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# SERVICE STATION MANUAL

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## GRISO 8V - 1200

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### THE VALUE OF SERVICE

Only the mechanics of the official Moto Guzzi Service Network know this vehicle well, thanks to constant technical professional development and Moto Guzzi specific training programmes, and have the tools needed to carry out maintenance and repair operations correctly.

The reliability of the vehicle also depends on its mechanical conditions. Checking the vehicle before setting off, carrying out routine maintenance and using only Moto Guzzi Original Spare parts is fundamental!

For information about the nearest Official Dealer and/or Service Centre, consult the Yellow Pages or search directly on the inset map in our Official Website:

[www.motoguzzi.it](http://www.motoguzzi.it)

Only by purchasing Moto Guzzi Original Spare Parts will you get a product designed and tested during the bike designing phase. Moto Guzzi Original Spare Parts are subject to systematic quality control procedures so that their reliability and performance over time is guaranteed.

The descriptions and illustrations given in this publication are not binding; while the basic features as described and illustrated in this manual remain unchanged, Moto Guzzi reserves the right, at any time and without being required to update this publication beforehand, to make any changes to components, parts or accessory supplies, which it deems necessary to improve the product or which

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are required for manufacturing or commercial reasons.

Not all versions shown in this publication are available in all countries. The availability of individual versions should be checked with the official Moto Guzzi sales network.

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# SERVICE STATION MANUAL GRISO 8V - 1200

This manual provides the main information to carry out regular maintenance operations on your vehicle.

This manual is intended to **Moto Guzzi Dealers** and their qualified mechanics; several concepts have been deliberately omitted as they are considered unnecessary. As it is not possible to include complete mechanical notions in this manual, users should have basic mechanical knowledge or minimum knowledge about the procedures involved when repairing scooters. Without this knowledge, repairing or checking the vehicle may be inefficient or even dangerous. As the vehicle repair and check procedures are not described in detail, be extremely cautious so as not to damage components or injure individuals. In order to optimise customer satisfaction when using our vehicles, **Moto Guzzi** s.p.a. commits itself to continually improve its products and the relative documentation. The main technical modifications and changes in repair procedures are communicated to all **Moto Guzzi Sales Outlets and its International Subsidiaries**. These changes will be introduced in the subsequent editions of the manual. In case of need or further queries on repair and check procedures, consult **Moto Guzzi CUSTOMER DEPARTMENT**, which will be prepared to provide any information on the subject and any further communications on updates and technical changes related to the vehicle.

**NOTE** Provides key information to make the procedure easier to understand and carry out.

**CAUTION** Refers to specific procedures to carry out for preventing damages to the vehicle.

**WARNING** Refers to specific procedures to carry out to prevent injuries to the repairer.



**Personal safety** Failure to completely observe these instructions will result in serious risk of personal injury.



**Safeguarding the environment** Sections marked with this symbol indicate the correct use of the vehicle to prevent damaging the environment.



**Vehicle intactness** The incomplete or non-observance of these regulations leads to the risk of serious damage to the vehicle and sometimes even the invalidity of the guarantee.



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## INDEX OF TOPICS

CHARACTERISTICS

CHAR

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## Rules

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### Safety rules

#### Carbon monoxide

If you need to keep the engine running in order to carry out any procedure, please ensure that you do so in an open or very well ventilated area. Never let the engine run in an enclosed area. If you do work in an enclosed area, make sure to use a smoke-extraction system.

#### CAUTION



**EXHAUST EMISSIONS CONTAIN CARBON MONOXIDE, A POISONOUS GAS WHICH CAN CAUSE LOSS OF CONSCIOUSNESS AND EVEN DEATH.**

#### Fuel

#### CAUTION



**FUEL USED TO POWER INTERNAL COMBUSTION ENGINES IS HIGHLY FLAMMABLE AND CAN BECOME EXPLOSIVE UNDER SPECIFIC CONDITIONS. IT IS THEREFORE RECOMMENDED TO CARRY OUT REFUELLING AND MAINTENANCE PROCEDURES IN A VENTILATED AREA WITH THE ENGINE SHUT OFF. DO NOT SMOKE DURING REFUELLING AND NEAR FUEL VAPOURS, AVOID ANY CONTACT WITH NAKED FLAMES, SPARKS OR OTHER SOURCES WHICH MAY CAUSE THEM TO IGNITE OR EXPLODE.**

**DO NOT DISPOSE OF FUEL INTO THE ENVIRONMENT.**

**KEEP OUT OF THE REACH OF CHILDREN**

#### Hot components

The engine and the exhaust system components get very hot and remain in this condition for a certain time interval after the engine has been shut off. Before handling these components, make sure that you are wearing insulating gloves or wait until the engine and the exhaust system have cooled down.

#### Used engine oil and transmission oil

#### CAUTION



**IT IS ADVISABLE TO WEAR LATEX GLOVES WHEN SERVICING THE VEHICLE. THE ENGINE OR TRANSMISSION OIL MAY CAUSE SERIOUS INJURIES TO THE SKIN IF HANDLED FOR PROLONGED PERIODS OF TIME AND ON A REGULAR BASIS. WASH YOUR HANDS CAREFULLY AFTER HANDLING OIL.**



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**HAND THE OIL OVER TO OR HAVE IT COLLECTED BY THE NEAREST USED OIL RECYCLING COMPANY OR THE SUPPLIER.**

**DO NOT DISPOSE OF OIL INTO THE ENVIRONMENT**

**KEEP OUT OF THE REACH OF CHILDREN**

**Brake and clutch fluid**



**BRAKE AND CLUTCH FLUIDS CAN DAMAGE PLASTIC OR RUBBER PAINTED SURFACES. WHEN SERVICING THE BRAKING OR THE CLUTCH SYSTEMS PROTECT THESE COMPONENTS WITH A CLEAN CLOTH. ALWAYS WEAR PROTECTIVE GOGGLES WHEN SERVICING THE SYSTEMS. BRAKE AND CLUTCH FLUIDS ARE EXTREMELY HARMFUL FOR YOUR EYES. IN THE EVENT OF ACCIDENTAL CONTACT WITH THE EYES, RINSE THEM IMMEDIATELY WITH ABUNDANT COLD, CLEAN WATER AND SEEK MEDICAL ADVICE IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN**

**Battery electrolyte and hydrogen gas**

**CAUTION**



**BATTERY ELECTROLYTE IS TOXIC, CORROSIVE AND AS IT CONTAINS SULPHURIC ACID, IT CAN CAUSE BURNS WHEN IN CONTACT WITH THE SKIN. WHEN HANDLING BATTERY ELECTROLYTE, WEAR TIGHT-FITTING GLOVES AND PROTECTIVE APPAREL. IF THE ELECTROLYTIC FLUID COMES INTO CONTACT WITH THE SKIN, RINSE WELL WITH ABUNDANT FRESH WATER. IT IS PARTICULARLY IMPORTANT TO PROTECT YOUR EYES AS EVEN TINY AMOUNTS OF BATTERY ACID MAY CAUSE BLINDNESS. IF THE FLUID GETS INTO CONTACT WITH YOUR EYES, WASH WITH ABUNDANT WATER FOR FIFTEEN MINUTES AND CONSULT AN EYE SPECIALIST IMMEDIATELY. IF THE FLUID IS ACCIDENTALLY SWALLOWED, DRINK LARGE QUANTITIES OF WATER OR MILK, FOLLOWED BY MILK OF MAGNESIA OR VEGETABLE OIL AND SEEK MEDICAL ADVICE IMMEDIATELY. THE BATTERY RELEASES EXPLOSIVE GASES; KEEP IT AWAY FROM FLAMES, SPARKS, CIGARETTES OR ANY OTHER HEAT SOURCE. ENSURE ADEQUATE VENTILATION WHEN SERVICING OR RECHARGING THE BATTERY.**

**KEEP OUT OF THE REACH OF CHILDREN**

**BATTERY LIQUID IS CORROSIVE. DO NOT POUR OR SPILL IT, PARTICULARLY ON PLASTIC COMPONENTS. ENSURE THAT THE ELECTROLYTIC ACID IS COMPATIBLE WITH THE BATTERY TO BE ACTIVATED.**

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## Maintenance rules

### GENERAL PRECAUTIONS AND INFORMATION

When repairing, disassembling and reassembling the vehicle, strictly follow the recommendations reported below.

### BEFORE DISASSEMBLING COMPONENTS

- Before disassembling components, remove dirt, mud, dust and foreign bodies from the vehicle. Use the special tools designed for this vehicle, as required.

### COMPONENTS REMOVAL

- Do not loosen and/or tighten screws and nuts using pliers or other tools other than the especially designed wrench.
- Mark positions on all connection joints (pipes, cables, etc.) before separating them, and identify them with distinctive symbols.
- Each component needs to be clearly marked in order to be identified during assembly.
- Clean and wash the removed components carefully using a low-flammability detergent.
- Keep coupled parts together since they have "adjusted" to each other due to normal wear and tear.
- Some components must be used together or replaced altogether.
- Keep away from heat sources.

### REASSEMBLING COMPONENTS

#### CAUTION

**BEARINGS MUST BE ABLE TO ROTATE FREELY, WITHOUT JAMMING AND/OR NOISE, OTHERWISE THEY NEED REPLACING.**

- Only use ORIGINAL Moto Guzzi SPARE PARTS.
- Comply with lubricant and consumables usage guidelines.
- Lubricate parts (whenever possible) before refitting them.
- When tightening nuts and screws, start from the ones with the largest section or from the internal ones, moving diagonally. Tighten nuts and screws in successive steps before applying the tightening torque.
- Always replace self-locking nuts, washers, sealing rings, circlips, O-rings, split pins and screws with new ones if their tread is damaged.
- When fitting bearings, make sure to lubricate them well.
- Check that each component is fitted correctly.
- After a repair or routine maintenance procedure, carry out pre-ride checks and test the vehicle on private grounds or in an area with low traffic density.
- Clean all coupling surfaces, oil guard rims and washers before refitting them. Apply a light layer of lithium-based grease on the oil guard rims. Refit the oil guard and the bearings with the brand or lot number facing outward (visible side).

### ELECTRIC CONNECTORS

Electric connectors must be disconnected as described below as non-compliance with the procedure so described causes irreparable damage to both the connector and the cable harness:

Press the relevant safety hooks, if any.

- Grip the two connectors and disconnect them by pulling them in opposite directions.
- If there are signs of dirt, rust, humidity, etc., clean the connector internal parts carefully

using a pressurised air jet.

- Make sure that the cables are correctly linked to the connector internal terminal ends.
- Then insert the two connectors making sure that they couple correctly (if the relevant hooks are provided, you will hear them "click" into place).

**CAUTION**

**TO DISCONNECT THE TWO CONNECTORS, DO NOT PULL THE CABLES.**

**NOTE**

**THE TWO CONNECTORS CONNECT ONLY FROM ONE SIDE: CONNECT THEM THE RIGHT WAY ROUND.**

**TIGHTENING TORQUE****CAUTION**

**DO NOT FORGET THAT TIGHTENING TORQUES FOR ALL FASTENING ELEMENTS ON WHEELS, BRAKES, WHEEL PINS AND ANY OTHER SUSPENSION COMPONENTS PLAY A KEY ROLE IN ENSURING THE VEHICLE'S SAFETY AND MUST COMPLY WITH SPECIFIED VALUES. CHECK THE TIGHTENING TORQUE OF FASTENING PARTS ON A REGULAR BASIS AND ALWAYS USE A TORQUE WRENCH TO REFIT THESE COMPONENTS. FAILURE TO COMPLY WITH THESE RECOMMENDATIONS MAY CAUSE ONE OF THESE COMPONENTS TO GET LOOSE AND EVEN DETACHED, THUS BLOCKING A WHEEL, OR OTHERWISE COMPROMISING VEHICLE HANDLING. THIS CAN LEAD TO FALLS, WITH THE RISK OF SERIOUS INJURY OR DEATH.**

## Running-in

Engine run-in is essential to ensure engine long life and correct operation. Twisty roads and gradients are ideal to run in the engine, brakes and suspensions effectively. Vary your driving speed during run-in. In this way, you allow for the work of components to be "loaded" and then "unloaded", thus cooling engine parts.

**CAUTION**

**THE CLUTCH MAY EMIT A SLIGHT BURNING SMELL WHEN FIRST USED. THIS PHENOMENON SHOULD BE CONSIDERED NORMAL AND WILL DISAPPEAR AS SOON AS THE CLUTCH PLATES GET ADAPTED.**

**IT IS IMPORTANT TO STRAIN ENGINE COMPONENTS DURING RUN-IN, HOWEVER, MAKE SURE NOT TO OVERDO THIS.**

**CAUTION**

**ONLY AFTER THE SERVICE AT THE END OF THE RUN-IN PERIOD CAN THE BEST PERFORMANCE OF YOUR VEHICLE BE OBTAINED.**

**Follow the guidelines detailed below:**

- Do not twist the throttle grip abruptly and completely when the engine is working at a low revs, either during or after run-in.
- During the first 100 km (62 miles) operate the brakes with caution, avoid rough and long braking. That is to permit the adequate adjustment of the pad friction material to the brake discs.



**AFTER THE SPECIFIED MILEAGE, TAKE THE VEHICLE TO AN OFFICIAL Moto Guzzi DEALER FOR THE CHECKS INDICATED IN THE "AFTER-RUN" TABLE IN THE SCHEDULED MAINTENANCE SECTION TO AVOID INJURING YOURSELF, OTHERS AND /OR DAMAGING THE VEHICLE.**

## Vehicle identification

### SERIAL NUMBER POSITION

These numbers are necessary for vehicle registration.

#### NOTE

**ALTERING IDENTIFICATION NUMBERS CAN BE SERIOUSLY PUNISHED BY LAW, PARTICULARLY MODIFYING THE CHASSIS NUMBER WILL IMMEDIATELY INVALIDATE THE WARRANTY.**

This number is composed by numbers and letters, as in the example shown below.

**ZGULSE000YMXXXXXX**

#### KEY:

**ZGU:** WMI (World manufacturer identifier) code;

**LS:** model;

**E00:** version variation;

**0:** digit free

**Y** year of manufacture

**M:** production plant (M= Mandello del Lario);

**XXXXXX:** progressive number (6 digits);

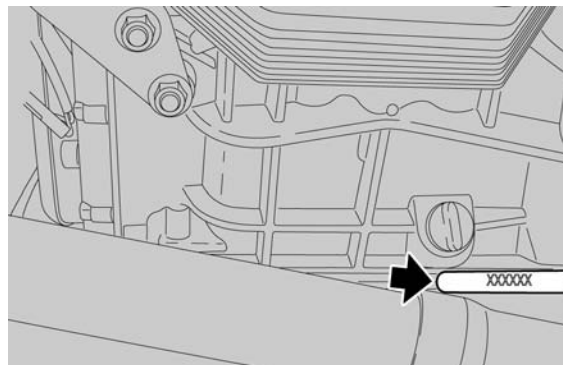
### CHASSIS NUMBER

The chassis number is stamped on the right side of the headstock.



### ENGINE NUMBER

The engine number is stamped on the left side, close to the engine oil level check cap.



## Dimensions and mass

### WEIGHT AND DIMENSIONS

Specification	Desc./Quantity
Length	2260 mm (89.0 in)
Max. width	830 mm (32.68 in)
Maximum height	1070 mm (42.1 in)
Saddle height	800 mm (31.5 in)
Minimum ground clearance	185 mm (7.3 in)
Wheelbase	1554 mm (61.2 in)
Kerb weight	240 kg (529 lb)

## Engine

### ENGINE

Specification	Desc./Quantity
Type	90° transversal V-twin, four stroke
Cylinder quantity	2
Cylinder layout	90° V
Bore / stroke	95 x 81.2 mm (3.74 x 3.20 in)
Cubic capacity	1151 cm <sup>3</sup> (70 cu.in.)
Compression ratio	11: 1
Maximum power	over 80.8 kW (110 CV) at 7,500 rpm
Start-up	electric
Engine revs at idle speed	1100 ± 100 rpm
Clutch	dry single disc with integrated hydraulic drive and anti-vibration buffer
Lubrication system	Pressure-fed lubrication system adjusted through valves and a trochoidal pump
Air filter	cartridge, dry
Cooling	air and oil with independent trochoidal pump and pressure regulating valve for the oil cooling system
Timing system diagram	Single overhead camshaft with valves, bowls and rocking levers
Valid values with checking clearance between rocking levers and valve	inlet: 0.10 mm (0.0039 in) outlet: 0.15 mm (0.0059 in)

## Transmission

**TRANSMISSION**

Specification	Desc./Quantity
Main transmission	With helical teeth, ratio 26/35 = 1:1.346
Gear	Mechanical, 6 speeds with foot lever on the left-hand side of the engine
1st gear ratios	17/38 = 1 :2.2353
2nd gear ratios	20/34 = 1:1.7
3rd gear ratios	23/31 = 1:1.3478
4th gear ratio	26/29 = 1:1.1154
5th gear ratios	31/30 = 1:0.9677
6th gear ratios	29/25 = 1:0.8621
Final transmission	cardan shaft
Ratio	12/44 = 1:3.6667

**Capacities****CAPACITY**

Specification	Desc./Quantity
Engine oil	Oil change and oil filter replacement: 3,500 cm <sup>3</sup> (214 cu.in)
Gearbox oil	500 cm <sup>3</sup> (30.5 cu.in)
Transmission oil	380 cm <sup>3</sup> (23.2 cu.in)
Fuel (reserve included)	16.4 l (4.33 Uk gal)
Fuel reserve	3.3 l (0.87 gal)
Fork oil	520 ± 2.5 cm <sup>3</sup> (31.7 ± 0.15 in) (for each stem)
Seats	2
Vehicle maximum load	210 kg (463 lb) (rider + passenger + luggage)

**Electrical system****ELECTRICAL SYSTEM**

Specification	Desc./Quantity
Spark plug	NGK PMR8B (long life)
Electrode gap	0.6 - 0.7 mm (0.024 - 0.028 in)
Battery	12 V - 18 Ampere/hour
(Permanent magnet) Generator	12V - 550W
Main fuses	30 A
Auxiliary fuses	3 A - 15 A

Specification	Desc./Quantity
Tail light	12 V - LED
Low-/ High-beam light bulb (halogen)	12 V - 55 W/ 60 W H4
Turn indicators	12V - 10 W
Rear tail light / stop light	LED
Instrument panel lighting	LED
License plate light	12V - 5 W
Turn indicator warning light	LED
Gear in neutral warning light	LED
Alarm warning light - Gear shift	LED
Side stand down warning light	LED
Low fuel warning light	LED
High-beam warning light	LED
Oil pressure warning light	LED

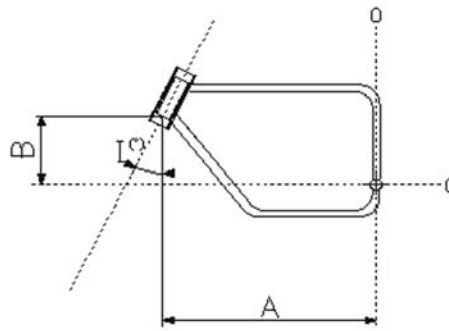
## Frame and suspensions

### CHASSIS

Specification	Desc./Quantity
Type	double cradle, high strength steel tube chassis
Trail	108 mm (4.25 in)
Headstock angle	26° 30'
Front	Hydraulic telescopic upside-down fork, Ø 43 mm (1.69 in), with foot for radially-mounted brake caliper, adjustable spring preloading, hydraulic compression and rebound damping.
Wheel travel	120 mm (4.72 in)
Rear	single-sided arm suspension with progressive rising-rate linkage, single shock absorber with fully adjustable compression and rebound damping and spring preloading.
Wheel travel	110 mm (4.33 in)

### SIZES A AND B

Specification	Desc./Quantity
Size A	793.4 mm (31.24 in)
Size B	344.5 mm (13.56 in)



**Brakes**

**BRAKES**

Specification	Desc./Quantity
Front	double stainless steel floating disc, Ø 320 mm (12.6 in), wave type, radially-mounted callipers with 4 differentiated and counteracting plungers.
Rear	Single stainless steel disc; Ø 282 mm (11.1 in)

**Wheels and tyres**

**WHEELS AND TYRES**

Specification	Desc./Quantity
Type	hollow 3-spoke rim in chilled cast aluminium alloy
Front wheel rim	3.50" x 17"
Rear wheel rim	5.50" x 17"
Tyres	METZELER Sportec M3
Front	120/70 - ZR 17" 58 W
Inflation pressure (front)	2.3 bar (230 kPa) (33.4 PSI)
Inflation pressure with passenger (front)	2.3 bar (230 kPa) (33.4 PSI)
Rear	180/55 - ZR 17" 73 W
Inflation pressure (rear)	2.5 bar (250 kPa) (36.3 PSI)
Inflation pressure with passenger (rear)	2.5 bar (250 kPa) (36.3 PSI)

**Supply**

**FUEL SUPPLY**

Specification	Desc./Quantity
Fuel supply	Electronic injection (Weber . Marelli) with Stepper motor



Specification	Desc./Quantity
Diffuser	diameter: 50 mm (1.97 in)
Fuel	Premium unleaded petrol, minimum octane rating of 95 (NORM) and 85 (NOMM)

## Tightening Torques

### HEADS

Name	Torque in Nm
Oil cap (2)	25 Nm (18.44 lbf ft)
Rocking lever support nut - M10x1.5 (8)	15 Nm (11.06 lbf ft) + 90° + 90°
Camshaft - rocking levers support fixing screws (12)	17 Nm (12.54 lbf ft)
Head fixing screw (4)	15 Nm (11.06 lbf ft) + 90°
Screw fixing head to chain compartment - M6x120 (4)	10 Nm (7.38 lbf ft)
Oil temperature sensor	11 Nm (8.11 lbf ft) - Loctite 243
Oil temperature sensor container	11 Nm (8.11 lbf ft) - Loctite 601
Head covers fixing screws (8)	8 Nm (5.9 lbf ft)
Spark plug (2)	30 Nm (22.13 lbf ft) - Molikote

### CRANKCASE

Name	Torque in Nm
Crankcase stud bolt - cylinder (8)	25 Nm (18.44 lbf ft)
Transmission side flange stud bolt - M8x66 (3)	35 Nm (25.81 lbf ft)
Transmission side flange stud bolt - M8x75 (2)	35 Nm (25.81 lbf ft)
Gear side crankshaft flange screw - TE M8x25 (8)	26 Nm (19.18 lbf ft)
Timing system cover screw - TCEI M8x55 (4)	25 Nm (18.44 lbf ft)
Timing system cover screw - TCEI M6x30 (10)	10 Nm (7.38 lbf ft)
Oil vapour union screw - TCEI M6x20 (2)	10 Nm (7.38 lbf ft)
TCEI M6x40 Screw (2)	10 Nm (7.38 lbf ft)
Timing sensor - TCEI M5x12 (2)	6 Nm (4.42 lbf ft)
Service shaft bearing locking screw (2)	10 Nm (7.38 lbf ft)
Oil pressure sensor (1)	25 Nm (18.44 lbf ft)
Screw fixing oil pressure sensor support - TCEI M10x20 (1)	18 Nm (13.28 lbf ft)
Oil cap (2)	25 Nm (18.44 lbf ft)

### OIL SUMP

Name	Torque in Nm
Oil pipe on sump reduction (1)	20 Nm (14.75 lbf ft)
Oil pipe on sump	20 Nm (14.75 lbf ft)
Oil sump lower screw - TCEI M6x30 (4)	10 Nm (7.38 lbf ft)
Oil sump screw - TCEI M6x55 (14)	10 Nm (7.38 lbf ft)
Oil sump screw - TCEI M6x60 (2)	10 Nm (7.38 lbf ft)
Oil drainage plug - M10x1 (1)	20 Nm (14.75 lbf ft)
Oil filter (1)	15 Nm (11.06 lbf ft)
Oil filter fitting (1)	40 Nm (29.5 lbf ft) - Loctite 243
Oil pipe in sump	20 Nm (14.75 lbf ft) - Loctite 648
Pressure-relief plug	40 Nm (29.5 lbf ft)
Cap on oil sump flange (2)	20 Nm (14.75 lbf ft)
Cap (1)	40 Nm (29.5 lbf ft)

### **CRANKSHAFT - FLYWHEEL**

Name	Torque in Nm
Connecting rod screw (4) - pre-tightening	40 Nm (29.5 lbf ft)
Connecting rod screw (4) - final tightening	80 Nm (59 lbf ft)
Screw fixing clutch disc on crankshaft - M8x25 (6)	42 Nm (30.98 lbf ft) - Loctite 243
Screw fixing clutch bell on disc - M7x16 (6)	20 Nm (14.75 lbf ft)
Start-up crown gear fixing screw (6)	10 Nm (7.38 lbf ft)

### **OIL PUMP**

Name	Torque in Nm
Oil pump fixing screws - M6x45 (3)	10 Nm (7.38 lbf ft)
Oil pump gear nut - M10x1.25 (1)	20 Nm (14.75 lbf ft)
Pressure-relief plug	40 Nm (29.5 lbf ft)
Cooling oil intake filter fixing screw (5)	10 Nm (7.38 lbf ft)
Lubrication oil intake filter fixing screw (2)	10 Nm (7.38 lbf ft)

### **TIMING SYSTEM**

Name	Torque in Nm
Service shaft flange screw - TBEI M6x14 (2)	8 Nm (5.9 lbf ft)
Timing system gear nut on service shaft - M18 (1)	150 Nm (110.6 lbf ft)
Timing system gear nut on crankshaft - M25 (1)	120 Nm (88.51 lbf ft)
Belt tension	50 Nm (36.88 lbf ft)
Timing system upper gear TE screw (2)	30 Nm (22.13 lbf ft)
Screw fixing timing system upper gear closing	7 Nm (5.16 lbf ft)

Name	Torque in Nm
cap - TBEI M5x10 (4)	
Cylinder chain tensioner cap (2)	30 Nm (22.13 lbf ft)
Screw fixing movable chain slider (2)	25 Nm (18.44 lbf ft)
Timing system outer cover screw - TCEI M6x16 (5)	10 Nm (7.38 lbf ft)

**GENERATOR**

Name	Torque in Nm
Generator fixing screw - TCEI M8x45 (1)	22 Nm (16.23 lbf ft)
Generator fixing nut - M10x1.5 (1)	30 Nm (22.13 lbf ft)
Generator pulley nut on crankshaft - M16 (1)	80 Nm (59 lbf ft) - Loctite 243

**GEAR**

Name	Torque in Nm
Gear shift cable lever nut	10 Nm (7.38 lbf ft)
Gear shift tie rod lever nut on gear pre-selector	10 Nm (7.38 lbf ft)
Gearbox to crankcase fixing nut - M8 (5)	20 Nm (14.75 lbf ft)
TE flanged screw fixing gearbox to crankcase - M8x45 (1)	20 Nm (14.75 lbf ft)
Oil cap M18x1.5 (1)	28 Nm (20.65 lbf ft)
Breather cap (1)	8 Nm (5.9 lbf ft)
Gear in neutral sensor (1)	10 Nm (7.38 lbf ft)
Oil drainage plug - M10x1 (1)	24 Nm (17.7 lbf ft)
Transmission shaft ring nut (1)	100 Nm (73.76 lbf ft)

**OIL RADIATOR**

Name	Torque in Nm
Slot screw fixing oil radiator pipes - TCEI M10x20 (3)	20 Nm (14.75 lbf ft)
Oil radiator spacer (1)	50 Nm (36.88 lbf ft)
Oil radiator fixing screws - M8x40 (3)	25 Nm (18.44 lbf ft)
Screws fixing oil radiator grille - TBEI M5x12 (4)	4 Nm (2.95 lbf ft)
Screws fixing oil radiator air deflector - TE M6x30 (3)	10 Nm (7.38 lbf ft)

**CHASSIS TO ENGINE UNIT**

Name	Torque in Nm
M6x40 TCEI DA screw	8 -12 Nm
Reduction	20 Nm

**FUEL SUPPLY CONTROL UNIT**

<b>Name</b>	<b>Torque in Nm</b>
M5x12 TCEI screw	6 -7 Nm
Stainless steel M5x16 TBEI flanged screw	6 -7 Nm
M6x25 TCEI DA screw	8 -12 Nm

**CHASSIS**

<b>Name</b>	<b>Torque in Nm</b>
Front engine to chassis retainer	80 Nm
Transmission to chassis retainer (M12x250 + M12x230)	50 Nm
Right fixing plate - transmission retainer	25 Nm
Plate clamp - blow-by retainer	10 Nm
Coil plate retainer	10 Nm
Electronic control unit retainer	10 Nm
Bushings to electronic control unit retainer	10 Nm
Retainer for tank to chassis rear support rubber rings	Manual
Filter casing fixing bolts	10 Nm
Left and right footrest plate to chassis upper retainer	25 Nm
Left and right footrest plate to chassis lower retainer	18 Nm
Brake switch on plate retainer	Manual
Plate ring to plate retainer	6 Nm
Retainer for cable guide on right footrest plate	6 Nm

**FOOTRESTS AND LEVERS**

<b>Name</b>	<b>Torque in Nm</b>
Footrest rubber retainer	10 Nm
Rider footrest sliding pin - M8	25 Nm
Passenger footrest support to lateral plates retainer	38 Nm
Rider heelrest to plates retainer	6 Nm
Passenger heelrest retainer	3 Nm
Rod retainer (nut)	10 Nm
Gear shift lever / brake pin retainer	10 Nm
Gear shift lever / pre-selector retainer	10 Nm

Name	Torque in Nm
Gear shift lever - brake pin retainer	15 Nm

**SIDE STAND**

Name	Torque in Nm
Stand plate to engine upper retainer	50 Nm
Stand plate to engine lower retainer	25 Nm
Side stand retainer pin	10 Nm
Switch fixing screw	10 Nm
Lock nut	30 Nm
Stand cable guide to engine retainer	50 Nm
Lateral lever arm retainer	10 Nm

**SWING ARM**

Name	Torque in Nm
Fork on bushing clamp retainer	10 Nm
Fork on bevel gear pair retainer	50 Nm
Reaction rod to bevel gear pair retainer	50 Nm
Reaction rod to chassis retainer	50 Nm
Fork bolt to fork retainer	60 Nm
Preloading bushing to fork bolt retainer	10 Nm

**FRONT SUSPENSION**

Name	Torque in Nm
Tube lock plate to steering base retainer	6 Nm
Fork stem on upper plate retainer	18 Nm
Upper and lower screws fixing fork stem on lower plate	22 Nm
Central screw fixing fork stem on lower plate	20 Nm
Headstock ring nut	40 Nm
Headstock counter ring nut	manual + 90 degrees
Upper plate fixing cover	100 Nm
Fork hubs closing	25 Nm

**REAR SUSPENSION**

Name	Torque in Nm
Shock absorber to chassis retainer, 8.8	50 Nm
Double connecting rod/shock absorber retainer, 10.9	40 Nm

Name	Torque in Nm
Single connecting rod/double connecting rod retainer, 10.9	50 Nm
Single connecting rod to chassis retainer, 8.8	50 Nm
Double connecting rod/fork retainer, 10.9	50 Nm

#### **AIR FILTER CASING**

Name	Torque in Nm
Blow-by expansion tank spacer to engine retainer	10 Nm
Blow-by expansion tank to spacer retainer	10 Nm
Filter housing to chassis retainer	10 Nm

#### **EXHAUST**

Name	Torque in Nm
Exhaust pipe to engine retainer	25 Nm
Silencer to chassis connecting pipe retainer	25 Nm
Silencer to footrest support retainer	25 Nm
Protection to connecting pipe retainer	10 Nm
Lambda probe retainer	38 Nm
Clamp retainer	10 Nm

#### **FRONT WHEEL**

Name	Torque in Nm
Wheel pin nut	80 Nm
Disc retainer	30 Nm

#### **REAR WHEEL**

Name	Torque in Nm
Disc retainer	25 Nm
Rear wheel retainer, 10.9	110 Nm

#### **FRONT BRAKING SYSTEM**

Name	Torque in Nm
Front brake right and left calliper retainer	50 Nm

#### **REAR BRAKING SYSTEM**

Name	Torque in Nm
Rear brake calliper retainer	50 Nm
Rear brake fluid reservoir retainer	3 Nm
Rear brake fluid reservoir support to plate retainer	10 Nm

Name	Torque in Nm
Rear brake rod lock nut	manual
Brake pump retainer	10 Nm

### **HANDLEBAR AND CONTROLS**

Name	Torque in Nm
Retainer for handlebar lower U-bolts on steering upper plate	50 Nm
Retainer for handlebar upper U-bolts	25 Nm
Anti-vibration weights retainer	10 Nm
Brake pump and clutch U-bolts retainer	10 Nm
Right and left light switch retainer	1.5 Nm
Clutch control cylinder to gear retainer	10 Nm
Rear-view mirror	Manual

### **ELECTRICAL SYSTEM**

Name	Torque in Nm
Coil retainer	2 Nm
Horn retainer	15 Nm
Odometer sensor on bevel gear pair retainer	3 Nm

### **INSTRUMENT PANEL AND LIGHTS**

Name	Torque in Nm
Instrument panel support to light support retainer	10 Nm
Instrument panel support to fork upper plate retainer	10 Nm
Instrument panel retainer	3 Nm
Light support to fork lower plate retainer	25 Nm
Retainer for front and rear arrows	10 Nm
Headlamp retainer	15 Nm
Rear light to tail clamp retainer	3 Nm

### **FUEL PUMP FLANGE**

Name	Torque in Nm
Pump support to tank retainer	6 Nm
Tank breather joint	6 Nm

### **FUEL TANK**

Name	Torque in Nm
Filler to tank retainer	5 Nm

Name	Torque in Nm
Cap ring nut to tank retainer	5 Nm
Screws on cap ring nut (aesthetic)	5 Nm
Tank to chassis front retainer	10 Nm
Battery housing and tank to chassis rear retainer	6 Nm

#### **CHASSIS/ FAIRINGS (FRONT)**

Name	Torque in Nm
Front mudguard retainer	6 Nm
Control unit protection retainer	6 Nm
Deflectors to chassis front upper retainer	Manual
Deflectors to chassis front lower retainer	Manual
Deflectors to chassis rear retainer	Manual
Retainer fixing the deflectors to deflector clamp	Manual

#### **CHASSIS/ FAIRINGS (REAR)**

Name	Torque in Nm
reflector to support retainer	4 Nm
reflector support to license plate holder retainer	4 Nm
License plate holder and light support retainer	4 Nm
License plate holder to lower clamp retainer	manual
Tail section to chassis lower clamp retainer	25 Nm
Fuse bracket and relay support retainer	4 Nm

#### **FINISHING**

Name	Torque in Nm
Ignition lock retainer - shear head screw	- Nm

## **Overhaul data**

### **Assembly clearances**

#### **Cylinder - piston assy.**

Measurement of the cylinder diameter must be done at three heights, turning the dial gauge 90°.

Check that cylinders and pistons are of the same selection types (D, E, F).

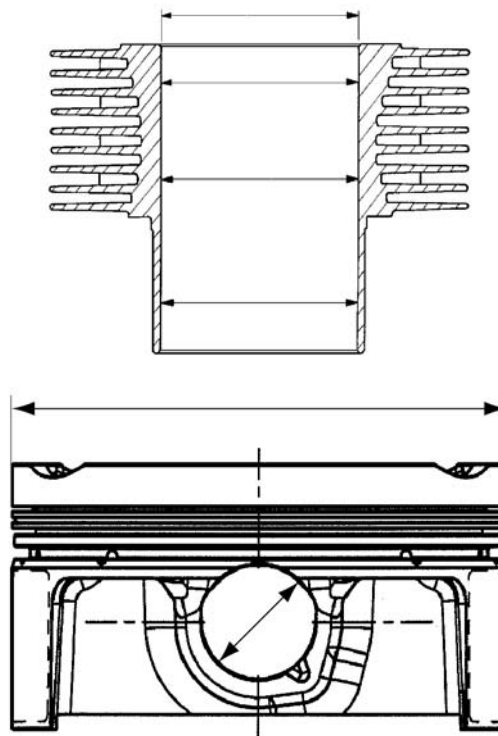
Check clearance between cylinders and pistons on the selected diameter; if it exceeds the value specified, it is necessary to replace cylinders and pistons.



The pistons of an engine must be balanced; a weight difference of up to 1.5 g (0.0033 lb) is allowed.

### **PISTON - CYLINDER SELECTION TYPES**

<b>Specification</b>	<b>Desc./Quantity</b>
Piston diameter - selection D	94.935 - 94.945 mm (3.73759 - 3.73798 in)
Cylinder diameter - selection D	95.000 - 95.010 mm (3.74015 - 3.74054 in)
Piston diameter - selection E	94.945 - 94.955 mm (3.73798 - 3.73837 in)
Cylinder diameter - selection E	95.010 - 95.020 mm (3.74054 - 3.74093 in)
Piston diameter - selection F	94.955 - 94.965 mm (3.73837 - 3.73877 in)
Cylinder diameter - selection F	95.020 - 95.030 mm (3.74093 - 3.74133 in)



### **PIN - PISTON COUPLING**

<b>Specification</b>	<b>Desc./Quantity</b>
Pin diameter	21.998 - 21.994 mm (0.86606 - 0.86590 in)
Pin hole diameter on piston	22.016 - 22.011 mm (0.86677 - 0.86657 in)
Clearance between pin and holes on piston	0.013 - 0.022 mm (0.00051 - 0.00087 in)

### **Piston rings**

On each piston there are:

- 1 top piston ring;
- 1 middle piston ring;

- 1 oil scraper piston ring.

Turn the rings so that the coupling ends are 120 degrees from each other.

#### **CLEARANCE BETWEEN PISTON RINGS AND SEATS ON PISTON**

<b>Specification</b>	<b>Desc./Quantity</b>
Top ring	0.030 - 0.065 mm (0.00118 - 0.00256 in)
Middle ring	0.020 - 0.055 mm (0.00079 - 0.00216 in)
Oil scraper ring	0.010 - 0.045 mm (0.00039 - 0.00177 in)

Gap between the end of the piston rings inserted in the cylinder:

- Top and middle piston ring: 0.40 - 0.65 mm (0.00158 - 0.00255 in)
- Oil scraper piston ring: 0.30 - 0.60 mm (0.00118 - 0.00236 in).

### **Crankcase - crankshaft - connecting rod**

#### **CRANKSHAFT SEAT (TIMING SYSTEM SIDE)**

<b>Specification</b>	<b>Desc./Quantity</b>
Diameter of crankshaft main journal, timing system side	37.975 - 37.959 mm (1.49507 - 1.49444 in)
Inside diameter of crankshaft bushing, timing system side	38.016 - 38.0 mm (1.49669 - 1.49606 in)
Clearance between bushing and main journal (timing system side)	0.025 - 0.057 mm (0.00098 - 0.00224 in)

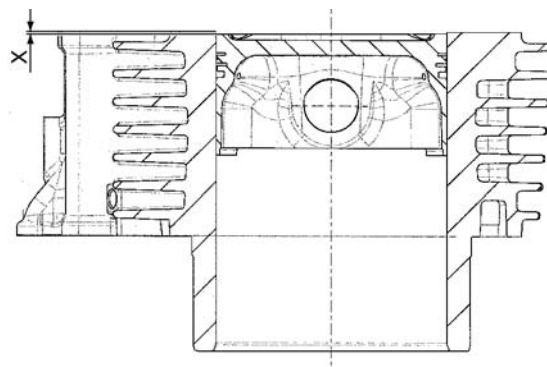
#### **CRANKSHAFT SEAT (CLUTCH SIDE)**

<b>Specification</b>	<b>Desc./Quantity</b>
Diameter of crankshaft main journal, clutch side	53.97 - 53.961 mm (2.12480 - 2.12444 in)
Inside diameter of crankshaft bushing on clutch-side flange	54.019 - 54.0 mm (2.12673 - 2.12598 in)
Clearance between bushing and main journal (clutch side)	0.030 - 0.058 mm (0.00118 - 0.00228 in)

### **Slot packing system**

- Fit both pistons on the connecting rods.
- Working from both sides, fit the gasket between the crankcase and the cylinder on the crankcase.
- Fit both cylinders.

- Take the left cylinder piston to TDC and lock crankshaft rotation.
- Place the tool on the left cylinder stud bolts to determine the "squish" (X).



- Tighten both nuts fixing the tool.
- Reset the micrometer on the cylinder rim.
- Move the micrometer up to the highest point of the piston crown.
- Take note of the measurement and, according to the values found, consult the chart at the bottom of the page to decide the thickness of the gasket to be fitted between the cylinder and the head.
- Unlock crankshaft rotation.
- Rotate the crankshaft by 90° until the right cylinder piston reaches the TDC.
- Lock crankshaft rotation.
- Place the tool on the right cylinder stud bolts to determine the "squish" (X).
- Repeat the same operations to determine the thickness of the left cylinder gasket between the cylinder and the head also for the right cylinder .

### **CYLINDER GASKET THICKNESS - HEAD**

<b>Specification</b>	<b>Desc./Quantity</b>
Value (X) -0.56 / -0.37 mm (-0.022 / -0.0146 in)	gasket thickness: 0.65 mm (0.0256 in)
Value (X) -0.37 / -0.19 mm (-0.0146 / -0.0075 in)	gasket thickness: 0.85 mm (0.0335 in)
Value (X) -0.19 / 0 mm (-0.0075 / 0 in)	gasket thickness: 1.05 mm (0.0413 in)

### **Recommended products chart**

#### **RECOMMENDED PRODUCTS**

<b>Product</b>	<b>Description</b>	<b>Specifications</b>
AGIP RACING 4T 10W-60	Engine oil	SAE 10W - 60. Top-branded oils that meet or exceed the requirements of CCMC G-4 API SG specifications can be used as an alternative for recommended oils.

