

aprilia

1055-1

01/2001-10

V990 engine

www.serviceaprilia.com



UK

8140586

workshop manual

Date of the first edition: 10 – 10 – 2001

COVERING LETTER FOR RELEASE 01/2001-10 UPDATE

Date of the first edition (Release 00) and of the following Releases:

First edition (Release 00) june 2001
Release 01 october 2001

INFORMATION ON THE UPDATING OF THE MANUAL

The manual must be updated every time a new "Release" is received.

Insert the pages of the current Release in the manual and eliminate the corresponding obsolete pages (even if belonging to a previous Release).

The failure to update the manual and to eliminate the obsolete pages makes it more difficult to consult the manual and may lead to the performance of incorrect operations on the vehicle, with serious consequences for the safety of the engine, of the vehicle and of persons and property.

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V990 engine **1055-1** UK 01/2001-10



workshop manual



aprilia part# 8140586

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0.1 UPDATE OF RELEASE 01/2001-10

Date of the first edition (Release 00) and of the following Releases:

First edition (Release 00) june 2001
Release 01october 2001

0.1.1 INFORMATION ON THE UPDATING OF THE MANUAL

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Insert the pages of the last Release in the manual and eliminate the corresponding obsolete pages (even if belonging to a previous Release).

⚠ WARNING

The failure to update the manual and to eliminate the obsolete pages makes it more difficult to consult the manual and may lead to the performance of incorrect operations on the vehicle, with serious consequences for the safety of the engine, of the vehicle and of persons and property.

The manual consists of # 7 sections, for a total amount of # 166 pages, as listed below.

NOTE For the nomenclature of the standard page of the manual (and specifically for the definition of the page number) see 0.2 (HOW TO CONSULT THE MANUAL).

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0.2 HOW TO CONSULT THE MANUAL



8 **4.3 BALL BEARINGS AND OIL SEALS INSTALLED ON THE ENGINE CRANKCASE HALVES**

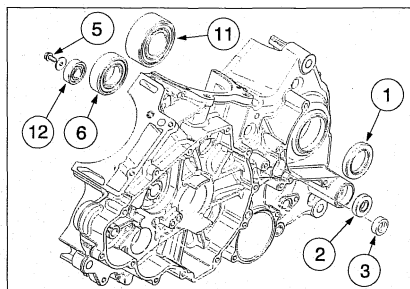
Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

9 **4.3.1 REMOVING THE OIL SEALS**

NOTE The oil seals can be disassembled and assembled without removing the engine from the vehicle.

- 10 ♦ Lift and take out the oil seals:
- secondary gearshift shaft (1);
 - selector shaft (2);
 - clutch disengaging shaft (3).

NOTE As a rule, the disassembled oil seals should be replaced.



4.3.2 REMOVING THE BALL BEARINGS

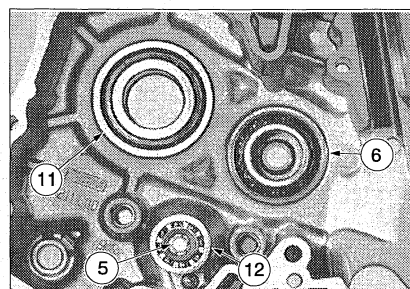
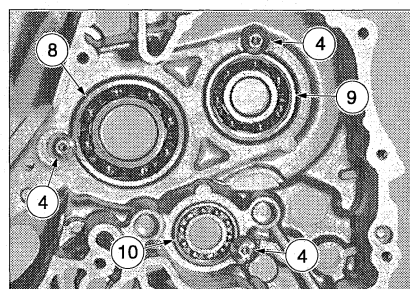
- ♦ Unscrew and remove the M6 FH screws (4) securing the ball bearings.
- ♦ Remove the M6 x 13 flanged-head screw (5).
- ♦ Make sure that there are no damage and rolling traces or grooves on the sliding surface of the bearings.
- ♦ In order to remove and insert the ball bearings, heat the engine casing to a temperature of approx. 80 – 100°C (176 – 212° F).

NOTE In order to avoid damaging the gasket surface, an old engine casing gasket should be placed underneath the puller plate.

- ♦ Extract the ball bearings (6) of the gearbox input shaft by means of a universal extractor (7) for bearings.
- ♦ Remove the ball bearings using the relevant drift.
- gearshift primary shaft (8), clutch side;
- gearshift secondary shaft (9), clutch side;
- shift cam (10), clutch side;
- gearshift secondary shaft (11), flywheel side.

- ♦ Remove the shift cam ball bearings (12).

NOTE As a rule, the disassembled ball bearings should be replaced.



1) Vehicle (or engine) model

2) Section

3) Release consecutive number ("00" indicates the first edition)

4) Year and month of publication of the Release

5) Section number

6) Section page consecutive number

7) Updated page consecutive number

8) Chapter title (numbered consecutively)

9) Paragraph title (numbered consecutively)

10) Description of the operation (always preceded by a rhombus)

0.3 FOREWORD

- This manual supplies the main information for normal servicing procedures.
- In the future, the information and illustrations that make up this manual will be updated by means of "Releases", see 0.1 (UPDATE OF RELEASE 00/2001-06).
- This publication is intended for the **aprilia** Dealers and their qualified engineers; many notions were voluntarily omitted, because they were considered superfluous. Since it is not possible to include complete mechanical information in this publication, the persons using this manual must have a basic mechanical training and a basic knowledge of the procedures regarding engines repair systems.

Without this knowledge, the repair or servicing of the engine may be ineffective or even dangerous.

The manual does not describe all the procedures for the repair and servicing of the engine in detail, therefore it is important to be particularly careful, in order to avoid any damage to components and persons.

In order to grant its customers more and more satisfaction, **aprilia s.p.a.** will keep improving its products and the relevant documentation.

The main technical modifications and the modifications in the engine repair procedures are communicated to all **aprilia** Outlets and Branches the world over. These modifications will be described in the successive editions of this manual.

In case of need or in case there are any doubts regarding the repair and servicing procedures, contact the **aprilia s.p.a. Divisione Ricambi**, which will give you any information required and will also inform you about any updating and technical modifications of the vehicle.

aprilia s.p.a. reserves the right to modify its models at any time, without prejudice to the main characteristics here described.

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aprilia takes no responsibility as to the performance or use of said products.

For further information, see 0.4 (REFERENCE MANUALS).

0.4 REFERENCE MANUALS**0.4.1 VEHICLE WORKSHOP MANUALS**

Consult the workshop manual of the vehicle.

Consult the specific tables to find the manual code and the country to which the vehicle and, consequently, the engine are destined.

0.4.2 SPARE PARTS CATALOGUES

Consult the workshop manual of the vehicle.

Consult the specific tables to find the manual code and the country to which the vehicle and, consequently, the engine are destined.

0.4.3 SPECIAL TOOL MANUALS

aprilia part# (countries)	
8202278	I F D E UK

0.4.4 USE AND MAINTENANCE BOOK

Consult the workshop manual of the vehicle.

Consult the specific tables to find the manual code and the country to which the vehicle and, consequently, the engine are destined.

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0.5 SAFETY WARNINGS

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

⚠ Safety warning. When you find this symbol on the engine or in the manual, be careful to the potential risk of personal injury. Non-compliance with the indications given in the messages preceded by this symbol may result in grave risks for your and other people's safety and for the engine!

⚠ WARNING

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

⚠ CAUTION

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

NOTE The word "NOTE" in this manual precedes important information or instructions.

0.5.1 PRECAUTIONS AND GENERAL INFORMATION

Follow with care these recommendations when repairing, disassembling and reassembling the engine.

⚠ WARNING

The use of naked flames is forbidden for any type of operation.

Keep away from the red-hot parts of the engine, in order to avoid burns.

⚠ WARNING

Do not hold any mechanical piece or other parts of the engine with your mouth: the components are not edible and some of them are noxious or even toxic.

If not expressly indicated otherwise, for the reassembly of the units repeat the disassembly operations in reverse order.

Any reference to operations from other chapters must be interpreted logically in order to avoid components being removed unnecessarily.

When two or more persons are working together, make sure that each is working in safe conditions.

Carefully read 1.2 (INSTRUCTIONS FOR USE OF FUEL, LUBRICANTS, COOLANT AND OTHER COMPONENTS).

0.5.2 BEFORE THE DISASSEMBLY OF THE COMPONENTS

- Remove any dirt, mud, dust and foreign matters from the engine before disassembling the components.
- Use, when necessary, the special tools designed for this engine.

0.5.3 DISASSEMBLING THE COMPONENTS

- Do not loosen and/or tighten the screws and nuts using pliers or other tools: instead, always use the proper spanner.
- Before disconnecting the joints (pipes, cables, etc.), mark the positions on all of them and mark them with different distinguishing signs.
Each piece must be marked clearly, in order not to have problems during installation.
- Clean and wash carefully any disassembled parts with low inflammability detergents.
- Keep the parts that are used in pairs together, since they have adapted to each other following the normal wear.
Some components must be used together or replaced completely.
- Keep away from heat sources.

0.5.4 REASSEMBLING THE COMPONENTS

⚠ CAUTION

Never use a seeger ring twice. When a seeger ring is removed, it must be replaced with a new one. When assembling a new seeger ring be careful not to stretch its ends more than strictly necessary to put it on the shaft.

After installing a seeger ring, make sure that it is completely and firmly inserted in its seat.

Do not use compressed air to clean the bearings.

NOTE The bearings must rotate freely, without halting a/o noise otherwise they must be replaced.

- Use only original **aprilia** SPARE PARTS.
- Use the recommended lubricants.
- Whenever possible, lubricate the parts before reassembly.
- When tightening screws and nuts, begin with those having greater diameters or with inner ones, proceeding diagonally.
Tighten screws or nuts in successive passages before applying driving torque.
- Always replace lock nuts, seals, sealing rings, snap rings, O-rings, split pins and screws, whenever the thread appears damaged, with new ones.
- Before the assembly, clean all the connection surfaces, the oil seal edges and the gaskets.
Apply a thin layer of lithium-based grease on the oil seal edges.
Put back the oil seals and the bearings with the mark or serial number facing towards the outside (visible side).
- When installing the bearings, lubricate them abundantly.
- Make sure that each component has been reassembled correctly.

0.6 HOW TO USE YOUR WORKSHOP MANUAL

0.6.1 ADVICE FOR CONSULTATION

- This manual is divided into section and chapters, each one of which corresponds to a category of main components.
To consult them, see the sections' index, see page 0-1.
 - If not expressly indicated otherwise, for the reassembly of the units repeat the disassembly operations in reverse order.
 - For normal maintenance operations, consult the "USE AND MAINTENANCE" manual.
- ★ **The operations preceded by this symbol must be repeated on the opposite side of the engine.**

In this manual the various versions are indicated by the following symbols:

RSV	RSV mille
RSV R	RSV mille R
SL	SL mille
RST	RST mille Futura
ETV	ETV mille Caponord
OPT	optional

VERSION:

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

0.7 ABBREVIATIONS / SYMBOLS / INITIALS

#	= number	PICK-UP	= pick-up
<	= is less than	BDC	= bottom dead centre
>	= is greater than	TDC	= top dead centre
≤	= is equal to or less than	PPC	= Pneumatic Power Clutch
≥	= is equal to or greater than	RIGHT	
~	= approximately	SIDE	= right side
∞	= infinity	SAE	= Society of Automotive Engineers
°C	= degrees Celsius (centigrade)	TEST	= diagnostics test
°F	= degrees Fahrenheit	T.B.E.I.	= convex socket head
±	= plus or minus	T.C.E.I.	= hexagonal socket head
a.c.	= alternating current	T.E.	= hex-head
A	= ampère	T.P.	= flat head
Ah	= ampere per hour	TSI	= Twin Spark Ignition
API	= American Petroleum Institute	UPSIDE-	
HV	= high voltage	DOWN	= upside-down rods
AV/DC	= AntiVibration Double Countershaft	V	= volt
bar	= unit of pressure (1 bar = 100 kPa)	W	= watt
d.c.	= direct current	Ø	= diameter
cm ³	= cubic centimetres		
CO	= carbon monoxide		
CPU	= Central Processing Unit		
DIN	= German industrial normative (Deutsche Industrie Norm)		
DOHC	= Double Overhead Camshaft		
ECU	= Engine Control Unit		
rpm	= revolutions per minute		
HC	= unburnt hydrocarbons		
ISC	= idle speed control		
ISO	= International Standardization Organization		
kg	= kilograms		
kgm	= kilograms per metre (1 kgm = 10 Nm)		
km	= kilometres		
km/h	= kilometres an hour		
kΩ	= kilo-ohms		
kPa	= kiloPascal (1 kPa = 0.01 bar)		
KS	= clutch side (Kupplungseite)		
kW	= kilowatt		
ℓ	= litres		
LAP	= lap (race course)		
LED	= Light Emitting Diode		
LEFT			
SIDE	= left side		
m/s	= metres an second		
MAX	= maximum		
mbar	= millibar (1mbar = 0.1 kPa)		
mi	= mile		
MIN	= minimum		
MPH	= miles per hour		
MS	= flywheel side (Magnetoseite)		
MΩ	= megaohm		
N.A.	= not Available (Not Available)		
N.O.M.M.	= "Motor" method octane number		
N.O.R.M.	= "Research" method octane number		
Nm	= newton per meter (1 Nm = 0.1 kgm)		
Ω	= ohm		

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GENERAL INFORMATION

1

GENERAL INFORMATION**TABLE OF CONTENTS****1.1 POSITION OF THE SERIAL****NUMBERS** 1-3-00

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**1.2 INSTRUCTIONS FOR USE OF
FUEL, LUBRICANTS, COOLANT
AND OTHER COMPONENTS** 1-3-00

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1.2.2 ENGINE OIL 1-3-00

1.2.3 COOLANT 1-4-00

1.2.4 CARBON MONOXIDE 1-4-00

1.2.5 HOT COMPONENTS 1-4-00

1.3 SPARE PARTS 1-4-00

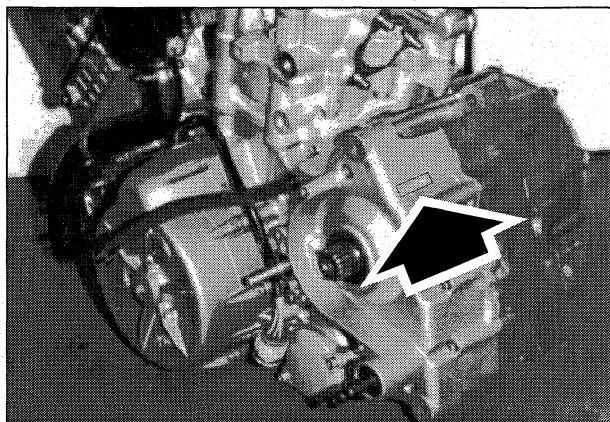
1.1 POSITION OF THE SERIAL NUMBERS

These numbers are necessary for the registration of the vehicle.

Do not alter the identification numbers if you do not want to incur severe penal and administrative sanctions.

1.1.1 ENGINE NUMBER

The engine number is stamped on the rear part of the engine, near the pinion.



1.2 INSTRUCTIONS FOR USE OF FUEL, LUBRICANTS, COOLANT AND OTHER COMPONENTS

1.2.1 FUEL

⚠ WARNING

The fuel used for internal combustion engines is extremely inflammable and in particular conditions it can become explosive.

Avoid any contact of the fuel with the skin and the inhalation of vapours; do not swallow fuel or pour it from a receptacle into another by means of a tube.

DO NOT DISPOSE OF FUEL IN THE ENVIRONMENT.

KEEP AWAY FROM CHILDREN.

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

1.2.2 ENGINE OIL

⚠ WARNING

Engine oil may cause serious damage to the skin if handled daily and for long periods.

Wash your hands carefully after use.

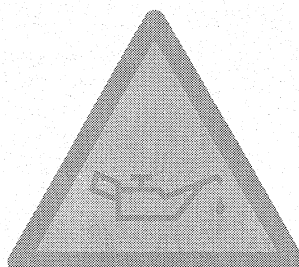
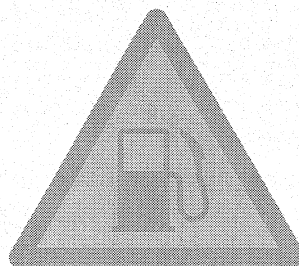
Do not dispose of the oil in the environment.

Deliver it to or have it collected by the nearest oil salvage center or by the supplier.

In case any maintenance operation has to be carried out, it is advisable to use latex gloves.

For the maintenance intervals, see 0.4.1 (VEHICLE WORKSHOP MANUALS).

For the lubricant types, see 2.2 (LUBRICANT CHART).



1.2.3 COOLANT

WARNING

The coolant is noxious: do not swallow it; if the coolant gets in contact with the skin or the eyes, it can cause serious irritations. If the coolant gets in contact with your skin or eyes, rinse with plenty of water and consult a doctor.

If it is swallowed, induce vomit, rinse mouth and throat with plenty of water and consult a doctor without delay.

DO NOT DISPOSE OF THE FLUID IN THE ENVIRONMENT.

KEEP AWAY FROM CHILDREN.

Be careful not to spill the coolant on the red-hot parts of the engine: it may catch fire and send out invisible flames.

In case any maintenance operation should be required, it is advisable to use latex gloves.

Do not use the vehicle if the coolant is below the minimum prescribed level.

For the maintenance intervals, see 0.4.1 (VEHICLE WORKSHOP MANUALS).

For the lubricant types, see 2.2 (LUBRICANT CHART).

NOTE The characteristics of the various antifreeze liquids are different. Be sure to read the label on the product to learn the degree of protection it guarantees.

CAUTION

Use only antifreeze and anticorrosive without nitrite in order to ensure protection at at least -35 °C.

1.2.4 CARBON MONOXIDE

If it is necessary to let the engine run in order to carry out some work, make sure that the area in which you are operating is properly ventilated.

Never run the engine in enclosed spaces.

If it is necessary to work indoors, use an exhaust evacuation system.

WARNING

The exhaust fumes contain carbon monoxide, a poisonous gas that can cause loss of consciousness and even death.

1.2.5 HOT COMPONENTS

WARNING

The engine and the components of the exhaust system become very hot and remain hot for some time after the engine has been stopped.

Before handling these components, wear insulating gloves or wait until the engine and the exhaust system have cooled down.

1.3 SPARE PARTS

For any replacement, use **aprilia** Genuine Spare Parts only, see 0.4.2 (SPARE PARTS CATALOGUES).

aprilia Genuine Spare Parts are high-quality parts, expressly designed and manufactured for **aprilia** vehicles.

CAUTION

Failure to use **aprilia** Genuine Spare Parts may result in incorrect performance and damages.

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TECHNICAL INFORMATION

2

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2.1 TECHNICAL SPECIFICATIONS

ENGINE	
Model	V990
Type	60° longitudinal V-type, two-cylinder, 4-stroke, with 4 valves per cylinder, DOHC.
Number of cylinders	2
Total displacement RSV RSV R ('98 – '99 – 2000 models) SL	997.6 cm ³
Total displacement RSV RSV R (models starting from 2001) ETV	998 cm ³
Total displacement RST	997.62 cm ³
Max. rated power (to driving shaft)	86.5 kW (118 HP) at 9250 rpm
Max. rated power (to driving shaft) RSV RSV R F	70 kW (94 HP) at 9250 rpm
Max. rated power (to driving shaft) SL F	77 kW (104 HP) at 9250 rpm
Max. torque	96.5 Nm (9.65 kgm) at 7250 rpm
Max. torque RSV RSV R F	82 Nm (8.2 kgm) at 7000 rpm
Max. torque SL F	90 Nm (9.0 kgm) at 7000 rpm
Bore/stroke	97 mm/67.5 mm
Compression ratio RSV RSV R SL	11.4 ± 0.5 : 1
Compression ratio RST	11.8 ± 0.5 : 1
Compression ratio ETV	10.4 ± 0.5 : 1
Average piston speed	22.5 m/s at 10000 rpm
Camshaft during intake stroke RSV RSV R ('98 – '99 – 2000 models) SL	262°, valve lifting= 10.60 mm
Camshaft during intake stroke RSV RSV R (models starting from 2001)	262°, valve lifting= 11.40 mm
Camshaft during intake stroke RST	259°, valve lifting= 10.60 mm
Camshaft during intake stroke ETV	242°, valve lifting= 9.50 mm
Camshaft during exhaust stroke RSV RSV R SL RST	259°, valve lifting= 10.60 mm
Camshaft during exhaust stroke ETV	242°, valve lifting= 9.50 mm
Valve advance (with valve clearance 1mm) RSV RSV R SL	opening during intake stroke = 20° before TDC closing during intake stroke = 62° after BDC opening during exhaust stroke = 64° before TDC closing during exhaust stroke = 15° after BDC
Valve advance (with valve clearance 1 mm) RSV RSV R SL (models starting from 2001)	opening during intake stroke = 25° before TDC closing during intake stroke = 59° after BDC opening during exhaust stroke = 65° before TDC closing during exhaust stroke = 15° after BDC
Valve advance (with valve clearance 1mm) RST	opening during intake stroke = 20° before TDC closing during intake stroke = 59° after BDC opening during exhaust stroke = 64° before TDC closing during exhaust stroke = 15° after BDC
Valve advance (with valve clearance 1mm) ETV	opening during intake stroke = 25° before TDC closing during intake stroke = 37° after BDC opening during exhaust stroke = 57° before TDC closing during exhaust stroke = 5° after BDC
Valve clearance during intake stroke	0.12 – 0.17 mm
Valve clearance during exhaust stroke	0.23 – 0.28 mm
Diameter of the inlet valve plate	36.0 mm
Diameter of the exhaust valve plate	31.0 mm
# Engine revolutions at minimum rpm RSV RSV R SL RST	1250 ± 100 rpm
# Engine revolutions at minimum rpm ETV	1200 ± 100 rpm
# Engine revolutions at peak rpm RSV RSV R SL	10250 ± 100 rpm
# Engine revolutions at peak rpm RST	10500 ± 100 rpm
# Engine revolutions at peak rpm ETV	9000 ± 100 rpm
Ignition	electronically controlled
Starting	electric

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ENGINE	
Spark advance	At start: 5° before TDC, additional advance depending on specific consumption levels
Starter motor gear ratio	$i = 49/9 \cdot 30/11 \cdot 64/30 = 31.677$
Clutch	multidisc in oil bath, with hydraulic control on the left side of the handlebar and PPC device - # 9 friction discs; thick 3.5 mm - # 10 steel discs; thick 1.5 mm
Transmission	Mechanical, 6 gears with foot control on the left side of the engine
Lubrication system	dry pan with separate oil tank, # 2 trochoidal pumps and cooling radiator
Lubrication pressure	min 500 kPa (5 bar) at max 80 °C (176 °F) and 6000 rpm
Air cleaner	with dry filter cartridge
Cooling	liquid-cooled
Coolant pump gear ratio	$i_{wp} = 28/27 \cdot 28/28 = 1.037$
Coolant pump delivery (with thermal expansion valve open)	90 l/min and 9000 rpm
Thermal expansion valve opening start temperature	65 ± 2 °C (149 ± 5 °F)
Engine dry weight	~ 65 – 67 kg

DRIVE RSV RSV R					
GEAR RATIOS	Ratio	Primary	Secondary	Final ratio	Total ratio
1 ^a		31/60 = 1: 1.935	14/35 = 1: 2.50	17/42 = 1: 2.470	11.948
2 ^a			16/28 = 1: 1.750		8.368
3 ^a			19/26 = 1: 1.368		6.543
4 ^a			22/24 = 1: 1.090		5.216
5 ^a			23/22 = 1: 0.956		4.573
6 ^a			27/23 = 1: 0.851		4.073
# sprocket teeth			17		













DRIVE SL					
GEAR RATIOS	Ratio	Primary	Secondary	Final ratio	Total ratio
1 ^a		31/60 = 1: 1.935	14/35 = 1: 2.50	16/41 = 1: 2.563	12.399
2 ^a			16/28 = 1: 1.750		8.679
3 ^a			19/26 = 1: 1.368		6.787
4 ^a			22/24 = 1: 1.090		5.411
5 ^a			23/22 = 1: 0.956		4.744
6 ^a			27/23 = 1: 0.851		4.225
# sprocket teeth			16		

DRIVE RST					
GEAR RATIOS	Ratio	Primary	Secondary	Final ratio	Total ratio
1 ^a		31/60 = 1: 1.935	14/35 = 1: 2.50	16/43 = 1: 2.687	13.00
2 ^a			16/28 = 1: 1.750		9.102
3 ^a			19/26 = 1: 1.368		7.117
4 ^a			22/24 = 1: 1.090		5.674
5 ^a			23/22 = 1: 0.956		4.975
6 ^a			27/23 = 1: 0.851		4.431
# sprocket teeth			16		



DRIVE ETV					
GEAR RATIOS	Ratio	Primary	Secondary	Final ratio	Total ratio
1 ^a		31/60 = 1: 1.935	14/35 = 1: 2.50	17/45 = 1: 2.647	12.804
2 ^a			16/28 = 1: 1.750		9.041
3 ^a			19/26 = 1: 1.368		7.006
4 ^a			22/24 = 1: 1.090		5.582
5 ^a			23/22 = 1: 0.956		4.896
6 ^a			27/23 = 1: 0.851		4.358
# sprocket teeth			17		




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FUEL SUPPLY SYSTEM	
Type	electronic injection
Choke    	Ø 51 mm
Choke 	Ø 47 mm
FUEL SUPPLY	
Type	indirect injection (MULTIPOINT)
Fuel	premium grade unleaded petrol, min. O.N. 95 (N.O.R.M.) and 85 (N.O.M.M.).
SPARK PLUGS	
Standard	NGK R DCPR9E
Spark plug gap	0.6 – 0.7 mm
Resistance	5 kΩ
ELECTRIC SYSTEM	
Generator (with permanent magnet)    	12 V – 400 W (350 W for models   up to 2000)
Generator (with permanent magnet) 	12 V – 470 W
Starter	12 V/0.9 kW
Starter motor gear ratio	i = 49/9* 30/11* 64/30 = 31.677

2.2 LUBRICANT CHART

Engine oil (recommended):  EXTRA RAID 4, SAE 15W - 50 or  Agip TEC 4T SAE 15W - 50.
As an alternative to the recommended oil, it is possible to use high-quality oils with characteristics in compliance with or superior to the CCMC G-4, A.P.I. SG specifications.

Bearings and other lubrication points (recommended):  Bimol Grease 481,  AUTOGREASE MP or  Agip GREASE 30.
As an alternative to the recommended product, use high-quality grease for rolling bearings, working temperature range -30 °C...+140 °C, dripping point 150 °C...230 °C, high protection against corrosion, good resistance to water and oxidation.

⚠ WARNING

Use new clutch fluid only.

Clutch fluid (recommended):  F.F., DOT 5 (DOT 4 compatible) or  Agip BRAKE 5.1, DOT 5 (DOT 4 compatible).

⚠ WARNING

Use only antifreeze and anticorrosive without nitrite, ensuring protection at -35 °C at least.

Engine coolant (recommended):  ECOBLU -40 °C or  Agip COOL.

2.3 SPECIAL TOOLS OPT

In order to perform assembly, reassembly and settings correctly, special tools suitable for the task must be used. The use of special tools avoids the potential risk of damage as a result of inappropriate tools and/or improvised methods.

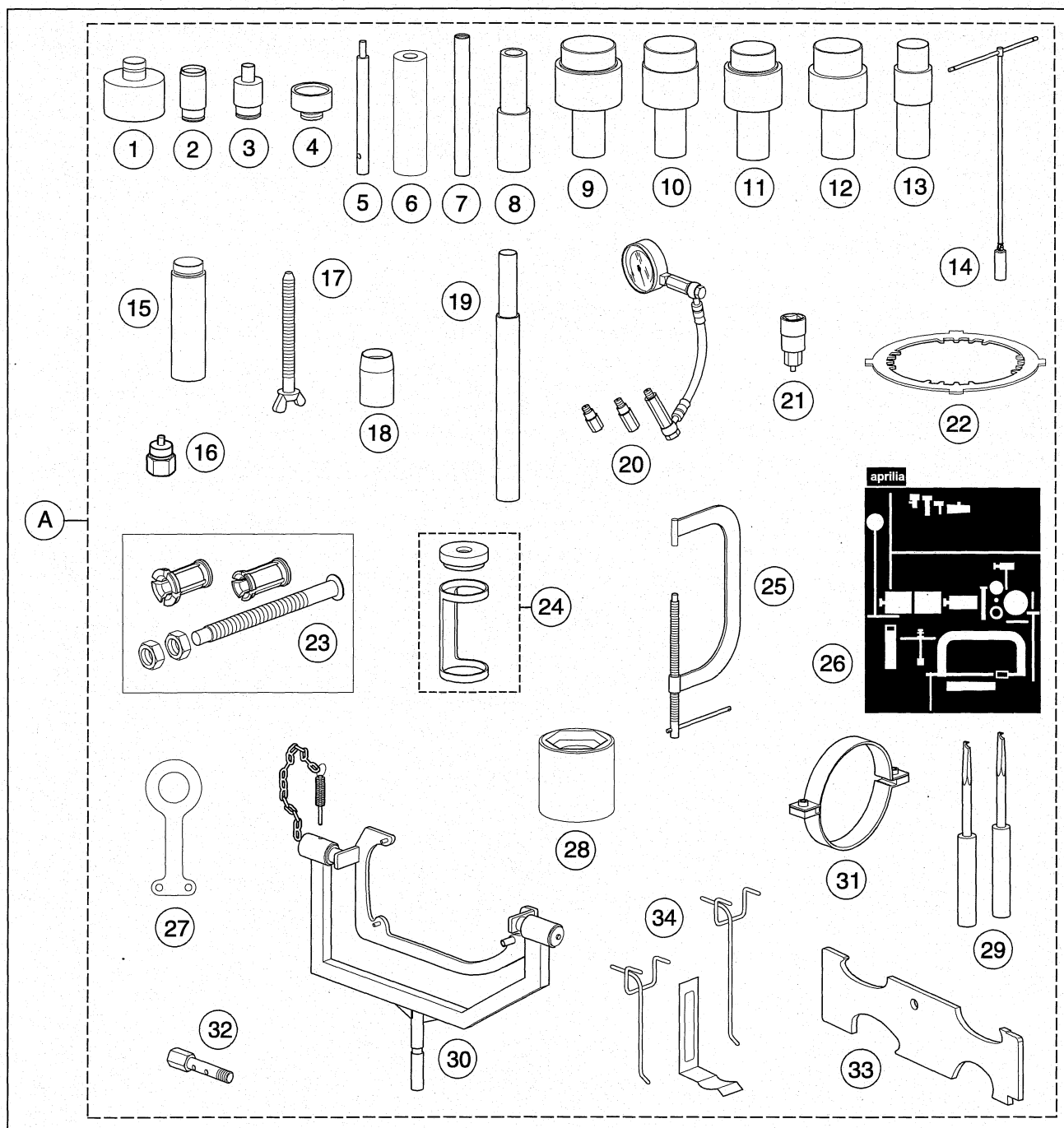
Below is a list of the special tools designed especially for this specific engine.

If necessary, request the multi-purpose special tools, see 0.4.3 (SPECIAL TOOL MANUALS).

CAUTION

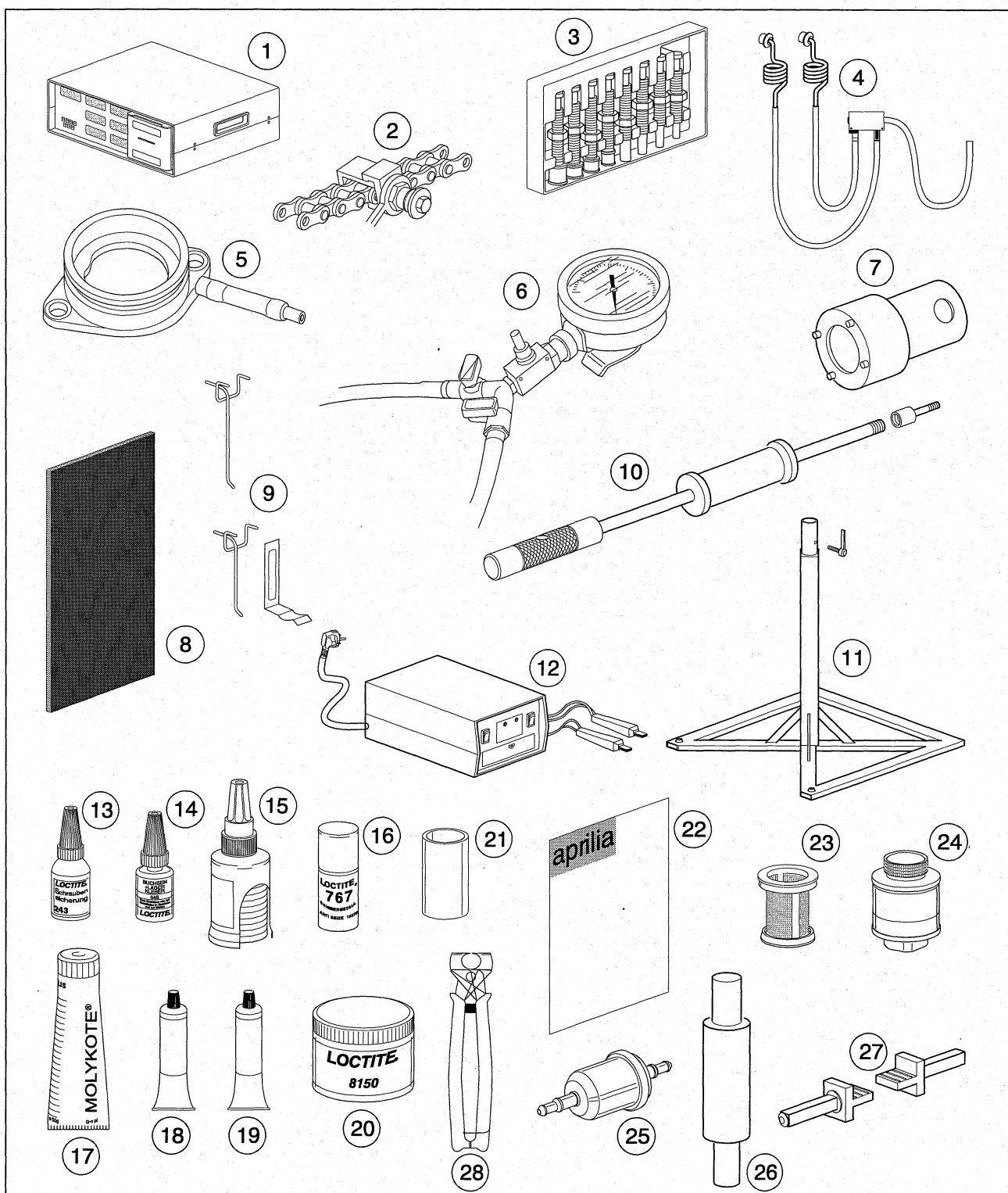
Before using the special tools, consult any documents attached.

2.3.1 ENGINE TOOLS



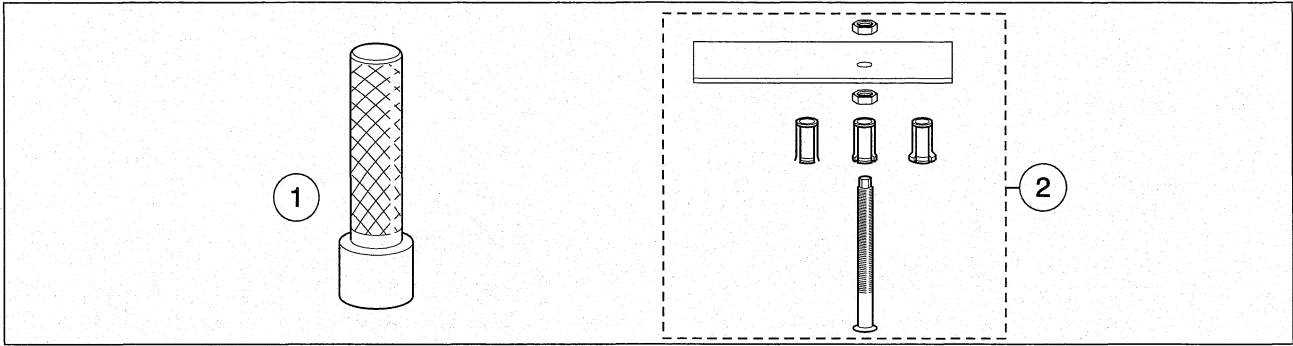
Pos.	aprilia part# (tool description and function)
A	8140175 (complete tool kit for engine including)
1	0277680 (gearshift secondary shaft oil seal assembly pad)
2	0277660 (secondary countershaft oil seal assembly pad)
3	0277670 (coolant pump shaft housing oil seal assembly pad)
4	0877257 (assembly pad for water pump shaft seat sliding ring)
5	0277510 (valve guide disassembly pad)
6	0277210 (valve guide ass assembly)
7	0277695 (valve guide oil seal assembly pad)
8	8140155 (gearshift shaft oil seal - clutch shaft oil seal assembly pad)
9	0277725 (driving shaft bush inserter pad)
10	0277720 (driving shaft sleeve puller pad)
11	0277537 (main countershaft bush inserter pad)
12	0277727 (driving shaft - clutch cover bush inserter pad)
13	0277729 (insertion pad for lower balance shaft clutch cover bushes)
14	8140177 (plug socket spanner)
15	0277252 (flywheel magneto cover removal tool)
16	0277730 (flywheel removal hexagonal bolt)
17	0240880 (threaded bolt to lock the drive shaft at the TDC)
18	0277308 (gearshift secondary shaft guide bush)
19	8140178 (pin installation and removal pad)
20	8140181 (fuel-oil pressure gauge-compression)
21	8140182 (rotor bolt bush)
22	0277881 (clutch blocking tool)
23	8140156 + 8140157 + 0276377 (clutch cover sleeve puller)
24	0276479 (valve spring compression tool)
25	8140179 (valves disassembly and reassembly bow)
26	8157143 (adhesive for tool holder panel RSVmille)
27	8140183 (engine lifting eye hook)
28	8140184 (primary transmission nut disassembly bush)
29	8140185 (clutch disc extraction hook lever)
30	8140188 (engine support)
31	8140186 (piston ring compression tool)
32	8140197 (perforated bolt for fuel pressure test fuel)
33	8140205 (camshaft template)
34	8140426 (panel hooks)


2.3.2 MISCELLANEOUS TOOLS



Pos.	aprilia part# (tool description and function)
1	8140196 (analyser)
2	8140192 (chain installation kit)
3	8140180 (bearing extractors)
4	8140202 (exhaust gas analysis probes)
5	8140267 (intake flange for vacuumeter)
6	8140256 (vacuometer)
7	8140424 (OHLINS fork spanner)
8	8140199 (tool panel)
9	8140426 (panel hooks)
10	8140432 (pushing extractor)
11	8140187 (engine support stand)
12	8124838 (battery charger M.F.)
13	0897651 [LOCTITE® 243 blue (10 cm³)]
14	0899788 [LOCTITE® 648 green (5 g)]
15	0899784 (LOCTITE® 574 orange)
16	0297434 (LOCTITE® 767 Anti-Seize 15378)
17	0297433 [MOLYKOTE® G-N (50 g)]
18	0897330 (multi-purpose grease bp lz)
19	0297386 [SILASTIC 732 RTV (100 g)]
20	8116067 (LOCTITE® 8150)
21	8140395 [exhaust gas analyzer spare part: aprilia part# 8140196 (analyser)]. Particulate filter
22	8202222 (panel adhesive sheet)
23	8010396 [exhaust gas analyzer spare part: aprilia part# 8140196 (analyser). Tubular screen filter]
24	8010397 [exhaust gas analyzer spare part: aprilia part# 8140196 (analyser). Oxygen sensor]
25	8010398 [exhaust gas analyzer spare part: aprilia part# 8140196 (analyser). Inlet screen filter]
26	8140074 (main countershaft bush inserter pad)
27	8140204 (rear stand supports)
28	0277295 (click clamp installation pliers)

2.3.3 TOOLS USED FOR OTHER aprilia VEHICLES



Pos.	aprilia part# (tool description and function)
1	0877650 (handle for pads)
2	0277265 (extractor for balance shaft, gearbox input and output shaft)
-	8116050 (engine oil)
-	8116053 (grease  Bimol Grease 481)
-	8116038 (grease LUBERING ST)
-	xxxxxxx N.A. (AP-LUBE temporary lubricant)
-	xxxxxxx N.A. (grease DID CHAIN LUBE)
-	8116031 ("Fluid Biosolvent" frame detergent)
-	8116945 ("ACRILON 28" cyanoacrylic glue)
-	xxxxxxx N.A. (MOTUL MOTOWASH degreaser)
-	8116043 (anti-corrosive paste ANTI-SEIZE MOTAPAGESTE AS 1800)
-	xxxxxxx N.A. (alcohol)
-	0898011 (fluorescent green LOCTITE® 275)
-	xxxxxxx N.A. (LOCTITE® 572)

xxxxxxx N.A. = not available







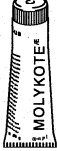
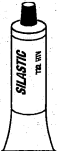
2.4 CONSUMABLES

Only use the products given below for any maintenance work.

The materials mentioned have been tested for many years and are suitable for all the application conditions indicated by the manufacturer.

NOTE The consumables, which are coded, are available on application, see 2.4.2 (USE OF CONSUMABLES).

2.4.1 PRODUCT PROPERTIES

aprilia part# (product)		Use and properties
aprilia part# 0897651 [LOCTITE® 243 blue (10 cm³)]		Adhesive in paste for screws and nuts up to M36 and for couplings with medium hold. It can be used on parts which have not been completely degreased. The hardening time depends on the temperature and the material (maximum one hour). Resistance to temperatures in the range – 55 to 150 °C (– 99 to 302 °F).
aprilia part# 0898011 (fluorescent green LOCTITE® 275) (**)		It prevents the loosening of the threaded components and the fluid leakages due to vibrations. It must be used on clean, degreased and non-oxidized components. Apply a quantity sufficient to cover all the threaded part.
aprilia part# 0899788 [LOCTITE® 648 green (5 g)]		Paste for strong fastening of screws. The hardening time depends on the temperature and the material (maximum twelve hours). Resistance to temperatures in the range -55 to 175 °C (– 99 to 347 °F). In order to release the part glued, it may be necessary to heat the coupled parts to a temperature of 250 °C (482 °F).
aprilia part# 0899784 (LOCTITE® 574 orange)		Solvent-free seal in paste, to be used instead of seals where there is a high friction factor and where a precise distance is required between the two components. Applied in its liquid state, it hardens after assembly on contact with the metal within a few hours. A seal is created whose surface structure adapts to the surfaces to be sealed. Resistance to temperatures in the range – 55 to 200 °C (– 99 to 392 °F); where applied, it seals the surfaces against corrosion.
aprilia part# 8116067 (LOCTITE® 8150)		Paste to be used on components subjected to high temperature.
aprilia part# 0297434 (LOCTITE® 767 Anti-Seize 15378)		Lubricant and anticorrosion resistant to high temperatures. It must be sprayed on both components and makes sure the sliding surfaces remain maintenance free for a long time. It prevents corrosion.
aprilia part# 0297433 [MOLYKOTE® G-N (50 g)]		Lubricating paste to be used on support points subjected to heavy loads, for standard lubrication and on couplings under pressure, in order to prevent corrosion which would prevent subsequent disassembly. To apply on the two surfaces.
aprilia part# 0297386 [SILASTIC 732 RTV (100 g)]		It is used as a sealant, preventing water from getting inside the flywheel cover.

2.4.2 USE OF CONSUMABLES

For use descriptions that have been involuntarily omitted in this list and for any further information on the use of expendable materials, see 0.4.2 (SPARE PARTS CATALOGUES).

(*) = see 2.2 (LUBRICANT CHART).


(**) = see 2.4.1 (PRODUCT PROPERTIES).

xxxxxxx N.A. = not available

aprilvia part# (product)	Description of use
aprilvia part# 8116050 (engine oil) (*)	<ul style="list-style-type: none"> – On timing intermediate gear roller bearings. – On lower countershaft thrust washer. – Clutch disengaging shaft. – On valve stems and valve lifter buckets. – On valve guide oil seals. – On camshaft housings. – On the timing chain tightener. – On double starter gear and idler gear pins. – On the freewheel gear/freewheel contact surface. – On the freewheel inner contact surface. – On the piston segment seats.
aprilvia part# 0897651 [LOCTITE® 243 blue (10 cm³)] (**)	<ul style="list-style-type: none"> – Fastening of pinion. – On coolant pump centre fastening screw. – On cylinder joining bracket fastening screws. – On engine half-casing bearing lock screws. – On the cylinder fastening stud bolts (engine crankcase half side). – On driving shaft position sensor fastening screws. – On the camshaft position sensor fastening screws. – RST ETV On the revolution number sensor fastening screw. – On index lever and plate fastening screws. – On driving shaft fastening nut. – On timing gear fastening screws. – On upper countershaft counterweight fastening nut. – On intermediate timing gear bearing support lower fastening screw. – On the thread of the coolant duct plug on the rear cylinder. – On the thread of the engine oil pressure sensor. – On the thread of the stator fastening screws.
aprilvia part# 0898011 (fluorescent green LOCTITE® 275) (**)	<ul style="list-style-type: none"> – On the thread of the cylinder coolant inlet and outlet pipes.
aprilvia part# xxxxxxx N.A. (LOCTITE® 572)	<ul style="list-style-type: none"> – Fastening of coolant thermal switch. – Fastening of the coolant draining screws positioned on the radiators.

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aprilia part# (product)	Description of use
aprilia part# 0899788 [LOCTITE® 648 green (5 g)] (**)	<ul style="list-style-type: none"> – On coolant pump idler gear pin. – On engine oil pump plug. – On fastening screws of spring-holding plate/primary transmission gear/clutch housing. – Freewheel assembly on flywheel magneto. – On the freewheel/rotor flange fastening screws. – On clutch housing fastening nut. – On lower countershaft counterweight fastening screw. – On the freewheel housing fastening screws. – On flywheel rotor inner cone. – On flywheel fastening screw. – On the contact surface between the freewheel housing and the flywheel magneto. – On the thread of the stud bolts that fasten the exhaust pipes to the cylinders (cylinder side).
aprilia part# 8116067 (LOCTITE® 8150) (**)	<ul style="list-style-type: none"> – Assembly of plugs for checking CO on exhaust pipes.
aprilia part# 0899784 (LOCTITE® 574 orange) (**)	<ul style="list-style-type: none"> – Fastening of coolant thermistors. – On neutral gear switch contact screw. – On the contact surface of the engine oil pump central body with the external body and with the crankcase. – On the cylinder's base where it rests on the engine casing. – On the thread of the 90° oil union on the rear cylinder.
aprilia part# 0297434 (LOCTITE® 767 Anti-Seize 15378) (**)	<ul style="list-style-type: none"> – On gearshift primary and secondary shaft. – On gearshift primary and secondary shaft housings. – On driving shaft and countershaft. – On the gearshift primary shaft housing and toothing.
aprilia part# 0297433 [MOLYKOTE® G-N (50 g)]	<ul style="list-style-type: none"> – On main bush housings. – On main bushes. – On engine casing bearing housings. – On coolant pump shaft. – On valve guide slots on the head. – On valve guide edges. – On the contact area with the cams of the valve caps. – On driving shaft and countershaft bush housings. – On driving shaft and countershaft housings. – On connecting rod/piston pin slots. – On camshaft cams. – On starter motor fastening housing.
aprilia part# 0297386 [SILASTIC 732 RTV (100 g)] (**)	<ul style="list-style-type: none"> – On cable bracket on flywheel cover. – On camshaft sensor cable. – On the camshaft sensor cable guide. – RST On the contact surfaces of the plastic plug with the front cylinder.
aprilia part# 8116053 (grease  Bimol Grease 481)	<ul style="list-style-type: none"> – Assembly of clutch pump control rod. – On intermediate timing gear thrust washer. – Upper countershaft oil seal. – Starter motor gear.
aprilia part# xxxxxxxx N.A. (alcohol)	<ul style="list-style-type: none"> – Cleaning of lower part of engine.

2.5 FASTENING ELEMENTS

2.5.1 JOINTS WITH CLICK CLAMPS AND SCREW CLAMPS

Carefully read 1.2 (INSTRUCTIONS FOR USE OF FUEL, LUBRICANTS, COOLANT AND OTHER COMPONENTS).

⚠ CAUTION

Remove **ONLY** the clamps indicated in the maintenance procedures.

This text is not to be intended as an authorization to arbitrarily remove the clamps present on the vehicle.

⚠ WARNING

Before removing a clamp, make sure that the removal does not involve any fluid leakage; if so, provide for preventing such leakages and protect the components positioned near the joint.

CLICK CLAMPS

For the removal it is sufficient to use simple pliers, while for the installation it is necessary to use a special tool (see below).

Before removing a clamp, prepare the material necessary for the correct reassembly.

NOTE Have the appropriate special tool **OPT** to hand:
– **aprilia** part# 0277295 (click clamp installation pliers).

⚠ CAUTION

Upon installation, replace the click clamp that has been removed with a new one having the same dimensions, see 0.4.2 (SPARE PARTS CATALOGUES).

Do not attempt to reinstall the removed click clamp, since it is unusable.

Do not replace the removed click clamp with a screw clamp or with other types of clamp.

⚠ CAUTION

Proceed with care, in order not to damage the joint components.

♦ Work with the pliers on the head of the click clamp, forcing until you release it.

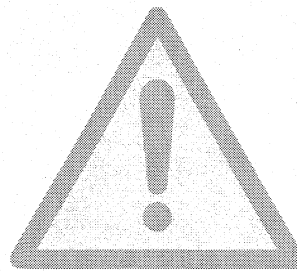
SCREW CLAMPS

For the removal and installation it is sufficient to use a simple screwdriver.

⚠ CAUTION

Check the conditions of the screw clamp and if necessary replace it with a new one of the same type and dimensions, see 0.4.2 (SPARE PARTS CATALOGUES).

When fastening the clamp, make sure that the joint is sufficiently stable.



2.5.2 GENERAL SPECIFICATIONS OF THE DRIVING TORQUES

The following table indicates the standard driving torques for screws and bolts with metric ISO thread.

Screw or bolt thread	Spanner	Driving torque	
		Nm	kgm
M6	10	6	0.6
M8	12	15	1.5
M10	14	30	3.0
M12	17	55	5.5
M14	19	85	8.5
M16	22	130	13.0

For specific joints or couplings of the vehicle, see 2.5.3 (DRIVING TORQUE).

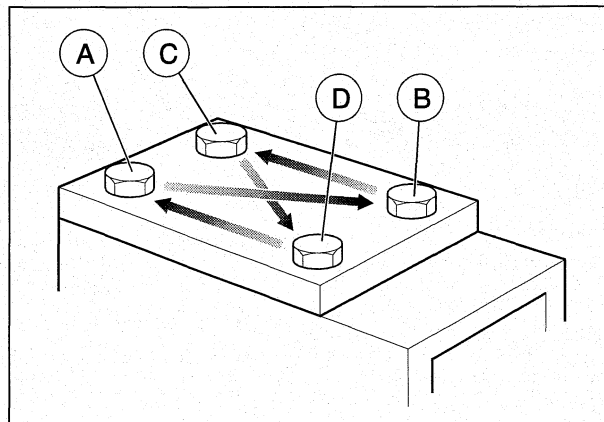
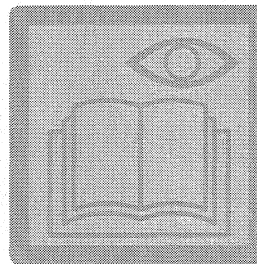
If not specified otherwise, the indicated driving torques are valid for clean and dry threads, at room temperature.

NOTE In order to avoid any deformation and/or imperfect coupling, tighten the screws or bolts by proceeding as described below:

- ◆ Manually screw all the fastening elements.
- ◆ Applying half the prescribed driving torque, tighten the elements that are diametrically opposite each other: (A) and (B); (C) and (D).
- ◆ Repeat the previous operation by applying the prescribed driving torque.

NOTE In this way the pressure exerted by the fastening elements will be uniformly distributed on the joint surface.

For the maintenance intervals, see 0.4.1 (VEHICLE WORKSHOP MANUALS).



2.5.3 DRIVING TORQUE

NOTE

L243 = fasten with LOCTITE® 243
 L572 = fasten with LOCTITE® 572
 L8150 = fasten with LOCTITE® 8150
 man. = fasten by hand

Steel/aluminium fastening screws with similar coefficient of elasticity

Screw or bolt thread	Driving torque	
	Nm	kgm
M4	3	0.3
M5	6	0.6
M6	10	1.0
M8	25	2.5
M10	50	5.0
M12	86	8.6

⚠ CAUTION

The fastening elements featured in the table must be torqued to specification using a torque spanner and LOCTITE® applied, where indicated.
 The elements marked (●) are particularly important for safety.

ENGINE					
Elements fastened to the engine					
Description	Q.ty	Screw/nut	Nm	kgm	Note
Engine oil inlet flange	2	M6	12	1.2	—
Engine oil drain plug	1	M8	12	1.2	—
● Pinion fastening	1	M10	50	5.0	L243
Clutch control cylinder fastening	3	M6	12	1.2	—
Coolant drain screw	1	M6	10	1.0	—
Coolant thermistors	2	M14	30	3.0	—

Engine casing					
Description	Q.ty	Screw/nut	Nm	kgm	Note
Grooved ball bearings for selector roller/casing [flywheel side (MS)]	1	Screw T.P. M6 x 13	11	1.1	L243
Grooved ball bearings for selector roller/casing [clutch side (KS)]	1	Screw T.P. M6 x 13	11	1.1	L243
Grooved ball bearings for propeller shaft/casing [clutch side (KS)]	2	Screw T.P. M6 x 13	11	1.1	L243
Coolant pump idler gear/casing [clutch side (KS)]	1	Pin 10	—	—	L648
Gasket crankcase [flywheel side (MS)]/crankcase [clutch side (KS)]	1	—	—	—	On both sides in the oil labyrinth seal area.
Casing [flywheel side (MS)]/casing [clutch side (KS)]	13	Screw T.C.E.I. M6 x 65	11	1.1	—
Casing [flywheel side (MS)]/casing [clutch side (KS)]	1	Screw T.C.E.I. M6 x 80	11	1.1	—
Casing [flywheel side (MS)]/casing [clutch side (KS)]	5	Screw T.C.E.I. M6 x 45	11	1.1	—
Casing [flywheel side (MS)]/casing [clutch side (KS)]	1	Screw T.C.E.I. M6 x 25	11	1.1	—
Casing	1	Magnetic screw M12 x 1.5	20	2.0	—
Casing	1	Contact screw M10	4	0.4	L574
Oil filter cover	2	Screw T.C.E.I. M6 x 20	11	1.1	—
Casing/nozzle 75	1	Screw T.C.E.I. M6 x 10	6	0.6	—
Bearing flange [clutch side (KS)]/[flywheel side (MS)]	2	Screw T.E. M8 x 45	25	2.5	—
Bearing flange [clutch side (KS)]	2	Screw T.E. M8 x 25	25	2.5	—

Follow ►

Follow ►

Engine casing					
Bearing flange [flywheel side (MS)]	1	Screw T.C.E.I. M8 x 20	25	2.5	–
Bearing flange [flywheel side (MS)]	1	Screw T.C.E.I. M6 x 20	11	1.1	L243

Oil pump					
Description	Q.ty	Screw/nut	Nm	kgm	Note
Oil pump	1	Without head screw with double diameter M12 x 1.5	–	–	L648 on both sides in the oil labyrinth seal area.
Oil pump casing	1	–	–	–	Upper and lower surfaces: L574
Oil pump lid	4	Screw T.C.E.I. M6 x 45	11	1.1	–

Clutch					
Description	Q.ty	Screw/nut	Nm	kgm	Note
Secondary shaft [clutch side (KS)]	1	Nut M24 x 1.5	170	17.0	L648
Clutch spring	6	Screw T.E. M6 x 25	11	1.1	–
Disengagement rod	1	Locking nut M12	30	3.0	–
Complete diaphragm ring	8	Screw T.C.E.I. M5 x 20	5	0.5	–
Primary transmission (spring-holding plate/primary transmission gear/clutch housing)	3	Screw T.E. M8 x 16	30	3.0	L648
Primary transmission (spring-holding plate/primary transmission gear/clutch housing)	3	Screw M8x25/ M8 nut	30	3.0	L648

Head, cylinders					
Description	Q.ty	Screw/nut	Nm	kgm	Note
Camshaft support/front head	8	Screw T.C.E.I. M6 x 30	11	1.1	–
Front head	2	Exhaust pipe M18 x 1.5	13	1.3	L275
ETV Front head	1	Breather nipple	20	2.0	L243
Rear head	1	Exhaust pipe M18 x 1.5	13	1.3	L275
Camshaft support/rear head	4	Screw T.C.E.I. M6 x 30	11	1.1	–
Camshaft support/rear head	2	Screw T.C.E.I. M6 x 45	11	1.1	–
Camshaft support/rear head	2	Screw T.C.E.I. M6 x 55	11	1.1	–
Rear head	1	Plug screw M18 x 1.5	20	2.0	L243
Head/exhaust	6	Stud bolt M8 x 16/20	10	1.0	L648
Rear head	1	Angular union	–	–	L574
RSV RSV R SL Head/case	8	Stud bolt M10 x 171	6	0.6	L243
RST ETV Head/case	8	Stud bolt M10 x 171	6	0.6	L648
Cylinder/head	8	Hex-head screws with shoulder M8 x 45	Not varnished cylinder version 28 – 30 Nm (2.8 – 3.0 kgm) Varnished cylinder version 25 – 28 Nm (2.5 – 2.8 kgm)		–

Follow ►

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Head, cylinders					
Head/stud bolt	8	Nut M10	varnished head version 58 Nm (5.8 kgm)		Grease the nut support surface
			varnished head version 50 – 55 Nm (5.0 – 5.5 kgm)		
			varnished head version (with nut on outer side) 58 Nm (5.8 Kgm)		
Head/chain compartment	4	Screw T.C.E.I. M6 x 100	11	1.1	–
Rear head/bearing flange	2	Screw T.E. M6 x 35	11	1.1	–
Rear head/bearing flange	2	Screw T.E. M6 x 20	11	1.1	–
Front head/Driven gear (timing chain) - Inlet camshaft	3	Screw T.C.E.I. M6 x 14	11	1.1	L243
Front head/Upper chain guide	1	Screw spacer M6 x 16	11	1.1	–
Rear head/Driven gear (timing chain) - Inlet camshaft	3	Screw T.C.E.I. M6 x 11.5	11	1.1	L243
Rear head/Driving gear (upper balance shaft unit) + driven gear (timing chain) - Exhaust camshaft	3	Screw T.C.E.I. M6 x 14	11	1.1	L243
Rear head/Counterweight + driven gear (upper balance shaft unit) - Upper balance shaft	1	Nut M14 x 1	50	5.0	L243
Rear head/Upper chain guide	2	Screw T.E. M6 x 35	11	1.1	–
Valve cover	10	Spacer screw M6 x 23	9	0.9	–
Head	4	Spark plug	18	1.8	–
Induction flange	4	Screw T.C.E.I. M8 x 25	19	1.9	–
Cylinder/chain tightener	2	Plug screw M16 x 1.5	30	3.0	–
Front head	1	Coolant thermistor	20	2.0	–
Rear head	1	Coolant thermistor	20	2.0	–
Cylinder bracket support shoe	2	Screw T.C.E.I. M10 x 40	40	4.0	–
Cylinder bracket support shoe	2	Nut M10	40	4.0	L243

Follow ►

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Ignition system, starter motor					
Description	Q.ty	Screw/nut	Nm	kgm	Note
RSV RSV R Driving shaft position sensor/flywheel cover	2	Taptite screw M6 x 16	11	1.1	–
RST ETV Revolution number sensor/flywheel cover	1	Taptite screw M6 x 12	10	1.0	L243
Flywheel cover/generator	3	Screw T.C.E.I. M6 x 40	11	1.1	L243
Flywheel magneto/freewheel housing/flywheel ring	–	–	–	–	L648
RST ETV Magneto flywheel/freewheel housing/flywheel ring	6	Screw T.C.E.I. M8 x 18	30	3.0	L648
Freewheel housing	3	Screw T.C.E.I. M8 x 16	30	3.0	L648
RSV RSV R Freewheel housing	3	Screw T.C.E.I. M8 x 16	30	3.0	L648
Flywheel magneto cone	–	–	–	–	L648
Magneto flywheel/driving shaft	1	Screw T.C.E.I. M16 x 30	130	13.0	L648
Ignition device cover/casing [clutch side (KS)]	12	Screw T.C.E.I. M6 x 35	11	1.1	–
Ignition device cover	1	Plug screw M24 x 1.5	Manual tight- ening		–
RST ETV Ignition device cover/cable-holding bracket	1	Screw T.C.E.I. M6 x 10	7	0.7	L243
Camshaft position sensor/front head	2	Taptite screw M5 x 12	4	0.4	L243
RSV RSV R Camshaft position sensor/front head	2	Taptite screw M5 x 12	4	0.4	L243
Starter	2	Screw T.C.E.I. M6 x 30	11	1.1	–

Clutch cover, coolant pump					
Description	Q.ty	Screw/nut	Nm	kgm	Note
Coolant pump	1	Impeller	Manual tight- ening, min 7 Nm (0.7 kgm)		–
Clutch cover	1	Oil pressure switch M10 x 1	15	1.5	L243
Coolant pump casing	1	Screw T.C.E.I. M6 x 25	11	1.1	
Coolant pump casing	3	Screw T.C.E.I. M6 x 55	11	1.1	L243 only for left cen- tral screw
Clutch cover	11	Screw T.C.E.I. M6 x 35	11	1.1	–
Clutch cover	3	Screw T.C.E.I. M8 x 40	19	1.9	–
Clutch cover	1	Screw T.C.E.I. M8 x 65	19	1.9	–

NOTE

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DISASSEMBLING THE ENGINE

3

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3.1 TECHNICAL INFORMATION

3.1.1 TECHNICAL DATA

See 2.1 (TECHNICAL SPECIFICATIONS).

3.1.2 MAINTENANCE INTERVALS

See 0.4.1 (VEHICLE WORKSHOP MANUALS).

3.1.3 TROUBLESHOOTING

See 0.4.1 (VEHICLE WORKSHOP MANUALS).

3.1.4 SEALANTS

See 2.4 (CONSUMABLES).

3.1.5 LUBRICANTS

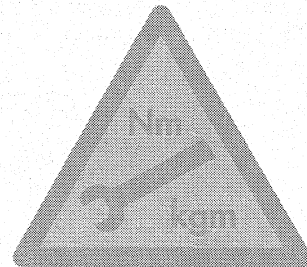
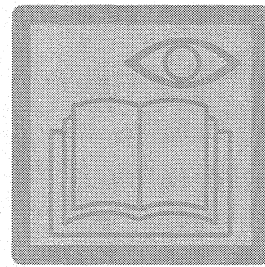
See 2.2 (LUBRICANT CHART).

3.1.6 SPECIAL TOOLS

See 2.3 (SPECIAL TOOLS **OPT**).

3.1.7 DRIVING TORQUE

See 2.5 (FASTENING ELEMENTS).



3.1.8 PRECONDITIONS TO BE MET WHEN PERFORMING MAINTENANCE AND REPAIR WORK

⚠ WARNING

During the assembly phase, bear in mind the engines weight (approx. 65 – 67 kg) and centre of gravity: support accordingly.

Take care around any potentially hazardous points where you might be squashed or cut.

⚠ CAUTION

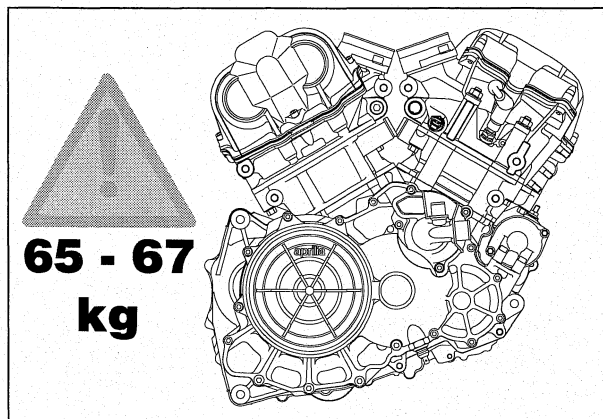
The maintenance of engines and systems calls for specific experience and the use of special tools.

Any maintenance and repair work must be performed by suitably trained technical personnel only.

NOTE Comply with the instructions furnished by the manufacturer of the vehicle.

3.1.9 GENERAL INDICATIONS ON MAINTENANCE AND REPAIR WORK

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).



3.1.10 SPECIAL MARKS ON THE ENGINE

For disassembly, reassembly and replacement purposes, some parts of the engine are marked with coloured points, letters or reference marks.

The table indicates the part (seat and element), the type of mark, the mark function and the reference to the manual chapter or paragraph.

Component		Mark (type)	Mark function	Reference to the text
Housing	Element			
Engine crankcase (inside both crankcase halves).	Main bushes (installed on the engine crankcase).	Colour: Red (minimum diameter group). Blue (medium diameter group). Yellow (maximum diameter group).	Reference to the diameters of the bush seats (drive shaft and balance shaft) on the crankcase halves, for the choice of the size group.	4.4 (DRIVE SHAFT MAIN BUSHES AND BALANCE SHAFT MAIN BUSHES) under INSTALLING THE BUSHES.
Connecting rod (with no mark).	Connecting rod bushes.	Colour: Red (minimum thickness). Blue (medium thickness). Yellow (maximum thickness).	Reference to the thickness of the connecting rod bush.	4.12 (REPLACING AND INSTALLING THE CONNECTING RODS).
Clutch cover (with no mark).	Support bushes (installed on the clutch cover).	Colour: Red (minimum diameter group). Blue (medium diameter group). Yellow (maximum diameter group).	Reference to the diameters of the bush seats (drive shaft and balance shaft) on the clutch cover, for the choice of the size group.	4.21 (SUPPORT BUSHES).
Valve seats (on the head) (with no mark).	Valve springs.	Not provided. To be made on the upper part of the springs upon disassembly.	Reference to the upper part of the springs, indispensable for the correct reassembly.	4.25 (DISASSEMBLING THE INTAKE AND EXHAUST VALVES). 4.30 (VALVES) under ASSEMBLING THE VALVES IN THE HEAD.
Front head (with no mark).	Front cylinder.	Letter "A" or "B" stamped on the lower side of the front cylinder.	Reference to the "size group" of the front cylinder.	4.31 (CYLINDERS) 4.32 (PISTONS AND GUDGEON PINS). 5.11 (ASSEMBLING THE PISTON AND REAR CYLINDER).
Rear head (with no mark).	Rear cylinder.	Letter "A" or "B" stamped on the lower side of the rear cylinder.	Reference to the "size group" of the rear cylinder.	5.17 (ASSEMBLING THE PISTON AND FRONT CYLINDER).
Front cylinder.	Original front piston installed.	Not provided. The piston and the front cylinder must be marked with number "1" upon disassembly.	Reference to the cylinder-piston assembly and to the position of the piston in the front cylinder.	3.4 (DISASSEMBLING FRONT CYLINDER, HEAD AND PISTON).
Rear cylinder.	Original rear piston installed.	Not provided. The piston and the rear cylinder must be marked with number "2" upon disassembly.	Reference to the cylinder-piston assembly and to the position of the piston in the rear cylinder.	3.5 (DISASSEMBLING REAR CYLINDER, HEAD AND PISTON).
Front cylinder marked with letter "A" or "B".	New replacement front piston.	Colour: Red (group "A"). Green (group "B").	Reference to the front cylinder "size group" ("A" or "B") and to the direction of assembly.	4.32 (PISTONS AND GUDGEON PINS).
Rear cylinder marked with letter "A" or "B".	New replacement rear piston.	Colour: Red (group "A"). Green (group "B").	Reference to the rear cylinder "size group" ("A" or "B") and to the direction of assembly.	4.32 (PISTONS AND GUDGEON PINS).

