

# ***RR-S*** 125 4T

***2017-2019***

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**WORKSHOP MANUAL**





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## INTRODUCTION

This publication is intended for workshops specialised in repairing motorbikes and motorcycles. Where prescribed, use special Betamotor tools.

Use Betamotor spare parts only. For their codes refer to the spare parts catalogue for the specific vehicle or version.

The warranty and liability on vehicle safety lapses when maintenance or repairs:

- Are NOT performed by workshops specialised in the repair of motorbikes and motorcycles.
- Are NOT carried out carefully following the requirements contained in the technical documentation;
- Are NOT carried out using special Betamotor tools, where required;
- Are NOT carried out using official Betamotor spare parts.

Carefully read this manual in its entirety before working on the engine. Good knowledge of all the engine components and all the procedures to be followed for inspection and maintenance help lengthen the life of the engine.

The paragraphs have been enhanced with schematic illustrations highlighting each topic in order to make the text immediately understandable.

### Informative note

Betamotor S.p.A. is committed to a policy of ongoing improvement of its products. This is why you might notice slight differences between the content of this document and the vehicle that you are about to carry out repairs and/ or maintenance on. Betamotor S.p.A. models are exported to a number of countries where there are different rules concerning the Highway Code and vehicle type-approval procedures. Betamotor S.p.A. therefore reserves the right to modify its products and technical documentation at any time without prior notice, thank you for your understanding.

### ***We respect and defend the environment***

*Everything we do has an impact on the entire planet and its resources. Betamotor S.p.A., wishing to safeguard the interests of the entire Community, would like to make customers and technical operators aware of ways of using the vehicle and the disposal of its parts in total compliance with standards in force in terms of environmental pollution, waste disposal and recycling.*

## SAFETY

### **Carbon monoxide**

- Exhaust gases contain carbon monoxide, which is poisonous. Carbon monoxide may cause loss of consciousness and lead to death. If the engine needs to be started, make sure the location is well-ventilated. Never start the engine indoors.
- The engine can be started indoors only if fitted with the appropriate exhaust gas extraction devices.

### **Petrol**

- Petrol is extremely flammable and can be explosive under certain conditions.
- Keep sources of heat, sparks and flames away from the work area.
- Always work in a well-ventilated area.

- Never use petrol as a solvent for cleaning. Do not handle it unless strictly necessary.
- Never use petrol to clean components by means of compressed air.
- Keep out of the reach of children.

### **Engine oil**

- Engine oil can cause skin conditions if it remains in contact with the skin often and for prolonged periods.
- If you touch engine oil, wash the parts with soap and water as soon as possible.
- In case of contact with the eyes, rinse them with plenty of water and seek medical advice.
- If swallowed, do not induce vomiting in order to prevent the product from entering into the lungs; seek immediate medical advice. If you





*believe the product has entered the lungs, take the person concerned to hospital immediately.*

- *Waste oil contains dangerous substances that are harmful for the environment. In order to change it one must be equipped for disposal, in compliance with applicable laws.*
- *Do not discard waste oil into the environment.*
- *Keep out of the reach of children.*

### Coolant liquid

- *In some situations, the ethylene glycol contained in the coolant is flammable and its flame is invisible. Should ethylene glycol catch fire, it can cause burns even though its flame is invisible.*
- *Do not bring the coolant into contact with hot parts. These parts could be hot enough to cause the liquid to ignite.*
- *The coolant (ethylene glycol) may irritate the skin and is poisonous if swallowed.*
- *Should the coolant come into contact with the skin, immediately remove contaminated clothing or footwear and wash with soap and water. In the event of contact with the eyes, rinse with plenty of clean water and seek medical advice immediately. Should it be swallowed, do not induce vomiting in order to prevent the product from entering the lungs. Administer clean water, immediately take the person concerned to hospital, and show this product to hospital staff.*

- *In the event of exposure to a high concentration of vapours, move the person concerned to an uncontaminated area and seek medical advice if necessary.*
- *Do not remove the radiator cap when the engine is still hot. As the coolant is pressurised, it may spurt out violently and cause burns.*
- *The coolant contains dangerous substances that are harmful for the environment. In order to change it one must be equipped for disposal in compliance with applicable laws.*
- *Do not disperse coolant into the environment.*
- *Keep out of the reach of children.*

### Hot parts

- *The engine and the exhaust system get very hot and remain at that temperature for a long time, even after the engine has been turned off. Wait for them to cool down before handling these parts or carrying out work on areas around them. Wear insulated gloves.*

### WARNINGS

*The information contained in this paragraph is important to ensure the operations carried out on the engine are performed without causing damage.*

- *Before disassembly, thoroughly clean the motorcycle.*
- *While disassembling it, clean all the parts and place them in containers accurately following the order of disassembly.*
- *Always use special tools wherever necessary and when required.*
- *Always use glues, sealant and lubricants wherever required. Follow the indications concerning their technical features.*
- *Always replace parts such as gaskets, O-rings and safety washers with newly supplied parts.*
- *When loosening or tightening nuts or screws, always start with the larger ones or from the centre. Always adhere to the specified tightening torques.*
- *Use only Betamotor original spare parts.*



## TECHNICAL ENGINE SPECIFICATIONS

Type	4-stroke single-cylinder liquid-cooled with electric starter
Bore for stroke	52.0x58.6
Displacement [cm <sup>3</sup> ]	124.7
Compression ratio	11.2:1
Distribution	4 valves
Standard compression pressure	550 kPa/600 rpm
Minimum-maximum	480–620 kPa (4.8–6.2 kgf/cm <sup>2</sup> , 68.3–88.2 psi)
<b>FUEL</b>	
Recommended fuel	Super petrol without lead
<b>ENGINE OIL</b>	
Lubrication system	With wet crankcase
Type	SAE 10W-30, 10W-40, 15W-40, 20W-40 or 20W-50
Recommended engine oil grade	API service type SG or superior, JASO standard MA
Quantity (disassembled)	1.15 L
Quantity without replacing the oil filter element	0.95 L
Quantity with replacing the oil filter element	1.00 L
<b>OIL FILTER</b>	
Type	Paper filter
<b>OIL PUMP</b>	
Type	Trochoidal
Internal rotor - external rotor end backlash	Less than 0.15 mm - Limit 0.23 mm
External rotor - oil pump housing backlash	0.13–0.18 mm - Limit 0.25 mm
Oil pump housing - internal and external rotor backlash	0.06–0.11 mm - Limit 0.18 mm
Safety valve operating pressure	39.2–78.4 kPa
Pressure check position	Check bolt on cylinder head body
<b>THERMOSTAT</b>	
Valve opening temperature	80.5–83.5 °C
Complete valve opening temperature	95.0 °C
Valve lift (fully open)	3.0 mm
<b>WATER PUMP</b>	
Type	Single intake centrifugal pump
Gear ratio	19/38
<b>SPARK PLUG</b>	
Manufacturer/model	NGK/CR9E
Distance between the electrodes	0.7–0.8 mm
<b>CYLINDER HEAD</b>	
Combustion chamber volume	9.90–10.50 cm <sup>3</sup>
Deformation limit	0.03 mm
<b>CAMSHAFT</b>	
Transmission system	Chain control
Lobe height (intake)	30.225–30.325 mm - Limit 30.125 mm
Lobe height (exhaust)	30.261–30.361 mm - Limit 30.161 mm
Camshaft offset limit	0.030 mm
<b>TIMING CHAIN</b>	
Tensioning system	Automatic
<b>ROCKER ARM/ROCKER ARM SMALL SHAFT</b>	
Rocker arm internal diameter	9.985–10.000 mm - Limit 10.015 mm
Rocker arm small shaft external diameter	9.966–9.976 mm - Limit 9.941 mm
Rocker arm - rocker arm small shaft backlash	0.009–0.034 mm - Limit 0.074 mm



VALVE, VALVE SEAT, VALVE GUIDE	
Valve backlash (when cold)	Intake 0.10–0.14 mm - Exhaust 0.20–0.24 mm
Valve head diameter (intake)	19.40–19.60 mm
Valve head diameter (exhaust)	16.90–17.10 mm
Valve seat contact width (intake)	0.90–1.10 mm - Limit 1.6 mm
Valve seat contact width (exhaust)	0.90–1.10 mm - Limit 1.6 mm
Valve margin thickness (intake)	0.50–0.90 mm
Valve margin thickness (exhaust)	0.50–0.90 mm
Valve stem diameter (intake)	4.475–4.490 mm - Limit 4.445 mm
Valve stem diameter (exhaust)	4.460–4.475 mm - Limit 4.430 mm
Valve guide internal diameter (intake)	4.500–4.512 mm - Limit 4.550 mm
Valve guide internal diameter (exhaust)	4.500–4.512 mm - Limit 4.550 mm
Valve stem - valve guide backlash (intake)	0.010–0.037 mm - Limit 0.080 mm
Valve stem - valve guide backlash (exhaust)	0.025–0.052 mm - Limit 0.100 mm
Valve stem offset	0.010 mm
VALVE SPRING	
Free length (intake)	41.71 mm - Limit 39.62 mm
Free length (exhaust)	41.71 mm - Limit 39.62 mm
Installed length (intake)	35.30 mm
Installed length (exhaust)	35.30 mm
K1 flexibility (intake)	23.54 N/mm
K2 flexibility (intake)	36.58 N/mm
K1 flexibility (exhaust)	23.54 N/mm
K2 flexibility (exhaust)	36.58 N/mm
Installed compression spring pressure (intake)	140.00–162.00 N
Installed compression spring pressure (exhaust)	140.00–162.00 N
CYLINDER	
Boring	52.000–52.010 mm
Wear tolerance	52.110 mm
Taper limit	0.050 mm
Out of roundness limit	0.005 mm
PISTON	
Cylinder - piston backlash	0.015–0.048 mm
Diameter	51.962–51.985 mm
Measurement point (from the bottom of the piston skirt)	5.0 mm
Offset	0.50 mm
Pin bolt hole internal diameter	14.002–14.013 mm - Limit 14.043 mm
Pin bolt external diameter	13.995–14.000 mm - Limit 13.975 mm
Pin bolt - pin bolt hole backlash	0.002–0.018 mm - Limit 0.068 mm
SEGMENT	
Upper band	
Gap between the ends (installed)	0.10–0.25 mm - Limit 0.50 mm
Band side backlash	0.030–0.065 mm - Limit 0.100 mm
Second band	
Gap between the ends (installed)	0.10–0.25 mm - Limit 0.60 mm
Band side backlash	0.020–0.055 mm - Limit 0.100 mm
Oil-scraper band	
Gap between the ends (installed)	0.20–0.70 mm
Band side backlash	0.040–0.160 mm



CRANKSHAFT	
Crank lever unit width	47.95–48.00 mm
Offset limit	0.030 mm
Connecting rod head side backlash	0.110–0.410 mm
Connecting rod head radial backlash	0.004–0.014 mm
COUNTERSHAFT	
Countershaft control mode	Gear
CLUTCH	
Type	With multiple discs, wet
Clutch release mode	Internal control, cam control
Clutch lever backlash	10.0–15.0 mm
Friction disc 1 thickness	2.90–3.10 mm - Wear tolerance 2.80 mm
Number of discs	4 pieces
Friction disc thickness	2 2.90–3.10 mm - Wear tolerance 2.80 mm
Number of discs	1 piece
Clutch disc thickness	1.90–2.10 mm
Number of discs	4 pieces
Deformation limit	0.20 mm
Clutch spring free length	40.48 mm - Limit 36.80 mm
Number of springs	4 pieces
Thrust rod bending limit	0.500
TRANSMISSION	
Type	6 ratios always engaged, operation with left foot
Primary gear ratio	73/24
Secondary gear ratio	48/14
1 <sup>st</sup> gear ratio	34/12 (2.833)
2 <sup>nd</sup> gear ratio	30/16 (1.875)
3 <sup>rd</sup> gear ratio	30/22 (1.364)
4 <sup>th</sup> gear ratio	24/21 (1.143)
5 <sup>th</sup> gear ratio	22/23 (0.957)
6 <sup>th</sup> gear ratio	21/25 (0.840)
Final transmission	CHAIN
Primary shaft offset limit	0.08 mm
Secondary shaft offset limit	0.08 mm
GEAR COUPLING MECHANISM	
Gear coupling mechanism type	Gear and guide bar selector drum
Gear coupling fork thickness	5.76–5.89 mm • 1
Gear coupling fork thickness	4.76–4.89 mm • 2
DECOMPRESSION DEVICE	
Device type	Auto decompressor
AIR FILTER	
Filtering element	Dry element
MINIMUM CONDITIONS	
Minimum speed	1350–1550 rpm
Water temperature	85.0–95.0 °C
Oil temperature	55.0–65.0 °C
Accelerator knob backlash	3.0–5.0 mm





## SYMBOLS



*Tightening torque value*



*Engine oil*



*Medium-intensity threadlocker*



*Grease*



# ENGINE REMOVAL FROM VEHICLE

1

# 1 ENGINE REMOVAL FROM VEHICLE

1

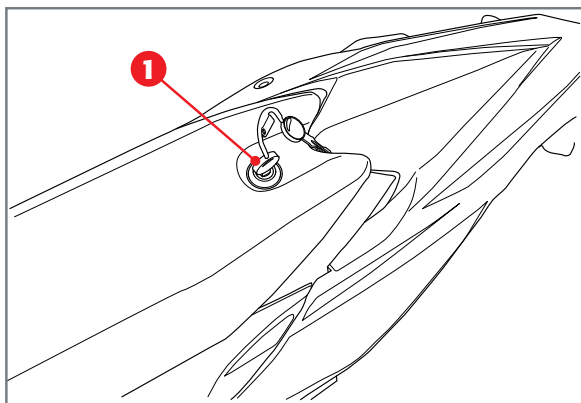
ENGINE REMOVAL FROM VEHICLE

To remove and insert the engine in the vehicle it is necessary to perform the steps shown in the table below.

Order	Component	Quantity	Operation/Notes
	Seat		Refer to "1.1 SEAT REMOVAL AND ASSEMBLY" on page 10
	Filter box side-panels		Refer to "1.2 FILTER BOX SIDE-PANELS" on page 11
	Tank		Refer to "1.3 TANK" on page 12
	Exhaust system		Refer to "1.4 EXHAUST SYSTEM" on page 14
	Filter box rotation		Refer to "1.5 FILTER BOX ROTATION" on page 16
	Carburettor		Refer to "1.6.1 CARBURETTOR DISCONNECTION AND RECONNECTION" on page 19
	Cooling system		Refer to "1.7 COOLING SYSTEM" on page 21
	Head Connections		Refer to "1.14 HEAD CONNECTIONS AND VENTILATION PIPES UNIT" on page 32
	Coil		Refer to "1.8 COIL" on page 26
	Electrical connectors		
	Horn		
	Clutch cable		Refer to "1.9 CLUTCH CABLE" on page 27
	Brake pedal		Refer to "1.10 BRAKE PEDAL" on page 28
	Pinion		Refer to "1.11 PINION" on page 29
	Rear suspension unit		Refer to "1.12 REAR SUSPENSION UNIT DISASSEMBLY AND REASSEMBLY" on page 30
	Engine fixing		Refer to "1.13 ENGINE FIXING" on page 31

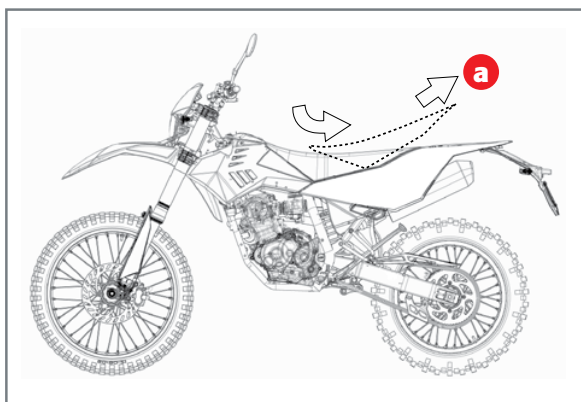


## 1.1 SEAT REMOVAL AND ASSEMBLY



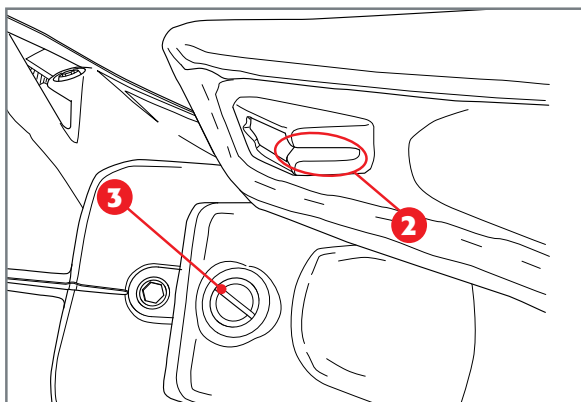
**Seat opening**

To remove the seat, insert the key into the lock 1 and turn it clockwise.



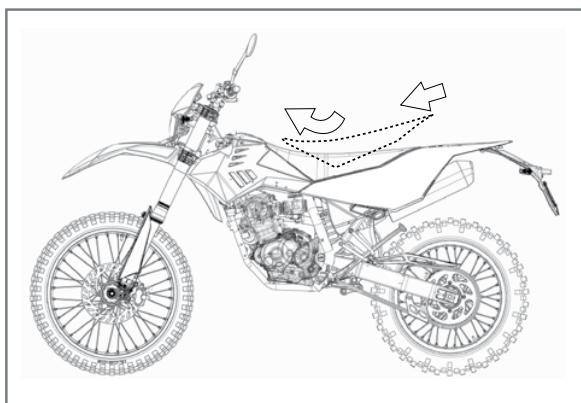
**Remove the seat**

Pull the seat towards **a** as shown in the figure.



**Hook the seat on**

For reassembly, insert the cavity 2 of the seat into guide 3.



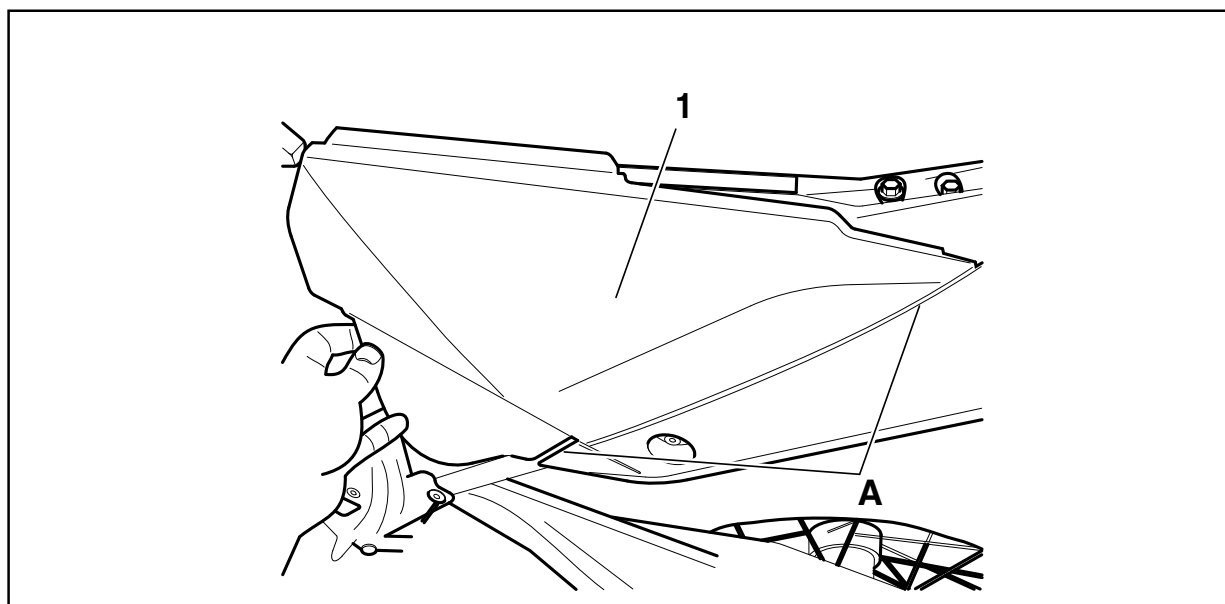
**Push the seat into place**

Press the seat downwards in the central part and at the same time, push it forwards until the bullet coupling hooks into place.

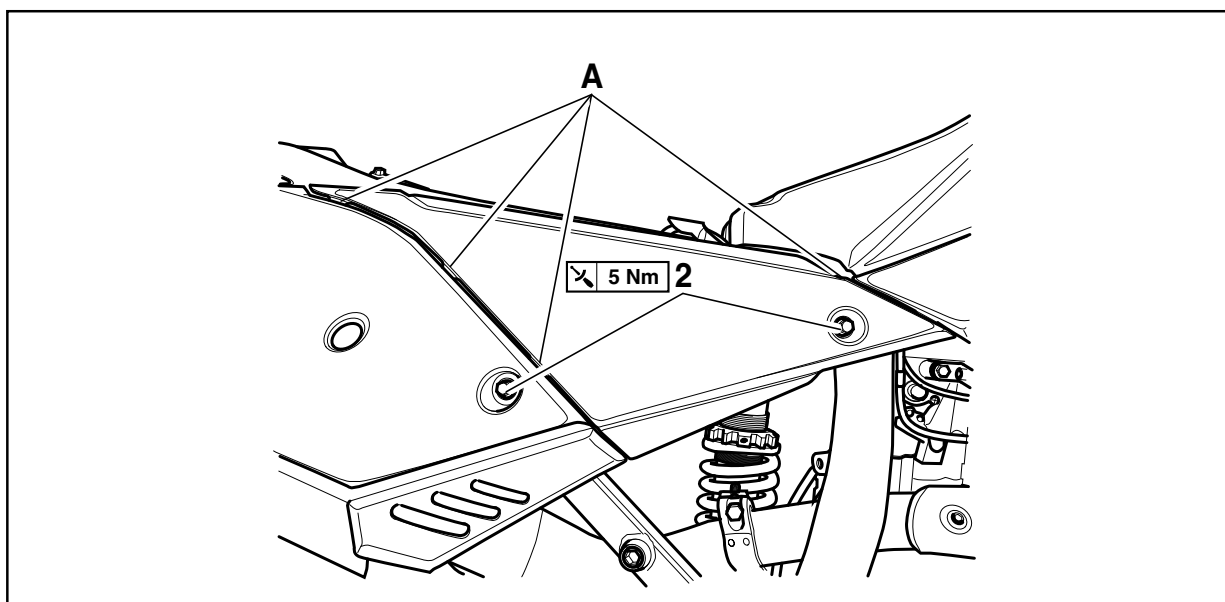
## 1.2 FILTER BOX SIDE-PANELS

# 1

ENGINE REMOVAL FROM VEHICLE



Order	Component	Quantity	Operation/Notes
	Seat	1	Remove, refer to "1.1 SEAT REMOVAL AND ASSEMBLY" on page 10
1	Left-hand side-panel	1	Grasp the side panel from the front and pull outwards.
			For reassembly, insert the keys <b>A</b> into the specific housings. Push the side panel towards the vehicle.



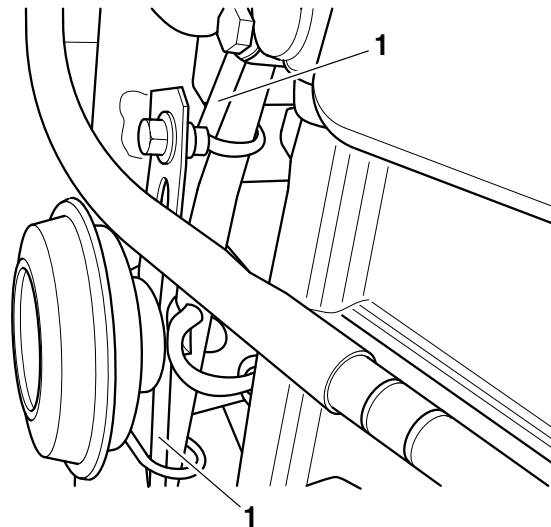
Order	Component	Quantity	Operation/Notes
	Seat	1	Remove, refer to "1.1 SEAT REMOVAL AND ASSEMBLY" on page 10
2	Screws	2	Remove
3	Right-hand side-panel	1	Remove the side panel
			For reassembly, insert the keys <b>A</b> into the specific housings. Tighten to the specified torque



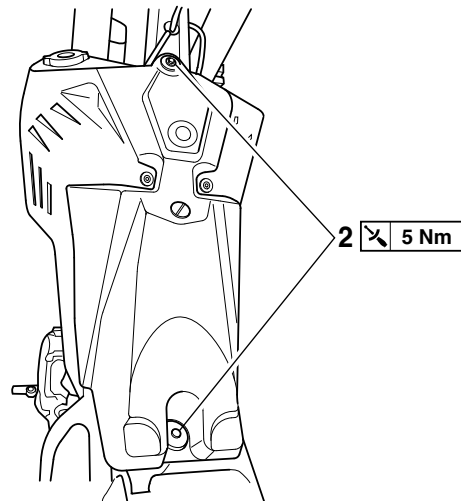


### 1.3 TANK

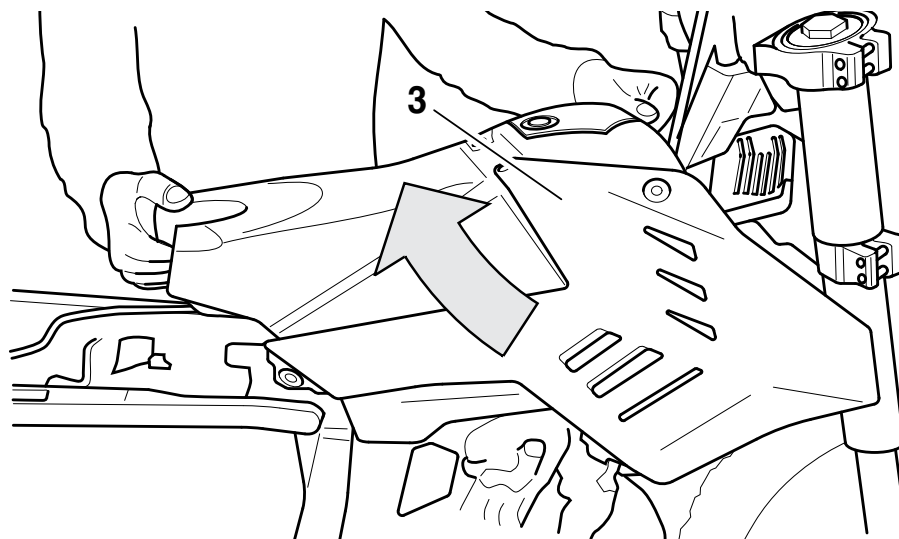
**Tank overflow pipe**



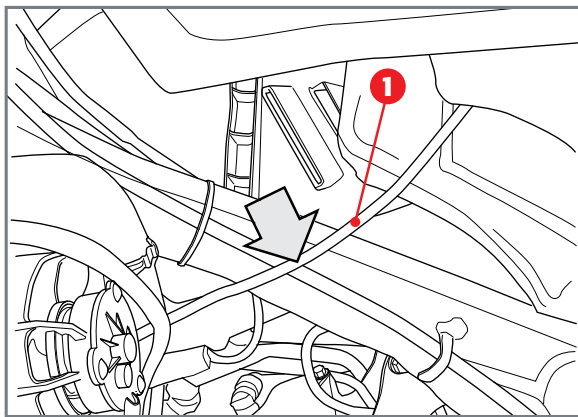
**Tank screws**



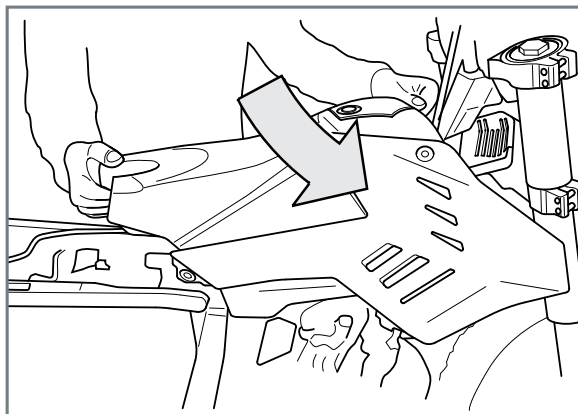
**Tank handling**



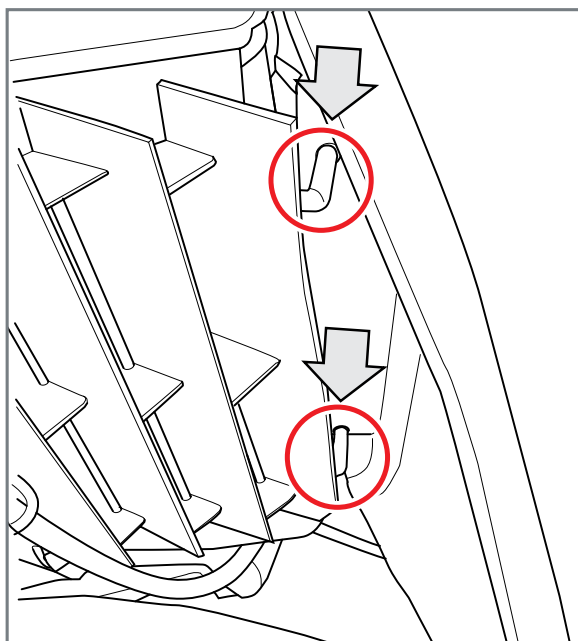
Order	Component	Quantity	Operation/Notes
	Seat	1	Remove, refer to "1.1 SEAT REMOVAL AND ASSEMBLY" on page 10
	Filter box side-panels		Refer to "1.2 FILTER BOX SIDE-PANELS" on page 11
	Petrol valve		Set it to <b>OFF</b>
	Petrol pipe		Disconnect from petrol valve
1	"Overflow" drain pipe	1	Remove from the tube hold
2	Screws	2	Remove
3	Tank		Remove as shown in the figure
			For installation, perform the removal procedure in reverse. See reassembly notes. Tighten to the indicated torques, where required.



**Tank overflow pipe reassembly**



**Tank reassembly**



**Tank hole connection**

**Note 1:** Pass the "overflow" drain pipe **1** as shown in the figure.

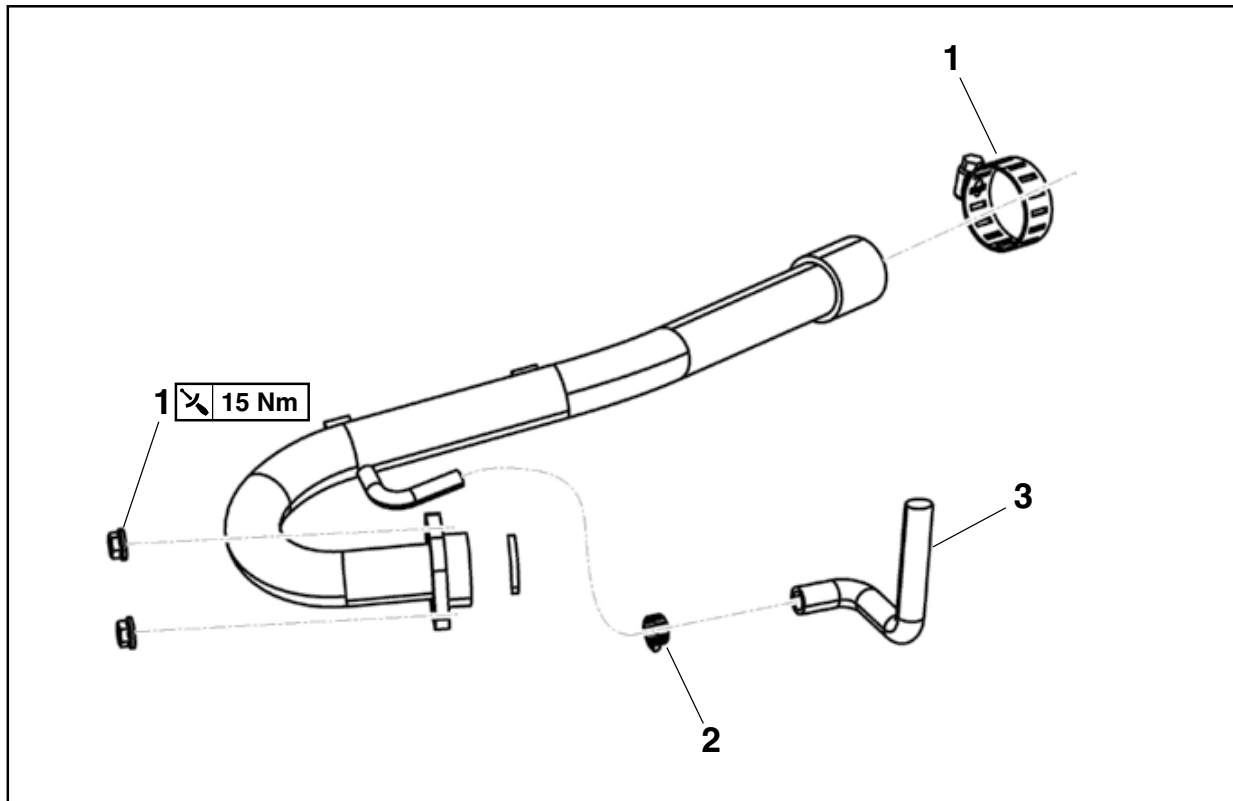
**Note 2:** Place the tank on the frame by first placing the front and then the rear part.

**Note 3:** Make sure that the tank side panel holes have been inserted into the plugs on the conveyors.

**WARNING:** Make sure that the gas and electric control cables are not strained and are not stretched.

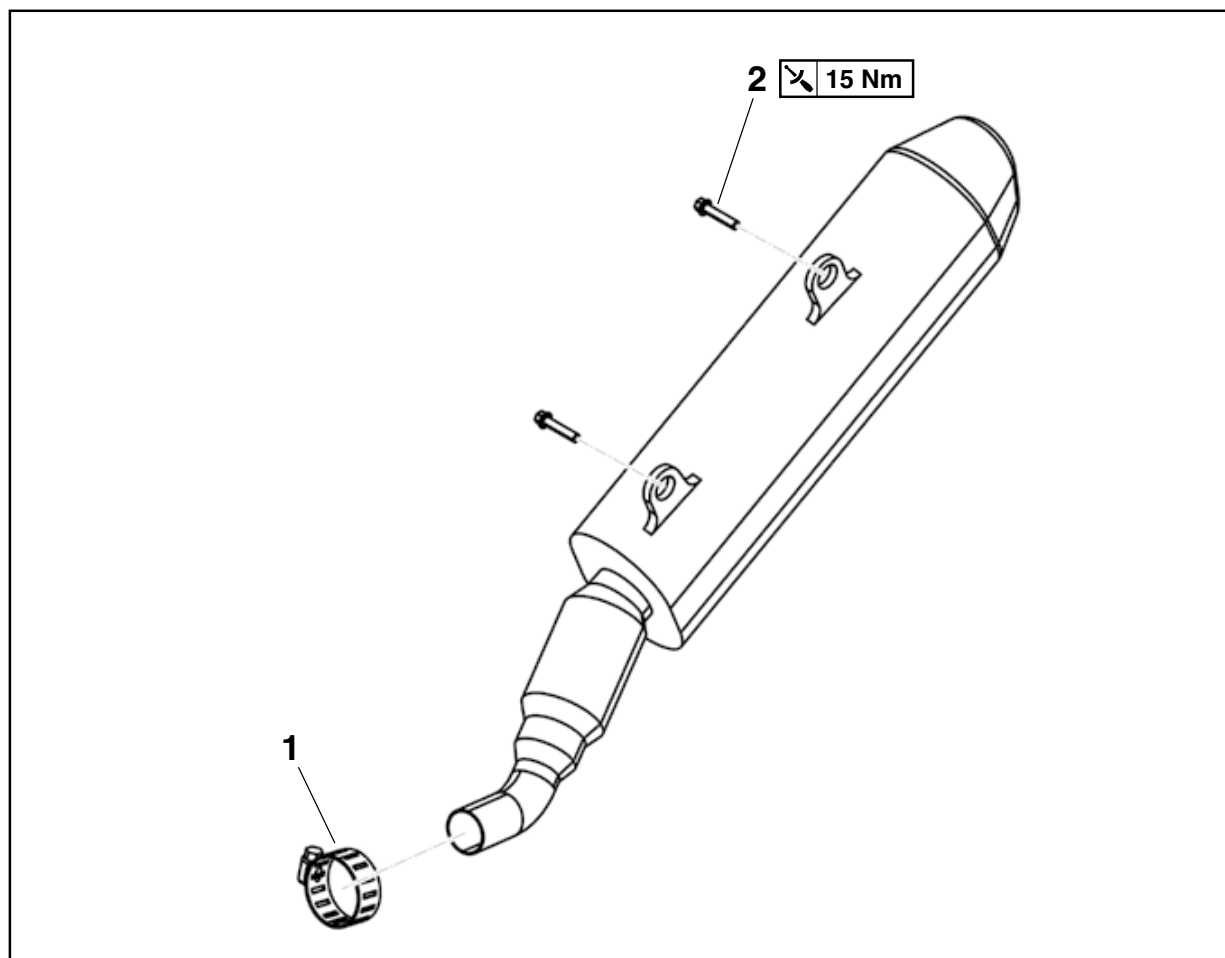
## 1.4 EXHAUST SYSTEM

### 1.4.1 MANIFOLD



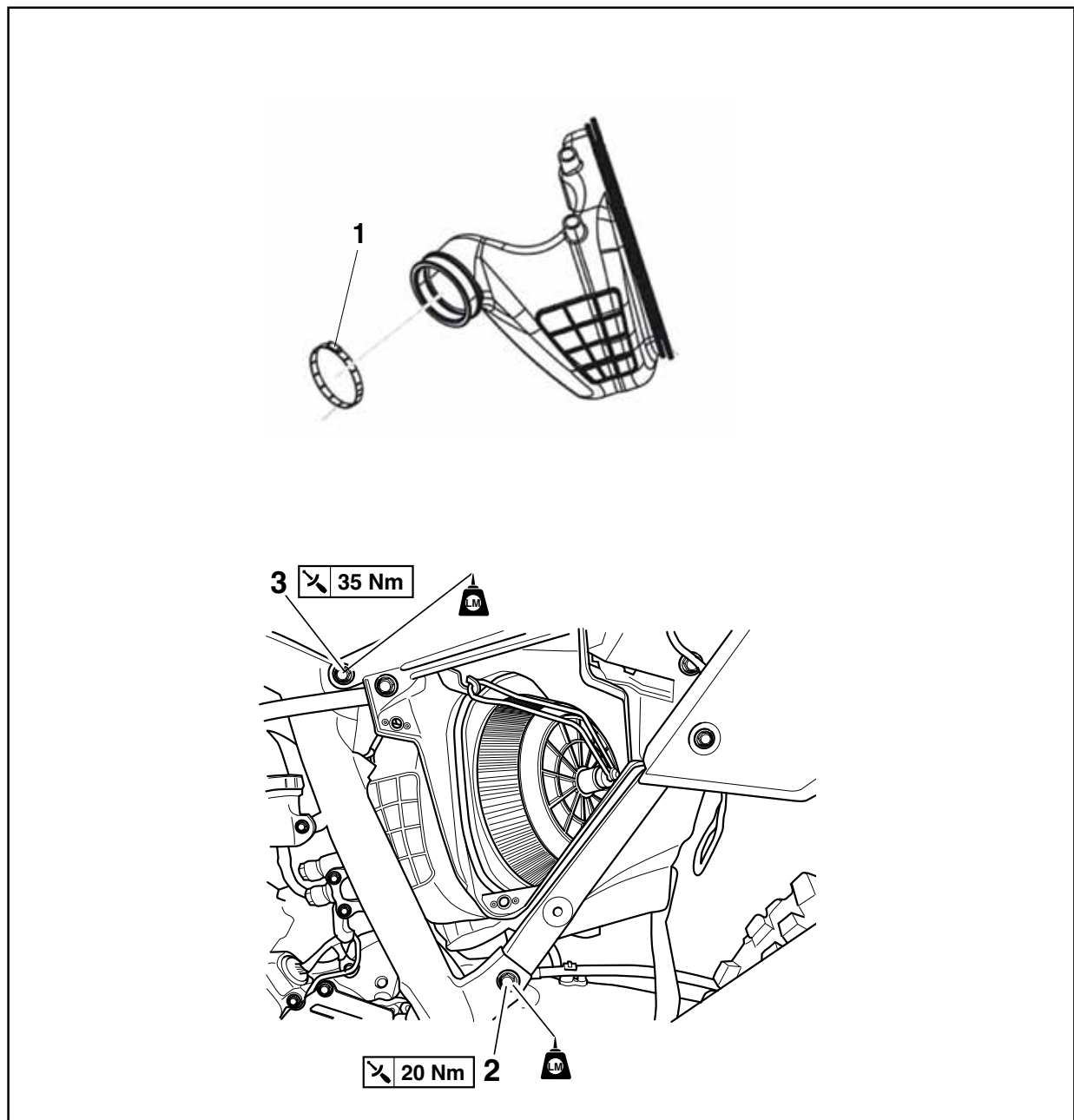
Order	Component	Quantity	Operation/Notes
1	Clamp	1	Loosen
2	Clamp	1	Release
3	AIS pipe	1	Remove
4	Nut	2	Remove
			For installation, perform the removal procedure in reverse. Once the pipes have been reconnected, tighten them by using the specific clamps. Where required, tighten to the specified tightening torques.

## 1.4.2 SILENCER



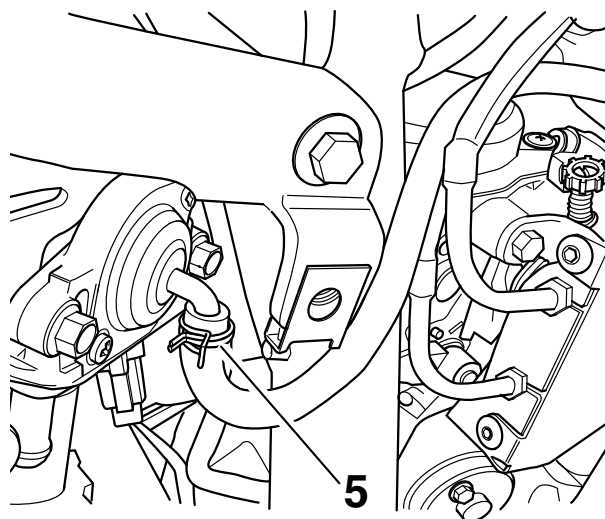
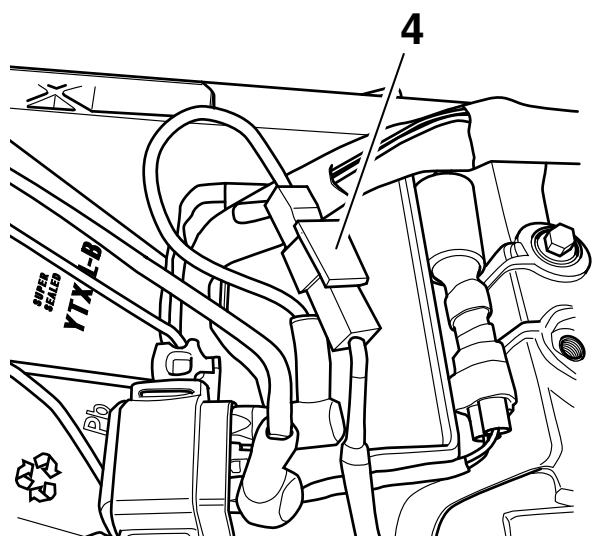
Order	Component	Quantity	Operation/Notes
1	Clamp	1	Loosen
2	Screw	2	Remove
			For installation, perform the removal procedure in reverse. Once the pipes have been reconnected, tighten them by using the specific clamps. Where required, tighten to the specified tightening torques.

## 1.5 FILTER BOX ROTATION

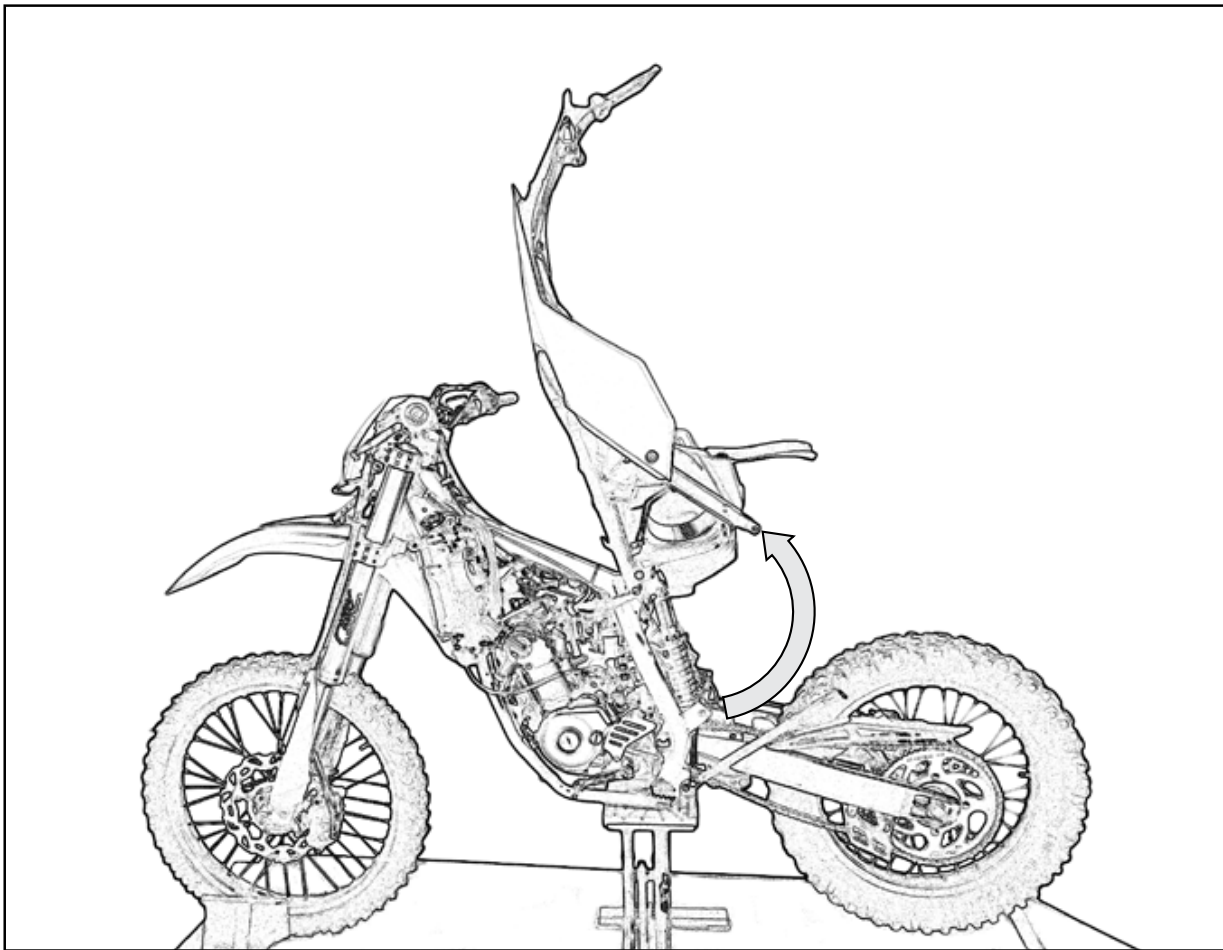


Order	Component	Quantity	Operation/Notes
	Seat	1	Remove
	Filter box side-panels	2	Refer to "1.2 FILTER BOX SIDE-PANELS" on page 11
	Tank	1	Refer to "1.3 TANK" on page 12
	Exhaust manifold		Refer to "EXHAUST SYSTEM"- "1.4.1 MANIFOLD" on page 14
1	Filter conveyor clamp	1	Loosen
2	Pin	2	Remove
3	Screw	2	Loosen – See note 1-





Order	Component	Quantity	Operation/Notes
4	Battery connector	1	Disconnect and remove the cable from the filter box
5	AIS negative pressure pipe	1	Disconnect



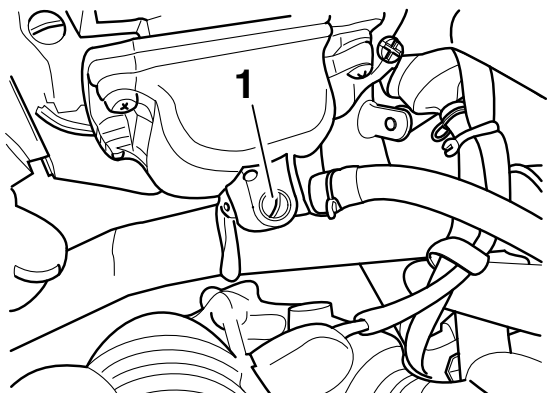
Order	Component	Quantity	Operation/Notes
6	Complete filter box		Rotate anticlockwise
			For installation, perform the procedure in reverse. Once the sleeve has been reconnected, tighten it by using the specific strap. Where required, tighten to the specified tightening torques.

**Note 1:** Once the filter box has been returned to its original position, it is recommended to remove the three frame screws, apply medium-resistance threadlocker and reapply the screws: then tighten to the indicated torque.

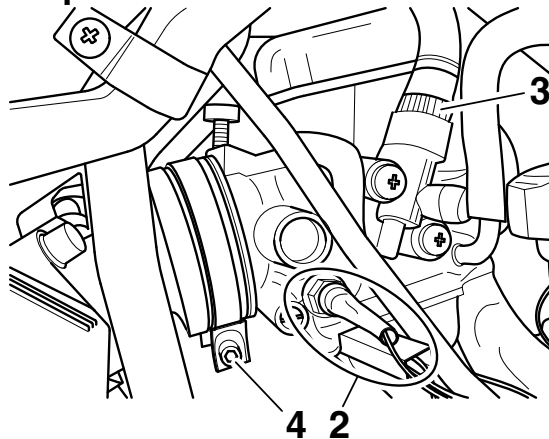
## 1.6 CARBURETTOR

### 1.6.1 CARBURETTOR DISCONNECTION AND RECONNECTION

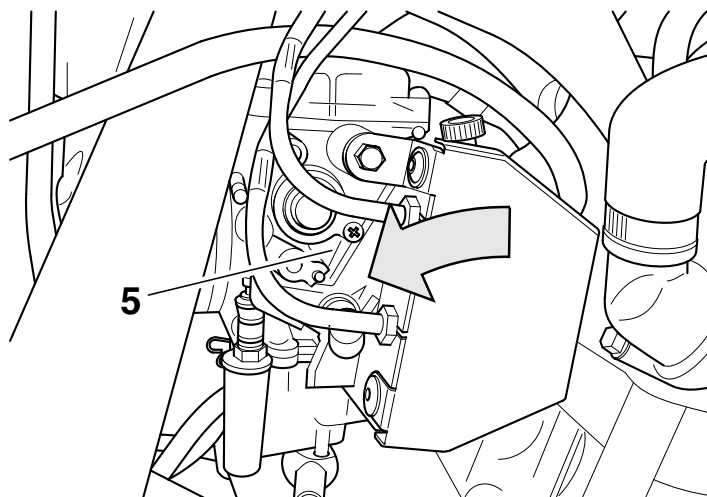
**Carburettor exhaust**



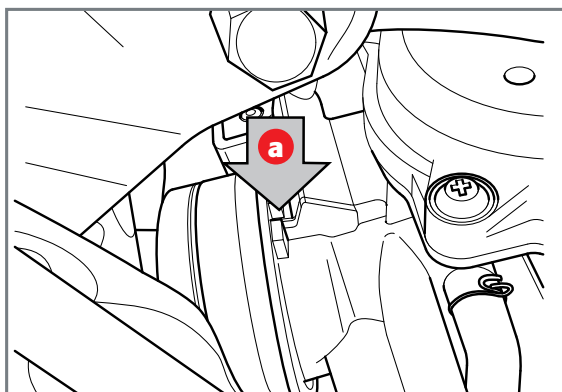
**Connectors, starter command, carburettor clamp**



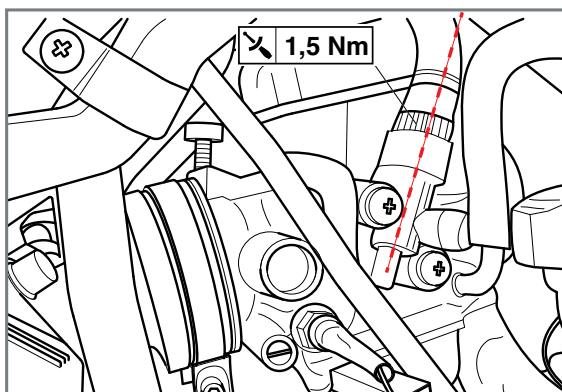
**Carburettor handling**



Order	Component	Quantity	Operation/Notes
		1	Place a container under the carburettor pipe in order to collect the leaked fuel.
	Filter box rotation		Refer to "1.5 FILTER BOX ROTATION" on page 16
1	Screw	1	Loosen and drain the petrol. Tighten at the end of the operation
2	Connectors	2	Disconnect
3	Starter command	1	Unscrew
4	Clamp	1	Loosen
5	Carburettor	1	Pull the carburettor to the rear by slightly rotating it downwards
			For installation, perform the procedure in reverse. For carburettor installation, see Note 1. For starter command installation, refer to Note 2. Once the sleeve has been reconnected, tighten it by the specific clamp. Where required, tighten to the specified torques.