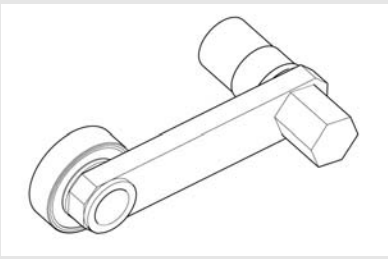
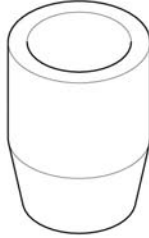
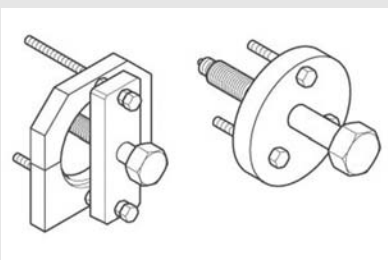
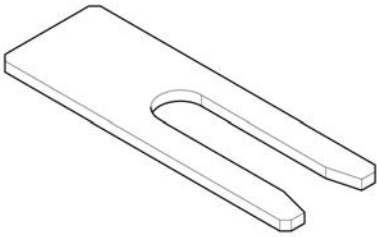
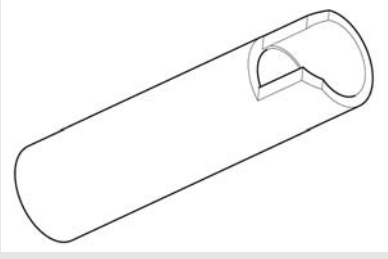

Product	Description	Specifications
AGIP GEAR SAE 80 W 90	Transmission oil	-
AGIP GEAR MG/S SAE 85 W 90	Gearbox oil	-
AGIP FORK 7.5W	Fork oil	SAE 5W / SAE 20W
AGIP GREASE SM2	Lithium grease with molybdenum for bearings and other points needing lubrication	NLGI 2
Neutral grease or petroleum jelly.	Battery poles	
AGIP BRAKE 4 / BRAKE 5.1	Brake fluid	Top-branded fluids that meet or exceed the requirements of SAE J1703, NHTSA 116 DOT 4, ISO 4925 Synthetic fluid specifications can be used as an alternative for recommended fluids.
AGIP BRAKE 4 / BRAKE 5.1	Clutch fluid	Top-branded fluids that meet or exceed the requirements of SAE J1703, NHTSA 116 DOT 4, ISO 4925 Synthetic fluid specifications can be used as an alternative for recommended fluids.

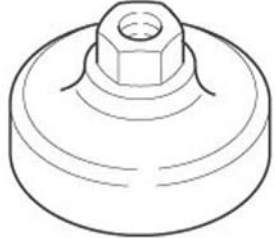
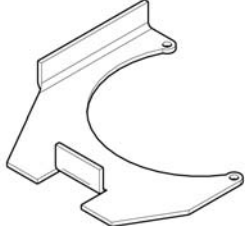

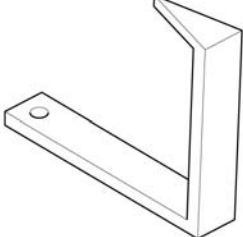
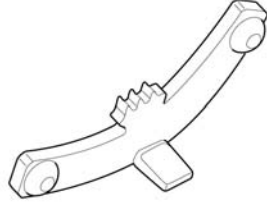
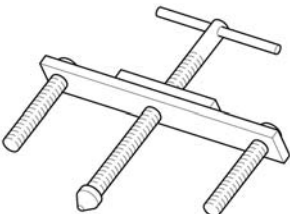
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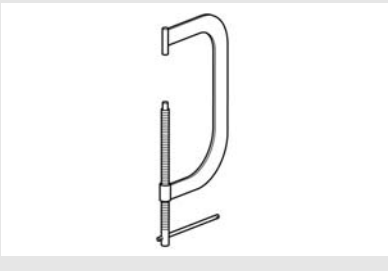
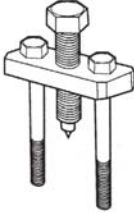
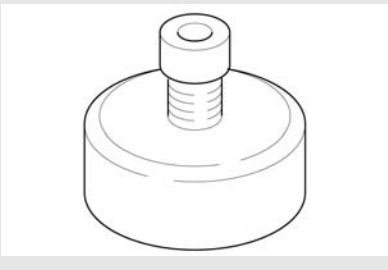
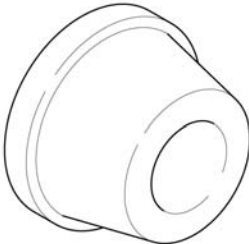
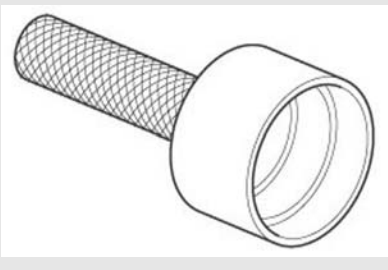

**SPECIAL TOOLS**

**S-TOOLS**

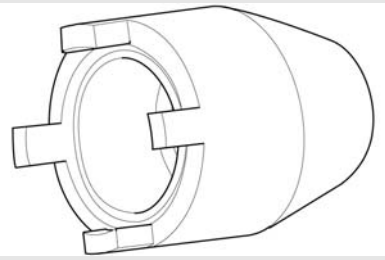
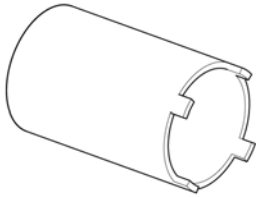
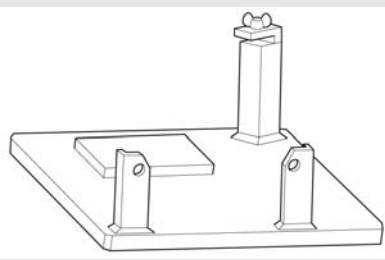

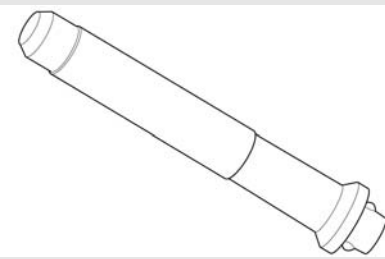
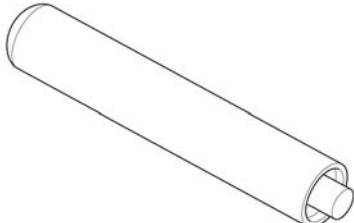
**SPECIAL TOOLS**

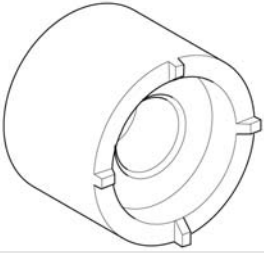

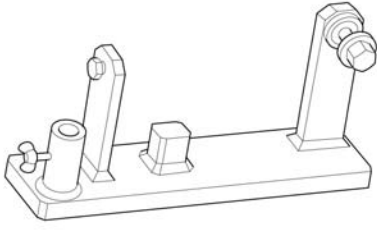
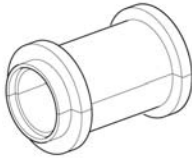

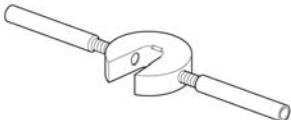
<b>Stores code</b>	<b>Description</b>	
06.94.86.00	belt tensioning tool	
05.91.17.30	Front cover insertion cone	
05.91.25.30	Gearbox opening	
020716Y	Connecting rod locking	
020717Y	Piston ring driver	
05.92.72.30	Timing system cover sealing ring punch	

Stores code	Description	
01.92.91.00	Wrench for removing the cover on sump and filter	
05.90.25.30	Gearbox support	
19.92.96.00	Graduated dial to control ignition timing	
17.94.75.60	Arrow to control ignition timing	
12.91.18.01	Tool to lock flywheel and start-up crown gear	
12.91.36.00	Tool to remove the flywheel-side flange	

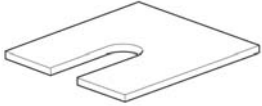
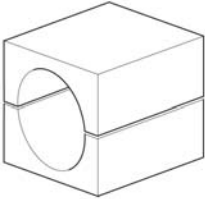
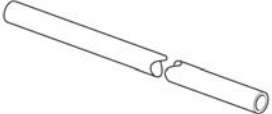
Stores code	Description	
AP8140179	Support for valve fitting/removal	
AP8106698	Crankcase separator	
14.92.71.00	Tool to fit the sealing ring on the flywheel-side flange	
12.91.20.00	Tool to fit the flywheel-side flange together with sealing ring on the crankshaft	
19.92.71.00	Tool to fit the sealing ring on the flywheel-side flange	
981006	Graduated dial hub	



Stores code	Description	
05.91.26.30	Tool for tightening the fork pin ring nut - clutch hub	
AP8140190	Tool for steering tightening	
05.90.27.30	Gearbox support	
05.90.27.31	Gearbox oil seal buffer	
05.90.27.32	Buffer handgrip	
05.90.27.33	Ball joint sealing buffer	

Stores code	Description	
05.90.27.34	Wrench for pinion ring nut	
05.90.27.35	Pinion oil seal buffer	
05.90.27.36	Bevel gear pair support	
AP8140145	fitting tool for Ø 41 mm sealing rings	
AP8140146	Weight	
AP8140147	Spacer tool	

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Stores code	Description	
AP8140148	Spacer-pumping element separating plate	
AP8140149	Protection for fitting operations	
AP8140150	Perforated rod for pumping member air bleed	
AP8140151	Complete tool kit for fork	

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## INDEX OF TOPICS

**MAINTENANCE**

**MAIN**

## Maintenance chart

### NOTE

**CARRY OUT THE MAINTENANCE OPERATIONS AT HALF THE INTERVALS SHOWN IF THE VEHICLE IS USED IN WET OR DUSTY AREAS, OFF ROAD OR FOR SPORTS APPLICATIONS.**

### AT EVERY START-UP

#### Action

Engine oil pressure warning light - check and clean, adjust, grease or replace if necessary

### BEFORE EACH RIDE AND EVERY 2000 KM (1250 MI)

#### Action

Tyre pressure - Adjust

Brake pad wear - Check and clean, adjust or replace if necessary

### AFTER RUN-IN (1,500 KM (932 MI)

#### Action

Exhaust pipe flange fixing bolts - Check and clean, adjust, grease or replace if necessary

Transmission cables and controls - Check and clean, adjust, grease or replace if necessary

Steering bearings and steering clearance - Check and clean, adjust, grease or replace if necessary

Disc brakes - Check and clean, adjust or replace if necessary

Engine oil filter - Replace

Fork - Check and clean, adjust and lubricate

General vehicle operation - Check and clean, adjust, grease or replace if necessary.

Braking systems - Check and clean, adjust, grease or replace if necessary

Light circuit - Check and clean, adjust or replace if necessary

Safety switches - Check and clean, adjust, grease or replace if necessary

Gearbox oil - Change

Engine oil - Change

Final transmission oil - Change

Tyres - Check and clean, adjust or replace if necessary

Tyre pressure - Adjust

Engine revs at idle speed - Adjust

Valve clearance adjustment - Adjust

Wheels - Check and clean, adjust, grease or replace if necessary

Bolt, nut and screw tightening - Check and clean, adjust, grease or replace if necessary

Battery terminal tightening - Check and clean, adjust, grease or replace if necessary

Cylinder synchronisation - Check and clean, adjust, grease or replace if necessary

Suspensions and position adjustment - Check and clean, adjust, grease or replace if necessary

**Action**

Brake pad wear - Check and clean, adjust or replace if necessary

**EVERY 4 YEARS****Action**

Fuel pipes - Replace

Brake pipes - Replace

**EVERY 5000 KM (3125 MI) - IF THE VEHICLE IS USED FOR RACING****Action**

Spark plugs - Replace

Engine oil filter - Replace

Engine oil - Change

Purge fluid present in oil drainage pipe from the filter casing - Clean

Clutch wear - Check and clean, adjust, grease or replace if necessary

**EVERY 10,000 KM (6250 MI) OR 12 MONTHS****Action**

Spark plugs - Replace

Idle mixture (CO) - Check and clean, adjust, grease or replace if necessary

Transmission cables and controls - Check and clean, adjust, grease or replace if necessary

Steering bearings and steering clearance - Check and clean, adjust, grease or replace if necessary

Wheel bearings - Check and clean, adjust, grease or replace if necessary

Disc brakes - Check and clean, adjust or replace if necessary

Air filter - Check and clean, adjust, grease or replace if necessary

Engine oil filter - Replace

General vehicle operation - Check and clean, adjust, grease or replace if necessary.

Braking systems - Check and clean, adjust, grease or replace if necessary

Gearbox oil - Change

Engine oil - Change

Final transmission oil - Change

Valve clearance adjustment - Adjust

Wheels - Check and clean, adjust, grease or replace if necessary

Bolt, nut and screw tightening - Check and clean, adjust, grease or replace if necessary

Cylinder synchronisation - Check and clean, adjust, grease or replace if necessary

Purge fluid present in oil drainage pipe from the filter casing - Clean

Fuel pipes - Check and clean, adjust, grease or replace if necessary

Brake pipes - Check and clean, adjust, grease or replace if necessary

**Action**

Clutch wear - Check and clean, adjust, grease or replace if necessary

**AFTER THE FIRST 10,000 KM (6,250 MILES) AND THEN AFTER EVERY 20,000 KM (12,500 MILES)**

**Action**

Fork oil - Change

Fork oil seals - Replace

**EVERY 20,000 KM (12,500 MI) OR 24 MONTHS**

**Action**

Alternator belt - Adjust; EVERY 50,000 km (31,050 mi)

Air filter - Replace

Fork - Check and clean, adjust and lubricate

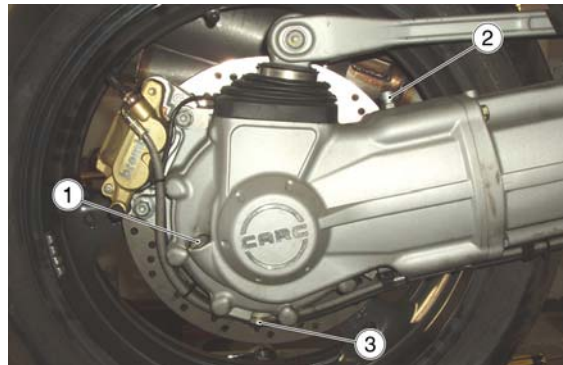
Brake fluid - change

Suspensions and position adjustment - Check and clean, adjust, grease or replace if necessary

Brake pad wear - Check and clean, adjust or replace if necessary

**Transmission fluid****Check**

- Keep the vehicle upright with both wheels on the ground.
- Unscrew and remove the level plug (1).
- The level is correct if the oil is close to the hole of the level plug (1).
- If the oil is lower than specified, top-up until it reaches the level plug hole (1).

**CAUTION**

**DO NOT ADD ADDITIVES OR OTHER SUBSTANCES TO THE FLUID. WHEN USING A FUNNEL OR ANY OTHER ELEMENT, MAKE SURE IT IS PERFECTLY CLEAN.**

**Replacement****CAUTION**

**THE UNIT MUST BE HOT WHEN THE OIL IS CHANGED AS UNDER SUCH CONDITIONS OIL IS FLUID AND THEREFORE EASY TO DRAIN.**

**NOTE**

**RIDE SOME km (miles) TO WARM UP ENGINE OIL**

- Place a container with +400 cm<sup>3</sup> (25 cu.in) capacity under the drainage plug (3).
- Unscrew and remove the drainage plug (3).
- Unscrew and remove the breather cap (2).
- Drain the oil into the container; allow several minutes for oil to drain out completely.
- Check and if necessary, replace the sealing washer of drainage plug (3).
- Remove any metal scrap attached to the drainage plug (3) magnet.
- Screw and tighten the drainage plug (3).
- Pour new oil through the fill opening (1) until it reaches the level plug hole (1).

**CAUTION**

**DO NOT ADD ADDITIVES OR ANY OTHER SUBSTANCE TO THE FLUID. WHEN USING A FUNNEL OR ANY OTHER ELEMENT, MAKE SURE IT IS PERFECTLY CLEAN.**

- Screw and tighten the caps (1 - 2).



## Engine oil

### Check

**CAUTION**

**ENGINE MUST BE WARM TO CHECK ENGINE OIL LEVEL**

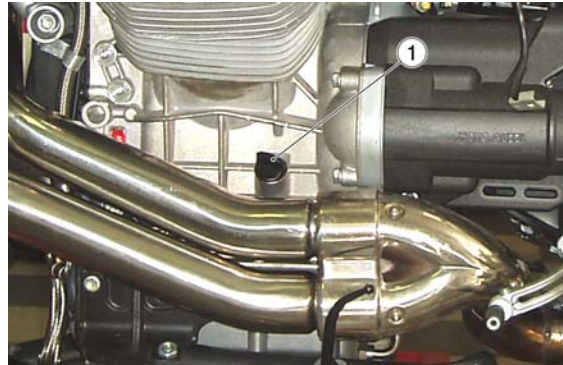
**NOTE**

**DO NOT LET THE ENGINE IDLE WITH THE VEHICLE AT STANDSTILL TO WARM UP THE ENGINE AND REACH THE OPERATING TEMPERATURE OF ENGINE OIL. OIL IS BEST CHECKED AFTER RUNNING FOR ABOUT 15 km (10 miles).**

- Shut off the engine.
- Keep the vehicle upright with the two wheels on the ground.



- Unscrew and remove the dipstick (1).
- Clean the dipstick (1).
- Reinsert the dipstick (1) into the opening but do not screw it.
- Remove the dipstick (1).
- Check oil level on the dipstick (1).
- The oil level is correct when it is close to the "MAX" mark.



**MAX** = maximum level

**MIN** = minimum level

Add engine oil if required:

- Unscrew and remove the dipstick (1).
- Top up with engine oil until it goes above the minimum level marked "MIN".

#### CAUTION

**DO NOT ADD ADDITIVES OR ANY OTHER SUBSTANCE TO THE OIL. WHEN USING A FUNNEL OR ANY OTHER ELEMENT, MAKE SURE IT IS PERFECTLY CLEAN.**

## Replacement

#### NOTE

**HOT OIL IS MORE FLUID AND WILL DRAIN OUT MORE EASILY AND COMPLETELY.**

- Place a container with +4000 cm<sup>3</sup> (245 cu.in) capacity under the drainage plug (2).
- Unscrew and remove the drainage plug (2).



- Unscrew and remove the filler plug (1).
- Drain the oil into the container; allow several minutes for oil to drain out completely.

- Check and if necessary, replace the sealing washers of drainage plug (2).
- Remove any metal scrap attached to the drainage plug (2) magnet.
- Screw and tighten the drainage plug (2).
- Pour new engine oil until it goes above the minimum level marked "MIN".
- Screw the filler cap (1).



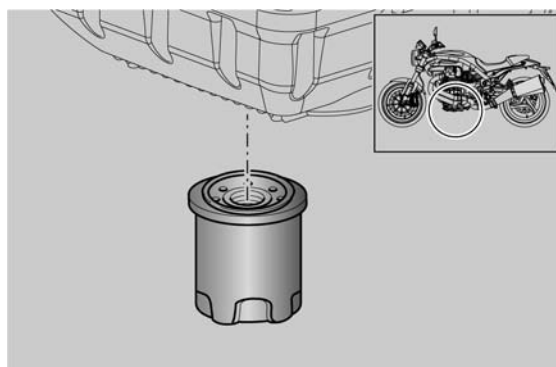
## Engine oil filter

Replace the engine oil filter each time you change the engine oil.

- Drain off the engine oil completely.
- Unscrew the engine oil filter and remove it from its seat.

### NOTE

**NEVER REUSE A FILTER.**



- Spread a thin layer of oil on the sealing ring of the new engine oil filter.
- Fit and screw the new engine oil filter in its seat.

**See also**

[Replacement](#)

## Gearbox Oil

### Inspection

#### CHECKING AND TOPPING UP

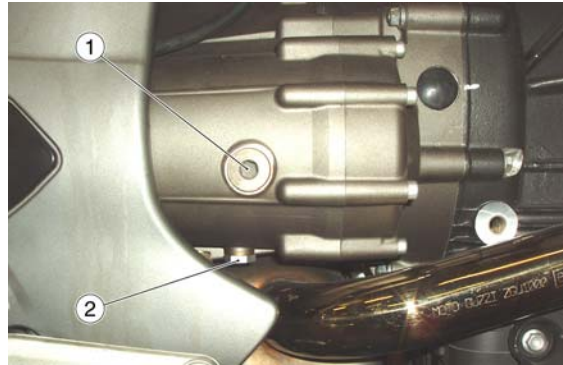
#### CAUTION

**ENGINE MUST BE WARM TO CHECK GEARBOX OIL LEVEL.**

#### NOTE

**DO NOT LET THE ENGINE IDLE WITH THE VEHICLE AT STANDSTILL TO WARM UP THE ENGINE AND REACH THE OPERATING TEMPERATURE OF ENGINE OIL. OIL IS BEST CHECKED AFTER RUNNING FOR ABOUT 15 KM (10 miles).**

- Shut off the engine.
- Keep the vehicle upright with both wheels on the ground.
- Unscrew and remove the cap/dipstick (1) placed on the gearbox right side.
- The level is correct if the oil is on the rim of the hole of the level plug (1).



If necessary:

- Top-up with oil until it reaches the dipstick opening (1).

#### CAUTION

**DO NOT ADD ADDITIVES OR ANY OTHER SUBSTANCE TO THE FLUID. WHEN USING A FUNNEL OR ANY OTHER ELEMENT, MAKE SURE IT IS PERFECTLY CLEAN.**

## Replacement

#### NOTE

**HOT OIL IS MORE FLUID AND WILL DRAIN OUT MORE EASILY AND COMPLETELY.**

- Place a container with suitable capacity under the drainage plug (2).
- Unscrew and remove the drainage plug (2).
- Unscrew and remove the filler cap (1).
- Drain the oil into the container; allow several minutes for oil to drain out completely.
- Check and replace, if necessary, the sealing washers of drainage plug (2).
- Remove any metal scrap attached to the drainage plug (2) magnet.
- Screw and tighten the drainage plug (2).
- Pour in new oil until it reaches the dipstick opening (1).
- Tighten the filler cap (1).



#### CAUTION

**DO NOT ADD ADDITIVES OR ANY OTHER SUBSTANCE TO THE FLUID. WHEN USING A**

---

**FUNNEL OR ANY OTHER ELEMENT, MAKE SURE IT IS PERFECTLY CLEAN.**

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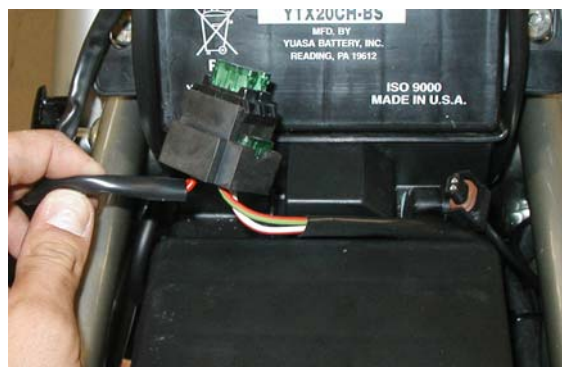
### Air filter

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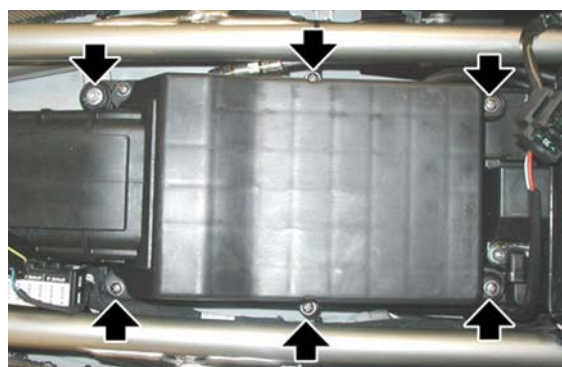
- Disconnect the air temperature sensor connector.



- Slide off and remove the main fuse box from its holder.



- Undo and remove the six screws.



- Lift the filter housing cover.



- Remove the air filter frame.



- Remove the air filter.
- Cover the inlet duct with a clean cloth so that no foreign bodies get into the inlet ducts.



**DO NOT START THE ENGINE WITHOUT THE AIR FILTER.  
TO CLEAN THE FILTERING ELEMENT, USE A PRESSURE AIR JET FROM THE INSIDE TO THE OUTSIDE.**

## Checking the valve clearance

If the timing system is very noisy, check the clearance between the valves and the rocking levers.

### NOTE

**ADJUST WITH COLD ENGINE, WITH PISTON AT TOP DEAD CENTRE (TDC) IN COMPRESSION STROKE (VALVES CLOSED).**

- Disconnect both spark plug tubes.



- Undo and remove the four head cover fixing screws and collect the sealing O-rings.
- Remove the head cover together with the gasket.

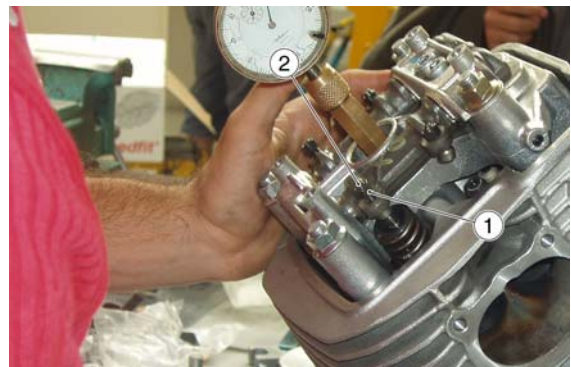


- Loosen the nut (1).
- Use a screwdriver to act on the set screw (2) until the following clearances are obtained:

Inlet valve: 0.10 mm (0.0039 in)

Outlet valve: 0.15 mm (0.0059 in)

- The measurement must be done using a special thickness gauge .



#### CAUTION

**IF CLEARANCE IS LARGER THAN RECOMMENDED, THE TAPPET WILL BE NOISY. OTHERWISE, THE VALVES DO NOT CLOSE CORRECTLY, WHICH CAN LEAD TO PROBLEMS SUCH AS:**

- PRESSURE DROP;
- ENGINE OVERHEAT;
- VALVE BURNOUT, ETC.

## Braking system

## Level check

### Brake fluid check

- Place the vehicle on the service stand.
- For the front brake, turn the handlebar fully to the right.
- For the rear brake, keep the vehicle upright so that the fluid in the reservoir is at the same level with the plug.
- Make sure that the fluid level in the reservoir is above the "MIN" reference mark:

MIN = minimum level

**MAX** = maximum level

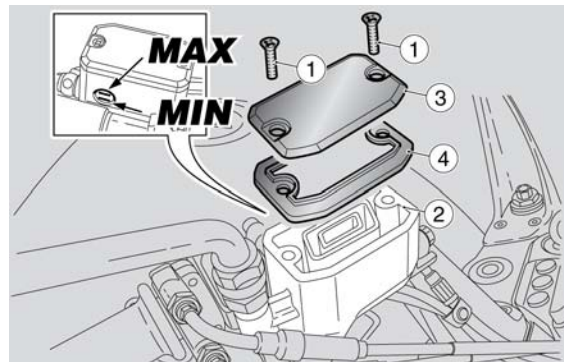
If the fluid does not reach at least the "**MIN**" reference mark:

- Check brake pads and disc for wear.
- If the pads and/or the disc do not need replacing, top-up the fluid.

## Top-up

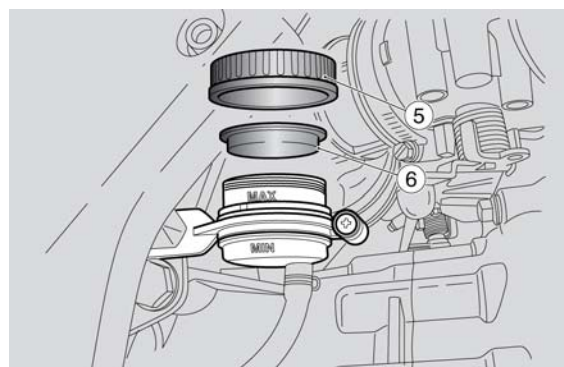
Front brake:

- Undo the two screws (1) of the brake fluid reservoir (2) using a Phillips screwdriver.
- Lift and remove the cover (3) and screws (1) as well.
- Remove the gasket (4).



Rear brake:

- Unscrew and remove the cap (5).
- Remove the gasket (6).
- Top-up the reservoir with brake fluid to the correct level, which is between the two "MIN" and "MAX" reference marks.



**RISK OF BRAKE FLUID SPILLS. DO NOT OPERATE THE BRAKE LEVER WITH BRAKE FLUID RESERVOIR CAP LOOSENED OR REMOVED.**



**AVOID PROLONGED AIR EXPOSURE OF THE BRAKE FLUID. BRAKE FLUID IS HYGROSCOPIC AND ABSORBS MOISTURE WHEN IN CONTACT WITH AIR. LEAVE THE BRAKE FLUID RESERVOIR OPEN ONLY FOR THE TIME NEEDED TO COMPLETE THE TOPPING UP PROCEDURE.**



**TO AVOID SPILLING FLUID WHILE TOPPING-UP, KEEP THE TANK PARALLEL TO THE RESERVOIR EDGE (IN HORIZONTAL POSITION).**

**DO NOT ADD ADDITIVES OR OTHER SUBSTANCES TO THE FLUID.**

**WHEN USING A FUNNEL OR ANY OTHER ELEMENT, MAKE SURE IT IS PERFECTLY CLEAN.**



**DO NOT EXCEED THE "MAX" LEVEL MARK WHEN TOPPING UP.**

**TOP-UP TO "MAX" LEVEL MARK ONLY WHEN BRAKE PADS ARE NEW. WHEN TOPPING UP DO NOT EXCEED THE "MAX" LEVEL MARK WHEN BRAKE PADS ARE WORN AS YOU RISK SPILLING FLUID WHEN CHANGING THE BRAKE PADS.**

**CHECK BRAKING EFFICIENCY. IN CASE OF EXCESSIVE TRAVEL OF THE BRAKE LEVER OR POOR PERFORMANCE OF THE BRAKE SYSTEM, TAKE YOUR VEHICLE TO AN Official Moto Guzzi Dealer, AS IT MAY BE NECESSARY TO PURGE THE AIR IN THE SYSTEM.**

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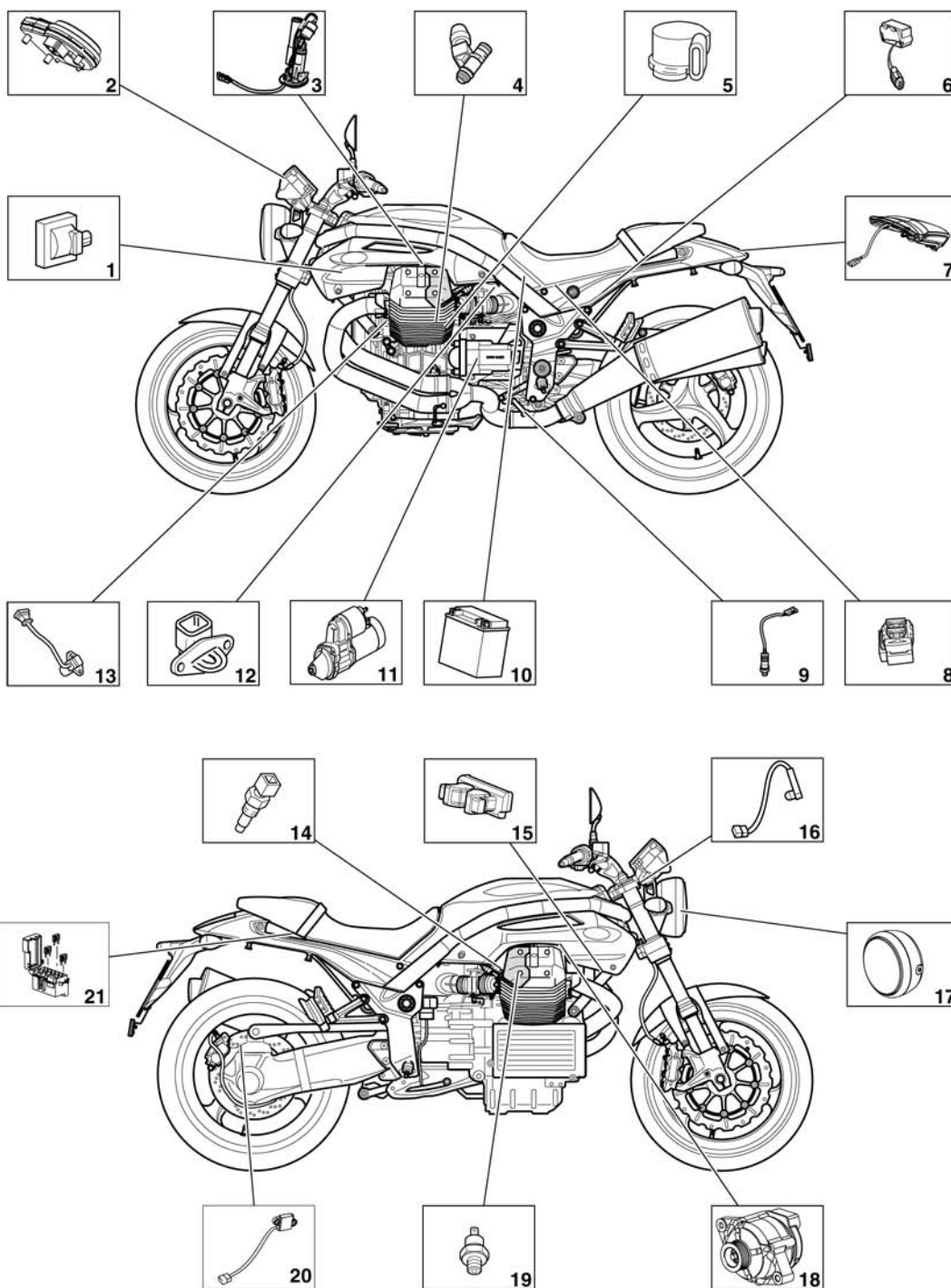


# INDEX OF TOPICS

ELECTRICAL SYSTEM

ELE SYS

**Components arrangement**



**Key:**

- 1 Coil
- 2 Instrument panel
- 3 Fuel pump

- 
- 4 Injector
  - 5 Throttle valve potentiometer
  - 6 Fall sensor
  - 7 Rear light
  - 8 Main fuses
  - 9 Lambda probe
  - 10 Battery
  - 11 Starter motor
  - 12 Intake air temperature sensor
  - 13 Engine revolution sensor
  - 14 Head temperature sensor
  - 15 Engine control unit
  - 16 Instrument panel air temperature sensor
  - 17 Front headlamp
  - 18 Alternator
  - 19 Oil pressure sensor
  - 20 Speed sensor
  - 21 Auxiliary fuses

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## Electrical system installation

### INTRODUZIONE

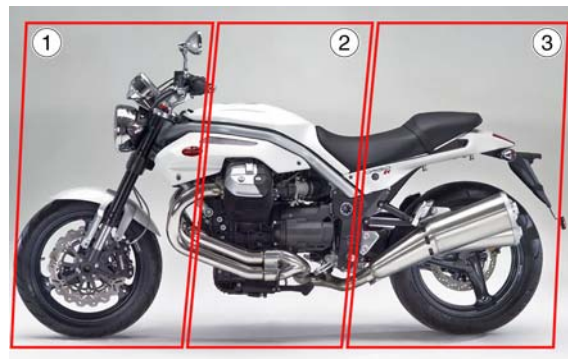
#### Scopo e applicabilità

Nella sezione che segue si definiscono i passaggi dei cablaggi, il loro fissaggio sulla moto e le eventuali criticità, al fine di raggiungere gli obiettivi di affidabilità del veicolo.

#### Divisione moto

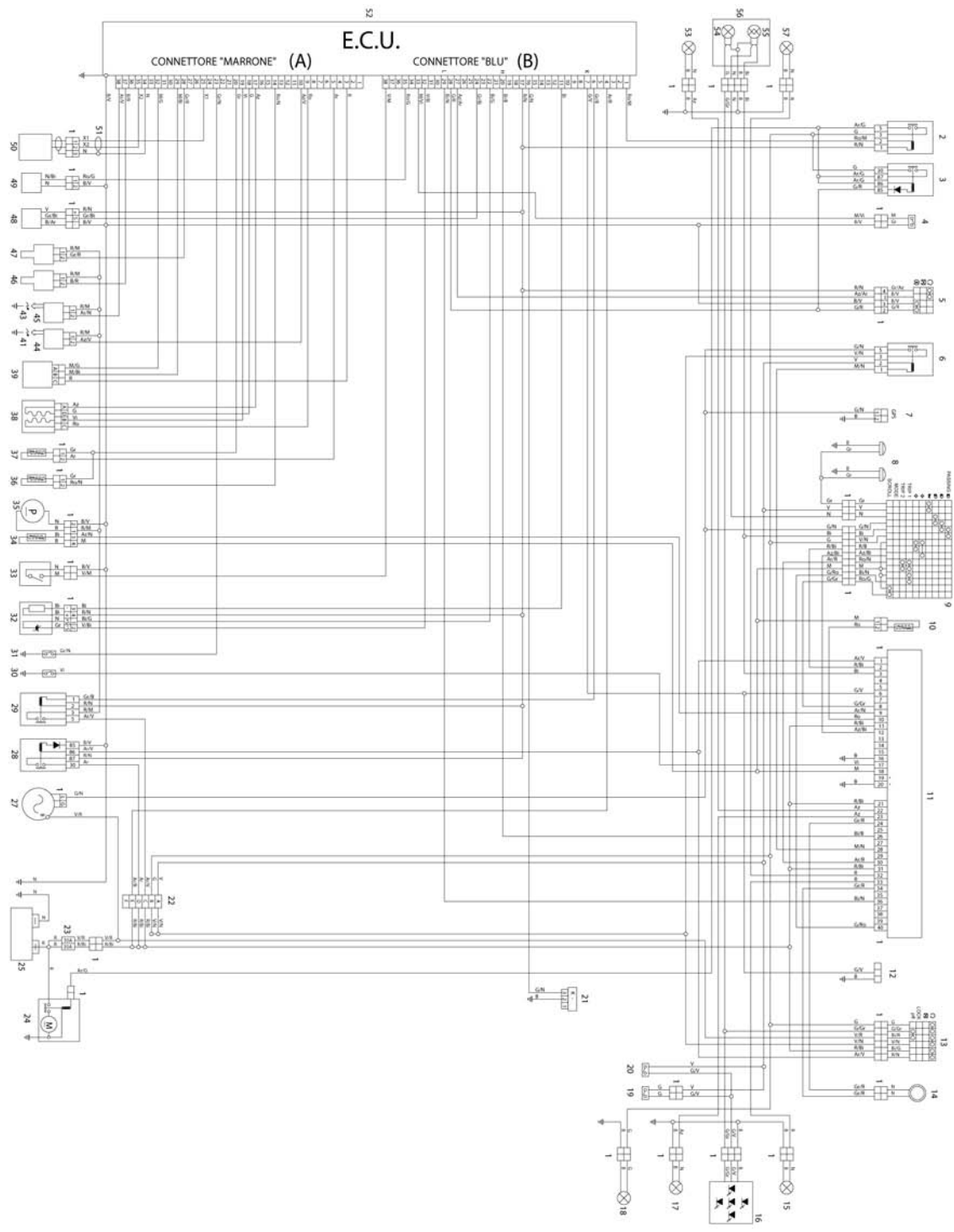
La distribuzione dei cablaggi elettrici viene suddivisa in tre parti fondamentali, come indicato in figura.

1. Parte anteriore
2. Parte centrale
3. Parte posteriore



---

## General wiring diagram



**Key:**

- 1. Multiple connectors
- 2. Start-up relay
- 3. Maintenance relay
- 4. Clutch switch
- 5. Right light switch

6. Light relay
7. GPS coupling
8. Horn
9. Left light switch
10. Instrument panel air temperature thermistor
11. Instrument panel
12. Instrument panel diagnosis
13. Key switch
14. Immobilizer aerial
15. Right rear turn indicator
16. Rear light (LED)
17. Left rear turn indicator
18. License plate light
19. Rear stop switch
20. Front stop switch
21. (ECU) Diagnosis connector
22. Auxiliary fuses
23. Main fuses
24. Starter motor
25. Battery
26. -
27. Alternator
28. Main injection relay
29. Secondary injection relay
30. Oil pressure bulb
31. Gear in neutral switch
32. Lambda probe
33. Side stand switch
34. Fuel reserve sensor
35. Fuel pump
36. Intake air temperature thermistor
37. Head temperature thermistor
38. Automatic air
39. Throttle sensor
40. -

41.Right cylinder outer spark plug

42.-

43.Left cylinder outer spark plug

44.Right cylinder coil

45.Left cylinder coil

46.Right cylinder injector

47.Left cylinder injector

48.Speed sensor

49.Fall sensor

50.Flywheel pick up

51.Pick-up wire shielding

52.ECU

53.Left front turn indicator

54.Tail light bulb

55.High-/low-beam bulb

56.Front headlamp

57.Right front turn indicator

**Cable colour:**

**Ar** orange

**Az** sky blue

**B** blue

**Bi** white

**G** yellow

**Gr** grey

**M** brown

**N** black

**R** red

**Ro** pink

**V** green

**Vi** violet

---

## Checks and inspections

---

## Dashboard

---

---

ELE SYS - 6

## Diagnosis

### Changing the CODE

If you know the code, just enter it and then a new code that will be automatically stored in the memory. If the vehicle is new, the user code is: 00000

### Resetting the CODE

This function is used to set a new code when the old one is not available; in this case, at least two of the programmed keys have to be inserted in the ignition lock.