3.2 DISASSEMBLING THE ENGINE

CAUTION

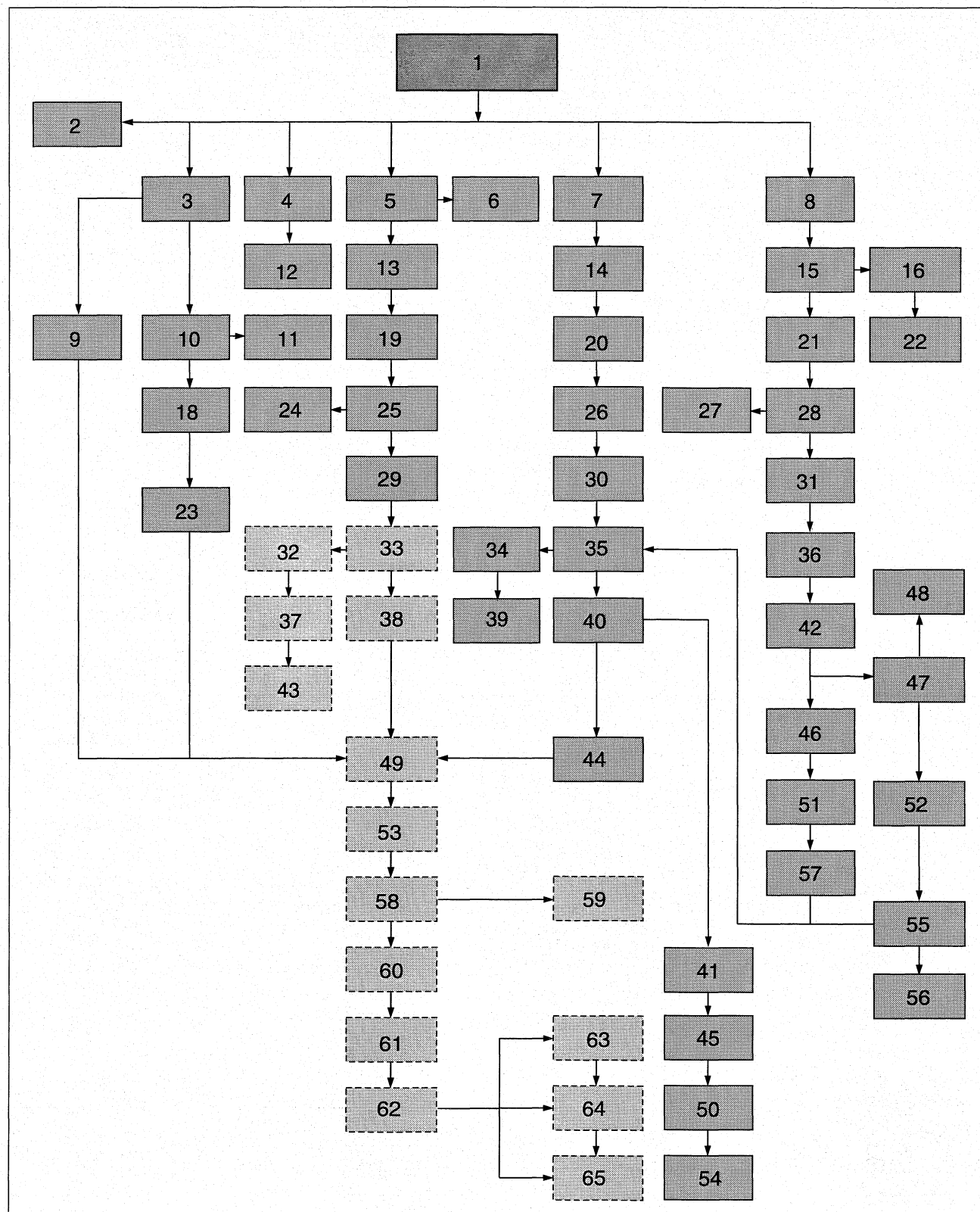
Any components removed must be set aside in groups according to the respective assembly position in order to make sure they are subsequently re-fitted in the right place.

NOTE Before going ahead with the disassembly of the engine, gather the appropriate special tools, see 2.3.1 (ENGINE TOOLS).

3.2.1 ENGINE DISASSEMBLY SEQUENCE

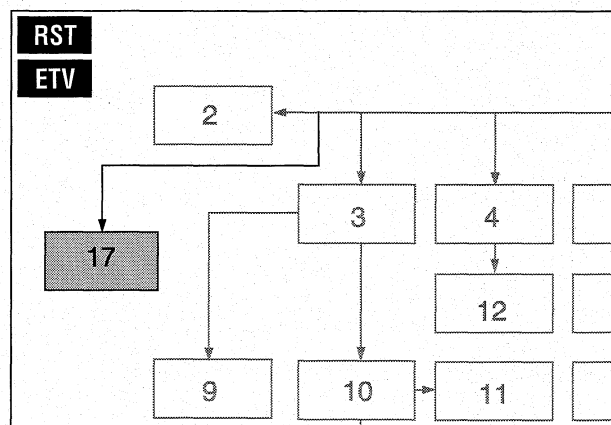
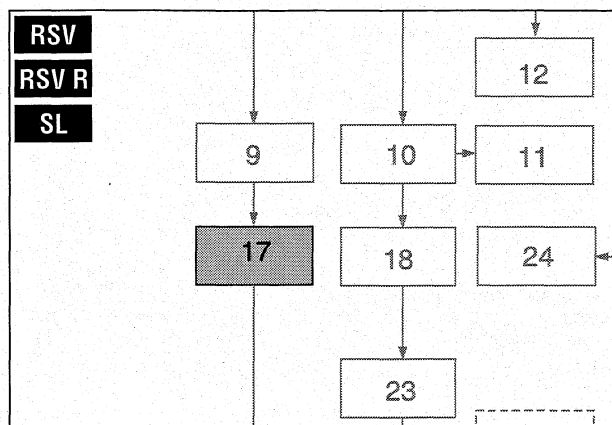
NOTE This diagram shows the operations to be performed and the sequence to be followed when disassembling the engine parts.

In order to remove the parts outlined with short dashes, (---) the engine must be removed from the frame, see 0.4.1 (VEHICLE WORKSHOP MANUALS).



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**Key**

- 1) Engine
- 2) Starter
- 3) Flywheel cover
- 4) Oil filter cover
- 5) Front cylinder tappet cover
- 6) Camshaft position sensor
- 7) Rear cylinder tappet cover
- 8) Complete clutch diaphragm cover
- 9) Stator
- 10) Magnetic wheel
- 11) Clutch
- 12) Oil filter cartridge
- 13) Front cylinder TDC position
- 14) Rear cylinder TDC position
- 15) Clutch membrane
- 16) Complete support plate and disengagement rod
- 17) **RSV RSV R SL** Driving shaft position sensor
- 17) **RST ETV** Driving shaft position sensor
- 18) Starter motor transmission
- 19) Front cylinder timing chain tensioner
- 20) Upper balance shaft transmission
- 21) Coolant pump lid
- 22) Clutch discs
- 23) Front cylinder timing control transmission
- 24) Front cylinder camshafts
- 25) Front cylinder timing drive gears
- 26) Rear cylinder timing chain tensioner
- 27) Coolant pump
- 28) Clutch cover
- 29) Front cylinder timing chain
- 30) Rear cylinder timing drive gears
- 31) Complete support plate and disengagement rod
- 32) Front cylinder head
- 33) Front cylinder head with cylinder
- 34) Rear cylinder top side countershaft
- 35) Rear cylinder timing chain
- 36) Clutch discs
- 37) Front cylinder camshafts
- 38) Front cylinder piston
- 39) Rear cylinder camshafts
- 40) Rear cylinder head with cylinder
- 41) Rear cylinder head
- 42) Primary transmission
- 43) Front cylinder valves
- 44) Rear cylinder piston
- 45) Rear cylinder top side countershaft
- 46) Countershaft gear
- 47) Oil pump gear
- 48) Oil pump
- 49) Engine crankcase half removal
- 50) Rear cylinder camshafts
- 51) oil pump gear
- 52) Complete gearshift shaft
- 53) Countershaft
- 54) Rear cylinder camshafts
- 55) Index plate
- 56) Index lever
- 57) Rear cylinder timing control transmission
- 58) Driving shaft
- 59) Connecting rod
- 60) Gearshift rods
- 61) Gearshift fork
- 62) Gearshift, shift cam
- 63) Drive gears
- 64) Gearshift bearings
- 65) Driving shaft, countershaft bearings

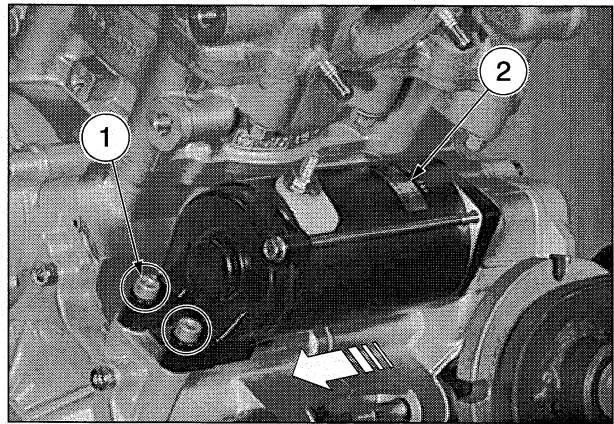
3.3 REMOVING THE STARTER MOTOR

NOTE The following operations can be performed without removing the engine from the frame.

- ◆ Move the protection element aside, unscrew and remove the nut, recover the washer and disconnect the cable of the starter motor.
- ◆ Unscrew and remove the two M6 T.C.E.I. screws (1).

Screws (1) driving torque: 11 Nm (1.1 kgm).

- ◆ Pull out the starter motor (2).



3.4 DISASSEMBLING FRONT CYLINDER, HEAD AND PISTON

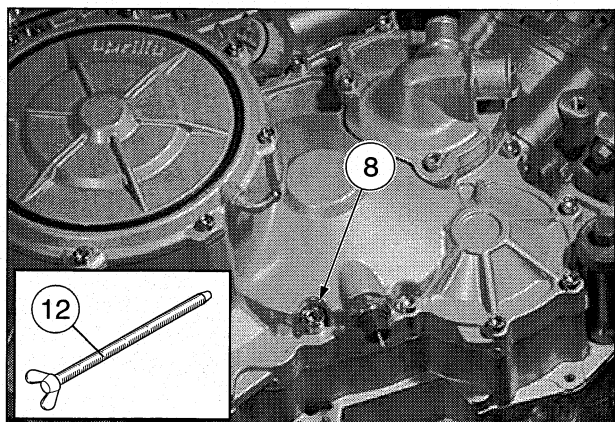
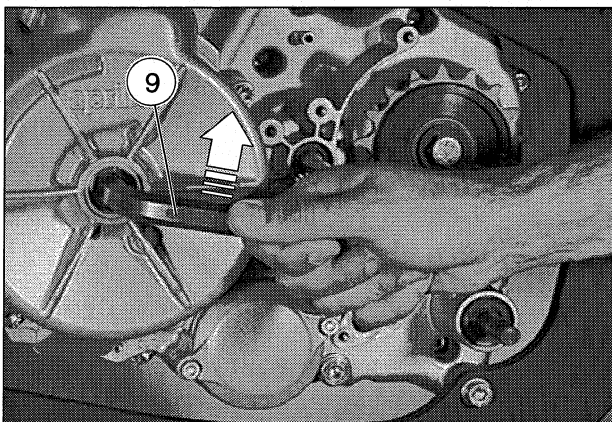
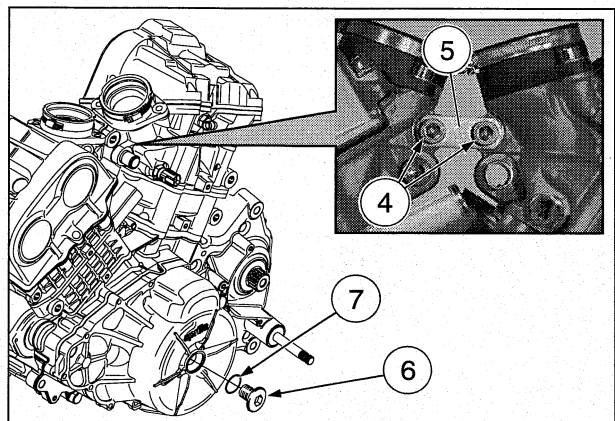
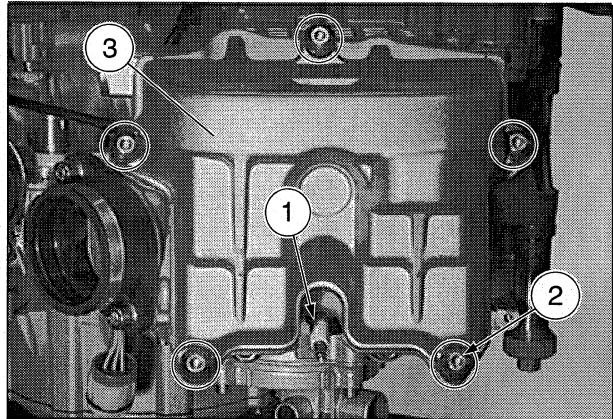
Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

⚠ CAUTION

The head must be disassembled together with the cylinder. This is the only way in which the head can be detached from the actual cylinder.

- ◆ Remove the two spark plugs of the front cylinder (1) from the head, see 0.4.1 (VEHICLE WORKSHOP MANUALS).
- ◆ Unscrew and remove the five complete spacer screws M6 (2) and remove the head cover (3) together with the gasket.
- ◆ Unscrew and remove the two M10 T.C.E.I. screws (4) and remove the support bracket (5).
- ◆ Remove the closing screw (6), made from plastic, complete with O-ring (7) housed in the centre of the fly-wheel cover.
- ◆ Remove the M8 T.C.E.I. screw (8) complete with seal.
- ◆ Use a size 14 mm (9) bent hexagon-head driver to turn the driving shaft anticlockwise until the front piston is at TDC (ignition).

Follow ►



Follow ►

NOTE At the TDC (ignition), the reference marks "IN" (10) and "EX" (11) of the two gears prove parallel to the head uncoupling surface, and face each other.

NOTE Have the appropriate special tool **OPT** to hand:
– **aprilia** part# 0240880 (threaded bolt to lock the drive shaft at the TDC) (12).

- ◆ Screw the special tool (12) into the slot previously occupied by the M8 T.C.E.I. screw (8) by hand so that you can feel it fit perfectly inside the driving shaft fastening slot.

NOTE Turn the driving shaft both ways to make sure that the threaded bolt is engaged perfectly. The bolt should not be overtightened.

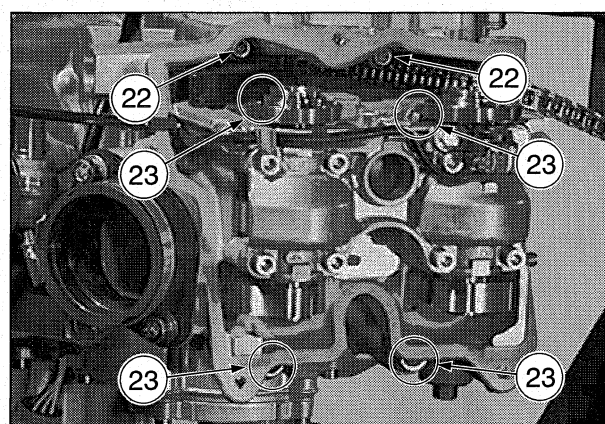
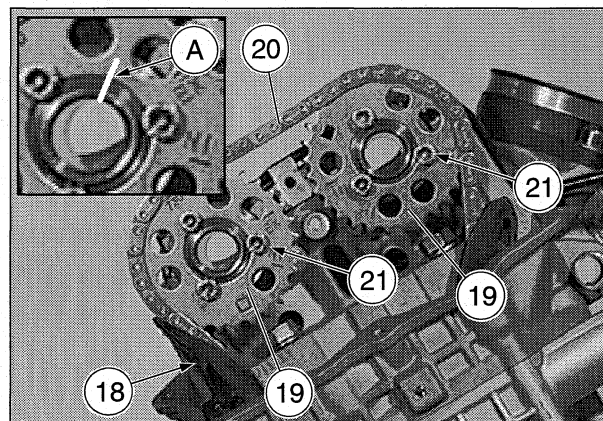
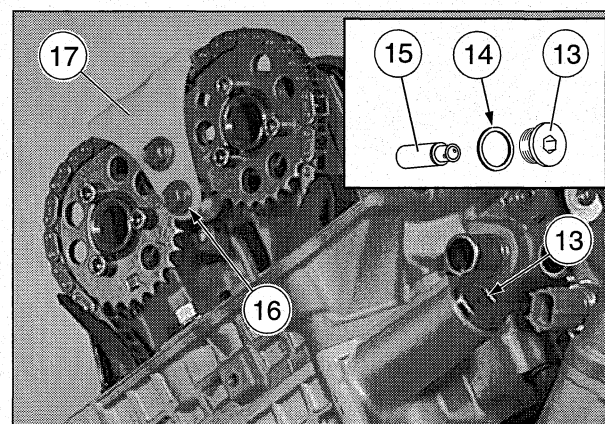
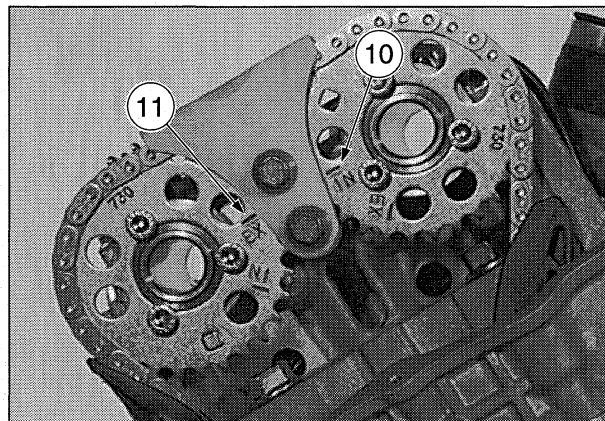
Threaded pin driving torque: max. 5 Nm (0.5 kgm).

- ◆ Unscrew and remove the closing screw (13) complete with seal (14) and remove the complete chain tightener (15).
- ◆ Unscrew and remove the two M6 spacer screws (16) and remove the chain guide bracket (17).
- ◆ Pull the chain guide shoe (18) out from above.

NOTE In order to be able to reassemble the two gear wheels (19) correctly, proceed as follows: before removing them, use a felt tip pen to mark the left and right gear wheels with LH and RH, respectively, and the gear wheels and the camshafts with a reference mark (A).

- ◆ Release the two gear wheels (19) from the timing chain (20), then withdraw and remove them.
- ◆ Unscrew and remove the six T.C.E.I. M6 x11.5 screws (21).
- ◆ Let the timing chain (20) drop into the cylinders chain compartment.
- ◆ Unscrew and remove the two M6 T.C.E.I. screws (22).
- ◆ Unscrew and remove the four M10 nuts (23).

Follow ►



Follow ►

⚠ WARNING

Be careful to avoid possible injury caused by allowing hands to get trapped between the cylinder and the stud bolts (24).

- ◆ Remove the cylinder (25) together with the complete head (26).

⚠ CAUTION

When removing the cylinder, take care not to damage the cylinder.

Be careful to keep the two locating dowels (27) from dropping inside the crankcase.

NOTE See 4.24 (HEAD AND CAMSHAFT) for instructions on taking the complete head apart.

- ◆ Cover the opening in the base with a clean cloth.
- ◆ Remove the cylinder base gasket from its slot and pull out the two locating dowels (27).

⚠ CAUTION

Do not apply any mechanical markings.

- ◆ Use a felt pen to mark the piston crown and the cylinder on the exhaust side (28), in order to be able to reassemble it in the correct direction.
- In the same way, mark both the piston and the cylinder with a "1" so that the two components can be reconnected in the same point.

⚠ CAUTION

In order to prevent unbalanced forces, the axis of the pistons' gudgeon pin is positioned off-centre, towards the front of the vehicle.

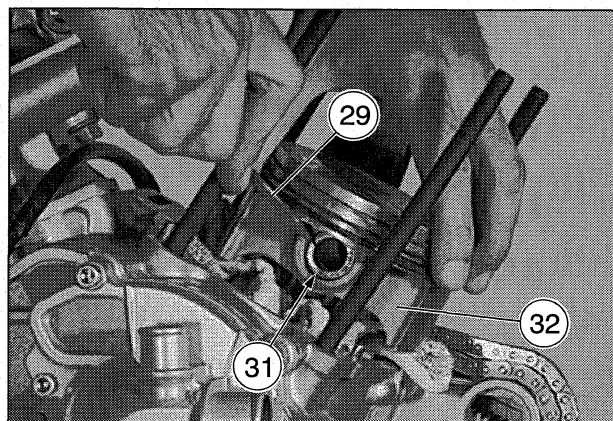
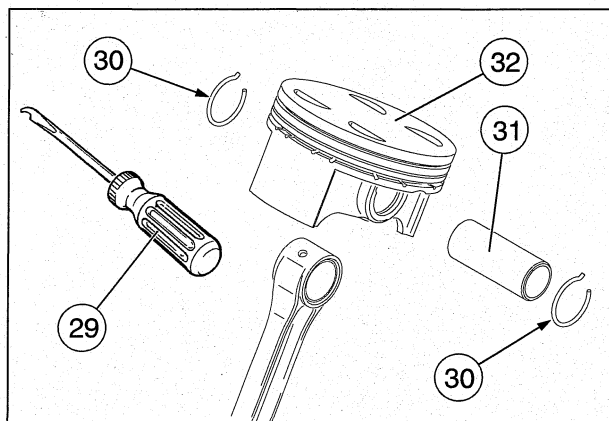
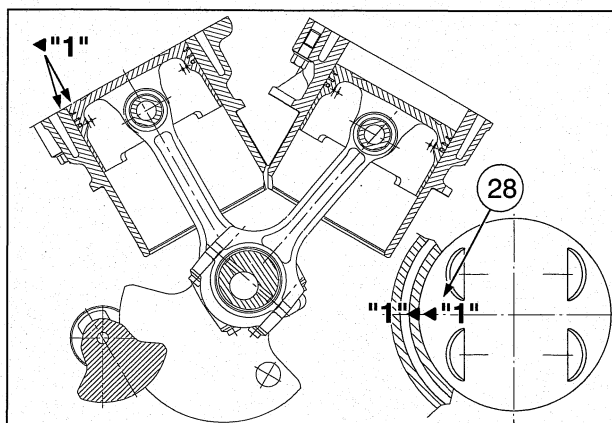
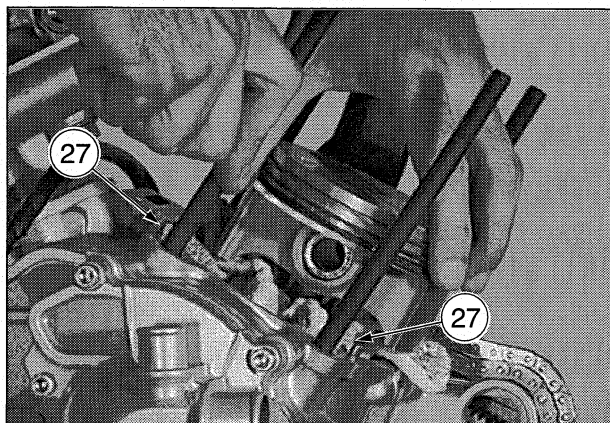
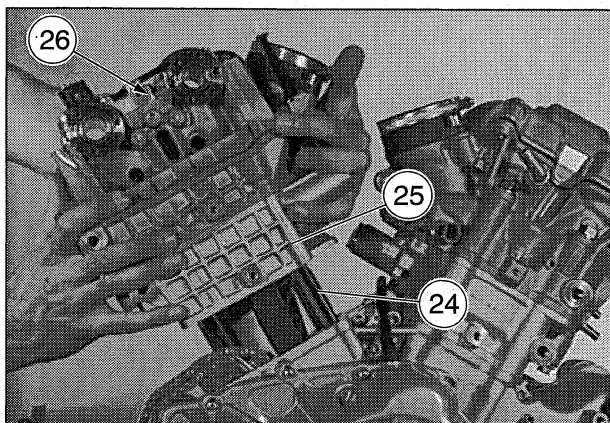
When reassembling, the piston must be positioned on the connecting rod facing the right way.

- ◆ Using a sharp-point screwdriver (29), extract the right and left stop rings (30) (pin locking).
- ◆ Use a special drift to push out the gudgeon pin (31).

⚠ CAUTION

Hold the piston in one hand so that the connecting rod bush is not tilted and hence damaged.

- ◆ Remove the piston (32).



3.5 DISASSEMBLING REAR CYLINDER, HEAD AND PISTON

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE The following operations can be performed without removing the engine from the frame.

⚠ WARNING

The head must be disassembled together with the cylinder. This is the only way in which the head can be detached from the actual cylinder.

NOTE If the disassembly is carried out after the removal of the front cylinder, the operations marked with “*” have already been carried out. Otherwise (removal of rear cylinder only), do not carry out the operation marked with “*”.

- ◆ Remove the two spark plugs of the rear cylinder (1) from the head, see 0.4.1 (VEHICLE WORKSHOP MANUALS).
- ◆ Unscrew and remove the five complete spacer screws M6 (2) and remove the head cover (3) together with the gasket.
- ◆ Unscrew and remove the two M10 T.C.E.I. screws (4) and remove the support bracket (5).
- ◆ * Remove the closing screw (6), made from plastic, complete with O-ring (7) housed in the centre of the fly-wheel cover.
- ◆ * Remove the M8 T.C.E.I. screw (8) complete with seal.

NOTE With the driving gear (9) installed, it is NOT possible to read the reference marks “IN” (10) and “EX” (11) on the gear wheel (12), but it is necessary to refer only to the marks “IN” (10) and “EX” (11) on the gear wheel (13).

Do not remove the driving gear (9) in order to be able to read the reference marks, since the removal would prevent the rotation of the upper balance shaft.

⚠ CAUTION

* When turning the driving shaft, guide the connecting rod and timing chain of front cylinder so as to prevent them from getting stuck inside the housing.

- ◆ Use a size 14 mm bent hexagon-head driver (14) to turn the driving shaft anticlockwise so that rear piston is at TDC (ignition).

NOTE At the TDC (ignition), the reference marks “IN” (10) and “EX” (11) of the two gears prove parallel to the head uncoupling surface, and face each other.

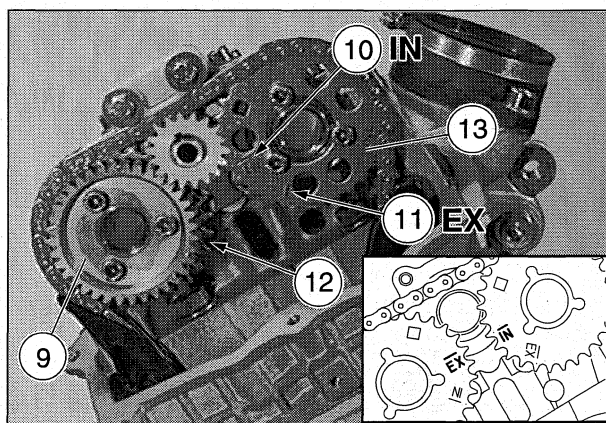
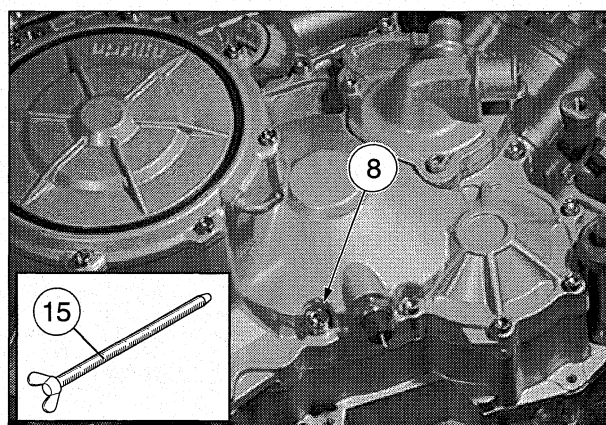
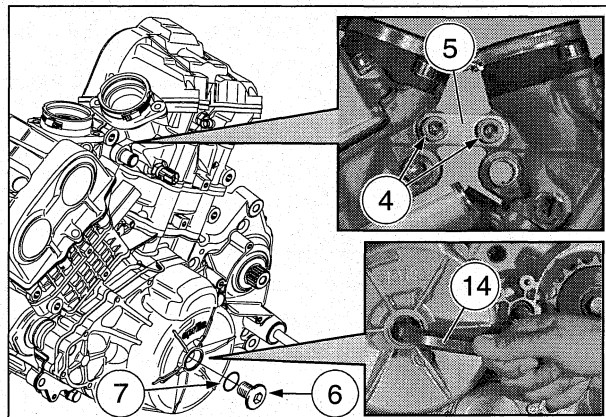
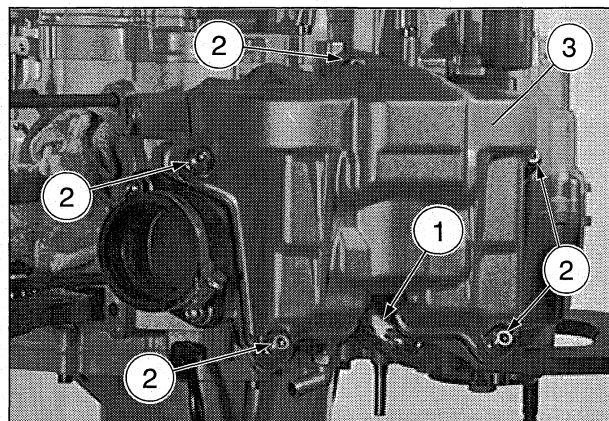
NOTE Have the appropriate special tool **OPT** to hand:
– **aprilia** part# 0240880 (threaded bolt to lock the drive shaft at the TDC) (15).

- ◆ Screw the special tool (15) into the slot previously occupied by the M8 T.C.E.I. screw (8) by hand so that you can feel it fit perfectly inside the driving shaft fastening slot.

NOTE Turn the driving shaft both ways to make sure that the threaded bolt is engaged perfectly. The bolt should not be overtightened.

Threaded pin driving torque: max. 5 Nm (0.5 kgm).

Follow ►



Follow ►

- ◆ Unscrew and remove the closing screw (16) complete with seal (17) and remove the complete chain tightener (18).
- ◆ Insert an appropriate drift (Ø 7.5 mm) (19) in the upper countershaft hole (20).

⚠ CAUTION

When loosening the nut M14x1 (21), counter the force with the drift (19) so as not to strain the driving chain.

- ◆ Unscrew and remove the M14x1 nut (21).
- ◆ Remove the counterweight (22) from the upper countershaft (23).

⚠ CAUTION

Be careful to keep the key (24) from dropping into the chain compartment. Cover the chain compartment with a clean cloth.

- ◆ Withdraw the driven gear (25) and remove it.
- ◆ Remove the key (24).
- ◆ Pull the chain guide shoe (26) out from above.

NOTE In order to be able to reassemble the two gear wheels (12) (13) correctly, proceed as follows: before removing them, use a felt tip pen to mark the left and right gear wheels with LH and RH, respectively, and the gear wheels and the camshafts with a reference mark (A).

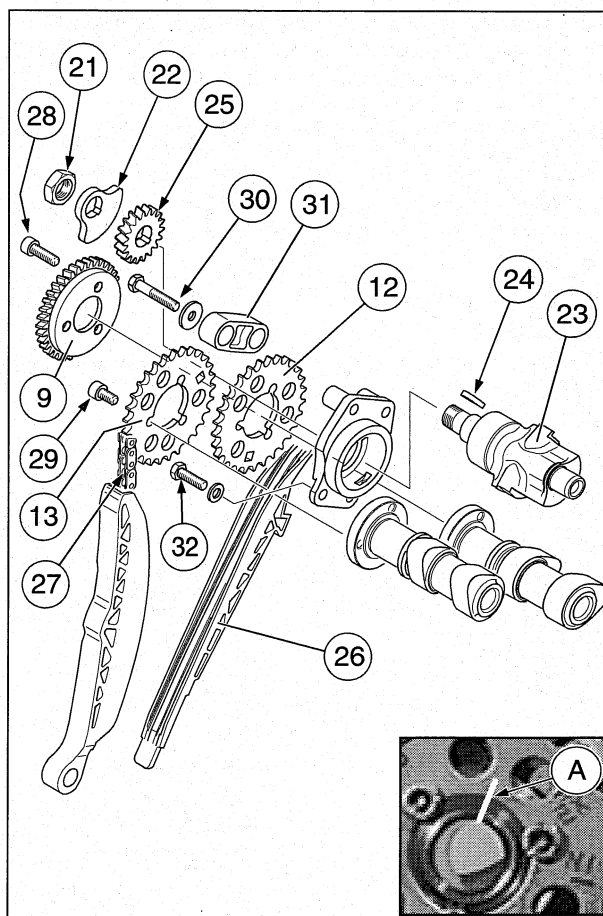
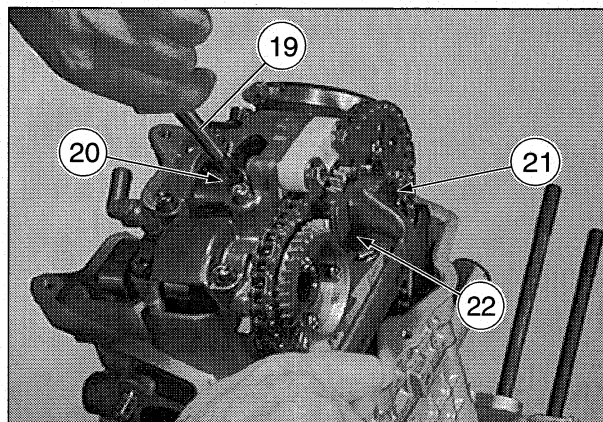
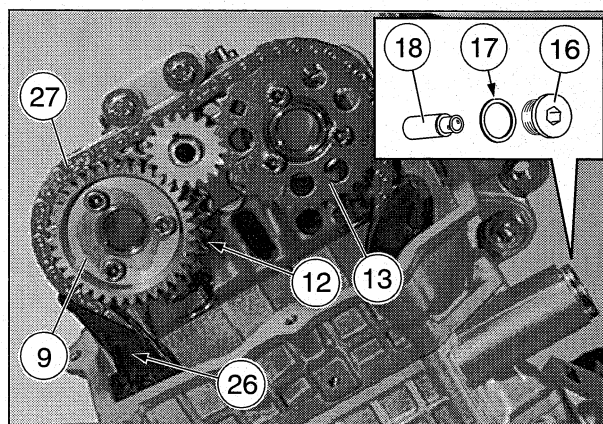
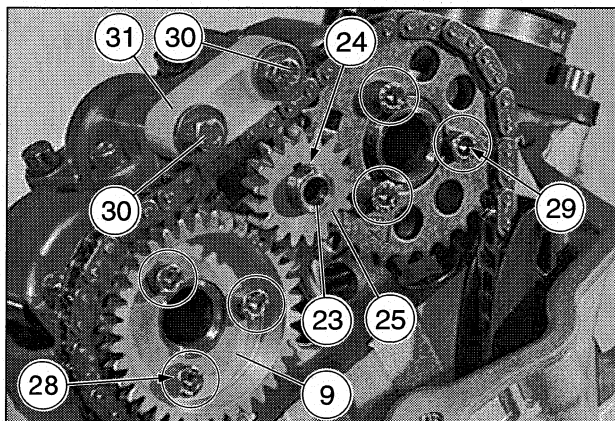
- ◆ Release the two gear wheels (12) (13) from the timing chain (27), then withdraw and remove them.

⚠ WARNING

Before removal, the three T.C.E.I. M6x14 screws (28) must be marked so that they are refitted in the right place; danger of major engine damage and physical injury.

- ◆ Unscrew and remove the three M6x14 T.C.E.I. screws (28).
- ◆ Withdraw the driving gear (9) and remove it.
- ◆ Unscrew and remove the three M6x10 T.C.E.I. screws (29).
- ◆ Unscrew and remove the two M6 T.C.E.I. screws (30) with the relevant washers and remove the chain guide (31).
- ◆ Let the timing chain (27) drop into the cylinders chain compartment.
- ◆ Unscrew and remove the two M6 T.C.E.I. screws (32).
- ◆ Rotate the upper balance shaft (23) upwards and withdraw it.

Follow ►



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- ◆ Unscrew and remove the two M6 T.C.E.I. screws (33) and four M10 nuts (34).

⚠ WARNING

Be careful to avoid possible injury caused by allowing hands to get trapped between the cylinder and the stud bolts (35).

- ◆ Remove the cylinder (36) together with the complete head (37).

⚠ CAUTION

When removing the cylinder, take care not to damage the cylinder.

Be careful to keep the two locating dowels (38) from dropping inside the crankcase.

NOTE See 4.24 (HEAD AND CAMSHAFT) for instructions on taking the complete head apart.

- ◆ Cover the opening in the base with a clean cloth.
- ◆ Remove the cylinder base gasket from its slot and pull out the two locating dowels (38).

⚠ CAUTION

Do not apply any mechanical markings.

- ◆ Use a felt pen to mark the piston crown on the exhaust side (39), in order to be able to reassemble it in the correct direction.
- In the same way, mark both the piston and the cylinder with a "2" so that the two components can be reconnected in the same point.

⚠ CAUTION

In order to prevent unbalanced forces, the axis of the pistons' gudgeon pin is positioned off-centre, towards the front of the vehicle.

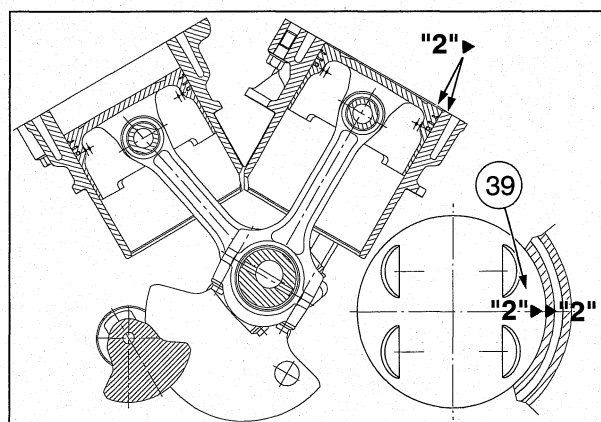
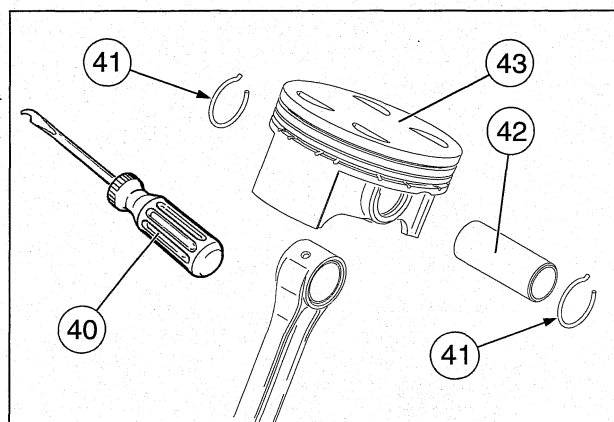
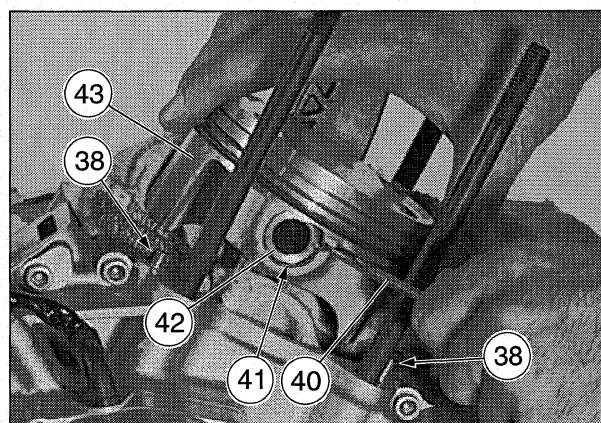
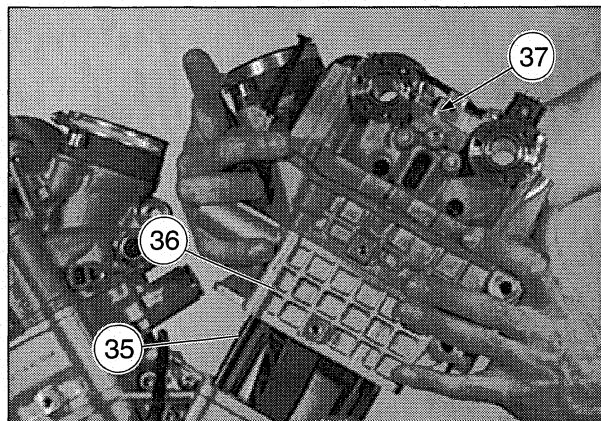
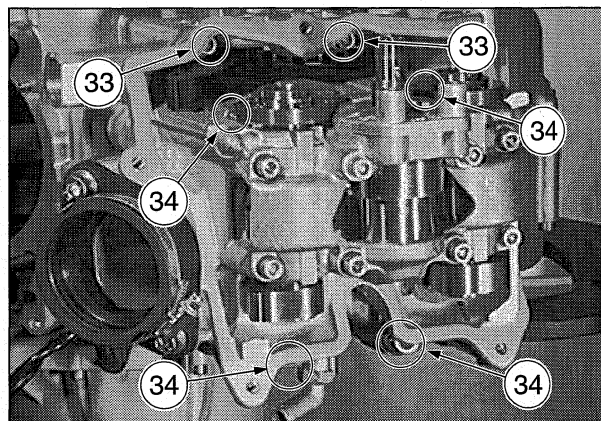
When reassembling, the piston must be positioned on the connecting rod facing the right way.

- ◆ Using a sharp-point screwdriver (40), extract the right and left stop rings (41) (pin locking).
- ◆ Use a special drift to push out the gudgeon pin (42).

⚠ CAUTION

Hold the piston in one hand so that the connecting rod bush is not tilted and hence damaged.

- ◆ Remove the piston (43).



3.6 REMOVING THE FLYWHEEL COVER AND IGNITION SYSTEM

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE The following operations can be performed without removing the engine from the frame.

⚠ WARNING

When performing work on the ignition system:

- switch off the engine;
- disconnect the battery: always disconnect the negative pole (–) first;
- drain the engine oil tank completely, see 0.4.1 (VEHICLE WORKSHOP MANUALS);
- lock the drive shaft at the TDC of the front or rear piston.

◆ Disconnect the ignition generator connector (A) from the electric wiring.

◆ unscrew and remove the twelve M6 T.C.E.I. screws (1).

NOTE Have the appropriate special tool **OPT** to hand:

- **aprilia** part# 0277252 (flywheel magneto cover removal tool) (2).

◆ Screw the special tool (2) onto the flywheel cover (3).

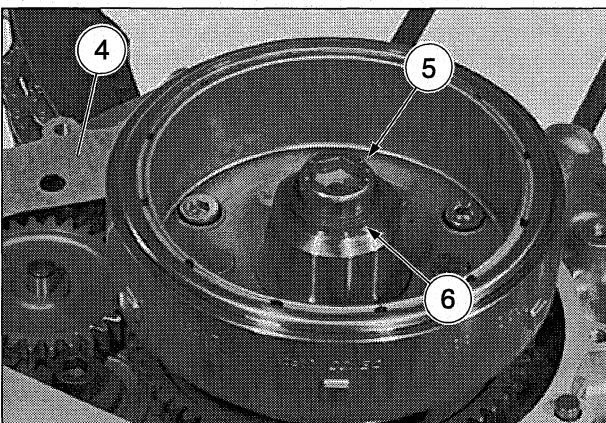
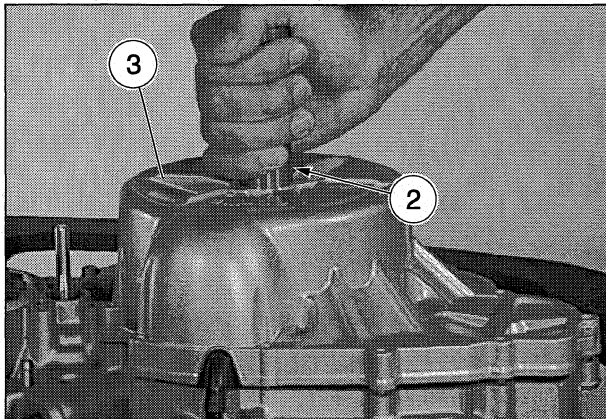
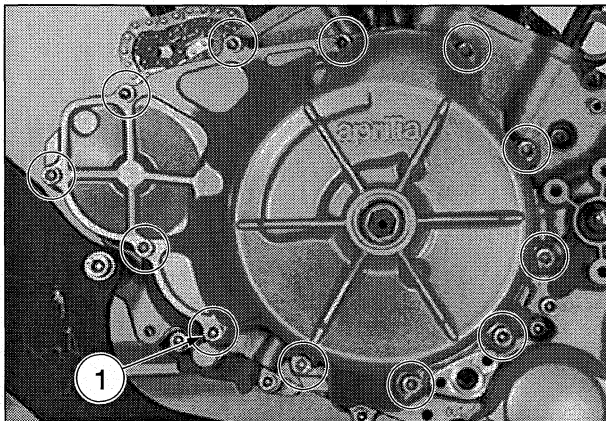
◆ Lift the flywheel cover (3).

◆ Remove the gasket (4).

NOTE The driving shaft must be retained at the TDC of front piston or rear piston.

- ◆ Unscrew and remove the M16 T.C.E.I. screw (5) and remove the washer (6).

Follow ►



Follow ►

NOTE Have the appropriate special tool **OPT** to hand:
 – **aprilia** part# 0277730 (flywheel removal hexagonal bolt) (7).

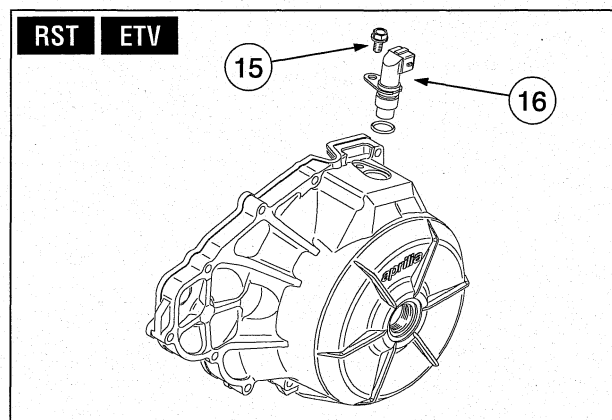
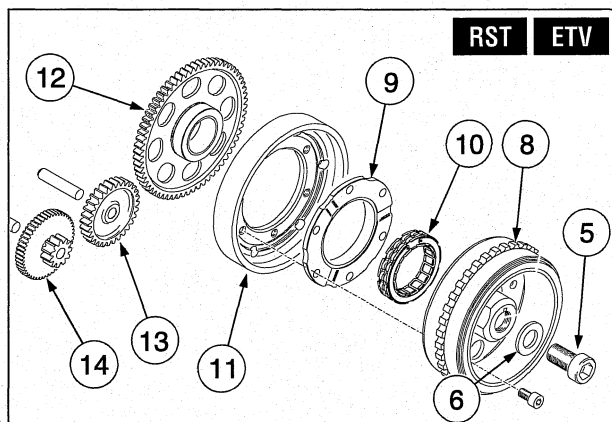
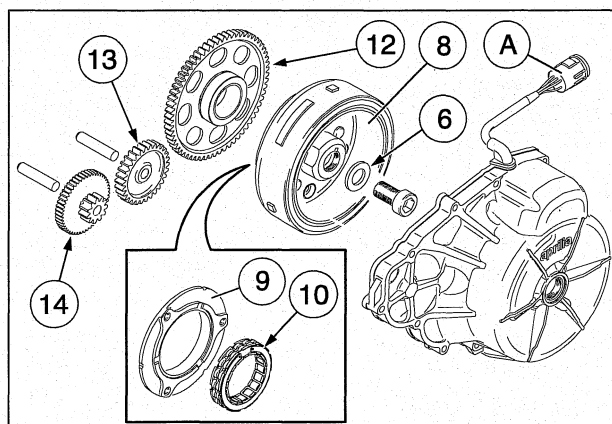
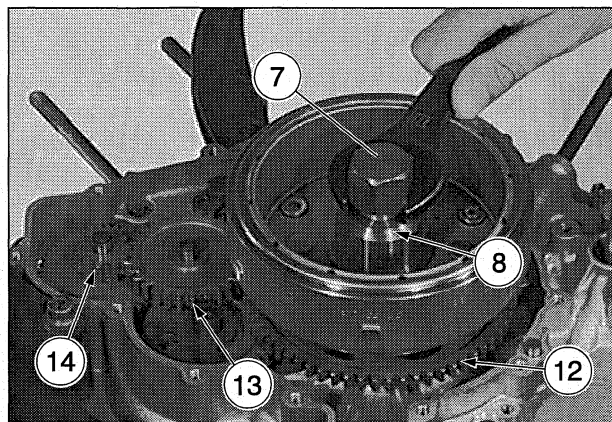
- ◆ Screw the special tool (7) into the thread of the flywheel (8).

CAUTION

Do not heat the hub of the magneto flywheel (8) over a flame; instead use a suitable jet of warm air.

NOTE Heat, for five-ten minutes, the hub of the magneto flywheel (8) with a jet of warm air since the cone is also fastened with **LOCTITE®** 648.

- ◆ Remove the flywheel with the freewheel flange (9) and the freewheel (10).
- ◆ **RST ETV** Extract the flywheel ring (11).
- ◆ Extract the gear of the freewheel (12).
- ◆ Remove the starter idler gear (13) and double gear (14).
- ◆ **RST ETV** If necessary, unscrew and remove the screw (15) and remove the drive shaft position sensor (16) together with the sealing ring.



3.7 DISASSEMBLING FRONT CYLINDER TIMING DRIVE ASSEMBLY

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATION).

NOTE The following operations can be performed without removing the engine from the frame.

- ◆ Unscrew and remove the M10 T.C.E.I. screw (1).
- ◆ Remove the external counterweight (2), the drive pinion (3), the internal counterweight (4) and the countershaft key (5).
- ◆ Unscrew and remove the two M8 T.E. screws (6) and remove both spring washers (7).
- ◆ Unscrew and remove the M6 T.C.E.I. screw (8) and remove the complete roller bearing flange (9).

NOTE The cylinder and the head are still fitted on the engine. In order to remove the timing chain (14), the chain tightener and camshaft gears must be removed, see 3.4 (DISASSEMBLING FRONT CYLINDER, HEAD AND PISTON).

NOTE During disassembly of the roller bearing flange (9), there is no need to remove the components (10) (11) (12) from the actual flange.

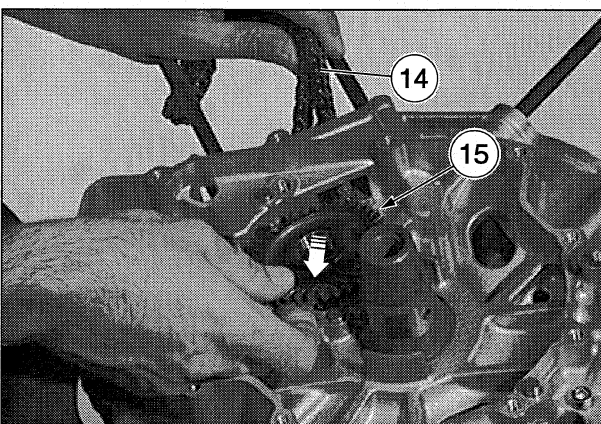
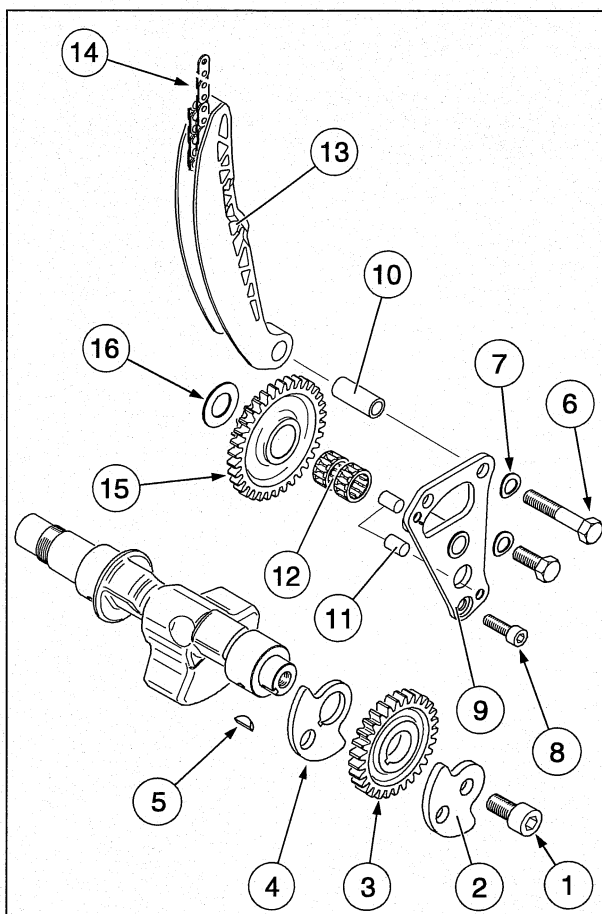
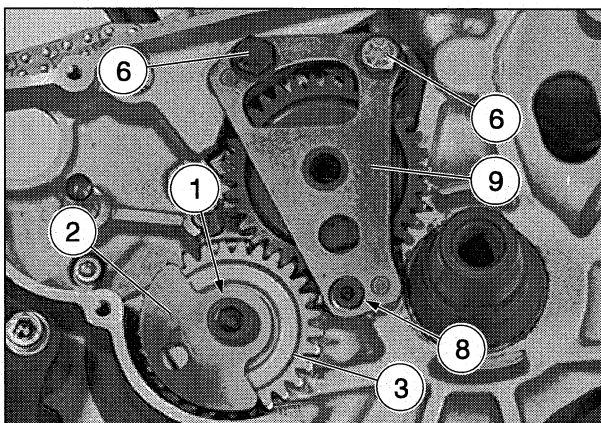
- ◆ Pull out the spacer bush (10), the two locating dowels (11) and two roller bearings (12).

NOTE As of engine # 527354, the locating dowels (11) are no longer fitted: centring is achieved with the aid of the flange (9).

- ◆ Remove the chain tightener shoe (13), pulling it out from above.

NOTE Mark the timing chain (14) with a coloured dot so that you are sure to refit it with the same direction of rotation.

Pull the timing chain (14) out from below, complete with the idler gear (15), and remove the washer (16).



3.8 REMOVING THE MOTOR OIL FILTER

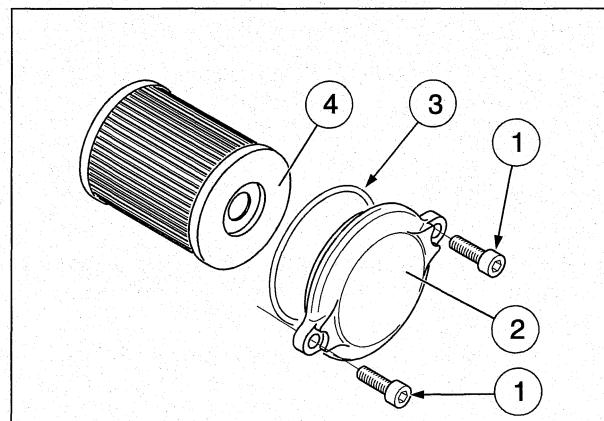
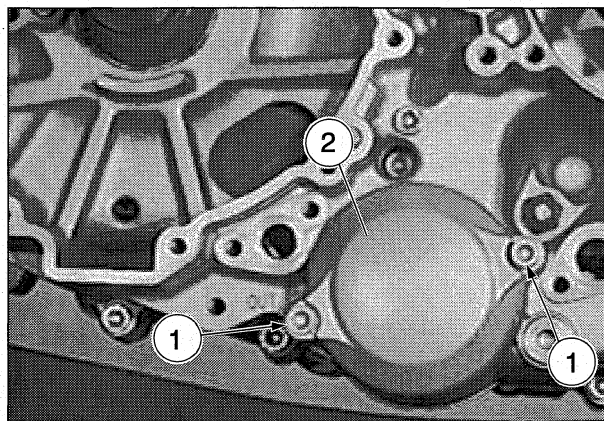
Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATION).

NOTE The following operations can be performed without removing the engine from the frame.

CAUTION

In order to avoid any contact with used oil, wear protective gloves.

- ◆ Unscrew and remove the two M6 T.C.E.I. screws (1).
- ◆ Remove the cover of the oil filter (2) and the O-ring (3).
- ◆ Remove the oil filter cartridge (4) from the filter housing.



3.9 REMOVING THE CLUTCH COVER

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE The following operations can be performed without removing the engine from the frame.

- ◆ Drain the engine oil, see 0.4.1 (VEHICLE WORKSHOP MANUALS);
- ◆ Drain the coolant, see 0.4.1 (VEHICLE WORKSHOP MANUALS);
- ◆ Remove the starter motor, see 3.3 (REMOVING THE STARTER MOTOR);
- ◆ Remove the expansion tank, see 0.4.1 (VEHICLE WORKSHOP MANUALS);
- ◆ Remove the rear brake control lever, see 0.4.1 (VEHICLE WORKSHOP MANUALS);
- ◆ Unscrew and remove the eight M5 T.C.E.I. screws (1) and remove the complete diaphragm cover (2).
- ◆ Remove the diaphragm (3) from the clutch cover retainers (4) and turn it approx. 20°.
- ◆ Unscrew and remove the M12 stop nut (5) and remove the washer (6), cup (7), diaphragm (3), support ring (8) and the washer (9).

NOTE In order to unscrew and remove the M12 stop nut (5), the clutch disengaging shaft must be held still with a bent hexagon-head driver.

- ◆ Unscrew and remove the four M6 T.C.E.I. screws (10) and remove the coolant pump casing (11) complete with shaped seal.

NOTE The lower T.C.E.I. screw (12) (coolant drain plug) also features a seal.

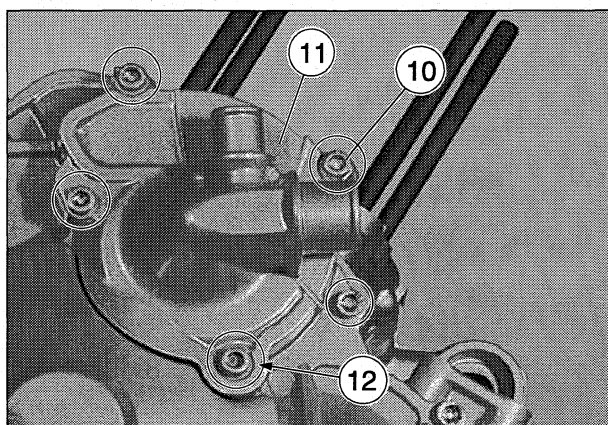
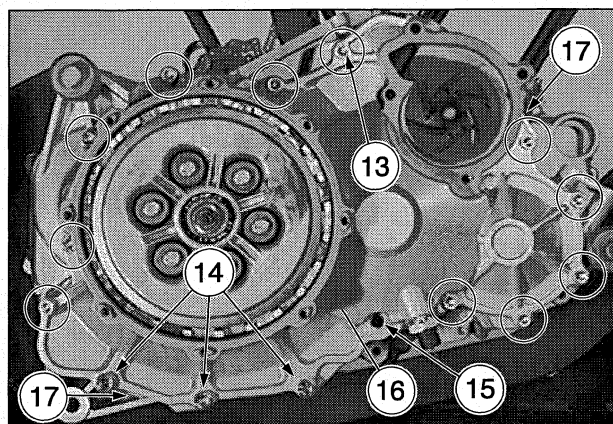
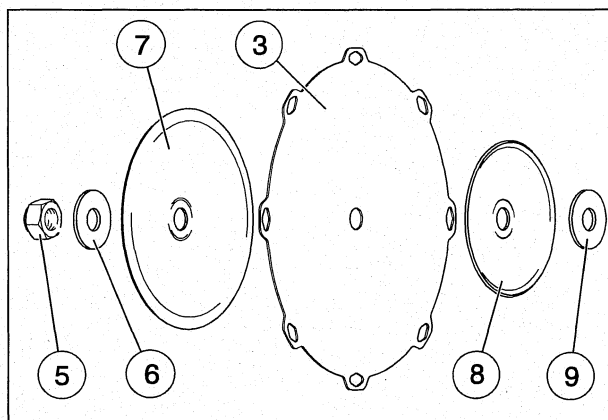
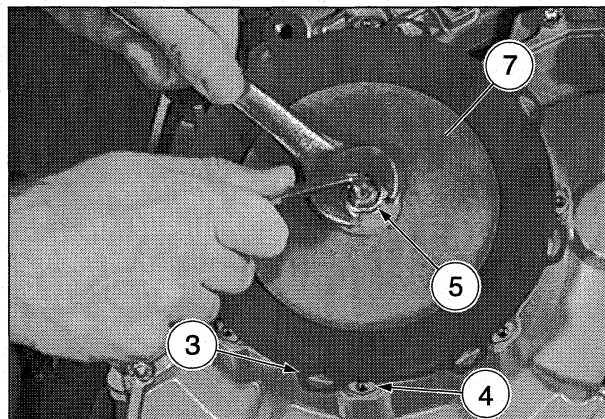
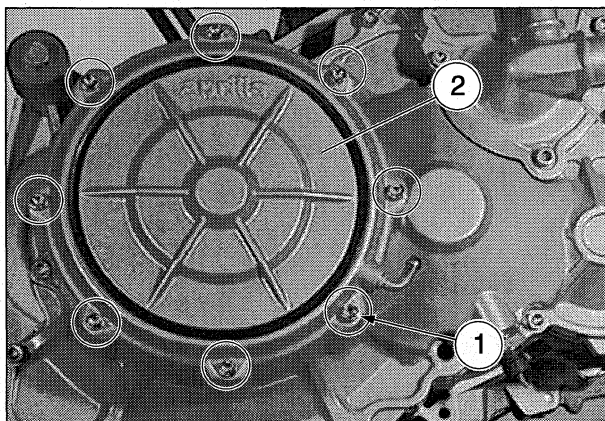
See 4.22 (COOLANT PUMP) for instructions on disassembling the coolant pump.

- ◆ If the M8 T.C.E.I. screw (15) has not been previously removed, to retain the shaft at TDC, this screw must also be removed.
- ◆ Unscrew and remove the eleven M6 T.C.E.I. screws (13) and the three M8 T.C.E.I. screws (14).

⚠ CAUTION

Be careful not to damage the gasket surfaces when lifting the clutch cover.

- ◆ Lift the clutch cover (16) carefully, using a screwdriver to work the pull-out tabs (17), and remove it.
- ◆ Remove the gasket.



3.10 DISASSEMBLING THE CLUTCH

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE The following operations can be performed without removing the engine from the frame.

NOTE The driving shaft must be retained at TDC, see 3.4 (DISASSEMBLING FRONT CYLINDER, HEAD AND PISTON).

- ◆ Unscrew and remove the six M6 T.E. screws (1).
- ◆ Remove the washer (2), clutch springs (3) and support plate (4).
- ◆ Remove the complete clutch disengaging shaft (5).

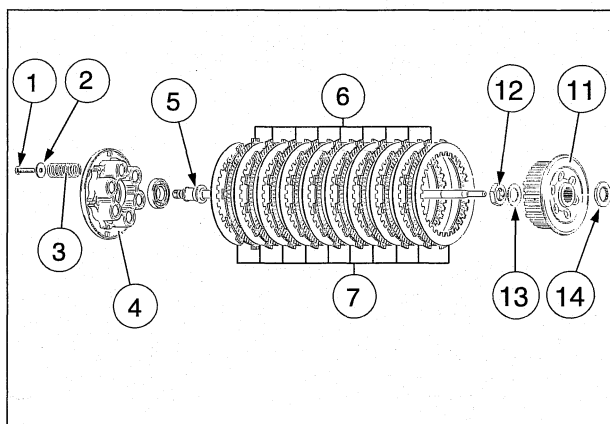
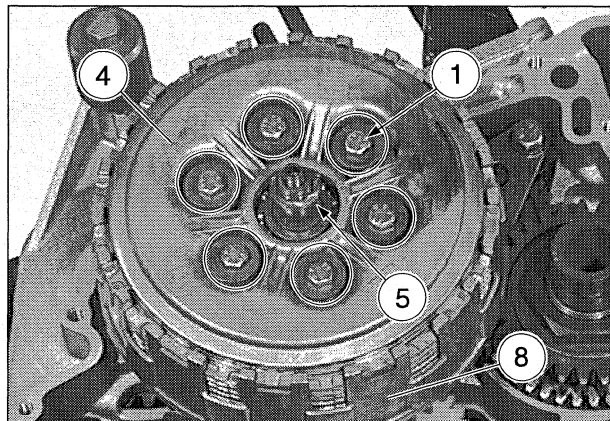
NOTE Have the appropriate special tool **OPT** to hand:
– **aprilia** part# 8140185 (clutch disc extraction hook lever) (9).

NOTE The lower clutch discs can only be removed individually with the aid of the appropriate hook levers (9).

- ◆ Remove the lined discs (6) and steel discs (7) from the clutch housing (8).

NOTE Have the appropriate special tool **OPT** to hand:
– **aprilia** part# 0277881 (clutch blocking tool) (10).

- ◆ Insert the clutch blocking tool (10) in the clutch housing (8) and on the clutch hub (11).

