



SERVICE STATION MANUAL

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Engine V85 E4-E5-E5+



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SERVICE STATION MANUAL

Engine V85 E4-E5-E5+

This workshop manual has been produced for consultation by the technical staff of Dealerships, Service Centres, Authorised Service Network Workshops.

This manual is addressed to service mechanics who are supposed to have a basic knowledge of mechanics principles and of vehicle mounting techniques and procedures.

Any technical changes made to the vehicles or to specific mounting operations will be promptly reported by updates to this manual.

In order to achieve satisfactory operations, it is necessary to have adequate work areas and the necessary specific equipment or hierarchies.

N.B.

Indicates a note that provides information to make the process easier and clearer.

IMPORTANT

Indicates the specific processes that must be followed in order to prevent possible injury to the person repairing the vehicle.

WARNING

Indicates the specific processes that must be followed in order to prevent damage to the vehicle.



avvertenze-sicurezza-titolo The total or partial failure to follow these instructions may lead to serious personal injury.



Environmental Protection

Indicates the correct behaviour to adopt for an environmentally-friendly use of the vehicle.



Vehicle Integrity

The total or partial failure to follow these instructions may lead to serious damage to the vehicle and may even invalidate the warranty.

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LIST OF TOPICS

General mandatory requirements

General Information

This section contains general information regarding the vehicle and the use of the manual, as well as important notes regarding safety.

WARNINGS AND IMPORTANT NOTES

Each symbol has a precise meaning, as illustrated below.

- **IMPORTANT:** - This symbol indicates risks for the health of the operator and of the nearby persons if the described procedures are performed incorrectly.
- **WARNING:** - This symbol indicates that the component on which works are being performed may be damaged if the described procedures are performed incorrectly.
- **NOTE:** - This paragraph provides additional instructions for the ongoing procedure, so that the operation may be performed in an efficient manner.

REACH REGULATION WARNINGS :

To protect the health and safety of the PROFESSIONAL CLIENT, as provided by the:

- (EC) Regulation No. 1907/2006 (REACH);
- 2000/53/EC (END of LIFE VEHICLES);
- SCIP Database Directive (art.9, par.1 lett.i) of the framework directive regarding waste, as modified by the Directive 2018/851

-
- 1 . chemical protection gloves if the specific type is not explicitly indicated, or, if required, special gloves according to the substance used;
 - 2 . mask, possibly a chemically active one, if specifically required;
 - 3 . protective goggles.

The above indications represent an alternative for the prescriptions of other regulations and of the legislation in force in the specific countries. Regarding the use of other PPE, governed by the laws regarding the safety at work, the relevant legislation in force apply.

GENERAL SAFETY WARNINGS :

-
- 1 . Always wear protective goggles and proper clothing.
 - 2 . Always use a safety support to operate under the vehicle.
 - 3 . Check that the ignition switch is always OFF, unless the procedure indicates otherwise.
 - 4 . Pull the hand brake (if applicable) before starting working on the vehicle.
 - 5 . Start the engine only in well ventilated places, to avoid the risks related to the carbon oxide.
 - 6 . Keep a safe distance from the mobile parts during the operation of the engine, especially from the fans and belts.
 - 7 . To avoid burns, avoid contact with the hot metallic parts, such as the radiator, exhaust manifold, exhaust pipe, catalytic converter and silencer.
 - 8 . Do not smoke during maintenance operations.
 - 9 . To avoid any injuries, do not wear rings, watches, jewellery and loose clothing before starting to work on the vehicle.
 - 10 . Keep your hands and other objects away from the blades of the radiator's fan (if present)!
 - 11 . The cooling fan (if present) is fitted on the radiator and may start any time due to a temperature increase of the cooling fluid. It is important to check that the cooling fan's starter motor is disconnected from the wiring harness before starting the works.

The units of measurement used in this manual are indicated as **SI UNITS** (International System of Units). Example: 24,5 ÷ 34,3 Nm



1.1 maintenance instructions

GENERAL PRECAUTIONS AND INFORMATION

When repairs, disassembly and reassembly of the vehicle is carried out, follow the following recommendations strictly.

BEFORE REMOVING COMPONENTS

- Remove the dirt, mud, dust and foreign objects from the vehicle before disassembling components. Wherever required, use the special tools designed for this vehicle.

COMPONENTS REMOVAL

- Do not loosen and/or tighten the screws and nuts using pliers or other tools, but always use the specific wrench.
- Mark the positions on all the connection joints (hoses, cables, etc.) before separating them and identify them with different distinctive marks.
- Each piece should be clearly marked in order to be identified during the installation phase.
- Carefully clean and wash the disassembled components with detergents with a low flammability grade.
- Keep the coupled parts together because they have "adapted" to one another following normal wear.
- Some components must be used together or replaced entirely.
- Keep away from heat sources.

REASSEMBLING THE COMPONENTS

WARNING



THE BEARING MUST ROTATE FREELY, WITHOUT JAMMING AND/OR NOISE, OTHERWISE THEY MUST BE REPLACED.

- Only use ORIGINAL **Moto Guzzi** SPARE PARTS.
- Always use the recommended lubricants and consumable material.
- Lubricate the parts (when possible) before reassembling them.
- When tightening screws and nuts, begin with the larger diameter or internal ones, proceeding diagonally. Tighten with subsequent steps before applying the prescribed torque.
- Always replace the locknuts, gaskets, seal rings, snap rings, O-Rings (OR), cotter pins and screws if they have damaged thread, with new ones.
- When disassembling the bearings, lubricate them abundantly.
- Ensure that each component has been assembled correctly.
- After a repair or periodic maintenance operation, carry out the preliminary checks and test the vehicle on private property or in an area with light traffic.
- Clean all coupling surfaces, oil seal rims and gaskets before refitting them. Smear a light layer of lithium-based grease on the oil seal rims. Reassemble oil seals and bearings with the brand or lot number facing outward (visible side).

ELECTRICAL CONNECTORS

The electrical connectors should be disconnected as follows. Failure to observe these procedures will cause irreparable damage to the connector and the wiring:

If present, press on the specific safety catches.

- Grip the two connectors and unplug them, pulling them apart in opposite directions.
- If there is dirt, rust, moisture, etc., carefully clean the inside of the connector using pressurised air.
- Ensure that the cables make correct contact with the terminals inside the connectors.
- Then plug in the two connectors, ensuring correct coupling (if the specific catches are present, you will hear a typical "click").

WARNING



TO UNPLUG THE TWO CONNECTORS, DO NOT PULL ON THE CABLES.

N.B.:



THE TWO CONNECTORS CAN BE PLUGGED IN ONLY IN ONE DIRECTION, THEREFORE JOIN THEM TOGETHER IN THE RIGHT DIRECTION.

TIGHTENING TORQUES

WARNING



IN THE EVENT THAT A SELF-BRAKING NUT IS UNSCREWED, IT IS NECESSARY TO REPLACE IT WITH A NEW ONE.

CAUTION



REMEMBER THAT THE TIGHTENING TORQUE FOR ALL THE FIXING ELEMENTS LOCATED ON WHEELS, BRAKES, WHEEL AXLES AND OTHER SUSPENSION COMPONENTS PLAY A FUNDAMENTAL ROLE IN GUARANTEEING THE SAFETY OF THE VEHICLE AND MUST BE KEPT AT THE PRESCRIBED VALUES.

REGULARLY CHECK THE TIGHTENING TORQUE OF THE FIXING ELEMENTS AND ALWAYS USE A TORQUE WRENCH WHEN REFITTING.

IF THESE WARNINGS ARE NOT OBSERVED, ONE OF THESE COMPONENTS COULD LOOSEN AND COME OFF, BLOCKING A WHEEL OR CAUSING OTHER PROBLEMS THAT WOULD COMPROMISE MANOEUVRABILITY, LEADING TO A CRASH WITH THE RISK OF SERIOUS INJURY OR EVEN DEATH.

LIST OF TOPICS

Specifications

2.1 Tightening torques

If the following tables do not expressly indicate the tightening torque values, refer to the table with the generic torque values indicated below.

GENERAL TIGHTENING TORQUES

	M4	M5	M6	M8	M10	M12
Metric tightening torque: TE -	3 Nm	6 Nm	10 Nm	25 Nm	50 Nm	80 Nm
TEFL - SHC - TBEI - TCC - TS	(2.21 lbf ft)	(4.43 lbf ft)	(7.38 lbf ft)	(18.44 lbf ft)	(36.88 lbf ft)	(59.00 lbf ft)

GENERAL TIGHTENING TORQUES FOR SELF TAPPING SCREWS FOR PLASTIC

	2.9 mm	3.9 mm	4.2 mm	5 mm
Tightening torque	2 Nm (1.48 lbf ft)	2 Nm (1.48 lbf ft)	3 Nm (2.21 lbf ft)	3 Nm (2.21 lbf ft)

WARNING

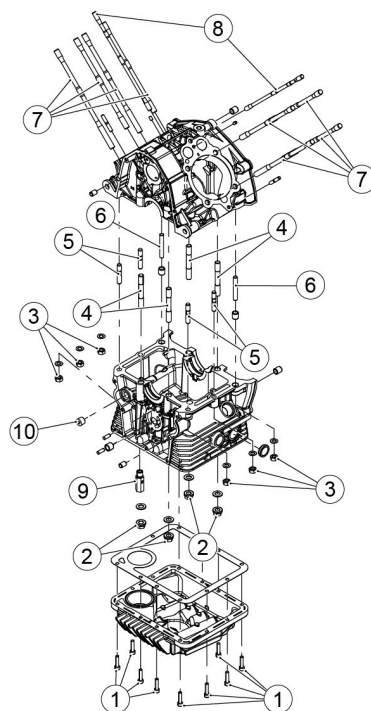


THE SCREWS WITH THREAD-LOCK SEALANT (PRE-IMPREGNATED) MUST BE REPLACED WITH NEW SCREWS AFTER THEY HAVE BEEN LOOSENED.

BEFORE FITTING THE NEW SCREWS, CLEAN THE THREADED HOLES CAREFULLY, MAKING SURE THAT ALL TRACES OF THE OLD THREAD-LOCK SEALANT HAVE BEEN ELIMINATED.

2.1.1 Engine

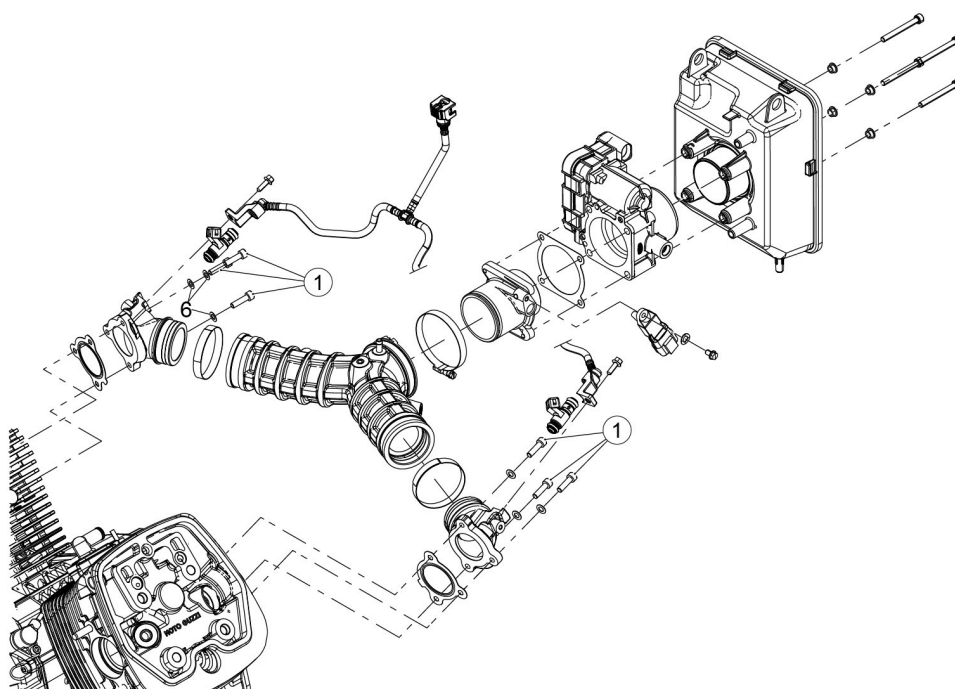
CARTERS



POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Oil sump screws (Euro 4 - Euro 5)	SHC M6	14	9-11 Nm (6.64-8.11 lb ft)	-
1	Oil sump screws (Euro 5 Plus)	SHC M6	14	12 - 14 Nm (8.85 - 10.33 lb ft)	-
2	Crankcase half flanged nuts (pre-tightening)	M10	4	22-27 Nm (16.23-19.91 lb ft)	-
2	Crankcase half flanged nuts (final tightening)	M10	4	44-49 Nm (32.45-36.14 lb ft)	-
3	Crankcase half nuts	M8	6	30 - 34 Nm (22.13 - 25.08 lb ft)	-
4	Crankcase half stud bolts	M10	4	22-25 Nm (16.23-18.44 lb ft)	Pre-applied Loct.; alternatively Loct. 2510
5	Crankcase half stud bolts	M8	4	22-25 Nm (16.23-18.44 lb ft)	Loct. 648

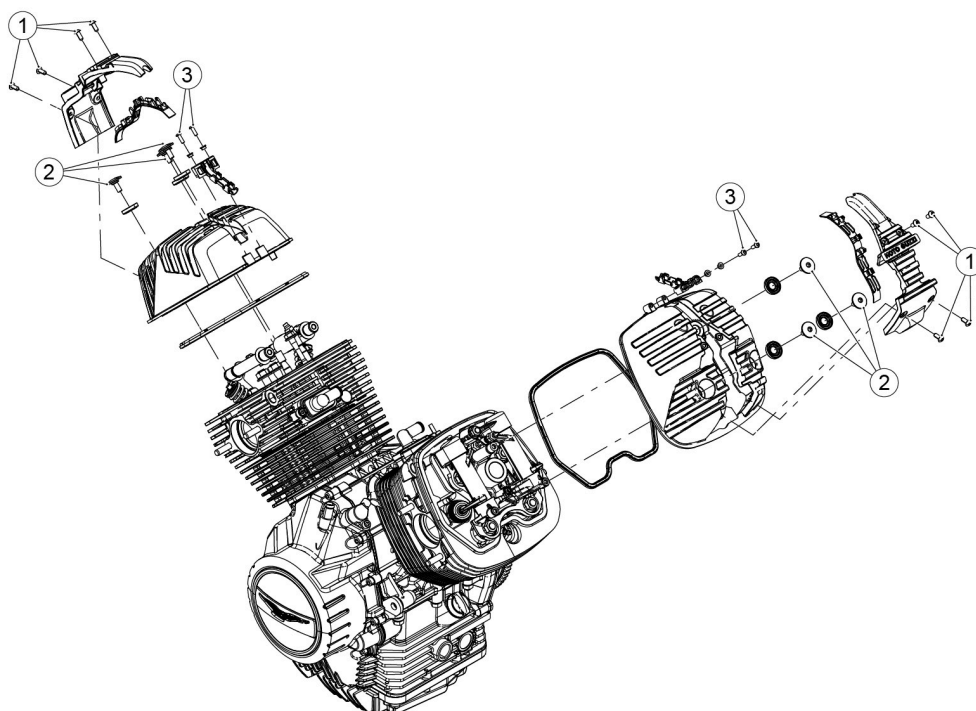
POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
6	Crankcase half stud bolts	M8	2	22-25 Nm (16.23-18.44 lb ft)	Loct. 648
7	Long/short head stud bolts	M10	8	9-11 Nm (6.64-18.44 lb ft)	Pre-applied Loct.; alternatively Loct. DRI- LOC 211 / 3M SCOTCH GRIP 2510
8	Central head stud bolts	M8	2	9-11 Nm (6.64-18.44 lb ft)	Pre-applied Loct.; alternatively Loct. DRI- LOC 211 / 3M SCOTCH GRIP 2510
9	Oil filter joint	M12	1	20-24 Nm (14.75-17.70 lb ft)	-
10	Cap	M14	1	15-19 Nm (11.06-14.01 lb ft)	Pre-applied Loct. - LOCTITE DRI-SEAL 506 alternatively LOCTITE 5061 - Regularly check that the cap is flush with the surface

THROTTLED BODY

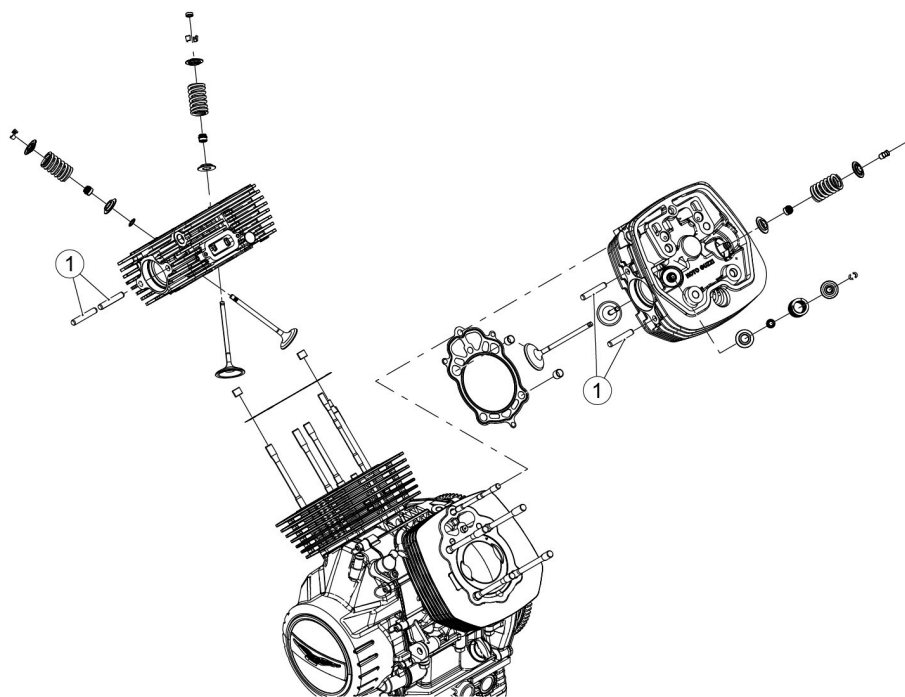


POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Intake fittings screws	M6x22	6	9-11 Nm (6.64-8.11 lb ft)	-

HEAD COVERS

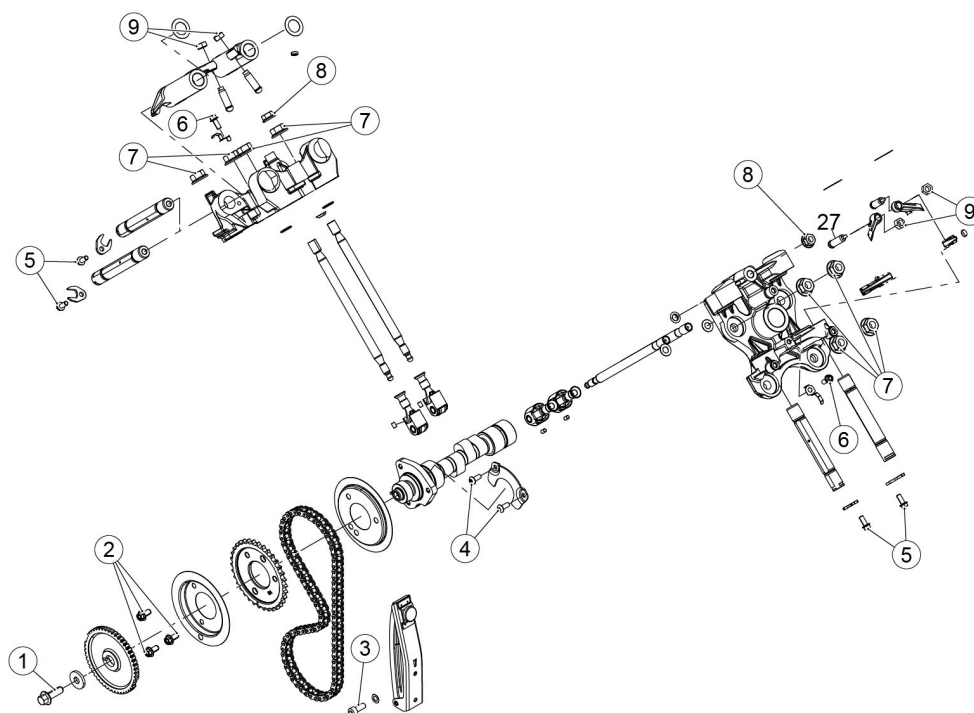


POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Spark plugs cover hex socket screws	M5x12	8	6-8 Nm (4.42-5.90 lb ft)	-
2	Head covers screws	M6	6	7-9 Nm (5.16-6.64 lb ft)	-
3	Rounded head torx screws for spark plugs cable clamp on head covers	M4	4	2.6-3.1 Nm (1.92-2.29 lb ft)	-
-	Spark plugs	-	2	10-12 Nm (7.38-8.85 lb ft)	-

HEAD - VALVES

POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Stud bolts for exhaust manifolds	M8	4	20-24 Nm (14.75-17.70 lb ft)	-

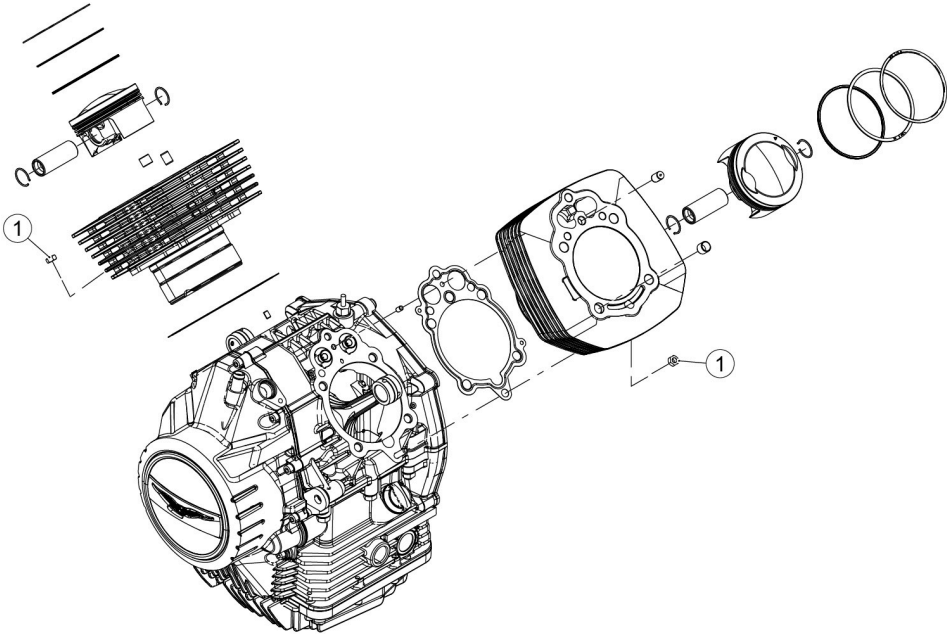
TIMING SYSTEM



POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Tone wheel flanged hex head screw (Euro 4 - Euro 5)	M8x25	1	28-32 Nm (20.65-23.60 lb ft)	Pre-applied Loct.
1	TEF scew for Timing CVT (Euro 5 Plus)	M8x25	1	30 - 34 Nm (22.13 - 25.08 lb ft)	-
2	Timing system sprocket flanged hex head screws (Euro 4 - Euro 5)	M6	3	9-11 Nm (6.64-8.11 lb ft)	Pre-applied Loct.; alternatively 3M SCOTCH-GRIP 2353
3	Chain tensioner screw	M6	1	9-11 Nm (6.64-8.11 lb ft)	-
4	Camshaft retainer plate torx rounded head screws	M5x12	2	6-7 Nm (4.42-5.16 lb ft)	Pre-applied Loct.; alternatively 3M SCOTCH-GRIP 2353
5	Rocker axles forks hex head flanged screws	M5x12	4	7 - 8 Nm (5.16 - 5.90 lb ft)	Loct. 243

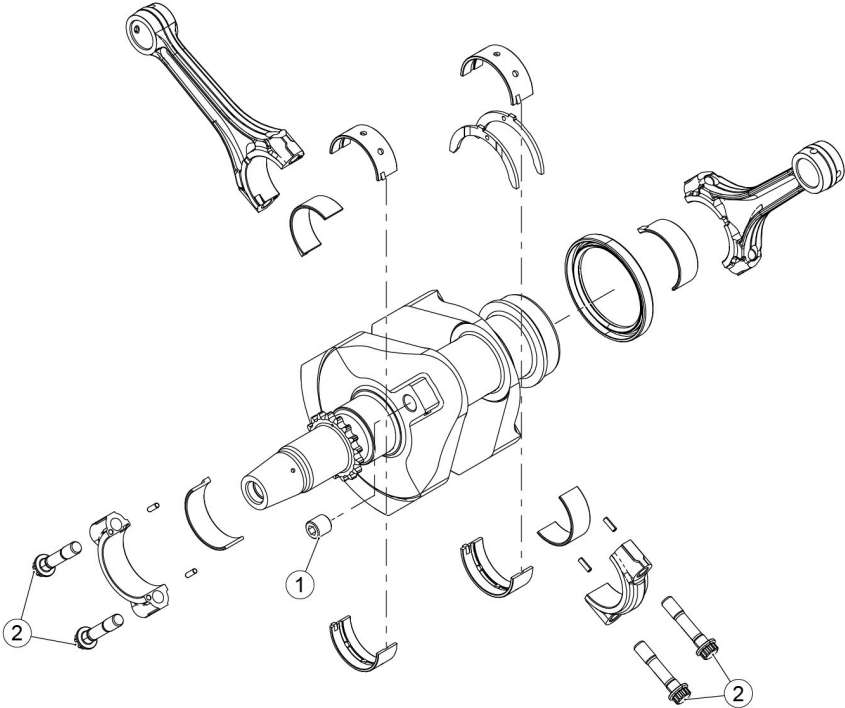
POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
6	Flanged HH screws for ground plates on rocker supports	M5x12	2	7 - 8 Nm (5.16 - 5.90 lb ft)	Loct. 243
7	Camshaft support nuts (pre-tightening)	M10	8	13-16.6 Nm (9.59-12.24 lb ft)	Lubricate the threads and the support surface with MOLYCOTE GRAPID PLUS SPRAY grease
7	Camshaft support nuts (final tightening)	M10	8	87°-93° - 24-34 Nm (17.70-25.08 lbf ft)	Lubricate the threads and the support surface with MOLYCOTE GRAPID PLUS SPRAY grease
8	Camshaft support flanged nut (pre-tightening)	M8	2	9-11.5 Nm (6.64-8.48 lb ft)	Lubricate the threads and the support surface with MOLYCOTE GRAPID PLUS SPRAY grease
8	Camshaft support flanged nut (final tightening)	M8	2	88°-92° - 14-18 Nm (10.32-13.28 lbf ft)	Lubricate the threads and the support surface with MOLYCOTE GRAPID PLUS SPRAY grease

CYLINDER - PISTON

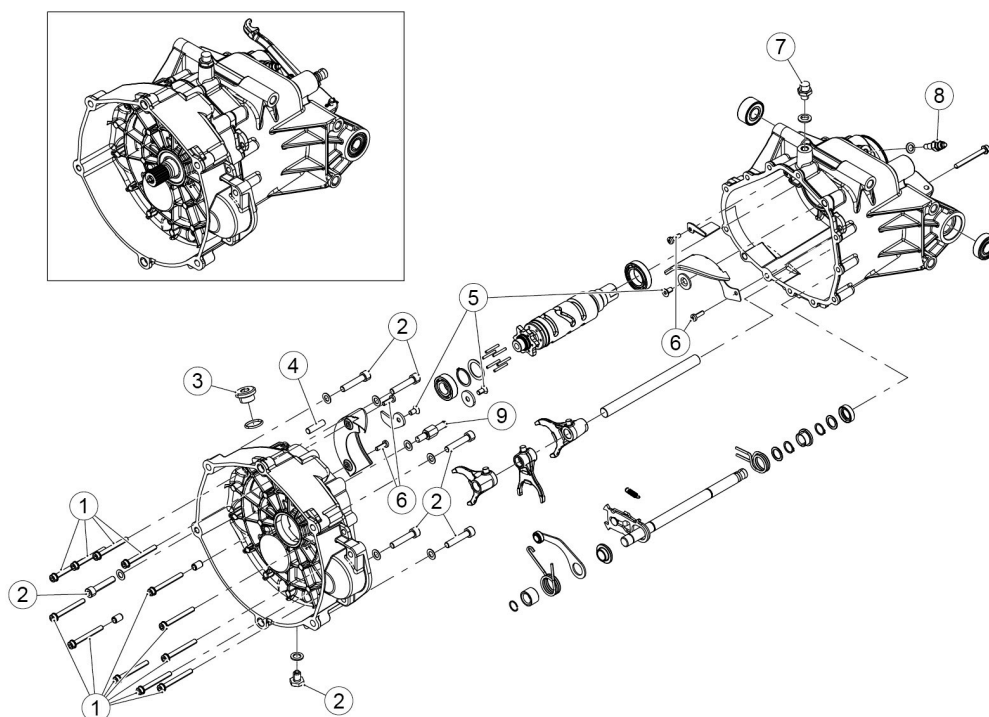


POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Cylinder nut	M6	2	9-11 Nm (6.64-8.11 lb ft)	-

CRANKSHAFT



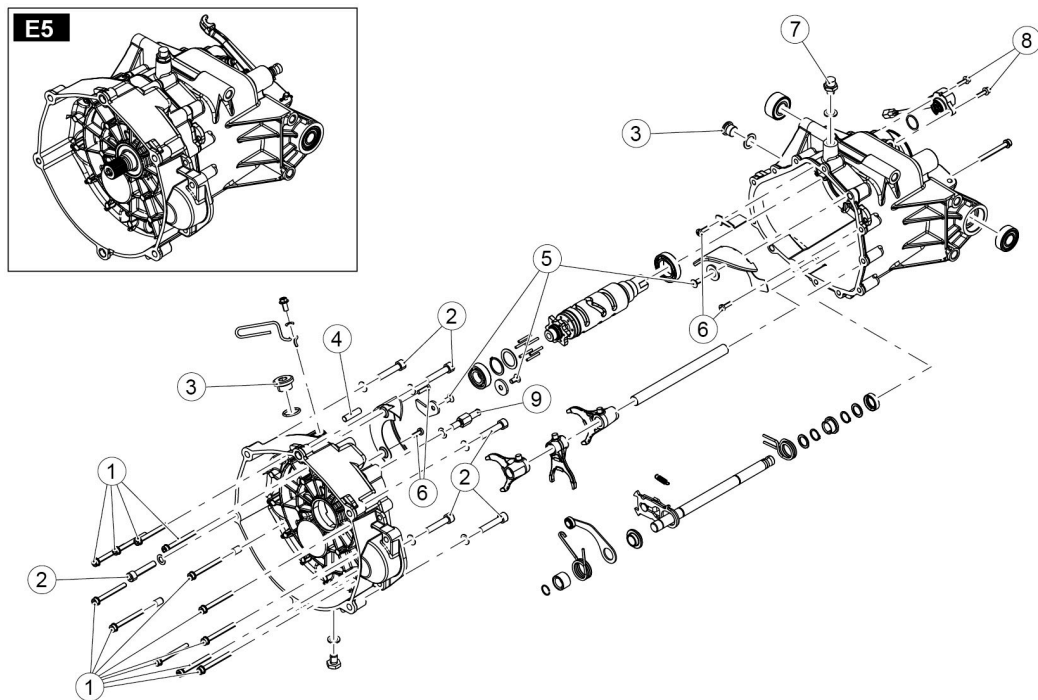
POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Crankshaft plug	M12	1	15-18 Nm (11.06-13.28 lb ft)	Loct. 648
2	Connecting rods screws (pre-tightening 1st coupling)	M8	4	10 Nm (7.37 lbf ft)	Lubricate the thread and underhead with Pankl PLB 19
2	Connecting rods screws (pre-tightening 2nd coupling)	M8	4	20 Nm (14.75 lbf ft)	Lubricate the thread and underhead with Pankl PLB 19
2	Connecting rods screws (final tightening)	M8	4	65°+/-2° - 40-70 Nm (29.50-51.73 lbf ft)	Lubricate the thread and underhead with Pankl PLB 19

CPL. GEARBOX / SELECTOR - DESMODROMIC

POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Clutch housing/ gearbox fastening SHC screws	M6x55	13	9-11 Nm (6.64-8.11 lb ft)	-

POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
2	Engine / gearbox fastening SHC screws	M8x40	6	24-28 Nm (17.70-20.65 lb ft)	-
3	Oil load cap	M20	1	23-27 Nm (16.96-19.91 lb ft)	-
4	Threaded pin for ground cable screw	M8x30	1	9-11 Nm (6.64-8.11 lb ft)	Loct. 243
5	Bearing stoppers countersunk hex head screws	M6x12	5	9-11 Nm (6.64-8.11 lb ft)	Pre-applied Loct.; alternatively 3M SCOTCH-GRIP 2353 or Loct. DRI LOC 2045 BLU
6	Oil duct plates Torx screws	M5x16	4	9-11 Nm (6.64-8.11 lb ft)	Pre-applied Loct.; alternatively Loct. 20450 or 3M or 2353
7	Bleeder cap	M10	1	18-22 Nm (13.28-16.23 lb ft)	-
8	Neutral switch	M8	1	9-11 Nm (6.64-8.11 lb ft)	-

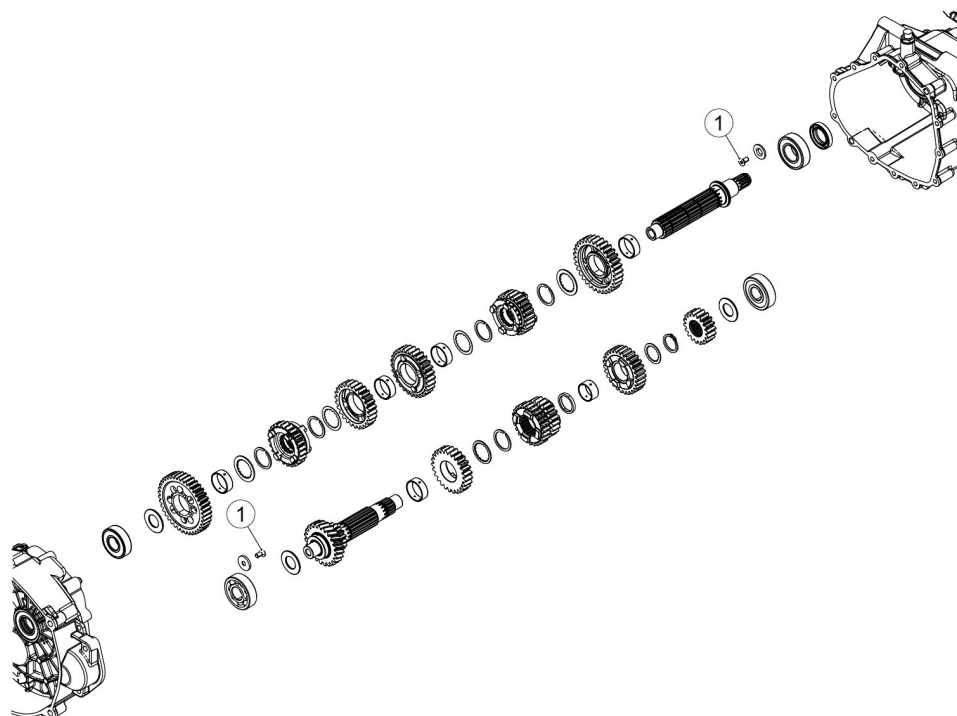
CPL. GEARBOX / SELECTOR - DESMODROMIC E5



POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Clutch housing/ gearbox fastening SHC screws	M6x55	13	9-11 Nm (6.64-8.11 lb ft)	-
2	Engine / gearbox fastening SHC screws	M8x40	6	24-28 Nm (17.70-20.65 lb ft)	-
3	Oil load cap	M20	1	23-27 Nm (16.96-19.91 lb ft)	-
4	Threaded pin for ground cable screw	M8x30	1	9-11 Nm (6.64-8.11 lb ft)	Loct. 243
5	Bearing stoppers countersunk hex head screws	M6x12	5	9-11 Nm (6.64-8.11 lb ft)	Pre-applied Loct.; alternatively 3M SCOTCH- GRIP 2353 or Loct. DRI LOC 2045 BLU
6	Oil duct plates Torx screws	M5x16	3	6-7 Nm (4.23-5.16 lb ft)	Pre-applied Loct.; alternatively Loct. 20450 or 3M or 2353

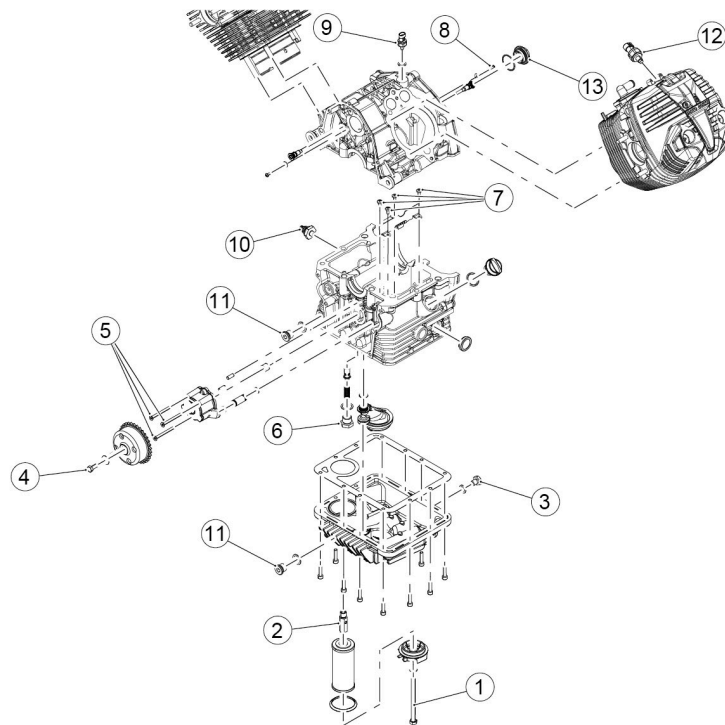
POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
7	Bleeder cap	M10	1	18-22 Nm (13.28-16.23 lb ft)	-
8	Gear sensor fastening flanged hex head screw	M5x20	2	6-7 Nm (4.23-5.16 lb ft)	-

GEARBOX COMPONENTS



POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Bearing stoppers countersunk hex head screws	M6x12	2	9-11 Nm (6.64-8.11 lb ft)	Pre-applied Loct.; alternatively 3M SCOTCH-GRIP 2353 or Loct. DRI LOC 2045 BLU

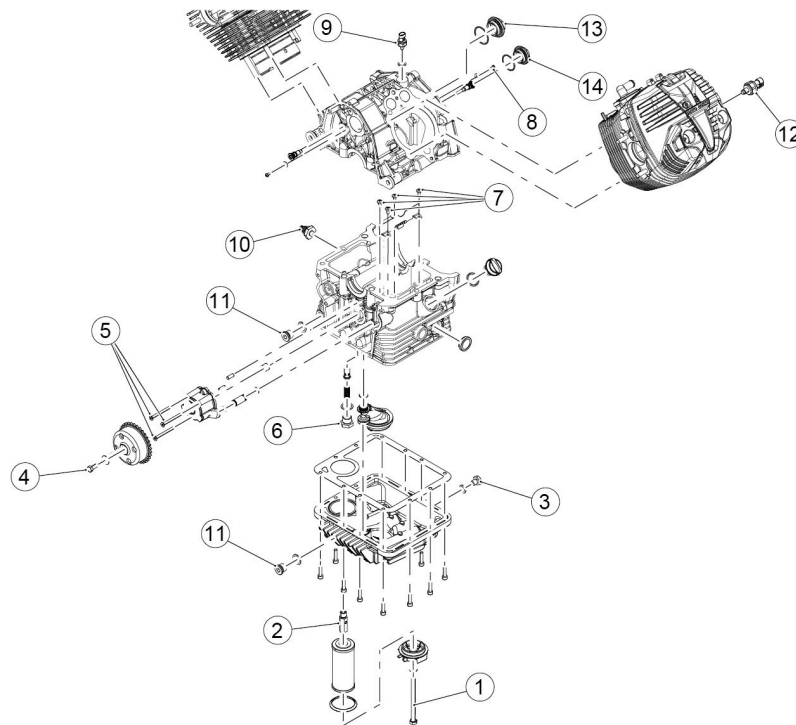
LUBRICATION SYSTEM



POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Cover and oil filter cartridge fixing hex head screw	M8x105	1	18-22 Nm (13.28-16.23 lb ft)	-
2	Oil filter connector fitting	M12	1	20-24 Nm (14.75-17.70 lb ft)	-
3	Oil sump drainage plug	M10	1	20-24 Nm (14.75-17.70 lb ft)	-
4	Special oil pump gear screw	M7x18	1	20 - 22 Nm (14.75 - 16.23 lb ft)	Pre-applied Loct.; alternatively 3M SCOTCH-GRIP 2353, Loctite 2045 or PRELOX PRECOTE 80
5	Oil pump countersunk head screws	M5x55	3	5-6 Nm (3.69-4.42 lb ft)	3M SCOTCH GRIP 2353
6	Oil pressure valve plug	M18	1	20-25 Nm (14.75-18.44 lb ft)	-

POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
7	Oil scraper plate notched cylindrical head screws	M5x10	4	3-4 Nm (2.21-2.95 lb ft)	Pre-applied Loct.; alternatively 3M SCOTCH-GRIP 2353
8	Cooling jet torx screw	M4x12	2	2.6-3.4 Nm (1.92-2.51 lb ft)	Pre-applied Loct.; alternatively 3M SCOTCH-GRIP 2353 or Loct. DRI LOC 2045 BLU
9	Oil temperature sensor	M10	1	18-22 Nm (13.28-16.23 lb ft)	-
10	Oil pressure sensor	R 1/8"	1	20-24 Nm (14.75-17.70 lb ft)	-
-	Cable screw on the minimum oil pressure sensor	M4	1	1.5-1.8 Nm (1.11-1.33 lb ft)	-
11	Caps	M16	2	28-32 Nm (20.65-23.60 lb ft)	-
12	Engine temperature sensor	M10	1	18-22 Nm (13.28-16.23 lb ft)	Loct. 243
13	Piston lubrication jet seat cap	M28	1	24 - 29 Nm (17.70 - 21.40 lb ft)	-

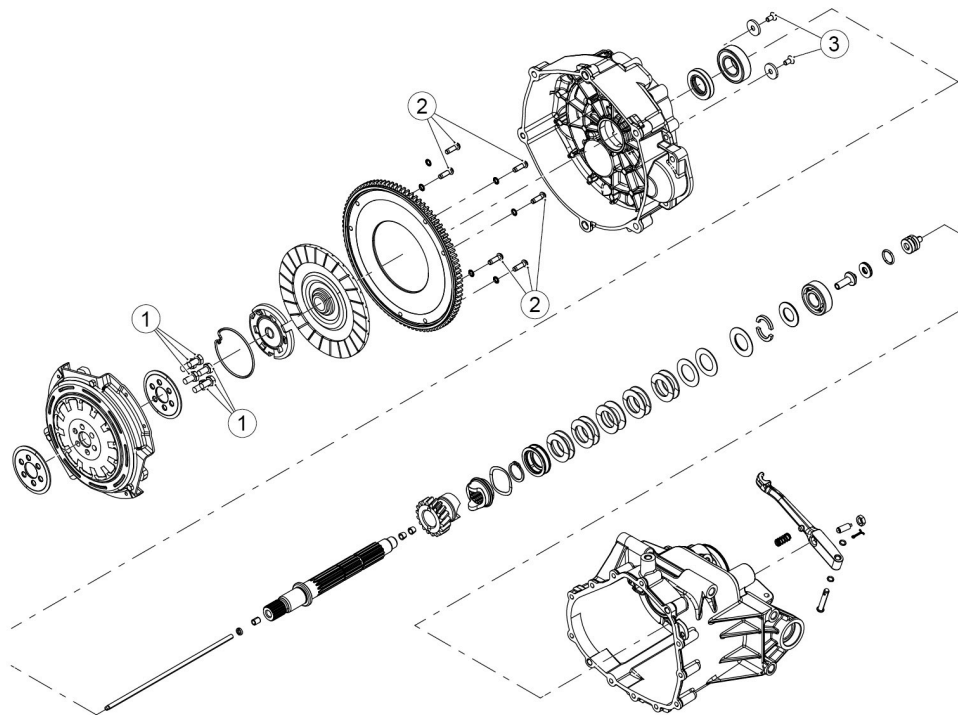
E5 LUBRICATION



POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Cover and oil filter cartridge fixing hex head screw	M8x105	1	18-22 Nm (13.28-16.23 lb ft)	-
2	Oil filter connector fitting	M12	1	20-24 Nm (14.75-17.70 lb ft)	-
3	Oil sump drainage plug	M10	1	20-24 Nm (14.75-17.70 lb ft)	-
4	Special oil pump gear screw	M7	1	20 - 22 Nm (14.75 - 16.23 lb ft)	Pre-applied Loct.; alternatively 3M SCOTCH-GRIP 2353, Loctite 2045 or PRELOX PRECOTE 80
5	Oil pump countersunk head screws	M5x55	3	5-6 Nm (3.69-4.42 lb ft)	3M SCOTCH GRIP 2353
6	Oil pressure valve plug	M18	1	20-25 Nm (14.75-18.44 lb ft)	-

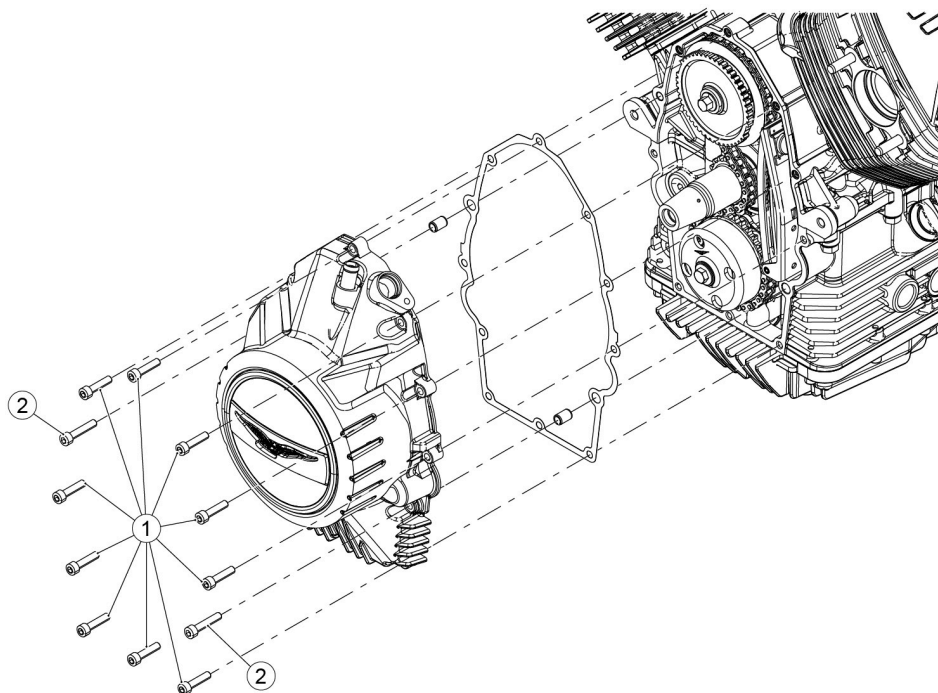
POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
7	Oil scraper plate notched cylindrical head screws	M5x10	4	3-4 Nm (2.21-2.95 lb ft)	Pre-applied Loct.; alternatively 3M SCOTCH-GRIP 2353, Loctite 2045 or PRELOX PRECOTE 80
8	Cooling jet torx screw	M4x12	2	2.8-3.4 Nm (2.07-2.51 lb ft)	Pre-applied Loct.; alternatively 3M SCOTCH-GRIP 2353 or Loct. DRI LOC 2045 BLU
9	Oil temperature sensor	M10X1	1	18-22 Nm (13.28-16.23 lb ft)	
9	Oil temperature sensor	M10	1	18-22 Nm (13.28-16.23 lb ft)	Loct. 243
-	Cable screw on the minimum oil pressure sensor	M4	1	1.5-1.8 Nm (1.11-1.33 lb ft)	-
11	Caps	M16	2	28-32 Nm (20.65-23.60 lb ft)	-
12	Engine temperature sensor	M10	1	18-22 Nm (13.28-16.23 lb ft)	-
13	Cam shaft seat closure cap (Euro 5 Plus)	M30	1	33 - 35 Nm (24.34 - 25.81 lb ft)	-
14	Piston lubrication jet seat cap	M28	1	24 - 29 Nm (17.70 - 21.40 lb ft)	-

ASSEMBLY



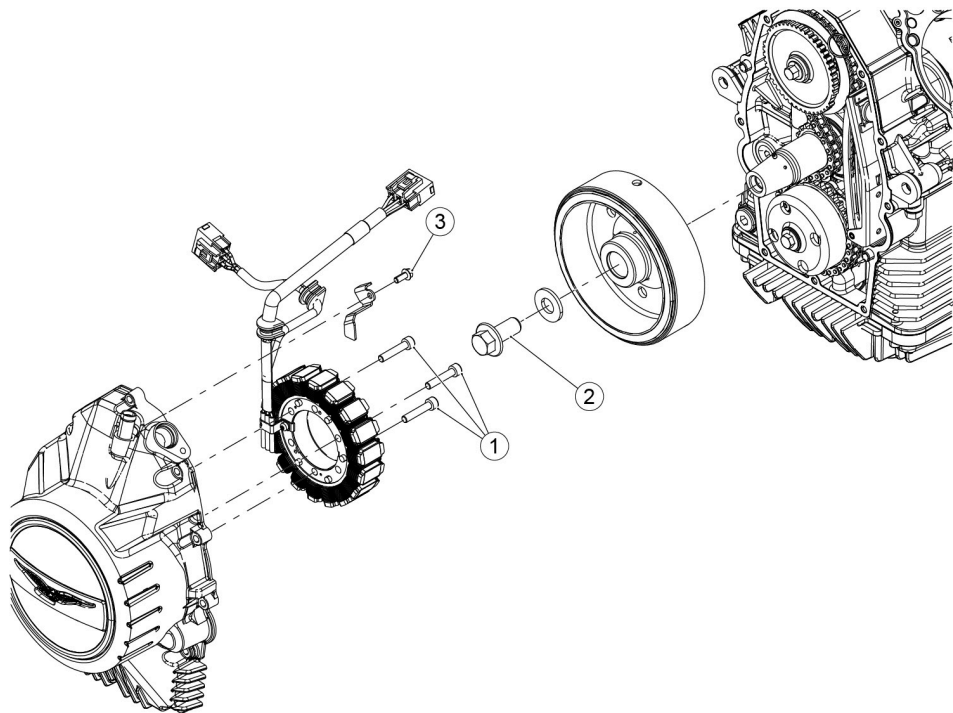
POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Clutch-crankshaft screws	M8	6	38-42 Nm (28.03-30.98 lb ft)	Loct. 243
2	Starter sprocket fixing torx rounded head screws	M6x20	6	9-11 Nm (6.64-8.11 lb ft)	Pre-applied Loct.; alternatively Loct. DRI-LOC 2040 or 3M SCOTCH GRIP 2353
3	Bearing stopper countersunk hex head screws	M6x12	2	9-11 Nm (6.64-8.11 lb ft)	Pre-applied Loct.; alternatively 3M SCOTCH-GRIP 2353 or Loct. DRI LOC 2045 BLU

FLYWHEEL COVER

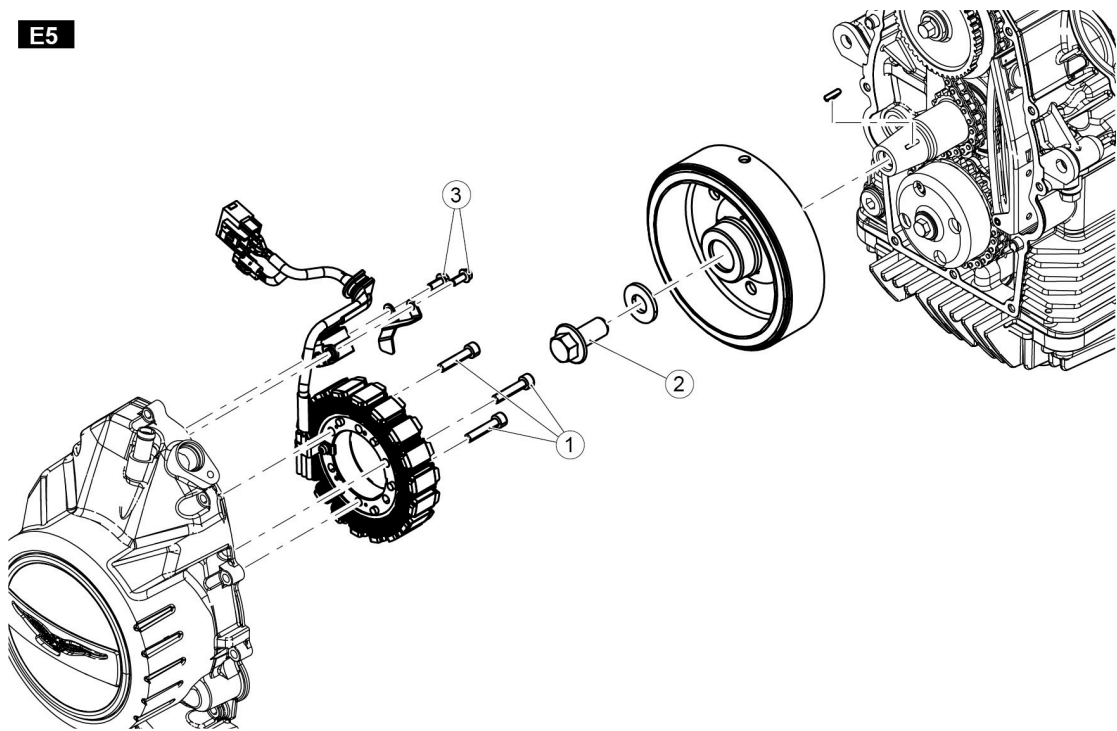


POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Flywheel cover SHC screws	M6x25	10	9-11 Nm (6.64-8.11 lb ft)	-
2	Flywheel cover SHC screws	M6x20	2	9-11 Nm (6.64-8.11 lb ft)	-

MAGNETO FLYWHEEL / START-UP

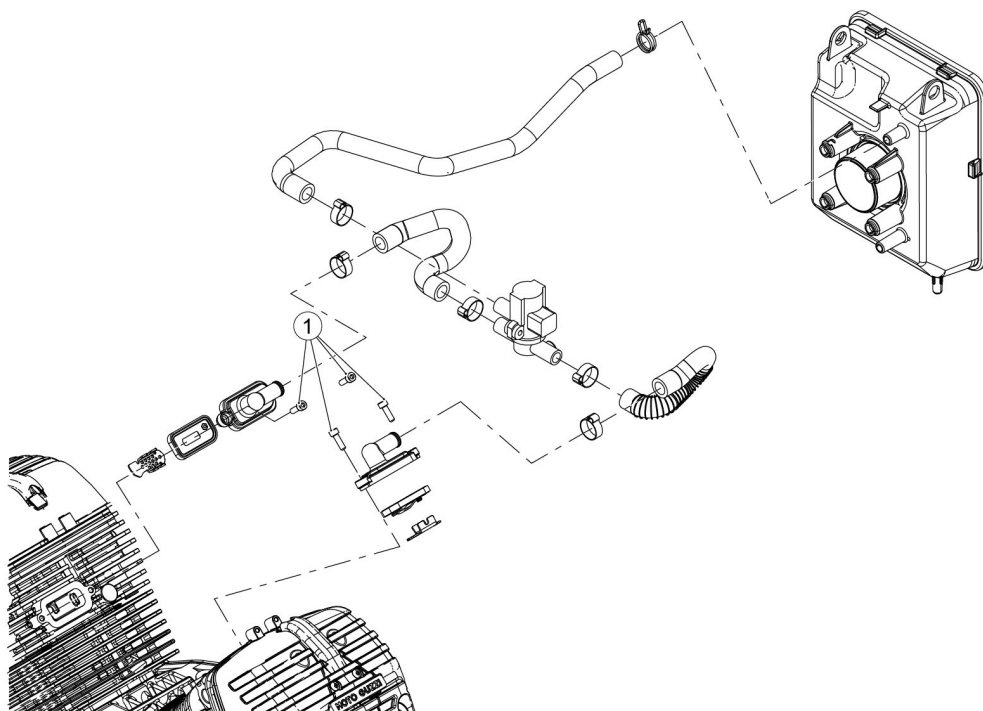


E5



POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Stator SHC screws	M6x20	3	9-11 Nm (6.64-8.11 lb ft)	Loct. 243

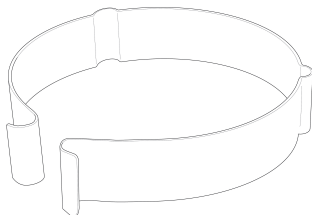
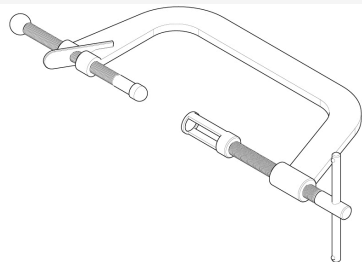
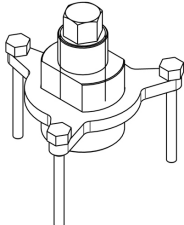
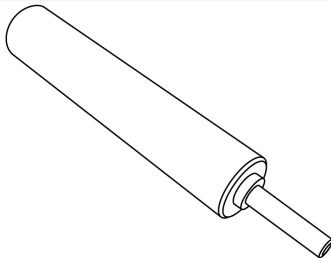
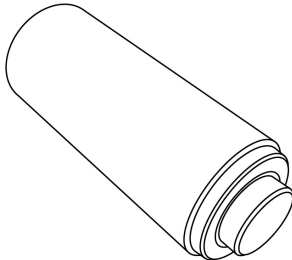
POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
2	Flywheel flanged hex head screw	M14x30	1	114-125 Nm (84.08-92.19 lb ft)	-
3	Flanged hex head screws for cable clamp plate on the alternator's cover	M5x12	1	5-6 Nm (3.69-4.42 lb ft)	-

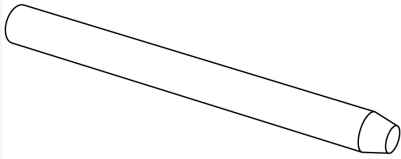
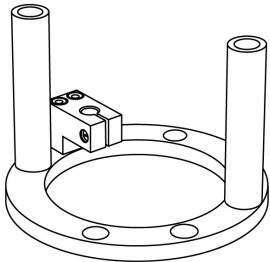
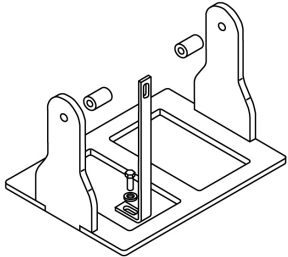
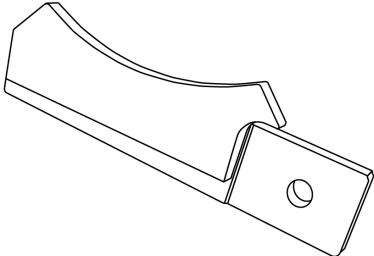
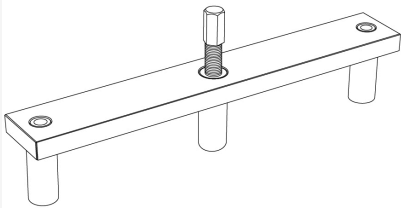
SECONDARY AIR

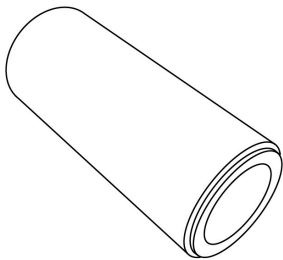
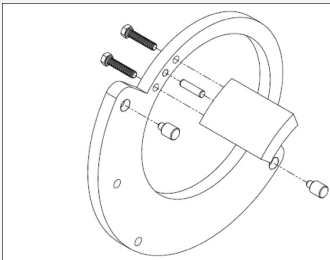
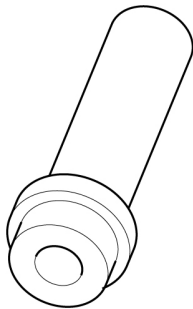
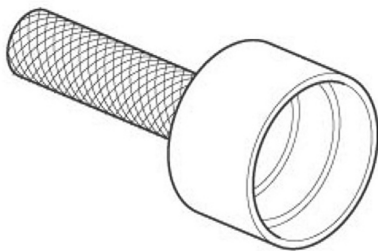
POSITION	DESCRIPTION	TYPE	QUANTITY	TORQUE	NOTES
1	Secondary air covers SHC screws	M5	4	3-4 Nm (2.21-2.95 lb ft)	-

LIST OF TOPICS

Special tools

CODE	DESCRIPTION	IMAGE
020128Y	Piston ring compressor	
020382Y	Valve removal and fitting	
020713Y	Flywheel puller tool	
020976Y	Clutch control dust seal installation punch	
020978Y	Secondary cardan shaft oil seal installation punch	

CODE	DESCRIPTION	IMAGE
020995Y	Rocker arm centring pin	
020996Y	Tool for measuring piston protrusion	
020997Y	Engine support frame	
021001Y	Clutch retainer	
021002Y	Clutch centring	

CODE	DESCRIPTION	IMAGE
021020Y	Clutch housing oil seal punch	
021055Y	Pick-up fitting template	
GU19926500	Punch for transmission bearing external ring	
021088Y	Clutch-side oil seal punch	

LIST OF TOPICS

Engine

4.1 Alternator

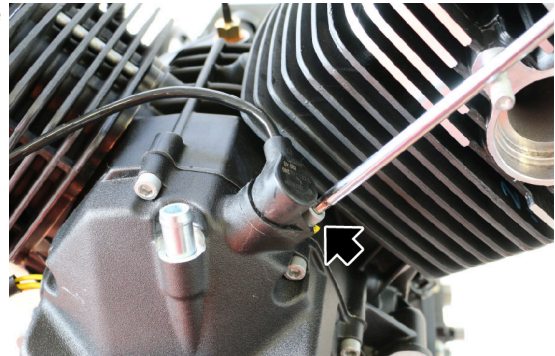
4.1.1 Engine speed sensor removal

N.B



PROCEDURE VALID ONLY FOR E4 VEHICLES.

- Undo and remove the fixing screw of the sensor



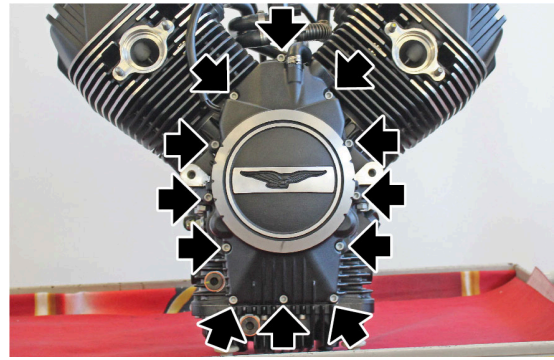
- Remove the timing system cover sensor



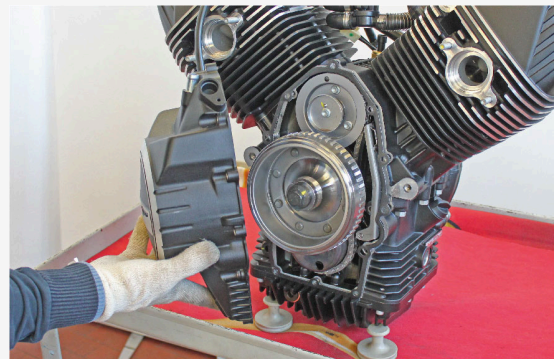
4.1.2 Alternator removal

ALTERNATOR COVER REMOVAL

- Remove the alternator cover fixing screws



- Remove the alternator cover.

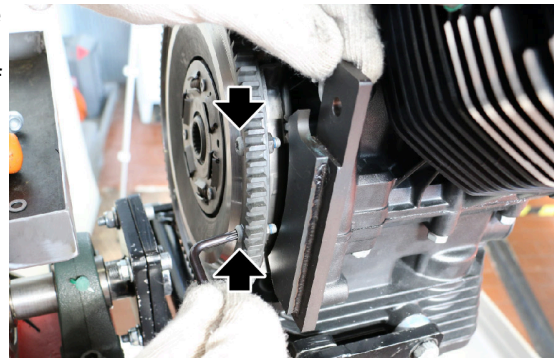


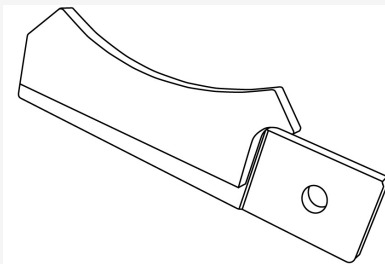
- Remove the gasket.



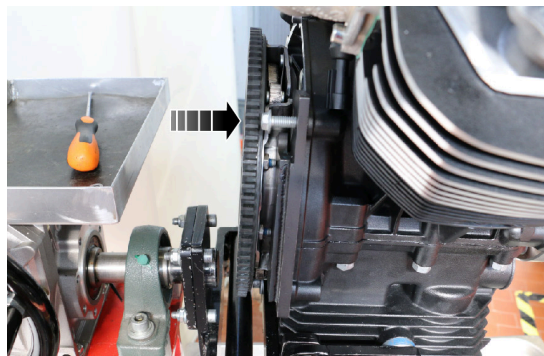
ROTOR REMOVAL

- From the clutch side, partially unscrew the two fixing screws of the clutch plate, as indicated, to allow the correct positioning of the specific clutch lock tool.



CODE	DESCRIPTION	IMAGE
021001Y	Clutch retainer	

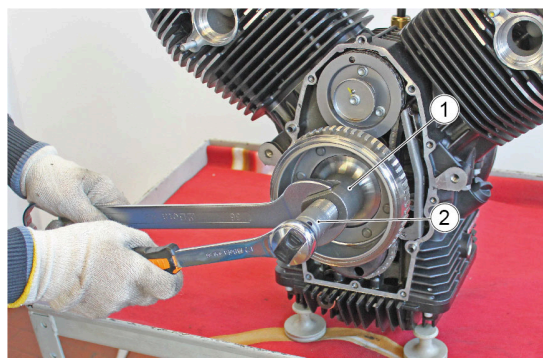
- Using one of the fixing screws of the gearbox assembly, secure the specific tool.

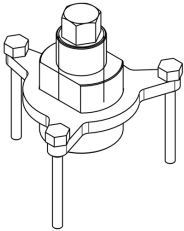


- Unscrew the fixing screw of the rotor to the crankshaft and retrieve the relative washer.



- Place the tool (1) on the rotor, tighten the threaded pin (2) of the tool and proceed with the rotor removal



CODE	DESCRIPTION	IMAGE
020713Y	Flywheel puller tool	

N.B



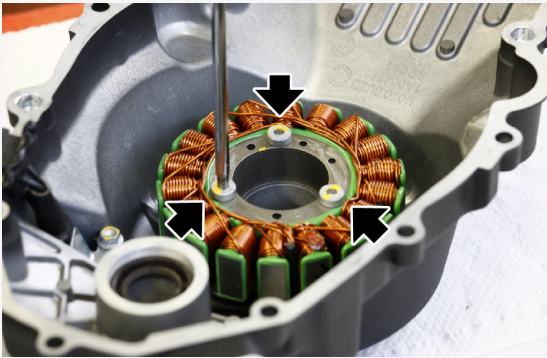
PROCEDURE VALID ONLY FOR E4 VEHICLES.

STATOR REMOVAL

- Remove the stator wiring harness lock plate



- Removing the three stator fixing screws makes it possible to disconnect it

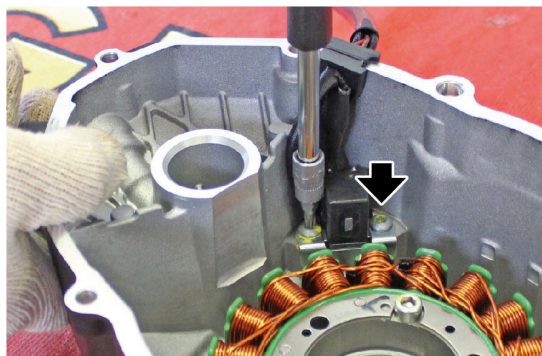


N.B.:

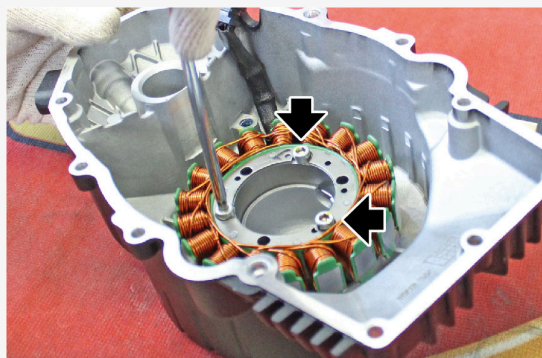


PROCEDURE VALID ONLY FOR E5 VEHICLES.**STATOR REMOVAL**

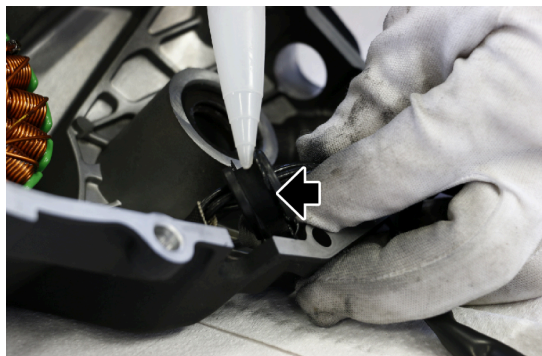
- Remove the two pick-up plate fixing screws



- Remove the three fixing screws fastening the stator to the timing system cover
- At this point, the stator can be removed from the cover, together with the wiring harness and the pick-up

**4.1.3 Alternator installation****N.B****PROCEDURE VALID ONLY FOR E4 VEHICLES.**

- During refitting of the flywheel cover it is necessary to apply a great amount of threebond on the cable grommet of the stator before placing it in its seat



- Check that plentiful threebond leaks out and covers all space between the seat on the cover and the cable grommet. Apply another layer of threebond over the cable grommet.



