aprilia

SERVICE STATION MANUAL

854104

TUONO R_FACTORY

SERVICE STATION MANUAL

TUONO R_FACTORY

SERVICE STATION MANUAL TUONO R_FACTORY

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

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

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

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

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

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

INDEX OF TOPICS

INDEX OF TOPICS

Rules

Safety rules

Carbon monoxide

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

CAUTION

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

Fuel

CAUTION

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

Hot components

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

Coolant

The coolant contains ethylene glycol which, under certain conditions, can become flammable.
When it burns, ethylene glycol produces an invisible flame which however can cause burns.

CAUTION

MAKE SURE NOT TO POUR THE COOLANT ON HOT ENGINE OR EXHAUST SYSTEM COMPONENTS; IT MAY CATCH FIRE PRODUCING INVISIBLE FLAMES. WHEN CARRYING OUT MAINTENANCE OPERATIONS, IT IS ADVISABLE TO WEAR LATEX GLOVES. EVEN IF IT IS TOXIC, THE COOLANT HAS A SWEET FLAVOUR WHICH MAKES IT VERY ATTRACTIVE TO ANIMALS. NEVER LEAVE THE COOLANT IN OPEN CONTAINERS IN AREAS ACCESSIBLE TO ANIMALS AS THEY MAY DRINK IT.

KEEP OUT OF THE REACH OF CHILDREN

DO NOT REMOVE THE RADIATOR CAP WHEN THE ENGINE IS STILL HOT. THE COOLANT IS UNDER PRESSURE AND MAY CAUSE BURNS.

Used engine oil and transmission oil

CAUTION

IT IS ADVISABLE TO WEAR LATEX GLOVES WHEN SERVICING THE VEHICLE. THE ENGINE OR GEARBOX OIL MAY CAUSE SERIOUS DAMAGE TO THE SKIN IF HANDLED FOR PROLONGED PERIODS OF TIME AND ON A REGULAR BASIS. IT IS RECOMMENDED TO WASH YOUR HANDS CAREFULLY AFTER HANDLING IT. HAND THE OIL OVER TO OR HAVE IT COLLECTED BY THE NEAREST USED OIL RECYCLING COMPANY OR THE SUPPLIER. IT IS ADVISABLE TO WEAR LATEX GLOVES WHEN SERVICING THE VEHICLE.

DO NOT DISPERSE THE OIL IN THE ENVIRONMENT

KEEP OUT OF THE REACH OF CHILDREN

Brake and clutch fluid

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

KEEP OUT OF THE REACH OF CHILDREN

Battery electrolyte and hydrogen gas

CAUTION

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

KEEP OUT OF THE REACH OF CHILDREN

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

Maintenance rules

GENERAL PRECAUTIONS AND INFORMATION

When repairing, dismantling and reassembling the vehicle follow the recommendations reported below carefully.

BEFORE DISMANTLING COMPONENTS

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

DISMANTLING COMPONENTS

- Do not loosen and/or tighten screws and nuts using pliers or other tools than the especially designed wrench.
- Mark positions on all connection joints (pipes, cables etc.) before separating them, and identify them with distinctive symbols.

- Each component needs to be clearly marked in order to be identified during assembly.
- Clean and wash the dismantled components carefully using a low-flammability detergent.
- Keep coupled parts together since they have "adjusted" to each other due to normal wear and tear.
- Some components must be used together or replaced altogether.
- Keep away from heat sources.

REASSEMBLY OF COMPONENTS

CAUTION

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

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

ELECTRIC CONNECTORS

Electric connectors must be disconnected as described as follows as non-compliance with the procedure described below causes irreparable damages to both the connector and the cable harness: Press the relevant safety hooks, if any.

- Grip the two connectors and disconnect them by pulling them in opposite directions.
- In presence of dirt, rust, humidity etc. clean the connector's internal parts carefully, using a pressurised air jet.
- Make sure that the cables are correctly linked to the connector's internal terminal ends.
- Then insert the two connectors making sure that they couple correctly (if the relevant

hooks are provided, you will hear them "click" into place).

CAUTION

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

NOTE

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

TIGHTENING TORQUES

CAUTION

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

Running-in

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

CAUTION

THE CLUTCH MAY EMIT A SLIGHT BURNING SMELL WHEN FIRST USED. THIS PHENOMENON SHOULD BE CONSIDERED NORMAL AND WILL DISAPPEAR AS SOON AS THE CLUTCH DISCS GET ADAPTED.
IT IS IMPORTANT TO STRAIN ENGINE COMPONENTS DURING RUN-IN, HOWEVER, MAKE SURE NOT TO OVERDO THIS.

CAUTION

ONLY AFTER THE SERVICE AT THE END OF THE RUN-IN PERIOD, IT IS POSSIBLE TO ATTAIN THE BEST PERFORMANCE OF YOUR VEHICLE.

Follow the guidelines detailed below:

- Do not twist the throttle grip abruptly and completely when the engine is working at a low revs, either during or after run-in.
- During the first 100 km (62 miles) brake carefully to avoid rough and long braking. That is to permit the adequate adjustment of the pad friction material to the brake discs.
- During the first 1000 km (620 miles), never exceed 6000 rpm.

AFTER THE SPECIFIED MILEAGE, TAKE YOUR VEHICLE TO AN Official aprilia Dealer FOR THE CHECKS INDICATED IN THE "AFTER-RUN-IN" TABLE IN THE SCHEDULED MAINTENANCE SECTION TO AVOID INJURING YOURSELF, OTHERS AND /OR DAMAGING THE VEHICLE.

- Between 1000 km (625 miles) and 1500 km (932 miles) travelled, ride more vigourously, vary speeds and twist throttle fully for some short periods for best coupling of the components; do not exceed 7500 rpm.
- After 1500 km (932 miles) a better engine performance may be expected but without exceeding the engine maximum rpm [11000 rpm].

Vehicle identification

Write down the chassis and engine number in the specific space of this manual. The chassis number is handy when purchasing spare parts.

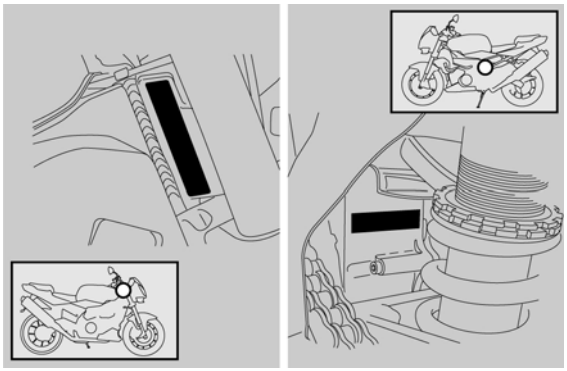
CAUTION

ALTERING IDENTIFICATION NUMBERS IS AN OFFENCE WHICH CAN RESULT IN SEVERE CRIMINAL AND ADMINISTRATIVE CHARGES. PARTICULARLY MODIFYING THE CHASSIS NUMBER WILL IMMEDIATELY INVALIDATE THE WARRANTY

ENGINE NUMBER

The engine number is stamped on the base of the left side engine crankcase.

Engine No .....



CHASSIS NUMBER

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

Chassis No. .....

Dimensions and mass

DIMENSIONS

Specification	Desc./Quantity
Max. length	2025 mm (79.72 in)
Max. width	830 mm (32.68 in)
Max. height (to top fairing)	1100 mm (43.31 in)
Saddle height	810 mm (31.89 in)
Centre to centre distance	1410 mm (55.51 in)
Minimum ground clearance	150 mm (5.91 in)
Kerb weight	R 209 kg (461 lb) - FACT. 205 kg (452 lb) (with forged wheels, aluminium bolt and carbon body-work parts)

Engine

ENGINE

Specification	Desc./Quantity
Model	V990RR NG
Type	60° longitudinal V-twin, 4-stroke, 4 valves per cylinder, 2 overhead camshafts.
Cylinder quantity	2
Overall engine capacity	997.6 cm³ (60.88 cu.in)
Max. nominal power (to crankshaft)	102 kW (137 HP) at 9500 rpm
Max. torque	107 Nm (10.7 kgm) at 7750 rpm
Bore / stroke	97 mm / 67.5 mm (3.82 in / 2.66 in)
Compression ratio	11.8 +/- 0.5 :1
Camshaft intake	266°, valve lift = 11.8 mm (0.465 in)
Camshaft outlet	259°, valve lift = 10.6 mm (0.417 in)
Valve advance - with 1 mm (0.039 in) valve clearance	Intake opening = 25° before the TDC Intake closing = 61° after the BDC Outlet opening = 64° before the TDC Outlet closing = 15° after the BDC
Valve clearance at intake	0.11 - 0.18 mm (0.0043 - 0.0071 in)
Valve clearance at outlet	0.22 - 0.29 mm (0.0087 - 0.0114 in)

Specification	Desc./Quantity
Ignition	Electric
Engine revs at idle speed	1250 +/- 100 rpm
Engine revs at maximum speed	11000 ± 100 rpm
Ignition	electronically controlled ignition system
Ignition advance	at start-up: 5° before TDC, further advance depending on consumption levels
Starter motor gear ratio	I = 49/9 * 30/11 * 64/30 = 31.677
Clutch	Multiple disks in oil bath with hydraulic control on the left side of the handlebar and PPC device • 9 lined discs; thickness: 3.5 mm (0.138 in) • 10 internal discs; thickness: 1.5 mm (0.059 in)
Lubrication system	Dry sump system with separate oil tank and cooling radiator
Lubrication pressure	Min. 350 kPa (3.5 bar) At 80°C (176°F) and 6000 rpm max.
Air filter	with dry cartridge filter
Cooling	Fluid
Coolant pump gear ratio	Iwp = 28/27 * 28/28 = 1.037
Coolant pump capacity (with thermostatic valve open)	100 l/min (26.4 USgal/min) (22 UKgal/min) at 9000 rpm
Temperature when thermostatic valve starts to open	65 ± 2 °C (149 ± 5 °F)
Engine dry weight	approx. 67 kg (147.7 lb)

Transmission

TRANSMISSION

Specification	Desc./Quantity
Type	Mechanical, 6 speeds with foot lever on the left hand side of the engine

GEAR RATIO

Specification	Desc./Quantity
Gear ratio	Primary gears 31/60
1º gear ratio	15/34 (secondary)
2º gear ratio	19/31 (secondary)
3º gear ratio	20/26 (secondary)

Specification	Desc./Quantity
4º gear ratio	22/24 (secondary)
5º gear ratio	25/24 (secondary)
6º gear ratio	26/23 (secondary)
Final gear ratio	16/40

Capacities

CAPACITY

Specification	Desc./Quantity
Fuel (reserve included)	18 l (4.76 USgal)
Fuel reserve	4 +/- 1 l (1.06 +/- 0.26 USgal)
Engine oil	oil change: 3700 cm³ (225.78 cu.in) - oil and oil filter change: 3900 cm³ (237.99 cu.in)
Oil for R fork	520.0 +/- 2.5 cm³ (31.73 +/- 1.15 cu.in) (for each stem)
Oil for Ohlins fork	FG8903 fork type, oil level from the sleeve rim : 85 mm (3.35 in) - FG616 fork type, oil level from the sleeve rim: 130 mm (5.12 in). (with spring fitted and sleeve as far as it will go)
Coolant	2.2 l (0.58 USgal) (50% water + 50% ethylene glycol antifreeze fluid)
Seats	2
Vehicle max. load	R 192 kg (423.3 lb) - FACT. 196 kg (432.1 lb) (driver + passenger + luggage)

Drive chain

TRANSMISSION CHAIN

Specification	Desc./Quantity
Type	endless (without master link) and with sealed links
Model	525

Electrical system

ELECTRICAL SYSTEM

Specification	Desc./Quantity
Battery	12V - 10 Ah
Main fuses	30 A

Specification	Desc./Quantity
Auxiliary fuses	5A, 15A, 20A
Generator (permanent magneto)	12V - 500W

Frame and suspensions

CHASSIS

Specification	Desc./Quantity
Type	box section sloping twin spar frame in aluminium alloy.
Steering inclination angle	25°
Front stroke	101.7 mm (4.00 in) (with 120/70 tyres)

SUSPENSIONS

Specification	Desc./Quantity
Front:	adjustable upside-down hydraulic action telescopic fork, Ø 43 mm (1.69 in) stems
Travel	R - 127 mm (4.99 in) FACT - 120 mm (4.72 in)
Rear	double banana aluminium alloy swing arm, gradual linkage connecting rod, APS system. Hydraulic shock absorber, rebound adjustment and spring preloading.
Wheel travel	133 mm (5.39 in)

Brakes

BRAKES

Specification	Desc./Quantity
Front:	Ø 320 mm (12.59 in) twin floating disc brake, Ø 34 mm (1.34 in) 4-plunger callipers
Rear	Ø 220 mm (8.66 in) disc brake, Ø 32 mm (1.25 in) twin plunger calliper

Wheels and tyres

WHEEL RIMS

Specification	Desc./Quantity
Type	in light alloy with extractable bolt
Front:	3.50 x 17" DIE CAST for R version - FORGED for FACT. version

Specification	Desc./Quantity
Rear	6.00 x 17" DIE CAST for R version - FORGED for FACT. version

TYRES

Specification	Desc./Quantity
Type	Standard equipment R Version: PIRELLI DIABLO; METZELER RENNSPORT; MICHELIN PILOT POWER; DUNLOP SPORTMAX D208RR Standard equipment FACTORY Version: PIRELLI DRAGON SUPERCORSA EVO
Front:	120/70 ZR 17"
Inflation pressure	2.53 bar (253.31 kPa) (36.74 PSI)
Rear	190/50 ZR 17"
Inflation pressure	2.83 bar (283.71 kPa) (41.14 PSI)
Type	alternatively for R version: PIRELLI DIABLO CORSA; PIRELLI DRAGON SUPERCORSA EVO; METZELER SPORTTEC; METZELER RENNSPORT; MICHELIN PILOT POWER; MICHELIN PILOT POWER RACE; DUNLOP SPORTMAX QUALIFER alternatively for FACTORY version: PIRELLI DIABLO CORSA; PIRELLI DRAGON SUPERCORSA EVO; METZELER SPORTTEC; METZELER RENNSPORT; MICHELIN PILOT POWER RACE; DUNLOP SPORTMAX D 208 RR; DUNLOP SPORTMAX QUALIFER
Front:	120/70 - ZR 17"
Rear	180/55 ZR 17" - 190/55 - ZR 17"

Supply

FUEL SUPPLY

Specification	Desc./Quantity
Fuel	Premium unleaded petrol, minimum octane rating of 95 (NORM) and 85 (NOMM)

SUPPLY SYSTEM

Specification	Desc./Quantity
Type	Electronic injection (Multipoint)
Diffuser	Ø 57 mm (2.24 in)

Tightening Torques

ENGINE TO CHASSIS RETAINER

Name	Torque in Nm
Front clamp M10	50
Rear top and bottom left clamp M10	50
Rear top and bottom right clamp for adjust. bushing M20x1.5	12
Rear top and bottom right clamp for counter ring nut M20x1.5	50
Rear top and bottom right clamp M10	50

PARTS FIXED TO THE ENGINE

Name	Torque in Nm
Engine oil intake flange M6	10
Engine oil outlet flange M6	10
Rear brake lever support M6	10
Rear brake lever support M8	25
Rear brake pump support M8	25
Pinion clamp M10	50 - Loctite 243
Clutch pin clamp M6	10
Pinion crankcase clamp M6	10
Retainer for pipe delivering fuel to throttle body M12X1.5	22
retainer for 72/78 kW reduction bushing M5	3 - (shear head screw) Loctite 243

SWING ARM

Name	Torque in Nm
bolt ring nut for swing arm M30x1.5	60
swing arm bolt for adjustment bushing M30x1.5	12
swing arm bolt nut M20x1.5	90
Lock bolt of calliper support M12	50 - Loctite 243
Chain tensioner screw and nut M8	manual
Retainer for rear brake pipe cable guide M5	4
Top retainer of chain crankcase M5	4
bottom retainer of crankcase chain and chain eye support M5	5
Chain guide pad retainer M5	3
Retainer for fixing upper chain eye to chain eye	5

Name	Torque in Nm
support M5	
Rear stand bushing retainer M6	10
Chain eye retainer M6	10

SIDE STAND

Name	Torque in Nm
Stand plate to chassis retainer M10	50
Side stand retainer bolt M10x1.25	10
Switch fixing screws M6	10 - Loctite 243
Lock nut M10x1.25	30

FRONT FORK

Name	Torque in Nm
Fork stem to upper plate retainer M8	25
Fork stem to lower plate retainer M8	25
Headstock ring nut M35x1	40
Headstock counter ring nut M35x1	Manual + 90°
Upper plate fixing cover M29x1	100
(Showa) Fork hub cap nut M8	22
(Ohlins) Fork hub cap nut M6	12

STEERING SHOCK ABSORBER

Name	Torque in Nm
Shock absorber to chassis retainer M6	10 - Loctite 243
Shock abs. stem to lower plate retainer M6	10

FOOTRESTS

Name	Torque in Nm
Driver footrests M8	2.5
Passenger footrests M8	2.5

REAR SHOCK ABSORBER

Name	Torque in Nm
Shock absorber to chassis retainer M10	50

CONNECTING RODS

Name	Torque in Nm
Single connecting rod to chassis retainer M10	50
Single connecting rod/double connecting rod re-	50

Name	Torque in Nm
tainer M10	
Double connecting rod/swing arm retainer M10	50
Double connecting rod/shock absorber retainer M10	50

ELECTRICAL SYSTEM

Name	Torque in Nm
Battery clamping bracket M5	2
Horn M8	15
Odometer sensor to rear brake calliper support retainer M6	12
Voltage regulator support retainer M6	10
Voltage regulator to support retainer M6	10
Coil support to chassis retainer M6	10
Coil to coil support retainer M6	10
Control unit retainer M6	10
Start-up relay support on saddle pillar retainer M6	10
Bracket retainer for relay holder on saddle pillar M6	3
Atmospheric pressure sensor to saddle pillar clamp retainer M5	1
Cable on starter motor retainer M6	5
Retainer for start-up relay cables M6	4
Ground lead to engine retainer M6	5
SWP 3.9 Plate retainer for main cable harness on air intake	1

LIGHTS / INSTRUMENT PANEL

Name	Torque in Nm
Rear arrow retainer M4	1
Front arrow retainer M6	4
Rear light to tail retainer M5	2
Front headlamp to deflector retainer M5	2
Front headlamp to front fairing retainer M5	2
SWP 5x14 Instrument panel retainer	3

FILTER HOUSING

Name	Torque in Nm
SWP 5x20 Filter housing cover	3
Filter housing to throttle body retainer M6	5
SWP 3.9 Intake ducts	1
SWP 5x20 MAP sensor support retainer	2
SWP 5x20 Filter frame retainer	2
Deflector to chassis retainer M6	10

REAR WHEEL

Name	Torque in Nm
Crown on crown holder retainer M10	50
Rear wheel bolt nut M25x1.5	120

FRONT WHEEL

Name	Torque in Nm
Wheel bolt nut M25x1.5	80

COOLING SYSTEM

Name	Torque in Nm
Water radiator upper support to chassis retainer M6	10
Electrical fan to water radiator retainer M6	6
Water radiator to upper support retainer M6	10
Filler to water radiator retainer M6	-
Retainer for attaching water radiator side supports to engine coupling spacers M6	10
Water radiator to side supports retainer M6	6
Oil radiator support to engine retainer M6	10
Oil radiator to oil radiator support retainer M6	10
Expansion tank to chassis retainer M6	10
Expansion tank cover retainer M28x3	6
8104097 Hose clamp retainer	4

FRONT BRAKING SYSTEM

Name	Torque in Nm
Front brake right and left calliper retainer M10x1.25	50
Front brake oil reservoir to bracket retainer M6	7
Retainer for front brake fluid reservoir to clutch upper bracket M6	10

Name	Torque in Nm
Clutch fluid reservoir to bracket retainer M5	3
Retainer for front brake pipe cable guide to lower steering plate M5	4
Brake disc retainer M8	30 - Loctite 243

REAR BRAKING SYSTEM

Name	Torque in Nm
Rear brake calliper retainer M8	25
Rear brake lever pin M8	15 - Loctite 243
Rear brake fluid reservoir retainer M5	3
Rear brake rod lock nut M6	manual
Brake disc retainer M8	30 - Loctite 243

EXHAUST

Name	Torque in Nm
Front exhaust pipe to engine retainer M6	12
Rear exhaust pipe to engine (upper screws) retainer M6	manual
Rear exhaust pipe to engine (lower screws) retainer M6	12
Lambda probe retainer M18x1.5	38
Rear manifold protection retainer M4	2.5
Silencer to support retainer M8	25
Protections to silencer retainer M4	2.5

FUEL PUMP

Name	Torque in Nm
Fuel return pipe fitting M6	6 (Loctite 243)
Pump support to flange retainer M5	4
Wire cap to flange retainer M5	5
Fuel return pipe clamp M6	10 (Loctite 243)
Petrol delivery pipe on flange M12x1.5	22
Fuel level sensor on pump support SWP 2,9x12	1
Fuel pump cable harness on flange M6	10

TANK

Name	Torque in Nm
Filler to tank retainer M5	5

Name	Torque in Nm
Fuel pump flange to tank retainer M5	6

ENGINE OIL RESERVOIR

Name	Torque in Nm
Oil reservoir retainer (nuts) M6	10
Oil filter shank M20x1.5	30
Oil drainage plug M8	15
Oil level pipe retainer M10x1	20

LOWER SADDLE PILLAR CLAMP

Name	Torque in Nm
Lower clamp to saddle pillar retainer M6	5
Lower clamp to chassis retainer M5	4
Rear stand bushing retainer for lower saddle pillar clamp M6	12

LICENSE PLATE HOLDER

Name	Torque in Nm
Retainer fixing license plate holder to lower saddle pillar clamp M6	3
Retroreflector to license plate holder retainer M4	1

MUDGUARDS

Name	Torque in Nm
Front mudguard retainer M5	5
Rear mudguard retainer M5	5

TAIL

Name	Torque in Nm
Tail to saddle pillar retainer M5	5
Tail camp to saddle pillar retainer M6	7

RIGHT / LEFT FAIRING

Name	Torque in Nm
Fairings to tail retainer M5	2
Fairings to tank retainer M5	5

LUG

Name	Torque in Nm
Retainer fixing lug assembly to oil radiator support and spacers on engine M6	7

RIGHT/LEFT SIDE COVERS

Name	Torque in Nm
Rear side cover retainer M6	7
Front side cover retainer (with spoiler spacers) M6	10
Retainer for right side cover to voltage regulator support M6	5

RIGHT/LEFT RADIATOR FAIRING

Name	Torque in Nm
SWP 3.9 Retainer fixing radiator right-left fairing to fan pin	1

RIGHT / LEFT SPOILER

Name	Torque in Nm
Rear spoiler to spacer retainer M6	7
Front spoiler to water radiator retainer M6	7

OIL RESERVOIR COVER

Name	Torque in Nm
Oil reservoir retainer M5	5

FRONT

Name	Torque in Nm
Front retainer fixing headlight assembly and deflector M5	3

WINDSHIELD

Name	Torque in Nm
Front fairing retainer M4	1

RADIATOR SPOILER

Name	Torque in Nm
Retainer for water radiator bottom supports M5	3

FORK BOTTOM CLAMP

Name	Torque in Nm
Steering lower plate retainer M6	3
Retainer fixing steering lower plate to steering shock absorber M6	10

SADDLE COVER

Name	Torque in Nm
SWP 3.9 Saddle cover base retainer	1

HANDLEBAR AND CONTROLS

Name	Torque in Nm
handlebar support upper U-bolt M8	25
Retainer fixing handlebar supports to steering top plate (only for workshop manual) M10	30 - Loctite 243
Anti-vibration weight retainer M6	10
Terminals to anti-vibration weights retainer M18x1	35
Left light switch M5x1	1.5
Right light switch M4	1.5
Front brake pump retainer M6	8
Clutch pump retainer M6	8

LOCKS

Name	Torque in Nm
Key switch to steering plate retainer M8	25
Rear lock to tail retainer M22x1.5	10 - Nylon nut

CHASSIS

Name	Torque in Nm
Chain bottom pad retainer M6	10
Saddle pillar retainer M10	50

PARTS FIXED TO THE ENGINE

Name	Torque in Nm
Engine oil intake flange M6x20	11
Engine oil drainage plug M12x1.5	20
Pinion retainer M10x35	50
Clutch control cylinder retainer M6x45	11
Coolant drainage screws M6x25	11
Gearbox lever fixing screws	12

ENGINE CRANKCASE

Name	Torque in Nm
Torx screws locking ball bearings of selector roller / crankcase [flywheel side (MS)] M6x12	11 - Loctite 243
ball bearings of selector roller /crankcase [clutch side (KS)] M6x20	11

Name	Torque in Nm
Torx ball bearings of propeller shaft /crankcase [clutch side (KS)] M6x12	11 - Loctite 243
Crankcase [flywheel side (MS)] / crankcase [clutch side (KS)] M6x45	11
Crankcase [flywheel side (MS)] / crankcase [clutch side (KS)] M6x65	11
Crankcase [flywheel side (MS)] / crankcase [clutch side (KS)] M6x80	11
Crankcase (magnetic screw) M12x1.5	20
Crankcase neutral sensor	4 - Loctite 574
Oil filter cover M6x20	11
Crankcase/nozzle 60	6
Bearing flange [flywheel side (MS)] M6x12	11 - Loctite 243

OIL PUMP

Name	Torque in Nm
Oil pump	-
Oil pump body	-
Oil pump cover M6x45	11

CLUTCH

Name	Torque in Nm
Main shaft [clutch side (KS)] M24x1.5	170 - Loctite 648
Clutch spring M6x30	11
Disengaging shaft M12	30
Main transmission (spring holding plate/ main transmission gear / clutch bell) M8x25	30
Main transmission (spring holding plate/ main transmission gear / clutch bell) M8	30 - Loctite 648

CYLINDER HEADS AND CYLINDERS

Name	Torque in Nm
Camshaft support / front cylinder head M6x30	11
Front cylinder head (water hose) M18x1.5	manual - Loctite 275
Front cylinder head cover M18x1.5	manual - Loctite 243
Rear cylinder head (water hose) M18x1.5	manual - Loctite 275
Camshaft support / rear cylinder head M6x30	11
Camshaft support / rear cylinder head M6x55	11
Camshaft support / rear cylinder head M6x45	11

Name	Torque in Nm
Discharge stud bolt M6x16/20	10 - Loctite 275
Rear cylinder head	Manual - Loctite 275
Cylinder head / crankshaft (screw stud) M10x171	6 - Loctite 648
Cylinder / cylinder head (version with non-coated cylinder) M8x45	27
Cylinder head / screw stud (version with non-coated cylinder head) M10x4	58
Cylinder head / chain compartment M6x100	12
Rear cylinder head / bushing flange M6x35	11
Rear cylinder head / bushing flange M6x20	11
Front cylinder head / Driven gear (timing system chain) - Camshaft intake M6x45	11 - Loctite 243
Front cylinder head / top chain guide M6x16	11
Rear cylinder head / Driven gear (timing system chain) - Camshaft intake M6x11.5	11 - Loctite 243
Rear cylinder head / Counterweight + Driven gear (upper countershaft assembly) - Upper counter shaft M14x1	50 - Loctite 243
Rear cylinder head / Upper chain guide M6x35	11
Valve cover M6x23	9
Intake flange M8x25	19
Cylinder / chain tensioner M16x1.5	30
Water temperature sensor	20
Supporting bracket retainer M10; M10x40	40 - Loctite 243

IGNITION SYSTEM AND STARTER MOTOR

Name	Torque in Nm
Camshaft position sensor / front cylinder head M6x15	11
Starter motor M6x30	11
Crankshaft position sensor / flywheel cover M6	11 - Loctite 243
Flywheel cover / generator M6x35	11
Magneto flywheel / freewheel housing / flywheel ring M8x18	30 - Loctite 648
Magneto flywheel / crankshaft M16x30	130 - Loctite 648
Ignition device cover / cable holding bracket M5	7

CLUTCH AND COOLANT PUMP COVER

Name	Torque in Nm
Coolant pump rotor	manual
Coolant pump cover M6x25	11
Coolant pump body M6x55	11 - Loctite 243
Clutch cover M6x35	11
Clutch cover M6x50	11
Clutch cover M8x55	19
Clutch cover M8x65	19

Overhaul data

Assembly clearances

Cylinder - piston assy.

CYLINDERS

All seal surfaces must be clean and flat. Seal surface levelness:

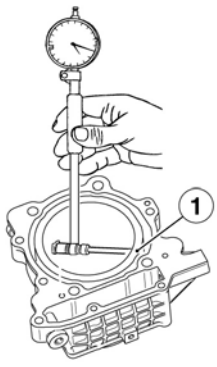
Max. distortion allowed 0.04 mm (0.0016 in).

Make sure all threads are in proper conditions. Check cylinder sliding surface for signs of friction and scratches. Also check the seal surfaces for damages.

CAUTION

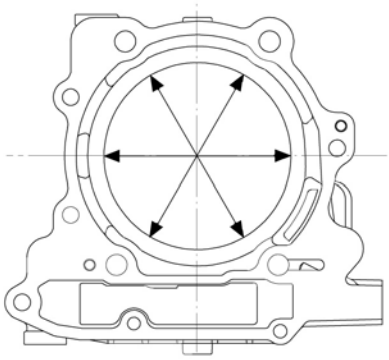
REPLACE CYLINDER OR PISTON IF GROOVES ON THE NIKASIL LINER, CYLINDER INNER SIDE, ARE EVIDENT.

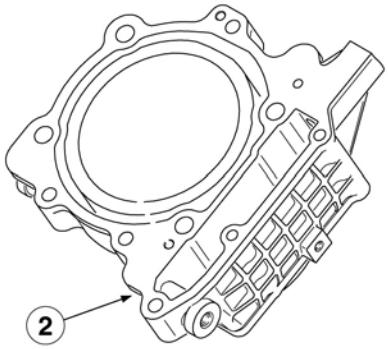
Clean off lime scales on the cylinder cooling slots. Measure the cylinder bore **45 mm (1.77 in)** from the upper rim (1) at three different points; the highest value should be considered to estimate wear limits.



CAUTION

EITHER GROUP "A" OR "B" IS PUNCHED AT THE BOTTOM OF CYLINDER (2).





- Measurement group "A", dimension as new:

bore diam. 97.000 ÷ 97.012 mm (3.81889 - 3.81936 in);

wear limits: Max. diam. 97.027 mm (3.81936 in).

- Measurement group "B", dimension as new:

bore Diam. 97.012 - 97.025 mm (3.81936 - 3.81987 in);

wear limits: Max. diam. 97.040 mm (3.82046 in)

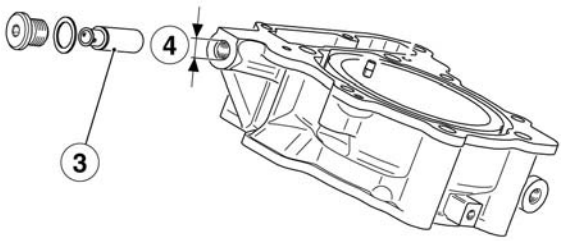
CAUTION

TO ASSESS WEAR LIMITS IT IS NECESSARY TO DETERMINE THE ASSEMBLING CLEARANCE.

Check that the chain tensioner (3) and the cylinder guide are in proper conditions.

- Chain tensioner backlash (3) / hole on cylinder (4);

Wear limits (hole diam. - Chain tensioner diam.): **max. 0.08 mm (0.0032 in)**.



- Hole on cylinder for chain tensioner;

Wear limits (4): **Max. diam. 14.07 mm (0.5539 in).**

PISTONS AND PINS

Clean off combustion residues from the piston crown and from the area above the upper ring.

Check for cracks on the piston and for compression on the piston sliding surface (seizing); Replace the piston if required.

CAUTION

SMALL STRIATIONS ON THE PISTON LINER ARE ADMISSIBLE.

PISTON WEAR LIMITS

With an outside micrometer, measure the piston diameter at **10 mm (0.40 in)** high, crosswise to the pin axis.

- "Red" piston:

wear limit Max. diam. 96.918 mm (3.81566 in).

- "Green" piston:

wear limit Max. diam. 96.930 mm (3.81613 in).

- Piston clearance - measurement: cylinder diameter minus piston diameter;

max. wear limit 0.090 mm (0.00354 in).

CAUTION

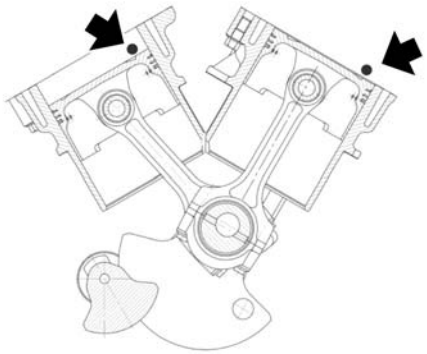
IF WEAR LIMITS ARE EXCEEDED IT IS NECESSARY TO USE A NEW PISTON OR REPLACE THE CYLINDER OR THE PISTON.
IF THE PISTON IS REPLACED, ALWAYS REPLACE BOTH PIN SAFETY LOCKS AS WELL AS THE PINS.

Comply with cylinder - piston coupling:

"red" piston - Cylinder "A".

"Green" piston - Cylinder "A".

Negligible difference: **0.01 mm (0.00039 in)**



CAUTION

ASSEMBLE BOTH PISTONS WITH THE MARK POINTING TOWARDS THE REAR CYLINDER.

With an external micrometer, measure the pin hole diameter on the piston in vertical direction

and the pin diameter at both ends and at the centre.

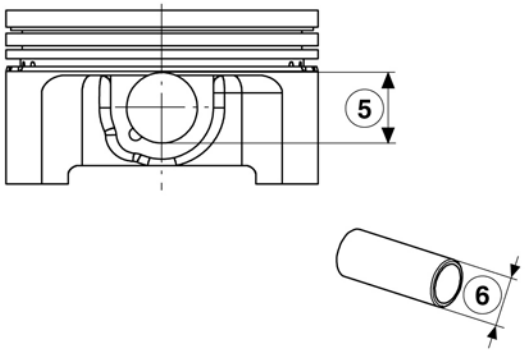
- pin hole in vertical direction:

wear limit (5) max. diam. 22.018 mm (0.86685 in).

- Pin:

wear limit (6) min. diam. 21.998 mm (0.86606 in).

Check pin locking stops wear with bent end.



Piston rings

Measure the axial clearance (1) (2) (3) of the piston rings inside the slots.

- L-shaped ring:

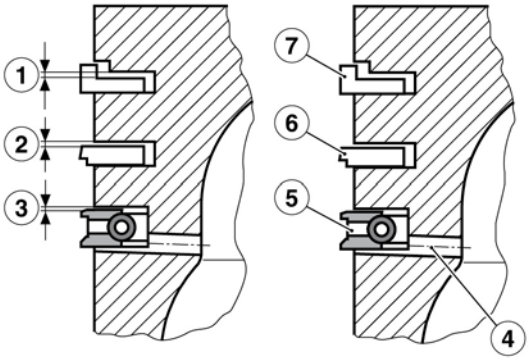
max. wear limit (1) 0.12 mm (0.0047 in).

- Tapered ring with protrusion:

max. wear limit (2) 0.12 mm (0.0047 in).

- Oil scraper ring:

max. wear limit (3) 0.10 mm (0.0039 in).



PISTON RINGS ARE FRAGILE.

Carefully remove the piston rings from the piston.

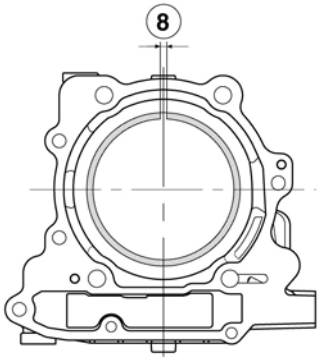
CAUTION

CLEAN THE PISTON RING SLOT WITH CAUTION WITH THE AID OF A SCRAPER OR AN OLD PISTON RING.

Clean the piston ring slots and the oil flow holes (4) on the oil scraper ring grooves, then blow in a jet of compressed air.

Check the oil scraper ring (5), the tapered ring with protrusion (6) and the L-shaped ring (7) to check that the sliding surface is clean.

Use a thickness gauge to measure the piston rings opening (8).



Max. wear limit 1.00 mm (0.0394 in).

CAUTION

IN ORDER TO MEASURE THE GAP INSERT THE PISTON RING TO THE CYLINDER AND ALIGN IT BY PUSHING IT INSIDE WITH THE PISTON.

The cylinder bore must not show signs of wear.

Use a micrometer to measure ring thickness.

- L-shaped ring:

min. wear limit (9) 0.85 mm (0.0335 in).

- Tapered ring with protrusion:

min. wear limit (10) 1.20 mm (0.0472 in).

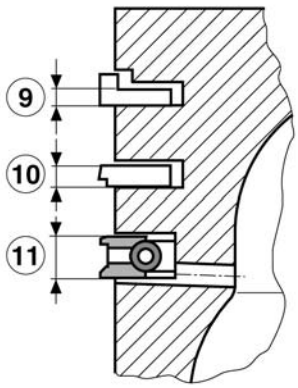
- Oil scraper ring:

min. wear limit (11) 2.45 mm (0.0965 in).

From bottom to top fit the oil scraper ring (5), the tapered ring with protrusion (6) and the L-shaped ring (7); the word "TOP" on the rings must be facing up.

CAUTION

TURN THE PISTON RINGS SO THAT THE THREE OPENINGS ARE OFFSET AT APPROX. 120°.



Crankcase - crankshaft - connecting rod

Using a non-aggressive solvent thoroughly clean both sections of the engine crankcase, the ball bearings and all the bearing seats.

Clean the seal surfaces and check that they are not damaged.

CAUTION

TO AVOID DAMAGING BOTH CRANKCASE HALVES PLACE THEM ON A FLAT SURFACE.

Check that both crankcase halves are not cracked or damaged.

Check that all threads are in proper conditions.

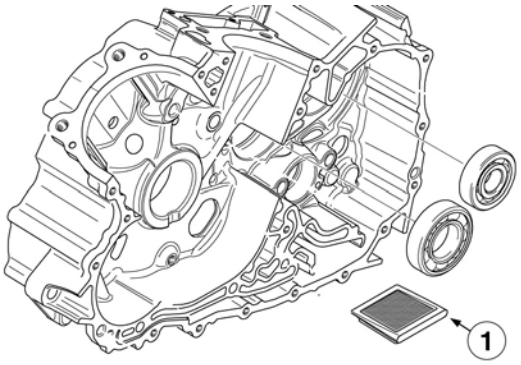
Check that all oil seals remaining in their position are not worn or damaged.

Check all ball bearings for clearance, smoothness and potential distortions.

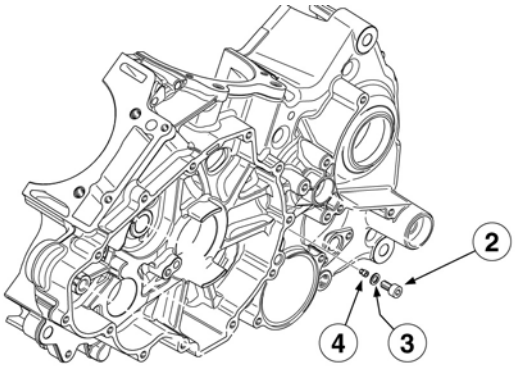
CAUTION

LUBRICATE BALL BEARINGS WITH ENGINE OIL BEFORE FURTHER CHECKING.

If the internal ring does not rotate smoothly and silently or if there is some noise while it turns, it means that the bearing is faulty and must be replaced. Take out the oil net (1).
Clean the oil net with petrol and inspect the net links for potential damage.

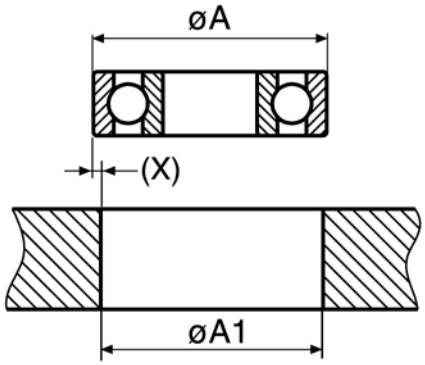


Unscrew and take out the screw (2), the seal washer (3) and the nozzle (4).
Check that the conducts are clean at every lubricating hole on both crankcase halves and if required, clean them by blowing in a jet of compressed air.



BALL BEARING FITTING

Check the interference between the bearing and the hole on the engine crankcase halves.
Interference (X) = (Diam. A) minus (Diam. A1) : 0.01 mm (0.0004 in)



CRANKSHAFT AND COUNTERSHAFT MAIN BUSHINGS

MAIN BUSHINGS MUST BE REPLACED ONLY AT AUTHORISED WORKSHOPS, USING SPECIFIC MEASURING DEVICES AND EQUIPMENT.

Measure the inside diameter of the crankshaft main bushings of both crankcase halves.

Crankshaft main bushings: wear limits Diam. 46.035 mm (1.81240 in).

Measure the inside diameter of the countershaft main bushings of both crankcase halves.

Countershaft main bushings: wear limits Diam. 32.060 mm (1.26220 in).

CARRY OUT SEVERAL MEASUREMENTS, SPECIALLY IN THE DIRECTION OF THE AXIS OF BOTH CYLINDER, AVOIDING THE COUPLING SURFACE OF THE 2 HALF-SHELLS.

VALUES MUST NEVER EXCEED THE LIMITS SPECIFIED.

MEASURE THE RADIAL CLEARANCE BETWEEN THE MAIN BUSHINGS AND THE RELATED CRANKSHAFT AREAS.

CHECK THE RADIAL CLEARANCE BETWEEN THE MAIN BUSHINGS AND THE RELATED COUNTERSHAFT AREAS.

Check there are no signs of wear or sliding marks on the axial thrust surfaces on the crankshaft, on both crankcase halves..

Check there are no signs of wear or sliding marks on the axial thrust surfaces on the countershaft, on both crankcase halves, clutch side.

CHECK CRANKCASE AXIAL CLEARANCE.

CHECK COUNTERSHAFT AXIAL CLEARANCE.

Clean the seat diameter of the main bushings inside the engine crankcase On the engine crankcase check the measurement group of the main bushings based on the colour marks.

THE CRANKSHAFT LOWER MAIN BUSHING, FLYWHEEL SIDE, HAS A LUBRICATION HOLE.

CAUTION

THE MAIN BUSHING TOLERANCE UNIT IS ALSO MARKED WITH A COLOUR DOT.

If the colour mark on the engine crankcase is not clear, calculate the diameter by averaging out the different measurements.

PERFORM SEVERAL MEASUREMENTS, PARTICULARLY IN THE DIRECTION OF THE AXLES OF BOTH CYLINDERS.

CRANKSHAFT

Bushing seat hole on engine crankcase halves - Diam. mm (in)

Specification	Desc./Quantity
Red	49.899 - 49.908 mm (1.96452 - 1.96488 in)
Blue	49.908 - 49.918 mm (1.96488 - 1.96527 in)
Yellow	49.918 - 49.929 mm (1.96527 - 1.96570 in)

COUNTERSHAFT

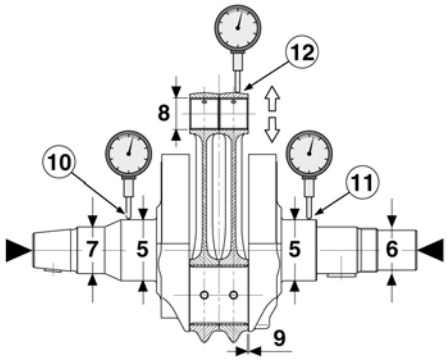
Bushing seat hole on engine crankcase halves - Diam. mm (in)

Specification	Desc./Quantity
Red	35.909 - 35.918 mm (1.41374 - 1.41409 in)
Blue	35.918 - 35.928 mm (1.41409 - 1.41448 in)
Yellow	35.928 - 35.939 mm (1.41448 - 1.41492 in)

ENGINE CRANKCASE HALVES CYLINDRICAL PINS

With a micrometer check the cylindrical pins of the starter motor control and the coolant pump intermediate gear for wear.

Wear limits Diam. 9.990 mm (0.39306 in).



CRANKSHAFT

Check crankshaft for wear:

- main bushings area (engine crankcase) (5);

wear limits Min. diam. 45.955 mm (1.80925 in).

- supporting bushings area (flywheel cover) (6);

wear limits Min. diam. 29.970 mm (1.17992 in).

- freewheel gear bearing area (7);

wear limits Min. diam. 34.960 mm (1.37637 in).

- rod small end (8);

wear limits max. diam. 22.030 mm (0.86732 in).

- axial clearance between connecting rod and crank arm (9);

max. limit 0.60 mm (0.0236 in).

CAUTION

MEASURE CRANKSHAFT ECCENTRICITY BETWEEN ENDS

- crankshaft eccentricity (10), flywheel side;

max. limit 0.020 mm (0.00079 in);

- crankshaft eccentricity, clutch side (11);

max. wear limit 0.020 mm (0.00079 in);

CAUTION

DO NOT REUSE ENGINE CRANKCASE GASKETS WHICH HAVE BEEN REMOVED.
USE NEW APRILIA ORIGINAL GASKETS ONLY.
WITH A COMPARATOR, DETERMINE THE CRANKSHAFT AXIAL CLEARANCE AFTER CRANKCASE HALVES COUPLING.

Max. crankshaft axial clearance 0.5 mm (0.020 in). With a comparator, determine the rod small end radial clearance (12).
Max. wear limit 0.060 mm (0.00236 in). Measure the radial clearance between the (engine crankcase) main bushings and the related crankshaft (5) areas.
Max. radial clearance allowed 0.060 mm (0.00236 in). Radial clearance is derived from the following values:

- the maximum inside diameter value of the (engine crankcase) main bushings minus the diameter value of the (engine crankcase) main bushing area on the crankshaft.
- Measure the main bushings (engine crankcase) inside diameter.

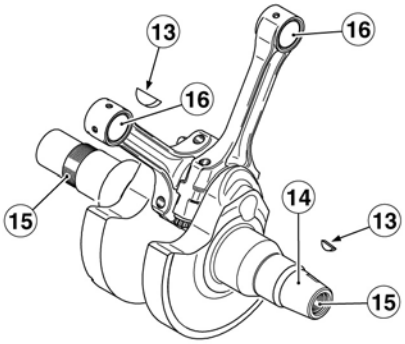
IF THIS MAX. RADIAL CLEARANCE ALLOWED IS EXCEEDED, REPLACE THE WORN OUT COMPONENT.

Measure the radial clearance between the supporting bushings (clutch cover) and the related crankshaft (6) area.
Max. radial clearance allowed 0.065 mm (0.00256 in). Radial clearance is derived from the following values:
the maximum inside diameter value of the (clutch cover) supporting bushings minus the diameter of

the (clutch cover) supporting bushing area on the crankshaft. Measure the supporting bushings (clutch cover) inside diameter.

IF THIS MAX. RADIAL CLEARANCE ALLOWED IS EXCEEDED, REPLACE THE WORN OUT COMPONENT.

Also check that the material of the following components is not worn or damaged: Crankshaft keys (13) and grooves. Bearing seat colour. Crankshaft bevel surface (14), flywheel side. Clean off any remaining LOCTITE from the thread (15) and check that it is in proper conditions. Check that the bushing (16) inside the rod small end is correctly set and centred (along the longitudinal axis).



CONNECTING RODS

Check that there are no signs of wear or shape / colour alteration on the bushings. Check whether the connecting rod seat is worn out:

- connecting rod pins;

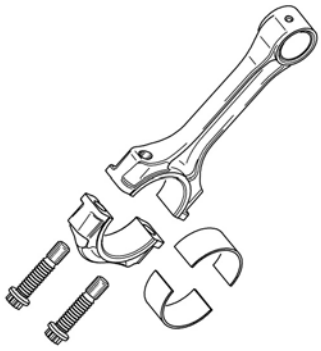
wear limits Min. diam. 41.98 mm (1.6528 in).

- rod head (after tightening the screws);

wear limits Max. diam. 42.050 mm (1.6555 in).

CAUTION

VALUES MUST NEVER EXCEED THEIR LIMITS. IN CASE OF WEAR, REPLACE THE CONNECTING ROD AND ITS COVER.



Measure the rod head radial clearance.

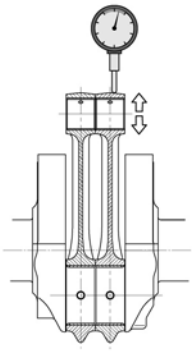
Max. wear limit 0.070 mm (0.00276 in).

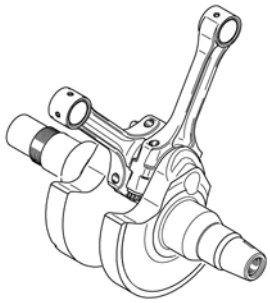
With a comparator measure the connecting rod eye radial clearance.

Radial clearance 0.020 - 0.045 mm (0.00079 -

0.00177 in).

If radial clearance exceeds 0.045 mm (0.00177 in), choose bushings with sizes corresponding to the blue or yellow types based on the table below and insert them in place of the red bushings.





- RED bushing thickness: 1.471 - 1.476 mm (0.05791 - 0.05811 in)
- BLUE bushing thickness: 1.476 - 1.481 mm (0.05811 - 0.05831 in)
- YELLOW bushing thickness: 1.481 - 1.486 mm (0.05831 - 0.05850 in)

COUNTERSHAFT AND COUNTERSHAFT MECHANISM

Check countershaft for wear:

- main bushings (engine crankcase) area (17);

wear limits Min. diam. 31.980 mm (1.25905 in).

- supporting bushing areas (clutch cover) (18);

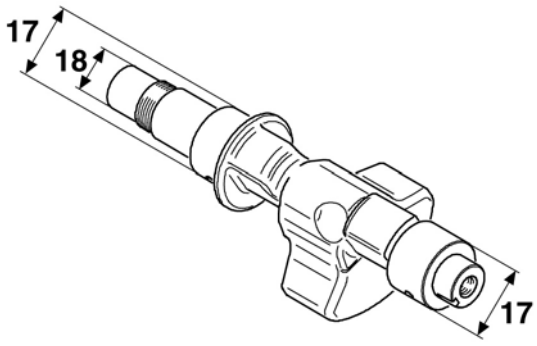
wear limits Min. diam. 19.990 mm (0.78701 in).

IF THIS MAX. RADIAL CLEARANCE ALLOWED IS EXCEEDED, REPLACE THE WORN OUT COMPONENT.

Measure the radial clearance between the (engine crankcase) main bushings and the related countershaft (18) areas.

Min. radial clearance allowed 0.060 mm (0.00236 in).

Radial clearance is derived from the following values:the maximum inside diameter value of the (engine crankcase) main bushings minus the diameter value of the related main bushings (18)



areas on the countershaft. Measure the main bushings (engine crankcase) inside diameter.

IF THIS MAX. RADIAL CLEARANCE ALLOWED IS EXCEEDED, REPLACE THE WORN OUT COMPONENT.

Measure the radial clearance between the supporting bushings (clutch cover) and the related countershaft (18) area.

Min. radial clearance allowed 0.060 mm (0.00236 in). Radial clearance is derived from the following values:

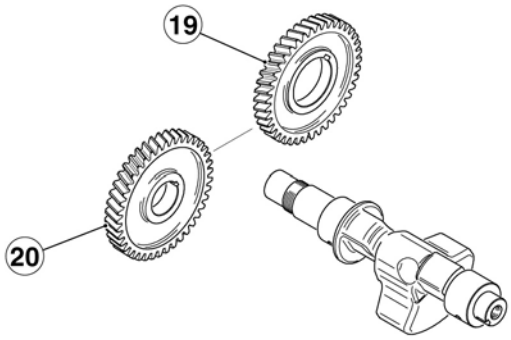
the maximum inside diameter value of the (clutch cover) supporting bushings minus the diameter value of the related supporting bushing (18) area on the countershaft. Measure the supporting bushings (clutch cover) inside diameter.

CAUTION

AFTER COUPLING THE CRANKCASE HALVES CHECK THE AXIAL CLEARANCE OF THE COUNTERSHAFT WITH A COMPARATOR.

Max. countershaft axial clearance 0.30 mm (0.0012 in).

Check the sides of the driving (19) and driven (20) gear teeth for damage or shape alterations.



Recommended products chart

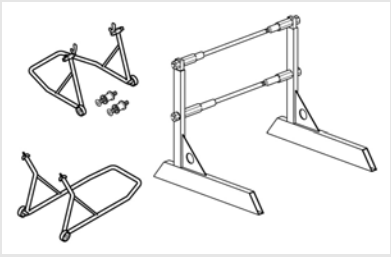
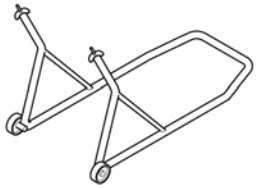
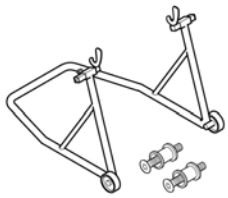
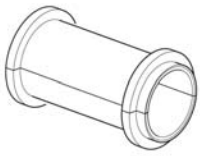
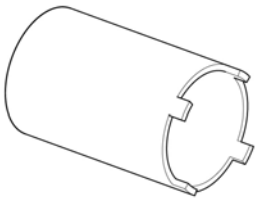
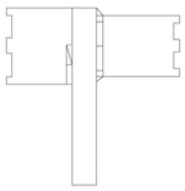
RECOMMENDED PRODUCTS

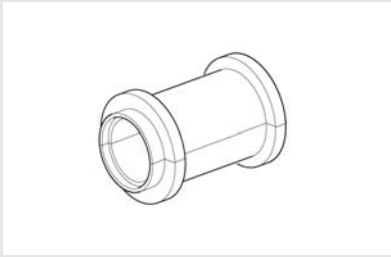
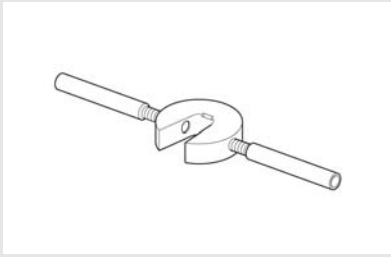
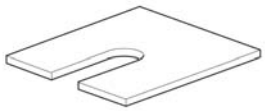
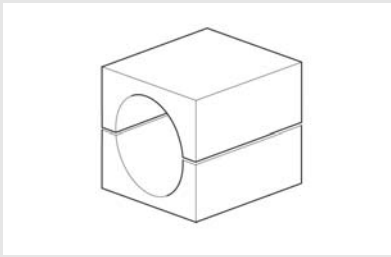
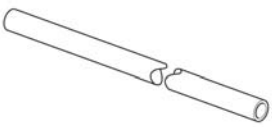
Product	Description	Specifications
AGIP RACING 4T 15W-50	engine oil	Use top branded oils with performances equal to or exceeding CCMC G-4 API SG SAE 15W-50 specifications
AGIP MP GREASE	Grease for bearings, joints, couplings and linkages	As an alternative to the recommended product, use top branded grease for roller bear-

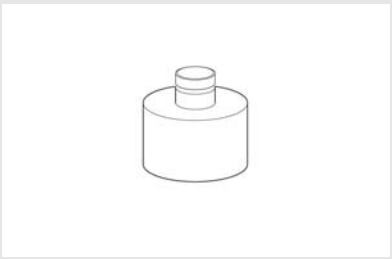
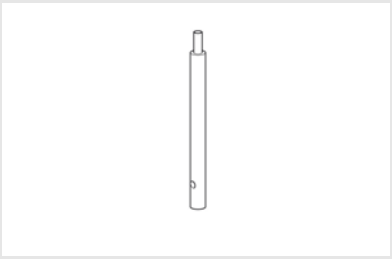
Product	Description	Specifications
		ings, useful temperature range: -30°C...+140°C (-22°F...+284°F), drop point: 150°C...230°C (302°F...446°F), high anticorrosive protection, good water and rust resistance.
AGIP ANTIFREEZE PLUS	Coolant	CUNA NC 956 - 16
AGIP BRAKE FLUID DOT 4 PLUS	Brake fluid	As an alternative to the recommended fluid, other fluids that meet or exceed the specified requirements may be used. SAE J1703, NHTSA 116 DOT 4, ISO 4925 Synthetic fluid
AGIP FORK 5W or AGIP FORK 20W	Fork oil - (R)	If you intend to have an intermediate performance, as an alternative to the recommended AGIP FORK 5W or AGIP FORK 20W use: AGIP FORK 7.5W AGIP FORK 10W AGIP FORK 15W
OHLINS 5W	Fork oil (Factory)	-

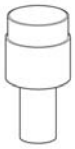
INDEX OF TOPICS

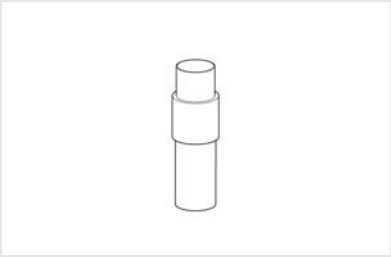
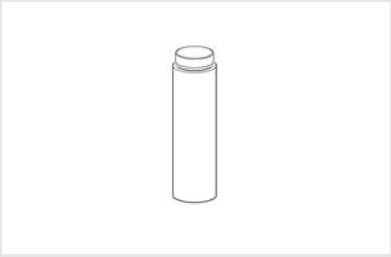
SPECIAL TOOLS

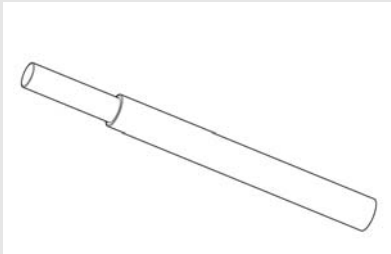
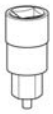
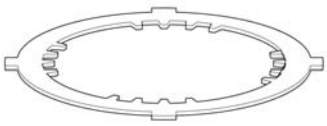
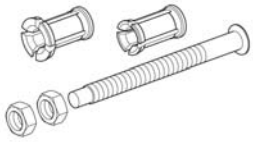
Stores code	Description	
8140176	Complete front, rear and central service stands kit	
8146486	Front service stand	
8705021	Rear service stand	
8140189	Oil seal fitting tool for Ø 43 mm (1.69 in) holes	
8140190	Tool for steering tightening	
8140191	Tool to tighten swing arm bolt and engine support	

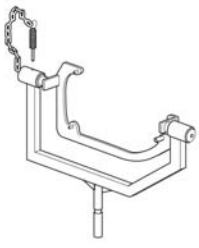
Stores code	Description	
8140145	Fitting tool for Ø 41 mm (1.61 in) sealing ring	
8140146	Weight to be applied to the tool: 8140145 and 8140189	
8140147	Spacer holder tool	
8140148	Spacer / pumping member separating plate	
8140149	Cover removal operations	
8140150	Perforated rod for pumping member air drainage	

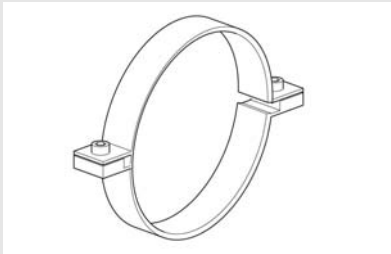
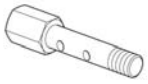
Stores code	Description	
0277680	Buffer for fitting oil seal on gear secondary shaft	
0277660	Buffer for fitting oil seal on upper countershaft	
0277670	Buffer for fitting oil seal on coolant pump shaft seat	
0877257	Buffer for fitting sliding ring on coolant pump shaft seat	
0277510	Buffer for removing valve guide	
0277210	Buffer for fitting valve guide	

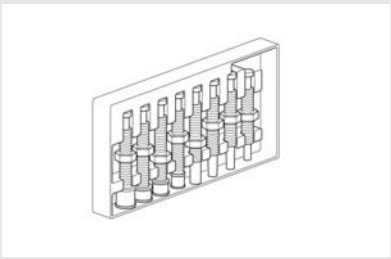
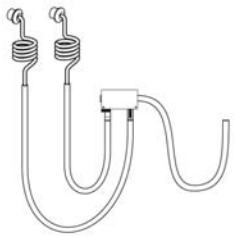
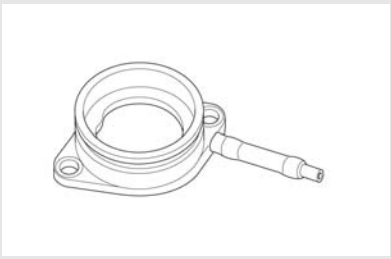
Stores code	Description	
0277695	Buffer for fitting valve guide oil seal	
8140155	Buffer for fitting gear shaft oil seal - clutch shaft oil seal	
0277720	Buffer for crankshaft bushings extractor	
0277725	Buffer for fitting crankshaft bushings	
0277537	Buffer for fitting countershaft bottom bushings	
0277727	Buffer for fitting clutch cover - crankshaft bushings	

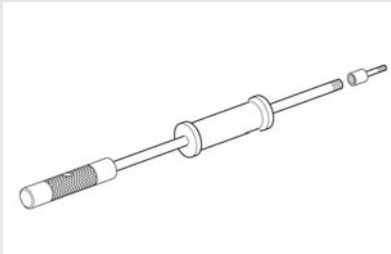
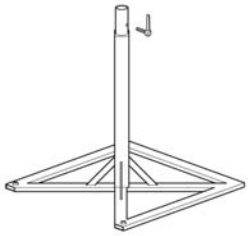
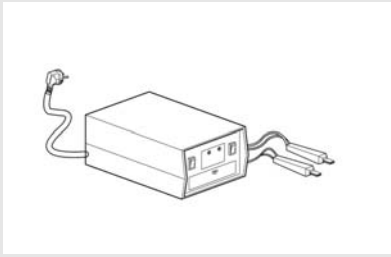
Stores code	Description	
0277729	Buffer for fitting the clutch cover - lower countershaft bushings	
8140177	Spark plug wrench	
0277252	Tool for removing ignition cover	
0277730	Hexagonal bolt for removing fly-wheel	
0240880	Threaded bolt for locking crank-shaft at TDC	
0277308	Guide bushing for gear second-ary shaft	

Stores code	Description	
8140178	Buffer for fitting - removing pin	
8140181	manometer for fuel - oil - compression pressure	
8140182	Bushing for rotor bolt	
0277881	Clutch locking tool	
8140156+8140157+0276377	Extractor for clutch cover bushings	
0276479	Tool for pump pressure plate	

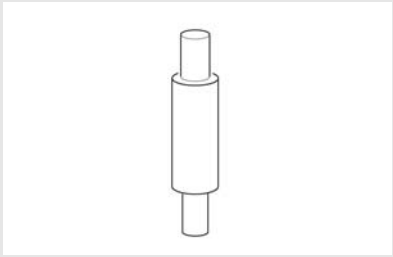
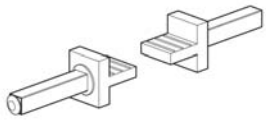
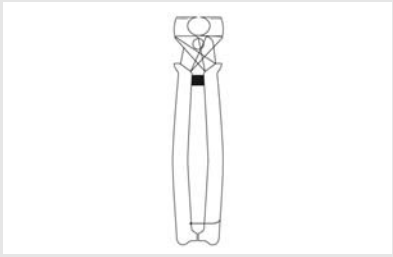
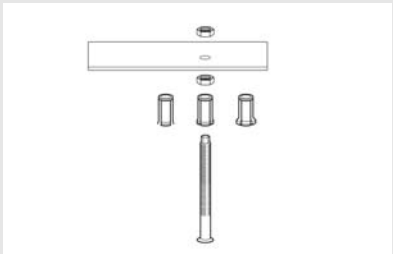
Stores code	Description	
8140179	Valve spring compressor	
8157143	Adhesive for tool panel - RSTV mille	
8140183	Hook for lifting engine	
8140184	Bushing for removing primary transmission nut	
8140185	Hook lever for removing clutch discs	
8140188	Engine support	

Stores code	Description	
8140186	Piston ring clamp tool	
8140197	Perforated bolt for testing fuel pressure	
8140205	Camshaft template tool	
8140426	Hooks for panel	
8140196+8140578	Plurigas (8140196 in Italian, 8140578 in English)	
8140192	Chain fitting kit	

Stores code	Description	
8140180	Bearing extractor	
8140202	Probes for exhaust fumes analysis	
8140267	Sleeve for vacuometer	
8140256	Vacuometer	
8140424	Wrench for OHLINS forks	
8140199	Tool panel	

Stores code	Description	
8140432	Expeller	
8140187	Engine supporting stand	
8124838	MF Battery charger	
0897651	LOCTITE 243 Blue (10 cm³) (0.61 in³)	
0899788	LOCTITE 648 green (5 g) (0.011 lb)	
0899784	LOCTITE 574 orange	

Stores code	Description	
0297434	LOCTITE 767 Anti-Seize 15378	
0297433	MOLYKOTE G-N (50 g) (0.11 lb)	
0897330	bp lz multipurpose grease	
0297386	SILASTIC 732 RTV (100 g) (0.22 lb)	
8116067	LOCTITE 8150	
8202222	Generic adhesive film for panel	

Stores code	Description	
8140074	Buffer for removing lower countershaft bushings	
8140204	Supports for rear service stand	
0277295	Pliers for clic clamps	
0877650	Buffer handgrip	
0277265	Extractor for countershaft, main and secondary shaft bearings	

INDEX OF TOPICS

Maintenance chart

AT EVERY START-UP

Action
Warning light indicating error on the instrument panel - check

BEFORE EACH RIDE AND EVERY 2000 KM (1250 MI)

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

AFTER-RUN 1000 KM (625 MI)

Action
Gearing chain - Check and lubricate or replace if necessary
Bowden cables and controls - Check and clean, adjust, grease or replace if necessary
Steering and steering clearance bearings - Check and clean, adjust, grease or replace if necessary
Brake discs - Check and clean, adjust, grease or replace if necessary
Engine oil filter - Replace
Engine oil filter (on oil reservoir) - Clean
General vehicle operation - Check and clean, adjust, grease or replace if necessary
Valve clearance - Check and adjustment
Braking systems - Check and clean, adjust, grease or replace if necessary
Light circuit - Check and clean, adjust or replace if necessary
Safety switches - Check and clean, adjust, grease or replace if necessary
Clutch lever fluid - check and top-up if necessary
Brake fluid - check
Coolant - Check and top-up
Engine oil - Replace
Tyres - Check and clean, adjust or replace if necessary
Tyre pressure - Adjust
Wheels - Check and clean, adjust, grease or replace if necessary
Bolts, nuts and screws tightening - Check and clean, adjust, grease or replace if necessary
Cylinder synchronisation - Check and clean, adjust, grease or replace if necessary
Suspensions and trim - Check and clean, adjust, grease or replace if necessary
Brake pad wear - Check and clean, adjust, grease or replace if necessary

EVERY 1000 KM (625 MI)

Action
Tyre pressure and wear - check

Action
Gearing chain tension and lubrication - check and clean, adjust, grease or replace if necessary
Brake pad wear - Check and clean, adjust, grease or replace if necessary

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

Action
Rear shock absorber - Check
Complete transmission - Wear check (every 10000 km - 6250 mi)
Spark plugs - Replace
Transmission cables and controls - check and clean, grease or replace if necessary
Wheel bearings - Check and clean, adjust, grease or replace if necessary
Steering and steering clearance bearings - Check and clean, adjust, grease or replace if necessary
Brake discs - check and clean, replace if necessary.
Air filter - Replace
Engine oil filter - Replace
Engine oil filter (on oil reservoir) - Clean
General vehicle operation - Check and clean, adjust, grease or replace if necessary
Valve clearance - Check and adjustment
Braking systems - Check and clean, adjust, grease or replace if necessary
Cooling system - check and clean, adjust, grease or replace if necessary.
Clutch control fluid - Replace (every 12 months)
Brake fluid - Change (every 12 months)
Coolant - Check and top-up
Engine oil - Replace
Fork oil - Replacement
Fork oil seal - check and clean, replace if necessary
Brake pads: check and replace in case of excessive wear
Complete piston - Replacement
Valve clearance adjustment - Adjust
Wheels - Tyres - Check
Bolts, nuts and screws tightening - Check and clean, adjust, grease or replace if necessary
Suspensions - check
Brake discs thickness - Check
Purge fluid present in oil drain pipe from the filter casing - Clean
Final drive (chain, crown, pinion) - check and clean, grease or replace if necessary (according to the Workshop Booklet specifications)

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

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

Action
Spark plug - Check
Gearing chain - Check and lubricate or replace if necessary
Bowden cables and controls - Check and clean, adjust, grease or replace if necessary
Steering and steering clearance bearings - Check and clean, adjust, grease or replace if necessary
Brake discs - Check and clean, adjust, grease or replace if necessary
Air filter - Check and clean, adjust, grease or replace if necessary
Engine oil filter - Replace
General vehicle operation - Check and clean, adjust, grease or replace if necessary
Cooling system - check and clean, adjust, grease or replace if necessary.
Braking systems - Check and clean, adjust, grease or replace if necessary
Light circuit - Check and clean, adjust or replace if necessary
Safety switches - Check and clean, adjust, grease or replace if necessary
Clutch lever fluid - check and top-up if necessary
Brake fluid - Check
Fork oil - Replacement
Engine oil - Replace
Light direction - operation - Check
Fork oil seal - check and clean, replace if necessary
Wheels - Check and clean, adjust, grease or replace if necessary
Bolts, nuts and screws tightening - Check and clean, adjust, grease or replace if necessary
Cylinder synchronisation - Check and clean, adjust, grease or replace if necessary
Fuel pipes - Check and clean, adjust, grease or replace if necessary

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

Action
Rear shock absorber - Check
Spark plug - Replace
Rear suspension connecting rod bearings - Check and clean, adjust or replace if necessary
Air filter - Replace
Engine oil filter (on oil reservoir) - Clean
Coolant - Check and top-up
Valve clearance adjustment - Adjust

Action
Suspensions and trim - Check and clean, adjust, grease or replace if necessary

EVERY 24 MONTHS

Action
Clutch control fluid - Replace
Brake fluid - Change
Coolant - Replace

EVERY 4 YEARS

Action
Fuel pipes - Replace

Fuel filter

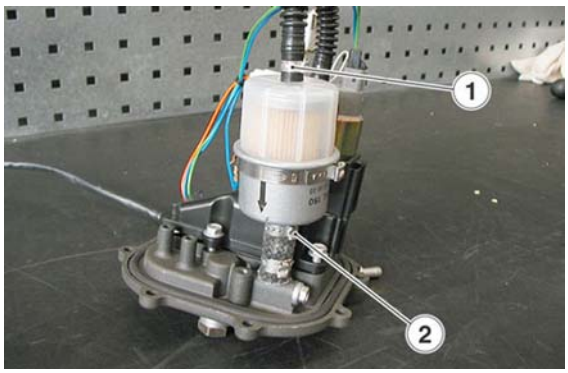
- Remove the entire fuel pump assembly.

UPON REFITTING, REPLACE CLIC CLAMP REMOVED WITH A NEW ONE OF EQUAL SIZE.

Specific tooling

0277295 Pliers for clic clamps

- Release the clic clamp (1).
- Remove the pipe from the filter.
- Release the clic clamp (2).
- Remove the filter from the pipe.



NOTE

NEVER REUSE A FILTER.

- Replace the filter with a new one of the same type.