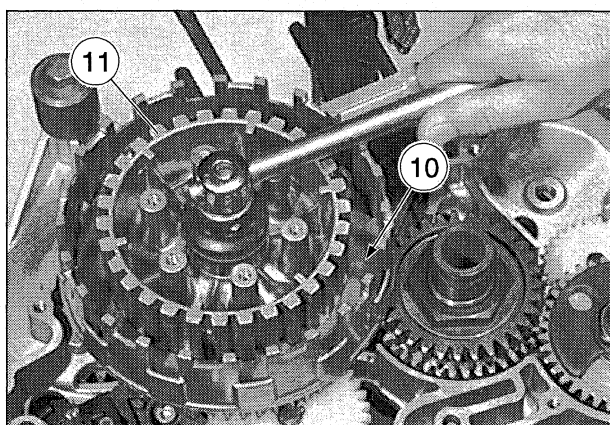
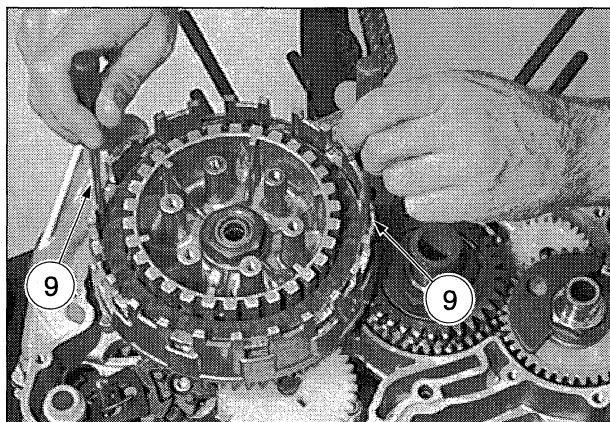


CAUTION

Insert the clutch blocking tool all the way into the clutch drum so as not to damage the basket when loosening the hex-head nut.

- ◆ Unscrew and remove the M24x1.5 T.E. nut (12).
- ◆ Remove the clutch blocking tool (10), spring washer (13) and clutch hub (11).
- ◆ Take the thrust ring (14).

NOTE See 4.19 (DISASSEMBLING THE PRIMARY TRANSMISSION) for instructions on disassembling the primary transmission.

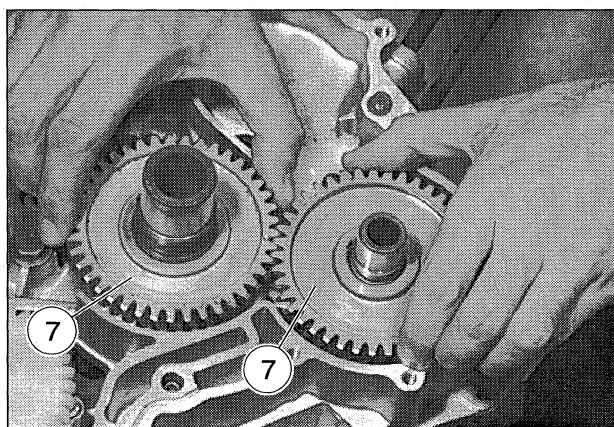
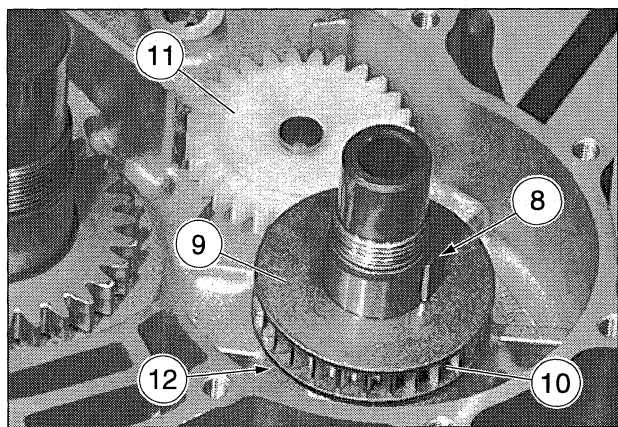
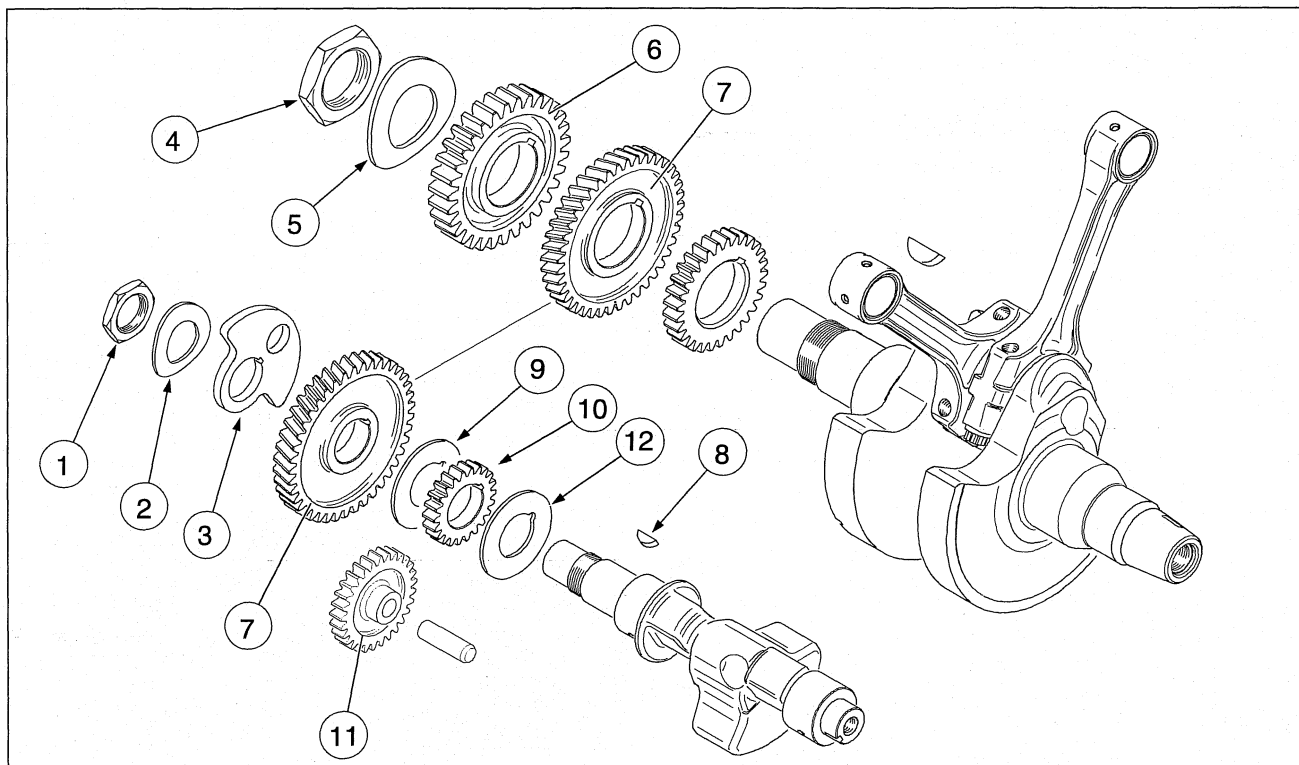
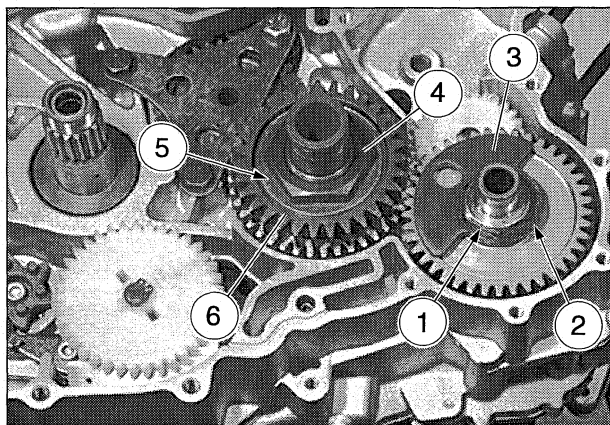


3.11 DISASSEMBLING THE COUNTERSHAFT MECHANISM AND PRIMARY TRANSMISSION

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE The driving shaft must be retained at TDC, see 3.4 (DISASSEMBLING FRONT CYLINDER, HEAD AND PISTON).

- ◆ Unscrew and remove the M22x1.5 T.E. nut (1), remove the spring washer (2) and countershaft counterweight (3).
- ◆ Unscrew and remove the M33x1.5 T.E. nut (4) and remove the spring washer (5).
- ◆ Remove the drive gear (6) from the driving shaft.
- ◆ Remove the differential gears (7) from the driving shaft and countershaft together.
- ◆ Detach the key (8), the upper washer (9) and coolant pump gear (10) from the countershaft.
- ◆ Remove the coolant pump idler gear (11).
- ◆ Detach the lower washer (12) from the countershaft.



3.12 DISASSEMBLING REAR CYLINDER TIMING DRIVE ASSEMBLY

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

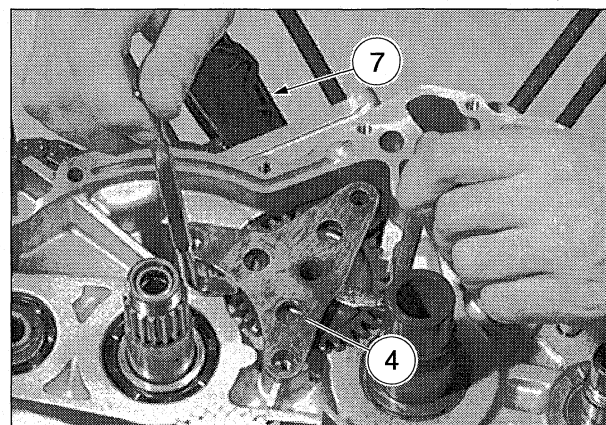
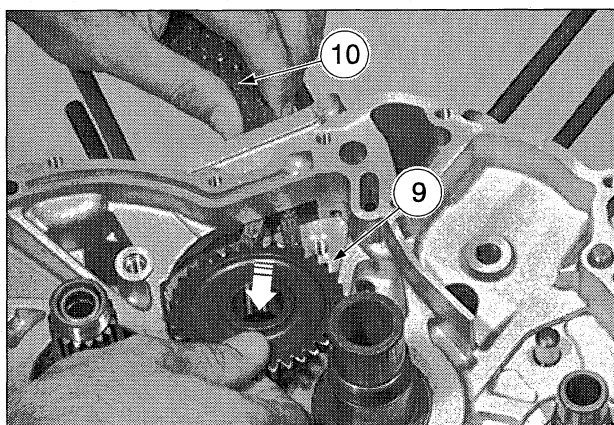
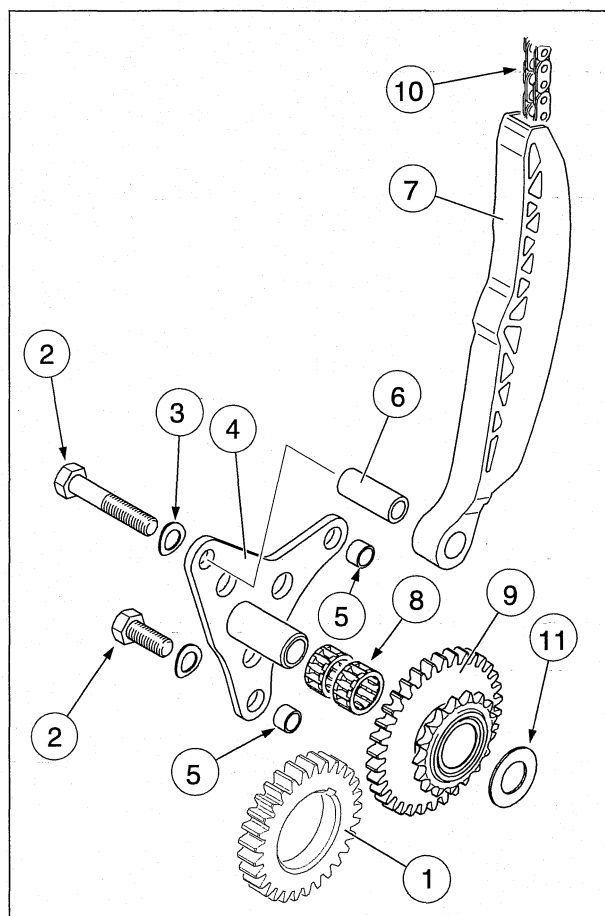
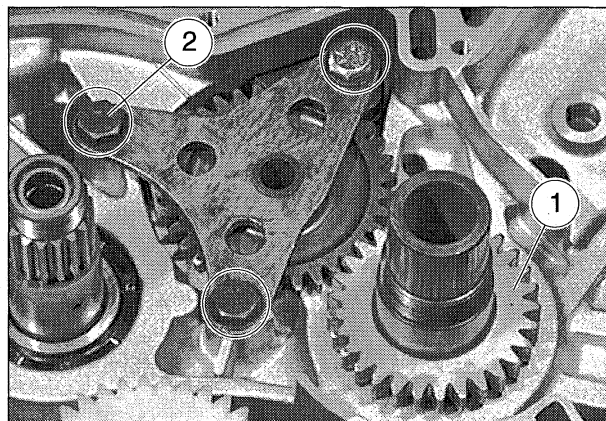
- ◆ Remove the drive gear (1) from the driving shaft.
- ◆ Unscrew and remove the three M8 T.E. screws (2) and detach the lock washers (3).

NOTE The cylinder and the head are still fitted on the engine. In order to remove the timing chain (10), the chain tightener and camshaft gears must be removed, see 3.5 (DISASSEMBLING REAR CYLINDER, HEAD AND PISTON).

- ◆ Remove the complete roller bearing flange (4) together with the two calibrated bushes (5) and spacer bush (6).
- ◆ Remove the chain tightener shoe (7), pulling it out from above.
- ◆ Remove the two roller bearings (8).
- ◆ Remove the intermediate drive gear (9) and timing chain (10), pulling both out together downwards.

NOTE Mark the timing chain (10) with a coloured dot so that you are sure to refit it with the same direction of rotation.

- ◆ Remove the washer (11).



3.13 REMOVING THE OIL PUMP

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

⚠ CAUTION

The oil pump gears, both driving (1) and driven (2), must always be replaced once they have been disassembled.

NOTE The oil pump drive gear (1) is attached to the support plate of the complete clutch housing.

- ◆ Remove the seeger ring (3).
- ◆ Slide the oil pump drive gear (1) up and off.

NOTE Turn the oil pump (4) shaft so that the pin (5) can be slid out through the slot (6) on the pump cover (7).

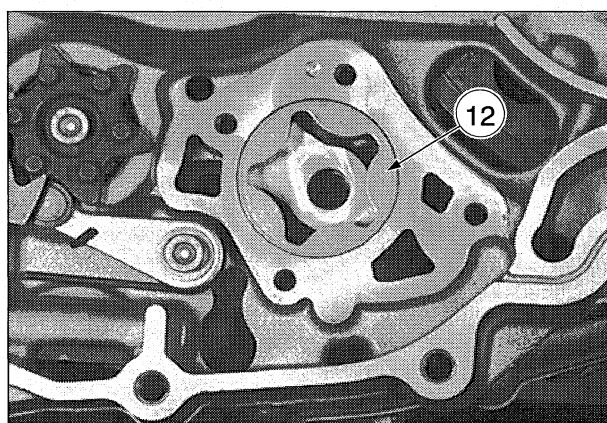
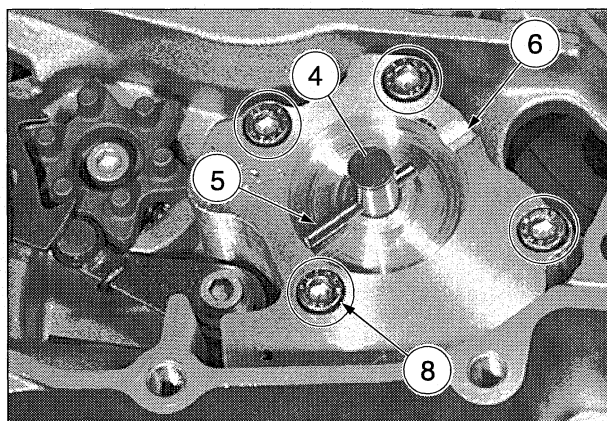
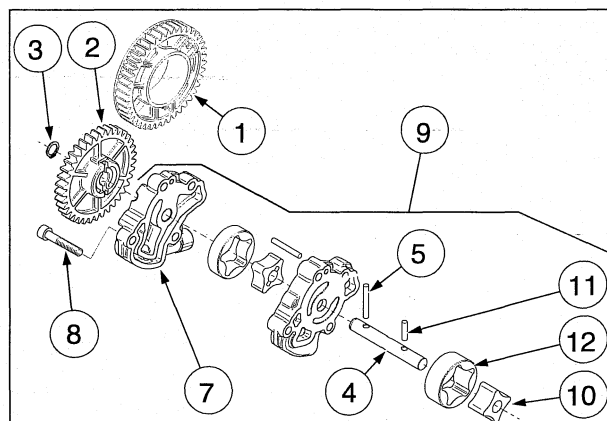
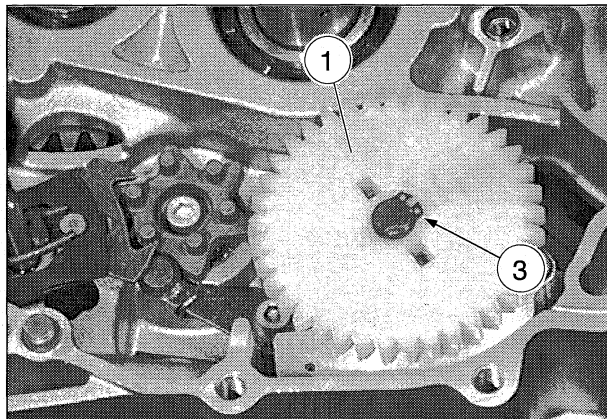
- ◆ Slide the pin (5) out of the oil pump shaft (4).
- ◆ Unscrew and remove the four M6 T.C.E.I. screws (8) and remove the complete oil pump (9) from the engine casing.

⚠ CAUTION

When removing the whole oil pump (9), it is advisable to leave the inside rotor (10) and pin (11) fitted since there is a danger of the pin (11) falling into the oil sump.

- ◆ Remove the suction pumps external rotor (12) from the engine casing.

NOTE Take the oil pump apart, see 4.9 (OIL PUMP AND OIL PUMP DRIVE ASSEMBLY).



3.14 DISASSEMBLING THE GEAR SELECTION MECHANISM

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

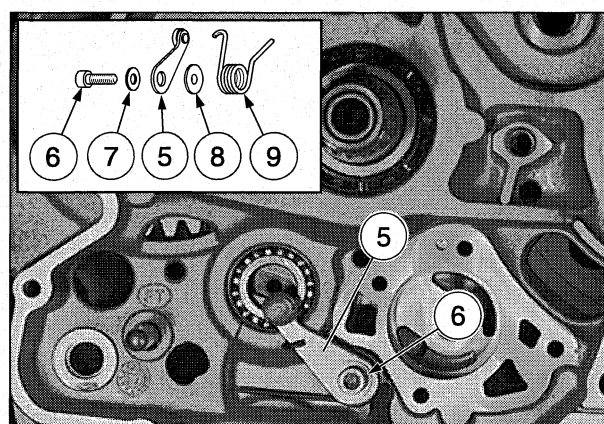
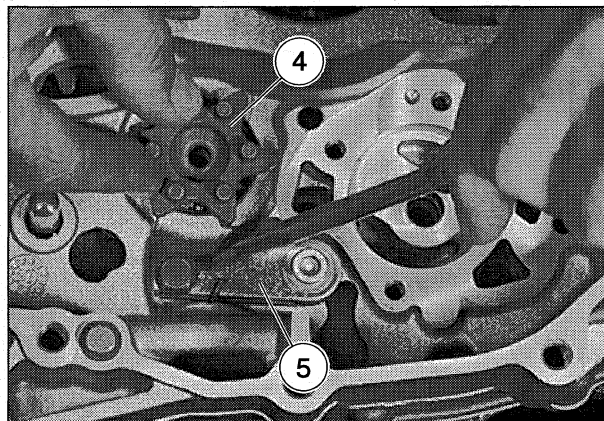
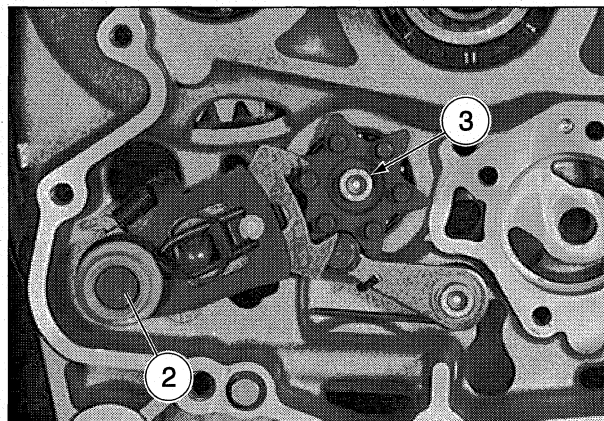
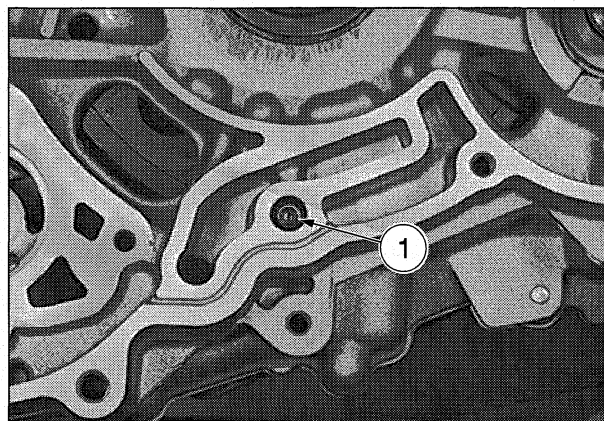
- ◆ Unscrew the threaded pin M8 (1) retaining the driving shaft at TDC.

NOTE Turn the driving shafts by hand to enable the gear to engage.

- ◆ Engage 6th gear.
- ◆ Remove the complete selector shaft (2).
- ◆ Unscrew and remove the M6 T.C.E.I. screw (3) and remove the index plate (4).

NOTE Use a screwdriver to push the complete index lever (5) down to make it easier to remove the index plate.

- ◆ Unscrew and remove the M6 T.C.E.I. screw (6) and remove the washer (7), index lever (5), graduated ring (8) and index spring (9).



3.15 SPLITTING THE ENGINE CASING OPEN

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Take the seeger ring (1) and thrust washer (2) off the secondary shaft.
- ◆ Unscrew and remove the twenty M6 T.C.E.I. screws (3).

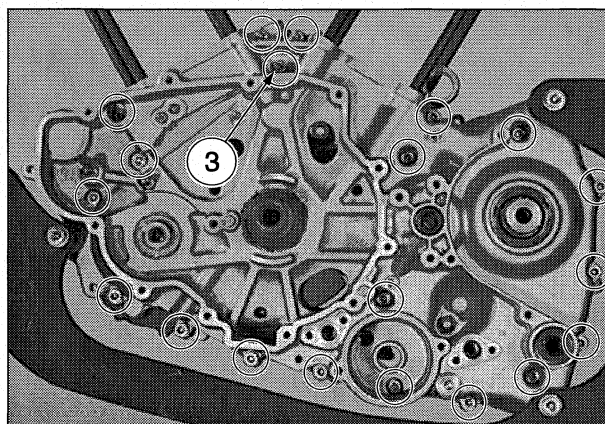
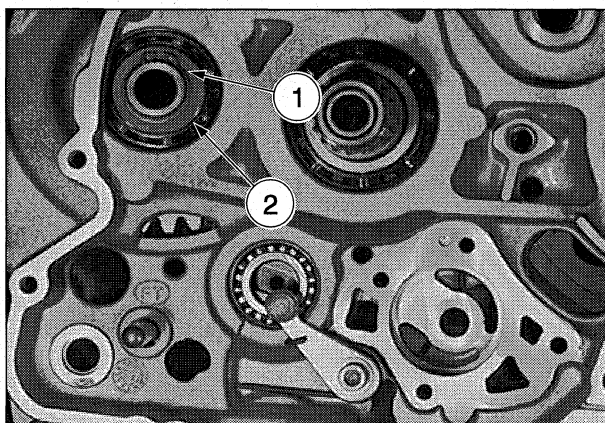
⚠ CAUTION

Comply with the following instructions:

- Use a plastic hammer to strike the primary and secondary shafts alternately until they are embedded in the flywheel side half of the engine casing.
- Make sure the engine half-casing is lifted parallel to the surface so that the main bearings are not tilted and hence damaged.
- Where necessary, use a screwdriver, inserted in the appropriate points (4), to help prise them apart.
- Take your time and work with extreme care.
- Never strike the gasket surface.
- Do not use excessive force.
- Should it prove impossible to separate the two halves of the casing, check for any screws which have not been loosened.

NOTE When lifting the engine half-casing, the washers of the secondary shaft may be attached on the inside of the clutch side half of the engine casing.

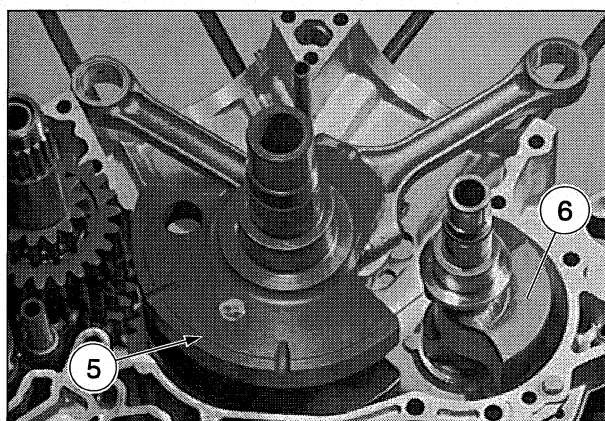
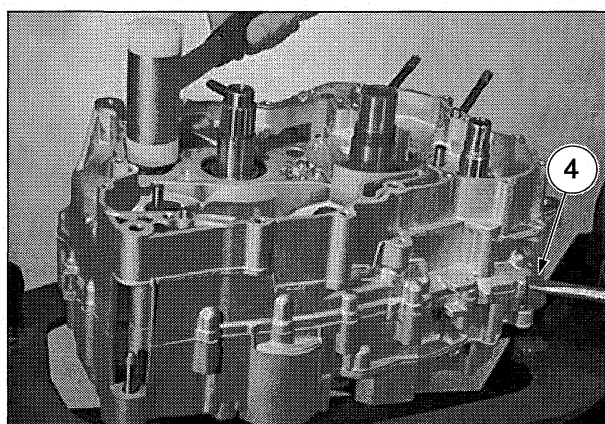
- ◆ Split the two sections of the engine casing apart by lifting the clutch side section.



3.16 DISASSEMBLING THE DRIVING SHAFT AND COUNTERSHAFT

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Turn the driving shaft (5) so that it does not mate with the countershaft (6).
- ◆ Remove the countershaft (6).
- ◆ Remove the driving shaft (5).



3.17 DISASSEMBLING THE GEARSHIFT

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Remove the two spindles (1).
- ◆ Turn both gearshift forks (2) of the secondary shaft (3) outwards, moving them away from the guides of the selector cylinder (4), and remove them.
- ◆ Turn the gearshift fork (5) of the primary shaft (6) outwards, moving it away from the guide of the selector cylinder (4), and remove the selector cylinder.
- ◆ Push the 3rd and 4th gear selector gear (7) upwards and remove the fork (5) from the primary shaft.
- ◆ Set the engine half-casing upright on the assembly bench.

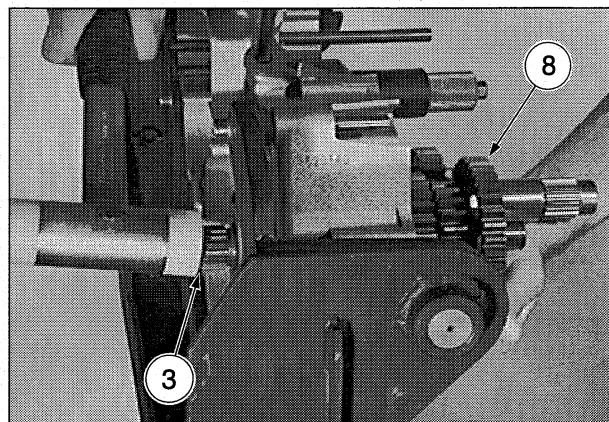
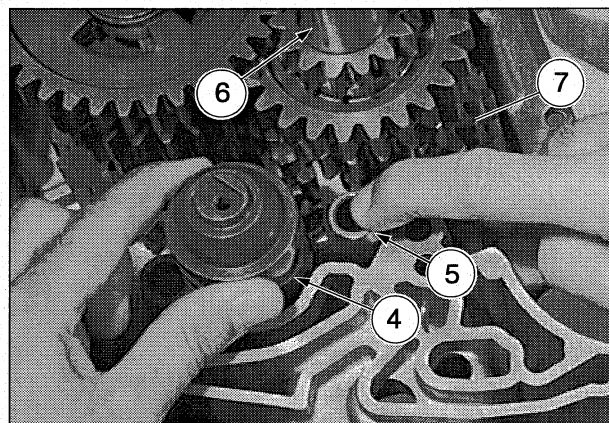
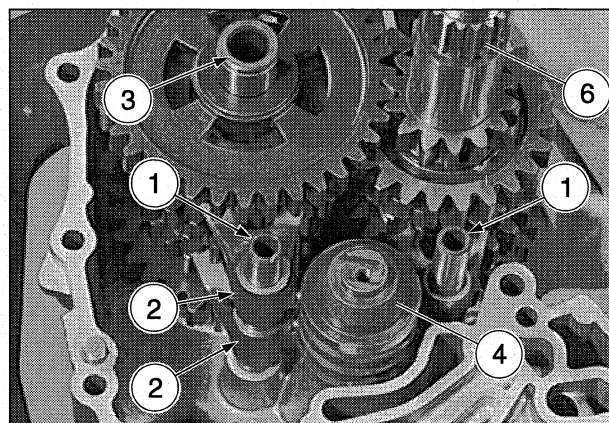
NOTE Keep both the secondary shaft and primary shaft still with one hand whilst tapping the secondary shaft (3) with a plastic hammer, working from the outside. This forces the two shafts out of their relevant housings complete with the gearshift gears.

- ◆ Disassemble the gearshift (8).

CAUTION

The secondary shafts seal is inevitably damaged whilst disassembling the gearshift and must, therefore, be replaced.

NOTE Take the gearshift apart, see 4.14 (TRANSMISSION).



NOTE

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WORK ON THE INDIVIDUAL PARTS

4

WORK ON THE INDIVIDUAL PARTS

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4.1 GENERAL INDICATIONS

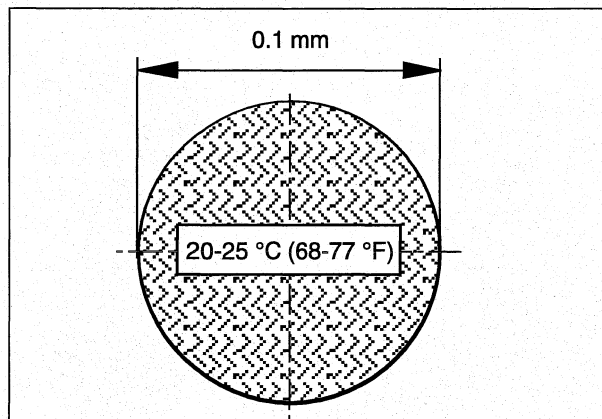
⚠ WARNING

Take care not to burn yourself when handling hot engine parts.

⚠ CAUTION

If any of the components has exceeded one of the wear limits or if, during the visual inspection of a component, a defect is detected liable to compromise the operation of the engine, said component must be replaced.

If the measurement values indicated are precise to one tenth of a millimetre or over, the temperature of the component must be in the range 20 to 25 °C (68 to 77 °F).



4.2 ENGINE CASING

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

⚠ CAUTION

Do not use anti-sealer products, degreasers or cold detergents.

- ◆ Clean the two sections of the engine casing, ball bearings and all bearing housings thoroughly with a gentle solvent.
- ◆ Clean all the gasket surfaces and check for damage.

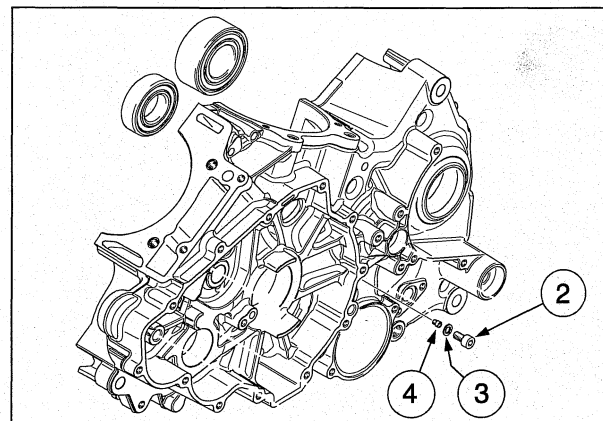
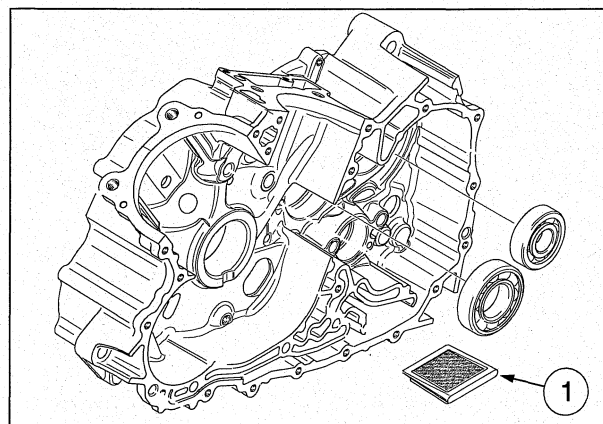
NOTE Place the two halves of the engine half-casing on a flat surface to prevent damage.

- ◆ Make sure the two halves of the engine half-casing do not feature cracks or signs of damage.
- ◆ Make sure all the threads are in a perfect state of repair.
- ◆ Make sure all the oil seals remaining in their slots are not worn or damaged.
- ◆ Check the slack of all the ball bearings and make sure they slide smoothly and are not distorted in any way.

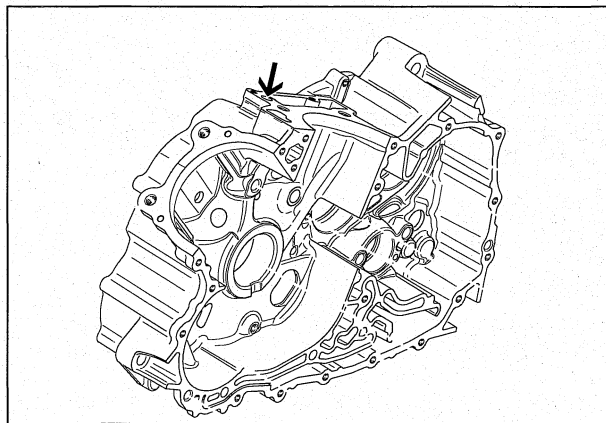
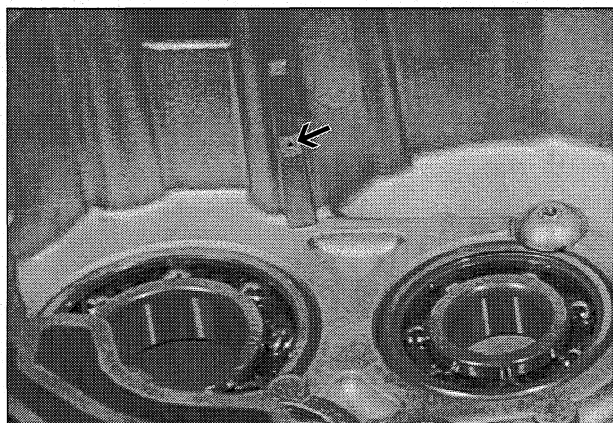
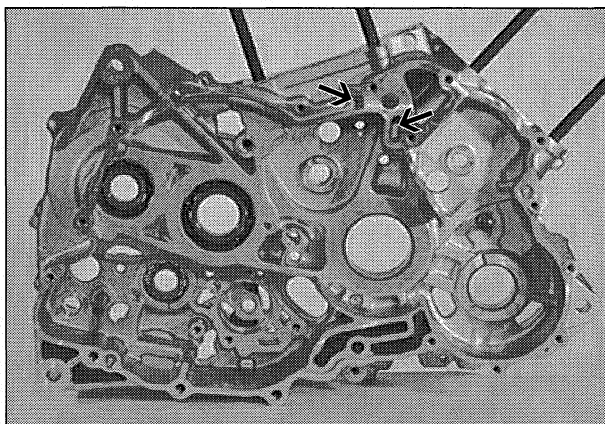
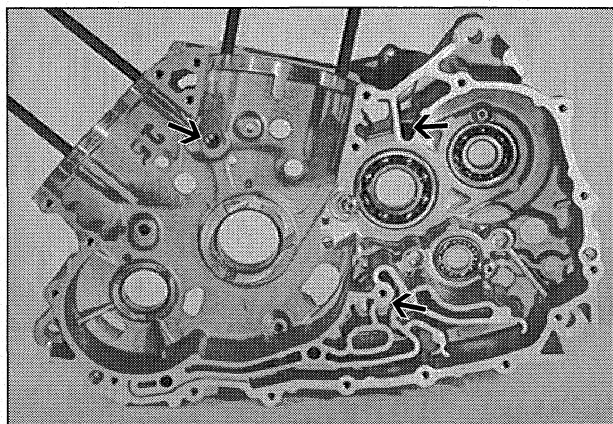
NOTE Use motor oil to lubricate the ball bearings before performing the check.

If the inner race does not turn easily and silently, or if it makes a noise, it means the bearing is defective and needs replacing.

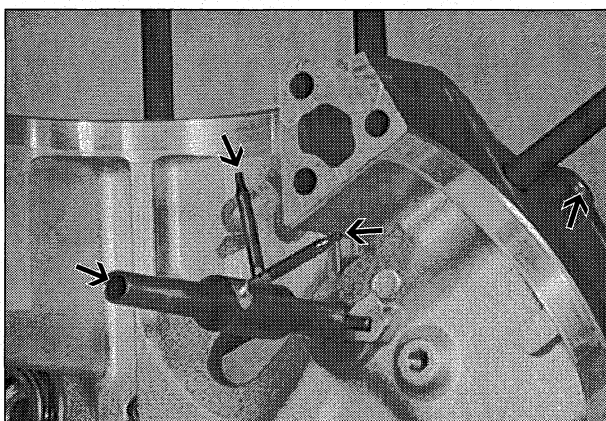
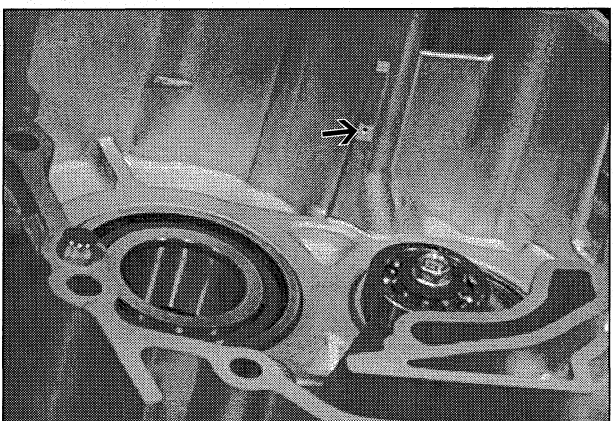
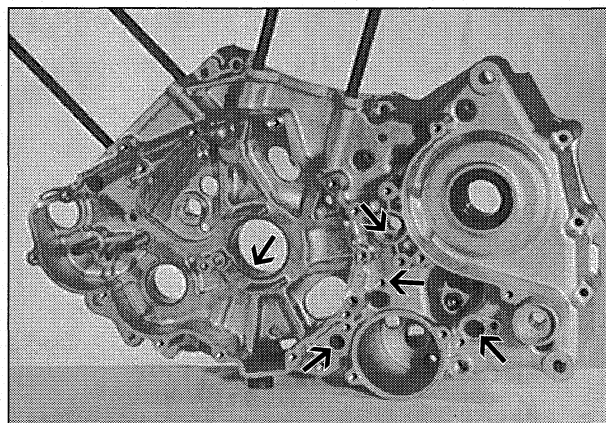
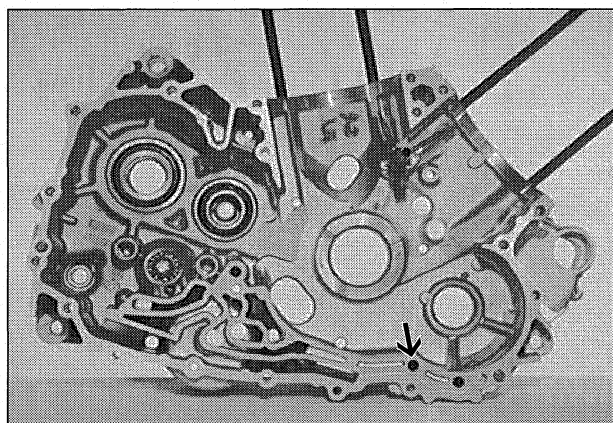
- ◆ Remove the oil gauze (1).
- ◆ Clean the oil gauze with naphtha and check the mesh of the gauze for possible signs of damage.
- ◆ Unscrew and remove the M6 T.C.E.I. screw (2), the seal (3) and the nozzle (4).
- ◆ Make sure the galleries are clear in all the lubrication holes in the two halves of the casing and, where necessary, clean them by blowing a jet of compressed air inside 4.2.1 (ENGINE HALF-CASING, CLUTCH SIDE) and 4.2.2 (ENGINE HALF-CASING, FLYWHEEL SIDE).



4.2.1 ENGINE HALF-CASING, CLUTCH SIDE



4.2.2 ENGINE HALF-CASING, FLYWHEEL SIDE



4.3 BALL BEARINGS AND OIL SEALS INSTALLED ON THE ENGINE CRANKCASE HALVES

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

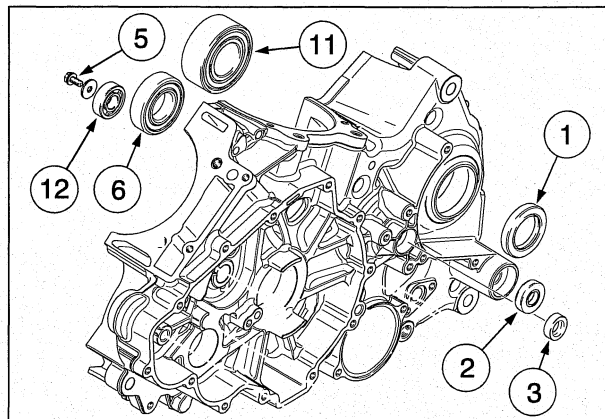
4.3.1 REMOVING THE OIL SEALS

NOTE The oil seals can be disassembled and assembled without removing the engine from the vehicle.

◆ Lift and take out the oil seals:

- secondary gearshift shaft (1);
- selector shaft (2);
- clutch disengaging shaft (3).

NOTE As a rule, the disassembled oil seals should be replaced.



4.3.2 REMOVING THE BALL BEARINGS

◆ Unscrew and remove the M6 screws (4) securing the ball bearings.

◆ Remove the M6 x 13 flanged-head screw (5).

◆ Make sure that there are no damage and rolling traces or grooves on the sliding surface of the bearings.

◆ In order to remove and insert the ball bearings, heat the engine casing to a temperature of approx. 80 – 100 °C (176 – 212 ° F).

NOTE In order to avoid damaging the gasket surface, an old engine casing gasket should be placed underneath the puller plate.

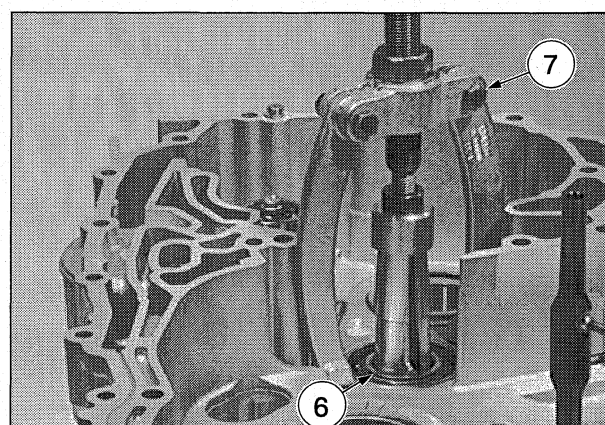
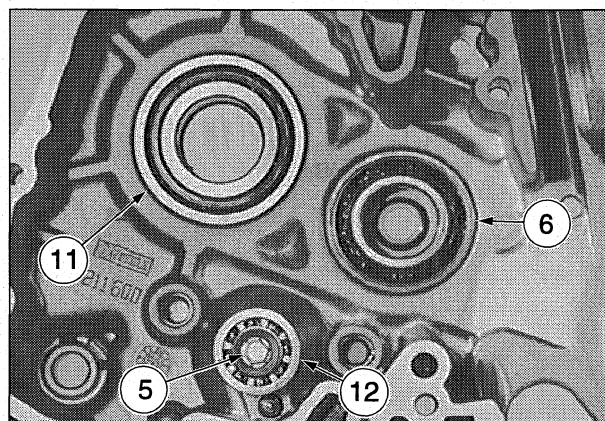
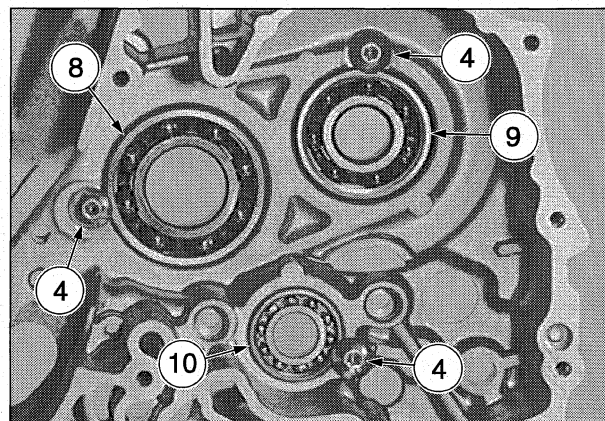
◆ Extract the ball bearings (6) of the gearbox input shaft by means of a universal extractor (7) for bearings.

◆ Remove the ball bearings using the relevant drift.

- gearshift primary shaft (8), clutch side;
- gearshift secondary shaft (9), clutch side;
- shift cam (10), clutch side;
- gearshift secondary shaft (11), flywheel side.

◆ Remove the shift cam ball bearings (12).

NOTE As a rule, the disassembled ball bearings should be replaced.



4.3.3 INSTALLING THE BALL BEARINGS

- ◆ Check the interference between the bearing and the engine casing hole.

Interference (X) = (Ø A) minus (Ø A1): 0.01 mm.

- ◆ Lubricate the external diameter of the bearings slightly and, with due care, fit them all the way in on the outer ring using a suitable assembly punch:

- gearshift primary shaft (6), flywheel side;
- gearshift primary shaft (8), clutch side;
- gearshift secondary shaft (9), clutch side;
- shift cam (10), clutch side;
- gearshift secondary shaft (11), flywheel side.

⚠ CAUTION

The sealing washer of the gearshift primary shaft ball bearing (6), flywheel side, must face outwards.

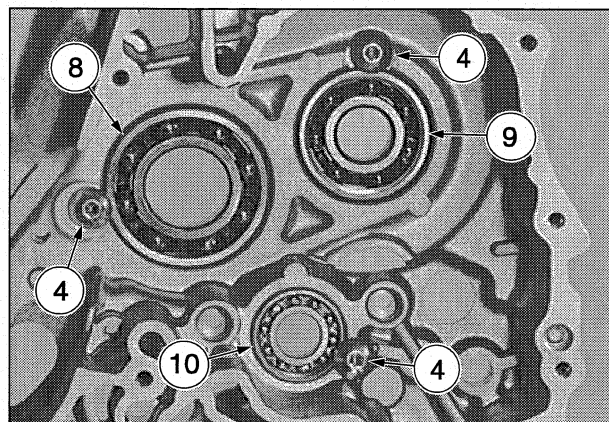
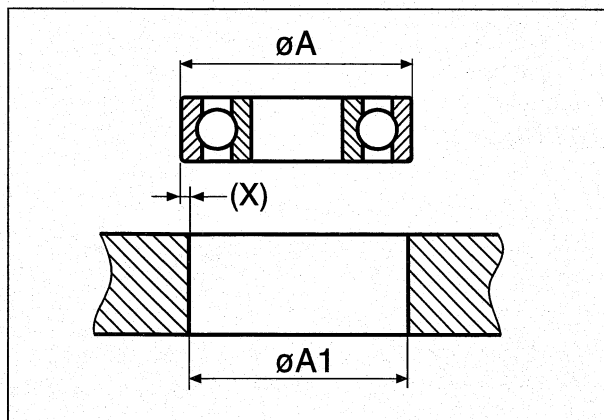
NOTE As a rule, the disassembled ball bearings should be replaced.

- ◆ Lubricate the internal diameter of the shift cam ball bearing (12), flywheel side, slightly and, with due care, fit it all the way in on the inner ring using a suitable assembly punch.

- ◆ Apply LOCTITE® 243 on the screws (4) (5) securing the ball bearings and screw them into the engine casing.

M6 flat head screw (4) driving torque: 11 Nm (1.1 kgm)

M5x10 flanged-head screw (5) driving torque: 11 Nm (1.1 kgm)



4.3.4 INSTALLING THE OIL SEALS

NOTE Have the appropriate special tools **OPT** to hand:

- **aprilia** part# 0877650 (handle for pads) (13);
- **aprilia** part# 0277680 (gearshift secondary shaft oil seal assembly pad) (14);
- **aprilia** part# 8140155 (gearshift shaft oil seal - clutch shaft oil seal assembly pad) (15).

NOTE Before assembling the shaft sealing rings, their external diameter must be lubricated slightly.

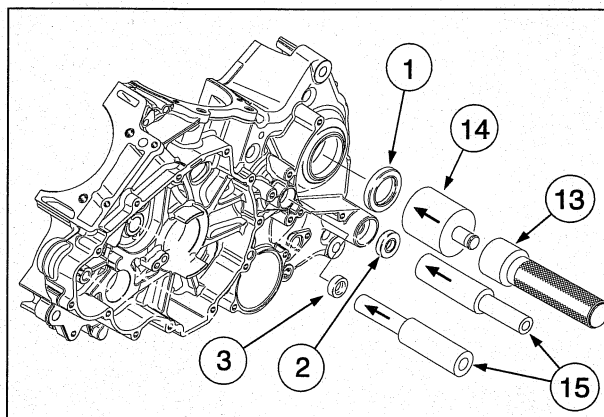
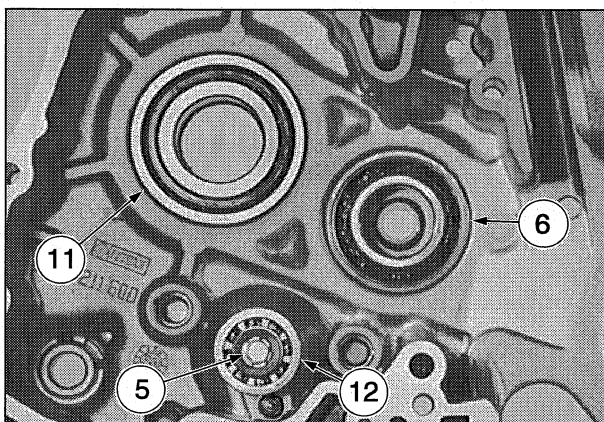
The closed side of the shaft sealing rings must face outwards.

Grease the sealing lips.

⚠ CAUTION

The oil seal (1) of the secondary shaft must not touch the inner race of the bearing in any way as this would result in damage.

- ◆ Insert the oil seal (1) flush with the engine casing using the assembly pad (14).
- ◆ Insert the shaft sealing rings (2) (3) all the way using the assembly pad (15).



4.4 DRIVE SHAFT MAIN BUSHES AND BALANCE SHAFT MAIN BUSHES

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

⚠ CAUTION

The main bushes may only be replaced by authorized repair shops suitably skilled in the use of the relevant measuring equipment and tools.

- ◆ Measure the inner diameter of the drive shaft main bushes (1) on both crankcase halves.

Drive shaft main bushes (1): wear limit \varnothing 46.035 mm.

- ◆ Measure the inner diameter of the balance shaft main bushes (2) on both crankcase halves.

Balance shaft main bushes (2): wear limit \varnothing 32.060 mm.

⚠ CAUTION

Take a number of measurements, especially in the direction of the axis of both cylinders. None of the values must exceed the limit value.

⚠ CAUTION

Measure the radial play between the main bushes and the corresponding areas of the drive shaft, see 4.10 (DRIVING SHAFT). Check the radial play between the main bushes and the corresponding areas of the balance shaft, see 4.13 (COUNTERSHAFT AND COUNTERSHAFT MECHANISM).

- ◆ Make sure that there are no wear or sliding traces on the axial thrust bearing surfaces (3) (4) for the drive shaft, in both crankcase halves.
- ◆ Make sure that there are no wear or sliding traces on the axial thrust bearing surfaces (5) (6) for the balance shaft in the crankcase half, clutch side.

⚠ CAUTION

Check the end play of the drive shaft, see 4.10 (DRIVING SHAFT).

Check the end play of the balance shaft, see 4.13 (COUNTERSHAFT AND COUNTERSHAFT MECHANISM).

4.4.1 REMOVING THE BUSHES

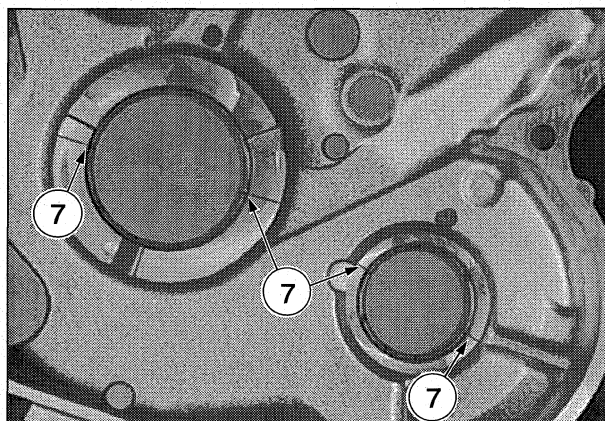
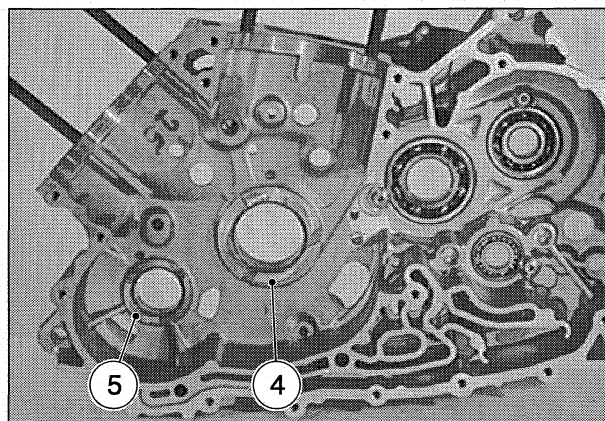
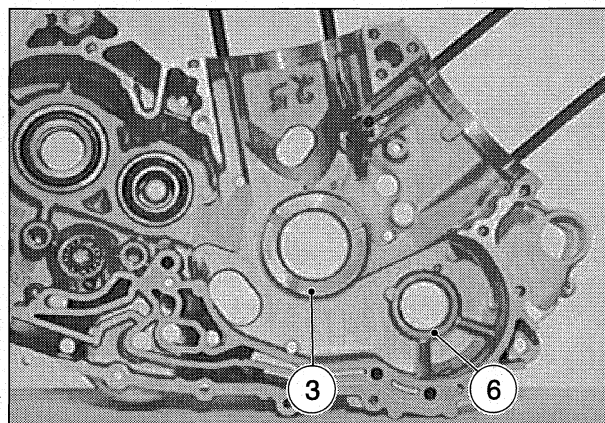
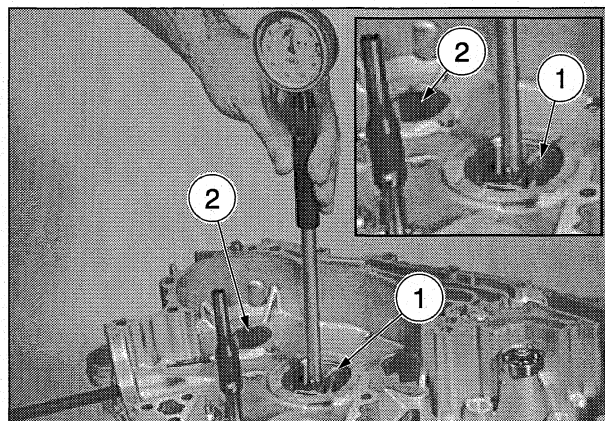
NOTE Remove the main bushes working on the inner side of the relevant crankcase half.

- ◆ Use a felt pen to mark the contact surfaces (7) of the main bushes on both halves of the engine casing (inner side) so as to provide an external visual reference.

⚠ CAUTION

Do not perform any mechanical markings.

Follow ►



Follow ►

NOTE Have the appropriate special tools **OPT** to hand:

- **aprilia** part# 0277720 (driving shaft sleeve puller pad) (8);
- **aprilia** part# 8140074 (main countershaft bush inserter pad) (9).

NOTE To remove the main bushes it is necessary to use a press.

NOTE To extract (and insert) the main bushes it is necessary to have two supports (A) on which the engine crankcase half must be positioned.

The two supports must be in hardwood, must be smooth and have the following dimensions:

L = 300 mm; l = 200 mm; h = 50 mm.

- ◆ Position the two supports (A) on the work surface of the press.
- ◆ Heat the engine casing to approx. **150 °C (302 °F)** for approx. fifteen minutes.

⚠ WARNING

Risk of burns.

Use working gloves and fire-retardant, heat-insulating material to handle the hot crankcase half.

NOTE Position the crankcase half so that it rests on its outer side, in order to be able to work on its inner side.

- ◆ Position the crankcase half (B) on the two supports (A).

⚠ WARNING

To counteract the action of the press, proceed as follows: position the two supports (A) near the main bushes on which you are working, without entering the area of the same, see distance (C).

Otherwise, the action of the press may cause cracks or breakages, even slight, which may pass unnoticed, but successively cause a sudden engine failure, with consequent seizure of the same and risk of serious accidents and even death.

⚠ WARNING

Remove the bushes one by one.

The simultaneous removal of the bushes may damage the bushes themselves, the crankcase half and cause serious damage to persons and property.

- ◆ Position the appropriate extractor (8) or (9) on the bush to be removed.

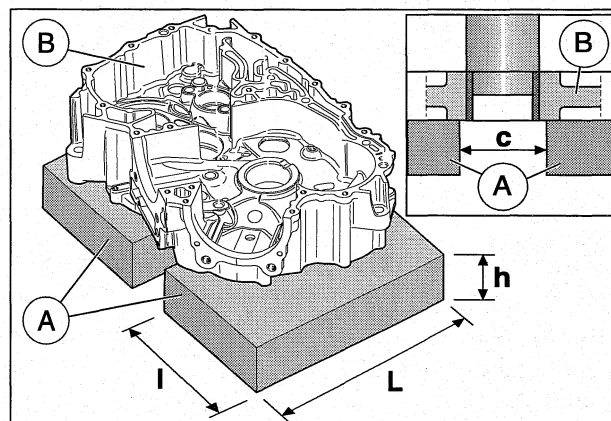
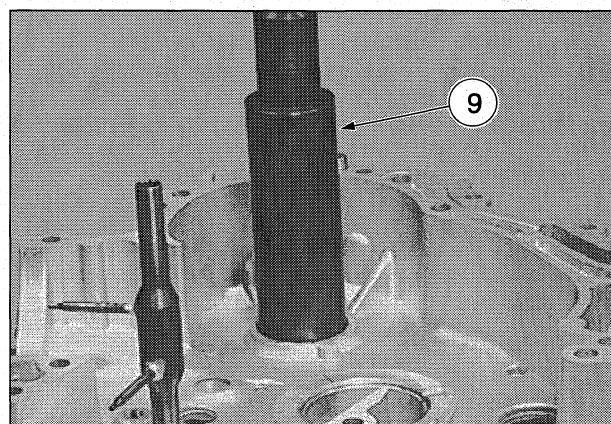
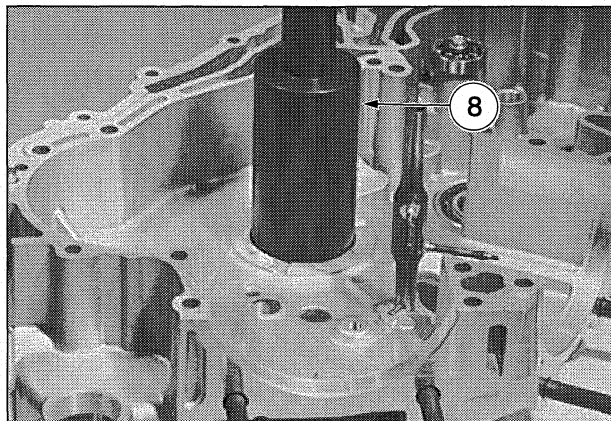
⚠ WARNING

Use the press with care.

Before use, make sure that no one is standing near the press.

- ◆ Proceeding with care, use the press to extract the main bushes from the engine crankcase half.

NOTE As a rule, the disassembled main bushes should be replaced in pairs.



4.4.2 INSTALLING THE BUSHES

NOTE Install the main bushes working on the inner side of the relevant engine crankcase half.

- ◆ Clean the diameter of the main bush housing inside the engine casing.
- ◆ Determine the main bush size group based on the coloured markings (10) on the engine casing.

⚠ CAUTION

The lower main bush (11) of the driving shaft, fly-wheel side, features a lubrication hole.

NOTE The size group of the main bushes is also marked with a coloured dot.

- ◆ If the coloured marking applied on the engine casing is no longer clearly legible, calculate the diameter based on the average of a number of different measurements.

⚠ CAUTION

Take a number of measurements, especially in the direction of the axis of both cylinders.

Driving shaft		
Bush seat hole in the engine crankcase halves Ø mm	Main bushes marking	Engine casing marking
49.899 – 49.908	red	red
49.908 – 49.918	blue	blue
49.918 – 49.929	yellow	yellow

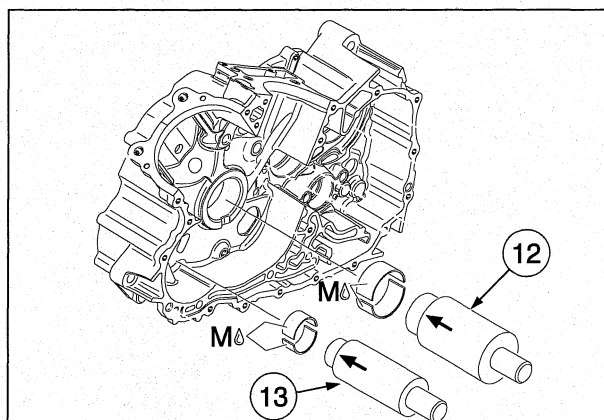
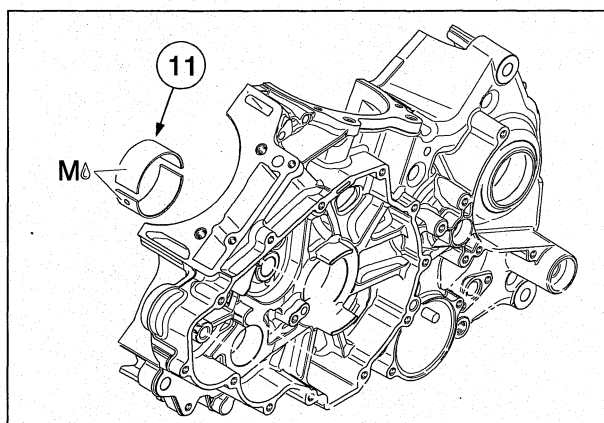
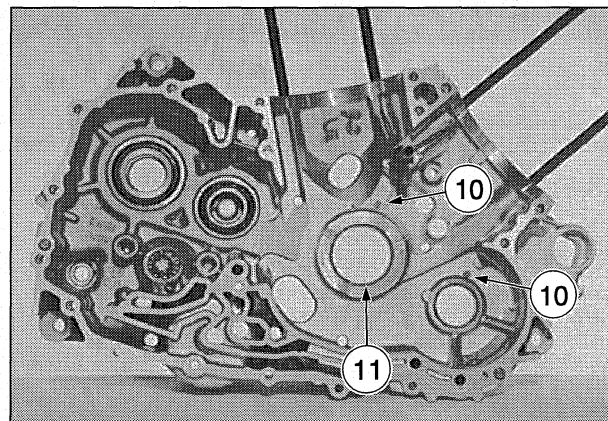
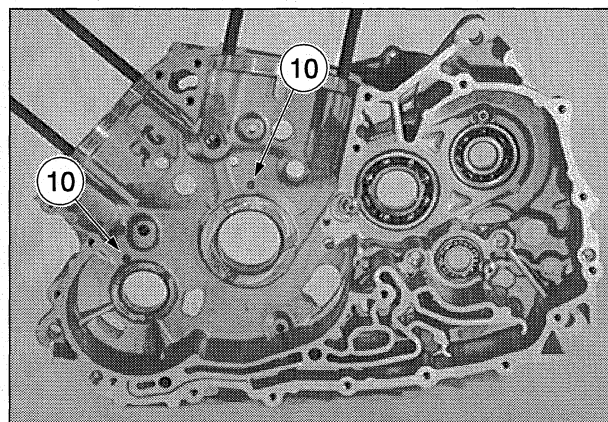
Countershaft		
Bush seat hole in the engine crankcase halves Ø mm	Main bushes marking	Engine casing marking
35.909 – 35.918	red	red
35.918 – 35.928	blue	blue
35.928 – 35.939	yellow	yellow

NOTE Have the appropriate special tools **OPT** to hand:

- **aprilia** part# 0277725 (driving shaft bush inserter pad) (12);
- **aprilia** part# 0277729 (insertion pad for lower balance shaft clutch cover bushes) (13).

NOTE To install the main bushes it is necessary to use a press.

Follow ►



Follow ►

NOTE To extract (and insert) the main bushes it is necessary to have two supports (A) on which the engine crankcase half must be positioned.

The two supports must be in hardwood, must be smooth and have the following dimensions:

L = 300 mm; l = 200 mm; h = 50 mm.

- ◆ Position the two supports (A) on the work surface of the press.
- ◆ Heat the engine casing to approx. 150 °C (302 °F) for approx. fifteen minutes.

⚠ WARNING

Risk of burns.

Use working gloves and fire-retardant, heat-insulating material to handle the hot crankcase half.

NOTE Position the crankcase half so that it rests on its outer side, in order to be able to work on its inner side.

- ◆ Position the crankcase half (B) on the two supports (A).

⚠ WARNING

To counteract the action of the press, proceed as follows: position the two supports (A) near the main bushes on which you are working, without entering the area of the same, see distance (C).

Otherwise, the action of the press may cause cracks or breakages, even slight, which may pass unnoticed, but successively cause a sudden engine failure, with consequent seizure of the same and risk of serious accidents and even death.