- Refit a new gasket.



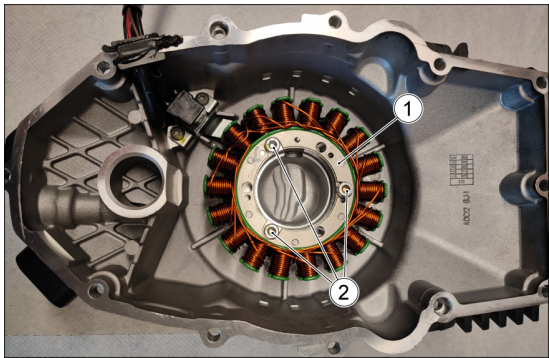
N.B.:



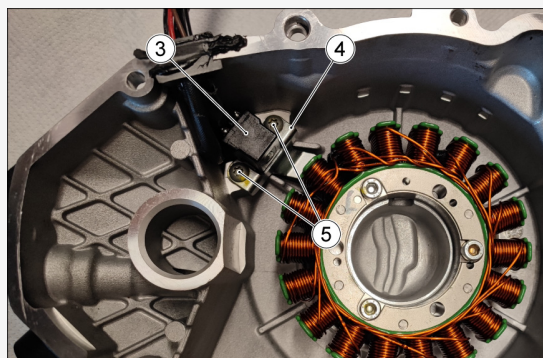
PROCEDURE VALID ONLY FOR E5 VEHICLES.

- Position the stator (1) in its seat on the timing system cover.
- Apply threadlock **Loctite 243** to the threads of the three fixing screws (2) of the stator, fit them and then tighten them to the prescribed torque.

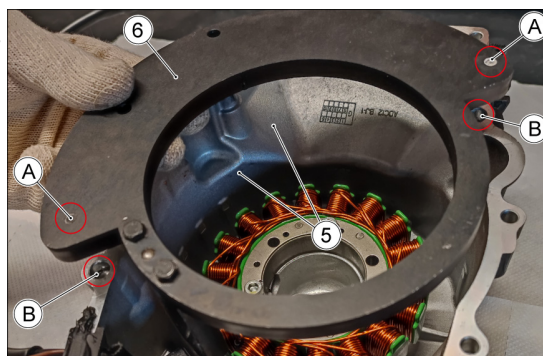
DESCRIPTION	TORQUE
Stator clamping screw	9-11 Nm (6.64-8.11 lb ft)

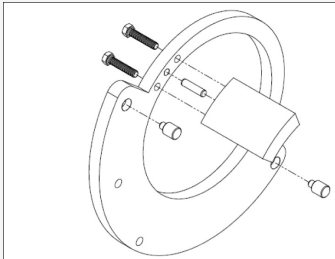


- Position the pick-up (3) and the retainer plate (4) of the stator wiring harness in its seat.
- Tighten the two fixing screws (5) until the end, but **WITHOUT** tighten them definitively.



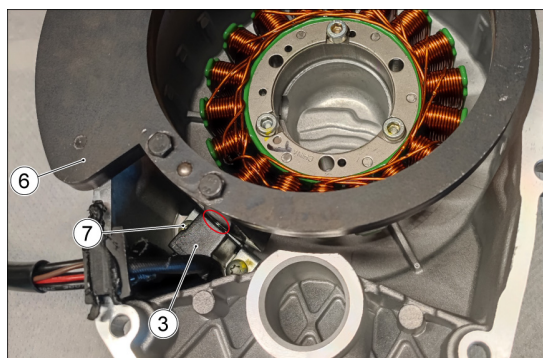
- Install the specific tool (6) on the timing system cover, aligning the dowel pins (A) of the tool with the relative centring holes (B) on the cover.



CODE	DESCRIPTION	IMAGE
021055Y	Pick-up fitting template	

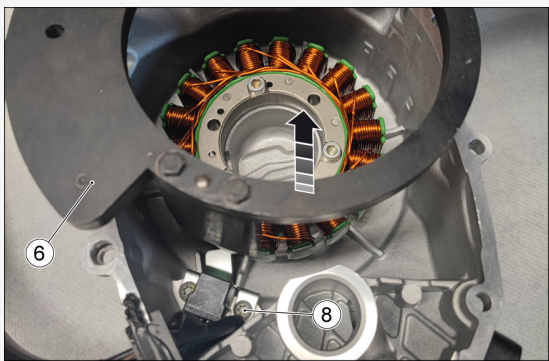
- Place the sensitive surface of the pick-up (3) on the specific tool (6).
- While holding the Pick-up (3), tighten the screw (7) to the specified torque to stabilize the Pick-up position.

DESCRIPTION	TORQUE
Pick-Up clamping screw	5-6 Nm (3.69-4.42 lb ft)

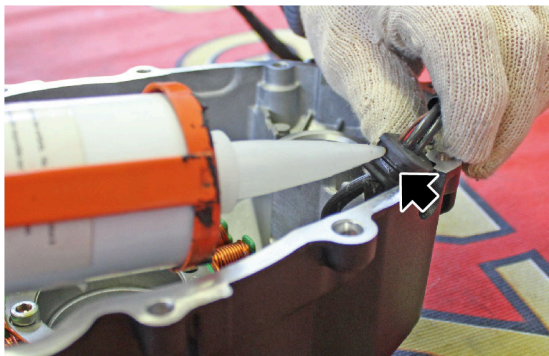


- Tighten the fixing screw (8) to the prescribed torque.
- Remove the specific tool (6) from the timing system cover.

DESCRIPTION	TORQUE
Pick-Up clamping screw	5-6 Nm (3.69-4.42 lb ft)



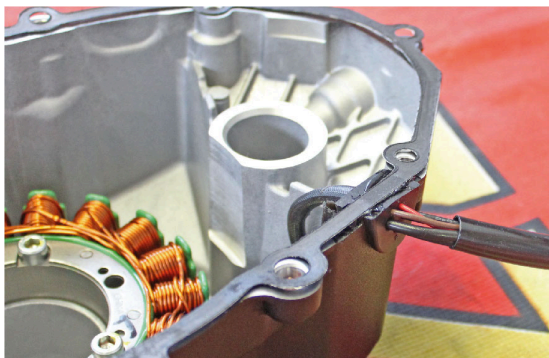
- Apply a generous amount of threebond to the stator grommet before positioning it in its seat on the timing cover.



- Check that plentiful threebond leaks out and covers all space between the seat on the cover and the cable grommet. Apply another layer of threebond over the cable grommet.

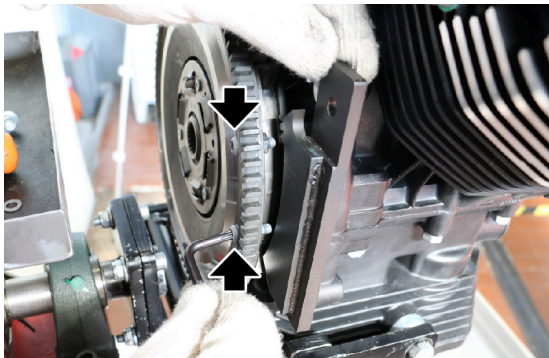


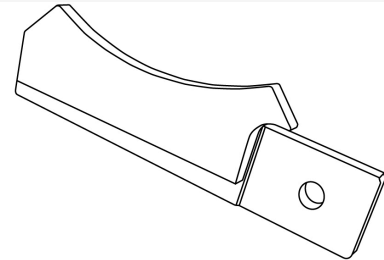
- Refit a new gasket.



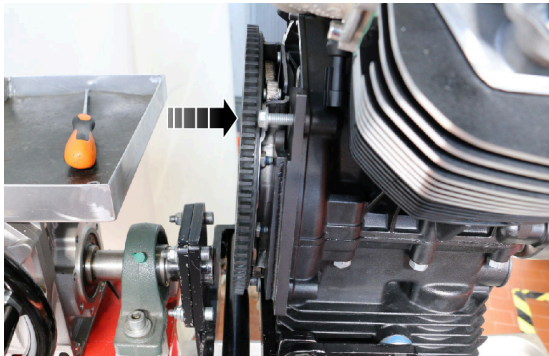
ROTOR INSTALLATION

- From the clutch side, partially unscrew the two fixing screws of the clutch plate, as indicated, to allow the correct positioning of the specific clutch lock tool.



CODE	DESCRIPTION	IMAGE
021001Y	Clutch retainer	

- Using one of the fixing screws of the gearbox assembly, secure the specific tool.



- Install the rotor on the crankshaft.



- Install the rotor fixing screw and washer.

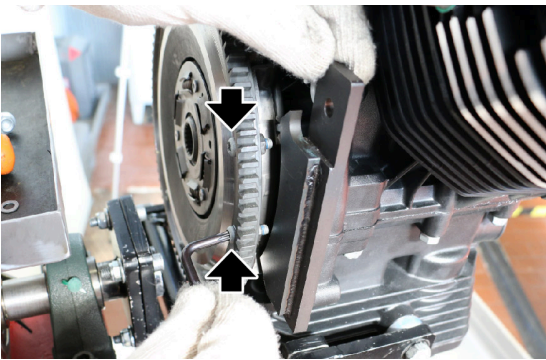


- Tighten the rotor fixing screw to the prescribed torque:

DESCRIPTION	TORQUE
Rotor fastening screw	114-125 Nm (84.08-92.19 lb ft)

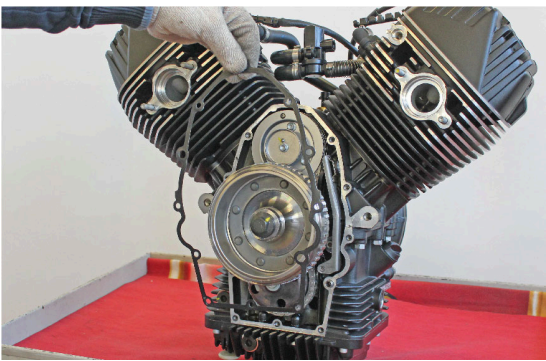


- Working from the clutch side, tighten the two clutch plate fixing screws, which were previously loosened, then remove the specific clutch locking tool.



ALTERNATOR COVER INSTALLATION

- Place the gasket on the crankcase coupling surface.

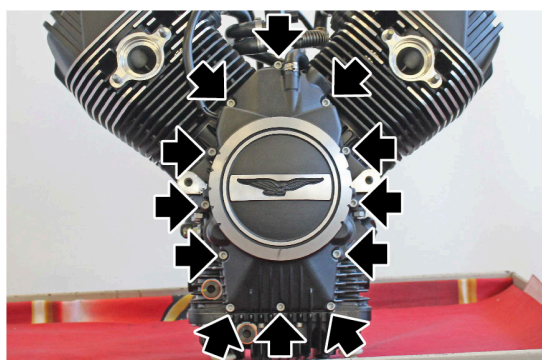


- Install the alternator cover on the crankcase.



- Tighten the fixing screws of the alternator cover to the specified torque.

DESCRIPTION	TORQUE
Flywheel cover screws	9-11 Nm (6.64-8.11 lb ft)



TONE WHEEL CALIBRATION PROCEDURE

N.B.:



PROCEDURE VALID ONLY FOR E5 VEHICLES.

ATTENTION



TO COMPLY WITH THE STRICT "MISFIRE" MONITORING REQUIREMENTS OF BY THE EURO 5 REGULATIONS, A NEW TONE WHEEL AND A NEW INTEGRATED PICK-UP HAVE BEEN INCLUDED IN THE STATOR'S WIRING HARNESS.

WHEN THE "MISFIRE" MONITORING DOES NOT RETURN OPTIMAL RESULTS AND/OR IF THE TONE WHEEL CALIBRATION PROCEDURE IS NOT PERFORMED, THE MIL INDICATOR LIGHT WILL START FLASHING (THE ECU WILL SHOW THE ERROR P1309).

ALL MOTORCYCLES ARE DELIVERED WITH THE CALIBRATION PROCEDURE ALREADY PERFORMED, BUT IN CASE OF REPLACING THE: ENGINE ECU, MAGNET FLYWHEEL, PICK UP, THE CALIBRATION PROCEDURE DESCRIBED BELOW MUST BE REPEATED.

- Use P.A.D.S. to "RESET THE TONE WHEEL VALUES". This item can be selected from the following path: "Adjustments" - "Reset. EEPROM ECU"
- Bring the engine to a temperature of 80°
- With the gearbox in neutral and the vehicle at a standstill, accelerate three times over 6500 rpm
- Switch off the panel and wait for at least one minute (Power Latch)



ATTENTION

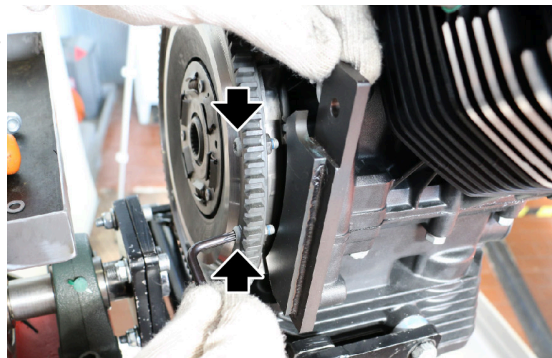


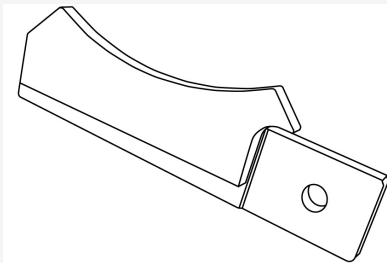
THE PROCEDURE IS SUCCESSFUL ONLY IF THE VEHICLE'S SPEED STAYS A 0 KM/H.

4.2 Clutch side

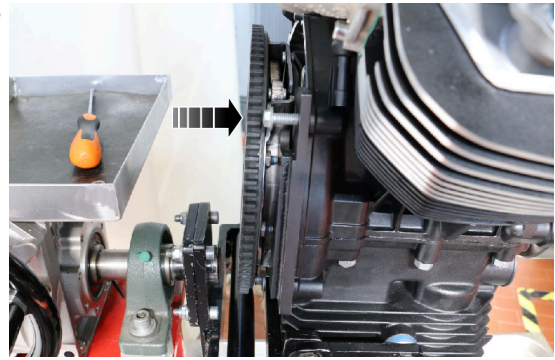
4.2.1 Removing the clutch

- Remove the clutch cover.
- Partially unscrew the two fixing screws of the clutch plate, as indicated, to allow the correct positioning of the specific clutch lock tool.

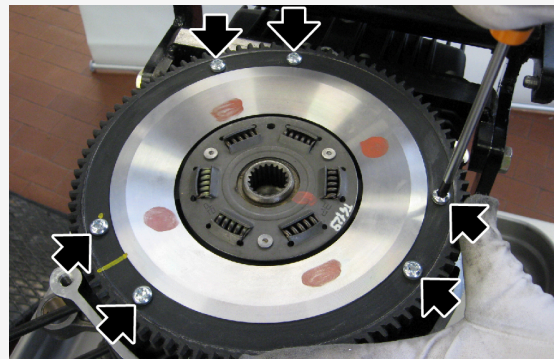


CODE	DESCRIPTION	IMAGE
021001Y	Clutch retainer	

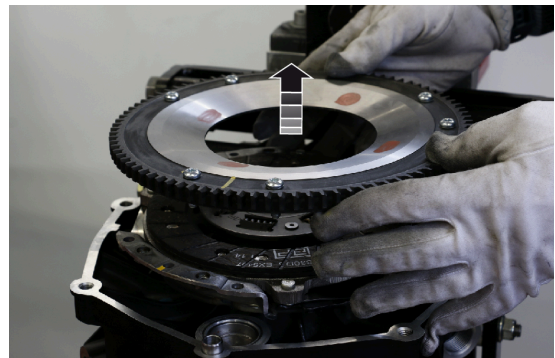
- Using one of the fixing screws of the gearbox assembly, secure the specific tool.



- Remove the 6 fixing screws of the clutch plate complete with starter sprocket



- Remove the clutch plate complete with starter sprocket



- Remove the clutch disc.



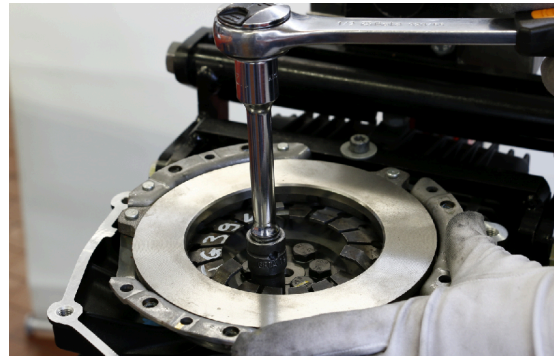
- Remove the retainer ring



- Remove the thrust plate



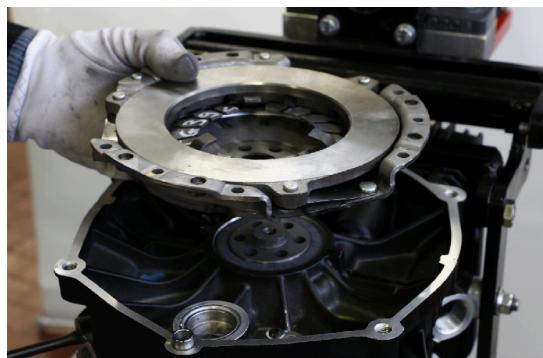
- Remove the 6 fixing screws of the locking plate



- Remove the reinforcement flange of the clutch thrust plate



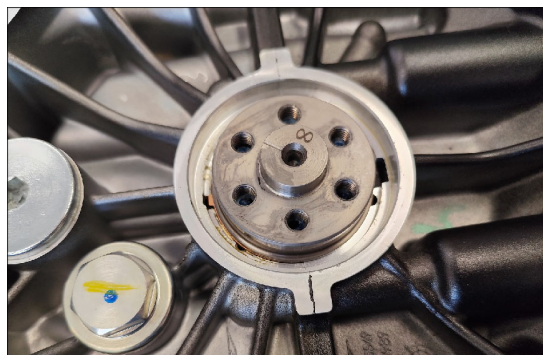
- Remove the clutch lock complete



- Remove the spacer plate.



- Remove the crankshaft oil seal and clean the crankcase housing.



4.2.2 Checking clutch discs

Clutch disc

Make sure that the clutch plate is not scratched or badly worn. Check the flexible springs and the thickness of the clutch disc.

CHARACTERISTIC	DESCRIPTION / VALUE
Disc minimum thickness limit	5.7 mm (0.2249 in)

Starting sprocket

Check that the supporting surface with the driven plate is perfectly smooth and even.

Also check that the tothing where the starter motor pinion works is not chipped or scratched; otherwise, replace it.

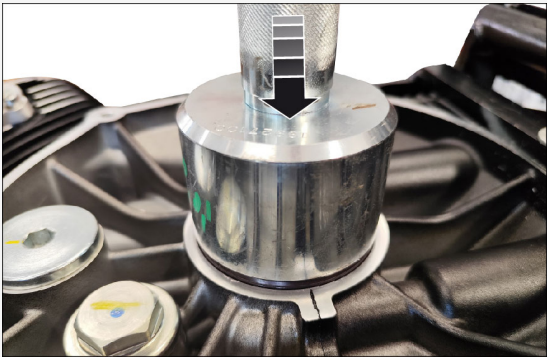


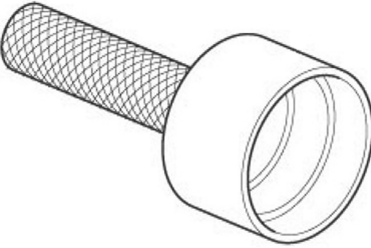
4.2.3 Fitting the clutch

- Position a new oil seal in its seat in the crankcase.



- Using the special tool, insert the oil seal until the tool is flush with the crankcase.

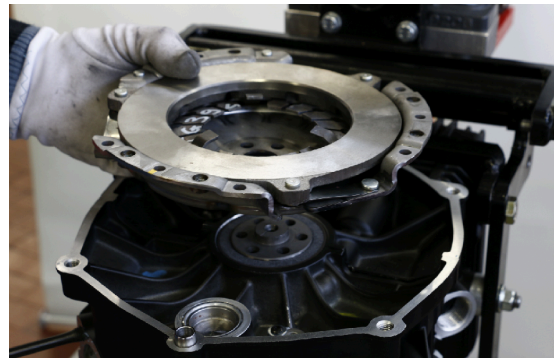


CODE	DESCRIPTION	IMAGE
021088Y	Clutch-side oil seal punch	

- Insert the spacer plate on the crankshaft.



- Insert the complete clutch lock.



- Place the reinforcement flange of the clutch thrust plate, aligning the holes with the ones of the clutch base



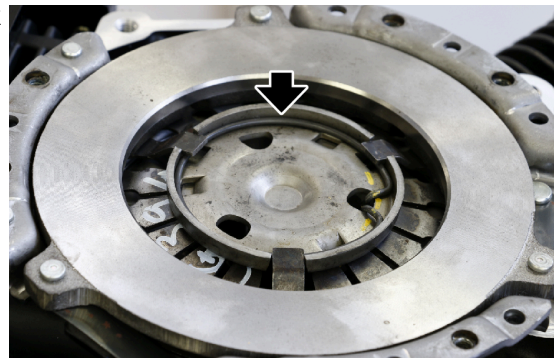
- Insert the 6 fastening screws and tighten to the prescribed torque



- Insert the thrust plate cap



- Lock the thrust plate using the special lock ring



- Place the clutch plate



- Place the starter sprocket and screw the fixing screws by hand



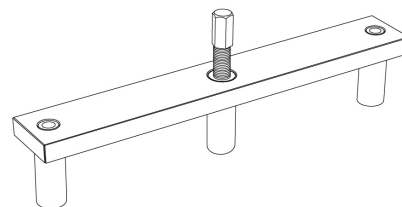
- Using the special tool for the centring of the clutch plate



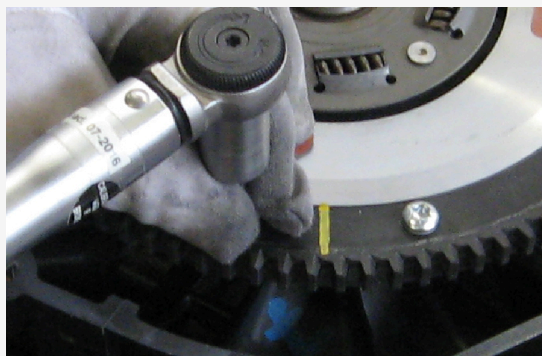
CODE	DESCRIPTION	IMAGE
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021002Y

Clutch centring



- Insert the six fastening screws at the recommended torque.

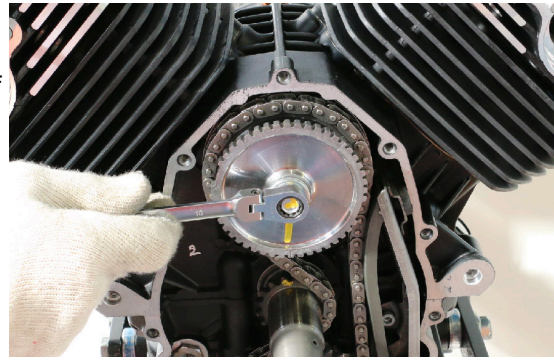


4.3 Timing

4.3.1 Tone wheel removal

N.B**PROCEDURE VALID ONLY FOR E4 VEHICLES.**

- Remove the timing system cover.
- Remove the rotor.
- Remove the screw fastening and washer of the tone wheel.

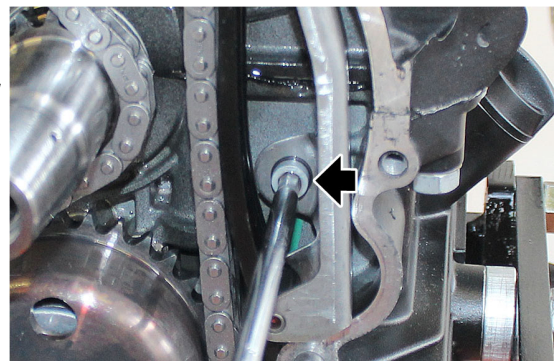


- Remove the tone wheel

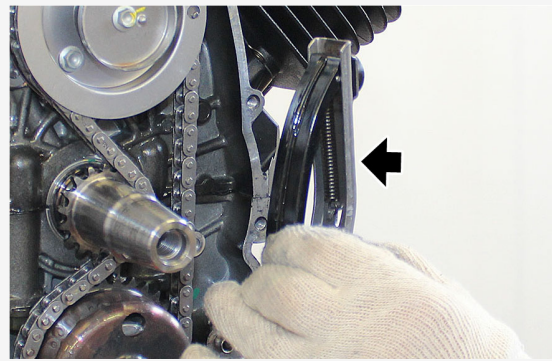


4.3.2 Chain tensioner removal

- Remove the timing system cover
- Remove the flywheel
- Remove the chain tensioner fixing screw recovering the washer



- Remove the chain tensioner



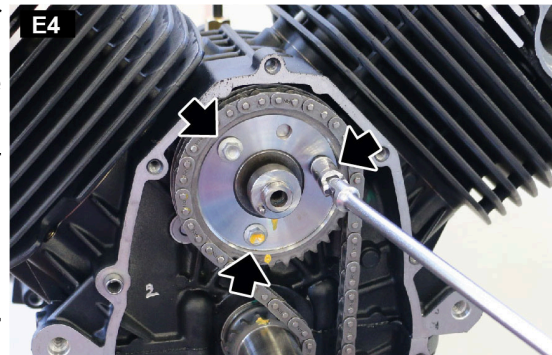
4.3.3 Chain removal

- Remove the timing system cover, the rotor and the tone wheel.
- Remove the three fixing screws of the timing gear.

N.B



PROCEDURE VALID ONLY FOR E4 VEHICLES.

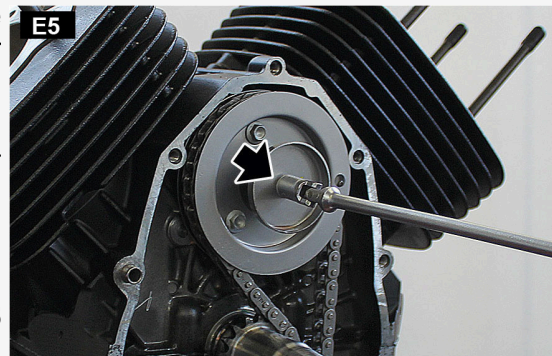


- Remove the timing system cover, the flywheel and the chain tensioner adjuster screw.
- Remove the bulkhead screw.

N.B.:



PROCEDURE VALID ONLY FOR E5 VEHICLES.

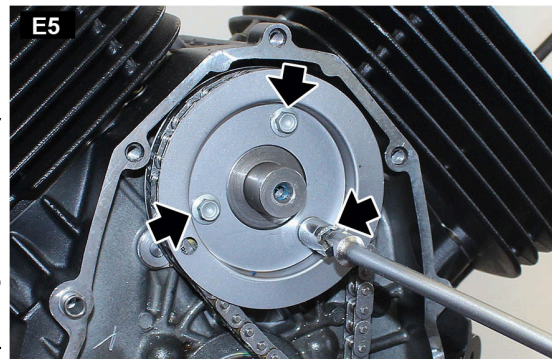


- Remove the 3 fixing screws of the timing system sprocket and retrieve the front chain guide cap.

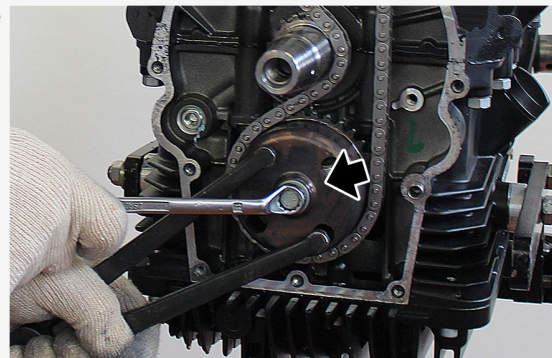
N.B.:



PROCEDURE VALID ONLY FOR E5 VEHICLES.



- Remove the fixing screw with relative washer for the oil pump gear.

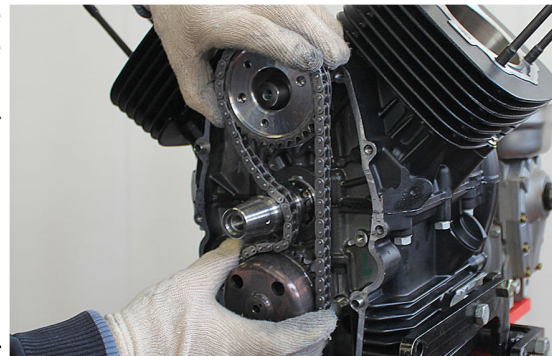


- Remove the timing chain, removing the camshaft gear and the oil pump gear at the same time

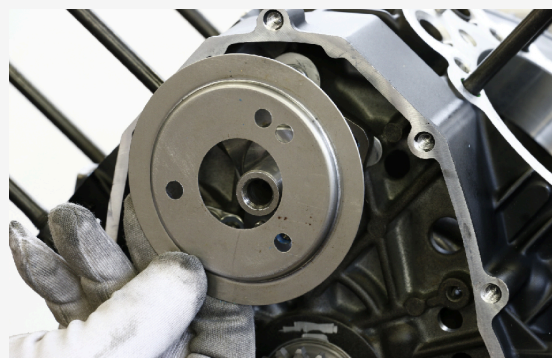
N.B



PAY ATTENTION TO THE CENTRING PIN OF THE OIL PUMP GEAR.



- Retrieve the rear chain guide cap.



4.3.4 Camshaft removal

N.B



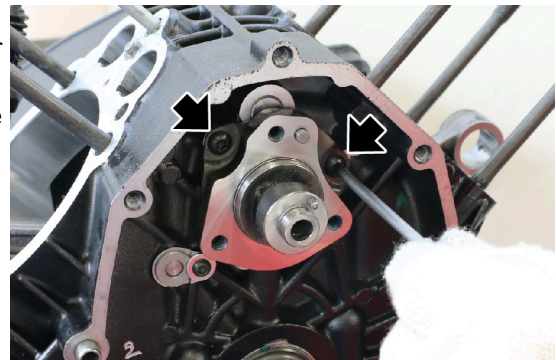
PROCEDURE VALID ONLY FOR E4 VEHICLES.

WARNING

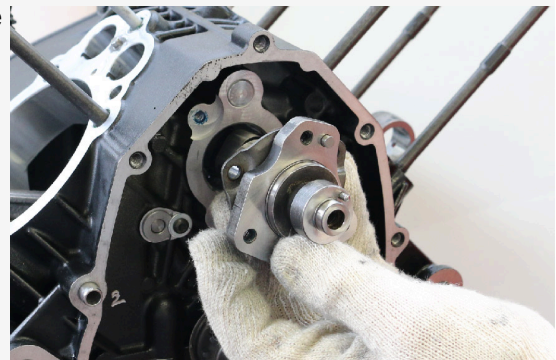


THE BUCKET TAPPETS MUST BE REMOVED IN ORDER TO DISASSEMBLE THE CAMSHAFT.

- Remove the timing system cover, the rotor, the tone wheel, the timing system with gear and the blow-by cap.
- Remove the two fixing screws of the camshaft.

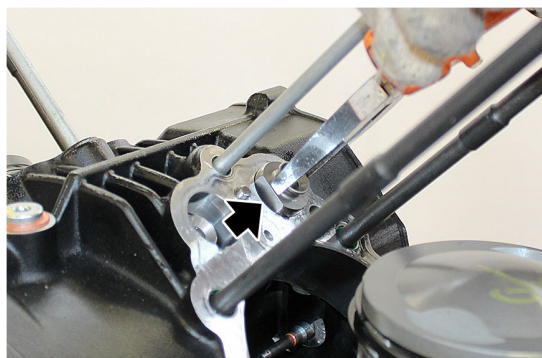


- Remove the camshaft extracting it from the crankcase.

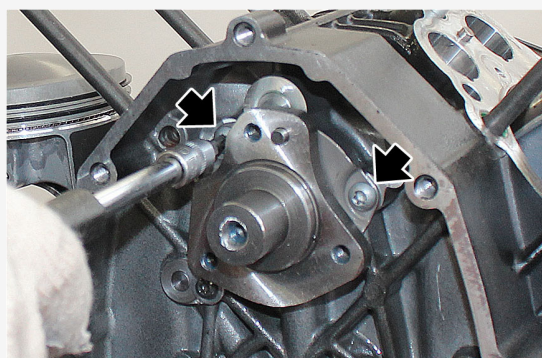


N.B**PROCEDURE VALID FOR EURO 5 AND EURO 5 PLUS VEHICLES.**

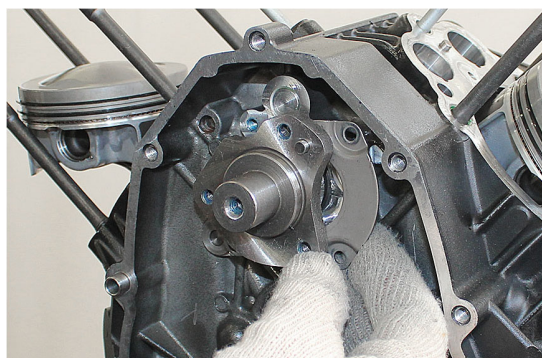
- Remove the big ends and the cylinders.
- Remove the bucket tappets from the engine crankcase.



- Remove the timing system cover, the rotor and the timing system chain.
- Remove the two fixing screws of the camshaft.



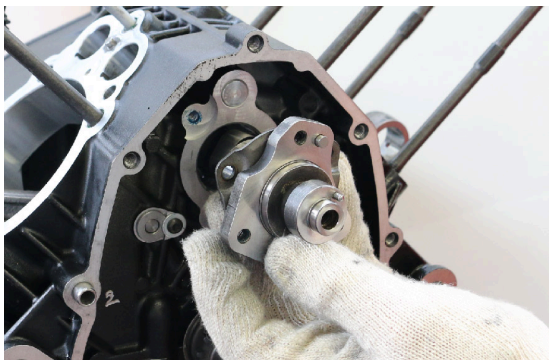
- Remove the camshaft extracting it from the crankcase and retrieve the fixing flange.