After the first key has been inserted, the second one is requested with the following message:

INSERT KEY II

If the second key is not inserted within 20 seconds, the operation is finished.

After recognising the second key, the new code is required with the message:

ENTER NEW CODE

Once the operation is finished, the instrument panel goes back to the SET-UP menu.

## DIAGNOSIS

Access to this menu (diagnosis functions), for the technical service only, after requesting a service code.

It will read: ENTER THE SERVICE CODE This vehicle code is: **12425**

The functions in this menu are

- Exit
- ECU diagnosis
- Instrument Panel Errors
- Error clearing
- Reset Service
- Update
- Change Keys
- km / Miles

## ECU ERRORS

The instrument panel receives only the current errors from the control unit.

Description Error code

Throttle Valve Error DC V DC ECU 10

Throttle Valve Error DC Gnd ECU 11

Engine Temperature Error DC V DC ECU 14

Engine Temperature Error DC Gnd ECU 15

Air Temperature Error DC V DC ECU 16

Air Temperature Error DC Gnd ECU 17  
Low Battery Error ECU 20  
Lambda Probe Error ECU 21  
Coil 1 Error DC V DC ECU 22  
Coil 1 Error DC Gnd ECU 23  
Coil 2 Error DC V DC ECU 24  
Coil 2 Error DC Gnd ECU 25  
Injector 1 Error DC V DC ECU 26  
Injector 1 Error DC Gnd ECU 27  
Injector 2 Error DC V DC ECU 30  
Pump Relay Error ECU 36  
Local Loopback Error ECU 37  
Start-up Remote Error DC V DC ECU 44  
Remote Error Start-up DC Gnd ECU 45  
Canister Error DC V DC ECU 46  
Canister Error DC Gnd ECU 47  
Battery Error Hig ECU 50  
Generic ECU Error ECU 51  
Rpm Sensor Error ECU 54  
Self-adaptability Value Error ECU 55  
Vehicle Speed Error ECU 56  
Stepper Error AC ECU 60  
Stepper Error DC V DC ECU 61  
Stepper Error DC Gnd ECU 62  
Not recognised error ECU 00

### **INSTRUMENT PANEL ERRORS**

In this mode a chart is displayed showing potential errors in the immobilizer and its sensors.

This is the error decoding chart:

Description: Immobilizer failure: Key code read but not recognised. Error code: DSB 01

Description: Immobilizer failure: Key code not read (Key not inserted or transponder broken) Error code: DSB 02

Description: Immobilizer failure: Aerial not working (Open or short-circuited). Error code: DSB 03

Description: Immobilizer failure: Internal controller failure. Error code: DSB 04

Description: - Error code: DSB 05

Description: Air temperature sensor failure. Error code: DSB 06



Description: Oil sensor failure. Error code: DSB 07

Description: Oil pressure anomaly. Error code: DSB 08

The instrument panel keeps all previous errors stored in its **memory**.

### **ERROR CLEARING**

This option deletes instrument panel errors only, a further confirmation is requested.

---

### **INSTRUMENT PANEL SOFTWARE UPGRADE**

This function is used to program the instrument panel again with a new software through Axone. The Display reads: "Instrument panel disconnected. Now connect the diagnosis instrument"; the instrument panel will connect normally after the key is extracted-inserted.

The white connector is placed under the saddle, beside the fuse box, close to the diagnosis connector for the injection system.

Use the Ditech connector in the Axone 2000

**Aprilia-Moto Guzzi** package to connect to the Axone cable.



### **KEY CHANGE FUNCTION**

This function can be used:

- 1) if one key is lost; the dealer can disable this key;
- 2) to activate up to 4 keys;
- 3) should a new key lock be necessary and thus program the new set of keys.

In the first phase the user code must be entered and, after confirming the inserted key (key I) has been programmed, the other keys must be entered too.

The procedure finishes once the 4 keys have been programmed or after 20 seconds.

Should a new key lock be necessary, the procedure is: once the key is set to ON but the instrument panel does not recognise it, the user code is requested: enter the user code.

Now enter MENU, DIAGNOSIS (entering the service code), KEY CHANGE and program the new keys.

---

## **Battery recharge circuit**

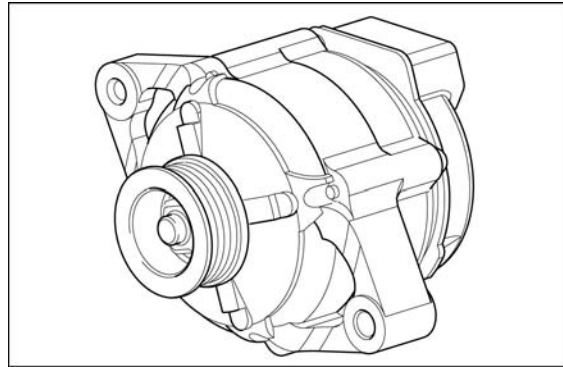
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## **Checking the stator**

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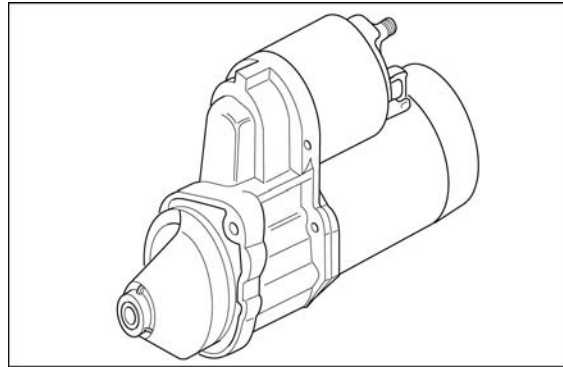
Single-phase generator with regulated voltage  
Maximum load 40A (550W)  
Charging voltage 14.2 - 14.8 V (5000 rpm)



---

### Start-up system check

pick-up input about 100 A



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### level indicators

Petrol pump:

Input: 3.5 A (to be measured between pins 1 and 2 with 12V voltage)

Fuel level sensor:

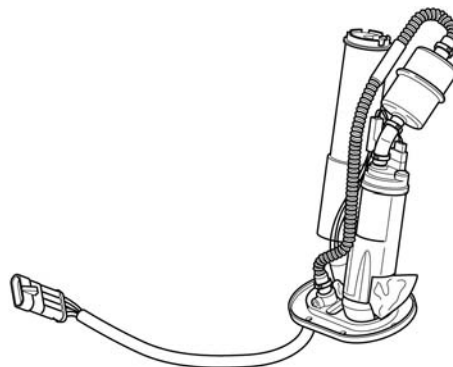
Resistance (to be measured between pins 3 and 4)

250-300 Ohm with fuel level equal to 0 litre

100 Ohm with fuel level equal to 11.25 litres  
(20.43 pt)

10-20 Ohm with fuel level equal to 22.5 litres  
(40.86 pt)

The low fuel warning light turns on with values over 230 Ohm.



In case there is anomaly on the fuel probe, the low fuel warning light flashes on the instrument panel.

The alarm warning light on the instrument panel does not light up and the word Service is not displayed.

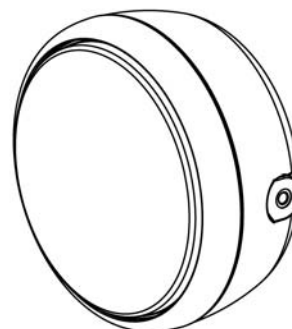
## Lights list

### FRONT HEADLAMP

Tail light: 12V - 5W

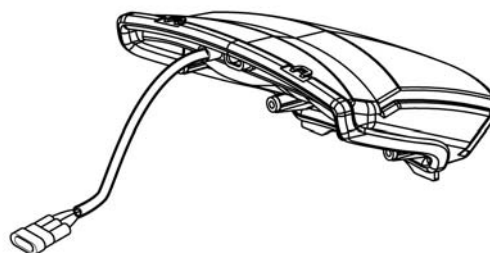
Low-beam light: 12V - 55W

High-beam light: 12 V - 60 W H4



### REAR LIGHT

LED



## Fuses

### AUXILIARY FUSES

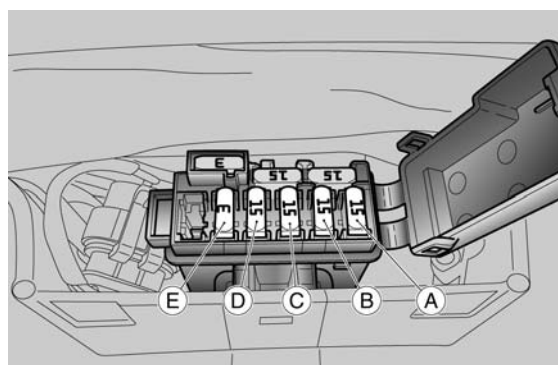
A - Stop, horn, lights, coil, light relay (15 A).

B - Tail lights, license plate light, passing, ignition relay (15 A).

C - Fuel pump, coils, injectors (15 A).

D - Lambda burner, secondary injection relay coil, start-up relay coil, speed sensor power supply, ECU control unit power supply, engine kill (15 A).

E - Permanent positive, ECU power supply (3A).



### MAIN FUSES

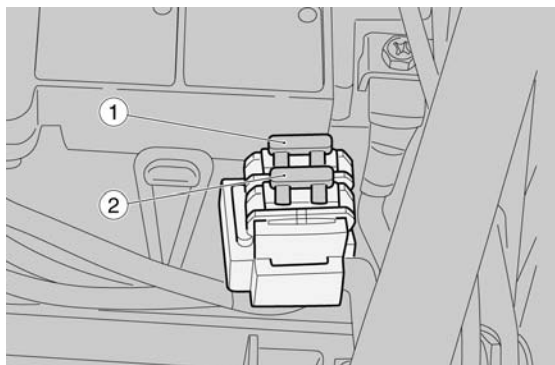
1 - From battery to voltage regulator (30 A).

2 - From battery to key and auxiliary fuses C - D

(30 A).

**NOTE**

**THERE IS ONE SPARE FUSE.**



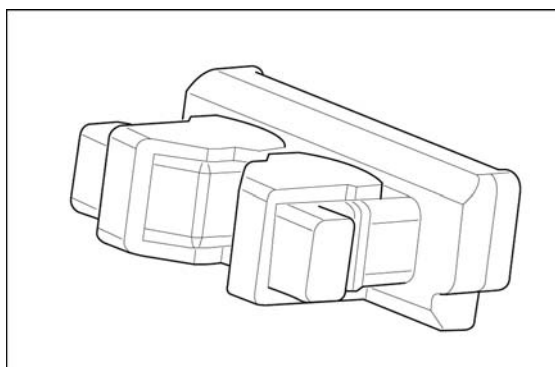
## Control unit

Model: Magneti Marelli IAW 5 AM2

**Black connector pins**

Pin Use

- 1 Not used
- 2 Not used
- 3 Ignition potentiometer signal
- 4 Not used
- 5 Engine temperature signal
- 6 Not used
- 7 Not used
- 8 Not used
- 9 Stepper motor (+)
- 10 Right cylinder coil control
- 11 Not used
- 12 Not used
- 13 Not used
- 14 Air temperature signal
- 15 Not used
- 16 Not used
- 17 Stepper motor (+)
- 18 Stepper motor (-)
- 19 Stepper motor (-)
- 20 5V power supply (NTC sensors)
- 21 Not used
- 22 Not used



- 23 Neutral sensor signal
- 24 Not used
- 25 Engine revolution sensor signal
- 26 Not used
- 27 Not used
- 28 Left cylinder injector control
- 29 Ignition potentiometer power supply
- 30 Not used
- 31 Not used
- 32 Ignition potentiometer negative
- 33 Not used
- 34 Revolution sensor anti-jamming cable
- 35 Engine revolution sensor signal
- 36 Not used
- 37 Right cylinder injector control
- 38 Left cylinder coil control

**Grey connector pins**

## Pin Use

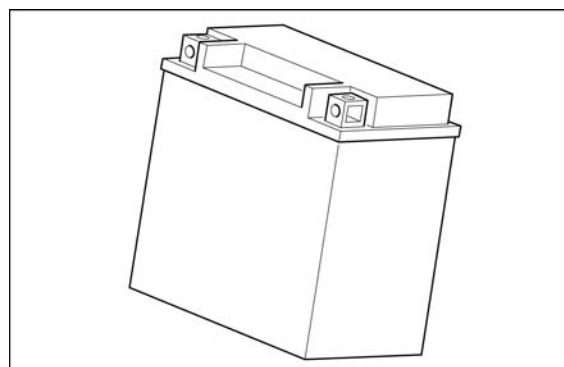
- 1 Pin 85 ignition relay control
- 2 Not used
- 3 Not used
- 4 Power supply protected from instrument panel
- 5 Not used
- 6 Pin 86 auxiliary relay control
- 7 Immobilizer line
- 8 Pin 85 ignition relay control
- 9 Not used
- 10 Not used
- 11 Oxygen probe negative control
- 12 Not used
- 13 Not used
- 14 Not used
- 15 Not used
- 16 K line (diagnosis)
- 17 Power supply from main relay

- 18 Not used
  - 19 Not used
  - 20 CAN - H line (ccm/instrument panel)
  - 21 Not used
  - 22 Oxygen probe signal
  - 23 Not used
  - 24 Vehicle speed signal input
  - 25 Not used
  - 26 Not used
  - 27 "Engine stop" signal input
  - 28 Ignition signal input
  - 29 CAN - L line (ccm/instrument panel)
  - 30 Not used
  - 31 Not used
  - 32 Oxygen probe power supply
  - 33 Clutch sensor signal
  - 34 Not used
  - 35 Fall sensor signal
  - 36 Not used
  - 37 Not used
  - 38 Side stand sensor signal
- 

## Battery

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12 V - 18 Ampere/hour



## Speed sensor

---

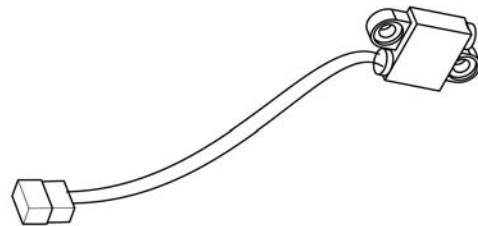
Active inductive sensor

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ELE SYS - 14

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3-pin connector (Power supply - Signal-Earth connection).



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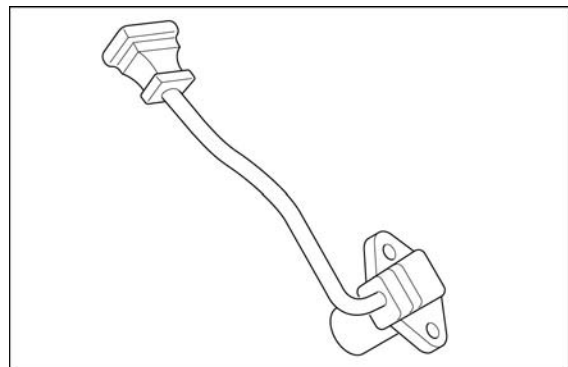
### Engine rpm sensor

Measures the engine revolution speed and each cylinder timing in relation to the TDC

Inductive type sensor, with three-way connector:

- positive voltage pin;
- negative voltage pin: resistance from 650 to 720 Ohm (to be measured between pins 1 and 2);
- shielding pin.

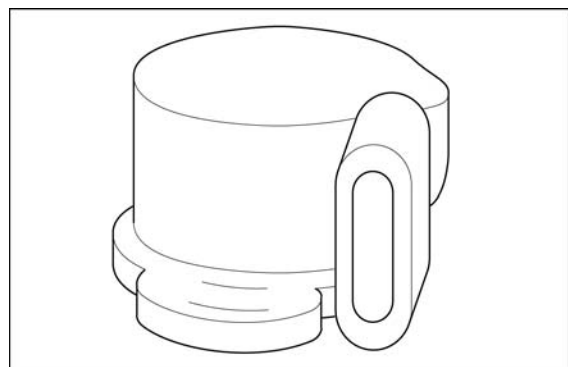
Air gap value: (measure sensor length with a depth gauge): 0.5 - 0.7 mm (0.0197 - 0.0276 in).



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### Throttle position sensor

Output voltage 0.55 - 4.4 V (variable depending on the position of the throttle valve, to be measured between pins C and A)



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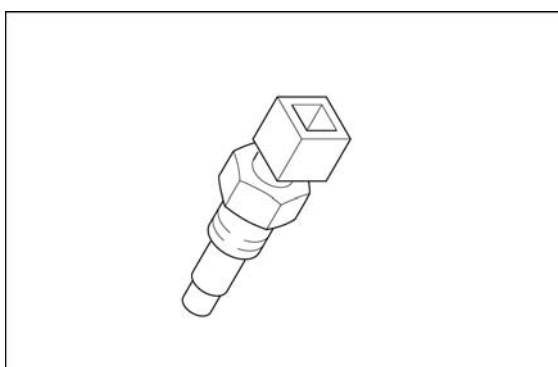
### Engine temperature sensor

This sensor, 5V powered, features NTC specifications and sends the control unit a signal which varies depending on temperature to help manage the stoichiometric ratios during engine speed adjust-

ment.

**ENGINE TEMPERATURE SENSOR RESISTANCE**

	<b>Specification</b>	<b>Desc./Quantity</b>
1	Resistance at -40 °C (-40 °F)	100.950 kOhm
2	Resistance at -30 °C (-22 °F)	53.100 kOhm
3	Resistance at -20 °C (-4 °F)	29.120 kOhm
4	Resistance at -10 °C (14 °F)	16.600 kOhm
5	Resistance at 0 °C (32 °F)	9.750 kOhm
6	Resistance at +10 °C (50 °F)	5.970 kOhm
7	Resistance at +20 °C (68 °F)	3.750 kOhm
8	Resistance at +30 °C (86 °F)	2.420 kOhm
9	Resistance at +40 °C (104 °F)	1.600 kOhm
10	Resistance at +50 °C (122 °F)	1.080 kOhm
11	Resistance at +60 °C (140 °F)	0.750 kOhm
12	Resistance at +70 °C (158 °F)	0.530 kOhm
13	Resistance at +80 °C (176 °F)	0.380 kOhm
14	Resistance at +90 °C (194 °F)	0.280 kOhm
15	Resistance at +100 °C (212 °F)	0.204 kOhm
16	Resistance at +110 °C (230 °F)	0.153 kOhm
17	Resistance at +120 °C (257 °F)	0.102 kOhm



**Air temperature sensor**

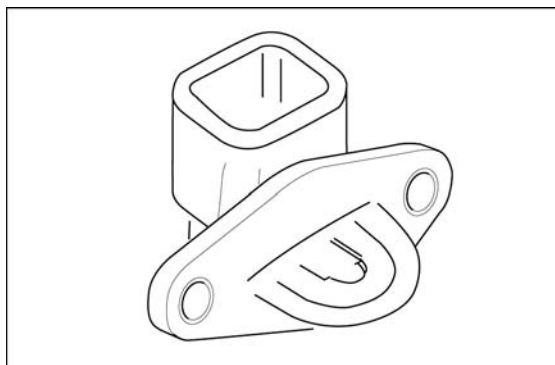
NTC type sensor

**AIR TEMPERATURE SENSOR RESISTANCE**

	<b>Specification</b>	<b>Desc./Quantity</b>
1	Resistance at -40 °C (-40 °F)	100.950 kOhm
2	Resistance at 0 °C (32 °F)	9.750 kOhm



	Specification	Desc./Quantity
3	Resistance at 10 °C (50 °F)	5.970 kOhm
4	Resistance at 20 °C (68 °F)	3.750 kOhm
5	Resistance at 30 °C (86 °F)	2.420 kOhm
6	Resistance at 40 °C (104 °F)	1.600 kOhm
7	Resistance at 90 °C (194 °F)	0.280 kOhm

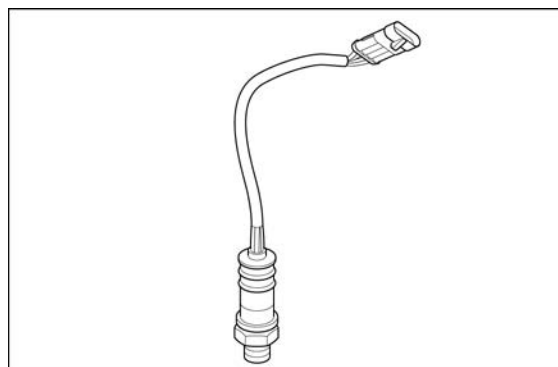


### Lambda sensor

Oxygen sensor with heater.

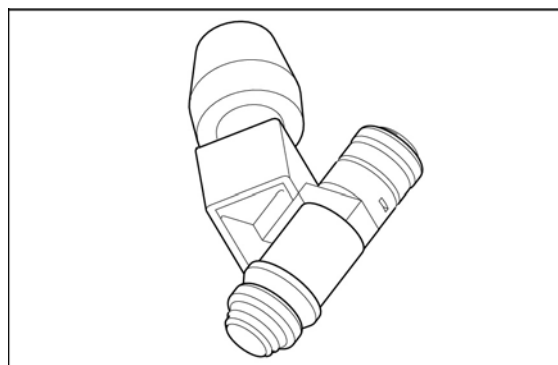
Sensor voltage between 0 and 0.9 V (to be measured between pins 1 and 2).

Heater resistance 12.8 Ohm (to be measured between pins 3 and 4 at 20°C - 68°F).



### Injector

Resistance 14 Ohm  $\pm$  2 Ohm measured at 20 °C (68 °F)



---

## Coil

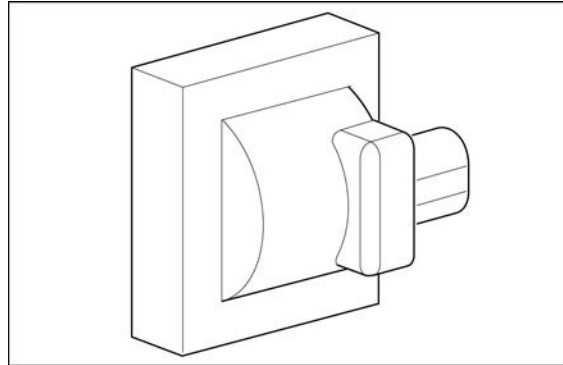
### Characteristic

#### Primary resistance:

0.9 - 1.1  $\Omega$  (measured between pins 1 and 15)

#### Secondary resistance:

6.5 - 7.2 K $\Omega$ .



---

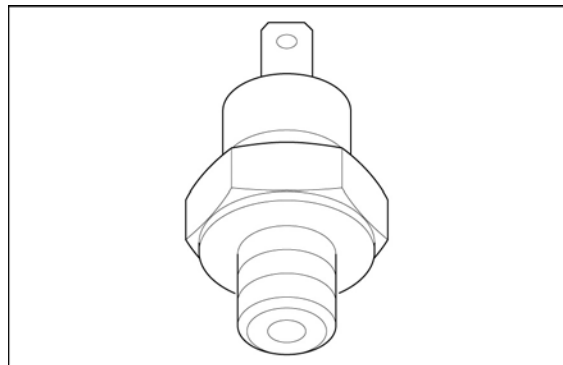
## Engine oil pressure sensor

An oil pressure sensor anomaly is signalled by the lighting of the "bulb" icon which should remain lit even with the engine running.

There is an oil pressure anomaly when, with engine running at over 1500 rpm, the sensor is detected as conducting (closed) at least for one second.

At lower rpm, there is an anomaly when the sensor remains closed for at least 300 seconds.

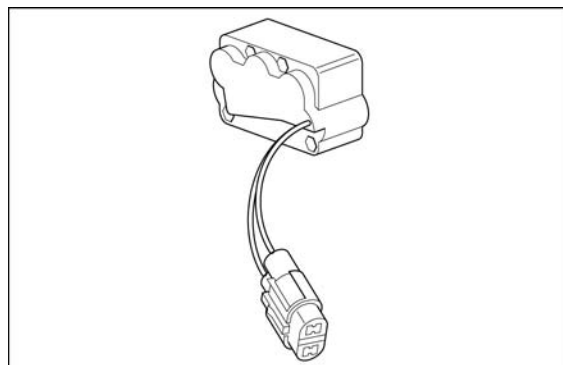
The opening of the sensor, and therefore the alarm triggering, is detected if the contact is open for at least one second.



---

## Bank angle sensor

Normally open contact, 62 kOhm resistance, with vehicle upright (straight sensor); Closed contact, 0 Ohm resistance, when the sensor is turned by 90° with respect to its fitting position.



---

## Air temperature sensor - instrument panel

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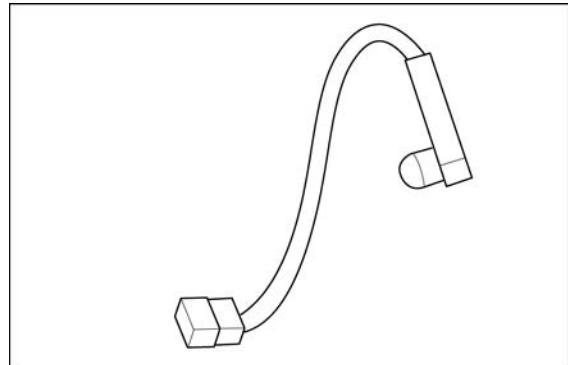
### Characteristic

#### Resistance

10 kOhm (at 25°C - 77°F)

#### Resistance

32.5 kOhm (at 0°C - 32°F)



---

## Connectors

---

### Dashboard

The pin configuration of the grey-bodied connector is as follows:

#### PIN USE

1 + KEY

2 RIGHT TURN INDICATOR CONTROL

3 HIGH-BEAM LIGHT INPUT

4 -

5 -

6 K LINE

7 -

8 SELECT 1 - SET

9 FUEL LEVEL SENSOR

10 AIR TEMPERATURE SENSOR

11 + BATTERY

12 LEFT TURN INDICATOR CONTROL

13 -

14 -

15 -

16 GENERAL EARTH CONNECTION

17 OIL PRESSURE SENSOR INTAKE

18 SENSORS EARTH CONNECTION

19 GENERAL GROUND (OPTIONAL)

20 GENERAL GROUND (OPTIONAL)

The pin configuration of the black-bodied connector is as follows:

PIN USE

21 + BATTERY

22 LEFT FRONT TURN INDICATOR ACTIVATION

23 LEFT REAR TURN INDICATOR ACTIVATION

24 AERIAL 1

25 -

26 CAN H

27 -

28 LIGHTS RELAY ACTIVATION

29 -

30 SELECT 2

31 + BATTERY

32 RIGHT FRONT TURN INDICATOR ACTIVATION

33 RIGHT REAR TURN INDICATOR ACTIVATION

34 AERIAL 2

35 -

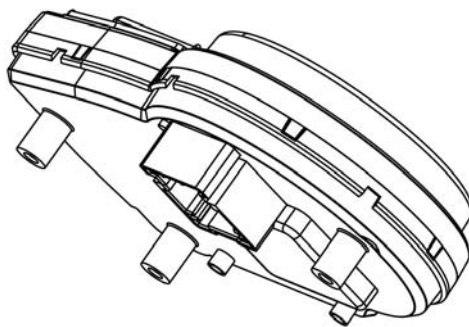
36 CAN L

37 -

38 -

39 -

40 SELECT 3



## INDEX OF TOPICS

ENGINE FROM VEHICLE

ENG VE

---

## Vehicle preparation

---

Before removing the engine block, proceed as follows:

- From the back, secure the vehicle with belts attached to a hoist.
- From the front, secure the vehicle with belts attached to the handlebar and fixed to the work bench.
- Place the engine service stand under the oil sump.
- Remove the exhaust system, the fork with cardan shaft and the fuel tank.



---

## Removing the engine from the vehicle

- Disconnect the spark plug tubes.
- Working on both sides disconnect the injector connectors



- Disconnect the throttle cables.



- Disconnect the engine temperature

sensor connector



- Disconnect the revolution sensor connector.



- Disconnect the alternator connectors.



- Disconnect the neutral sensor connector.



- Undo and remove the two screws and collect the washers.

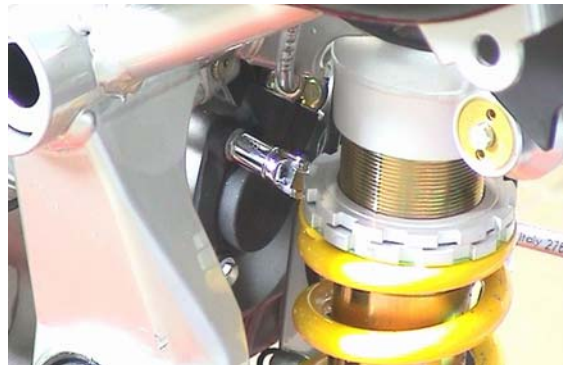
- Remove the starter motor cover.
- Unscrew and remove the stud bolt.
- Disconnect the ground leads.



- Disconnect the starter motor connectors.



- Undo and remove the three screws and remove the clutch control cylinder.
- Lock the cylinder using a clamp to prevent oil leaks.



- Slide off the gearbox oil breather pipe.



- Working on both sides, release the clamp and slide off the engine oil



---

breather pipe.



- 
- Undo and remove the two screws fixing the oil vapour union.
  - Remove the oil vapour union.



- 
- Disconnect the stand sensor connector and release it from the clamps.



- 
- Undo and remove the two screws and remove the control unit protection.
  - Undo and remove the two screws and move the control unit downwards.



- 
- Undo and remove the screws and move the oil vapour recovery reser-

voir.

- Unscrew and remove the stud bolt.



- Slide off the oil pipe from the blow-by tank and keep it fitted to the oil sump.
- Slide off the blow-by tank from the two hooks on the chassis.



- Working from both sides, undo and remove the three inlet manifold screws.
- Collect the gasket.
- Remove both footrest holding plates.



- Unscrew and remove the engine lower fixing nut and collect the washer.
- Remove the lower bolt and collect the washer.

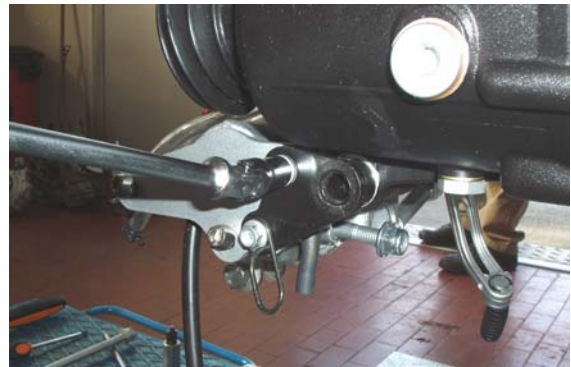


- Undo and remove the two screws and collect the cable guide.

- Remove the plate.

**CAUTION**

**PERFORM THE OPERATIONS BELOW HELPED BY A SECOND OPERATOR.**



- Working on both sides, undo and remove the front screw and collect the washer.



- Unscrew and remove the engine upper fixing nut and collect the washer.
- Remove the upper bolt and collect the washer.



- Lower the engine partially.
- Disconnect the oil pressure sensor connector.
- Lower the engine completely.
- Lift the rear part of the vehicle.
- Release the front belts.
- Hold the rear part of the vehicle, remove the chassis from the engine.

**See also**

[Exhaust](#)

## Removing Fuel tank

### Installing the engine to the vehicle

- Place the vehicle chassis over the engine with the gear.
- From the back, secure the chassis with belts attached to a hoist.
- From the front, secure the vehicle with belts attached to the handlebar and fixed to the work bench.
- Lift the engine placing it in position.
- Connect the oil pressure sensor connector.



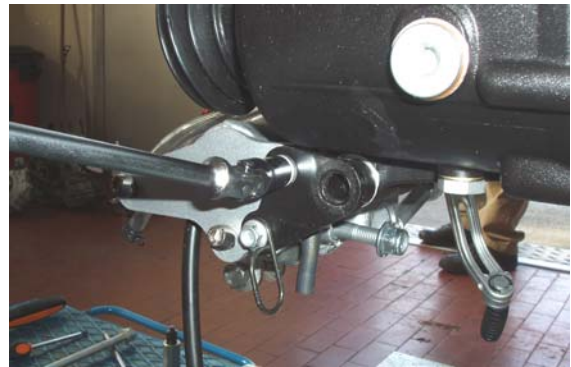
- Working from the left side, fit the engine upper bolt with the washer.
- From the opposite side, fit the washer and screw the nut.



- Working on both sides, insert the washer and screw the screw without tightening it.



- Place the plate and the cable guide and fix them using the two screws.



- Working from the left side, fit the engine lower bolt with the washer.
- From the opposite side, fit the washer and tighten the nut.



- Working on both sides, tighten the front screw to the prescribed torque.

- 
- Tighten the stud bolt.



- 
- Place the oil vapour recovery reservoir and tighten the screw.



- 
- Fit the control unit and tighten the two

screws.

- Fit the control unit cover and tighten the two screws.



- Working from both sides, place the inlet manifold fitting a new gasket between the manifold and head.
- Fasten the inlet manifold with the three screws.



- Connect the stand sensor connector and fix it to the chassis with new clamps.



- Place the oil vapour union and tighten the two fixing screws.



- Insert the oil breather pipe and fasten it with a new clamp.



- Fit the gearbox oil breather pipe.



- Fit the clutch control cylinder.
- Tighten the three screws.



- Connect the starter motor connectors.



- Connect the ground cables and tighten the screw.

- Fit the starter motor cover.
- Place the two washers and tighten the two screws.



- Connect the neutral sensor connector.



- Connect the alternator connectors.



- Connect the revolution sensor connector.



- Connect the engine temperature sensor connector.





- Connect and adjust the throttle grip cable clearance.



- Place the fork with cardan shaft and the rear wheel.
- Working on both sides, connect the injector connectors.
- Working from both sides, connect the spark plug tube.
- Install the fuel tank.
- Fit the saddle.
- Working from both sides, fit the fairing and tighten the three screws.
- Install the complete exhaust.



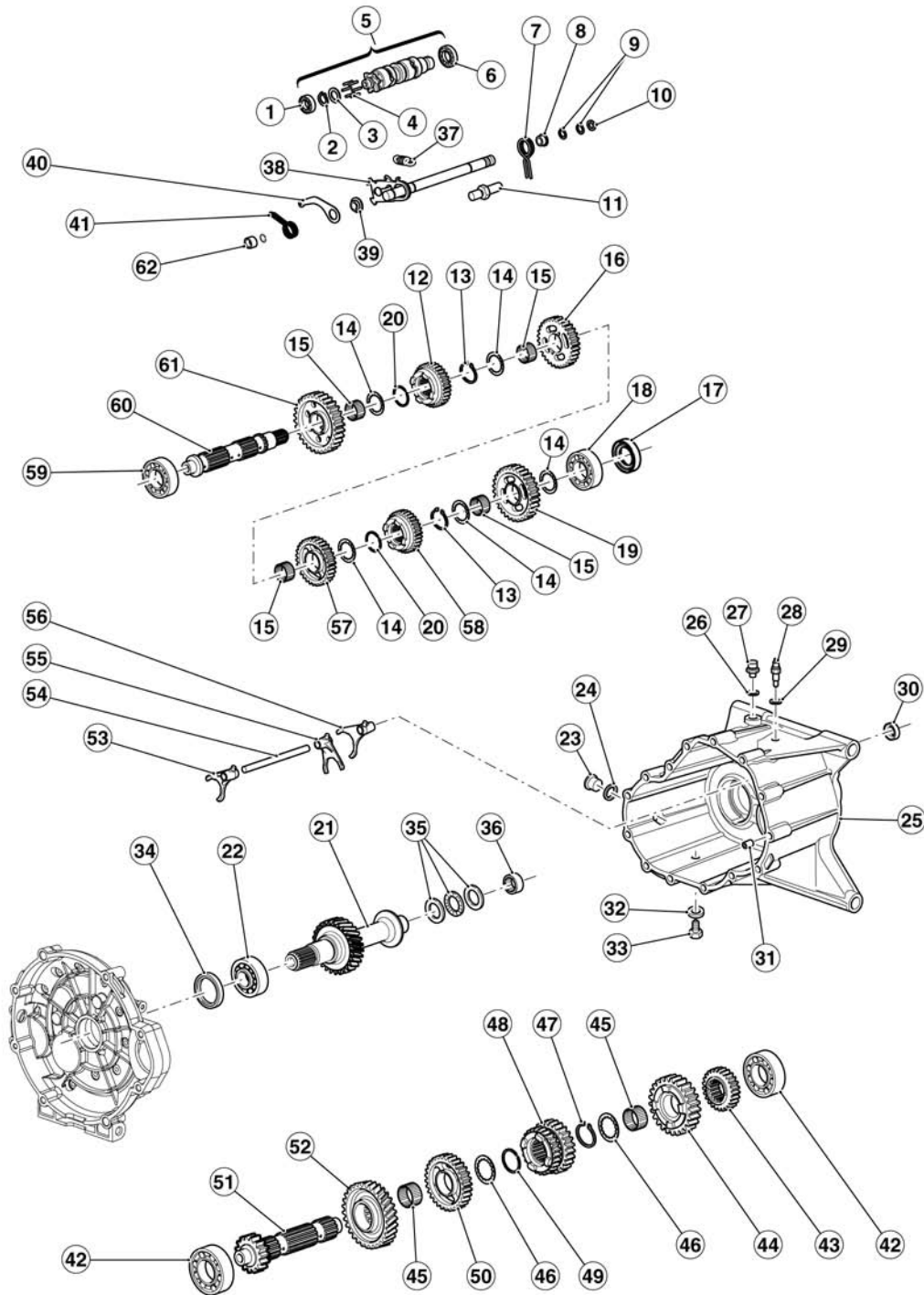
## INDEX OF TOPICS

**ENGINE**

**ENG**

**Gearbox**

**Diagram**



**Key:**

- 1. Ball bearing

2. Circlip
3. Thickness
4. Pin
5. Complete desmodromic
6. Ball bearing
7. Spring
8. Spacer
9. Circlip
10. Fifth wheel
11. Linking pin
12. Gear
13. Circlip
14. Thrust washer
15. Ball bearing cage
16. Gear
17. Sealing ring
18. Ball bearing
19. Gear
20. Circlip
21. Clutch shaft
22. Ball bearing
23. Oil plug
24. Washer
25. Gearbox
26. Aluminium washer
27. Breather cap
28. Neutral sensor
29. Gasket
30. Sealing ring
31. Bushing
32. Gasket
33. Oil drainage plug
34. Sealing ring
35. Thrust bearing
36. Roller bearing

- 37.Spring
- 38.Complete pre-selector
- 39.Bushing
- 40.Index lever
- 41.Spring
- 42.Ball bearing
- 43.Gear
- 44.Gear
- 45.Ball bearing cage
- 46.Thrust washer
- 47.Circlip
- 48.Gear
- 49.Circlip
- 50.Gear
- 51.Main shaft
- 52.Transmission gear
- 53.Fork (5th - 1st)
- 54.Fork shaft
- 55.Fork (3rd - 4th)
- 56.Fork (2nd - 4th)
- 57.Gear
- 58.Gear
- 59.Ball bearing
- 60.Transmission shaft
- 61.Gear
- 62.Spacer

---

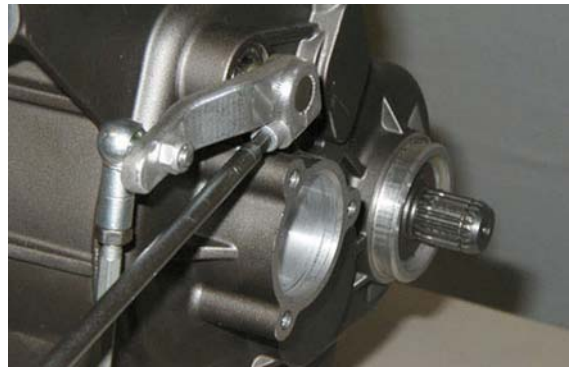
## **Gearbox**

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### **Removing the gearbox**

---

- Remove the starter motor.
- Make sure the transmission is in idle.
- Undo and remove the screw and re-move the gearbox lever.



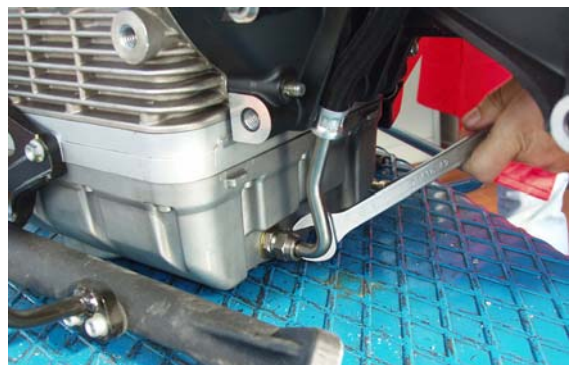
- Unscrew and remove the gearbox oil filler cap.