- ◆ Coat the main bushes and bearing housings inside the engine casing with MOLYKOTE® G-N.
- ◆ Position the new main bushes on the appropriate inserting pad (12) or (13) and fix them with an O ring (14) suitable for this purpose.

⚠ WARNING

Install the bushes one by one.

The simultaneous installation of the bushes may damage the bushes themselves, the crankcase half and cause serious damage to persons and property.

- ◆ Position the main bushes, complete with pad and O ring, in their seat on the engine crankcase half and make their contact surface coincide with the coloured mark applied previously (7).

⚠ WARNING

Use the press with care.

Before use, make sure that no one is standing near the press.

NOTE In this phase, do not insert the bushes completely.

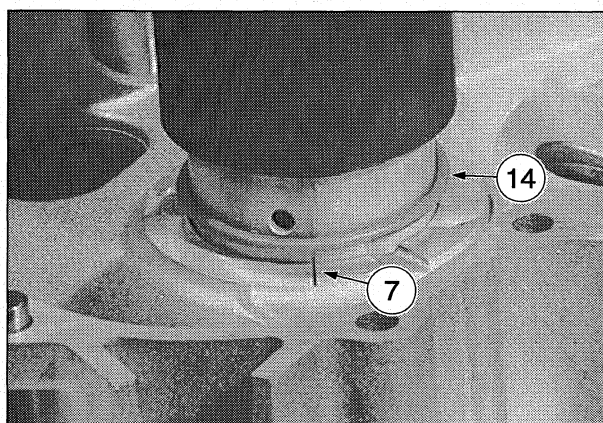
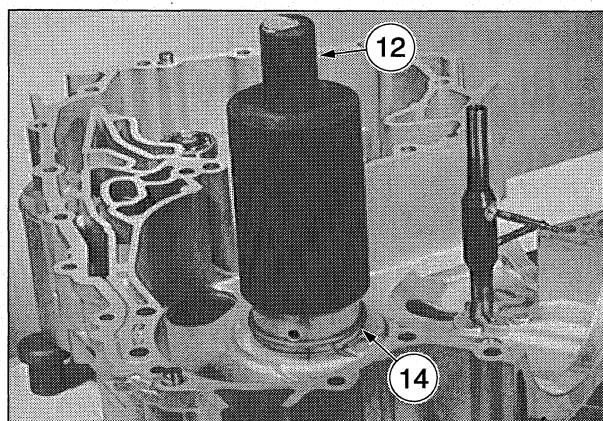
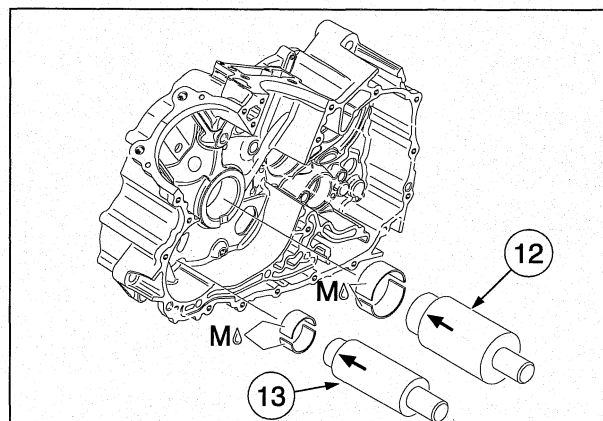
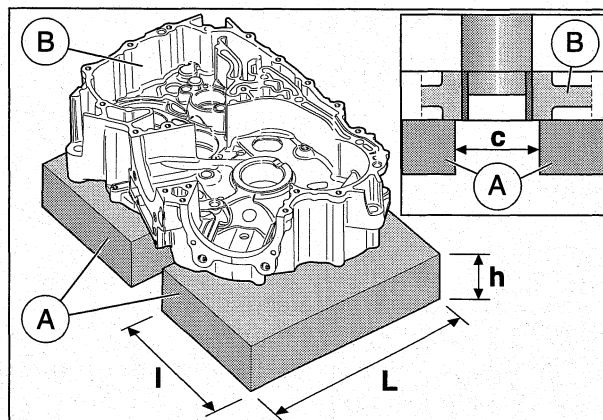
- ◆ Proceeding with care, use the press and insert the main bushes for half their height.

⚠ CAUTION

Do not cut or damage the surface of the bushes.

- ◆ Move the O ring (14) from the bush, then cut and remove it.

Follow ►



Follow ►

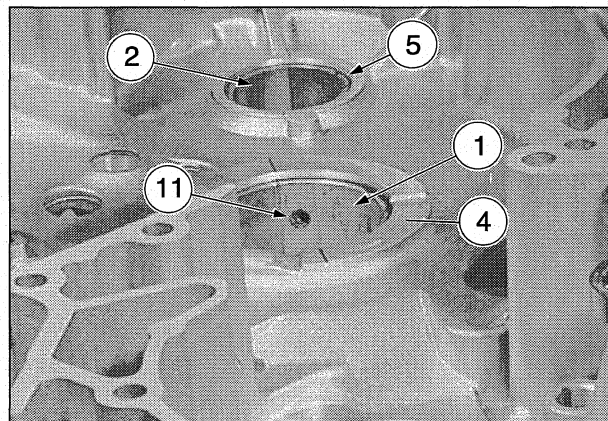
- ◆ Proceeding with care, use the press and insert the main bushes until the assembly punch (12) or (13) touches the thrust bearing surface (3) or (4) or (5) or (6) of the engine crankcase half.

NOTE The main bushes (1) of the drive shaft are inserted in such a way as to be **2.0 mm** deeper than the thrust bearing surfaces (3) (4).

NOTE The main bushes (2) of the balance shaft are inserted in such a way as to be **1.5 mm** deeper than the thrust bearing surfaces (5) (6).

NOTE The lower main bush of the driving shaft, fly-wheel side, features a lubrication hole (11).

- ◆ Once assembled, make sure the lubrication hole (11) on the main bush is lined up with the engine casing.

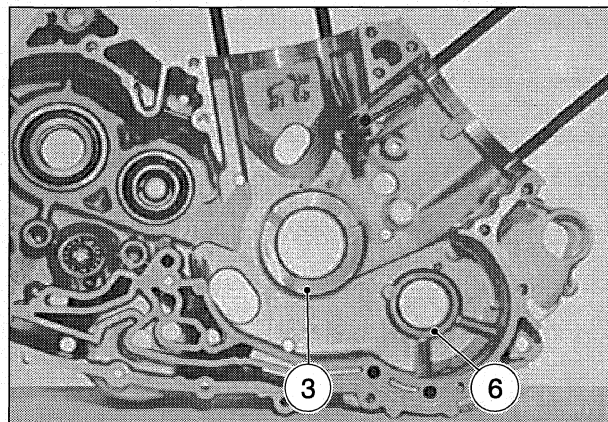


⚠ CAUTION

Should the main bushes be assembled incorrectly, they must be removed using the disassembly punch, as described above, see **DISASSEMBLY**.

Disassembled main bushes must not be reused.

M = MOLYKOTE® G-N.



4.5 REPLACING THE ENGINE HALF-CASING CYLINDRICAL PINS

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Use a micrometer to check the wear of the cylindrical pins (1) (2) of the starter motor drive assembly and (3) coolant pump idler gear.

Wear limit \varnothing 9.990 mm.

4.5.1 REMOVING THE PINS

- ◆ Should the cylindrical pin prove worn, during disassembly, heat the peripheral range of the cylindrical pin slot on the outer wall of the engine half-casing with a jet of hot air (4) (approx. 100 °C – 212 °F); next, pull the cylindrical pin out with a pair of pliers, rotating it upwards.

4.5.2 INSTALLING THE PINS

- ◆ With due care, insert the cylindrical pins all the way in using a plastic hammer. Coat the cylindrical pin (3) of the coolant pump idler gear with LOCTITE® 648.

NOTE Insert the cylindrical pin (5) of the needle spring with the chamfered part external.

4.6 NEUTRAL GEAR INDICATION

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Make sure the contact pin (6) of the contact screw (7) slides smoothly and check the preloading of the spring.

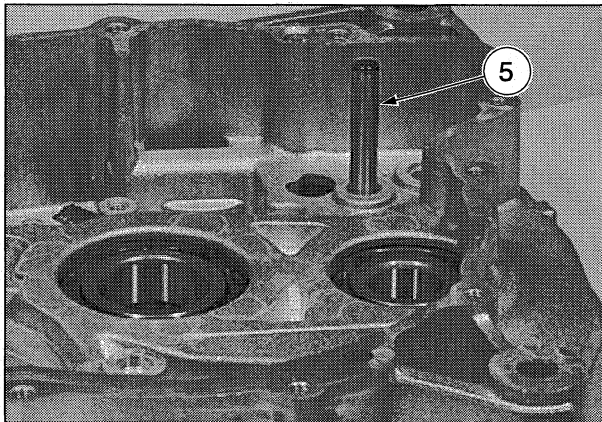
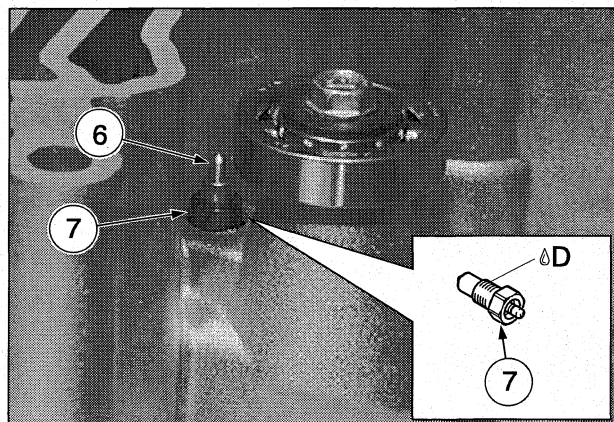
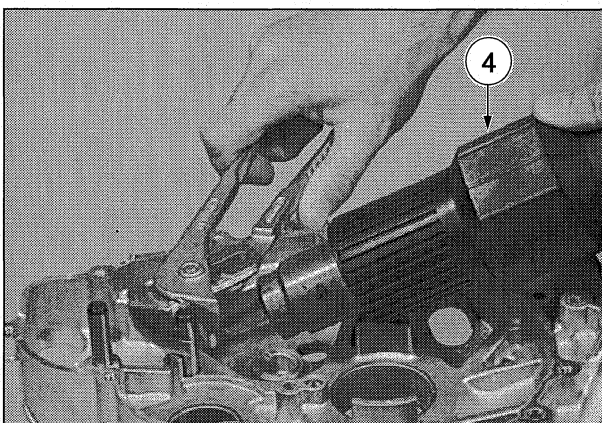
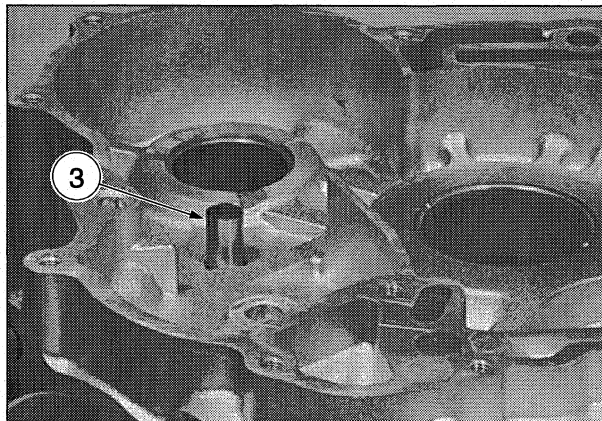
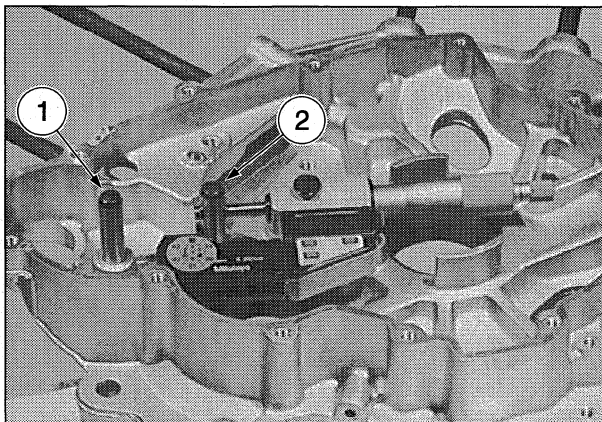
⚠ CAUTION

The cap on the pin must not be worn. Where necessary, replace the contact screw.

- ◆ If the contact screw (7) is replaced, it must be coated with LOCTITE® 574.

Screw (7) driving torque: 4 Nm (0.4 kgm).

D = LOCTITE® 574.



4.7 ASSEMBLING THE ENGINE HALF-CASING

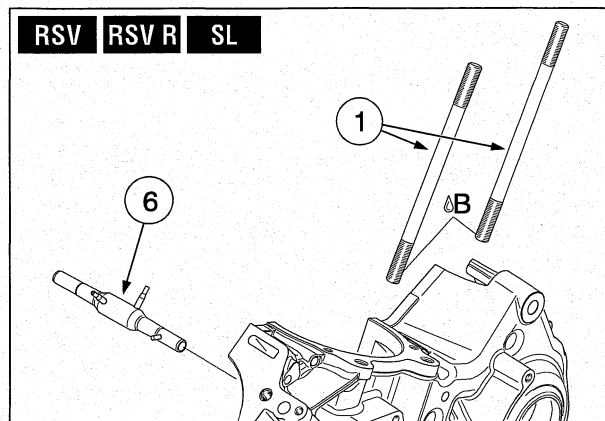
- ◆ **RSV RSV R SL** Should a stud bolt (1) need replacing, coated with LOCTITE® 243 and the new one must be screwed on all the way.
- ◆ **RST ETV** Should a stud bolt (1) need replacing, coated with LOCTITE® 648 and the new one must be screwed on all the way.

Stud bolt (3) driving torque: 10 Nm (1.0 kgm).

- ◆ Screw on the nozzle (2).
- ◆ Fasten the M6 T.C.E.I. screw (3) together with the seal (4).

Screw (4) driving torque: 6 Nm (0.6 kgm).

- ◆ Insert the oil gauze (5).



4.8 COMPLETE OIL-SPRAY PIPE

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

4.8.1 REMOVING THE OIL-SPRAYING PIPE

- ◆ Heat the peripheral range of the oil-spray pipe (6) on the engine casing using a jet of hot air (approx. 100 °C – 212 °F) before removing it using a pair of pliers to rotate it up and out.

4.8.2 INSTALLING THE OIL-SPRAYING PIPE

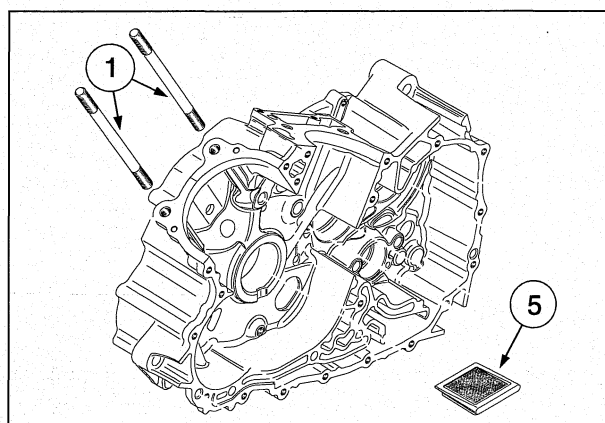
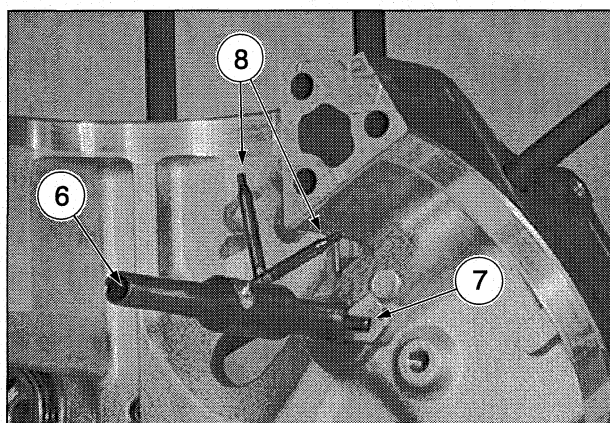
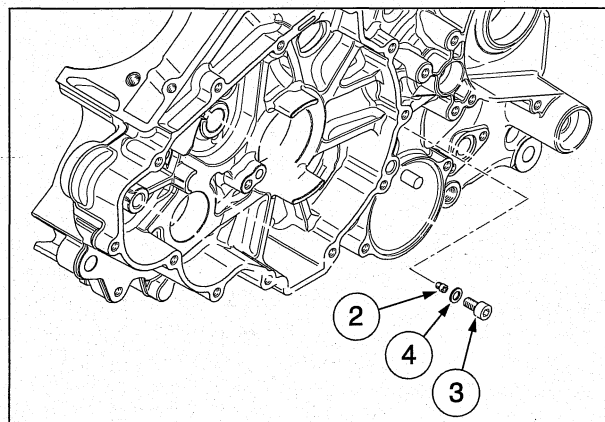
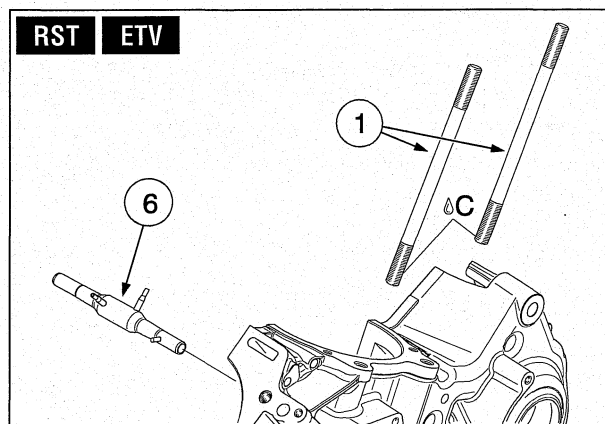
NOTE There is a special slot (7) incorporated into the engine casing for correctly housing the oil-spray pipe (6).

⚠ CAUTION

Take care not to damage the nozzles (8).

- ◆ Keep the oil-spray pipe (6) in place and insert it into the engine casing, flywheel side (7).

B = LOCTITE® 243.
C = LOCTITE® 648.



4.9 OIL PUMP AND OIL PUMP DRIVE ASSEMBLY

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

⚠ CAUTION

The oil pump gears, both driving (1) and driven (2), must always be replaced once they have been disassembled.

NOTE The oil pump drive gear (1) is attached to the support plate of the complete clutch housing.

4.9.1 TAKING THE OIL PUMP APART

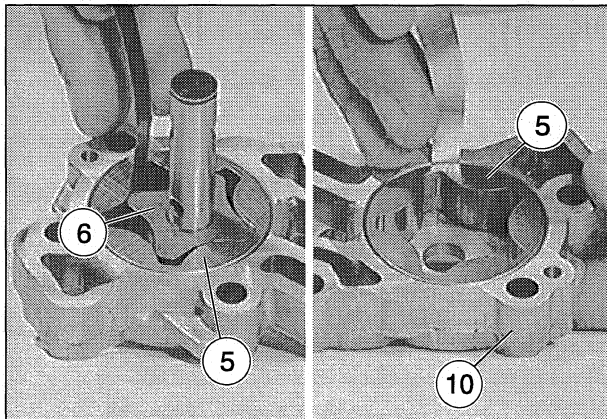
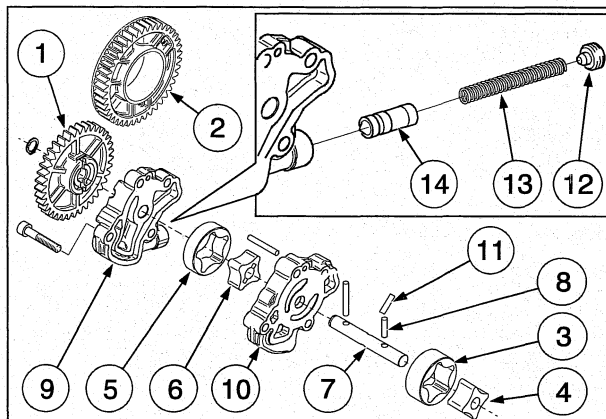
◆ Remove the oil pump apart, see 3.13 (REMOVING THE OIL PUMP).

NOTE Store the following assemblies, keeping them separate:

- outer rotor (3) inner rotor (4) (of the suction pump);
- outer rotor (5) inner rotor (6) (of the pressure pump).

Do not mix the components of these assemblies.

- ◆ Remove the suction pumps internal rotor (4) from the oil pump shaft (7).
- ◆ Remove the pin (8).
- ◆ Slip off the oil pump lid (9).
- ◆ Remove the pin (6).
- ◆ Remove the pressure pumps external rotor (5).
- ◆ Remove the oil pump shaft (7) from the pressure pump casing (10).
- ◆ Remove the pressure pumps internal rotor (6) and pin (11).
- ◆ Unscrew the plug (12) and remove the compression spring (13) with the adjusting piston (14).



4.9.2 CHECKING THE OIL PUMP

- ◆ Check the oil pump rotors, the sliding surfaces of the external rotors in both pump casings and the thrust-bearing surfaces for any signs of grooving.
- ◆ Using a feeler gauge, measure the free play between:
 - outer rotor (3) of the suction pump and engine crankcase (16);
 - outer rotor (5) of the pressure pump and body of the pressure pump (10).

max. wear limit 0.25 mm.

- ◆ Measure the end play (17) of the rotors.

Max. wear limit 0.15 mm.

NOTE If the play exceeds one of the two wear limits, the defective component must be replaced.

- ◆ Make sure the adjusting piston (14) slides smoothly in the oil pump lid (9).
- ◆ Check the adjusting piston and oil pump lid for any signs of wear:

- adjusting piston (14);

wear limit (18) min. \varnothing 9.975 mm;

- oil pump lid (9);

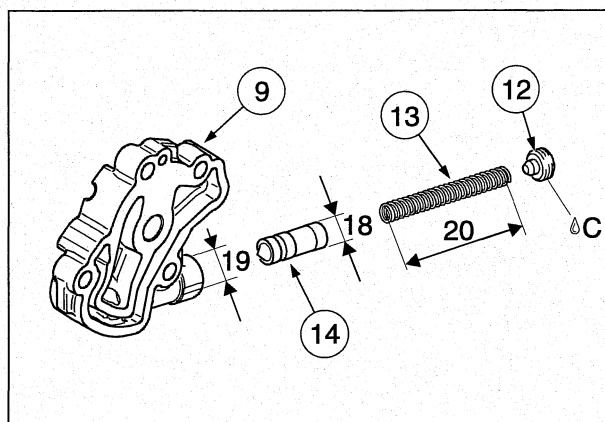
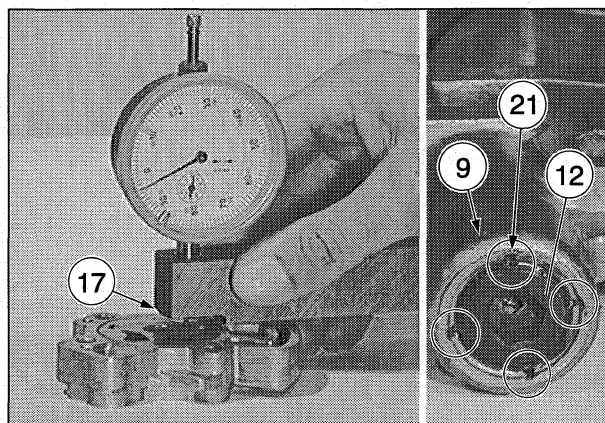
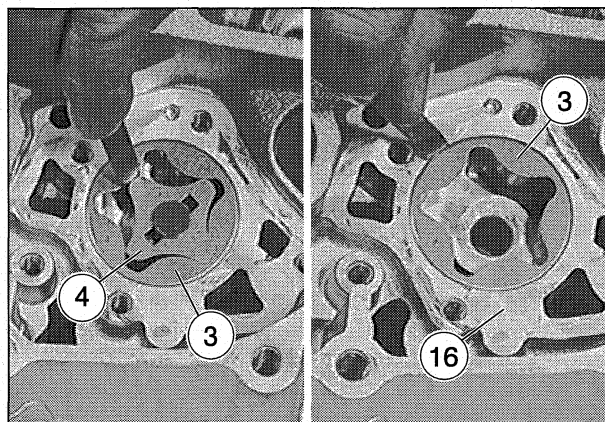
wear limit (19) max. \varnothing 10.035 mm;

- compression spring (13);

minimum length of the spring (20) when not compressed: 56.0 mm.

- ◆ Engage the adjusting piston (14) with the cone end facing forwards and insert the compression spring in the slot on the oil pump lid (9).
- ◆ Apply LOCTITE® 648 on the caps thread (12).
- ◆ Screw the cap (12) 2 mm further in than the outer edge of the neck of the oil pump lid (9) and secure it in place by punching in four more points (21).

C = LOCTITE® 648



4.10 DRIVING SHAFT

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

Check the wear of the driving shaft:

- main bush area (engine crankcase) (1);
wear limit min. \varnothing 45.955 mm;
- support bush area (flywheel cover) (2);
wear limit min. \varnothing 29.970 mm;
- area of the freewheel gear bearing (3);
wear limit min. \varnothing 34.960 mm;
- connecting rod small end (4);
wear limit max. \varnothing 22.030 mm;
- end play between connecting rod and crank arm (5);
max. limit 0.60 mm;

NOTE Measure the eccentricity of the driving shaft between the ends.

- driving shaft eccentricity, flywheel side (6);
max. limit 0.020 mm;
- driving shaft eccentricity, clutch side (7);
max. wear limit 0.020 mm.

NOTE Do not reuse the engine crankcase gaskets after they have been removed.

Use exclusively new original **aprilia** gaskets.

NOTE Use a comparator to determine the end play of the driving shaft once the two halves of the casing are coupled.

End play of the driving shaft max. 0.5 mm.

- ◆ Determine the radial play (8) of the connecting rod small end by means of a comparator.

Max. wear limit 0.060 mm.

- ◆ Measure the radial play between the main bushes (engine crankcase) and the corresponding areas of the drive shaft (1).

Permissible radial play max. 0.060 mm.

The radial play is determined based on the following values:

maximum value of the inner diameter of the main bushes (engine crankcase) minus diameter of the main bush area (engine crankcase) on the drive shaft.

- ◆ Measure the inner diameter of the main bushes (engine crankcase), see 4.4 (DRIVE SHAFT MAIN BUSHES AND BALANCE SHAFT MAIN BUSHES).

⚠ CAUTION

If the max. permissible radial play is exceeded, the worn part must be replaced.

- ◆ Measure the radial play between the support bushes (clutch cover) and the corresponding area of the drive shaft (2).

Permissible radial play max. 0.065 mm.

The radial play is determined based on the following values:

maximum value of the inner diameter of the support bushes (clutch cover) minus diameter of the support bush area (clutch cover) on the drive shaft.

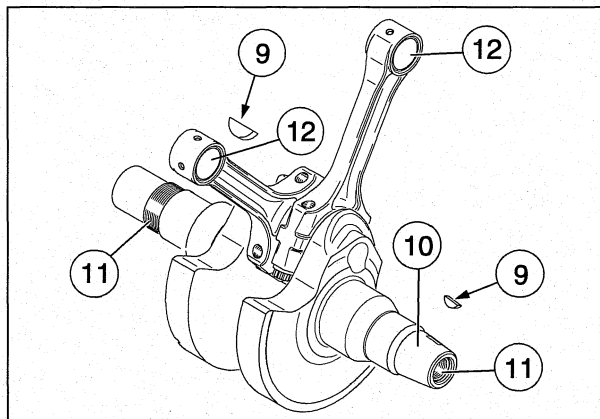
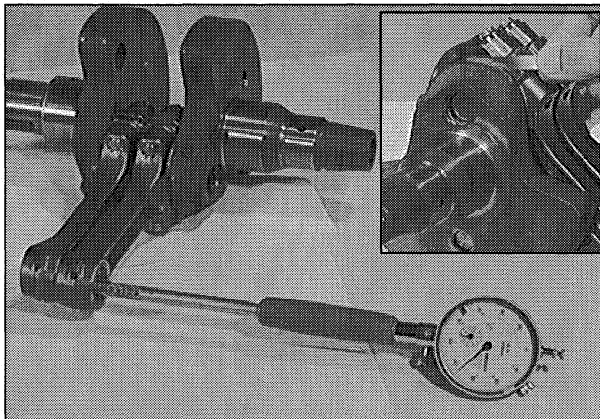
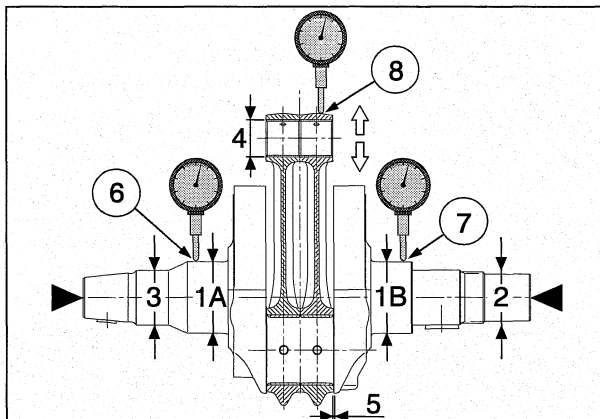
- ◆ Measure the inner diameter of the support bushes (clutch cover), see 3.9 (REMOVING THE CLUTCH COVER).

⚠ CAUTION

If the max. permissible radial play is exceeded, the worn part must be replaced.

Following components must also be checked for wear or broken material:

- ◆ Key (9) and grooves in the driving shaft.



- ◆ Colouring of a bearing housing.
- ◆ Conical surface (10) of the drive shaft - flywheel side.
- ◆ Clean the thread (11) of any LOCTITE® residues and make sure it is in a perfect state of repair.
- ◆ Check to make sure the bush (12) inside the connecting rod small end is correctly installed and centred (on the longitudinal axis).

4.11 DISASSEMBLING THE CONNECTING RODS

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

⚠ CAUTION

Before disassembling the connecting rods (1) and covers (2), mark them so they are refitted in the same position (front and rear cylinder) and with the same direction of rotation.

- ◆ Unscrew and remove the M10x1 connecting rod screws (3) and detach the connecting rod cover (2), tapping lightly with a plastic hammer.
- ◆ Remove the connecting rod screws with the cover and connecting rod (1).
- ◆ Clean the driving shaft lubrication holes.
- ◆ Check the bushes (4) for signs of wear, distortion and altered colouring.
- ◆ Check the connecting rod housing for wear:
 - connecting rod pins (5);**wear limit min. \varnothing 41.98 mm;**
 - connecting rod big end (6);**wear limit max. \varnothing 42.050 mm.**

⚠ CAUTION

Measure the diameter of the connecting rod big end.

Fasten the cover (2) with the connecting rod M10x1 screws (3).

Screws (3) driving torque: see 4.12 (REPLACING AND INSTALLING THE CONNECTING RODS).

⚠ CAUTION

The fastening of the connecting rod M10x1 screws (3) will require the use of a setting dial (7) and a fitting for a size 12 socket spanner.

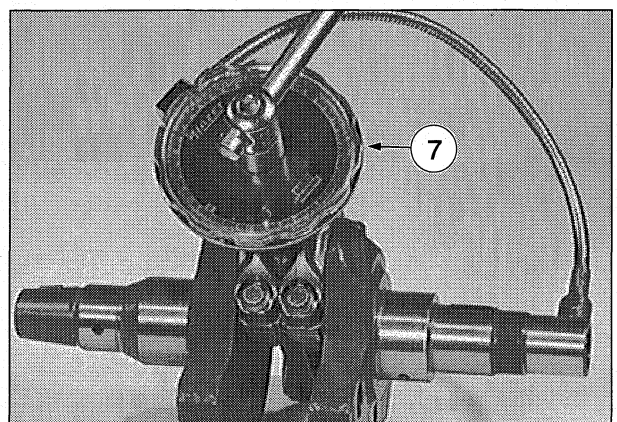
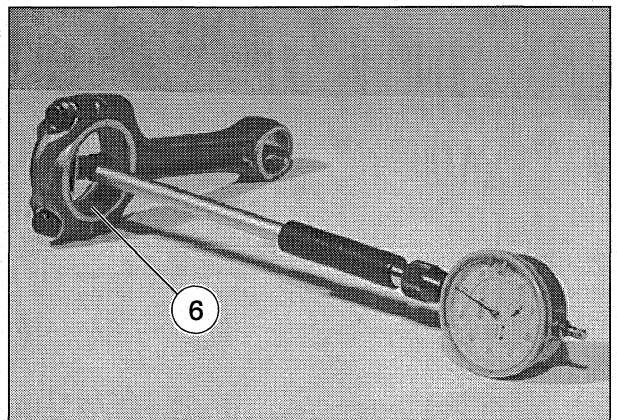
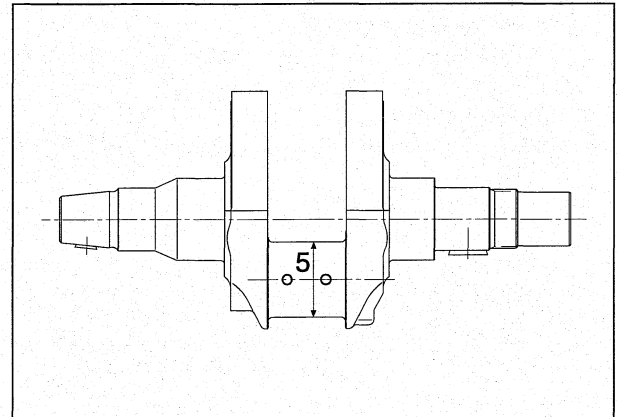
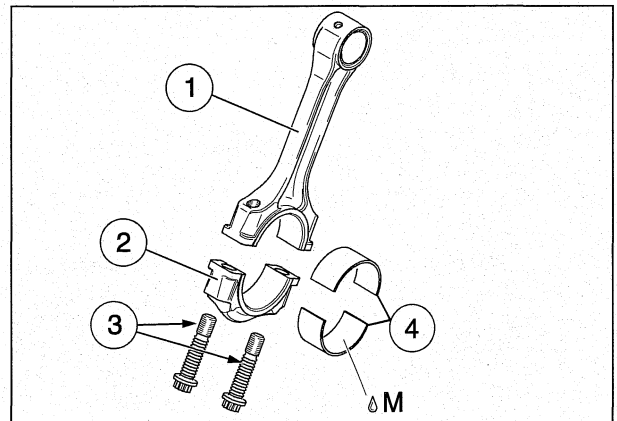
NOTE None of the values may exceed the limit value. In the event of wear, the whole connecting rod, complete with cover, must be replaced.

- ◆ Measure the radial play of the connecting rod big end (6).

Max. wear limit 0.070 mm.

NOTE The radial play of the driving shaft is calculated based on the following values:
maximum value of the diameter of the bushes minus the diameter of the coupling shaft.

NOTE The radial play of the connecting rod big end may also be measured with the aid of a plastic gauge. If a plastic gauge is used, the connecting rod must be kept still.



4.12 REPLACING AND INSTALLING THE CONNECTING RODS

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE The complete connecting rods supplied as spare parts include bushes in all three sizes (see table). The bushes are marked, according to size, in red, blue and yellow (4).

- ◆ Insert the bushes with the minimum thickness (red) between the connecting rod (1) and the cover (2), taking care to position them correctly (3). Line the bushes up on a flat surface.
- ◆ Insert the connecting rod and cover on the driving shaft so that the two reference points (5) and piece number (6) coincide on the two connecting rods.
- ◆ Fasten the cover (2) with the old M10x1 screws (7) in three phases.

1st phase (pre-tightening):

- tighten the two screws with a driving torque of 2 Nm (0.2 kgm);

2nd phase (tightening):

- tighten the two screws with a driving torque of 30 Nm (3.0 kgm);

3rd phase (final tightening):

- tighten the two screws by 70°.

⚠ CAUTION

The fastening of the M10x1 screws (7) will require the use of a goniometer (8) and a ring socket spanner.

- ◆ Measure the radial play (9) of the connecting rod end with a comparator.

Radial play 0.020 – 0.045 mm.

If the radial play is greater than 0.045 mm, the bushes of the size corresponding to the colours blue or yellow must be chosen based on the following table, and must be inserted in place of the red bushes.

Bush colour	Thickness (mm)
Red	1.471 – 1.476
Blue	1.476 – 1.481
Yellow	1.481 – 1.486

- ◆ Unscrew the screws (7).
- ◆ Lubricate the bushes and pins.

NOTE Use new M10x1 screws (7) only.

- ◆ Lubricate the supporting surfaces of the heads of the new screws (7).
- ◆ Fasten the cover (2) in the three phases described above, using the two new M10x1 screws (7).

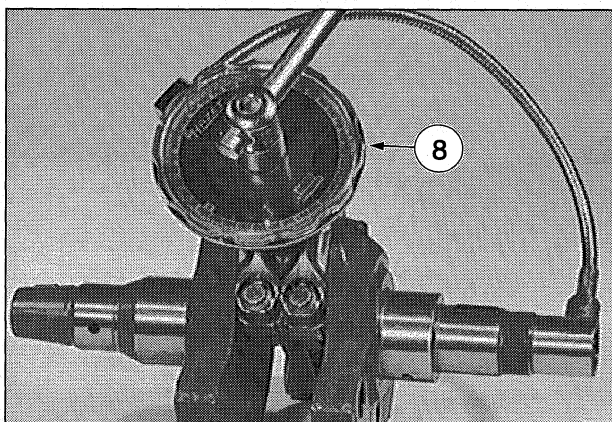
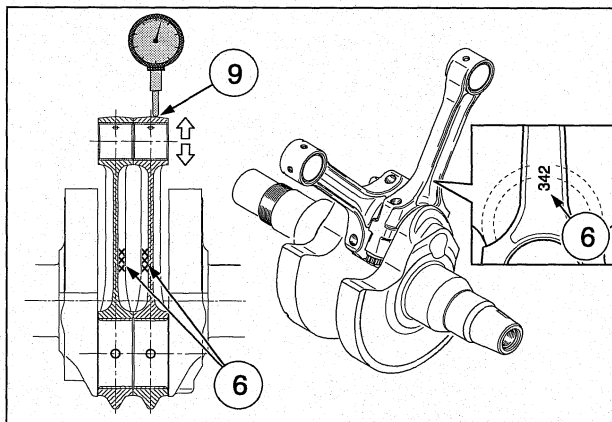
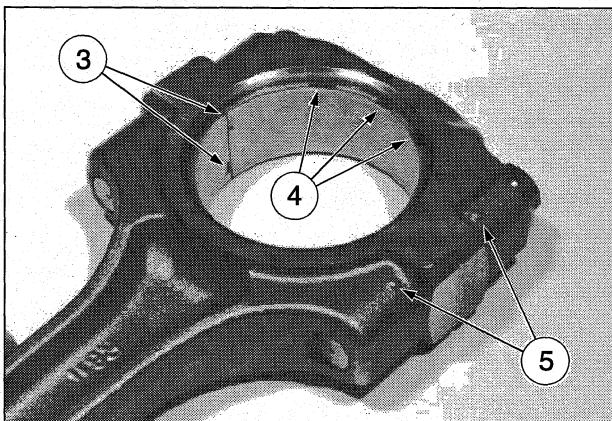
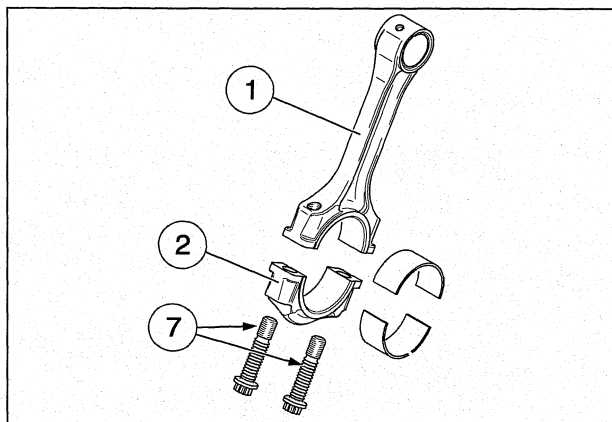
⚠ CAUTION

The fastening of the M10x1 screws (7) will require the use of a goniometer (8) and a ring socket spanner.

- ◆ Check the radial play (9) again.

Radial play 0.020 – 0.045 mm.

- ◆ Make sure the connecting rods do not encounter any friction during the stroke.



4.13 COUNTERSHAFT AND COUNTERSHAFT MECHANISM

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

Check the wear of the countershaft:

- main bush area (engine crankcase) (1);
wear limit min. \varnothing 31.980 mm;
- support bush area (clutch cover) (2);
wear limit min. \varnothing 19.990 mm.

CAUTION

If the max. permissible radial play is exceeded, the worn part must be replaced.

- ◆ Measure the radial play between the main bushes (engine crankcase) and the corresponding areas of the balance shaft (1).

Permissible radial play min. \varnothing 0.060 mm.

The radial play is determined based on the following values:

maximum value of the inner diameter of the main bushes (engine crankcase) minus value of the diameter of the corresponding areas of the main bushes (1) on the balance shaft.

- ◆ Measure the inner diameter of the main bushes (engine crankcase), see 4.4 (DRIVE SHAFT MAIN BUSHES AND BALANCE SHAFT MAIN BUSHES).

CAUTION

If the max. permissible radial play is exceeded, the worn part must be replaced.

- ◆ Measure the radial play between the support bushes (clutch cover) and the corresponding area of the balance shaft (2).

Permissible radial play min. \varnothing 0.060 mm.

The radial play is determined based on the following values:

maximum value of the inner diameter of the support bushes (clutch cover) minus value of the diameter of the corresponding area of the support bushes (2) on the balance shaft.

- ◆ Measure the inner diameter of the support bushes (clutch cover), see 3.9 (REMOVING THE CLUTCH COVER).

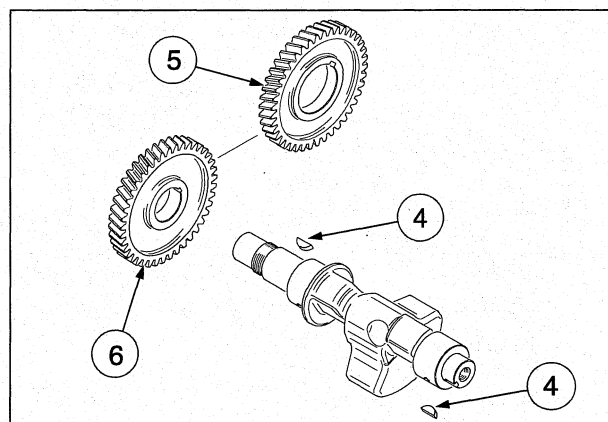
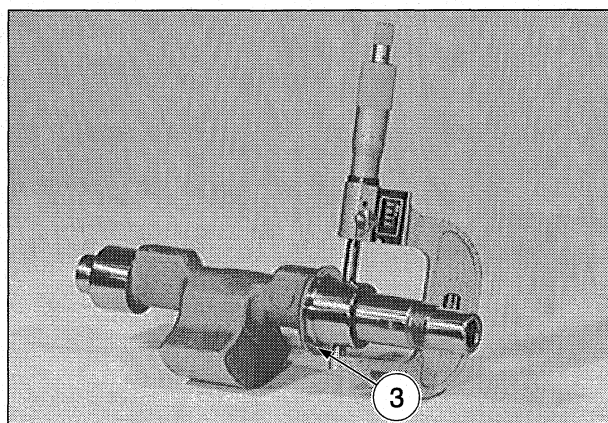
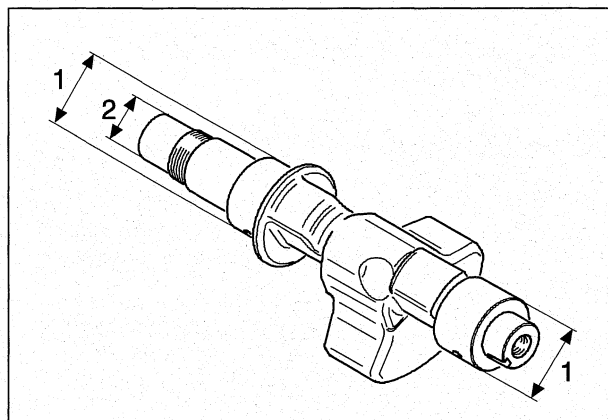
NOTE Once the two halves of the engine casing have been coupled, check the end play of the countershaft with a comparator.

Permissible radial play of the countershaft max. 0.30 mm.

Following components must also be checked for wear or broken material:

- axial thrust-bearing surfaces (3);
- key (4) and grooves in the countershaft;
- colouring of a bush housing.
- ◆ Clean the thread of any LOCTITE® residues and make sure it is in a perfect state of repair.
- ◆ Check the sides of the teeth of the driving gear (5) and driven gear (6) for any signs of broken material or distortion.

NOTE To check the main bushes (engine crankcase), see 4.4 (DRIVE SHAFT MAIN BUSHES AND BALANCE SHAFT MAIN BUSHES) and to check the support bushes (clutch cover), see 3.9 (REMOVING THE CLUTCH COVER).



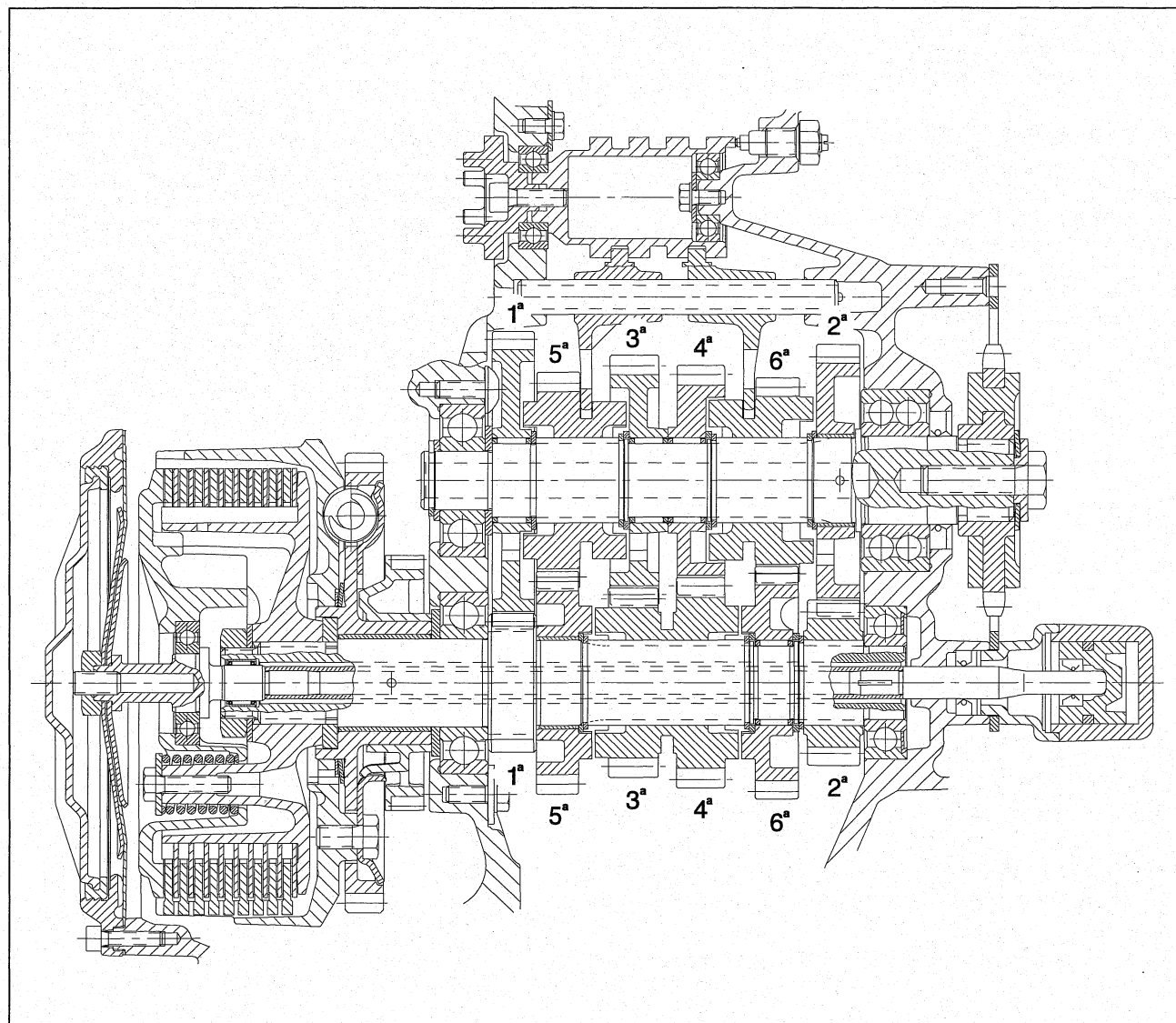
4.14 TRANSMISSION

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

⚠ CAUTION

When taking the gearshift apart, set the disassembled components down according to the assembly position, assigning them to the corresponding shaft so as to be sure they are reassembled and installed correctly.

Following disassembly, the seeger rings must always be replaced.

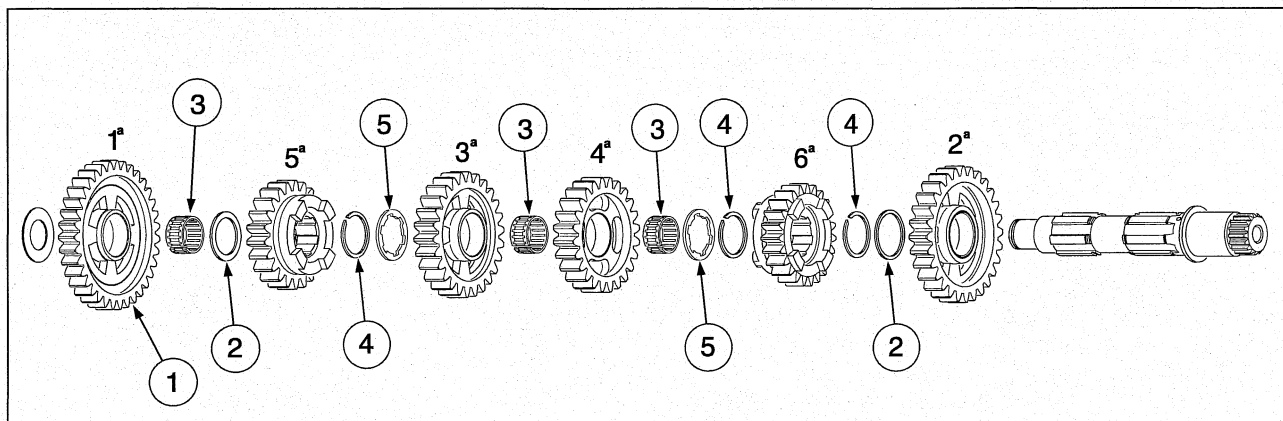


4.14.1 DISASSEMBLING THE GEARBOX

Secondary shaft

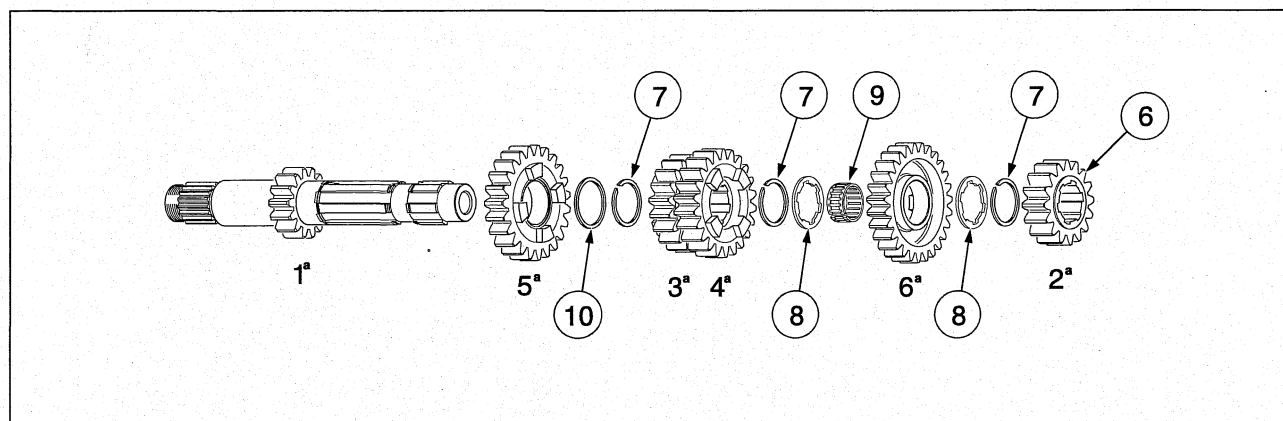
Use crimpers to remove the seeger rings (4).

- ◆ Remove the gearshift gears from the secondary shaft, starting with the idle gear of 1st gear (1) and then moving on to the shim washers (2), roller cages (3), seeger rings (4) and shim rings (5).

**Primary shaft**

Use crimpers to remove the seeger rings (7).

- ◆ Remove the gears from the primary shaft, starting with the fixed gear of 2nd gear (6) and then moving on to the seeger rings (7), shim rings (8), the roller bearing (9) and shim washer (10).



4.14.2 CHECKING THE GEARBOX

◆ Check the following components for wear:

- roller bearings (3) (9);

⚠ CAUTION

Do not reuse the needle bearings (3) (9).

The needle bearings (3) (9) must be replaced every time they are removed.

- sides of the teeth (11) of all gears.

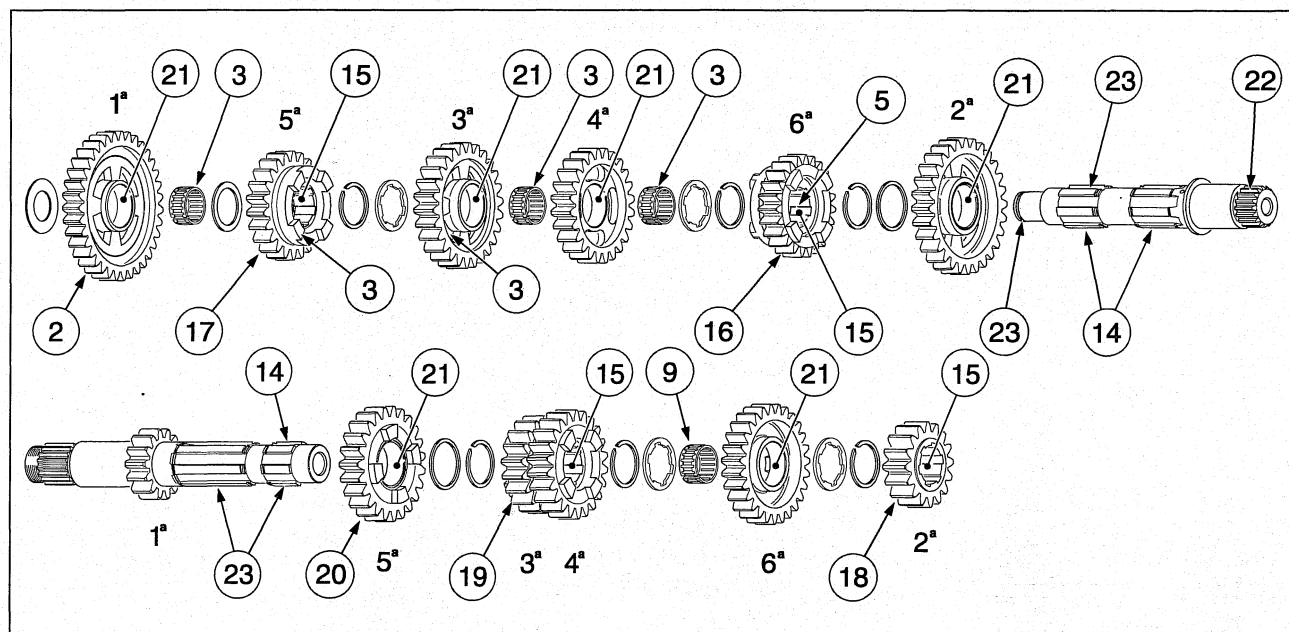
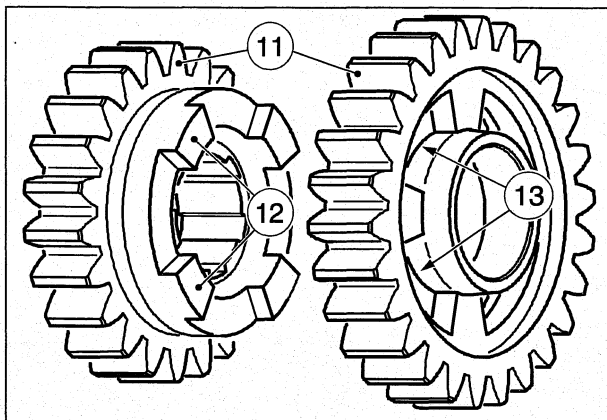
NOTE Y marks and tiny hollows are tolerated up to a maximum corresponding to approx. 0.5% of the sides surface area.

NOTE Should the sides of the teeth be worn, the relevant pair of gears must be replaced.

Should the engagement teeth or mating slots prove worn, the relevant gears must be replaced, mating with each other.

- clutch claws (12) and clutch holes (13) of all gears;
- grooved profiles (14) of the gearbox input and output shafts;
- grooved profiles (15) of the change gears;
- check all the gear selection gears:
 - on the gearbox output shaft, gears (16) (17);
 - on the gearbox input shaft, gears (18) (19) (20);
- make sure that there are no rolling traces and grooves on the seats of the idle gear bearings (21);
- triangular tooth profile (22) for chain pinion;
- the grooves for seeger rings (23) on the secondary shaft and on the primary shaft must have sharp edges.

Follow ►



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◆ Check the housings of the secondary shaft:

- housing (24) wear limit min. \varnothing 19.972 mm;
- housing (25) wear limit min. \varnothing 29.915 mm;
- housing (26) wear limit min. \varnothing 29.030 mm;
- housing (27) wear limit min. \varnothing 24.978 mm;
- housing (27A) wear limit min. \varnothing 24.978 mm.

◆ Check the housings of the primary shaft:

- housing (28) wear limit min. \varnothing 29.965 mm;
- housing (29) wear limit min. \varnothing 24.972 mm;
- housing (30) wear limit min. \varnothing 29.030 mm;
- housing (31) wear limit min. \varnothing 24.978 mm.

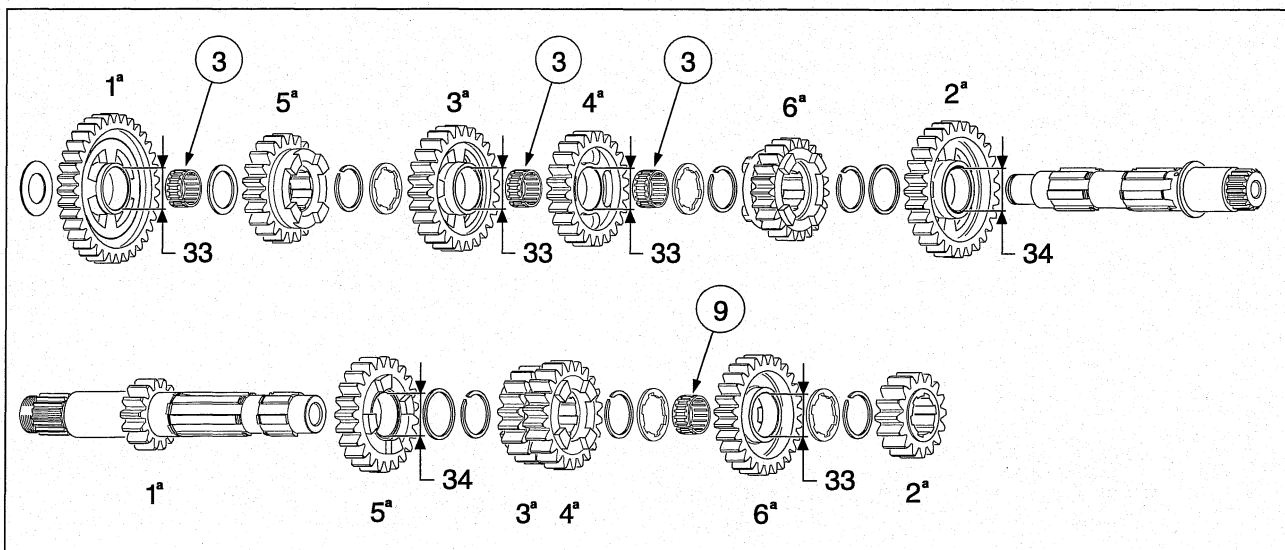
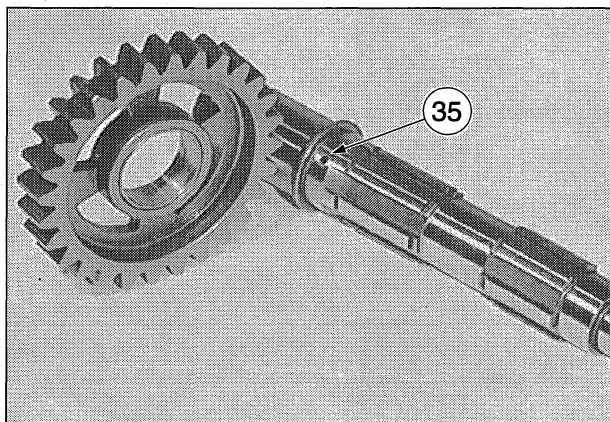
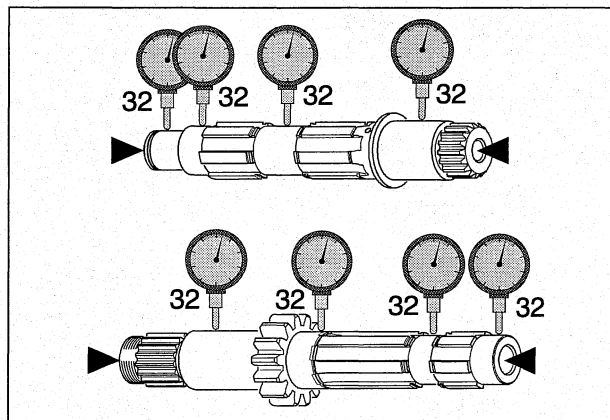
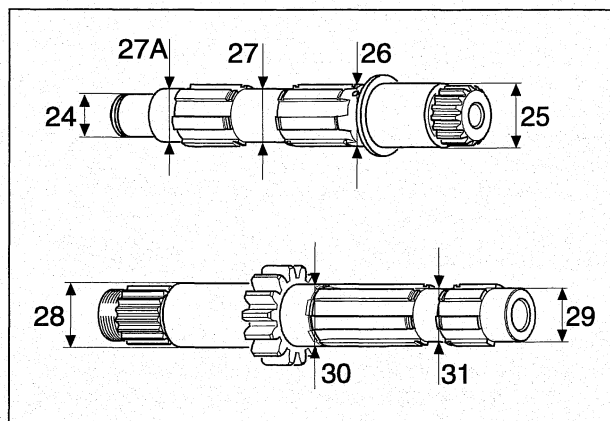
◆ Check the eccentricity (32) of all the seats of the gearbox input and output shafts:

- for all seats, eccentricity allowed \varnothing max. 0.020 mm.

◆ Make sure that there are no rolling traces and grooves on the above mentioned seats of the gearbox input and output shafts.

◆ Check the internal diameter (33) of the idle gears of 1st, 3rd, 4th and 6th gear.wear limit max. \varnothing 29.022 mm.◆ Check the internal diameter (34) of the idle gears of 2th, and 5th gear.Wear limit max. \varnothing 29.125 mm.

◆ Make sure the lubrication hole (35) of the secondary shaft is clear.



4.14.3 ASSEMBLING THE GEARBOX

- ◆ Moderately oil the gearbox output and input shafts, the gears and the needle cages.
- ◆ Reassemble the secondary shaft and primary shaft in the reverse order, see 4.14.1 (DISASSEMBLING THE GEARBOX).
- ◆ Fit the seeger ring, using the plier for seeger ring only.

⚠ CAUTION

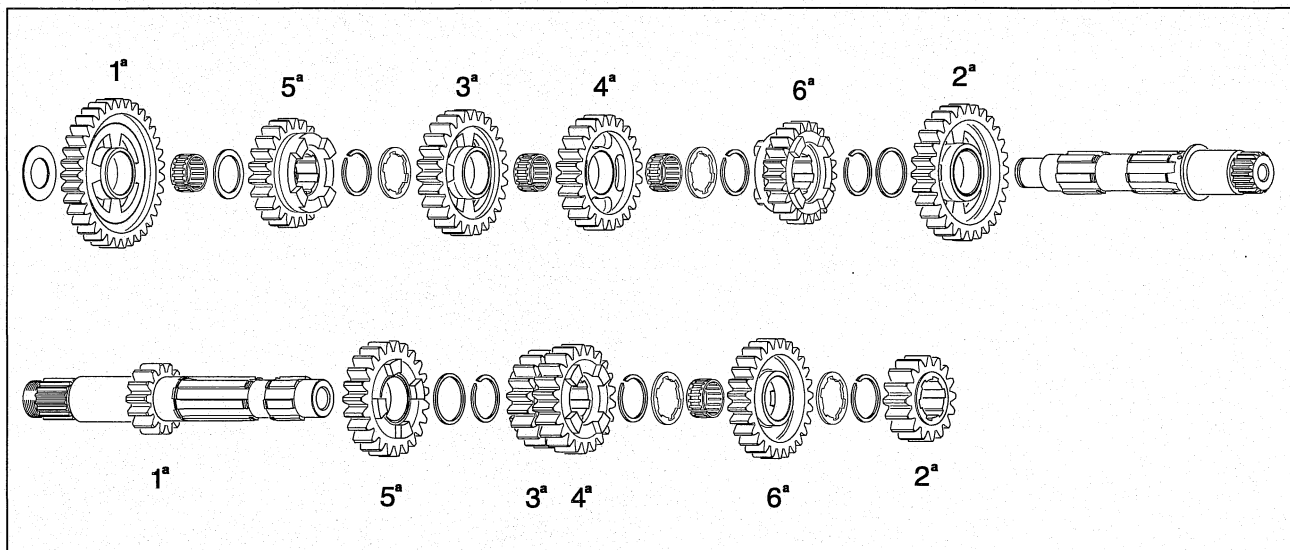
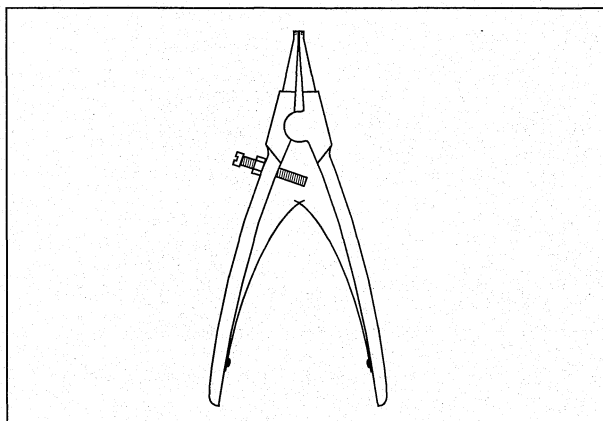
Do not reuse the seeger rings.