4.3.5 Camshaft installation

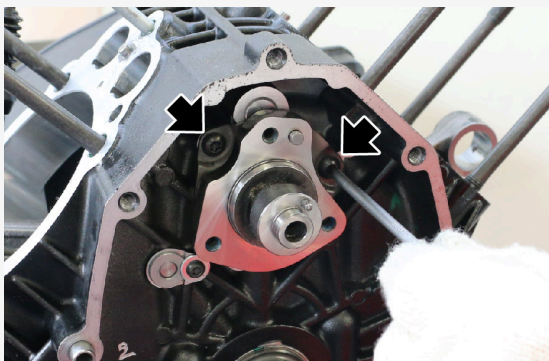
N.B**PROCEDURE VALID ONLY FOR E4 VEHICLES.**

- Insert the camshaft into the crankcase.



- Apply threadlock to the threads of the retaining screws.
- Place the two fixing screws and tighten them to the specified torque:

DESCRIPTION	TORQUE
Camshaft fixing on crankcase	6 ÷ 7 Nm (4.43 ÷ 5.16lbf ft)



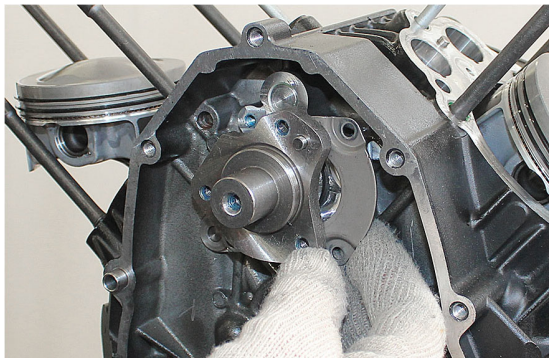
PRODUCT	DESCRIPTION	CHARACTERISTICS
Loctite 2045	Medium strength thread-locking sealant	Blue

N.B



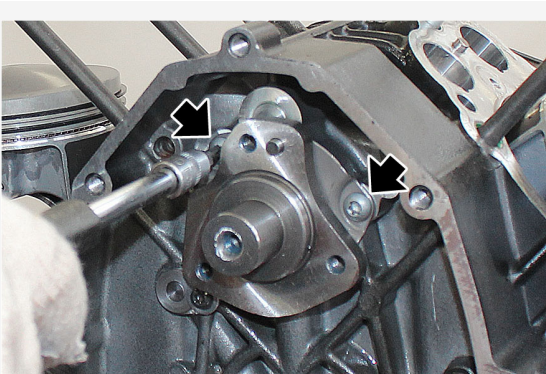
PROCEDURE VALID FOR EURO 5 AND EURO 5 PLUS VEHICLES.

- Insert the camshaft into the crankcase.
- Insert the flange in the specific slot.



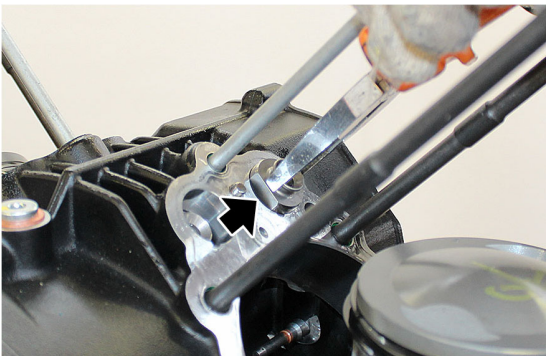
- Apply threadlock to the threads of the retaining screws.
- Place the two fixing screws and tighten them to the specified torque:

DESCRIPTION	TORQUE
Camshaft fixing on crankcase	6 ÷ 7 Nm (4.43 ÷ 5.16lbf ft)



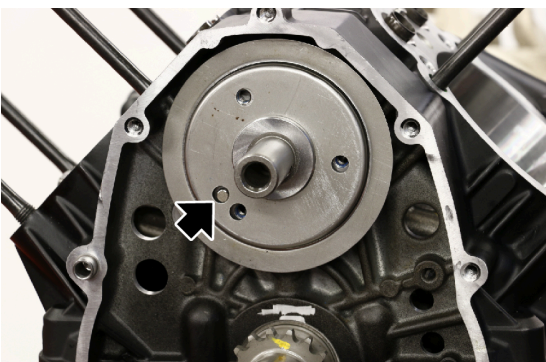
PRODUCT	DESCRIPTION	CHARACTERISTICS
Loctite 2045	Medium strength thread-locking sealant	Blue

- Place the bucket tappets paying attention to the centring pin. Apply grease ensuring that it does not fall.



4.3.6 Blow-by cap installation

- Place the blow-by cap on the camshaft making the holes and the special timing plug match



4.3.7 Chain installation

- For the installation of the timing chain, it is necessary to carry out the "Timing" procedure, therefore consult the specific chapter.

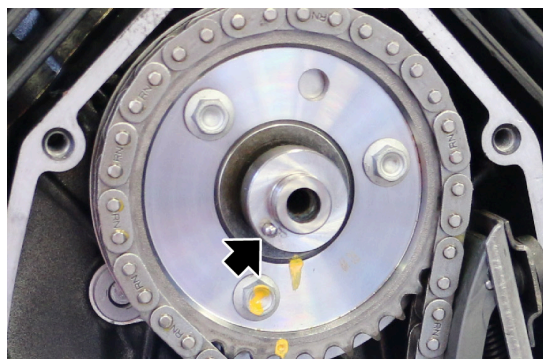
4.3.8 TONE WHEEL INSTALLATION

N.B

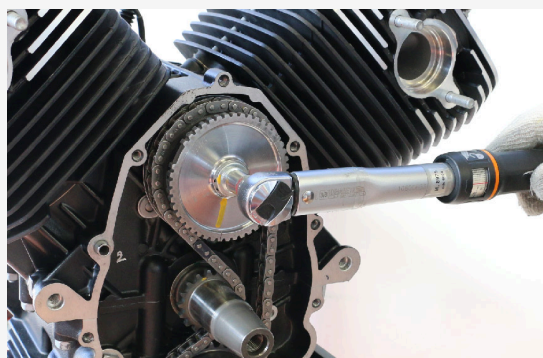


PROCEDURE VALID ONLY FOR E4 VEHICLES.

- Fit the tone wheel checking the correct positioning on the camshaft, using the centring plug

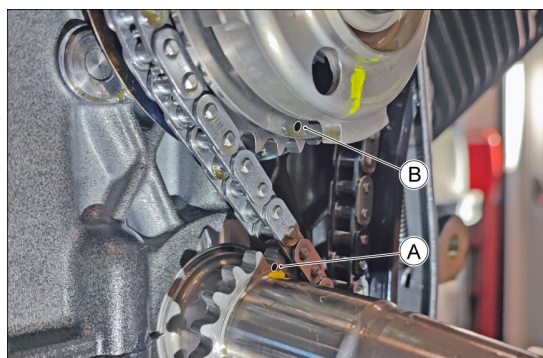


- Insert the screw complete with washer to fasten the tone wheel and tighten it to the prescribed torque.

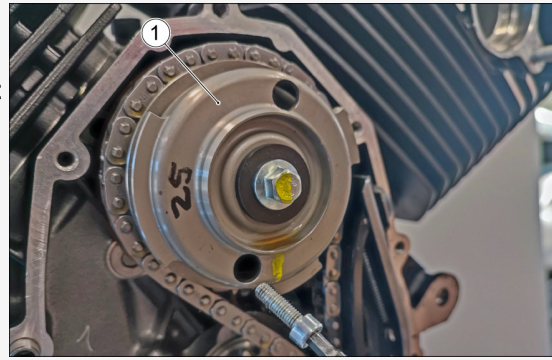


4.3.9 E5 PLUS engine timing system removal

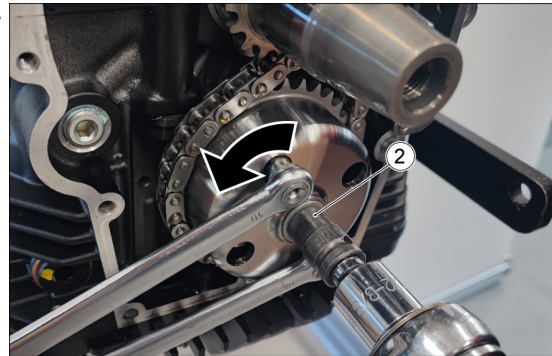
- First remove the alternator cover and the rotor from the engine, as shown in chapter "Alternator removal".
- Turn the engine until aligning the punch of the crankshaft (A) with the punch of the camshaft sprocket (B).



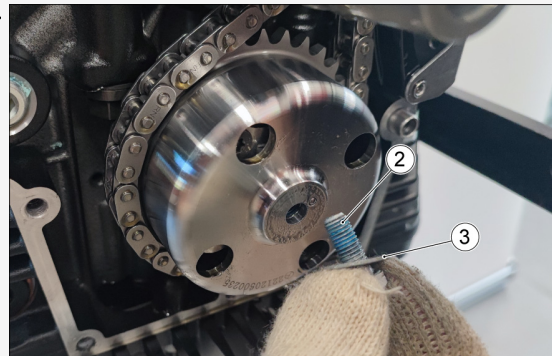
- Insert two M5x20 screws into the holes on the tone wheel (1) of the timing CVT.
- Tighten the two screws all the way, **without over tightening them.**



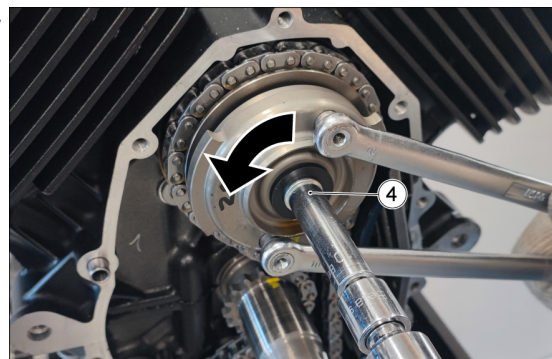
- Blocking rotation using a spanner, unscrew the fixing screw (2) of the oil pump's pinion.



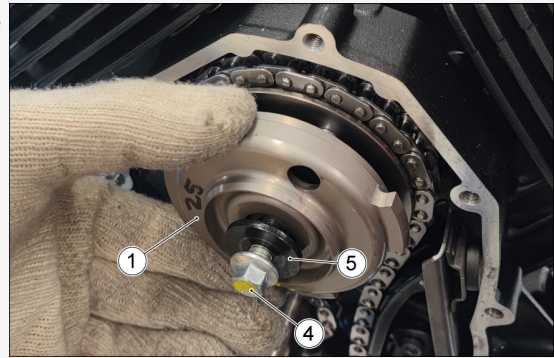
- Remove the fixing screw (2) and the washer (3) from the pinion of the oil pump.



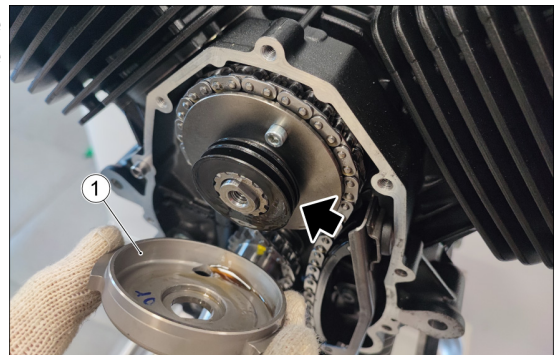
- Blocking rotation using a spanner, unscrew the fixing screw (4) of the timing CVT.



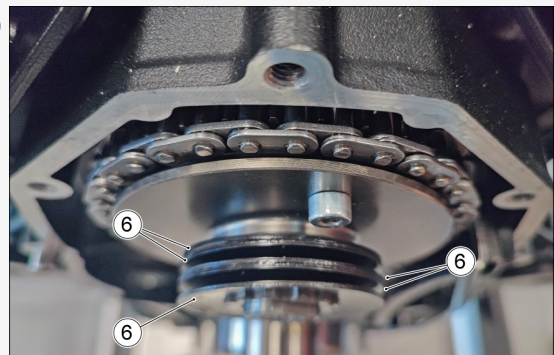
- Remove the screw (4) and the relative washer (5) hold the tone wheel (1) in position.



- Remove the tone wheel (1) from the camshaft, being **careful not to drop** the spring washers present on the camshaft.



- Remove the five spring washers (6) positioned on the camshaft.

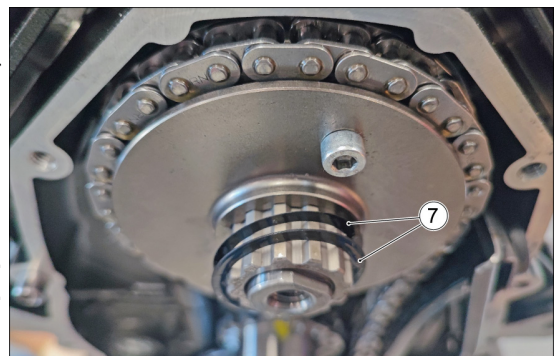


- Collect the shims (7) from the camshaft.

WARNING



THERE MAY BE BETWEEN ZERO AND 7 WASHERS DEPENDING ON THE CONSTRUCTION DIMENSIONS OF THE PHASE SHIFTER, ALWAYS USE AGAIN THE SAME WASHERS FITTED TO THE COMPONENT.



WARNING



THE NUMBER OF SHIM WASHERS (7) MAY VARY DEPENDING ON THE CALIBRATION PERFORMED AT THE FACTORY DURING ASSEMBLY.

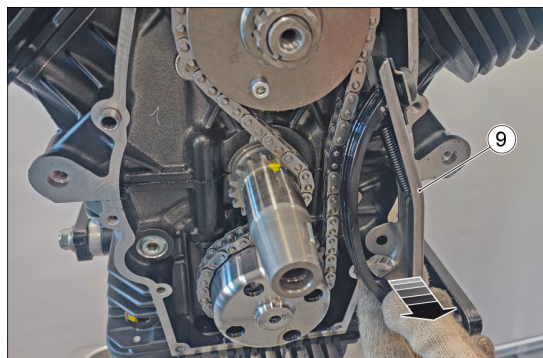
IN THE CASE OF DISASSEMBLY AND REASSEMBLY OF THE PHASE SHIFTER, REASSEMBLE EXACTLY THE SAME SHIM WASHERS THAT WERE IN THE ENGINE AT THE TIME OF DISASSEMBLY.

WHEN REPLACING THE PHASE SHIFTER, FIT ALL THE SHIM WASHERS CONTAINED IN THE NEW REPLACEMENT KIT.

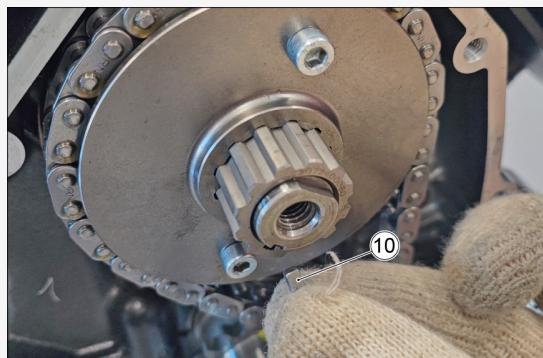
- Remove the fixing screw (8).



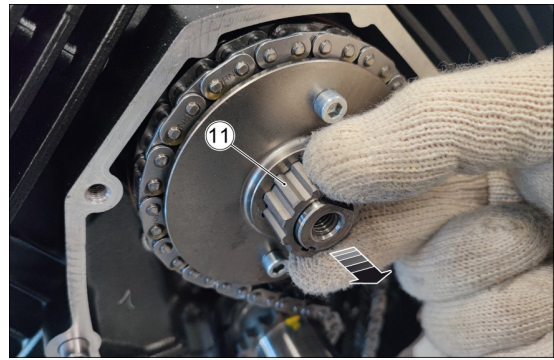
- Remove the chain tensioner pad (9).



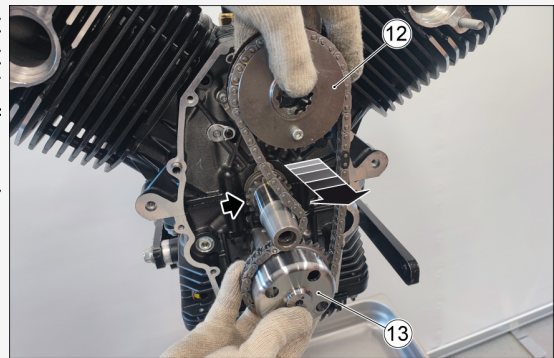
- Remove the spline (10) from the camshaft



- Remove the hub (11) of the timing CVT from the camshaft, pulling it outwards.



- Remove the timing chain disconnecting it from the toothed wheel on the crankshaft and pulling simultaneously the timing CVT (12) from the camshaft and the sprocket of the oil pump (13).

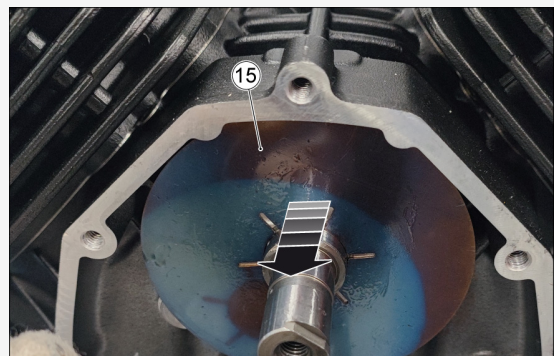
**N.B**

PAY ATTENTION TO THE CENTRING PIN OF THE OIL PUMP GEAR.

- Retrieve the centring pin (14) from the oil pump.

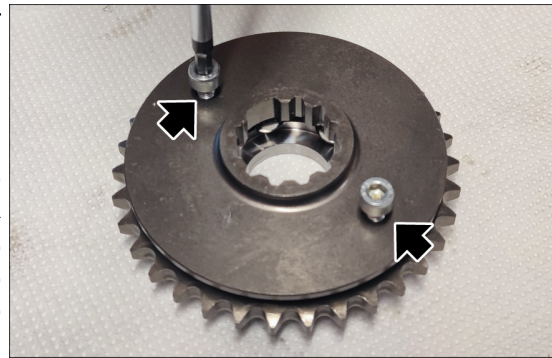


- Remove the shield (15) for the oil vapours from the camshaft, sliding it outwards.



WARNING

DO NOT REMOVE THE TWO M5 SCREWS INSTALLED ON THE PHASE SHIFTER UNTIL IT IS REASSEMBLED ON THE ENGINE. IF REMOVED, THE PHASE SHIFTER COULD BREAK DOWN AND THE COMPONENTS INSIDE COULD BE LOST.

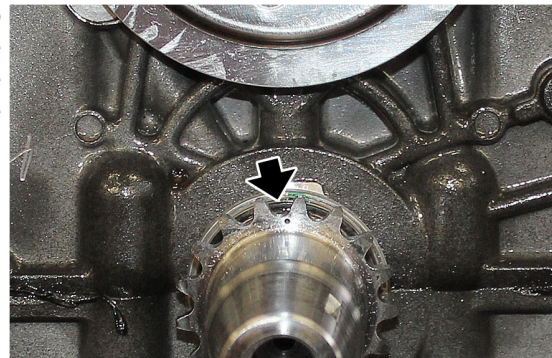


To refit the timing CVT, consult the "TIMING" section.

4.3.10 Timing

4.3.10.1 Timing

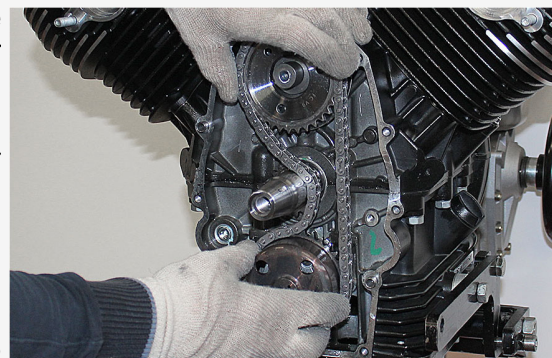
- Bring the piston of the left cylinder to top dead centre making sure that the reference mark on the crankshaft gear is up on the perpendicular axis and that the rocker have clearance



- After having placed the rear chain guide cap, fit the timing system chain, together with the timing system gear and the oil pump gear.

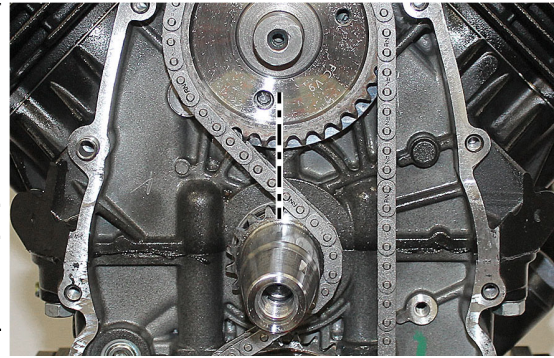
WARNING

PRIOR TO POSITIONING THE TIMING CHAIN WITH GEAR, ALIGN AS MUCH AS POSSIBLE THE MILLING PRESENT ON THE OIL PUMP PIN WITH THE GEAR OF THE PUMP ITSELF, TO ALLOW THE INSERTION OF THE SAFETY PLUG.

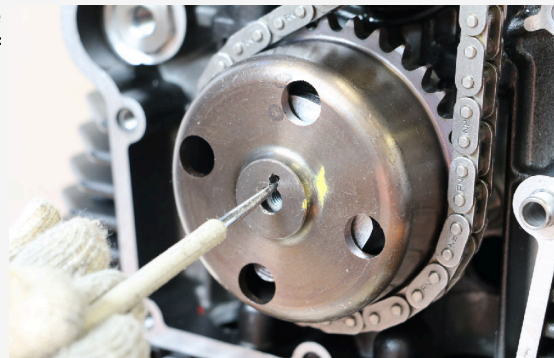


ATTENTION

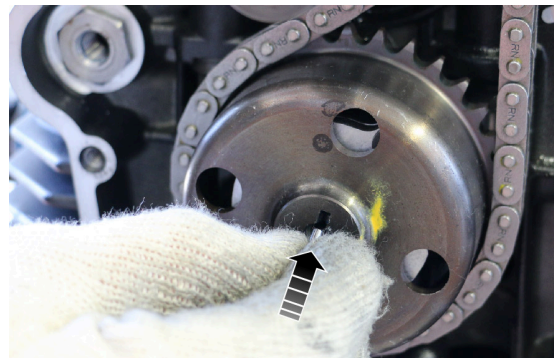
CHECK THE CORRECT INSTALLATION USING THE ALIGNMENT OF THE REFERENCE NOTCHES ON THE CRANKSHAFT AND ON THE TIMING SYSTEM GEAR.



- Using a thin tool, refine the alignment of the oil pump pin with the milling on the pinion of the pump itself.



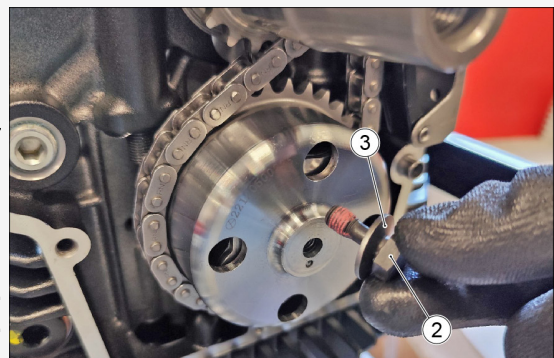
- Fit the safety plug.



- Screw a **NEW special pre-impregnated screw** (2) and its cup washer (3) into the oil pump shaft.

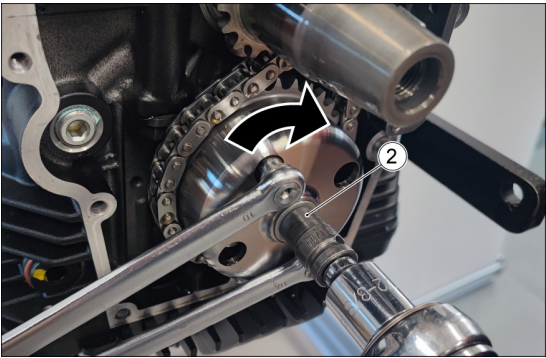
WARNING

INSTALL THE SPRING WASHER WITH THE CONCAVE SIDE FACING TOWARDS THE INSIDE OF THE ENGINE.



- Locking the rotation using a socket wrench, tighten the fixing screw (2) to the specified torque:

DESCRIPTION	TORQUE
Fastening of the oil pump pinion	20 - 22 Nm (14.75 - 16.23 lb ft)

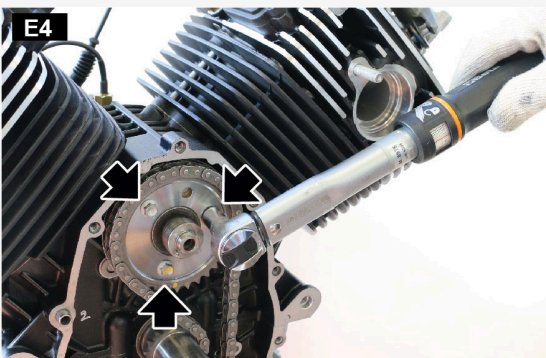


- Position the three fixing screws of the timing gear and tighten to the prescribed torque.

N.B



PROCEDURE VALID ONLY FOR E4 VEHICLES.

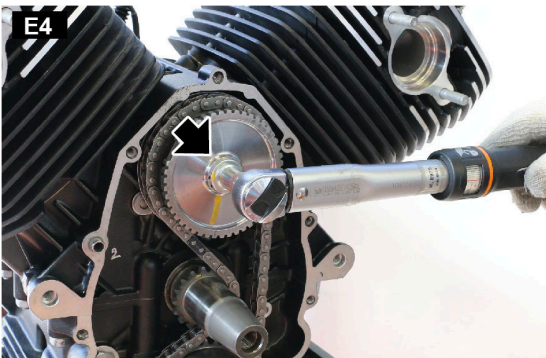


- Position the tone wheel and after inserting the fixing screw with washer, tighten to the prescribed torque.

N.B



PROCEDURE VALID ONLY FOR E4 VEHICLES.

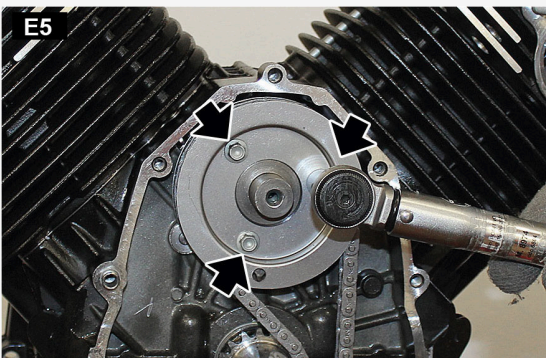


- Fit the front chain guide on the timing system sprocket and then insert the three fixing screws and tighten them to the recommended torque.

N.B.:



PROCEDURE VALID ONLY FOR E5 VEHICLES.

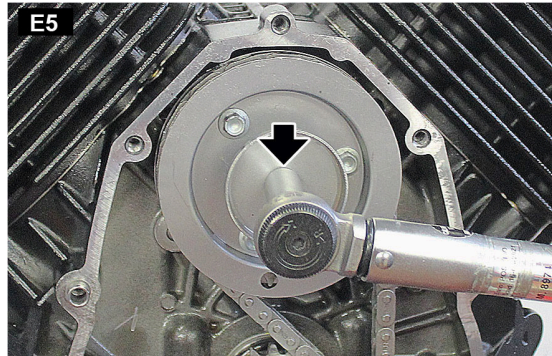


- Fit the bulkhead on the camshaft, fit the fixing screw and tighten it to the recommended torque.

N.B.:



PROCEDURE VALID ONLY FOR E5 VEHICLES.



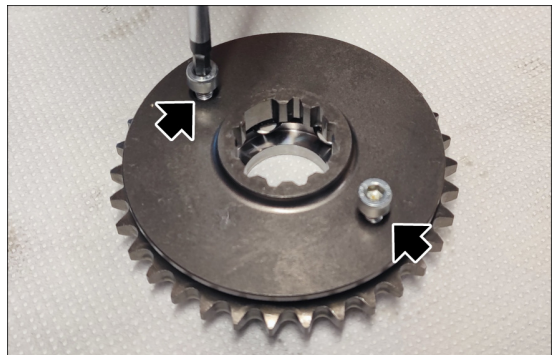
- Turn the crankshaft manually checking that there is no jamming. If jamming does occur, repeat the timing operation.

4.3.10.2 E5 PLUS engine timing

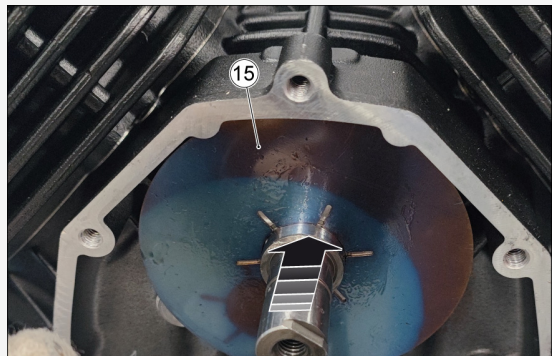
WARNING



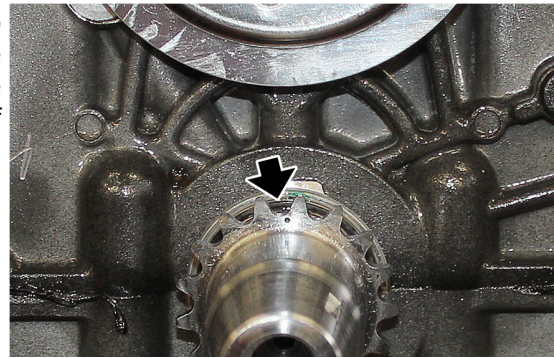
DO NOT REMOVE THE TWO M5 SCREWS INSTALLED ON THE PHASE SHIFTER UNTIL IT IS REASSEMBLED ON THE ENGINE. IF REMOVED, THE PHASE SHIFTER COULD BREAK DOWN AND THE COMPONENTS INSIDE COULD BE LOST.



- Install the shield (15) for the oil vapours on the camshaft.



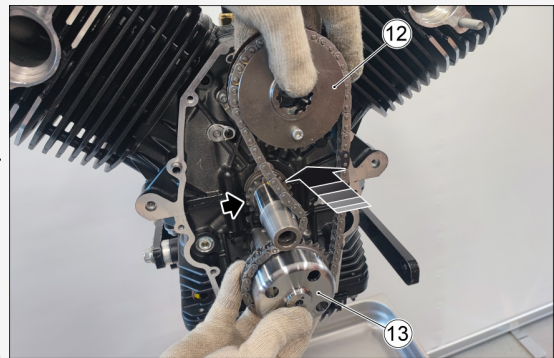
- Bring the piston of the left cylinder to top dead centre making sure that the reference mark on the crankshaft gear is up on the perpendicular axis and that the rockers of the valves have clearance



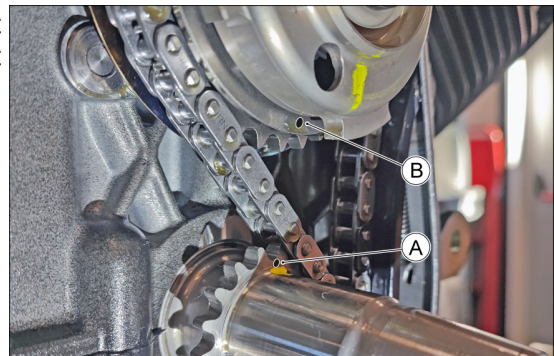
- Fit the timing chain together with the timing CVT (12) and pinion of the oil pump (13), in the engine, making sure to correctly fit it on the pinion of the crankshaft.

WARNING

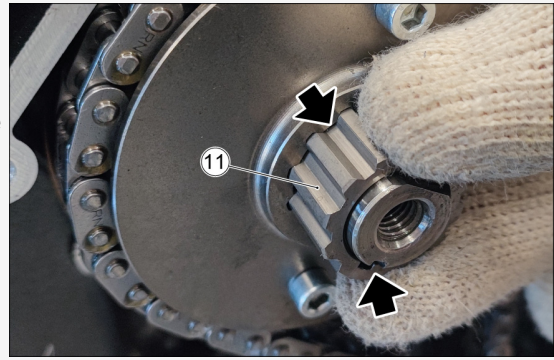
PRIOR TO POSITIONING THE TIMING CHAIN WITH GEAR, ALIGN AS MUCH AS POSSIBLE THE MILLING PRESENT ON THE OIL PUMP PIN WITH THE GEAR OF THE PUMP ITSELF, TO ALLOW THE INSERTION OF THE SAFETY PLUG.



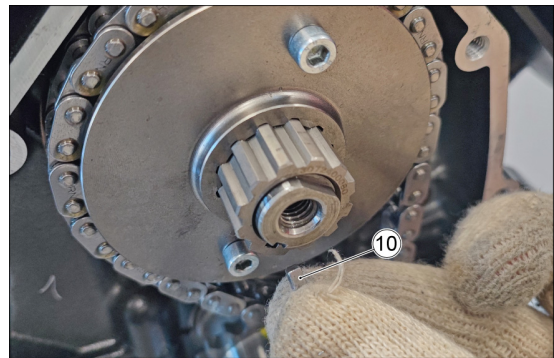
- Make sure that the punch of the crankshaft (A) is aligned with the punch of the camshaft sprocket (B).



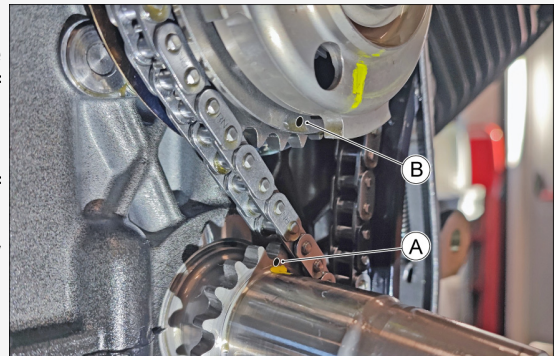
- Insert the hub (11) in the timing CVT.
- Make sure to coincide: The external splines with the internal one of the timing CVT, the internal milling with the one on the camshaft, for the insertion of the spline.



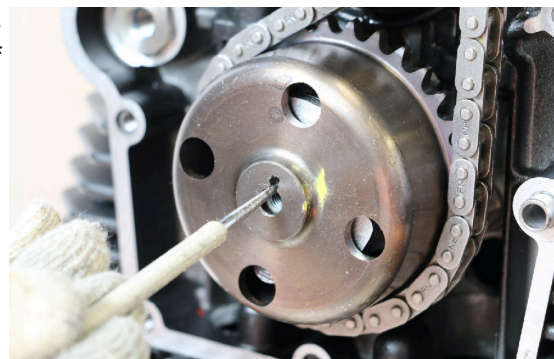
- Install the spline (10) on the camshaft.



