SUMMARY

0.1. INTRODUCTION

0.1.1. INTRODUCTION

- This manual provides the information required for normal servicing.
- This publication is intended for use by **Moto Guzzi** dealerships and their qualified mechanics; many concepts have been omitted inasmuch as their inclusion would be superfluous for such an audience. Since complete mechanical explanations have not been included in this manual, the reader must be familiar with basic notions of mechanics, as well as with basic repair procedures. Without such familiarity, repairs and checks could be ineffective and even hazardous. Since the repair and vehicle check instructions are not exhaustive, special care must be taken to avoid damage and injury. To ensure maximum customer satisfaction with the vehicle, **Moto Guzzi spa** continuously improves its products and their documentation. The main technical modifications and changes in repair procedures are communicated to all **Moto Guzzi** dealerships and agencies worldwide. Such modifications will be entered in subsequent editions of the manual. In case of doubt regarding specific repairs or checks, contact the **Moto Guzzi** SERVICE DEPARTMENT; we will be pleased to provide all necessary information and assistance as well as keeping you updated on changes and modifications to the vehicle.

For more details see (REFERENCE MANUALS)

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0.1.2. REFERENCE MANUALS

WORKSHOP MANUALS

part# (description)	
32.92.01.10	I
32.92.01.11	E
32.92.01.12	F
32.92.01.13	D
32.92.01.14	UK
32.92.01.15	USA

PARTS CATALOGUES

part# (description)
GU000 rel.00 BREVA 750 IE (32920010)

OWNER'S MANUALS

part# (description)					
32.92.00.10	I	F	D	NL	UK
32.92.00.12	USA				
32.90.00.15	E				

0.1.3. ABBREVIATIONS/SYMBOLS/CONVENTIONS

= number
< = less than
> = greater than
≤ = less than or equal to
≥ = more than or equal to
~ = approximately
∞ = infinity
°C = degrees Celsius (centigrade)
°F = degrees Fahrenheit
± = plus or minus
AC = alternating current
A = Ampere
Ah = Ampere per hour
API = American Petroleum Institute
HV = high voltage
AV/DC = Anti-Vibration Double Countershaft
bar = pressure measurement (1 bar =100 kPa)
DC. = Direct Current
cc = cubic centimetres
CO = carbon monoxide
CPU = Central Processing Unit
DIN = German industrial standards (Deutsche Industrie Norm)
DOHC = Double Overhead Camshaft
ECU = Electronic Control Unit
rpm = revolutions per minute
HC = unburnt hydrocarbons
ISC = Idle Speed Control
ISO = International Standardization Organization
Kg = kilograms
Kgm = kilogram metre (1 kgm =10 Nm)
km = kilometres
kph = kilometres per hour
kΩ = kilo Ohm
kPa = kiloPascal (1 kPa =0.01 bar)
KS = clutch side (from the German "Kupplungseite")
kW = kiloWatt
l = litres
LAP = racetrack lap
LED = Light Emitting Diode
LEFT SIDE = left side
m/s = metres per second
max = maximum
mbar = millibar (1 mbar =0.1 kPa)
mi = miles
MIN = minimum
MPH = miles per hour
MS = flywheel side (from the German "Magnetoseite")
MΩ = megaOhm
N.A. = Not Available
N.O.M.M. = Motor Octane Number
N.O.R.M. = Research Octane Number
Nm = Newton metre (1 Nm =0.1 kgm)
Ω = ohm
PICK-UP = pick-up
BDC = Bottom Dead Centre
TDC = Top Dead Centre
PPC = Pneumatic Power Clutch
RIGHT SIDE = right side
SAE = Society of Automotive Engineers
TEST = diagnostic check

T.B.E.I.	= crown-head Allen screw
T.C.E.I.	= cheese-head Allen screw
T.E.	= hexagonal head
TP	= flat head screw
TSI	= Twin Spark Ignition
UPSIDE-DOWN	= inverted fork
V	= Volt
W	= Watt
Ø	= Diameter

SUMMARY

1.1. STRUCTURE OF THE MANUAL

1.1.1. CONVENTIONS USED IN THE MANUAL

- This manual is divided in sections and subsections, each covering a set of the most significant components. Refer to the index of sections when consulting the manual.
- Unless expressly specified otherwise, assemblies are reassembled by reversing the dismantling procedure.
- The terms "right" and "left" are referred to the rider seated on the vehicle in the normal riding position.
- Motorcycle operation and basic maintenance are covered in the «OWNER'S MANUAL».

In this manual any variants are identified with these symbols:

OPT	optional
✿	catalytic version
-	all versions
MP	national certification
SF	European certification (EURO 1 limits)

VERSION:

I	Italy	GR	Greece	MAL	Malaysia
UK	United Kingdom	NL	Holland	RCH	Chile
A	Austria	CH	Switzerland	HR	Croatia
P	Portugal	DK	Denmark	AUS	Australia
SF	Finland	J	Japan	USA	United States of America
B	Belgium	SGP	Singapore	BR	Brazil
D	Germany	SLO	Slovenia	RSA	South Africa
F	France	IL	Israel	NZ	New Zealand
E	Spain	ROK	South Korea	CDN	Canada

1.1.2. SAFETY WARNINGS

The following precautionary warnings are used throughout this manual in order to convey the following messages:

Safety warning. This symbol appears, whether in the manual or on the vehicle itself, to indicate a personal injury hazard. Non-compliance with the indications given in the messages preceded by this symbol may result in grave risks for your and other people's safety and for the vehicle!

WARNING
Indicates a potential hazard which may result in serious injury or even death.

CAUTION
Indicates a potential hazard which may result in minor personal injury or damage to the vehicle.

IMPORTANT: *The word "IMPORTANT" in this manual precedes important information or instructions.*

1.2. GENERAL RULES

1.2.1. BASIC SAFETY RULES

CARBON MONOXIDE
Should it be necessary to perform some operations with the vehicle running, make sure to work outdoors or in a well-aerated room.
Avoid starting the engine in closed or badly-ventilated rooms.
In case you are working indoors, make use of an exhaust gases scavenging system.

DANGER
Exhaust gases contain carbon monoxide, which is extremely toxic if inhaled and may cause loss of consciousness or even lead to death by asphyxia.

FUEL

DANGER
The fuel used to operate engines is highly flammable and becomes explosive under particular conditions. Refuelling and engine service should take place in a well-ventilated area with the engine stopped. Do not smoke when refuelling or in the proximity of sources of fuel vapours, avoid flames, sparks and any element that could ignite fuel or provoke explosions.

DO NOT DISPOSE OF FUEL IN THE ENVIRONMENT.

KEEP AWAY FROM CHILDREN.

HIGH-TEMPERATURE COMPONENTS
The engine and the exhaust system parts become hot and continue to be hot even for some time after the engine has been stopped.
Before handling these parts, wear insulating gloves or wait for the engine and the exhaust system to cool completely down.

USED GEARBOX AND FORK OILS

DANGER
In case any maintenance operation should be required, it is advisable to use latex gloves.
Gear oil may cause serious damage to the skin if handled daily and for long periods.
Wash your hands carefully after use.
Put it in a sealed container and take it to the filling station where you usually buy it or to an oil salvage center.
In case any maintenance operation should be required, it is advisable to use latex gloves.

DO NOT DISPOSE OF OIL IN THE ENVIRONMENT

KEEP AWAY FROM CHILDREN.

BRAKE FLUID

WARNING
When using the brake fluid, take care not to spill it on the plastic, rubber or painted parts, since it can damage them.
When carrying out the maintenance operations on the braking system, use a clean cloth to cover these parts.
Always wear safety goggles when working on the braking system.
The brake fluid is highly irritant. Avoid contact with your eyes.
If the brake fluid gets in contact with the skin or the eyes, carefully wash the parts of your body that get in contact with the fluid and consult a doctor.

KEEP AWAY FROM CHILDREN.

HYDROGEN GAS AND BATTERY ELECTROLYTE

DANGER
The battery electrolyte is a toxic, caustic substance containing sulphuric acid and thus able to cause severe burns in case of contact.
Always wear tight gloves and protective clothes when handling this fluid.
If the electrolyte gets in contact with the skin, carefully wash the parts of your body that get in contact with the fluid with abundant fresh water.
Always use a protection for your eyes since also a very small amount of the battery fluid can cause blindness. In the event of contact with your eyes, carefully wash them with water for fifteen minutes and then consult immediately an eye specialist.
Should you accidentally drink some fluid, drink abundant water or milk, then drink magnesia milk or vegetable oil and consult immediately a doctor. Battery releases explosive gases. Keep flames, sparks, cigarettes and any other heat source away from the battery. Make sure the room is well-aerated when servicing or recharging the battery.

KEEP AWAY FROM CHILDREN.

The battery fluid is corrosive
Do not pour it on the plastic parts.
Make sure that the electrolyte acid is suitable for the type of battery used.

GENERAL PRECAUTIONS AND INFORMATION

Follow these instructions closely when repairing, disassembling or reassembling the motorcycle or its components.

DANGER
Using bare flames is strictly forbidden when working on the motorcycle. Before servicing or inspecting the motorcycle: stop the engine and remove the key from the ignition switch; allow for the engine and exhaust system to cool down; where possible, lift the motorcycle using adequate equipment placed on firm and level ground. Be careful of any parts of the engine or exhaust system which may still be hot to the touch to avoid scalds or burns.
Never put any mechanical parts or other vehicle components in your mouth when you have both hands busy. None of the motorcycle components is edible. Some components are harmful to the human body or toxic.
Unless expressly specified otherwise, motorcycle assemblies are refitted or re-assembled by reversing the removal or dismantling procedure. Where a procedure is cross-referred to relevant sections in the manual, proceed sensibly to avoid disturbing any parts unless strictly necessary. Never attempt to polish matte-finished surfaces with lapping compounds.
Never use fuel instead of solvent to clean the motorcycle.
Do not clean any rubber or plastic parts or the seat with alcohol, petrol or solvents. Clean with water and neutral detergent.
Always disconnect the battery negative (–) lead before soldering any electrical components.
When two or more persons service the same motorcycle together, special care must be taken to avoid personal injury.
Read (DANGEROUS ELEMENTS).

BEFORE DISASSEMBLING ANY COMPONENTS

- Clean off all dirt, mud, and dust and clear any foreign objects from the vehicle before disassembling any components.
- Use the model-specific special tools where specified.

DISASSEMBLING THE COMPONENTS

- Never use pliers or similar tools to slacken and/or tighten nuts and bolts. Always use a suitable spanner.
- Mark all connections (hoses, wiring, etc.) with their positions before disconnecting them. Identify each connection using a distinctive symbol or convention.
- Mark each part clearly to avoid confusion when refitting.
- Thoroughly clean and wash any components you have removed using a detergent with low flash point.
- Mated parts should always be refitted together. These parts will have seated themselves against one another in service as a result of normal wear and tear and should never be mixed up with other similar parts on refitting.
- Certain components are matched-pair parts and should always be replaced as a set.
- Keep the motorcycle and its components well away from heat sources.

REASSEMBLING THE COMPONENTS

DANGER
Never reuse a circlip or snap ring. These parts must always be renewed once they have been disturbed.
When fitting a new circlip or snap ring, take care to move the open ends apart just enough to allow fitment to the shaft.
Make a rule to check that a newly –fitted circlip or snap ring has located fully into its groove.
Never clean a bearing with compressed air.

NOTE *All bearings must rotate freely with no hardness or noise. Replace any bearings that do not meet these requirements.*

- Use ORIGINAL **Moto Guzzi** SPARE PARTS only.
- Use the specified lubricants and consumables.
- Where possible, lubricate a part before assembly.
- When tightening nuts and bolts, start with the largest or innermost nut/bolt and observe a cross pattern. Tighten evenly in subsequent steps until achieving the specified torque.
- Replace any self-locking nuts, gaskets, seals, circlips or snap rings, O-rings, split pins, bolts and screws which have a damaged thread.
- Lubricate the bearings abundantly before assembly.
- Make a rule to check that all components you have fitted are correctly in place.
- After repairing the motorcycle and after each service inspection, perform the preliminary checks, and then operate the motorcycle in a private estate area or in a safe area away from traffic.
- Clean all joint surfaces, oil seal edges and gaskets before assembly. Apply a light coat of lithium grease along the edges of oil seals. Fit oil seals and bearings with the marking or serial number facing outwards (in view).

ELECTRICAL CONNECTORS

To disconnect the electrical connector, follow the procedures below. Failure to comply with these procedures may lead to irreparable damages to the connector and the wiring as well. If present, press the special safety hooks.

WARNING
Do not pull cables to disconnect the two connectors.

- Grasp the two connectors and disconnect them by pulling them in the two opposite directions.
- In case of dirt, rust, moisture, etc.., thoroughly clean the inside of the connectors with compressed air.
- Make sure that the cables are correctly fitted inside the connectors terminals.

NOTE *The two connectors have just one correct positioning. Make sure to position them in the right direction.*

- Then fit the two connectors. Make sure they are correctly coupled (a click will be heard).

TIGHTENING TORQUE SETTINGS

DANGER
Always remember that the tightening torque settings of all wheel, brake, wheel shaft and other suspension parts play a fundamental role to ensure vehicle safety. Make sure that these values are always within the specified limits.
Check fastening parts tightening torque settings at regular intervals. Upon reassembly, always use a torque wrench.
Failure to comply with these recommendations could lead to the loosening and detachment of one of these parts with a consequent locking of the wheel or other serious troubles affecting the vehicle maneuverability, and thus the risk of falls and serious injuries or death.

1.3. DANGEROUS ELEMENTS

1.3.1. WARNINGS

FUEL

DANGER
The fuel used to operate engines is highly flammable and becomes explosive under particular conditions. Refuelling and engine service should take place in a well-ventilated area with the engine stopped. Do not smoke when refuelling or in the proximity of sources of fuel vapours. Avoid contact with bare flames, sources of sparks or any other source which may ignite the fuel or lead to explosion.
Take care not to spill fuel out of the filler, or it may ignite when in contact with hot engine parts. In the event of accidental fuel spillage, make sure the affected area is fully dry before starting the engine. Fuel expands from heat and when left under direct sunlight.
Never fill the fuel tank up to the rim. Tighten the filler cap securely after each refuelling.
Avoid contact with skin. Do not inhale vapours. Do not swallow fuel. Do not transfer fuel between different containers using a hose.
DO NOT RELEASE FUEL INTO THE ENVIRONMENT.
KEEP AWAY FROM CHILDREN.

Use only premium grade unleaded petrol, min. O.N. 95 (N.O.R.M.) and 85 (N.O.M.M.).

LUBRICANTS

DANGER
A good lubrication ensures the vehicle safety.
Failure to keep the lubricants at the recommended level or the use of a non-suitable new and clean type of lubricant can lead to the engine or gearbox seizure, thus leading to serious accidents, personal injury or even death.
Gear oil may cause serious damage to the skin if handled daily and for long periods.
Wash your hands carefully after use.
Do not dispose of oil into the environment.
Take it to the filling station where you usually buy it or to an oil salvage center.

WARNING
When filling the vehicle with this oil, take care not to spill it out since it could damage the vehicle paintwork.
In case of contact with oil, the tyres surface will become very slippery, thus becoming a serious danger for your safety.
In case of leaks, do not use the vehicle. Check and trace the cause of leaks and proceed to repair.

ENGINE OIL

DANGER
Prolonged or repeated contact with engine oil may cause severe skin damage.
Wash your hands thoroughly after handling engine oil.
Do not release into the environment.
Dispose of engine oil through the nearest waste oil reclamation firm or through the supplier.
Wear latex gloves during servicing

FRONT FORK FLUID

DANGER
Front suspension response can be modified to a certain extent by changing damping settings and/or selecting a particular grade of oil. Standard oil grade is SAE 20 W. Different oil grades can be selected to obtain a particular suspension response. (Choose SAE 5W for a softer suspension, 20W for a stiffer suspension).
The two grades can also be mixed in varying solutions to obtain the desired response.

BRAKE FLUID

NOTE *This vehicle is fitted with front and rear disc brakes. Each braking system is operated by an independent hydraulic circuit. The information provided below applies to both braking systems.*

DANGER
Do not use the vehicle in case brakes are worn out or do not work properly! The brakes are the parts that most ensure your safety and for this reason they must always be perfectly working. Failure to comply with these recommendations will probably lead to a crash or an accident, with a consequent risk of personal injury or death.
A wet surface reduces brakes efficiency.

DANGER
In case of wet ground the braking distance will be doubled, since both brakes and tyres drives on the road surface are extremely reduced by the water present on the road surface.
Any water on brakes, after washing the vehicle or driving on a wet road surface or crossing puddles or gips, can wet brakes so as to greatly reduce their efficiency.
Failure to comply with these recommendations may lead to serious accidents, with a consequent risk of severe personal injuries or death.
Brakes are critical safety components. Do not ride the vehicle in case brakes are not working at their best.
Check for brakes proper operation before every trip.
Brake fluid is an irritant. Avoid contact with eyes or skin.
In the event of accidental contact, wash affected body parts thoroughly. In the event of accidental contact with eyes, contact an eye specialist or seek medical advice.
DO NOT RELEASE BRAKE FLUID INTO THE ENVIRONMENT.KEEP AWAY FROM CHILDREN.
When handling brake fluid, take care not to spill it onto plastic or paint-finished parts or they will damage.

DANGER
Do not use any brake fluids other than the specified type. Never mix different types of fluids to top up level, as this will damage the braking system.
Do not use brake fluid from containers which have been kept open or in storage for long periods.
Any sudden changes in play or hardness in the brake levers are warning signs of problems with the hydraulic circuits.
Ensure that the brake discs and brake linings have not become contaminated with oil or grease. This is particularly important after servicing or inspections.
Make sure the brake lines are not twisted or worn.
Prevent accidental ingress of water or dust into the circuit.
Wear latex gloves when servicing the hydraulic circuit.

DISC BRAKES

DANGER
The brakes are the parts that most ensure your safety and for this reason they must always be perfectly working; check them before every trip.
A dirty disc soils the pads.
Dirty pads must be replaced, while dirty discs must be cleaned with a high-quality degreaser.
Perform the maintenance operations with half the indicated frequency if the vehicle is used in rainy or dusty areas, on uneven surfaces or on racetracks.
When the disc pads wear out, the level of the fluid decreases to automatically compensate for their wear.
The front brake fluid reservoir is located on the right handlebar, near the front brake lever.
The rear brake fluid reservoir is located under the right fairing.
Do not use the vehicle if the braking system leaks fluid.

COOLANT

DANGER
Coolant is toxic when ingested and is an irritant, contact with eyes or skin may cause irritation.
In the event of contact with eyes, rinse repeatedly with abundant water and seek medical advice. In the event of ingestion, induce vomiting, rinse mouth and throat with abundant water and seek medical advice immediately.
DO NOT RELEASE INTO THE ENVIRONMENT.
KEEP AWAY FROM CHILDREN.

DANGER
Take care not to spill coolant onto hot engine parts. It may ignite and produce invisible flames. Wear latex gloves when servicing.
Do not ride when coolant is below the minimum level.

Coolant mixture is a 50% solution of water and anti-freeze. This is the ideal solution for most operating temperatures and provides good corrosion protection.
This solution is also suited to the warm season, as it is less prone to evaporative loss and will reduce the need for top-ups.
In addition, less water evaporation means fewer minerals salts depositing in the radiator, which helps preserve the efficiency of the cooling system.
When temperature drops below zero degrees centigrade, check the cooling system frequently and add more anti-freeze (up to 60% maximum) to the solution.
Use distilled water in the coolant mixture. Tap water will damage the engine.
Refer to the chart given below and add water with the quantity of anti-freeze to obtain a solution with the desired freezing point:

Freezing point °C	Coolant % of volume
-20°	35
-30°	45
-40°	55

NOTE *Coolants have different specifications. The protection degree is written on the label.*

WARNING
Use nitrate-free coolant only, with a protection until at least -35°C.

TYRES

WARNING
If tyres are excessively inflated, the vehicle will be hard and uneasy to ride, thus making you feel not at your ease.
In addition the roadworthiness, mainly on wet surfaces and during cornering, will be impaired.
Flat tyres (insufficient pressure) can slip on the rim and make you lose the control of the vehicle.
In this case too, both vehicle roadworthiness, maneuverability and brake efficiency will be impaired.
Tyres changing, repair, maintenance and balancing must be carried out by specialized technicians using suitable equipment.
When new, tyres can have a thin slippery protective coating. Drive carefully for the first kilometers (miles). Never use rubber treating substances on tyres.
In particular, avoid contact with fluid fuels, leading to a rapid wear.
In case of contact with oil or fuel, do not clean but change tyres.

DANGER
Some of the factory-assembled tyres of this vehicle are provided with wear indicators.
There are several kinds of wear indicators.
For more information on how to check the wear, contact your Dealer.
Visually check if the tyres are worn and in this case have them changed.
If a tyre deflates while driving, stop immediately.
Avoid hard brakings or moves and do not close throttles too abruptly.
Slowly close throttle grip, move to the edge of the road and make use of the engine brake to slow down until coming to a halt.
Failure to comply with these recommendations can lead to serious accidents and consequent personal injuries or death.
Do not install tyres with air tube on rims for tubeless tyres and viceversa.

1.4. RUNNING-IN

1.4.1. RUNNING-IN RECOMMENDATIONS

The running-in of the engine is essential to ensure its duration and correct functioning.
If possible, drive on hilly roads and/or roads with many bends, so that the engine, the suspensions and the brakes undergo a more effective running-in.
During running-in, change speed.
In this way the components are first "loaded" and then "relieved" and the engine parts can thus cool down.
Even if it is important to stress the engine components during running-in, take care not to exceed.

WARNING
Only after the first 2000 km (1243 mi) of running-in you can expect the best performance levels from the vehicle.

Keep to the following indications:

- Do not open the throttle completely if the speed is low, both during and after the running-in.
- During the first 100 km (62 mi) pull the brakes with caution, avoiding sharp and prolonged brakings. This ensures a correct bedding-in of the pads on the brake disc.
- During the first 1000 km (621 mi) never exceed 5000 rpm (see table).

WARNING
After the first 1000 km (621 mi), Dealer carry out the checks indicated in the column "After running-in", see (REGULAR SERVICE INTERVALS CHART), in order to avoid hurting yourself or other people and/or damaging the vehicle.

- Between the first 1000 km (621 mi) and 2000 km (1243 mi) drive more briskly, change speed and use the maximum acceleration only for a few seconds, in order to ensure better coupling of the components; never exceed 6000 rpm (see table).
- After the first 2000 km (1243 mi) you can expect better performance from the engine, however, without exceeding the maximum allowed [7600 rpm].

Engine maximum rpm recommended	
Mileage km (mi)	rpm
0÷1000 (621)	5000
1000÷2000 (621÷1243)	6000
over 2000 (1243)	7600

1.5. LOCATION OF SERIAL NUMBERS

1.5.1. LOCATION OF SERIAL NUMBERS

These numbers are necessary for vehicle registration.

***IMPORTANT**: Altering the identification numbers of vehicle or engine is a legal offence punishable by heavy fines and penalties. In addition, altering the frame number (VIN) results in immediate warranty invalidation.*

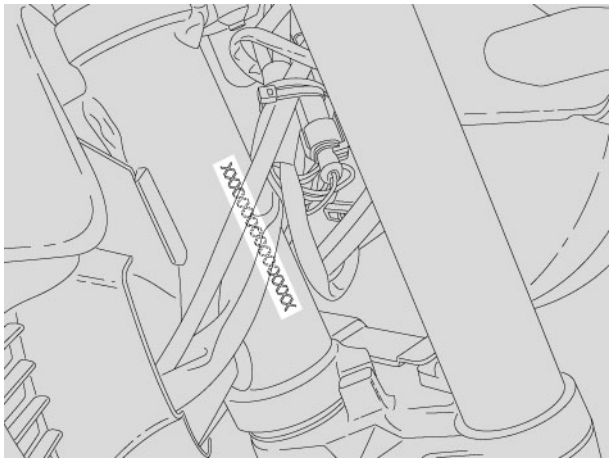
The serial number is composed of numbers and letters as shown in the following example.

ZGULL01003MXXXXXX.

Key:
ZGU: WMI code (World Manufacture Identifier).
LL: model;
010: version variant;
0: free digit
3 year of manufacture (variable) (3 – for 2003)
M: production plant;
XXXXXX: 6-figure sequential number;

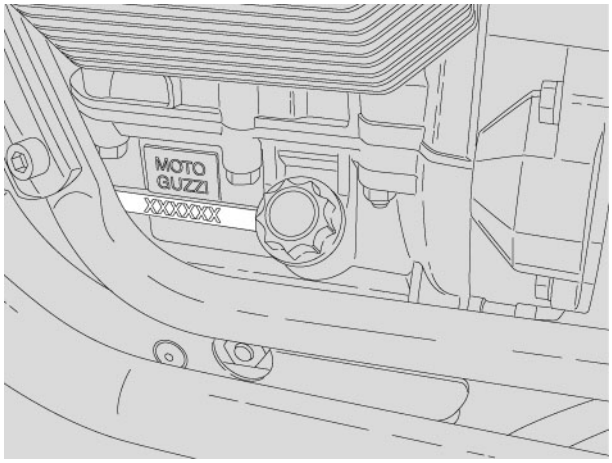
FRAME NUMBER

The frame number (Vehicle Identification Number) is punched on the right-hand side of the headstock.



ENGINE NUMBER

The engine number is punched on the right hand side of the engine next to the oil level plug.



SUMMARY

2.1. GENERAL TECHNICAL INFORMATION

2.1.1. TECHNICAL DATA

ENGINE – TRANSMISSION

ENGINE	
Type	two-cylinder 4-stroke
Number of cylinders	two
Cylinder layout:	90° V
Pistons	forged, two compression rings, one oil control ring
Bore	80 mm
Stroke	74 mm
Total displacement	744 cc
Cooling	air
Air cleaner	dry cartridge type
Compression ratio	9.6:1
Maximum horsepower (CE correction)	35.5 kW at 6800 rpm
Maximum torque (CE correction)	54.7 Nm at 3600 rpm
Engine idling speed	1100 ± 100 rpm
TIMING	
Timing diagram:	2 valves with push-rods and rockers
intake valve opens	18° B.T.D.C.
intake valve closes	50° A.B.D.C
exhaust valve opens	53° B.T.D.C.
exhaust valve closes	15° A.B.D.C
Values valid with clearance between rockers and valve of	0.15 mm opens 0.20 mm closes
FUEL SUPPLY	
Type	Electronic injection (Weber – Marelli)
Choke	Ø 36 mm
Fuel	Premium grade unleaded petrol, min. O.N. 95 (N.O.R.M.) and 85 (N.O.M.M.).
STARTING	electric
EXHAUST	Three-way manifold with catalyser
DRIVE	
- clutch	dry single disc with cush drive
- primary drive	gear-type, ratio: 16/21 = 1:1.3125
- transmission	5 gears
- gear ratios:	
1st	11/26 = 1:2.3636
2nd	14/23 = 1:1.6429
3rd	18/23 = 1:1.2778
4th	18/19 = 1:1.0556
5th	20/18 = 1:0.9
- final drive	cardan shaft type
- ratio	8/33 = 1:4.825
Lubrication	Pressure system, valve adjustment, lobe pump

VEHICLE

FRAME	
Type	Detachable tubular duplex cradle with high yield strength
Trail	109 mm
Rake	27.5°
SUSPENSION	
Front	MARZOCCHI 40 mm hydraulic telescopic fork
Front wheel travel	130 mm
Rear	swing arm in light cast alloy with two dampers, spring adjustable for pre-load and rebound
Rear wheel travel	95 mm
BRAKES	
Front	Stainless steel 320 mm floating disc with 4 differentiated and opposing pistons
Rear	Stainless steel 260 mm disc
Brake master cylinder diameter:	
- front brake	13 mm
- rear brake	13 mm
Calliper piston diameters:	
- front calliper	34/30 mm
- rear calliper	32 mm
Total friction surface area:	
- front	21.3 cm^2
- rear	16.1 cm^2
Brake pads compound	Frendo 222
WHEELS	
Type	3-spoke diecast in light alloy
Front rim	3" x 17"
Rear rim	3.50" x 17"
TYRES	
Type	BRIDGESTONE BATLAX or PIRELLI SPORT DAEMON
- front	110/70 ZR 17”
Inflation pressure	220 Kpa
Inflation pressure with pillion	+ 0.3 atm
- rear	130/80 ZR 17”
Inflation pressure	240 Kpa
Inflation pressure with pillion	+ 0.3 atm
ELECTRICAL SYSTEM	
Battery	12 V – 14 Ah
Alternator (with permanent magnet)	12 V – 400 W
Main fuses	30 A
Secondary fuses	3 A – 10 A – 15 A
BULBS	
Headlamp low beam / high beam (halogen)	12V – 55/60 W H4
Front parking light	12V – 5 W
Direction indicators	12V – 10 W (RY 10W amber lamp)
Rear parking /brake lights	12V – 5/21 W
Instruments lighting	LED
EFI	LED
Number plate light	12V – 5 W
WARNING LIGHTS	
Neutral	LED
Direction indicators	LED
Fuel reserve	LED
High beam	LED
Engine oil pressure	LED

SPARK PLUGS	
Standard	NGK BR8ES
Gap	0.6 – 0.7 mm
Resistance	5 KΩ
DIMENSIONS	
Length	2190 mm
Width	730 mm
Maximum height (at front fairing)	1175 mm
Seat height	790 mm
Ground clearance	176 mm
Wheelbase	1449 mm
Dry weight	182 kg
CAPACITIES	
Fuel (reserve included)	18 litres
Fuel reserve	5 litres
Engine oil	Oil and filter change 1.78 litres
Front fork fluid	400 ± 2.5 cm^3 (each leg)
Seats	2
Vehicle max. load	180 kg (rider + pillion + luggage)
ACCESSORIES	Luggage rack, saddle bags brackets, centre stand

2.1.2. PERIODIC MAINTENANCE CHART

OPERATIONS PERFORMED BY THE Official **Moto Guzzi Dealer** (THAT CAN ALSO BE PERFORMED BY THE OWNER).

1 = inspect and clean, set or adjust, lubricate or replace as required;
2 = clean;
3= replace;
4= adjust.

IMPORTANT ***Perform the maintenance operations more often if the vehicle is used in rainy or dusty areas, on uneven surfaces or on racetracks.***

(*) = Check every fifteen days or at the recommended intervals.

Components	After running-in [1000 km (621 mi)]	Every 7500 km (4687 mi) or 12 months	Every 15000 km (9375 mi) or 24 months
Spark plugs	-	3	-
Engine oil filter	3	3	-
Front fork	1	-	1
Efficiency/aiming of lights	-	1	-
Lights system	1	1	-
Safety switches	1	1	-
Brake fluid	-	1	-
Engine oil	3	3	-
Tyres	1	1	-
Tyre pressure (*)	4	4	-
Engine idling speed	4	4	-
Tightness of battery terminals	1	-	-
Cylinder head screws torque	4	-	-
Engine oil pressure LED	each time engine is started: 1		
Brake pads	1	before long trips and every 2000 km (1250 mi):1	

OPERATIONS TO BE PERFORMED BY THE Official **Moto Guzzi** Dealer

1 = inspect and clean, set or adjust, lubricate or replace as required;
2 = clean;
3= replace;
4= adjust.

IMPORTANT Perform the maintenance operations more often if the vehicle is used in rainy or dusty areas, on uneven surfaces or on racetracks.

(*) = Check every fifteen days or at the recommended intervals.

Components	After running-in [1000 km (621 mi)]	Every 7500 km (4687 mi) or 12 months	Every 15000 km (9375 mi) or 24 months
CO emissions at idle speed	-	1	-
Transmission cables and controls	1	1	-
Steering bearings and play	1	1	-
Wheel hub bearings	-	1	-
Brake discs	1	1	-
Air cleaner	-	1	-
General running of the vehicle	1	1	-
Braking systems	1	1	-
Brake fluid	Every two years: 3 or every 20000 km (12427 mi)		
Transmission oil	3	3	-
Front fork fluid	after the first 7500 km (4687 mi) and every 22500 km (14000 mi) thereafter: 3		
Fork oil seals	after the first 30000 km (18750 mi) and every 22500 km (14000 mi) thereafter: 3		
Brake pads	every 2000 km (1243 mi): 1 - If worn: 3		
Valve clearance adjustment	4	4	-
Wheels/Tyres	1	1	-
Tightening torque of nuts and bolts	1	1	-
Tightness of battery terminals	1	-	-
Cylinder timing	1	1	-
Suspension and ride height	1	-	1
Final drive transmission oil	3	3	-
Fuel lines	-	1	every four years: 3
Brake lines	-	1	every four years: 3
Clutch wear	-	1	-

2.1.3. TABLE OF LUBRICANTS

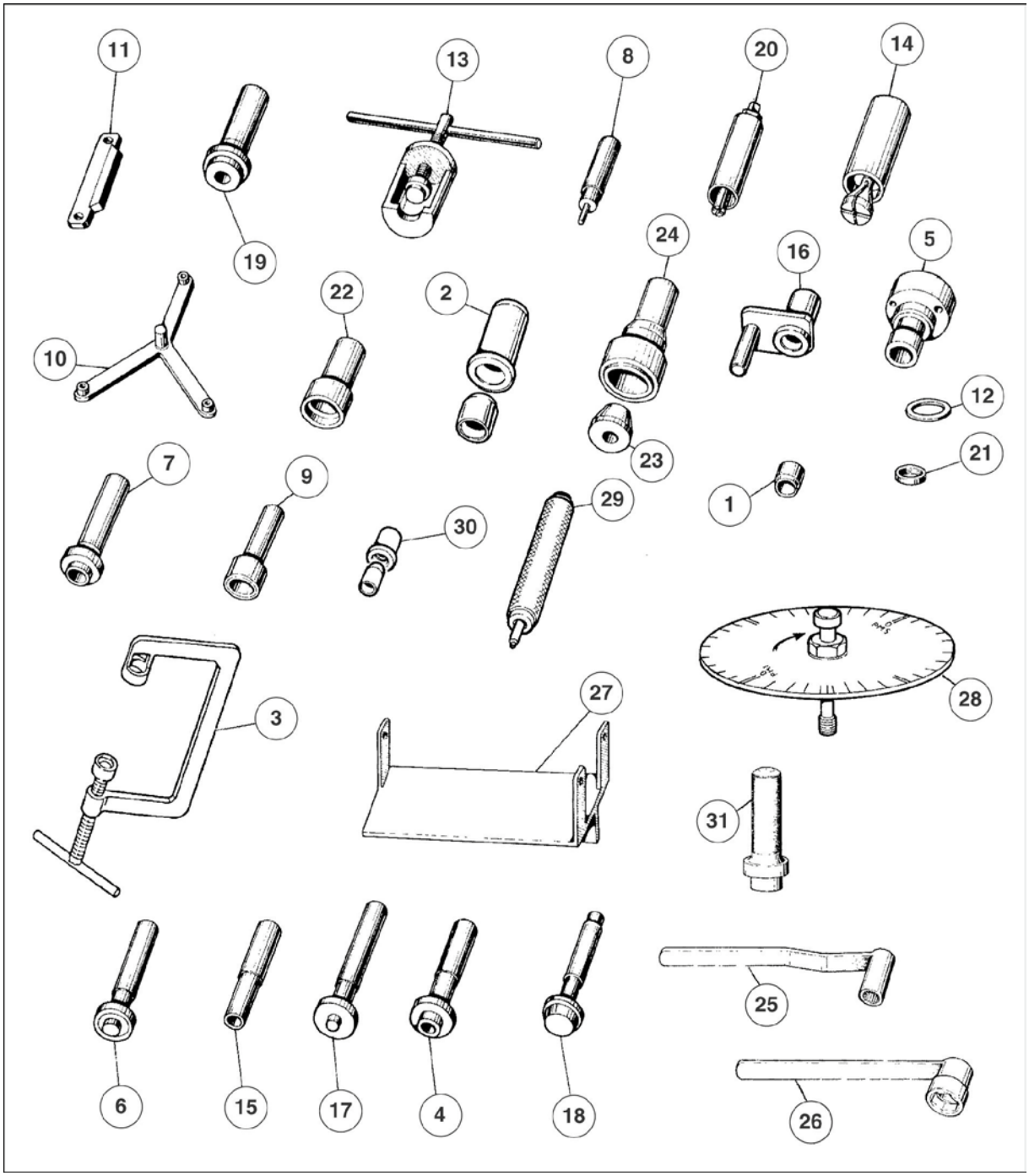
LUBRICANT	PRODUCT
Engine oil	RECOMMENDED: Agip RACING 4T Alternatively, use brand name oil complying with or exceeding CCMC G-4 A.P.I. S.G. specifications.
Transmission oil	RECOMMENDED: Agip TRUCK GEAR 85 W 140
Gearbox oil	RECOMMENDED: Agip ROTRA MP/S 80 W 90
Front fork fluid	RECOMMENDED: IP F.A. 5W or IP F.A. 20W, alternatively use Agip FORK 5W or Agip FORK 20W.
Bearings and other lubrication points	RECOMMENDED: IP BIMOL GREASE 481, IP AUTOGREASE MP or Agip GREASE SM2. As an alternative to recommended grease, use top brand rolling bearing grease that will resist a temperature range of -30°C…+140°C, with dropping point 150°C…230°C, high corrosion protection, good resistance to water and oxidisation.
Battery terminals	Use neutral grease or Vaseline.
Brake fluid	RECOMMENDED: IP Autofluid FR. DOT 4 (the brake circuit is also compatible with DOT 5) or Agip BRAKE 5.1 DOT 4 (the brake circuit is also compatible with DOT 5) As an alternative to the recommended brake fluid, use brake fluids complying with or exceeding SAE J1703, NHTSA 116 DOT 4, ISO 4925 synthetic brake fluid specifications. ***IMPORTANT*** *Use new brake fluid only. Don't mix different brands or types of brake fluids unless you have ascertained their compatibility.*

2.1.4. TIGHTENING TORQUES

DESIGNATION	TIGHTENING TORQUES (Nm)
CYLINDER HEADS	
Cylinder head covers fixing screws	10
Spark plugs	25
CRANKCASE AND COVERS	
Cylinder heads-barrels to crankcase fixing nut (M10)	40÷42
Cylinder heads-barrels to crankcase fixing nut (M8)	28÷30
Crankcases joining nuts (M8)	22÷25
Crankcases joining nuts (M10)	40÷42
Timing cover fixing screws	10
Sump fixing screws	10
Valves cover insert fixing screw	5
CONNECTING ROD GROUP	
Rods fixing screws	30÷32
Flywheel to crankshaft fixing screws	40
Ring gear fixing screws	10
TIMING	
Camshaft to crankcase fixing connection	30
Timing gear to camshaft fixing screws	25
Phonic wheel fixing screw	25
ELECTRIC STARTING	
Starter motor fixing screws	25
FUEL SUPPLY	
Injector cap fixing screws (M5)	4
Intake manifolds to heads fixing screws	10
LUBRICATION	
Oil pressure sensor	8÷10
Oil pump to crankcase fixing screws	10
Filter cartridge sealing cover fixing screws	25
IGNITION	
Alternator stator fixing screws	5
Alternator rotor fixing nut	80
CLUTCH	
Clutch shaft fixing nut	100

GEARBOX	
Primary shaft fixing nuts	65
Cover to gearbox fixing screws	10
Gearbox to clutch housing cover fixing screws	10
Index lever fixing screw nut.	6
ENGINE CONNECTING PARTS	
Front tie rod nut	45
Nut for long and short screws	45
Clutch housing cover to engine fixing screws	25
REAR TRANSMISSION	
Bevel pinion to case fixing nut	100
Bevel gear to hollow shaft fixing screws	42
Cover to transmission case fixing screws	25
FRAME	
Semi-cradle, frame cradle fixing screws	45
FRONT SUSPENSION	
Centre stand to frame fixing screws	10
Lock nut	30
Fork head fixing screws	45
Fork base fixing screws	45
Slider to wheel spindle fixing screws	10
REAR SUSPENSION	
Rear suspension upper and lower sections fixing screws	20
FRONT WHEEL AND BRAKE DISC	
Wheel spindle	80
Brake disc to hub fixing screws	25
Brake calliper fixing screws	50
REAR WHEEL AND BRAKE DISC	
Brake calliper fixing screw	30
Wheel spindle fixing nut	120
Wheel spindle fixing screws on swing arm	45
Brake disc fixing screws	25
STEERING	
Steering head fixing screw	50
TANK	
Cap fixing screws	6
Breather screws	12
BODYWORK	
Pillion/rider footpeg support plate fixing screws	25
Brake fixing screw	25
Front mudguard fixing screws	25
Steering ringnut	7
Steering yoke fixing nut	80

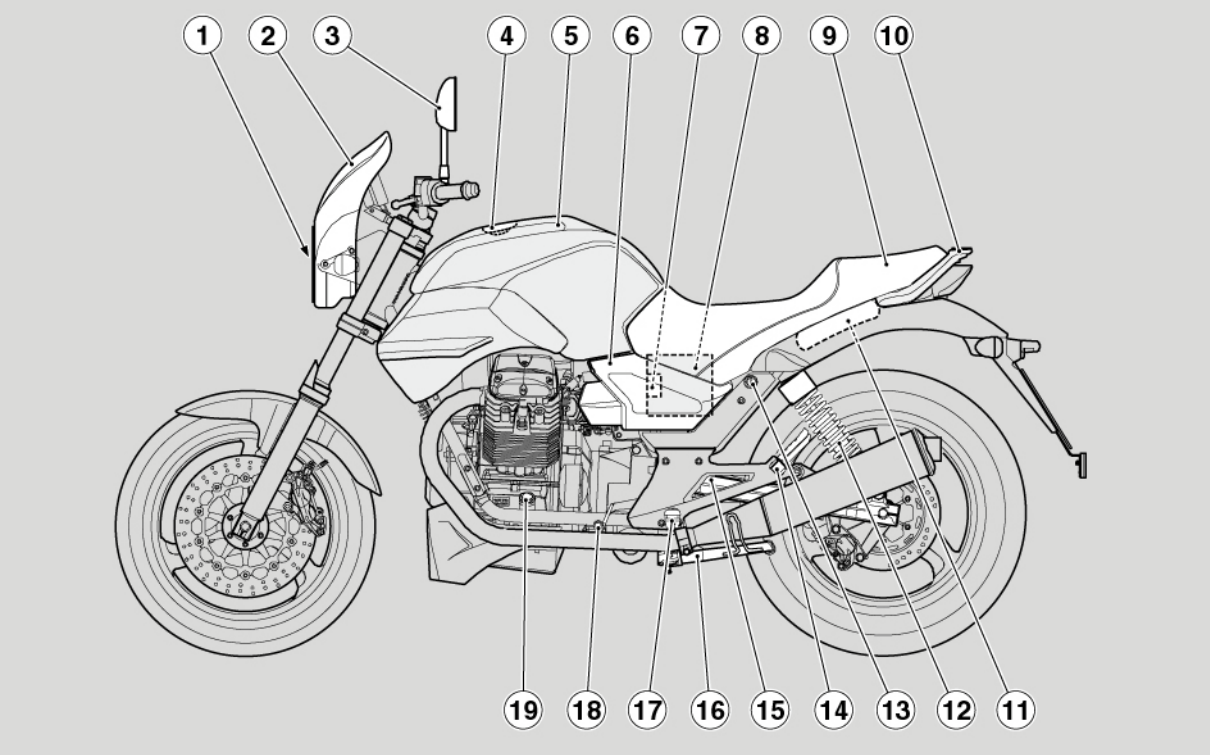
2.1.5. SPECIAL TOOLS



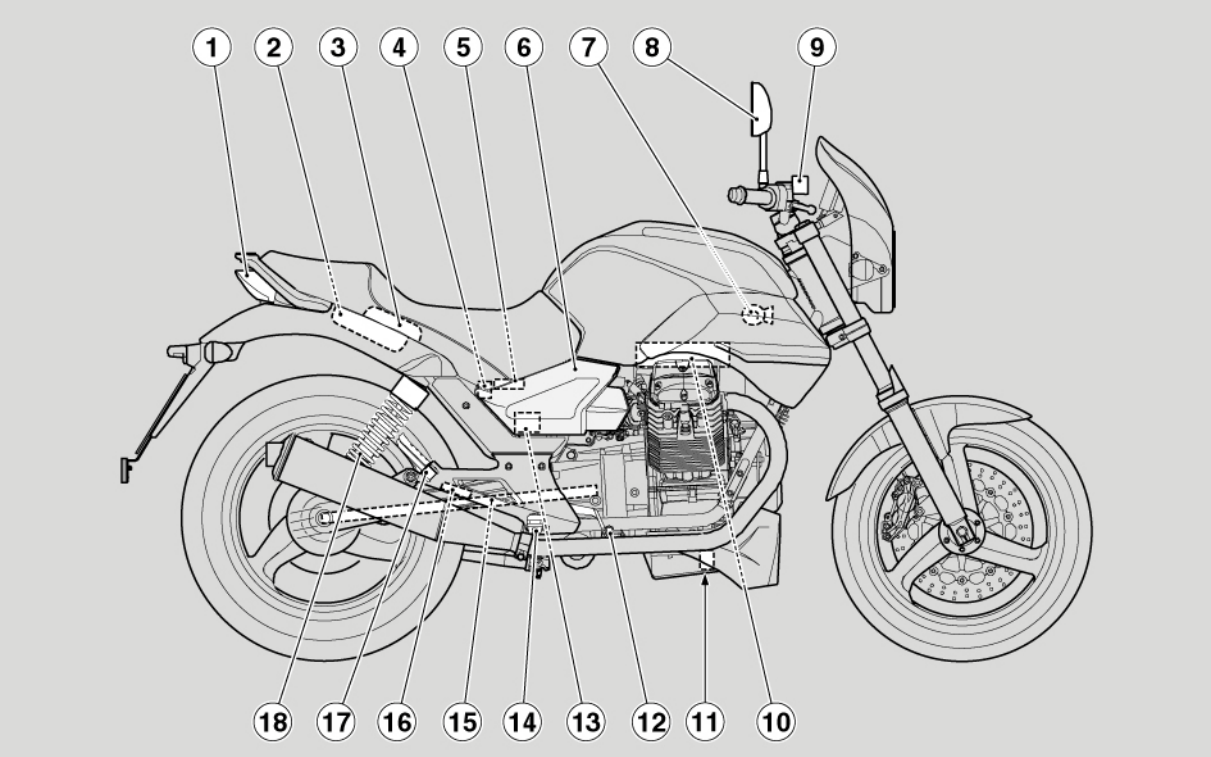
Key:

Position	Tool designation and application	Part number
1	Bush for fitting oil seal on secondary shaft	19 92 73 00
2	Tool for fitting oil seal on timing cover (crankshaft)	19 92 72 20
3	Valves disassembly / assembly tool	10 90 72 00
4	Punch for bevel gear pair pinion oil seal	19 92 61 00
5	Bevel gear pair alignment preassembly tool	19 92 88 00
6	Punch for clutch shaft bearing on case	19 92 94 00
7	Punch for transmission case oil seal	19 92 60 00
8	Punch for clutch shaft oil seal	19 90 59 00
9	Punch for assembling oil seal on gearbox cover for secondary shaft	19 92 72 00
10	Clutch disk assembly and centring tool	19 90 65 00
11	Flywheel holder tool	19 91 18 00
12	Spacer for installation of ring on secondary shaft	19 92 72 02
13	Puller for internal ring on hollow shaft	19 90 70 00
14	Puller for transmission case bearing external ring	19 92 75 00
15	Punch for bearing on bevel gear pair pinion	19 92 62 00
16	Intermediate gear holding tool for removal of gearbox	19 92 77 00
17	Punch for primary shaft bearing on gearbox	19 92 63 00
18	Punch for taper bearing outer race on bevel gear pair pinion holder body	19 92 64 00
19	Punch for transmission case bearing outer race	19 92 65 00
20	Puller for swing arm holder bearing on gearbox cover	19 92 76 00
21	Reducer bush for valve disassembly tool (this tool is marked with No. 10 90 72 00)	19 92 78 00
22	Punch for driving bearing inner race onto hollow shaft	19 92 79 00
23	Tool for assembling oil seal on crankshaft - flywheel side	12 91 20 00
24	Punch for driving oil seal onto flange and crankshaft – flywheel side	19 92 71 00
25	Clutch shaft holding tool	19 90 71 60
26	Clutch shaft nut holding wrench	19 90 54 60
27	Gearbox support	19 90 25 00
28	Graduated disk	19 92 96 00
29	Punch for mounting cap on valve guide	19 92 60 20
30	Tool for assembling oil seal to timing cover (camshaft)	19 92 73 20
31	Secondary shaft bearing outer race inserter tool	19 92 64 60

2.1.6. LOCATION OF MAIN PARTS

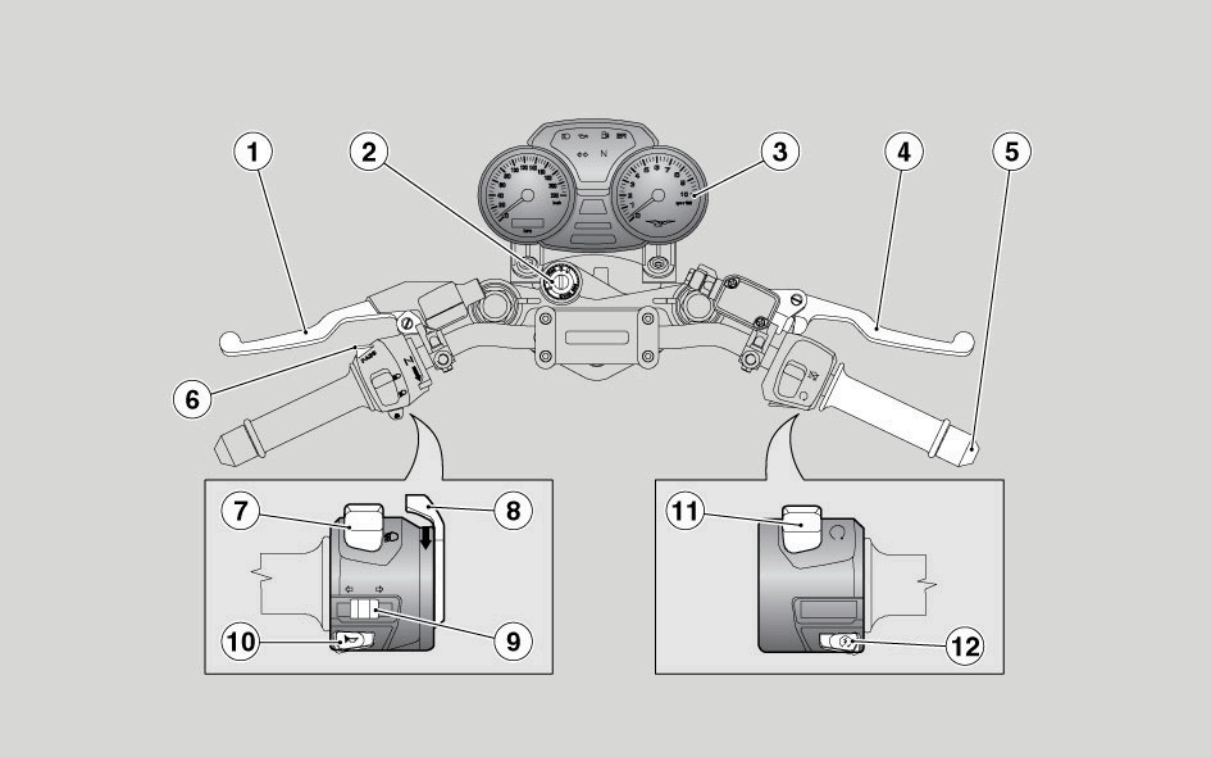


Key:
1) Headlight
2) Front fairing
3) Left rear-view mirror
4) Fuel filler cap
5) Fuel tank
6) Left side fairing
7) Main fuse-holder (30A)
8) Battery
9) Rider/pillion seat
10) Pillion grab handle
11) Toolkit compartment
12) Rear left damper
13) Seat lock
14) Pillion left footpeg
15) Swing arm
16) Side stand
17) Rider left footpeg
18) Gear shift lever
19) Engine oil dipstick.



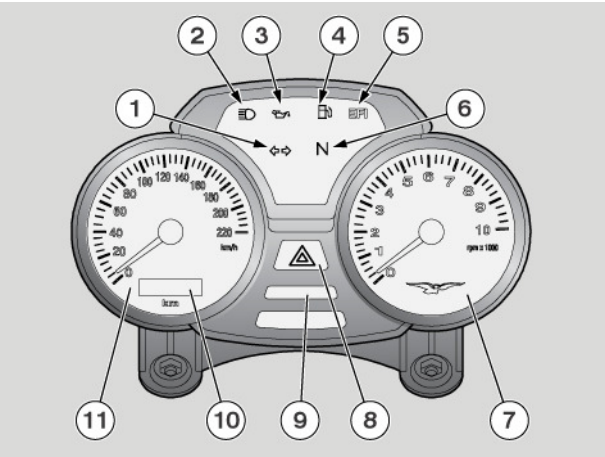
Key:
1) Tail light
2) Glove compartment
3) Disc lock compartment
4) Rear brake fluid reservoir
5) Secondary fuseholders
6) Right side fairing
7) Horn
8) Right rear-view mirror
9) Front brake fluid reservoir
10) Air cleaner
11) Engine oil filter
12) Rear brake lever
13) Engine Control Unit
14) Rider right footpeg
15) Driveshaft transmission
16) Rear brake master cylinder
17) Pillion right footpeg
18) Right rear damper

2.1.7. LOCATION OF CONTROLS / INSTRUMENTS



Key:
1) Clutch lever
2) Ignition switch / steering lock (- -)
3) Instruments and indicators
4) Front brake lever
5) Throttle twistgrip
6) High beam flasher button ( )
7) Lights selector (-)
8) Choke lever ( )
9) Direction indicators switch ( )
10) Horn button ( )
11) Engine cut-out switch (-)
12) Starter button ( )

Key:
1) Direction indicator warning light ( ) green
2) High beam warning light ( ) blue
3) Engine oil pressure warning light ( ) red
4) Fuel reserve warning light ( ) amber yellow
5) "*EFI*" indicator light, red
6) Neutral gear warning light (N) green
7) Rev counter
8) Hazard lights button ( ) red
9) MODE button (multifunction display)
10) Multifunction digital display
11) Speedo

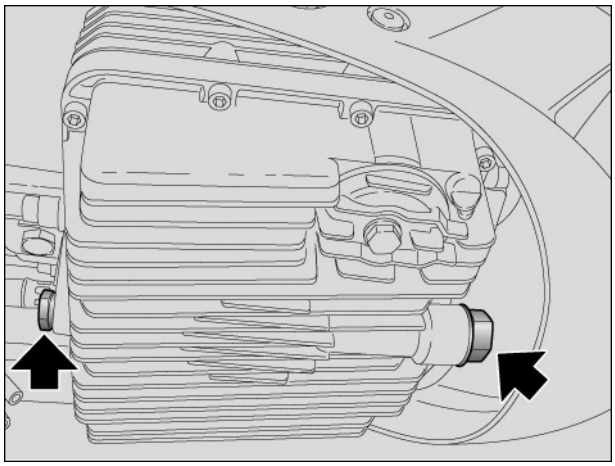


2.1.8. ENGINE OIL AND FILTER CHANGE

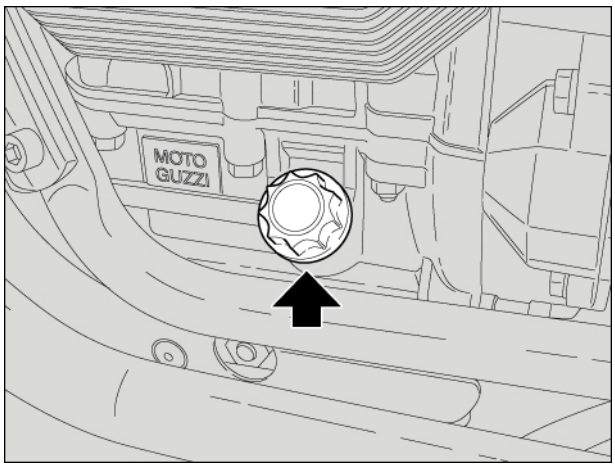
ENGINE OIL CHANGE

IMPORTANT *Oil flows more easily when warm. Let the engine warm up for about twenty minutes to facilitate total drainage.*

Place a container of capacity greater than 4000 cm^3 under the drain plug.
Unscrew and remove the drain plugs.



Unscrew and remove the filler plug.
Drain the oil into the container allowing the last of the oil drip out for several minutes.
Inspect the sealing washer of the drain plugs and replace if necessary.
Clean off any metal debris sticking to the drain plug magnet.
Refit and tighten the drain plugs.

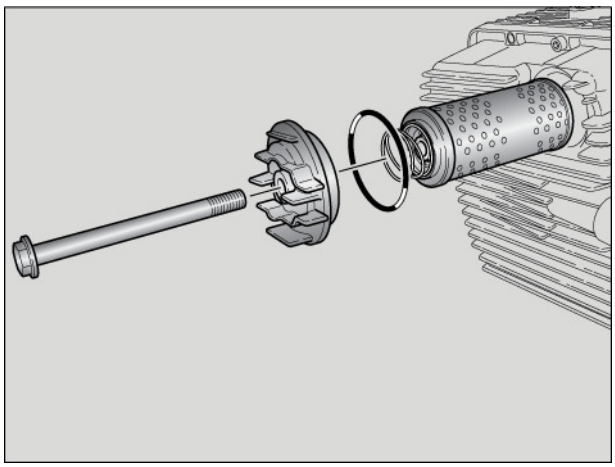


ENGINE OIL FILTER CHANGE

Unscrew the screw and remove the cover.
Remove the engine oil filter.

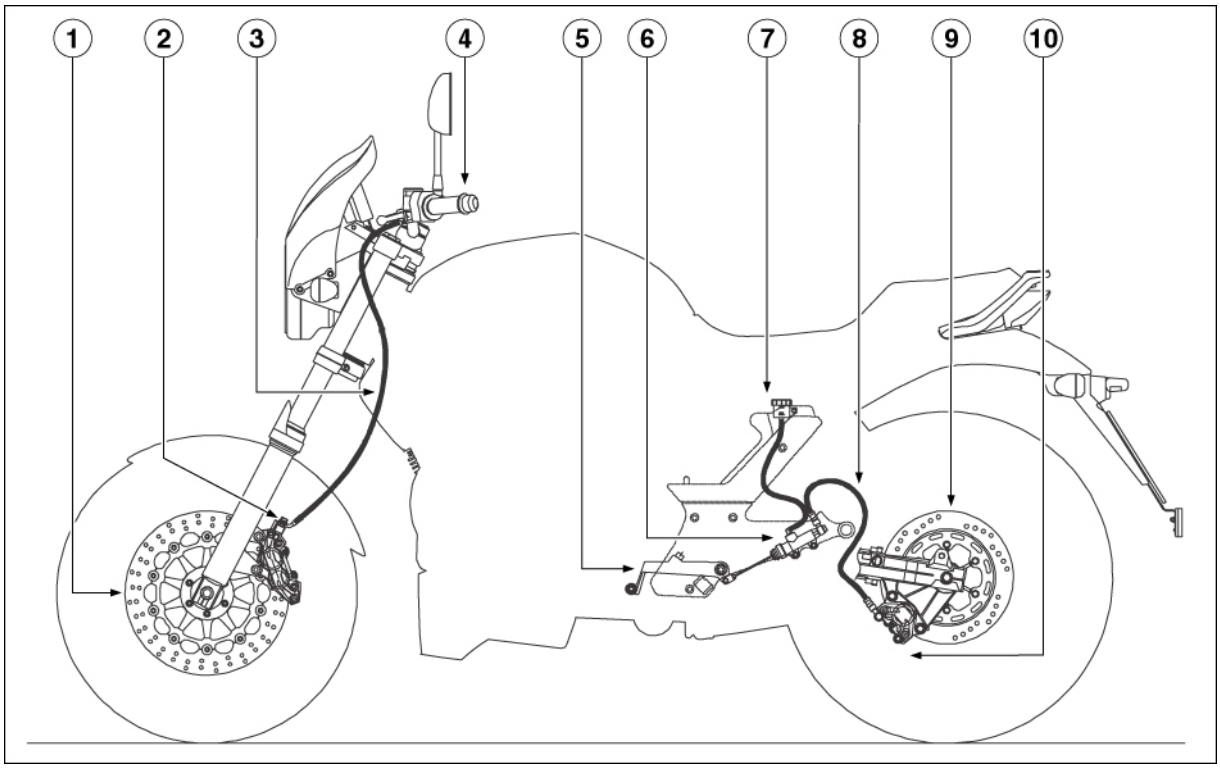
IMPORTANT *Do not use filters that have already been used.*

Smear a film of oil onto the sealing ring of the new engine oil filter.
Fit the new engine oil filter with the spring facing downwards.
Refit the cover, screw down and tighten the two screws.