CO check

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

- Turn on the scanner.
- Connect the exhaust fumes analyser pipes to their fittings.
- Start with both by-pass screws on the throttle body closed.
- Perform the following procedures with engine temperature over 75°C (167°F)

OPTION 1 (version with traditional exhaust pipes)

- On the AXONE, read the "front cylinder pressure" and "rear cylinder pressure" parameters, and check that the result is as follows:

front cylinder pressure = rear cylinder pressure - (50 ± 100) mbar

- If the value of the FRONT CYLINDER PRESSURE parameter is not right, actuate on the by-pass screw on the FRONT CYLINDER.
- Observe the residual CO values by opening the analyser valves alternately. If value is not kept around 0.7 - 1.2 % and especially if both values are different from each other by more than 0.5 %, operate on the by-pass screws.
- Once the CO checking is completed, check that the value of the FRONT CYLINDER PRESSURE and REAR CYLINDER PRESSURE parameters is approximately within the requested field.

OPTION 2 (version with unmuffled exhaust pipes)

USING SPORT SETTINGS AND RIDING THE VEHICLE SO SET ON ROADS AND MOTOR-

WAYS IS STRICTLY FORBIDDEN.

CAUTION

THE FOLLOWING SETTINGS REFER ONLY TO CONTROL UNITS WITH RACING CONFIGURATION FOR UNMUFFLED EXHAUST PIPES.

- On the AXONE, read the "front cylinder pressure" and "rear cylinder pressure" parameters, and check that the result is approximately as follows:

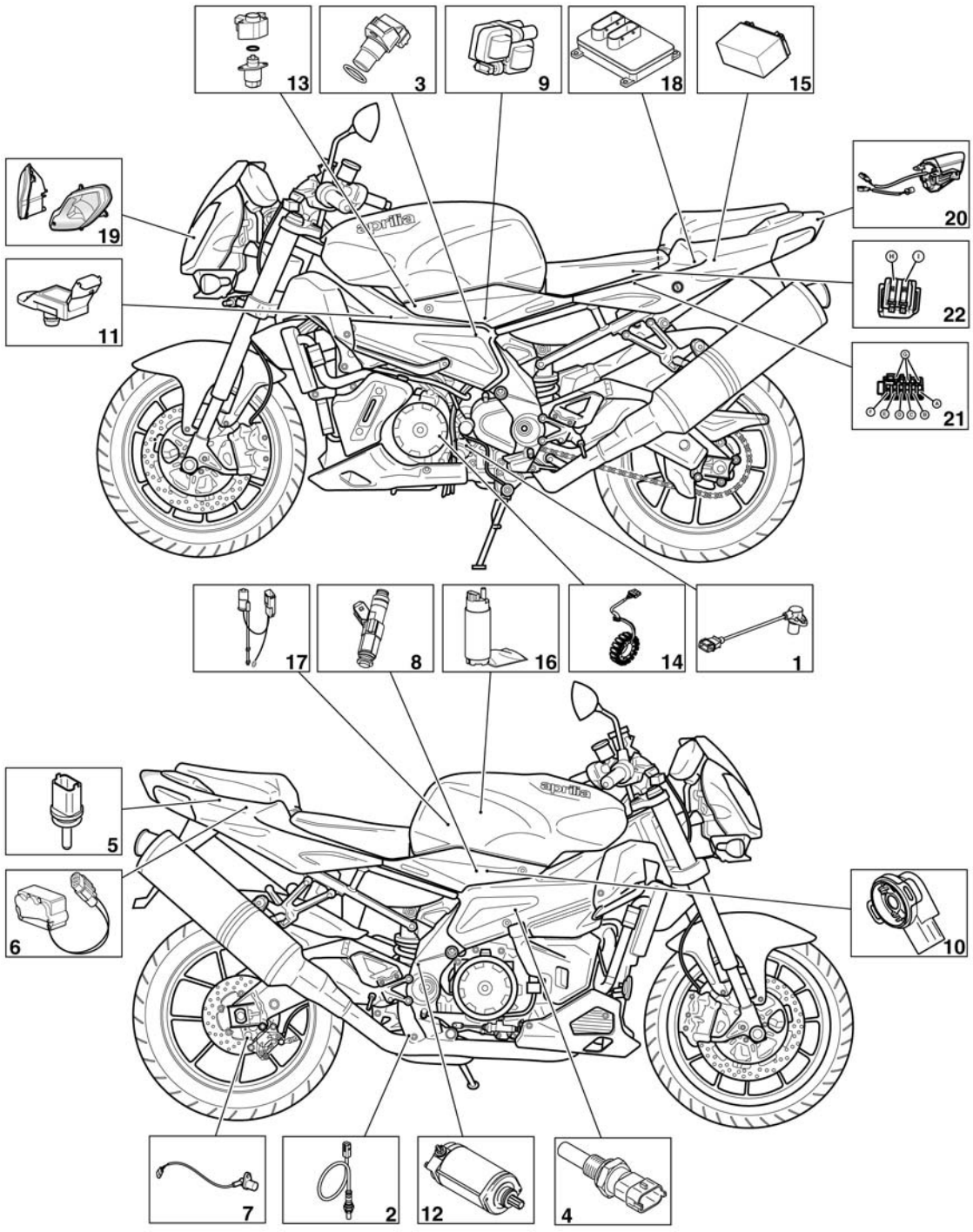
front cylinder pressure = rear cylinder pressure - (50 ± 100) mbar

- If the value of the FRONT CYLINDER PRESSURE parameter is not right, actuate on the by-pass screw on the FRONT CYLINDER.
- Observe the residual CO values by opening the analyser valves alternately. If value is not kept around 2.0 - 4.0 % and especially if both values are different from each other by more than 0.5 %, operate on the by-pass screws.
- Once the CO checking is completed, check that the value of the FRONT CYLINDER PRESSURE and REAR CYLINDER PRESSURE parameters is approximately within the requested field.

FOR A COMPLETE AKRAPOVIC EXHAUST SYSTEM, THE CO VALUE READ DECREASES ONCE THE APPROVED SYSTEM HAS BEEN INSTALLED.

INDEX OF TOPICS

Components arrangement



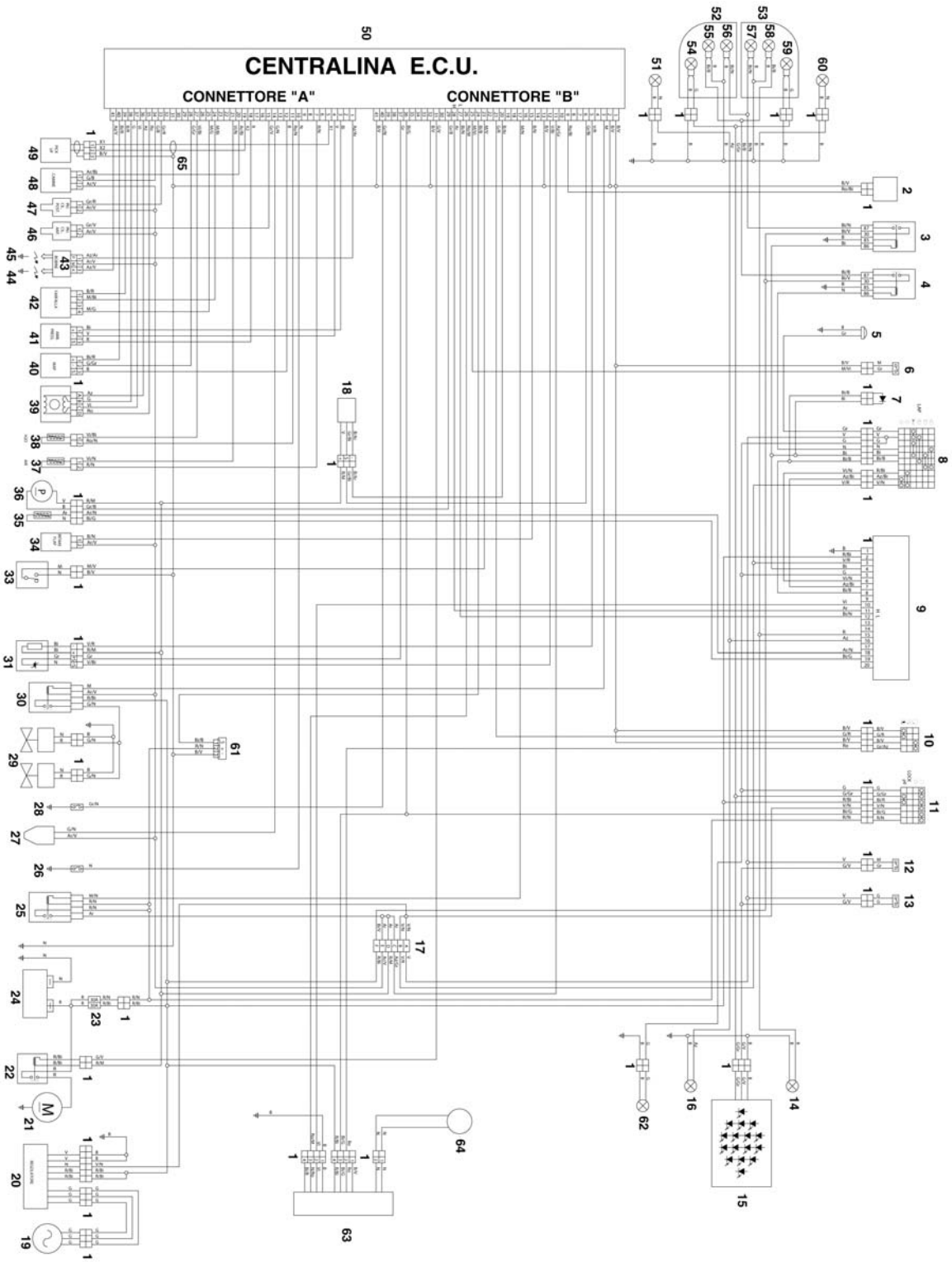
Key:

1. Engine revolution sensor
2. Lambda probe
3. Camshaft sensor

4. Coolant temperature sensor
5. Intake air temperature sensor
6. Fall sensor
7. Vehicle speed sensor
8. Injector
9. Ignition coils
10. Throttle potentiometer (TPS)
11. Intake pressure sensor
12. Starter motor
13. Stepper
14. Generator
15. Recharge voltage
16. Fuel pump
17. Fuel reserve sensor
18. Control unit
19. Front headlamp
20. Rear light
21. Auxiliary fuses
22. Main fuses

Electrical system installation

General wiring diagram



Key:

1. Multiple connectors
2. Fall sensors
3. High-beam light relay

4. Low-beam light relay
5. Horn
6. Clutch Switch
7. Instrument panel diagnosis
8. Left light switch
9. Instrument panel
10. Right light switch
11. Key switch
12. Front stop switch
13. Rear stop switch
14. Rear right turn indicator
15. Rear light (LED)
16. Rear left turn indicator
17. Auxiliary fuses
18. Speed sensor
19. Flywheel
20. Voltage regulator
21. Starter motor
22. Start-up relay
23. Main fuses
24. Battery
25. Injection relay
26. Oil pressure sensor
27. Purge valve (only California)
28. Gear in neutral switch
29. Fans
30. Fan relay
31. Lambda probe
32. -
33. Side stand switch
34. -
35. Fuel level sensor
36. Fuel pump
37. Air thermistor
38. Water thermistor

39.Automatic air

40.Intake pressure sensor

41.Ambient pressure sensor

42.Throttle sensor

43.Double coil

44.Front cylinder spark plug

45.Rear cylinder spark plug

46.Front cylinder injector

47.Rear cylinder injector

48.Camshaft sensor

49.Pick-up

50.ECU

51.Front left turn indicator

52.Front left headlamp

53.Front right headlamp

54.Left headlamp tail light

55.Left headlamp low-beam bulb

56.Left headlamp high-beam bulb

57.Right headlamp high-beam bulb

58.Right headlamp low-beam bulb

59.Right headlamp position light

60.Front right turn indicator

61.ECU diagnosis

62.License plate light

63.-

64.Immobilizer aerial

65.Pick-up twisted cable

CABLE COLOUR

Ar Orange

Az Sky blue

B Blue

Bi White

G Yellow

Gr Grey

M Brown

N Black

R Red

Ro Pink

V Green

Vi Purple

Checks and inspections

Dashboard

Immobilizer

The immobilizer system is integrated to the instrument panel electronic card. The card structure should admit instrument panels without immobilizer or with the immobilizer function disabled, to be used in countries where immobilizer systems are not allowed or not fitted.

The supplier shall be responsible for homologating the instrument panel immobilizer device according to the regulations set by the Ministry of Post & Telecommunications of the different countries, and for sticking the adequate system certification labels on the instrument panel.

Operation

Upon starting the vehicle the instrument panel will read the key code. If it corresponds to one of the stored codes, the instrument panel will carry out the initial check and enable the vehicle start-up.

Up to four keys should be stored.

If the key code is not recognised, the instrument panel disables the vehicle start-up, the display shows the request of the manual unlocking code; in this case the menu should be accessed through the diagnosis function.

Code

This function is used to manually unlock the immobilizer by entering a code. If the instrument panel does not recognise the key inserted, entering the access code is requested, and the following message is displayed:

- Enter the code

The code must have 5 characters selected between 0-9. At the end of the line, the code will be empty (five 0 digits or rather 00000) and it will be programmed by the user. If the code is not entered within 10 seconds, an alarm message is displayed:

- Remember to enter the user code

This code can be modified by the user after re-entering of the old code, and if the user has lost the access code, by means of a code entering procedure requiring inserting both keys the user has.

Programming keys at first start-up

The customer is provided with two keys, both with transponder in the handgrip. The instrument panel requests programming the keys when it is turned on for the first time.

The display shows the following message:

- Insert the X key
- X+1 key programmed

At least one key must be stored, for the next start-ups. If no other keys are inserted within 20 seconds or if there is lack of power or after the fourth key is programmed, the procedure finishes and all the functions of the vehicle and the instrument panel must be enabled (even if only one key has been programmed).

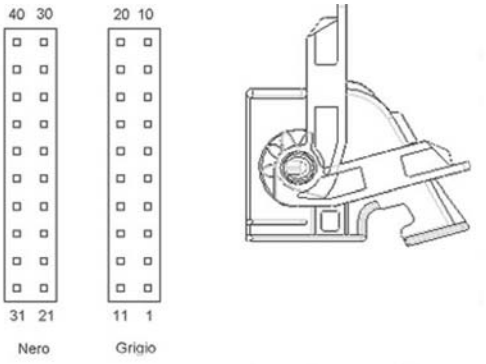
Programming new keys

If one key is lost, the customer can disable the lost key or disable and replace the whole key set by changing the key lock.

CONNECTOR

The connector diagram on the instrument panel and the relevant pin configuration are shown in the figure.

The numbers are also stamped on the plastic part of the connectors and also on the connector body.



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

- PIN 1: + LIVE
- PIN 2: RIGHT INDICATOR CONTROL
- PIN 3: INPUT FOR HIGH-BEAM LIGHTS
- PIN 4: -
- PIN 5: CHRONOMETER (OPTIONAL)
- PIN 6: K LINE
- PIN 7: SELECTION TUONO / RSV 1000
- PIN 8: SELECT 1 - SET
- PIN 9: FUEL LEVEL SENSOR
- PIN 10: -

- PIN 11: + BATTERY
- PIN 12: LEFT INDICATOR CONTROL
- PIN 13: -
- PIN 14: -
- PIN 15: -
- PIN 16: GENERAL GROUND
- PIN 17: -
- PIN 18: GROUND FOR SENSORS
- PIN 19: GENERAL GROUND (OPTIONAL)
- PIN 20: GENERAL GROUND (OPTIONAL)

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

- PIN 21: + BATTERY
- PIN 22: FRONT LEFT INDICATOR ACTIVATION
- PIN 23: REAR LEFT INDICATOR ACTIVATION
- PIN 24: AERIAL 1
- PIN 25: -
- PIN 26: CAN H
- PIN 27: -
- PIN 28: LIGHT RELAY ACTIVATION
- PIN 29: -
- PIN 30: SELECT 2
- PIN 31: + BATTERY
- PIN 32: FRONT RIGHT INDICATOR ACTIVATION
- PIN 33: REAR RIGHT INDICATOR ACTIVATION
- PIN 34: AERIAL 2
- PIN 35: CONTACT 2 (ECU STAND INPUT)
- PIN 36: CAN L

- PIN 37: -
- PIN 38: -
- PIN 39: -
- PIN 40: SELECT 3

Pins marked with " - " are present but not used.

Diagnosis

This function interfaces with the systems present on the motorbike and diagnoses them. To enable this function, enter an access code available only from **aprilia** service centres.

This vehicle code is: **13432**

If the code is incorrect, the following message is displayed:

- Incorrect code

The instrument panel shows the main menu. Otherwise, the following **menu** is displayed:

- EXIT
- ECU DIAGNOSIS
- INSTRUMENT PANEL ERRORS
- DELETE ERRORS
- RESET SERVICE
- UPDATE
- CHANGE KEYS
- KM / MILES

Once the operation is finished, the instrument panel goes back to the main menu.

ECU diagnosis

Diagnosis code table:

Code 11: Camshaft sensor

Code 12: Crankshaft sensor

Code 13: Intake pressure sensor

Code 15: Throttle valve position (TPS) sensor

Code 21: Engine temperature sensor

Code 22: Air temperature sensor

Code 23: Atmospheric pressure sensor

Code 33: injection 1

Code 35: Injection 2

Code 41: Tip over switch

Code 42: Injector 1

Code 43: Injector 2

Code 44: Idle adjustment motor

Code 45: Fuel pump

Code 46: Lambda probe

Code 47: Oil pressure sensor

Code 48: Fan relay

Code 49: Tank purge

Code 50: Starter

Code 51: Battery voltage

Instrument panel errors

In this mode, a chart is displayed showing the potential errors in the immobilizer and its sensors. This is the error transcoding chart:

Immobilizer failure: Key code read but not recognised

- Error code: DSB 01

Immobilizer failure: Key code not read (Key not present or transponder not working)

- Error code: DSB 02

Immobilizer failure: Aerial not working (Open or short-circuited)

- Error code: DSB 03

Immobilizer failure: Internal controller failure

- Error code: DSB 04

Fuel sensor failure

- Error code: DSB 05

The instrument panel must keep all previous errors stored in its memory. In case of fuel sensor failure, the relative icon on the display should flash.

Delete errors

This option deletes all the errors, both control unit and instrument panel errors; a further confirmation is requested.

Reset service

This function is used to reset the service interval.

Update

This function is used to program the instrument panel again. This screen shows the software version

that is currently loaded. The LCD shows:

- Instrument panel disconnected. Now connect the diagnosis instrument.

The instrument panel will restart to work normally after the key is inserted-extracted.

Modify Keys

With this function the instrument can update the keys. Up to 4 keys can be stored.
The user code is first requested to be entered:

- Enter the code.

After entering the correct code, the following message should be shown on the display:

- Enter the X key.
- X+1 programmed.

At least one key must be stored, for the next start-ups. If no other keys are inserted within 20 seconds or if there is lack of power or after the fourth key is programmed, the procedure finishes and all the functions of the vehicle and the instrument panel must be enabled (even if only one key has been programmed).

Code reset

This function is used when the old CODE is not available and it needs to be changed. In this case, two programmed keys will have to be inserted. After having checked the first key, already inserted, a second key is requested through the message:

- INSERT KEY II

In between the two keys, the instrument panel should not go off; if the second key is not inserted within 20 seconds, the operation finishes. After the second key is recognised, the new code is requested with the message:

- ENTER NEW CODE

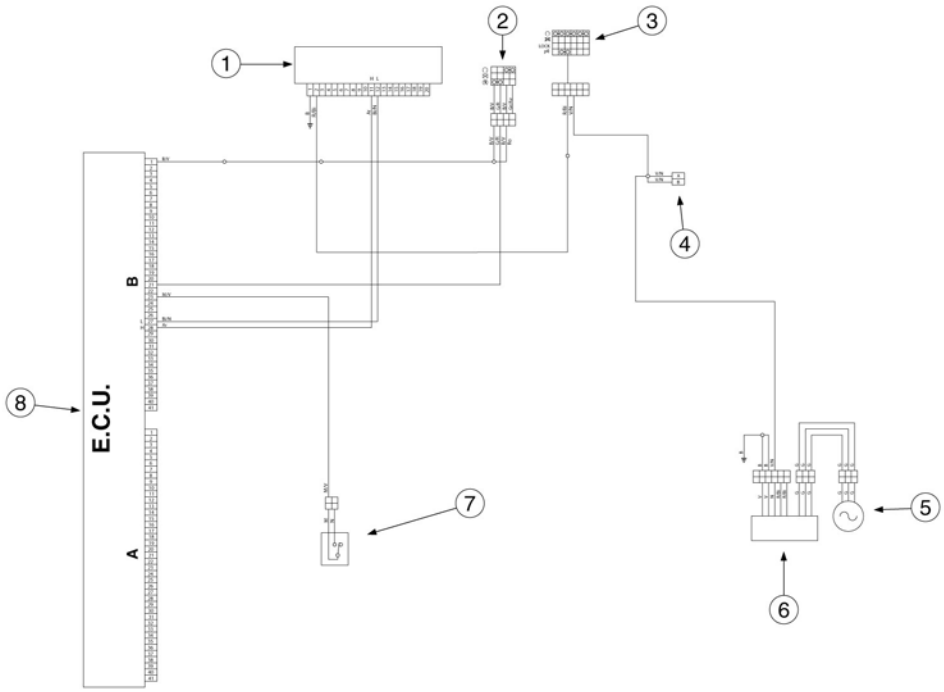
If the user has used the code, this operation is not allowed.
Once the operation is finished, the instrument panel goes back to the SETTINGS menu.
This procedure is not possible when entering using the User-Code.

Km / miles

This menu selects the unit of measurement for the speed.

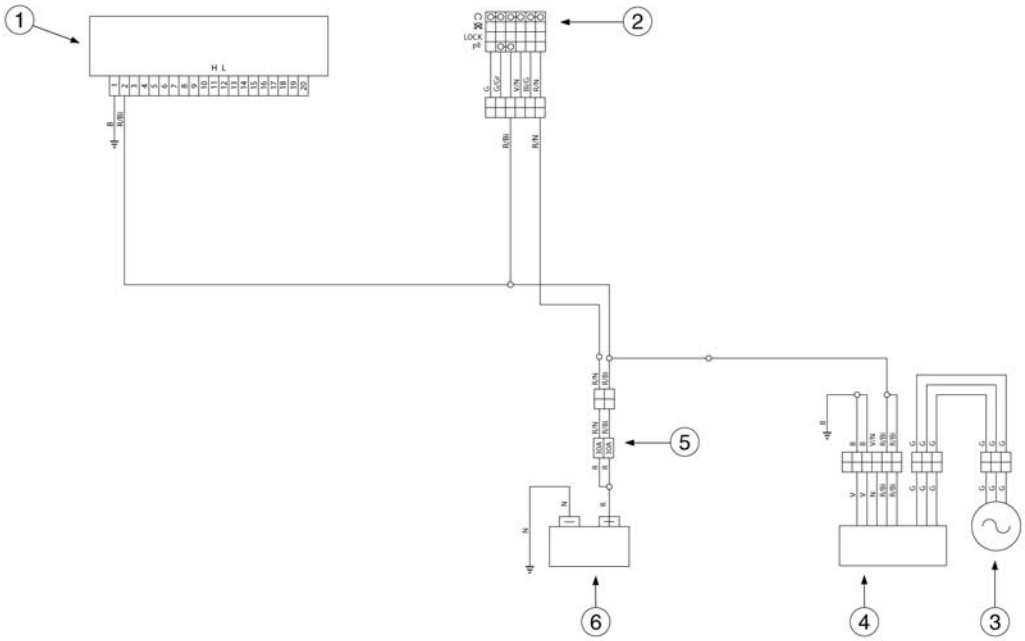
- KM
- MILES

Ignition circuit



Starter motor check

Battery recharge circuit



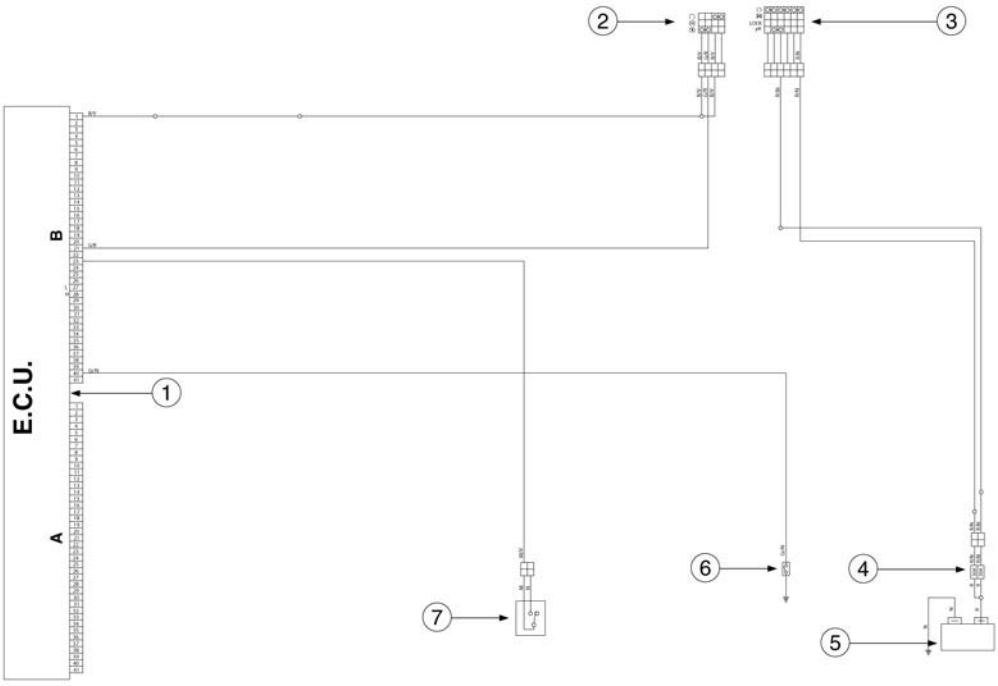
Key:

1. Instrument panel

2. Key switch
3. Flywheel
4. Voltage regulator
5. Main fuses
6. Battery

Start-up system check

Start-up enabling switch

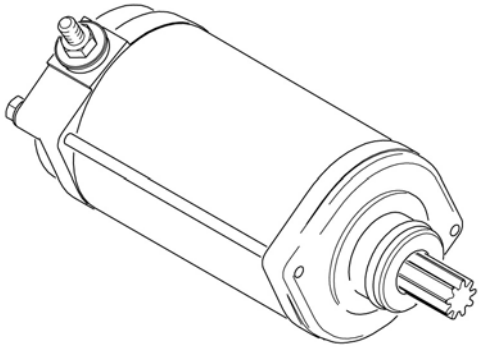


Key:

1. ECU
2. Right light switch
3. Key switch
4. Main fuses
5. Battery
6. Gear in neutral switch
7. Side stand switch

Starter motor check

Pick-up input 120 A



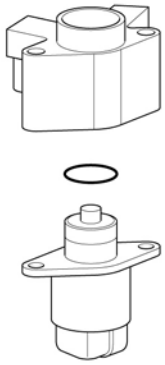
Checking the idle speed adj.system

Phase resistance 50 Ohm.

Stepper is supplied by the control unit.

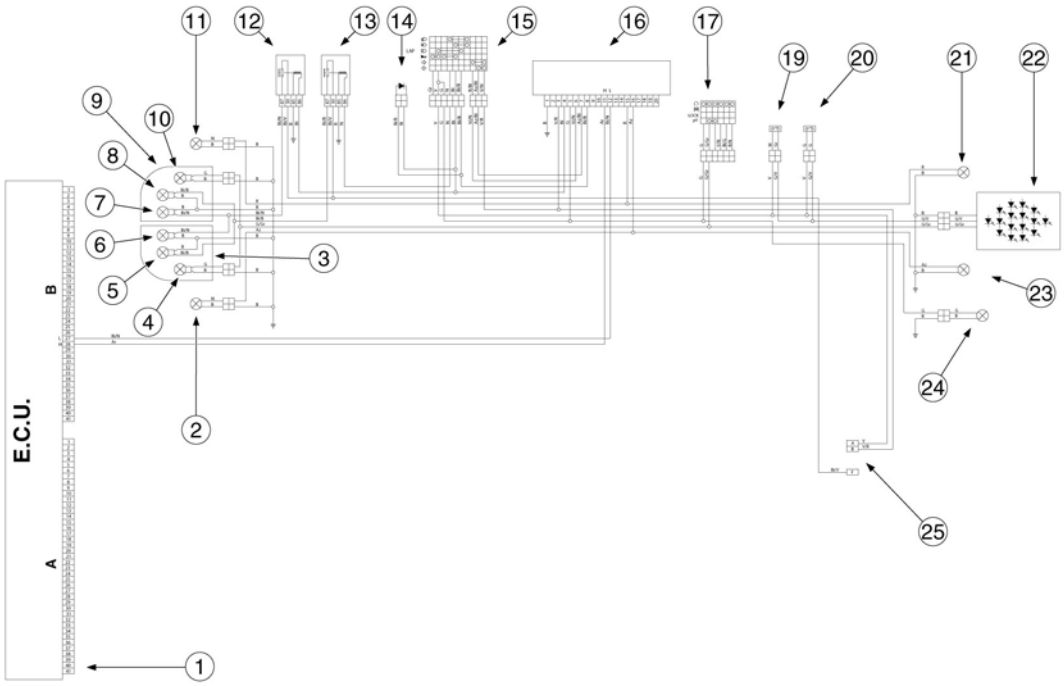
Rotation is divided into fractions called "steps". By varying the opening "steps" it is possible to properly feed the engine to facilitate the start-up procedure and adjust the feeding with cold engine.

When the engine has reached its working temperature, the Stepper partly closes.



Lights list

Lighting system wiring diagram



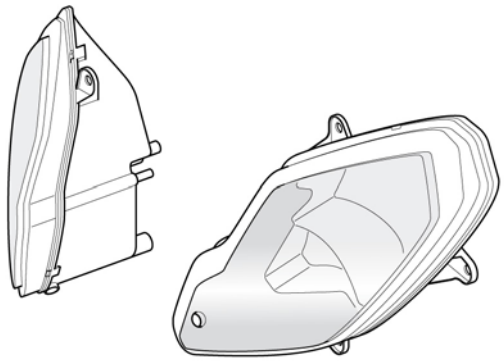
Key:

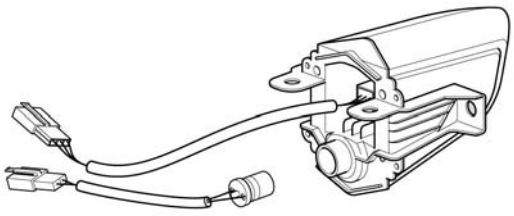
1. ECU
2. Left front turn indicator
3. Left front headlight
4. Left headlamp tail light
5. Left headlamp low-beam bulb
6. Left headlamp high-beam bulb
7. Right headlamp high-beam bulb
8. Right headlamp low-beam bulb
9. Front right headlamp
10. Right headlamp position light
11. Right front turn indicator
12. High-beam light relay
13. Low-beam light relay
14. Instrument panel diagnosis
15. Left light switch
16. Instrument panel
17. Key switch
18. Front stop switch
19. Rear stop switch

20. Right rear turn indicator
21. Rear light (LED)
22. Left rear turn indicator
23. License plate light
24. Auxiliary fuses

Lighting system main components

- Low-beam light (halogen) 12V - 55W H11x2
- High-beam light (halogen) 12V - 55W H11x2
- Front tail light 12V - 5W
- Rear light (LED)
- License plate light 12V - 5W

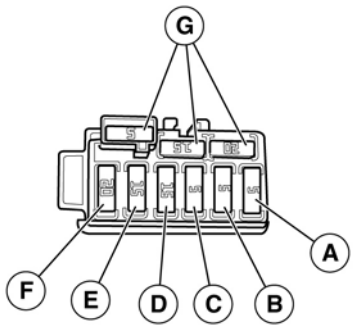




Fuses

AUXILIARY FUSES

- A - From key to: light relay, stop, horn, tail lights (5A).
- B - From key to: turn indicators, instrument panel (5A).
- C - From battery to: permanent power supply positive to ECU (5A).
- D - From battery to: speed sensor, fuel pump, relay, starter, lambda probe (15A).

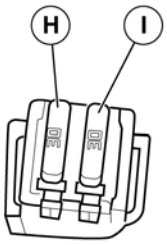


- E - From battery to: electric fan relay, coils, injectors, air intake flaps, camshaft position sensor (15A).
- F - From ignition switch to: high-beam lights, low-beam lights (20A).

There are three spare fuses (G).

MAIN FUSES

- H - Battery recharge and vehicle loads (red and red/white cables) + immobilizer (30A).
- I - Injection load (red and red/black cables) (30A).



There is one spare fuse.

Control unit

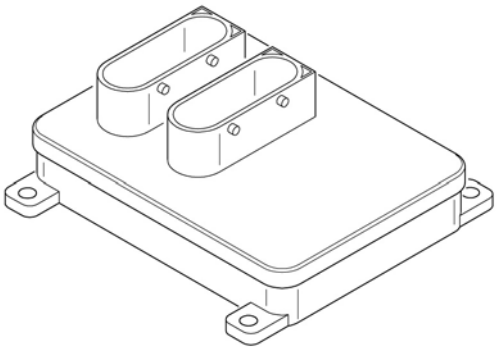
Engine control unit pinout

CONNECTOR A

1. Rear cylinder coil control - Signal type: Power output
2. n.c
3. Barometric pressure sensor power supply (5V) - Signal type: Fuel supply
4. Barometric pressure sensor power supply (ground) - Signal type: Fuel supply
5. Revolution sensor signal - signal type: Frequency input
6. n.c.
7. Air temperature sensor signal - signal type: Analogue input
8. n.c.
9. n.c.
10. Minimum oil pressure sensor signal - Signal type: Digital input
11. Water temperature sensor signal - Signal type: Analogue input
12. Manifold pressure sensor signal - Signal type: Analogue input
13. n.c.
14. Purge valve control - Signal type: Power output
15. Front cylinder injector 2 control - Signal type: Power output
16. n.c.

17. n.c.
18. Barometric pressure sensor signal - Signal type: Analogue input
19. Revolution sensor signal (ground) - Signal type: Supply
20. Phase sensor (ground) - Signal type: Supply
21. Air temperature sensor signal - Signal type: Supply
22. n.c.
23. n.c.
24. Throttle potentiometer signal - Signal type: Analogue input
25. Throttle potentiometer power supply (ground) - Signal type: Supply
26. n.c.
27. Water temperature sensor signal (ground) - Signal type: Supply
28. Manifold pressure sensor power supply (ground) - Signal type: Supply
29. n.c.
30. n.c.
31. n.c.
32. n.c.
33. Rear cylinder injector 1 control - Signal type: Power output
34. Phase sensor - Signal type: Analogue input
35. Stepper D phase - Signal type: Power output
36. Stepper A phase - Signal type: Power output
37. Stepper C phase - Signal type: Power output
38. Stepper B phase - Signal type: Power output
39. Throttle potentiometer power supply (5V) - Signal type: Supply
40. Manifold pressure sensor power supply (5V) - Signal type: Supply
41. Front cylinder coil control - Signal type: Power output

CONNECTOR B



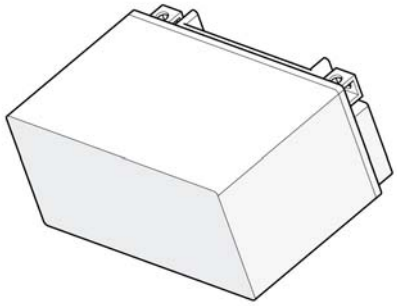
1. Control unit power supply (ground) - Signal type: Supply
2. Control unit power supply (ground) - Signal type: Supply
3. Fan - Signal type: Power output
4. n.c.
5. Lambda probe heater control - Output type: Power output

6. Vehicle speed sensor signal - Output type: Frequency input
7. n.c.
8. n.c.
9. Fall sensor signal - Output type: Digital input
10. n.c.
11. Control unit power supply (15) - Output type: Supply
12. Lambda probe signal (ground) - Output type: Supply
13. Control unit power supply (ground) - Output type: Supply
14. n.c.
15. Intake flap control - Output type: Power output
16. n.c.
17. Injection relay control - Output type: Digital output
18. n.c.
19. n.c.
20. Vehicle speed sensor power supply (ground) - Output type: Supply
21. Start-up request - Output type: Digital input
22. n.c.
23. Side stand switch - Output type: Digital input
24. Diagnosis line (K) - Output type: Communication line
25. Clutch switch - Output type: Digital input
26. Stop switch - Output type: Digital input
27. CAN Line (L) - Output type: Communication line
28. CAN Line (H) - Output type: Communication line

29. Fuel pump control - Output type: Power output
30. n.c.
31. Start-up relay control - Output type: Digital output
32. Control unit power supply - Output type: Power input
33. n.c.
34. n.c.
35. n.c.
36. Power supply 12V - Output type: Supply
37. Lambda probe signal - Output type: Analogue input
38. n.c.
39. n.c.
40. Neutral gear switch - Output type: Digital input
41. Control unit power supply (ground) - Output type: Supply

Battery

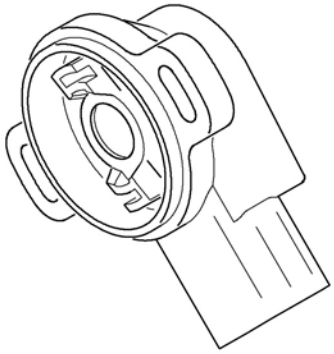
Voltage 13.8 V to be checked at the battery poles (with engine at 4000 rpm).



Throttle position sensor

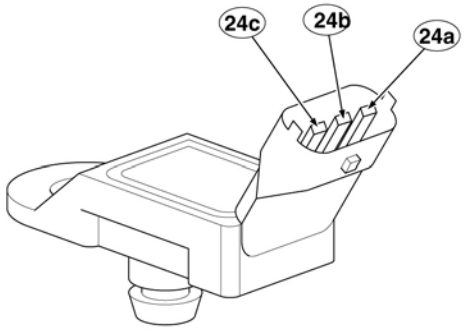
Mechanically coupled to the throttle so that its output voltage depends on the throttle position.
Power supply between 4.5 and 5.5 V to be meas-

ured between pins 10a and 10c
Resistance between VC (10a) and E2 (10c) = 2.87 - 5.33 kOhm
Resistance between VTA (10b) and E2 (10c) throttle open = 2.87 - 8.41 kOhm
Resistance between VTA (10b) and E2 (10c) throttle closed = 0.34 - 5.69 kOhm



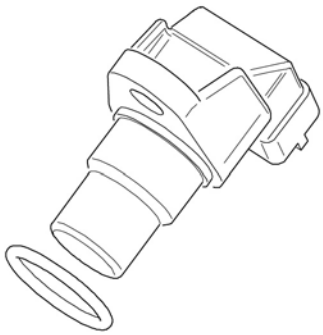
Intake pressure sensor

Extensiometric diaphragm type sensor; if the diaphragm gets deformed, this becomes an electrical signal.
It is located below the filter casing.
the sensor is connected to the throttle body by means of two pipes.
5V power supply to be measured between pins 24a and 24b and between pins 24a and 24c.
Output voltage: at 350 mbar = 1.07 V; at 950 mbar = 3.76V



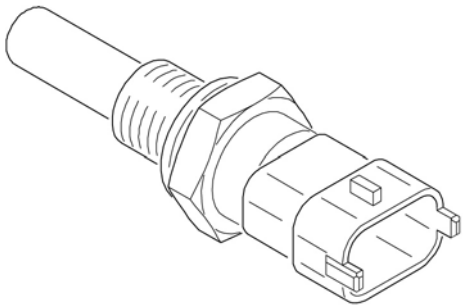
Camshaft sensor

Hall effect sensor
Installed on the front cylinder head.
the sensor allows the control unit to recognise the precise sequence for each single cylinder by re-setting the internal counter during the ignition asynchronous phase.
12V power supply between pins 3c and 3a.
Output square wave with one pulse every two engine revs (to be measured between pins 3b and 3a)



Engine temperature sensor

NTC type sensor (variable resistance, value decreases as temperature rises).



ENGINE TEMPERATURE SENSOR

Resistance mean value Ohm

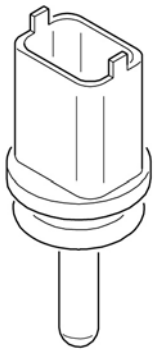
Specification	Desc./Quantity
-30 °C (-22 °F)	28000 Ohm
-20 °C (-4 °F)	14500 Ohm
0 °C (32 °F)	5500 Ohm
20 °C (68 °F)	2500 Ohm
40 °C (104 °F)	1200 Ohm
60 °C (140 °F)	600 Ohm
80 °C (176 °F)	320 Ohm
100 °C (212 °F)	180 Ohm
130 °C (266 °F)	90 Ohm

Air temperature sensor

NTC type sensor (variable resistance, value decreases as temperature rises)

Resistance 2.5 kOhm (temperature: 20°C - 68°F)

Power supply 5V



Lambda sensor

Its function is to measure the oxygen content in exhaust fumes and then indirectly provide information about the combustion conditions.

The lambda probe signal allows the injection control unit to constantly correct the mixture strength, if

it is not stoichiometric (lambda adjustment).

To obtain an ideal mixture and consequently the correct stoichiometric rate, the air quantity sucked in by the engine should be equal to the theoretical value, which would burn all the injected fuel.

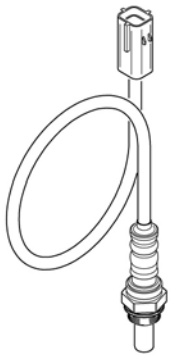
In this case, the lambda rate factor between the intake air quantity and the theoretical air quantity (needed to burn all the injected fuel) is equal to 1.

Oxygen sensor with heater

Sensor voltage between 0 and 0.9 V (to be measured between pins 3 and 4)

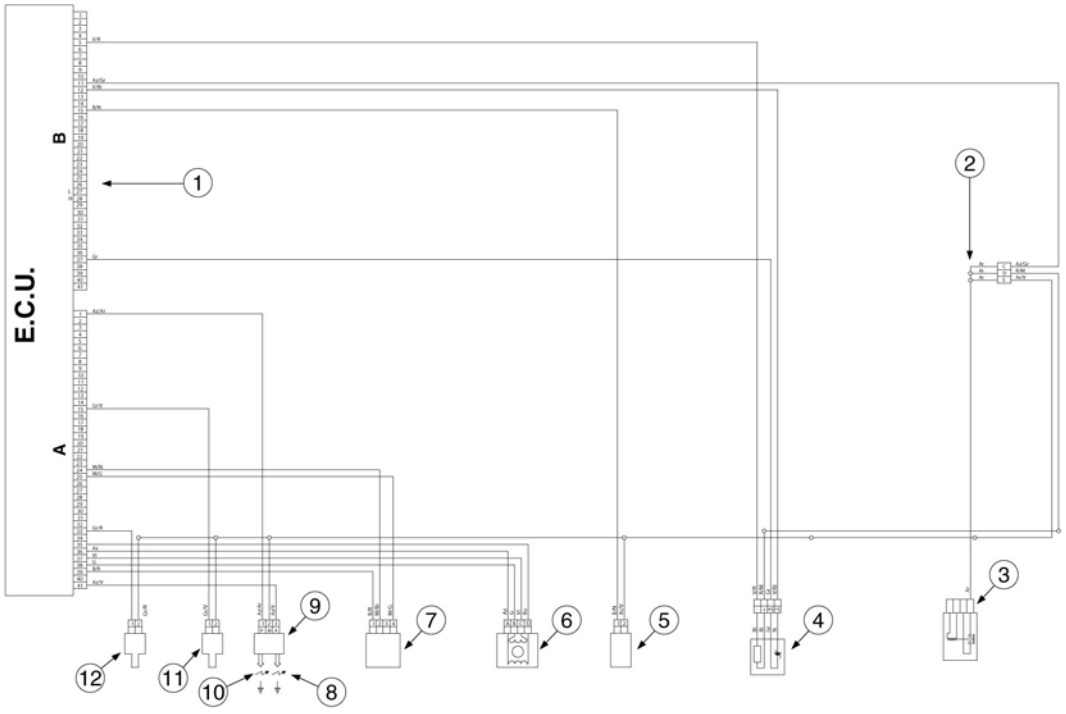
Heater resistance between 12.8 and 14.2 Ohm (to be measured between pins 1 and 2 at 20°C - 68°F)

Supply voltage 12V



Injector

Injection diagram



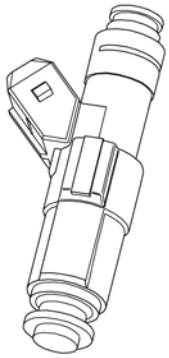
Key:

1. ECU
2. Auxiliary fuses
3. Start-up relay

4. Injection relay
5. -
6. Automatic air
7. Throttle sensor
8. Front cylinder spark plug
9. Double coil
10. Rear cylinder spark plug
11. Front cylinder injector
12. Rear cylinder injector

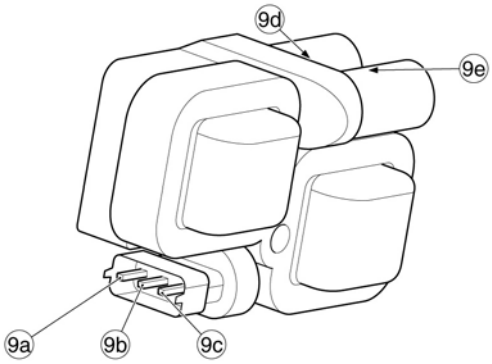
Injector

Resistance between 13.8 and 15.2 Ohm.
Power supply 12V
The pulse signal sent by the control unit activates an electromagnet which attracts an armature that causes the nozzles set on the injector to open.
Considering the physical properties of the fuel and the constant pressure of 3.5 bar on the injectors, the injected volume depends only on the time these injectors remain open.



Coil

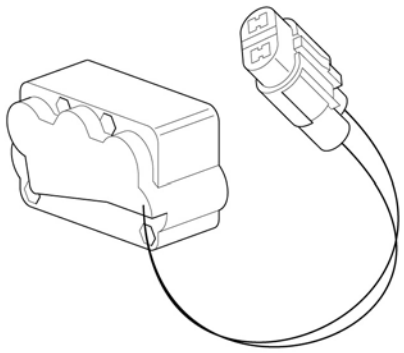
Rear cylinder primary winding resistances between 0.40 and 1.15 Ohm (to be measured between pins 9c and 9b).
Front cylinder primary winding resistances between 0.40 and 1.15 Ohm (to be measured between pins 9a and 9b).
Secondary winding resistance between 0.40 and 1.15 Ohm (to be measured between pins 9d and 9e).



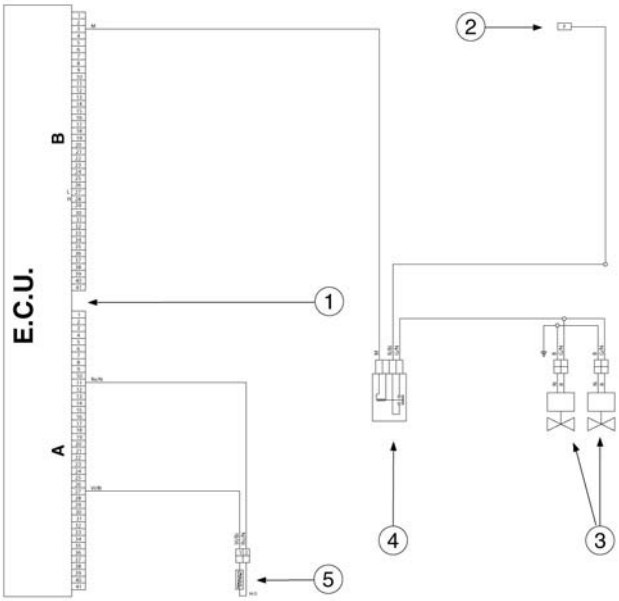
Bank angle sensor

62 kOhm resistance with sensor at fitting position.

Resistance = Ohm when the sensor is turned 90° with respect to the fitting position.



Electric fan circuit



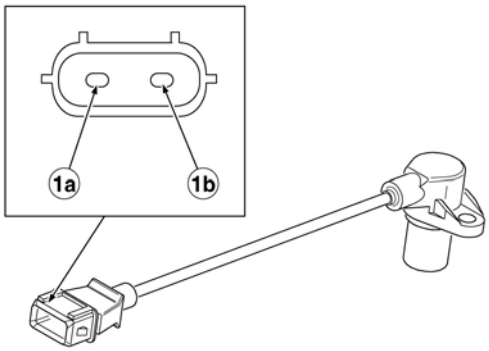
Key:

1. ECU
2. Auxiliary fuse (F)
3. Fans
4. Low-beam light relay
5. Horn

Connectors

Engine rev. sensor

Inductive type sensor.
It uses a 36-tooth tone wheel.
The sensor produces one voltage pulse every 10º rotation to enable the control unit to calculate the engine revs and the crankshaft position.
Winding resistance 0.7 - 1.1 kOhm (to be measured between pins 1a and 1b)
Output alternating voltage 1 - 2 V (to be measured between pins 1a and 1b)



Can line

Can system advantages

A CAN (controller Area network) line is a connection among the vehicle several electronic devices, organised as a computer network (Internet).
The CAN network has greatly simplified the electrical system layout and consequently, its complexity. With this communication line, needless duplication of several sensors present on the motorbike has been obviated. The sensor signals are shared by the two electronic elaboration units (instrument panel and control unit).

- Cable number reduction: The CAN line travels through a twisted cable to several nodes.
- These nodes can also isolate the errors without causing a system breakdown (Faults Confination).
- Immunity to interference: the signal travels through two cables and the signal reading is differential (voltage difference between the two signals on both cables). If the two signals are disturbed by an external factor, their difference remains unaltered.
- Communication speed: messages travel at a speed of 250 kbps (data arrive at nodes every 20 ms, i.e. 50 times/second).

Can protocol (area network controller)

The communication protocol is CSMA/CD (Carrier Sense Multiple Access w/ Collision Detection).
In order to transmit, every nod must first check that the BUS (the connection among all devices) is free before attempting to send a message with BUS (Carrier Sense).
If during this period there is no activity on BUS, every nod has the same chance to send a message (Multiple Access). If two nodes start transmitting simultaneously, the nodes recognise the "collision"

(Collision Detection) and initiate an exchange action based on message priority (messages remain unaltered during exchange and there is no delay for high priority messages).
CAN protocol is based on messages and not on addresses. The message itself is divided into several parts (frames), each of which has a meaning: message priority, data contained, error detection, reception confirmation, etc.
Every network nod receives all the messages sent through the BUS (with reception confirmation or error messages) and each nod decides if the message is to be processed or rejected. Besides, every nod can request information from the other nodes (RTR = Remote Transmit Request).

Avviamento

In order to confirm start-up, the control unit waits for a CAN confirmation message by the instrument panel to identify the engine model V990 (information contained in the instrument panel).
No sensor (besides the "fuel reserve sensor") is connected to the instrument panel which reads directly from the control unit through the CAN line. All sensors/switches are connected to the engine control unit.

Instrument panel warning light activation

Warning lights are activated by the control unit through the CAN line

- Warning light NEUTRAL; SMD GREEN led
- Warning light SIDE STAND; SMD AMBER led
- Warning light EFI; SMD RED led
- Warning light OIL PRESSURE; SMD RED led

Signals via can-bus line

TRANSMITTED SIGNAL

Frequency

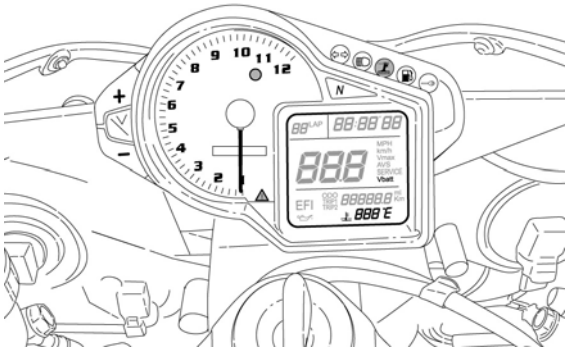
Specification	Desc./Quantity
Revs	50 Hz
Speed	50 Hz
Diagnosis	50 Hz
Neutral (warning light)	50 Hz
Stand (warning light)	50 Hz
Oil pressure (warning light)	50 Hz
Water temperature	50 Hz

SENT SIGNAL

Frequency

Specification	Desc./Quantity
Odometer (stored in injection control unit for future development)	50 Hz
Model identification	50 Hz

If no data are received (CAN line damaged and/or disconnected), the Overrevving, Warning and Stand warning lights will be on steadily, the Neutral warning light will remain off, revolutions and speed will remain null, the battery voltage will show "9.0V" and the water temperature will show a blinking "Err" message.



INDEX OF TOPICS

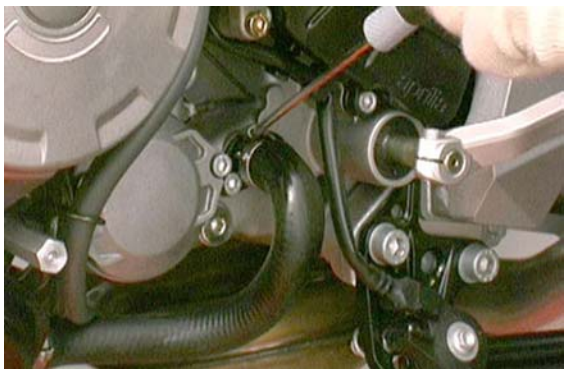
Vehicle preparation

To remove the engine from the chassis proceed as follows:

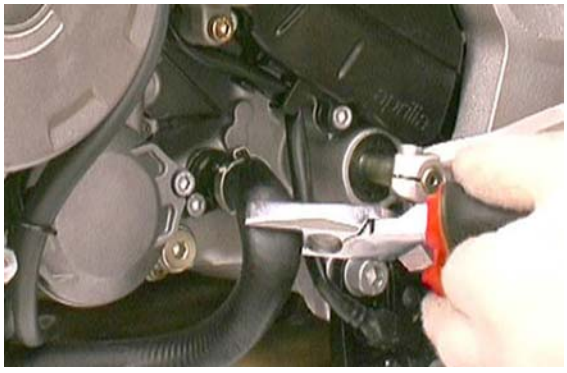
- Remove the saddle.
- Remove the fuel tank connected to the throttle body.
- Disconnect the cables at both poles (positive / negative) and then remove the battery
- Remove the filter housing
- Remove the exhaust
- Disconnect the throttle grip cables
- Disconnect all engine to chassis electrical connections: general connectors, ignition coils, engine oil pressure sensor, vehicle speed sensor, stop light switch, starter motor, engine temperature sensor, timing sensor, engine revolution sensor, side stand safety switch, generator, ground leads, neutral sensor, spark plug tubes.
- Disconnect the various elements of the engine cooling system.
- Remove the gearbox lever.

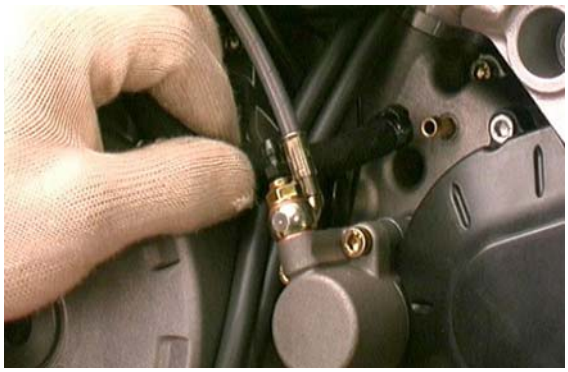
Removing the engine from the vehicle

- Open the clamps on the lubrication system pipes that lead to the oil tank.

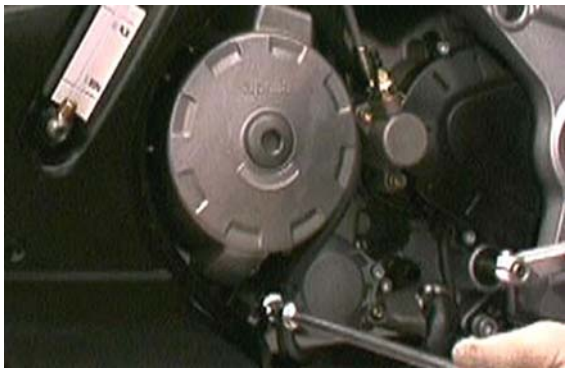


- Detach the oil pipes on the engine crankcase.

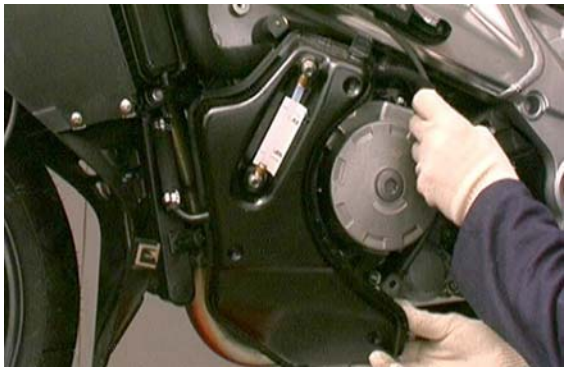




- Unscrew the three fixing screws from the oil reservoir.

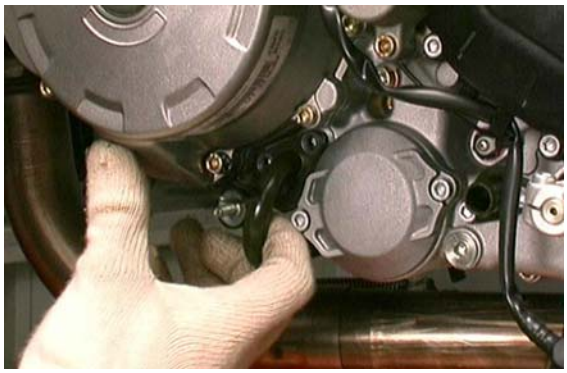


- Remove the oil reservoir by sliding off the pipe coming from the radiator.



- Detach the breather pipes from the compartment.

- Detach the oil pipe on the engine crankcase.



- Unscrew and remove the fixing screws from the rear brake fluid reservoir and slide down the reservoir, keeping it up-right.

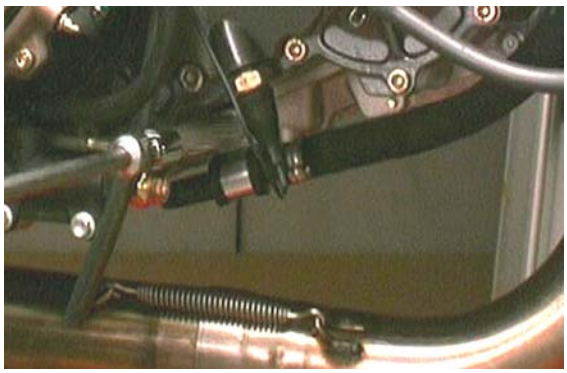
- Detach the seal clamp.
- Slide off the coolant breather pipe.

- Unscrew and remove the expansion tank fixing screws and then remove the tank.

- Unscrew and remove the two fixing screws and remove the voltage regulator.

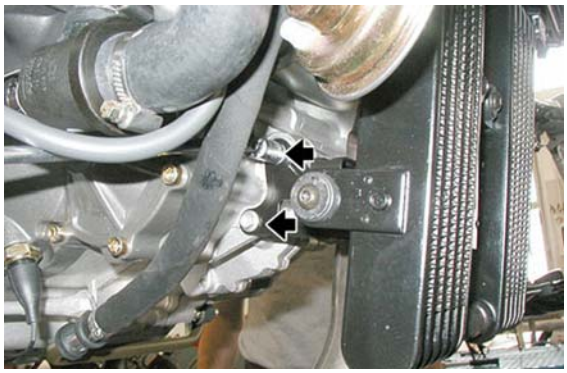
- Unscrew and remove the two fixing screws and remove the voltage regulator supporting plate.

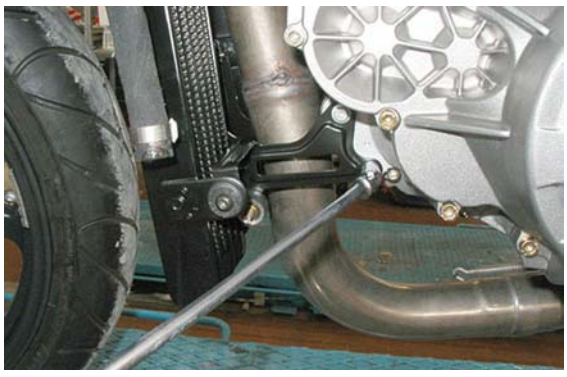
- Unscrew the stud bolt fixing the oil pipe clamp to the engine crankcase.



- Detach the oil pipe from the right side.

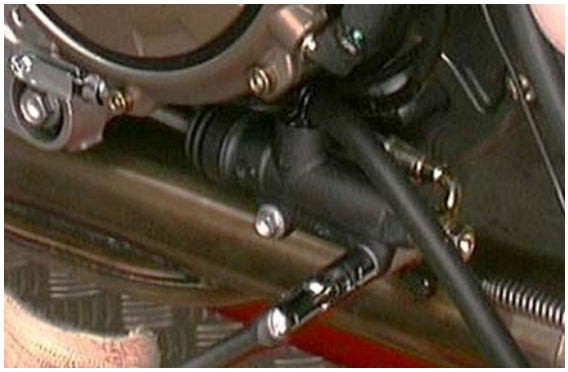
- Unscrew and remove the four screws fixing the frame of the oil radiators (for the left side upper screw, lock the internal nut with a spanner).





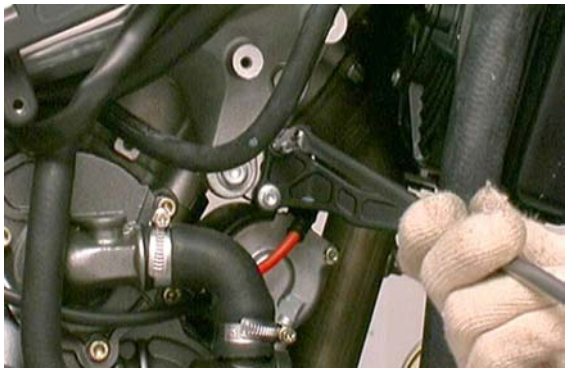
- Remove the entire frame with the oil radiators.

- Undo the rear brake pump fixing screws.



- Release the clip fixing the pump to the brake lever.

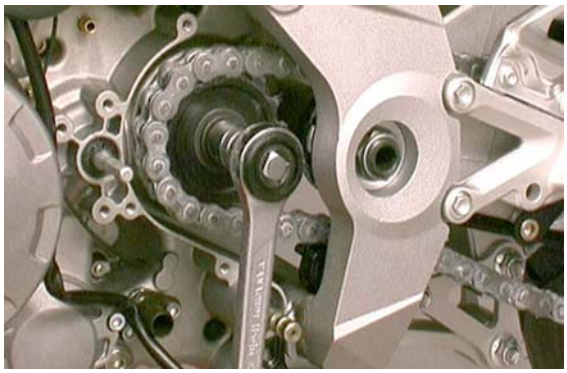
- Dismount the radiator lower supports and move the radiator, keeping it up-right.



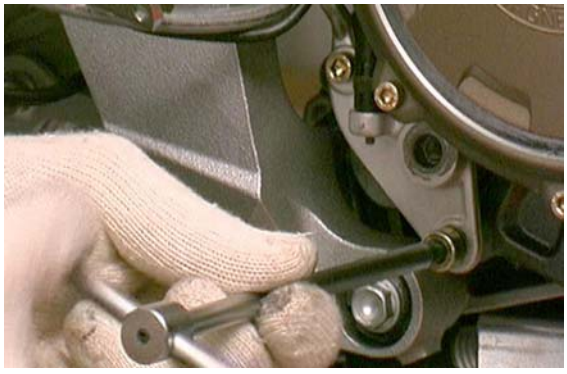
- Dismount the clutch actuator together with the flange.

- Remove the pinion crankcase and the guiding plate on the engine crankcase.

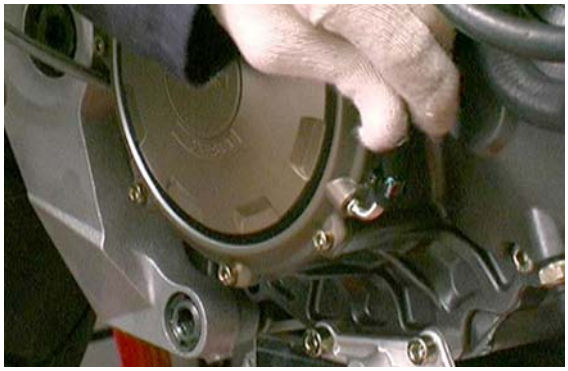
- Unscrew the bolt fixing the pinion and collect the sealing washers.
- Remove the pinion.



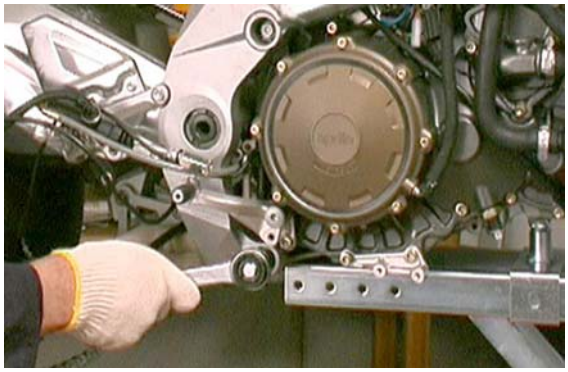
- Dismount the rear brake lever.
- Dismount the lever support and the rear brake pump.
- Dismount the brake pump support.

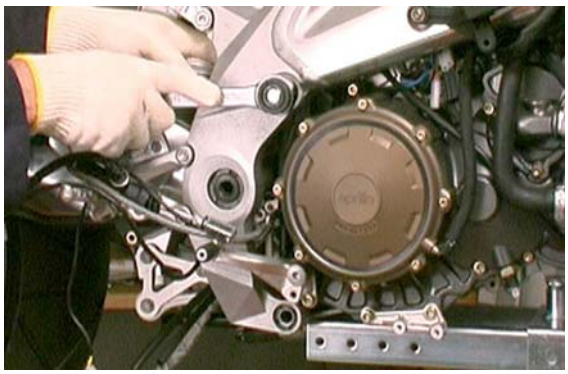


- Detach the suction pipe on the clutch pneumatic actuator.

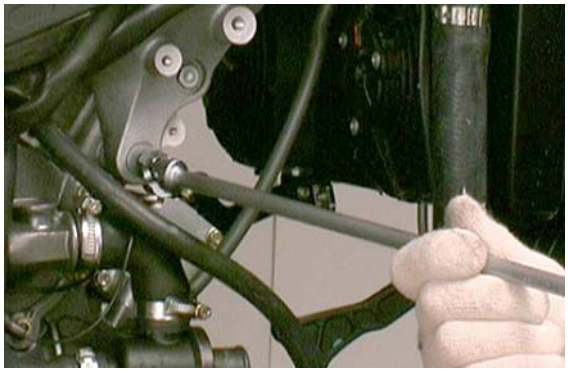


- Support the engine with a specific stand.
- Remove the rear screws fixing the engine to the chassis.

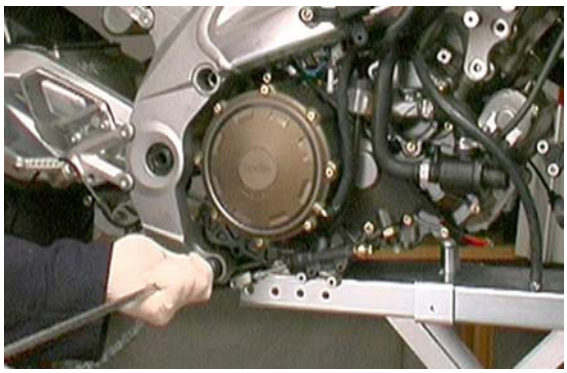


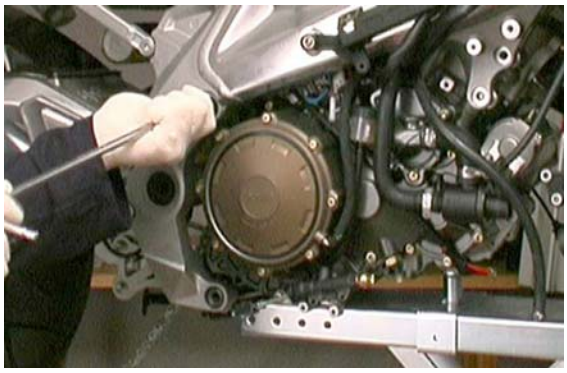


- Undo the four screws of the engine front attachments.
- Remove the screws and the spacers placed between the chassis and the engine.



- Move back the adjustment bushings between the engine and the chassis.
- Lower the engine completely.

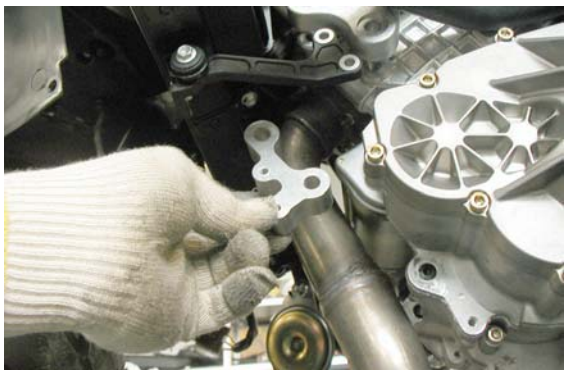




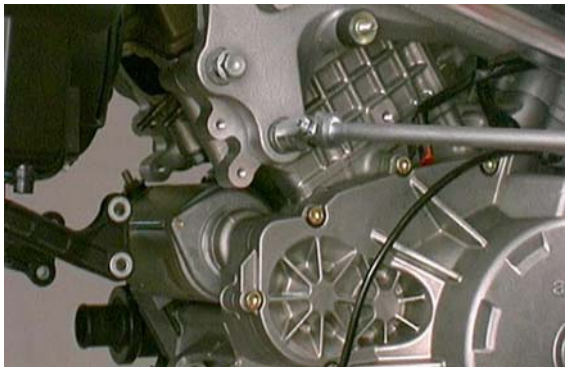
Installing the engine to the vehicle

- Place the engine on a suitable lower stand.
- Lift the engine.
- Place the engine so the rear attachments on the chassis are aligned.

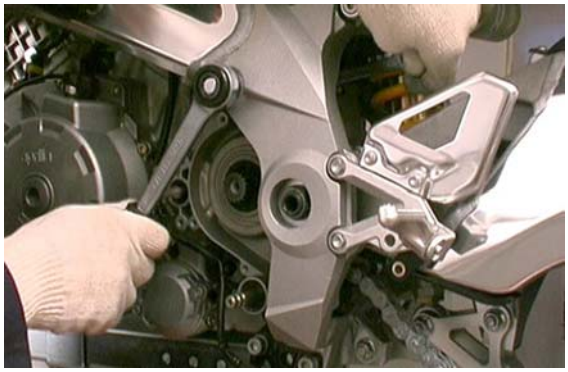
- Place the front left spacer.