The seeger rings must be replaced every time the gearshift is taken apart.

Pull the ends of the seeger rings apart just enough to be able to slide the ring on the shaft. If the seeger ring is pulled apart too much, its locking effect is irreparably reduced.

Make sure the seeger rings are properly installed in the corresponding groove.

- ◆ Once the two gearshift shafts have been assembled, make sure the gears turn smoothly.



4.15 GEAR SELECTION

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Check the end play (1) of the gearshift forks inside the corresponding grooves in the selection gears.

Max. wear limit 0.15 mm.

NOTE If the wear limit is exceeded, you must determine which component needs replacing by checking the gearshift forks and selection gears.

- ◆ Width of the groove (2) of the selection gears.

Max. wear limit 4.35 mm.

- ◆ Thickness (3) of the gearshift forks. Check the degree of wear on the chromium-plated thrust-bearing surfaces of the gearshift forks.

Max. wear limit 3.950 mm.

NOTE If the chromium finish is missing in some points, replace the fork in question.

- ◆ Check the diameters (4) of the gearshift fork guide pins.

Wear limit min. \varnothing 5.850 mm.

- ◆ Check the eccentricity of the two fork shafts (5).

Max. permissible eccentricity 0.02 mm.

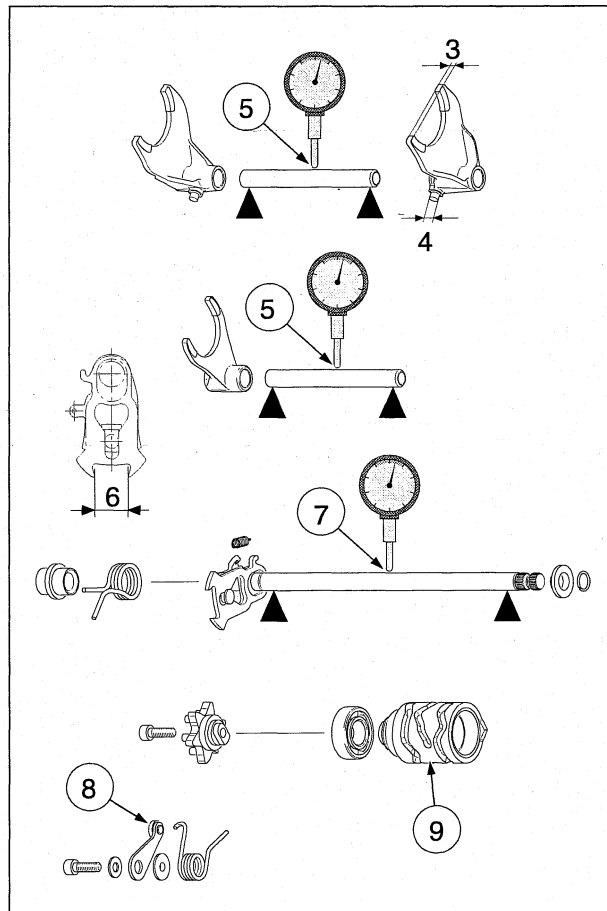
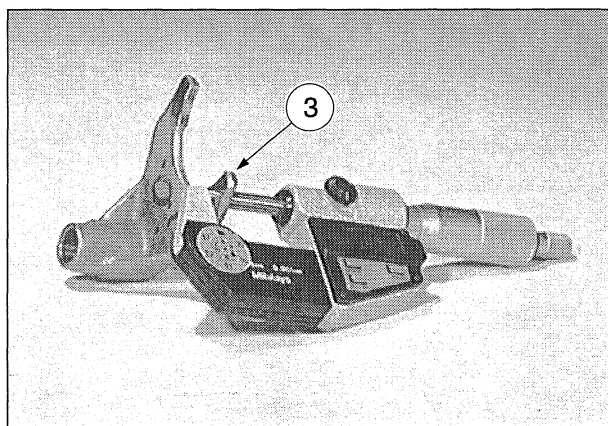
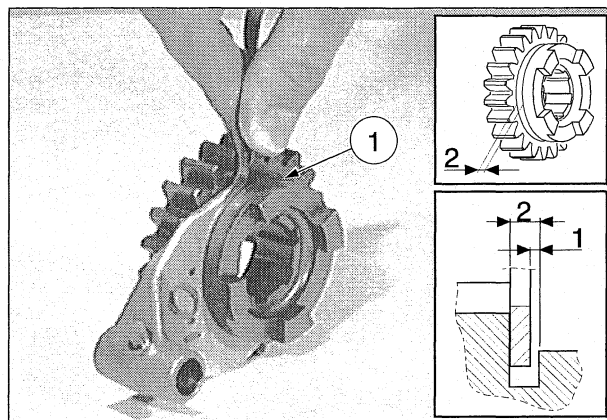
- ◆ Check the wear of the ratchet gear in the area in which it comes into contact with the index plate pins.

Wear limit (6): visual inspection.

- ◆ Check the eccentricity of the selector shaft (7) and also check for any signs of rolling on the sliding surface of the shaft sealing ring.

Max. permissible eccentricity 0.25 mm.

- ◆ The roller (8) of the positioning lever must turn freely.
- ◆ Check the wear of the guide tracks (9) of the shift cam.



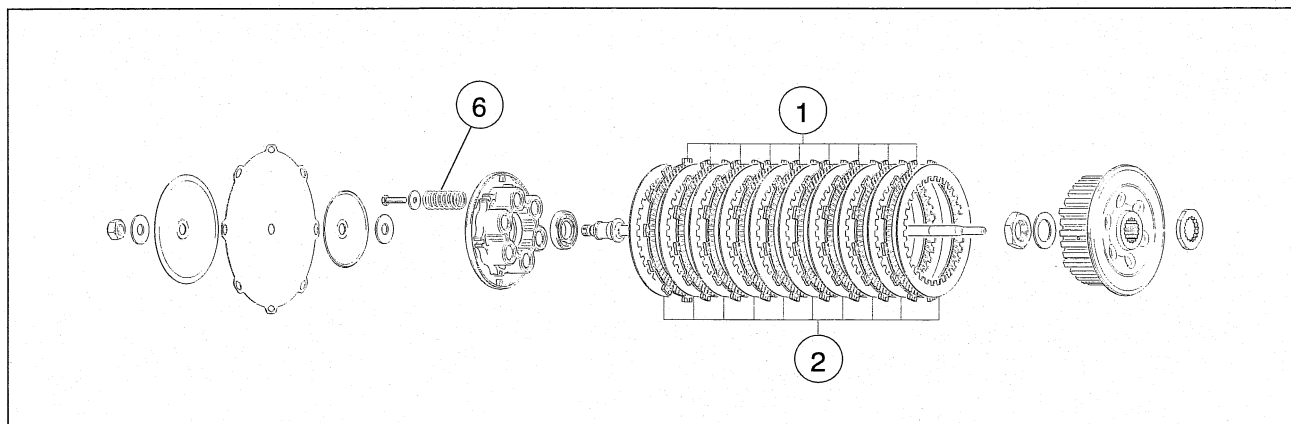
4.16 CLUTCH (VERSIONS)

NOTE There are different clutch versions.

For information regarding the components of the clutch, refer to the specific spare parts catalogue, according to the vehicle model on which the engine is installed, see 0.4.2 (SPARE PARTS CATALOGUES).

For the clutch check, see 4.17 (CHECKING AND TOPPING UP THE CLUTCH).

4.17 CHECKING THE CLUTCH



NOTE The information given below is valid for all clutch versions.

For the clutch versions, see 4.16 [CLUTCH (VERSIONS)].

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Check the lined discs (1) and steel discs (2) for cracks or any distortion (3) by placing them on a flat surface.

Max. permissible distortion (3): 0.15 mm.

NOTE The steel discs (2) must not present scores and temper colours.

- ◆ Measure the width (4) of the driving element.

Wear limit (4) min. 13.7 mm.

NOTE Check the wear of the clutch discs, measuring the entire clutch disc unit.

Do not measure the steel disc unit and the friction disc unit separately, since this is useless for the purpose of checking the wear.

- ◆ Measure (5) the entire clutch disc unit (comprising ten steel discs and nine friction discs).

Wear limit (5) min. 44.9 mm.

NOTE The wear of one or more clutch discs (steel or friction discs) requires the replacement of the entire clutch disc unit (comprising ten steel discs and nine friction discs).

No partial replacement (of the worn discs only) is allowed.

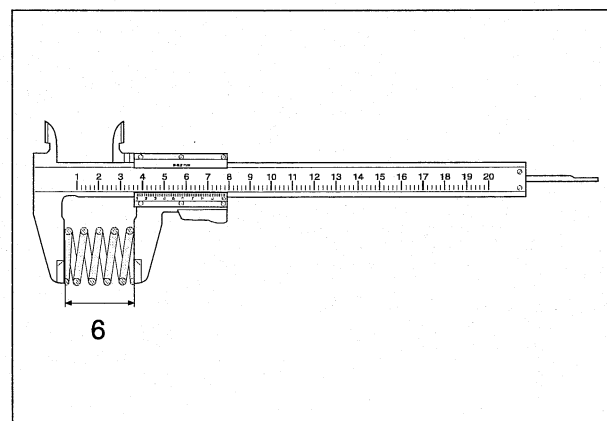
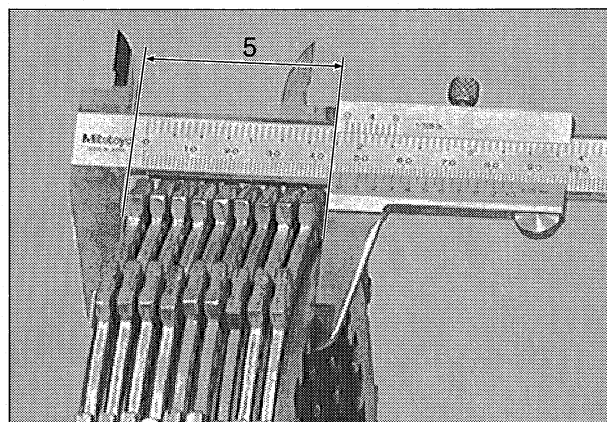
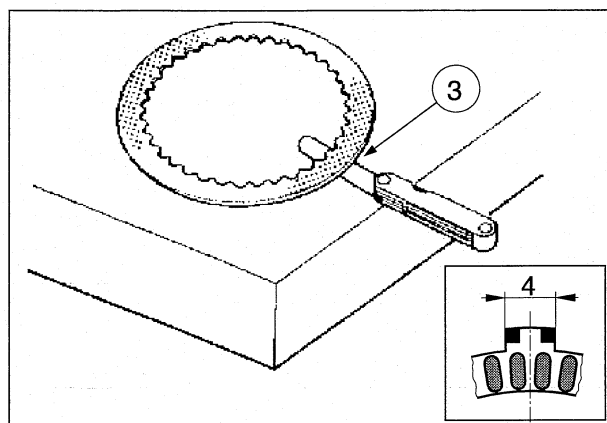
NOTE The replacement of the entire clutch disc unit requires also the replacement of the clutch spring unit. It is not possible to install a new clutch disc unit with an used spring unit.

- ◆ Measure the length of the individual clutch springs (6) in the released position.

Wear limit (6) min. 43.0 mm.

NOTE The wear of one or more clutch springs requires the replacement of all clutch springs. No partial replacement (of the worn springs only) is allowed.

Follow ►



Follow ►

- ◆ Check the smoothness and slack of the ball bearings (7) on the spring plate (8) and, where necessary, replace them.

NOTE When removing and refitting the ball bearings, heat the spring plate to 80 – 100 °C (176 – 212 °F) and use a suitable assembly punch.

- ◆ Check the compression surface (9) of the spring plate (8) for signs of wear and make sure it is flat.

Max. permissible distortion (9): 0.1 mm.

- ◆ Check the depth (10) of the spring plate.

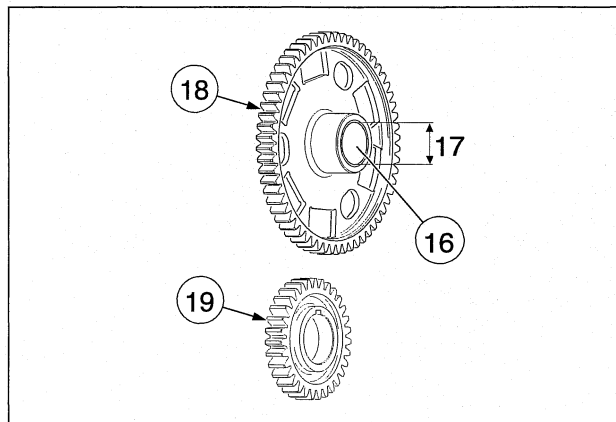
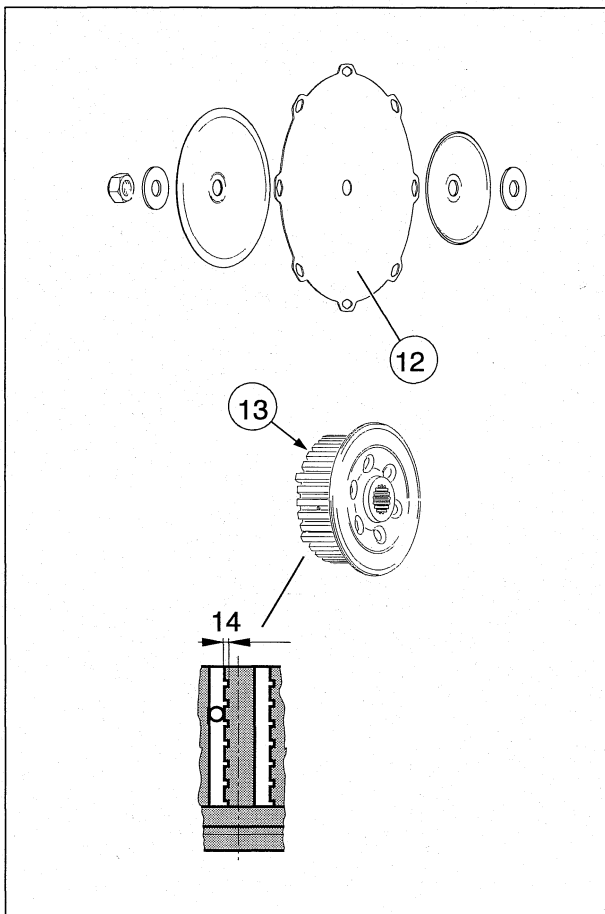
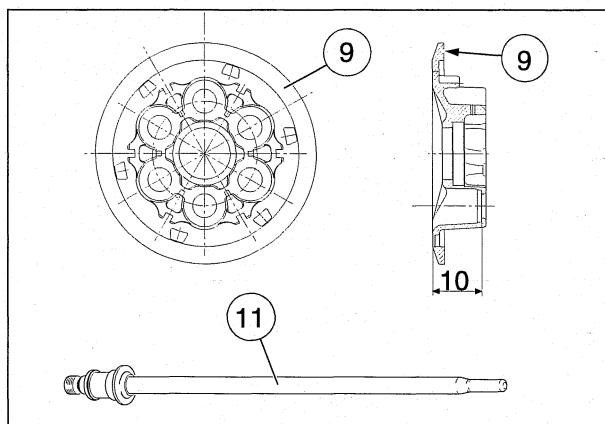
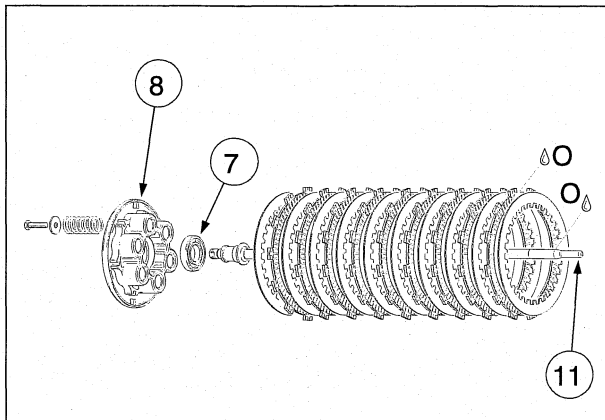
Wear limit (10) max. 33.5 mm.

- ◆ Check the eccentricity of the disengaging shaft (11), also checking for signs of rolling on the oil seal sliding surface.

- ◆ Check the diaphragm (12) for cracks and, where necessary, replace it.

- ◆ Check the external toothing of the clutch hub (13) for any dents (14).

Recess depth (14) max. 0.3 mm.



NOTE

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4.18 PRIMARY TRANSMISSION (VERSIONS)

NOTE There are different primary transmission versions.

Consult the paragraph corresponding to the vehicle model on which the engine is installed.

Vehicle	Model	Primary transmission	Paragraph
RSV	'98 - '99	aprilia part# 0295790	4.19.1 (PRIMARY TRANSMISSION aprilia part# 0295790)
	SP '99		
	2000		
	2001 USA		
RSV R	2000		
	2001 USA		
SL	2000 - 2001		
RST	2001 (up to engine aprilia part# 854075)		
RSV RSV R	2001 A AUS B CH D DK E F GR I J UK P	aprilia part# 0295792	4.19.2 (PRIMARY TRANSMISSION aprilia part# 0295792 and 0295793)
RST	2001 (as of engine aprilia part# 854076)		
ETV	2001		
RSV RSV R SL RST ETV	2001 (as of engine aprilia part# 954103)	aprilia part# 0295793	4.19.2 (PRIMARY TRANSMISSION aprilia part# 0295792 and 0295793)

NOTE Up to engine **aprilia** part# 954102 the primary transmission is coded as follows: **aprilia** part# 0295792. From engine **aprilia** part# 954103 the primary transmission is coded as follows: **aprilia** part# 0295793. Difference between the two codes: the primary transmission **aprilia** part# 0295793 is provided with an additional shim (**aprilia** part# 0627910).

Code **aprilia** part# 0295793 cancels and replaces code **aprilia** part# 0295792.

It is possible to install the additional shim (**aprilia** part# 0627910) on the primary transmission **aprilia** part# 0295792 (thus transforming it into code **aprilia** part# 0295793).

In case this replacement is performed, only the primary transmission code **aprilia** part# 0295793 will be available as spare part.

4.19 DISASSEMBLING THE PRIMARY TRANSMISSION

NOTE For information on the primary transmission versions, see 4.18 [PRIMARY TRANSMISSION (VERSIONS)].

4.19.1 PRIMARY TRANSMISSION *april*a part# 0295790

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

DISASSEMBLY

- ◆ Remove the primary transmission assembly from the primary shaft.
- ◆ Remove the washer (A) from the primary shaft.
- ◆ Slip off the oil pump drive gear (1).
- ◆ Unscrew and remove the three M8 T.E. screws (2) and remove the support plate (3).
- ◆ Remove the six compression rings (5) together with the twelve spring pins (6) from the clutch gear (4).
- ◆ Remove the clutch gear (4) with the spring washer (7) and the washer (8) from the clutch housing (9).

NOTE You are strongly recommended to replace all the compression springs (5) and spring pins (6) together.

- ◆ Measure the length of the spring housing in the clutch housing (9).

Wear limit (10) max. 32.65 mm.

PREASSEMBLY

- ◆ Insert the washer (8) and the spring washer (7) on the clutch housing (9).

⚠ CAUTION

Make sure the spring washer is positioned correctly. Fit it with the concavity facing the clutch gear (4).

- ◆ Place the clutch gear (4) on the clutch housing and insert the six compression springs (5) in the clutch gear slot using the two spring pins (6) respectively.
- ◆ Coat the M8 T.E. screws (2) with LOCTITE® 648.
- ◆ Apply the support plate (3) on the clutch gear (4) and fasten it with the three M8x16 T.E. screws (2).

Screws (2) driving torque: 30 Nm (3.0 kgm).

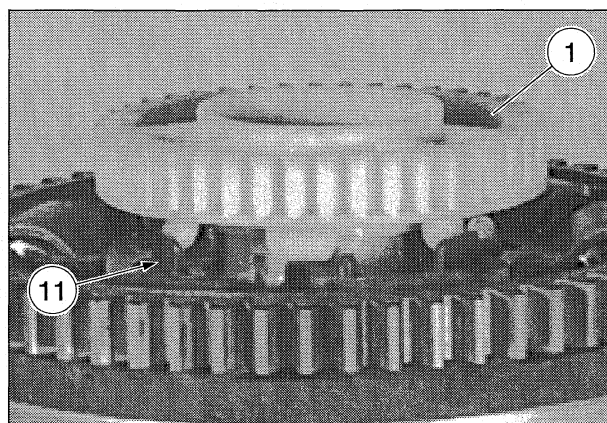
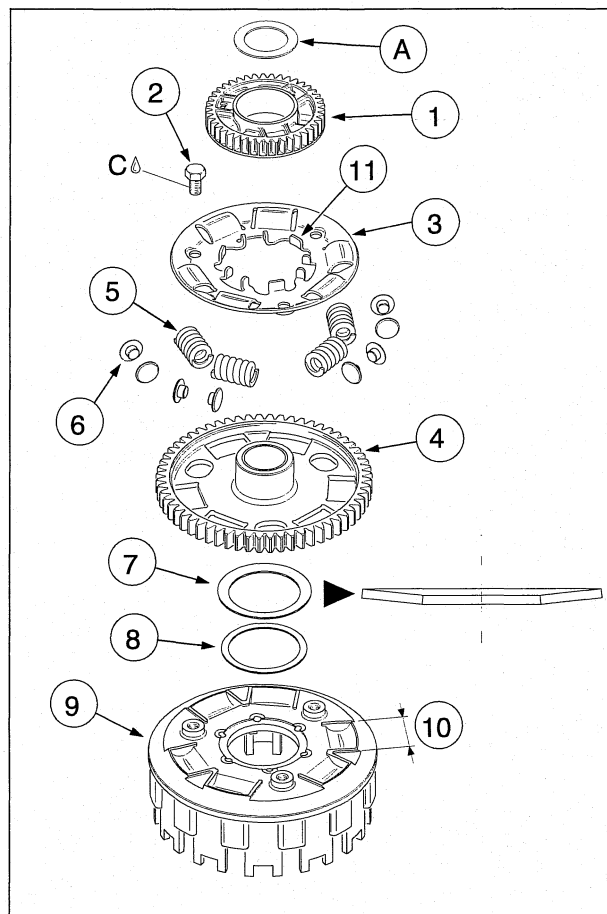
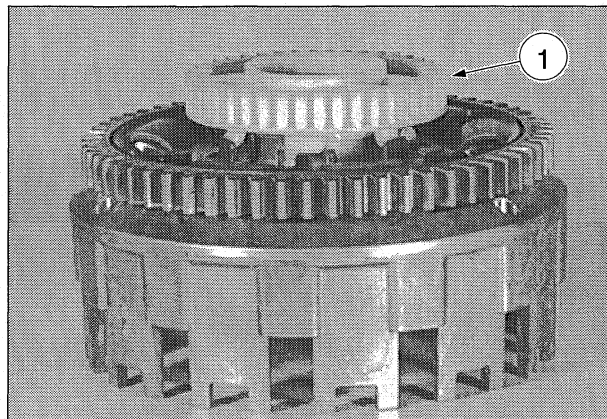
⚠ CAUTION

The oil pump drive gear (1) must always be replaced once it has been disassembled.

- ◆ Install a new driving gear (1) of the oil pump so that the pins are engaged in the tangs (11) of the support sheet (3).
- ◆ Install the washer (A) on the primary shaft.

NOTE To install the primary transmission assembly on the primary shaft, see 5.10 (ASSEMBLING THE PRIMARY TRANSMISSION AND CLUTCH).

C = LOCTITE® 648.



4.19.2 PRIMARY TRANSMISSION **aprilia** part# 0295792 and 0295793

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

DISASSEMBLY

- ◆ Remove the primary transmission assembly from the primary shaft.
- ◆ Remove the washer (A) from the primary shaft.
- ◆ Slip off the oil pump drive gear (1).

CAUTION

The oil pump drive gear (1) must always be replaced once it has been disassembled.

- ◆ Unscrew and remove the three M8 nuts (2).
- ◆ Remove the three countersunk-head screws M8x25 (3).
- ◆ Remove the external support sheet (4) and the three spacing couplings (5).

NOTE Observe the assembly position of the different compression springs.

- ◆ Remove the clutch gear (6) with the compression springs and the spring pins.
- ◆ Extract the compression springs (7) (8) (9) and the spring pins (10) (11) from the clutch gear.

NOTE You are strongly recommended to replace all the compression springs (7) (8) (9) and spring pins (10) (11) together.

- ◆ Remove the elastic washer (12).
- ◆ **Only for primary transmission **aprilia** part# 0295793 (and, if installed, primary transmission **aprilia** part# 0295792).** Remove the additional shim (**aprilia** part# 0627910) (13).
- ◆ Remove the external support sheet (14).

ASSEMBLY

NOTE The assembly positions of the clutch housing, of both support sheets and of the clutch gear are marked by a hole (15). Install these pieces so that the reference holes coincide.

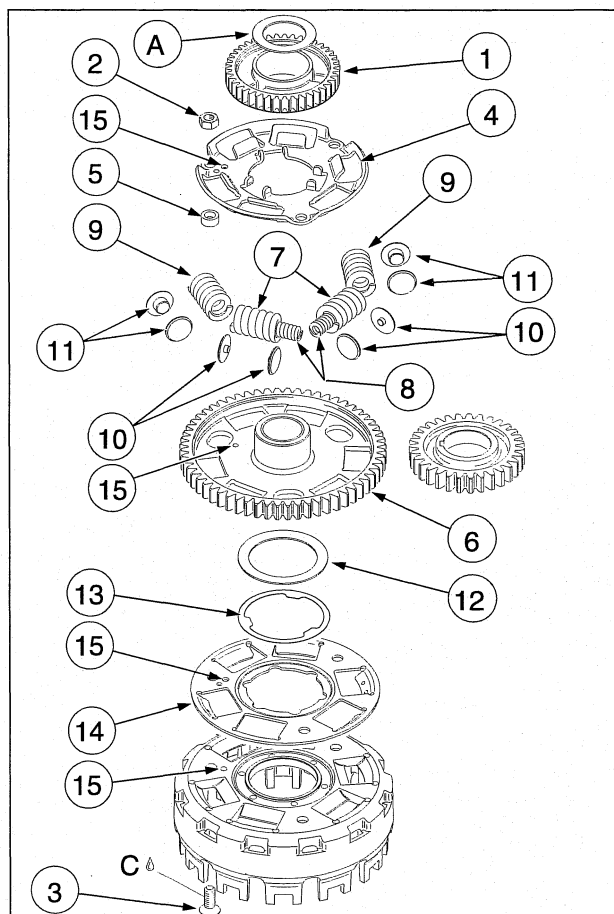
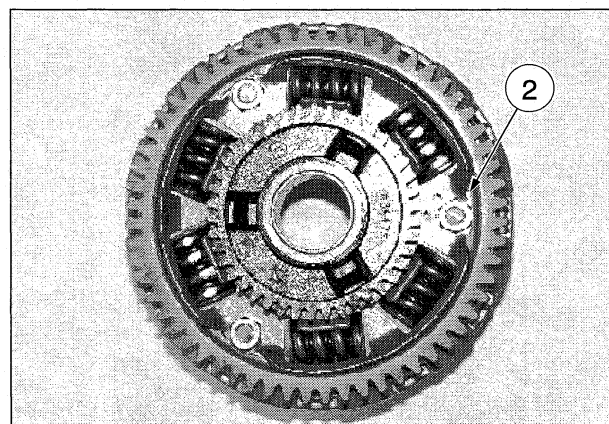
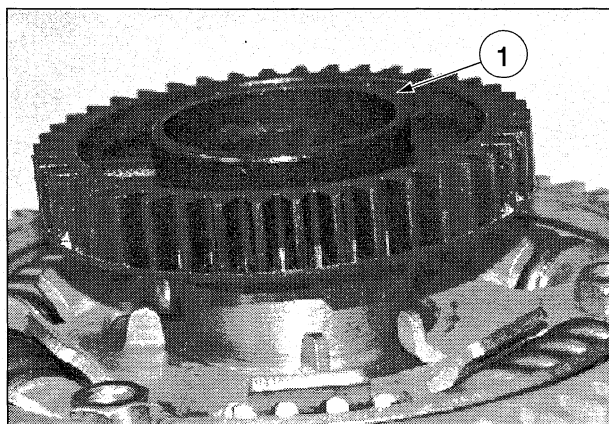
- ◆ Install the internal support sheet (14) on the clutch housing (18) so that the two reference holes (15) coincide.

NOTE It is possible to install the additional shim (**aprilia** part# 0627910) on the primary transmission **aprilia** part# 0295792 (thus transforming it into code **aprilia** part# 0295793).

- ◆ **Only for primary transmission **aprilia** part# 0295793 (and, if installed, primary transmission **aprilia** part# 0295792).** Install the additional shim (**aprilia** part# 0627910) (13).

C = LOCTITE® 648.

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- ◆ Install the elastic washer (12) with the outer diameter towards the support sheet (14).
- ◆ Install the clutch gear (6) so that the reference holes (15) coincide.
- ◆ Insert the two compression springs (9), marked in white, with the relevant spring pins (11) in each one of the two marked housings (19).

NOTE Assembly position mark: one and two holes (19) in the internal support sheet.

- ◆ Insert the four inner compression springs (8) in the four outer compression springs (7).
- ◆ Position the two spring pins (10) and insert each unit in its own housing.
- ◆ Insert the three spacing couplings (5).
- ◆ Apply LOCTITE® 648 on the thread of the three screws (3).
- ◆ Install the external support sheet (4) and fix the unit with the three countersunk-head screws M8x25 (3) and the three nuts M8 (2).

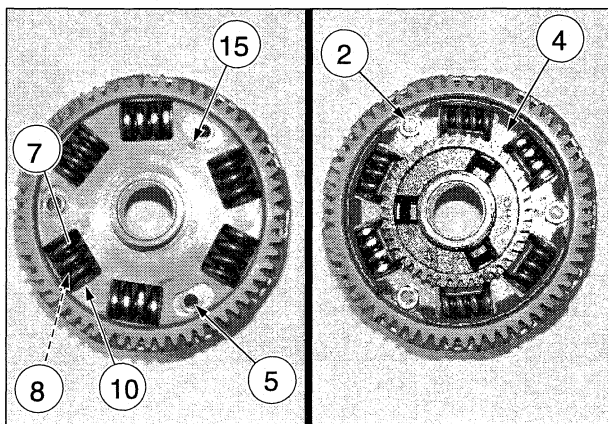
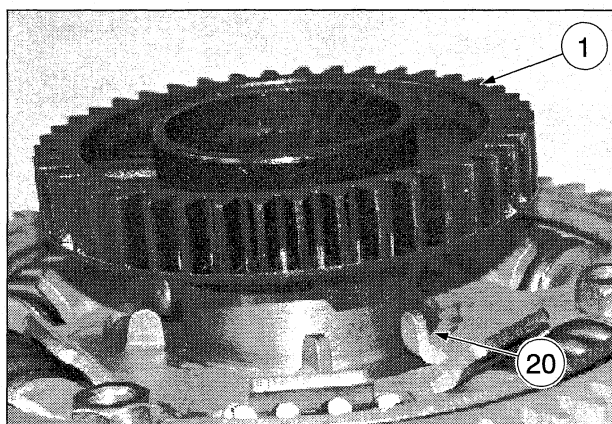
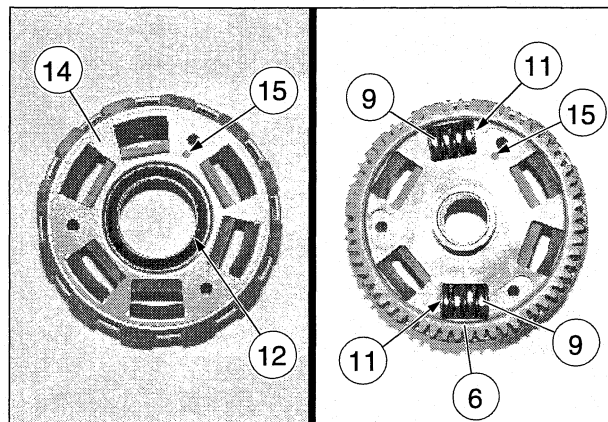
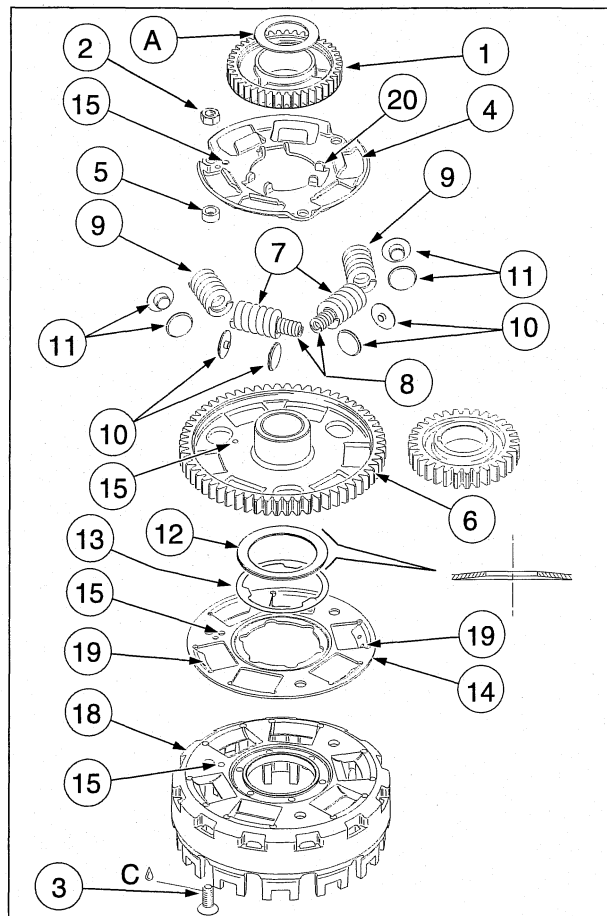
Nuts (3) driving torque: 30 Nm (3 kgm).

⚠ CAUTION

The oil pump drive gear (1) must always be replaced once it has been disassembled.

- ◆ Install a new driving gear (1) of the oil pump so that the pins are engaged in the tangs (20) of the support sheet (4).
- ◆ Insert the washer (A) on the primary shaft.
- ◆ Install the primary transmission assembly on the primary shaft.

C = LOCTITE® 648.



4.19.3 PRIMARY TRANSMISSION WEAR LIMITS

NOTE The information given below is valid for all primary transmission versions.

- ◆ Measure the length of the single compression springs (1) (2) (3) in released position.

NOTE The two compression springs (3) are marked in white.

Spring (1) wear limit: min. 26.75 mm

Spring (2) wear limit: min. 26.65 mm

Spring (3) wear limit: min. 26.75 mm

⚠ CAUTION

You are strongly recommended to replace all the compression springs and spring pins together.

- ◆ Make sure that the spring pins (4) (5) are neither worn, nor damaged, and that they do not present scores.
- ◆ Check the guide grooves of the clutch housing and make sure that the outer tooting of the driving mechanism is not damaged.

Recess depth (6): max. 0.3 mm

- ◆ Make sure that the bush (7) in the clutch gear (8) is neither scored, nor damaged.
- ◆ Measure the diameter of the bush.

Max. wear limit (9): Ø 30.060 mm

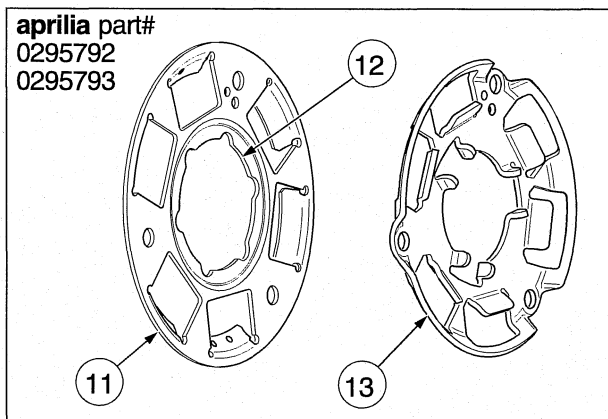
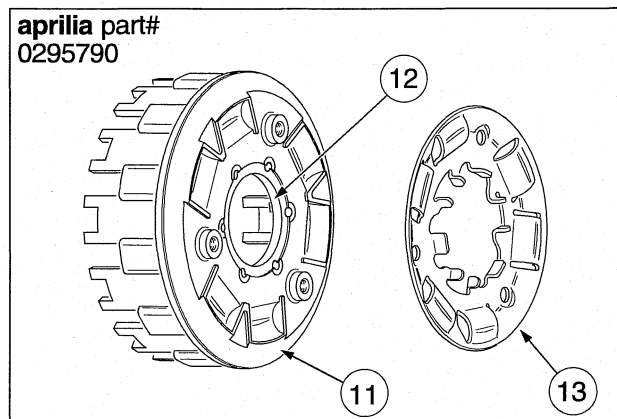
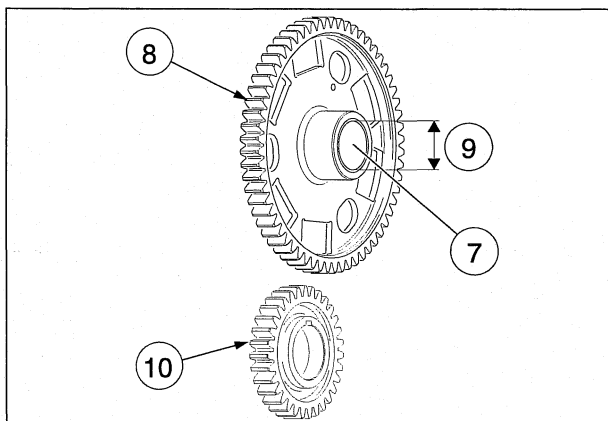
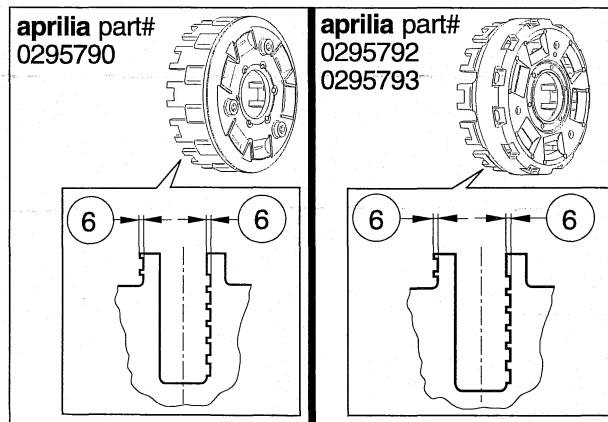
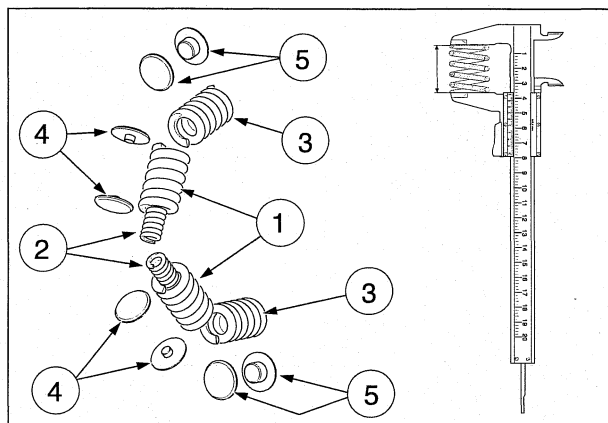
- ◆ Make sure that the sides of the teeth of the clutch gear (8) and of the control gear (10) are neither damaged, nor deformed.

NOTE If the clutch gear or the drive gear are worn, it is necessary to replace the whole gear unit (8) (10).

- ◆ Make sure that the internal support sheet (11) is not worn and that it does not present depressed areas on the contact surface (12).

NOTE Depressed areas on the internal support sheet may result in noisy operation of the engine at idling speed.

- ◆ Make sure that the internal (11) and external (13) support sheets do not present cracks.



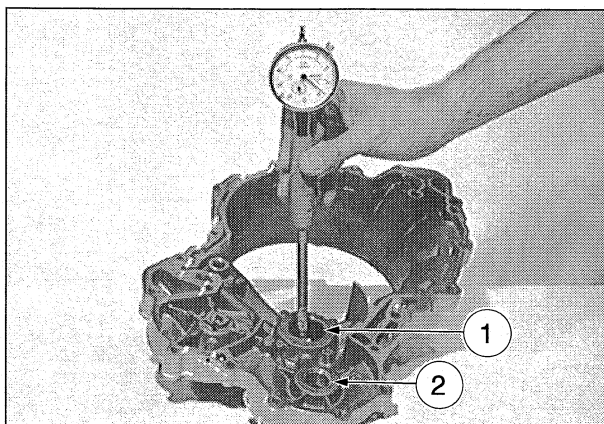
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4.20 CLUTCH COVER

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

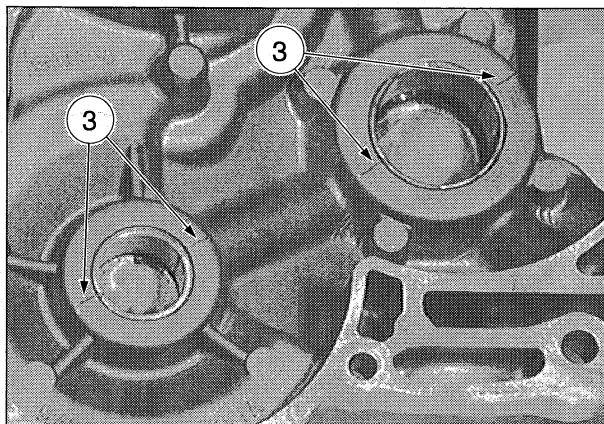
- ◆ Check the gasket surface for signs of damage and check the whole thread to make sure it is in a perfect state of repair.
- ◆ Check the support bushes of the driving shaft (1) and countershaft (2) for signs of rolling or grooves.
- ◆ Measure the diameter of the two support bushes.
- Driving shaft bushes:
wear limit \varnothing 30.040 mm.
- Countershaft bushes:
wear limit \varnothing 20.060 mm.



⚠ CAUTION

Take a number of measurements, especially in the direction of the axis of both cylinders.
None of the values must exceed the limit value.

- ◆ Measure the radial play of the driving shaft and countershaft, see 4.4 (DRIVE SHAFT MAIN BUSHES AND BALANCE SHAFT MAIN BUSHES).



4.21 SUPPORT BUSHES

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

4.21.1 REMOVING THE BUSHES

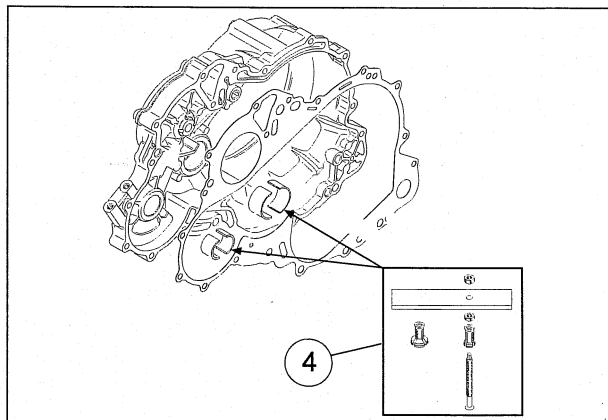
- ◆ Mark the contact surface (3) of the two bushes on the clutch cover.

NOTE Have the appropriate special tool **OPT** to hand:

- **aprilia** part# 8140156 + 8140157 + 0276377 (clutch cover sleeve puller) (4).
- ◆ Remove the main bushes with the special tool (4).

⚠ CAUTION

As a rule, the main bushes should all be replaced together.



4.21.2 INSTALLING THE BUSHES

- ◆ Clean the diameter of the main bush housing and the lubrication hole between the bush housings inside the clutch cover.
- ◆ Determine the driving shaft bushes size group based on the coloured markings (5) on the clutch cover.

NOTE The size group of the main bushes is also marked with a coloured dot.

- ◆ If the coloured marking applied on the clutch cover is no longer clearly legible, calculate the diameter based on the average of a number of different measurements.

⚠ CAUTION

Take a number of measurements, especially in the direction of the axis of both cylinders.

Hole in the clutch cover	Bush cover marking	Clutch cover marking
Ø 32.921 – Ø 32.930 mm	red	red
Ø 32.930 – Ø 32.940 mm	blue	blue
Ø 32.940 – Ø 32.951 mm	yellow	yellow

- ◆ Heat the engine casing to approx. 130 °C (266 °F).
- ◆ Coat the main bushes and the bush housings in the clutch cover with MOLYKOTE® G-N.

NOTE Have the appropriate special tools **OPT** to hand:

- **aprilia** part# 0277727 (driving shaft - clutch cover bush inserter pad) (6);
- **aprilia** part# 0277729 (insertion pad for lower balance shaft clutch cover bushes) (7).

- ◆ Place the driving shaft and countershaft main bushes on the inserter pads (6) (7), using a suitable O-ring (8) to hold them in place.
- ◆ Line up the contact surface of the main bushes with the previously applied coloured marking (3).
- ◆ With due care, insert the main bushes on a press until the installer punch touches.

⚠ CAUTION

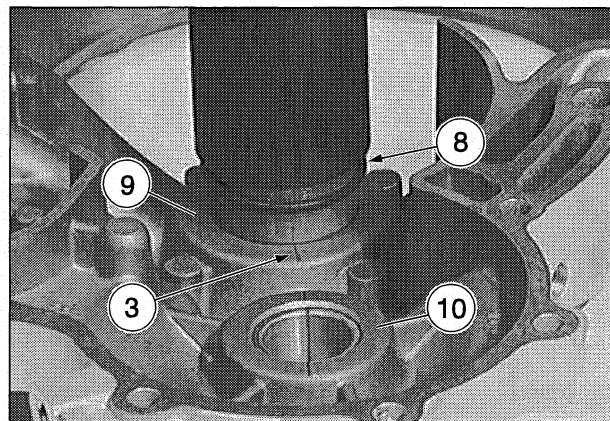
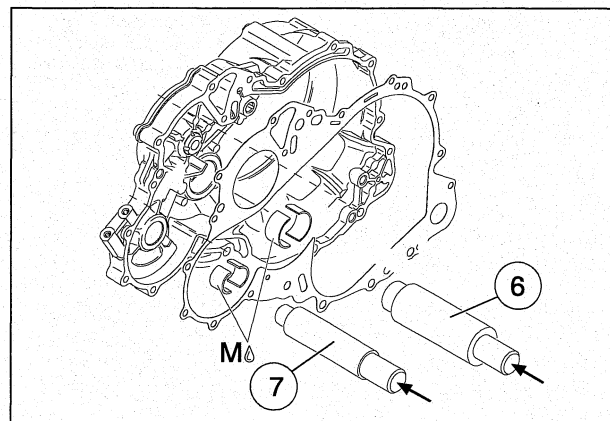
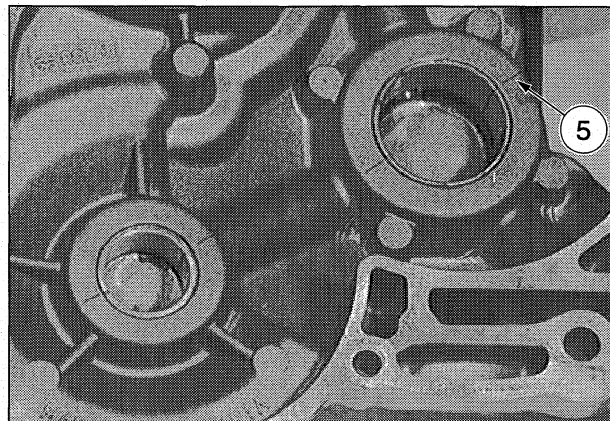
In order to insert the bushes, the clutch cover must be supported around the bush housing.

- ◆ Remove the O-ring (8) before the installer punch makes contact.
- The driving shaft main bushes must be **flush** with the thrust-bearing surface (9).
- The countershaft bushes are assembled **1.0 mm further down** with respect to the thrust-bearing surface (10).

⚠ CAUTION

Once disassembled, the bushes must not be reused.

M = MOLYKOTE® G-N.



4.22 COOLANT PUMP

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

⚠ CAUTION

The coolant pump only needs disassembling in the event of oil or coolant leakage.

- ◆ Check the drainage hole (1) for any signs of oil or coolant leakage.

4.22.1 DISASSEMBLING THE PUMP

- ◆ Hold the coolant pump gear (2) still whilst unscrewing the impeller (3).
- ◆ Slide the coolant pump gear (2) up and off, and remove the pin (4) together with the washer (5).

⚠ CAUTION

Take care not to damage the thread of the coolant pump shaft.

- ◆ Remove the coolant pump shaft (6) in the direction of the coolant pump gear (2).

NOTE For the removal of the oil seal (7) and of the sliding-ring gasket (8), two holes (A) and (B) are provided inside the clutch cover.

⚠ CAUTION

In order to extract the two components (7) (8) correctly, repeat the following operation alternately on both holes.

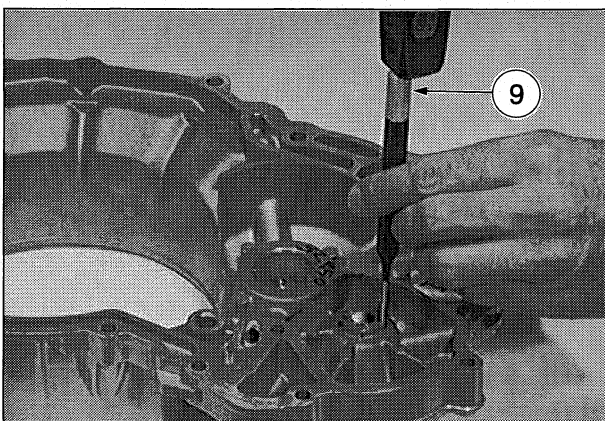
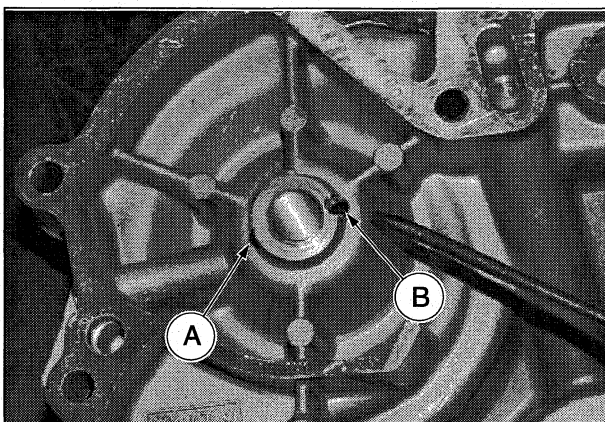
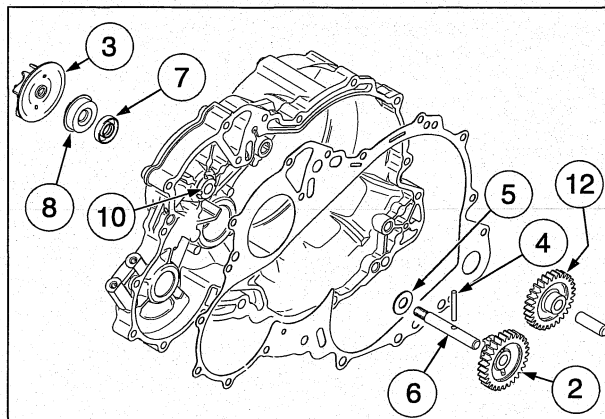
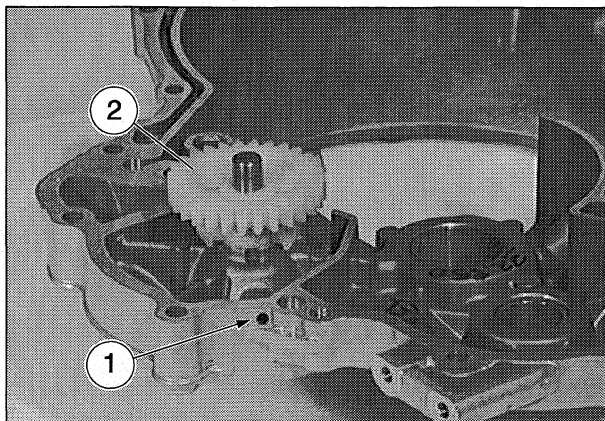
- ◆ Insert a punch (9) in the hole (A) and strike moderately only once with a light hammer. Repeat the operation on the second hole (B).

4.22.2 INSPECTING THE PUMP

- ◆ Check the impeller (3) for signs of damage or distortion and, where necessary, replace it.
- ◆ Check the coolant pump shaft (6) for signs of rolling around the oil seal sliding area and, where necessary, replace it.
- ◆ Measure the coolant pump shaft housing slot (10) on the clutch cover.

Slot wear limit (10) max. Ø 10.10 mm.

Follow ►



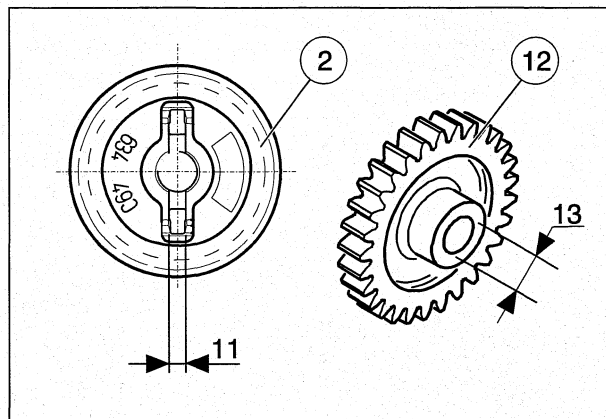
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- ◆ Check the teeth of the coolant pump gear (2) for signs of damage or broken material and check the distance of the grooves protruding from the central slot (11) due to accommodate the pin.

Slot wear limit (11) max. Ø 3.70 mm.

- ◆ Check the teeth of the coolant pump idler gear (12) for signs of damage or broken material.
- ◆ Measure the housing slot (13).

Slot wear limit (13) max. Ø 10.22 mm.



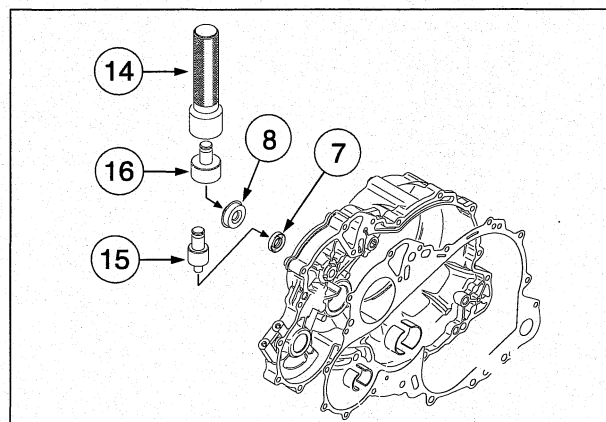
4.22.3 ASSEMBLING THE PUMP

NOTE Have the appropriate special tools **OPT** to hand:

- **aprilia** part# 0877650 (handle for pads) (14);
- **aprilia** part# 0277670 (coolant pump shaft housing oil seal assembly pad) (15);
- **aprilia** part# 0877257 (assembly pad for water pump shaft seat sliding ring) (16).

NOTE The closed side of the oil seal must be fitted so that it faces the impeller (3).

- ◆ Insert the oil seal (7) all the way into the slot using the assembly punch.
- ◆ Insert the sliding sealing ring (8) all the way in using the assembly pad.



⚠ CAUTION

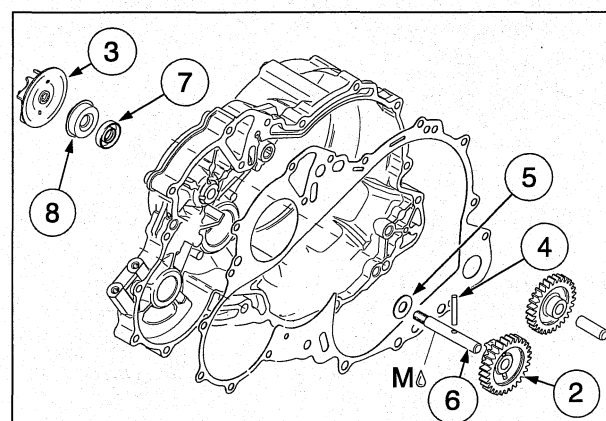
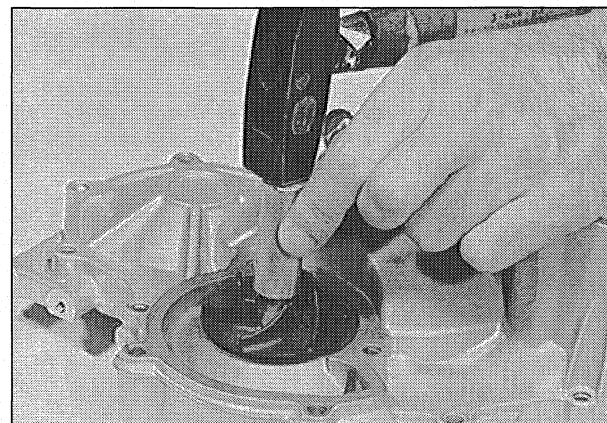
Take care not to damage the impeller (3).

- ◆ Screw the rotor (3) completely on the shaft (6) of the coolant pump by hand.
- ◆ Coat the coolant pump shaft (6) with MOLYKOTE® G-N and insert it from the outside all the way onto the oil seal assembly.
- ◆ Install the washer (5) on the coolant pump shaft.
- ◆ Install the pin (4) in the coolant pump shaft slot and engage the coolant pump gear (2).

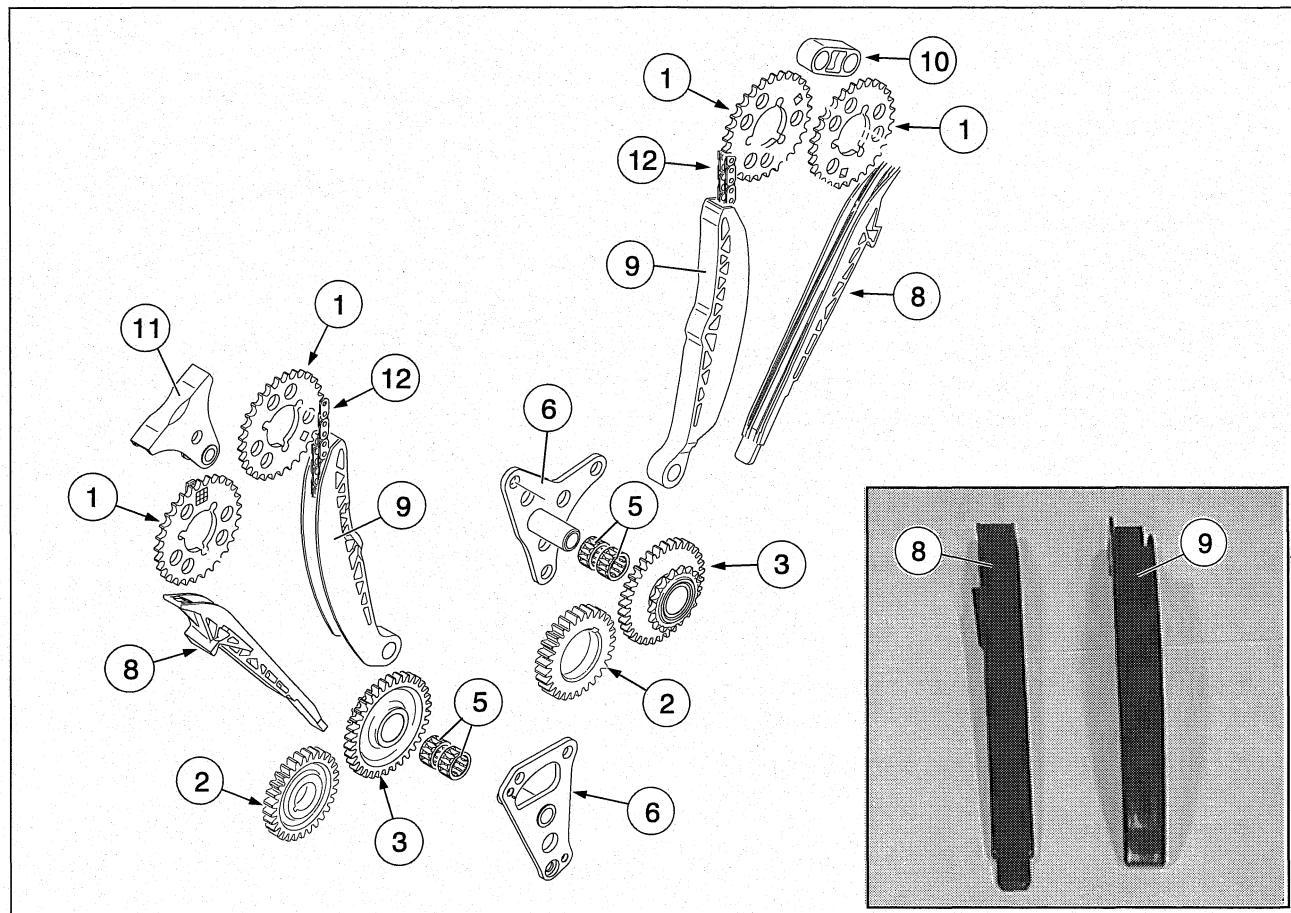
NOTE You must feel the pin is perfectly inserted in the slot in the coolant pump gear.

- ◆ Tighten the impeller (3) by hand, holding the coolant pump gear (2) still.

M = MOLYKOTE® G-N.



4.23 TIMING DRIVE ASSEMBLY



CAUTION

Set the front and rear cylinder timing drive assemblies aside in distinct groups so that you are sure to refit the parts in the same housing when it comes to reassembly.

- ◆ Check the sides of the timing gear (1), drive gears (2) and intermediate drive gears (3) for broken materials or distortion.
- ◆ Check the slots of the idler gears (3) for wear.

Wear limit (4) max. 22.015 mm.

- ◆ Check the roller bearings (5) for wear.
- ◆ Check the two bearing flanges (6) for wear around the sliding area of the roller bearings (5).

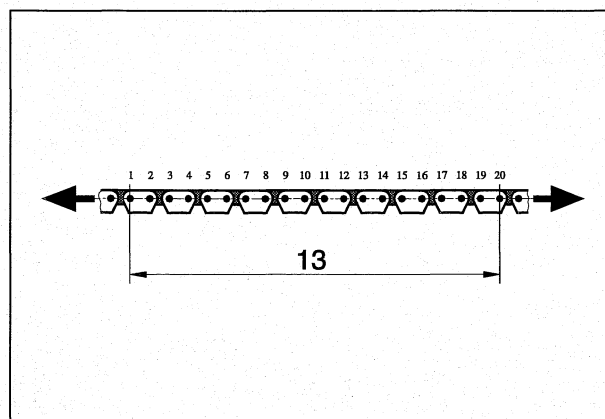
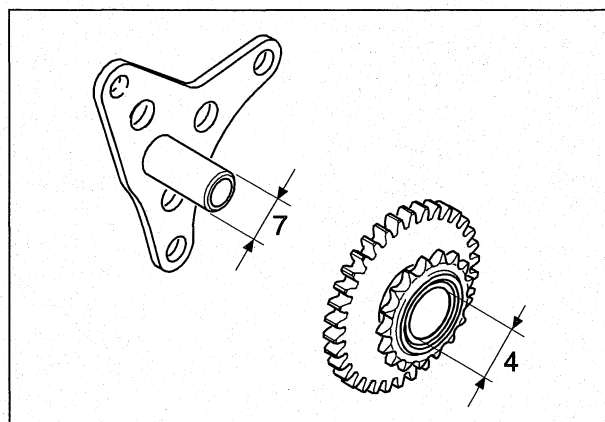
Wear limit (7) max. 15.98 mm.

- ◆ Check the chain guide shoe (8), chain tightener shoe (9), chain guide (10) and chain guide bracket (11) for any traces of rolling.

Max. depth of the rolling traces: 1.2 mm.

- ◆ Check the teeth of the two timing chains (12) for any signs of distortion.
- ◆ Tighten the timing chain, count 20 pins (19 pitches) and measure the distance (13) between the centre of the first and the centre of the twentieth pin.

Max. wear limit 166.2 mm.



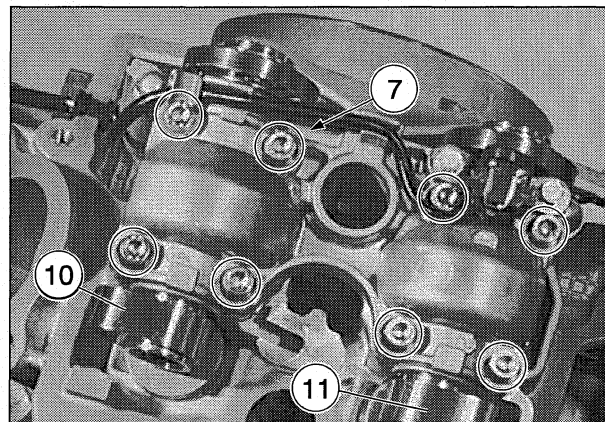
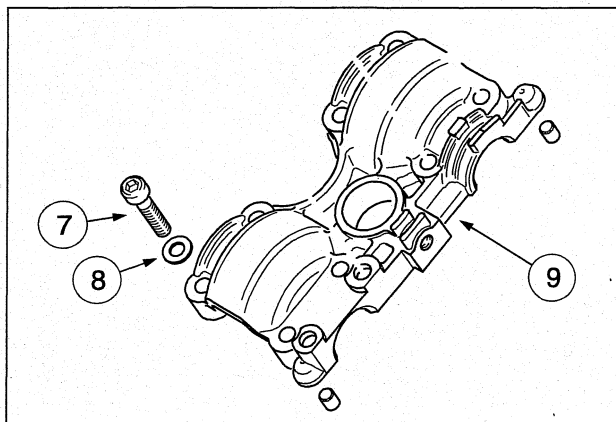
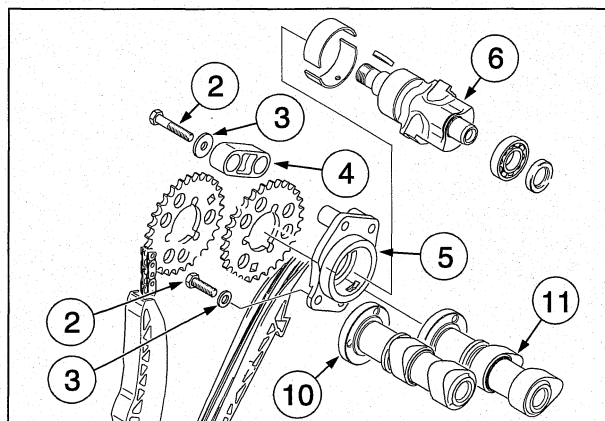
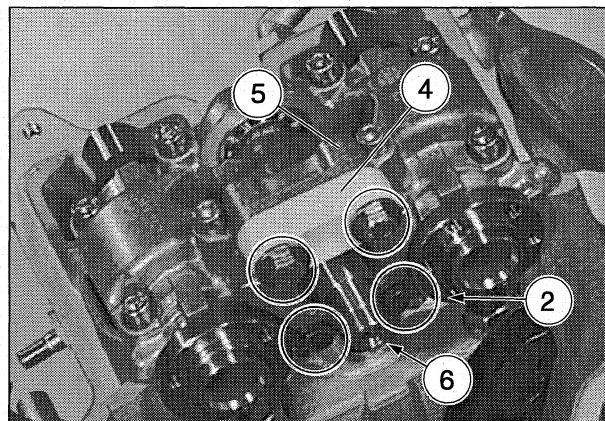
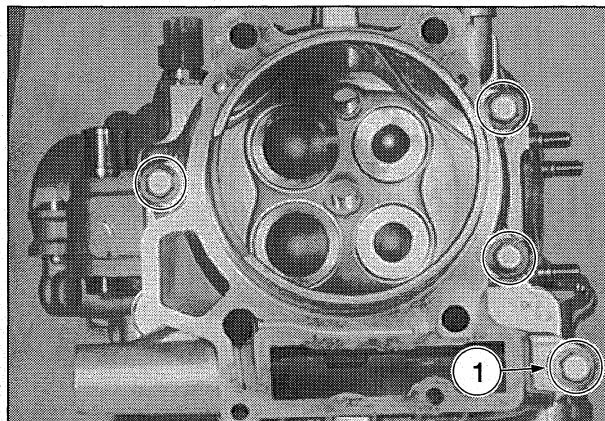
4.24 HEAD AND CAMSHAFT

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

4.24.1 DISASSEMBLY THE HEAD AND CAMSHAFT

- ◆ Unscrew and remove the four shouldered M8 screws (1) respectively and remove front and rear head from the cylinder.
- ◆ Unscrew and remove the four M6 T.C.E.I. screws (2) together with the respective washers (3) from the rear head and remove the chain guide (4) and the bush plate (5).
- ◆ Remove the upper countershaft (6) from the rear head.
- ◆ Unscrew and remove the eight M6 T.C.E.I. screws (7), together with the respective washers (8), and remove the camshaft U bolt (9) from the front and rear head.
- ◆ Remove the intake camshaft (10) and exhaust camshaft (11) from the front and rear head

NOTE Set the disassembled components aside in groups according to the respective head so you are sure to refit them in the same position when it comes to reassembly.