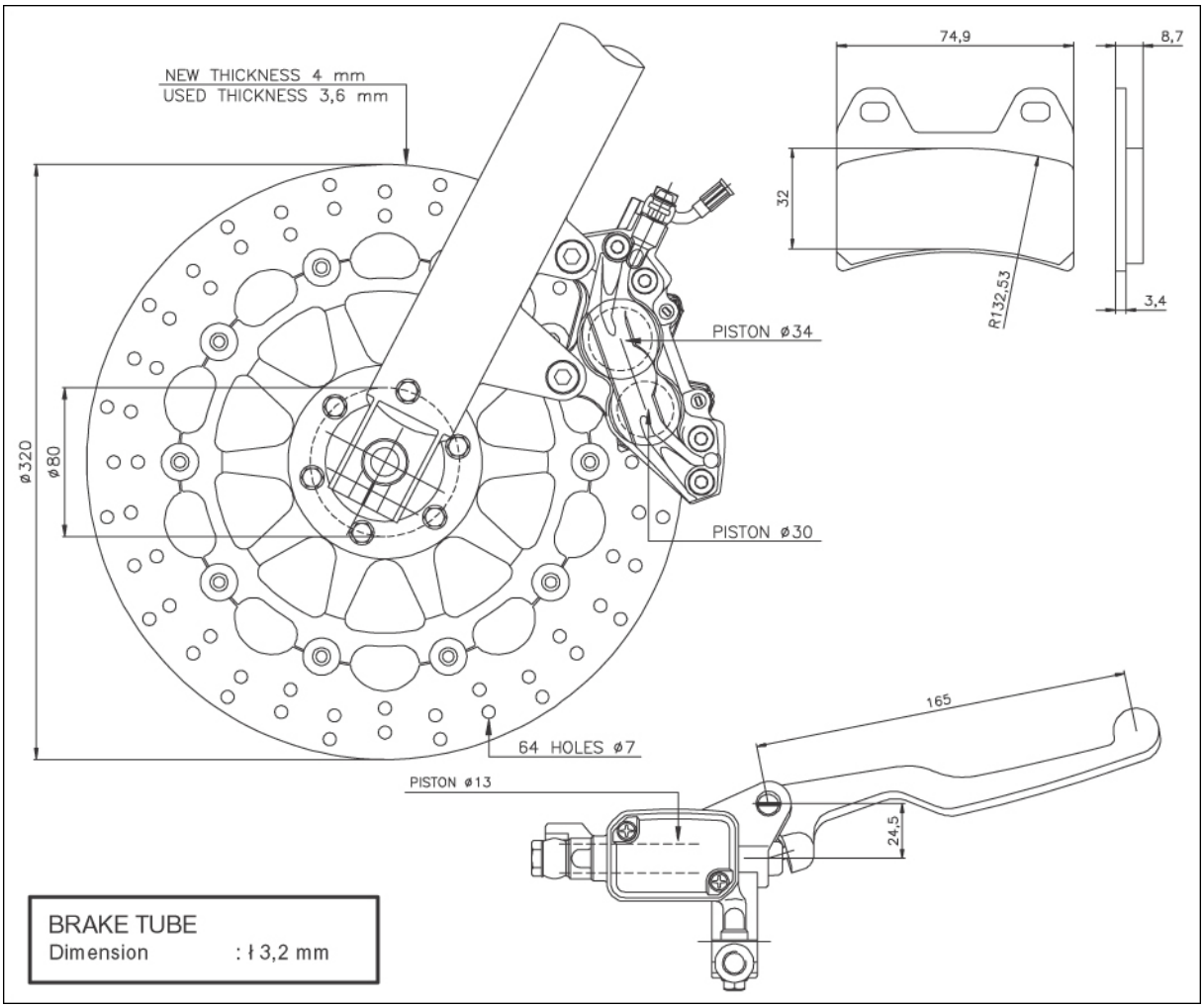


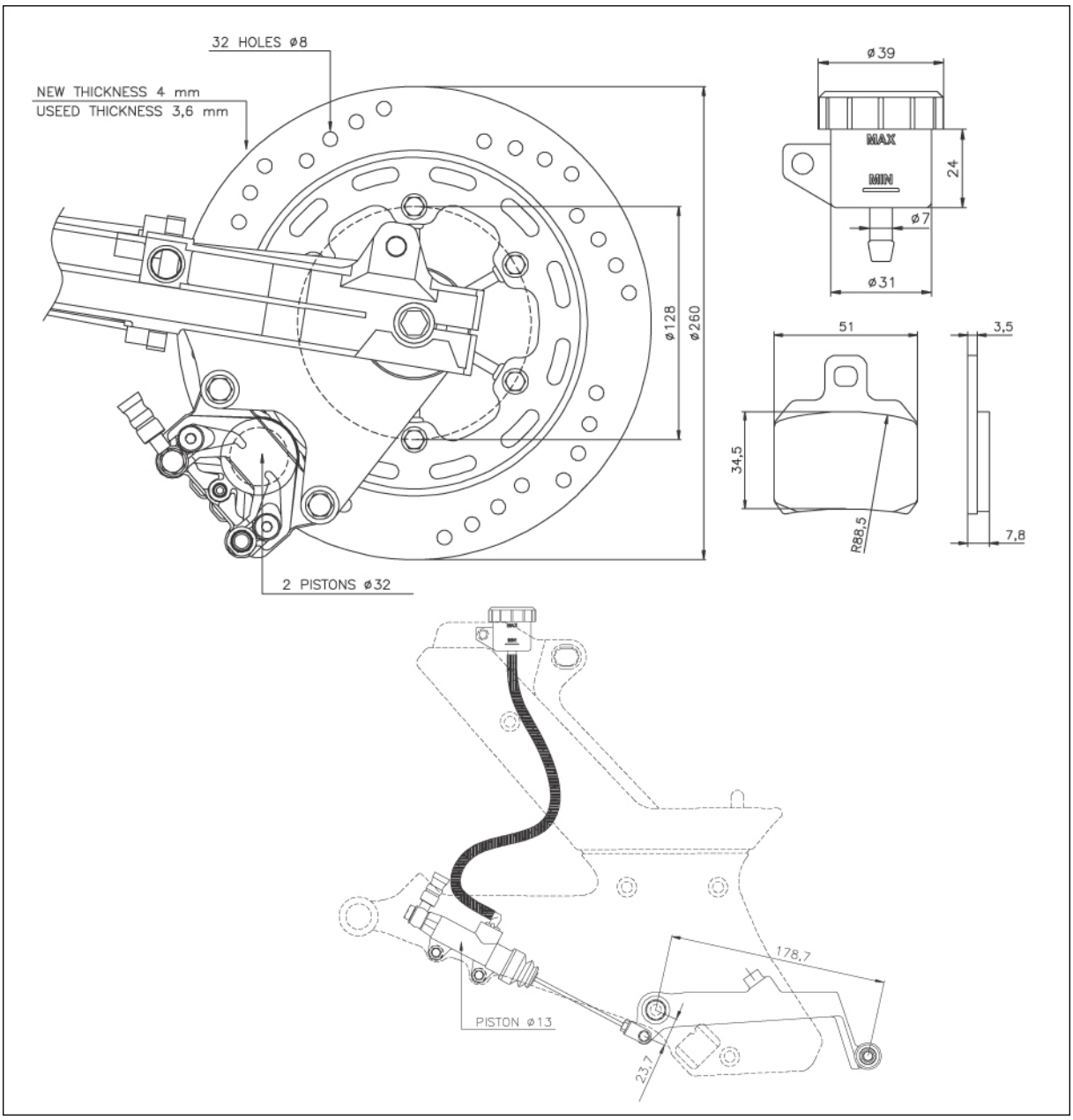
2.1.9. SYSTEMS LAYOUT

BRAKES SYSTEM

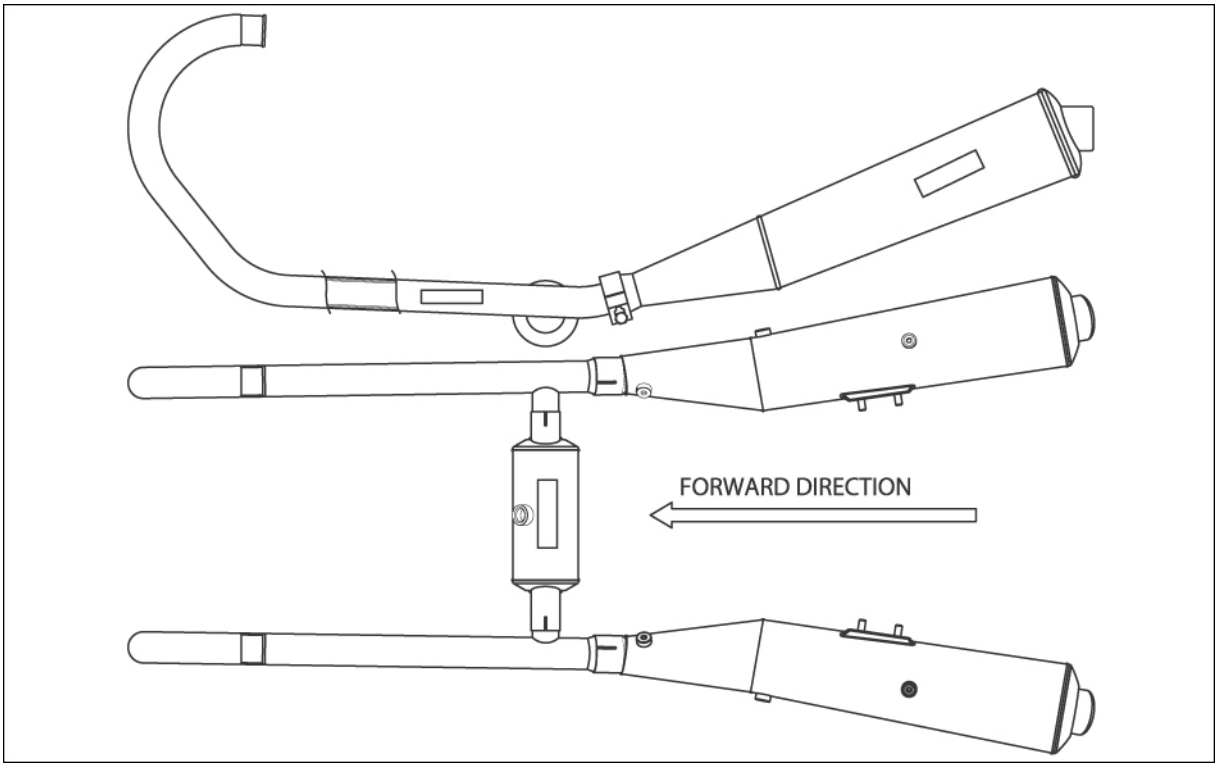


Key:
1) Front brake disc
2) Front calliper.
3) Front brake line.
4) Front brake master cylinder with lever and reservoir.
5) Rear brake lever (left-and side).
6) Rear brake master cylinder (left-hand side).
7) Rear brake reservoir.
8) Rear brake lines.
9) Rear brake disc (right-hand side).
10) Rear calliper

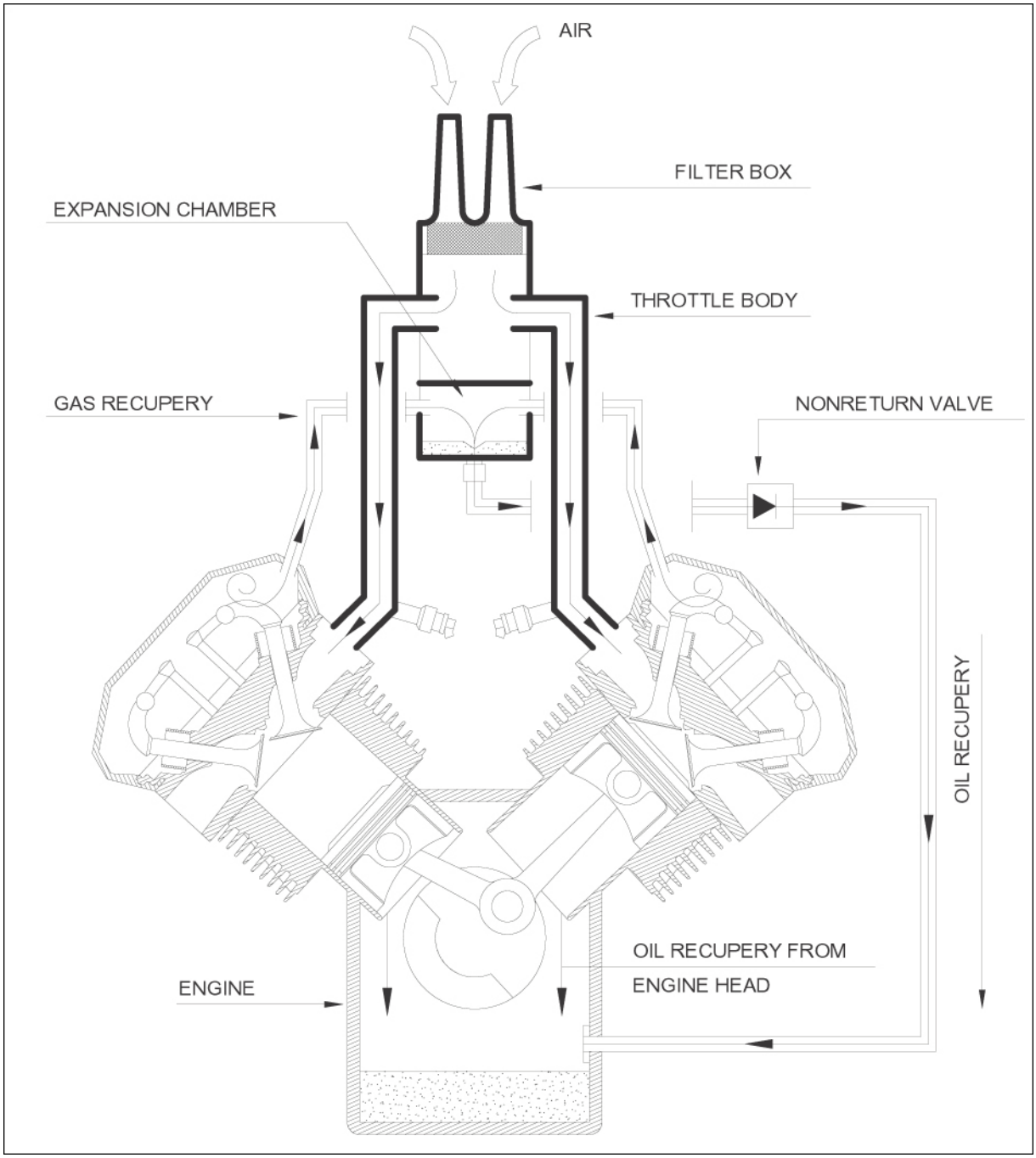




EXHAUST SYSTEM



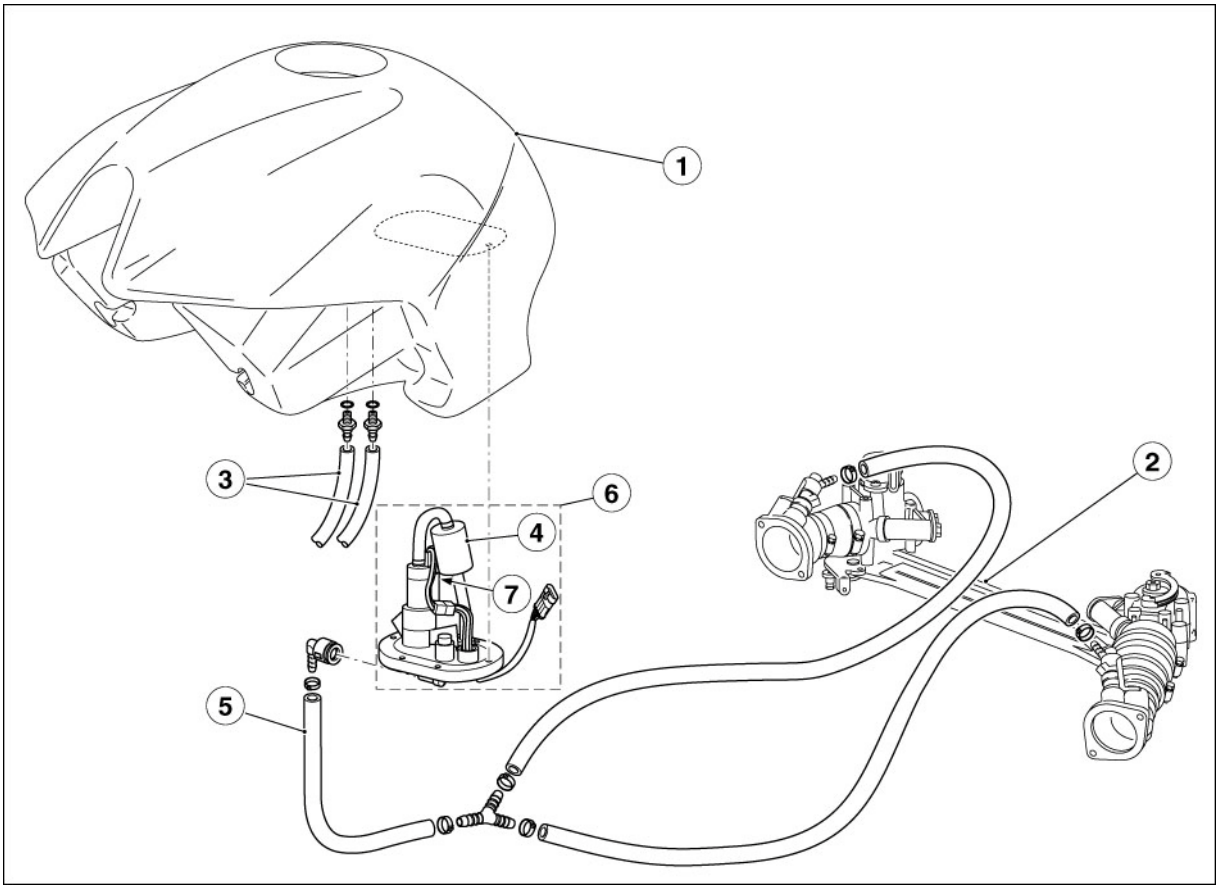
CRANKCASE OIL AND EXHAUST GAS RECOVERY SYSTEM



SUMMARY

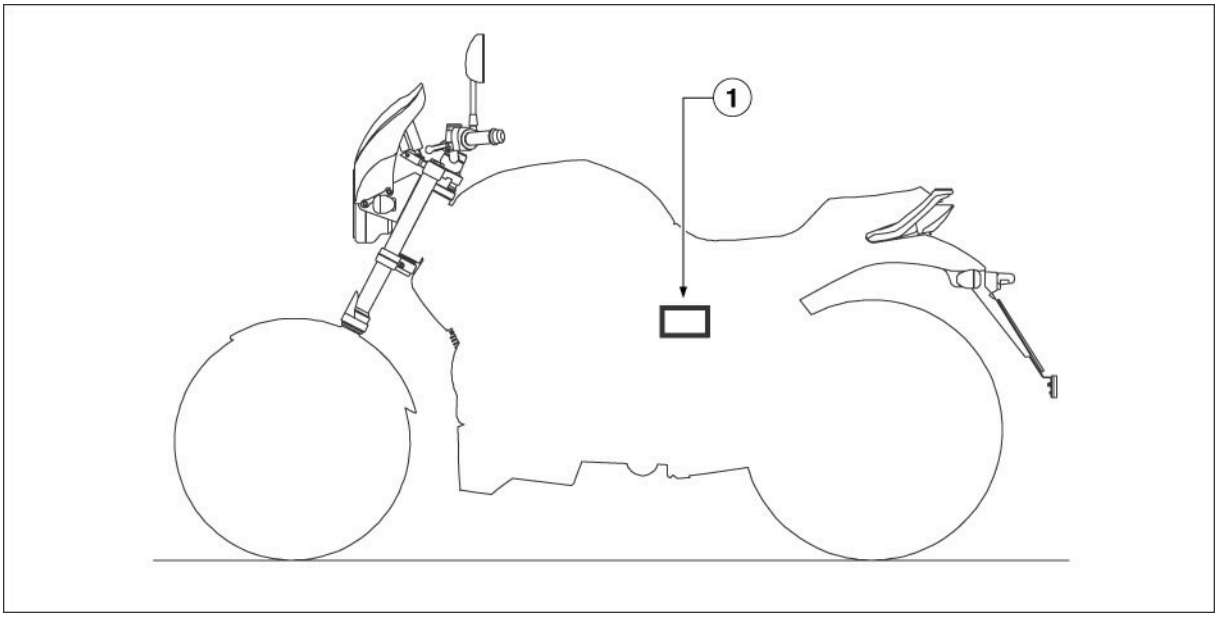
3.1. FUEL SYSTEM

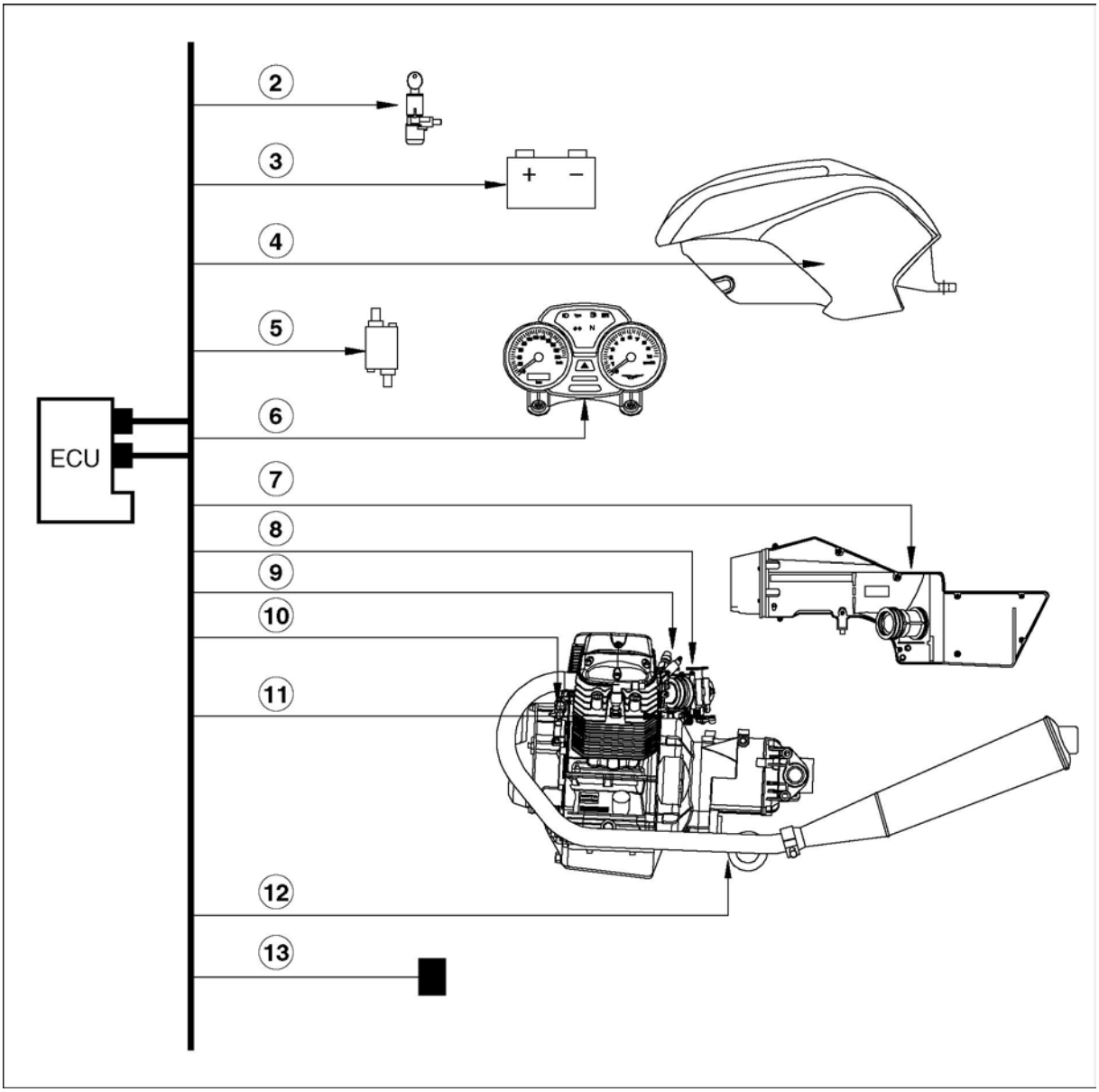
3.1.1. FUEL SYSTEM LAYOUT



Key:
1. Fuel tank
2. Throttle body
3. Drain lines
4. Fuel filter
5. Fuel delivery line
6. Fuel pump assembly
7. Level check thermistor

3.1.2. INJECTION SYSTEM LAYOUT

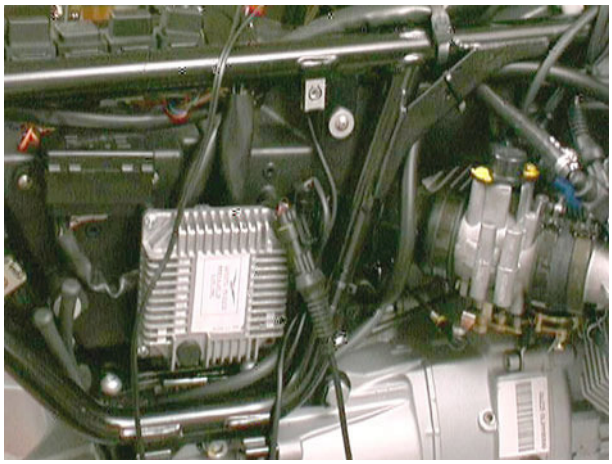




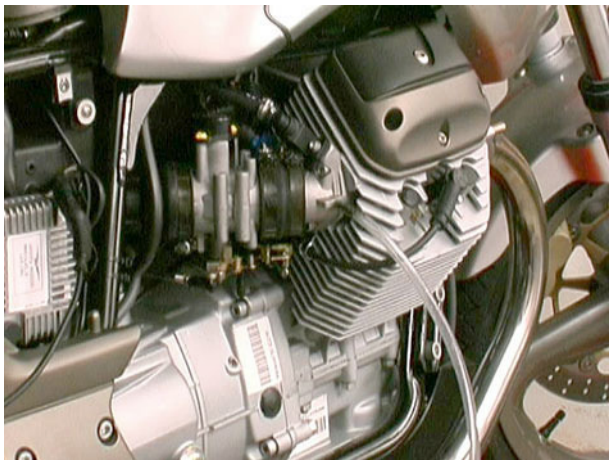
Key:
1. Engine control unit
2. Ignition switch
3. Battery
4. Fuel pump
5. Coil
6. Dashboard
7. Air temperature sensor
8. Throttle valve position sensor
9. Injectors
10. Crankshaft position sensor
11. Engine temperature sensor
12. Lambda sensor
13. Bank angle sensor

3.1.3. CYLINDER SYNCHRONISATION

- With the vehicle engine switched off, connect the Axone 2000 instrument to the diagnostics connector and the vehicle battery.



- Switch on the instrument.
- Screw the unions for connection of the vacuum meter lines to the threaded bores on the intake pipes.
- Connect the vacuum meter lines to the respective unions.

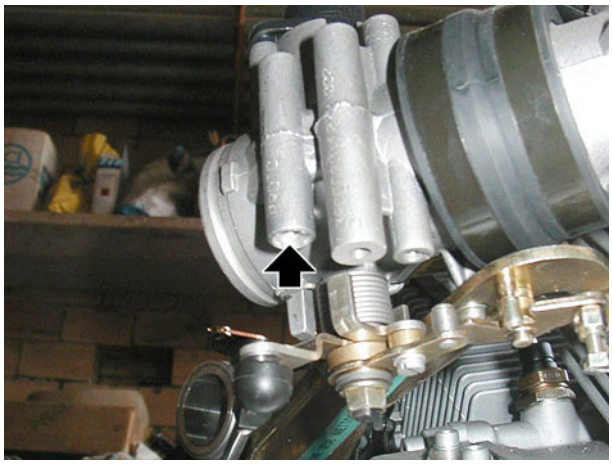


- Set Axone to the adjustments-setup page
- Execute the throttle position self-teach procedure

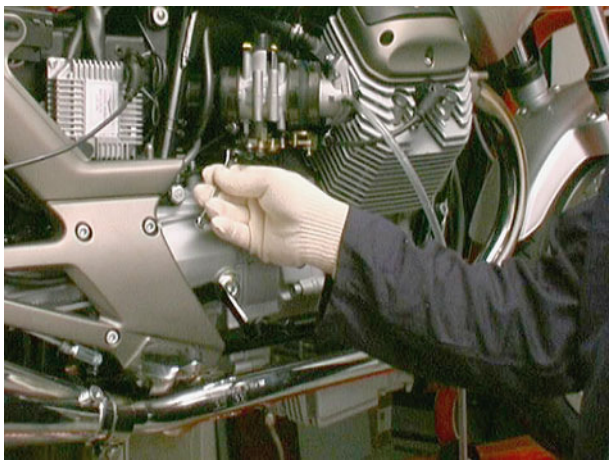
- Make sure that the throttle is at the stroke end position
- Set the ignition key to "OFF" and leave it in this position for at least 30 seconds

IMPORTANT *Do not touch the throttle end stop screw, otherwise the throttle body must be renewed. Check that the throttle return cable is not taut*

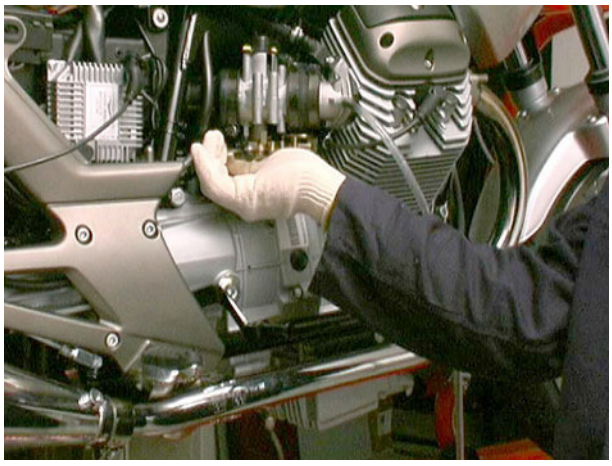
- Start the engine.
- Bring the engine to the prescribed temperature: **50 °C (122 °F).**
- Completely close the two bypass screws on the throttle bodies.

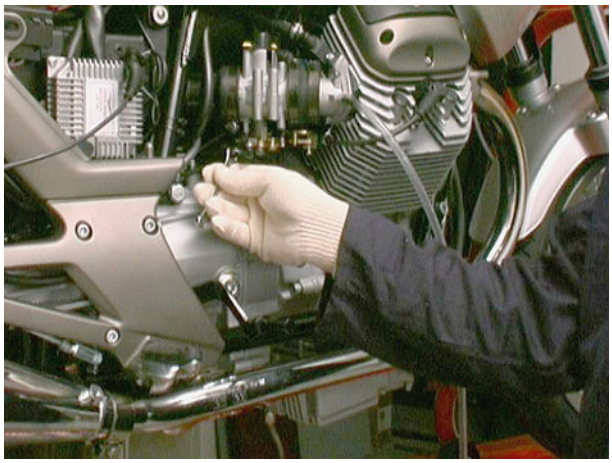


- Bring the engine to just above idle speed:
  2000 – 3000 rpm.
- Check cylinder balancing on the vacuum meter.
- To correct balancing, loosen the throttle body control rod locknuts.



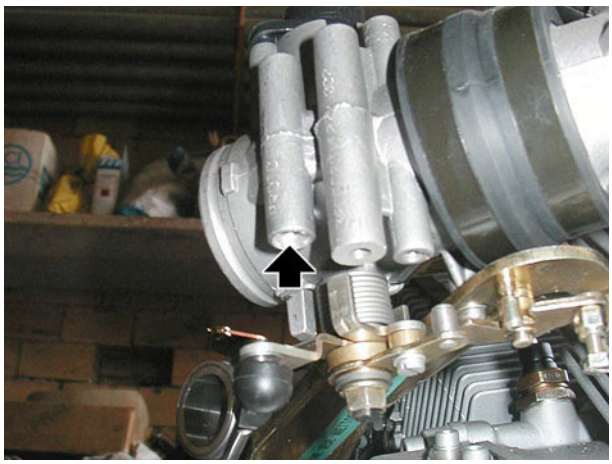
- Turn the rod manually until the cylinders are balanced and then tighten the locknuts.





Now adjust engine idle speed:

- Bring the engine to the prescribed temperature:
  70 – 80 °C (158 - 176 °F).
- Adjust idle speed by means of the bypass screws:
  1100 ± 50 rpm.

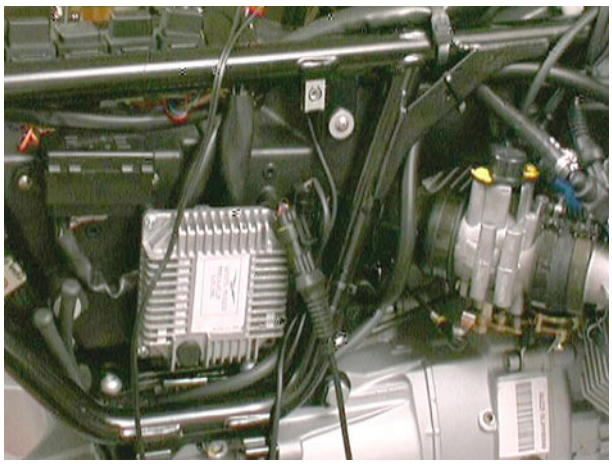


3.1.4. SETTING THE CO RATE

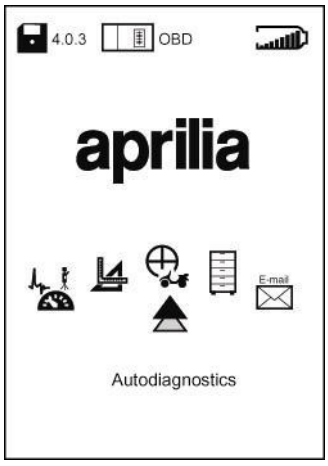
The CO setting (injectors opening time) cannot be adjusted; the only facility is that of resetting the self-adaptive parameters in the event of replacement of the throttle body due to wear.

3.1.5. AXONE

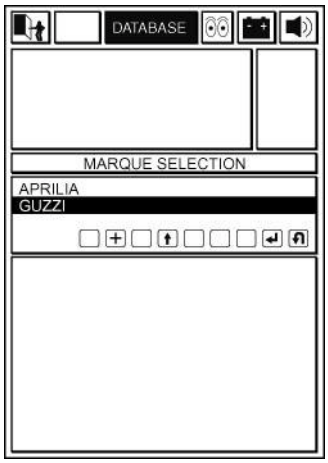
- With the vehicle ignition switched off, connect the Axone 2000 instrument to the diagnostics connector and the vehicle battery.

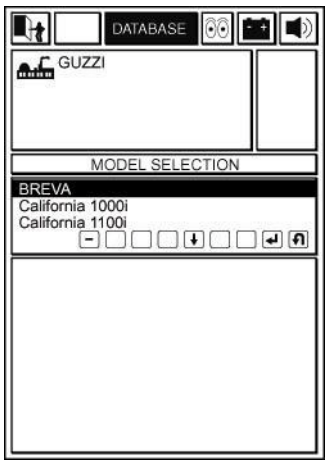


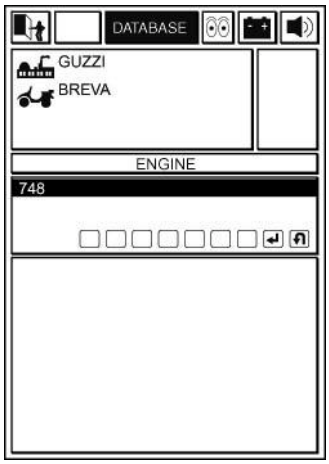
- Switch on the instrument.

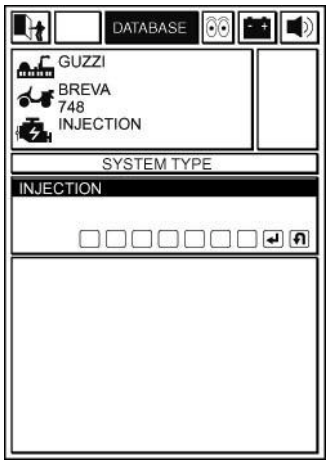


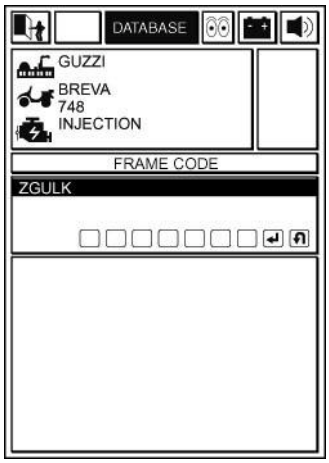
- Navigate through the introductory pages selecting the vehicle make and model (press ENTER " ↵ " to move from one page to the next).

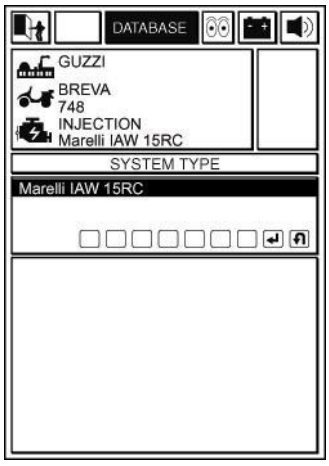


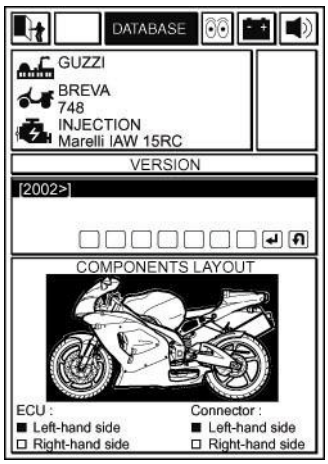


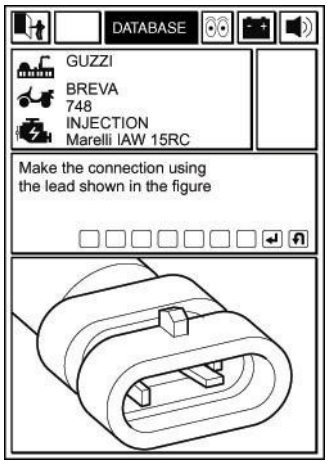


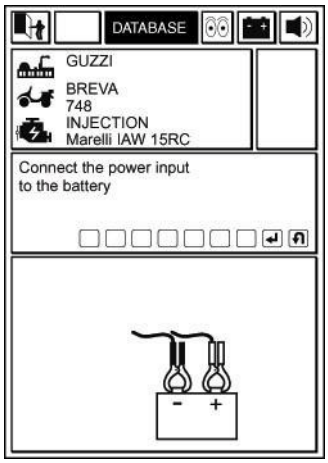


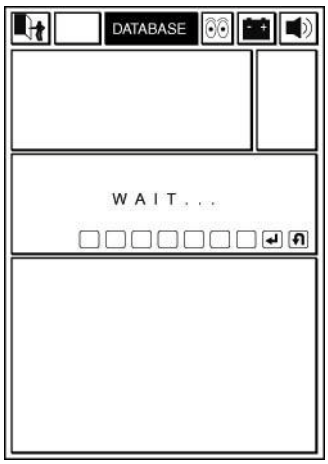


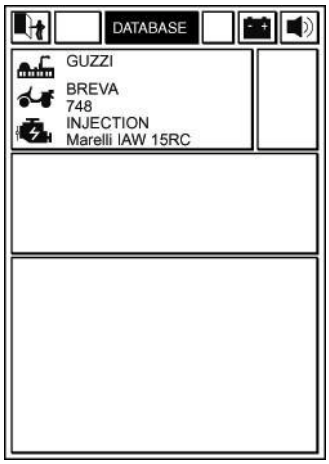




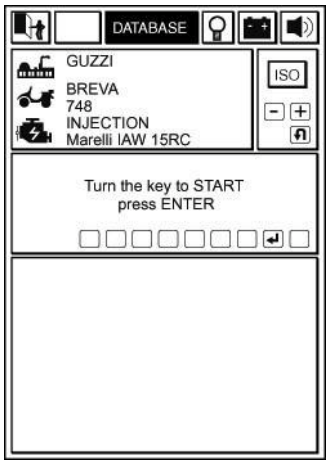








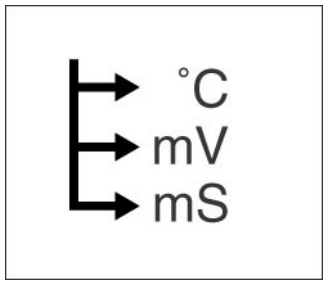
- Switch on the vehicle ignition key when prompted to do so.
- The first page to be displayed shows the "ISO" icon and contains information concerning the engine control unit.



- To go from one active page to the next press the plus and minus keys:

"**+**" or "**-**".

- Engine parameters display page.

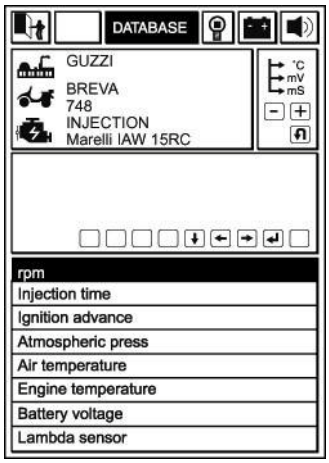


- Enables you to display the readings of the main signals as detected by the engine control unit: you can display eight parameters at any one time. To display the remaining parameters, use the arrow keys:

"←" and "→".

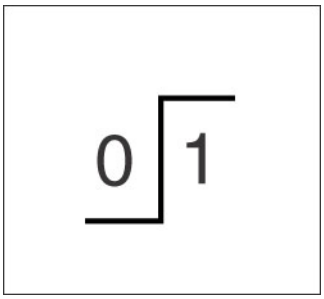
- The following parameters can be consulted:

Engine speed (rpm)
Injection time
Ignition advance
Atmospheric pressure
Air temperature
Engine temperature
Battery voltage
Lambda Sensor [mV signal from sensor: from 300 to 3000 millivolt]



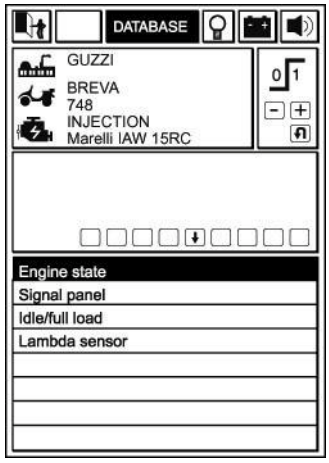
Lambda integrator [multiplying correction coefficient for injection time in relation to the status detected by the lambda control]
Partial load self-adaptation [injection time additive correction factor in above-idling conditions]
Idle speed control self-adaptation [injection time additive correction coefficient in idling conditions]
Multiplying richness adaptation [multiplying correction coefficient for injection time]
Non-synchronised phase of one tooth [number of engine phases in which the speed/timing sensor has lost the signal of one tooth]
Non-synchronised phase greater than one tooth [number of engine phases in which the speed/timing sensor has lost the signal of more than one tooth]
TPS trimmer [additive parameter relative to throttle position on spindle in calibration]
Throttle potentiometer [voltage signal from the throttle position sensor]
Precise throttle position [throttle opening angle in degrees: once the throttle position self-teach procedure has been performed this angle is located in the following range of values: 3.1 ± 0.4 degrees]

- Engine status page



- Axone is able to detect the following conditions:

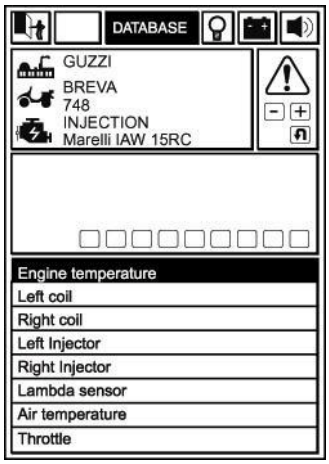
Engine status (running / stopped)
Signal panel (synchronised / unsynchronised)
Idle / full load (throttle at idle or full load position)
Lambda Sensor (lambda sensor closed / open)



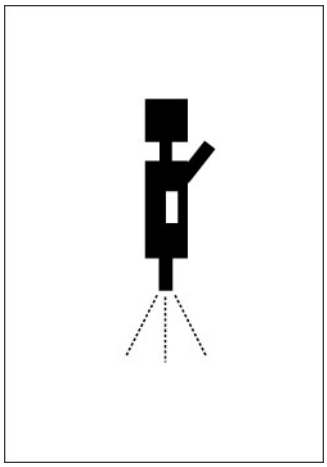
- Errors display page

- Axone is able to detect several error types automatically:

Engine temperature
Left-hand coil
Right-hand coil
Left-hand injector
Right-hand injector
Lambda Sensor
Air temperature
Throttle
Pressure
Battery voltage
Pump relay
Autoadaptive parameters
RAM memory
ROM memory
EEPROM
Microprocessor
Signal panel (detects errors on the engine speed/timing sensor)



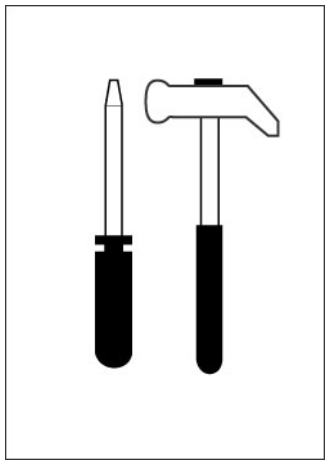
- Active diagnostics page.



- Provides the facility to test operation of certain devices.
- Select the device using the relevant keys: ↑ and ↓ and and then activate it by pressing ENTER "↵".
- The devices that can be tested are as follows:

Errors deletion (if errors are present they can be deleted from the memory by pressing ENTER " ↵ ")
Fuel pump (ON for 30 seconds)
Left coil (ON for 2 mS per second 5 successive times)
Right coil (ON for 2 mS per second 5 successive times)
Rev counter (125 Hz command [3750 rpm] for 2 seconds)
Left injector (ON for 2 mS per second 5 successive times)
Right injector (ON for 2 mS per second 5 successive times)

- Adjustments – setup page.



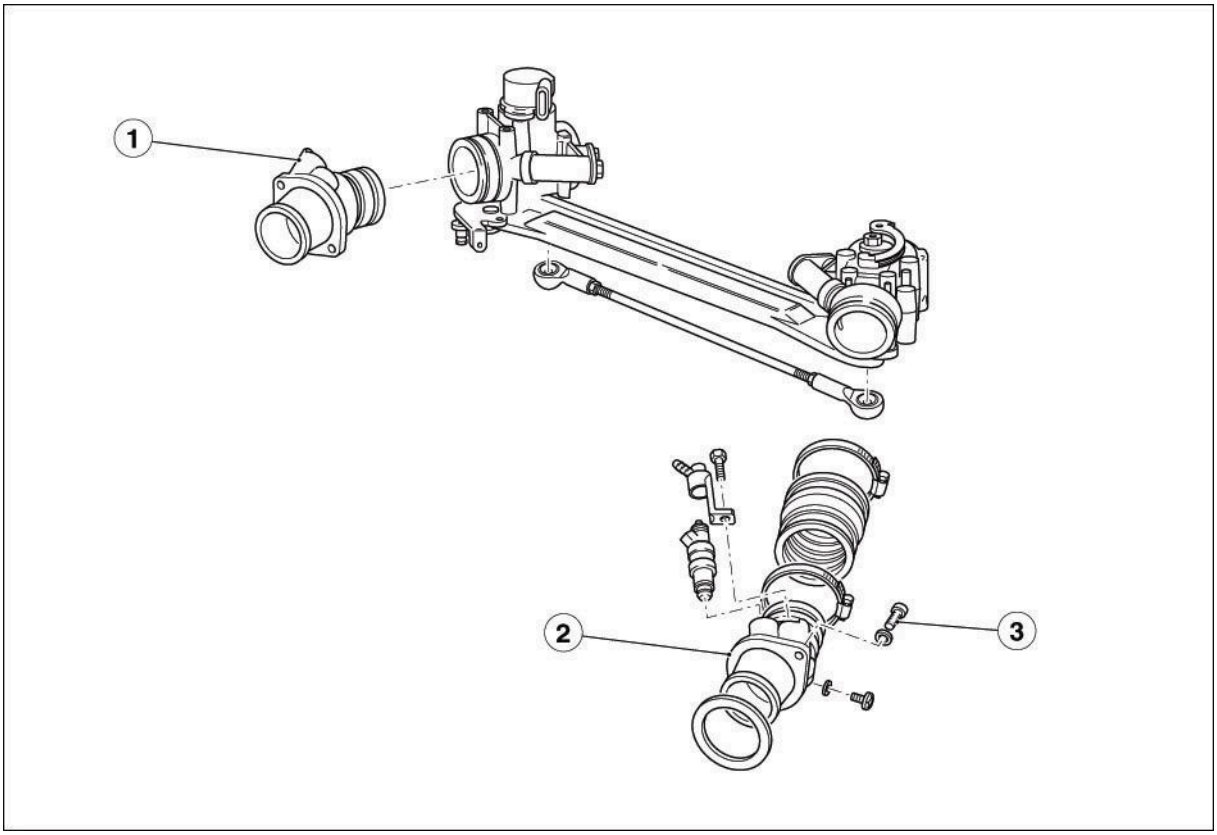
- This page features the following options: throttle position sensor alignment and lambda control self-adaptive parameters reset
- Alignment of the throttle position sensor is required in the event that the throttle body and/or engine control unit is/are replaced.
- Select the function: "throttle position self-teach".
- Make sure that the throttle is at the stroke end position
- Press ENTER " ↵ ".
- Set the ignition key to "OFF" and leave it in this position for at least 30 seconds.

Resetting of lambda control self-adaptive parameters is an operation required in the case of replacement of major parts of the engine (valves, cylinder. camshaft), exhaust system, ECU, fuel injection system, or lambda sensor.
The three self-adaptive correction factors of the lambda control relative to injection timing are reset electronically.

- Select the function: "lamda control self-adaptive parameters reset"

- Select self-adaptive parameters reset and press ENTER " ↵ ".

3.1.6. INTAKE MANIFOLDS



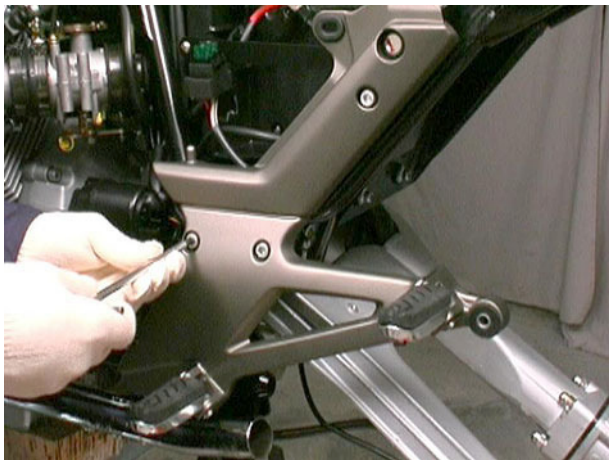
- When fitting intake manifolds (**1-2**) tighten screws (**3**) simultaneously

SUMMARY

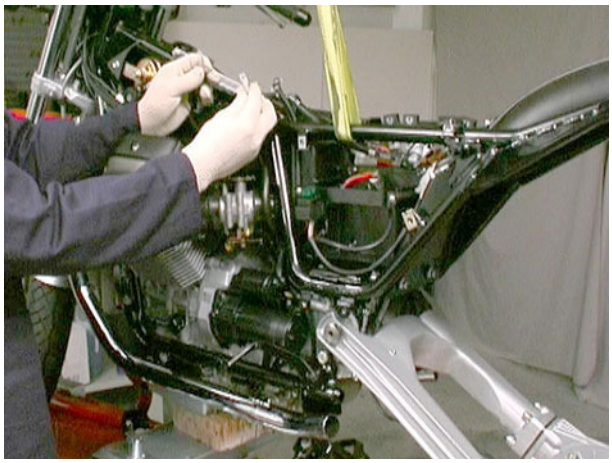
4.1. DROPPING AND REFITTING THE ENGINE

4.1.1. DROPPING THE ENGINE FROM THE FRAME

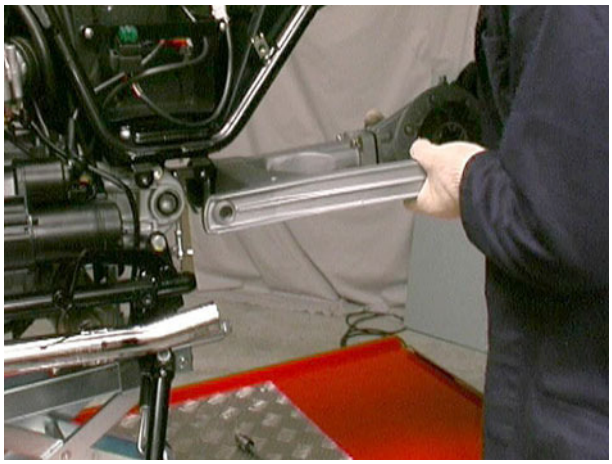
- To drop the engine block first remove the superstructures, the battery, the exhaust tailpipes, the dampers and the rear wheel.
- Disconnect the speed sensor and remove the cable from the harness.
- Remove the footpeg brackets.
- To disassemble the left hand footpeg bracket from the bike first disconnect the seat release cable. The right hand footpeg bracket must be removed together with the brake calliper complete with its support.



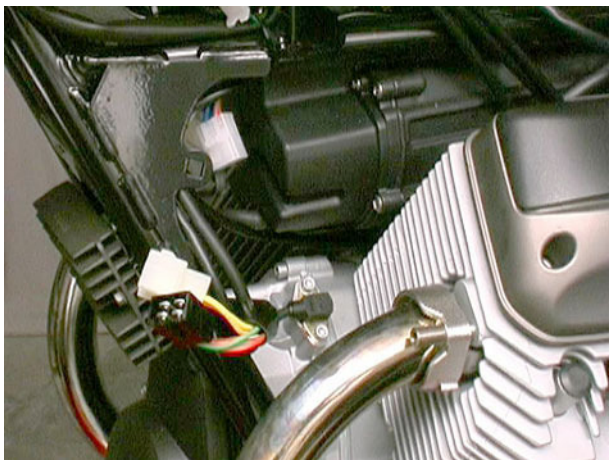
- While removing the right hand footpeg bracket remove also the brake light switch.



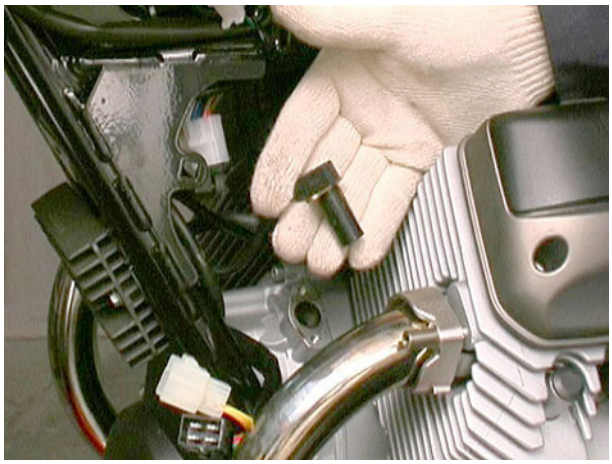
- Remove the swing arm complete with bevel gear set.



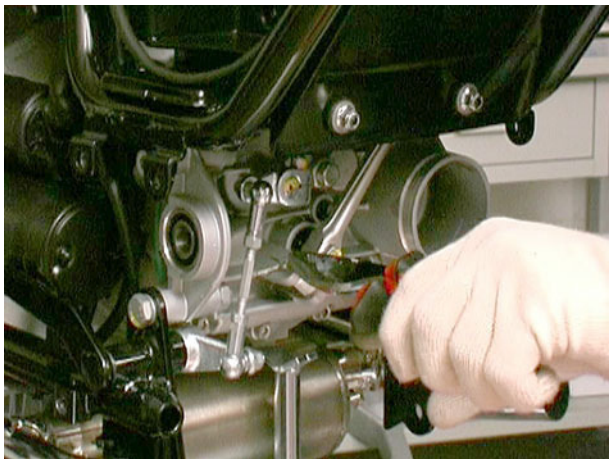
- Disconnect the alternator electrical connections.

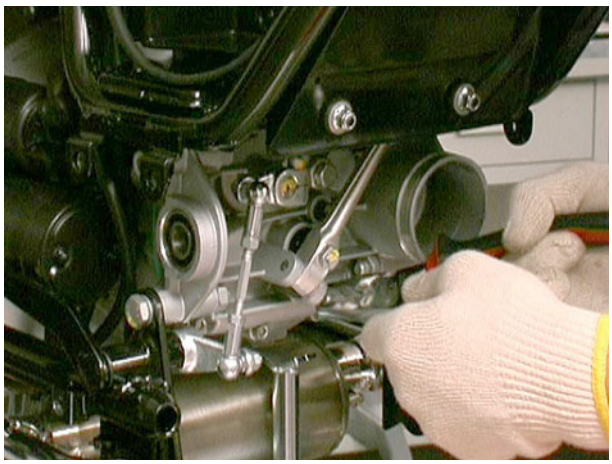


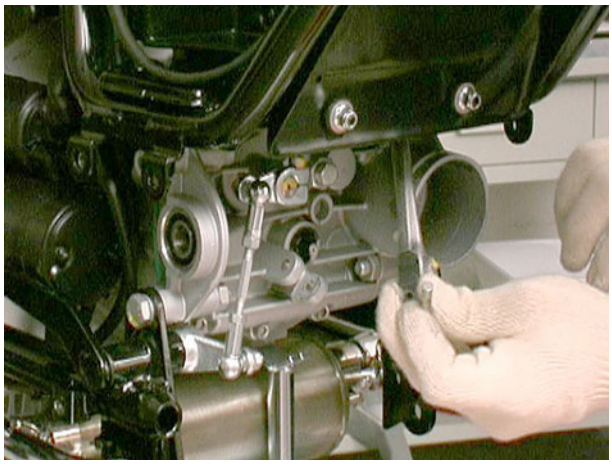
- Remove the rpm sensor without disconnecting the wiring.



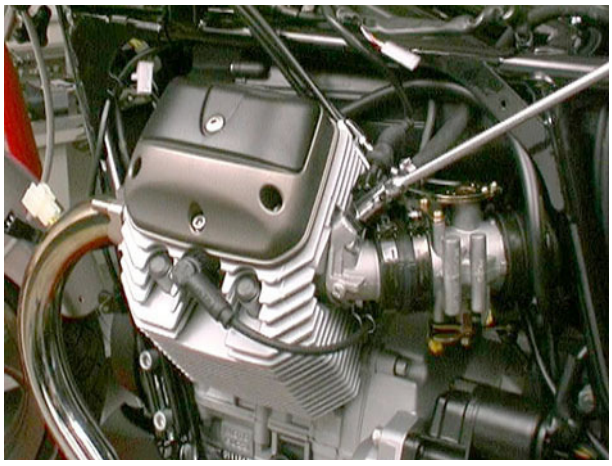
- Remove the spindle, with cotter, responsible for securing the clutch linkage to the engine block, and then free the control cable.

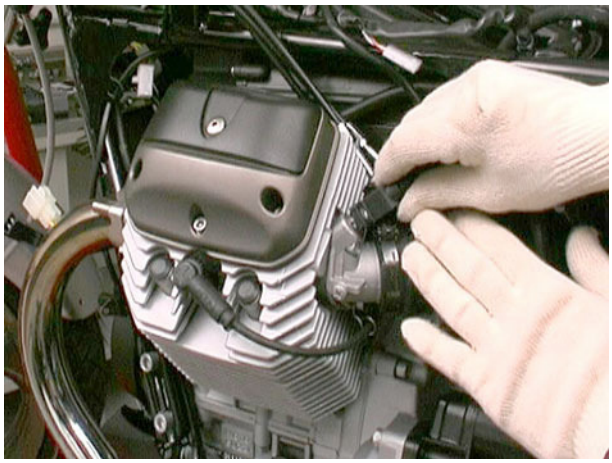




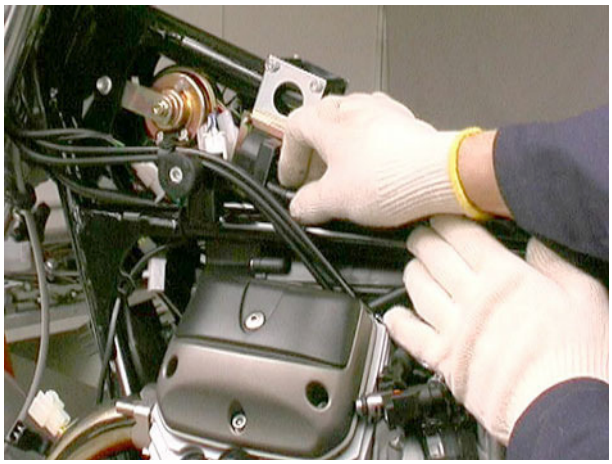


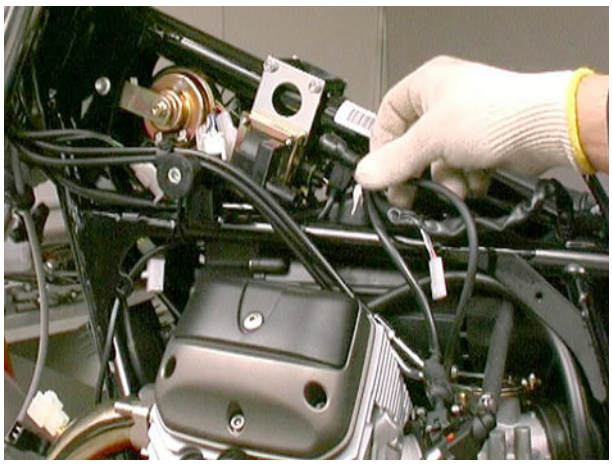
- Remove the injectors retainer and withdraw the injectors from their seat on the intake manifolds.



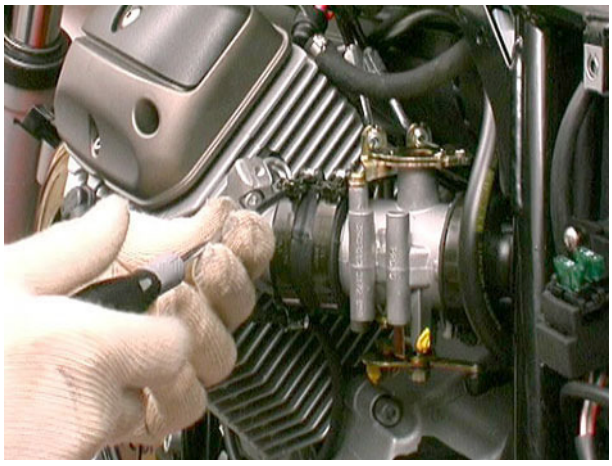


- Disconnect the spark plug leads from the coils and separate them from the frame.

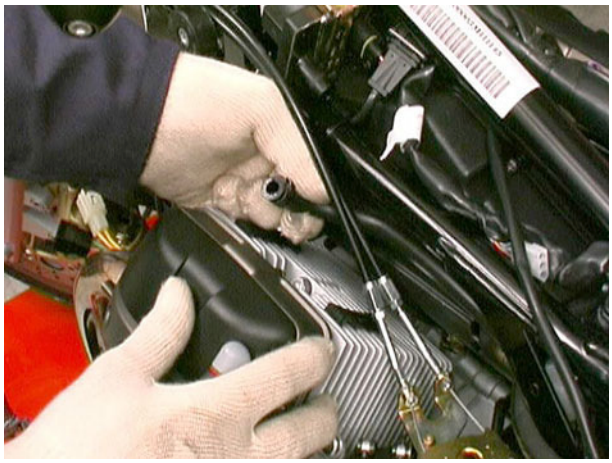




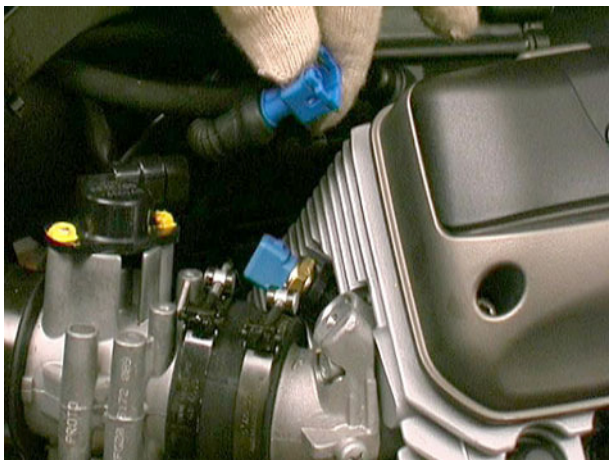
- Loosen the clamps on the intake manifolds.



