
MANUALE STAZIONE DI SERVIZIO

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XEVO 400ie



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MANUALE STAZIONE DI SERVIZIO XEVO 400ie

This service station manual has been drawn up by Piaggio & C. S.p.A. to be used by the workshops of Piaggio-Gilera dealers. It is assumed that the user of this manual for maintaining and repairing Piaggio vehicles has a basic knowledge of mechanical principles and vehicle repair technique procedures. Any significant change to vehicle characteristics or to specific repair operations will be communicated by updates to this manual. Nevertheless, no mounting work can be satisfactory if the necessary equipment and tools are unavailable. It is therefore advisable to read the sections of this manual concerning special tools, along with the special tool catalogue.

N.B. 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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CHARACTERISTICS

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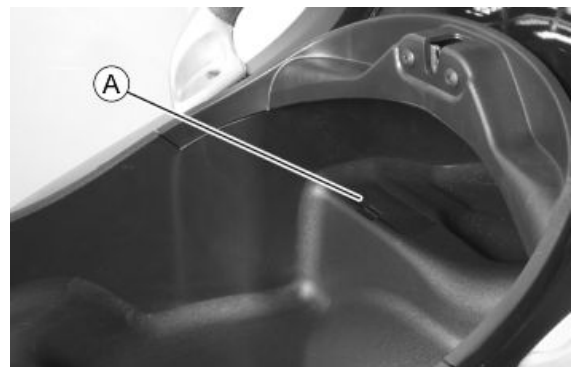
Maintenance rules

- Use original PIAGGIO spare parts and lubricants recommended by the Manufacturer. Non-original or non-conforming spares may damage the vehicle.
- Use only the special tools designed for this scooter.
- Always use new gaskets, sealing rings and split pins upon reassembly.
- After removal, clean the components using non-flammable or low fire-point solvent. Lubricate all the work surfaces except the tapered couplings before refitting.
- After reassembly, check that all components have been installed properly and that they are in good working order.
- For removal, overhaul and reassembly operations use only tools provided with metric measures. Metric bolts, nuts and screws are not interchangeable with coupling members with English measurement. Using unsuitable coupling members and tools may damage the scooter.
- Should any interventions to the scooter electrical system be required, check that the electrical connections - especially earth and battery connections - have been implemented properly.

Vehicle identification

Chassis prefix

ZAPM52101

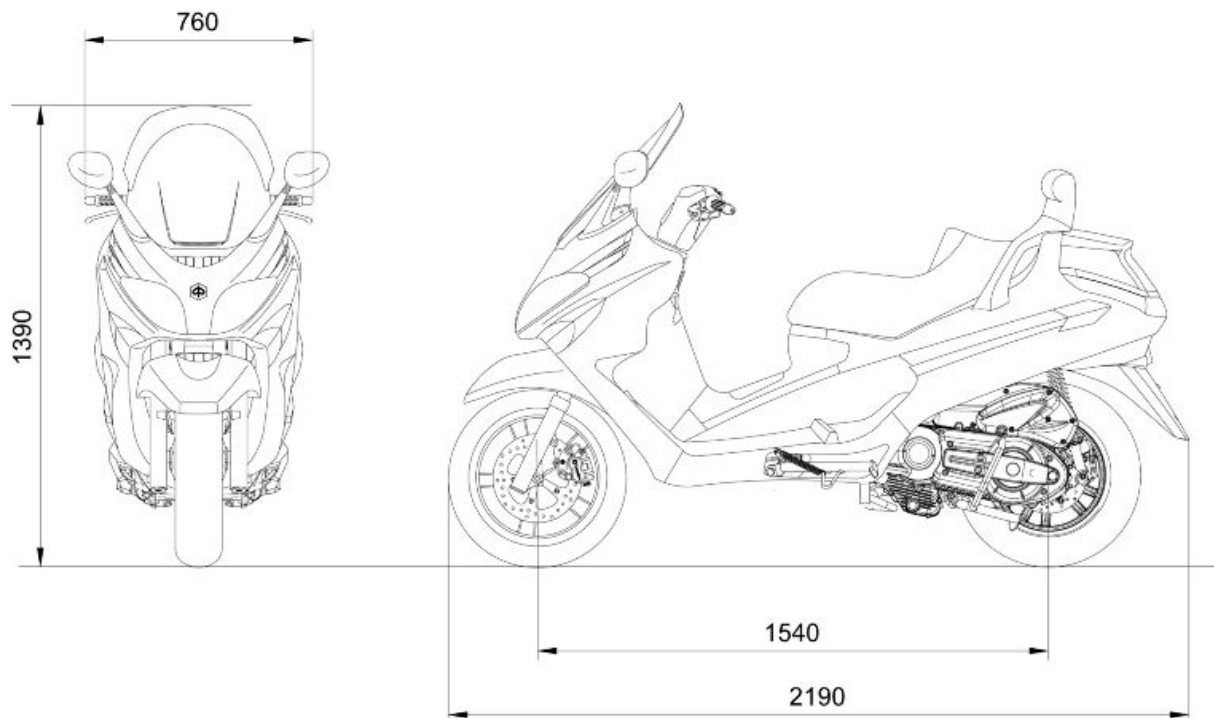


Engine prefix

M521M



Dimensions and mass



WEIGHTS AND DIMENSIONS

Specification	Desc./Quantity
Kerb weight	171 ± 6 kg

Engine

ENGINE

Specification	Desc./Quantity
Type	Single-cylinder, 4-stroke
Bore x stroke	85.8 X 69 mm
Cubic capacity	399 cm ³
Compression ratio	10.6 ± 0.5 : 1
Timing system	Four valves, single overhead camshaft, chain-driven.
Valve clearance	Inlet: 0.15 mm Outlet: 0.15 mm
Engine idle speed	1,500 ± 100 rpm
Start-up	Electric
LUBRICATION	Engine lubrication with trochoidal pump (inside the crankcase), oil filter and pressure adjustment by-pass.
FINAL REDUCTION GEAR	Gear reduction unit in oil bath.
Muffler	Absorption-type exhaust muffler with catalytic converter and lambda probe.
Fuel supply	Electronic injection with Ø 38-mm throttle body and electric fuel pump.
MAX Power	24 kW at 7,250 rpm
MAX torque	38 Nm at 5,250 rpm
Cooling	Forced coolant circulation system.

Transmission

TRANSMISSION

Specification	Desc./Quantity
TRANSMISSION	Automatic expandable pulley variator with torque server, V-belt, automatic clutch.

Capacities

CAPACITY

Specification	Desc./Quantity
Engine oil	1.7 l
Transmission oil	250 cm ³
Cooling system fluid	~ 1.8 l
Fuel tank (reserve)	approx. 12 l (approx. 2 l)

Electrical system

ELECTRICAL SYSTEM

Specification	Desc./Quantity
Ignition	Electronic, inductive, high efficiency ignition, integrated with the injection system, with variable advance and separate HV coil.
Ignition advance	Three-dimensional map managed by control unit
Spark plug	CHAMPION RG 6 YC
Alternative spark plug	NGK CR7EKB
Battery	12V-12Ah

Frame and suspensions

CHASSIS AND SUSPENSIONS

Specification	Desc./Quantity
Frame	Tubular and steel sheets.
Front suspension	Hydraulic telescopic fork with Ø 35-mm stem
Rear suspension	Two double-acting shock absorbers, adjustable to four positions at preloading.

Brakes

BRAKES

Specification	Desc./Quantity
Front brake	Ø 240-mm double disc brake with hydraulic control operated by the handlebar right-hand lever.
Rear brake	Ø 240-mm disc brake with hydraulic control operated by the handlebar left-side lever.

Wheels and tyres

WHEELS AND TYRES

Specification	Desc./Quantity
Wheel rim type	Light alloy rims.
Front tyre	Tubeless 120/70 - 14" 55P

Specification	Desc./Quantity
Rear tyre	Tubeless 140/70 - 14" 68S
Front tyre pressure (with passenger)	2.3 bar (-)
Rear tyre pressure (with passenger)	2.6 bar (-)

N.B.

CHECK AND ADJUST TYRE PRESSURE WITH TYRES AT AMBIENT TEMPERATURE. ADJUST PRESSURE ACCORDING TO THE WEIGHT OF RIDER AND ACCESSORIES.

CAUTION

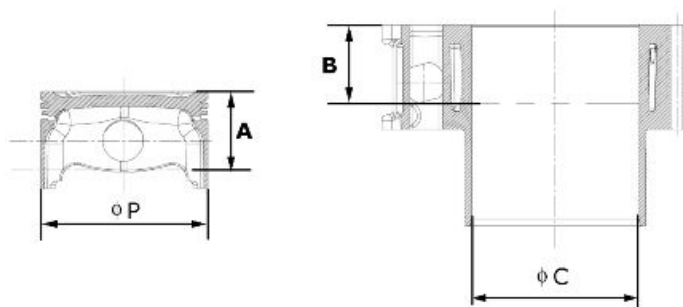


IT IS MANDATORY TO ADOPT EXCLUSIVELY "S" CLASS TYRES, WHICH GUARANTEE CORRECT VEHICLE PERFORMANCE AT THE DIFFERENT SCOOTER SPEEDS. USING ANY OTHER TYRE MAY RESULT IN VEHICLE INSTABILITY. IT IS ADVISABLE TO USE TYRE TYPES RECOMMENDED BY PIAGGIO.

Overhaul data

Assembly clearances

Cylinder - piston assy.



HEIGHT AT WHICH THE DIAMETER SHOULD BE MEASURED

Specification	Desc./Quantity
A	43.2 mm
B	43 mm

CYLINDER- PISTON

Specification	Desc./Quantity
Cylinder diameter C	85.8 - +0.018 -0.01 mm
Piston Ø P	85.768 ± 0.014 mm

CYLINDER - PISTON

COUPLING CATEGORIES

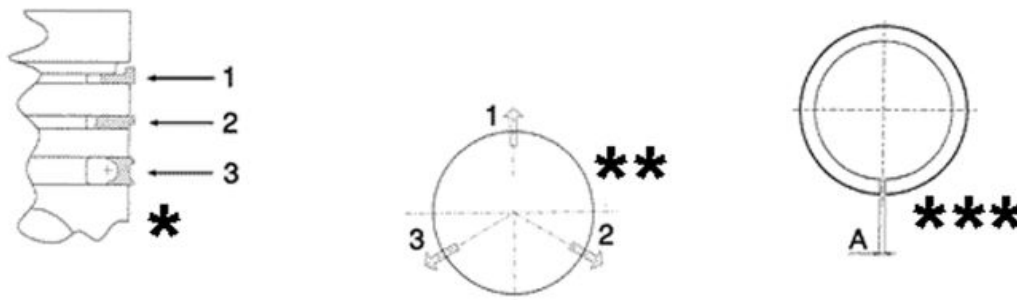
Name	Initials	Cylinder	Piston	Play on fitting
Cylinder- Piston	A	85.790÷85.797	85.754÷85.761	0.029÷0.043
Cylinder- Piston	B	85.797÷85.804	85.761 ÷ 85.768	0.029÷0.043
Cylinder- Piston	C	85.804÷85.811	85.768÷85.775	0.029÷0.043
Cylinder- Piston	D	85.811÷85.818	85.775÷85.782	0.029÷0.043

CATEGORIES OF COUPLING

N.B.

THE PISTON MUST BE INSTALLED WITH THE ARROW FACING TOWARDS THE EXHAUST SIDE, THE PISTON RINGS MUST BE INSTALLED WITH THE WORD «TOP» OR THE STAMPED MARK FACING UPWARDS.

Piston rings



*Fit rings «2» and «3» with the word «TOP» facing upwards.

** Position the port of the rings as shown here.

***Value «A» of sealing ring inside the cylinder.

Check the size of the sealing ring opening:

Compression ring: $0.15 \div 0.35$ mm. Max. value 0.5 mm

Oil scraper ring: $0.25 \div 0.50$ mm. Max. value 0.65 mm

Oil scraper ring: $0.25 \div 0.50$ mm. Max. value 0.65 mm

Rings/housing coupling clearances:

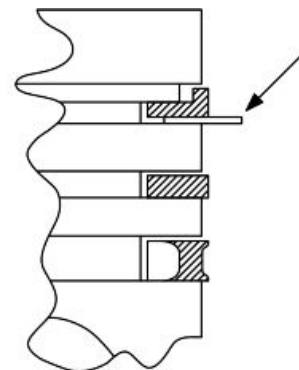
Carefully clean the sealing ring housings.

Place a thickness gauge between the ring and the housing as shown in the drawing and check the coupling clearances.

Top ring Standard coupling clearance:

$0.01 \div 0.06$ mm

Maximum clearances allowed after use: 0.10 mm



Intermediate ring Standard coupling clearance:
ance: $0.02 \div 0.07$ mm

Maximum clearances allowed after use: 0.10 mm

Oil scraper ring Standard coupling clearance:
 $0.01 \div 0.06$ mm

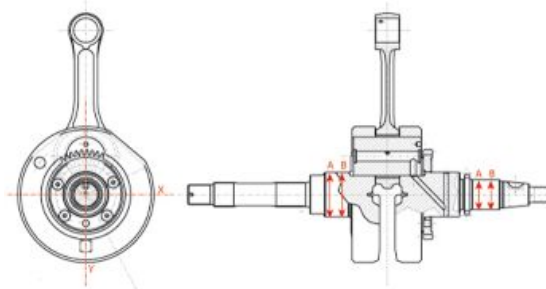
Maximum clearances allowed after use: 0.10 mm

Replace the piston if clearances exceed the maximum limits specified in the table.

Crankcase - crankshaft - connecting rod

Diameter of crankshaft bearings.

Measure the bearings on both axes x-y.



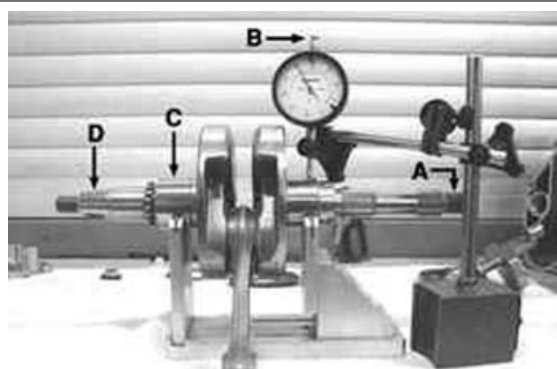
CRANKSHAFT

Specification	Desc./Quantity
Cat. 1	Standard diameter: $40.020 \div 40.026$
Cat. 2	Standard diameter: $40.026 \div 40.032$

Crankshaft alignment

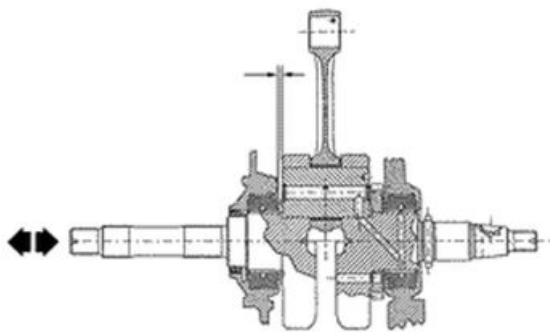
Specific tooling

020335Y Magnetic support for dial gauge

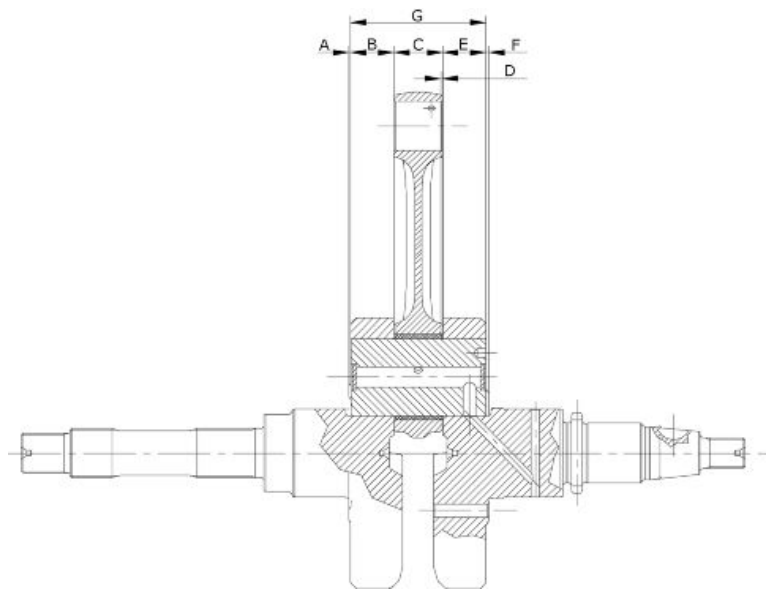


MAX. ADMISSIBLE DISPLACEMENT

Specification	Desc./Quantity
A =	0.15 mm
B =	0.010 mm
C =	0.010 mm
D =	0.10 mm



Characteristic
crankshaft / crankcase axial clearance:
0.1 ÷ 0.405 mm



AXIAL CLEARANCE BETWEEN CRANKSHAFT AND CONNECTING ROD

Name	Description	Dimensions	Initials	Quantity
Transmission-side shoulder		1±0.025	A	D = 0.20 - 0.50
Half-shaft, transmission side		20.9 -0.05	B	D = 0.20 - 0.50
Connecting rod		22 -0.10 -0.15	C	D = 0.20 - 0.50
Flywheel-side shoulder		1.8±0.025	F	D = 0.20 - 0.50
Flywheel-side half-shaft		19.6 -0.05	E	D = 0.20 - 0.50
Complete crankshaft		65.5 +0.10 -0.05	G	D = 0.20 - 0.50

Crankcase / countershaft coupling

Besides considering it should match the crankshaft, the crankcase is chosen according to the centre to centre distance between the seat of the crankshaft and that of the contra-rotating shaft.

Both the centre to centre distance and the pair of gears driving the contra-rotating shaft are divided into two types (A and B) to be matched (**A** with **A** and **B** with **B**).

This selection is useful to keep the difference between the working distance of the gears and their distance without clearance at a given value in order to avoid abnormal noise.

TYPE A

Specification	Desc./Quantity
Centre to centre distance of the gears without clearance	76.937 ÷ 76.867
Centre to centre distance on the crankcase	77.022 ÷ 76.992

TYPE B

Specification	Desc./Quantity
Centre to centre distance of the gears without clearance	76.907 ÷ 76.837
Centre to centre distance on the crankcase	76.992 ÷ 76.962

The gears with centre to centre distance without clearance between 76.867 and 76.907 are considered universal and can be fitted to either crankcase type.

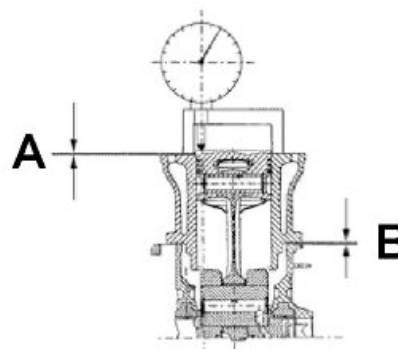
Either the pair of gears or the crankcase is identified with the letter referring to the type (on the crankcase, this mark is found at the cylinder mouth, flywheel side).

Slot packing system

Shimming system for keeping the compression ratio

DISTANCE «A» IS A PROTRUSION OR RECESS VALUE OF THE PISTON CROWN WITH RESPECT TO THE CYLINDER PLANE.

DISTANCE «A» HELPS DETERMINE THE THICKNESS OF GASKET «B» THAT HAS TO BE FITTED TO THE CYLINDER HEAD IN ORDER TO RESTORE COMPRESSION RATIO. BASE GASKET «B» MUST BE THICKER THE MORE THE PLANE FORMED BY THE PISTON TOP PROTRUDES FROM THE PLANE FORMED BY THE CYLINDER HEAD. ON THE OTHER HAND, THE MORE THE PISTON TOP IS RECESSED INTO THE CYLINDER TOP PLANE, THE SMALLER THE GASKET THICKNESS.



Characteristic

Compression ratio

10.6 ± 0.5 : 1

BASE GASKET THICKNESS

Name	Measure A	Thickness
«A» MEASURE TAKEN	- 0.185 - - 0.10	0.4 ± 0.05
«A» MEASURE TAKEN	- 0.10 - + 0.10	0.6 ± 0.05
«A» MEASURE TAKEN	+ 0.10 ÷ + 0.185	0.8 ± 0.05

N.B.

VALUES INDICATED WITH «-» REFER TO PISTON CROWN RECESSES WITH RESPECT TO THE CYLINDER PLANE.

N.B.

DISTANCE «A» MUST BE MEASURED WITHOUT ANY GASKET FITTED AT «B»

Products

RECOMMENDED PRODUCTS TABLE

Product	Description	Specifications
AGIP ROTRA 80W-90	Rear hub oil	SAE 80W/90 Oil that exceeds the requirements of API GL3 specifications
AGIP CITY HI TEC 4T	Oil to lubricate flexible transmissions (throttle control)	Oil for 4-stroke engines
AGIP FILTER OIL	Oil for air filter sponge	Mineral oil with specific additives for increased adhesiveness
AGIP GP 330	Calcium complex soap-based grease with NLGI 2; ISO-L-XBCIB2	Grease (brake control levers, throttle grip)
AGIP CITY HI TEC 4T	Engine oil	SAE 5W-40, API SL, ACEA A3, JASO MA Synthetic oil
AGIP BRAKE 4	Brake fluid	FMVSS DOT 4 Synthetic fluid
SPECIAL AGIP PERMANENT fluid	coolant	Monoethylene glycol-based antifreeze fluid, CUNA NC 956-16
AGIP FORK 7.5 W	Fork oil	Grade 7.5 W
AGIP GREASE PV2	Grease for the steering bearings, pin seats and swinging arm	White anhydrous-calcium based grease to protect roller bearings; temperature range between -20 C and +120 C; NLGI 2; ISO-L-XBCIB2.

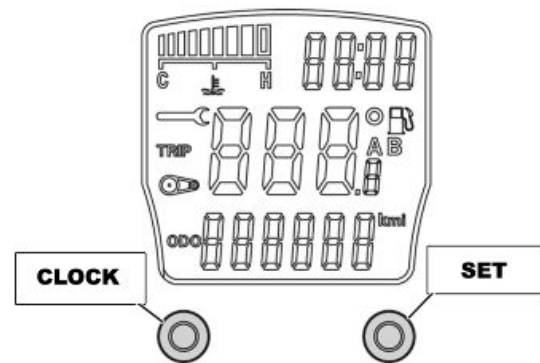
INDEX OF TOPICS

MAINTENANCE

MAIN

Follow these steps to reset the service icons:

1. With the key set to OFF, hold down the "SET" button and turn the key to ON : the "BELT" and "SERVICE" icons start flashing.
2. Push the "CLOCK" button for less than 1 second and the icons are displayed sequentially. The icon selected remains ON and the other is no longer displayed.
3. Press the "CLOCK" button again for more than 3 seconds to reset the relative maintenance step and the icon is no longer displayed.



Maintenance chart

EVERY 2 YEARS

60'

Action

Coolant - change
Brake fluid - change

AFTER 1,000 KM

60'

Action

Safety locks - check
Throttle lever - adjustment
Engine oil - change
Electrical system and battery - check
Coolant level - check
Brake fluid level - check
Engine oil - replacement
Brake pads - check condition and wear
Tyre pressure and wear - check
Vehicle and brake test - road test
Hub oil - change
Steering - Check

AFTER 5,000 KM; 25,000 KM; 35,000 KM; 55,000 KM; 65,000 KM

10'

Action

Engine oil - level check/ top-up
Brake pads - check condition and wear
Centre stand - lubrication

AFTER 10,000 KM; 50,000 KM; 70,000 KM

120'

Action

Safety locks - check
Driving belt - replacement
Throttle lever - adjustment

Action

Air filter - clean
Engine oil - change
Electrical system and battery - check
Coolant level - check
Brake fluid level - check
Engine oil - replacement
Brake pads - check condition and wear
Sliding block / variable speed rollers - change
Tyre pressure and wear - check
Vehicle and brake test - road test
Hub oil - check
Suspensions - check
Steering - Check
Centre stand - lubrication
Spark plugs - replacement

AFTER 15,000 KM; 45,000 KM; 75,000 KM

10'

Action

Engine oil - level check/ top-up
Brake pads - check condition and wear
Centre stand - lubrication

AFTER 20,000 KM; 40,000 KM; 60,000 KM AND 80,000 KM

190'

Action

Spark plugs - replacement
Driving belt - replacement
Throttle lever - adjustment
Air filter - check
Engine oil - change
Valve clearance - check
Electrical system and battery - check
Coolant level - check
Engine oil - replacement
Brake pads - check condition and wear
Sliding block / variable speed rollers - change
Tyre pressure and wear - check
Vehicle and brake test - road test
Hub oil - change
Suspensions - check
Steering - Check
Centre stand - lubrication
Brake fluid level - check

30,000 KM

200'

Action

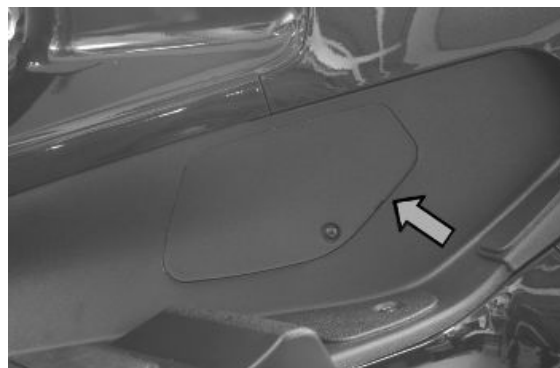
Safety locks - check
Driving Belt - replacement
Throttle lever - adjustment
Air filter - cleaning
Engine oil - change
Electrical system and battery - check
Coolant level - check
Brake fluid level - check
Engine oil - replacement
Hub oil - check
Brake pads - check condition and wear
Sliding block / variable speed rollers - change
Tyre pressure and wear - check
Vehicle and brake test - road test
Suspensions - check

Action
Steering - Check
Centre stand - lubrication
Spark plugs - replacement

Spark plug

Remove the port on the left-hand side panel of the vehicle by undoing the fixing screw and using a small screwdriver in the rear recess shown in the figure, then do the following:

- Disconnect the HV wire cap «A» of the spark plug;
- Unscrew the spark plug using the wrench supplied;
- Upon refitting, place the spark plug at the required angle and tighten by hand until it is finger tight;
- Use the wrench only for final tightening of the spark plug;
- Place cap «A» fully over the spark plug.
- Refit the port making sure the rear hook is inserted.



WARNING



THE SPARK PLUG MUST BE REMOVED WHEN THE ENGINE IS COLD. REPLACE THE SPARK PLUG AS INDICATED IN THE SCHEDULED MAINTENANCE TABLE. THE USE OF ELECTRONIC CENTRAL UNITS AND OF NON-COMPLIANT ELECTRONIC IGNITIONS OR SPARK PLUGS OTHER THAN THOSE PRESCRIBED MAY SERIOUSLY DAMAGE THE ENGINE.

N.B.

USING SPARK PLUGS OTHER THAN THE INDICATED TYPE OR SHIELDLESS SPARK PLUG CAPS CAN CAUSE ELECTRICAL SYSTEM FAILURES.

Characteristic

Spark plug

CHAMPION RG 6 YC

Alternative spark plug

NGK CR7EKB

Electric characteristic

Electrode gap

0.7 ÷ 0.8 mm

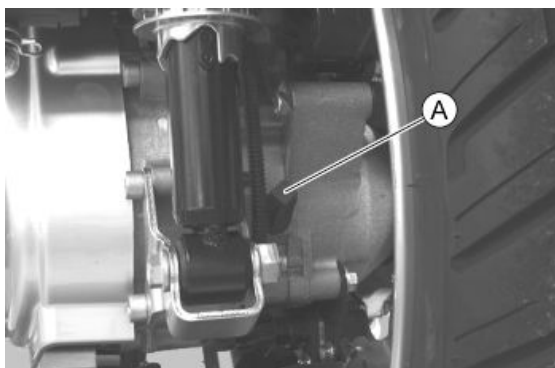
Locking torques (N*m)

Spark plug 12 ÷ 14

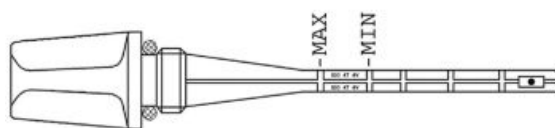
Hub oil

Check

- Park the vehicle on its centre stand on flat ground;
- Remove the oil dipstick «A», dry it with a clean cloth and put it back into its hole **tightening it completely**;



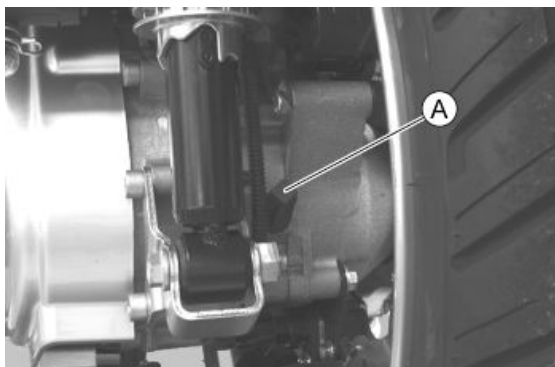
Remove the dipstick and check that the oil level is slightly over the second notch starting from the lower end; if the level is below the **MAX** mark, it needs to be filled up with the right amount of hub oil.



- Screw up the oil dipstick again and make sure it is locked properly into place.

Replacement

- Remove the oil filler cap «A».
- Unscrew the oil drainage cap "B" and drain out all the oil.
- Screw in the drainage cap again and fill the hub with the prescribed oil.



Recommended products

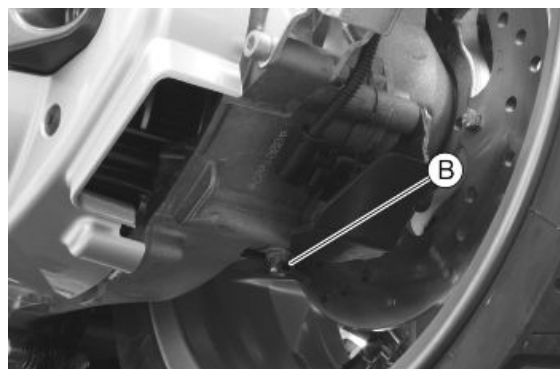
AGIP ROTRA 80W-90 Rear hub oil

SAE 80W/90 Oil that exceeds the requirements of API GL3 specifications

Characteristic

Rear hub oil

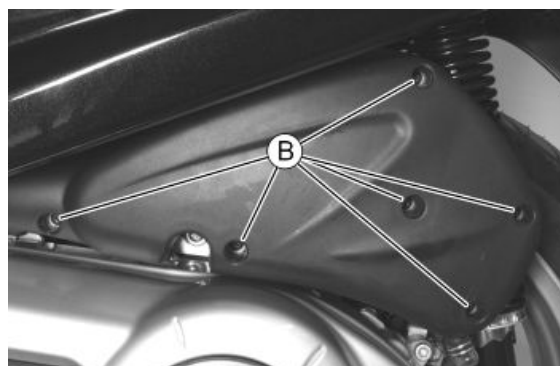
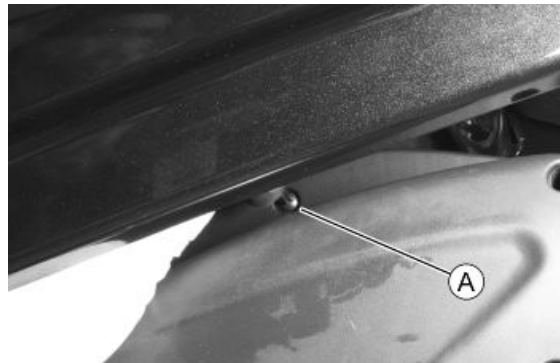
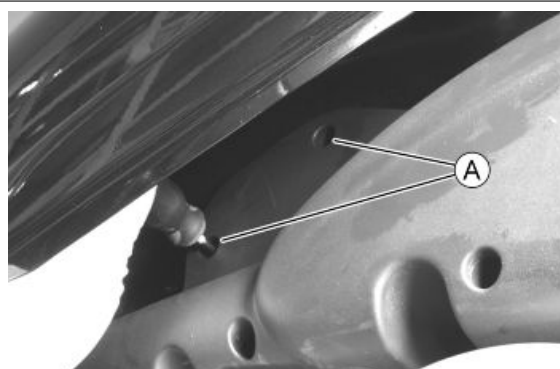
Capacity approximately 250 cc

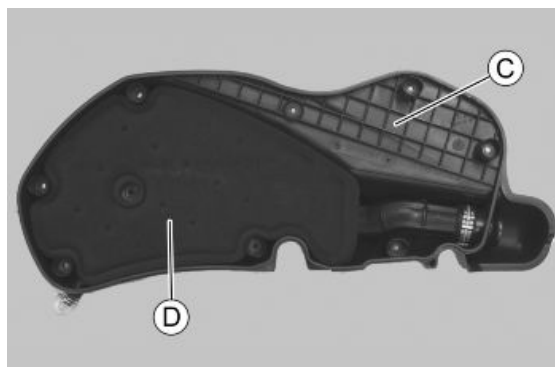


Air filter

Proceed as follows:

1. From the inside of the rear wheel housing, undo the three screws «A».
2. Undo the six screws «B».
3. Remove the air filter cover «C».
4. Remove the air filter «D».





- Wash the sponge with water and mild soap.
- Dry it with a clean cloth and short blasts of compressed air.
- Soak it in a mixture of 50% petrol and 50% specified oil.
- Gently squeeze the filtering element with your hands but do not wring it; allow it to drip dry and then refit.

**CAUTION**

IF THE VEHICLE IS USED ON DUSTY ROADS, IT IS NECESSARY TO SERVICE THE AIR FILTER MORE OFTEN TO AVOID DAMAGING THE ENGINE.

Recommended products**AGIP FILTER OIL Oil for air filter sponge**

Mineral oil with specific additives for increased adhesiveness

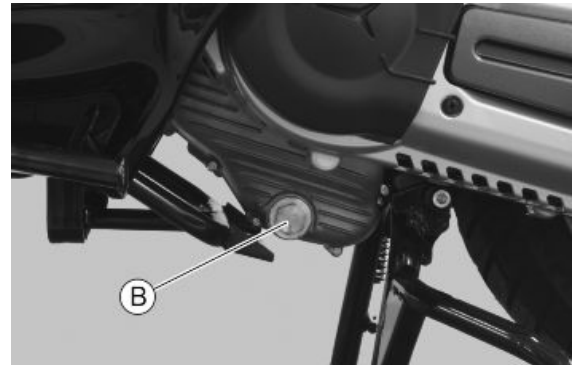
Engine oil

In 4T engines, the engine oil is used to lubricate the distribution elements, the bench bearings and the thermal group. **An insufficient quantity of oil can cause serious damage to the engine.**

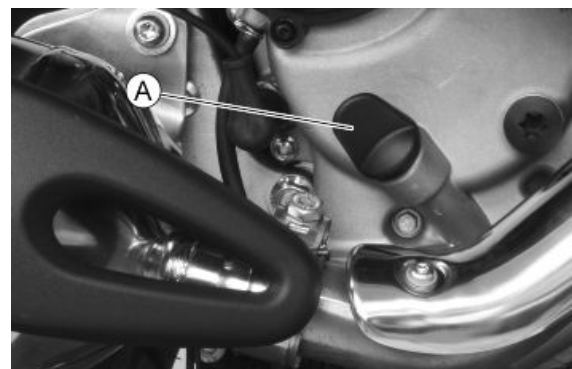
In all 4T engines, the deterioration of the oil characteristics, or a certain consumption should be considered normal, especially if during the run-in period. Consumption levels in particular can be influenced by the conditions of use (e.g.: oil consumption increases when driving at "full throttle").

Replacement

Change oil and replace filter as indicated in the scheduled maintenance table. Empty the engine by draining the oil through drainage plug «B».



To facilitate oil drainage, loosen the cap/dipstick «A».



Once all the oil has drained through the drainage hole, unscrew and remove the oil cartridge filter «C».



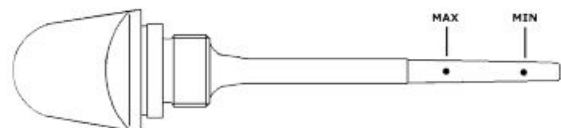
Make sure the pre-filter and drainage plug O-rings are in good conditions.

Lubricate them and refit the mesh filter and the oil drainage plug, screwing them up to the prescribed torque.

Refit the new cartridge filter being careful to lubricate the O-ring before fitting it.

Change the engine oil.

Since a certain quantity of oil still remains in the circuit, engine oil must be added through plug «A». Then start the scooter, leave it running for a



few minutes and switch it off: after five minutes check the level and if necessary top up without exceeding the **MAX** level. The cartridge filter must be replaced every time the oil is changed. Use new oil of the recommended type for topping up and changing purposes.

N.B.

THE ENGINE MUST BE HOT WHEN THE OIL IS CHANGED.

Recommended products**AGIP CITY HI TEC 4T Engine oil**

SAE 5W-40 Synthetic oil that exceed the requirements of API SL, ACEA A3, JASO MA specifications

Locking torques (N*m)

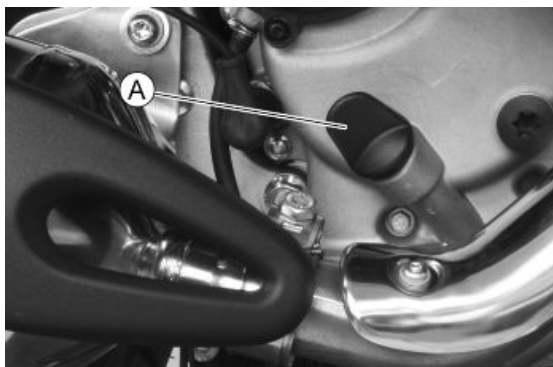
Engine oil filter 12 - 16 Engine oil drainage plug
24 ÷ 30

Check

This operation must be carried out with the engine cold and following the procedure below:

- Place the vehicle on its centre stand and on flat ground.
- Unscrew the cap/dipstick «A», dry it with a clean cloth and reinsert it, **screwing it all the way down**.
- Remove the cap/dipstick again and check that the level is between the min and max reference marks; top-up, if required.

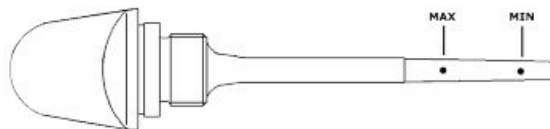
If the check is carried out after the vehicle has been used, and therefore with a hot engine, the level line will be lower; in order to carry out a correct check, wait at least 10 minutes after the engine has been stopped so as to get the correct level.



Oil top up

The oil should be topped up after having checked the level and in any case by adding oil **without ever exceeding the MAX. level.**

Restoring the level from the **MIN** to the **MAX** marks requires approx. **400 m³** of oil.



Engine oil filter

CAUTION

DO NOT DISPOSE OF OIL IN THE ENVIRONMENT. OIL, GASKET AND FILTER SHOULD BE DISPOSED OF ACCORDING TO THE REGULATIONS IN FORCE.

WARNING

AVOID TOUCHING PARTS OF THE ENGINE WHEN HOT, AS THIS MAY CAUSE BURNS.

The cartridge filter must be replaced every time the oil is changed. Use new oil of the recommended type for topping up and changing purposes.

Make sure the pre-filter and drainage plug O-rings are in good conditions. Lubricate them and refit the mesh filter and the oil drainage plug, screwing them up to the prescribed torque. Refit the new cartridge filter being careful to lubricate the O-ring before fitting it. Change the engine oil.

Recommended products

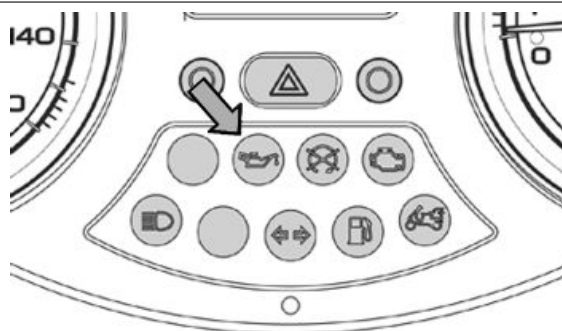
AGIP CITY HI TEC 4T Engine oil

SAE 5W-40 Synthetic oil that exceed the requirements of API SL, ACEA A3, JASO MA specifications

Oil pressure warning light

The vehicle is equipped with a warning light on the instrument panel that lights up when the key is turned to the «ON» position. However, this light should switch off once the engine has been started.

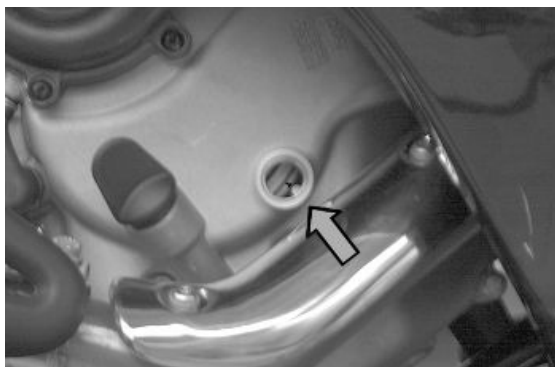
If the light turns on during braking, at idling speed or while turning a corner, it is necessary to check the oil level and the lubrication system.



Checking the ignition timing

- Remove the plastic cap on the flywheel cover
- Turn the flywheel until the reference mark «T» on the rotor matches the reference mark on the flywheel cover as shown in the figure (TDC). Make sure that the 4V reference point on the camshaft control pulley is aligned with the reference point on the head as shown in the second figure. If the reference is opposite the indicator on the head, turn the crankshaft once more.

For the use of this reference mark, remove the spark plug and turn the engine in the direction that is the reverse of the normal direction using a caliper spanner applied to the camshaft command pulley casing.



Checking the valve clearance

- To check the clearance in the valves collimate the references between the cam shaft control pulley and head.
- Use a feeler to make sure the clearance between the valve and register screw correspond to the indicated values. If the clearance does not correspond, adjust it by loosening the lock nut using a screwdriver on the set screw as shown in the figure.



Characteristic

Valve clearance

Inlet: 0.15 mm

Outlet: 0.15 mm

Cooling system

Adding engine coolant.

Check coolant level when the engine is cold as indicated in the scheduled maintenance table, following the steps below:

Place the scooter on its centre stand and on flat ground.

- Undo the screw shown in the figure and remove the expansion tank cap on RHS.

- Top up if the fluid level is near or below the MIN level edge. The liquid level must always be between the MIN and MAX level.

- The coolant consists of an ethylene glycol and corrosion inhibitor based 50% de-ionised water-antifreeze solution mix.

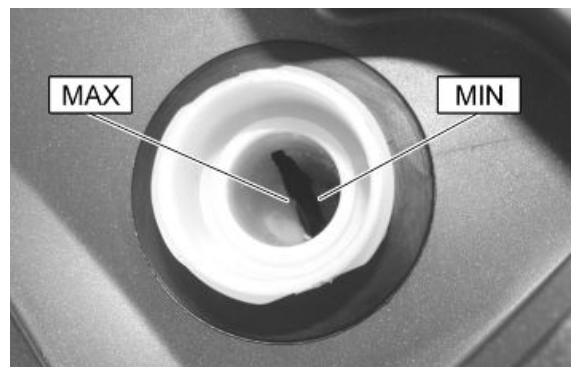
CAUTION

DO NOT EXCEED THE MAX LEVEL WHEN FILLING SO THAT COOLANT DOES NOT SPILL OVER THE EXPANSION TANK WHEN THE VEHICLE IS BEING USED.

Recommended products

SPECIAL AGIP PERMANENT fluid Coolant

Monoethylene glycol based antifreeze solution, CUNA NC 956-16

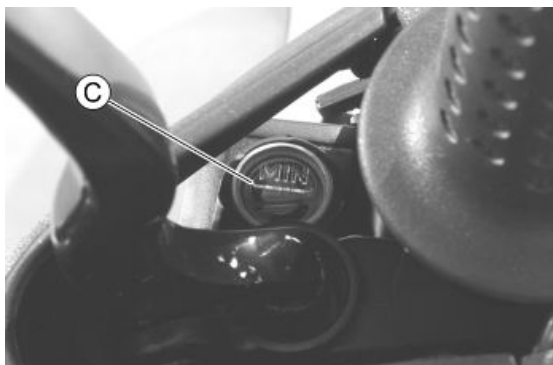


Braking system

Level check

The front and rear brake fluid reservoirs are both positioned on the handlebars. Proceed as follows:

- Rest the vehicle on its centre stand with the handlebars perfectly horizontal;
- Check the fluid level through the sight glass «C». A certain lowering of the level is caused by wear on the pads.



Top-up

Proceed as follows: Loosen the screw «B» and lift the plastic cover «A» in order to access the brake fluid reservoir. Loosen the two fixing screws and remove the reservoir cover; top-up with the recommended fluid without exceeding the 'MAX.' mark.

This procedure applies to the rear brake pump top-up operation; follow the same procedure for the front brake pump.

Under standard climatic conditions, replace coolant as indicated in the scheduled maintenance table.

WARNING



ONLY USE DOT 4 CLASS BRAKE FLUIDS. BRAKING CIRCUIT FLUIDS ARE HIGHLY CORROSIVE. MAKE SURE THAT IT DOES NOT COME INTO CONTACT WITH THE PAINTWORK.

CAUTION

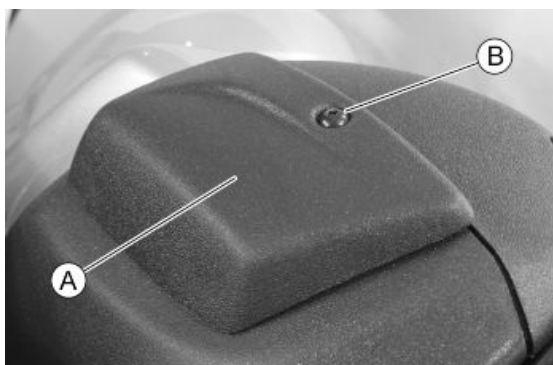


AVOID CONTACT OF THE BRAKE FLUID WITH YOUR EYES, SKIN, AND CLOTHING. IN CASE OF ACCIDENTAL CONTACT, WASH WITH WATER.

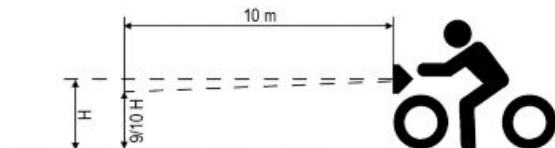
Recommended products

AGIP BRAKE 4 Brake fluid

FMVSS DOT4 Synthetic fluid



Headlight adjustment



Proceed as follows:

1. Position the unloaded vehicle, in running order and with the tyres inflated to the prescribed pressure, on a flat surface 10 m away from a half-lit white screen; ensure that the longitudinal axis of the vehicle is perpendicular to the screen;
2. Turn on the headlight and check that the borderline of the projected light beam is lower than 9/10 and higher than 7/10 of the distance from the ground to the centre of the vehicle headlight;
3. If not, adjust the headlight by turning the central screw «A» placed behind the Piaggio badge.



N.B.

THE ABOVE PROCEDURE COMPLIES WITH THE EUROPEAN STANDARDS REGARDING MAXIMUM AND MINIMUM HEIGHT OF LIGHT BEAMS. REFER TO THE STATUTORY REGULATIONS IN FORCE IN EVERY COUNTRY WHERE THE VEHICLE IS USED.

Checking the end compression pressure

- Remove the spark plug cap when the engine is cold.
- Remove the ignition spark plug.
- Fit a compression test gauge into the spark plug seat using a 10mm spark plug union at the proper tightening torque.
- Turn the switch to «ON», wait a few seconds and then disconnect the rpm-timing sensor connector to disable the injector and spark plug operation.
- Let the engine run using the starter motor and with the throttle body in fully open position as long as the pressure gauge value is steady.
- If the pressure exceeds the level specified, remove the tool and proceed with the vehicle refitting.
- If the pressure is below the level specified, check the rpm at which the test is carried out; if less than 450 rpm, check the start-up system.

If the compression end pressure is below the standard, remove the pressure gauge coupling and pour some oil into the combustion chamber, turn the engine (preferably manually) to lubricate the cylinder.

Repeat the pressure test:

If the new values are still low, check valves for correct sealing.

Characteristic**Compression ratio**

10.6 ± 0.5 : 1

Locking torques (N*m)

Spark plug 12 ÷ 14

INDEX OF TOPICS

TROUBLESHOOTING

TROUBL

This section makes it possible to find what solutions to apply when troubleshooting.

For each failure, a list of the possible causes and pertaining operations is given.

Engine

Excessive oil consumption/Exhaust smoke

EXCESSIVE CONSUMPTION

Possible Cause	Operation
Wrong valve adjustment	Adjust the valve clearance properly
Overheated valves	Remove the head and the valves, grind or replace the valves
Misshapen/worn valve seats	Replace the head unit
Worn cylinder, Worn or broken piston rings	Replace the piston cylinder assembly or piston rings
Worn or broken piston rings or piston rings that have not been fitted properly	Replace the piston cylinder unit or just the piston rings
Oil leaks from the couplings or from the gaskets	Check and replace the gaskets or restore the coupling seal
Worn valve oil guard	Replace the valve oil guard
Worn valve guides	Check and replace the head unit if required

Insufficient lubrication pressure

LOW LUBRICATION PRESSURE

Possible Cause	Operation
By-Pass remains open	Check the By-Pass and replace if required. Carefully clean the By-Pass area.
Oil pump with excessive clearance	Perform the dimensional checks on the oil pump components
Oil filter too dirty	Replace the cartridge filter
Oil level too low	Restore the level adding the recommended oil type

Transmission and brakes

Clutch grabbing or performing inadequately

IRREGULAR CLUTCH PERFORMANCE OR SLIPPAGE

Possible Cause	Operation
Faulty clutch	Check that there is no grease on the masses. Check that the clutch mass faying surface with the bell is mainly in the centre with equivalent characteristics on the three masses. Check that the clutch casing is not scored or worn in an anomalous way

Insufficient braking

INEFFICIENT BRAKING SYSTEM

Possible Cause	Operation
Inefficient braking system	Check the pad wear (1.5 min). Check that the brake discs are not worn, scored or warped. Check the correct level of fluid in the pumps and change brake fluid if necessary. Check there is no air in the circuits; if necessary, bleed the air. Check that the front brake calliper moves in axis with the disc.
Fluid leakage in hydraulic braking system	Failing elastic fittings, plunger or brake pump seals, replace

Possible Cause	Operation
Brake disc slack or distorted	Check the brake disc screws are locked; measure the axial shift of the disc with a dial gauge and with wheel mounted on the scooter.

Brakes overheating

BRAKES OVERHEATING

Possible Cause	Operation
Defective plunger sliding	Check calliper and replace any damaged part.
Brake disc slack or distorted	Check the brake disc screws are locked; use a dial gauge and a wheel mounted on the vehicle to measure the axial deviation of the disc.
Clogged compensation holes on the pump	Clean carefully and blast with compressed air
Swollen or stuck rubber gaskets	Replace gaskets.

Steering and suspensions

Heavy steering

STEERING HARDENING

Possible Cause	Operation
Steering hardening	Check the tightening of the top and bottom ring nuts. If irregularities continue in turning the steering even after making the above adjustments, check the seats in which the ball bearings rotate: replace them if they are recessed or if the balls are flattened.

Excessive steering play

EXCESSIVE STEERING CLEARANCE

Possible Cause	Operation
Torque not conforming	Check the tightening of the top and bottom ring nuts. If irregularities continue in turning the steering even after making the above adjustments, check the seats in which the ball bearings rotate: replace them if they are recessed or if the balls are flattened.

Noisy suspension

NOISY SUSPENSION

Possible Cause	Operation
Malfunctions in the suspension system	If the front suspension is noisy, check: the efficiency of the front shock absorber; the condition of the ball bearings and relevant lock-nuts, the limit switch rubber buffers; and the movement bushings. In conclusion, check the tightening torque of the wheel hub, the brake calliper, the shock absorber disc in the attachment to the hub and the steering tube.

Suspension oil leakage

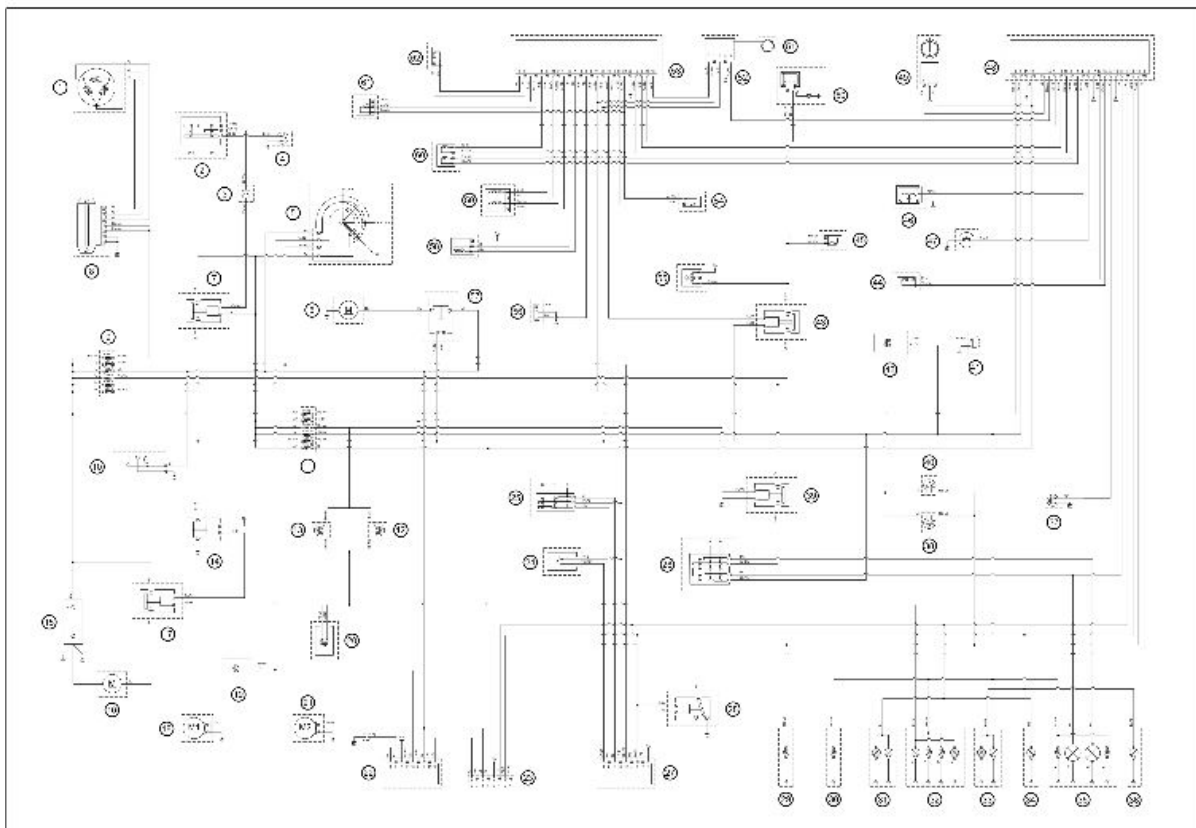
OIL LEAKAGE FROM SUSPENSION

Possible Cause	Operation
Faulty or broken seals	Replace the shock absorber Check the condition of wear of the steering covers and the adjustments.

INDEX OF TOPICS

ELECTRICAL SYSTEM

ELE SYS

**KEY**

1. Magneto flywheel
2. Engine stop switch
3. Diode
4. Side stand button
5. Key switch
6. Electric fan
7. Engine stop remote control switch
8. Voltage regulator
9. Main fuses
10. 12V-180W Plug socket
11. Auxiliary fuses
12. Stop button on front brake
13. Stop button on rear brake
14. Immobilizer remote control switch
15. 12V-12Ah Battery
16. Starter motor
17. Start-up remote control switch
18. Boot actuator
19. Boot opening switch

- 20. Starter button
- 21. Saddle opening actuator
- 22. Saddle opening control unit
- 23. Wiring for anti-theft device
- 24. «HAZARD» button
- 25. Turn indicator switch
- 26. Light switch
- 27. Turn indicator control device
- 28. Light switch remote control
- 29. Helmet compartment light bulb
- 30. License plate bulb
- 31. Rear left turn indicator
- 32. Rear light
 - A. Stop light bulbs
 - B. Tail light bulbs
- 33. Rear right turn indicator
- 34. Front left turn indicator
- 35. Front light
 - A. Tail light bulbs
 - B. High-beam light bulb
 - C. Low-beam light bulb
- 36. Front right turn indicator
- 37. «MODE» button
- 38. Helmet compartment light switch
- 39. Headlight remote control
- 40. Boot light switch
- 41. Horn
- 42. Horn button
- 43. Injection load remote control
- 44. Ambient temperature sensor
- 45. Fuel injector
- 46. Fuel level transmitter
- 47. Oil pressure sensor
- 48. Instrument panel
- 49. Wheel turning sensor
- 50. HV coil
- 51. Immobilizer aerial
- 52. Decoder

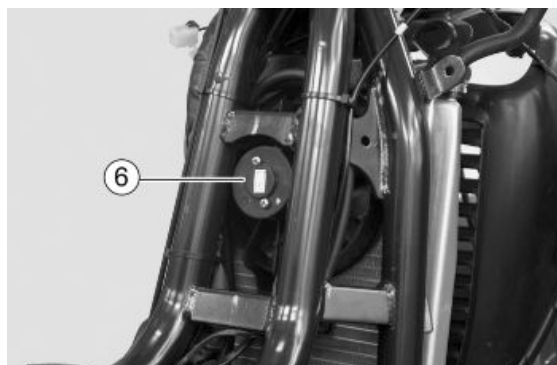
- 53. Injection ECU
- 54. Intake air temperature sensor
- 55. Fuel pump
- 56. Diagnosis connector

Ar = Orange, **Az** = Sky Blue, **Bi** = White, **Bl** = Blue, **Gi** = Yellow, **Gr** = Grey, **Ma** = Brown, **Ne** = Black, **Ro** = Pink, **Rs** = Red, **Ve** = Green, **Vi** = Purple

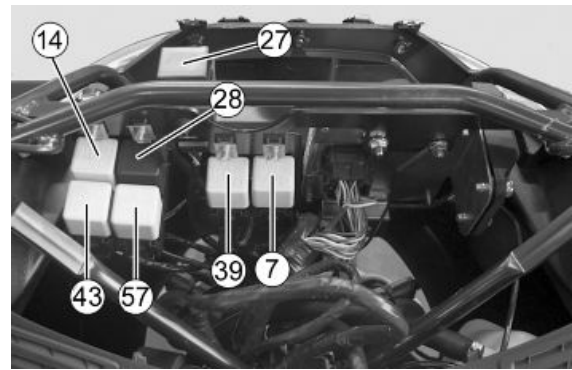
Components arrangement



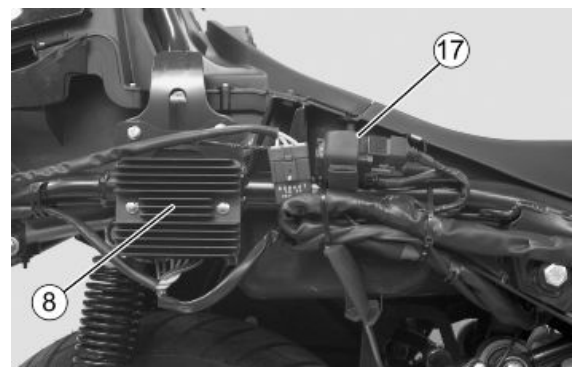
6 - Electric fan: placed at the front of the vehicle, remove the shield back plate to reach it and remove the radiator to extract it.



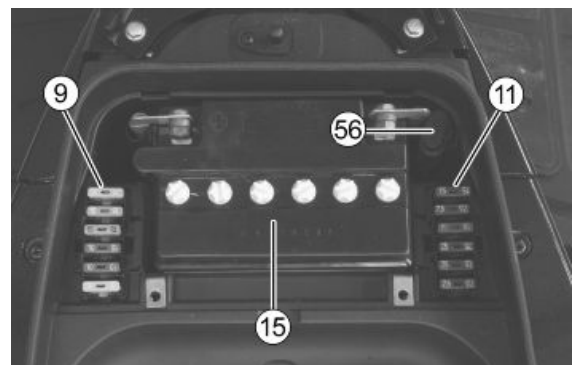
7 / 14 / 28 / 39 / 43 / 57 / 27 - Remote control switches: engine stop / immobilizer / light switch / headlight / injection load / electric fan / turn indicator control device: remove the instrument panel bottom section to reach them.



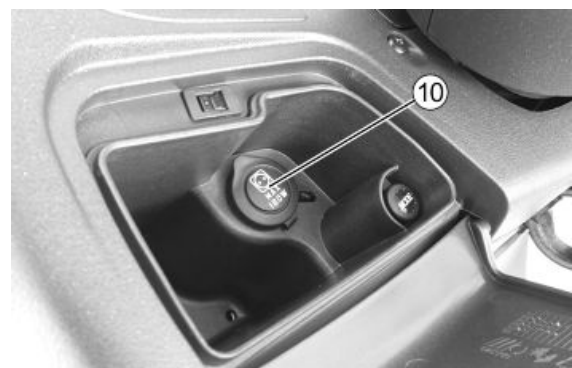
8 / 17 - Voltage regulator / Start-up remote control switch: remove the right fairing to reach them



9 / 11 / 15 / 56 - Main fuses / Auxiliary fuses / 12V-12Ah Battery / Connector for diagnosis: remove the cover located in the helmet compartment to reach them.



10 - 12V-180W Plug socket



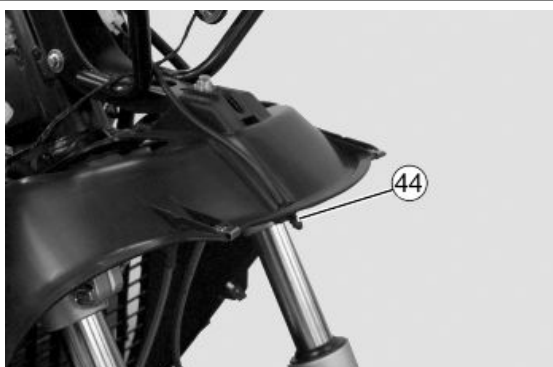
22 - Saddle opening control unit: remove the left side panel to reach it.



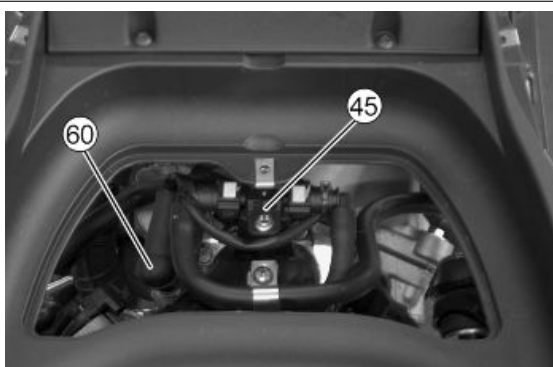
41 - Horn: remove the wheel housing lower clamp to reach it.



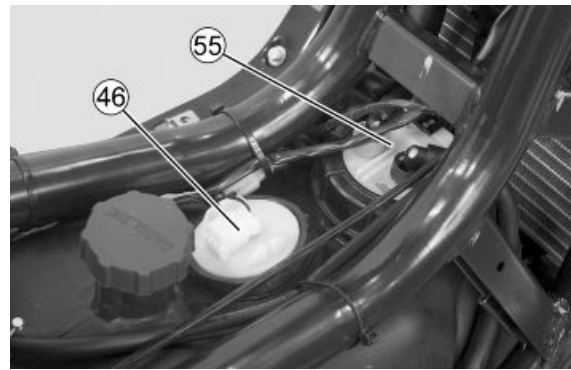
44 - Ambient temperature sensor: remove the front headlight assembly to reach it.



45 / 60 - Fuel injector / Engine temperature sensor: remove the inspection door in the helmet compartment to reach them.



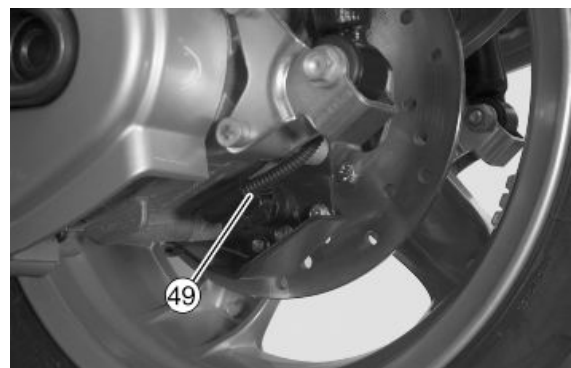
46 / 55 - Fuel level transmitter / Fuel pump: remove the central chassis cover to reach them.



47 - Oil pressure sensor.



49 - Wheel turning sensor: the sensor is placed on the engine crankcase, near the left shock absorber lower attachment.



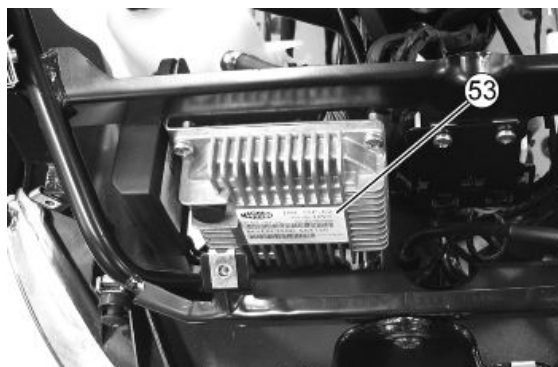
50 - HV coil: remove the central chassis cover to reach it.



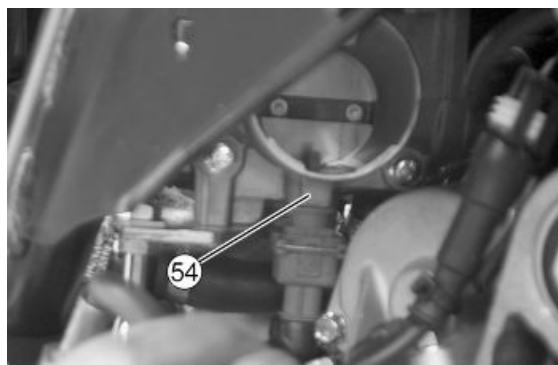
51 / 52: Immobilizer aerial / Decoder: remove the legshield and the shield back plate to reach them.



53 - Injection ECU: remove the front shield to reach it.



54 - Intake air temperature sensor: remove the left side fairing and the air filter manifold to reach it.



59 - Stepper motor: remove the inspection door in the helmet compartment to reach them.

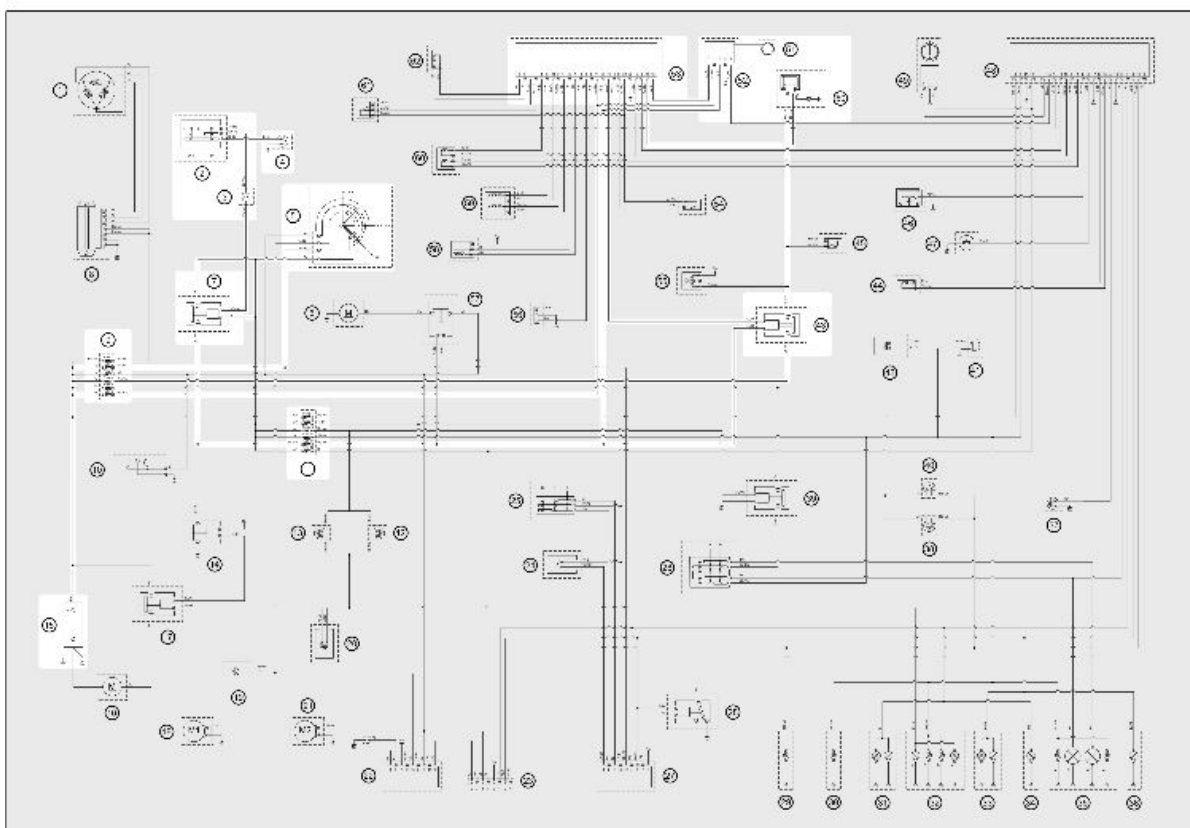


62 - Lambda probe: The lambda probe is fitted on the exhaust manifold.



Conceptual diagrams

Ignition

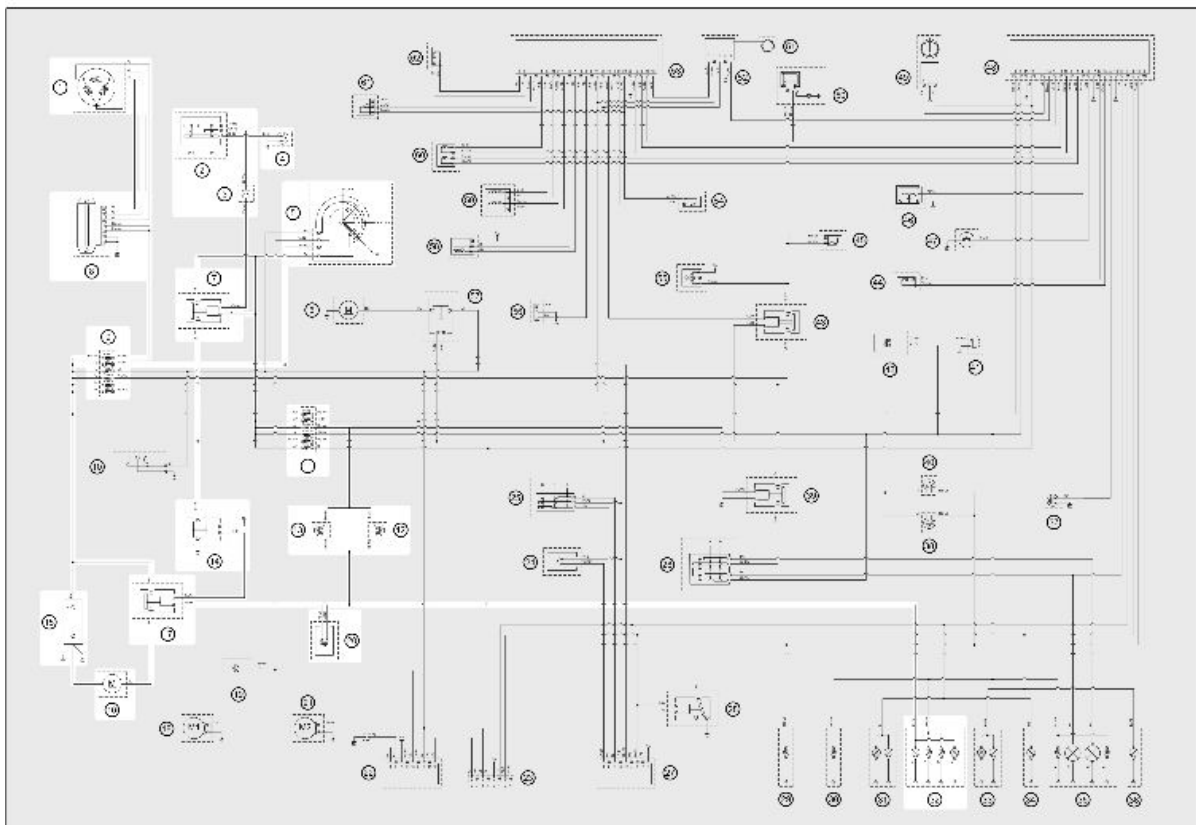


KEY

- 2. Engine stop switch
- 3. Diode
- 4. Side stand button
- 5. Key switch
- 7. Engine stop remote control switch
- 9. Main fuses
- 11. Auxiliary fuses

- 15. 12V-12Ah Battery
- 43. Injection load remote control
- 50. HV coil
- 51. Immobilizer aerial
- 52. Decoder
- 53. Injection ECU

Battery recharge and starting

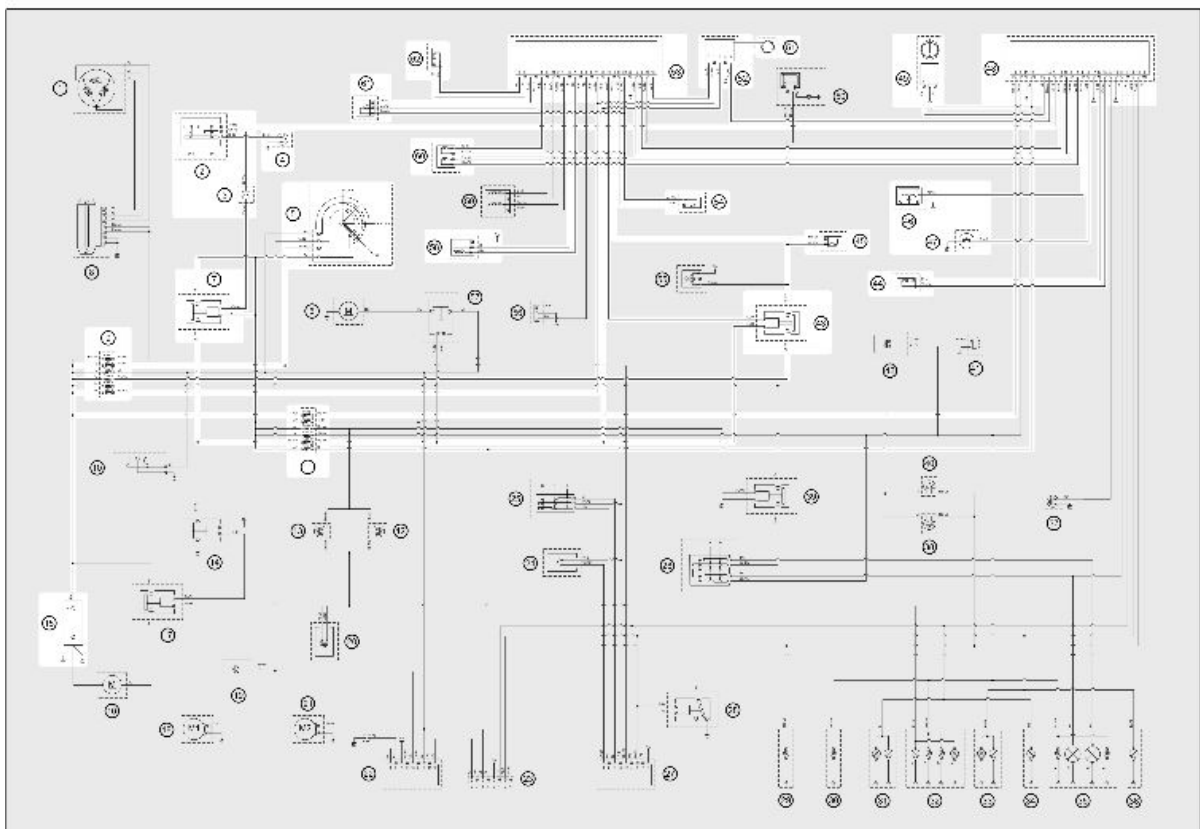


KEY

- 1. Magneto flywheel
- 2. Engine stop switch
- 3. Diode
- 4. Side stand button
- 5. Key switch
- 7. Engine stop remote control switch
- 8. Voltage regulator
- 9. Main fuses
- 11. Auxiliary fuses
- 12. Stop button on front brake
- 13. Stop button on rear brake

- 14. Immobilizer remote control switch
- 15. 12V-12Ah Battery
- 16. Starter motor
- 17. Start-up remote control switch
- 20. Starter button
- 32. Rear light
- A. Stop light bulbs

Level indicators and enable signals section

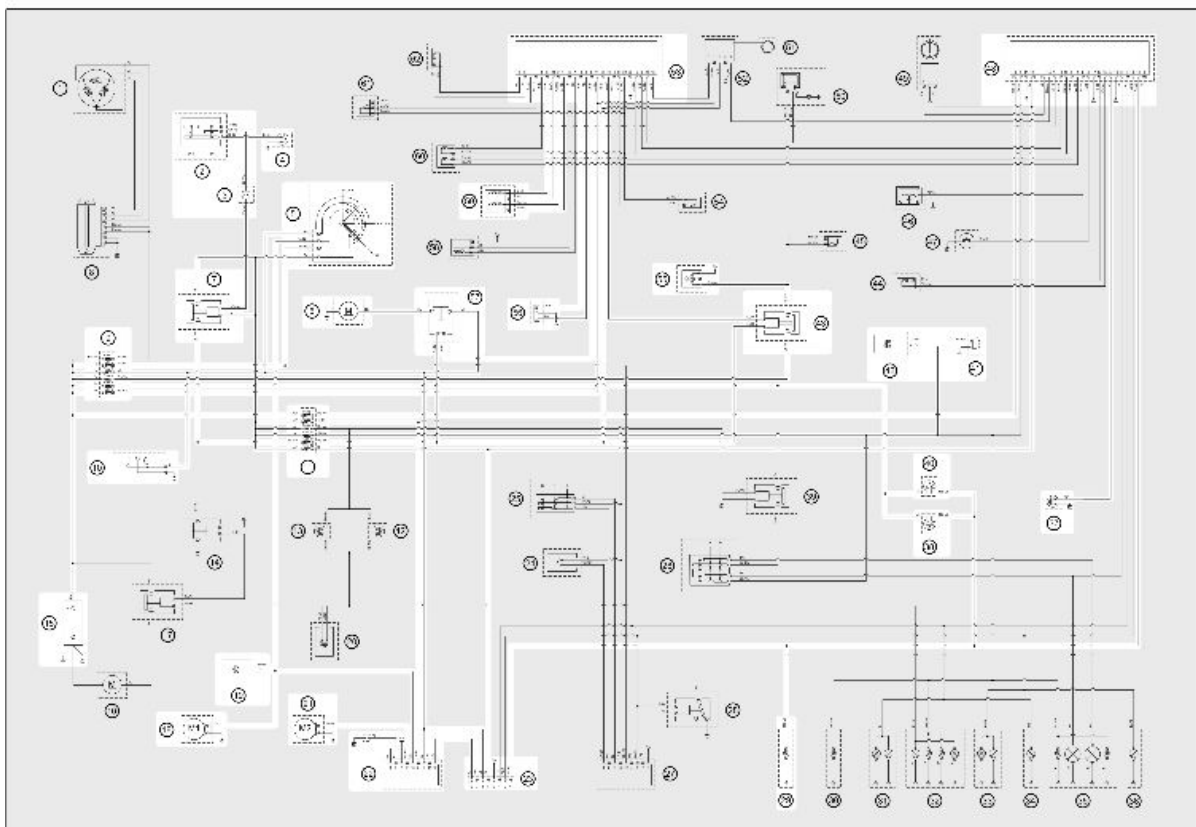


KEY

- 2. Engine stop switch
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- 7. Engine stop remote control switch
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- 43. Injection load remote control
- 44. Ambient temperature sensor

- 45. Fuel injector
- 46. Fuel level transmitter
- 47. Oil pressure sensor
- 48. Instrument panel
- 49. Wheel turning sensor
- 51. Immobilizer aerial
- 52. Decoder
- 53. Injection ECU
- 54. Intake air temperature sensor
- 58. Engine rpm sensor
- 60. Engine temperature sensor
- 61. Throttle valve potentiometer
- 62. Lambda probe

Devices and accessories

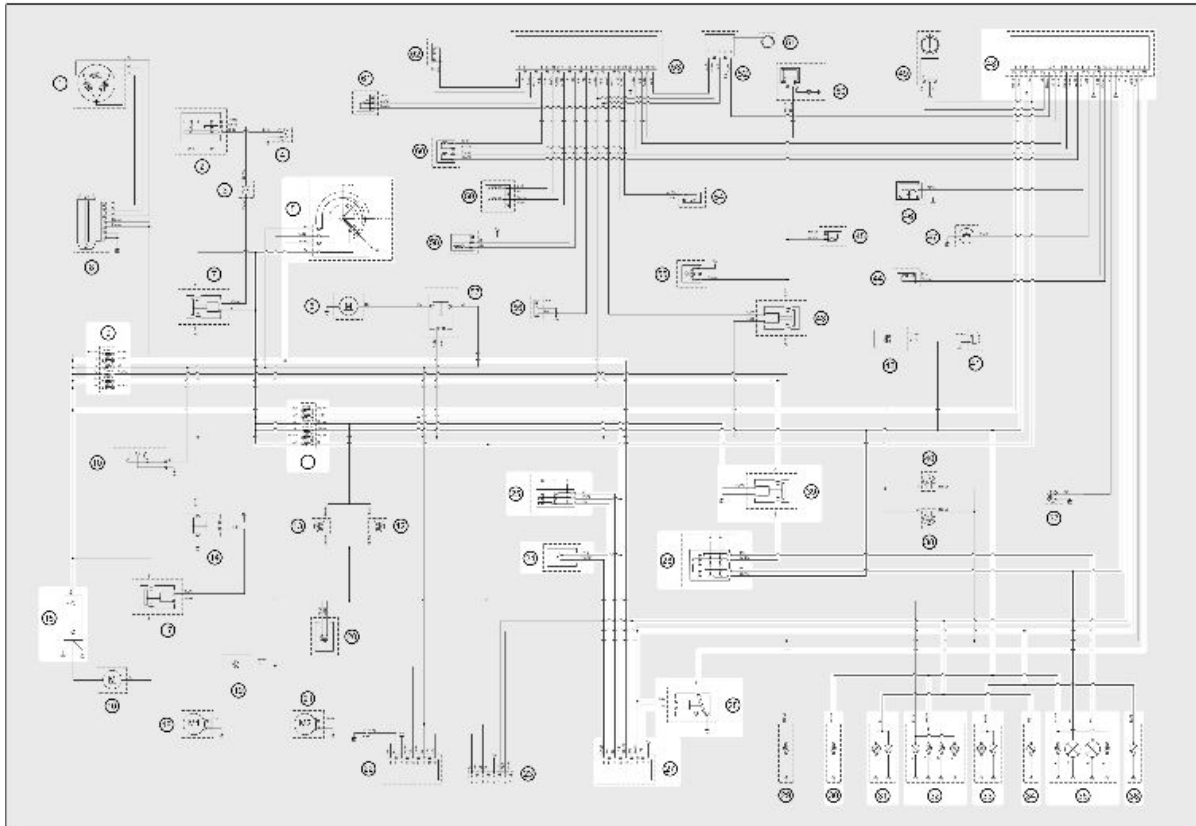


KEY

- 2. Engine stop switch
- 3. Diode
- 4. Side stand button
- 5. Key switch

- 6. Electric fan
 - 7. Engine stop remote control switch
 - 9. Main fuses
 - 10. 12V-180W Plug socket
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 - 18. Boot actuator
 - 19. Boot opening switch
 - 21. Saddle opening actuator
 - 22. Saddle opening control unit
 - 23. Wiring for anti-theft device
 - 29. Helmet compartment light bulb
 - 37. «**MODE**» button
 - 38. Helmet compartment light switch
 - 40. Boot light switch
 - 41. Horn
 - 42. Horn button
 - 43. Injection load remote control
 - 48. Instrument panel
 - 53. Injection ECU
 - 55. Fuel pump
 - 56. Diagnosis connector
 - 57. Electric fan remote control
 - 59. Stepper motor
-

Lights and turn indicators



KEY

- 5. Key switch
- 9. Main fuses
- 11. Auxiliary fuses
- 15. 12V-12Ah Battery
- 24. «HAZARD» button
- 25. Turn indicator switch
- 26. Light switch
- 27. Turn signal command device
- 28. Light switch remote control
- 30. License plate bulb
- 31. Rear left turn indicator
- 32. Rear light
- B. Tail light bulbs
- 33. Rear right turn indicator
- 34. Front left turn indicator
- 35. Front light
- A. Tail light bulbs

- B. High-beam light bulb
 - C. Low-beam light bulb
 - 36. Front right turn indicator
 - 39. Headlight remote control
 - 48. Instrument panel
-

Checks and inspections

Immobiliser

The electronic ignition system is controlled by the control unit and the immobilizer decoder. The immobilizer is an anti-theft system that allows the vehicle to be operated only when it is started with coded keys recognised by the control unit. The code is integrated in a transponder in the key block. This allows the driver clear operation without having to do anything other than just turning the key. The Immobiliser system consists of the following components:

- electronic control unit
- decoder
- immobilizer aerial
- master key with integrated transponder (brown key)
- service key with incorporated transponder (black key)
- HV coil
- diagnosis LED

The diagnosis LED also works as a theft-deterrent blinker. This function is activated every time the ignition switch is turned to the "OFF" position, or the emergency stop switch is turned to the "OFF" position. It remains activated for 48 hours in order not to affect the battery charge. When the ignition switch is turned to the "ON" position, the theft-deterrent blinker function is deactivated. Subsequently, a flash confirms the switching to the "ON" status. The duration of the flash depends on the programming of the electronic control unit. If the LED is off regardless of the position of the ignition-key switch and/or the instrument panel is not initiated, check if:

- there is battery voltage
- efficiency of fuse No. 7
- there is power to the control unit as specified below:

Disconnect the connector from the control unit. Check the following conditions:

With the key switch set to OFF:

- Battery voltage between terminals 17-23 and terminals 17-chassis ground (continuous power supply). If there is no voltage, check that fuse No. 6 is in good conditions.