**Carburettor reference.**



**Reassembly of the starter command.**



**WARNING:** Fire hazard! Fuel is easily flammable.



**Do not carry out the operation near open flames or lit cigarettes.**



**Wipe off any traces of spilled fuel immediately.**

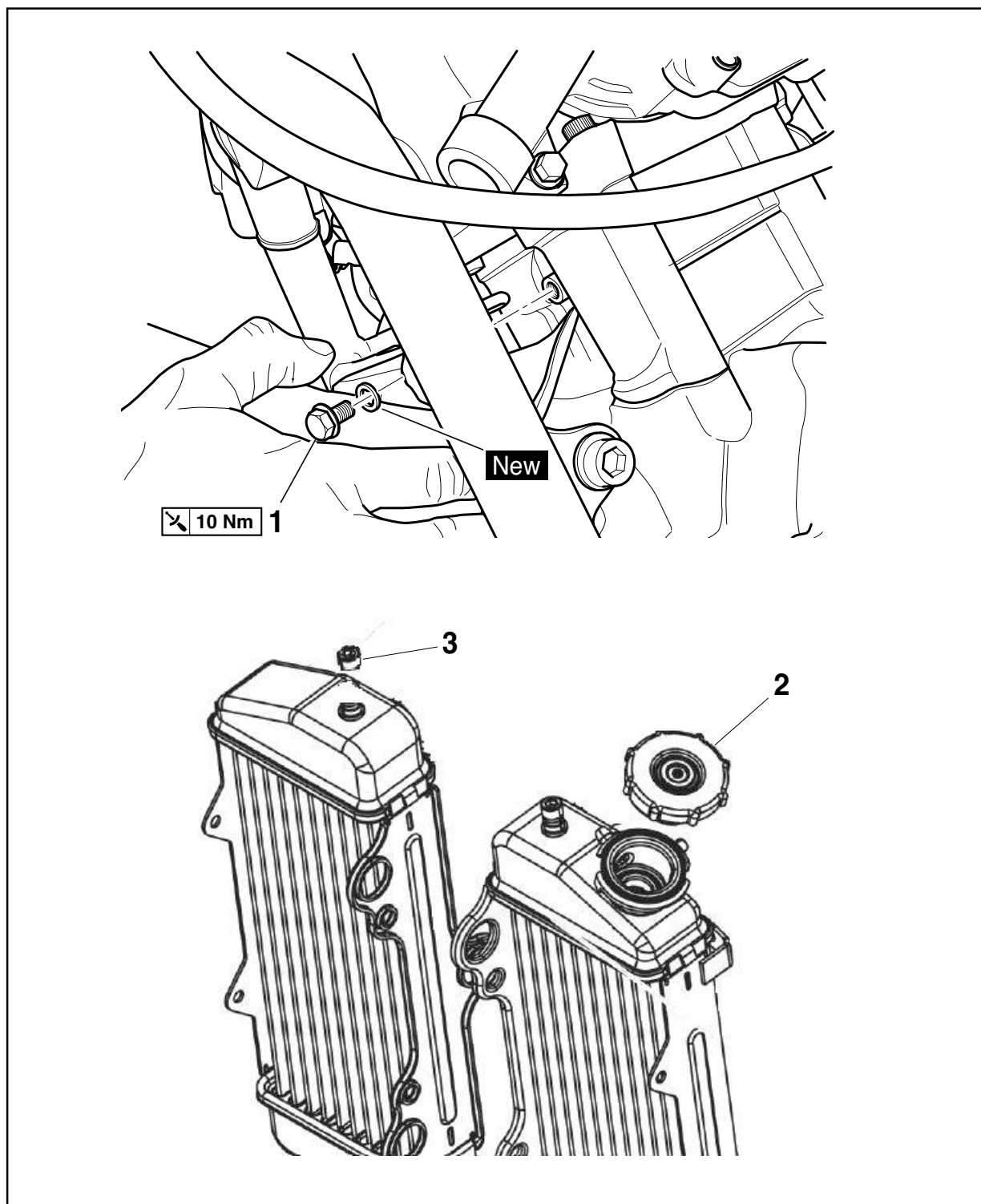
**Note 1:** Make sure that once the carburettor has been re-inserted on the manifold, the reference **A** on the carburettor body is inserted in the specific seat on the manifold.

**Note 2:** When reassembling the starter command:

- make sure it is aligned with its seat, upon insertion;
- manually tighten until flush;
- use the wrench only for final tightening to the indicated torque

## 1.7 COOLING SYSTEM

### 1.7.1 LIQUID DRAIN



Order	Component	Quantity	Operation/Notes
			Place a container under the drain screw
1	Drain cap	1	
2	Filler cap	1	
3	Vent screw	1	
			Drain all the liquid out
4	Drain cap	1	Apply and tighten.







**WARNING:** Never unscrew the radiator filler cap when the engine is hot. Burn hazard!



**WARNING:** Wear suitable protective equipment and safety gloves.



**Keep the coolant liquid out of the reach of children.**



**Do not bring the coolant liquid in contact with skin, eyes or clothing. In case of contact:**

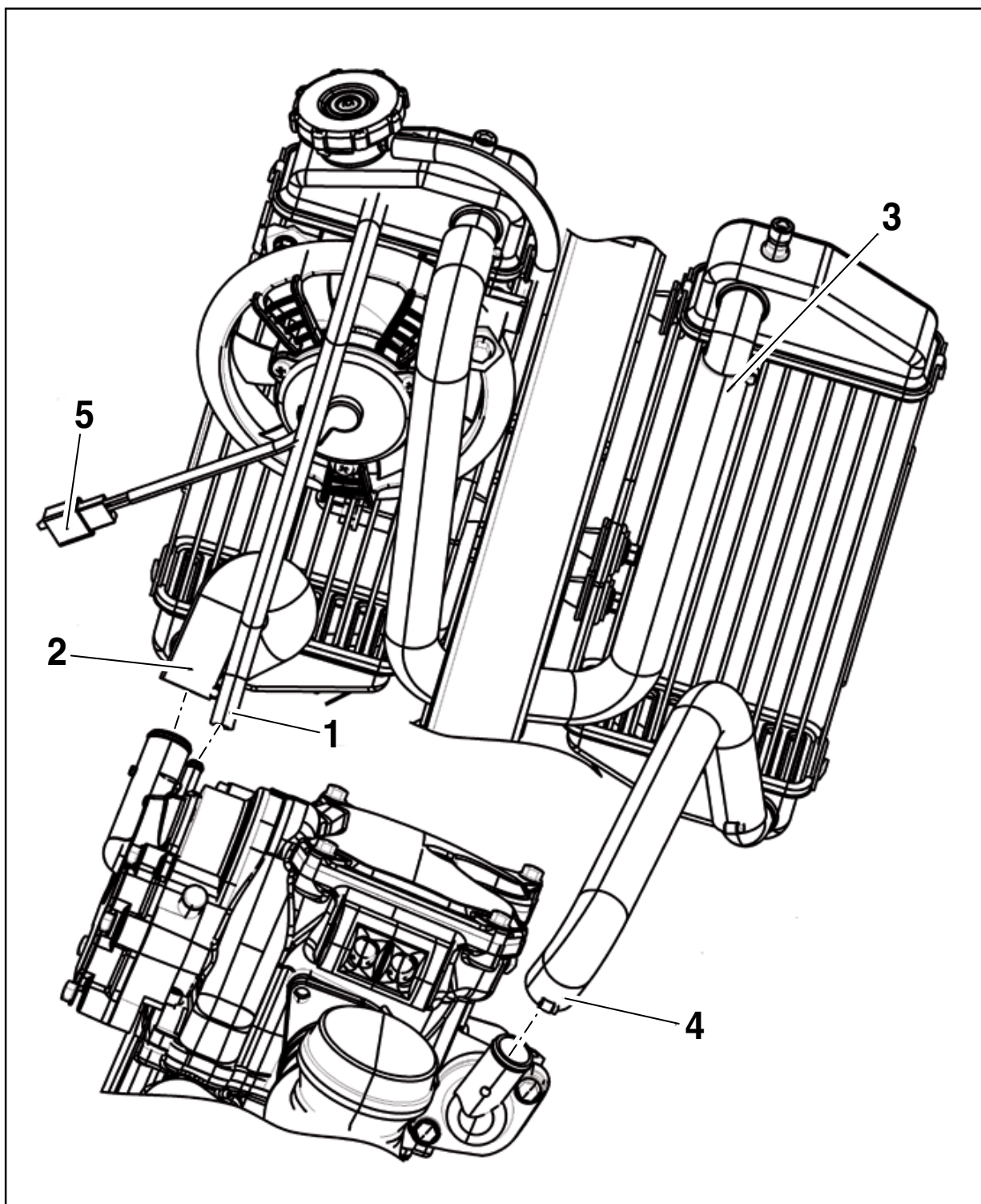
- with eyes, rinse them immediately with water and seek medical advice;
- with skin, clean the concerned areas immediately with soap and water. Change the clothing that came into contact with the coolant liquid.

**In case of ingestion of the coolant liquid, immediately seek medical advice.**

## 1.7.2 RADIATOR DISCONNECTION AND RECONNECTION

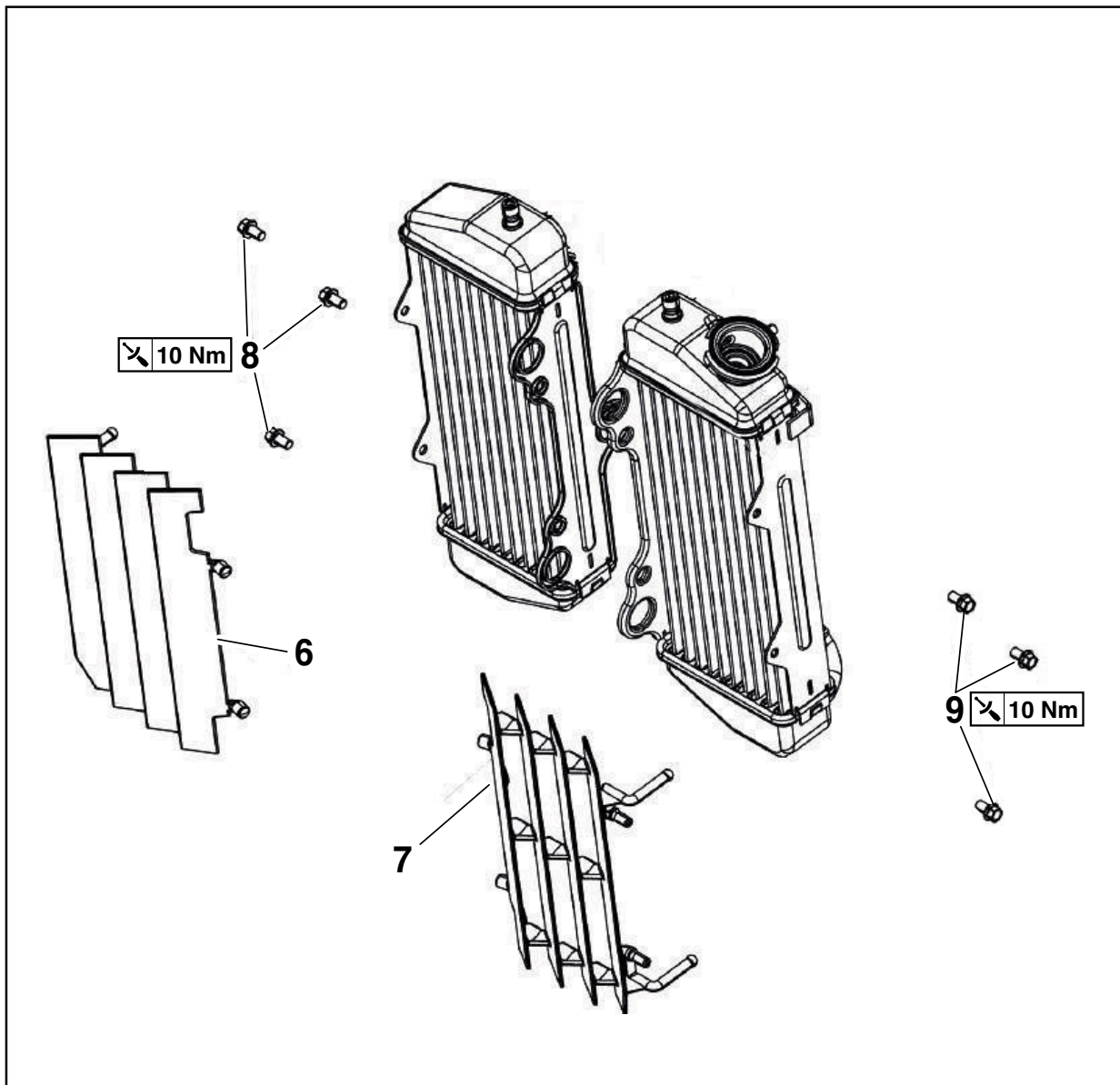
# 1

ENGINE REMOVAL FROM VEHICLE



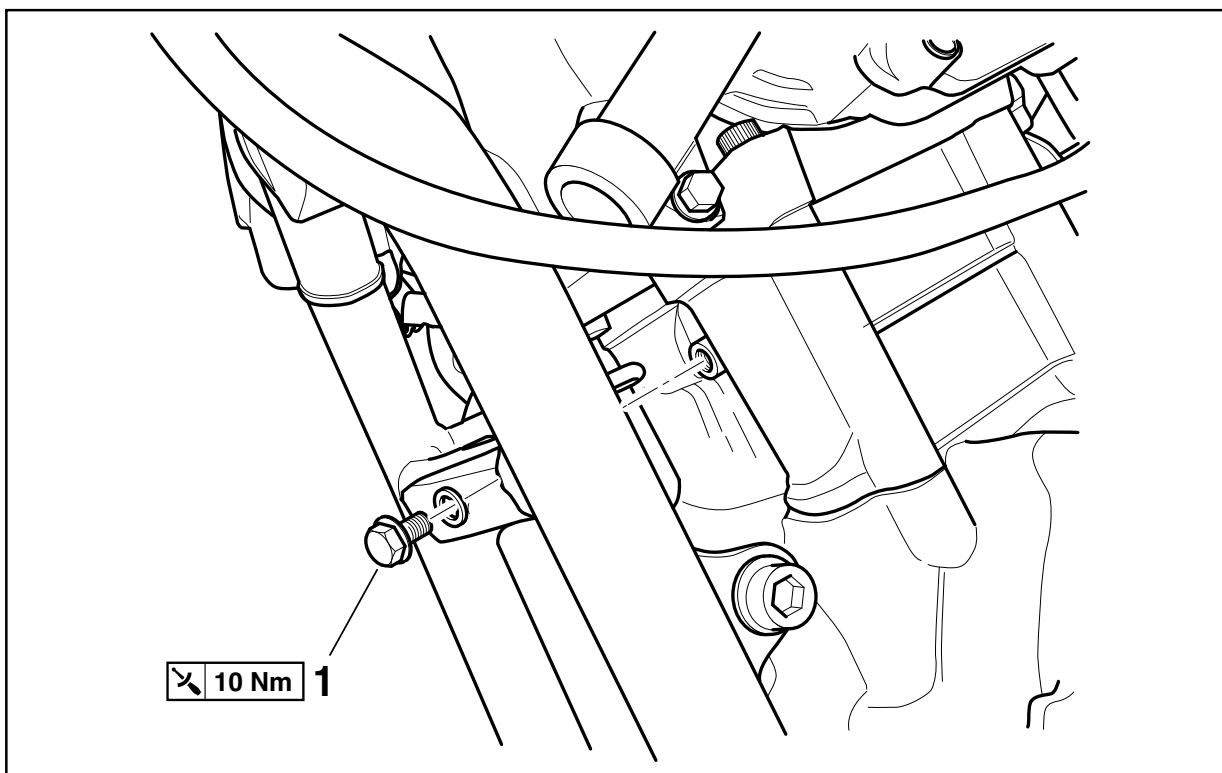
Order	Component	Quantity	Operation/Notes
			Tank unit removal, refer to "1.3 TANK" on page 12
1	Pump recirculation pipe	1	Disconnect
2	Water pump pipe	1	Disconnect
3	"U" pipe	1	Disconnect from one side
4	Thermostat pipe	1	Disconnect
5	Electric fan	1	Disconnect





Order	Component	Quantity	Operation/Notes
6	Right conveyor	1	
7	Left conveyor	1	
8	Right radiator screws	3	
9	Left radiator screws	3	
			For installation, perform the removal procedure in reverse. Once the pipes have been reconnected, tighten them by the specific clamps. Tighten to the tightening torques indicated where required.

### 1.7.3 FILLING THE COOLING SYSTEM



Order	Component	Quantity	Operation/Notes
1	Drain cap	1	
2	Coolant liquid	850 ml	Add the coolant liquid through the filler cap, with vent screw open
3			Start the engine and warm up until the electric fan starts
4			Check that the radiator elements are fully covered by the liquid
5			Turn off the engine and let it cool down
6			If required, top up to obtain the condition of point 4



**WARNING:** Wear suitable protective equipment and safety gloves.



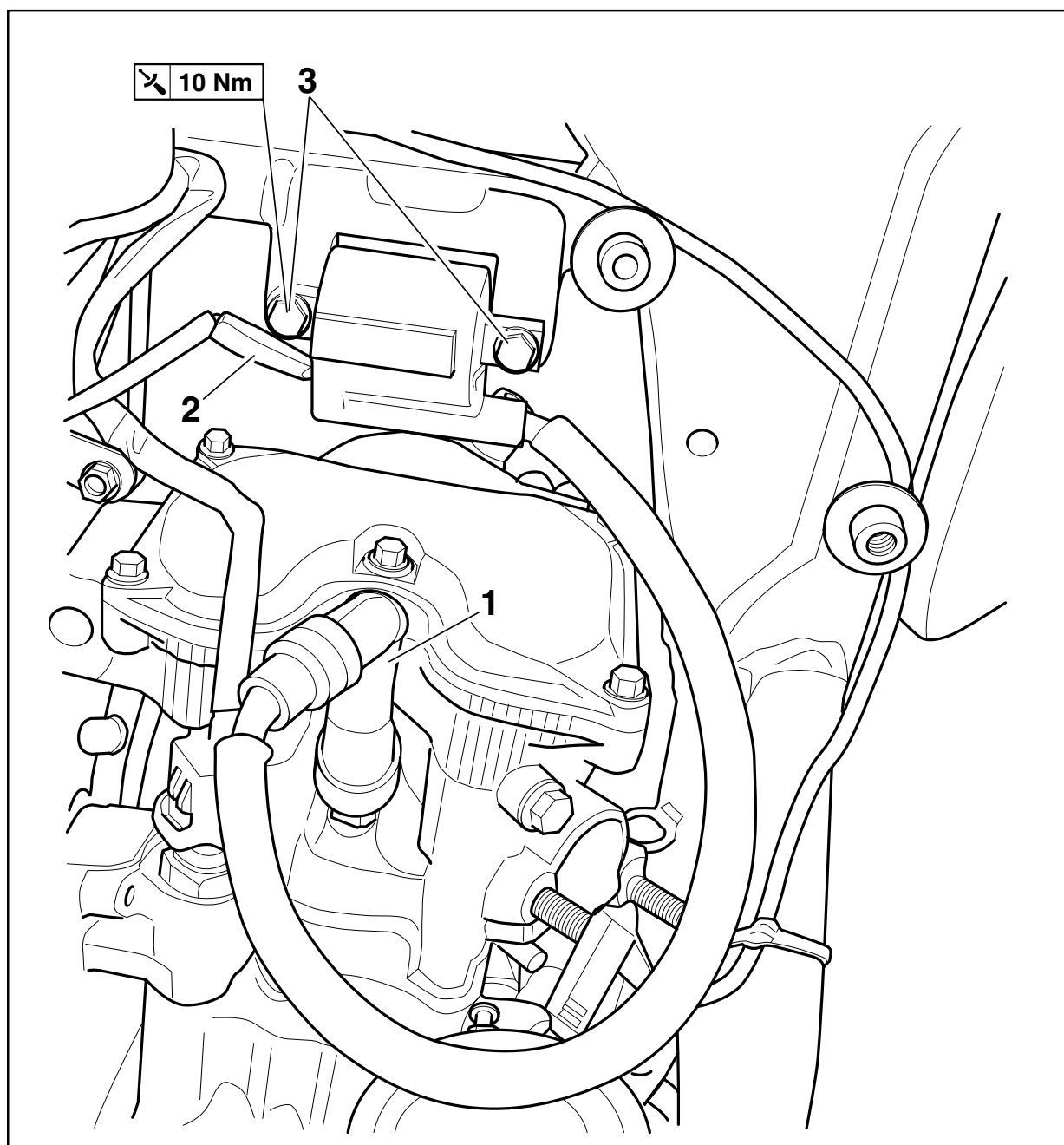
**Keep the coolant liquid out of the reach of children.**



**Do not bring the coolant liquid in contact with skin, eyes or clothing. In case of contact:**

- with eyes, rinse them immediately with water and seek medical advice;
- with skin, clean the concerned areas immediately with soap and water. Change the clothing that came into contact with the coolant liquid.

**In case of ingestion of the coolant liquid, immediately seek medical advice.**



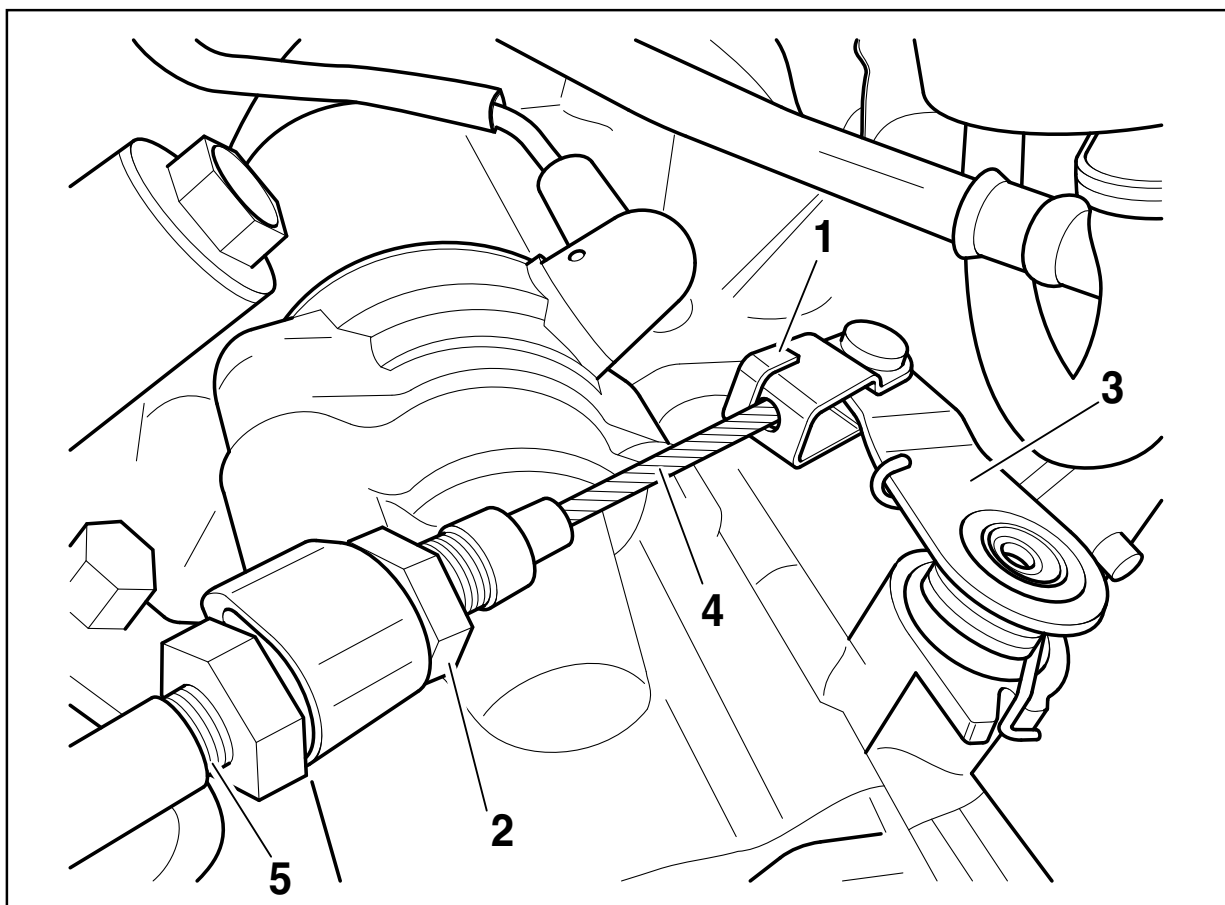
Order	Component	Quantity	Operation/Notes
			Tank unit removal, refer to "1.3 TANK" on page 12
1	Spark plug fitting		Spark plug fitting disconnection
2	Connector		Connector disconnection
3	Screw	2	Remove
			For installation, perform the removal procedure in reverse.



## 1.9 CLUTCH CABLE

# 1

ENGINE REMOVAL FROM VEHICLE

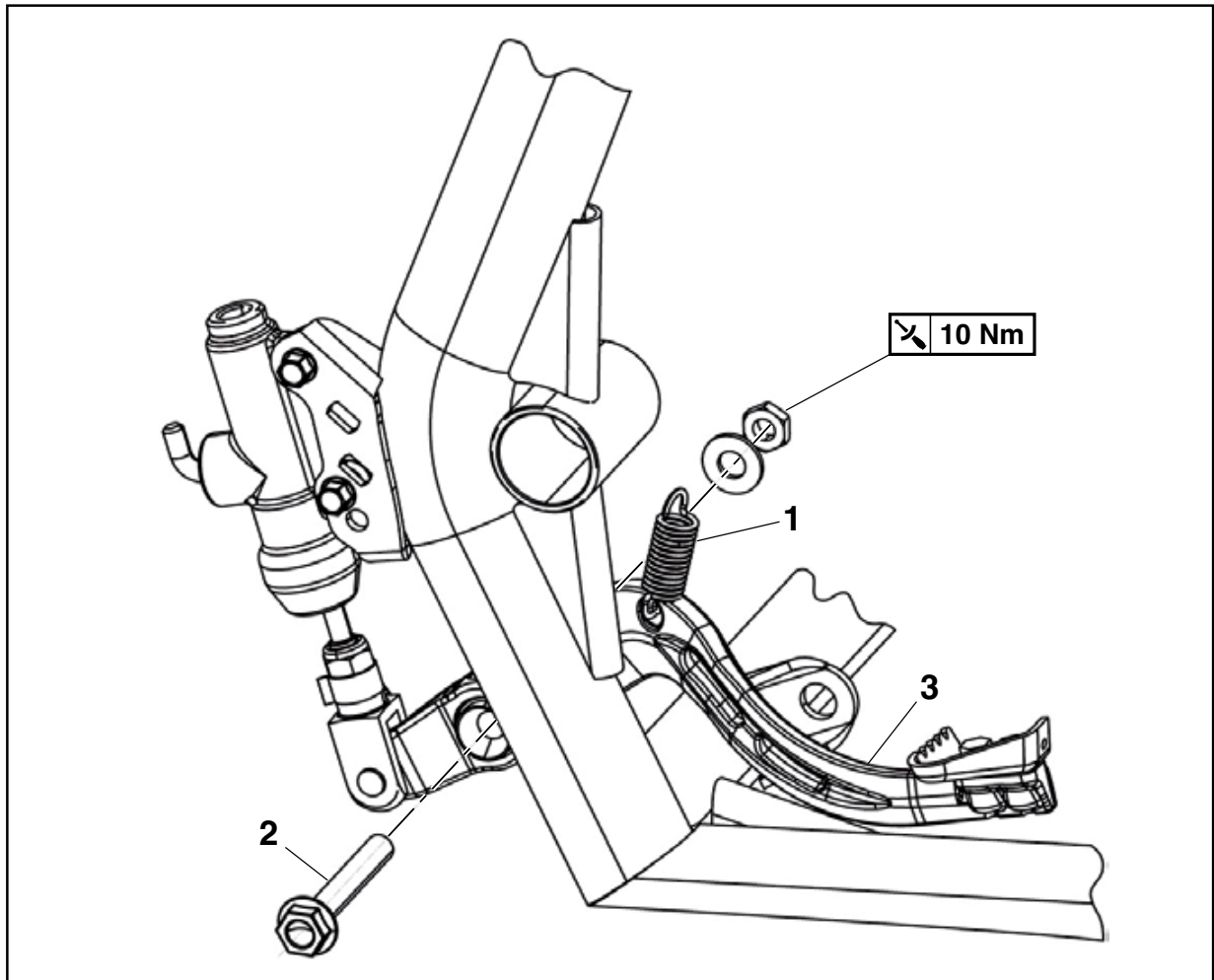


Order	Component	Quantity	Operation/Notes
1	Safety key		Bend until the cable slot is freed up
2	Nut	1	Loosen completely
3	Clutch lever		Rotate anticlockwise
4	Clutch cable		Remove from clutch lever
5	Adjustment screw		Remove from support
			For installation, perform the procedure in reverse. Pay attention to <b>Note 1</b> and <b>Note 2</b>

**Note 1:** To insert the lever cable, turn the lever anticlockwise.

**Note 2:** Once the cable has been reinserted in the clutch lever, bend the safety key downwards.



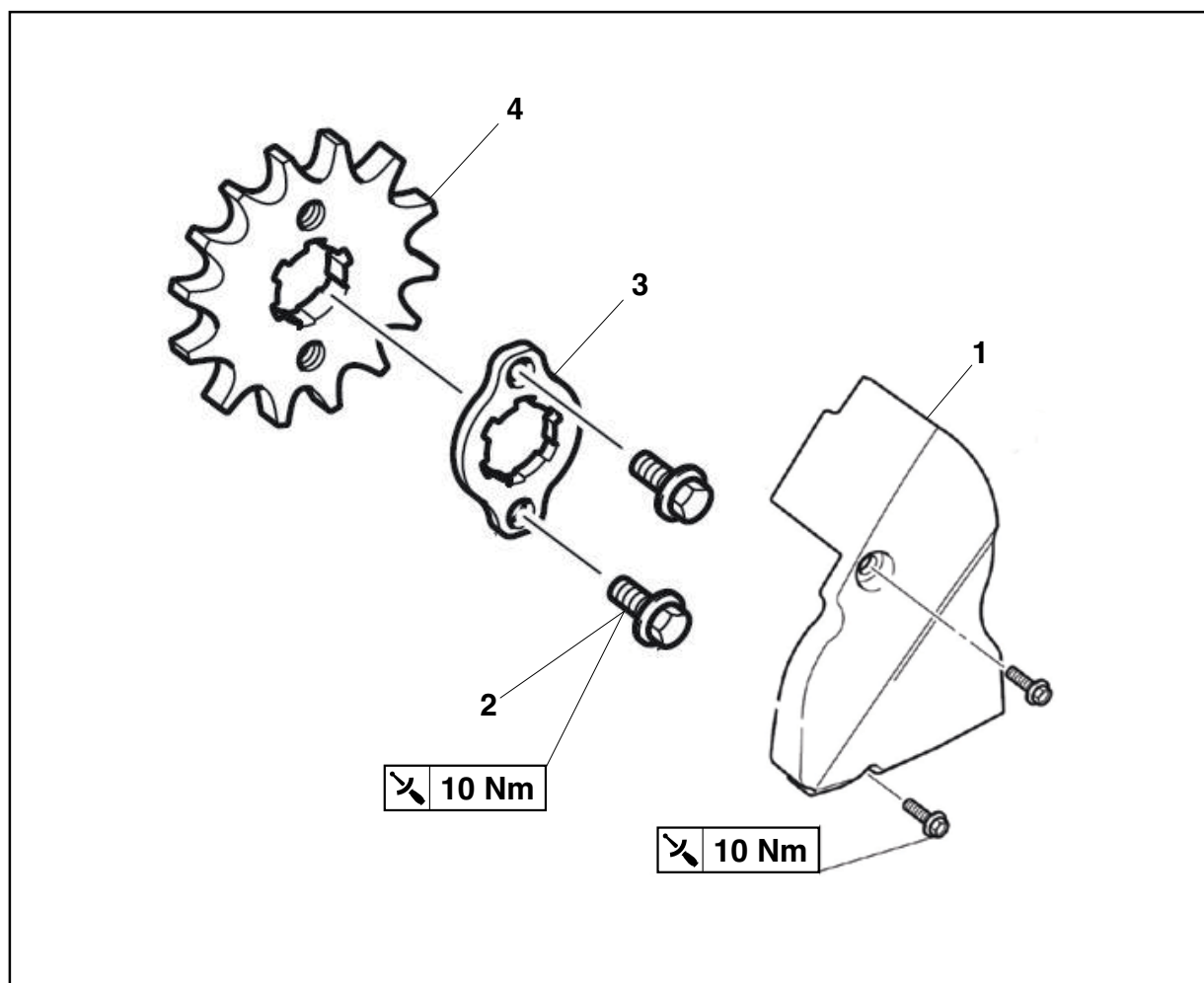


Order	Component	Quantity	Operation/Notes
1	Spring	1	Release from engine
2	Bolt	1	
3	Pedal	1	Remove

## 1.11 PINION

1

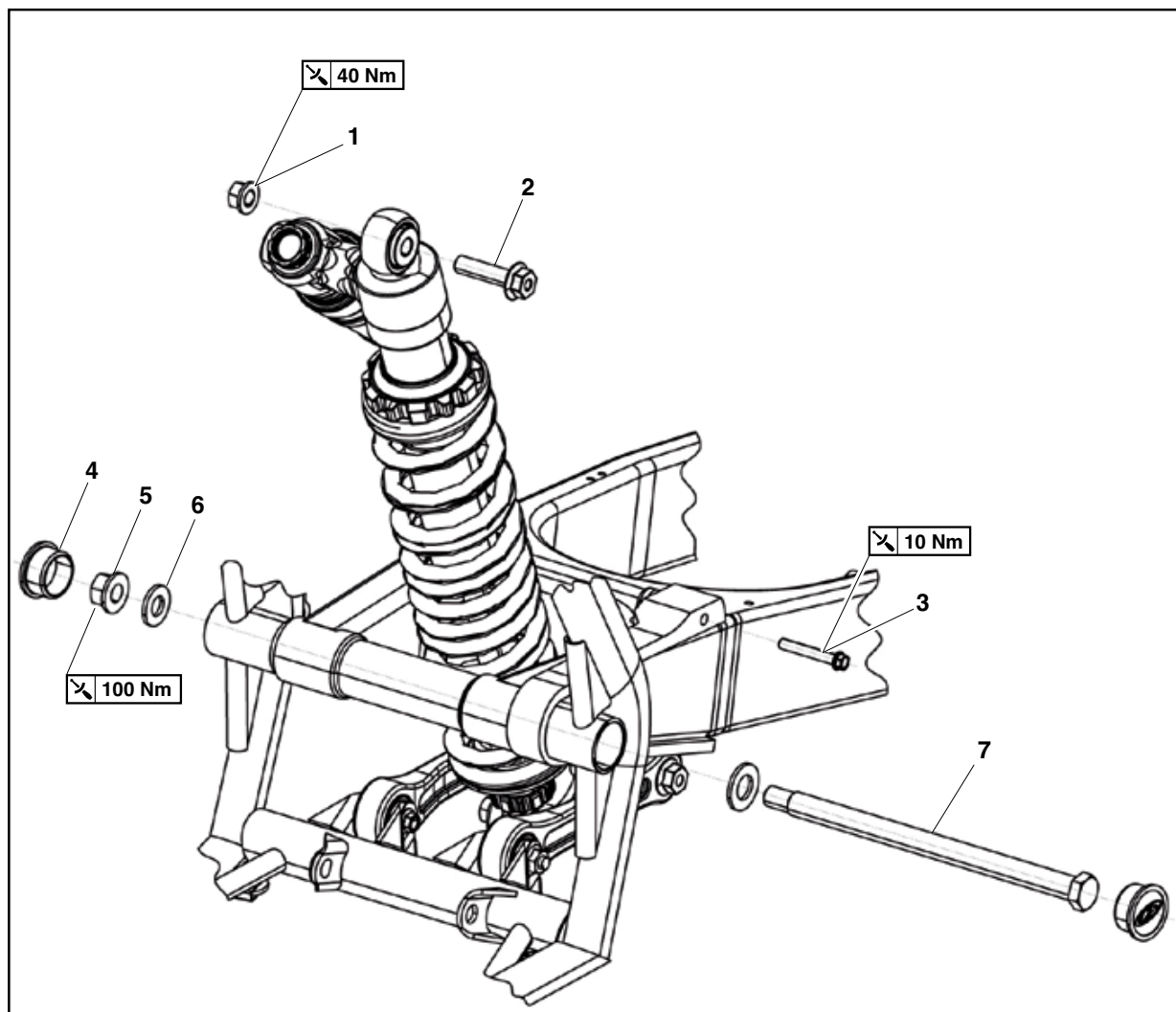
ENGINE REMOVAL FROM VEHICLE



Order	Component	Quantity	Operation/Notes
1	Pinion protection	1	
2	Screws	2	
3	Safety plate	1	
4	Pinion	1	



## 1.12 REAR SUSPENSION UNIT DISASSEMBLY AND REASSEMBLY

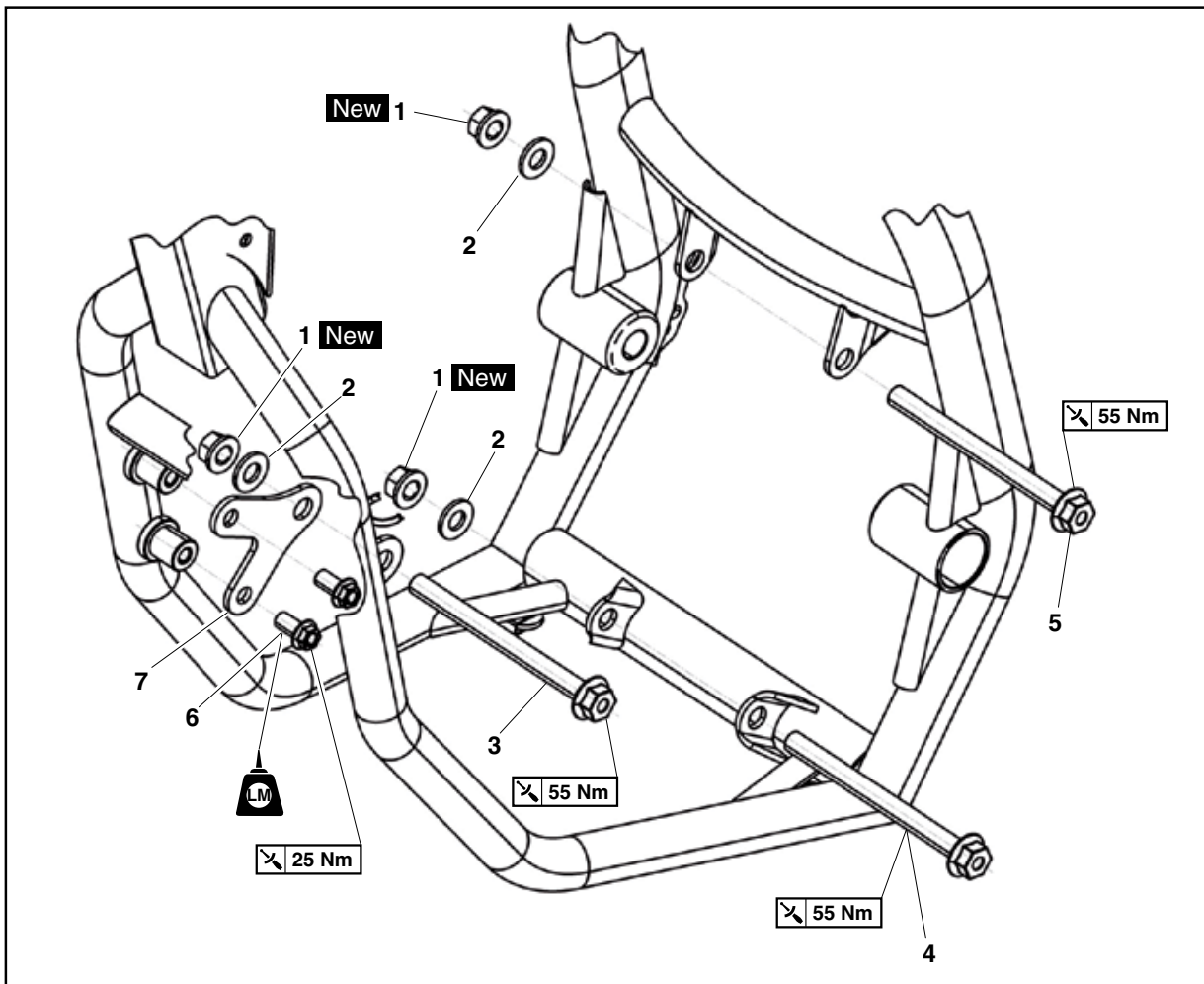


Order	Component	Quantity	Operation/Notes
1	Nut	1	
2	Pin	1	
3	Screw	1	
4	Cap	2	
5	Nut	1	
6	Washer	1	
7	Swingarm pin	1	
			Pull the complete swing-arm unit towards the rear. For installation, perform the removal procedure in reverse. Tighten to the tightening torques indicated where required.

### 1.13 ENGINE FIXING

1

ENGINE REMOVAL FROM VEHICLE

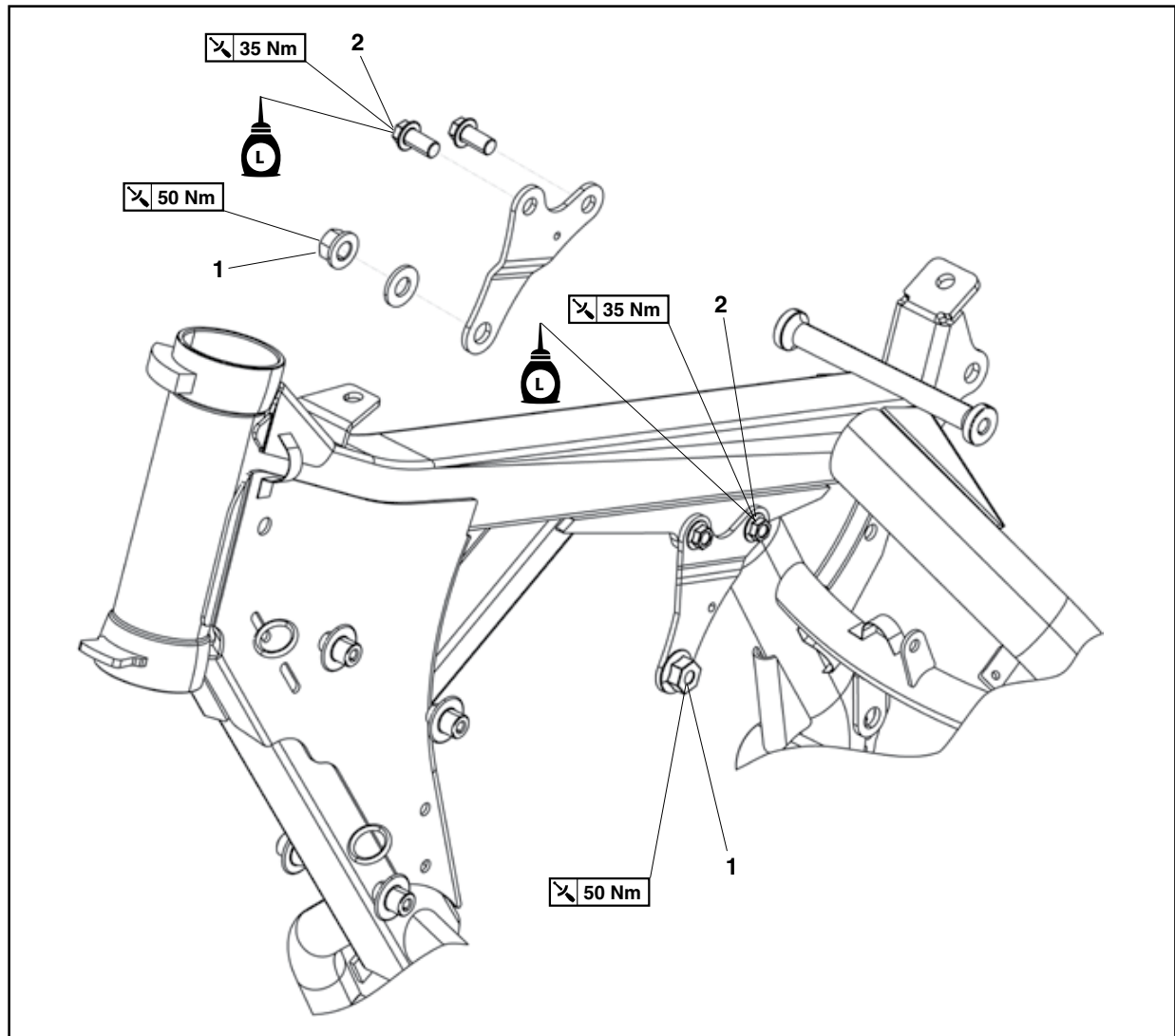


Order	Component	Quantity	Operation/Notes
1	Nut	3	
2	Washer	3	
3	Pin	1	
4	Pin	1	
5	Pin	1	
6	Screw	2	
7	Bracket	1	
			Remove the engine from the vehicle by pulling it out of the right side of the frame. For installation, perform the removal procedure in reverse. Tighten to the tightening torques indicated where required.



## 1.14 HEAD CONNECTIONS AND VENTILATION PIPES UNIT

### 1.14.1 HEAD CONNECTIONS

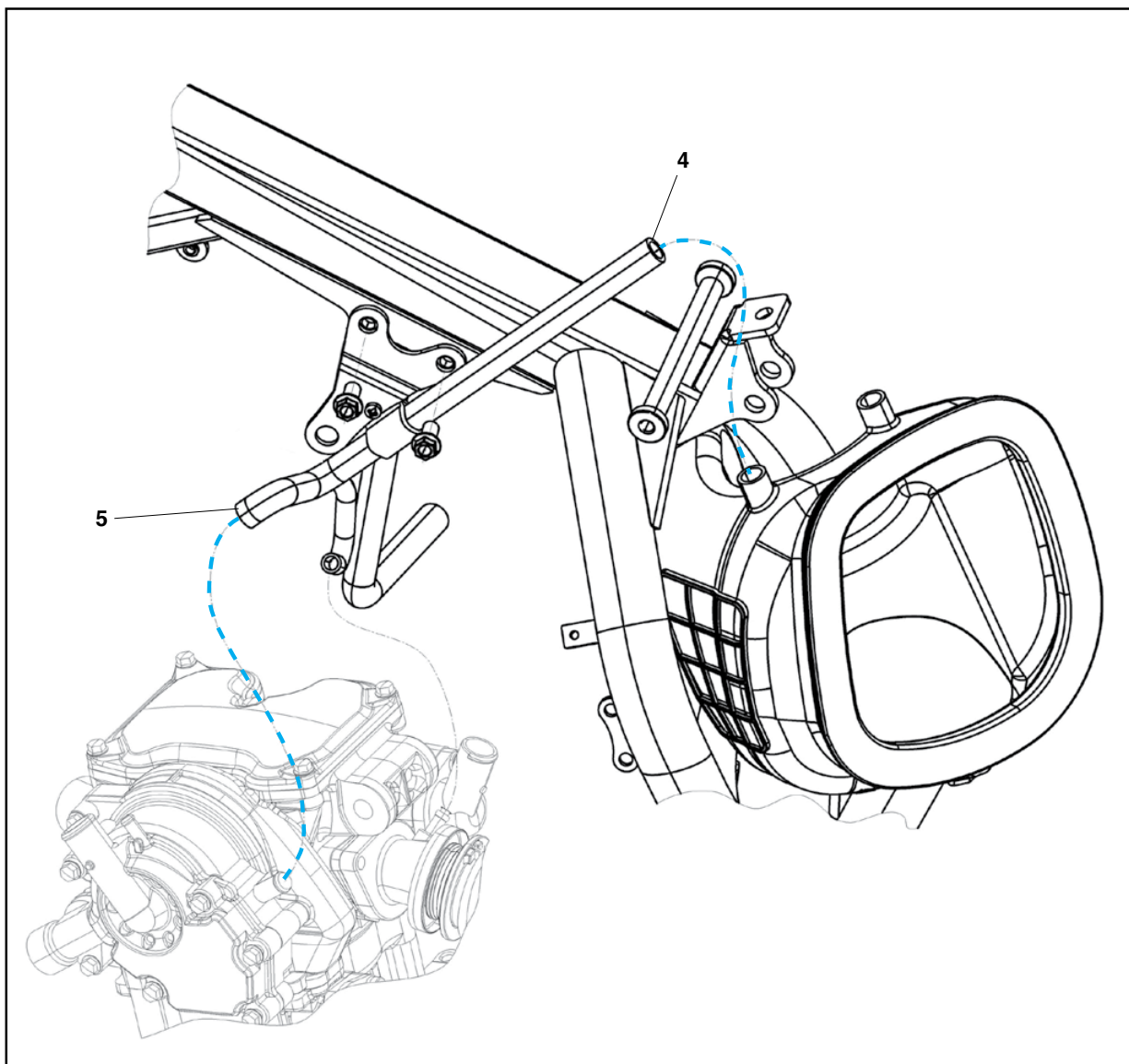


Order	Component	Quantity	Operation/Notes
			Removing the tank unit
1	Head – engine connections bracket pin	1	Remove
2	Right-side head connection bracket	1	Remove
3	Left-side head connection bracket	1	Remove
			For installation, perform the removal procedure in reverse.