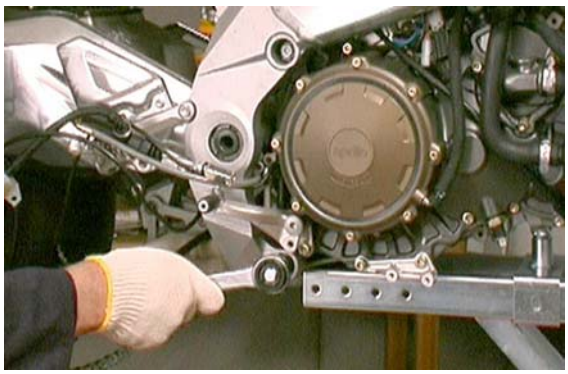


- Screw the two screws on the engine front left attachment.

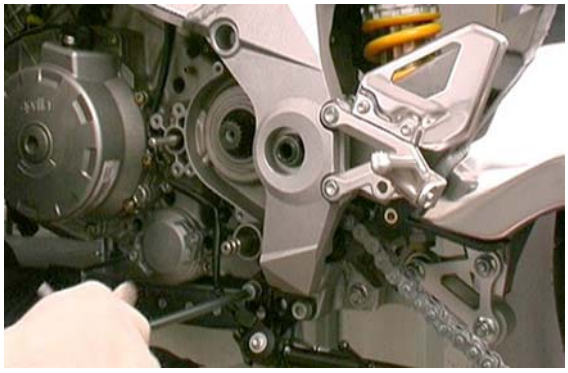


- Position the rear left spacer and screw the screws to the prescribed torque.



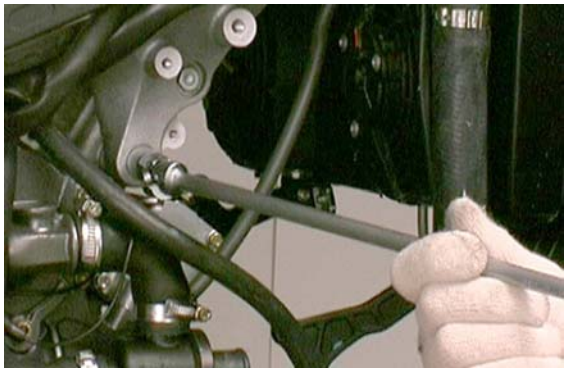


- Screw the rear left screw.

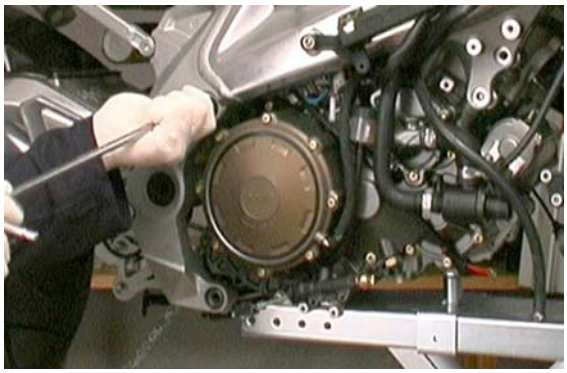


- Position the front right spacer.

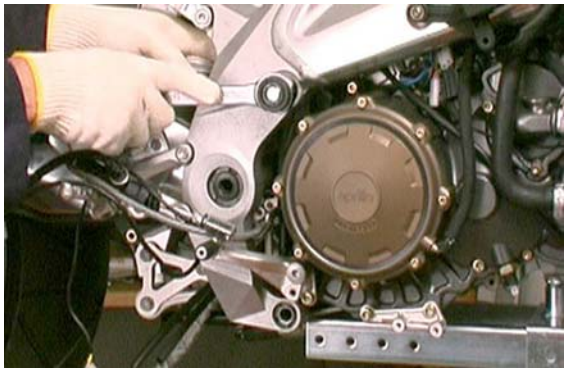
- Screw the two screws on the front right attachment.
- Screw the four screws on the left side.



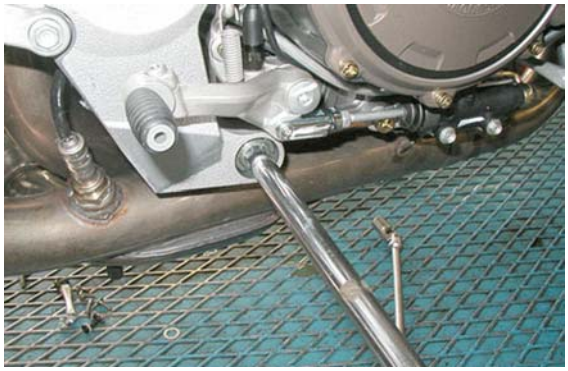
- Screw the front right bushing to the prescribed torque.



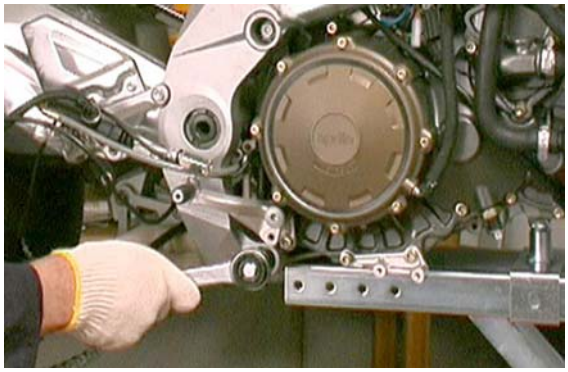
- Screw the upper right ring nut to the prescribed torque.



- Screw the lower right bushing to the prescribed torque.

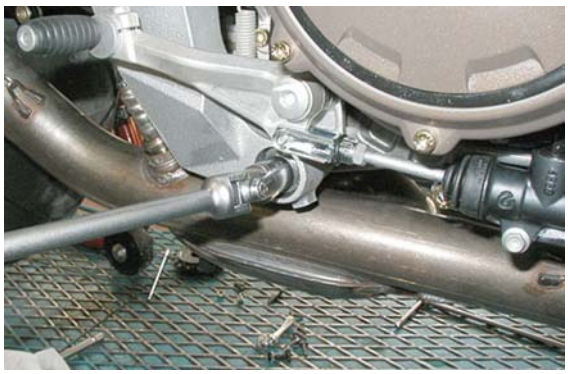


- Screw the lower right ring nut to the prescribed torque.



- Screw the upper right screw.

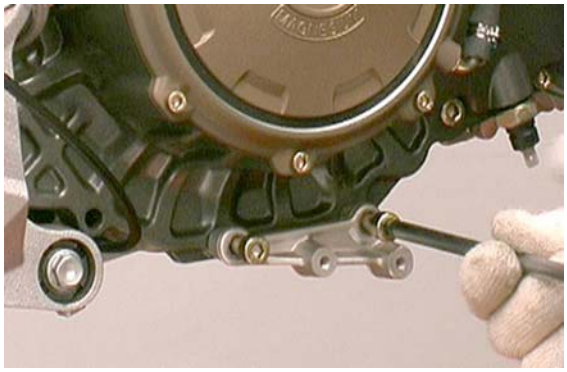
- Screw the lower right screw.
- Tighten the four screws on the right side.
- Remove the engine lower stand.

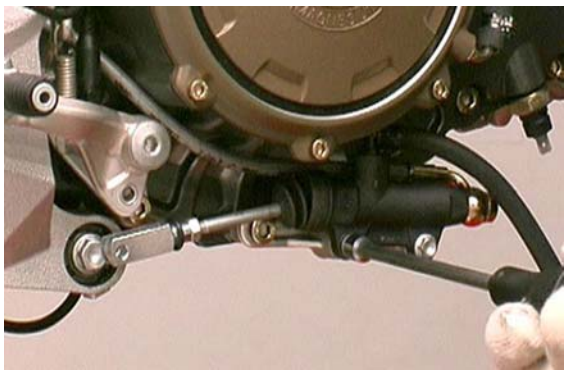


- Reattach the suction pipe on the clutch pneumatic actuator and lock it

with a clamp.

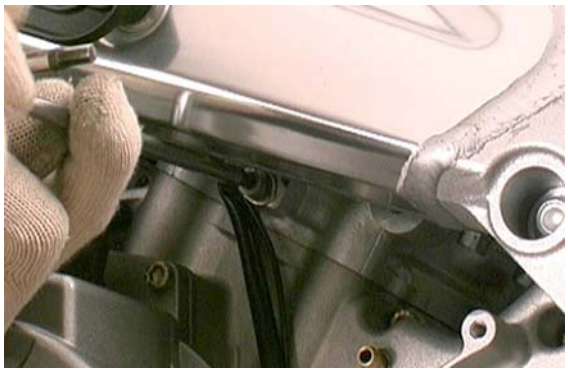
- Mount the lever support and the rear brake pump and screw the screws to the prescribed torque.
- Mount the rear brake lever and screw the screws to the prescribed torque.
- Mount the rear brake pump and connect it to the brake lever.



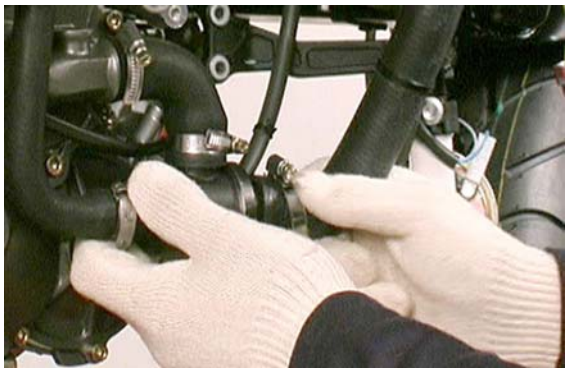


- Screw the neutral sensor connection.

- Refit the ground leads on the engine crankcase by screwing the screws to the prescribed torque.

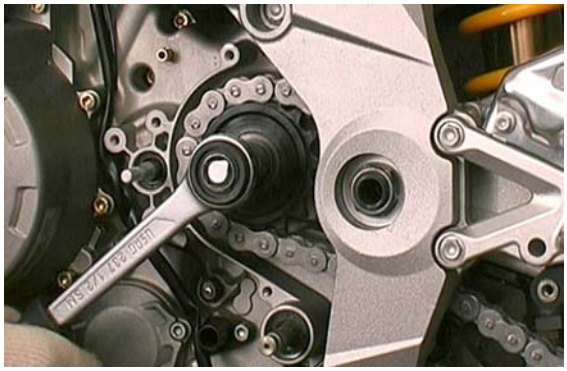


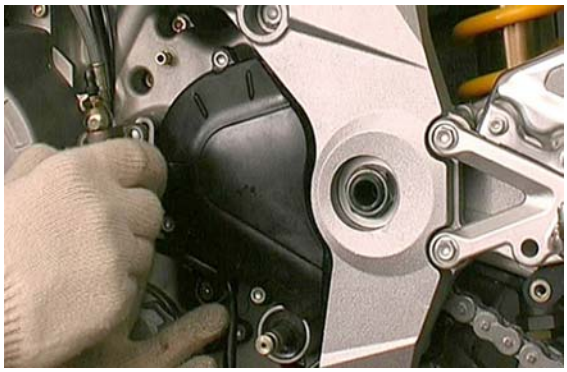
- Fit the coolant pipes on the radiator and lock them with clamps.



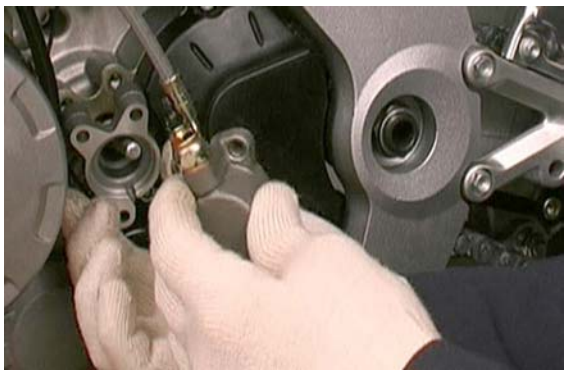
- Position the pinion respecting the fitting direction.
- Fasten the pinion by tightening the fixing bolt to the prescribed torque.

- Mount the pinion crankcase and the guide plate by screwing the screws to the prescribed torque.

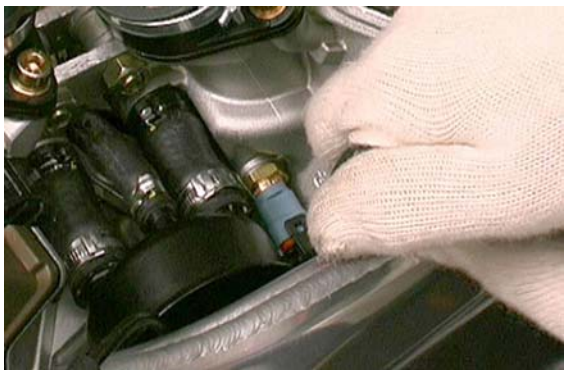




- Fit the clutch actuator together with the flange.
- Fit the gearbox lever.
- Insert the spark plug tubes.



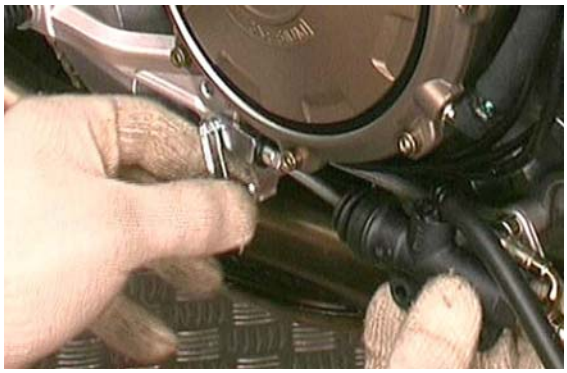
- Connect the connectors corresponding to the temperature sensor, timing sensor, engine revolution sensor, side stand safety switch and generator.
- Refit the exhaust system.
- Screw the starter motor connection.



- Take the radiator towards the engine and reattach the lower supports.

- Reattach the connections corresponding to the lambda probe, stop light switch and speed sensor.
- Connect the engine oil pressure sensor.

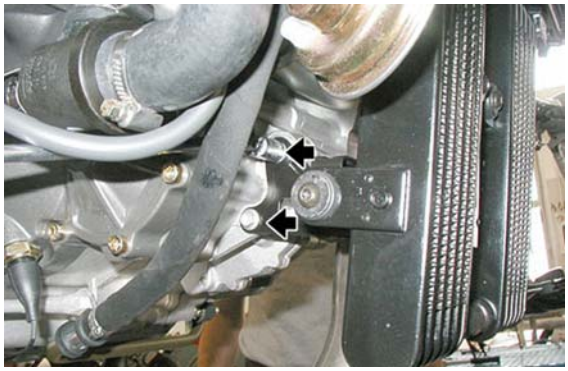
- Attach the fixing clip to the brake lever pump.

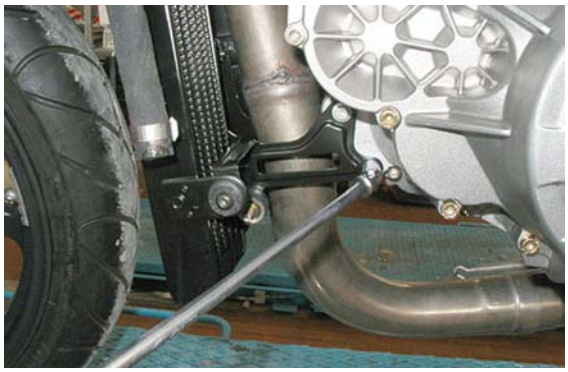


- Screw again the rear brake pump fixing screws.

- Position the frame with the oil radiators.

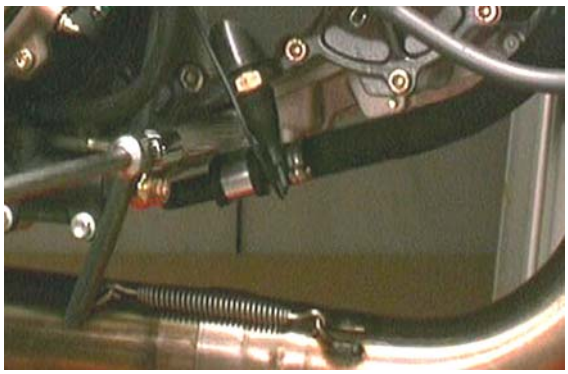
- Screw the four screws to the prescribed torque (for the left upper screw, lock the internal nut with a spanner).





- Connect the oil pipe from the right side.

- Screw the stud bolt fixing the oil pipe clamp to the engine crankcase.



- Position the voltage regulator supporting plate and screw the two fixing screws.

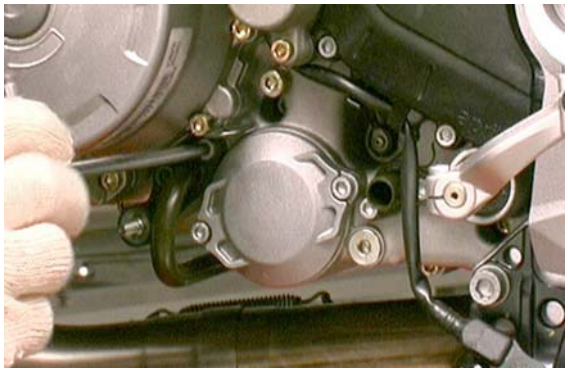
- Position the voltage regulator and screw the two fixing screws.
- Reattach the general connections.

- Position the expansion tank and screw the two fixing screws.

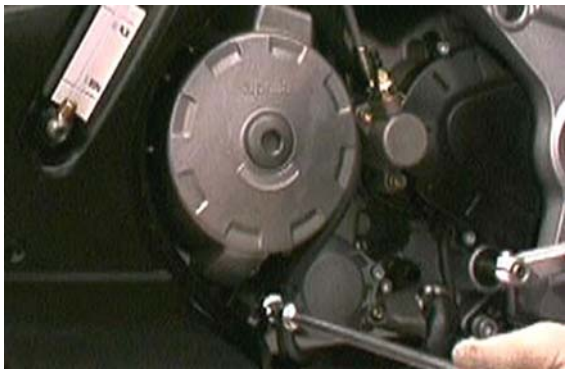
- Position the coolant breather pipe.
- Position the seal clamp.

- Position the rear brake fluid reservoir and screw the fixing screw.

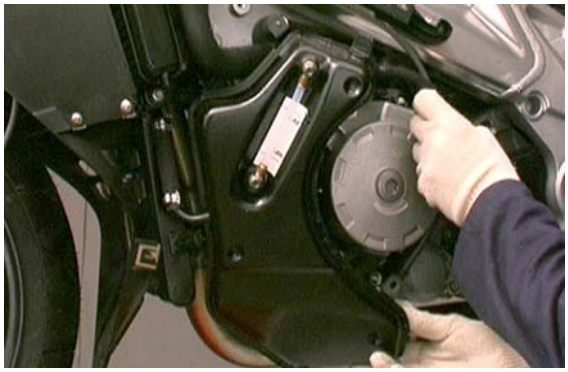
- Fit the oil pipe on the engine crank-case.



- Position the oil reservoir.
- Screw the three fixing screws of the oil reservoir.



- Fix the pipe coming from the radiator with a new clamp and insert it into the housing.



- Insert the pipes in the housing.

- Fit the oil pipes on the engine crank-case and secure them with new clamps.

- Remove the protection present on the pipes.
- Fit the throttle body.
- Screw the clamps on the inlet manifolds.
- Attach the connectors on the injectors.
- Insert the suction pipes to the throttle valve.
- Reattach the throttle potentiometer connection.

- Fit the throttle grip cables and adjust their clearance.
- Connect the wiring to the ignition coils.
- Position the airbox.
- Reattach the manifold pressure sensor connection and the related pipes coming from the throttle body.

- Connect the oil vapour recovery pipe.

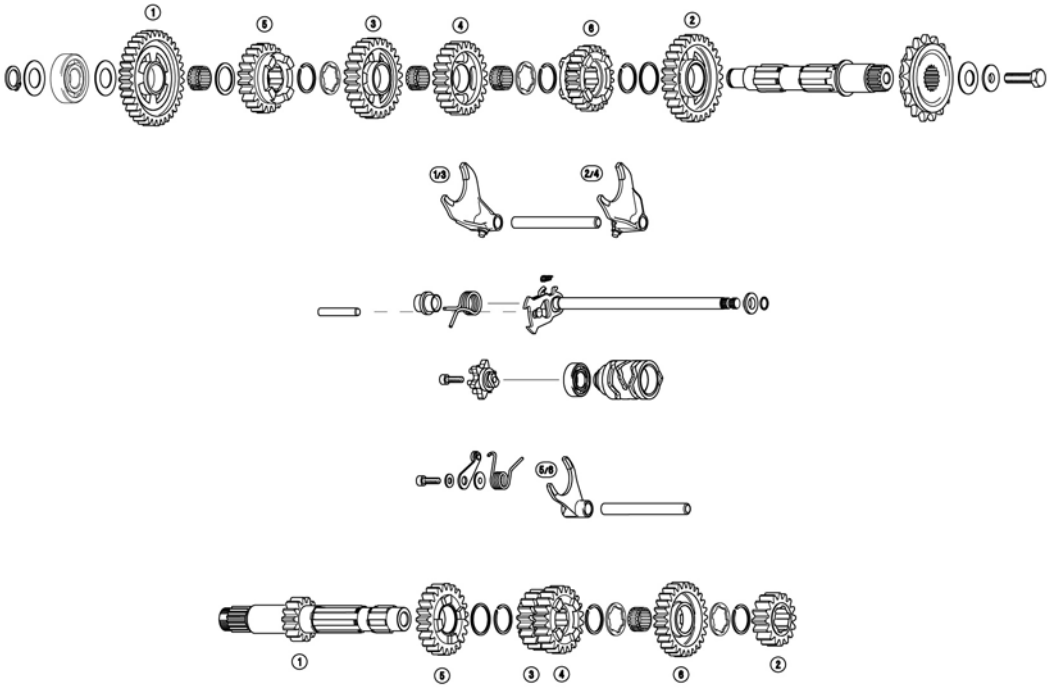
- Connect the by-pass pipes coming from the throttle body and the Stepper motor connection.

- Tighten the six fixing screws of the throttle body to the airbox.
- Fit the airbox cover.
- Then position the battery, the fuel tank and the saddle.

INDEX OF TOPICS

Gearbox

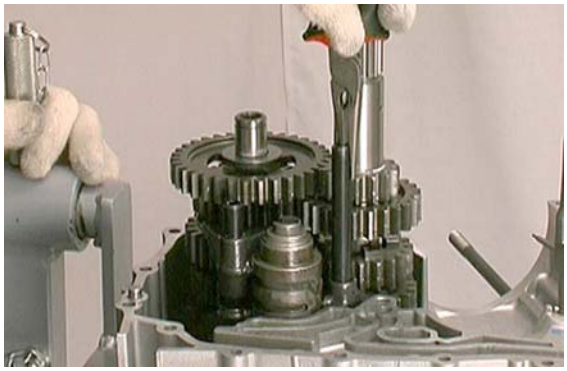
Diagram

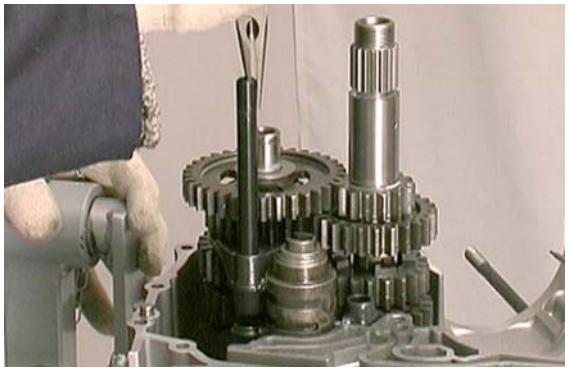


Gearbox shafts

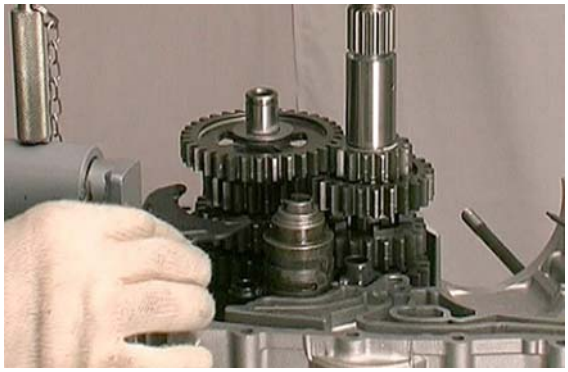
Disassembling the gearbox

- Slide off the shafts on which the gear selector fork slide.

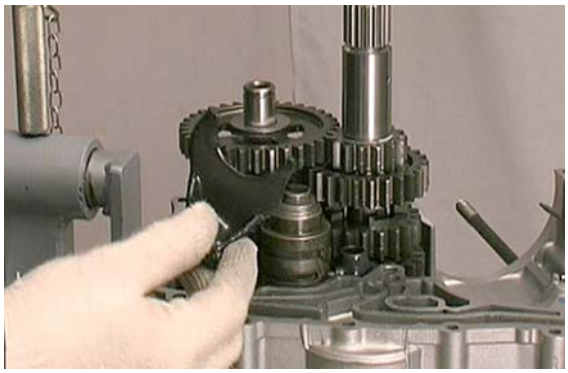




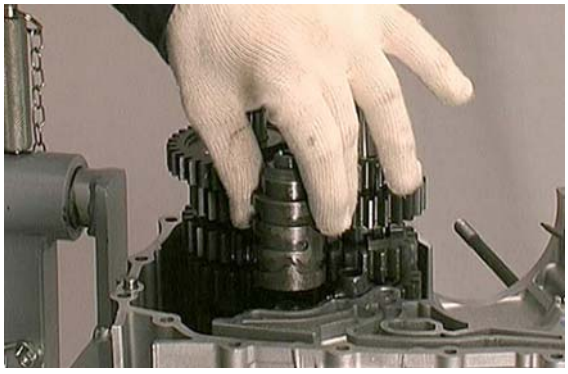
- Remove the forks of the secondary shaft selector.



- Detach the main shaft fork from the guide of the desmodromic.



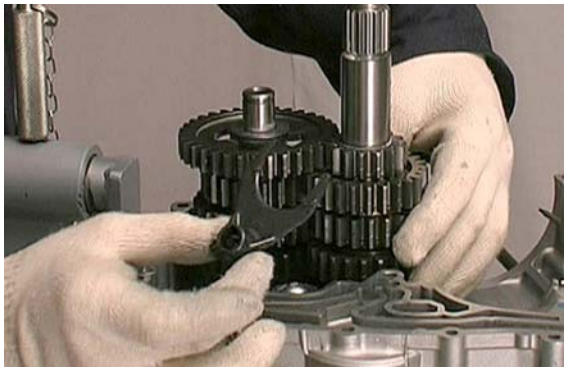
- Remove the selector cylinder.



- Pull up the selector gear for the third and fourth gears and take out the

main shaft fork.

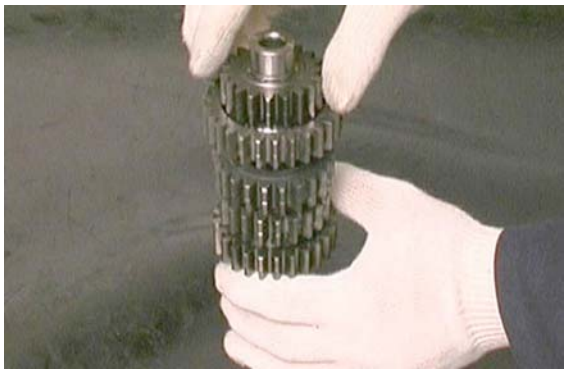
- Set the crankcase halves in horizontal position.



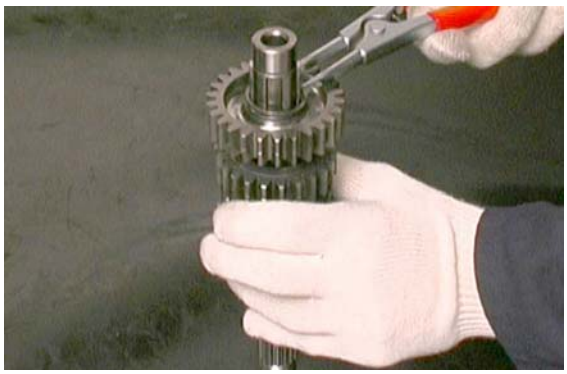
- Hit the secondary shaft with a plastic hammer so that the two shafts come out their places together with the transmission gears.

Removing the primary shaft

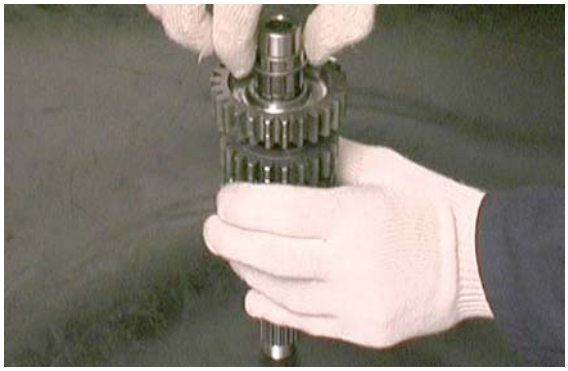
- Slide off the fixed gear of the second gear.

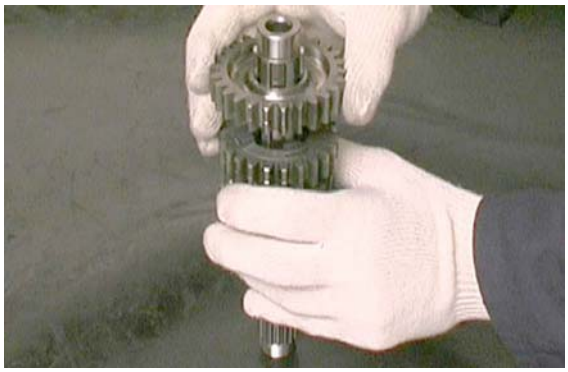


- Release the seeger ring.

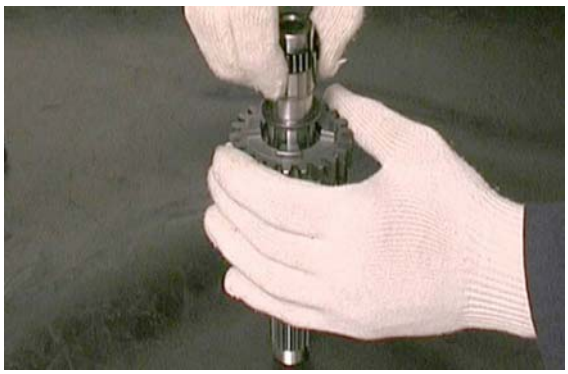


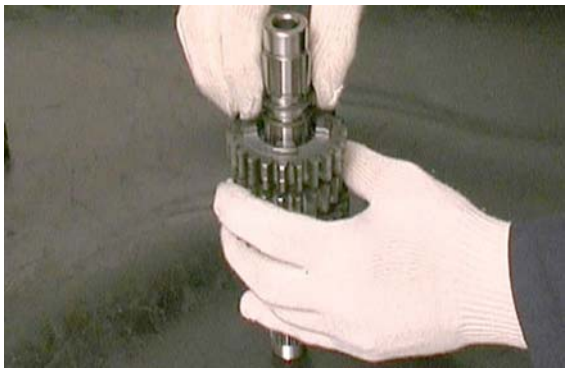
- Slide off the shim washer and the neutral gear of the sixth gear.



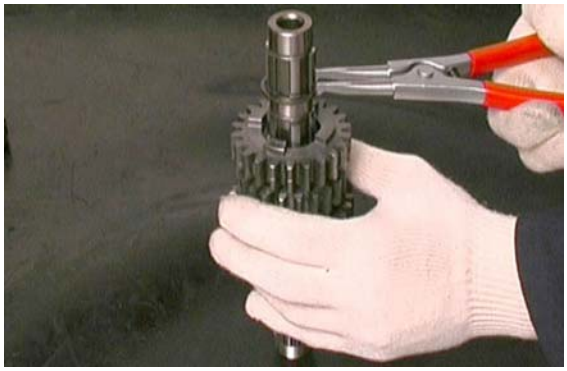


- Slide off the ball bearing cage and the shim washer.

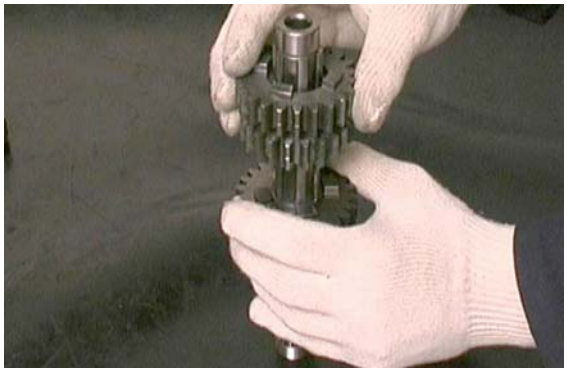




- Release the seeger ring.



- Remove the fixed gear of the third and fourth gears.



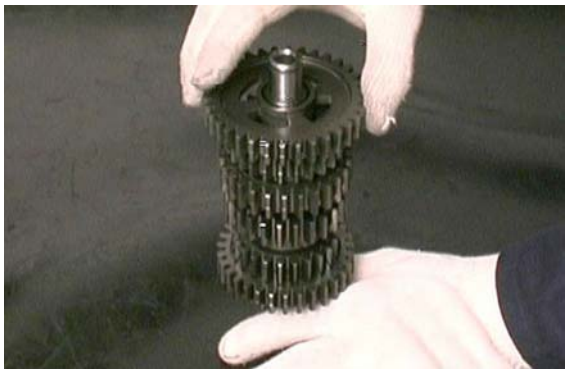
- Release the seeger ring.

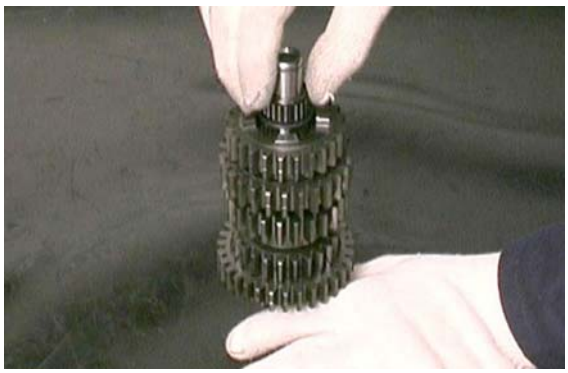
- Slide off the shim washer and the neutral gear of the fifth gear.

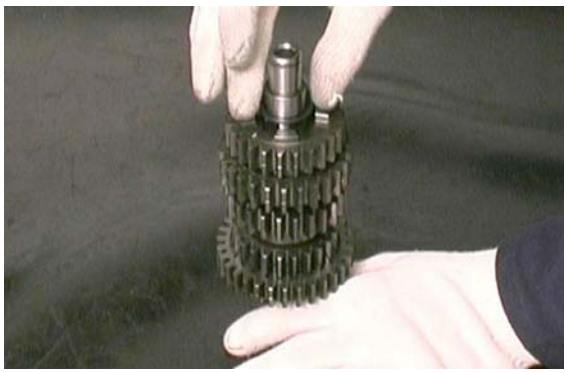
Removing the secondary shaft

- Remove the shim washer.

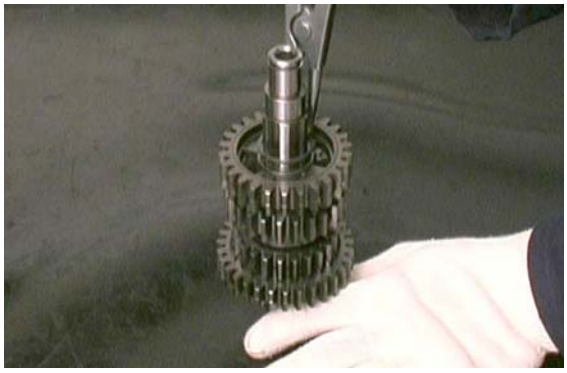
- Slide off the neutral gear of the first gear, the ball bearing cage and the shim washer.
- Slide off the fixed gear of the fourth gear.



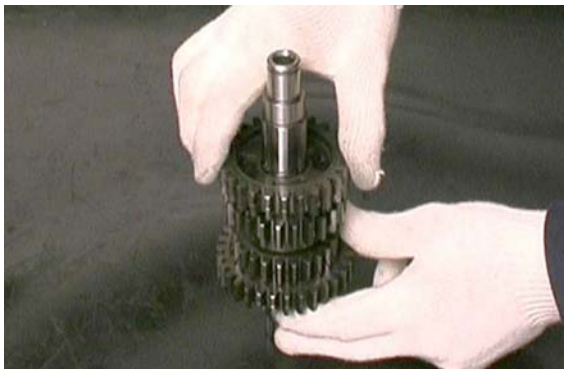


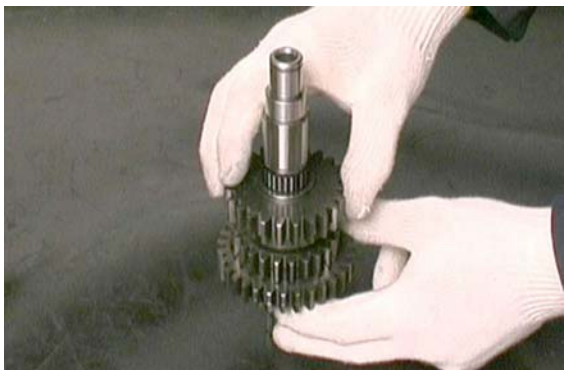


- Release the seeger ring.

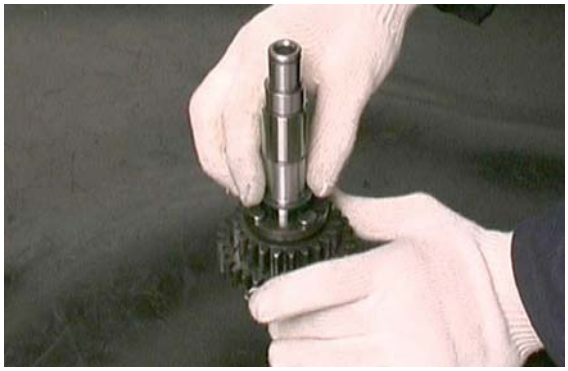


- Slide off the neutral gears of the third and fourth gears and the related ball bearing cages.

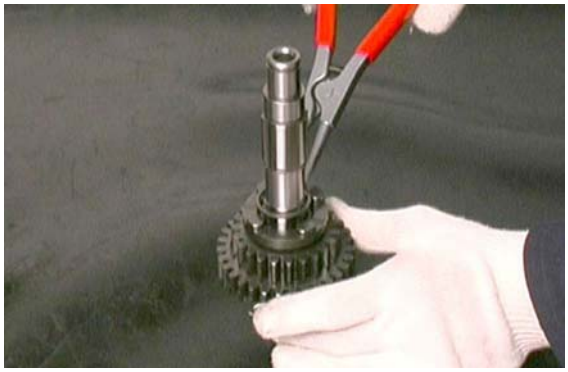




- Slide off the shim washer.



- Release the seeger ring.

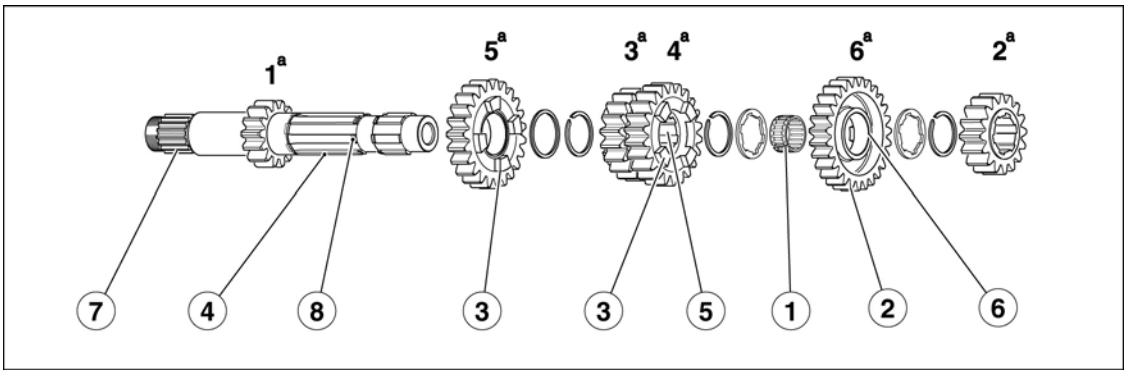


- Slide off the fixed gear of the sixth gear.

- Release the seeger ring.

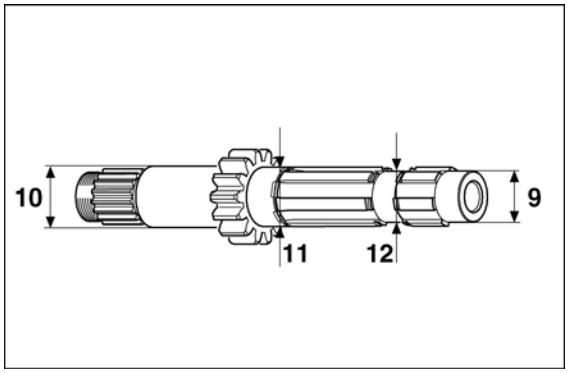
- Slide off the shim washer and the neutral gear of the second gear.

Checking the primary shaft



Check the following components for wear:

- Needle bearings (1);
- Tooth (2) sides of all gears;
- Coupling teeth (3) and coupling holes of transmission gears;
- Profile for the grooved shafts (4) of the secondary and main shafts;
- Check the smoothness of all selector gears (5) of the secondary and main shafts;

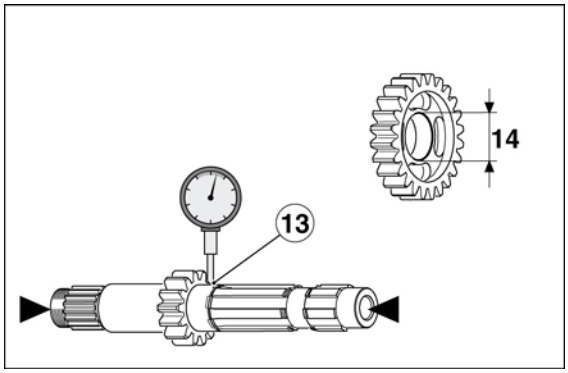


- Bearing seats (6) of the neutral gears;
- Triangular-toothed profile (7) of the chain pinion;
- The grooves for seeger rings (8) on the secondary and main shafts must be sharp-edged.

CAUTION

SMALL GREY SPOTS AND NOT VERY DEEP RECESSES ARE ADMISSIBLE UP TO 0.5% OF THE SIDE SURFACE MAXIMUM.

Check the secondary and main shaft seats for wear:



- Wear limit (9) Min. diam. 29.965 mm (1.17972 in);
- Wear limit (10) Min. diam. 24.972 mm (0.98315 in);
- Wear limit (11) Min. diam. 29.030 mm (1.14291 in);
- Wear limit (12) Min. diam 24.978 mm (0.98338 in);

Allowed eccentricity (13) Max. diam. 0.02 mm (0.0008 in).

- Check the inside diameter of the neutral gears of the 3rd, 4th and 6th gears.

Wear limit (14) Max. diam. 29.022 mm (1.14181 in).

- Check the bushings of the neutral gears of the 2nd and 5th gears for rolling marks and grooves. Measure the inside diameter of the gears.
- Check the bushings of the free wheels (13-14) for rolling marks and grooves. Measure the inside diameter of the bearings.

Wear limit Max. diam. 29.125 mm (1.14665 in).

- Check that the lubrication hole of the secondary shaft is clean.

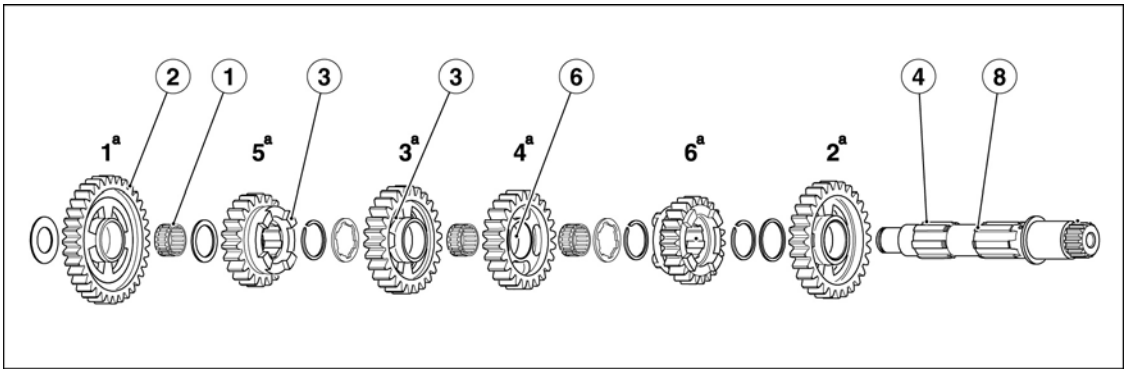
CAUTION

REPLACE THE GEAR PAIR WHEN THE SIDES OF THEIR TEETH ARE WORN OUT.

WHEN THE COUPLING TEETH OR HOLES ARE WORN OUT, REPLACE THE CORRESPOND-

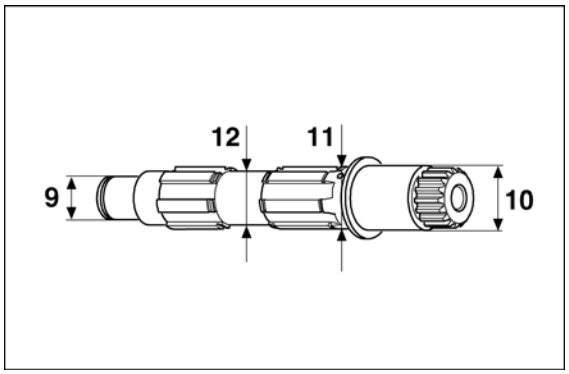
ING ENGAGING GEARS.

Checking the secondary shaft



Check the following components for wear:

- Needle bearings (1);
- Tooth (2) sides of all gears;
- Coupling teeth (3) and coupling holes of transmission gears;
- Profile for the grooved shafts (4) of the secondary and main shafts;
- Check the smoothness of all selector gears (5) of the secondary and main shafts;
- Bearing seats (6) of the neutral gears;
- Triangular-toothed profile (7) of the chain pinion;
- The grooves for seeger rings (8) on the secondary and main shafts must be sharp-edged.



CAUTION

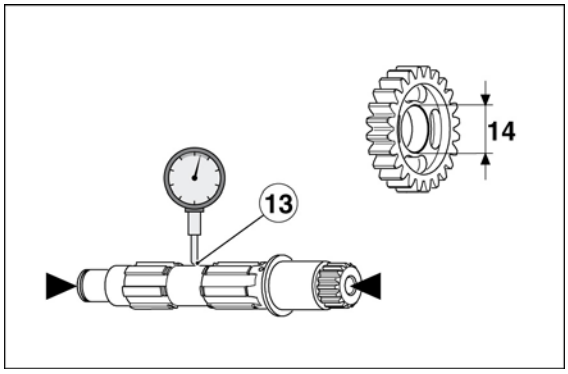
SMALL GREY SPOTS AND NOT VERY DEEP RECESSES ARE ADMISSIBLE UP TO 0.5% OF THE SIDE SURFACE MAXIMUM.

Check the secondary and main shaft seats for wear:

- Wear limit (9) Min. diam. 19.972 mm

(0.78630 in);

- Wear limit (10) Min. diam. 29.915 mm (1.17775 in);
- Wear limit (11) Min. diam. 29.030 mm (1.14291 in);
- Wear limit (12) Min. diam 24.978 mm (0.98338 in);



Allowed eccentricity (13) Max. diam. 0.02 mm (0.0008 in).

- Check the inside diameter of the neutral gears of the 3rd, 4th and 6th gears.

Wear limit (14) Max. diam. 29.022 mm (1.14181 in).

- Check the bushings of the neutral gears of the 2nd and 5th gears for rolling marks and grooves. Measure the inside diameter of the gears.
- Check the bushings of the free wheels (13-14) for rolling marks and grooves. Measure the inside diameter of the bearings.

Wear limit Max. diam. 29.125 mm (1.14665 in).

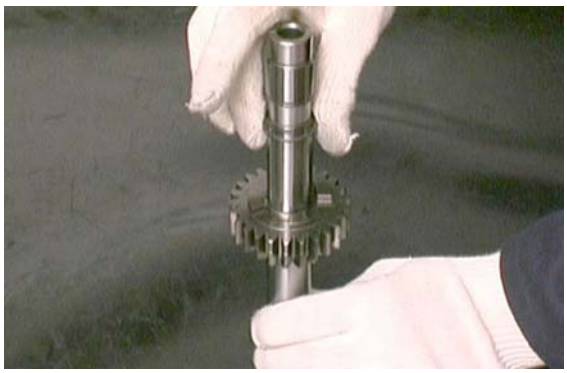
- Check that the lubrication hole of the secondary shaft is clean.

CAUTION

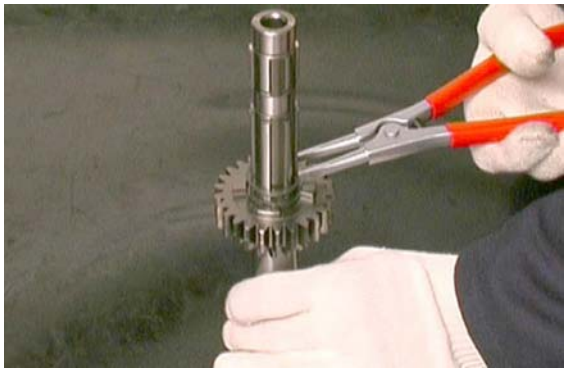
REPLACE THE GEAR PAIR WHEN THE SIDES OF THEIR TEETH ARE WORN OUT.
WHEN THE COUPLING TEETH OR HOLES ARE WORN OUT, REPLACE THE CORRESPONDING ENGAGING GEARS.

Fitting the primary shaft

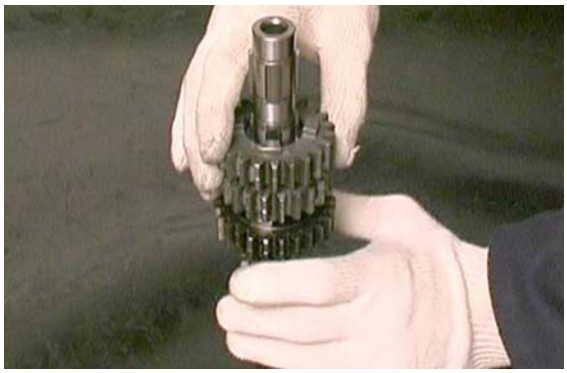
- Fit the gear of the fifth gear and the shim washer on the shaft.



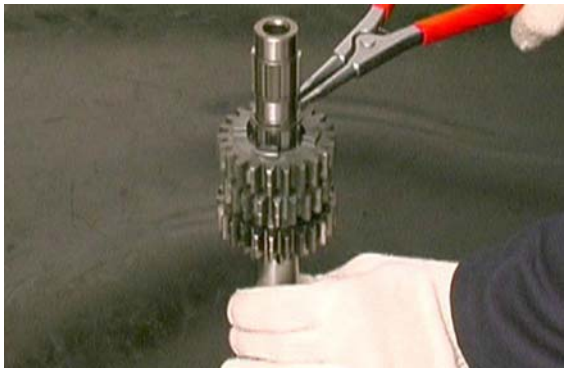
- Fit the seeger ring.



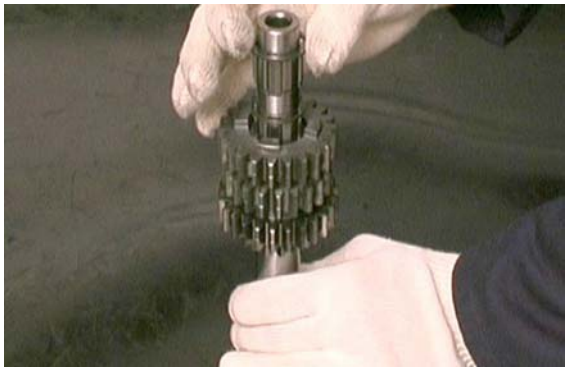
- Insert the fixed wheel of the third and fourth gear.

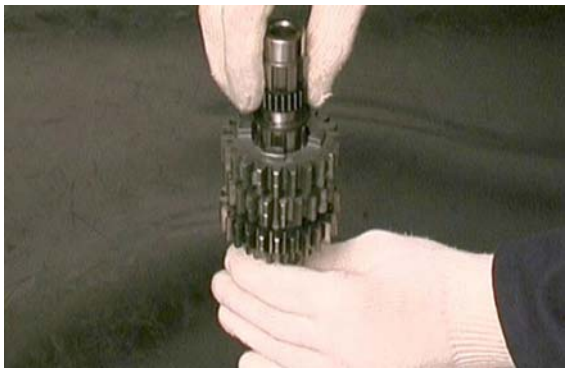


- Fit the seeger ring.

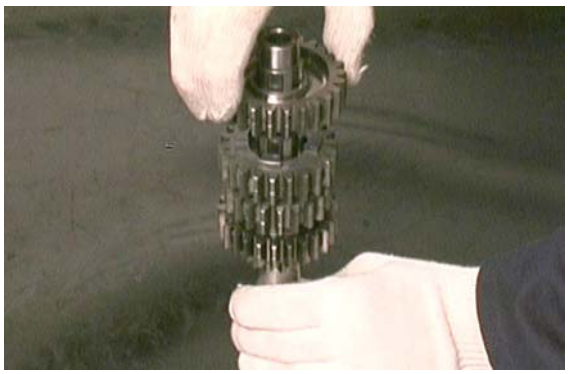


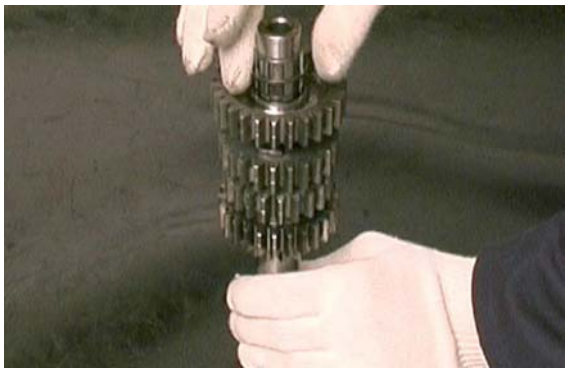
- Insert the shim washer and the ball bearing cage.



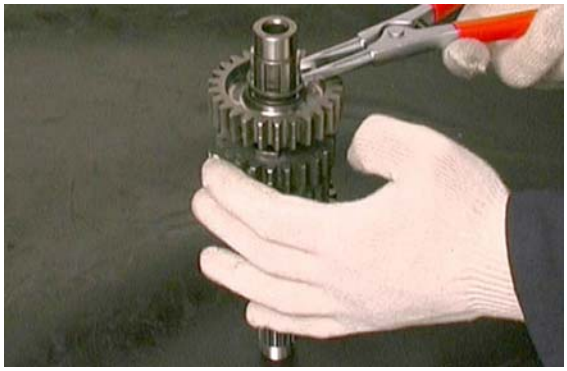


- Fit the neutral gear of the sixth gear and the shim washer.





- Fit the seeger ring.



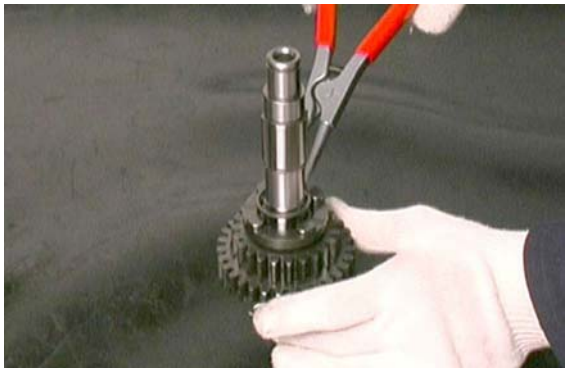
Fitting the secondary shaft

- Fit the neutral gear of the second gear and the shim washer on the shaft.

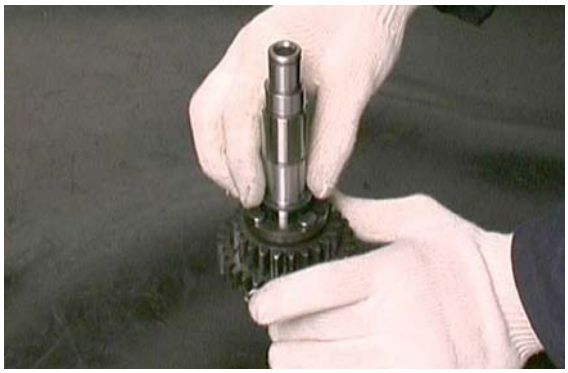
- Fit the seeger ring.

- Fit the fixed gear of the sixth gear.

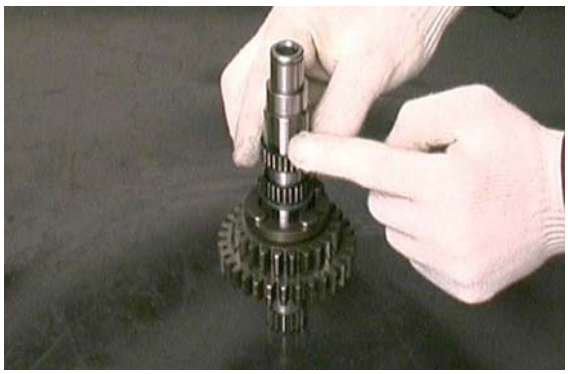
- Fit the seeger ring.



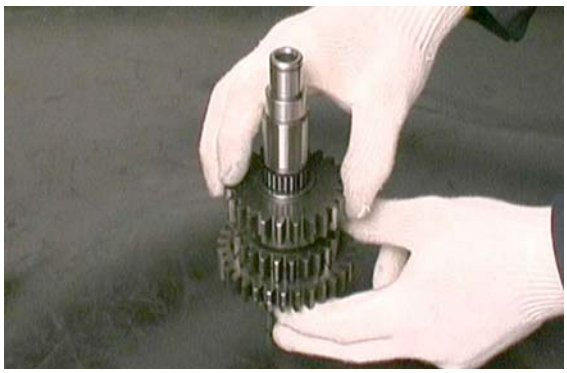
- Insert the shim washer.

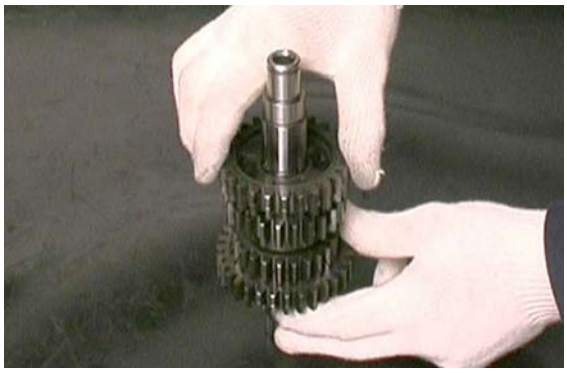


- Insert the ball bearing cages of the neutral gears of the third and fourth gears.

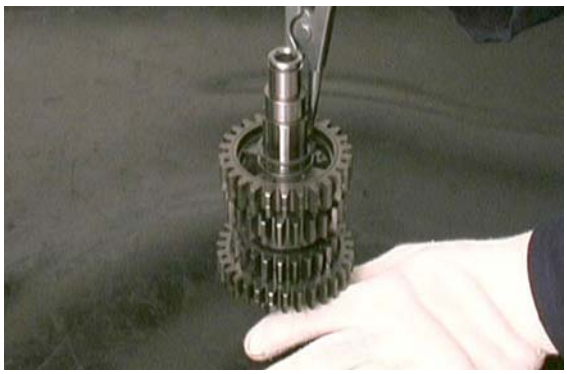


- Fit the neutral gears of the third and fourth gears.

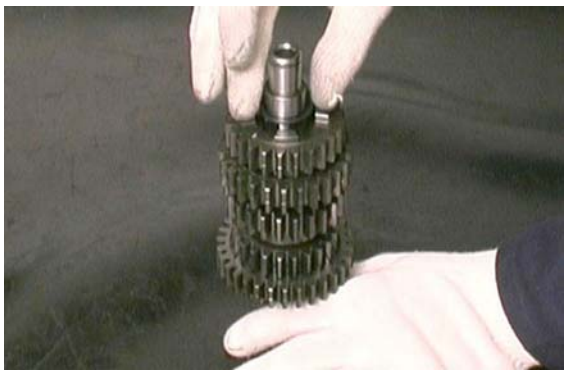


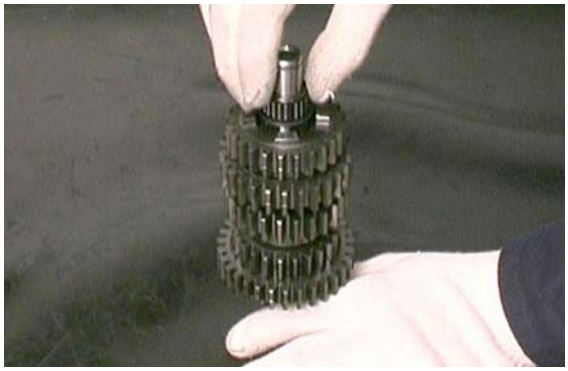


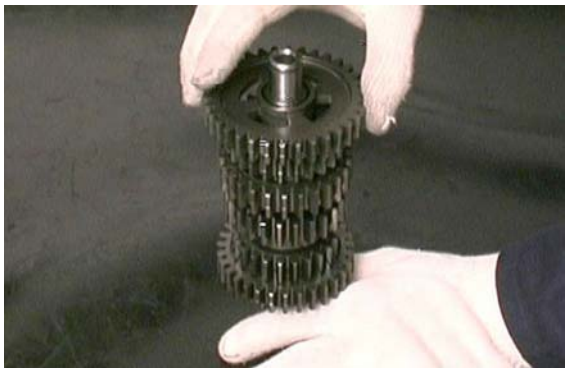
- Fit the seeger ring.



- Fit the fixed gear of the fourth gear.
- Insert the shim washer, the ball bearing cage and the neutral gear of the first gear on the shaft.



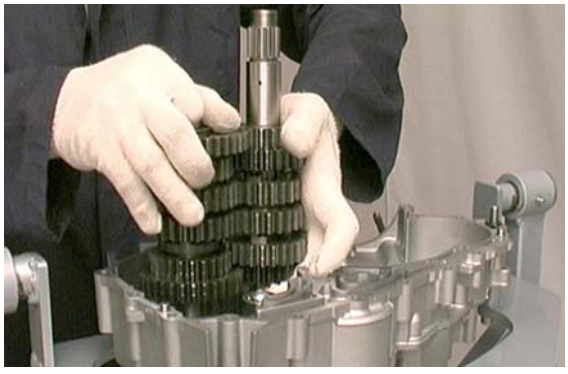




- Insert the shim washer.

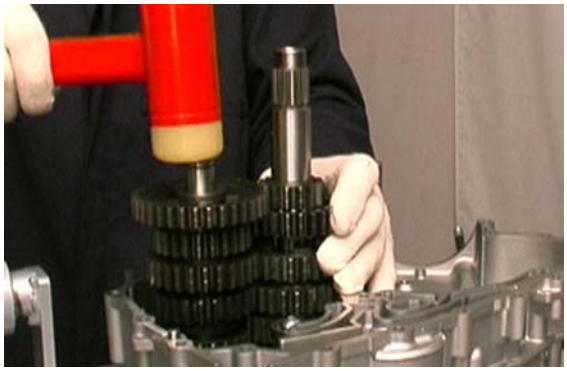
Assembling the gearbox

- Fit the gear shafts on the crankcase.

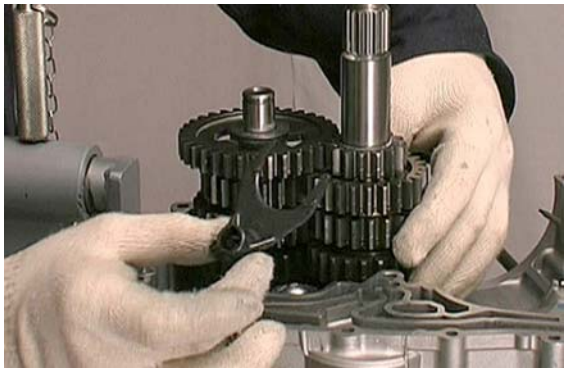


- With a plastic hammer, alternately hit

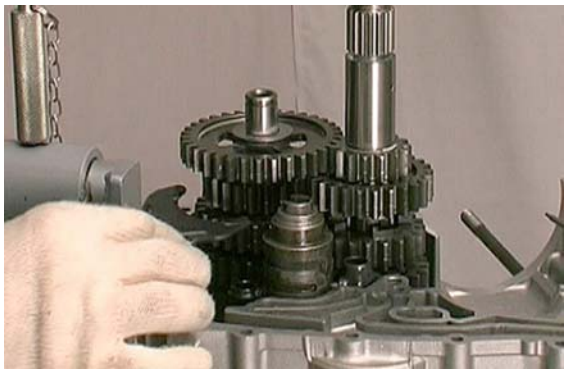
both shafts in order to position them in their seats.



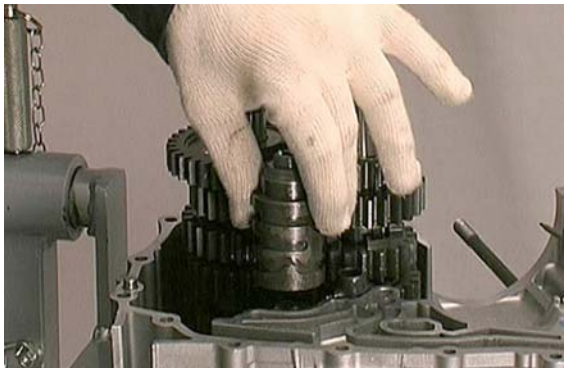
- Push up the selector gear of the third and fourth gears and fit the fork on the main shaft.



- Position the selector forks on the secondary shaft.

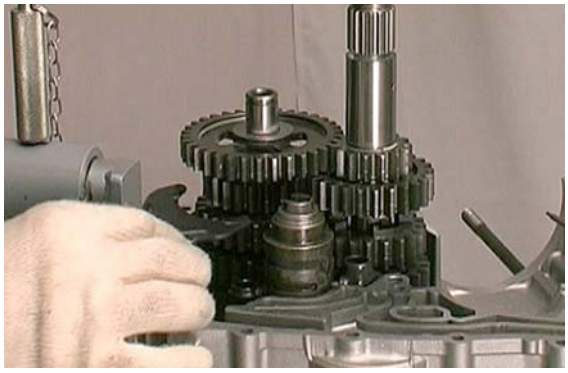


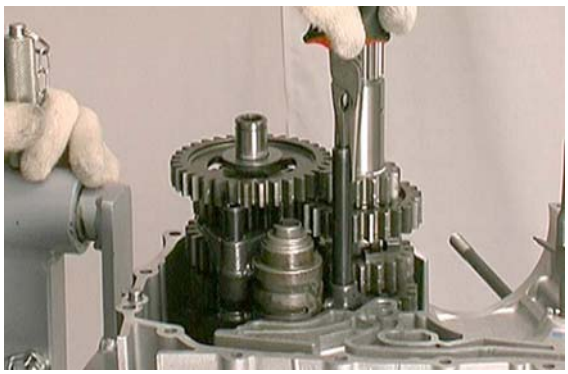
- Fit the desmodromic into its position.



- Position the forks on the desmodromic tracks.

- Position the shafts on which the selector forks slide.



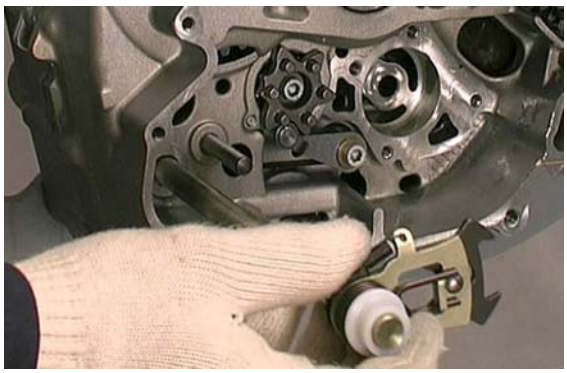


Gear selector

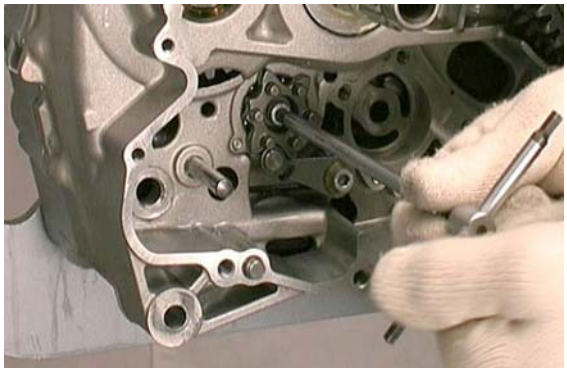
Removing the gear selector

- Before starting the removal operations, engage the sixth gear.

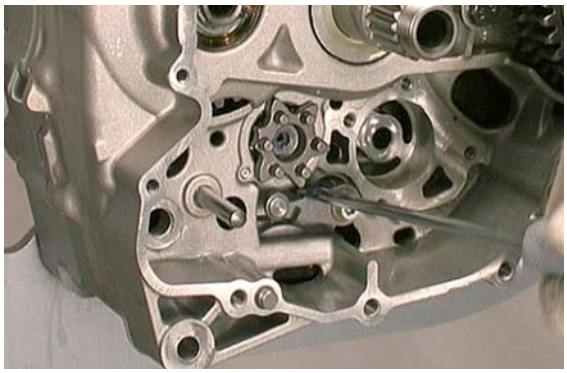
- Take out the entire selector shaft.

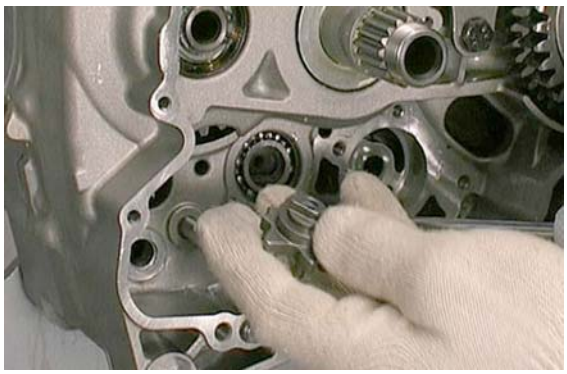


- Unscrew the index cap fixing screw.

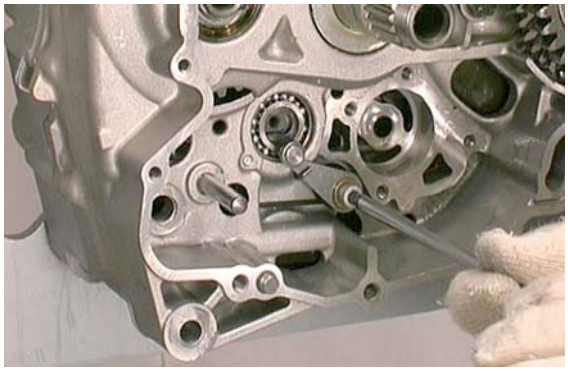


- Lower the gear positioning lever and take out the index cap.





- Unscrew the fixing screw of the positioning lever and remove the assembly.