With the key switch in position ON and the engine stop switch in RUN:

- Battery voltage between terminals 26-23 and terminals 26-chassis ground (continuous power supply). If there is no voltage, check:

1. that fuses No. 11 and No. 2 and their wirings are in good conditions.

2. that the engine stop remote control switch is in good conditions.

- Check for voltage on the white-black cable at the exit from the engine stop remote control switch. If there is no voltage, check:

1. key switch contacts

2. the condition of the engine stop switch, then the ground connection of the green/black cable of the engine stop remote control switch with the stand lifted and the engine stop switch in the RUN position.

3. that the engine stop remote control switch diode is in good conditions.

If no fault is found, replace the control unit.

N.B.

AN ACCIDENTAL LOSS OF THE SERVICE KEY PROGRAMMING CAN ARISE FROM GENERAL FAULTS OF THE IGNITION SYSTEM. IN THIS CASE, CHECK THE HV LINE SHIELDING.

In any case it is advisable to use resistive spark plugs.

Virgin circuit

When the ignition system is not encrypted, any key will start the engine but limited to 2000 rpm. The keys can only be recognised when the decoder has been correctly programmed. The procedure for programming a new decoder requires the recognition of the "master" key as the first key to be programmed: this is particularly important as it is the only key that allows the decoder to be reset and reprogrammed for programming the service keys.

The master and service keys must be used to code the system as follows:

- Insert the Master key, turn it to «ON» and keep this position for two seconds (lower and upper limits 1 to 3 seconds).
- Insert the service key and turn it to «ON» for 2 seconds.
- If you have copies of the key, repeat the operation with each key.
- Insert the MASTER key again and turn it to «ON» for 2 seconds.

The maximum time to change keys is 10 seconds.

A maximum of 7 service keys can be programmed at one time.

It is essential to adhere to the times and the procedure. If you do not, start again from the beginning. Once the system has been programmed, master key transponder, decoder and control unit are strictly matched. With this link established, it is now possible to encode new service keys, in the event of losses, replacements, etc. Each new programming deletes the previous one so, in order to add or eliminate keys, you must repeat the procedure using all the keys you intend to keep using.

If a service key becomes uncoded, the efficiency of the high voltage circuit shielding must be thoroughly inspected: In any case it is advisable to use resistive spark plugs.

Characteristic

MASTER key:

BROWN KEY

SERVICE key.

BLACK KEY

Diagnostic codes

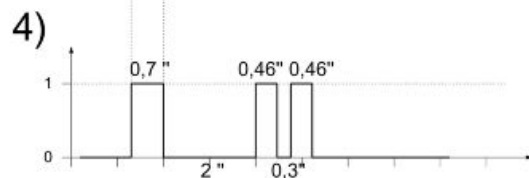
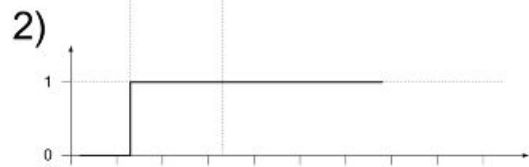
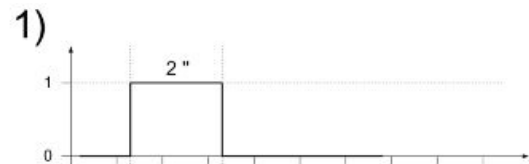
The immobiliser system is tested each time the ignition-key switch is turned from OFF to ON. During this diagnosis phase a number of control unit statuses can be seen and various light codes displayed. Regardless of the code transmitted, if at the end of the diagnosis the led remains off permanently, the ignition is enabled. If, however, the led remains on permanently, it means the ignition is inhibited:

1. New decoder - key inserted: a single 2 second flash is displayed, after which the LED remains off permanently. The keys can be stored to memory, the vehicle can be started but with a limitation imposed on the number of revs.

2. New decoder - transponder missing or illegible: The LED is permanently ON; in this condition, no operations are possible, including starting of the vehicle.

3. Decoder programmed - service key inserted (normal operating condition): a single 0.7-second flash is displayed, after which the LED remains off steadily. The engine can be started.

4. Decoder programmed - master key inserted: a 0.7-sec flash is displayed followed by the LED remaining off for 2 sec. and then by short 0.46-sec flashes the same number of times as there are keys stored in the memory including the Master key. When the diagnosis has been completed, the LED remains permanently OFF. The engine can be started.

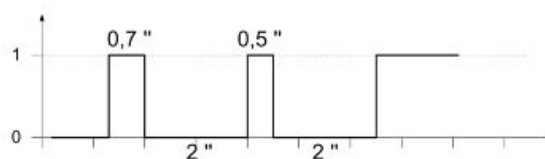


5. Decoder programmed - fault detected: a light code is displayed according to the fault detected, after which the LED remains on steadily. The engine cannot be started. The codes that can be transmitted are:

- 1-flash code
- 2-flash code
- 3-flash code

Diagnostic code - 1 flash

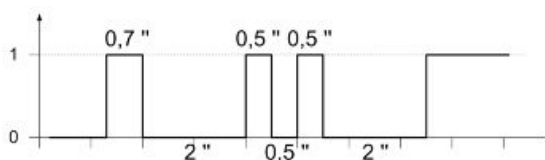
A one-flash code indicates a system where the serial line is not present or is not detected. Check the Immobilizer aerial wiring and change it if necessary.



Diagnostic code - 2 flashes

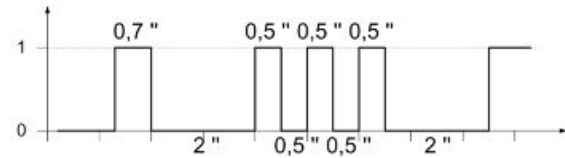
A 2-flash code indicates a system where the decoder does not recognise the transponder signal. This might depend on the inefficiency of the immobiliser aerial or the transponder.

Turn the switch to ON using several keys: if the code is repeated even with the Master key, check the aerial wiring and change it if necessary. Otherwise replace the faulty key and/or reprogram the decoder. If the problem persists, replace the decoder.



Diagnostic code - 3 flashes

The 3-flash code indicates a system where the decoder does not recognise the key. Turn the switch to ON using several keys: If the error code is repeated even with the Master key, replace the decoder. If this is not the case, reprogram the decoder.



Battery recharge circuit

The recharge system is provided with a three phase alternator with permanent flywheel.

The alternator is directly connected to the voltage regulator.

This, in its turn, is connected directly to the ground and the battery positive terminal passing through the 30A protective fuse.

This system therefore requires no connection to the key switch.

The three- phase generator provides good recharge power and at low revs, a good compromise is achieved between generated power and idle stability.

Stator check

Checking the stator windings

WARNING

THIS CHECK-UP CAN BE MADE WITH THE STATOR PROPERLY INSTALLED.

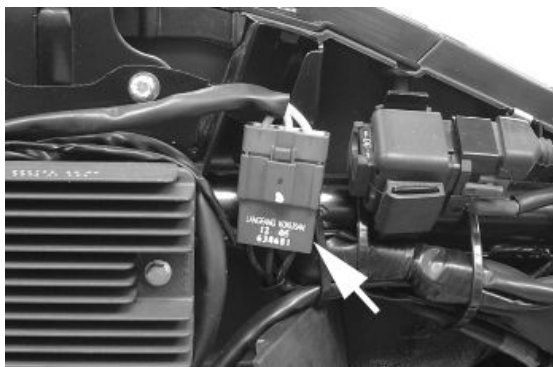
- 1) Remove the right side panel.
- 2) Disconnect the connectors between stator and regulator with the three yellow cables.
- 3) Measure the resistance between each of the yellow terminals and the other two.

Electric characteristic

Resistance:

0.2 - 1 Ω

- 4) Check that there is insulation between the each yellow cable and the ground.
- 5) If values are incorrect, replace the stator.



Recharge system voltage check

Maximum current output check.

- With engine off and panel set to "ON" turn on the lights and let the battery voltage set to 12V.
 - Connect ammeter pliers to the 2 recharge positive poles in output from the regulator.
 - Keep the lights on and start the engine, bring it to normal speed and read the values on the ammeter.
- With an efficient battery a value must be detected: > 20A

Charging current check

WARNING

BEFORE CARRYING OUT THE CHECK, MAKE SURE THAT THE BATTERY IS IN GOOD WORKING ORDER.

- 1) Place the vehicle on its centre stand
- 2) With the battery correctly connected to the circuit, place the tester terminals between the battery terminals..
- 3) Start the engine, ensure that the lights are all out, increase the engine speed and at the same time measure the voltage.

Electric characteristic

Voltage ranging between 14.0 and 15.0V at 5000 rpm.

Look for any leakage

- 1) Check that the battery does not show signs of leaking fluid before checking the output voltage.
- 2) Turn the ignition key to OFF and connect the multimeter leads between the battery negative pole (-) and the Black cable.
- 3) With the multimeter leads connected, disconnect the Black cable from the battery negative pole (-).
- 4) With the ignition key always at OFF, the reading indicated by the ammeter must be ≤ 0.5 mA.

VOLTAGE REGULATOR/RECTIFIER

Specification	Desc./Quantity
Type	Non-adjustable three-phase transistor
Voltage	14 ÷ 15V at 5000 rpm with lights off

Turn signals system check

The circuit of the turn indicators is controlled by the electronic control unit. If it does not work, it is necessary to:

1. Check that the fuse No. 8 is in good condition
2. Check that the bulbs are in good condition
3. Check that the turn signal indicator switch is in good condition
4. With the key switch set to ON; check there is battery voltage on the turn indicator switch connector.

If there is no voltage, check the wiring and the correct function of the electrical control units. Replace the control unit if the problem persists.

Lights list

BULBS

	Specification	Desc./Quantity
1	High-beam light bulb	Type: HALOGEN (H7) Power: 12V - 55W Quantity: 1
2	Low-beam light bulb	Type: HALOGEN (H7) Power: 12V - 55W Quantity: 1
3	Front tail light bulb	Type: ALL GLASS Power: 12V - 5W Quantity: 2
4	Instrument panel bulb	Type: ALL GLASS Power: 12V - 2W Quantity: 4
5	Front turn indicator light bulb	Type: ALL GLASS Power: 12V - 10W Quantity: 1 RHS + 1 LHS
6	Helmet compartment light bulb	Type: CYLINDRIC Power: 12V - 5W Quantity: 1
7	Rear turn indicator light bulb	Type: ALL GLASS Power: 12V - 5W Quantity: 2 RHS + 2 LHS
8	Rear tail light bulb	Type: ALL GLASS Power: 12V - 5W Quantity: 2
9	Stop light bulb	Type: SPHERICAL Power: 12V - 10W Quantity: 2
10	License plate bulb	Type: All glass Power: 12V - 5W Quantity: 1

Fuses

Remote control switches - Diode unit

The electrical system is equipped with 5 remote control switches plus the diode unit placed under legshield and the start-up remote control switch under the right side fairing.

To access the remote control switches under the shield it is necessary to:

- Remove the legshield.
- Remove the knee-guard panel.

In order to access the start-up remote control switch, remove the right side fairing.

The following table shows the functions of each remote control switch:

A: Immobiliser

B: Injection load

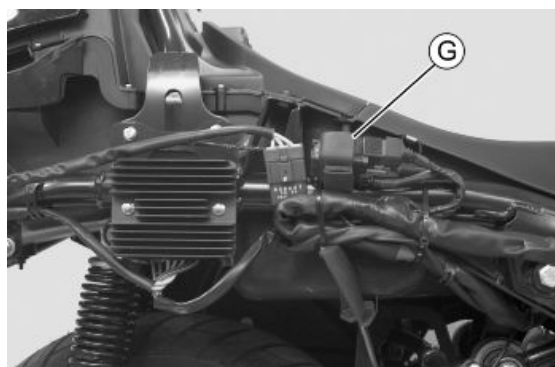
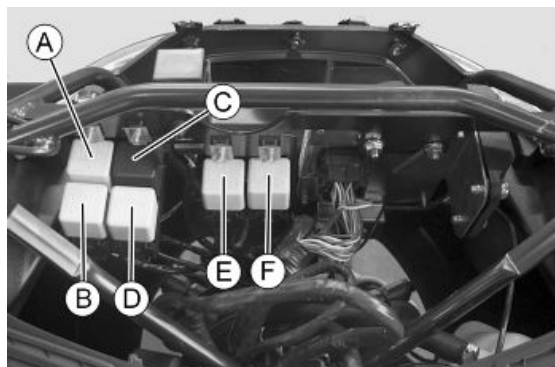
C: Light switch remote control

D: Electric fan remote control

E: Light remote control

F: Engine stop remote control switch

G: Starter remote control



The electrical system is equipped with 12 protective fuses for the various circuits on the vehicle, subdivided into two fuse boxes «**A**» and «**B**» located alongside the battery.

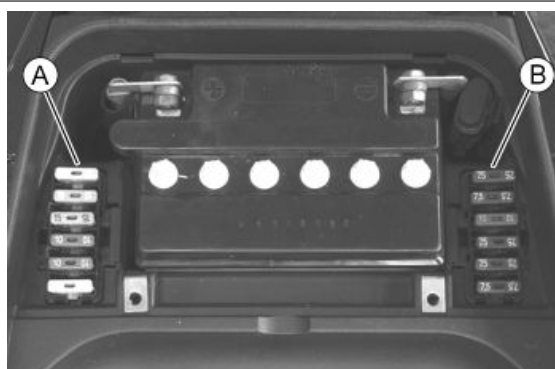
The chart shows the position and characteristics of the fuses in the vehicle.

CAUTION



NEVER TRY TO REPLACE A BLOWN FUSE WITH A FUSE OF A DIFFERENT RATING THAN THAT SPECIFIED OR USING OTHER MATERIAL (FOR EXAMPLE, A PIECE OF ELECTRICAL WIRE).

BESIDES, IF AFTER REPLACING A FUSE, THE NEW FUSE ALSO BLOWS, THE SCOOTER NEEDS TO BE TAKEN TO AN AUTHORISED PIAGGIO/GILERA SERVICE CENTRE TO IDENTIFY THE CAUSE OF THE FAULT AND AVOID FUR-

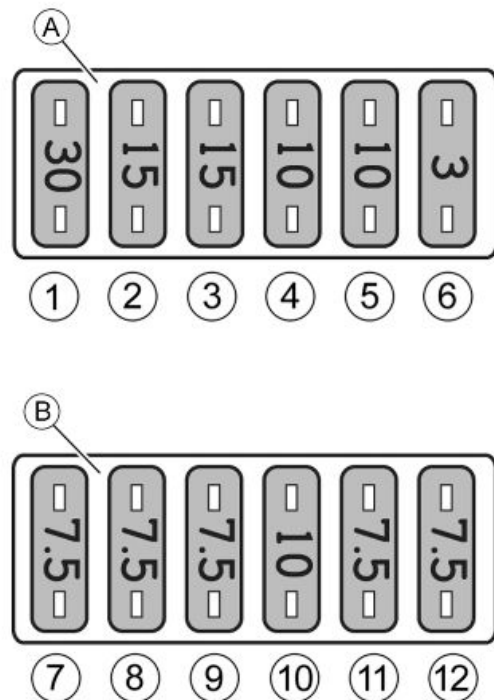


OTHER DAMAGE TO THE ELECTRIC SYSTEM COMPONENTS OR THE VEHICLE ITSELF.

CAUTION



MODIFICATIONS OR REPAIRS TO THE ELECTRICAL SYSTEM, PERFORMED INCORRECTLY OR WITHOUT STRICT ATTENTION TO THE TECHNICAL SPECIFICATIONS OF THE SYSTEM, CAN CAUSE OPERATING ERRORS AND RISK OF FIRE.



FUSES

	Specification	Desc./Quantity
1	Fuse No. 1	Capacity: 30 A Protected circuits: battery recharge. Location: battery compartment, on vehicle LHS.
2	Fuse No. 2	Capacity: 15A Protected circuits: Turn indicator control device, live fuses No. 8-9-10-12, live engine stop remote control switch. Location: Battery compartment - on LHS.
3	Fuse No. 3	Capacity: 15A Protected circuits: - LV socket, electric fan (via relay), wiring for anti-theft device, saddle opening control unit. - boot opening live power supply. Location: battery compartment - on LHS
4	Fuse No. 4	Capacity: 10 A Protected circuits: injection load (via relay). Location: battery compartment, on vehicle LHS.
5	Fuse No. 5	Capacity: 10A Protected circuits: luggage light, headlight (via relay). Location: battery compartment, on vehicle LHS.
6	Fuse No. 6	Capacity: 3A Protected circuits: injection ECU, decoder. Location: battery compartment, on vehicle LHS.
7	Fuse No. 7	Capacity: 7.5 A Protected circuits: instrument panel. Location: battery compartment, on vehicle RHS.
8	Fuse No. 8	Capacity: 7.5 A Protected circuits: saddle opening control unit power supply, hazard button, turn indicator switch, turn indicator control device. Location: battery compartment, on vehicle RHS.
9	Fuse No. 9	Capacity: 10 A Protected circuits: stop lights, headlight remote control. Location: battery compartment, on vehicle RHS.
10	Fuse No. 10	Capacity: 7.5 A

Specification		Desc./Quantity
		Protected circuits: horn, instrument panel lightning, tail lights, license plate light, light switch. Location: battery compartment, on vehicle RHS. Capacity: 7.5 A
11	Fuse No. 11	Protected circuits: injection load remote control, injection ECU, electrical fan remote control, decoder. Location: battery compartment, on vehicle RHS. Capacity: 7.5 A
12	Fuse No. 12	Protected circuits: wheel turning sensor, instrument panel, wiring for anti-theft device. Location: battery compartment, on vehicle RHS.

Dashboard

A = Immobilizer / antitheft LED

B = Speedometer with twin scale (km/h and mph)

C = CLOCK switch

D = Digital display

E = Emergency turn indicator warning light

F = SET switch

G = Rpm indicator

H = Fuel gauge

I = Warning light for helmet compartment courtesy light on

L = Engine control telltale light and injection system failure warning light

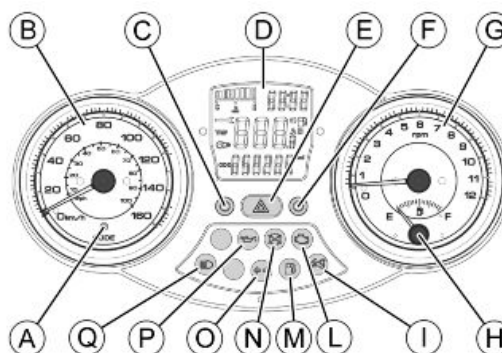
M = Low fuel warning light

N = Engine stop warning light

O = Turn indicator warning light

P = Low oil pressure warning light

Q = High-beam warning light



The clock, powered directly by the vehicle's battery, may be set by pressing the «T» button located inside the LHS glove-box on the knee-guard panel.

Pressing the button for less than one second will add one minute to the displayed time; Keep the «T» button pressed to rapidly increase the time.



Sealed battery

Commissioning sealed batteries

If the vehicle is provided with a sealed battery, the only maintenance required is the check of its charge and recharging, if necessary.

These operations should be carried out before delivering the vehicle, and on a six-month basis while the vehicle is stored in open circuit.

Besides, upon pre-delivery it is therefore necessary to check the battery charge and recharge it, if required, before storing the vehicle and, afterwards, every six months.

INSTRUCTIONS FOR THE BATTERY REFRESH AFTER OPEN-CIRCUIT STORAGE

1) Voltage check

Before installing the battery on the vehicle, check the open circuit voltage with a regular tester.

- If voltage exceeds 12.60 V, the battery can be installed without any renewal recharge.
- If voltage is below 12.60 V, a renewal recharge is required as explained in 2).

2) Constant voltage battery charge mode

- Constant voltage charge equal to 14.40 ÷ 14.70V
- Initial charge voltage equal to 0.3 ÷ 0.5 for Nominal capacity
- Charge time:
10 to 12 h recommended
Minimum 6 h
Maximum 24 h

3) Constant current battery charge mode

- Charge current equal to 1/10 of the nominal capacity of the battery
- Charge time: 5 h

Specific tooling

020333Y Single battery charger

020334Y Multiple battery charger

Cleaning the battery

The battery should always be kept clean, especially on its top side, and the terminals should be coated with Vaseline.

CAUTION

NEVER USE FUSES WITH A CAPACITY HIGHER THAN THE RECOMMENDED CAPACITY. USING A FUSE OF UNSUITABLE RATING MAY SERIOUSLY DAMAGE THE VEHICLE OR EVEN CAUSE A FIRE.

CAUTION

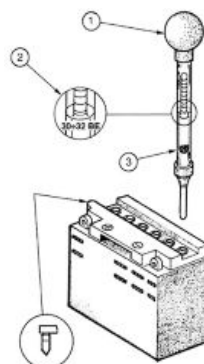
CHARGE THE BATTERY BEFORE USE TO ENSURE OPTIMUM PERFORMANCE. FAILURE TO CHARGE THE BATTERY ADEQUATELY BEFORE BEING PUT INTO OPERATION WILL LEAD TO A PREMATURE FAILURE OF THE BATTERY.

If the scooter is not used for a given time (1 month or more) it will be necessary to periodically recharge the battery.

The battery runs down completely in the course of three months. If it is necessary to refit the battery in the vehicle, be careful not to reverse the connections, remembering that the ground wire (**black**) marked (-) must be connected to the **negative** clamp while the other two **red** wires marked (+) must be connected to the clamp marked with the + **positive** sign.

Dry-charge battery

- Remove the short closed tube and the caps, then pour sulphuric acid into the cells using the type specified for batteries with a specific gravity of 1.26, corresponding to 30 Bé at a minimum temperature of 15°C until the upper level is reached.
- Allow to stand for at least 2 hours, then top up the level with sulphuric acid.
- Within 24 hours, recharge using the special battery charger (single) or (multiple) at an intensity of about 1/10 of the battery nominal capacity and until the acid gravity is about 1.27, corresponding to 31 Bé and such values become steady.
- After charging, top up the acid (adding **distilled water**). Close and clean carefully.
- After carrying out the operations above, install the battery on the scooter, observing the connections described in point 3) of paragraph "**Battery re-charge**".



Specific tooling

020333Y Single battery charger

020334Y Multiple battery charger

- 1 Keep the pipe in vertical position
- 2 Inspect visually
- 3 The float must be freed

Checking the electrolyte level

The electrolyte level must be checked frequently and must reach the upper level. Only use distilled water, to restore this level. If it is necessary to add water too frequently, check the vehicle's electrical system: the battery works overcharged and is subject to quick wear.

Charging status check

After topping-up the electrolyte level, check its density using special density gauge.

When the battery is charged, you should detect a density of 30 to 32 Bé corresponding to a specific weight of 1.26 to 1.28 at a temperature of no lower than 15° C.

A density reading of less than 20° Bé indicates that the battery is completely flat and it must therefore be recharged.

If the scooter is not used for a given time (1 month or more) it will be necessary to periodically recharge the battery.

The battery runs down completely in the course of three months. When refitting the battery onto the scooter pay attention not to invert the cables, bearing in mind that the earth (**black**) wire marked with a (-) must be connected to the **negative** terminal whilst the other two **red** wires, marked with a (+) must be attached to the **positive**, + terminal.

Battery recharge

WARNING

BEFORE RECHARGING THE BATTERY, REMOVE THE PLUGS OF EACH CELL. KEEP SPARKS AND NAKED FLAMES AWAY FROM THE BATTERY WHILE RECHARGING.

Remove the battery from the vehicle removing the negative clamp first.

Normal bench charging must be performed using the special battery charger (single) or (multiple), setting the battery charge selector to the type of battery that requires recharging (i.e., at a current equal to 1/10 of the battery rated capacity). Connections to the power supply source must be implemented by connecting corresponding poles (+ to + and - to -).

Specific tooling

020333Y Single battery charger

020334Y Multiple battery charger

The battery should always be kept clean, especially on its top side, and the terminals should be coated with Vaseline.

CAUTION

NEVER USE FUSES WITH A CAPACITY HIGHER THAN THE RECOMMENDED CAPACITY. USING A FUSE OF UNSUITABLE RATING MAY SERIOUSLY DAMAGE THE VEHICLE OR EVEN CAUSE A FIRE.

CAUTION

ORDINARY AND DRINKING WATER CONTAINS MINERAL SALTS THAT ARE HARMFUL FOR THE BATTERY. FOR THIS REASON, YOU MUST ONLY USE DISTILLED WATER.

CAUTION

CHARGE THE BATTERY BEFORE USE TO ENSURE OPTIMUM PERFORMANCE. FAILURE TO CHARGE THE BATTERY ADEQUATELY BEFORE BEING PUT INTO OPERATION WILL LEAD TO A PREMATURE FAILURE OF THE BATTERY.

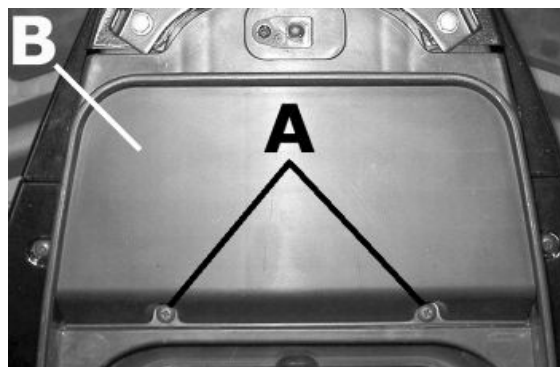
Battery installation

To access the battery, proceed as follows:

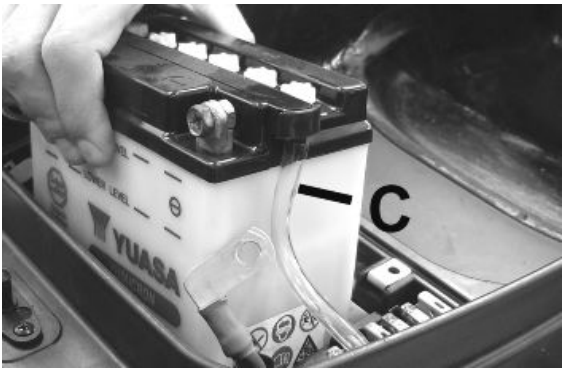
1. Place the scooter on its centre stand;
2. Open the saddle.
3. Remove the two screws **A** and the cover **B**.
4. Remove the electrical connections, disconnect the breather pipe **C** and take out the battery.

To refit, follow the steps but in reverse order.

CAUTION



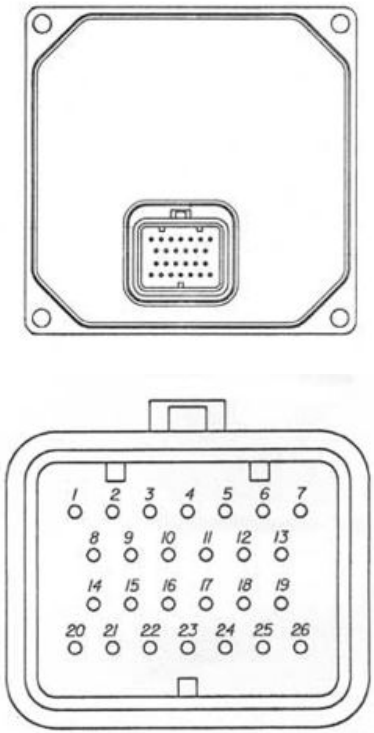
IN ORDER TO AVOID DAMAGING THE ELECTRICAL SYSTEM, NEVER DISCONNECT THE WIRING WHILE THE ENGINE IS RUNNING. DO NOT TIP THE SCOOTER TOO MUCH IN ORDER TO AVOID DANGEROUS LEAKS OF BATTERY ELECTROLYTE.



Connectors

ECU

Layout of the system-side connectors and the connectors on the electronic control unit.

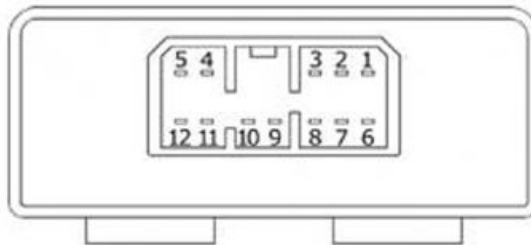


ECU

	Specification	Desc./Quantity
1	Throttle potentiometer power supply	+5 V
2	Lambda sensor	(-)
3	Rpm indicator	
4	Engine temperature	(+)
5	Electric fan remote control	
6	Stepper motor	Stepper motor
7	Engine rpm sensor	
8	Lambda sensor	(+)
9	EMS diagnostic connector	
10	EMS diagnostic connector	
11	Throttle potentiometer signal	
12	Engine rpm sensor	

	Specification	Desc./Quantity
13	Injector control	(-)
14	Stepper motor	Stepper motor
15	Injection telltale light	(-)
16	Decoder (serial)	
17	Battery powered	(+)
18	Intake air temperature sensor	(+)
19	Injection load remote control	(-)
20	HV coil	(-)
21	Stepper motor	Stepper motor
22	Sensor ground	(-)
23	Ground lead	
24	Stepper motor	Stepper motor
25	-	
26	Continuous power supply	(+)

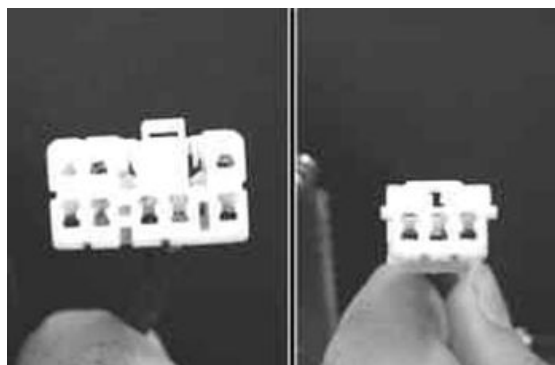
Seat opening receiver



SADDLE OPENING RECEIVER CONTROL UNIT

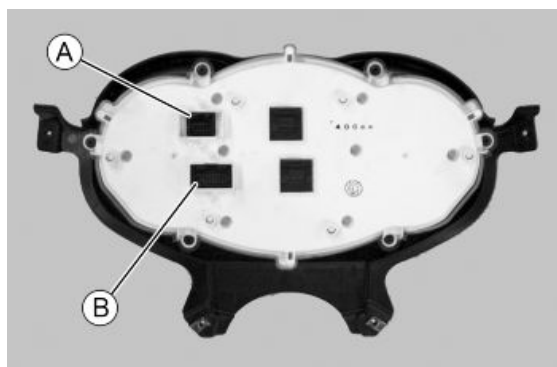
	Specification	Desc./Quantity
1	Radio aerial	
2	Actuator 2	
3	Reset / Input clearing	
4	Battery positive	
5	(Not connected)	
6	Live positive lead	
7	Ground lead	
8	(Not connected)	
9	(Not connected)	
10	Actuator 1	
11	Channel selection 1/3	
12	Alarm code output	

Immobiliser decoder



IMMOBILIZER DECODER

	Specification	Desc./Quantity
1	-	
2	Immobilizer LED control	(negative)
3	Base power supply	(positive)
4	Ground lead	
5	-	
6	electronic control unit	(serial)
7	-	
8	Continuous power supply (positive)	

Dashboard**CONNECTOR A**

	Specification	Desc./Quantity
1	-	
2	-	
3	-	
4	-	
5	Live supply	Instrument panel lighting
6	Battery-powered	
7	-	
8	-	
9	-	
10	-	
11	Ground lead	
12	General live power supply	

CONNECTOR B

	Specification	Desc./Quantity
1	Speed sensor	
2	Fuel level indicator	
3	Water temperature sensor	(+)
4	Water temperature sensor	(-)
5	«MODE» button	
6	Oil pressure sensor	
7	Left direction warning light	
8	Right direction warning light	
9	High-beam lamp warning light	
10	Open boot warning light	
11	Rpm indicator signal	
12	Ambient temperature sensor	(+)
13	Ambient temperature sensor	(-)
14	Engine disabled warning light	
15	Immobilizer LED	
16	Injection check warning light	
17	Ground lead	
18	Hazard warning light	

	Specification	Desc./Quantity
19	Ground lead	
20	-	

Remote seat opening

The vehicle is equipped with a remote control to open the saddle.

This remote control is supplied together with the keys and at the manufacturing stage, it has been programmed to work together with the ECU that control the opening device.

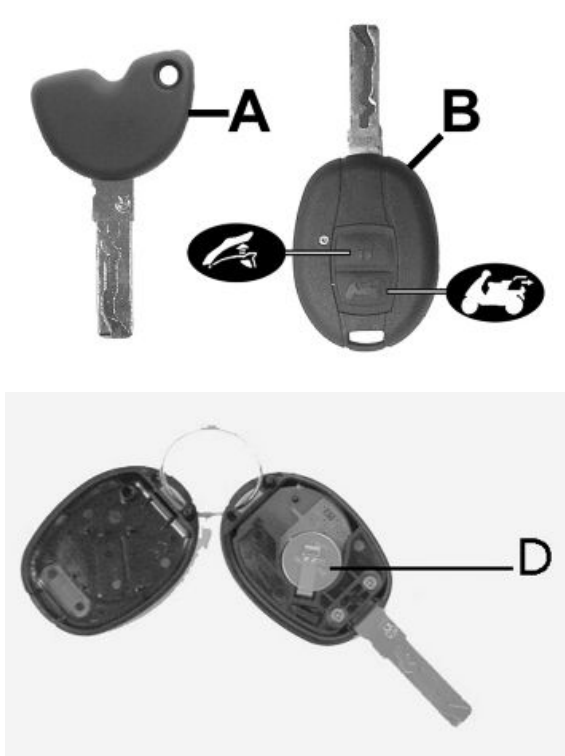
If the remote control is lost, a new one can be requested and reprogram it by resetting the ECU memory and following the same steps as per programming the immobilizer system in the keys.

Battery replacement

The remote control for the black key is powered by inner batteries that get discharged after extended used.

You may need to replace the batteries if the remote control fails or if its range of operation is reduced.

To replace the batteries remove the three screws and uncouple the two half-shells.



Electric characteristic

Batteries used:

CR1616

Zeroing

- To access the saddle opening control/reception unit, remove the left side fairing.
- A white cable, that comes from pin 3 of the control unit, goes out from the wiring.
- Earth the cable at least 10 seconds in order to delete all the remote controls stored in the control unit.



Programming

- Follow these steps to program the remote controls:
 1. Insert the remote control key to be programmed in the steering lock key block.
 2. Turn the key to ON, press the button on the remote control, release the button, turn the key back to OFF from the ON position, all within four seconds.
 3. Wait 1 to 8 seconds
 4. Repeat steps 2 and 3 for 4 times without removing the key. The control unit confirms the programming has been successful by opening the saddle.

N.B.

THE CONTROL UNIT CAN PROGRAMME UP TO 7 REMOTE CONTROLS.

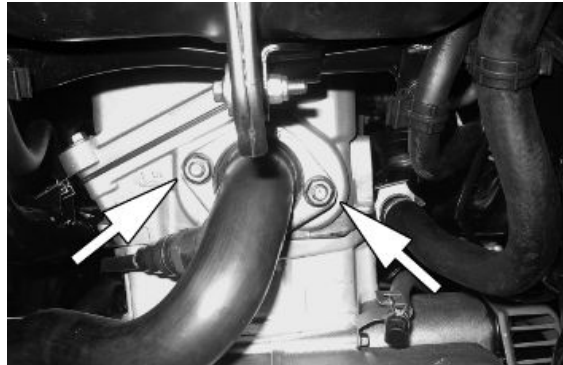
INDEX OF TOPICS

ENGINE FROM VEHICLE

ENG VE

Exhaust assy. Removal

- Remove the right-hand side fairing
- Undo the two exhaust manifold fixings on the head.



- Remove the Lambda probe from its support and disconnect it.



Remove the screw indicated in the photograph.

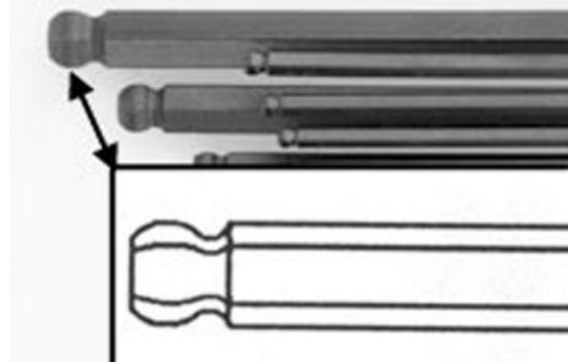


- Loosen the screw shown in the figure so as to loosen the muffler strap and remove the whole muffler.



N.B.

DUE TO MUFFLER DIMENSIONS IT IS NOT POSSIBLE TO ACTUATE ON THE SCREW PERPENDICULARLY TO REMOVE IT; USE A COMMERCIALLY AVAILABLE «BONDUS» MALE HEXAGONAL WRENCH.



Remove the lambda probe from the manifold.

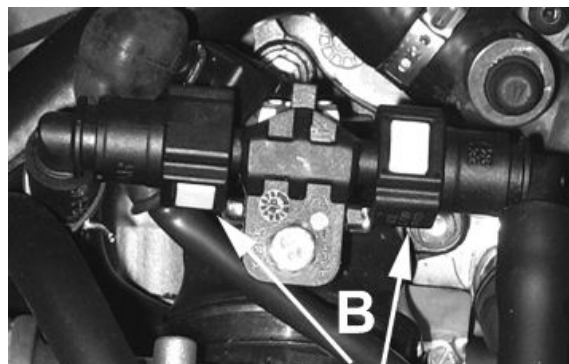
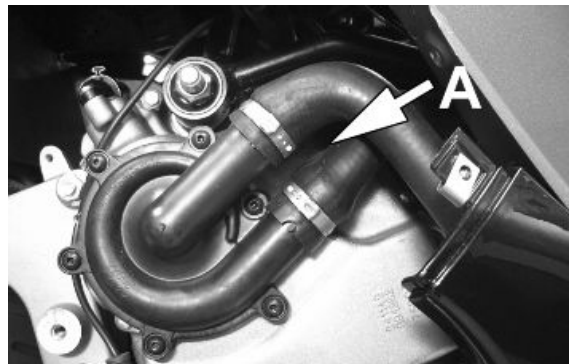


Removal of the engine from the vehicle

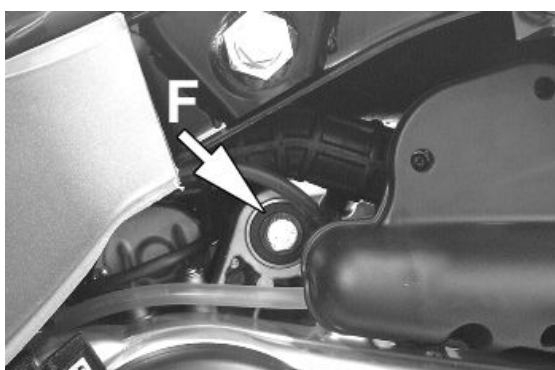
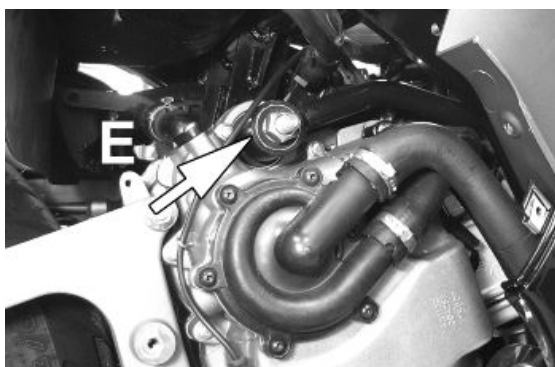
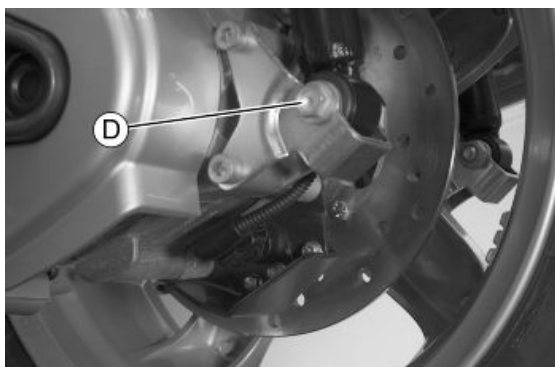
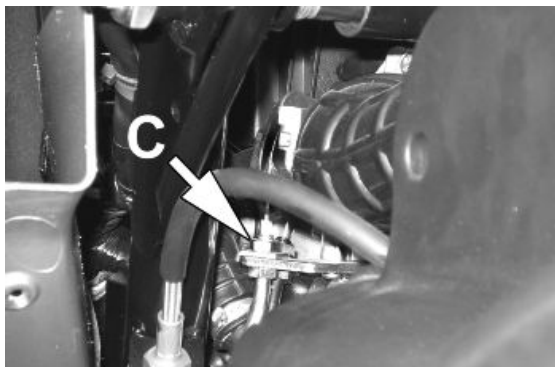
CAUTION

THIS OPERATION MUST BE CARRIED OUT WHEN THE ENGINE IS COLD.

- Disconnect the battery.
 - Remove the side fairings.
 - Remove the helmet compartment.
- Remove the full muffler unit.
- Remove the rear wheel.
 - Remove the pipe feeding coolant into the pump "A" as shown in the photograph and then empty the system.
 - Remove the engine coolant outlet pipe as indicated.
 - Disconnect the delivery and reverse fuel pipes "B".
 - Remove the coolant outlet pipe from the motor as indicated.
 - Remove the spark plug cap.



- Remove the electrical connections to the sensors and devices.
- Remove the throttle control cable from the throttle body by undoing the nut "C".
- Remove the positive and negative wiring from the starter motor.
- Disconnect the connectors from the flywheel wiring harness.
- Remove the lower screw of the left shock absorber "D".
- Use a jack to support the vehicle properly.
- Remove the engine-swinging arm fixing pin by undoing the nut "E" and operating on the head of the pin "F" indicated in the photograph.
- Remove the rear brake calliper and the relevant pipes from the engine crankcase.
- The engine is now free.



Installing the engine on the scooter

- Carry out the removal operations but in reverse order and respect the locking torques indicated in the «Specifications» Chapter.

CAUTION

PAY PARTICULAR ATTENTION TO POSITIONING THE THROTTLE CONTROL TRANSMISSION PROPERLY.

Check that there is a small clearance when the valve is in abutment against the set screw.

- Check the engine oil level and if necessary top it up with the recommended type.
 - Top-up the cooling circuit.
 - Check the functioning of the accelerator and the electrical devices.
-

INDEX OF TOPICS

ENGINE

ENG

This section describes the operations to be carried out on the engine and the tools to be used.



Automatic transmission

Transmission cover

- Using a screwdriver, remove the driven pulley axle cover near the bottom of the cap.



- Loosen the driven pulley shaft fastening nut using a misaligned wrench and prevent the pulley shaft rotation using a machine hexagon bush.
- Remove the nut and the two washers.

N.B.

DUE TO THE HIGH TIGHTENING TORQUE, USING DIFFERENT WRENCHES - SUCH AS A CONVENTIONAL POLYGONAL BUSH - MAY DAMAGE THE HEXAGON OBTAINED ON THE SHAFT OR BREAK THE BUSH ITSELF.



- Loosen the 4 fastening screws
- Extract the outside plastic transmission cover.



- Remove the six M6 screws.

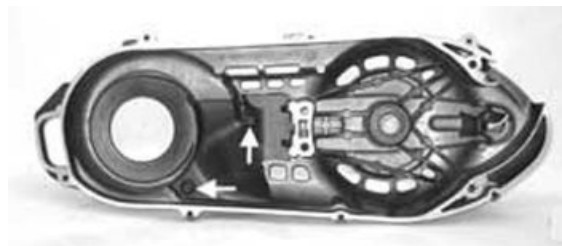


- Remove the four M8 screws.
- Remove the transmission cover.
- Check that the bearing rotates freely, otherwise replace it.



Air duct

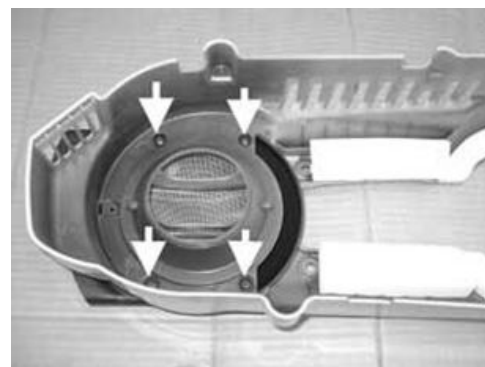
- Remove the transmission cover.
- Unscrew the two screws shown in the figure to remove the air conveyor.



Locking torques (N*m)

Air conveyor screws 11 ÷ 12

- Remove the external transmission cover.
- Unscrew the 4 fastening screws shown in the figure to remove the external air conveyor.



Air duct filter

- Remove the external air conveyor.
- Unscrew the 2 fastening screws shown in the figure to remove the conveyor filter.



Removing the driven pulley shaft bearing

- Remove the transmission cover.
- Remove the Seeger ring.



- Place transmission cover on a wood surface and use the special tool so that it is adequately supported.
- Pull out the bearing using the special tool.

N.B.

BELL MUST BE PLACED INTO THE TRANSMISSION COVER, CLOSE TO THE BEARING SEAT AND THE WOODEN SURFACE, SINCE WITHOUT BELL THE ENTIRE COVER STRUCTURE WOULD BEND. NOT ONLY IN THE AREA OF MAXIMUM STURDINESS.



Specific tooling

001467Y002 Driver for OD 73 mm bearing

020376Y Adaptor handle

020375Y 28 x 30 mm adaptor

020439Y 17-mm guide

Refitting the driven pulley shaft bearing

- Heat the transmission cover interior using the heat gun.

N.B.

BE CAREFUL NOT TO OVERHEAT THE COVER AS THIS WOULD DAMAGE THE OUTSIDE PAINTED SURFACE.

Specific tooling

020151Y Air heater



- Place the bearing onto the special tool with a little grease to prevent it from coming out.
- Install the new bearing using the special tool.

N.B.

PROPERLY SUPPORT THE OUTSIDE COVER TO PREVENT DAMAGING THE PAINTED SURFACE.

Specific tooling

020376Y Adaptor handle

020358Y 37x40-mm Adaptor

020439Y 17-mm guide



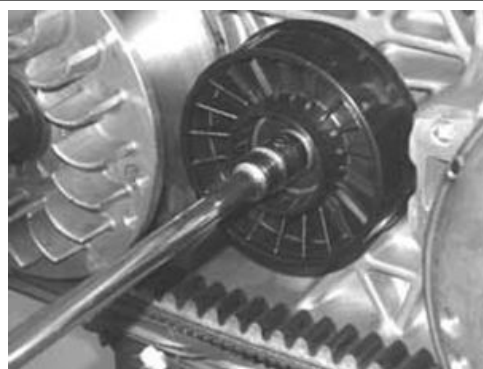
Baffle roller

Plastic roller

- Check that the roller does not show signs of wear and that it turns freely.
- Loosen the retaining bolt using a 13 mm spanner.
- Remove the complete roller with bearing.

N.B.

IF THE ROLLER DOES NOT ROTATE FREELY, REPLACE THE COMPLETE ROLLER.

**Installation of belt anti-vibration roller**

- Install the anti-flapping roller with the lip facing the engine crankcase.
- Tighten the central screw to the prescribed torque.

N.B.

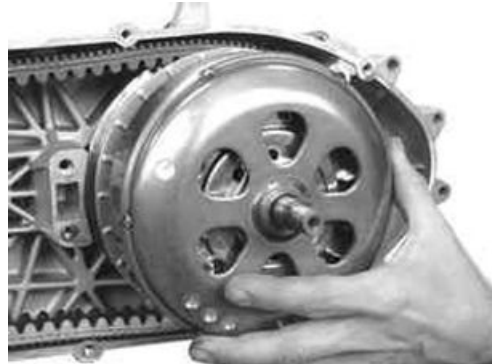
TURN THE DRIVEN AND/OR DRIVING PULLEY UNTIL A CORRECT TENSIONING OF THE BELT IS OBTAINED.

Locking torques (N*m)

Anti-vibration roller screw 16.7 ÷ 19.6

Removing the driven pulley

- Remove the clutch bell.



- Remove the fixed driving half-pulley.
- Remove the driven pulley assembly with the belt.



Inspecting the clutch drum

- Check that the clutch bell is not worn or damaged.
- Measure the clutch bell inside diameter.

N.B.

CHECK THE ECCENTRICITY MEASURED, 0.2 MM MAX.

Characteristic

Max. value:

160.5 mm

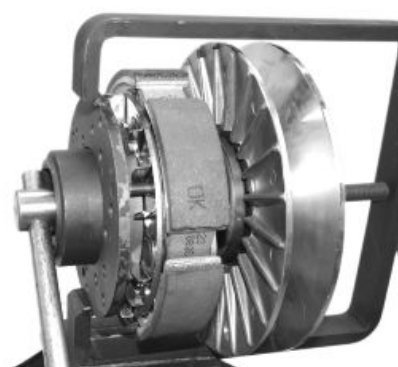
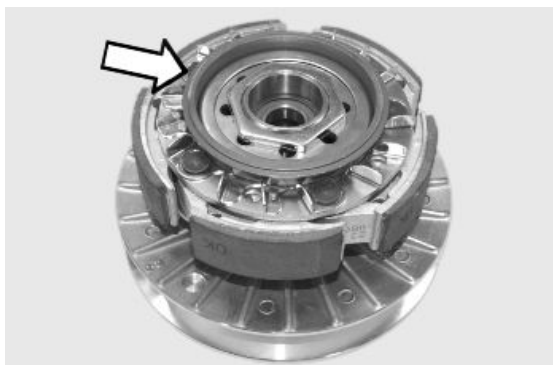
Standard value:

160.2 mm



Removing the clutch

- To remove the clutch with the driven pulley it is necessary to use the special tool;
- Arrange the tool with the mean pins screwed in position "E" on the inside;
- Fit the adapter ring to the clutch assembly as shown in the photograph.
- Install the driven pulley unit onto the tool inserting the pins into the ventilation holes;
- Move the rear stop screw in abutment against the fixed driven pulley as shown in the figure.



CAUTION

THE TOOL SHOULD BE FIRMLY SECURED IN A VICE USING THE SPECIAL TOOL. DO NOT TIGHTEN THE REAR SCREW TOO MUCH AS THIS COULD IRRETRIEVABLY DEFORM THE TOOL.

USING THE SPECIAL 55-MM WRENCH, REMOVE THE FASTENING RING NUT.

LOOSEN THE TOOL SCREW AND DISASSEMBLE THE DRIVEN PULLEY UNIT, CLUTCH, SPRING WITH SHEATH.

Specific tooling

020444Y Tool for fitting/ removing the driven pulley clutch

Inspecting the clutch

- Check the thickness of the clutch mass friction material.

Characteristic

Minimum thickness permitted:

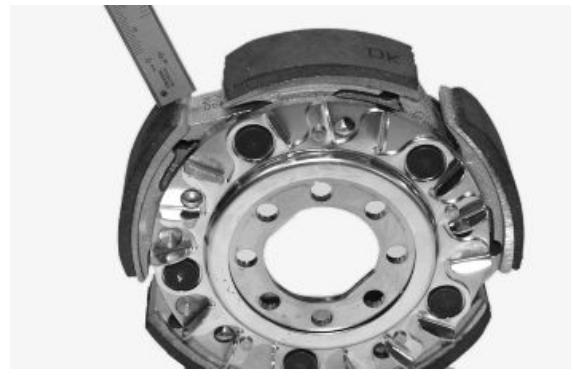
1 mm

- The masses must not show traces of lubricants. Otherwise, check the driven pulley unit seals.

N.B.

UPON RUNNING-IN, THE MASSES MUST EXHIBIT A CENTRAL CONTACT SURFACE AND MUST NOT BE DIFFERENT FROM ONE ANOTHER. VARIOUS CONDITIONS CAN CAUSE THE CLUTCH TO TEAR.

- Do not open the masses using tools to prevent a variation in the return spring load.



Pin retaining collar

- Extract the collar using 2 screwdrivers.



- Remove the 4 guide pins.
- Extract the moving driven half-pulley.



Removing the driven half-pulley bearing

- Check that the bushing is free from wear and damage; otherwise replace the fixed driven half-pulley.
- Remove the lock ring using pliers.



-
- Using the special tool inserted through the roller bearing, pull out the ball bearing.

N.B.

PROPERLY SUPPORT THE PULLEY TO PREVENT DAMAGING THE THREADING.

Specific tooling

020376Y Adaptor handle

020456Y Ø 24 mm adaptor

020363Y 20-mm guide

N.B.

IF YOU NEED TO OVERHAUL THE BEARINGS ON AN ASSEMBLED DRIVEN PULLEY UNIT, IT IS NECESSARY TO SUPPORT THE UNIT BY THE BELL

Specific tooling

001467Y002 Driver for OD 73 mm bearing

-
- Remove the roller bearing using the special tool, supporting the fixed half-pulley with the bell.

Specific tooling

020376Y Adaptor handle

020375Y 28 x 30 mm adaptor

020364Y 25-mm guide

001467Y002 Driver for OD 73 mm bearing



Inspecting the driven fixed half-pulley

-
- Check that the belt contact surface is free from wear.
 - Measure the outer diameter of the pulley bushing.

Characteristic

Minimum admissible diameter

49.91 mm

Standard diameter:

50.00 -0.015 -0.035 mm



Inspecting the driven sliding half-pulley

- Check that the belt contact surface is free from wear.
- Remove the 2 inside sealing rings and the 2 outside O-rings.
- Measure the movable half-pulley bushing inside diameter.



Characteristic

Maximum admissible diameter:

50.05 mm

Standard diameter:

50.00 +0.035 0.00 mm

Refitting the driven half-pulley bearing

- Install a new roller bearing using the special tool.

N.B.

PLACE THE BEARING WITH THE WRITINGS AND THE EMBEDDED OIL GUARD FACING OUTWARDS.

- Properly support the half-pulley to prevent damaging the threading.

If you are working on the driven pulley unit fully assembled, use the special tool.

Specific tooling

020478Y Punch for driven pulley roller casing

001467Y002 Driver for OD 73 mm bearing



-
- Install a new ball bearing using the special tool.

Specific tooling

020376Y Adaptor handle

020477Y 37 mm adaptor

020363Y 20-mm guide



- Insert the Seeger lock ring.

Refitting the driven pulley

- Insert the new oil guards
- Insert the new O-rings

N.B.

O-RINGS ARE OF TWO SIZES. THE LARGE ONE IS INSTALLED ON THE MACHINING END RADIUS, AT THE BASE OF THE HALF-PULLEY.

- Install the half-pulley on the bushing being careful not to damage the top sealing ring during the introduction.
- Make sure the pins and collar are not worn, re-assemble the pins and collar.



- Using a bent beak greaser, lubricate the driven pulley unit with about 10 gr. of grease, this operation should be carried out through one of the two holes into the bushing to obtain the exit of the grease from the opposite hole. This operation is necessary to avoid the presence of grease beyond the O-rings.

Inspecting the clutch spring

- Measure the length of the movable driven half-pulley spring while it is unloaded.

Characteristic

Standard length:

125.5 mm

Admissible limit after use:

120 mm



Refitting the clutch

- Prepare the special tool as for removal;
- Preassemble the driven pulley unit with the drive belt according to its direction of rotation;
- Insert the driven pulley unit, the spring with sheath and clutch into the tool.

Specific tooling

020444Y Tool for fitting/ removing the driven pulley clutch

- Compress the spring and insert the clutch on the driven pulley bushing.

N.B.

BE CAREFUL NOT TO DAMAGE THE SHEATH OR THE BUSHING THREADED END.

- Tighten the ring nut by hand and complete the tightening using the special wrench to the prescribed torque.

Specific tooling

020444Y Tool for fitting/ removing the driven pulley clutch

Locking torques (N*m)

Clutch ring nut 65 - 75

- To facilitate reassembly on the engine, turn the moving driven pulley and insert the belt onto the smaller diameter.



Refitting the driven pulley

- Install the driven pulley assembly with belt.



Drive-belt

- Check that the driving belt is not damaged.
- Check the width of the belt.

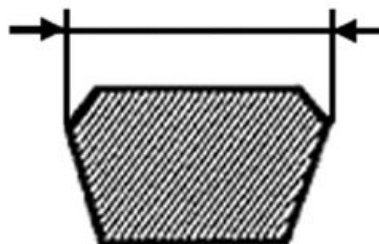
Characteristic

Minimum width:

27 mm

Standard width:

28.2 mm



Removing the driving pulley

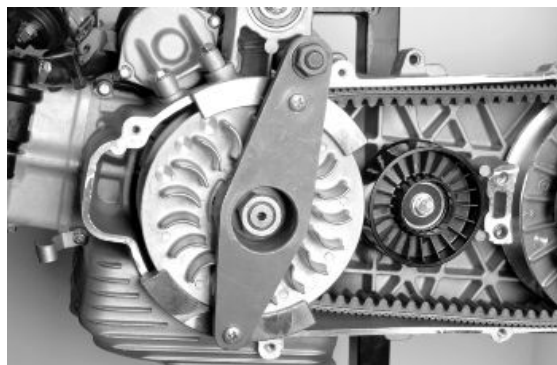
- Using a 27 mm wrench, turn the central pulley nut to horizontally align the central inside holes and install the special tool.

Specific tooling

020474Y Driving pulley lock wrench



- First fit the 2 retainer clamps of the special tool onto the pulley so that the splines are completely engaged.
- Then, insert the tool so as to insert the stud bolts on the ring into the holes obtained onto the tool itself.
- Tighten the two tool fixing screws, also manually.
- Loosen the central nut.
- Remove the spring washer and the flat washer.
- Remove the fixed driving half-pulley.
- Remove the bushing connection washer.



- Move the belt downwards.
- Suitable support the roller contrast and extract the movable driving half-pulley with the relevant bushing and the rear washer, being careful not to make the rollers come out.



Inspecting the rollers case

- Check that the inside bushings shown in the figure exhibit no signs of abnormal wear and measure the inside diameter.

CAUTION

DO NOT LUBRICATE OR CLEAN THE BUSHINGS

Characteristic

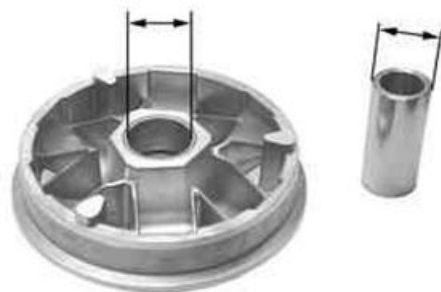
Maximum admissible diameter:

30.12 mm

Standard diameter:

30.021 mm

- Measure the pulley sliding bushing outside diameter shown in the figure.



Characteristic

Minimum admissible diameter

Ø 29.95 mm

Standard diameter:

Ø 29.959 mm

- Check that the rollers are not damaged or worn.

Characteristic

Minimum admissible diameter

Ø 24.5 mm

Standard diameter:

Ø 24.9 mm

- Check the guide shoes for the variator back-plate are not worn.
- Check the wear of the roller housings and of the belt contact surfaces on both pulley halves.



Refitting the driving pulley

Installing the roller container

- Install the spacer with the internal chamfer facing towards the inside.



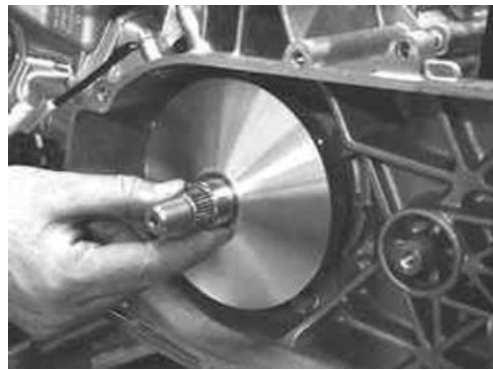
- Position the rollers on the half-pulley as shown in the figure.
- The closed side must rest on the inside thrust face of the roller container.



- Assembly the half-pulley with the roller contrast plate and sliding blocks.

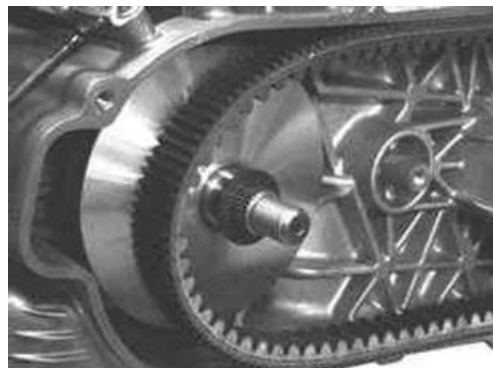


- Insert the half-pulley on the crankshaft.
- Insert the spacer bushing.



Installing the fixed driving half-pulley

- Insert the spacer.



- Install the fixed driving half-pulley and check that it is in contact with the spacer and with the guide bushing of the movable driving pulley.



- Remove the flat washer and the spring washer as shown in the figure.



- Insert the nut in the original position (nut side in contact with the belleville washer).



- Turn the central pulley nut to horizontally align the holes and install the special tool.

N.B.

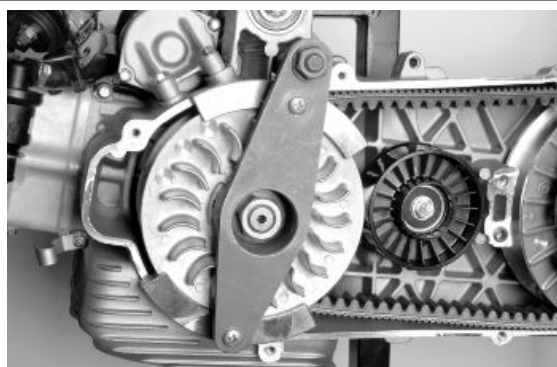
CHECK THAT THE STOP WRENCH TOOL IS EASILY INSERTED INTO THE PULLEY AND IN THE ENGINE CRANKCASE.

Specific tooling

020474Y Driving pulley lock wrench



- Install the lock ring from the rear so that the splines are completely engaged.
- Finally install the tool by sliding the nuts by hand and ensuring the tool is resting flatly.
- Tighten the driving pulley fastening nut to the prescribed torque
- Remove the special tool.



Locking torques (N*m)

Drive pulley nut 160 - 175

Refitting the transmission cover

- Ensure the correct installation on the crankcase of the 2 centring dowels.



- Insert the transmission cover with the bearing and install the relevant retainers.
- Lock the four M8 retainers.

Locking torques (N*m)**M8 retainers for transmission cover 23 ÷ 26**

- Lock the 7 M6 retainers.

Locking torques (N*m)**M6 retainer 11 ÷ 13**

- Insert the washers on the driven pulley shaft.

N.B.**INSERT THE SMALLER WASHER FIRST, THEN THE LARGER ONE.**

- Insert the flanged nut.
- Prepare the torque wrench for LHS locking using a machine hexagon wrench.
- Tighten the driven pulley shaft fastening nut using an offset wrench.

N.B.**DUE TO THE HIGH TIGHTENING TORQUE, USING DIFFERENT WRENCHES - SUCH AS A CONVENTIONAL POLYGONAL BUSH - MAY DAMAGE THE HEXAGON OBTAINED ON THE SHAFT OR BREAK THE BUSH ITSELF.****Locking torques (N*m)****Driven pulley nut 92 - 100**

- Install the driving pulley shaft cover, positioning the tooth gap on the lower part with the reference mark on the transmission crankcase.

**N.B.****ENSURE THAT THE AIR INTAKE AND EXHAUST OPENINGS ARE COMPLETELY FREE.**

-
- Install the outside plastic transmission cover.
 - Tighten the 4 fastening screws to the prescribed torque.

Locking torques (N*m)**External transmission cover screws 7 ÷ 9**

End gear

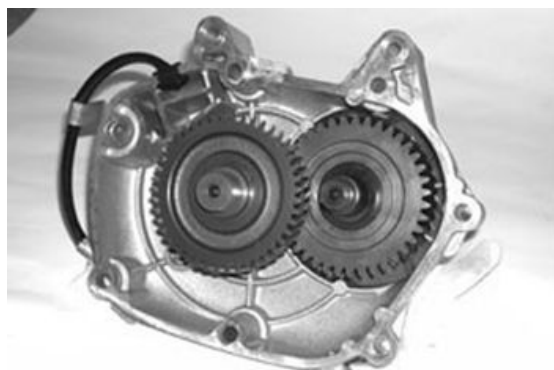
Removing the hub cover

-
- Drain the rear hub oil through the oil drainage cap located under the engine.
 - Remove the 7 fastening screws. Remove the hub cover and the relevant gasket.



Removing the wheel axle

-
- Remove the countershaft.
 - Remove the wheel axis complete with gear.



Removing the hub bearings

- Check all bearings (wear, clearance and noise).
In case of anomalies, proceed as follows.
To remove the gear shaft bearing on the engine crankcase, use the following parts.

Specific tooling

001467Y014 Pliers to extract $\varnothing$ 15-mm bearings

001467Y034 Pliers to extract $\varnothing$ 15-mm bearings

001467Y031 Bell

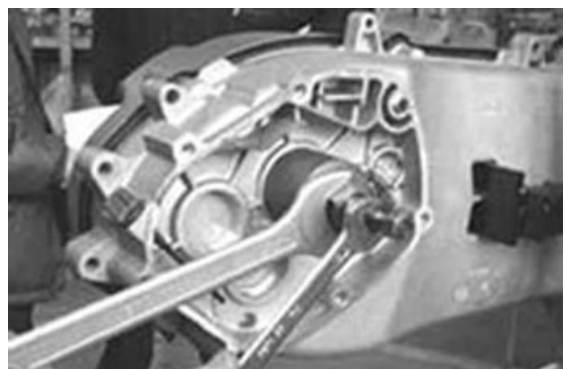


- Use the special extractor to disassemble the bearing on the engine chassis of the countershaft.

Specific tooling

001467Y006 Pliers to extract 20 mm bearings

001467Y035 Bearing housing, outside $\varnothing$ 47 mm



- Support the hub cover using the stud bolt set.
- Pull out the bearing using the special tool.

Specific tooling

020476Y Stud bolt set

001467Y006 Pliers to extract 20 mm bearings

001467Y007 Driver for OD 54-mm bearings

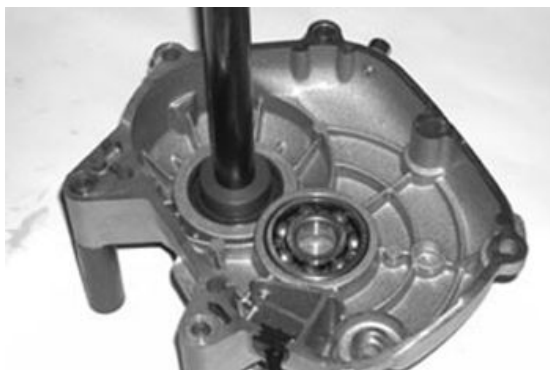


Removing the wheel axle bearings

- Take out the clip on the outside of the gearbox cover.



- Support the hub cover using the stud bolt set.
- Pull out the bearing using the special tool.

Specific tooling**020476Y Stud bolt set****020376Y Adaptor handle****020477Y 37 mm adaptor****020483Y 30-mm guide**

- Remove the oil guard using a screwdriver.



Removing the driven pulley shaft bearing

- If you have to remove the driven pulley shaft, the relevant bearing and the oil guard, remove the transmission cover and the clutch unit as described in the « Automatic transmission» chapter.
- Extract the driven pulley shaft from its bearing.
- Remove the oil guard using a screwdriver into the hub gear box.
- Remove the Seeger ring shown in the figure.

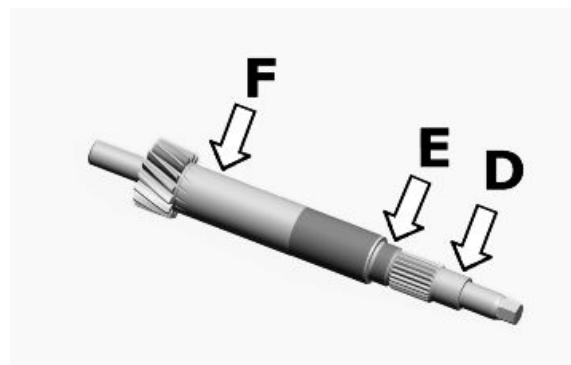
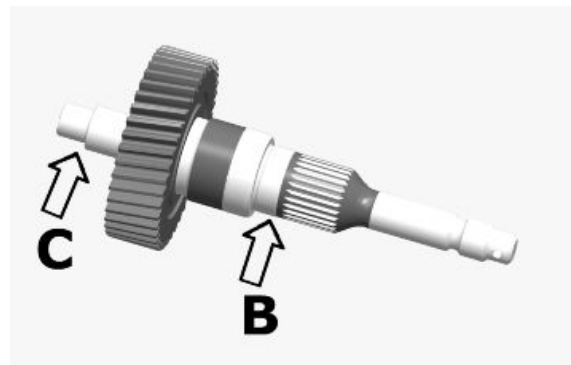
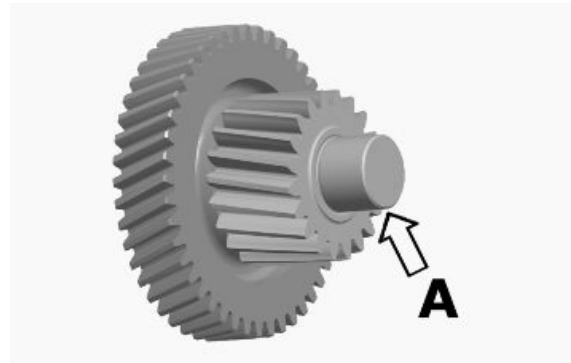


- Pull out the driven pulley shaft bearing from the engine crankcase using the special tool.

Specific tooling**020376Y Adaptor handle****020358Y 37x40-mm Adaptor****020364Y 25-mm guide**

Inspecting the hub shaft

- Check that the 3 shafts exhibit no wear or deformation on the grooved surfaces, at the bearings and at the oil guards.
- In case of faults, replace the damaged parts.



Characteristic

Connection diameter for countershaft:

A = diameter 20 - 0.01 -0.02 mm

Connection diameter for wheel shaft:

B = diameter 30 - 0.010 -0.023 mm

C = diameter 15 - 0.01 -0.02 mm

Bearing diameter for driven pulley shaft:

D = diameter 17 - 0.01 -0.02 mm

E = diameter 20 - 0.01 -0.02 mm

F = diameter 25 - 0.01 -0.02 mm

Inspecting the hub cover

- Check that the mounting surface is not damaged or deformed.

- Check the capacity of the bearings.

In case of faults, replace the hub cover.

Refitting the driven pulley shaft bearing

- Heat the crankcase using the heat gun.

Specific tooling

020151Y Air heater



- Insert the driven pulley shaft bearing until it abuts against the bottom of the seat using the special tool.

N.B.

PLACE IT WITH THE BALLS FACING THE HUB (THIS APPLIES TO BEARINGS WITH PLASTIC CAGE).

Specific tooling

020376Y Adaptor handle

020360Y 52x55-mm Adaptor

020364Y 25-mm guide



- Heat the intermediate gear bearing seat.
- Insert the intermediate shaft bearing using the special tool.

N.B.

PLACE IT WITH THE BALLS FACING THE HUB (THIS APPLIES TO BEARINGS WITH PLASTIC CAGE).

Specific tooling

020376Y Adaptor handle

020359Y 42x47-mm Adaptor

020363Y 20-mm guide



- Heat the gear shaft bearing seat on the crank-case.
- Insert the gear shaft bearing in the upper crank-case seat using the special tool.

N.B.

PLACE IT WITH THE BALLS FACING THE HUB (THIS APPLIES TO BEARINGS WITH PLASTIC CAGE).

Specific tooling

020376Y Adaptor handle

020359Y 42x47-mm Adaptor

020412Y 15-mm guide



- Place the safety lock Seeger ring of the driven pulley shaft bearing.

N.B.

PLACE IT IN THE POSITION SHOWN IN THE FIGURE.



- Insert the pulley shaft oil guard on the transmission side.



Refitting the hub cover bearings

- Heat the bearing seats on the cover using the heat gun.
- Support the hub cover using the stud bolt set.

Specific tooling

020151Y Air heater

020476Y Stud bolt set



- Insert the intermediate shaft bearing on the cover using the special tool.

N.B.

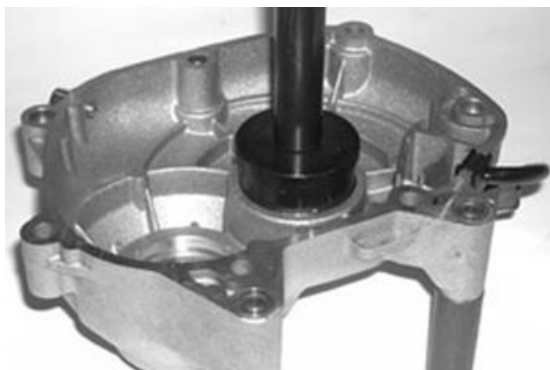
PLACE IT WITH THE BALLS FACING THE HUB (THIS APPLIES TO BEARINGS WITH PLASTIC CAGE).

Specific tooling

020376Y Adaptor handle

020360Y 52x55-mm Adaptor

020363Y 20-mm guide



- Heat the gear shaft bearing seat from the cover outside.

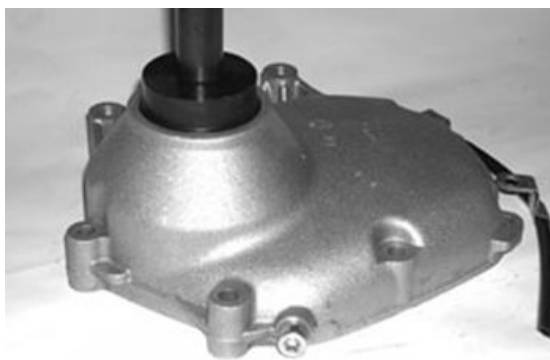
- Insert the gear shaft bearing on the cover using the special punch until abutment.

Specific tooling

020376Y Adaptor handle

020360Y 52x55-mm Adaptor

020483Y 30-mm guide



- Replace the snap ring



- Support the hub cover using the stud bolt set.
- Insert the wheel shaft oil guard with the sealing lip facing the inside of the cover.
- Place the oil guard flush with the crankcase.

Specific tooling

020376Y Adaptor handle

020360Y 52x55-mm Adaptor

020476Y Stud bolt set



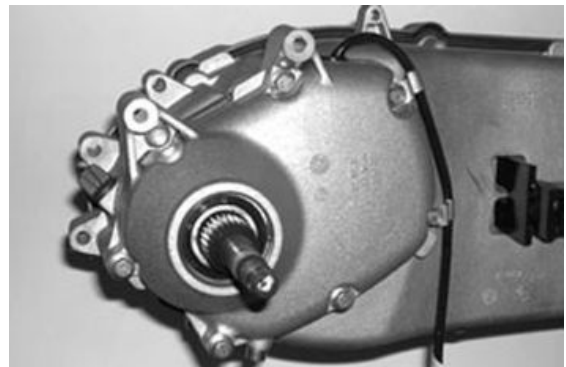
Refitting the hub bearings

- Place the 3 shafts as shown in the figure.



Refitting the hub cover

- Check the proper position of the centring dowels.
- Install a new gasket.
- Fit the gearbox cover, making sure the breather pipe is in the correct position.



- Position the 7 set screws, tighten them to the prescribed torque, being careful of the position of the bands holding the vent tube, and the position of the 3 shortest screws as indicated in the figure.
- Refill with the prescribed oil to the Max. level.

Recommended products

AGIP ROTRA 80W-90 rear hub oil

SAE 80W/90 Oil that exceeds the requirements of API GL3 specifications

Characteristic

Quantity:

approx. 250 cc

Locking torques (N*m)

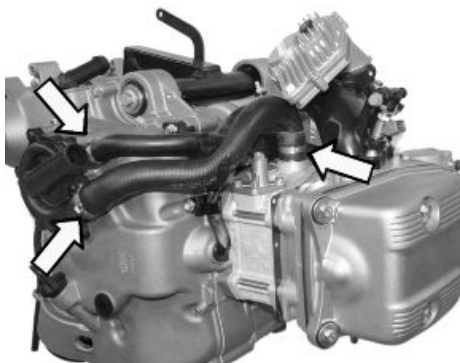
Rear hub cover screws 24 ÷ 27

Flywheel cover

- Remove the three bands shown in the figure for an easier removal of the flywheel cover, remove the feed hoses and disconnect the return hose from the pump cover.

N.B.

THE BANDS MUST BE REPLACED. TO REMOVE THEM, OPEN WITH A SCREWDRIVER OR CUT THEM. BE CAREFUL NOT TO DAMAGE THE PLASTIC UNIONS.



Removing the hub cover

- Drain the engine oil by removing the drainage cap.
- Prepare a suitable container to collect the oil.