## 1.14.2 VENTILATION PIPES

1

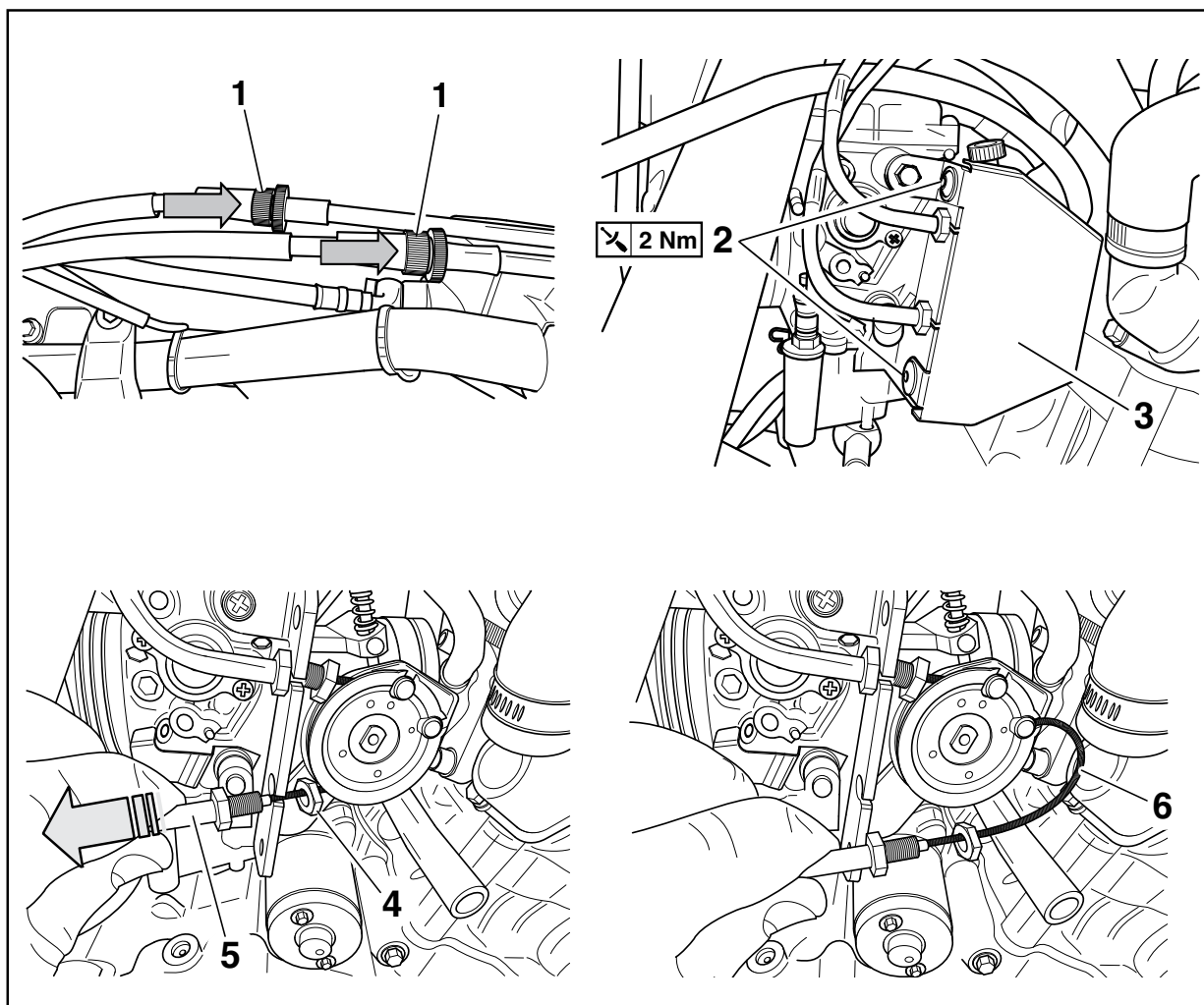
ENGINE REMOVAL FROM VEHICLE



Order	Component	Quantity	Operation/Notes
4	Ventilation pipe	1	Pipe disconnection from filter box sleeve
5	Ventilation pipe	1	Pipe disconnection from engine
			For installation, perform the removal procedure in reverse. Once the pipes have been reconnected, tighten them by the specific clamps.







Order	Component	Quantity	Operation/Notes
	Seat	1	Refer to "1.1 SEAT REMOVAL AND ASSEMBLY" on page 10
	Tank	1	Refer to "1.3 TANK" on page 12
1	Adjustments	2	Set the adjustments on the gas control to "0"
2	Screws	2	Remove
3	Cover	1	Remove
4	Counter-nut	1	Loosen completely
5	Sheath	1	Pull and remove the cable from the slot
6	Cable	1	Release the end of the cable from the throttle control pulley
			Repeat steps 4 to 6 for the other cable
			For installation, perform the procedure in reverse. Once reassembly is complete, check that the empty stroke of the gas knob is approximately 3mm (measured on the edge of the knob). If this measurement is not complied with, make the adjustment by using the adjustments referred to in point 1 Tighten to the indicated tightening torques, where required.

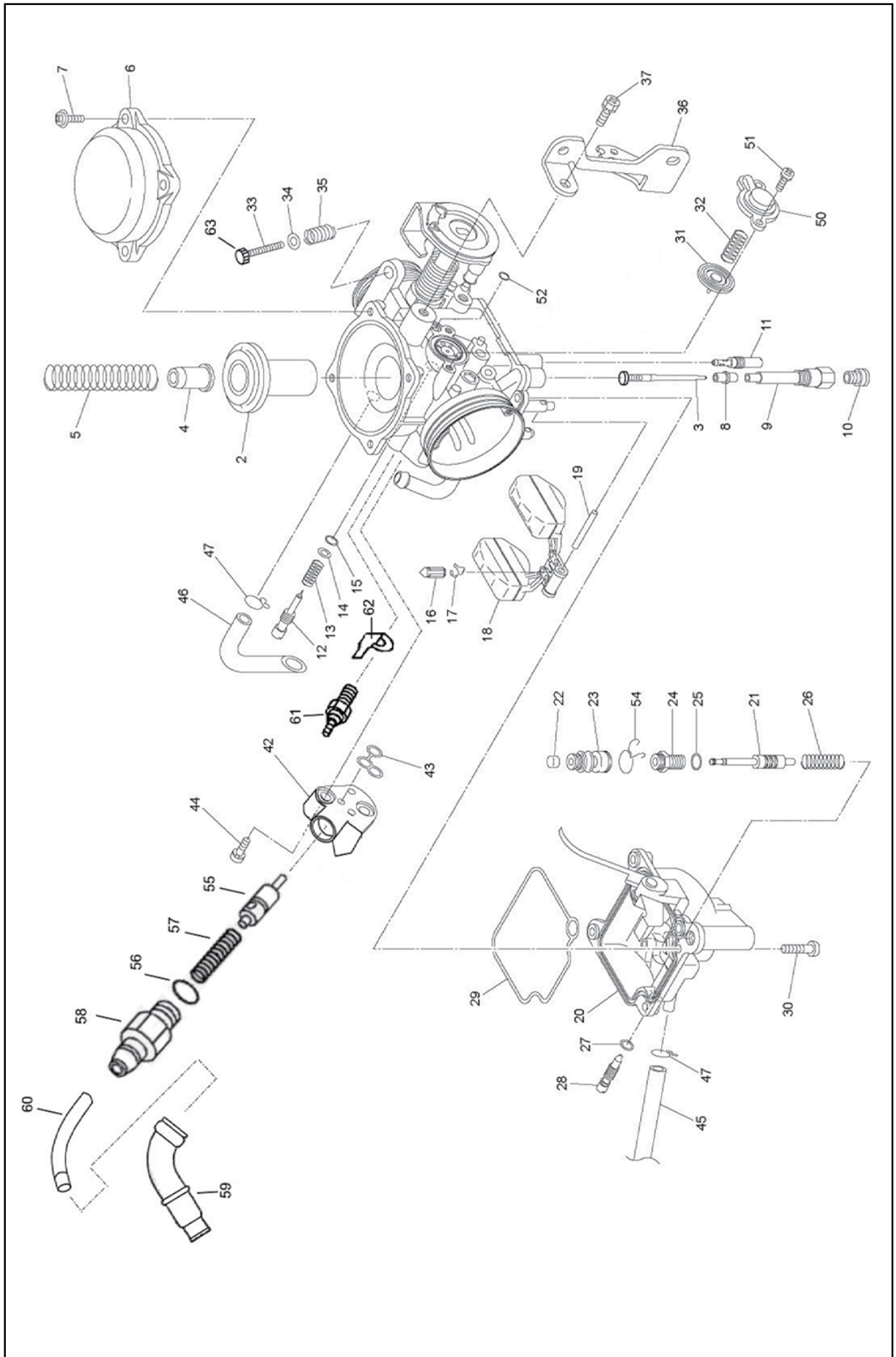
### 2.1.2 CARBURETTOR DISASSEMBLY AND REASSEMBLY

Order	Component	Quantity	Operation/Notes
	Carburettor	1	Refer to "1.6.1 CARBURETTOR DISCONNECTION AND RECONNECTION" on page 19
	Gas cables	2	Refer to "2.1.1 GAS CONTROL CABLES DISCONNECTION AND RECONNECTION" on page 34

**Note:** For all the operations described below, we recommend locking the carburettor on a vice by plastic, brass or aluminium jaws. Arrange all parts in an orderly fashion.

**WARNING:** ensure the workplace and the tools being used are completely clean.

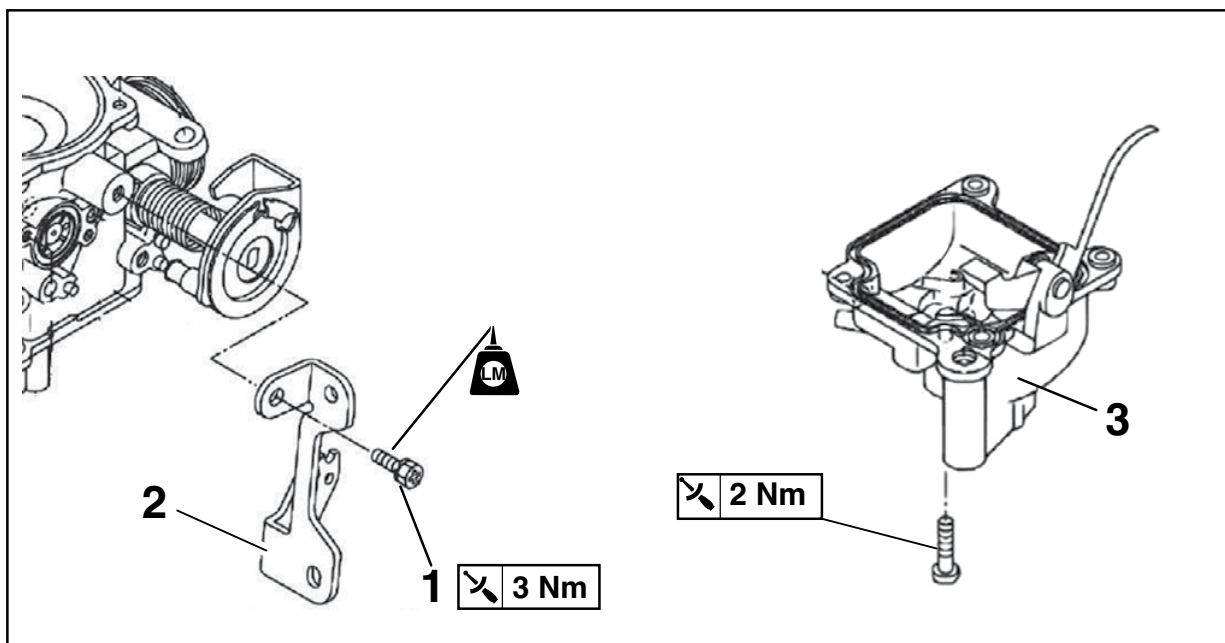




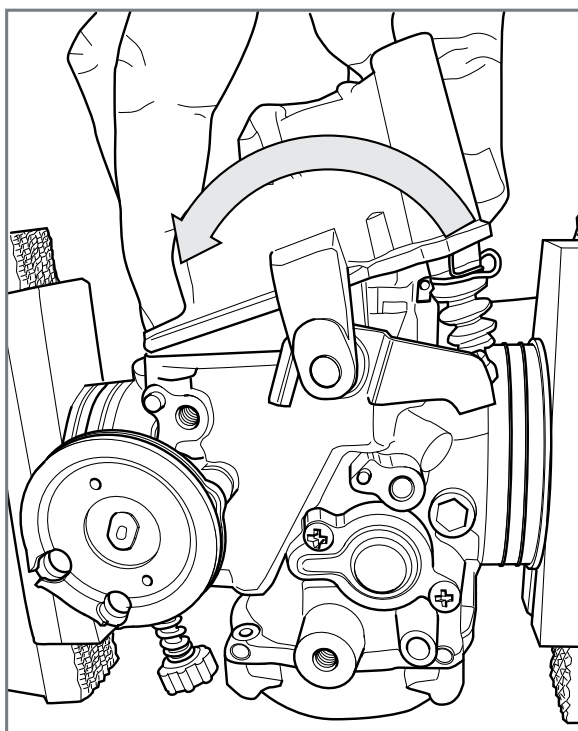
No.	Name	No.	Name
2	Complete piston	30	Screw
3	Needle	31	Membrane
4	Spring seat	32	Spring
5	Spring	33	Throttle adjustment screw
6	Cover	34	Washer
7	Screw	35	Spring
8	Atomiser	36	Fixing plate
9	Support	37	Screw
10	Maximum jet	42	Starter Body
11	Minimum jet	43	O-ring
12	Petrol screw	44	Screw
13	Spring	45	Pipe
14	Washer	46	Pipe
15	O-ring	47	Pipe clip
16	Floater needle	50	Cover
17	Clip	51	Screw
18	Floater	52	O-ring
19	Floater pin	54	Clip
20	Tank	55	Complete starter valve
21	Accelerator pump piston	56	O-ring
22	Cap	57	Spring
23	Bellows	58	Transmission support
24	Accelerator pump support	59	Rubber cap
25	O-ring	60	Transmission guide
26	Spring	61	Heater
27	O-ring	62	Terminal
28	Drain screw	63	Knob
29	Tank gasket		



## 2.1.2.1 Tank



Order	Component	Quantity	Operation/Notes
			Refer to "1.6.1 CARBURETTOR DISCONNECTION AND RECONNECTION" on page 19
			Refer to "2.1.1 GAS CONTROL CABLES DISCONNECTION AND RECONNECTION" on page 34
1	Screws	2	Remove
2	Fixing plate	1	Remove
3	Tank	1	Remove. See Note 1



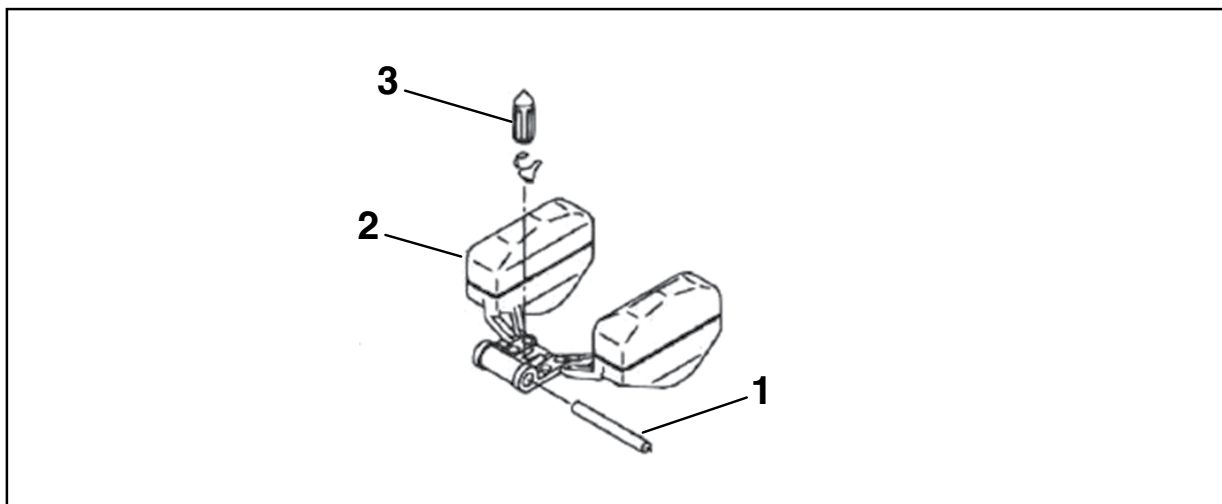
Carburettor tank handling.

**Note 1:** Warning! Move the tank as shown in the figure.

## 2.1.2.2 Floating unit disassembly, checks and reassembly

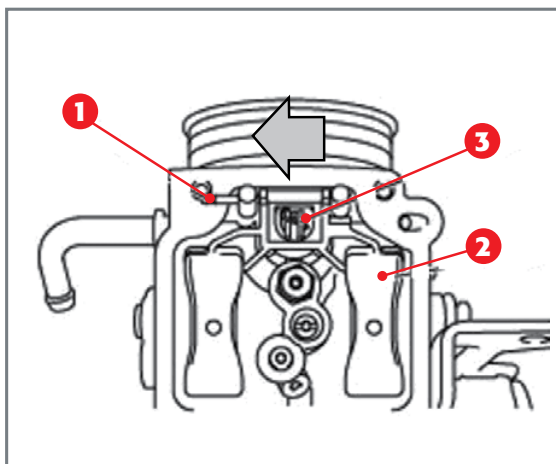
# 2

ENGINE DISASSEMBLY

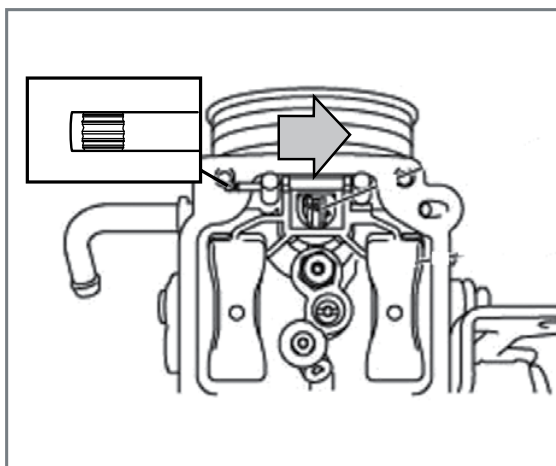


Order	Component	Quantity	Operation/Notes
			Refer to "1.6.1 CARBURETTOR DISCONNECTION AND RECONNECTION" on page 19
			Refer to "2.1.1 GAS CONTROL CABLES DISCONNECTION AND RECONNECTION" on page 34
			Refer to "2.1.2.1 Tank" on page 38
1	Floater pin	1	Remove. See Note 1
2	Floater	1	Remove
3	Needle	1	Remove
			For installation, perform the procedure in reverse.
			WARNING! To install the floater pin, see Note 2





**Float pin.**

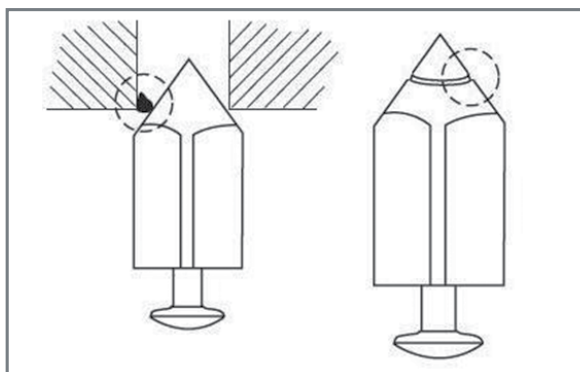


**Float pin insertion.**

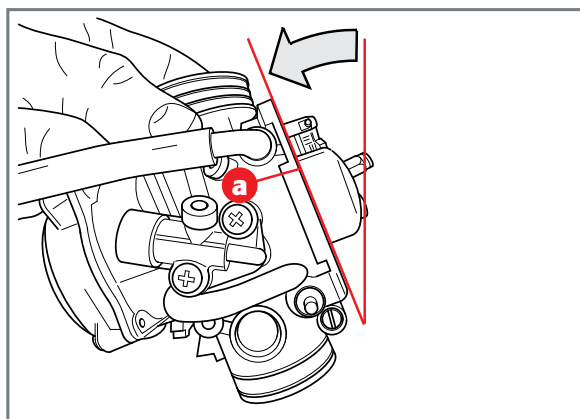
**Note 1:** Remove the float pin 1 in the direction indicated by the arrow.

**Note 2:** Proceed with reassembly, taking care to reinsert the float pin as shown in the figure.

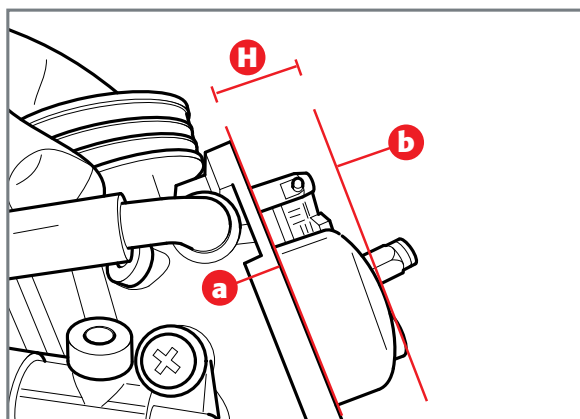




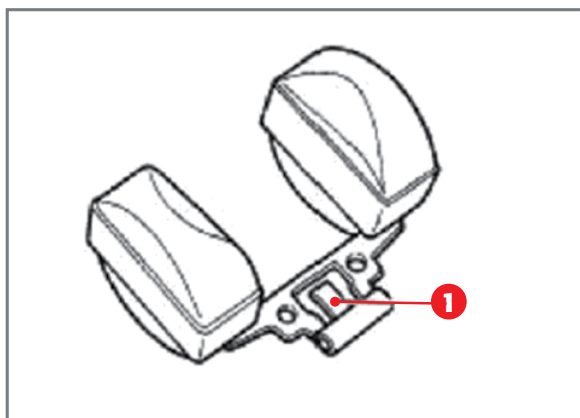
Needle deformation check



Floater position



Floater height



Floater key

**Checks**

Check for deformation on the sealing surface of the needle.

Make sure there is no dirt between the seat and the needle.

To check the floater height, it is necessary to replace the floater unit.

Place the carburettor with the tray surface **a** vertically and turn it anticlockwise, stopping as soon as the floater starts to close the needle.

The distance **H** between surface **a** and top **b** is the floater height.

<i>H</i>	17.5mm
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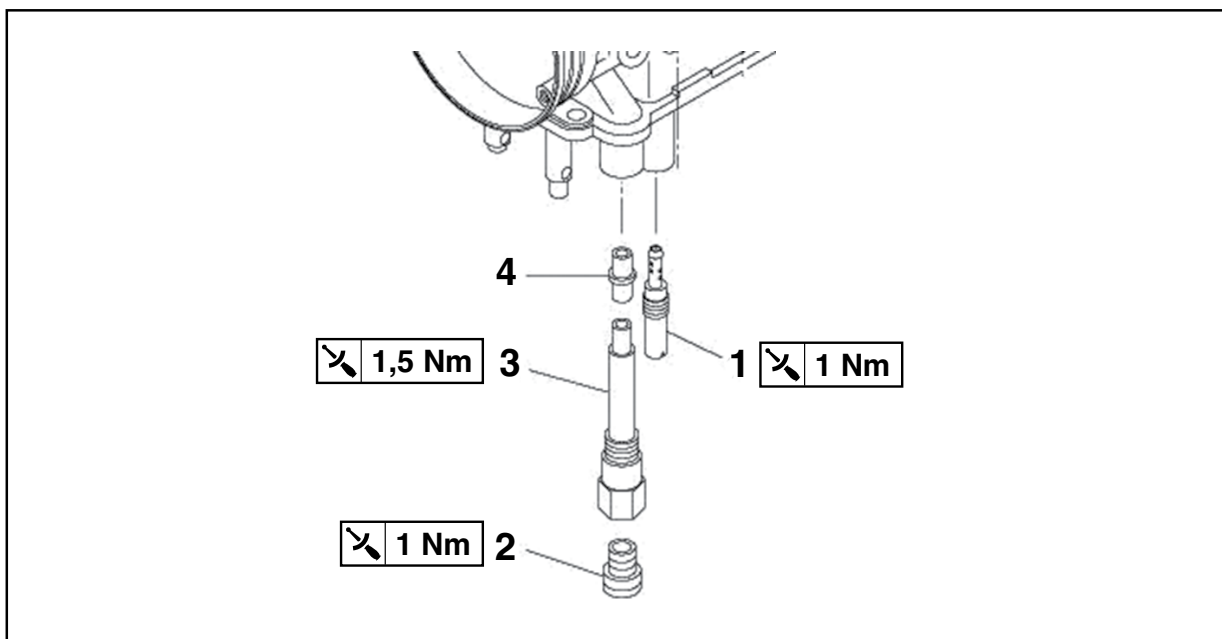
**Warning:** do not rotate the carburettor beyond this position, otherwise the weight of the floater will cause the closing needle internal spring to crush, thus showing a wrong floater position at first sight.

If the floater height does not fall within the specifications, check the needle valve:

- If worn, replace it;
- If it is in good condition, adjust the floater height by bending the floater key **1**.



## 2.1.2.3 Jet disassembly, checks and reassembly

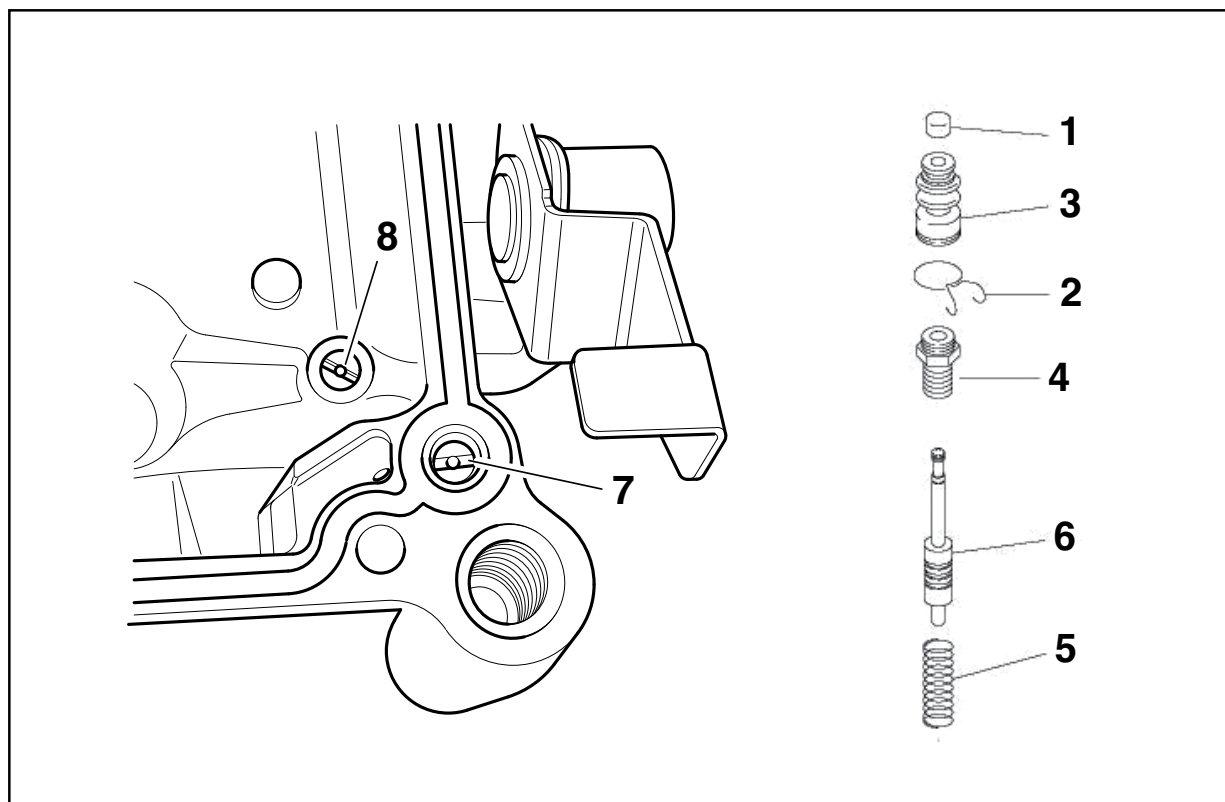


Order	Component	Quantity	Operation/Notes
	Tank		Refer to "2.1.2.1 Tank" on page 38
1	Minimum jet	1	Remove
2	Maximum jet	1	Remove
3	Support	1	Remove
4	Atomiser	1	Remove
			Wash using a specific cleaner and blow with compressed air.
			For installation, perform the removal procedure in reverse. Tighten to the indicated tightening torques, where required.

## 2.1.2.4 Accelerator pump unit disassembly, checks and reassembly

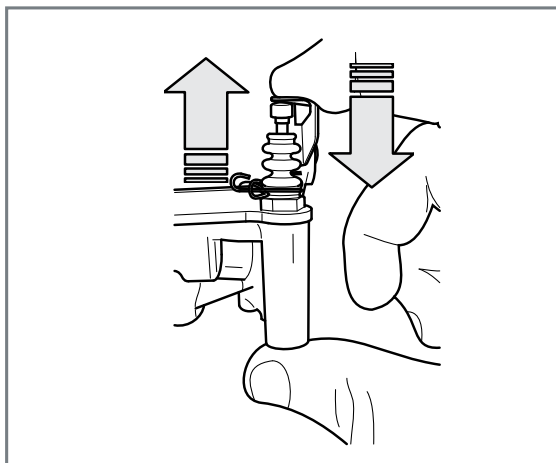
2

ENGINE DISASSEMBLY



Order	Component	Quantity	Operation/Notes
	Tank		Refer to "2.1.2.1 Tank" on page 38
1	Cap	1	Disconnect from piston
2	Clip	1	Open and remove
3	Bellows	1	Remove
4	Accelerator pump support	1	Unscrew
5	Spring	1	Remove
6	Accelerator pump piston	1	Remove
7	Supply jet	1	Unscrew
8	Intake jet	1	Unscrew
			Wash using a specific cleaner and blow with compressed air.
			For installation, perform the removal procedure in reverse.





*Accelerator pump unit operation check.*

Once the entire unit has been reassembled, make sure the pump unit slides regularly.

Put a small amount of petrol in the tank so that the intake jet is covered. Move the accelerator pump and check that the petrol is sprayed by the delivery jet.



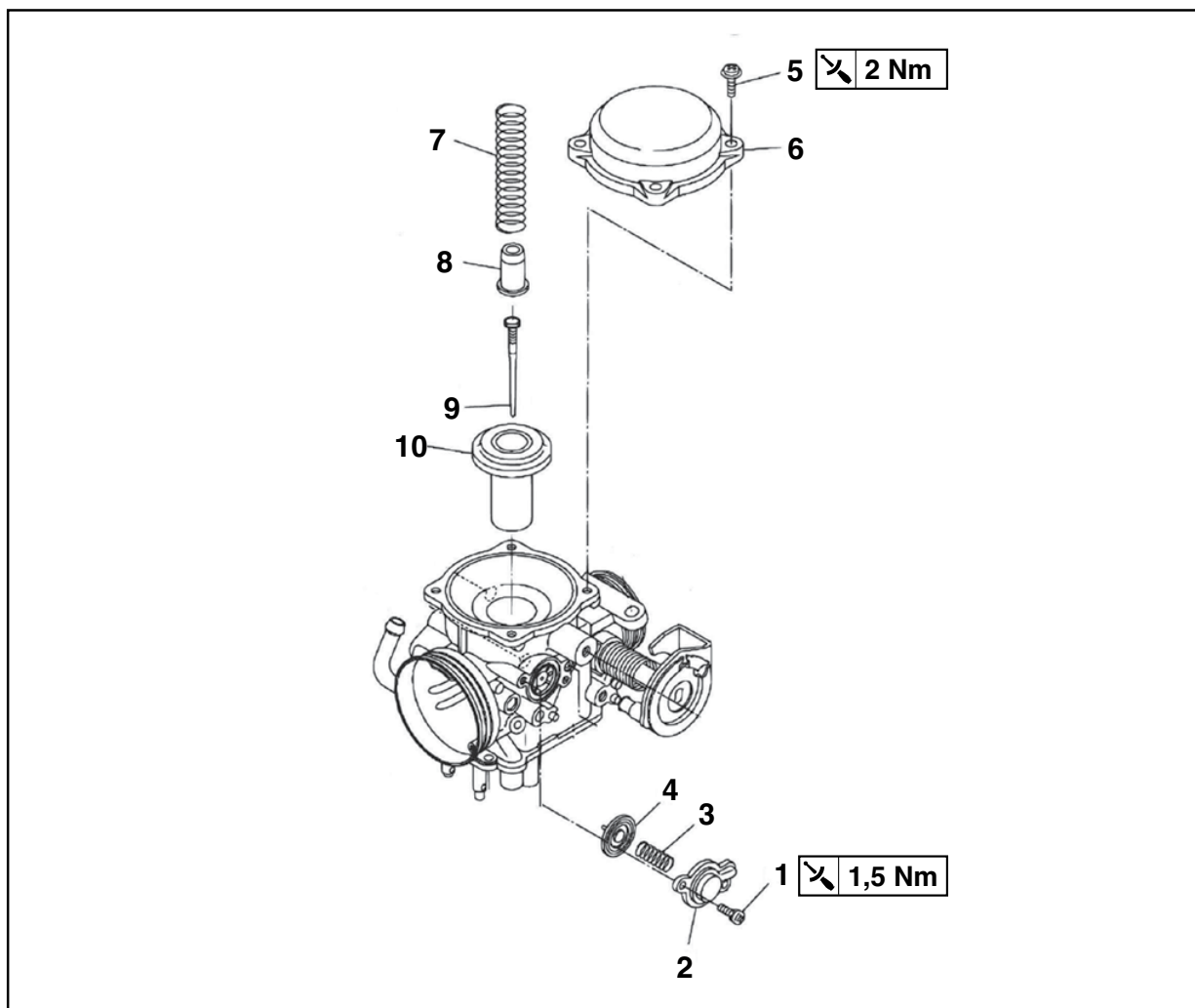
**WARNING:** Perform the check in way that the petrol will not spill towards yourselves or others.  
Fire hazard! Fuel is easily flammable.



**Do not carry out the operation near open flames or lit cigarettes.**

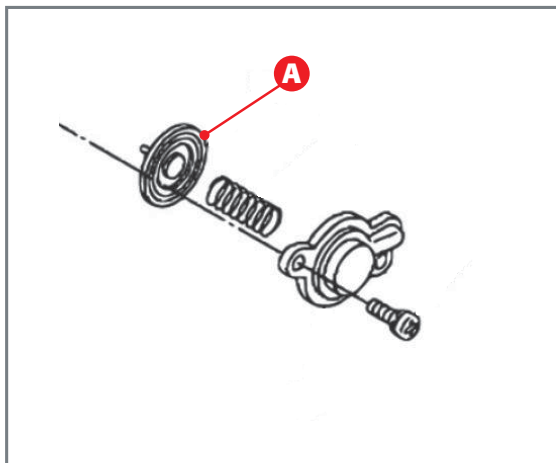


**Wipe off any traces of spilled fuel immediately.**

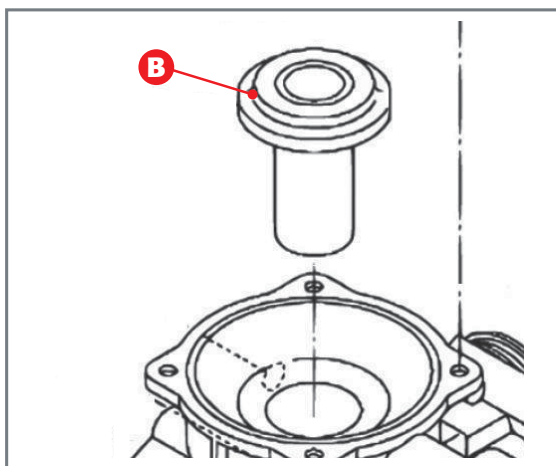


Order	Component	Quantity	Operation/Notes
	Carburettor	1	Refer to "1.6.1 CARBURETTOR DISCONNECTION AND RECONNECTION" on page 19. It is also recommended to see "2.1.1 GAS CONTROL CABLES DISCONNECTION AND RECONNECTION" on page 34
1	Screw	2	Remove
2	Cover	1	Remove ⚠ Pay attention: the cover compresses a spring
3	Spring	1	Remove
4	Membrane	1	Remove
5	Screw	4	Remove
6	Cover	1	Remove ⚠ Pay attention: the cover compresses a spring
7	Spring	1	Remove
8	Spring seat	1	Remove from the seat
9	Needle	1	Remove from the seat
10	Piston	1	Remove from the seat
			For installation, perform the removal procedure in reverse. Tighten to the indicated torque, where required.





*Membrane integrity check.*



*Piston integrity check.*

### Checks

Check the integrity of the membrane **A**, replace if worn.

Check the integrity of the membrane on the piston **B**, replace if worn.

Make sure no scratches or superficial deformations are present on piston **B**. Otherwise replace them.

Wash all parts with specific cleaner and blow with compressed air.

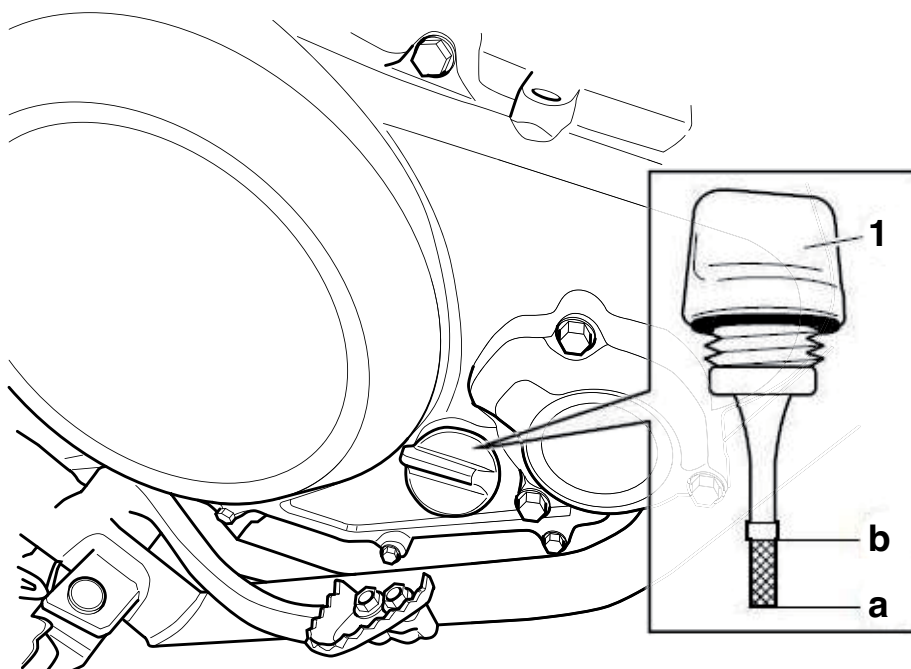
Blow all ducts with compressed air.

At the end of the reassembly operations, move the piston with a finger, making sure it slides normally.

## 2.2 ENGINE OIL CHECK AND REPLACEMENT

### 2.2.1 ENGINE OIL LEVEL CHECK

Oil filler cap

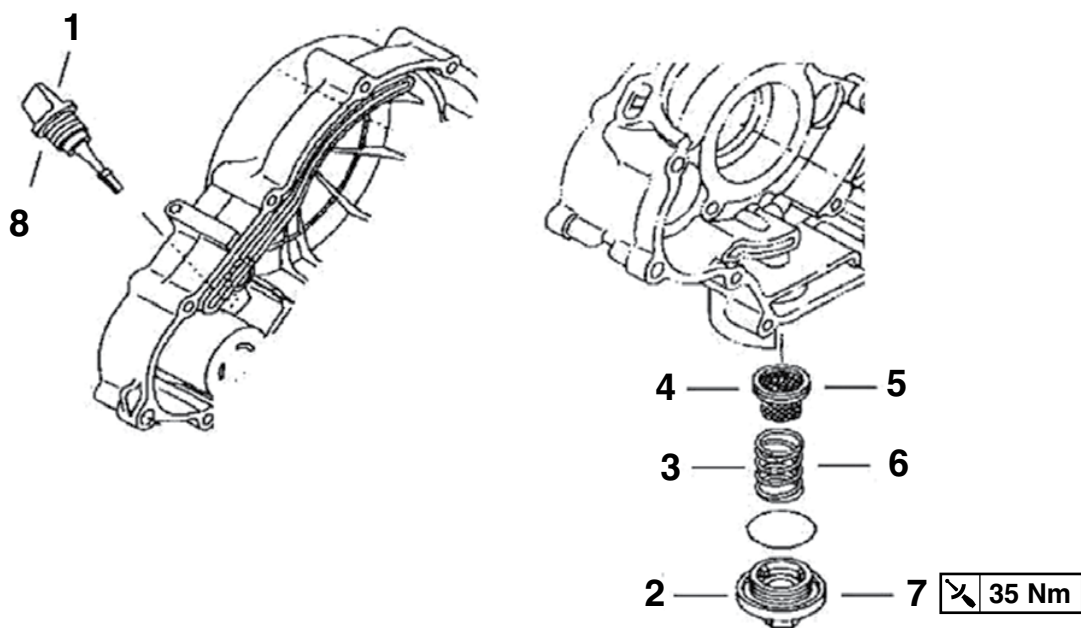


Order	Component	Quantity	Operation/Notes
			Start the engine, warm it up for a few minutes, then turn it off
			Keep the vehicle in a vertical position with respect to the Ground
			Wait a few minutes for the oil to settle
1	Filler cap	1	Remove
			check that the level is between the two notches <b>a</b> (Min) and <b>b</b> (Max).
			If the level is below the notch <b>a</b> (Min) add oil until it goes back to notch <b>b</b> (Max).



## 2.2.2 ENGINE OIL REPLACEMENT

## Engine oil drain



Order	Component	Quantity	Operation/Notes
			Start the engine, warm it up for a few minutes, then turn it off
			Keep the vehicle in a vertical position with respect to the Ground
			Place a container under the oil drain cap
1	Filler cap	1	Remove
2	Drain cap	1	Remove
3	Spring	1	Remove
4	Oil filter	1	Remove
			Drain all the oil out
			Clean the oil filter, replace if required
5	Oil filter	1	Insert
6	Spring	1	Insert
			Pay attention to the O-ring. Replace if required
7	Drain cap	1	Apply and tighten to the specified torque
	Oil	950ml	Without paper filter replacement
		1000ml	With paper filter replacement
8	Filler cap	1	Apply and tighten to the specified torque
			Check engine oil level. Refer to "2.2.1 ENGINE OIL LEVEL CHECK" on page 47
			Check for engine oil pressure. Refer to "2.2.4 ENGINE OIL PRESSURE CHECK" on page 50



**WARNING: Hot oil may cause severe burns!**

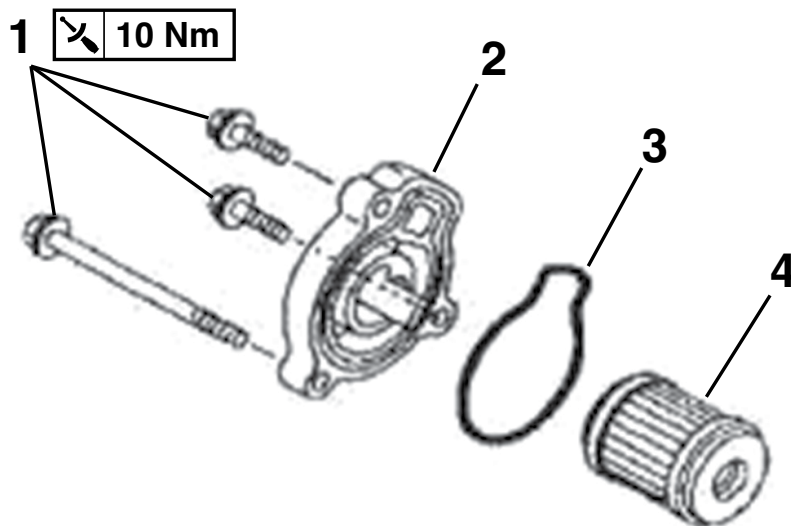
**WARNING: Dispose of used oil by following the regulations in force.**

## 2.2.3 PAPER OIL FILTER REPLACEMENT

2

ENGINE DISASSEMBLY

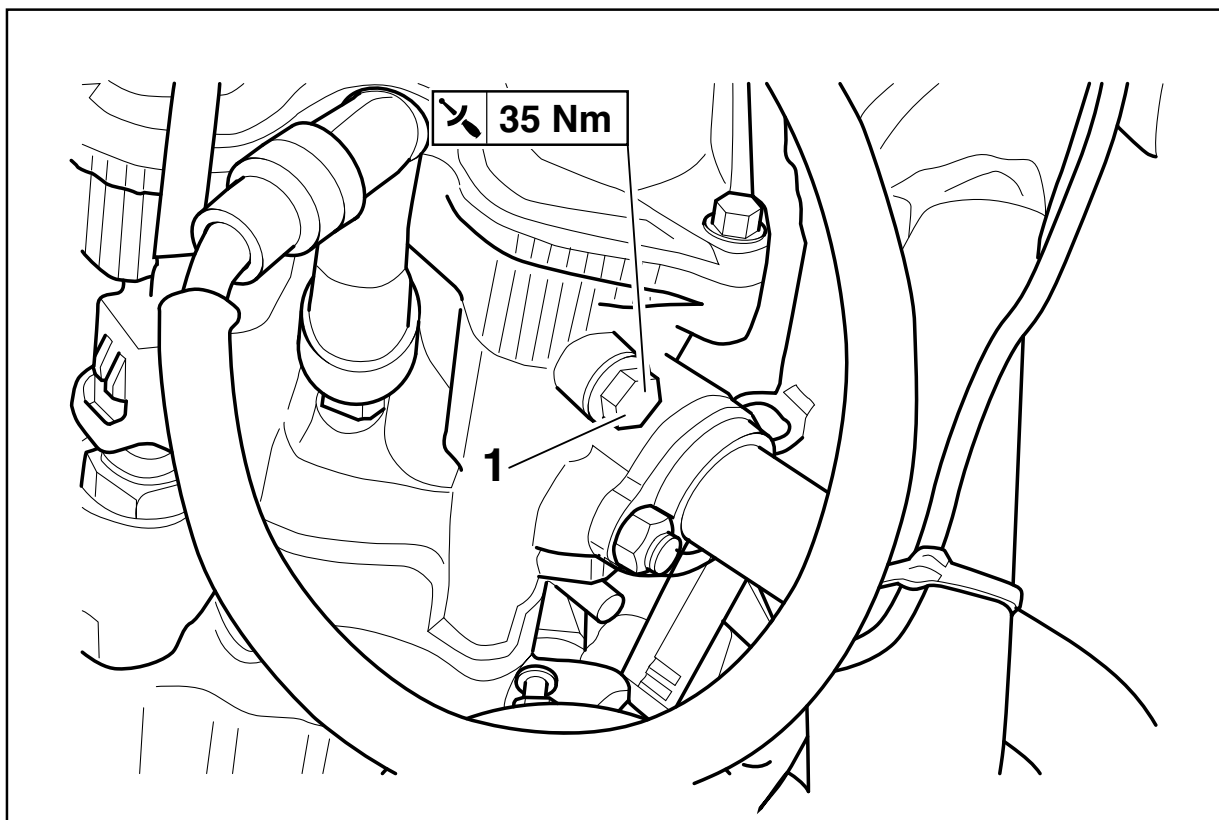
### Oil filter replacement



Order	Component	Quantity	Operation/Notes
1	Screw	3	Remove
2	Filter cap	1	Remove
3	O-ring	1	Remove and replace
4	Paper oil filter	1	Remove and replace
			For installation, perform the removal procedure in reverse. Tighten to the indicated torque, where required.
			Check engine oil level. Refer to "2.2.1 ENGINE OIL LEVEL CHECK" on page 47
			Check for engine oil pressure. Refer to "2.2.4 ENGINE OIL PRESSURE CHECK" on page 50



## 2.2.4 ENGINE OIL PRESSURE CHECK

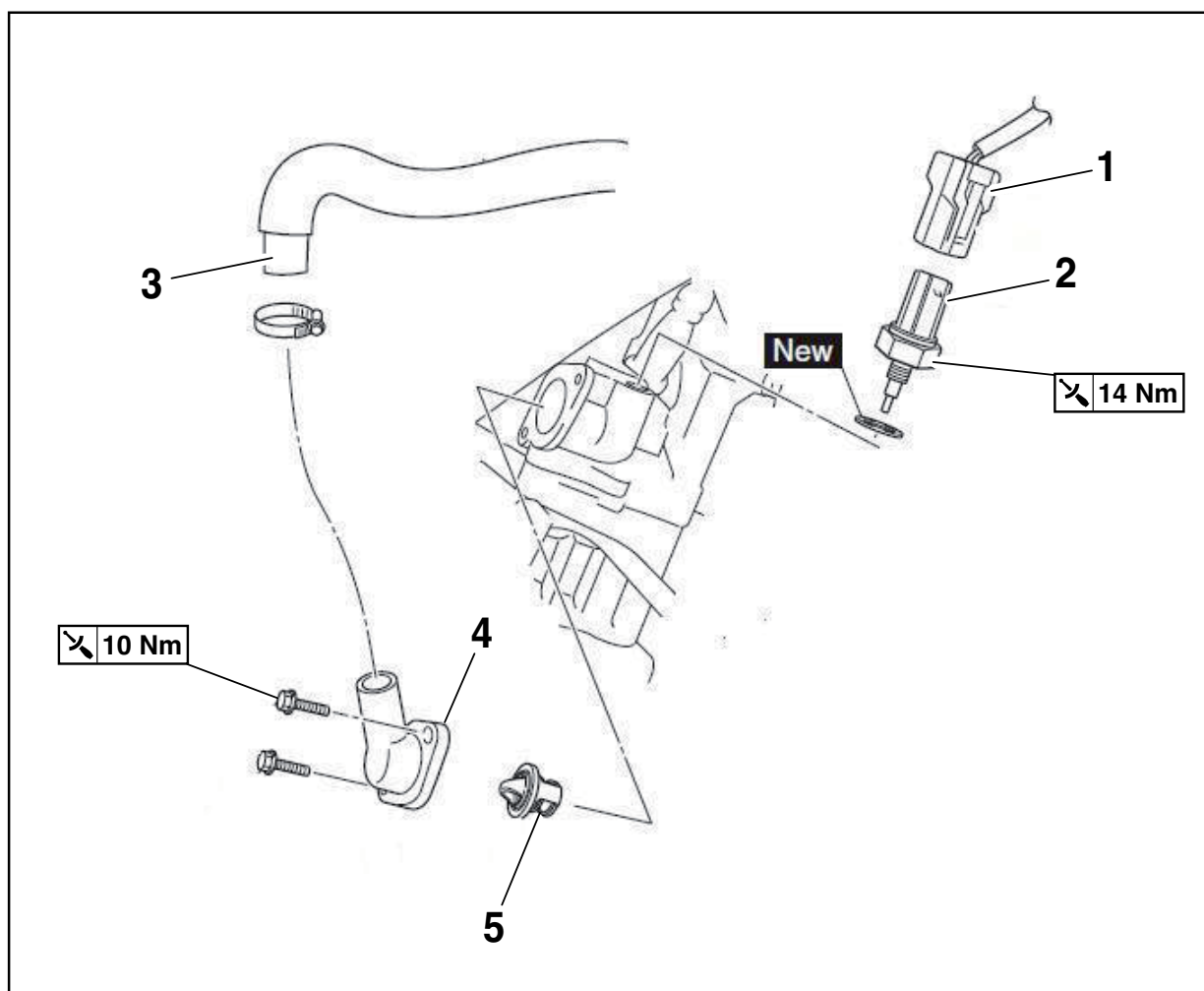


Order	Component	Quantity	Operation/Notes
1	Inspection cap	1	Remove
			Start the engine and let it run at minimum until the engine oil begins to filter from the oil level inspection cap. If no engine oil starts coming out after a minute, switch off the engine so that it does not lock.
			Check the engine oil routes, the oil filter element and the oil pump for any damage or leaks. Refer to "2.4.21 OIL PUMP" on page 97
			Start the engine after solving the problem or problems and check the engine oil pressure again.
			Tighten the oil level inspection cap as required