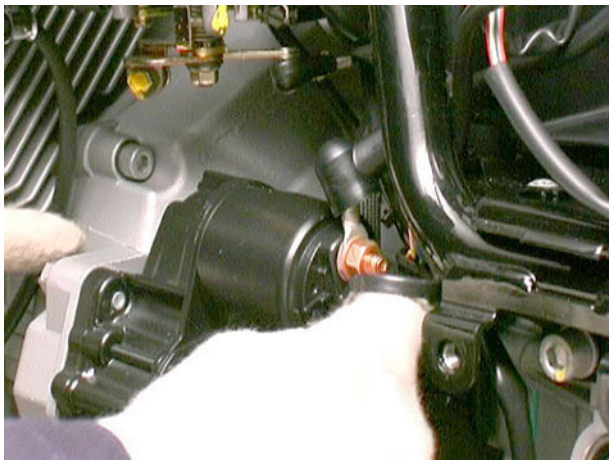
- Detach the oil breather pipes on the cylinder heads.

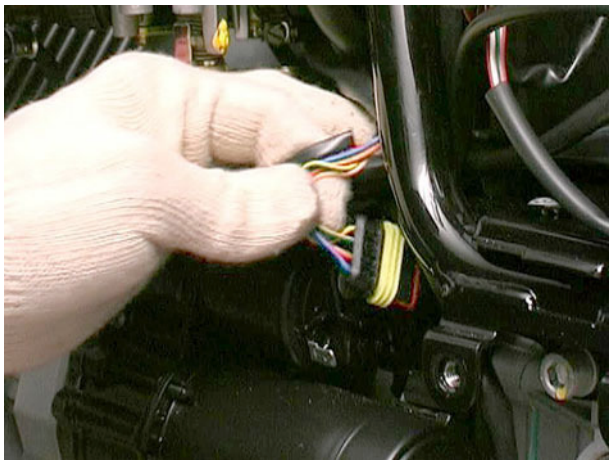


- Remove the engine temperature sensor connection.

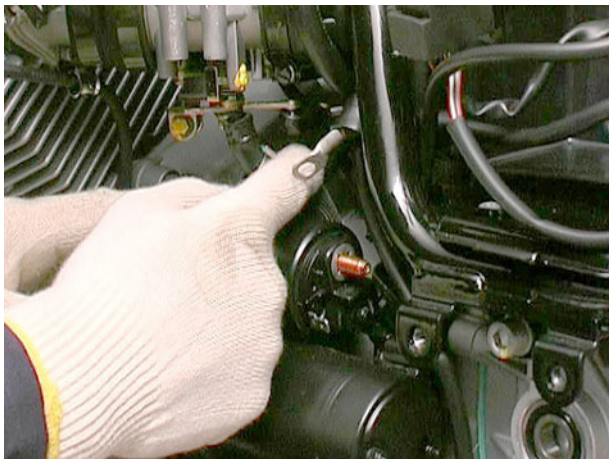


- Disconnect the starter motor and the lambda sensor.

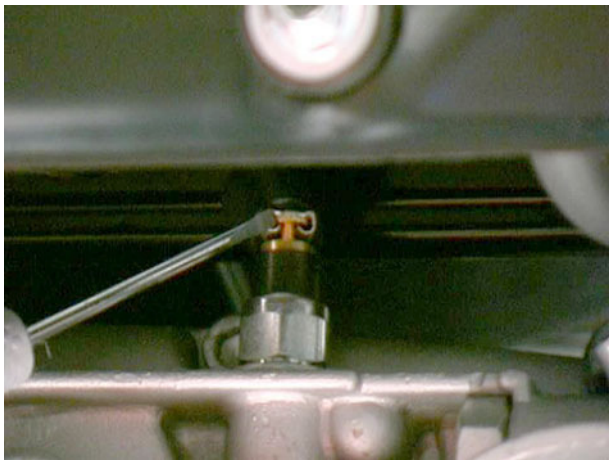




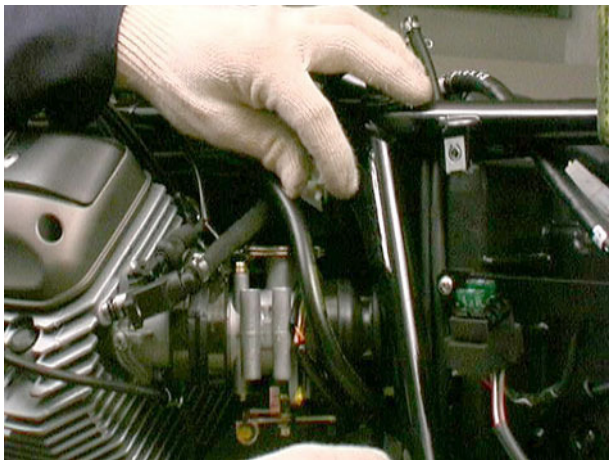
- Open the clamp and detach the airbox oil breather tube.



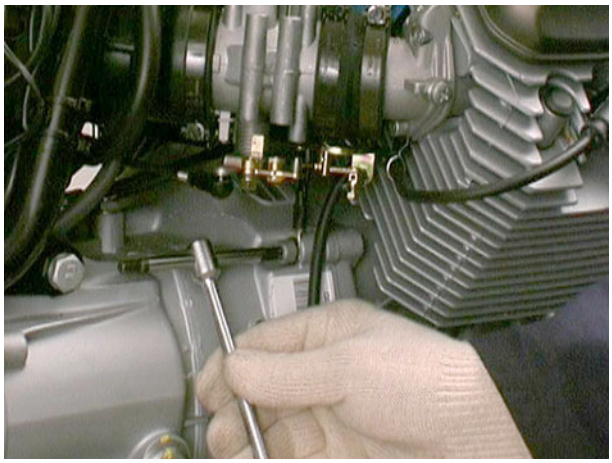
- Disconnect the neutral indicator.



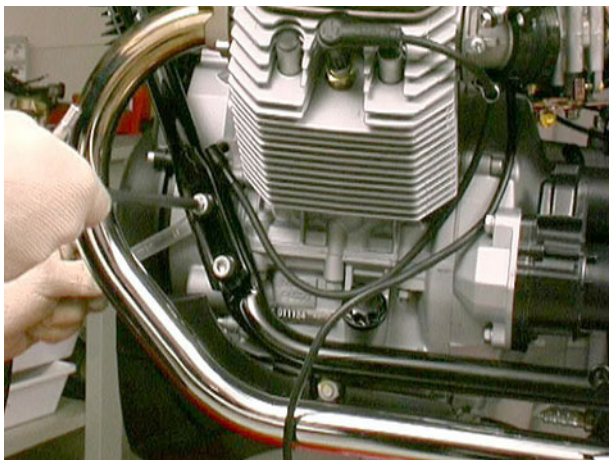
- Disconnect the sidestand safety switch connector and separate the wiring from the frame.



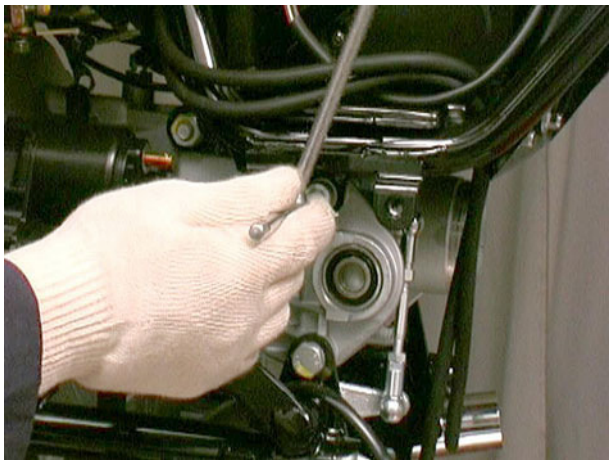
- Unscrew the screw that secures the earth lead lug to the engine block.



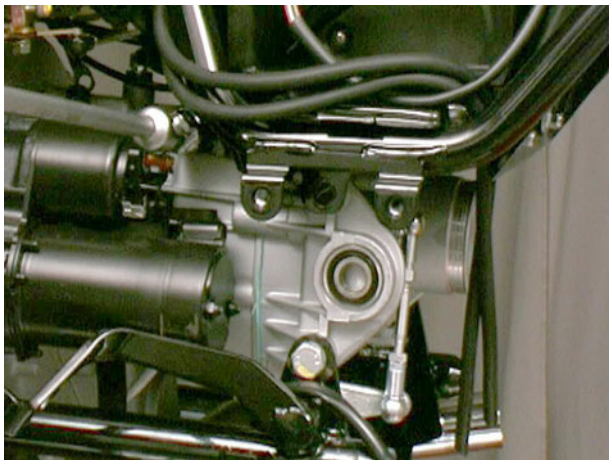
- Unscrew the four Allen screws that secure the frame front arms to the engine cradle.



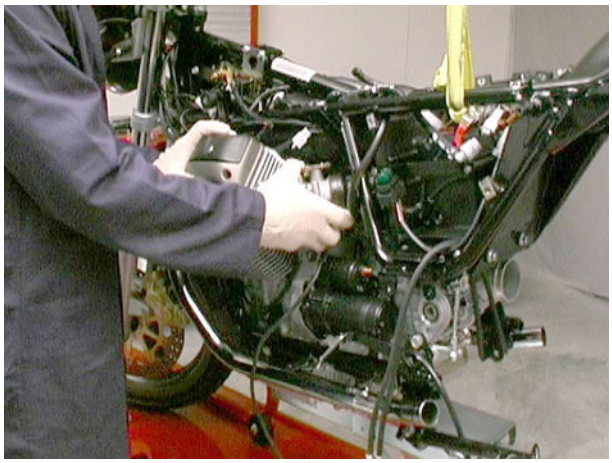
- Remove the upper screws joining the frame and the gearbox cover.



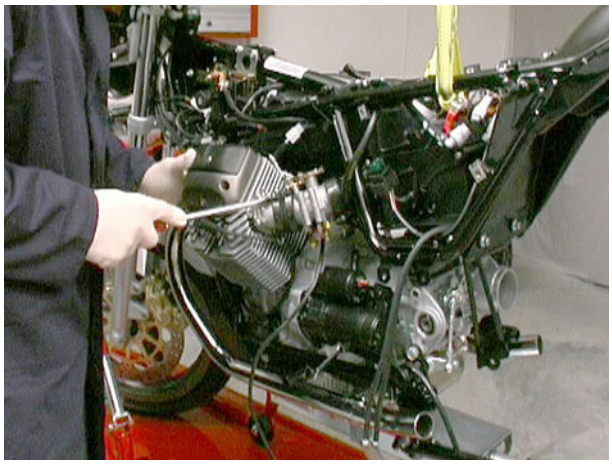
- Remove the tie rod between the frame and gearbox.



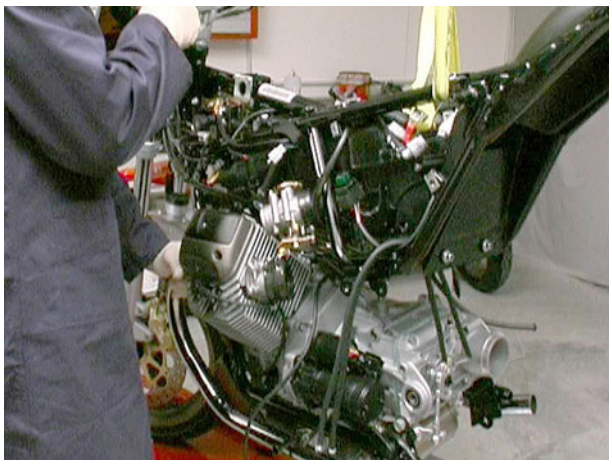
- Support the bike frame on a motorcycle lift.



- Proceed to drop the engine: during the procedure check that the throttle body hoses detach properly from the intake manifolds without sustaining damage.



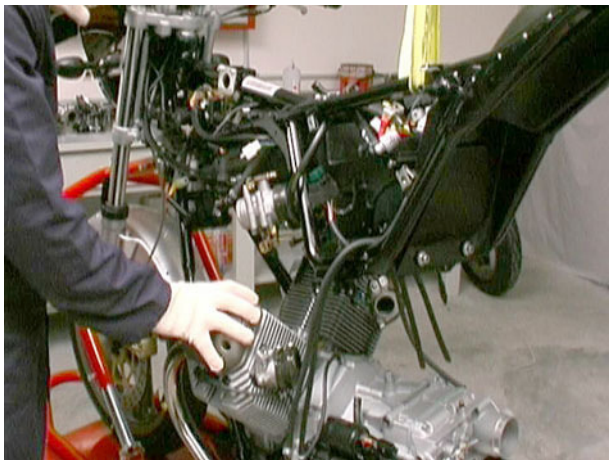
- Lower the engine checking that it separates correctly from the frame.



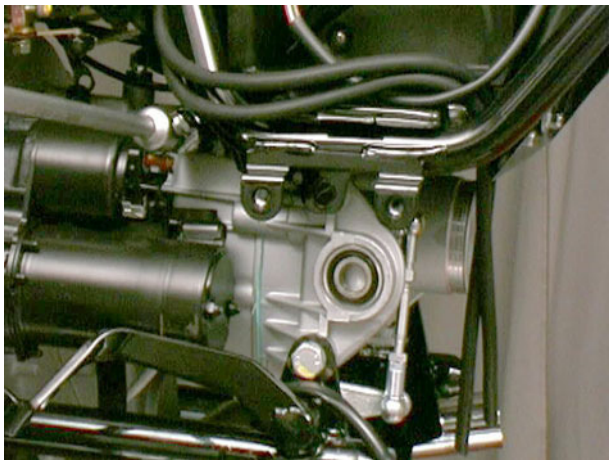
- During the operation detach the oil pressure transmitter connection.

4.1.2. REFITTING THE ENGINE IN THE FRAME

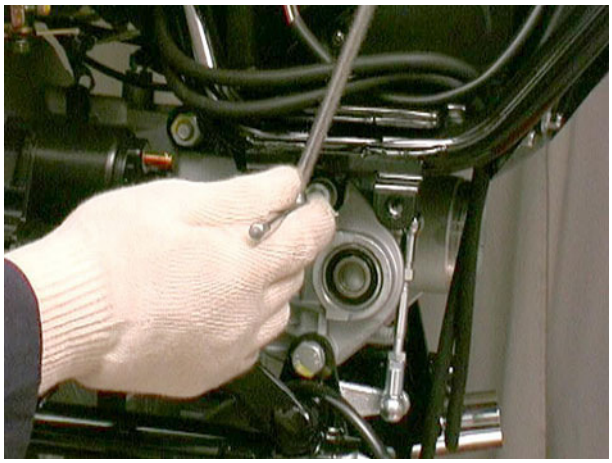
- With the motorcycle frame secured on a lift, jack up the engine into position.



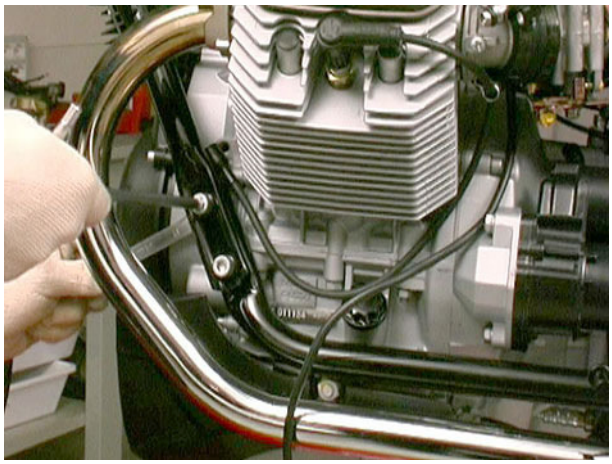
- During this procedure reconnect the oil pressure transmitter and check that the throttle body hoses engage correctly over the intake manifolds.
- With the engine in position, fit the frame-to-gearbox fixing tie rod and torque to the prescribed value.



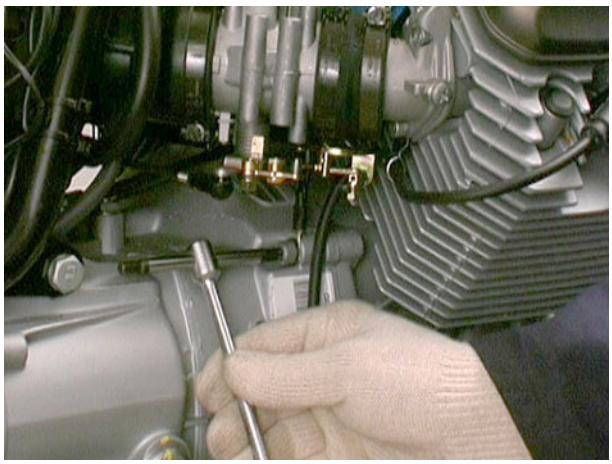
- Fit the upper screws that secure the frame to the gearbox cover and torque to the prescribed value.



- Secure the frame front arms to the engine cradle by means of the four Allen screws and torque the screws to the prescribed value.

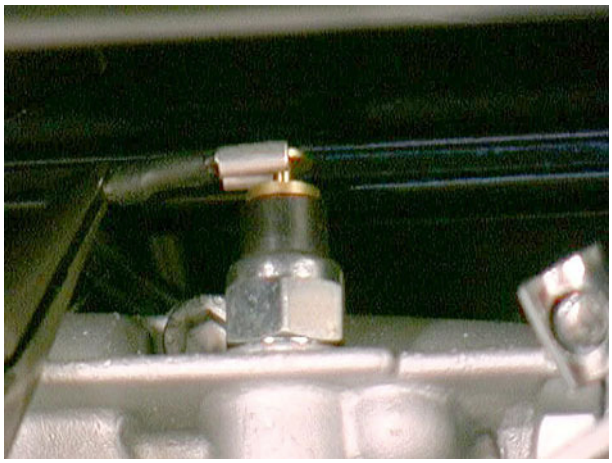


- Fit the screw responsible for securing the earth lead lug to the engine block.

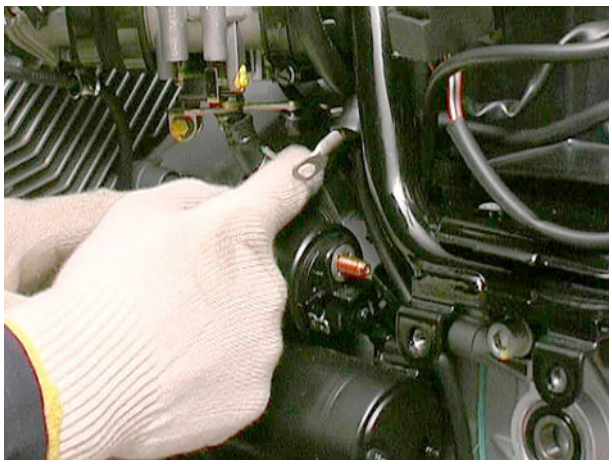


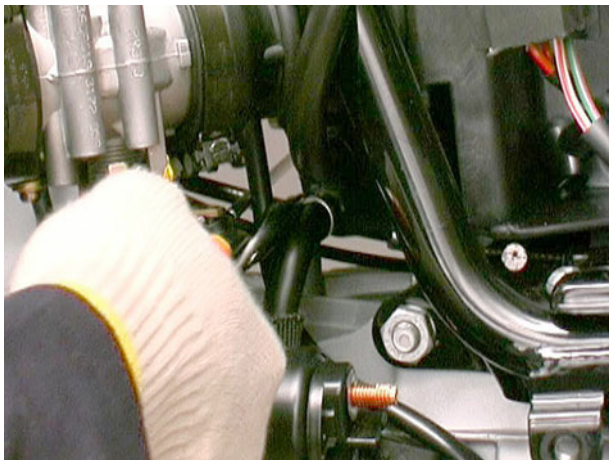
- Reconnect the sidestand safety switch.

- Connect the neutral indicator.

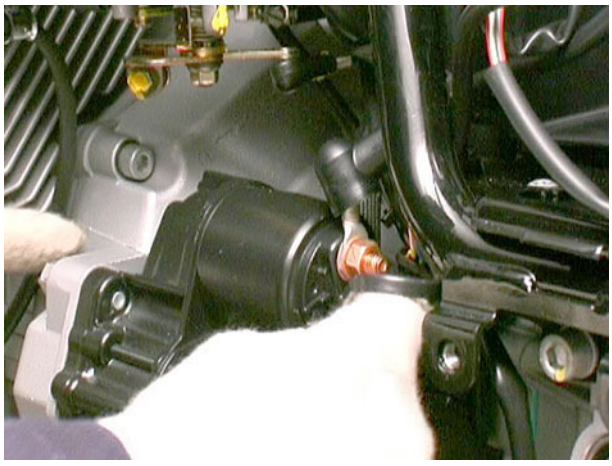


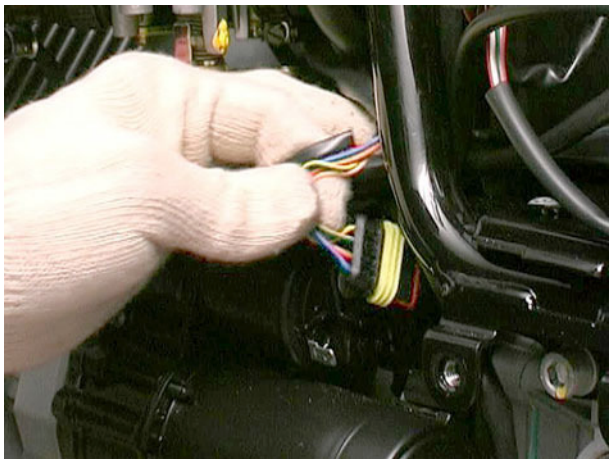
- Insert the oil breather pipe into the airbox and secure it with the specific clamp.



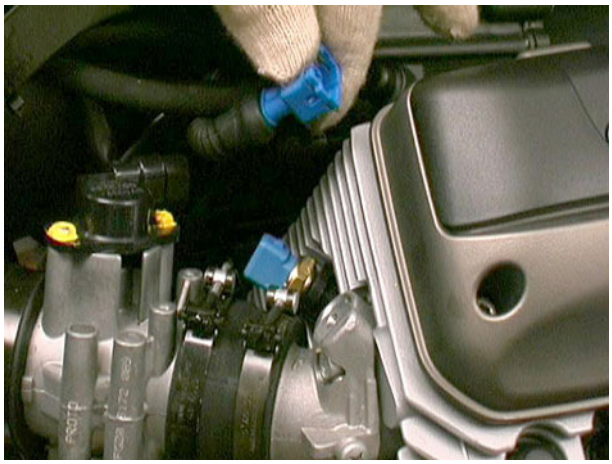


- Connect the starter motor and the lambda sensor.



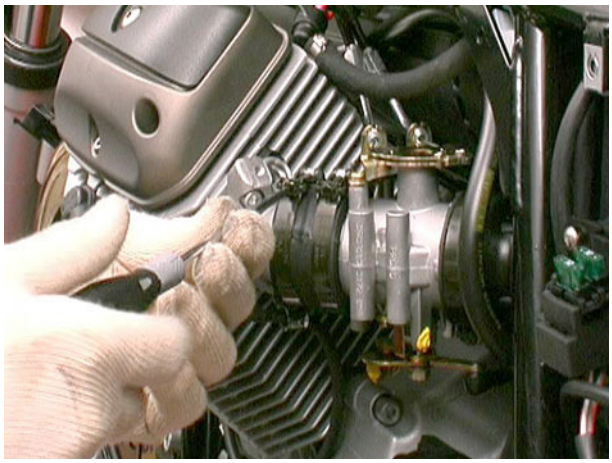


- Reconnect the engine temperature sensor.

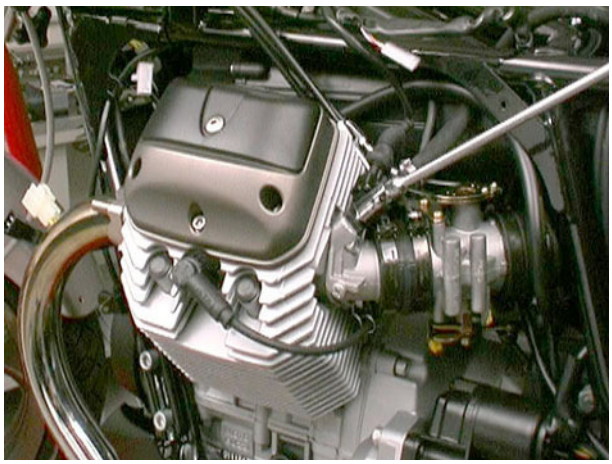


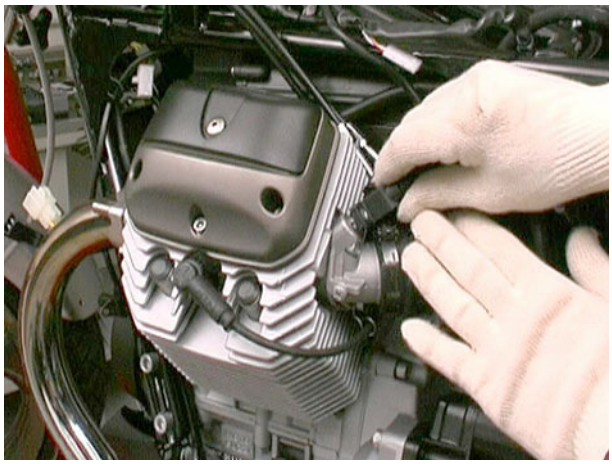
- Fit the breather pipes in the cylinder heads and secure them with the specific clamps.

- Tighten the clamps on the intake manifolds.

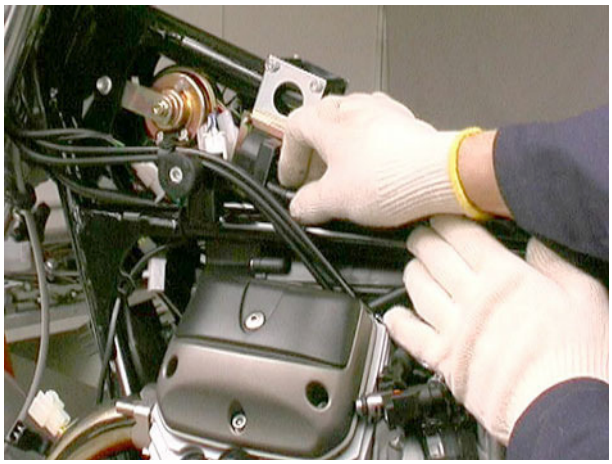


- Fit the injectors into their seats and assemble the retainer, tightening the screw to the prescribed torque value.

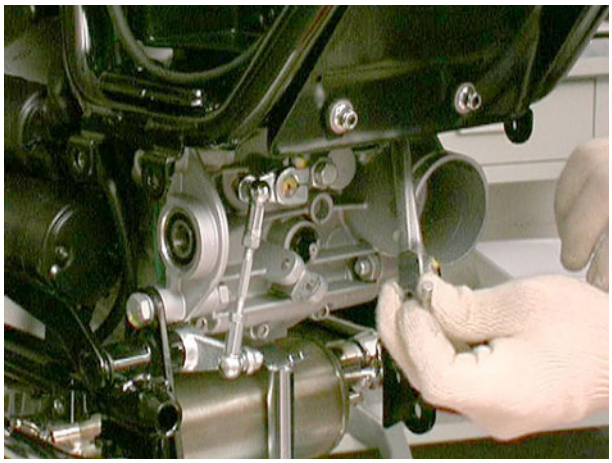


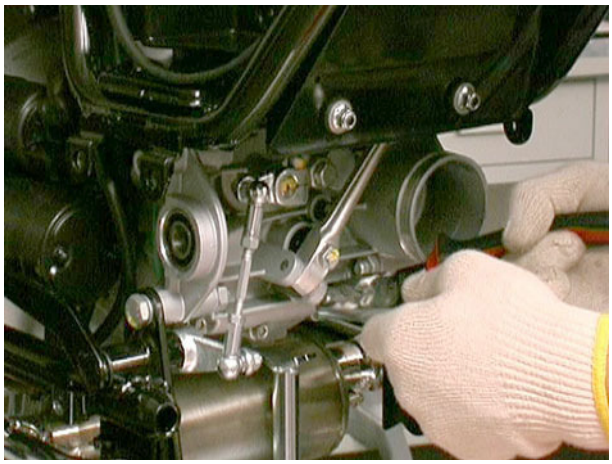


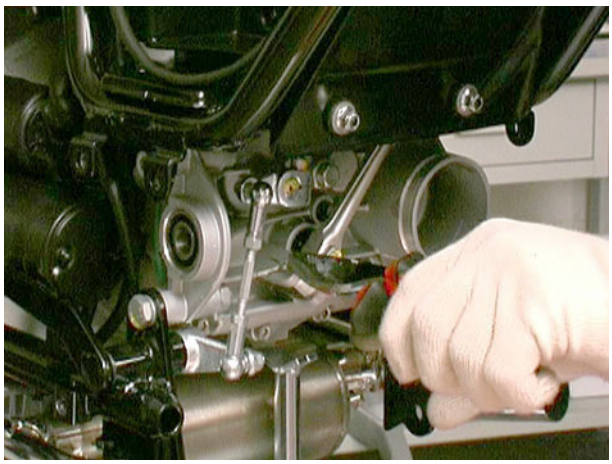
- Connect the spark plug leads to the ignition coils.



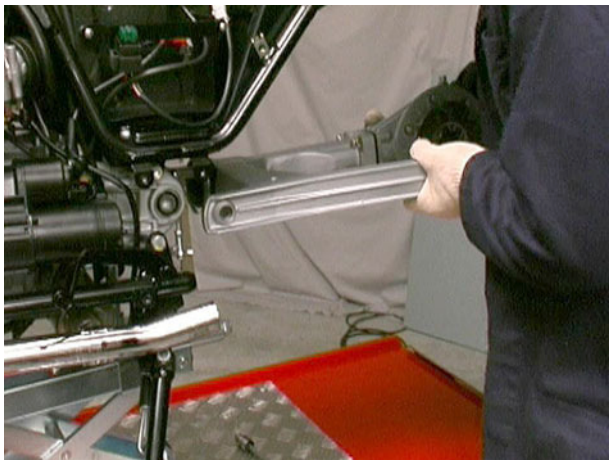
- Position the clutch linkage and fit the spindle to the engine block, fixing with the relative cotter.



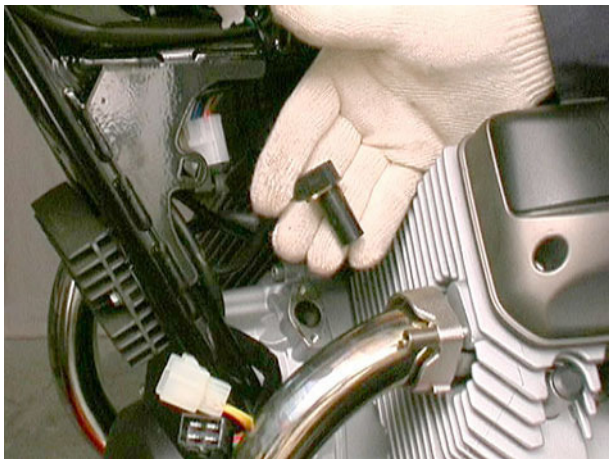




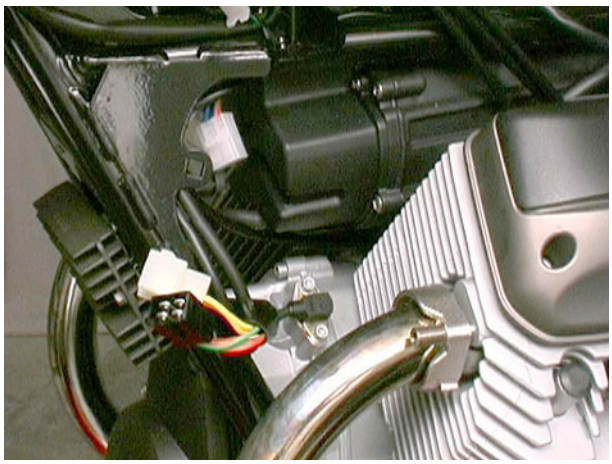
- Refit the swing arm complete with bevel gear set.



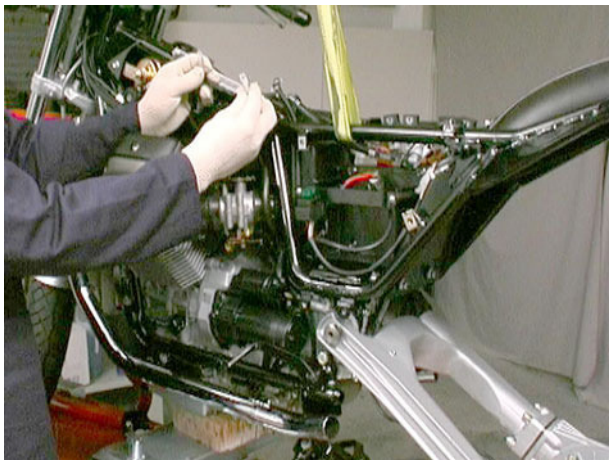
- Fit the rpm sensor and torque the screws to the prescribed value.



- Remake the alternator electrical connections.

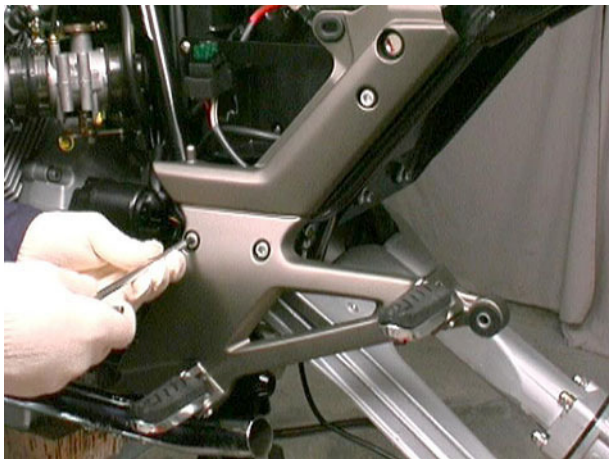


- Position the right hand footpeg bracket together with the brake calliper.
- Fit the brake light switch to its support.



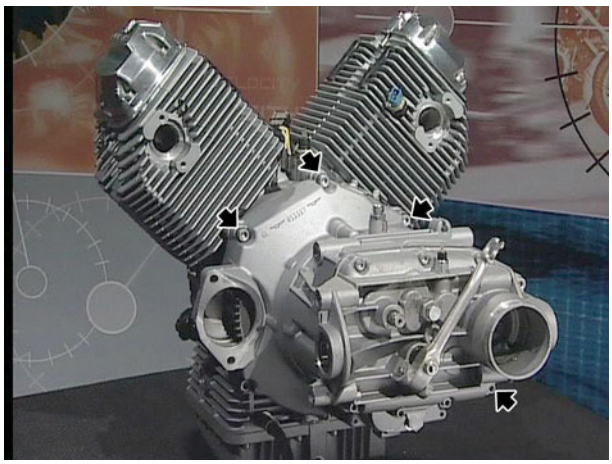
- Tighten the right hand footpeg bracket screws to the prescribe torque value.

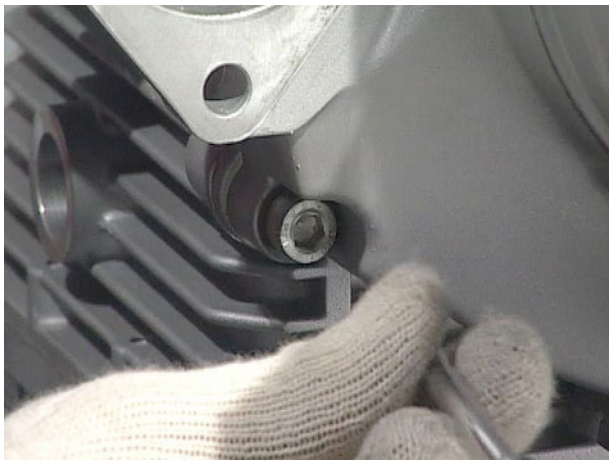
- Reconnect the vehicle speed sensor.
- Position the left hand footpeg bracket and attach the seat release cable.
- Tighten the left hand footpeg bracket screws to the prescribe torque value.



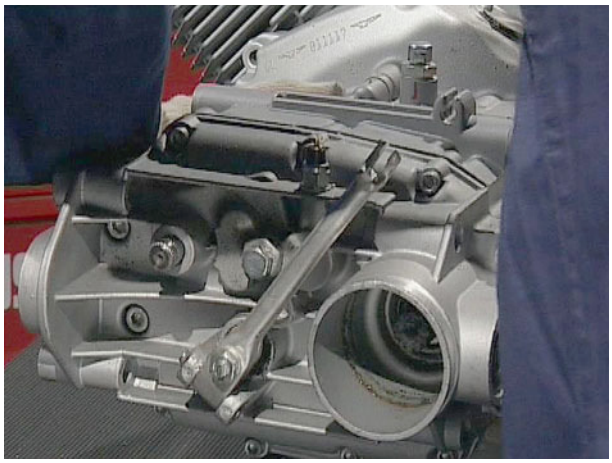
4.1.3. GEARBOX DISASSEMBLY FROM ENGINE

- Remove gearbox securing screws from engine.





- Remove gearbox.



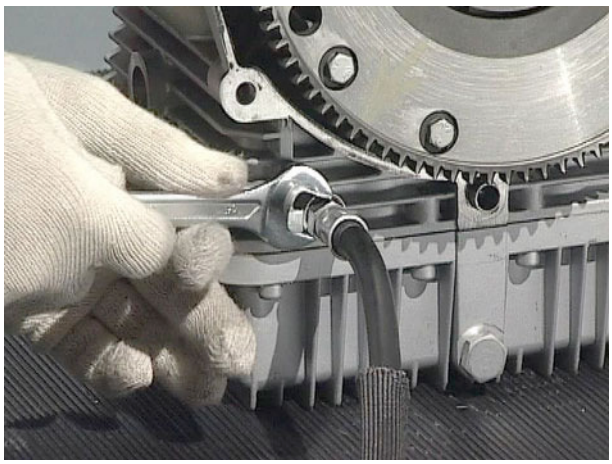
4.1.4. STARTER MOTOR REMOVAL

- Remove starter motor securing screws.

- Remove starter motor.

4.1.5. OIL SUCTION PIPE DETACHMENT FROM BLOCK

- Remove oil fume suction pipe from block.



4.1.6. TIGHTENING TORQUES

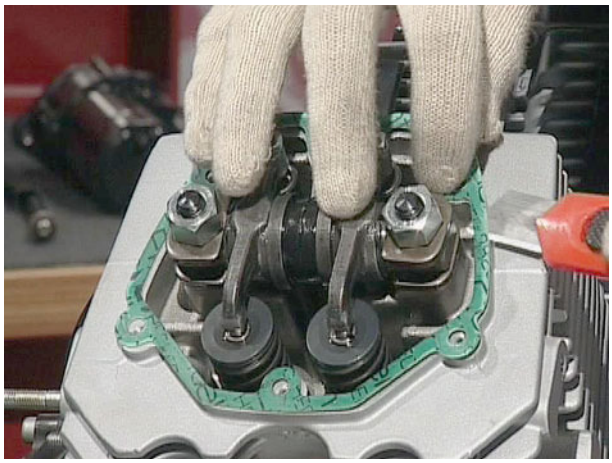
ELECTRIC STARTING	
Starter motor fixing screws	25 Nm

ENGINE CONNECTING PARTS	
Front tie rod nut	45 Nm
Nut for long and short screws	45 Nm
Clutch housing cover to engine fixing screws	25 Nm

4.2. CYLINDER HEAD COVERS

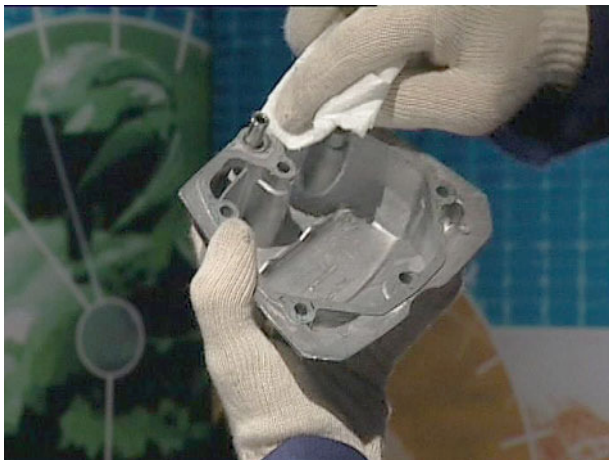
4.2.1. CYLINDER HEAD COVERS REMOVAL

- Remove screws and take off head covers and head gaskets.



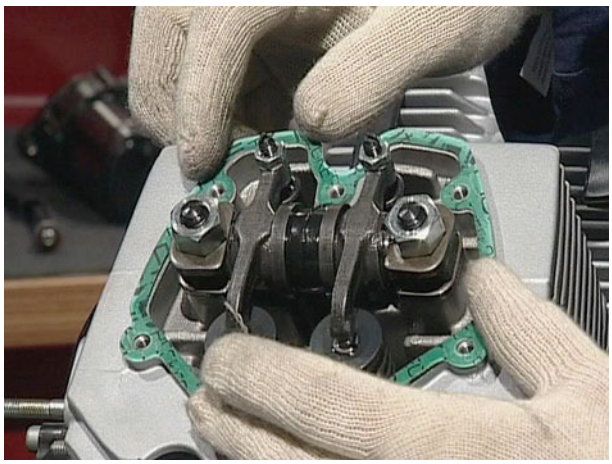
4.2.2. CHECK

- Check for damage to contact surfaces to heads and for blowholes.



4.2.3. REASSEMBLY

- Change cover gaskets, reassemble covers on heads.



- Lock screws crosswise with dynamometric spanner to the prescribed torque value.

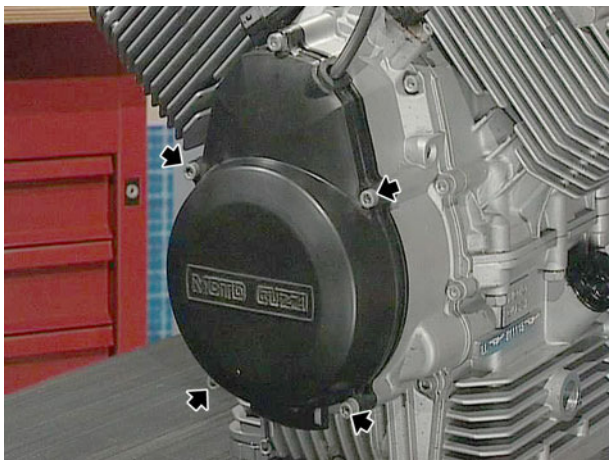
4.2.4. TIGHTENING TORQUES

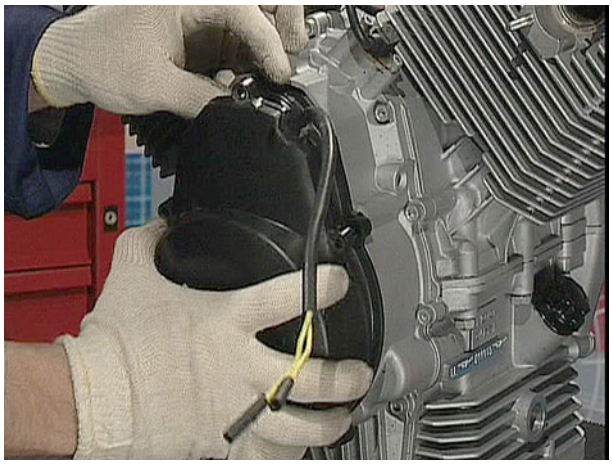
CYLINDER HEADS	
Cylinder head covers fixing screws	10 Nm
Spark plugs	25 Nm

4.3. TIMING

4.3.1. ENGINE FRONT COVER DISASSEMBLY

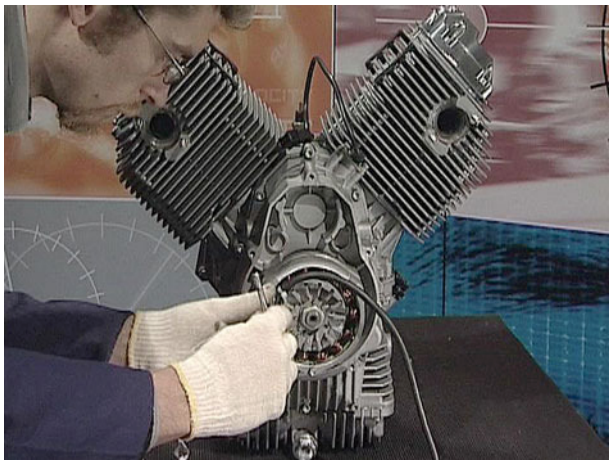
- Remove securing screws and take protective covers off alternator unit.



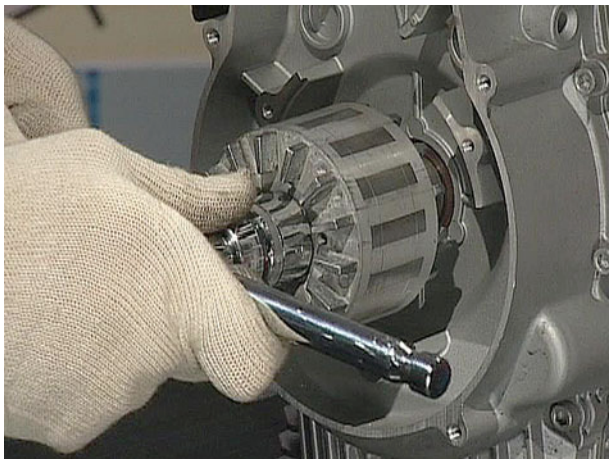


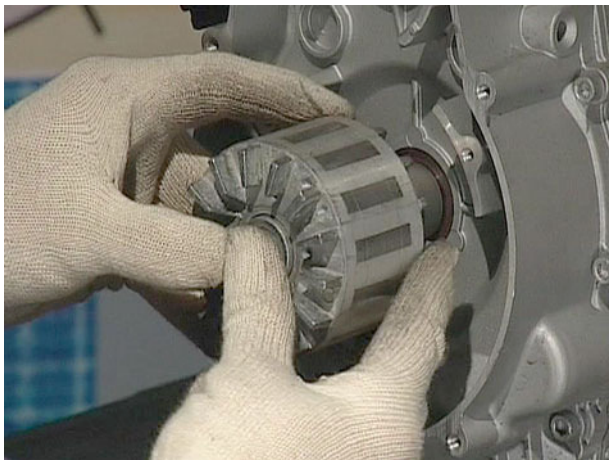
4.3.2. ALTERNATOR DISASSEMBLY

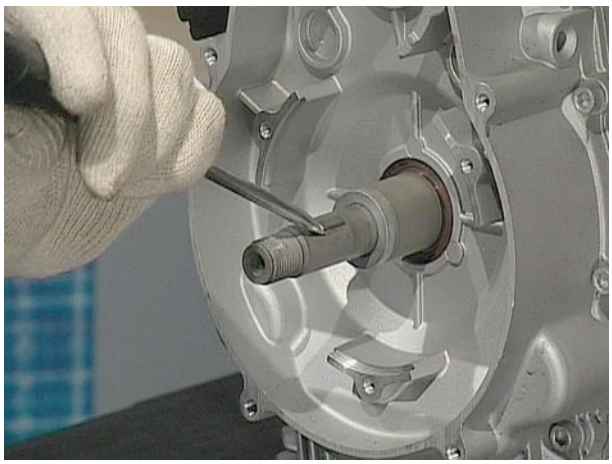
- Remove screws securing stator to timing cover and slide stator out.



- Unscrew the rotor to crankshaft fixing nut, withdraw the rotor and remove the key.

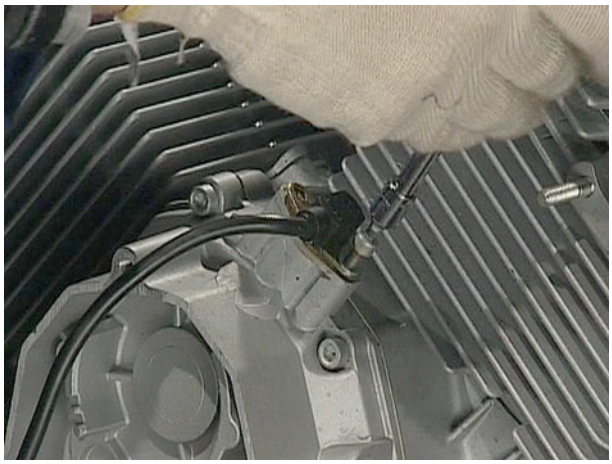






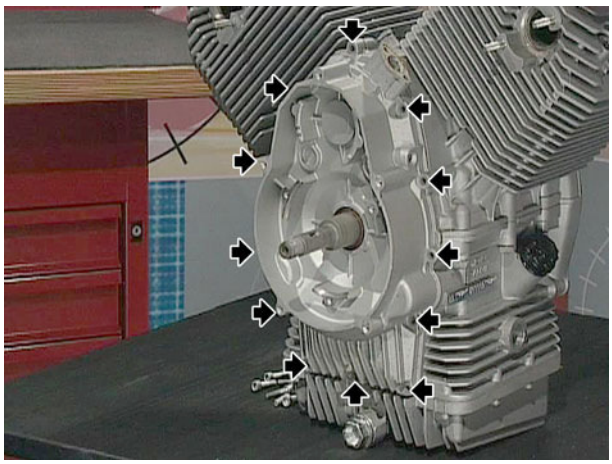
4.3.3. REV AND STROKE SENSOR REMOVAL

- Remove the two securing screws and slip stroke sensor out.

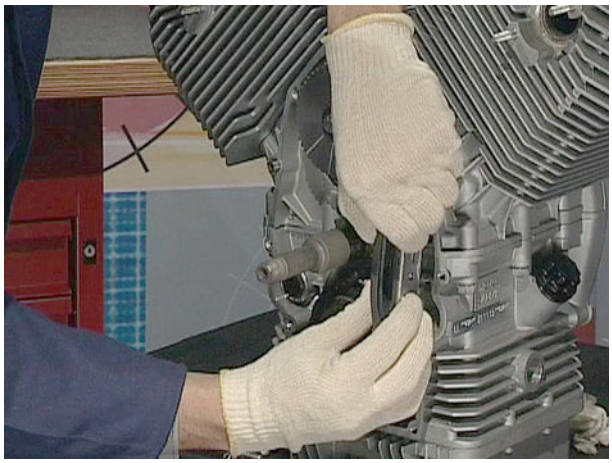


4.3.4. TIMING COVER REMOVAL

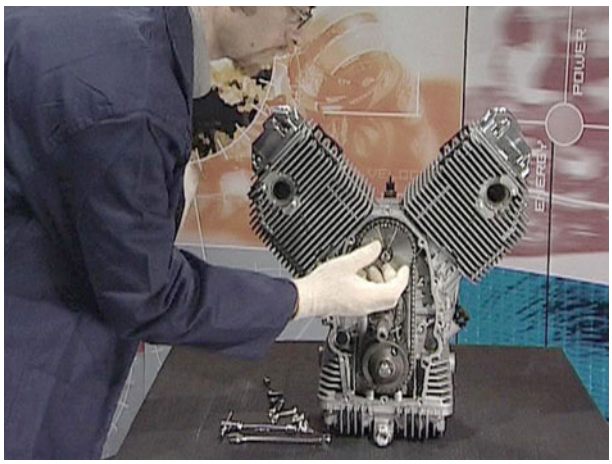
- Remove securing screws and take off timing cover with its gasket.

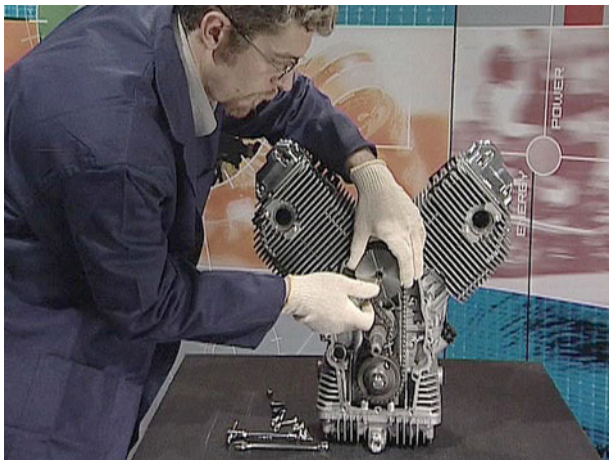


- Remove chain stretcher.

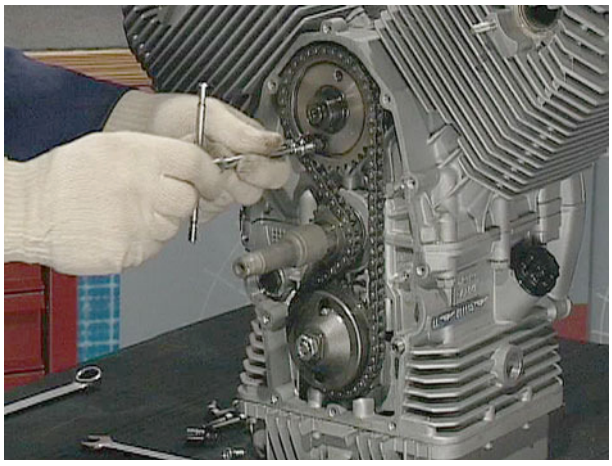


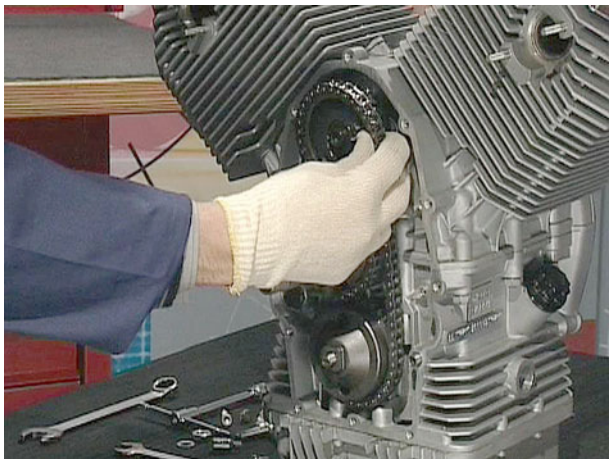
- Remove securing screw of sound wheel and take it out.

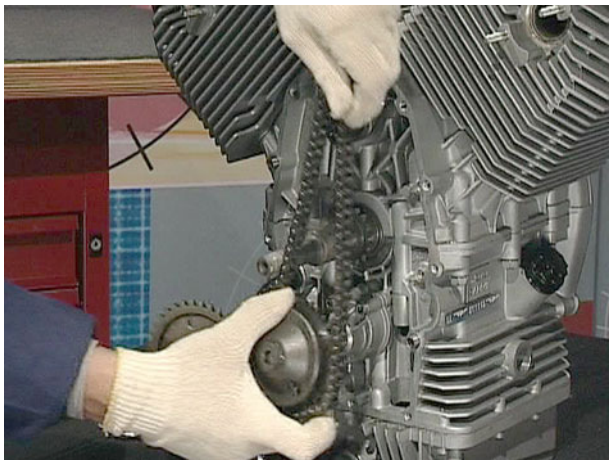




- Remove the two screws, timing gear to shaft, chain and oil pump gear.



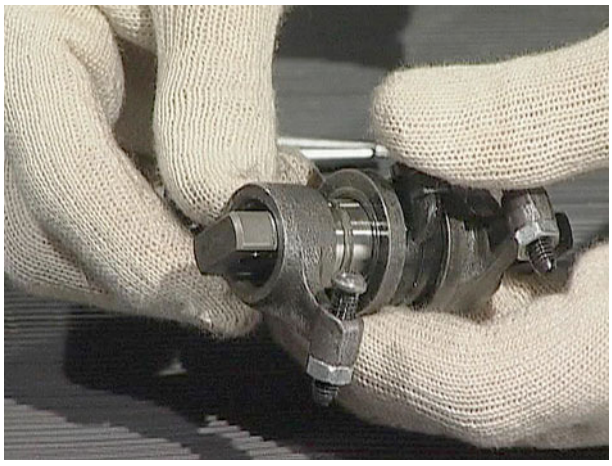


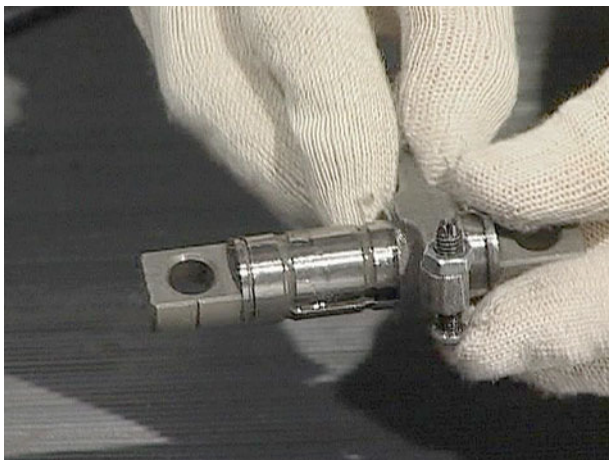


4.3.5. TIMING CHECK

ROCKER ARM DISASSEMBLY

- Remove piston rings and slip the two rocker arms and the oil delivery union out.





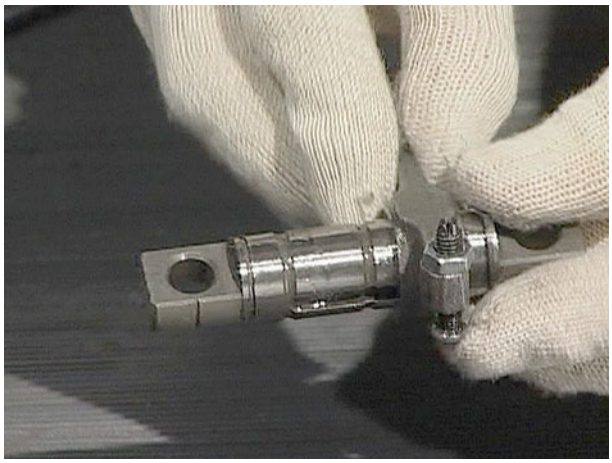
- Check that pin surface in contact with rocker arms is not overworn.
- Check contact surfaces of both valve rocker arm and rocker arm rod.

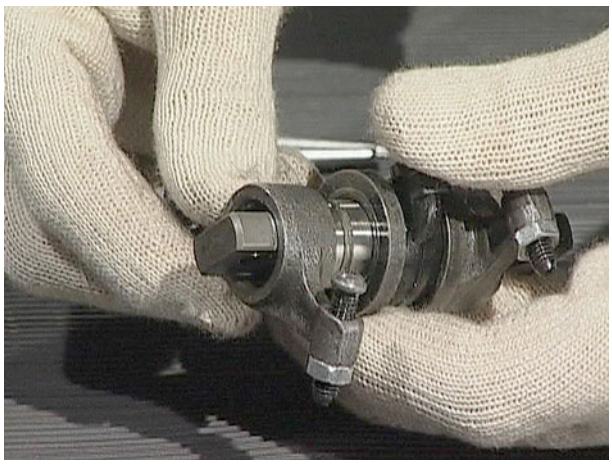
ROCKER ARM REASSEMBLY

- Check that longitudinal milling is set towards oil delivery duct.

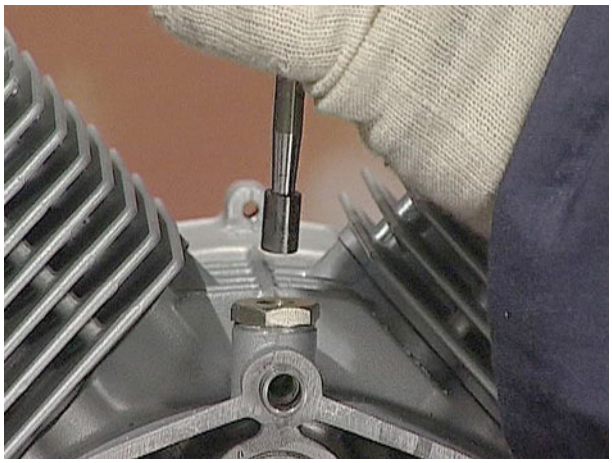
IMPORTANT *Pay special attention to the correct orientation of the washers at the time of reassembly.*

- Insert oil delivery union and rocker arms on the axes locking them in place with the piston rings.



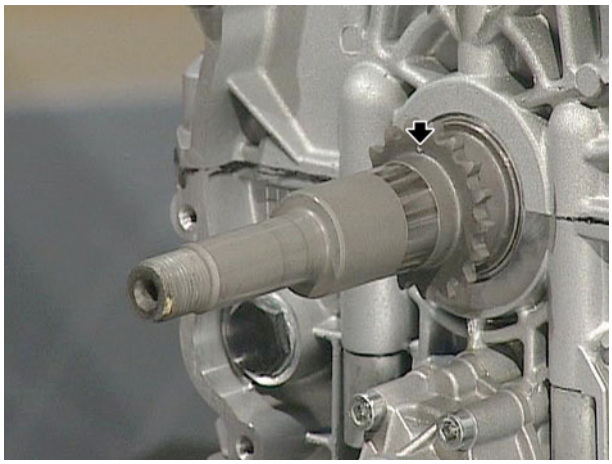


- Check that rocker arm push rods are straight, and that end contact surfaces do not show signs of seizing. If so, replace them.
- An easy way to check if the pressed ends on the rods (pads) have become slack is to drop them from a short distance onto a flat surface; on impact rods should produce a high-pitched metallic sound: this indicates that the pad has no slack.

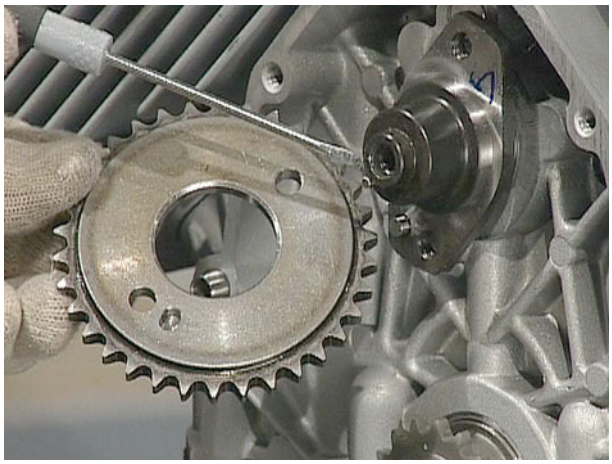


4.3.6. TIMING REASSEMBLY

- Put left cylinder at top dead centre by checking that reference on driving shaft gear is at top of its perpendicular axis.

