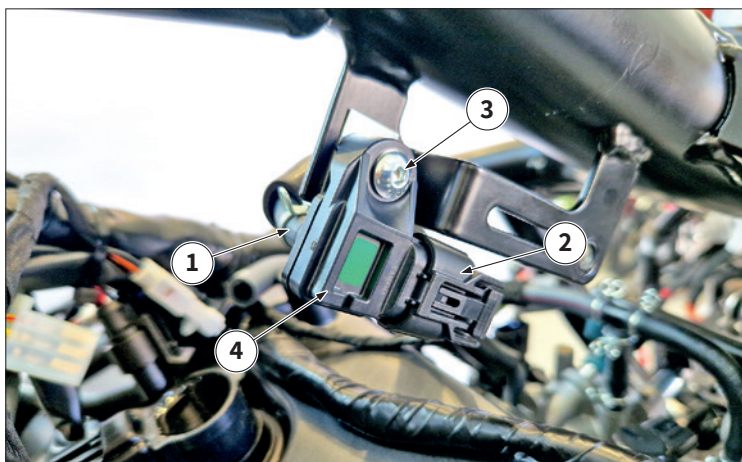
 **- Pressure gauge;**
- Fuel injector pressure adapter.

- Close the valve on the pressure adapter;
- Apply air pressure with the compressor;
- Open the valve on the pressure adapter until the prescribed pressure is reached;

✂ Prescribed air pressure:
490 kPa (4.9 kgf/cm², 69.7 psi)

⚠ Never exceed the prescribed air pressure to avoid damage.

- Close the valve on the pressure adapter ;
- Check that the air pressure is maintained for about one minute: if pressure drops, check the pressure gauge, adapter, seals and O-rings, then reinstall or replace the injectors.

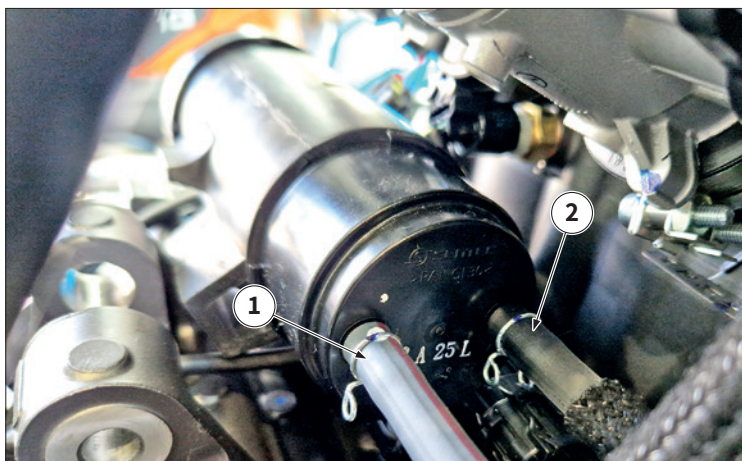


13.21 MAP SENSOR REMOVAL

Preliminary operations:

- Remove the complete tank (as described on page 106).
- Remove tube "1" by acting on its retaining clip.
- Disconnect the connector "2";
- Remove screw "3" and then MAP sensor "4" from the vehicle.

i Proceed in the reverse order for reassembly.

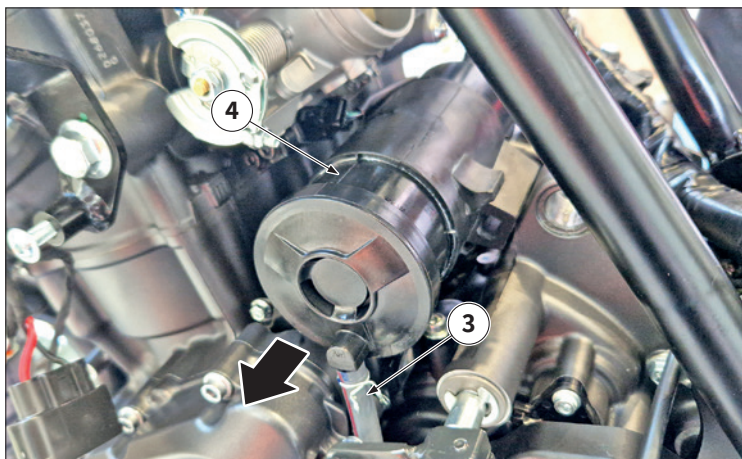


13.22 CANISTER FILTER REMOVAL

13.22.1 Filter Removal

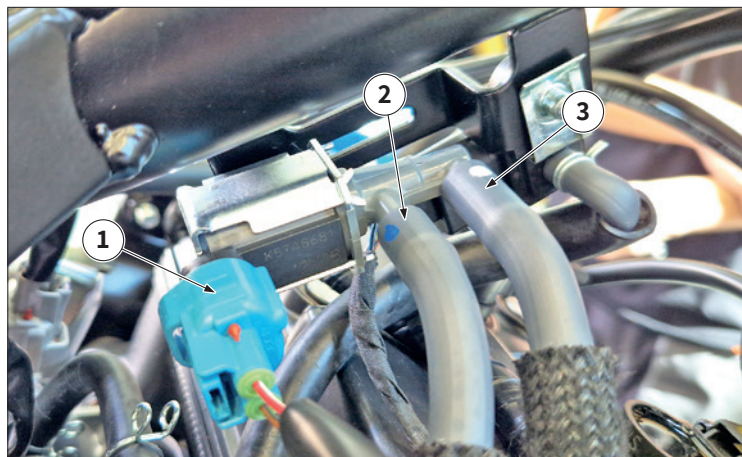
Preliminary operations:

- Remove the complete tank (as described on page 106);
- Remove the Side panels (as described on page 104).
- Remove the tube "1" from the "PURGE" coupling.
- Remove the tube "2" from the "TANK" coupling.



- Remove the tube "3" from the "AIR" coupling.
- Remove the canister filter "4" from the vehicle.

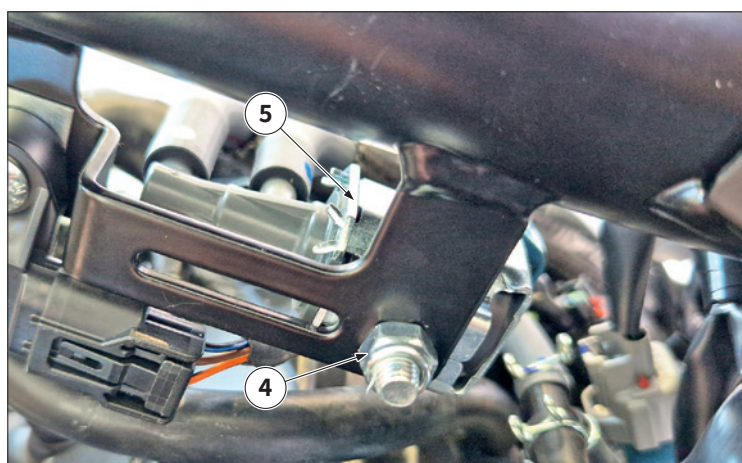
i Proceed in the reverse order for reassembly.



13.22.2 Solenoid valve removal

Preliminary operations:

- Remove the complete tank (as described on page 106).
- Disconnect the connector "1".
- Remove the tube "2".
- Remove the tube "3".



- Remove the nut "4".
- Remove the solenoid valve "5" from the vehicle.

i Proceed in the reverse order for reassembly.