## 2.3 THERMOSTAT AND TEMPERATURE SENSOR DISASSEMBLY AND REASSEMBLY

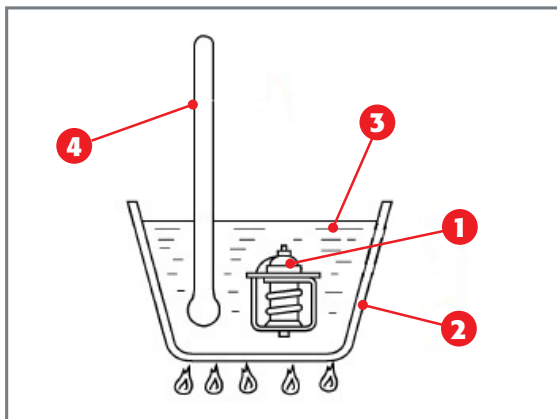
# 2

ENGINE DISASSEMBLY

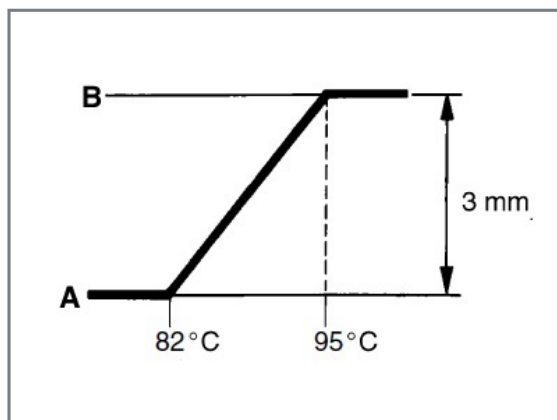


Order	Component	Quantity	Operation/Notes
	Coolant liquid		Drain. Refer to "1.7.1 LIQUID DRAIN" on page 21
	Tank		Remove. Refer to "1.3 TANK" on page 12
1	Temperature sensor connector		Release
2	Temperature sensor	1	Remove
3	Sleeve	1	Remove
4	Thermostat cover	1	Remove
5	Thermostat	1	Remove
			For installation, perform the removal procedure in reverse. Tighten to the indicated torques, where required. For thermostat reassembly, see NOTE 1

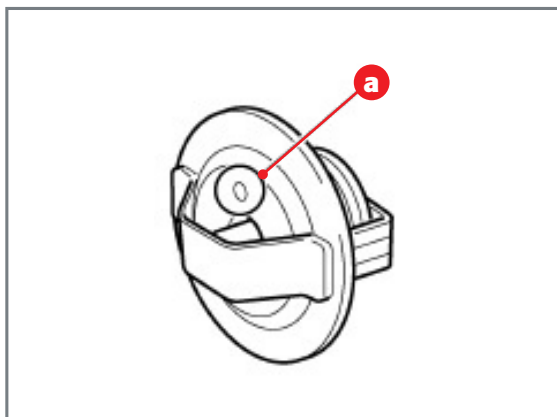




**Thermostat operation check.**



**A: Fully closed**  
**B: Fully open**



**Thermostat assembly.**

### 2.3.1 THERMOSTAT CHECK

- Keep the thermostat **1** suspended in a container **2** full of water.
- Slowly heat the water **3**.
- Insert thermometer **4** in the water.
- Observe the thermostat and the temperature indicated by the thermometer

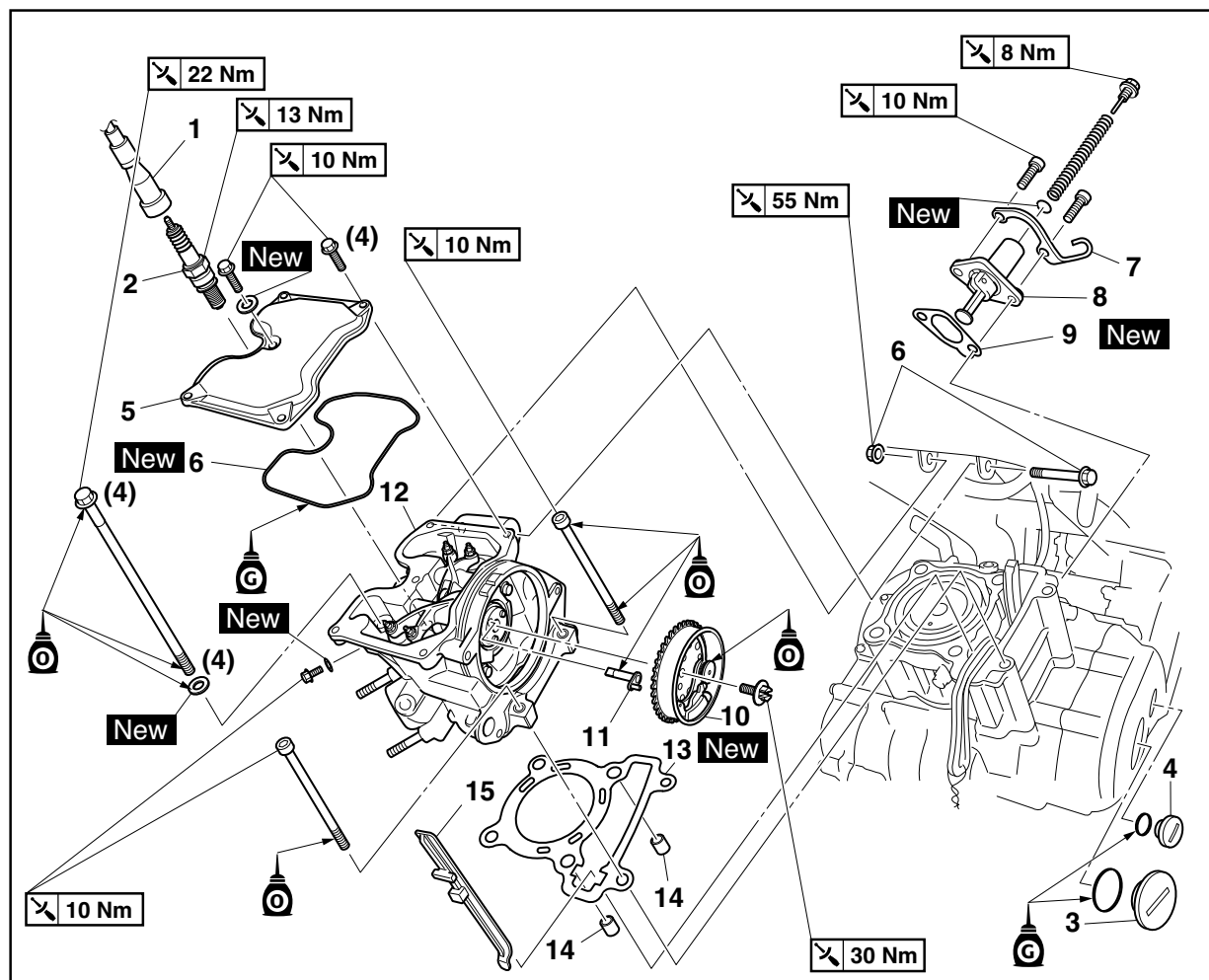
If you doubt the accuracy of the thermostat, replace it.

A faulty thermostat may cause dangerous overheating or sub-cooling.

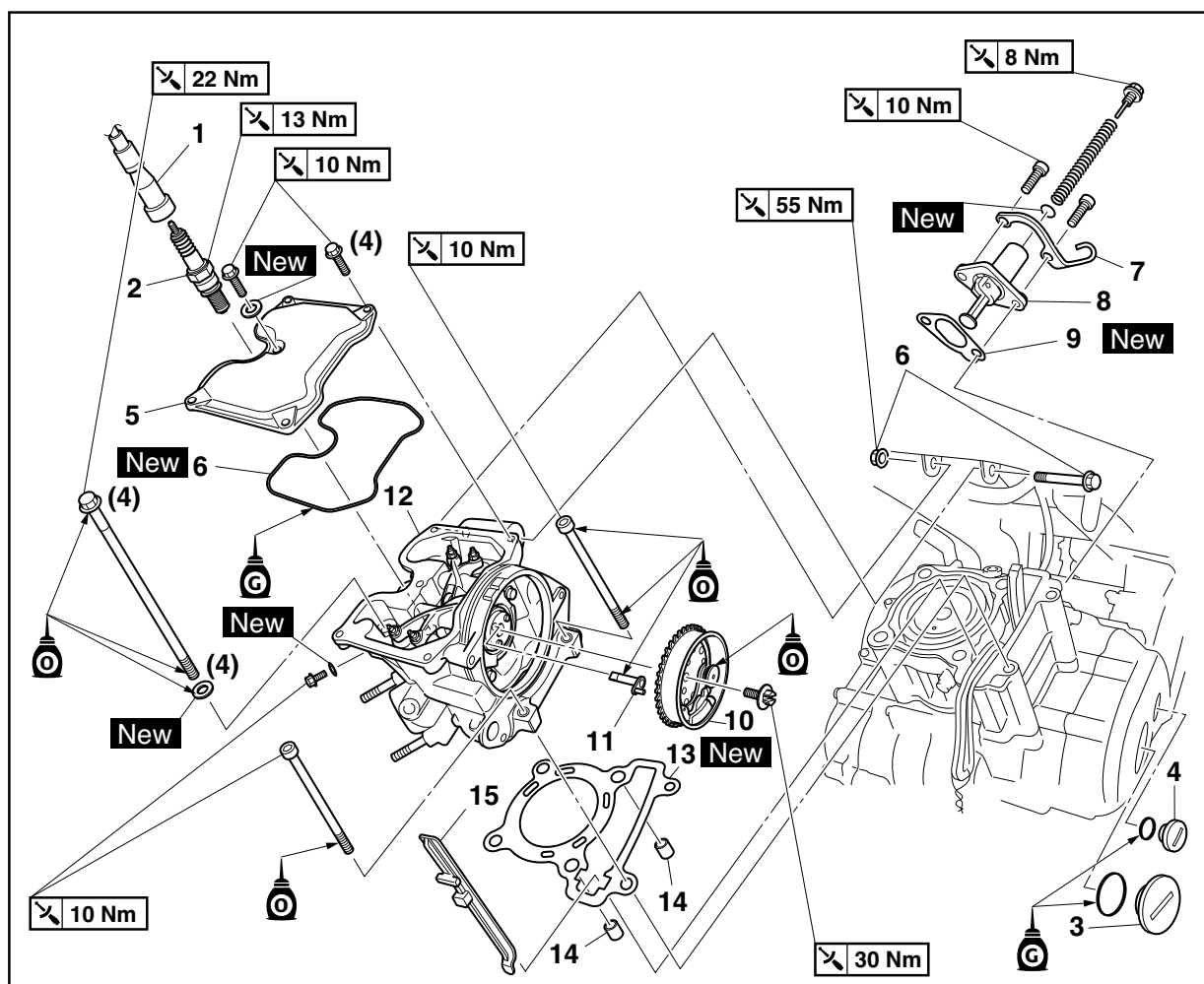
**Note 1:** Install the thermostat with the venting hole "a" facing up.

## 2.4 ENGINE DISASSEMBLY, CHECKS AND REASSEMBLY

### 2.4.1 CYLINDER HEAD

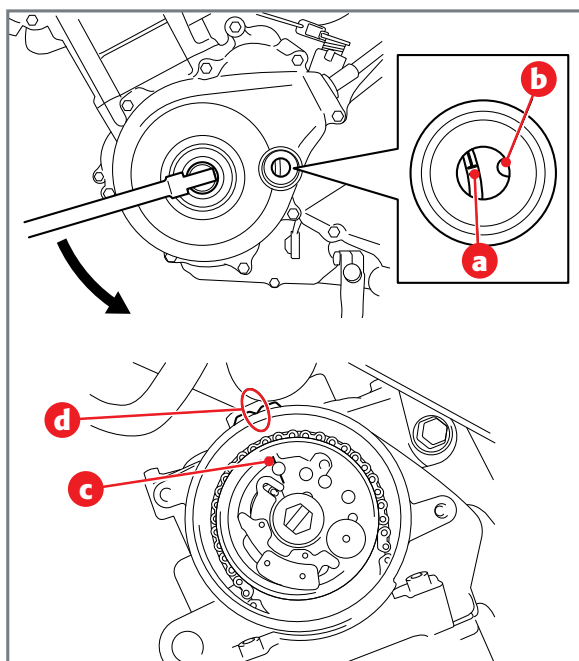


Order	Operation/Components to be removed	Quantity	Notes
	Filter box rotation		Refer to "1.5 FILTER BOX ROTATION" on page 16
	Carburettor		Refer to "1.6.1 CARBURETTOR DISCONNECTION AND RECONNECTION" on page 19
	Cooling system		Refer to "1.7 COOLING SYSTEM" on page 21
	Head unit connections		Refer to "1.14 HEAD CONNECTIONS AND VENTILATION PIPES UNIT" on page 32
	Clutch cable		Refer to "1.9 CLUTCH CABLE" on page 27
	Coil		Refer to "1.8 COIL" on page 26
	Coolant liquid temperature Thermostat/Sensor		Refer to "2.3 THERMOSTAT AND TEMPERATURE SENSOR DISASSEMBLY AND REASSEMBLY" on page 51
	Water pump		Refer to "2.4.27 WATER PUMP" on page 122.

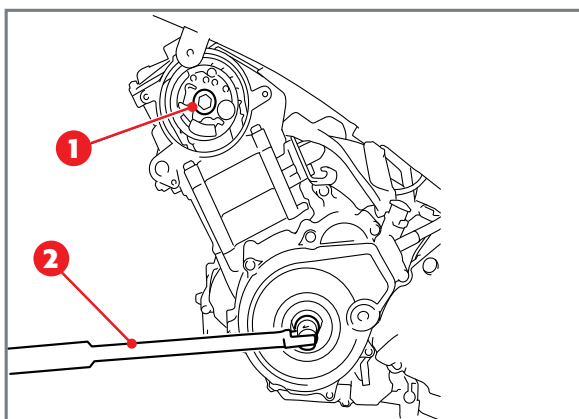


Order	Operation/Components to be removed	Quantity	Notes
1	Spark plug cap	1	Disconnect
2	Spark plug	1	
3	Crankshaft end access screw	1	
4	Phasing reference access screw	1	
5	Cylinder head cover	1	
6	Cylinder head cover gasket	1	
7	Clutch cable support	1	
8	Timing chain tensioner	1	
9	Timing chain tensioner gasket	1	
10	Camshaft pinion	1	
11	Decompressor cam	1	
12	Cylinder head	1	
13	Cylinder head gasket	1	
14	Centring pin	1	
15	Timing chain guide (exhaust side)	1	
			For installation, perform the removal procedure in reverse.

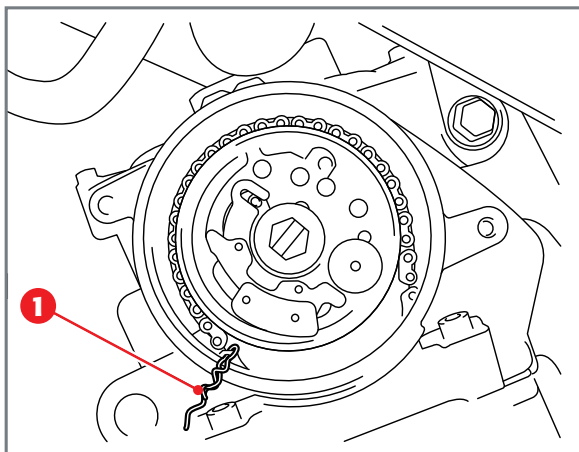




References **a**, **b** on the rotor, **c** on the camshaft pinion and **d** on the cylinder head



Camshaft pinion screw **1** and wrench **2**.



Chain fixing with wire **1**.

## 2.4.2 CYLINDER HEAD REMOVAL

Align:

- Reference "I" **a** on the generator rotor (with the stationary reference **b** on the generator cover).
- a. Rotate the crankshaft anticlockwise.  
 b With the piston at the TDC of the compression stage, align reference "I" **c** on the camshaft pinion to reference **d** on the cylinder head.

Loosen:

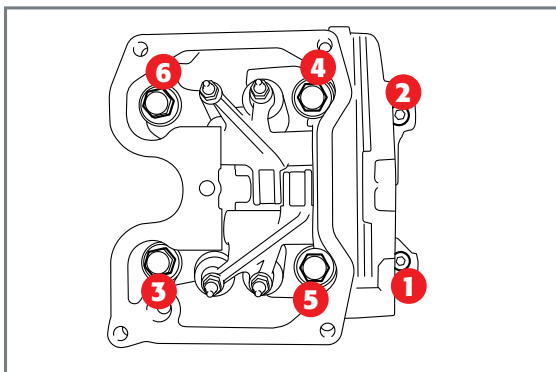
- Camshaft pinion screw **1**.

**Note:** Keeping the generator rotor nut locked with a wrench **2**, loosen the camshaft pinion screw.

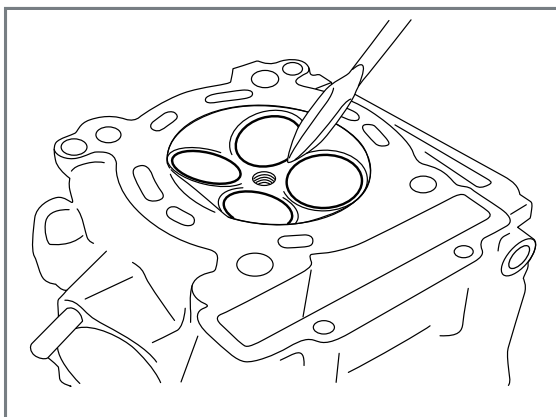
Remove:

- Camshaft pinion.

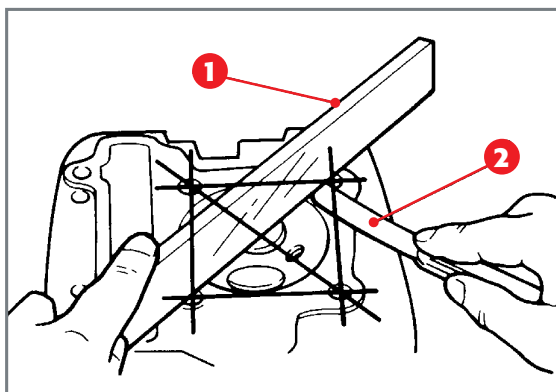
**Note:** To prevent the timing chain from falling into the crankcase, fasten it by using a wire **1**.



**Bolt loosening order.**



**Combustion chamber cleaning.**



**Head deformation measurement.**

**Note:** Loosen the screws in the indicated sequence. Loosen each screw by 1/2 turn at a time. When all bolts have been fully loosened, remove the screws **1, 2, 4** and **6**, then remove the cylinder head by screws **3** and **5** inserted in the relative holes.

### 2.4.3 CYLINDER HEAD CHECK

Remove:

- Carbon deposits from the combustion chamber (using a rounded scraper).

**Note:** Do not use a sharp instrument, to avoid damaging or scratching:

- Spark plug hole threading
- Valve seats

Check:

- Cylinder head  
Damage/scratches → Replace.
- Cylinder head water jacket  
Mineral deposits/rust → Remove.

Measure:

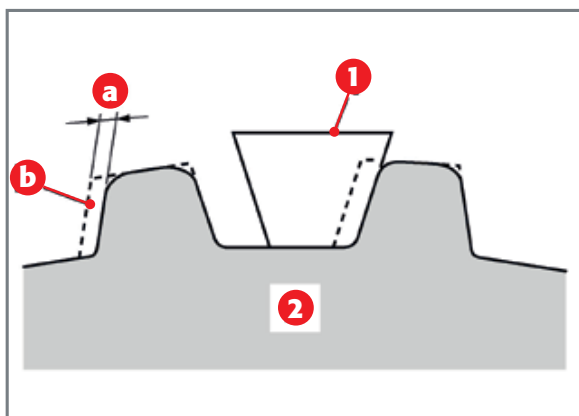
- Cylinder head deformation  
Not compliant with specifications → Smoothen the cylinder head.

**Deformation limit**  
**0.03mm**

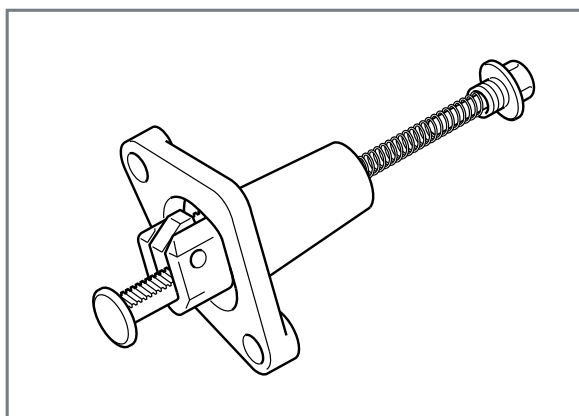
- Place a stop line **1** and a thickness gauge **2** transversely on the cylinder head.
- Measure the deformation.
- If the limits are exceeded, smoothen the cylinder head as follows.

Place 400-600 grit wet sandpaper on a levelling table and smoothen the cylinder head following an eight movement.

**Note:** To obtain an even surface, turn the cylinder head several times.



Chain roller 1 and camshaft pinion 2



Timing chain tensioner.

## 2.4.4 CAMSHAFT PINION AND TIMING CHAIN GUIDE CHECK

Check:

- Camshaft pinion  
More than 1/4 tooth wear **a** → Fully replace the camshaft pinion, the timing chain and the crankshaft.

- a** 1/4 of a tooth
- b** Correct
- 1** Timing chain roller
- 2** Camshaft pinion

Check:

- Timing chain guide (exhaust side)  
Damage/wear → Replace.

## 2.4.5 TIMING CHAIN TENSIONER CHECK

Check:

- Timing chain tensioner  
Cracks/damage → Replace.

Check:

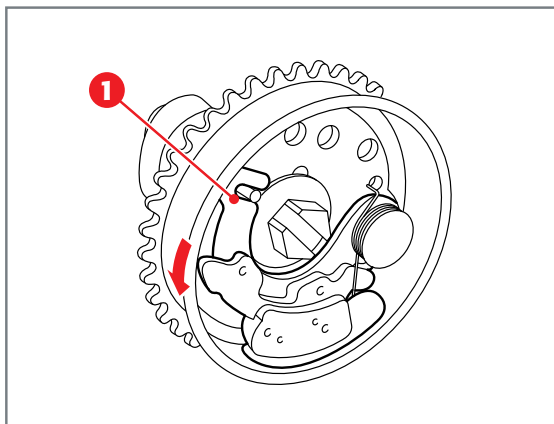
- Unidirectional cam operation  
Difficult movement → Replace the timing chain tensioner

Check:

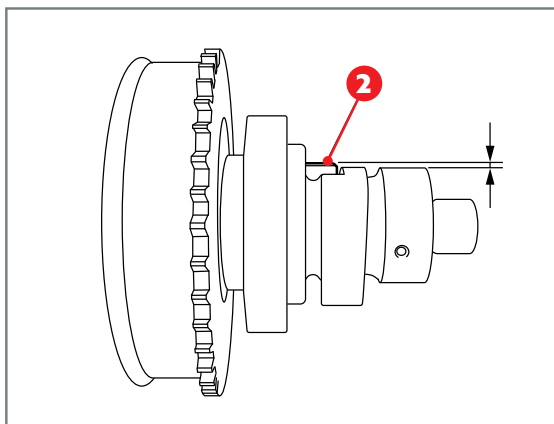
- Cover screw
- O-ring
- Spring
- Unidirectional cam
- Gasket

- Timing chain tensioner rod  
Damage/wear → Replace the faulty component (or faulty components).

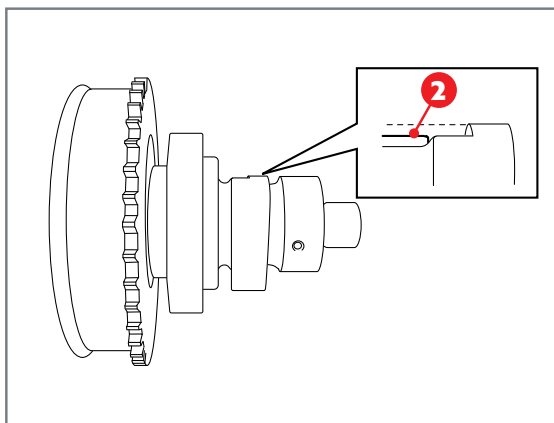
- Remove the cover screw and the spring.
- Press the unidirectional cam of the timing chain tensioner. Push the tensioner rod into the timing chain tensioner housing.
- Install the cover screw and the spring.
- Be sure to return to the end of the timing chain tensioner.



**Decompressor lever 1.**



**Figure A: Decompressor cam 2.**



**Figure B: Decompressor cam 2.**

## 2.4.6 DECOMPRESSION SYSTEM CHECK

Check:

- Decompression system
- a. Check the decompression system with the camshaft pinion and the decompressor cam installed in the camshaft.
  - b. Check that the decompressor lever **1** moves smoothly.
  - c. Without operating the decompressor lever, check that the decompressor cam **2** protrudes from the camshaft (exhaust cam) as shown in figure **A**.
  - d. Move the decompressor lever **1** in the direction of the arrow and check that the decompressor cam does not protrude from the camshaft (exhaust cam) as shown in figure **B**.

## 2.4.7 CYLINDER HEAD INSTALLATION

Install:

- Cylinder head.

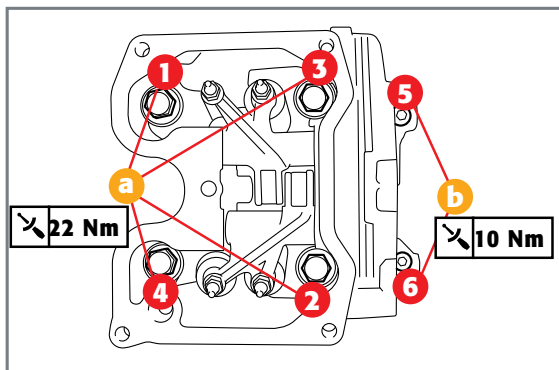
**Note:** Pass the timing chain through the timing chain groove.

Tighten:

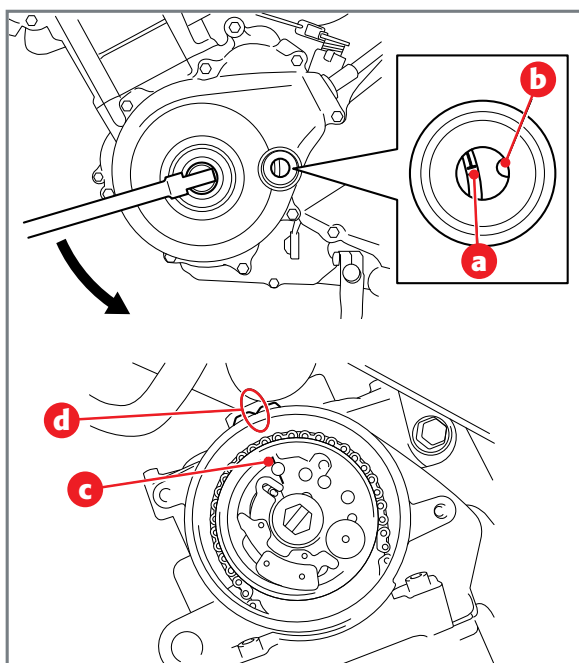
- Cylinder head screws **a**.
- Cylinder head screws **b**.

**Note:** Lubricate cylinder head screws and washers with engine oil.

Tighten the cylinder head screws in two stages, by following the tightening sequence shown in the figure.



Tightening order and torques of the bolts.



References **a**, **b** on the rotor, **c** on the camshaft pinion and **d** on the cylinder head

Install:

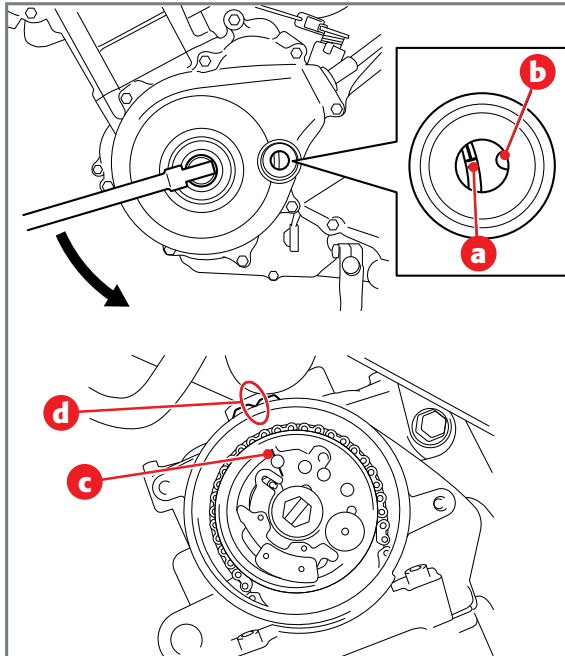
- Camshaft pinion.

- Rotate the crankshaft anticlockwise.
- Align reference "I" **a** on the generator rotor to reference **b** on the generator cover.
- Align reference "I" **c** on the camshaft pinion to stationary reference **d** on the cylinder head.
- Install the timing chain on the camshaft pinion, then install the camshaft pinion on the camshaft.

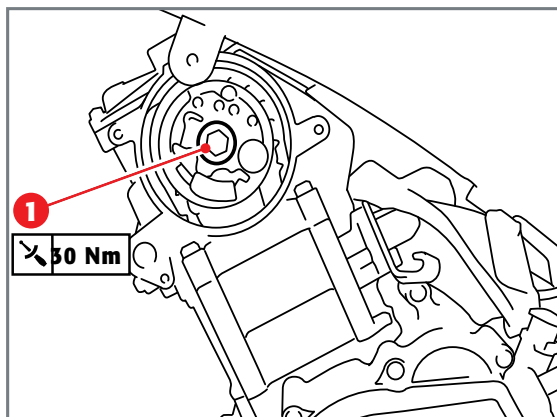
**Note:** When installing the camshaft pinion, be sure to keep the timing chain as tight as possible on the exhaust side.

**WARNING:** Do not turn the crankshaft when installing the shaft/camshafts to avoid damage or incorrect valve adjustment.

- Keeping the camshaft locked, temporarily tighten the camshaft pinion screw.
- Remove the wire from the timing chain.



**References *a, b* on the rotor, *c* on the camshaft pinion and *d* on the cylinder head**



### **Camshaft 1 pinion screw tightening**

- Timing chain tensioner gasket.
- Timing chain tensioner.

- Note:** Apply sealant to the timing chain tensioner screw threads.

- Crankshaft (multiple anticlockwise rotations).

- Reference **"1" a**  
Align reference **"1"** on the generator rotor with reference **b** on the generator cover.
- Reference **"1" c**  
Align reference **"1"** on the camshaft pinion with reference **d** on the cylinder head.  
Out of alignment → Fix.  
Refer to the installation operations provided above.

- Camshaft pinion screw.

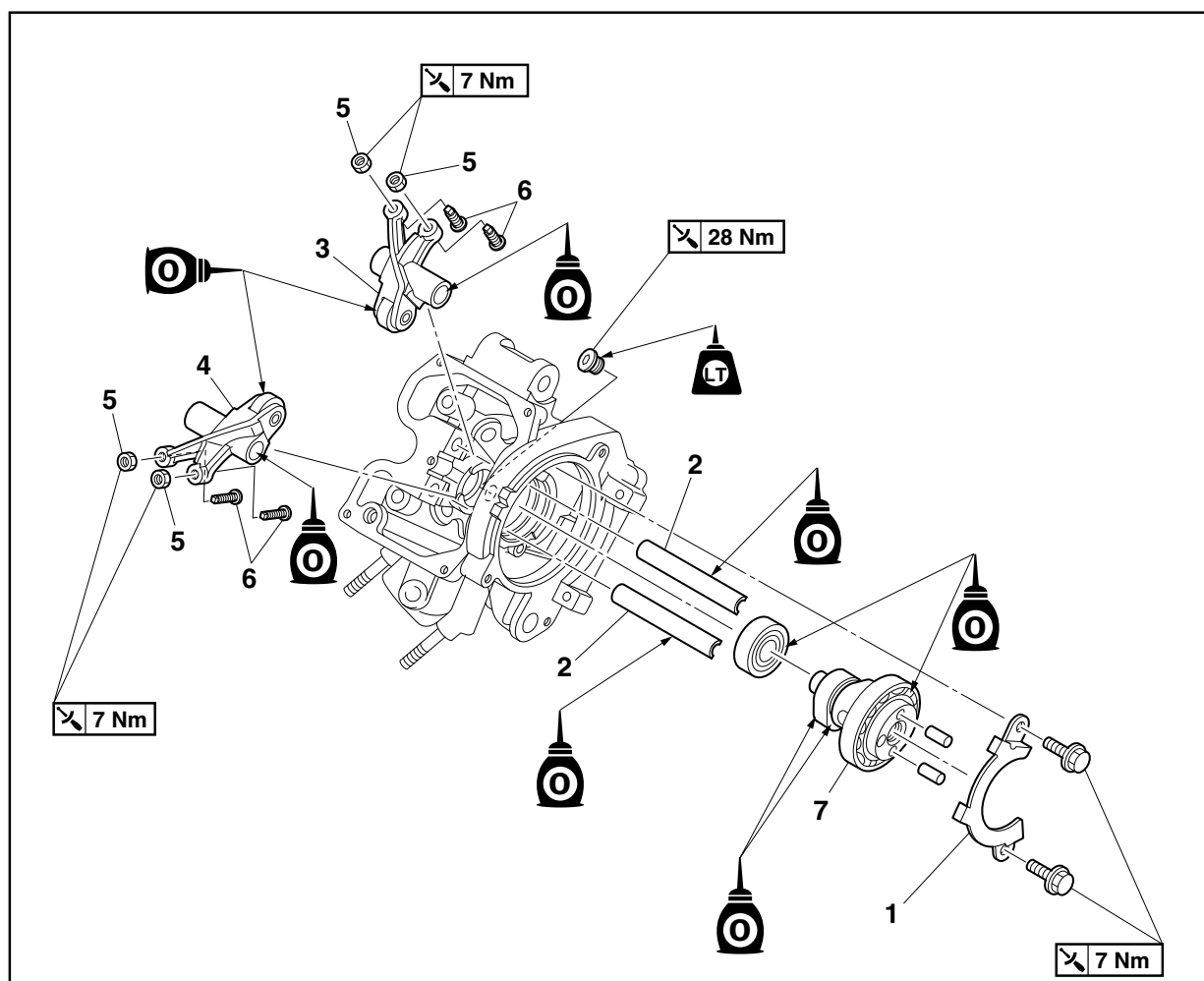
**WARNING:** Be sure to tighten the camshaft pinion screw to the specified torque to prevent the screw from coming loose and damaging the engine.

- Valve backlash  
Not complying with the prescribed values → Adjust.  
Refer to “2.4.11 VALVE BACKLASH ADJUSTMENT” on page 72

## 2.4.8 CAMSHAFT

# 2

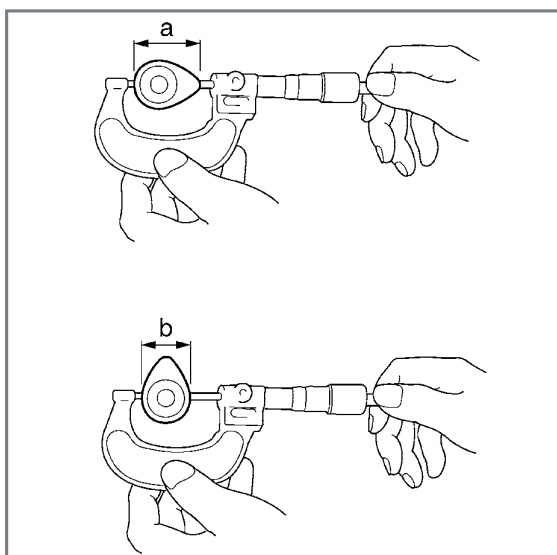
ENGINE DISASSEMBLY



Order	Operation/Components to be removed	Quantity	Notes
	Cylinder head		Refer to "2.4.1 CYLINDER HEAD" on page 53.
1	Camshaft stop	1	
2	Rocker arm small shaft	2	
3	Intake rocker arm	1	
4	Exhaust rocker arm	1	
5	Counter-nut	4	
6	Adjustment screw	4	
7	Camshaft	1	
			For installation, perform the removal procedure in reverse.







Camshaft lobe dimensions

### 2.4.8.1 Camshaft check

Check:

- Valve backlash  
Blue discoloration/pitting/scratches  
→ Replace the camshaft.

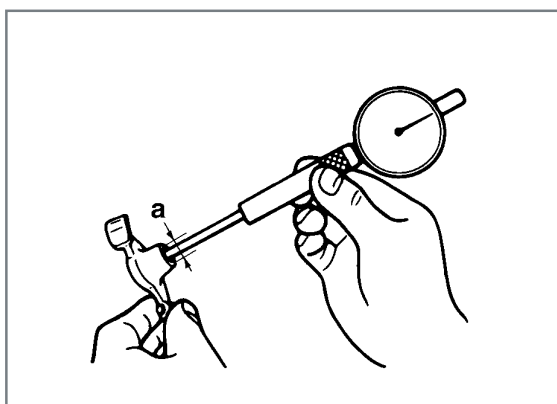
Measure:

- Camshaft lobe dimensions **a** and **b**  
Not compliant with prescribed values → Replace the camshaft.

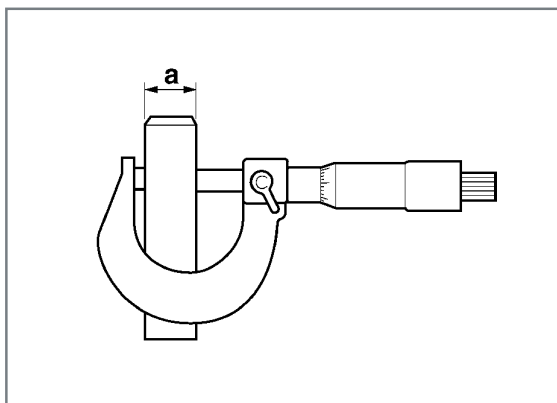
Check:

- Camshaft oil duct.  
Obstruction → Clean with compressed air.

Camshaft lobe dimensions	
Lobe height (intake)	30.225–30.325 mm
Primitive cover diameter (intake)	25.064–25.194 mm
Limit	24.964 mm
Lobe height (exhaust)	30.261–30.361 mm
Limit	30.161 mm
Primitive cover diameter (exhaust)	25.121–25.221 mm
Limit	25.021 mm



Rocker arm internal diameter



External rocker arm diameter

### 2.4.8.2 Rocker arm and rocker arm shaft check

The following procedure applies to all rocker arms and to rocker arm small shafts.

Check:

- Damage/wear → Replace

Check:

- Rocker arm small shaft  
Blue discoloration/excessive wear/pitting/scratches → Replace or check the lubrication system.

Measure:

- Internal rocker arm diameter **a**  
Not compliant with specifications → Replace.

Rocker arm internal diameter	9.985–10.000 mm
Limit	10.015 mm

Measure:

- Rocker arm small shaft external diameter **a**  
Not compliant with specifications → Replace.

Rocker arm internal diameter	9.966–9.976 mm
Limit	9.941 mm

Calculate:

- Rocker arm - rocker arm small shaft backlash

**Note:** Calculate the backlash by subtracting the outer diameter of the rocker arm small shaft from the internal diameter of the rocker arm.

Not compliant with specifications → Replace the faulty part or parts.

Rocker arm - rocker arm small shaft backlash	0.009– 0.034 mm
Limit	0.074 mm

## 2.4.9 CAMSHAFT AND ROCKER ARM INSTALLATION

Lubricate:

- Rocker arms
- Rocker arm small shafts.

Recommended lubricant	
Rocker arm internal surface	
	<b>ENGINE OIL</b>
Rocker arm small shaft	
	<b>ENGINE OIL</b>

Lubricate:

- Camshaft

Recommended lubricant	
Camshaft	
	<b>ENGINE OIL</b>
Camshaft bearing	
	<b>ENGINE OIL</b>

Install:

- Camshaft **1**

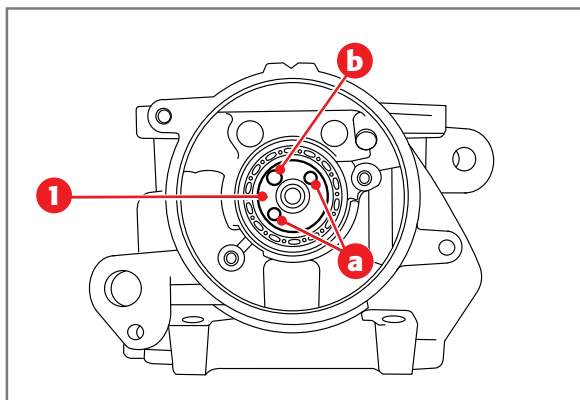
**Note:** Make sure that the protruding parts of camshaft **a** and the hole **b** are positioned as shown in the figure.

Install:

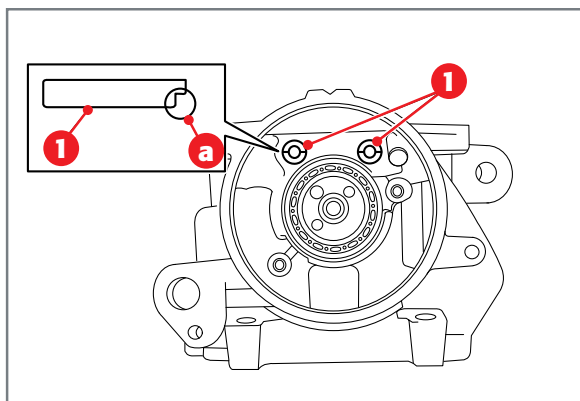
- Rocker arm
- Rocker arm small shafts **1**

**Note:** Make sure the cut-out **a** of each rocker arm small shaft is facing down as shown in the figure.

Make sure that the rocker arm shafts (intake and exhaust) are fully inserted into the cylinder head.



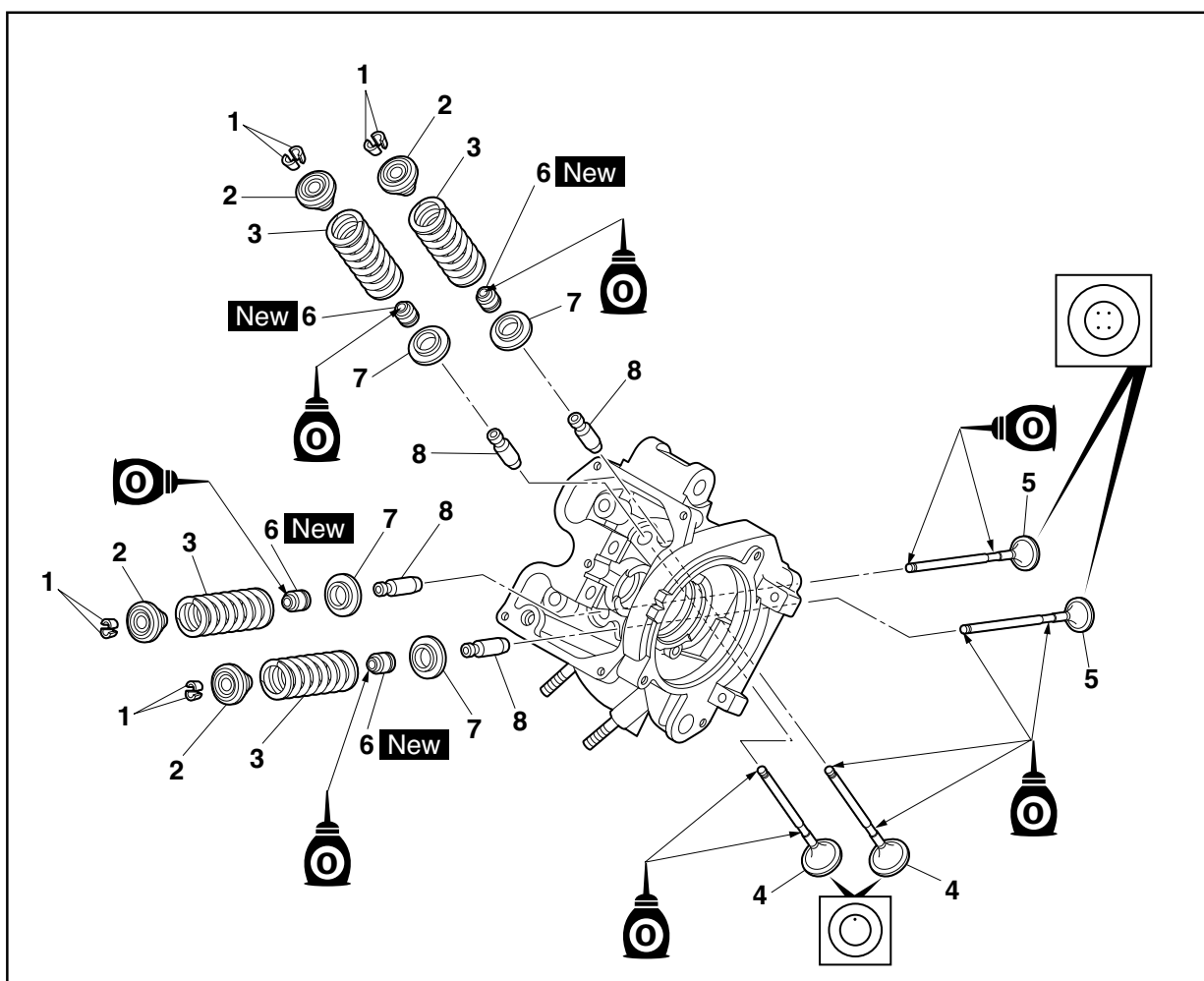
Positioning camshaft



Rocker arm small shaft positioning



## 2.4.10 VALVES AND VALVE SPRINGS



Order	Operation/Components to be removed	Quantity	Notes
	Cylinder head		Refer to "2.4.1 CYLINDER HEAD" on page 53.
	Rocker arms/Camshaft		Refer to "2.4.8 CAMSHAFT" on page 61.
1	Valve half-cone	8	
2	Upper spring seat	4	
3	Valve spring	4	
4	Intake valve	2	
5	Exhaust valve	2	
6	Valve stem gasket	4	
7	Lower spring seat	4	
8	Valve guide	4	
			For installation, perform the removal procedure in reverse.

### 2.4.10.1 Valve removal

The following procedure applies to all valves and relative components.

**Note:** Before removing the internal components of the cylinder head (e.g. valves, valve springs and valve seats), check the correct tightness of the valves.

Check:

- Valve tightness.  
Leakage from valve seat → Check valve face, valve seat and valve seat width.  
Refer to "2.4.10.3 Valve seat check" on page 68.

- Pour a clean solvent **a** into the intake and exhaust gaps.
- Check the correct tightness of the valves.

**Note:** There must be no leaks from the seat of valve **1**.

Remove:

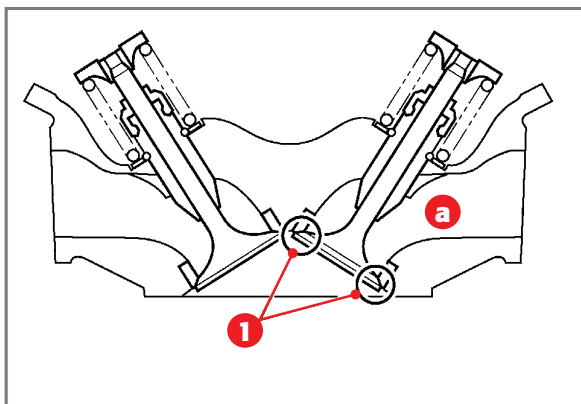
- Half-cones of valves **1**.

**Note:** Remove the valve half-cones by compressing the valve spring with the relative compressor and adapter of compressor **2**.

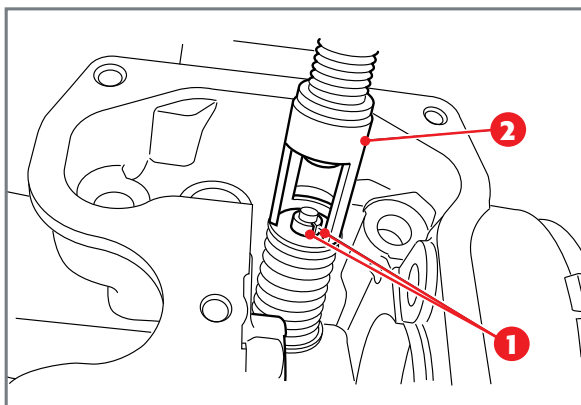
Remove:

- Upper spring seat **1**.
- Valve spring **2**.
- Valve **3**.
- Valve stem gasket **4**.
- Lower spring seat **5**.

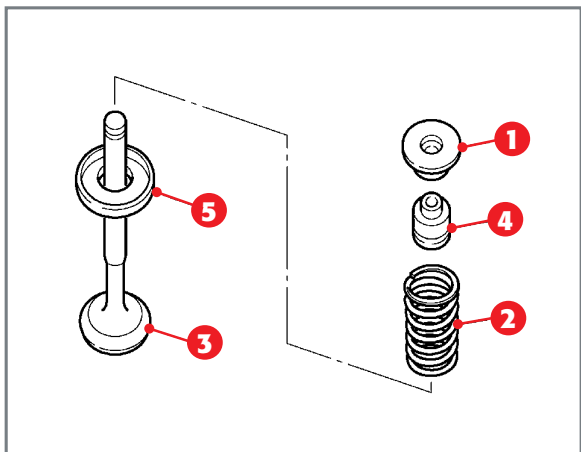
**Note:** Identify the position of each component very carefully, so that it can be installed again in its original position.



Valve tightness check.