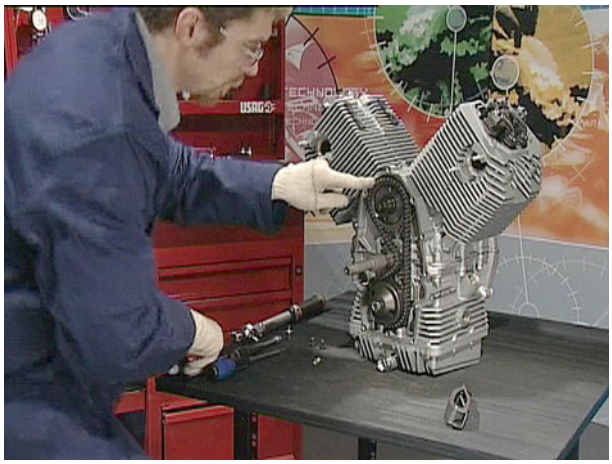


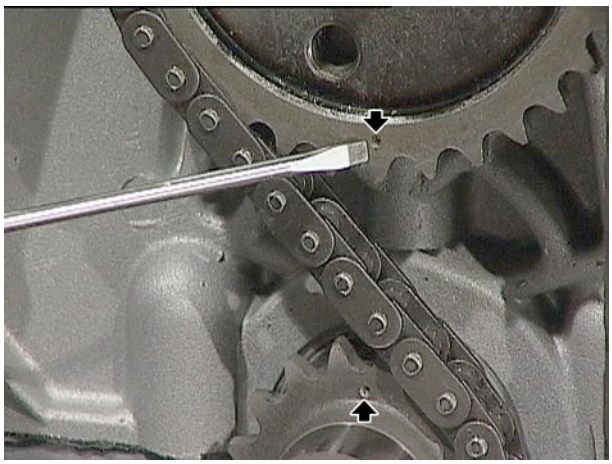
- Position timing shaft with gear reference pin pointing downwards.



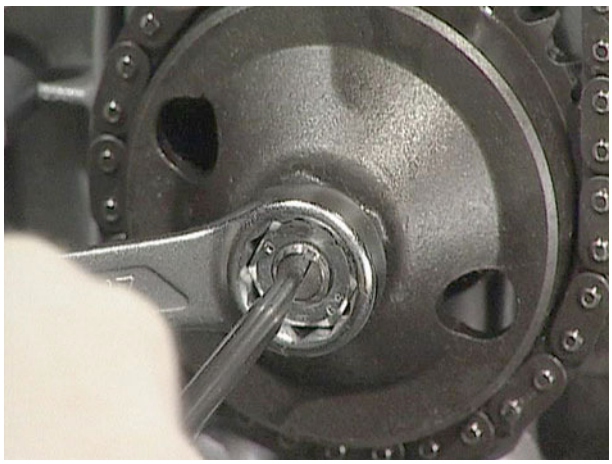
- Insert oil pump shaft locking spline.

- Insert the two gears with the timing belt; once assembled check position of indicator notches and tighten screws with dynamometric spanner to prescribed torque.

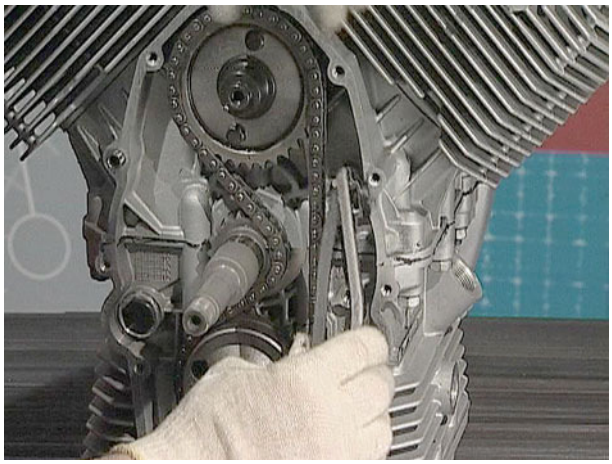


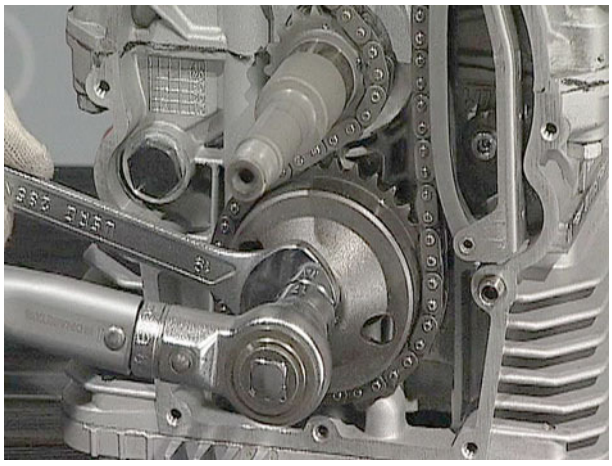


- Tighten oil pump nut with oil pump shaft held still.



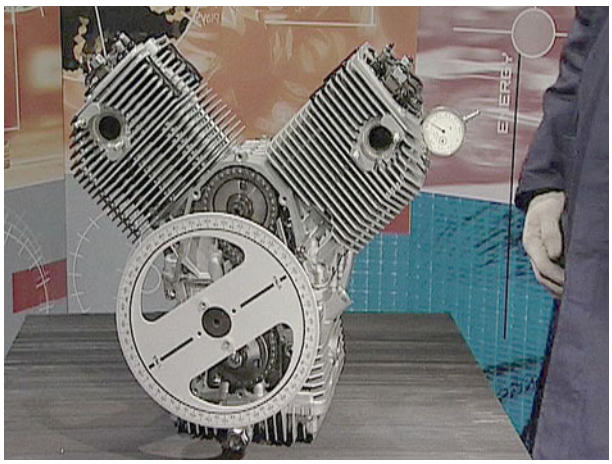
- Insert belt stretcher and tighten with dynamometric spanner to prescribed torque.

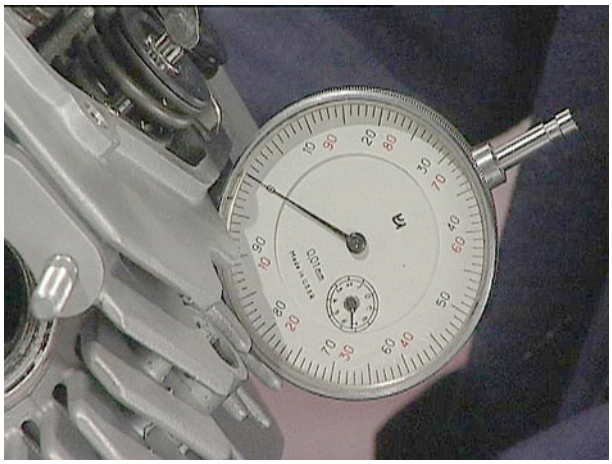




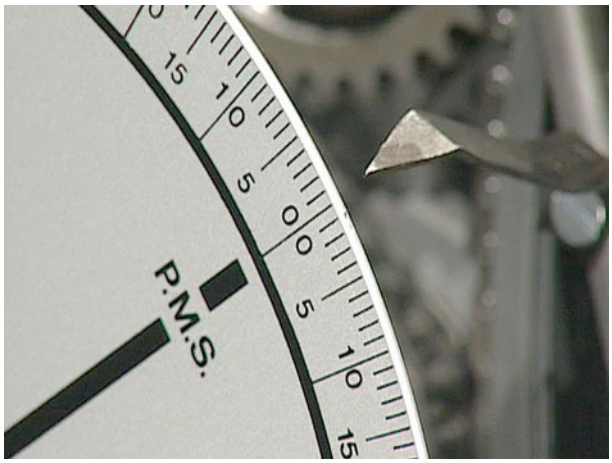
4.3.7. TIMING CHECK

- After positioning the goniometer and centesimal comparator: put the cylinder at top dead centre in compression phase and check exact positioning by following the centesimal comparator readings.

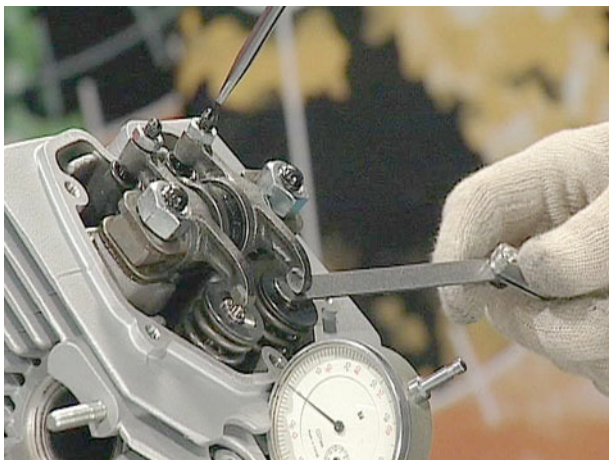




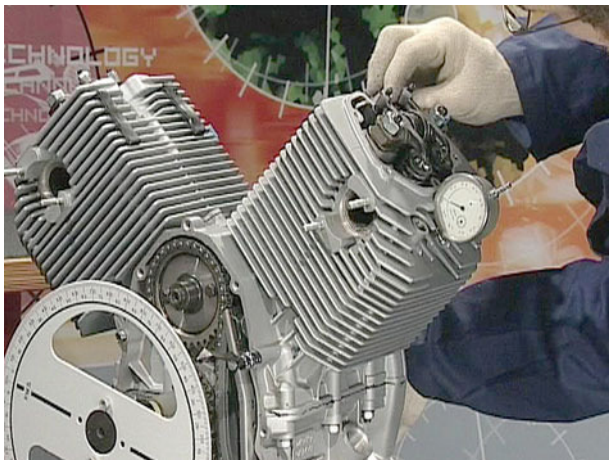
- Zero goniometer using top dead centre on indicator as reference.



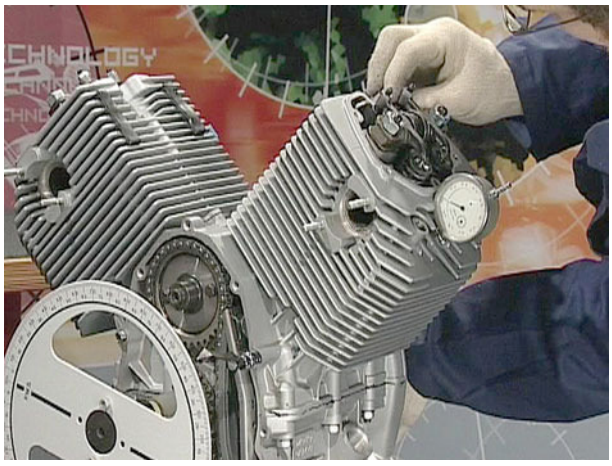
- Adjust tappets to theorectical clearance prescribed.



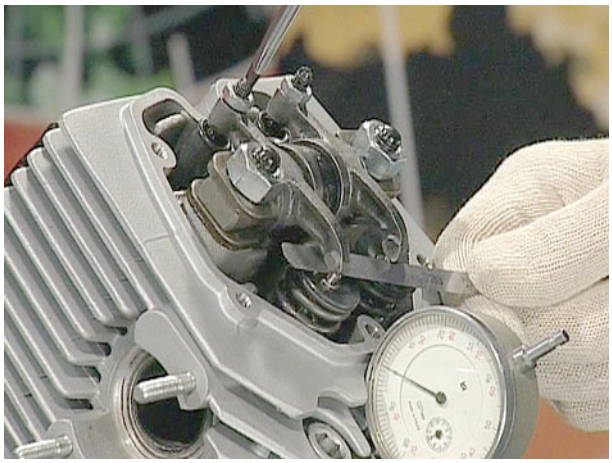
- Turn clockwise until contact between rod and rocker arm is reached and on goniometer check intake valve advance with respect to top dead centre.



- Continue to turn until rod is free, read the value representing retard of the valve closing with respect to bottom dead centre.

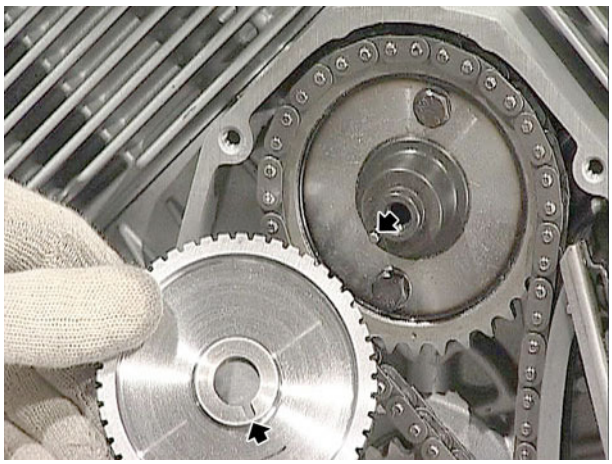


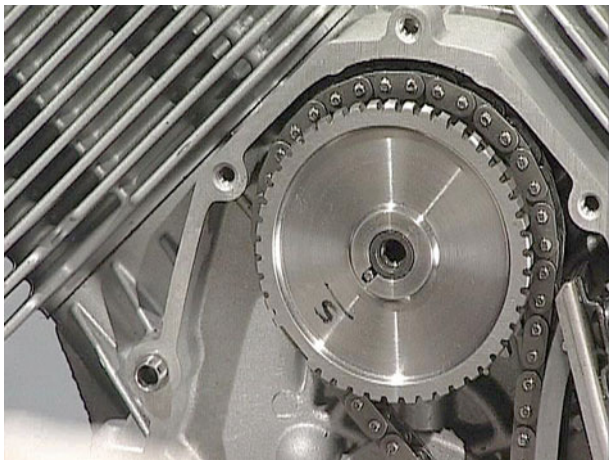
- Repeat operation for the other valves.
- Adjust tappet clearance to clearance prescribed.

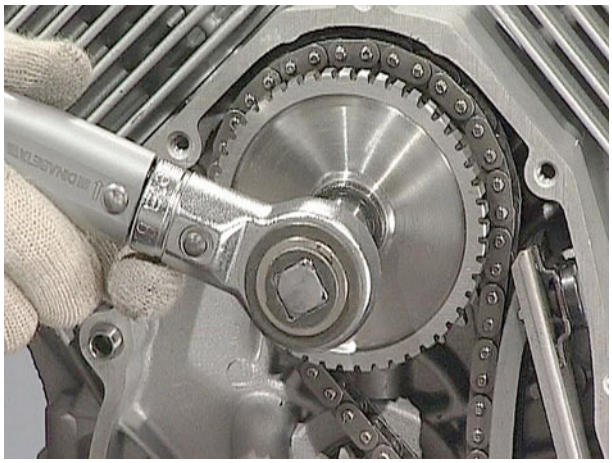


4.3.8. SOUND WHEEL ASSEMBLY

- Sound wheel position is given by the dowel on timing shaft.
- Position sound wheel by checking correct insertion on timing shaft (see notch) and tighten using dynamometric spanner to prescribed torque.





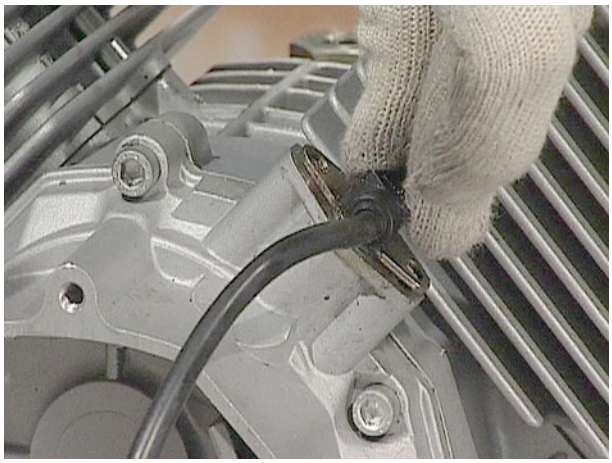


- Once the gasket is inserted remount cover on timing and tighten with dynamometric spanner to prescribed torque.

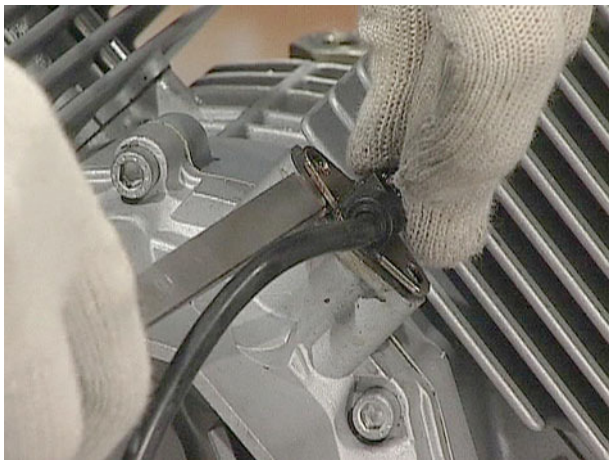
4.3.9. AIR GAP MEASUREMENT AND SENSOR RE-ASSEMBLY

- Insert a flat washer on the sensor to measure thickness.

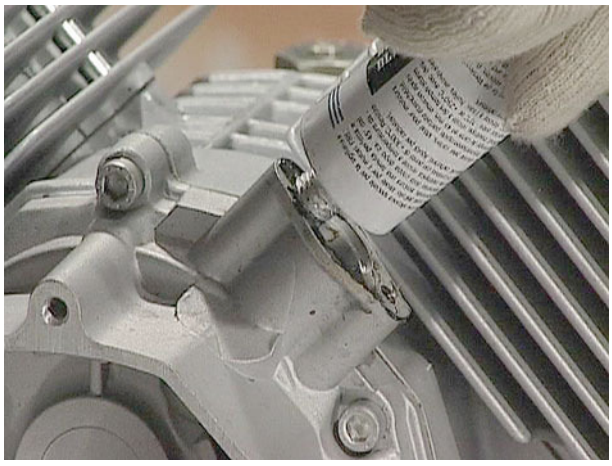
- Position the sensor on timing cover and contact it with the sound wheel.

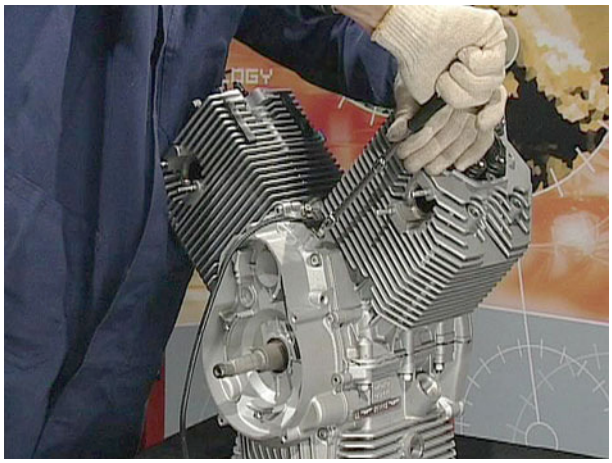


- Use a thickness gauge to measure clearance between securing plate and cover. Substraction of flat washer thickness from the found value gives the clearance between sensor and sound wheel.



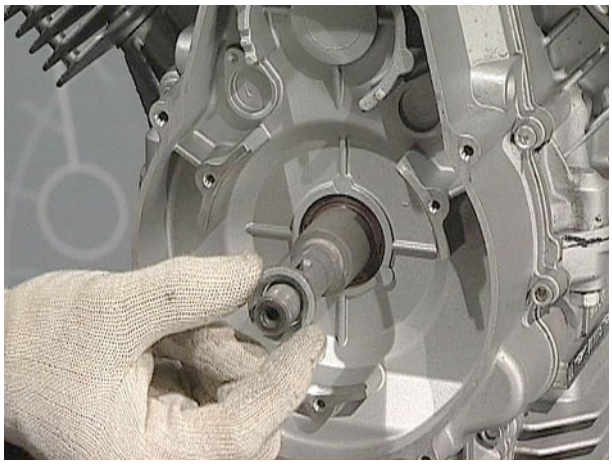
- Remove the washer and insert the sensor after covering securing plate surface with sealant paste and tighten the screws to torque.

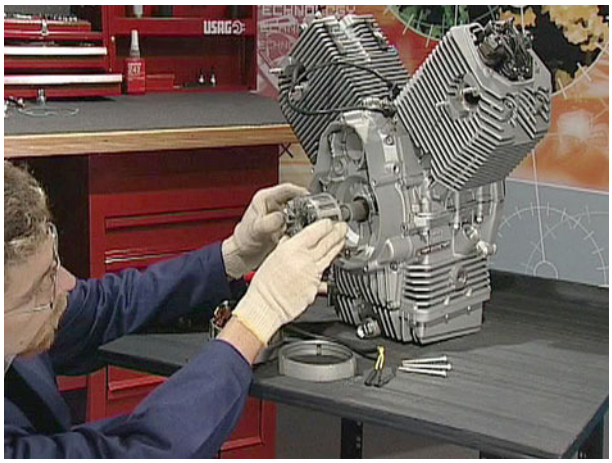


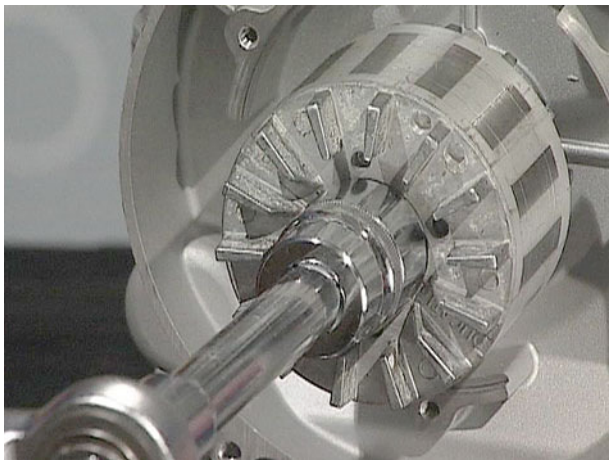


4.3.10. ALTERNATOR REASSEMBLY

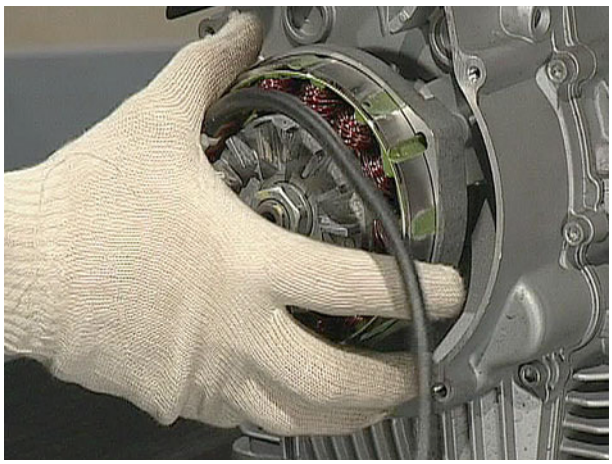
- Insert the contact washer, locking spline and rotor, and tighten the screw nut with the dynamometric spanner to torque.

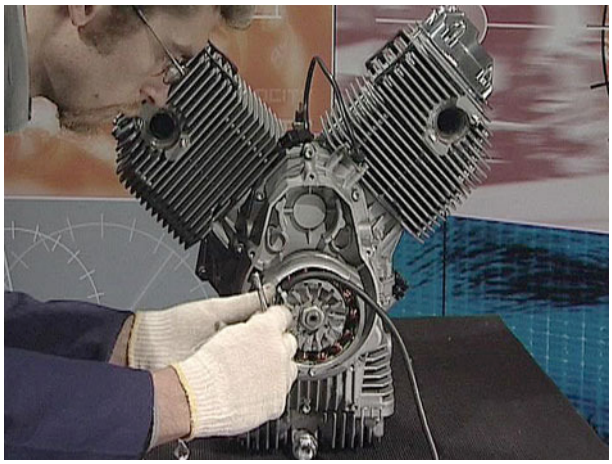




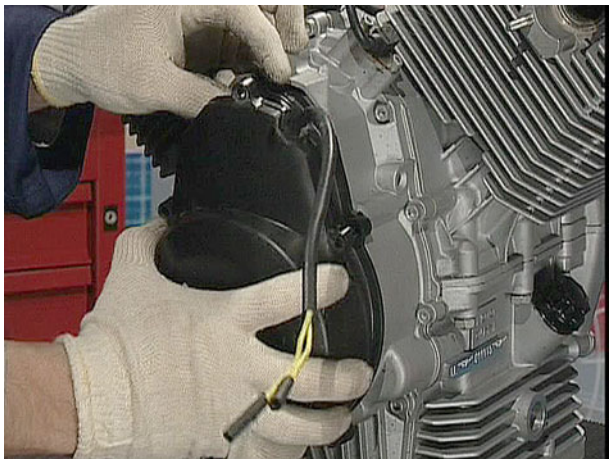


- Insert stator and its cover and tighten the three screws.





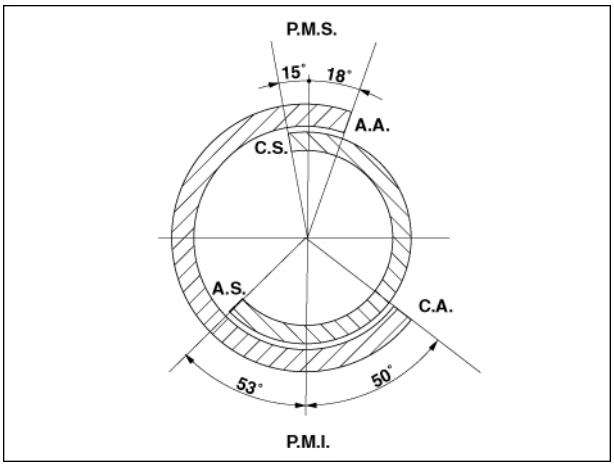
- Insert stator cover.



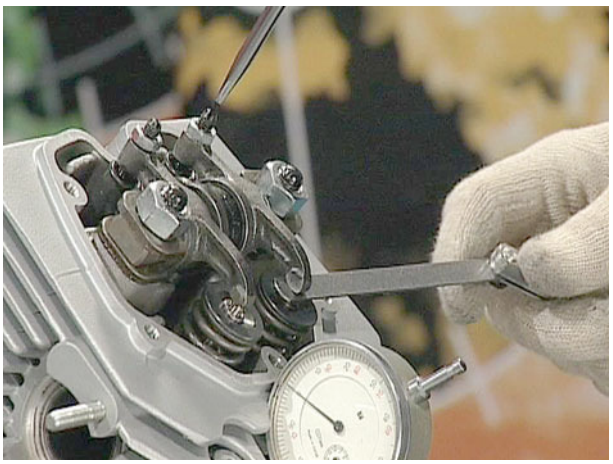
4.3.11. TIMING DATA

Intake:
- **opens 18° before T.D.C.;**
- **closes 50° after B.D.C.**

Exhaust:
- **opens 53° before B.D.C.;**
- **closes 15° after T.D.C.**



Valves clearance for timing check 1 mm.
Valves clearance for operation:
- **intake 0.15 mm;**
- **exhaust 0.20 mm.**



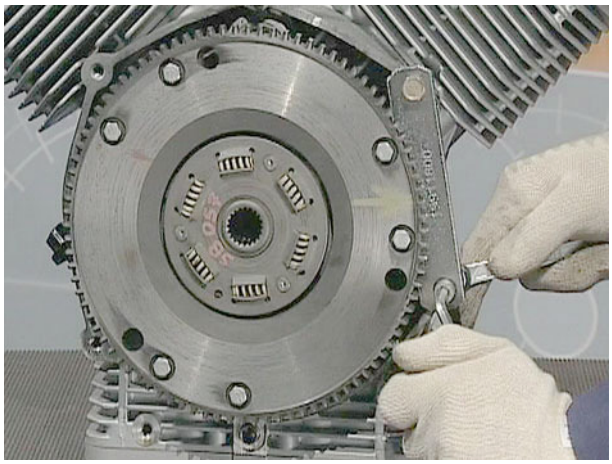
4.3.12. TIGHTENING TORQUES

TIMING	
Camshaft to crankcase fixing connection	30 Nm
Timing gear to camshaft fixing screws	25 Nm
Phonic wheel fixing screw	25 Nm

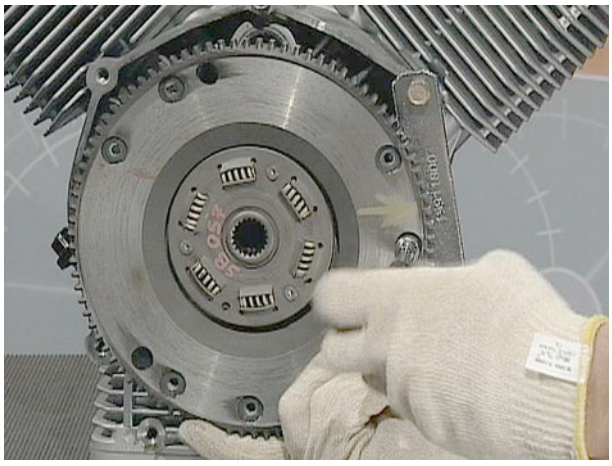
4.4. CLUTCH

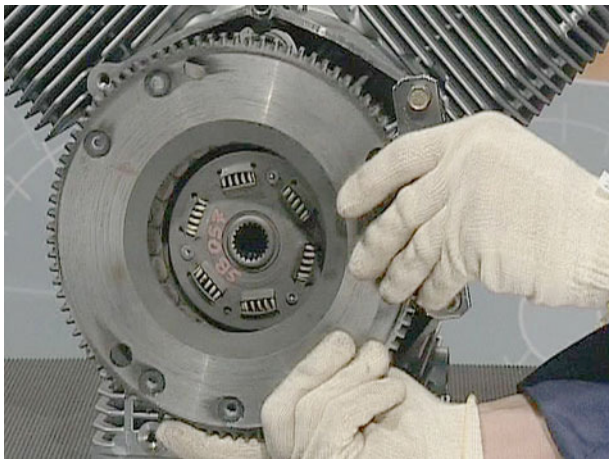
4.4.1. DISASSEMBLY OF CLUTCH PLATE AND DISK

- Mount prescribed engine flywheel stopping tool on block.



- Unscrew clutch plate securing screws and remove it complete with starter ring.





- Remove clutch disk.

4.4.2. CHECK

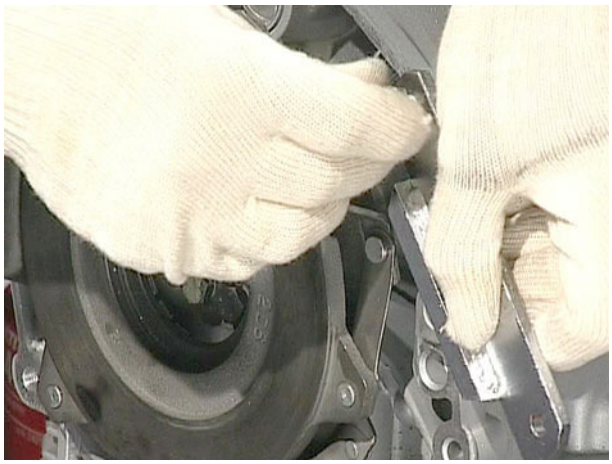
- Check clutch disk for scratches or overwear.

- Check antijerk rings and that clutch disk thickness is not less than value prescribed: if so, clutch disk must be replaced.

- Check clutch disk ring gears of rim and contact surface for wear.

4.4.3. CLUTCH PLATE AND DISK ASSEMBLY

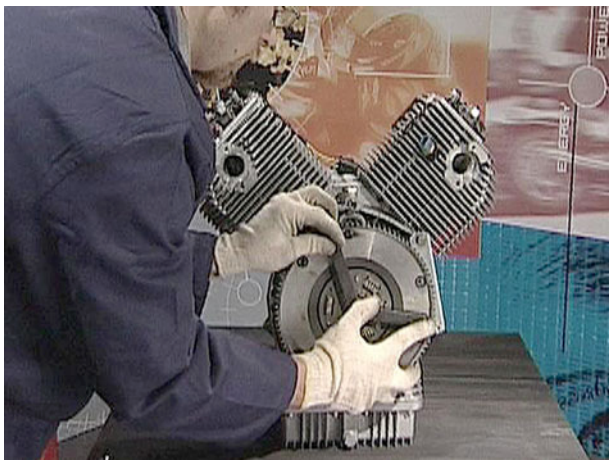
- Once the flywheel stopping tool has been inserted.

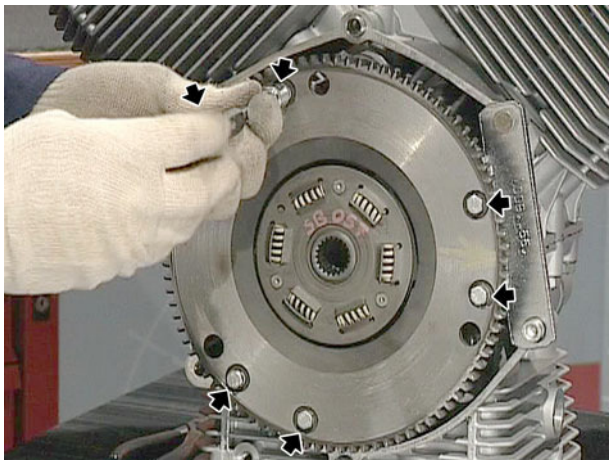


- insert cup with relative blocking ring.

- Position appropriate tool to centre clutch disk on plate and position disk in seat.

- Fix the assembly on flywheel thrust plate by tightening screws to torque.





4.4.4. TIGHTENING TORQUES

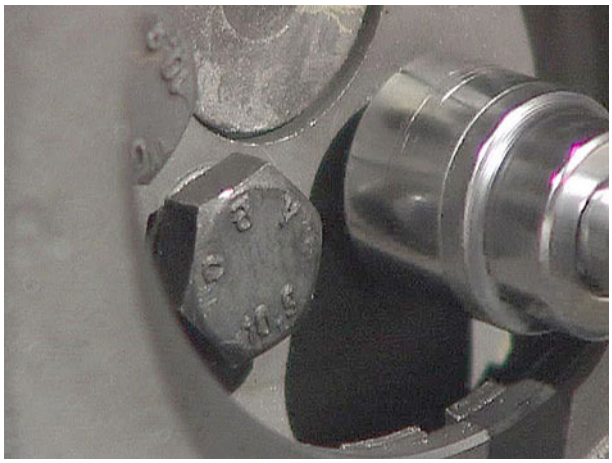
CLUTCH	
Clutch shaft fixing nut	100 Nm

4.5. ENGINE THRUST PLATE FLYWHEEL

4.5.1. FLYWHEEL DISASSEMBLY

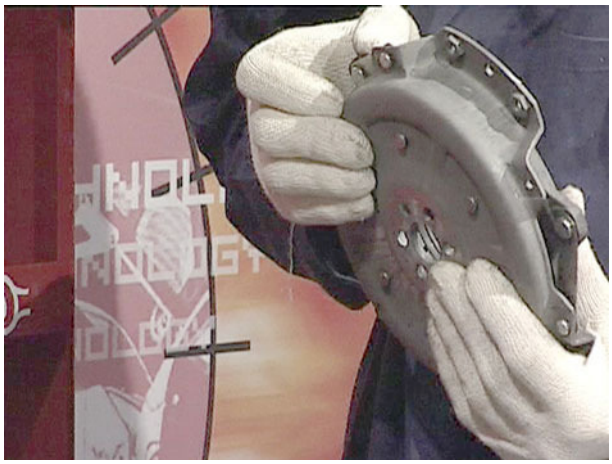
- Remove stop ring and engage-disengage cup.

- Remove screws securing thrust plate flywheel to driving shaft, then take it out.



4.5.2. CHECK

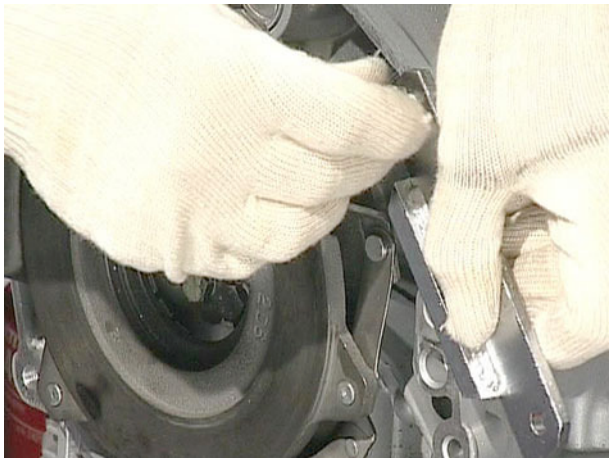
- Check that flywheel surfaces in contact with disk are not scratched.
- Check that driving shaft contact surfaces are not deformed. If so, flywheel must be replaced.



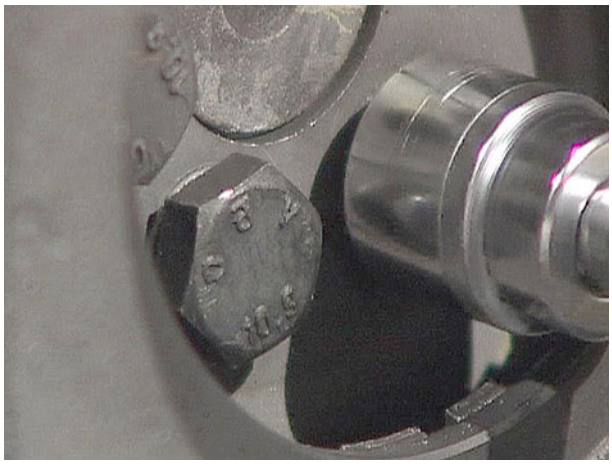
4.5.3. FLYWHEEL THRUST PLATE REASSEMBLY

- When reassembling flywheel thrust plate on driving shaft make sure that "yellow" mark on driving shaft is perfectly in line with groove on engine flywheel.

- Tighten the screws and insert the appropriate flywheel stopping tool.



- Crosswise lock screws with dynamometric spanner to prescribed torque. It is advisable to replace flywheel securing screws to driving shaft.



- Insert clutch engage-disengage cup and relative blocking ring.

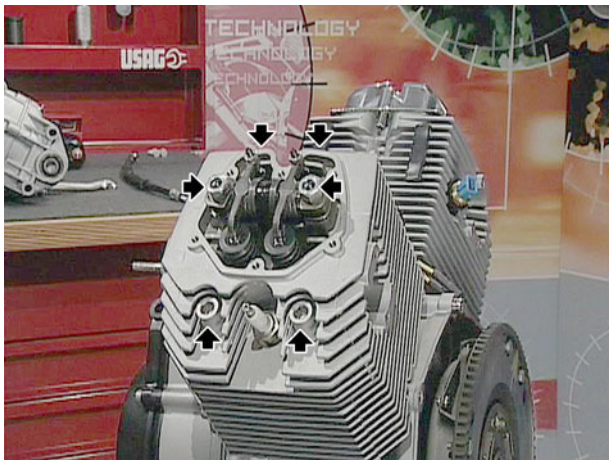
4.5.4. TIGHTENING TORQUES

CONNECTING ROD GROUP	
Rods fixing screws	30÷32 Nm
Flywheel to crankshaft fixing screws	40 Nm
Ring gear fixing screws	10 Nm

4.6. ENGINE HEAD

4.6.1. ENGINE HEAD DISASSEMBLY

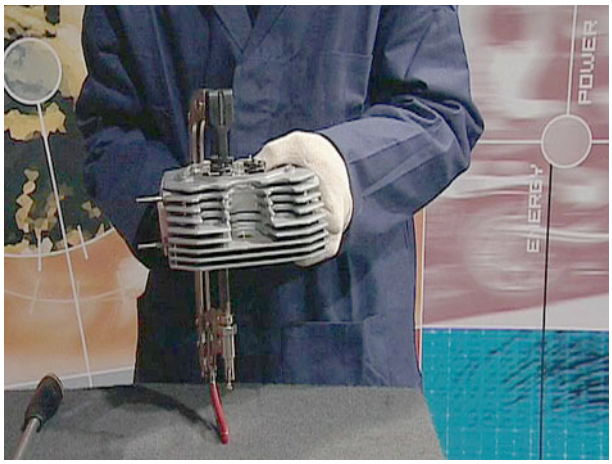
- Crosswise unscrew nuts at block securing heads, cylinders and rocker arm pins.



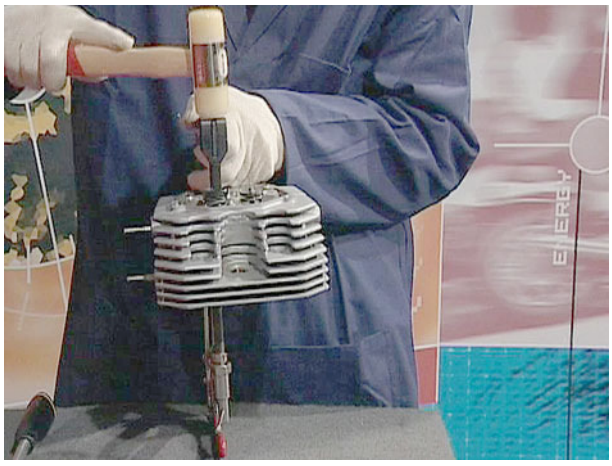
- Remove top spacers, rocker arms complete with pins, bottom spacers, rocker arm control push rods and slide heads out of stud bolts.

4.6.2. DISASSEMBLY OF HEAD VALVES

- Place the prescribed tool on the top cap of the valve to be removed and at the centre of valve mushroom.

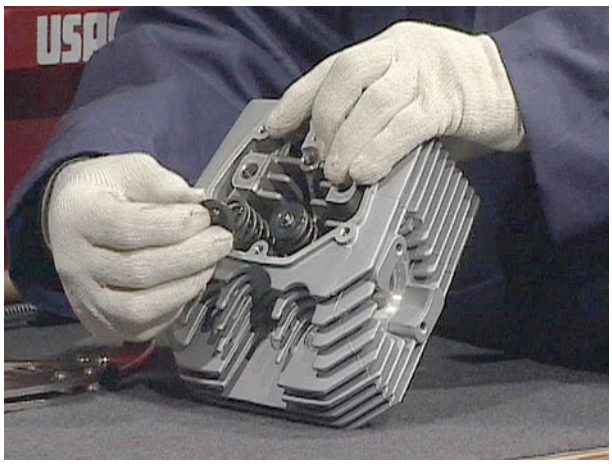


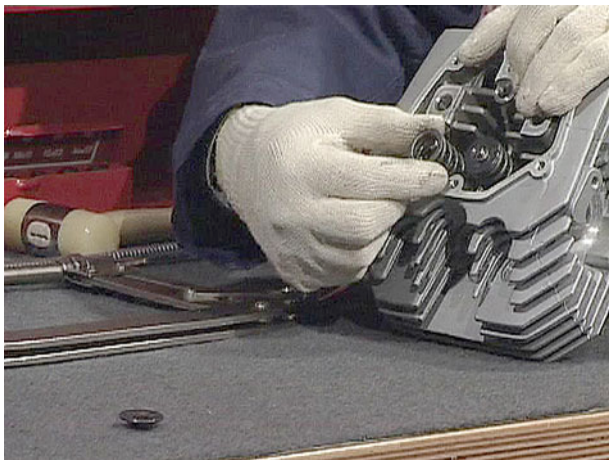
- Close tool by compressing the spring and hit the head of the tool with a mallet to remove the two cotters from top cap.



- Unscrew the tool and remove it from the head.

- Slip out top cap, spring and then valve.

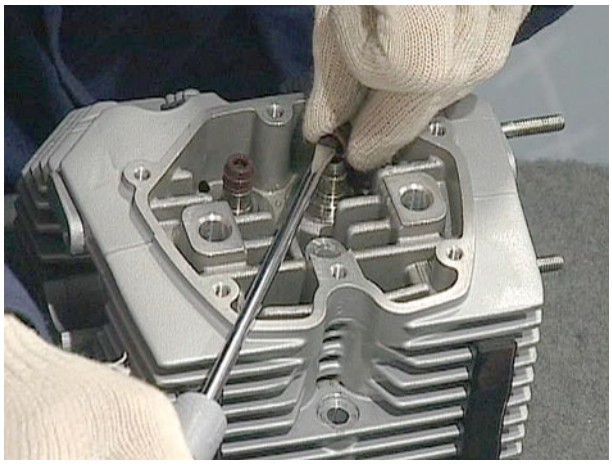


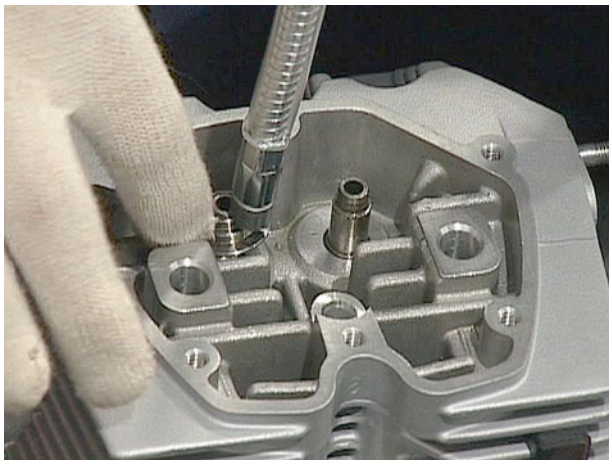


4.6.3. VALVE GUIDE FROM HEADS DISASSEMBLY

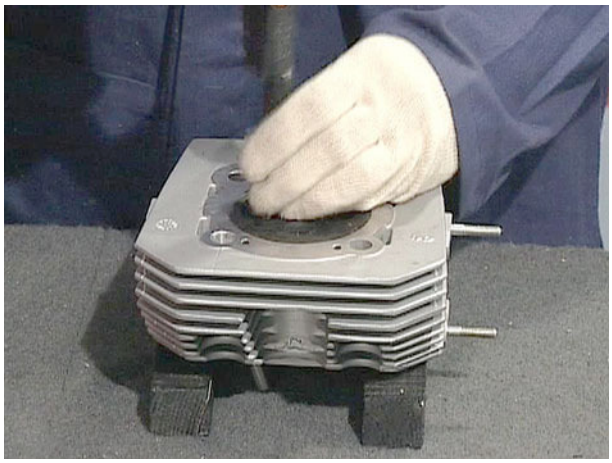
- Remove valve guide gaskets and take out bottom spring cap.

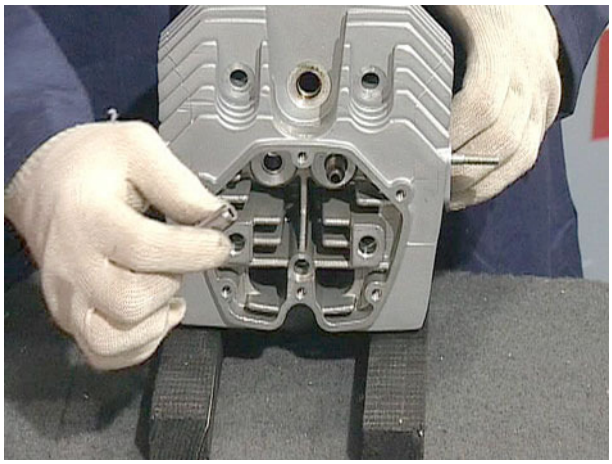
NOTE *Valve guides must be replaced when wear is such that valve replacement alone is insufficient to eliminate clearance between valve stem and internal hole of valve guide.*





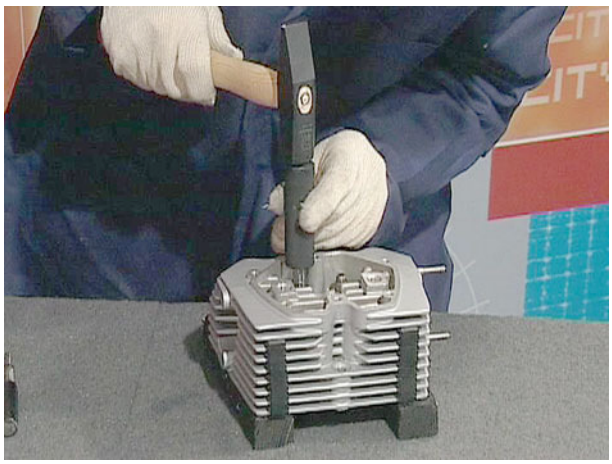
- Valve guides are removed with an appropriate punch and mallet by hitting from the inside towards the outside; this operation is made easier by preheating the head to about 50-60°C.



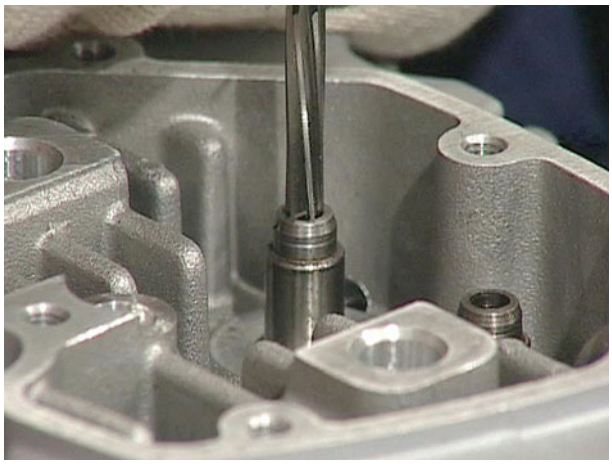


4.6.4. VALVE SEAT REASSEMBLY AND CHECK

- Hit the valve guides back into place with punch and mallet from the outside towards the inside; it is advisable to preheat the head to around 60°C.

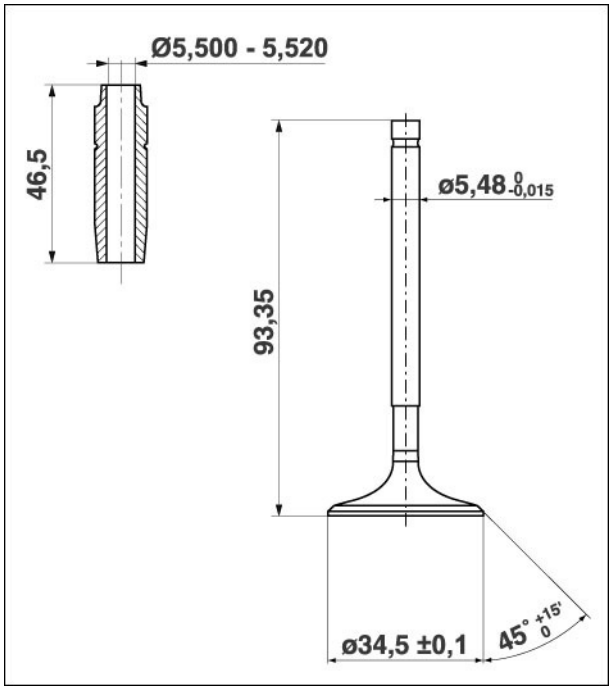


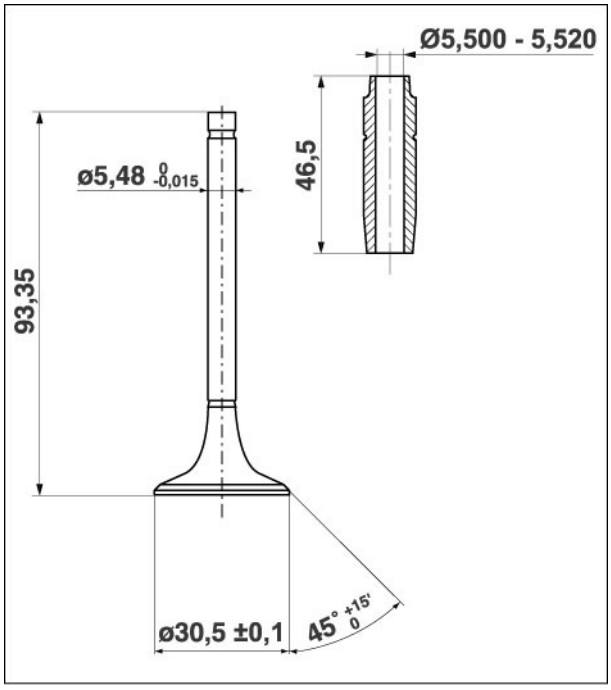
- Once the valve guides are back in place rectify them with a reamer to obtain internal diameter measurement given in table.



Valves and valve guides assembly data

	VALVE GUIDE INSIDE DIAMETER mm	VALVE STEM DIAMETER mm	ASSEMBLY CLEARANCE mm
Intake Exhaust	5,500÷5,520 5,500÷5,520	5,480÷5,465 5,480÷5,465	0,020÷0,055



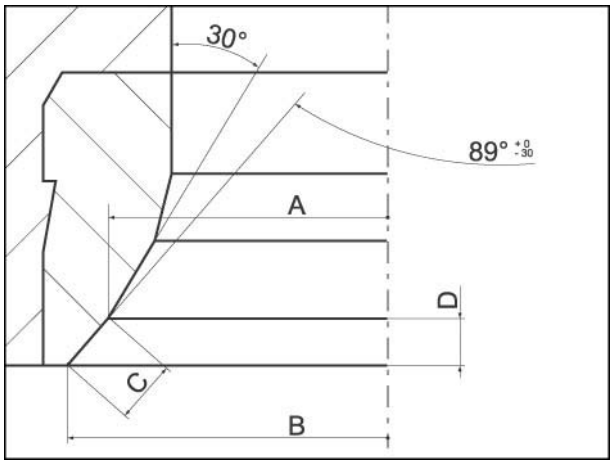


INTAKE

A ø	B (theoretical) ø	C (theoretical)	D
32,0÷32,25	34	1,42	1

EXHAUST

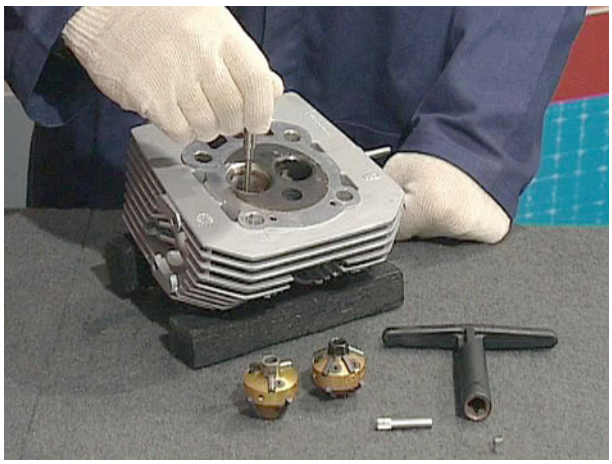
A ø	B (theoretical) ø	C (theoretical)	D
27,72÷27,97	30	1,6	1,14

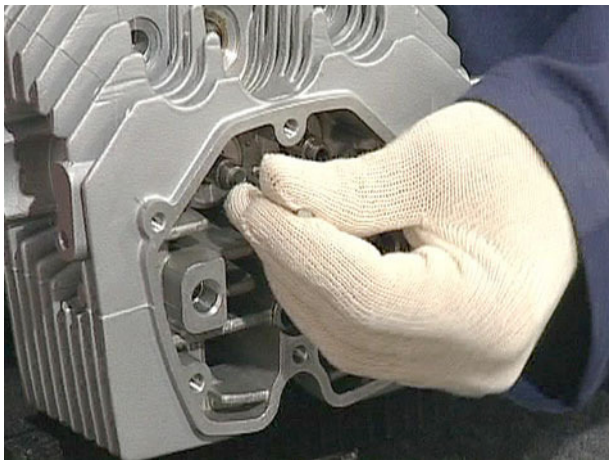


4.6.5. VALVE SEAT RECTIFICATION

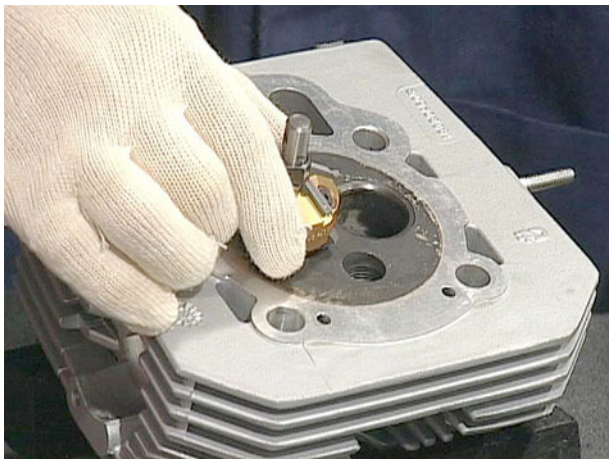
NOTE *Valve seat rectification after valve guide replacement or when valve seat is not tight rectification must be carried out.*

- Once the pilot tool has been chosed put it in the valve guide and lock in place.

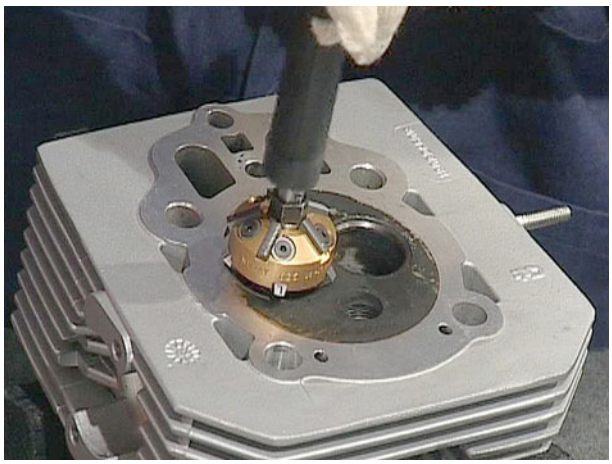


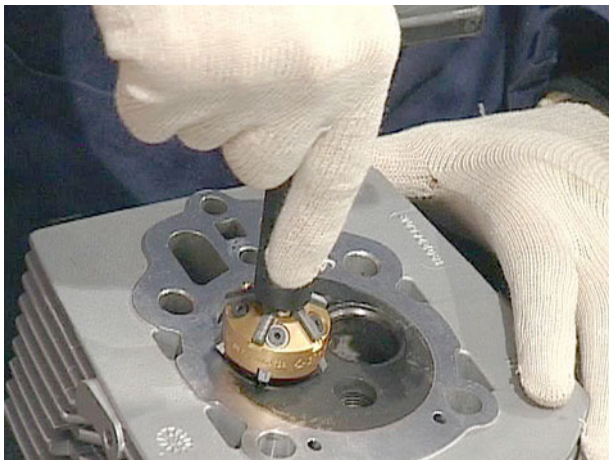


- Choose mill according to diameter and valve seat inclination.
- Insert the mill in pilot tool and carefully push it down to valve seat level.



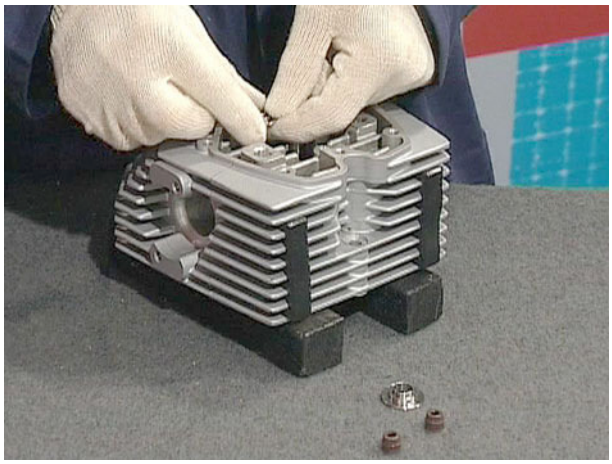
- Put the mill in the T spanner and turn clockwise applying pressure lightly until uniform valve contact surface is obtained.

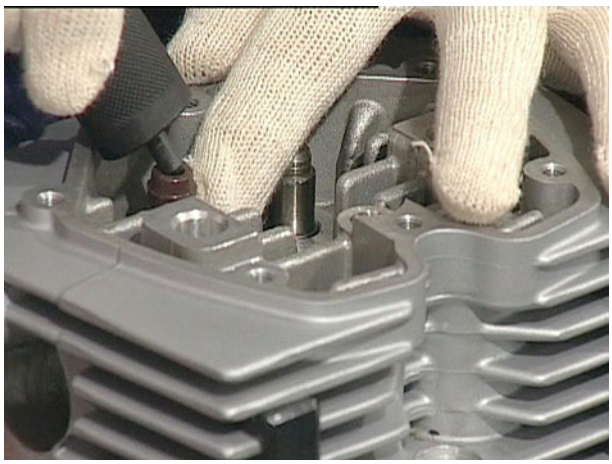




- Repeat operation with appropriate mill to restore valve blocking seat width.

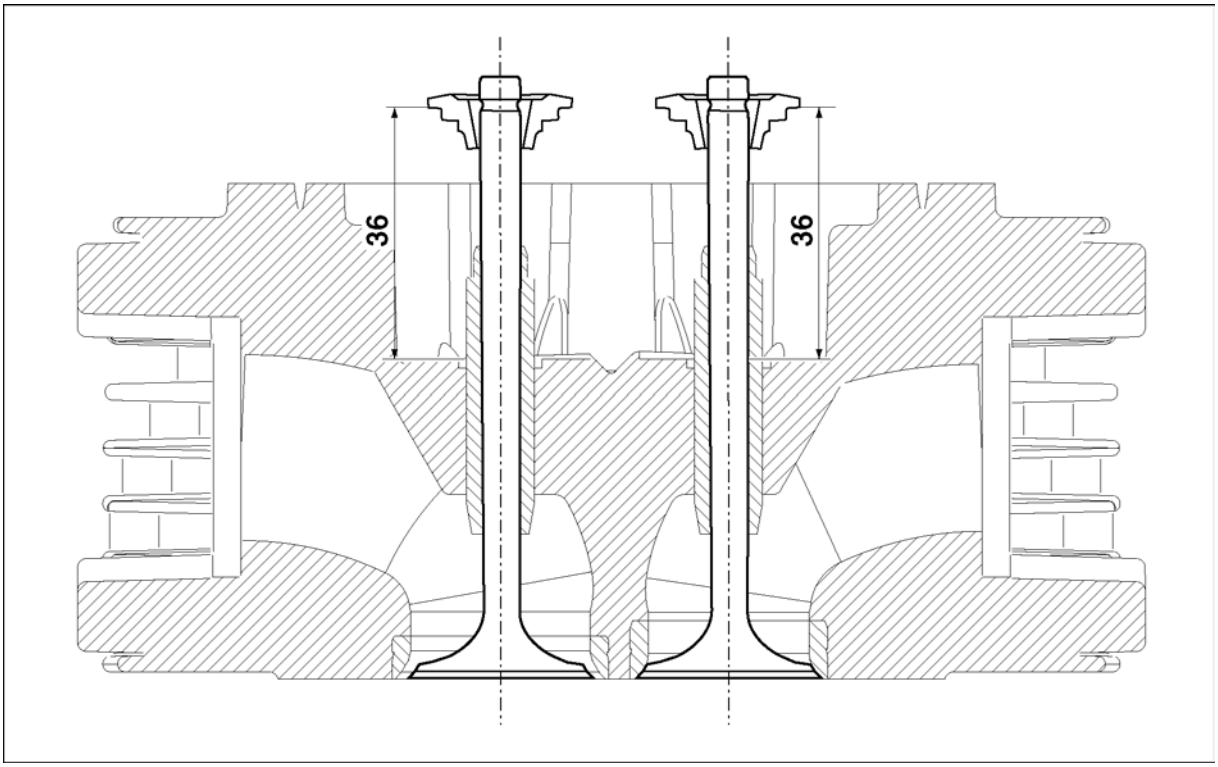
- Remove all tools used when operation is completed.
- Put back spring bottom seats and use the prescribed tool to insert blocking gaskets on valve guide.