- Remove the pre-filter.



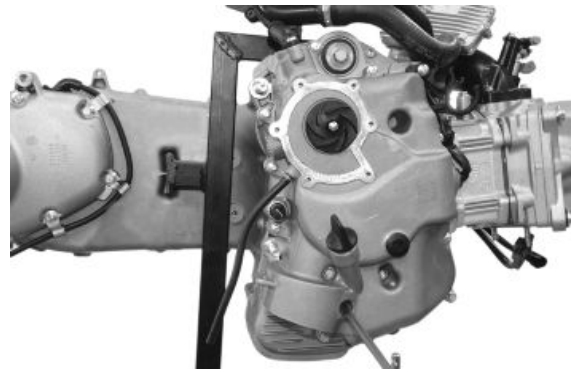
- Remove the oil filter using a filter tape or shaped cup wrench.



- Loosen the 14 fastening screws.
- Remove the flywheel cover with the relevant gas-ket and the cooling system sleeve support.

N.B.

THE SCREWS ARE OF 4 DIFFERENT LENGTHS. NOTE THE RELEVANT POSITIONS.



CAUTION

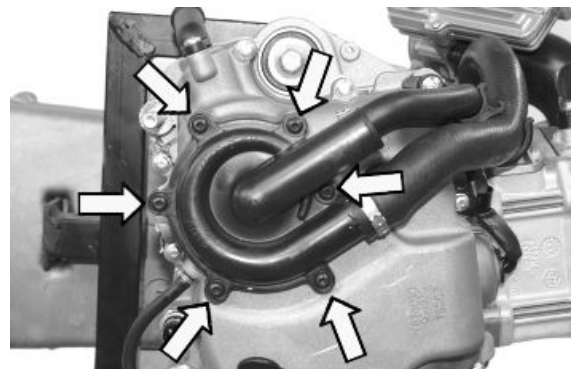
REMOVE THE COVER AVOIDING ANY POSSIBLE INTERFERENCE BETWEEN STATOR AND ROTOR.

CAUTION

BE CAREFUL TO PREVENT SLIPPAGE OF THE BY-PASS VALVE AND OF THE RELEVANT SPRING.

Removing the flywheel cover components

- Loosen the six mounting screws and remove the water pump cover.

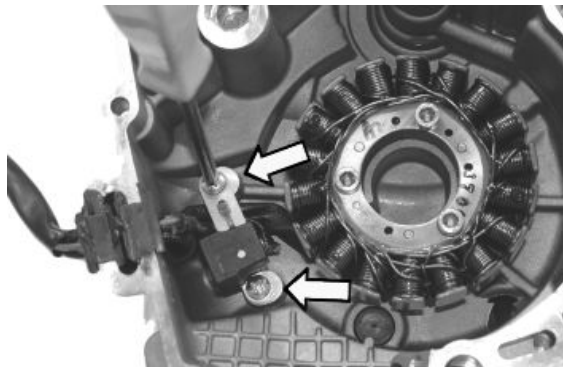


- Remove the by-pass and the relevant spring.
- Remove the oil pump seal.



Removing the stator

- Remove the two retaining screws and the cable guide bracket.



- Unscrew the 3 fastening screws and remove stator and its wiring.



Inspecting the cover components

- Loosen the two retaining screws and remove the reed valve support with bulkhead.



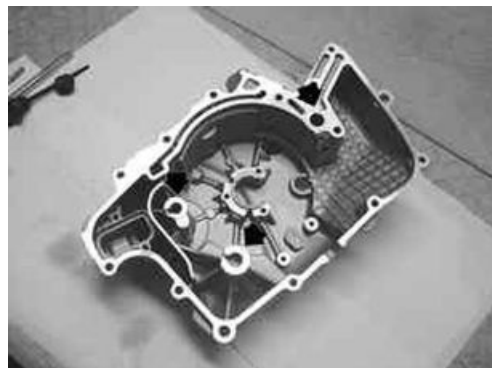
- Remove the blow-by reed valve with the relevant sealing gasket.



- Unscrew the fastening screw and remove the gas outlet union with the relevant O-ring.



- Check that the mounting surface of the crankcase is not worn or deformed.
- Check that the by-pass valve seat and the torque limiter bearing are free from wear.

**Characteristic****By-pass housing hole diameter:**

13.9 mm

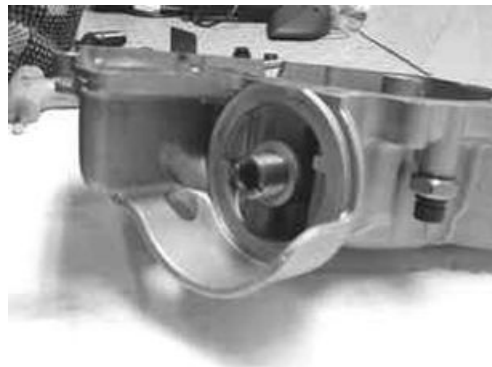
Connection diameter for start-up gear shaft:

12 mm

Connection diameter for pump shaft:

8 mm

- Check that the oil filter union and matching surface exhibit no deformations or wear.



- Check the condition of the stator and the relevant cable harness.



- Check the continuity between the 3 phases.

N.B.

VALUES ARE STATED AT AMBIENT TEMPERATURE. A CHECK WITH THE STATOR AT OPERATING TEMPERATURE MAY RESULT IN VALUES HIGHER THAN THOSE STATED.

Electric characteristic

Resistance:

0.2 - 1 Ω



- Check the ground insulation of each phase.
- If a fault is found, carry out a thorough check of the cable harness that contains two types of cable: Rigid cables close to the stator and flexible cables close to the connector.



- Check that the winding is positioned so as not to interfere with the heads of the retaining screws.



Refitting the stator

- Install the stator assembly together with the wiring harness, tightening the 3 screws to the prescribed torque.

N.B.

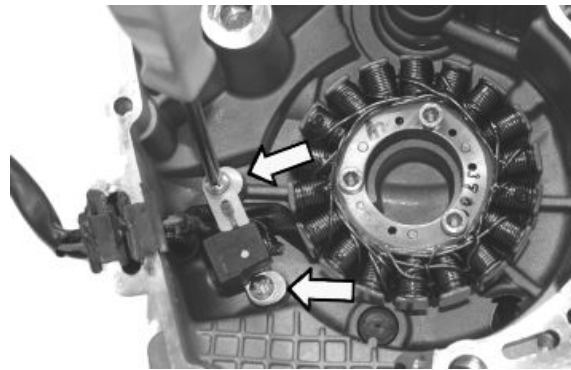
INSERT THE RUBBER WIRING SEALING GASKET INTO THE SPECIAL SEAT ON THE CRANKCASE.

Locking torques (N*m)

Stator retainers 8 - 10



- Install the wiring guide bracket tightening the 2 screws to the prescribed torque.

Locking torques (N*m)**Stator cable harness guide bracket screws 3 - 4**

Refitting the flywheel cover components

- Before reassembling, check that all components are perfectly clean.
- For the cover, carefully check all lubrication channels, in particular:
 - The 3 by-pass channels.



- Oil pressure sensor feeding duct.



- Oil vapour decantation chamber



- Temporarily install the distribution timing check hole cover and the engine oil filling cap/bar.
- Insert the blow-by recovery duct using a new O-ring.
- Tighten the screws to the prescribed torque.

Locking torques (N*m)**Blow-by recovery duct fixing screws 3 - 4**

- Insert the spring and the by-pass piston on the flywheel cover.

N.B.**LUBRICATE THE BY-PASS VALVE.**

- Reinstall the blow-by reed valve using a new sealing gasket.
- Reinstall the support with head and tighten the screws to the prescribed torque.

Locking torques (N*m)**Supporting screws with bulkhead 0.3 - 0.4**

- Correctly fit a new O-ring, do not allow it to come into contact with grease or oil.

FAILURE TO OBSERVE THIS PRECAUTION WILL IRRETRIEVABLY DEFORM THE O-RING.

- Refit the water pump cover and tighten the 6 fixing screws to the prescribed torque.

Locking torques (N*m)**Pump cover fixing screws: 3 ÷ 4**

Refitting the flywheel cover

- Install a new oil filter, lubricate the gasket, screw on and finally tighten to the prescribed torque.

Locking torques (N*m)

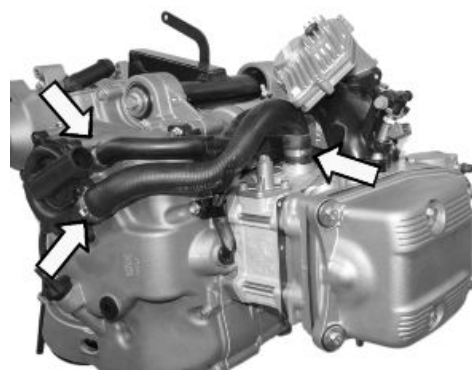
Engine oil filter 12 - 16



- Install the supply hose to the cylinder and connect the return hose to the pump cover using 3 new clamps.

N.B.

TIGHTEN THE CLAMPS USING APPROPRIATE PLIERS, PAYING ATTENTION NOT TO CONSTRICT THE HOSES BUT ALSO TAKING CARE TO TIGHTEN THE CLAMPS SUFFICIENTLY.



- Install the pre-filter again and insert the engine oil drain plug, tightening to the prescribed torque.
- Refill the engine with the prescribed type of oil.

Recommended products

AGIP CITY HI TEC 4T Engine oil

SAE 5W-40, API SL, ACEA A3, JASO MA Synthetic oil



Locking torques (N*m)

Engine oil drainage plug 24 ÷ 30

- Lubricate the intermediate gear seat with torque limiter on the flywheel cover.
- Align the water pump movement sensor with a reference and install the flywheel cover as described in the Flywheel cover chapter.



- Install a new gasket on the engine crankcase.
- Check the presence of the three centring dowels.



- Turn the crankshaft in order to align the counter-shaft movement sensor with a reference point on the crankcase (see figure).



- Repeat the alignment for the water pump crankshaft using the same reference point on the engine.

N.B.

THIS PREPARATION IS USEFUL PARTICULARLY IN THE EVENT OF REPAIRS WITH THE WATER PUMP COVER INSTALLED.



- Install the flywheel cover on the engine, paying attention to avoid interference between the stator and rotor.

WARNING

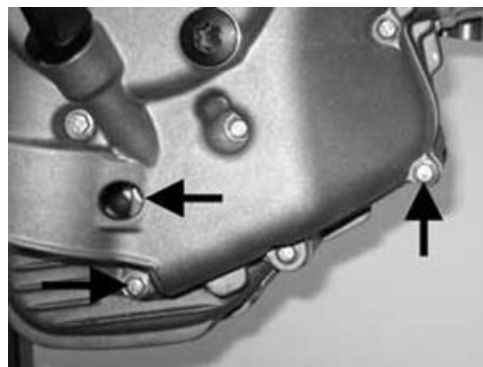
FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN DESTRUCTION OF THE CERAMIC MAGNETS.

- Tighten the 14 retaining bolts of the cover to the prescribed torque.

N.B.

THE BOLTS HAVE FOUR LENGTHS:

- THE 3 SHORTEST ARE INSERTED AS SHOWN IN THE FIGURE.
- THE LONGEST IS INSERTED UNDER THE ENGINE OIL FILLER PLUG.

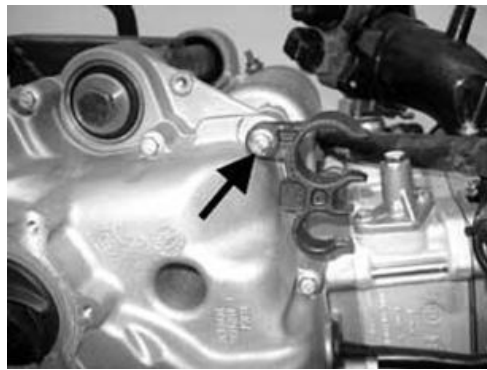


N.B.

- THE INTERMEDIATE BOLTS FOR THE REMAINING MOUNTING POINTS WITH THE EXCEPTION OF THE BOLT FOR THE MANIFOLD SUPPORT (SHOWN IN THE FIGURE) ARE SLIGHTLY LONGER.

Locking torques (N*m)

Flywheel cover screws 11 - 13



Flywheel and starting

Removing the starter motor

N.B.

THIS OPERATION MAY ALSO BE CARRIED OUT WITH FLYWHEEL COVER ASSEMBLED.

- Loosen the two fastening screws.
- Extract the complete starter motor.

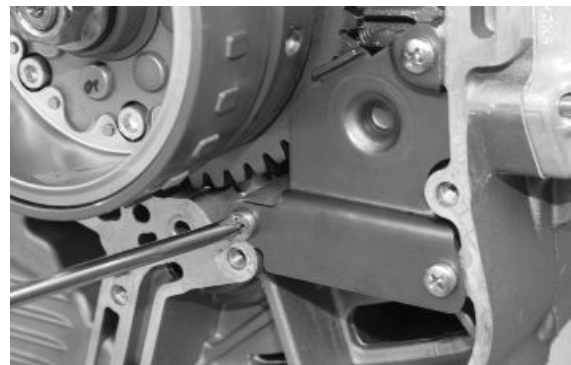


Removing the flywheel magneto

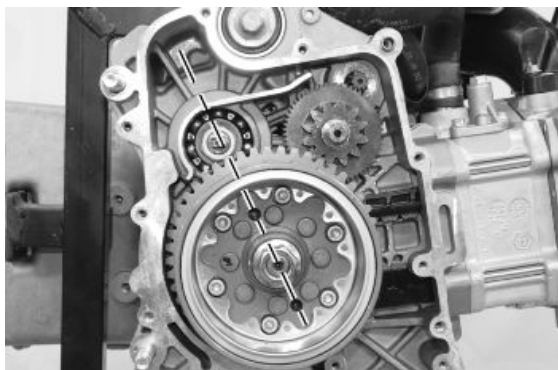
N.B.

IF YOU MUST REMOVE THE FLYWHEEL, IT IS NECESSARY TO REMOVE THE CHAIN GUIDE SLIDING BLOCK RETAIN PLATE FIRST.

- Unscrew the 3 fastening screws and remove the chain guide sliding block retain plate and the start-up rim.



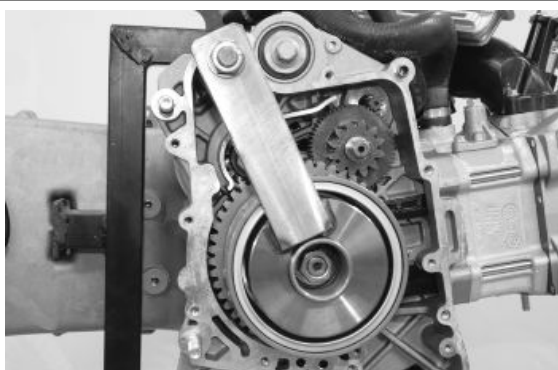
- Align the holes obtained on the flywheel with the crankcase housing to allow the introduction of the special tool.



- Tighten the bushing of the flywheel lock tool on the removing tool threading.



- Insert the special tool as shown in the figure, making sure that the pins are perfectly inserted into the previously aligned holes and that it is perfectly abutted and almost flush with the flywheel.



Specific tooling

020472Y Flywheel lock wrench

- Loosen the magneto flywheel fastening nut.
- Remove the special tool and the fastening nut.



- Remove the washer.



- Insert the nut again so as to slightly uncover the shaft and free the space that was occupied by the washer.

CAUTION

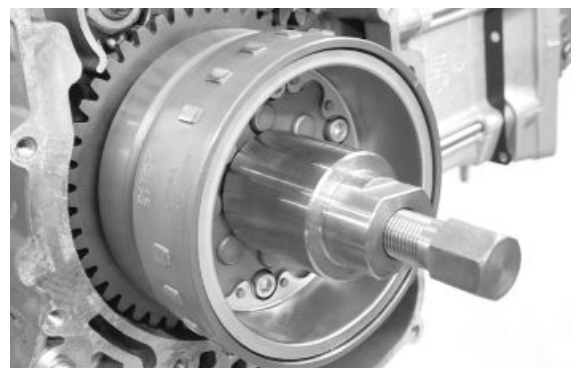
THIS OPERATION IS REQUIRED AS THE FLYWHEEL IS STRONGLY LOCKED; THE CONE DETACHMENT MAY THEREFORE CAUSE THE ROTOR SLIPPAGE, WITH THE CONSEQUENT BREAKAGE OF THE MAGNETS.



- Insert the special removing tool.
- Using a 27-mm wrench and a 19-mm bushing, release the flywheel.

Specific tooling

020467Y Flywheel extractor



- Remove the extractor.
- Remove the nut and extract the flywheel with the start-up rim.
- Remove the crankshaft key.



- To remove the start-up rim from the freewheel it is necessary to turn it clockwise and pull it out.



- Remove the freewheel from the flywheel by loosening the 6 fastening screws.

SINCE THE FREEWHEEL MUST BE REMOVED, IT IS ADVISABLE TO LOOSEN THE 6 FASTENING SCREWS IN ADVANCE WITH THE FLYWHEEL STILL INSTALLED ON THE CRANKSHAFT.



- The freewheel is coupled to the flywheel with high precision; if removal is difficult, use 2 screws as gripping points and as removing tools, if required.



- Extract the intermediate gear provided with torque limiter.



Inspecting the flywheel components

- Check the integrity of the magnets.
- Check that the magnet support cage is free from deformation or cracks.
- Check that the flywheel splines exhibit no loosening.



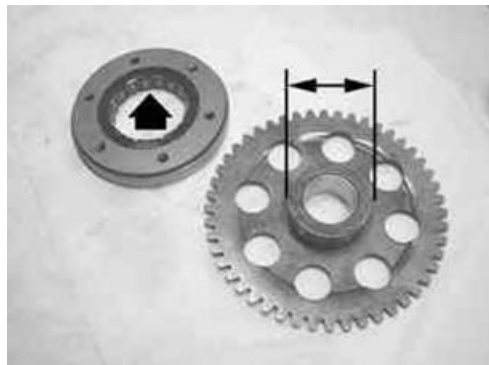
Starter gear rim

- Check that there is no wear or abnormal impressions on the "rollers" of the freewheel and on the surface of the starter ring gear hub.
- Check the hub outside diameter.

Characteristic

Hub outside diameter:

Diameter $45.665 + 0.008 + 0.005$ mm



- Check the inside diameter of the bushing of the starter gearing.
- Check that the toothing is not worn.

Characteristic

Inside diameter of the bushing:

Diameter $27 + 0.020 + 0.041$ mm



N.B.

IF THE FAULTS DISCOVERED AFFECT THE HUB, REPLACE THE STARTER RING GEAR AND FREEWHEEL.

IF ONLY THE BUSHING IS WORN, IT IS POSSIBLE TO REPLACE ONLY THE COMPLETE STARTING RING GEAR. IN THAT CASE, CHECK ALSO THE DIAMETER AND THE SURFACE OF THE CONNECTION ON THE CRANKSHAFT. IN CASE OF IRREGULARITIES, REPLACE THE CRANKSHAFT.

Intermediate gear

- Check that the tothing is not worn.
- Check the diameter of the two bearings.

Characteristic

Gear bearing diameter:

12 - 0 0.011 mm



Also check the shaft diameter on the flywheel cover and on the engine crankcase.

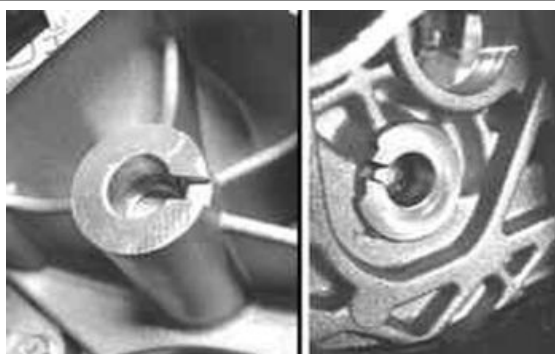
Characteristic

Bearing diameter on the flywheel cover

12 + 0.034 -0.016 mm

Bearing diameter on the engine crankcase:

12 + 0.034 -0.016 mm



N.B.

THE TORQUE LIMITER IS PROVIDED WITH 4 GEARS THAT HAVE THE FUNCTION OF CLUTCH DRIVE PLATES.

Driven plates consist of 4 Belleville springs provided with grooved profiles; this assembly allows transmitting torque lower than 10 kg.

In case of incorrect start-up manoeuvres, the limiter prevents any kicks, with consequent reversal of direction of the crankshaft which would impair the engine structure.



The limiter assembly cannot be overhauled. In case of irregularities on the toothed discs, replace the assembly.

Refitting the free wheel

- Make sure the freewheel faying surfaces are in good condition.
- Thoroughly clean the free wheel to remove LOCTITE residue.
- Degrease the threading of the holes in the free wheel and the clamping screws.
- Apply the recommended product to the end of the screws.

Recommended products

Loctite 243 Medium strength threadlock

Medium Loctite 243 threadlock

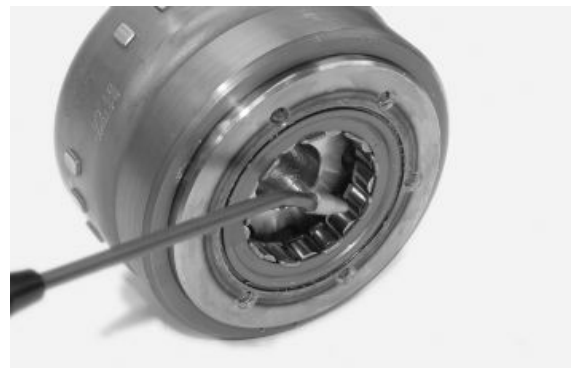
- Fit the freewheel on the magneto flywheel making sure that the ground side is in contact with the flywheel itself, i.e. with wheel Seeger ring visible.
- Lock the six clamping screws in criss-cross fashion to the prescribed torque.

Locking torques (N*m)

Screw fixing freewheel to flywheel 13 ÷ 15



- Oil the free wheel "rollers".



Refitting the intermediate gear

- Lubricate the gear housing on the engine crankcase.



- Insert the intermediate gear with torque limiter



- Lubricate the inside bushing and the starter ring gear hub surface.



- Install the start-up rim on the flywheel turning it clockwise and inserting at the same time.



Refitting the flywheel magneto

- Insert the key on the crankshaft.
- Install the flywheel checking the proper insertion of the key and engaging the torque limiter gear with the start-up rim.



- Insert washer and nut on the crankshaft.



- Tighten thoroughly the guide bushing of the flywheel lock tool and loosen by 1/4 turn.

N.B.

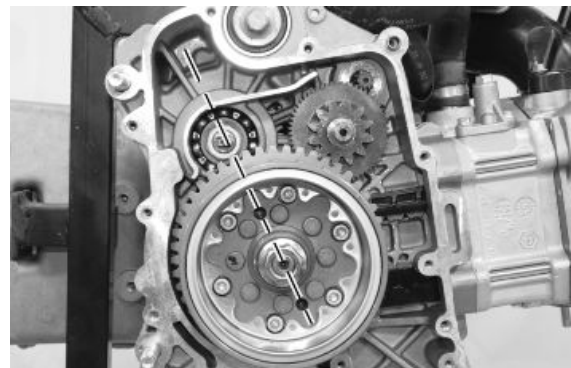
FAILURE TO OBSERVE THIS PRECAUTION CAUSES THE LOCKING OF THE GUIDE ON THE FLYWHEEL.

Specific tooling

020472Y Flywheel lock wrench



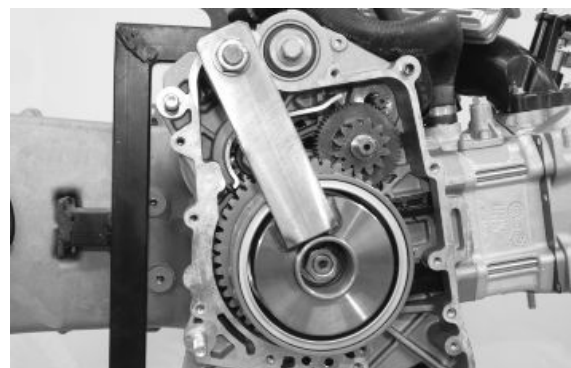
- Align the 2 holes of the flywheel with the case housing to allow the introduction of the special tool.



- Insert the special tool checking that the pins are perfectly introduced into the seat.

Specific tooling

020472Y Flywheel lock wrench



- Tighten the flywheel lock nut to the prescribed torque.

Locking torques (N*m)

Flywheel fixing nut 115 - 125



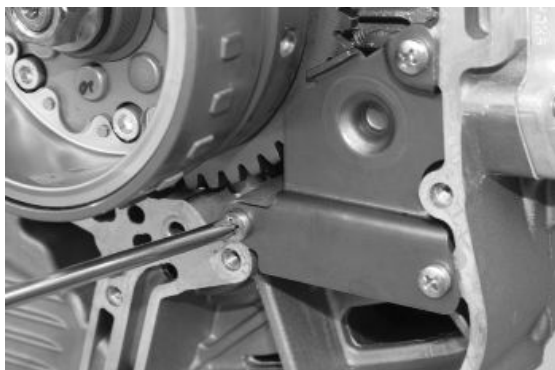
- Install the chain guide retain plate tightening the 3 screws to the prescribed torque.

N.B.

BEFORE TIGHTENING THE SCREWS, MOVE THE START-UP RIM IN CONTACT WITH THE CRANKCASE AND CHECK THAT IT IS FREE TO ROTATE IN ANTICLOCKWISE DIRECTION.

Locking torques (N*m)

Chain guide sliding block retain plate fastening screws 3 ÷ 4



Refitting the starter motor

- Check that the O-ring is in good working order and lubricate it.
- Insert the starter motor.
- Tighten the 2 fastening screws to the prescribed torque.

Locking torques (N*m)

Starter screws 11 ÷ 13



Cylinder assy. and timing system

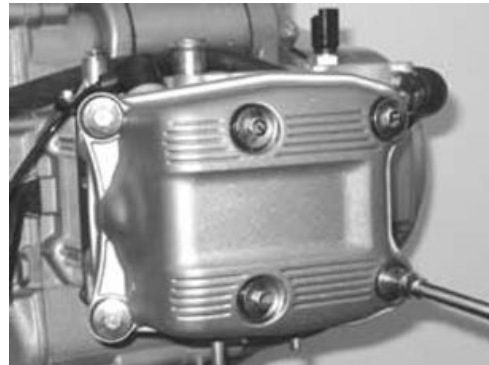
Removing the intake manifold

- Remove the 3 mounting screws.
- Remove the intake manifold unit.



Removing the rocker-arms cover

- Loosen the 6 special screws with stop and the relevant rubber gaskets.
- Remove the tappet cover with relevant gasket.



Removing the timing system drive

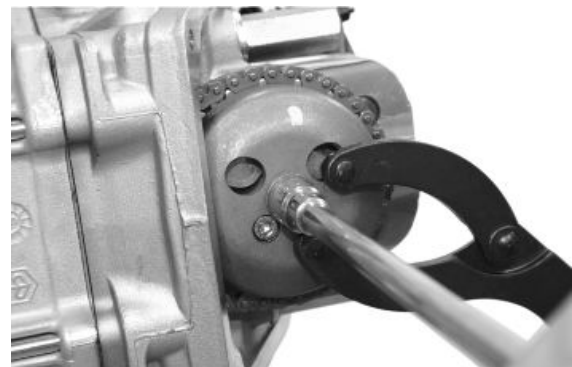
- Turn the engine to close the intake valves.



- Remove the central screw and the valve lifting device mass stop bell using the special tool.

Specific tooling

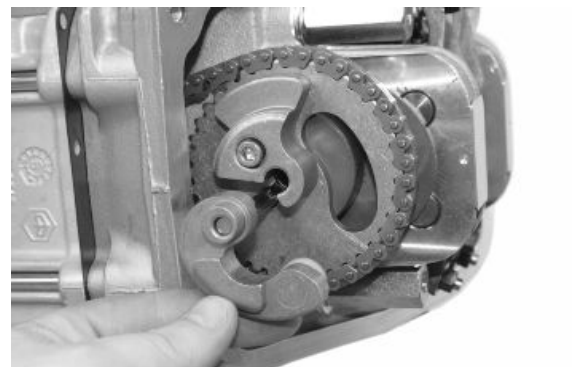
020565Y Flywheel lock calliper spanner



- Remove the return spring and the valve lifting mass with relevant travel end washer.

N.B.

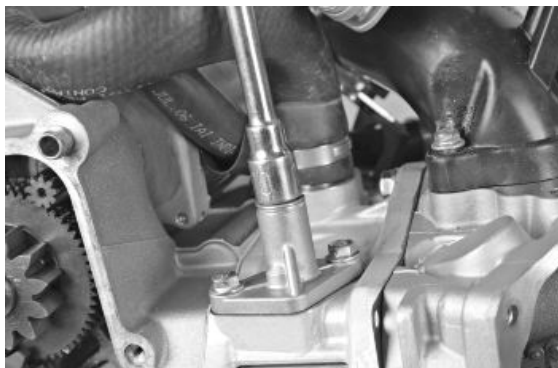
BE CAREFUL NOT TO ALLOW THE WASHER AND SPRING TO FALL INTO THE ENGINE THROUGH THE CHAIN COMPARTMENT.



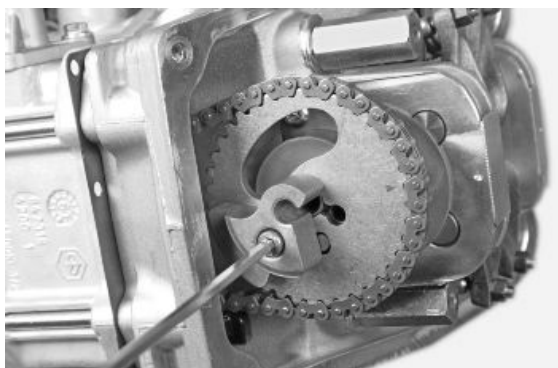
-
- Align the reference marks on the timing chain rim with those on the head.



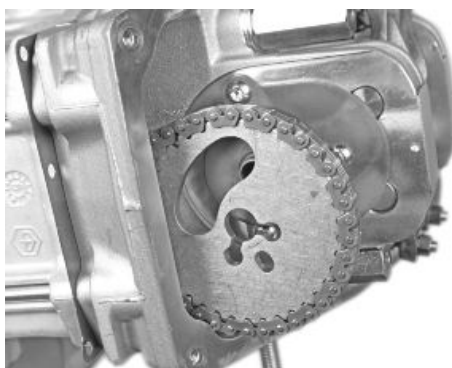
-
- Loosen the central screw on the tensioner first.
 - Unscrew the 2 fastening screws and remove the tensioner with relevant gasket.



Remove the inside hexagon screw and the counterweight as shown in the figure.



-
- Remove the timing belt rim from the camshaft.
 - Remove the timing belt rim.

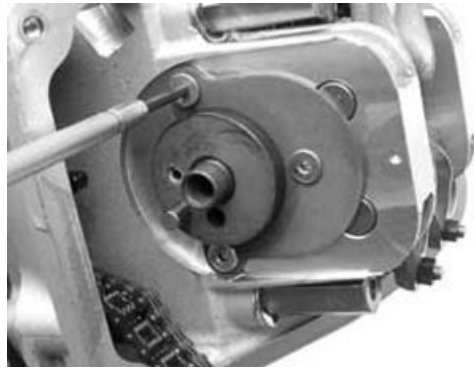


Removing the cam shaft

- Unscrew the 3 fastening screws and remove camshaft retaining bracket.

N.B.

REMOVING THE FASTENING SCREWS MAY BE DIFFICULT. BE CAREFUL NOT TO DAMAGE THE INSIDE HEXAGON. IF NECESSARY, SEPARATE THE THREADS IN ADVANCE.



- Remove the cam shaft.

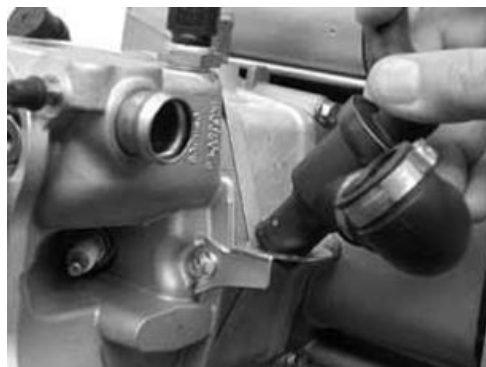


- Remove pins and rocking levers by the transmission side holes.



Removing the cylinder head

- Remove the spark plug.
- Remove the cooling system outlet sleeve with thermostat.



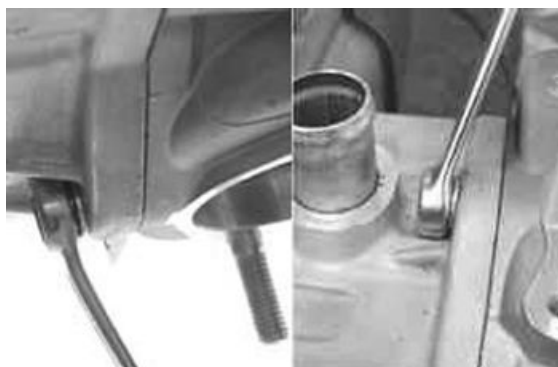
- Remove the coolant temperature sensor.

N.B.

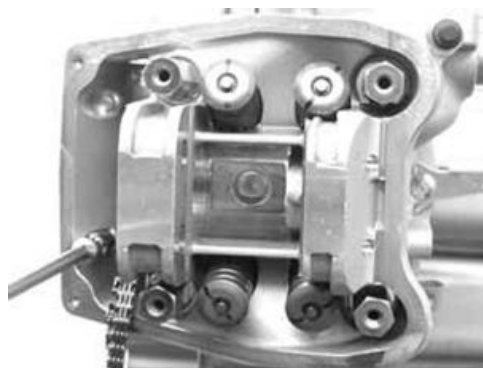
THE SENSOR CONTROLS BOTH INJECTION AND THE ANALOGUE INSTRUMENT ON THE PANEL. TO CHECK THIS COMPONENT, SEE THE INJECTION CHAPTER.



- Remove the 2 fastening nuts on the head, on the exhaust and on the intake side.



- Remove the two M6 screws into the distribution channel and the M6 screw on the spark plug side with the thermostat support.



N.B.

THE HEAD MAY BE REMOVED WITH THE CAMSHAFT, ROCKING LEVER PINS AND FITTING BRACKET IF NECESSARY.

- Loosen the 4 head-cylinder fastening nuts in 2 or 3 times and in a crossed sequence.
- Remove the head, the 2 centring dowels, the gasket and the lower chain guide sliding block.

N.B.

DO NOT REMOVE THE DOWELS IF THEY ARE FORCED INTO THEIR SEAT.



CAUTION

WHEN YOU HAVE TO REMOVE THE HEAD, PREPARE A SUITABLE CONTAINER SINCE THE THERMAL GROUP CONTAINS COOLANT.

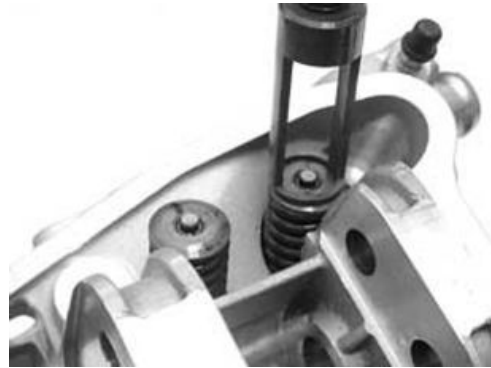
Removing the valves

- Using the appropriate tool fitted with an adaptor, remove the cotters, caps, springs and valves.

Specific tooling

020382Y Valve cotters equipped with part 012 removal tool

020382Y012 bush (valve removing tool)



CAUTION

ARRANGE THE VALVES SO AS TO RECOGNISE THE ORIGINAL POSITION ON THE HEAD (FLY-WHEEL SIDE AND TRANSMISSION SIDE).

- Remove the oil guards using the special tool.

Specific tooling

020431Y Valve oil seal extractor



- Remove the spring supports.

N.B.

BLOW THE SEATS WITH COMPRESSED AIR TO FACILITATE THE SPRING SUPPORT REMOVAL.



Removing the cylinder - piston assy.

- Remove the timing chain.
- Loosen the fastening screw and remove the spacer and the tightening sliding block.

N.B.

IT IS ADVISABLE TO MARK THE CHAIN IN ORDER TO ENSURE THAT THE INITIAL DIRECTION OF ROTATION IS MAINTAINED.



- Extract the cylinder with the relevant gasket and the centring dowel.

N.B.

THE SECOND CENTRING IS ENSURED BY A PIN SET INTO THE CYLINDER.

CAUTION

TO PREVENT DAMAGING THE PISTON, SUPPORT IT WHILE REMOVING THE CYLINDER.



- Remove the 2 piston pin locking rings by the specific housings.
- Extract the pin and remove the piston.

N.B.

USE PAPER OR A CLOTH TO CLOSE THE CYLINDER HOUSING MOUTH ON THE CRANKCASE TO PREVENT SLIPPAGE OF ONE OF THE PIN LOCKING RINGS INTO THE CASE.



- Remove the piston sealing rings and the oil scraper.

CAUTION

NOTE THE ASSEMBLY POSITIONS OF THE LININGS TO PREVENT INVERTING THE POSITION IN CASE OF REUSE.

N.B.

BE CAREFUL NOT TO DAMAGE THE SEALING RINGS DURING REMOVAL.



Inspecting the small end

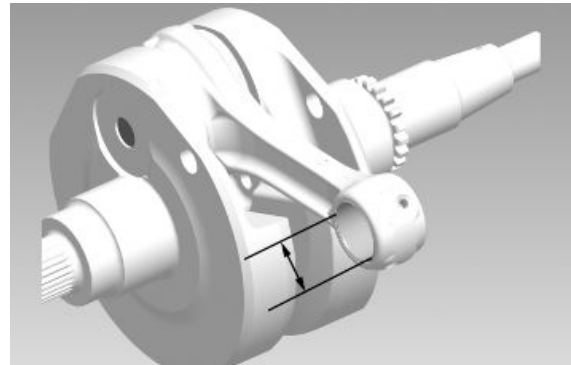
- Using a bore gauge, measure the connecting rod small end diameter.

N.B.

IF THE CONNECTING ROD SMALL END DIAMETER EXCEEDS THE STANDARD DIAMETER, EXHIBITS WEAR OR OVERHEATING, PROCEED TO REPLACE THE CRANK-SHAFT AS DESCRIBED IN THE CRANKCASE AND CRANKSHAFT CHAPTER.

Characteristic**Standard diameter:**

22 + 0.025 + 0.015 mm



Inspecting the wrist pin

- Check the pin outside diameter using a micrometer.

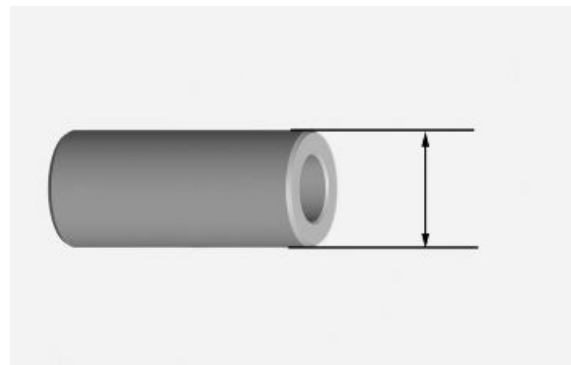
Characteristic**Standard diameter:**

22 0 -0.004 mm

- Calculate the coupling clearance between pin and connecting rod end.

Characteristic**Standard clearance:**

0.015 ÷ 0.029 mm

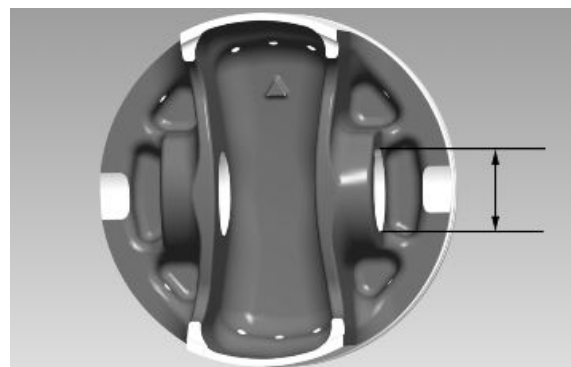


Inspecting the piston

- Measure the diameter of the bearings on the piston.

Characteristic**Standard diameter:**

22 + 0.006 + 0.001 mm



- Calculate the piston pin coupling clearance.

N.B.

THE PIN HOUSINGS HAVE 2 LUBRICATION CHANNELS. FOR THIS REASON, MEASUREMENT MUST BE MADE ACCORDING TO THE PISTON AXIS.

Characteristic

Standard clearance:

0.001 ÷ 0.010 mm

- Measure the outside diameter of the piston, perpendicular to the gudgeon pin axis.
- Take the measurement in the position shown in the figure.

N.B.

REFER TO THE «SPECIFICATIONS» SECTION FOR THE SIZES OF THE PISTON AND THE CYLINDER-PISTON COUPLING CLEARANCES.

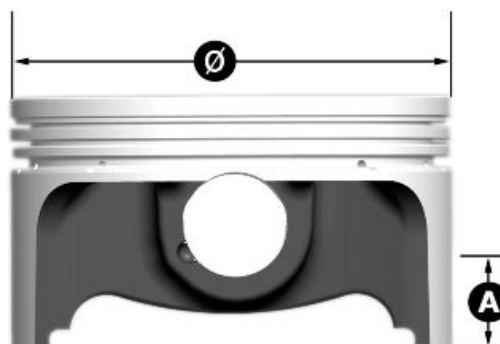
Characteristic

A:

10 mm

Piston diameter:

85.8 mm nominal value



- Using a bore meter, measure the cylinder inner diameter at a given height according to the directions shown in the figure.

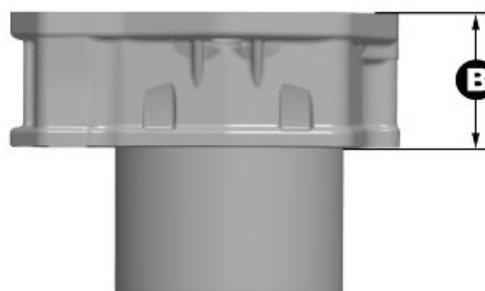
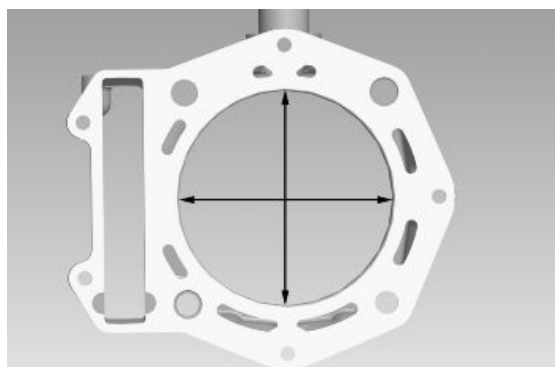
Characteristic

B:

43 mm

Standard diameter:

85.8 mm nominal value



- Check that coating is free from flakes.
- Check that the head matching surface exhibits no deformations or wear.

Characteristic

Maximum allowable run-out:

0.05 mm

- Pistons and cylinders are classified into categories based on their diameter. The coupling is carried out in pairs (A-A, B-B, C-C, D-D).

N.B.

REFER TO THE «SPECIFICATIONS» SECTION FOR THE SIZES OF THE CYLINDER AND THE CYLINDER-PISTON COUPLING CLEARANCES.

Inspecting the piston rings

- Alternately insert the three sealing rings into the cylinder, in the area where it retains its original diameter. Using the piston, insert the rings perpendicularly to the cylinder axis.
- Make sure that each single sealing ring evenly adheres to the cylinder liner. If it does not, this means the ring is worn. Replace it.
- Measure the opening (see figure) of the sealing rings using a feeler gauge.
- If higher values than those prescribed are measured, replace the linings.



Check the size of the sealing ring opening:

Compression ring: 0.15 ÷ 0.35 mm. Max. value 0.5 mm

Oil scraper ring: 0.25 ÷ 0.50 mm. Max. value 0.65 mm

Oil scraper ring: 0.25 ÷ 0.50 mm. Max. value 0.65 mm

Rings/housing coupling clearances:

Carefully clean the sealing ring housings.

Place a thickness gauge between the ring and the housing as shown in the drawing and check the coupling clearances.

Top ring Standard coupling clearance:

0.01÷0.06 mm

Maximum clearances allowed after use: 0.10 mm

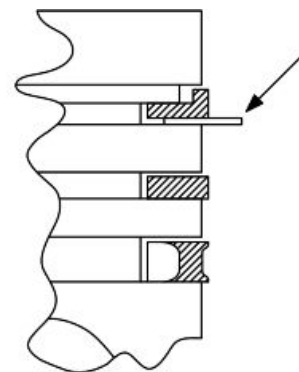
Intermediate ring Standard coupling clearance:

0.02÷0.07 mm

Maximum clearances allowed after use: 0.10 mm

Oil scraper ring Standard coupling clearance:

0.01÷0.06 mm



Maximum clearances allowed after use: 0.10

mm

Replace the piston if clearances exceed the maximum limits specified in the table.

Removing the piston

- Install piston and wrist pin onto the connecting rod, aligning the piston arrow the arrow facing towards the exhaust.



- Insert the locking ring into the special tool, with the opening in the position indicated on the tool.

S = left

D= right



- Place the wrist pin stop ring into position using a punch



- Install the pin lock using the key shown in the figure.

Specific tooling

020470Y Pin retainers installation tool



N.B.

THE TOOL FOR INSTALLING THE SNAP RINGS MUST BE USED MANUALLY.

CAUTION

USING A HAMMER MIGHT DAMAGE THE STOPS' HOUSING.

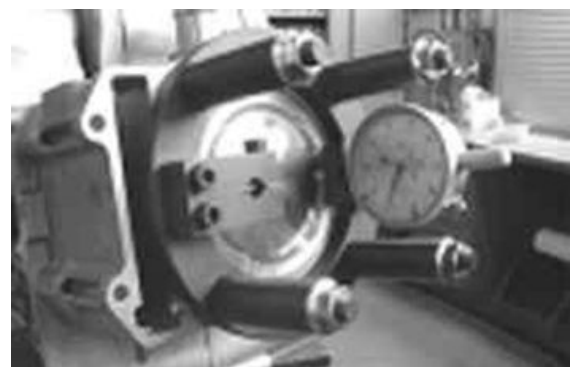
Choosing the gasket

- Provisionally fit the piston into the cylinder, without any base gasket.
- Install a dial gauge on the special tool using the short union, as shown in the figure.

Specific tooling

020475Y Piston position checking tool

- Using an abutment plane, reset the dial gauge with a preload of a few millimetres.
- Finally fix the dial gauge.
- Check the perfect sliding of the feeler pin.
- Install the tool on the cylinder without changing the dial gauge position.
- Lock the tool using the original head fixing nuts.
- Rotate the crankshaft up to the TDC (the inversion point of the dial gauge rotation)
- Measure the deviation from the reset value.



- Identify the thickness of the cylinder base gasket to be used for reassembly by the table below. Correctly identify the cylinder base gasket thickness to keep the correct compression ratio.
- Remove the special tool and the cylinder.

N.B.

IF DEVIATIONS (OR RECESSES OR PROJECTIONS) CLOSE TO THE CHANGE OF CATEGORY ARE MEASURED, REPEAT THE MEASUREMENT AT THE OPPOSED SIDE. TO DO SO, REPEAT THE TOOL INSTALLATION BY INVERTING ITS POSITION.

Characteristic

Recess / Projection measured 1

- 0.185 - - 0.10

Gasket thickness 1

0.4 ± 0.05

Recess / Projection measured 2

- 0.10 - + 0.10

Gasket thickness 2

0.6 ± 0.05

Recess / Projection measured 3

+ 0.10 ÷ + 0.185

Gasket thickness 3

0.8 ± 0.05

Refitting the piston rings

- Place the scraper ring spring on the piston.
- Install the scraper ring keeping the opening opposed to the spring junction and with the writing "top" facing the piston top. The chamfered side of the oil scraper ring should always be facing the piston crown.
- Fit the second lining with the identification letter or the writing "top" facing the piston crown. In any case, the step must be facing opposite the piston top.
- Install the first compression lining in the direction imposed by the housing.
- It is advisable to use a fitter to facilitate the installation of the linings.



N.B.

THE TWO PISTON RINGS ARE MADE WITH A TAPERED CYLINDRICAL CONTACT CROSS-SECTION. THIS IS TO ACHIEVE A BETTER BEDDING.

- Misalign the lining openings at 120° as shown in the figure.
- Lubricate the components with engine oil.
- The engine uses the first compression lining with an L section.

Refitting the cylinder

- Insert the cylinder base gasket with the thickness determined above.
- Using the fork and the ring clamp, fit the cylinder as shown in the figure.

N.B.

BEFORE FITTING THE CYLINDER, CAREFULLY BLOW THE LUBRICATION DUCT AND LUBRICATE THE CYLINDER LINER. CHECK THE PRESENCE OF THE TWO REFERENCE DOWELS.

Specific tooling

020468Y Piston assembly band

020512Y Piston fitting fork



Inspecting the cylinder head

- Using a trued bar and a feeler thickness gauge check that the cylinder head surface is not worn or distorted.

Characteristic**Maximum allowable run-out:**

0.1 mm

- In case of irregularities, replace the head.
- Check the sealing surfaces for the intake and exhaust manifold.
- Check that the camshaft and the rocking lever pin capacities exhibit no wear.
- Check that the head cover surface is not worn.
- Check that the coolant sealing pad exhibits no oxidation.



Inspecting the timing system components

- Check that the guide shoe and the tensioner shoe are not worn out.
- Check that the crankshaft pinion and the camshaft timing gear and crankshaft pinion exhibit no wear.

In case of wear of the sliding blocks, replace them.

In case of wear of the chain or rim, replace the entire unit.



N.B.

IF THE CHAIN HAS DAMAGED THE PINION, REPLACE THE CRANKSHAFT AS DESCRIBED IN CHAPTER CRANKCASE AND CRANKSHAFT.

Chain tensioner:

- Remove the centre screw with the washer and the tensioner spring. Check that the one-way mechanism is not worn.
- Check the condition of the tensioner spring.
- If examples of wear are found, replace the whole unit.



Inspecting the valve sealings

- Visually inspect the valve sealing surface.

CAUTION

DO NOT REVERSE THE FITTING POSITIONS OF THE VALVES (RIGHT - LEFT).

- If the sealing surface of the valve is found to be interrupted at one or more points or is not flat, replace the valve.



- Insert the valves into the cylinder head.
- Alternatively check the intake and exhaust valves.
- The test is carried out by filling the manifold with petrol and checking that the head does not ooze through the valves when these are just pressed with the fingers.



Inspecting the valve housings

- Clean the valve seats of any carbon residues.
- Using the Prussian blue, check the width of the impression on the valve seat "V".

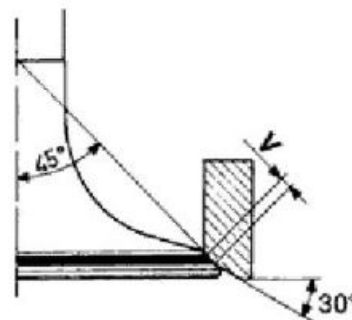
Characteristic

Standard value:

1 - 1.3 mm

Admissible limit:

1.6 mm



- If the impression width on the valve seat is larger than the prescribed limits, true the seats with a 45° mill and then grind.
- In case of excessive wear or damage, replace the head.

Inspecting the valves

- Measure the diameter of the valve stems in the three positions indicated in the diagram.

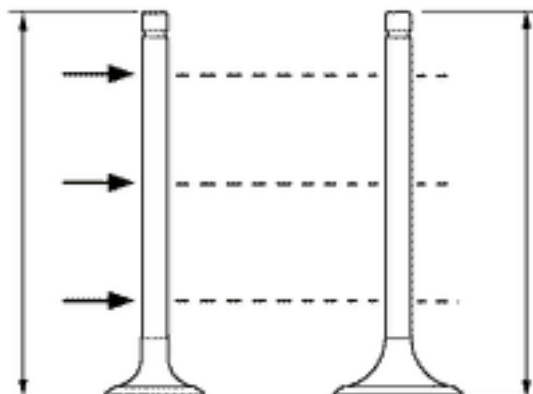
STANDARD DIAMETER

Specification	Desc./Quantity
Inlet:	4.987 - 4.972 mm
Outlet:	4.975 - 4.960 mm

MINIMUM ADMISSIBLE DIAMETER

Specification	Desc./Quantity
Inlet:	4.96 mm
Outlet:	4.945 mm

- Calculate the clearance between valve and valve guide.

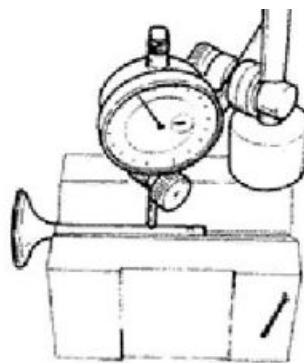


- Check the deviation of the valve stem by resting it on a «V» shaped abutment and measuring the extent of the deformation with a dial gauge.

Characteristic

Limit values admitted:

0.1 mm

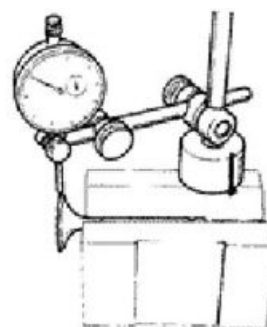


- Check the concentricity of the valve head by arranging a dial gauge at right angle relative to the valve head and rotate it on a "V" shaped abutment.

Characteristic

Admissible limit:

0.03 mm



Inspecting the valve stem guide clearance

- After measuring the valve guide diameter and the valve stem diameter, check clearance between guide and stem.

INLET

Specification	Desc./Quantity
Standard clearance:	0.013 - 0.04 mm
Admissible limit:	0.08 mm

OUTLET

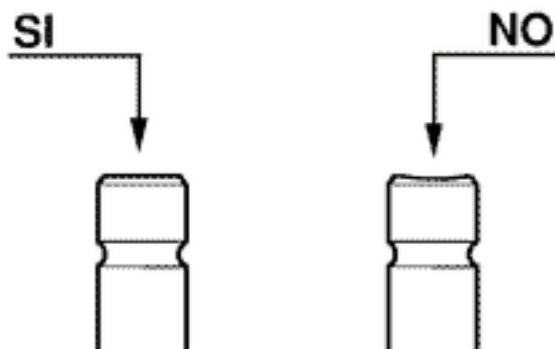
Specification	Desc./Quantity
Standard clearance:	0.025 ÷ 0.052 mm
Admissible limit:	0.09 mm



STANDARD VALVE LENGTH

Specification	Desc./Quantity
Inlet:	95.0 ± 0.3 mm
Outlet:	94.2 ± 0.3 mm

- Check that there are no signs of wear on the surface of contact with the articulated register terminal.



- If no anomalies are found during the above checks, you can use the same valves. To obtain better sealing performance, grind the valve seats. Grind the valves gently with a fine-grained lapping compound. During the grinding, keep the cylinder head with the valve axes in a horizontal position. This will prevent the lapping compound residues from penetrating between the valve stem and the guide (see figure).

**CAUTION**

TO AVOID SCORING THE FAYING SURFACE, DO NOT KEEP ROTATING THE VALVE WHEN NO LAPPING COMPOUND IS LEFT. CAREFULLY WASH THE CYLINDER HEAD AND THE VALVES WITH A SUITABLE PRODUCT FOR THE TYPE OF LAPPING COMPOUND BEING USED.

CAUTION

DO NOT REVERSE THE FITTING POSITIONS OF THE VALVES (RIGHT - LEFT).

Inspecting the springs and half-cones

- Check that the upper and lower supporting spring washers, the cotters and the oil seal show exhibit no signs of abnormal wear. Replace a component when worn.



- Measure the unloaded spring length.

Characteristic

Standard length:

44.4 mm

Admissible limit after use:

42.4 mm



Refitting the valves

- Place the valve spring support washers on the head.
- Alternately insert the 4 oil guards using the special tool.
- Lubricate the oil guards and the valve guides.

Specific tooling

020306Y Punch for assembling valve seal rings



- Fit the valves, the springs and the caps. Using the appropriate tool with adapter, compress the springs and insert the cotters in their seats.

Specific tooling

020382Y Valve cotters equipped with part 012 removal tool

020382Y012 bush (valve removing tool)



N.B.

DO NOT CHANGE THE VALVE FITTING POSITION. FIT THE VALVE SPRINGS WITH THE REFERENCE COLOUR ON COTTER SIDE (TURNS WITH GREATER PITCH).

Inspecting the cam shaft

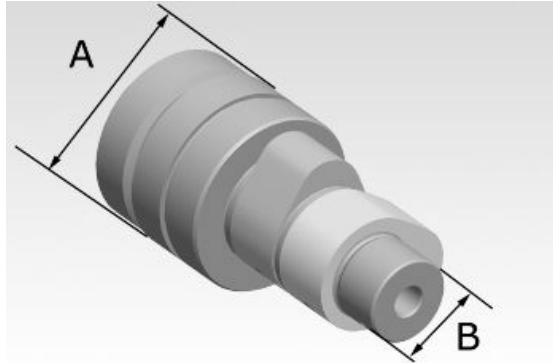
- Check that the camshaft bearings exhibit no scores or abnormal wear.
- Using a micrometer, measure the camshaft bearings.

STANDARD DIAMETER

Specification	Desc./Quantity
Bearing A Ø:	42 - 0.060 -0.085 mm
Bearing B diameter:	20 - 0.020 -0.041 mm

MINIMUM ADMISSIBLE DIAMETER

Specification	Desc./Quantity
Bearing A Ø:	41.910 mm
Bearing B diameter:	19.940 mm



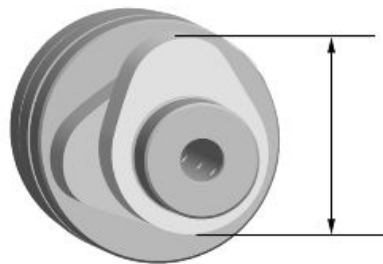
-Using a gauge, measure the cam height.

STANDARD HEIGHT

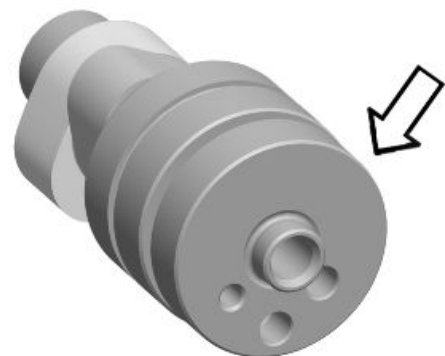
Specification	Desc./Quantity
intake	33.774 mm
discharge	33.273

ADMISSIBLE LIMITS

Specification	Desc./Quantity
intake	33.526 mm
discharge	33.026 mm
Standard axial clearance:	0 - 0.22 mm
Maximum admissible axial clearance:	0.3 mm



- If any of the above dimensions are outside the specified limits, or there are signs of excessive wear, replace the defective components with new ones.
- Check that the retaining plate seat shown in the figure exhibits no wear.



- Check that the automatic valve lifting device cam, the travel end roller and the rubber abutment on the containment bell are free from wear.
- Check that the valve lifting spring has not yielded.
- Replace any defective or worn components.



- Check that the rocking lever pins exhibit no scores or wear.

Characteristic**Standard diameter:**

13 - 0.010 -0.018 mm

- Measure the inside diameter of each rocking lever.

**Characteristic****Standard diameter:**

13 + 0.026 +0.015 mm

- Check that the cam contact sliding block and the articulated register plate is free from wear.
- In case of wear, replace the component.

Refitting the head and timing system components

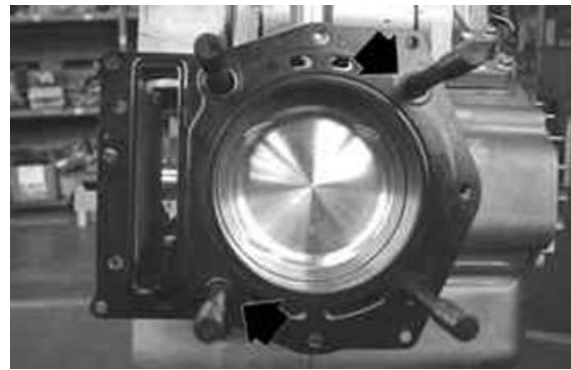
- Insert the chain guide sliding block.
- Insert the two centring dowels between head and cylinder.
- Install the head gasket.



N.B.

THE FIGURE SHOWS THE INSERTION POSITION OF THE TWO CENTRING DOWELS BETWEEN HEAD AND CYLINDER. THE DIRECTION OF INSTALLATION FOR THE GASKET IS FORCED BY THE DOWELS.

- The head gasket is made of steel and has a standard thickness.



- Check that the head lubrication channel is perfectly clean. Clean with compressed air jets, if required.
- Insert the head.
- Lubricate the stud bolts and the 4 fixing stud bolts.



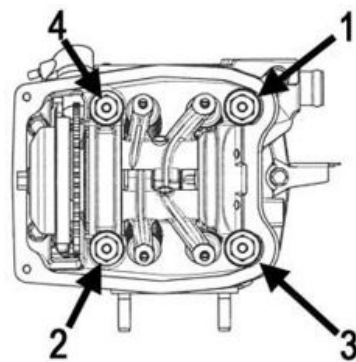
- Tighten the 4 fixing stud bolts crosswise to the prescribed torque as shown in the figure.

Locking torques (N*m)

Head fixing stud bolts ***

*** Apply a preliminary torque of 7 Nm in a crossed sequence.

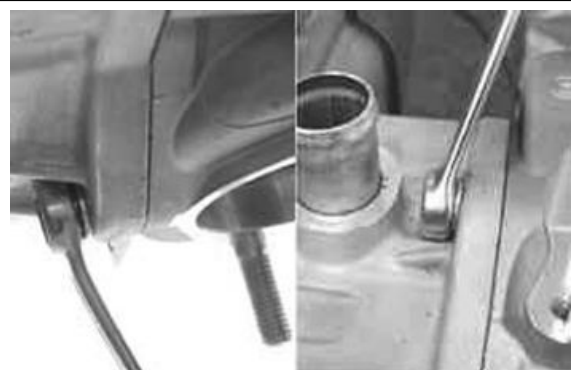
- Tighten by 90° in a crossed sequence.
- tighten again by 90° in a crossed sequence.



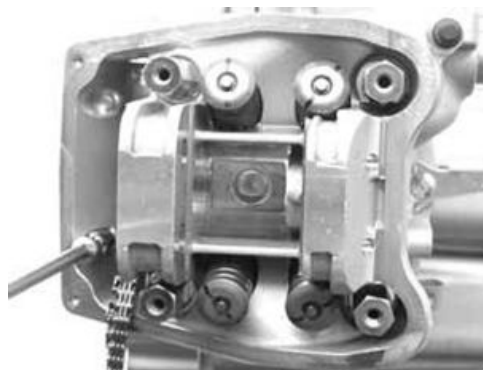
- Tighten the fastening nuts on the exhaust and on the intake side to the prescribed torque.

Locking torques (N*m)

Exhaust / intake head fixing nuts 10 - 12



- Tighten the 3 side screws to the prescribed torque.

Locking torques (N*m)**Head fixing screws 10 - 12**

- Install the coolant temperature sensor with the washer and tighten to the prescribed torque.

CAUTION**FAILURE TO OBSERVE THE TIGHTENING TORQUE CAN DAMAGE THE SENSOR.****Locking torques (N*m)****Coolant temperature sensor: 10 - 12**

- Install the spark plug and tighten to the prescribed torque.

Locking torques (N*m)**Spark plug 12 ÷ 14**

- Insert the timing control belt on the crankshaft according to the initial direction of rotation.
- Install the tensioner shoe with its spacer, tightening the bolt to the prescribed torque, using the recommended product.

Recommended products**Loctite 243 Medium strength threadlock**

Medium Loctite 243 threadlock

**Locking torques (N*m)****Tensioner sliding block fixing screw 10 - 14**

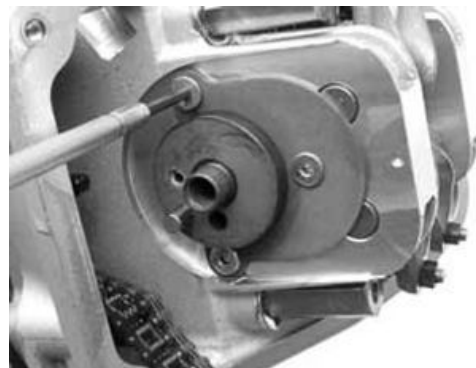
- Insert pins and rocking levers on the flywheel side.
- Lubricate the two rocking levers through the holes at the top.



- Clean the camshaft by blowing with little compressed air jets, especially the retaining plate housing.
- Lubricate the 2 shafts.
- Insert the camshaft into the head with the cams opposite the rocking levers.



- Remove any LOCTITE residues from the screws fixing the camshaft retaining bracket using a brush.
- Apply the recommended product to the fixing screws and tighten to the prescribed torque.



Recommended products

Loctite 243 Medium strength threadlock

Medium Loctite 243 threadlock

- Insert the camshaft retain bracket with visible countersinks and tighten the 3 fastening screws to the prescribed torque, being careful not to damage the inside hexagon.

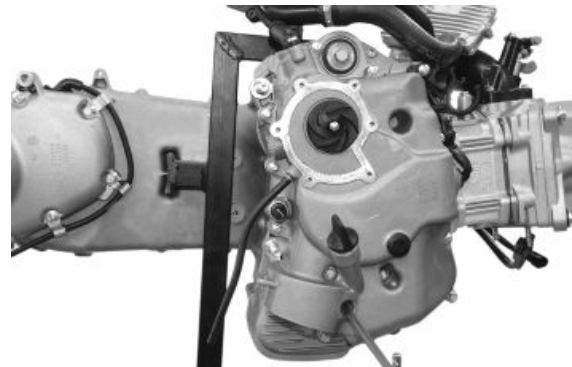
Locking torques (N*m)

Camshaft retaining bracket screws: $4 \div 6$

- Install the intermediate gear with torque limiter, the flywheel and its cover, as described in Chapter "Flywheel and start-up system", and in Chapter "Flywheel cover".

N.B.

FOR MORE CONVENIENCE, INSTALL THE FLYWHEEL COVER WITHOUT THE COOLING SYSTEM SLEEVES.



- Using the TORX wrench, remove the timing check cap.



- Insert the belt on the camshaft control timing rim.
- Insert the timing rim on the camshaft checking that the references are aligned.

N.B.

DURING THE STROKE CHECK, KEEP THE BELT TENSIONED BY PRESSING ON THE TIGHTENER COMPARTMENT SIDE.



- Keeping the belt slightly pulled, turn the crankshaft using the driving pulley to make the reference on the magnet support collimate with that on the flywheel cover.



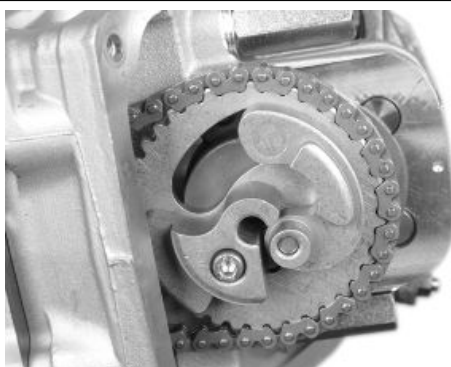
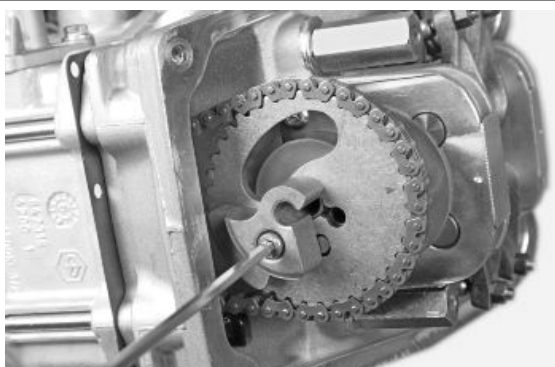
- Install the counterweight mass.
- Centre using the bell fastening screw.
- Lock the mass fixing screws to the prescribed torque, using the recommended product.

Recommended products**Loctite 243 Medium strength threadlock**

Medium Loctite 243 threadlock

Locking torques (N*m)**Counterweight screw $7 \div 8.5$**

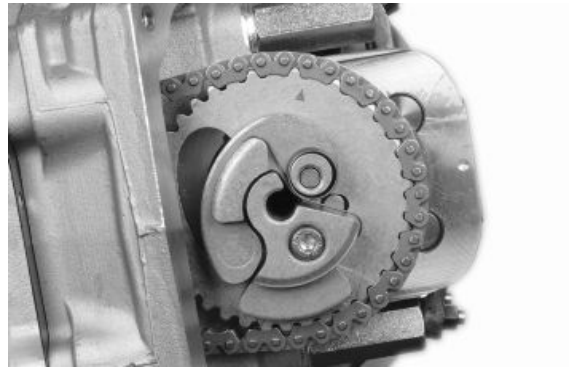
- Remove the central screw.
- Install the valve lifting mass being careful to the proper positioning of the travel end ring.
- Lubricate the mass and de-compressor control pin.



- Install the return spring and load it by about 3/4 turn.



- Turn the engine to move the references to the top as shown in the figure (intake end).



- Insert the valve lifting device mass stop bell.
- Tighten the retaining screw to the prescribed torque, using the recommended product.

N.B.

THE BELL TIMING IS ENSURED BY THE COUNTERWEIGHT MASS FASTENING SCREW HEAD.

Recommended products

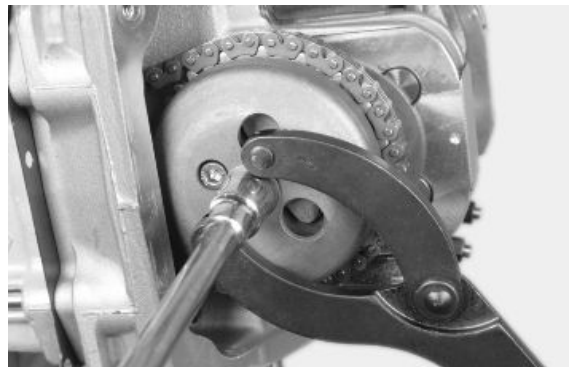
Loctite 243 Medium strength threadlock

Medium Loctite 243 threadlock

- Check that the decompression mass is free and that it is pulled by the spring.

Locking torques (N*m)

Valve lifter mass stop bell fixing screws 30 - 35



- Place the tightener cursor in the rest position, keeping the retain tab pressed.



- Install a new tightener on the cylinder using a new gasket.
- Tighten the two fastening screws to the prescribed torque.

Locking torques (N*m)**Tightener fastening screws: 11 ÷ 13**

- Insert the spring with the central screw and the washer.
- Tighten the central screw to the prescribed torque.

Locking torques (N*m)**Tightener screw: 5 ÷ 6**

- Place the engine with the valve clearance adjustment timing references aligned with the head.
- Check the clearance between valve and rocking lever using a thickness gauge.

PRESCRIBED CLEARANCE

Specification	Desc./Quantity
Inlet	0.15 mm (engine cold)
drainage	0.15 mm (engine cold)

- In case different values are found, adjust by loosening the lock nut and use a screwdriver for the set screw as shown in the figure.



Refitting the timing chain

The ignition advance is determined electronically on the basis of parameters known by the control unit. For this reason it is not possible to interpret the reference values based on the engine rpm.

The ignition advance value is detectable at any time using the diagnostic tester.

It is possible to check whether the ignition advance determined by the injection system matches the value actually activated on the engine, by means of the stroboscopic light.

Specific tooling

020680Y Diagnosis Tool

020330Y Stroboscopic light to check timing

Proceed as follows:

- Remove the outside transmission cover as described in the automatic transmission chapter.



- Remove the TDC reference inspection cap between flywheel and crankcase cover. See the flywheel cover chapter.



- By the driving pulley, turn the engine to find the alignment of the references to identify the TDC.



- Repeat for the reference between driving pulley and transmission housing.



- Refit the inspection cap on the flywheel side.
- Connect the diagnostic tester.
- Start the engine.
- Select the «parameters» function in this menu.
- Select the stroboscopic light control in the traditional four-stroke engine position (1 spark, 2 revs).
- Check that the real values of rpm and ignition advance match those measured using the diagnostic tester.



Specific tooling

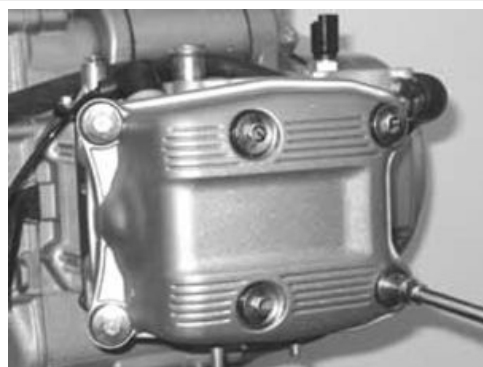
020680Y Diagnosis Tool

If the values do not match, check:

- distribution timing
- revolution timing sensor
- injection control unit

Refitting the rocker-arms cover

- Check that the gasket is in good working order.



- Tighten the two screws indicated in the figure with «1» and «2» to limit the reciprocal sliding of the cover surface with the head surface.
- Tighten the remaining 4 screws in a crossed sequence (3, 4, 5, 6).

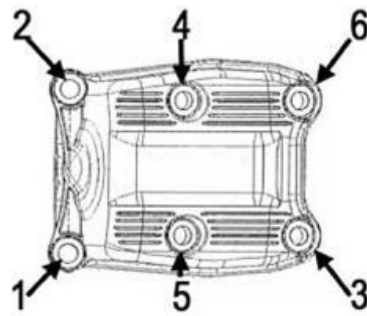
N.B.

CHECK THE PROPER POSITION OF THE GASKET.

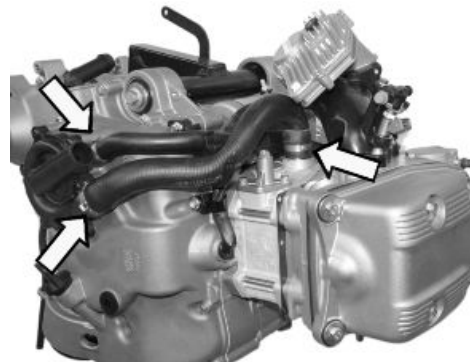
Locking torques (N*m)

Tappet cover fixing screws 7 - 9

- Install the transmission cover and the relevant mesh filter and the outside transmission cover as described in the "Automatic transmission" chapter.



- Install the cooling system sleeves using new bands, as described in the "Flywheel cover" chapter.



Refitting the intake manifold

- Install the intake manifold on the engine.
- Insert the 3 fastening screws, one of which with a support band for the cooling system sleeve, and tighten to the prescribed torque.

Locking torques (N*m)

Inlet manifold screws 11 ÷ 13



Crankcase - crankshaft

- Remove the outside and inside transmission cover and the complete driving pulley as described in "Automatic transmission".

- Remove the flywheel cover with the cooling system sleeves, as described in the "Flywheel cover" chapter.
- Remove the flywheel with the starting system following the instruction given in "Flywheel and Starting system".
- Remove the thermal group (cylinder, head, piston) as described in the «Thermal group and timing system chapter».
- Before opening the crankcase, check the crankshaft axial clearance.

For this purpose, use a plate (e.g. the special tool) and a support with special tool comparator.

Specific tooling

020262Y Crankcase splitting plate

020335Y Magnetic support for dial gauge

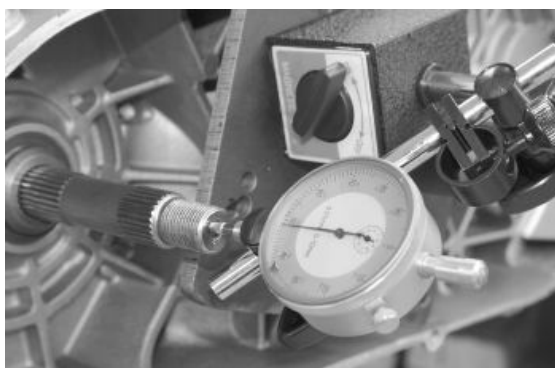
Characteristic

Standard clearance:

0.10 - 0.50 mm

Admissible increase limit after use:

0.60 mm



- Upper clearances are an indication of wear on the surfaces of the crankshaft casing support.
- To carry out an accurate measurement, measure the clearance in both directions between crankcase and crankshaft.

Splitting the crankcase halves

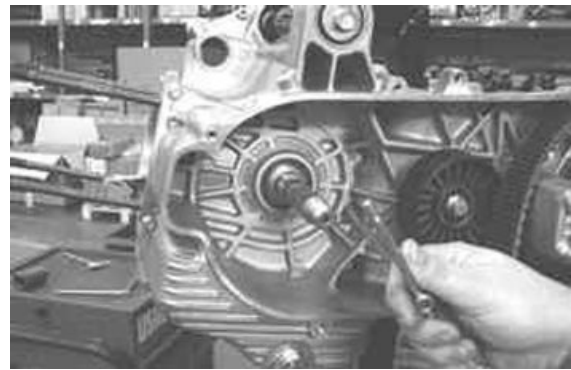
- Remove the engine support retain screw on the flywheel side half-crankcase.



- Remove the 14 crankcase coupling screws.

N.B.

THE FASTENING SCREWS ARE OF 3 DIFFERENT LENGTHS. NOTE THEIR CORRECT POSITION.



- Split the crankcases while keeping the crankshaft inserted on the flywheel side half-crankcase.

- Remove the coupling gasket.

N.B.

THE BUSHING SUPPORT CAN BE LEFT IN THE FLY-WHEEL SIDE HALF-CRANKCASE.



Removing the crankshaft

- Before removing the crankshaft, check the timing with the countershaft. To carry out this check, turn the crankshaft to align the two holes obtained on the crankshaft with the hole on the countershaft control gear.

This is an optimal position also to remove the crankshaft.



- Remove the crankshaft with the shim adjustment washer on the flywheel side.

CAUTION

WHILE OPENING THE CRANKCASE AND REMOVING THE CRANKSHAFT, CHECK THAT THE SHAFT THREADED ENDS DO NOT INTERFERE WITH THE MAIN BEARINGS. FAILURE TO OBSERVE THIS PRECAUTION CAN DAMAGE THE MAIN BEARING.



Removing the oil pump and countershaft control gear.

- To remove the control gear, loosen the 4 fastening screws.

Remove the gear only if actually required.

CAUTION

THE SCREWS HAVE A COUNTERSUNK HEAD AND THEIR THREADING IS LOCKED BY LOCTITE. BE CAREFUL NOT TO DAMAGE THE CONTROL HEXAGON. TO OBTAIN BETTER RESULTS IT IS PREFERABLE TO USE AN INSIDE HEXAGON SOCKET WRENCH.



Removing the countershaft

- Place the special tool as shown in the figure.

Specific tooling

020479Y Countershaft lock wrench



- Remove the fastening nut with relevant washer.



- Remove the special tool and extract the countershaft with the control gear.



Replacing the countershaft bearings

- Check that the bearings are free from irregular noise or clearance. If it does, replace it.

Flywheel-side half-crankcase

- Remove the inside Seeger ring.



- Upturn the half-crankcase.
- Remove the bearing from the flywheel side half-crankcase using the special tool and a mallet.

Specific tooling

020376Y Adaptor handle

020358Y 37x40-mm Adaptor

020439Y 17-mm guide



- Remove the bearing from the transmission side half-crankcase using the special tool.

Specific tooling

001467Y008 Pliers to extract 17 mm $\varnothing$ bearings

001467Y007 Driver for OD 54-mm bearings



- Before installing a new bearing, heat the flywheel side half-crankcase using the special tool.
- Place the half-crankcase on a wooden base.

Specific tooling

020151Y Air heater



- Insert a new bearing on the special tool after greasing the guide seat.
- Install the new bearing on the half-crankcase using the special tool.

N.B.

IF A BEARING WITH PLASTIC CAGE IS USED, KEEP THE BALLS VISIBLE FROM THE CRANKCASE INTERNAL SIDE.

Specific tooling

020376Y Adaptor handle

020359Y 42x47-mm Adaptor

020439Y 17-mm guide

- Fit the Seeger ring.



- Before installing the new bearing on the transmission side crankcase, heat the seat using the special tool.

Specific tooling

020151Y Air heater



- Insert a new bearing on the special tool after greasing the guide seat.
- Install the new bearing on the engine crankcase using the special tool.

N.B.

IF A BEARING WITH PLASTIC CAGE IS USED, KEEP THE BALLS VISIBLE FROM THE CRANKCASE INTERNAL SIDE.

Specific tooling

020376Y Adaptor handle

020359Y 42x47-mm Adaptor



020439Y 17-mm guide

Inspecting the crankshaft components

- Check the axial clearance on the connecting rod.

Characteristic**Standard clearance:**

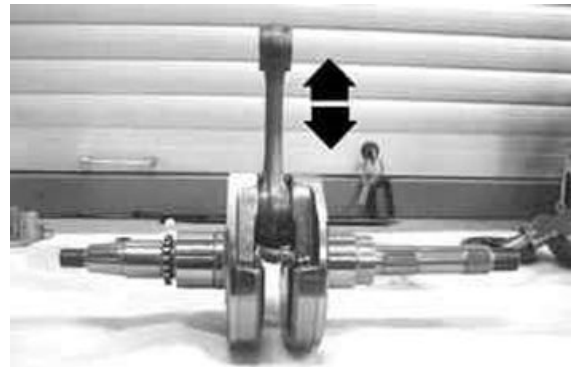
0.20 ÷ 0.40 mm



- Check the connecting rod diametrical clearance.