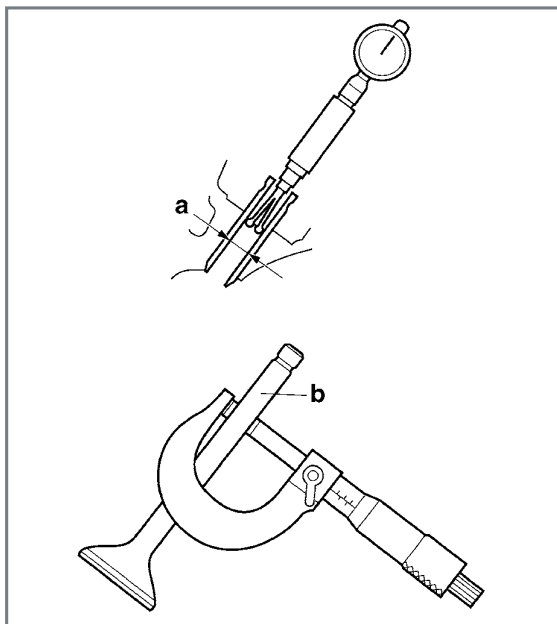


Half-cones **1** removal.



Valve removal.





Valve backlash check.

### 2.4.10.2 Valve and valve guide check

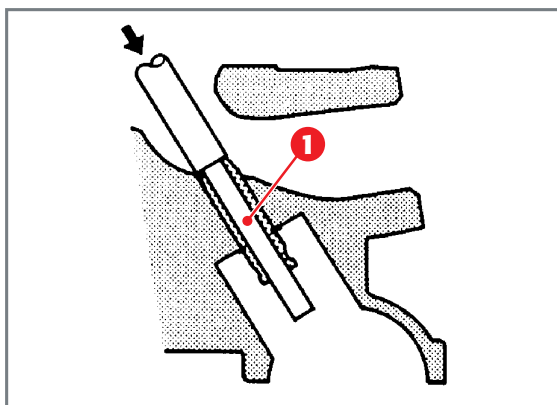
The following procedure applies to all valves and valve guides.

Measure:

- Valve stem-valve guide backlash.
- Not compliant with prescribed values → Replace the valve guide.

- Valve stem-valve guide backlash =  
Valve guide internal diameter **a** -  
Valve stem diameter **b**.

Valve stem - valve guide backlash (intake)	0.010–0.037 mm
Limit	0.080 mm
Valve stem - valve guide backlash (exhaust)	0.025–0.052 mm



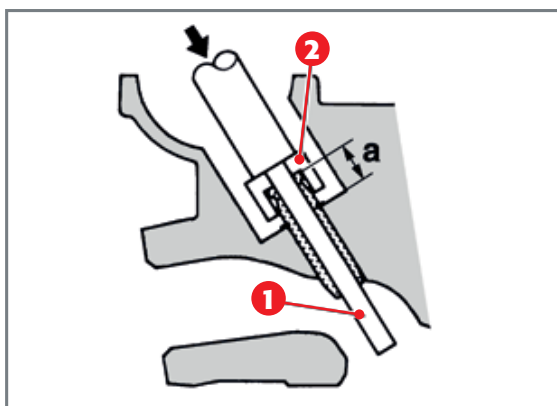
Valve guide removal.

Replace:

- Valve guide

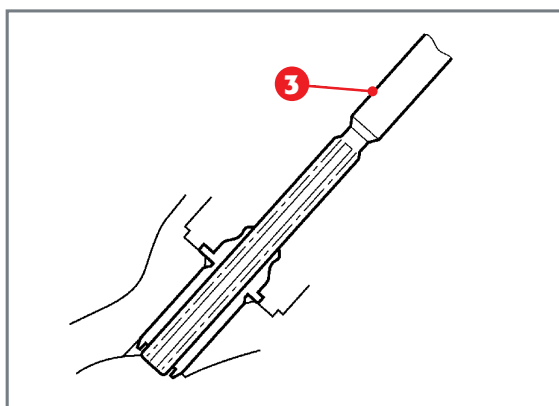
**Note:** To facilitate the removal and installation of the valve guide and to maintain the correct coupling, heat the cylinder head in an oven at 100 °C

- Remove the valve guide by using the specific extractor **1**.

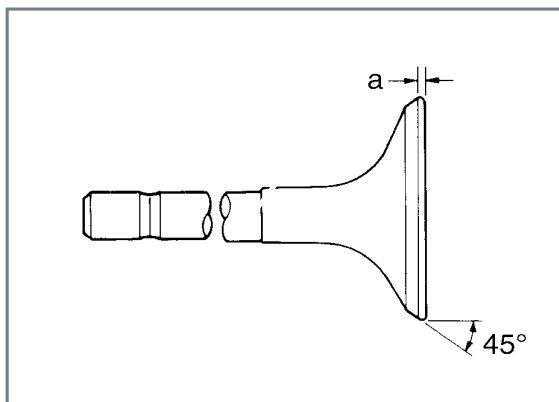


New valve guide installation - at valve guide position.

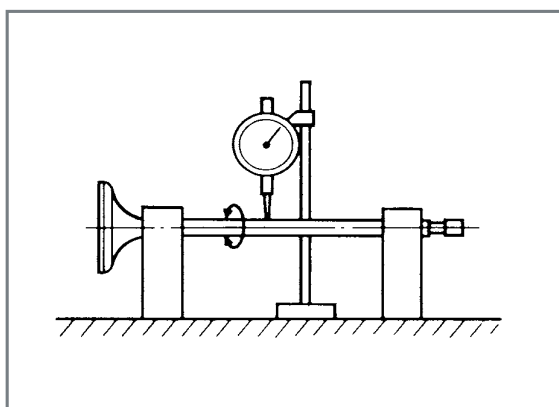
- Install the new valve guide by using the specific installer **2** and extractor **1**.



Valve guide boring.



Valve check.



Valve stem diameter measurement.

After installing it, bore the valve guide using the specific reamer **3** to obtain the correct valve guide-valve backlash.

**Note:** After replacing the valve guide, rectify the valve seat.

Remove:

- Carbon deposits  
(from the valve face and from the valve seat).

Check:

- Valve face  
Pitting/wear → Bore the face of the valve.
- Valve stem end  
Mushroom shape or larger diameter of the valve stem body → Replace the valve.

Measure:

- Valve margin thickness **a**  
Not compliant with prescribed values → Replace the valve.

Valve margin thickness (intake)	0.50–0.90 mm
Valve margin thickness (exhaust)	0.50–0.90 mm

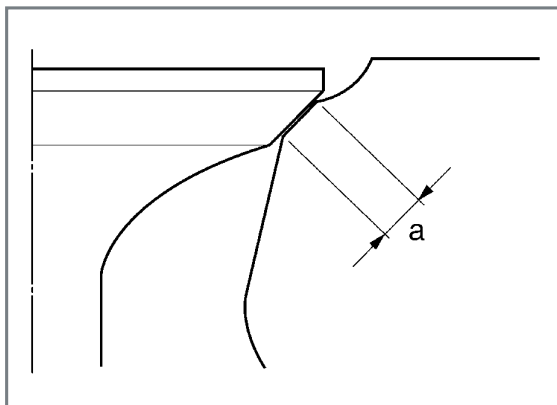
Measure:

- Valve stem offset  
Not compliant with prescribed values → Replace the valve.

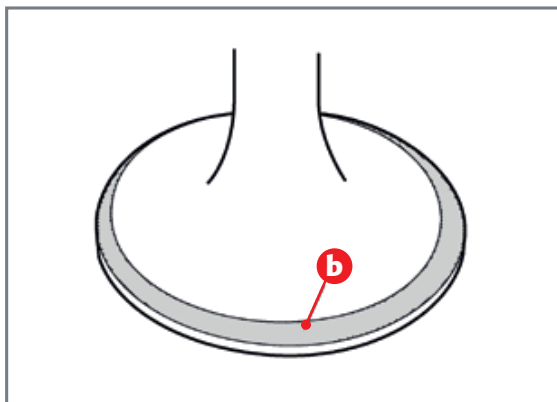
**Note:** When installing a new valve, always replace the valve guide.

If removing or replacing the valve, always replace the valve stem gasket as well.

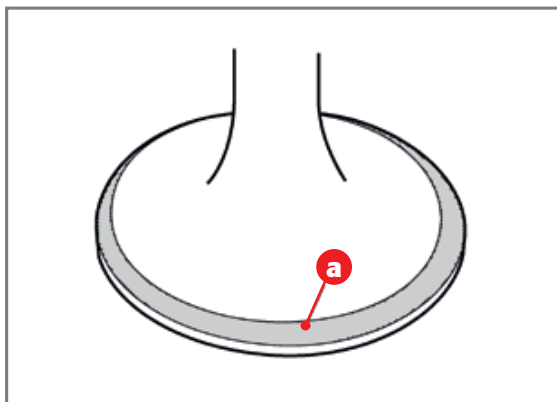
Valve stem offset	0.010 m
-------------------	---------



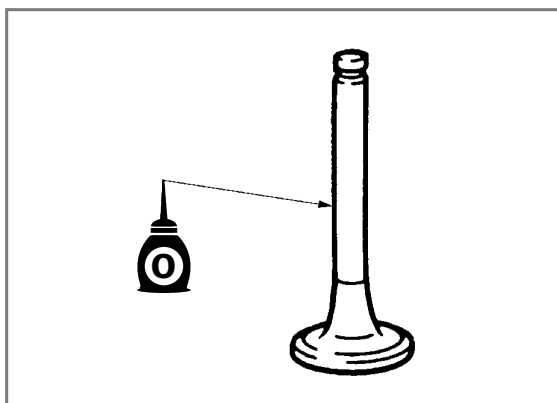
Valve seat check.



Fluid application on face b of the valve.



Abrasive agent application on face a of the valve.



Oil application on the stem.

### 2.4.10.3 Valve seat check

The following procedure applies to all valves and valve seats.

Remove:

- Carbon deposits  
(from the valve face and from the valve seat)

Check:

- Valve seat  
Pitting/wear → Replace cylinder head.

Measure:

- Valve seat contact width **a** Not compliant with prescribed values → Replace the cylinder head.

Valve seat contact width (intake)	0.90–1.10 mm
Valve seat contact width (exhaust)	0.90–1.10 mm

- Apply Prussian Blue **b** on the valve face.
- Install the valve in the cylinder head.
- Press the valve through the valve guide and on the valve seat to create a clear footprint.
- Measure the valve seat width.

**Note:** Where the valve seat and valve face have touched, the Blue Layout Fluid will have been removed.

Lap:

- Valve face
- Valve seat

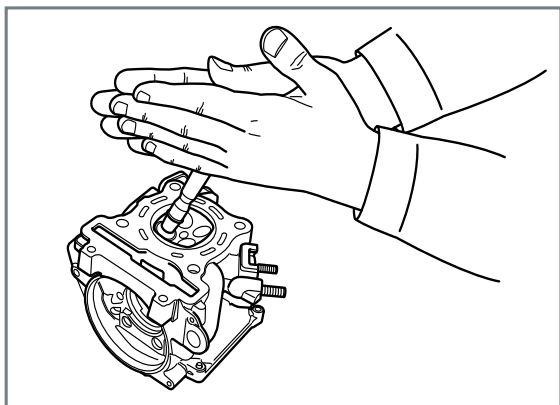
**Note:** After replacing the cylinder head or the valve and the valve guide, the valve seat and valve face must be lapped.

- Apply a coarse-grained abrasive agent **a** on the face of the valve.

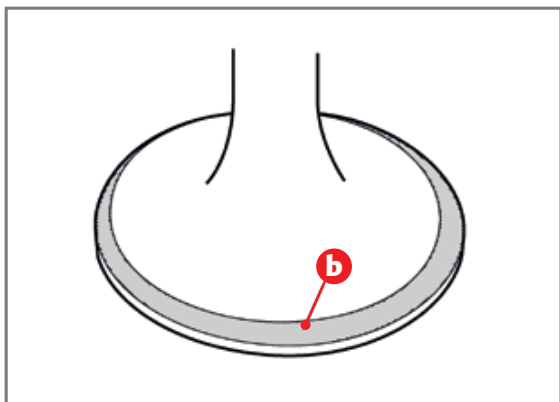
**WARNING:** Do not allow the abrasive lapping agent to penetrate into the gap between valve stem and valve guide.

- Apply molybdenum disulfide oil to the valve stem.
- Install the valve in the cylinder head.
- Turn the valve until the valve face and valve seat are evenly smooth, then remove all the lapping abrasive agent.

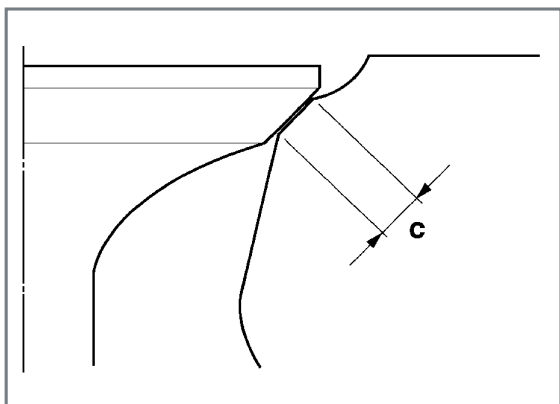




**Valve lapping.**



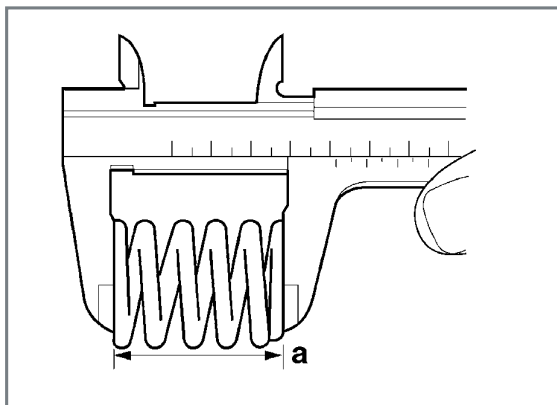
**Fluid application on face b of the valve.**



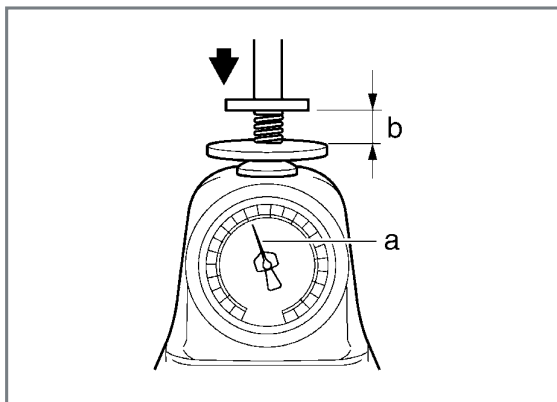
**Valve seat check.**

**Note:** To obtain excellent lapping, lightly tap the valve seat by turning the valve back and forth between one's hands.

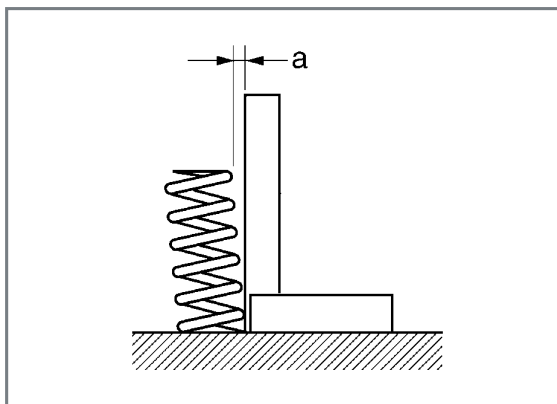
- e. Apply a fine-grained lapping abrasive agent to the valve face and repeat the steps described above.
- f. After each lapping process, be sure to remove all the lapping abrasive agent from the valve face and valve seat.
- g. Apply Blue Layout Fluid **b** on the valve face.
- h. Install the valve in the cylinder head.
- i. Press the valve through the valve guide and on the valve seat to create a clear footprint.
- j. Measure the seat width of valve "c" again. If the valve seat width does not comply with the prescribed values, rectify and lap the valve seat.



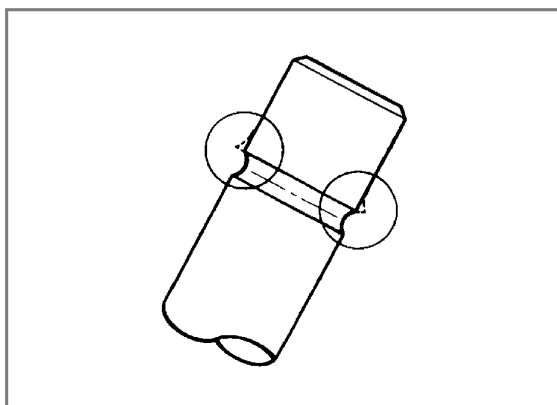
Spring free length **a**.



Compressed spring force **a** - installed length **b**.



Valve inclination check **a**.



Valve stem end.

#### 2.4.10.4 Valve spring check

The following procedure applies to all valve springs.  
Measure:

- Spring free length of valve **a**.  
Not compliant with specifications → Replace the valve spring.

Free length (intake)	41.71 mm
Limit	39.62 mm
Free length (exhaust)	41.71 mm
Limit	39.62 mm

Measure:

- Compressed valve spring force **a**.  
Not compliant with specifications → Replace the valve spring.

Installed compression spring pressure (intake)	140.00–162.00 N
Installed compression spring pressure (exhaust)	140.00–162.00 N
Installed length (intake)	35.30 mm
Installed length (exhaust)	35.30 mm

Measure:

- Inclination of the valve spring **a**.  
Not compliant with specifications → Replace the valve spring.

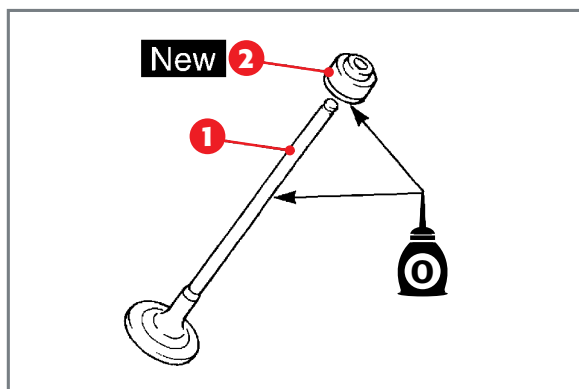
Spring inclination (intake)	1.8 mm
Spring inclination (exhaust)	1.8 mm

#### 2.4.10.5 Valve installation

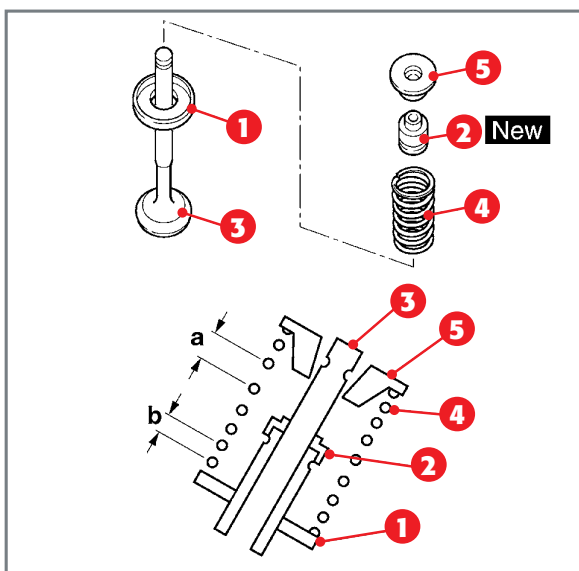
The following procedure applies to all valves and relative components.

Deburr:

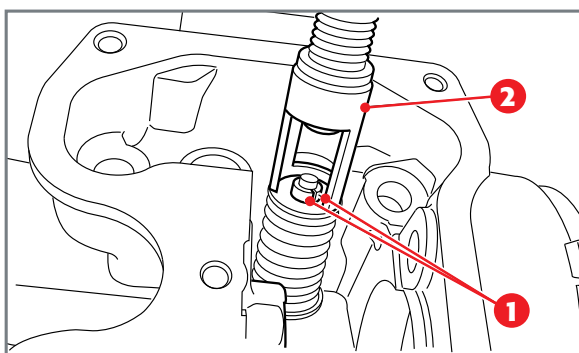
- Valve stem end  
(using the sharpening stone)



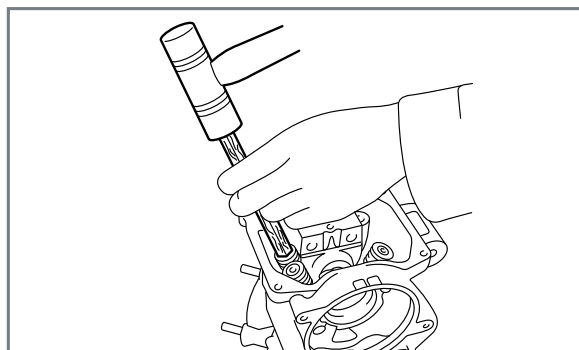
Stem 1 and stem 2 gasket lubrication.



Valve installation - smaller pitch b.



Half-cone installation 1.



Stem 1 and stem 2 gasket lubrication.

Lubricate:

- Valve stem 1.
- Valve stem gasket 2.  
(with the recommended lubricant).

Recommended lubricant
ENGINE OIL

Lubricate:

- Lower spring seat 1.
- Valve stem gasket 2.
- Valve 3.
- Valve spring 4.
- Upper spring seat 5.  
(in the cylinder head)

**Note:** Make sure that each valve is installed in its original position.

Install the valve springs with the larger pitch **a** facing upwards.

Install:

- Half-cones of valves 1.

**Note:** Install the valve half-cones by compressing the valve spring by using the specific compressor and adapter for valve springs 2.

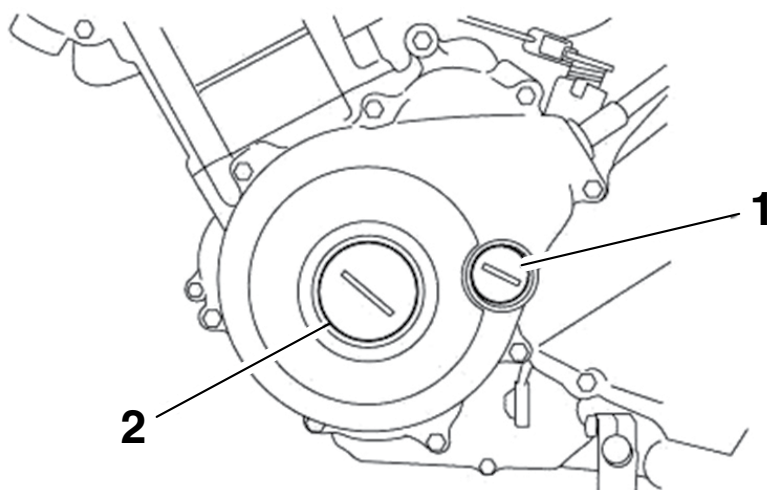
To fix the valve half-cones on the valve stem, tap lightly with a soft hammer on the valve tip.

**WARNING:** If you hit the valve tip with too much force, you risk damaging the valve.

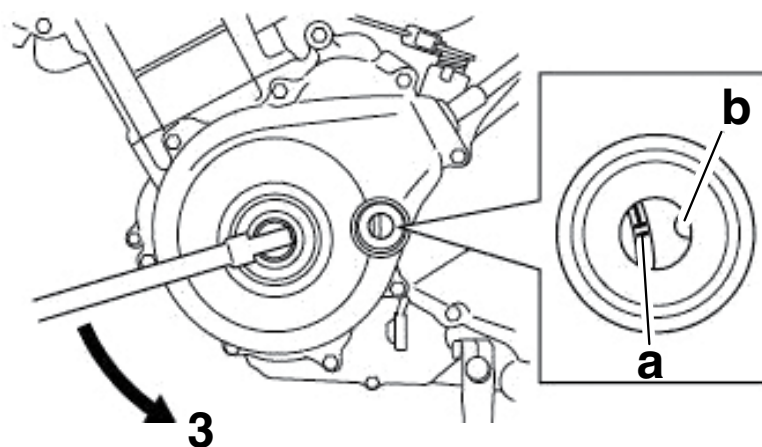


## 2.4.11 VALVE BACKLASH ADJUSTMENT

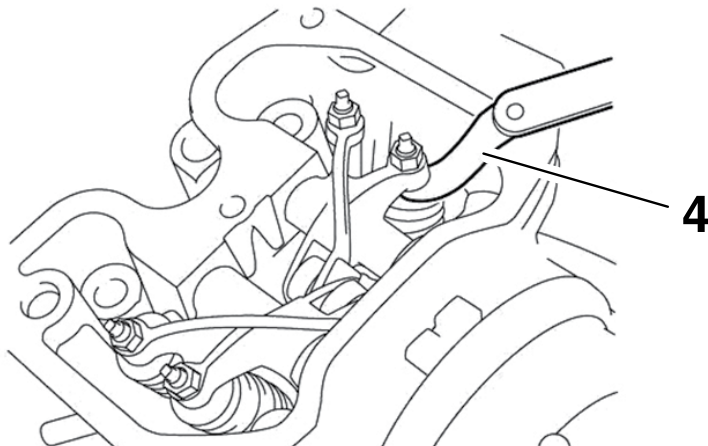
## Phasing caps



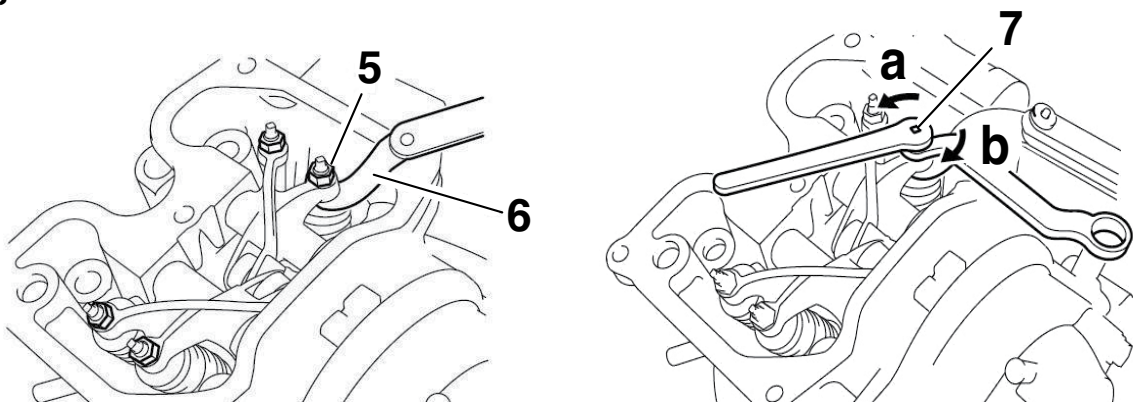
## Phasing



Order	Component	Quantity	Operation/Notes
	Seat		Refer to "1.1 SEAT REMOVAL AND ASSEMBLY" on page 10
	Tank		Refer to "1.3 TANK" on page 12
	Ignition coil		Refer to "1.8 COIL" on page 26
	Spark plug		
	Cylinder head cover		Refer to "2.4.1 CYLINDER HEAD" on page 53
1	Phasing cap	1	
2	Crankshaft nut cap	1	
3			Rotate the crankshaft anticlockwise.
			Align reference PMS "a" on the generator rotor to reference "b" on the generator cover

**Valve backlash (when cold):****Intake****0.10–0.14 mm****Exhaust****0.20–0.24 mm**

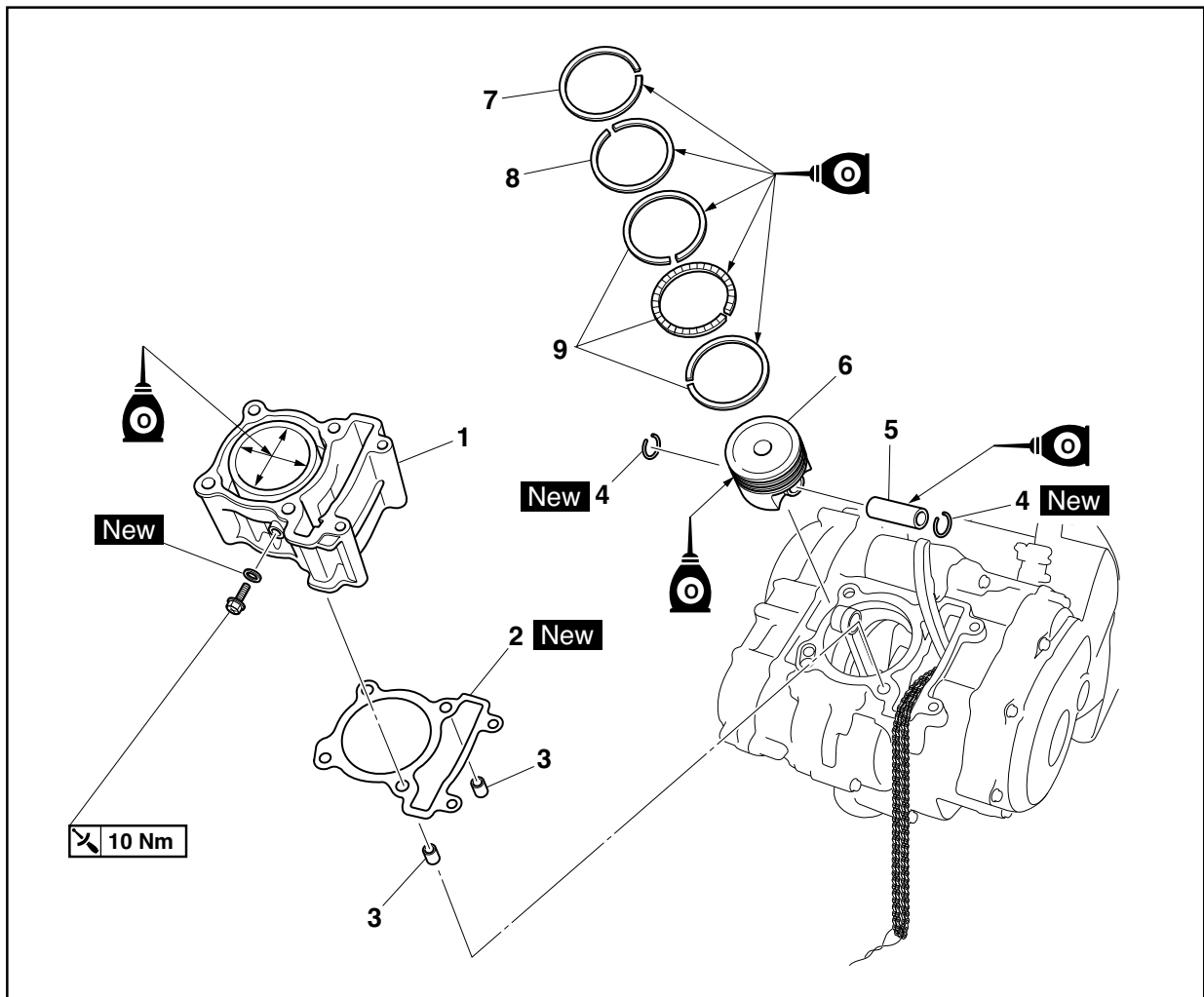
Order	Component	Quantity	Operation/Notes
4			Measure the valve backlash using a thickness gauge. If not compliant, adjust

**Adjustment**

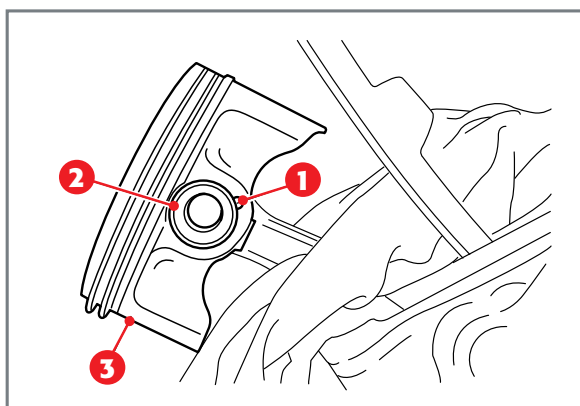
Order	Component	Quantity	Operation/Notes
5	Counter-nut		Loosen the counter-nut
6	Thickness gauge		Insert a thickness gauge between the end of the adjustment screw and the tip of the valve.
7	Adjustment key		Perform the adjustment: Direction "a" valve backlash increases. Direction "b" valve backlash decreases.
			Once the right backlash has been achieved, hold the adjusting screw to prevent it from moving and tighten the counter-nut as required.
			Measure valve backlash again.
			If the valve backlash still does not comply with the required values, repeat all the valve clearance adjustment operations until the required backlash is achieved



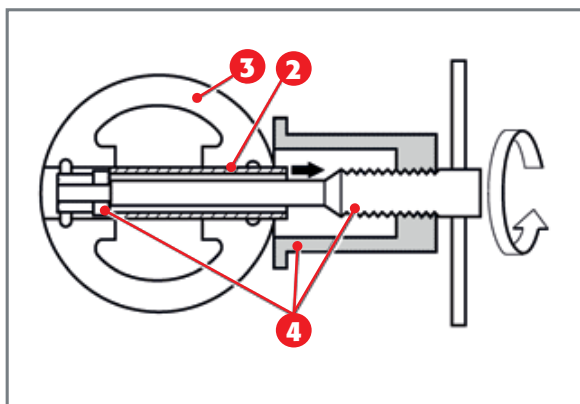
## 2.4.12 CYLINDER AND PISTON



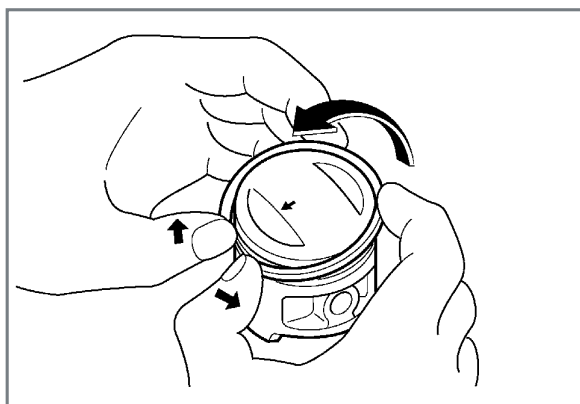
Order	Operation/Components to be removed	Quantity	Notes
	Cylinder head		Refer to "2.4.1 CYLINDER HEAD" on page 53.
1	Cylinder	1	
2	Cylinder gasket	1	
3	Centring pin	2	
4	Pin bolt clip	2	
5	Pin bolt	1	
6	Piston	1	
7	Upper band	1	
8	Second band	1	
9	Oil-scraper band	1	
			For installation, perform the removal procedure in reverse.



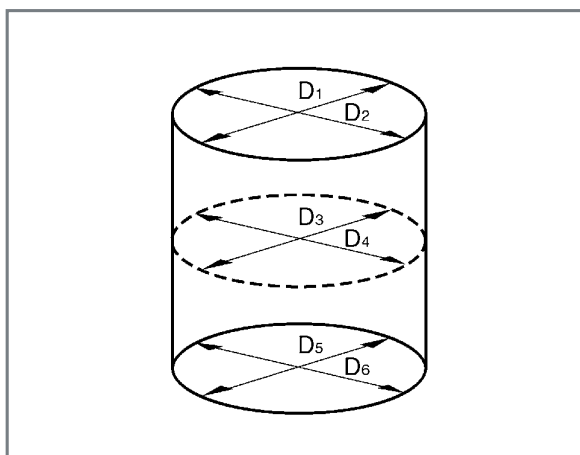
Removal of pin bolt.



Pin bolt removal kit.



Segment removal.



Boring measurement.

### 2.4.12.1 Piston removal

1. Remove:
  - Pin bolt clips 1
  - Pin bolt 2
  - Piston 3

**WARNING:** Do not use a hammer to release the pin bolt.

**Note:** Before removing the pin bolt clip, cover the crankcase opening with a clean cloth to prevent the pin bolt clip from falling into the crankcase.

Before removing the pin bolt, deburr the groove of the pin bolt clip and the pin bolt hole area. If both areas have been deburred and the pin bolt is still difficult to remove, remove it using a pin bolt extractor kit 4.

1. Remove:
  - Upper band
  - Second band
  - Oil-scraper band

**Note:** To remove a segment, widen the gap between the ends by using your fingers and lift the other side of the segment above the crown of the piston.

### 2.4.12.2 Cylinder and piston check

1. Check:
  - Piston wall
  - Cylinder wall

Vertical scratches → Replace the cylinder and replace the piston and the segments as a whole
2. Measure:
  - Backlash between piston and cylinder.

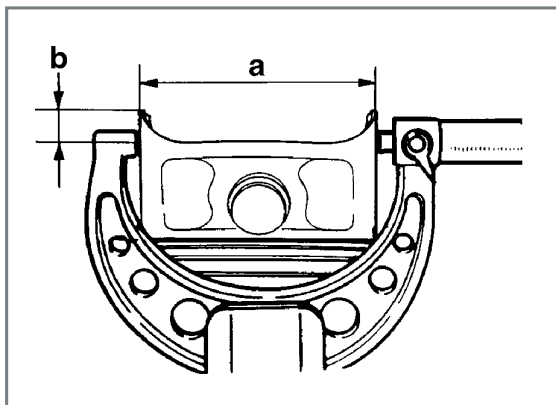
a. Measure cylinder boring "C" using a bore meter.

**Note:** Measure cylinder boring "C" by measuring the cylinder from side to side and from front to back. Then, calculate the average of the measurements.

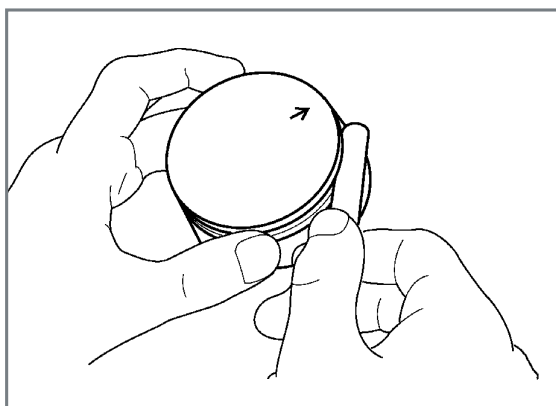
Boring	52.000–52.010 mm
Taper limit	0.050 mm
Out of roundness limit	0.005 mm



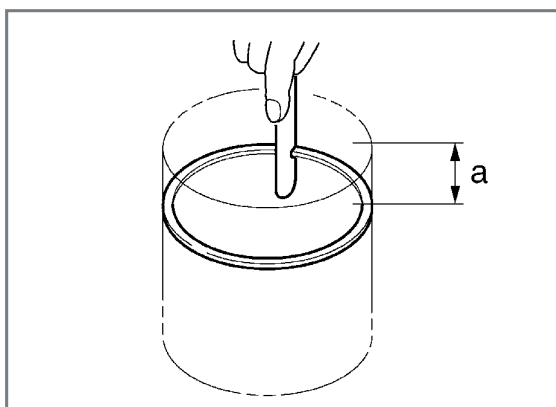




b. 5.0 mm from bottom edge of the piston



Segment backlash measurement



a. 40 mm

"C" = maximum of  $D_1$ - $D_2$

"T" = maximum of  $D_1$  or  $D_2$  - maximum of  $D_5$  or  $D_6$

"R" = maximum of  $D_1$ ,  $D_3$  or  $D_2$  - minimum of  $D_2$ ,  $D_4$  or  $D_6$

- b. If not compliant with the required values, replace the cylinder and replace the piston and the segments as a whole.
- c. Measure the diameter of the piston skirt  $D_a$  by using the micrometer, positioning the micrometer at the height  $b$  of 5mm.

Piston Diameter	51.962–51.985 mm
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- d. If not compliant with the required values, replace the piston and the segments as a whole.
- e. Calculate the backlash between piston and cylinder by using the following formula.

Backlash between piston and cylinder =  
Cylinder "C" boring - Diameter of piston skirt "D"

Cylinder - piston backlash	0.015–0.048 mm
----------------------------	----------------

- f. If not compliant with the required values, replace the cylinder and replace the piston and the segments as a whole.

### 2.4.12.3 Segment check

1. Measure:

- Segment side backlash  
Not compliant with the specifications → Replace the piston and the segments as a whole.

**Note:** Before measuring the side backlash of the segments, remove the carbon deposits from the grooves of the segments and the segments themselves.

Upper band	
Band side backlash	0.030–0.065 mm
Limit	0.100 mm
Second band	
Band side backlash	0.020–0.055 mm
Limit	0.100 mm

2. Install:

- Segment (in the cylinder) at the height from the edge of the cylinder of 40mm.

**Note:** Before measuring the side backlash of the segments, eliminate

3. Measure:

- Gap between the ends of the segment  
Not compliant with specifications → Replace the segment.

**Note:** It is not possible to measure the gap between the ends of the scraper band expander spacer. If the gap of the oil scraper band element is excessive, replace all three segments.

<b>Upper band</b>	
Gap between the ends (installed)	0.10–0.25 mm
Limit	0.50 mm
<b>Second band</b>	
Gap between the ends (installed)	0.10–0.25 mm
Limit	0.60 mm
<b>Oil-scraper band</b>	
Gap between the ends (installed)	0.20–0.70 mm

#### 2.4.12.4 Pin bolt check

- Check:
  - Pin bolt  
Blue discoloration/grooves → Replace the pin bolt, then check the lubrication system.
- Measure:
  - Pin bolt external diameter **a**  
Not compliant with specifications → Replace the pin bolt.

Pin bolt external diameter	13.995–14.000 mm
Limit	13.975 mm

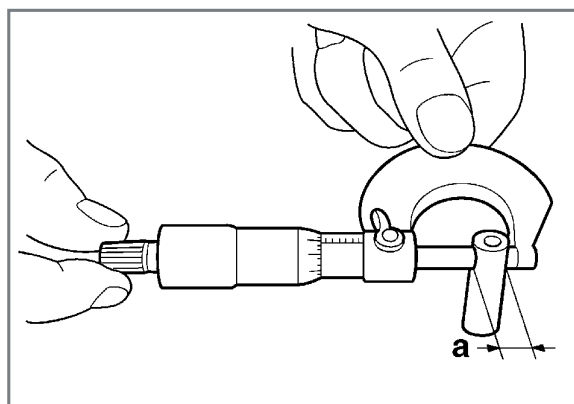
- Measure:
  - Pin bolt hole diameter **b**  
Not compliant with specifications → Replace the piston.

Pin bolt hole internal diameter	14.002–14.013 mm
Limit	14.043 mm

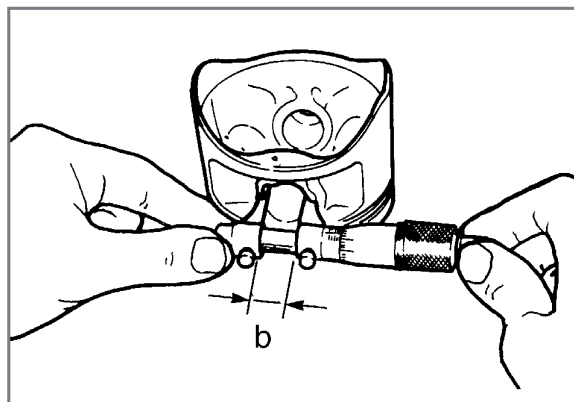
- Calculate:
  - Pin bolt - pin bolt hole backlash  
Not compliant with specifications → Replace both piston and pin bolt.

Pin bolt - pin bolt hole backlash= Pin bolt hole diameter <b>b</b> - Pin bolt external diameter <b>a</b>	
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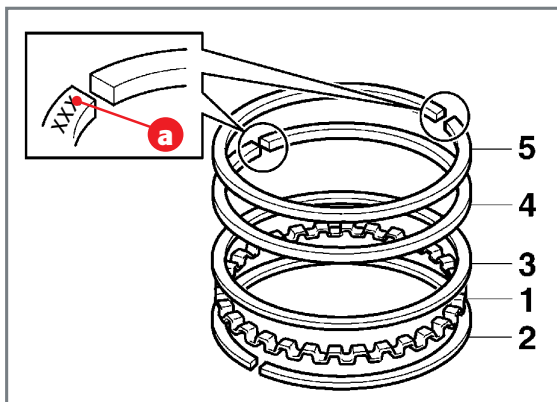
Pin bolt - pin bolt hole backlash	0.002–0.018 mm
Limit	0.068 mm



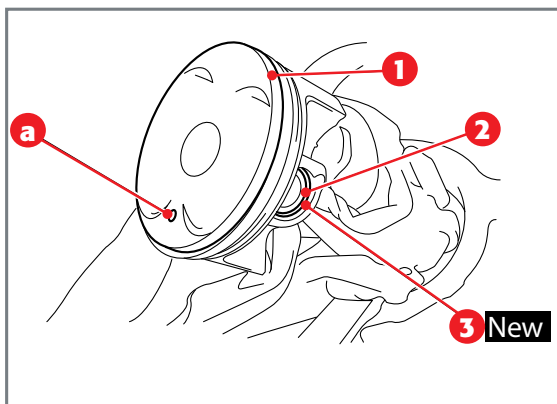
Pin bolt diameter check



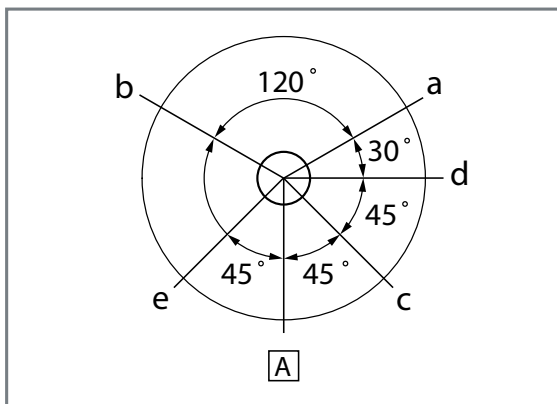
Pin bolt hole check



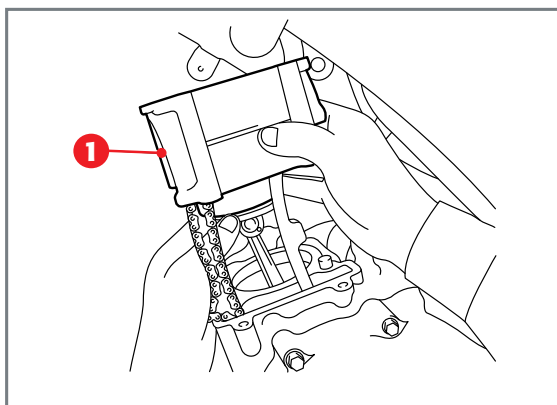
Piston segment installation



Piston segment installation



Piston segment installation



Piston segment installation

## 2.4.12.5 Piston and cylinder installation

1. Install:
  - Expander 1 oil-scraping band
  - Lower oil-scraping band ring 2
  - Upper oil-scraping band ring 3
  - Second band 4
  - Upper band 5

**Note:** Make sure the segments are installed with the manufacturer's references or numbers "a" facing up.

2. Install:
  - Piston 1
  - Pin bolt 2
  - Pin bolt clips 3.

**Note:** Apply engine oil to the pin bolt.

Make sure that the reference arrow **a** on the piston faces the discharge side of the cylinder.

Before installing the pin bolt clips, cover the crankcase opening with a clean cloth to prevent the clips from falling into the crankcase.

3. Lubricate:
  - Piston
  - Segments
  - Cylinder
 (with the recommended lubricant)

Recommended lubricant
ENGINE OIL

4. Offset:
  - Gaps between the ends of the segment

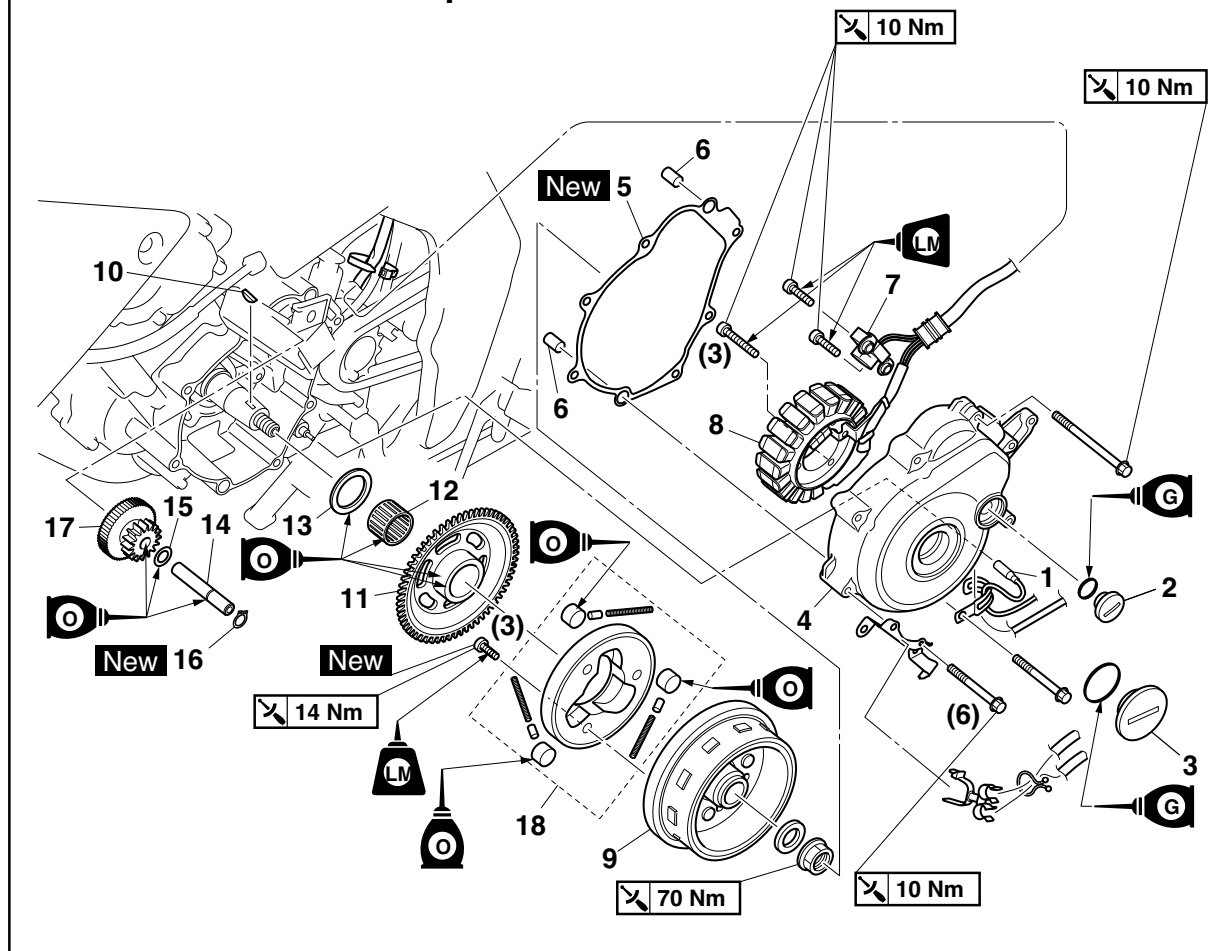
- a. Upper band
- b. 2<sup>nd</sup> band
- c. Upper oil-scraping band gap
- d. Oil-scraping band expander
- e. Lower oil-scraping band gap
- A. Exhaust side

5. Install:
  - Centring pins
  - Cylinder head gasket **NEW**
  - Cylinder 1

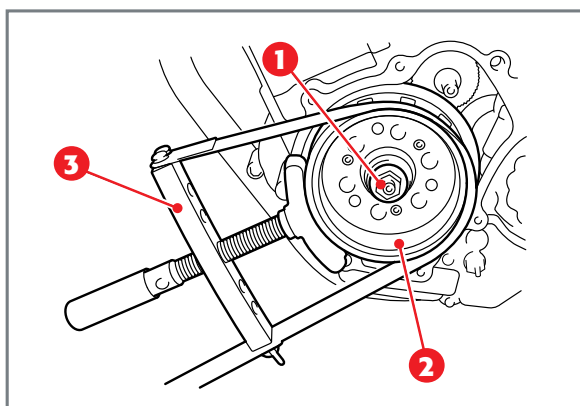
**Note:** By compressing the segments with one hand, install the cylinder with the other.