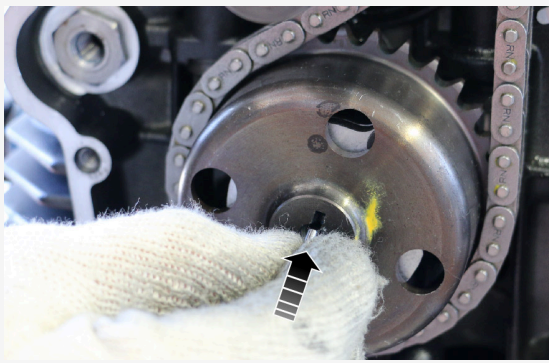
- After inserting the spline on the camshaft, make sure again that the punch of the crankshaft (A) is aligned with the punch of the camshaft sprocket (B).
- If the punch marks are no longer aligned, repeat the installation of the hub (11) and of the relative spline (10), keeping the timing chain / timing CVT / crankshaft assembly still during the operation.



- Using a thin tool, refine the alignment of the oil pump pin with the milling on the pinion of the pump itself.



- Insert the centring pin.

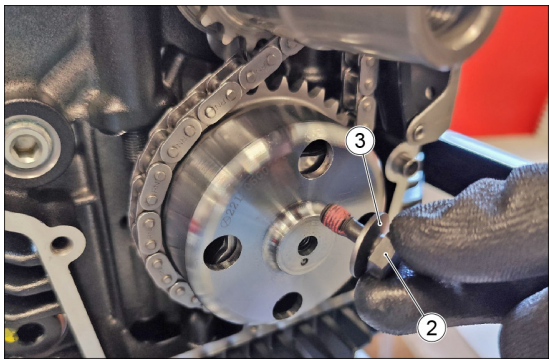


- Screw a **NEW special pre-impregnated screw** (2) and its cup washer (3) into the oil pump shaft.

WARNING

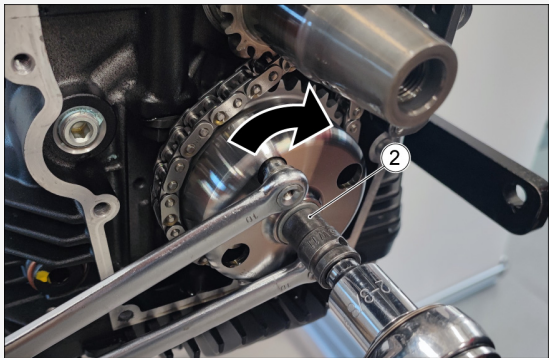


INSTALL THE SPRING WASHER WITH THE CONCAVE SIDE FACING TOWARDS THE INSIDE OF THE ENGINE.



- Locking the rotation using a socket wrench, tighten the fixing screw (2) to the specified torque:

DESCRIPTION	TORQUE
Fastening of the oil pump pinion	20 - 22 Nm (14.75 - 16.23 lb ft)

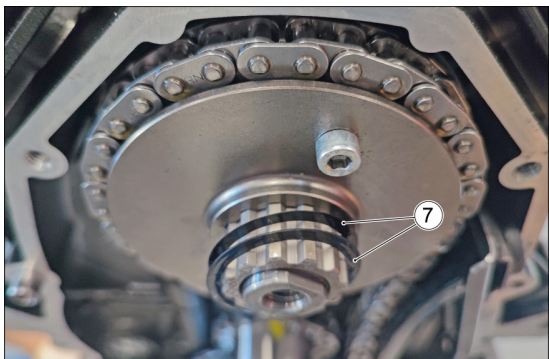


- Position the shims (7) on the camshaft.

WARNING



THERE MAY BE BETWEEN ZERO AND 7 WASHERS DEPENDING ON THE CONSTRUCTION DIMENSIONS OF THE PHASE SHIFTER, ALWAYS USE AGAIN THE SAME WASHERS FITTED TO THE COMPONENT.



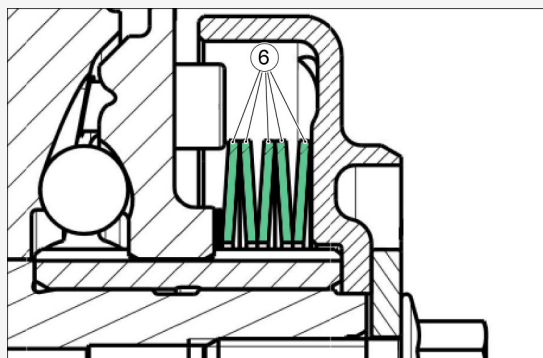
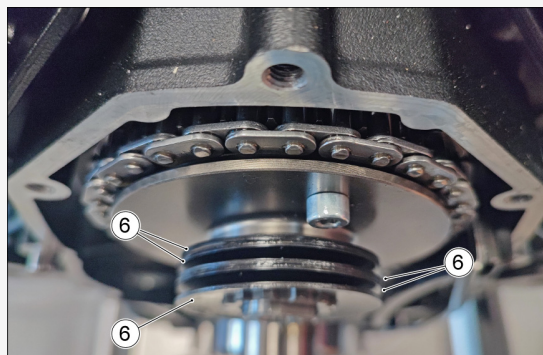
WARNING

THE NUMBER OF SHIM WASHERS (7) MAY VARY DEPENDING ON THE CALIBRATION PERFORMED AT THE FACTORY DURING ASSEMBLY.

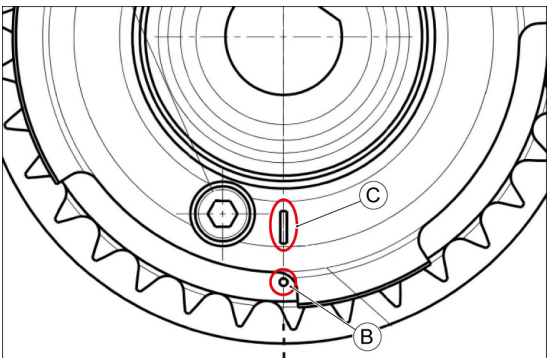
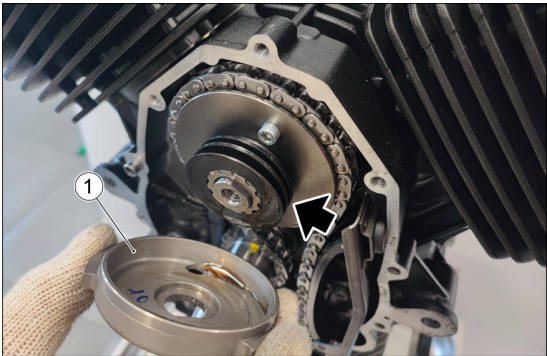
IN THE CASE OF DISASSEMBLY AND REASSEMBLY OF THE PHASE SHIFTER, REASSEMBLE EXACTLY THE SAME SHIM WASHERS THAT WERE IN THE ENGINE AT THE TIME OF DISASSEMBLY.

WHEN REPLACING THE PHASE SHIFTER, FIT ALL THE SHIM WASHERS CONTAINED IN THE NEW REPLACEMENT KIT.

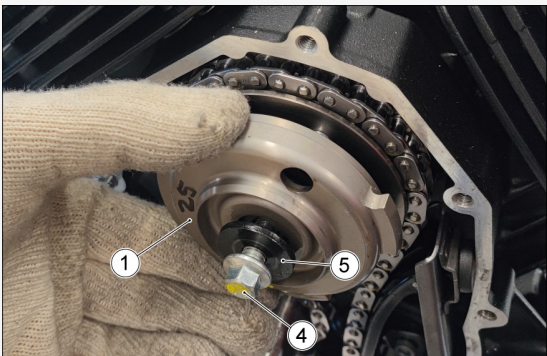
- Position the five spring washers (6) on the camshaft, respecting the direction shown in the drawing.



- Fit the tone wheel (1) on the camshaft, making sure that the reference (C) the punch mark (B) on the sprocket of the timing CVT.
- Pay attention not to drop the spring washers previously installed on the camshaft.

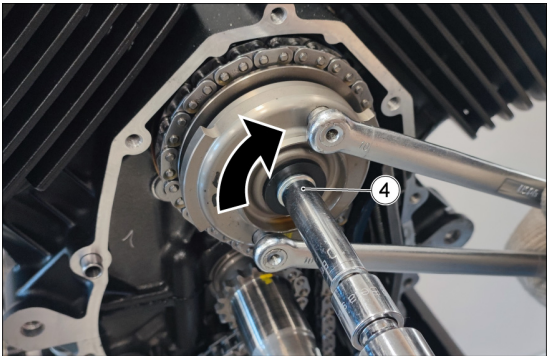


- Keeping the tone wheel (1) pressed in position, fit the screw (4) and the relative washer (5).

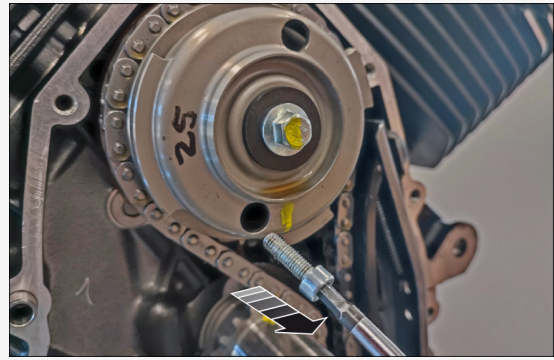


- Locking the rotation using a socket wrench, tighten the fixing screw (4) to the specified torque:

DESCRIPTION	TORQUE
Timing CVT fixing	30 - 34 Nm (22.13 - 25.08 lb ft)



- Remove the two M5x20 fixing screws, fitted during disassembly, on the timing CVT (1).



- Turn the crankshaft manually checking that there is no jamming. If jamming does occur, repeat the timing operation.

4.3.11 Big end and valve timing system

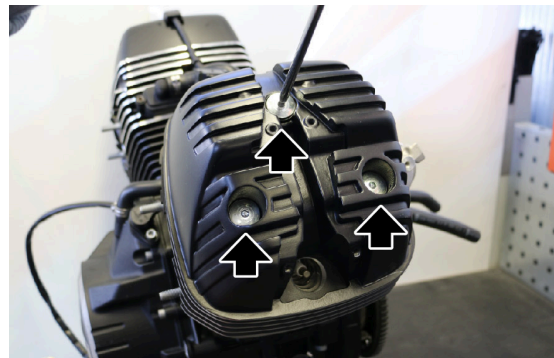
4.3.11.1 Head cover removal

N.B.:



THE OPERATIONS FOR THE REMOVAL OF THE HEAD COVER ARE THE SAME FOR BOTH SIDES.

- Remove the spark plug cover
- Disconnect the spark plug tube
- Remove the blow-by pipe
- Undo the three fixing screws of the head cover and remove the gasket



- Remove the head cover together with the gaskets



- Remove the gasket from the head cover



- Check that the mating faces that contact the heads are not damaged or blistered

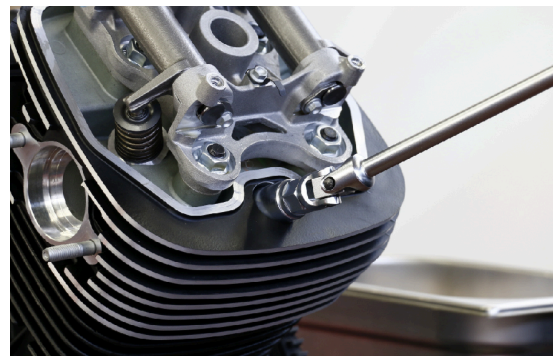
4.3.11.2 Head removal

N.B

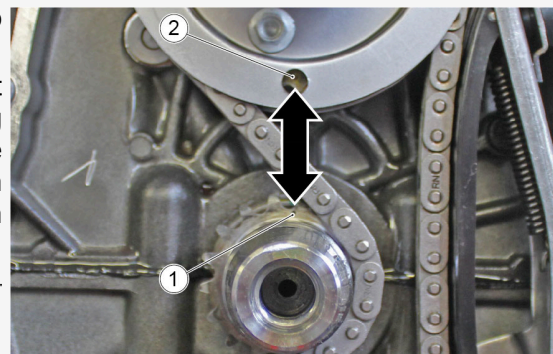


THE HEAD REMOVAL OPERATIONS REFER TO ONE HEAD BUT APPLY TO BOTH.

- Remove the head cover
- Unscrew the spark plug



- Bring the cylinder of the left piston to top dead centre
- Check that the punching of the crankshaft pinion (1) is aligned with the punching on the timing system sprocket (2). The punching on the timing system sprocket can be viewed through the hole of the chain guide cap

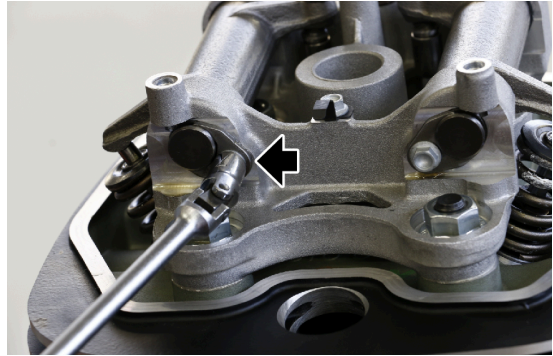


N.B.:

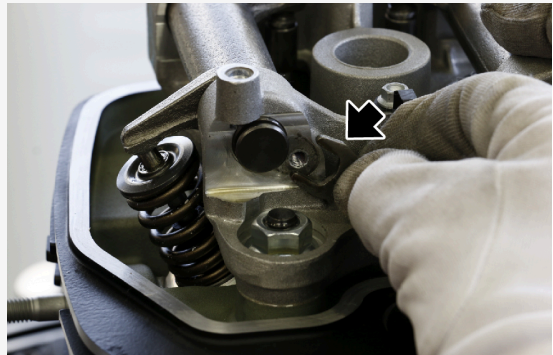


PROCEDURE VALID ONLY FOR E5 VEHICLES.

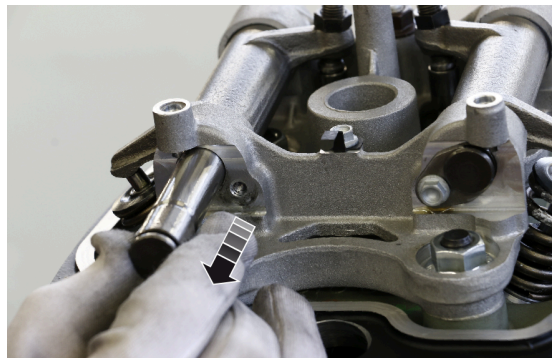
- Remove the fastening screw of the rocker pin retainer fork



- Remove the rocker pin retainer fork

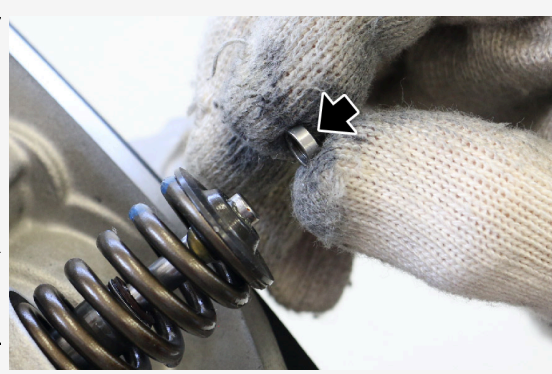


- Remove the rocker pin



ATTENTION

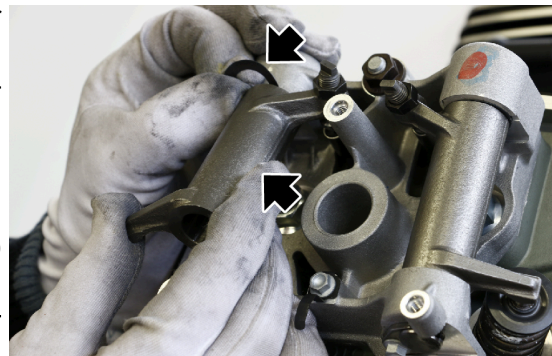
THE INTAKE VALVE IS CHARACTERIZED BY THE PRESENCE OF A CALIBRATED PAD, THEREFORE PAY PARTICULAR ATTENTION TO RECOVER IT DURING DISASSEMBLY.



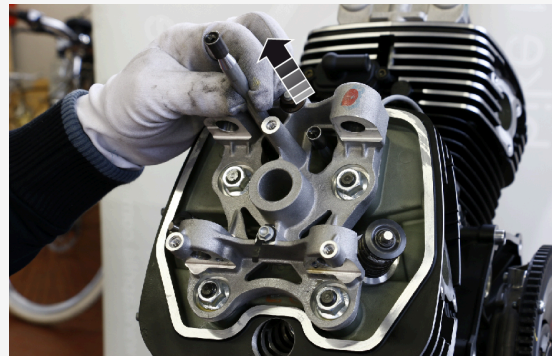
- Remove the rocker, being careful to recover the Belleville spring

N.B

REPEAT THE SAME PROCEDURE TO REMOVE THE OTHER ROCKER.



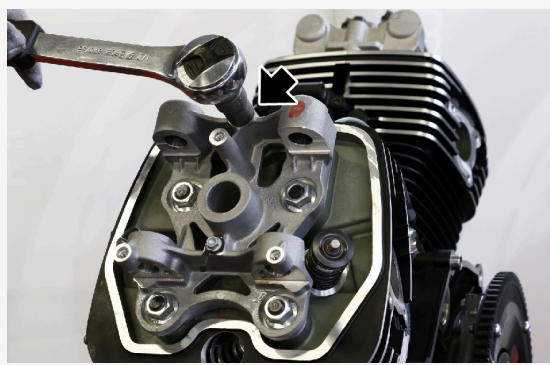
- Remove the rocker rods



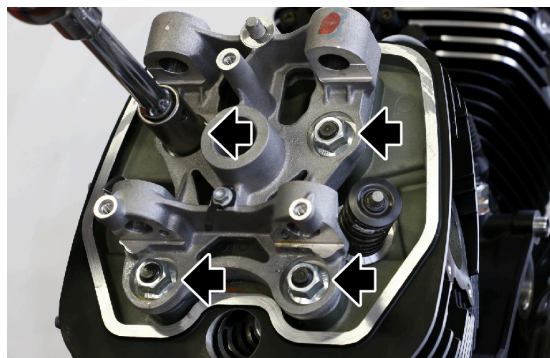
- Remove the nut with relevant fixing washer of the cylinder to the crankcase



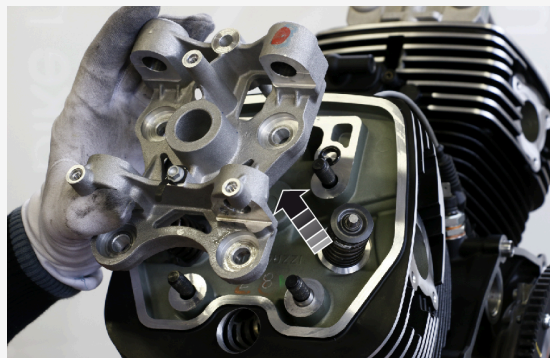
- Unscrew and remove the compensation nut of the cam tower



- Undo and remove the fastening nuts of the cam tower



- Remove the cam tower

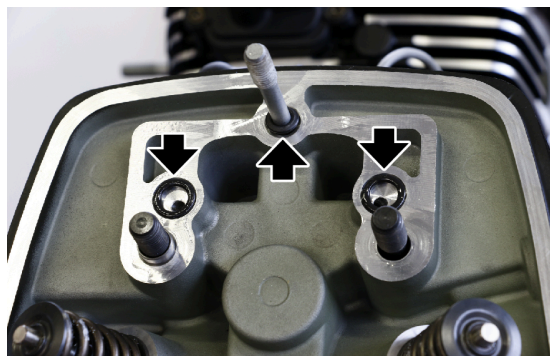


- Remove the three rubber O-Rings

ATTENTION



PAY SPECIAL ATTENTION THAT THE O-RINGS DO NOT ACCIDENTALLY FALL INTO THE PROCESSING HOLES OF THE ROCKERS RODS.



- Remove the complete head



- Remove the cylinder head gasket



- Undo and remove the engine oil pressure sensor

N.B



PROCEDURE VALID ONLY FOR E4 VEHICLES.



- Undo and remove the secondary air valve cover



- Remove the secondary air valve
- check and if necessary replace the external rubber gasket



- Remove the internal filter paying attention to the direction during refitting

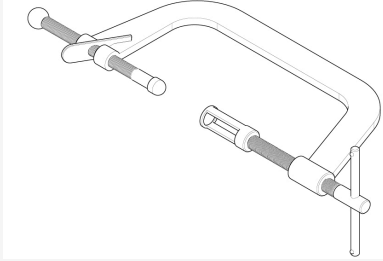


4.3.11.3 Head

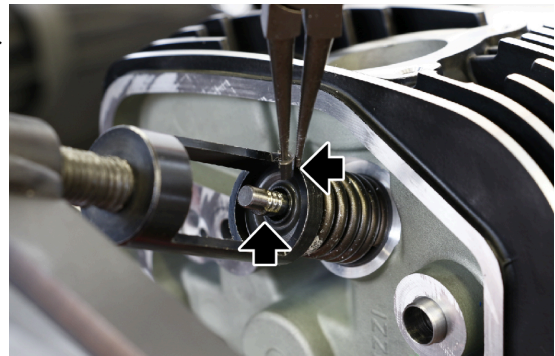
Removing valves

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



CODE	DESCRIPTION	IMAGE
020382Y	Valve removal and fitting	

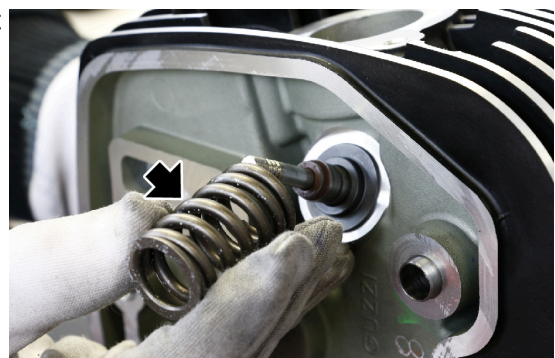
- Close the tool to compress the spring and remove the two half-cones from the upper cap



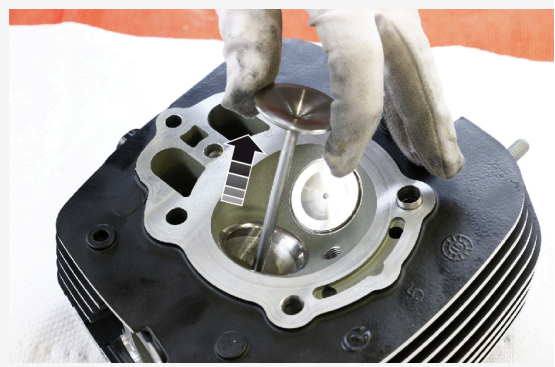
- Unscrew the tool and remove it from the head
- Remove the upper cap



- Remove the spring and replace it if it is out of the wear limit.



- Remove the valve from the head



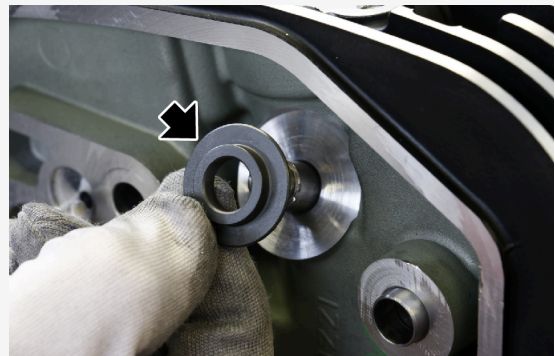
- Remove the gasket of the valve guide

ATTENTION

VALVE GUIDES MUST BE REPLACED WHEN THEY ARE WORN TO THE POINT THAT REPLACING THE VALVE ALONE IS NOT ENOUGH TO ELIMINATE CLEARANCE BETWEEN VALVE STEM AND VALVE GUIDE BORE.



- Remove the lower cap of the spring



Rockers check

- Check that the bolt surface in contact with the rockers is not exceedingly worn.
- Check the rocker to valve and rocker to rod contact surfaces.

**Valve check**

If the below shown values are out of the limits of the component wear, replace it

Intake valves:

CHARACTERISTIC	DESCRIPTION / VALUE
Assembly clearance between valve and valve guide (WEAR LIMIT)	0.04 mm (0.0016 in)
Valve stem distortion (MEASURED ON 45°)	0.03 mm (0.0012 in)
Valve stem diameter (MINIMUM WEAR VALUE)	5.95 mm (0.2343 in)
Valve head eccentricity (MAXIMUM ALLOWED VALUE)	0.10 mm (0.0039 in)

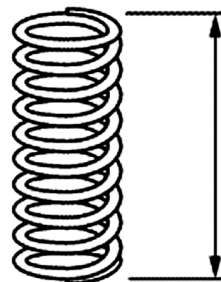
Outlet valves:

CHARACTERISTIC	DESCRIPTION / VALUE
Assembly clearance between valve and valve guide (WEAR LIMIT)	0.06 mm (0.0024 in)
Valve stem distortion (MEASURED ON 45°)	0.03 mm (0.0012 in)
Valve stem diameter (MINIMUM WEAR VALUE)	5.92 mm (0.2331 in)
Valve head eccentricity (MAXIMUM ALLOWED VALUE)	0.10 mm (0.0039 in)

Springs and cotters check

- Check that the upper spring caps and the half-cones show no signs of abnormal wear.
- Check the length of the spring subjected to load:

CHARACTERISTIC	DESCRIPTION / VALUE
Control load 1 238 ± 14.5 N	Control length 1 40.9 mm (1.61 in)
Control load 2 831.7 ± 27 N	Control length 2 30.7 mm (1.21 in)



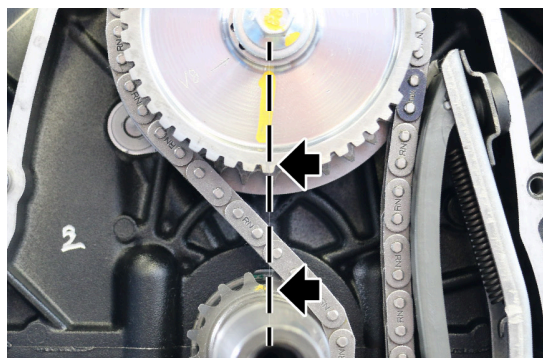
Valve clearance adjustment

- Bring the piston of the left cylinder to top dead centre making sure that the reference mark on the crankshaft gear and on the timing system shaft are aligned.

N.B



PROCEDURE VALID ONLY FOR E4 VEHICLES.

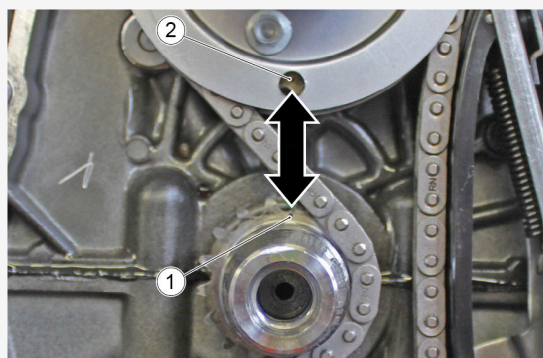


- Bring the cylinder of the left piston to top dead centre
- Check that the punching of the crankshaft pinion (1) is aligned with the punching on the timing system sprocket (2). The punching on the timing system sprocket can be viewed through the hole of the chain guide cap

N.B.:

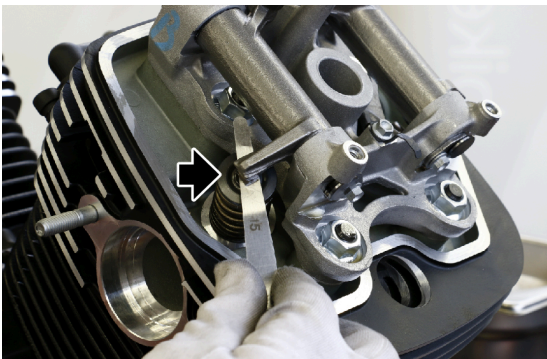


PROCEDURE VALID ONLY FOR E5 VEHICLES.

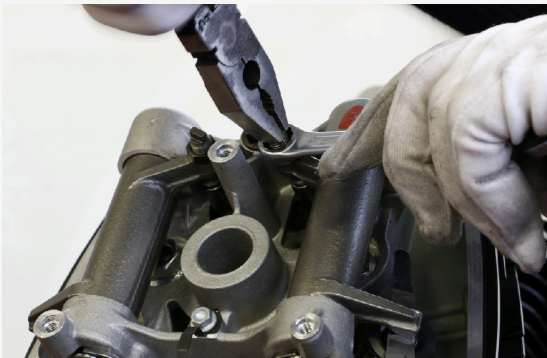


- Use a feeler gauge to check that the clearance between the valve and the set screw corresponds with the indicated values. The corresponding intake and outlet valve clearances are different than what is indicated below, proceed with adjusting them.

CHARACTERISTIC	DESCRIPTION / VALUE
Intake valve clearance	0.10 mm (0.0039 in)
Exhaust valve clearance	0.15 mm (0.0059 in)



- Loosen the lock nut, adjust the clearance by acting on the adjuster until reaching the prescribed values
- Tighten the lock nut



4.3.11.4 Head-engine block-piston assembly

Cylinder removal

- Slide off the cylinder from the stud bolts.

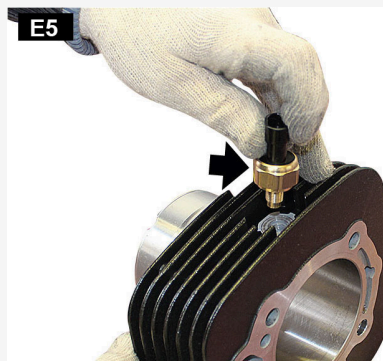


- Remove the temperature sensor from the left cylinder.

N.B.:



PROCEDURE VALID ONLY FOR E5 VEHICLES.

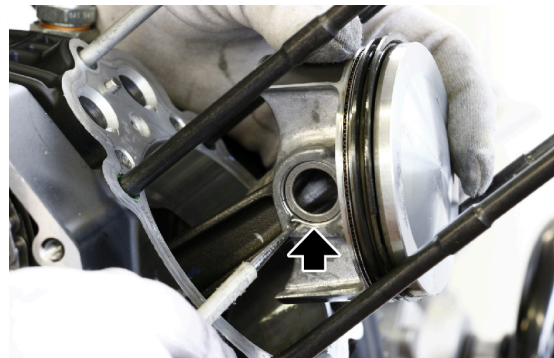


- Remove the gasket from the stud bolts



Piston removal

- Remove one of the two retainer rings from the pin paying attention that it does not fall inside the engine



- Before removing the pin, check the mounting clearance between pin and piston. Replace it if the value is out of the limits
- Slide off the pin



CHARACTERISTIC	DESCRIPTION / VALUE
Mounting clearance between piston and pin	0.02 mm (0.0008 in)

- Remove the piston

ATTENTION

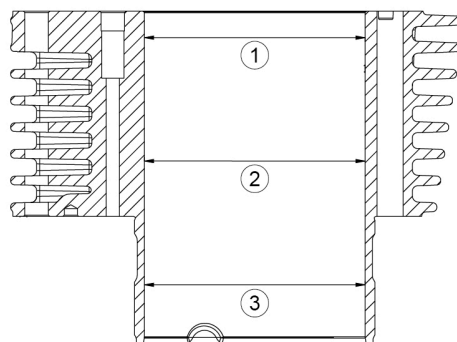


DURING SERVICING, CLEAN OFF ANY DEPOSITS FROM PISTON CROWN AND CIRCLIP GROOVES.



Cylinder check

- After checking that there is no scoring, check cylinder surface wear using a dial gauge graduated in hundredths of a millimetre.
- Measure the inner diameter of the cylinders at three different heights, turn the dial gauge (graduated in hundredths of a millimetre) 90° and repeat the measurements; set the dial gauge graduated in hundredths of a millimetre to zero using a ring gauge before measuring.



Key:

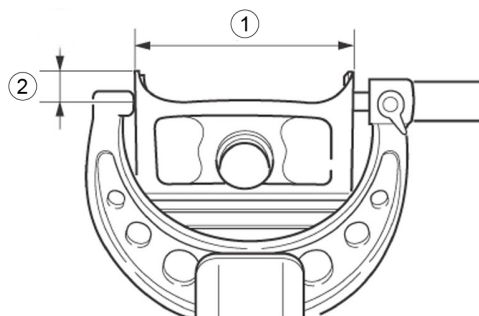
- 1 . 1st measurement
- 2 . 2nd measurement
- 3 . 3rd measurement

CYLINDERS CONTROL

Type	Allowed diameter	Assembly clearance between piston and cylinder
G	84.000-84.007 mm (3.3071-3.3073 in)	0.040-0.054 mm (0.0016-0.0021 in)
H	84.007-84.014 mm (3.3074-3.3076 in)	0.040-0.054 mm (0.0016-0.0021 in)
L	84.014-84.021 mm (3.3076-3.3079 in)	0.040-0.054 mm (0.0016-0.0021 in)
M	84.021-84.028 mm (3.3079-3.3082 in)	0.040-0.054 mm (0.0016-0.0021 in)

Piston check

- Measure the piston skirt diameter (1) with a micrometer from the piston lower border (2)=10 mm (0.39 in).
- Replace the cylinder, the piston and the piston ring all together if not complying with specifications.



PISTONS CHECK

Type	Allowed diameter	Assembly clearance between piston and cylinder
G	83.953-83.960 mm (3.3052-3.3055 in)	0.040-0.054 mm (0.0016-0.0021 in)
H	83.960-83.967 mm (3.3055-3.3058 in)	0.040-0.054 mm (0.0016-0.0021 in)
L	83.967-83.974 mm (3.3058-3.3061 in)	0.040-0.054 mm (0.0016-0.0021 in)
M	83.974-83.981 mm (3.3061-3.3063 in)	0.040-0.054 mm (0.0016-0.0021 in)

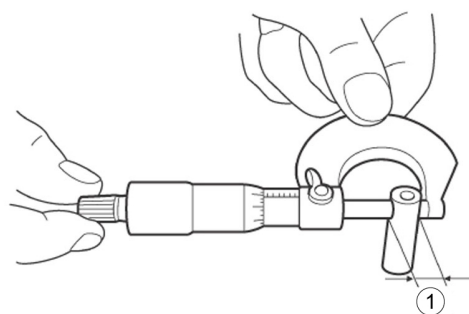
Pin check

PISTON PIN

- Clean off combustion residues from the piston crown and from the area above the top ring.
- Check for cracks on the piston and for compression on the piston sliding surface (seizing); Replace the piston if required.