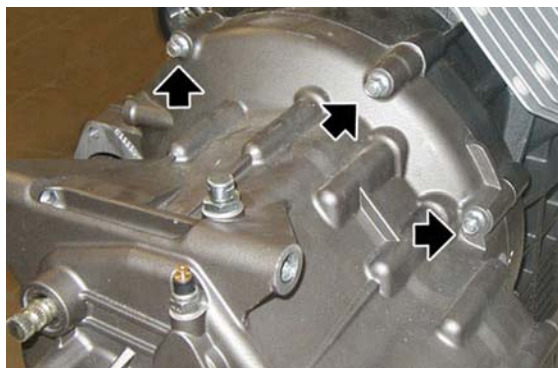
- Place a container of suitable capacity under it, unscrew and remove the cap and then bleed all gearbox oil.



- Loosen and turn the oil pipe fitting on the sump.



- Undo and remove the three screws.



- Undo and remove the two screws.



- Undo and remove the screw.



- Remove the gearbox.



#### See also

[Removing the starter motor](#)  
[Replacement](#)

## Gearbox shafts

---

### Disassembling the gearbox

---

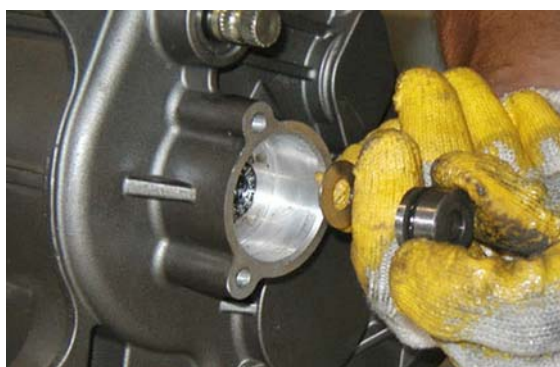
- Remove the gearbox.



- Unscrew and slide off the odometer gear and collect the abutment washer that is inside the gearbox.



- From the outside, slide off the thrust cylinder and collect the O-Ring and the washer.



- Remove the thrust bearing and the washer.

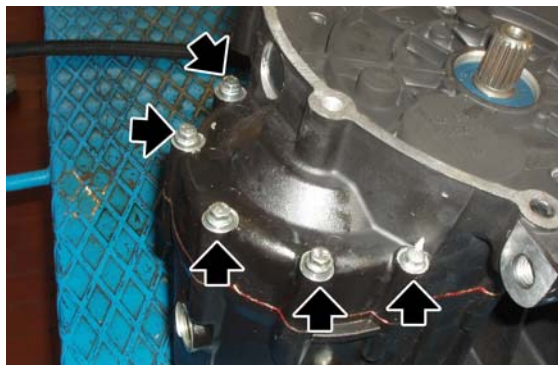




- Slide off the rod with the two bushings.



- Undo and remove the five external screws.



- Place the gearbox on the specific gearbox support tool and on a vice.

### Specific tooling

#### 05.90.25.30 Gearbox support

- Undo and remove the nine internal screws.



- Open the gearbox using the specific tool.

### Specific tooling

#### 05.91.25.30 Gearbox opening



- Remove the bearings from the gearbox if necessary.



- Release the spring.



- Pressing the selector, slide off the whole transmission lever.

- Use rubber bands to tie down the transmission shaft unit and extract it.



- Once the transmission shaft unit is in on a bench, remove the rubber bands, being careful with the group.
- Detach the shafts and label the forks before removal.



- Remove the forks and collect the shaft.





- Replace bearings if necessary and remove the clutch shaft.



**See also**

[Removing the gearbox](#)

---

## Removing the primary shaft

---

- Remove the main shaft.
- Operate on the main shaft from the second gear side.



- Remove the gear of the second gear and collect the ball bearing cage.



- Remove the gear of the sixth gear and collect the shoulder washer.



- Remove the circlip.



- Remove the gear of the third and fourth gears.



- Remove the circlip and collect the shoulder washer.



- Remove the gear of the fifth gear and collect the ball bearing cage.



- Heat the shaft with a specific heater and remove the helical transmission gear.



## Removing the secondary shaft

- Remove the transmission shaft.
- Operate on the shaft from the grooved side.



- Remove the shoulder washer.



- Remove the gear of the second gear and collect the ball bearing cage and the shoulder washer.



- Remove the circlip.



- Remove the gear of the sixth gear.



- Remove the circlip and collect the shoulder washer.



- Remove the gear of the fourth gear and collect the ball bearing cage.



- Remove the gear of the third gear and collect the ball bearing cage and the shoulder washer.



- Remove the circlip.





- Remove the gear of the fifth gear.



- Remove the circlip, the shoulder washer and remove the gear of the first gear, collect the ball bearing cage.
- Remove the bearing if necessary.



### See also

[Disassembling the gearbox](#)

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## Checking the primary shaft

---

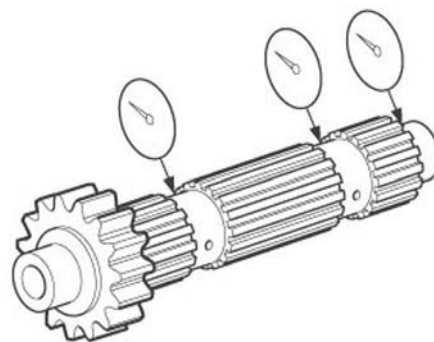
Measure coaxiality of the main shaft with a dial gauge and a centring device and replace it if not complying with specifications.

### Characteristic

**transmission shaft coaxiality limit**

0.08 mm (0.0031 in)

---



Check transmission gears for signs of pitting and wear and replace damaged gears if necessary.  
 Check the gear fitting teeth for cracks, damage and wear and replace those damaged if necessary.  
 Check the transmission gears movement and, if it is not regular, replace the damaged part.

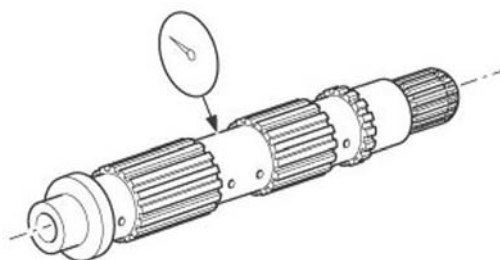
### Checking the secondary shaft

Measure the coaxiality of the transmission shaft with a dial gauge and a centring device and replace it if not complying with specifications.

#### Characteristic

#### transmission shaft coaxiality limit

0.08 mm (0.0031 in)



Check transmission gears for signs of pitting and wear and replace damaged gears if necessary.  
 Check the gear fitting teeth for cracks, damage and wear and replace those damaged if necessary.  
 Check the transmission gears movement and, if it is not regular, replace the damaged part.

### Checking the desmodromic drum

Check gear drum for damage, scratches and wear and replace the desmodromic if necessary.  
 Check the desmodromic segment «3» for damage and wear and replace it if necessary.  
 Check the desmodromic bearing «4» for damage and cracks and replace it if necessary.

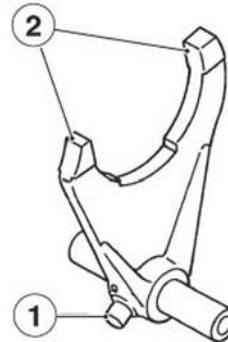


## Checking the forks

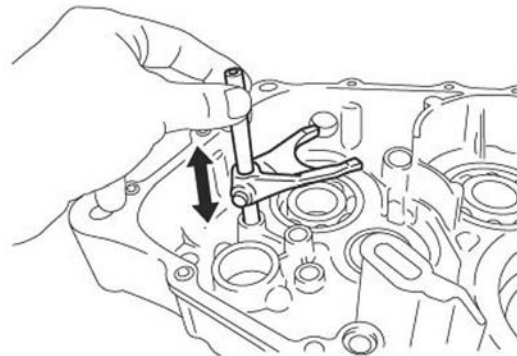
### NOTE

THE FOLLOWING PROCEDURE IS VALID FOR ALL TRANSMISSION FORKS.

- Check the transmission fork cam roller «1» and the transmission fork tooth «2» for damage, deformation and wear.
- Replace the transmission fork if necessary.



- Check the transmission fork movement and if it is not regular, replace the transmission forks.



### See also

[Disassembling the gearbox](#)

## Fitting the primary shaft

### NOTE

TO REFIT, FOLLOW THE SAME INSTRUCTIONS AS FOR REMOVAL BUT IN REVERSE ORDER. REMEMBER TO REPLACE ALL SEALING RINGS, CIRCLIPS AND SAFETY RINGS PREVIOUSLY REMOVED.

### See also

[Removing the primary shaft](#)

## Fitting the secondary shaft

### NOTE

TO REFIT, FOLLOW THE SAME INSTRUCTIONS AS FOR REMOVAL BUT IN REVERSE ORDER. REMEMBER TO REPLACE ALL SEALING RINGS, CIRCLIPS AND SAFETY RINGS PREVIOUSLY REMOVED.

### See also

[Removing the secondary shaft](#)

## Assembling the gearbox

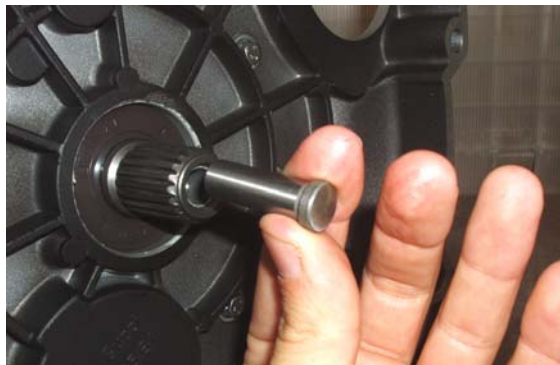
### NOTE

**TO REFIT, FOLLOW THE SAME INSTRUCTIONS AS FOR REMOVAL BUT IN REVERSE ORDER. REMEMBER TO REPLACE ALL SEALING RINGS, CIRCLIPS AND SAFETY RINGS PREVIOUSLY REMOVED.**

If the clutch is replaced, measure the length of the clutch control rod in order to use the correct rod.

Measure as follows:

- Fit the new clutch on the crankshaft.
- Fit the clutch control bowl in the gearbox.
- Fit the gearbox on the engine block.
- Fit the tool in the gearbox to determine the clutch control rod length.
- According to the value found, select the correct rod based on the following table:



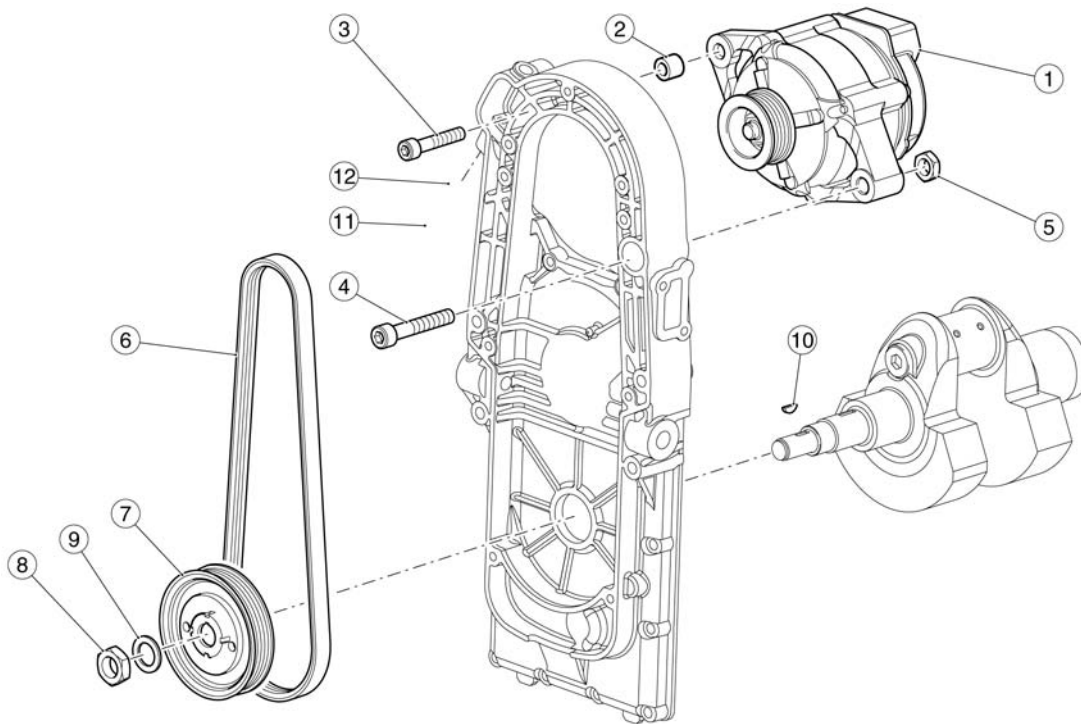
### **CLUTCH CONTROL ROD SELECTION**

Specification	Desc./Quantity
Clutch control rod (code 976593)	183 mm (7.205 in)
Clutch control rod (code 976594)	184.5 mm (7.264 in)
Clutch control rod (code 976595)	186 mm (7.323 in)
Clutch control rod (code 976596)	187.5 mm (7.382 in)

### See also

[Disassembling the gearbox](#)

## Generator

**Key:**

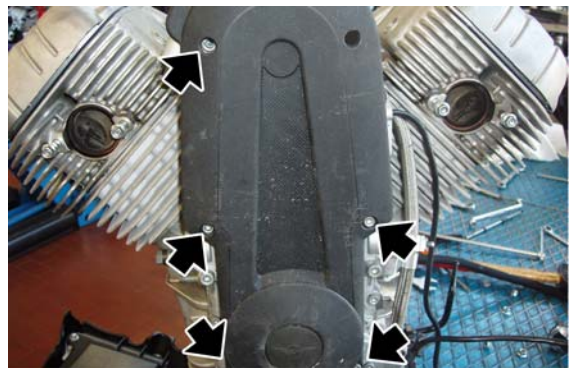
1. Alternator
2. Spacer
3. Screw
4. Screw
5. Nut
6. Belt
7. Generator control pulley
8. Nut
9. Washer
10. Magneto flywheel cotter
11. Screw
12. Nut

---

**Removing the generator**

---

- Remove the fuel tank.
- Remove the control unit from its seat.
- Disconnect the alternator connectors.
- Undo and remove the five screws and collect the bushings.



- Remove the cover.

- Unscrew the nut and collect the screw.

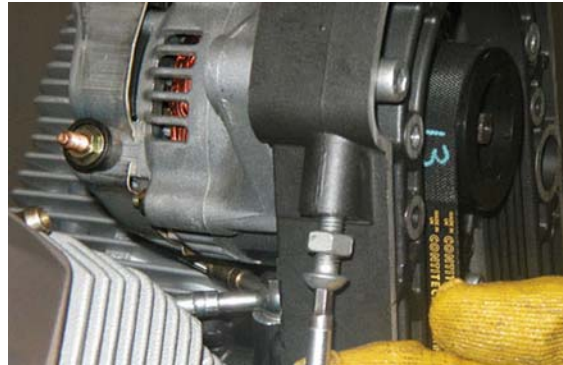


- Loosen the screw.



- Loosen the nut and undo the set

screw so that the alternator slides down.



- Completely loosen and remove the screw.

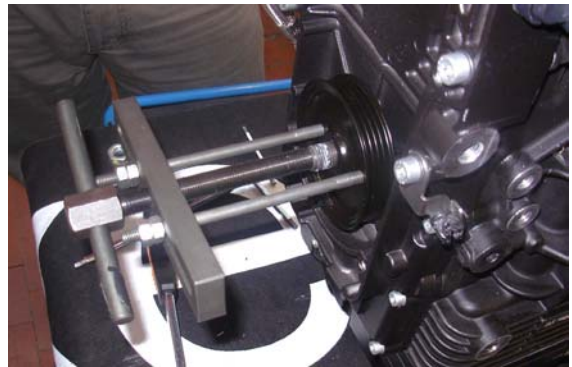


- Remove the belt and the alternator with pulley.

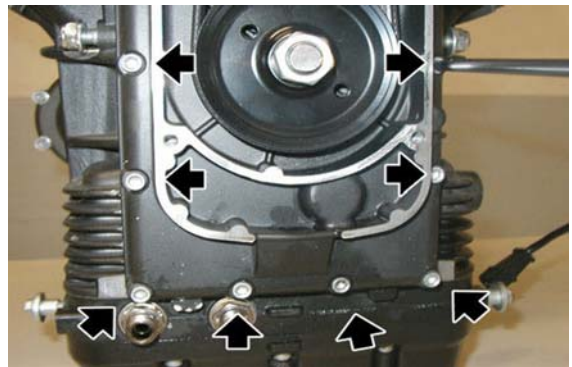


- Using a compressed air gun, unscrew and remove the nut and collect the spacer.
- Remove the lower pulley.





- Undo and remove the eight screws.



- Undo and remove the two screws.



- Undo and remove the two screws.



- Remove the alternator frame.
- Remove the sealing ring if necessary.



**See also**[Fuel tank](#)**Tensioning the belt**

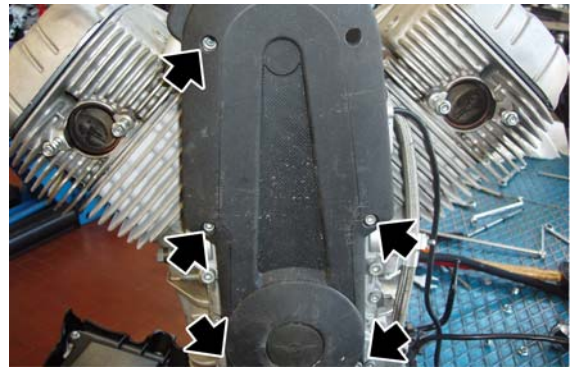
- Remove both fuel tank side fairings.
- Remove the right exhaust manifold.
- Remove the control unit.
- Undo and remove the fixing screw of the engine oil recovery tank.



- Unscrew and remove the spacer.



- Undo and remove the five fixing screws of the timing system cover.
- Remove the timing system cover.
- Loosen the set screw lock nut.



- Using the belt tensioning tool (code 06.94.86.00), tension the belt to the prescribed torque.
- Screw the set screw.
- Tighten the lock nut.

### Specific tooling

**06.94.86.00 belt tensioning tool**



## Installing the generator

- If the sealing ring has been previously

removed, replace it using the punch of the timing system cover sealing ring.

### Specific tooling

#### 05.92.72.30 Timing system cover sealing ring punch



- Place the bolt and the pin in the generator cover.



- Replace the gasket and place the alternator frame using the front cover insertion cone.
- Remove the insertion cone afterwards.

### Specific tooling

#### 05.91.17.30 Front cover insertion cone

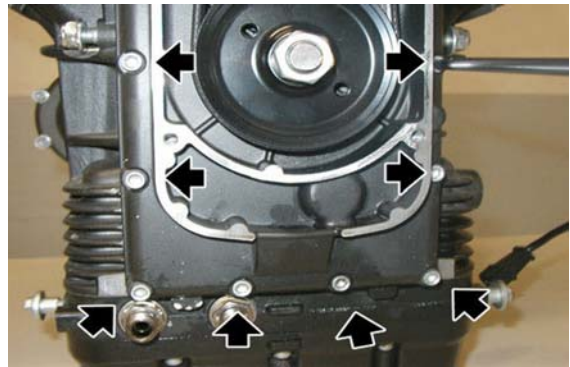


- Tighten the two screws.

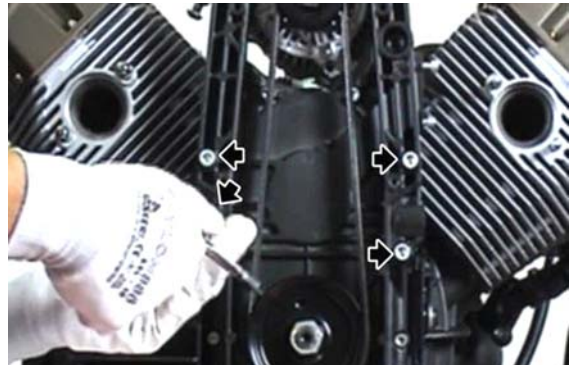


- Tighten the eight lower screws.
- Operating diagonally and in stages,

tighten the ten fixing screws on the alternator fitting.



- Tighten the four screws, operating diagonally and in stages.



- Position the lower pulley and the spacer.
- Tighten the nut to the prescribed torque.



- Position the alternator and the timing system belt.



- Position the screw and pre-tighten it.



- Position the screw and tighten the nut.



- Using the belt tensioning tool (code 06.94.86.00), tension the belt to the prescribed torque and screw the set screw.
- Remove the belt tensioning tool.
- Lock the set screw in position by screwing the lock nut.



### Specific tooling

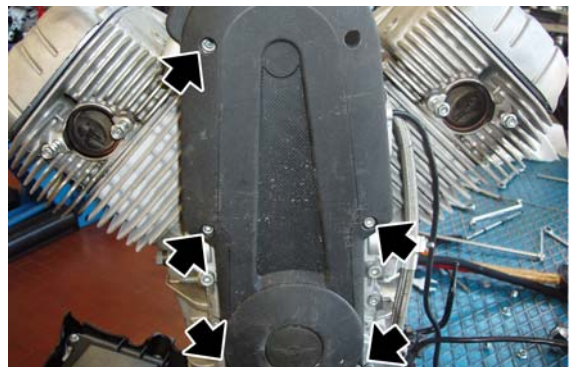
#### 06.94.86.00 belt tensioning tool



- Tighten the alternator fixing screws.



- Position the timing system cover.
- Tighten the five screws, operating in oblique direction and in stages.



## Starter motor

### Removing the starter motor

- Undo and remove the two screws and collect the washers.

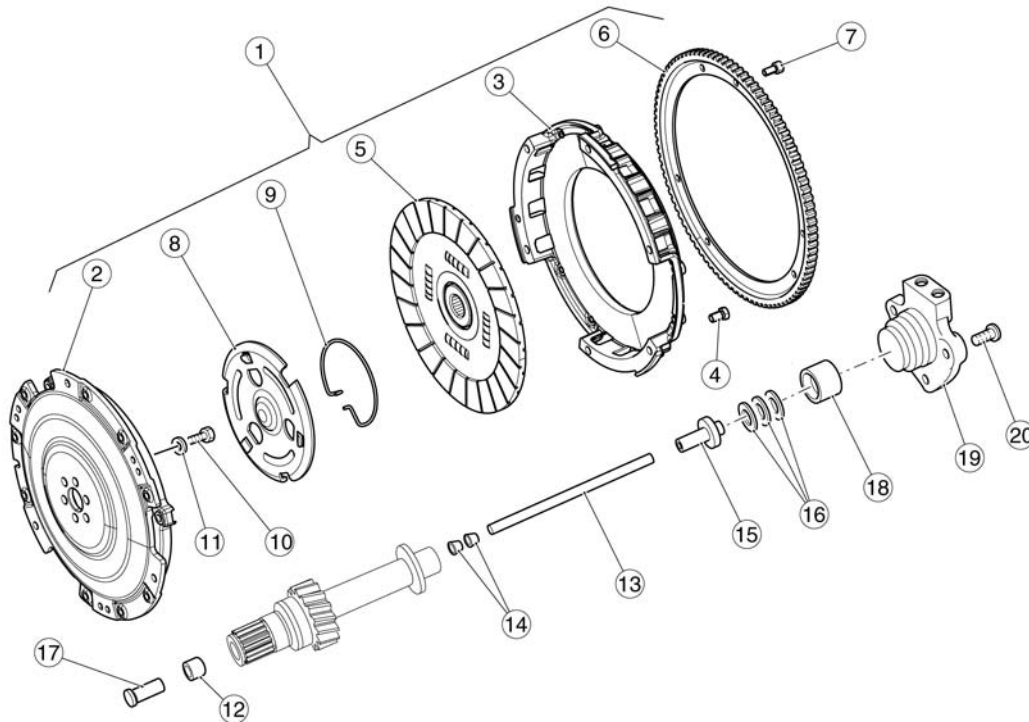


- Slide off the starter motor.



## Clutch side

### Disassembling the clutch



**Key:**

1. Complete clutch
2. Clutch
3. Clutch bell
4. TCEI screw
5. Clutch disc
6. Crown
7. TCEI screw

8. Clutch pressure plate
  9. Ring
  10. TE flanged screw
  11. Conical washer
  12. Bushing
  13. Rod
  14. Bushing
  15. Intermediate body
  16. Thrust bearing
  17. Clutch control bowl
  18. Thrust cylinder
  19. Clutch control cylinder
  20. TE flanged screw
- 

- Remove the complete gearbox.
- Undo and remove the six screws.
- Remove the start-up crown gear.



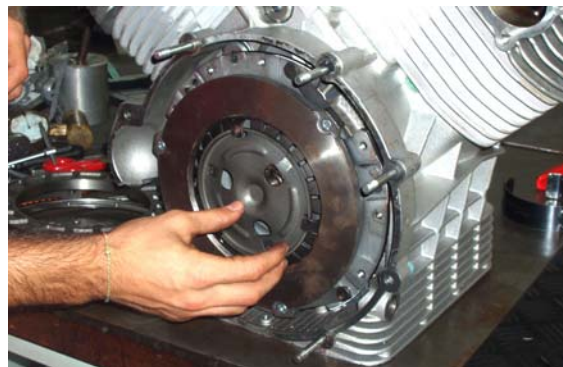
- Remove the clutch bell and the friction disc.







- Remove the Seeger ring.
- Remove the clutch pressure plate.



- Undo and remove the six screws and collect the belleville springs.
- Remove the clutch disc.



**See also**

[Removing the gearbox](#)

---

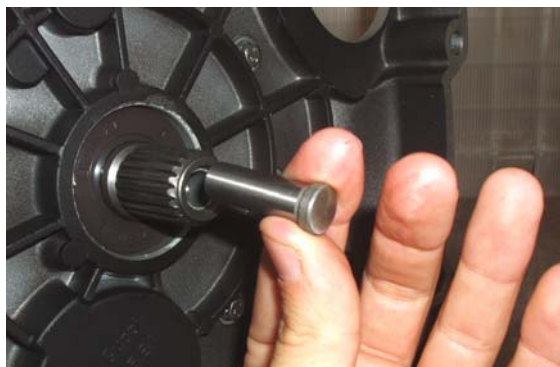
## Checking the clutch actuator

---

If the clutch is replaced, measure the length of the clutch control rod in order to use the correct rod.

Measure as follows:

- Fit the new clutch on the crankshaft.
- Fit the clutch control bowl in the gear-box.
- Fit the gearbox on the engine block.
- Fit the tool in the gearbox to determine the clutch control rod length.
- According to the value found, select the correct rod based on the following table:



#### **CLUTCH CONTROL ROD SELECTION**

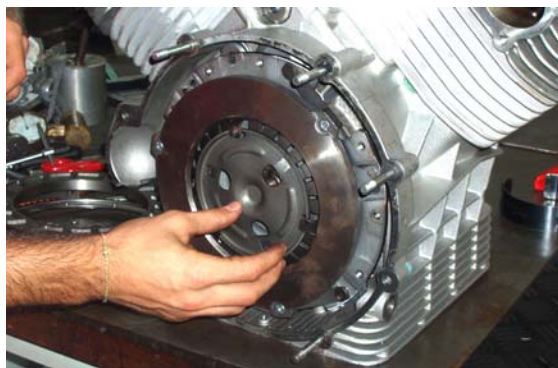
<b>Specification</b>	<b>Desc./Quantity</b>
Clutch control rod (code 976593)	183 mm (7.205 in)
Clutch control rod (code 976594)	184.5 mm (7.264 in)
Clutch control rod (code 976595)	186 mm (7.323 in)
Clutch control rod (code 976596)	187.5 mm (7.382 in)

### **Assembling the clutch**

- Lock crankshaft rotation with the crankpin facing upwards.
- Place the clutch disc with the reference facing upwards.
- Fasten the clutch disc on the crankshaft with the six screws, Loctite 243 and the Belleville springs.



- Place the clutch pressure plate.



- Lock the plate with a snap ring.
- Centre the plate.



- Place the friction disc; centre it.



- Place the clutch bell with the reference facing upwards.

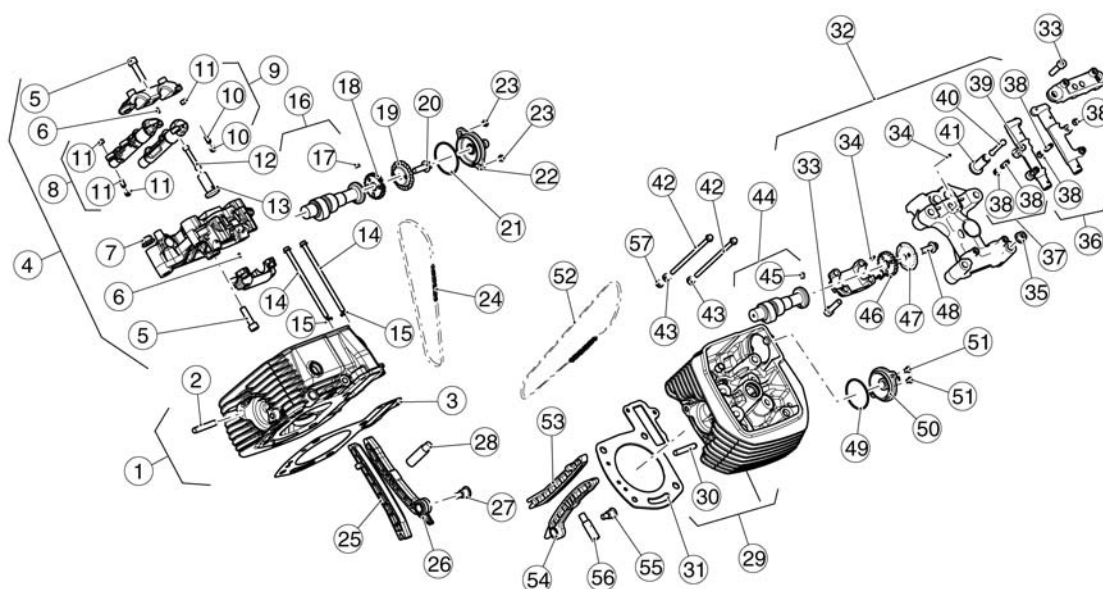


- Place the start-up crown gear with the reference facing upwards.

- Tighten the six screws to the prescribed torque operating diagonally and in stages.



## Head and timing



### Key:

1. Right cylinder head
2. Stud bolt
3. Cylinder head gasket
4. Right rocking lever support
5. Screw
6. Pin
7. Nut
8. Right exhaust, left intake rocking lever
9. Left exhaust, right intake rocking lever

10. Set screw
11. Nut
12. Rocking lever rod
13. Tappet bowl
14. Flanged screw
15. Spacer
16. Camshaft
17. Pin
18. Timing system gear
19. Breather plate
20. TE flanged screw
21. O-ring
22. Complete breather cover
23. TBEI screw
24. Timing system chain
25. Chain guide slider
26. Chain tensioner pad
27. Chain tensioner screw
28. Right chain tensioner
29. Left cylinder head
30. Stud bolt
31. Cylinder head gasket
32. Left rocking lever support
33. Screw
34. Pin
35. Nut
36. Right exhaust, left intake rocking lever
37. Left exhaust, right intake rocking lever
38. Set screw
39. Nut
40. Rocking lever rod
41. Tappet bowl
42. Flanged screw
43. Spacer
44. Camshaft

- 45.Pin
  - 46.Timing system gear
  - 47.Breather plate
  - 48.TE flanged screw
  - 49.O-ring
  - 50.Complete breather cover
  - 51.TBEI screw
  - 52.Timing system chain
  - 53.Chain guide slider
  - 54.Chain tensioner pad
  - 55.Chain tensioner screw
  - 56.Left chain tensioner
  - 57.Spacer
- 

## Removing the head cover

### NOTE

THE OPERATIONS DESCRIBED BELOW REFER TO REMOVING ONLY ONE HEAD BUT APPLY TO BOTH HEADS.

---

- Disconnect the spark plug tube.



- Undo and remove the four head cover fixing screws and collect the sealing O-rings.
- Remove the head cover together with the gasket.



## Removing the cylinder head

**CAUTION**

**WHEN REMOVING THE COMPONENTS, MARK THE POSITION OF EACH PART VERY CAREFULLY IN ORDER TO PLACE THEM IN THEIR ORIGINAL POSITION UPON FITTING.**

- Remove the head cover.
- Undo and remove the two screws
- Remove the cap.



- Undo and remove the screw.
- Remove the timing system upper gear bulkhead.



For the right head:

- Unscrew and remove the chain tensioner cap.
- Remove the right chain tensioner.



For the left head:

- Undo and remove the screw and the washer.
- Relief oil pressure from the left chain tensioner.

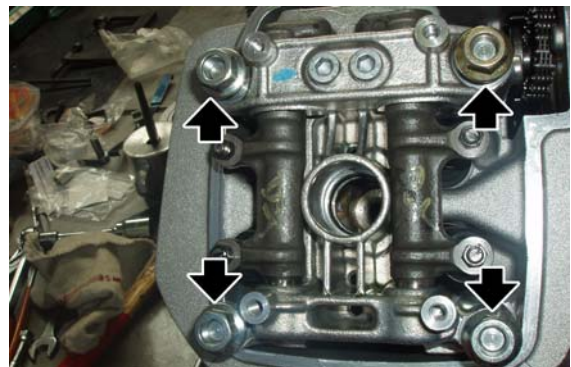




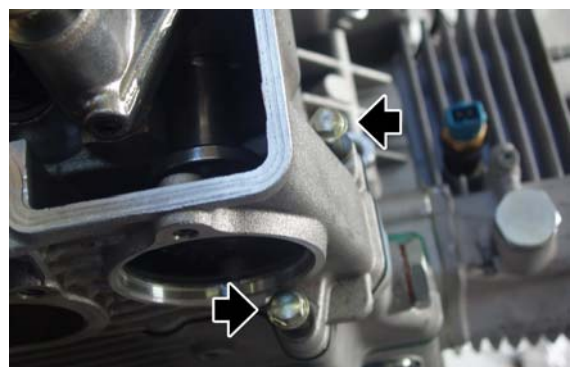
- Slide off the timing system gear from the chain to remove it from the camshaft.



- Unscrew and remove the four nuts on the stud bolts.
- Remove the complete cam cap.



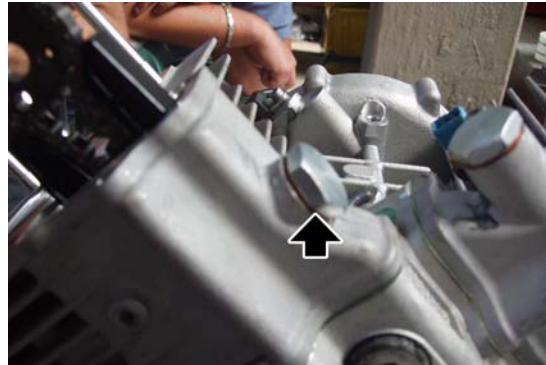
- Undo and remove the two screws.
- Remove the head.



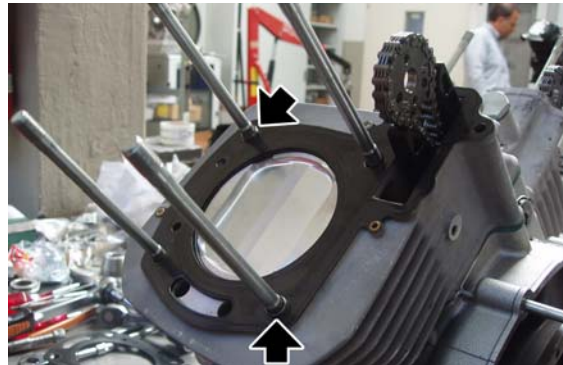
- Fit the timing system upper gear back to the chain.



- Fit the chain tensioner cap temporarily and keep the chain taut on the service shaft.



- Collect the two head dowel pins.
- Collect the gasket between the head and the cylinder.



See also

[Removing the head cover](#)

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## Cylinder head

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### Removing the overhead camshaft

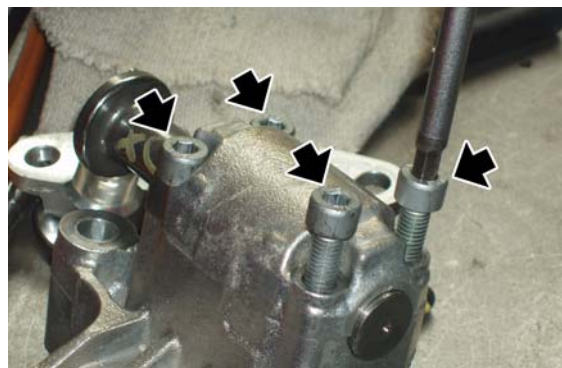
**CAUTION**

**WHEN REMOVING THE COMPONENTS, MARK THE POSITION OF EACH PART VERY CAREFULLY IN ORDER TO PLACE THEM IN THEIR ORIGINAL POSITION UPON FITTING.**

- Remove the two rocking levers from the cam cap.
- Remove the two rods.



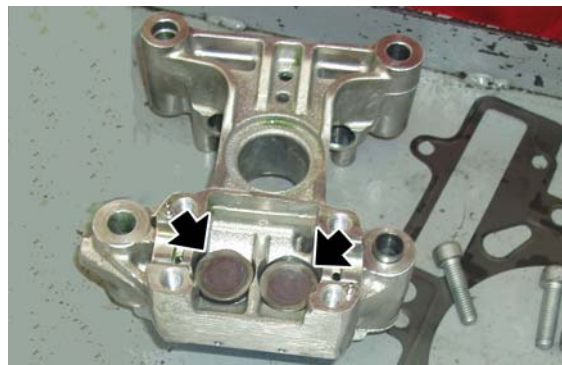
- Undo and remove the four screws.
- Remove the U-bolt.



- Remove the camshaft.



- Remove the bowls from the cam cap, and mark their position so as not interchange them when refitting.



#### See also

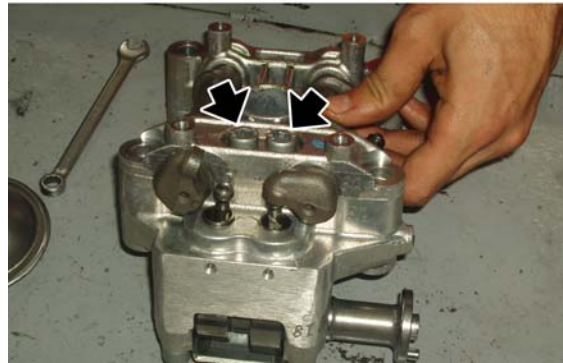
[Removing the rocker arms](#)

## Removing the rocker arms

### CAUTION

**WHEN REMOVING THE COMPONENTS, MARK THE POSITION OF EACH PART VERY CAREFULLY IN ORDER TO PLACE THEM IN THEIR ORIGINAL POSITION UPON FITTING.**

- Remove the cam cap from the stud bolts.
- Undo and remove the two screws.
- Remove the U-bolt.



- Remove the two rocking levers from the cam cap.



#### See also

[Removing the cylinder head](#)

## Removing the valves

- Remove the head.
- Place the special tool on the upper cap and at the centre of the head of the valve to be removed.

#### Specific tooling

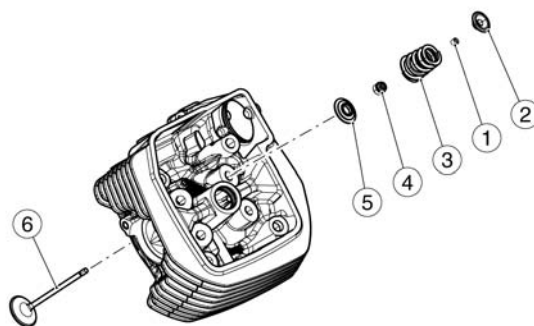
**10.90.72.00 Tool for valve removal and refitting**



- Tighten the tool screw until fitted, and then hit the tool head (where the upper cap works) with a mallet so that the two cotters (1) get detached from the upper cap (2).
- Once the two cotters (1) are detached,

screw these cotters until they can be slid off the valve seats; unscrew the tool and remove it from the head.

- Slide off the upper cap (2).
- Remove the spring (3).
- Remove the lower cap (5) and the valve guide oil seal (4), if necessary.
- Remove the valve (6) from inside the head.



## Checking the valve guides

Use a punch to extract the valve guides from the heads.

The valve guides should be replaced only if the clearance between them and the stem cannot be eliminated by simply replacing the valves.