Characteristic**Standard clearance:**

0.046 ÷ 0.076 mm



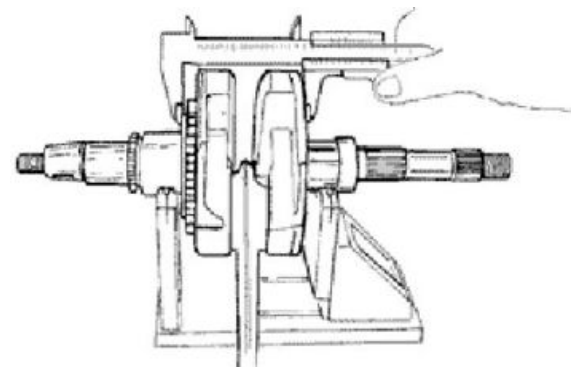
- Check the surfaces that limit the axial free-play are not scored and measure the width of the crankshaft between these surfaces, as shown in the diagram.

N.B.

BE CAREFUL NOT TO LET THE MEASUREMENT BE AFFECTED BY THE UNIONS WITH THE CRANKSHAFT ENDS.

Characteristic**Standard dimensions:**

63.6 - 63.45 mm

**CAUTION**

THE CRANKSHAFT CAN BE REUSED WHEN THE WIDTH FALLS WITHIN THE STANDARD VALUES AND THE SURFACES ARE FREE FROM SCRATCHES.

Shimming

- Check the overall height of the crankshaft - shoulders - gear assembly.

Characteristic**Standard thickness:**

71.804 - 72.000 mm

- Check that shim adjustment is free from scratches.

N.B.

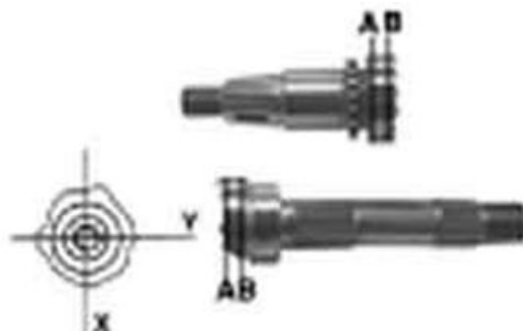
IN CASE OF NEW UTILISATION, MAINTAIN THE FIRST FITTING POSITION.

Specific tooling

020074Y Support base for checking crankshaft alignment

- If the crankshaft - crankcase axial clearance is higher than the standard value and the crankshaft exhibits no irregularity, the problem is caused by wear or by a wrong machining on the engine crankcase.

- Check the diameters of both bearings of the crankshaft in accordance with the axes and surfaces shown in the figure. Half shafts are classified into two categories, Cat 1 and Cat. 2. Refer to the chart below.



STANDARD DIAMETER

Specification	Desc./Quantity
Cat. 1	40.010 ÷ 40.016
Cat. 2	40.016 ÷ 40.022

Inspecting the crankshaft alignment

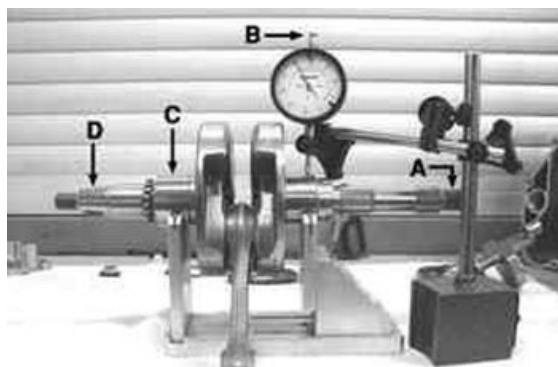
- Install the crankshaft on the support and measure the displacement at the 4 points shown in the figure.

Specific tooling

020074Y Support base for checking crankshaft alignment

MAX ADMISSIBLE DISPLACEMENT:

Specification	Desc./Quantity
A	= 0.15 mm
B	= 0.01 mm
C	= 0.01 mm
D	= 0.10 mm



- Check that the driving shaft cone, the tab seat, the oil seal capacity, the toothed gear and the threaded tangs are in good working order.
- In case of failures, replace the crankshaft.

N.B.

MAIN BEARINGS CANNOT BE MODIFIED.

The connecting rod cannot be replaced. To check the connecting rod small end diameter, see chapter "Thermal group and timing system".

- When cleaning the crankshaft, be careful to prevent any impurity from entering into the shaft lubrication hole.

N.B.

IN CASE OF REPLACEMENT OF A CRANKSHAFT CONSISTING OF TWO HALF-SHAFTS OF DIFFERENT CATEGORY, REPLACE THE TWO HALF-CRANKCASES AS WELL, COUPLING THE TWO COMPONENTS (SHAFT AND CRANKCASE) WITH THE SAME CATEGORY.

- To check the gearing of the crankshaft, see section "Thermal group and timing system".



See also

[Cylinder assy. and timing system](#)

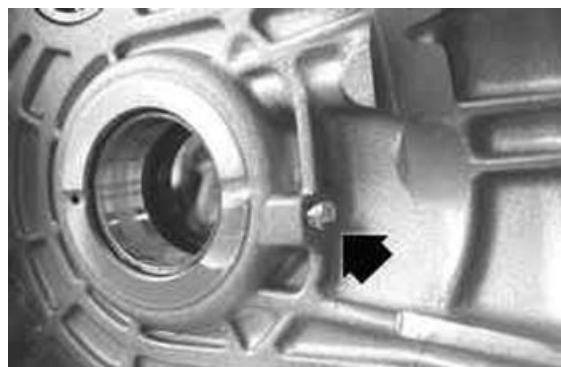
Inspecting the crankcase halves

- Before proceeding to check the crankcase halves, thoroughly clean all surfaces and oil ducts.
- For the transmission-side half-crankcase, special attention should be given to the bushings, to the cooling jet on the transmission side (see figure) and to the lubrication duct.



N.B.

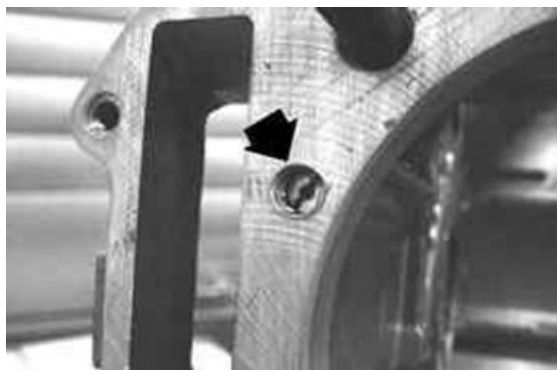
THE JET IS FED THROUGH THE MAIN BUSHINGS. PROPER OPERATION OF THIS COMPONENT IMPROVES THE PISTON TOP COOLING. CLOGGING HAS EFFECTS THAT ARE DIFFICULT TO DETECT (PISTON TEMPERATURE INCREASE). FAILURE OR LEAK CAN CONSIDERABLY DECREASE THE MAIN BUSHING AND CONNECTING ROD LUBRICATION PRESSURE.



- For the flywheel side half-crankcase, special attention should be given to the lubrication channels for the main bearings and to the compartment and the channels for the oil pump, as well as to the duct for the by-pass located on the flywheel cover.

N.B.

AS ALREADY DESCRIBED IN THE "LUBRICATION" CHAPTER, IT IS ESPECIALLY IMPORTANT THAT THE BY-PASS HOUSING ON THE FLYWHEEL COVER IS FREE FROM WEAR THAT MAY IMPAIR THE PROPER SEALING OF THE LUBRICATION PRESSURE ADJUSTMENT PISTON. THE HEAD LUBRICATION CHANNEL IS EQUIPPED WITH A SHUTTER JET; THIS GIVES A "LOW PRESSURE" HEAD LUBRICATION. THIS CHOICE WAS MADE TO REDUCE THE OIL TEMPERATURE IN THE SUMP.



The jet clogging impairs the head lubrication and the timing mechanisms.

A jet failure causes a decrease in the main bearing and connecting rod lubrication pressure.

- Check that the surfaces exhibit no dents or deformations, with special attention to the crankcase coupling and the crankcase-cylinder surfaces.
- Any defects in the crankcase gasket or matching surfaces (see Flywheel cover coupling) can cause pressurised oil leaks, thereby affecting the connecting rod and main bearing lubrication pressure.
- Check the main bearing seats that limit axial clearance in the crankshaft exhibit no wear. For the dimensional check, refer to the instructions about checking the axial clearance and the dimensions on the crankshaft

Inspecting the crankshaft plain bearings

- To obtain a good bushing lubrication it is necessary to have both an optimal lubricating pressure (4 bar) and a good oil flow rate; the bushings must be correctly positioned so as not to obstruct the oil supply channels.
- The main bushings are comprised of two half-bearings, one with holes and channels for lubrication whereas the other is solid.



- The solid half-bearing is intended to stand the thrusts caused by combustion, and for this reason it is arranged opposite the cylinder.
- To prevent obstructions in the oil feeding channels, the matching surface of the two half-bearings must be perfectly perpendicular to the cylinder axis, as shown in the figure.
- The oil feeding channel section is also affected by the bushings driving depth compared with the crankshaft axial clearance of the limiting surface.

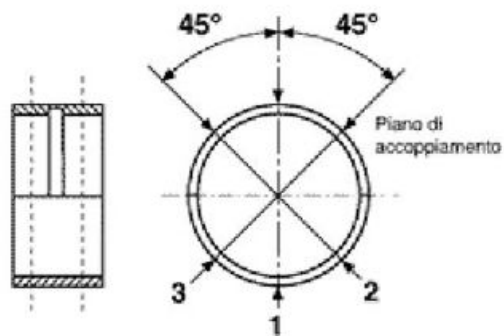
N.B.

TO KEEP THE BUSHINGS ON THE CRANKCASE IN SUCH POSITION, DRIVING IS FORCED ON CAST-IRON RINGS INSERTED IN THE CASTING OF BOTH CRANKCASE HALVES.

- Check the inside diameter of the main bushings in the three directions indicated in the diagram.
- Repeat the measurements for the other bushing half. see diagram.

N.B.

DO NOT TAKE THE MEASUREMENT ON THE TWO HALF-SHELL COUPLING SURFACE SINCE THE ENDS ARE RELIEVED TO ALLOW BENDING DURING THE DRIVING OPERATION.



Before assembling, check that the clearance between the engine crankcase bushing and the crankshaft is within the predetermined limits.

Characteristic**Crankshaft-bushing maximum clearance admitted:**

0.08 mm

- The standard bushing diameter after driving is variable on the basis of a coupling selection.
- The crankcase bushing seats are classified into 3 categories while the crankshaft ones, into 2 categories.
- Bushings are subdivided into 4 categories according to their thickness (see the table).

CHECK THE BENCH BUSH

Name	Description	Dimensions	Initials	Quantity
Type A - Red		1.971 ÷ 1.974		
Type B - Blue		1.974 ÷ 1.977		
Type C - Yellow		1.977 ÷ 1.980		
Type D - Green		1.980 ÷ 1.983		

Coupling chart

The following kinds of bushings indicated in the table must be used according to the kind of coupling between the crankshaft and the crankcase.

		X	
		1	2
Y	1	B	A
	2	C	B
	3	D	C

KEY

X = Crankshaft category

Y = Crankcase half-shell category

A = Red

B = Blue

C = Yellow

D = Green

In case of breakdown, crankcases are together with bushings and are classified according to the centre to centre distance of the countershaft. Find below the possible couplings.

- Complete FC1 type crankcase equipped with bushings for housing a category 1 crankshaft and a countershaft with centre to centre distance A.
- Complete FC2 type crankcase equipped with bushings for housing a category 2 crankshaft and a countershaft with centre to centre distance A.
- Complete FC3 type crankcase equipped with bushings for housing a category 1 crankshaft and a countershaft with centre to centre distance B.
- Complete FC4 type crankcase equipped with bushings for housing a category 2 crankshaft and a countershaft with centre to centre distance B.

N.B.

THE CRANKSHAFT CATEGORY IS STAMPED ON THE COUNTERWEIGHT SHOULDER.

A spare crankcase cannot be combined with a driving shaft with mixed categories. Spare shafts have half-shafts of the same category.

N.B.

TO REPLACE THE HALF-SHAFTS, REMOVE THE COUNTERSHAFT BEARINGS AS DESCRIBED ABOVE. REMOVE THE COMPLETE DRIVEN PULLEY AND THE ANTI-FLAPPING ROLLER FROM

THE TRANSMISSION SIDE HALF-CRANKCASE, AS DESCRIBED IN CHAPTER "AUTOMATIC TRANSMISSION", AND THE HUB COVER WITH THE RELEVANT GEARS AND BEARINGS AS DESCRIBED IN CHAPTER "FINAL REDUCTION".

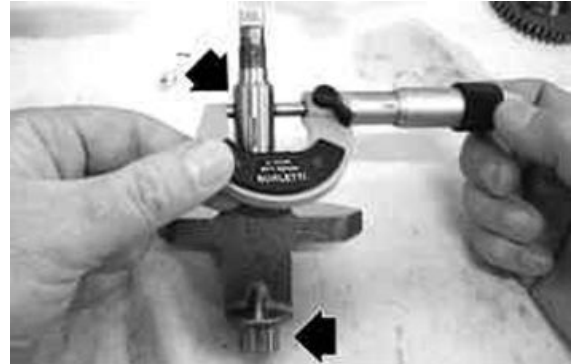
Countershaft

- Using a micrometer, measure the 2 bearings of the countershaft as shown in the figure.

Characteristic

Standard diameter:

17 - 0.01 - 0.02 mm



- Check that the water pump drive is not worn.

Refitting the crankshaft

- Check that the oil pump and countershaft control gear are free from deformations or dents. Replace, if required.

N.B.

IF YOU HAVE TO REPLACE THE OIL PUMP AND COUNTERSHAFT CONTROL GEAR IT IS NECESSARY TO REPLACE THE COUNTERSHAFT GEAR AS WELL.

- Before installing the gear on the crankshaft, carefully clean the two matching surfaces removing any residues of LOCTITE from the holes using a brush.



Blow with compressed air and degrease the mounting holes on both surfaces to make the new LOCTITE grip.

Apply the recommended product to the holes again.

Recommended products

Loctite 243 Medium strength threadlock

Medium Loctite 243 threadlock

- Repeat the same procedure for the 4 fastening screws.
- Insert the control gear on the crankshaft with the hole countersink visible.
- Tighten the 4 fastening screws to the prescribed torque.

N.B.

TO AVOID DAMAGING THE SCREW CONTROL HEXAGON, IT IS PREFERABLE TO USE AN INSIDE HEXAGON SOCKET WRENCH.

Locking torques (N*m)

Gear mounting on crankshaft screws 10 -12

- Lubricate the main bearing on the flywheel side half-crankcase.
- Lubricate the shim adjustment washer.
- Insert the shim adjustment washer on the crankshaft in its original position.
- Insert the special timing tool in the hole on the countershaft.



Specific tooling

020471Y Pin for countershaft timing

- Insert the crankshaft on the pin and into the bushing.
- Before inserting thoroughly, make the oil pump gear align with the control gear.
- Insert thoroughly and remove the special tool.



N.B.

WHEN INSERTING THE SHAFT ON THE HALF-CRANKCASE, BE CAREFUL NOT TO DAMAGE THE MAIN BEARING WITH THE THREADED TANG OF THE CRANKSHAFT AND WITH THE TIMING CONTROL TOOTHED PINION.

- Install the oil pump closing plate.
- Tighten the 2 flanged fastening screws to the prescribed torque.



Locking torques (N*m)

Bulkhead screws for oil pump housing cover 8 - 10

Refitting the crankcase halves

- Remove the oil guard from the transmission side half-crankcase using a screwdriver.



- Install a new oil guard after lubricating it, using the special tool, arranging it at a 0.5 mm recess from the crankcase plane.

CAUTION

A WRONG POSITIONING OF THE OIL GUARD AFFECTS THE LUBRICATION OIL CIRCULATION.

Specific tooling

020360Y 52x55-mm Adaptor

020376Y Adaptor handle



- Insert the gasket on the flywheel side half-crankcase.



- Lubricate the main bearing on the transmission side half-crankcase.

- **Couple the 2 half-crankcases being careful not to damage the bushing on the transmission side half-crankcase with the threaded tang of the crankshaft.**

- Insert the engine support retain screw on the flywheel side half-crankcase without tightening.

- Insert the 14 fastening screws by arranging the single shorter screw «A» and the single longer screw «B» as shown in the figure.

- Tighten the screws thoroughly and tighten to the prescribed torque.



- Check that the crankshaft rotates freely.

N.B.

REMOVE ANY EXCESS FROM THE CRANKCASE COUPLING GASKET ON THE CYLINDER PLANE, TO ENSURE BETTER SEALING PERFORMANCE.

Locking torques (N*m)

Engine-crankcase coupling screws 11 ÷ 13

- Install the thermal group (cylinder, head, piston) as described in section «Thermal group and timing system».
- Install the flywheel with start-up control as described in the "Flywheel and start-up" chapter.
- Install the flywheel cover with the cooling system sleeves, as described in the "Flywheel cover chapter".
- Install the complete driving pulley, the transmission cover and the relevant mesh filter and the outside transmission cover as described in the «Automatic transmission» chapter.

See also

[Flywheel cover](#)

[Cylinder assy. and timing system](#)

Lubrication

TECHNICAL SPECIFICATIONS

SUMP CAPACITY

Specification	Desc./Quantity
Overhaul	1.7 l
Oil and filter replacement	1.5 l

RECOMMENDED ENGINE OIL

Product	Description	Specifications
AGIP CITY HI TEC 4T	Engine oil	SAE 5W-40, API SL, ACEA A3, JASO MA Synthetic oil

OIL PUMP

Specification	Desc./Quantity
Type	Trochoidal
Rotor washers	8 mm
Assembly clearances	Lobe ends 0.05-0.008 mm
External rotor radial clearance	0.05- 0.12 mm
Rotor axial clearance	0.025 - 0.065 mm

BY-PASS

Specification	Desc./Quantity
Type	with piston
Plunger diameter	13.9 - 0.039 -0.057 mm
Spring free length	62.5 mm
Calibration pressure	4 bar

PRE-FILTER

Specification	Desc./Quantity
Type	mesh, plastic

OIL FILTER

Specification	Desc./Quantity
Type	Paper with pressure relief and anti-drain back by-pass valves

OIL MINIMUM PRESSURE INDICATOR LIGHT SWITCH

Specification	Desc./Quantity
Calibration	0.3 - 0.6 bar

HEAD LUBRICATION CONTROL JET

Specification	Desc./Quantity
Diameter	1 ± 0.05 mm *

* Tightening torque 5÷7 N.m

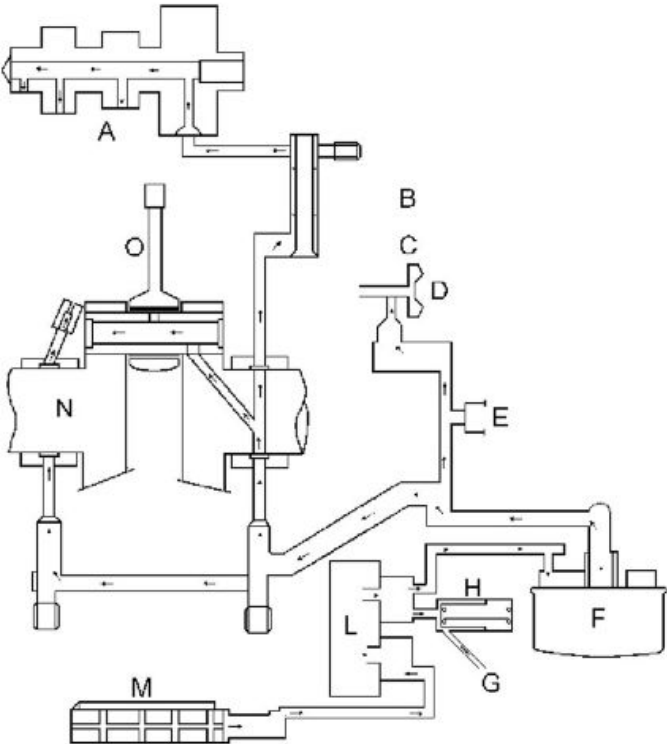
PISTON COOLING NOZZLE

Specification	Desc./Quantity
Diameter	0.8 ± 0.05 mm

CRANKCASE VENTILATION CHECK

Specification	Desc./Quantity
Device	metal reed valve and decantation chamber

Conceptual diagrams



PRINCIPLE DIAGRAM

Specification	Desc./Quantity
A	Camshaft
B	Cylinder-head plane
C	Cylinder-crankcase plane
D	Water pump impeller
E	Minimum oil pressure sensor

Specification	Desc./Quantity
F	Oil filter cartridge
G	To the oil sump
H	By-pass valve
L	Oil pump
M	Mesh pre-filter
N	Crankshaft
O	Connecting rod

General characteristics

The lubrication system is divided into two sections:

- High pressure

- Low pressure

The high pressure section includes all components located on the engine crankcase whereas the low pressure section only refers to the thermal group.

The trochoidal pump is installed in the sump and is controlled by a pair of gears.

To guarantee the integrity of the pump, a pre-filter is fitted.

This is a screw-in type pre-filter and the relevant plug serves at the same time as an engine oil drain plug.

The pump is controlled by means of a piston by-pass calibrated to 4 bar. This is located before the cartridge filter and both are installed on the flywheel cover, so that the seal of the filter is subject to the pressure of the circuit.

The by-pass located before the cartridge filter improves the operating conditions for the filter, particularly with cold oil.

The filter is equipped with an anti-drain back valve and a pressure-relief valve; the latter intervenes when the filtering mass causes a pressure drop above 1 ± 0.2 bar.

These conditions naturally occur only with cold oil and at high engine revs or if the filter is clogged.

The filtered oil is used to lubricate the water pump shaft and once at the engine crankcase, to lubricate the main bearings, the connecting rod head and the piston cooling nozzle, on the transmission-side bearing.

The main bearing on the transmission side is fitted with an oil seal and the respective drain line.

The supply line for the timing system comes from the flywheel-side bearing; the supply to the head is controlled by the respective spray jets in the engine crankcase.

The components of the timing system function with low-pressure oil lubrication.

The camshaft bearings are installed directly on the aluminium of the head; the camshaft axial clearance is partially compensated by the oil supplied to the smaller diameter bearing.

The camshaft supplies the lubricant to the rocking levers via the holes provided; these are installed in a position to ensure that the lubrication is maintained even after the scooter has stopped. This is achieved when the camshaft reaches its most usual and likely position when the engine is shut off.

The oil used to lubricate the head returns to the sump via the chain casing channel and therefore it also provides lubrication for the chain.

A one-way valve and a decantation chamber are used so that gases from the crankcase do not carry any oil. The one-way valve is a metal reed valve; the decantation chamber has a drainage hole. A failure in these components implies oil getting into the line supplying air to the engine.

Excessive oil vapours may result in clogged ducts on the throttle body.

In order to signal low oil pressure in the system, a pressure switch is used, located immediately after the oil filter outlet.

The lubrication circuit does not include the countershaft. The countershaft is lubricated by the oil transported by the gears or by the centrifugal effect of the crankshaft

The same applies to the piston or the pin, but in this case the cooling nozzle is particularly important.

Diagnosis guide

1 - Minimum oil pressure warning light on with hot engine.

AHEAD - go to 2

2 - Remove the minimum pressure switch electric connector.

Check that the warning light turns off.

YES - go to 3 NO go to 11

3 Check the actual oil pressure.

AHEAD - go to 4

4 - Remove the switch and fit the special tool with the relevant gasket.

Specific tooling

020193Y Oil pressure check gauge

020434Y Oil pressure check fitting

- Remove the dipstick with the oil filling cap and insert a cap fitted with the temperature probe supplied with the special tool. Insert the probe to feel contact with the crankcase bottom and pull back a few millimetres.

Specific tooling

020331Y Digital multimeter

AHEAD - go to 5



5 - Measure the pressure with cold and idling engine.

STANDARD VALUES

Specification	Desc./Quantity
20°C Temperature	
1400 rpm	

approx. 4.5 bar

N.B.

RPM CAN BE MEASURED BOTH BY THE EXHAUST GAS ANALYSER AND BY THE DIAGNOSTIC TESTER

Specific tooling**020680Y Diagnosis Tool**

YES go to 6 NO go to 12

6 - Let the engine warm up and repeat the check with hot oil.

STANDARD VALUES

Specification	Desc./Quantity
80°C Temperature	
1400 rpm	

approx. 1.5 bar

YES go to 7 NO go to 8

7 - Replace the oil minimum pressure switch.

8 - If pressure lower than 1.3 ÷ 1.5 bar is measured.

AHEAD go to 9

9 - Replace the oil filter and repeat the pressure check with oil at 80°C.

YES go to 10 NO go to 13

10 - The failure was fixed.

It is recommended to respect the suggested number of kilometres covered.

11 - Check and restore the electrical system.

12 - If pressure lower than 4 bar is measured.

AHEAD go to 9

13 - Remove the flywheel cover and check the by-pass and the cover sealing gasket efficiency towards the case internal side, as described in the "Flywheel cover" chapter.

YES go to 14 NO go to 15

14 - Check whether there is an irregular clearance on the crankshaft:

- axial clearance (see the "Crankcase and crankshaft" chapter)
- radial clearance, especially in the direction of the cylinder axis
- clearance according to the direction of rotation with the connecting rod in quadrature

YES go to 16 NO go to 17

15 - Replace the faulty components ("Flywheel cover" chapter).

16 - Overhaul the engine ("Crankcase and crankshaft" chapter).

17 - Open the engine crankcase and remove the oil pump as described in the "Crankcase and crankshaft" chapter.

- Check the oil pump as described in the following pages.
- Check that the cooling nozzle and the timing system feeding jet are properly installed.
- Visually inspect the crankshaft couplings and their size ("Crankcase and crankshaft" chapter).

N.B.

POTENTIAL IRREGULARITIES IN COUPLINGS AND THE TIMING SYSTEM COMPONENTS CANNOT BE DETECTED WHEN INSPECTING THE LUBRICATION PRESSURE. THEY MAY BECOME EVIDENT BY AN INCREASE IN NOISE.

N.B.

IN CASE OF IRREGULAR PRESSURE ON THE CRANKCASE, CARRY OUT A VISUAL AND DIMENSIONAL INSPECTION OF THE TIMING SYSTEM COMPONENTS (SEE "THERMAL GROUP AND TIMING SYSTEM" CHAPTER).

Oil pressure check

1 - In case of oil leaks from the oil filter or from the flywheel cover coupling gasket, check the lubrication pressure.

AHEAD go to 2

2 - Install the special tool.

Specific tooling

020193Y Oil pressure check gauge

020434Y Oil pressure check fitting

AHEAD go to 3

3 - Check the system pressure with cold engine and medium - high speed.

Standard pressure < 6 bar

YES go to 4 NO go to 5

4 - Replace the damaged components.

5 - Check the working order of the adjustment by-pass (see "flywheel cover" chapter) and restore proper sliding.

N.B.

STANDARD PRESSURES ARE OBTAINED USING OIL WITH THE PRESCRIBED VISCOSITY. A HIGHER VISCOSITY CAUSES AN INCREASE OF THE SYSTEM PRESSURE.

1 - If oil consumption is above 250 g/1000 km on a run-in engine, proceed as follows.

AHEAD go to 2

2 - Check the presence of oil in the scavenge duct on the filter box.

YES go to 3 NO go to 4

3 - Check the one-way reed valve and the decantation chamber drainage hole.

YES go to 5 NO go to 4

4 - Check the thermal group seals (piston rings, valve guides and oil guards), see "Thermal group and Timing system" chapter.

5 - Restore the valve or the drainage hole efficiency.

Oil pump

Removal

- Remove the closing plate of the oil pump housing by loosening the 2 retaining screws with their washers.



- Remove the oil pump complete with the gearing by loosening the 2 retaining screws through the eyes machined in the gearing proper.



- Remove the gasket.



- Remove the two screws and the oil pump cover.



- Remove the inside rotor retaining snap ring turning it to move the opening at the shaft face.



- Remove and wash the rotors thoroughly with petrol and compressed air.
- Extract the shaft with its gear and check that it is in good working order and free from wear.



- Reassemble the rotors in the pump body, keeping the two reference marks visible
- Insert the shaft with the gear and install the lock ring; then, turn it with the opening opposed to the shaft face.
- Check any irregular clearance between shaft and pump body.



- Using a thickness gauge, check the distance between the rotors in the position shown in the figure.



Characteristic

Admissible limit clearance:

0.012 mm

- Check the distance between external rotor and pump body; see figure.

Characteristic**Admissible limit clearance:**

0.25 mm



- Check the rotor axial clearance using a rectified bar as reference plane, as shown in the figure.

Characteristic**Limit values admitted:**

0.1 mm



Refitting

- Make sure the gasket is in the correct position.

N.B.**THE TOOTH OF THE GASKET MUST BE IN ITS SEAT.**

- Lubricate the internal rotors.
- Check there are no signs of scoring or wear on the oil pump cover.
- If non-conforming values or signs of wear are found, replace the pump.
- Fit the pump cover in the position that permits the crankcase fixing screws to be aligned.
- Tighten the two fastening screws to the prescribed torque.

**Locking torques (N*m)****Oil pump cover screws $0.7 \div 0.9$**

- Insert the oil pump with gear

- Insert the 2 retaining screws through the slots on the gear and tighten to the prescribed torque.

N.B.

THE ASSEMBLY POSITION OF THE PUMP IS FIXED BY INSTALLATION OF THE SCREWS.

Failure to observe the tightening torque may alter the coupling clearance of the rotors with the pump body.

Locking torques (N*m)

Screws fixing oil pump to the crankcase 5 ÷ 6



- Insert the countershaft with gearing into the fly-wheel-side half-crankcase.
- Install the special tool in the position shown in the figure.

Specific tooling

020479Y Countershaft lock wrench



- Keep the countershaft in position and insert the washer with the nut.
- Tighten the nut to the prescribed torque, using the recommended product.
- Remove the special tool.

Recommended products

Loctite 243 Medium strength threadlock

Medium Loctite 243 threadlock

Locking torques (N*m)

Countershaft fixing nut 25 ÷ 29



INDEX OF TOPICS

INJECTION

INJEC

EMS injection system

This vehicle is fitted with an integrated injection and ignition system.

Injection is indirect in the manifold through an electro-injector.

Injection and ignition are timed on the 4-stroke cycle using a tone wheel pivoted on the camshaft control and a reluctance variation sensor.

Combustion and ignition are managed on the basis of engine revs and throttle valve opening. Further corrections are made according to the following parameters:

- Coolant temperature.
- Intake air temperature
- Ambient pressure

The system implements an idle feeding correction with cold engine through a Stepper motor on a by-pass circuit of the throttle valve. The control unit manages the Stepper motor and the injector opening time, thereby ensuring the idle steadiness and the proper combustion.

In all conditions of use, mixture preparation is managed by modifying the injector opening time.

The fuel supply pressure is kept constant based on the ambient pressure.

The **fuel supply circuit** consists of:

- Fuel pump
- Fuel filter
- Injector
- Pressure regulator

The pump, the filter and the regulator are placed inside the fuel tank on a single support.

The injector is connected by two pipes provided with quick couplings. This allows obtaining a continuous circulation, thereby avoiding the risk of fuel boiling. The pressure regulator is situated at the end of the circuit.

The fuel pump is controlled by the EMS control unit; this ensures the scooter safety

The **ignition circuit** consists of:

- HV coil
- HV cable
- Shielded cap
- EMS control unit
- Spark plug

The EMS control unit manages the ignition with optimum timing, ensuring the timing on the 4-stroke cycle (ignition only during compression).

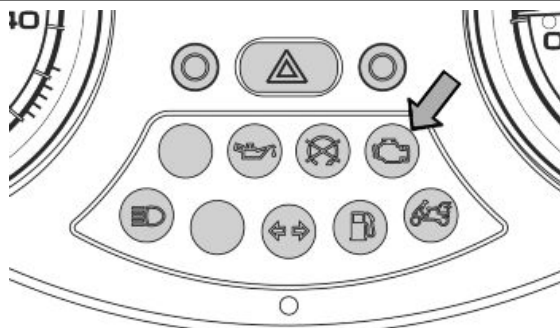
The EMS injection/ignition system manages the engine function according to a pre-set program.

Should any input signals fail, an acceptable working order of the engine is ensured to allow the user to reach a service station.

Of course, this cannot happen when the rpm-timing signal is missing, or when the failure involves the control circuits:

- Fuel pump
- HV coil
- Injector

The control unit is provided with a self-diagnosis system connected to an indicator light in the instrument panel.



Failures are detected and restored by the diagnostic tester.

In any case, when the fault is no longer present, the data storage is automatically cleared after 16 cycles of use (cold start, running at regular engine temperature, stop).

The diagnostic tester is also required to adjust the idle mixture.



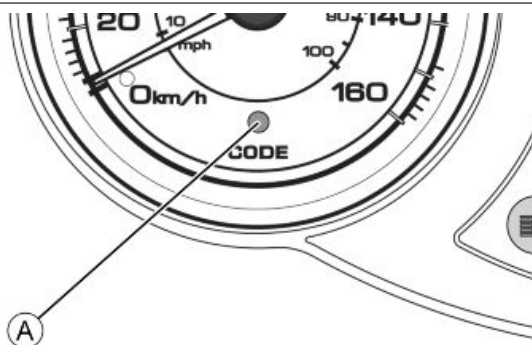
Specific tooling

020680Y Diagnosis Tool

The EMS injection-ignition system has a control function over the rpm indicator and the radiator cooling electric fan.

The EMS is connected to the anti-theft immobilizer system decoder.

In turn, the decoder is connected to a flashing diagnostic LED that also serves as deterrent.



The EMS control unit power supply is further controlled by the emergency switch and by the side stand switch, that is to provide further safety for the scooter.

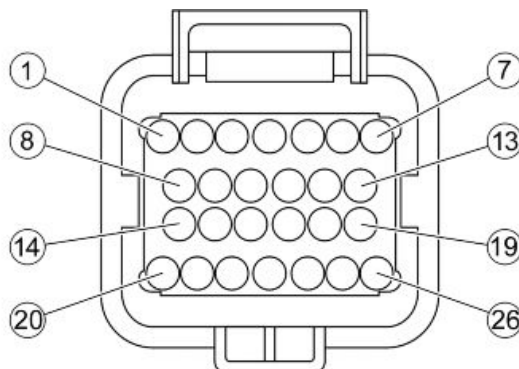


Precautions

1. Before fixing any part of the injection system, check to see if there are any registered faults. Do not disconnect the battery before checking for faults.
 2. The fuel supply system is pressurised at 300 kPa (3 BAR). Before disconnecting the quick coupler of a pipe in the fuel supply system, check that there are no naked flames. Do not smoke. Act with caution to prevent spraying in the eyes.
 3. When fixing electric components, operate with the battery connected only when actually required.
 4. When functional checks are performed, check that the battery voltage is over 12V.
 5. Before trying to start up, check to make sure there is at least two litres of fuel in the tank. Failure to respect this norm will damage the fuel pump.
 6. If the scooter is expected to remain unused for a long time, refill the tank up to a little over half the level. This will ensure the pump will be covered by fuel.
 7. When washing the vehicle, be careful with the electric components and wiring.
 8. When an ignition fault is detected, start the checks from the battery and the injection system connections.
 9. Before disconnecting the EMS control unit connector, perform the following operations in the following order:
 - Set the switch to «OFF»
 - Disconnect the batteryFailure to respect this norm may damage the control unit.
 10. Do not invert the polarity when fitting the battery.
 11. In order to prevent damages, disconnect and reconnect the EMS connectors only if actually required. Before reconnecting, check that the connectors are dry.
 12. When carrying out electric inspections, do not force the tester probes into the connectors. Do not take measurements not specifically foreseen by the manual.
 13. At the end of every check performed with the diagnostic tester, protect the system connector with its cap. Failure to respect this norm may damage the EMS control unit.
 14. Before reconnecting the quick couplers of the power supply system, check that the terminals are perfectly clean.
-

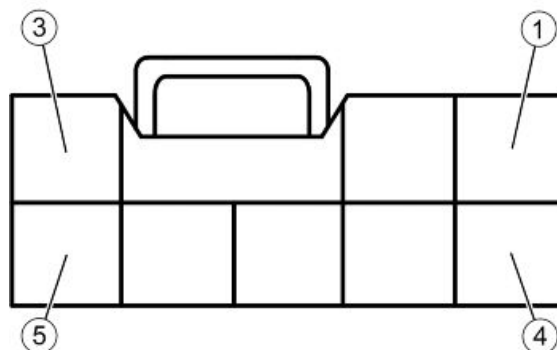
Terminals setup

Layout of the system-side connectors and the connectors on the electronic control unit.



ECU

	Specification	Desc./Quantity
1	Throttle potentiometer power supply	+5 V
2	Lambda sensor	(-)
3	Rpm indicator	
4	Engine temperature	(+)
5	Electric fan remote control	
6	Stepper motor	Stepper motor
7	Engine rpm sensor	
8	Lambda sensor	(+)
9	EMS diagnostic connector	
10	EMS diagnostic connector	
11	Throttle potentiometer signal	
12	Engine rpm sensor	
13	Injector control	(-)
14	Stepper motor	Stepper motor
15	Injection telltale light	(-)
16	Decoder (serial)	
17	Battery powered	(+)
18	Intake air temperature sensor	(+)
19	Injection load remote control	(-)
20	HV coil	(-)
21	Stepper motor	Stepper motor
22	Sensor ground	(-)
23	Ground lead	
24	Stepper motor	Stepper motor
25	-	
26	Continuous power supply	(+)

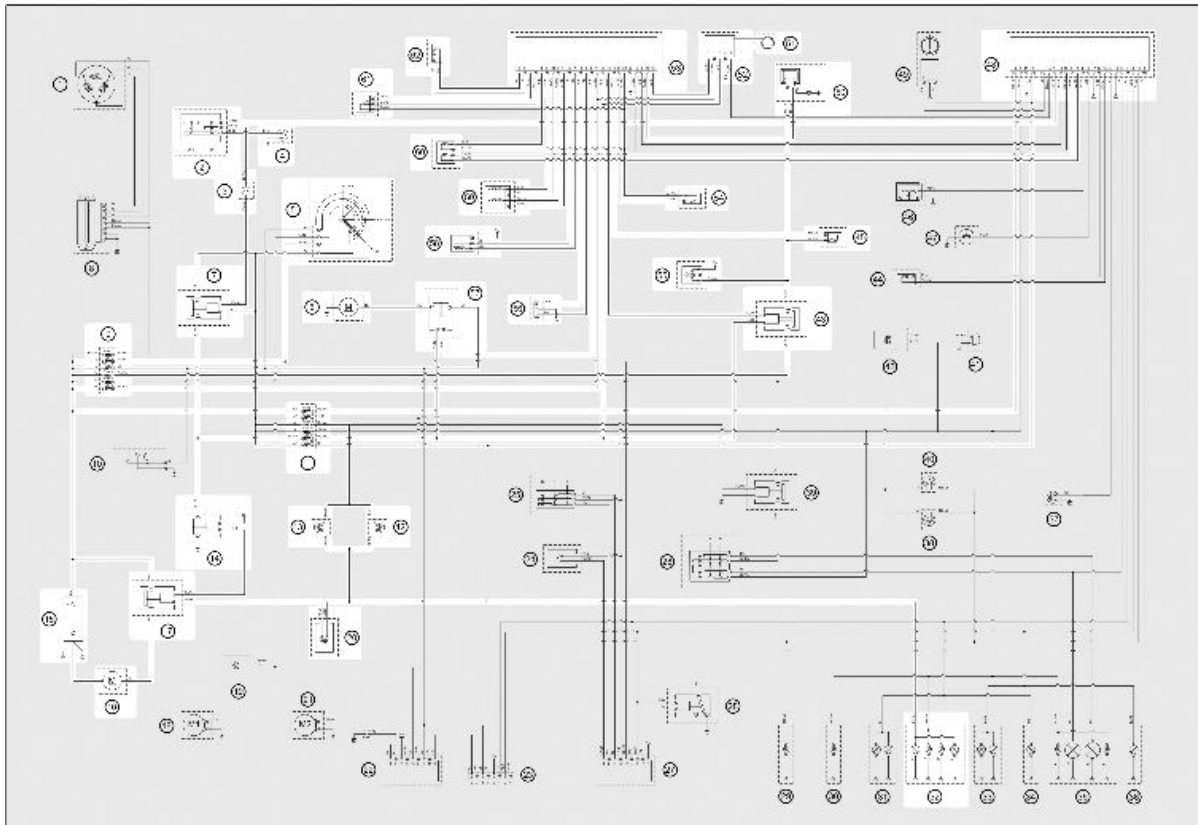


IMMOBILIZER DECODER

	Specification	Desc./Quantity
1	-	
2	Immobilizer LED control	(negative)

	Specification	Desc./Quantity
3	Base power supply	(positive)
4	Ground lead	
5	-	
6	electronic control unit	(serial)
7	-	
8	Continuous power supply (positive)	

EMS circuit diagram



KEY:

- 2. Engine stop switch
- 3. Diode
- 4. Side stand button
- 5. Key switch
- 6. Electric fan
- 7. Engine stop remote control switch
- 9. Main fuses
- 11. Auxiliary fuses
- 12. Stop button on front brake
- 13. Stop button on rear brake
- 14. Immobiliser remote control switch
- 15. 12V-12Ah Battery
- 16. Starter motor

- 17. Start-up remote control switch
- 20. Starter button
- 32. Rear light
- A. Stop light bulbs
- 43. Injection load remote control
- 45. Fuel injector
- 48. Instrument panel
- 50. HV coil
- 51. Immobilizer aerial
- 52. Decoder
- 53. Injection ECU
- 54. Intake air temperature sensor
- 55. Fuel pump
- 56. Diagnosis connector
- 57. Electric fan remote control
- 58. Engine rpm sensor
- 59. Stepper motor
- 60. Engine temperature sensor
- 61. Throttle valve potentiometer
- 62. Lambda probe

Troubleshooting procedure

This section makes it possible to find what solutions to apply when troubleshooting.

Engine does not start

ENGINE DOES NOT START IF ONLY PULLED

Possible Cause	Operation
Immobiliser enabling signal	System not encoded System not efficient, repair according to the indications of the self-diagnosis
Presence of faults detected by the self diagnosis	Injection load relay HV coil Injector Revolution timing sensor
Fuel supply	Fuel in the tank Fuel pump activation Fuel pressure (low) Injector capacity (low)
Power to the spark plug	Shielded cap resistance check HV coil resistance check
Parameter reliability	Coolant temperature Distribution timing - injection ignition Intake air temperature
End of compression pressure	End of compression pressure

Starting difficulties

ENGINE START-UP PROBLEMS

Possible Cause	Operation
Presence of faults detected by the self diagnosis	Injection load relay HV coil Injector revolution timing sensor Air temperature Coolant temperature Atmospheric pressure
Start-up speed	Starter motor and remote control Battery Ground connections
End of compression pressure	End of compression pressure
Power to the spark plug	Spark plug Shielded cap HV coil Rpm-timing sensor Ignition advance
Fuel supply	Fuel pressure (low) Injector capacity (low) Injector sealing (poor)
Correctness of the parameters	Coolant temperature Stepper throttle valve position intake air temperature (steps and actual opening) Cleaning of the auxiliary air pipe and throttle valve; air filter efficiency

Engine stops at idle

ENGINE DOES NOT IDLE/ IDLING IS UNSTABLE/ IDLING TOO LOW

Possible Cause	Operation
Presence of faults detected by the self diagnosis	Injection load relay HV coil Injector revolution timing sensor Air temperature Coolant temperature Atmospheric pressure
Ignition efficiency	Spark plug Ignition timing
Correctness of the parameters	Throttle valve position sensor Stepper Coolant temperature sensor Intake air temperature sensor
Intake system cleaning	Air filter Diffuser and throttle valve Additional air pipe and Stepper
Intake system sealing (infiltrations)	Intake manifold - head Throttle body - manifold Intake sleeve Filter box
Fuel feed (low pressure)	Fuel pump Pressure regulator Fuel filter Injector capacity

Engine does not rev down

ENGINE DOES NOT RETURN TO THE IDLING SPEED/IDLING SPEED TOO HIGH

Possible Cause	Operation
Presence of faults detected by the self diagnosis	Injection load relay HV coil Injector revolution timing sensor Air temperature Coolant temperature Atmospheric pressure
Ignition efficiency	Ignition timing
Correctness of the parameters	Throttle valve position sensor Stepper Coolant temperature sensor Intake air temperature sensor
Intake system sealing (infiltrations)	Intake manifold - head Throttle body - manifold Intake sleeve Filter box
Fuel feed (low pressure)	Fuel pump Pressure regulator Fuel filter Injector capacity

Exhaust backfires in deceleration

EXHAUST BACKFIRES WHEN DECELERATING

Possible Cause	Operation
Presence of faults detected by the self diagnosis	Injection load relay HV coil Injector revolution timing sensor Air temperature Coolant temperature Atmospheric pressure
Correctness of the parameters	Throttle valve position sensor Stepper Coolant temperature sensor Intake air temperature sensor
Intake system sealing (infiltrations)	Intake manifold - head Throttle body - manifold Intake sleeve Filter box
Fuel feed (low pressure)	Fuel pump Pressure regulator Fuel filter Injector capacity
Exhaust system sealing (infiltrations)	Manifold - head Manifold - muffler Analyser socket Muffler welding

Engine revs irregularly

ENGINE IRREGULAR PERFORMANCE WITH VALVE SLIGHTLY OPEN

Possible Cause	Operation
Presence of faults detected by the self diagnosis	Injection load relay HV coil Injector revolution timing sensor

Possible Cause	Operation
Intake system cleaning	Air temperature
	Coolant temperature
	Atmospheric pressure
Intake system sealing	Air filter
	Diffuser and throttle valve
	Additional air pipe and Stepper
Ignition system	Intake sleeve
	Filter box
	Spark plug wear check
Parameter reliability	Throttle valve position signal
	Coolant temperature indicator
	Intake air temperature indicator
TPS reset successful	Ignition advance
	TPS reset successful

Poor performance at full throttle

POOR ENGINE PERFORMANCE AT FULL POWER/ ENGINE IRREGULAR PERFORMANCE ON PICKUP

Possible Cause	Operation
Presence of faults detected by the self diagnosis	Injection load relay
	HV coil
	Injector
	revolution timing sensor
	Air temperature
	Coolant temperature
Spark plug power supply	Atmospheric pressure
	Spark plug
	Shielded cap
	HV cable
	HV coil
	Air filter
Intake system	Filter box (sealing)
	Intake sleeve (sealing)
Parameter reliability	Throttle valve position signal
	Coolant temperature indicator
	Intake air temperature indicator
	Ignition advance
Fuel supply	Fuel level in the tank
	Fuel pressure
	Fuel filter
	Injector capacity

Engine knocking

PRESENCE OF KNOCKING (COMBUSTION SHOCKS)

Possible Cause	Operation
Presence of faults detected by the self diagnosis	Injection load relay
	HV coil
	Injector
	revolution timing sensor
	Air temperature
	Coolant temperature
Ignition efficiency	Atmospheric pressure
	Spark plug
Parameter reliability	Throttle valve position signal
	Coolant temperature indicator
	Intake air temperature indicator
	Ignition advance
Intake system sealing	Intake sleeve
	Filter box
TPS reset successful	TPS reset successful

Possible Cause	Operation
Fuel supply	Fuel pressure Fuel filter Injector capacity Fuel quality
Selection of the cylinder base gasket thickness	Selection of the cylinder base gasket thickness

Decoder master-box circuit

This section describes the operations to be carried out to check the power supply circuit.

Constant supply circuit check

The decoder basic power supply is necessary for the deterrent flashing management. The injection control unit power supply is necessary for the Stepper motor management.

A power supply failure disables both ignition and injection.

In case of power supply faults, the diagnostic tester gives the information "NO REPLY FROM THE CONTROL UNIT".

To carry out the check, proceed as follows:

Specific tooling

020680Y Diagnosis Tool

1 - Check whether the immobiliser system LED indicates that the switch is in position "**ON**" and that the deterrent flashing is on.

YES go to 2 NO go to 7

2 - The decoder is properly programmed.

YES go to 3

3 - Switch set to "**ON**" with side stand raised and emergency switch set to "**OFF**". The injection telltale light turns on for about 3 seconds.

YES go to 5 NO go to 4

4 - Check the instrument unit and its power supply.

YES go to 3

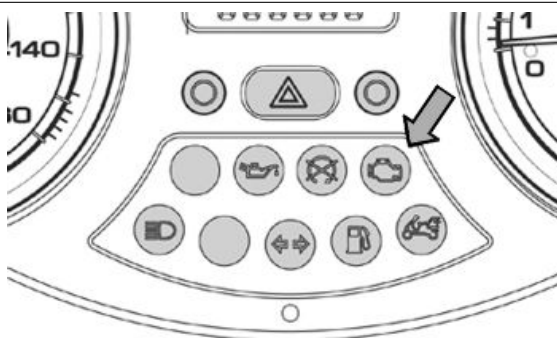
5 - Set the emergency switch to "**RUN**". The injection telltale light comes on for about 5 seconds.

YES go to 6 NO go to 7

6 - The injection control unit is certainly powered.

7 - Check that fuses No. 6 and 11 are in good conditions.

YES go to 10 NO go to 8



8 - Fix any wiring short circuits and replace the fuse.

YES go to 1 NO go to 9

9 - Check any short circuit on decoder or control unit and replace, if necessary.

YES go to 1

10 - Place the special tool between control unit and power supply system. Disconnect the main decoder connector and check the following conditions:

Terminal no. 3= battery positive

Terminal no. 4= battery negative

YES go to 11 NO go to 13

Specific tooling

020481Y Control unit interface wiring

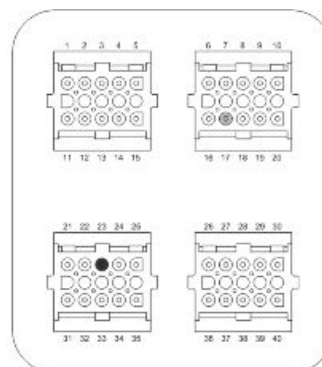
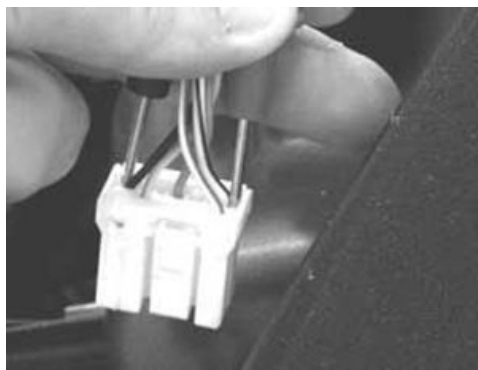
11 - Decoder with proper base power supply.

Use the special tool to check the control unit power supply:

Pin 17 = battery positive

Pin 23 = battery negative

YES go to 12 NO go to 13



12 - Control unit with proper base power supply.

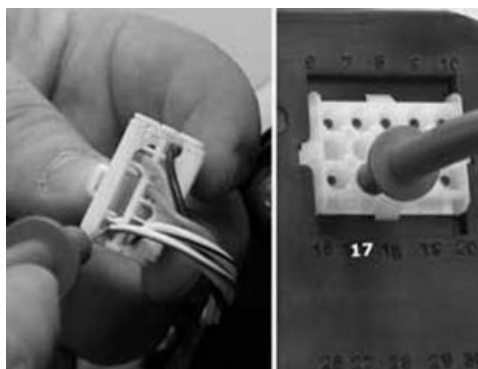
13 - If the battery negative is not present, check continuity between Pin 23 of the special tool and earth.

Detect the presence of the battery positive on Pin 17 of the special tool and on pin 3 of the decoder connector.

YES go to 12 NO go to 14

YES go to 11

14 - Fix the cable harness.



Key-switch power supply circuit check

A failure of the constant power supply disables both ignition and injection functions. In case of power supply faults, the diagnostic tester gives the information "NO REPLY FROM THE CONTROL UNIT".

Specific tooling

020680Y Diagnosis Tool

1 - Check whether the immobilizer system LED indicates switching to "ON"

YES go to 2 NO go to 4

2 - Raise the side stand. Set the emergency switch to "OFF". Turn the key switch to "ON". Set the emergency switch to "RUN". Check whether the injection telltale light turns on for 5 seconds

YES go to 3 NO go to 4

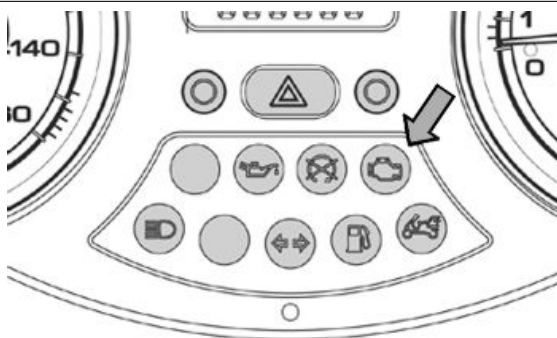
3 - Continuous power supplies are regular

4 - Check that fuse No. 11 and the engine stop remote control switch are in good conditions.

YES go to 5 NO go to 6

5 - Place the special tool between control unit and injection system.

YES go to 7



Specific tooling

020481Y Control unit interface wiring

6 - Fix any short circuits and replace the fuse.

Check decoder and control unit, if necessary

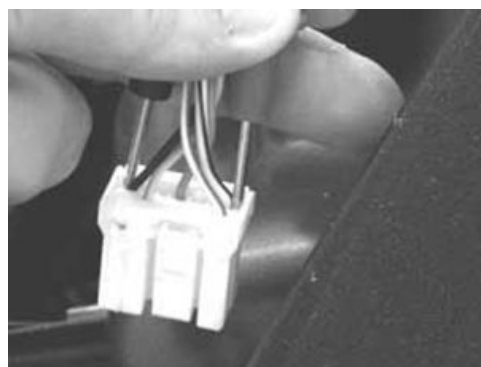
YES go to 1

7 - Disconnect the main decoder connector and check the following conditions: switch set to "ON", switch to "RUN" and side stand raised

Terminal no. 8 = battery positive

Terminal no. 4= battery negative

YES go to 8 NO go to 10



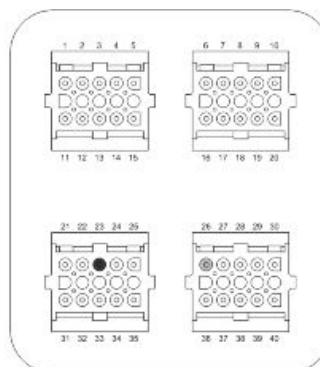
8 - Decoder with proper continuous power supply.

Use the special tool to check the control unit continuous power supply. Switch set to "ON", switch to "RUN" and side stand raised.

Pin 26 = battery positive

Pin 23 = battery negative

YES go to 9 NO go to 10



Specific tooling

020481Y Control unit interface wiring

9 - Control unit with proper continuous power supply.

10 - If only one component is not powered check the relevant connector. If the problem involves both the decoder and ECU check the continuity of the decoder ECU power supply line.

Pin 26 control unit - Pin 30 engine stop remote control switch = continuity

Pin 8 decoder - Pin 30 engine stop remote control switch = continuity

YES go to 12 NO go to 11

11 - Fix the cable harness or the connection

YES go to 10

12 - Proper continuous power supply

YES go to 13

13 - Check the connector and the continuity of the key switch set to "ON"

Pin 1 - 2 = continuity

YES go to 14

14 - Check the engine stop remote control switch connector and the switch efficiency.

85 - 86 = approx. 70W

YES go to 15

N.B.

CHECK THE COIL RESISTANCE

15 - Check the signal circuit:

- emergency switch and connector
- side stand switch and connector

YES go to 16

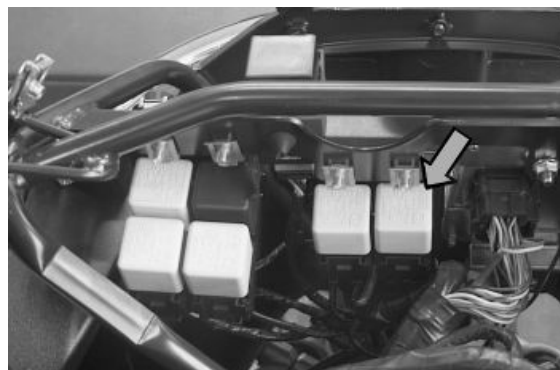
16 - Check the cable harness continuity. Check the utility control main remote control switch.

Disconnect the master remote control switch.

Check the diode installed on the earth connection of the main remote control switch pickup.

86 - earth = continuity with high resistance (connect the tester: positive with 86; negative with earth).

When the polarity is inverted there should be no continuity.



Diagnostic circuit

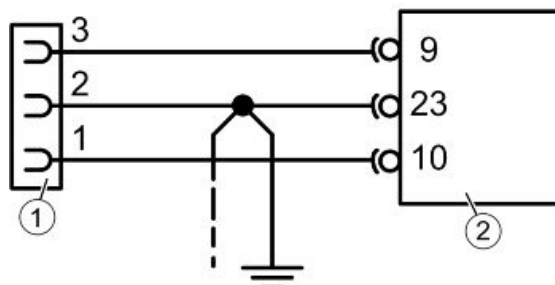
1 = CONNECTOR FOR DIAGNOSTIC TESTER

2 = INJECTION ECU

Connect the diagnostic tester.

Specific tooling

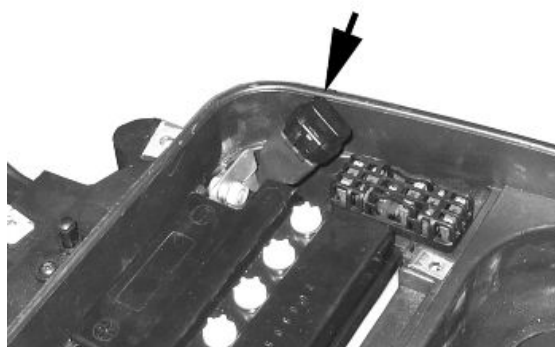
020680Y Diagnosis Tool



If the diagnostic tester displays «No reply from the control unit», disconnect the continuous power supply for 10 seconds and switch to «ON» again; if the message is still displayed, proceed as follows:

1 - Check the diagnostic tester connections.

YES go to 2 NO go to 3



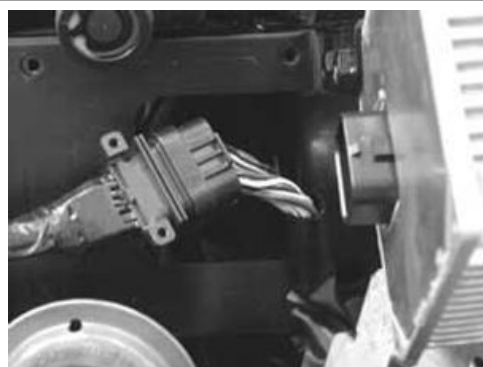
2 - Check the control unit base and continuous power supplies.

YES go to 4

3 - Restore

4 - Place the special tool between control unit and system. Keep the control unit disconnected.

YES go to 5



Specific tooling

020481Y Control unit interface wiring

5 - Check the following conditions:

PIN 1 diagnostic socket - PIN 10 control unit = continuity

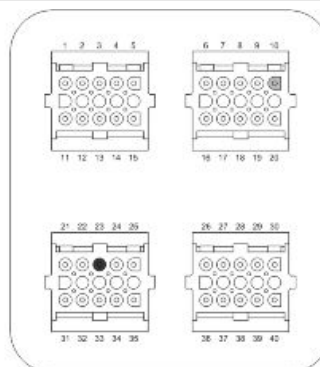
PIN 2 diagnostic socket - PIN 23 control unit = continuity with earth

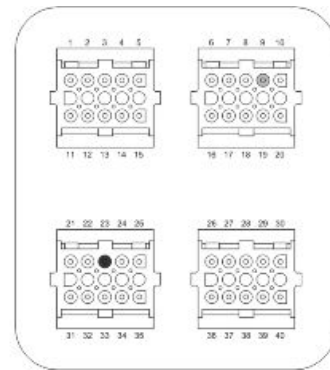
PIN 3 diagnostic socket - PIN 9 control unit = continuity

10 - 23 = insulation (>1 MΩ)

9 - 23 = insulation (>1 MΩ)

YES go to 6 NO go to 7

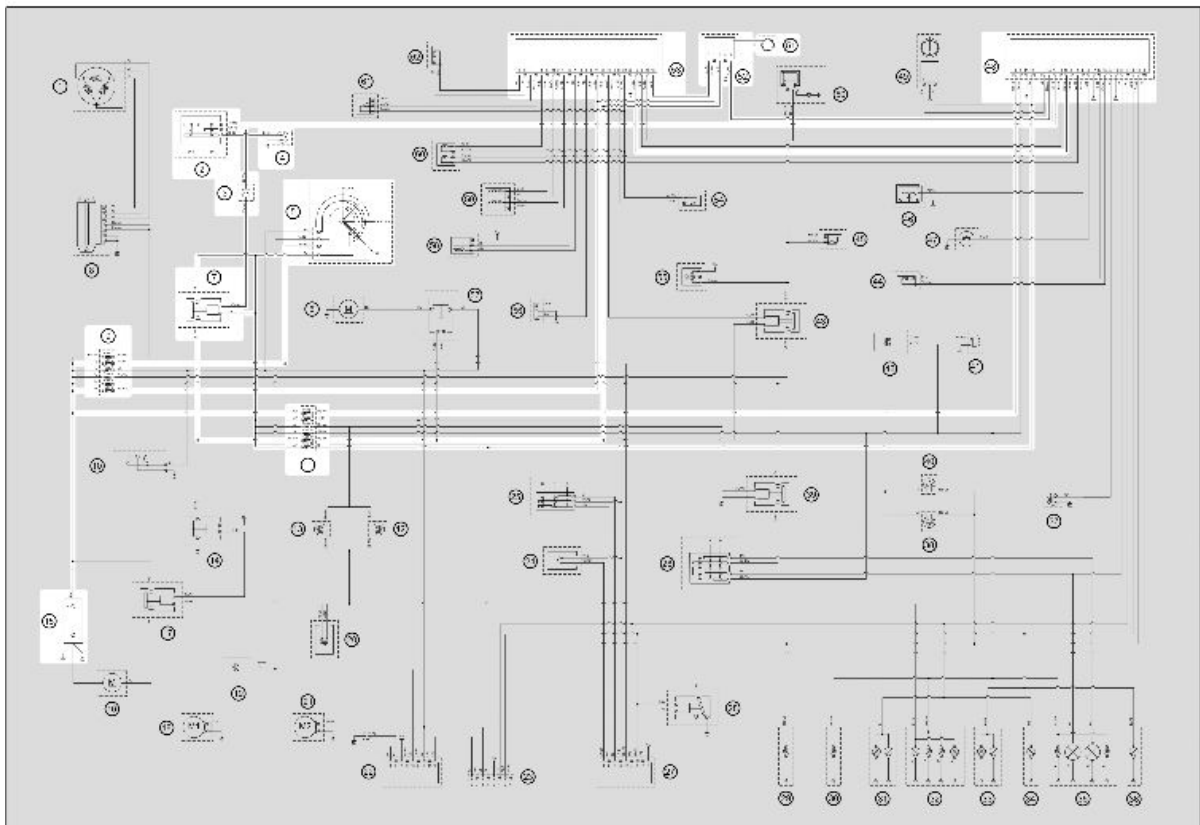




6 - The circuit is in good working order. Check the control unit.

7 - Fix the interruption or short-circuit.

Injection warning light circuit



KEY:

- 2. Engine stop switch
- 3. Diode
- 4. Side stand button
- 5. Key switch
- 7. Engine stop remote control switch
- 9. Main fuses
- 11. Auxiliary fuses

15. 12V-12Ah Battery

48. Instrument panel

51. Immobilizer aerial

52. Decoder

53. Injection ECU

REFERENCE VALUES

	Specification	Desc./Quantity
1	TERMINAL: 15 - 23	CONDITIONS: DURING THE CHECK - Switch set to "ON" - Side stand raised - Switch to "RUN" STANDARD VALUES : 0 V
2	TERMINAL: 15 - 23	CONDITIONS: AFTER THE CHECK - Switch set to "ON" - Side stand raised - Switch to "RUN" STANDARD VALUES : Battery voltage

The injection telltale light is controlled upon every switching to "ON" by the 3-second timing generated by the digital instrument. This step is normally interrupted by the injection control unit control. The timing lasts 5 seconds.

The diagnostic tester is not programmed to check this circuit.

Proceed as follows:

Specific tooling**020680Y Diagnosis Tool**

1 - Turn the switch to the "ON" position Turn the emergency switch to position "RUN". Keep the side stand raised. Make sure the light goes on for 5 seconds.

YES go to 2 NO go to 3

2 - The system is working.

3 - Put the special tool between the control unit and system.

YES go to 4

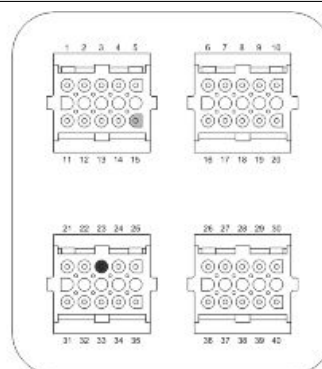
Specific tooling**020481Y Control unit interface wiring**

4 - Switch in «ON» position Emergency switch on «RUN».

Side stand up Wait more than 5 seconds.

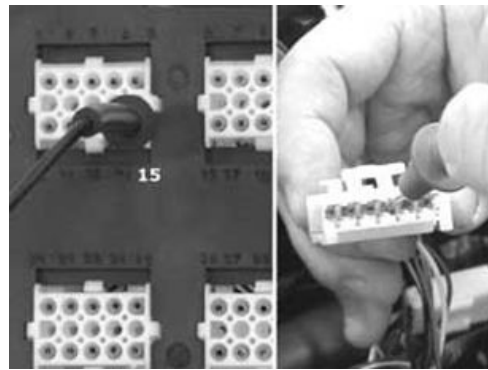
15 - 23 = battery voltage

YES go to 5 NO go to 6



5 - Check the control unit connector. Check the control unit.

6 - Check the continuity between pin 15 of the control unit and pin 16 of connector B of the instrument panel.



The injection ECU manages the negative of the light. The light must go off after the initial check. The light goes on again when the ECU self-diagnosis detects a fault. When the fault disappears the light goes back off, however, the related operating tests need to be carried out. The light can go on whether the engine is able to run or not.

Self-diagnosis system

The injection control unit is provided with an auto-diagnosis function.

When a failure is detected, the control unit:

- turns on the injection telltale light (only when it is current).
- enables the engine management check according to the data entered in the control unit (where possible).
- stores the failure (always).

In the event of intermittent failures, the indicator follows the failure trend and storage remains active. Stored data are automatically deleted when the failure does not occur for over 16 usage cycles of the scooter (heating - use - cooling). The battery disconnection does not delete stored data.

Checking stored failures

Connect the diagnostic tester to the scooter system.

Select the function "ERROR" in the menu.

Specific tooling

020680Y Diagnosis Tool



The tester pages display the list of errors detectable by the auto-diagnosis.

Errors detected by the auto-diagnosis are marked by one or two reference dots.

They are arranged on two lines:

Line A = current failures (present)

Line M = stored failures



Errors detectable by the auto-diagnosis may refer to the following system circuits or sectors of the control unit:

- Throttle valve position signal
- ambient pressure signal
- coolant temperature signal
- intake air temperature signal
- wrong battery voltage
- Injector and relevant circuit
- HV coil and relevant circuit
- Stepper and relevant circuit
- Pump relay circuit
- Electric fan relay circuit
- RAM memory
- ROM memory
- EEPROM
- Microprocessor
- Signals panel (stroke - revolution signal - unsteady cycle)

Underlined failures cause the engine to stop.

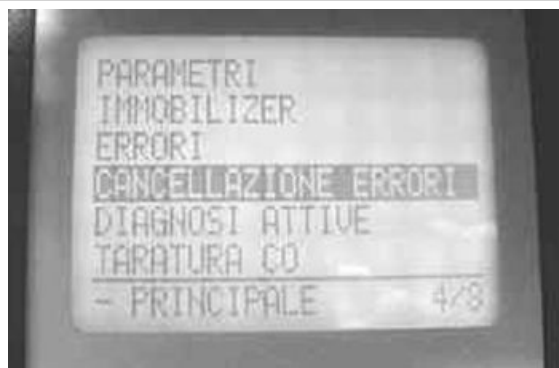
In the other cases, the engine works managed by the basic data.

Deleting stored failures

After mounting any failures, connect the diagnostic tester.

Select the menu on the "errors deleting" function.

Press "OK" and follow the instructions. Perform a trial cycle and check whether the failure occurs again.



Specific tooling

020680Y Diagnosis Tool

For troubleshooting for any faults see the related chapter sections.

Fuel supply system

Fuel is fed to the injector by a pump, a filter and a pressure regulator integrated with the fuel level indicator inside the tank.



The pump unit is connected to the injector by:

2 semi-flexible pipes

4 quick unions

1 T union with O-ring and retain bracket for the injector

The pipes are crossed and fixed to the intake manifold to prevent wear of the quick unions connected to the T union for the injector.

N.B.

BEFORE WORKING ON THE FUEL SUPPLY SYSTEM, CAREFULLY CLEAN THE PARTS TO PREVENT DAMAGING THE FAST-RELEASE COUPLING SEAL OR TO PREVENT DIRT GETTING INTO THE DUCTS.

CAUTION

THE SYSTEM IS UNDER PRESSURE.

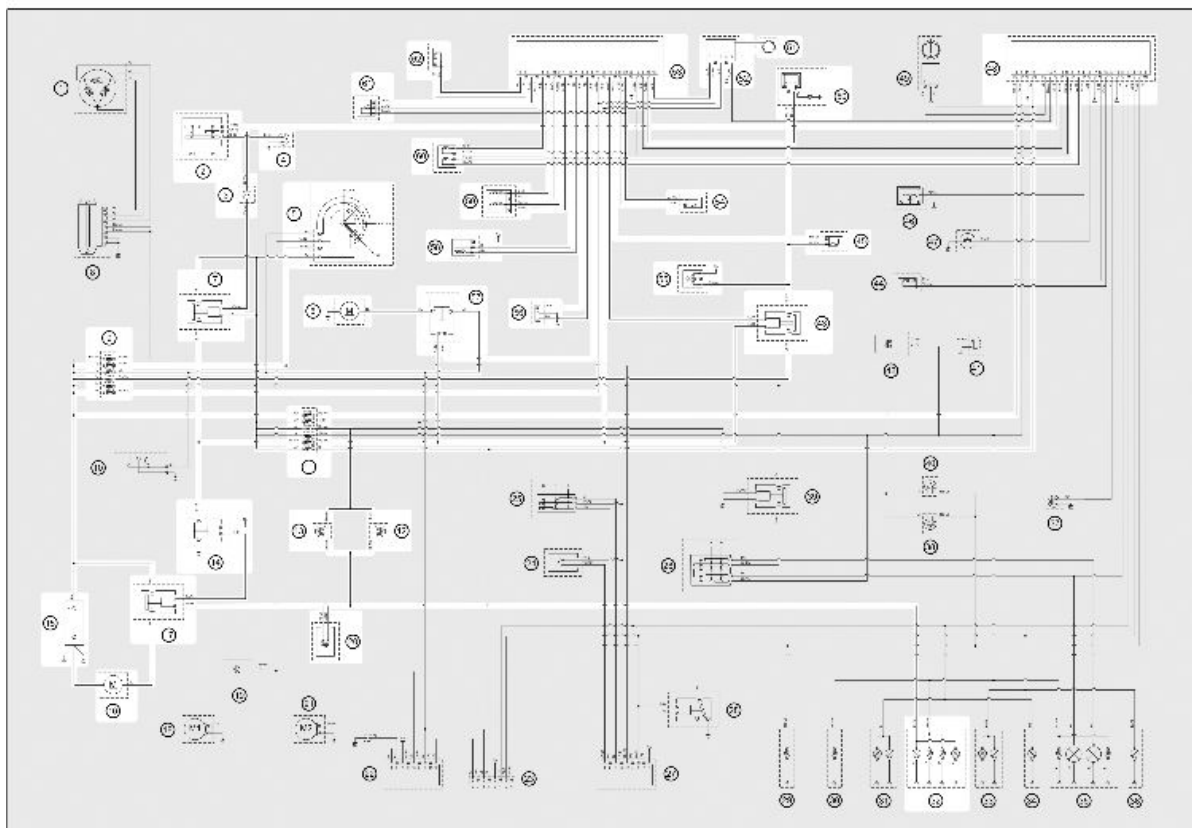
DO NOT SMOKE DURING ANY OPERATION.

PREVENT ANY FUEL SPRAYING.

WARNING

- **BEFORE STARTING THE ENGINE, CHECK WHETHER THERE IS FUEL IN THE TANK.**
 - **DO NOT USE THE SCOOTER IN RESERVE FOR A LONG TIME, UP TO THE POSSIBILITY OF RUNNING OUT OF FUEL.**
 - **IF THE SCOOTER IS EXPECTED TO REMAIN UNUSED FOR A LONG TIME, REFILL THE TANK AT LEAST TO HALF THE LEVEL.**
- FAILURE TO OBSERVE THESE RULES CAN DAMAGE THE PUMP.**
-

Circuit diagram



KEY:

- 2. Engine stop switch
- 3. Diode
- 4. Side stand button
- 5. Key switch
- 6. Electric fan
- 7. Engine stop remote control switch
- 9. Main fuses
- 11. Auxiliary fuses
- 12. Stop button on front brake
- 13. Stop button on rear brake
- 14. Immobiliser remote control switch
- 15. 12V-12Ah Battery
- 16. Starter motor
- 17. Start-up remote control switch
- 20. Starter button
- 32. Rear light
- A. Stop light bulbs

- 43. Injection load remote control
- 45. Fuel injector
- 48. Instrument panel
- 50. HV coil
- 51. Immobilizer aerial
- 52. Decoder
- 53. Injection ECU
- 54. Intake air temperature sensor
- 55. Fuel pump
- 56. Diagnosis connector
- 57. Electric fan remote control
- 58. Engine rpm sensor
- 59. Stepper motor
- 60. Engine temperature sensor
- 61. Throttle valve potentiometer
- 62. Lambda probe

Removing the injector

N.B.

ONLY REMOVE THE INJECTOR FROM THE MANIFOLD IN THE EVENT OF A PROVEN DEFECT. OPERATING TEST OF THE INJECTOR MUST BE PERFORMED WITH THE INJECTOR INSTALLED ON THE MANIFOLD (SEE "INJECTION").

- To remove the injector, remove the central set screw of the "T" shunt acting as a support for the injector.



- Remove the injector from the manifold.



Refitting the injector

Carefully check to make sure the components are clean.

- Fit new O-rings and grease them.
- Apply the recommended product to the set screws and tighten to the prescribed torque.

Recommended products

Loctite 243 Medium strength threadlock

Medium Loctite 243 threadlock

Locking torques (N*m)

injector fixing screw 3 ÷ 4



Removing the butterfly valve

N.B.

THE THROTTLE BODY IS A PART WHICH INCLUDES VARIOUS COMPONENTS AND IS USUALLY SUPPLIED COMPLETE. TO TEST THESE COMPONENTS SEE THE "INJECTION" CHAPTER.

- Remove the 3 retaining screws indicated in the figure.



CAUTION

THE THROTTLE BODY COMES PRE-CALIBRATED. TAMPERING WITH THE THROTTLE STOP REGISTER IS TO BE ABSOLUTELY AVOIDED. THIS REGISTER HAS BEEN SEALED FOR THIS PURPOSE. FOR PROBLEMS WITH IDLING SEE THE "INJECTION" CHAPTER.

N.B.

REMOVAL OF THE THROTTLE BODY CAN BE EFFECTED WITH THE MANIFOLD ON OR OFF THE ENGINE.

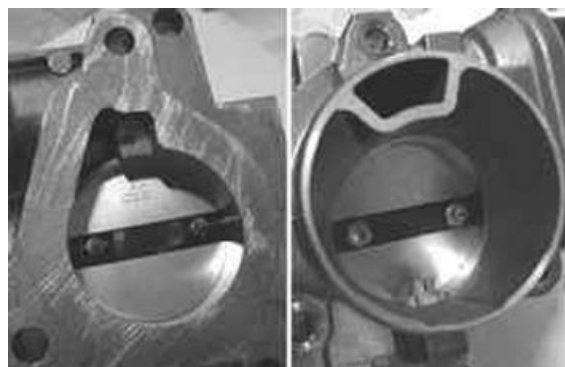
- Make sure the seal rims on the coupling surfaces between the manifold-throttle body and manifold-head are in good condition.

CAUTION

IF AIR GETS IN IT CAN JEOPARDISE THE OPERATION OF THE INJECTION SYSTEM, ESPECIALLY WHEN THE ENGINE IS IDLING.



- Make sure the throttle valve and related conduit are clean.
- Make sure the supplementary air channel managed by the Stepper motor is clean.



N.B.

IF THE THROTTLE BODY IS REPLACED RESET THE TPS.

Throttle body

after checking the material under warranty, several throttle bodies are replaced incorrectly because the valve was dirty. Dirt deposited in the valve, mainly on the inlet manifold side, can be easily removed. Once clean, the throttle body has an air flow equivalent to the original one. The throttle valve gets dirty at variable periods according to the type of use given to the scooter, ambient conditions and the idle speed set-up. The beginning of this problem can be easily detected because the idle speed gradually decreases. An accurate diagnosis can be performed with the appropriate tools. The parameter situation, with engine temperature at 90° minimum, can be the following:

	Standard	Throttle body dirty
Engine revs	1500±5	< 1400
Ignition advance	5°÷7°	10°
Throttle valve opening	5.24°	5.24°

The "rpm sensor" warning can be displayed on the error menu, in a stored status. This occurs only if the engine stops several times with the key switch turned to «ON».

Specific tooling

020680Y Diagnosis Tool

Refitting the butterfly valve

- Carry out the removal operations but in reverse order, tighten the 3 fixing screws to the prescribed torque.

Locking torques (N*m)

Throttle body fixing screws 11 ÷ 13



Pump supply circuit

The control unit starts the pump in the following conditions:

- by setting the switch to «**ON**» with the emergency switch to «**RUN**» and side stand raised. The pump does not supply.
- If the rpm-timing signal is received. Continuous supply.

The initial timing is useful to bleed the system especially after a stop with engine in temperature. In these conditions, the fuel altered by boiling will be mixed with that in the tank.

During use, the pump operation will be subject to the engine speed.

Circuit check

The injection system control unit is programmed to guarantee optimum carburetion during riding. Idle mixture needs to be improved in order to compensate for productive tolerances and engine adjustments.

This adjustment is performed by modifying the injector opening time with the engine at idle speed.

To adjust, proceed as follows:

Idle mixture adjustment must be performed on an engine with good tune-in conditions.

First check:

- spark plug
- air filter cleaning
- throttle body cleaning
- suction system proper sealing
- exhaust system proper sealing
- valve clearance
- fuel filter
- fuel pressure

N.B.

IDLE SPEED IS OBTAINED BY PRE-CALIBRATING THE THROTTLE BODY AND THE ACTIVITY OF THE STEPPER.

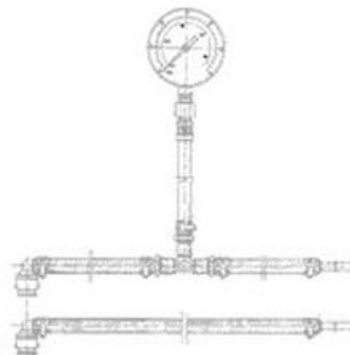
Characteristic**Engine idle speed**

1500 ± 50 rpm

Circuit leak test

Before performing the checks concerning the system pressure, it is necessary to carefully clean all feeding system components.

To perform the inspections it is necessary to use the special tooling kit for fuel pressure check.

Specific tooling**020480Y Petrol pressure check set**

Before disconnecting any fastener, reduce the system pressure.

Detach the electrical connector from the pump support with the engine running, and wait for the shut-down.

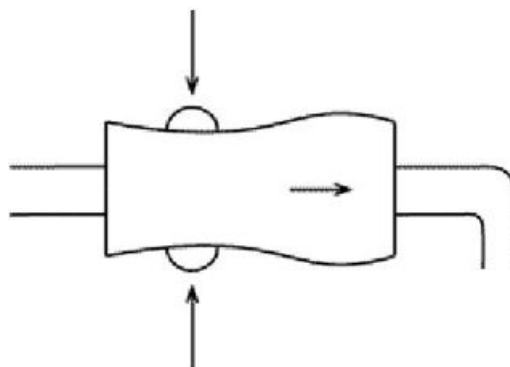
The engine stops at approximately 1.5 bar.

CAUTION

CAREFULLY DETACH THE HOSE TERMINAL PREVENT ANY POSSIBLE SPRAYING INTO THE EYES.

The special tool is equipped with fast-release fittings, similar to those provided for the circuit.

In order to disconnect the female terminals (injector side), it is necessary to press the two extensions and draw them.

**CAUTION**

DO NOT FORCE THE TERMINAL IF THIS DOES NOT COME LOOSE; EVENTUALLY, TRY TWISTING IT. THE TERMINAL IS DESIGNED SO THAT AN INCREASE IN TENSION INCREASES THE LOCKING FORCE.

To detach male type terminals (pump side) it is necessary to press the coaxial rings towards the pump, and extract the terminals.