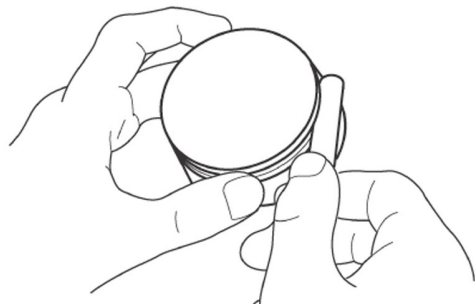
- Measure the pin outside diameter (1) and if not complying with specifications; replace the pin.

CHARACTERISTIC	DESCRIPTION / VALUE
Pin external diameter (MINIMUM WEAR VALUE)	19.996 mm (0.7872 in)



Check the sealing rings

- Clean off any carbon deposits from the grooves in the piston rings and from the rings themselves.
- Measure the piston ring side clearance and replace the piston and the piston rings all together if not complying with specifications.



SEAL RING CLEARANCE (MAXIMUM WEAR VALUES)

Type	Maximum clearance between the rings and cables on the piston	Maximum opening of the rings mounted on the piston
Upper ring	0.07 mm (0.0028 in)	0.10-0.30 mm (0.0039-0.0118 in)
Intermediate ring	0.06 mm (0.0024 in)	0.35-0.55 mm (0.0138-0.0217 in)
Oil scraper ring	0.18 mm (0.0071 in)	0.20-0.70 mm (0.0079-0.0276 in)

- Fit the piston ring to the cylinder.
- Level the installed piston ring with the piston crown.
- Measure piston ring port and replace it if not complying with specifications.

ATTENTION



IT IS NOT POSSIBLE TO MEASURE THE CLEARANCE OF THE END OF THE OIL SCRAPER RING: IF THERE IS EXCESSIVE PLAY, REPLACE THE THREE ELASTIC RINGS.

- Insert the piston rings paying attention to their mounting direction and end gap arrangement; the end gaps must be approximately 180 degrees from each other.

Fitting the piston

- Place the piston on the connecting rod notch

ATTENTION



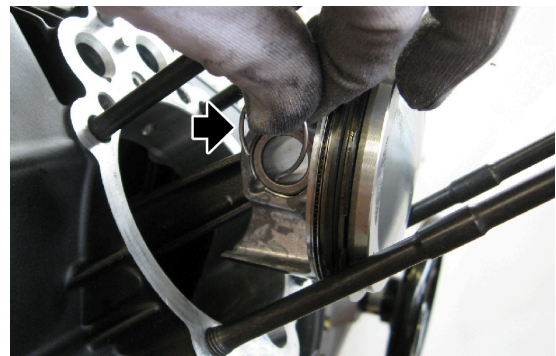
MOUNTING POSITION IS INDICATED BY AN ARROW POINTING IN THE DIRECTION OF TRAVEL.



- Insert the pin

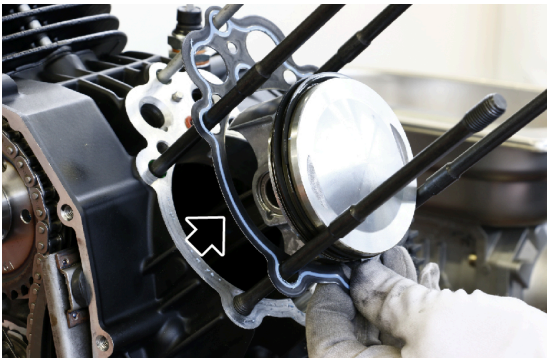


- Insert the retainer ring



Cylinder installation

- Check that the piston ring end gaps are approximately 120 degrees from each other.
- Fit a new gasket



- Fit the existing temperature sensor only on the left cylinder.

N.B.:



PROCEDURE VALID ONLY FOR E5 VEHICLES.



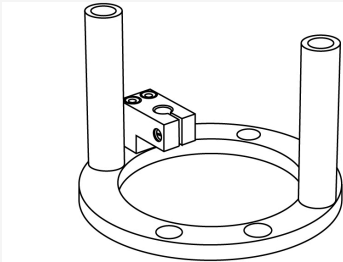
- Place the appropriate ring clamp on the piston
- Place the cylinder so that the piston correctly enters the seat and as soon as the segments zone is exceeded remove the ring clamp



CODE	DESCRIPTION	IMAGE
020128Y	Piston ring compressor	

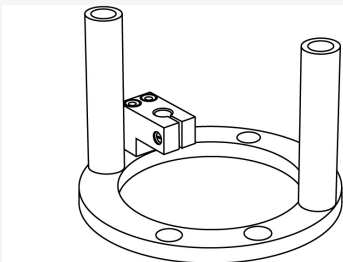
- After fitting the cylinder it is necessary to check the piston projection for correct head gasket selection.
- Fit a dial gauge on the specific tool and set it to zero on a horizontal plane.



CODE	DESCRIPTION	IMAGE
020996Y	Tool for measuring piston protrusion	

- Fit the tool together with the dial gauge on the cylinder and tighten the fixing nuts.
- Detect the deviation on the dial gauge



CODE	DESCRIPTION	IMAGE
020996Y	Tool for measuring piston protrusion	

ATTENTION



THE PISTON PROJECTION MUST BE DETECTED BY FITTING THE GASKET BETWEEN CRANKCASE AND CYLINDER. BEFORE THE DETECTION TIGHTEN THE CYLINDER UNTIL THE GASKET IS COMPLETELY WOUND.

HEAD GASKET SELECTION

Piston protrusion	Gasket thickness
$0.1 \div 0.28 \text{ mm}$ ($0.0393 \div 1.1024 \text{ in}$)	0.6 mm (0.0236 in)
$- 0.1 \div 0.1 \text{ mm}$ ($- 0.0393 \div 0.0393 \text{ in}$)	0.8 mm (0.0315 in)
$- 0.28 \div 0.1 \text{ mm}$ ($- 1.1024 \div 0.0393 \text{ in}$)	1.0 mm (0.0394 in)

- Place the cylinder.

4.3.11.5 Head fitting

- Insert the flame trap of the secondary air valve



- Insert the reed valve



- Fit the cover of the secondary air valve and tighten the screws to the prescribed torque



- Fit the engine oil pressure sensor, only in the left head and tighten it to the prescribed torque

N.B



PROCEDURE VALID ONLY FOR E4 VEHICLES.



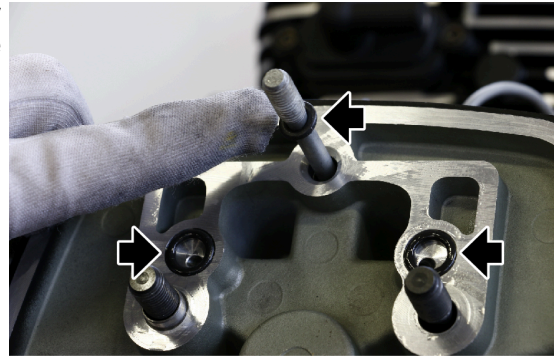
- Place the gasket



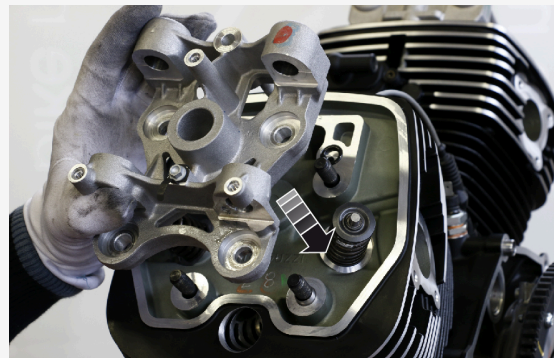
- Place engine head into place



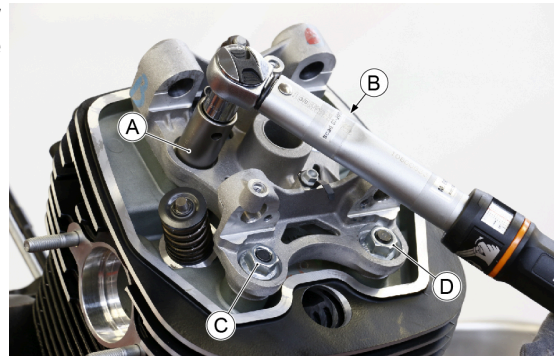
- Place the three rubber O-Rings, particularly apply grease to the O-Ring that will be inserted in the stud bolt in order to avoid damaging it



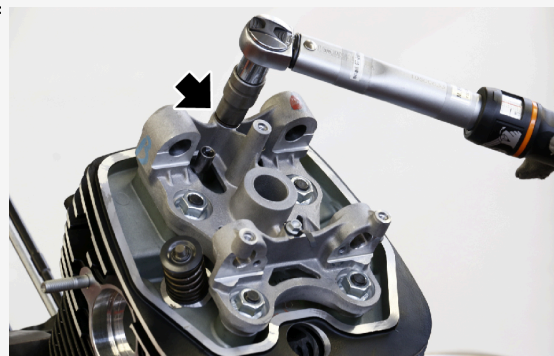
- Position the cam tower in its seat



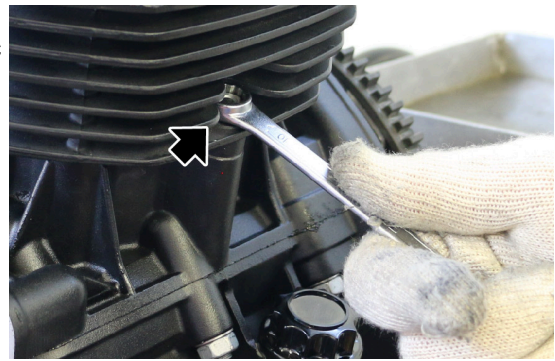
- Following a cross order "A-C-B-D" screw the fixing nuts of the cam tower to the prescribed torque



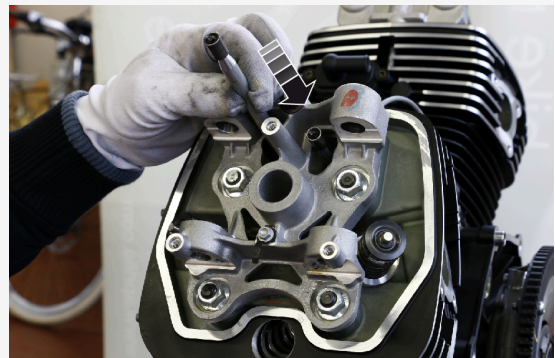
- Insert and tighten the compensation nut of the cam tower to the prescribed torque



- Position the washer with the relevant nut on the cylinder base and tighten to the specific torque.



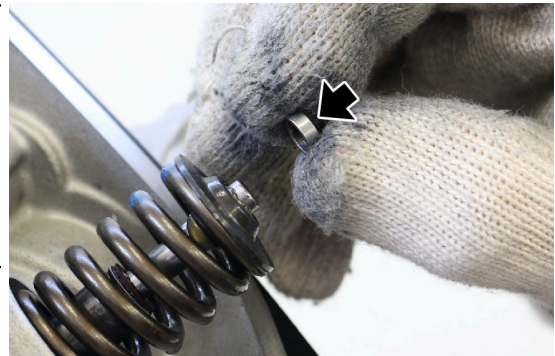
- Insert the rocker rods



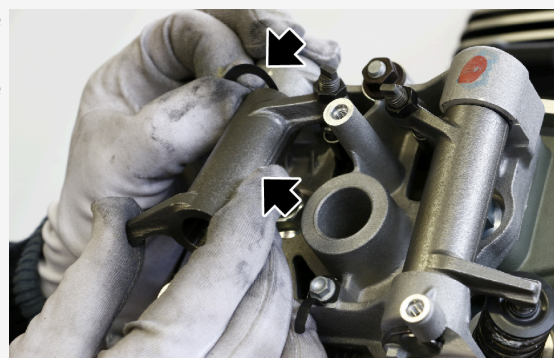
ATTENTION



PRIOR TO POSITIONING THE ROCKERS, CHECK THAT THE CALIBRATED PAD ON THE INTAKE VALVE IS INSERTED.



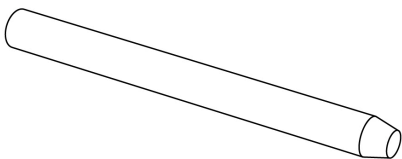
- Place the rocker in its seat by inserting the Belleville spring at the same time
- Using the rocker shim centring pin, align the rocker and the Belleville spring with the pin seat for easy insertion



CODE	DESCRIPTION	IMAGE
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020995Y

Rocker arm centring pin

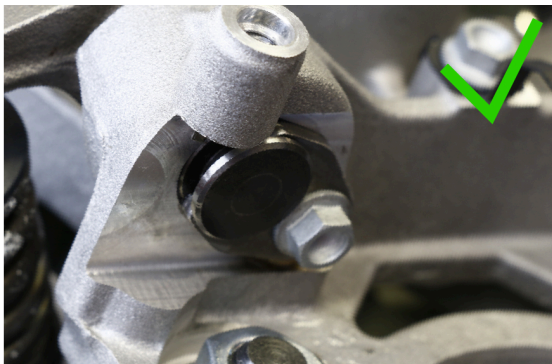
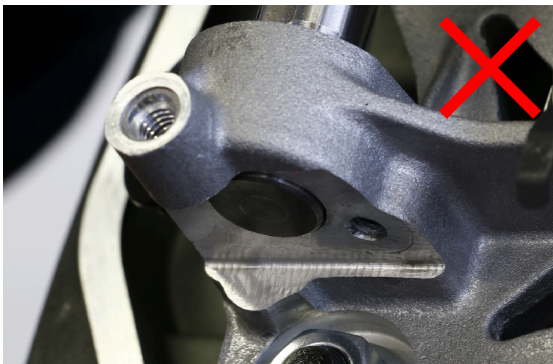
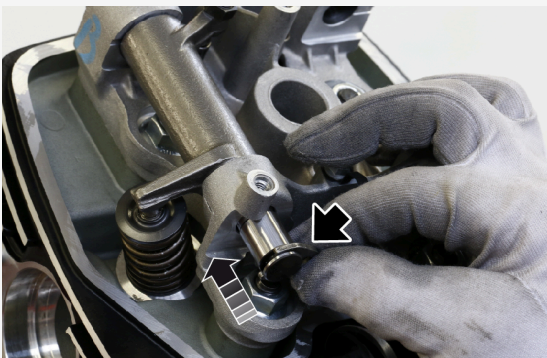


- Insert the rocker pin retainer fork on the pin and insert it in the seat

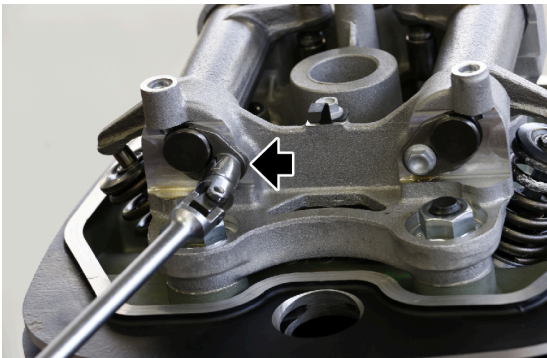
ATTENTION



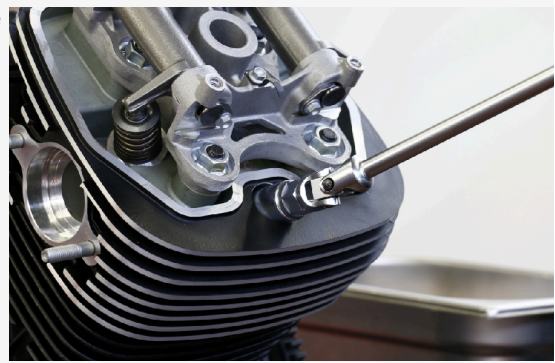
SLOWLY INSERT THE ROCKER PIN UNTIL THE FORK REACHES THE SUPPORT POINT ON THE CAM TOWER. THE INSERTION OF THE ROCKER PIN WITHOUT THE FORK REACHES A NON-CONTROLLED DEPTH.



- Insert and tighten the fixing screw of the rocker pin lock fork to the prescribed torque



- Insert and tighten the spark plug to the prescribed torque



4.3.11.6 Head cover fitting

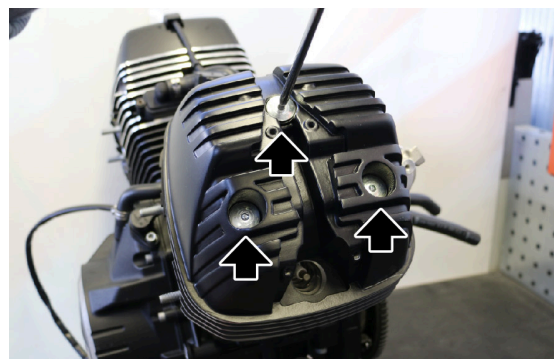
- Fit the gasket on the head cover



- Place the head cover together with the gaskets on the seats of the fixing screws



- Place the cover fixing screws and tighten them to the prescribed torque

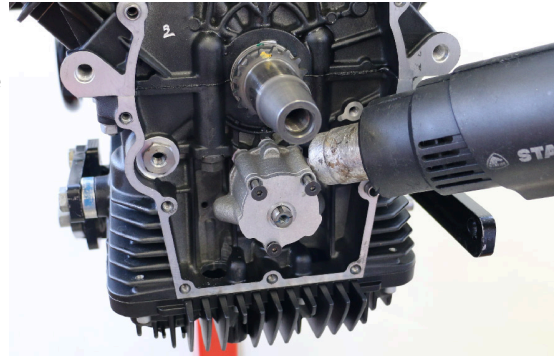


4.3.12 Lubrication

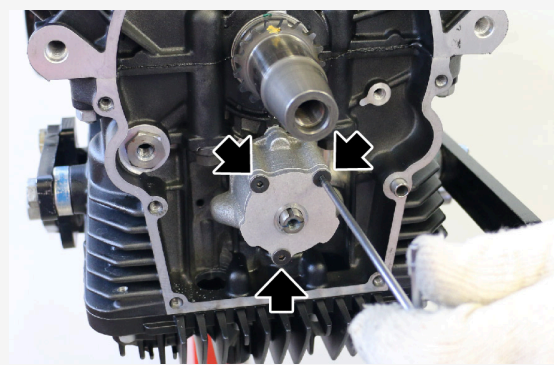
4.3.12.1 Oil pump

Removal

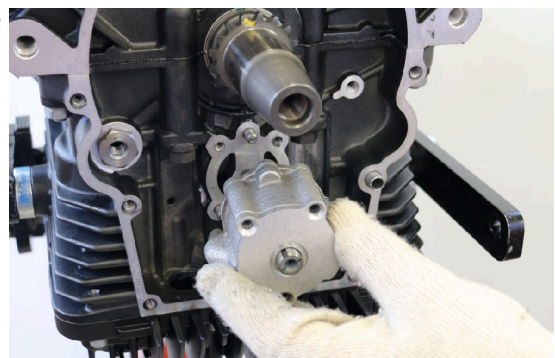
- Remove the timing system complete with oil pump gear.
- Using a hairdryer, heat the fixing base of the three oil pump screws.



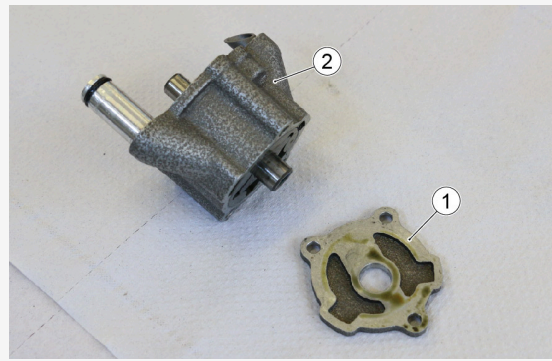
- Remove the three fixing screws of the oil pump.



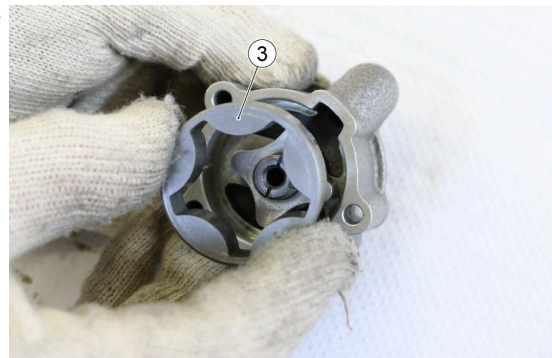
- Remove the complete pump from the crankcase.



- Remove the cover (1) from the pump (2).



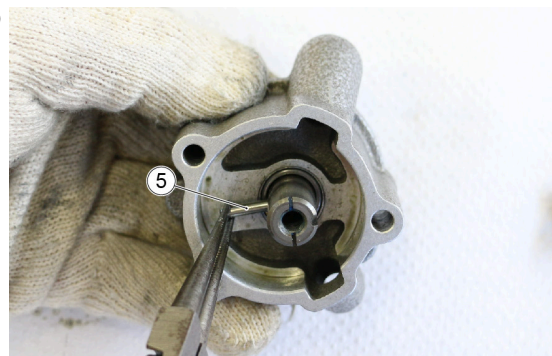
- Working on the oil pump gear side, remove the external rotor (3).



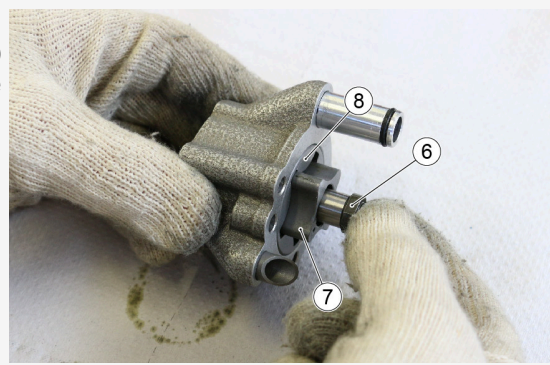
- Remove the internal rotor (4).



- Remove the safety pin (5) from the pump drive shaft.



- Working from the opposite side of the oil pump, extract the pump drive shaft (6) removing the internal rotor (7) and the external rotor (8).



Check

OIL PUMP BODY

Check that the faces and inner seats of the oil pump body are not scored, damaged or dented.

Pump body specifications:

CHARACTERISTIC	DESCRIPTION / VALUE
External rotors seat diameter (MAXIMUM WEAR VALUE)	40.675 mm (1.6014 in)
Diameter hole for pump drive shaft (MAXIMUM WEAR VALUE)	15.995 mm (0.6297 in)

EXTERNAL ROTORS

Check that the inner and outer surfaces and the flat faces are not scored, damaged or dented; if they are, replace both rotors of the side in question.

Data of the external rotors:

EXTERNAL ROTOR (ROTOR SIDE)

CHARACTERISTIC	DESCRIPTION / VALUE
External diameter (WEAR LIMIT VALUE)	40.53 mm (1.5957 in)
Internal diameter (MAXIMUM WEAR VALUE)	24.23 mm (0.9539 in)
Thickness of seat (MAXIMUM WEAR VALUE)	12.07 mm (0.4752 in)

EXTERNAL ROTOR (CRANKCASE SIDE)

CHARACTERISTIC	DESCRIPTION / VALUE
External diameter (WEAR LIMIT VALUE)	40.53 mm (1.5957 in)
Internal diameter (MAXIMUM WEAR VALUE)	24.23 mm (0.9539 in)
Thickness of seat (MAXIMUM WEAR VALUE)	14.07 mm (0.5539 in)

INTERNAL ROTORS

Check that the inner and outer surfaces and the flat faces are not scored, damaged or dented; if they are, replace both rotors of the side in question.

Data of the internal rotors:

INTERNAL ROTOR (ROTOR SIDE)

CHARACTERISTIC	DESCRIPTION / VALUE
External diameter (WEAR LIMIT VALUE)	29.73 mm (0.1705 in)
Internal diameter (MAXIMUM WEAR VALUE)	12.04 mm (0.4740 in)
Thickness of seat (MAXIMUM WEAR VALUE)	11.97 mm (0.4713 in)

INTERNAL ROTOR (CRANKCASE SIDE)

CHARACTERISTIC	DESCRIPTION / VALUE
External diameter (WEAR LIMIT VALUE)	29.73 mm (0.1705 in)
Internal diameter (MAXIMUM WEAR VALUE)	12.04 mm (0.4740 in)
Thickness of seat (MAXIMUM WEAR VALUE)	13.95 mm (0.5492 in)

OIL PUMP DRIVE SHAFT

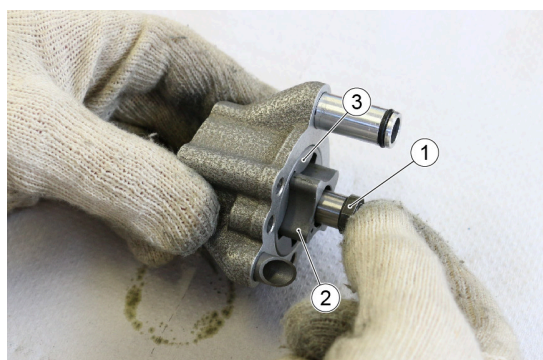
Check shaft and thread for damage; check the keyway for burrs and make sure the head the runs in the rotor is not damaged; replace the shaft if needed.

Shaft specifications:

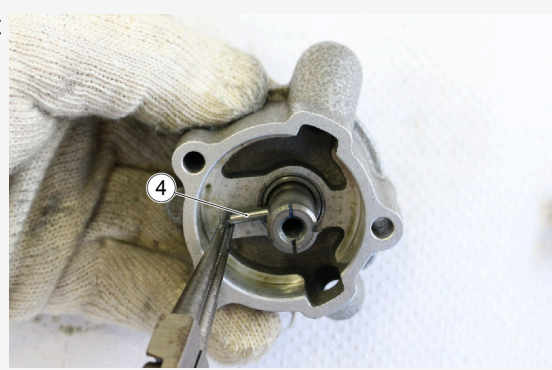
CHARACTERISTIC	DESCRIPTION / VALUE
Diameter for pump body seat (MINIMUM WEAR VALUE)	11,982 mm (0.4717 in)
Diameter for roller bearings (MINIMUM WEAR VALUE)	9,985 mm (0.3931 in)

Installation

- Working from the rear side of the oil pump, insert the pump drive shaft (1) the internal rotor (2) and the external rotor (3).



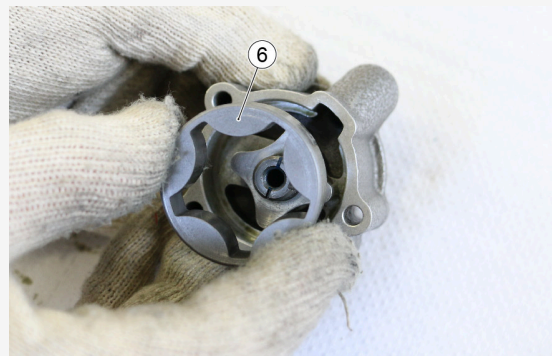
- Working from the front of the oil pump, insert the internal rotor retaining pin (4).



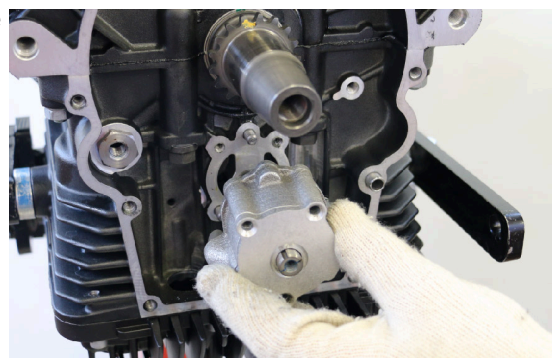
- Insert the internal rotor (5) paying attention that the pin enters the machining seat.



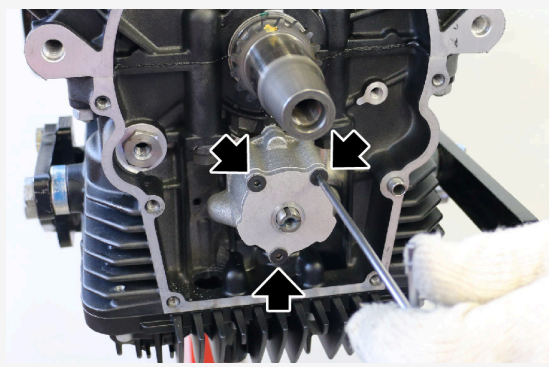
- Insert the external rotor (6) paying attention to the punch mark that must be facing outwards.



- After inserting the cover, position the complete oil pump in place.



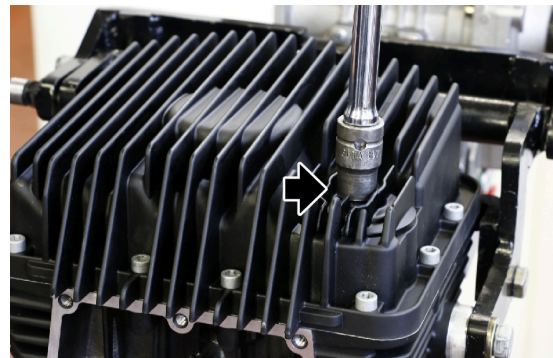
- Insert the three oil pump retaining screws and tighten them to the pre-defined tightening torque.



4.3.12.2 Oil sump

Oil sump removal

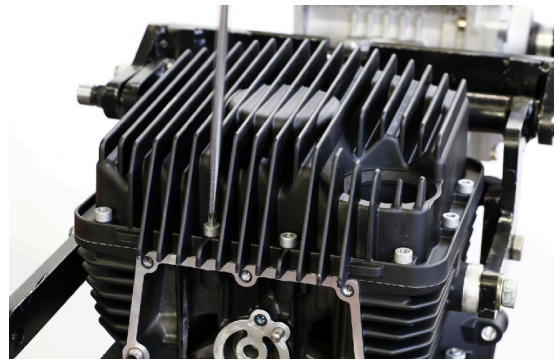
- Remove the engine oil filter fixing screw



- Remove the engine oil filter



- -Remove the 14 fastening screws of the oil sump



- Remove the oil sump



- Remove the gasket



- Remove the rose pipe



- Remove the cap and the relative copper gasket



- Remove the spring



- Remove the overpressure valve

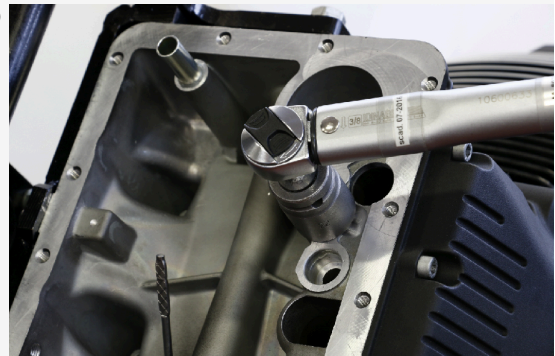


Oil sump fitting

- Install the overpressure valve in the engine crankcase



- Insert the spring and afterwards the cap provided with a new copper gasket, tighten it to the prescribed torque



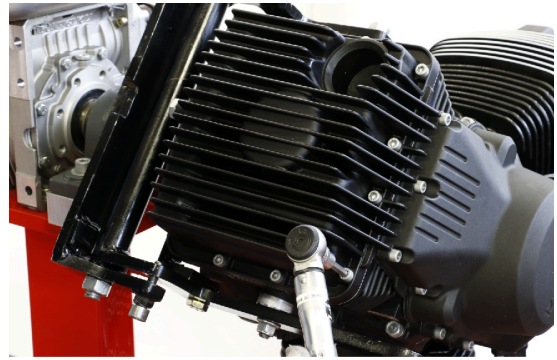
- Insert the rose pipe



- Place the gasket and insert the oil sump cover



- Insert and tighten the 14 fastening screws of the oil sump to the prescribed torque



- Insert the engine oil filter together with the cover

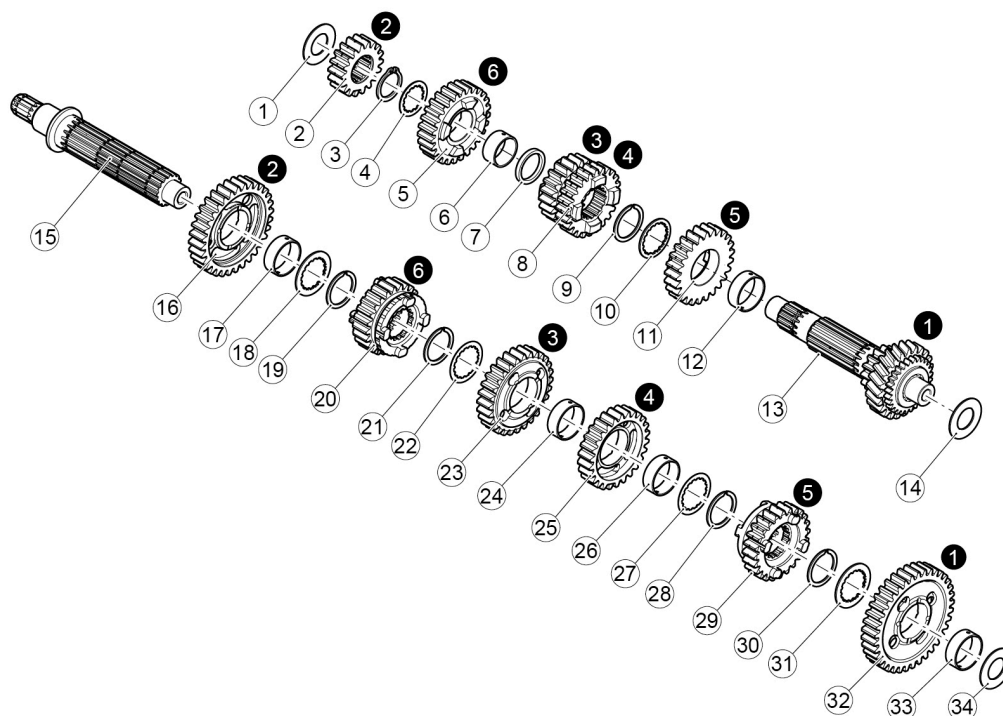


- Insert and tighten the locking screw of the engine oil filter to the prescribed torque



4.4 Gearbox

4.4.1 Diagram



Key:

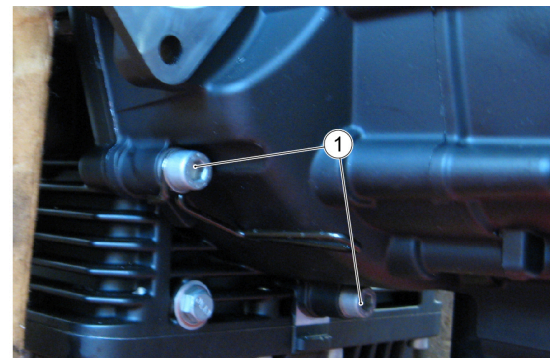
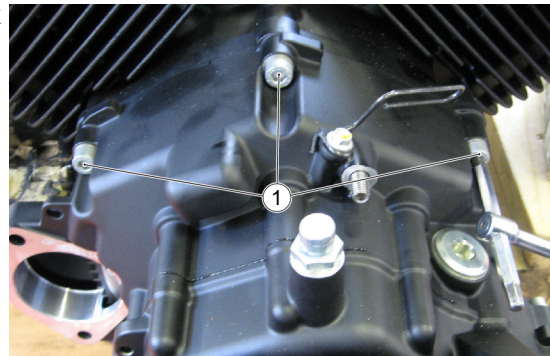
- 1 . Thrust washer
- 2 . 2nd speed gear on main shaft
- 3 . Snap ring
- 4 . Thrust washer
- 5 . 6th speed gear on main shaft
- 6 . Floating bush
- 7 . Main shaft thrust washer
- 8 . 3rd and 4th speed sliding gear on main shaft
- 9 . Circlip for the shaft
- 10 . Thrust washer
- 11 . 5th speed gear on main shaft
- 12 . Floating bush
- 13 . Main shaft with PI
- 14 . Thrust washer
- 15 . Secondary transmission shaft
- 16 . 2nd speed gear on transmission shaft
- 17 . Floating bush
- 18 . Thrust washer
- 19 . Circlip for the shaft
- 20 . 6th speed gear on transmission shaft
- 21 . Circlip for the shaft
- 22 . Thrust washer
- 23 . 3rd speed gear on transmission shaft
- 24 . Floating bush

- 25 . 4th speed gear on transmission shaft
- 26 . Floating bush
- 27 . Thrust washer
- 28 . Circlip for the shaft
- 29 . 5th speed gear on transmission shaft
- 30 . Circlip for the shaft
- 31 . Thrust washer
- 32 . 1st speed gear on transmission shaft
- 33 . Floating bush
- 34 . Thrust washer

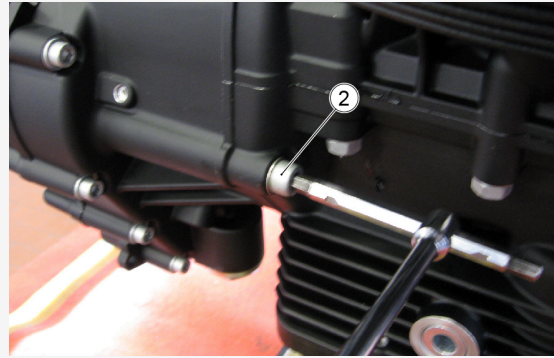
4.4.2 Gearbox housing

4.4.2.1 Gearbox housing removal

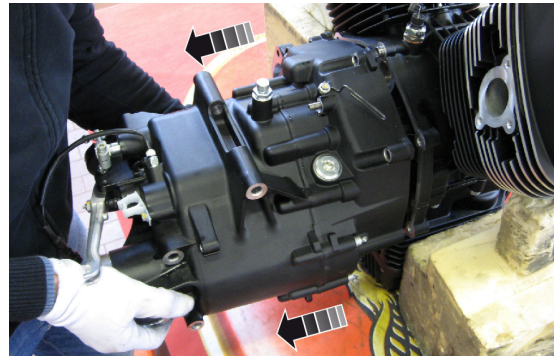
- Remove the 5 screws (1) fixing the gearbox to the engine crankcase



- Remove the fixing screw (2) of the gearbox, placed from the engine crankcase side



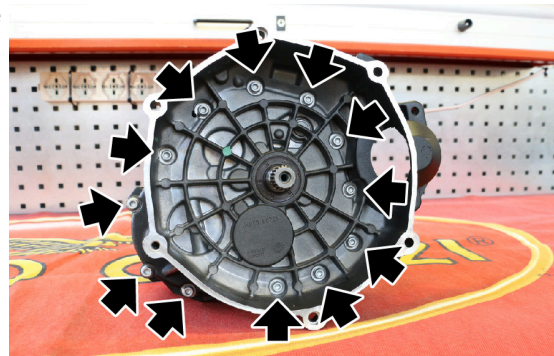
- Remove the complete gearbox screw



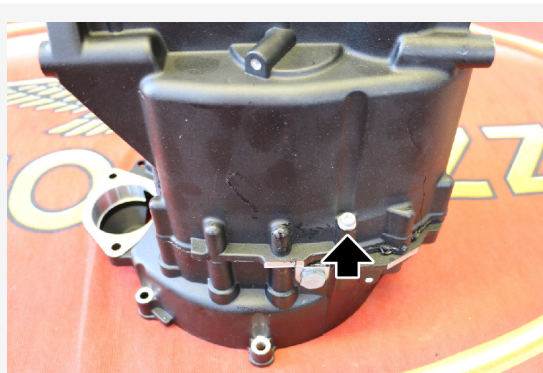
4.4.3 Transmission shafts

4.4.3.1 Gear removal

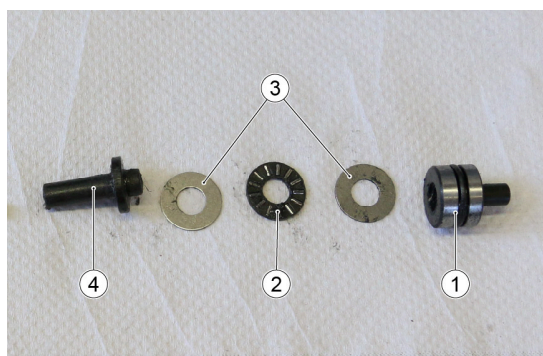
- Remove the 12 fixing screws of the gearbox, engine side.



- Remove the fastening screw of the gearbox, cardan side.



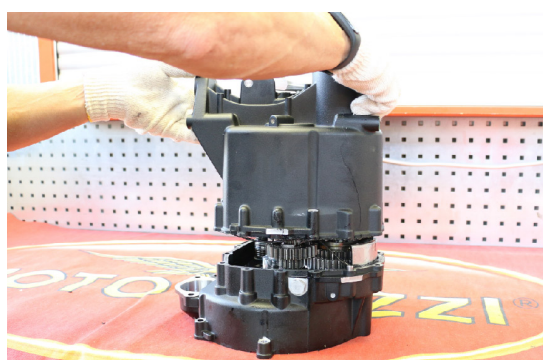
- Remove the external body (1), the thrust bearing (2) and two related sliding washers (3) and the external body (4).



- Remove the pusher plate



- Remove the gearbox cover with a few mallet strokes

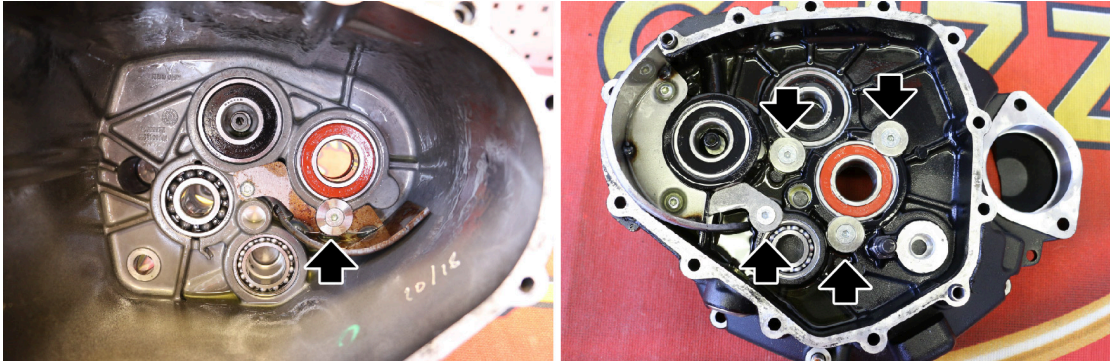


ATTENTION



CLEAN THE SUPPORT SURFACES THOROUGHLY FROM THE THREEBOND BEFORE APPLYING A NEW LAYER OF THREEBOND 1207B DURING REFITTING OF THE GEAR.

- Having removed all internal components, to remove the bearings fitted in the gearbox crankcases, the safety washers/plate must be removed first.



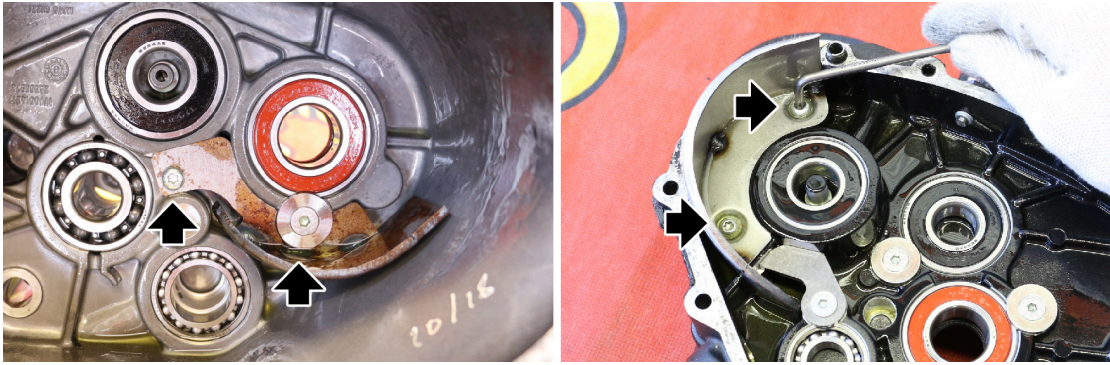
- The bearings from the gearbox crankcases can be removed using generic extractors.



- Heat the primary shaft bearing area on the base of the gearbox crankcase and the secondary shaft area on the gearbox crankcase cover very well with a hair dryer. It will then be possible to remove the bearings by knocking the crankcasings on a surface. If necessary, use a dummy ball bearing extractor.



- If necessary, remove the screws securing the bulkheads located in the crankcase to be able to extract them.



4.4.3.2 Primary shaft removal

ATTENTION



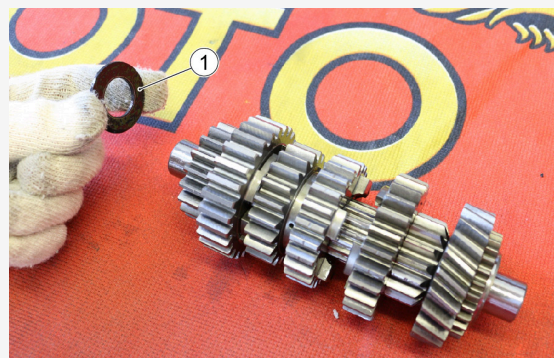
FIT NEW CIRCLIPS WHEN REASSEMBLING.

- Remove the gear selector shaft, the desmodromic shaft and the forks with shaft
- Remove the complete gear unit

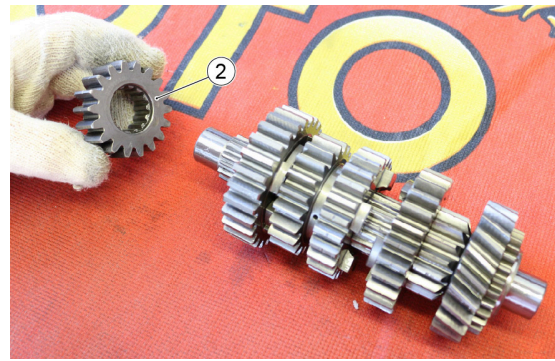


To dismantle the main shaft, proceed as follows:

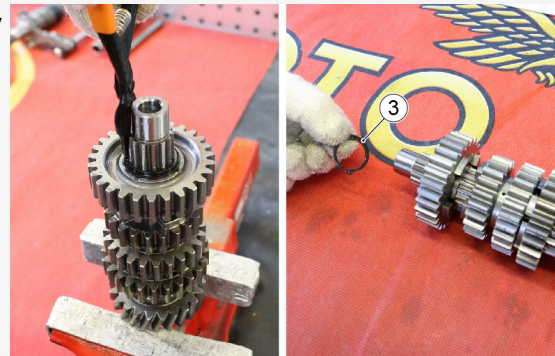
- Remove the shim washer (1)



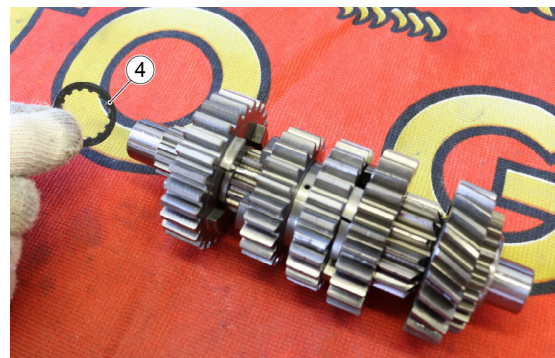
- Remove the gear of the 2nd gear (2)



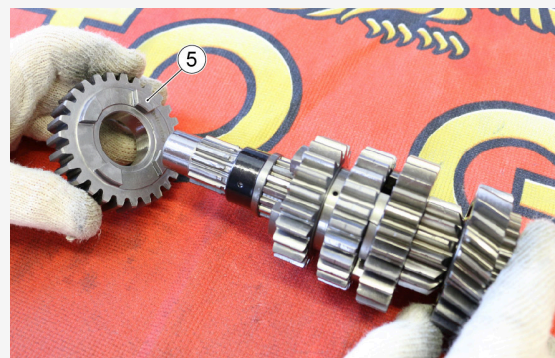
- Using the appropriate jaws, lock the primary shaft in a vice and remove the circlip (3)



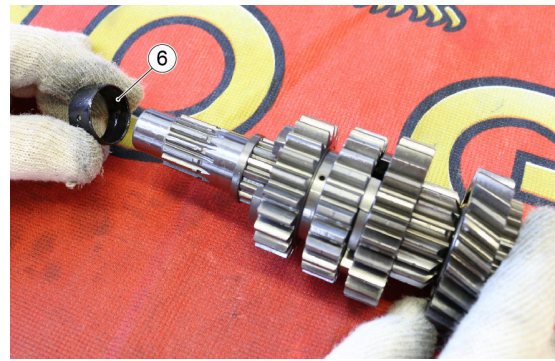
- Remove the spacer (4)



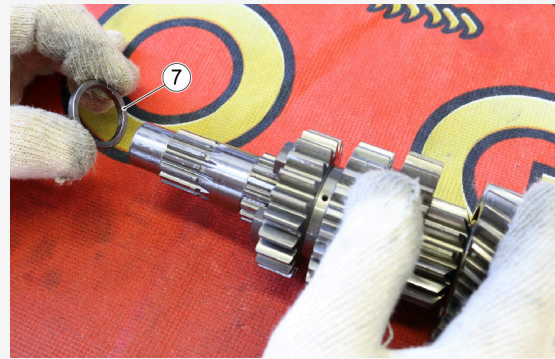
- Remove the gear of the 6th gear (5)



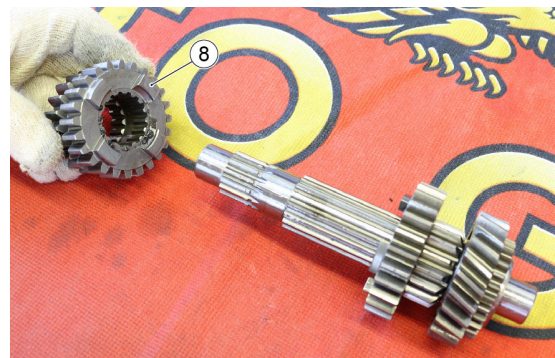
- Remove the bushing (6)



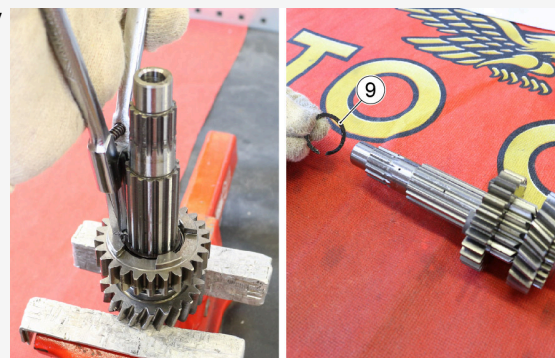
- Remove the spacer (7)



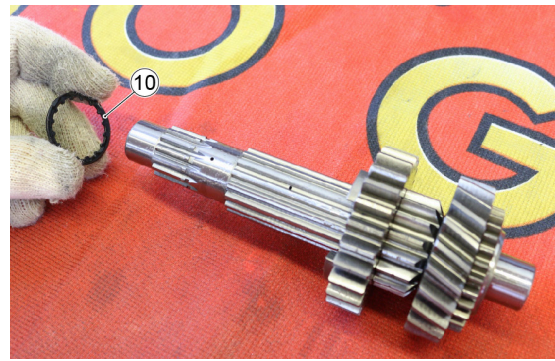
- Remove the gear of the 3rd-4th gear (8)



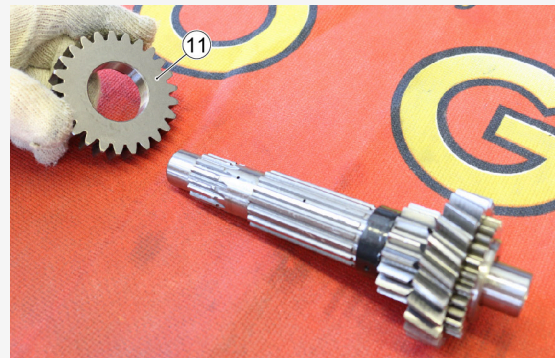
- Using the appropriate jaws, lock the primary shaft in a vice and remove the circlip (9)



- Remove the spacer (10)



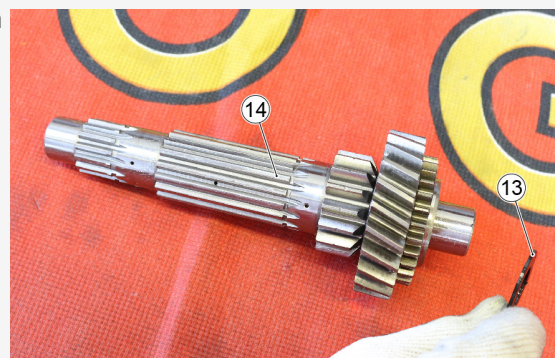
- Remove the gear of the 5th gear (11)



- Remove the bushing (12)



- Remove the washer (13) from the main shaft (14)



4.4.3.3 removing the transmission shaft

ATTENTION



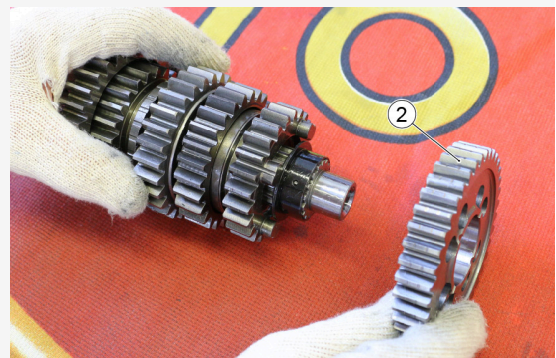
FIT NEW CIRCLIPS WHEN REASSEMBLING.

Disassemble the secondary shaft as follows:

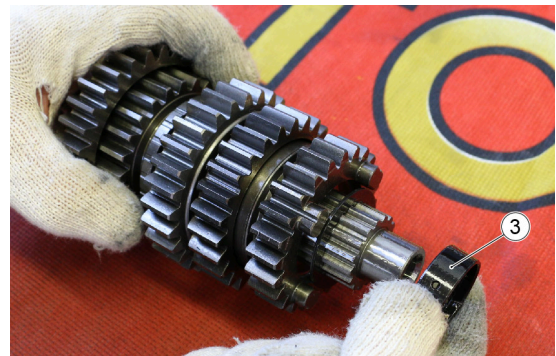
- Remove the shim washer (1)



- Remove the gear of the first gear (2)



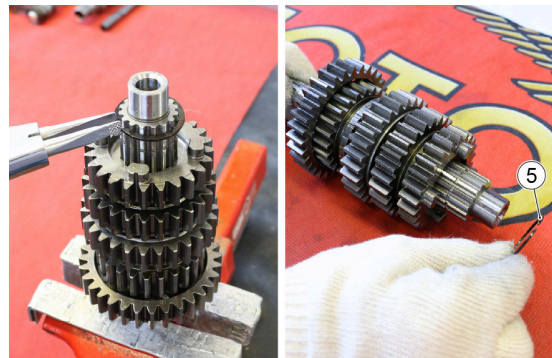
- Remove the bushing (3)



- Remove the shim washer (4)



- Remove the seeger ring (5)



- Remove the gear of the 5th gear (6)



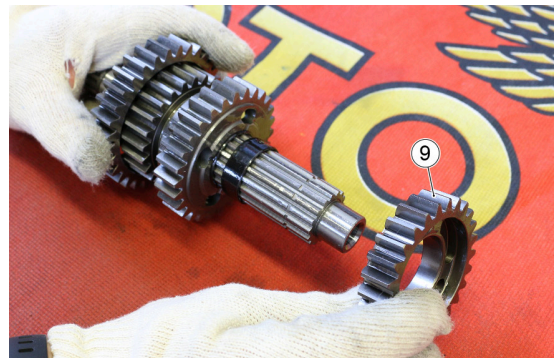
- Remove the seeger ring (7)



- Remove the shim washer (8)



- Remove the gear of the 4th gear (9)



- Remove the bushing (10)



- Remove the gear of the 3rd gear (11)



- Remove the bushing (12)



- Remove the shim washer (13)



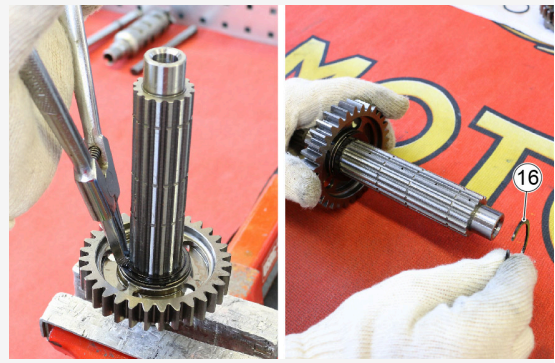
- Remove the seeger ring (14)



- Remove the gear of the 6th gear (15)



- Remove the seeger ring (16)



- Remove the shim washer (17)



- Remove the gear of the 2nd gear (18)

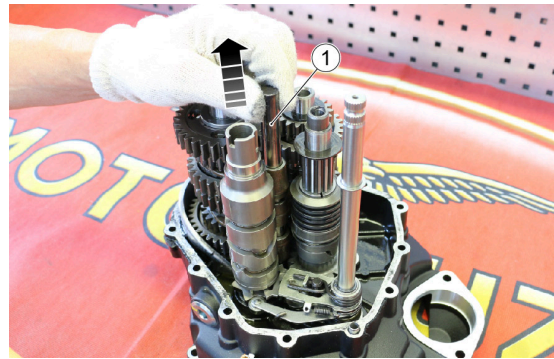


- Remove the bushing (19)

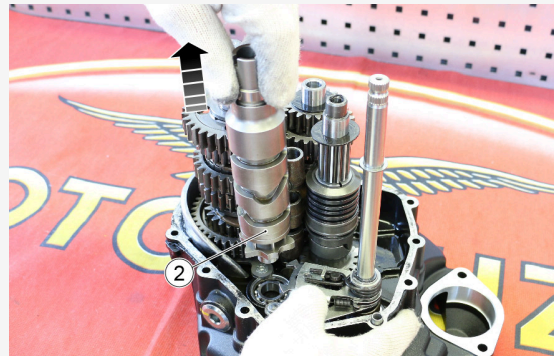


4.4.3.4 Desmodromic removal

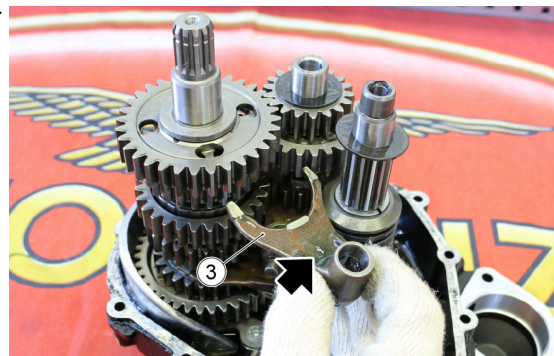
- Remove the fork carrier shaft (1).



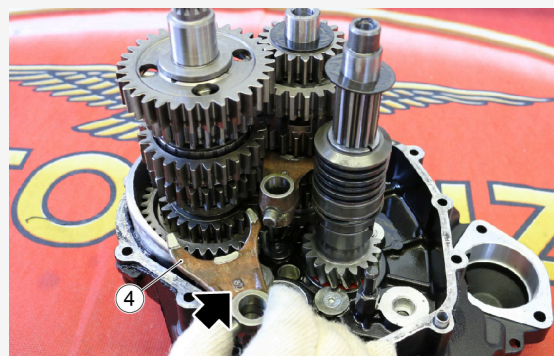
- Remove the desmodromic shaft (2).



- The forks are marked with a serial number that indicated the correct positioning.
- Remove the upper fork No.1 (3)



- Remove the lower fork No.3 (4)



- Remove the primary and secondary shaft, as well as the intermediate fork No. 2



4.4.3.5 Removing the clutch shaft

- To remove the clutch shaft it is necessary to remove first all gearbox components (the input shaft, the secondary shaft, fork travel shaft and the forks, gearbox selector).
- At this point, the clutch shaft can be removed with a few mallet taps, paying attention to retrieve the shimming washer.



- Remove the oil seal from the clutch shaft

WARNING



IN CASE OF OIL SEAL REPLACEMENT, WHEN REFITTING USE THE SUITABLE PUNCH UNTIL IT REACHES THE END.



CODE	DESCRIPTION	IMAGE
020976Y	Clutch control dust seal installation punch	

- Remove the oil seal

WARNING



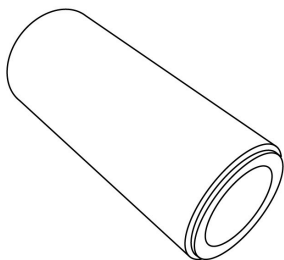
**IN CASE OF OIL SEAL REPLACEMENT,
USE THE SUITABLE PUNCH UNTIL IT
REACHES THE CRANKCASE.**



CODE	DESCRIPTION	IMAGE
------	-------------	-------

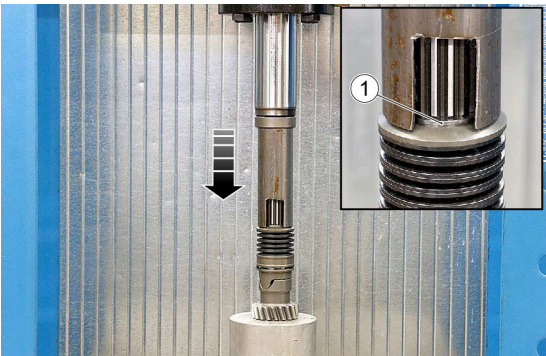
021020Y

C
hou
seal

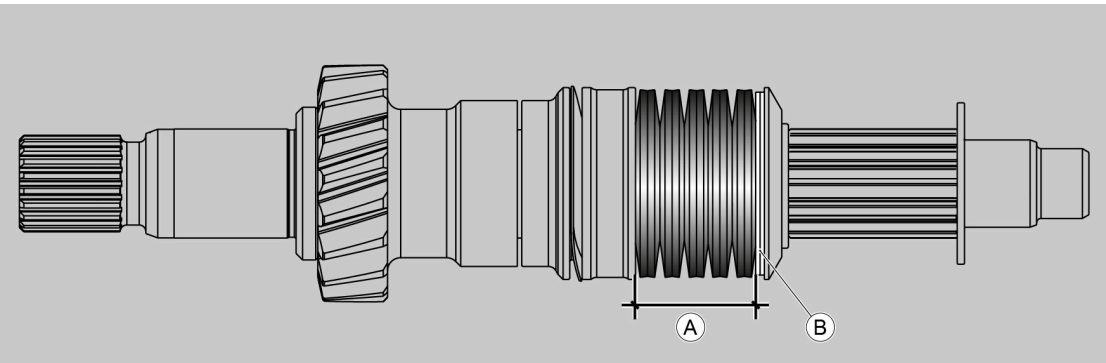


CLUTCH SHAFT DISASSEMBLY

- Using a hydraulic press and a generic support, remove the seeger ring (1) for the inspection / check of the concentric springs of the clutch shaft.



- Measure the free spring pack (A) and, following this measurement, use the corresponding number of "support washers" (B) identified in the table below.



SUPPORT WASHERS SELECTION

(A) 10 SPRING WASHERS PACK FREE THICKNESS	(B) SUPPORT WASHERS QUANTITY
26.000-26.999 mm	4
27.000-27.999 mm	3
28.000-28.999 mm	2
29.000-30.000 mm	1

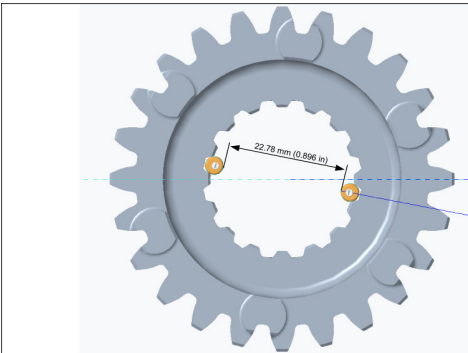
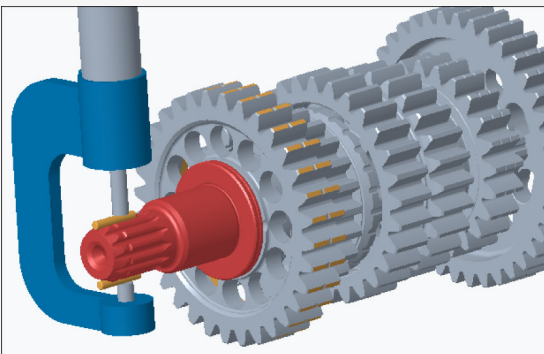
4.4.3.6 Check shafts

Check transmission gears for any signs of pitting or wear, and replace the defective gears if necessary.

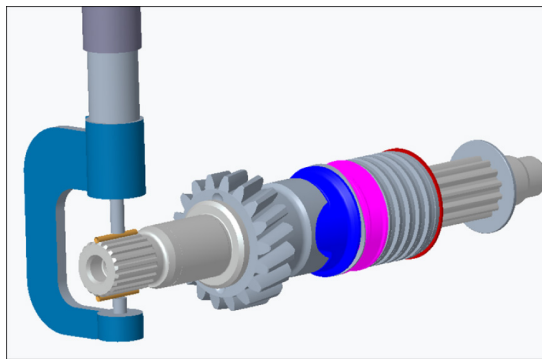
Check the gears' engagement teeth for any signs of cracks, damage or wear, and replace the defective ones if necessary.

Check the transmission gears' movement and, if irregular, replace the defective part.

WEAR LIMITS

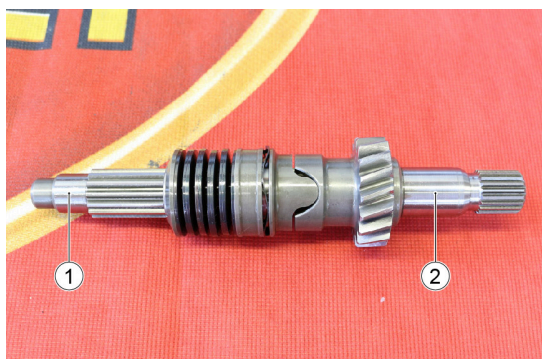
CHARACTERISTIC	DESCRIPTION / VALUE	
Maximum wear limit for selector gear splines	22.78 mm (0.896 in) with rollers diam. 3.5 mm (0.14 in)	
Minimum wear limit of the cardan shaft side secondary shaft seats	23.294 mm (0.9171 in) with rollers diam. 3.0 mm (0.12 in)	

CHARACTERISTIC	DESCRIPTION / VALUE
Minimum wear limit of the clutch side primary and secondary shaft seats	24.112 mm (0.9493 in) with rollers diam. 2.0 mm (0.08 in)



4.4.3.7 Clutch shaft check

Check for pitting, wear, cracks or damage, signs of deterioration on the teeth of the primary drive gear and replace the gear if necessary



WEAR LIMITS

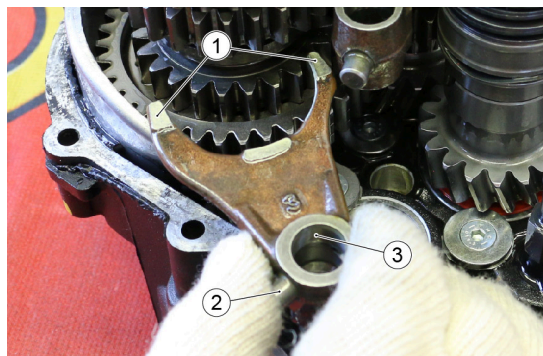
CHARACTERISTIC	DESCRIPTION / VALUE
(1) Minimum wear limit of the rotation point on the gearbox cover bearing	19.975 mm (0.7864 in)
(2) Minimum wear limit of the rotation point on the gearbox cover base	24.987 mm (0.9837 in)

4.4.3.8 Desmodromic unit check

Check the desmodromic drum for damage, scratches and wear and replace the assembly if required.

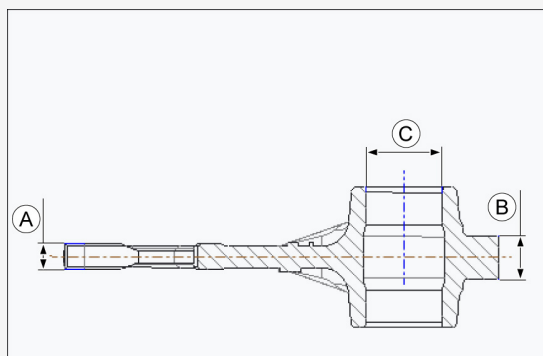
4.4.3.9 Forks check

Check that the forks work area are well levelled and are not worn, so as to have lost the toughening characteristics and that the nose-pieces operating in the drum splines are not excessively worn, otherwise replace the forks.



WEAR LIMITS

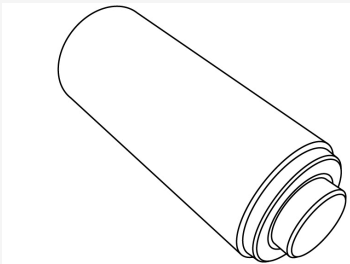
CHARACTERISTIC	DESCRIPTION / VALUE
Minimum thickness of the tines (A)	4.75 mm (0.19 in)
Guide pins minimum diameter (B)	8 mm (0.31 in)
Sliding hole diameter maximum limit (C)	14 mm (0.55 in)



4.4.3.10 Gearbox fitting

- In case of secondary oil seal replacement of the cardan on the gearbox cover, use the special punch until it stops.