To refit the valve guides on the head, follow this procedure:

- Heat the head in an oven at about 60°C (140°F).
- Lubricate the valve guide.
- Fit the circlips.
- Press the valve guide with a punch.
- Use a reamer to bore the holes the valve stems slide through so that the inside diameter is at the prescribed value. The interference between the seat on the head and the valve guide must be 0.046 - 0.075 mm (0.0018 - 0.0030 in)

### **VALVE GUIDE COUPLING - VALVES (INLET)**

Specification	Desc./Quantity
Valve guide inside diameter	5.0 ÷ 5.012 mm (0.19685 ÷ 0.19732 in)
Valve stem diameter	4.972 ÷ 4.987 mm (0.19574 ÷ 0.19633 in)
Fitting clearance	0.013 ÷ 0.040 mm (0.00051 ÷ 0.00157 in)

### **VALVE GUIDE COUPLING - VALVES (OUTLET)**

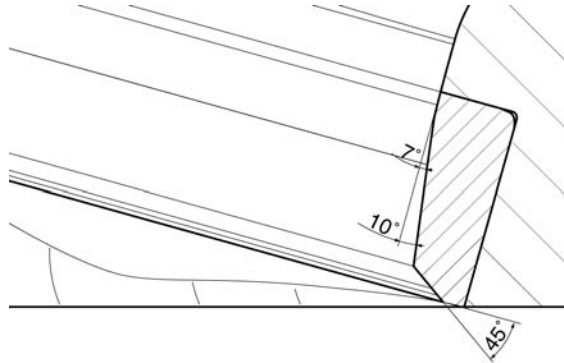
Specification	Desc./Quantity
Valve guide inside diameter	5.0 ÷ 5.012 mm (0.19685 ÷ 0.19732 in)
Valve stem diameter	4.960 ÷ 4.975 mm (0.19527 ÷ 0.19587 in)
Fitting clearance	0.025 ÷ 0.052 mm (0.00098 ÷ 0.00205 in)

## Checking the cylinder head

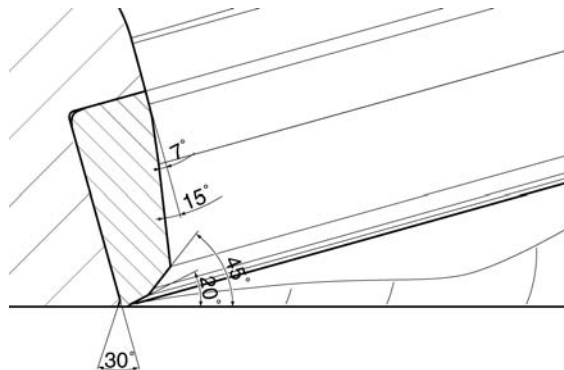
Check that:

- the faying surfaces with the cover and the cylinder are not scored or damaged, jeopardising a perfect sealing.
- Check that the tolerance between the valve guide holes and the valve stems is within the prescribed limits.
- Check the valve seats are in good conditions.

#### INLET VALVE SEAT DETAIL DRAWING



#### OUTLET VALVE SEAT DETAIL DRAWING



- If the width of the mark on the valve seat is larger than the prescribed limits, true the seats with a 45° mill and then grind.

- Replace the head in case of excessive wear or damage.

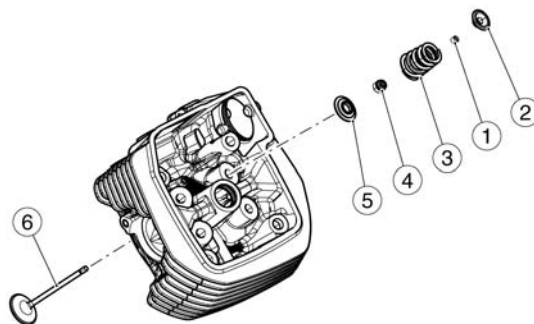
### Installing the valves

#### NOTE

**THE FOLLOWING OPERATIONS REFER TO REMOVING ONLY ONE HEAD BUT APPLY TO BOTH HEADS.**

- Place the valve guide oil seal (4) in the head.
- Place the lower cap (5).
- Place the valve (6) inside the head.

- Place the spring (3).
- Fit the upper cap (2).
- Place the two cotters (1) on the seats in the valves.
- By compressing the spring (3) with the special tool, fit the valve cotters.



### Specific tooling

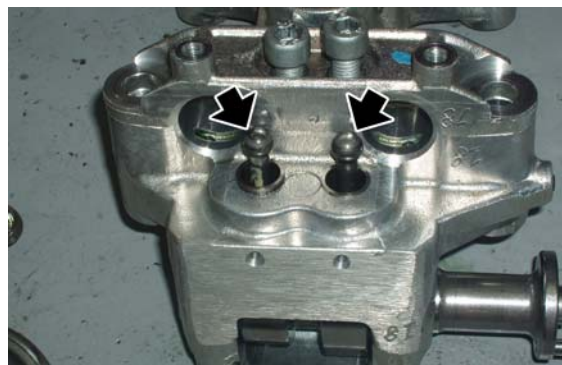
#### 10.90.72.00 Tool for valve removal and refitting

- Remove the special tool



### Installing the rocker arms

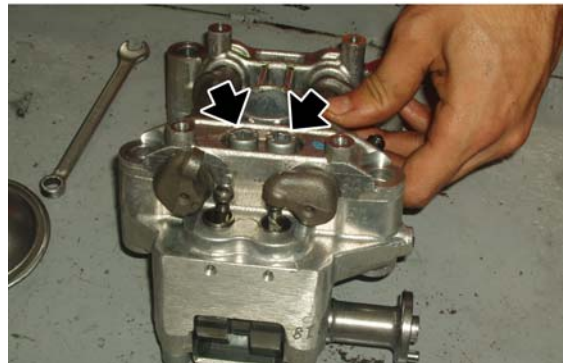
- Fit the camshaft.
- Fit the two rods.



- Place the two rocking levers in the cam cap seats.



- Place the U-bolt on the rocking levers making sure the two reference pins match the seats on the cam cap.
- Tighten the two screws operating diagonally and in stages.



#### See also

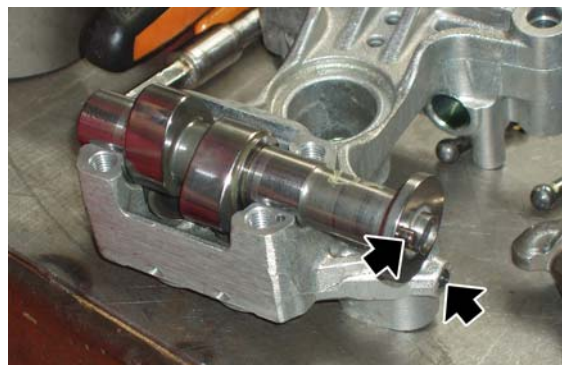
[Installing the overhead camshaft](#)

### Installing the overhead camshaft

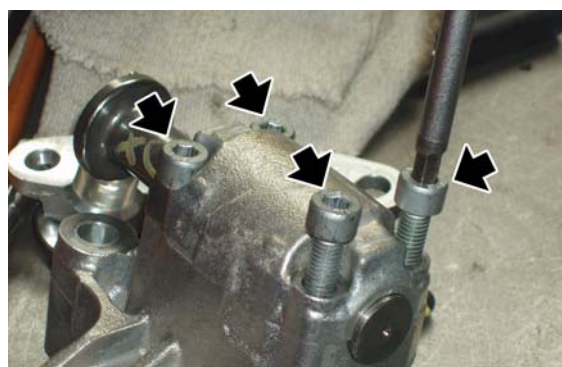
- Place the bowls in the cam cap, if those previously removed are refitted be careful not to interchange them.



- Place the camshaft with the gear seat on the dowel side.



- Place the U-bolt on the camshaft making sure the two reference pins match the seats on the cam cap.
- Tighten the four screws operating diagonally and in stages.



## Timing

### Removing the phonic wheel

- Remove the generator and the timing system cover.
- Unscrew and remove the nut and collect the washer.
- Remove the timing system gear on the service shaft.



- Remove the timing sensor and any shim washers.
- Remove the tone wheel.
- Remove the cotter and shim washer from the service shaft.



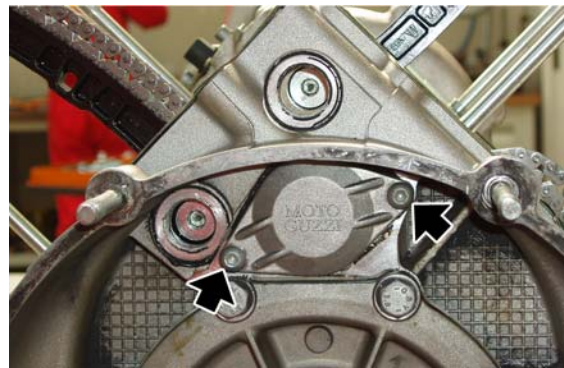
**See also**

[Removing the generator](#)

---

**Rimozione albero di servizio**

- Remove the tone wheel.
- Remove both cylinders.
- Undo and remove the two screws.
- Remove the service shaft closing cap.



- Mark the timing chains so as not to invert the direction of rotation upon fitting.
- Slide off the service shaft from the chains.
- Remove both chains.

**See also**

[Removing the phonic wheel](#)

---

**Installazione albero di servizio**

- Place the service shaft bearing (if previously removed) on the crankcase.

- Fix it to the seat with the lock washer and screw.



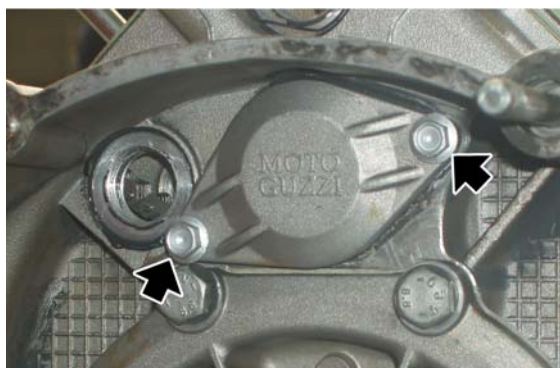
- Fit the timing chains according to the references marked at the removal phase.
- Lubricate the service shaft.
- Insert the service shaft in its crankcase seat by sliding it through the two chains.
- Fit each chain to the corresponding service shaft gear.



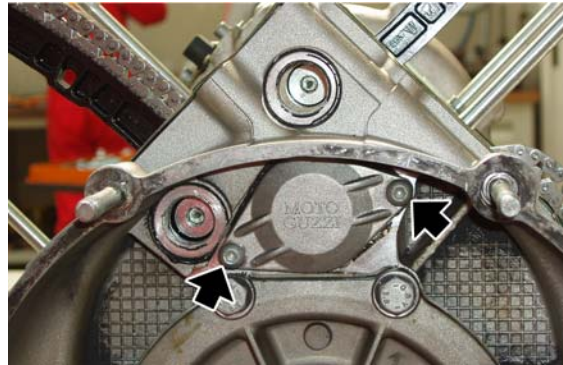
- Fit the roller cage and a new O-ring on the service shaft closing cap.



- Partially fit the service shaft closing cap.
- To screw the cap until it stops, use two M6 flanged screws larger than the original screws.
- Tighten the two M6 flanged screws operating in stages until the cap stops against the crankcase.



- Undo and remove the two M6 flanged screws.
- Tighten the cap with the two original TBEI screws.

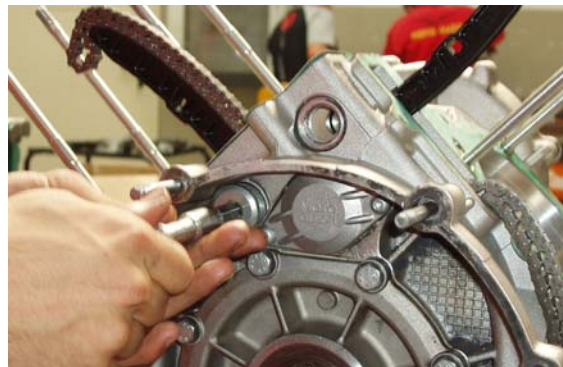


## Installing sliders

- Fit the crankshaft and the service shaft on the crankcase.
- Fit the fixed chain sliders and tighten the fixing screws.



- Tighten the chain caps with O-rings.
- The operations related to the movable chain sliders are described in the cylinder fitting section.



### See also

[Installing the crankshaft](#)

[Installazione albero di servizio](#)

## Cam timing

- Fit the crankshaft and the service shaft on the crankcase.
- Fit the cylinders.
- Turn the crankshaft until the left cylin-

der piston reaches the top dead centre (TDC).

- Fit the cotter and the shim washer on the service shaft.
- Fit the tone wheel with the chamfered side facing the crankcase on the service shaft.



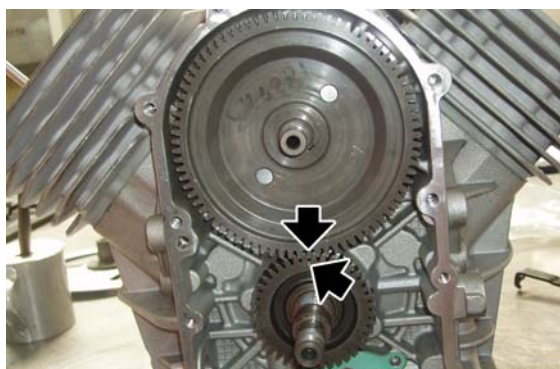
- Lock crankshaft rotation.
- Unscrew and remove the nut fixing the crankshaft gear.
- Remove the oil pump control gear.

### Specific tooling

#### 12.91.18.01 Tool to lock flywheel and start-up crown gear



- Fit the timing system gear and align the reference with that on the crankshaft gear. Turn the crankshaft to align the two gears.

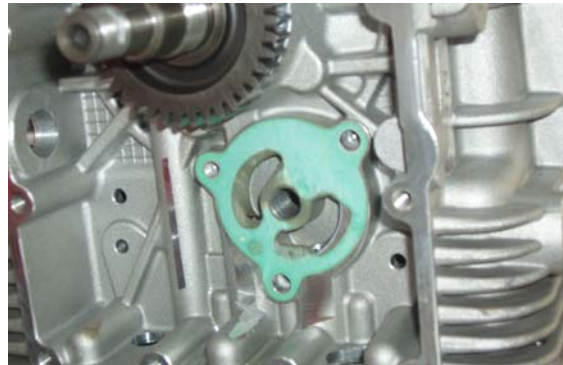


- After shimming the timing sensor properly, proceed to fit it.
- Fit the washer and tighten the timing

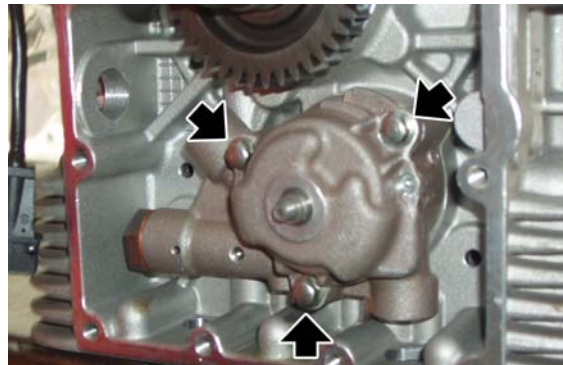
system gear fixing nut of the service shaft.



- Place a new gasket between the crankcase and the oil pump.



- Place the oil pump.
- Tighten the three screws fixing the oil pump.



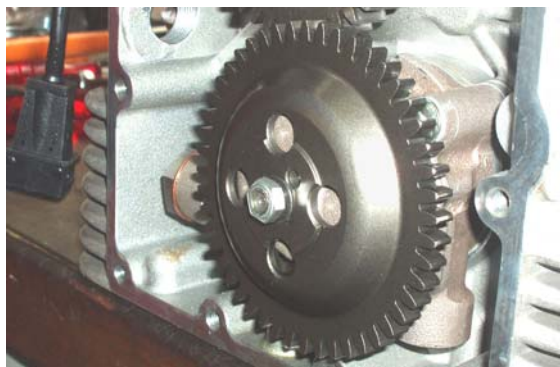
- Place the driving pin on the oil pump shaft.



- Place the gear on the oil pump shaft.



- Place the washer on the oil pump shaft.
- Tighten the nut to the specified torque.



- Place the oil pump control gear on the crankshaft and align its reference with that marked during the removal phase on the oil pump driven gear.
- Tighten the nut to the specified torque.



- Tighten the screw with the washer to the prescribed torque.



#### See also

[Installing the crankshaft](#)

[Installazione albero di servizio](#)

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## Measuring air gap

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### Measuring air gap

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- Undo and remove the two screws and remove the sensor.

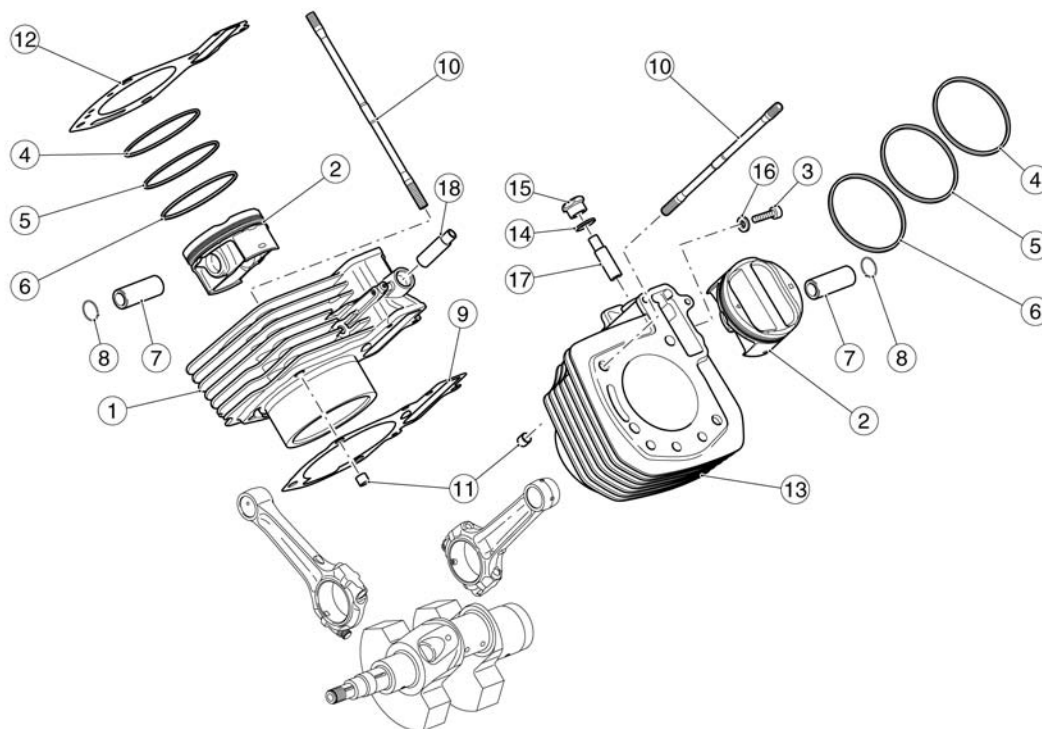


- Fit a suitable plain washer on the sensor and note its thickness.



- Place the sensor on the crankcase and move it until it makes contact with the tone wheel.
  - Measure the clearance between the fixing plate and the crankcase with a thickness gauge. Subtract the plain washer value from this measurement to obtain the clearance between the sensor and the tone wheel.
  - Remove the washer and fit the sensor after applying adequate sealing paste on the fixing plate, then tighten the screws to the prescribed torque.
-

## Cylinder-piston assembly



### Key:

1. Right cylinder
2. Piston
3. Screw
4. Top piston ring
5. Middle piston ring
6. Oil scraper piston ring
7. Pin
8. Snap ring
9. Cylinder base gasket
10. Stud bolt
11. Pin
12. Cylinder head gasket
13. Left cylinder
14. Washer
15. Chain tensioner cap
16. Washer
17. Left chain tensioner
18. Right chain tensioner



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## Removing the cylinder

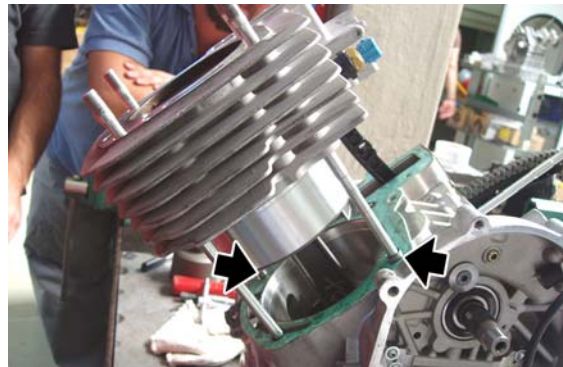
### NOTE

THE OPERATIONS DESCRIBED BELOW REFER TO REMOVING ONLY ONE HEAD BUT APPLY TO BOTH HEADS.

- Remove the head, the gasket between the head and the cylinder and the two dowel pins.
- Slide off the movable chain slider.
- Remove the cylinder from the stud bolts.



- Remove the two dowel pins on the stud bolts.
- Remove the two gaskets between the crankcase and the cylinder.
- Cover the crankcase opening with a clean cloth.



### See also

[Removing the cylinder head](#)

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## Disassembling the piston

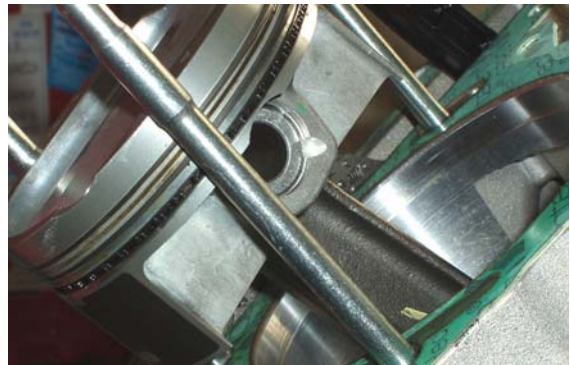
### NOTE

THE OPERATIONS DESCRIBED BELOW REFER TO REMOVING ONLY ONE HEAD BUT APPLY TO BOTH HEADS.

- Remove the cylinder.
- Cover the crankcase opening with a clean cloth.
- Disengage the pin clip.



- Remove the pin.
- Mark the piston crown on the outlet side to remember its position when re-fitting.
- Remove the piston.



## Fitting the piston

### NOTE

**THE OPERATIONS DESCRIBED BELOW REFER TO REMOVING ONLY ONE HEAD BUT APPLY TO BOTH HEADS.**

- The reference on the piston ring must be facing the piston crown.
- Fit the piston rings on the piston: - the oil scraper in the lower slot; - the thicker smooth ring in the intermediate slot; - the less thick smooth ring in the upper slot.
- The piston rings must be offset at 120° one from the other.
- Fit one of the two pin snap rings on the piston.
- Lock crankshaft rotation.



### Specific tooling

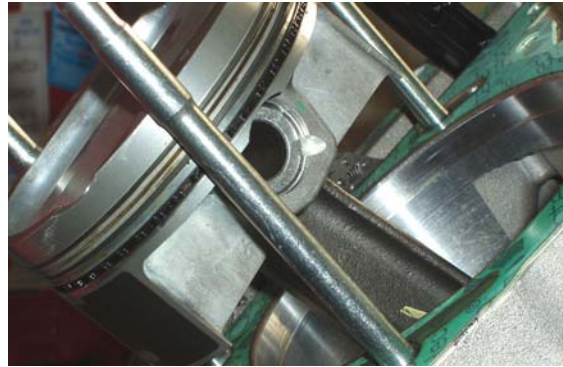
**12.91.18.01 Tool to lock flywheel and start-up crown gear**

- Fit the piston.

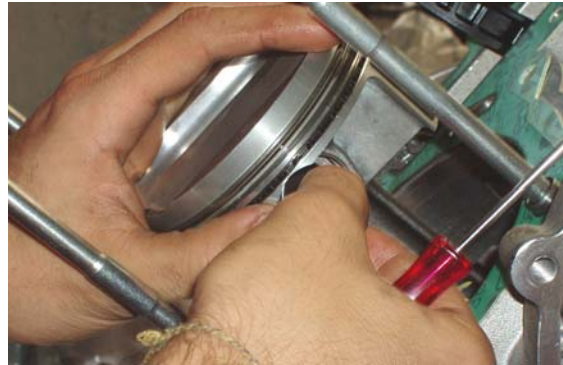
### NOTE

**CHECK THE PISTON DIRECTION ACCORDING TO THE REFERENCES MARKED ON THE PISTON CROWN. DO NOT ASSEMBLE PISTONS AND CYLINDERS OF DIFFERENT SELECTOR TYPES.**

- Insert the pin.



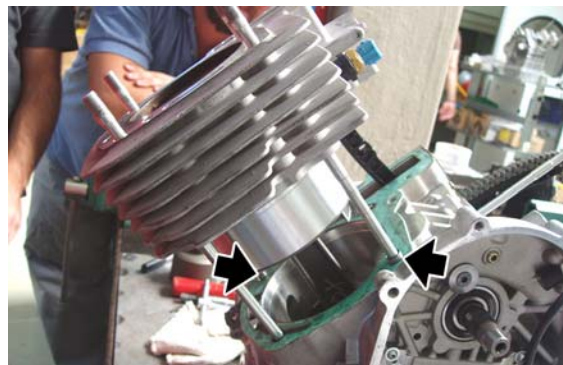
- Insert the pin clip.



## Installing the cylinder

### RIGHT CYLINDER

- Fit the piston.
- Remove the cloth used to prevent foreign bodies from getting into the crankcase.
- Turn the rings so that the coupling ends are 120 degrees from each other.
- Place a new metal gasket between the crankcase and the cylinder. Place the two dowel pins on the stud bolts. Lubricate the piston and the cylinder. Lock connecting rod motion with the fork tool. Using the suitable piston ring clamp tool, place the cylinder and fit the chain in the timing system plate.



**CAUTION**

**DURING THIS OPERATION, PAY ATTENTION NOT TO DAMAGE THE PISTON.**

**Specific tooling**

**05.92.80.30 Piston ring clamp**

**020716Y Connecting rod locking**

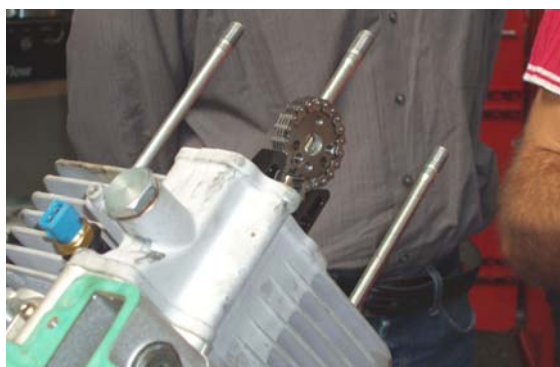
- Remove the piston ring clamp tool and finish positioning the cylinder.

**Specific tooling**

**05.92.80.30 Piston ring clamp**



- Fit the movable chain slider.
- Fit the upper gear.
- Fit the chain tensioner and the chain tensioner cap temporarily and keep the chain taut on the service shaft.

**LEFT CYLINDER**

- Fit the piston.
- Remove the cloth used to prevent foreign bodies from getting into the crankcase.
- Turn the rings so that the coupling ends are 120 degrees from each other.
- Place a new metal gasket between the crankcase and the cylinder.
- Place the two dowel pins on the stud bolts.



- 
- Undo the screw which will be used to time the upper gear.

- 
- Check that the oil in the left cylinder chain tensioner has been drained off by compressing it. If the operation is difficult, use a pin drive to push the central hole so that the oil is drained off from the circuit.



- 
- Fit the chain tensioner in the cylinder.
  - Lubricate the piston and the cylinder.
  - Lock connecting rod motion with the fork tool.
  - Using the suitable piston ring clamp tool, place the cylinder and fit the chain in the timing system plate.

**CAUTION**

**DURING THIS OPERATION, PAY ATTENTION NOT TO DAMAGE THE PISTON.**

**Specific tooling**

**05.92.80.30 Piston ring clamp**

**020716Y Connecting rod locking**



- 
- Fit the movable chain slider.
  - Fit the upper gear.
  - Fit the chain tensioner cap temporarily and keep the chain taut on the service

shaft.



## Installing the cylinder head

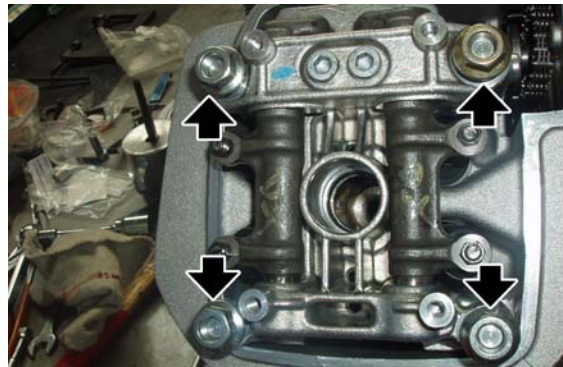
- Fit the valves in the head, if previously removed.
- Take the left cylinder piston to TDC and lock crankshaft rotation.
- Determine the thickness of the gasket to be fitted between the head and the cylinder as described in the section: Shimming system.
- Place the two dowel pins.
- Fit the gasket with the correct thickness between the head and the cylinder.
- Fit the left cylinder head.



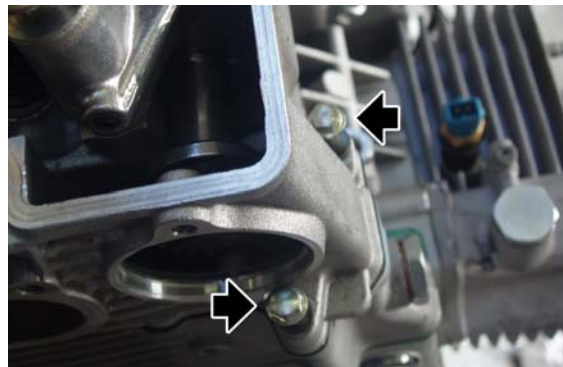
- Fit a new O-ring in the spark plug hole.
- Fit the complete cam cap.



- Fix the cam cap with the four nuts on the stud bolts.



- Fix the head with the two screws.
- Tighten nuts and screws to the prescribed torque operating diagonally and in stages.
- Loosen the valve set screws.



- Using a thin screwdriver relief oil pressure from the left cylinder chain tensioner.



- Screw two screws in the threaded holes of the timing system upper gear.
- Place the gear in the chain.
- On the left camshaft pin, fit the hole marked with the letter "L" of the timing system gear.



- Block the left chain tensioner hole with screw and washer.

- Rotate the crankshaft by 90° so that the right cylinder piston reaches the TDC; lock crankshaft rotation.
- Also determine the thickness of the gasket for the right cylinder, to be fitted between the head and the cylinder as described in the section: Shimming system.
- Place the two dowel pins.
- Fit the gasket with the correct thickness between the head and the cylinder.
- Fit the right cylinder head.



- Unscrew and remove the right chain tensioner cap.



- Screw two screws in the threaded holes of the timing system upper gear.
- Place the gear in the chain.
- On the right camshaft pin, fit the hole marked with the letter "R" of the timing system gear.



- Screw the cap of the right chain tensioner.
- Undo and remove the screws used to place the gear on the camshaft.
- Place the bulkhead and align the



holes with the timing system gear.

- Fix the bulkhead on the timing system gear using a screw with Loctite on the thread.
- Tighten the screw to the prescribed torque.
- Also place the bulkhead of the other head.



- Place the cap.
- Tighten the two screws to the prescribed torque.
- Also place the cap of the other head.
- Adjust valve clearance.



### See also

[Checking the valve clearance](#)

## Installing the head cover

- Replace the gasket and install the head cover.



- Place the plastic half-cover.
- Replace the four rubber rings.
- Tighten the four screws to the prescribed torque.



- Place the spark plug tube.



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## Crankcase - crankshaft

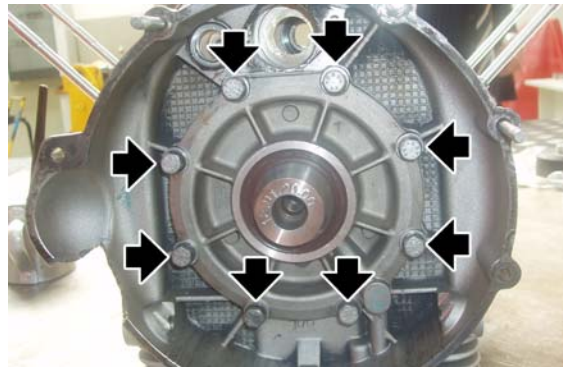
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### Removing the crankshaft

---

- Remove the clutch.
- Remove the tone wheel and the oil pump gear.
- Working from the generator side, unscrew and remove the nut.
- Remove both gears.
- Remove the connecting rods.
- Undo and remove the eight fixing screws and collect the washers.





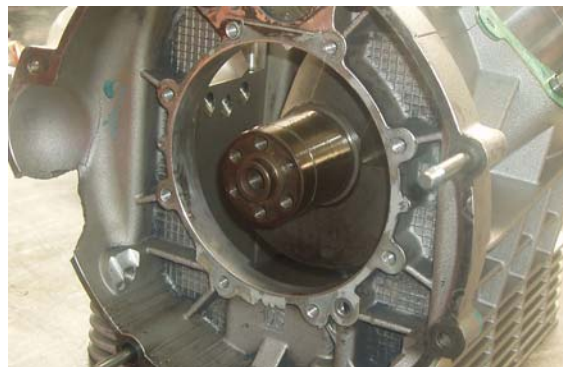
- Hold the crankshaft during flange removal.
- Using the suitable special tool, remove the crankshaft flange.
- Remove the sealing ring from the flange, if necessary.



### Specific tooling

#### 12.91.36.00 Tool to remove the flywheel-side flange

- Remove the crankshaft afterwards.



- Collect the shim washer from inside the crankcase.

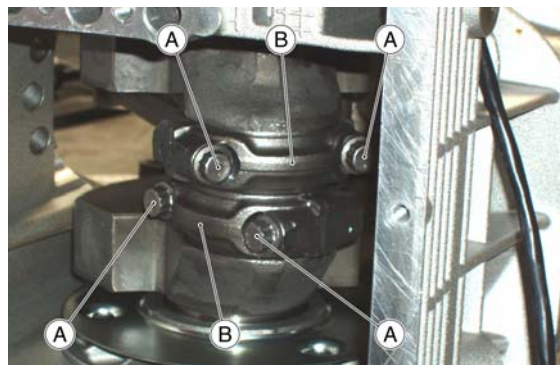


### See also

[Disassembling the clutch](#)  
[Removing the phonic wheel](#)

## Disassembling the connecting rod

- Remove both heads.
- Remove the cylinders and the pistons.
- Remove the oil sump.
- Undo the coupling screws (A) inside the crankcase and remove the connecting rods (B).



### See also

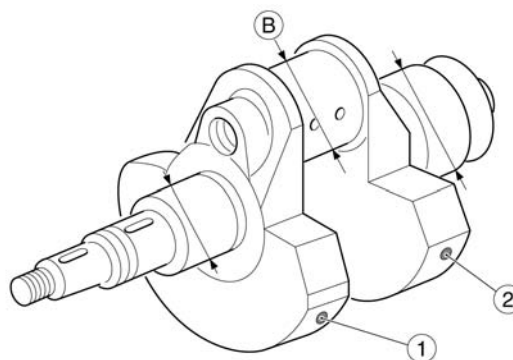
[Removing the flywheel](#)  
[Disassembling the piston](#)  
[Removing the cylinder](#)  
[Removing the cylinder head](#)

## Inspecting the crankshaft components

Check the surfaces of the main journals; if they are scored or oval-shaped, reface them (observing the undersize charts), and replace the main bushing/s.

Reference (1) indicates the position where the coloured reference is applied to select diameter (B).

Reference (2) indicates the position where the coloured reference is applied to select balancing.



### **CRANKSHAFT SEAT (TIMING SYSTEM SIDE)**

Specification	Desc./Quantity
Diameter of crankshaft main journal, timing system side	37.975 - 37.959 mm (1.49507 - 1.49444 in)
Inside diameter of crankshaft bushing, timing system side	38.016 - 38.0 mm (1.49669 - 1.49606 in)
Clearance between bushing and main journal (timing system side)	0.025 - 0.057 mm (0.00098 - 0.00224 in)

**CRANKSHAFT SEAT (CLUTCH SIDE)**

Specification	Desc./Quantity
Diameter of crankshaft main journal, clutch side	53.97 - 53.961 mm (2.12480 - 2.12444 in)
Inside diameter of crankshaft bushing on clutch-side flange	54.019 - 54.0 mm (2.12673 - 2.12598 in)
Clearance between bushing and main journal (clutch side)	0.030 - 0.058 mm (0.00118 - 0.00228 in)

**CRANKPIN DIAMETER (B)**

Specification	Desc./Quantity
'Blue' bushing half-shell regular production	44.008 ÷ 44.014 mm (1.73259 ÷ 1.73283 in)
'Red' bushing half-shell regular production	44.014 ÷ 44.020 mm (1.73283 ÷ 1.73307 in)

**BALANCING SELECTION COLOURS (2)**

Specification	Desc./Quantity
Crankshaft selection colour (2) brown	Type 1 to be used with brown connecting rods. Balance with a <b>1558 g (54.96 oz) +/- 0.25%</b> weight fitted on the crankpin (B). Maximum imbalance allowed for each shoulder: <b>2 g (0.07 oz)</b> .
Crankshaft selection colour (2) green	Type 2 to be used with green connecting rods. Balance with a <b>1575 g (55.56 oz) +/- 0.25%</b> weight fitted on the crankpin (B). Maximum imbalance allowed for each shoulder: <b>2 g (0.07 oz)</b> .
Crankshaft selection colour (2) black	Type 2 to be used with black connecting rods. Balance with a <b>1592 g (56.16 oz) +/- 0.25%</b> weight fitted on the crankpin (B). Maximum imbalance allowed for each shoulder: <b>2 g (0.07 oz)</b> .

**Checking the connecting rod**

When examining the connecting rods, check that:

- Bushing conditions and bushings-pins clearance;
- Shaft parallelism;
- Connecting rod bearings.

These are thin shell bearings, anti-friction alloy that does not allow for any adaptation; replace them immediately if seizing or wear marks are found.

Upon replacing the bearings it may be necessary to ream the crankshaft pin.

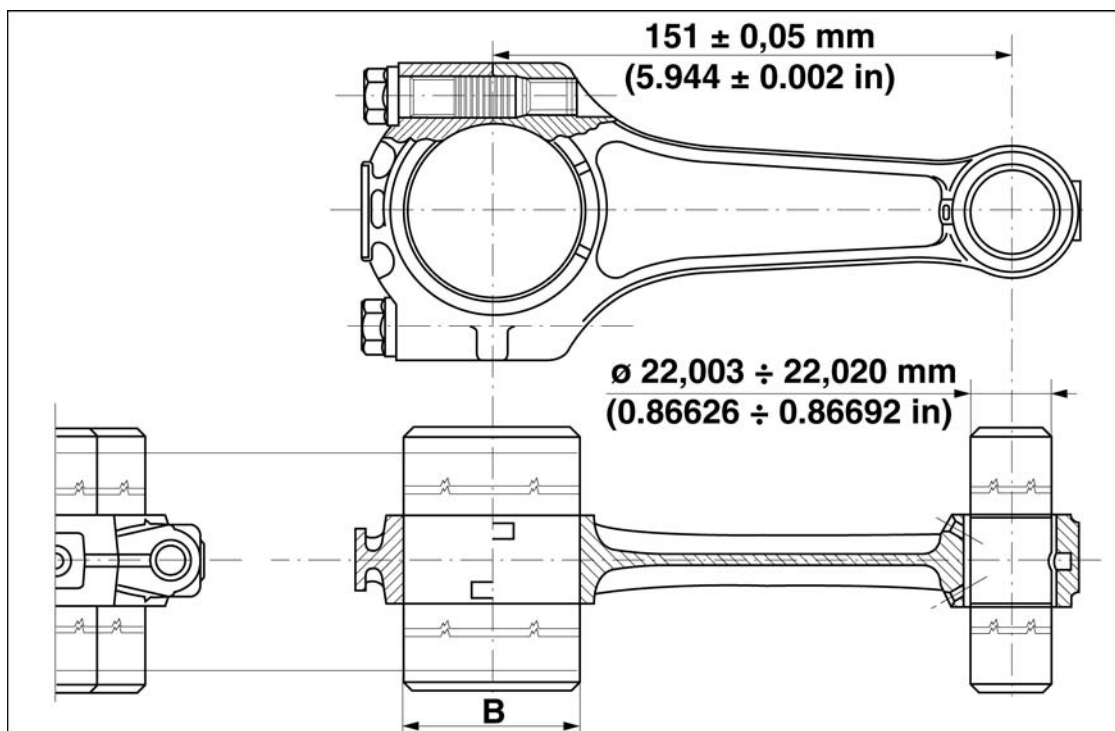
Before reaming the crankpin, measure the pin diameter (B) comparing it with the maximum wear allowed, as indicated in the figure; this defines what kind of undersizing the bearing should have and to which diameter the pin (B) should be reamed.

**Checking shaft parallelism**

Check shafts for squaring before fitting them.

It is therefore necessary to check that the head holes and the rod small end are parallel and on the same plane.

The maximum parallelism and plane error of the two head shafts and connecting rod small end should be +/- 0.10 mm (0.00393 inch).



### CONNECTING ROD BEARING THICKNESS

Specification	Desc./Quantity
Regular 'Blue' connecting rod bearing (production)	1.539 - 1.544 mm (0.06059 - 0.06079 in)
Regular 'Red' connecting rod bearing (production)	1.535 - 1.540 mm (0.06043 - 0.06063 in)

### CRANKPIN DIAMETER (B)

Specification	Desc./Quantity
'Blue' bushing half-shell regular production	44.008 ÷ 44.014 mm (1.73259 ÷ 1.73283 in)
'Red' bushing half-shell regular production	44.014 ÷ 44.020 mm (1.73283 ÷ 1.73307 in)

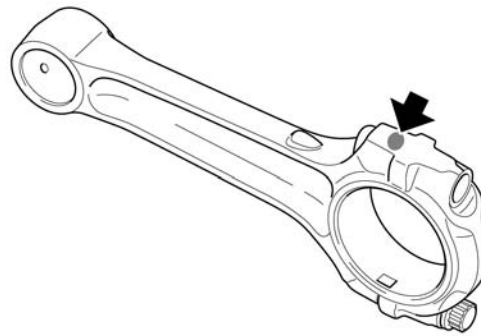
### PIN-BUSHING COUPLING DATA

Specification	Desc./Quantity
Fitted and machined bushing - inside $\varnothing$	22.003 - 22.020 mm (0.86626 - 0.86692 in)
Pin diameter	21.998 - 21.994 mm (0.86606 - 0.86590 in)
Clearance between pin and bushing	0.005 - 0.026 mm (0.000197 - 0.001024 in)

The connecting rods have a marked area for

weight selection.