CAUTION

DO NOT FORCE THE TERMINAL IF THIS DOES NOT COME LOOSE; EVENTUALLY, TRY TWISTING IT. THE TERMINAL IS DESIGNED SO THAT AN INCREASE IN TENSION INCREASES THE LOCKING FORCE.

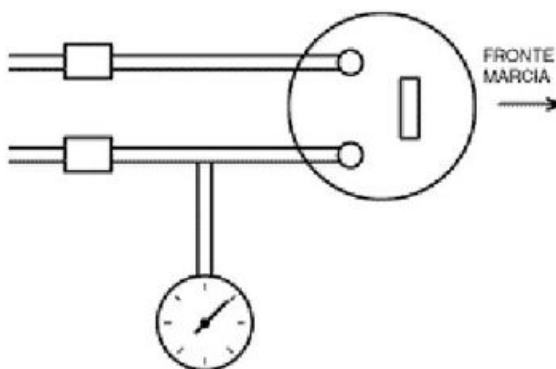


The system pressure check must be carried out, for practical reasons, by connecting on the pump side.

Connect the manometer to the outlet duct (RHS) and the extension tube to the inlet duct (LHS).

CAUTION

BEFORE REASSEMBLING CHECK THE TOOL DUCTS ARE CLEAN.



Pressure regulator check

1 - Connect the diagnostic tester.

Specific tooling

020680Y Diagnosis Tool



Select the menu on the "ACTIVE DIAGNOSIS" function.

Select the "PUMP DIAGNOSIS" function.

YES go to 2

2 - Enable the function with continuous power supply on and engine off.

The control unit starts the pump for 30 seconds

YES go to 3

3 - Let the system bleed for a few seconds.

Make sure that there are no external leaks.

Check the regulation pressure with pump power supply voltage higher than 12 V.

Regulation pressure = 300 - 320 kPa (3 - 3.2 BAR)

YES go to 4 NO go to 5



4 - The pressure regulator is efficient.

5 - Pressure too high

Check that the return duct is not clogged or squashed

YES go to 6 NO go to 7

6 - Replace the pressure regulator.

7 - Pressure regulation too low

Start the pump rotation again. Using pliers with flat and long tips, temporarily clamp the return duct by the extension of the specific tool (**the serial pipe does not allow this operation**).

fuel pressure = over 300 kPa (3 BAR)

YES go to 8 NO go to 9

8 - Replace the pressure regulator.

9 - Replace the fuel pump.



Fuel pump and filter check

This procedure is useful during maintenance to check the filter efficiency in delivery.

Connect the diagnostic tester.

Connect the fuel pressure check kit.

Specific tooling

020680Y Diagnosis Tool

020480Y Petrol pressure check set

1 - Select the diagnostic tester menu on the «**ACTIVE DIAGNOSIS**» function.

Select the «**PUMP DIAGNOSIS**» function.

The pump starts for 30 seconds.

YES go to 2



2 - Let bleed for a few seconds.

Make sure that there are no leaks.

Using pliers with flat and long tips, temporarily clamp the return duct by the extension of the special tool with pump power supply voltage higher than 12 V, check the system maximum pressure.

Maximum pressure = > 600 kPa (6 BAR)

YES go to 3 NO go to 4



Specific tooling

020480Y Petrol pressure check set

3 - Check the system seal.

Start the pump for 30 seconds using the diagnostic tester.

When the pump stops, wait 3 minutes.

Check the system pressure.

Fuel pressure = over 200 kPa (2 BAR)

YES go to 5 NO go to 6

Specific tooling

020680Y Diagnosis Tool

4 - If pressure is lower, carefully check the voltage with pump under stress.

If voltage is higher than 12 V, replace the pump.

5 - The system seal is efficient.

Check the free flow rate.

AHEAD go to 16

6 - Repeat the test. When the pump stops, use pliers with flat and long tips to temporarily clamp the return duct by the extension of the special tool.

This causes an increase of the fuel pressure.

AHEAD go to 7



7 - Check whether the pressure decreases with the same trend as the system when free from bottle-necks

AHEAD go to 8

8 - Pressure decreases much more slowly

YES go to 9 NO go to 10

9 - Replace the pressure regulator. Check the system seal again.



10 - There occur trend variations

YES go to 11 NO go to 13

11 - Repeat the test clamping the pipe of the special tool in the portion between the branch and the injector.

Check whether the pressure decreases with the same trend as the system when free. Pressure decreases much more slowly

YES go to 12 NO go to 13

Specific tooling

020480Y Petrol pressure check set

12 - Check and replace the injector, if required, due to an insufficient seal.

(see "THERMAL GROUP AND TIMING SYSTEM")

13 - There are no trend variations

Repeat the test clamping the pipe of the special tool in the portion between the branch and the pump. Check whether pressure decreases much more slowly.

YES go to 14 NO go to 15

Specific tooling

020480Y Petrol pressure check set

14 - The pump unidirectional valve is faulty. Replace the pump. (see Pump bracket overhaul)

15 - Check the pipe and the injector union seals more carefully.

Check the component seals again, if necessary.

A POOR SYSTEM SEAL ONLY AFFECTS THE START-UP VELOCITY.

16 - Disconnect the pump connector, start the engine, wait until it stops and connect the connector again.

Disconnect the fuel return pipe from the pump support (left pipe).

AHEAD go to 17



17 - Introduce the return pipe into a graduated container.

Using the diagnostic tester, start the fuel pump for 10 seconds.

Make sure that the power supply voltage is more than 12V.

Measure the amount of fuel delivered.

Pump free flow rate = 300 - 320 cc.

YES go to 18 NO go to 19



Specific tooling

020680Y Diagnosis Tool

18 - The fuel filter is not clogged.

The scooter can be used respecting the limit of 48000 km.

19 - The flow rate is less than 250 cc.

The fuel filter is dirty. Replace the pump support.

Pump electrics check

This section describes the operations to be carried out to perform electric checks on the pump.

Resistor check

Disconnect the connector from the pump support.

Using a tester, measure the pump winding resistance.

Connect the tester probes to the pump support pins as shown in the figure.



Electric characteristic

Resistance:

approx. 1.5 Ω

In case of infinite resistance, replace the pump.

With infinite resistance, the pump does not rotate.

With a resistance close to 0 Ω , the pump power consumption is too high with the possibility of blowing fuse No. 4. Perform the following check.

Pump consumption check

The pump power consumption may vary according to:

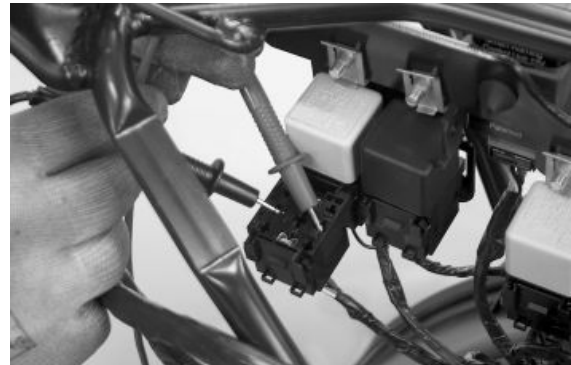
- Power supply voltage
- Pump running-in
- Regulation pressure
- Delivery filter cleaning

To check current consumption, proceed as follows

- disconnect the injection load remote control connector.

- with the key switch turned to «OFF», jump pins 30 and 87.

- check the rotation and power consumption of the pump with the multimeter probes in ammeter function (see figure).



N.B.

THIS CONSUMPTION REFERS TO:

- **POWER SUPPLY VOLTAGE = approx. 12 V**
- **PUMP RUN IN**
- **SYSTEM PRESSURE = 300 kPa (3 BAR)**
- **FUEL FILTER CLEAN**

Electric characteristic

Current consumption:

approx. 3.5 - 4.2 A

A dirty filter causes an increase of input. If the pressure-relief valve opens, the pump absorbs approx. 6-7A.

In case of excessive input (5A), replace the filter. See pump support overhaul.

If the fault continues, replace the pump.

Fuel filter check

To check the fuel filter inspect the following:

- Free flow
- Current consumed by the pump. A clogged filter causes:
- Poor performance especially at full power
- Pump input increase

N.B.

DO NOT BLOW THE FILTER WITH COMPRESSED AIR. A DAMAGED FILTER MAY CAUSE THE INJECTOR CLOGGING.

Pump bracket overhaul

To remove the pump support from the tank, proceed as follows:

- Disconnect the electric connector.
- Start the engine and wait for the spontaneous stop.
- Clean the tank and the pump support (wash and blow with compressed air, if necessary).
- Disconnect the delivery and return pipes by the fast-release fittings.



CAUTION

PREVENT ANY FUEL SPRAYING.

- Loosen the pump support mounting ring nut (RH threading).



- Remove the pump support and the sealing gasket.

N.B.

UPON EXTRACTING IT, BE CAREFUL NOT TO DEFORM THE FLOATING ARM.



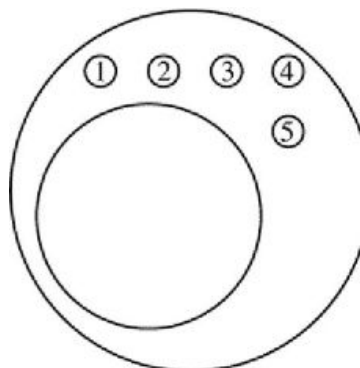
To replace the components, proceed as follows:

(1) Level indicator:

- Note the assembly position and the path of the two connecting wires.

pos 2 = wire connected to the circuit

pos 3 = wire connected to the movable arm



Pass the wires through the hole found between filter and pressure regulator.

- Disconnect and extract the wires
- Using a screwdriver on the retain tab as shown in the figure, extract the level indicator from the support



- Level indicator check

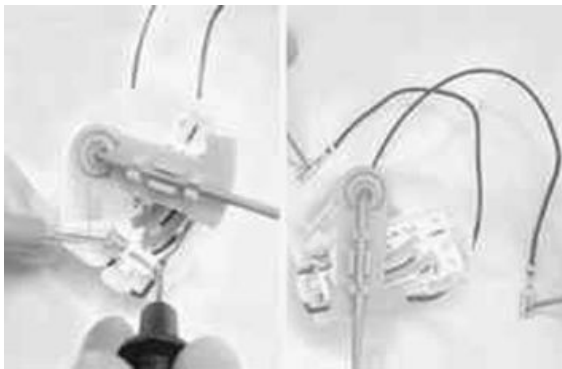
The check may also be carried out before removing it from the support.

Measure the resistance between the two level indicator wires.

Moving the float arm, check that the resistance is subject to gradual variations according to the arm motion.

LIMIT VALUES

	Specification	Desc./Quantity
1	Empty tank position:	95 - 105 Ω
2	Full tank position:	0 - 9 Ω



- To refit, repeat the removal operations but in reverse order.

(2) Pressure regulator:

- Remove the locking spring
- Extract the pressure regulator with sealing rings.

N.B.

TO OVERCOME THE RESISTANCE OF THE O-RINGS, LEVER WITH A SCREWDRIVER THROUGH THE OPENINGS OBTAINED ON THE STOP INSERTION SIDE.

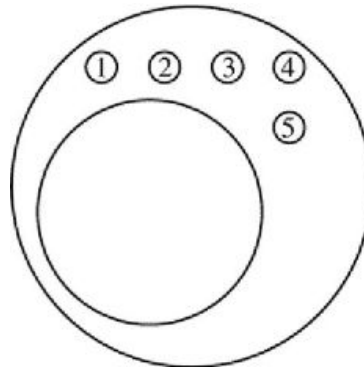
- Lubricate the O-rings and repeat the operations in the reverse order for reassembly.



(3) Fuel pump

- Note the position of the power supply wires on the support
pos 1 = positive (red)
pos 4 = negative (black)

- Disconnect the power supply cables



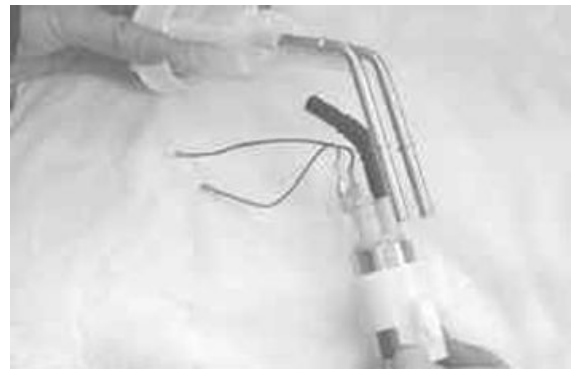
- Cut the delivery pipe fastening clamp on the support.



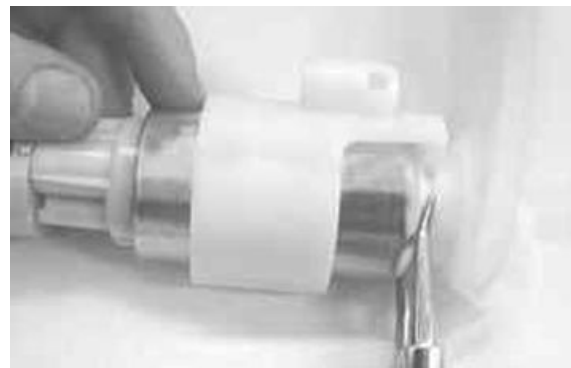
- Remove the pump mounting washer



- Remove the filter coupling pipe
- Remove the pump with annular support and pre-filter.



- If the pump requires replacement, remove the pre-filter and the annular support.
- For reassembly, perform the removal operations but in the reverse order using a new clamp for the delivery pipe and a new pump mounting washer.



N.B.

TO CLEAN THE PRE-FILTER, USE PETROL AND COMPRESSED AIR.

Orientate the pump properly.



(4) Fuel filter

The fuel filter is supplied already assembled to the pump support.

To replace the support, move the level indicator, the pressure regulator and the pump from the old to the new support.

For these operations, follows the instructions given above.



Pump bracket installation

- Before reassembling, carefully check that the tank is clean.
- In case of dirt or water, remove the tank.
- Install the sealing gasket on the pump support.
- Introduce the pump into the tank being careful not to deform the level indicator arm.



- Place the sealing gasket on the tank.
- Install the pump support onto the seat aligning the connector with the scooter longitudinal axle.

N.B.

AN INCORRECT ORIENTATION MAY IMPAIR THE LEVEL INDICATOR PERFORMANCE.



- Screw the mounting ring nut and tighten thoroughly.

Locking torques (N*m)

Electric pump locking ring nut 20

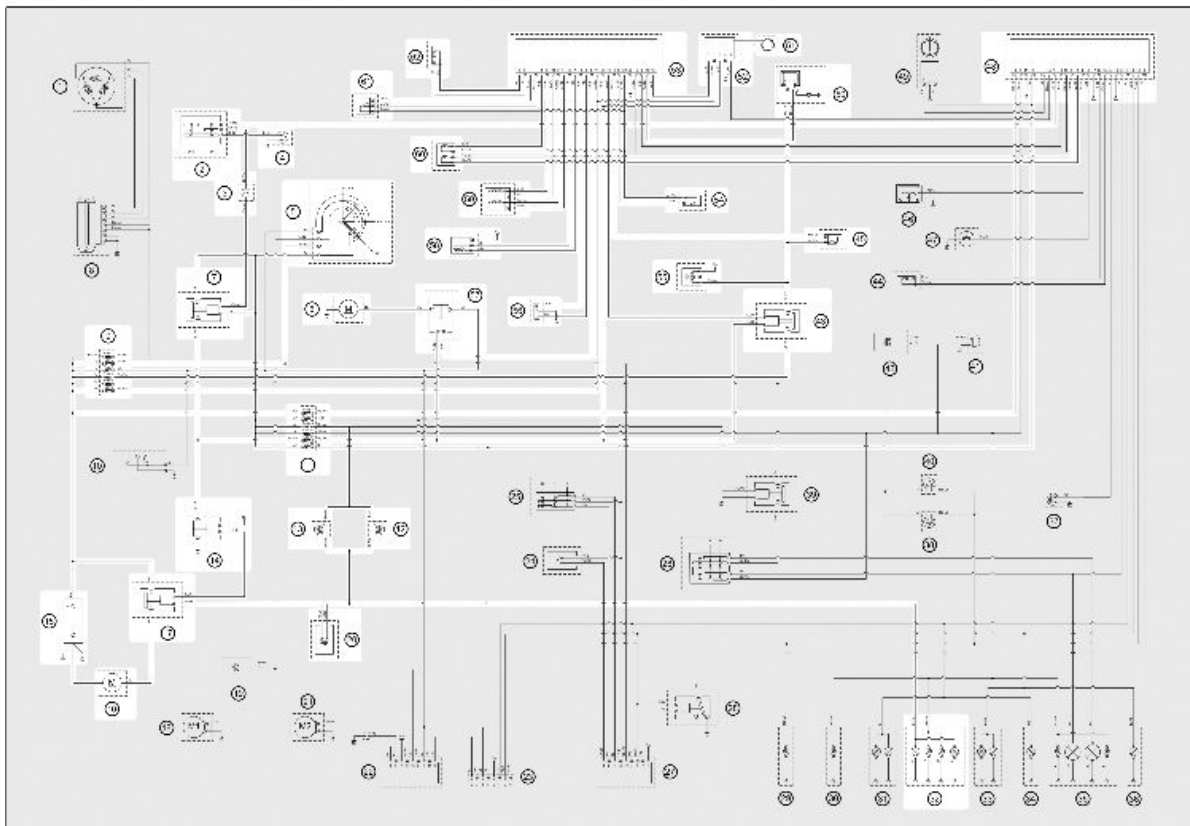
- Connect the feeding circuit pipes again and check the proper introduction by pulling and turning upwards.
- Reconnect the electric connector.
- Recharge the system with at least 4÷5 timings (key switch «OFF-ON»)

N.B.

DO NOT START THE PUMP BEFORE REFILLING THE TANK. FAILURE TO OBSERVE THIS RULE CAN DAMAGE THE PUMP.

- Check that the fuel feeding system fast-release fitting seal is efficient.

Inspecting the injector circuit



KEY:

- 2. Engine stop switch
- 3. Diode
- 4. Side stand button
- 5. Key switch
- 6. Electric fan
- 7. Engine stop remote control switch
- 9. Main fuses
- 11. Auxiliary fuses
- 12. Stop button on front brake
- 13. Stop button on rear brake
- 14. Immobiliser remote control switch
- 15. 12V-12Ah Battery
- 16. Starter motor
- 17. Start-up remote control switch
- 20. Starter button
- 32. Rear light
- A. Stop light bulbs

- 43. Injection load remote control
- 45. Fuel injector
- 48. Instrument panel
- 50. HV coil
- 51. Immobilizer aerial
- 52. Decoder
- 53. Injection ECU
- 54. Intake air temperature sensor
- 55. Fuel pump
- 56. Diagnosis connector
- 57. Electric fan remote control
- 58. Engine rpm sensor
- 59. Stepper motor
- 60. Engine temperature sensor
- 61. Throttle valve potentiometer
- 62. Lambda probe

2 - Enable the function with continuous power supply on and engine off. The control unit controls the fuel pump continuously and at the same time starts the injector opening. The injector openings are repeated for a few seconds.

YES go to 3

3 - Acoustically check the injector openings and wait for the tester results

YES go to 4 NO go to 5

4 - 5 injector openings detected. The injection tester displays «test successful».

YES go to 7

5 - No injector openings detected. The injection tester displays «test failed».

YES go to 9 NO go to 6

6 - No injector openings detected. The injection tester displays «test successful».

YES go to 8

7 - The injector control circuit is efficient. Perform the injector hydraulic check.



8 - The injector control circuit is efficient. Repeat the acoustic check and perform the injector hydraulic check for safety reasons.

9 - Select the menu on the "ERRORS" function. Check whether the injector failure message only is displayed.

YES go to 14 NO go to 10

10 - There are also fault messages for: pump relay

YES go to 13 NO go to 11



11 - There is also a fault message for the HV coil.

YES point 12

12 - Check the power supply circuit with the fuse No. 4 and the remote control switch. Common feeding to the fuel pump.

13 - Check the injection load relay control circuit

14 - Install the special tool between the injection system and the control unit.

YES go to 15

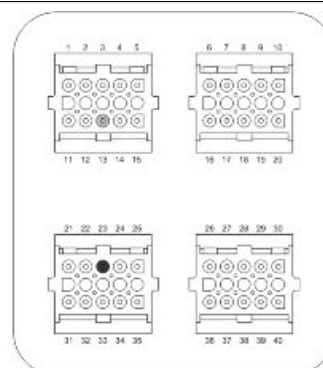
Specific tooling

020481Y Control unit interface wiring

15 - Arrange a multimeter with positive prod on pin 13 and negative prod on pin 23. Set the switch to "ON" with switch to "RUN" and side stand raised. Check the presence of battery voltage during the fuel pump timing.

13 - 23 = battery voltage for 2 seconds.

YES go to 16 NO go to 17



16 - The injector electric circuit is steady Repeat the checks. If the fault persists, check the control unit connector. If necessary, replace the electronic control unit.

17 - Repeat the test using the resistance multimeter. Check the resistance between pin 13 and pin 87 (black/green cable) of the injection load remote control.

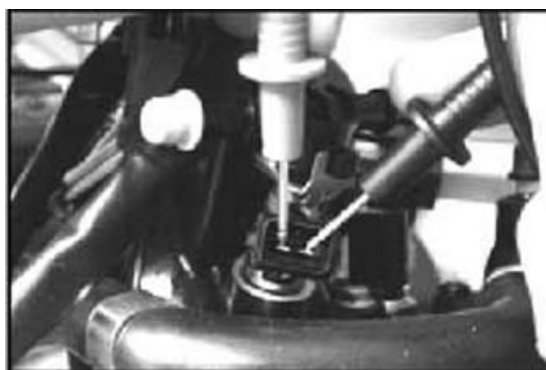
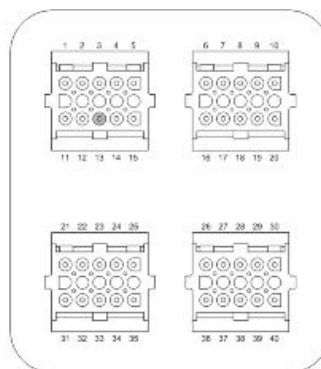
13 - black/green = $14.5\Omega \pm 5\%$ (resistance of the injector)

YES go to 19 NO go to 18

18 - No continuity. Disconnect the connector and repeat the resistive check directly at the injector terminals.

Resistance = $14.5\Omega \pm 2\%$

YES go to 21 NO go to 22



19 - Check the earth insulation of the injector negative line. Disconnected control unit and injector connectors.

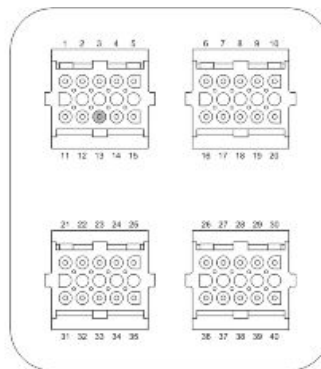
13 - 23 = Ω infinite

NO go to 20

20 - Repair or replace the cable harness.

21 - Check the continuity between the injector power supply connector (red - yellow) and pin 13. Restore the continuity, if required, or replace the wiring.

22 - Replace the injector.



Inspecting the injector hydraulics

To check the injector it is advisable to remove the intake manifold along with throttle body and injector.

The injector should be removed from the manifold only if necessary.

For these operations, see the "thermal group and timing system" chapter

1 - Connect the diagnostic tester. Use the socket in the under-saddle compartment.

Install the fuel pressure check kit special tool.

In this case, the injector can be connected directly to the tool quick couplings.

AHEAD go to 2

Specific tooling

020680Y Diagnosis Tool

020480Y Petrol pressure check set

2 - Prepare a graduated container with minimum capacity of 100 cm³ and a resolution of 10-20 cm³. Connect the injector to the wire supplied with the injection tester. The wire is provided with alligator clips for direct connection to the battery.

Prepare an auxiliary battery.

Set the switch to "**ON**" with switch to "**RUN**" and stand raised.

Select the "active diagnosis" function.

Start the pump diagnosis.

During the first 30 seconds of pump diagnosis, power the injector by the wire and the auxiliary battery for 15 seconds.

Collect the fuel delivered by the injector into the graduated container.

Power supply pressure = 300 kPa (3 BAR)

Quantity delivered = approx. 40 cm³

YES go to 3 NO go to 4



3 - Perform the injector sealing test.

Dry the injector outlet with a blast of compressed air. Activate the fuel pump. Wait for one minute, making sure there are no leaks coming from the injector. Slight oozing is normal.

Value limit = 1 drop per minute

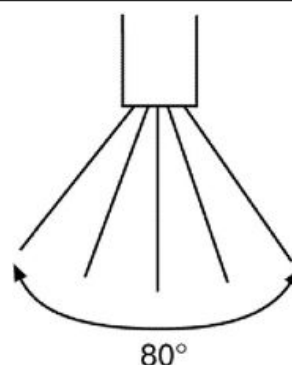
YES go to 5 NO go to 6

**4 - Higher quantities are not expected.**

For lower quantities, replace the injector (THERMAL GROUP AND TIMING SYSTEM).

5 - The injector is conforming.**6 - Repeat the test. If the fault continues, replace the injector (THERMAL GROUP AND TIMING SYSTEM)**

The injector atomisation cannot be checked by simple methods. The injector is provided with 5 holes whose angulation forms a jet with a taper of about 80°. The jet thus formed impinges both intake valves.

**N.B.**

- AN INJECTOR WITH LOW FLOW RATE AFFECTS THE MAXIMUM PERFORMANCE.
- AN INJECTOR WITH POOR SEAL AFFECTS IDLING AND THE START-UP FEATURES AFTER A SHORT STOP WITH HOT ENGINE.
- IN CASE OF CLOGGING OF THE INJECTOR, IT IS NECESSARY TO REPLACE IT, ALONG WITH THE FUEL FILTER CONTAINED IN THE TANK. CAREFULLY CLEAN THE SYSTEM AND THE TANK.

Troubleshooting

1 - A failure of the EMS system is more likely to be due to the connections than to the components.

Before searching the EMS system for failures, perform the following checks:

SUGGESTION FOR TROUBLESHOOTING

	Specification	Desc./Quantity
1	Electrical power supply	- Battery voltage - Burnt fuse - Remote control switches - Connectors
2	Fuel supply	- Faulty fuel pump - Dirty fuel filter
3	Ignition system	- Faulty spark plug - Faulty coil
4	Intake circuit	- Faulty screened cap - Dirty air filter

Specification		Desc./Quantity
5	Other	- Dirty by-pass circuit - Faulty Stepper motor
		- Wrong distribution timing - Wrong idle speed carburetion - Wrong reset of the throttle valve position sensor

2 - Failures to the EMS system may depend on loosened connectors. Make sure that all connections are properly implemented.

Check the connectors being careful of the following: check that terminals are not bent and that connectors have been connected up properly.

Check whether the failure changes if the connector is slightly vibrating.

3 - Before replacing the EMS control unit, check the whole system carefully.

If the fault is fixed by replacing the EMS control unit, install the original control unit again and check whether the fault occurs again.

4 - For troubleshooting, use a multimeter with an internal resistance of more than 10KΩ/V.

Improper instruments may damage the EMS control unit.

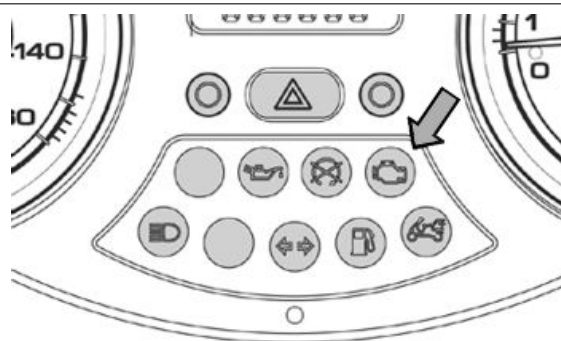
The instruments to be preferred have a definition of more than 0.1V and 0.5Ω and an accuracy of more than ± 2%.

Immobiliser circuit

The EMS system is integrated with the immobiliser anti-theft device.

Its functions are:

- Start-up enabled by key recognition.
- Deterrent flashing.



System components

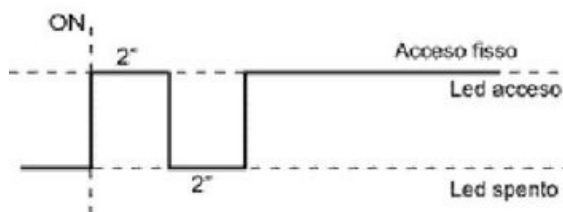
The system consists of:

- EMS system control unit
- Decoder
- Aerial
- master key (brown)
- service key (black)
- Deterrent and diagnosis LED

Virgin circuit

When control unit (ECU) and decoder are not programmed, the following conditions occur:

- Key switch set to "OFF". Deterrent flashing inactive.
- Key switch set to "ON". Ignition and injection disabled and LED on with solid light.



When the key switch is set to "ON", the LED switches on as shown in the figure.

The LED is turned on by the decoder.

The control unit data can be checked by the diagnostic tester.

Specific tooling

020680Y Diagnosis Tool

To connect the diagnostic tester, open the spark plug inspection port and pull out the EMS Diagnosis socket. Remove the protection cap and connect the tester terminal.

Power the diagnostic tester by connecting the terminals to the battery poles, or the specific connector to the socket inside the gloves compartment.

Set the switch to "ON" and select the diagnostic tester menu to the immobiliser function.

Scroll the pages to display the control unit data.



N.B.

AN UNPROGRAMMED SYSTEM CANNOT BE DETECTED UPON FIRST FITTING, OR IN CASE THE DECODER AND THE CONTROL UNIT ARE REPLACED CONCURRENTLY.

The information will be as follows:

Unprogrammed control unit «ON»

Start-up disabled «ON»

Key number Zero > 250

Setting the circuit

The electronic ignition system is controlled by the control unit with the integrated Immobilizer system. The immobilizer is an anti-theft system that allows the vehicle to be operated only when it is started with coded keys recognised by the control unit. The code is integrated in a transponder in the key block.

This allows the driver clear operation without having to do anything other than just turning the key. The Immobiliser system consists of the following components:

- electronic control unit
- decoder
- immobilizer aerial
- master key with integrated transponder (brown key)
- service key with incorporated transponder (black key)
- HV coil
- diagnosis LED

The diagnosis LED also works as a theft-deterrent blinker. This function is activated every time the ignition switch is turned to the "OFF" position, or the emergency stop switch is turned to the "OFF" position. It remains activated for 48 hours in order not to affect the battery charge. When the ignition switch is turned to the "ON" position, the theft-deterrent blinker function is deactivated. Subsequently, a flash confirms the switching to the "ON" status. The duration of the flash depends on the programming of the electronic control unit. If the LED is off regardless of the position of the ignition-key switch and/or the instrument panel is not initiated, check if:

- there is battery voltage
- efficiency of fuse No. 7
- there is power to the control unit as specified below:

Disconnect the connector from the control unit. Check the following conditions:

With the key switch set to OFF:

- Battery voltage between terminals 17-23 and terminals 17-chassis ground (continuous power supply). If there is no voltage, check that fuse No. 6 is in good conditions.

With the key switch in position ON and the engine stop switch in RUN:

- Battery voltage between terminals 26-23 and terminals 26-chassis ground (continuous power supply). If there is no voltage, check:

1. that fuses No. 11 and No. 2 and their wirings are in good conditions.

2. that the engine stop remote control switch is in good conditions.

- Check for voltage on the white-black cable at the exit from the engine stop remote control switch. If there is no voltage, check:

1. key switch contacts

2. the condition of the engine stop switch, then the ground connection of the green/black cable of the engine stop remote control switch with the stand lifted and the engine stop switch in the RUN position.

3. that the engine stop remote control switch diode is in good conditions.

If no fault is found, replace the control unit.

N.B.

AN ACCIDENTAL LOSS OF THE SERVICE KEY PROGRAMMING CAN ARISE FROM GENERAL FAULTS OF THE IGNITION SYSTEM. IN THIS CASE, CHECK THE HV LINE SHIELDING.

In any case it is advisable to use resistive spark plugs.

LED signals

When the ignition system is not encrypted, any key will start the engine but limited to 2000 rpm. The keys can only be recognised when the decoder has been correctly programmed. The procedure for programming a new decoder requires the recognition of the "master" key as the first key to be programmed: this is particularly important as it is the only key that allows the decoder to be reset and reprogrammed for programming the service keys.

The master and service keys must be used to code the system as follows:

- Insert the Master key, turn it to «ON» and keep this position for two seconds (lower and upper limits 1 to 3 seconds).
- Insert the service key and turn it to «ON» for 2 seconds.
- If you have copies of the key, repeat the operation with each key.
- Insert the MASTER key again and turn it to «ON» for 2 seconds.

The maximum time to change keys is 10 seconds.

A maximum of 7 service keys can be programmed at one time.

It is essential to adhere to the times and the procedure. If you do not, start again from the beginning.

Once the system has been programmed, master key transponder, decoder and control unit are strictly matched. With this link established, it is now possible to encode new service keys, in the event of losses, replacements, etc. Each new programming deletes the previous one so, in order to add or eliminate keys, you must repeat the procedure using all the keys you intend to keep using.

If a service key becomes uncoded, the efficiency of the high voltage circuit shielding must be thoroughly inspected: In any case it is advisable to use resistive spark plugs.

Characteristic

MASTER key:

BROWN KEY

SERVICE key.

BLACK KEY

Checking master-box data

Connect the diagnostic tester.

Set to «ON» and select the immobilizer function.

Scroll the pages the find the data.

Specific tooling

020680Y Diagnosis Tool



The information will be as follows:

- Unprogrammed control unit «OFF»
- Start-up disabled «OFF»
- Number of keys 2*

*The number denotes how many keys have been used for programming, master key included.

Resetting the circuit

1 Replacing the small cylinder

- Remove the original master key transponder and install it on the master key of the new cylinder.
- Program the system again as described above.

2 Decoder replacement

When the decoder is replaced it is necessary to program the system again.

Programming is indispensable for the engine start-up. (see System programming).

3 Control unit replacement

Programming is indispensable when the control unit is replaced to enable the engine start-up.

In this case it is sufficient to switch to "ON" using the master key.

N.B.

- **THE SERVICE KEY (BLACK-COLOURED) IS NOT USED FOR PROGRAMMING.**
- **WHEN NOT PROGRAMMED, THE CONTROL UNIT ALLOWS NO FUNCTIONAL DIAGNOSIS ON THE ENGINE.**

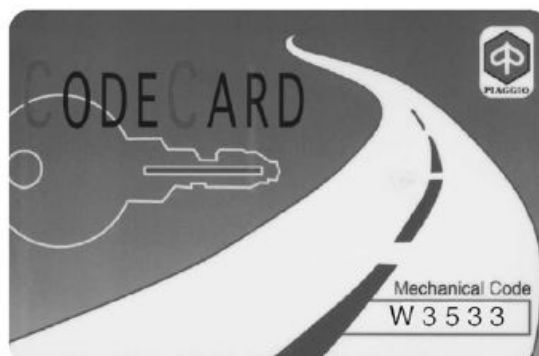
4 Replacing or duplicating service keys

Keys can be duplicated using the blank keys and the original master key.

A copy may also be requested using the scooter CODE CARD.

Program the system again using the master key and all service keys (see System programming).

N.B.



THE CODE CARD CAN ONLY BE USED WHEN THE ORIGINAL MASTER KEY IS AVAILABLE.

Diagnostic codes

The immobiliser system is tested each time the ignition-key switch is turned from OFF to ON. During this diagnosis phase a number of control unit statuses can be seen and various light codes displayed. Regardless of the code transmitted, if at the end of the diagnosis the led remains off permanently, the ignition is enabled. If, however, the led remains on permanently, it means the ignition is inhibited:

1. New decoder - key inserted: a single 2 second flash is displayed, after which the LED remains off permanently. The keys can be stored to memory, the vehicle can be started but with a limitation imposed on the number of revs.

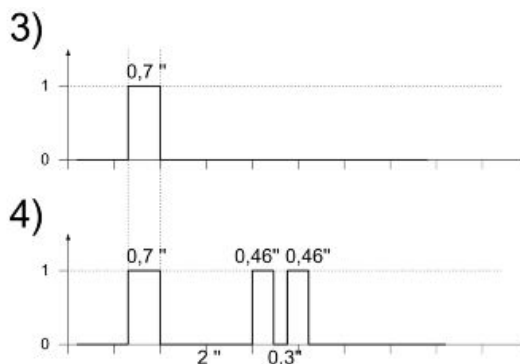
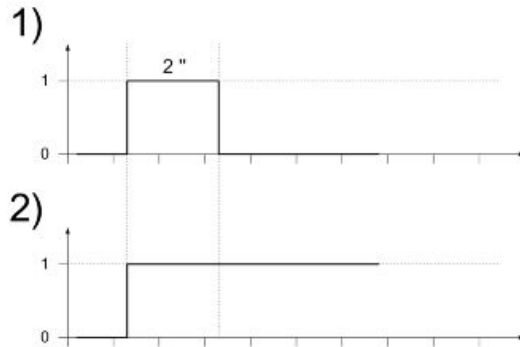
2. New decoder - transponder missing or illegible: The LED is permanently ON; in this condition, no operations are possible, including starting of the vehicle.

3. Decoder programmed - service key inserted (normal operating condition): a single 0.7-second flash is displayed, after which the LED remains off steadily. The engine can be started.

4. Decoder programmed - master key inserted: a 0.7-sec flash is displayed followed by the LED remaining off for 2 sec. and then by short 0.46-sec flashes the same number of times as there are keys stored in the memory including the Master key. When the diagnosis has been completed, the LED remains permanently OFF. The engine can be started.

5. Decoder programmed - fault detected: a light code is displayed according to the fault detected, after which the LED remains on steadily. The engine cannot be started. The codes that can be transmitted are:

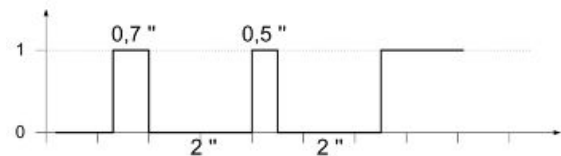
- 1-flash code



- 2-flash code
- 3-flash code

Code 1

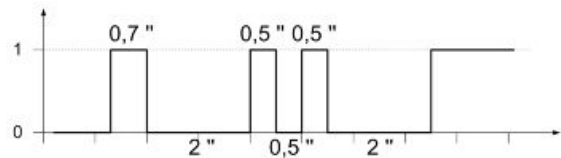
A one-flash code indicates a system where the serial line is not present or is not detected. Check the Immobiliser aerial wiring and change it if necessary.



Code 2

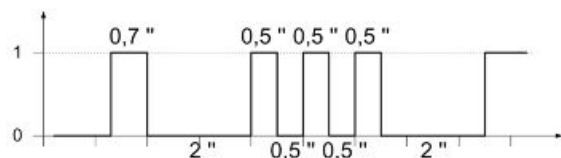
A 2-flash code indicates a system where the decoder does not recognise the transponder signal. This might depend on the inefficiency of the immobiliser aerial or the transponder.

Turn the switch to ON using several keys: if the code is repeated even with the Master key, check the aerial wiring and change it if necessary. Otherwise replace the faulty key and/or reprogram the decoder. If the problem persists, replace the decoder.



Code 3

The 3-flash code indicates a system where the decoder does not recognise the key. Turn the switch to ON using several keys: If the error code is repeated even with the Master key, replace the decoder. If this is not the case, reprogram the decoder.



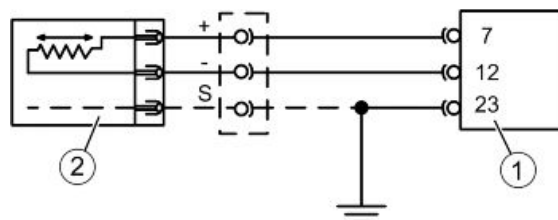
Tachometer

Electric characteristic

TERMINAL: 7 - 12

CONDITIONS : Start-up speed

STANDARD: approx. 0.8 - 4.5 V



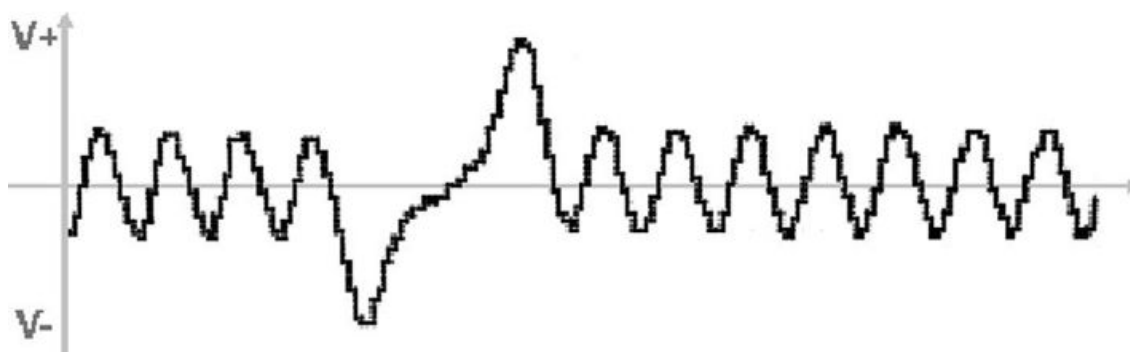
CIRCUIT LAYOUT

	Specification	Desc./Quantity
1	Electronic control unit	
2	Engine rpm sensor	

The sensor allows the rotations and the angular position of the crankshaft to be recognised by reference to the TDC. Since the wheel speed sensor is pivoted on the camshaft it is also possible to recognise the 4-stroke cycle. Such solution allows controlling the injector and the spark plug every two revolutions of the crankshaft.

The sensor is of the reluctance variation type and is therefore comparable to an alternate current generator that powers the control unit.

The signal frequency is interrupted by the vacuum generated by the two missing teeth on the wheel speed sensor.

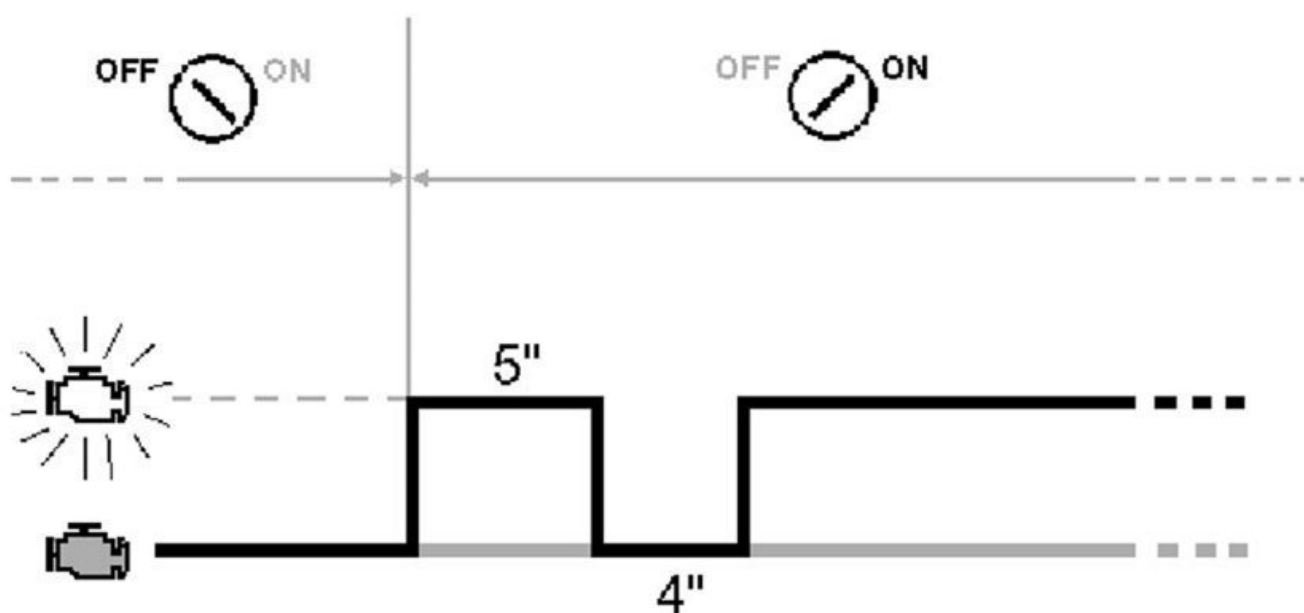


The sensor signal is fundamental for obtaining starting of the engine.

The ECU self-diagnosis is enabled on this circuit in 2 different ways based on use conditions.

Right after turning to «ON» (Power under the panel present in the CPU), the continuity and isolation of the sensor and related circuit are checked.

Any faults discovered in this phase are signalled via the injection telltale light.



The fault continues to be signalled, but the circuit is only checked when turning to "ON". Therefore faults which occur or disappear after turning to "ON" are not acknowledged.

During and after the start phase, the self-diagnosis checks the alternating current produced by the sensor (synchronisation of the signal panel).

If a signal panel is detected which is not perfectly synchronised, corrective interventions are applied used to reconstruct the cycle. In this case the self-diagnosis records the number of lost synchronisations and signals the fault via the injection telltale light.

The light remains on during the period the cycle is reconstructed.

If the rpm-timing signal is completely missing due to mechanical faults or lack of magnetic activity, it will be impossible to start the engine (or it will stop while driving) and the self-diagnosis will not be able to record any faults.

To check the sensor and related circuit, proceed as follows:

1 - Connect the scooter tester.

Select the function "**ERRORS**" in the menu.

Check for any faults on the «**Signal panel**».

YES go to 2 NO go to 3

Specific tooling

020680Y Diagnosis Tool

2 THE FAULT HAS BEEN RECORDED IN MEMORISED STATUS:

The signal panel may be synchronised with possibility of starting. The fault is probably occasional.

N.B.

A NON-CONFORMING SIGNAL PANEL FAULT MAY ALSO BE DETECTED IF THE ENGINE STOPS AFTER A FAULT INVOLVING IDLING.

THE FAULT HAS BEEN RECORDED IN CURRENT STATUS:

The control circuit gave a negative result when switching to "ON".

AHEAD go to 8

3 Select the "**PARAMETERS**" function on the menu.

Check the number of «lost synchronisations»:

1 TOOTH and > 1 TOOTH

YES go to 4 NO go to 5

4 THE INDICATION INCREASES PROGRESSIVELY OVER TIME WITH THE ROTATION OF THE ENGINE.

AHEAD go to 8

5 INDICATION = 1-3

THE RPM-TIMING CIRCUIT IS IN COMPLIANCE.

Make an attempt to start and use the parameters function to check for the «engine revs» indication.

YES go to 6 NO go to 7

6 The signal panel is in conformance.

7 CHECK THE AIR GAP AND MAGNETIC ACTIVITY OF THE SENSOR.

See engine mechanics.

8 Check the sensor and related connection circuit with the control unit.

AHEAD go to 9

9 Install the connection wiring between the control unit and injection system. Do not make the connection with the control unit.

CONTINUE at 10

Specific tooling**020481Y Control unit interface wiring**

10 Install the connection connector between the rpm timing sensor and injection system.

Measure the sensor resistance by connecting a multimeter between the terminals marked + and - (see the "Electrical system" chapter).



RESISTANCE OF THE RPM TIMING SENSOR: (AT 25°C)

	Specification	Desc./Quantity
1	Model with 1 clamp:	860 $\Omega \pm 130 \Omega$
2	Model with 2 clamps:	680 $\Omega \pm 100 \Omega$

YES go to 11 NO go to 12



11 - Check the earth isolation between a pole and the shielding.

(see the «Electrical system» chapter).

Electric characteristic

S - + =

infinite ($>M\Omega$)

YES go to 13 NO go to 12



12 - Replace the revolution sensor.

13 - Reconnect the rpm-timing sensor connector.

Repeat the resistance check through the injection wiring pin 7, pin 12.

Electric characteristic

7-12 =

680 $\Omega \pm 100 \Omega$ (Model with 2 clamps)

7-12 =

890 $\Omega \pm 130 \Omega$ (Model with 1 clamp)

The value should be very close to that detected directly by the sensor.

YES go to 17 NO go to 14

14 - Higher or infinite resistance.

YES go to 15 NO go to 16



15 - Check the connectors carefully. Disconnect and check the continuity between connector and pin 7-12

Electric characteristic

Connector - 7 =

Continuity

Connector - 12 =

Continuity

Fix the connectors or replace the cable harness.

Electric characteristic

Resistance

0

16 Repair or replace the injection wiring (short circuit)

17 - Check the earth insulation again.

Electric characteristic

7-23 =

infinite ($>1M\Omega$)

YES go to 19 NO go to 18

18 - Check the sensor and control unit connectors.

Repair or replace the injection wiring

19 - Measure the alternated voltage between pins 7 and 12 with engine at start-up speed.

Electric characteristic

7-12 =

approx. 0.8 - 4.5 V eff

Revolution speed =

approx. 300-400 rpm

YES go to 20 NO go to 21

20 The sensor circuit is in conformance.

Use the parameter function to check if the engine rpm indication is present when trying to start.

If not, carefully check the ECU connection connector and replace it if necessary.

21 Check the air gap and magnetic activity of the sensor.

See the "Combustion unit and distribution" chapter.

If there is no magnetic activity replace the sensor.

N.B.

-THE SENSOR CABLE MUST BE PROPERLY INSTALLED FOR SERVICING.

-DO NOT FORCE THE CABLE.

-A POOR CABLE SHIELDING CAN IMPAIR THE ENGINE PERFORMANCE AT HIGH SPEED.



HT coil

This section describes the ignition system operation.

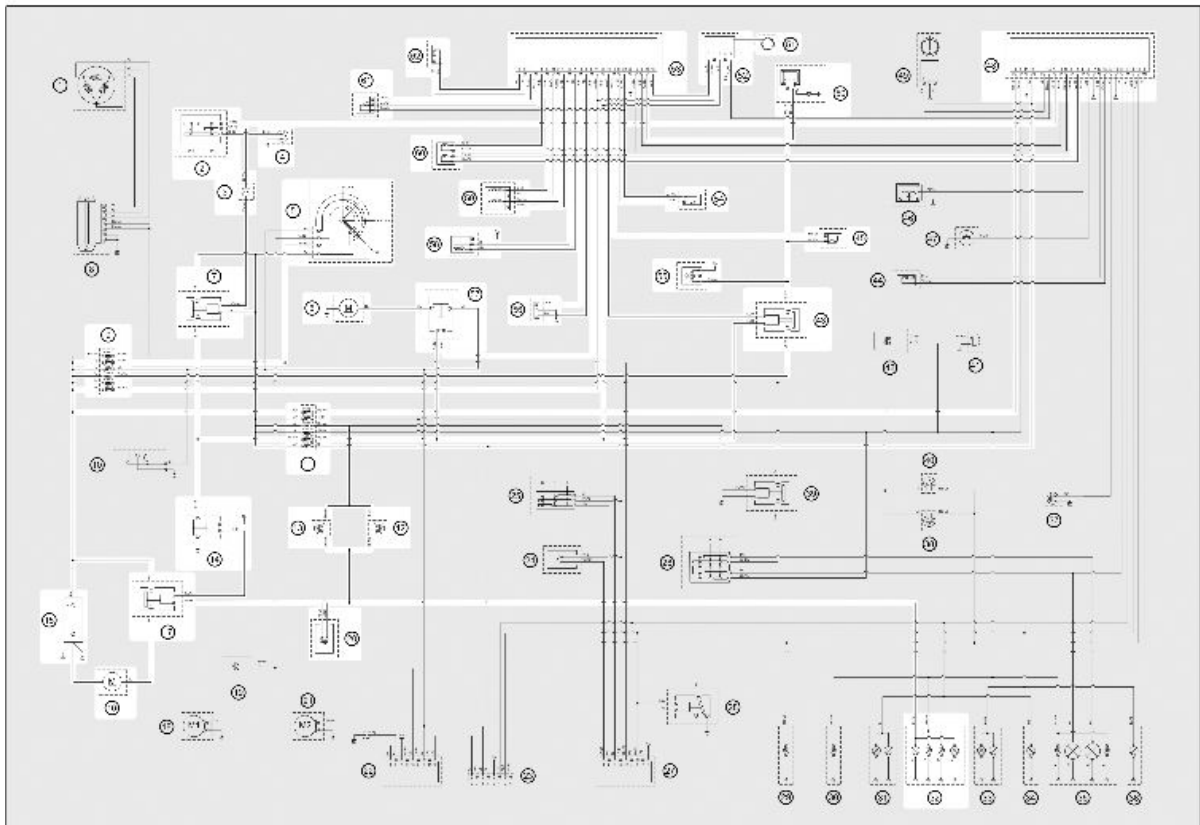
Circuit diagram

Electric characteristic

TERMINALS: 20 - 23

CONDITIONS : During the pump timing with engine off.

STANDARD: Battery voltage



KEY:

- 2. Engine stop switch
- 3. Diode
- 4. Side stand button
- 5. Key switch
- 6. Electric fan
- 7. Engine stop remote control switch
- 9. Main fuses
- 11. Auxiliary fuses
- 12. Stop button on front brake
- 13. Stop button on rear brake
- 14. Immobiliser remote control switch

- 15. 12V-12Ah Battery
- 16. Starter motor
- 17. Start-up remote control switch
- 20. Starter button
- 32. Rear light
- A. Stop light bulbs
- 43. Injection load remote control
- 45. Fuel injector
- 48. Instrument panel
- 50. HV coil
- 51. Immobilizer aerial
- 52. Decoder
- 53. Injection ECU
- 54. Intake air temperature sensor
- 55. Fuel pump
- 56. Diagnosis connector
- 57. Electric fan remote control
- 58. Engine rpm sensor
- 59. Stepper motor
- 60. Engine temperature sensor
- 61. Throttle valve potentiometer
- 62. Lambda probe

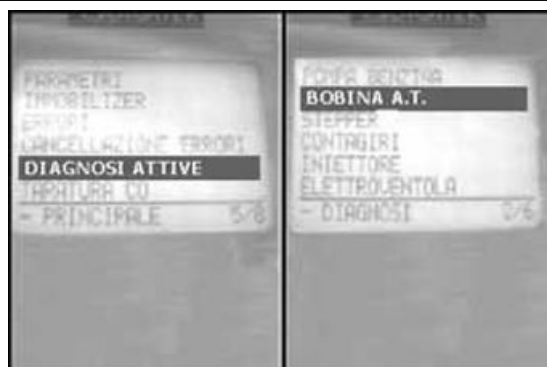
The ignition system is integrated with the injection and it is a high-efficiency inductive type ignition. The control unit manages two important parameters:

- Ignition advance

This is optimised according to the engine rpm, to the engine load, temperature and ambient pressure

With idle engine, it is optimised to obtain the stabilisation of the speed at 1450 ± 50 R/1'. - Magnetisation time

The coil magnetisation time is controlled by the control unit. The ignition power is increased during the engine start-up.



The injection system recognises the 4-stroke cycle and therefore, ignition is only controlled during compression.

To check the ignition circuit, proceed as follows:

1 - Connect the diagnostic tester. Select the menu on the "ACTIVE DIAGNOSIS" function. Start the HV coil check with switch set to «ON», switch to «RUN» and side stand raised. Wait for the tester to display: "TEST SUCCESSFUL"

YES go to 3 NO go to 2

Specific tooling

020680Y Diagnosis Tool

2 - The tester displays: «TEST FAILED». Repeat the test and wait for the tester to display: «TEST SUCCESSFUL»

YES go to 3 NO go to 4

3 - Select the menu on the "ERRORS" function. Check the presence of current or stored errors relating to the HV coil.

YES go to 6 NO go to 5

4 - Test failed

YES go to 6

5 - The coil control circuit is efficient.

Check the HV coil secondary, the cable and the shielded cap.

6 - Install the special tool between the injection system and the control unit.

Measure voltage of the specific tool between pins 20 and 23 during the timing phase of the fuel pump.

To start the timing, set the switch to «ON» with switch to «RUN» and side stand raised.

Electric characteristic

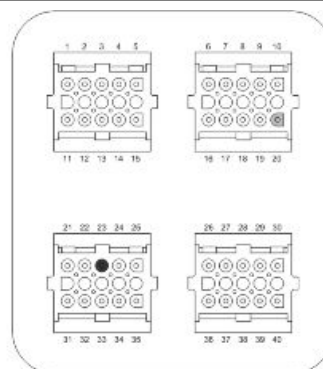
20-23 =

Battery voltage (coupled to the pump rotation -2 seconds).

If you want to increase the test time, enable the "pump relay diagnosis" function (30 seconds)

YES go to 7 NO go to 8

7 - The coil primary control circuit is efficient.



Carefully check the connectors to the control unit and to the coil.

Replace the control unit, if necessary.

8 - Disconnect the connector to the HV coil primary.

Repeat the voltage check between the black-green wire and earth.

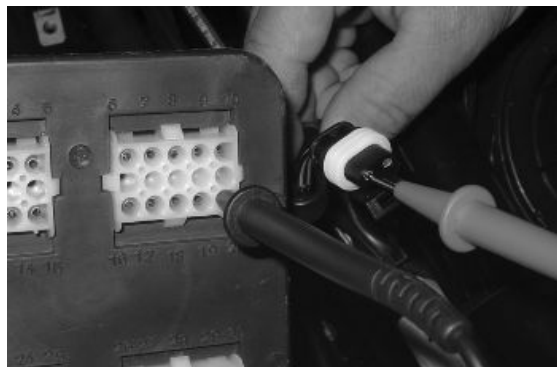
Electric characteristic

Black-green-23 =

battery voltage

(coupled to the pump rotation-2 seconds).

YES go to 10 NO go to 9



9 - Check the black-green wire continuity.

Repair or replace the cable harness.

N.B.

A FAILURE OF THE REMOTE CONTROL SWITCH WOULD CAUSE THE PUMP ROTATION FAILURE

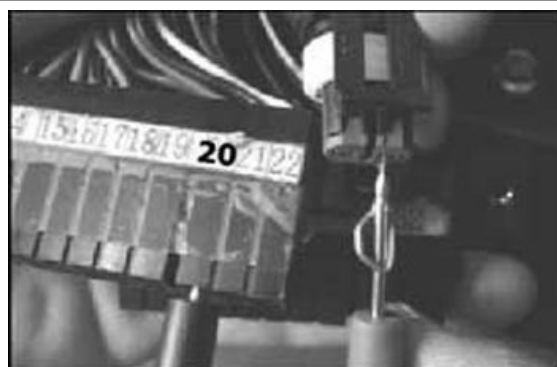
10 - The positive power supply is conforming. Check the continuity between the pink-black wire of the connector and pin 20.

Electric characteristic

Pink-black-20 =

Continuity

YES go to 12 NO go to 11



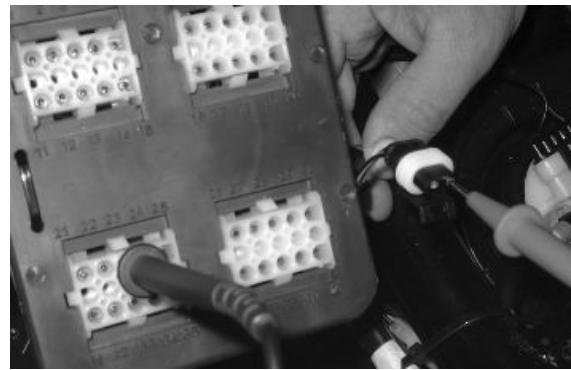
11 - Check the continuity of the pink-black wire in the two systems.

Electric characteristic

Pink-black (coil connector)-20 =

Continuity

YES go to 12 NO go to 13



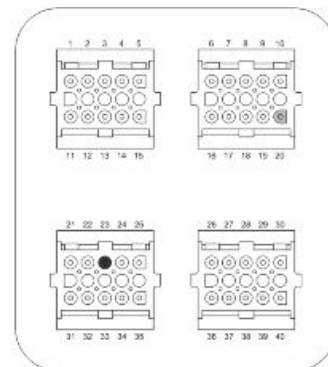
12 - Check the earth insulation of the negative line.

Electric characteristic

20-23 =

Ω infinite ($>1M\Omega$)

YES go to 15 NO go to 14



13 - Repair or replace the faulty system. Repeat the check with the menu on «ACTIVE DIAGNOSIS».

14 - Repeat the earth insulation check in the two sections. Repair or replace the cable harness. Repeat the check with the menu on «ACTIVE DIAGNOSIS» HV coil control simulation. Delete the errors stored in memory.

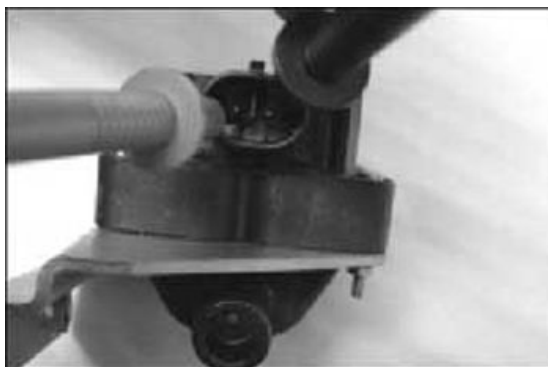
15 - Check the continuity of the HV coil primary between pin 20 of the interface wiring and the black-green cable of the injection load remote control base with both the control unit and the remote control switch disconnected.

Electric characteristic

Primary resistance =

$0.5 \pm 8\% \Omega$

YES go to 16 NO go to 19



16 - Check the earth insulation of the primary circuit
Measure between one of the primary terminals and earth.

Electric characteristic

Primary-earth =

Ω infinite ($>1M\Omega$)

YES go to 17 NO go to 19



17 - Check the secondary resistance.
Measure the resistance between one of the primary terminals and the spark plug cable output

Electric characteristic

Primary HV cable output =

$3.1 \pm 9\% K \Omega$

YES go to 18 NO go to 19



18 - The coil is conforming.

19 - Replace the coil

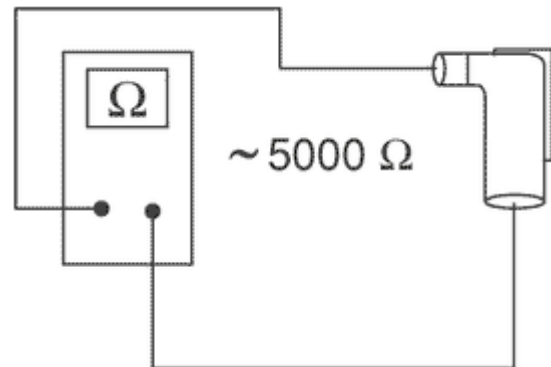
Inspecting the spark plug shielded cap

Measure the shielded cap resistance.

Electric characteristic

Resistance:

5 K Ω



If different values are measured (<1; >20K Ω), replace the shielded cap.

N.B.

A SHIELDLESS CAP OR SPARK PLUG CAN ADVERSELY AFFECT THE INJECTION SYSTEM. FOR INFORMATION ON THE SPARK PLUG, SEE THE «SPECIFICATIONS» AND «MAINTENANCE» CHAPTERS.

Spark advance

The ignition advance is determined electronically on the basis of parameters known by the control unit.

For this reason it is not possible to interpret the reference values based on the engine rpm.

The ignition advance value is detectable at any time using the diagnostic tester.

It is possible to check whether the ignition advance determined by the injection system matches the value actually activated on the engine, by means of the stroboscopic light.

Specific tooling

020680Y Diagnosis Tool

020330Y Stroboscopic light to check timing

Proceed as follows:

- Remove the transmission compartment cover as described in the "automatic transmission" chapter.



-
- Remove the TDC reference inspection cap between flywheel and crankcase cover. See the "fly-wheel cover" chapter



-
- By the driving pulley, turn the engine to find the alignment of the references to identify the TDC.



-
- Repeat for the reference between driving pulley and engine crankcase.



-
- Refit the inspection cap on the flywheel side.
 - Connect the diagnostic tester.
 - Start the engine.
 - Select the «parameters» function in this menu.
 - Select the stroboscopic light control in the traditional four-stroke engine position (1 spark, 2 revs).
 - Check that the real values of rpm and ignition advance match those measured using the diagnostic tester.



If the values do not match, check:

- distribution timing
- revolution timing sensor
- injection control unit

Coolant temperature sensor

Electric characteristic

TERMINALS: 4 - 22

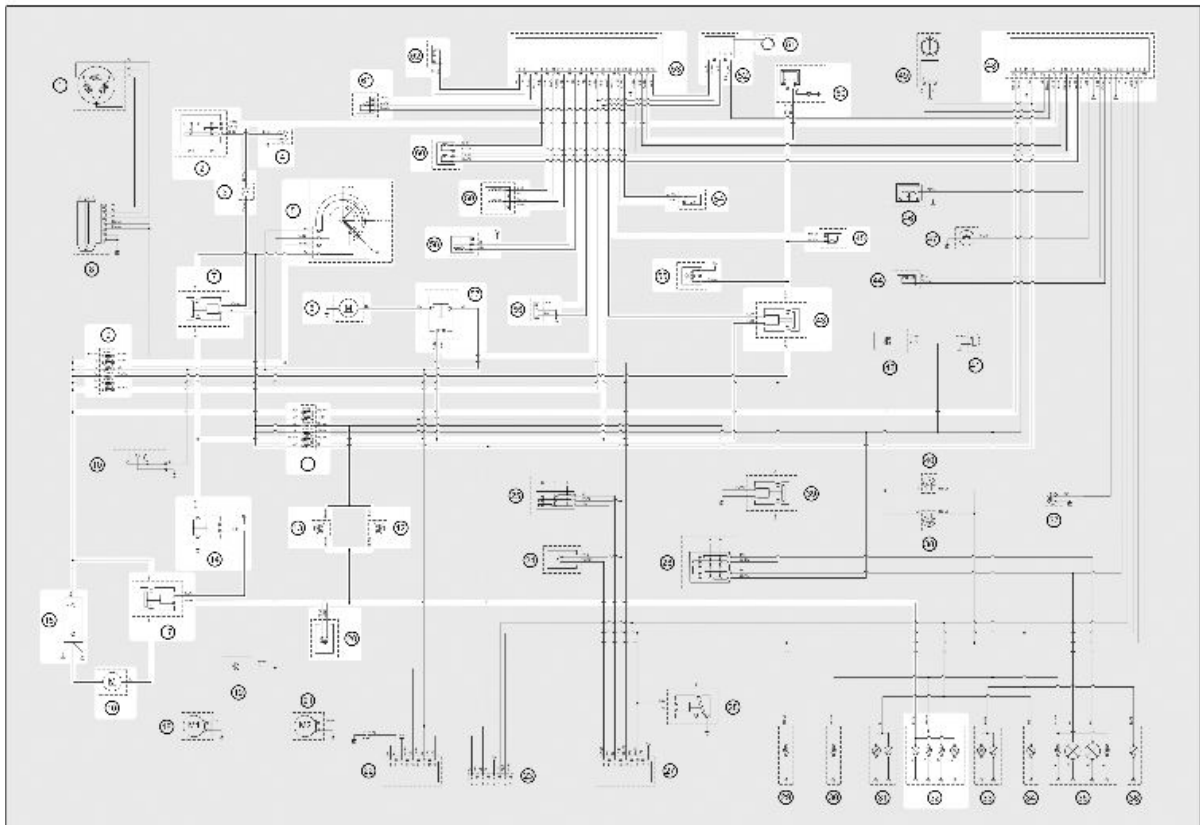
CONDITIONS : coolant temperature

STANDARD:

With connected sensor:

20° = $2500 \pm 100 \Omega$

80° = $308 \pm 6 \Omega$



KEY:

- 2. Engine stop switch
- 3. Diode
- 4. Side stand button
- 5. Key switch
- 6. Electric fan
- 7. Engine stop remote control switch
- 9. Main fuses
- 11. Auxiliary fuses
- 12. Stop button on front brake
- 13. Stop button on rear brake
- 14. Immobiliser remote control switch

- 15. 12V-12Ah Battery
- 16. Starter motor
- 17. Start-up remote control switch
- 20. Starter button
- 32. Rear light
- A. Stop light bulbs
- 43. Injection load remote control
- 45. Fuel injector
- 48. Instrument panel
- 50. HV coil
- 51. Immobilizer aerial
- 52. Decoder
- 53. Injection ECU
- 54. Intake air temperature sensor
- 55. Fuel pump
- 56. Diagnosis connector
- 57. Electric fan remote control
- 58. Engine rpm sensor
- 59. Stepper motor
- 60. Engine temperature sensor
- 61. Throttle valve potentiometer
- 62. Lambda probe

The coolant temperature sensor is installed on the engine head and provides the indications for the digital instrument and for the injection.

It is realised with two electrically different sections.

The injection section is realised with an NTC sensor connected to a 5V powered circuit. The resistance variation causes a variation of the circuit voltage. Such voltage is combined with a temperature value. By this value, the control unit can manage the engine operation, optimising it for all temperatures.

A failure of this circuit causes the switching on of the injection telltale light and the tripping of the safeties (among which the electric fan continuous start). In these conditions, the engine works, even though not in an optimum way, always safeguarding the catalytic converter integrity.

A false temperature value that falls within the range of possible temperatures is a failure very difficult to manage. This can cause a failure of the safeties and an improper management of the ignition. Such failure is more easily detected upon the engine start-up.

To check the sensor and related circuit, proceed as follows:

1 - Connect the injection diagnostic tester and select the menu on the "errors" function.

Check whether faults have been recorded regarding the coolant temperature sensor.

YES go to 3 NO go to 2

Specific tooling**020680Y Diagnosis Tool**

2 - The EMS system has received no indications of temperatures out of the range of possible temperatures.

If you suspect a wrong temperature indication, proceed to perform the following check.

N.B.

**A WRONG TEMPERATURE SIGNAL CAN BE DETECTED BY COUPLING THE ANALOGUE INSTRUMENT INDICATION WITH THE ELECTRIC FAN START.
IN ANY CASE, BEFORE CHECKING THE SENSOR, CHECK THE FILLING AND BLEEDING OF THE COOLING SYSTEM**

3 - Before checking the sensor and the relevant circuit, wait until the engine has cooled down and the scooter has set to the working area temperature.

YES go to 4

4 - Set the switch to "ON" with switch to "RUN" and side stand raised. Select the menu on the "parameters" function. Do not start the engine.

YES go to 5

5 - Check the following values: coolant temperature intake air temperature ambient temperature The three indications are equal or they are slightly different (e.g. 1° C).

YES go to 6 NO go to 7

6 - The temperature sensor is providing probably correct information.

Check at approx. 80° C.

7 - Install the special tool.

WARNING

DO NOT CONNECT THE CONTROL UNIT CONNECTOR.

Specific tooling**020481Y Control unit interface wiring**

YES go to 8

8 - Disconnect the coolant temperature sensor connector. Measure the sensor resistance between the terminals shown in the figure.
Check that the resistance matches the values declared according to the temperature.

Electric characteristic**TEMPERATURE RESISTANCE**

9.6 Ω -10° C

5.975 Ω 0

3.81 Ω +10° C

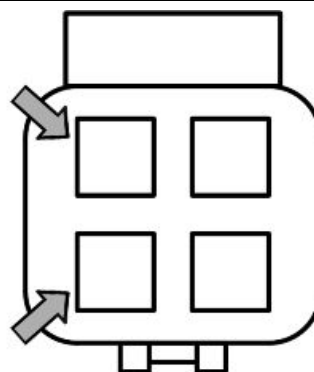
2.5 Ω +20° C

1.68 Ω +30° C

0.3 Ω +80° C

YES go to 10 NO go to 9

9 - Replace the sensor.



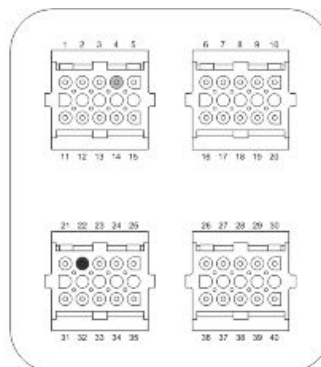
10 - Connect the sensor connector and repeat the resistive check at terminals 4 and 22;

Electric characteristic

4-22 =

Resistance equal to the value directly detected at the sensor.

YES go to 13 NO go to 11



11 - If slightly higher values are detected, check the connectors.

If infinite resistance is detected ($>1\text{M}\Omega$), check the continuity of the two lines with disconnected connectors.

Electric characteristic

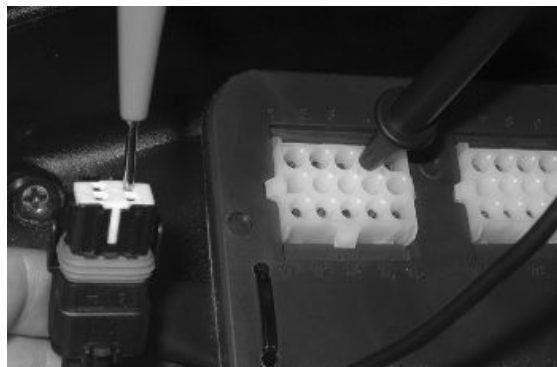
Blue-white-4 =

0 Ω (continuity)

Light blue/green-22 =

0 Ω (continuity)

YES point 12



12 - Repair or replace the cable harness.

YES go to 10

13 - Check that the sensor circuit is earth insulated.

Electric characteristic

4-23 =

Ω infinite ($>1\text{M}\Omega$)

22-23 =

Ω infinite ($>1\text{M}\Omega$)

YES go to 15 NO go to 14



14 - Repair or replace the wiring.

Check the air temperature lines and the throttle valve position.

YES go to 15

15 - Connect the special tool to the control unit.

Set the switch to "**ON**" with switch to "**RUN**" and side stand raised.

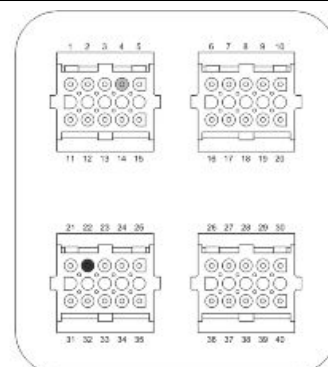
YES go to 16



Specific tooling

020481Y Control unit interface wiring

16 - Measure voltage at terminals 4 and 22;



TEMPERATURE VOLTAGE

	Specification	Desc./Quantity
1	X V	-10° C
2	X V	0
3	X V	+10° C
4	X V	+20° C
5	X V	+30° C
6	X V	+80° C

YES go to 21 NO go to 17

17

Repeat the wiring and sensor continuity checks.

YES go to 18

18

Electric characteristic

Measured value =0 Ω

Repeat the sensor and circuit earth insulation check.

YES go to 19 NO go to 20

19 - Check the control unit connector.

Check the control unit power supply.

Replace the control unit, if necessary.

20 - Repair or replace the cable harness.

21 - Start the engine and check that voltage decreases gradually according to the temperature increase as per table.

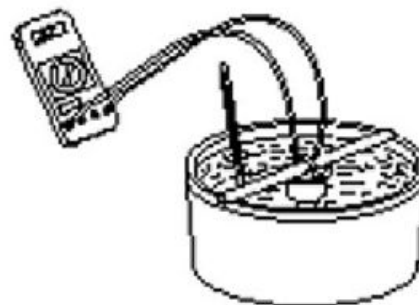
YES go to 22 NO go to 23

22 - The temperature signal is conforming.

23 - Replace the temperature sensor.

N.B.

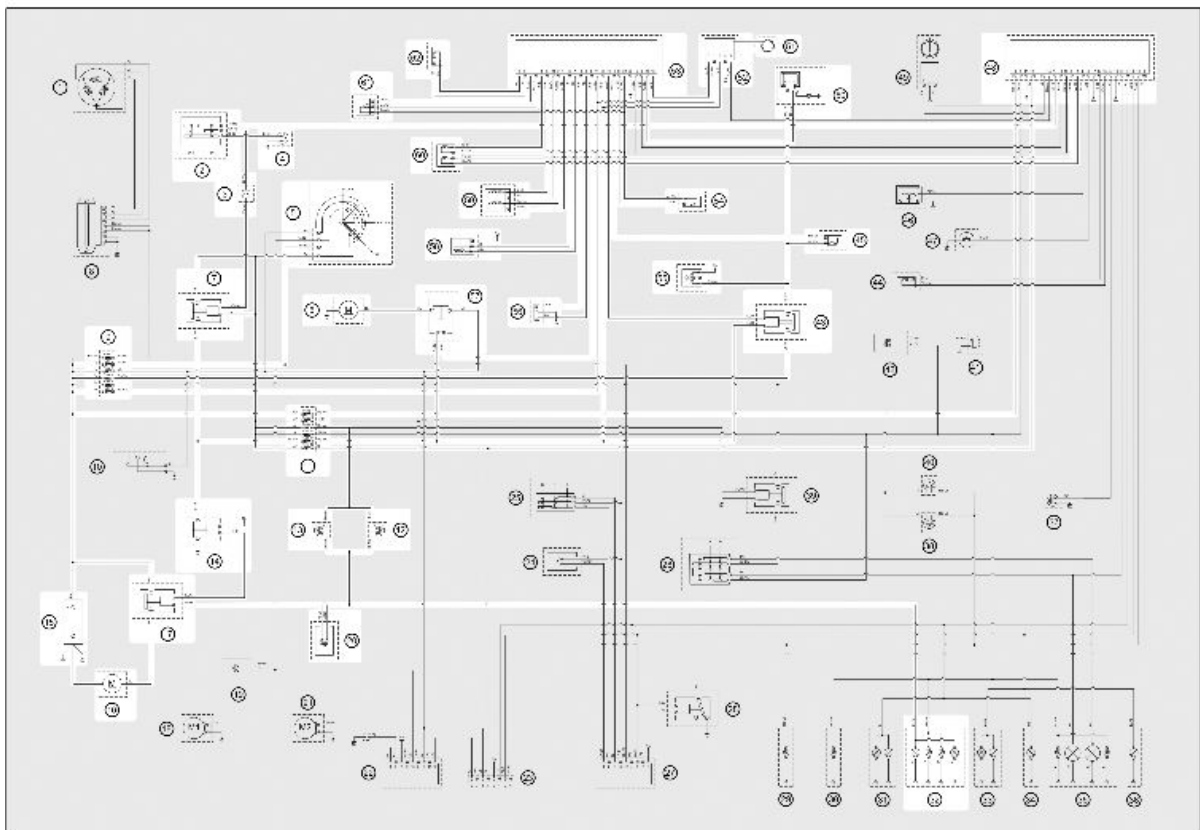
FOR A MORE ACCURATE CHECK OF THE SENSOR, REMOVE IT FROM THE ENGINE AND CHECK ITS RESISTANCE AT CONTROLLED TEMPERATURE. USING A SUITABLE CONTAINER, IMMERSE THE METAL PORTION OF THE SENSOR IN WATER, HEAT GRADUALLY AND READ THE TEMPERATURE AND RESISTANCE VALUES. CHECK THE MATCHING AS PER TABLE

**Intake air temperature sensor****Electric characteristic**

TERMINALS: 18 - 22

CONDITIONS: Intake air temperature 20°

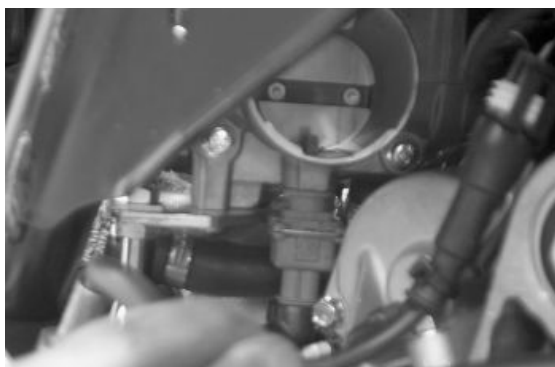
STANDARD: With connected sensor: 3750 $\pm$ 200 Ω

**KEY:**

- 2.** Engine stop switch
- 3.** Diode
- 4.** Side stand button
- 5.** Key switch
- 6.** Electric fan
- 7.** Engine stop remote control switch
- 9.** Main fuses
- 11.** Auxiliary fuses
- 12.** Stop button on front brake
- 13.** Stop button on rear brake
- 14.** Immobiliser remote control switch
- 15.** 12V-12Ah Battery
- 16.** Starter motor
- 17.** Start-up remote control switch
- 20.** Starter button
- 32.** Rear light
- A.** Stop light bulbs
- 43.** Injection load remote control
- 45.** Fuel injector

- 48. Instrument panel
- 50. HV coil
- 51. Immobilizer aerial
- 52. Decoder
- 53. Injection ECU
- 54. Intake air temperature sensor
- 55. Fuel pump
- 56. Diagnosis connector
- 57. Electric fan remote control
- 58. Engine rpm sensor
- 59. Stepper motor
- 60. Engine temperature sensor
- 61. Throttle valve potentiometer
- 62. Lambda probe

The intake air temperature sensor is installed on the bottom side of the throttle body on the filter box side.



This is NTC sensor and has the same functional layout as the coolant temperature sensor.

This signal is used to optimise the engine performance. Anyway, this data is less important than the coolant temperature signal.

A failure of this circuit causes the control unit to turn on the injection telltale light and activate the safety control, thereby ensuring the engine operation.

To check the sensor and related circuit, proceed as follows:

1 - Connect the diagnostic tester.

Select the function "ERROR" in the menu.

Check whether there are any indications regarding the intake air temperature sensor.



YES go to 3 NO go to 2

Specific tooling

020680Y Diagnosis Tool

2 - The EMS system has received no indications of temperatures out of the range of possible values. If you suspect a wrong temperature indication, proceed to perform the following check.

3 - Before checking the sensor and the relevant circuit, wait until the engine has cooled down and the scooter has set to the working area temperature.

YES go to 4

4 - Set the switch to "**ON**" with switch to "**RUN**" and side stand raised. On the diagnostic tester, select the «**PARAMETERS**» menu.

YES go to 5

5 - Check the following values:

coolant temperature

intake air temperature

ambient temperature indicated by the digital instrument.