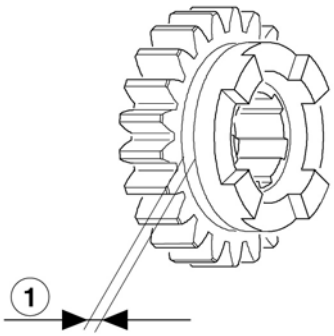


Checking the gear selector

Check the axial clearance of the selector forks on the inside of the corresponding grooves of the selector gears.

Max. wear limit 0.15 mm (0.0059 in).

Selector gears - Groove width (1).



CAUTION

IF WEAR LIMITS ARE EXCEEDED, CHECK THE SELECTOR FORKS AND GEARS TO SEE WHICH COMPONENTS NEEDS REPLACING.

Max. wear limit 4.35 mm (0.1713 in).

Selector forks - Thickness (2). Check the chrome-plated thrust surfaces of the selector forks for wear.

Max. wear limit 3.95 mm (0.1555 in).

Check the diameters (3) of the selector fork guide pins.

Wear limits Min. diam. 5.85 mm (0.2303 in).

Check the eccentricity of the two fork shafts (4).

Max. eccentricity allowed 0.02 mm (0.0008 in).

Check the ratchet gear for wear on the contact zone with the index cap pins.

Wear limits (5): visual inspection.

Check the eccentricity of the selector shaft (6) and also the eventual presence of rolling marks

on the sliding surface of the shaft O-rings.

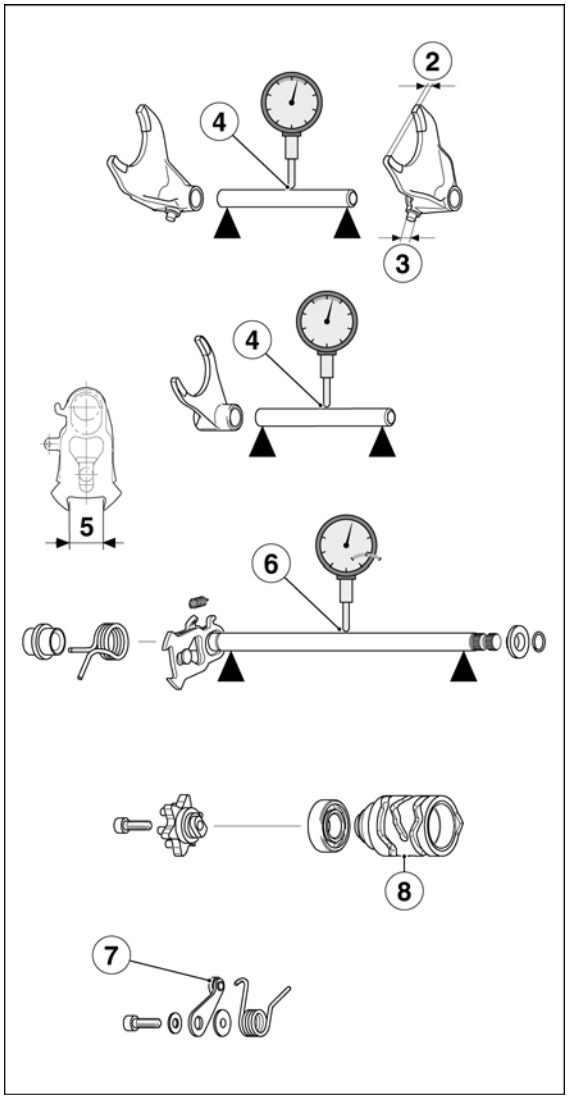
Max. eccentricity allowed 0.25 mm (0.0098 in).

The roller (7) of the position lever must be able to turn easily.

Check the desmodromic guide tracks (8) for wear.

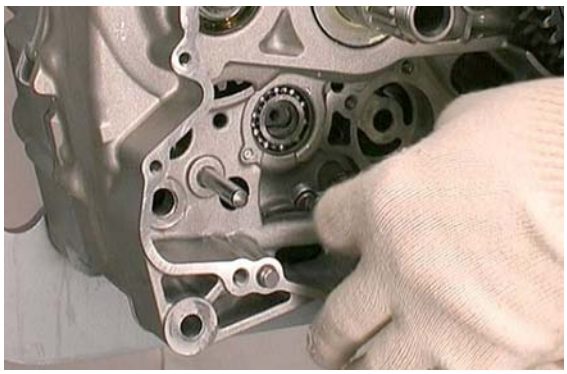
CAUTION

REPLACE THE FORK THAT SHOWS NO CHROME PLATE AT ANY POINT.

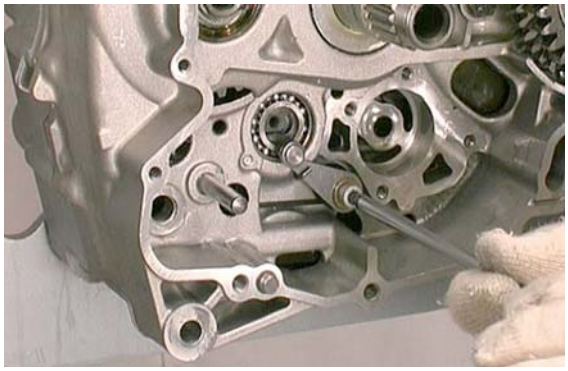


Reassembling the gear selector

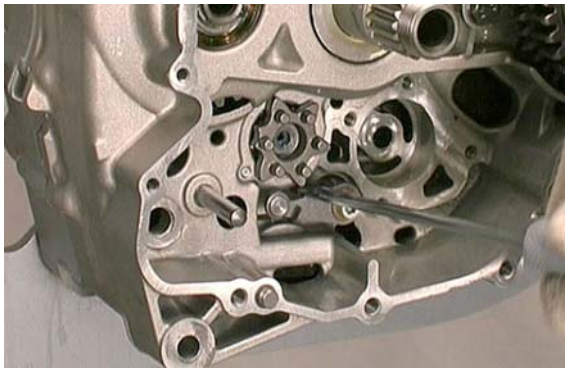
- Insert gear position lever spring on the crankcase.



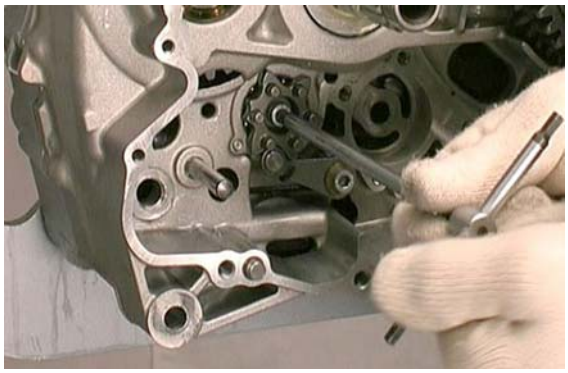
- Fit the position lever and tighten the fixing screws to the prescribed torque.



- Lower the lever and insert the index cap.



- Tighten the index cap fixing screw to the prescribed torque.

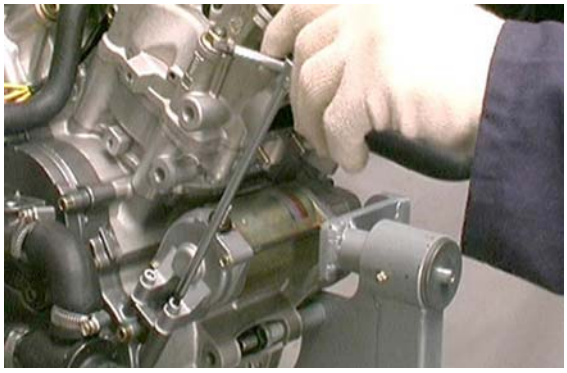


- Fit the selector shaft assembly into its position.

Starter motor

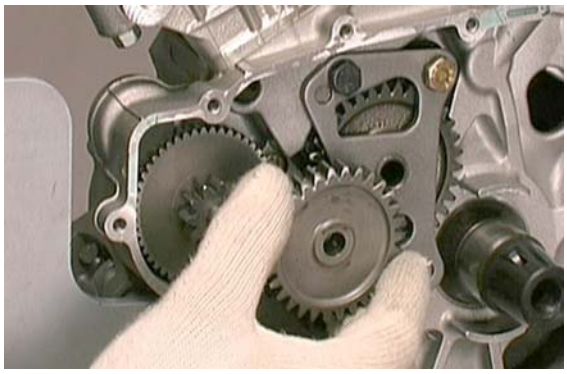
Removing the starter motor

- Unscrew the starter motor fixing screws and pull it out of its housing.

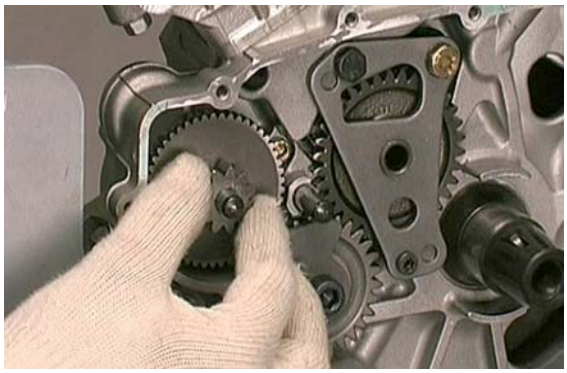


Removing the idle gear

- Remove the magneto flywheel.
- Remove the intermediate gear.

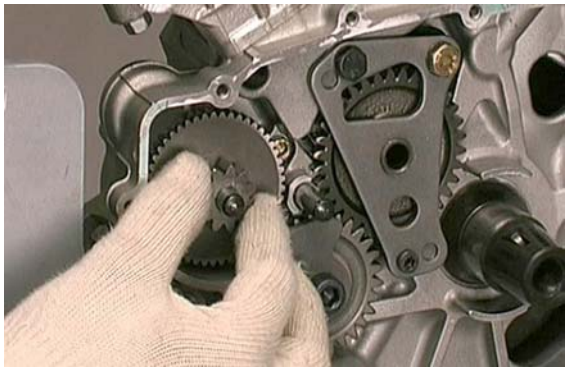


- Remove the double start-up gear.
- To check the start-up system gears, refer to the FREE WHEEL CHECK section.

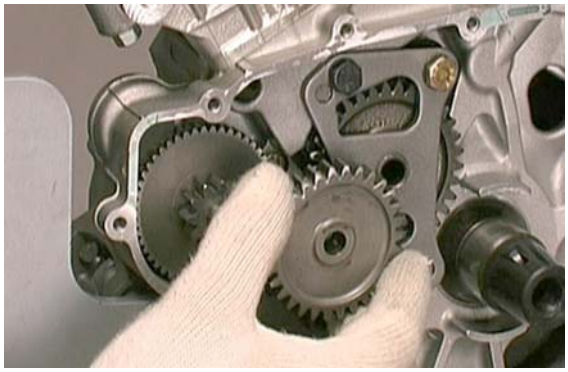


Fitting the idle gear

- Position the start-up double gear.



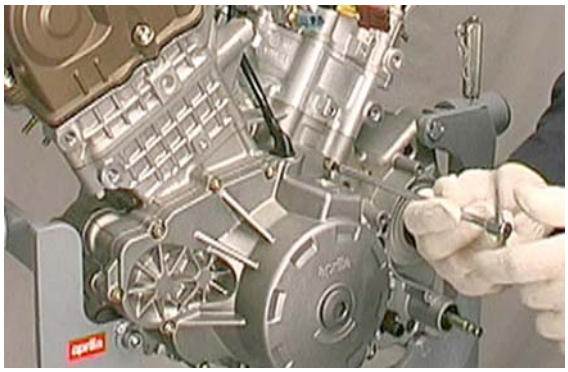
- Fit the intermediate gear.



Generator side

Removing the flywheel cover

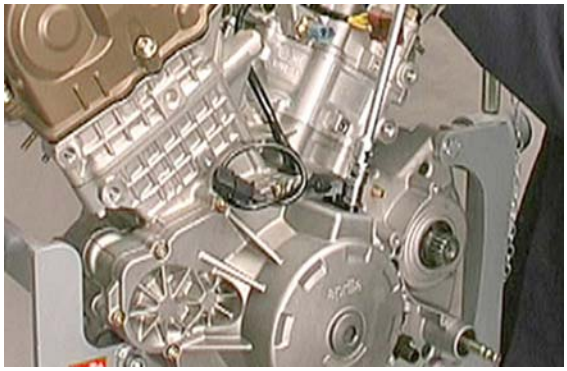
- Remove the revolution sensor.
- Unscrew and take out the screws of the flywheel cover.



- Remove the flywheel cover and collect the seal gasket.

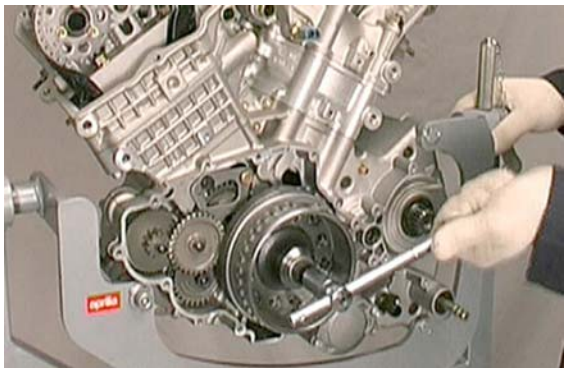
Removing the flywheel cover components

- Unscrew and remove the screw.
- Remove the revolution sensor.



Magneto flywheel removal

- Remove the flywheel cover.
- Turn the engine anticlockwise with the specific tool in order to take the front cylinder to the top dead centre in the combustion phase.
- Remove the front head cover and check that the "IN" and "EX" reference marks on the toothed wheels of the overhead camshafts are aligned.

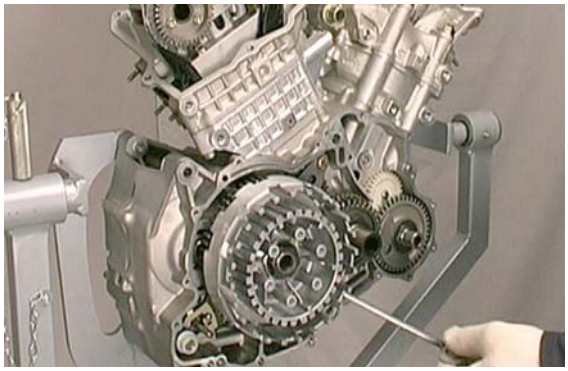


Specific tooling

8140182 Bushing for rotor bolt

- Screw the tool to lock the crankshaft but do not overtighten.

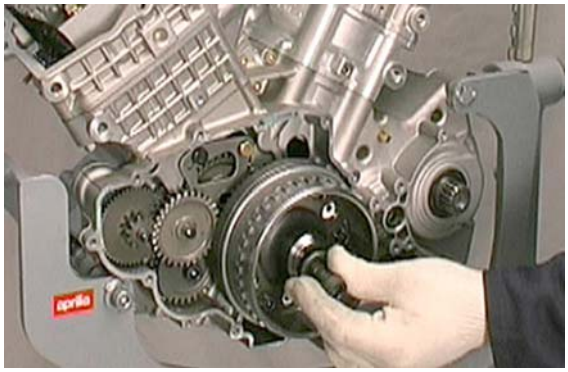
- Check that the crankshaft is firmly locked by turning it in both directions alternately.



Specific tooling

0240880 Threaded bolt for locking crankshaft at TDC

- Unscrew the magneto flywheel fixing screws.



- Fit the prescribed tool to take out the flywheel.
- With a suitable air-jet heater, warm the hub for approx. 5-10 minutes.
- Take out the flywheel with the flange and the entire freewheel.

Specific tooling

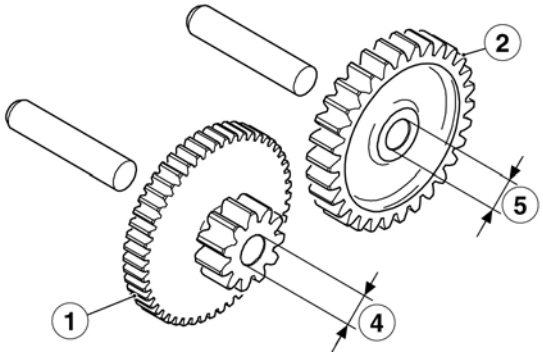
0277730 Hexagonal bolt for removing flywheel

- Remove the tongue on the crankshaft.

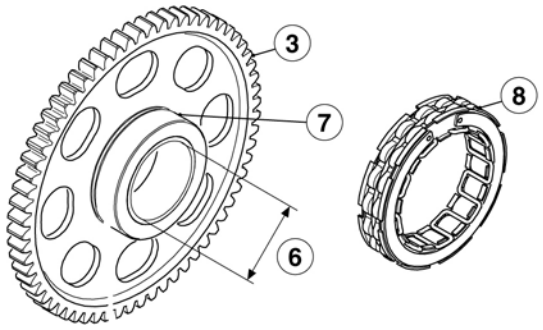
Checking the starter clutch

IF THE START-UP DOUBLE GEAR TOOTHING IS DEFORMED, INSPECT ALSO THE STARTER MOTOR TOOTHING.

Check toothing of the start-up double gear (1), intermediate gear (2) and freewheel gear (3) to see if the material is damaged or distorted.
Check the bushing of the freewheel gear (3) for rolling marks or grooves.



Measure the gear bearings diameter.
Start-up double gear:
wear limit (4) max. diam. 10.10 mm (0.398 in).
Intermediate gear:
wear limit (5) max. diam. 10.08 mm (0.397 in).
Freewheel gear:
wear limit (6) max. diam. 35.07 mm (1.381 in).



THE BUSHING INSIDE THE FREEWHEEL GEAR (3) MUST BE INSERTED AND FIXED SO THAT IT CANNOT MOVE FREELY.

Replace the freewheel gear if the material of the sliding surface is distorted or damaged.

Check the sliding surface (7) of the freewheel for wear.

Remove any remaining LOCTITE from the rotor cone.

Check that the cone and the groove for the key are in proper conditions.

REPLACE THE ROTOR IF THE CONE OR THE GROOVE FOR THE KEY IS DAMAGED.

Take out the freewheel (8) from its housing and check the freewheel (8) bearings for wear marks.

Check that the external spring is pre-loaded enough so as to keep the bearings in the right position.

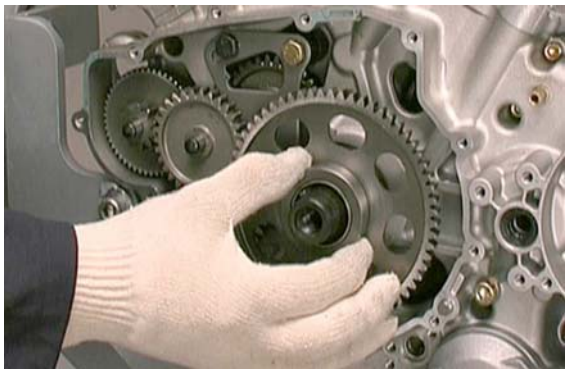
Check the sliding surface of the freewheel for wear inside its housing.

REPLACE THE FREEWHEEL HOUSING IF THE SLIDING SURFACE IS DISTORTED OR SERIOUSLY GROOVED.

Installing the flywheel

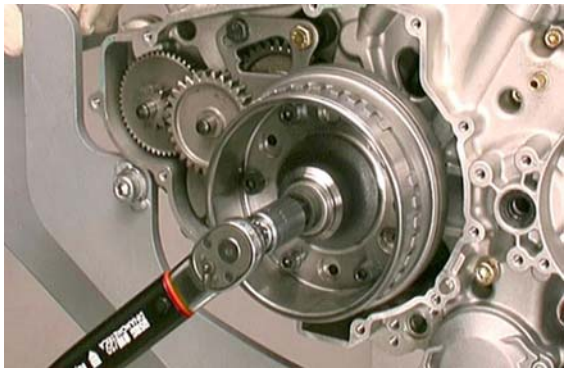
- Fit the start-up gears if previously removed.
- Position the tongue on the crankshaft.

- Fit the freewheel on the crankshaft.



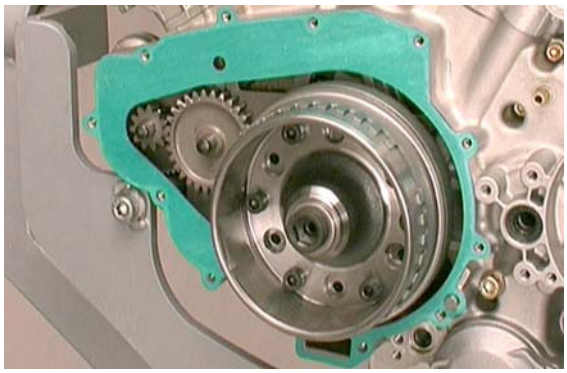
- Fit the flywheel with flange.

- Screw the flywheel fixing screw.
- Refit the cover.



Flywheel cover installation

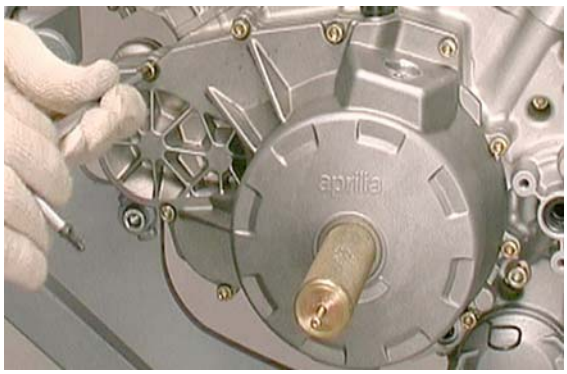
- Fit the sealing gasket on the crankcase flywheel side.



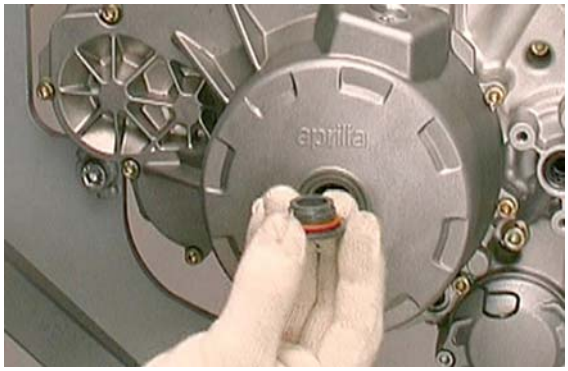
- Fit the flywheel cover using the specific tool.
- Tighten the side fixing screws to the prescribed torque.

Specific tooling

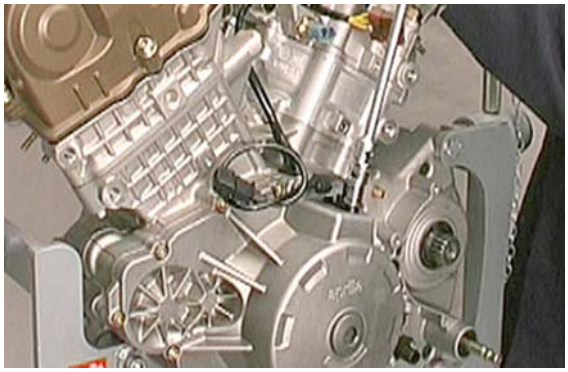
0277252 Tool for removing ignition cover



- Remove the specific tool.
- Screw the locking screw with O-ring.



- Fit the revolution sensor.



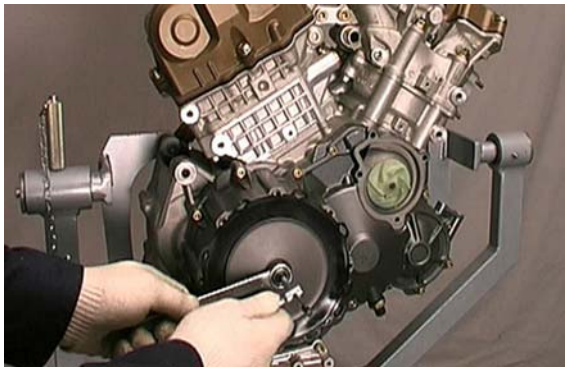
Clutch side

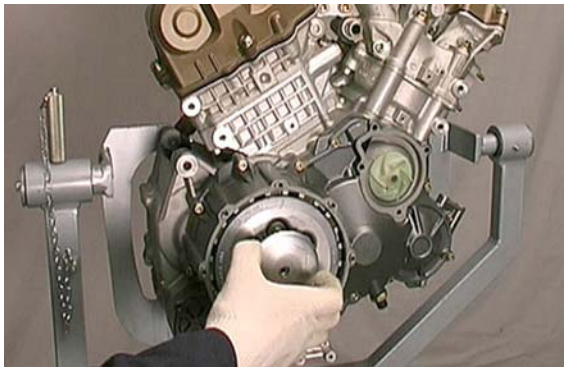
Removing the clutch cover

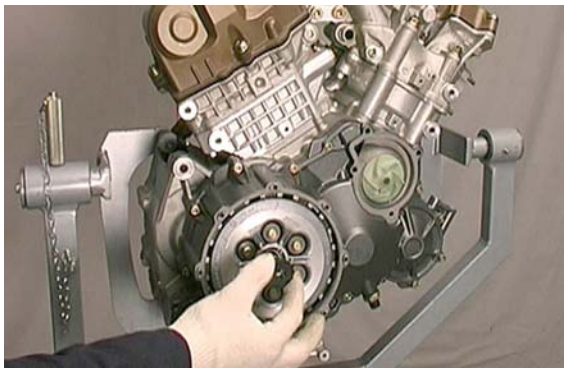
- Unscrew and remove the side fixing screws.
- Remove the clutch cover.

Disassembling the clutch

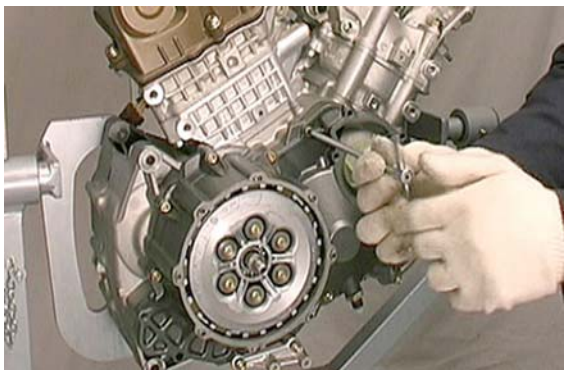
- Disconnect the diaphragm from its seat on the crankcase.
- Lock the pin with an Allen wrench and unscrew the retaining nut.
- Remove the washer, the disc, the diaphragm and the aluminium disc.



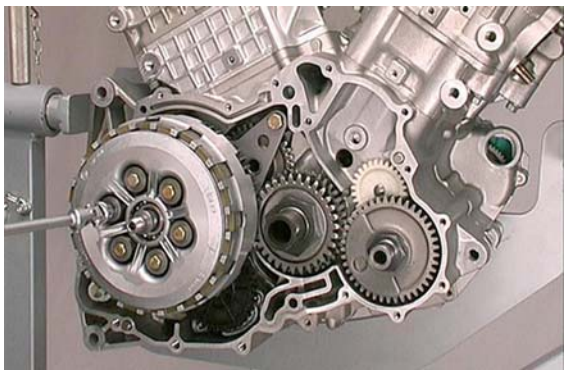




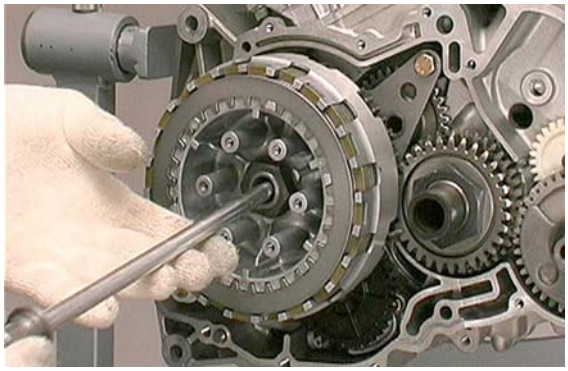
- Remove the side screws of the clutch crankcase and then remove the crankcase.



- Unscrew the six fixing screws from the clutch plate.
- Remove the clutch plate.



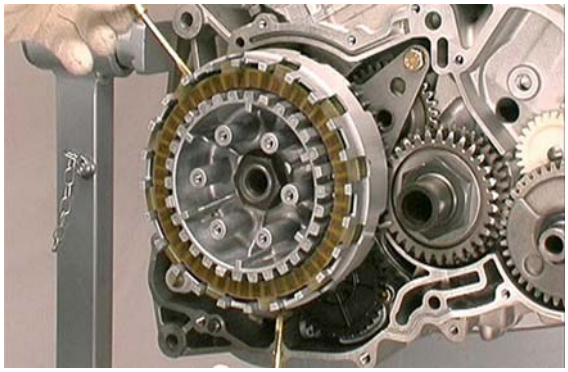
- Slide off the entire disengaging shaft.



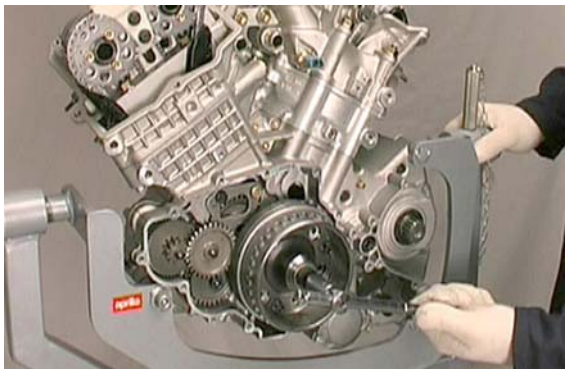
- Remove the clutch discs with the specific tools.

Specific tooling

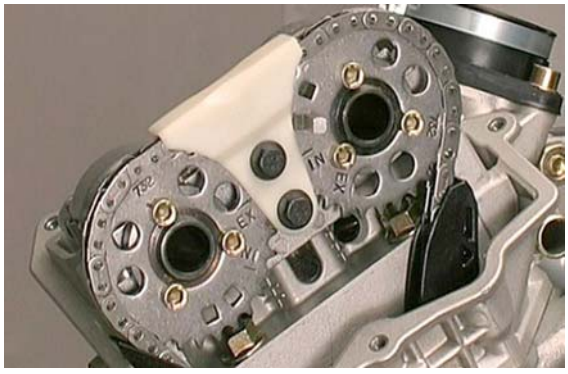
8140185 Hook lever for removing clutch discs



- Turn the engine anticlockwise with the specific tool in order to take the front cylinder to the top dead centre in the combustion phase.



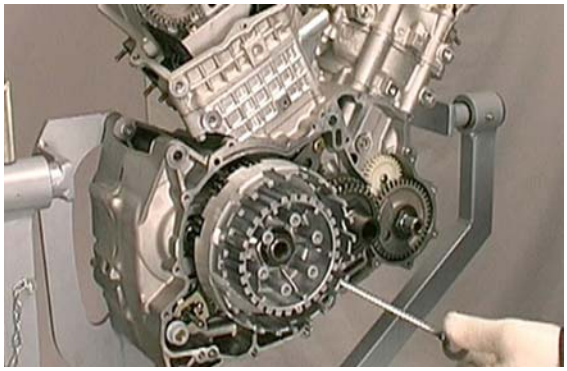
- This position is marked by aligning the "IN" and "EX" reference marks.



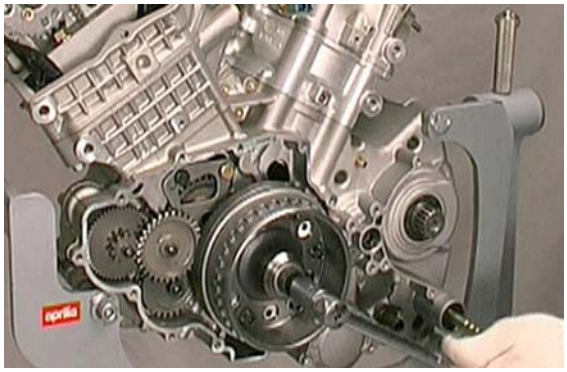
- Screw the tool to lock the crankshaft but do not overtighten it.

Specific tooling

0240880 Threaded bolt for locking crankshaft at TDC



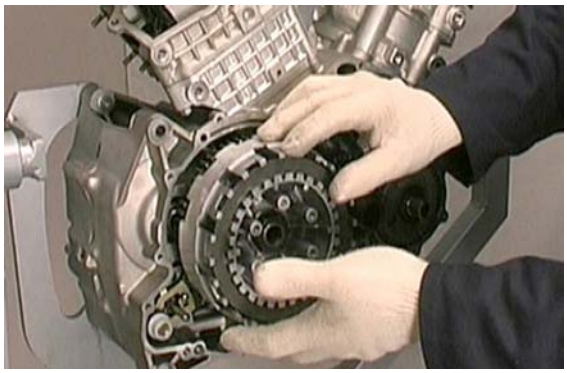
- Check that the crankshaft is firmly locked by turning it in both directions alternately.



- Insert the clutch locking tool on the bell and on the clutch hub.

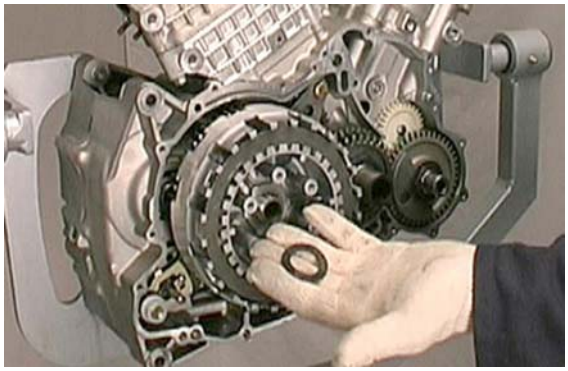
Specific tooling

0277881 Clutch locking tool

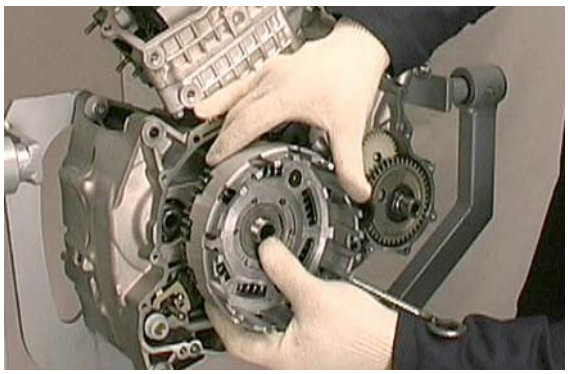


- Unscrew and remove the central locking nut.

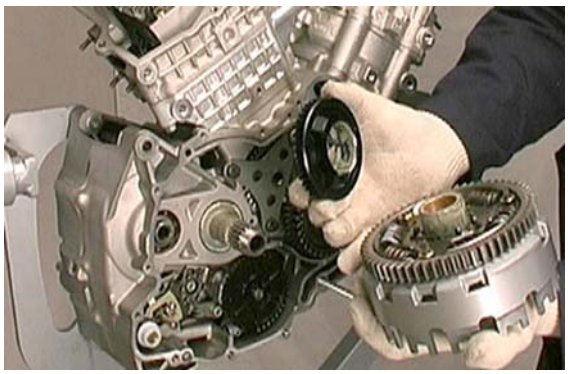
- Remove the clutch locking tool, the spring washer and the clutch hub.



- Remove the clutch bell with the thrust ring.



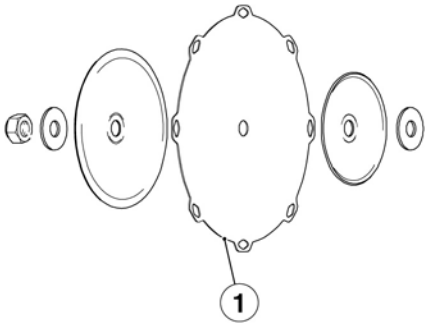
- Take the oil pump control gear out of its fitting on the clutch bell.



Ppc system

- Check the diaphragm (1) for cracks

and replace it, if required.

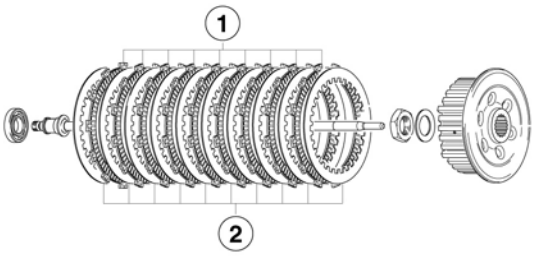


Checking the clutch plates

- Check the friction discs (1) and the steel discs (2) for signs of cracking as well as distortions (3) by placing them on a flat surface.

Max. allowed distortion (3) 0.15 mm (0.0059 in).

- Measure the trailing groove width (4).



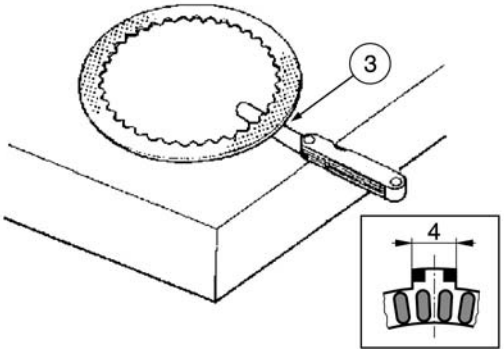
CAUTION

THE STEEL DISCS (2) MUST NOT SHOW SIGNS OF SCORING OR TEMPER COLOUR.

Min. wear limit 13.7 mm (0.539 in).

CAUTION

CHECK CLUTCH DISCS FOR WEAR BY MEASURING THE ENTIRE CLUTCH DISC ASSEMBLY.
DO NOT MEASURE THE STEEL DISC UNIT AND THE FRICTION DISC UNIT INDIVIDUALLY SINCE DOING SO IS IRRELEVANT FOR CHECKING WEAR.



Measure the complete clutch disc assembly (comprising ten steel discs and nine friction discs).

Min. wear limit (4) 46.3 mm (1.823 in).

Partial replacement (worn discs only) is not allowed.

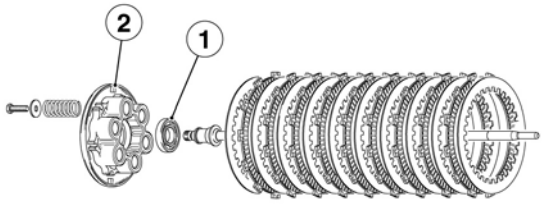
CAUTION

IF ONE OR MORE (STEEL OR FRICTION) CLUTCH DISC IS WORN, THE ENTIRE CLUTCH DISC ASSEMBLY (COMPRISING TEN STEEL DISCS AND NINE FRICTION DISCS) MUST BE REPLACED.

REPLACING THE ENTIRE FRICTION DISC UNIT INVOLVES CHANGING THE CLUTCH SPRING UNIT. ASSEMBLING A NEW CLUTCH DISC ASSEMBLY WITH A USED SPRING UNIT IS NOT ALLOWED.

Checking the pusher plate

Check the smoothness and the clearance of the ball bearing (1) of the spring holder plate (2) and replace them if required.



CAUTION

TO REFIT AND FIT THE BALL BEARING WARM THE SPRING HOLDER PLATE TO 80 - 100 °C (176 - 212 °F). USE A SUITABLE ASSEMBLY PUNCH.

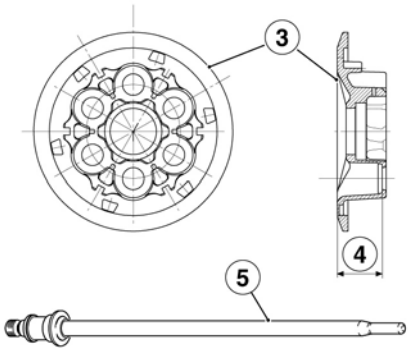
Check that the compression surface (3) of the spring holder plate (2) is not worn or uneven.

Max. allowed distortion (3) 0.10 mm (0.004 in).

Check the spring holder plate depth (4).

Max. wear limit (4) 33.5 mm (1.319 in).

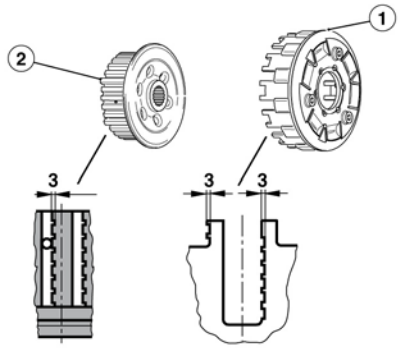
Check the eccentricity of the disengaging shaft (5) and also the presence of rolling marks on the sliding surface of the oil seal.



Checking the clutch hub

Check the external toothing of the clutch hub (1) to see if it is not dented (2).

Check the coupling surfaces with the discs, and that the marks left by the grooves are not deeper than the max. 0.3 mm (0.012 in) (2-3).

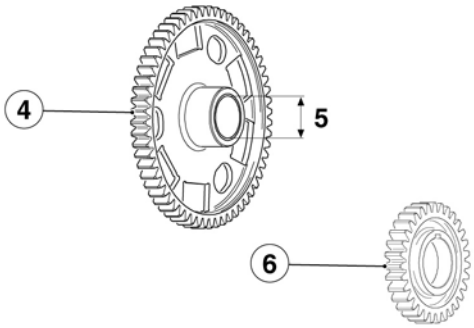


Wear limits (5) Diam. 30.060 mm (1.18346 in).

Check the sides of the teeth of the clutch (12) and the control gear (6) for damage or shape alterations.

CAUTION

IF THE CLUTCH GEAR OR CONTROL GEAR IS WORN OUT, THE PRIMARY TRANSMISSION UNIT SHOULD BE REPLACED.



Checking the springs

Measure each clutch spring length at release position.

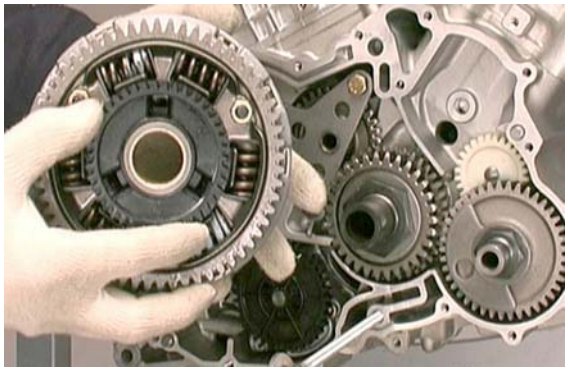
Min. wear limit 44.0 mm (1.732 in).

CAUTION

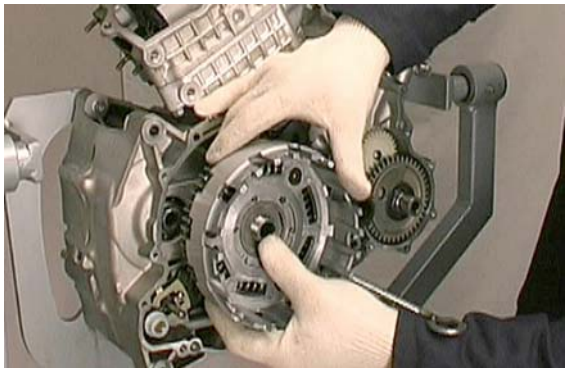
IF ONE OR MORE CLUTCH SPRINGS IS WORN, ALL THE CLUTCH SPRINGS MUST BE REPLACED. PARTIAL REPLACEMENT (WORN SPRINGS ONLY) IS NOT ALLOWED.

Assembling the clutch

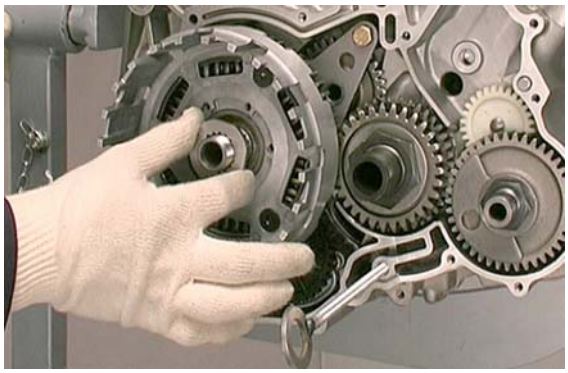
- Position the oil pump control gear on the clutch bell.
- Check that the clutch gear is correctly coupled.



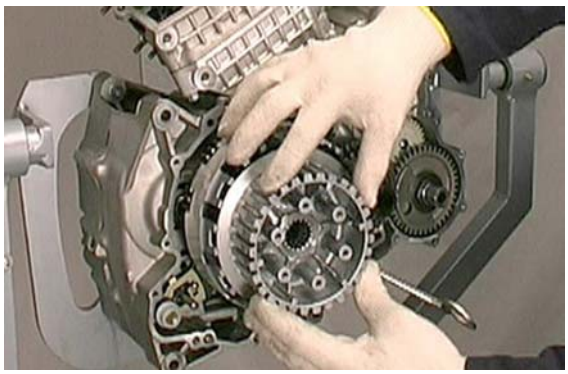
- Insert the unit in the crankshaft.

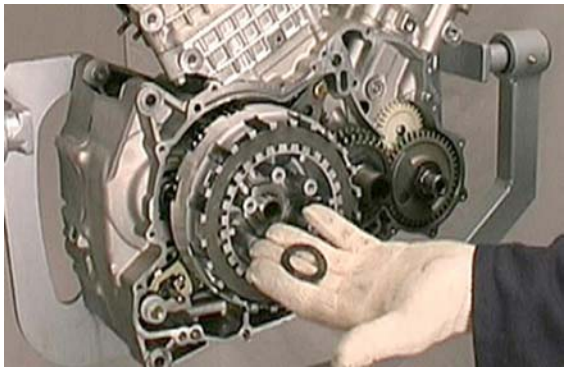


- Fit the thrust ring.



- Fit the clutch hub, the spring washer and manually screw the fixing nut

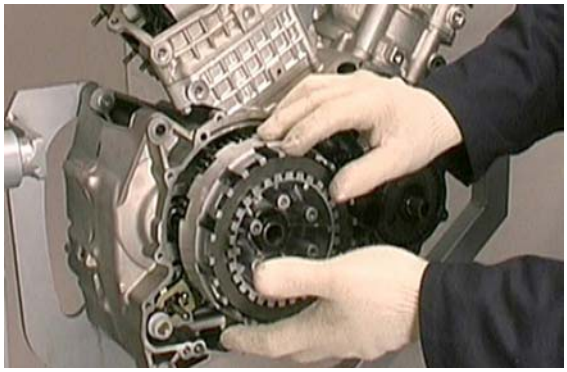




- Insert the clutch locking tool on the bell and on the clutch hub.

Specific tooling

0277881 Clutch locking tool



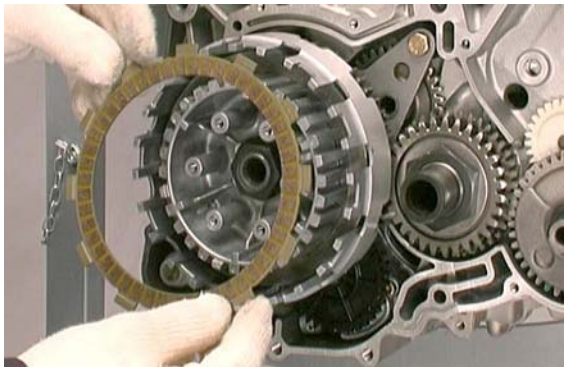
- Screw the fixing nut according to the procedure described.
- Remove clutch locking tool.
- Unscrew the crankshaft locking tool.

Specific tooling

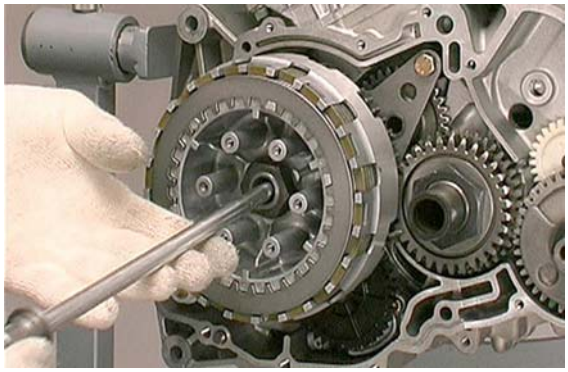
0277881 Clutch locking tool

0240880 Threaded bolt for locking crankshaft at TDC

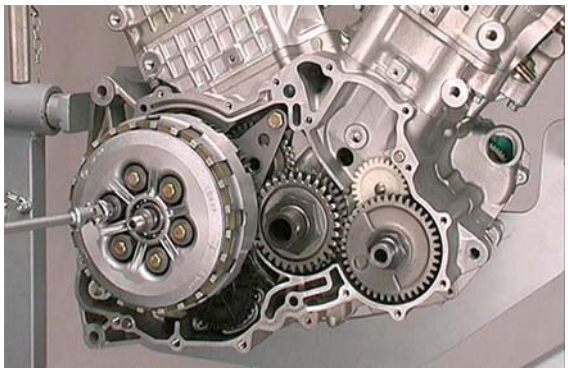
- Lubricate and insert the clutch discs on the bell.
- The first disc has a reference mark on the outside diameter.
- Insert a coated disc and a steel disc alternately.
- The upper coated disc must be inserted on the offset groove.



- Lubricate the clutch disengaging shaft and insert it in the main shaft hole.
- Fit the clutch plate.



- Insert the clutch spring and tighten the screws to the prescribed torque.



Installing the clutch cover

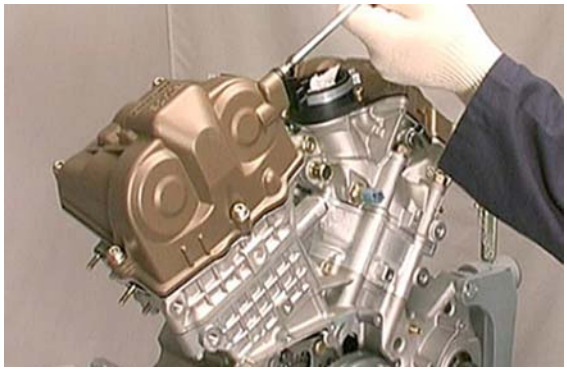
- Position the clutch cover.
- Fix the side fixing screws.

Head and timing

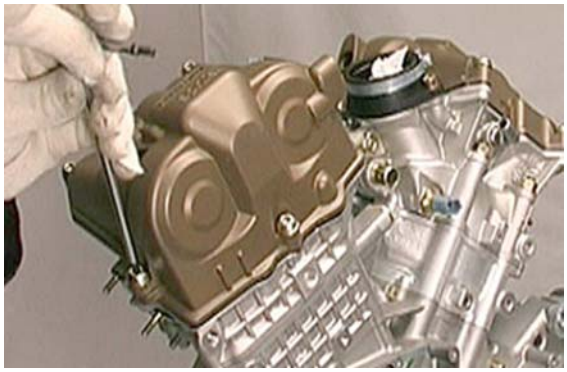
Removing the head cover

- Remove the engine from the vehicle.
- Dismount the ignition spark plugs

- Dismount the phase sensor.



- Unscrew and remove the head cover fixing screws.
- Remove the head cover.
- Collect the gasket between the head and the cylinder.

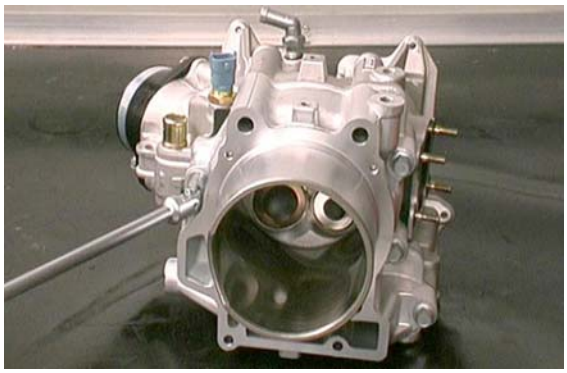


Removing the cylinder head

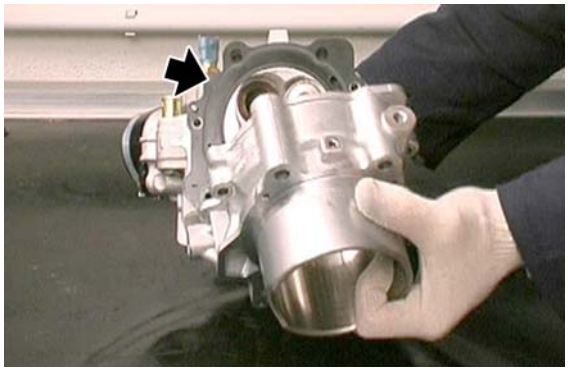
NOTE

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

- Remove the head cylinder unit.
- Unscrew and remove the four shoulder screws joining the head to the cylinder.



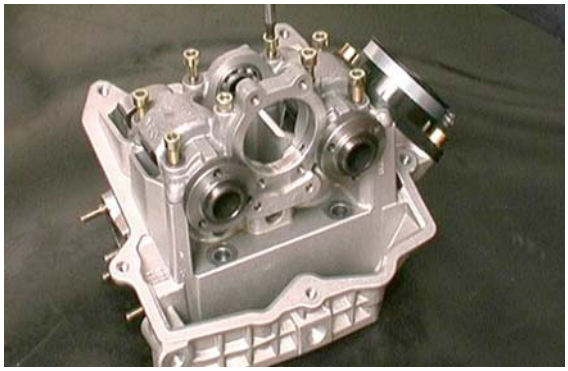
- Separate the cylinder from the head.
- Collect the washer.



Cylinder head

Removing the overhead camshaft

- Remove the balancing countershaft (only for the rear head).
- Unscrew the eight U-bolt screws fixing the camshafts.
- Remove the U-bolt.
- Remove the camshafts.



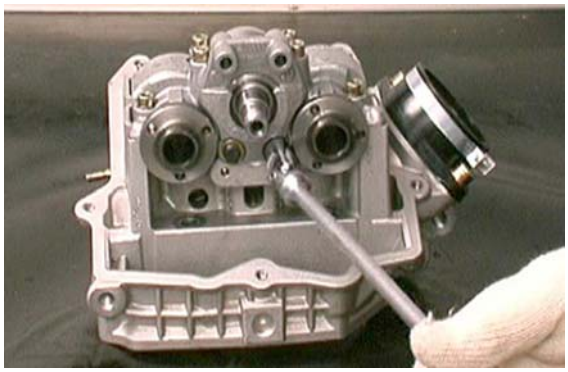
Removing the balancing counter shaft

- Remove the rear head.

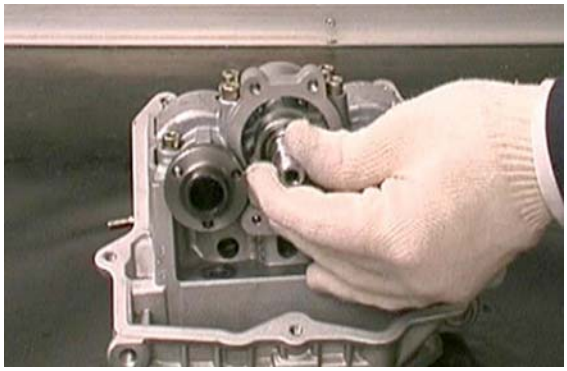
NOTE

THE BALANCING COUNTERSHAFT IS LOCATED ONLY AT THE REAR HEAD.

- Unscrew the two fixing screws of the countershaft supporting plate.

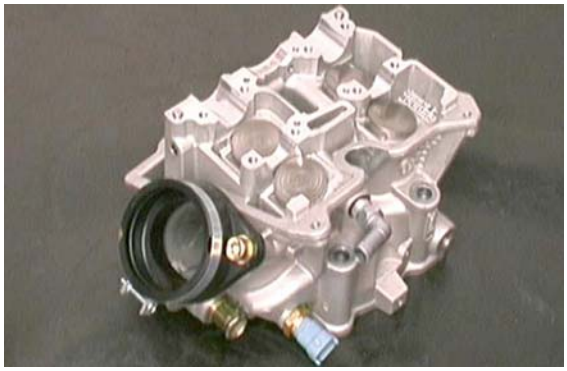


- Remove the balancing countershaft.

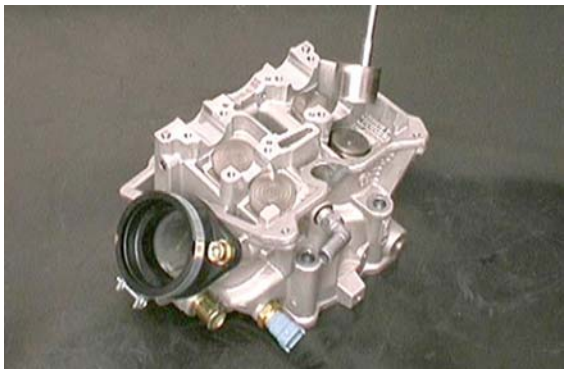


Removing the valves

- When removing the valve, mark the components according to the position and the cylinder they belong to, in order to refit the components to their correct positions.



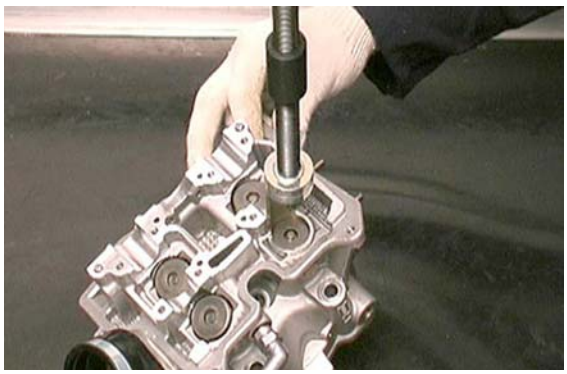
- Remove the bowl tappets and the adjustment shims using a magnet.



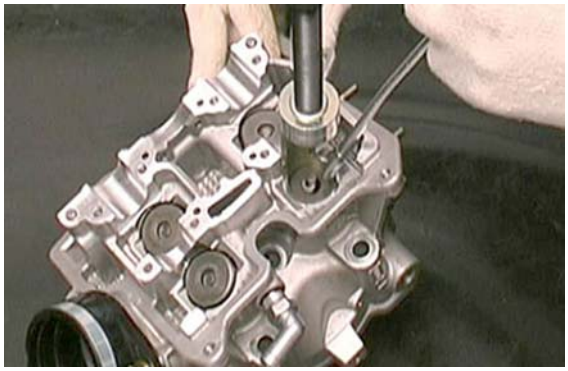
- Compress the valve springs with the specific tightening bow and with the spring compressing tool.

Specific tooling

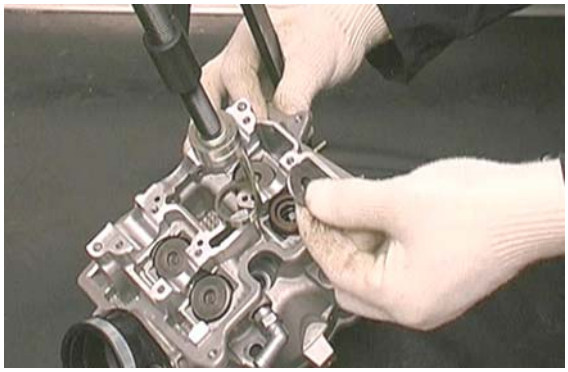
8140179 Valve spring compressor

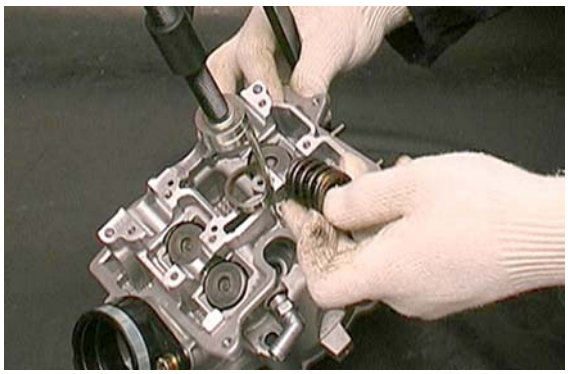


- Remove the cotters using a magnet.

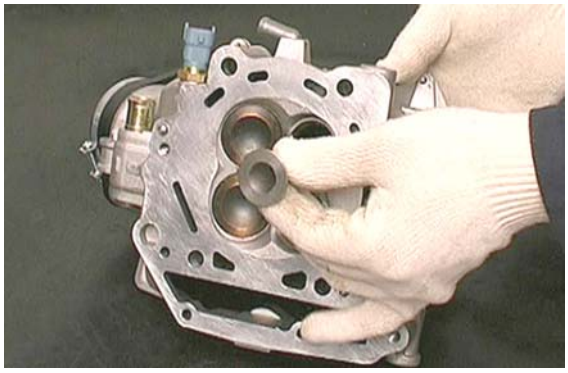


- Release the valve springs.
- Remove the valve spring fittings plus the springs.

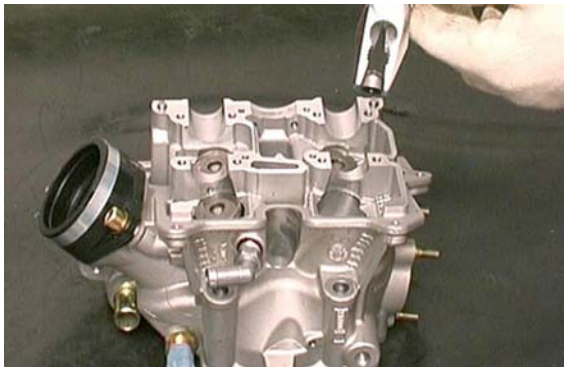




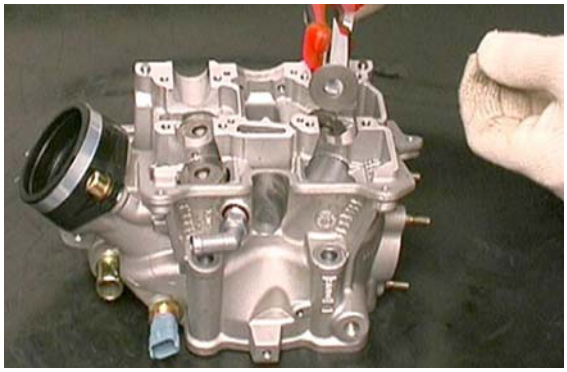
- Slide off the valves.



- Remove the oil seal from the valve stem.



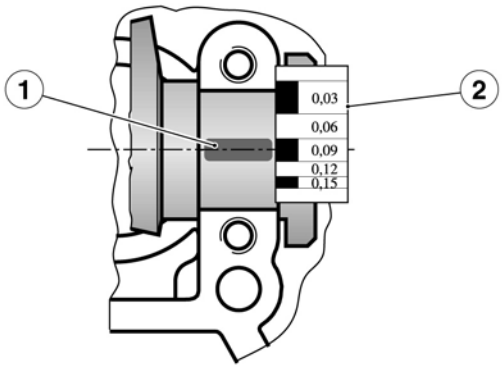
- Take out the valve spring cap.



Checking the overhead camshaft

Check the camshaft for damaged, distorted or worn material; replace the camshaft if required.
Measure the camshaft clearance:

- Set the camshafts in the head.
- Apply a plastic gauge (1) on the camshaft bearing seats.
- Fit the U-bolts according to the corresponding marking and fix them with TCEI M6. screws.
- Remove the TCEI screws and the U-bolts.
- With the specific graduated scale (2), the maximum width of the pressed plastic gauge.



Max. wear limit 0.060 mm (0.00236 in).

If the wear limit is exceeded, measure the bush-

ing seats on the camshaft and on the head and replace the worn component.

Camshafts bushing seats:

wear limit (3) min. diam. 23.950 mm (0.9429 in).

Bushing seats on the head:

wear limit max. diam. 24.040 mm (0.9464 in).

Insert the intake and outlet camshafts in their seats on the head and measure the axial clearance with a comparator.

Camshaft axial clearance:

wear limits: max. 0.40 mm (0.0157 in)

If the wear limit is exceeded, measure the axial faying surfaces of the camshaft and on the head and replace the worn component.

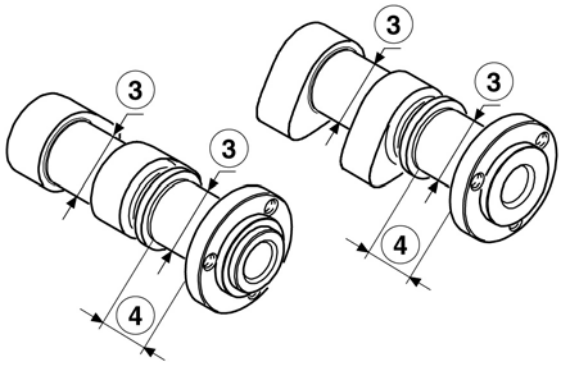
Axial faying surfaces, (4) camshaft:

wear limits: max. 27.77 mm (1.093 in)

Axial faying surfaces, head:

wear limits: min. 27.10 mm (1.067 in)

If a camshaft is replaced, the bowls must also be replaced.



Checking the balancing counter shaft

CAUTION

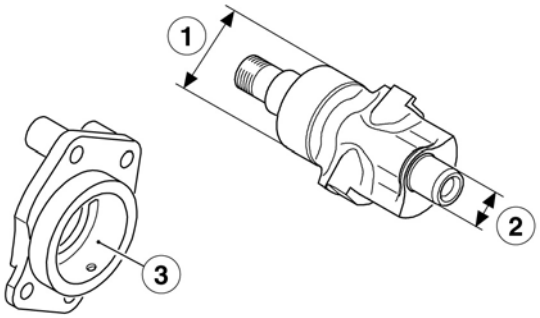
THE BUSHING SEAT (1) IS SLIGHTLY CONIC, THEREFORE THE MEASUREMENT MUST BE DONE AT THE SEAT CENTRE.

Bushing seat (1): **wear limit min. diam 34.98 mm (1.377 in);**

Ball bearing pin (2): **wear limit min. diam. 14.97 mm (0.589 in).**

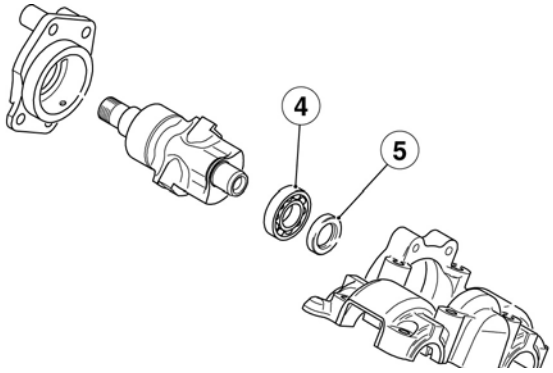
The bushing (3) is slightly conic.

Check the inside diameter (3) of the bushings on the plate and also check bushings for wear and cracking.



Install the countershaft and measure the radial clearance with a comparator.
Measure the bushing radial clearance.
Max. radial clearance allowed 0.70 mm (0.0276 in).
If the maximum radial clearance allowed is exceeded, replace the worn component.
When the bushings are worn, replace the entire bushing plate.
Install the countershaft on the (rear) head and measure axial clearance with a comparator.
Wear limits: max. 0.040 mm (0.0157 in)
If the axial clearance wear limit is exceeded, replace the bushing plate.

Install the countershaft on the rear head. Check the ball bearing (4) for smoothness, pitting and clearance on the U-bolt. **Interference = minimum diam. 0.030 mm (0.0012 in).** Lubricate the ball bearings with engine oil before proceeding with the check. If the internal ring does not rotate smoothly and silently or if there is some noise while it turns, it means that the bearing is faulty and must be replaced. Check the oil seal (5) behind the ball bearing (4) for potential wear or damage.



NOTE

FROM ENGINE NUMBER 8116303 (NOVEMBER 2003) THE UPPER COUNTERSHAFT AND THE RELATED SUPPORT HAVE BEEN MODIFIED.
THE NEW COMPENSATING SHAFT IS NOT INTERCHANGEABLE WITH PREVIOUS MODELS UNLESS BOTH COMPONENTS- COUNTERSHAFT AND SUPPORT- ARE REPLACED

UPPER COUNTERSHAFT: IDENTIFICATION

CODE 441 B **WITH CYLINDRIC ROLLERS.**

SUPPORT: INTERNAL WITHOUT BUSHINGS,

EXTERNAL WITHOUT O-RINGS.

Valve check

CAUTION

REPLACE THE VALVES ONE AT A TIME. DO NOT MIX THE COMPONENTS.

EACH VALVE MUST BE INSERTED IN ITS SEAT, MARKED BEFORE REMOVAL.

CAUTION

THE SEAT (1) ON THE VALVE HEAD IS STRENGTHENED BY AN INDUCTIVE HARDENING; THAT IS WHY THE SEAT CANNOT BE REGROUND. IF REQUIRED, REPLACE THE VALVE. GRINDING WITH ABRASIVE PASTE IS ALLOWED, REGRINDING VALVE STEM END IS NOT ALLOWED.

Clean off any combustion residues from the valves.

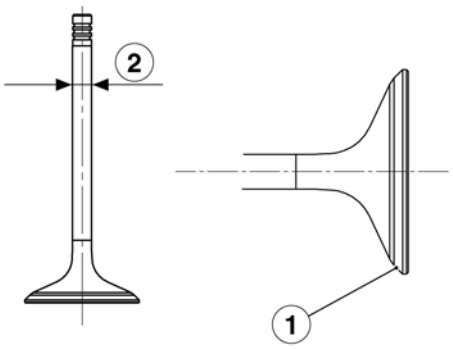
Check the seat (1) on the valve head with a ruler flush.

The surface of the seat must not be concave; replace the valve if necessary.

Check the stem diameter with a micrometer:

intake valve: **wear limit (2) minimum diam.: 5.950 mm (0.2342 in)**

intake valve: **wear limit (2) minimum diam.: 5.935 mm (0.2337 in)**

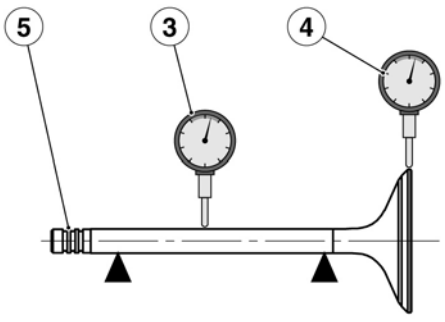


Check the valve eccentricity:

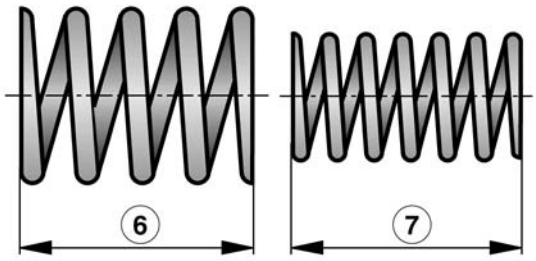
valve stem (3) maximum eccentricity allowed: 0.05 mm (0.00197 in)

valve head (4) maximum eccentricity allowed: 0.05 mm (0.00197 in)

Check that the fixing grooves (5) of the valve cotters are in proper conditions.



VALVE SPRINGS



Carry out a measurement and a visual inspection of the valve springs for damage, distortion or loss of tension.

Measure the spring length at release position.

Valve springs: **minimum wear limit (6) 43.4 mm (1.709 in).**

Valve springs: **minimum wear limit (7) 40.9 mm (1.610 in).**

VALVE SEATS - INSPECTION AND GRINDING

Clean off any combustion residues from the valves.

Apply a coat of paste for contact marks (Prussian blue) on the surfaces of the valve seats.

Insert the corresponding valve and turn it by pressing it slightly with a grinder for valves.

Remove the valve and examine the surface.