The weight indicated in the chart includes screws, dowels and the bushing.

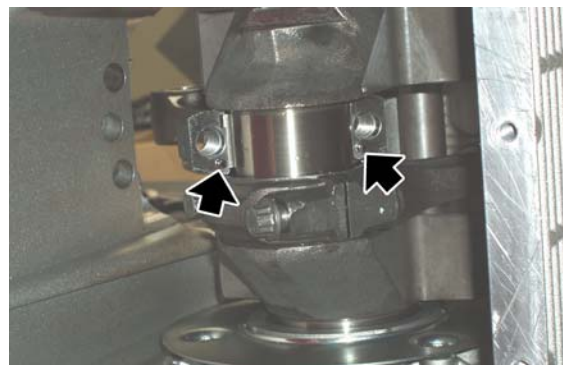


**CONNECTING ROD WEIGHT SELECTION**

Specification	Desc./Quantity
Connecting rod - brown	0.588 - 0.598 mm (0.02074 - 0.02109 in)
Connecting rod - green	0.598 - 0.608 mm (0.02109 - 0.02145 in)
Connecting rod - black	0.608 - 0.618 mm (0.02145 - 0.02180 in)

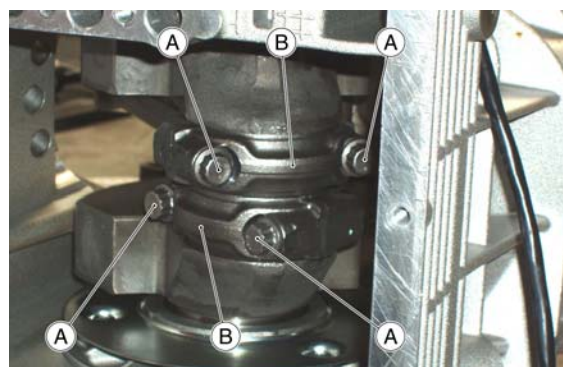
**Assembling the connecting rod**

- Lubricate the crankpin on which the connecting rods are to be fixed.
- If the connecting rods are not replaced, be careful not to interchange the right connecting rod with the left one and vice versa.



To place the connecting rods: the two pins must be facing the crankcase internal side.

- Place the connecting rods and the caps (B) on the crankshaft and fasten them with new screws (A).
- Remember these recommendations:



- The screws fixing the connecting rods to the crankshaft must be replaced with new ones at the following refitting as they are subject to high loads and stress;
- The fitting clearance between bearing and connecting rod pin is 0.028 mm (0.0011 inch)

minimum and 0.052 mm (0.0020 inch) maximum;

- The clearance between the shim washers of the connecting rod and those of the crankshaft is comprised between 0.30 mm (0.01181 in) and 0.50 mm (0.01968 in);
- Lock the screws (A) on the caps (B) with a torque wrench at the prescribed torque.



**PAY ATTENTION TO CRANKSHAFT ROTATION WHEN ONLY THE CONNECTING RODS ARE FITTED BECAUSE IT COULD HIT THE TWO LUBRICATION JETS INSIDE THE CRANKCASE.**

---

## Installing the crankshaft

- Fit the shim washer inside the crankcase with the chamfered side facing the generator side.



- Lubricate the crankshaft bushing on the crankcase, generator side.



- Use the sealing ring fitting tool on the flywheel-side flange to fit the sealing ring on the flange.

### Specific tooling

#### 19.92.71.00 Tool to fit the sealing ring on the flywheel-side flange

- Fit a new gasket between the crankcase and the crankshaft flange, flywheel side.
- 
- Fit the crankshaft on the crankcase,



flywheel side.

- Mark the crankshaft on the flywheel side with the crankpin facing upwards.
- Place the suitable sealing ring centring tool on the crankshaft.



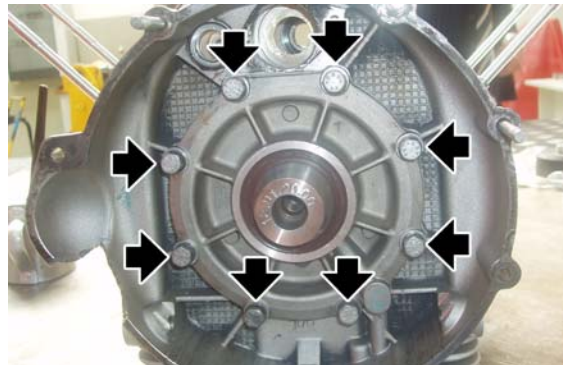
### Specific tooling

#### 12.91.20.00 Tool to fit the flywheel-side flange together with sealing ring on the crankshaft

- Place the flywheel-side flange on the crankshaft and check if the dowel pin with the O-ring is correctly placed.
- When fitting the flange on the crankcase, make sure that the three dowel pins match the seats on the crankcase.



- Apply Teflon tape on the two lower fixing screws at the back in order to prevent oil leaks.
- Screw the eight flange screws on the flywheel side proceeding diagonally.



- Remove the sealing ring centring tool from the crankshaft.

### Specific tooling

#### 12.91.20.00 Tool to fit the flywheel-side flange together with sealing ring on the crankshaft

- To avoid that the shim washer inside the crankcase moves out of its seat, fit the two gears and the nut on the crankshaft on the generator side.

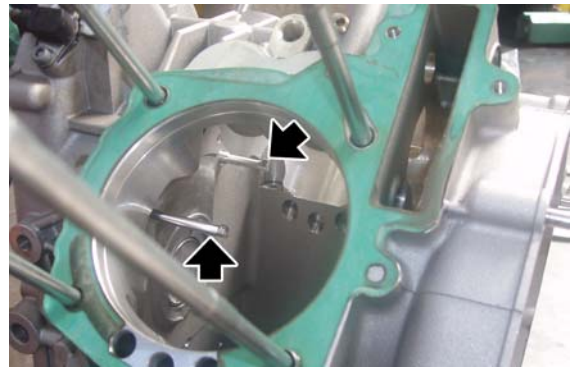


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### Refitting the crankcase halves

In case the lubrication jets are removed, replace them with two new of the same type. Check that the O-ring is fitted on the jets.

Do not interchange them upon refitting because they have a different length.

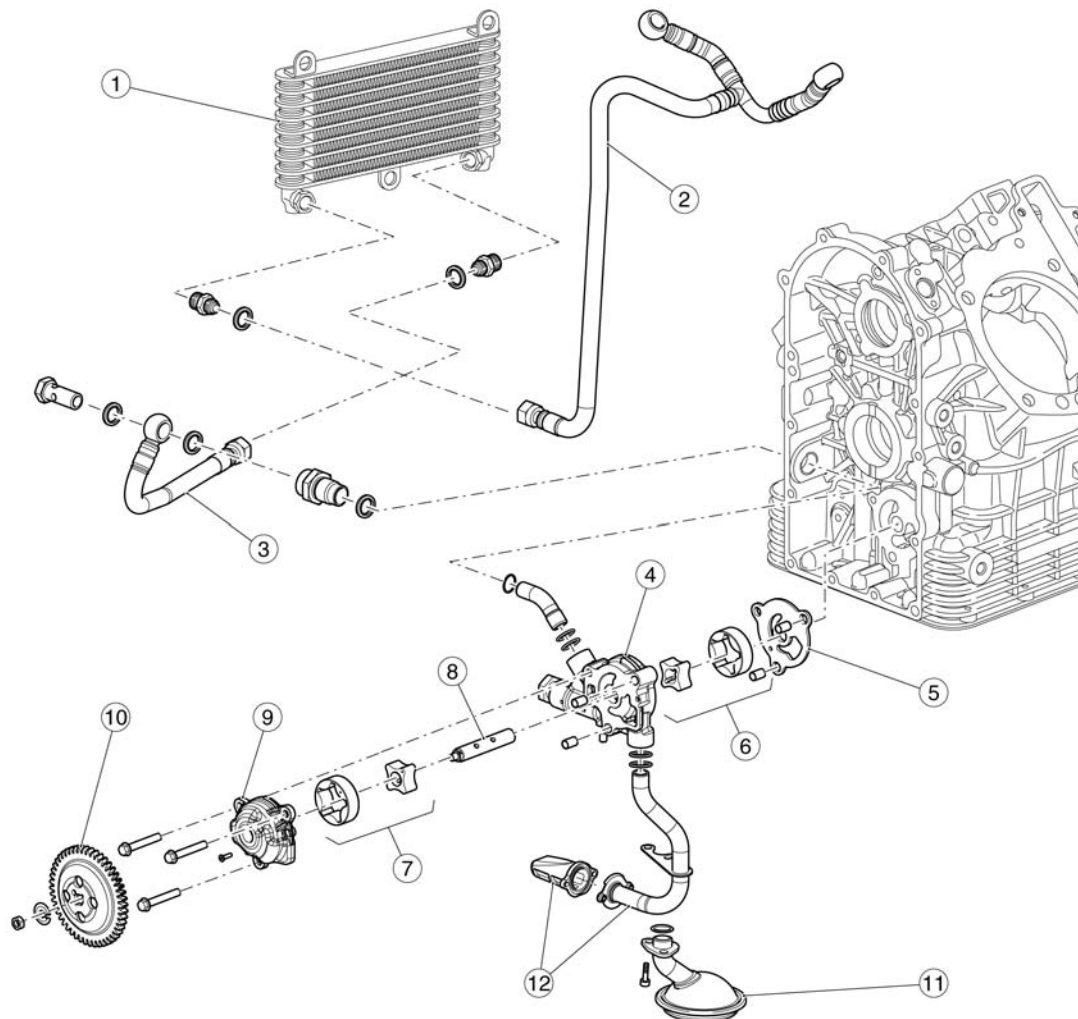


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### Lubrication

---

### Conceptual diagrams

**Key:**

1. Oil radiator
2. Oil delivery pipe to heads
3. Oil delivery pipe to radiator
4. Oil pump body
5. Oil pump gasket
6. Rotor for lubrication
7. Rotor for cooling
8. Rotor control shaft
9. Oil pump cover
10. Oil pump control gear
11. Lubrication oil intake filter
12. Cooling oil intake filter

The oil pump is operated by the gear (10) which receives the motion directly from the crankshaft. The gear (10) is mounted on the shaft (8), on which two rotors are fitted: one for engine cooling (7) and another for lubrication (6).

#### Cooling:

The rotor (7) takes in oil from the sump through the filter (12); the oil is sent to the radiator (1) through the hoses (3). Oil passes through the radiator (1) dispersing part of the heat and reaches the heads through the hoses (2). Oil goes down to the sump again and joins the oil used for lubrication.

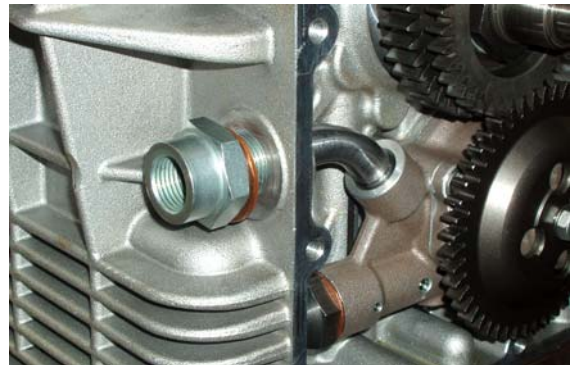
#### Lubrication:

The rotor (6) takes in oil from the sump through the filter (11); the oil is sent through special ducts in the crankcase to all the parts to be lubricated. Oil goes down to the sump again and joins the oil used for cooling.

## Oil pump

### Removing

- Drain off the engine oil.
- Remove the generator and the timing system cover.
- Unscrew and remove the nipple.
- Collect the gasket.



- Remove the nipple - oil pump fitting.



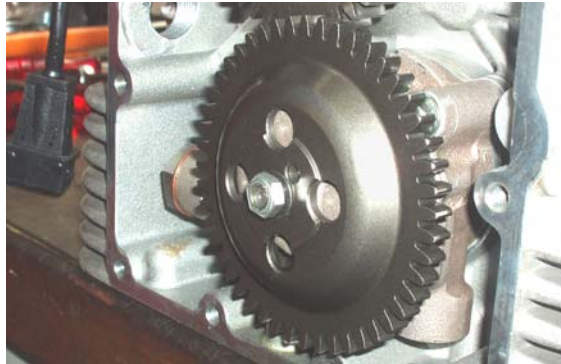
- Bring the left cylinder piston to the TDC in combustion phase.
- Mark a reference on the oil pump con-

control gear and another on the driven gear so as to place them correctly again upon refitting.

- Unscrew and remove the nut on the crankshaft.
- Remove the oil pump control gear.
- Screw the nut again so that the internal shim washer does not fall in the crankshaft crankcase.



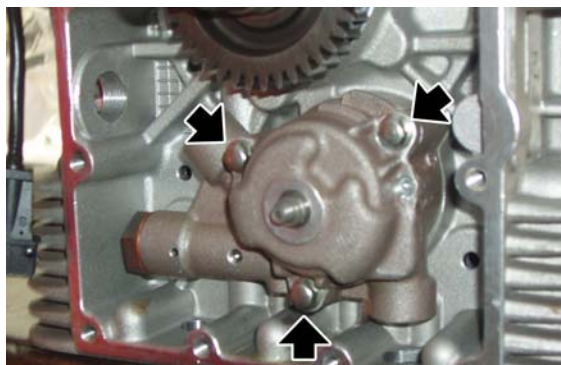
- Unscrew and remove the driven gear nut.
- Collect the washer.
- Remove the oil pump driven gear.



- Remove the driving pin.



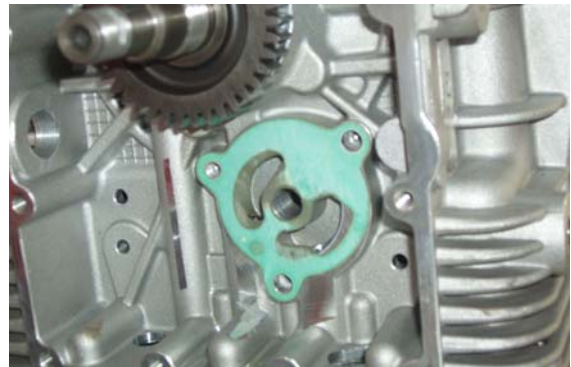
- Undo and remove the three screws.
- Remove the oil pump.



- Remove the gasket between the

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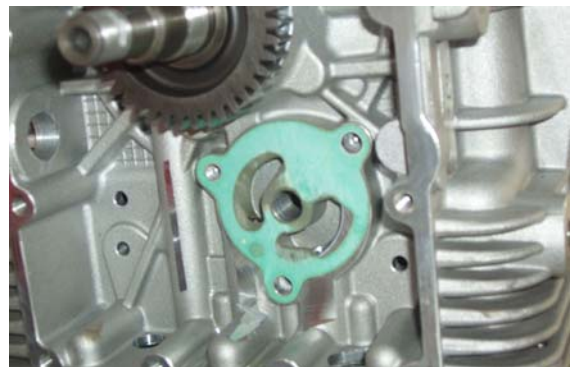
crankcase and the oil pump.

**See also**[Replacement](#)[Removing the generator](#)

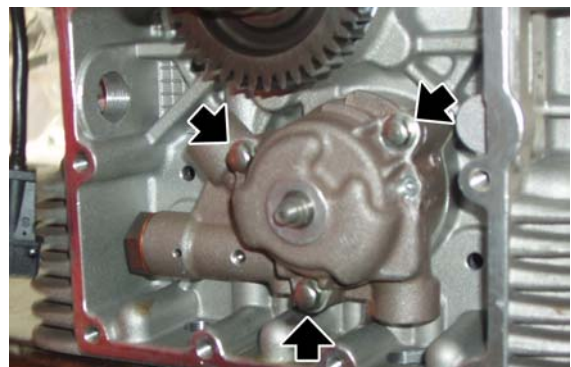
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**Installing**

- Place a new gasket between the crankcase and the oil pump.



- Place the oil pump.
- Tighten the three screws fixing the oil pump.



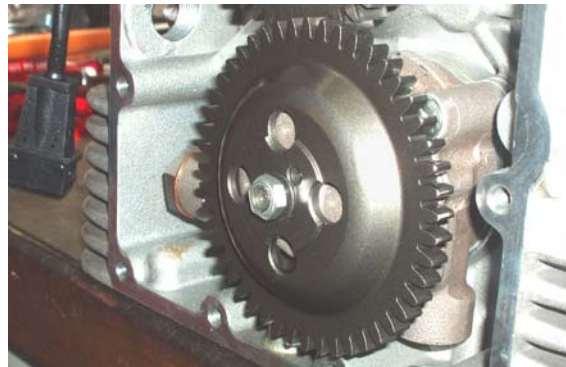
- Place the driving pin on the oil pump shaft.



- Place the gear on the oil pump shaft.



- Place the washer on the oil pump shaft.
- Tighten the nut to the specified torque.



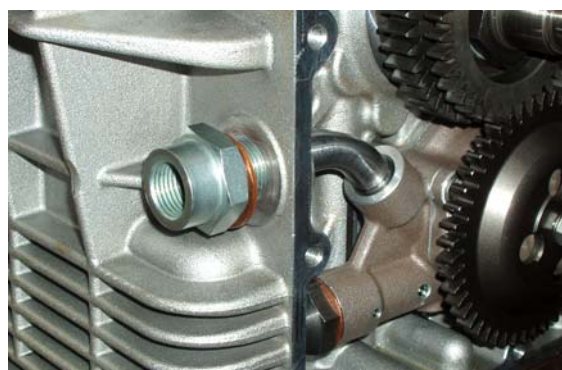
- Place the oil pump control gear on the crankshaft and align its reference with that marked during the removal phase on the oil pump driven gear.
- Tighten the nut to the specified torque.



- Insert the joint in the oil pump.



- Fit the nipple with the gasket on the crankcase.
- Tighten the nipple to the prescribed torque.



## Removing the oil sump

### NOTE

**TO REMOVE THE OIL SUMP, PLACE A SUITABLE CONTAINER UNDER IT TO COLLECT THE USED OIL AND DRAIN OUT ALL OIL.**

- If necessary, the filter can be removed with the suitable special tool.

### Specific tooling

#### 01.92.91.00 Wrench for removing the cover on sump and filter

- Unscrew and remove the oil level plug and collect the O-Ring.



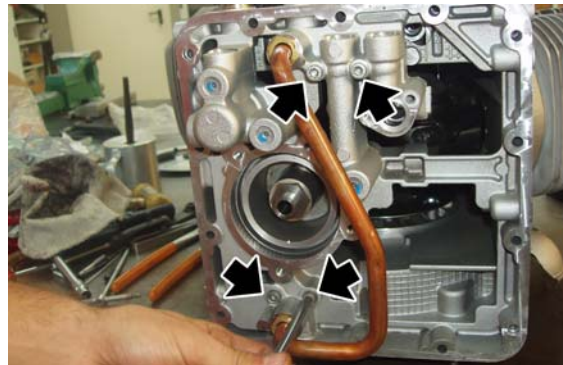
- Undo and remove the fourteen screws fixing the oil sump to the engine crank-



case.



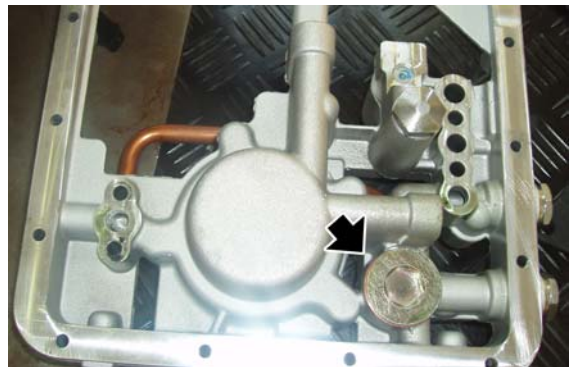
- Undo and remove the four screws.
- Remove the flange.



- Undo and remove the two screws.
- Remove both filters.



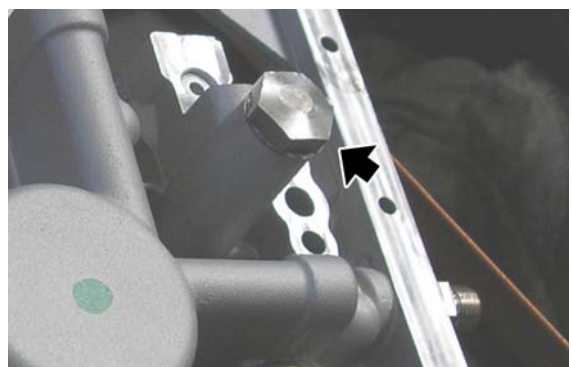
- Unscrew and remove the plug.



- Remove the thermostatic valve.



- Unscrew and remove the pressure relief valve plug.
- Remove the pressure relief valve components





## Refitting the oil sump

- Place the pressure relief valve components correctly.
- Screw the pressure relief valve plug.



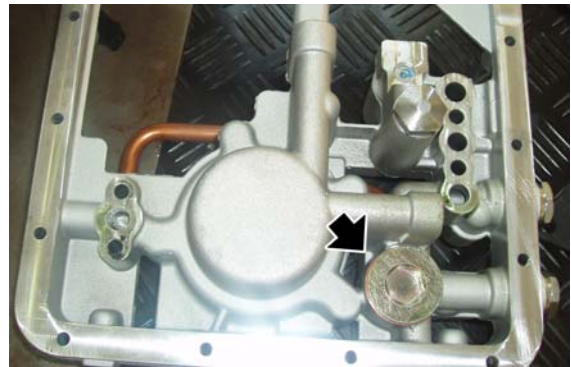
- Place the thermostatic valve.



**CHECK THAT THE ENGINE OIL PASSAGE HOLE IS NOT CLOGGED.**



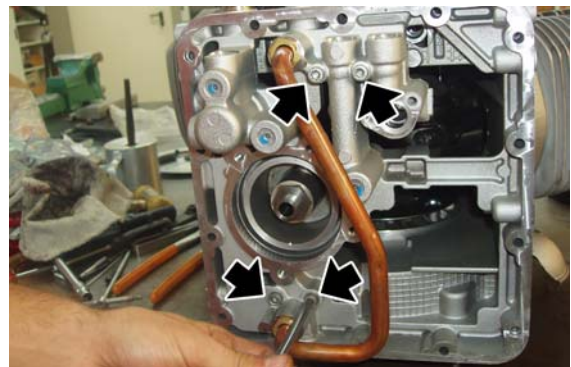
- Tighten the thermostatic valve plug.



- Place a new gasket between the crankcase and the flange.



- Fit the flange.
- Fix the flange with the four screws.



- Fit the lubrication oil intake filter.



- Check that the O-rings are fitted on the oil pump.

- Fit the cooling oil intake filter.



- Fix both filters and tighten the two screws to the prescribed torque.



- Fit a new oil filter and tighten it to the prescribed torque.



- Place a new gasket between the flange and the sump.



- Place the oil sump.
- Tighten the fourteen screws to the

prescribed torque.

- Add engine oil up to the correct level.

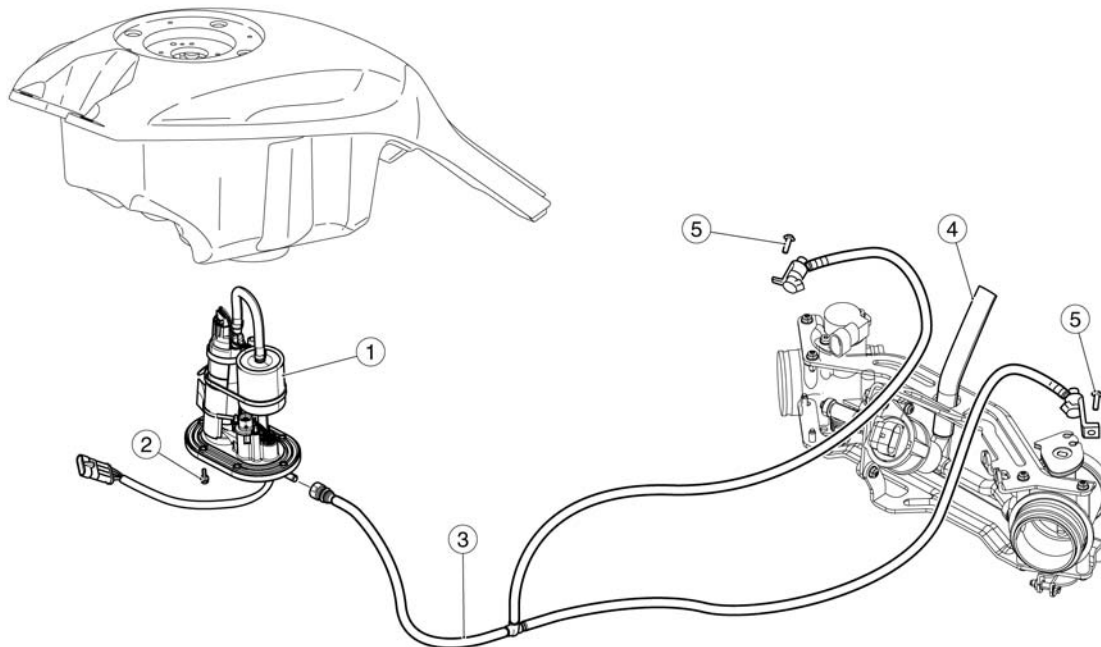


## INDEX OF TOPICS

POWER SUPPLY

P SUPP

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**Circuit diagram****Key:**

1. Complete fuel pump unit
2. Screw
3. Fuel pipe
4. Pipe
5. Screw

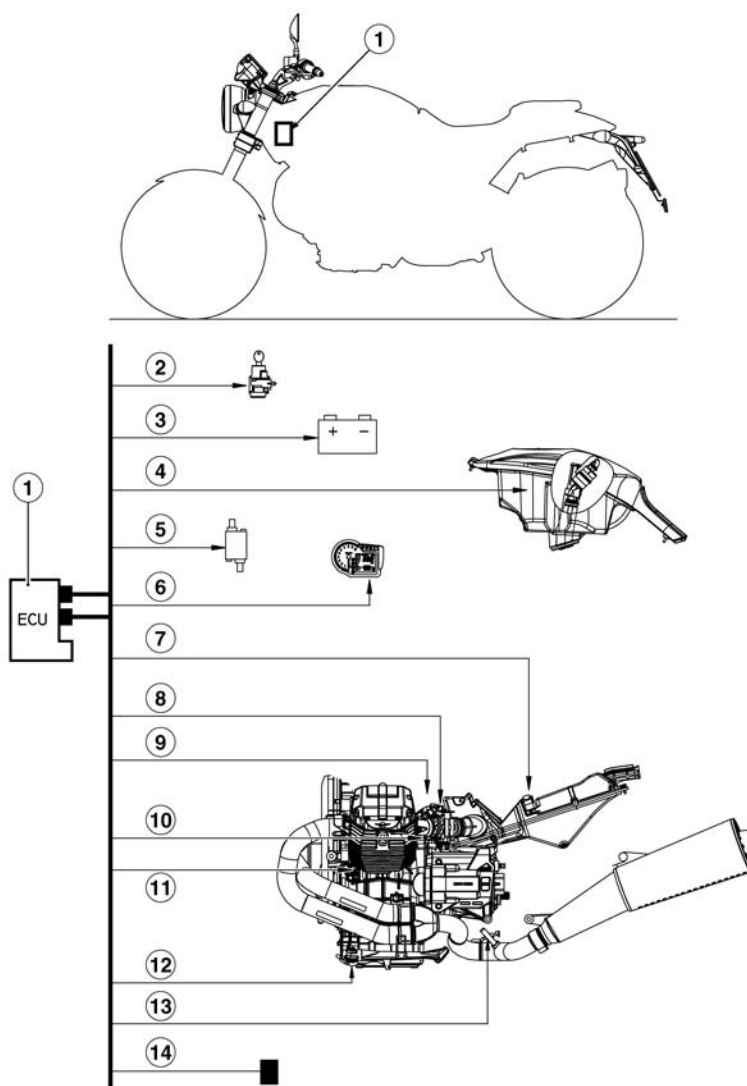
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**Injection**

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**Diagram**



**Key:**

- 1 Control unit
- 2 Ignition switch
- 3 Battery
- 4 Fuel pump
- 5 Coils
- 6 Instrument panel
- 7 Air temperature sensor
- 8. Throttle valve position sensor
- 9 Injectors
- 10 Engine temperature sensor
- 11 Crankshaft position sensor
- 12. Side stand

13 Lambda probe

14 Fall sensor

## Cylinders synchronisation

- With engine off, connect the Axone 2000 tool to the diagnosis connector and to the vehicle battery.



- Turn on the scanner.
- Screw the joints connecting the vacuumeter pipes on the inlet pipe holes.
- Connect the vacuumeter pipes to the relative joints.
- Set the key to ON.
- Make sure there are no errors in the control unit; otherwise, solve them and repeat the procedure.



- Make sure the left throttle is fully in.



**DO NOT TOUCH THE THROTTLE ABUTMENT SCREW OR THE THROTTLE BODY MUST BE REPLACED. CHECK THAT THE THROTTLE RETURN CABLE IS NOT TAUT.**



- The Axone should display the adjustable parameters screen.
- Autodetect the throttle position.

- Turn the key to "OFF" and leave it for at least 30 seconds.

- Turn the key back to "ON" and restore the Axone session.
- Check that the "Throttle" value reading is  $4.7 \pm 0.2^\circ$ . If the value is incorrect, replace the control unit and repeat the procedure from the start.
- Completely close the two by-pass screws on the throttle bodies.
- Start the engine.
- Take the engine to the prescribe temperature:  $60^\circ\text{C}$  ( $140^\circ\text{F}$ ).
- Make the engine rev at 2000/3000 rpm and with the vacuummeter check that the difference between the two pressures is maximum 1 cm Hg (1.33 kPa).



If this condition is detected:

- take the engine back to idle and check the depression values so that they are aligned between the two cylinders. Otherwise, open only the screw with higher depression, using the by-pass screws, to compensate.

If there is a larger difference:

- work on the set screw of the throttle body connecting rod to reduce the pressure difference in the two pipes.
- Repeat the procedure "Throttle position autodetection" as explained above.
- Bring the engine back to idle and check the depression values so that they are aligned between the two cylinders.



- Otherwise, open only the screw with higher depression, using the by-pass screws, to compensate.

## Recovery function

If the signal of the following sensors is interrupted, the control unit determines some values to keep the engine running or it uses a different parameter. The instrument panel and the Axone also signal the problem.

### RECOVERY FUNCTION

Specification	Desc./Quantity
air temperature	25 °C (77 °F)
engine temperature	30 °C (86 °F) with linear increase from the air temperature at ignition
barometric pressure	1010 hPa
throttle valve potentiometer	2.9° at idle, otherwise variable.
idle motor	fixed value variable depending on the vehicle

## Using axone for injection system

### Injection

### Iso screen page

#### ISO

This display shows general data regarding the control unit, for example software type, mapping, control unit programming date



### ISO SCREEN PAGE

Specification	Desc./Quantity
Mapping	-

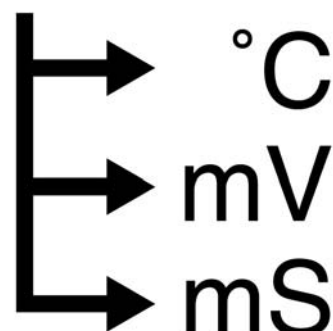
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**Engine parameter reading screen page**


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**ENGINE PARAMETER READING**

This display shows the parameters measured by the several sensors (engine revs, engine temperature, etc.) or values set by the control unit (injection time, ignition advance, etc.)

**ENGINE PARAMETER READING SCREEN PAGE**

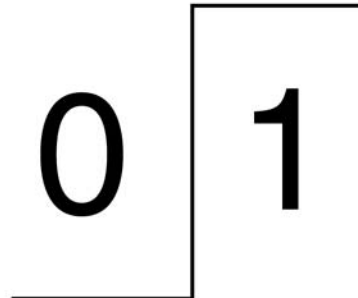
Specification	Desc./Quantity
Engine rpm	Engine revolutions per minute: the minimum value is set by the control unit cannot be adjusted
Injection time	- ms
Ignition advance	- °
Air temperature	°C Temperature of the air taken in by the engine, measured by the sensor in the filter casing. This is not the temperature indicated by the instrument panel
Engine temperature	°C
Battery voltage	V
Throttle	Value corresponding to the throttle when closed (approximate value between 4.5 and 4.9°) (left throttle supported by the end of stroke screw). If a different value is read, it is necessary to activate the parameter "Throttle positioner autodetection" and obtain this value.
Atmospheric pressure	1015 mPa (approximate values) The sensor is inside the instrument panel
Lambda probe	100 - 900 mV (approximate values) Signal when energised that the control unit receives from the lambda probe: inversely proportional to the presence of oxygen
Lambda integrator	When the control unit uses the lambda probe signal (see the 'Lambda' parameter on the 'Device status' display) this value should be close to 0%
Vehicle speed	- km/h
Target engine revs	1150 rpm (approximate values) Parameter valid at idle, setting depends espe-

Specification	Desc./Quantity
	cially on the engine temperature: the control unit will try to keep the engine running at this revs, acting on the ignition advance and the Stepper motor
Stepper base	70 - 100 (approximate values) Steps corresponding to the Stepper motor reference position
CL Stepper	70 - 150 (approximate values) Steps set by the control unit for the Stepper motor. At idle, steps so that the engine keeps the target engine revs set by the control unit
Stepper regulator	Difference between current steps of motor at idle and those at the reference position
Virtual throttle angle from Stepper	0° With engine not at idle speed, this value indicates the throttle degrees corresponding to the Stepper motor air flow

### Device status screen page

#### DEVICE STATUS

This screen page shows the status (ON/OFF only) of the vehicle devices or the operation condition of some vehicle systems (for example, lambda probe functioning status)



#### DEVICE STATUS

Specification	Desc./Quantity
Engine status	ON/run/power-latch/stopped operation conditions
Throttle position	Released / pressed indicates if the throttle potentiometer is open or closed
Stand	Retracted / expanded indicates the position of the side stand (only with gear engaged)
IGNITION	Enabled / disabled indicates if the control unit consents engine start-up

Specification	Desc./Quantity
RUN / STOP switch	Run / stop indicates the position of the safety switch
Clutch	No / Yes indicates the clutch sensor status
Gear engaged	No / Yes indicates the gear sensor status
Fall sensor	Normal / Tip over indicates the vehicle fall sensor status
Lambda	Open loop / Closed loop Indicates if the control unit is using (CLOSED) the lambda probe signal to keep the stoichiometric combustion. At idle CLOSED only if: Air T over 20°C (68°F) and engine T over 30°C (86°F) and engine on for at least 2-3 minutes
Synchronisation	Synchronised / Not synchronised Indicates if the control unit detects the revolution sensor signal correctly

## Devices activation screen page

### DEVICES ACTIVATION

This displays is used to delete errors in the control unit memory and activate some systems controlled by the control unit



### DEVICES ACTIVATION

Specification	Desc./Quantity
Left coil	operation for 2.5 m, 5 times
Right coil	operation for 2.5 m, 5 times
Left injector	Operation for 4 m, 5 times
Right injector	Operation for 4 m, 5 times
Error clearing	By pressing the 'enter' button, the stored errors (MEM) become part of the historical data (STO). In the next connection between the Axone and the control unit, the historical errors (STO) are no longer shown
Fuel pump	Operation for 30"

Specification	Desc./Quantity
Stepper control	For 4", advancement control of 32 steps; for the next 4", retrocession control of 32 steps and so on for 30"

## Errors display screen page

### ERRORS DISPLAY

This screen page shows potential errors detected in the vehicle (ATT) or stored in the control unit (MEM) and it is possible to check error deletion (STO)



### ERRORS DISPLAY

Specification	Desc./Quantity
Pressure sensor	Possible short circuit in the earth lead, battery or open circuit: recovery function noticeable for customer. Careful with the air pressure sensor in the instrument panel
Air temperature	Possible short circuit in the earth lead, battery or open circuit: recovery function hardly noticeable for customer.
Engine temperature	Possible short circuit in the earth lead, battery or open circuit: recovery function.
Throttle actuator position sensor	Possible short circuit in the earth lead, battery or open circuit: recovery function noticeable for customer.
Lambda probe	Possible short circuit on the earth lead, battery or open circuit or plausibility: recovery function hardly noticeable for customer.
Left injector	Possible short circuit in the earth lead, battery or open circuit. If both injectors do not work, the engine does not work
Right injector	Possible short circuit in the earth lead, battery or open circuit. If both injectors do not work, the engine does not work
Fuel pump relay	Possible short circuit in the earth lead, battery or open circuit: the engine does not start.
Left coil	Possible short circuit in the earth lead, battery or

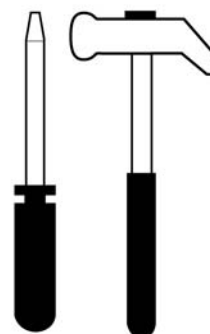


Specification	Desc./Quantity
	open circuit. If both coils do not work, the engine does not work.
Right coil	Possible short circuit in the earth lead, battery or open circuit. If both coils do not work, the engine does not work.
Idle regulator	Possible short circuit in the earth lead, battery or open circuit: recovery function noticeable for the customer due to no idle management
Battery voltage	Battery voltage detected is too low (7V) or too high (16V) for a certain period
Starter diagnosis	Possible short circuit in the earth lead, battery or open circuit.
Engine revolution sensor	Possible open circuit.
Lambda heater	Possible short circuit in the earth lead, battery or lambda probe heating circuit open.
SPEED SENSOR	Possible short circuit in the earth lead, battery or speed sensor circuit open: also possible lack of supply from the control unit
CAN line diagnosis	Possible error on the CAN line: short circuit or line break or no signal or plausibility error detected.
RAM memory	Possible internal control unit error. Also check the control unit supply and earth connections
ROM memory	Possible internal control unit error. Also check the control unit supply and earth connections
Microprocessor	Possible internal control unit error. Also check the control unit supply and earth connections
Checksum EPROM	Possible internal control unit error. Also check the control unit supply and earth connections

## Adjustable parameters screen page

### ADJUSTABLE PARAMETERS

This screen page is used to adjust some control unit parameters



### ADJUSTABLE PARAMETERS

Specification	Desc./Quantity
Throttle positioner autodetection	Allows the control unit to detect the closed throttle position: just press the enter button

---

## INDEX OF TOPICS

**SUSPENSIONS**

**SUSP**

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## Front

---

### Removing the front wheel

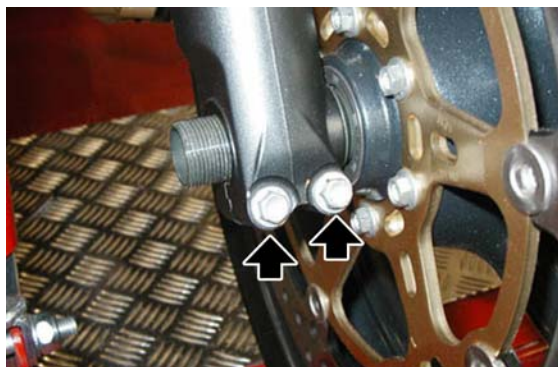
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- Working from both sides, undo and remove the two fixing screws from the front brake callipers and remove them from their seats.

- Support the front part of the vehicle.
- Unscrew and remove the nut fixing the wheel bolt and collect the sealing ring.



- Working from both sides, loosen the screws on the wheel bolt clamps.



- Hit the wheel pin slightly with a rubber hammer so that the hole on the opposite side is exposed.



- Take out the wheel bolt by inserting a

screwdriver in the bolt holes.

- Upon extracting the wheel, hold it and then remove it.

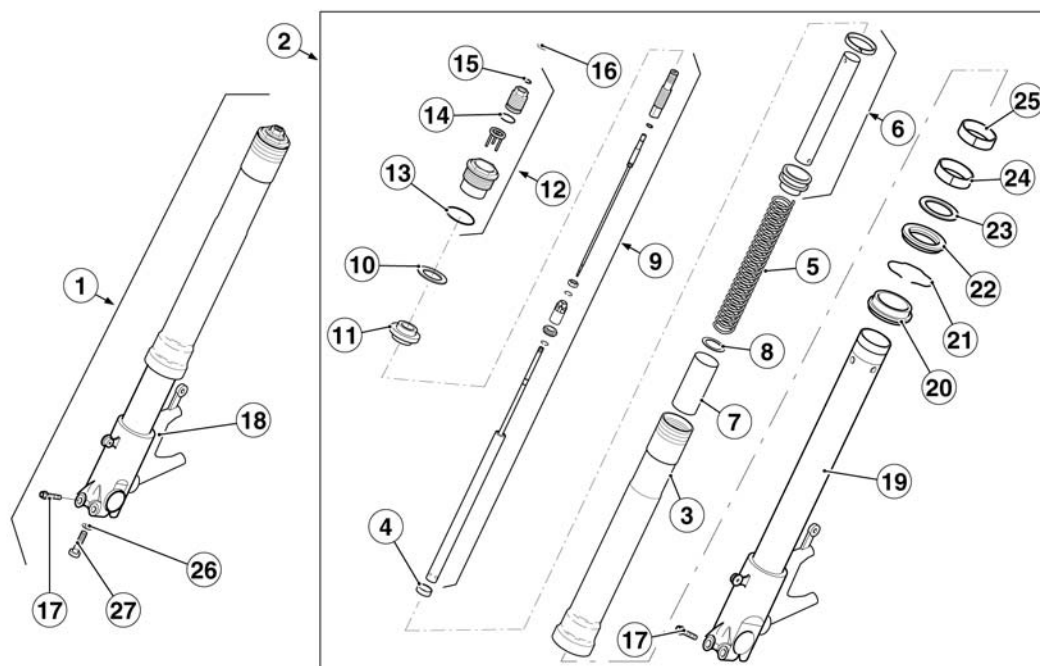


- Collect the spacer from the front wheel right side.