The three indications are equal or they are slightly different (e.g. 1° C).

YES go to 6 NO go to 7

6 - The intake air temperature sensor is providing an incorrect information.

7 - Install the special tool. Do not connect the control unit connector.

YES go to 8

Specific tooling

020481Y Control unit interface wiring

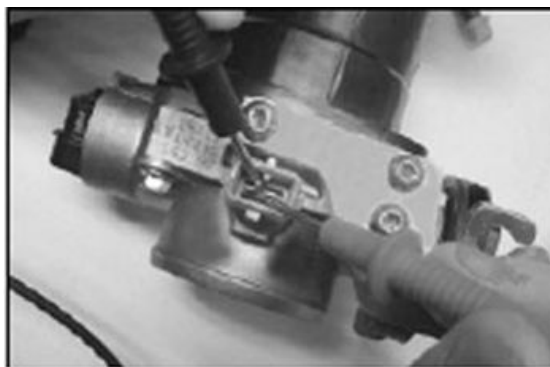
8 - Disconnect the intake air temperature sensor connector.

Measure the resistance between the sensor terminals. Check that the resistance matches the values declared according to the temperature.

TEMPERATURE RESISTANCE

	Specification	Desc./Quantity
1	9,6 KΩ	-10° C
2	5,975 KΩ	0
3	3,81 KΩ	+10° C
4	2,5 KΩ	+20° C
5	1,68 KΩ	+30° C

YES go to 10 NO go to 9



9 - Replace the sensor.

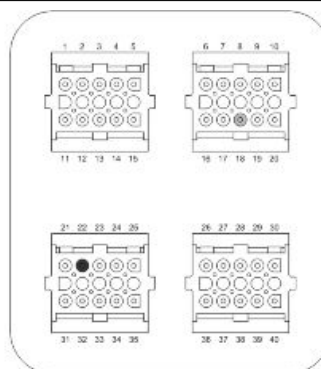
10 - Connect the sensor connector and repeat the resistive check at terminals 18 and 22.

Electric characteristic

18-22 =

Resistance equal to the value directly detected at the sensor.

YES go to 13 NO go to 11



11 - If slightly higher values are detected, check the connectors.

If infinite resistance is detected ($>1\text{M}\Omega$), check the continuity of the two lines with disconnected connectors.

Electric characteristic

Grey-white-18 =

0 Ω (continuity)

Light blue/green-22 =

0 Ω (continuity)

YES point 12



12 - Repair or replace the cable harness.

YES go to 10

13 - Check that the sensor circuit is earth insulated.

Electric characteristic

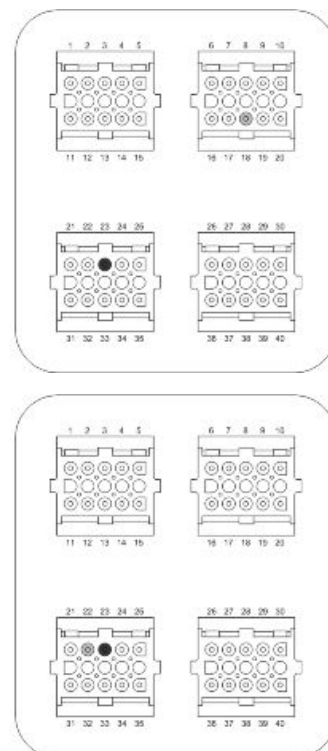
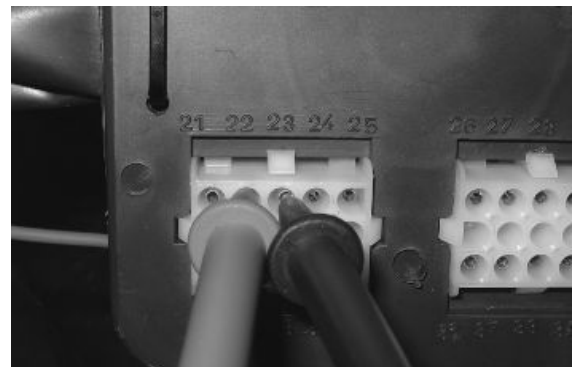
18-23 =

infinite ($>1\text{M}\Omega$)

22-23 =

infinite ($>1\text{M}\Omega$)

YES go to 15 NO go to 14



14 - Repair or replace the wiring. Check the valve position and the fluid temp. lines.

YES go to 13

15 - Connect the special tool to the control unit.

Set the switch to "ON" with switch in "RUN" and side stand raised.

YES go to 16

Specific tooling

020481Y Control unit interface wiring

16 - Measure voltage at terminals 18 and 22.

Electric characteristic

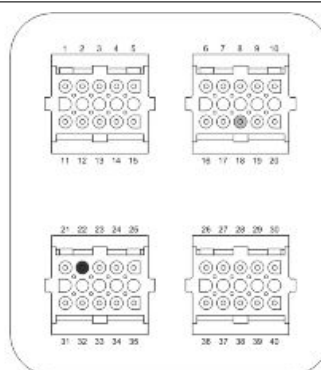
18-22 =

V as in the table.

TEMPERATURE VOLTAGE

	Specification	Desc./Quantity
1	X V	-10° C
2	X V	0
3	X V	+10° C
4	X V	+20° C
5	X V	+30° C
6	X V	+80° C

YES go to 21 NO go to 17



17

Electric characteristic

Power supply voltage value =

5±0.2 V

Repeat the wiring and sensor continuity checks.

YES go to 18

18

Electric characteristic

Measured value =

0 Ω

Repeat the sensor circuit earth insulation check.

YES go to 19 NO go to 20

19 - Check the control unit connector. Check the control unit power supply. Replace the control unit, if necessary.

20 - Repair or replace the cable harness.

21 - Start the engine and check that voltage decreases gradually according to the air filter box temperature increase.

N.B.

WITH MILD WEATHER, 30° C CAN BE EASILY REACHED AFTER A FEW MINUTES OF STOP WITH IDLE ENGINE.

Pressure sensor

This sensor does not have a system since it is directly installed into the control unit.

The sensor allows the control unit to optimise the engine performance based on altimetric variations.

To check the sensor, proceed as follows:

1 - Connect the diagnostic tester.

Select the function "**ERRORS**" in the menu.

Check whether there are any indications regarding the pressure sensor.

YES go to 2 NO go to 3



Specific tooling

020680Y Diagnosis Tool

2 - Replace the injection control unit.

3 - Select the menu on the "**PARAMETERS**" function.

Check that the pressure value in mm/Hg matches that of another scooter or of an external barometer.

Electric characteristic

Max error:

± 20 mmHg

YES go to 4 NO go to 5



4 - The ambient pressure signal is correct.

5 - Replace the injection control unit.

Throttle valve opening sensor

Throttle position sensor (t.p.s.)

Electric characteristic

TERMINALS: 1 - 22

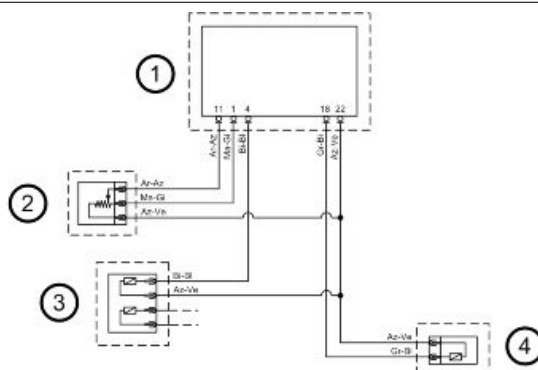
CONDITIONS: Switch set to "ON"

STANDARD: 5 V

TERMINALS: 11 - 22

CONDITIONS: Opening the throttle gradually

STANDARD: Volt= Progressive increase



CIRCUIT LAYOUT

	Specification	Desc./Quantity
1	Electronic control unit	
2	Valve position sensor	
3	Fluid temperature sensor	
4	Air temperature sensor	

The throttle valve position sensor is not removable and is installed on the throttle body.

This sensor receives a 5-V power supply from the control unit and transmit a gradually increasing voltage to the same, with an increase of the throttle valve opening. The control unit converts this voltage at an angular position of the valve.

The engine rpm and the throttle valve position are the two basic signals for the engine management. A failure of this circuit causes the switching on of the injection telltale light and the tripping of the safeties. In these conditions, the engine works, even though not in an optimum way, always safeguarding the catalytic converter integrity.

The throttle valve position signal is especially important at the small valve openings. These areas are also where the sensor works more frequently, and therefore they require more frequent checks after a high number of kilometres run.

To check the sensor and related circuit, proceed as follows:

1 - Connect the diagnostic tester.

Set the switch to "ON" with switch to "RUN" and side stand raised.



Select the tester menu on the «**ERRORS**» function.

Check whether the control unit has detected any failures relating to the throttle valve position signal.

YES go to 6 NO go to 2

Specific tooling

020680Y Diagnosis Tool

2 - Select the diagnostic tester menu on the "**PARAMETERS**" function.

Check whether the control unit recognises the extreme positions:

Throttle valve to minimum

Throttle valve to maximum

YES go to 4 NO go to 3



3 - Check the adjustment of the throttle valve control flexible transmissions. Fix or replace, if required.

YES go to 2

4 - Gradually open the throttle valve, check that the mV value increases progressively and proportionally with the opening variation.

YES go to 5 NO go to 6

5 - The throttle valve position signal is conforming.

6 - Connect the special tool to the injection system.

Do not connect the tool to the control unit.

Disconnect the throttle valve position sensor connector.

Check the continuity between the connector's terminals and the relevant pins on the control unit.

Specific tooling

020481Y Control unit interface wiring

Electric characteristic

Light blue/green-22 =

0 Ω (continuity)

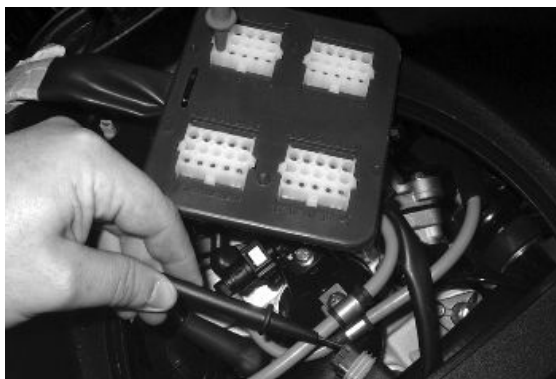
Brown-yellow-1 =

0 Ω (continuity)

Orange-light blue-11 =

0 Ω (continuity)

YES go to 8 NO go to 7



7 - Repair or replace the injection wiring.

YES go to 6

8 - Check the earth insulation of the three circuit lines.

Electric characteristic

22-23 =

Ω infinite (>1M)

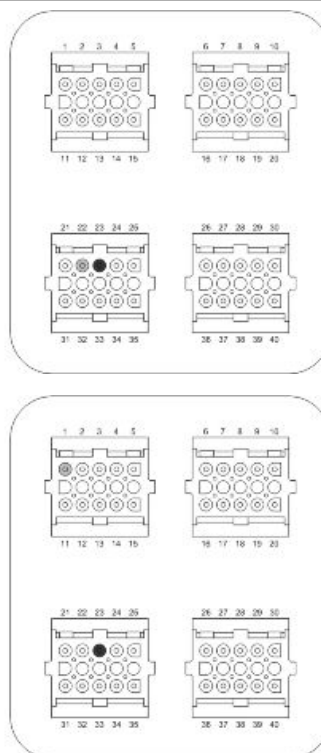
1-23 =

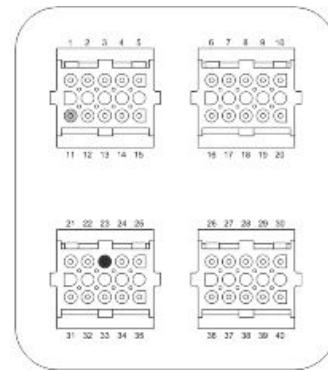
Ω infinite (>1M)

11-23 =

Ω infinite (>1M)

YES go to 10 NO go to 9





9 - Repair or replace the injection wiring

YES go to 8

10 - Connect the special tool to the control unit.

Set the switch to "ON" with switch to "RUN" and side stand raised.

Measure voltage between terminals 1 and 22 of the special tool.

Specific tooling

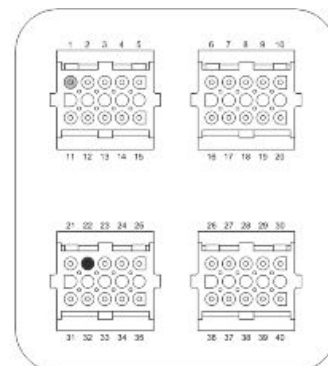
020481Y Control unit interface wiring

Electric characteristic

1-22 =

5±0.2 V

YES go to 12 NO go to 11



11 - Check the control unit connector.

Replace the control unit, if necessary.

YES go to 10

12 - Connect the throttle valve position sensor connector.

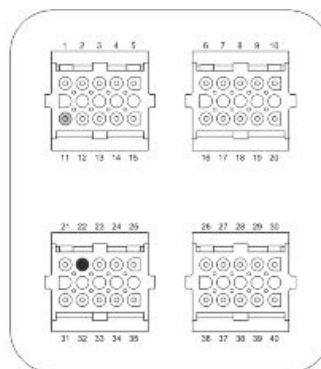
Repeat the voltage measurement between terminals 1 and 22 of the special tool.

Electric characteristic

1-22 =

5±0.2 V

YES go to 13 NO go to 14



13 - Measure voltage between terminals 11 and 22. Gradually open the throttle valve and check that the voltage value increases progressively.

N.B.

BY WAY OF AN INDICATION, VOLTAGE MAY VARY FROM APPROX. 700MV AT MINIMUM, AND ABOVE 4V AT MAXIMUM.

Electric characteristic

11-22 =

V (progressive variation)

The possible variations of the limit values are caused by the sensor installation tolerances.

YES go to 15 NO go to 14

14 - Replace the throttle body along with sensors and Stepper.

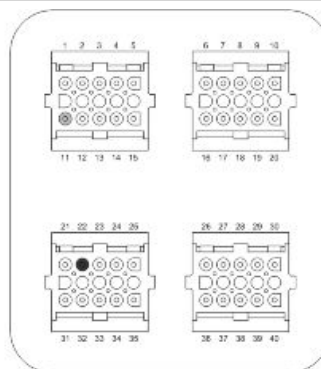
YES point 12

15 - Check that the voltage measured at pins 11 and 22 matches that indicated by the diagnostic tester set to "**PARAMETERS**".

YES go to 16 NO go to 17

16 - The throttle valve position sensor and relevant circuit are conforming.

17 - Replace the control unit.



Zeroing the throttle

Resetting the throttle valve position signal (TPS reset)

The throttle body is supplied with throttle valve position sensor and is pre-calibrated.

Pre-calibration entails regulating the minimum opening of the throttle valve to obtain a certain flow of air under pre-set reference conditions.

Pre-calibration ensures optimal air flow to control idling.

This regulation must not be tampered with in any way whatsoever.

The injection system will complete the management of the idling through the Stepper motor and the variation of the ignition advance.

The throttle body after the pre-calibration has an opened valve with an angle that can vary depending on the tolerances of the machining of the pipe and the valve itself.

The valve position sensor can also assume various fitting positions. For these reasons the mV of the sensor with the valve at idle can vary from one throttle body to another.

To obtain the optimum fuel mixture, especially at small openings of the throttle valve, it is essential to match the throttle body with the control unit following the procedure known as TPS resetting.

With this operation we inform the control unit, as the starting point, of the mV value corresponding to the pre-calibrated position. The control unit will recognise such value as angle 5.24°.

To reset, proceed as follows:

Connect the diagnostic tester.

Set the switch to "ON" with switch in "RUN" and side stand raised.

Select the functions of the diagnostic tester on «TPS RESET».

Specific tooling

020680Y Diagnosis Tool



Make sure that the throttle valve with the control is supporting the stop screw.



Guaranteeing that this position will be kept, send a confirmation for the TPS reset procedure.



Select the "**PARAMETERS**" function and check that the TPS reset "**YES**" is displayed.



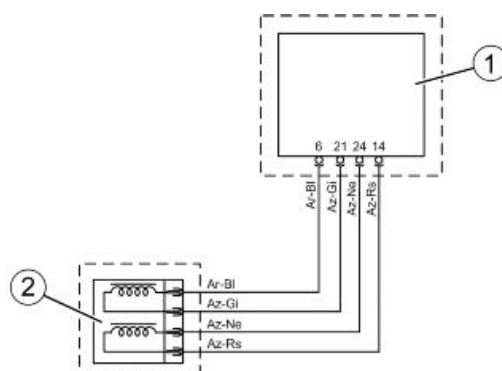
Reset should be performed in the following cases:

- on first fitting.
- in case of replacement of the throttle body
- if the injection control unit is replaced.

N.B.

THE TPS RESET PROCEDURE MUST NOT BE CARRIED OUT WITH A USED THROTTLE BODY BECAUSE POSSIBLE VALVE WEAR AND STOP WEAR FOR THE MINIMUM OPENING MAKE THE AIR FLOW DIFFERENTLY FROM THAT OF PRE-CALIBRATION.

Step motor



CIRCUIT LAYOUT

	Specification	Desc./Quantity
1	Electronic control unit	
2	Stepper motor	Stepper motor

The throttle body is provided with an auxiliary air circuit. This is enabled by a piston valve controlled by a Stepper motor.

The Stepper is powered by the control unit only when the opening must be changed.

The revolution is divided into portions called "steps".

By changing the opening "steps" it is possible to properly feed the engine to facilitate the start-up



procedure and adjust the air feeding with cold engine. When the engine reaches the working temperature, the Stepper partly closes again.

To prevent wear of the adjustment piston, operation at full speed is obtained with a minimum opening of 43 - 45 "steps".

To recover possible adjustments, every switching to "**OFF**" causes the piston to close up to end of travel and to open up again by a fixed number of steps (self-reset).

When the control unit changes the Stepper opening "steps" it also changes the injection time to ensure proper ignition.

The engine idle speed is practically stabilised at 1550-50 rpm. After a hot start-up step you can perceive the first increase in the revolutions and the subsequent closing of the Stepper to stabilise the speed.

In case of irregular speed, before carrying out electric checks inspect the throttle valve and the auxiliary air circuit cleaning.

To check the Stepper and the relevant circuit, proceed as follows:

1 - Connect the diagnostic tester.

Set the switch to "**ON**" with switch to "**RUN**" and side stand raised.

Lift the scooter on the central stand. Select the function "**ERRORS**" in the menu.

Check whether the control unit has detected any failures relating to the Stepper circuit.

YES go to 8 NO go to 2

Specific tooling

020680Y Diagnosis Tool

2 - Select the menu on the "**PARAMETERS**" function. Check the number of "steps" programmed by the control unit to obtain start-up. This setting is a function of the engine temperature.

Electric characteristic

20° C =

approx. 135 - 140 steps

YES go to 3 NO go to 4



3 - Start the engine and let it warm up.

With a coolant temperature of more than 70°C, the control unit must control the Stepper with about 45 «steps».

YES go to 5 NO go to 4



4 - Check the coolant temperature sensor signal. Check the control unit, if necessary.

5 - Select the menu on the «**ACTIVE DIAGNOSIS**» function. Select «**STEPPER**» diagnosis. Start the diagnosis with idle engine at the working temperature. Check whether the Stepper controls some revolution variations and wait for the diagnostic tester response.

N.B.

THE ECU ENABLES THE DIAGNOSIS ONLY WHEN THE IDLE SPEED IS WITHIN THE SPECIFICATIONS.

YES go to 6 NO go to 8



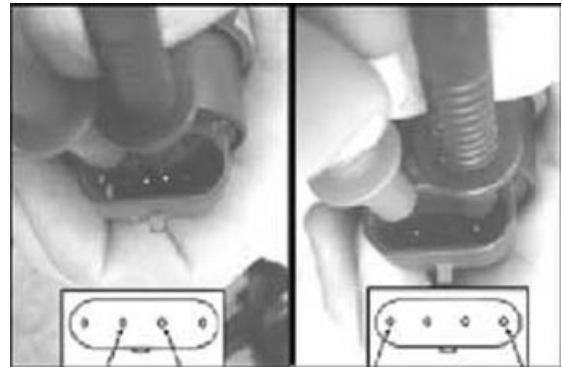
6 - Test successful. Variations of revolutions perceived.

YES go to 7 NO go to 9

7 - Stepper and relevant circuit efficient.

8 - Test failed. No variations of revolutions. Check the Stepper circuit. Disconnect the Stepper connector. Check the resistance of the Stepper circuits by connecting the tester as indicated in the figure. The two measurements must have the same value.

Electric characteristic

Resistance =approx. 51 Ω YES go to 11 NO go to 10**9 - Test successful.**

No variations of revolutions.

Remove the throttle body.

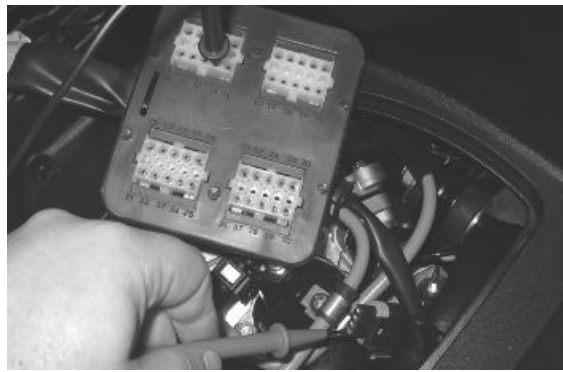
Check the auxiliary air circuit cleaning. Switch from "ON" to "OFF" and again to "ON" and check whether the piston valve moves. If the valve does not move, replace the throttle body.

**10 - Replace the throttle body****11 - Connect the special tool.**

For these checks, do not connect the special tool to the control unit. Check the continuity of the 4 power supply lines of the Stepper.

Specific tooling**020481Y Control unit interface wiring****Electric characteristic****A Light blue-red-14 =**0 Ω (continuity)**B Orange-blue-6 =**0 Ω (continuity)**C Light blue-yellow-21 =**0 Ω (continuity)**D Light blue-black-24 =**0 Ω (continuity)

YES go to 12 NO go to 13



12 - Check the earth insulation of the 4 Stepper lines.

Electric characteristic

14-23 =

>1 M Ω (infinite)

6-23 =

>1 M Ω (infinite)

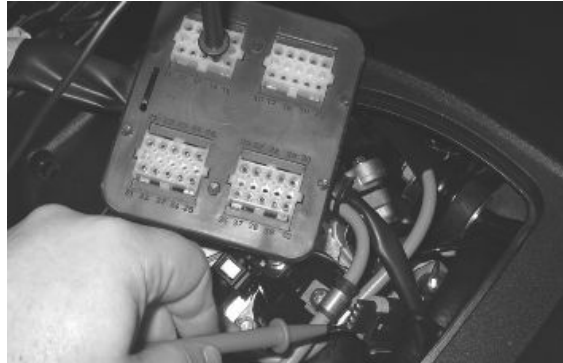
21-23 =

>1 M Ω (infinite)

24-23 =

>1 M Ω (infinite)

YES go to 14 NO go to 13



13 - Repair or replace the wiring.

YES go to 11

14 - Connect the Stepper connector.

Repeat the continuity check with the tool pins.

Electric characteristic

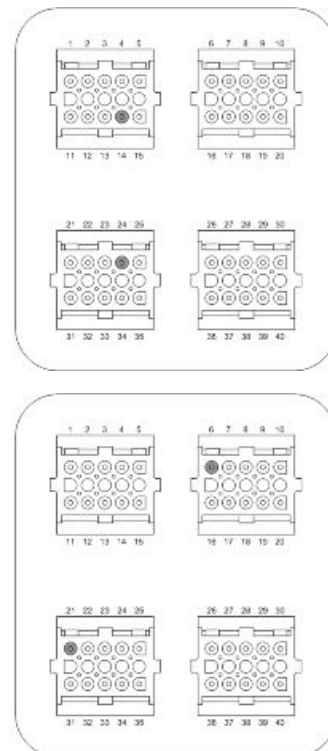
14-24 =

approx. 51 Ω

6-21 =

approx. 51 Ω

YES go to 16 NO go to 15



15 - Check cable harness and connectors more carefully.

16 - Connect the control unit connector.

Set the switch to «**ON**» with switch to «**RUN**» and side stand raised. Repeat the «**ON**» «**OFF**» «**ON**» switching.

Check the presence of voltage pulses on the Stepper command lines.

Set-up for direct voltage measurements.

N.B.

PULSES ARE USED TO CHANGE THE STEPPER POSITION.

Electric characteristic

14-24 =

V (pulses for a few seconds)

6-21 =

V (pulses for a few seconds)

After reaching the optimum position, the power supply voltage becomes null.

YES go to 17 NO go to 18

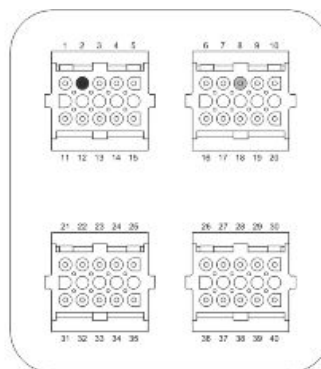
17 - The Stepper circuit is efficient.

18 - Check the control unit connector. Replace the control unit, if necessary.

Lambda probe

SIGNAL CONTROL

Install the electronic control unit interface wiring.
 Start the engine and warm up until the electric fan switches on.
 Use an analogue multimeter with a direct voltage scale measuring down to 2 V.
 Connect the multimeter probes between pin 2 (-) and pin 8 (+)

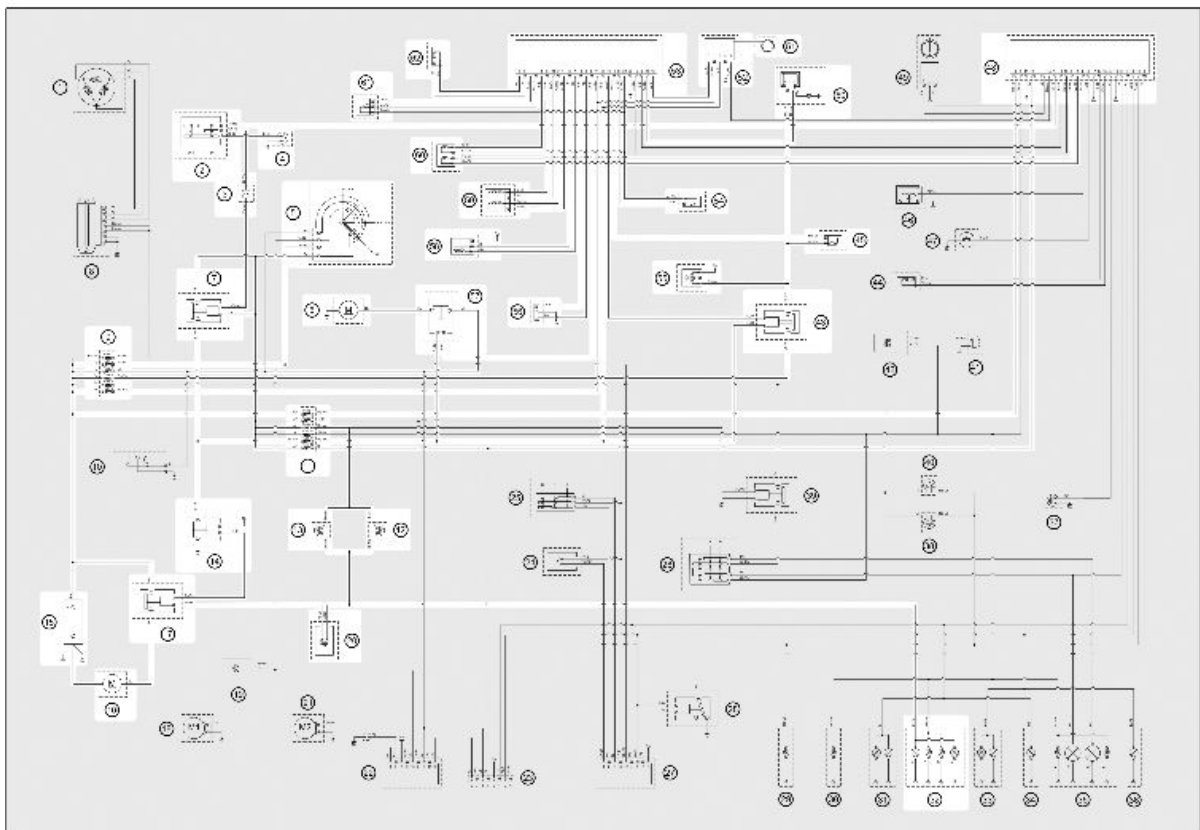


With the engine running at idle speed, check that the voltage oscillates between 0V and 1V.
 With the throttle valve completely open, the voltage is approx. 1V.
 During the closing phase, the voltage is approx. 0V.
 If the voltage remains constant, the sensor may be damaged. Remove the sensor and check that there are no oil or carbon deposits inside it..



Impianto elettroventilatore

TERMINALS	CONDITIONS	STANDARD
5 - 23	Switch in position "ON"	Battery voltage
	Switch on "RUN"	
	Side stand raised	
	Electric fan off	

**KEY:**

- 2.** Engine stop switch
- 3.** Diode
- 4.** Side stand button
- 5.** Key switch
- 6.** Electric fan
- 7.** Engine stop remote control switch
- 9.** Main fuses
- 11.** Auxiliary fuses
- 12.** Stop button on front brake
- 13.** Stop button on rear brake
- 14.** Immobiliser remote control switch
- 15.** 12V-12Ah Battery
- 16.** Starter motor
- 17.** Start-up remote control switch
- 20.** Starter button
- 32.** Rear light
- A.** Stop light bulbs
- 43.** Injection load remote control
- 45.** Fuel injector

- 48. Instrument panel
- 50. HV coil
- 51. Immobilizer aerial
- 52. Decoder
- 53. Injection ECU
- 54. Intake air temperature sensor
- 55. Fuel pump
- 56. Diagnosis connector
- 57. Electric fan remote control
- 58. Engine rpm sensor
- 59. Stepper motor
- 60. Engine temperature sensor
- 61. Throttle valve potentiometer
- 62. Lambda probe

The electric fan system is powered by a remote control switch connected to the continuous power supply controlled by the electronic control unit of the injection system.

The electronic control unit of the injection system controls the electric fan in relation to the measured engine temperature.

If prolonged running of the electric fan is noticed, check the following carefully before starting to check the electrical system:

- Coolant level in the expansion tank - bleeding of the inlet hose to the engine
- Bleeding of the outlet from the head
- Function of the thermostat
- Function of the pump

For these checks, see chapter "Cooling system".

To check the circuit, proceed as follows:

- 1 - Connect the diagnostic tester. Set the switch to "ON" with switch to "RUN" and side stand raised. Select the "ERRORS" function. Check whether the control unit has detected any failures relating to the electric fan control circuit.

YES go to 8 NO go to 2



2 - Select the menu on the "ACTIVE DIAGNOSIS" function. Activate the electric fan diagnostic function. Check acoustically for rotation of the electric fan. Wait for the exit from the diagnostic tester.

YES go to 3 NO go to 4



3 - Test successful. The fan is rotating.

YES go to 5

4- Test failed. The fan is not rotating.

YES go to 8 NO go to 6

5- The electric fan system is OK

6 - Test successful. The fan is not functioning

YES go to 7

7 - The remote control switch circuit is OK. Check the connections to the electric fan, the function of the contacts of the remote control switch, the positive lines, the negative line and the motor of the electric fan.

8 - Disconnect the remote control unit of the electric fan. Check the continuity of the excitation coil.

85 - 86 = $100 \pm 50\Omega$

YES go to 10 NO go to 9



9 - Replace the remote control switch

YES go to 8

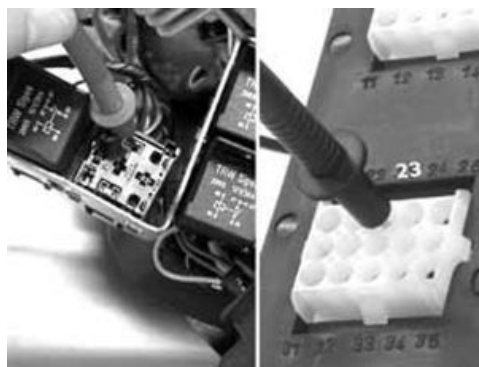
10 - Connect the special tool between the control unit and the system. Do not connect the electronic control unit

YES go to 11

11 - Check for positive battery voltage at pin 86 of the remote control switch connector.

86 - 23 = battery voltage with switch set to «ON»

YES go to 13 NO go to 12

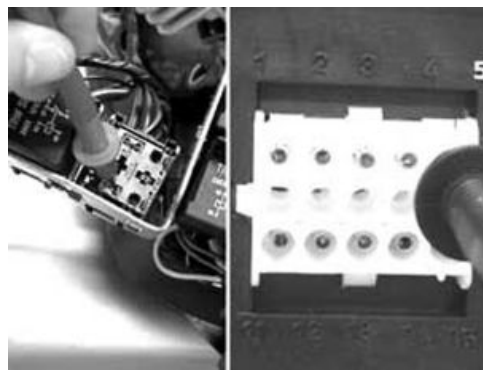


12 - Repair or replace the wiring.

13 - Leaving the remote control switch disconnected, check for continuity between pin 85 of the remote control switch connector and pin 5 of the ECU.

85 (green/white) - 5 = 0Ω (continuity)

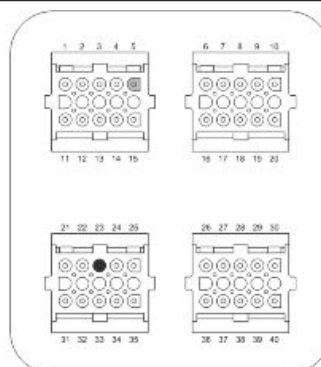
YES go to 14 NO go to 15



14 - Check the earth insulation.

5 - 23 >1 MΩ (infinite)

YES go to 16 NO go to 15

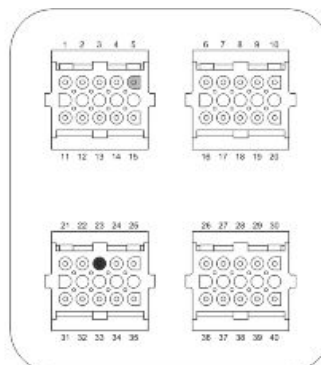


15 - Repair or replace the cable harness.

16 - Connect the remote control switch and check for battery voltage between terminals 5 and 23 with the key switch in position "ON".

5 - 23 = Battery voltage with panel in position "ON"

YES go to 17



17 - Repeat the check with the electronic control unit connected and the engine cold.

5 - 23 = Battery voltage with panel in position "ON"

If the fault continues, replace the electronic control unit.

INDEX OF TOPICS

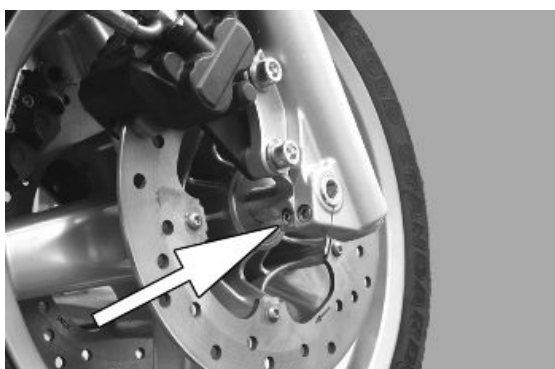
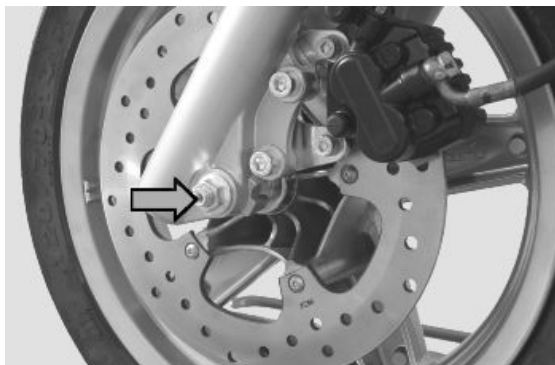
SUSPENSIONS

SUSP

Front

Removing the front wheel

- Remove the fixing nut from the wheel axle on the left side of the vehicle.
- Loosen the two screws fixing the wheel axle clamp and remove the clamp.



Front wheel hub overhaul

Check that the wheel bearings do not show signs of wear.

If you have to replace the wheel bearings, proceed as follows:

- Remove the two bearings on the brake disc side using pliers 14 and the special bell 9.
- Remove the internal spacer.





- Support the front wheel with two wooden shims that make it possible to avoid scratching in the case of contact with the rim.
- Insert the punch (consisting of adaptor handle, 24 mm adaptor and 15 mm guide) from the brake disc side to permit the removal of the opposite side bearing and the spacer bushing.



Specific tooling

020376Y Adaptor handle

020456Y Ø 24 mm adaptor

020412Y 15-mm guide

- Heat the bearing seat on the side opposite the brake disc with the heat gun.



- Insert the bearing using the punch consisting of adaptor handle, 40x37 mm adaptor and 15 mm guide, and take it to the stop.



- Reinsert the spacer bushing on the brake disc side using the appropriate tool and take it to the stop.

Specific tooling**020376Y Adaptor handle****020359Y 42x47-mm Adaptor****020412Y 15-mm guide****020201Y Spacer bushing driving tube**

- Refit the cap and tighten the five fixing screws.



- Turn over the wheel and insert the internal spacer with the part fitted with the Seeger ring facing the bearing on the brake disc side.



- Heat the bearing seat on the side the brake disc with the heat gun.



- 2 - Insert the two bearings one at a time using the punch consisting of adaptor handle, 32x35 mm adaptor and 15 mm guide, and take it to the stop.

Specific tooling

020376Y Adaptor handle

020357Y 32x35-mm Adaptor

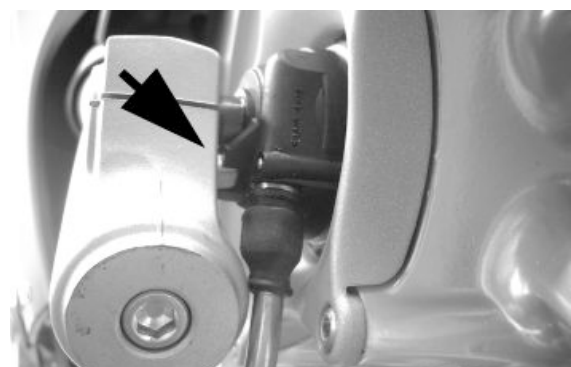
020412Y 15-mm guide

Refitting the front wheel

- Grease the wheel axle, then install it from the tone wheel side and install the tone wheel properly.
- Tighten the wheel axle nut to the prescribed torque.

N.B.

TAKE CARE NOT TO DAMAGE THE ODOMETER DRIVE.
FOR THE SAKE OF SAFETY, OFFSET THE INTERNAL
STOP FROM THE STOP OF THE TONE WHEEL BY 90°.



- Tighten the two safety screw on the leg to the prescribed torque.

Locking torques (N*m)

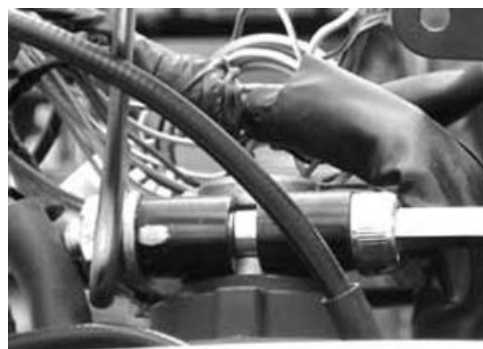
Front wheel axle nut 45 - 50 Safety screw on fork leg 6 ÷ 7



Front fork

Removal

- Remove the front wheel.
- Remove the front mudguard
- Remove the front brake calliper
- Remove the front and rear handlebar covers.
- Remove the pin mounting the handlebar to the steering tube.
- Remove the handlebar and rest it on the shield back plate.



Using the special tool, loosen and remove the upper ring nut, the spacer washer and the counter-ring nut.

- Extract the fork.

N.B.

TAKE CARE TO SUPPORT THE FORK SO AS TO PREVENT IT FROM COMING OFF ABRUPTLY

Specific tooling

020055Y Wrench for steering tube ring nut



Overhaul

Servicing fork stems

- Using an inside 17 mm hexagonal spanner, loosen the top stem closing cap.



- Loosen the stem support clamp and remove fork leg and stem.



- Remove the spring.
- Drain the oil.
- Remove the screw with copper washer shown in the figure. To prevent the pumping member rotation, insert an inside 22 mm hexagon spanner into the stem.
- Remove the pumping member.



- Remove the dust guard ring using a screwdriver as shown in the figure.

N.B.

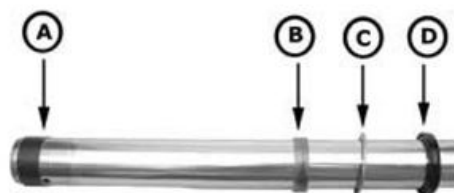
BE CAREFUL NOT TO DAMAGE THE DUST GUARD AND THE STEM.



- Remove the oil guard safety lock using a screwdriver.
- Repeatedly actuate the stem to remove it from the fork leg.



- Extract the oil guard "D", the abutment washer "C" and the top bushing "B".
- Widen and remove the bottom bushing "A".



Check pump unit

- Check that the oil holes on the pumping are free from clogging.
- Check that the sealing snap ring is not damaged.



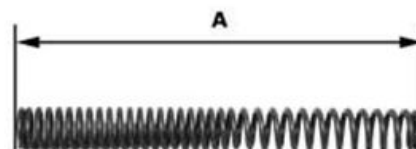
Check the spring length

- Check the length "A" of the spring.

Characteristic

Standard spring length:

291.6 mm



Servicing tapered bearing seats

- Check that the seats and the tapered bearings exhibit no scratches or wear.

N.B.

THE TAPERED BEARING SEATS SHOULD BE REMOVED ONLY IF STRICTLY NECESSARY.

In case of replacement, proceed as follows:

- Using a bearing removal punch, inserted from the bottom, remove the top seat on the steering head. Then, remove the bottom seat of the tapered bearing inserting the punch from the top of the headstock.



Specific tooling

020004Y Punch for removing fifth wheels from headstock

Refitting

Refitting stems on fork legs

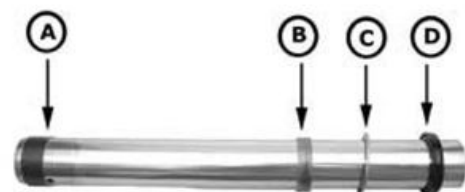
Preassemble the stem as indicated:

- Install the bushing from the bottom of the stem



- Insert the following from the top of the stem:

- 1 Bushing "B"
- 2 Abutment washer "C"
- 3 Oil guard "D"



- Insert the pumping member guiding bushing at the bottom end of the stem.



- Insert the stem into the casing being careful not to let the guiding bushing come out of the stem.
- Move the oil guard in abutment using a tube.



TUBE SIZE

Specification	Desc./Quantity
Inside:	44 mm
Outside:	51 mm
Height:	approx. 105 mm

- Insert the contrast spring into the pumping member.
- Insert the pumping member into the stem.
- Insert the stem into the fork leg being careful not to let the guiding bushing come out of the stem.
- Insert and screw the pumping member screw with a new copper washer and tighten to the prescribed torque.



CAUTION

TO PREVENT THE PUMPING MEMBER ROTATION, INSERT AN INSIDE 22 MM HEXAGON WRENCH INTO THE STEM.

Locking torques (N*m)

Pumping element fixing screw 25 - 35

- Pour recommended oil into the stem.

Recommended products

AGIP FORK 7.5 W Oil for front staple

Hydraulic oil SAE 7.5 W

Characteristic

Amount oil:

195 ± 3 cc

- Insert the spring with the thickest turns at the bottom.
- Insert the stem into the fork clamp.
- Tighten the clamp to screw the top stem closing cap.
- Check that the sealing ring on the cap is in good working order, then tighten the cap on the stem to the prescribed torque.



Locking torques (N*m)

Stem upper cap 35 - 55

- Loosen the fork clamp screws and move the stem closing cap in abutment with the clamp.
- Tighten the clamp screws to the prescribed torque.



Locking torques (N*m)

Fork clamp screws 20 ÷ 25

- Grease the tapered bearing using the specified product.

Recommended products

AGIP GREASE PV2 Grease for the steering bearings, pin seats and swinging arm

White anhydrous-calcium based grease to protect roller bearings; temperature range between -20 C and +120 C; NLGI 2; ISO-L-XBCIB2.



- Insert the fork into the headstock.
- Insert the tapered bearing after applying the specified product.

Recommended products

AGIP GREASE PV2 Grease for the steering bearings, pin seats and swinging arm

White anhydrous-calcium based grease to protect roller bearings; temperature range between -20 C and +120 C; NLGI 2; ISO-L-XBCIB2.



- Using the special tool, tighten the first ring-nut on the steering tube to a holding torque, then tighten completely.

Locking torques (N*m)**Holding torque of lower ring nut 20 ÷ 25**

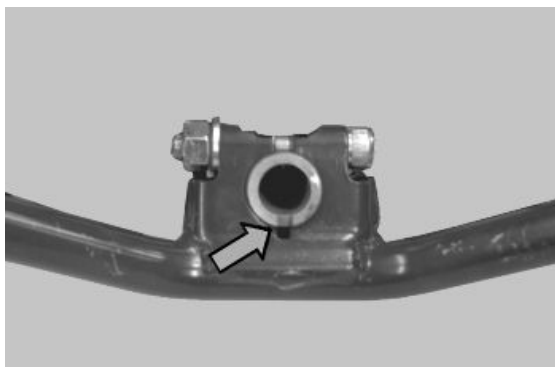
- Tighten to the prescribed torque.

Locking torques (N*m)**Steering lower ring nut 10 - 13 ****

- Install the space washer.
- Using the special tool, tighten the second locking ring nut on the steering tube to the prescribed torque.

Locking torques (N*m)**Upper steering ring nut 36 - 39**

- Install the handlebars on the steering tube, paying attention to the centring, aligning the recess on the handlebar with that on the steering tube as shown in the figure.



- Tighten the handlebar fixing screw on the steering tube to the prescribed torque.
- Install the front and rear handlebar covers as described in the section "Scooter body".
- Install the front mudguard
- Install the front wheel.
- Install the front brake callipers.
- Tighten the retaining screws of the brake calliper to the support.

Specific tooling

020055Y Wrench for steering tube ring nut

Locking torques (N*m)

Fixing screw handlebar to steering tube 45 ÷ 50 Holding torque of lower ring nut 20 ÷ 25 Upper steering ring nut 36 - 39 Steering lower ring nut 10 - 13 ** Front brake calliper mounting on fork 20 ÷ 25 Front brake disc mounting 11 ÷ 13 Plastic protection retaining screw 5 - 6

Steering bearing

Removal**Service of tapered bearing on fork**

- Check that the tapered bearing on the fork exhibits no deformations or wear.

THE BEARING SHOULD BE REMOVED ONLY IF STRICTLY NECESSARY.

In case of replacement, proceed as follows:

- Support the fork in a vice.
- Insert the contrast plate in the upper end of the steering tube



- Insert the special tool as shown in the figure.



- Insert the retaining band of the two half-rings.



- Using a 19 mm hexagonal spanner, extract the roller bearing.

Specific tooling

020458Y Puller for lower bearing on steering tube



Refitting

Reassembly of tapered bearing in steering tube

- Insert the a new plate and a new dust guard in the steering tube
- Insert the a new tapered bearing in the steering tube
- Using the special tool and a mallet to move the dust guard and the bearing in abutment.



Specific tooling

006029Y Punch for fitting fifth wheel seat on steering tube

Reassembly of steering tapered bearing seats

Using the special tool, reassemble the tapered bearing housings on the head as described below:

- Place a new top housing on the head and a new bearing seat on the bottom side.
- Insert the screw of the special tool set-up with the adapters for inserting bearing and seat, into the steering head, as shown in the figure.
- Using two 24 mm wrenches, tighten the screw to move the two seats in abutment.



N.B.

ALWAYS USE A NEW BEARING AND A NEW SEAT.

Specific tooling

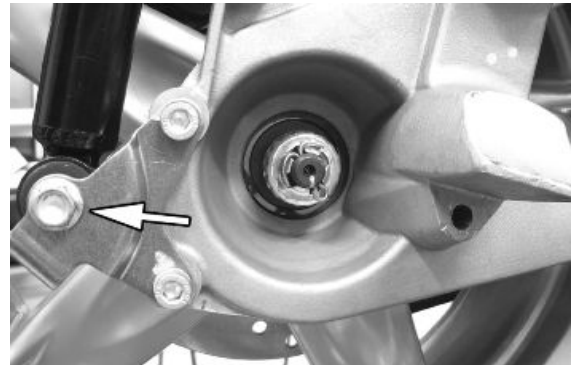
001330Y Tool for fitting steering seats

Rear

Removing the rear wheel

Remove the full muffler assembly.

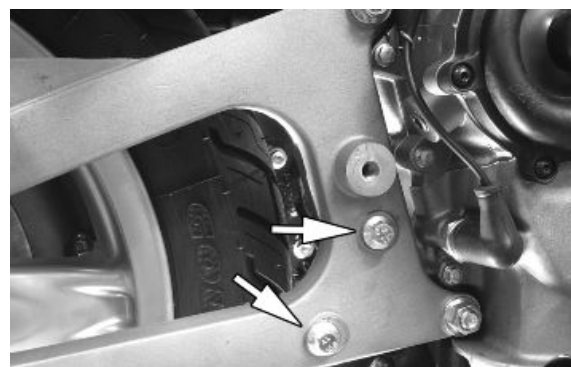
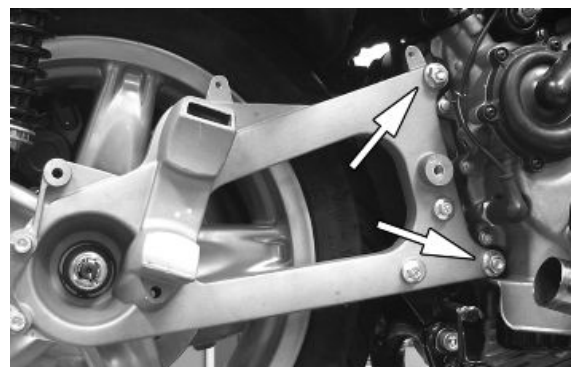
- Remove the screw fixing the right-hand shock absorber to the bracket



- Remove the cotter pin, the cap, the wheel axle fixing nut and the outer one of the two spacers.



- Remove the two screws fixing the bracket to the engine
- Remove the two screws fixing the stand to the bracket



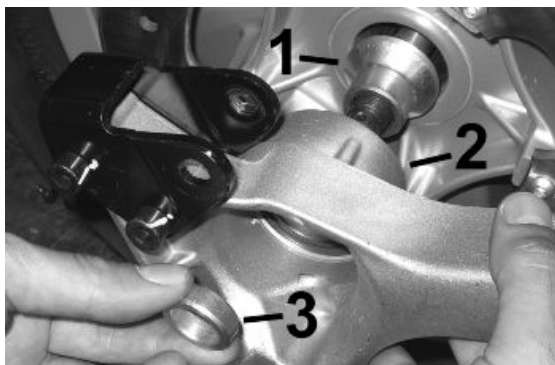
- Slide off the wheel axle bracket, using the heat gun if necessary.
-

Refitting the rear wheel

To fit, follow the removal steps but in the reverse sequence, being careful to fit the spacers on the wheel axle as shown in the picture.

Locking torques (N*m)

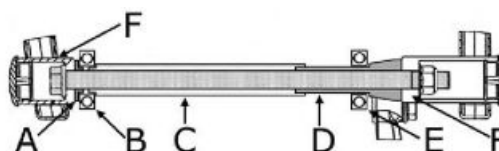
Muffler arm clamping screws 27 ÷ 30 **Rear wheel axle nut** 104 ÷ 126 **Shock absorber-crankcase attachment bracket** 20 ÷ 25 **Lower shock absorber clamping screw** 33 ÷ 41 Nm **Rear brake calliper fixing screws** 25 ÷ 30 Nm



Swing-arm

The scooter features a rigid engine-chassis retainer called Direct-link.

The system comprises the following components:



A= Left spacer

B= RHS engine support bearing

C= Central spacer

D= Right spacer

E= LHS engine support bearing

F = Chassis

Removal

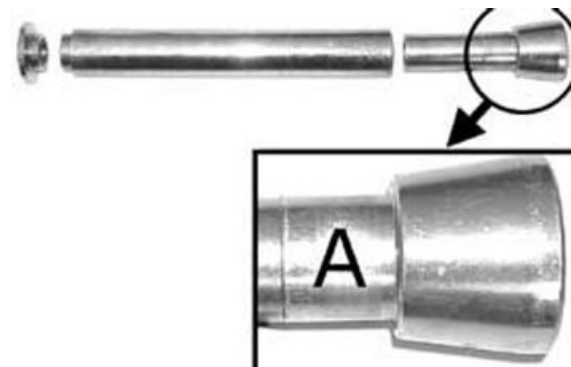
- Support the engine adequately.
- Remove the pin anchoring the engine to the chassis.
- Move the engine backwards to take out spacers
- Remove the left spacer highlighted in the figure.



- Remove the central and the right spacer.



- To refit, follow the removal operations but in reverse order, being careful to observe the original torque and to lubricate the sliding area «A» of the right spacer on the engine bearing.



Locking torques (N*m)

Engine - chassis fixing pin 100 - 120

Two types of engine fixing pins, without distinction, have been fitted on the scooter:

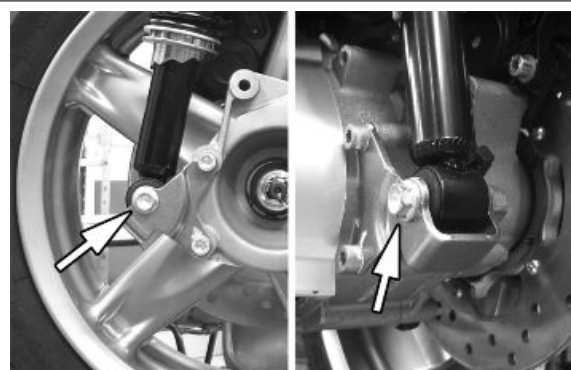
- 17-mm flanged-head pin.
- 22-mm head pin and washer.

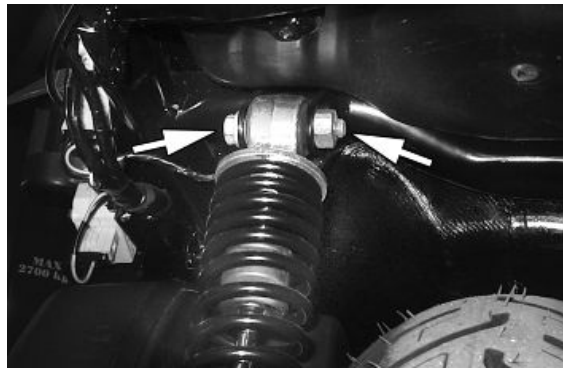
Shock absorbers

Removal

Proceed as follows:

- place the vehicle on its centre stand;
- lift the engine a little with a jack so as to free the two shock absorbers;
- remove the muffler
- undo the shock absorber spring assembly clamping screw from the support fixed to the engine on the one side and from that fixed to the muffler on the other;
- unscrew the two upper nuts (one on each side) fixing the shock absorber spring assembly to the frame and remove the shock absorbers.





Centre-stand

- Use a jack to support the vehicle properly.
- Remove the two stand return springs.



- Working from both sides, unscrew the two bolts connecting it to the supporting plate.



- To refit, follow the removal steps but in reverse order; be careful to tighten to the prescribed torque.

Locking torques (N*m)

Centre stand bolt 31 ÷ 39

Side stand

- Unhook the springs.
- Loosen the nut.
- Pull out the screw.

Fitting

Carry out the previous operations but in reverse order.

Locking torques (N*m)

Side stand clamp 15 ÷ 20



INDEX OF TOPICS

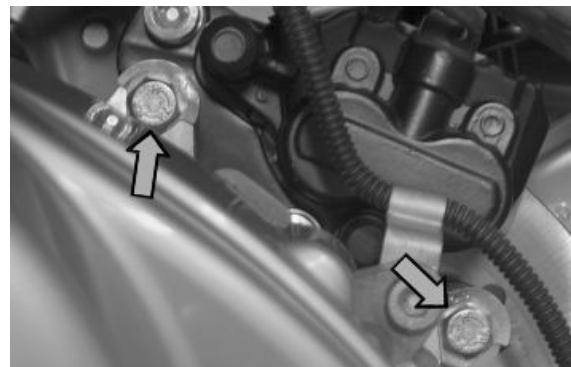
BRAKING SYSTEM

BRAK SYS

Rear brake calliper

Removal

- Rest the scooter on its centre stand and adequately support the rear part of the scooter.
- Remove the wheel.
- Unscrew the air filter to the crankcase retainers.
- Unscrew the left shock absorber lower retainer.
- Release the screws from the safety washers and unscrew the crankcase fixing screws indicated.



- Remove the calliper together with its supporting bracket.

N.B.

SHOULD THE BRAKE CALLIPER BE REPLACED, BEFORE REMOVING THE FITTINGS FIXING THE CALLIPER TO THE SUPPORTING BRACKET, FIRST LOOSEN THE OIL HOSE FITTING AFTER HAVING EMPTIED THE SYSTEM OF THE CIRCUIT BEING INSPECTED.

Refitting

To fit the calliper, follow the above operations but in reverse order.

Locking torques (N*m)

Rear brake calliper fixing screws 20 ÷ 25 Rear brake calliper-pipe fitting 20 ÷ 25 Rear shock absorber retainer to the chassis 38 - 46

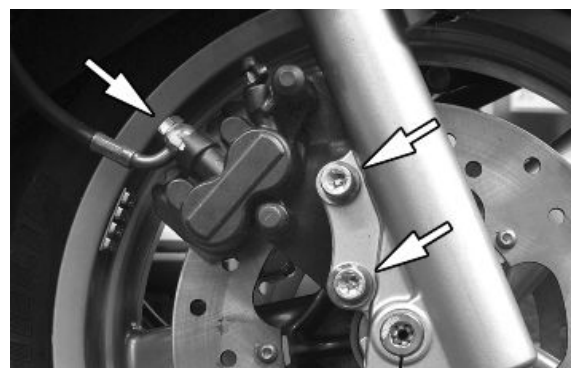
Front brake calliper

Removal

- Remove the two retainers fastening the front brake calliper to the support as shown in the photograph.

N.B.

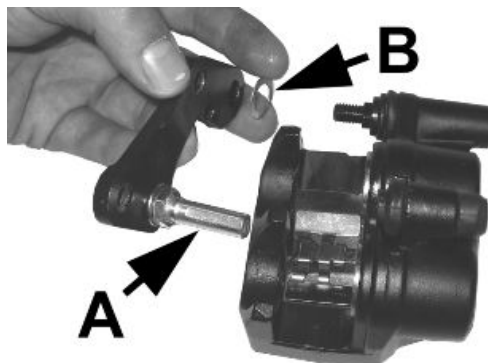
SHOULD IT BE NECESSARY TO REPLACE THE CALLIPER, FIRST LOOSEN THE FITTING CONNECTING THE PIPE TO THE BRAKE CALLIPER.



- Repeat the same operations for the other front calliper.

Refitting

- Fit the fixed plate being careful to grease the guide «A» and to insert washer «B» correctly as indicated in the photo.



- Hold the pads in the correct position and insert the calliper in the brake disc.
- Fix the calliper to the support by means of the two screws to the prescribed torque.
- Lock the pipe joint to the calliper to the prescribed torque.
- Purge the system.

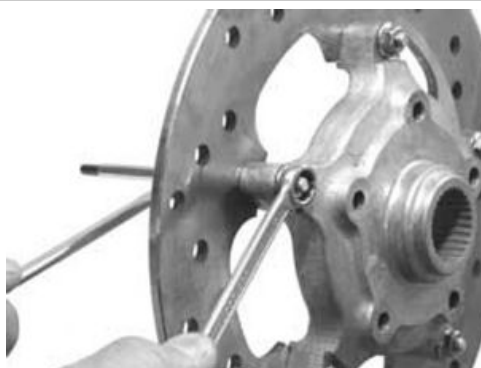
Locking torques (N*m)

Front brake calliper mounting on fork 20 ÷ 25 Pipe / brake calliper coupling 20 ÷ 25

Rear brake disc

Removal

- Remove the rear brake calliper
- Remove the brake disc with hub from the wheel axle.
- To remove the brake disc from the hub, support the unit in a vice and tighten the 5 fastening bolts with self-locking nuts.



Refitting

- To reassemble the brake disc on the hub, carry out the removal operations in the reverse order arranging the brake disc on the hub on the side opposed the wheel keying
- Follow the direction of rotation shown by the arrow and tighten to the prescribed torque.
- Lubricate the seat of the wheel bearing shaft on the manifold support with the recommended grease.

N.B.

APPLYING AN EXCESSIVE QUANTITY OF GREASE MAY IMPAIR THE BRAKE PERFORMANCE

Recommended products

AGIP GREASE PV2 Grease for the steering bearings, pin seats and swinging arm

White anhydrous-calcium based grease to protect roller bearings; temperature range between -20 C and +120 C; NLGI 2; ISO-L-XBCIB2.

- Insert the hub - disc assembly in the wheel axle.

Locking torques (N*m)

Rear brake disc mounting 11 ÷ 13



Disc Inspection

- Remove the rear brake calliper
- Use a micrometer to check the disc thickness as shown in the photograph.

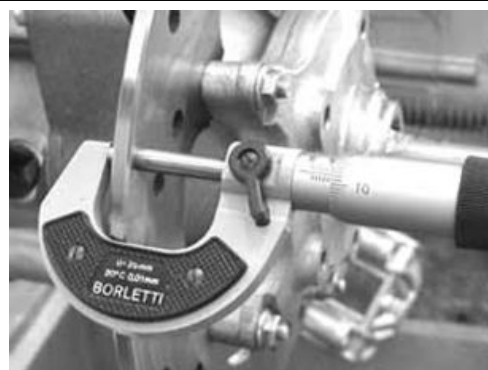
Characteristic

Standard thickness:

5 +0.2-0.1 mm

Minimum thickness allowed after use:

4 mm



- Repeat the measurement at no fewer than six points on the disc.
- Check that the measurements do not deviate over 0.1 mm
- Remove the front calliper.
- Place the magnetic base with the dial gauge on the brake calliper support bracket as shown in the photograph.



- Suitably fix the flange to the wheel axle with the original nut and spacer and a Ø 17-mm bearing

N.B.

SO AS NOT TO GET A DISTORTED READING, CAUSE THE DRIVEN PULLEY SHAFT TO TURN IN ORDER TO ROTATE THE DISC.

Specific tooling

020335Y Magnetic support for dial gauge

Characteristic

Max. deviation allowed:

0.1 mm

- If you detect incorrect values, replace the disc. If the anomaly persists, replace the hub.

Front brake disc

Removal

- These operations are described once but apply to both brake discs.
- Remove the front wheel.
- Undo the five clamping screws shown in the photograph



Refitting

- These operations are described once but apply to both brake discs.

For fitting, position the disc correctly using the arrow stamped on it as reference.

- Do up the screws to the prescribed torque and apply the recommended product

N.B.

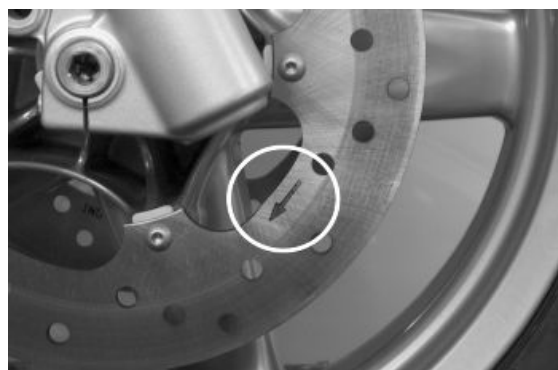
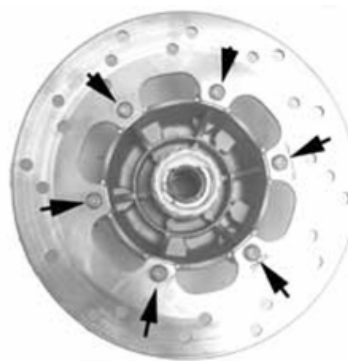
THE ARROW STAMPED ON THE DISC INDICATING THE RUNNING DIRECTION MUST BE FITTED TOWARDS THE OUTSIDE OF THE VEHICLE.

Recommended products**Loctite 243 Medium strength threadlock**

Medium Loctite 243 threadlock

Locking torques (N*m)

Front brake disc mounting 5 ÷ 6 •

**Disc Inspection**

- These operations are described once but apply to both brake discs.
- Checking the disc is important; it must be perfectly clean, with no sign of rust, oil or grease or any other dirt, and must show no signs of deep scoring.

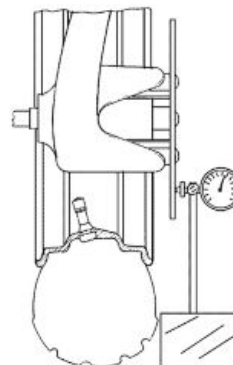
Characteristic**New rear disc thickness**

4.0 mm

Disc thickness at wear limit (front)

3.5 mm

- Using the appropriate tool, measure how much the disc protrudes when the wheel is fitted properly. The protrusion, measured near the external edge of the disc, must be less than 0.1 mm.
- If a value other than that prescribed is detected, remove the front wheel and check how much the disc protrudes. Maximum permissible out of true is 0.1 mm. If the value measured is greater, replace the disc and repeat the check.
- If the problem persists, check and replace the wheel hub if required.



Specific tooling

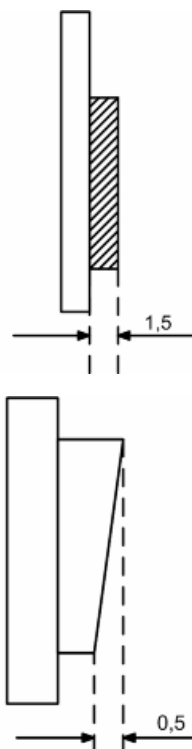
020335Y Magnetic support for dial gauge

Front brake pads

Removal

Proceed as follows:

- Remove the front brake calliper.
- Loosen the two pins shown in the figure that lock the two pads.
- Remove the pads, being careful with the pad spring clamp.
- Check the thickness of the friction material of the pads.
- Replace the pads if the thickness is below the minimum value.
- The replacement must be made with greater residual thickness if the pad has not worn evenly. A 0.5 mm thickness difference in the residual friction material is permitted.



Characteristic

Minimum value

1.5 mm

Repeat the operation for the other calliper.

See also

[Front](#)
brake calliper

Refitting

To fit, proceed as follows:

- Insert the two pads in the callipers.

- Screw the two pad lock pins to the correct torque, and apply the recommended product.
- Fit the calliper on its support, tightening the two screws to the prescribed torque.

N.B.

IF IT IS NOT POSSIBLE TO CORRECTLY POSITION THE CALLIPER ON THE DISC DURING FITTING, GENTLY EXPAND THE PADS.

Recommended products

Loctite 243 Medium strength threadlock

Medium Loctite 243 threadlock

Locking torques (N*m)

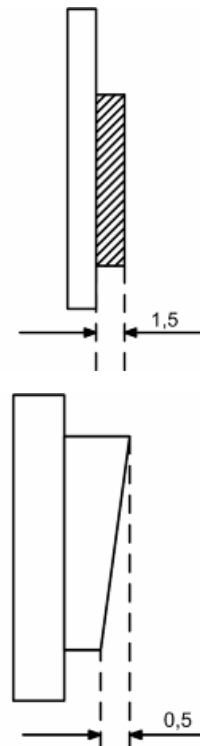
Screw tightening calliper to support 24 ÷ 27 Pad fixing pin 19.6 ÷ 24.5

Rear brake pads

Removal

Proceed as follows:

- Remove the rear brake calliper
- Loosen the two pins shown in the figure that lock the two pads.
- Remove the pads, being careful with the pad spring clamp.
- Check the thickness of the friction material of the pads.
- Replace the pads if the thickness is below the minimum value.
- The replacement must be made with greater residual thickness if the pad has not worn evenly. A 0.5 mm thickness difference in the residual friction material is permitted.



Characteristic

Minimum value

1.5 mm

Repeat the operation for the other calliper.

See also

[Front](#)
brake calliper

Refitting

To fit, proceed as follows:

- Insert the two pads in the callipers.
- Screw the two pad lock pins to the correct torque, and apply the recommended product.
- Fit the calliper on its support, tightening the two screws to the prescribed torque.

N.B.

IF IT IS NOT POSSIBLE TO CORRECTLY POSITION THE CALLIPER ON THE DISC DURING FITTING, GENTLY EXPAND THE PADS.

Recommended products

Loctite 243 Medium strength threadlock

Medium Loctite 243 threadlock

Locking torques (N*m)

Screw tightening calliper to support 24 ÷ 27 Pad fixing pin 19.6 ÷ 24.5

Fill

Rear - combined

- Remove the rubber cap from the bleed screw.
- Insert a rubber pipe in the bleed screw to permit the brake fluid to be recovered.
- With the left-hand brake lever, load the system and bring it up to the required pressure.
- Keeping the left-hand brake lever pulled, loosen the bleed screw to permit the air in the system to escape. Then tighten the bleed screw
- Repeat the operation until only brake fluid comes out of the rubber pipe.
- Remove the fluid recovery pipe and refit the rubber cap over the bleed screw.
- Top up the brake fluid to the right level in the reservoir.



If necessary, bleeding can be done using a special vacuum pump

N.B.

DURING THE BLEEDING OPERATIONS, MAKE SURE THE BRAKE FLUID DOES NOT COME INTO CONTACT WITH THE BODYWORK SO AS NOT TO DAMAGE IT. FURTHERMORE, DURING THE BLEEDING OPERATIONS REGARDING THE BRAKE CALLIPERS, MAKE SURE THE BRAKE FLUID DOES NOT COME INTO CONTACT WITH THE DISC BRAKES AND WITH THE BRAKE PADS. FAILURE TO OBSERVE THIS PRECAUTION WILL ENDANGER THE PROPER WORKING AND EFFICIENCY OF THE BRAKING SYSTEM

Specific tooling

020329Y Mity-Vac vacuum-operated pump

Locking torques (N*m)

System bleed calliper fitting: 12 ÷ 16 Nm

Front

- Remove the rubber hood from the bleed screw.
- Insert a rubber pipe in the bleed screw to permit the brake fluid to be recovered.
- With the right-hand brake lever, load the system and bring it up to the required pressure.
- Keeping the right-hand brake lever pulled, loosen the bleed screw to purge the air. Then tighten the bleed screw.



- Repeat the operation until only brake fluid comes out of the rubber pipe.
- Remove the fluid recovery pipe and refit the rubber cap over the bleed screw.
- Top up the brake fluid to the right level in the reservoir.

If necessary, bleeding can be done using a special vacuum pump

N.B.

DURING THE BLEEDING OPERATIONS, MAKE SURE THE BRAKE FLUID DOES NOT COME INTO CONTACT WITH THE BODYWORK SO AS NOT TO DAMAGE IT. FURTHERMORE, DURING THE BLEEDING OPERATIONS REGARDING THE BRAKE CALLIPERS, MAKE SURE THE BRAKE FLUID DOES NOT COME INTO CONTACT WITH THE DISC BRAKES AND WITH THE BRAKE PADS. FAILURE TO OBSERVE THIS PRECAUTION WILL ENDANGER THE PROPER WORKING AND EFFICIENCY OF THE BRAKING SYSTEM

Specific tooling

020329Y Mity-Vac vacuum-operated pump

Locking torques (N*m)

System bleed calliper fitting: 12 ÷ 16 Nm

- Repeat the operation for the other brake calliper.

Brake fluid level check

- Position the vehicle on a flat surface and on the centre stand
- Remove the brake pump cover as indicated in the photo



- Use the appropriate spyglass on the pump to check the level of the brake fluid, as shown in the photograph



- If the level is below the minimum, fill up by acting on the two screws shown in the figure.
- Remove the gasket and fill with recommended brake fluid until the spyglass is completely covered.



CAUTION



AVOID CONTACT OF THE BRAKE FLUID WITH YOUR EYES, SKIN, AND CLOTHING. IN CASE OF ACCIDENTAL CONTACT, WASH WITH WATER.

WARNING

BRAKING CIRCUIT FLUID IS HIGHLY CORROSIVE; DO NOT LET IT COME INTO CONTACT WITH PAINTED PARTS.

WARNING

BRAKE FLUID IS HYGROSCOPIC; THAT IS, IT ABSORBS MOISTURE FROM THE SURROUNDING AIR. IF THE LEVEL OF MOISTURE IN THE FLUID EXCEEDS A GIVEN VALUE, BRAKING WILL BE INEFFICIENT. THEREFORE, ALWAYS USE FLUID FROM SEALED CONTAINERS. UNDER NORMAL DRIVING AND CLIMATIC CONDITIONS YOU SHOULD CHANGE THIS FLUID EVERY TWO YEARS. IF BRAKES ARE USED INTENSELY AND/OR IN HARSH CONDITIONS, CHANGE THE FLUID MORE FREQUENTLY.

Recommended products

AGIP BRAKE 4 Brake fluid

FMVSS DOT 4 Synthetic fluid

Locking torques (N*m)

Brake pump reservoir screws 1.5 ÷ 2

Never use brake liquid in open or partially used containers.

Under standard climatic conditions, replace coolant as indicated in the scheduled maintenance table.

For refitting, carry out the removal operations but in reverse order and respect the tightening torque of the reservoir cover screws.

Front brake pump

Removal

- Remove the front handlebar cover.
- Drain off the braking system corresponding to the circuit being tested.
- Remove the two fixing screws from the brake pump to the handlebar indicated in the photograph.



- Remove the oil pipe fitting from the pump undoing the screw indicated in the figure.
- Remove the stop light switch connector



BRAKE PUMP TECHNICAL DATA

Specification	Desc./Quantity
Pump right piston diameter:	Ø 12
Pump left piston diameter:	Ø 15

Refitting

To refit, carry out the removal operations but in reverse order, observing the specified torques.

N.B.

USE NEW COPPER GASKETS ON THE JOINTS.

CAUTION

ONCE REFITTING IS FINISHED, BLEED THE SYSTEM.

Locking torques (N*m)

Pipe / brake calliper coupling 20 ÷ 25

Rear brake pump - combined

Removal

- Remove the front handlebar cover.
- Drain off the braking system corresponding to the circuit being tested.
- Remove the two fixing screws from the brake pump to the handlebar indicated in the photograph.



- Remove the oil pipe fitting from the pump undoing the screw indicated in the figure.
- Remove the stop light switch connector



BRAKE PUMP TECHNICAL DATA

Specification	Desc./Quantity
Pump right piston diameter:	Ø 12
Pump left piston diameter:	Ø 15

Refitting

To refit, carry out the removal operations but in reverse order, observing the specified torques.

N.B.

USE NEW COPPER GASKETS ON THE JOINTS.

CAUTION

ONCE REFITTING IS FINISHED, BLEED THE SYSTEM.

Locking torques (N*m)

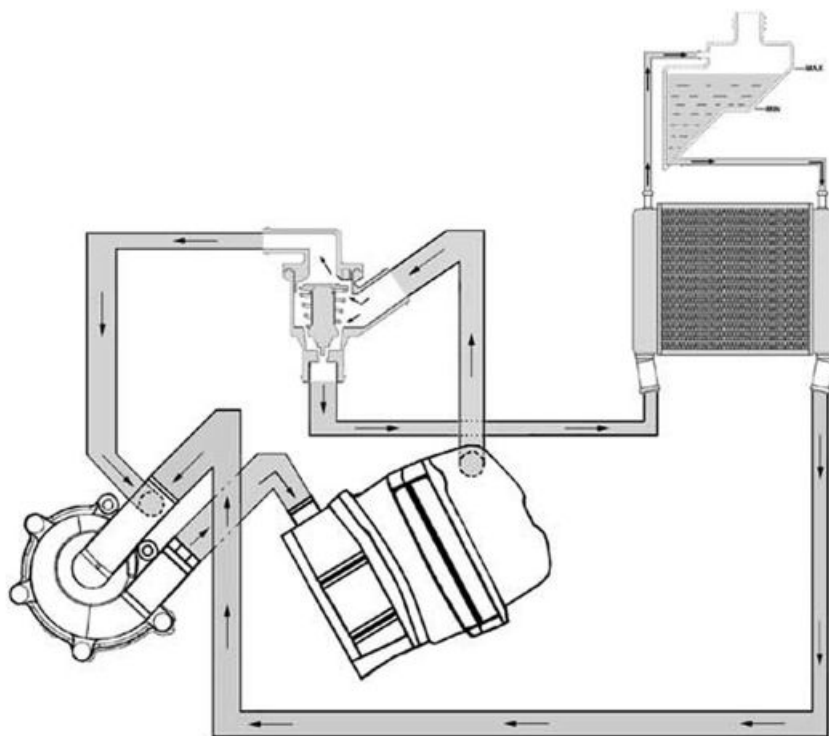
Pipe / brake calliper coupling 20 ÷ 25

INDEX OF TOPICS

COOLING SYSTEM

COOL SYS

Circuit diagram



The cooling system is a forced circulation type system, with continuous venting and air pressurisation. Circulation takes place by a centrifugal pump driven by the countershaft.

The pump delivers the coolant to the thermal group.

The two-way thermostat support is connected in output to the head. One way is connected to the pump and the other to the radiator (of the horizontal circulation type).

The radiator output is directly connected to the pump.

The expansion tank is connected in parallel to the radiator.

The radiator hot box is connected to the upper side of the expansion tank (in air).

The radiator cold box is connected to the lower side of the expansion tank (in the fluid).

When the engine is cold, the thermostat output to the radiator is closed, even though there is still a little flow for de-aeration obtained by a hole into the closing plate.

In this case, the circulation into the thermal group is active to ensure an even heating.

Once the working temperature has been reached, the main circulation on radiator and expansion tank starts.

With the small openings in the thermostat there is a flow overlapping (recirculation and main one).

When the temperature is higher, the thermostat allows excluding the recirculation to favour the main circulation.

In this case, the flow is consistent in the expansion tank as well, and this ensures a continuous automatic venting.

For the system venting during the circuit filling step, there is a special union at the top of the head (see filling rules).

To ensure cooling in case of poor dynamic ventilation, there is an electric fan controlled by the injection system.

TECHNICAL SPECIFICATIONS

Specification	Desc./Quantity
Cooling system capacity	1.7 l
Prescribed fluid	Mixture of 50% water and 50% fluid for sealed circuits
Sealing pressure	Cap calibrated at 0.9 bar

THERMOSTAT

Specification	Desc./Quantity
Type	Wax-type, with deviator
Starts opening	82 ± 2°C

ELECTRIC VENTILATION

Specification	Desc./Quantity
Type	With piston
Electric ventilation starts at	107°C
Electric ventilation stops at	103°C

WATER PUMP

Specification	Desc./Quantity
Type	Centrifugal
Control	Coaxial at the countershaft

RADIATOR

Specification	Desc./Quantity
Type	Aluminium, with horizontal circulation

EXPANSION TANK

Specification	Desc./Quantity
Calibration	Automatic bleeding, in parallel with the radiator

Electric fan check

- Connect the injection diagnostic tester and select the «ERRORS» function in this menu.
- Check any failures in the electric fan control circuit (see «Injection» chapter)

Specific tooling

020680Y Diagnosis Tool



- Select the menu on the "ACTIVE DIAGNOSIS" function and start the electric fan operation simulation (see "Injection" chapter).
- If the electric fan is certainly efficient, check the ventilation start and stop temperatures.



- Select the «PARAMETERS» function in this menu to display the coolant temperature.

Electric fan starts: 107°C

Electric fan stops: 103°C

- If non-conforming values are detected, replace the injection control unit (see «Injection» Chapter).
- If the analogue instrument temperature is close to the red zone, but the degrees indicated by the diagnostic tester are below the electric fan start temperature, check the temperature sensor on the head and the relevant injection circuit (see «Injection» chapter);



N.B.

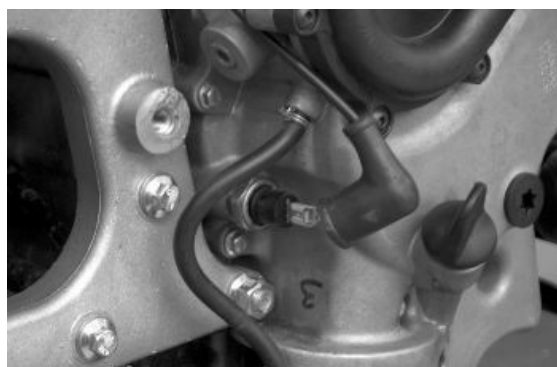
THE ELECTRIC FAN TEMPERATURE AT 107° C CAN ONLY BE MANAGED BY A SYSTEM SUPPLIED WITH A 50% MIXTURE AND PRESSURISED AT 0.9 BAR.

AVOID STARTING THE ENGINE WITHOUT PRESSURISATION SINCE IT MAY REACH THE BOILING TEMPERATURE BEFORE THE ELECTRIC FAN STARTS WORKING.

IN CASE OF AN INCREASE OF THE ELECTRIC FAN START TIME, CHECK THE THERMOSTAT OPENING TEMPERATURE AND CHECK THAT THE COOLANT DENSITY IS CORRECT. THE OPTIMUM DENSITY IS OBTAINED WITH A 50% WATER / 50% COOLING CIRCUIT FLUID MIXTURE.