Pass the timing chain and the timing chain guide (intake side) in the groove in the timing chain.

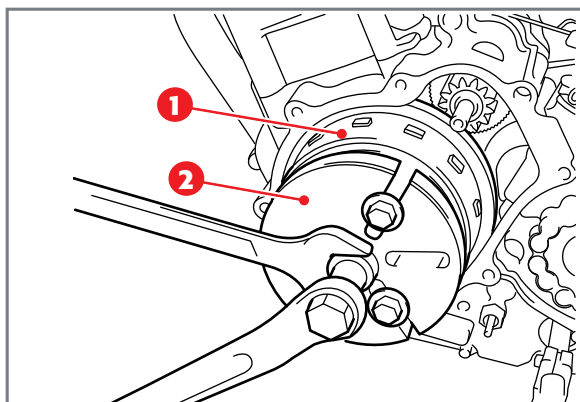


**Generator and unidirectional start-up**

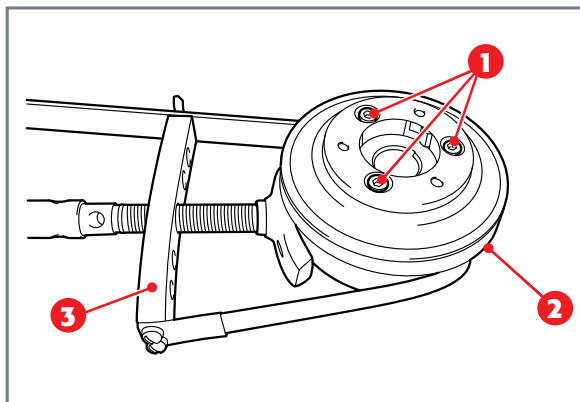
Order	Operation/Components to be removed	Quantity	Notes
15	Washer	1	
16	Safety elastic ring	1	
17	Unidirectional start-up neutral gear	1	
18	Unidirectional start-up unit	1	



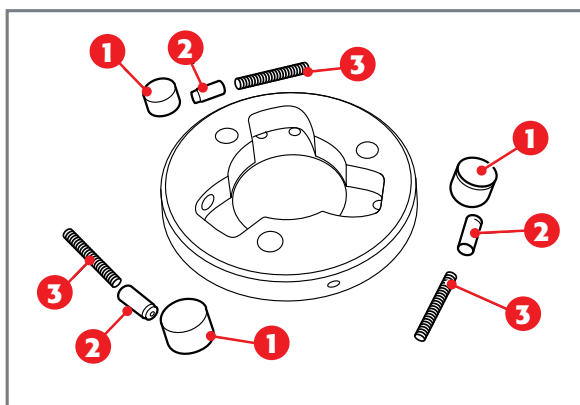
Generator unlock.



Generator removal.



Unidirectional start-up removal.



Unidirectional start-up check.

## 2.4.14 GENERATOR REMOVAL

1. Remove:
  - Generator rotor nut 1
  - Washer

**Note:** Holding the generator rotor 2 still with a special universal tool 3, loosen the generator rotor nut.

Do not allow the pulley support to come into contact with the protruding part on the generator rotor.

2. Remove:
  - Generator rotor 1 (with flywheel extractor 2)
  - Woodruff Key

**WARNING:** To protect the end of the crankshaft, place a suitable socket wrench between the centring screw of the flywheel extractor kit and the crankshaft.

**Note:** Make sure the flywheel extractor is centred over the generator rotor.

## 2.4.15 UNIDIRECTIONAL START-UP REMOVAL

1. Remove:
  - Unidirectional start-up bolts 1.

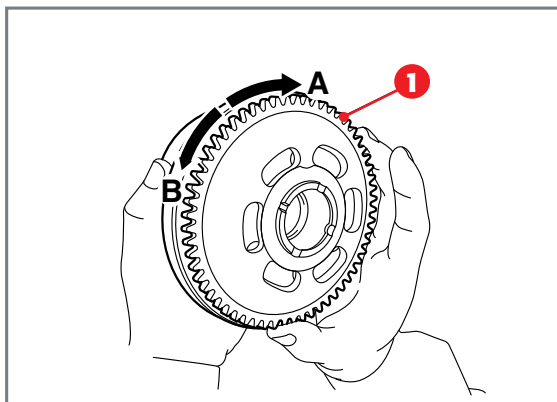
**Note:** Holding the generator rotor 2 still with a special universal tool 3, remove the unidirectional start-up bolts.

Do not allow the pulley support to come into contact with the protruding part on the generator rotor.

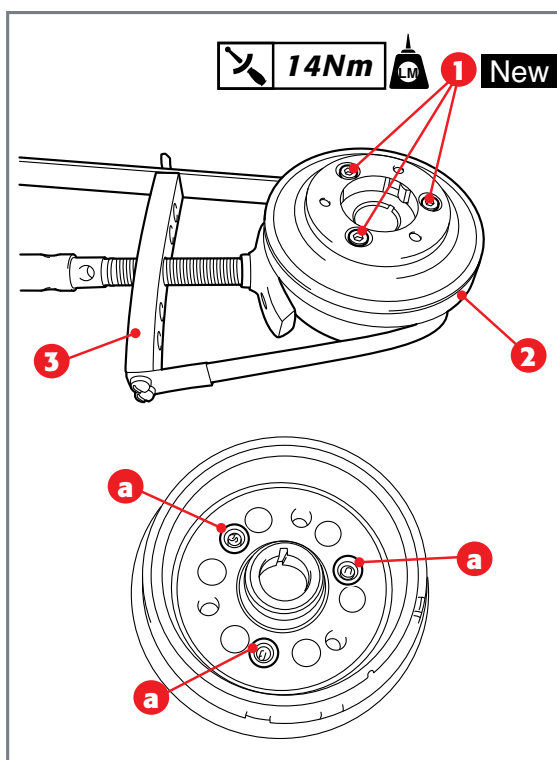
### 2.4.15.1 Unidirectional start-up check

1. Check:
  - Unidirectional start-up rollers 1.
  - Unidirectional start-up spring caps 2
  - Unidirectional start-up springs 3
 Damage/wear → Replace the unidirectional start-up unit.





Gear installation.



Unidirectional start-up installation.

2. Check:
  - Unidirectional start-up neutral gear
  - Unidirectional start-up gear  
Burrs/chipping/roughness/wear → Replace the faulty part or parts.
3. Check:
  - Unidirectional start-up gear contact surfaces.  
Damage/pitting/wear → Replace the unidirectional start-up gear.
4. Check:
  - Unidirectional start-up operation.

- a. Install the unidirectional start-up gear 1 on the unidirectional start-up and lock the generator rotor.
- b. When rotating the unidirectional start-up gear A clockwise, it must engage with the unidirectional start-up, otherwise the unidirectional start-up is faulty and must be replaced.
- c. When rotating the unidirectional start-up gear B anticlockwise, it must rotate freely, otherwise the unidirectional start-up is faulty and must be replaced.

## 2.4.16 UNIDIRECTIONAL START-UP INSTALLATION

1. Install:
  - Unidirectional start-up unit
  - Unidirectional start-up screws 1 .

**Note:** Holding the generator rotor 2 still with a special universal tool

3, tighten the unidirectional start-up screws.

Do not allow the pulley support to come into contact with the protruding part on the generator rotor.

Connect the end a of each unidirectional start-up screw by force.



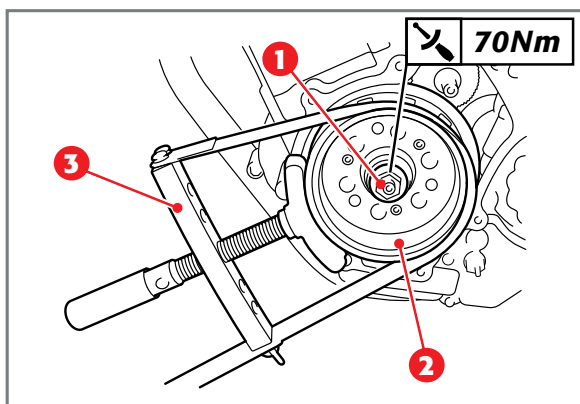
## 2.4.17 GENERATOR INSTALLATION

### 1. Install:

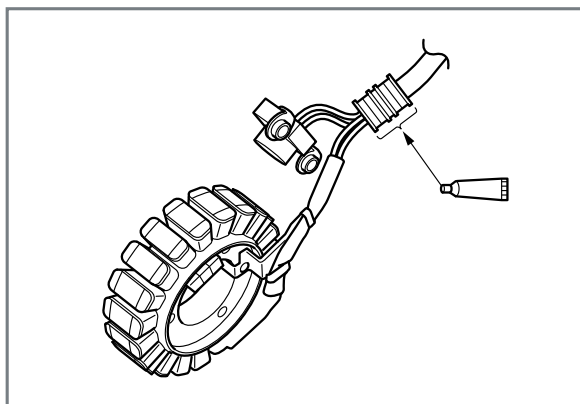
- Woodruff Key
- Generator rotor
- Washer
- Generator rotor nut

**Note:** Clean the tightened part of the crankshaft and the generator rotor hub.

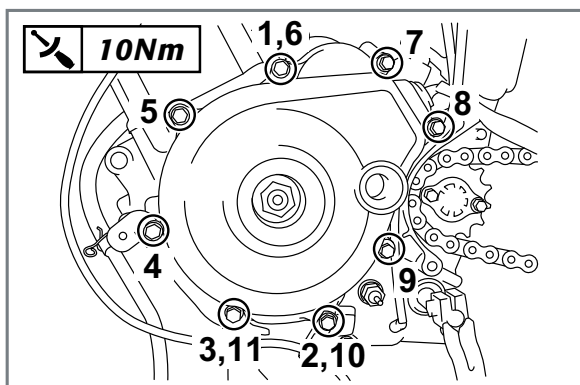
When installing the generator rotor, make sure the Woodruff key is properly secured in the key-way of the crankshaft.



Generator reassembly.



Seal the rubber washer.



Generator cover tightening.

### 2. Tighten:

- Generator rotor nut 1 to the indicated torque.

**Note:** Holding the generator rotor 2 still with the special universal tool 3, tighten the generator rotor nut.

Do not allow the pulley support to come into contact with the protruding part on the generator rotor.

### 3. Apply:

- Seal  
(on the crankshaft position stator/sensor unit cable rubber washer)

### 4. Install:

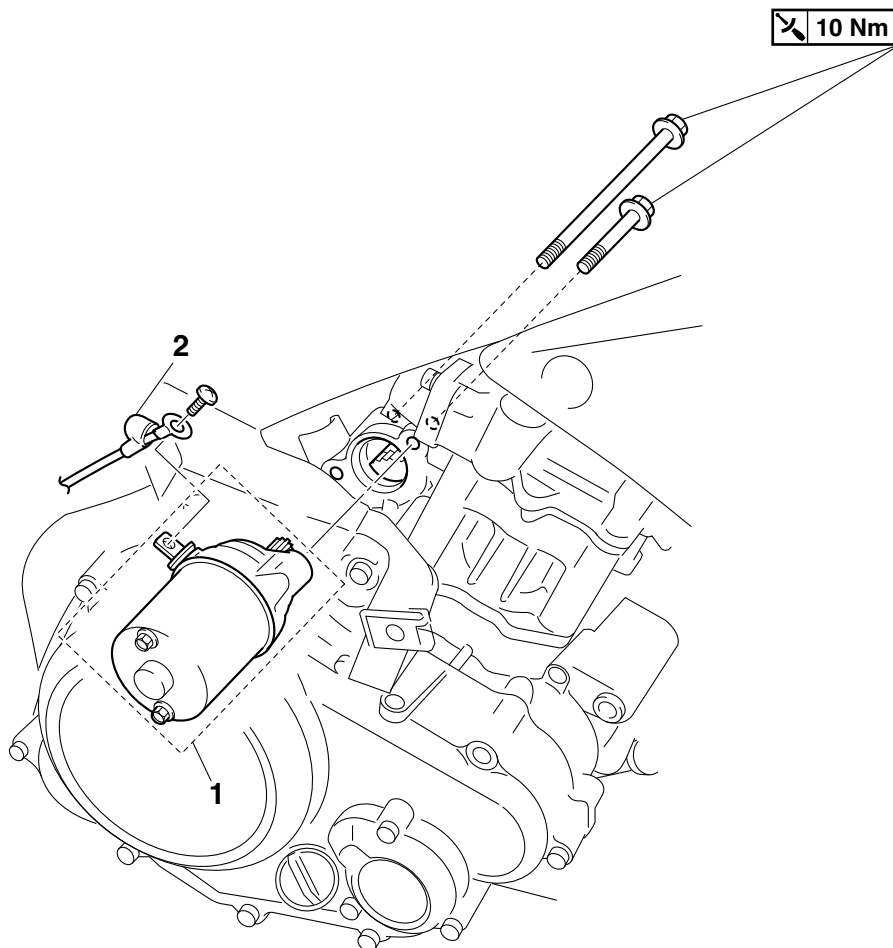
- Generator cover

**Note:** Tighten the generator cover screws in the specific sequence shown in the figure.

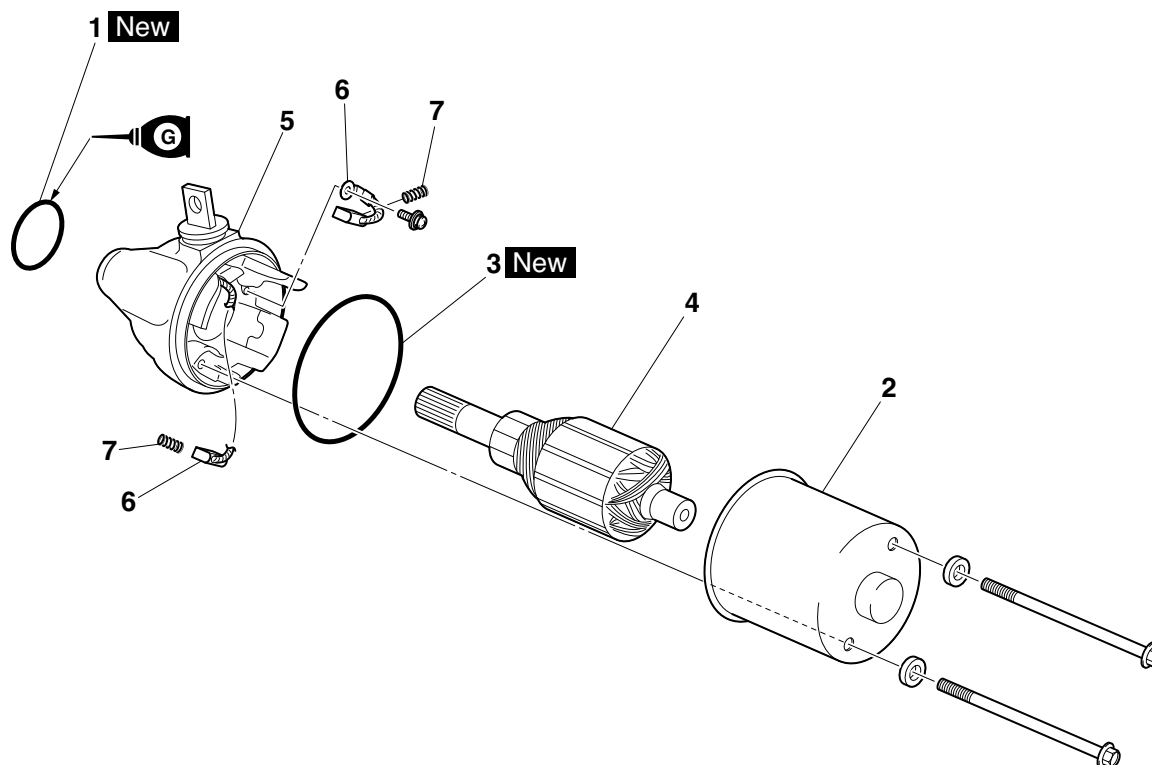


## 2.4.18 STARTER MOTOR REMOVAL

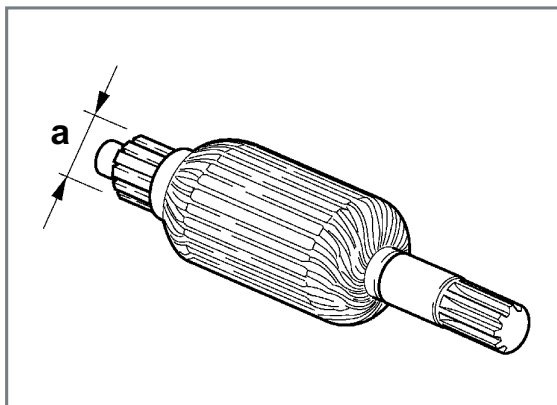
Starter motor



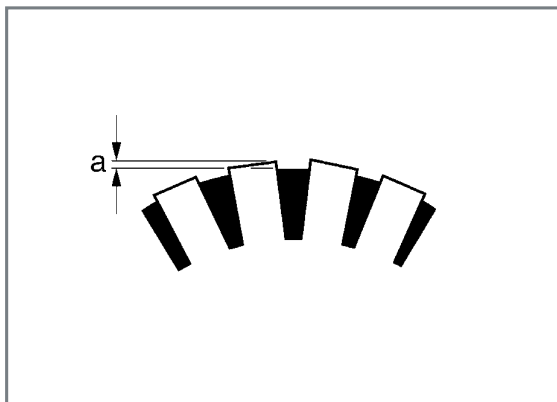
Order	Operation/Components to be removed	Quantity	Notes
	Exhaust manifold		Refer to "1.4 EXHAUST SYSTEM" on page 14.
1	Starter motor	1	
2	Starter motor cable	1	
			For installation, perform the removal procedure in reverse.

**Starter motor breakdown**

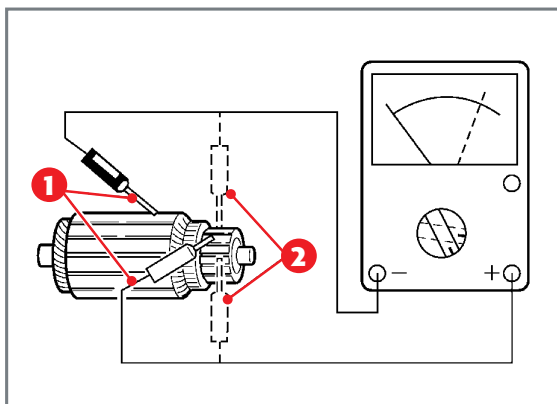
Order	Operation/Components to be removed	Quantity	Notes
1	O-ring	1	
2	Starter motor fork	1	
3	O-ring	1	
4	Switch	1	
5	Brush support start/set starter motor front cover	1	
6	Brush	2	
7	Brush spring	2	
			For installation, perform the removal procedure in reverse.



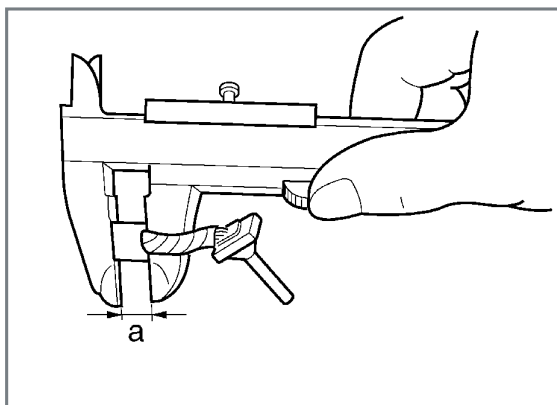
Switch diameter



Mica coating thickness



Resistance measurement



Brush length measurement

### 2.4.18.1 Starter motor check

1. Check
  - Manifold  
Impurities → Clean by using sandpaper with 600 grain number
2. Measure:
  - Diameter **a** of the manifold
  - Not compliant with prescribed values → Replace the starter motor.

Limit	16.6 mm
-------	---------

3. Measure:
  - Mica coating **a**  
Not compliant with prescribed values → Scrape the mica coating until it reaches the appropriate size by using a saw blade connected to earth to adapt it to the switch.

Mica coating	1.35 mm
--------------	---------

**Note:** The mica coating of the switch must be thinned to ensure correct operation of the manifold.

4. Measure:
  - Armature unit resistors (*manifold* and insulation)  
Not compliant with prescribed values → Replace the starter motor.

- a. Measure the resistance of the armature unit with a pocket tester.

Armature winding	
Switch resistance 1	0.0315–0.0385 Ω
Switch resistance 2	Greater than 1MΩ

- b. If any of the resistors do not conform to the prescribed values, replace the starter motor.

5. Measure:
  - Length of brush **a**  
Not compliant with specifications → Replace the brush support start/set starter motor front cover.

Limit	3.50 mm
-------	---------

6. Measure:
  - Brush spring pressure  
Not compliant with specifications → Replace the brush springs.

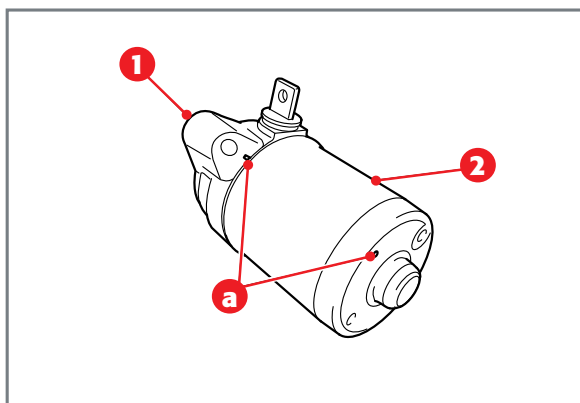
Brush spring pressure	3.92–5.88 N
-----------------------	-------------

7. Check
  - Gear teeth  
Damage/wear → Replace the gear.
8. Check:
  - Bearing
  - Oil seal  
Damage/wear → Replace the brush support start/set starter motor front cover.

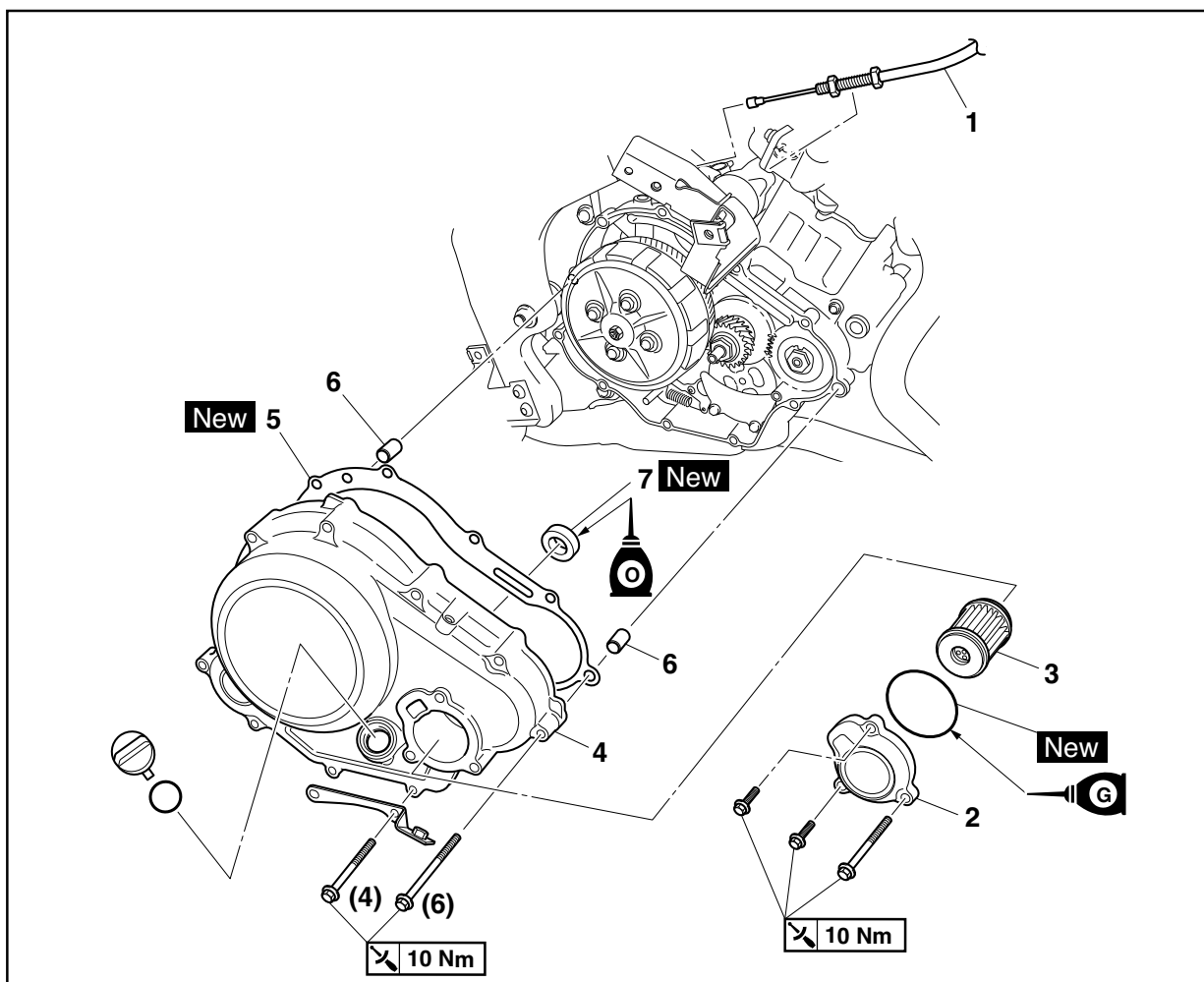
### 2.4.19 STARTER MOTOR INSTALLATION

1. Install
  - Brush support start/set starter motor front cover 1
  - Starter motor fork 2.

**Note:** Align the references **a** on the starter motor fork and on the brush support start/set starter motor front cover.

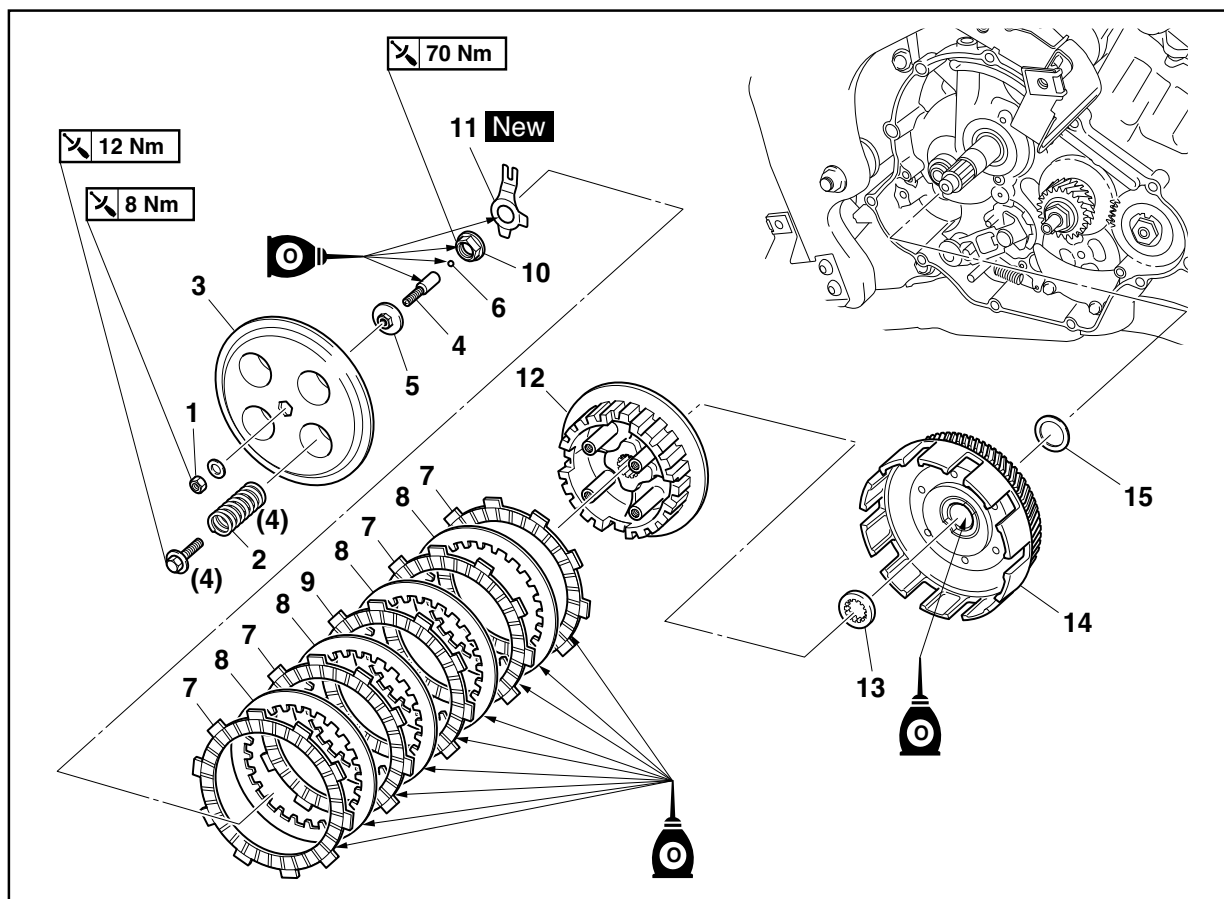


**Starter motor reassembly**

**2.4.20 CLUTCH****2.4.20.1 Clutch crankcase**

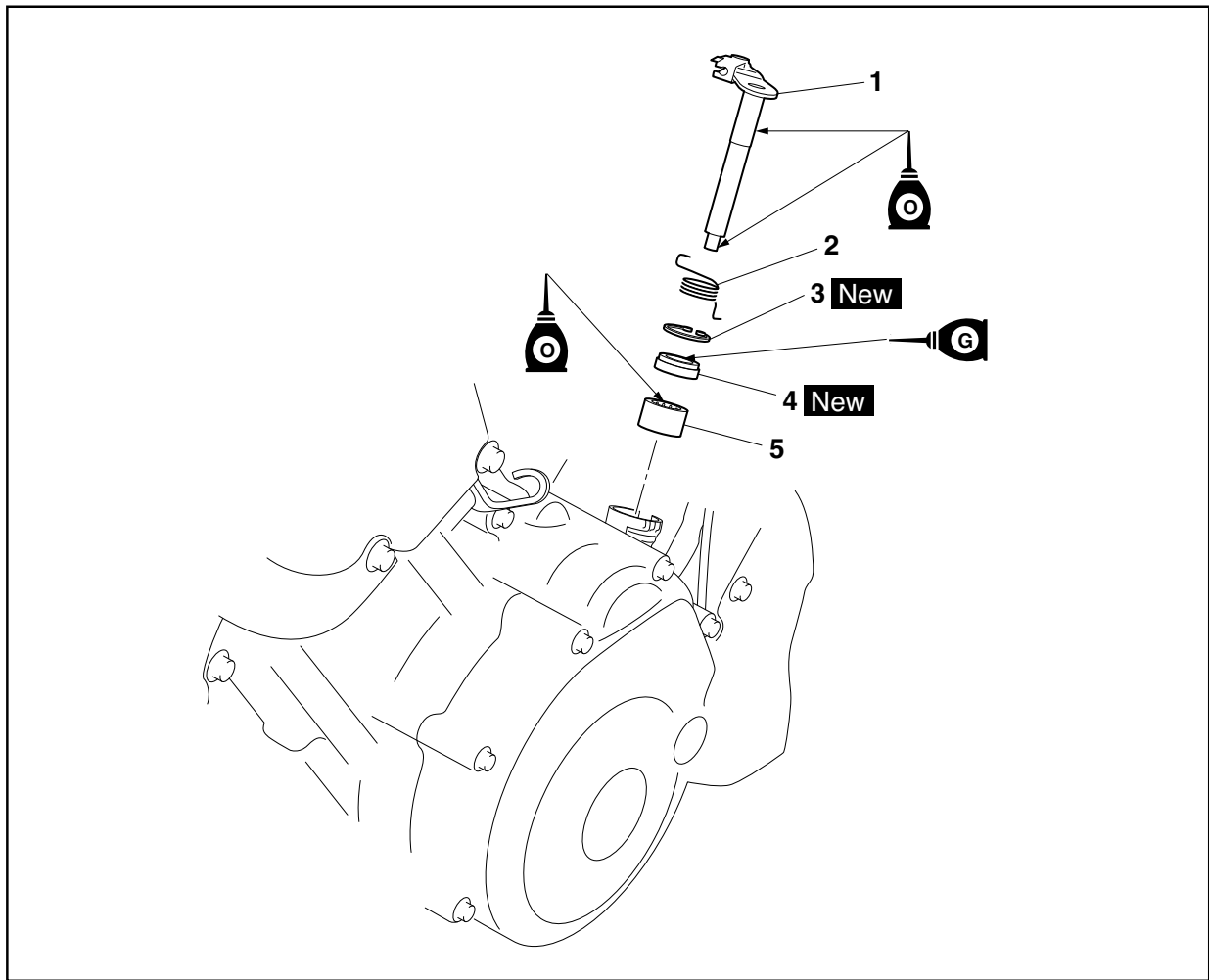
Order	Operation/Components to be removed	Quantity	Notes
	Engine oil		Drain. Refer to "2.2.2 ENGINE OIL REPLACEMENT" on page 48.
1	Clutch cable	1	Disconnect. Refer to "1.9 CLUTCH CABLE" on page 27
2	Oil filter element cover	1	
3	Oil filtering element	1	
4	Clutch crankcase	1	
5	Clutch crankcase gasket	1	
6	Centring pin	2	
7	Oil seal	1	
			For installation, perform the removal procedure in reverse.

## 2.4.20.2 Clutch



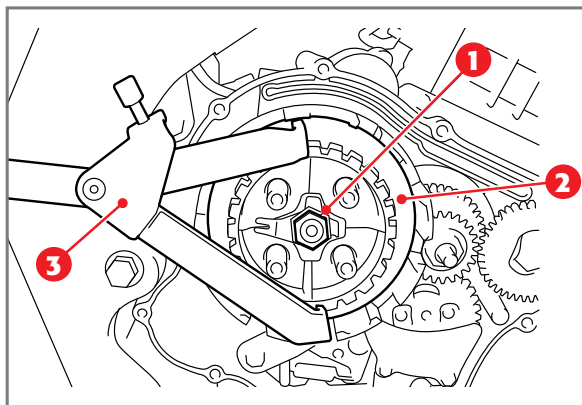
Order	Operation/Components to be removed	Quantity	Notes
1	Counter-nut	1	
2	Clutch spring	4	
3	Pressure plate	1	
4	Short clutch control rod	1	
5	Clutch control rod support	1	
6	Ball	1	
7	Driving disc	5	
8	Driven disc	4	
9	Clutch hub nut	1	
10	Locking washer	1	
11	Clutch hub	1	
12	Thrust washer	1	
13	Clutch case	1	
14	Elastic washer	1	
			For installation, perform the removal procedure in reverse.

## 2.4.20.3 Engine side clutch control lever

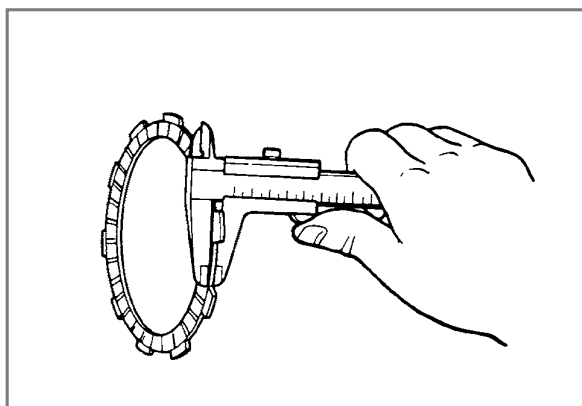


Order	Operation/Components to be removed	Quantity	Notes
1	Clutch control lever	1	
2	Clutch control lever spring	1	
3	Safety elastic ring	1	
4	Oil seal	1	
5	Bearing	1	
			For installation, perform the removal procedure in reverse.

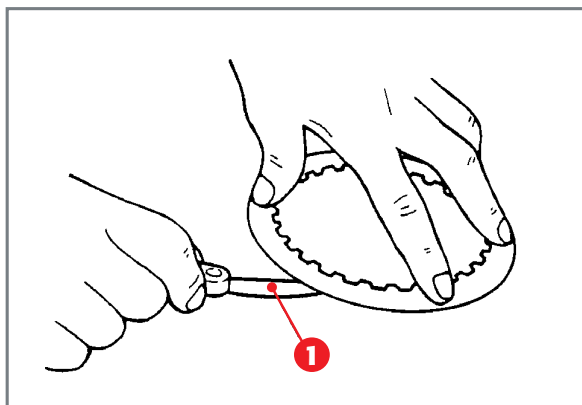




Clutch disc disassembly.



Driving disc 8



Disc deformation measurement

## 2.4.20.4 Clutch removal

1. Smoothen the locking washer key.
2. Indicator Loosen:
  - Clutch hub nut 1

**Note:** Holding the clutch hub 2 with the universal tool 3, loosen the clutch hub nut.

### 2.4.20.4.1 Driving disc check

1. Check:
  - Driving disc
    - Damage/wear → Replace all driving discs.
2. Measure:
  - Driving disc thickness
    - Not compliant with required values → Replace all the driving discs.

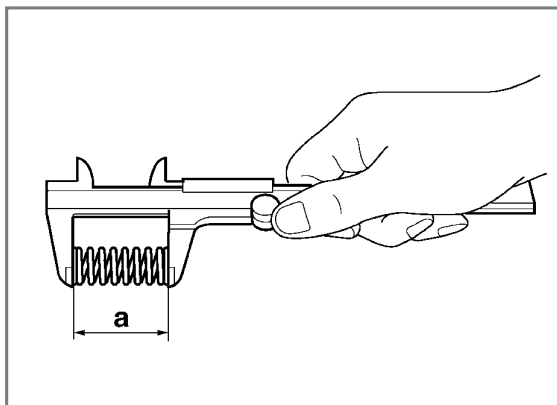
**Note:** Measure the driving disc in four different positions.

Driving disc thickness 7	2.90–3.10 mm
Wear limit	2.80 mm

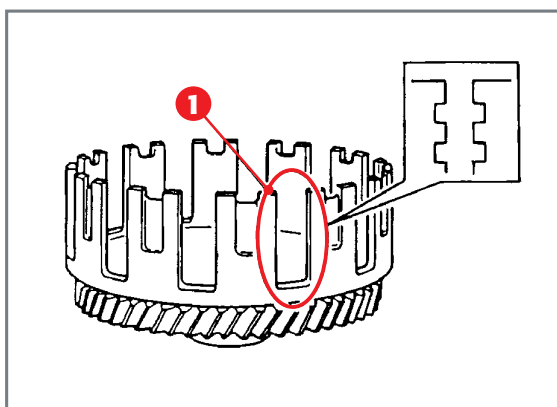
### 2.4.20.4.2 Driven disc check

1. Check:
  - Driven disc
    - Damage → Replace all driven discs.
2. Measure:
  - Driven disc deformation
    - (using a levelling table and a thickness gauge 1)
    - Not compliant with specifications → Replace all the driven discs.

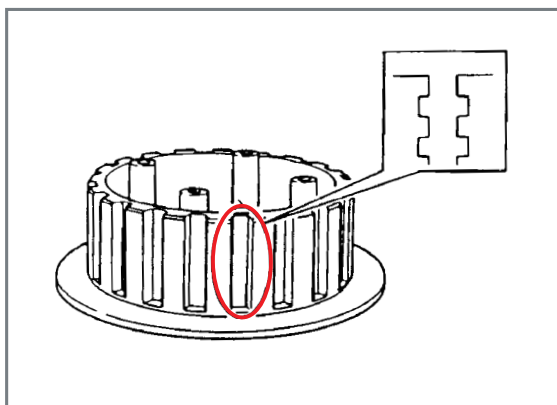
Driven disc thickness	1.90–2.10 mm
Deformation limit	0.20 mm



Clutch spring length



Clutch case teeth check



Clutch hub check

### 2.4.20.4.3 Clutch spring check

The following procedure applies to all clutch springs.

1. Check
  - Clutch spring
  - Damage → Replace all clutch springs.
2. Measure:
  - Free length of valve spring **a**.
  - Not compliant with specifications → Replace all clutch springs.

Clutch spring free length	40.48 mm
Limit	36.80 mm

### 2.4.20.4.4 Clutch case check

1. Check
  - Teeth of clutch case "1"
  - Damage/pitting/wear → Deburr the clutch case teeth or replace the clutch case.

**Note:** The presence of pitting on the teeth of the clutch case will cause irregular operation of the clutch.

2. Check:
  - Bearing
  - Damage/wear → Replace the bearing housing and the clutch case.

### 2.4.20.4.5 Clutch hub check

1. Check
  - Clutch hub ribbing
  - Damage/pitting/wear → Replace the clutch hub.

**Note:** The presence of pitting on the ribbing of the clutch hub will cause irregular operation of the clutch.

### 2.4.20.4.6 Pressure plate check

1. Check
  - Pressure plate
  - Cracks/damage → Replace.

### 2.4.20.5 Clutch control lever and clutch control rod check

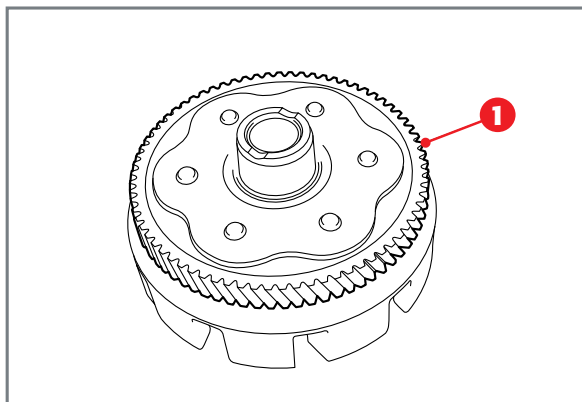
1. Check
  - Clutch control lever
  - Short clutch control rod
  - Damage/wear → Replace the faulty part or parts.

### 2.4.20.6 Primary drive gear check

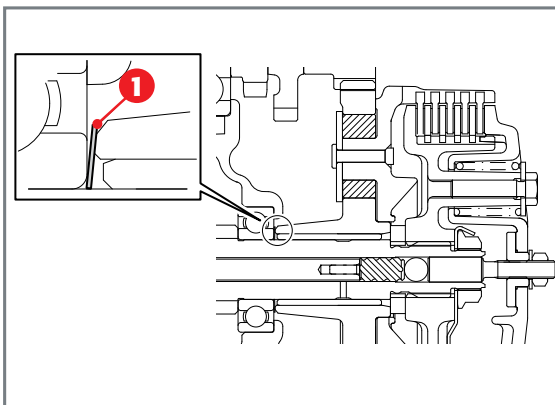
1. Remove:
  - Primary transmission drive gear  
Refer to "2.4.23 COUNTERSHAFT GEAR" on page 103.
2. Check:
  - Primary transmission drive gear  
Damage/wear → Replace the drive gear of the primary transmission and the clutch case as a whole.  
Excessive noise during operation → Replace the drive gear of the primary transmission and the clutch case as a whole.
3. Install:
  - Primary transmission drive gear  
Refer to "2.4.23 COUNTERSHAFT GEAR" on page 103.

### 2.4.20.7 Primary duct gear check

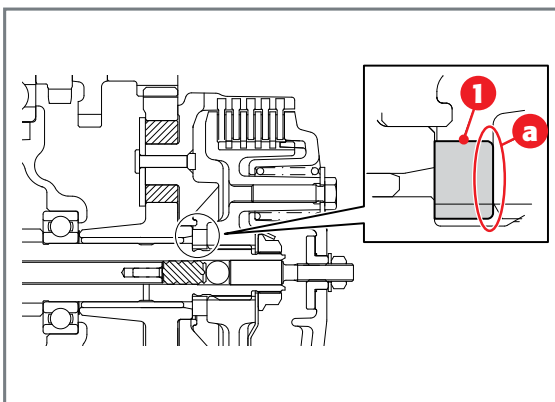
1. Check:
  - Primary transmission driven gear 1  
Damage/wear → Replace the drive gear of the primary transmission and the clutch case as a whole.  
Excessive noise during operation → Replace the drive gear of the primary transmission and the clutch case as a whole.



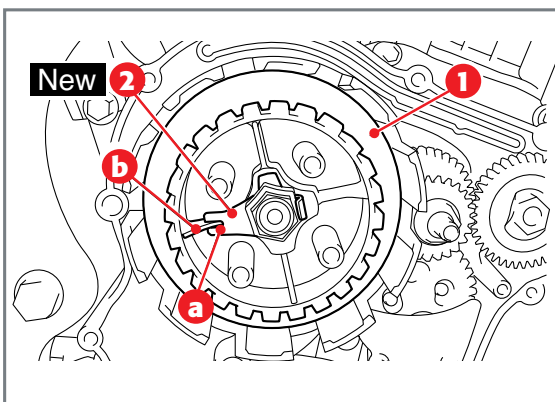
**Duct gear check**



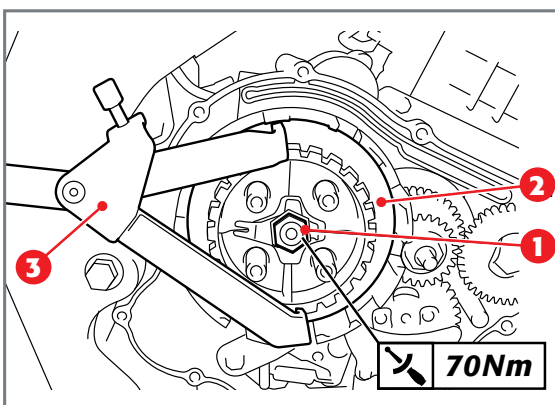
Elastic washer installation



Thrust washer installation



Clutch hub installation



Clutch hub tightening.

## 2.4.20.8 Clutch installation

1. Install
  - Elastic washer 1

**Note:** Install the elastic washer as shown in the figure.

2. Install:
  - Clutch case
  - Thrust washer 1

**Note:** Install the thrust washer with the rounded side **a** facing the clutch hub.

3. Install:
  - Clutch hub 1
  - Locking washer 2.
  - Clutch hub nut

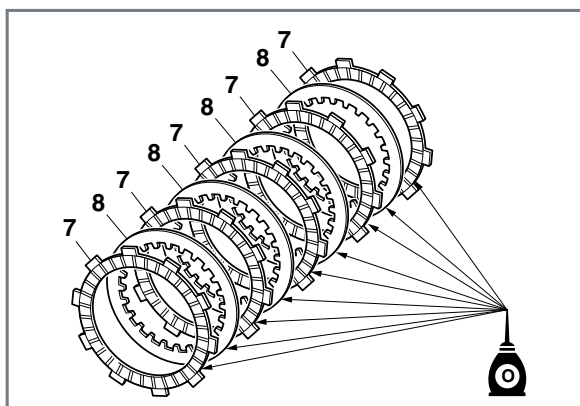
**Note:** Lubricate the clutch hub nut threads and damping surfaces of the locking washer with engine oil.

Align the groove **a** in the locking washer by using a thread **b** on the clutch hub.

4. Tighten:
  - Clutch hub nut 1, tighten to the specified torque.

**Note:** Holding the clutch hub 2 still with the universal tool 3, tighten the clutch hub nut.

5. Fold the locking washer key along one of the flat sides of the nut.



Clutch discs

6. Lubricate:
- Friction discs
  - Clutch discs

Recommended lubricant
Engine oil

7. Install:
- Driving disc 7
  - Driven discs 8

**Note:** First install a friction plate and then alternate a clutch disc and a friction plate.

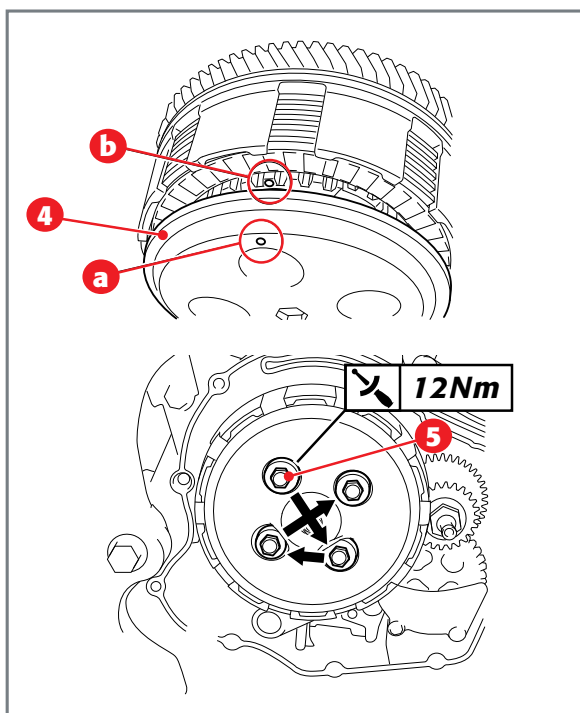
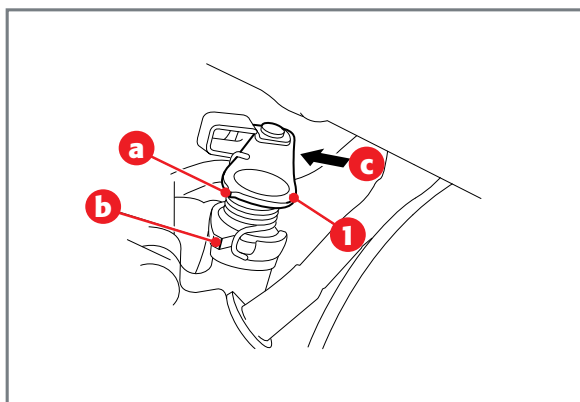


Plate and bolt installation

8. Install:
- Pressure plate 4
  - Clutch springs
  - Clutch spring screws 5, tighten to the specified torque.

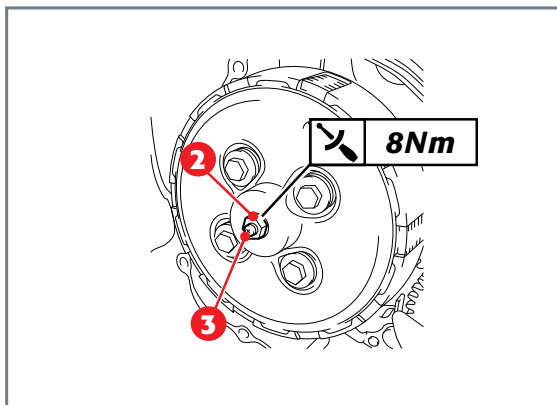
**Note:** Align the punching a on the pressure plate with the punching b on the clutch hub.

Tighten the clutch spring bolts in a gradual and crossed order.