Check the valve seat width (8) (9) and the contact marks for potential wear.

Intake valve A:

contact marks (8): 1.0 - 1.4 mm (0.039 - 0.055 in)

diameter (10): 37.7 mm (1.48 in)

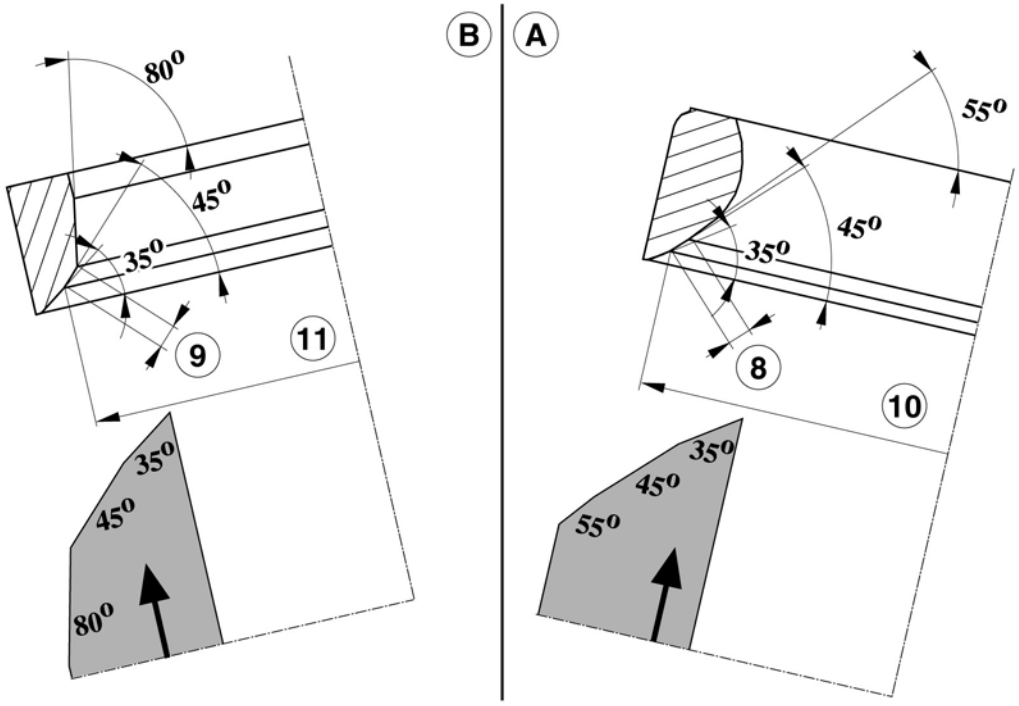
Outlet valve B:

contact track (9): 1.25 ÷ 1.55 mm (0.049 ÷ 0.061 in)

diameter (11): 30.3 mm (1.19 in)

CAUTION

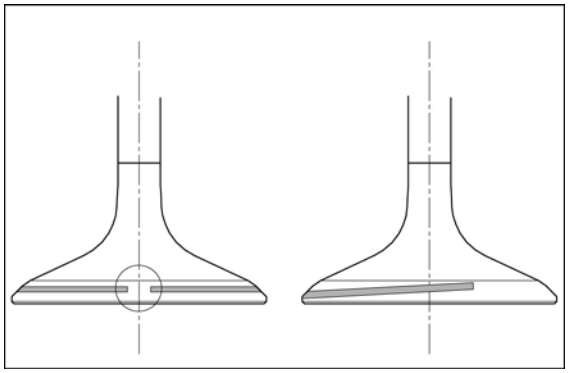
THE CIRCULAR TRACK ON THE SURFACES OF THE VALVE SEATS AND THE VALVES MUST BE CONTINUOUS AND WITHOUT INTERRUPTIONS.



If the width of the valve seat is not within the wear limits or if the surface is not continuous, the valve seat can be ground.

Inspect the surface of the valve seat to check whether:

- The seat width is not regular: Replace the valve and grind the valve seat.
- The surface is damaged: Replace the valve and grind the valve seat.

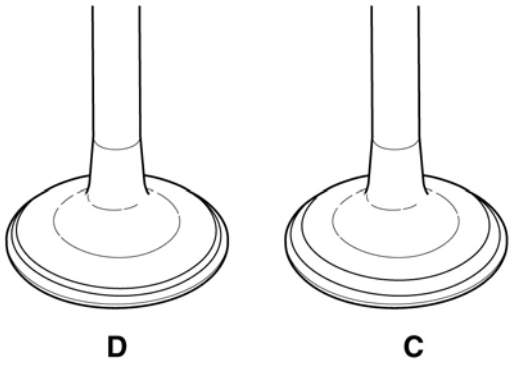


Faying surface: too high (C) or too low (D):

- grind the valve seat.

CAUTION

REPLACE THE VALVE IF ITS SURFACE IS BURNED, SEVERELY WORN OR THE CONTACT IS NOT HOMOGENEOUS.



Use suitable grinding devices to grind valve seats.

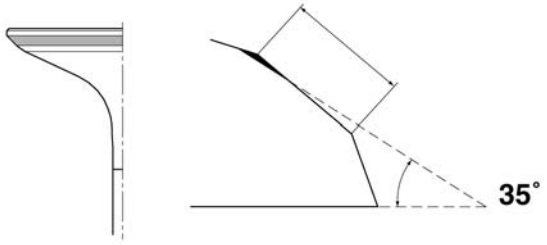
Grinding devices for intake valve seats with angles of:

35° - 45° - 55°

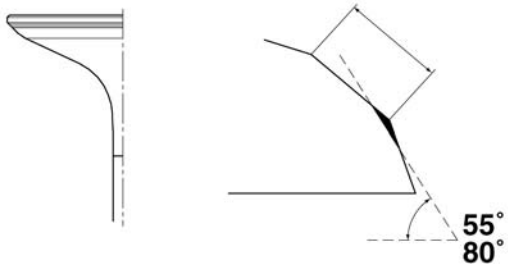
Grinding devices for outlet valve seats with angles of:

35° - 45° - 80°

- If the faying surface on the valve is too high: Grind valve seats to 35° with a valve grinding device.



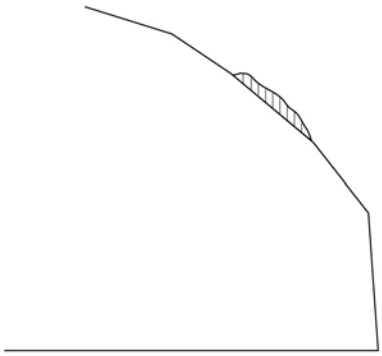
- If the faying surface on the valve is too low: Grind valve seats to 55° (intake) or to 80° (outlet) with a valve grinding device.



Grind valve sears to **45°** with the valve grinding device to remove any rough section or irregularity on the seat and bring the valve seat width to fall within the following values:

Intake valve A: **contact mark (8): 1.0 ÷ 1.4 mm (0.039 ÷ 0.055 in)**

Outlet valve B: **contact mark (9): 1.25 ÷ 1.55 mm (0.049 ÷ 0.061 in)**



After grinding the seat apply the grinding paste for valves.

Slightly press and turn the valve.

EXCESS PRESSURE COULD DAMAGE THE VALVE SEAT.

TO AVOID IRREGULAR WEAR, CHANGE THE ROTATION ANGLE.

DO NOT LET PASTE INTO THE GUIDES.

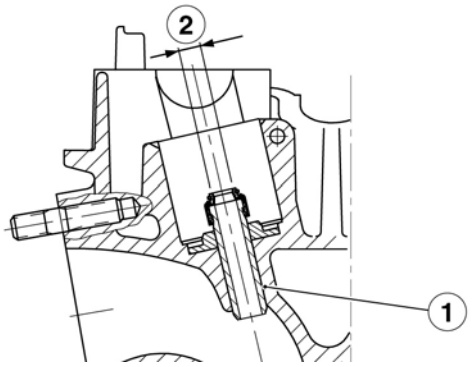
AFTER APPLYING THE GRINDING PASTE FOR VALVES, CLEAN OFF ANY RESIDUE FROM THE CYLINDER HEAD, THE CYLINDER AND THE VALVE.

Checking the valve guides

With a dial comparator measure the valve guide wear (1).

Wear limit (2) maximum diameter: 6.05 mm (0.24 in)

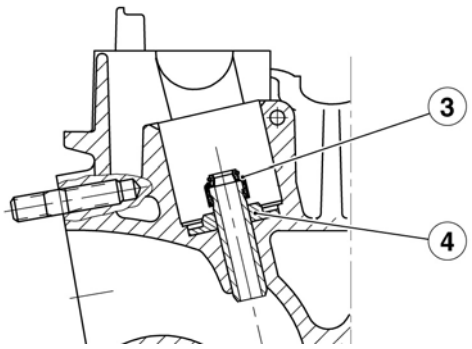
Replace the valve guide if worn.



VALVE GUIDE REMOVAL

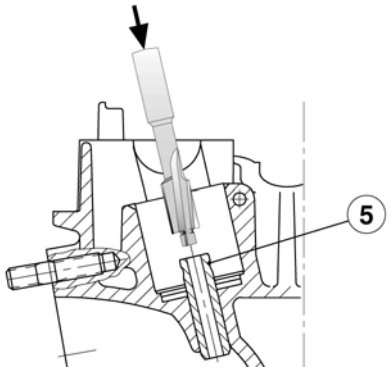
Slide off the valve stem gasket (3) and take out the valve spring washer (4).

REPLACE THE VALVE STEM GASKET (3).



Remove the valve guide with a straight reamer up to the beginning of the incision (5).

REMOVE THE VALVE GUIDE SHARP EDGES OR THE HEAD HOLE CAN BE DAMAGED WHEN THE VALVE GUIDE IS EXTRACTED.



- Do not warm the cylinder head.
- With the adequate buffer, take out the rest of the valve guide towards the manifold.
- Check the valve guide hole for residues.

REPLACE THE HEAD WHEN THERE ARE VISIBLE MARKS OF SEIZING.

Specific tooling

0277510 Buffer for removing valve guide

VALVE GUIDE FITTING

- Apply a coat of MOLYKOTE® G-N on the hole of the cylinder head and on the fitting edge of the valve guide.
- With the appropriate buffer insert the new valve guide in the cylinder head going from the oil compartment towards the combustion chamber, until the fitting punch is in flat position.

Specific tooling

0277695 Buffer for fitting valve guide oil seal

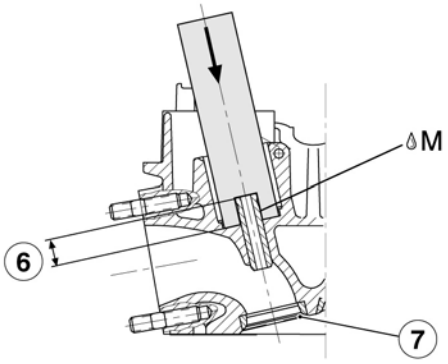
- The outlet and the intake valve guides are different. The difference lies in the fact that the valve guide of the intake valve has a very long smooth surface. Check the protrusion of the head (6) of the valve guide on the camshaft side.

Protrusion (6) = 13.3 +/- 0.2 mm (0.524 +/- 0.079 in).

Ream the valve guide with a Ø 6 mm (0.236 in) F7 reamer. **Valve guide hole diam. 6.006 - 6.018 mm (0.2365 - 0.2369 in).**

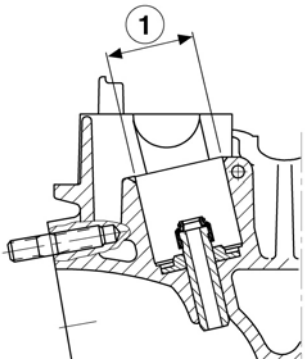
ONLY USE CUTTING OIL TO LUBRICATE THE REAMER.

- The reamer is turned only in the cutting direction, never in the opposite direction, and cleared of residues at frequent intervals, always taking it out in the cutting direction.
- After having bored the valve guide, clean thoroughly the head and grind the valve seat (7) smoothing it with a threading device for valve seats; then grind the valve.
- Check the contact mark with the specific paste (Prussian blue).



Checking the cylinder head

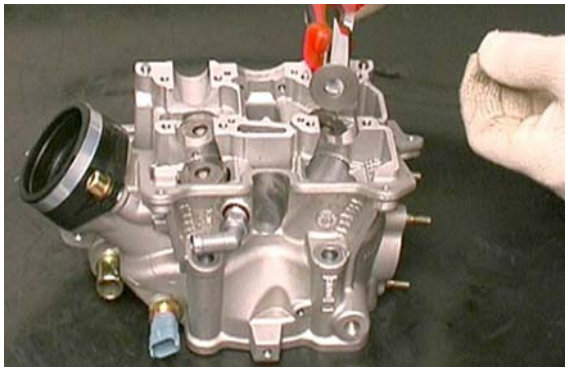
Clean the combustion compartment by removing any combustion residues and deposits from the cooling slots.
Check the thread of the ignition spark plugs and the fixing thread to see whether they are in proper conditions.
Check that the passage of the oil pipes is free and if required, clean them by blowing in a jet of compressed air.
Inspect for potential damage and check that the seal surfaces are even.
Maximum distortion allowed:**0.03 mm (0.00118 in)**
Check that the valve bowl and the guide on the head are in proper conditions.



- Bowl hole on the head (1): wear limits: max. diam. Ø 33.58 mm (1.322 in).
- Bowl: wear limits: min. diam. Ø 33.44 mm (1.316 in).
- Bowl radial clearance: wear limits: max. diam. Ø 0.08 mm (0.0031 in).

Installing the valves

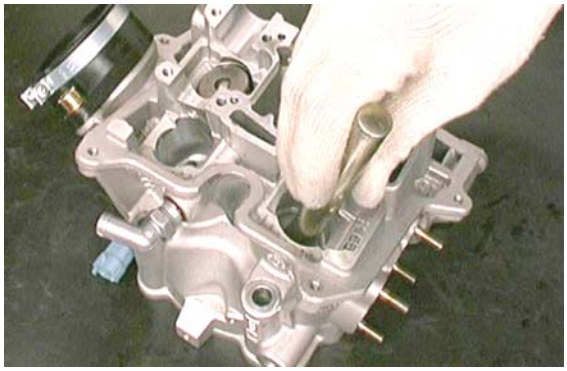
- Fit the valve spring cap.



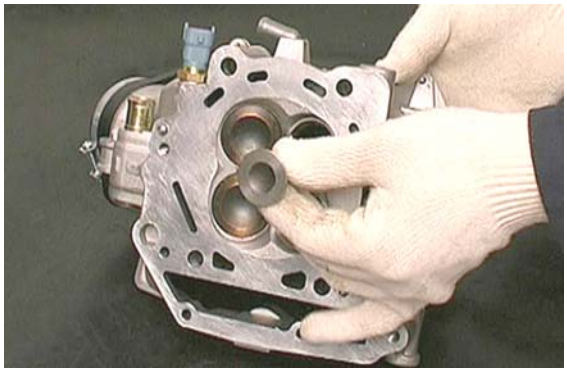
- Fit the oil seal stem with the specific buffer.

Specific tooling

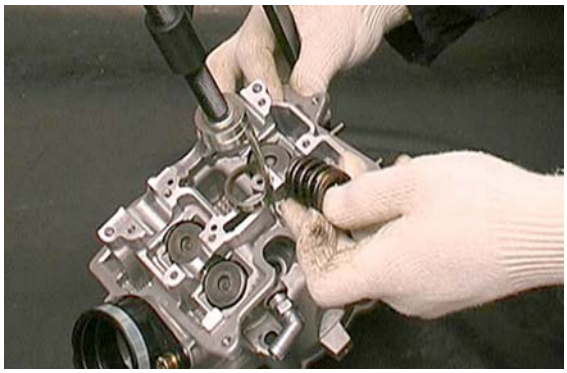
0277695 Buffer for fitting valve guide oil seal



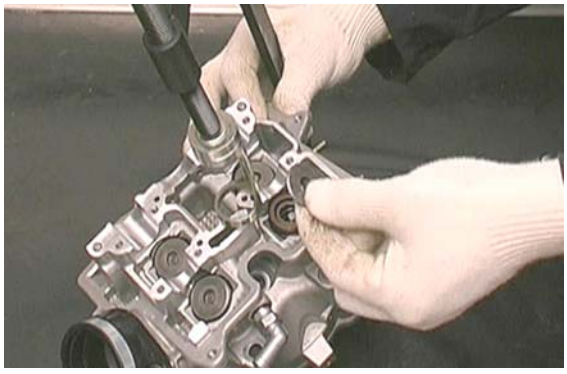
- Lubricate the valve stem and insert the valves on the valve guide.



- Fit the valve springs with colour marking facing up.



- Fit the caps.



- Compress the valve springs with the spring compressing tool and the spe-

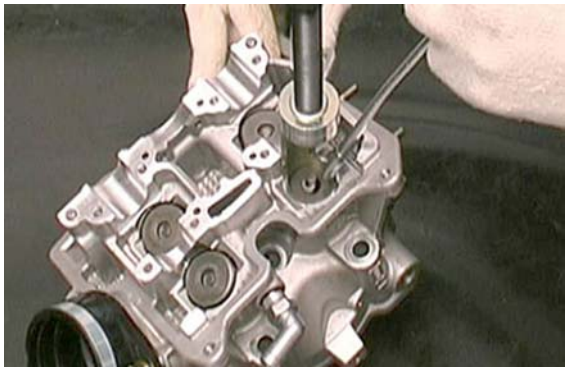
cific tightening bow.

- Fit the cotters in their positions.

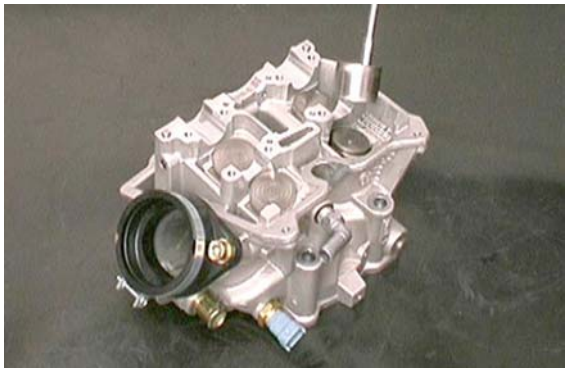
Specific tooling

0276479 Tool for pump pressure plate

8140179 Valve spring compressor

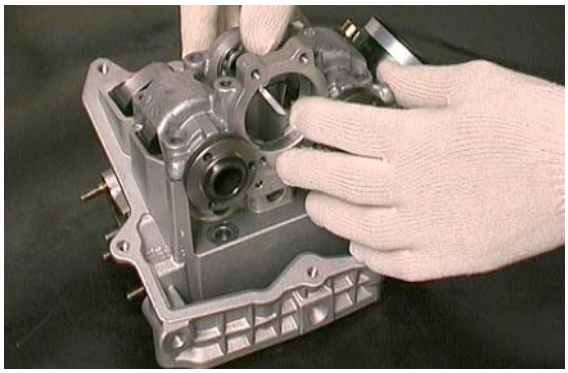


- Release the tightening bow checking that the cotters are in correctly positioned on the valve grooves.
- Fit the adjustment shim washers and then the bowl tappet.

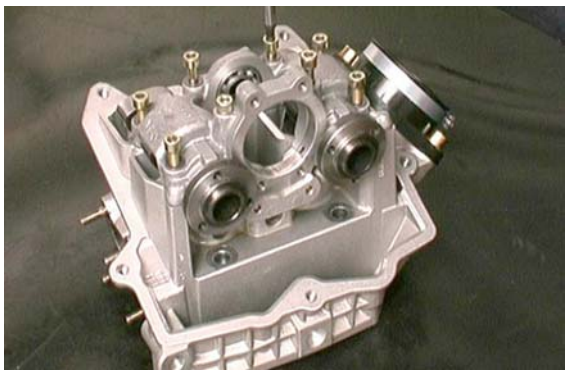


Installing the balancing counter shaft

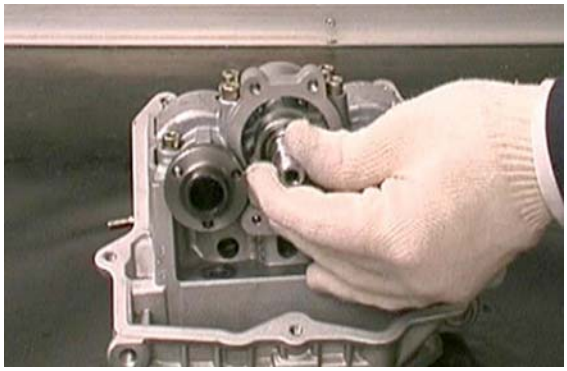
- Place the rear head camshafts, if they have been previously removed.
- Place the camshaft U-bolt.



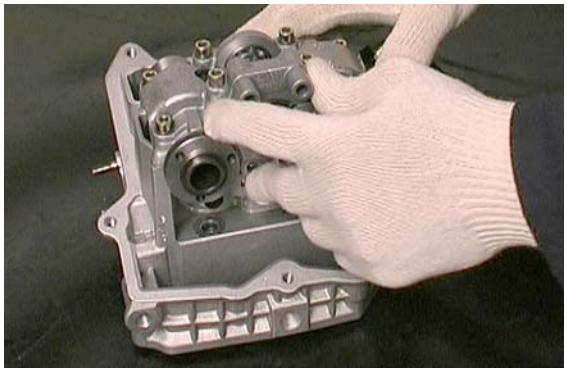
- Operate diagonally to tighten the screws from the inside to the prescribed torque.



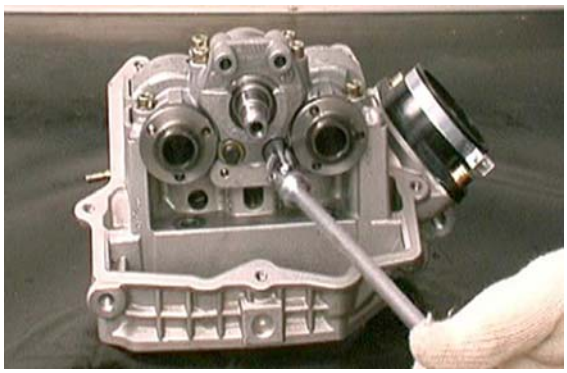
- Fit the countershaft to its seat.



- Place the countershaft supporting plate.

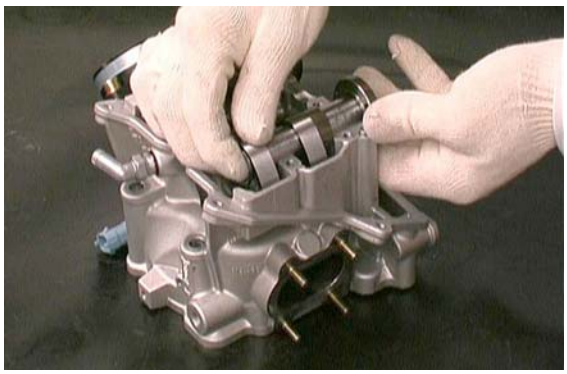


- Tighten the two fixing screws on the plate to the prescribed torque.

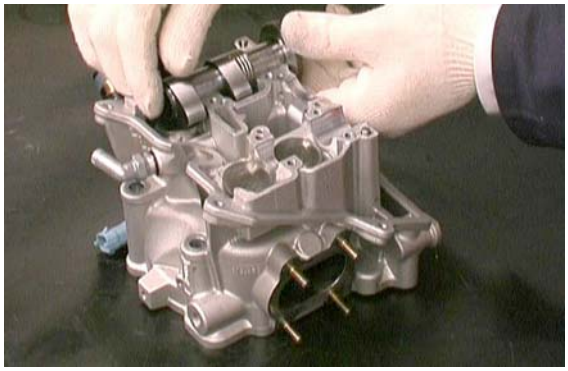


Installing the overhead camshaft

- Place the camshafts after lubricating their seats with engine oil.



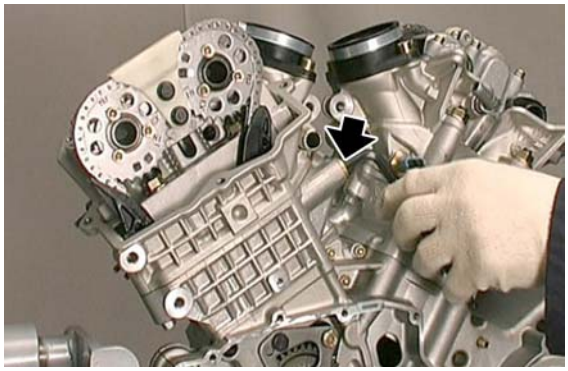
- The intake camshaft is marked with three grooves.

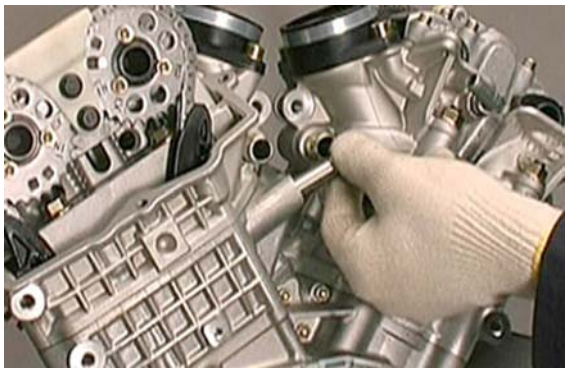


Timing

Removing the chain tensioner

- Unscrew the locking screws plus the sealing gaskets, and take out the complete chain tensioner.





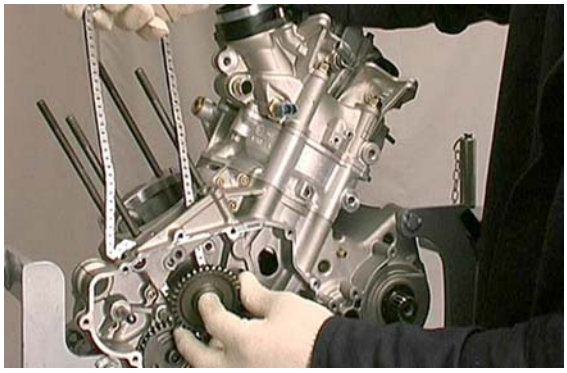
Chain removal

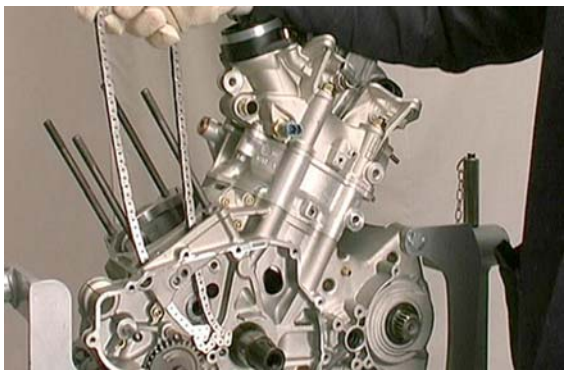
FRONT CYLINDER

- Remove the front cylinder.
- Remove the movable chain tensioner pad.
- Remove the alternator.

- Mark the timing chain with a colour dot so as to refit it in the same direction of rotation.

- Take out the intermediate gear.
- Collect the washer.





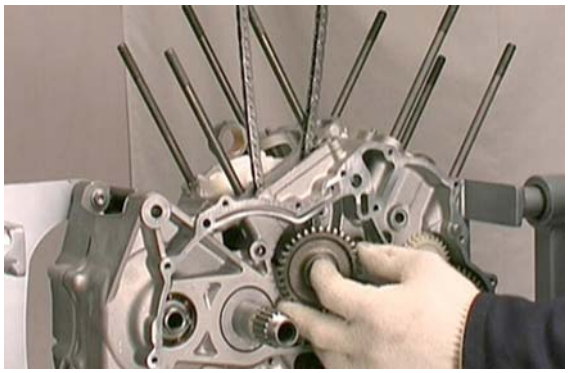
- Remove the timing chain.

REAR CYLINDER

- Remove the rear cylinder.
- Remove the alternator.

- Remove the movable chain tensioner pad.
- Mark the timing chain with a colour dot so as to refit it in the same direction of rotation.

- Take out the intermediate gear.
- Collect the washer.



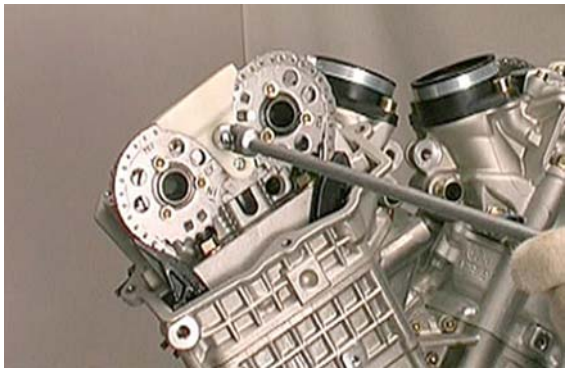
Removing the chain sliders

FIXED CHAIN PADS

- Remove the head covers.
- Remove the chain tensioners.

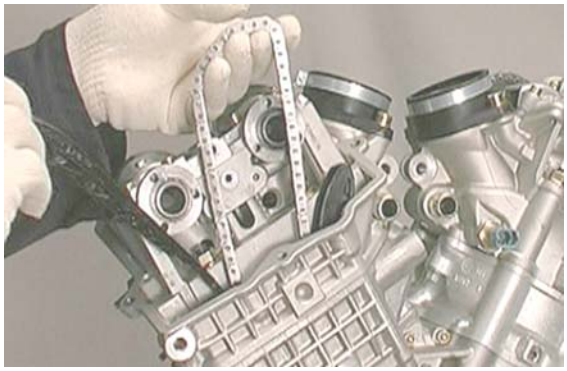
FRONT CYLINDER

- Remove the upper chain guide bracket.



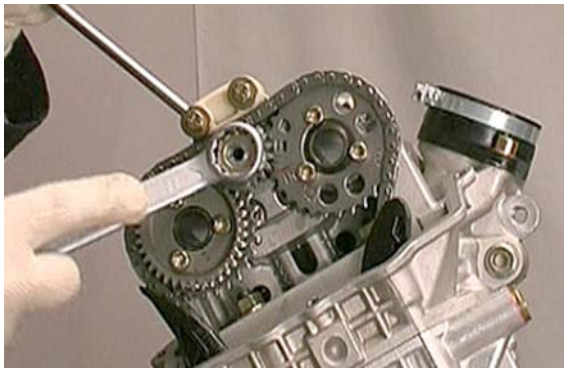
- Remove the toothed wheels of the front camshafts.

- Remove the fixed front chain guide pad.

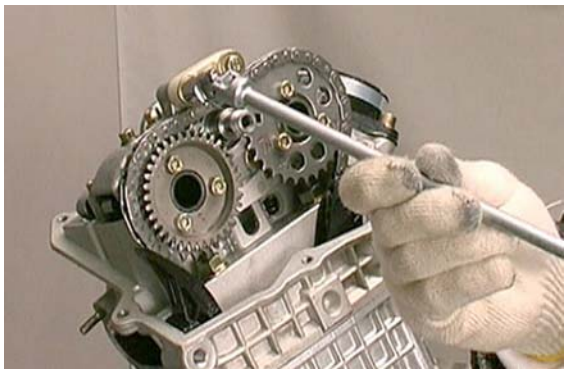


REAR CYLINDER

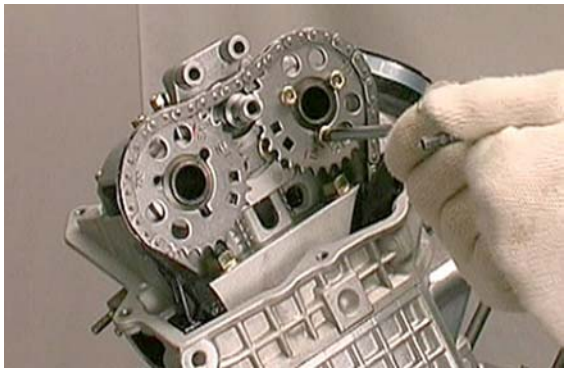
- Loosen the lock-nut of the counter-shaft gear with a punch inserted in the countershaft.
- During this operation pay attention not to load the timing chain.



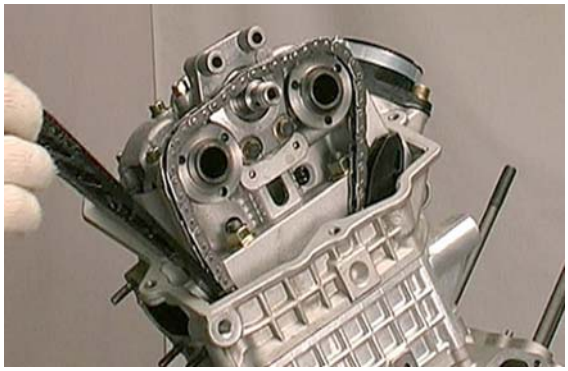
- Remove the upper chain guide pad.



- Remove the toothed wheels of the rear camshafts.



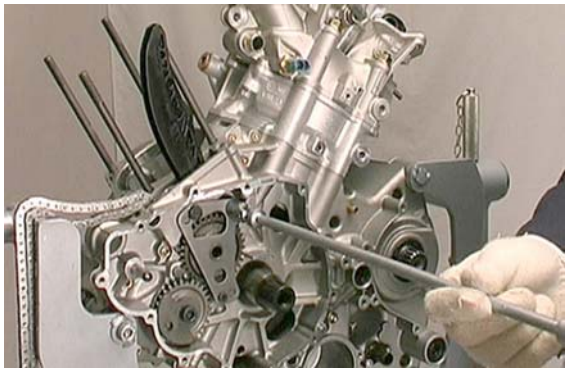
- Remove the fixed rear chain guide pad.



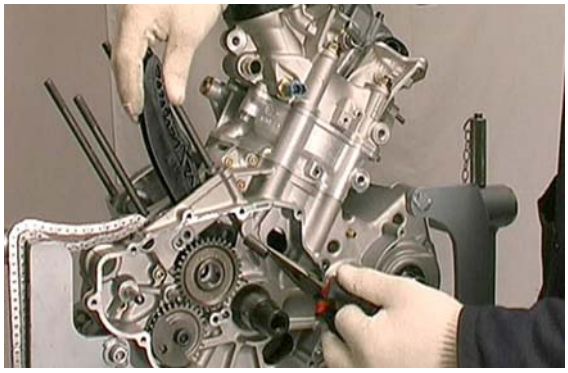
MOBILE CHAIN PADS

FRONT CYLINDER

- Remove the front cylinder.
- Remove the alternator.
- Undo the fixing screws on the needle bearing flange.
- Remove the flange together with the roller cage.

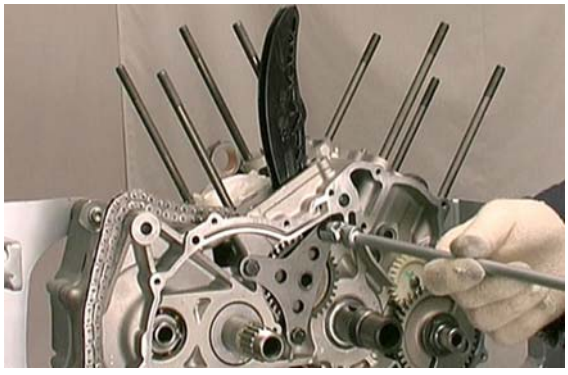


- Slide off the bushing and the movable pad.

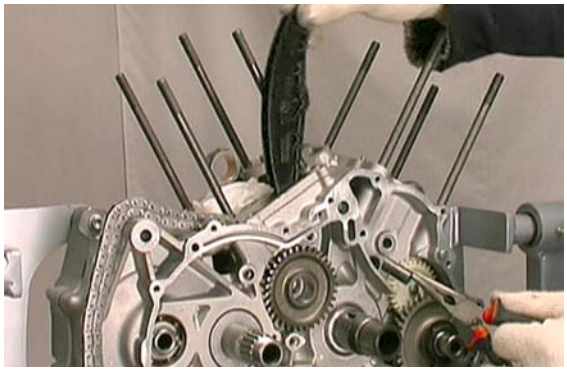


REAR CYLINDER

- Remove the rear cylinder.
- Remove the clutch.
- Undo the fixing screws on the needle bearing flange.
- Remove the flange together with the roller cage.

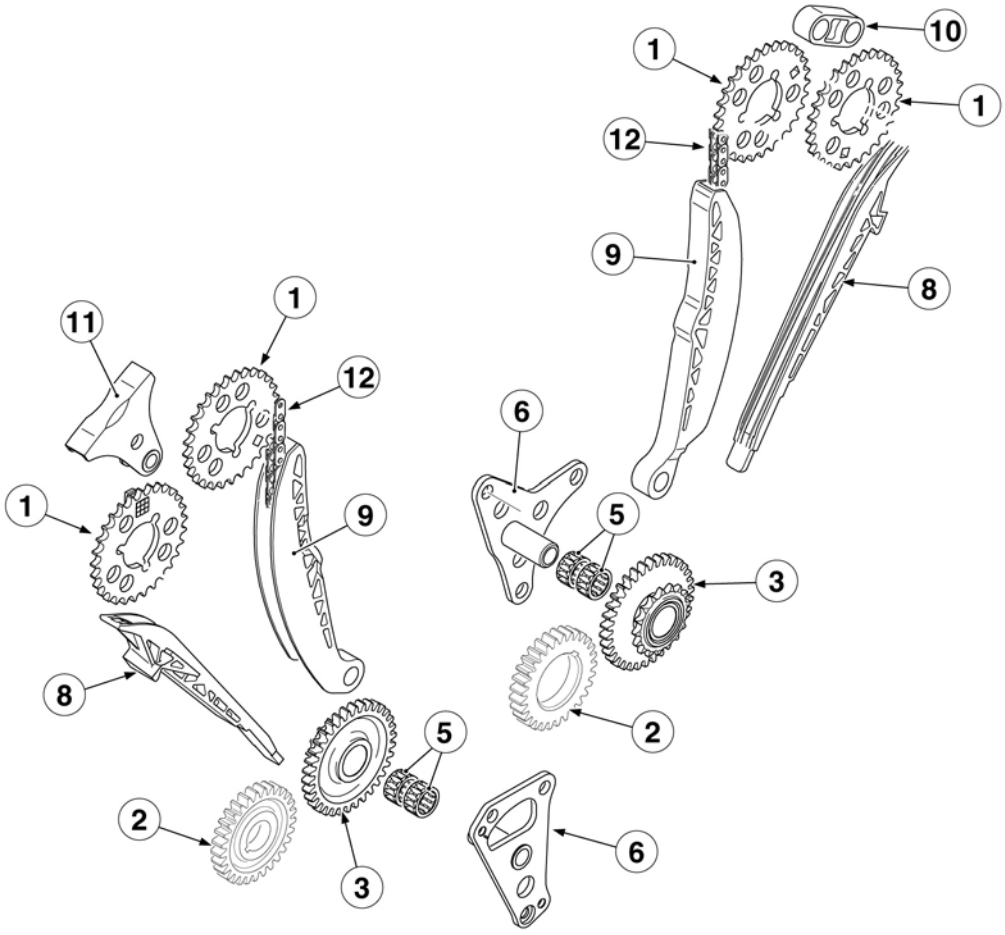


- Slide off the bushing and the movable pad.



Checking the chain

Arrange the timing system control of the front and rear cylinder in groups so that they are installed in the same seat upon refitting.



Check if there is damage or distortions on the

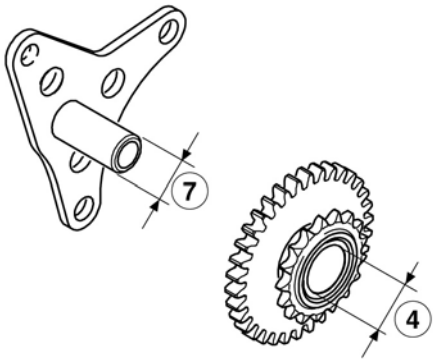
sides of the teeth of the timing system gears (1), on the control gears (2) and on the control intermediate gears (3).

Check the holes in the intermediate gears (3) for wear.

Max. wear limit (4) 22.015 mm (0.86673 in).

Check the roller bearings (5) for wear.

Check the two flanges of bearing (6) corresponding to the sliding surface of the roller bearings (5) for wear.



Max. wear limit (7) 15.98 mm (0.6291 in).

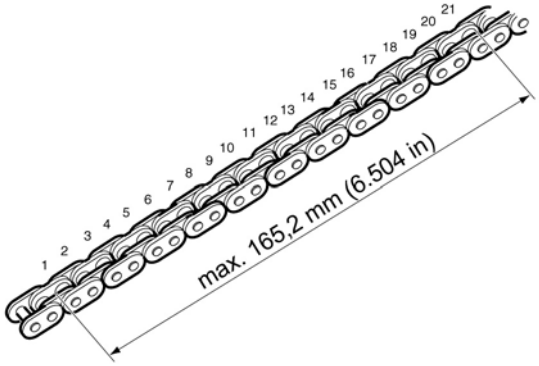
Check if there are rolling marks on the chain guide pad (8), the chain tensioner pad (9), the chain guide (10) and the chain guide bracket (11).

Rolling marks max. depth 1.2 mm (0.047 in).

Check the toothing of the two timing chains (12) for potential distortions.

Tension the timing chain, count 21 pins and measure the distance between the outside of the first and twenty-first pin.

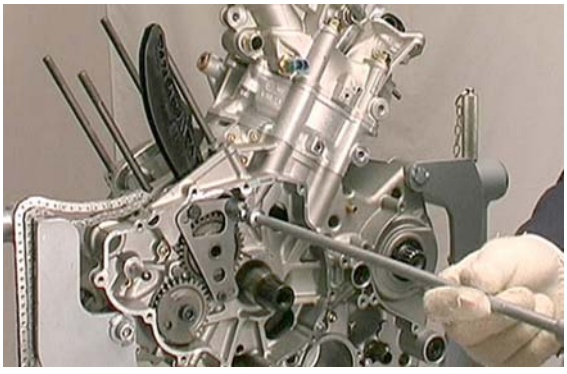
Max. wear limit 165.2 mm (6.504 in).



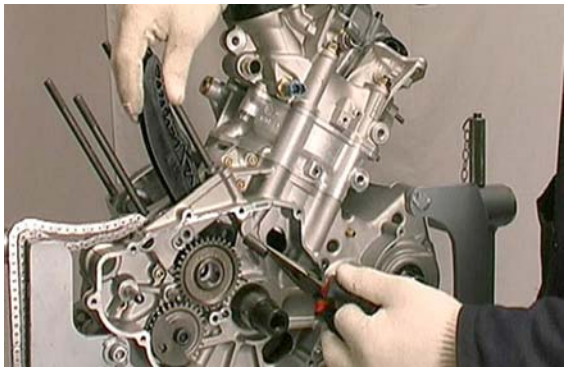
Installing sliders

FRONT CYLINDER

- Assemble the movable pad and insert the bushing in its seat.

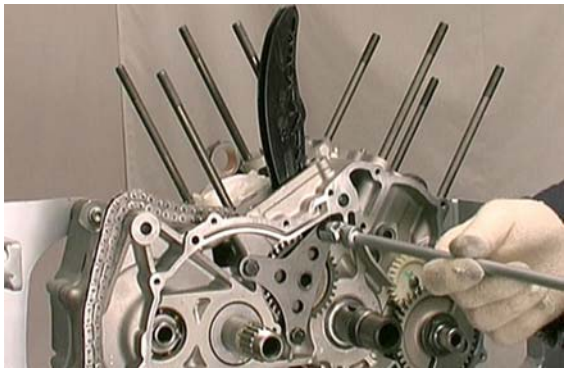


- Tighten the fixing screws to the prescribed torque.

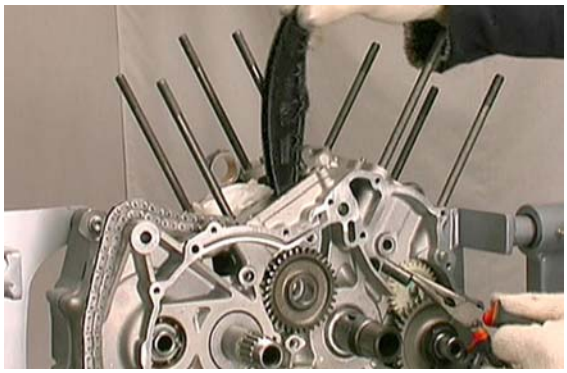


REAR CYLINDER

- Assemble the movable pad and insert the bushing in its seat.
- Tighten the fixing screws to the prescribed torque.

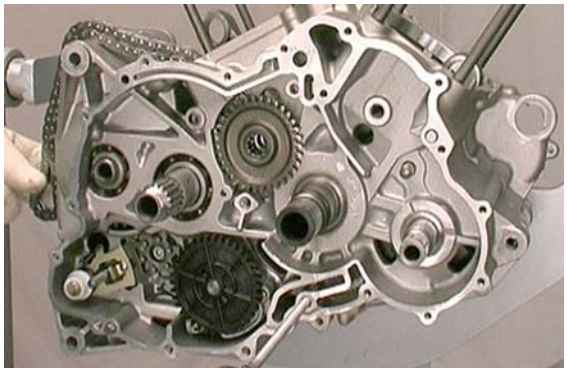


- Place the flange and the ball bearing cage.
- Tighten the fixing screws to the prescribed torque.



Installing the chain

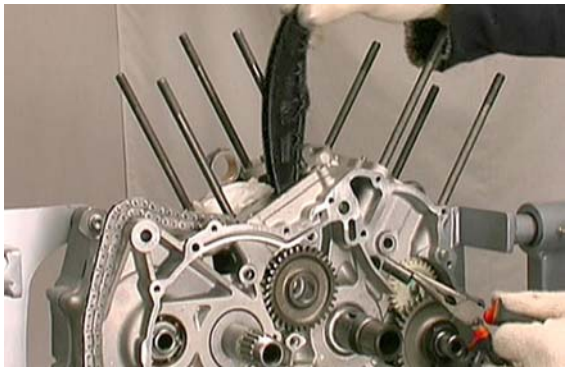
- Insert the timing chain according to the references marked at the removal phase.



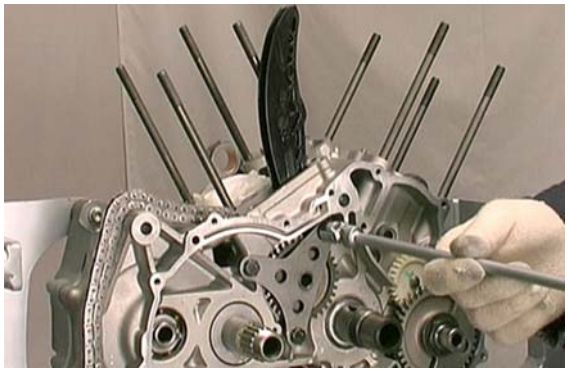
- Fit the intermediate gear on the engine crankcase.

PAY ATTENTION TO THE CORRECT POSITION OF THE WHEEL HOLES WHICH SERVE AS REFERENCE.

- Place the chain tensioner pad and the flange together with the ball bearing cage on the engine crankcase.



PAY ATTENTION TO THE CORRECT POSITION OF THE WHEEL HOLES WHICH SERVE AS REFERENCE.



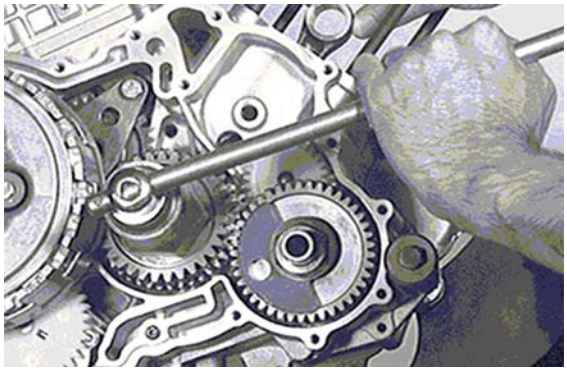
- Turn the crankshaft so that its position matches the front cylinder top dead centre.
- Screw the tool to lock the crankshaft but do not overtighten.
- Check that the crankshaft is firmly locked by turning it in both directions alternately.
- Refit the cylinder and the cylinder head and time them.

Cam timing

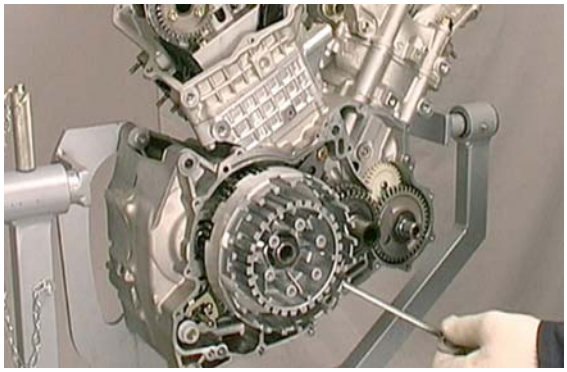
Timing

REAR CYLINDER

- Turn the crankshaft so that the rear cylinder piston reaches the top dead centre in the combustion phase.



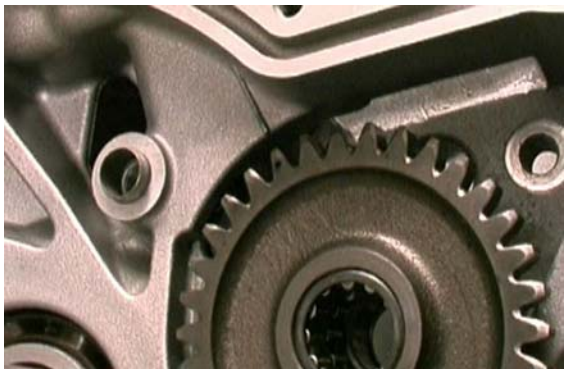
- Screw the tool to lock the crankshaft but do not overtighten.



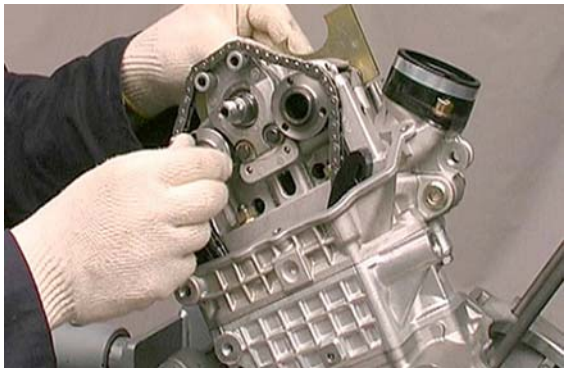
Specific tooling

0240880 Threaded bolt for locking crankshaft at TDC

- Place the gear of the timing system control of the rear cylinder so that the reference on the intermediate gear is aligned with the reference on the crankcase.

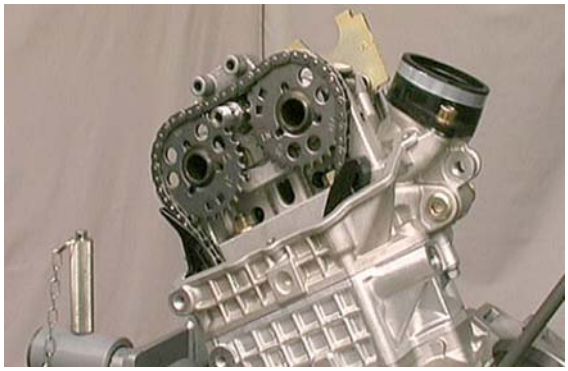


- Align the camshafts with the specific tool which is inserted on the eccentrics.

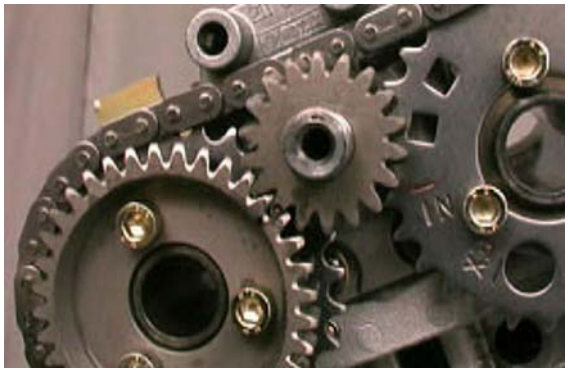


- Insert the toothed wheel on the camshaft aligning the 'IN' and 'EX' refer-

ence marks.

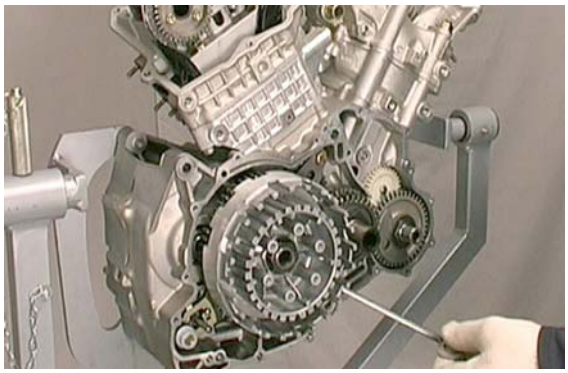


- Fit the gear on the countershaft so that the references are aligned.

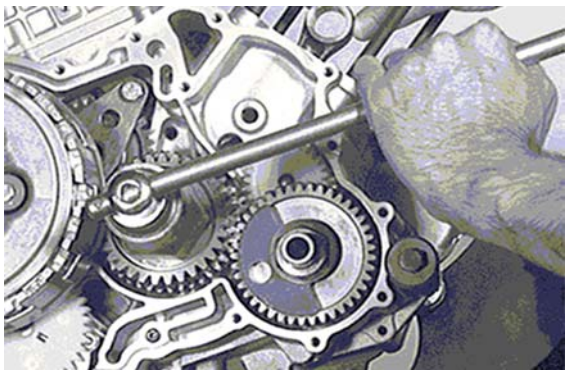


FRONT CYLINDER

- Remove the crankshaft locking tool.

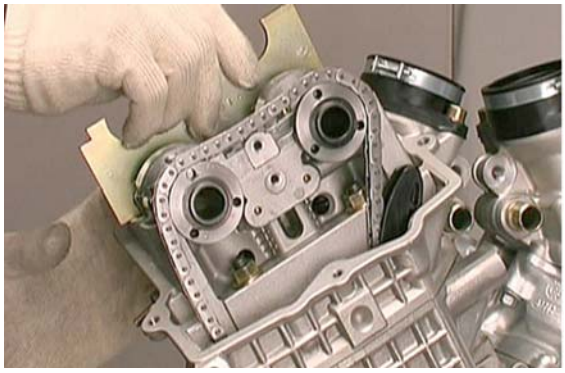


- Turn the crankshaft 300° anticlockwise so that the front cylinder piston reaches the top dead centre in the combustion phase.



- Align the reference on the intermediate gear with that on the flange.

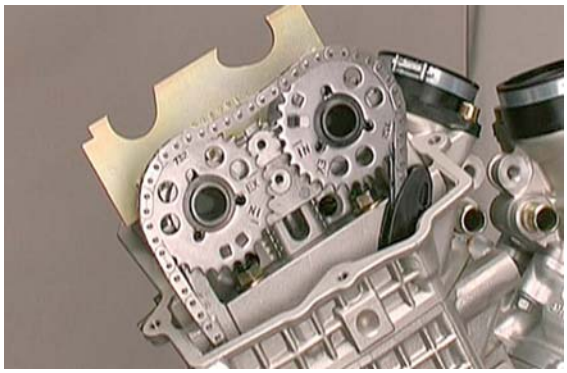
- Align the camshafts with the specific tool which is inserted on the eccentrics.



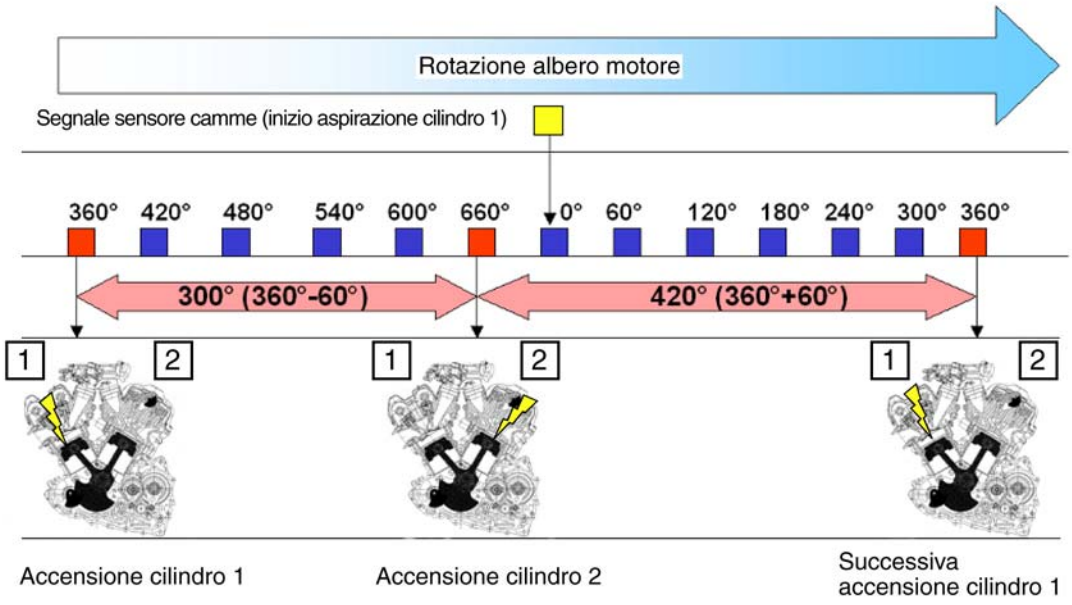
Specific tooling

8140205 Camshaft template tool

- Insert the toothed wheel on the camshaft aligning the 'IN' and 'EX' reference marks.



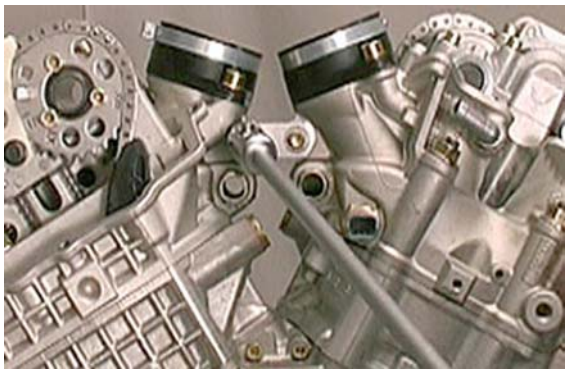
COMBUSTION SEQUENCE



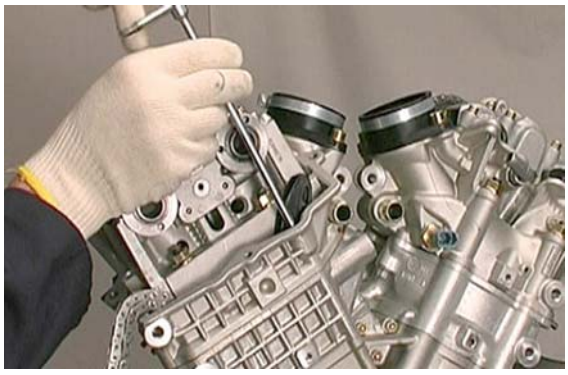
Cylinder-piston assembly

Removing the cylinder

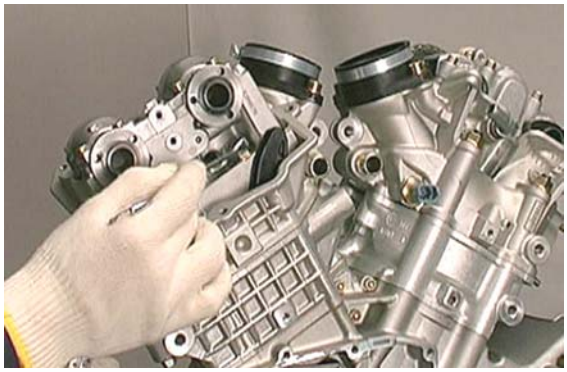
- Unscrew the nuts and remove the cylinder coupling brackets.



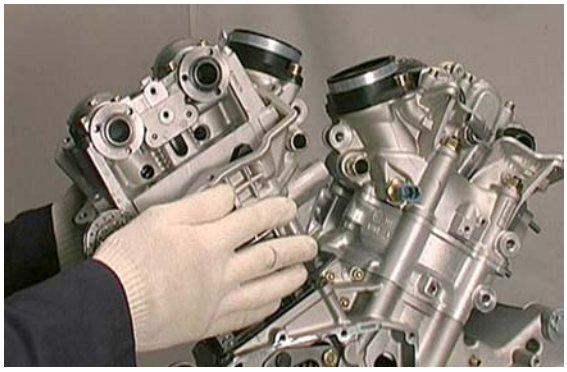
- Remove the chain pads.
- Undo the two screws on the timing system plate.



- Remove the nuts on the cylinder stud bolts.



- Remove the cylinder and the complete head together paying attention not to damage the piston.
- Cover the opening on the base with a clean cloth.



- Remove the gasket on the cylinder base from the housing.

Disassembling the piston

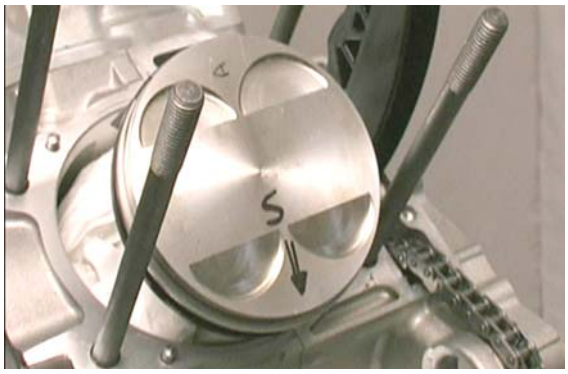
- Remove the cylinder.
- Cover the base opening with a clean cloth.
- Disengage the pin clip.

- Remove the pin.

- Mark the piston crown on the outlet side to remember its position when refitting.
- Remove the piston.

Fitting the piston

- Fit the piston.



NOTE

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

- Insert the pin with the suitable special tool.

Specific tooling

8140178 Buffer for fitting - removing pin

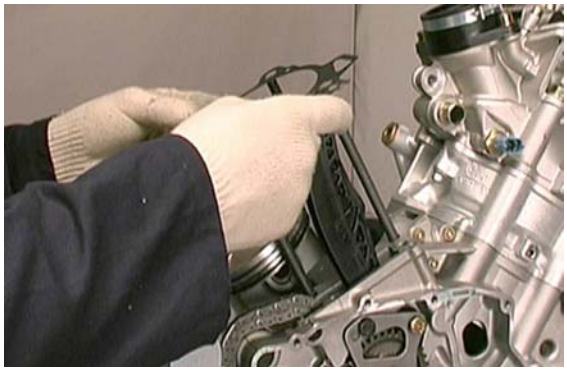
- Insert the pin clip.

Installing the cylinder

- Place the cylinder base gasket.
- Fit the piston.
- Remove the cloth used to prevent for-

eign bodies getting into the crankcase.

- Turn the rings so that the connection ends are 120 degrees from each other.
- Lubricate piston and cylinder.
- Using a specific tool for piston ring clamps, place the cylinder.



CAUTION

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

Specific tooling

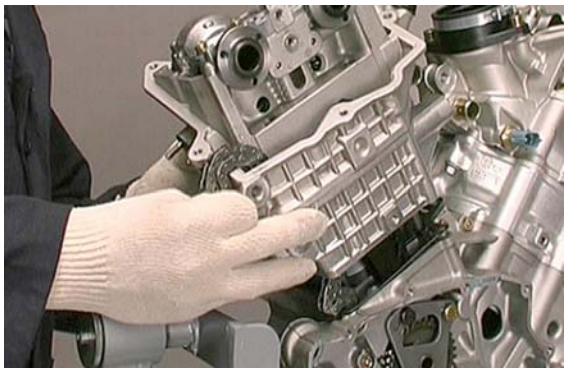
8140186 Piston ring clamp tool

- Remove the tool for piston ring clamps and finish positioning the cylinder.

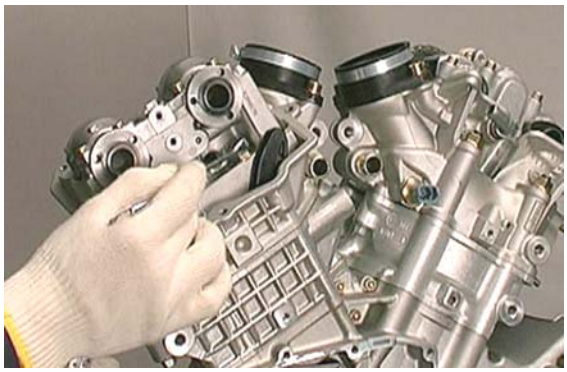
Specific tooling

8140186 Piston ring clamp tool

- Finish fitting the cylinder and the head by moving the timing chain upwards.



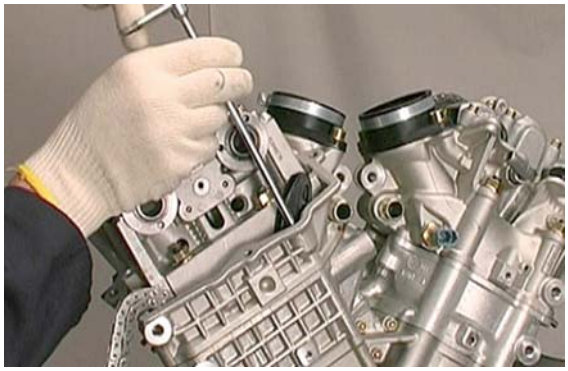
- Fit the nuts on the cylinder stud bolts by tightening them to the prescribed torque.



- Tighten the two screws to the timing

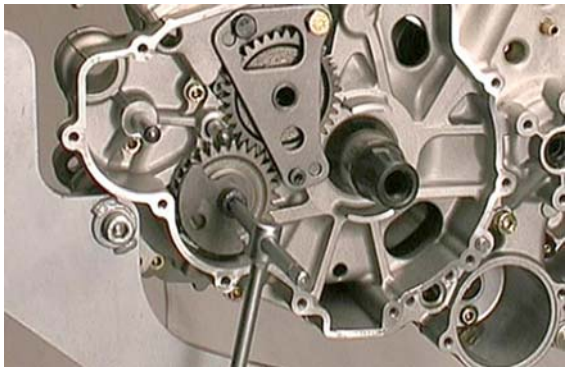
system plate to the specified torque.

- Proceed to time the overhead camshafts.



Splitting the crankcase halves

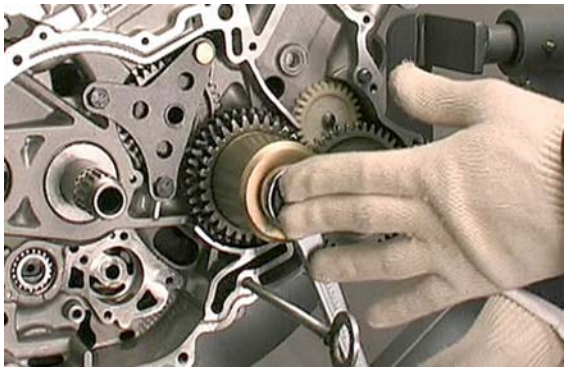
- Unscrew the fixing screw of the control pinion of the front cylinder timing system.
- Remove the external counterweight, the pinion and the internal counterweight.

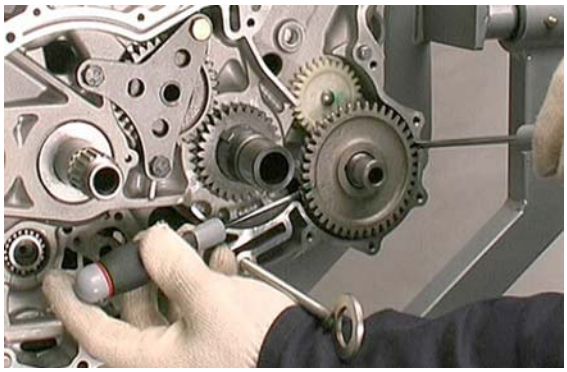


- Remove the tongue.

- Unscrew the countershaft nut.
- Remove the spring washer and the counterweight.

- Unscrew the nut on the crankshaft using the specific tool.
- Remove the spring washer and the primary transmission gear from the crankshaft.
- Remove the countershaft control gears on the crankshaft and the countershaft.

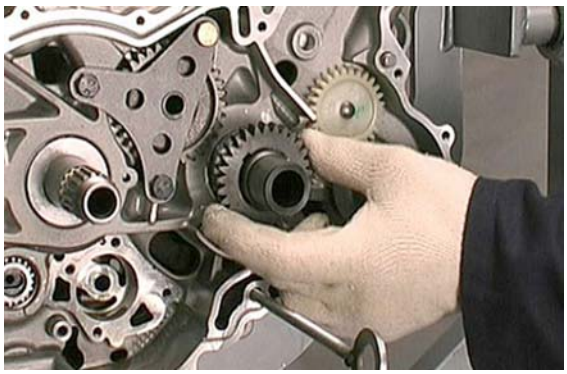




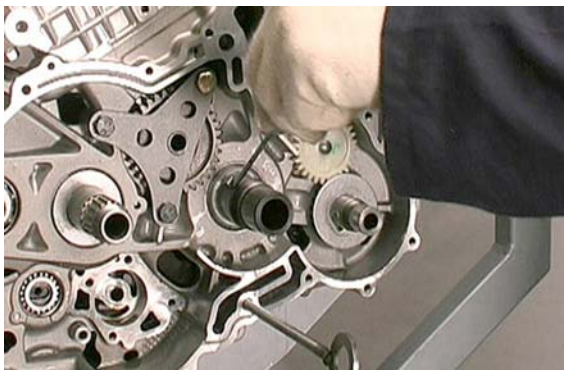
Specific tooling

8140184 Bushing for removing primary transmission nut

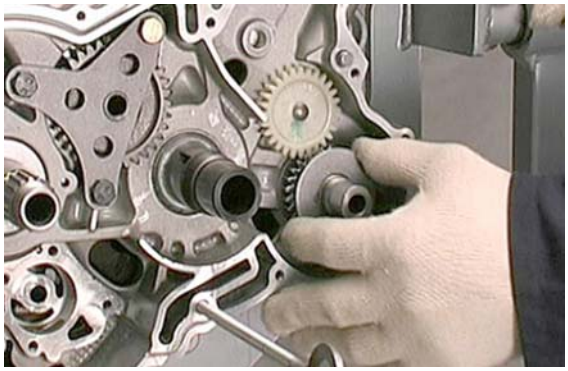
- Remove the control gear of the rear cylinder timing system.



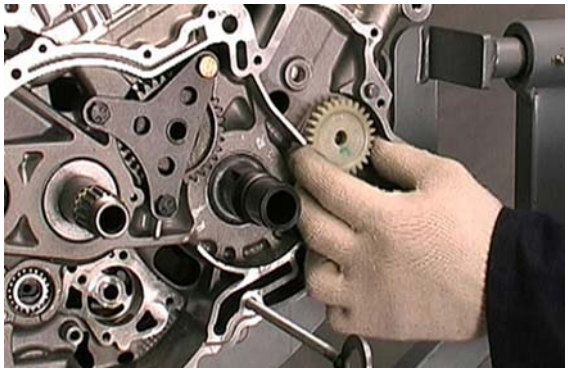
- Remove the tongue on the crankshaft.