System sealing check

- Check the proper circuit sealing when it is under pressure and at the temperature.
- For a more accurate check, wait until the system has cooled down since small leaks may not be visible due to evaporation
- The water pump is provided with a drainage hole in case of leaks from the cooling system mechanical seal, or from the shaft sealing oil guard.
- If coolant or oil leaks are detected, replace the pump (see «Flywheel Cover» Chapter).



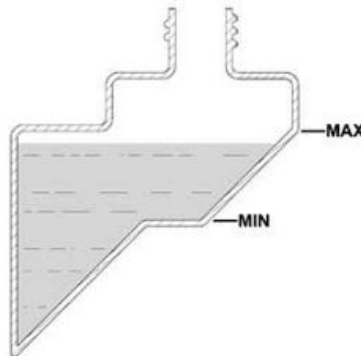
N.B.

DO NOT USE OILS OR GREASES WHILE MOUNTING THE COOLING SYSTEM. FAILURE TO OBSERVE THIS PRECAUTION WILL IRRETRIEVABLY DEFORM THE SEALING GASKETS.

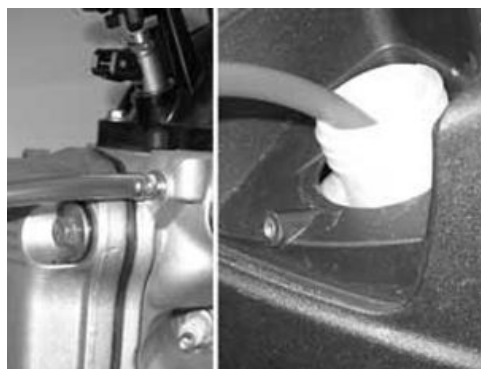
Coolant replacement

System filling instructions

- Prepare the mixture of 50% water and 50% coolant.
- Fill the system to reach a level ranging between the MIX and MAX levels indicated in the expansion tank filler.
- Do not close the expansion tank with the cap.



- Use a transparent hose to connect the venting union with the expansion tank filler.
- Loosen the vent and start the engine.



- Keep it open until the air has been fully vented.
- Close the bleed screw.
- Stop the engine.
- Restore the level into the expansion tank and tighten the cap.
- Start the engine and let it warm up to reach the electric ventilation temperature.
- Stop the engine.
- Restore the level with cold engine.

CAUTION

ELECTRIC VENTILATION IS CONTROLLED BY THE TEMPERATURE MEASURED AT THE HEAD. THE ELECTRIC VENTILATION START DOES NOT MEAN THAT THE VENTING HAS BEEN COMPLETED.

VENTING IS COMPLETE WHEN THE EXPANSION TANK TEMPERATURE RISES.

Water pump

Water pump

If noise or loss of liquid at the drain hole of the water pump is discovered, replace the flywheel cover and the water pump as described in the "Flywheel Cover" Chapter.

Proceed to carry out a few preliminary operations as described below:

- Place the vehicle on its centre stand and on flat ground.
- Remove the bodywork components as described in the "Bodywork" Chapter.
- Remove the muffler to access the flywheel cover as described in the "Removing the Engine from the Vehicle" Chapter.
- Empty the cooling system, removing the hoses located on the water pump cover and the loading cap located on the expansion tank.

CAUTION

THIS OPERATION MUST BE CARRIED OUT WHEN THE ENGINE IS COLD.

- Remove the water pump cover shown in the figure by loosening the 6 fastening screws.
- Proceed to partially drain the circuit as described in the "Engine" Chapter.
- Once the fault has been fixed and all components have been replaced, fill and purge the system again.

**N.B.**

FOR CHANGING THE COOLANT AND BLEEDING THE SYSTEM, SEE THE "COOLANT CHANGE" SECTION.

Characteristic**Cooling system**

approx. 1.8 l

Removing the water pump cover:

- Check that the water pump cover is not deformed or dented.
- Check that the sealing O-ring is in good working order.
- Otherwise, replace the component.



- Correctly fit a new O-ring, do not allow it to come into contact with grease or oil.

CAUTION

FAILURE TO OBSERVE THIS PRECAUTION WILL IRRETRIEVABLY DEFORM THE O-RING.

- Refit the water pump cover and tighten the 6 fixing screws to the prescribed torque.

Locking torques (N*m)

Water pump cover screws 3 ÷ 4

See also

[Engine](#)

Flywheel cover

Thermostat

Check

Before proceeding to disassemble, carry out a few checks:

- Connect the diagnostic tester and select the «PARAMETERS» function (see Injection chapter).
- Start the cold engine and let it warm up.
- Manually check the moment when there is a sudden increase in temperature at the output of the radiator cold box.

**N.B.**

THERE SHOULD BE A SLIGHT AND GRADUAL HEATING CAUSED BY A SMALL PASSAGE ON THE THERMOSTAT TO THE OFF POSITION.

Specific tooling

020680Y Diagnosis Tool

- Check the temperature read by the diagnostic tester.

Thermostat opening starts: approx. 80°C

- If opening occurs at different temperatures, check the thermostat.
- Remove the thermostat as described in the fly-wheel cover paragraph.



- Visually check that the thermostat exhibits no mechanical faults.
- Prepare a metal container with approx. 1 litre of water.
- Immerse the thermostat, keeping it in the centre of the container.
- Immerse the multimeter temperature probe close to the thermostat.
- Warm up the container using the heat gun.
- Heat the water and periodically pull the thermostat out until its opening becomes visible.
- Insert a thin copper wire between the seat and the thermostat closing plate.
- Keep the wire into position until locking up is perceived.



- Let water and thermostat cool down.
- Progressively heat the water keeping the thermostat immersed by the wire.
- Check the opening temperature when the thermostat is released from the wire.

Opening starts temperature approx. 82° C

Specific tooling

020331Y Digital multimeter

020151Y Air heater

- Heat up until the thermostat is completely open:

N.B.

HEATING SHOULD BE GRADUAL.

N.B.

AVOID CONTACT BETWEEN THERMOSTAT AND CONTAINER FOR A CORRECT TEST PERFORMANCE.

- If incorrect values are detected, replace the thermostat.
- Repeat the filling and bleeding procedure.



diagnosis

Excessive system pressure

- 1 - Check the expansion tank cap efficiency.

N.B.

THE CAP IS EQUIPPED WITH A PRESSURE-RELIEF VALVE CALIBRATED AT 0.9 BAR.

There is also a valve that must allow air inlet during the cooling step.

YES go to 2 NO go to 3

- 2 - Check the head gasket seal (see «Thermal group and timing system» chapter)
- 3 - Replace the cap.

Cooling fluid consumption

- 1 - Check the system outer seals as described above.

YES go to 2 NO go to 3

- 2 - Check the head gasket seal (see «Thermal group and timing system» chapter)
- If water leaks are detected in the engine oil, inspect the pad on the head cooling circuit.

3 - Fix any damaged seals.

Oil in the fluid

1 - Presence of oil in the coolant.

YES go to 2

2 - Check the head gasket seal (see «Thermal group and timing system» chapter)

INDEX OF TOPICS

CHASSIS

CHAS

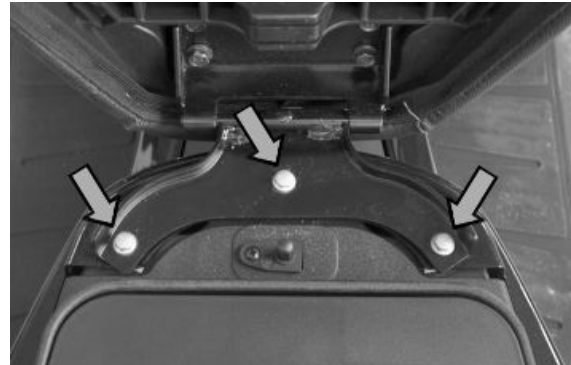
This section is devoted to the operations that can be carried out on the vehicle bodywork.

CAUTION

WE STRONGLY RECOMMEND NOT TO CLEAN THE PAINTED PLASTIC PARTS WITH SOLVENTS CONTAINING PETROL OR PETROL BY-PRODUCTS.

Seat

- Raise the saddle
- Undo the three screws fixing the plate to the central cover and remove the saddle.



Side fairings

- The scooter has two self-sticking mouldings placed on the side fairings.
 - To replace them, remove the relevant part, clean the surface accurately and apply the new moulding.
-

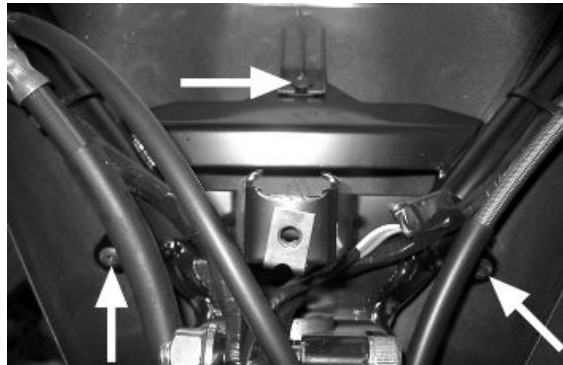
Driving mirrors

- Remove the joint rubber of the mirror housing from the bottom;
- Unscrew the two screws, then remove the covering from the support arm;
- Remove the 2 lower retainers fixings the mirror to the frame.



Rear handlebar cover

- - Remove the front handlebar cover
- Undo the 3 screws fixing the rear handlebar cover and remove the cover once the connectors of the controls have been disconnected.

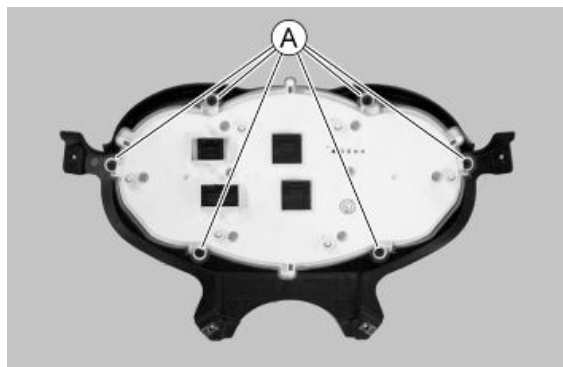


See also

[Front handlebar cover](#)

Instrument panel

- Remove the instrument panel support and tip it.
- Undo the six fixing screws «A» to remove the instrument panel.



See also

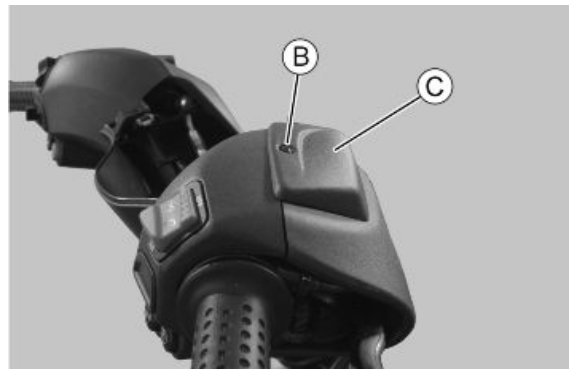
[Analogue instrument panel support](#)

Front handlebar cover

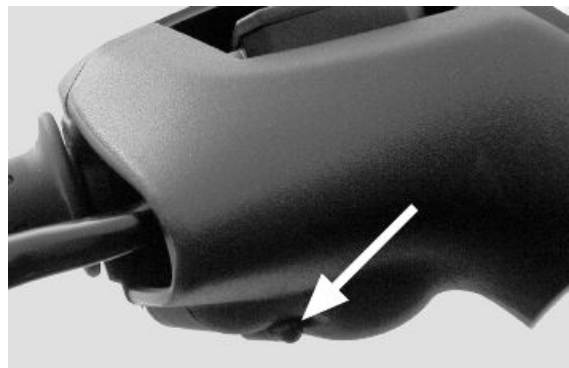
- Undo the three screws«A» fixing the handlebar upper cover and slide it off upwards.



- Undo the screw «B», then remove the cover «C» on both sides of the handlebar.

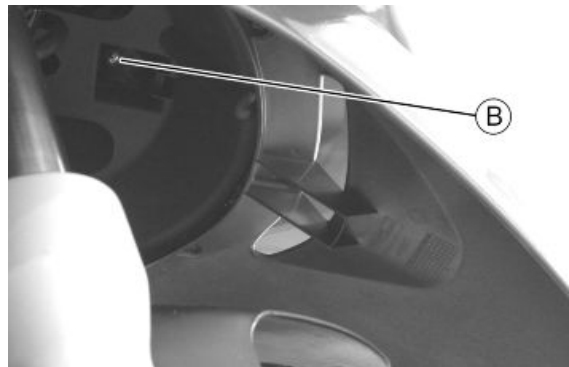


- Undo the two fixing screws at the bottom part.
- Take out the cover by pulling it upwards.



Headlight assy.

- Remove the upper cover of the headlight
- Undo the two upper fixing screws «A», the lower screw «B» and remove the headlight assembly once the connector has been removed.



For the front turn indicators:

- Undo the screw «C» and remove the plastic cover.
- Undo the screw «D» and remove the turn indicator once the connector has been removed.



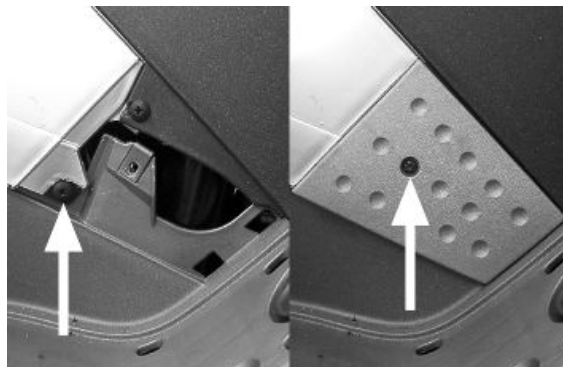
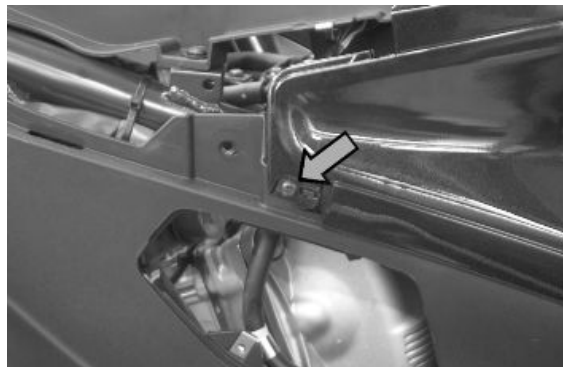
See also

[Legshield](#)

[Flyscreen](#)

Frame central cover

- Remove the saddle
- - Remove the shield back plate
- - Remove the side panels
- Undo the two rear clamping screws
- Detach the covering caps of the front screw and remove the screws



See also

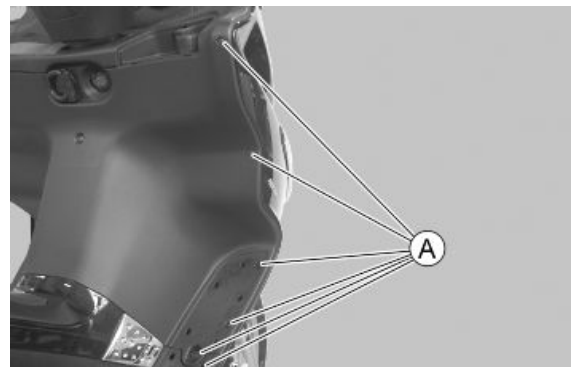
[Handles and top side fairings](#)[Seat](#)[Knee-guard](#)

Legshield

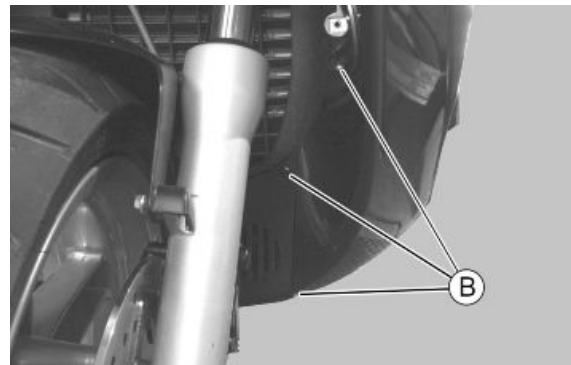
- Remove the front headlight.
- Remove the three upper retainers.



- Remove the mats on the footrest.
- Remove the ten fixing screws «A» (five per side) on the shield back plate.



- Remove the front mudguard.
- Remove the six screws «B» (four per side) fixing the shield with the radiator grille and the spoiler.
- Remove the shield.

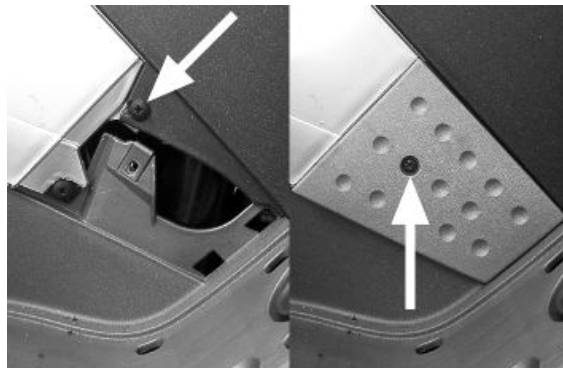
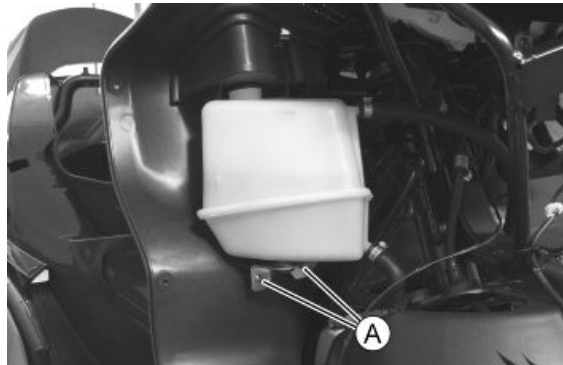


See also

[Front mudguard](#)

Knee-guard

- - Remove the front shield.
- Remove the expansion tank from the shield back plate by undoing the two screws «A» and fix it to the small front frame in such a way that it does not turn over.
- Disconnect the connectors of the MODE button and the plug socket.
- Undo the screw fixing the caps of the two lower screws and remove them.



- Remove the three fixing screws to the frame.
- Remove the instrument panel support.
- Remove the shield back plate by removing the lower part.
- To make the operation easier it might be necessary to turn the steering alternately to right and left to free the upper appendages.

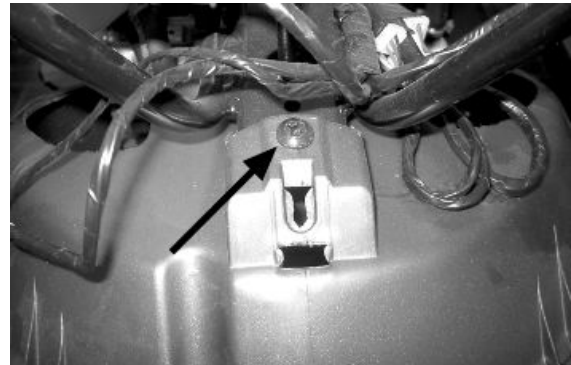


See also

[Analogue instrument panel support](#)
[Legshield](#)

Front wheel housing

- - Remove the front shield.
- Remove the front fork.
- Undo the central screw fixing the wheel house to the frame.
- Disconnect the brake pipe to the pump and slide it off.

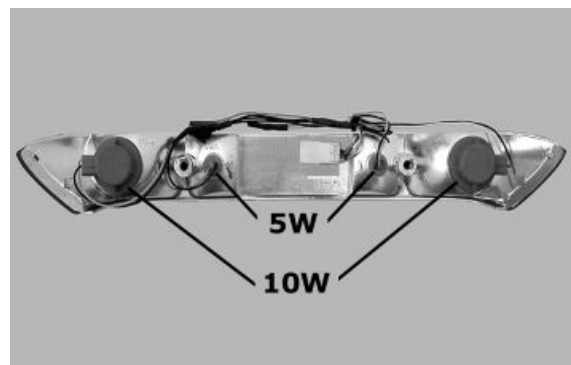


See also

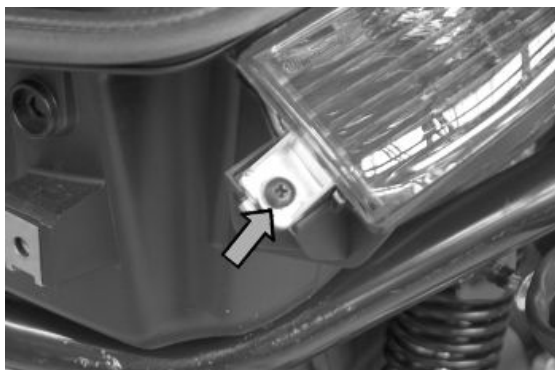
[Legshield](#)

Taillight assy.

- From inside the rear case, undo two screws «D» fixing the rear light.
 - Disconnect the connector and remove the rear light unit.
-
- Central bulbs: tail lights.
 - Side bulbs: stop lights.

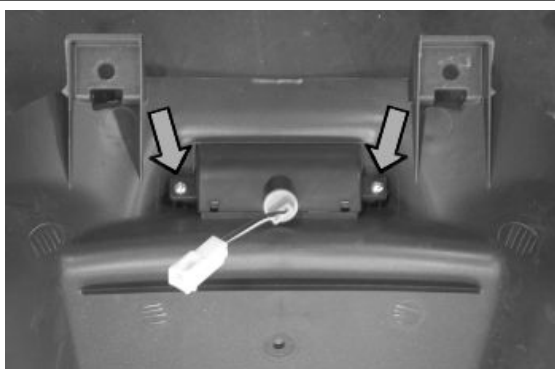


- From both sides, undo the screw indicated to remove the turn indicators.



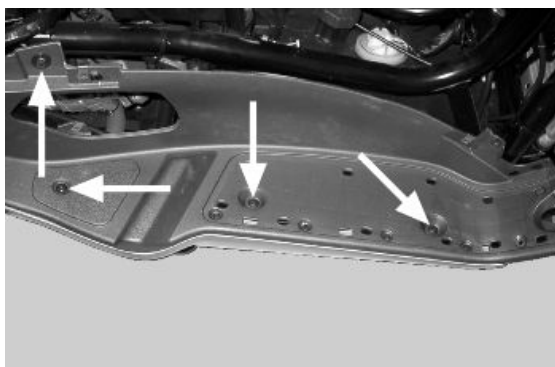
License plate light

- Remove the license plate support.
- Undo the two screws indicated to get access to the license plate light.



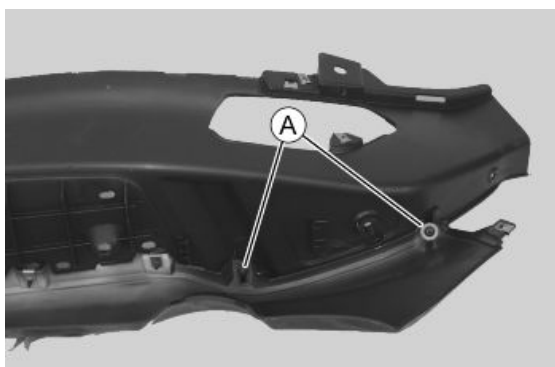
Footrest

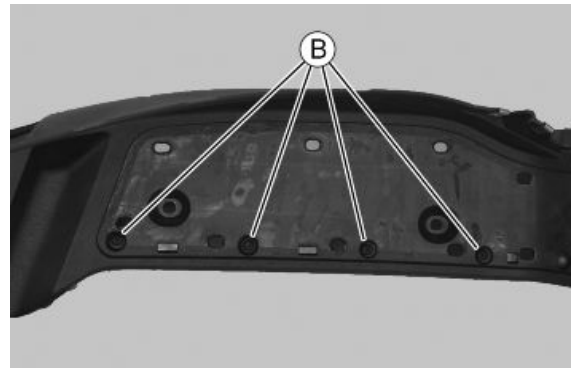
- Remove the frame central cover.
- Undo the four screws fixing the footrest, two of which are underneath the mat, and remove the footrest.



- Undo the two screws «A» on the internal side of the footrest.
- Undo the four fixing screws «B» on the edge of the footrest and remove the lower cover.

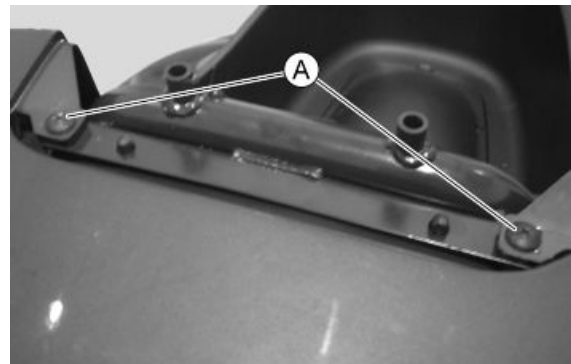
The diagram illustrates what to do on the right-hand footrest; follow the same procedure to remove the left-hand footrest.



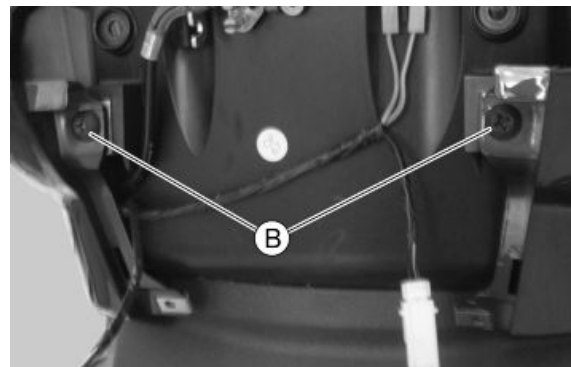
**See also**[Central cover](#)

Side fairings

- Remove the passenger grab handle.
- Remove the two upper screws «A» fixing the side fairings.



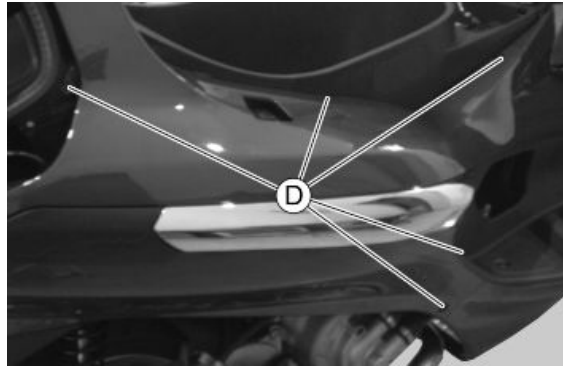
- Remove the rear light unit, then undo the two fairing fixing screws «B» underneath.



- From both sides, remove the turn indicators.
- Undo screw «C» underneath the turn indicator.



- Remove the five screws «D», then slide off the fairing by pulling it backwards to free the teeth hooking it to the central cover.



See also

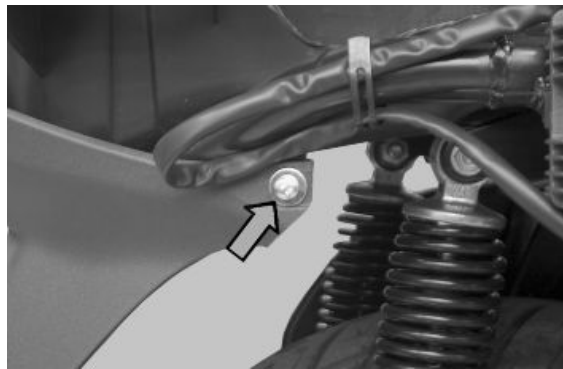
[Taillight assy.](#)

[Handles and top side fairings](#)

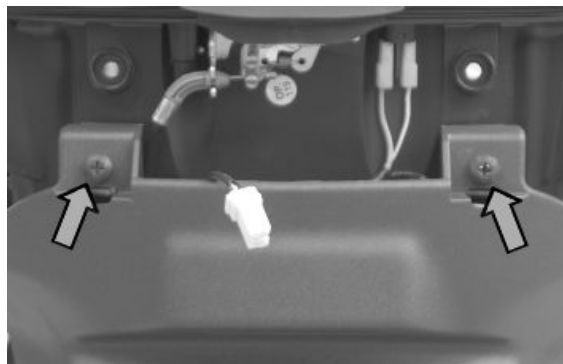
[License plate light](#)

License plate holder

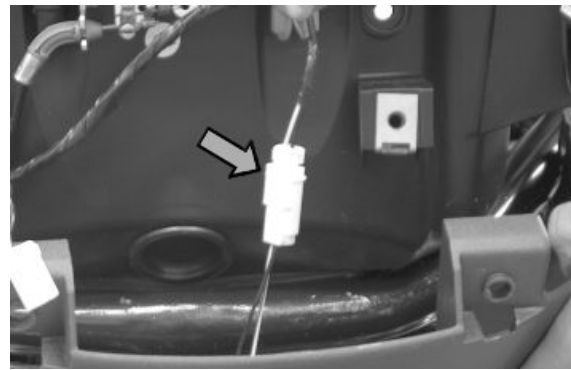
- Remove the two side screws fixing the licence plate support.



- Remove the rear light unit and undo the screws indicated.

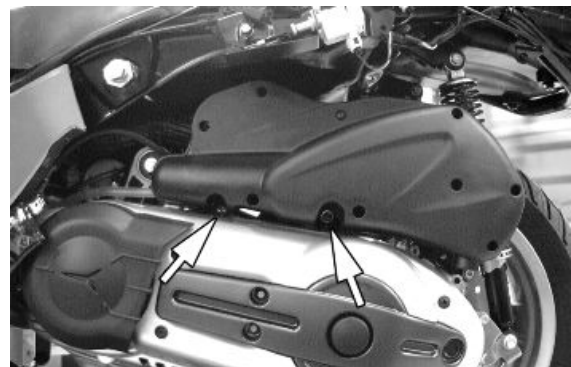


- Disconnect the license plate light connector and remove the license plate support.

**See also**[Helmet bay](#)

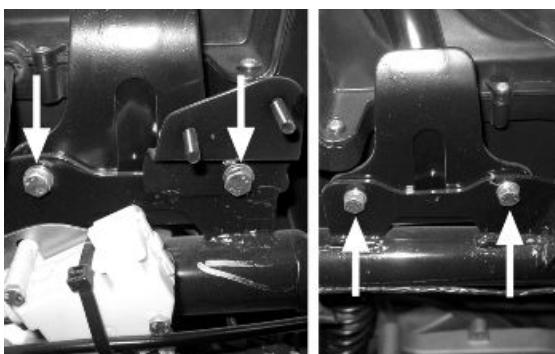
Air filter

- Remove the left fairing.
- Undo the two screws fixing the housing to the engine crankcase.
- Loosen the screw tightening the sleeve on the carburettor and slide off the sleeve.
- Push the housing upwards to free it from the appendages on the crankcase and remove it.

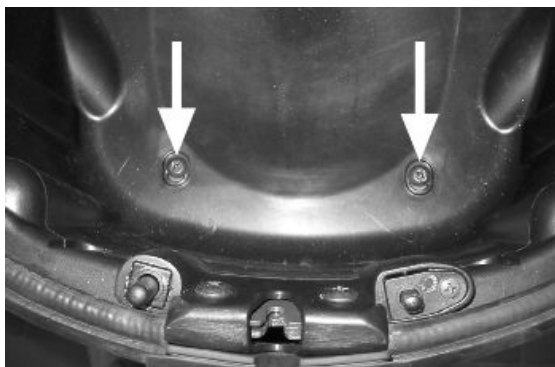
**See also**[Side fairings](#)

Helmet bay

- Remove the side fairings;
- Remove the frame central cover;
- Remove the saddle opening receiver from its support by undoing the two screws «A» on the left fairing;
- Undo the four screws fixing the frame upper pipe and remove it once the boot light connector has been removed.



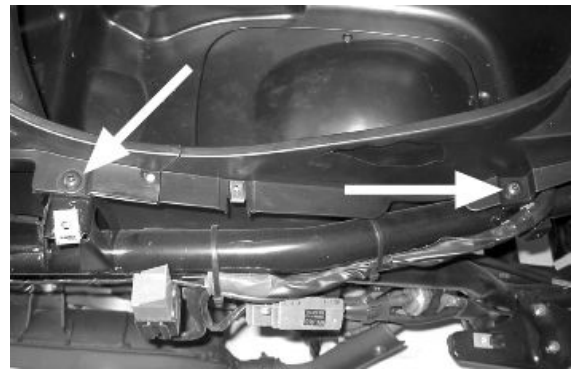
- Open the glove box flap;
- Undo the 2 screws two on the bottom of the helmet compartment.



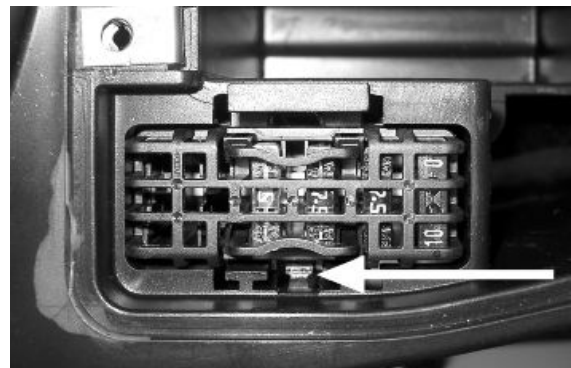
- Undo the 2 screws located in the front part of the helmet compartment.



- Undo the 4 screws (2 per side) on the sides of the helmet compartment.



- Raise the helmet compartment as much as possible;
- Disconnect the electrical connection of the two light buttons;
- Remove the glove box flap hook;
- Remove the saddle hook;
- Disconnect the spark plug HV wire.
- Pull the right and left fuse box out downwards freeing the tooth with a screwdriver from above;
- Slide off the battery positive and negative leads and the diagnostics socket from the side slots.



See also

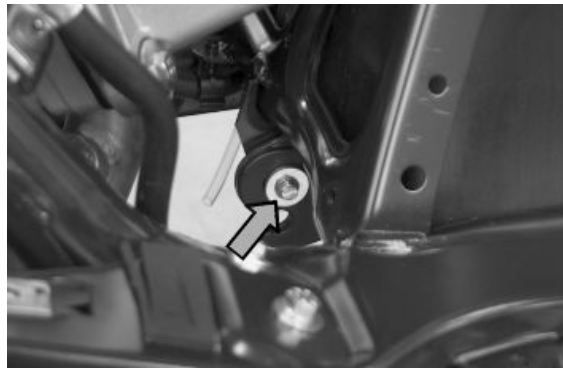
[Frame central cover](#)

[Side fairings](#)

Fuel tank

- Remove the central chassis cover.
- Remove the footrest.
- Disconnect the electric wiring and the fuel pipes.
- Remove the three tank retainers.





See also

[Footrest](#)

Front mudguard

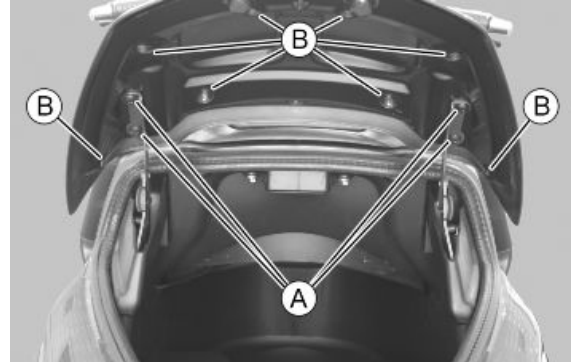
- Remove the four fixing screws «A» (two per side) on the mudguard internal side.



Top-case

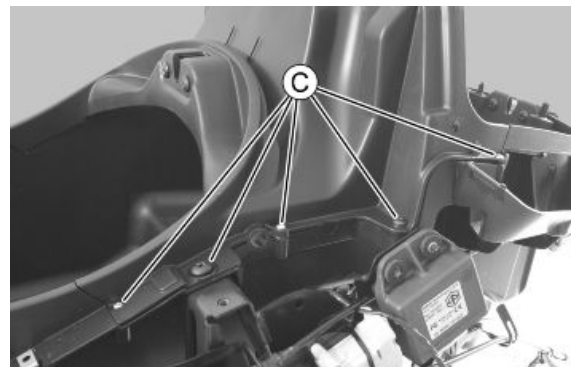
Rear

- Open the case;
- Undo the four screws «A» to remove the case cover;
- Undo the eight screws «B» to remove the plastic cover;



In order to remove the case support:

- Remove the side fairings;
- Remove the frame upper pipe;
- Undo the ten screws «C» (five per side) fixing the helmet compartment;
- First slide off the rubber rim and then remove the upper cover;



- Undo the four screws «D» (two per side) on the lower part of the case support;
- Pull up the case support to remove it.

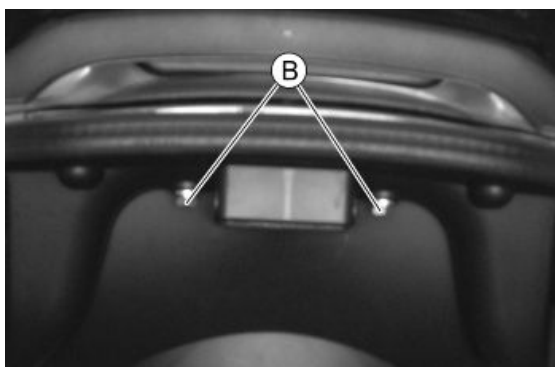
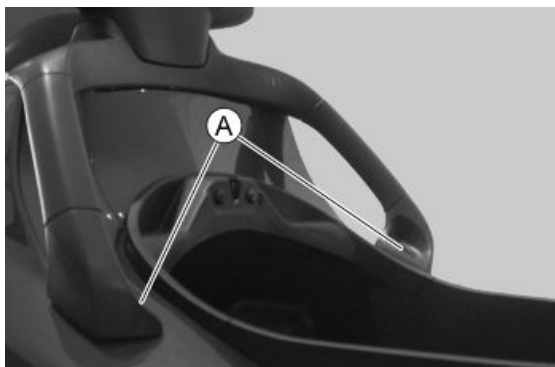


See also

[Side fairings](#)
[Helmet bay](#)

Handles and top side fairings

- Remove the passenger grab handle by undoing the two upper screws «A» and the two lower screws «B» in the helmet compartment.

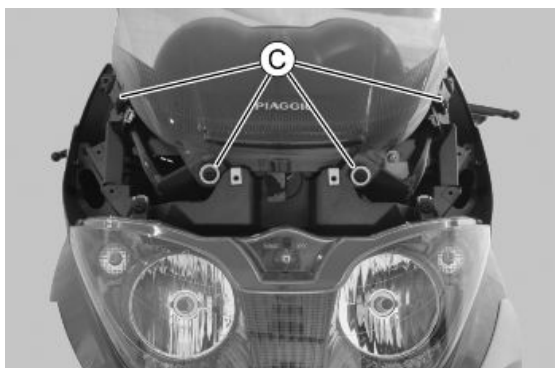


Flyscreen

- Remove the rear-view mirrors;
- Undo the four fixing screws «A» and the screw «B», then take out the cover.



- Remove the four screws «C» fixing the windshield;
- Remove the windshield being careful to collect the washers supporting the rubber support blocks.



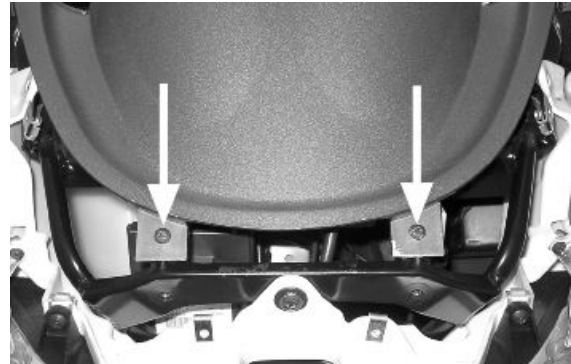
See also

[Driving](#)

mirrors

Analogue instrument panel support

- Remove the windshield;
- - Remove the front shield.
- Undo the two front screws.



- Undo the two screws «A» at the side of the handlebar cover and the two screws «B» on the upper part of the shield back plate;
- Detach the cover from the front frame;
- Remove the two instrument panel connectors;
- Remove the entire assembly.



See also

[Legshield](#)

[Flyscreen](#)

INDEX OF TOPICS

PRE-DELIVERY

PRE DE

Carry out the listed tests before delivering the vehicle.

WARNING

BE VERY CAREFUL WHEN HANDLING FUEL.

Aesthetic inspection

Appearance check:

- Paintwork
- Fitting of plastics
- Scratches
- Dirt

Tightening torques inspection

Lock check

- Safety locks

SAFETY LOCKS

Name	Torque in Nm
Upper shock absorber clamp	33 ÷ 41
Lower shock absorber clamp	33 ÷ 41
Front wheel axle	45 ÷ 50
Rear wheel axle	104 ÷ 126
Rear brake disc mounting	11 ÷ 13
Engine - chassis fixing pin	100 - 120
Fixing screw handlebar to steering tube	45 ÷ 50
Upper steering ring nut	36 - 39
Steering lower ring nut	10 - 13 **

** tighten and loosen by 90°

- Cover retaining screws

Electrical system

Electrical System:

- Main switch
- Headlamps: high beams, low beams, side/taillights (front and rear) and relevant warning lights
- Adjusting the headlights according to the regulations currently in force
- Front and rear stop light buttons and bulb
- Turn indicators and their warning lights
- Instrument lighting
- Instrument panel: fuel and temperature indicator
- Instrument panel warning lights
- Horn
- Electric start-up
- Engine stop by emergency stop switch and side stand

- Saddle electric opening button

CAUTION

TO ENSURE MAXIMUM PERFORMANCE, THE BATTERY MUST BE CHARGED BEFORE USE. INADEQUATE CHARGING OF THE BATTERY WITH A LOW LEVEL OF ELECTROLYTE BEFORE IT IS FIRST USED SHORTENS THE LIFE OF THE BATTERY.

CAUTION

WHEN INSTALLING THE BATTERY, CONNECT THE POSITIVE CABLE BEFORE CONNECTING THE NEGATIVE ONE, AND PERFORM THE REVERSE OPERATION UPON REMOVAL.

WARNING

BATTERY ELECTROLYTE IS TOXIC AND IT MAY CAUSE SERIOUS BURNS. IT CONTAINS SULPHURIC ACID. AVOID CONTACT WITH YOUR EYES, SKIN AND CLOTHING.

IN CASE OF CONTACT WITH YOUR EYES OR SKIN, RINSE WITH ABUNDANT WATER FOR ABOUT 15 MINUTES AND SEEK IMMEDIATE MEDICAL ATTENTION.

IF IT ACCIDENTALLY SWALLOWED, IMMEDIATELY DRINK LARGE QUANTITIES OF WATER OR VEGETABLE OIL. SEEK IMMEDIATE MEDICAL ATTENTION.

BATTERIES PRODUCE EXPLOSIVE GASES; KEEP THEM AWAY FROM NAKED FLAMES, SPARKS AND CIGARETTES. IF THE BATTERY IS CHARGED IN A CLOSED PLACE, TAKE CARE TO ENSURE ADEQUATE VENTILATION. ALWAYS PROTECT YOUR EYES WHEN WORKING CLOSE TO BATTERIES.

KEEP OUT OF THE REACH OF CHILDREN

CAUTION

NEVER USE FUSES WITH A CAPACITY HIGHER THAN THE RECOMMENDED CAPACITY. USING A FUSE OF UNSUITABLE RATING MAY SERIOUSLY DAMAGE THE VEHICLE OR EVEN CAUSE A FIRE.

Levels check

Level check:

- Hydraulic brake system liquid level.
- Rear hub oil level
- Engine coolant level
- Engine oil level

Road test

Test ride

- Cold start
- Instrument operations
- Response to the throttle control
- Stability on acceleration and braking
- Rear and front brake efficiency
- Rear and front suspension efficiency
- Abnormal noise

Static test

Static test after test ride:

- Restarting when warmed up
 - Starter operation
 - Minimum hold (turning the handlebar)
 - Uniform turning of the steering
 - Possible leaks
 - Operation of the radiator electric fan
-

Functional inspection

Operating test:

- Hydraulic brake system
- Lever travel
- Clutch - Check for correct operation
- Engine - Check for correct general operation and make sure there is no unusual noise
- Other
- Check documents:
- Check the frame and engine numbers
- Check tool kit
- License plate fitting
- Check locks
- Check tyre pressures
- Installation of mirrors and any accessories

CAUTION

NEVER EXCEED THE RECOMMENDED INFLATION PRESSURES OR TYRES MAY BURST.

CAUTION

CHECK AND ADJUST TYRE PRESSURE WITH TYRES AT AMBIENT TEMPERATURE.

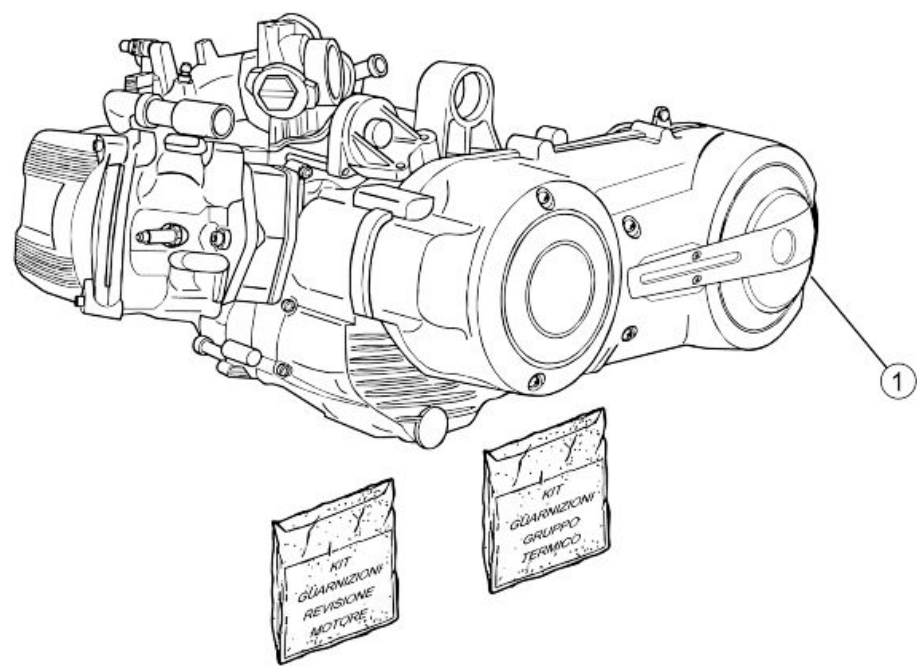
INDEX OF TOPICS

TIME

TIME

This section is devoted to the time necessary to carry out repairs.
For each operation, the description, code and time envisages are specified.

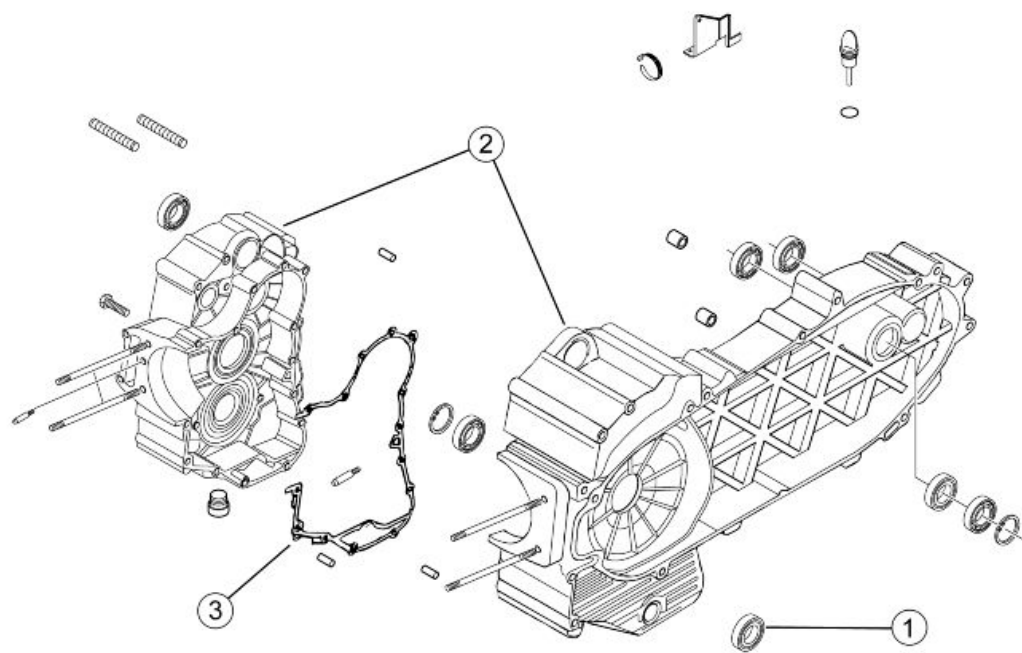
Engine



ENGINE

	Code	Action	Duration
1	001001	Engine to chassis - Replacement	

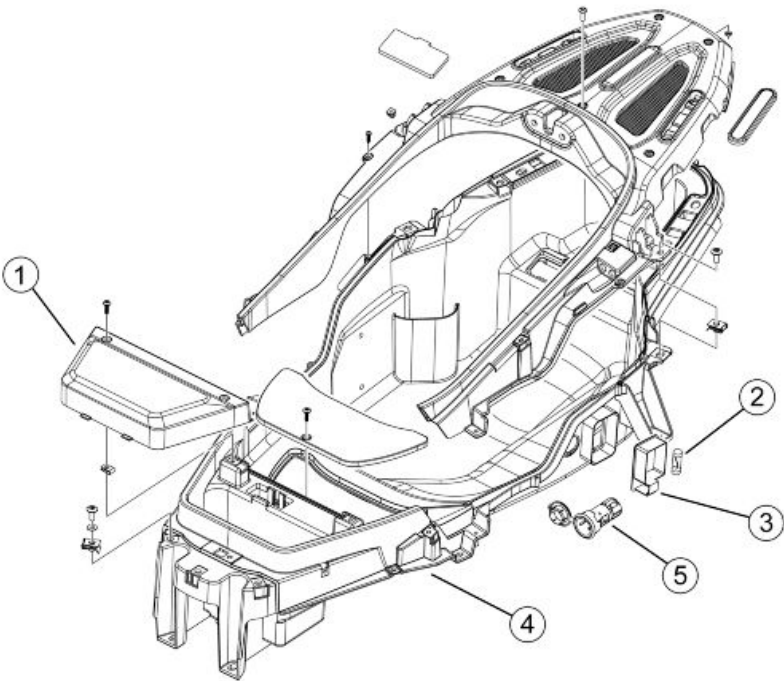
Crankcase



CRANKCASE

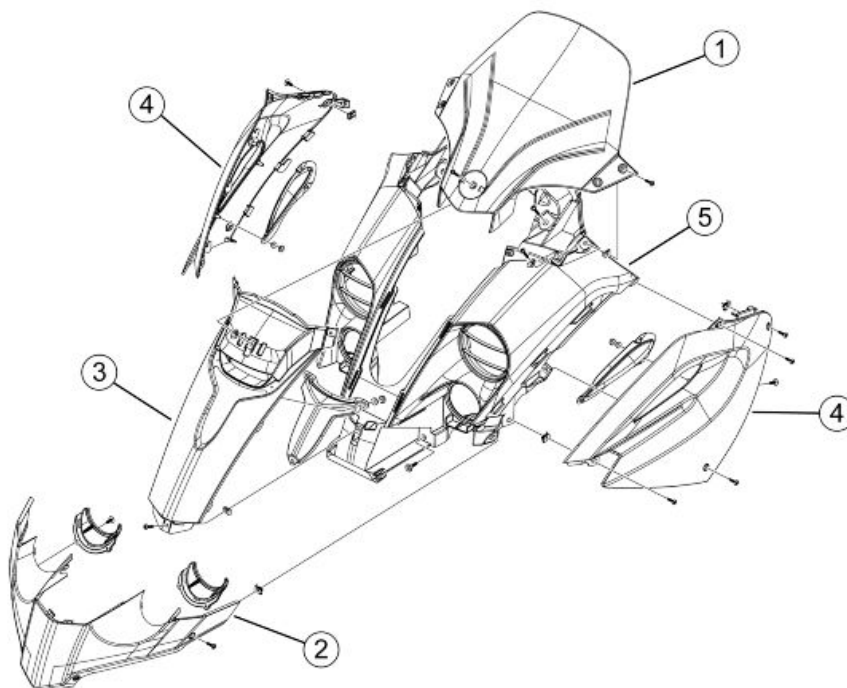
	Code	Action	Duration
1	001100	Oil seal, clutch side - Replacement	
2	001133	Engine crankcase - Replacement	
3	001153	Crankcase half gasket - Replacement	

Crankshaft



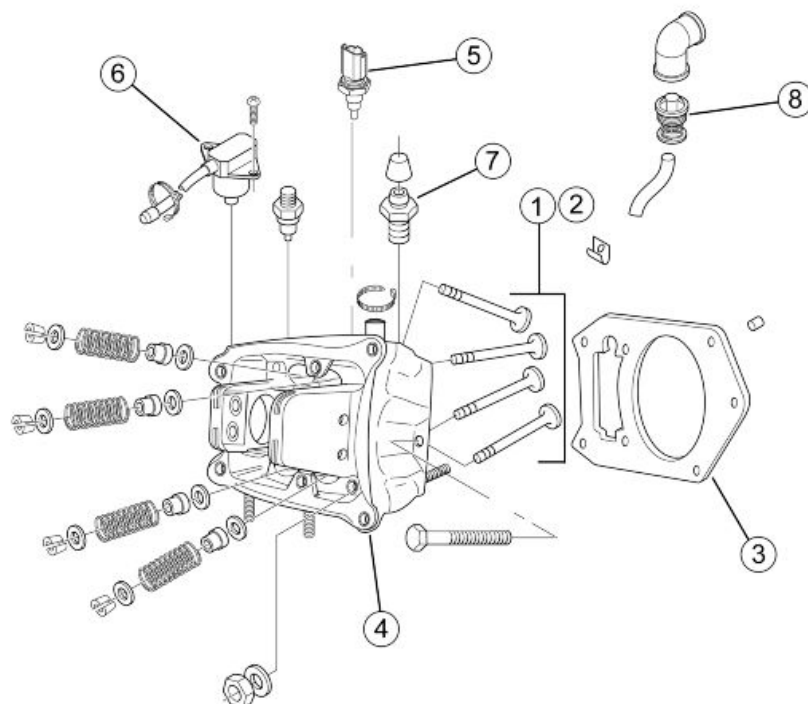
CRANKSHAFT

	Code	Action	Duration
1	001117	Crankshaft - Replacement	
2	001098	Countershaft - Replacement	

Cylinder assy.**CYLINDER ASSEMBLY**

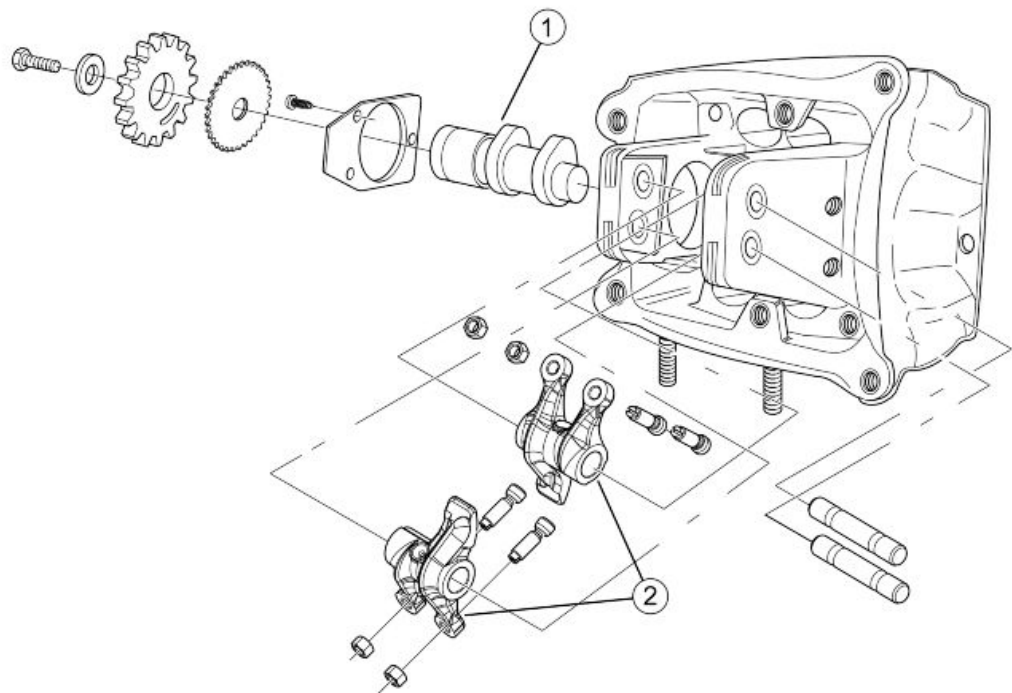
	Code	Action	Duration
1	001002	Cylinder / Piston - Replacement	
2	001154	Pistonsrings-pin assembly - Service	
3	001129	Chain tensioner - Service and Replacement	

Cylinder head assy.

**HEAD UNIT**

	Code	Action	Duration
1	001045	Valves - Replacement	
2	001049	Valves - Adjustments	
3	001056	Head gasket - Replacement	
4	001126	Head - Replacement	
5	832541	Water temperature sensor - Replacement	
6	005116	Rpm timing sensor - Replacement	
7	007012	Coolant bleed valve - Replacement	
8	001057	Thermostat - Replacement	

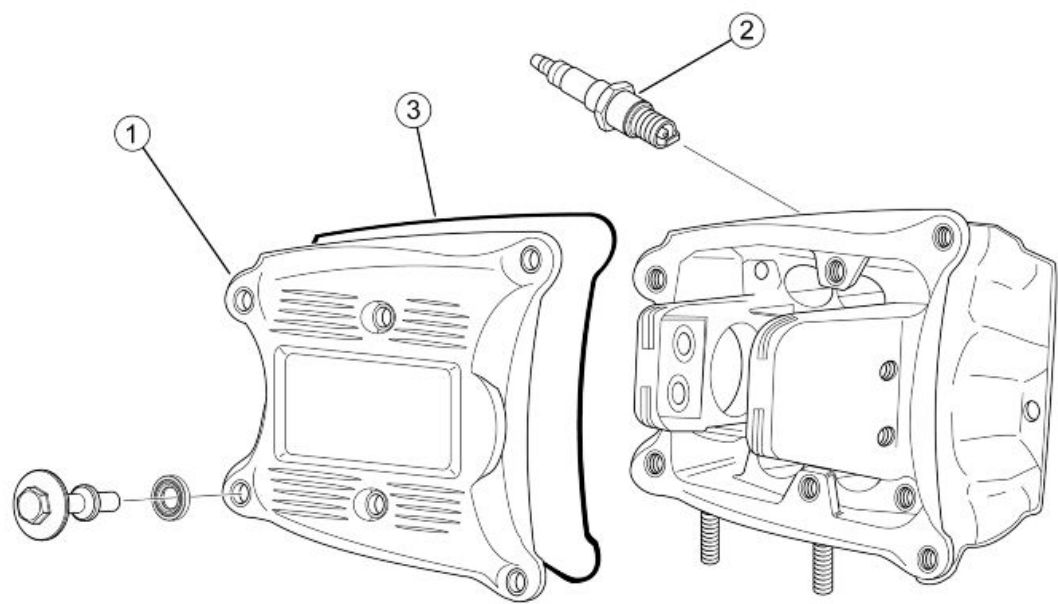
Rocker arms support assy.



ROCKING LEVER SUPPORT UNIT

	Code	Action	Duration
1	001044	Camshaft - Replacement	
2	001148	Valve rocking levers - Replacement	

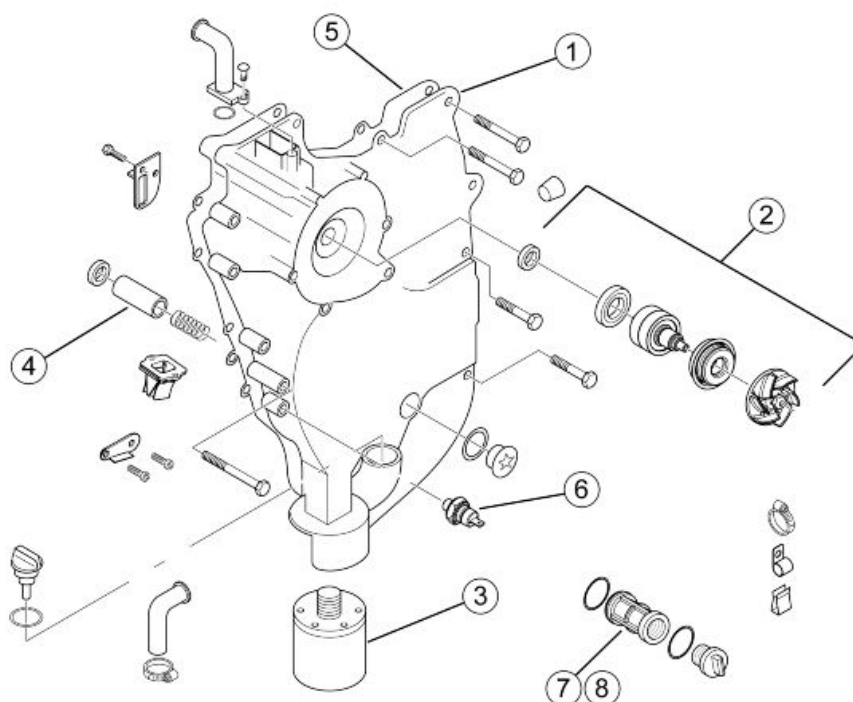
Cylinder head cover



HEAD COVER

	Code	Action	Duration
1	001089	Head cover - Replacement	
2	001093	Spark plug - Replacement	
3	001088	Head cover gasket - Replacement	

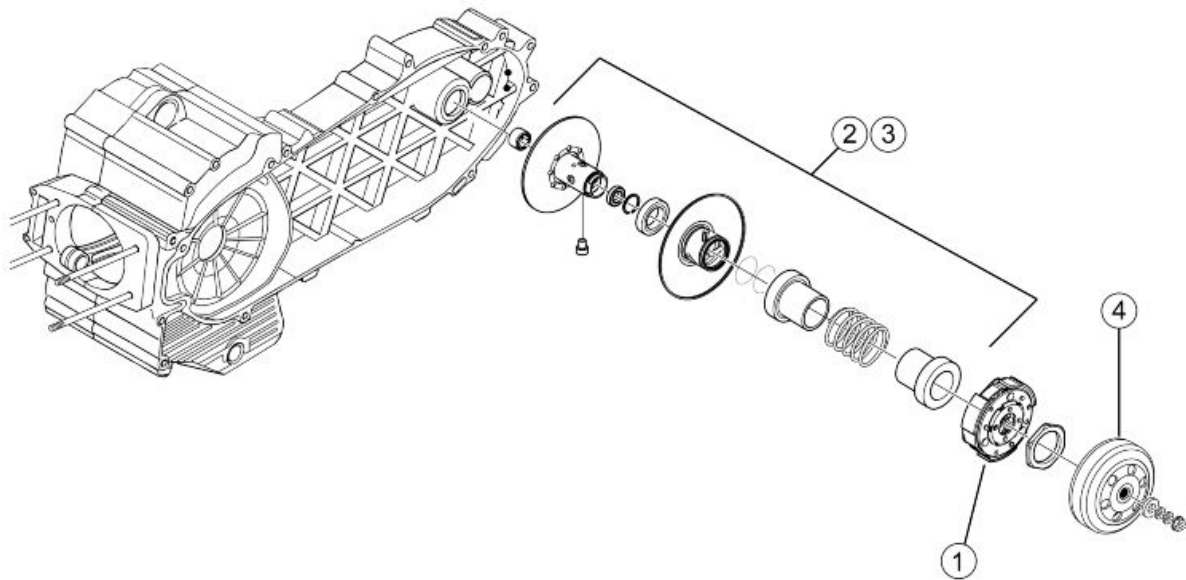
Flywheel cover



FLYWHEEL COVER

	Code	Action	Duration
1	001087	Flywheel cover - Replacement	
2	001113	Water pump - Replacement	
3	001123	Oil filter -Replacement	
4	001124	By-pass valve - Replacement	
5	001150	Flywheel cover gasket - change	
6	001160	Minimum oil pressure sensor - Re- placement	
7	001102	Net oil filter - change / Cleaning	
8	003064	Engine oil - change	

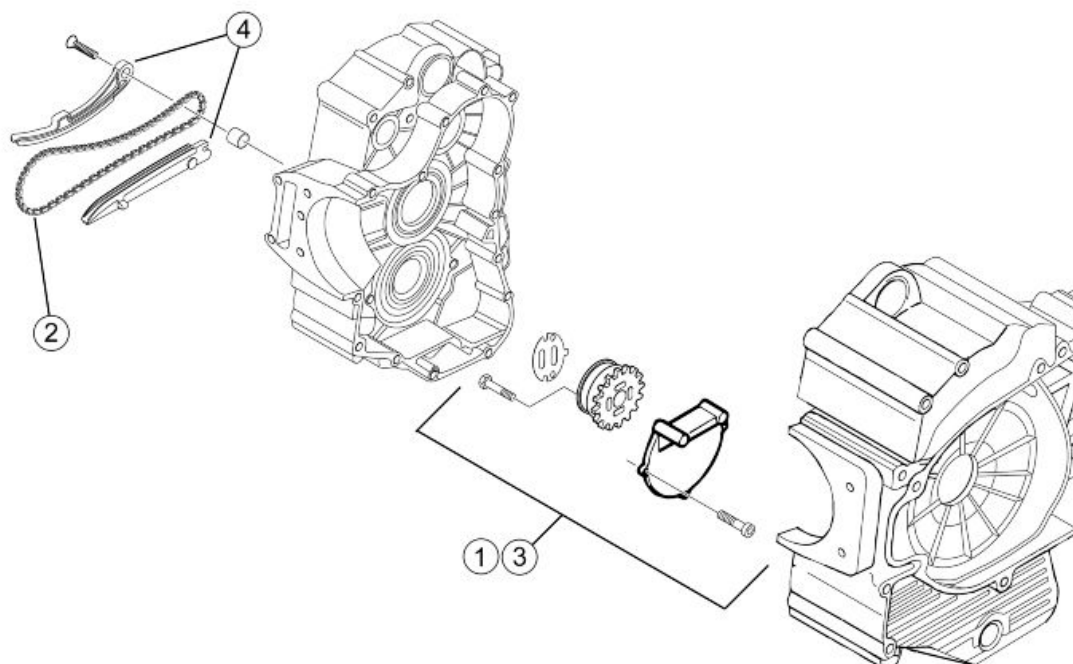
Driven pulley



DRIVEN PULLEY

	Code	Action	Duration
1	001022	Clutch - Replacement	
2	001012	Driven pulley - Overhaul	
3	001110	Driven pulley - Replacement	
4	001155	Clutch bell housing - Replacement	

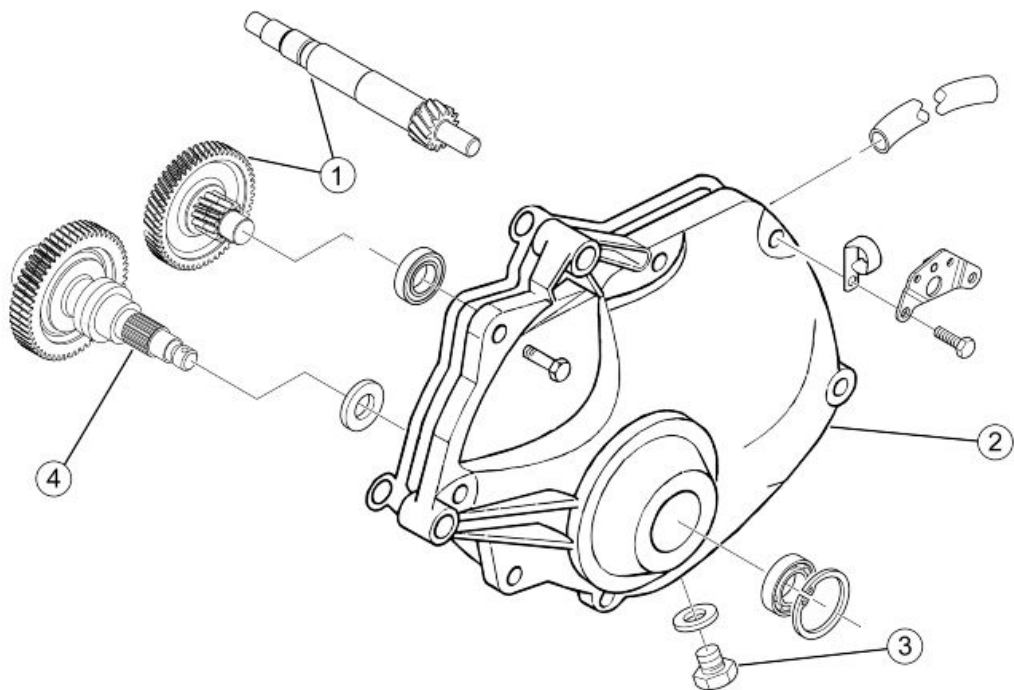
Oil pump



OIL PUMP

	Code	Action	Duration
1	001042	Oil pump - overhaul	
2	001051	Belt/ Timing chain - Replacement	
3	001112	Oil pump - change	
4	001125	Chain guide pads - Replacement	

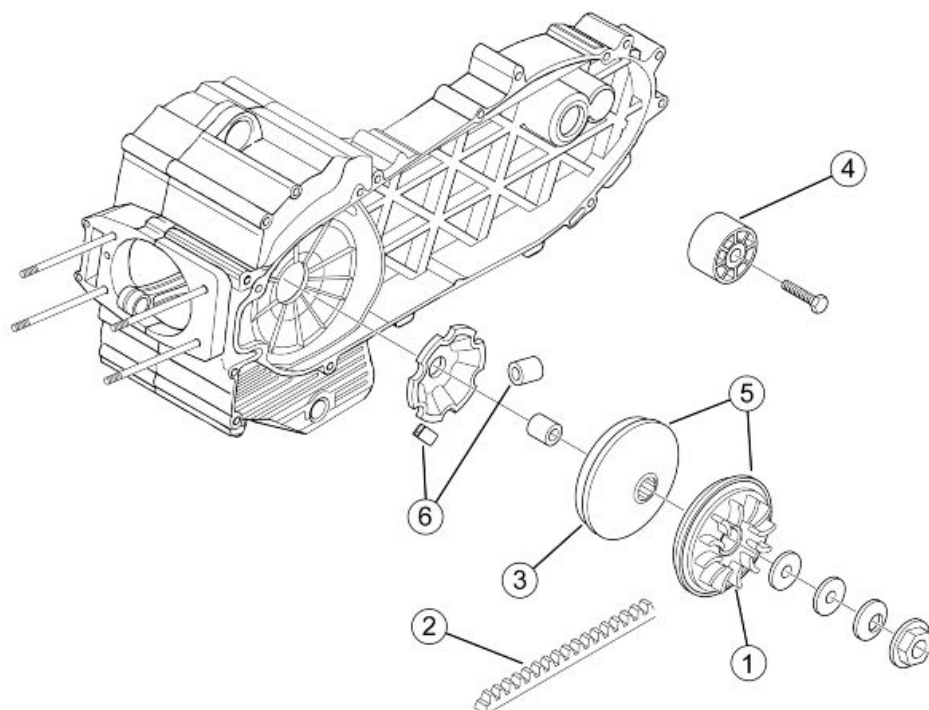
Final gear assy.