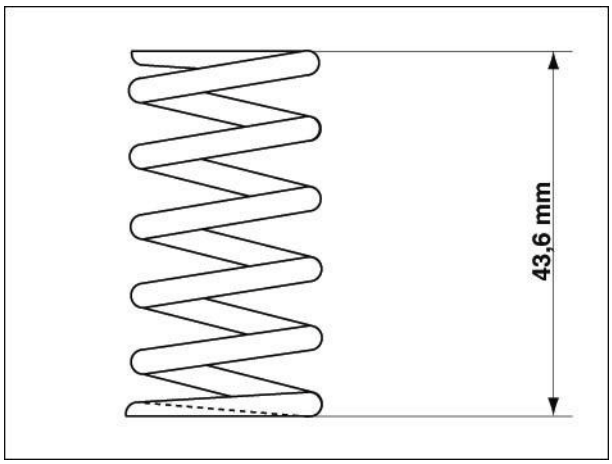


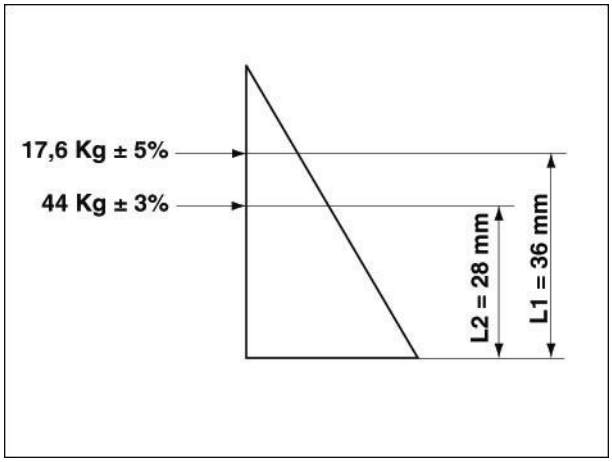
4.6.6. SPRING PACK INSPECTION

With the assembly (cups, springs, valves and half-cones) installed on the heads, the external springs must be compressed by 36 mm. Note that at their fully open position the valves must have an additional 1 mm excursion before the internal spring is completely compressed. If necessary add or remove shims until the above dimension is obtained.



Free length



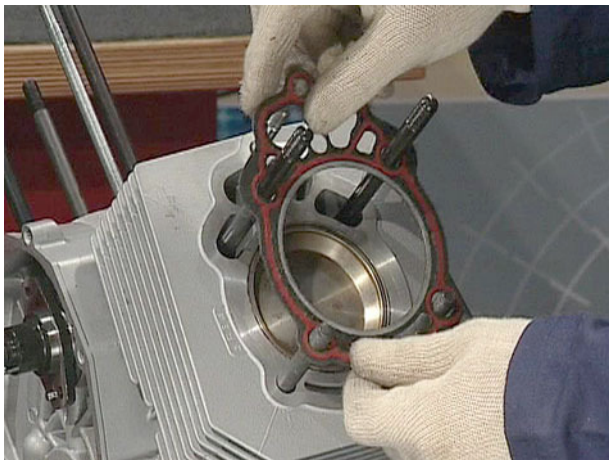


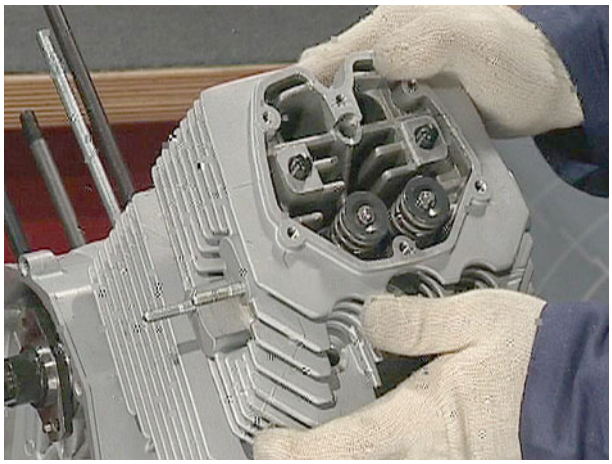
SPRING CHARACTERISTICS

DESCRIPTION	UNIT	VALUE
External diameter	mm	/
Internal diameter	mm	17.8 ± 0.2
Wire diameter	mm	3.4 ± 0.03
Free length	mm	43.6
Solid length	mm	27.5
Test length L1	mm	36
Test length L2	mm	28
Measured test load P1	kg	17.6 ± 5%
Measured test load P2	kg	44 ± 3%
Coil direction	/	right-hand
Spring class to UNI 7900/4	/	CC

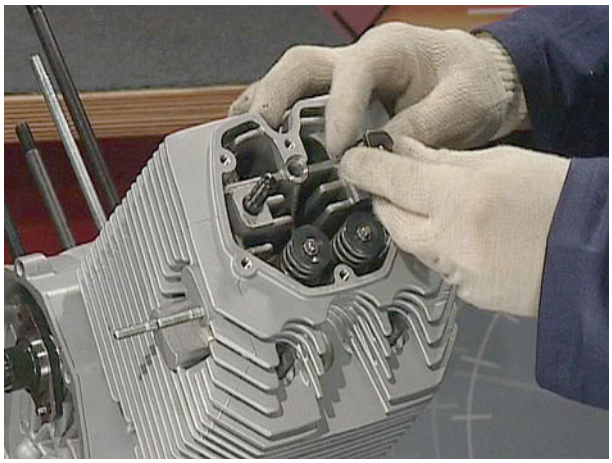
4.6.7. ENGINE HEAD REASSEMBLY

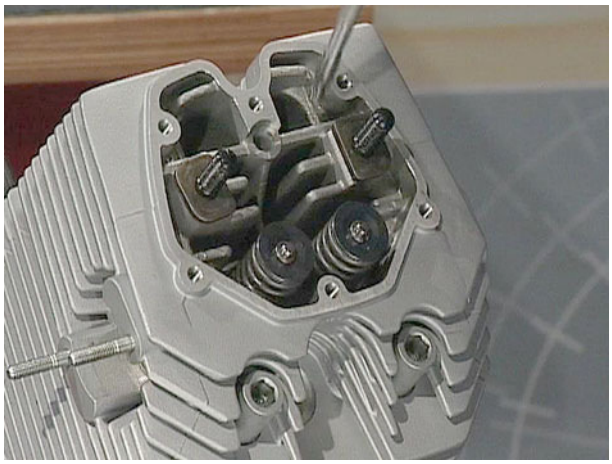
- Position new gasket and put engine head in seat.

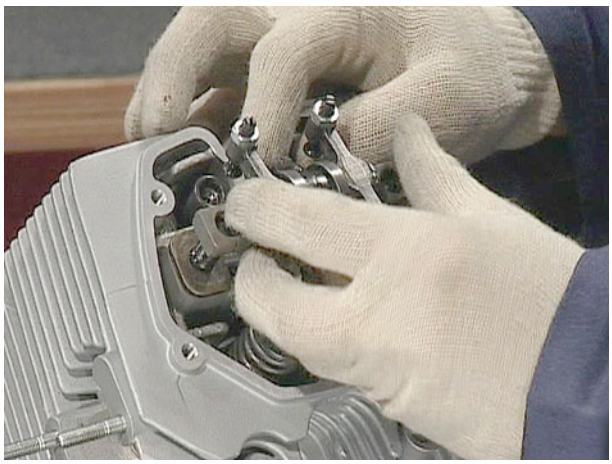


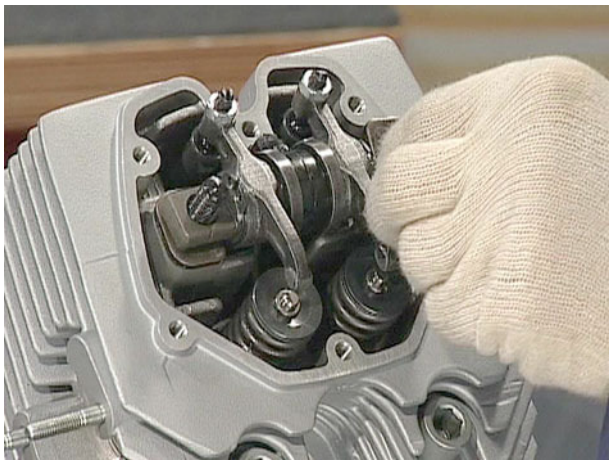


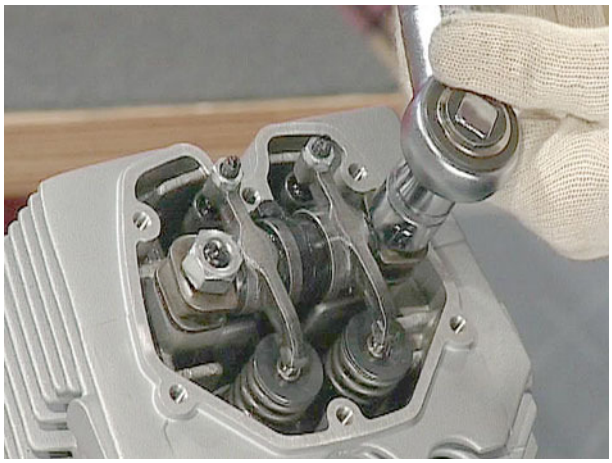
- Insert bottom spacers of rocker arms, rocker arm push rods, rocker arms and top spacers with all relative nuts.











- Crosswise lock the nuts to prescribed torque.

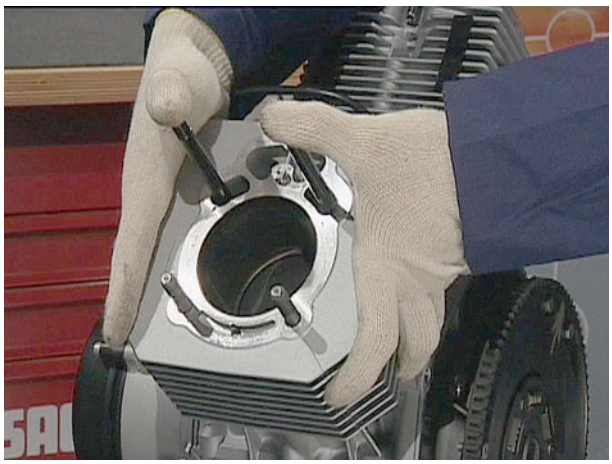
4.6.8. TIGHTENING TORQUES

CYLINDER HEADS	
Cylinder head covers fixing screws	10 Nm
Spark plugs	25 Nm

4.7. CYLINDERS

4.7.1. CYLINDERS DISASSEMBLY

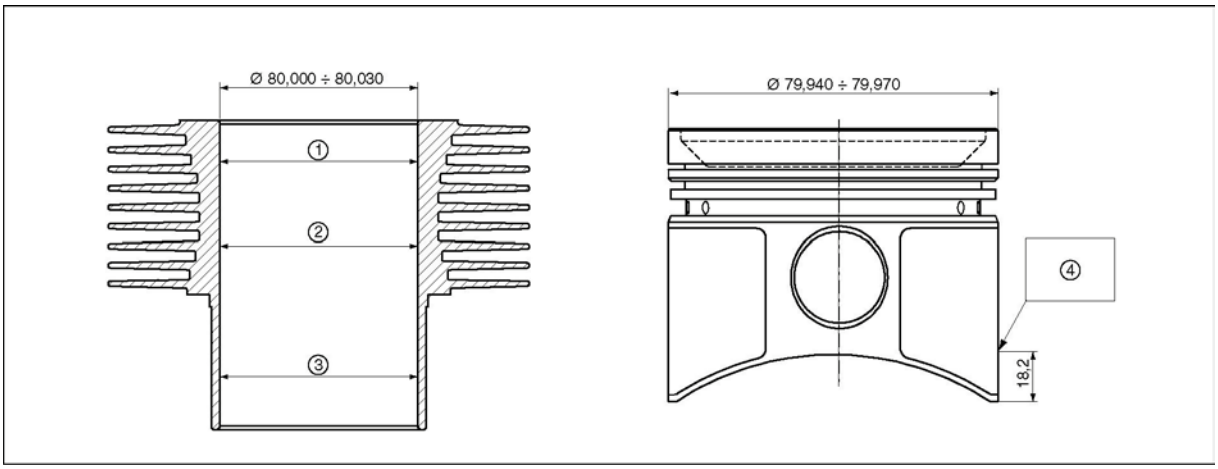
- Slip cylinders with their gaskets out of stud bolts.



- Remove the O ring between block and cylinder.

4.7.2. CHECK

- After checking scoring, use a centesimal comparator to check for cylinder surface wear.
- Measure inside cylinder diameter at three heights (insert legend) by revolving centesimal comparator by 90ø and repeat measurements; Centesimal comparator must be previously zeroed on a ring gauge.



Key:
1) 1st measurement
2) 2nd measurement
3) 3rd measurement
4) control dimension for selection

Cylinders selection ø

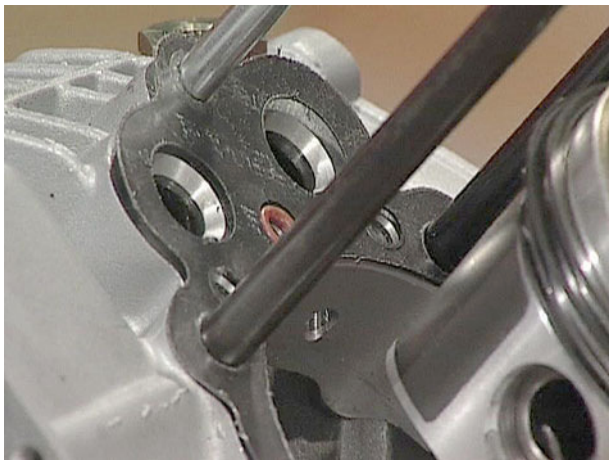
GRADE “D”	GRADE “E”	GRADE “F”
80,000÷80,010	80,010÷80,020	80,020÷80,030

When fitting new units, cylinder categories “D-E-F” must be paired with the corresponding pistons selected in categories “D-E-F”.
Assembly clearance between piston and cylinder: 0.050 ÷ 0.070 mm

4.7.3. CYLINDER ASSEMBLY

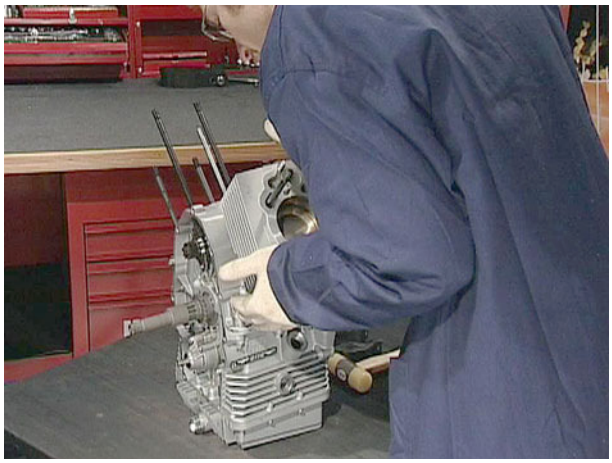
- Check that compression ring notches are staggered at angles of about 120 degrees between each other.

- Once the new gasket is in place and the ring is inserted in its seat on the block, put an adequate market available ring-tightener on the piston.



- Lubricate inside cylinder wall and piston. Start fitting the piston in the cylinder seat using a mallet.

- Once past the segment area remove ring-tightener from piston and insert cylinder in its seat.



4.7.4. TIGHTENING TORQUES

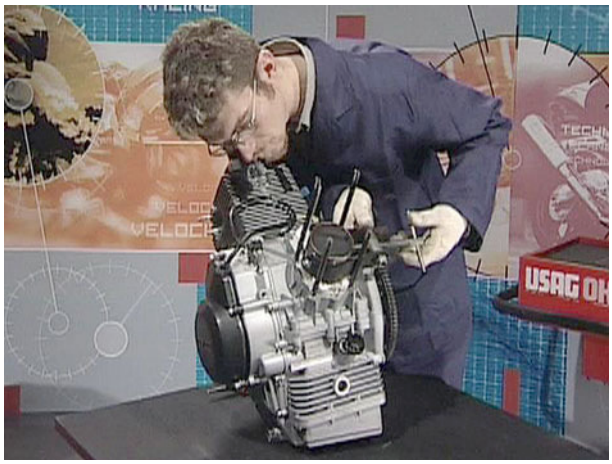
CRANKCASE AND COVERS	
Cylinder heads-barrels to crankcase fixing nut (M10)	40÷42 Nm
Cylinder heads-barrels to crankcase fixing nut (M8)	28÷30 Nm
Crankcases joining nuts (M8)	22÷25 Nm
Crankcases joining nuts (M10)	40÷42 Nm
Timing cover fixing screws	10 Nm
Sump fixing screws	10 Nm
Valves cover insert fixing screw	5 Nm

4.8. PISTONS

4.8.1. PISTONS DISASSEMBLY

- After protecting cylinder seat, remove the two gudgeon retaining springs.

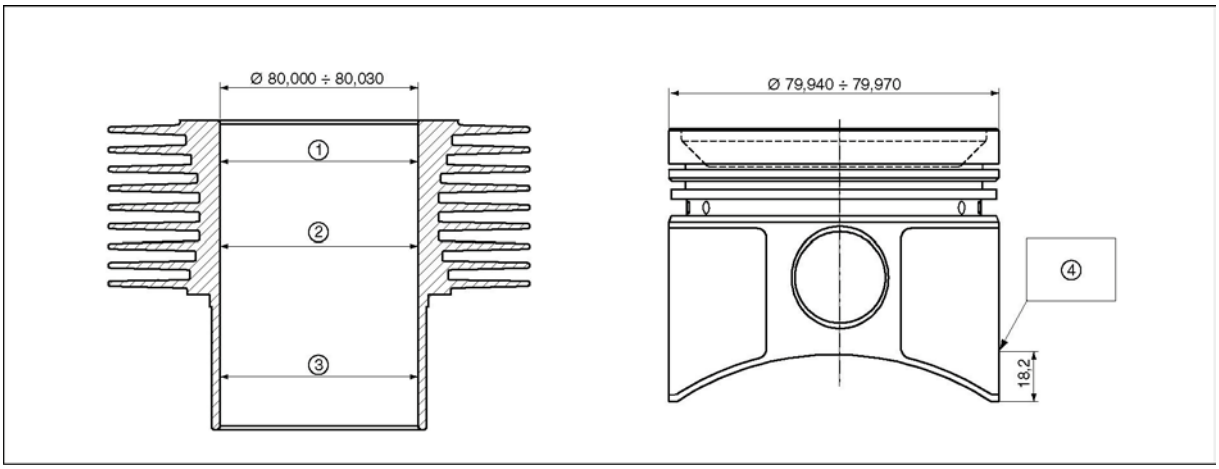
- Use the screw of the prescribed tool to slip gudgeon out and remove piston.



NOTE *When overhauling carry out decarbonization of piston crown and piston ring housings.*

4.8.2. CHECK

- First check for superficial scoring and then check wear of the cylinder bore surfaces using a dial gauge
- Measure the inside diameter of the cylinder bore at three different heights then turn the dial gauge through 90° and repeat the measurements; the dial gauge must be first zero set on a ring gauge.



Key:
1) 1st measurement
2) 2nd measurement
3) 3rd measurement
4) control dimension for selection

- Check the piston diameter at the specified height and on an axis perpendicular to the gudgeon pin.
- Selection values refer to the bare piston (without graphite facing).

- Check that the selection mark and assembly arrows are punch marked on the piston.

Piston diameter selection

GRADE “D”	GRADE “E”	GRADE “F”
79.940÷79.950	79.950÷79.960	79.960÷79.970

IMPORTANT *Graphite facing thickness when new: 0.015 ± 0.005 mm*

Gudgeon pin to piston bore assembly data

GUDGEON PIN EXTERNAL DIAMETER mm	*DIAMETER OF BORES IN PISTON* mm	*ASSEMBLY CLEARANCE* mm
19.996÷20.000	22.000÷22.006	From 0.006 clearance to 0.002 interference

4.8.3. PISTON REASSEMBLY

- In reassembling piston to con rod eye, heat piston in oil bath to about 60°C to slightly dilate it so gudgeon is easier to put back.
- Insert blocking spring in piston and fit appropriate tool on piston to insert gudgeon.

- Position piston with tool attached on the con rod and screw to insert gudgeon.

- Remove tool when operation is completed and insert the second blocking spring of gudgeon seat after protecting cylinder seat.

NOTE *Assembly position is indicated by an arrow to be set according to rotation direction.*

4.9. COMPRESSION RINGS AND SCRAPER RING

4.9.1. DISASSEMBLY

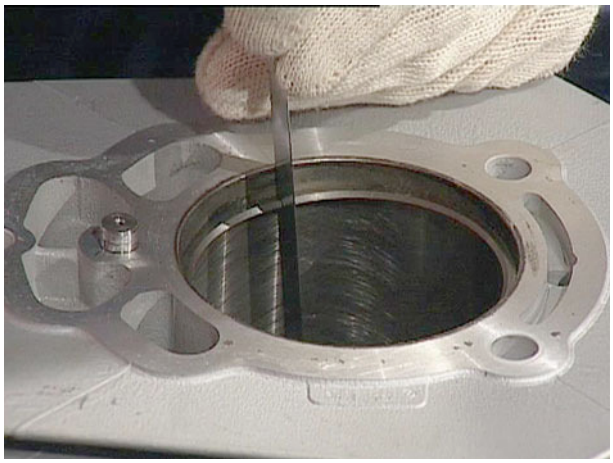
- Remove compression rings and scraper ring.

NOTE *to avoid breaking, rings must not be stretched more than is necessary to slip them off piston.*

4.9.2. COMPRESSION RING CHECK

- Use a feeler gauge to check that the assembly clearance between ring and ring groove on the piston is as specified.

top compression ring mm 0.030 ÷ 0.062;
second compression ring mm 0.030 ÷ 0.062;
oil control ring mm 0.030 ÷ 0.062.



- Insert the piston rings one at a time into the cylinder square to the cylinder wall and use a feeler gauge to check the end gap.

top compression and second compression and scraper ring: mm 0.25 ÷ 0.45;
oil control ring: mm 0.20 ÷ 0.45.

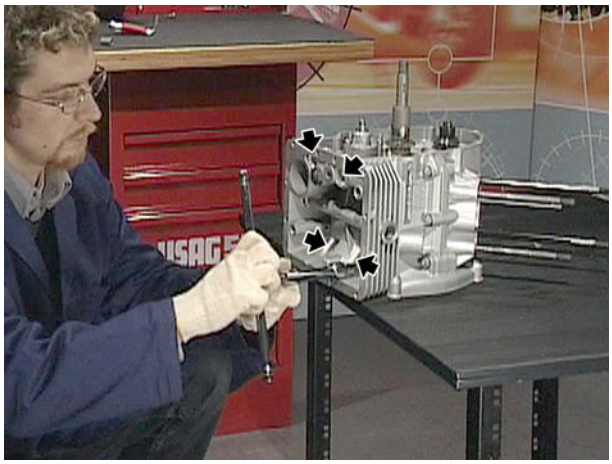
4.9.3. COMPRESSION RING AND SCRAPER RING REASSEMBLY

- Insert compression rings according to notches and ring assembly direction; rings must be staggered at angles of about 120 degrees between each other.

4.10. ENGINE BLOCK

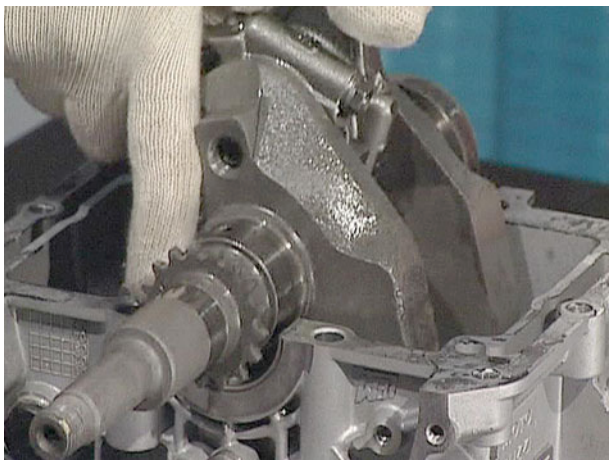
4.10.1. ENGINE BLOCK DISASSEMBLY

- Remove the four column nuts from inside the block and the six nuts outside.

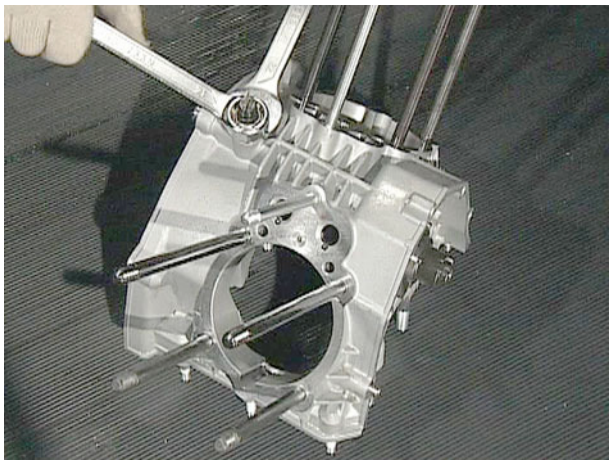


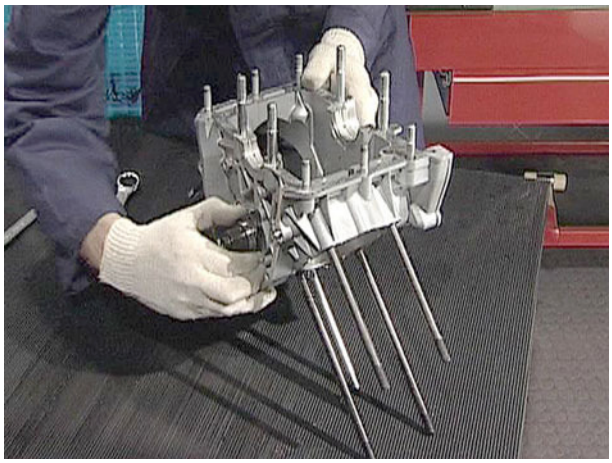
- Insert a bar in engine union tie rod seat to chassis, then use a plastic mallet to lightly hit the rod to get the two halfblocks to separate.

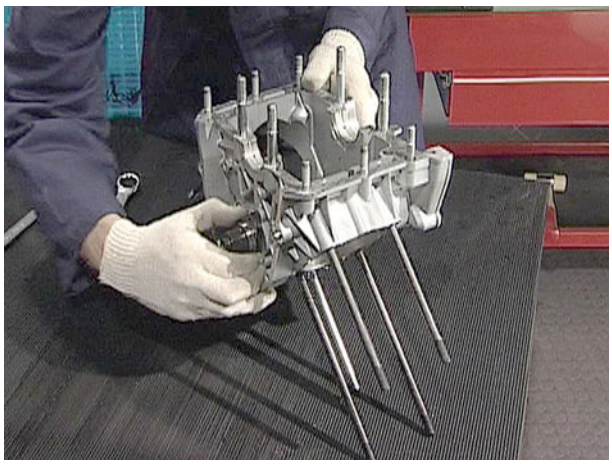
- Remove top block taking care not to damage contact surface.
- Remove driving shaft complete with connecting rods and halfbearings.

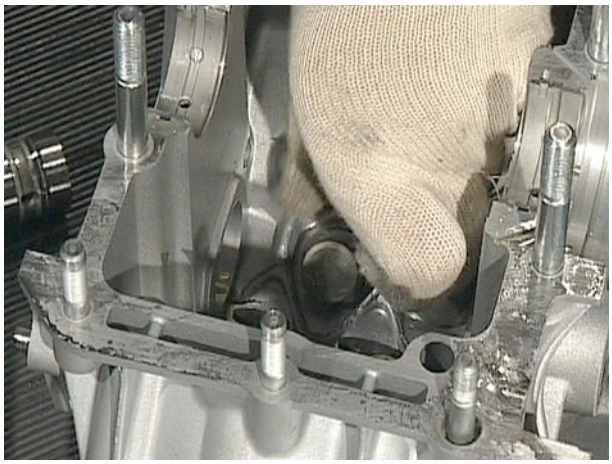


- Unscrew oil pressure sensor from top block and remove timing shaft check bushing and then slip out the shaft and tappets and classify them.



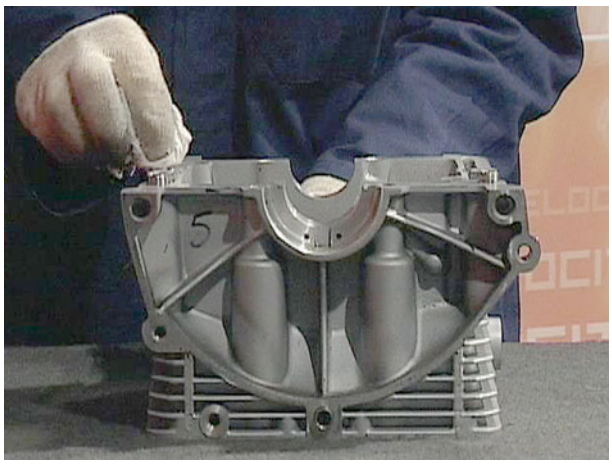




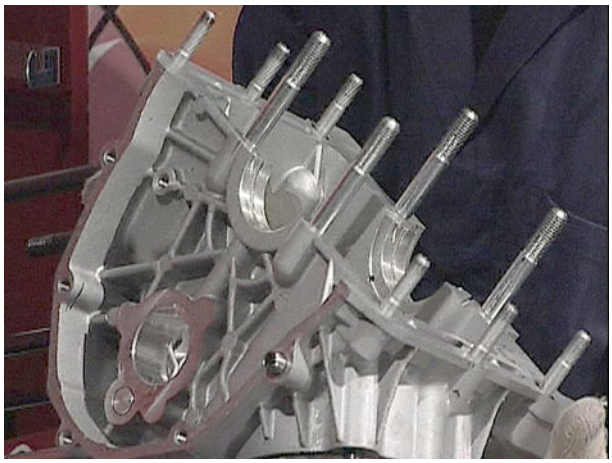


4.10.2. CHECK

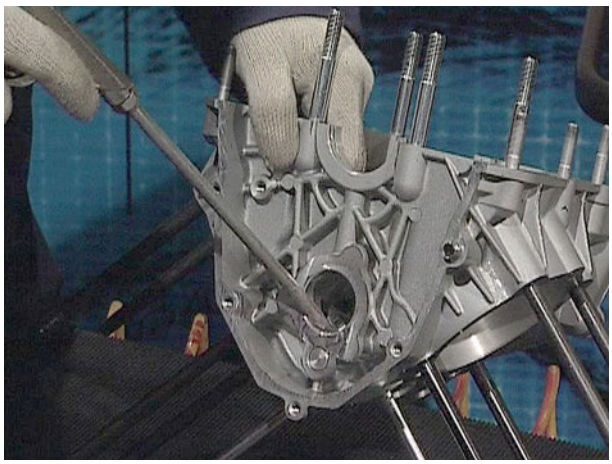
- Check that junction surfaces are whole, not either dented or scratched. Remove liquid sealant with tri-chloroethylene.



- Check that stud bolt threading is not dented or stripped. If so, replace stud bolts.

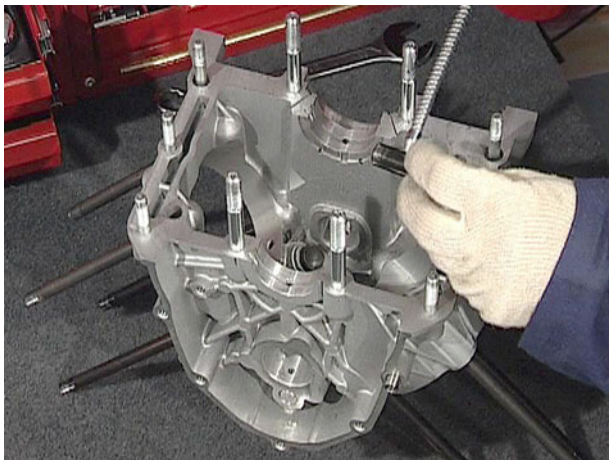


- Clean all lubricant channels of the two blocks with compressed air.

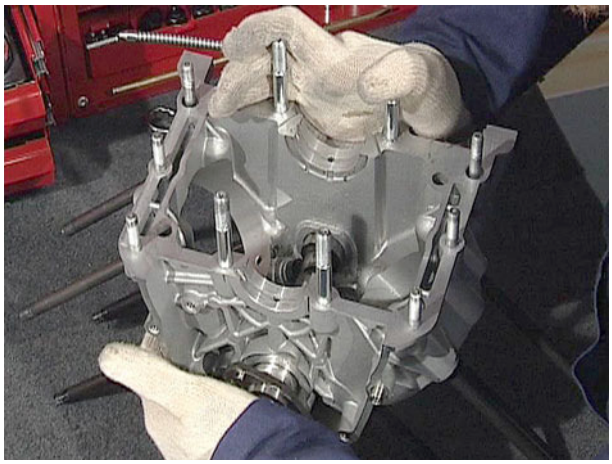


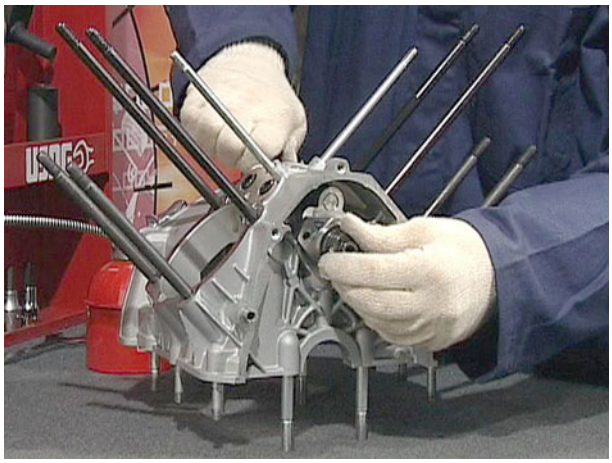
4.10.3. ENGINE BLOCK REASSEMBLY

- Lubricate and reinsert tappets.

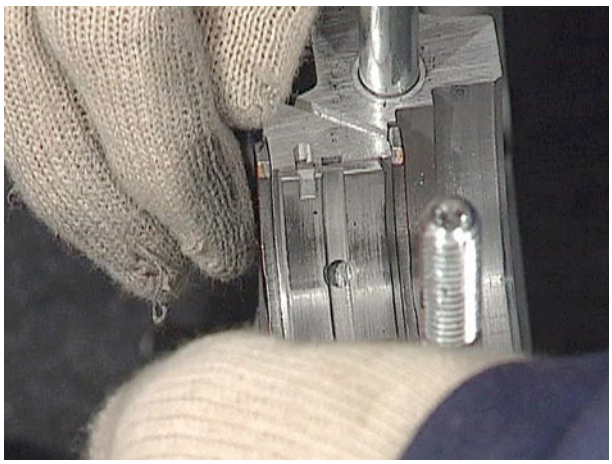


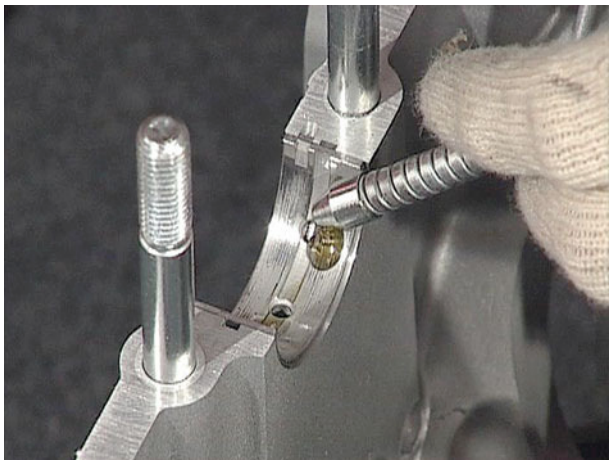
- Reposition timing shaft in top block seat and lubricate and lock timing shaft-stopper union into place.



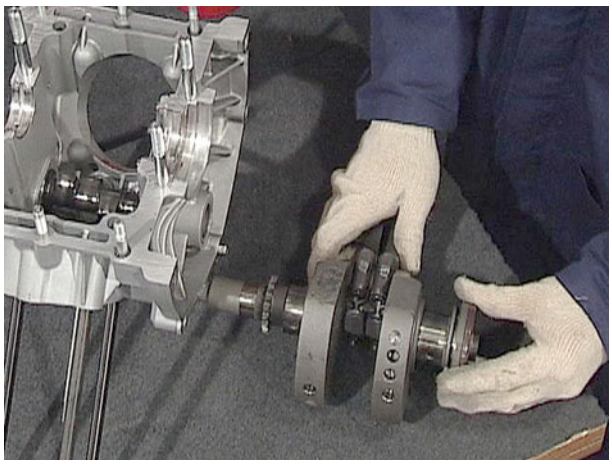


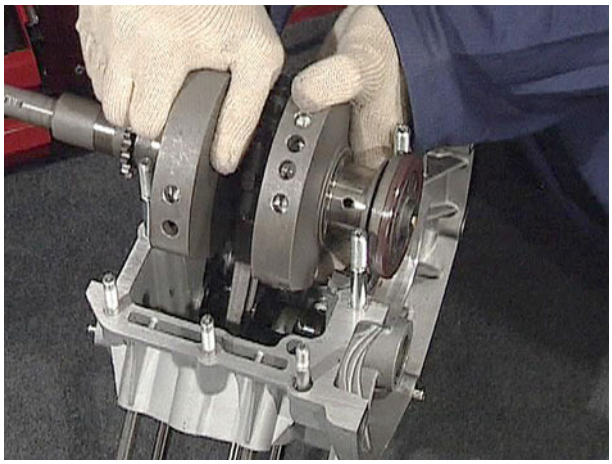
- Insert halfbearing on timing and flywheel sides with shoulders on top block and lubricate parts assembled.





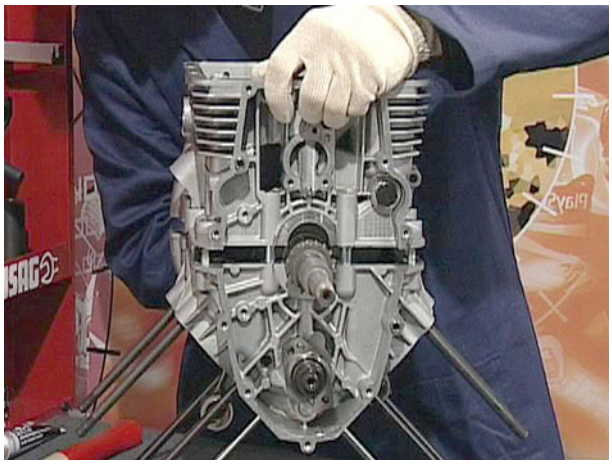
- Insert lubricated blocking ring on driving shaft and re-position the assembly on engine block making sure con rods are correctly inserted in their seats.

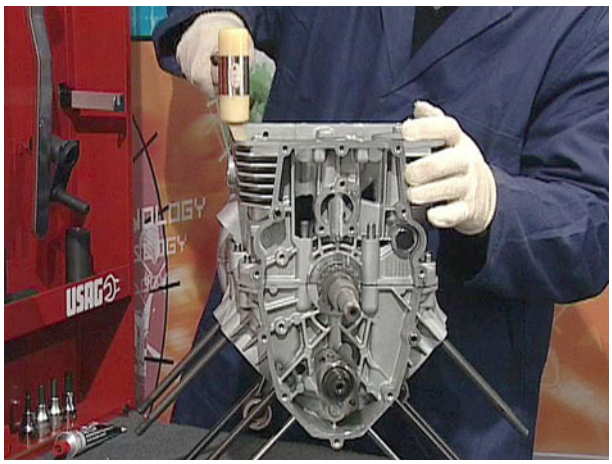


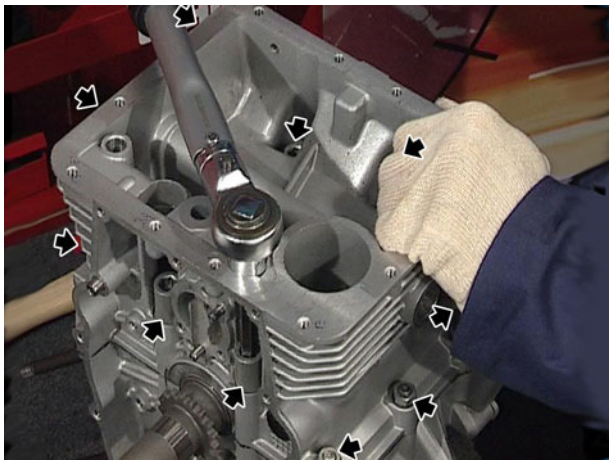


- Put lubricated halfbearings back in their housings in bottom block, cover block junction surfaces with prescribed fluid sealant.

- Couple the two blocks making sure the two surfaces adhere perfectly by lightly hitting them with a mallet and crosswise tighten the four centre stud bolts and external nuts to the prescribed torque.







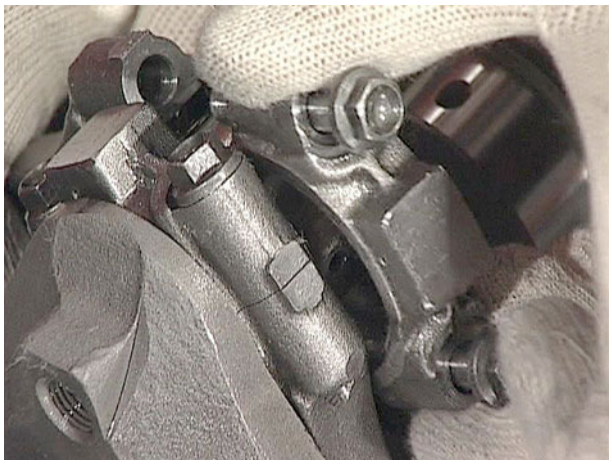
4.10.4. TIGHTENING TORQUES

CRANKCASE AND COVERS	
Cylinder heads-barrels to crankcase fixing nut (M10)	40÷42 Nm
Cylinder heads-barrels to crankcase fixing nut (M8)	28÷30 Nm
Crankcases joining nuts (M8)	22÷25 Nm
Crankcases joining nuts (M10)	40÷42 Nm
Timing cover fixing screws	10 Nm
Sump fixing screws	10 Nm
Valves cover insert fixing screw	5 Nm

4.11. CON RODS

4.11.1. CON RODS DISASSEMBLY

- Once the driving shaft, complete with con rods, has been removed from the top block, remove screws and separate con rod from small end making sure reference marks and assembly direction are followed.

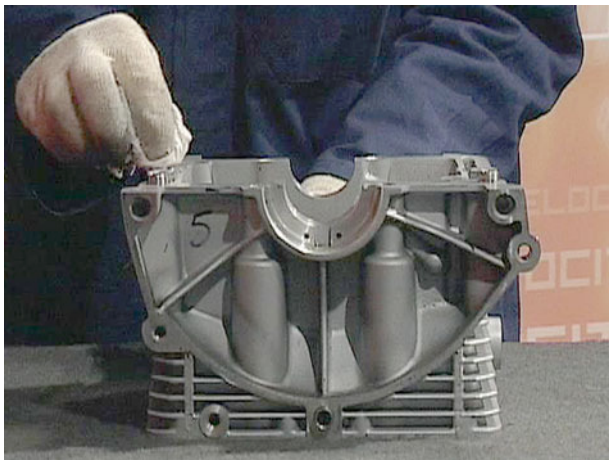


- Remove halfbearings from con rods and small ends.

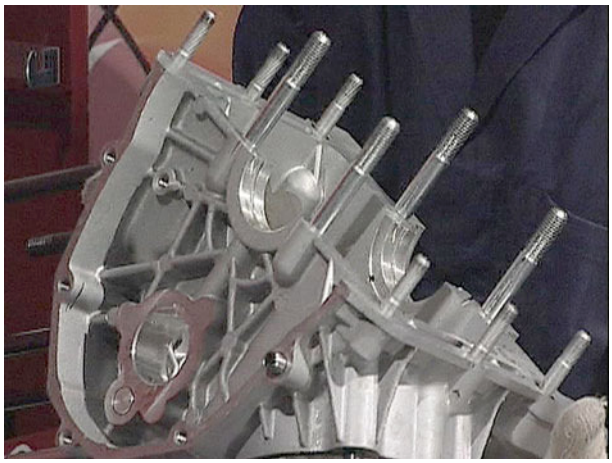
NOTE *repeat for other con rod.*

4.11.2. CHECK

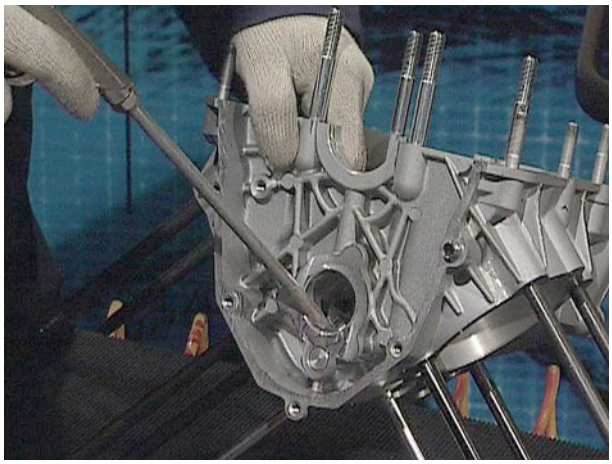
- Check that junction surfaces are whole, not either dented or scratched. Remove liquid sealant with tri-chloroethylene.



- Check that stud bolt threading is not dented or stripped. If so, replace stud bolts.

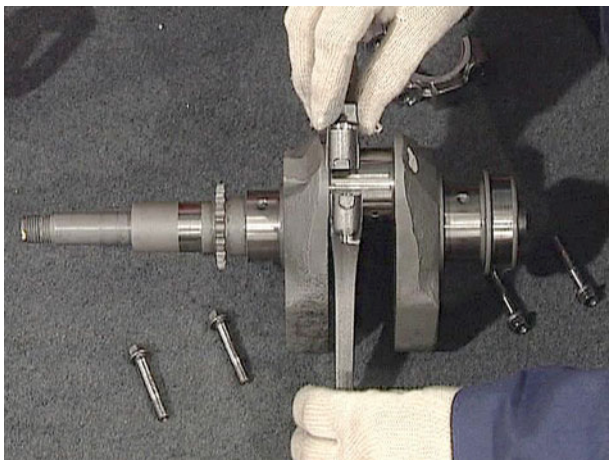


- Clean all lubricant channels of the two blocks with compressed air.



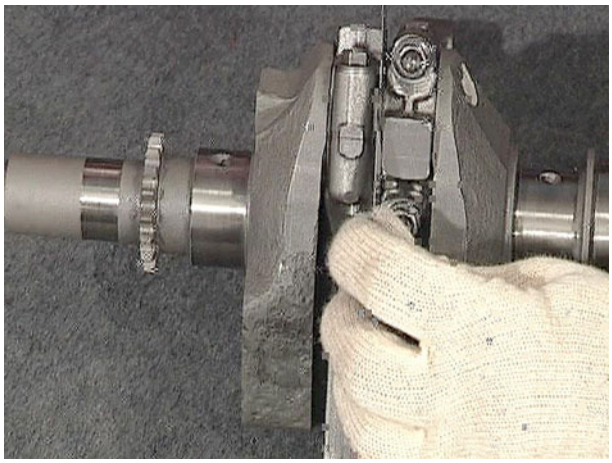
4.11.3. CON ROD REASSEMBLY

- Before assembling check reference marks and assembly direction.
- Reassemble con rods in driving shaft seat on con rod pin by tightening the screws to the prescribed torque.



CON ROD SHIM CHECK
Make sure that assembly clearance of con rods and driving shaft shoulders complies with prescribed values:

mm 0,265÷0,515;



4.11.4. TIGHTENING TORQUES

CRANKCASE AND COVERS	
Cylinder heads-barrels to crankcase fixing nut (M10)	40÷42 Nm
Cylinder heads-barrels to crankcase fixing nut (M8)	28÷30 Nm
Crankcases joining nuts (M8)	22÷25 Nm
Crankcases joining nuts (M10)	40÷42 Nm
Timing cover fixing screws	10 Nm
Sump fixing screws	10 Nm
Valves cover insert fixing screw	5 Nm

4.12. DRIVING SHAFT

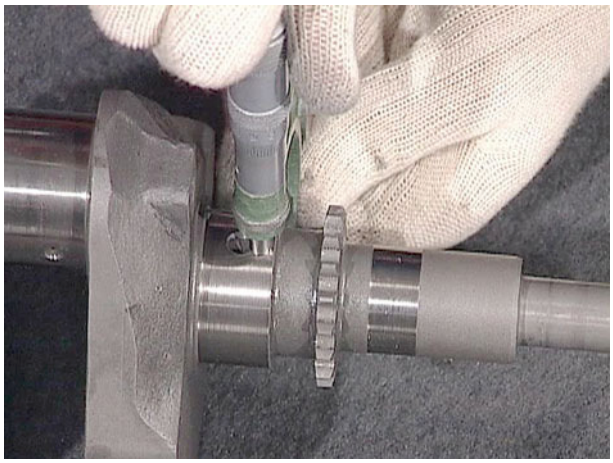
4.12.1. DRIVING SHAFT DISASSEMBLY

- Disassemble driving shaft con rods.
- Unscrew oil plug and thoroughly clean oil ducts and passages to con rods and main journals.

4.12.2. DRIVING SHAFT CHECK

- Apply thread locking paste to plug thread and screw it firmly back into place.
- Clean lubricant passages with compressed air.

NOTE *Driving shaft is nitrided therefore cannot be ground; if wear, ovalization or deep scratching has occurred driving shaft must be replaced.*



Diameter of timing side crankshaft journal

Normal (production) mm
40.023÷43.007

Diameter of flywheel side main bearing seat

Normal (production) mm
47.130÷47.142

Total thickness for flywheel side main bearing

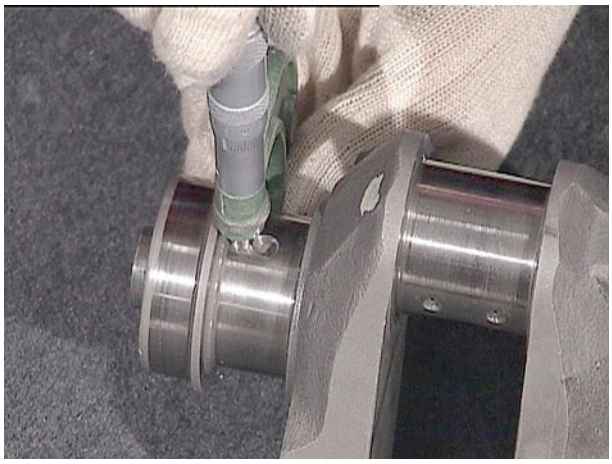
Normal (production) mm
2.044÷2.050

Clearance between crankshaft and flywheel side main bearing

Normal (production) mm
0.007÷0.047

Diameter of flywheel side crankshaft journal

Normal (production) mm
39.995÷40.011



Thickness of thrust half washer on flywheel side main bearing

Normal (production) mm
2.310÷2.360

Main bearing journal to shell clearance

Normal (production) mm
0.35÷0.40

maximum parallelism error of the two crankshaft axes (crankpin and flywheel / timing side main journals) must be no greater than 0.02 mm at a distance of 40 mm.

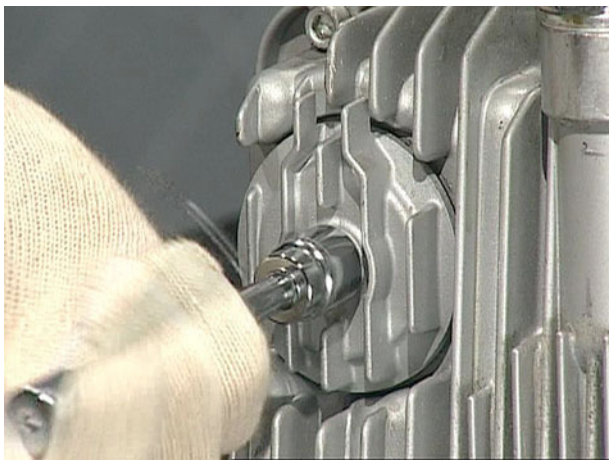
4.12.3. TIGHTENING TORQUES

CONNECTING ROD GROUP	
Rods fixing screws	30÷32 Nm
Flywheel to crankshaft fixing screws	40 Nm
Ring gear fixing screws	10 Nm

4.13. OIL SUMP

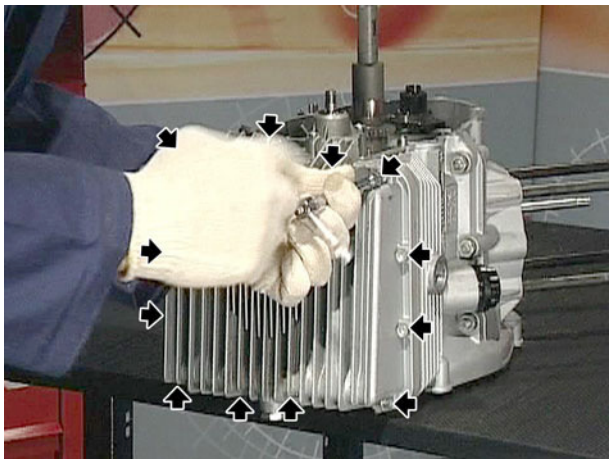
4.13.1. OIL SUMP DISASSEMBLY

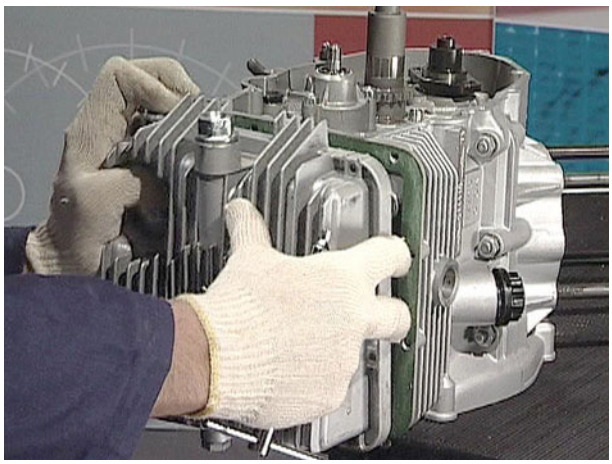
- Remove oil filter securing screw to sump.

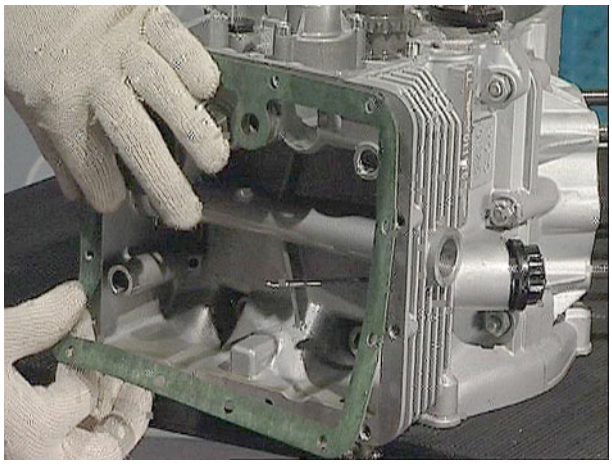


- Remove cartridge filter.

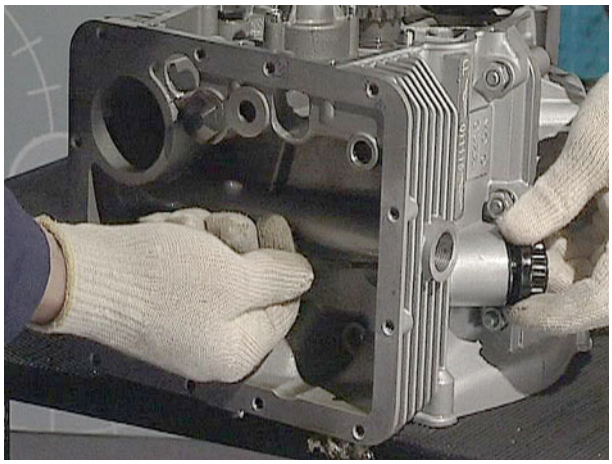
- Remove screws securing oil sump to engine block and take sump out and slide gasket off.



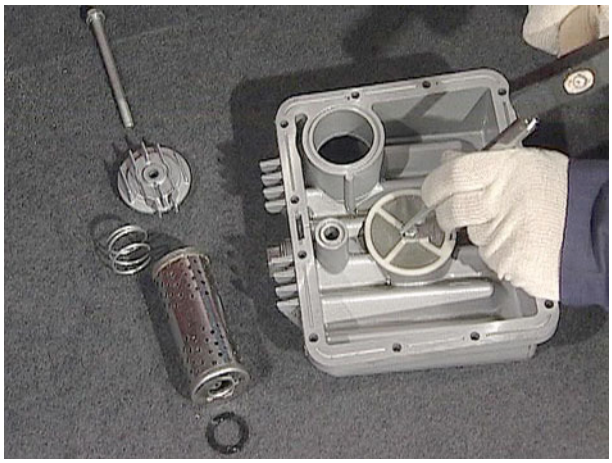


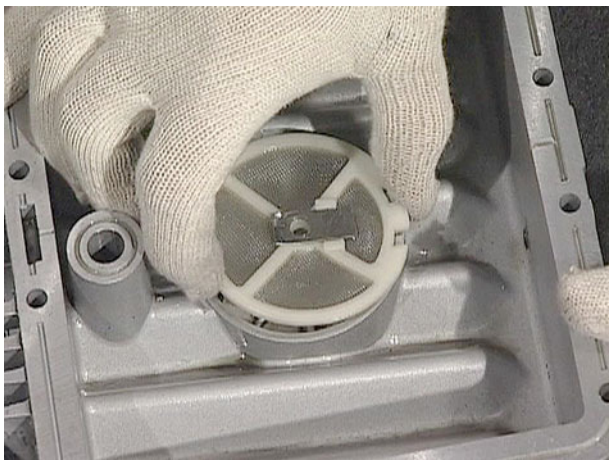


- Remove oil level indicator.



- Flatten safety plate, remove mesh filter blocking screw and filter from oil sump.



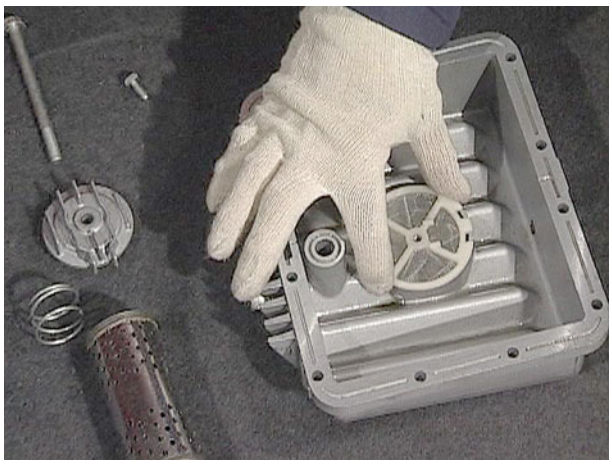


4.13.2. OIL SUMP CHECK

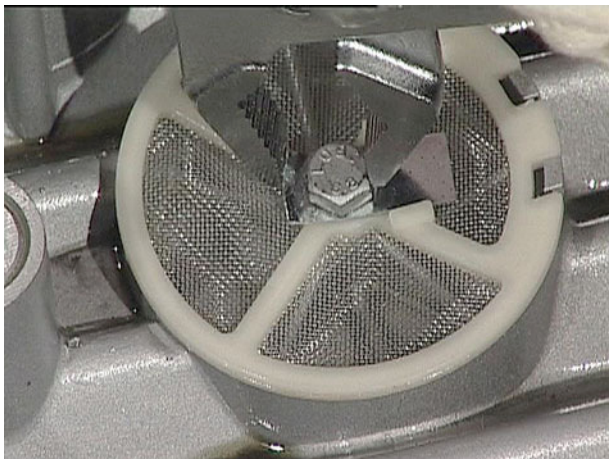
- Check mesh filter for dirt. If so, wash and clean with compressed air.

4.13.3. REASSEMBLY

- Insert filter, safety plate and tighten securing screw.

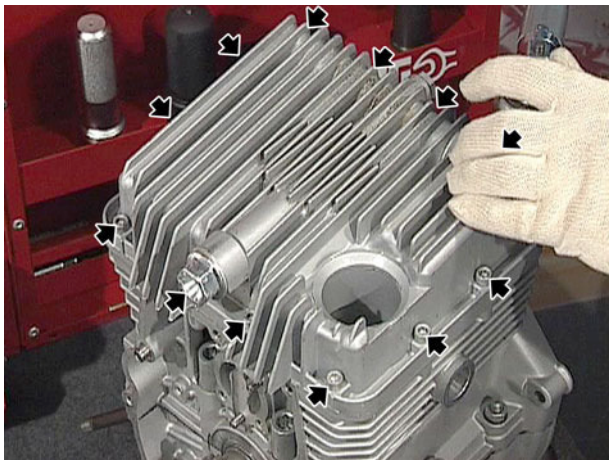


- Bend safety plate.



- Position gasket between oil sump and block (Always replace gasket). Take care to position gasket correctly since incorrect assembly causes anomalous oil circulation.