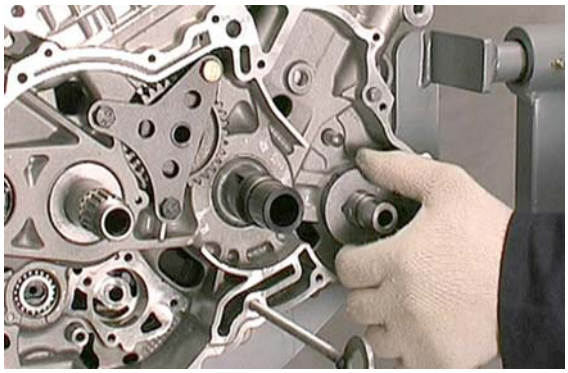
- Remove the upper washer and the control gear of the coolant pump.



- Remove the intermediate gear of the coolant pump.



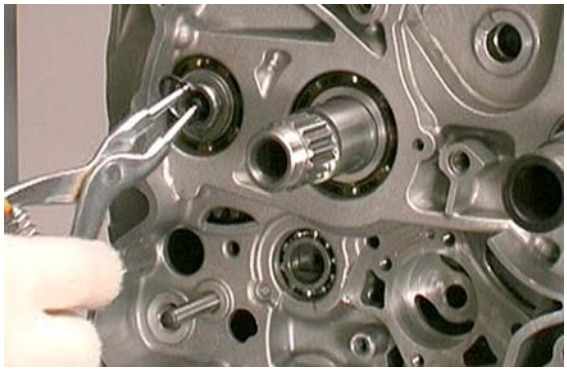
- Remove the countershaft lower washer.
- Remove the tongue from the countershaft.



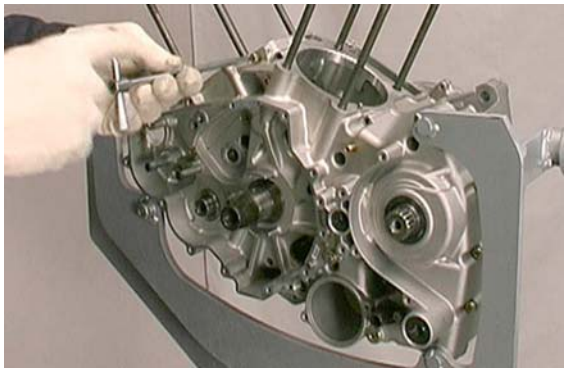
- - Remove the washer on the crankshaft.

- Remove the seeger ring and the thrust washer of the transmission secondary

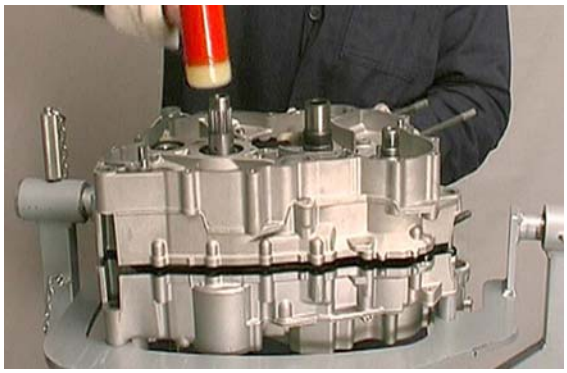
shaft.



- Unscrew and remove the twenty screws coupling the crankcase.

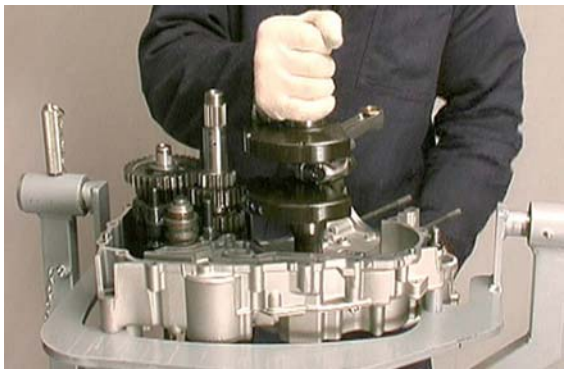


- Detach the two crankcase halves by tapping with a hammer.
- Remove the sealing gaskets on the crankcase halves coupling surface.



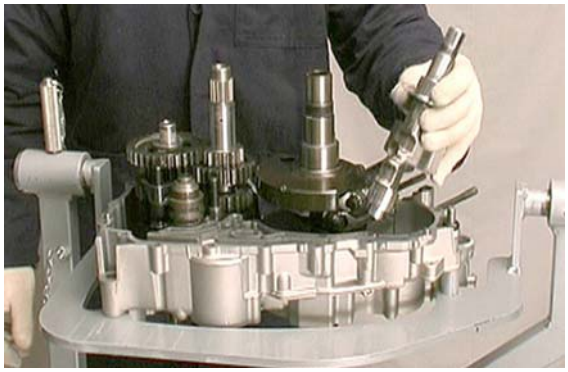
Removing the crankshaft

- Take out the crankshaft.



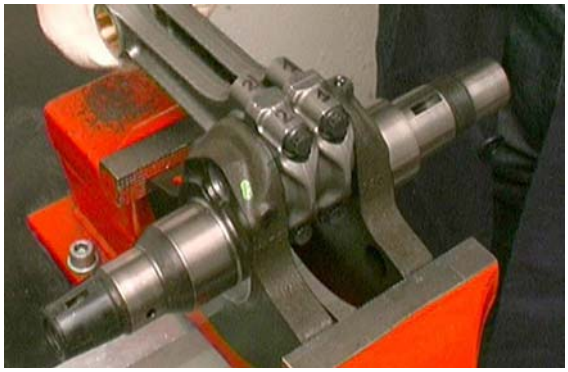
Removing the countershaft

- Take out the countershaft.



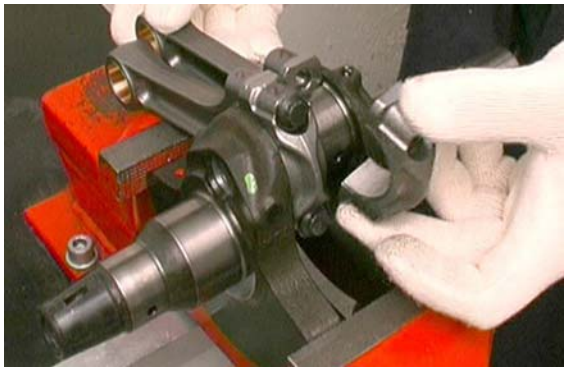
Disassembling the connecting rod

- Before removing the connecting rods and the caps mark them so as to refit them in the same position and direction of rotation.



- Unscrew the connecting rod screws.

- Remove the caps.



Inspecting the crankcase halves

Using a non-aggressive solvent thoroughly clean both sections of the engine crankcase, the ball bearings and all the bearing seats.

Clean the seal surfaces and check that they are not damaged.

CAUTION

TO AVOID DAMAGING BOTH CRANKCASE HALVES PLACE THEM ON A FLAT SURFACE.

Check that both crankcase halves are not cracked or damaged.

Check that all threads are in proper conditions.

Check that all oil seals remaining on their seats are not worn or damaged.

Check all ball bearings for clearance, smoothness and potential distortions.

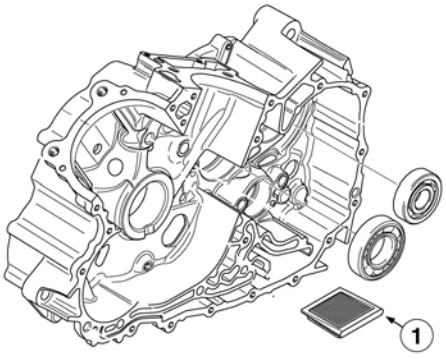
CAUTION

LUBRICATE BALL BEARINGS WITH ENGINE OIL BEFORE FURTHER CHECKING.

If the internal ring does not rotate smoothly and silently or if there is some noise while it turns, it means that the bearing is faulty and must be replaced.

Take out the oil net (1).

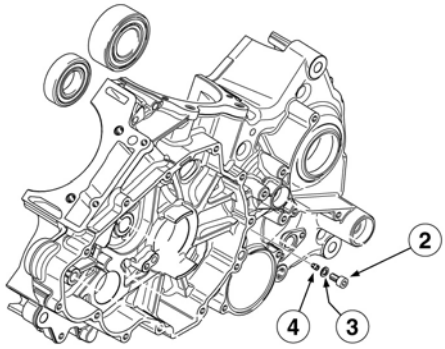
Clean the oil net with petrol and inspect the net links for potential damage.



Unscrew and take out the screw (2), the seal washer (3) and the nozzle (4).

Check that the conducts are clean at every lubricating hole on both crankcase halves and if required, clean them by blowing in a jet of com-

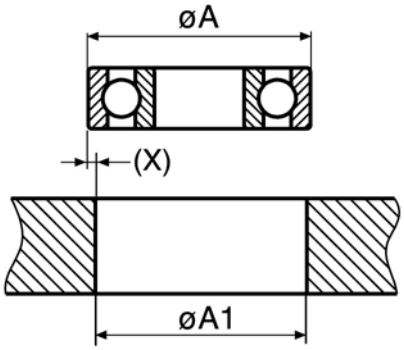
pressed air.



BALL BEARING FITTING

Check the interference between the bearing and the hole on the engine crankcase halves.

Interference (X) = (Diam. A) minus (Diam. A1) : 0.01 mm (0.0004 in)



CRANKSHAFT MAIN BUSHINGS AND COUNTERSHAFT MAIN BUSHINGS

MAIN BUSHINGS MUST BE REPLACED ONLY AT AUTHORISED WORKSHOPS, USING SPECIFIC MEASURING DEVICES AND EQUIPMENT.

Measure the inside diameter of the crankshaft main bushings of both crankcase halves.

Crankshaft main bushings: wear limits Diam. 46.035 mm (1.81240 in).

Measure the inside diameter of the countershaft main bushings of both crankcase halves.

Countershaft main bushings: wear limit Diam. 32.060 mm (1.26220 in).

CARRY OUT SEVERAL MEASUREMENTS, SPECIALLY IN THE DIRECTION OF THE AXIS OF BOTH CYLINDER, AVOIDING THE COUPLING SURFACE OF THE 2 HALF-SHELLS.
VALUES MUST NEVER EXCEED THE LIMITS SPECIFIED.
MEASURE THE RADIAL CLEARANCE BETWEEN THE MAIN BUSHINGS AND THE RELATED CRANKSHAFT AREAS.
CHECK THE RADIAL CLEARANCE BETWEEN THE MAIN BUSHINGS AND THE RELATED COUNTERSHAFT AREAS.

Check there are no signs of wear or sliding marks on the axial thrust surfaces on the crankshaft, on

both crankcase halves..

Check there are no signs of wear or sliding marks on the axial thrust surfaces on the countershaft, on both crankcase halves, clutch side.

CHECK CRANKCASE AXIAL CLEARANCE.

CHECK COUNTERSHAFT AXIAL CLEARANCE.

Clean the seat diameter of the main bushings inside the engine crankcase

On the engine crankcase check the measurement group of the main bushings based on the colour marks.

THE CRANKSHAFT LOWER MAIN BUSHING, FLYWHEEL SIDE, HAS A LUBRICATION HOLE.

THE MAIN BUSHING TOLERANCE UNIT IS ALSO MARKED WITH A COLOUR DOT.

IF THE COLOUR MARK ON THE ENGINE CRANKCASE IS NOT CLEAR, CALCULATE THE DIAMETER BY AVERAGING OUT THE DIFFERENT MEASUREMENTS.

PERFORM SEVERAL MEASUREMENTS, PARTICULARLY IN THE DIRECTION OF THE AXLES OF BOTH CYLINDERS.

CRANKSHAFT

RED mark: Bushing seat hole on engine crankcase halves - diam. 49.899 - 49.908 mm (1.96452 - 1.96488 in)

BLUE mark: Bushing seat hole on engine crankcase halves - diam. 49.908 - 49.918 mm (1.96488 - 1.96527 in)

YELLOW mark: Bushing seat hole on engine crankcase halves - diam. 49.918 - 49.929 mm (1.96527 - 1.96570 in)

COUNTERSHAFT

RED mark: Bushing seat hole on engine crankcase halves - diam. 35.909 - 35.918 mm (1.41374 - 1.41409 in)

BLUE mark: Bushing seat hole on engine crankcase halves - diam. 49.908 - 49.918 mm (1.41409 - 1.41448 in)

YELLOW mark: Bushing seat hole on engine crankcase halves - diam. 49.918 - 49.929 mm (1.41448 - 1.41492 in)

ENGINE CRANKCASE HALVES CYLINDRICAL PINS

With a micrometer check the cylindrical pins of the starter motor control and coolant pump intermediate gear for wear.

Wear limits Diam. 9.990 mm (0.39331 in)

Inspecting the crankshaft components

Check crankshaft for wear:

- main bushing area (engine crankcase) (1); wear limits min. diam. 45.955 mm (1.80925 in);
- support bushing area (flywheel cover) (2); wear limit min. diam. 29.970 mm (1.17992 in);
- freewheel gear bearing area (3); wear limit min. diam. 34.960 mm (1.37637 in);
- rod small end (4); wear limit max. diam. 22.030 mm (0.86732 in);
- axial clearance between connecting rod and crank arm (5); max. limit 0.60 mm (0.0236 in)

CAUTION

MEASURE CRANKSHAFT ECCENTRICITY BETWEEN ENDS

- crankshaft eccentricity (6), flywheel side; max. limit 0.020 mm (0.00079 in);
- crankshaft eccentricity, clutch side (7); max. wear limit 0.020 mm (0.00079 in).

CAUTION

DO NOT REUSE ENGINE CRANKCASE GASKETS WHICH HAVE BEEN REMOVED.
USE NEW APRILIA ORIGINAL GASKETS ONLY.
WITH A COMPARATOR, DETERMINE THE CRANKSHAFT AXIAL CLEARANCE AFTER CRANKCASE HALVES COUPLING.

Max. crankshaft axial clearance 0.5 mm (0.020 in).

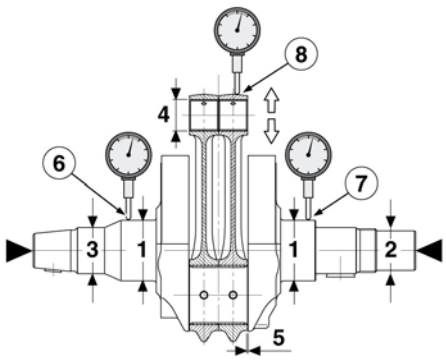
With a comparator, determine the rod small end radial clearance (8).

Max. wear limit 0.060 mm (0.00236 in)

Measure the radial clearance between the (engine crankcase) main bushings and the related crankshaft (1) areas.

Max. radial clearance allowed 0.060 mm (0.00236 in)

Radial clearance is derived from the following values:



- the maximum inside diameter value of the (engine crankcase) main bushings minus the diameter value of the (engine crankcase) main bushing area on the crankshaft.
- measure the (engine crankcase) main bushings inside diameter.

IF THIS MAX. RADIAL CLEARANCE ALLOWED IS EXCEEDED, REPLACE THE WORN OUT COMPONENT.

Measure the radial clearance between the supporting bushings (clutch cover) and the related crankshaft (2) area.

Max. radial clearance allowed 0.065 mm (0.00260 in)

Radial clearance is derived from the following values:

the maximum inside diameter value of the (clutch cover) supporting bushings minus the diameter value of the (clutch cover) supporting bushing area on the crankshaft.

Measure the supporting bushings (clutch cover) inside diameter.

IF THIS MAX. RADIAL CLEARANCE ALLOWED IS EXCEEDED, REPLACE THE WORN OUT COMPONENT.

Also check that the material of the following components is not worn or damaged:

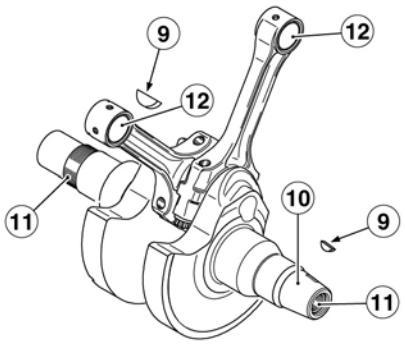
Crankshaft keys (9) and grooves.

Bearing seat colour.

Crankshaft bevel surface (10), flywheel side.

Clean off any remaining LOCTITE from the thread (11) and check that it is in proper conditions.

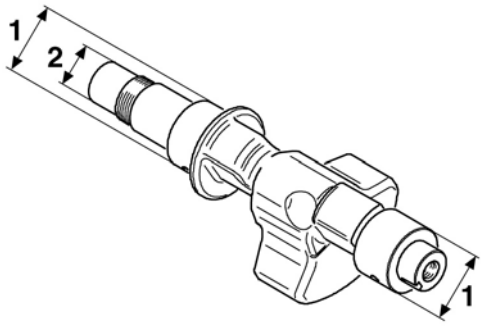
Check that the bushing (12) inside the rod small end is correctly set and centred (along the longitudinal axis).



Checking the counter shaft

COUNTERSHAFT AND COUNTERSHAFT MECHANISM

Check the countershaft for wear:



- Main bushings (engine crankcase) area (1); wear limit Min. diam. 31.980 mm (1.25905 in)
- Supporting bushings (clutch cover) area (2); wear limit Min. diam. 19.990 mm (0.78700 in)

IF THIS MAX. RADIAL CLEARANCE ALLOWED IS EXCEEDED, REPLACE THE WORN OUT COMPONENT.

Measure the radial clearance between the (engine crankcase) main bushings and the related countershaft (1) areas.

Min. radial clearance allowed 0.060 mm (0.00236 in).

Radial clearance is derived from the following values:

the maximum inside diameter value of the (engine crankcase) main bushings minus the diameter value of the related main bushing (1) areas on the countershaft.

Measure the main bushings (engine crankcase) inside diameter.

IF THIS MAX. RADIAL CLEARANCE ALLOWED IS EXCEEDED, REPLACE THE WORN OUT COMPONENT.

Measure the radial clearance between the supporting bushings (clutch cover) and the related countershaft (2) area.

Min. radial clearance allowed 0.060 mm (0.00236 in)

Radial clearance is derived from the following values:

the maximum inside diameter value of the (clutch cover) supporting bushings minus the diameter value of the related supporting bushing (2) areas on the countershaft.

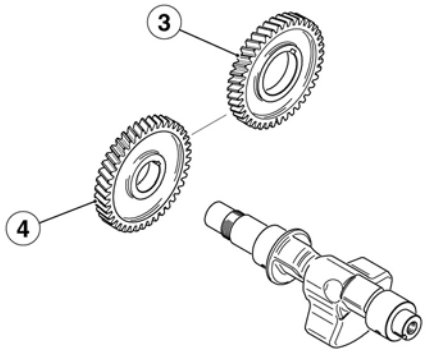
Measure the supporting bushings (clutch cover) inside diameter.

CAUTION

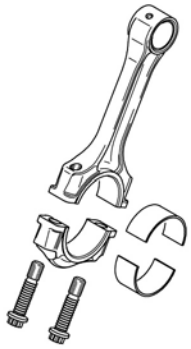
AFTER COUPLING THE CRANKCASE HALVES CHECK THE AXIAL CLEARANCE OF THE COUNTERSHAFT WITH A COMPARATOR.

Max. countershaft axial clearance 0.30 mm (0.00118 in).

Check the sides of the teeth of the driving (3) and driven (4) gears for damage or shape alterations.



Checking the connecting rod



Measure the rod head radial clearance.

Max. wear limit 0.070 mm (0.00286 in).

With a comparator measure the connecting rod eye radial clearance.

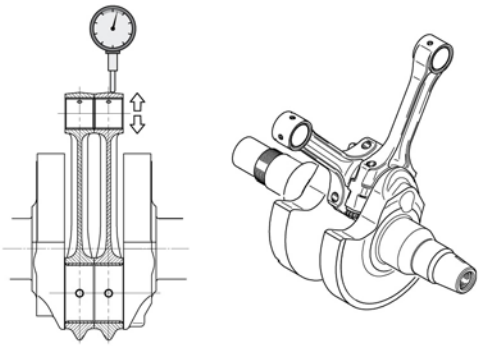
Radial clearance 0.020 - 0.045 mm (0.00079 - 0.00177 in).

If radial clearance exceeds **0.045 mm (0.00177 in)**, choose bushings with sizes corresponding to the blue or yellow types based on the table below and insert them in place of the red bushings.

RED bushing: **Thickness 1.471 - 1.476 mm (0.05791 - 0.05811 in)**

BLUE bushing: **Thickness 1.476 - 1.481 mm (0.05811 - 0.05830 in)**

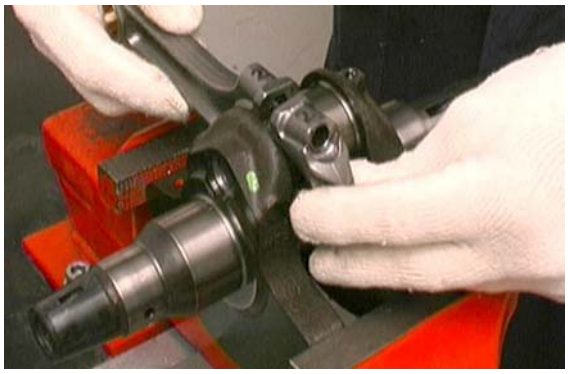
YELLOW bushing: **Thickness 1.481 - 1.486 mm**



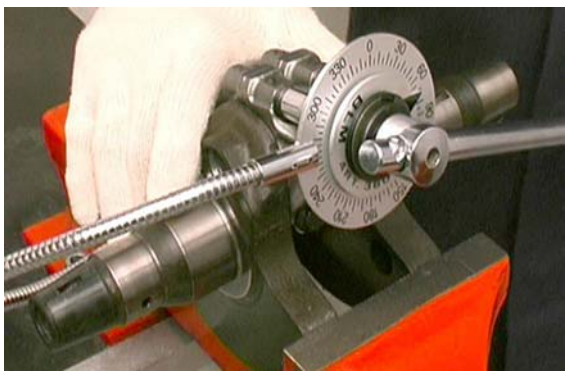
(0.05830 - 0.05850 in)

Assembling the connecting rod

- Fit the caps on the connecting rods respecting the reference marks done at the removal stage.
- If new connecting rods are fitted, make sure the reference dots and the quantity of parts coincide
- Lubricate the supporting surfaces of the connecting rod screws.

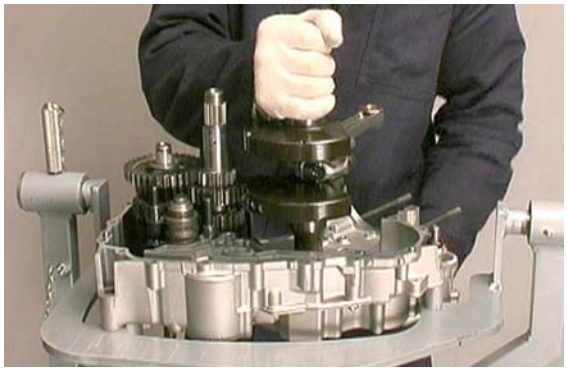


- Tighten the connecting rod to the prescribed torque using a torque wrench. Tighten angles with a goniometer.



Installing the crankshaft

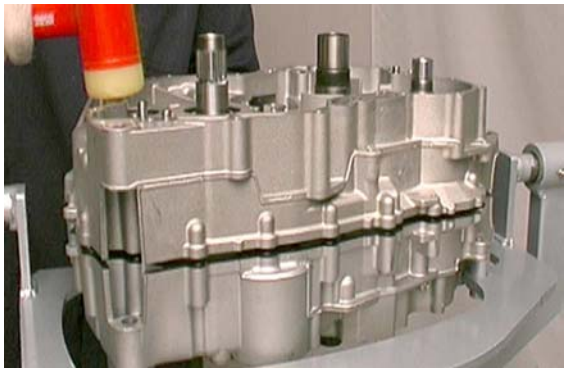
- Lubricate the crankshaft pins and insert them into their positions.



Refitting the crankcase halves

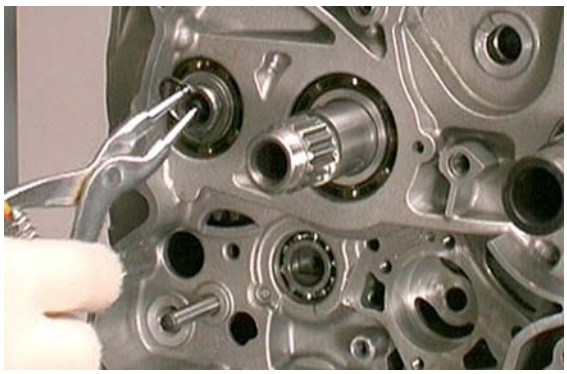
- Fit the crankshaft, the complete transmission and the countershaft in the crankcase half.

- Fit the sealing gaskets on the crank-case half coupling surface.
- Join the two crankcase halves tapping with a hammer.



- Rotate the engine block so that it is upright.
- Tighten the twenty screws fixing the crankcase to the prescribed torque.

- Fit the thrust washer and the seeger ring on the transmission secondary shaft.



- Insert the washer on the crankshaft.

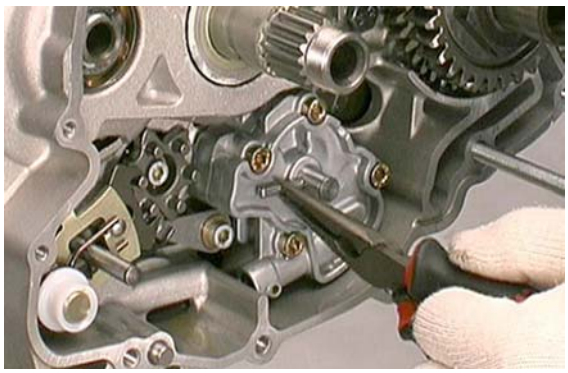
Lubrication

Oil pump

Removing

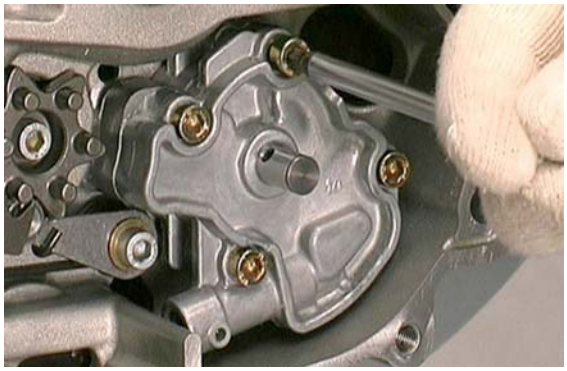
- Remove the seeger ring.
- Remove the oil pump gear.

- Take out the pin on the pump shaft.



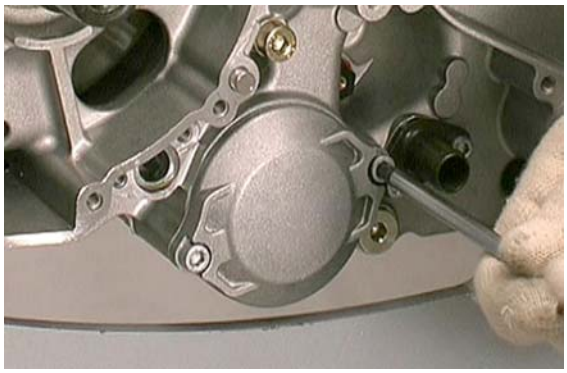
- Unscrew and remove the four fixing screws and remove the oil pump assembly.
- While carrying out this operation,

make sure the pin of the scavenge oil pump inner rotor does not fall into the crankcase.

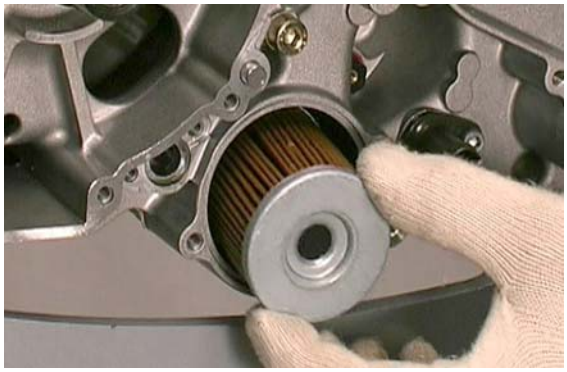


- Take out the scavenge oil pump outer rotor from the engine crankcase.

- Dismount the oil filter cover with its sealing ring.

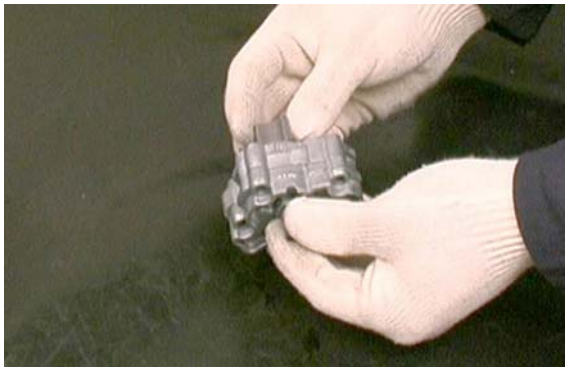


- Take out the oil filter cartridge from its housing.

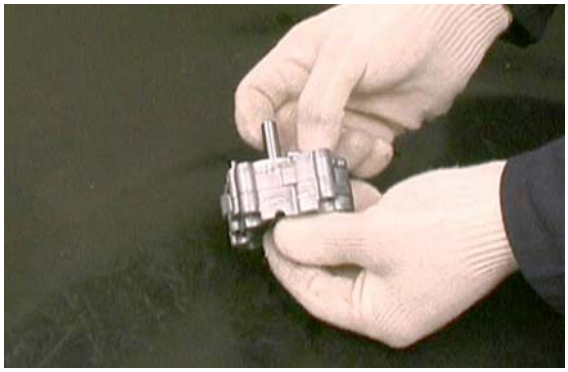


Inspection

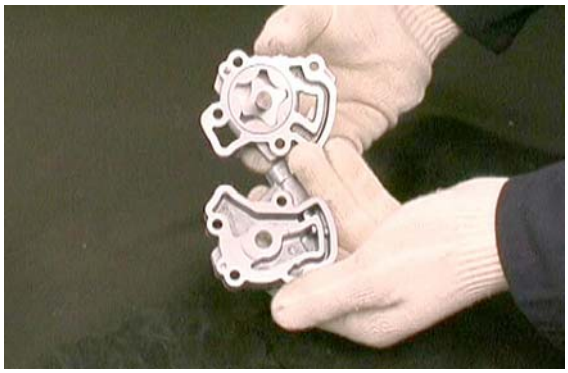
- Take out the scavenge oil pump outer rotor from the oil pump shaft.



- Remove the pin.



- Slide off the oil pump cover.



- Remove the pressure pump inner rotor.

- Remove the pin.

- Take out the pump shaft.

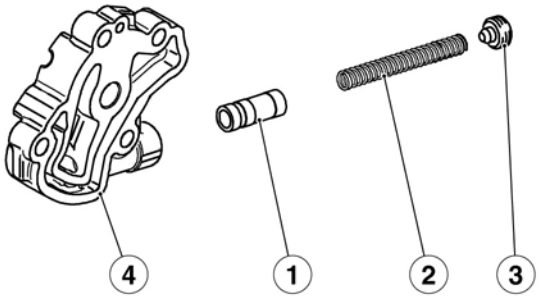
- Remove the pressure pump outer rotor.

CHECK

Check the oil pump rotors and the sliding surfaces of the outer rotors on both the bodies and the thrust surfaces for grooves.

Using a thickness gauge, measure the clearance between:

- scavenge oil pump outer rotor and engine crankcase;
- pressure pump outer rotor and pressure pump body.



Max. wear limit 0.25 mm (0.0098 in).

Measure the axial clearance of the rotors.

Max. wear limit 0.15 mm (0.0059 in).

CAUTION

REPLACE THE FAULTY PART IF CLEARANCE EXCEEDS EITHER WEAR LIMIT.

Check the adjustment piston (1) smoothness on the oil pump (4) cover.

Check the adjustment piston (1) and the oil pump (4) cover for wear:

- adjustment piston (1);

wear limit min. diam. 9.975 mm (0.39272 in).

- oil pump cover (4);

wear limit max. diam. 10.035 mm (0.39508 in).

- compression spring (2);

unloaded spring minimum length: 56.0 mm (2.205 in)

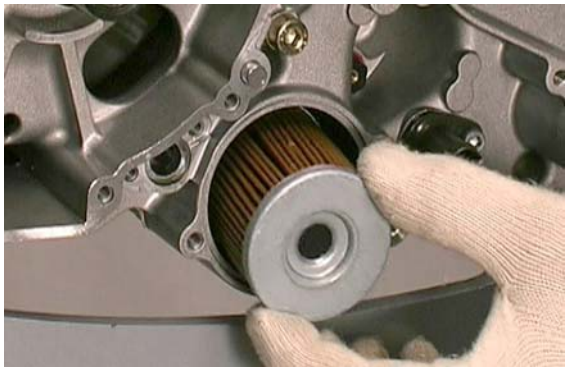
Fit the adjustment piston (1) with the cone side turned forwards and insert the compression spring in the hole of the oil pump cover.

Apply LOCTITE 648 on the cap thread (3).

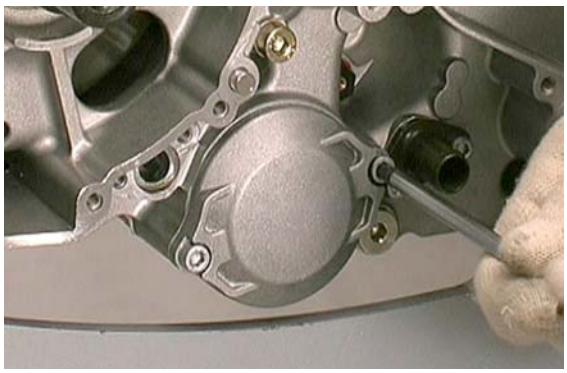
Screw the cap (3) up to **2 mm (0.079 in)** into the outside rim of the oil pump (4) cover collar and lock the cap into position with four additional punchings.

Installing

- Insert the oil filter cartridge in its housing.



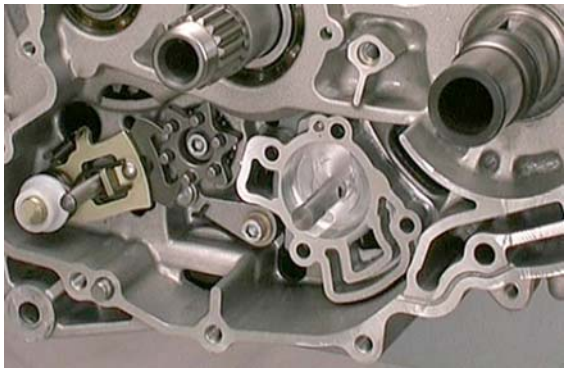
- Fit the filter cover, with its sealing ring, tightening the screws to the prescribed torque.



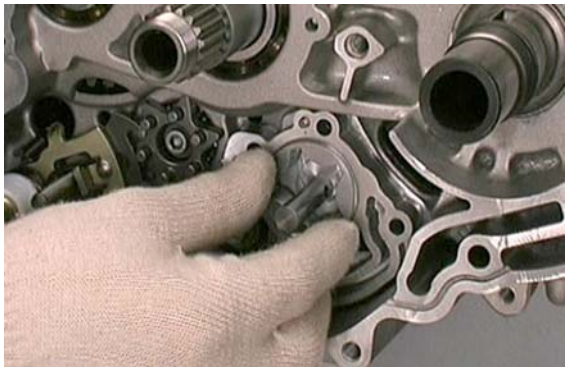
- Oil and fit the scavenge oil pump outer rotor in its base on the crankcase.

- Fit the pump shaft together with the scavenge oil pump inner rotor.

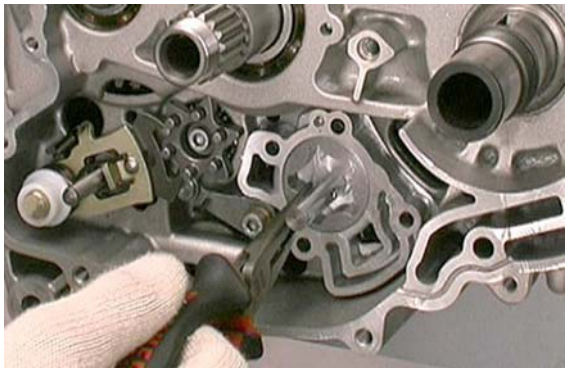
- Fit the pump body on the crankcase.



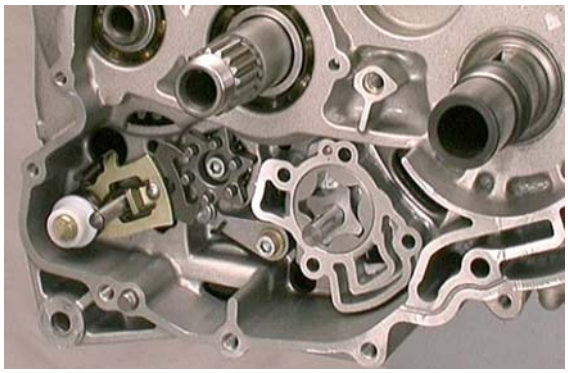
- Fit the pressure pump outer rotor.



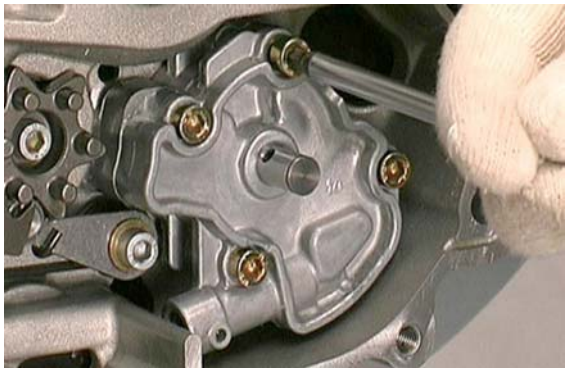
- Fit the pin on the shaft.



- Fit the pressure pump inner rotor.



- Fit the oil pump cover.
- Fix the cover by tightening the four fixing screws to the prescribed torque.



- Fit the pin on the pump shaft through the grooves on the cover.

- Fit the oil pump gear.
- Lock the gear with the seeger ring.

INDEX OF TOPICS

Circuit diagram

Key:

1. Fuel tank
2. Refuelling cap
3. Fuel pump unit
4. Fuel fumes breather pipe (fumes caused by overpressure in the tank)
5. Fuel drainage pipe "too full"
6. Fuel level sensor
7. Fuel delivery filter
8. Fuel supply pump
9. Fuel delivery pipe
10. Fuel return pipe

Fuel pump

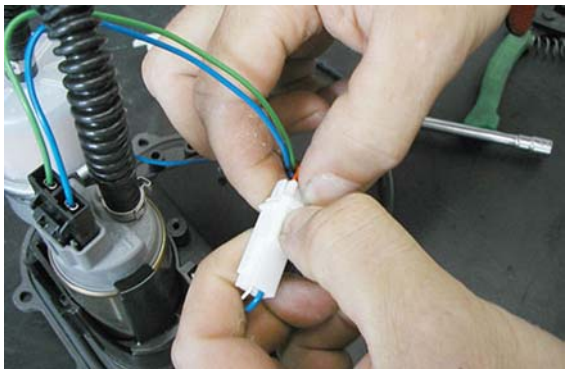
Removing

- Remove the entire fuel pump assembly.
- Disconnect the clic clamp with the special tool.
- Remove the fuel pipe from the pump.

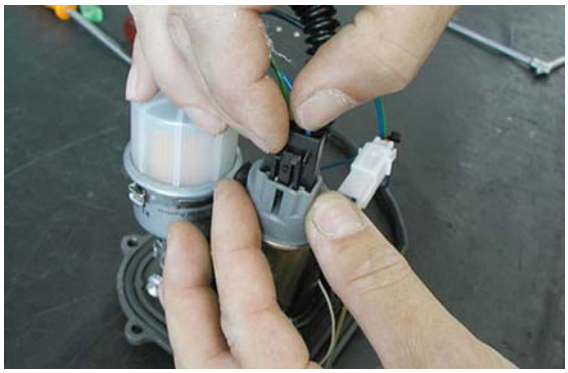
Specific tooling

0277295 Pliers for clic clamps

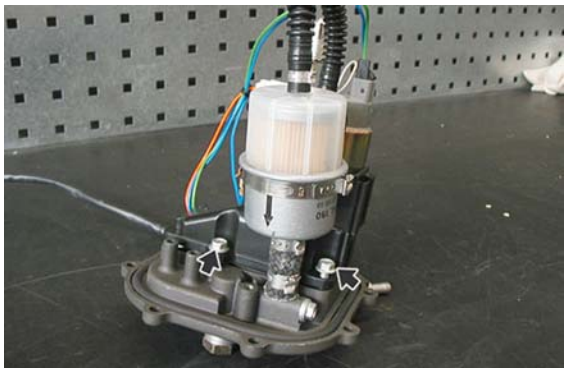
- Disconnect the electrical connector.



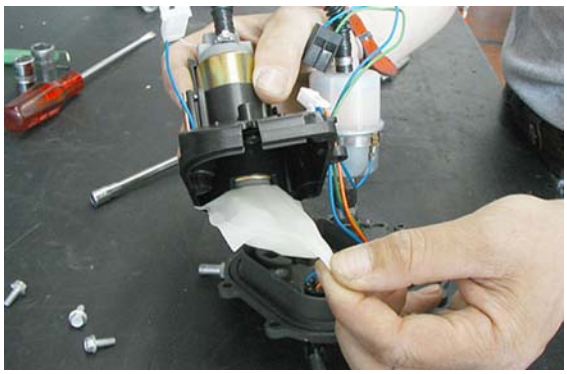
- Disconnect the electrical connector.



- Undo and remove the three screws.



- Fold the fuel filter sideways and keep it into position.

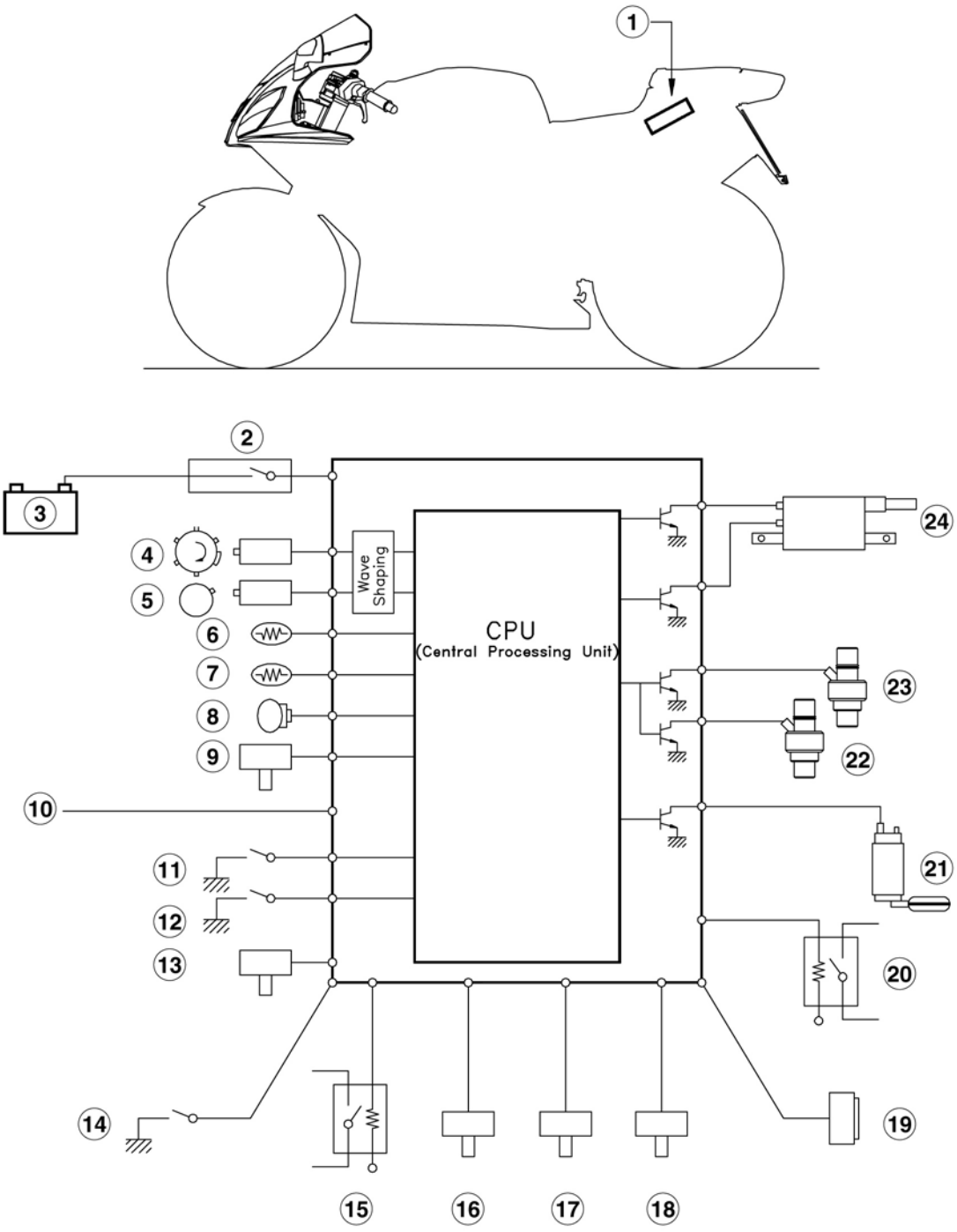


CAUTION

IF THE FILTERING MESH SHOWS SIGNS OF DEPOSITS, CLEAN IT WITH A PRESSURE AIR JET, DIRECTING IT IN SO THAT IMPURITIES DO NOT COME INTO THE FILTER.

Injection

Diagram



Key:

1. Control unit position
2. Ignition switch
3. Battery
4. Crankshaft position sensor
5. Camshaft position sensor

6. Engine temperature sensor
7. Air temperature sensor
8. Throttle valves position sensor
9. Intake pressure sensor
10. Safety system: side stand, neutral sensor
11. Test switch
12. Fall sensor
13. Atmospheric pressure sensor
14. Oil pressure sensor
15. Electric fan
16. Automatic air
17. Intake flap
18. Lambda probe
19. Diagnosis connector
20. Start-up relay
21. Fuel pump
22. Injector 1
23. Injector 2
24. Coil

Checking the injector

- Check the electrical cable harness and its connections.
- Injector or injection signal of the electronic control unit.

CAUTION

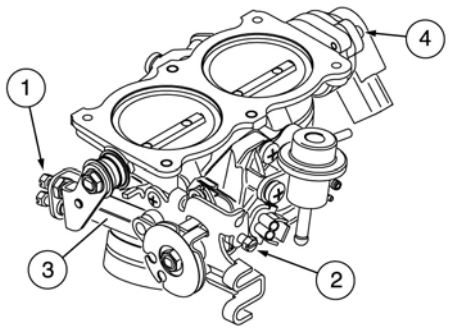
THE INJECTORS CAN BE ELECTRONICALLY CHECKED.

Removing the throttle body

THE SCREWS FOR THE THROTTLE VALVES
(1) SETTING ARE PAINTED AND CANNOT BE
ADJUSTED.
ONLY IF THE BRACKET FIXING THE CABLE
(2) IS REPLACED CAN THE TWO SET

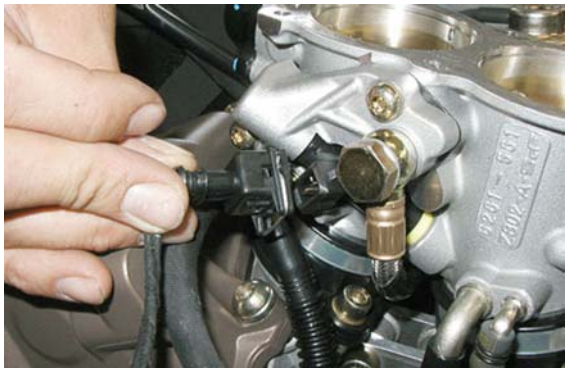
SCREWS BE OPERATED.

THE TWO M4X12 SCREWS (3) FIXING THE THROTTLE VALVE POTENTIOMETER ARE PAINTED AND CAN BE TAKEN OUT ONLY IF THE SENSOR NEEDS TO BE REPLACED.



- Partially remove the fuel tank.
- Remove the air filter housing.
- Disconnect the electric connectors:

- Right injector.



- Left injector.

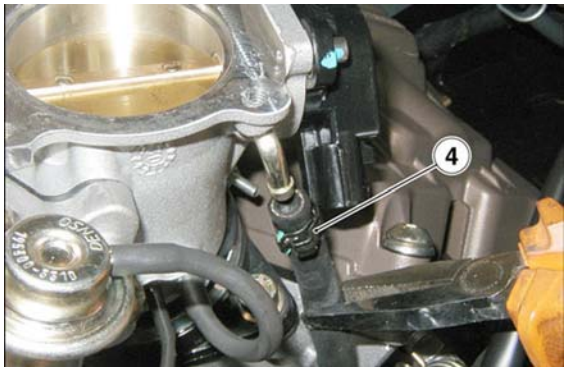
- Throttle valve potentiometer.

- Get the suitable special tool.
- Release the clic clamp (4).

- Release the clic clamp (5).
- Remove the pipes from the throttle unit.

Specific tooling

0277295 Pliers for clic clamps



- Disconnect the two throttle grip cables.

UPON REFITTING, MAKE SURE THE TWO THROTTLE GRIP CABLE REGULATORS ARE CORRECTLY FIXED TO THEIR HOOKS. CHECK CLEARANCE AND ADJUST IT IF REQUIRED.

- Remove the flap pipe for the airbox from the throttle unit.

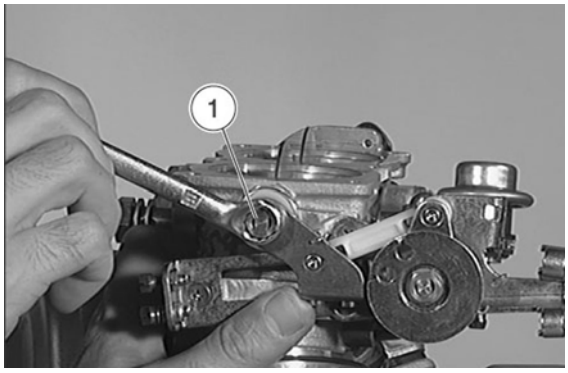
- Loosen the two clamps.

- Hold the throttle unit firmly, and with short alternating movements, lift and slide it off the intake flange.
- Fit the complete throttle unit together with the fuel tank on a clean surface.

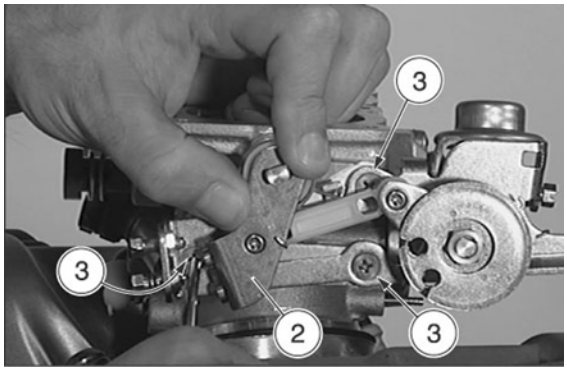
PAY SPECIAL ATTENTION WHEN REMOVING THE THROTTLE UNIT SINCE IT REMAINS CONNECTED TO THE FUEL TANK THROUGH THE FUEL PIPE.

Checking the throttle body

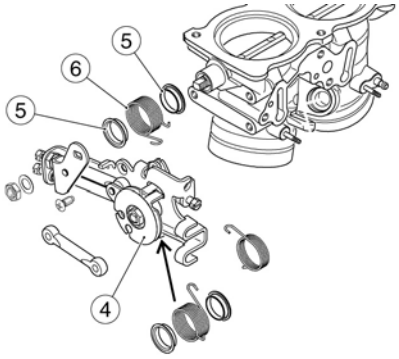
- Unscrew and remove the M8x1 nut (1) and remove the spring washer.



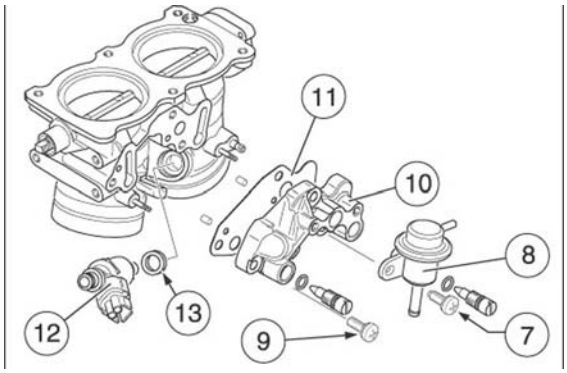
- Turn the throttle valve control lever (2) slightly, unscrew and remove the three TE screws. M5x12 (3).

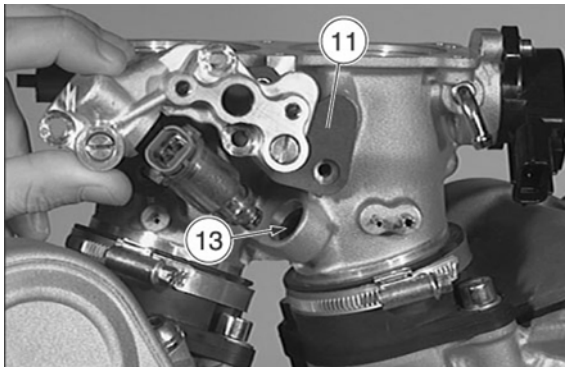


- Remove the complete fixing bracket (4) from the throttle grip cables with the two bushings (5) and the torsion spring (6) from the throttle body unit.



- Undo and remove the two M6x16 screws (7) and remove the fuel pressure regulator (8) together with its O-rings.
- Undo and remove the three M6x25 screws (9) and remove the left injector support (10) together with the corresponding gasket (11), the injector (12) and the sealing ring (13).

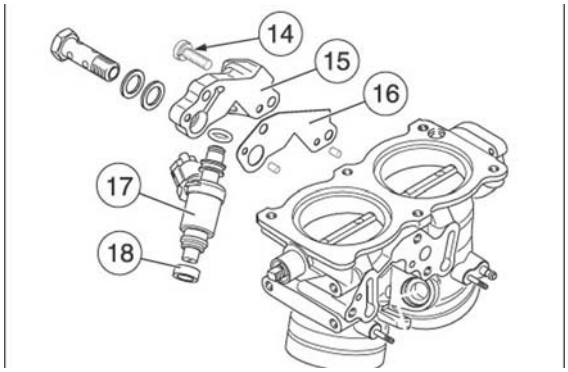


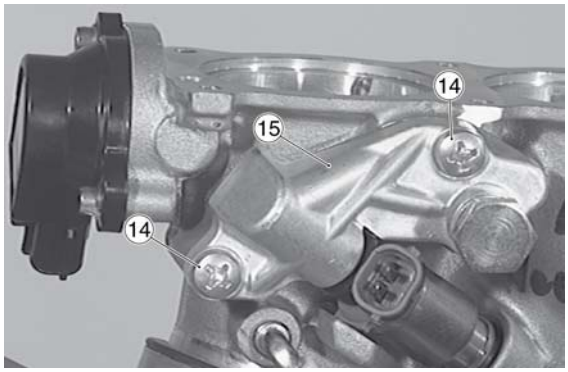


- Undo and remove the two M6x25 screws (14) and the left injector support (15) together with the corresponding gasket (16), the injector (17) and the sealing ring (18).

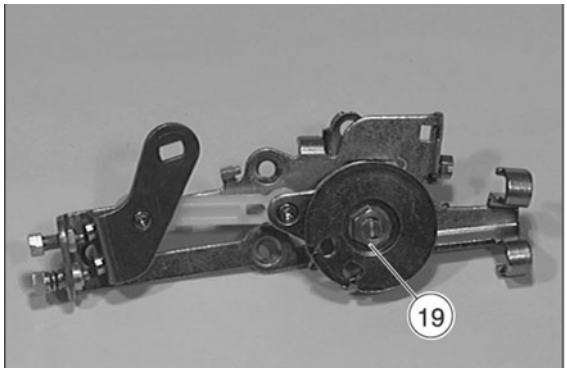
CAUTION

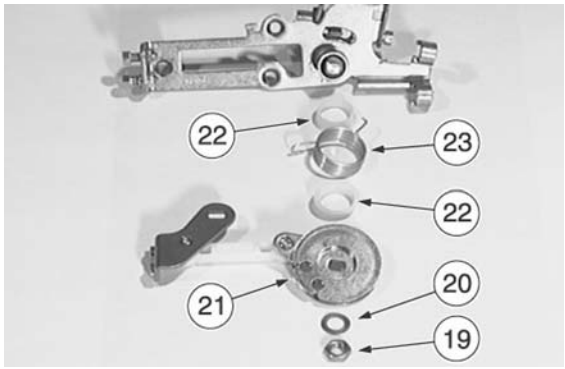
THE INJECTOR SEALING RING (18) MAY REMAIN FITTED IN THE THROTTLE GRIP HOLE.



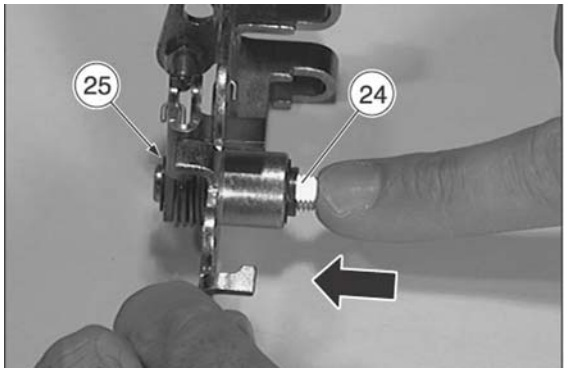


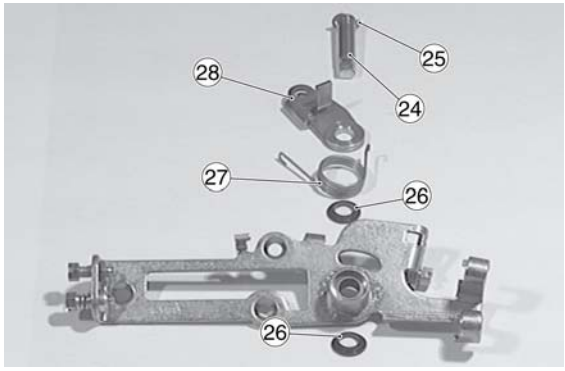
- Unscrew and remove the nut M8x1 (19) and remove the spring washer (20), the pulley (21), the two bushings (22) and the torsion spring (23).



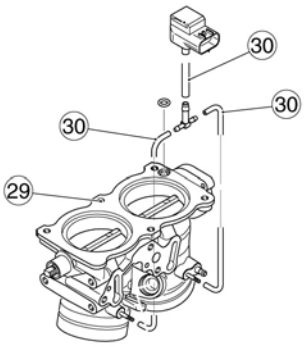


- Slide off the fulcrum pin (24) together with the safety washer (25) from the hole of the bracket fixing the throttle grip cables and remove the two gaskets and the ring for shafts (26) with the torsion spring (27) and the cold start lever (28).





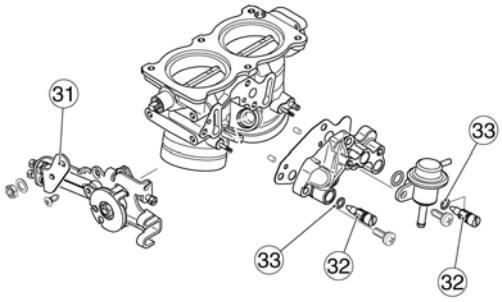
- Clean all the throttle unit openings and pipes (29) with compressed air.
- Check the intake pressure sensor pipes (30), making sure they are not clogged.
- Check the throttle valve unit and the cable fixing mechanism (31), making sure there are no mechanical damages.



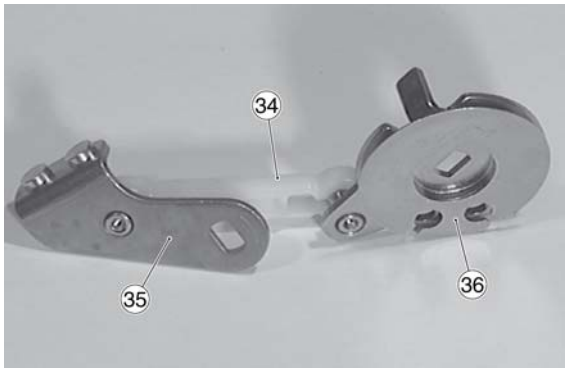
CAUTION

SYNCHRONISE THE CYLINDERS IF THE TWO

SYNCHRONISATION SCREWS (32) OR THE O-RING GASKETS (33) ARE REPLACED.



- Unscrew the two synchronisation screws (32) of the cylinders only if there are air leaks.
- Upon replacing the ball joint rod (34), release the rod from the throttle valve control lever (35) and from the throttle grip cable pulley (36).
- After fitting a new ball joint rod (34), check that it can move smoothly.



Installing the throttle body

- Handle the fuel pipe with caution, making sure that it is not twisted or placed where it can be flattened by other parts; replace it if it is damaged or gets deteriorated.
- The delivery fuel pipe must be placed in such a way that it reaches the throttle unit on the right side by going under the unit itself, between the two intake flanges.
- The throttle unit must be perfectly inserted to the intake flange.
- The clamps must be correctly tightened.

Recovery function

If the signal of the following sensors is interrupted, the control unit determines some values to keep the engine running or it uses a different parameter. The instrument panel will still warn about any malfunctioning.

RECOVERY VALUES

Specification	Desc./Quantity
Air temperature	18 °C (64.4 °F)

Specification	Desc./Quantity
Water temperature	88 °C (190.4 °F) If the signal is lost, the control unit sets the value to 88 °C (190.4 °F), linearly increasing by 0.33 °C/sec (32.6 °F/sec) from the air temperature at ignition. The message 135 °C (275 °F) flashes on the instrument panel, and the WARNING light turns on.
Barometric pressure	980 hPa (14.2 PSI)
Throttle valve potentiometer	9.8° Uses the intake pressure sensor value.
Intake pressure	The values are set according to the number of engine revolutions and to the position of the throttle sensor (the front and rear cylinder intake pressure values are fixed and are not used for engine operation).
Idle motor	21

Restricted rpm condition

The control unit limits the number of engine revs if one of the following conditions is present:

- no throttle position sensor signal.
- no idle motor signal.
- low oil pressure.
- the INITIALISED CONTROL UNIT parameter on the Axone device status screen page is NO.
- water temperature over 120°C (248°F).
- if the control unit detects malfunctioning of a combination of signals that could compromise riding the vehicle in safety. For instance: simultaneous loss of the throttle position and intake pressure signals.

Ecu mapping

MAPPING TYPE

Specification	Desc./Quantity
Control unit code 266531	mapping 266531 (mapping not updated for Tuono MY 2006; update with **VC5L980$.BIX**)
Control unit code 266532	mapping 266532 (mapping updated for Tuono MY 2006, **VC5L980$.BIX**)
Control unit code 266533	mapping 266533 (mapping for Tuono MY 2007, **VC5L981$.BIX**). With the "Engine option 1" setting, select the mapping for standard exhaust pipes, whereas

Specification	Desc./Quantity
	with the "Engine option 2" setting, select the mapping for non-standard Akrapovic exhaust pipes
Control unit code 266534	mapping 266534 (mapping for Tuono MY 2007, **VC5L982$.BIX**). With the "Engine option 1" setting, select the mapping for the standard exhaust pipes, whereas with the "Engine option 2" setting, select the mapping for non-standard EVO 6 exhaust pipes

On the adjustable parameters screen page, when the 'enter' button is pressed to start resetting the control unit, the system requests the date (dd/mm/yy), enter the current date:

After resetting, check on the ISO screen page of Axone:

- the mapping code;
- the day when it was remotely reloaded;
- the serial number of the Axone which has carried out the remote reloading.

CAUTION

AXONE AUTOMATICALLY DETECTS THE MAPPING PRESENT ON THE CONTROL UNIT AND ALLOWS RESETTING ONLY WITH THE CORRECT MAPPINGS.

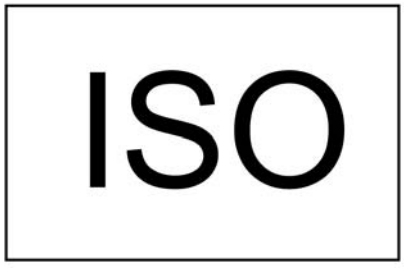
Using axone for injection system

Injection

Iso screen page

ISO

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



ISO DISPLAY

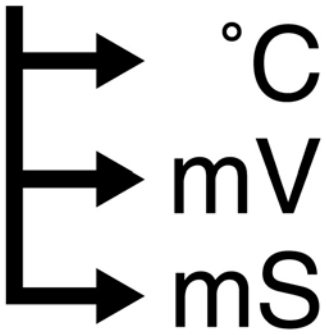
Specification	Desc./Quantity
Aprilia software	000000000 (not relevant field)
Service number	-

Specification	Desc./Quantity
Engine	V2 - 60° 990 (2-cylinder V engine, cylinder inclination, engine capacity)
Produced	dd/mm/yy (electronic control unit production date)
Mapping	Indicates the code of the configuration present on the control unit. Example value: 266531
Programming date	dd/mm/yy (date of last mapping downloading: day/month/year)
Person in charge for last programming	Identification code of the PC or the Axone that loaded the last mapping. The code displayed on this screen page is not right: in order to view it correctly, go to the ISO screen page that is displayed when selecting RESETTING

Engine parameter reading screen page

ENGINE PARAMETER READING

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



ENGINE PARAMETER READING DISPLAY

Specification	Desc./Quantity
Water temperature (°C)	The fans are activated at about 100 °C (212 °F). If the signal is lost, the control unit sets the value to 88 °C (190.4 °F), linearly increasing this value from the air temperature at ignition (1 °C - 33.8 °F each 3 seconds) and the cooling fans are activated
Air temperature	If the signal is lost, the control unit sets the value to 18 °C (64.4 °F)
Engine rpm	Engine revolutions per minute: the minimum value is set by the control unit cannot be adjusted
Target idle rpm	Revolutions that the ECU tries to make the engine reach (according to the water temperature)
Engine load	Parameter linked to the injection time (in turn, it depends on the intake air mass detected by the throttle position and intake pressures). The ECU also uses this parameter to choose among differ-

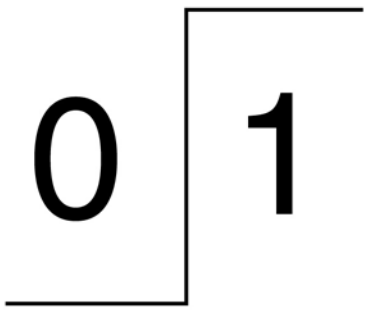
Specification	Desc./Quantity
	ent mapping strategies
Intake pressure	Average value detected through a sensor connected to the two inlet ducts. Example value: 650 hPa (9.43 PSI)
Overall throttle opening	Parameter which registers the throttle opening and the idle motor position. Example value: 2,7°
Ignition advance	- °
Throttle position sensor	Parameter that shows the throttle opening degrees. If the signal is lost, the control unit sets the value to 9.8° and uses the intake pressure values
Throttle offset	After having set the "Initialisation" or "Throttle position self-learning" parameter, this value is stored in the ECU memory and it indicates the position of the closed throttle: according to this reference, the control unit will learn the position the throttle is at that moment
Idle motor	Idle motor steps (if the signal is lost, the ECU sets the value to 21)
Battery voltage	V
Vehicle speed	- km/h
Front cylinder pressure	Pressure detected in the inlet duct through the intake pressure sensor. If the signal is lost, the control unit uses the values of the throttle position sensor to make the engine work. Example values corresponding to mappings 664586, 664588, 664585 or 664587: it is important that the front cylinder pressure value be higher than that of the rear cylinder - 50 hPa (0.72 PSI). Example value: 680 hPa (9.86 PSI)
Rear cylinder pressure	Pressure detected in the inlet duct through the intake pressure sensor. If the signal is lost, the control unit uses the values of the throttle position sensor to make the engine work. Example values corresponding to mappings 664586, 664588, 664585 or 664587: it is important that the front cylinder pressure value be higher than that of the rear cylinder - 50 hPa (0.72 PSI). Example value: 630 hPa (9.14 PSI)
Lambda correction	This value should fluctuate approx. 1 when the control unit uses the lambda probe signal to maintain the stoichiometric combustion
Lambda probe	Lambda probe signal voltage, fixed value if the circuit is interrupted
Injection time	- ms

Specification	Desc./Quantity
Atmospheric pressure	Sensor placed under the saddle. If the signal is lost, the control unit sets the value to 980 hPa (14.2 PSI). Example value: 1000 hPa (14.5 PSI)

Device status screen page

DEVICE STATUS

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



DEVICE STATUS

Specification	Desc./Quantity
Fall sensor	The control unit manages this as a status (therefore, it is not stored in the memory): if the circuit is interrupted (sensor disconnected), it is shown as an error on the instrument panel and with Axone it reads "Normal" (because the circuit is open when connected at the correct position) but the bike can be started. Possible statuses: Normal / Tip over
Control unit	If the instrument panel is not connected or if the CAN connection has problems, the control unit does not receive a code which it is supposed to receive from the instrument panel, and therefore it assumes the status: "Invalid combin". With Axone it is possible, though, to connect to the control unit. Possible statuses: valid combin / invalid combin
Oil pressure	If the low pressure limits the engine revs (if the cable is disconnected, it indicates "Normal": I only notice this when I set the key to ON and the warning light on the instrument panel does not turn on, and neither does the oil indicator). Possible statuses: Normal/Low
Idle	Engine idle operating conditions (which are seen also when the engine is off). Possible statuses: On/Off
Full load	Engine full load operating conditions (the engine

Specification	Desc./Quantity
	must be started). Possible statuses: On/Off
Engine stop button	Button status Engine kill and immobilizer enabled: if OFF, one or both devices are not working properly. Possible statuses: On/Off
Start-up request	The correct functioning can be shown with gear engaged and by pressing the start-up button: given these conditions, the control unit detects that the start-up button is enabled (with Axone, I read on) but for safety reasons the engine is not started. Check that the battery is charged. Possible statuses: On / Off
Active lambda probe	ON if the control unit is using the lambda probe signal to keep the stoichiometric combustion. Possible statuses: On / Off
Cut-off	Possible statuses: On / Off
Throttle self-learning completed	If for any reason the Throttle position self-learning is not successful, it goes OFF
Engine heating phases	During the heating phase, the engine is ON. Possible statuses: On / Off
Power latch completed	When the key is turned from ON to Off, before the control unit is deactivated, a series of parameters are saved to the memory (for instance Stepper motor position) during the power latch. Possible statuses: On / Off
Gear in neutral	Possible statuses: Yes/No
Selector	Parameter currently used. Possible statuses: On / Off
Side stand	Stand position. Possible statuses: Up/Down
Clutch engaged	If the clutch is engaged, YES is displayed. Possible statuses: Up/Down
Initialisation problem	Possible causes why the procedure carried out through the activation of the Throttle position self-learning or Initialisation adjustable parameters has failed: in order Engine speed>0/Vehicle speed>0/Idle motor error (Stepper motor)/Incorrect throttle range(position)/Incorrect battery voltage /Water temperature /Idle motor disconnected
Lambda check	Conditions for the lambda probe; for instance if the supply circuit is interrupted, it assumes the condition "deact. by err" The meaning of the various status is, respectively: initialisation phase/ Standby after start/Probe status recognition/ Standby after recognition/Deactivated to ride/

Specification	Desc./Quantity
	Deact. by error/Standby after interruption/Active lambda probe/Saturation
Engine option	1 activates the standard mapping, 2 activates the Racing mapping , necessary when using non original exhaust pipes. Possible statuses: 1/2
Number of injectors per cylinder	Non-modifiable control unit status: should show 1cyl.
Head knocking sensor	Non-modifiable control unit status: should show NO
Boost adjustment	Non-modifiable control unit status: should show NO
Lambda probe	Control unit status modifiable only through password, usually should show Yes, that is, lambda probe is present
Water injection	Non-modifiable control unit status: should show NO
Idle motor is present	Control unit status modifiable only through password, usually should show Yes, that is, idle motor is present
Purge valve	Non active parameter (mechanical purge valve). Possible statuses: Yes/No
Electronic reverse	Non-modifiable control unit status: should show NO
Electric start-up	Non-modifiable control unit status: should show Yes
Initialised control unit	If the status is "yes", this indicates that the "Initialised control unit" parameter has been activated. If the control unit is replaced, this parameter should be activated. Otherwise, the engine revs will be limited. Possible statuses: Yes/No

Devices activation screen page

DEVICES ACTIVATION

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

DEVICE ACTIVATION

Specification	Desc./Quantity
Error clearing	By pressing the 'enter' button, the stored errors (MEM) become part of the historical data (STO). In the next connection between the Axone and the control unit, the historical errors (STO) are no longer shown
Fuel pump	The device is activated: if it is not correctly activated, NO is displayed immediately, which shows that it has not been activated, but it is also necessary to check the errors display screen page
Intake reduction	There is no movable flap on this vehicle, therefore this activation is unnecessary.
Lambda probe heating	The device is activated: if it is not correctly activated, NO is displayed immediately, which shows that it has not been activated, but it is also necessary to check the errors display screen page
Fan	The device is activated: if it is not correctly activated, NO is displayed immediately, which shows that it has not been activated, but it is also necessary to check the errors display screen page
Front injector	The device is activated: if it is not correctly activated, NO is displayed immediately, which shows that it has not been activated, but it is also necessary to check the errors display screen page
Rear injector	The device is activated: if it is not correctly activated, NO is displayed immediately, which shows that it has not been activated, but it is also necessary to check the errors display screen page
Front coil	The device is activated: if it is not correctly activated, NO is displayed immediately, which shows that it has not been activated, but it is also necessary to check the errors display screen page
Rear coil	The device is activated: if it is not correctly activated, NO is displayed immediately, which shows that it has not been activated, but it is also necessary to check the errors display screen page

Errors display screen page

ERRORS DISPLAY

This screen page shows potential errors detected

in the vehicle (ATT) or stored in the control unit

(MEM) and it is possible to check error deletion

(STO)

ERRORS DISPLAY

Specification	Desc./Quantity
High atmospheric pressure sensor	Displayed in case of excessive voltage detected on the sensor circuit
Air temperature sensor	-
Low air temperature sensor	Displayed in case of low voltage detected on the sensor circuit
High air temperature sensor	Displayed in case of excessive voltage (for example interrupted circuit, in the frozen parameters, but it reads -40° maximum ohm resistance)
Water temperature sensor	-
Low water temperature sensor	Displayed in case of low voltage detected on the sensor circuit
High water temperature sensor	Displayed in case of excessive voltage (for example interrupted circuit, in the frozen parameters, but it reads -40° maximum ohm resistance)
Low throttle sensor	Displayed in case of low voltage detected on the sensor circuit
High throttle sensor	Displayed in case of low or null voltage (for instance interrupted circuit)
Lambda probe	Displayed if the probe signal circuit is interrupted or has problems during the probe operating phase, turns to STO without reconnection, and thus is not saved to the memory: it also noticeable on the 3-DEVICES STATUS screen page that the Lambda correction parameter remains Deactivated
Lambda probe heating	Appears if the supply circuit is interrupted or short circuited, turns from ACT to STO without reconnection if the bike is off. Otherwise, remains as ACT, but is not saved to the memory (also notice the mV fixed signal)
Lambda probe adaptability	Lambda probe functioning not within the regular operating conditions, whether it is in relation to

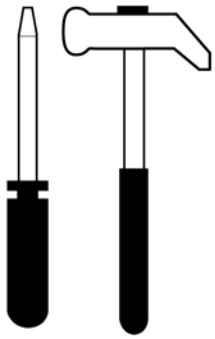
Specification	Desc./Quantity
	the auto-adaptability in short or long run.
Fuel pump in open circuit	Open or earthed circuit
Fuel pump short circuited	Short circuit
Front cylinder injector open circuit	This signal can also be shown by accident and not necessarily as a result of a problem
Front cylinder injector short circuit	short circuit
Rear cylinder injector open circuit	This signal can also be shown by accident and not necessarily as a result of a problem
Rear cylinder injector short circuit	short circuit
No engine rpm signal	-
Engine rpm signal	Displayed almost immediately (the vehicle can be started even when there is no signal). It is saved to MEM when the vehicle is off, then it can be deleted even if the problem persists
No cam signal	Displayed almost immediately (the vehicle can be started even when there is no signal). It is saved to MEM when the vehicle is off, then it can be deleted even if the problem persists
Front coil	-
Rear coil	-
Fan	Detects the relay error (open or short circuited). That is why it is not detected if one of the two fan connectors is detached
Stepper control	Detects if there is no idle motor check
Oil pressure bulb	-
Low battery voltage	-
High battery voltage	-
CAN line	Displayed if the CAN line is not correct or there is no signal: for instance when the instrument panel is disconnected
Control unit	-
Not initialised control unit	Carry out this command: Initialised control unit on the Adjustable parameters screen page
RAM error	-
Control unit	-
Open start-up relay	Right rear position
Start-up relay short circuited	Short circuit
Throttle position sensor	The bike still works because it uses the intake vacuum values.