## Front fork

### Diagram



**Key:**

1. Radial fork right stem
2. Radial fork left stem
3. Sleeve
4. Pumping member attachment bushing
5. Spring
6. Complete preloading pipe
7. Spacer
8. Washer
9. Complete pumping element
10. Washer
11. Ring
12. Complete sleeve cap
13. O-ring
14. O-ring
15. O-ring
16. Snap ring
17. TE flanged screw M8x40
18. Stem + right wheel holder
19. Stem + left wheel holder
20. Dust guard
21. Seeger ring
22. Oil seal
23. Ring
24. Bushing
25. Sliding bushing
26. Special washer
27. screws M10x1.5

---

**Adjustment**

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The standard front fork setting is adjusted to suit most low and high speed riding conditions, whether the vehicle is partially or fully loaded. This setting can also be customised based on vehicle

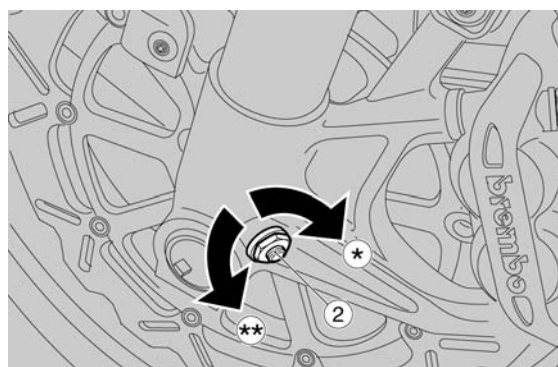
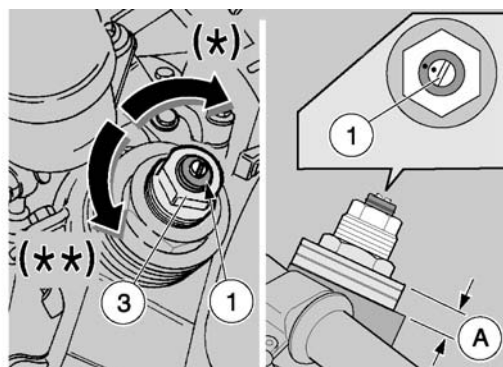
use.

**CAUTION**

**SPORTS SETTING MAY BE USED ONLY FOR OFFICIAL COMPETITIONS TO BE CARRIED OUT ON TRACKS, AWAY FROM NORMAL ROAD TRAFFIC AND WITH THE AUTHORISATION OF THE RELEVANT AUTHORITIES. IT IS STRICTLY FORBIDDEN TO USE SPORT SETTINGS AND RIDE THE VEHICLE SO SET ON ROADS AND MOTORWAYS.**



**FOR ADJUSTMENT, ALWAYS START FROM THE MOST RIGID SETTING (SET SCREWS (1 - 2) FULLY CLOCKWISE). USE THE NOTCHES ON SET SCREWS (1 - 2) AS REFERENCES TO ADJUST HYDRAULIC COMPRESSION AND REBOUND DAMPING. TURN THE SET SCREWS (1 - 2) GRADUALLY BY 1/8 OF A TURN AT A TIME.**



**FRONT FORK ADJUSTMENT**

Specification	Desc./Quantity
Standard rebound damping adjustment, screw (1)	open (**) 1,5 click from fully closed (*)
Hydraulic rebound damping adjustment for sports use, screw (1)	Open (**) 0.5 - 1 turn from fully closed (*)
Standard compression damping adjustment, screw (2)	open (**) 1 click with fully closed (*)
Hydraulic compression damping adjustment for sports use, screw (2)	Open (**) 0.5 - 1 turn from fully closed (*)
Spring preloading, nut (3)	Open (**) 4 - 5 protrusion notches from fully closed (*)
Stems (A) protrusion from top plate (excluding cover) (standard adjustment)	4 protrusion notches Take your vehicle only to a <b>Moto Guzzi</b> Official Dealer for this type of adjustment.
Stems (A) protrusion from top plate (excluding cover) (sports use adjustment)	5 protrusion notches Take your vehicle only to a <b>Moto Guzzi</b> Official Dealer for this type of adjustment.

(\*) = clockwise

(\*\*) = anticlockwise

**Removing the fork legs**

- Remove the front mudguard.
- Support the fork stem and loosen the screws on the upper and lower plates.
- Slide off the fork stem.



#### See also

[Removing the front wheel](#)

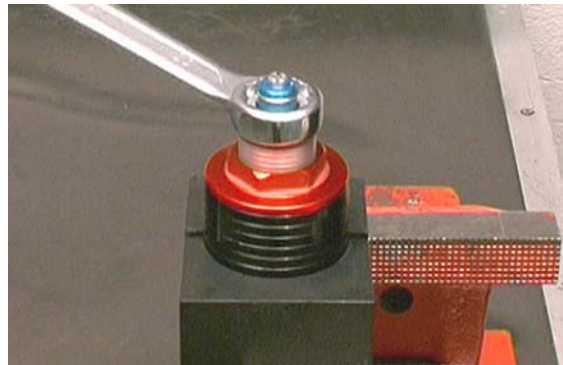
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## Draining oil

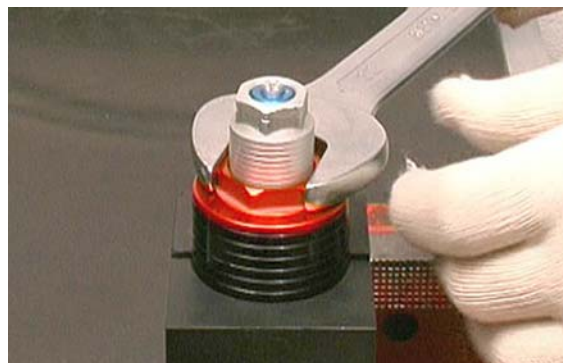
- Lock the sleeve in a vice with the specific tool (code AP8140149).
- Set the minimum spring preloading.

#### Specific tooling

**AP8140149 Protection for fitting operations**



- Unscrew the sleeve upper cap.





- Lock the fork end in a vice paying attention not to damage it.



- Fit the tool on the spring joint.

### Specific tooling

#### AP8140147 Spacer tool



- Push the tool against the spring and compress it. Fit the spacer of the tool under the cartridge lock nut.

### Specific tooling

#### AP8140148 Spacer-pumping element separating plate



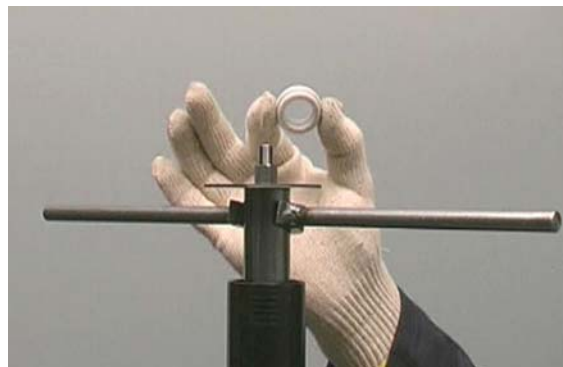
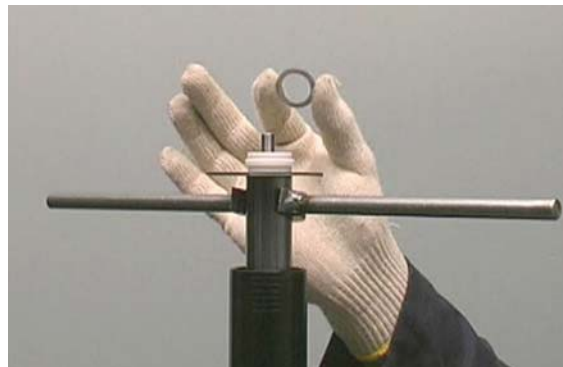
- Loosen the cap acting on the wrench slot and making the lock nut turn.



- Remove the whole cap.



- Detach the spacer and the washer.
- Press down the spring and slide off the spacer.



- Slide off the spring joint.



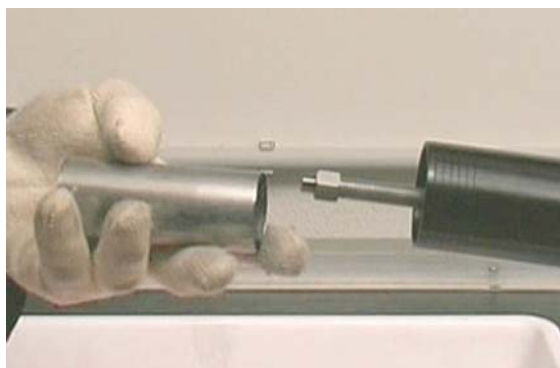
- Empty the oil into a container and remove the spring.



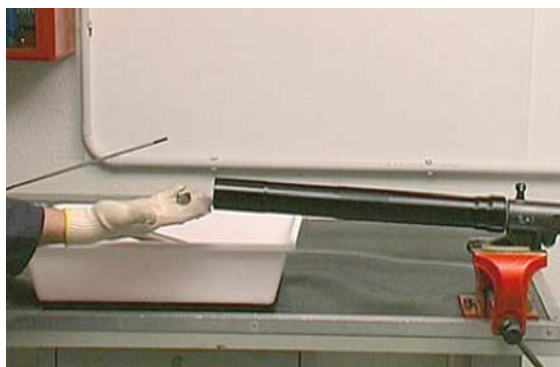
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### Disassembling the fork

- After emptying the oil, fasten the fork stem end in a vice.
- Take out the washer and the lower spacer.



- 
- Undo the screw fixing the cartridge on the fork end.
  - Collect the centring bushing.



- 
- Slide off the dust scraper from the

sleeve using a screwdriver as a lever.

- Do not damage the sleeve edge while doing this.



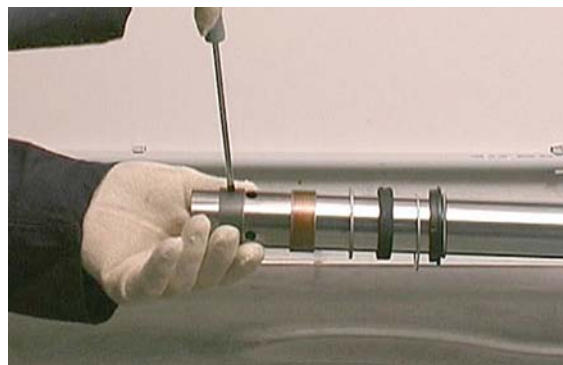
- Remove the snap ring.



- Take out the sleeve from the stem using the stem as a hammer puller.



- From the stem remove the fixed fitted bushing, the movable bushing, the ring and the oil seal.





- Remove the ring and the dust guard.



**See also**

[Draining oil](#)

---

## Checking the components

---

**Stem**

Check the sliding surface for scorings and/or scratches.

These scorings can be eliminated by rubbing them with wet sandpaper (grain 1).

If the scorings are deep, replace the stem.

Use a dial gauge to check that the stem bending is below the limit value.

If over the value, replace the stem.

**CAUTION**

**A BENT STEM SHOULD NEVER BE STRAIGHTENED BECAUSE ITS STRUCTURE WOULD BE WEAKENED AND USING THE VEHICLE MAY BECOME DANGEROUS.**

**Characteristic****Bending limit:**

0.2 mm (0.00787 in)

**Sleeve**

Check that there are no damages and/or cracks; otherwise, replace it.

**Spring**

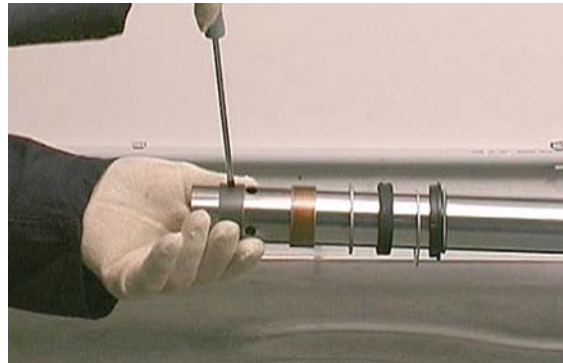
Check that the spring is in good conditions. Check that the spring length is within the limit value.

Replace the spring if its length does not fall within the limit values.

**SPRING MINIMUM LENGTH WHEN UNLOADED: 284 mm (11.2 in)**

Check that the following components are in good conditions:

- sliding bushing;
- guide bushing;
- pumping member.



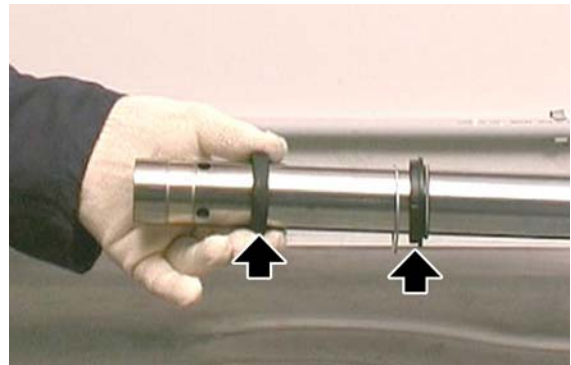
If there are signs of excessive wear or damage, replace the affected component.

**CAUTION**

**REMOVE ANY IMPURITY IN THE BUSHINGS, TAKING CARE NOT TO SCRATCH THEIR SURFACE.**

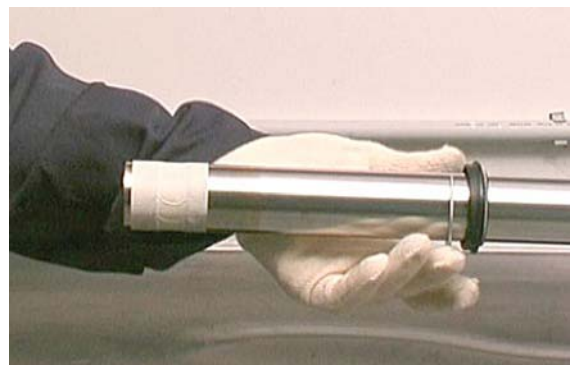
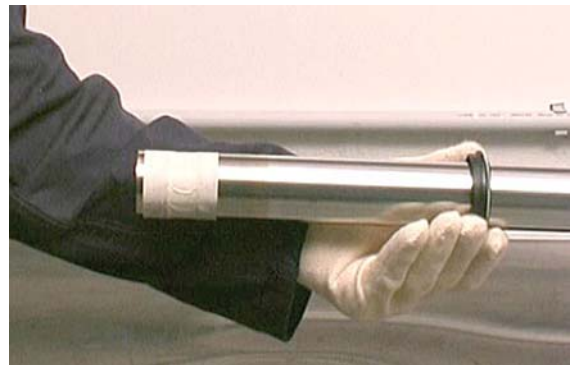
Replace the following components with new ones:

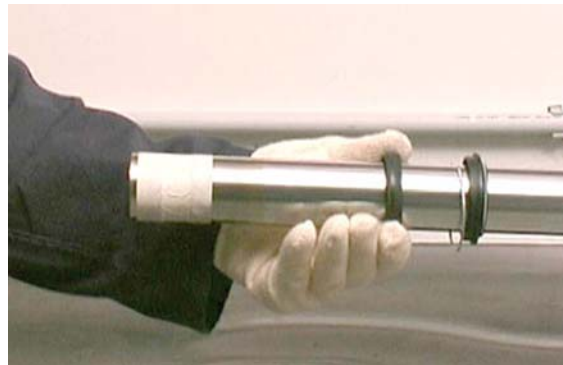
- gasket;
- dust guard gasket;
- the two O-rings on the regulator.



### Reassembling the fork

- Lock the stem in a vice without damaging the surfaces.
- Protect the bearing tube end with adhesive tape.
- Lubricate the sliding edges with fork oil or with seal grease.
- Fit the dust scraper, the snap ring and the sealing ring on the slider.

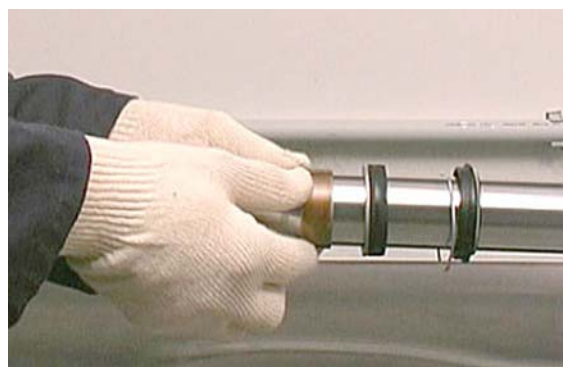




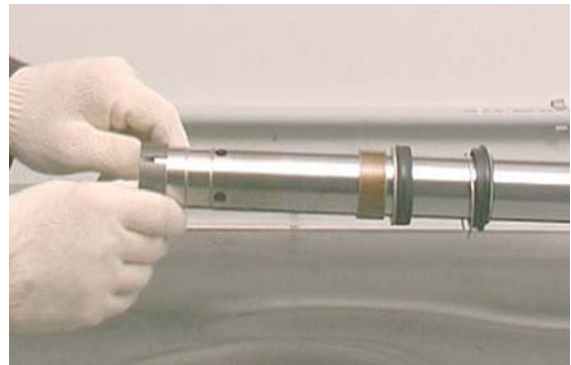
- The sealing ring must be placed with the stamped part facing the dust guard.



- Fit the ring, the movable bushing and, after removing the tape, fit the fixed bushing.







- Fit the sleeve on the stem and with the specified tool fit the oil seal into position.

### Specific tooling

**AP8140189 Oil seal fitting tool for Ø 43 mm (1.69 in) holes**

**8140145 Fitting tool for Ø 41 mm (1.61 in) sealing ring**

**8140146 Weight to be applied to the tool:  
8140145 and 8140189**



- Insert the snap ring in its position.



- Fit the oil seal with the specific tool.

### Specific tooling

**AP8140189 Oil seal fitting tool for Ø 43 mm (1.69 in) holes**

**8140145 Fitting tool for Ø 41 mm (1.61 in) sealing ring**

**8140146 Weight to be applied to the tool:**

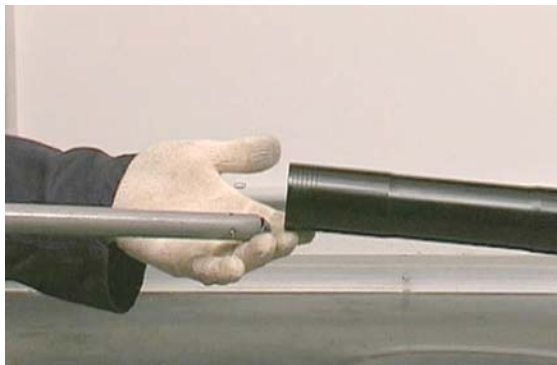


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**8140145 and 8140189**

---

- Fit the centring bushing on the cartridge and insert the whole assembly in the fork.



- Tighten the screw fixing the pumping element on the fork end to the prescribed torque.



- Position the lower spacer and the washer.

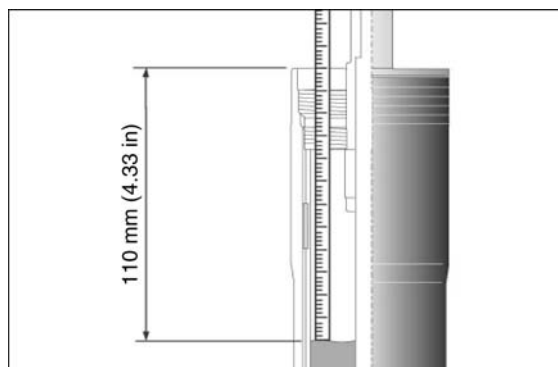


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**Filling oil**

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- Place the sleeve upright in a vice fitted with protection shoes.
- Compress the sleeve in the stem.
- Pour part of the fork oil into the sleeve.
- Wait for some minutes until the oil fills all the ducts.
- Pour the oil left.
- Pump out oil a few times.
- Measure the air gap between the oil level and the rim.



**THE SLEEVE MUST BE PERFECTLY VERTICAL FOR A CORRECT OIL LEVEL MEASUREMENT. THE OIL LEVEL MUST BE THE SAME IN BOTH STEMS.**

#### Characteristic

##### Fork oil

520 ± 2.5 cm<sup>3</sup> (31.7 ± 0.15 in) (for each stem)

**Oil level (from sleeve rim, without the spring and preloading pipe)**

**110 mm (4.33 in).**

- Fit the spring.



- Fit the complete preloading pipe.



- Fit the specified tool on the spring coupling so that the cartridge stem is locked in position.

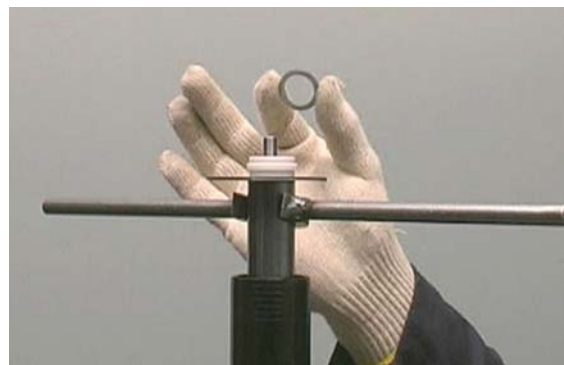
**Specific tooling**

**8140147 Spacer tool**

**8140148 Spacer / pumping member separating plate**



- Position the spacer and the washer.



- Screw the upper cover on the cartridge stem.



- Place the sleeve in the vice using the specified tool.
- Screw the upper cap to the prescribed torque.

### Specific tooling

AP8140149 Protection for fitting operations



## Steering bearing

### Adjusting play

- Undo and remove the two front screws.



- Undo and remove the two external screws and move the instrument panel forwards.



- Undo and remove the screws and collect the U-bolts, holding the handlebar.
- Move the handlebar forward without tilting the clutch and the front brake fluid reservoirs.



- Undo and remove the screw.
- Collect the right handlebar support.



- Unscrew and remove the fork upper plate cover; collect the shim.



- Working on both sides, undo and remove the upper plate fixing screw on

the fork stems.



- Lift the fork upper plate sliding it off from the stems.



- Rivet the safety washer on the headstock.



**UPON REFITTING, REPLACE THE SAFETY WASHER WITH A NEW ONE.**



- Using the suitable special tool, unscrew and remove the upper ring nut.

### Specific tooling

**AP8140190 Tool for steering tightening**



- Remove the safety washer.



- Using the suitable special tool, set the preloading of the steering bearings.

### Specific tooling

**AP8140190 Tool for steering tightening**



- Fit a new safety washer.



- Screw the upper ring nut manually and then slightly tighten the clamps on the plate so as to align notches on the ring nut.

### Specific tooling

**AP8140190 Tool for steering tightening**



- Rivet the tongues of the new safety washer.





- Fit the fork upper plate on the stems.



---

## Rear

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### Removing the rear wheel

- Support the vehicle from the rear with an adequate stand.
- Remove the cover.



- Engage the first gear.
- Undo and remove the four screws, collect the spacers and the dust-protection ring.
- Remove rear wheel.



---

## Shock absorbers

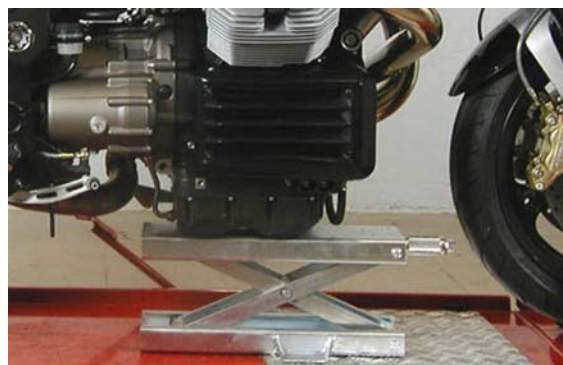
---

### Removing

- Secure the vehicle handlebar from the front with a hoist.



- Support the vehicle from below with a suitable underpan jack.



- Support the vehicle from the front with a suitable stand.



- Unscrew and remove the fixing nut.



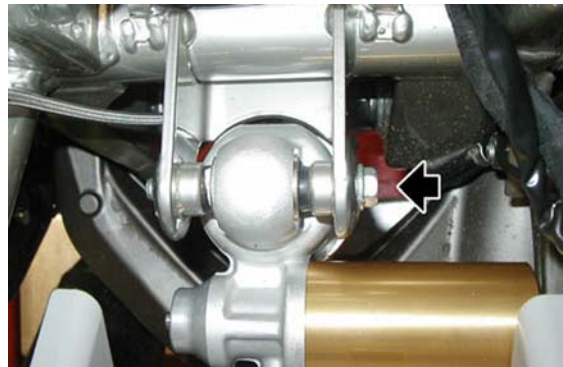
- Take out the screw tapping lightly with a rubber hammer and follow as the assembly slides out of its position.



- Undo and remove the suspension lower screw.



- Undo and remove the suspension upper screw.



# INDEX OF TOPICS

**CHASSIS**

**CHAS**

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## Swinging arm

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### Removing

---

- To remove the fork, first remove both footrest supporting plates and the exhaust silencer.
- Slide off the rear brake calliper from the disc and release the brake pipe.
- Remove the cover.



- Engage first gear.
- Undo and remove the four screws, collect the spacers and the dust-protection ring.



- Remove the rear wheel.



- Unscrew and remove the nut fixing the reaction rod.
- Remove the screw.
- Fix the reaction rod to the chassis with a clamp.



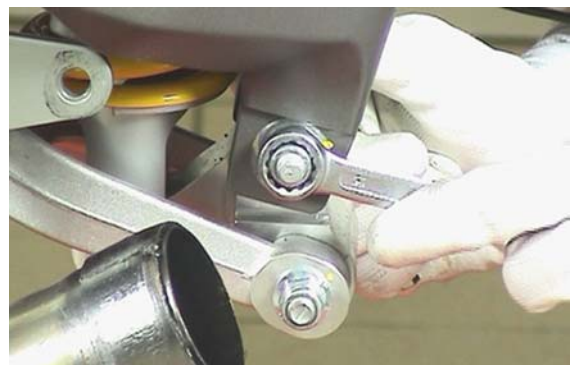
- 
- Remove the clamp from the dust guard cap.



- 
- Loosen the two fork terminal screws.

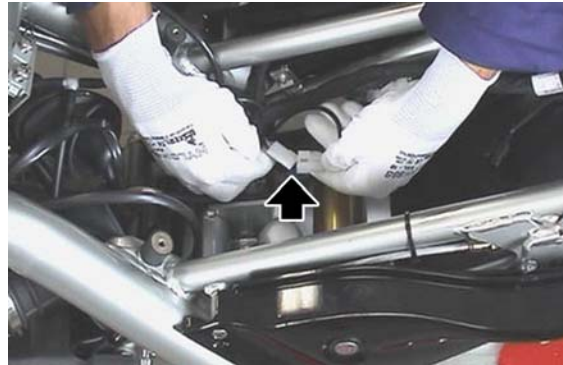


- 
- Unscrew and remove the fixing nut of the connecting rod assembly and collect the screw.



- 
- Disconnect the speed sensor connector and release the cable from the

clamp on the chassis.



- Loosen the ring nut.

### Specific tooling

**05.91.26.30 Tool for tightening the fork pin ring nut - clutch hub**



- Helped by a second operator, remove the pin and remove the fork with cardan shaft.



## Checking

- Check that the universal joint is not damaged, the gear teeth inserting in the sleeve grooves and the grooves on the joint are not deformed or damaged; otherwise, replace the joint.
- Check that the rubber bellows are not cut or pierced; otherwise, replace it.
- Check that the fork pin threads and the fork fixing nuts are not damaged,





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deformed or flattened; otherwise, replace them.

- Check that the sleeve grooves are not damaged, deformed or deteriorated; otherwise, replace the sleeve.
- Check that the sleeve outer tooting and grooves are not damaged.

---

## Installing

- Spread a thin layer of lubricating grease all along the fork pin.
- Fit the ring nut in the fork pin and screw it manually.



- Working from both sides, grease the cardan shaft cables with the recommended product from the recommended products table.
- Block the fork, insert the universal joint, align the holes and, at the same time, helped by a second operator, insert the pin completely.
- Tighten the fork pin.



- Use the suitable box-spanner to tighten the ring nut.

---

### Specific tooling

#### 05.91.26.30 Tool for tightening the fork pin ring nut - clutch hub



- Tighten the two fork terminal screws.



- Fit the dust guard cap in the gearbox.
- Lock the dust guard cap with a new clamp.

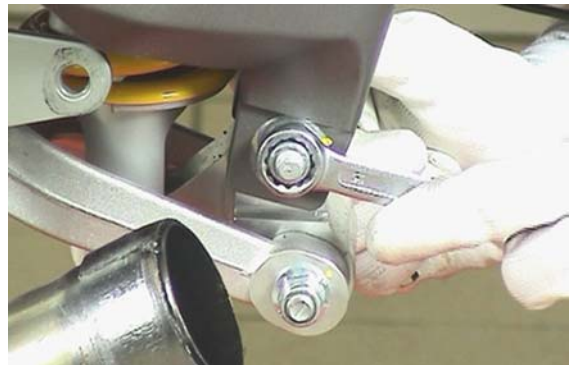


- Place the reaction rod in its seat.
- Insert the screw.
- Screw the reaction rod fixing nut.



- Place the connecting rod assembly on the fork.

- Insert the screw.
- Tighten the fixing nut of the connecting rod assembly.



- Connect the speed sensor connector and fix the cable to the chassis with clamps.



- Place the rear wheel on the fork.
- Tighten the four screws with their spacers and the dust-protection ring.
- Place the cover.
- Place the rear brake calliper on the disc and the brake pipe on the fork.



### See also

[Recommended products chart](#)

## Bevel gears

## Removing

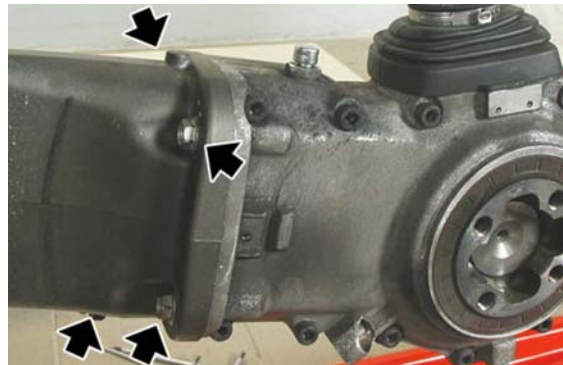
- To remove the gearbox, first remove the exhaust silencer and the rear wheel.



- Unscrew and remove the nut fixing the reaction rod.
- Remove the screw.
- Fix the reaction rod to the chassis with a clamp.



- Undo and remove the four screws.



- Remove the transmission casing sliding off the universal joint.

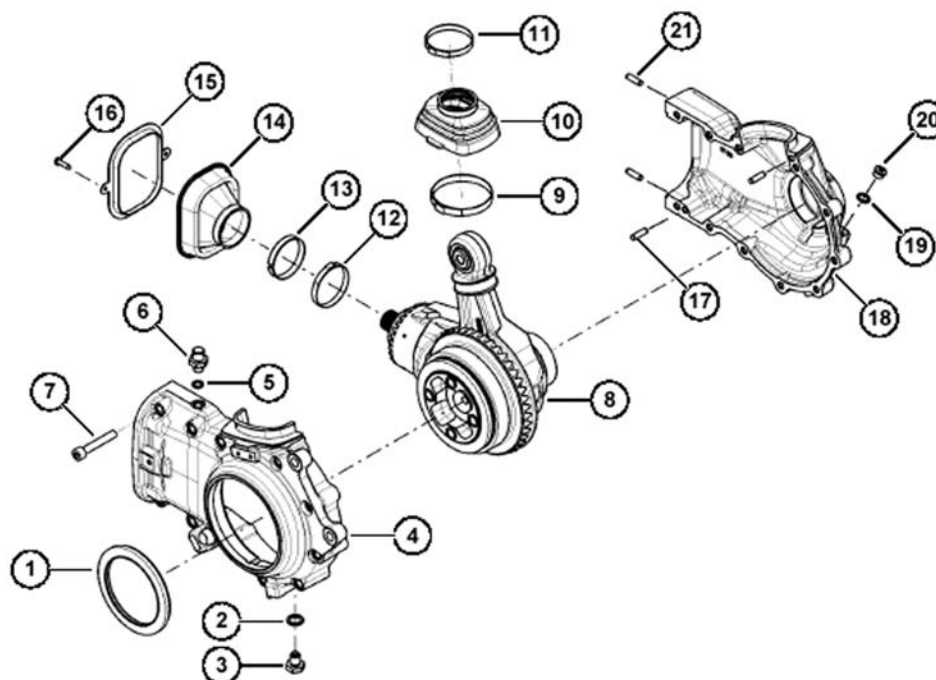


## Checking

### TROUBLESHOOTING

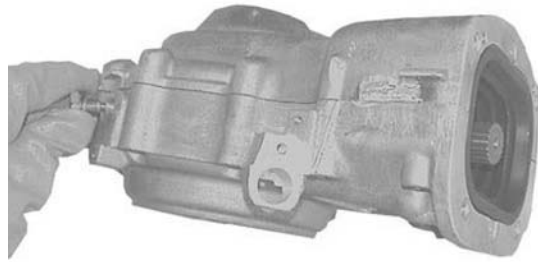
Possible Cause	Operation
1. Fitting error of the radial seal or seal damaged 2. Sliding surface of the wheel axle seal spoiled or damaged	1. Replace the sealing ring and fit it correctly with the suitable tool 2. Replace the wheel axle
1. Casing not sealed 2. Closing screws of the casing shells not tightened to the prescribed torque.	1. Open the casing shells, clean the surfaces, seal it and reassemble the casing 2. Tighten the closing screws to the correct torque
1. Dirt between sealing ring and casing 2. Worn sealing ring fitted 3. Plug not tightened to the prescribed torque	1. Clean and tighten to the correct torque 2. Replace the sealing ring 3. Tighten the plug to the correct torque
1. Damaged cap 2. Retaining clamps or closing cover slacken 3. Fitting error of the radial seal or seal damaged 4. Sliding surface of the wheel spacer seal spoiled or damaged	1. Replace the cap 2. Screw the clamp with suitable pliers 3. Replace the sealing ring and fit it correctly with the suitable tool 4. Replace the spacer
1. Cap damaged 2. Internal retaining clamp or external closing clamp loose	1. Replace the cap 2. Screw the internal or external clamp with suitable pliers
1. Bevel gear pair fitting error 2. Bevel gear pair toothing spoiled or damaged	1. Replace the bevel gear pair
1. Ball bearings on the wheel axle damaged	1. Replace the wheel bearings

### Casing unit removal



Remove the cover (20).

Remove the plug (3) to drain out the oil.

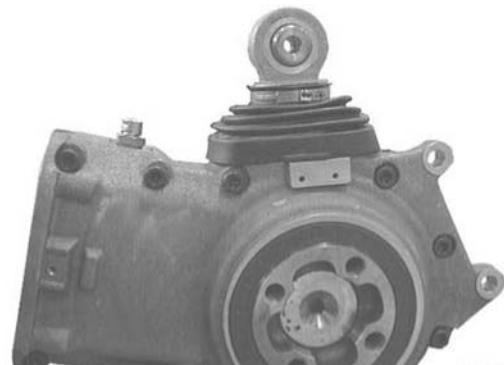


Lift the cap (10).



Remove the clamps (9) and (11).

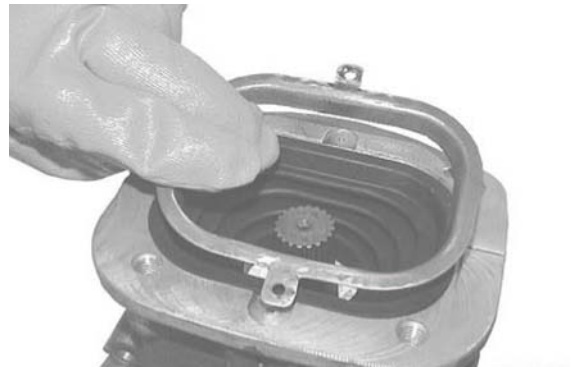
Remove the cap (14).



Remove the screws (16).

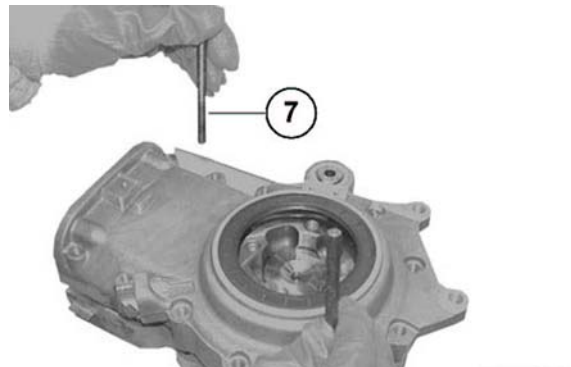


Collect the ring (15).



---

Remove the screws (7).  
Remove the casing (4).



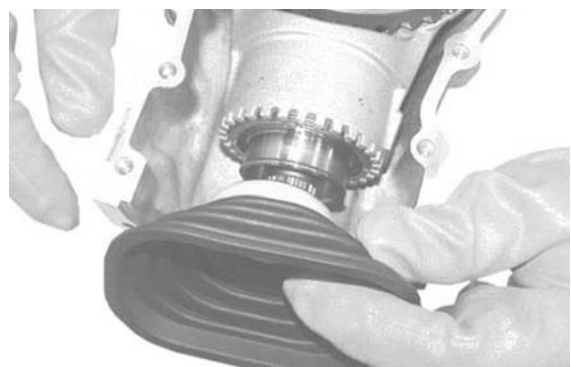
---

Remove the clamp (12).



---

Remove the cap (14).



---

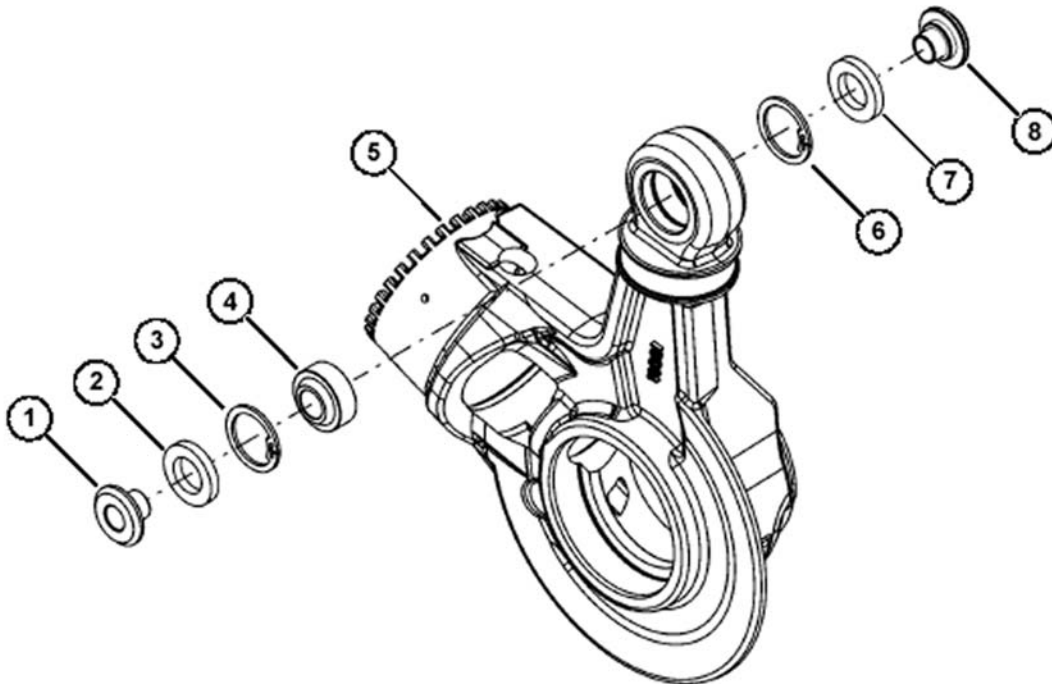
Collect the ring (13).



Remove the support unit (8).



## Support unit



## REMOVAL

Remove the bushing (1) with a punch.



Turn the support (5) over and remove the other bushing (8).

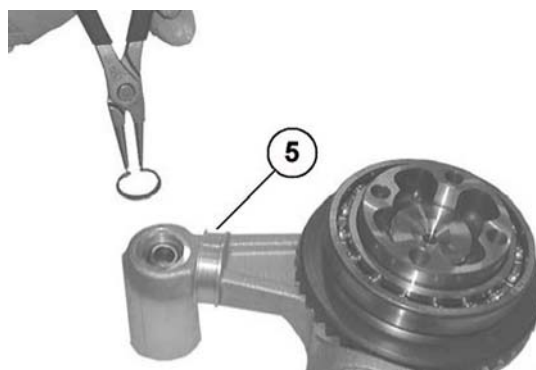


Remove the sealing rings (2) and (7) with a screwdriver.