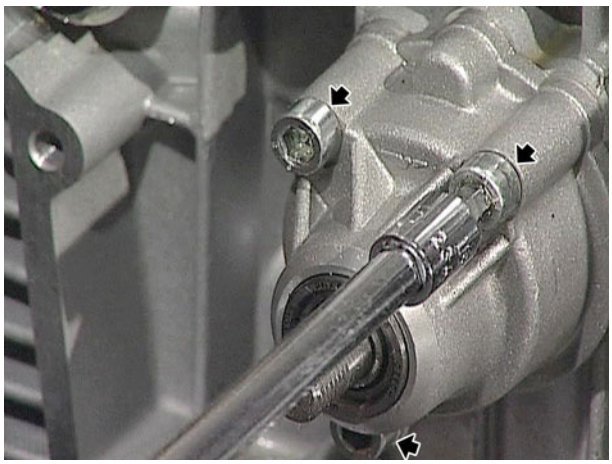
- Crosswise tighten sump screws and lock them with dynamometric spanner to prescribed torque.



- Insert filter cartridge and tighten screw to prescribed torque.

4.13.4. OIL PUMP DISASSEMBLY

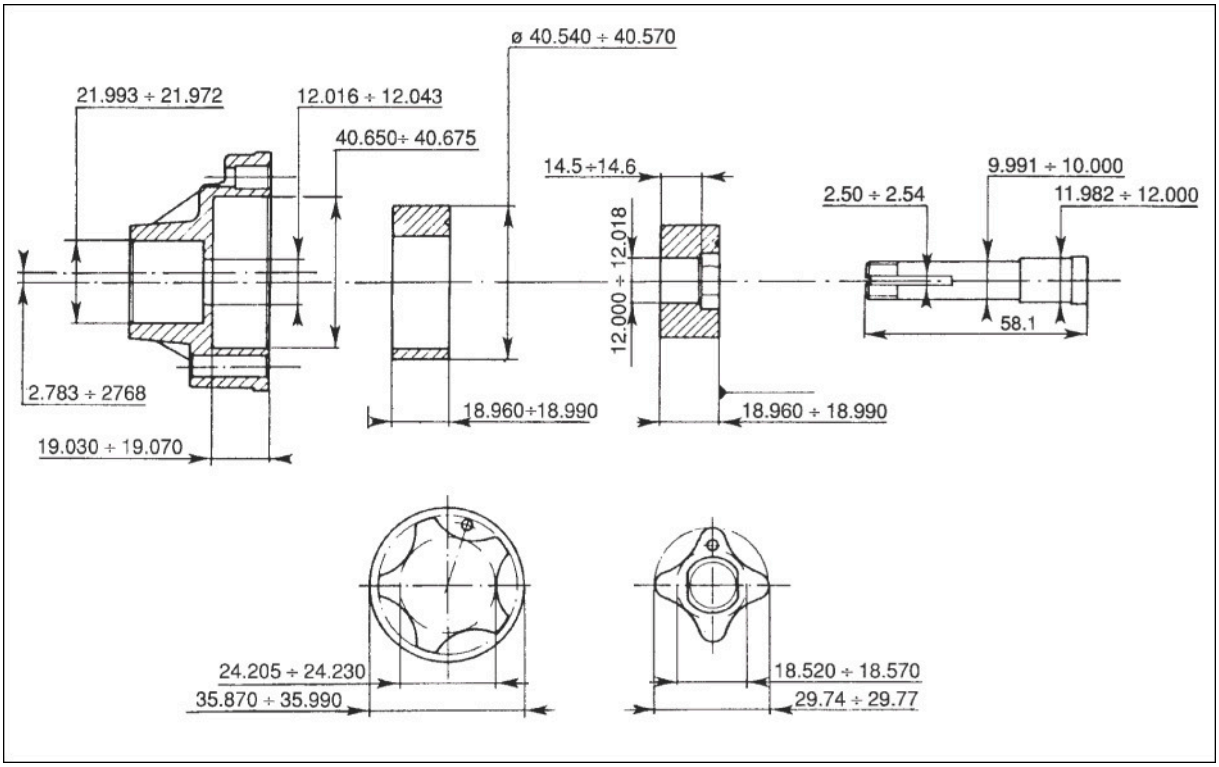
- After disassembling timing, unscrew Allen screws and remove oil pump from engine block. Disassemble pump as follows:



- Remove locking spline.
- Take pump drive shaft out with inside rotor attached.
- Remove external rotor.

- Slip bearings and their internal housing out of pump body.

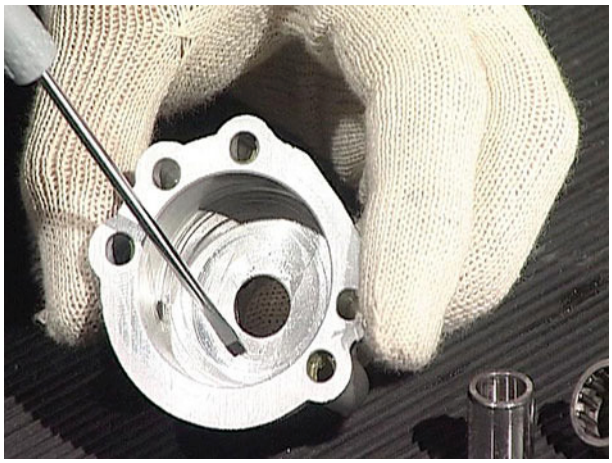
4.13.5. OIL PUMP INSPECTION



OIL PUMP BODY

Check that the faces and internal seats of the pump body are not scored, damaged or dented.
Oil pump data:

- ø of seat for external rotor
  40.650÷40.675 mm;
- ø of bore for pump drive shaft
  12.016÷12.043 mm;
- ø of seat for roller bearings
  21.972÷21.993 mm;
- thickness of seat for external rotor
  15.030÷15.070 mm;



EXTERNAL ROTOR

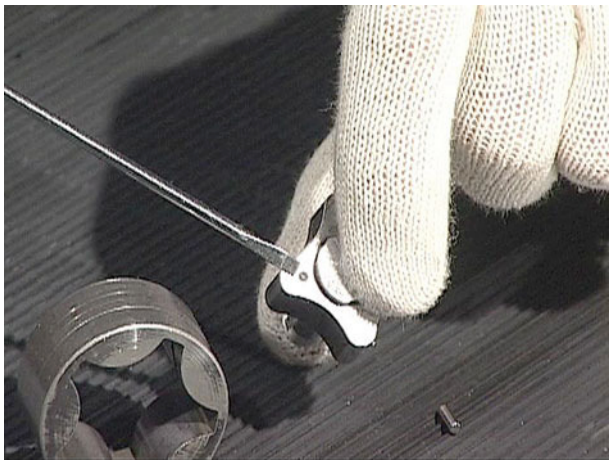
Check that the internal and external surfaces and the faces are not scored or damaged, otherwise renew both rotors.
External rotor data:

- external ø 40.540÷40.570 mm;
- internal ø 24.205÷24.230 mm;
- thickness 14.960÷14.990 mm.

INTERNAL ROTOR

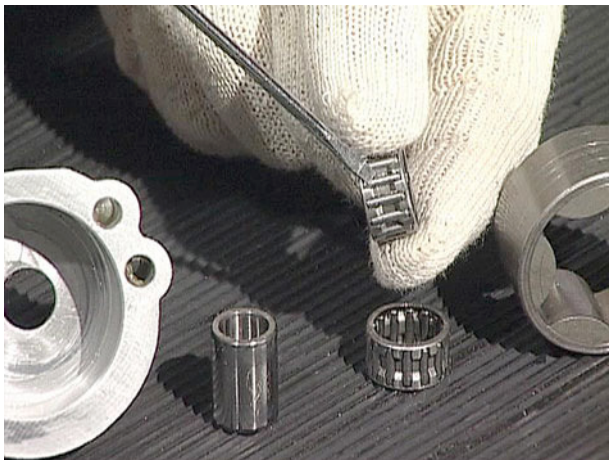
Check that the internal and external surfaces and the faces are not scored or damaged, otherwise renew both rotors. Internal rotor data:

- external ø
  29.745÷29.770 mm;
- ø of bore for pump drive shaft
  12.000÷12.018 mm;
- thickness
  14.960÷14.990 mm.



ROLLER BEARINGS

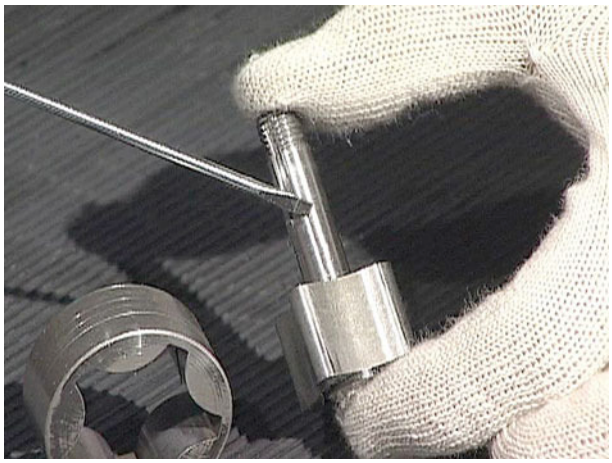
Check that the bearing rollers are not damaged, otherwise renew the bearings.



OIL PUMP DRIVE SHAFT

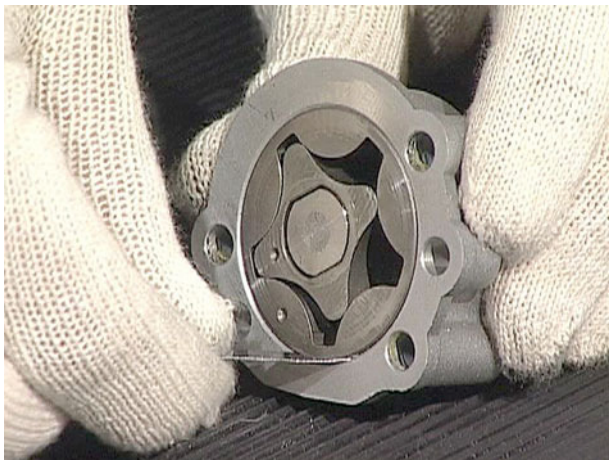
Check that the drive shaft is not damaged and that the threads are in good condition, that the keyway is not burred and that the end that operates in the internal rotor is not damaged, otherwise renew the shaft.
Shaft data:

- ø for pump body bore
  11.982÷12.000 mm;
- ø for roller bearings
  9.991÷10.000 mm.



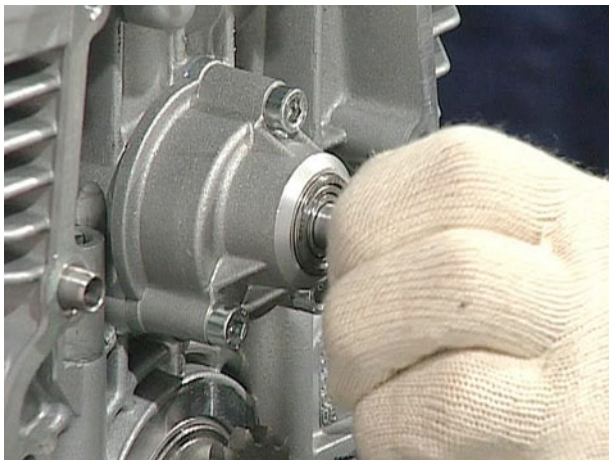
ASSEMBLY CLEARANCES

- between pump body and external rotor
  0.080÷0.135 mm;
- between bore on internal rotor and pump drive shaft
  0.016÷0.061 mm;
- between bore on pump body and pump drive shaft
  0.016÷0.061 mm.



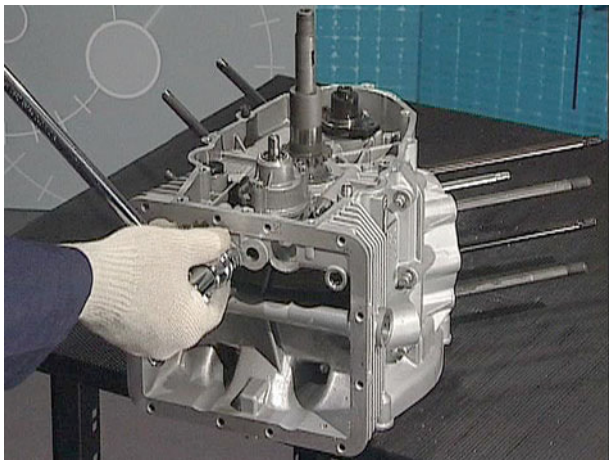
4.13.6. OIL PUMP REASSEMBLY

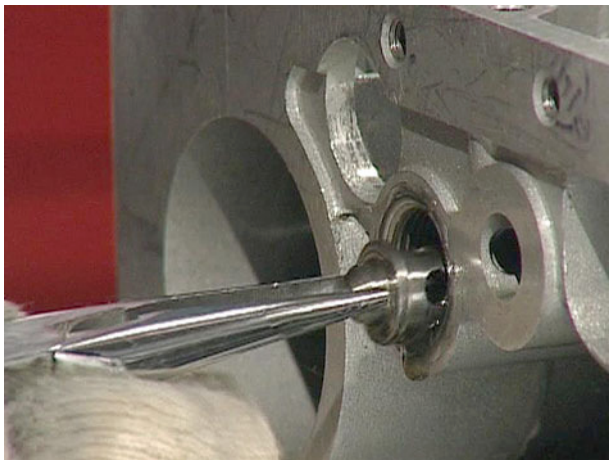
- Assemble oil pump and reposition on block according to the two centering dowels.
- Lock Allen screws to the prescribed torque and make sure the draw shaft revolves freely.



4.13.7. OIL PRESSURE ADJUSTMENT VALVE DISASSEMBLY

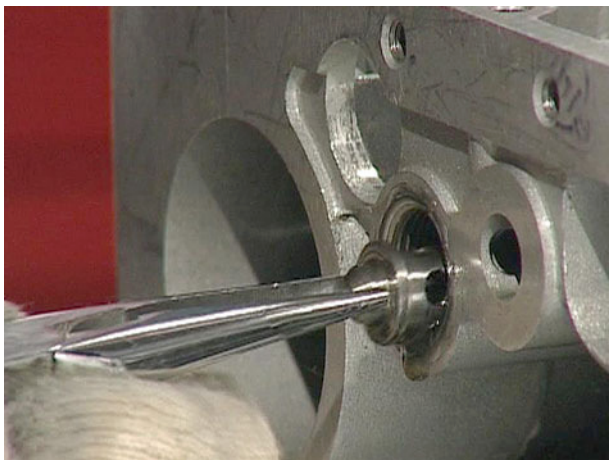
- Use appropriate spanner to unscrew adjustment valve fitted to threaded hole of block.

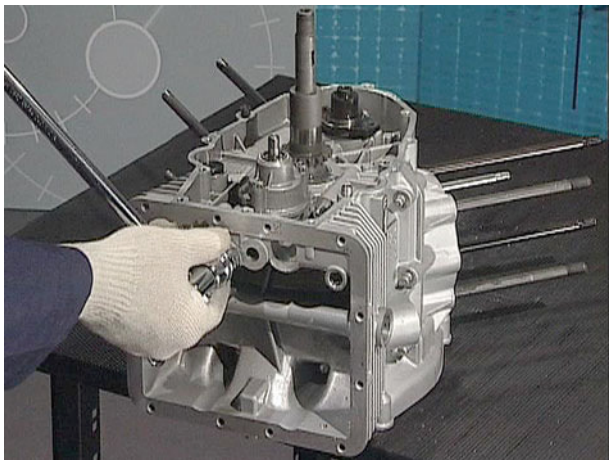




4.13.8. OIL PRESSURE ADJUSTMENT VALVE ASSEMBLY

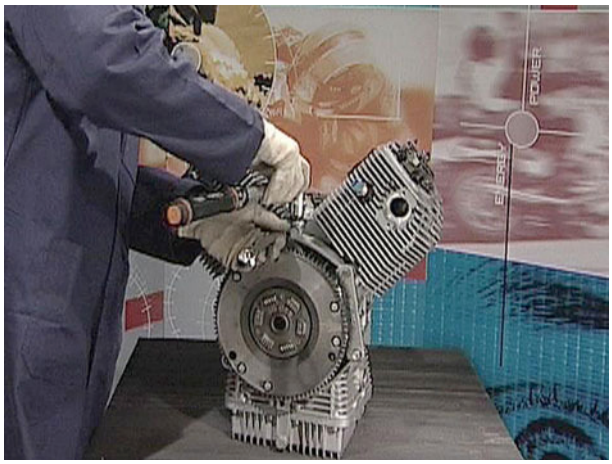
- Insert valve and spring and use dynamometric spanner to tighten the screw covered with thread locking paste to prescribed torque.





4.13.9. OIL TRANSMITTER REASSEMBLY

- Insert oil sensor transmitter telltale on bushing and tighten to torque.



4.13.10. TIGHTENING TORQUES

CRANKCASE AND COVERS	
Cylinder heads-barrels to crankcase fixing nut (M10)	40÷42 Nm
Cylinder heads-barrels to crankcase fixing nut (M8)	28÷30 Nm
Crankcases joining nuts (M8)	22÷25 Nm
Crankcases joining nuts (M10)	40÷42 Nm
Timing cover fixing screws	10 Nm
Sump fixing screws	10 Nm
Valves cover insert fixing screw	5 Nm

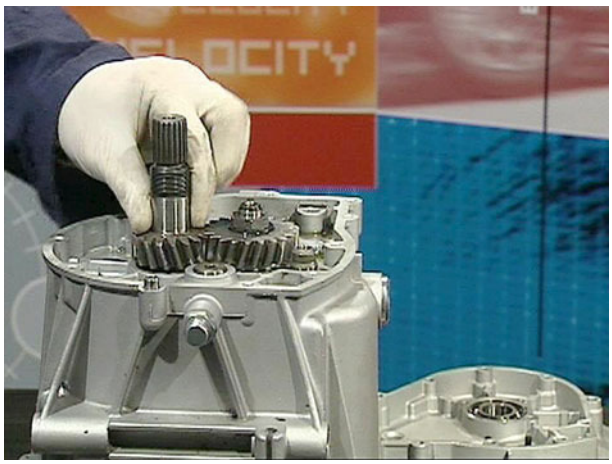
LUBRICATION	
Oil pressure sensor	8÷10 Nm
Oil pump to crankcase fixing screws	10 Nm
Filter cartridge sealing cover fixing screws	25 Nm

SUMMARY

5.1. GEARBOX HOUSING

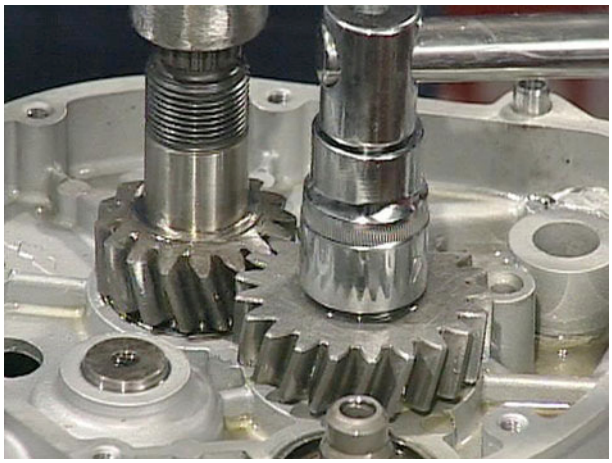
5.1.1. DISASSEMBLY

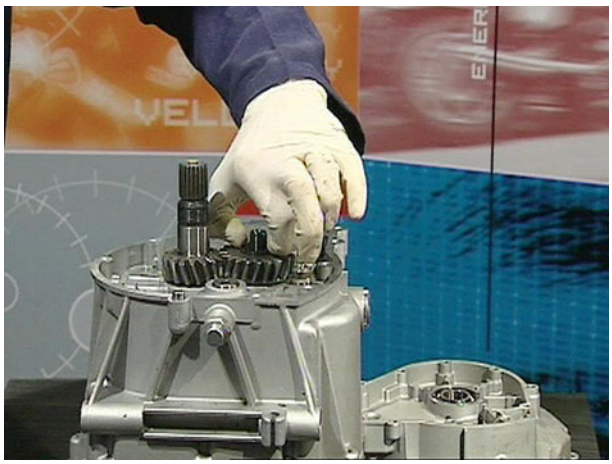
- Mount clutch shaft on housing so that the gear engages the main shaft gear.



- Insert the prescribed holding tool in the clutch shaft grooves

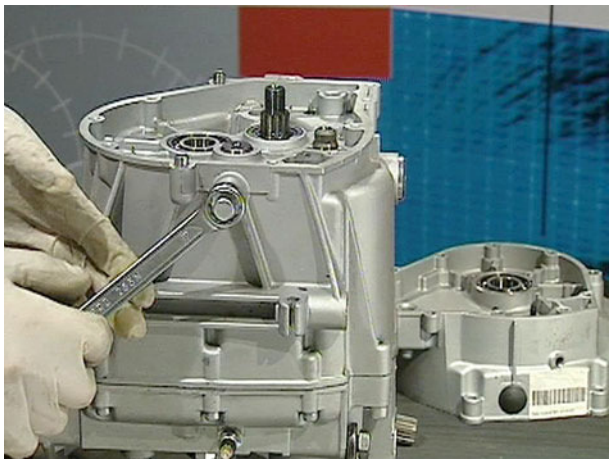
- Remove the intermediate gear blocking nut and take out the washer.



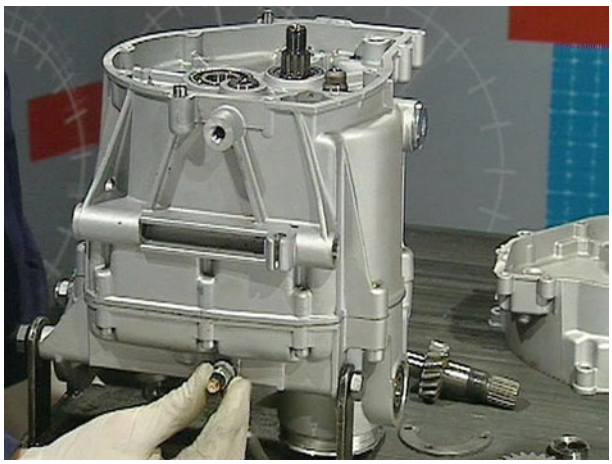


- Remove gear and clutch shaft.

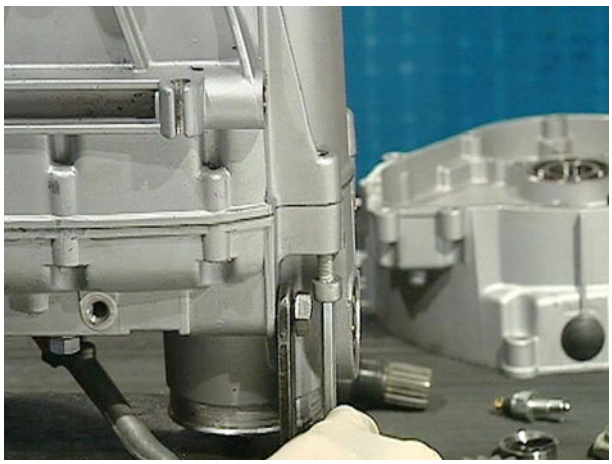
- Unscrew breather plug with its pawl.



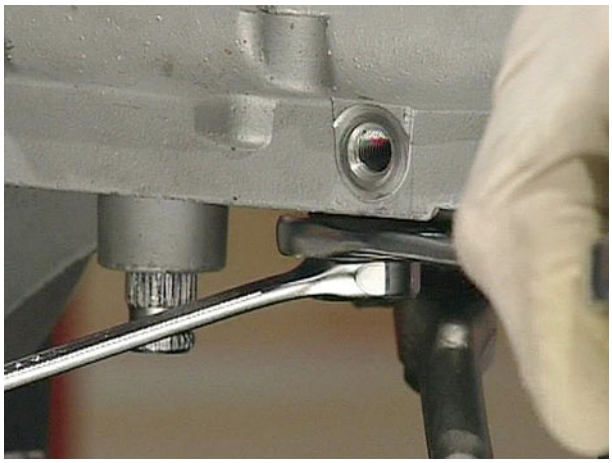
- Unscrew and remove idle gear indicator.

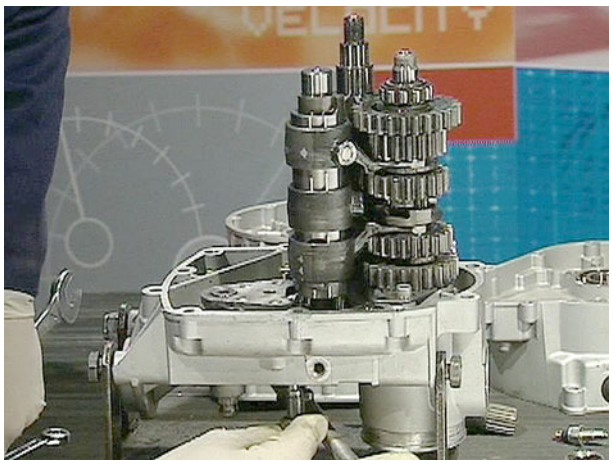


- Unscrew gearbox cover bolts and remove it with the help of a mallet.

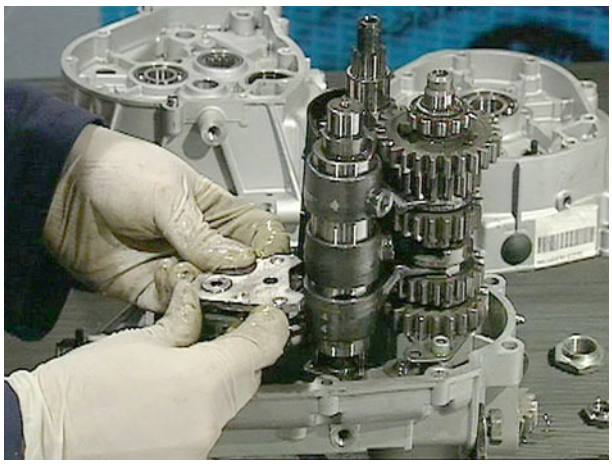


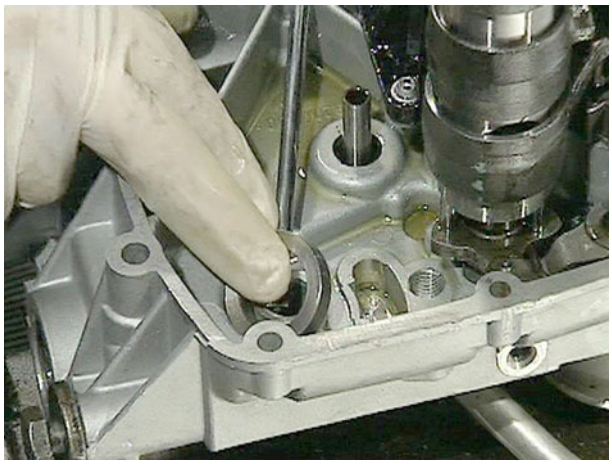
- Loosen counternut and remove the eccentric screw to position preselector.





- Slide preselector out and remove preselector blocking ring.





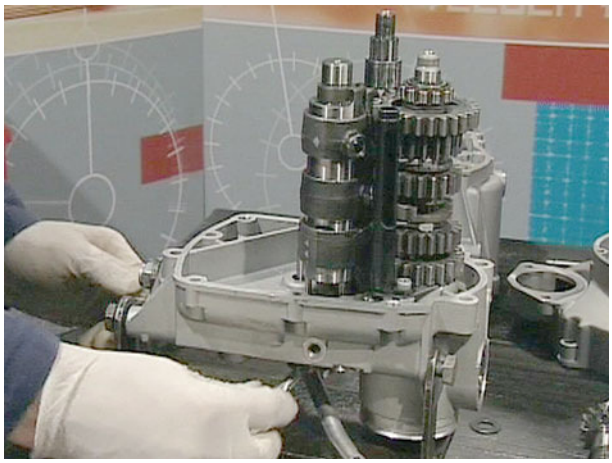
- After loosening securing screws of blocking plates carry on with unit removal complete with gear, shafts and forks.

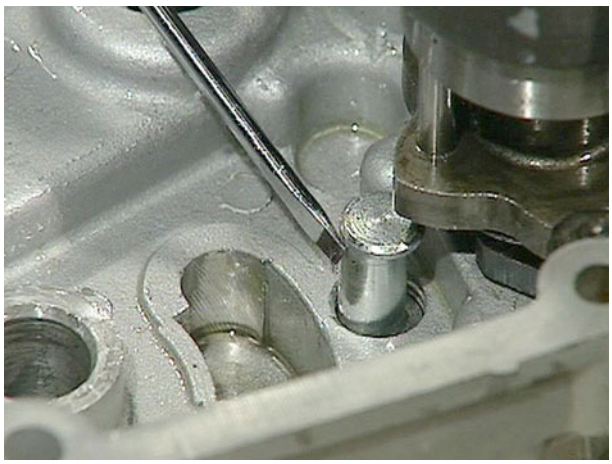
5.1.2. REASSEMBLY

Preselector reassembly

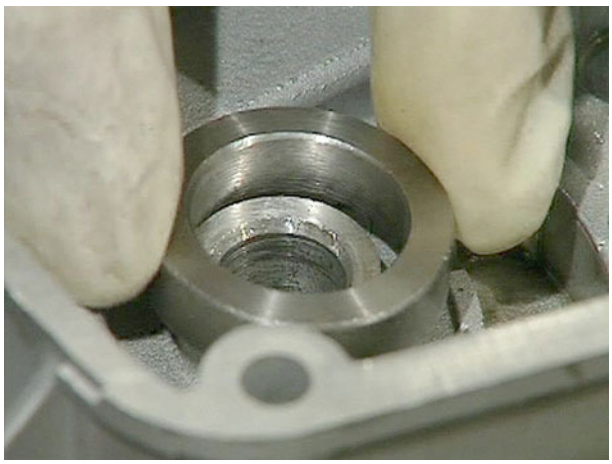
- After remounting the unit complete with shafts on gearbox cover, insert the spring and insert the two tangs on the preselector peg making sure the distance between the two tangs is equal both on the peg and at tangs ends.

- Remount eccentric screw and counternut on cover taking care that the eccentric part of the screw is oriented towards the preselector nut.

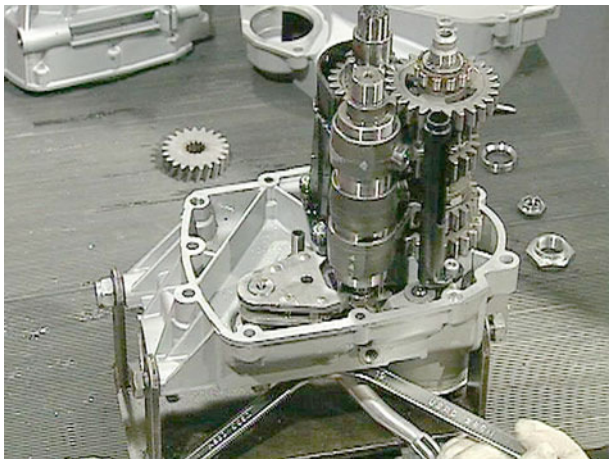




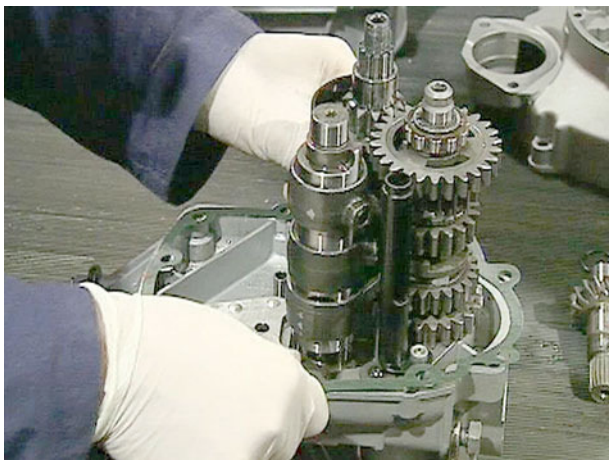
- Reassemble preselector spacer.



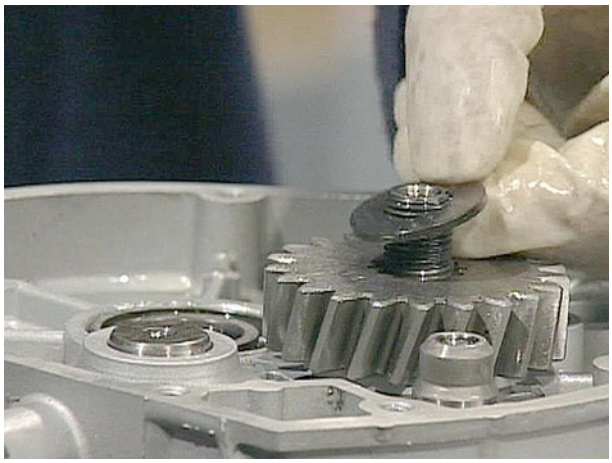
- Place preselector on the cover making sure that the two spring tangs are inserted in the hollow of the adjustment screw, then rotate the screw by 90ø and tighten counternut.

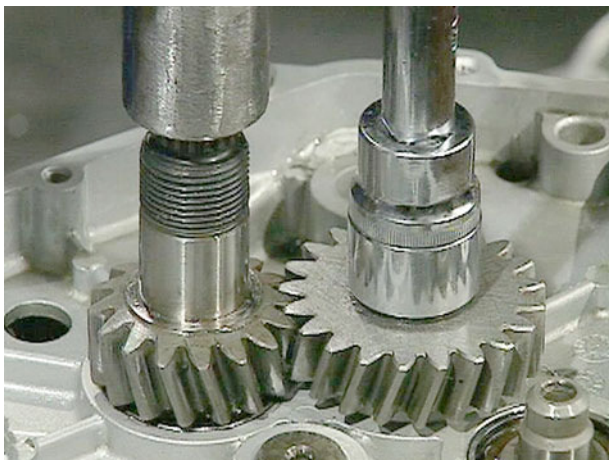


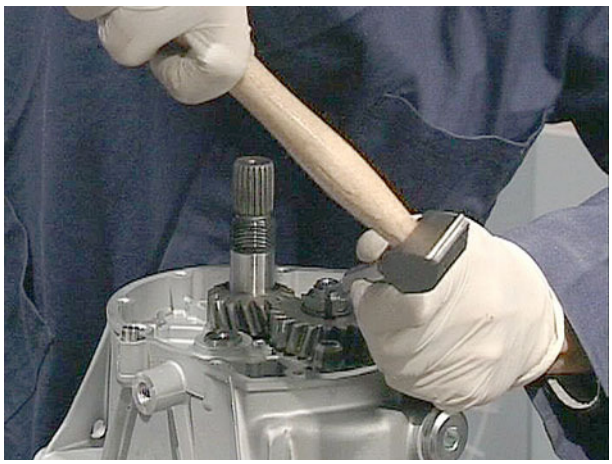
- Remount gasket, tighten securing screws of gearbox housing cover to prescribed torque.



- Insert gear with relative washer on main shaft of gear and tighten securing nut to prescribed torque and stake with punch.







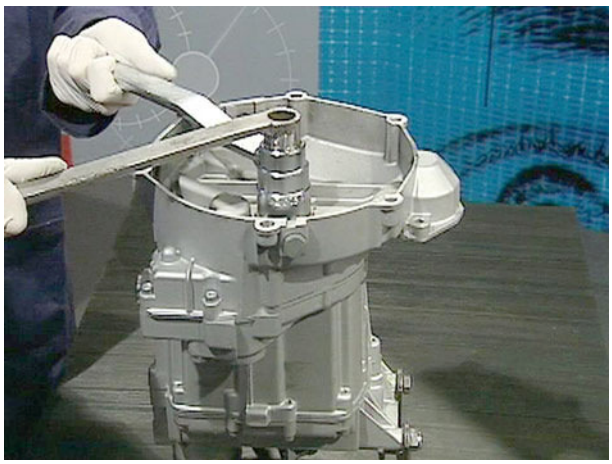
5.1.3. TIGHTENING TORQUES

GEARBOX	
Primary shaft fixing nuts	65 Nm
Cover to gearbox fixing screws	10 Nm
Gearbox to clutch housing cover fixing screws	10 Nm
Index lever fixing screw nut.	6 Nm

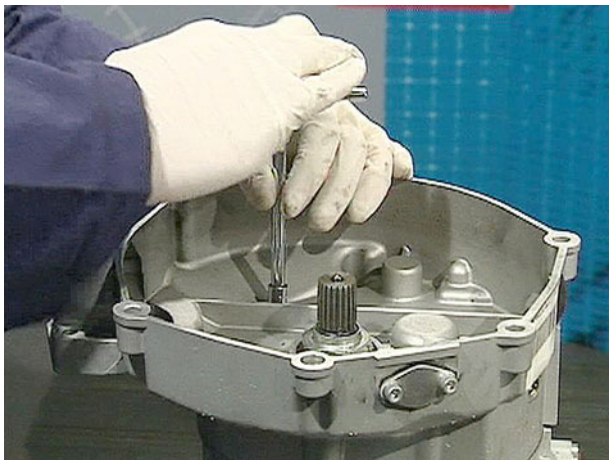
5.2. CLUTCH HOUSING

5.2.1. DISASSEMBLY

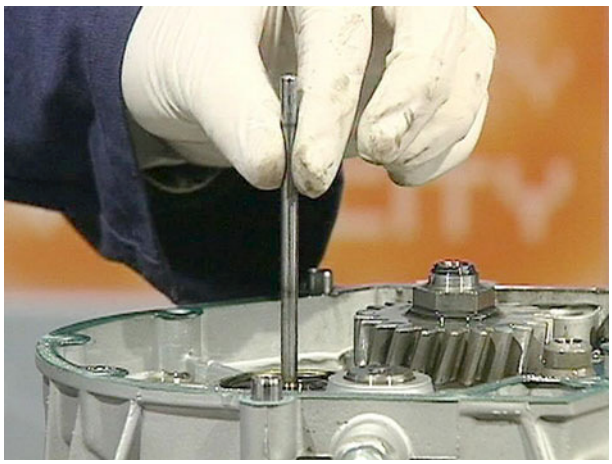
- Once the gearbox/clutch housing has been fixed to the vice-held support, use the nut holding tool to loosen the nut by turning the shaft with the appropriate tool.



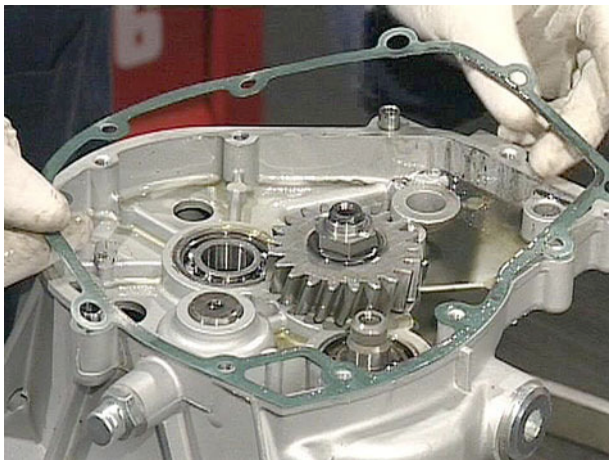
- Remove the Allen screws locking the clutch housing to gearbox.



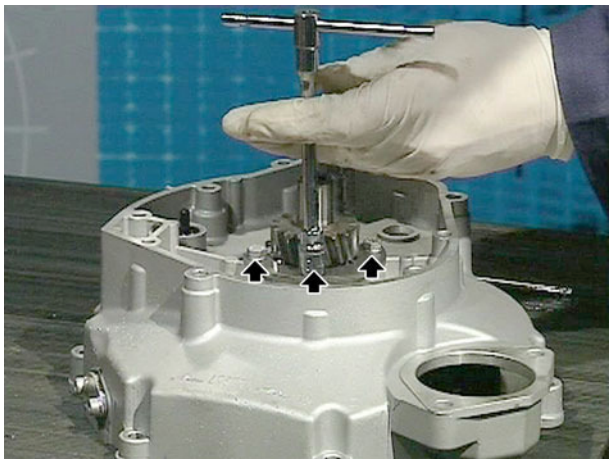
- Disconnect and remove housing, complete with clutch shaft, by lightly hitting housing sides..

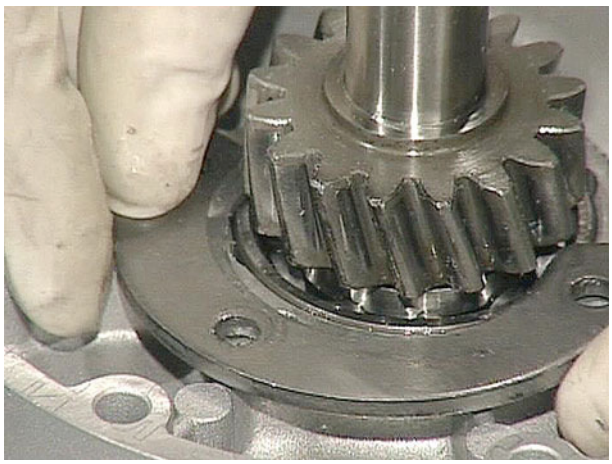


- Remove gasket.

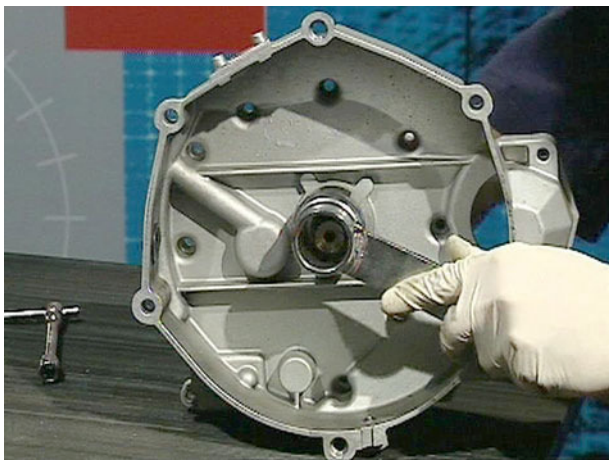


- Remove the three screws with washers and take off bearing blocking plate.

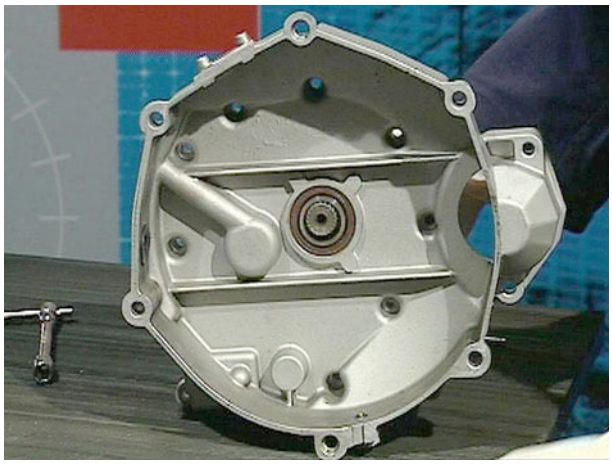




- Unscrew clutch shaft securing nut.

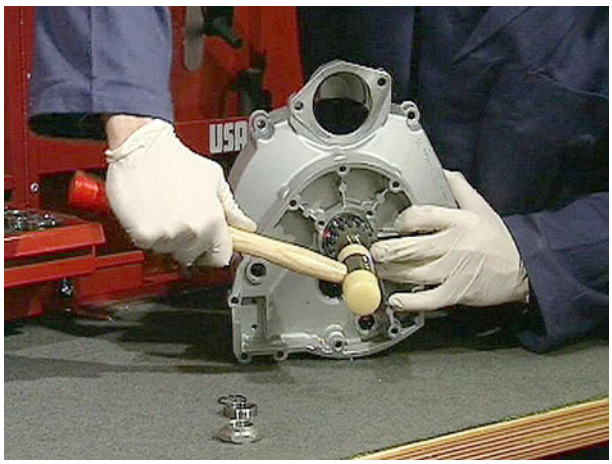


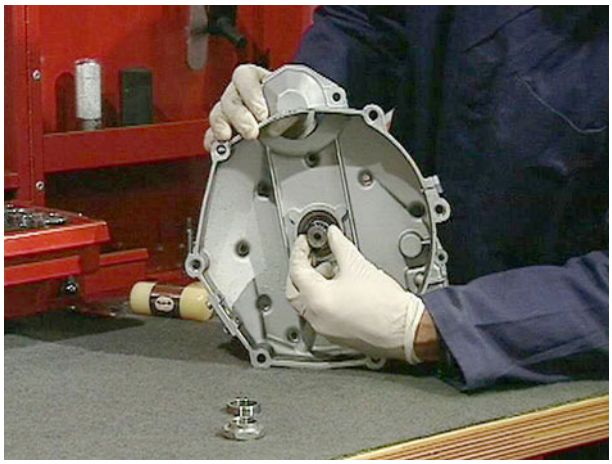
- Take out clutch shaft, remove clutch and blocking ring.



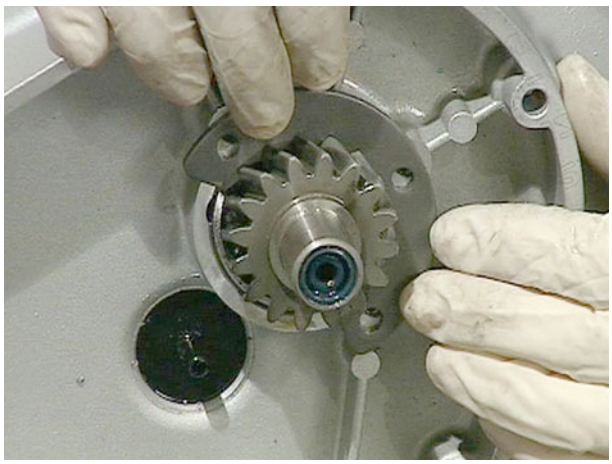
5.2.2. REASSEMBLY

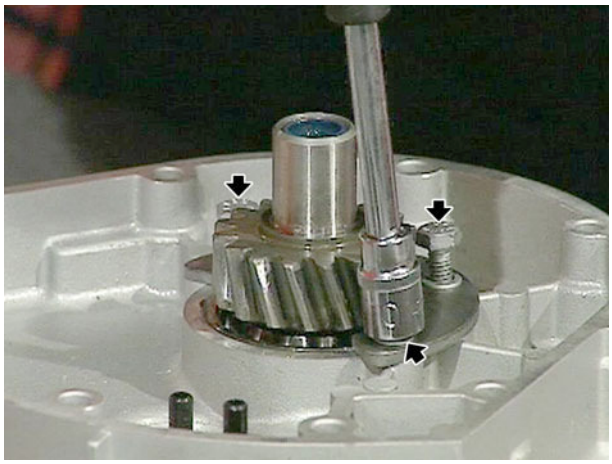
- Insert clutch shaft with the help of a plastic mallet, remount sieger and then blocking ring.



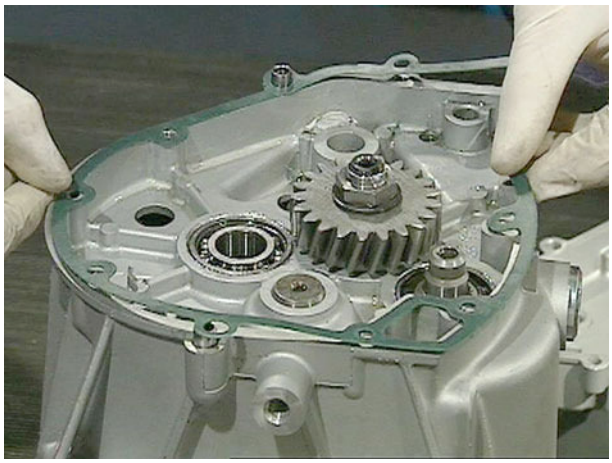


- Position blocking plate and tighten screws with washer after covering them with thread locking paste.

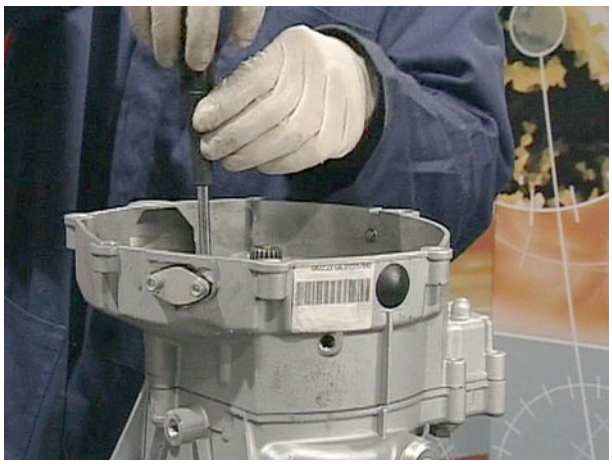




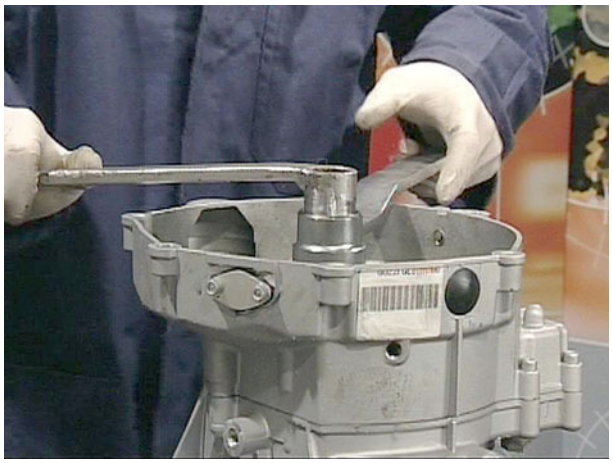
- Position clutch housing gasket and place clutch housing in its seat.



- Tighten Allen screws, external screws and tighten to prescribed torque.

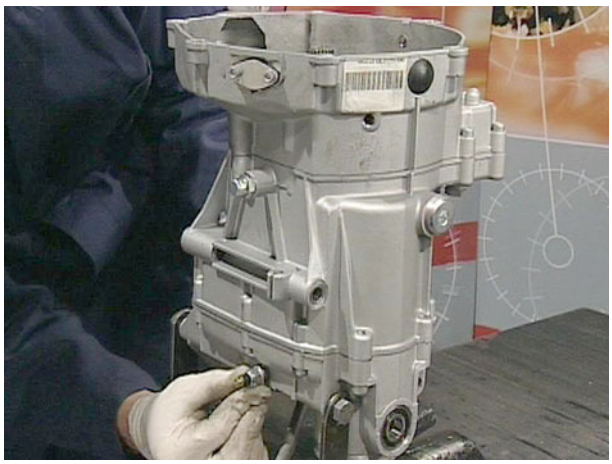


- Tighten clutch shaft nut using the appropriate tool and stake.



- Insert breather plug.

- Screw in gear in idle indicator.



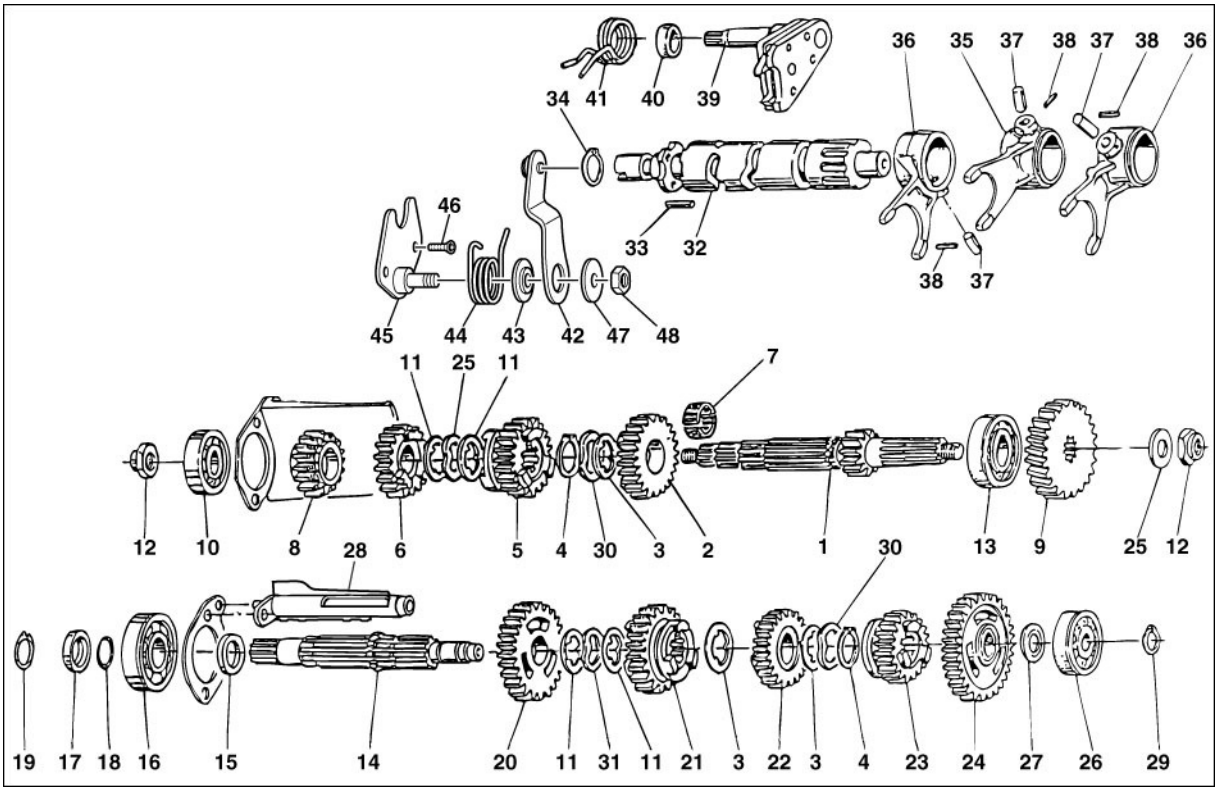
- Insert clutch push rod in shaft with the greater diameter towards the control lever.

5.2.3. TIGHTENING TORQUES

CLUTCH	
Clutch shaft fixing nut	100 Nm

5.3. GEARBOX

5.3.1. GEAR



1. Primary gear shaft
2. Gear
3. Thrust washer
4. Circlip
5. Gear
6. Gear
7. Roller cage
8. Gear
9. Idle gear
10. Bearing
11. Clearance washer
12. Nut
13. Bearing
14. Driven shaft
15. Spacer
16. Bearing
17. Spacer
18. Gasket ring
19. Circlip
20. Gear
21. Gear
22. Gear
23. Gear
24. Gear
25. Clearance washer
26. Bearing
27. Spacer
28. Gutter
29. Circlip
30. Washer
31. Washer
32. Shift cam
33. Pin
34. Snap ring
35. Fork
36. Fork
37. Roller
38. Pin
39. Preselection complete
40. Spacer
41. Spring
42. Lever
43. Washer
44. Spring
45. Plate
46. Screw
47. Washer
48. Nut

SUMMARY

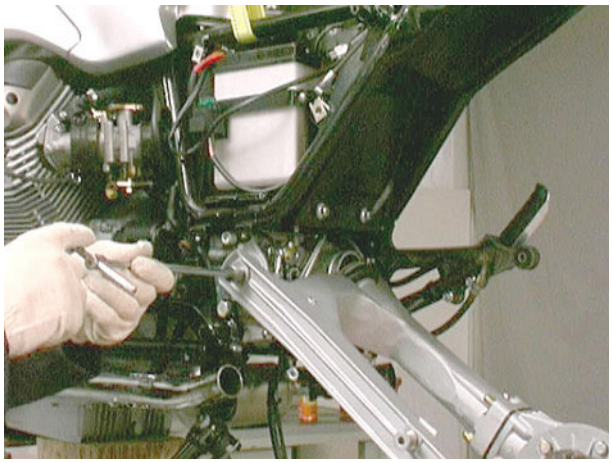
6.1. SWING ARM COMPLETE WITH TRANSMISSION ASSY

6.1.1. REMOVAL

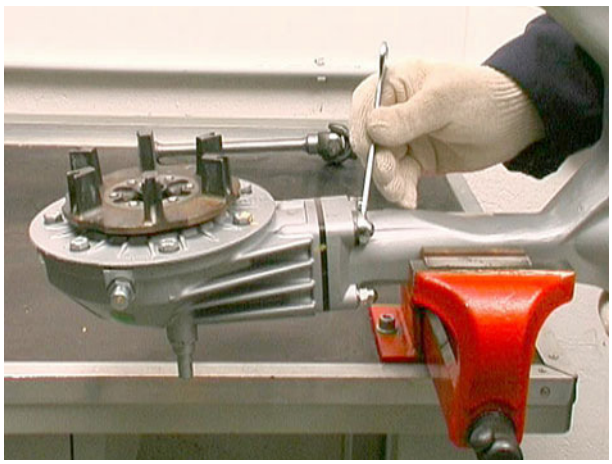
- Extract the cardan coupling from the rear swing arm.
- Unscrew the jubilee clamp.
- Remove the dust boot.

- Unscrew the nuts.

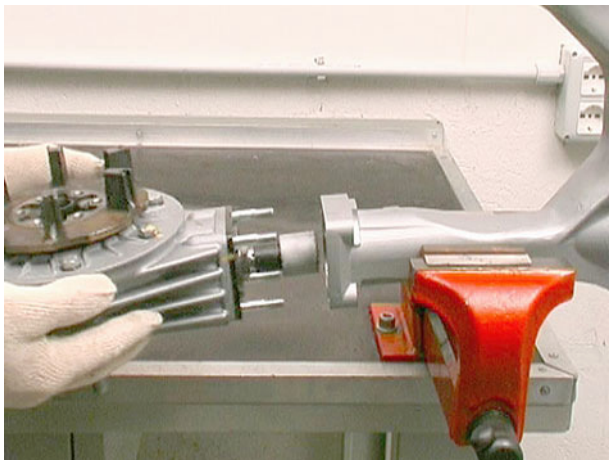
- Unscrew the swing arm pivot pins on the transmission case.
- Remove the shimming washer.



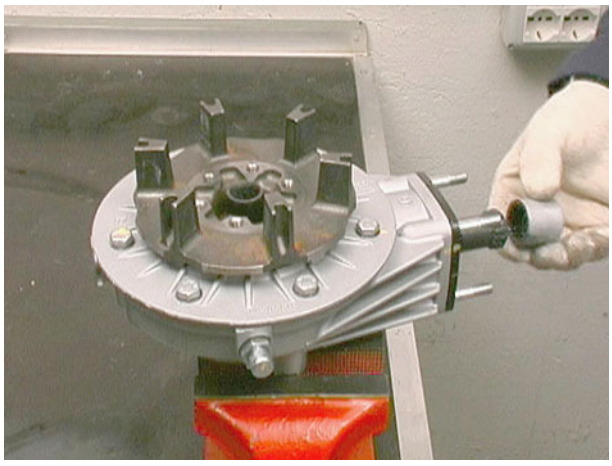
- Unscrew the four nuts and recover the washers.



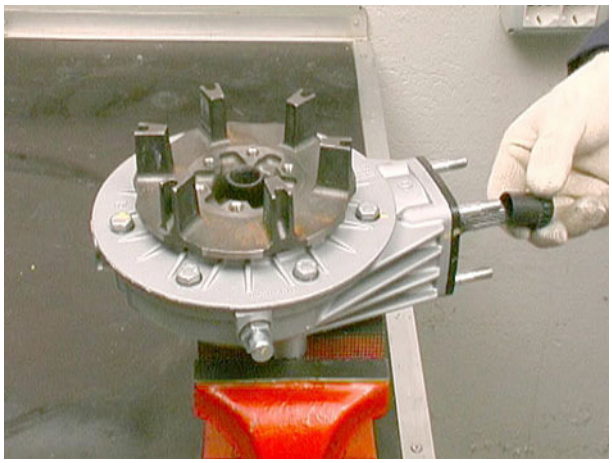
- Remove the complete transmission case from the swing arm.



- Remove the sleeve from the pinion.
- Remove the spring.
- Remove the seal ring.
- Remove the cap.



- Withdraw the gear.

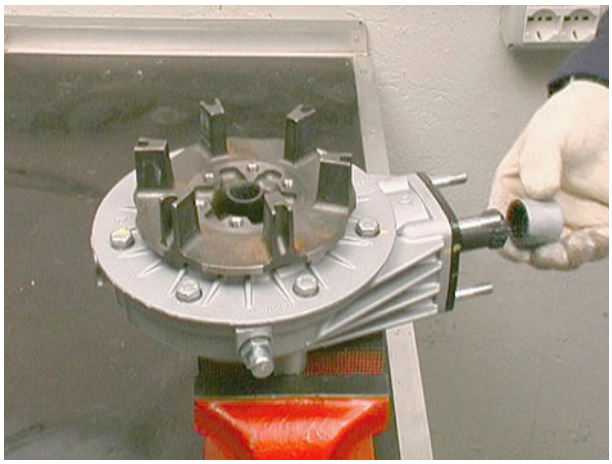


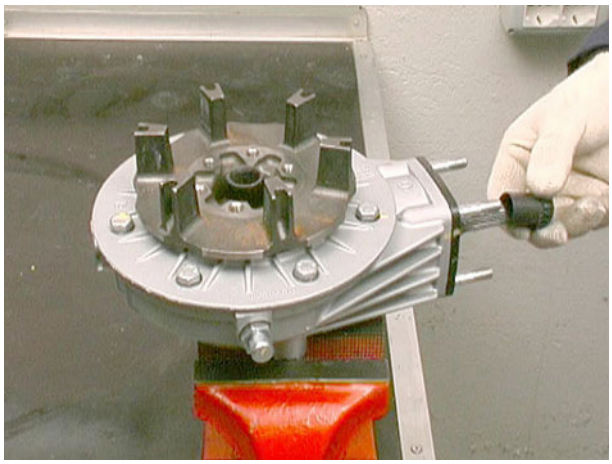
6.1.2. INSPECTION

- Check that the cardan coupling is in good condition, that the gear teeth that mesh with the sleeve splines and the coupling splines are not damaged or excessively worn; otherwise, renew the coupling.
- Check that the rubber boot is not cut or pierced, renew if necessary.
- Check that the threads of the swing arm fixing pins and nuts are in good condition and not stripped; renew if necessary.
- Check that the sleeve splines are in good condition and undamaged; renew if necessary.
- Check that the spring is not distorted; renew if necessary.
- Check that the circlip has not lost its elasticity and is not distorted.
- Check that the external teeth and internal splines of the sleeve are undamaged.