Specification	Desc./Quantity
TPS alignment interrupted	Displayed if the "Throttle self-learning position" or "initialisation" have failed because of a problem in the throttle potentiometer signal
Intake pressure low signal	-
Intake pressure high signal	-
Excessive cut-off time	-
Water temperature too high	This error is displayed if the control unit detects a water temperature value above 115 °C (239 °F)
Low oil pressure	This error is displayed if the control unit detects low oil pressure after the engine has been started
Low atmospheric pressure sensor	Displayed in case of low or null voltage (for instance interrupted circuit)

Adjustable parameters screen page

ADJUSTABLE PARAMETERS

This screen page is used to adjust some control unit parameters



ADJUSTABLE PARAMETERS

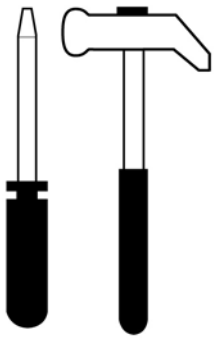
Specification	Desc./Quantity
Initialisation	To zero set the adjustable parameters when the control unit or the throttle body or the injectors are replaced (it may occur that during the first seconds after the start-up, it remains at 5000 rpm). The engine start-up number counter, displayed on the frozen error parameters, is reset
Throttle position self-learning	Autodetection by the control unit of the throttle position sensor and the idle motor (if the sensor or motor are replaced)
CO adjustment 1	Adjustment only through PASSWORD if it is not possible to balance the CO with the by-pass screws
CO adjustment 2	Adjustment only through PASSWORD if it is not possible to balance the CO with the by-pass screws

Specification	Desc./Quantity
Engine option	Set 1 if you wish to activate the standard mapping; set 2 if you wish to activate the Racing mapping (only with unmuffled exhaust pipes! for instance Akrapovic)
Lambda probe	Adjustment only through PASSWORD: if you wish to deactivate the lambda probe, regardless of the mapping type
Idle motor	Adjustment only through PASSWORD: if you wish to deactivate the idle motor
Initialised control unit	Enabling needed when a new control unit is installed (enables a series of parameters): the same parameters shown on the DEVICES SCREEN PAGE can be seen

Freeze frame screen page

FROZEN PARAMETERS

These are the values read by the control unit at the moment when the selected error is detected



FROZEN PARAMETERS

Specification	Desc./Quantity
Engine load	Unlike the Engine parameter reading screen page, it is expressed in %
Water temperature	-
Air temperature	-
Battery voltage	- V
Intake pressure	Warning reading in kPa therefore for instance 62 kPa (8.99 PSI) are equal to 620 hPa (8.99 PSI) (unit of measurement used in the Engine parameter reading screen page)
Vehicle speed (km/h)	- km/h
Engine rpm	rpm
Throttle position (%)	%
Dwell point cyl. 1	° Ignition advance

Specification	Desc./Quantity
Engine in VL mode	-
Cut-off active	-
Frequency	Number of readings of the error by the control unit (included also the times the control unit switches on and carries out a check, for some types of errors). example value: 2
Ignition time (min)	Time elapsed from the ignition comparatively to the last reading of the error in question, for instance detected at the 3rd minute.
Riding cycles	Number of times the engine has been started at the time of the last reading of the error in question. The counter is reset if the Initialisation parameter is activated. Example value: 8
Operation time (minutes)	Total minutes of engine operation at the time of the last reading of the error in question. Cannot be reset (value stored in the control unit memory). Example value: 72 min

Reprogramming

Iso screen page

ISO DISPLAY

Specification	Desc./Quantity
Aprilia hardware	This the mapping code with the numbers inverted. If they are all zeros, this means that the control unit is blank (no mapping): the suitable mapping should be remotely uploaded (the note related to the mapping parameter can be seen). Example value: 135662000
Aprilia software	000000000 (not relevant field)
Mapping	Indicates the code of the configuration present on the control unit. Example value: 266531
Service number	-
Engine	V2 - 60° 990 (2-cylinder V engine, cylinder inclination, engine capacity)
Produced	dd/mm/yy (electronic control unit production date)
Programming date	dd/mm/yy (date of last mapping downloading: day/month/year)
Person in charge for last programming	Identification code of the PC or the Axone that loaded the last mapping

Parameter adjustment screen page

ADJUSTABLE PARAMETERS

Specification	Desc./Quantity
-	File belonging to mapping 266531. Update mapping 266531 with mapping 266532 using the **VC5L980$.BIX** file
VC5L980$.BIX	File belonging to mapping 266532. Similarly to RSV 1000 '04, with the "Engine option 1" setting, select the mapping for standard exhaust pipes, whereas with the "Engine option 2" setting, select the mapping for non-standard exhaust pipes (Street Legal, Slip on, etc.). Latest mapping compared with the 266531 version.
VC5L981$.BIX	File belonging to mapping 266533. Similarly to RSV 1000 '04, with the "Engine option 1" setting, select the mapping for standard exhaust pipes, whereas with the "Engine option 2" setting, select the mapping for non-standard exhaust pipes (Street Legal, Slip on, etc.)
VC5L982$.BIX	File belonging to mapping 266534. Similarly to RSV 1000 '04, with the "Engine option 1" setting, select the mapping for standard exhaust pipes, whereas with the "Engine option 2" setting, select the mapping for non-standard EVO 6 exhaust pipes

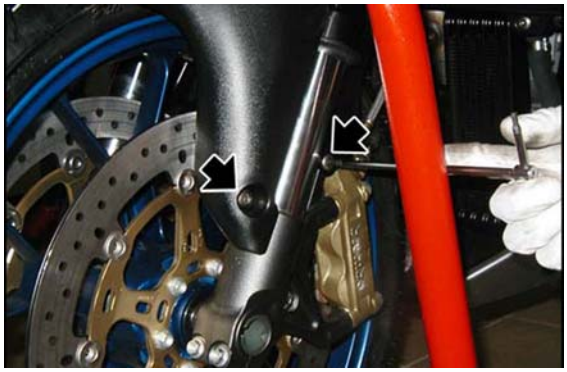
INDEX OF TOPICS

Front

Removing the front wheel

- Hold the scooter front part.

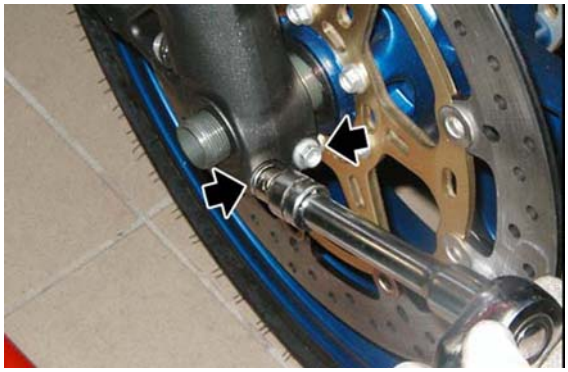
- Undo the screws fixing the front mudguard and remove it.



- Undo the screws fixing the front pliers and slide them off the disc.

- Remove the wheel pin fixing nut.
- Collect the sealing washer.

- Loosen the screws on the wheel pin clamps.



- Tap the wheel pin with a rubber hammer so that the holes on the opposite side are exposed.
- Remove the wheel pin by inserting a screwdriver in the holes on the pin.

- During extraction, support the wheel and then remove it.

Checking the front wheel

FRONT WHEEL BEARINGS

Carry out the check with the bearings fitted on the wheel.

CHECK THAT ALL THE PARTS ARE IN GOOD CONDITIONS, ESPECIALLY THOSE MENTIONED BELOW.

ROTATION CHECK

- Manually rotate the inside ring of each bearing. Rotation must be constant, smooth and noiseless.

If one or both bearings do not fall within the control parameters:

- Replace both wheel bearings.

RADIAL AND AXIAL CLEARANCE CHECK

- Check the radial and axial clearance.

Axial clearance: a minimum axial clearance is allowed.

Radial clearance: none.

If one or both bearings do not fall within the control parameters:

- Replace both wheel bearings.

ALWAYS REPLACE BOTH BEARINGS.

ALWAYS REPLACE THE BEARINGS WITH OTHERS OF THE SAME TYPE.

GASKETS

- Check that the gaskets are in good conditions; replace them if they show signs of damage or excessive wear.

ALWAYS REPLACE BOTH GASKETS.

ALWAYS REPLACE THE GASKETS WITH OTHERS OF THE SAME TYPE.

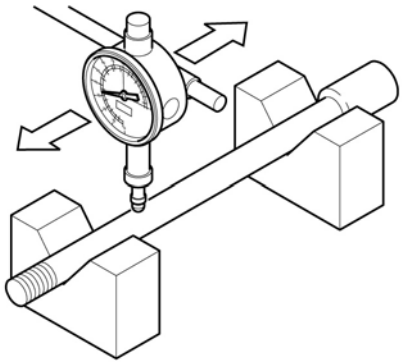
WHEEL PIN

- Using a dial gauge, check the wheel pin eccentricity. If the eccentricity exceeds the limit value, replace the wheel pin.

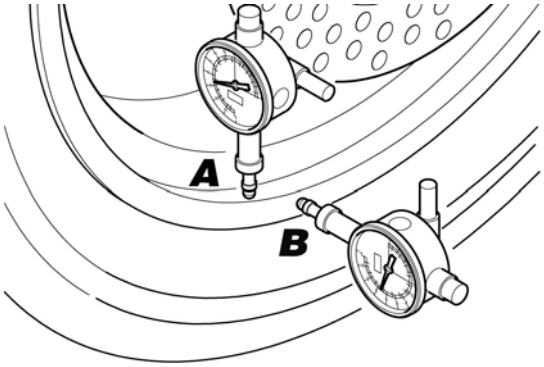
Characteristic

Maximum eccentricity:

0.25 mm (0.0098 in)



- Using a dial gauge, check that the radial (A) and the axial (B) eccentricities of the rim do not exceed the limit value. An excessive eccentricity is usually caused by worn or damaged bearings. Replace the rim if, after replacing the bearings, the value is not within the specified limit.



Characteristic

Maximum radial and axial eccentricity:

2 mm (0.0079 in)

FRONT WHEEL BEARINGS REMOVAL

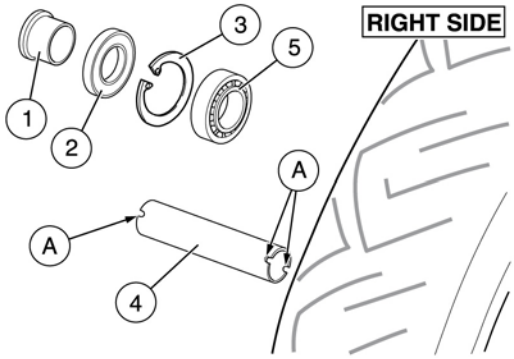
- Remove the front wheel.
- Clean the two sides of the hub with a cloth.

Working from the wheel right side:

- Remove the right spacer (1).
- Remove the sealing gasket (2).
- Remove the circlip (3).

CAUTION

THE CIRCLIP (3) IS FITTED ONLY ON THE WHEEL RIGHT SIDE.



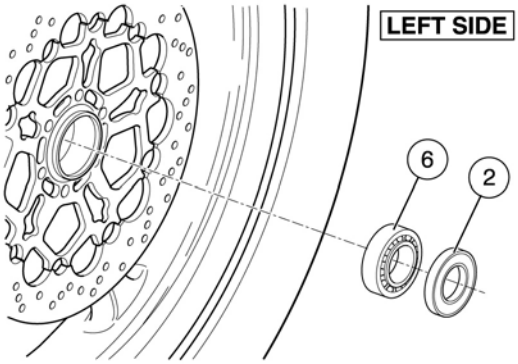
The spacer end (4) is fitted with slots (A) for the extractor teeth to pass through.

- Remove the right bearing (5) with the suitable extractor.

Specific tooling

8140180 Bearing extractor

- Collect the inside spacer (4).



Working from the wheel left side:

- Remove the sealing gasket (2).
- Remove the left bearing (6) with the suitable extractor.

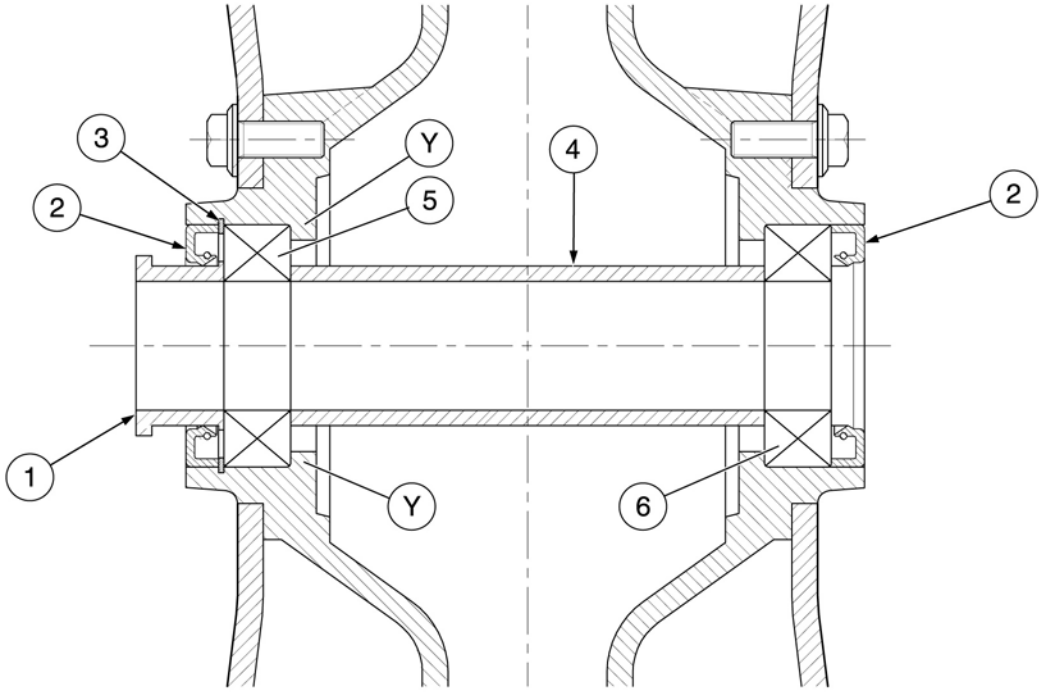
Specific tooling

8140180 Bearing extractor

- Clean the inside of the hub thoroughly.

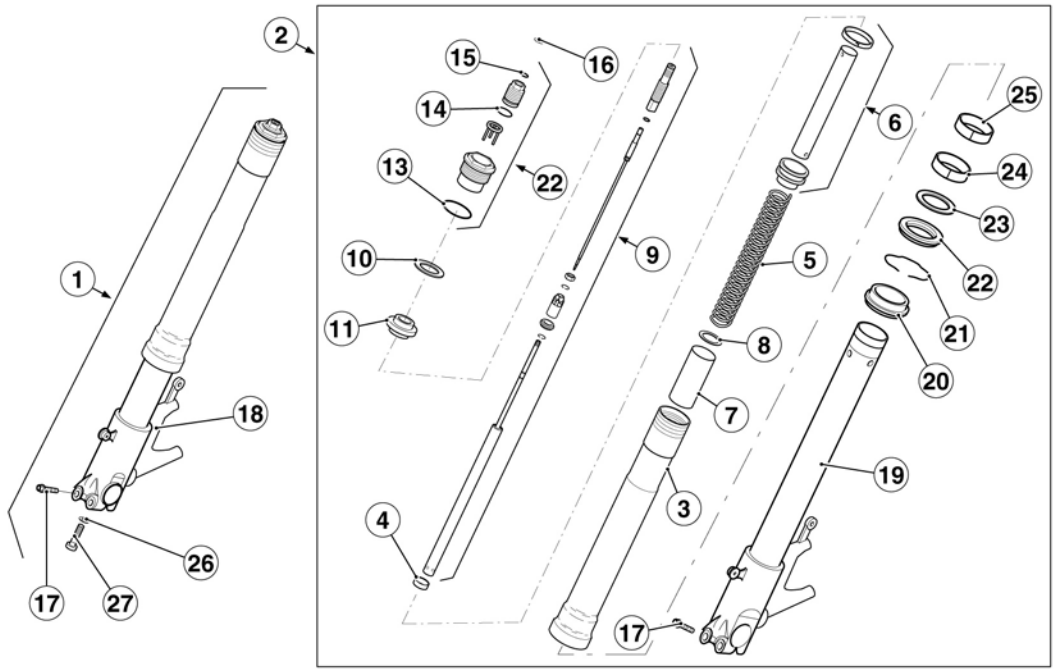
CAUTION

WASH ALL THE PARTS WITH CLEAN DETERGENT.



Front fork

Diagram



Key:

1. Radial fork right stem

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

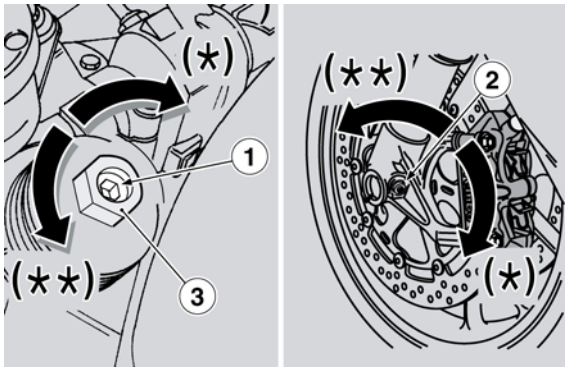
Adjustment

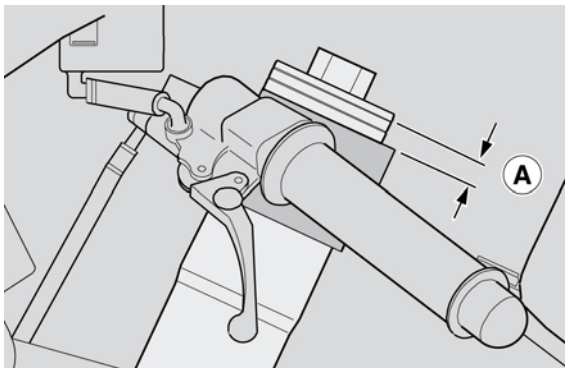
STANDARD FORK

Standard front fork setting is adjusted to suit most high and low speed riding conditions, whether the vehicle is partially or fully loaded.
However, this set can be modified for specific needs according to vehicle use.

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

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





STANDARD FORK ADJUSTMENT

Specification	Desc./Quantity
Rebound damping adjustment, screw (1)	open 1.5 turns (anticlockwise) from fully closed (clockwise)
Compression damping adjustment, screw (2)	open 1 turn (anticlockwise) from fully closed (clockwise)
Spring preloading, nut (3)	open 5 protrusion notches (anticlockwise) from fully closed (clockwise)
Stems (A) protrusion from top plate (excluding cover)	(for this type of adjustment, take your vehicle only to an official **aprilia** dealer) 1 protrusion notch

OHLINS FORK

Standard front fork setting is adjusted to suit most high and low speed riding conditions, whether the vehicle is partially or fully loaded.

However, this set can be modified for specific

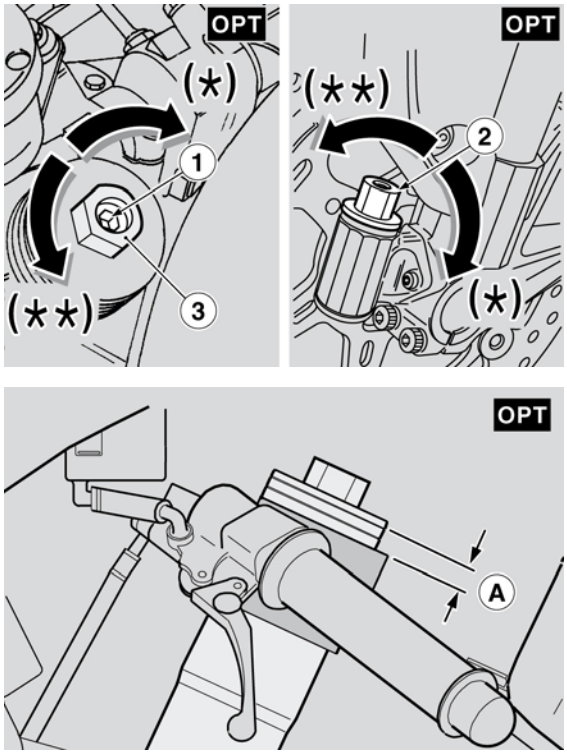
needs according to vehicle use.

NOTE

TO COUNT THE NUMBER OF CLICKS AND/OR TURNS OF THE SET SCREWS (1-2) ALWAYS START FROM THE MOST RIGID SETTING (SET SCREW FULLY CLOCKWISE).

USE THE SET SCREWS (1-2) AS REFERENCES FOR ADJUSTING THE HYDRAULIC COMPRESSION / REBOUND DAMPING.

GRADUALLY TURN THE SET SCREWS (1 -2) ONE NOTCH AT A TIME.



OHLINS FORK ADJUSTMENT

Specification	Desc./Quantity
Rebound damping adjustment, screw (1)	loosen 12 clicks (anticlockwise) from fully closed (clockwise)
Compression damping adjustment, screw (2)	open 12 clicks (anticlockwise) from fully closed (clockwise)
Spring preloading, nut (3)	loosen 8 turns (clockwise) from fully open (anticlockwise)
Stems (A) protrusion from top plate (excluding cover)	(for this type of adjustment, take your vehicle only to an official **aprilia** dealer) 4 protrusion notches

Removing the fork legs

- Remove the front wheel.
- Support the fork stem and loosen the screws on the upper and then the lower plate.
- Remove the fork stem.

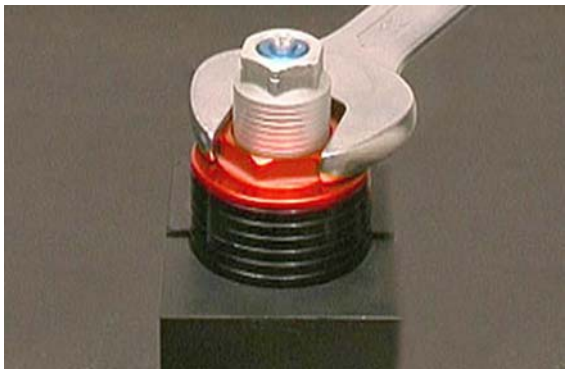
Draining oil

- Lock the clamp sleeve using the specified tool.
- Reduce spring load to the minimum.

Specific tooling

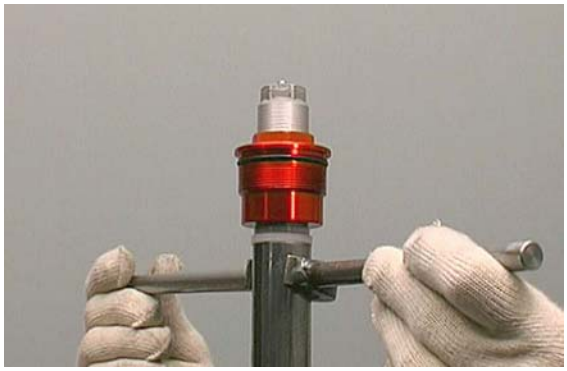
8140149 Cover removal operations

- Unscrew the sleeve top cap.

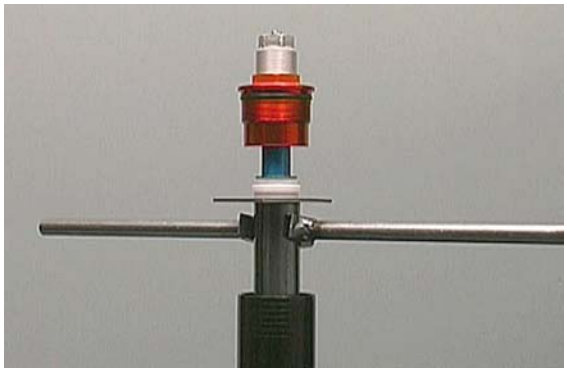


- Lock the fork end on a vice paying attention not to damage it.

- Fit the specified tool on the spring coupling.

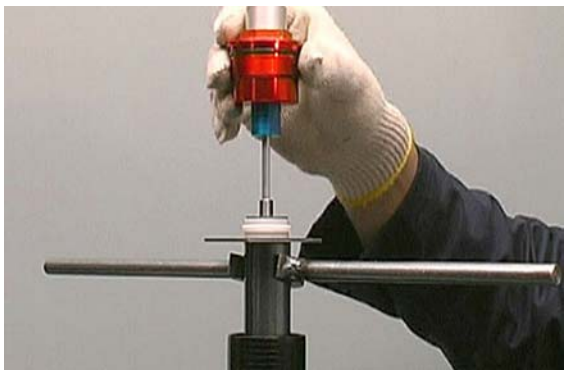


- Push down the tool to compress the spring and then fit the tool spacer below the cartridge lock nut.



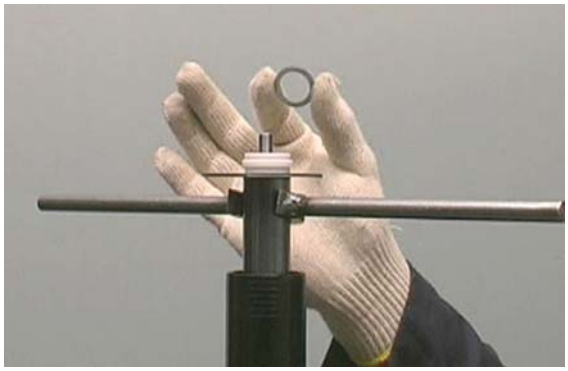
- Loosen the cap by the key grip and by making the lock nut turn.

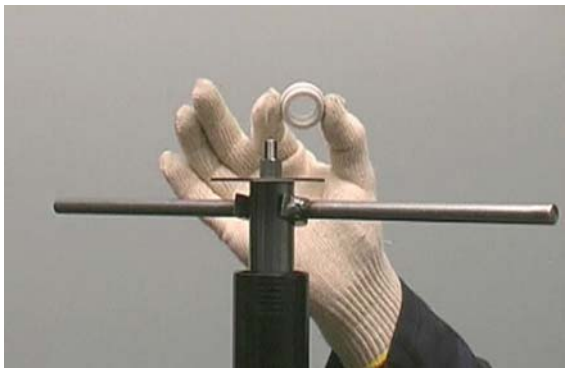
- Remove the complete cap.



- Remove the spacer and the washer.
- Push down and compress the spring,

slide off the spacer.





- Remove the spring coupling.

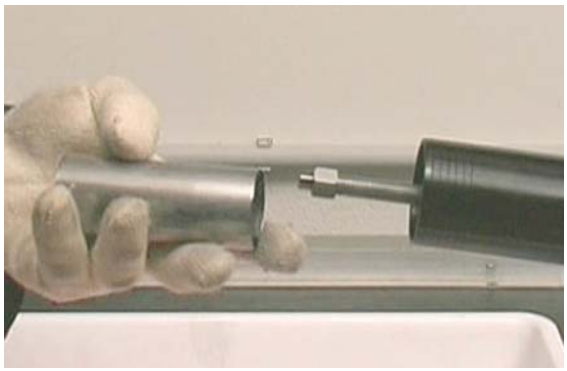
- Drain off oil into a collecting container and remove the spring.

Disassembling the fork

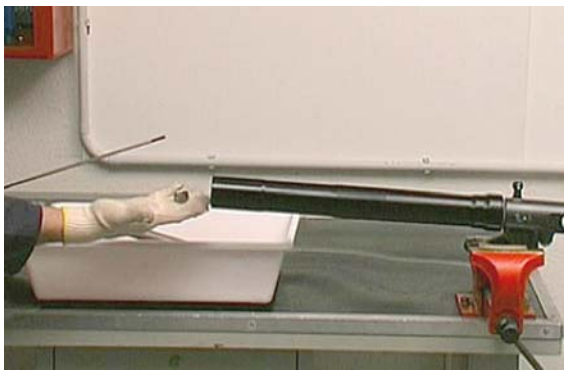
- After emptying the oil, fix the fork end

in a vice.

- Remove the washer and the bottom spacer.

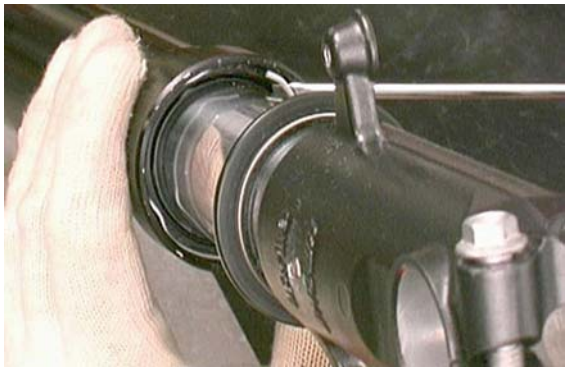


- Unscrew the cartridge fixing screws on the fork end.
- Collect the centring bushing.



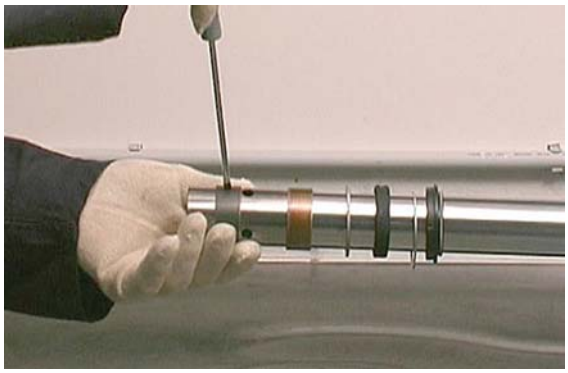
- Remove the dust scraper from the sleeve using a screwdriver as a lever.
- During this operation, pay attention not to damage the sleeve rim.

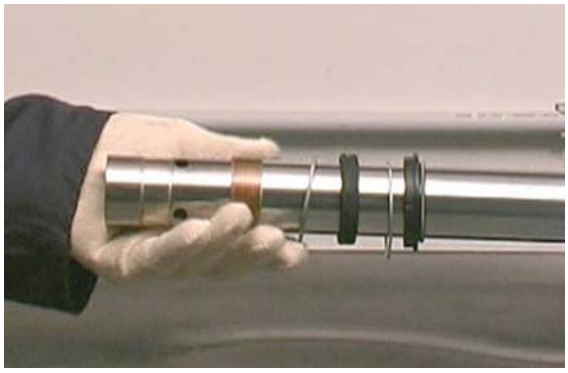
- Remove the snap ring.

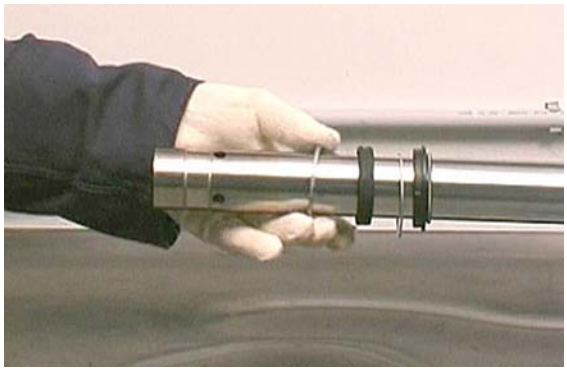


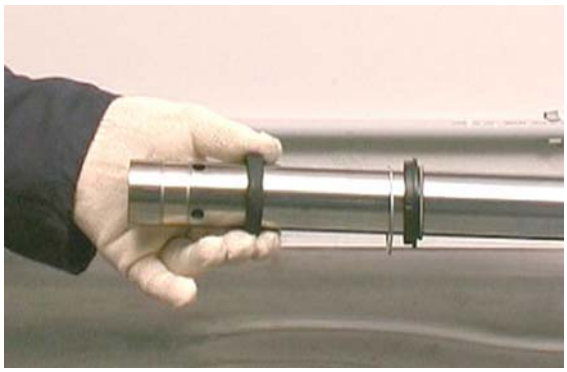
- Remove the sleeve from the stem using the sleeve itself as a hammer.

- Remove the fixed bushing fitted, the stem, the movable bushing, the ring and the oil seal from the stem.

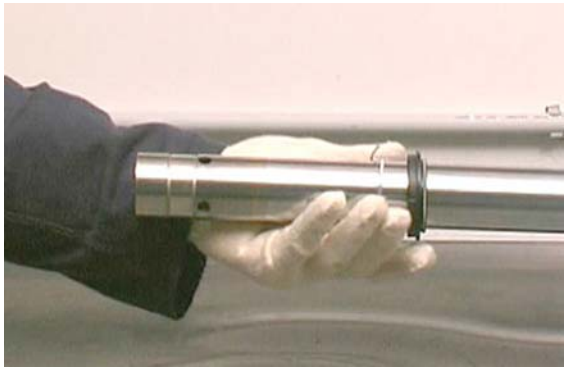








- Remove the ring and the dust guard.



Checking the components

Stem

Check the sliding surface for scorings and/or scratches.

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

If the scorings are deep, replace the stem.

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

If over the value, replace the stem.

CAUTION

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

Characteristic

Bending limit:

0.2 mm (0.00787 in)

Sleeve

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

Spring

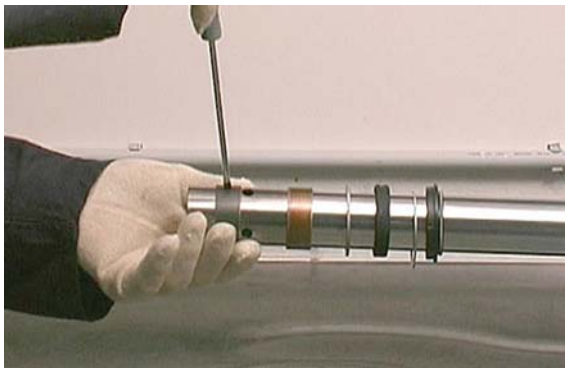
Check that the spring is in good conditions, check that spring length is within the limit value.

If the length does not correspond to the limit value, replace the spring.

UNLOADED SPRING MINIMUM LENGTH: 284 mm (11.2 in)

Check that the following components are in good conditions:

- sliding bushing;
- guide bushing;



- pumping member.

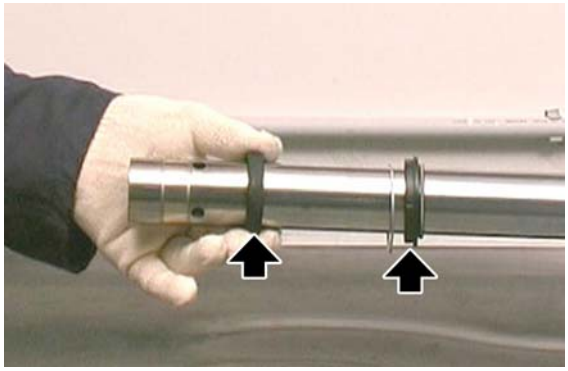
If there are signs of excessive wear or damage, replace the affected component.

CAUTION

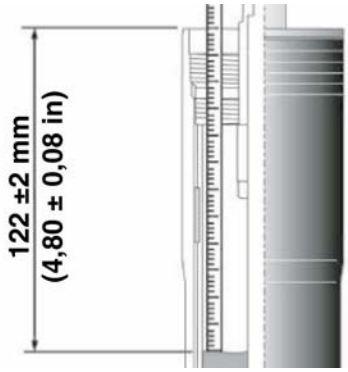
REMOVE ANY IMPURITY IN THE BUSHINGS, TAKING CARE NOT TO SCRATCH THEIR SURFACE.

Replace the following components with new ones:

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



Oil level: 122 ± 2 mm (4.80 ± 0.08 in) (from the sleeve rim).



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

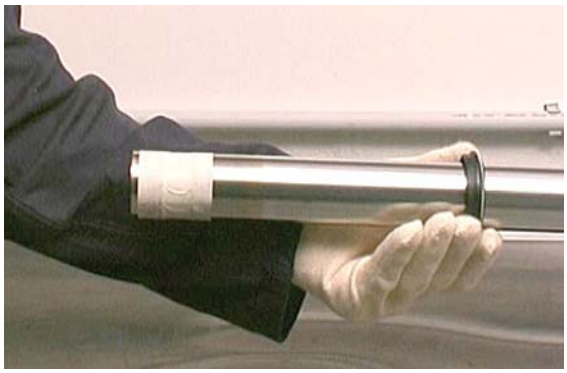
Characteristic

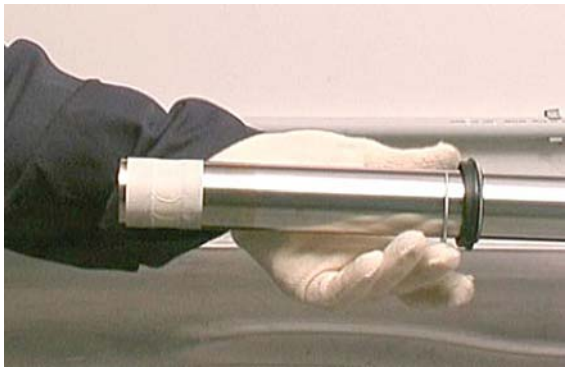
Oil for R fork

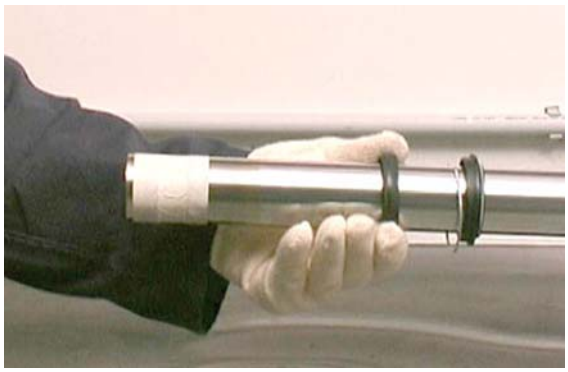
520.0 +/- 2.5 cm³ (31.73 +/- 1.15 cu.in) (for each stem)

Reassembling the fork

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

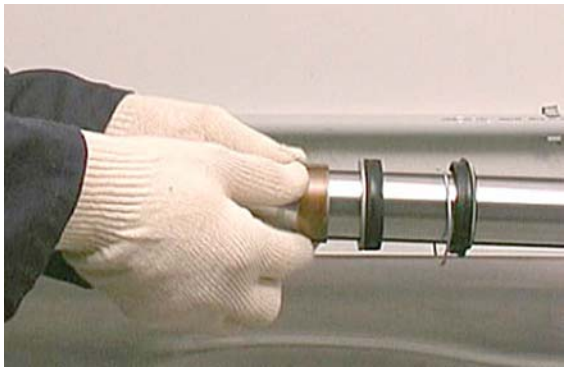






- This last component must be fitted with the stamped side facing towards the dust guard.

- Proceed to install the ring, the movable bushing and, after removing the tape, the fixed bushing.



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

Specific tooling

8140189 Oil seal fitting tool for Ø 43 mm (1.69 in) holes

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

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

- Insert the snap ring into its position.

- Insert the oil seal with the specified tool.

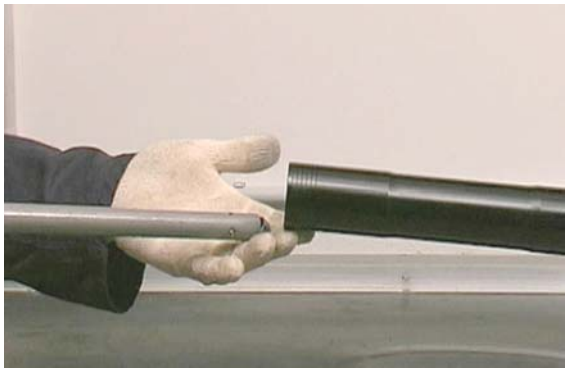
Specific tooling

8140189 Oil seal fitting tool for Ø 43 mm (1.69 in) holes

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

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

- Fit the centring bushing on the cartridge and fit this unit to the fork.



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

- Insert the lower spacer and the washer.

- Fit the fork spring.
- Fill with fork oil.

Filling oil

- Keep the sleeve in vertical position.
- Fill up the fork so that air bubbles trapped inside are freed.
- Fit the spring coupling.

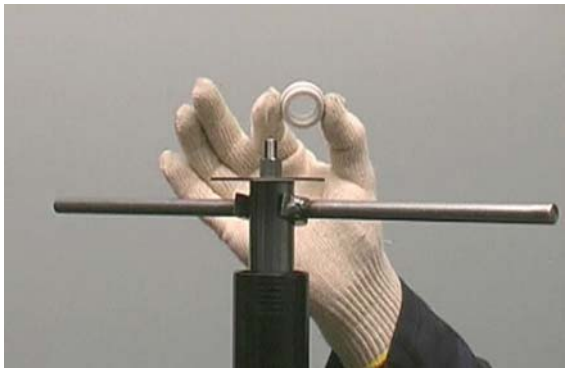
- Fit the specified tool on the spring coupling so that the cartridge stem is locked in position.

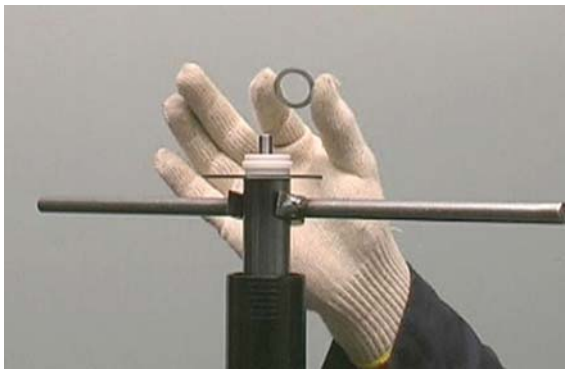
Specific tooling

8140147 Spacer holder tool

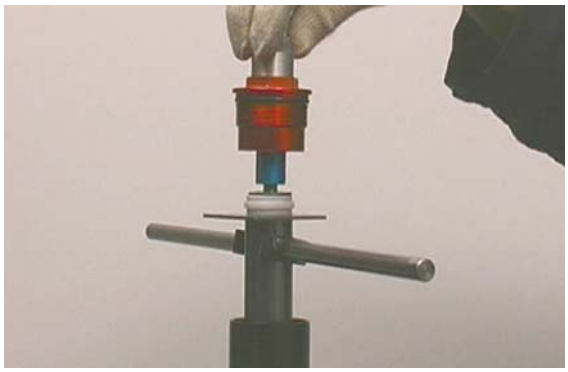
8140148 Spacer / pumping member separating plate

- Fit the spacer and the washer.

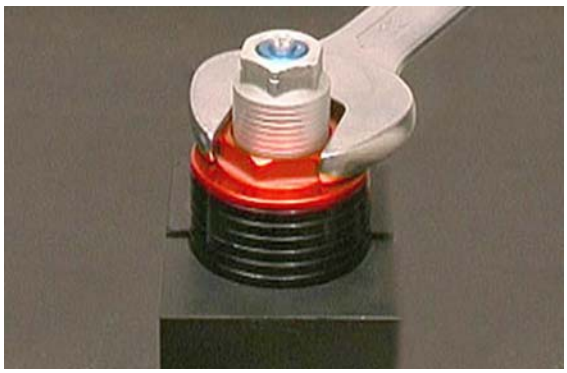




- Screw the top cap on the cartridge stem.



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

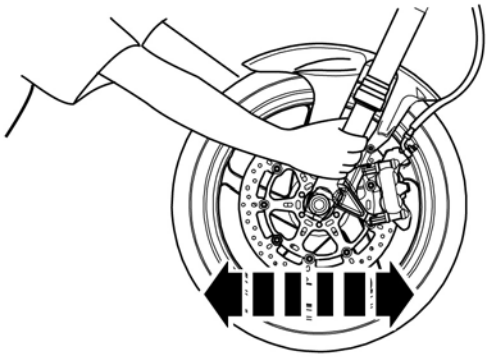


Steering bearing

Adjusting play

Steering bearings and steering clearance:

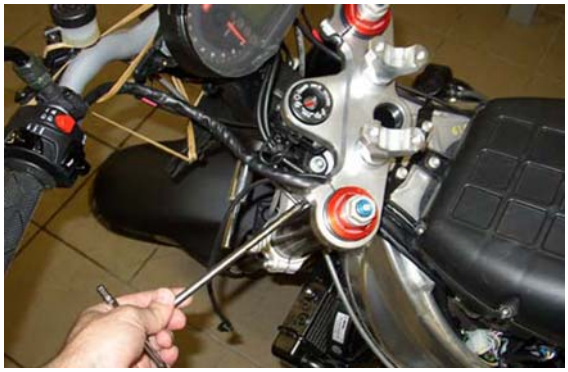
- Place the vehicle on the specific central service stand.
- Shake the fork in the riding direction.
- Adjust if clearance is detected.



- Unscrew and remove the four screws of the fixing U-bolt.
- Remove the U-bolt.
- Remove the handlebar and place it paying attention that oil in the clutch and front brake reservoirs does not spill out.

- Unscrew and remove the top bolt on the headstock and collect the washer.

- Loosen the screws fixing the fork stems to the upper plate.



- Slide off the fork upper plate by moving it towards the instrument panel.

- Rivet the safety washer on the headstock.

- Unscrew the upper ring nut and then remove the safety washer.

Specific tooling

8140190 Tool for steering tightening

- Adjust the preloading of the steering bearings by tightening the lower ring nut to the prescribed torque.

- Fit the safety washer.

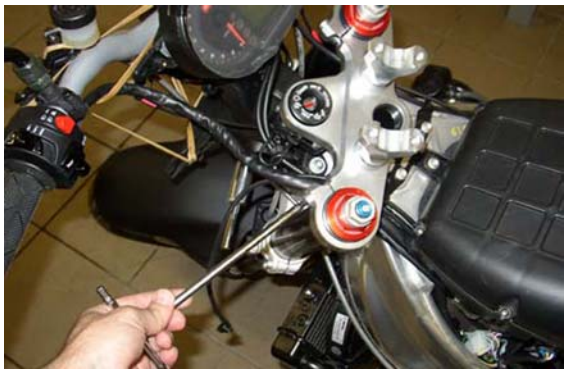
- Fit and tighten the upper ring nut so that the grooves match the tongues of the safety washer.

- Rivet the tongues on the upper ring nut.

- Fit the upper fork plate.

- Screw the top bolt on the headstock by tightening it to the prescribed torque.

- Tighten the screws fixing the fork stems to the upper plate to the prescribed torque.



- Fit the handlebar.
- Fit the fixing U-bolt.
- Tighten the four screws of the fixing U-bolt to the prescribed torque.

Rear

Removing the rear wheel

- Place the vehicle on the specific rear service stand.
- Loosen and remove the wheel pin nut.
- Collect the shoulder washer and the left chain tightener pad.

- Hit slightly on the wheel pin so as to remove the head from the housing.
- Move the wheel forward and release the transmission chain from the crown.

- Slide off the wheel bolt together with the right chain guide pad.
- Remove the whole wheel releasing the disc from the brake calliper.

- Holding the outer rim of the crown gear with both hands, slide off the final transmission unit by pulling it parallel to the wheel axis.

OPERATE WITH CAUTION. IF THE FINAL TRANSMISSION UNIT IS INSTALLED ON THE ANTI-VIBRATION BUFFER HOLDER, DO NOT TURN OVER O ROTATE THE REAR WHEEL CROWN SIDE HORIZONTALLY, OR THE FINAL TRANSMISSION UNIT COULD SLIDE OUT AND FALL, AND THE CROWN GEAR MAY GET DAMAGED.

CAUTION

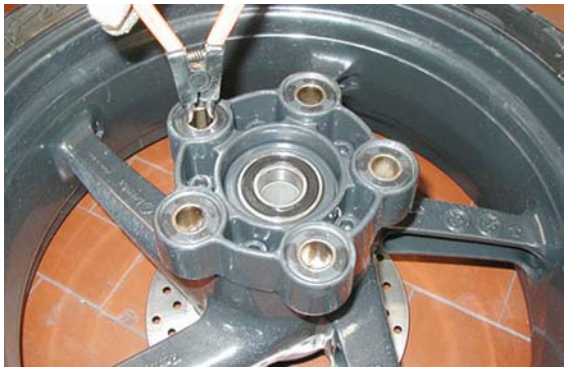
DO NOT UNSCREW THE FIVE NUTS. THE FINAL TRANSMISSION UNIT CAN BE SLID OFF COMPLETELY FROM THE ANTI-VIBRATION BUFFER HOLDER.

- Remove the final transmission unit.

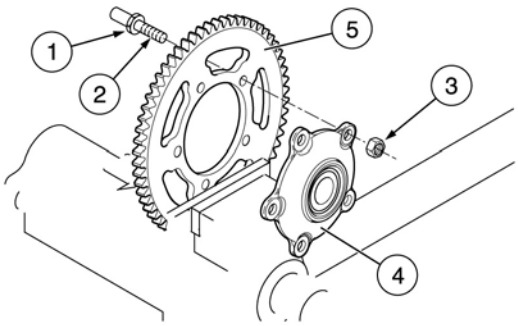
CAUTION

THE ANTI-VIBRATION BUFFERS REMAIN FITTED ON THEIR HOLDER.

- Remove all the anti-vibration buffers.



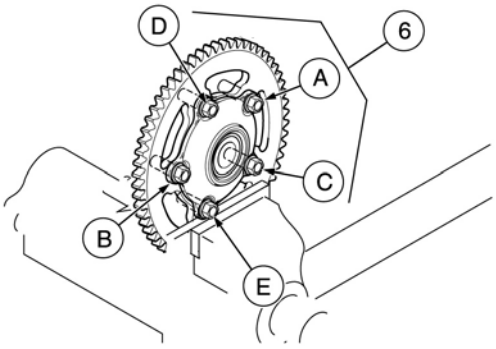
- Using an Allen spanner on the related seat (1), lock the rotation of the threaded pin (2), unscrew and remove the self-locking nut (3) and the threaded pin (2).



THE SELF-LOCKING NUTS (3) MUST BE REPLACED EVERY THREE CROWN GEAR REMOVALS.
REPLACE THE SELF-LOCKING NUTS (3) WITH NUTS OF THE SAME TYPE.

- Remove the crown gear holder (4).
- Clean the crown gear (5) and the crown gear holder (4) with clean deter-

gent.



Reassembly:

- Insert the five threaded pins (2) to the crown gear (5).
- Assemble the crown gear holder to the crown gear - threaded pins unit.
- Screw the five self-locking nuts (3) manually.

NEVER INSTALL THE FINAL TRANSMISSION UNIT (6) ON THE WHEEL TO TIGHTEN THE SELF-LOCKING NUTS.

TO PROTECT THE CROWN GEAR, INSTALL (WOODEN OR ALUMINIUM) PROTECTIONS ON THE VICE JAWS. LOCK THE CROWN GEAR ONLY IN A VICE. DO NOT LOCK ANY OTHER COMPONENT OF THE FINAL TRANSMISSION UNIT.

- Lock crown gear in a vice.

CAUTION

TO AVOID POTENTIAL DISTORTIONS AND/OR INCORRECT COUPLING, TIGHTEN AS FOLLOWS:

- Using an Allen key on the specific seat (1), lock the rotation of the threaded pin (2), and applying half the specified torque, tighten the diametrically opposed elements in this sequence: (A) (B) (C) (D) (E).
- Repeat this operation applying the specified torque.

CAUTION

IN THIS WAY THE PRESSURE EXERTED BY THE FIXING ELEMENTS WILL BE EVENLY DISTRIBUTED ON THE COUPLING SURFACE.

Checking the rear wheel

CHECK THAT ALL THE PARTS ARE IN GOOD CONDITIONS, ESPECIALLY THOSE MENTIONED BELOW.

REAR WHEEL BEARINGS

Carry out the check with the bearings fitted on the wheel.

ROTATION CHECK

- Manually rotate the inside ring of each bearing. Rotation must be constant, smooth and noiseless.

If one or both bearings do not fall within the control parameters:

- Replace both wheel bearings.

ALWAYS REPLACE BOTH BEARINGS.

ALWAYS REPLACE THE BEARINGS WITH OTHERS OF THE SAME TYPE.

- Check the radial and axial clearance.

Axial clearance: a minimum axial clearance is allowed.

Radial clearance: none.

If one or both bearings do not fall within the control parameters:

- Replace both wheel bearings.

REAR WHEEL GASKETS

- Check that the gaskets are in good conditions; replace them if they show signs of damage or excessive wear.

ALWAYS REPLACE BOTH GASKETS.

ALWAYS REPLACE THE GASKETS WITH OTHERS OF THE SAME TYPE.

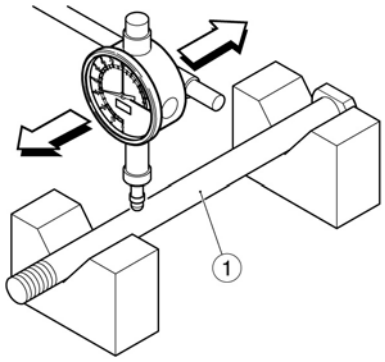
REAR WHEEL PIN

- Using a dial gauge, check the wheel pin eccentricity (1). If the eccentricity exceeds the limit value, replace the wheel pin (1).

Characteristic

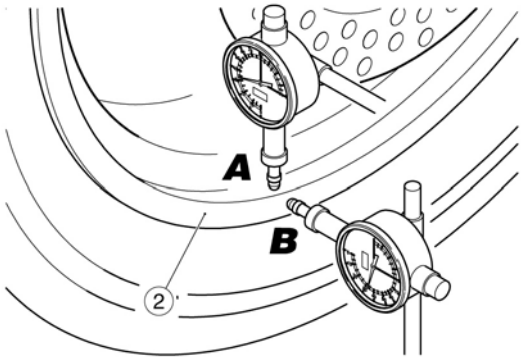
Maximum eccentricity:

0.25 mm (0.0098 in)



REAR WHEEL RIM

- Using a dial gauge, check that the radial (A) and the axial eccentricity (B) of the rim (2) do not exceed the limit value.



An excessive eccentricity is usually caused by worn or damaged bearings. Replace the rim (2) if after replacing the bearings, the value is not within the specified limit.

Characteristic

Maximum radial and axial eccentricity:

2 mm (0.0079 in)

FINAL TRANSMISSION UNIT BEARINGS

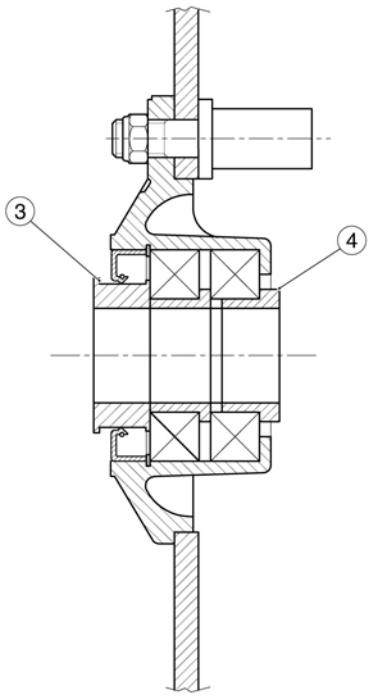
Carry out the check with the bearings fitted on the final transmission unit.

ROTATION CHECK

- Remove the left spacer (3).
- Remove the right spacer (4).
- Manually rotate the inside ring of each bearing. Rotation must be constant, smooth and noiseless.

If one or both bearings do not fall within the control parameters:

- Replace both bearings of the final transmission unit.



RADIAL AND AXIAL CLEARANCE CHECK

- Check the radial and axial clearance. Axial clearance: a minimum axial clearance is allowed. Radial clearance: none.

If one or both bearings do not fall within the control parameters:

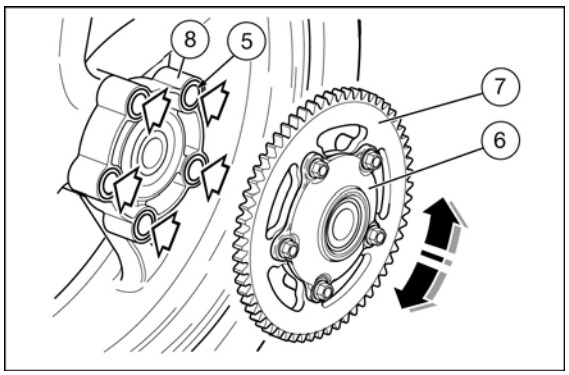
- Replace both bearings of the final transmission unit.

ANTI-VIBRATION BUFFERS

Check that the anti-vibration buffers (5) are not damaged or excessively worn.

To check:

- Fit the entire final transmission unit (6) to the wheel.
- Manually rotate the crown gear (7) to right and left, and check the clearance between the anti-vibration buffers (5) and their holder (8).



If there is excessive clearance:

- Replace all the anti-vibration buffers (5).

ALWAYS REPLACE ALL THE ANTI-VI-
BRATION BUFFERS WITH OTHERS OF THE
SAME TYPE.

CROWN GEAR

- Check the crown gear (7) toothing for proper conditions.

If there is excessive wear:

- Replace the crown gear.

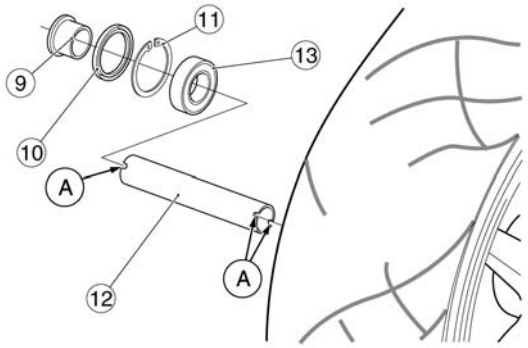
TO PREVENT EARLY WEAR OF NEW COMPONENTS, REPLACE THE CROWN GEAR, PINION AND TRANSMISSION CHAIN AT THE SAME TIME.

REAR WHEEL BEARINGS

- Remove the rear wheel.
- Clean the two hub sides with a cloth.

Working from the wheel right side:

- Remove the right spacer (9).
- Remove the sealing gasket (10).
- Remove the circlip (11).



CAUTION

THE CIRCLIP (11) IS FITTED ONLY ON THE
WHEEL RIGHT SIDE.

The spacer end (12) is fitted with slots (A) for the extractor teeth to pass through.

- Take out the right bearing (13) with the specific extractor.

Specific tooling

8140180 Bearing extractor

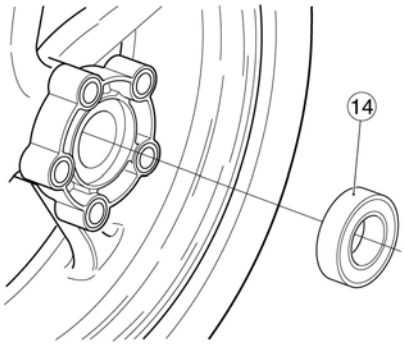
- Collect the inside spacer (12).

Working from the wheel left side:

- Take out the left bearing (16) with the specific extractor.

Specific tooling

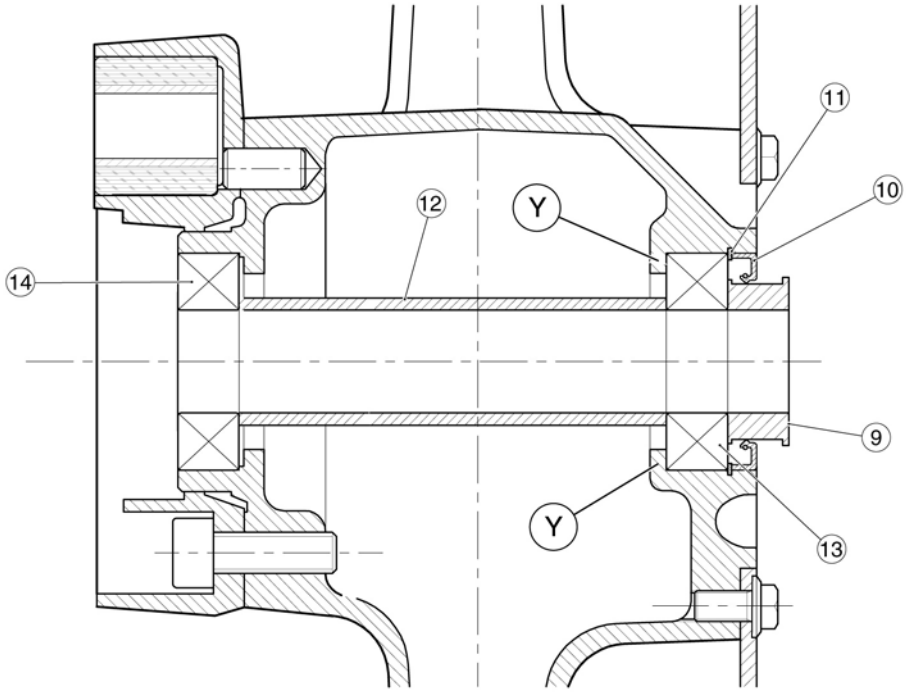
8140180 Bearing extractor



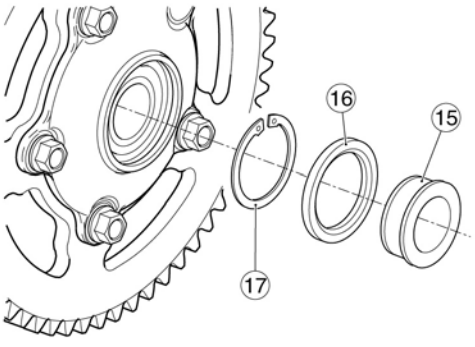
- Clean the inside of the hub thoroughly.

CAUTION

WASH ALL THE PARTS WITH CLEAN DETERGENT.



FINAL TRANSMISSION UNIT - BEARING REMOVAL

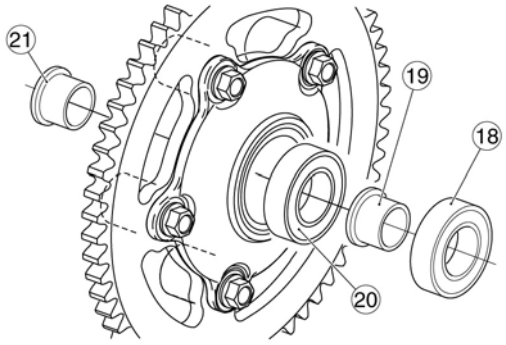


- Remove the final transmission unit.
- Clean the two sides of the hub with a cloth.
- Remove the left spacer (15).
- Remove the sealing gasket (16).
- Remove the circlip (17).

CAUTION

THE CIRCLIP (17) IS FITTED ONLY ON THE FINAL TRANSMISSION UNIT, LEFT SIDE.

- Take out the left bearing (18) with the specific extractor.
- Recover the internal spacer (19).
- Take out the right bearing (20) with the specific extractor.
- Collect the right spacer (21).
- Clean the inside of the hub thoroughly.

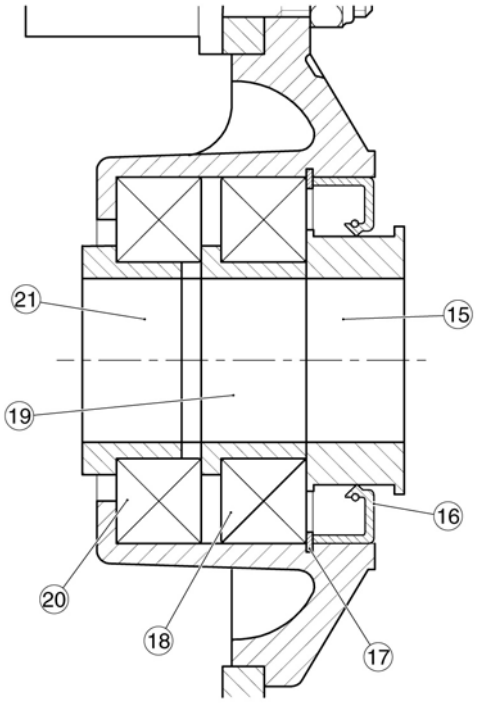


CAUTION

WASH ALL THE PARTS WITH CLEAN DETERGENT.

Specific tooling

8140180 Bearing extractor



Shock absorbers

Adjusting

BEARINGS

Make the bearings turn manually; they must rotate smoothly, continuously and silently.

There must be no axial clearance.

Replace the bearings if they present these problems.

Apply grease on the rollers.

GASKETS

Check that the gaskets are in good conditions; replace them if they show signs of damage or excessive wear.

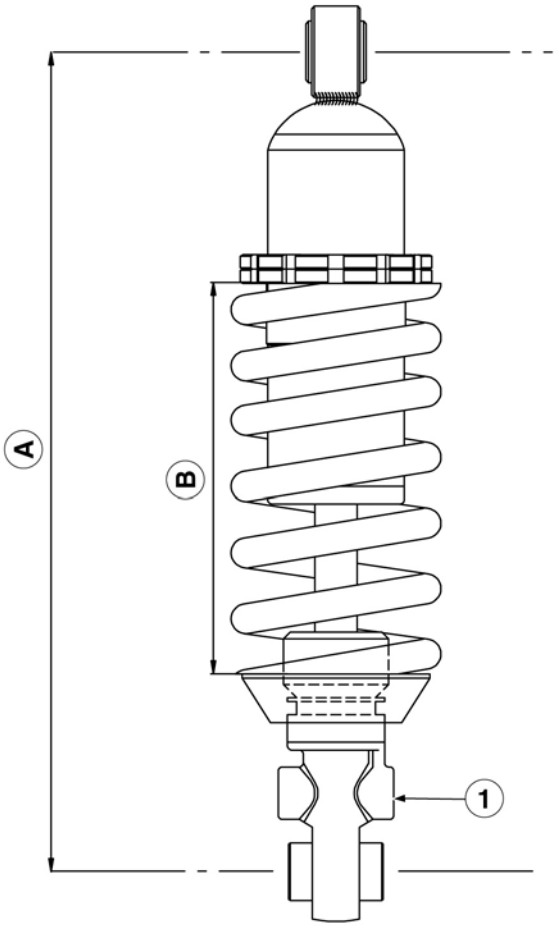
SHOCK ABSORBER

Check that the shock absorber shows no oil leaks and that it moves smoothly and progressively. Otherwise, replace the shock absorber.