4.25 DISASSEMBLING THE INTAKE AND EXHAUST VALVES

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE The following information refers to a single valve, but is valid for all of them.

◆ Position the head on a clean and free work surface.

⚠ CAUTION

The valve without cone halves may slip off, fall down and consequently be damaged.

Before disassembling the valves, check head pressure loss on a plate (Bosch or Suntester).

NOTE If the pressure loss is less than 5%, valve tightness is correct.

NOTE Remove the valve units one by one and store them separately, in order to avoid mixing components of different valve units.

NOTE Mark the components of the same valve unit and the relevant seat on the head, in order to be able to reassemble them correctly.

⚠ CAUTION

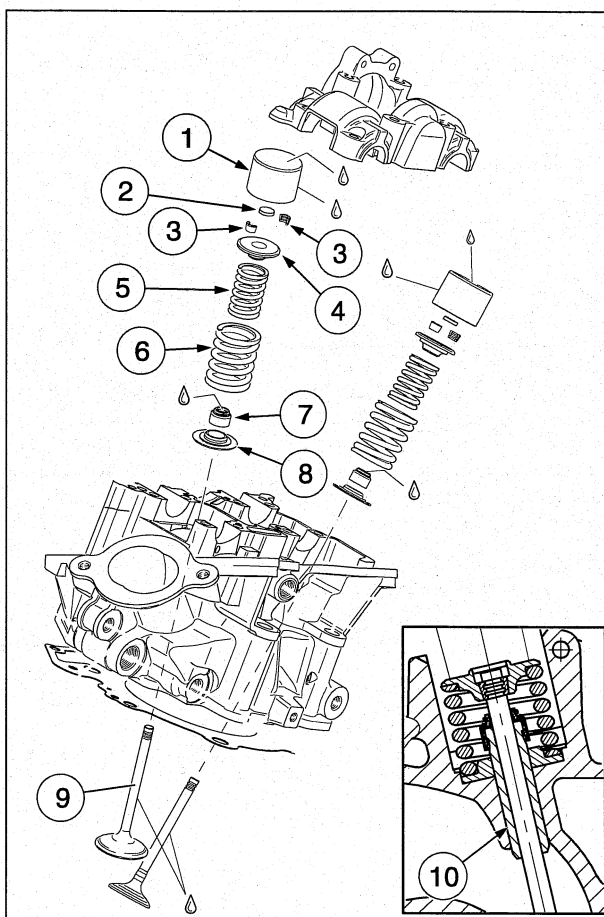
Before disassembly, mark the upper side of the valve springs, since they have a progressive winding due to which the assembly direction is compulsory (the side where the turn pitch is narrower must be directed towards the combustion chamber). Do not install the valve springs in overturned position. Overturned valve springs cause an anomaly in the operation of the engine and faulty performance of the same.

Valve unit components (inlet or exhaust valve):

- bucket (1);
- adjustment shim (2);
- valve cone halves (3);
- valve spring upper cap (4);
- valve inner spring (5);
- valve outer spring (6);
- valve guide oil seal (7);
- valve spring lower cap (8);
- valve (9);
- valve guide (10).

NOTE When the valve is removed, the valve guide (10) must not be removed.

Follow ►



Follow ►

NOTE Have the appropriate special tools **OPT** to hand:

- **aprilia** part# 8140179 (valves disassembly and reassembly bow) (11);
- **aprilia** part# 0276479 (valve spring compression tool) (12).

- ◆ Extract the cap (1) and the adjusting shim (2).
- ◆ Compress the valve springs (5) (6) with the appropriate arch (11) and with the spring compression tool (12) and extract the valve cone halves (3).
- ◆ * Release the valve springs (5) (6).
- ◆ * Remove the valve compression tool (12) and the arch (11).
- ◆ * Remove the valve spring upper cap (4).
- ◆ * Withdraw the two valve springs (5) (6).
- ◆ * Lift the head and rotate it by 180° (upside down).
- ◆ * Slip off the valve (9).

NOTE Repeat the operations marked with “*” for the second valve.

- ◆ Clean the combustion chamber, removing the residual combustion products and the deposits from the cooling cavity.
- ◆ Check the thread of the spark plugs and the fastening thread, making sure they are in a perfect state of repair.
- ◆ Check that the oil galleries are clear and, where necessary, clean them by blowing a jet of compressed air inside.
- ◆ Check the gasket surfaces for any signs of damage and make sure they are flat.

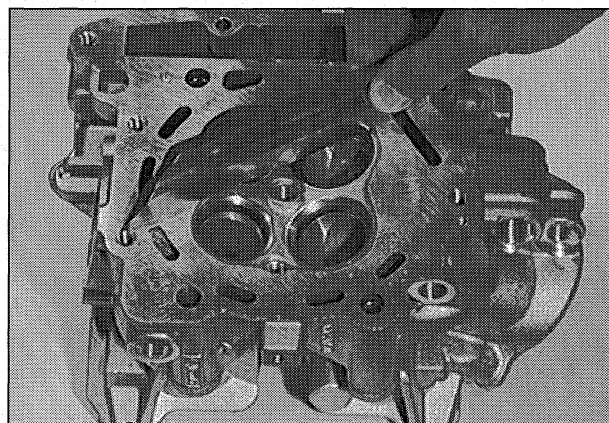
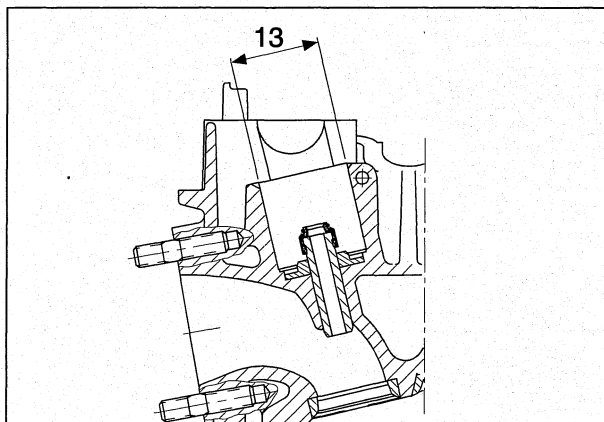
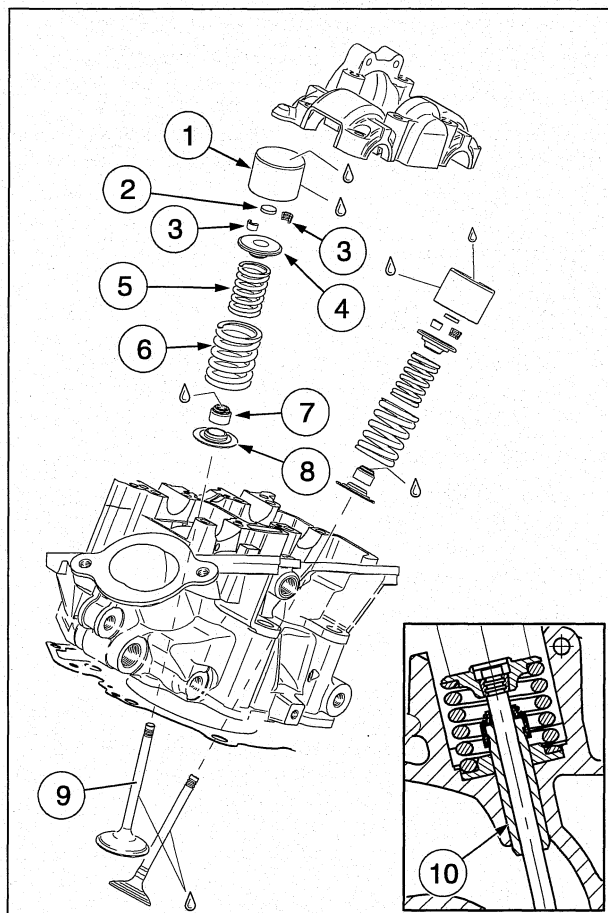
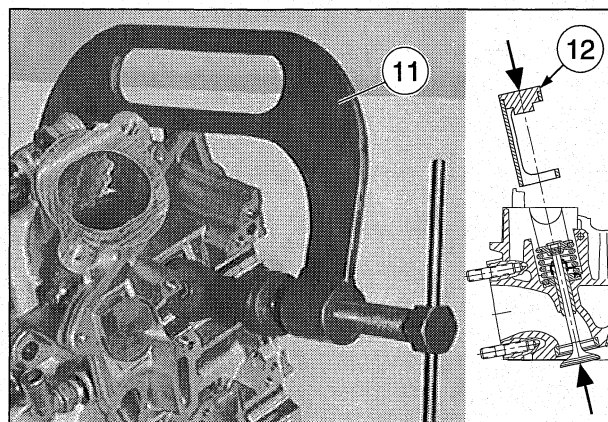
Max. permissible distortion: 0.03 mm.

⚠ CAUTION

If necessary, grind the sealing surfaces with a precision grinder.

- ◆ Make sure the valve bucket (1) and guide in the head are in a perfect state of repair.

- Bucket slot in the head (13):
wear limit: max. Ø 33.58 mm.
- Bucket (1):
wear limit: min. Ø 33.44 mm.
- Bucket radial play (1):
wear limit: max. Ø 0.08 mm.



4.26 CAMSHAFT AND CAMSHAFT BUSHES

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Check the cams (1) for broken material, signs of distortion or wear and, where necessary, replace the camshaft, see 4.26.1 (SPECIFIC FEATURES OF THE CAMSHAFTS).

Measure the play of the camshafts:

- ◆ Place the camshafts in the head.
- ◆ Apply a plastic gauge (2) on the bearing housings of the camshafts.
- ◆ Apply the U bolts according to which shaft they are assigned to and fasten them with the M6 T.C.E.I. screws.

Driving torque: 10 Nm (1.0 kgm).

- ◆ Remove the T.C.E.I. screws and the U bolts.
- ◆ Measure the maximum width of the pressed plastic gauge with the corresponding graduated scale (3).

Max. wear limit 0.060 mm.

- ◆ If the wear limit is exceeded, the bush housings on the camshafts and on the head must be measured, and the worn part replaced.

– Camshaft bush housings:
wear limit (4) min. Ø 23.950 mm.

– Head bush housings:
wear limit max. Ø 24.040 mm.

- ◆ Insert the intake and exhaust camshafts in the respective housings in the head and measure the end play with a comparator (5).

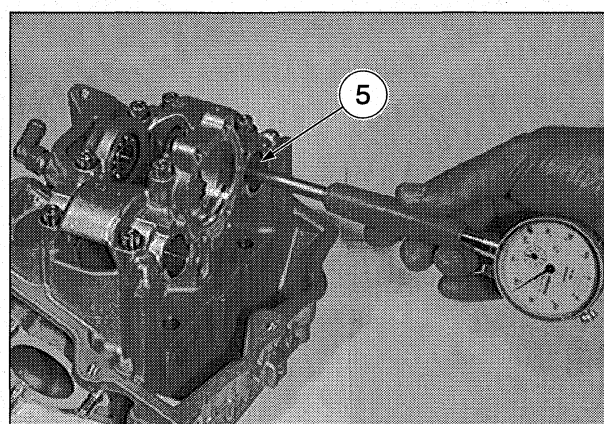
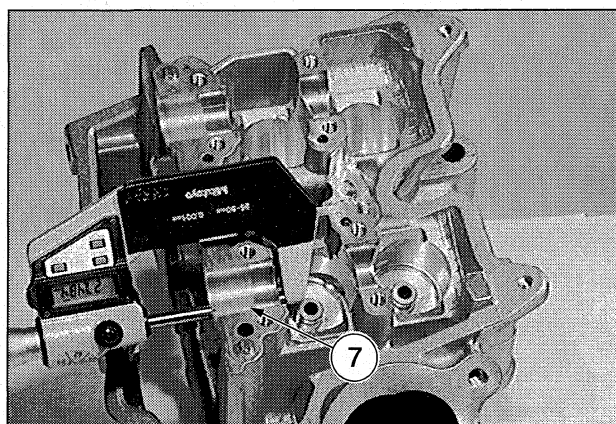
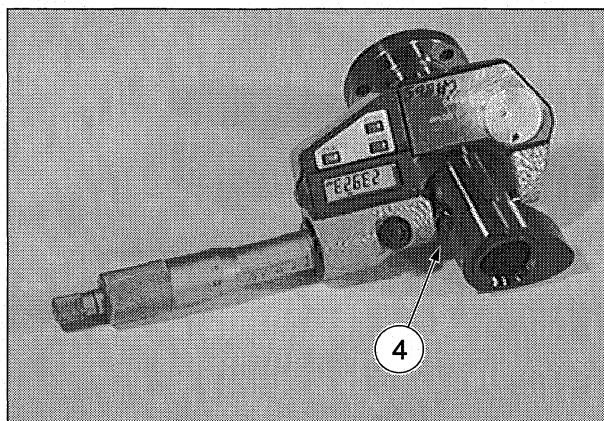
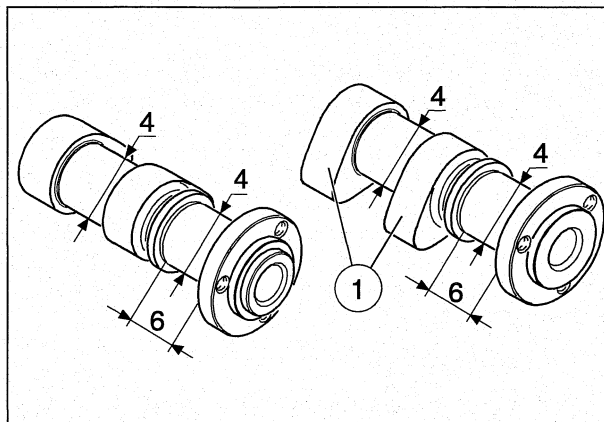
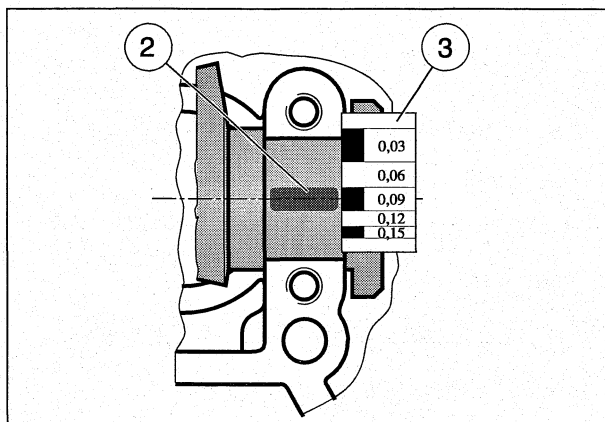
– End play of the camshafts:
wear limit: max. 0.40 mm.

- ◆ If the wear limit is exceeded, the axial contact surfaces, both of the camshafts and in the head, must be measured and the worn part replaced.

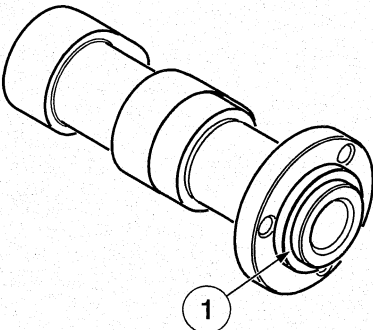
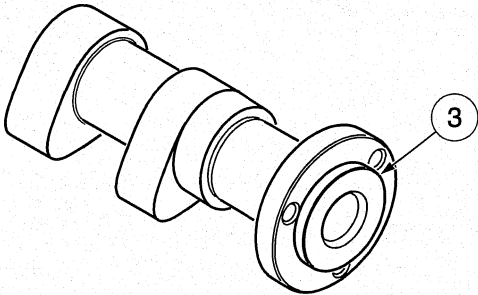
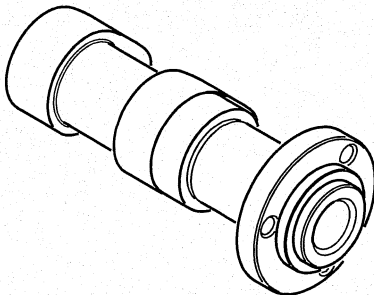
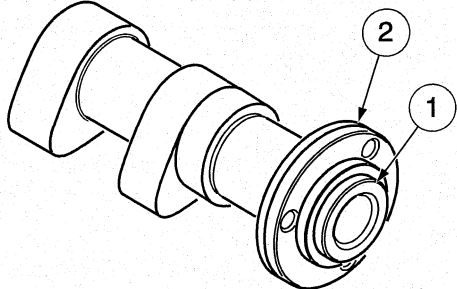
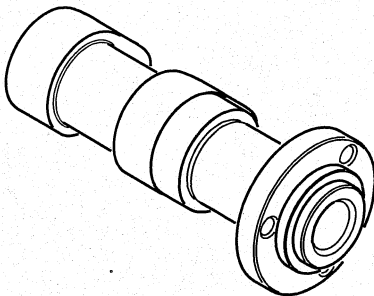
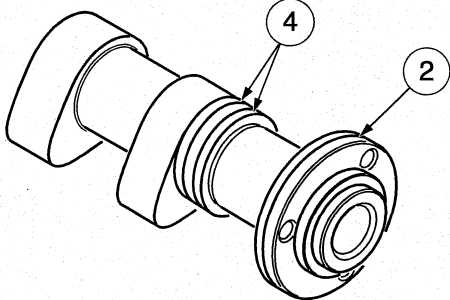
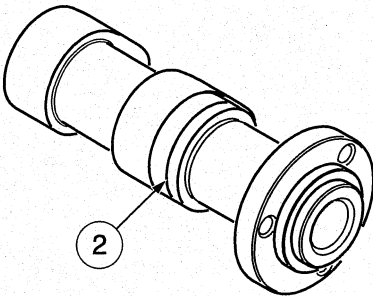
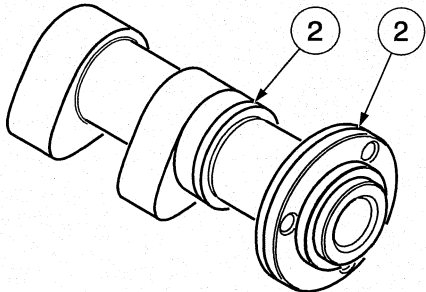
– Axial contact surfaces, (6) camshafts:
wear limit: max. 27.77 mm.

– Axial contact surfaces, (7) head:
wear limit: min. 27.10 mm.

NOTE If the camshaft is replaced, the buckets must also be changed.



4.26.1 SPECIFIC FEATURES OF THE CAMSHAFTS

Vehicle model	Exhaust camshaft	Intake camshaft
RSV RSV R (up to engine # 524388)	aprilia part# 0220385 	aprilia part# 0220380 
RSV RSV R (as of engine # 524389) SL RST	aprilia part# 0220385 	aprilia part# 0220380 
RSV RSV R (starting from 2001 models)	aprilia part# 0220385 	aprilia part# 0220384 
ETV	aprilia part# 0220387 	aprilia part# 0220382 

Key

- 1) Double shoulder
 2) Recognition groove

- 3) Shoulder
 4) Double recognition groove

4.27 UPPER COUNTERSHAFT

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Check the wear of the countershaft:

NOTE The bush housing (1) is slightly tapered, hence the measurement must be taken half way along the housing.

- Bush housing (1):
wear limit min. \varnothing 34.98 mm;
- Ball bearing pin (2):
wear limit min. \varnothing 14.97 mm.

NOTE The bush (3) is slightly tapered.

- ◆ Check the internal diameter (3) of the bushes in the plate and check for wear or cracks.

NOTE Install the countershaft and measure the radial play with a comparator.

- ◆ Measure the radial play of the bush.

Permissible radial play max. 0.70 mm.

- ◆ If the maximum permissible radial play is exceeded, the worn part must be replaced.

NOTE Should the bushes be worn, the whole bush plate must be replaced.

- ◆ Install the countershaft in the head (2) (rear) and measure the end play with a comparator.

Wear limit: max. 0.040 mm.

NOTE If the end play wear limit is exceeded, replace the bush plate.

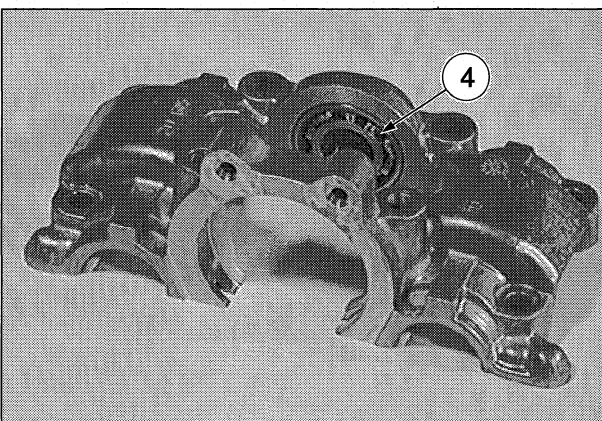
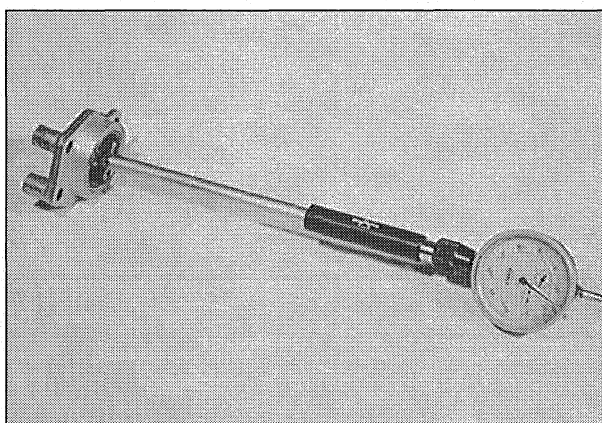
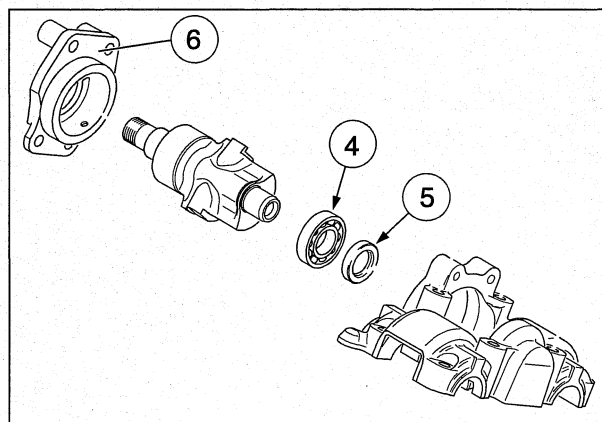
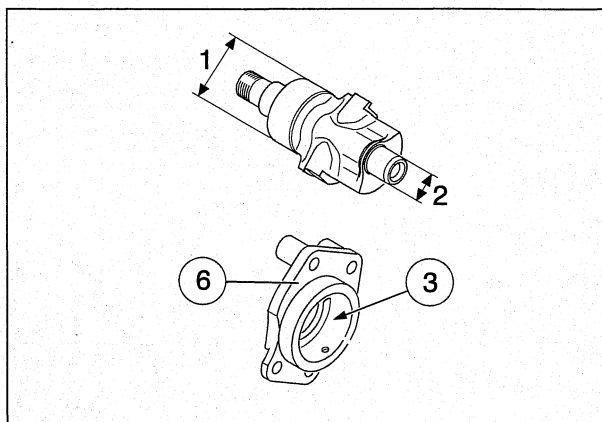
- ◆ Install the countershaft in the rear head, see 5.13 (ASSEMBLING REAR HEAD CAMSHAFT).

- ◆ Make sure the ball bearing (4) in the U bolt slides smoothly and does not feature pitting, and check slack.

NOTE Use motor oil to lubricate the ball bearings before performing the check.

If the inner race does not turn easily and silently, or if it makes a noise, it means the bearing is defective and needs replacing.

- ◆ Check the oil seal (5) behind the ball bearing (4) for any wear or signs of damage.



4.28 DISASSEMBLING AND ASSEMBLING THE UPPER COUNTERSHAFT BALL BEARINGS AND OIL SEAL

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE Have the appropriate special tools **OPT** to hand:

- **aprilia** part# 0277265 (extractor for balance shaft, gearbox input and output shaft) (6);
- **aprilia** part# 0877650 (handle for pads) (7);
- **aprilia** part# 0277660 (secondary countershaft oil seal assembly pad) (8).

◆ Heat the camshaft U bolt to approx. 80 – 100 °C (176 – 212 °F).

NOTE Take care not to damage the camshaft U bolt.

◆ Remove the ball bearings (4) with the puller plate (6) and with the expansion sleeve suitable for the bearing.

NOTE As a rule, the ball bearings and the oil seals should be replaced.

◆ Lift the oil seal (5).

NOTE Before assembling, oil the external diameter of the oil seal slightly.
The closed side of the oil seal must face outwards.
Grease the sealing lips.

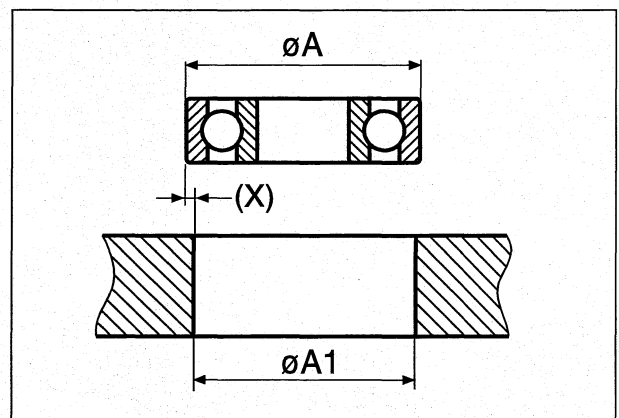
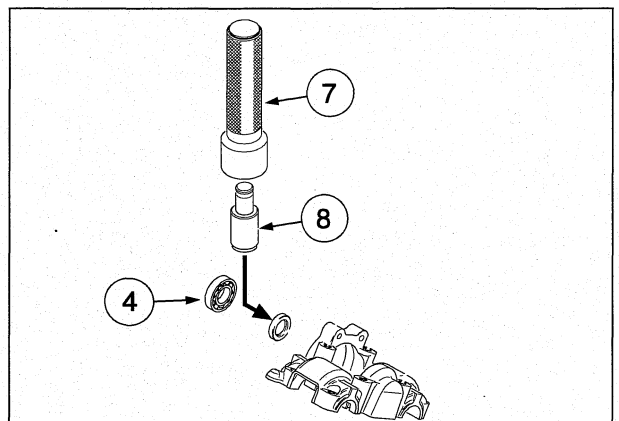
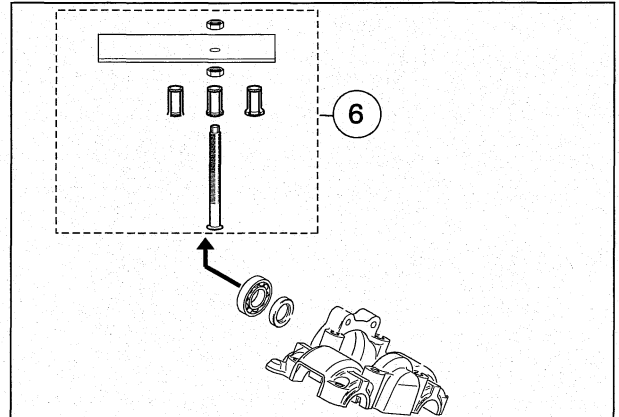
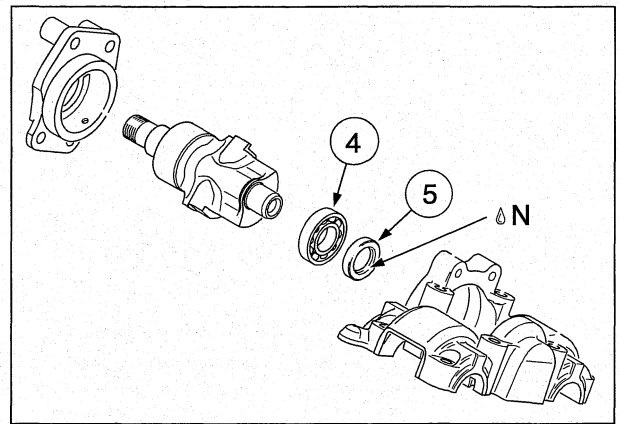
⚠ CAUTION

In order to avoid damaging the ball bearing, under no circumstances should the oil seal touch the bearings inner race.

- ◆ Insert the oil seal (5) all the way in using the assembly punch.
- ◆ Oil the external diameter of the ball bearing (4) slightly and insert it all the way onto the outer ring with a suitable assembly punch.
- ◆ Check the ball bearing housing (4) on the U bolt for signs of wear.

Interference (X) = (Ø A) – (Ø A1): 0.030 mm.

N = Lubricating grease.



4.29 VALVES GUIDE

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Use a dial gauge to measure the wear of the valve guide (1).

Wear limit (2): max. Ø 6.05 mm.

NOTE If the valve guide is worn, it can be replaced.

4.29.1 REMOVING THE VALVES GUIDE

- ◆ Slip off the valve stem seal (3) and remove the valve spring shim (4).

NOTE Replace the valve stem seal (3).

- ◆ To eliminate the valve guide with a reamer (5) as far as the start of the notch (6).

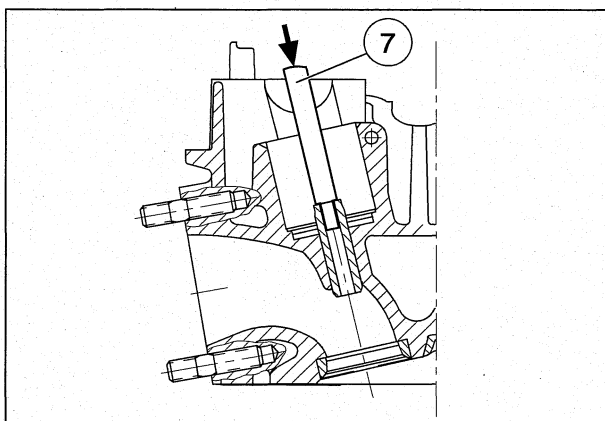
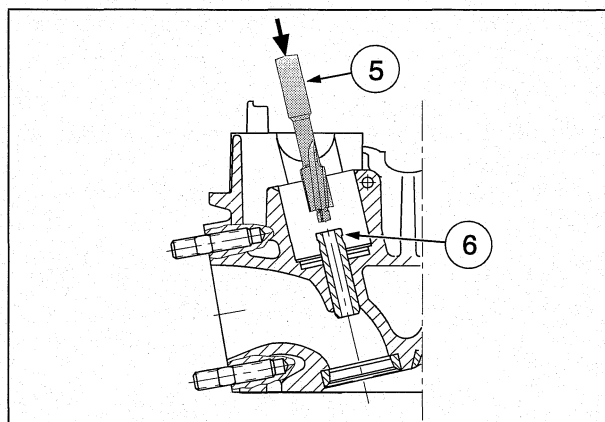
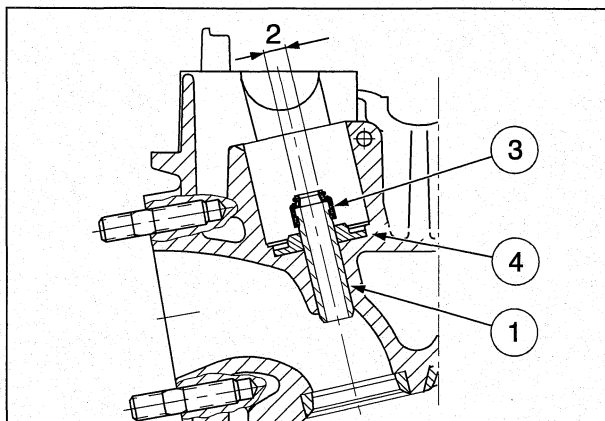
NOTE The sharp edge of the valve guide must be eliminated as, otherwise, the head slot is in danger of being to slide when the valve guide is removed.

NOTE Have the appropriate special tool **OPT** to hand:
– **aprilia** part# 0277510 (valve guide disassembly pad) (7).

NOTE Do not heat the head.

- ◆ Use the pad (7) to remove the rest of the guide valve in the direction of the exhaust manifold.
- ◆ Check the valve guide slot for tailings.

NOTE Should any signs of picking-up be encountered, the head must be replaced.



4.29.2 INSTALLING THE VALVES GUIDE

CAUTION

La testata o il guidavalvola si danneggia se non si usa il MOLYKOTE® G-N.

- ◆ Apply a coat of MOLYKOTE® G-N on the head hole and on the valve guide assembly edge.

NOTE Have the appropriate special tool **OPT** to hand:
– **aprilia** part# 0277695 (valve guide oil seal assembly pad) (8).

- ◆ Using the assembly pad (8), insert the new valve guide in the head, working from the oil chamber towards the combustion chamber until the assembly punch reaches a level position.

NOTE The exhaust valve and intake valve guides are different.

The difference consists in the fact that the intake valve guide has a longer smoothed surface (9).

- ◆ Check how much the head (10) of the valve guide protrudes on the camshaft side.

(10) Protrusion = 13.3 ± 0.2 mm.

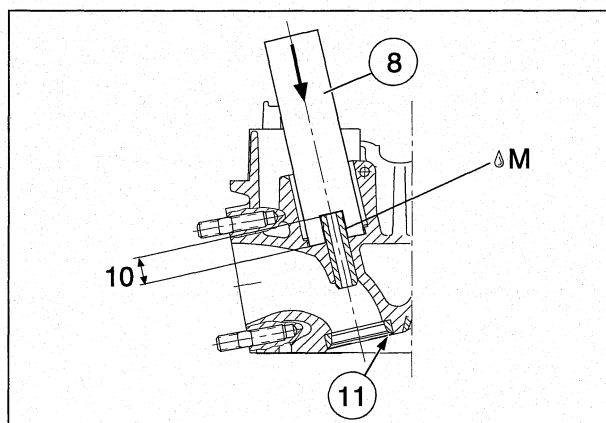
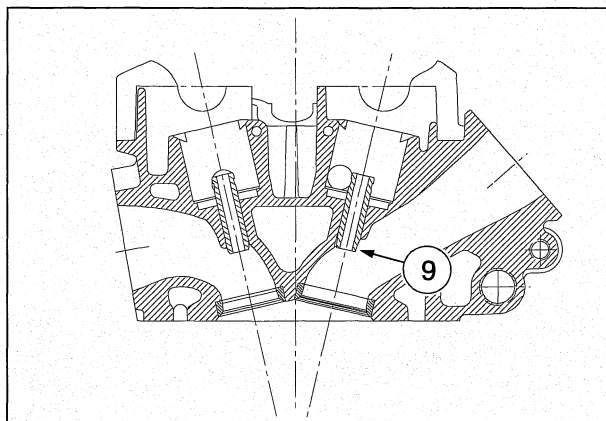
- ◆ Bore the valve guide with a $\varnothing 6$ mm F7 reamer.

Hole of the valve guide $\varnothing 6.006 - 6.018$ mm.

NOTE Use cutting fluid only to lubricate the reamer. The reamer should only be turned in the cutting direction, never in the opposite direction, and cleaned of tailings at frequent intervals, again always removing it in the direction of the cut.

- ◆ Having bored the valve guide, clean the head thoroughly and grind the valve seat (11), smoothing the valve seat with a valve seat reconditioning device, and grind the valve, see 4.30 (VALVES).
- ◆ Check the contact mark using the relevant marking paste (Prussian blue).

M = MOLYKOTE® G-N



4.30 VALVES

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

⚠ CAUTION

Change the valves one by one. Do not mix the components.

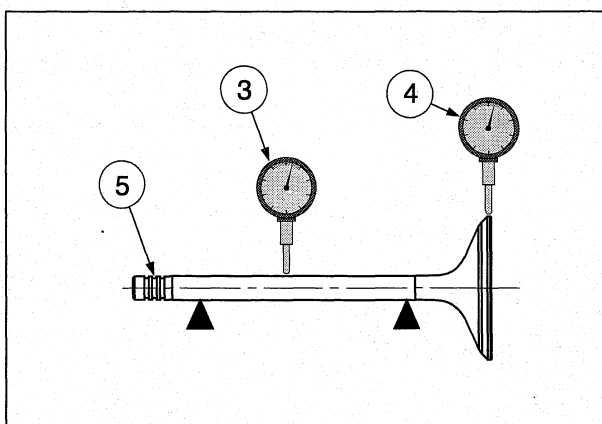
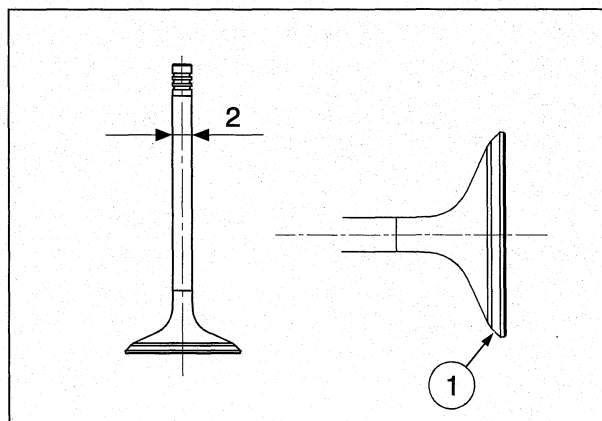
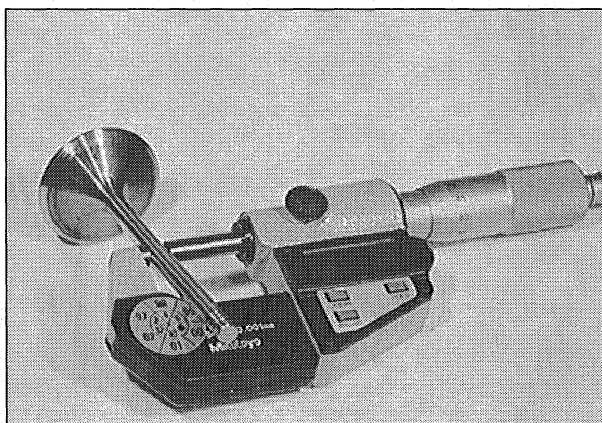
Each valve must be inserted in its seat, which must be marked before disassembly.

⚠ CAUTION

The seat (1) on the head of the valve is reinforced by means of inductive hardening. For this reason, the seat cannot be reground and, instead, the valve must be replaced.

Grinding with abrasive paste is nonetheless permitted, whilst it is prohibited to regrind a valve at the end on the valve stem.

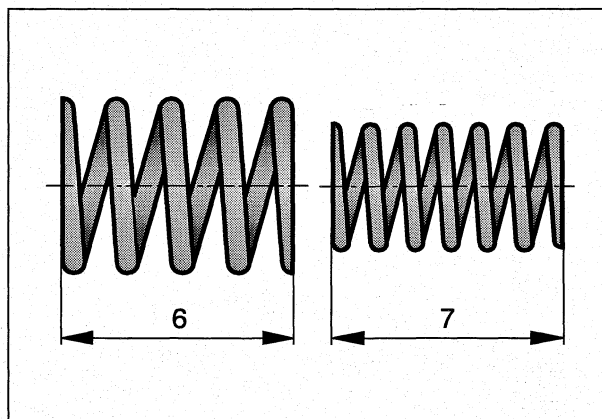
- ◆ Clean the valves of all residual combustion products.
- ◆ Check the seat (1) on the valve head with a line.
The surface of the seat must not be concave; where necessary, replace it.
- ◆ Check the diameter of the stem with a micrometer:
 - intake valve:
wear limit (2) min. \varnothing 5.950 mm;
 - exhaust valve:
wear limit (2) min. \varnothing 5.935 mm.
- ◆ Check the eccentricity of the valve:
 - valve stem:
permissible eccentricity (3) max. 0.05 mm;
 - valve head:
permissible eccentricity (4) max. 0.05 mm.
- ◆ Check whether the fastening grooves (5) of the valve cotters are in a perfect state of repair.



4.30.1 VALVE SPRINGS

- ◆ Measure and visually inspect the valve springs to check for breakage, distortion or loss of tension.
Measure the length of the springs in released position.
- Valve springs:
wear limit (6) min. 43.4 mm.
- Valve springs:
wear limit (7) min. 40.9 mm.

NOTE Worn spring valves may result in a reduction in engine power and increased noise from the valve assembly.



4.30.2 VALVE SEATS

- ◆ Coat the valve seat surfaces with marking paste (Prussian blue).
 - ◆ Insert the corresponding valve (1) and turn the valve, pressing down slightly with a valve grinder.
 - ◆ Check the width of the valve seat (2) (3) and the contact mark, checking for any signs of wear.
- Intake valve:
max. wear limit (2) 1.6 mm or 1.5 mm (*)
 - Exhaust valve:
wear limit (3) max. 1.8 mm.

NOTE The circular contact mark on the valve seat and valve surfaces must be continuous and unbroken. If the width of the valve seat exceeds the wear limit or if the valve seat surface is not continuous, the valve seat can be ground.

(*) = For vehicle models starting from 2001.

4.30.3 GRINDING THE VALVE SEATS

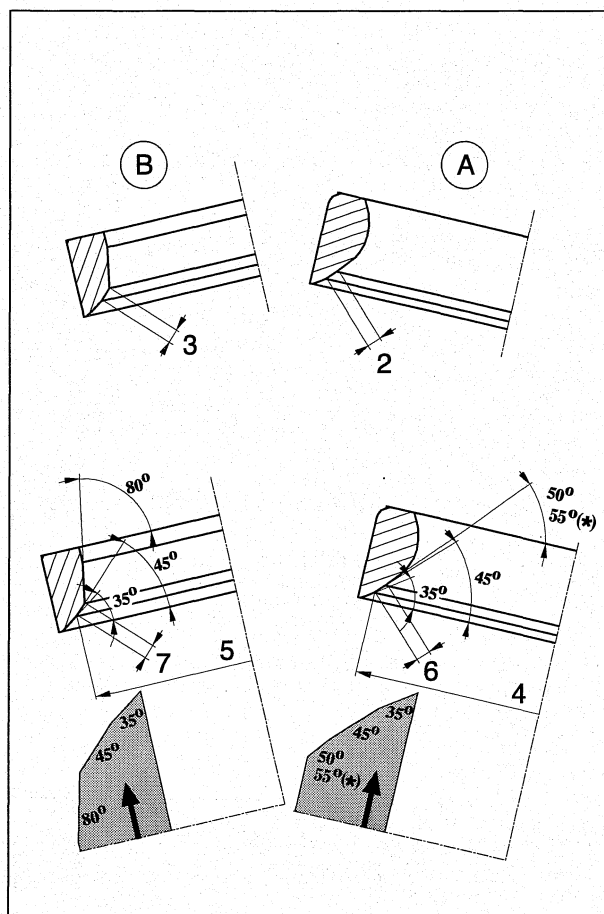
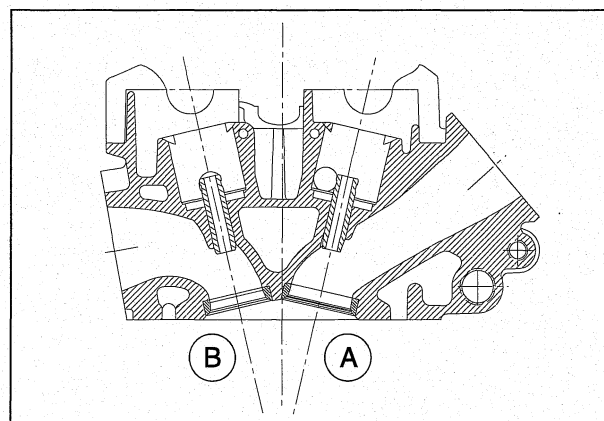
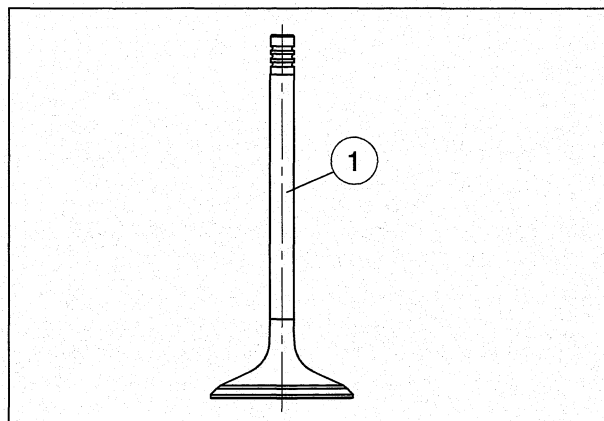
A = intake

B = exhaust

NOTE The valve seats can be ground with a valve seat grinding device centred in the valve guide.

- ◆ Perform grinding at **45°** with the valve seat grinding device until the whole valve seat is covered in tailing. During this operation, make sure no more material than necessary is removed.
 - ◆ Lastly, grind at **35°** until the given diameter (4) (5) is obtained.
- Intake valve (4) **Ø 35.3 mm or 37.7 mm (*)**
 - Exhaust valve (5) **Ø 30.3 mm.**
- ◆ Next, grind the intake valve at **50° or 55°** and the exhaust valve at **80°** with the grinding device until the given width (6) (7) for the valve seat surface is obtained.
- Intake valve (6) **1.05 – 1.35 mm.**
 - Exhaust valve (7) **1.25 – 1.55 mm.**
- ◆ Grind the valve (1) with the valve grinder and the valve grinder paste.

(*) = For vehicle models starting from 2001.



4.30.4 ASSEMBLING THE VALVES IN THE HEAD

NOTE The following information refers to a single valve, but is valid for all of them.

⚠ CAUTION

Reassemble the valve units one by one.
Do not mix the components of different valve units.
Reassemble each valve unit in the corresponding seat, which must be marked upon disassembly.

NOTE Have the appropriate special tools **OPT** to hand:
– **aprilia** part# 0277210 (valve guide ass assembly) (3);
– **aprilia** part# 0276479 (valve spring compression tool) (8);
– **aprilia** part# 8140179 (valves disassembly and reassembly bow) (9).

- ◆ Insert the valve spring housing cap (1) through the valve guide.
- ◆ Fit a new valve stem oil seal (2) with the assembly pad (3).
- ◆ Lift the head and rotate it by 180° (upside down).

NOTE When inserting the valve (4), take care not to damage the new valve stem oil seal (2).

- ◆ Oil the valve stem and carefully insert the valve (4) inside the valve guide.

NOTE Make sure that the valve stem oil seal (2) is positioned correctly.

- ◆ Check head pressure loss on a plate (Bosch or Suntester).

NOTE If the pressure loss is less than 7%, this means valve tightness is correct.

- ◆ Lift the head and rotate it by 180° (upside down).
- ◆ Install the valve springs (5) (6) and the valve spring cap (7).

⚠ CAUTION

Respect the mark made on the upper side of the valve springs upon disassembly.
Make sure that the side where the turn pitch is narrower is directed towards the combustion chamber.

⚠ CAUTION

Risk of tension loss, do not compress the valve springs more than necessary. Compress the springs as much as necessary to fit the valve cone halves in the relevant seat on the valve.

- ◆ Preload the valve springs (5) (6), complete with cap (7), using the spring compression tool (8) and the special arch (9).

NOTE Apply grease on the valves cotters (10) to make assembly easier.

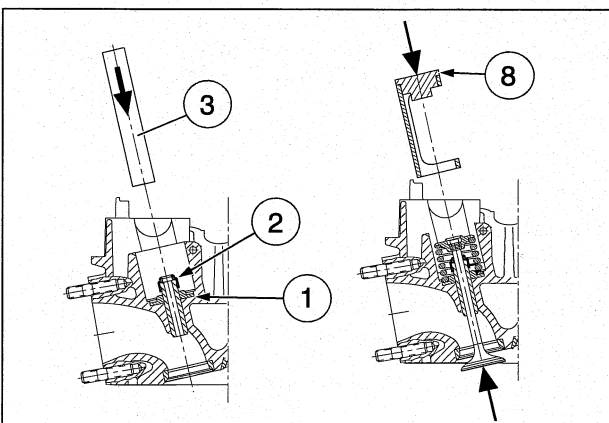
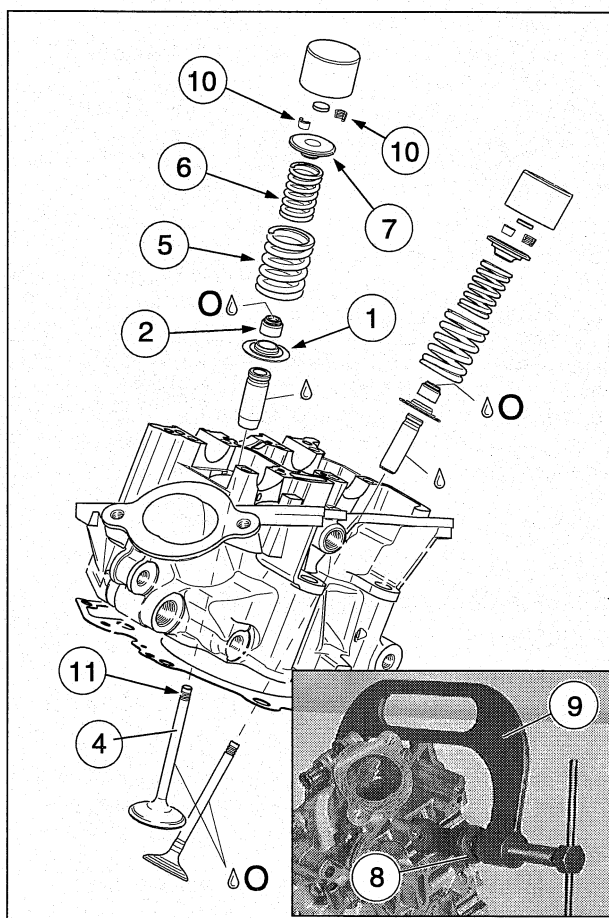
- ◆ Insert the valve cone halves (10) in the groove (11) of the valve (4).

NOTE When releasing the tightening device (9), make sure that the valve cone halves (10) are perfectly inserted in the valve groove (11); if necessary, use a plastic hammer and proceed with care.

- ◆ Remove the valve compression tool (8) and the arch (9).

⚠ CAUTION

Make sure that the valve springs are positioned correctly. If the valves are fitted obliquely, they will inevitably cause the valve stems to break.



- ◆ Repeat the operations for the second valve.
- ◆ After installing the valves, check head pressure loss on a plate (Bosch or Suntester).

NOTE If the pressure loss is less than 5%, valve tightness is correct.

O = Motor oil.

4.31 CYLINDERS

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ All the gasket surfaces must be cleaned and flat. Flatness of the gasket surfaces:

Max. permissible distortion: 0.04 mm.

- ◆ Make sure all the threads are in a perfect state of repair.
- ◆ Examine the sliding surface of the cylinder to check for any friction and scratches, and check whether the gasket surfaces feature signs of damage.

NOTE If there are evident grooves on the nikasil lining inside the cylinder, replace the cylinder complete with piston.

- ◆ Clean the cylinders cooling cavity of any lime scale.
- ◆ Measure the bore of the cylinder in three places at a distance of **45 mm** from the upper edge (1); consider the highest value for the wear limit.

NOTE The size group "A" or "B" is punched onto the lower side of the cylinder (2).

- Size group "A", dimension when the cylinder is new:

bore \varnothing 97.000 – 97.012 mm;

wear limit: max. \varnothing 97.027 mm.

- Size group "B", dimension when the cylinder is new:

bore \varnothing 97.012 – 97.025 mm;

wear limit: max. \varnothing 97.040 mm.

NOTE In order to assess the wear limit, the assembly play must be determined, see 4.32 (PISTONS AND GUDGEON PINS).

- ◆ Make sure the chain tightener (3) and the guide in the cylinder are in a perfect state of repair.

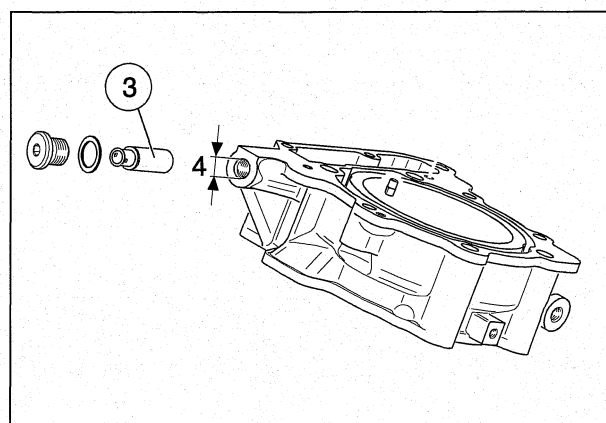
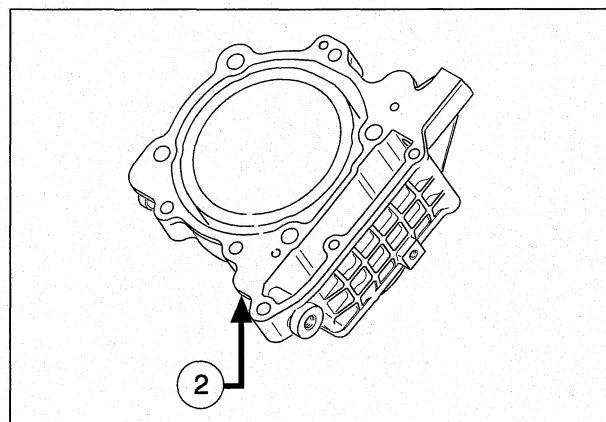
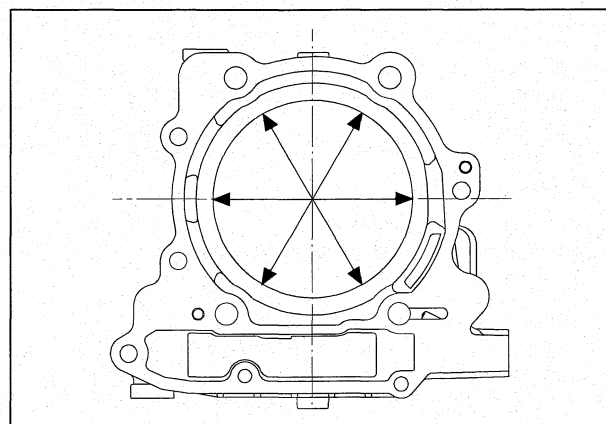
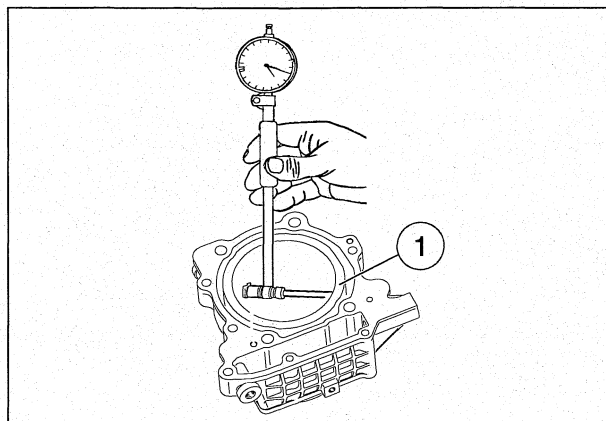
Chain tightener (3) / hole on the cylinder clearance (4):

wear limit (hole \varnothing – chain tightener \varnothing):

max. 0.08 mm.

Hole for chain tightener in the cylinder:

wear limit (4): max. \varnothing 14.07 mm.



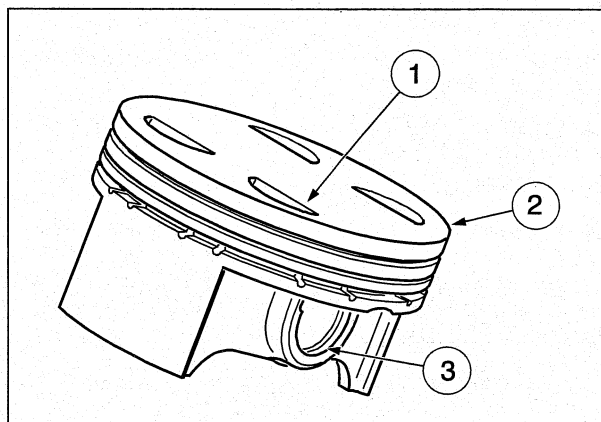
4.32 PISTONS AND GUDGEON PINS

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Clean the piston crown (1) and the area above the upper piston ring (2) of any residual combustion products.
- ◆ Check the piston for any cracks and the sliding surface of the piston for signs of compression (picking-up); Where necessary, replace the piston, see 4.32.2 (SPECIFIC FEATURES OF THE PISTONS).

NOTE Minor ridging on the piston lining is tolerable.

- ◆ Make sure that the annular groove (3) that protects the piston pin is not worn.



4.32.1 PISTONS WEAR LIMITS

- ◆ Measure the piston diameter at a height of **10 mm (3)** across the gudgeon pin axis, using an external micrometer.

“Red” piston:

max. wear limit Ø 96.890 mm.

“Green” piston:

max. wear limit Ø 96.900 mm.

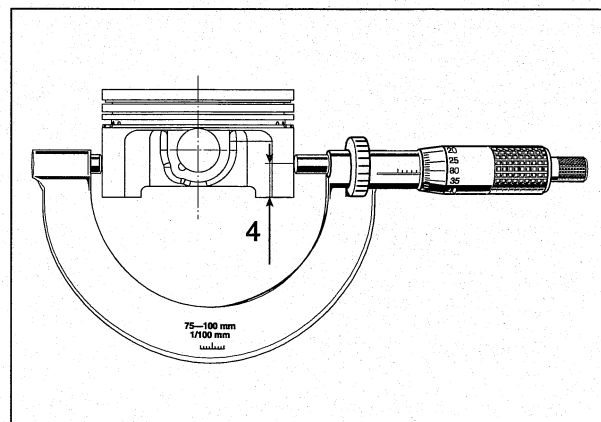
Piston play – measurement:

cylinder diameter minus piston diameter;

max. wear limit 0.120 mm.

NOTE If the wear limit is exceeded, a new piston must be used or the cylinder replaced, complete with piston.

If the piston is replaced, the two seeger rings securing the gudgeon pins must always be replaced, along with the actual gudgeon pins.



Take special care when matching the cylinder – piston:

“Red” piston – Cylinder “A”.

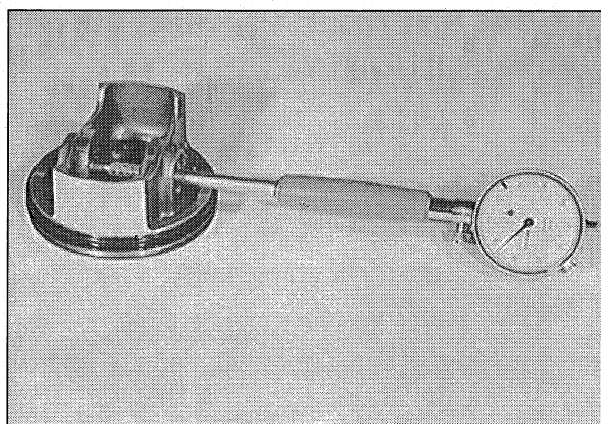
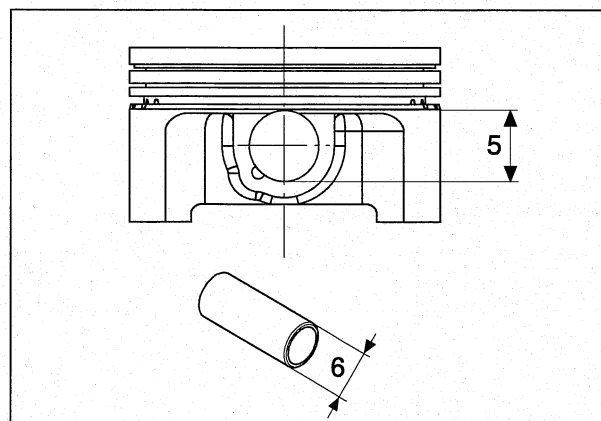
“Green” piston – Cylinder “B”.

- ◆ Use an external micrometer to measure the diameter of the gudgeon pin hole in the piston in the direction of lift and the diameter of the gudgeon pin at either end as well as in the middle.

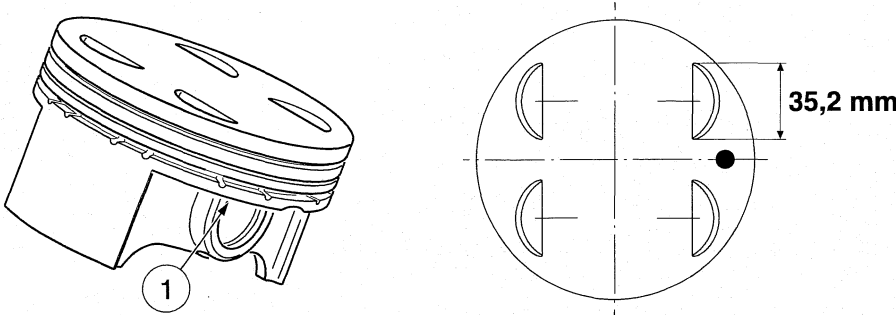
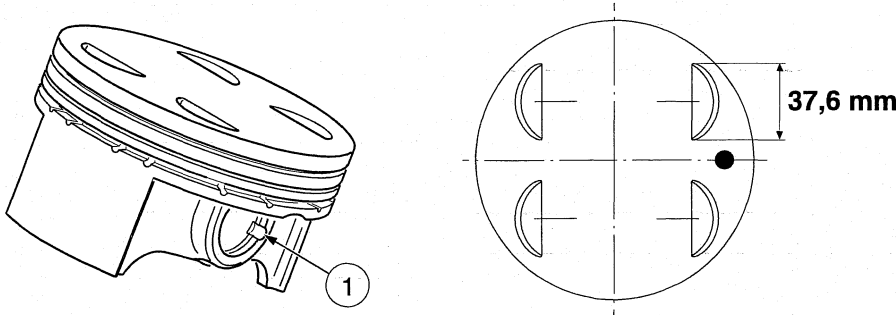
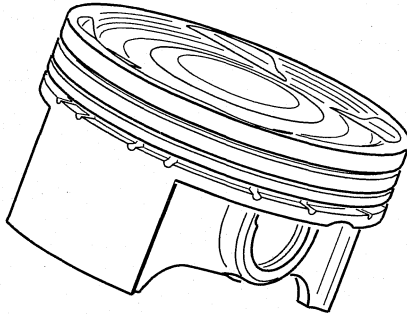
– Gudgeon pin hole in the direction of lift:
wear limit (4) max. Ø 22.018 mm.

– Gudgeon pin:
wear limit (5) min. Ø 21.998 mm.

- ◆ Check the wear of the gudgeon pin seeger rings with the bent ends.



4.32.2 SPECIFIC FEATURES OF THE PISTONS

Vehicle model	Features of the pistons
RSV RSV R SL ('98 – '99 – 2000 models)	aprilia part# 0295855 (complete piston) 
RSV RSV R SL (models starting from 2001) RST	aprilia part# 0295852 (complete piston) 
ETV	aprilia part# 0296590 (complete piston) 

Key

1) Groove for stop rings

CAUTION

The complete piston **aprilia part# 0295855** must not be installed on engines destined to RSV mille vehicles (starting from 2001 models), since the inlet valves touch this piston.

NOTE The complete piston **aprilia part# 0295852** can be installed on the engines destined to all RSV mille, SL mille and RST mille Futura models.

Follow ►

Follow ►

- ◆ Use a feeler gauge to measure the end play (7) (8) (9) of the piston rings inside the grooves.
- L-section ring:
wear limit (7) max. 0.12 mm.
- Tapered protruding ring:
wear limit (8) max. 0.12 mm.
- Scraper ring:
wear limit (9) max. 0.10 mm.

⚠ CAUTION

The piston rings are fragile.

- ◆ Carefully remove the piston rings from the piston.

NOTE The piston ring groove can be cleaned using a scraper or an old piston ring.

- ◆ Clean the piston ring grooves and the oil return holes (10) in the scraper ring groove, then blow a jet of compressed air inside.
- ◆ Check the scraper ring (11), the tapered protruding ring (12) and the L-section ring (13) to make sure the sliding surface is cleaned.
- ◆ Measure the piston ring gap (14) with a feeler gauge.

Max. wear limit 1.00 mm.

NOTE In order to measure the gap required, insert the piston ring in the cylinder and push it inside so that it is lined up with the piston.