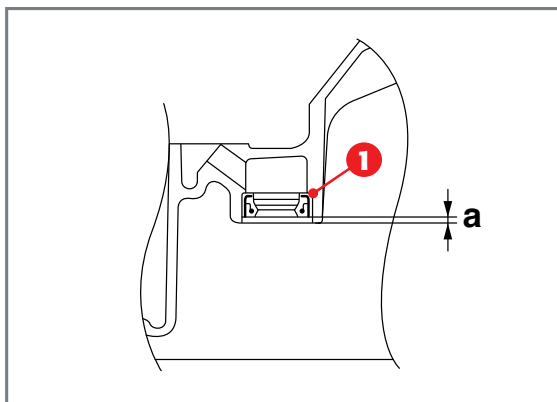


Control lever alignment

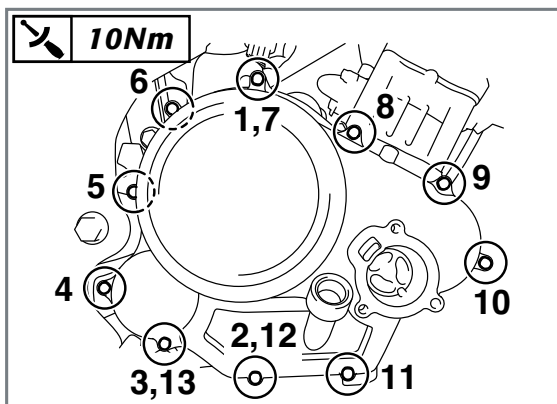
9. Adjust:
- Clutch mechanism backlash
- a. Check that the protruding part a on the clutch control lever 1 is aligned with the reference b on the crankcase as shown in the figure, pushing the clutch control lever manually in direction c until it stops.



Control lever adjustment



Oil seal installation



Crankcase fixing tightening

- b. If the protruding part **a** is not aligned with reference **b**, align as follows:
- Align the counter-nut **2**.
  - With the clutch control lever fully pressed in direction **c**, rotate the short clutch control rod **3** towards the inside or outside until reference **a** is aligned with reference **b**.
  - Stop the short clutch control rod to prevent it from moving and then tighten the counter-nut as required.

10. Install:
- Oil seal **1**

Oil seal installation depth <b>a</b>	1.4–1.9 mm
--------------------------------------	------------

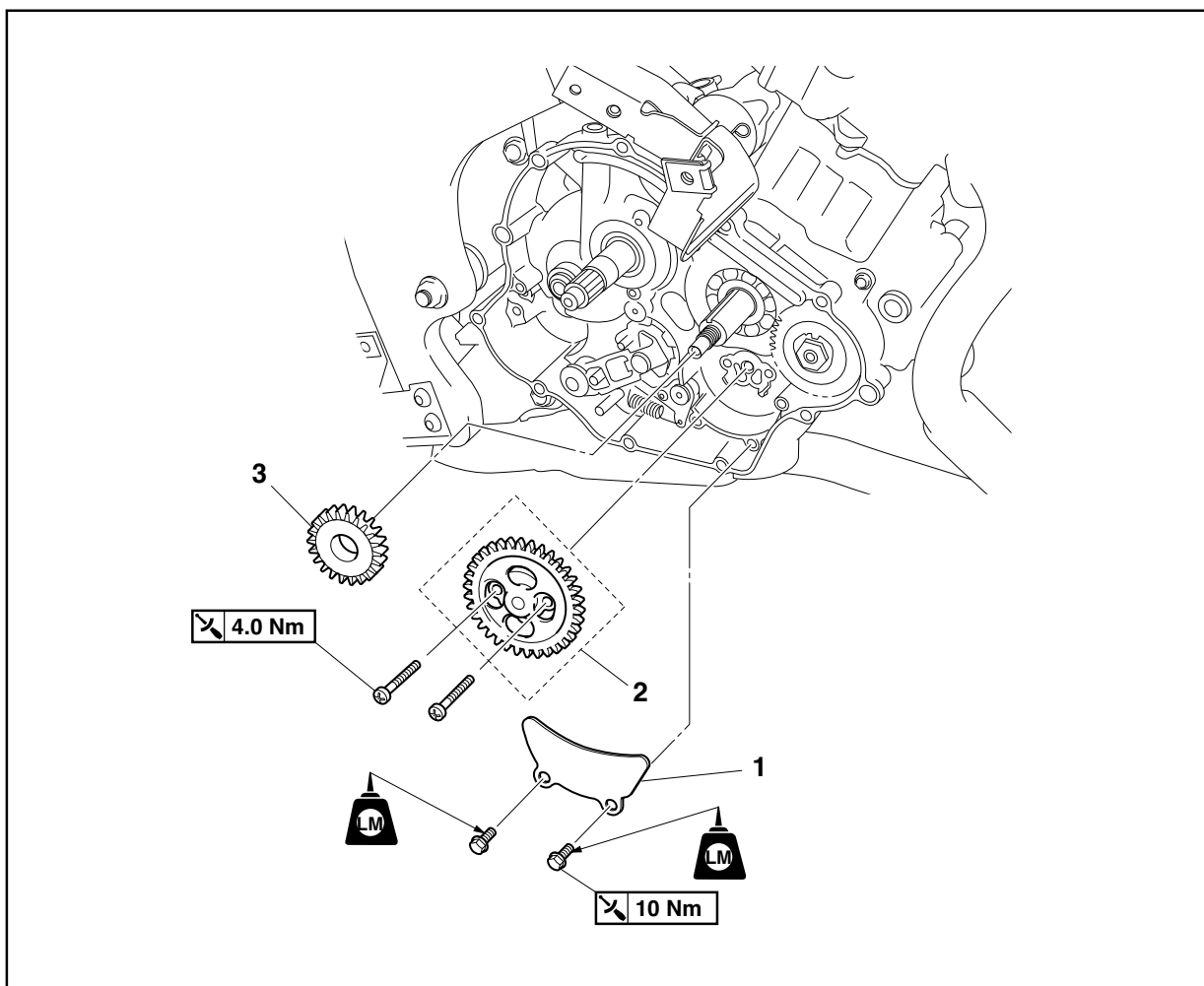
11. Install:
- Clutch crankcase, tighten to the specified torque

**Note:** Tighten the clutch crankcase bolts in the correct sequence, as shown.

## 2.4.21 OIL PUMP

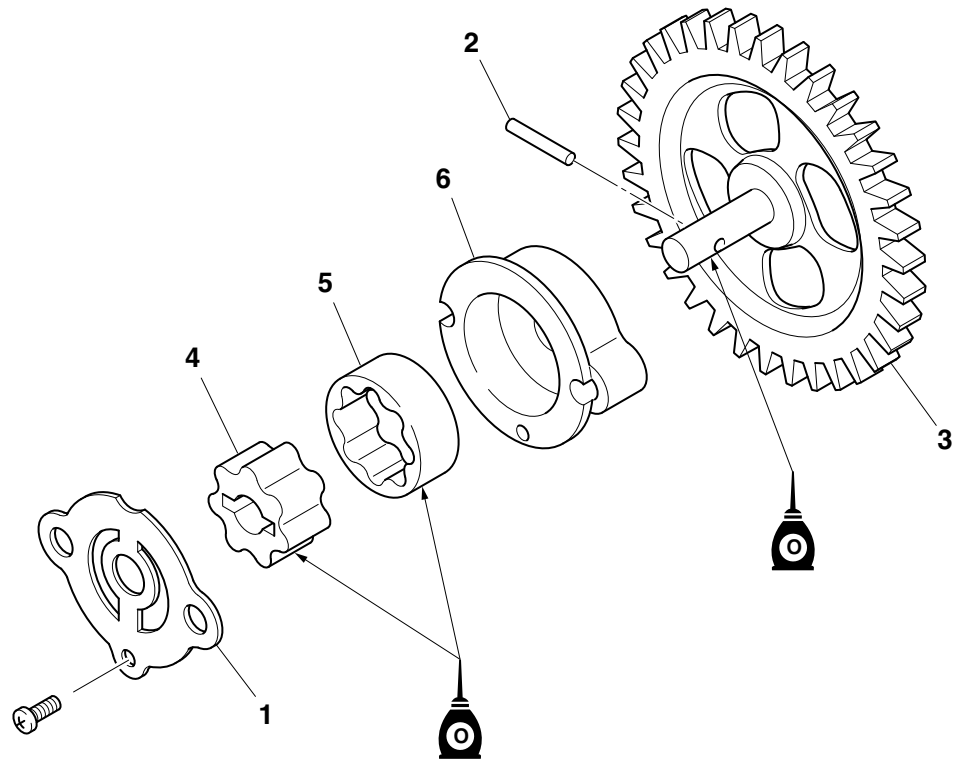
# 2

ENGINE DISASSEMBLY



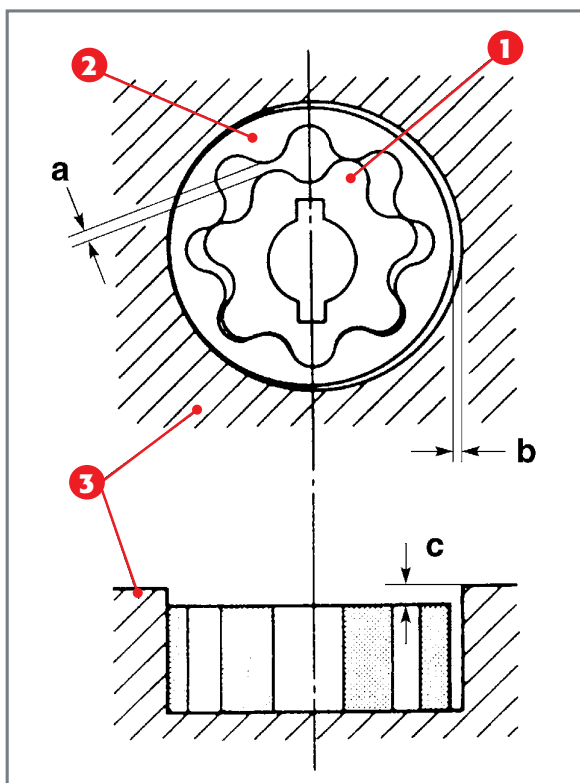
Order	Operation/Components to be removed	Quantity	Notes
	Clutch case		Refer to "2.4.20 CLUTCH" on page 88.
	Countershaft drive gear		Refer to "2.4.23 COUNTERSHAFT GEAR" on page 103.
1	Oil guard	1	
2	Oil pump unit	1	
3	Oil pump drive gear	1	
			For installation, perform the removal procedure in reverse.



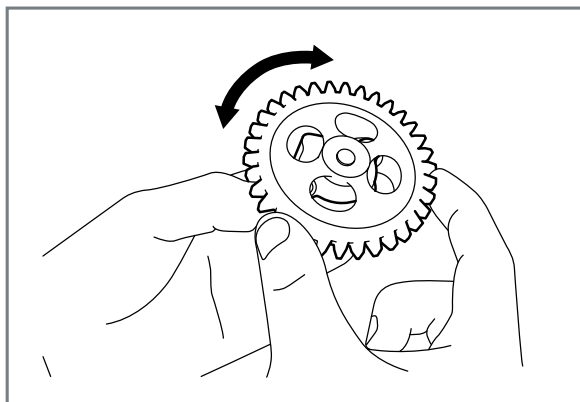
**Oil pump**

Order	Operation/Components to be removed	Quantity	Notes
1	Oil pump housing cover	1	
2	Pin	1	
3	Oil pump driven gear	1	
4	Oil pump internal rotor	1	
5	Oil pump external rotor	1	
6	Oil pump housing	1	
			For installation, perform the removal procedure in reverse.

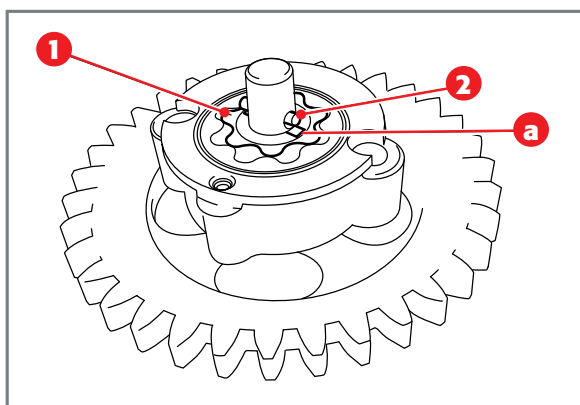




1. Internal rotor
2. External rotor
3. Oil pump housing



Rotor check



Rotor installation

### 2.4.21.1 Oil pump check

#### 1. Check:

- Oil pump drive gear
- Oil pump driven gear
- Oil pump housing
- Oil pump housing cover Cracks/damage/wear  
→ Replace the faulty part or parts.

#### 2. Measure:

- Internal rotor - external rotor end backlash **a**
  - External rotor - oil pump housing backlash **b**
  - Oil pump housing - internal and external rotor backlash **c**
- Not compliant with specifications → Replace the oil pump.

Internal rotor - external rotor end backlash	Less than 0.15 mm
Limit	0.23 mm
External rotor - oil pump housing backlash	0.13–0.18 mm
Limit	0.25 mm
Oil pump housing - internal and external rotor backlash	0.06–0.11 mm
Limit	0.18 mm

#### 2. Check:

- Oil pump operation Difficult movement → Repeat steps (1) and (2) or replace the faulty part or parts.

### 2.4.21.2 Oil pump assembly

#### 1. Lubricate:

- Oil pump internal rotor
- Oil pump external rotor
- Oil pump driven gear  
(by using the recommended lubricant)

Recommended lubricant
Engine oil

#### 2. Install:

- Oil pump external rotor
- Oil pump internal rotor **1**
- Oil pump driven gear
- Pin **2**

**Note:** When installing the internal rotor, align the pin 2 of the oil pump shaft with the groove a of the internal rotor 1.



## 3. Check:

- Oil pump operation  
Refer to "2.4.21.1 Oil pump check" on page 99.

**2.4.21.3 Oil pump installation on engine**

## 1. Install:

- Oil pump unit

Oil pump unit screw
---------------------

4 Nm
------

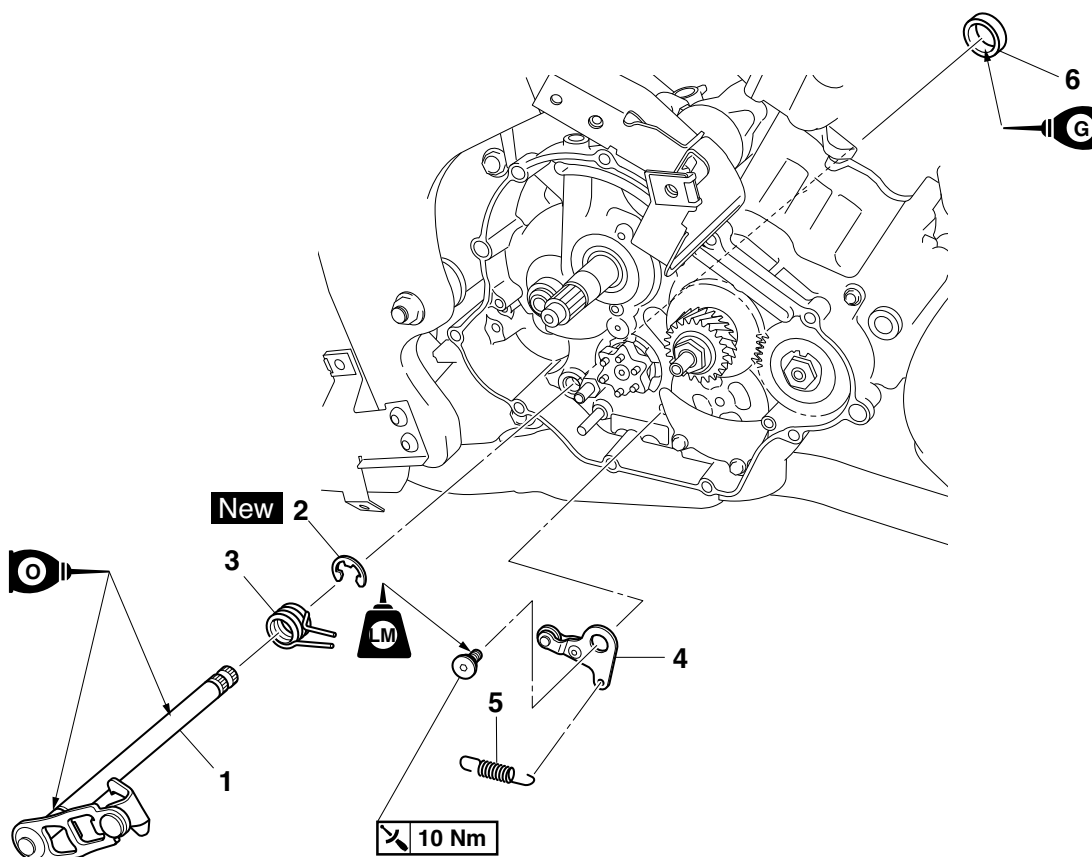
**WARNING:** After tightening the screws, make sure the oil pump rotates without forcing or jamming.

## 2.4.22 GEAR SHAFT

2

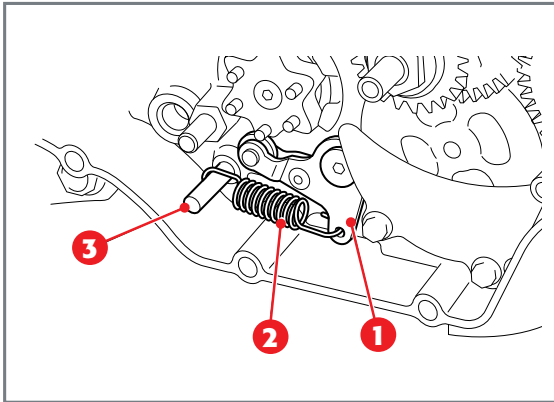
ENGINE DISASSEMBLY

### Gear shaft and stop lever

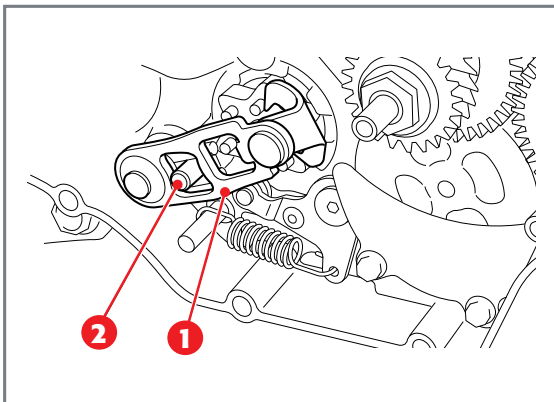


Order	Operation/Components to be removed	Quantity	Notes
	Clutch case		Refer to "2.4.20 CLUTCH" on page 88.
	Countershaft drive gear		Refer to "1 ENGINE REMOVAL FROM VEHICLE" on page 9.
1	Gear shaft	1	
2	Safety elastic ring	1	
3	Gear shaft spring	1	
4	Stop lever	1	
5	Stop lever spring	1	
6	Oil seal	1	
			For installation, perform the removal procedure in reverse.





Spring and stop lever installation



Control lever adjustment

#### 2.4.22.1 Gear shaft check

1. Check:
  - Gear shaft  
Bending/damage/wear → Replace
  - Gear shaft spring  
Damage/wear → Replace.

#### 2.4.22.2 Stop lever check

1. Check:
  - Stop lever  
Bending/damage → Replace  
Difficult roller rotation → Replace the stop lever.
  - Stop lever spring  
Damage/wear → Replace.

#### 2.4.22.3 Gear shaft installation

1. Install:
  - Stop lever 1
  - Stop lever spring 2

**Note:** Install the stop lever spring as shown in the figure.

Hook the ends of the stop lever spring onto the stop lever and crankcase hub 3.

Engage the stop lever in the gear selector drum segment unit.

2. Install:
  - Gear shaft 1

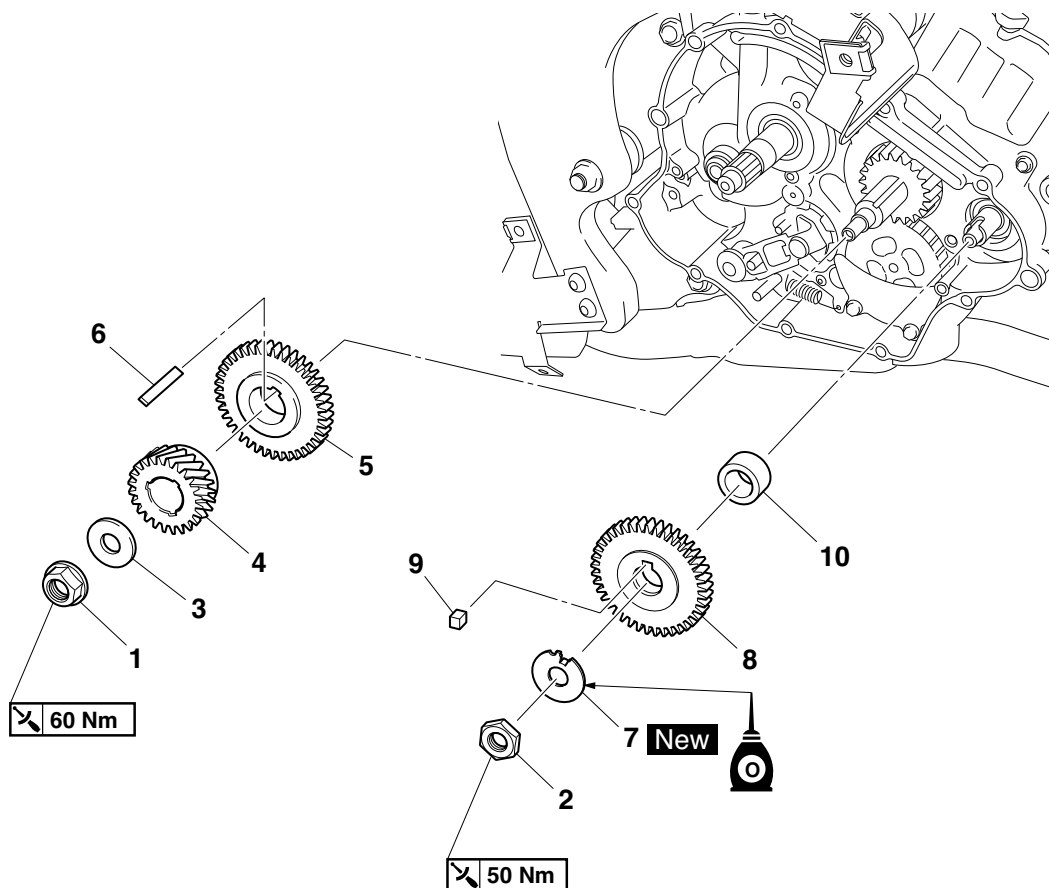
**Note:** Hook the end of the gear shaft spring onto the gear shaft spring stop 2.

## 2.4.23 COUNTERSHAFT GEAR

2

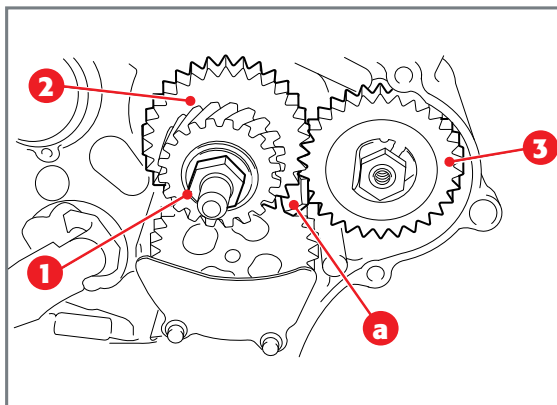
ENGINE DISASSEMBLY

### Primary transmission drive gear and countershaft gears

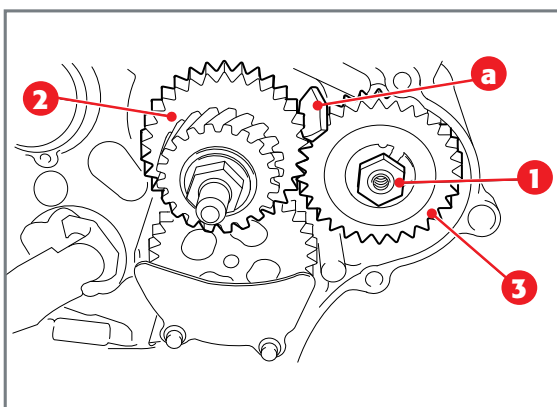


Order	Operation/Components to be removed	Quantity	Notes
	Clutch case		Refer to "2.4.20 CLUTCH" on page 88.
1	Primary transmission drive gear nut	1	
2	Countershaft driven gear nut	1	
3	Washer	1	
4	Primary transmission drive gear	1	
5	Countershaft drive gear	1	
6	Straight key	1	
7	Locking washer	1	
8	Countershaft driven gear	1	
9	Straight key	1	
10	Spacer	1	
			For installation, perform the removal procedure in reverse.





Driving gear removal



Driving gear removal

### 2.4.23.1 Primary transmission drive gear and countershaft gears removal

1. Loosen:
  - Primary transmission drive gear nut 1.

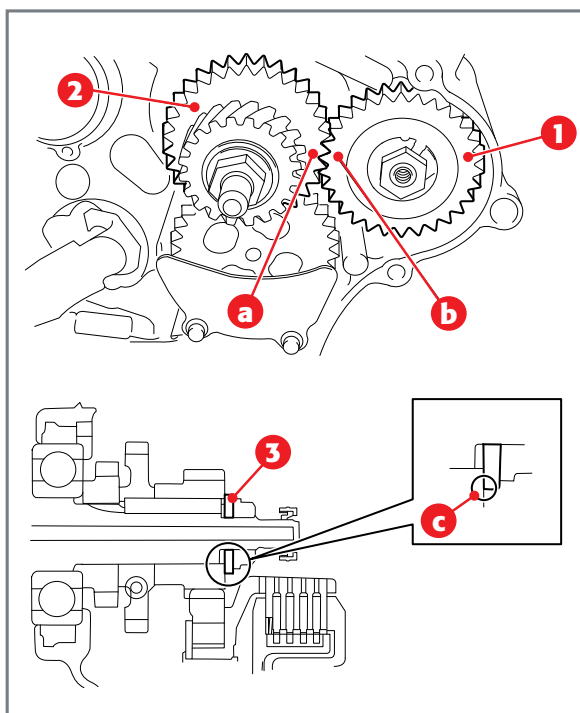
**Note:** Place the aluminium plate **a** between the countershaft drive gear **2** and the countershaft driven gear **3**, then loosen the primary transmission drive gear nut.

2. Smoothen the locking washer key.
3. Loosen:
  - Countershaft driven gear nut 1.

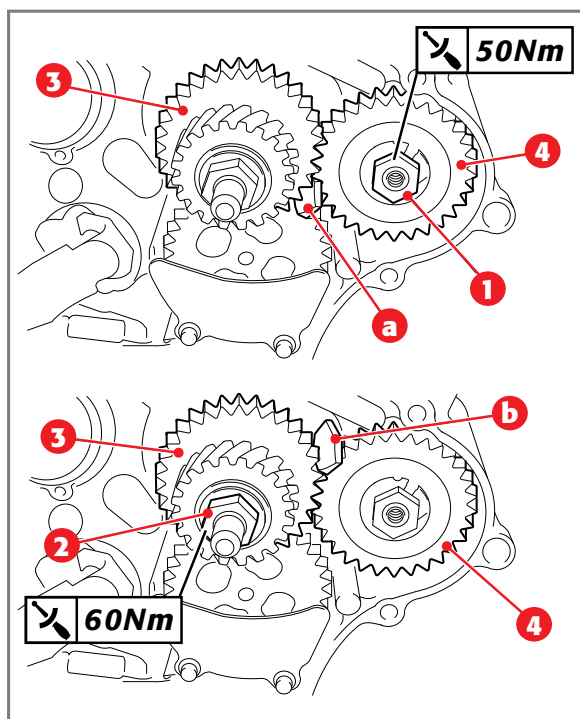
**Note:** Place the aluminium plate **a** between the countershaft drive gear **2** and the countershaft driven gear **3**, then loosen the countershaft driven gear nut.

### 2.4.23.2 Primary transmission drive gear and countershaft gears check

1. Check :
  - Countershaft drive gear
  - Countershaft driven gear
  - Cracks/damage/wear → Replace.
2. Check :
  - Primary transmission drive gear
  - Refer to "2.4.20.6 Primary drive gear check" on page 93.



Driving gear installation



Driving gear installation

### 2.4.23.3 Primary transmission drive gear and countershaft gear installation

#### 1. Install:

- Countershaft driven gear 1
- Locking washer **NEW**
- Countershaft drive gear 2
- Primary transmission drive gear
- Washer 3
- Countershaft driven gear nut
- Primary transmission drive gear nut

**Note:** Align the punching **a** of the countershaft drive gear 1 with the punching **b** of the countershaft driven gear 2.

Be sure to install the washer so that the sharp side **c** faces the primary transmission drive gear.

#### 2. Tighten:

- Countershaft driven gear nut 1, tighten to indicated torque.
- Primary transmission drive gear nut 2, tighten to indicated torque.

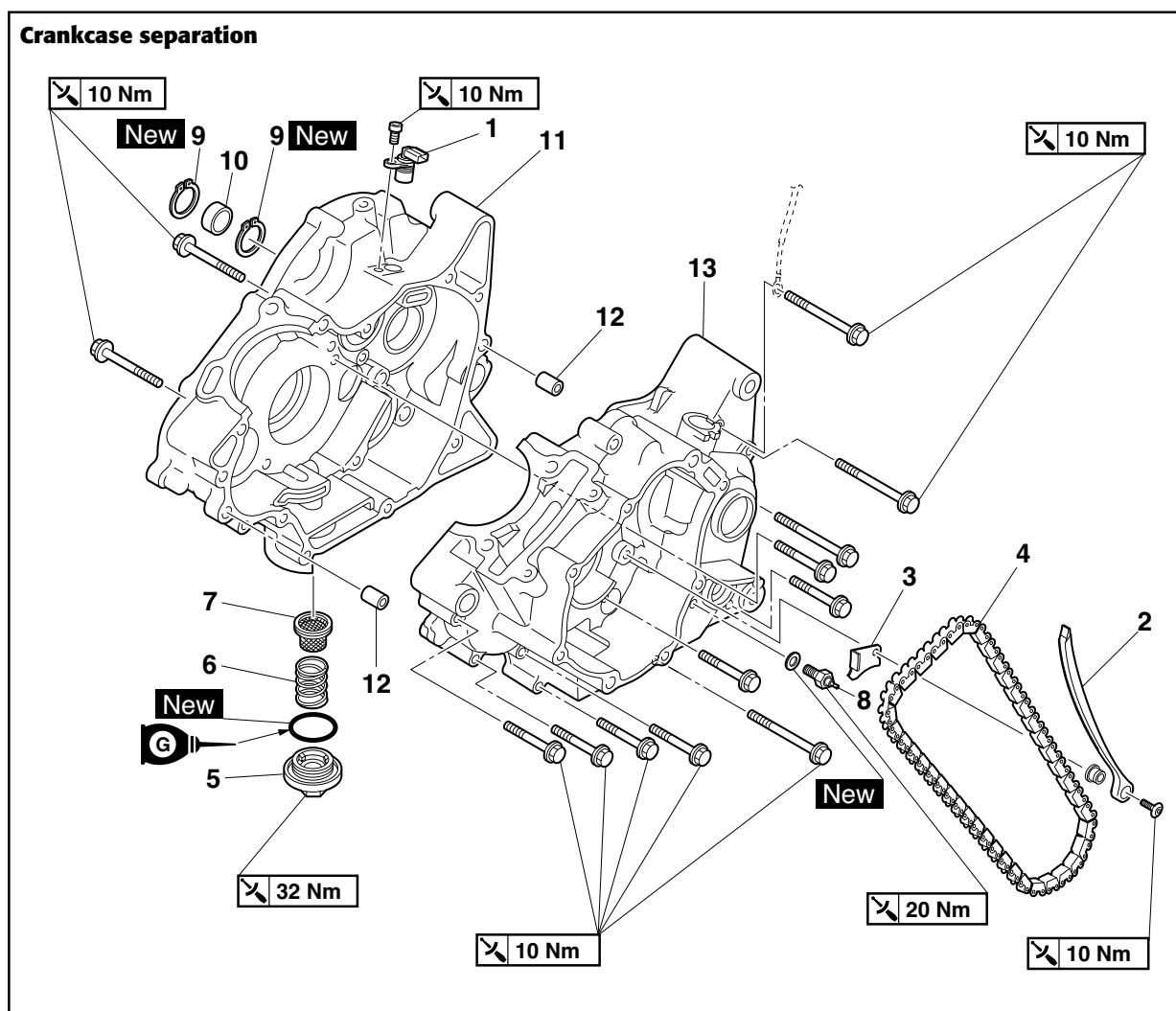
**Note:** Place the aluminium plate **a** between the countershaft drive gear 3 and the countershaft driven gear 4, then tighten the countershaft driven gear nut.

Place the aluminium plate **b** between the countershaft drive gear 3 and the countershaft driven gear 4, then tighten the primary transmission drive gear nut.

- 3. Fold the locking washer key along one of the flat sides of the nut.

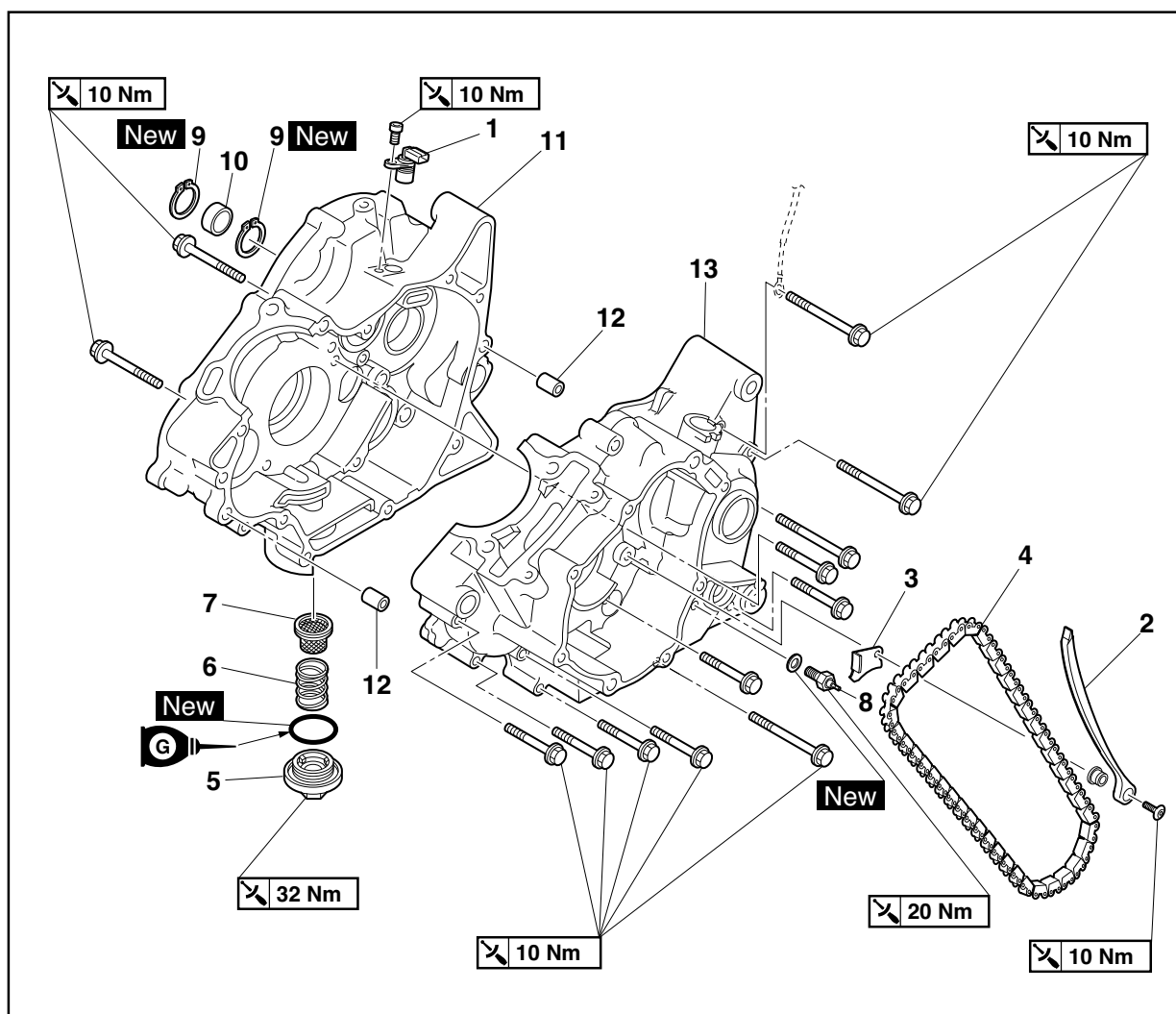
## 2.4.24 CRANKCASE

## Crankcase separation

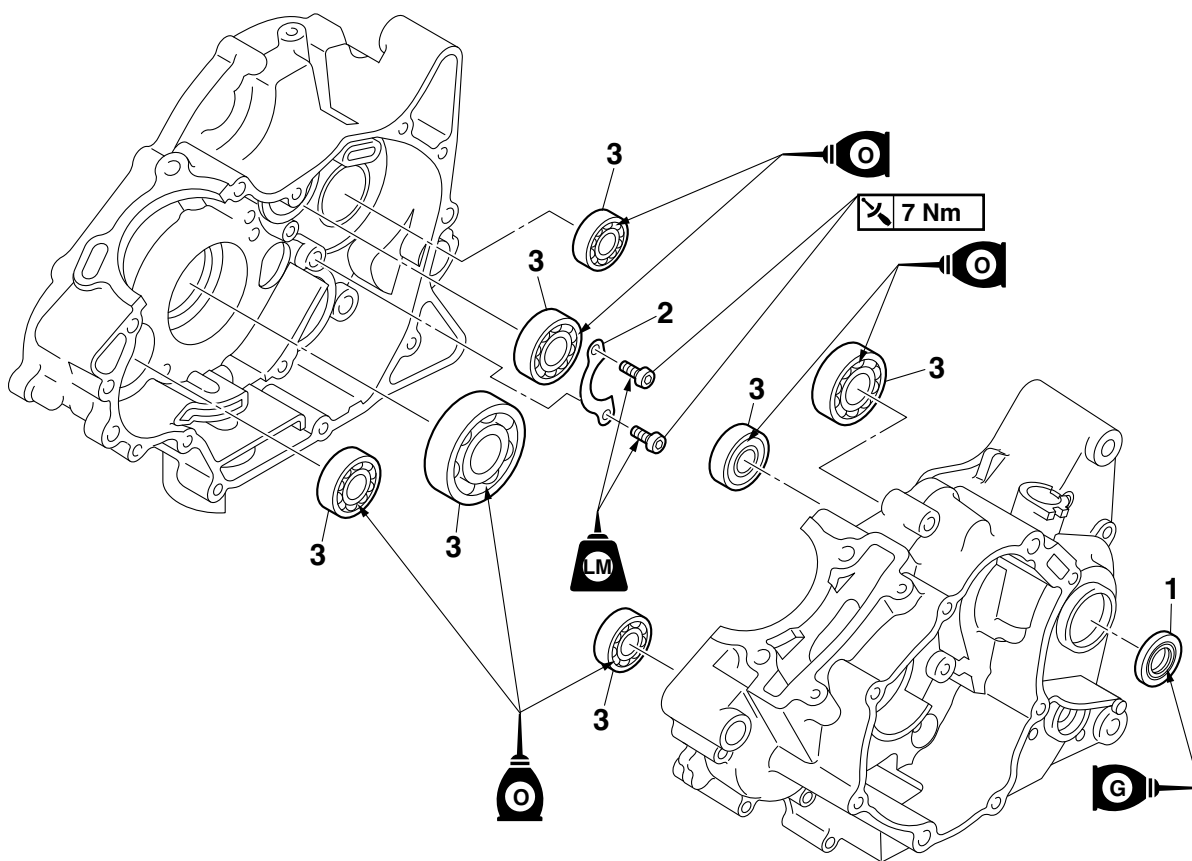


Order	Operation/Components to be removed	Quantity	Notes
	Engine		Refer to "1 ENGINE REMOVAL FROM VEHICLE" on page 9
	Cylinder head		Refer to "2.4.1 CYLINDER HEAD" on page 53
	Cylinder/Piston		Refer to "2.4.12 CYLINDER AND PISTON" on page 74
	Clutch case		Refer to "2.4.20 CLUTCH" on page 88
	Oil pump unit		Refer to "2.4.21 OIL PUMP" on page 97
	Gear shaft		Refer to "2.4.22 GEAR SHAFT" on page 101
	Starter motor		Refer to "2.4.18 STARTER MOTOR REMOVAL" on page 84
	Countershaft gears		Refer to "2.4.23 COUNTERSHAFT GEAR" on page 103
	Generator rotor		Refer to "2.4.13 GENERATOR AND UNIDIRECTIONAL START-UP" on page 79

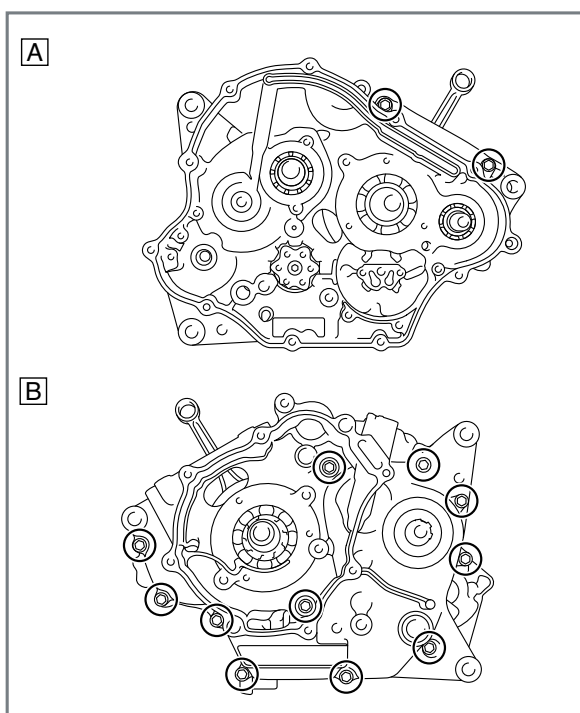




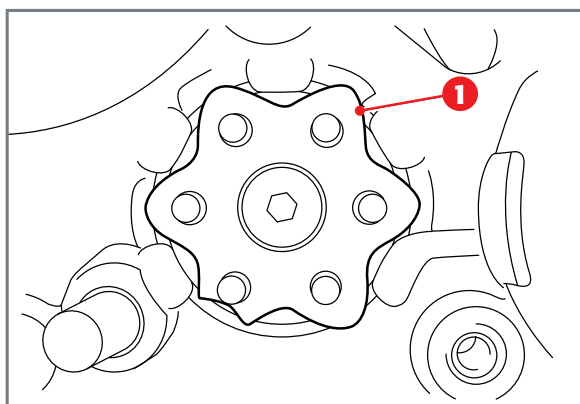
Order	Operation/Components to be removed	Quantity	Notes
1	Speed sensor	1	
2	Timing chain guide (intake side)	1	
3	Chain cover	1	
4	Timing chain	1	
5	Oil drain cap	1	
6	Spring	1	
7	Engine oil filter	1	
8	Neutral drive switch	1	
9	Safety elastic ring	2	
10	Spacer	1	
11	Right crankcase	1	
12	Centring pin	2	
13	Left crankcase	1	
			For installation, perform the removal procedure in reverse.

**Oil seal and bearing removal**

Order	Operation/Components to be removed	Quantity	Notes
	Crankshaft/Countershaft		Refer to "2.4.25 CRANKSHAFT" on page 112.
	Transmission		Refer to "2.4.26 TRANSMISSION" on page 115.
1	Oil seal	1	
2	Bearing stop	1	
3	Bearing	7	
			For installation, perform the removal procedure in reverse.



A. Right crankcase - B. Left crankcase



Gear selector drum positioning

### 2.4.24.1 Crankcase separation

1. Remove:
  - Crankcase screws

**Note:** Loosen each screw by 1/4 of a turn at a time, gradually and in crossed order. After fully loosening all the screws, remove them.

2. Rotate:
  - Gear selector drum segment

**Note:** Turn the gear selector drum segment 1 to the position shown in the figure. In this position, the teeth of the gear selector drum segment do not come into contact with the crankcase during crankcase separation.

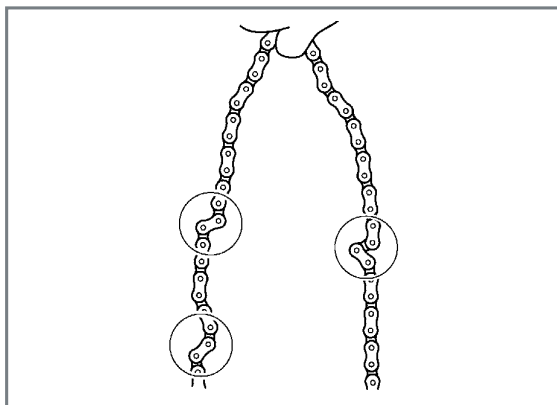
3. Remove:
  - Right crankcase

**WARNING:** Tap on one side of the crankcase with a soft mallet. Only tap on the reinforced parts of the crankcase, not on the crankcase coupling surfaces. Proceed slowly and carefully and make sure that the two half-crankcases separate evenly.

### 2.4.24.2 Crankcase check

1. Thoroughly wash the half-crankcases with a non-aggressive solvent.
2. Thoroughly wash all gasket surfaces and crankcase coupling surfaces.
3. Check:
  - Crankcase  
Cracks/damage → Replace.
  - Oil supply ducts  
Obstruction → Clean with compressed air jet.





Timing chain check

### 2.4.24.3 Timing chain check

1. Check:
  - Timing chain  
Damage/stiffness → Replace the timing chain and the camshaft pinion as a whole.
2. Check:
  - Timing chain guide (intake side)  
Damage/wear → Replace.

### 2.4.24.4 Oil filter check

1. Check:
  - Oil filter  
Damage → Replace.  
Contamination → Clean by using a solvent.

### 2.4.24.5 Bearing and oil seal check

1. Check:
  - Bearings  
Clean and lubricate the bearings, then rotate the inner track manually.  
Difficult movement → Replace.
  - Oil seal  
Damage/wear → Replace.

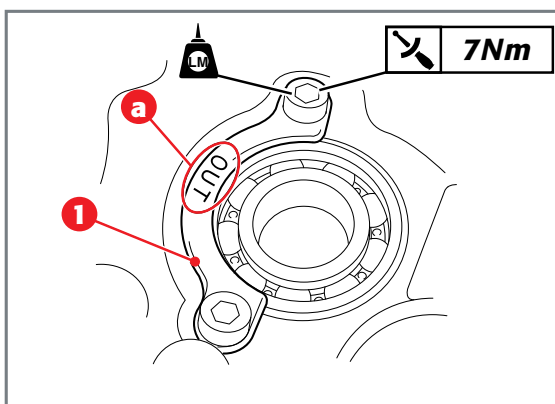
### 2.4.24.6 Bearing stop installation

1. Install:
  - Bearing stop 1

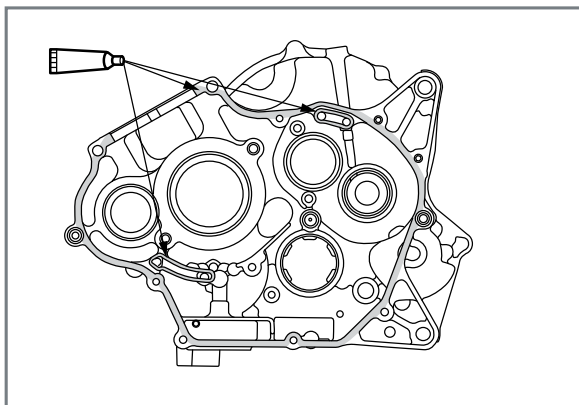
**Note:** Install the bearing stop 1 with the reference "OUT" (EXTERNAL) **a** facing outwards.

Apply the medium-resistance threadlocker on the bearing stop screw threads.

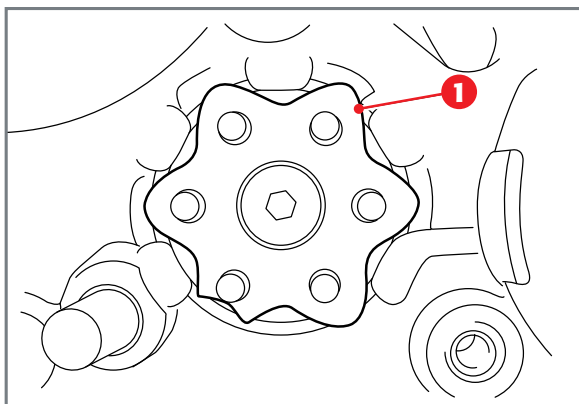
- Bearing stop screws, tighten to the torque specified.



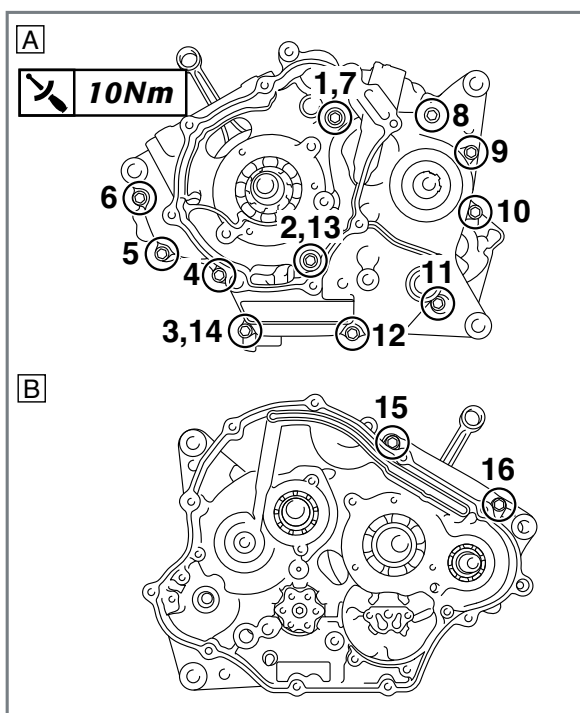
Bearing stop installation



Sealant application points



Gear selector drum positioning



A. Right crankcase - B. Left crankcase

### 2.4.24.7 Crankcase assembly

1. Thoroughly clean all gasket coupling surfaces and crankcase coupling surfaces.
2. Apply:
  - Sealant  
(on the crankcase coupling surfaces)

**Note:** Do not allow the sealant to come in contact with the oil passage.

3. Install:
  - Right crankcase

**Note:** Turn the gear selector drum segment 1 to the position shown in the figure. In this position, the teeth of the gear selector drum segment do not come into contact with the crankcase during crankcase installation.