Standard shock absorber

CHECK THAT NO COMPONENT IS EVIDENTLY DISTORTED, DAMAGED, CRACKED AND/OR DENTED.

REPLACE ALL DAMAGED COMPONENTS.



STANDARD SHOCK ABSORBER SETTING

Standard adjustment

Specification	Desc./Quantity
Length of (pre-loaded) spring (B)	147 mm (5.79 in)
Rebound adjustment, screw (1)	open 25 clicks (anticlockwise) from fully closed (clockwise)

OHLINS shock absorber

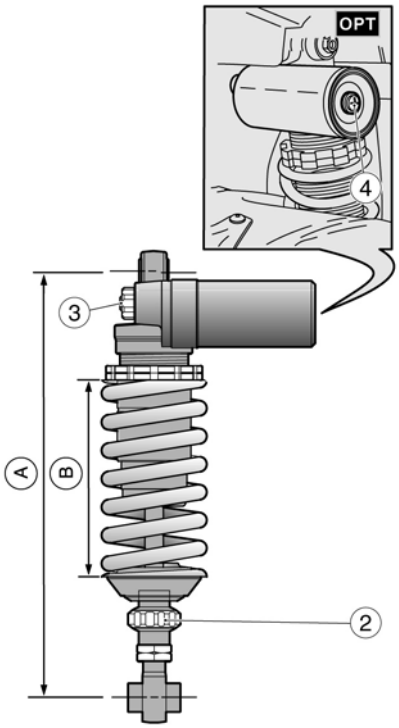
SET SPRING PRELOADING AND SHOCK ABSORBER HYDRAULIC REBOUND DAMPING ACCORDING TO THE VEHICLE USES.

IF THE SPRING PRELOADING IS INCREASED,

HYDRAULIC REBOUND DAMPING SHOULD BE INCREASED ACCORDINGLY TO AVOID SUDDEN JERKS WHEN RIDING.

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

TO AVOID COMPROMISING THE SHOCK ABSORBER OPERATION, DO NOT LOOSEN SCREW (4) AND DO NOT TAMPER WITH THE DIAPHRAGM UNDERNEATH, AS NITROGEN MAY COME OUT RESULTING IN RISK OF ACCIDENTS.



OHLINS SHOCK ABSORBER SETTING

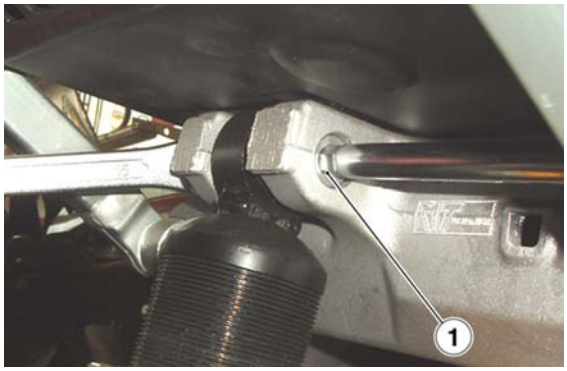
Standard adjustment

Specification	Desc./Quantity
shock absorber centre to centre distance (A)	312 ± 1.5 mm (12.28 ± 0.59 in)
Length of (pre-loaded) spring (B)	145 mm (5.71 in)
Rebound adjustment, ring nut (2)	open 20 clicks (anticlockwise) from fully closed (clockwise)
Compression adjustment, knob (3)	open 12 clicks (anticlockwise) from fully closed (clockwise)

Removing

- Secure the vehicle using a belt and a hoist.
- Working on the right side, unscrew the

upper screw (1) but do not remove it; collect the nut.



- Working on the left side, unscrew the lower screw (2) but do not remove it; collect the nut.
- With the hoist, hold the vehicle without lifting it from the ground, thus lightening the weight on the swing arm.
- Remove the upper screw (1).
- Remove the lower screw (2).

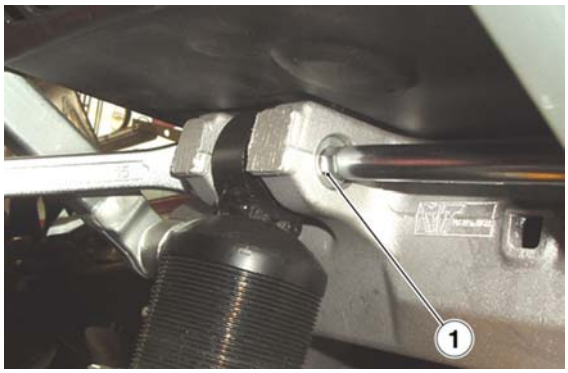
- Take out the rear shock absorber (3) through the swing arm and the rear frame.

Installing

- Fit in the shock absorber (3) through the swing arm and the rear frame.

- Insert the lower screw (2).
- With the hoist, align the frame hole with the upper fixing of the rear suspension.
- Insert the upper screw (1).
- Working on the right side, screw the nut on the lower screw (2).

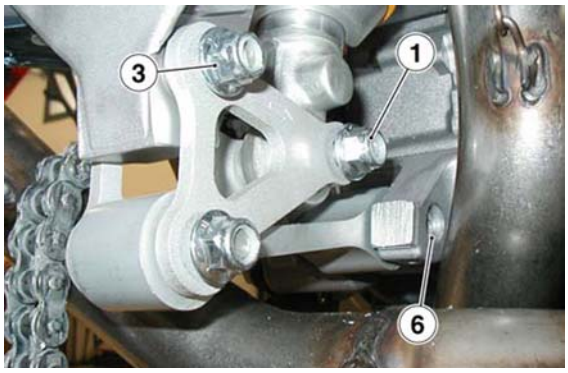
- Working on the left side, screw the nut on the upper screw (1).
- Free the vehicle from the belt and the hoist.

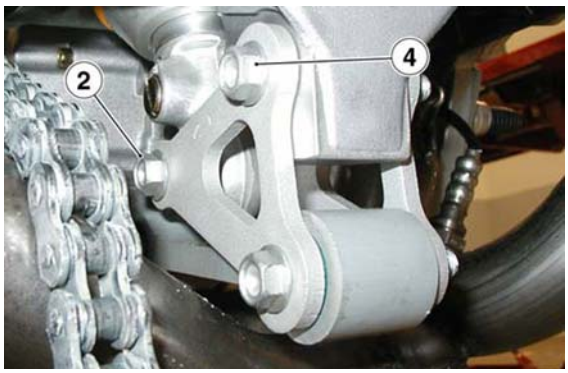


Linkages

Removing

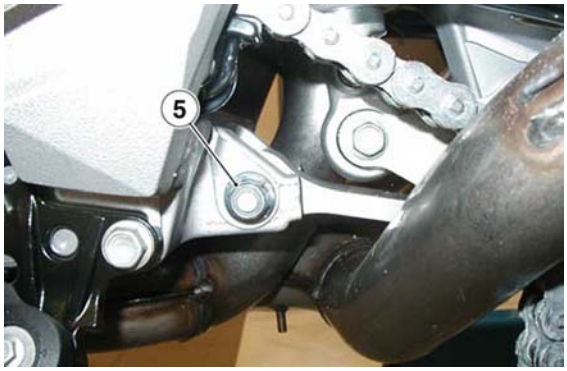
- Working from the right side of the vehicle, loosen and remove the nut (1).
- Slide off the screw (2) from the opposite side.
- Loosen and remove the nut (3).
- Slide off the screw (4) from the opposite side.
- Loosen and remove the nut (5).
- Slide off the screw (6) from the opposite side.
- Remove the complete suspension connecting rod assembly unit (7).

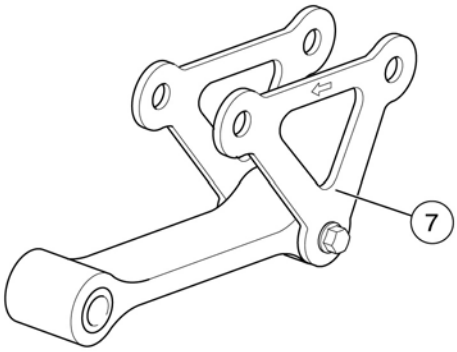




CAUTION

UPON REFITTING, GREASE THE FULCRUM POINTS ON THE CONNECTING ROD ASSEMBLY. PAY SPECIAL ATTENTION TO THE CORRECT POSITIONING OF THE PARTS AND CHECK SEVERAL TIMES THAT JOINTS MOVE SMOOTHLY.





INDEX OF TOPICS

Swinging arm

Removing

- Place the vehicle on the specific central service stand (OPT).
- Remove the rear wheel.

CAUTION

ALTHOUGH NOT NECESSARY FOR REMOVING THE REAR WHEEL, THE REAR SERVICE STAND (OPT) IS INDISPENSABLE FIXING THE REAR SWING ARM WITHOUT THE WHEEL FIRMLY IN POSITION.
ADD WEDGES TO BASE OF THE REAR SERVICE STAND (OPT) TO OBTAIN A SUITABLE POSITION TO WORK (FIXED TO THE TWO PINS ON THE SWING ARM).

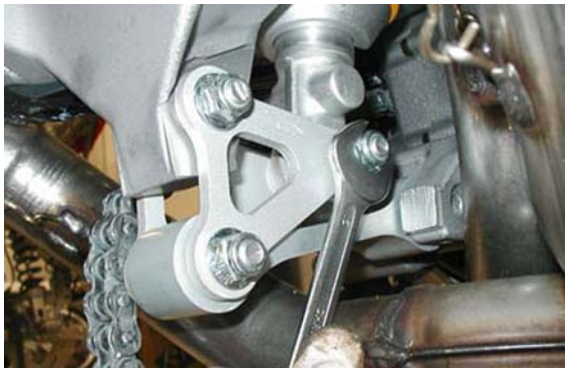
- Remove the exhaust system.
- Loosen and remove the three fixing screws from the protection profile and collect the washers.
- Carefully place laterally on the ground the supporting plate with the brake calliper and the speed sensor connected to the pipe and the cable respectively.

CAUTION

DO NOT ACTUATE ON THE REAR BRAKE LEVER AFTER REMOVING THE WHEEL OR THE CALLIPER PLUNGER COULD GO OUT OF ITS SEAT, RESULTING IN BRAKE FLUID LEAKAGE.

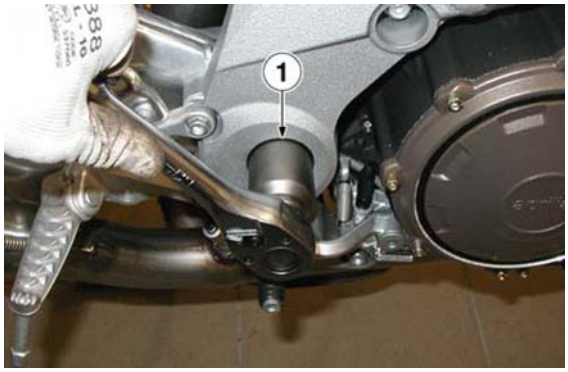
- Working on the left side, unscrew and remove the double connecting rod/ swing arm nut.
- From the opposite side slide off the screw.

- Working on the left side, unscrew and remove the lower shock absorber nut.
- From the opposite side slide off the screw.



- Unscrew and remove the nut and collect the washer.

- Using the suitable special tool and the specific box-spanner, unscrew and remove the locking ring nut (1) on the vehicle right-hand side.

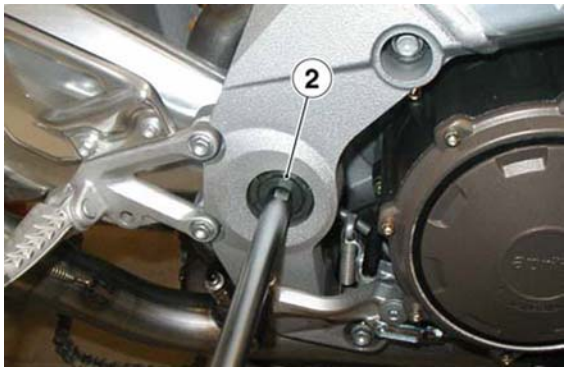


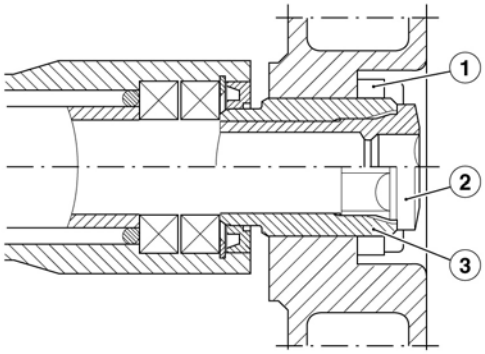
Specific tooling

8140191 Tool to tighten swing arm bolt and engine support

- Turn the swing arm pin (2) anticlockwise. When the pin makes the adjust-

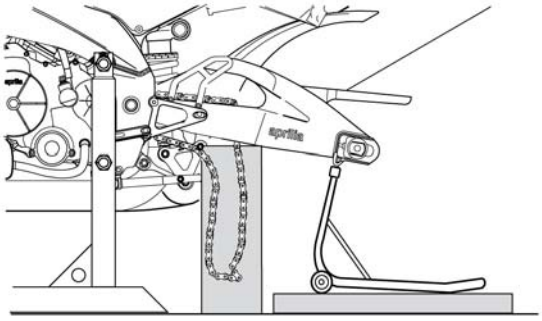
ment bushing (3) turn, the bushing will be loosened completely.





REMOVE WITH EXTREME CAUTION.
SUPPORT THE SWING ARM FROM THE FRONT TO AVOID ACCIDENTAL FALLS.
PLACE A WOODEN SUPPORT UNDER THE FRONT PART OF THE REAR SWING ARM TO PREVENT IT FROM LOWERING AND TO KEEP IT UPRIGHT.

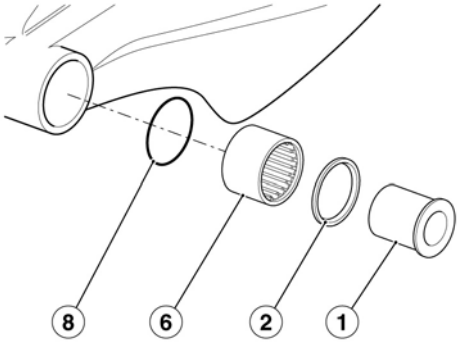
- Place a support under the front part of the swing arm.
- Support the swing arm from the front.
- From the right side slide off the swing arm pin (2).
- Support the swing arm front part and get ready to move it.
- With the aid of the rear service stand slide off the swing arm from behind until it is out of the vehicle range.
- Remove the adjustment bushing from the swing arm pin (2).



UPON REMOVING THE REAR SWING ARM PAY ATTENTION NOT TO JAM THE TRANSMISSION CHAIN.

Checking

- Remove the swing arm.
- Clean the two sides of the bearing seats with a cloth.
- Slide off the bushing (1).
- Remove the sealing gasket (2).
- Remove the sealing gasket (3).
- Remove the circlip (4)
- Take out the two bearings (5) and the roller bearing (6) with the suitable specific tool.

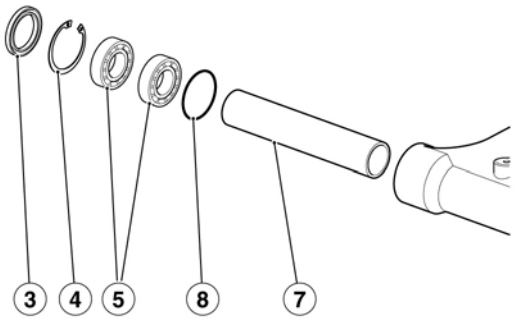


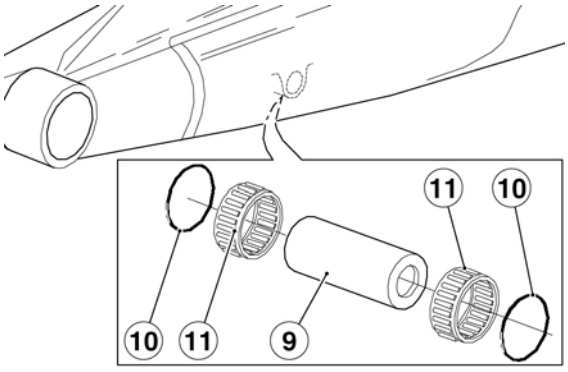
CHECK AND, IF REQUIRED, REPLACE THE BEARINGS AFTER EVERY BEARING REMOVAL.

Specific tooling

8140180 Bearing extractor

- Remove the internal spacer (7) and collect the two O-rings (8).
- Remove the internal spacer (9).
- Remove the gaskets (10).
- Take out the two roller bearings (11) with the specific extractor.
- Clean thoroughly the inside of the bearing seat.





CAUTION

WASH ALL THE PARTS WITH CLEAN DETERGENT.

UPON REFITTING, USE A BUFFER WITH A DIAMETER EQUAL TO THE EXTERNAL RING OF THE BEARINGS TO INSERT THE BEAR-

INGS.

DO NOT HIT THE BALLS AND/OR THE IN-

TERNAL RING.

CHECK THAT ALL THE PARTS ARE IN GOOD

CONDITIONS, ESPECIALLY THOSE MEN-

TIONED BELOW.

SWING ARM BEARINGS

Carry out the check with the bearings fitted on the swing arm.

ROTATION CHECK

- Manually rotate the inside ring of each bearing. Rotation must be constant, smooth and noiseless.

If one or both bearings do not fall within the control parameters:

- Replace both swing arm bearings.

RADIAL AND AXIAL CLEARANCE CHECK

- Check the radial and axial clearance.

Axial clearance: a minimum axial clearance is allowed.

Radial clearance: none.

If one or both bearings do not fall within the control parameters:

- Replace both swing arm bearings.

ALWAYS REPLACE BOTH BEARINGS.

ALWAYS REPLACE THE BEARINGS WITH OTHERS OF THE SAME TYPE.

SWING ARM GASKETS

- Check that the gaskets are in good conditions; replace them if they show signs of damage or excessive wear.

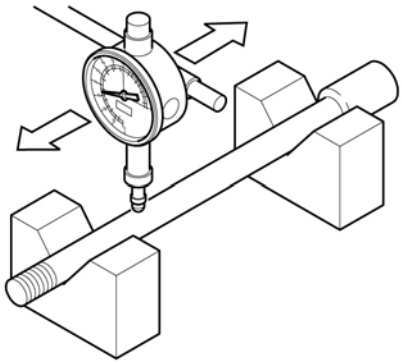
ALWAYS REPLACE BOTH GASKETS.

ALWAYS REPLACE THE GASKETS WITH OTHERS OF THE SAME TYPE.

SWING ARM PIN

- Using a dial gauge, check the swing arm pin eccentricity. If the eccentricity exceeds the limit value, replace the swing arm pin.

Maximum eccentricity: 0.3 mm (0.012 in)

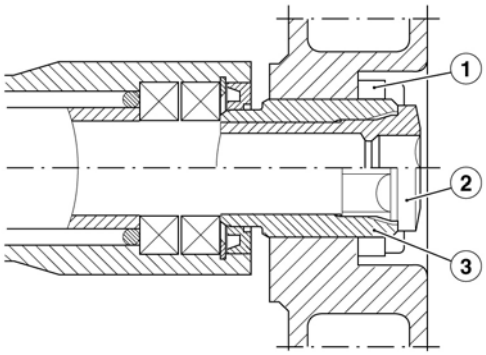


Installing

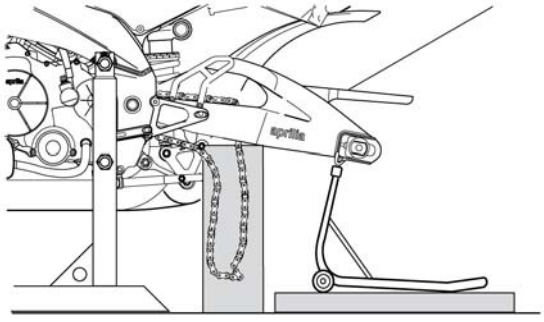
- Spread a thin layer of lubricating grease all along the swing arm pin.
- Fit the adjustment bushing (3) to its seat and tighten it manually.

CAUTION

THE ADJUSTMENT BUSHING (3) MUST NOT PROTRUDE BEYOND THE CHASSIS INTERNAL EDGE.



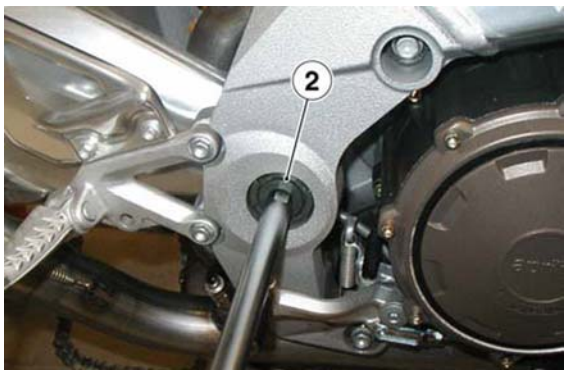
- Fit the transmission chain on the swing arm front (left) side and lock it with adhesive tape.
- Place a wooden support under the front part of the rear swing arm to prevent it from lowering and to keep it upright.
- Support the swing arm rear part on the specific rear service stand (OPT).
- Add wedges to the base of the rear service stand (OPT) to obtain a suitable position to work (fixed to the two pins on the swing arm).
- Support the swing arm from the front; place the fork so that it is aligned with



the holes and, at the same time, insert the pin (2) completely.

- Make sure that the hexagonal area on the pin head (2) is correctly fitted on the internal hexagonal seat of the adjustment bushing (3).
- Fit and tighten the counter ring nut (1) manually by some turns.
- Insert the washer and the pin swing arm fixing nut to the pin; tighten it manually.

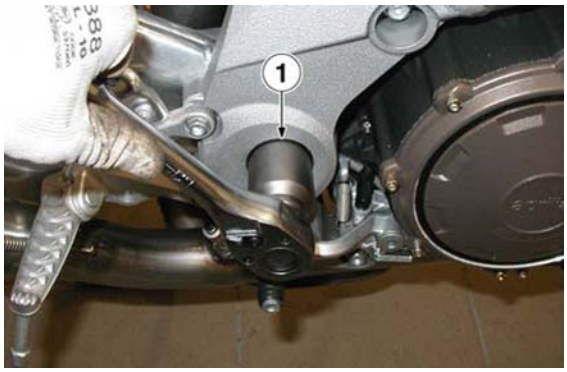
- Working on the scooter right-hand side, rotate the swing arm pin (2) clockwise. The swing arm pin will make the adjustment bushing (3) turn, which, in turn, will push the swing arm fully in.



- Get the appropriate box-spanner and tighten the locking ring nut (1).

Specific tooling

8140191 Tool to tighten swing arm bolt and engine support



- Screw the nut.

- Remove the adhesive tape freeing the chain.
- Refit the chain on the transmission pinion.

CAUTION

APPLY LOCTITE ANTI-SEIZE ON THE INTERNAL TOOTHING OF THE TRANSMISSION PINION.

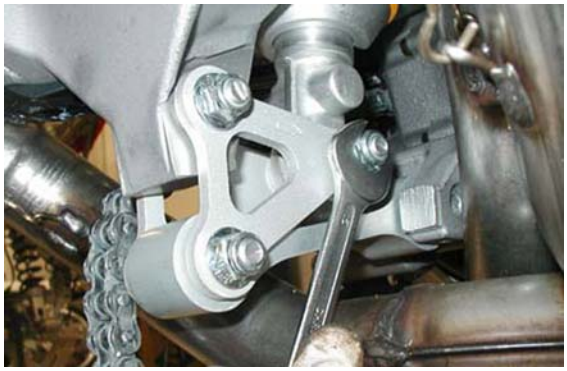
- Fit the pinion and the chain on the shaft.

CAUTION

APPLY LOCTITE 243 ON THE SCREW THREAD.

- Insert the washer on the screw.
- Screw and tighten the screw.

- Working on the right side, fit the shock absorber lower screw.
- Tighten the nut from the opposite side



- Working on the right side, fit the double connecting rod/swing arm screw.
- Tighten the nut from the opposite side

- Fit the supporting plate together with the brake calliper and the speed sensor.
- Tighten the three screws fixing the protection profile and the washers.

- Fit the pinion crankcase and tighten the three screws.
- Refit the rear wheel and the exhaust system.
- Adjust the transmission chain tension.

Drive chain

Adjusting

The vehicle is fitted with an endless chain, without master link.

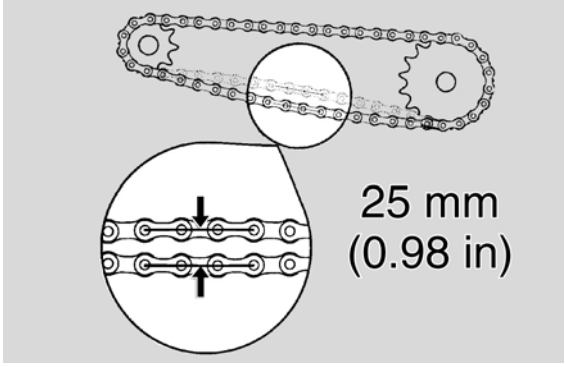
NOTE

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

CLEARANCE CHECK

To check the backlash:

- Shut off the engine.
- Rest the vehicle on its stand.
- Engage neutral gear.
- Check that at a point between the pinion and the crown on the lower branch of the chain the vertical oscillation is around 25 mm (0.98 in).
- Move the vehicle forward so as to check vertical oscillation in other positions too. backlash should remain constant during all wheel rotation phases.



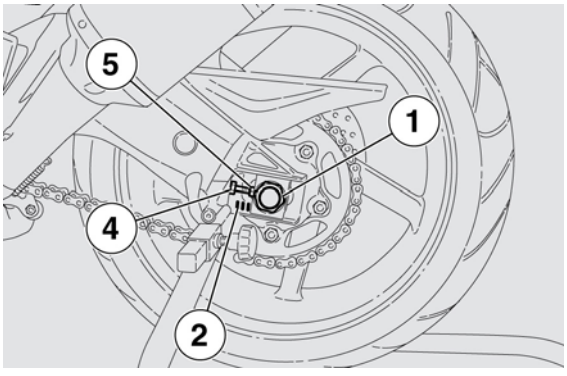
ADJUSTMENT

CAUTION

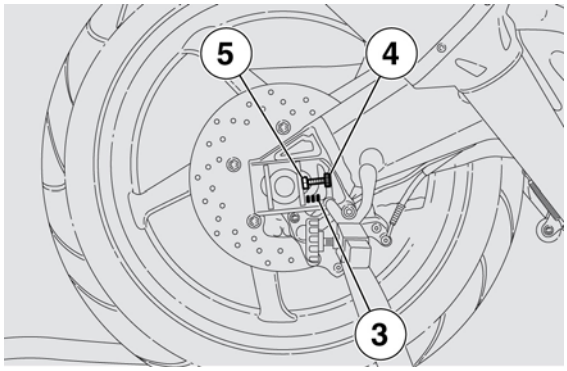
TO ADJUST THE CHAIN, GET THE APPROPRIATE REAR SERVICE STAND (OPT).

If chain tension needs adjusting after the check:

- Place the vehicle on its OPTIONAL rear service stand.
- Loosen the nut (1) completely.
- Loosen both lock nuts (4).
- Actuate on the set screws (5) and adjust the chain backlash checking that the references (2 - 3) match on both sides of the vehicle.
- Tighten both lock nuts (4).
- Tighten the nut (1).



- Check chain backlash.



CAUTION

WHEELS ARE CENTRED USING THE FIXED REFERENCES (2-3) VISIBLE IN THE SEATS OF THE CHAIN TENSIONER PADS ON THE SWING ARMS, IN FRONT OF THE WHEEL PIN.

CHECKING THE CHAIN, THE PINION AND THE CROWN FOR WEAR

Furthermore, check the following parts and make sure the chain, the pinion and the crown do not show:

- damaged rollers;
- loosened pins;
- dry, rusty, flattened or jammed chain links;
- excessive wear;
- missing sealing rings;
- excessively worn or damaged pinion or crown teeth.

IF THE CHAIN ROLLERS ARE DAMAGED, THE PINS ARE LOOSE AND/OR THE O-RINGS ARE MISSING OR DAMAGED, THE WHOLE CHAIN UNIT (PINION, CROWN AND CHAIN) SHOULD BE REPLACED.

LUBRICATE THE CHAIN ON A REGULAR BASIS, PARTICULARLY IF YOU DETECT DRY OR RUSTY PARTS.

FLATTENED OR JAMMED CHAIN LINKS SHOULD BE LUBRICATED AND GOOD OPERATING CONDITIONS RESTORED.

THE GEARING CHAIN HAS SEALING RINGS AMONG THE LINKS THAT KEEP THE GREASE INSIDE.

ADJUST, LUBRICATE, WASH AND REPLACE THE CHAIN WITH UTMOST CAUTION.

CLEANING AND LUBRICATION

Do not wash the chain with water jets, vapour jets, high-pressure water jets and highly flammable solvents.

- Wash the chain with fuel oil or kerosene. Maintenance operations should be more fre-

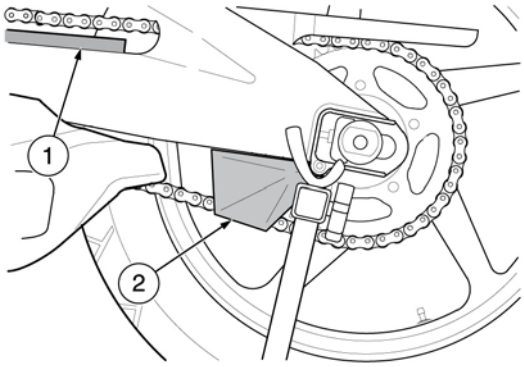
quent if there are signs of quick rust.

Lubricate the chain at the intervals specified on the routine maintenance table and whenever necessary.

- After washing and drying the chain, lubricate it with spray grease for sealed chains.

Chain sliders

- Place the vehicle on its OPTIONAL rear service stand.
- Check that the pad (1) is not worn or damaged. Replace it with a new one if it is.
- Check the chain guide (2) for wear.



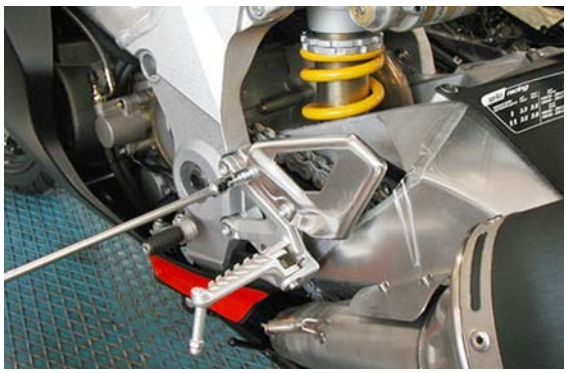
- Unscrew and remove the three screws.
- Remove the pinion protection.
- Loosen the chain.

- Unscrew and remove the pinion fixing screw and collect the washers.

CAUTION

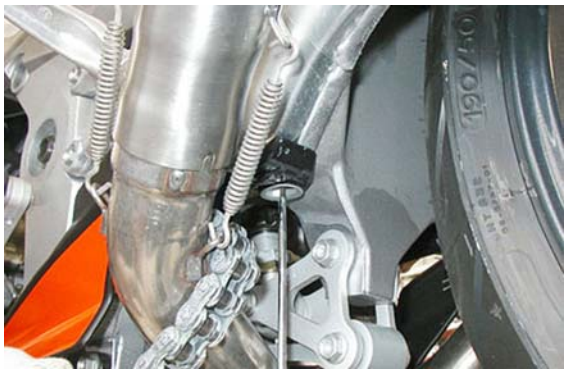
UPON REFITTING, APPLY LOCTITE ANTI-SEIZE ON THE TOOTHING INSIDE THE TRANSMISSION PINION AND LOCTITE 243 ON THE SCREW THREAD.

- Unscrew and remove the two screws from the left rider footrest protection.

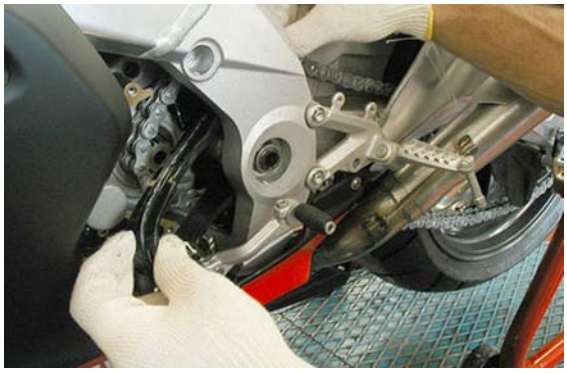


- Unscrew and remove the upper screw fixing the chain pad and collect the washer.

- Unscrew and remove the lower screw fixing the chain pad and collect the washers.



- Slide off the lower part of the chain pad by pulling it forwards.



- Remove the chain pad by pulling it backwards.

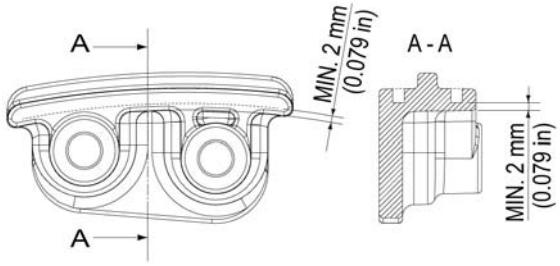
The pad should be removed to check it for wear.

- Unscrew and remove the two screws.
- Remove the lower chain pad.

WEAR CHECK

Check the chain pad for wear.

Minimum thickness: 2 mm (0.079 in)



Removing the tail pipe

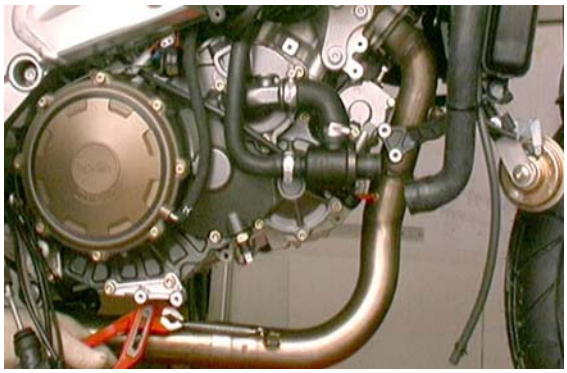
- Unhook the springs retaining the silencers.

- Undo the screws fixing the silencer clamp.

- Remove the silencers.

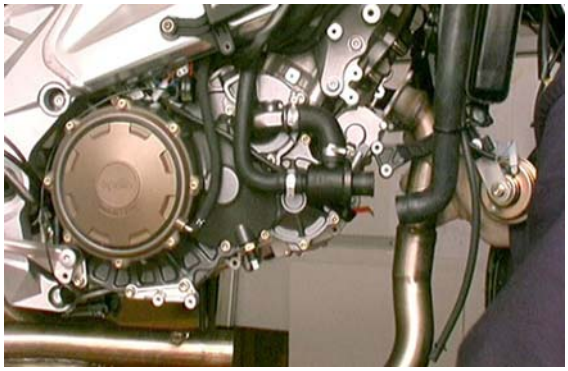
Removing the exhaust manifold

- Unhook the retaining spring between the front cylinder manifold and exhaust.

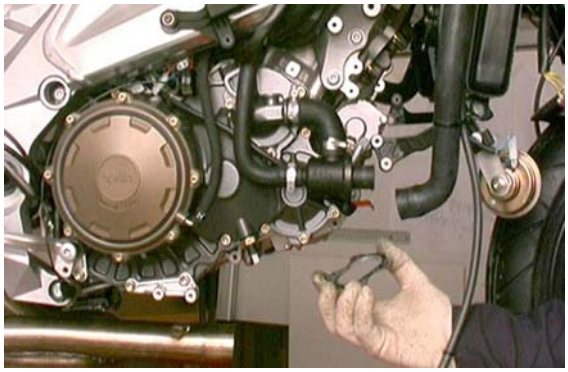


- Undo the four nuts fixing the manifold to the front cylinder.

- Remove the manifold.

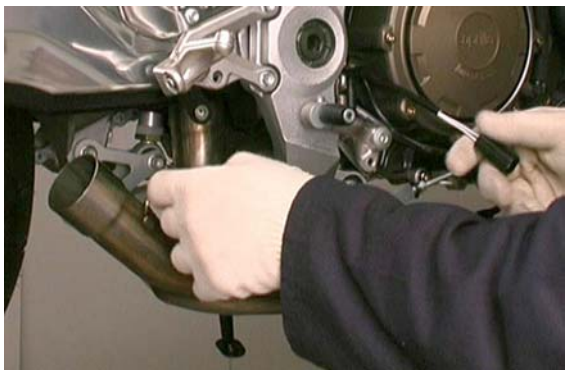


- Collect the sealing gasket.

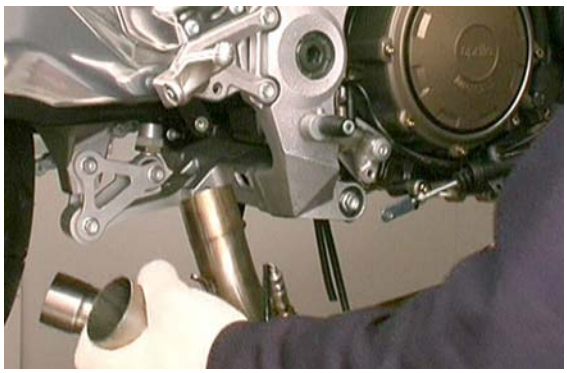


- Unhook the retaining spring placed between the rear manifold and exhaust.

- Slide off the wiring of the lambda probe from the chassis.



- Remove the exhaust together with the lambda probe.

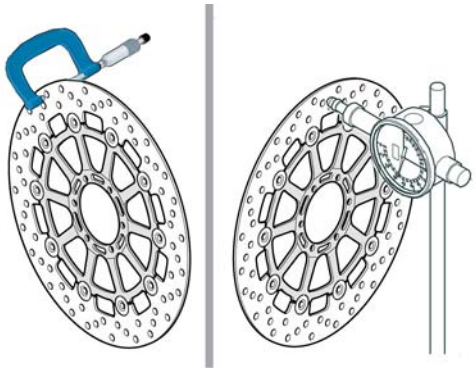


- Undo the four nuts fixing the manifold to the rear cylinder.

- Remove the exhaust manifold and collect the sealing gasket.

INDEX OF TOPICS

Checking



- The following operations must be carried out with the brake discs fitted on the wheel; they refer to a single disc, but apply to both.
- Check the disc for wear measuring the minimum thickness at different points with a micrometer. If the minimum thickness, even in a single point of the disc, is less than the minimum value, replace the disc.

Disc thickness minimum value: 4 mm (0.16 in)

- Using a dial gauge, check that the maximum oscillation of the disc does not exceed the tolerance; otherwise, replace it.

Disc oscillation tolerance: 0.3 mm (0.012 in)

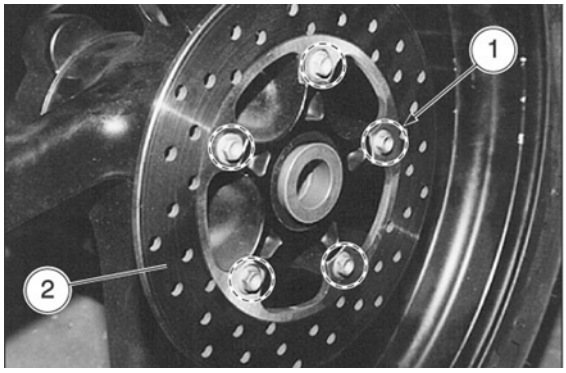
Rear brake disc

Removal

- Rear wheel removal.

CAUTION

TO UNDO THE SCREWS (1), USE AN AIR SCREWER GUN TO GIVE A CLEAN BLOW, WHICH WILL DETACH THE SCREWS STUCK WITH LOCTITE 243.

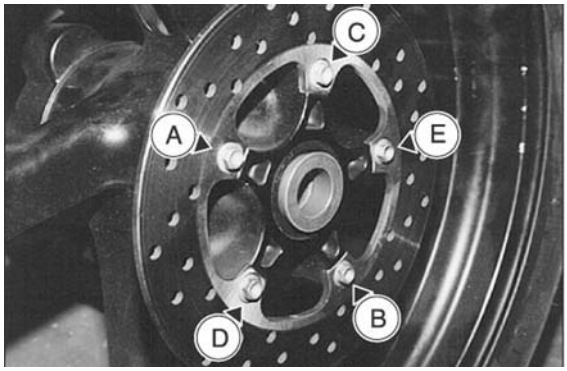


- Unscrew and remove the five brake disc screws (1).
- Remove the disc brake (2).

UPON REFITTING, APPLY LOCTITE 243 ON THE THREAD OF THE BRAKE DISC SCREWS (1).

CAUTION

UPON REFITTING, SCREW ALL THE SCREWS (1) MANUALLY AND TIGHTEN THEM OPERATING DIAGONALLY FOLLOWING THIS SEQUENCE: A-B-C-D-E-F.



Disc Inspection

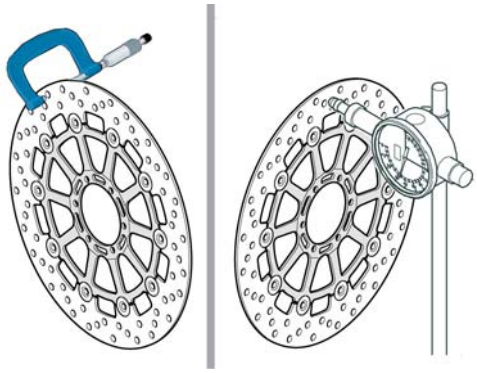
The operations must be carried out with the brake disc fitted on the wheel.

- Check the disc for wear, measuring the minimum thickness at different points.
- If the minimum thickness, even in a single point of the disc, is less than the minimum value, replace the disc.

Disc thickness minimum value: 4 mm (0.16 in)

- Using a dial gauge, check that the maximum oscillation of the disc does not exceed the tolerance; otherwise, replace it.

Disc oscillation tolerance: 0.3 mm (0.012 in)



Front brake disc

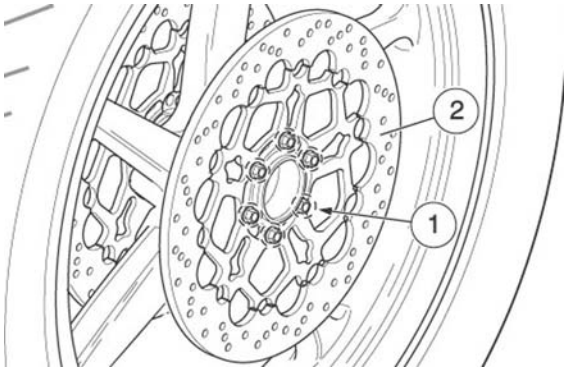
Removal

- Remove the front wheel.

The following operations refers to a single disc but apply to both.

To undo the screws (1), use an air screwer gun to give a clean blow, which will detach the screws stuck with LOCTITE 243.

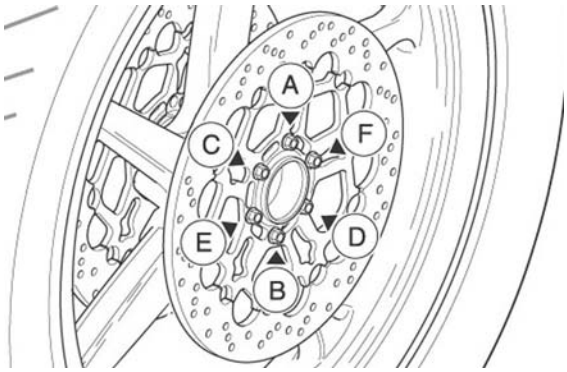
- Unscrew and remove the six brake disc screws (1).
- Remove the disc brake (2).



UPON REFITTING, APPLY LOCTITE 243 ON THE THREAD OF THE BRAKE DISC SCREWS (1).

CAUTION

UPON REFITTING, SCREW ALL THE SCREWS (1) MANUALLY AND TIGHTEN THEM OPERATING DIAGONALLY FOLLOWING THIS SEQUENCE: A-B-C-D-E-F.



Front brake pads

Removal

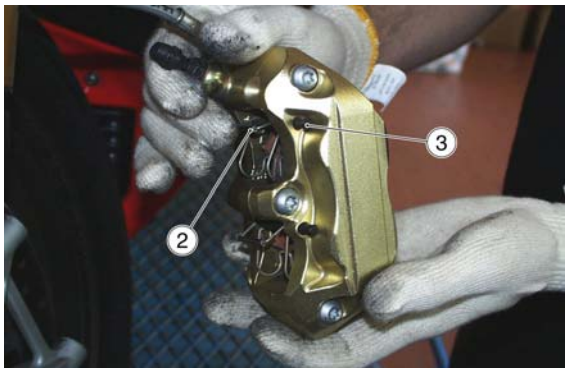
THIS SCOOTER IS FITTED WITH A DOUBLE DISC FRONT BRAKING SYSTEM (RIGHT AND LEFT SIDE).
ALWAYS REPLACE ALL THE PADS FROM BOTH FRONT BRAKE CALLIPERS.
REPLACING THE PADS OF ONLY ONE FRONT CALLIPER MAY JEOPARDISE THE SCOOTER STABILITY AND SAFETY, POSING SERIOUS DANGER FOR PEOPLE, OBJECTS AND THE SCOOTER ITSELF.

CAUTION

THE FOLLOWING OPERATIONS REFER TO A SINGLE CALLIPER, BUT APPLY TO BOTH.

- Unscrew and remove both calliper fixing screws (1).
- Slide off the disc from the front brake calliper.

- Press the safety spring (2) and, at the same time, fit the pin (3), operating on the inside.
- Remove the safety spring (2).
- Take out both pads.



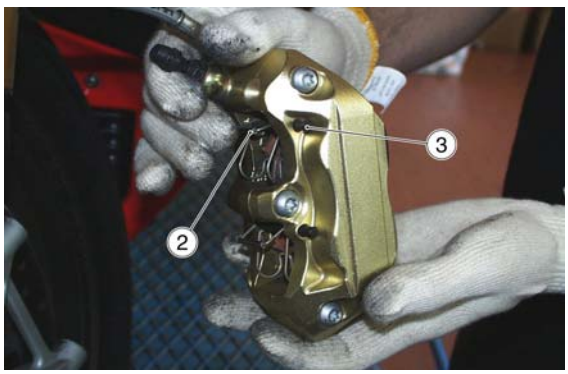
AFTER REMOVING THE PADS, DO NOT OPERATE THE BRAKE CONTROL LEVER OR THE CALLIPER PLUNGERS COULD GO OUT OF THEIR SEATS RESULTING IN BRAKE FLUID LEAKAGE.

Installing

- Fit the two new pads in the correct position.

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

- Place the safety spring (2).
- Press the safety spring (2) and, at the same time, fit the pin (3), operating on the inside.
- Release the safety spring (2) and attach it correctly to the pin (3).



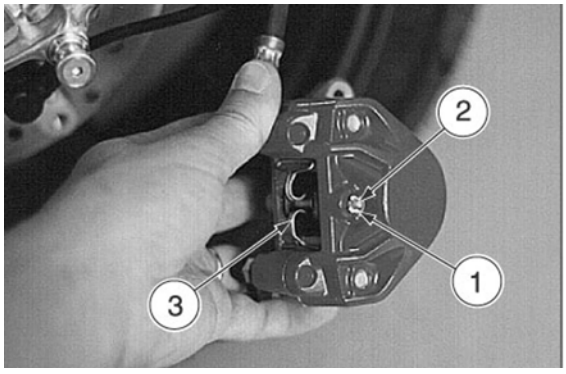
WHEN RELEASED, THE SAFETY SPRING (2) MUST LOCK THE PIN (3) INSERTING IT INTO THE APPROPRIATE SEATS. IF CORRECTLY POSITIONED, THE PIN (3) CANNOT BE SLID

OFF; CARRY OUT THE CHECK.

- Place the front brake calliper on the disc.
- Tighten the two screws (1) manually and completely.
- Pull the front brake lever so that the brake calliper can be correctly bedded.
- Keeping the brake lever pulled, tighten the two screws (1).
- Check the level of the front brake fluid.

Rear brake pads

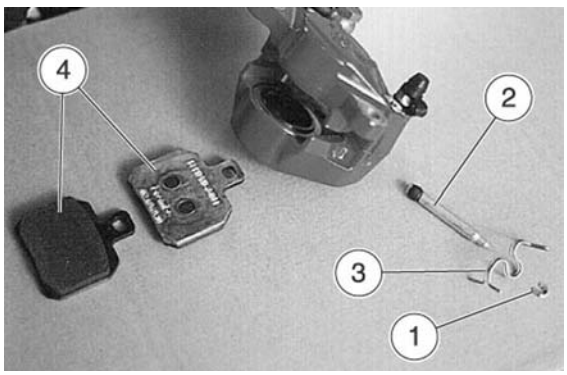
Removal



- Place the scooter on its stand.
- Remove the rear brake calliper.

CAUTION

DO NOT ACTUATE ON THE REAR BRAKE LEVER AFTER REMOVING THE WHEEL OR THE CALLIPER PLUNGER COULD GO OUT OF ITS SEAT, RESULTING IN BRAKE FLUID LEAKAGE.



- Remove the snap ring (1).

BEFORE REMOVING THE PIN (2), CHECK THAT THE SAFETY SPRING (3) IS CORRECTLY POSITIONED; WHEN REFITTED, IT MUST POSITIONED IN THE SAME WAY.

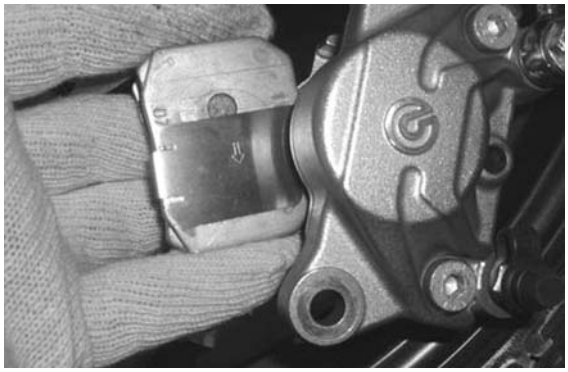
- Remove the pin (2) and collect the safety spring (3).

- Take out the two pads (4) and collect the anti-noise plates.
- If they are worn, replace the vibration-damping plates.

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

Installing

- Insert two new pads and the vibration-damping plates, placing them so that the holes are aligned with the calliper holes.

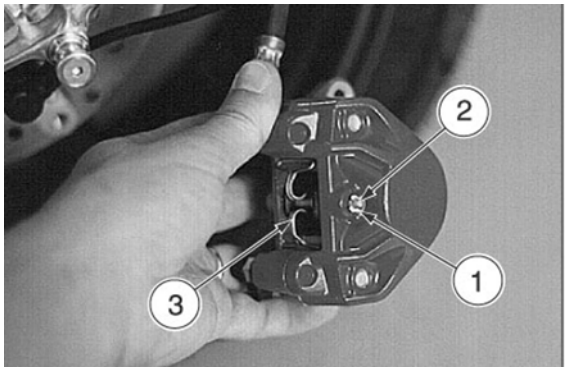


UPON REFITTING, MAKE SURE THE ARROWS ON THE VIBRATION-DAMPING PLATES ARE TURNED IN THE RIDING DIRECTION.

CAUTION

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

- Fit the safety spring (3).
- Keeping the safety spring (3) pressed on the central part, fit the pin (2) so that is passes over the spring.
- Fit the snap ring (1).
- Check the brake fluid level.

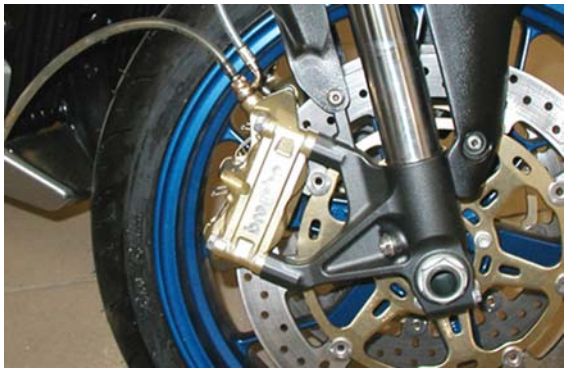


Bleeding the braking system

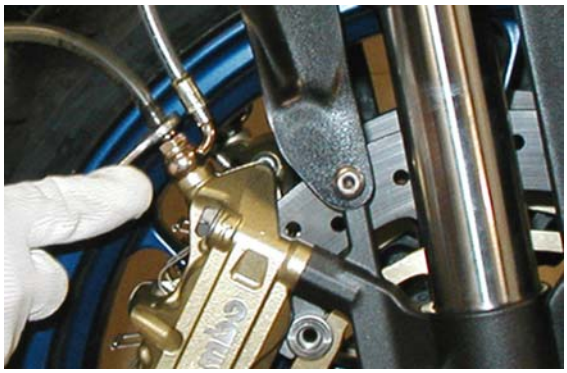
Front

Before purging, get a flexible hose of adequate size and a container of adequate capacity.

- Connect the hose on the brake pump bleed.
- Operate the brake lever and then slightly open the bleed on the pump so that the air is released.
- Close the bleed again before reaching the lever end of the stroke and repeat the operation until there is no air.
- Working on both sides, connect the hose on the brake calliper bleed.



- Operate the brake lever and then slightly open the bleed on the calliper that needs bleeding so that the air is released.
- Close the bleed again before reaching the lever end of the stroke and repeat the operation until there is no air.
- For safety, repeat the bleed operations on the brake pump.



Rear

Before purging, get a flexible hose of adequate size and a container of adequate capa-

city.

- Remove the fairing.
- Connect the hose on the brake pump bleed.
- Operate the brake lever and then slightly open the bleed on the pump so that the air is released.
- Close the bleed again before reaching the lever end of the stroke and repeat the operation until there is no air.

- Connect the hose on the brake calliper bleed.
- Operate the brake lever and then slightly open the bleed on the calliper that needs purging so that the air is released.
- Close the bleed again before reaching the lever end of the stroke and repeat the operation until there is no air.
- For safety, repeat the bleed operations on the brake pump

INDEX OF TOPICS

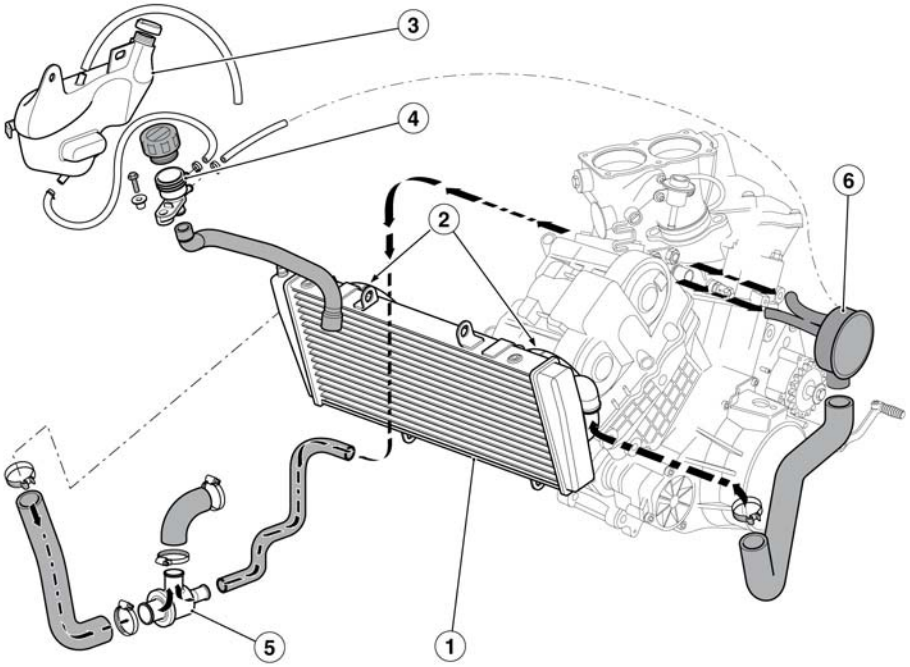
Bleeding the system

Before purging, get a flexible hose of adequate size and a container of adequate capacity.

- Connect the hose on the bleed of the clutch control wheel cylinder
- Operate the brake lever and then slightly open the bleed on the wheel cylinder so that the air is released.
- Close the bleed again before reaching the lever end of the stroke and repeat the operation until there is no air.

INDEX OF TOPICS

Circuit diagram

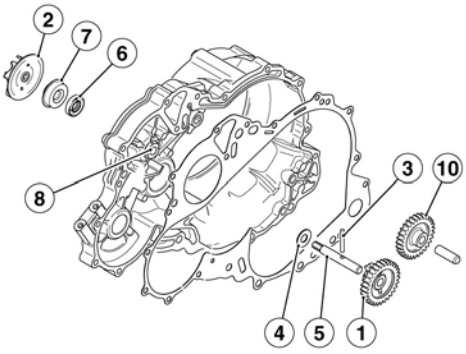


Key:

1. Radiator
2. Electrical fans
3. Expansion tank
4. Filler
5. Three-way thermostatic valve
6. Three-way manifold

Water pump - overhaul

- Check the drain holes for potential oil or coolant leaks.



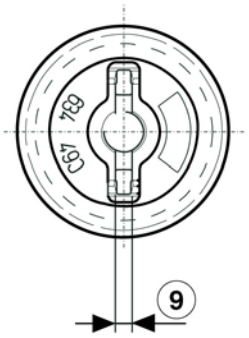
REMOVE THE COOLANT PUMP ONLY IN CASE OF OIL OR COOLANT LEAKS.

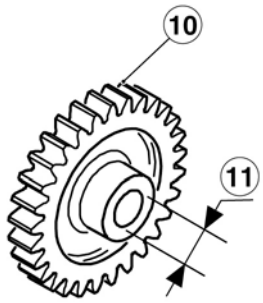
PUMP REMOVAL

- Keep the coolant pump gear (1) in position and unscrew the rotor (2).
- Slide the coolant pump gear (1) upwards and off and remove the pin (3) together with the washer (4).

DO NOT DAMAGE THE THREAD OF THE COOLANT PUMP SHAFT.

- Take out the shaft (5) from the coolant pump towards the coolant pump gear (1).

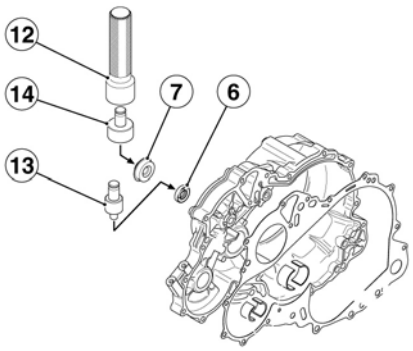




REMOVE THE OIL SEAL (6) AND THE GASKET IN THE SLIDING RING (7) THROUGH TWO HOLES INSIDE THE CLUTCH COVER.

TO CORRECTLY REMOVE THE TWO PARTS (6) (7), ALTERNATELY REPEAT THE FOLLOWING OPERATION ON BOTH HOLES.

- Insert a punch in the hole and hit slightly just once with a light hammer. Repeat the procedure for the second hole.



PUMP CHECK

- Check the rotor (2) for damage or shape distortions and replace it, if required.
- Check the coolant pump shaft (5) for signs of rolling matching the oil seal sliding area. Replace the shaft, if required.
- Measure the hole (8) for the coolant pump shaft on the clutch cover.

Hole wear limit (8) Max. diam. 10.10 mm (0.3976 in).

- Check that the material in the gear toothing (1) of the coolant pump is not damaged or broken and inspect the distance of the sealing protrusions (9) for the pin.

Hole wear limit (9) Max. diam. 3.70 mm (0.1457 in).

- Check that the material in the intermediate gear toothing (10) for the coolant pump is not damaged or broken. Measure the seat hole (11).

Hole wear limit (11) Max. diam. 10.22 mm (0.4024 in).

INSTALLING THE PUMP

GET THE SUITABLE SPECIFIC TOOLS (OPT.)

- (12) code 0877650 handle for buffers;
- (13) code 0277670 (buffer to fit the oil seal in its position on the coolant pump shaft);
- (14) code 0877257 (buffer to fit the sliding ring in its position on the coolant pump shaft).

- Fit the oil seal (6) fully down into its seat with the special punch for assembling.
- Insert the sliding ring gasket (7) until it stops.

THE CLOSED SIDE OF THE OIL SEAL MUST BE TURNED TOWARDS THE ROTOR (2).

- Fully unscrew the rotor (2) on the coolant pump shaft (5) with your hand.
- Apply a layer of MOLYKOTE G-N on the coolant pump shaft (5) and from the outside, fully insert it into the oil seal unit.
- insert the washer (4) on the coolant pump shaft.
- Fit the pin (3) in the hole on the coolant pump shaft and hook the gear (2) of the coolant pump.

- Manually tighten the rotor (2) holding the gear (1) of the coolant pump.

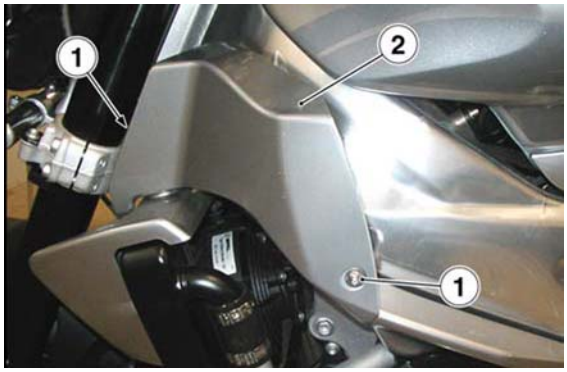
CAUTION

YOU SHOULD HEAR THE CLICKING SOUND INDICATING THE PERFECT FITTING OF THE PIN IN THE HOLE OF THE COOLANT PUMP GEAR.

INDEX OF TOPICS

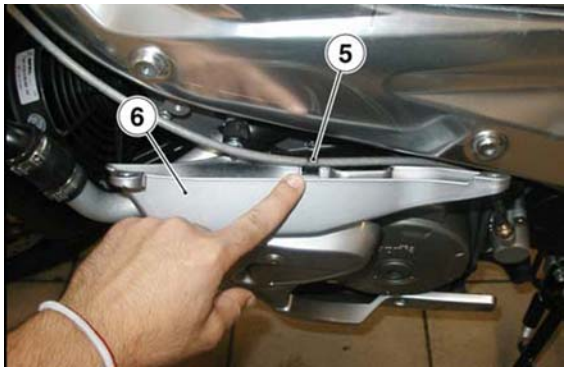
Side fairings

- Loosen and remove the two fixing screws (1) and collect the washers.
- Remove the fairing (2).



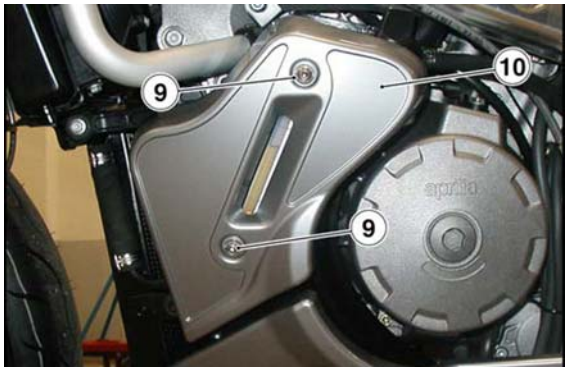
- Unscrew and remove the fixing pin (3).
- Unscrew and remove the fixing pin (4) and collect the washer.

- Release the Snap-On coupling (5) and remove the pipe.
- Remove the fairing (6).

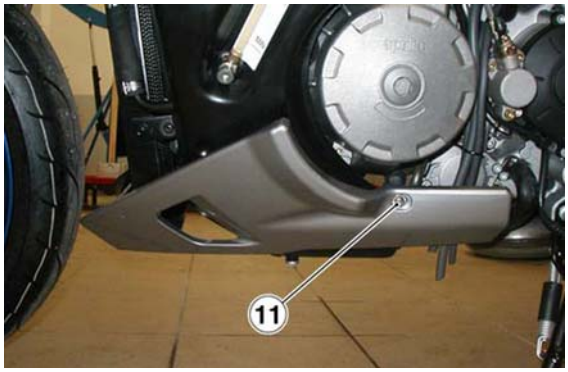


- Unscrew and remove the fixing screw (7).
- Remove the fairing (8).

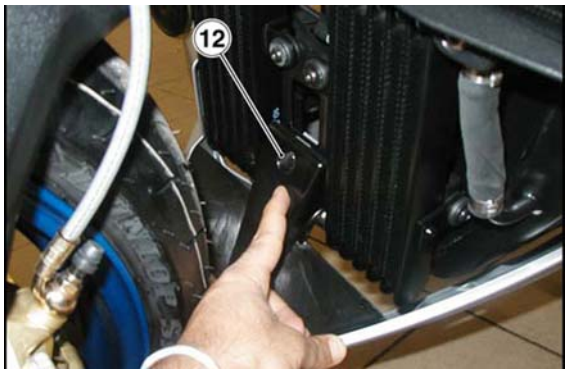
- Loosen and remove the two fixing screws (9) and collect the washers.
- Remove the fairing (10).



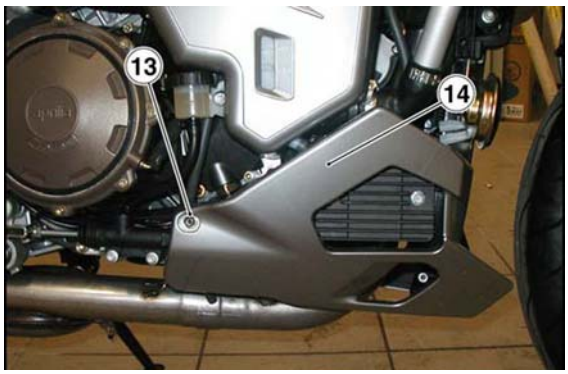
- Unscrew and remove the left fixing screw and collect the washer (11).



- Unscrew and remove the front fixing screw and collect the washer (12).



- Unscrew and remove the right fixing screw and collect the washer (13).
- Remove the fairing (14).

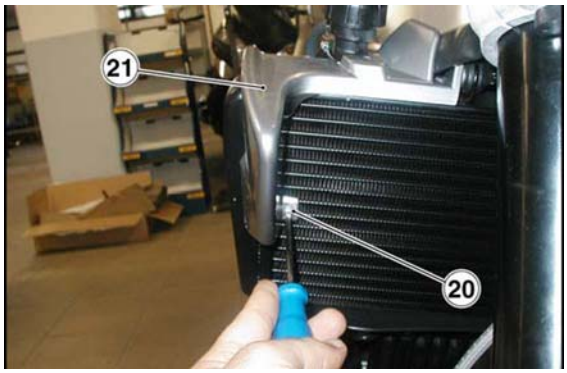


- Loosen and remove the two fixing screws (15) and collect the washers.

- Remove the fairing (16).

- Unscrew and remove the two fixing screws (17) and collect the washers.
- Unscrew and remove the fixing pin (18).
- Remove the fairing (19).

- Unscrew and remove the fixing screw (20).
- Remove the fairing (21).

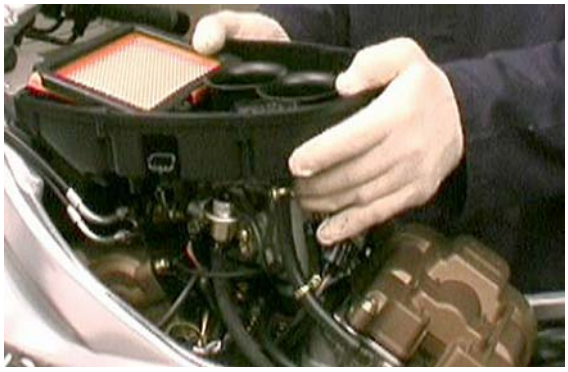


Air box

- Remove the fuel tank.
- Remove the airbox cover

- Undo the screws fixing the airbox to the chassis

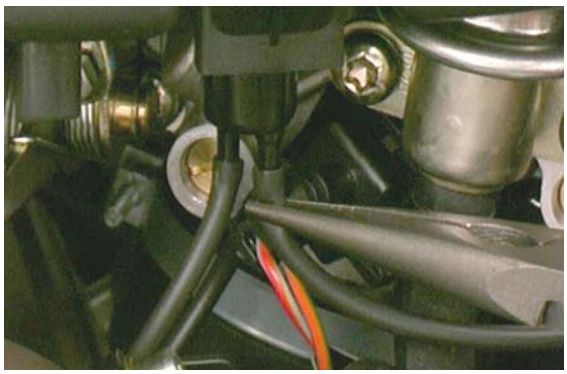
- Remove the six screws fixing the throttle body to the airbox.

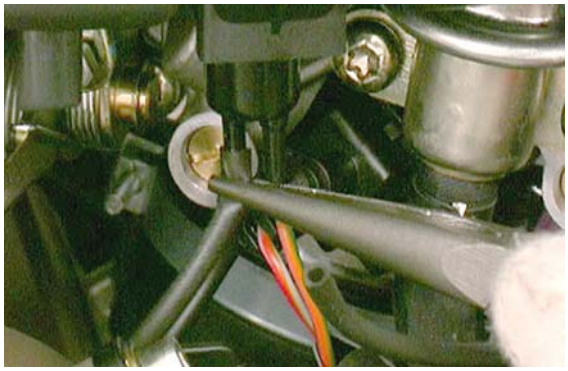


- Detach the by-pass pipes directed to the throttle body and the Stepper motor connection.

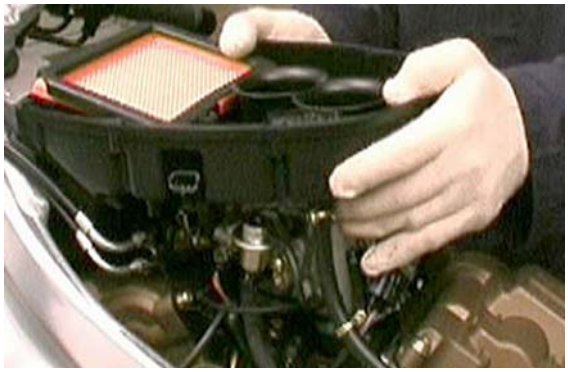
- Remove the oil vapour recovery pipe.

- Detach the manifold pressure sensor connection and the related pipes coming from the throttle body.





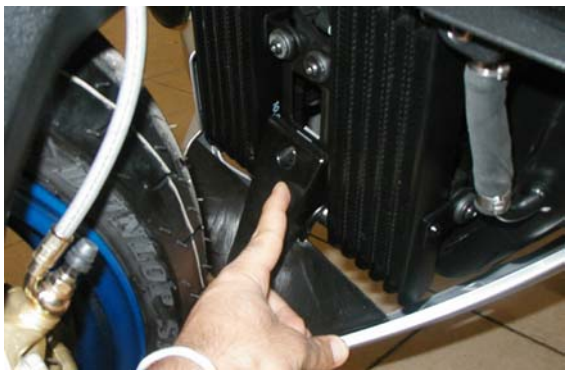
- Remove the airbox.



Lower cowl

- Undo and remove the left fixing screw and collect the washer.

- Undo and remove the front fixing screw and collect the washer.



- Undo and remove the right fixing screw and collect the washer.
- Remove the fairing.