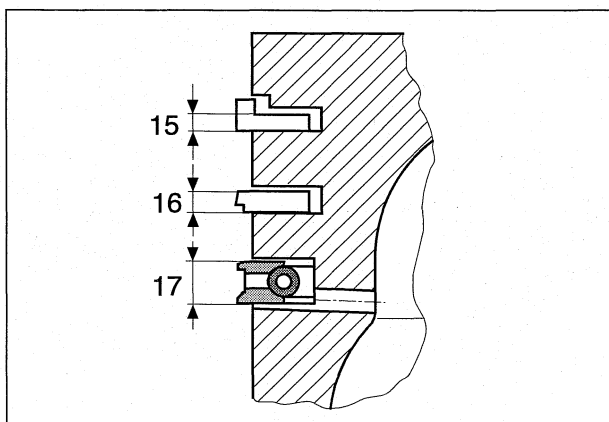
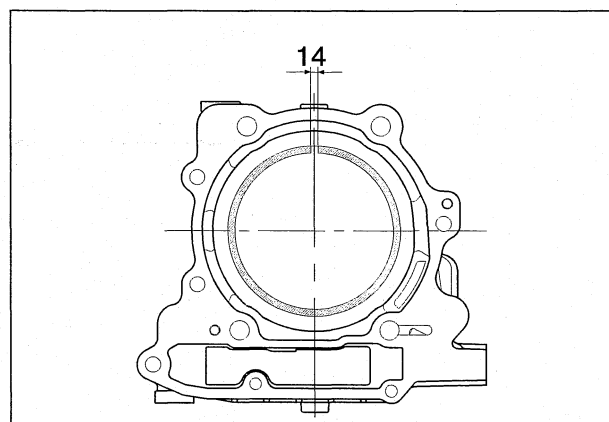
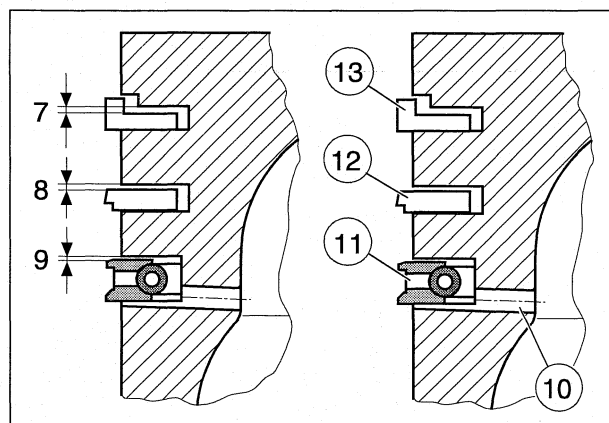
The cylinder bore must not feature any signs of wear.

- ◆ Measure the thickness of the rings with a micrometer.

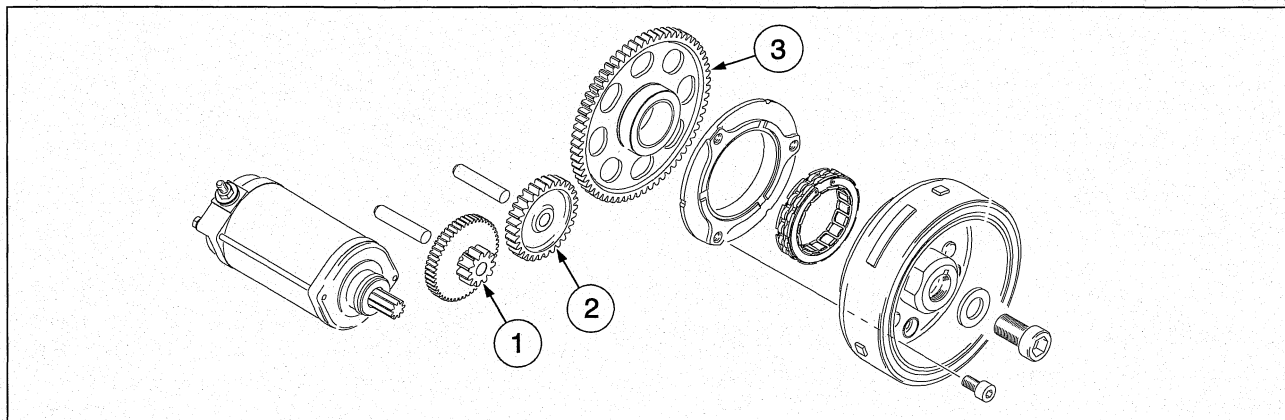
- L-section ring:
wear limit (15) min. 0.85 mm.
- Tapered protruding ring:
wear limit (16) min. 1.20 mm.
- Scraper ring:
wear limit (17) min. 2.45 mm.
- ◆ Fit the scraper ring (11), the tapered protruding ring (12) and the L-section ring (13) from the bottom up; the word "TOP" on the rings must face up.

NOTE Rotate the piston rings so that the three gaps are staggered by approx. 120°.

O = Motor oil.



4.33 STARTER MOTOR DRIVE ASSEMBLY



Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE If the toothing of the double starter gear is distorted, the toothing of the starter motor must also be checked.

- ◆ Check the toothing of the double starter gear (1), idler gear (2) and the freewheel gear (3) for broken material or distortion.
- ◆ Check the bush of the freewheel gear (3) for signs of rolling and grooves.
- ◆ Measure the gear bearing diameter.

– Double starter gear:
wear limit (4) max. Ø 10.10 mm.

– Idler gear:
wear limit (5) max. Ø 10.08 mm.

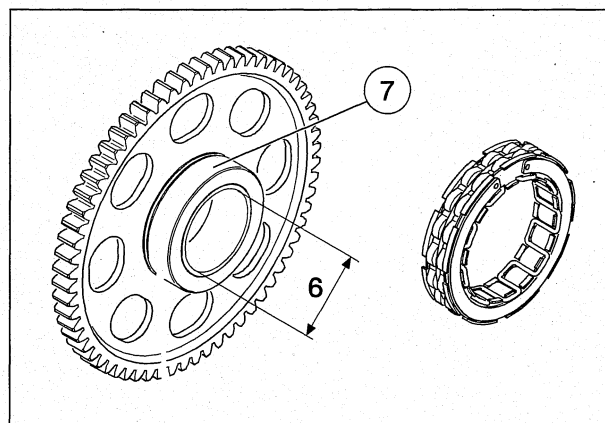
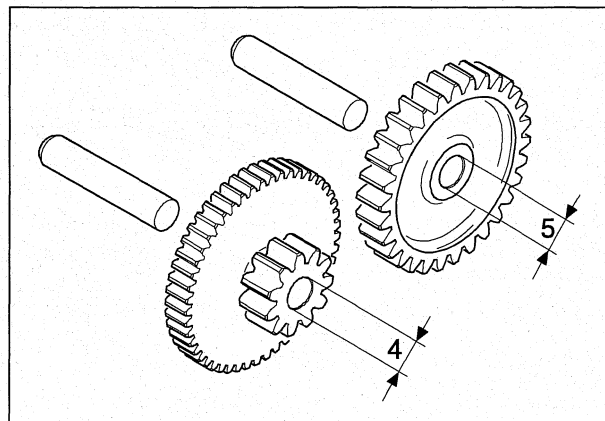
– Freewheel gear:
wear limit (6) max. Ø 35.07 mm.

NOTE The bush inside the freewheel gear (3) must be inserted so that it is fixed and unable to move freely.

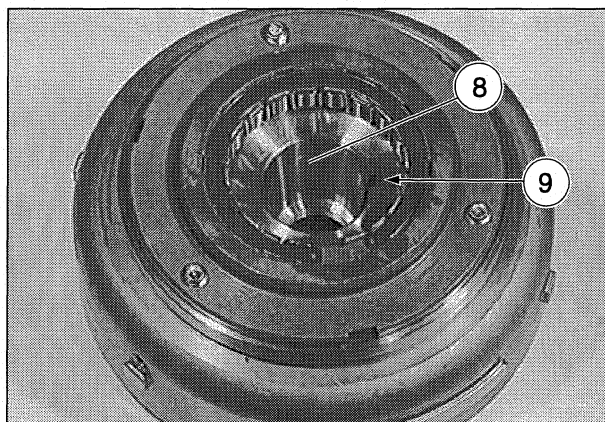
Should signs of distortion be encountered on the sliding surface, or materials found to be broken, the freewheel gear must be replaced.

- ◆ Check the sliding surface (7) of the freewheel for wear.
- ◆ Clean the cone (8) of the magnetic hub of any LOC-TITE® residues.
- ◆ Make sure the cone (8) and the slot (9) for the key are in a perfect state of repair.

NOTE If the cone or the slot for the key are damaged, the magnetic hub must be replaced.



Follow ►



Follow ►

- ◆ Remove the freewheel (10) from the relevant housing (11) and check the rollers of the freewheel (10) for signs of wear.
- ◆ Check whether the external helical spring is preloaded enough to keep the rollers in place.
- ◆ Check the sliding surface of the freewheel inside the relevant housing (11) for signs of wear.

NOTE Should the sliding surface feature signs of distortion or deep grooves, the freewheel housing must be replaced.

4.33.1 DISASSEMBLY THE FREEWHEEL HOUSING

- ◆ Unscrew and remove the three M8x16 T.C.E.I. screws (12) and detach the freewheel housing (11) from the magnetic wheel (13).

4.33.2 ASSEMBLY THE FREEWHEEL HOUSING

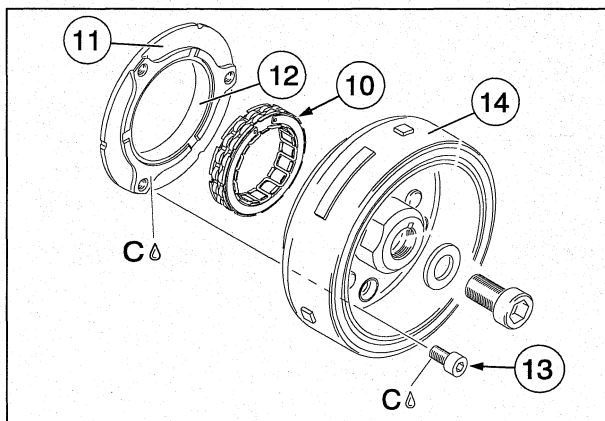
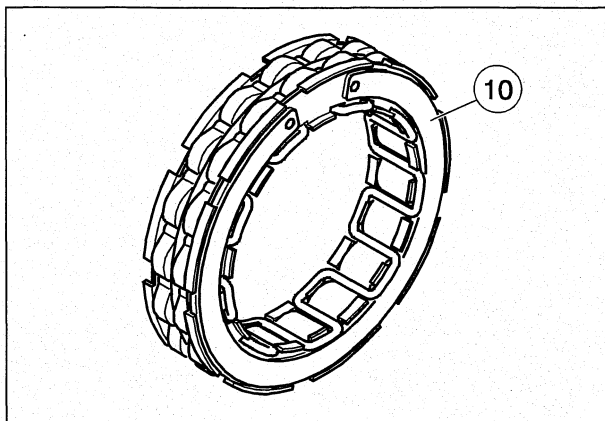
CAUTION

Use **LOCTITE® 648** on the flat surface of the housing (11).

- ◆ Apply a coat of **LOCTITE® 648** on the flat surface of the freewheel housing (11) and place it in the centre of the magnetic wheel (13).
- ◆ Apply a coat of **LOCTITE® 648** on the three M8x16 cheese-headed screws (12) and screw the freewheel housing onto the magnetic wheel.

Screws (12) driving torque: 30 Nm (3.0 kgm).

C = **LOCTITE® 648**.



4.34 IGNITION GENERATOR RSV RSV R SL

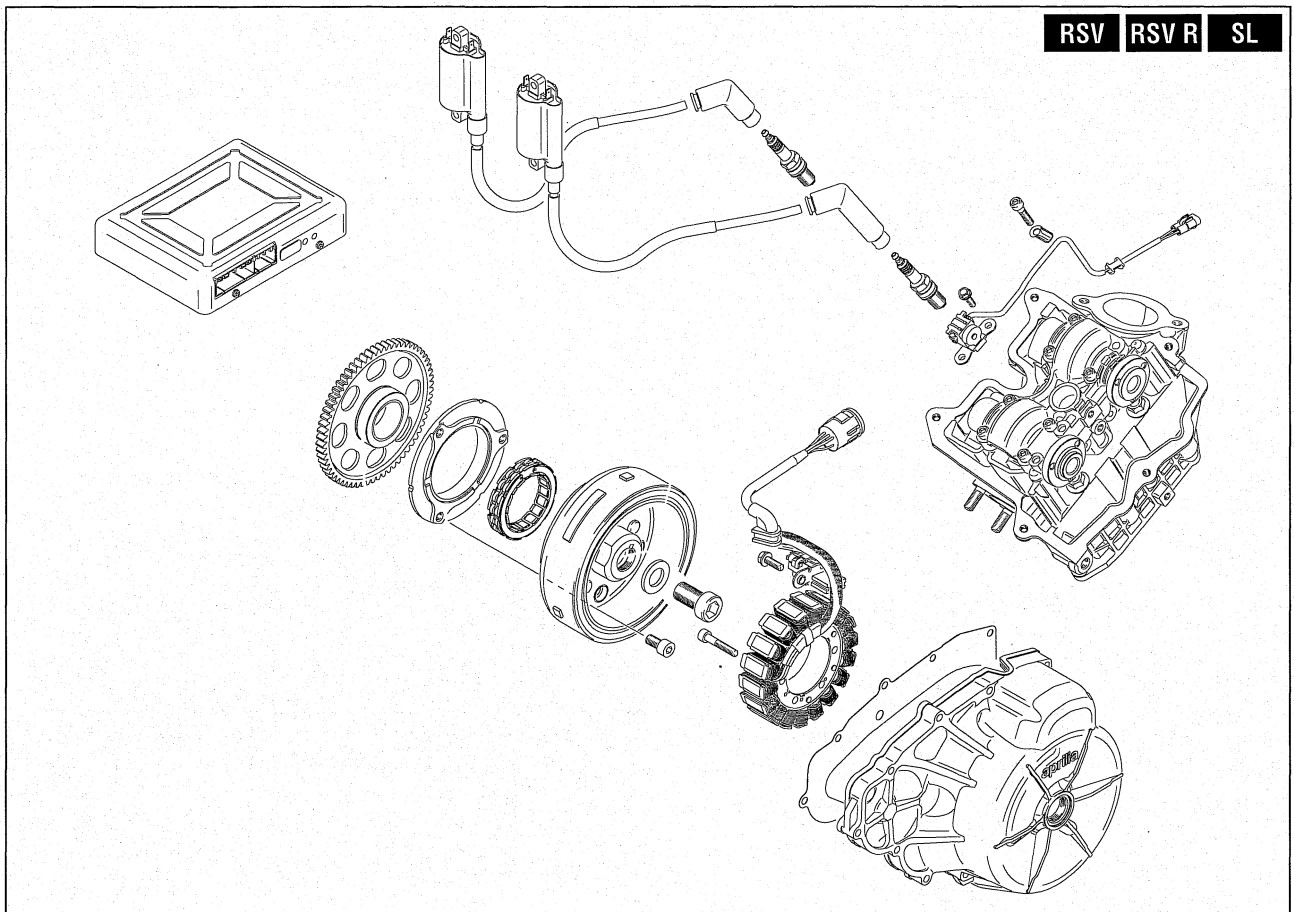
Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE The ignition generator produces alternating current which is then transformed into direct current by the regulator/rectifier, which then charges the battery.

⚠ WARNING

When performing work on the ignition system:

- switch off the engine;
- disconnect the battery: always disconnect the negative pole (-) first;
- drain the engine oil tank completely, see 0.4.1 (VEHICLE WORKSHOP MANUALS);
- lock the drive shaft at the TDC of the front or rear piston.



4.34.1 CHECKING THE STATOR

- ◆ Disconnect the ignition generator connector (1) from the electric wiring.
- ◆ Use an ammeter to measure the resistance between the three output connections to be found on the connector (yellow cables).
- **Standard resistance value in the range 0.2 – 0.5 Ω at 20 °C (68 °F).**

NOTE If the resistance value does not fall within this range, the stator must be replaced.

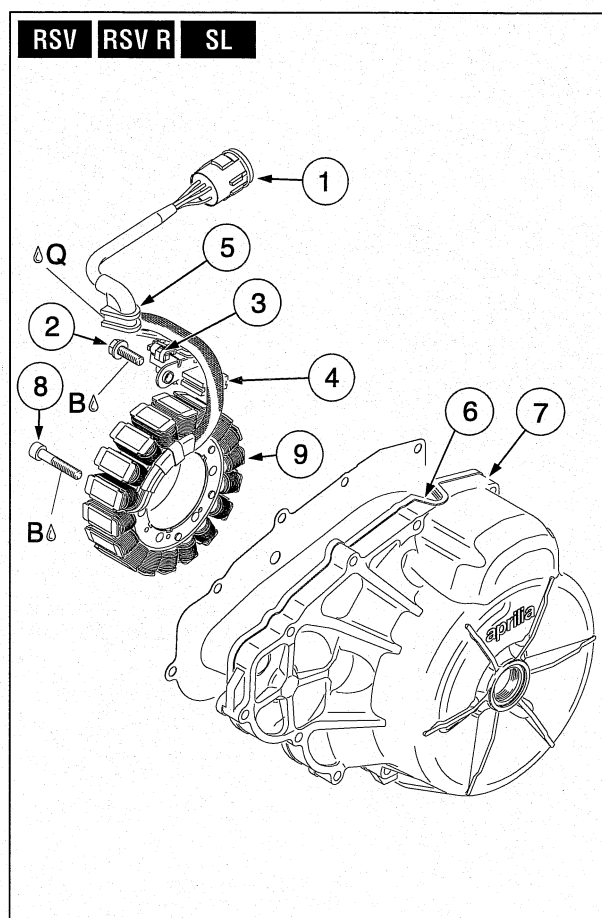
4.34.2 DISASSEMBLING THE STATOR

Driving torque of the drive shaft position sensor screws M6 (2): 11 Nm (1.1 kgm).

- ◆ Unscrew and remove the two M6 screws (2).
- ◆ Remove the drive shaft position sensor (3) and the cable-holding bracket (4).
- ◆ Release the cable guide rubber element (5) from the seat (6) of the flywheel magneto cover (7).

Stator T.C.E.I. screw M6 (8) driving torque: 11 Nm (1.1 kgm).

- ◆ Unscrew and remove the three stator screws T.C.E.I. M6 (8).
- ◆ Extract the stator (9) from the flywheel magneto cover seat.
- ◆ Check the flywheel ignition cover (7) is flat and make sure it features no signs of damage on the gasket surfaces.



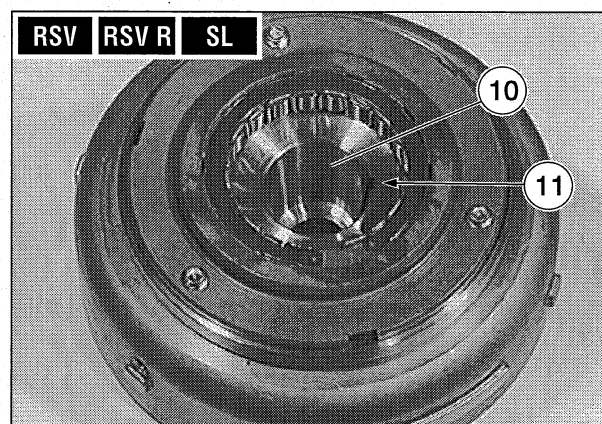
4.34.3 ASSEMBLING THE STATOR

- ◆ Insert the stator (9) in the flywheel magneto cover seat.
- ◆ Apply a layer of LOCTITE® 243 on the three stator screws T.C.E.I. M6 (8) and tighten them.

Stator T.C.E.I. screw M6 (8) driving torque: 11 Nm (1.1 kgm).

- ◆ Apply a layer of SILASTIC 732 RTV on the cable guide rubber element (5) and insert it in the seat (6) of the flywheel magneto cover (7).
- ◆ Position the cable-holding bracket (4) and the drive shaft sensor (3) correctly.
- ◆ Apply a layer of LOCTITE® 243 on the two screws M6 (2) of the drive shaft position sensor and tighten them.

Driving torque of the drive shaft position sensor screws M6 (2): 11 Nm (1.1 kgm).



4.34.4 MAGNETO FLYWHEEL

- ◆ Clean the magnetic hub cone (10) of any LOCTITE® residues.
- ◆ Make sure the cone (10) and the slot (11) for the key are in a perfect state of repair.

NOTE If the cone or the slot for the key are damaged, the magnetic hub must be replaced.

B = LOCTITE® 243.
Q = SILASTIC 732 RTV.

4.35 IGNITION GENERATOR RST ETV

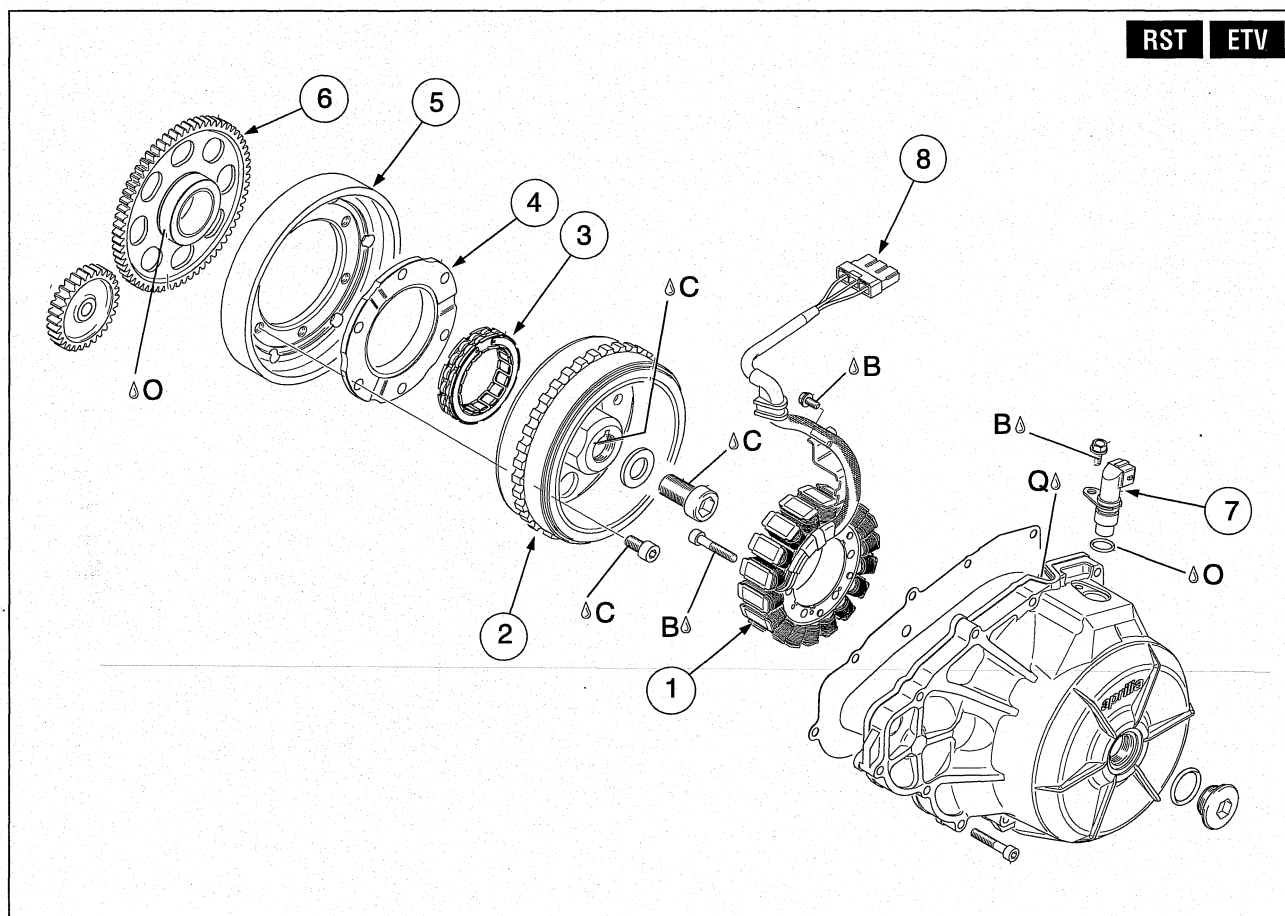
Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE The ignition generator produces alternating current which is then transformed into direct current by the regulator/rectifier, which then charges the battery.

⚠ WARNING

When performing work on the ignition system:

- switch off the engine;
- disconnect the battery: always disconnect the negative pole (-) first;
- drain the engine oil tank completely, see 0.4.1 (VEHICLE WORKSHOP MANUALS);
- lock the drive shaft at the TDC of the front or rear piston.

**Key**

- 1) Stator
- 2) Magneto flywheel
- 3) Free-wheel
- 4) Freewheel housing
- 5) Flywheel ring
- 6) Freewheel gear (Z 64)
- 7) Rpm sensor
- 8) Generator electric connector

B = LOCTITE® 243.
 C = LOCTITE® 648.
 M = MOLIKOTE® G-N.
 N = Lubricating grease.
 O = Motor oil.
 Q = SILASTIC® 732 RTV.

4.35.1 CHECKING THE STATOR

- ◆ Disconnect the ignition generator connector (1) from the electric wiring.
- ◆ Use an ammeter to measure the resistance between the three output connections to be found on the connector (yellow cables).

– **Standard resistance value in the range 0.1 – 1.0 Ω at 20 °C (68 °F).**

NOTE If the resistance value does not fall within this range, the stator must be replaced.

4.35.2 DISASSEMBLING THE STATOR

- ◆ Unscrew and remove the stators three M6 T.C.E.I. screws (2).
- ◆ Extract the stator (3) from the flywheel cover (4).
- ◆ Check the flywheel cover (4) is flat and make sure it features no signs of damage on the gasket surfaces.

4.35.3 ASSEMBLING THE STATOR

- ◆ Insert the stator in the flywheel cover and fasten it with the three M6 T.C.E.I. screws (2), coating the screws with LOCTITE® 243.

Driving torque: 11 Nm (1.1 kgm).

- ◆ Coat the cable rubber (5) with SILASTIC 732 RTV and place it in the ignition cover.

4.35.4 MAGNETO FLYWHEEL

- ◆ Clean the magnetic hub cone (6) of any LOCTITE® residues.
- ◆ Make sure the cone (6) and the slot (7) for the key are in a perfect state of repair.

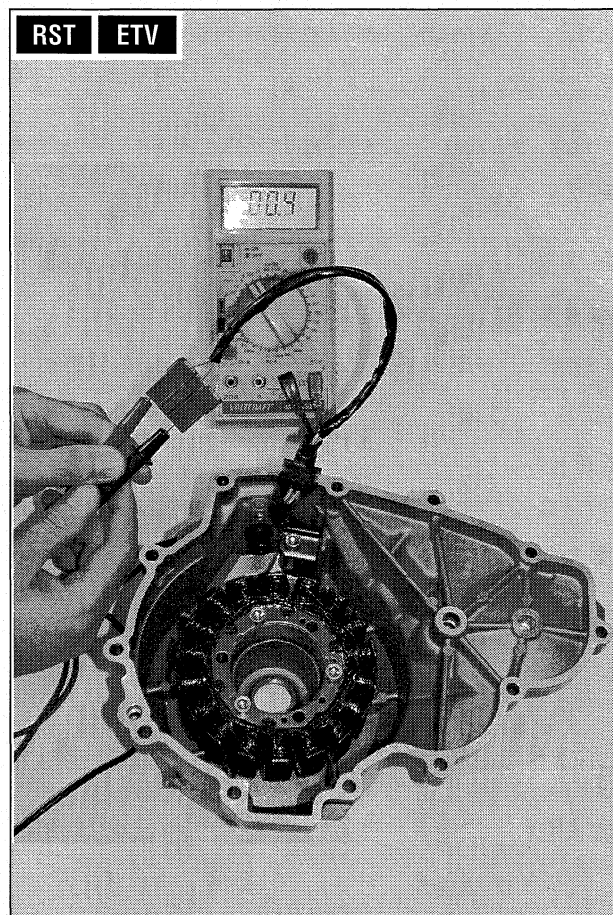
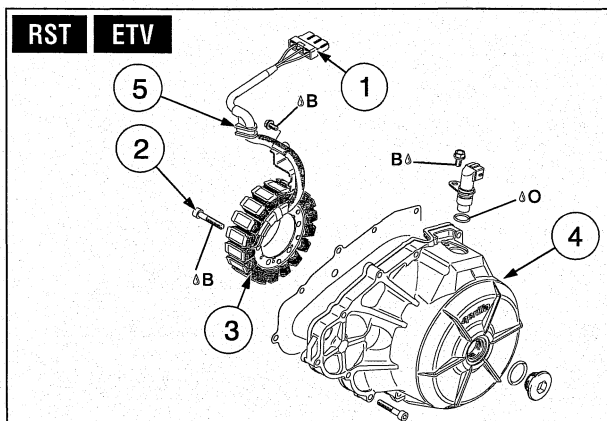
NOTE If the cone or the slot for the key are damaged, the magnetic hub must be replaced.

B = LOCTITE® 243.

C = LOCTITE® 648.

O = Motor oil.

Q = SILASTIC 732 RTV.



4.35.5 CHECKING THE FREEWHEEL

- ◆ Push the freewheel (1) in the housing of the freewheel (4).
- ◆ Rotate the freewheel (1) and make sure that it rotates smoothly.

⚠ CAUTION

The freewheel can rotate in one direction only. In case of strong resistance, remove the freewheel and make sure that it is not damaged.

4.35.6 DISASSEMBLY THE FREEWHEEL HOUSING

- ◆ Unscrew the six screws T.C.E.I. M8x18 (2) and remove the flywheel ring (3), the freewheel housing (4) and the freewheel (5) from the flywheel magneto (6).

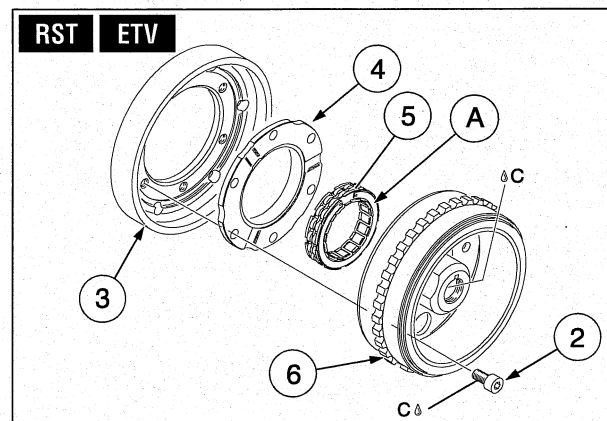
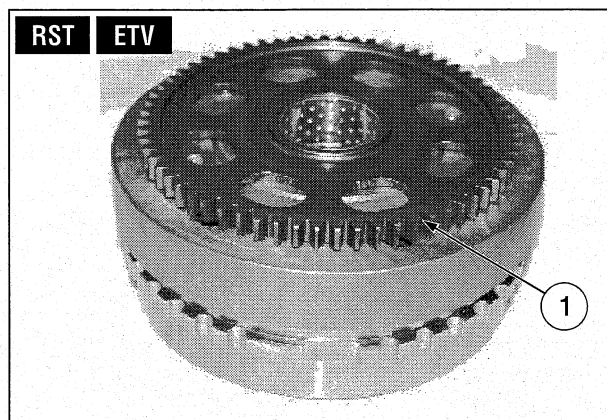
NOTE For the inspection and the wear limits of the electric starter transmission, see 4.33 (STARTER MOTOR DRIVE ASSEMBLY).

4.35.7 ASSEMBLY THE FREEWHEEL HOUSING

- ◆ Insert the freewheel (5) in the freewheel housing (4), so that the flange (A) is directed towards the magnetic gear (6); insert both of them in the centre of the flywheel ring (3).
- ◆ Insert the magneto flywheel (6).
- ◆ Apply LOCTITE® 648 on the thread of the screws (2).
- ◆ Fasten with six screws T.C.E.I. M8x18 (2).

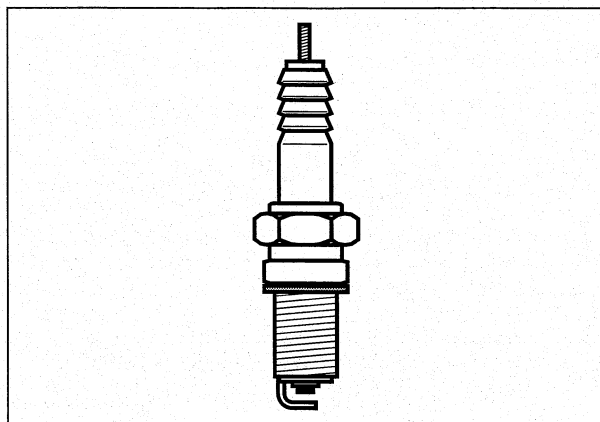
Screws (2) driving torque: 30 Nm (3.0 kgm).

C = LOCTITE® 648.



4.36 SPARK PLUGS

See 0.4.1 (VEHICLE WORKSHOP MANUALS).

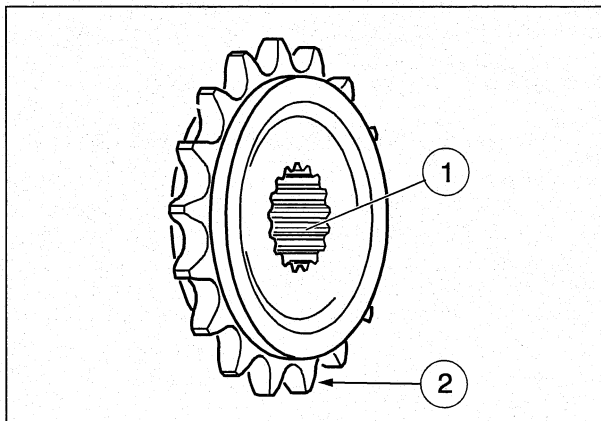


4.37 DRIVING CHAIN PINION

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Remove the transmission pinion (1), see the workshop manual of the vehicle.
- ◆ Check the pinions internal toothing (2) for wear.
- ◆ Check the pinions external toothing (3) for wear and signs of distortion.

NOTE If the toothing of the driving chain is worn, the chain pinion must be replaced together with the driving chain.



4.38 STARTER MOTOR

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Remove the starter motor, see 3.3 (REMOVING THE STARTER MOTOR).

NOTE The starter motor is not normally subject to any particular wear and tear.

In the event the carbon brushes are worn, they can be replaced using the available repair kit; if not, replace the complete starter motor.

- ◆ Check the starter motors toothing (4) for broken materials, wear and distortion.

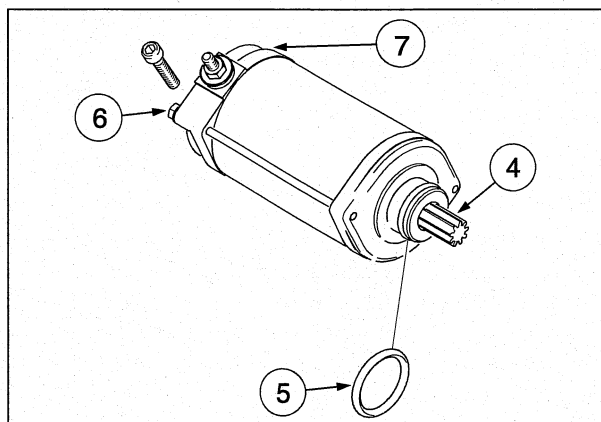
NOTE Where necessary, replace the starter motor.

- ◆ Check the starter motor mount O-ring (5) for wear and any signs of damage, and replace it.
- ◆ Unscrew and remove the two M6 T.E. screws (6) and remove the complete rear cover (7).
- ◆ The four carbon brushes must be allowed to move freely.
- ◆ Check the preloading of the brush springs.
- ◆ Check the length of the carbon brushes.

Max. wear limit 8.0 mm.

NOTE Kits are available containing rear covers complete with carbon brushes and seals.

- ◆ Fasten the complete rear cover with the two M6 T.E. screws (6).



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REASSEMBLING THE ENGINE

5

REASSEMBLING THE ENGINE**TABLE OF CONTENTS**

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5.1 GENERAL INDICATIONS

Carefully read 3.2.1 (ENGINE DISASSEMBLY SEQUENCE).

CAUTION

When repairing the engine, always replace all the previously disassembled gaskets, seeger rings, O-rings and seals.

Unless otherwise indicated, lubricate all the moving and sliding parts.

5.2 ASSEMBLING THE GEARSHIFT

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

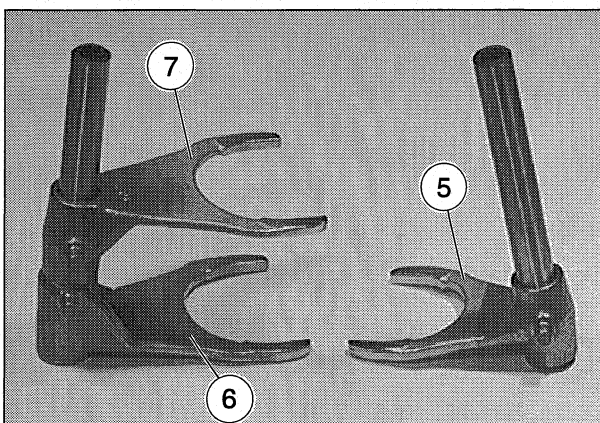
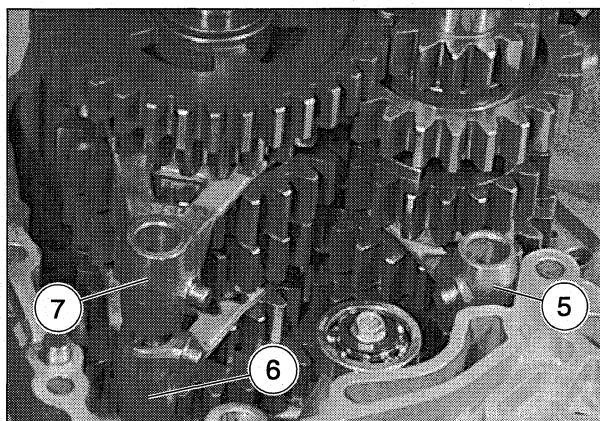
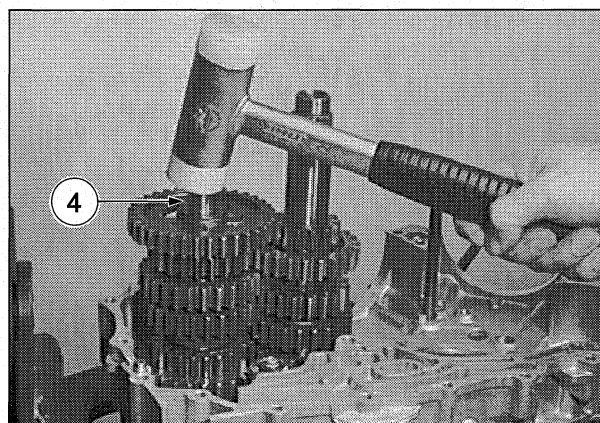
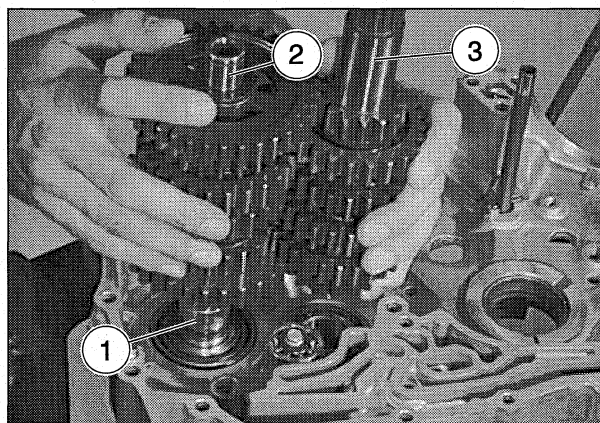
NOTE Assemble the gears on the driving shafts, see 4.14 (TRANSMISSION).

NOTE Have the appropriate special tool **OPT** to hand:

– **aprilia** part# 0277308 (gearshift secondary shaft guide bush) (1).

- ◆ Insert the guide bush (1) on top of the gear of the secondary shaft (2).
- ◆ Grease the secondary shaft seal between the two lips.
- ◆ Apply a coat of LOCTITE® 767 Anti-Seize on the housings of the secondary shaft (2) and primary shaft (3).
- ◆ Insert the primary shaft (3) in the housing in the fly-wheel side half of the engine casing.
- ◆ Insert the secondary shaft (2) in the housing in the fly-wheel side half of the engine casing.
- ◆ Insert the complete gearshift assembly in its housing, tapping the two shafts lightly all the way in with a plastic hammer.
- ◆ Insert the washer (4) on the secondary shaft (2).
- ◆ Oil the fork of 5th and 6th gear (5) and insert it in the selector gear of the primary shaft (3).
- ◆ Oil the fork of 2nd and 4th gear (6) and the fork of 1st and 3rd gear (7) and insert them in the respective selector gears of the secondary shaft (2).

Follow ►



Follow ►

- ◆ Oil the shift cam (8) and insert it in the relevant slot in the casing.
- ◆ Attach the 3 gearshift forks inside the respective guides of the shift cam (8).
- ◆ Insert the two gearshift rods (9), pushing them all the way into the respective slots in the flywheel side half of the engine casing.

5.3 ASSEMBLING THE DRIVING SHAFT AND COUNTERSHAFT

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Apply a coat of MOLYKOTE® G-N on the housings of the bushes for the driving shaft and countershaft.
- ◆ Insert the driving shaft (10) in the housing in the flywheel side half of the engine casing.

NOTE Position the lower connecting rod (11) towards rear cylinder and the upper connecting rod (12) towards front cylinder.

⚠ CAUTION

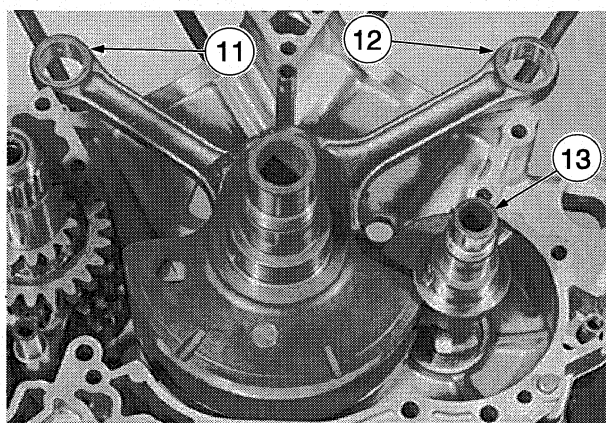
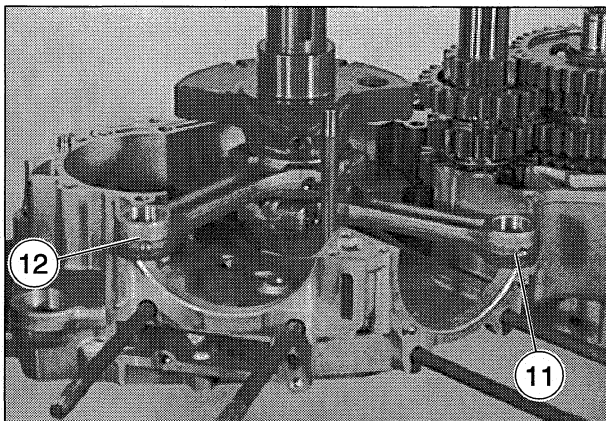
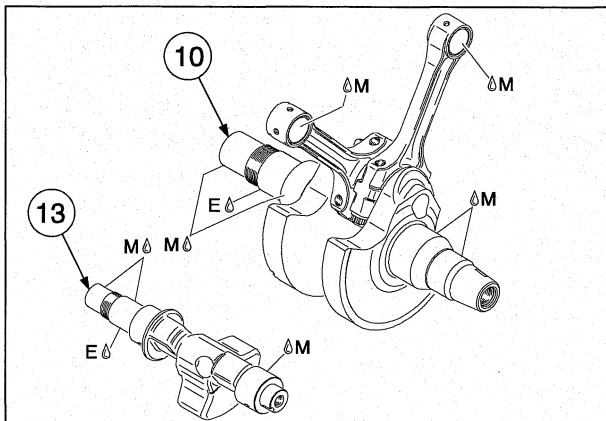
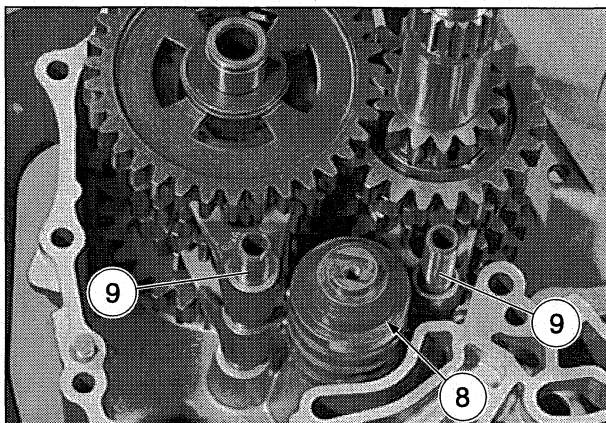
Do not tilt the driving shaft during insertion so as to avoid damaging the main bushes inside the housing.

- ◆ Insert the countershaft (13) in the relevant housing.

⚠ CAUTION

Do not tilt the countershaft during insertion so as to avoid damaging the bearing bushes inside the housing.

M = MOLYKOTE® G-N.
E = LOCTITE® 767 Anti-Seize.



5.4 ASSEMBLING THE ENGINE CASING

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

⚠ CAUTION

Use a new gasket.

- ◆ Apply the engine casing gasket (1) on the flywheel side half of the engine casing.

NOTE The engine casing gasket must coincide with all the engine casing holes over the whole area. Grease may be applied on the gasket to prevent the movement.

Work with extreme care to assure a perfect seal.

- ◆ Make sure the washer (2) is on the driving shaft.
- ◆ Apply a coat of LOCTITE® 767 Anti-Seize on the housings of the secondary shaft (3) and primary shaft (4).
- ◆ Coat the housings of the driving shaft (5) and counter-shaft (6) with MOLYKOTE® G-N.
- ◆ Make sure the oil-spray pipe (7) is fitted.
- ◆ Make sure the oil gauze is inserted in the clutch side half of the engine casing.
- ◆ Install the clutch side half of the engine casing (8) on the flywheel side half.

NOTE Where necessary, use a plastic hammer to tap on the casing rib, near of the shaft.

Take care not to damage the gasket surface of the clutch cover (9).

- ◆ Rotate the engine by 90° (A).

NOTE Work on the flywheel side.

⚠ CAUTION

Screw on the screws in a crisscross pattern, tightening them gradually.

- ◆ Screw the twenty M6 T.C.E.I. screws onto the engine casing, i.e.:
 - n° 13 M6x65 screws (10);
 - n° 5 M6x45 screws (11);
 - n° 1 M6x80 screw (12);
 - n° 1 M6x25 screw (13).

Screws (10) (11) (12) (13) driving torque: 11 Nm (1.1 kgm).

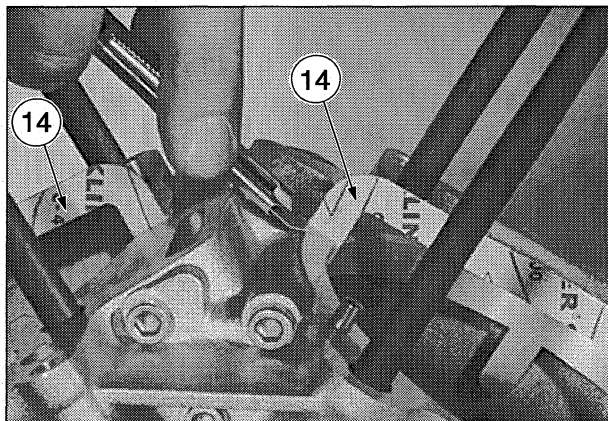
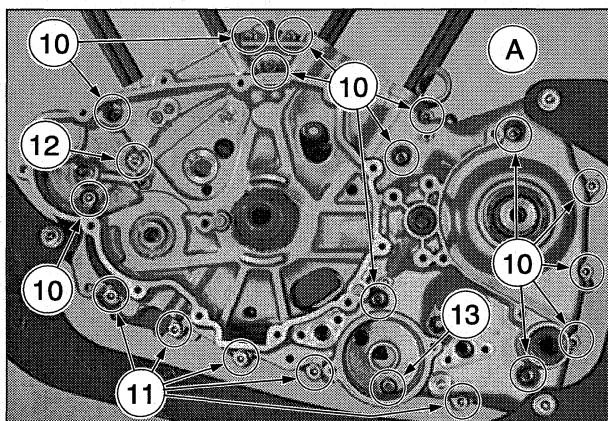
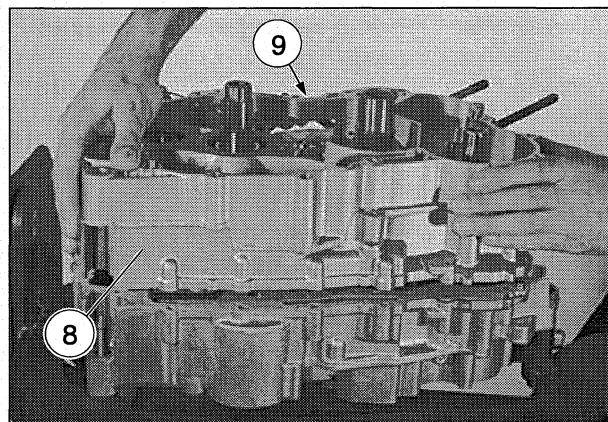
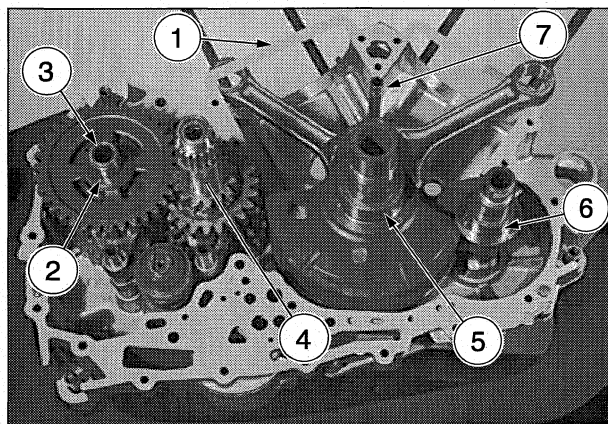
NOTE Having tightened the engine casing screws, make sure the driving shaft, countershaft, primary shaft and secondary shaft can turn slightly.

- ◆ Check the end play of the driving shaft with a comparator.

Wear limit: max. 0.5 mm.

NOTE Cover the engine compartment with a clean cloth.

- ◆ Use a paper cutter to cut the parts of the gasket sticking out from the engine casing (14) around the cylinder flange and where the cylinder is centred.



5.5 ASSEMBLING THE GEAR SELECTION MECHANISM

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE Lock the M6 T.C.E.I. screw (5) in place with a LOCTITE® 243 product.

- ◆ Fit the index spring (1), shim (2), index lever (3) and washer (4) and secure them with the M6 T.C.E.I. screw (5).

Screw (5) driving torque: 11 Nm (1.1 kgm).

NOTE Lock the M6 T.C.E.I. screw (8) in place with a LOCTITE® 243 product.

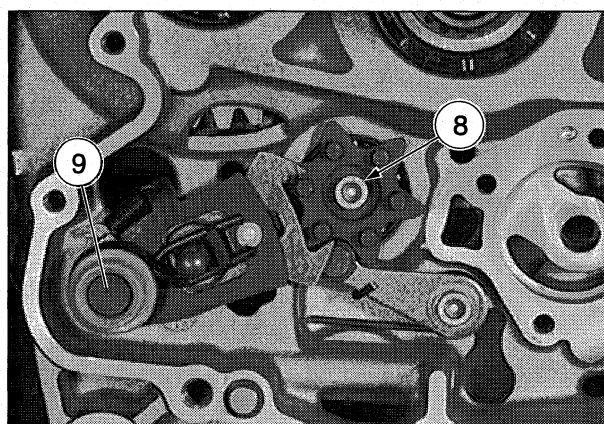
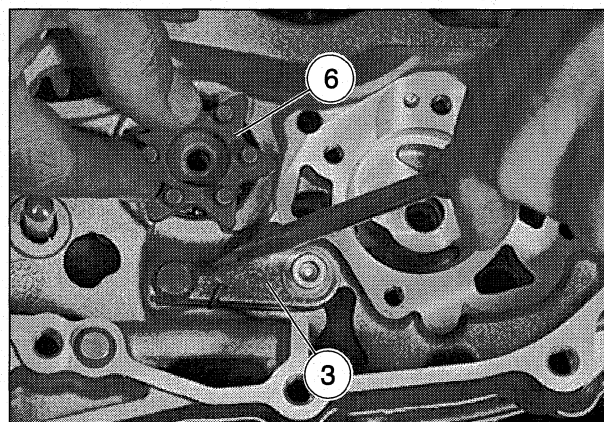
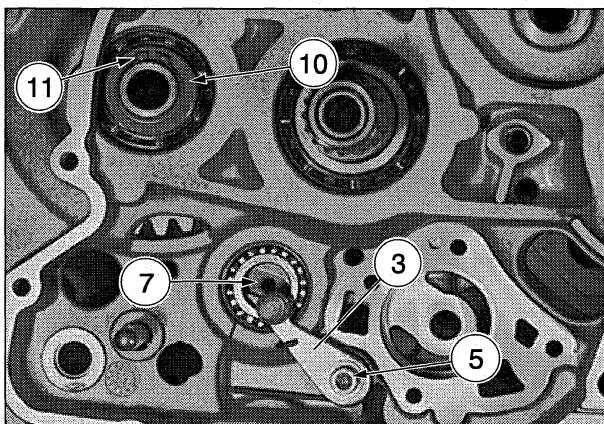
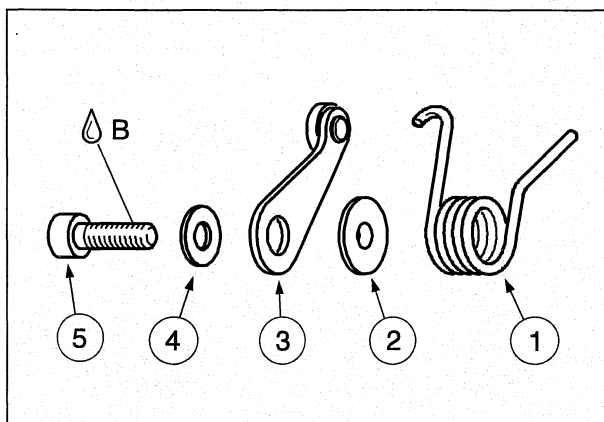
- ◆ Press the index lever (3) down and insert the index plate (6) in the shift cam slot (7), fastening it with the M6 T.C.E.I. screw (8).

Screw (8) driving torque: 11 Nm (1.1 kgm).

- ◆ Oil the complete gearshift shaft (9) and insert it in the relevant housing.
- ◆ Insert the thrust washer (10) and insert the seeger ring (11) in the groove of the secondary shaft.

NOTE Always replace the seeger ring (11). Make sure the ends are not pulled apart more than necessary (use a pair of pliers for seegar ring).

B = LOCTITE® 243.



5.6 CHECKING THE GEAR SELECTION MECHANISM

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Make sure the needle spring (1) in the rotating lever (2) and in the cylindrical pin (3) features no slack.

NOTE If this is not the case, one of the needle springs (1) end must be bent.

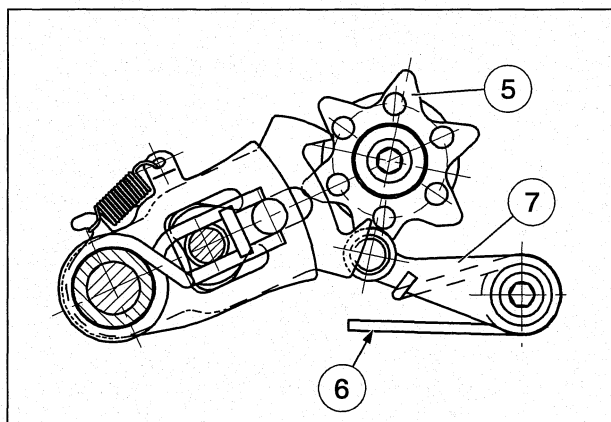
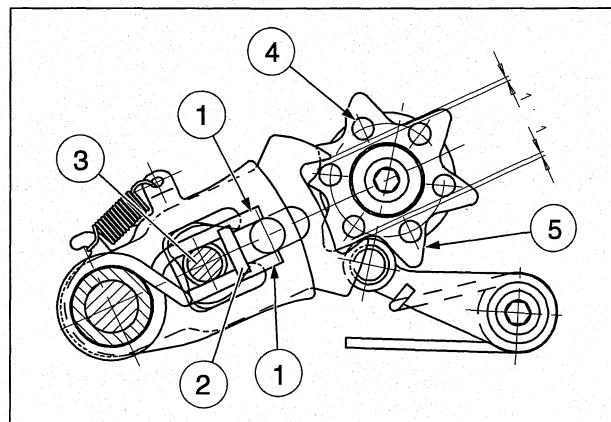
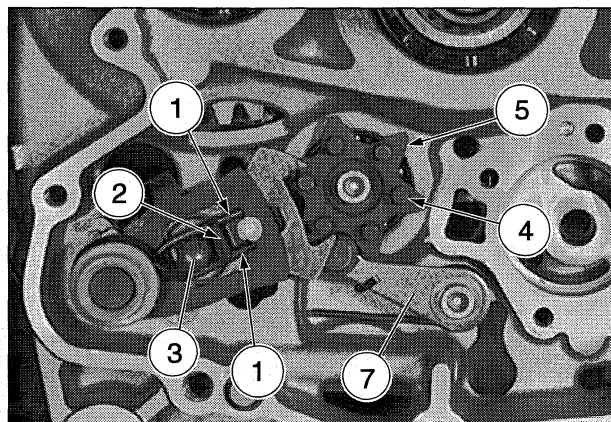
- ◆ Engage all the gears and make sure the drive pins (4) of the index plate (5) are in the central position.

NOTE If this is not the case, one of the needle springs (1) end must be bent.

- ◆ Check the preloading of the index spring (6). It must be quite hard to lift the index lever (7) of the shift cam index plate (5).

NOTE Rotating the shift cam must cause the positioning spring (6) to push the positioning lever (7) into the relevant slot on the index plate (5).

- ◆ Put the gearshift into neutral and make sure all the gearshift gears turn freely.



5.7 ASSEMBLING THE OIL PUMP

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

CAUTION

Make sure the **LOCTITE®** product does not get inside the suction pump hole.

- ◆ Apply a thin film of **LOCTITE®** 574 on the gasket surface (1) of the oil pump casing.
- ◆ Remove the oil pump apart, see 3.13 (REMOVING THE OIL PUMP).

NOTE Store the following assemblies, keeping them separate:

- outer rotor (2) inner rotor (5) (of the suction pump);
- outer rotor (10) inner rotor (9) (of the pressure pump).

Do not mix the components of these assemblies.

- ◆ Insert the duly oiled external rotor (2) in the slot of the casing.

NOTE The reference point must face down (towards the engine casing).

- ◆ Insert the pin (3) in the last hole at the bottom of the oil pump shaft (4).
- ◆ Insert the internal rotor (5) in the oil pump shaft (4), with the housing slot facing up.
- ◆ Insert the oil pump shaft (4) in the casing, complete with internal rotor (5).

CAUTION

Make sure the **LOCTITE®** product does not get inside the pressure pump hole.

- ◆ Apply a thin film of **LOCTITE®** 574 on the external gasket surface of the oil pump casing (6) and install it on the oil pump shaft (4).
- ◆ Fasten the oil pump casing (6), complete with pin (7), inside the casing.
- ◆ Insert the pin (8) in the central hole of the oil pump shaft.
- ◆ Insert the duly oiled internal rotor (9) of the pressure pump on the oil pump shaft, with the driving groove facing down.
- ◆ Insert the duly oiled external rotor (10) in the oil pump casing.
- ◆ Fasten the oil pump cover (11) with the four T.C.E.I. screws (12).

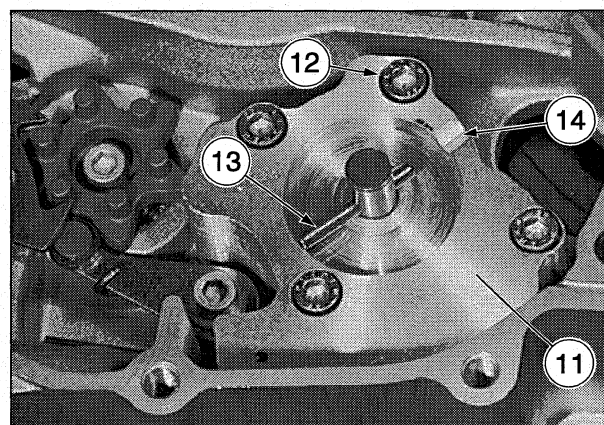
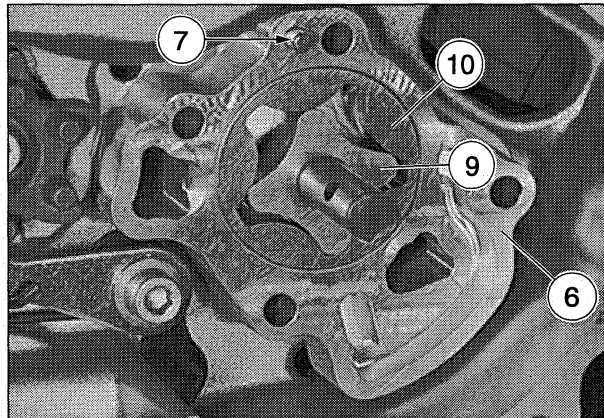
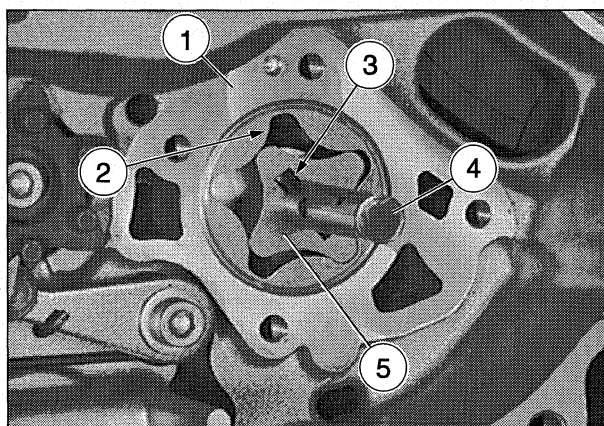
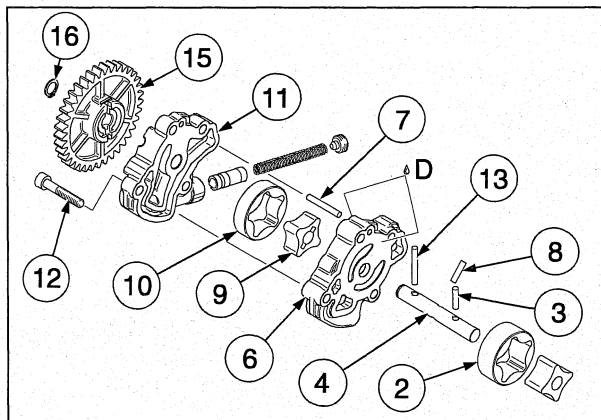
Screws (12) driving torque: 11 Nm (1.1 kgm).

- ◆ Insert the pin (13) in the hole of the oil pump shaft (4).

NOTE The oil pump cover features a groove (14) enabling the pin (13) to be fitted.

Line the pin (13) up with the centre of the oil pump shaft (4).

Follow ►



Follow ►

CAUTION

Once disassembled, the oil pump gear must always be replaced.

- ◆ Fit a new oil pump gear (15).

NOTE You must feel the pin (13) engaging perfectly inside the groove on the oil pump gear.

- ◆ Fit the seeger ring (16) in the groove of the oil pump shaft.

NOTE Make sure the seeger ring is inserted all the way into the groove.

Make sure the ends are not pulled apart any more than necessary.

- ◆ Check the rotation and end play of the oil pump shaft (4).

D = LOCTITE® 574.

5.8 ASSEMBLING THE REAR HEAD TIMING CONTROL UNIT (PART ONE)

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Turn the driving shaft so that the connecting rod of rear cylinder is at TDC.

NOTE Have the appropriate special tool **OPT** to hand:

- **aprilia** part# 0240880 (threaded bolt to lock the drive shaft at the TDC) (17).

- ◆ Lock the driving shaft in place with the threaded bolt (17).

NOTE When rear cylinder is at TDC, the fastening slot (18) of front cylinder is visible through the gap under the countershaft.

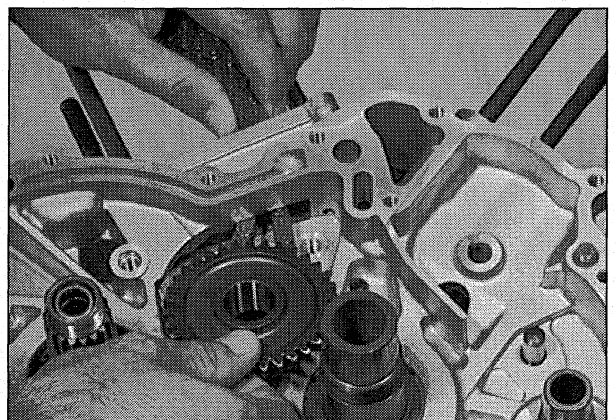
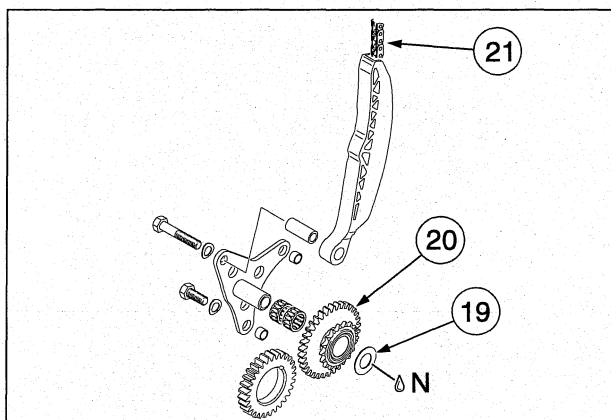
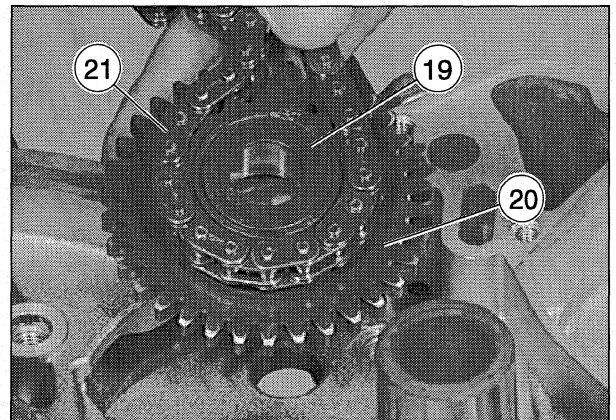
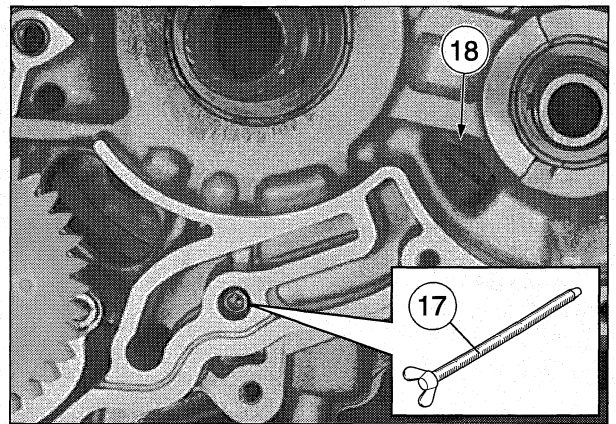
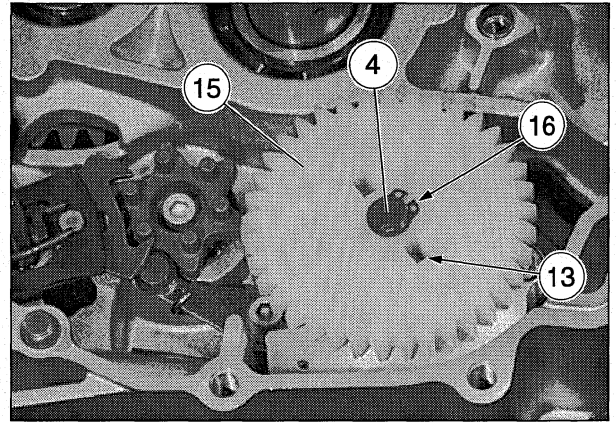
The threaded bolt (17) must never be overtightened; **max. 5 Nm (0.5 kgm)**.