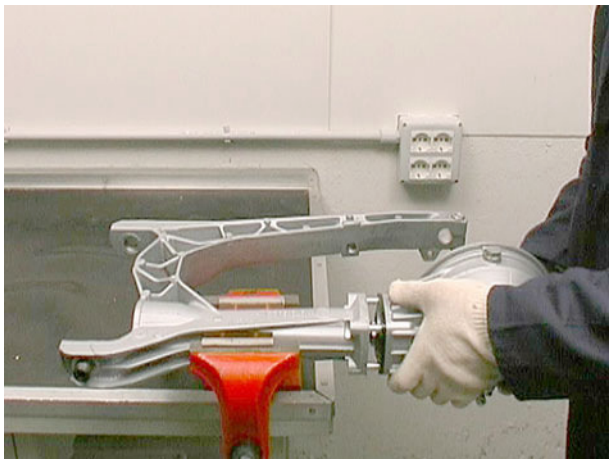
6.1.3. REASSEMBLY

- Fit the circlip in the internal groove in the sleeve.
- Equip the transmission case bevel pinion with the sleeve and cap

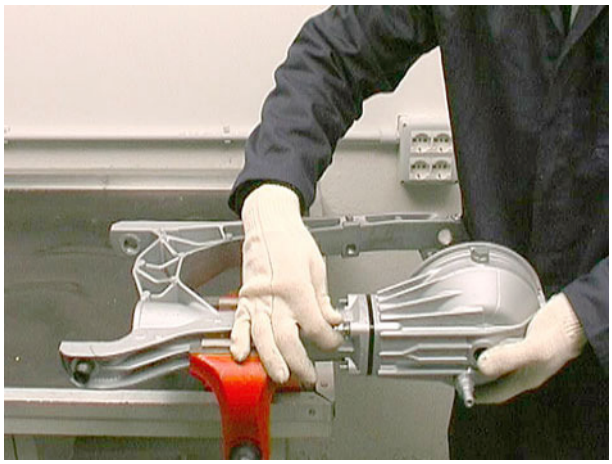




- Fit the transmission case studs correctly into the corresponding holes in the swing arm.



- Snug the nuts complete with washers without tightening.



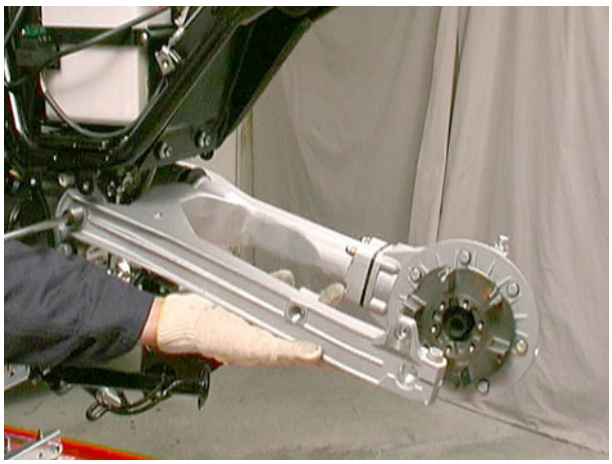
- Fit the spacer and wheel axle and tighten the nuts fully working in crosswise sequence.

- Fit the dust cover with internal circlip in the front of the swing arm.
- Tighten the jubilee clamp.
- Fit the spring in the relative bore in the cardan coupling and apply grease to hold it in position.

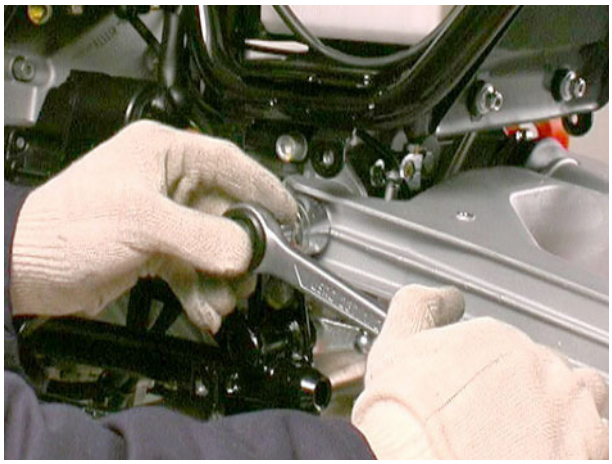
- Insert the cardan coupling into the swing arm through the dust boot.
- Take care to ensure that the spring does not fall out of place when inserting the sleeve into the coupling.

Now reassemble the swing arm as follows:

- Screw in the pin on the right-hand side until it protrudes from the swing arm sufficiently to hold the shim.
- Insert the swing arm into the transmission case cover.
- Tighten the left-hand pin fully down until the shim on the right-hand side is located against the bearing fitted to the transmission case cover.
- Snug the pin on the right-hand side without tightening.
- Articulate the swing arm to ensure that it moves freely without play.



- Fit the nuts onto the studs and tighten them fully down.



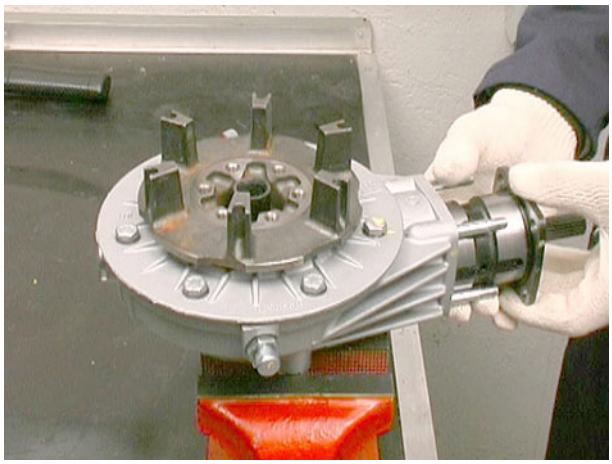
6.1.4. TIGHTENING TORQUES

ENGINE CONNECTING PARTS	
Front tie rod nut	45 Nm
Nut for long and short screws	45 Nm
Clutch housing cover to engine fixing screws	25 Nm

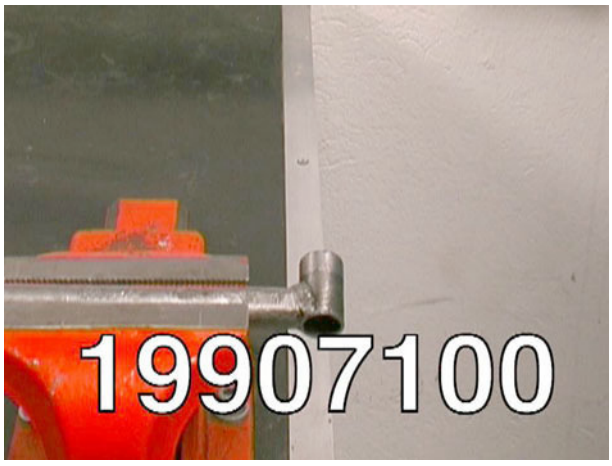
6.2. TRANSMISSION CASE

6.2.1. REMOVING THE PINION HOUSING

- Remove the swing arm case.
- Withdraw the complete pinion housing from the transmission case.

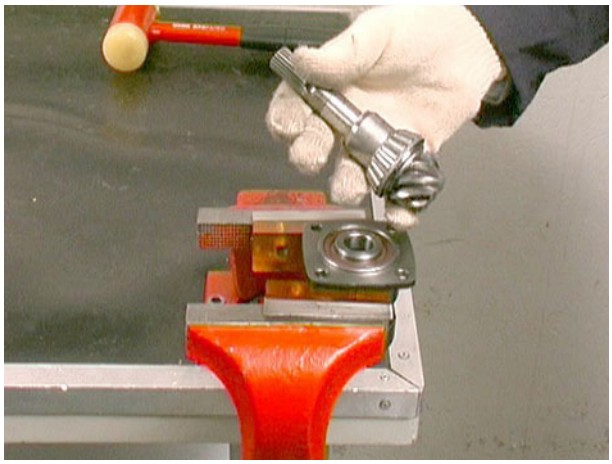


- Clamp the bevel gear set holder tool (19907100) in a vice.

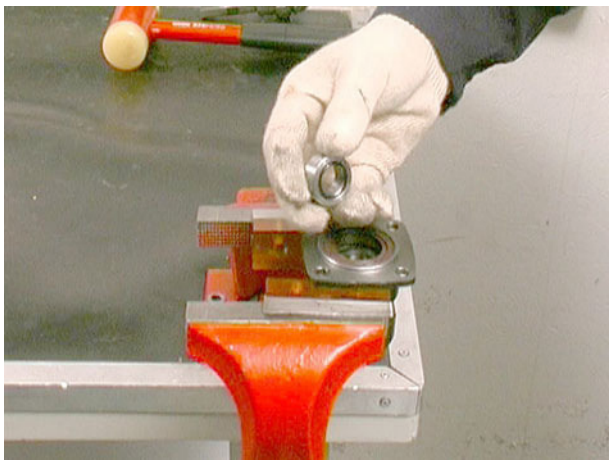


- Insert the splined shaft of the pinion in the tool and unscrew the nut.

- Remove the distance collar.
- Remove the pinion.

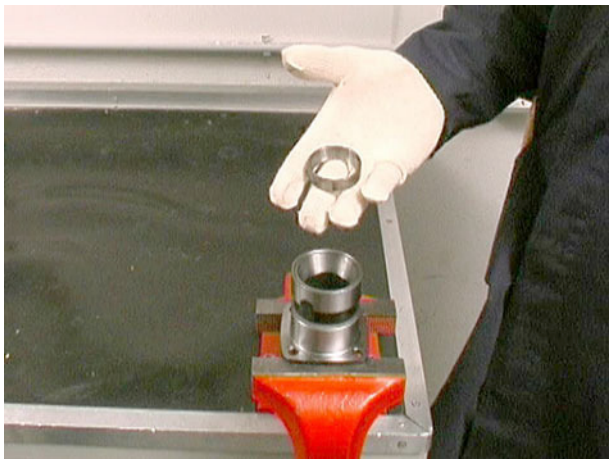


- Remove the clearance washer.
- Remove the O-ring.

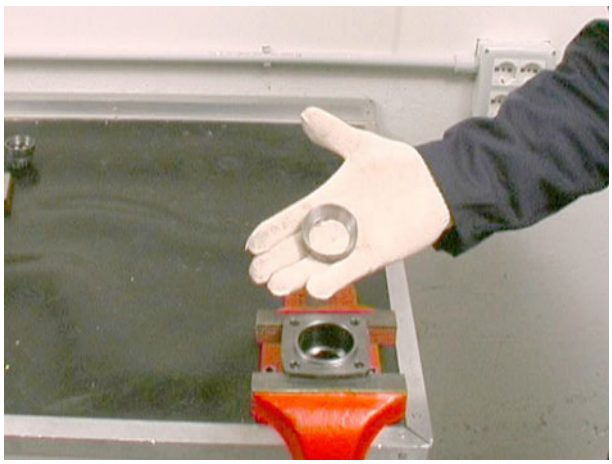


- Remove the oil seal.

- Remove the taper roller bearing from the housing.
- Remove the O-ring.
- Remove the distance collar.
- Remove the two washers.



- Remove the taper roller bearing from the housing.



6.2.2. INSPECTION

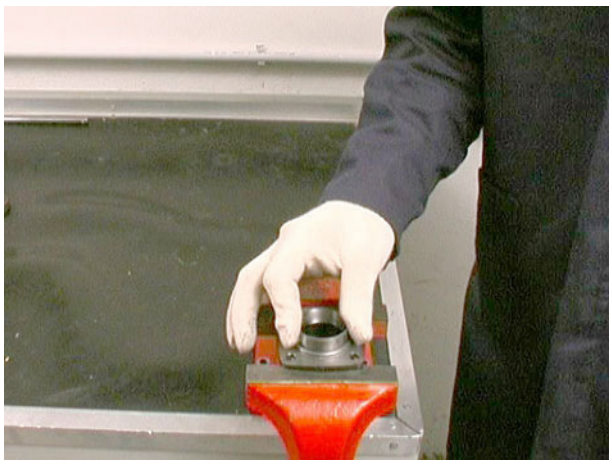
- Check that the pinion teeth are in good condition, not excessively worn and undamaged; if necessary renew the bevel gear set.
- Check that the two taper roller bearings are in good condition, that the rollers are undamaged and not excessively worn; renew if necessary.
- Check that the clearance washers are not distorted or chipped; renew if necessary.
- Check that the seal rings are compact, undamaged, and not excessively worn; renew if necessary.

6.2.3. REASSEMBLY

- If you need to renew the bevel pinion then you must also renew the bevel gear mounted on the transmission case. The pinion and gear in the set must be stamped with the same identification number.

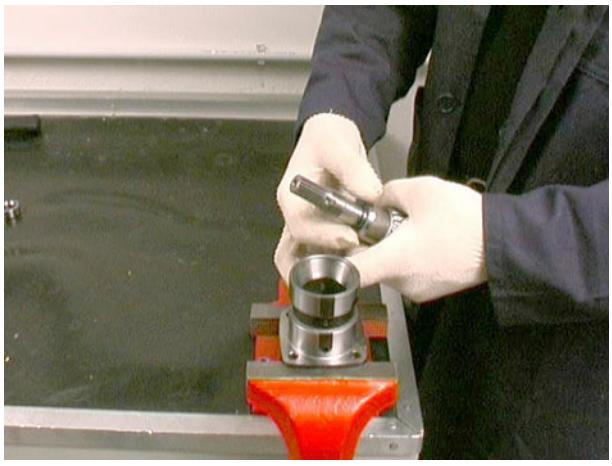
- Use the specific punch (19926400) to drive the outer race of the taper roller bearings into the bevel pinion housing.

- Fit the clearance washer.



- Use the specific punch (19926200) to fit the bearing inner race to the pinion.

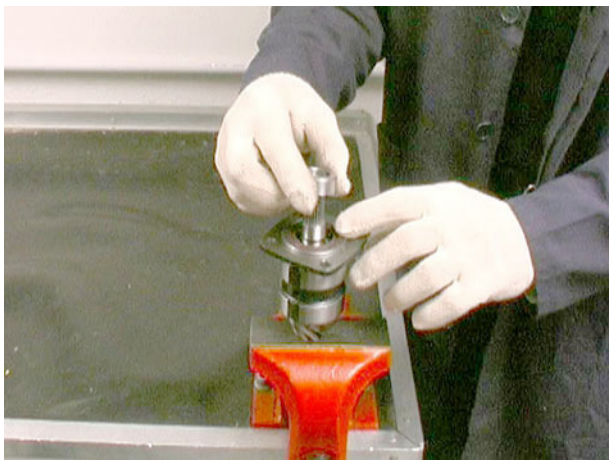
- Equip the pinion with the two clearance washers
- Equip the pinion with the distance collar
- Fit the O-ring.



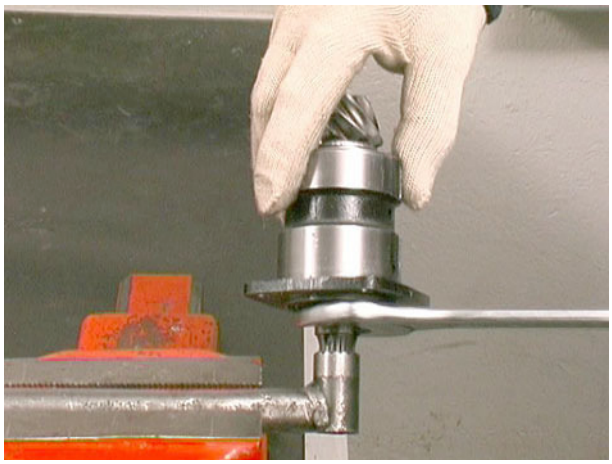
- Use the specific punch (19926100) to drive the complete pinion into the housing.

- Fit the oil seal;
- Fit the O-ring.

- Fit the distance collar.



- Insert the splined shaft of the pinion in the special tool (19907100) and tighten the nut.



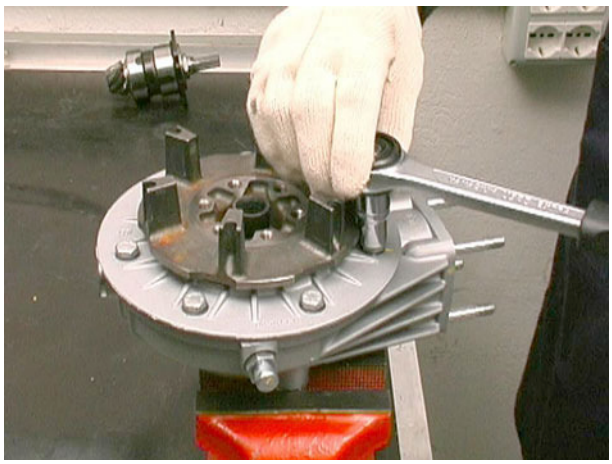
6.2.4. TIGHTENING TORQUES

REAR TRANSMISSION	
Bevel pinion to case fixing nut	100 Nm
Bevel gear to hollow shaft fixing screws	42 Nm
Cover to transmission case fixing screws	25 Nm

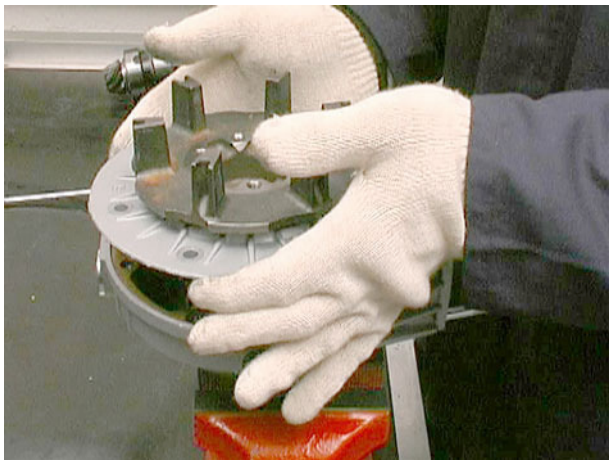
6.3. DISASSEMBLING THE TRANSMISSION CASE

6.3.1. DISASSEMBLING THE TRANSMISSION CASE

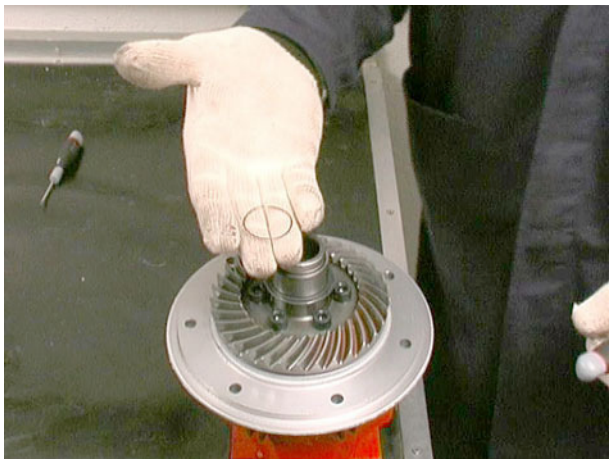
- Unscrew the screws and set the washers aside.



- Remove the brake disk from the hollow shaft.
- Unscrew the screws and set aside the square washers and spring washers.
- Remove the complete cover.
- Remove the gaskets.
- Remove the spacer.



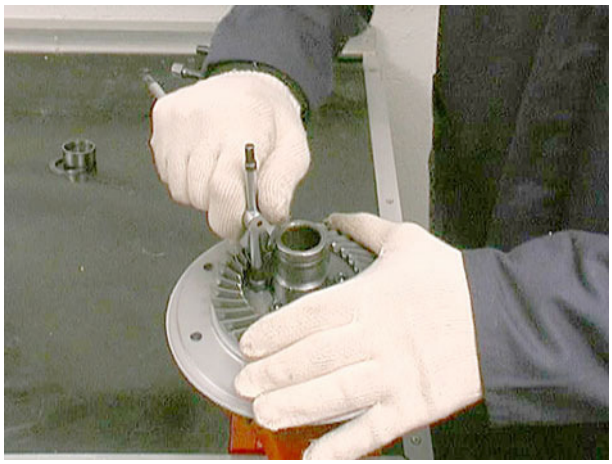
- Remove the circlip from the groove in the hollow shaft.



Remove the following parts from the cover:

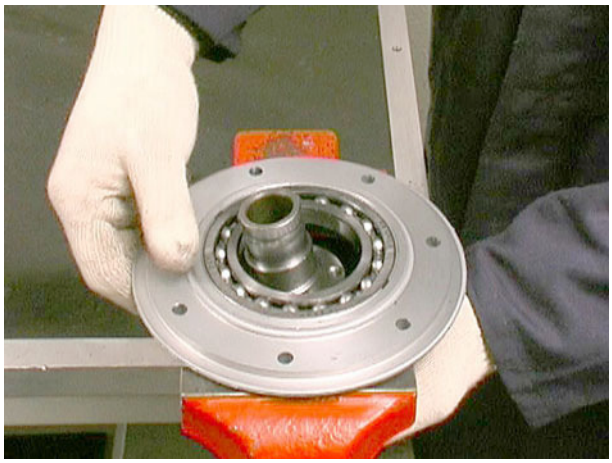
- The roller bearing.
- Use the specific punch (19907000) to drive out the taper roller bearing inner race.
- Remove the washer.
- Remove the washer.

- Unscrew the screws and set the locking tabs aside;

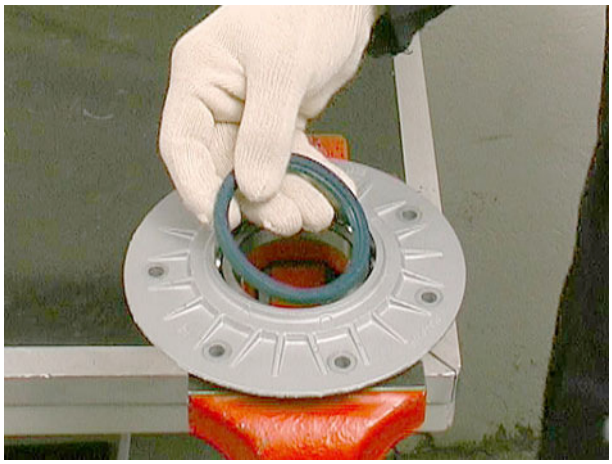


- Remove the bevel gear

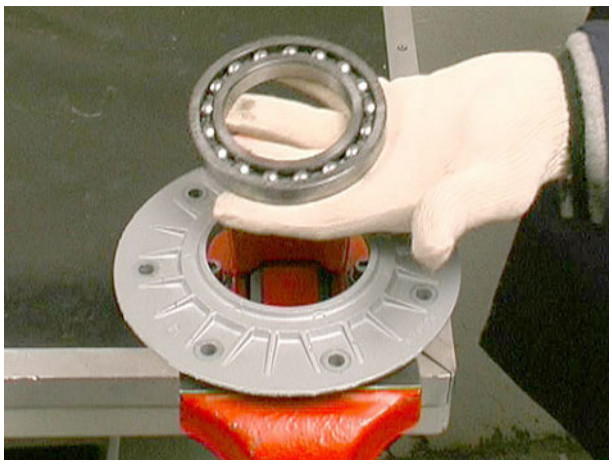
- Withdraw the hollow shaft from the bearing.



- Remove the seal ring.

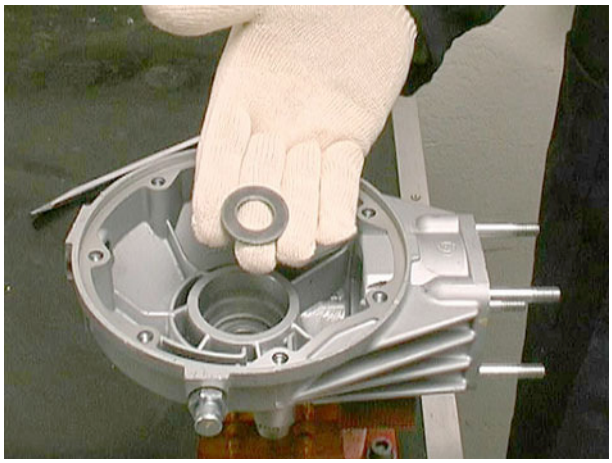


- Use the specific punch to drive the bearing out of the cover.



- Use the specific puller (19927500) to remove the taper roller bearing outer race from the transmission case.

- Remove the seal ring and the washer.



6.3.2. INSPECTION

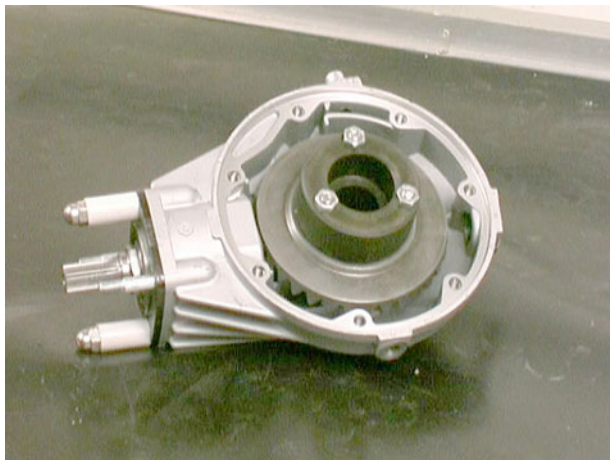
- Check that the fins of the hollow shaft subject to the action of the torque dampers are not damaged; check that the contact surfaces of: the seal ring, the bearing on the cover, the outer race of the bearing on the transmission case, the circlip groove on the hollow shaft: are not excessively worn, damaged, or pitted, otherwise renew the parts.
- Check that the seal ring on the case is compact and has not suffered a reduction of its elastic properties, otherwise renew;
- Check that the roller bearing on the transmission case shows no signs of out of round or worn rollers, otherwise, renew the bearing;
- Check that all the components are in perfect working order and that the mating surfaces of transmission case and cover are not scored or damaged.

6.3.3. PINION – GEAR MESHING (BEVEL GEAR SET)

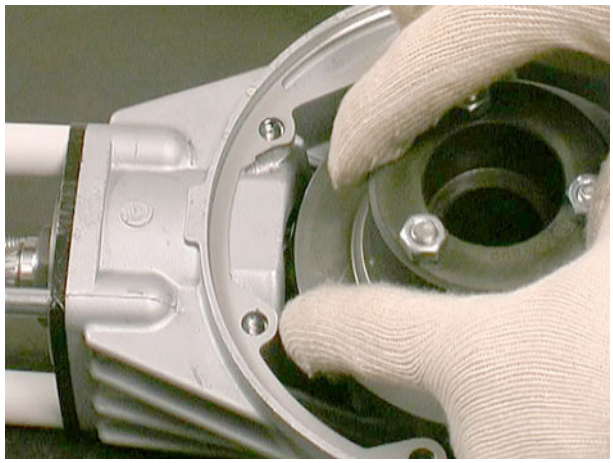
Perform these operations to mesh the pinion and gear:

- Use two nuts and suitable spacers to temporarily secure the housing complete with pinion to the transmission case;
- Fit the specific tool (19928800) to the gear.

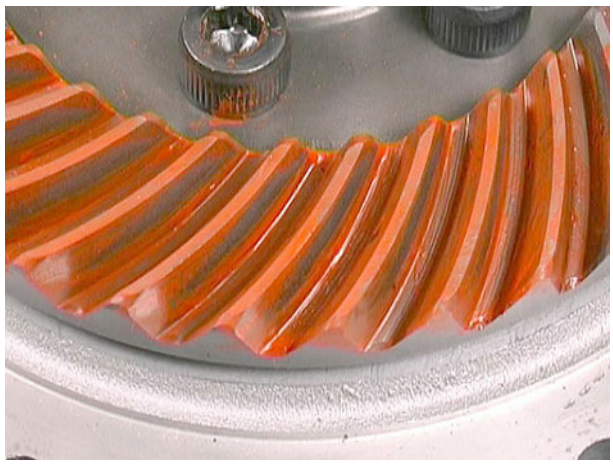
- Insert the tool onto the transmission case roller bearing.



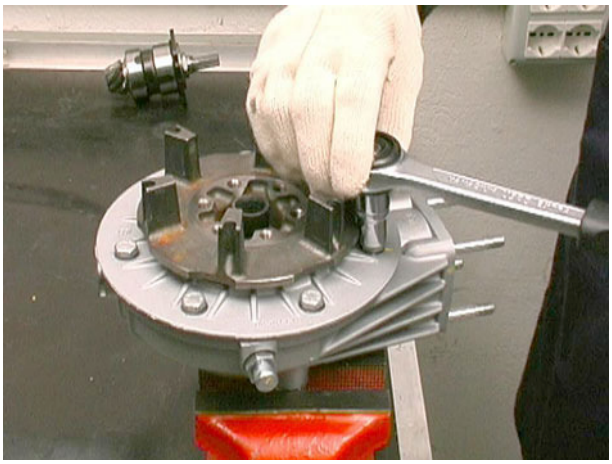
- Check the alignment between the pinion teeth and the gear teeth;
- If the teeth are not properly aligned adjust the thickness of the ring interposed between the pinion and the taper roller bearing.
- You must also check the contact area between the pinion teeth and the gear teeth as follows:



Coat the pinion teeth with a specific commercial marker dye.

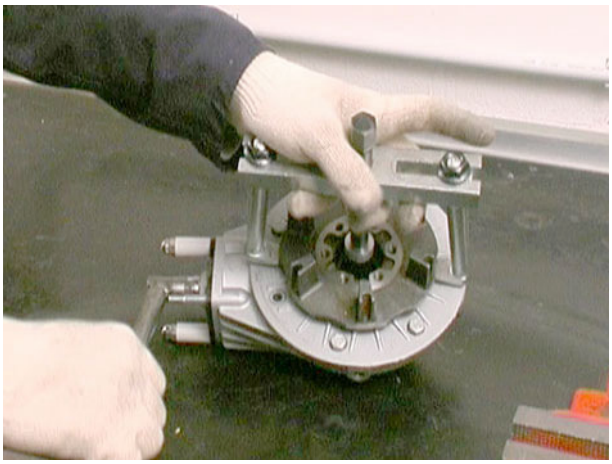


Fit the gear-hollow shaft assy., cover and relative spacers and gaskets to the transmission case and temporarily screw down the fixing screws.

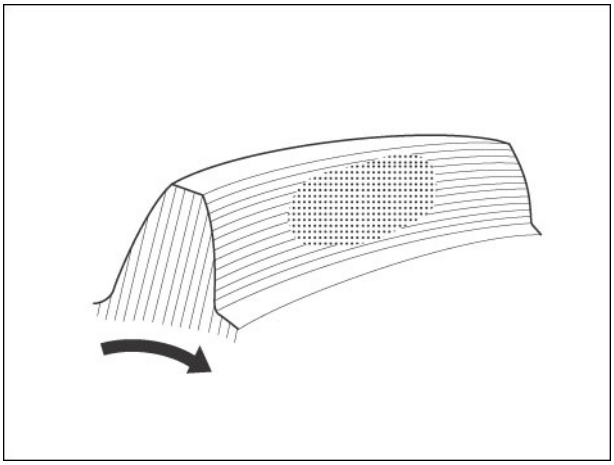


Equip the gear holder hollow shaft with a Universal puller tool having central spacers in such a way as to maintain the gear so that it exerts slight pressure towards the brake disk side.

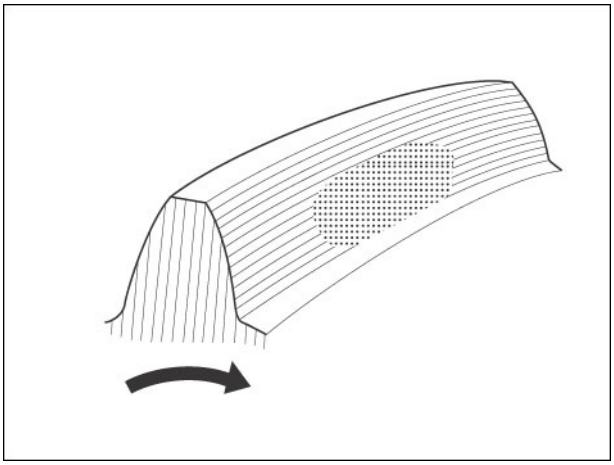
Turn the pinion in the direction of run while braking the gear so that the rotation takes place under load and the contact areas are marked on the pinion tooth surfaces.



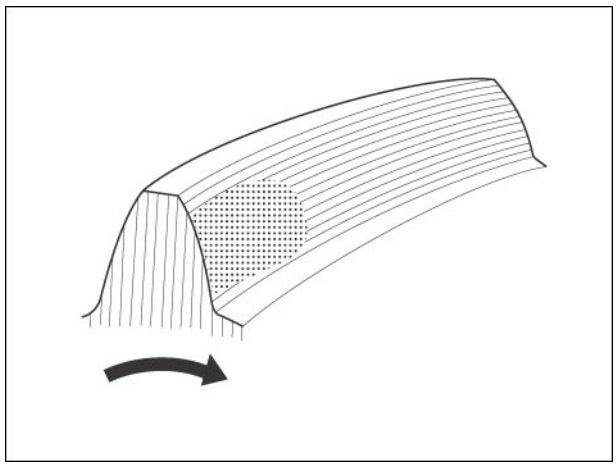
- If the contact is correct the marking on the pinion teeth should appear as shown. Note that the pinion is viewed from the driving shaft side



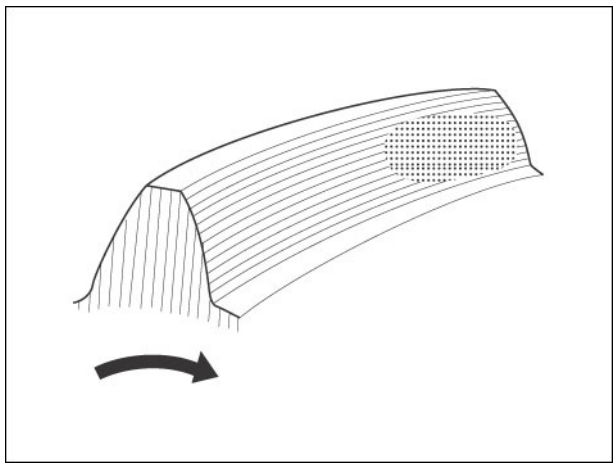
- If the contact markings are as shown here, the gear is too close to the pinion axis of rotation: move the gear back by increasing the thickness of the shim



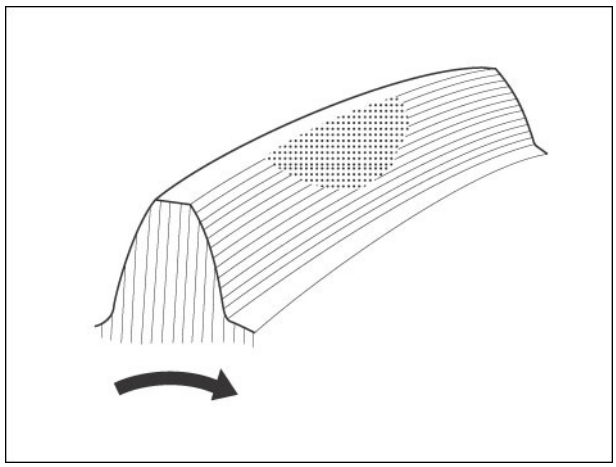
- If the contact markings are as shown here, the pinion is too close to the gear axis of rotation: move the pinion backwards by reducing the thickness of the shim



- If the contact markings are as shown here, the pinion is too far from the gear axis of rotation: move the pinion forwards by increasing the thickness of the shim.

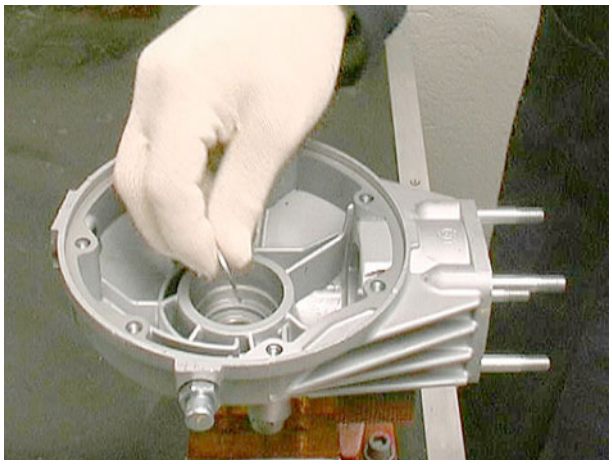


- If the contact markings are as shown here, the gear is too far from the pinion axis of rotation: move the gear forwards by reducing the thickness of the shim.

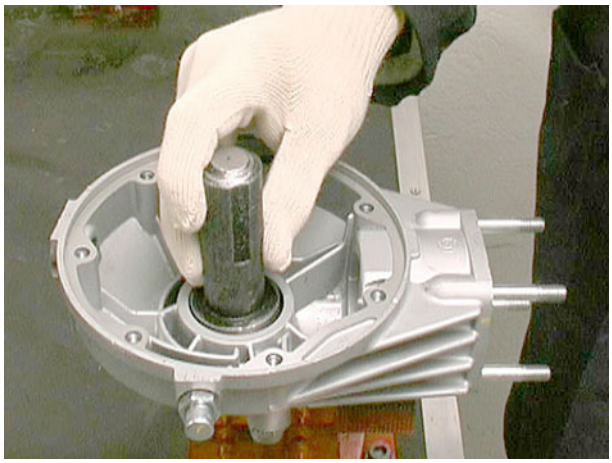


6.3.4. REASSEMBLY

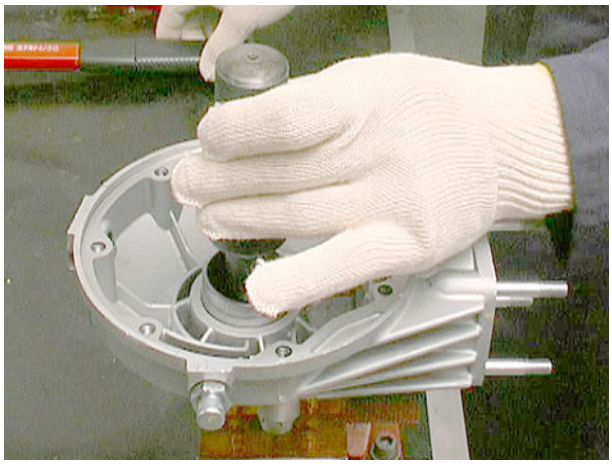
- Fit the washer on the transmission case.



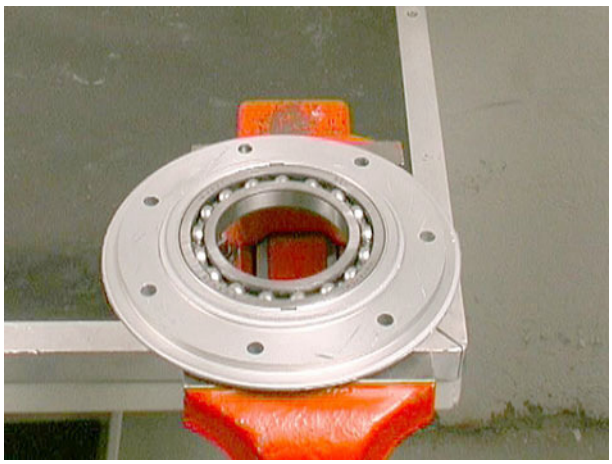
- Use the specific punch (19926000) to fit the seal ring on the transmission case.



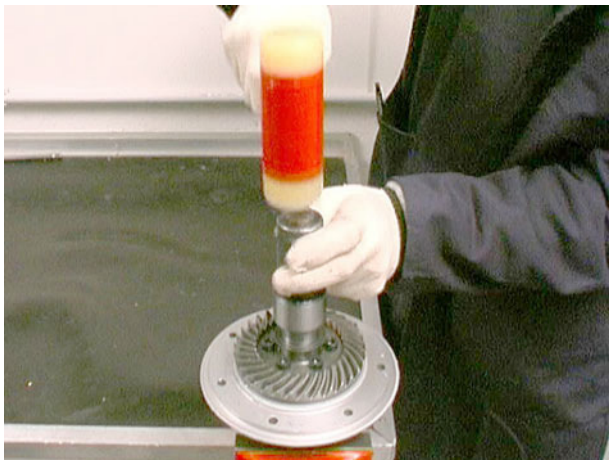
- Use the specific punch (19926500) to fit the roller bearing outer race to the transmission case.



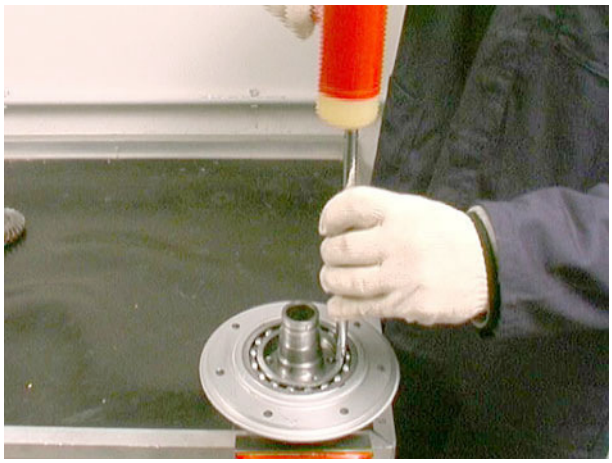
- Use the specific punch to fit the bearing to the cover.



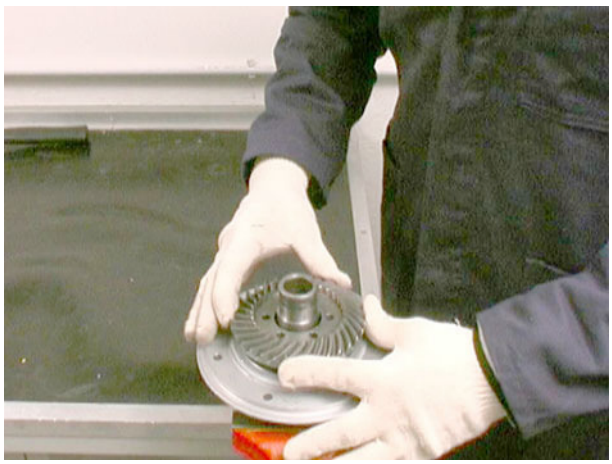
- Use the specific punch (19927900) to fit the roller bearing inner race to the hollow shaft;
- Fit the seal ring to the hollow shaft..



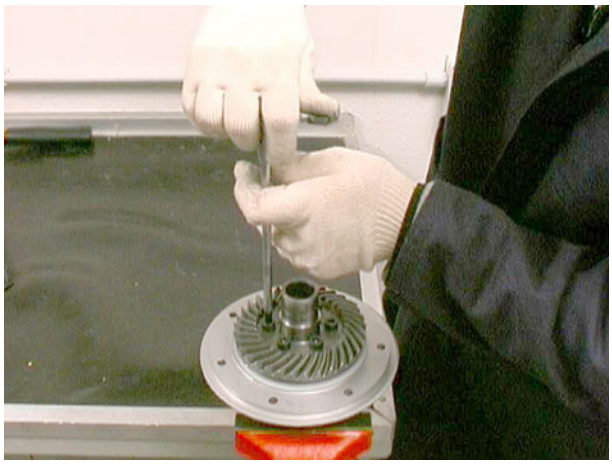
- Assemble the hollow shaft to the cover.



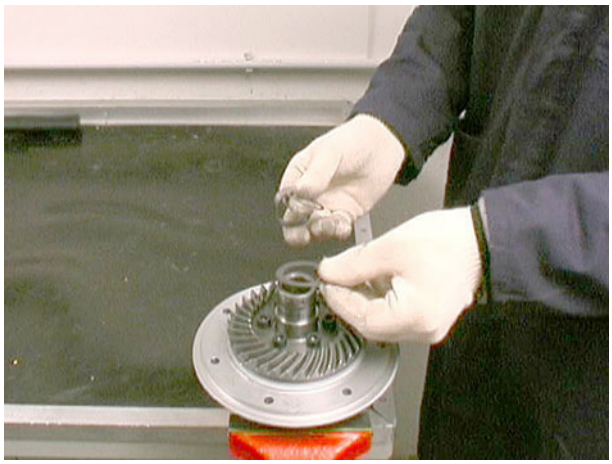
- Fit the gear.



- Insert the square locking tabs and tighten the screws.

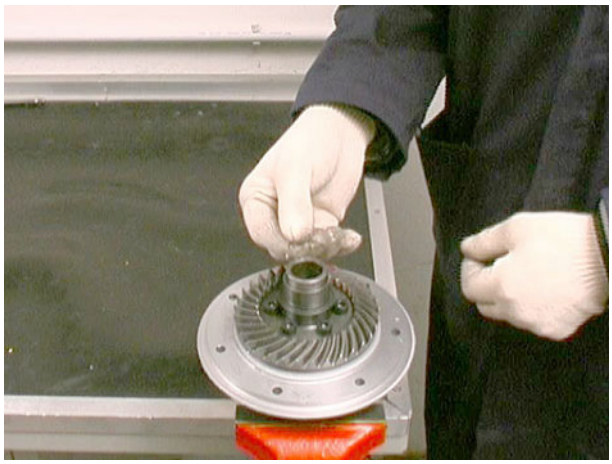


- Fit the washer.

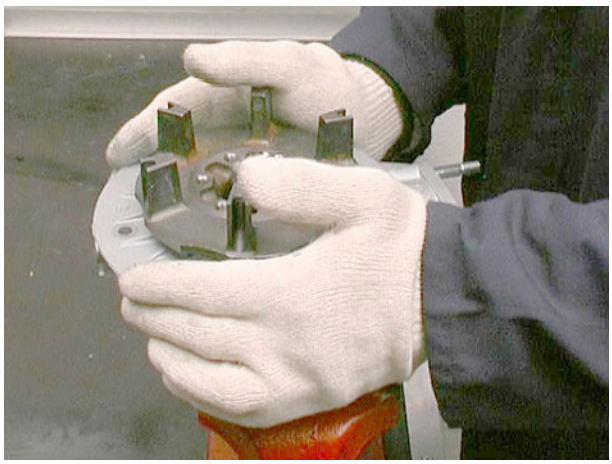


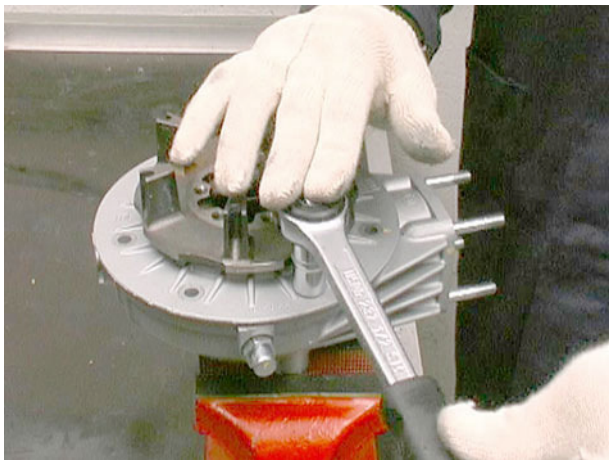
- Fit the washer.

- Fit the circlip.
- Fit the gaskets and spacer to the cover.
- Tighten the screws complete with square locking tabs and washers.

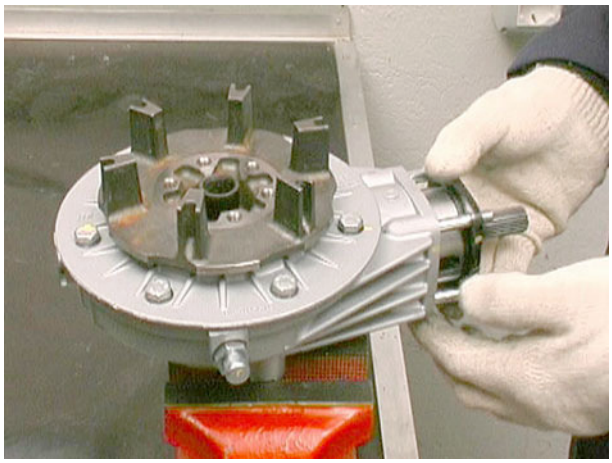


- Fit the brake disk to the hollow shaft and use a torque wrench to tighten the screws complete with washers.





- When reassembling the bevel pinion housing to the transmission assy. take account of the fact that the oil flow channels with holes must be assembled in a vertical line (observing the channels, one must be facing upwards and the other facing downwards).

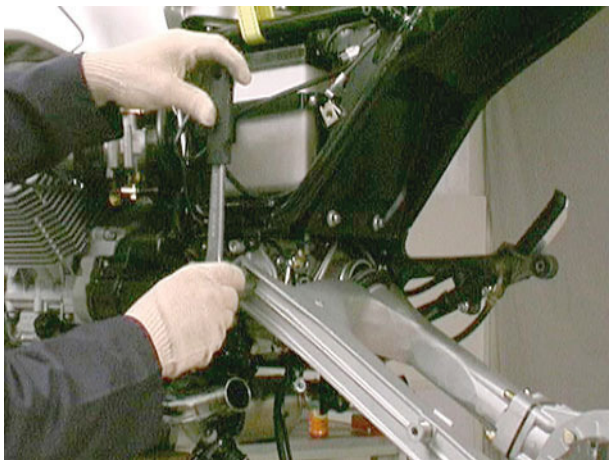


6.3.5. TIGHTENING TORQUES

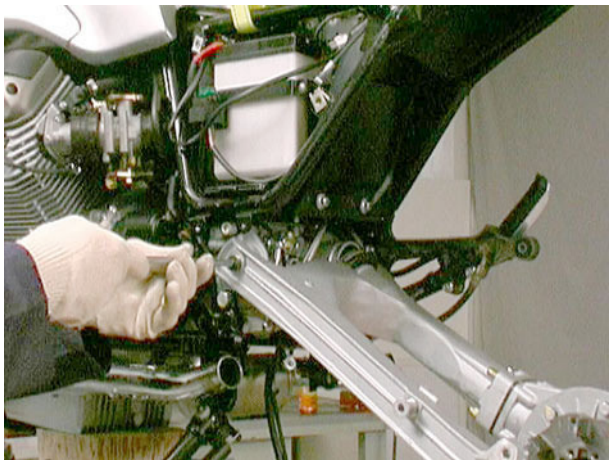
REAR TRANSMISSION	
Bevel pinion to case fixing nut	100 Nm
Bevel gear to hollow shaft fixing screws	42 Nm
Cover to transmission case fixing screws	25 Nm

6.4. REAR SWING ARM

6.4.1. DISASSEMBLY



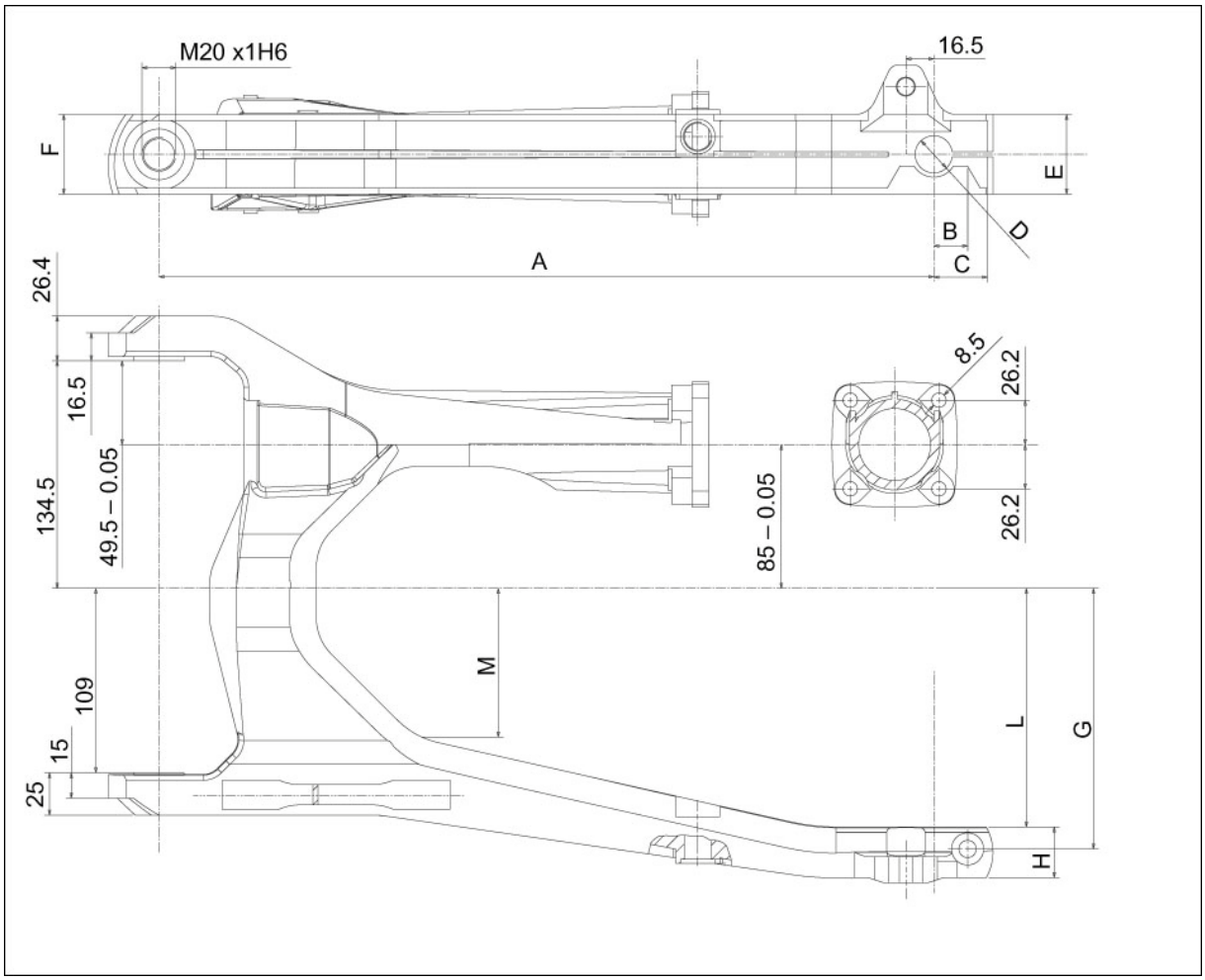
- Remove the rear wheel.
- Unscrew the nuts with washers.
- Remove the cardan coupling from the right arm of the swing arm assy.
- Remove the rear transmission case.
- Unscrew the nuts.



- Loosen the pins so that you can separate the swing arm from the transmission case.
- Remove the shimming washer from between the right arm of the swing arm assy. and the transmission case.

6.4.2. INSPECTION

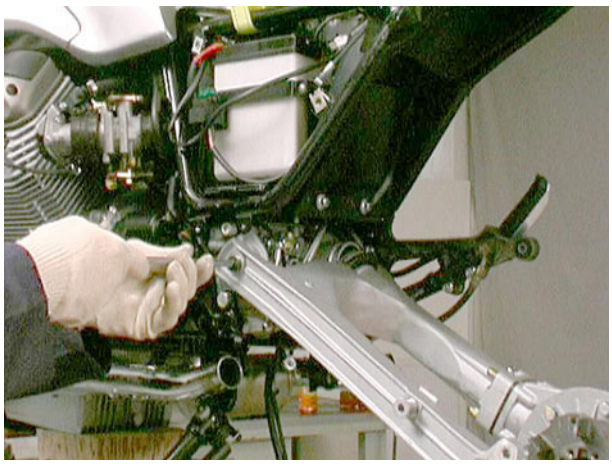
- Check that the arms of the swing arm assy. show no signs of cracking or distortion; otherwise, if possible, true up the swing arm assy. observing the measurements shown in the drawing.



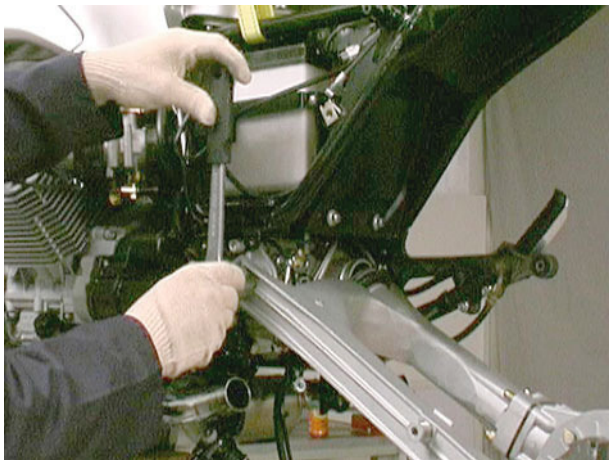
mm	
A	458 ± 0,1
B	20
C	31,8
D	Ø 22,000 – 22,052
E	47
F	47
G	154
H	30
L	141
M	87,8

6.4.3. REASSEMBLY

- Locate the cardan coupling in the right arm of the swing arm assy.
- Locate the rear transmission case on the right arm of the swing arm assy.
- Tighten the nuts with washers, working in diagonal sequence.
- Position the shim washer between the right arm of the swing arm assy. and the transmission case.
- Tighten the pins.



- Tighten the nuts.
- Fit the rear wheel.



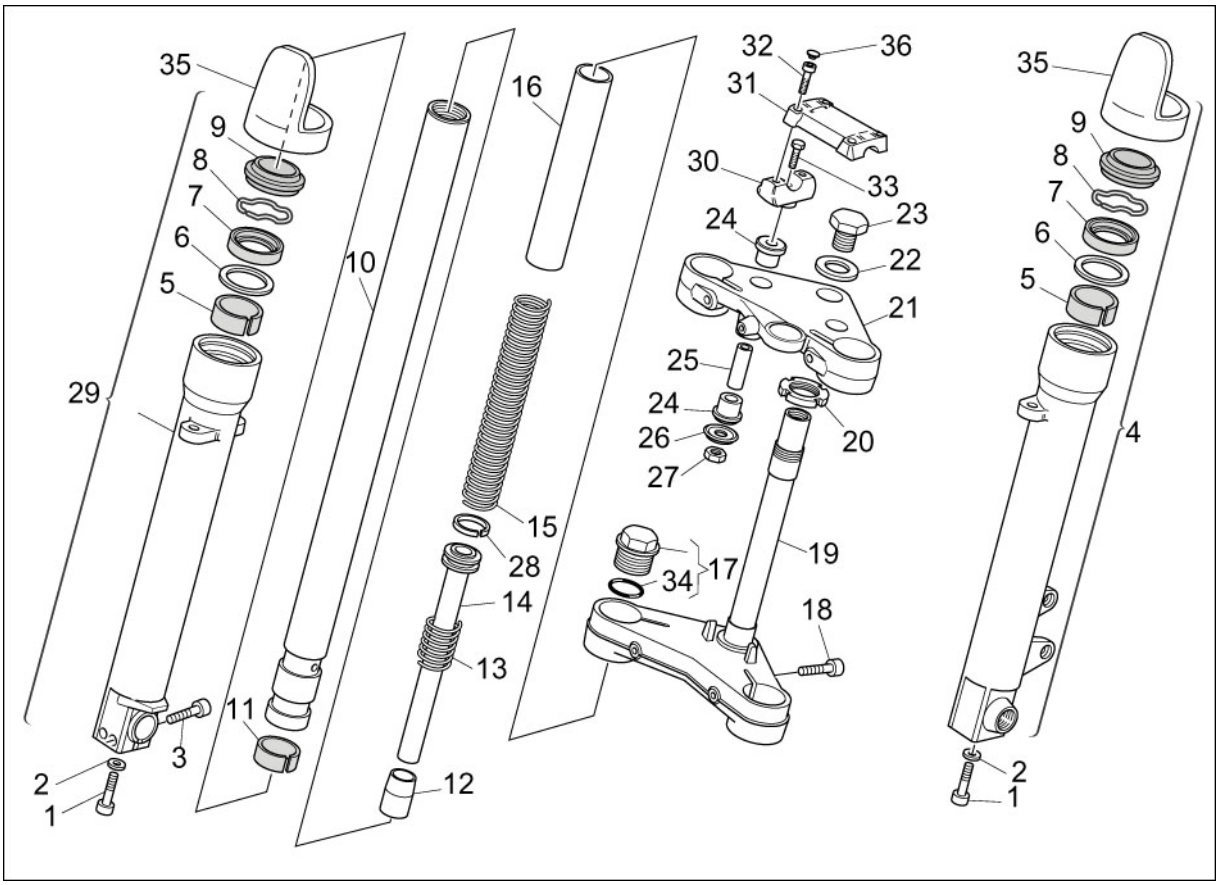
6.4.4. TIGHTENING TORQUES

ENGINE CONNECTING PARTS	
Front tie rod nut	45 Nm
Nut for long and short screws	45 Nm
Clutch housing cover to engine fixing screws	25 Nm

SUMMARY

7.1. FRONT FORK

7.1.1. DIAGRAM



Key:

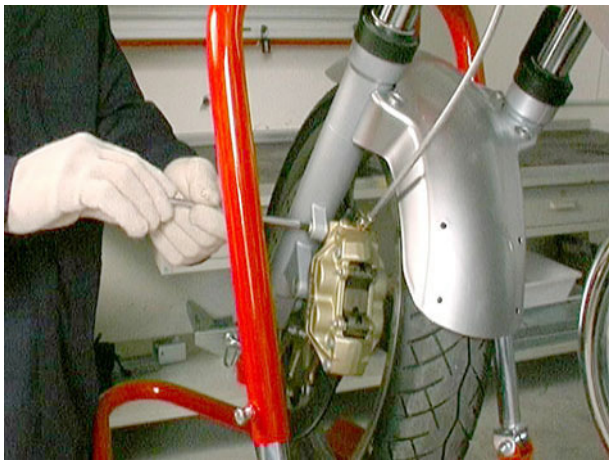
1. Screw
2. Washer
3. Screw
4. Complete left-hand slider
5. Upper Bushing
6. Cap
7. Seal ring
8. Stop ring
9. Wiper seal
10. Fork tube
11. Lower bushing
12. Oil lock piece
13. Counter spring
14. Rod
15. Spring
16. Pre-load tube
17. Plug assembly
18. Screw
19. Fork base
20. Ring nut
21. Fork bridge
22. Washer
23. Nut
24. Rubber plug
25. Spacer tube
26. Retainer
27. Nut
28. Ring
29. Complete right-hand slider
30. Lower clamp
31. Handlebar clamp
32. Screw
33. Screw
34. O-ring
35. Rod protection
36. Plug

7.1.2. FORK LEG REMOVAL

The motorcycle is equipped with a non-adjustable fork.
The procedures described below apply to both the fork legs.

WARNING
During the following procedures, the legs and their internal components must be clamped in a vice. Take great care not to damage them by overtightening; always use aluminium jaw coverings

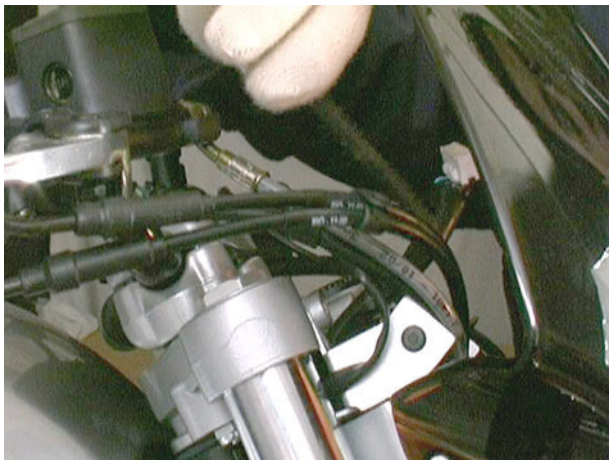
- Place the motorcycle on a stable stand so that the front wheel is lifted from the ground.
- Remove the front brake calliper without disconnecting the brake fluid line.