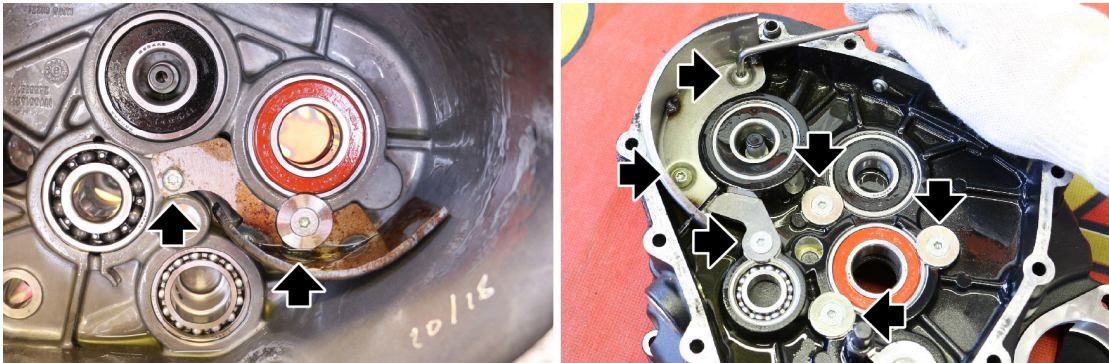
CODE	DESCRIPTION	IMAGE
020978Y	Secondary cardan shaft oil seal installation punch	

- Use commercial punches to insert the bearings on the gearbox crankcases.
- A special punch must be used to insert the bearings on the seats of the primary/secondary shaft with lubrication duct.



CODE	DESCRIPTION	IMAGE
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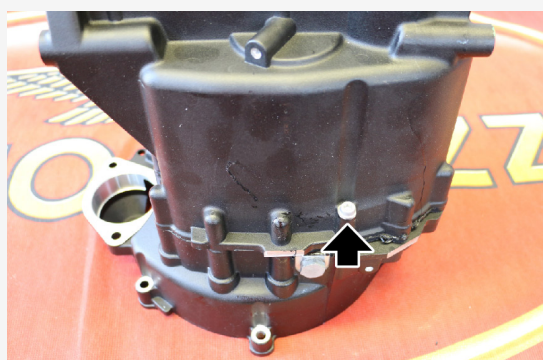
- After installing the bearings on the gearbox crankcasings, position the bulkheads and the safety washers/plates, and tightening them with the appropriate screws to the prescribed torque.



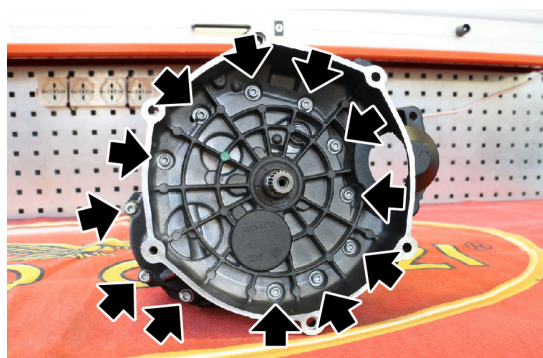
- After inserting all the internal components, apply a layer of threebond 1207B on the junction surface of the two crankcasings.



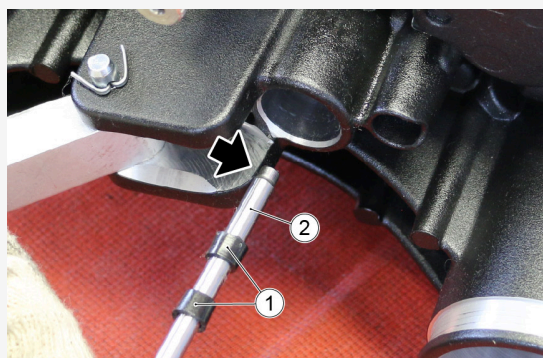
- Position the gearbox cover and manually tighten the gearbox fixing screw on the cardan side.



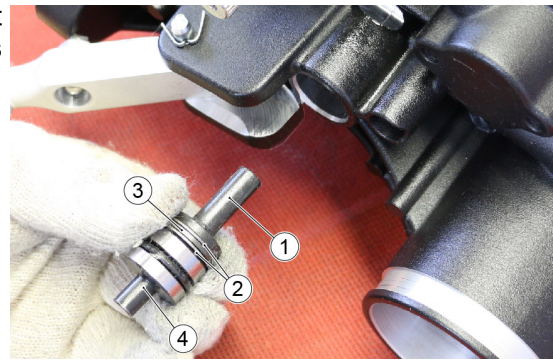
- Insert the 12 fixing screws of the gearbox, engine side and then tighten them to the prescribed torque, including the screw opposite the cardan side previously tightened manually.



- After inserting the two half-cones (1) on the thrust plate (2), insert it on the clutch shaft working from the cardan side and paying attention to the orientation, as the machining must push on the cap once the reassembling of the gearbox on the engine is complete.



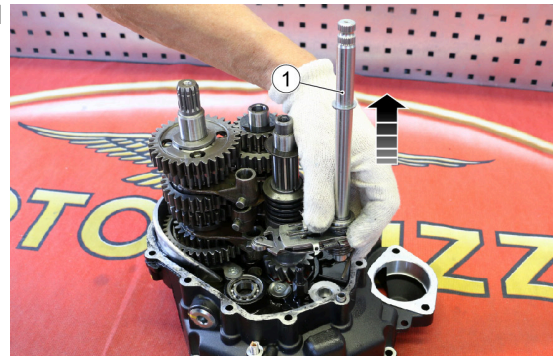
- Insert the intermediate body (3), the thrust bearing (4) and two related sliding washers (2) and the external body (1).



4.4.4 Gear selector

4.4.4.1 Gear selector removal

- Remove the desmodromic shaft first and then the complete gear selector shaft (1).



- Remove the spring from the index lever (2)



- Remove the washer (3)



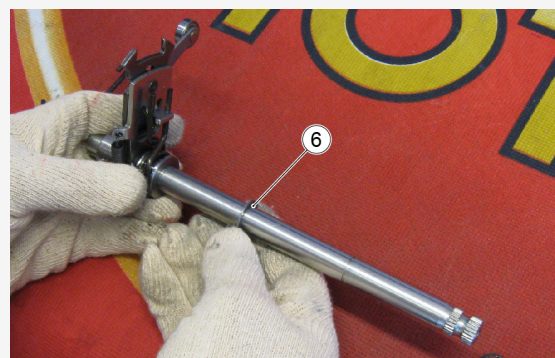
- Remove the seeger ring (4)



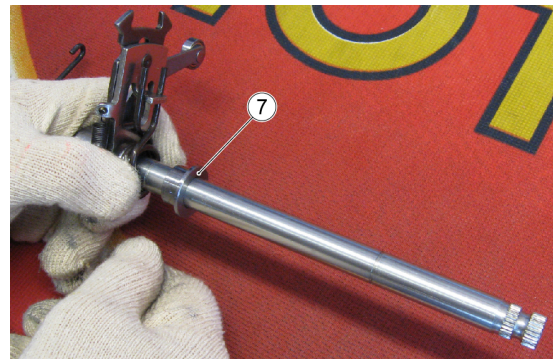
- Remove the seeger ring (5)



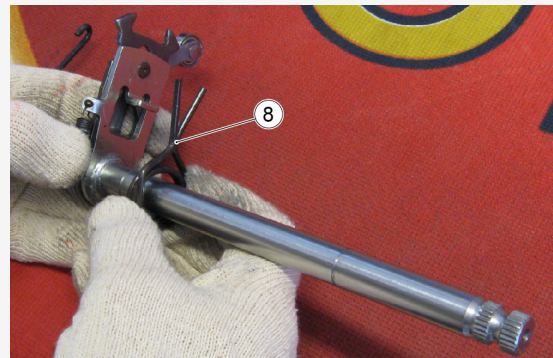
- Remove the washer (6)



- Remove the bushing (7)



- Remove the selector spring (8)



- Remove the ring (9)



- Remove the bushing (10)

WARNING

DURING REFITTING, PAY ATTENTION TO THE CORRECT POSITIONING OF THE BUSHING, AS THE SIDES ARE NOT SYMMETRICAL.



- Remove the index lever (11)



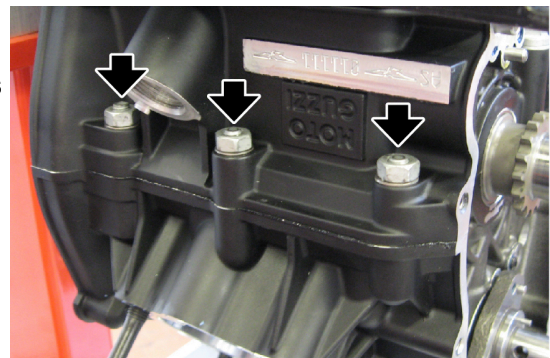
- Remove the selector return spring (13)

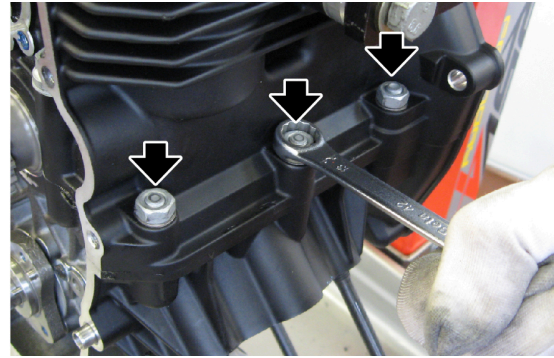


4.5 Crankshaft crankcase

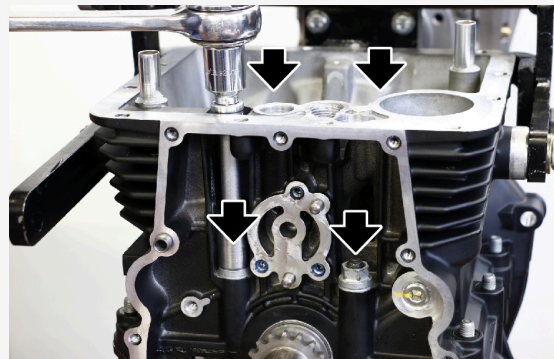
4.5.1 Crankcase opening

- Remove the bucket tappets, the oil sump, the filter and the overpressure valve.
- Unscrew and remove the six external nuts and their washers.

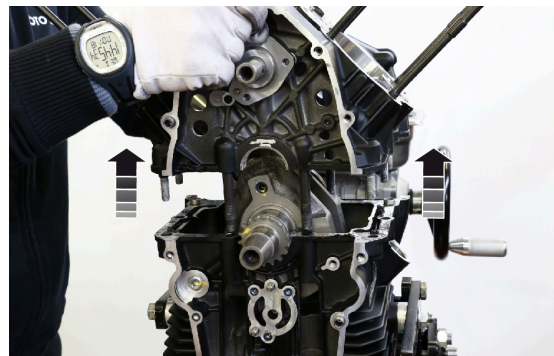




- Undo and remove the four long nuts from the inside of the crankcase.



- Remove the upper crankcase being careful not to damage its mating face



- Remove the crankshaft together with connecting rods and small ends



4.5.2 Crankshaft removal

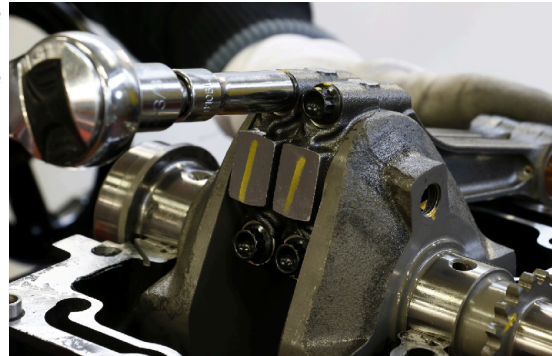
- Remove the crankshaft connecting rods.
- Unscrew the oil plug and thoroughly clean the oilway and oil passages delivering oil to connecting rods and main journals.

Also see

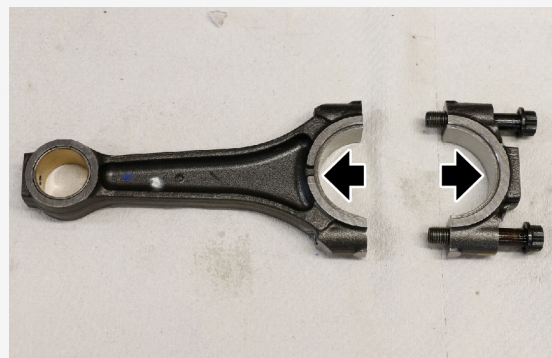
connecting rod removal

4.5.3 connecting rod removal

- Remove the screws and separate the connecting rod from the small end paying attention to the reference signs and the mounting direction.



- Remove the small ends from the connecting rods.
- REPEAT THE PROCEDURE FOR THE OTHER CONNECTING ROD



4.5.4 Crankcase half check

- Check that the mating faces are not damaged, dented or scored. Remove the liquid gasket residues.
- Check that the threads of the stud bolts are not dented or stripped; otherwise replace the stud bolt or stud bolts.
- Blow all oil galleries of the two crankcase halves with compressed air.

4.5.5 Crankshaft components check

- Smear the thread of the cap with threadlocker and tighten the cap firmly.
- Blow with compressed air to clean the lubrication passage seats.

ATTENTION

THE CRANKSHAFT IS NITRIDED AND CANNOT BE GROUND; IF WORN, TAPERED OR DEEPLY SCORED, THE CRANKSHAFT MUST BE REPLACED.

CRANKSHAFT CHECK - LIMIT VALUES

CHARACTERISTIC	DESCRIPTION / VALUE
Main journal diameter on timing system side (WEAR LIMIT VALUE)	40.004 mm (1.5750 in)
Main bushing seat diameter on timing system side (MAXIMUM WEAR VALUE)	43.657 ÷ 43.670 mm (1.7188 ÷ 1.7193 in)
Maximum permissible clearance between the main journal on the TIMING SYSTEM SIDE and bushing seat	0.07 mm (0.0028 in)
Main journal diameter on clutch side (MINIMUM WEAR VALUE)	43.007 mm (1.6932 in)
Main bushing seat diameter on clutch side (WEAR LIMIT VALUE)	47,130 ÷ 47,142 mm (1.8555 ÷ 1.8560 in)
Maximum permissible clearance between the main journal on the CLUTCH SIDE and bushing seat	0.07 mm (0.0028 in)
Crankshaft thrust height (A) (MAXIMUM WEAR VALUE)	24.83 mm (0.9776 in)
Crankcase thrust height (B) (MINIMUM WEAR VALUE)	19.95 mm (0.7854 in)
Thickness of the thrust half-bearings on main bushing on clutch side (MINIMUM WEAR VALUE)	2.29 mm (0.0902 in)
Diameter of crank pin (MINIMUM WEAR VALUE)	39.995 mm (1.5746 in)
Crankshaft axial clearance (MAXIMUM ALLOWED VALUE)	0.29 mm (0.0114 in)



The maximum parallelism deviation of the two crankshaft axes (connecting rod pin and main journals on flywheel side and timing system side) should not exceed 0.02 mm (0.0009 in) at 40 mm (1.5748 in) distance.

4.5.6 Connecting rod check

- Check using a micrometer the measure of the connecting rod pin orthogonal axes and in the working area of the small ends, check the measure of the small ends seats on the timing system side and on the flywheel side.
- Assemble the connecting rod without small ends and tighten the connecting rod screws to the prescribed torque. Measure the outer diameter of small ends seats with a dial gauge graduated in hundredths of a millimetre and the thickness of both small ends with a round tip micrometer.
- Check the bushings pressed in the small end of the connecting rod for notches due to seizing or deep scoring; replace as required.

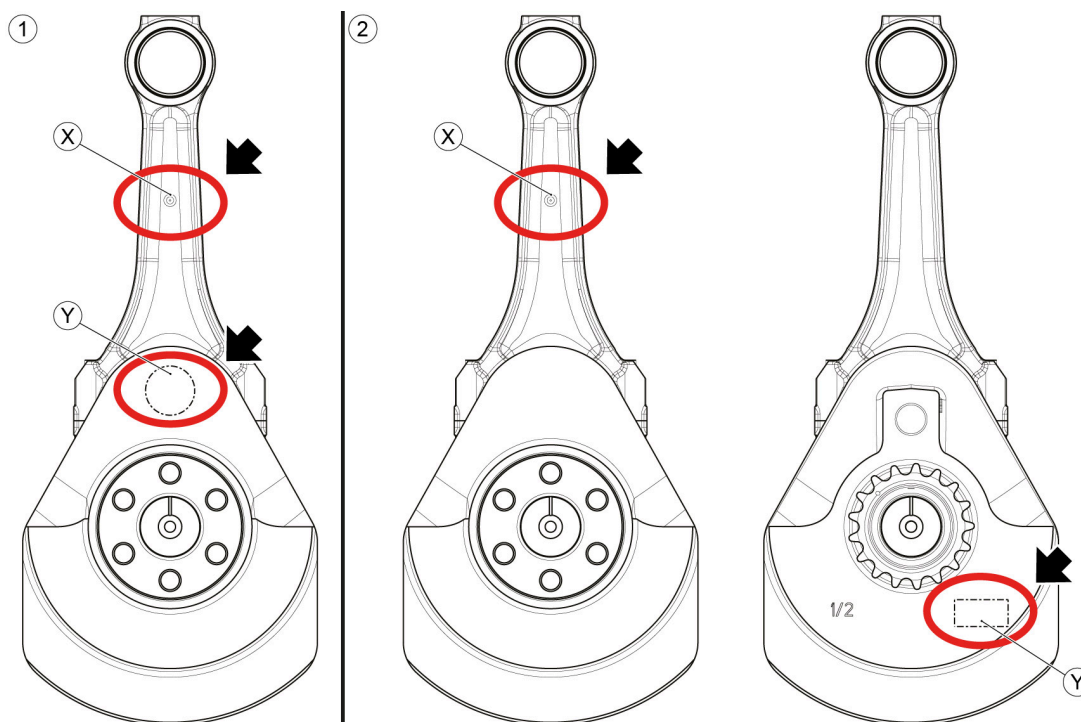
CONNECTING ROD CHECK

CHARACTERISTIC	DESCRIPTION / VALUE
Diameter connecting rod head seat (MAXIMUM WEAR VALUE)	43.67 mm (1.7193 in)
Connecting rod small end diameter (MAXIMUM WEAR VALUE)	20.015 mm (0.7880 in)
Clearance between the connecting rod big end and crankpin (MAXIMUM ALLOWED VALUE)	0.072 mm (0.0028 in)

4.5.7 Connecting rod installation

- Before assembly, take careful note of the reference markings and the correct direction of installation.
- There are two available models of connecting rods and the points where the laser marks or incisions are shown on the crankshaft may differ depending on the engine output:

A - B (indicated in the zone identified by the letter **X** in the drawing) to be assembled with the crankshaft in two sections **A - B** (indicated in the zone identified by the letter **Y** in the drawing) for the crankpin, using the appropriate bushing.

**CONNECTING ROD HEAD BUSHING CLASSES**

Selection class	Thickness
R	1.807-1.811 mm (0.0711-0.0713 in)
B	1.811-1.815 mm (0.0713-0.0715 in)
G	1.815-1.819 mm (0.0715-0.0716 in)

CONNECTING ROD/CRANKSHAFT CLASSES

Selection class	Connecting rod big end diameter	Diameter of crankshaft
A	43.657-43.664 mm (1.7188-1.7191 in)	39.995-40.003 mm (1.5746-1.5749 in)
B	43.664-43.670 mm (1.7191-1.7193 in)	40.003-40.011 mm (1.5749-1.5752 in)

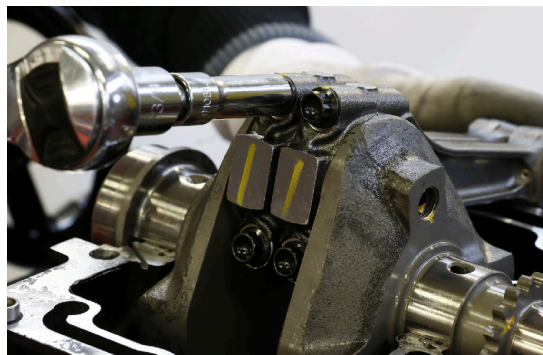
BUSHING SELECTION BASED ON CONNECTING ROD - CRANKSHAFT COUPLING

Connecting rod selection class	Crankpin marking A	Crankpin marking B
A	B - B	R - R
B	G-G	B - B

- The radial play between the connecting rod and the crankshaft must be within the following range: 0.045-0.069 mm (0.0018-0.0027 in)

- The identifying colour point of the connecting rod selection must be oriented for both connecting rods towards the clutch side.

- Before assembly, take careful note of the coupling classes.
- Reassemble the connecting rods in the crankshaft seat on the crankpin by screwing the screws with the correct tightening sequence specified in the "characteristics" chapter, "tightening torque / engine" section in the "**CRANKSHAFT**" table".



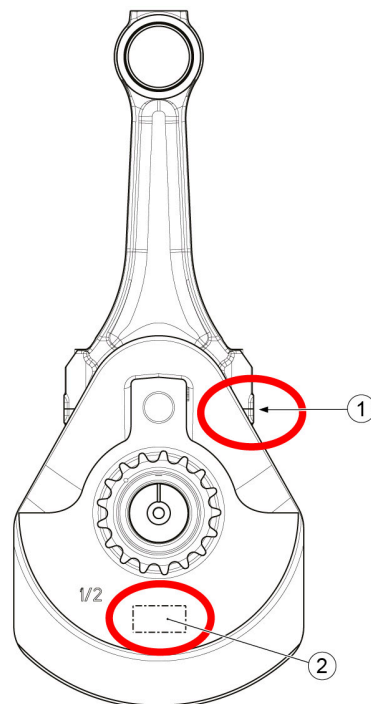
4.5.8 Crankshaft fitting

If it is necessary to replace the crankshaft or the connecting rods, follow the reference table regarding the couplings between the "CONNECTING ROD weight class mark" (1) and the "CRANKSHAFT weight class mark" (2).

WARNING



MOUNT A PAIR OF CONNECTING RODS OF THE SAME CRANKSHAFT WEIGHT CLASS.



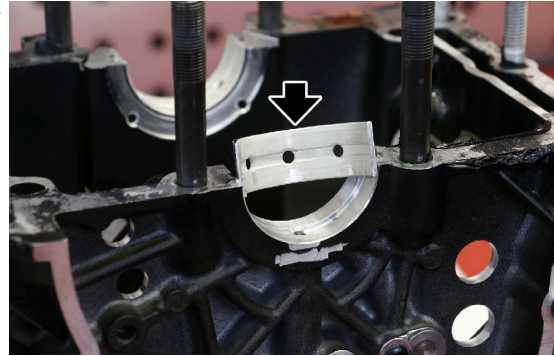
CONNECTING ROD/CRANKSHAFT WEIGHT CLASSES

CRANKSHAFT WEIGHT CLASS	CONNECTING ROD WEIGHT CLASS
E1	E1
E2	E2
E3	E3
E4	E4

CRANKSHAFT WEIGHT CLASS	CONNECTING ROD WEIGHT CLASS
E5	E5

4.5.9 Crankcase coupling

- Insert the small ends timing system side and flywheel side on both crankcases paying attention to lubricate them

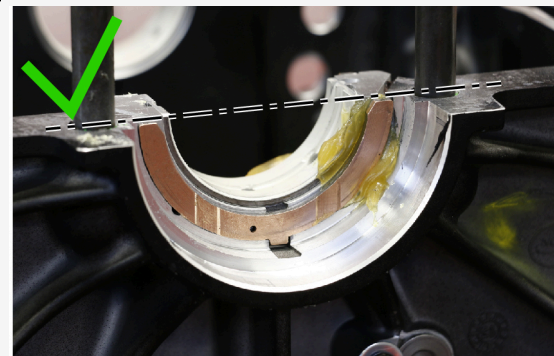
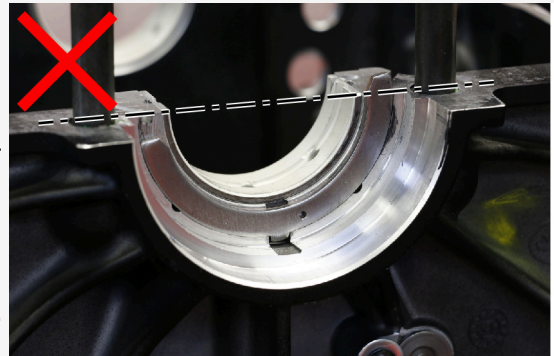


- With the help of grease, place the thrusts on the upper crankcase from the flywheel side, paying attention to lubricate them in the friction area

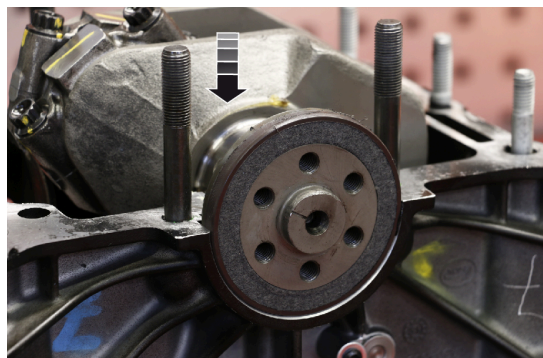
ATTENTION



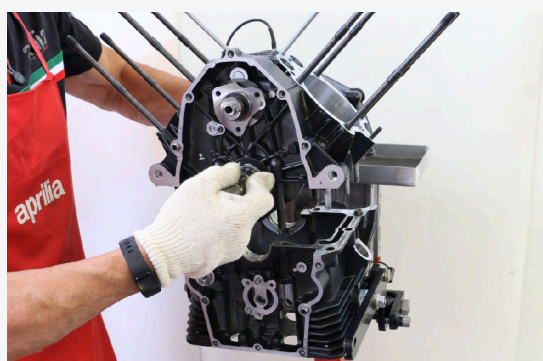
THE MOUNTING DIRECTION OF THE THRUSTS IS UNIQUE.



- Insert the seal ring (after lubricating it) on the crankshaft and the assembly onto the engine crankcase making sure that the connecting rods locate correctly into their seats.
- Smear the crankcases mating faces with the threebond



- Grasp the crankshaft assembly with the upper crankcase keeping the two components together, rotate them and lay them on the lower crankcase.
- Insert and screw the four long nuts and the six external nuts together with washers..
- Tighten all nuts to the prescribed torque proceeding with the cross order

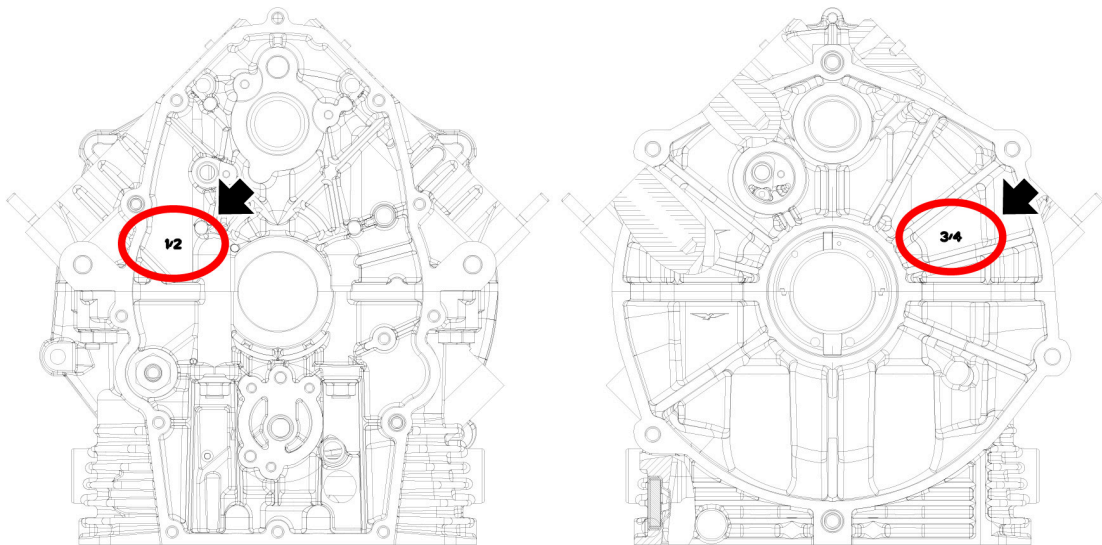


4.6 Bushing selection

CRANKSHAFT - CRANKCASE BUSHINGS

The crankcase class is stamped in the following locations:

- Alternator side, on the upper crankcase in correspondence with the crankshaft hole, on the left.
- Clutch side, on the upper crankcase in correspondence with the crankshaft hole, on the right.



CRANKCASE HOLE DIAMETER

CHARACTERISTIC	DESCRIPTION / VALUE
Class 1	Bushing seat diameter: 43.657-43.663 mm (1.7188-1.7190 in)
Class 2	Bushing seat diameter: 43.664-43.670 mm (1.7191-1.7193 in)
Class 3	Bushing seat diameter: 47.130-47.136 mm (1.8555-1.8557 in)
Class 4	Bushing seat diameter: 47.137-47.142 mm (1.8558-1.8560 in)

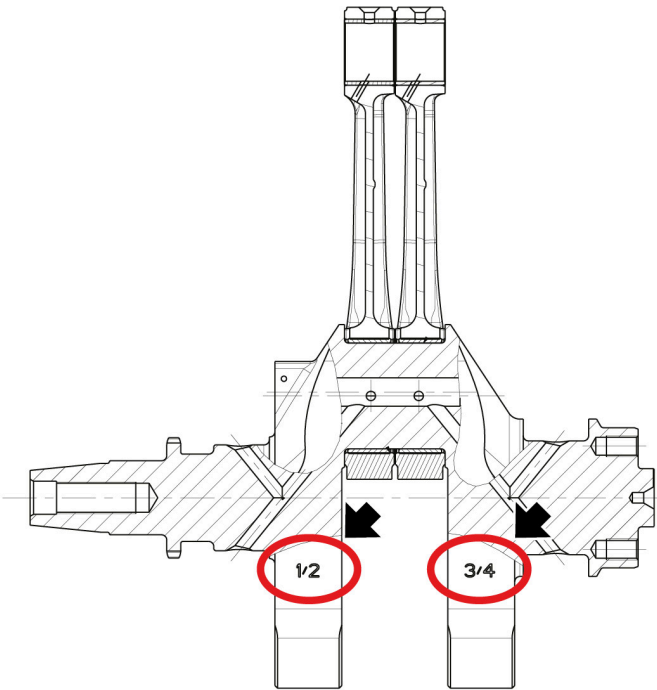
Four different crankcase classes are available:

- (1-2) according to diameter of hole in half crankcase shells on alternator side.
- (3-4) according to diameter of hole in half crankcase shells on clutch side.

CRANKSHAFT

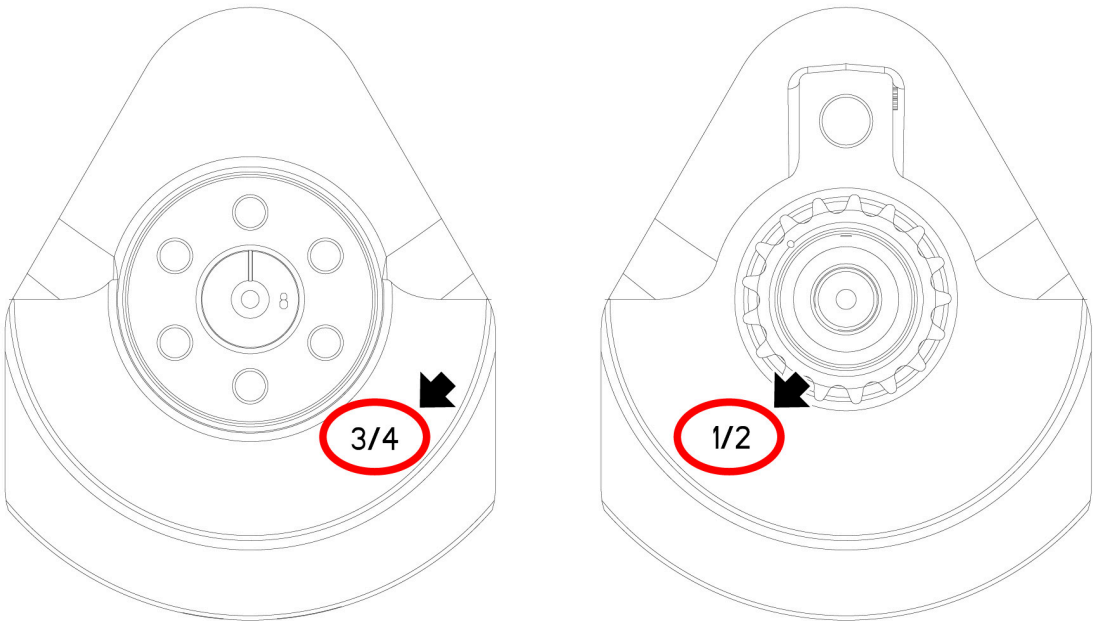
Based on the development and improvement process, the crankshaft categories can be stamped on the crankshaft counterweights (figure A)

(A)



Or alternatively, laterally on the counterweights of the crankshaft (figure B)

(B)



MAIN CRANKSHAFT JOURNAL DIAMETER

CHARACTERISTIC	DESCRIPTION / VALUE
Class 1	Diameter: 40.004-40.012 mm (1.5750-1.5753 in)

CHARACTERISTIC	DESCRIPTION / VALUE
Class 2	Diameter: 40.013-40.020 mm (1.5753-1.5756 in)
Class 3	Diameter: 43.007-43.015 mm (1.6932-1.6935 in)
Class 4	Diameter: 43.016-43.023 mm (1.6935-1.6937 in)

Four different crankshaft classes are available:

- (1-2) according to main journal diameter on alternator side.
- (3-4) according to main journal diameter on clutch side.

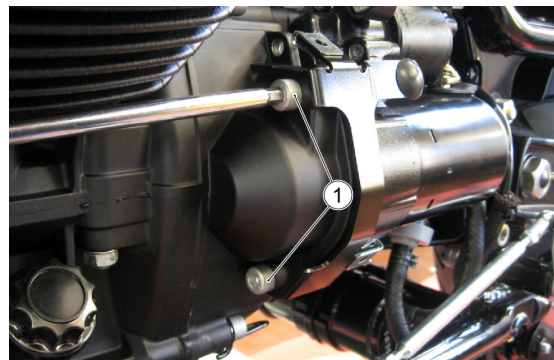
SELECTING CRANKSHAFT - CRANKCASE BUSHING CLASSES

Crankcase class	Class 1 crankshaft	Class 2 crankshaft	Class 3 crankshaft	Class 4 crankshaft
Class 1	green-green	yellow-yellow	-	-
Class 2	black-black	green-green	-	-
Class 3	-	-	green-green	yellow-yellow
Class 4	-	-	black-black	green-green

4.7 Starter Motor

4.7.1 Starter motor removal

- Remove the starter motor fixing screws (1)



- Remove the supporting clamp of the protection (2) and the starter motor (3)