Remove the stop rings (3) and (6) from the support (5) with suitable pliers.

**NOTE**

**THIS OPERATION DESTROYS THE SEALING RING.**

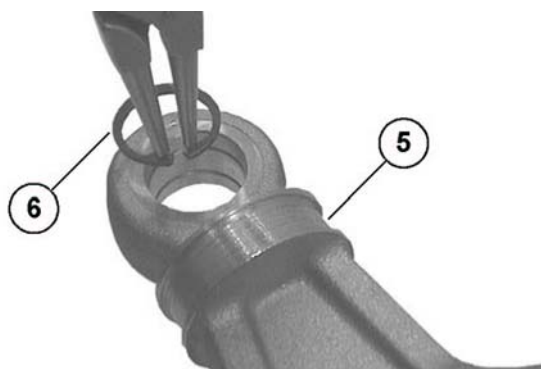


Remove the ball joint (4) with a suitable buffer and a rubber hammer.



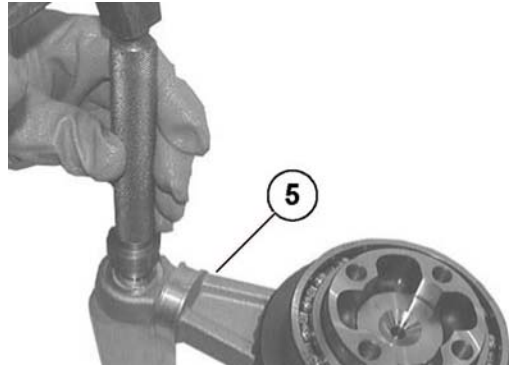
**FITTING**

Fit the stop ring (6) in the support (5) with suitable pliers.

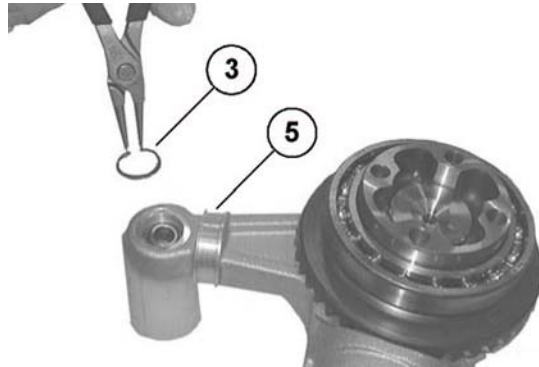


Turn the support (5) over.

Assemble the ball joint (4) with the buffer and a rubber hammer.



Fit the stop ring (3) in the support (5) with suitable pliers.



Manually assemble the new sealing rings (2) and (7).

Assemble the bushing (1).



Drive the bushing (1) in with a plastic hammer.

Turn the support (5) over and assemble the other bushing (8).



---

## Wheel axle unit

---

**REMOVAL**

Remove the bearing from the wheel axle with a suitable extractor.



Turn the unit over.

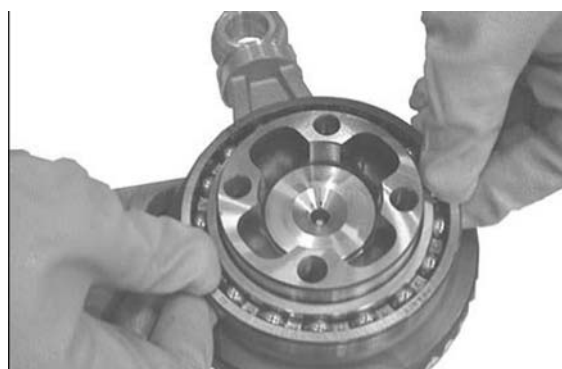
Remove the bearing from the wheel axle with a suitable extractor.

**FITTING**

Heat the bearings to 100°C (212 °F).



Assemble the bearings to the wheel axle.



Turn the unit over.

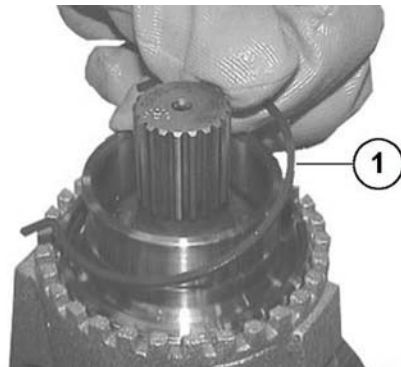
Assemble the bearings to the wheel axle.



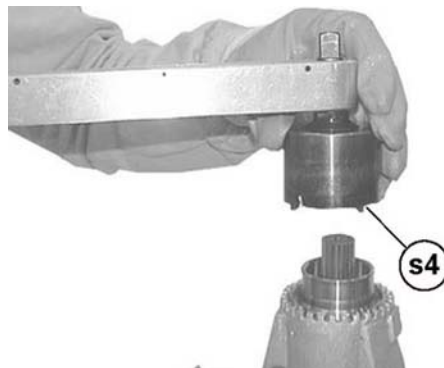
## Pinion unit

### REMOVAL

Remove the stop ring (1) from the ring nut.



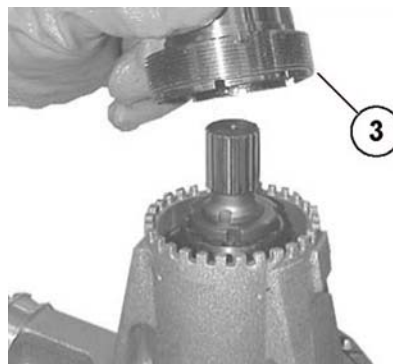
Unscrew the ring nut (2) with the special spanner (s4).



Remove the ring nut (2) and remove the sealing ring from the ring nut.

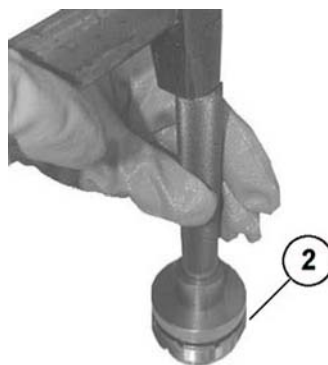
### NOTE

**THIS OPERATION DESTROYS THE SEALING RING.**



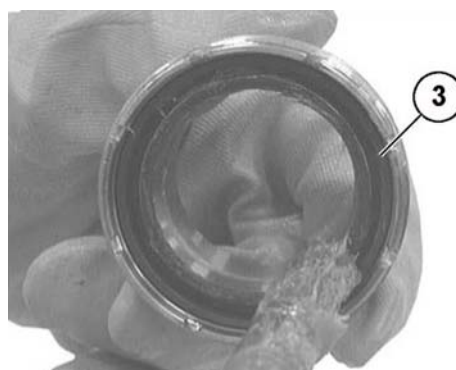
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Assemble the sealing ring (3) to the ring nut (2) with the buffer CA715855 (see Fig.1) and a hammer.



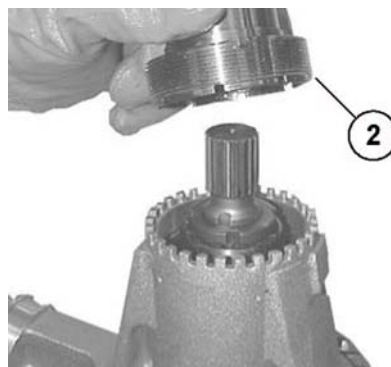
---

Lubricate the sealing ring (3).



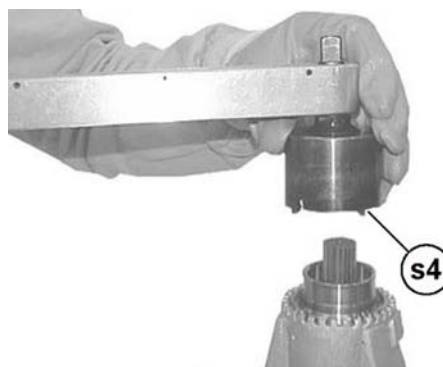
---

Assemble the ring nut (2).



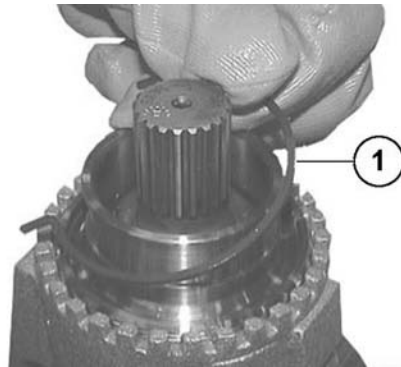
---

Tighten the ring nut (2) with the special spanner (s4) to the prescribe torque.

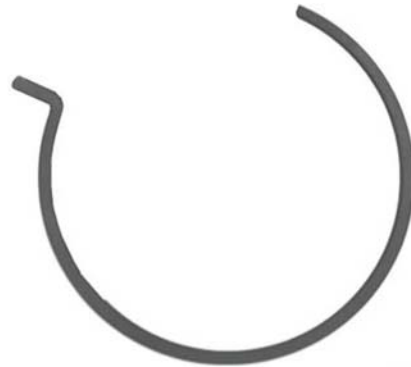


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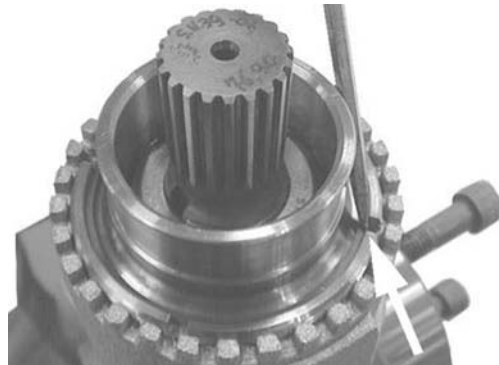
Insert the stop ring (1) in the ring nut (2) in the indicated direction.



Assembly position of the stop ring (1).

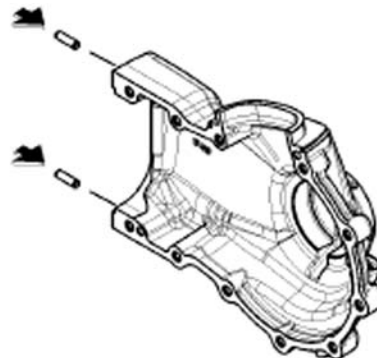


**CAUTION**  
**MAKE SURE THE STOP RING IS IN ITS SEAT.**



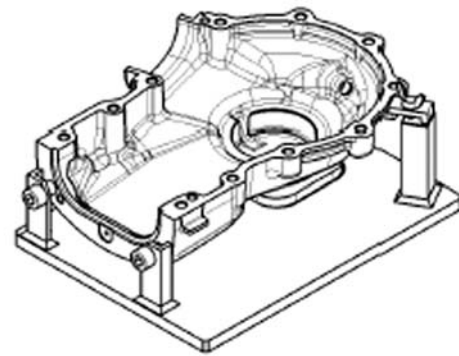
### Casing unit fitting

Assemble the dowel pins to the casing with the buffer and a hammer.



---

Assemble the casing to the special fastening tool.  
Clean the casing faying surfaces carefully.



---

Heat the casing.



---

Insert the support group in the casing.



---

Assemble the cap and the ring.



---

Fit the cap on the support.  
Fit the clamp.



Screw the clamp with the specific pliers.



Apply the prescribed sealant to the casing.



Fit a new sealing ring using the buffer.

Lubricate the sealing ring.



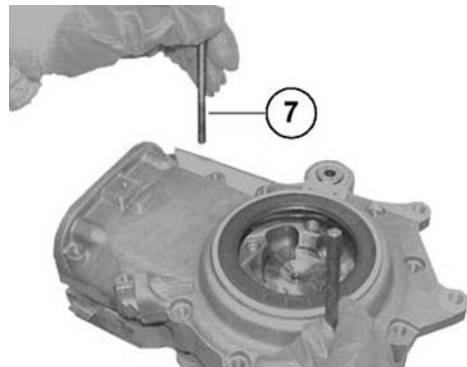
Assemble two centring stud bolts with M8 thread in the threaded holes of the casing as shown in the picture.





---

Fit the casing.  
Remove the two dowel pins.



---

Assemble the fixing screws (7).  
Tighten the screws (7) to the prescribed torque.  
Remove excessive sealant.



---

Assemble the ring to the casing.



---

Tighten the fixing screws to the prescribed torque.



---

Fit the cap with the washer.

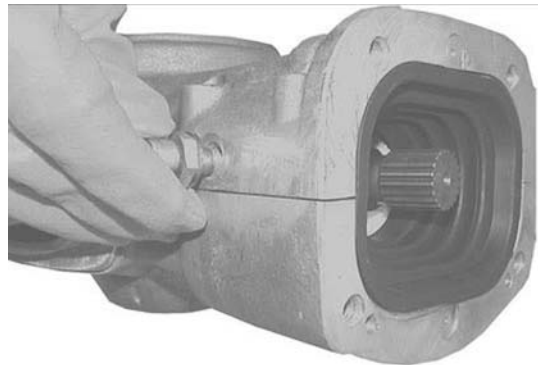
Screw the cap to the prescribed torque.



---

Fit the breather with the washer.

Screw the breather to the prescribed torque.



---

Fill the transmission with the prescribed oil.

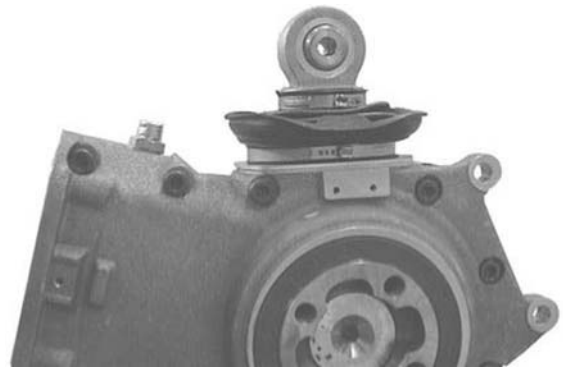
Fit the cap with the washer.

Screw the cap to the prescribed torque.



---

Assemble the cap with the clamps.



Fit the cap in its seat.



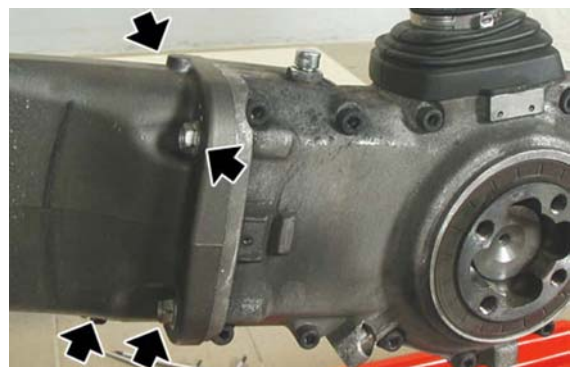
---

## Installing

- Insert the transmission casing on the fork making sure that the universal joint engages correctly.



- Tighten the four screws to the prescribed torque operating diagonally.



- Place the reaction rod in its seat.
- Insert the screw.
- Screw the reaction rod fixing nut.



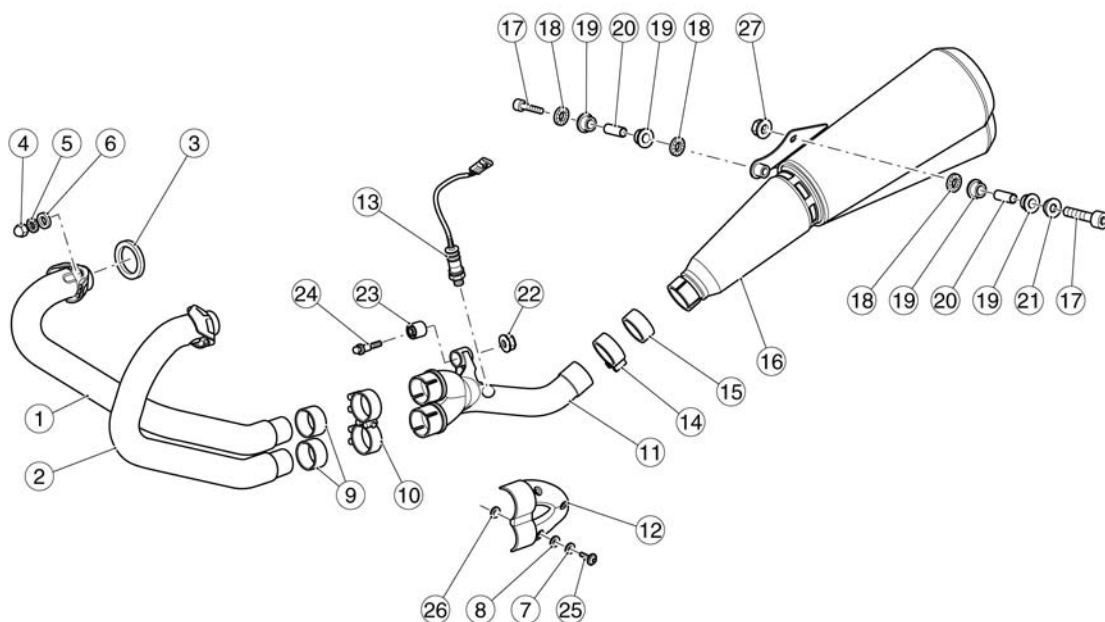
- Place the dust-protection ring between the rim and the cardan shaft taking care to mount it with the collar facing the transmission unit.



- Place the rear wheel on the fork.
- Tighten the four screws with their spacers and the dust-protection ring.
- Place the cover.
- Place the rear brake calliper on the disc and the brake pipe on the fork.



## Exhaust

**Key:**

1. Right exhaust pipe
2. Left exhaust pipe
3. Gasket
4. Blind nut
5. Washer
6. Washer
7. Washer
8. Washer
9. Gasket
10. Clamp
11. Central exhaust pipe
12. Heat-protecting cover
13. Lambda probe
14. Clamp
15. Gasket
16. Silencer
17. Screw
18. Washer
19. Muffler rubber ring

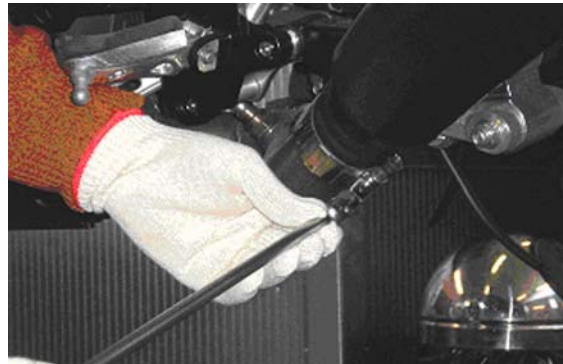
- 20.Spacer
- 21.Silencer fixing bushing
- 22.Nut
- 23.Silent-block
- 24.Screw
- 25.Screw
- 26.Washer
- 27.Nut

---

## Removing the tail pipe

---

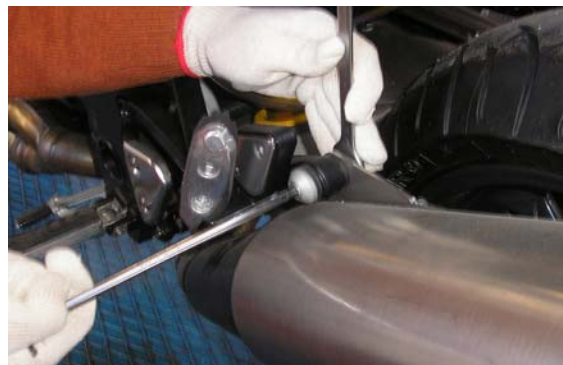
- Loosen the seal clamp between the exhaust and the central manifold.



- Undo and remove the front screw fastening the exhaust to the chassis.



- Undo and remove the rear attachment screw fixing the exhaust to the chassis; collect the locking nut, the spacer and the washer.



**DURING THIS OPERATION SUPPORT THE EXHAUST SO THAT IT DOES NOT FALL.**

**Locking torques (N\*m)**

---

**Silencer to chassis connecting pipe retainer**  
**25 Nm**

- Remove the exhaust end.

---

**Removing the manifold - tail pipe**

---

- Remove the exhaust end and the exhaust manifolds.
- Remove the starter motor protection in order to disconnect the lambda probe connector.



- Unscrew and remove the nut and remove the fixing screw.
- Remove the manifold - exhaust end coupling together with the lambda probe.

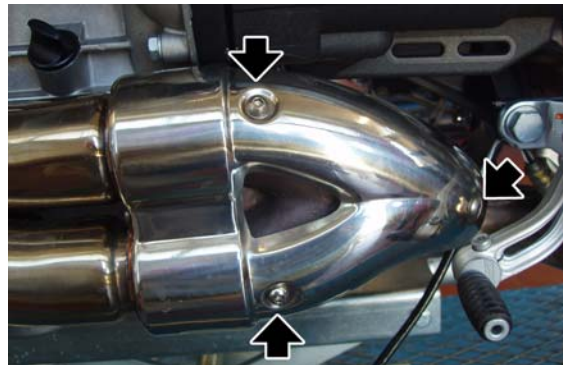
**See also**[Removing the exhaust manifold](#)[Removing the tail pipe](#)

---

**Removing the exhaust manifold**

The engine and the exhaust system components get very hot and remain in this condition for a certain time interval after the engine has been switched off. Before handling these components, make sure that you are wearing insulating gloves or wait until the engine and the exhaust system have cooled down.

- Undo and remove the three screws from the protection of the exhaust clamps.
- Remove the protection.



- Unscrew and remove the two nuts on the head exhaust stud bolts.
- Collect the washers.

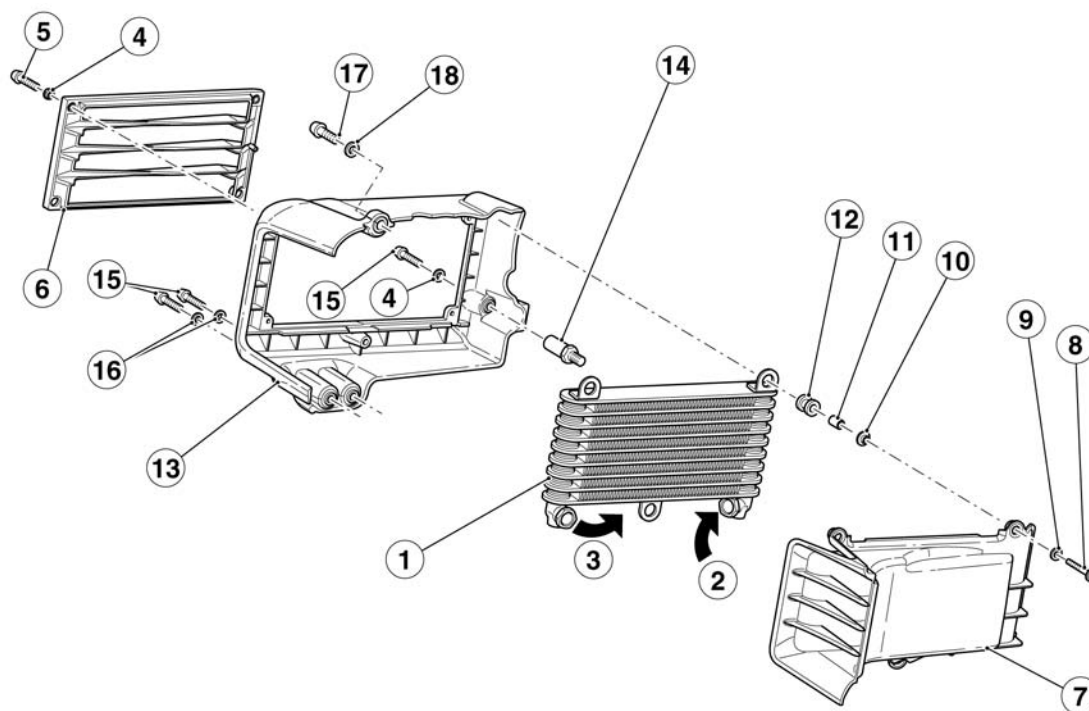


- Loosen the clamp.
- Remove the exhaust manifold.



## Engine oil cooler



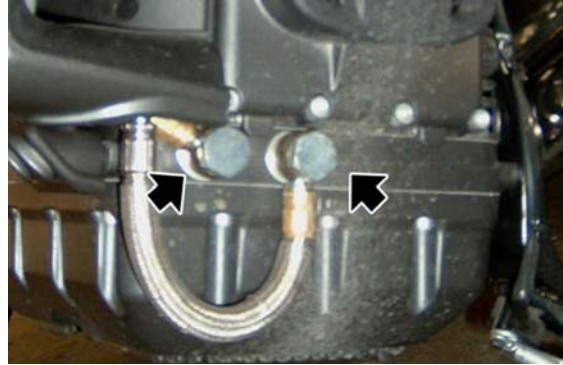
**Key:**

1. Complete oil radiator
2. From the oil pump
3. To the heads
4. T-shaped bushing
5. Screw
6. Radiator grille
7. Air deflector
8. Screw
9. Washer
10. Bushing
11. Spacer
12. Rubber ring
13. Cover
14. Spacer
15. Screw
16. Washer
17. Screw
18. Washer

## Removing

- Place a collecting container and empty the lubrication system.

- Undo and remove the two screws; collect the pipes and the four washers.



- Undo and remove the rear screw; collect the washer.



- Undo and remove the two screws; collect the washers.



- Undo and remove the screw; collect the washer.



- Remove the oil radiator.

---

## Installing

---

- Fit the oil radiator on the vehicle following the operations described in the removal chapter but in reverse order.
- Unscrew the filler cap / dipstick (1).
- Pour new oil until it goes over the minimum level marked "MIN" on the dipstick (1).
- Screw the dipstick (1).
- Start the vehicle and let the engine run for a few minutes so that the oil circulates and fills the radiator internal ducts.
- Stop the engine and check the oil level with the dipstick (1).
- Fill with engine oil as required.

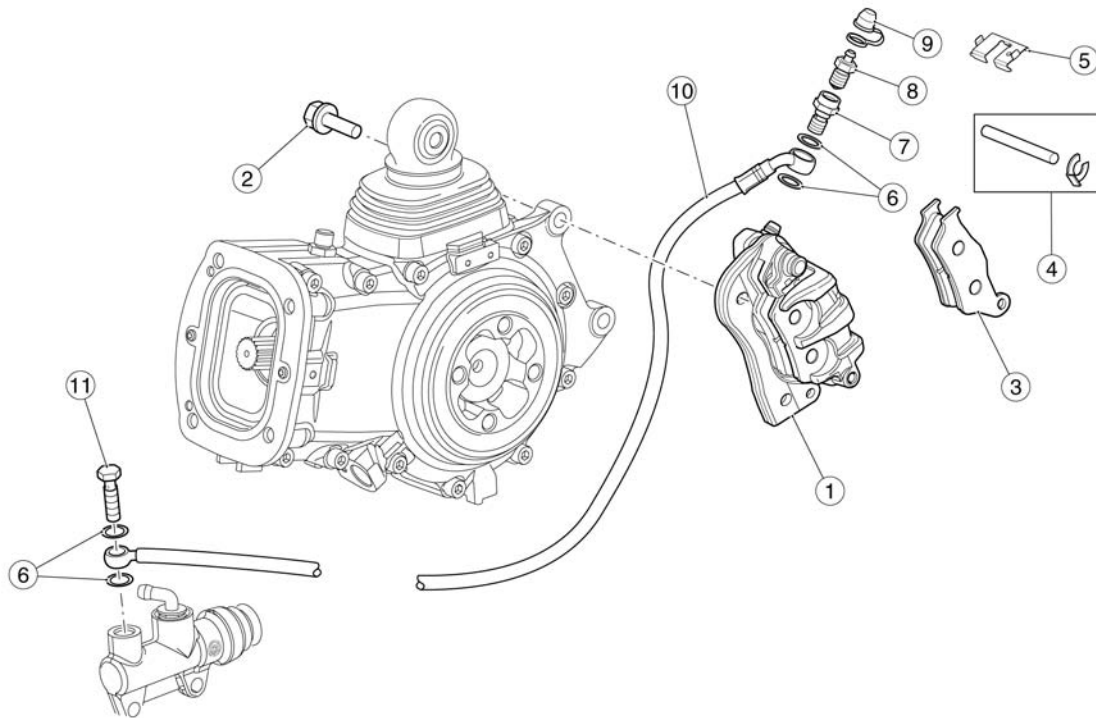


## INDEX OF TOPICS

**BRAKING SYSTEM**

**BRAK SYS**

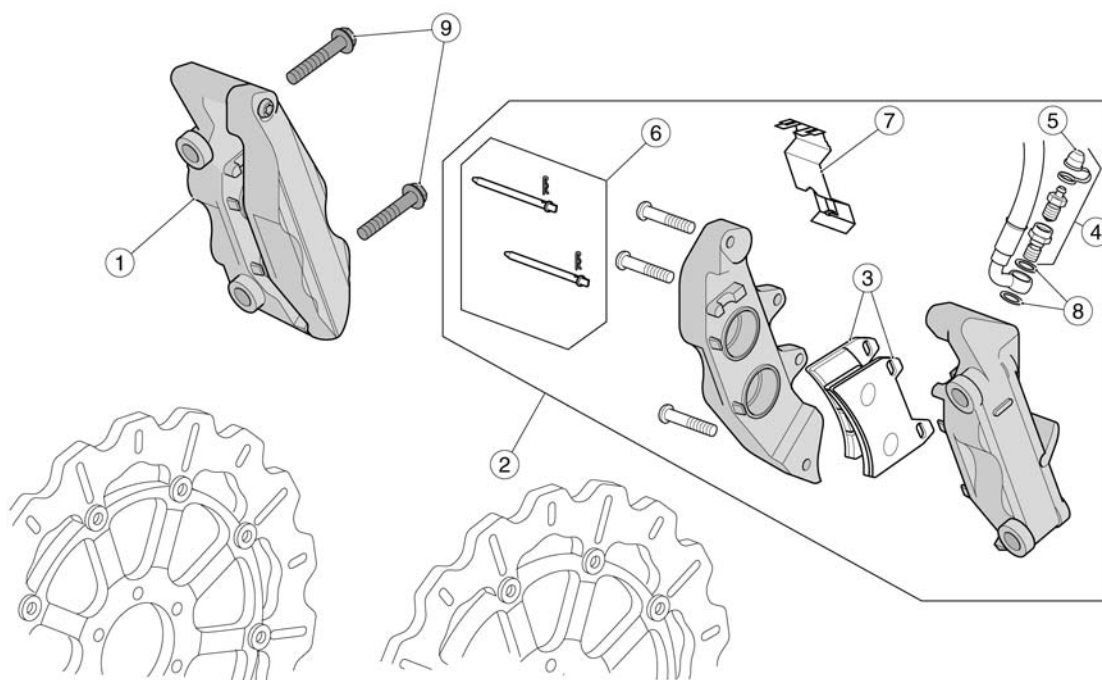
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**Rear brake calliper**
**Key:**

- 1. Rear brake calliper
- 2. Screw
- 3. Pads
- 4. Pin + calliper split pin
- 5. Spring
- 6. Gasket
- 7. Screw
- 8. Air bleed
- 9. Air bleed cap
- 10. Rear brake pipe
- 11. Oil pipe screw

---

**Front brake calliper**

**Key:**

1. Right front brake calliper
2. Left front brake calliper
3. Pads
4. Air bleed
5. Air bleed cap
6. Pins + Calliper springs
7. Spring
8. Aluminium gasket
9. Screw

---

## Front brake pads

---

### Removal

---

- Turn the pins and remove both split pins.



- Remove both pins.



- Remove the vibration-damping plate.



- Extract one pad at a time.

**CAUTION**

**AFTER REMOVING THE PADS, DO NOT OPERATE THE BRAKE CONTROL LEVER OR THE CALLIPER PLUNGERS COULD GO OUT OF THEIR SEATS RESULTING IN BRAKE FLUID LEAKS.**

**Installing**

- Insert two new pads, placing them so that the holes are aligned with the caliper holes.

**CAUTION**

**ALWAYS REPLACE BOTH PADS AND MAKE SURE THEY ARE CORRECTLY POSITIONED INSIDE THE CALLIPER.**



- Position the anti-vibration plate.
- Insert both pins.
- Position both split pins.
- Abut the plungers against the pads, acting on the brake pump lever several times.
- Check the brake fluid level in the reservoir.

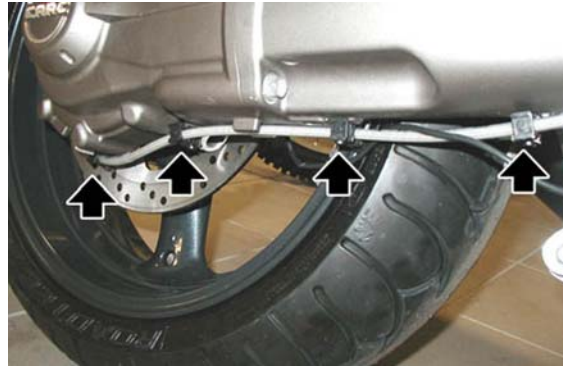


## Rear brake pads

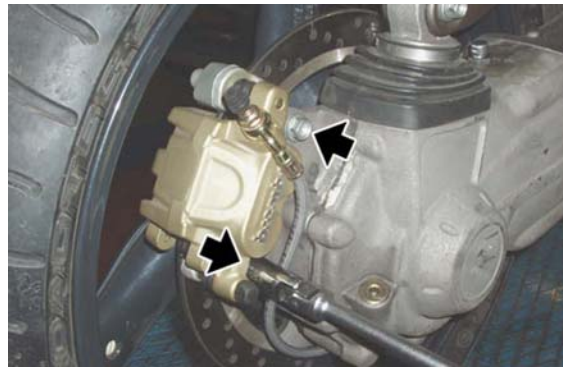
### Removal



- Free the brake pipe and the throttle grip cable from the clamps.



- Undo and remove the two screws.
- Remove the brake calliper from the disc.
- Turn the pin and remove the split pin.
- Remove the split pin.



- Remove the pin.



- Extract one pad at a time.

**CAUTION**

**AFTER REMOVING THE PADS, DO NOT OP-**

ERATE THE BRAKE CONTROL LEVER OR THE CALLIPER PLUNGERS COULD GO OUT OF THEIR SEATS RESULTING IN BRAKE FLUID LEAKAGE.



## Installing

- Insert two new pads, placing them so that the holes are aligned with the caliper holes.

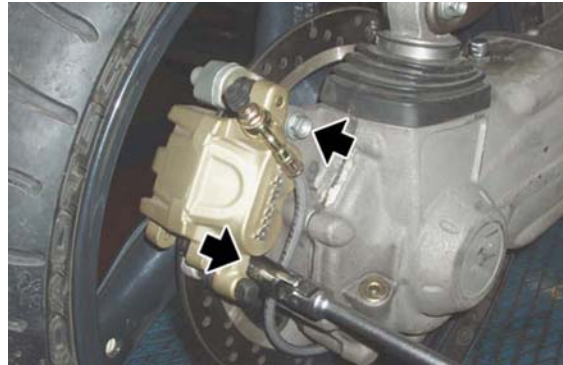
### CAUTION

**ALWAYS REPLACE BOTH PADS AND MAKE SURE THEY ARE CORRECTLY POSITIONED INSIDE THE CALLIPER.**



- Insert the pin.
- Position the split pin.
- Abut the plungers against the pads, acting on the brake pump pedal several times.
- Check the brake fluid level in the reservoir.





## Bleeding the braking system

### Front

If there is air in the hydraulic system, it acts as a bearing, absorbing a large part of the pressure from the brake pump and minimising calliper efficiency during braking.

The presence of air is signalled by the "sponginess" of the brake control and poor braking efficiency.



**CONSIDERING THE DANGER FOR VEHICLE AND RIDER, IT IS STRICTLY NECESSARY, AFTER REFITTING BRAKES AND RESTORING THE BREAKING SYSTEM TO THE REGULAR USE CONDITIONS, THAT THE HYDRAULIC CIRCUIT BE AIR PURGED.**

#### NOTE

**THE FOLLOWING OPERATIONS REFER TO ONLY ONE FRONT BRAKE CALLIPER BUT APPLY TO BOTH CALLIPERS. THE VEHICLE MUST BE ON LEVEL GROUND TO BE PURGED. WHILE PURGING THE HYDRAULIC SYSTEM, FILL THE RESERVOIR WITH THE NECESSARY QUANTITY OF BRAKE FLUID. CHECK THAT, DURING THE OPERATION, THERE IS ALWAYS BRAKE FLUID IN THE RESERVOIR.**

- Remove the rubber protection cover from the bleed valve.
- Insert the transparent plastic pipe in the front brake calliper bleed valve and slide the other end of this pipe in a container to collect the fluid.
- Remove the front brake oil reservoir cap.
- Quickly press and release the front



brake lever several times and then keep it fully pressed.

- Loosen the bleed valve 1/4 of a turn so that the brake fluid flows into the container. This will release the tension on the brake lever and will make it reach the end of stroke.
- Close the bleed valve before the lever reaches its end of stroke.
- Repeat the operation until the fluid draining into the container is air-bubble free.



#### NOTE

**WHILE PURGING THE HYDRAULIC SYSTEM, FILL THE RESERVOIR WITH THE NECESSARY QUANTITY OF BRAKE FLUID. CHECK THAT, DURING THE OPERATION, THERE IS ALWAYS BRAKE FLUID IN THE RESERVOIR.**

- Screw the bleed valve and remove the pipe.
- Top-up the reservoir until the right brake fluid level is obtained.
- Refit and block the front brake oil reservoir cap.
- Refit the rubber protection cover.

## Rear

If there is air in the hydraulic system, it acts as a bearing, absorbing a large part of the pressure from the brake pump and minimising calliper efficiency during braking.

The presence of air is signalled by the "sponginess" of the brake control and poor braking efficiency.

#### CAUTION

**CONSIDERING THE DANGER FOR VEHICLE AND RIDER, IT IS STRICTLY NECESSARY, AFTER REFITTING BRAKES AND RESTORING THE BRAKING SYSTEM TO THE REGULAR USE CONDITIONS, THAT THE HYDRAULIC CIRCUIT BE AIR PURGED. THE VEHICLE MUST BE ON LEVEL GROUND TO BE PURGED. WHILE PURGING THE HYDRAULIC SYSTEM, FILL THE RESERVOIR WITH THE NECESSARY QUANTITY OF BRAKE FLUID. CHECK THAT, DURING THE OPERATION, THERE IS ALWAYS BRAKE FLUID IN THE RESERVOIR.**

- Remove the rubber protection cover

from the bleed valve.

- Insert the transparent plastic pipe in the rear brake calliper bleed valve and insert the other end of this pipe into a container to collect the fluid.
- Remove the rear brake oil reservoir cap.
- Quickly press and release the rear brake lever several times and then keep it fully pressed.
- Loosen the bleed valve 1/4 of a turn so that the brake fluid flows into the container. This will release the tension on the brake lever and will make it reach the end of stroke.
- Close the bleed valve before the lever reaches its end of stroke.
- Repeat the operation until the fluid draining into the container is air-bubble free.

**NOTE**

**WHILE PURGING THE HYDRAULIC SYSTEM, FILL THE RESERVOIR WITH THE NECESSARY QUANTITY OF BRAKE FLUID CHECK THAT, DURING THE OPERATION, THERE IS ALWAYS BRAKE FLUID IN THE RESERVOIR.**

- Screw the bleed valve and remove the pipe.
- Top-up the reservoir until the right brake fluid level is obtained.
- Refit and lock the rear brake oil reservoir cap.
- Refit the rubber protection cover.

# INDEX OF TOPICS

**BODYWORK**

**BODYW**

---

## Rider footrest plate

---

### RIGHT

- Undo and remove the two lower screws and collect the nuts and the spacers.
- Free the rear brake pipe from the clamps and from pipe guide.
- Remove the rear brake calliper from the disc.



- Undo and remove the rear upper screw and collect the nut.



- Undo and remove the front upper screw.



- Remove the air filter housing.
- Disconnect the connector of the rear brake lever switch and release it from the clamps.



- Remove the right footrest plate, keeping the brake fluid reservoir in vertical position.

**LEFT**

- Remove the exhaust silencer.
- Undo and remove the screw and collect the nut and the spacer.



- Undo and remove the rear upper screw and collect the nut.



- Undo and remove the front upper screw.



- Undo and remove the screw and remove the left footrest plate.



**See also**[Air box](#)

---

**Air box**

- Remove the fuel tank.
- Disconnect the connector from the air temperature sensor.



- Slide off and remove the main fuse box from its holder.



- Undo and remove the four screws.



- Slide off and remove the secondary fuse box from its holder.



- Undo and remove the two screws.



- Disconnect the low pressure pipe.
- Disconnect the blow-by tank breather pipe.
- Free the pipes from the clamps.





- Release the breather pipe from the clamp on the right side of the filter casing and then remove the pipe.
- Working on both sides, loosen the clamp.
- Remove the filter casing by sliding it backwards; collect the blow-by drain pipe.



### See also

[Fuel tank](#)

## Fuel tank

- Remove both side fairings and the saddle.
- Undo and remove the two front screws fixing the tank.



- Undo and remove the two rear screws fixing the tank and collect the two T spacers.
- Remove the battery.



- Lift the front and then the rear of the fuel tank, leaning its lower part onto the support rubber pad of the brackets welded to the chassis.
- Disconnect the quick-release coupling.



- Disconnect the connector.
- Remove the fuel tank.