- Remove the front mudguard.

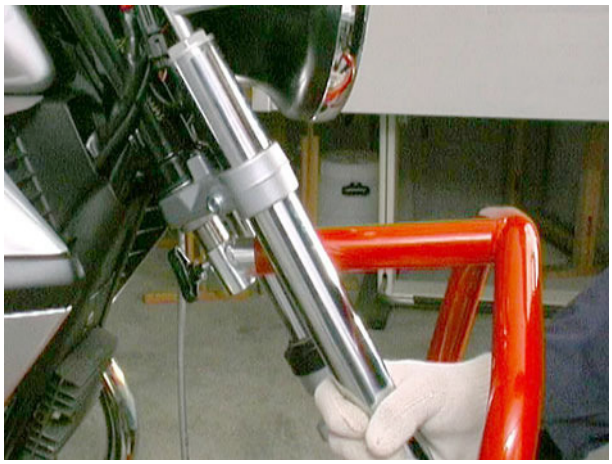
- Remove the front wheel.

- Unscrew the upper clamping screw.



- Unscrew the two lower clamping screws

- Slide out the fork leg downwards while rotating it first in one direction then in the opposite direction.



7.1.3. NORME GENERALI PER UNA CORRETTA REVISIONE

- Use new gaskets during reassembly after complete disassembly.
- Use a non-inflammable and preferably biodegradable solvent for cleaning.
- Lubricate all the contact surfaces before reassembly.
- Always smear grease on the seal ring lips before reassembly.

7.1.4. TROUBLESHOOTING

The following paragraph lists some potential problems with the fork and their causes complete with suggested solutions.
Always refer to this table before working on the fork.

PROBLEM		
Oil leakage from the seal ring	1. Worn seal ring 2. Scored stanchion 3. The ring is dirty	1. Replace the seal ring 2. Replace stanchion and ring 3. Clean or replace
Oil leakage from the bottom	1. Defective foot gasket 2. The foot screw is loose	1. Replace gasket 2. Tighten screw
Fork suspension too soft	1. Low oil level 2. Defective spring 3. Oil viscosity too low	1. Restore correct fork oil level 2. Replace spring 3. Change oil with oil of correct viscosity
Fork suspension too stiff	1. Oil level too high 2. Oil viscosity too high	1. Restore correct fork oil level 2. Change oil with oil of correct viscosity

7.1.5. FRONT FORK OIL CHANGE

IMPORTANT *The following procedures apply to both legs.*

The fork oil must be changed periodically, see (PERIODIC MAINTENANCE TABLE).

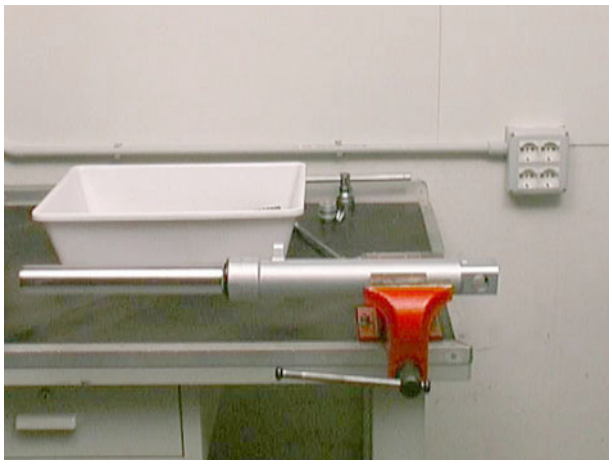
IMPORTANT *During oil drainage and filling operations, the fork leg and its internal parts must be clamped in a vice; take care to avoid damaging the parts by overtightening; always use aluminium jaw coverings.*

OIL DRAINAGE

To drain the oil follow the procedures described below:

- Disassemble the fork leg.

- Clamp the removed fork leg in a vice with aluminium jaw facings in order to avoid damaging it.



- Unscrew the upper oil plug. Beware of the force exerted by the spring on the plug once it is unscrewed.

- Take care not to damage the O-ring during removal.
- Push the stanchion into the slider.
- Remove the pre-load tube and the spring;

- Drain the oil contents from the interior of the fork leg

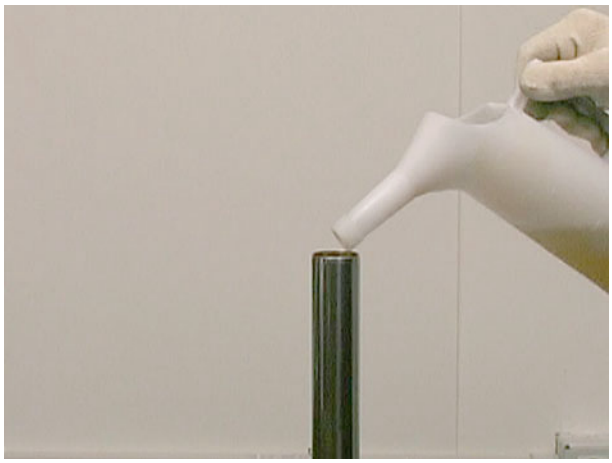
To facilitate the drainage of oil from inside the plunger rod, pump out the oil by repeatedly pushing the stanchion into the slider.

- Check the fork leg carefully and make sure there are no signs of damage.
- If no parts are damaged or particularly worn, reassemble the leg otherwise renew the damaged parts.

FILLING:

- Clamp the slider in a vice;

Pour oil into the stanchion ensuring that it also fills the internal passages of the plunger rod.



- Pump the stanchion up and down to ensure the plunger rod is completely filled with oil.

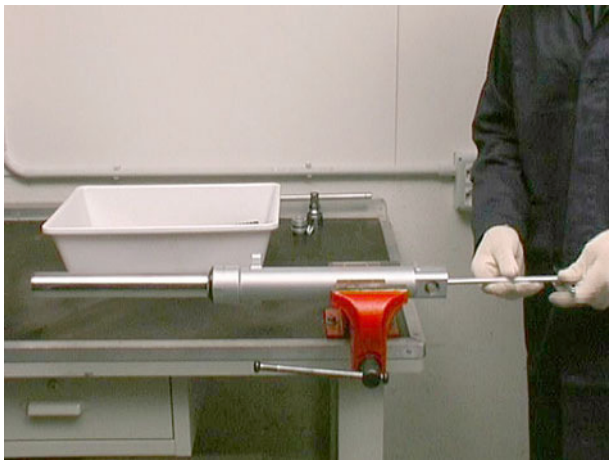
- Insert the spring and pre-load tube.

- Fit the plug on the stanchion tube taking care not to damage the O-ring.

- Tighten the plug to the prescribed torque.

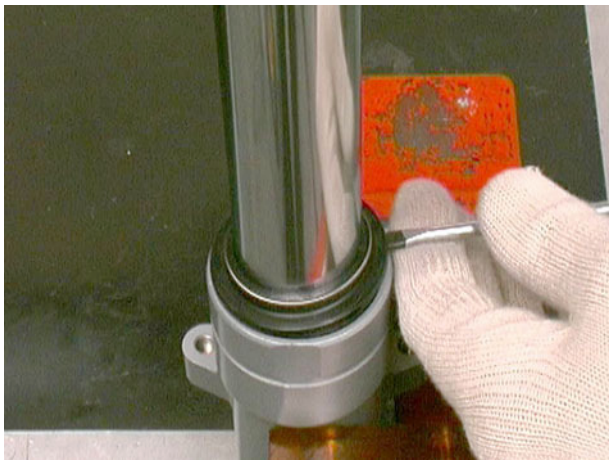
7.1.6. DISASSEMBLY / OVERHAUL

- Drain all the oil from the fork leg.
- Clamp the slider in a vice.
- Unscrew the foot screw and remove it with the relative seal.

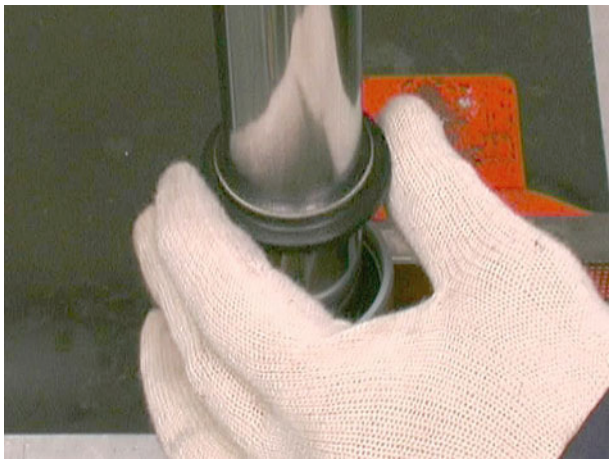


- Remove the dust wiper seal by prising it with a screwdriver.

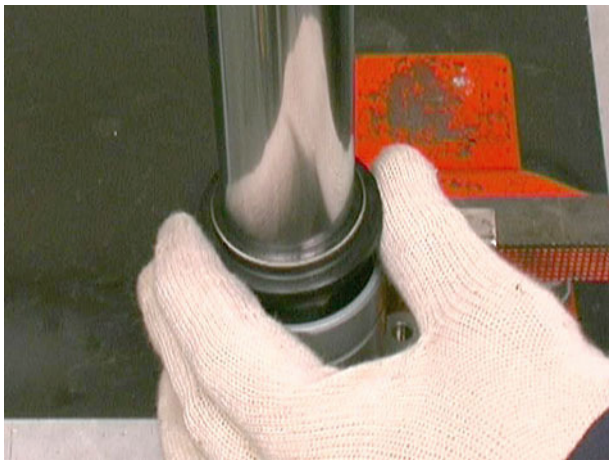
WARNING
Work carefully to avoid damaging the slider rim and the dust wiper seal.



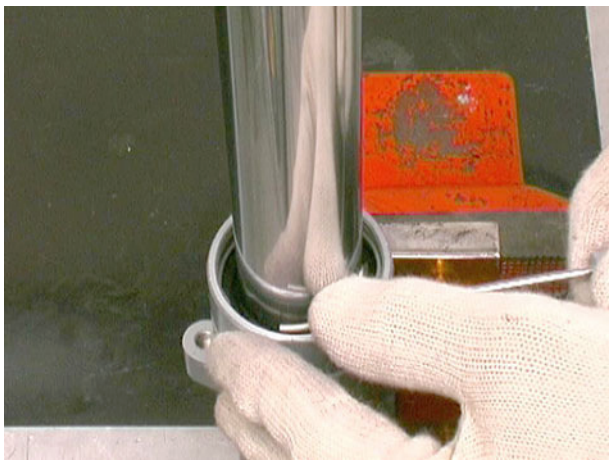
- Remove the dust wiper seal by sliding it upwards.



- Remove the stop ring from inside the slider using a small screwdriver.



WARNING
Be careful not to damage the slider rim



- Remove the stanchion tube from the slider together with the seal ring, the cap, the upper bushing and the lower bushing.

IMPORTANT While removing the stanchion tube from the slider several parts may remain inside the slider, in which case they must be removed afterwards taking care not to damage the rim of the slider or the upper bushing seat on the slider

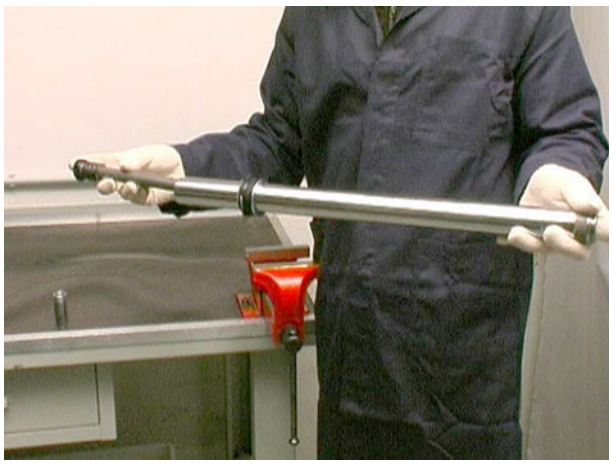
7.1.7. INSPECTION

- Check all the parts removed from inside the slider, specifically: the seal ring and the dust wiper seal since these parts ensure the oiltight properties; these parts must be renewed if damaged;
- Check the bushing on the stanchion; if damaged or worn, remove and renew;
- Extract the plunger assembly from the stanchion tube; renew the counter-spring and the plunger ring if damaged.

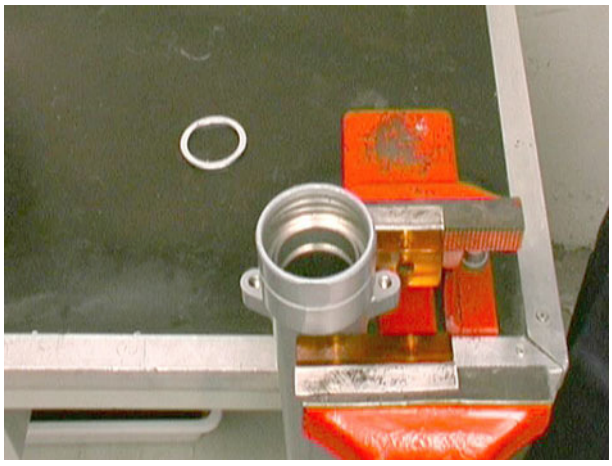
7.1.8. REASSEMBLY

WARNING
Before reassembly all components must be carefully washed and dried with compressed air.

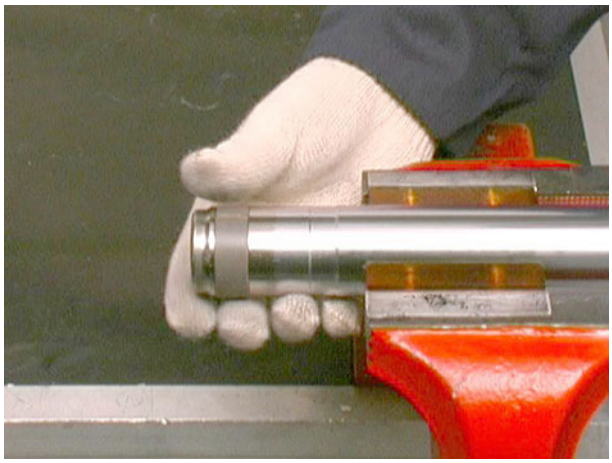
- Perform all the necessary overhaul procedures
- Insert the plunger assy. into the stanchion tube complete with counter-spring and ring.



- Check that the slider is equipped with the upper guide ring.



- Fit the lower sliding bushing in the seat on the stanchion.

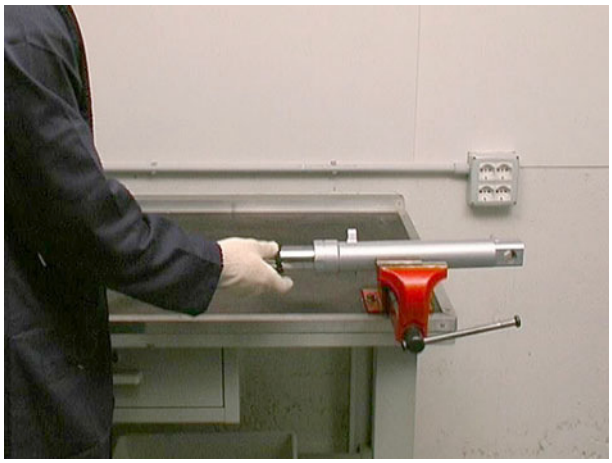


- Now reassemble the stanchion tube and slider.

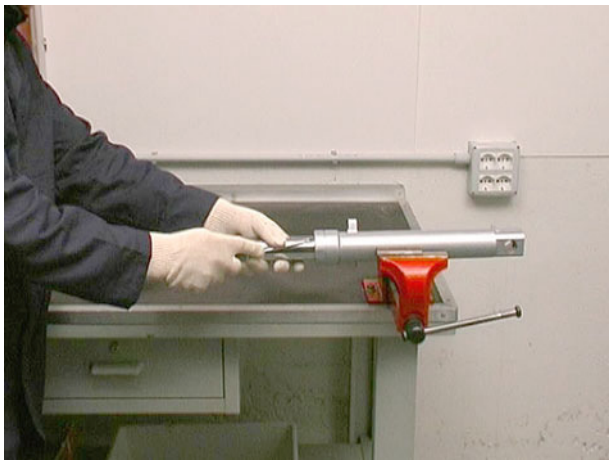
- Slide the stanchion into the slider and push it fully home.

- Screw in the foot screw with its seal and tighten it to the prescribed torque.

- Place the retainer and the well-lubricated seal ring on the stanchion tube.
- Push the seal ring fully home inside the slider by using the specific inserter tool.



- Install the retaining ring.



- Install the wiper seal.
- Pour oil into the stanchion ensuring that it also fills the internal passages of the plunger rod.
- Pump the stanchion up and down to ensure the plunger rod is completely filled with oil.
- Insert the spring and preload tube.
- Fit the plug on the stanchion tube taking care not to damage the O-ring. Tighten the plug to the prescribed torque.

7.1.9. REASSEMBLY OF THE FORK LEG

- Fit the fork leg to the motorcycle, passing it through the lower plate and the upper plate.

- Tighten the screws to the prescribed torque.

7.1.10. TIGHTENING TORQUES

FRONT SUSPENSION	
Centre stand to frame fixing screws	10
Lock nut	30
Fork head fixing screws	45
Fork base fixing screws	45
Slider to wheel spindle fixing screws	10

7.2. ADJUSTING PLAY IN THE STEERING BEARINGS

7.2.1. ADJUSTING PLAY IN THE STEERING BEARINGS

- Remove the handlebars
- Remove the dashboard
- Working on both sides, unscrew and remove the screw that secures the top plate to the front forks
- Unscrew and remove the central nut
- Remove the top plate from the front fork

- Adjust the ringnut
- Position the top plate on the front fork
- Tighten the central nut

- Working on both sides unscrew and remove the screw that secures the top plate to the front forks
- Fit the handlebars
- Fit the dashboard.

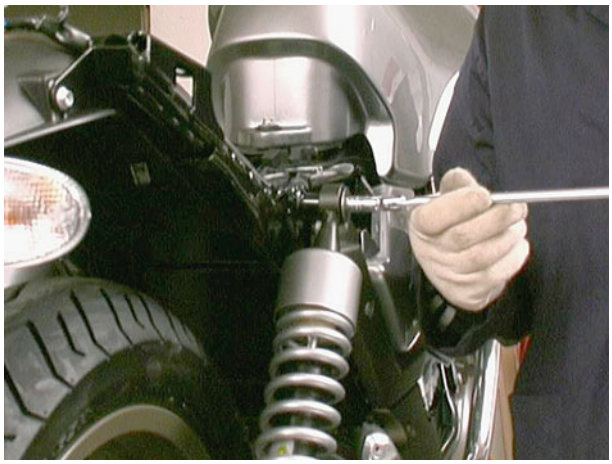
7.2.2. TIGHTENING TORQUES

STEERING	
Steering head fixing screw	50 Nm

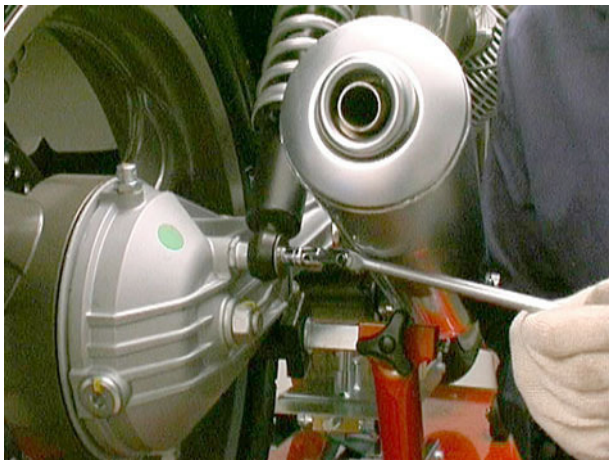
7.3. REAR SUSPENSION

7.3.1. REMOVAL FROM THE MOTORCYCLE

- Unscrew the screws that secure the suspension struts to the frame.



- Unscrew the screw that secures the suspension strut to the rear swing arm.
- Unscrew the screw that secures the suspension strut to the transmission case.



- Remove the suspension struts from the pins.

7.3.2. INSPECTION

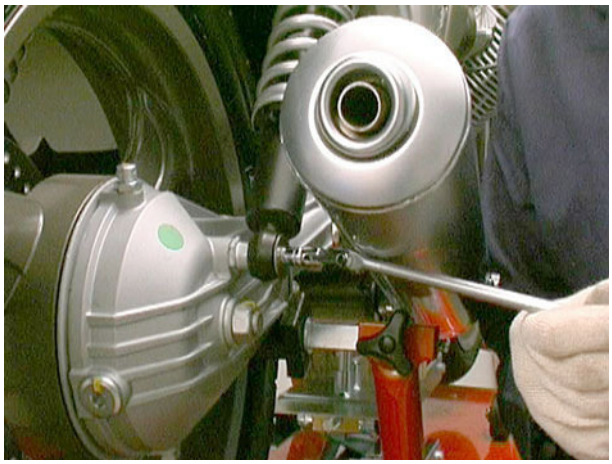
- Check the condition of the springs and the dampers (always inspect in pairs in order to ensure they present identical preload to avoid unequal forces being exerted on the rear swing arm and the transmission case); if necessary, renew either the springs or the complete suspension struts.
- Check that the flexible bushes on the struts for possible degradation or hardening and renew if necessary. If you notice irregularities in the cushioning action of the dampers, they must be renewed.

IMPORTANT *To ensure good stability of the motorcycle, both the suspension springs must be adjusted to the same position.*

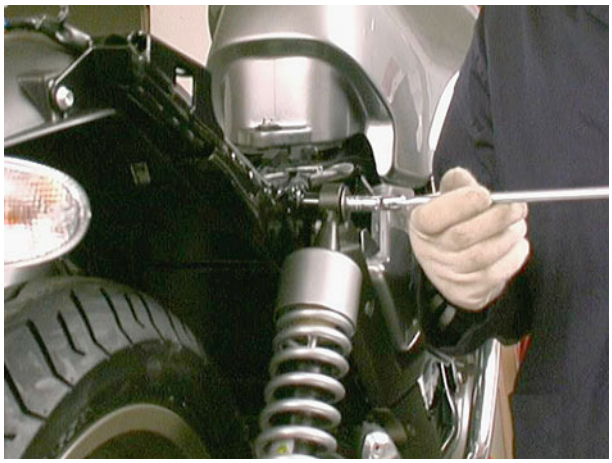
7.3.3. REASSEMBLY

- Fit the struts onto the pins.

- Tighten the screw that secures the rear suspension strut to the transmission case.
- Tighten the screw that secures the suspension strut to the rear swing arm.



- Tighten the screws that secure the rear suspension struts to the frame.



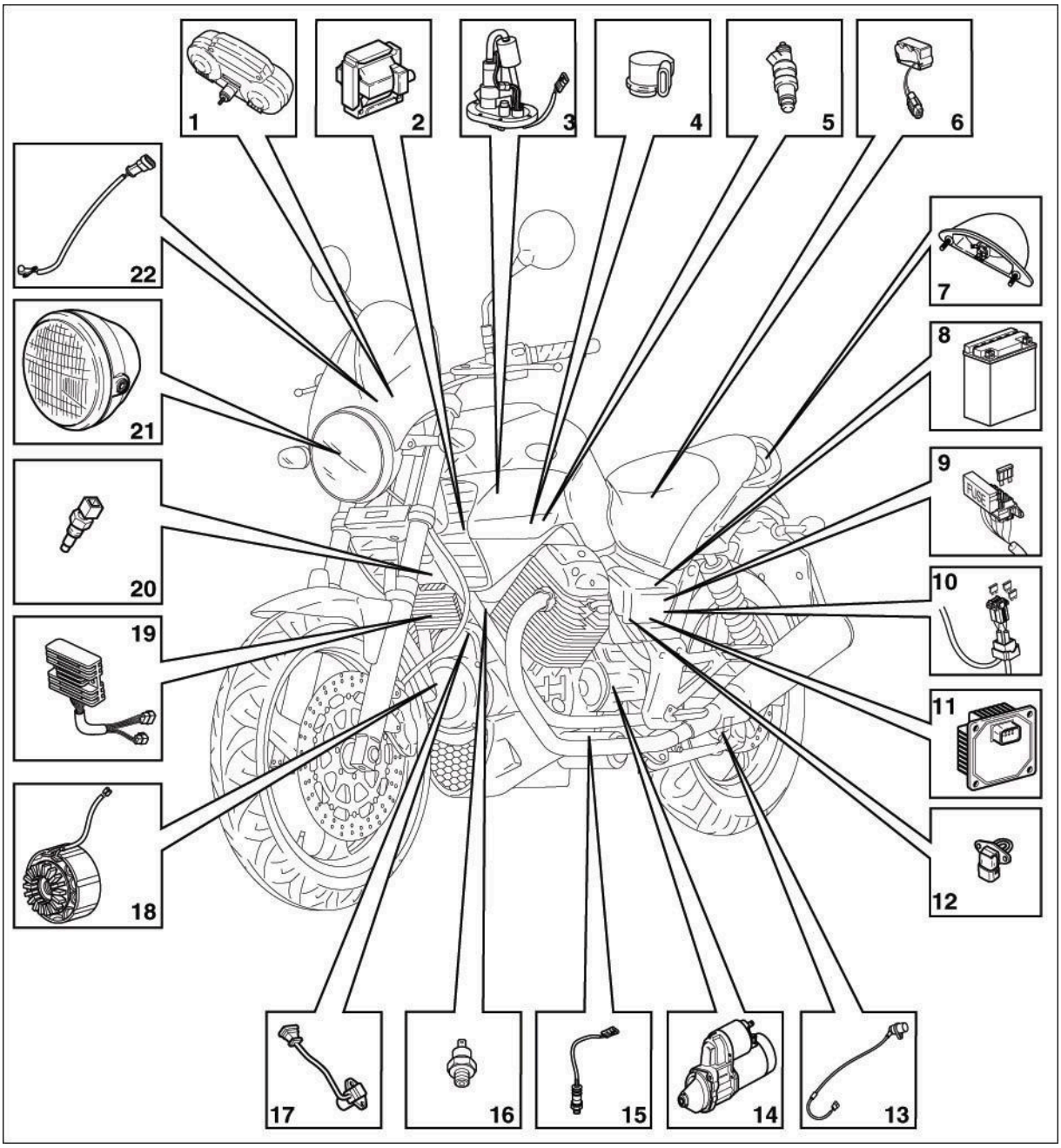
7.3.4. TIGHTENING TORQUES

REAR SUSPENSION	
Rear suspension upper and lower sections fixing screws	20 Nm

SUMMARY

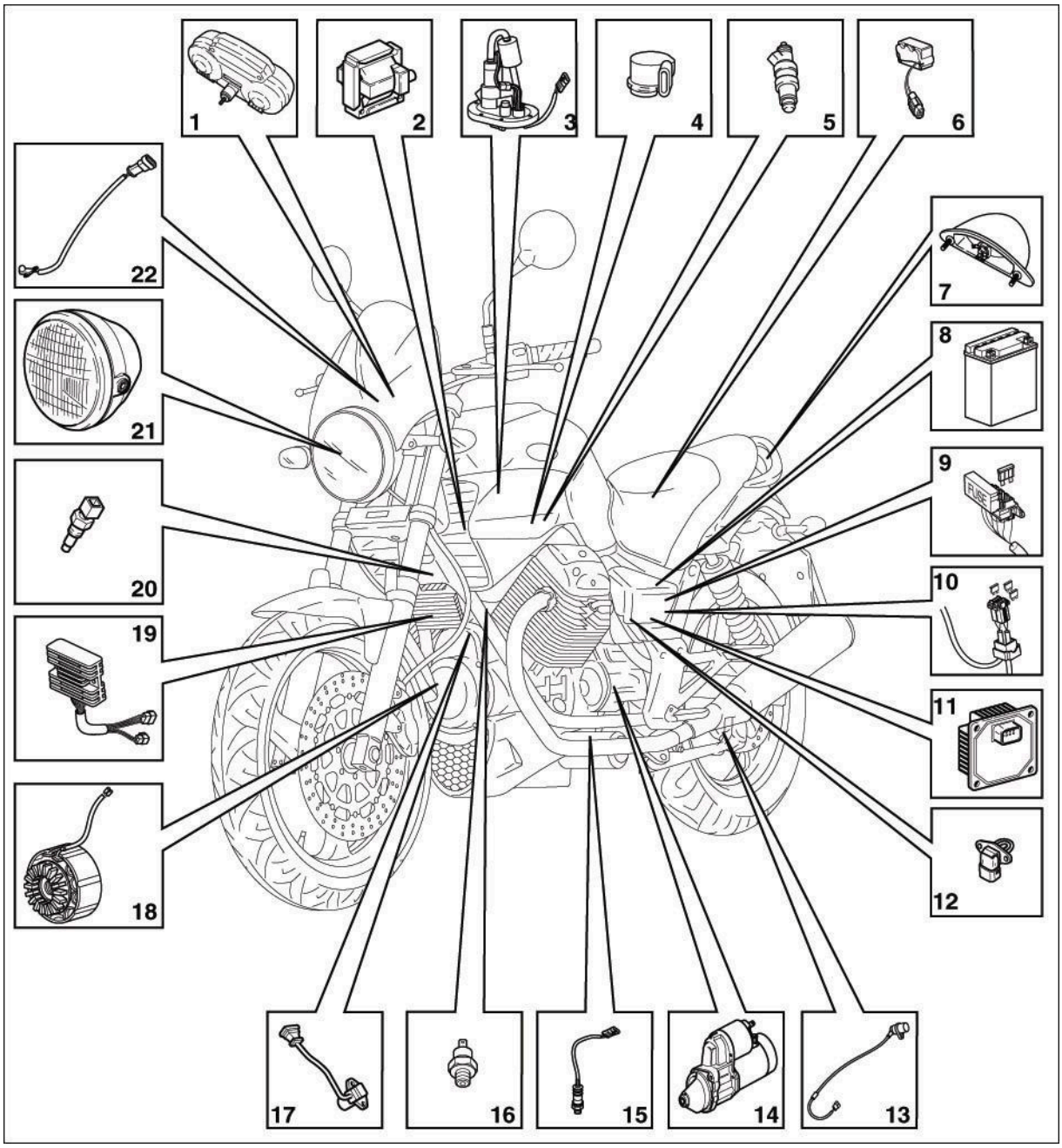
8.1. ELECTRICAL SYSTEM

8.1.1. COMPONENTS LAYOUT



Key:
1. Dashboard
2. Coil
3. Fuel pump
4. Throttle potentiometer (TPS)
5. Injector
6. Bank angle sensor
7. Tail-light
8. Battery
9. Secondary fuses
10. Main fuses
11. Engine control unit
12. Air temperature sensor
13. Speed sensor
14. Starter motor
15. Lambda sensor
16. Engine oil pressure sensor
17. Engine speed sensor
18. Alternator
19. Voltage regulator
20. Cylinder head temperature sensor
21. Headlight
22. Dashboard air temperature sensor

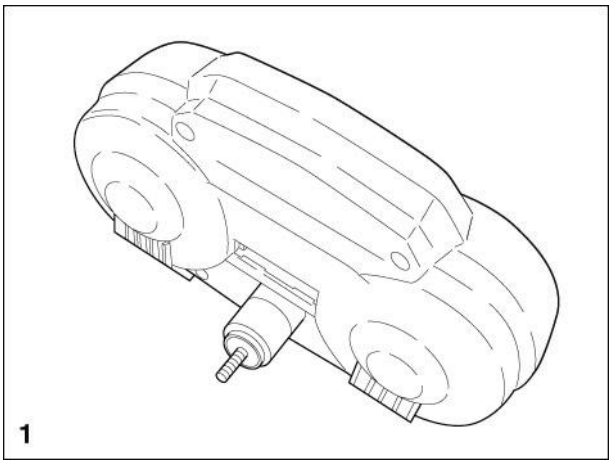
8.1.2. COMPONENTS CHECK



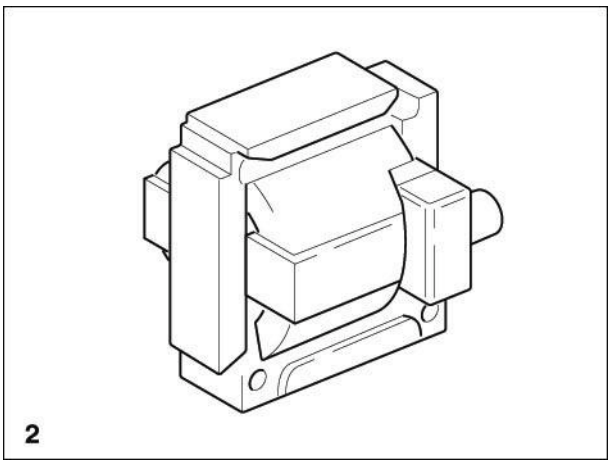
1 DASHBOARD

DASHBOARD PINOUT

Pin	Designation	Signal type
1	Right turn signal switch	Digital input
2	Vehicle speed sensor power supply	Power output
3	Right turn signal switch	Digital input
4	Dashboard power supply (+15)	Power input
5	Engine speed signal	Frequency input
6	Fuel level sensor signal	Analog input
7		
8	Fuel level sensor ground	Analog input
9		
10	Vehicle speed sensor power supply	Power output
11	Air temperature sensor ground	Analog input
12	Vehicle speed sensor signal	Frequency input
13	Air temperature sensor signal	Analog input
14		
15		
16		
17		
18	Neutral gear indicator	Digital input
19		
20	Oil pressure sensor signal	Digital input
21		
22	Engine control unit fault signal	Digital input
23		
24		
25	Dashboard power supply (ground)	Power input
26	High beam indicator lamp control	Power input
27	Dashboard power supply (+30)	Power input
28	Left turn signal control	Power output
29	Dashboard power supply (+30)	Power input
30	Right turn signal control	Power output

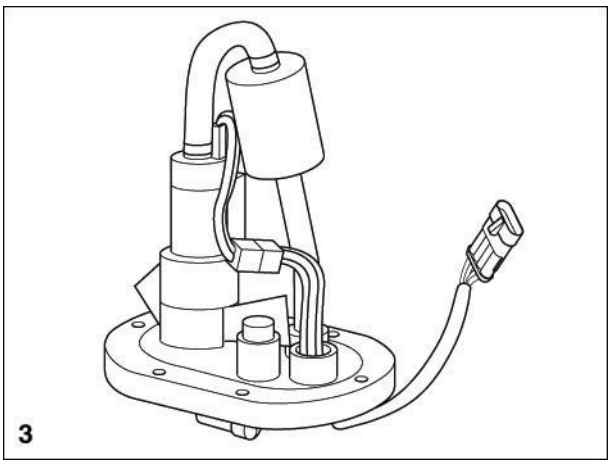

1

2 COIL
primary resistance: 0.5-0.6 Ω
secondary resistance: 3.3 KΩ

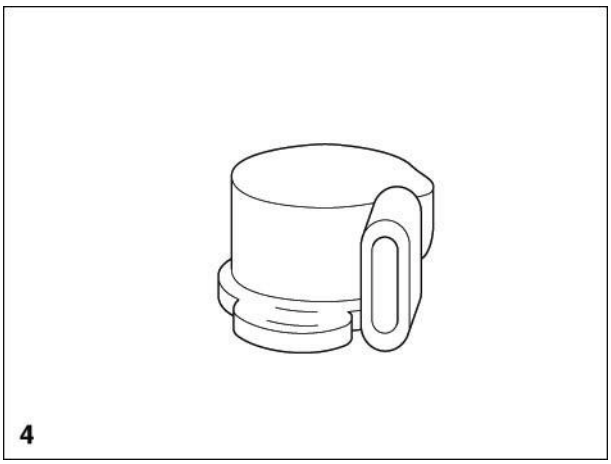

2

3 FUEL PUMP
Fuel pump
power draw 4A (with power supply of 12V measured across pins 1 and 2)

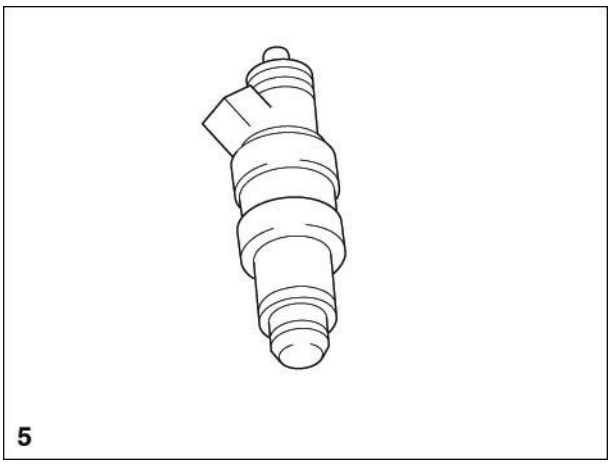
Fuel level sensor:
resistance 1.4KΩ (measured across pins 3 and 4 with fuel level 0 litres)


3

4 THROTTLE POTENTIOMETER (TPS)
resistance 1290 Ω (measured across pins A and B)
resistance 1110-2400 Ω (in accordance with the throttle position; measured across pins A and C)
output voltage 0.15-4.4 V (in accordance with the throttle position, measured across pins C and A)

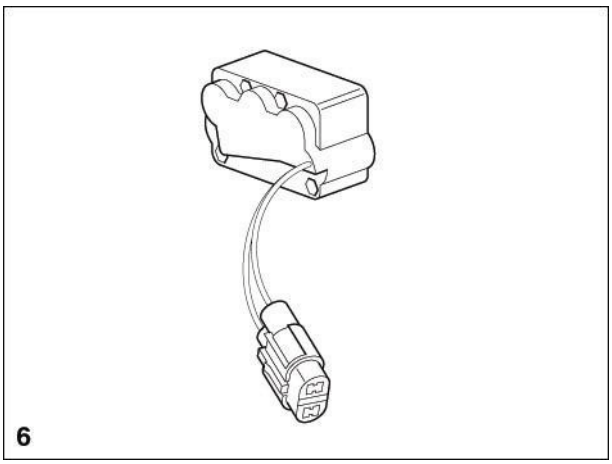

4

5 INJECTOR
resistance 16 Ω


5

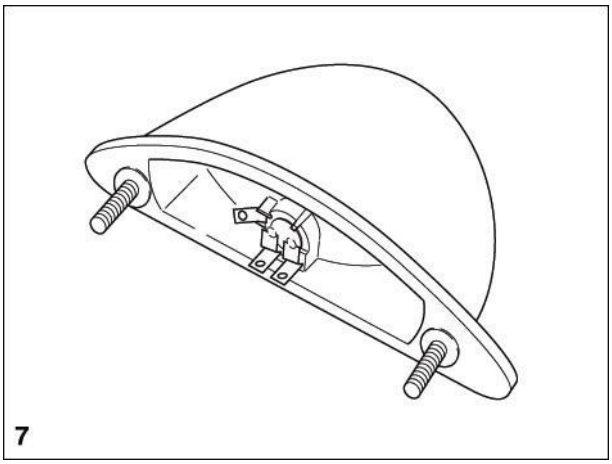
6 BANK ANGLE SENSOR

normally open contact
resistance 0 Ω when sensor is rotated through an angle of 90° with respect to its mounting position.


6

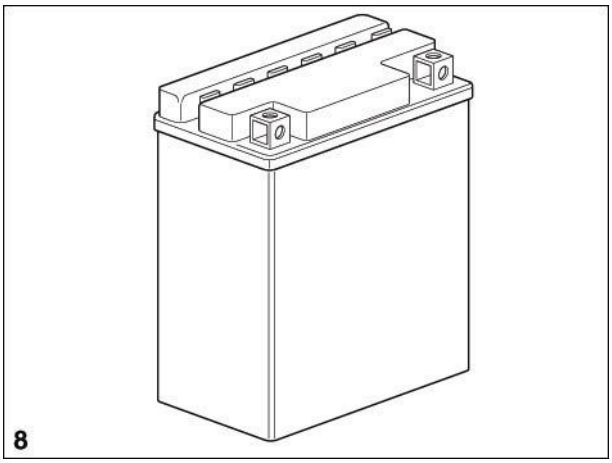
7 TAIL-LIGHT

rear parking light/brake light: 12V – 5/21 W
number plate light 12V – 5 W


7

8 BATTERY

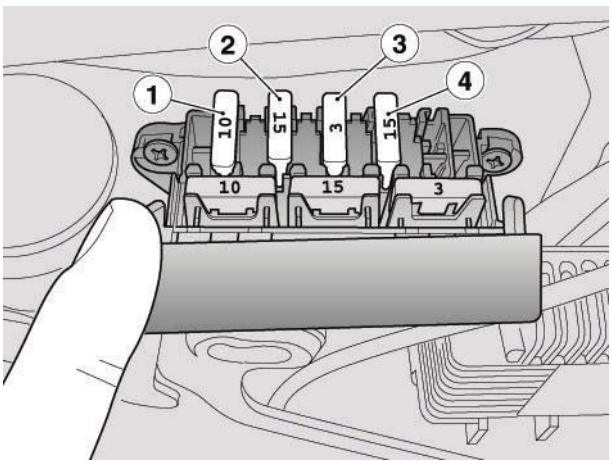
12 V – 14 Ampere/hour


8

9 SECONDARY FUSES

A – From ignition key to safety logic / starting (10 A).
B – From ignition key to lights, brake lights, horn, turn signals (15 A).
C – From battery to injection permanent power supply (3 A).
D – From battery to injection (15 A).
E – Free

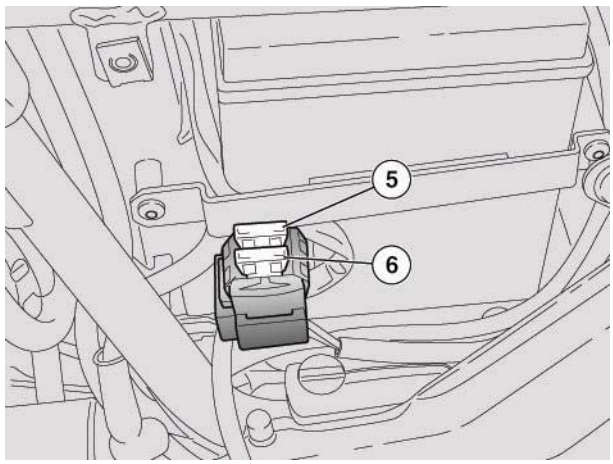
IMPORTANT *Three spare fuses are supplied (3, 10, 15 A).*



10 MAIN FUSES

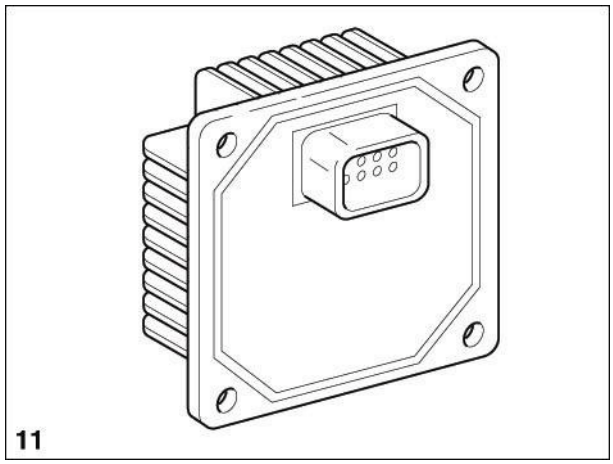
F – From battery to voltage regulator (30 A).
G – From battery to ignition key and fuses C and D (30 A).

IMPORTANT *One spare fuse is supplied.*



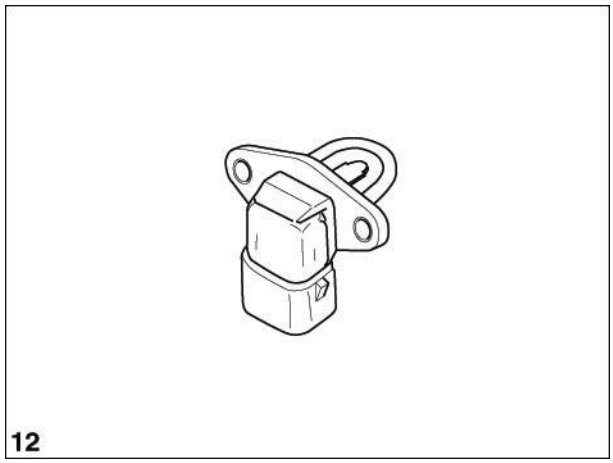
11 ENGINE CONTROL UNIT

Magneti Marelli 15 RC engine control unit



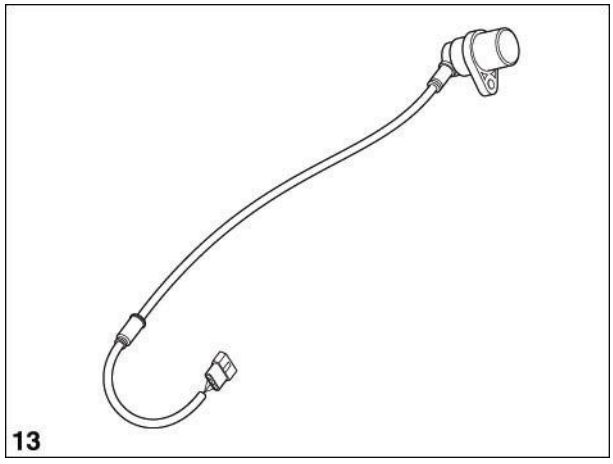
12 INTAKE AIR TEMPERATURE SENSOR

NTC type sensor
resistance 3.7 KΩ (temperature 20°C – 68°F)

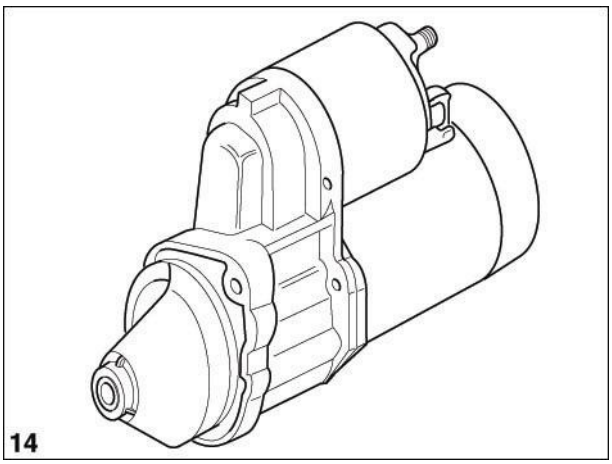


13 SPEED SENSOR

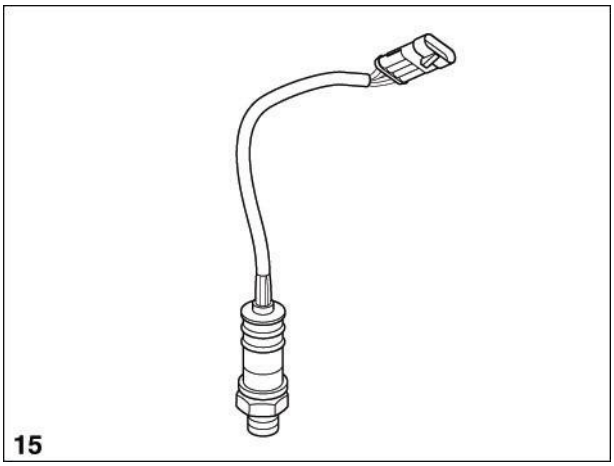
hall effect sensor with 6 pulse/revolution square wave output



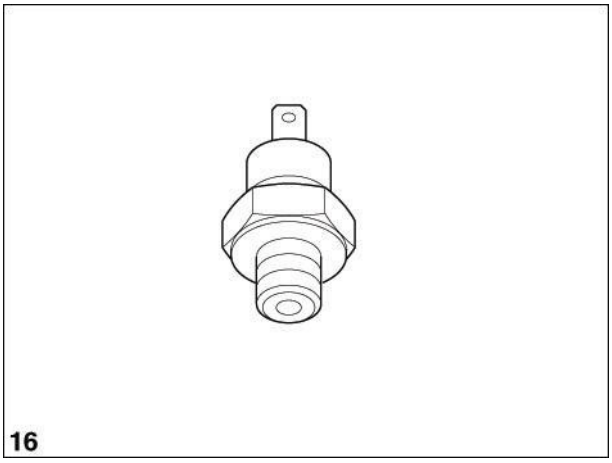
14 STARTER MOTOR
peak power draw approximately 100 A


14

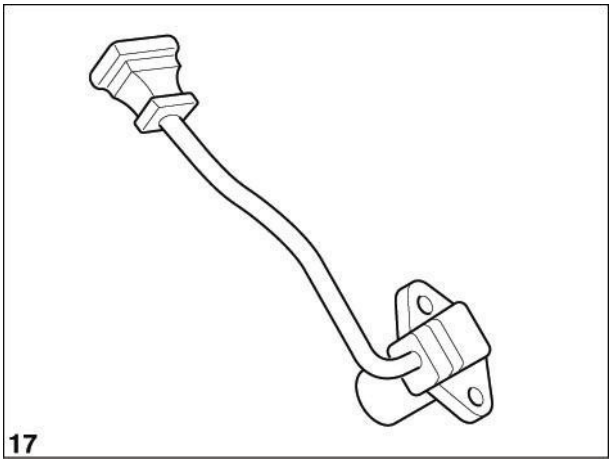
15 LAMBDA SENSOR
oxygen sensor with heater
sensor output between 0 and 0.9 V (measured across pins 1 and 2)
heater resistance 12.8 Ω (measured across pins 3 and 4 at temperature of 20°C – 68°F)


15

16 ENGINE OIL PRESSURE SENSOR
normally open contact

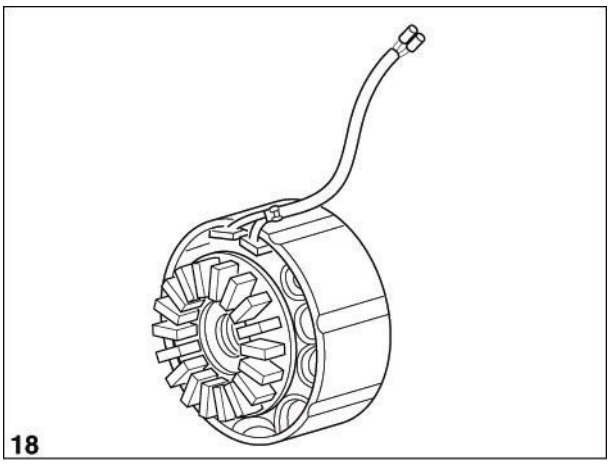

16

17 ENGINE SPEED SENSOR
inductive type sensor
winding resistance 650 Ω (measured across pins 1 and 2)
output voltage 0-5 V (measured during drive)


17

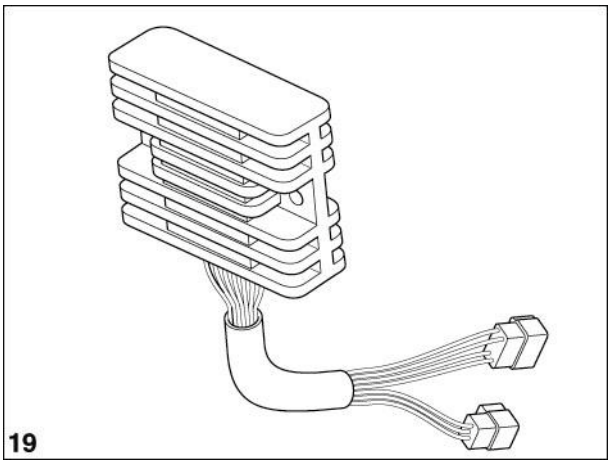
18 ALTERNATOR

330 W
single phase alternator
winding resistance 0.2-0.3 Ω
output voltage 20 V AC (measured with alternator disconnected from electrical system and engine idling)
output voltage 65 V AC (measured with alternator disconnected from electrical system and engine at 4000 rpm)


18

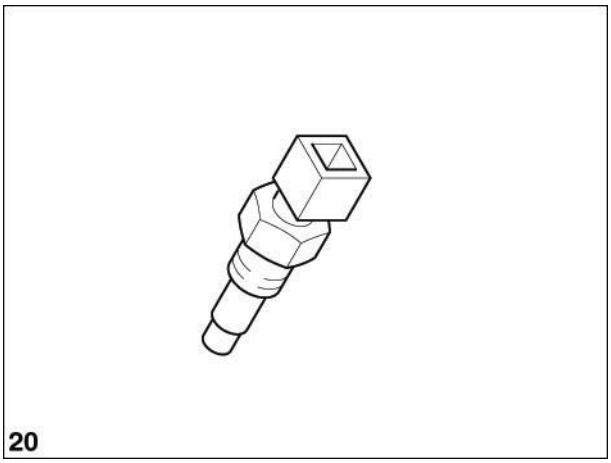
19 VOLTAGE REGULATOR

voltage to measure at battery poles (from 13.5 to 14V with engine at 4000 rpm depending on load)


19

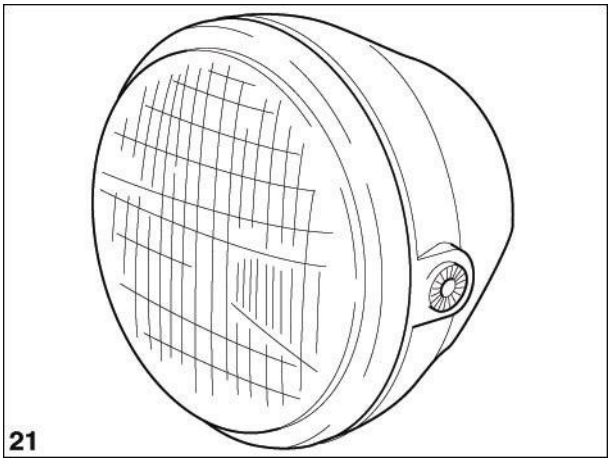
20 CYLINDER HEAD TEMPERATURE SENSOR

NTC type sensor
resistance 3.7 KΩ (temperature 20°C – 68°F)
resistance 220 Ω (temperature 100°C – 212°F)

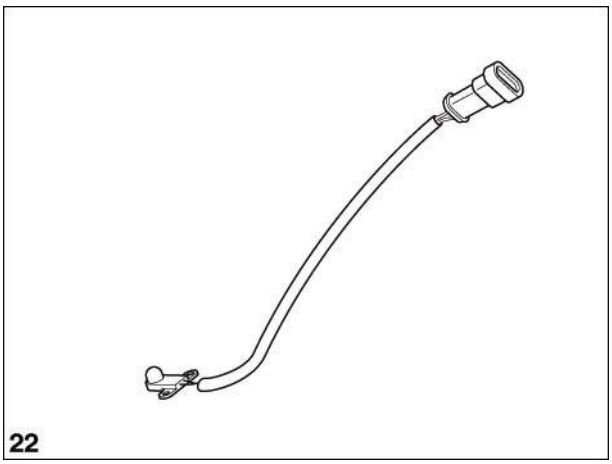

20

21 HEADLIGHT

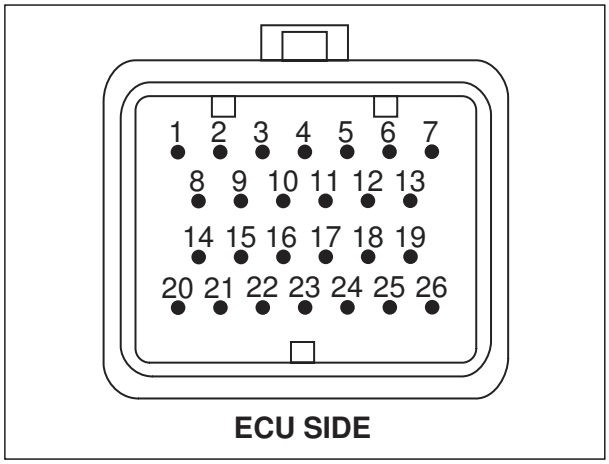
headlamp low beam / high beam (halogen): 12V – 55/60 W H4
front parking light: 12V – 5 W


21

22 DASHBOARD AIR TEMPERATURE SENSOR
resistance 32510 Ω (temperature 0°C + 2% – 32°F + 2%)
resistance 9960 Ω (temperature 25°C + 3% – 77°F + 3%)

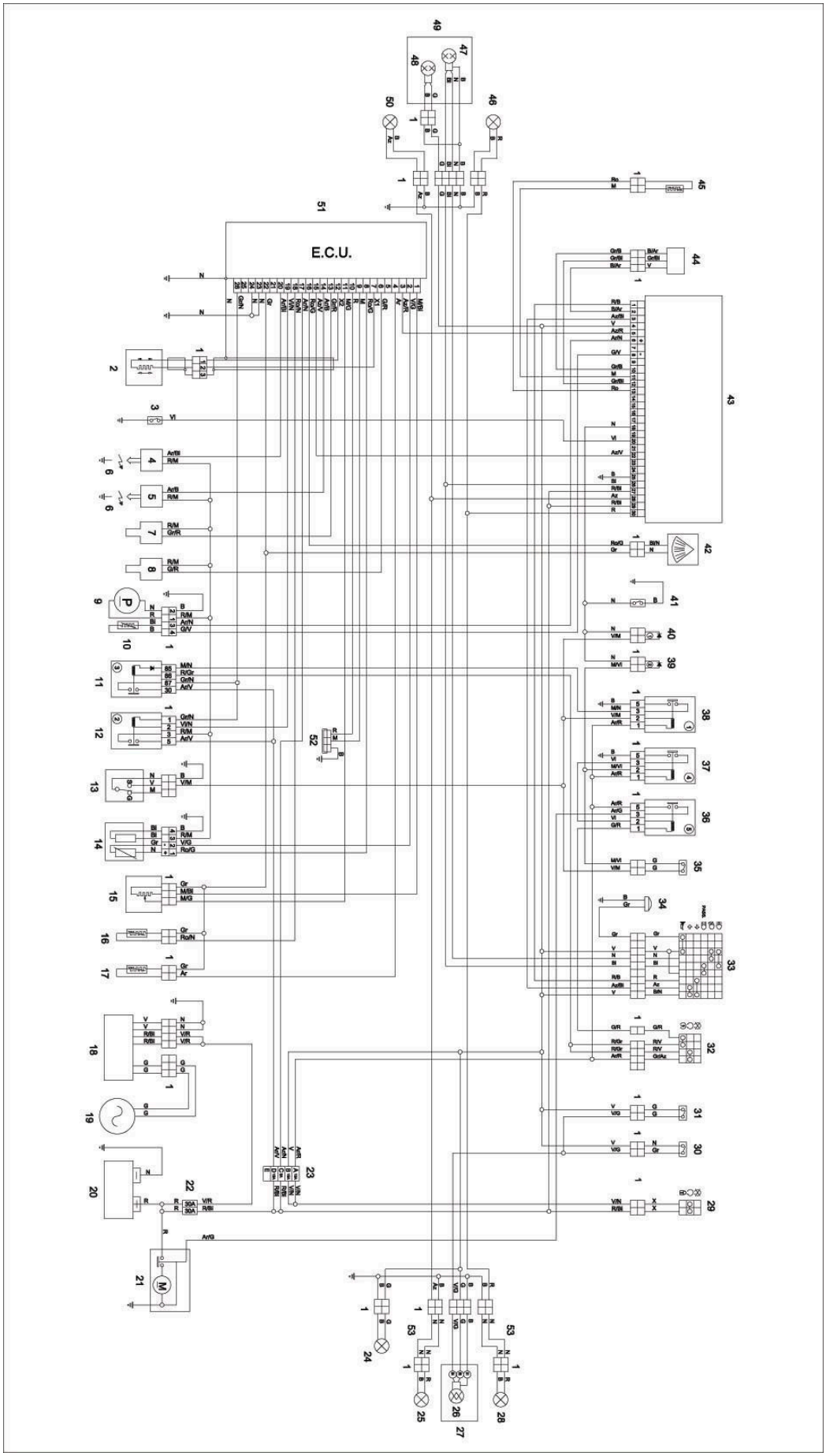


8.1.3. ECU CONNECTIONS



PIN	DESIGNATION	SIGNAL TYPE
1	Throttle position sensor power supply	Power output
2	Lambda sensor signal (ground)	Analog input
3	Rev counter control	Frequency output
4	Cylinder head air temperature sensor signal	Analog input
5		
6	Right-hand injector control	Power output
7	Engine speed sensor	Frequency input
8	Lambda sensor signal (positive)	Analog input
9	Diagnostics line (K)	Communication line
10	Diagnostics line (L)	Communication line
11	Throttle position signal	Analog input
12	Engine speed sensor	Frequency input
13	Right-hand injector control	Power output
14	Right-hand coil control	Power output
15	Injection indicator light control	Digital output
16	Bank angle sensor signal	Digital input
17	Engine control unit power supply	Power input
18	Intake air temperature sensor signal	Analog input
19	Injection relay control	Digital output
20	Left-hand coil control	Power output
21		
22	Sensors power supply (ground)	Power output
23	Engine control unit power supply (ground)	Power input
24	Engine control unit power supply (ground)	Power input
25		
26	Engine control unit power supply (+15)	Power input

8.1.4. WIRING DIAGRAM



Key:
1. Multiple connectors
2. Engine speed sensor
3. Engine oil pressure sensor
4. Left-hand coil
5. Right-hand coil
6. Spark plugs
7. Left-hand injector
8. Right-hand injector
9. Fuel pump
10. Low fuel sensor
11. Main injection relay (with diode)
12. Secondary injection relay
13. Side stand switch
14. Lambda sensor
15. Accelerator sensor
16. Engine air thermistor
17. Cylinder head temperature sensor
18. Voltage regulator
19. Alternator
20. Battery
21. Starter motor
22. Main fuses
23. Secondary fuses
24. Number plate light
25. Rear left-hand turn signal
26. Parking light/brake light lamp
27. Tail light
28. Rear right-hand turn signal
29. Ignition keyswitch
30. Front brake light switch
31. Rear brake light switch
32. Right-hand lights selector switch
33. Left-hand lights selector switch
34. Warning horn
35. Clutch switch
36. Starter motor relay
37. "B" safety logic relay
38. "A" safety logic relay
39. Diode 1
40. Diode 2
41. Neutral gear switch
42. Bank angle sensor
43. Dashboard
44. Speed sensor
45. Dashboard air temperature thermistor
46. Front right-hand turn signal
47. Headlamp low beam / high beam
48. Front parking light lamp
49. Headlight
50. Front left-hand turn signal
51. Engine control unit
52. Diagnostic tester socket
53. Extension (only for saddlebags kit)

SECONDARY FUSES:

A	Safety logic / starting
B	Brake, parking, and high lights, horn
C	Injection permanent power supply
D	Injection
E	Free

CABLE COLOURS

Ar	orange
Az	light blue
B	blue
Bi	white
G	yellow
Gr	grey
M	brown
N	black
R	red
Ro	pink
V	green
Vi	purple