FINAL REDUCTION GEAR ASSEMBLY

	Code	Action	Duration
1	001010	Geared reduction unit - Service	
2	001156	Gear reduction unit cover - Replacement	
3	003065	Gear box oil - Replacement	
4	004125	Rear wheel axle - Replacement	

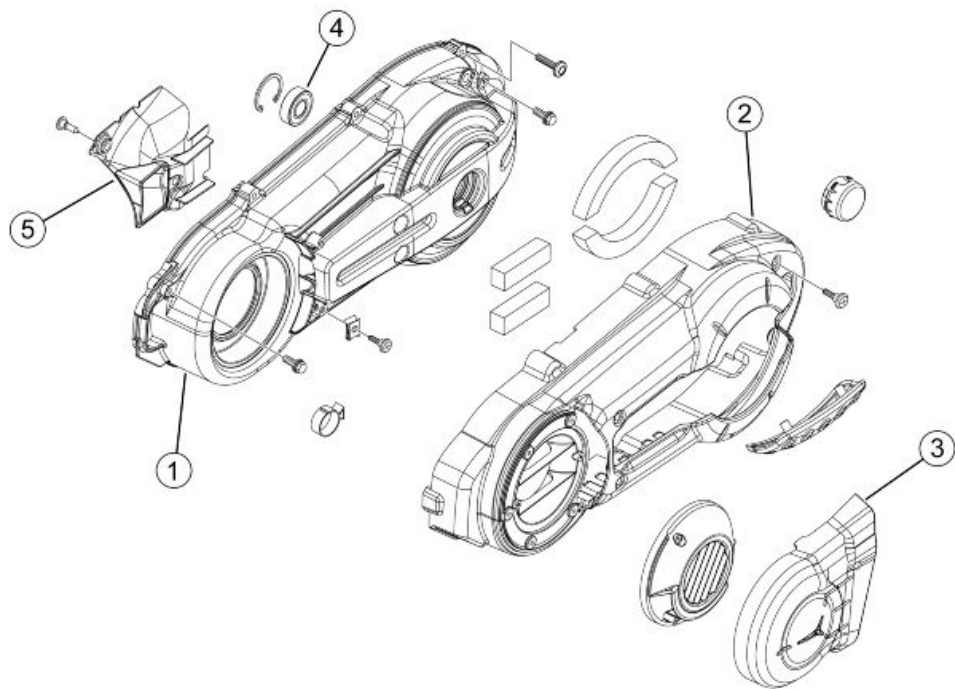
Driving pulley



REAR-VIEW PULLEY

	Code	Action	Duration
1	001086	Driving half-pulley - Replacement	
2	001011	Driving belt - Replacement	
3	001006	Driving pulley - Service	
4	001141	Belt anti-flapping roller - Replacement	
5	001066	rear-view pulley - Replacement	
6	001177	Variator rollers / shoes - Replacement	

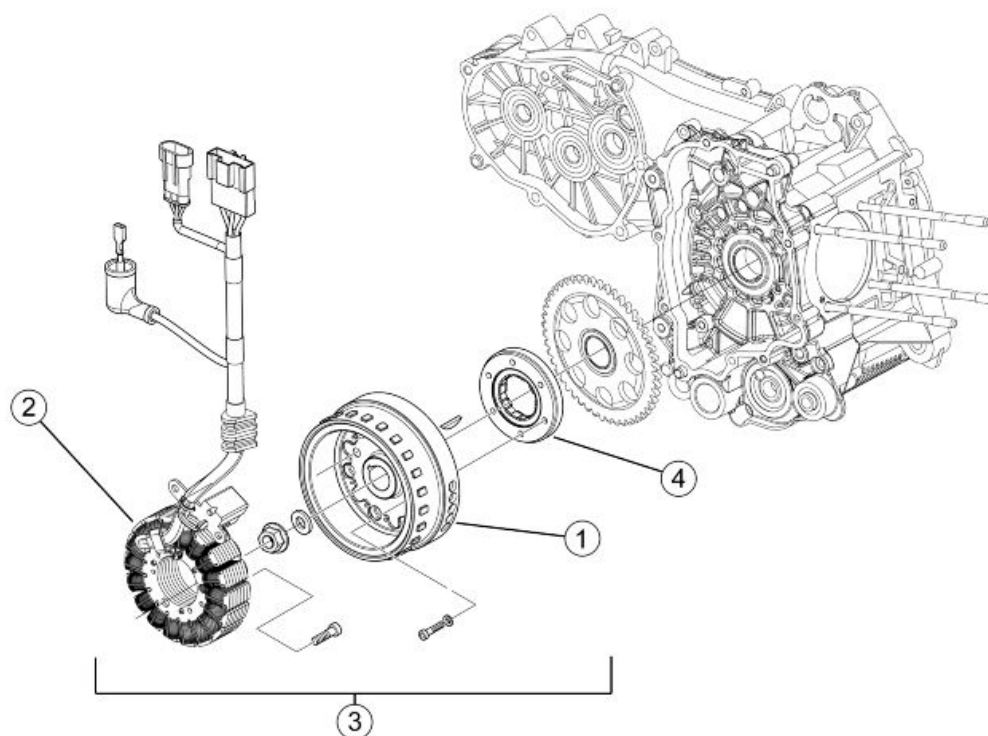
Transmission cover



TRANSMISSION COVER

	Code	Action	Duration
1	001065	Internal transmission cover - Replacement	
2	001096	External transmission cover - Replacement	
3	001131	Transmission air intake - Replacement	
4	001135	Transmission cover bearing - Replacement	
5	001170	Air manifold - replacement	

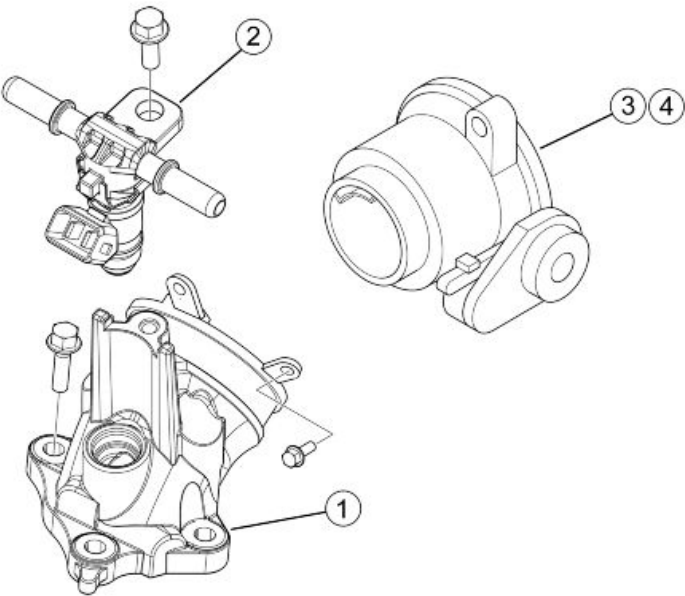
Flywheel magneto



MAGNETO FLYWHEEL

	Code	Action	Duration
1	001173	Rotor - Replacement	
2	001067	Stator - Replacement	
3	001058	Flywheel - Replacement	
4	001104	Start-up freewheel - Replacement	

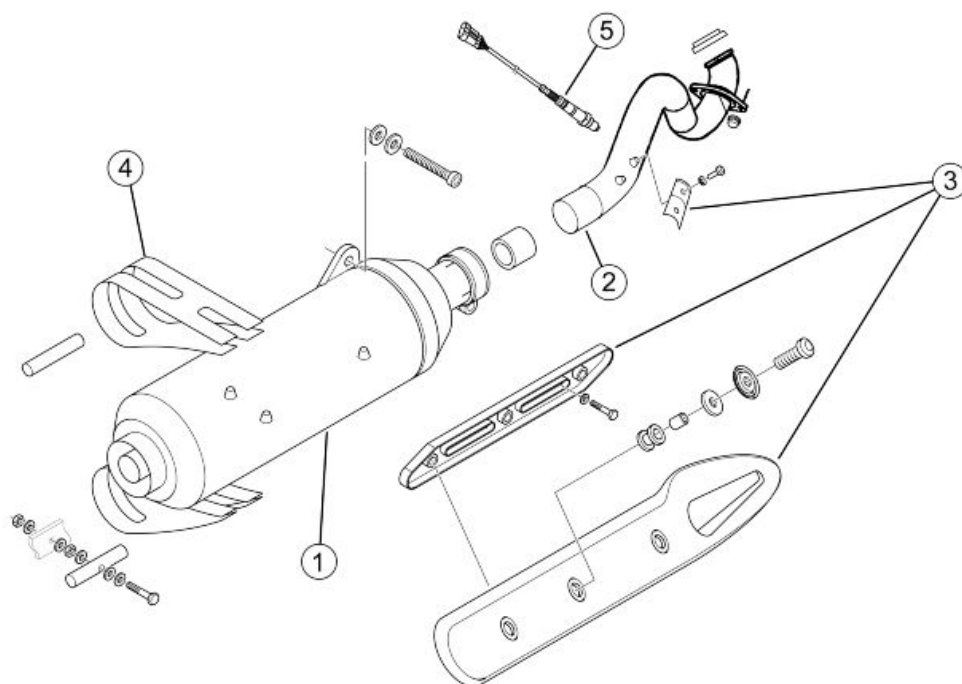
Butterfly valve



THROTTLE BODY

	Code	Action	Duration
1	001013	Intake manifold - Replacement	
2	001047	Injector - Replacement	
3	001166	Throttle body - Replacement	
4	001171	Throttle body - Service/cleaning	

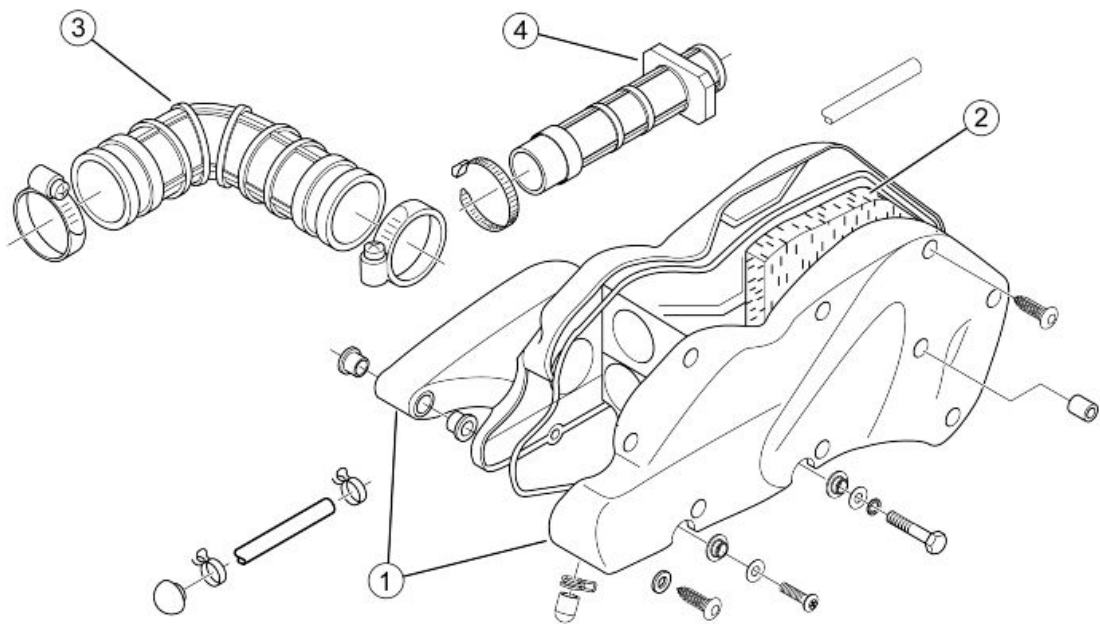
Exhaust pipe



MUFFLER

	Code	Action	Duration
1	001009	Muffler - Replacement	
2	001092	Exhaust manifold - Replacement	
3	001095	Muffler guard - Replacement	
4	004169	Muffler guard - Replacement	
5	005138	Lambda probe - Replacement	

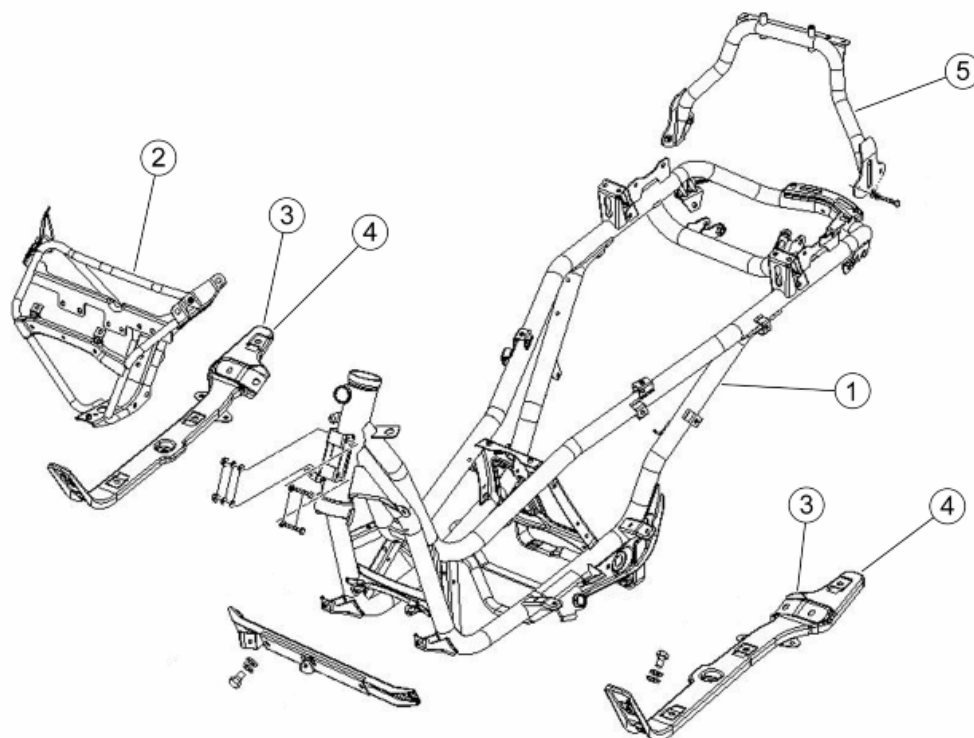
Air cleaner



AIR CLEANER

	Code	Action	Duration
1	001015	Air filter box - Replacement	
2	001014	Air filter - Replacement / cleaning	
3	004122	Cleaner / Throttle body union - Replacement	
4	001027	Body / air cleaner union - Replacement	

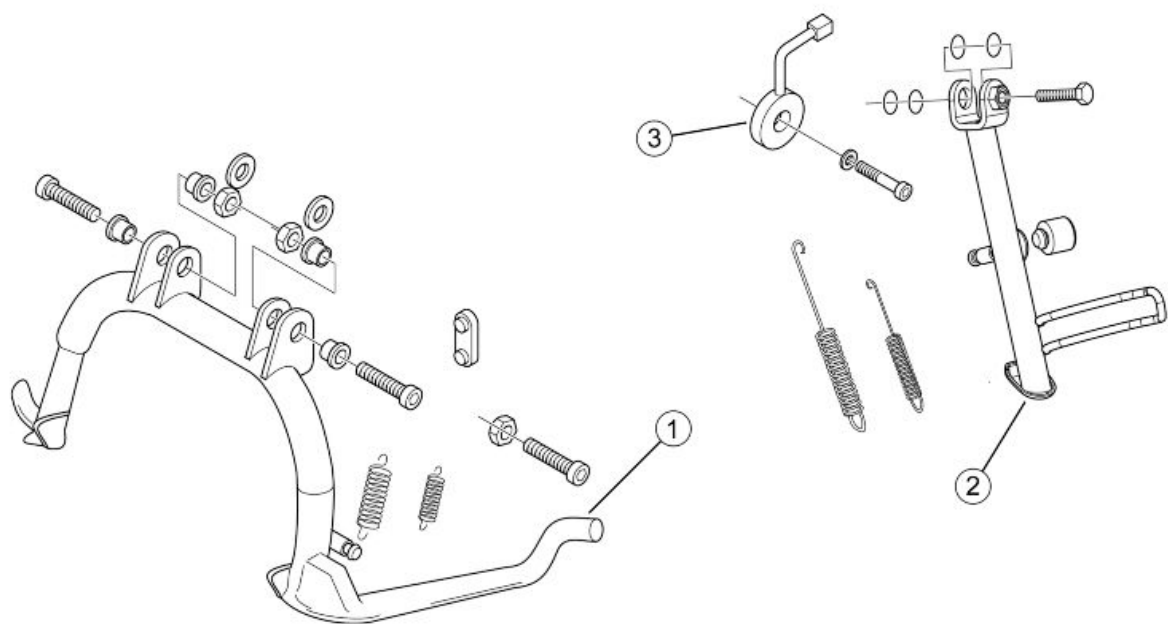
Frame



CHASSIS

	Code	Action	Duration
1	004001	Frame - Replacement	
2	004146	Front frame - Replacement	
3	004147	footboard support bracket one side - Replacement	
4	004148	Footrest support bracket, both sides - Replacement	
5	004116	Rear frame - Replacement	

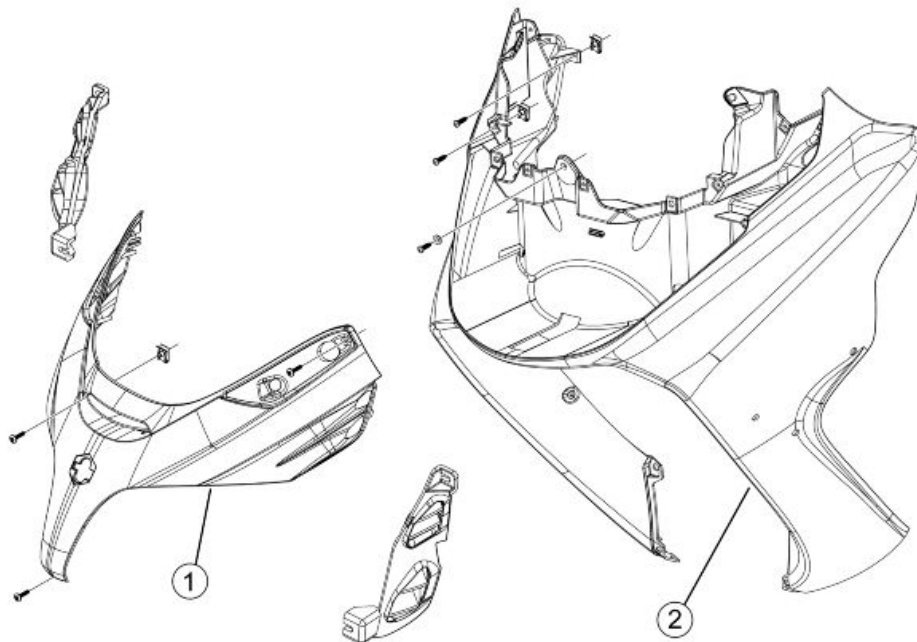
Centre-stand



SIDE/CENTRAL STAND

	Code	Action	Duration
1	004004	Stand - Replacement	
2	004102	Side stand - Replacement	
3	005079	Side stand switch - Replacement	

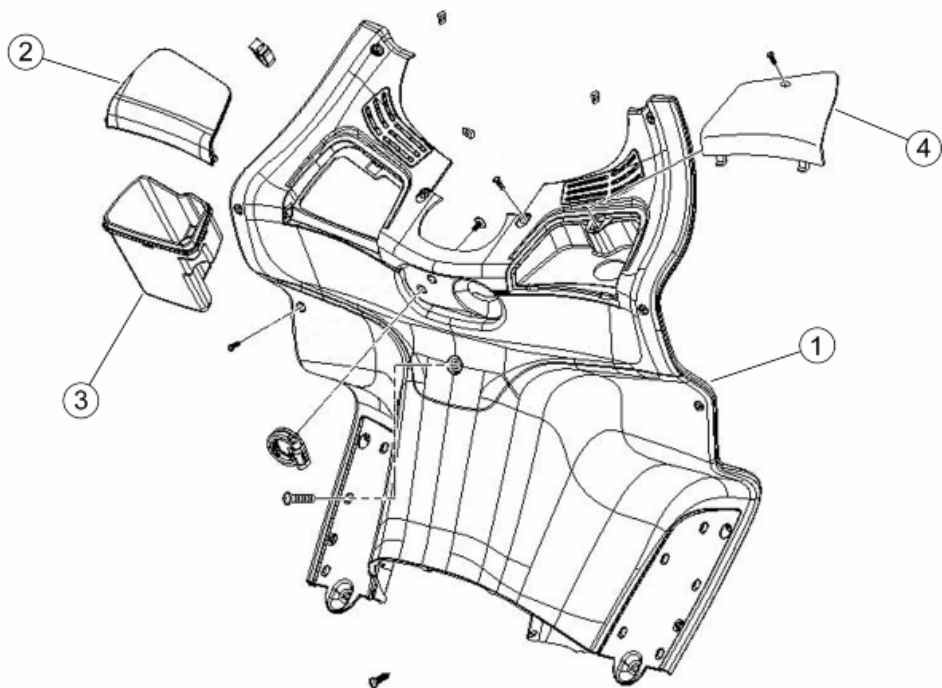
Legshield spoiler



FRONT SHIELD

	Code	Action	Duration
1	004020	Headlight frame - Replacement	
2	004064	Legshield - Replacement	

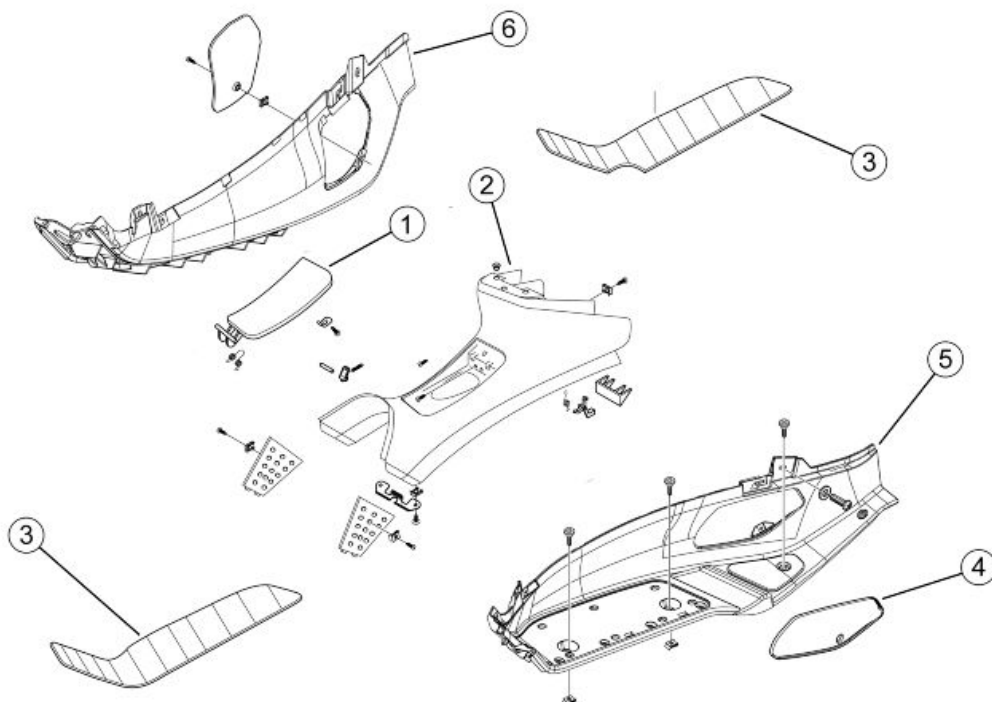
Rear cover



SHIELD BACK PLATE

	Code	Action	Duration
1	004065	Shield back plate - Replacement	
2	004156	Glove box flap and/or support - Replacement	
3	004145	Glove box - Replacement	
4	007024	Expansion tank cap - Replacement	

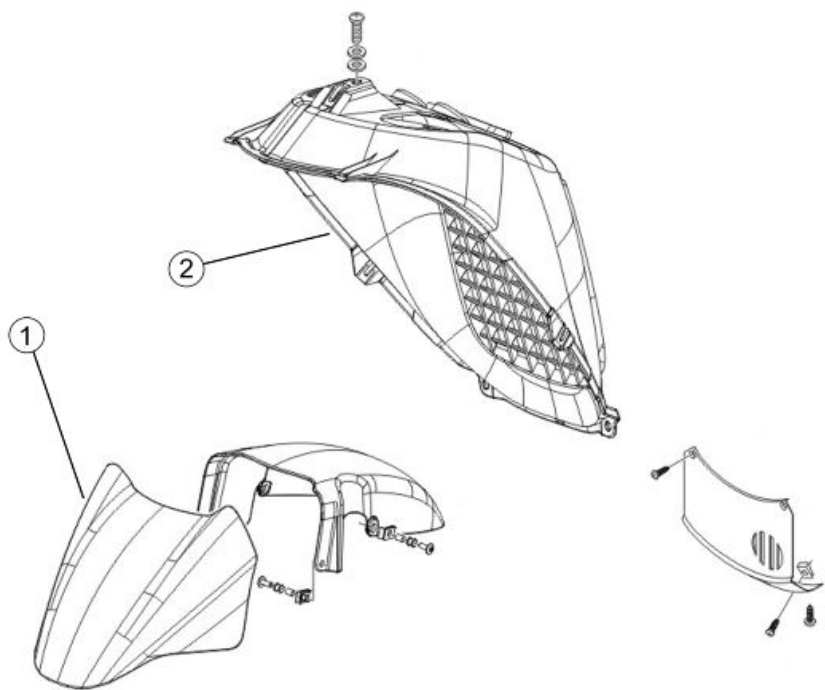
Central cover



CENTRAL COVER

	Code	Action	Duration
1	004135	Fuel tank lid - Replacement	
2	004011	Frame central cover - Replacement	
3	004075	Front mat - Replacement	
4	004059	Spark plug inspection flap - Replacement	
5	004015	Footrest - Replacement	

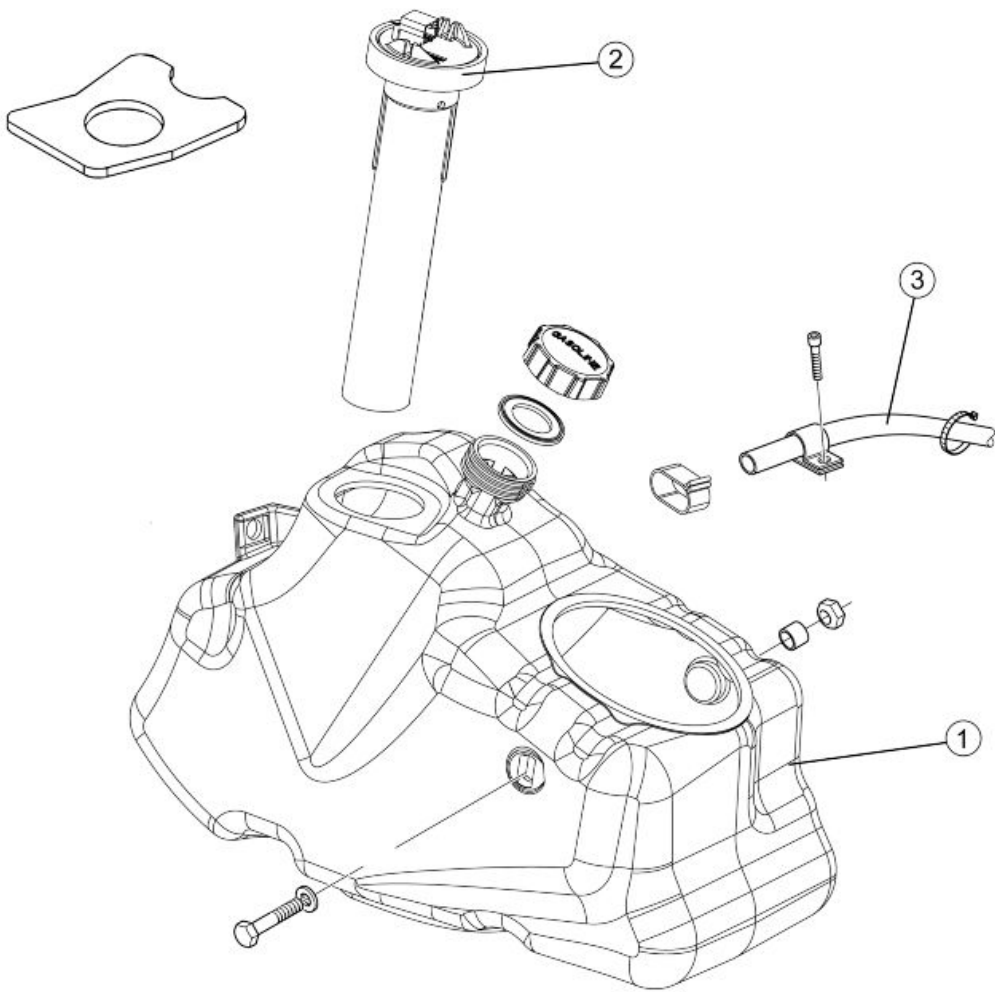
Mudguard



MUDGUARDS

	Code	Action	Duration
1	004002	Front mudguard - change	
2	004167	Grille / radiator cover - Replacement	

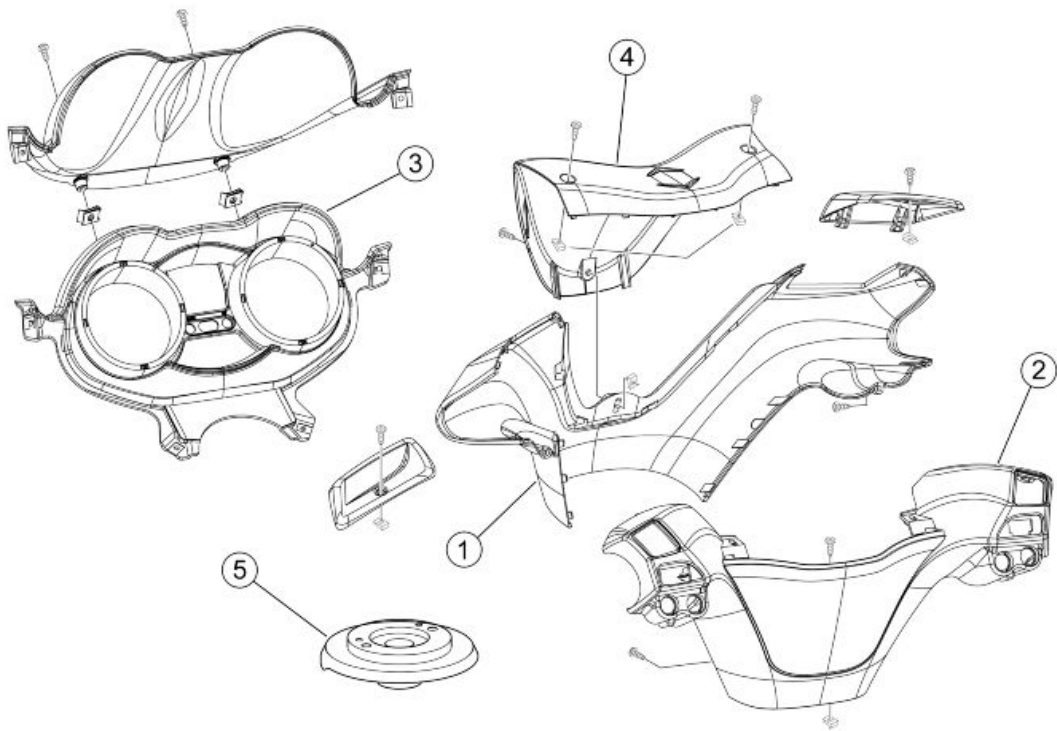
Fuel tank



FUEL TANK

	Code	Action	Duration
1	004005	Fuel tank - Replacement	
2	005010	Tank float - Replacement	
3	004109	Fuel tank breather - change	

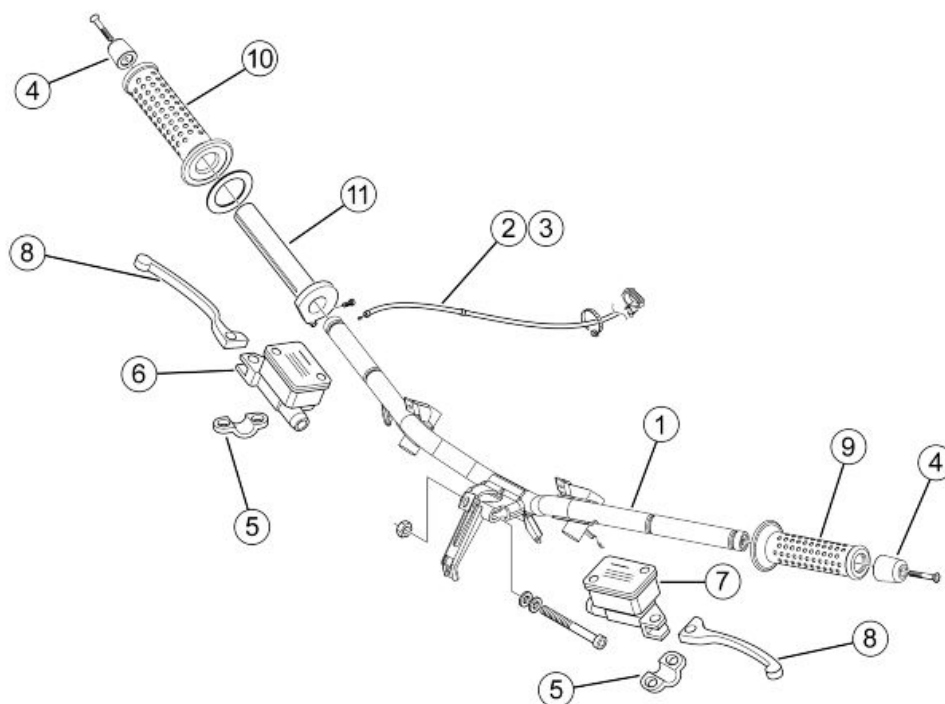
Handlebar covers



HANDLEBAR COVERS

	Code	Action	Duration
1	004018	Front handlebar covers - Replacement	
2	004019	Rear handlebar covers - Replacement	
3	004099	Odometer housing - Replacement	
4	004026	Handlebar cover - Replacement	
5	003043	Steering tube dust guard - Replacement	

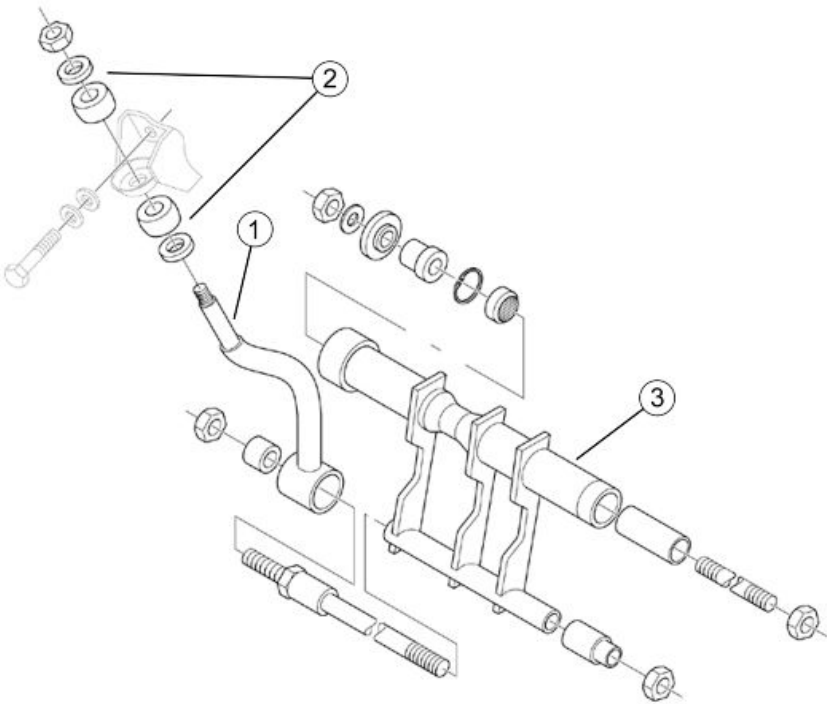
Handlebar components



HANDLEBAR COMPONENTS

	Code	Action	Duration
1	003001	Handlebar - Replacement	
2	002063	Complete throttle transmission - Replacement	
3	003061	Accelerator transmission - Adjustment	
4	003059	Counterweight - Replacement	
5	004162	Mirror support and/or brake pump fitting U-bolt - Replacement	
6	002024	Front brake pump - Replacement	
7	002067	Rear brake pump - Replacement	
8	002037	Brake lever - Replacement	
9	002071	Left knob - Replacement	
10	002059	Right-hand knob - Replacement	
11	002060	Complete throttle control - Replacement	

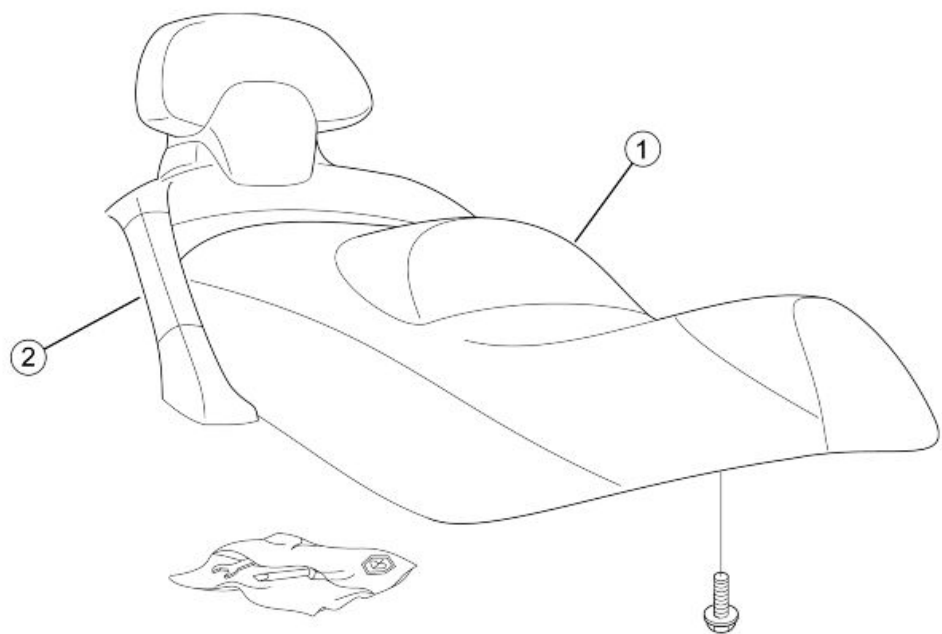
Swing-arm



SWINGING ARM

	Code	Action	Duration
1	003081	Swinging arm support flange - Replacement	
2	004058	Silent block - Replacement	
3	001072	Engine/frame swinging arm attachment - Replacement	

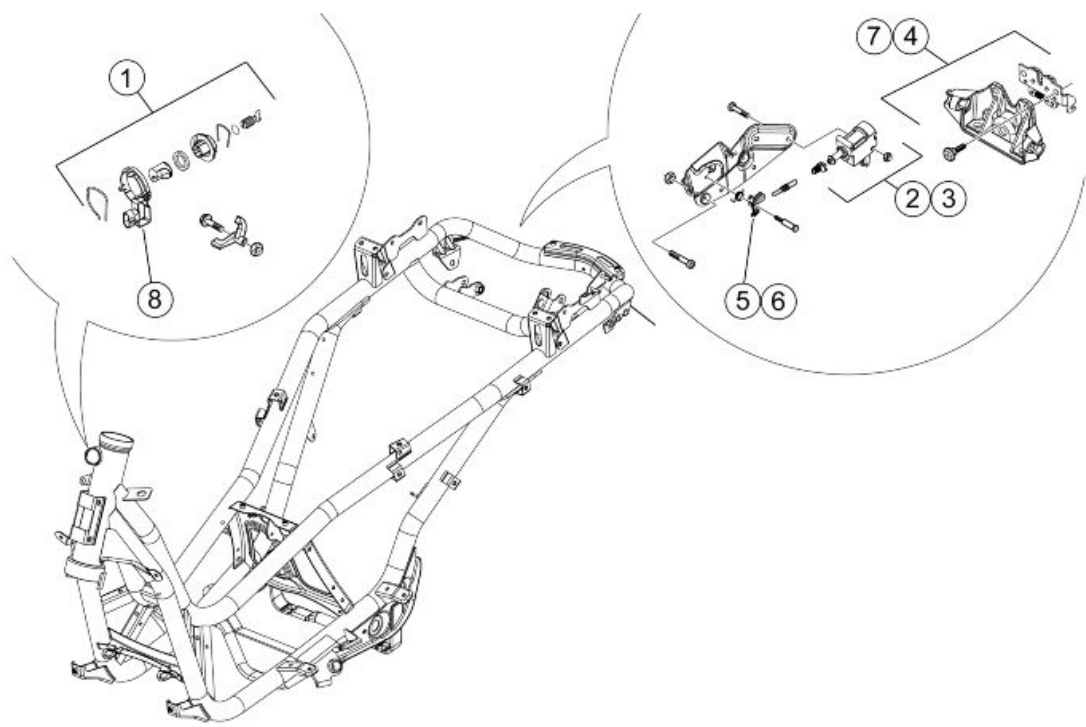
Seat



SADDLE

	Code	Action	Duration
1	004003	Saddle - Replacement	
2	004068	Passenger handgrip - Replacement	

Locks

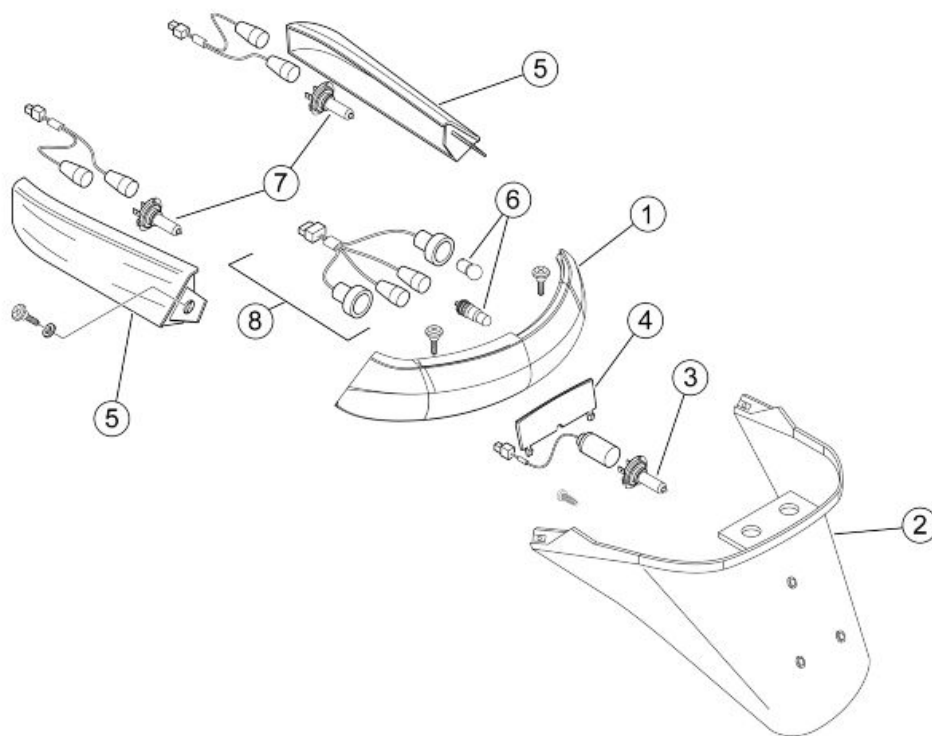


LOCKS + LOCK TRANSMISSIONS

	Code	Action	Duration
1	004010	Anti-theft lock - Replacement	
2	005146	Electric saddle opening activator - Replacement	
3	005133	Electric glove box activator - Replacement	
4	004054	Saddle lock catch - Replacement	
5	004173	Trunk opening splitter - Replacement	
6	004158	Saddle opening splitter - Replacement	
7	004172	Rear case lock catch - Replacement	
8	005072	Immobilizer aerial - Replacement	

Turn signal lights

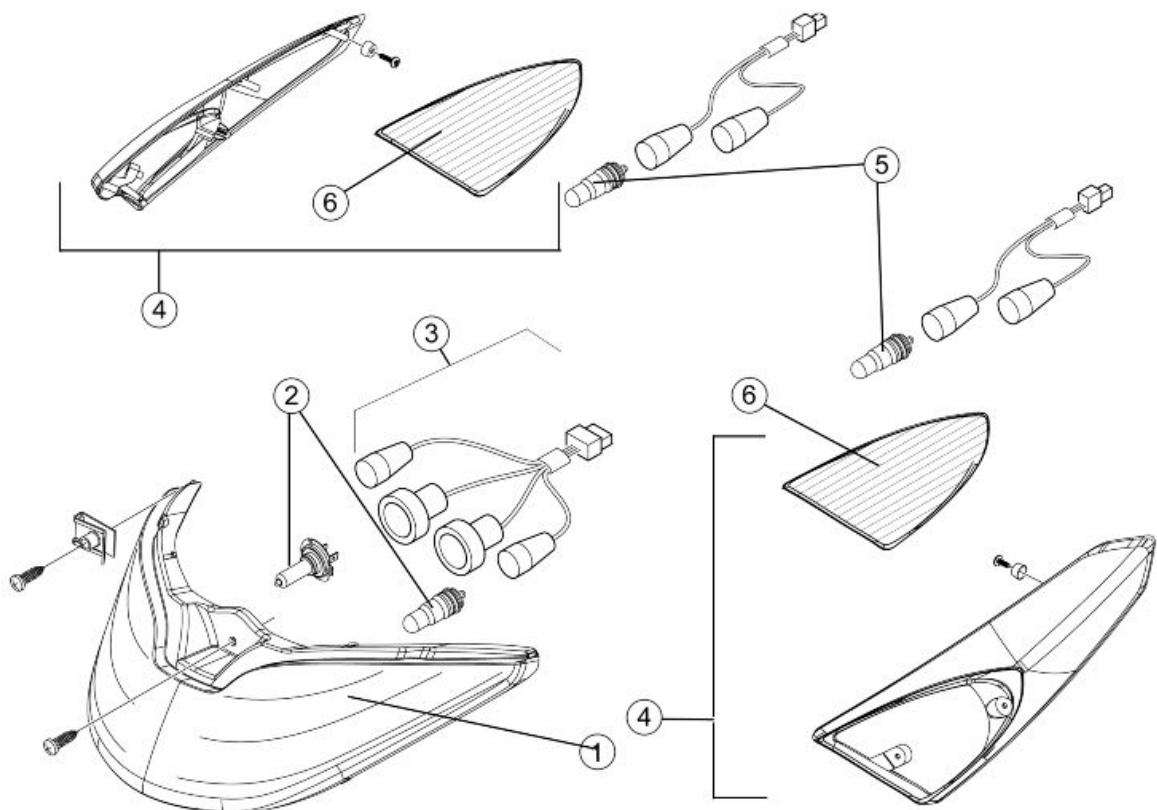
Rear lights



REAR LIGHTS

	Code	Action	Duration
1	005005	Taillight - change	
2	005048	number plate holder - Replacement	
3	005031	number plate light bulb - Replacement	
4	005032	number plate light glass - Replacement	
5	005022	Rear turning indicators - Replacement	
6	005066	Rear light bulbs - Replacement	
7	005068	Rear turning indicator bulb - Replacement	
8	005030	Rear headlight cable unit- Replacement	

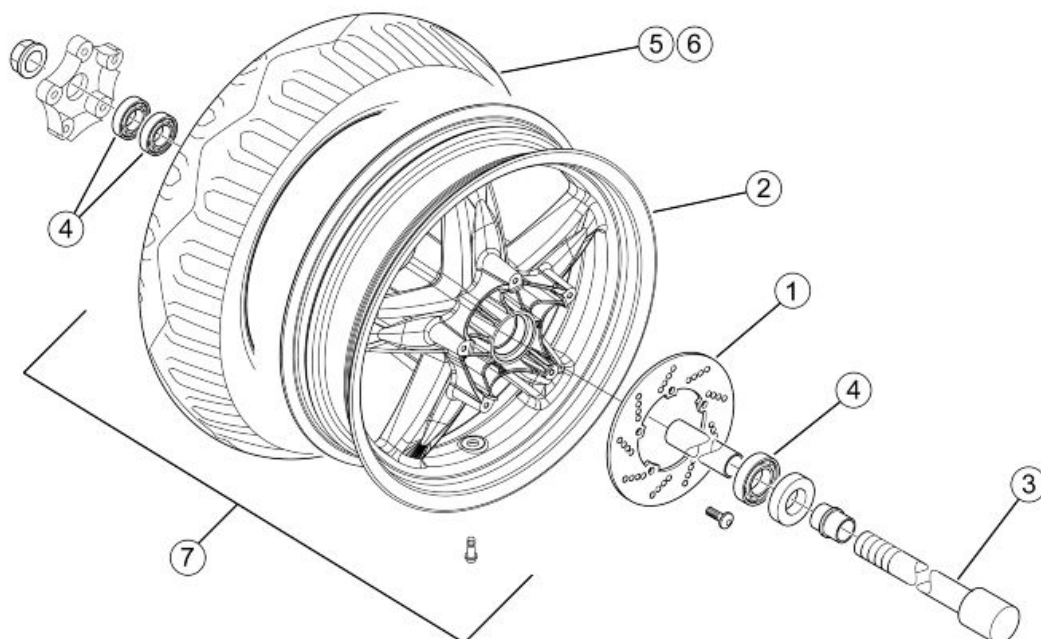
Front lights



TURN INDICATOR LIGHTS

	Code	Action	Duration
1	005002	Front light - replacement	
2	005008	Headlight bulbs - Replacement	
3	005044	Front lights cable unit- Replacement	
4	005012	Front turning indicators - Replacement	
5	005067	Front turning indicator bulb - replacement	
6	005091	Turn indicator glass - Replacement	

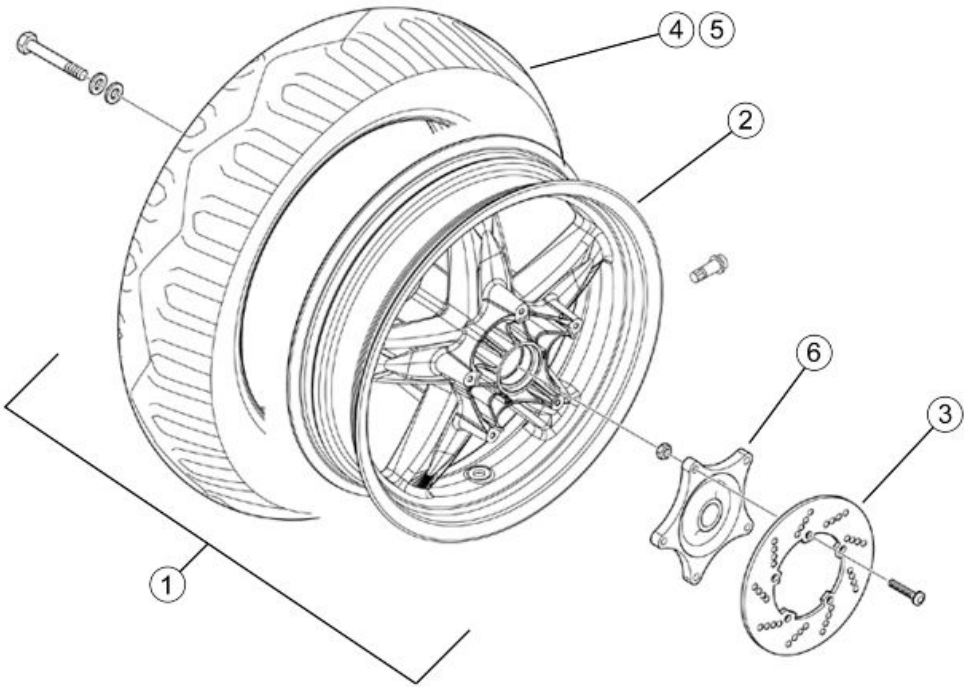
Front wheel



FRONT WHEEL

	Code	Action	Duration
1	002041	Front brake disc - Replacement	
2	003037	Front wheel rim - Replacement	
3	003038	Front wheel axle - Replacement	
4	003040	Front wheel bearings - Replacement	
5	003047	Front tyre - Replacement	
6	003063	Tyre pressure - Check	
7	004123	Front wheel - Replacement	

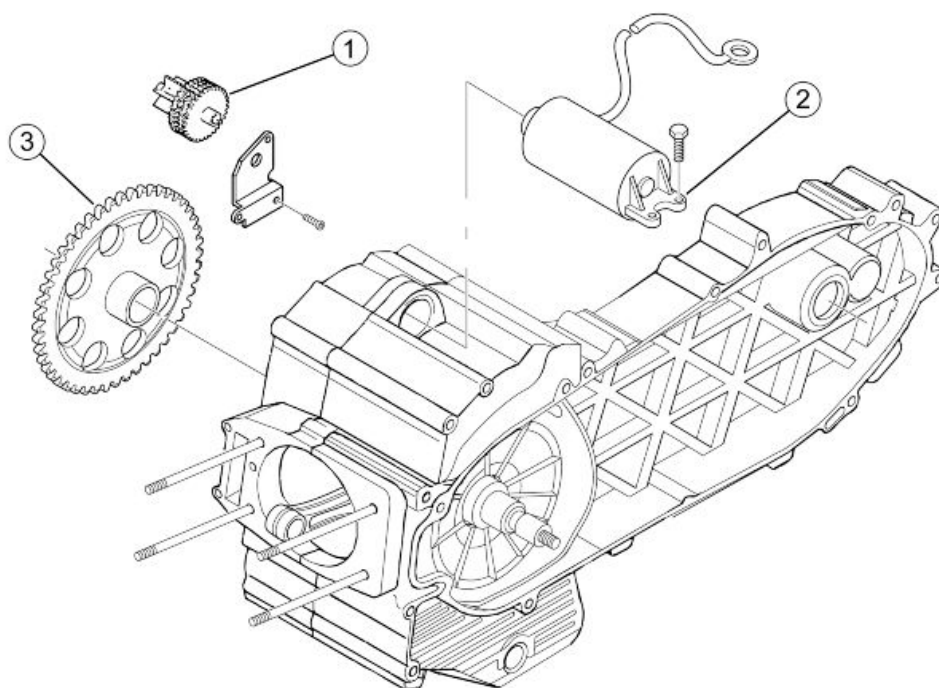
Rear wheel



REAR WHEEL

	Code	Action	Duration
1	001016	Rear wheel - Replacement	
2	001071	Rear wheel rim - Replacement	
3	002070	Rear brake disc - Replacement	
4	003063	Tyre pressure - Check	
5	004126	Rear wheel tyre - Replacement	
6	002028	Rear wheel hub - Replacement	

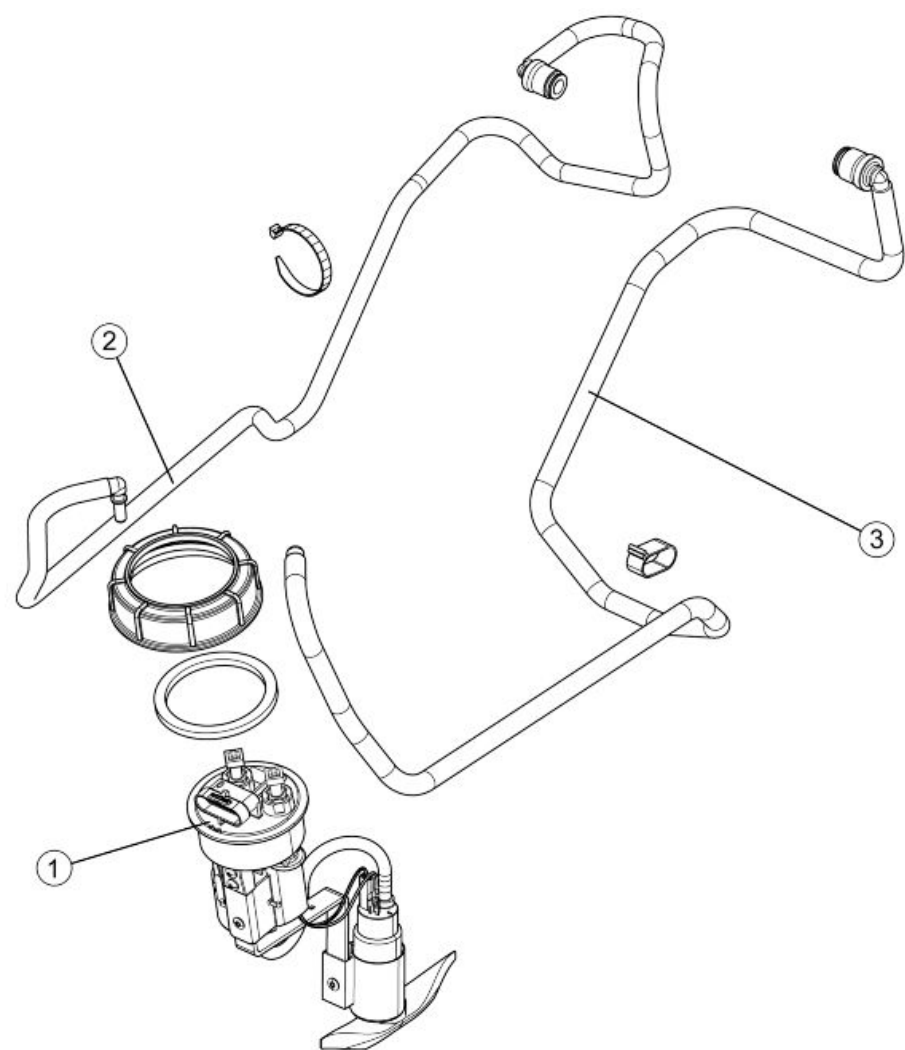
Electric start



START-UP

	Code	Action	Duration
1	001017	Start-up pinion - Replacement	
2	001020	Starter motor - Replacement	
3	001151	Starter driven gearing - Replacement	

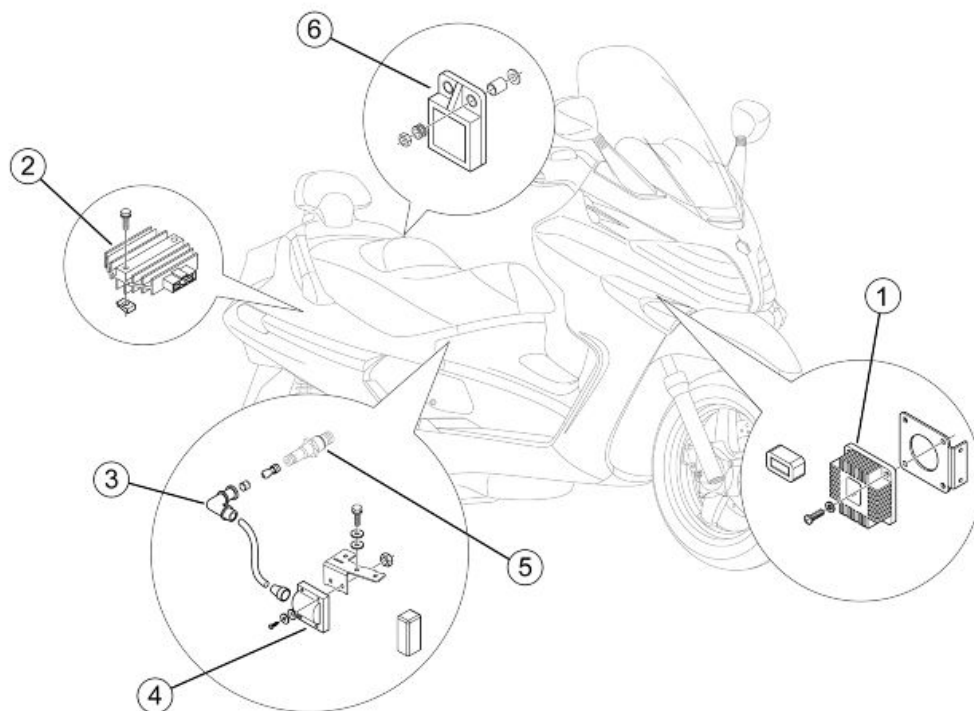
Fuel pump



FUEL PUMP

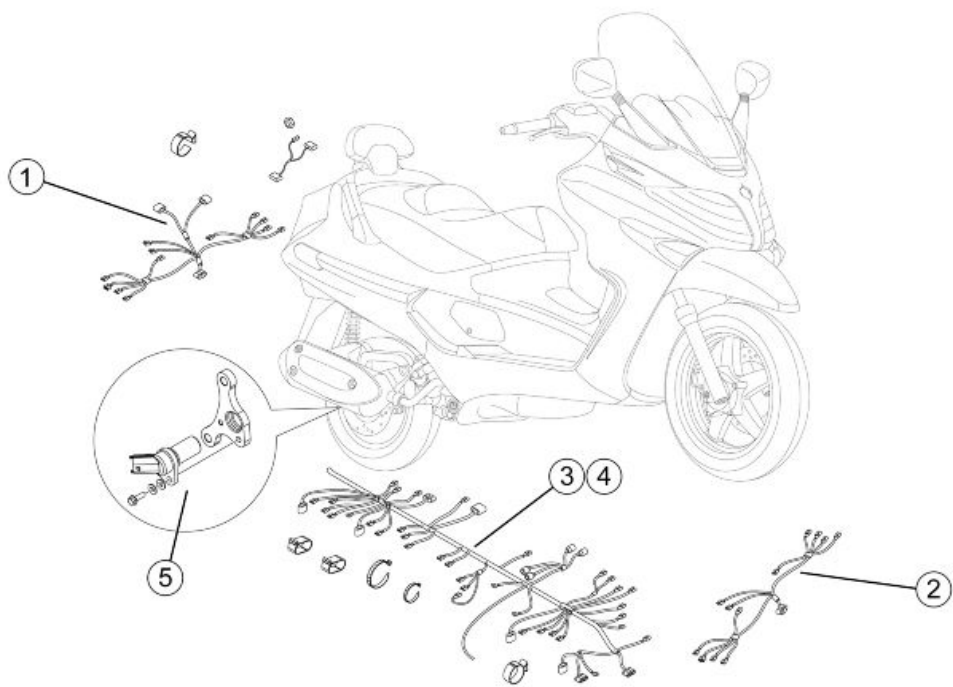
	Code	Action	Duration
1	004073	Fuel pump - Replacement	
2	004137	Pump/ injector pipe - Replacement	
3	004138	Fuel reverse pipe - Replacement	

Electric devices



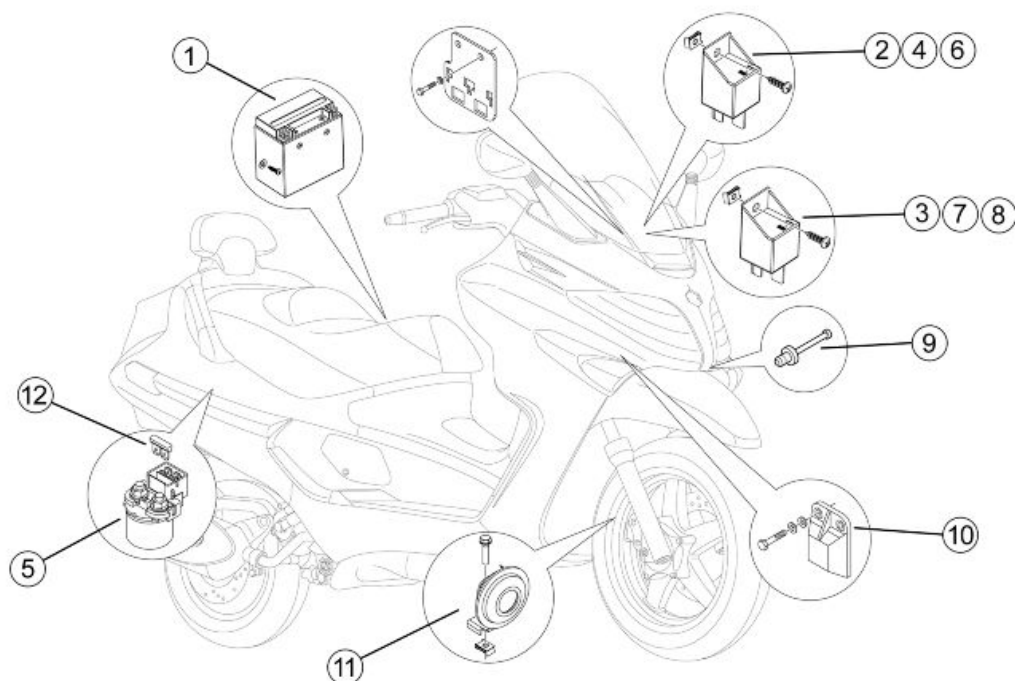
VOLTAGE REGULATOR

	Code	Action	Duration
1	001023	Injection ECU - Replacement	
2	005009	Voltage regulator - Replacement	
3	001094	Spark plug cap - Replacement	
4	001069	HV coil - Replacement	
5	001093	Spark plug - Replacement	
6	005099	Electric saddle opening device - Replacement	



WIRE UNIT

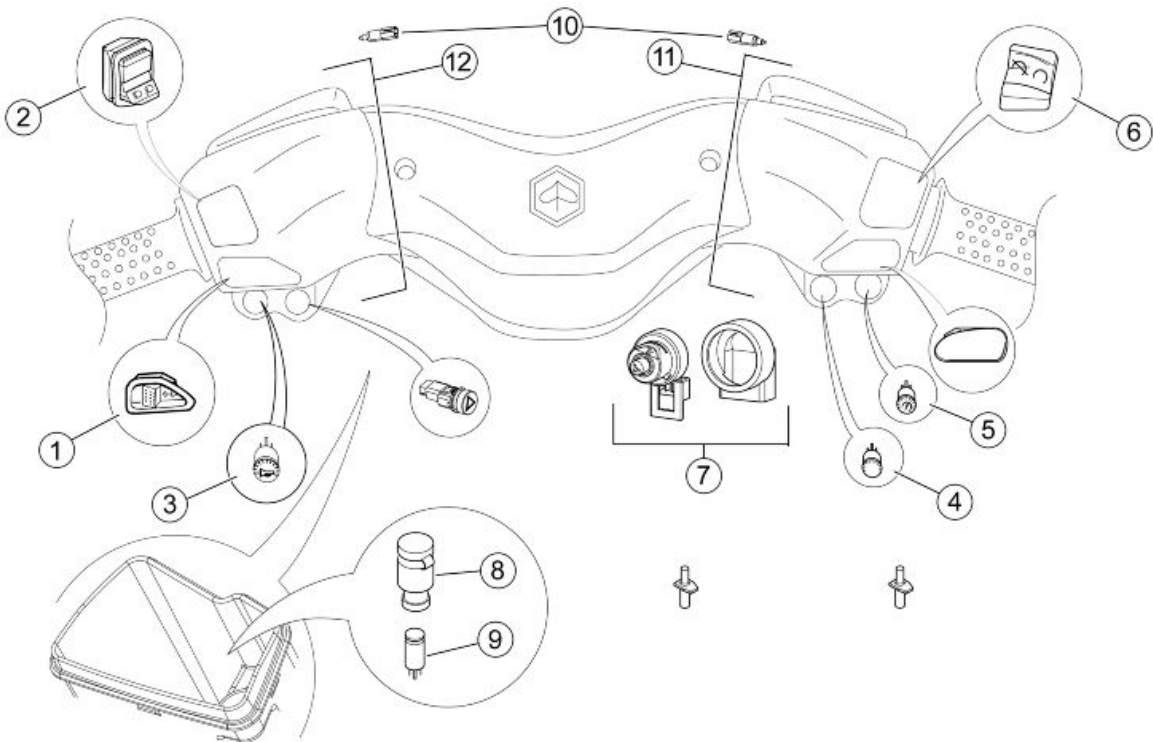
	Code	Action	Duration
1	005030	Rear headlight cable unit- Replacement	
2	005044	Front lights cable unit - replace	
3	005001	Electrical system - Replacement	
4	005114	Electrical system - Service	
5	002051	Odometer transmission assembly - Replacement	



BATTERY-REMOTE CONTROL SWITCHES -HORN

	Code	Action	Duration
1	005007	Battery - change	
2	005096	Remote control for injection components - Replacement	
3	005117	Electric fan remote control - Replacement	
4	005118	Arrows remote control - Replacement	
5	005011	Start-up remote control switch - Replacement	
6	005088	Emergency stop remote control - Replacement	
7	005035	Headlight remote control - Replacement	
8	005087	Side stand remote control - Replacement	
9	005081	Temperature sensor - Replacement	
10	005073	Immobilizer decoder - Replacement	
11	005003	Horn - Replacement	
12	005052	Fuse - Replacement	

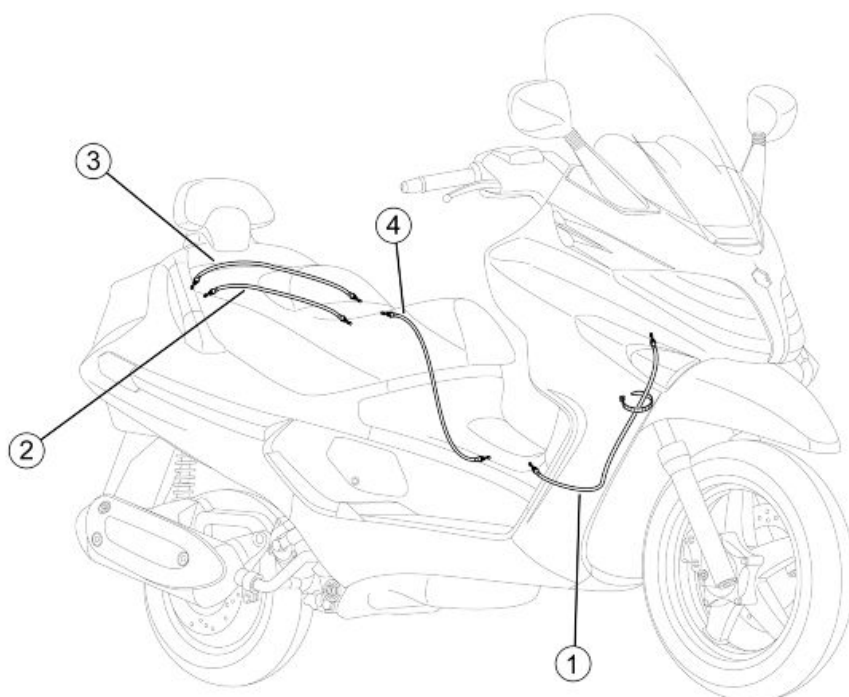
Electronic controls



ELECTRIC CONTROLS

	Code	Action	Duration
1	005006	Light or turning indicator switch - Replacement	
2	005039	Lights switch - Replacement	
3	005040	Horn button - Replacement	
4	005132	Trunk opening button - Replacement	
5	005041	Starter button - Replacement	
6	005077	Emergency stop switch - Replacement	
7	005016	Key switch - Replacement	
8	004142	electric socket - Replacement	
9	005085	Reset button - Replacement	
10	005017	Stop switch - Replacement	
11	003074	Handlebar right control - Replacement	
12	003075	Handlebar left control - Replacement	

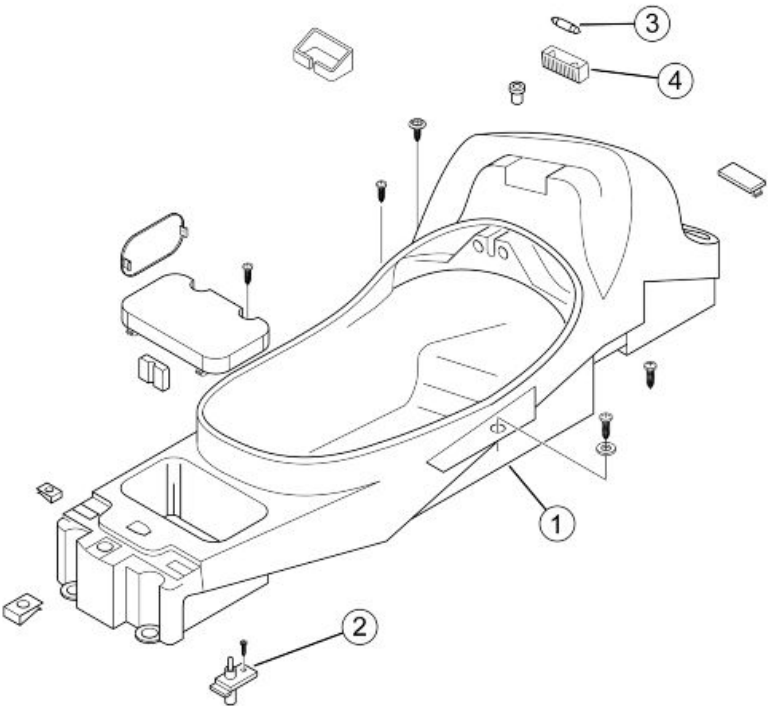
Transmissions



TRANSMISSIONS

	Code	Action	Duration
1	002082	Fuel tank door opening drive - Replacement	
2	002092	Transmission splitter/ hook transmission - Replacement	
3	002093	Top box opening transmission - Replacement	
4	002094	Trunk splitter/ hook transmission - Replacement	

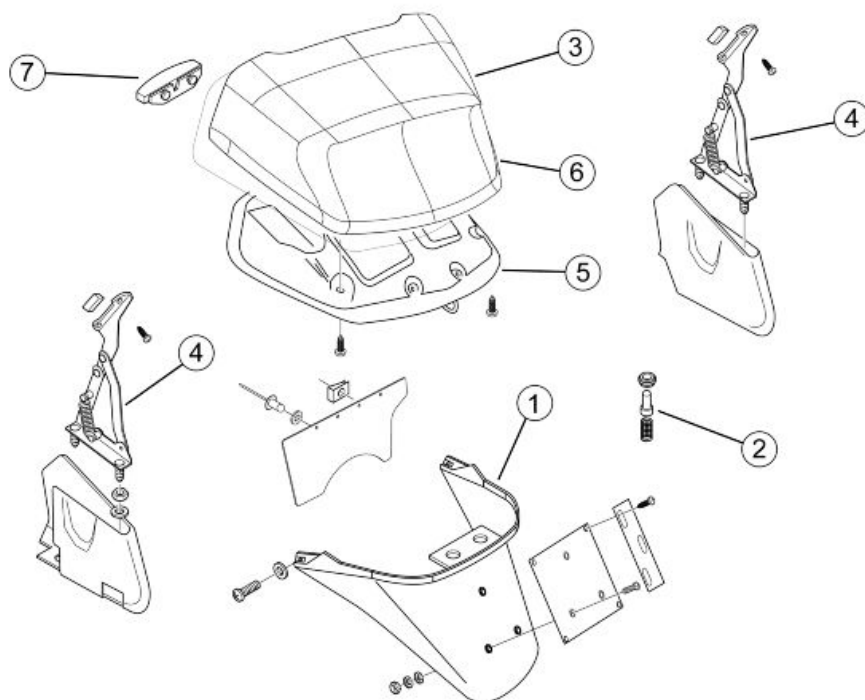
Helmet bay



HELMET COMPARTMENT

	Code	Action	Duration
1	004016	Helmet compartment - Replacement	
2	005033	Glove-box light switch - Replacement	
3	005026	Helmet compartment light - Replacement	
4	005027	Helmet compartment bulb support - Replacement	

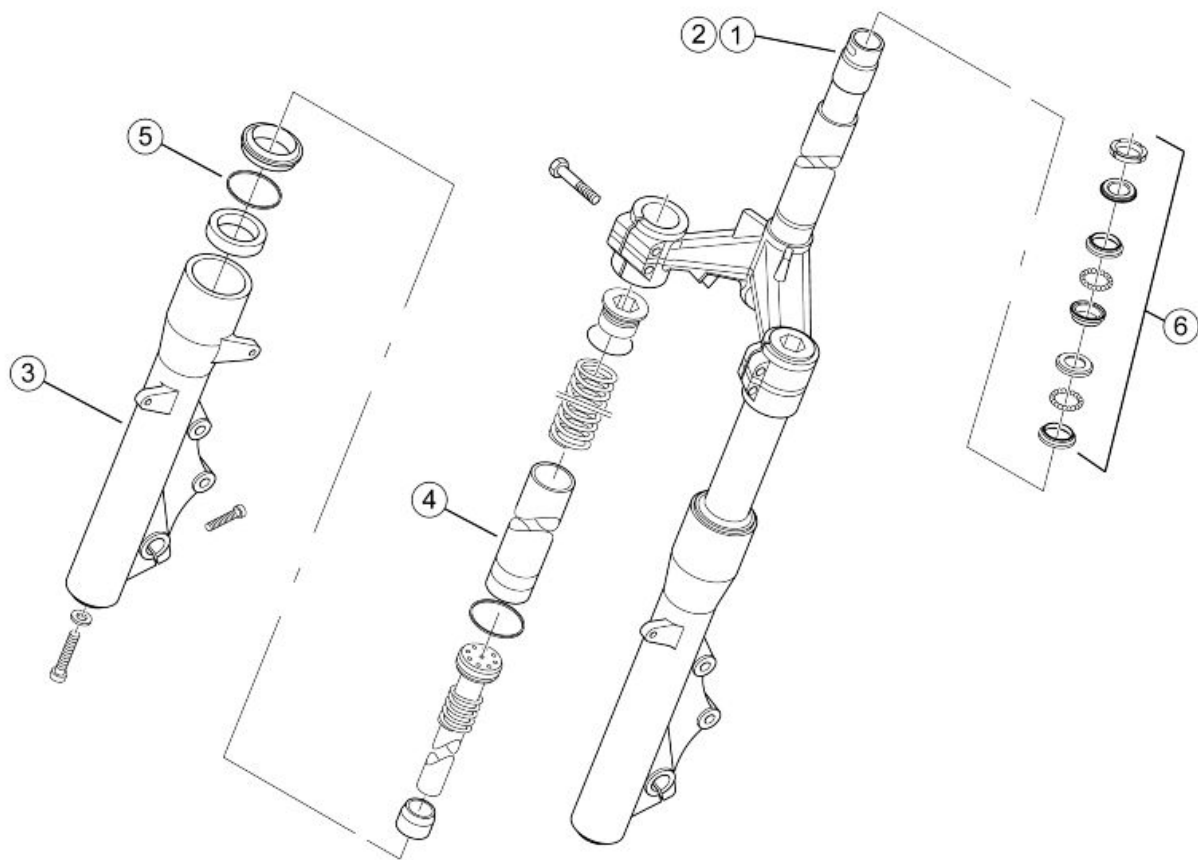
Rear side fairings



REAR COVERS

	Code	Action	Duration
1	005048	number plate holder - Replacement	
2	005033	Glove-box light switch - Replacement	
3	004081	Top box lid - Replacement	
4	004174	Trunk levers - Replacement	
5	004080	Trunk flap support - Replacement	
6	004082	Top box gasket - Replacement	
7	004036	Frame cover - Replacement	

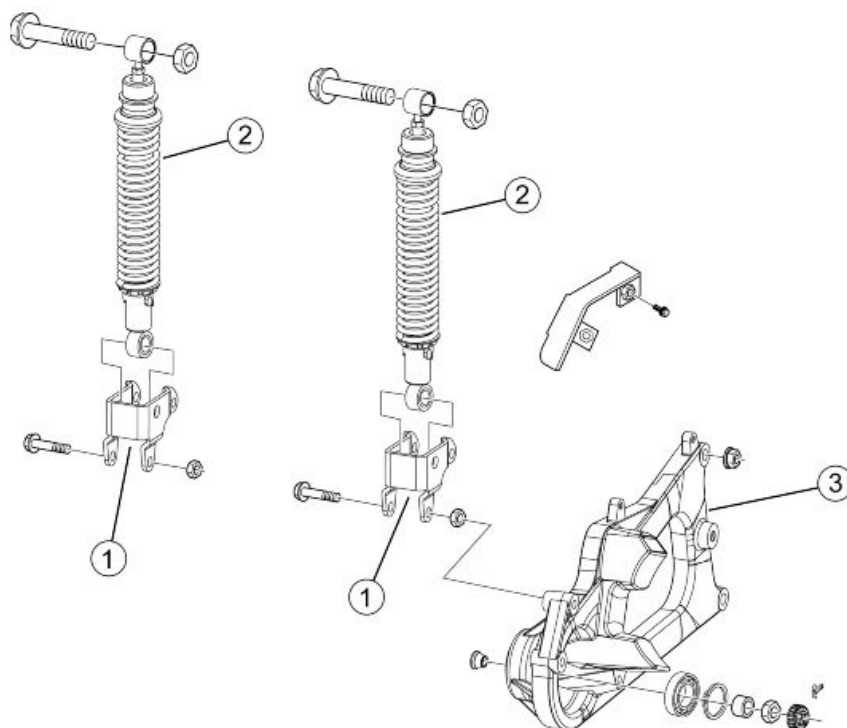
Front suspension



FRONT SUSPENSION

	Code	Action	Duration
1	003051	Complete fork - Replacement	
2	003010	Front suspension - Service	
3	003076	Fork sheath - Replacement	
4	003079	Fork stem - Replacement	
5	003048	Fork oil seal - Replacement	
6	003002	Steering fifth wheels - Replacement	

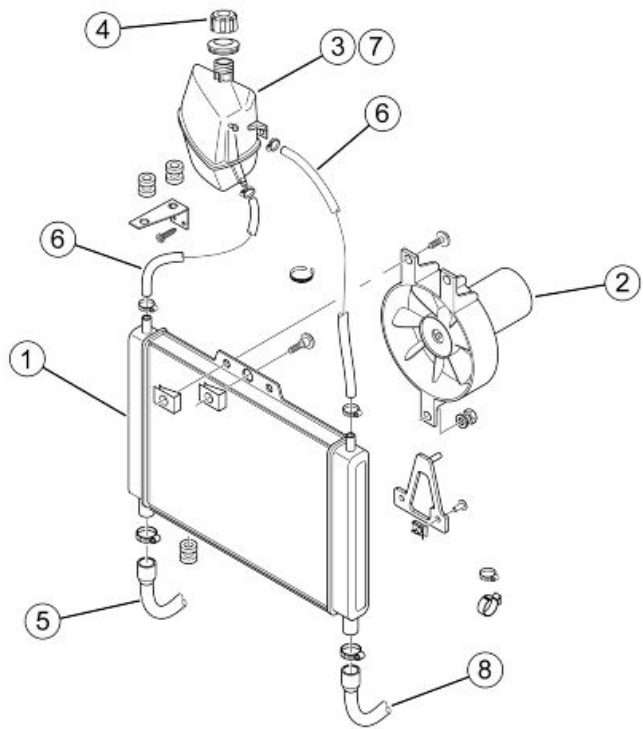
Rear suspension



REAR SUSPENSION

	Code	Action	Duration
1	003085	Suspension strut - Replacement	
2	003007	Rear shock absorber - Replacement	
3	003077	muffler/rear shock absorber support arm - Service	

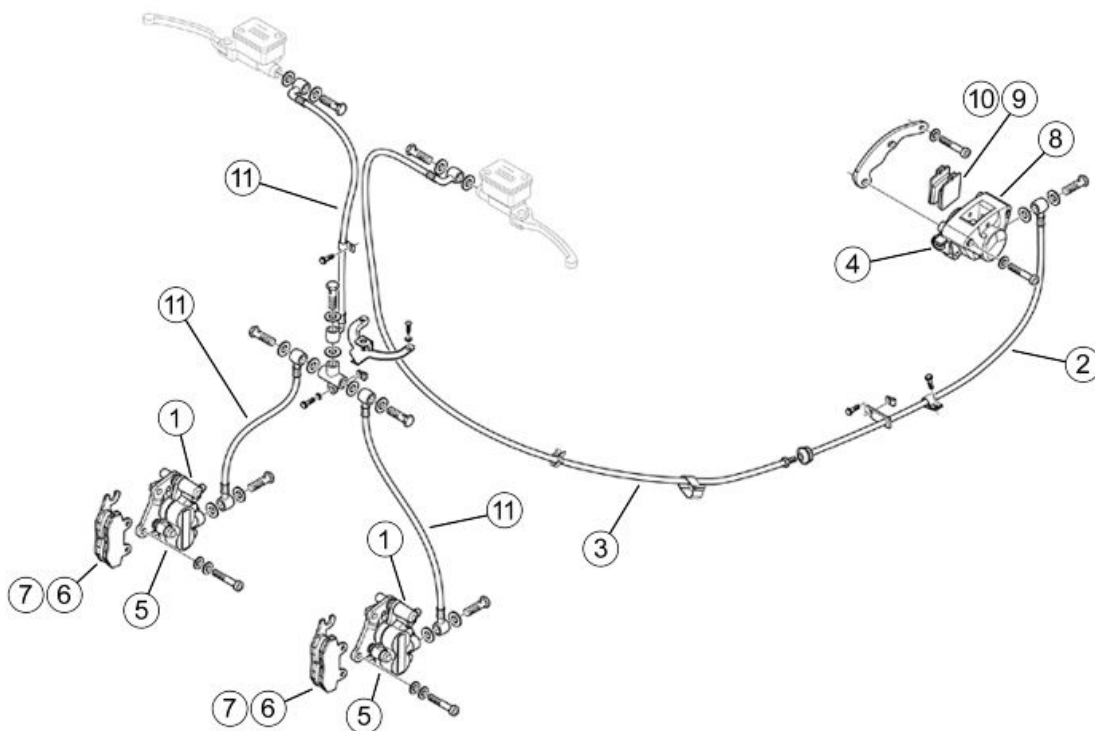
Cooling system



COOLING SYSTEM

	Code	Action	Duration
1	007002	Water radiator - replacement	
2	007016	Fan with support - Replacement	
3	007001	Expansion tank - Replacement	
4	007024	Expansion tank cap - Replacement	
5	007019	Connection water pump pipe / return pipe - Replacement	
6	007013	Radiator expansion tank connection pipe - change	
7	001052	Coolant and air bleed - Replacement	
8	007022	Coolant delivery pipe - Replacement	

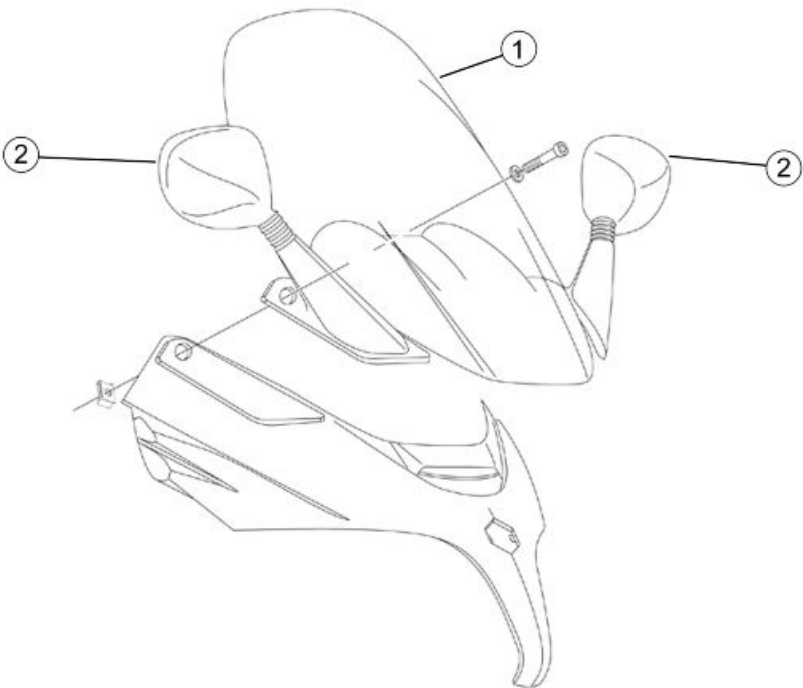
Braking system



BRAKE SYSTEM

	Code	Action	Duration
1	002047	Front brake fluid and air bleeding system - Replacement	
2	002020	Rear brake disc piping - Replacement	
3	002081	Rear brake disc piping - Replacement	
4	002080	Rear brake oil bleed system - Change	
5	002039	Front brake calliper - Replacement	
6	002007	Front brake pads - Replacement	
7	003070	Front brake pads - Wear check	
8	002002	Rear brake pads - Replacement	
9	003071	Rear brake pads - Wear check	
10	002048	Rear calliper - Replacement	
11	002021	Front brake piping - Replacement	

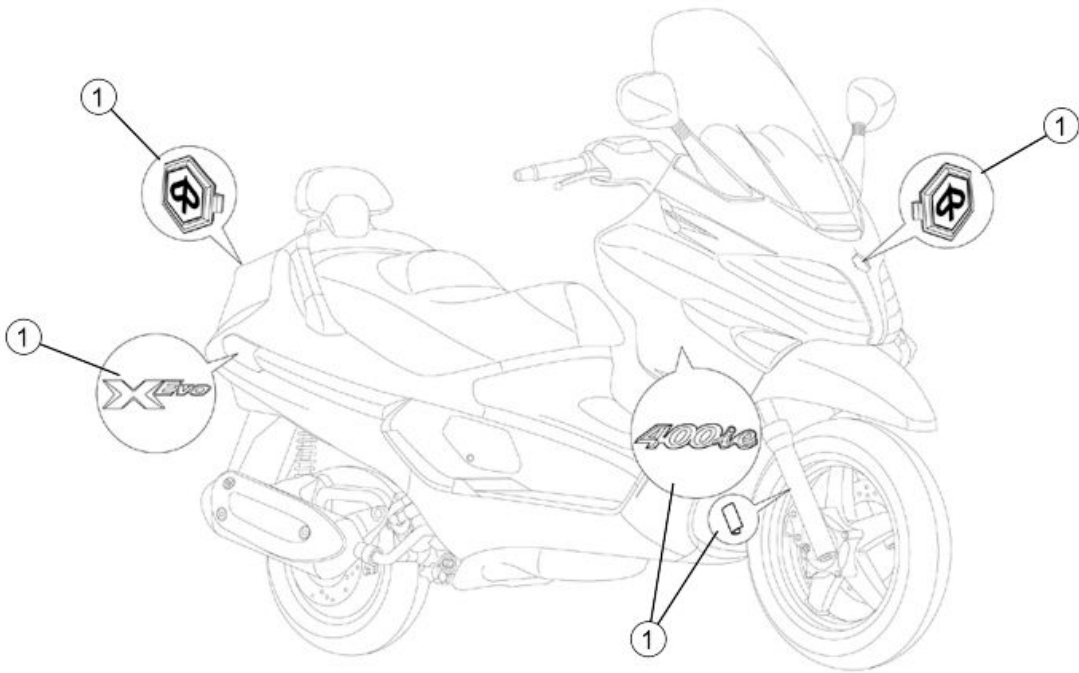
Windscreen



WINDSHIELD

	Code	Action	Duration
1	004101	Windshield - Replacement	
2	004066	Driving mirror - Replacement	

Stickers



TRANSFERS

	Code	Action	Duration
1	004159	Plates / Stickers - Replacement	

A

Air filter: 21, 315

B

Battery: 44, 53, 58, 60, 61, 65

Brake: 283, 284, 286, 288–293

Brake fluid: 291

C

Coolant: 233, 299

E

Engine oil: 22

F

Fuel: 189, 197, 201, 317, 350, 361

Fuses: 56

H

Headlight: 29, 307

Hub oil: 20

I

Identification: 7

Immobilizer:

Instrument panel: 306, 310, 321

L

Light switch:

M

Maintenance: 7, 17

Mirrors: 305, 321

O

Oil filter: 25

S

Saddle:

Shock absorbers: 279

Spark plug: 19, 231

Stand: 281

Start-up:

T

Tank: 317, 350

Technical Data:

Transmission: 9, 32, 73, 88, 339

Turn indicators: 48

Tyres: 9