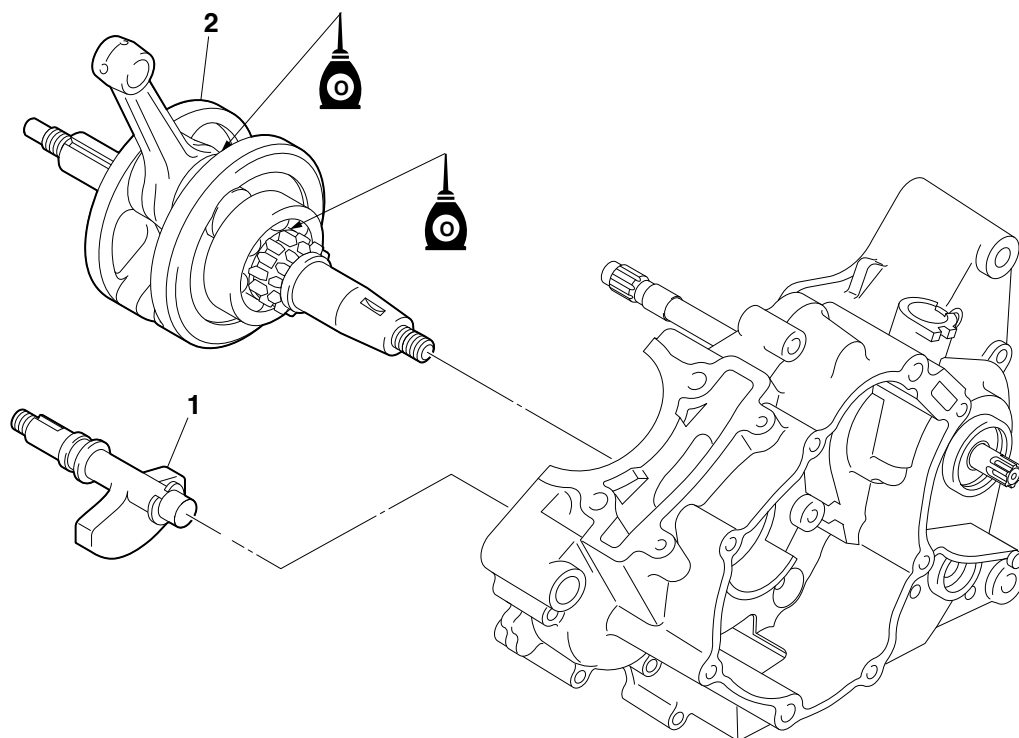
4. Install:
  - Crankcase screws, tighten to the specified torque.

**Note:** Tighten each bolt by 1/4 of a turn at a time, gradually and according to the indicated sequence.

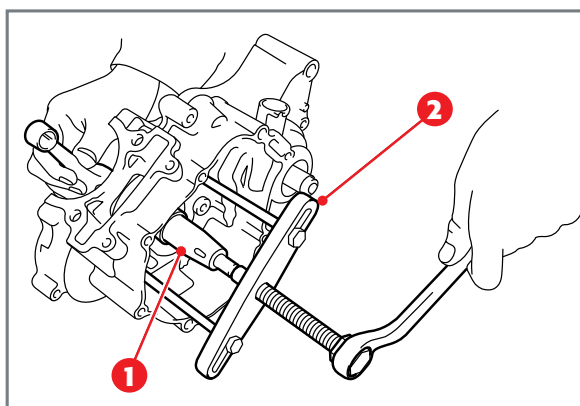
- M6 × 70 mm: 8–10, 12
- M6 × 55 mm: 15, 16
- M6 × 45 mm: 1–6, 11

## 2.4.25 CRANKSHAFT

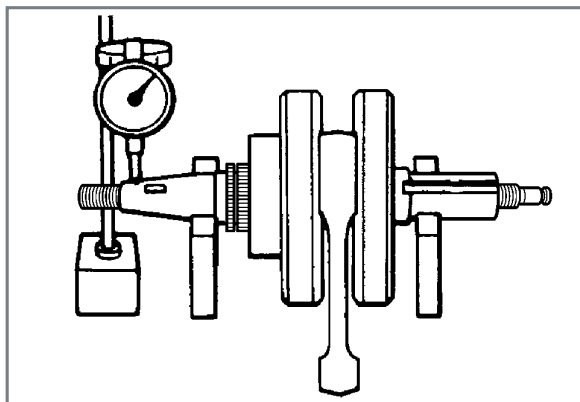
## Removal of crankshaft and countershaft



Order	Operation/Components to be removed	Quantity	Notes
	Crankcase		Refer to "2.4.24 CRANKCASE" on page 106
1	Countershaft	1	
2	Crankshaft	1	
			For installation, perform the removal procedure in reverse.



Crankshaft removal



Crankshaft check

### 2.4.25.1 Crankshaft removal

1. Remove:
  - Crankshaft 1

**Note:** Remove the crankshaft with the crankcase separator 2.

Make sure the crankcase separator is centred on the crankshaft.

**WARNING:** To protect the end of the crankshaft, place a suitable socket wrench between the crankcase separator bolt and the crankshaft.

**Do not tap on the crankshaft.**

### 2.4.25.2 Crankshaft check

1. Measure:
  - Crankshaft offset  
Not compliant with prescribed values → Replace the crankshaft, the bearings or both.

**Note:** Slowly rotate the crankshaft.

Offset limit	0.030 mm
--------------	----------

2. Measure:
  - Connecting rod head side backlash  
Not compliant with prescribed values → Replace the crankshaft.

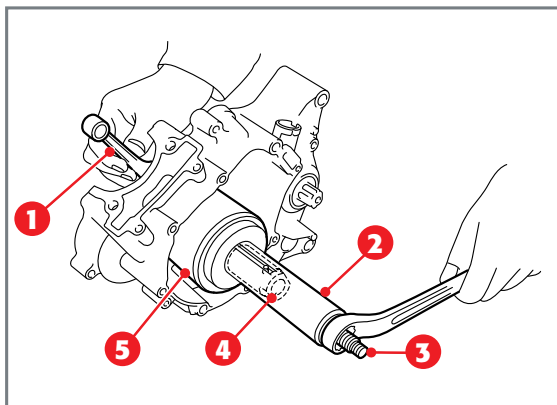
Connecting rod head side backlash	0.110–0.410 mm
-----------------------------------	----------------

3. Measure:
  - Crankshaft width  
Not compliant with prescribed values → Replace the crankshaft.

Crank lever unit width	47.95–48.00 mm
------------------------	----------------

4. Check:
  - Crankshaft pinion  
Damage/wear → Replace the crankshaft.
  - Bearing  
Cracks/damage/wear → Replace the crankshaft.
5. Check:
  - Crankshaft pin  
Scratches/wear → Replace the crankshaft.
  - Crankshaft pin oil duct  
Obstruction → Clean with compressed air.





Crankshaft installation

### 2.4.25.3 Crankshaft installation

1. Install:

- Crankshaft 1

**Note:** Install the crankshaft by using a crankshaft universal inserter 2, the crankshaft installation bolt 3, the adapter (M12) 4 and the spacer (crankshaft installer) 5.

**WARNING:** To avoid scratching the crankshaft and simplifying the assembly procedure, lubricate the oil seal lips with lithium soap-based grease and each bearing with engine oil.

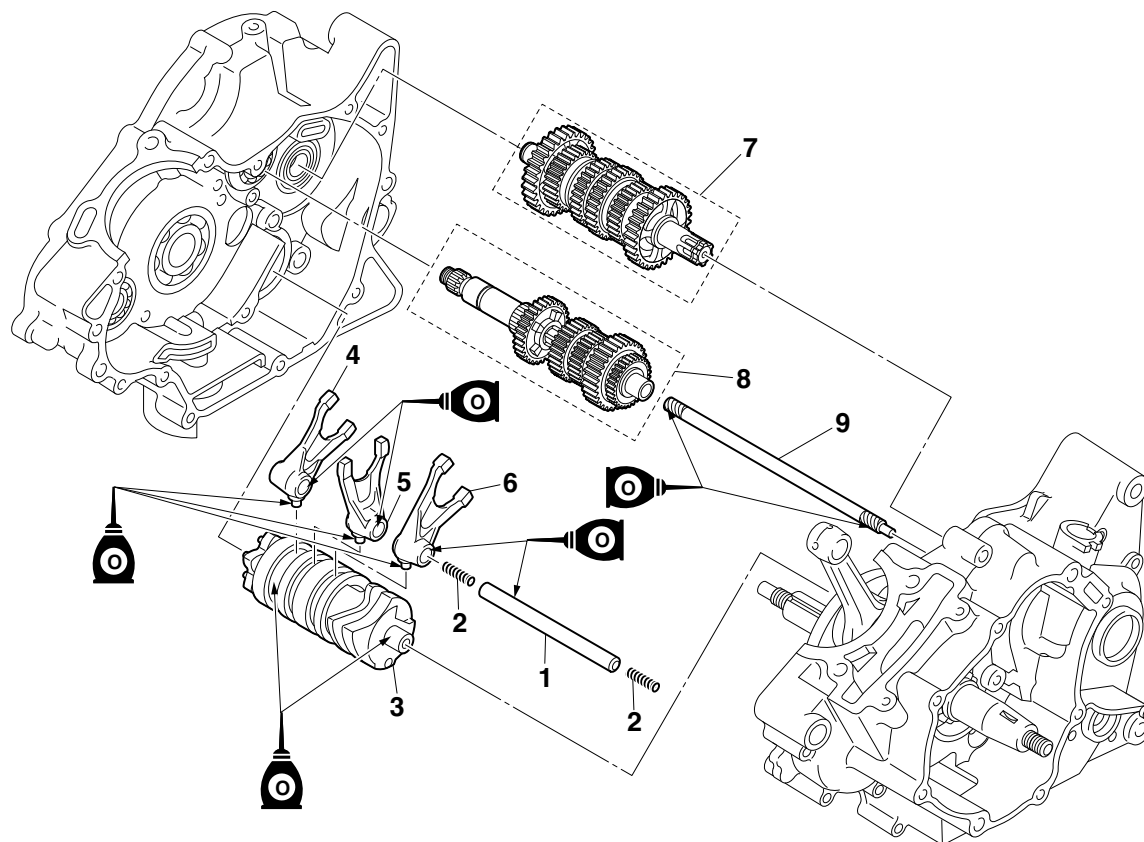
**Note:** Lock the connecting rod to the top dead centre (TDC) with one hand and at the same time rotate the nut of the crankshaft installer bolt with the other. Turn the crankshaft installer bolt until the lower part of the crankshaft unit reaches the bearing.

## 2.4.26 TRANSMISSION

2

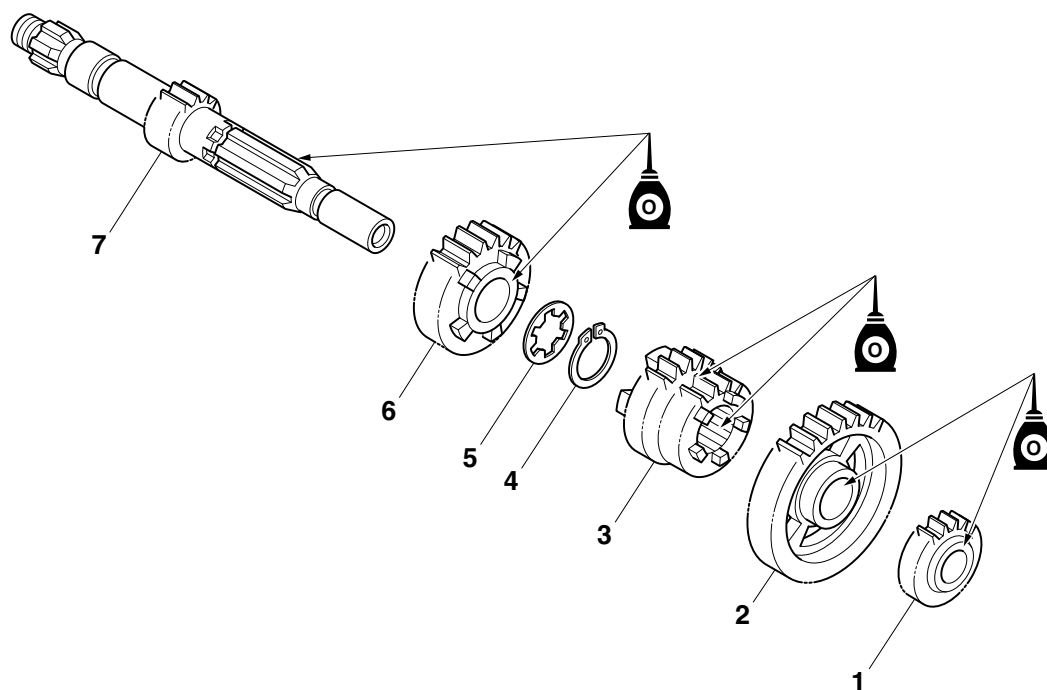
ENGINE DISASSEMBLY

### Transmission, gear selector drum unit and transmission coupling forks removal

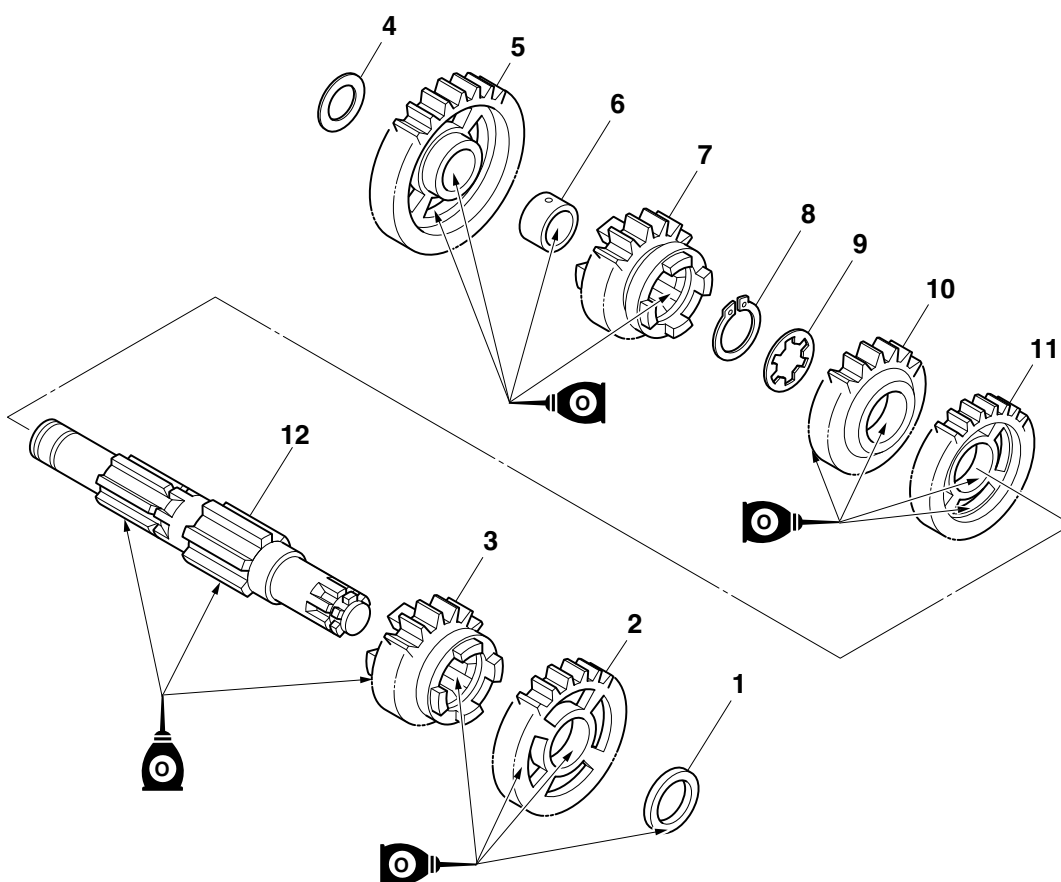


Order	Operation/Components to be removed	Quantity	Notes
	Crankcase		Refer to "2.4.24 CRANKCASE" on page 106
1	Gear fork guide bar	1	
2	Spring	2	
3	Gear selector drum unit	1	
4	Gear coupling fork-R	1	
5	Gear coupling fork-C	1	
6	Gear coupling fork-L	1	
7	Secondary shaft unit	1	
8	Complete primary shaft	1	
9	Long clutch control rod	1	
			For installation, perform the removal procedure in reverse.

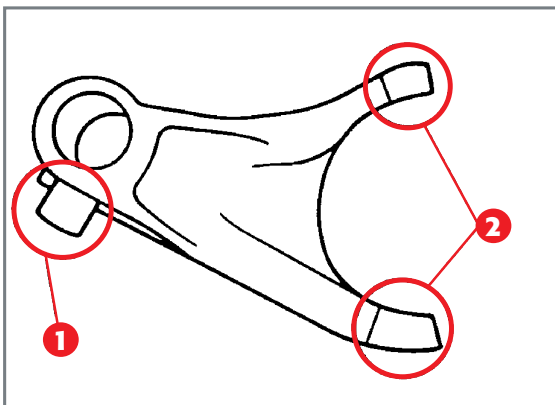


**Disassembly of primary shaft**

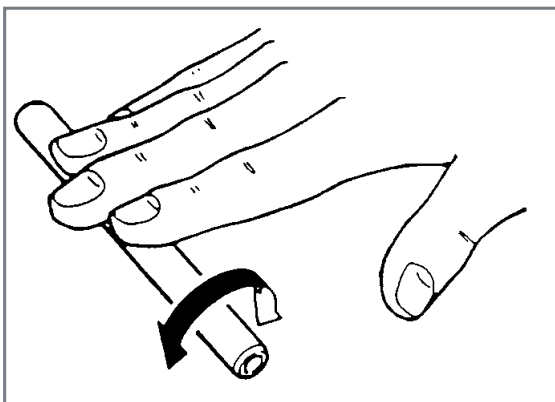
Order	Operation/Components to be removed	Quantity	Notes
1	2 <sup>nd</sup> pinion	1	
2	6 <sup>th</sup> pinion	1	
3	3 <sup>rd</sup> /4 <sup>th</sup> pinion	1	
4	Safety elastic ring	1	
5	Toothed washer	1	
6	5 <sup>th</sup> pinion	1	
7	Primary shaft/1 <sup>st</sup> pinion	1	
			For installation, perform the removal procedure in reverse.

**Disassembly of secondary shaft**

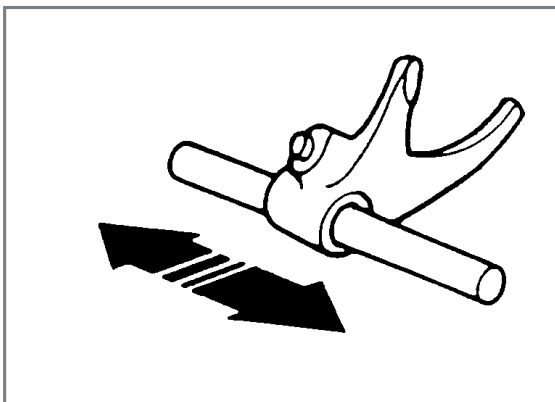
Order	Operation/Components to be removed	Quantity	Notes
1	Washer	1	
2	2 <sup>nd</sup> drive gear	1	
3	6 <sup>th</sup> drive gear	1	
4	Washer	1	
5	1 <sup>st</sup> drive gear	1	
6	Spacer	1	
7	5 <sup>th</sup> drive gear	1	
8	Safety elastic ring	1	
9	Toothed washer	1	
10	4 <sup>th</sup> drive gear	1	
11	3 <sup>rd</sup> drive gear	1	
12	Secondary shaft	1	
			For installation, perform the removal procedure in reverse.



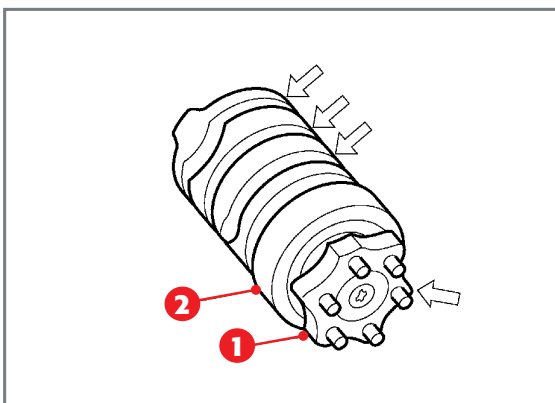
Coupling fork part check



Fork guide bar check



Coupling fork movement check



Drum unit check

### 2.4.26.1 Fork and gear coupling check

The following procedure applies to all gear coupling forks

1. Check:

- Gear coupling fork cam roller 1
- Gear coupling fork tooth 2  
Deformation/damage/scratches/wear → Replace gear coupling fork.

2. Check:

- Gear fork guide bar  
Roll the gear fork guide bar on a flat surface.  
Deformation → Replace.

**WARNING: Do not attempt to straighten the gear fork guide bar if it is deformed.**

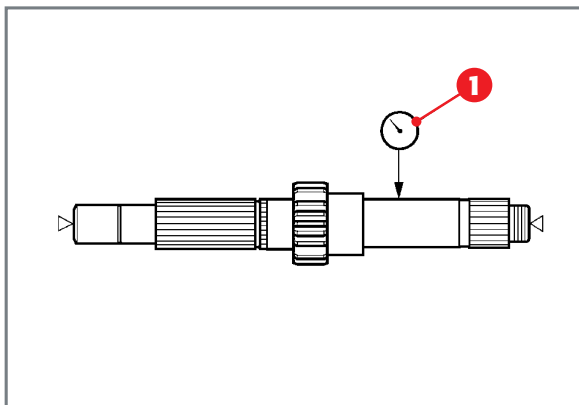
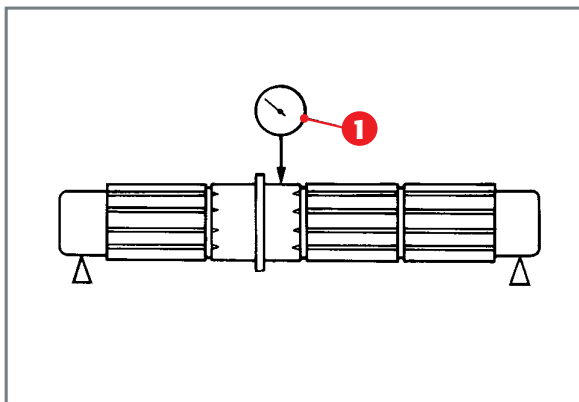
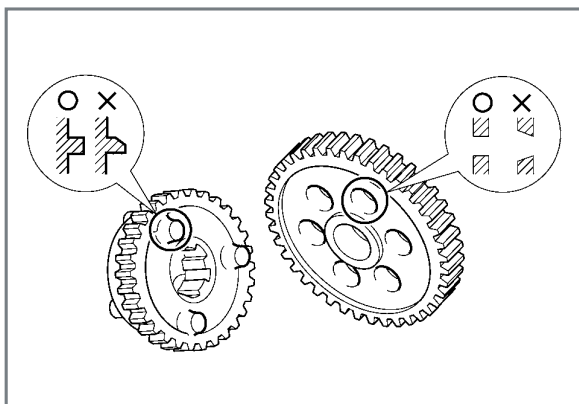
3. Check:

- Gear coupling fork movement (on the gear fork guide bar)  
Difficult movement → Replace the gear coupling forks and the gear fork guide bar as a whole.

### 2.4.26.2 Desmodromic check

1. Check:

- Gear selector drum groove  
Damage/scratches/wear → Replace the gear selector drum unit.
- Gear selector drum segment 1  
Damage/wear → Replace the gear selector drum unit.
- Gear selector drum bearing 2  
Damage/pitting → Replace the gear selector drum unit.

**Primary shaft check****Secondary shaft check****Transmission gear check****2.4.26.3 Transmission check****1. Measure:**

- Primary shaft offset  
(use a centring device and a comparator 1)  
Not compliant with specifications → Replace the primary shaft.

Primary shaft offset limit	0.08 mm
----------------------------	---------

**2. Measure:**

- Secondary shaft offset  
(use a centring device and a comparator 1)  
Not compliant with specifications → Replace the secondary shaft.

Secondary shaft offset limit	0.08 mm
------------------------------	---------

**3. Check:**

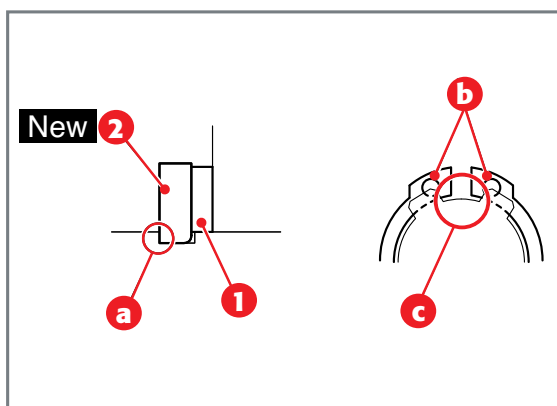
- Transmission gears  
Blue discoloration/pitting/wear → Replace the faulty gear or gears.
- Transmission gear teeth  
Cracks/damage/rounded edges → Replace the faulty gear or gears.

**4. Check:**

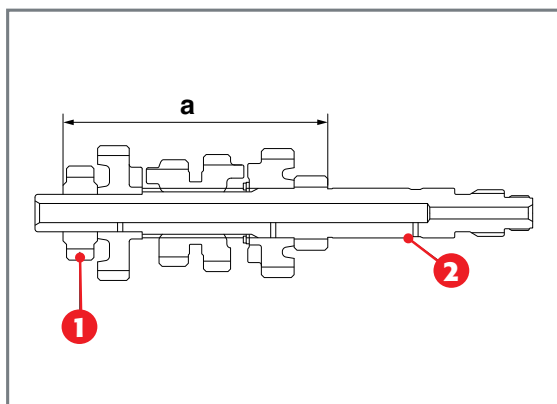
- Correct gear coupling  
(each pinion in relation to its gear)  
Incorrect → Reassemble the transmission axle units.

**5. Check:**

- Transmission gear movement  
Difficult movement → Replace the faulty part or parts.



Safety elastic ring installation

2<sup>nd</sup> pinion installation

#### 2.4.26.4 Clutch control rod check

1. Check:
  - Long clutch control rod  
Cracks/damage/wear → Replace the long clutch control rod.
2. Measure:
  - Thrust rod bending limit  
Not compliant with specifications → Replace the long clutch control rod.

Thrust rod bending limit	0.500 mm
--------------------------	----------

#### 2.4.26.5 Primary and secondary shaft assembly

1. Install:
  - Toothed washer 1
  - Safety elastic ring 2

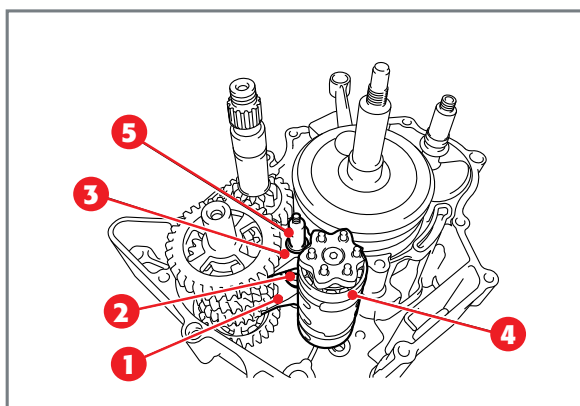
**Note:** Make sure to install a safety elastic ring so that the sharpened side **a** faces away from the toothed washer and gear.

Ensure that the ends of the safety elastic ring **b** are positioned on the groove of the ribbed of the shaft **c**.

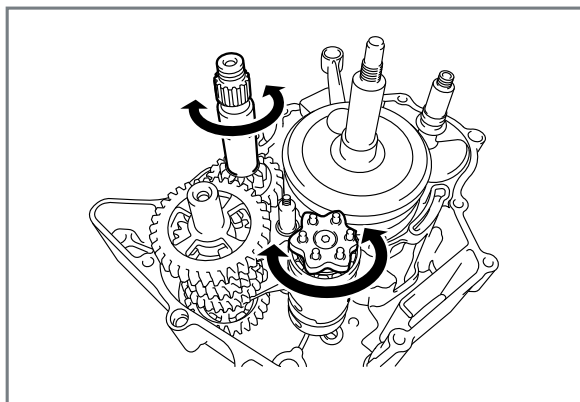
2. Install:
  - 2<sup>nd</sup> pinion 1

**Note:** Push the second pinion inside the primary shaft 2, as shown in the figure.

Installation depth <b>a</b>	106.85–107.05 mm
-----------------------------	------------------



**Gear coupling fork installation**



**Transmission movement check**

### 2.4.26.6 Gear coupling fork and desmodromic installation

#### 1. Install:

- Gear coupling fork-L 1
- Gear coupling fork-C 2
- Gear coupling fork-R 3
- Gear selector drum unit 4
- Springs
- Gear fork guide bar 5

**Note:** The reference protruding parts on the gear shift forks must point towards the right side of the engine and be in the indicated sequence: **R, C, L**.

#### 2. Check:

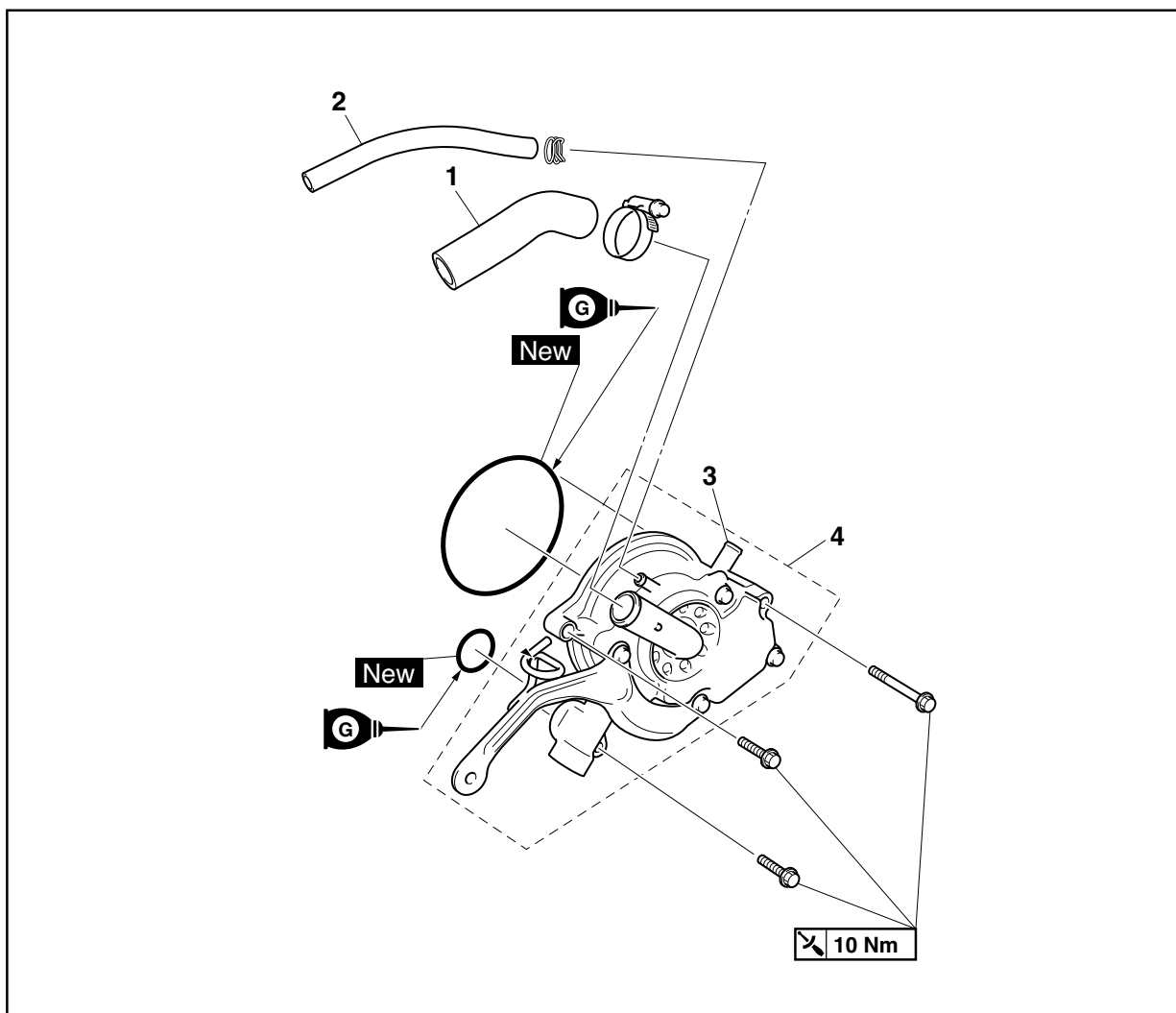
- Transmission  
Irregular movement → Repair.

**Note:** Apply engine oil fully to each gear and bearing.

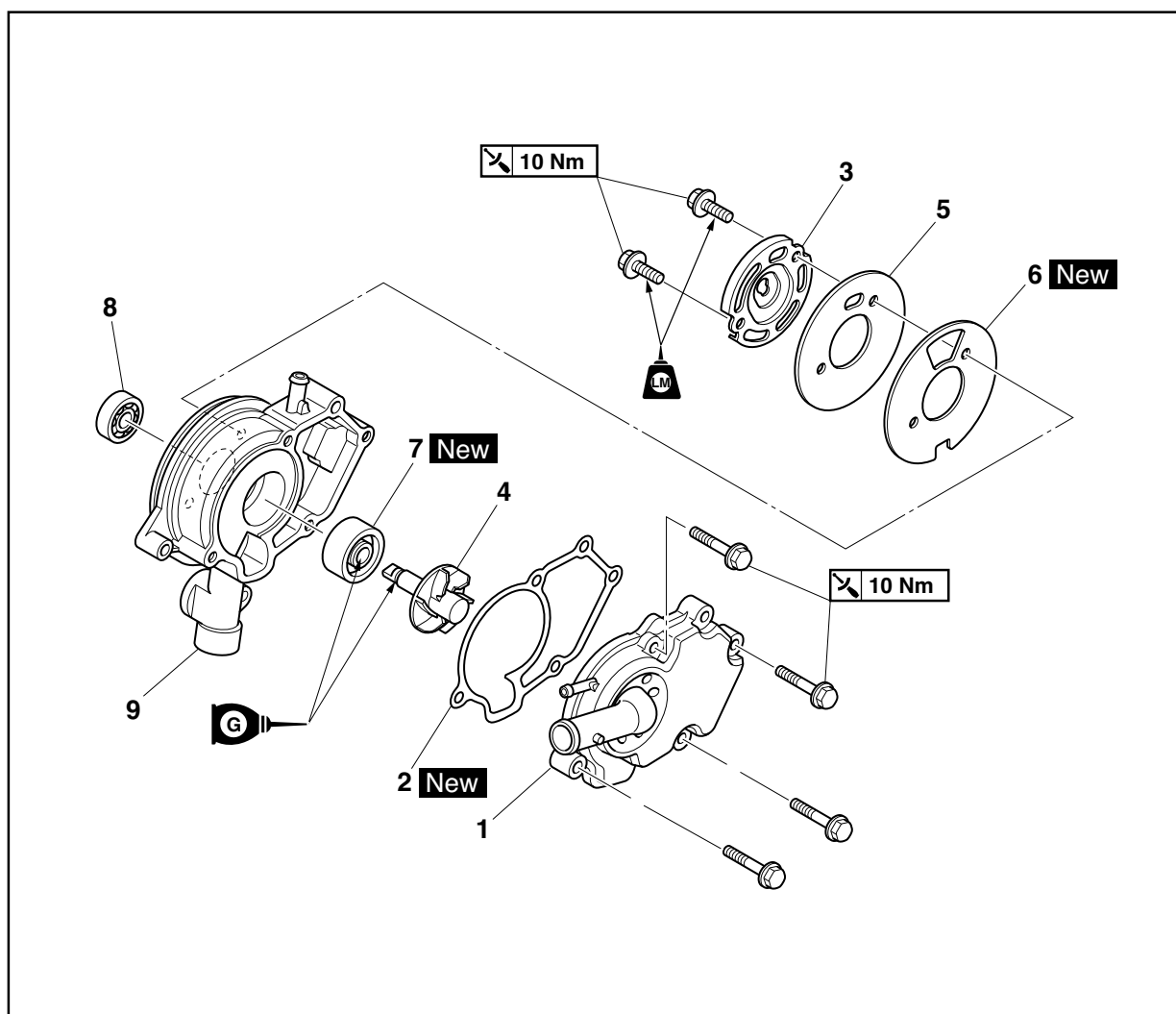
Before assembling the crankcase, make sure that the transmission is in neutral position and that the gears rotate freely.



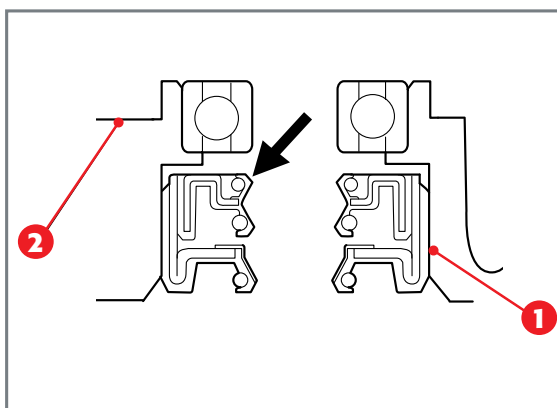
## 2.4.27 WATER PUMP



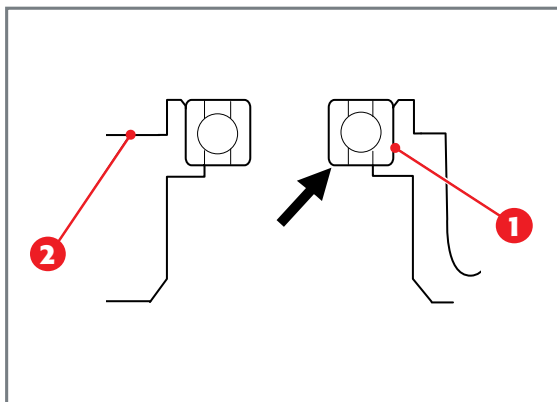
Order	Operation/Components to be removed	Quantity	Notes
			It is not required to remove the water pump, unless the coolant level is extremely low or the coolant liquid contains engine oil.
	Coolant liquid		Drain Refer to "1.7.1 LIQUID DRAIN" on page 21.
	Fuel tank		Refer to "1.3 TANK" on page 12.
1	Water pump pipe	1	Disconnect.
2	Pump recirculation pipe	1	Disconnect.
3	Cylinder head venting pipe	1	Disconnect.
4	Water pump unit	1	Remove.
			For installation, perform the removal procedure in reverse.



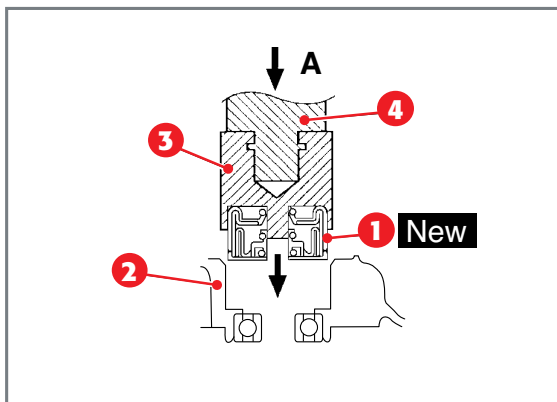
Order	Operation/Components to be removed	Quantity	Notes
1	Water pump housing cover	1	
2	Water pump housing cover gasket	1	
3	Impeller shaft stop	1	
4	Impeller shaft	1	
5	Water pump housing plate	1	
6	Water pump housing gasket	1	
7	Water pump gasket	1	
8	Bearing	1	
9	Water pump housing	1	
			For installation, perform the removal procedure in reverse.



**Pump gasket removal**



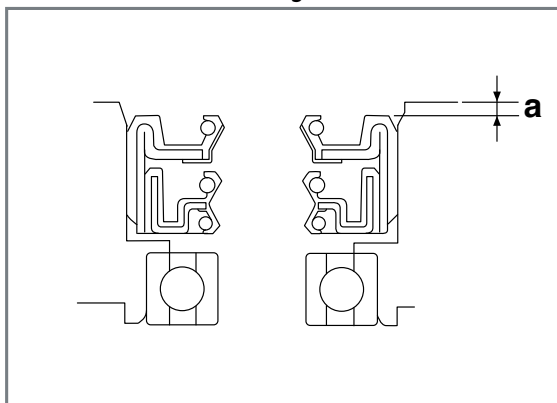
**Pump bearing removal**



**A. Push downwards**

**3. Mechanical gasket installer**

**4. Central duct shaft bearing installer**



**a. 0-0.5 mm (0-0.02)**



### 2.4.27.1 Water pump disassembly

1. Remove:
  - Water pump gasket 1

**Note:** Remove the water pump gasket from inside the water pump housing 2.

2. Remove:
  - Bearing 1

**Note:** Remove the bearing from the exterior of the water pump housing 2.

### 2.4.27.2 Water pump check

1. Check:
  - Water pump housing cover
  - Water pump housing  
Cracks/damage → Replace.
  - Impeller shaft  
Cracks/damage/wear → Replace.
  - Bearing  
Difficult movement → Replace.
  - Radiator outlet sleeve  
Cracks/damage → Replace.

### 2.4.27.3 Water pump assembly

1. Install:
  - Water pump gasket 1  
(in the water pump housing 2)

**WARNING:** Never lubricate the surface of the water pump gasket by using oil or grease.

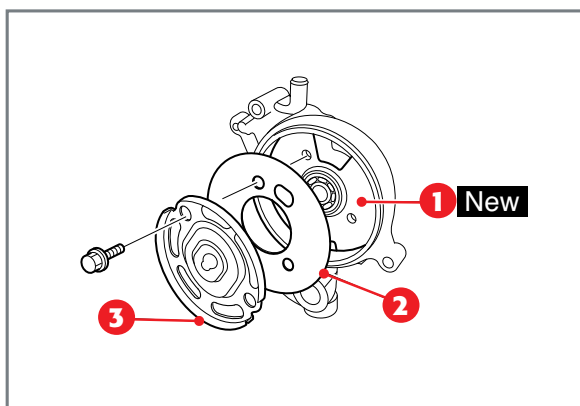
**Note:** Install the water pump gasket at the specified depth as shown in the figure.

2. Lubricate:
  - Water pump gasket lip

**Recommended lubricant**

**Lithium soap based grease**





Pump reassembly

## 3. Install:

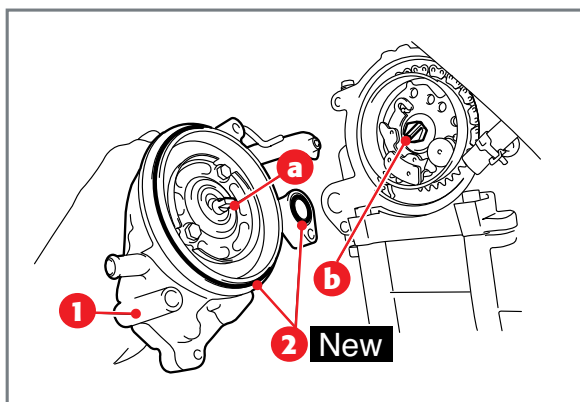
- Water pump housing gasket 1
- Water pump housing plate 2
- Impeller shaft
- Impeller shaft stop 3

Impeller shaft stop screw	10 Nm
---------------------------	-------

**Note:** Before installing the impeller shaft stop, lubricate the opening on the end of the impeller shaft with a thin layer of lithium soap grease.

Install the water pump housing gasket, the water pump housing plate and the impeller shaft stop as shown in the figure.

After installation, check that the impeller shaft rotates smoothly.



Pump installation

## 2.4.27.4 Water pump installation

## 1. Install:

- Water pump unit 1
- O-ring 2

**Note:** Align the protruding part **a** on the impeller shaft with the slot **b** on the camshaft pinion bolt.

Lubricate the O-rings by using a light coat of lithium soap-based grease.

## 2. Fill:

- Cooling system  
(with the required amount of recommended coolant liquid)  
Refer to "1.7.3 FILLING THE COOLING SYSTEM" on page 25.

## 3. Check:

- Cooling system  
Leaks → Repair or replace the faulty part.



### 3 TABLE OF ENGINE COMPONENTS TIGHTENING TORQUES

<i>Fixing</i>	<i>Threading dimension [mm]</i>	<i>Quantity</i>	<i>Threadlocker / Lubrication</i>	<i>Torque [Nm]</i>	<i>Notes</i>
<b>Engine</b>					
<i>Cylinder head screw</i>	<i>M8</i>	<i>4</i>	<i>Engine oil</i>	<i>22</i>	
<i>Cylinder head screw</i>	<i>M6</i>	<i>2</i>		<i>10</i>	
<i>Spark plug</i>	<i>M10</i>	<i>1</i>		<i>13</i>	
<i>Cylinder head cover screw</i>	<i>M6</i>	<i>5</i>		<i>10</i>	
<i>Oil level inspection cap</i>	<i>M6</i>	<i>1</i>		<i>10</i>	
<i>Drain pipe stud-bolt</i>	<i>M8</i>	<i>2</i>		<i>15</i>	
<i>Coolant liquid drain cap</i>	<i>M6</i>	<i>1</i>		<i>10</i>	
<i>Countershaft driven gear nut</i>	<i>M10</i>	<i>1</i>		<i>50</i>	
<i>Valve adjustment screw counter-nut</i>	<i>M5</i>	<i>4</i>		<i>7</i>	
<i>Camshaft pinion screw</i>	<i>M8</i>	<i>1</i>		<i>30</i>	
<i>Camshaft stop screw</i>	<i>M6</i>	<i>2</i>		<i>7</i>	
<i>Timing chain guide screw (intake side)</i>	<i>M6</i>	<i>1</i>		<i>10</i>	
<i>Timing chain tensioner screw</i>	<i>M6</i>	<i>2</i>		<i>10</i>	
<i>Timing chain tensioner cap screw</i>	<i>M8</i>	<i>1</i>		<i>8</i>	
<b>Cooling system</b>					
<i>Water pump unit screw</i>	<i>M6</i>	<i>2</i>		<i>10</i>	
<i>Water pump unit screw</i>	<i>M6</i>	<i>1</i>		<i>10</i>	
<i>Water pump housing cover screw</i>	<i>M6</i>	<i>4</i>		<i>10</i>	
<i>Impeller shaft stop screw</i>	<i>M6</i>	<i>2</i>	<i>Medium- resistance threadlocker</i>	<i>10</i>	
<i>Thermostat cover screw</i>	<i>M6</i>	<i>2</i>		<i>10</i>	
<b>Engine lubrication</b>					
<i>Oil pump unit screw</i>	<i>M5</i>	<i>2</i>		<i>4</i>	
<i>Oil drain cap</i>	<i>M35</i>	<i>1</i>		<i>32</i>	
<i>Oil filter element cover screw</i>	<i>M6</i>	<i>2</i>		<i>10</i>	
<i>Oil filter element cover screw</i>	<i>M6</i>	<i>1</i>		<i>10</i>	
<i>Oil guard screw</i>	<i>M6</i>	<i>2</i>		<i>10</i>	
<b>Exhaust</b>					
<i>Drain manifold nut</i>	<i>M8</i>	<i>2</i>		<i>15</i>	



<i>Fixing</i>	<i>Threading dimension [mm]</i>	<i>Quantity</i>	<i>Threadlocker / Lubrication</i>	<i>Torque [Nm]</i>	<i>Notes</i>
<b>Crankcase</b>					
<i>Crankcase screw</i>	<i>M6</i>	<i>2</i>		<i>10</i>	
<i>Crankcase screw</i>	<i>M6</i>	<i>7</i>		<i>10</i>	
<i>Crankcase screw</i>	<i>M6</i>	<i>4</i>		<i>10</i>	
<i>Generator cover screw</i>	<i>M6</i>	<i>7</i>		<i>10</i>	
<i>Clutch crankcase screw</i>	<i>M6</i>	<i>4</i>		<i>10</i>	
<i>Clutch crankcase screw</i>	<i>M6</i>	<i>6</i>		<i>10</i>	
<b>Transmission</b>					
<i>Crown cover screw</i>	<i>M6</i>	<i>2</i>		<i>10</i>	
<i>Unidirectional start-up screw</i>	<i>M6</i>	<i>3</i>		<i>14</i>	
<i>Primary transmission drive gear nut</i>	<i>M12</i>	<i>1</i>		<i>60</i>	
<i>Clutch spring screw</i>	<i>M6</i>	<i>4</i>		<i>12</i>	
<i>Short clutch control rod counter-nut</i>	<i>M6</i>	<i>1</i>		<i>8</i>	
<i>Clutch hub nut</i>	<i>M14</i>	<i>1</i>		<i>70</i>	
<i>Crown stop screw</i>	<i>M6</i>	<i>2</i>		<i>10</i>	
<i>Crankcase bearing stop screw</i>	<i>M6</i>	<i>2</i>	<i>Medium-strength threadlocker</i>	<i>7</i>	
<i>Gear selector drum segment screw</i>	<i>M6</i>	<i>1</i>	<i>Medium-strength threadlocker</i>	<i>12</i>	
<i>Stop lever screw</i>	<i>M6</i>	<i>1</i>	<i>Medium-strength threadlocker</i>	<i>10</i>	
<b>Electrical system components</b>					
<i>Stator coil screw</i>	<i>M6</i>	<i>3</i>	<i>Medium-strength threadlocker</i>	<i>10</i>	
<i>Crankshaft position sensor screw</i>	<i>M6</i>	<i>2</i>	<i>Medium-strength threadlocker</i>	<i>10</i>	
<i>Generator rotor nut</i>	<i>M12</i>	<i>1</i>		<i>70</i>	
<i>Neutral drive switch</i>	<i>M10</i>	<i>1</i>		<i>20</i>	
<i>Speed sensor</i>	<i>M6</i>	<i>1</i>		<i>10</i>	
<i>Starter motor screw</i>	<i>M6</i>	<i>1</i>		<i>10</i>	
<i>Starter motor screw</i>	<i>M6</i>	<i>1</i>		<i>10</i>	
<i>Temperature sensor coolant liquid</i>	<i>M10</i>	<i>1</i>		<i>14</i>	

## 4 RECOMMENDED ENGINE MAINTENANCE

The required engine maintenance strictly depends on the level of use and compliance with inspection frequency. The following frequency intervals refer to normal use, as long as the engine has not worked in extraordinary conditions and that the periodic inspections and interventions have been correctly carried out.

	<i>End of running-in period - 1000km</i>	<i>3000km</i>	<i>6000km</i>	<i>9000km</i>	<i>12000km</i>	<i>15000km</i>	<i>18000km</i>	<i>21000km</i>	<i>24000km</i>	<i>27000km</i>
<b>Spark plug</b>		C	S	C	S	C	S	C	S	C
<b>Engine oil filter</b>	S		S		S		S		S	
<b>Clutch</b>	C	C	C	C	S	C	C	C	S	C
<b>Valve backlash</b>	C	C	C	C	C	C	C	C	C	C
<b>Engine oil</b>	S	S	S	S	S	S	S	S	S	S
<b>Minimum adjustment</b>	C	C	C	C	C	C	C	C	C	C
<b>Engine oil pipes</b>	C	C	C	C	C	C	C	C	C	C
<b>Engine oil filter</b>	P	P	P	P	P	P	P	P	P	P
<b>Air filter (paper) *</b>	<i>blow every 2,500km</i>			S			S			S

### Key

<b>C</b>	<b>Check (Cleaning, adjustment, lubrication, replacement if required)</b>
<b>R</b>	<b>Replacement</b>
<b>A</b>	<b>Adjustment</b>
<b>K</b>	<b>Cleaning</b>
<b>T</b>	<b>Tightening</b>

\* It is recommended to blow the filter from the inside out after each use off-road. Replace the filter if required





## 5 RECOMMENDED LUBRICANTS AND LIQUIDS

<i>APPLICATION</i>	<i>PRODUCT</i>	<i>QUANTITY</i>
<b>ENGINE OIL</b>	<b>LIQUI MOLY MOTORBIKE 4T 10W-40 OFFROAD</b>	<b>1000ml</b>
<b>GREASE FOR JOINTS AND LINKAGE</b>	<b>LIQUI MOLY SCHMIERFIX</b>	
<b>COOLANT LIQUID</b>	<b>LIQUI MOLY COOLANT READY MIX RAF12 PLUS</b>	<b>850ml</b>

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