- ◆ Use grease to assure adherence between the thrust washer (19) and the intermediate drive gear (20).

NOTE Hook up the timing chain (21) based on the reference marking applied during its disassembly.

- ◆ Place the timing chain (21) around the intermediate drive gear (20), guiding both through the chain compartment and inserting them in the housing.

Follow ►

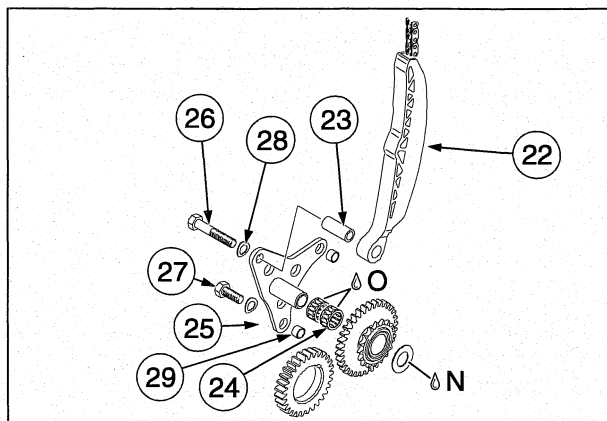


Follow ►

- ◆ Guide the chain tightener shoe (22) through the chain compartment and fasten it in the housing by means of the spacer bush (23).
- ◆ Oil the two roller bearings (24) and push them onto the bearing pins of the bearing flange (25).

NOTE Insert the bearing flange all the way in, tapping gently with a plastic hammer. The two calibrated bushes (29) must previously have been fastened in the casing.

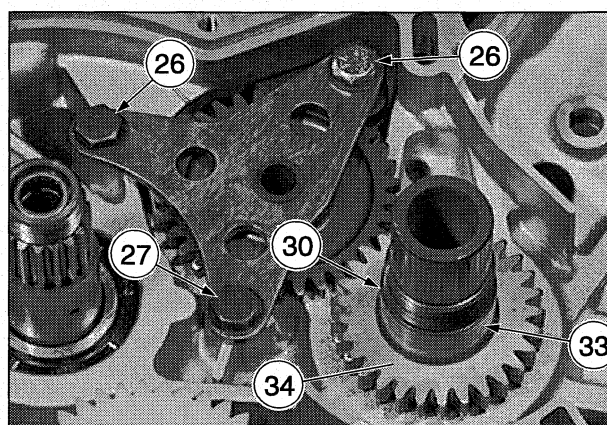
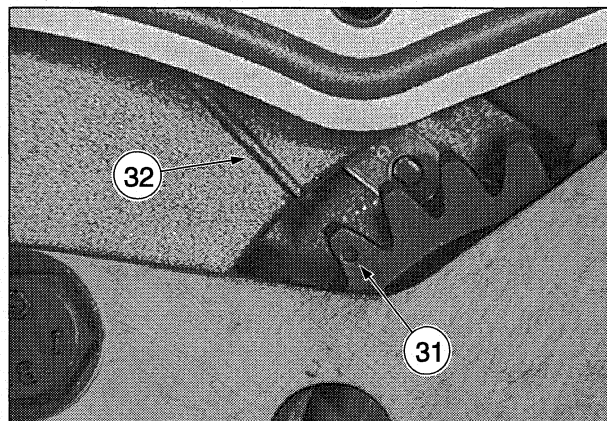
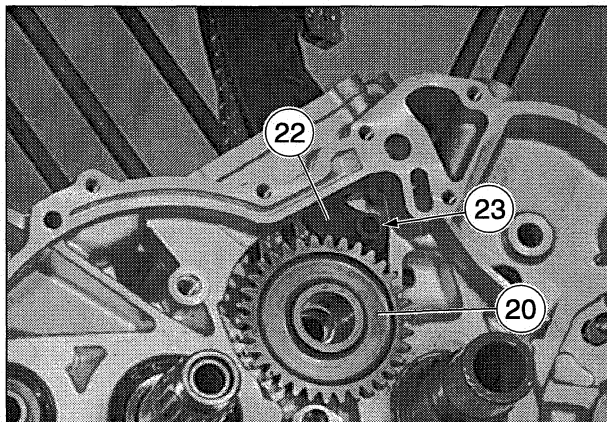
- ◆ Insert the bearing flange (25) and fasten it using the three M8 T.C.E.I. screws (26) (27) and the spring washers (28), i.e:
 - 2 M8x45 screws (26);
 - 1 M8x20 screw (27).



Screws (26) (27) driving torque: 25 Nm (2.5 kgm).

- ◆ Check the rotation of the intermediate drive gear.
- ◆ Insert the key (30) in the driving shaft.
- ◆ The reference mark (31) on the intermediate drive gear must coincide with the reference mark (32) on the casing.
- ◆ Apply a coat of LOCTITE® 767 Anti-Seize on the end of the driving shaft (33).
- ◆ Push the drive gear (34) onto the driving shaft.

N = Lubricating grease.
O = Motor oil.



5.9 ASSEMBLING THE COOLANT PUMP DRIVE

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Coat the end of the countershaft (1) with LOCTITE® 767 Anti-Seize.
- ◆ Oil the housing at the end of the countershaft.
- ◆ Insert the key (2) in the countershaft.
- ◆ Insert the washer (3) with the flared side facing down.
- ◆ Install the coolant pump gear (4) on the countershaft.
- ◆ Insert the coolant pump idler gear (5) on the cylindrical pin.
- ◆ Insert the washer (6) to the countershaft.
- ◆ Install the driving gear (7) on the driving shaft.

NOTE The reference point must be visible.

- ◆ Insert the gear (8) on the countershaft.

NOTE The reference point must be visible and must coincide with the reference mark on the driving gear.

- ◆ Lift the countershaft all the way in the axial direction and insert the counterweight (9) onto the countershaft.

NOTE The counterweight notch (10) must be engaged by the end of the key (2).

- ◆ Insert the spring washer (11) and tighten the M22x1.5 nut (12).

Nut (12) driving torque: 150 Nm (15.0 kgm).

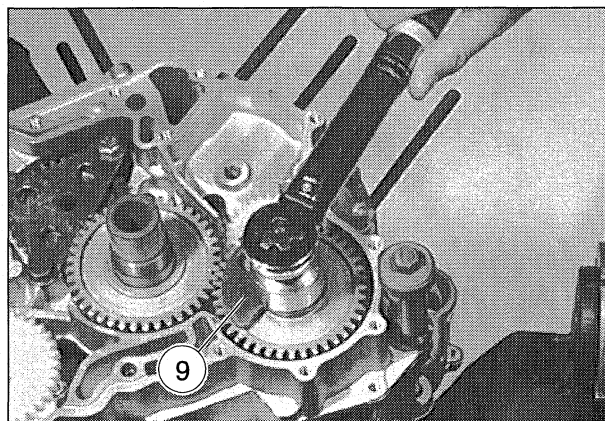
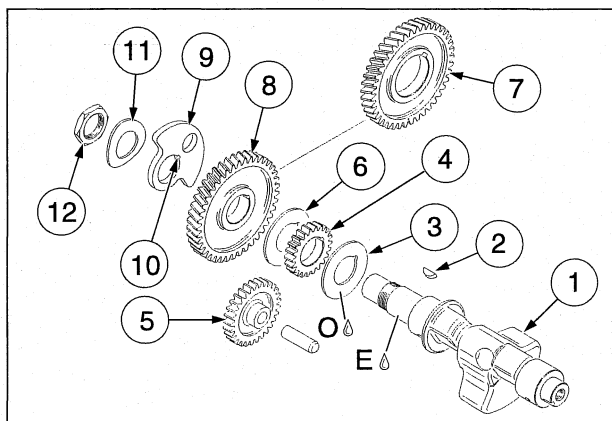
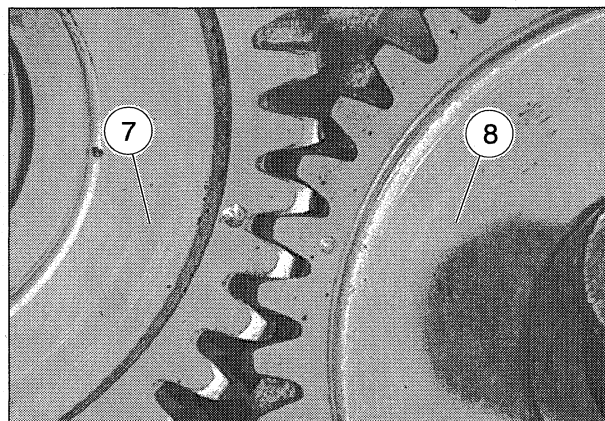
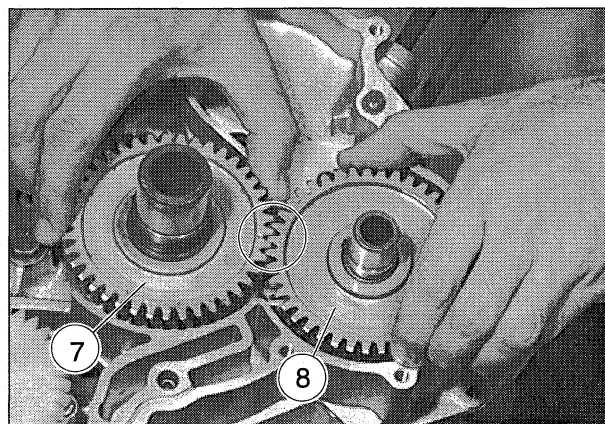
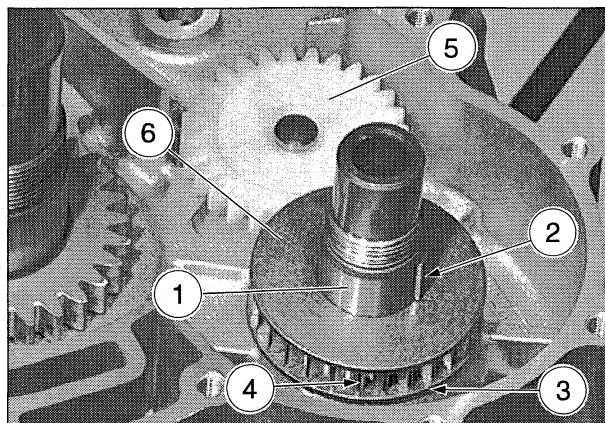
NOTE Make sure the position of the hole for the counterweight (9) is more or less at 10 o'clock.

- ◆ Check the end play of the countershaft with a comparator.

Wear limit: max. 0.3 mm.

O = Motor oil.

E = LOCTITE® 767 Anti-Seize.



5.10 ASSEMBLING THE PRIMARY TRANSMISSION AND CLUTCH

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Coat the end of the driving shaft with LOCTITE® 767 Anti-Seize.

NOTE The collar of the drive gear must face down.

- ◆ Insert the drive gear (1) on the driving shaft.
- ◆ Fit the spring washer, then fasten and tighten the M33x1.5 nut (2), coating it with LOCTITE® 243.

Nut (2) driving torque: 230 Nm (23.0 kgm).

- ◆ Assemble the primary transmission assembly, see 4.19.1 (PRIMARY TRANSMISSION aprilia part# 0295790 – PREASSEMBLY).
- ◆ Coat the housing (3) and tothing (4) of the primary shaft with LOCTITE® 767 Anti-Seize.
- ◆ Install the primary transmission assembly on the primary shaft.

NOTE Rotate the driven gear (5) of the oil pump, so that its tothing engages with the tothing of the drive gear (6) of the primary transmission unit.

- ◆ Fit the serrated thrust ring (8), the clutch hub (9) and the spring washer (10) on the primary shaft.

NOTE Have the appropriate special tool **OPT** to hand:
– **aprilia** part# 0277881 (clutch blocking tool).

- ◆ Insert the clutch blocking tool (11).

CAUTION

Insert the clutch blocking tool (11) all the way in to the clutch basket so as not to damage the basket when the nut (12) is tightened.

- ◆ Screw and tighten the nut (12), coating it with LOCTITE® 648.

Nut (12) driving torque: 170 Nm (17.0 kgm).

- ◆ Remove the clutch blocking tool (11).

NOTE The upper friction disc (Z) can be recognized by the blue point.

- ◆ Find the upper friction disc and store it, in order to assemble it as last friction disc.

NOTE There are different clutch versions.

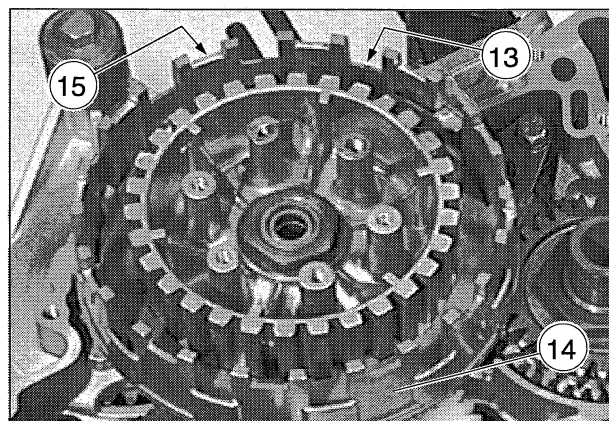
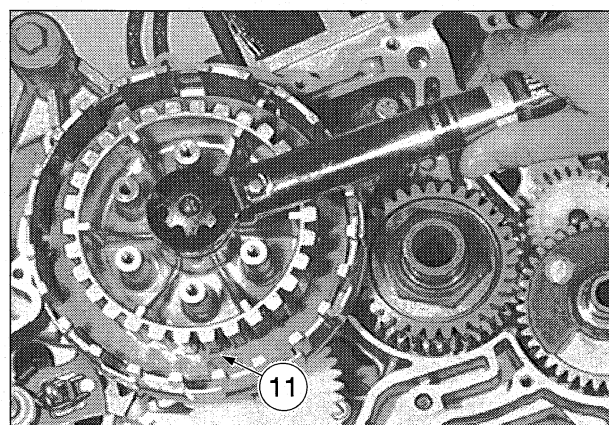
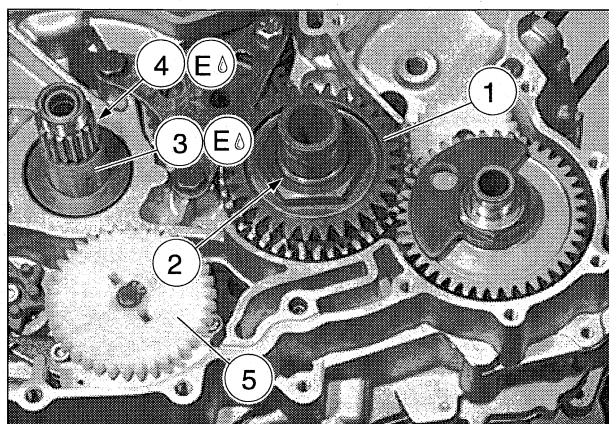
For information regarding the components of the clutch, refer to the specific spare parts catalogue, according to the vehicle model on which the engine is installed, see 0.4.2 (SPARE PARTS CATALOGUES).

According to the clutch version.

The lower steel disc can be recognized:

- no mark, the disc is exactly like the others;
- space between teeth (X);
- notch (Y).

- ◆ Identify the lower steel disc, in order to be able to position it first when installing the steel discs.



NOTE The friction discs must be inserted in the grooves (13) present on the clutch housing (14), except for the upper friction disc that must be inserted in the staggered groove (15).

Insert the clutch discs, starting with a steel one.

- ◆ Insert a steel disc (16) and a friction disc (17), alternately.

NOTE The upper friction disc (Z) must be inserted in the staggered groove (15).

- ◆ Insert the upper friction disc.

Follow ►

Follow ►

NOTE Make sure this disc does not feature any slack, though it must not be locked in place.

- ◆ Oil the friction disengaging shaft (18) and insert it in the primary shaft hole.
- ◆ Insert the spring plate (19).

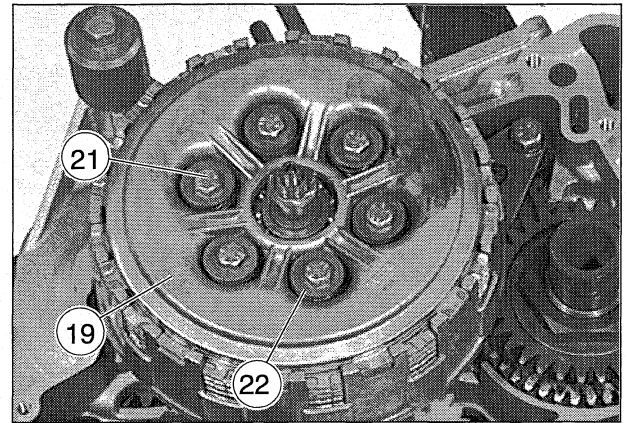
NOTE There are different clutch versions.

For information regarding the components of the clutch, refer to the specific spare parts catalogue, according to the vehicle model on which the engine is installed, see 0.4.2 (SPARE PARTS CATALOGUES).

According to the clutch version.

The clutch spring washers may be:

- normal (flat) (22);
- special (with collar) (22A).



CAUTION

In case of special washers (22A), pay attention to the correct assembly position (W).

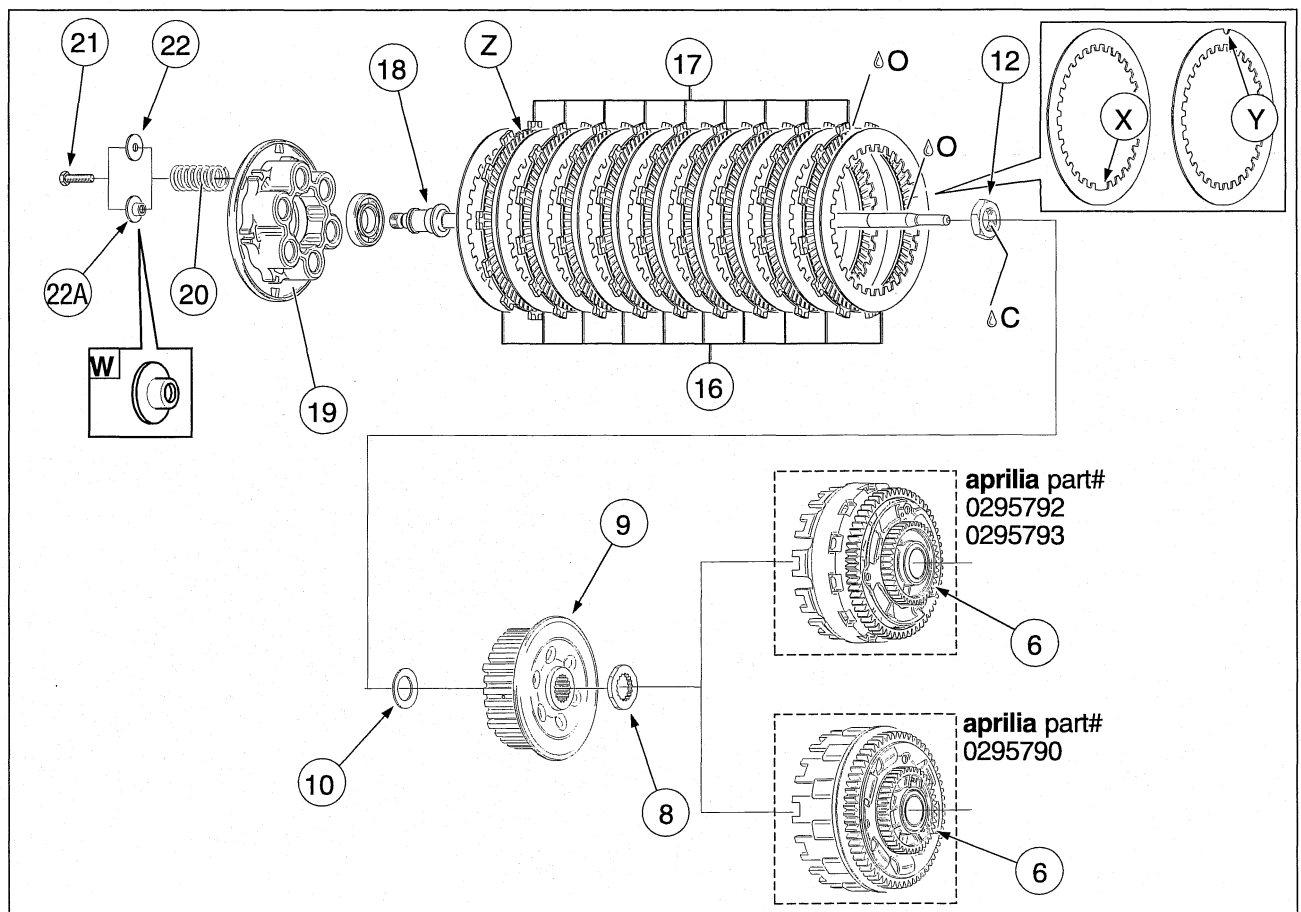
- ◆ Insert the six clutch springs (20) in the spring-holding plate and fix them with the six screws T.C.E.I. M6 (21) complete with washers (22).

Screws (21) driving torque: 11 Nm (1.1 kgm).

C = LOCTITE® 648.

E = LOCTITE® 767 Anti-Seize

O = Motor oil.



5.11 ASSEMBLING THE PISTON AND REAR CYLINDER

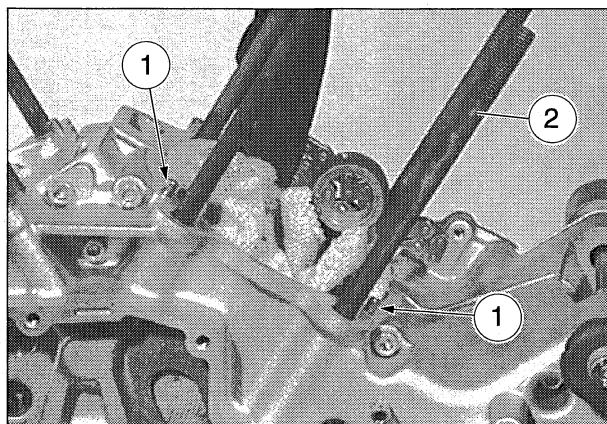
Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Cover the engine compartment with a cloth.
- ◆ Insert the two locating dowels (1).
- ◆ Coat the four M10 stud bolts (2) with LOCTITE® 243 and screw them onto the engine casing.

Stud bolts (2) driving torque: 10 Nm (1.0 kgm).

NOTE Various versions of pistons are used, depending on the vehicle model on which the engine is installed, see 4.32.2 (SPECIFIC FEATURES OF THE PISTONS).

- ◆ Coat the connecting rod small end and the hole of the gudgeon pin inside the piston with MOLYKOTE® G-N.
- ◆ Install the piston (3) on the connecting rod and push the gudgeon pin (4) in, using a punch suitable for the job.



⚠ CAUTION

Respect the assembly direction indicated by the reference mark made upon disassembly.

If the piston has been replaced:

⚠ CAUTION

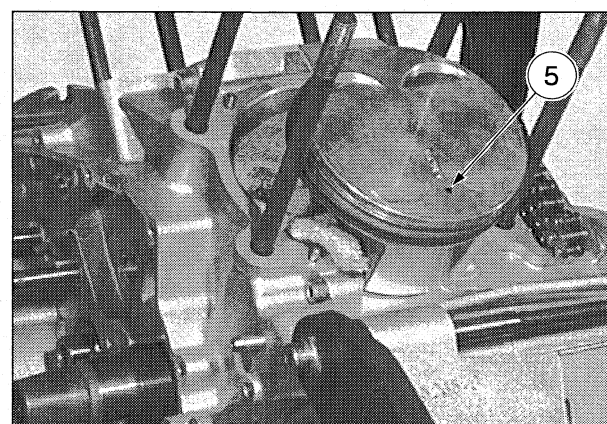
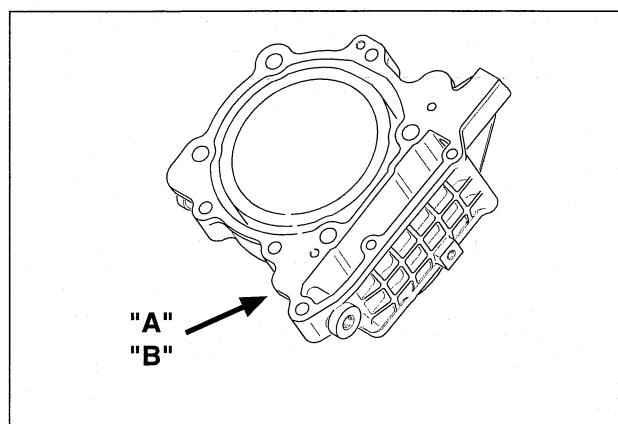
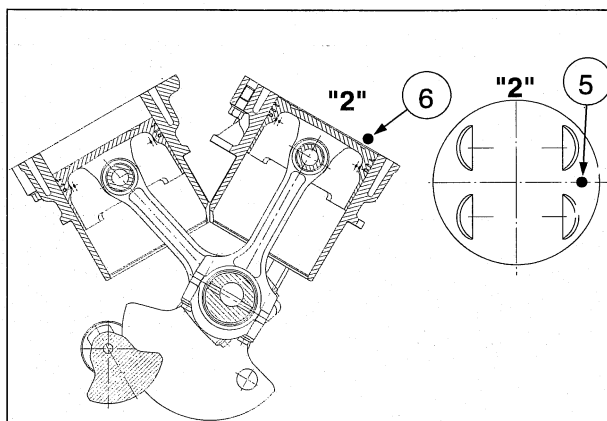
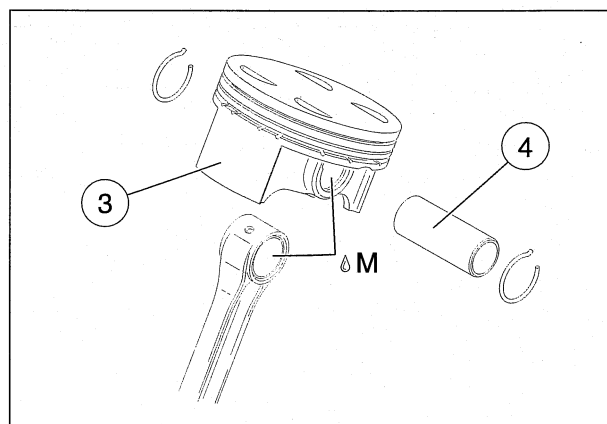
If a new piston is used, the "red" or "green" reference point (5) on the piston crown must face in the direction of the exhaust (6).

- ◆ Take special care when matching the cylinder – piston:
 - "Red" piston – cylinder "A";
 - "green" piston – cylinder "B".

NOTE The cylinders size group "A" or "B" is stamped onto the lower side of the actual cylinder in the timing chain compartment area.

M = MOLYKOTE® G-N.

Follow ►



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⚠ CAUTION**Use new bent-end gudgeon pin seeger rings (7) only.**

- ◆ Insert the two pin locks (7).

NOTE Support the piston (3).

Make sure the two gudgeon pin seeger rings are inserted perfectly in the groove of the piston and that the hook (8) is inserted in the slot of the actual piston.

- ◆ Insert the two locating dowels (9) in the cylinder.

⚠ CAUTION**Use a new head gasket.**

- ◆ Fit the head gasket (10) in place.
- ◆ Place the preassembled head in the cylinder and tighten it on with the four shouldered T.E. screws (11).

– **Non-painted cylinder version:**

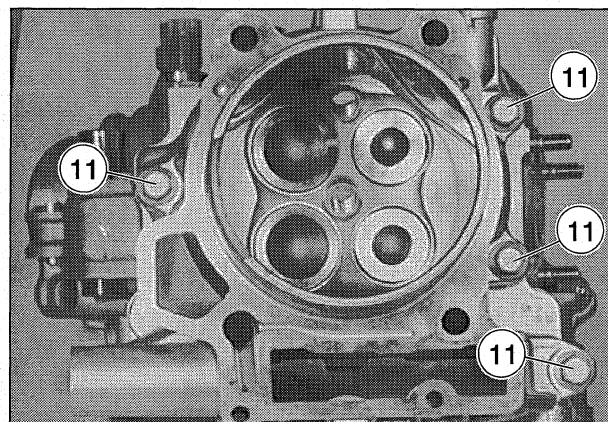
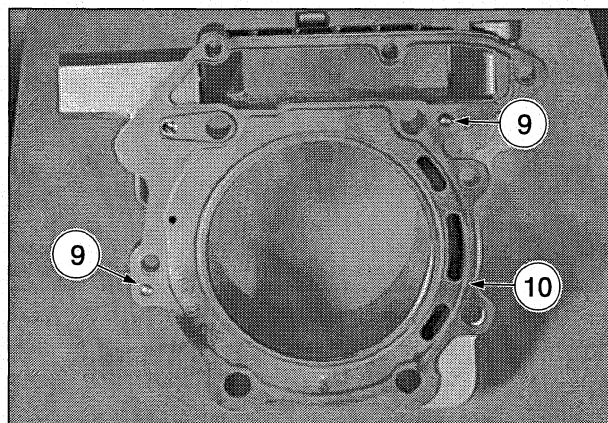
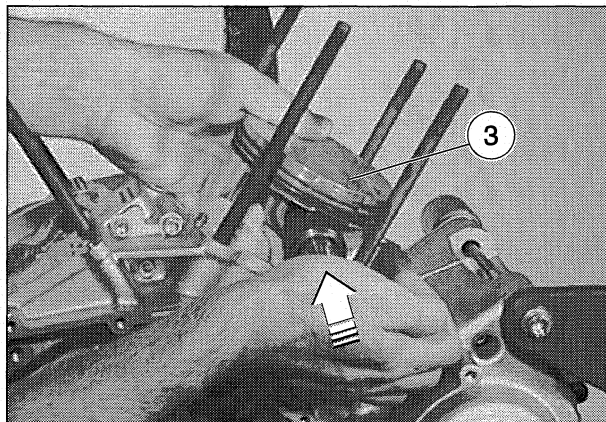
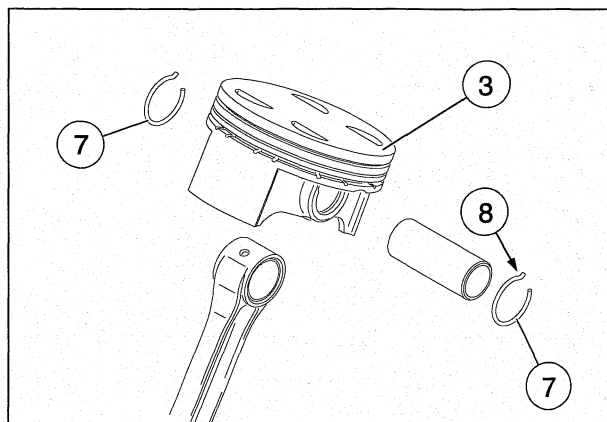
Screws (11) driving torque:
28 – 30 Nm (2.8 – 3.0 kgm).

– **Painted cylinder version:**

Screws (11) driving torque:
25 – 28 Nm (2.5 – 2.8 kgm).

- ◆ Apply a coat of LOCTITE® 574 on the casing around the gasket surface of the cylinder base gasket in the area of the line separating the two sections of the casing.
- ◆ Apply the cylinder base gasket on the casing.
- ◆ Oil the piston and the respective piston rings.
- ◆ Turn the piston rings so that the meeting ends of the three rings are staggered by approx. 120°.

Follow ►



Follow ►

NOTE Have the appropriate special tool **OPT** to hand:

- **aprilia** part# 8140186 (piston ring compression tool) (12).

- ◆ Lower the ring compressor (12) or piston ring pliers over the piston to preload the piston rings.
- ◆ Place the chain tightener shoe (13) in the chain compartment of the cylinder (14) and push the cylinder over the piston so that the ring compressor is pushed down.
- ◆ Remove the ring compressor (12).
- ◆ Insert the timing chain (15) through the cylinders chain compartment.

NOTE The timing chain can be guided inside using an O-ring or similar device to aid assembly.

- ◆ Place the cylinder (14) on the engine casing, pushing it in all the way.
- ◆ Oil the thread of the stud bolts (2) and the contact surfaces.

NOTE Screw on the M10 T.E. nuts (16) and M6 T.C.E.I. screws (17) evenly and gradually, working in a crisscross pattern.

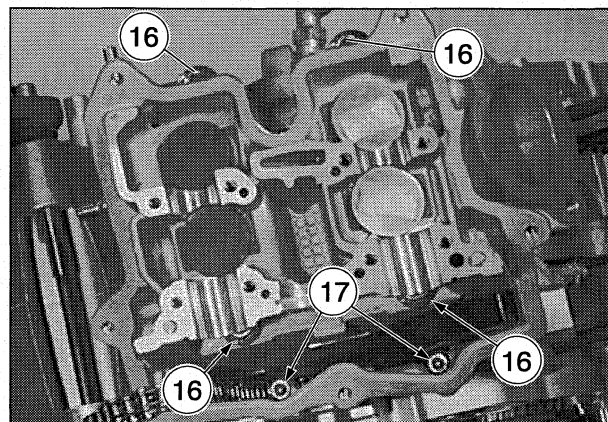
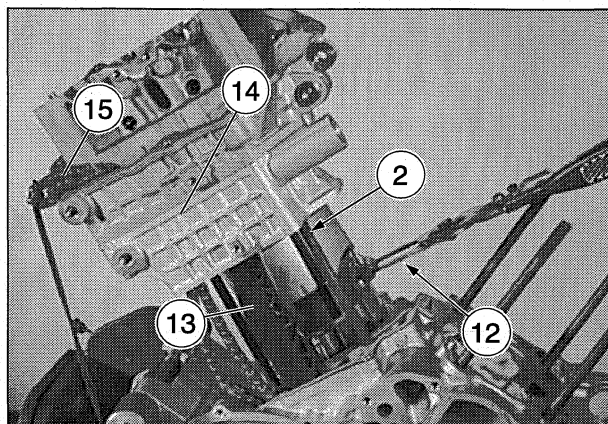
- ◆ Secure the cylinder together with the head with the four M10 T.E. nuts (16) and two M6 T.C.E.I. screws (17).

Non-painted head version:

- four M10 hex-head nuts (16), driving torque 58 Nm (5.8 kgm);
- two M6 T.C.E.I. screws (17), driving torque 12 Nm (1.2 kgm).

Painted head version:

- two M10 hex-head nuts (16), external, driving torque 50 – 55 Nm (5.0 – 5.5 kgm);
- two M10 hex-head nuts (16), chain compartment side, driving torque 58 Nm (5.8 kgm);
- two M6 T.C.E.I. screws (17), driving torque 12 Nm (1.2 kgm).



5.12 ADJUSTING VALVE CLEARANCE

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

⚠ CAUTION

Check and, where necessary, adjust the valve clearance:

- at periodic intervals, see 0.4.1 (VEHICLE WORKSHOP MANUALS);
- every time the timing drive assembly is repaired or taken apart;
- every time the head or camshaft is taken apart.

The valve clearance adjustment must be performed with the engine at room temperature.

NOTE The size is stamped on the adjustment shim. Insert the adjustment shims with the writing facing down. Before fitting them, always measure the adjustment shims with a micrometer.

- ◆ Insert the adjustment shims (1) in the valve spring housings (2).
- ◆ Oil the external diameter of the four valve lifter buckets (3) and insert them in the head.
- ◆ Oil the four camshaft bushes (4) inside the head.
- ◆ Fit the exhaust camshaft (5) and intake camshaft (6) with the cam lobe facing up.

NOTE Various versions of camshaft are used, depending on the vehicle model on which the engine is installed, see 4.26.1 (SPECIFIC FEATURES OF THE CAMSHAFTS).

- ◆ Insert the camshaft by hand and measure the valve clearance with a feeler gauge.
- ◆ Make a note of the value of the valve clearance measured.
- ◆ Measure the difference between the desired value and the actual value.

Valve clearance:

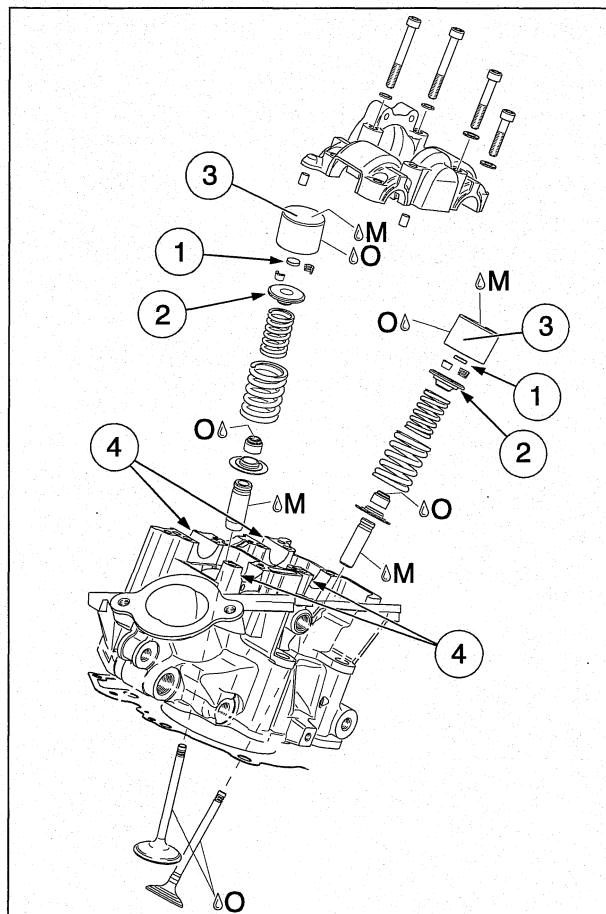
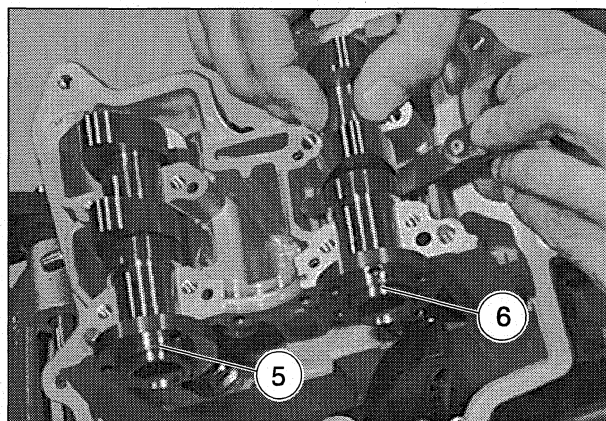
- intake valve 0.12 – 0.17 mm;
- exhaust valve 0.23 – 0.28 mm.

- ◆ Where necessary, replace the adjustment shim (1).

⚠ CAUTION

- Intake valve: the 0.15 mm gauge must be inserted whilst the 0.20 mm one does not need to be inserted.
- Exhaust valve: the 0.25 mm gauge must be inserted whilst the 0.30 mm one does not need to be inserted.

M = MOLYKOTE® G-N.
O = Motor oil.



5.13 ASSEMBLING REAR HEAD CAMSHAFT

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Adjust the valve clearance, see 5.12 (ADJUSTING VALVE CLEARANCE).

NOTE Various versions of camshaft are used, depending on the vehicle model on which the engine is installed, see 4.26.1 (SPECIFIC FEATURES OF THE CAMSHAFTS).

- ◆ Oil the housings of the exhaust camshaft (1) and intake camshaft (2).
- ◆ Coat the cams with MOLYKOTE® G-N and insert the camshafts in the head.

NOTE Tighten the camshaft U bolt gradually, starting from the inside and working in a crisscross pattern.

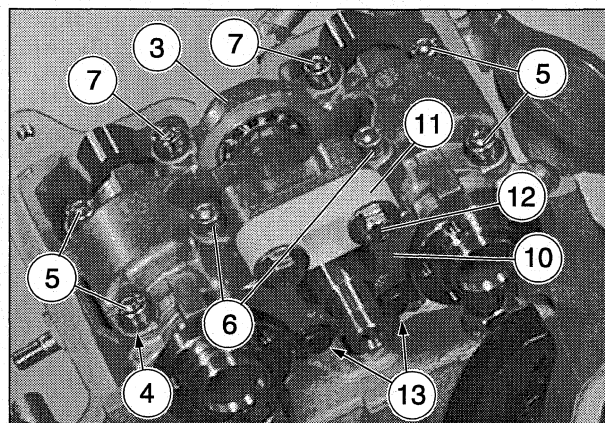
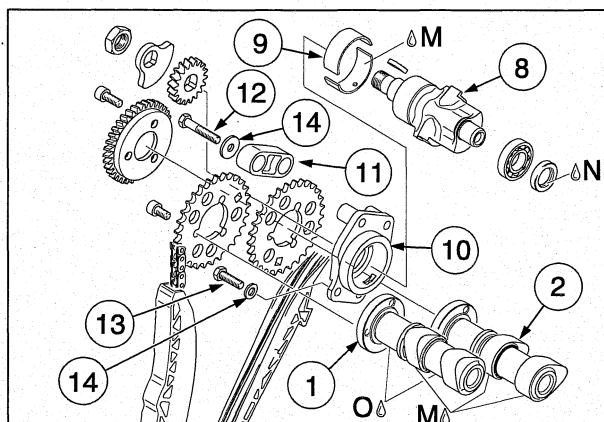
- ◆ Fasten the main U bolt of the camshaft (3) with the four washers (4) and the eight M6 T.C.E.I. screws (5) (6) (7):
 - four M6x30 T.C.E.I. screws (5);
 - two M6x45 T.C.E.I. screws (6);
 - two M6x55 T.C.E.I. screws (7).

Screws (5) (6) (7) driving torque: 11 Nm (1.1 kgm).

- ◆ Insert the countershaft (8).
- ◆ Coat both countershaft bushes (9) with MOLYKOTE® G-N.
- ◆ Insert the bush flange (10).
- ◆ Fit the chain guide (11) on the bush flange.
- ◆ Fasten the bush flange (10) with the four M6 T.E. screws (12) (13) and the four washers (14):
 - two M6x35 T.E. screws (12);
 - two M6x20 T.E. screws (13).

Screws (12) (13) driving torque: 11 Nm (1.1 kgm).

M = MOLYKOTE® G-N.
N = Lubricating grease.
O = Motor oil.



5.14 ASSEMBLING THE REAR HEAD TIMING CONTROL UNIT (PART TWO)

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE The driving shaft must be locked at TDC of rear cylinder, see 3.12 (DISASSEMBLING REAR CYLINDER TIMING DRIVE ASSEMBLY).

- ◆ Turn the camshafts so that the cam lobes (1) point away from each other.
- ◆ Fit the timing gear (2) in the output camshaft (3) and line up the holes.

NOTE In order to make assembly easier, the timing gear can be secured in place temporarily with an M6 T.C.E.I. screw.

- ◆ Turn the timing gear (2) with the exhaust camshaft (3) until the **"EX"** reference mark (4) faces the centre of the intake camshaft.
- ◆ Place the timing chain (5) over the timing gear (2) and under the chain guide (6).

NOTE The timing chain must be taught on the traction side (7).

- ◆ Engage the second timing gear (8) in the timing chain so that the **"IN"** reference mark (9) faces the **"EX"** reference mark (4) of the exhaust camshaft timing gear.
- ◆ In this position, push the timing gear (8) onto the intake camshaft and line up the holes of the timing gear with those on the camshaft.

⚠ CAUTION

The three T.C.E.I. M6 x 14 (11) screws must only be used for fastening the timing gear (10); danger of major engine damage and physical injury.

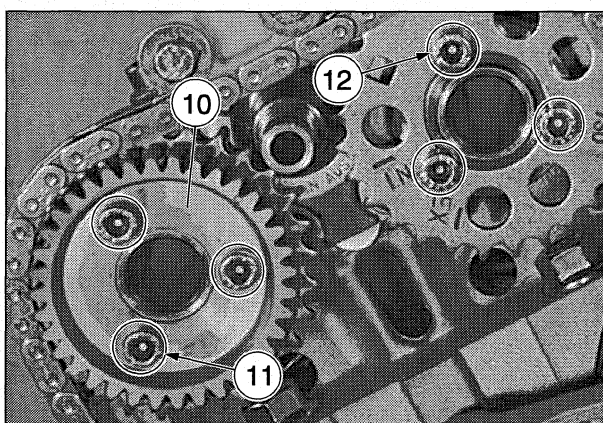
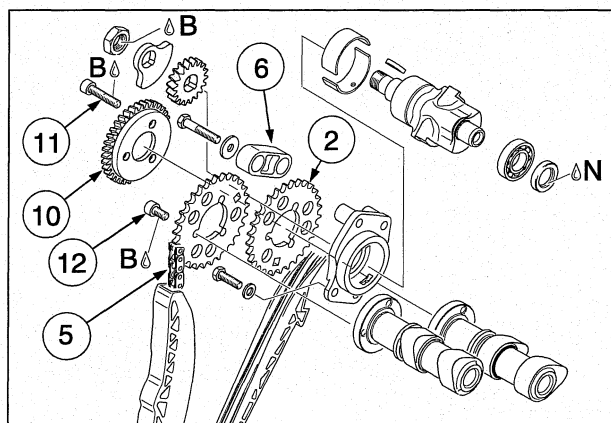
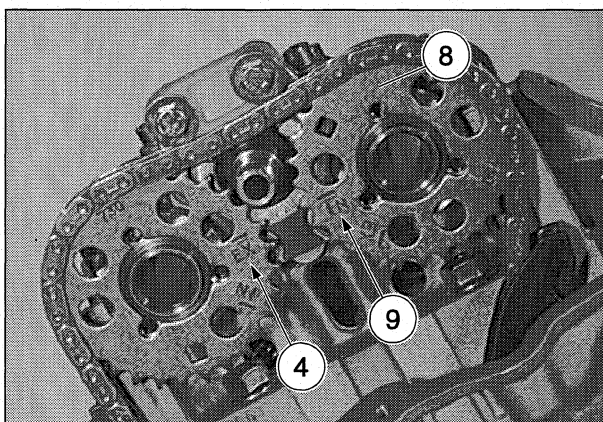
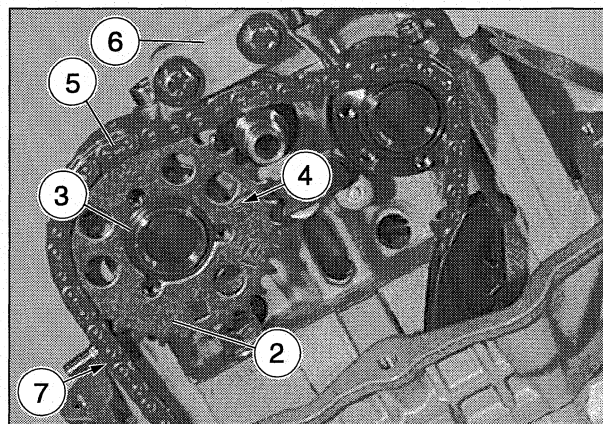
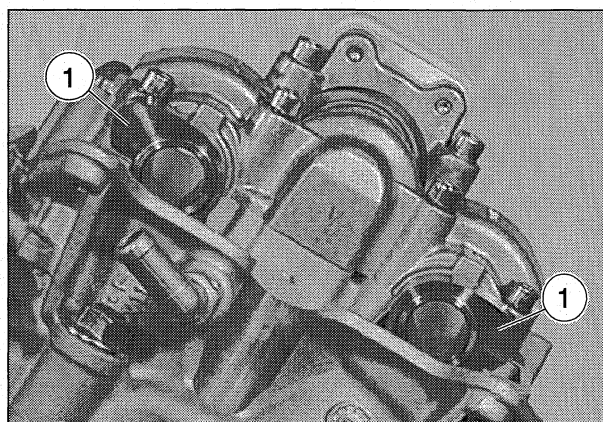
- ◆ Push the timing gear (10) onto the exhaust camshaft and fasten it with the three M6x14 T.C.E.I. screws (11).
- ◆ Fasten the M6 T.C.E.I. screws (11), coating them with LOCTITE® 243.

Screws (11) driving torque: 11 Nm (1.1 kgm).

- ◆ Secure the timing gear of the intake camshaft with three M6x10 T.C.E.I. screws (12), fastening the screws T.C.E.I. with a coat of LOCTITE® 243.

Screws (12) driving torque: 11 Nm (1.1 kgm).

Follow ►



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- ◆ Insert the chain guide (13) as far as it will go.
- ◆ Oil the chain tightener (14) and fit it in the cylinder with the closed end facing the chain tightener shoe (15).
- ◆ Screw on the M18x1 T.E. screw (16) complete with seal.

Screw (16) driving torque: 20 Nm (2.0 kgm).

NOTE Be careful to keep the key from dropping into the chain compartment.

Cover the chain compartment accordingly.

- ◆ Insert the key (17) in the slot on the countershaft.
- ◆ Push the differential gear (18) onto the countershaft so that the two reference marks (19) are lined up with each other.

NOTE Make sure the sharp-edged side of the counterweight faces the countershaft.

- ◆ Push the counterweight (20) onto the countershaft.
- ◆ Fasten the M14x1 T.E. nut (21) with a coat of LOC-TITE® 243 and tighten it.

Nut (21) driving torque: 50 Nm (5.0 kgm).

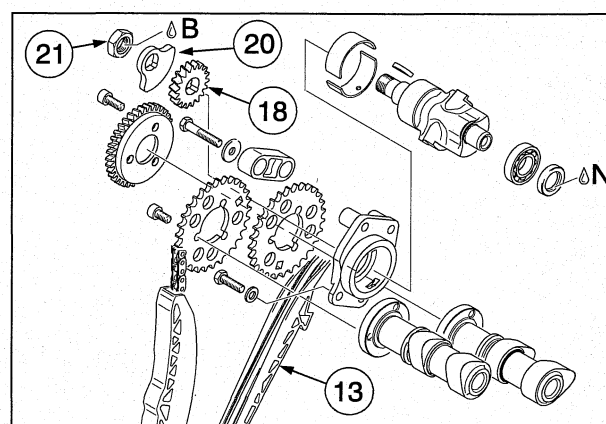
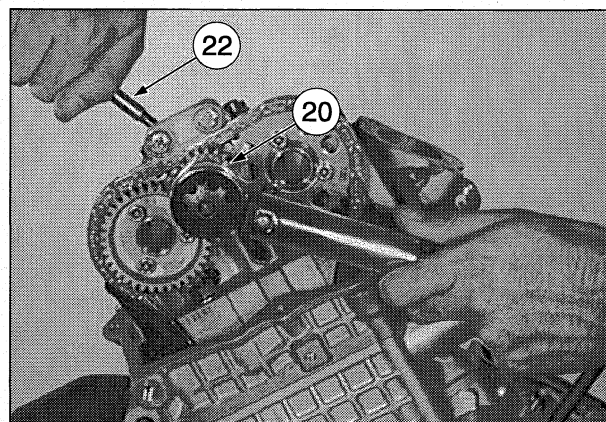
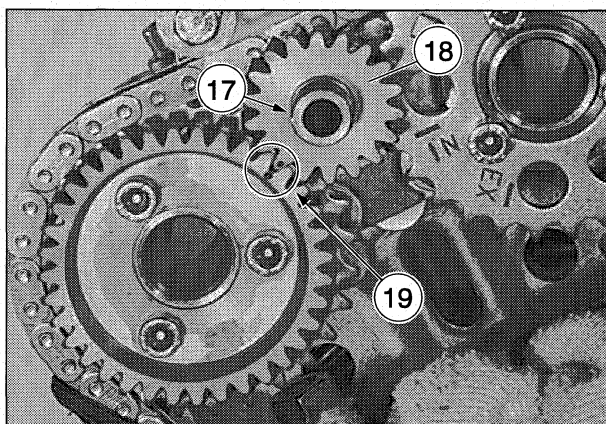
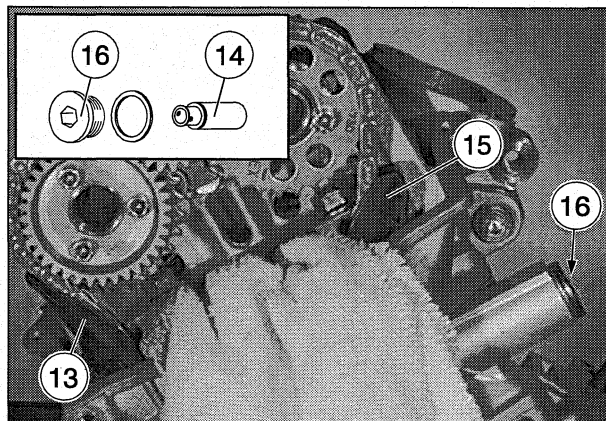
⚠ CAUTION

Hold the countershaft still using a punch (22) suitable for the job.

- ◆ Coat the valve lifter bucket and camshaft cams with MOLYKOTE® G-N.

B = LOCTITE® 243.

N = Lubricating grease.



5.15 ASSEMBLING THE FRONT HEAD TIMING CONTROL UNIT (PART ONE)

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Unscrew the threaded bolt (1) for retaining the shaft at TDC and turn the driving shaft (2) 300° anticlockwise so that the connecting rod (3) of the front cylinder is at TDC.

NOTE Move the connecting rod (3) to a central position so that it is not tilted in the casing.

- ◆ Screw the threaded bolt (1) back on.

NOTE Make sure the threaded bolt is inserted properly in the driving shaft handwheel slot. The threaded bolt (1) must not be overtightened: **max. 5 Nm (0.5 kgm)**.

- ◆ Where necessary, press hard to insert the two locating dowels (4) in the casing.

NOTE As of engine # 527354, the locating dowels (4) are no longer fitted; centring is achieved with the aid of the bearing support flange (11).

- ◆ Using an amount of grease, place the thrust washer (5) on the intermediate timing gear (6).
- ◆ Place the timing chain (7) around the intermediate timing gear (6), guiding both through the chain compartment and seating them.

NOTE Attach the timing chain (7) based on the reference mark applied during disassembly.

- ◆ Guide the chain tightener shoe (8) through the chain compartment and fasten it in the housing by means of the spacer sleeve (9).
- ◆ Oil the two roller bearings (10) and push them onto the pin of the bearing support flange (11).
- ◆ Insert the bearing support flange (11) push it on as far as it will go, tapping it with a hammer.

NOTE Coat the M6 T.C.E.I. screw (15) with a coat of LOCTITE® 243.

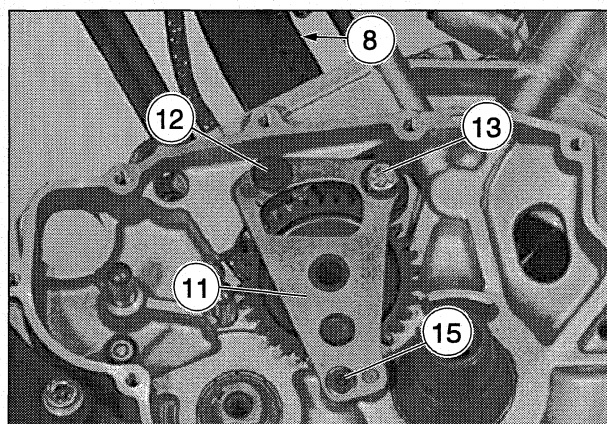
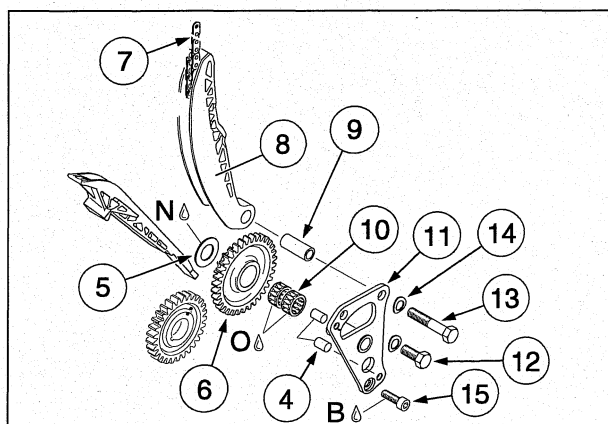
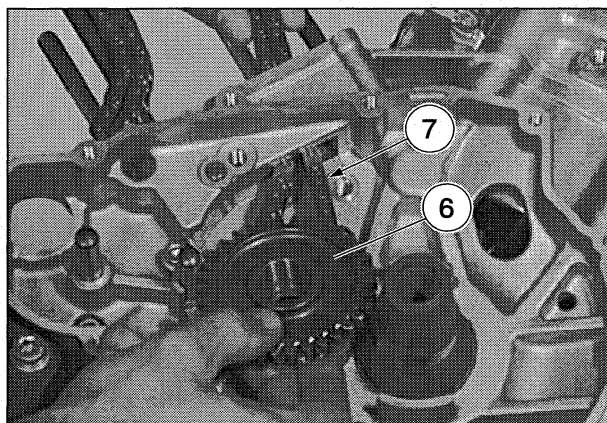
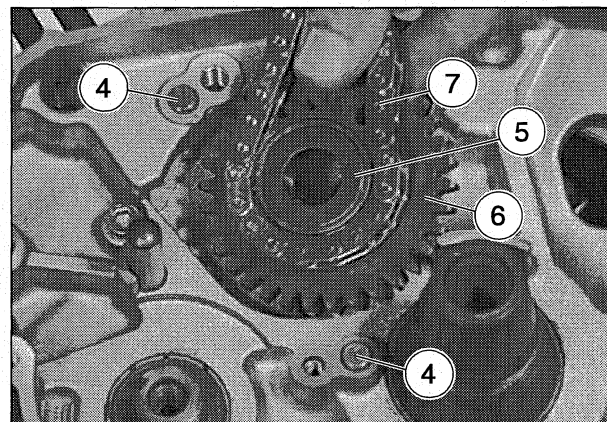
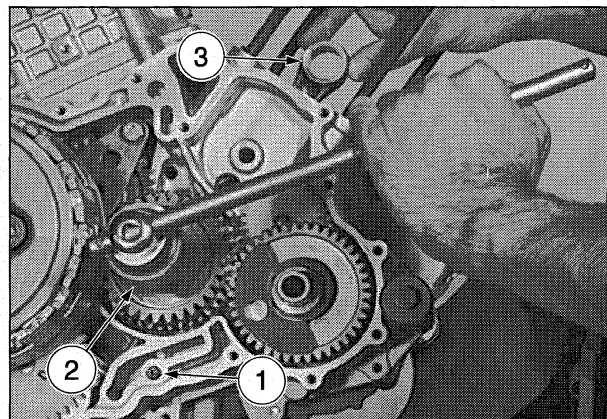
- ◆ Insert the bearing flange (11) and fasten it with the two M8 T.E. screws (12, 13), with the spring washers (14) and with the M6 T.C.E.I. screw (15).

- M8x20 T.E. screw (12).
- M8x45 T.E. screw (13).
- M6x20 T.C.E.I. screw (15).

Driving torque:

- M8 T.E. screws (12) (13): 25 Nm (2.5 kgm);
- M6 T.C.E.I. screw (15): 11 Nm (1.1 kgm).

Follow ►



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- ◆ Rotate the intermediate drive gear (6) so that the two reference marks (16) are lined up with each other.
- ◆ Place the counterweight (17) on the countershaft.
- ◆ Insert the key (18) in the countershaft.
- ◆ Push in the drive pinion (19) and counterweight (20).

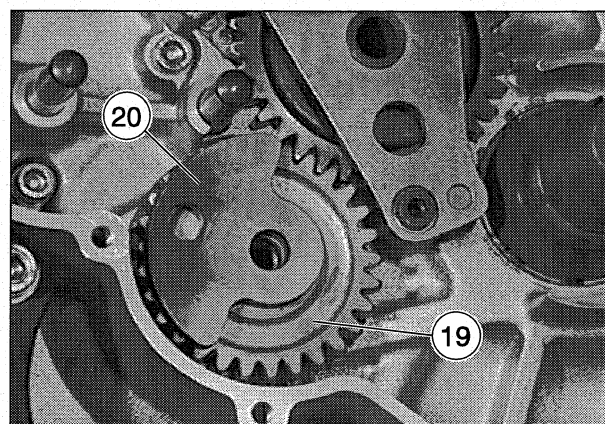
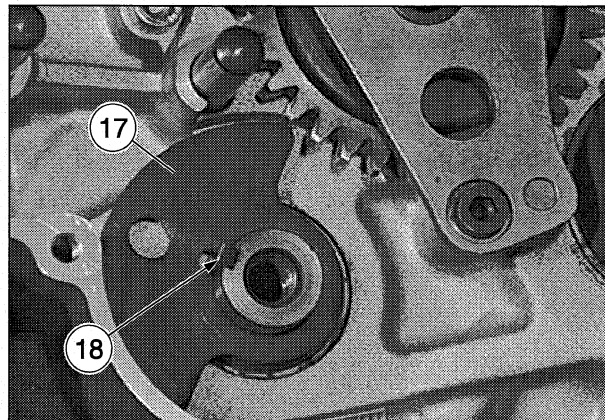
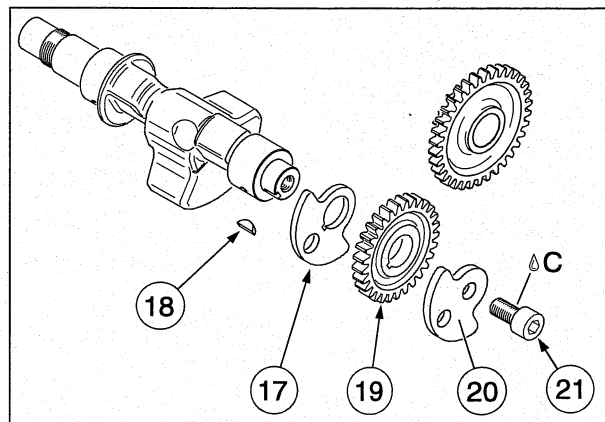
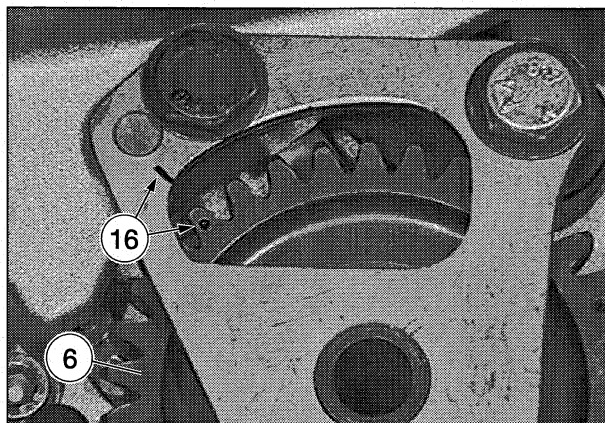
NOTE The half-moon shaped key (18) must be inserted in the upper counterweight slot. Make sure the reference mark on the intermediate drive gear coincides with the reference mark (16) on the bearing flange.

- ◆ Fasten the M10 T.C.E.I. screw (21) with a coat of **LOCTITE® 648** and screw it on to the countershaft.

Screw (21) driving torque: 50 Nm (5.0 kgm).

NOTE The countershaft is timed by timing the rear cylinder.

B = **LOCTITE® 243**.
C = **LOCTITE® 648**.
N = Lubricating grease.
O = Motor oil.



5.16 ASSEMBLING THE STARTER MOTOR DRIVE ASSEMBLY AND IGNITION SYSTEM

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE The driving shaft must be retained at the TDC of front piston or rear piston.

- ◆ Oil the two pins (1) and coat the housing (2) of the free-wheel gear on the driving shaft with MOLYKOTE® G-N.
- ◆ Insert the double starter gear (3), idler gear (4) and freewheel gear (5).
- ◆ Oil the surface (6) of the freewheel gear (5).
- ◆ Install the rotor (7), see 4.33 (STARTER MOTOR DRIVE ASSEMBLY).
- ◆ Oil the freewheel (8) inside the relevant casing (9).
- ◆ Degrease the tapered seat (10) of the drive shaft and the tapered seat (11) of the magnetic hub.

NOTE Upon assembly the LOCTITE® must not penetrate inside the seat (12) of the freewheel gear (5).

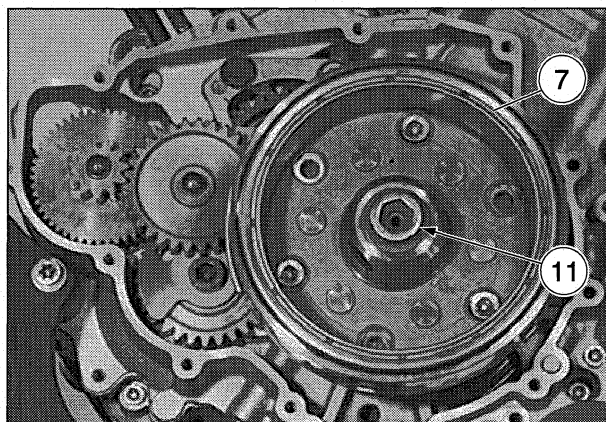
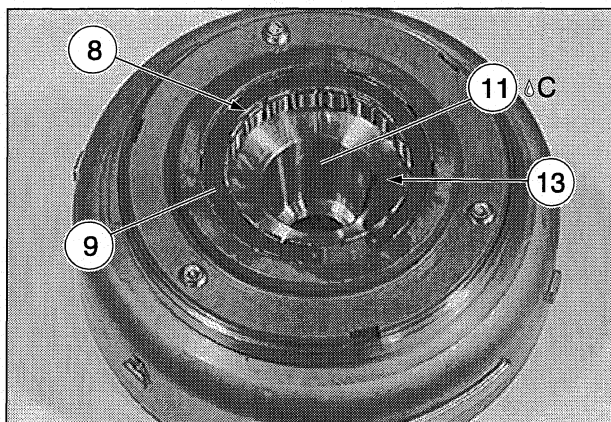
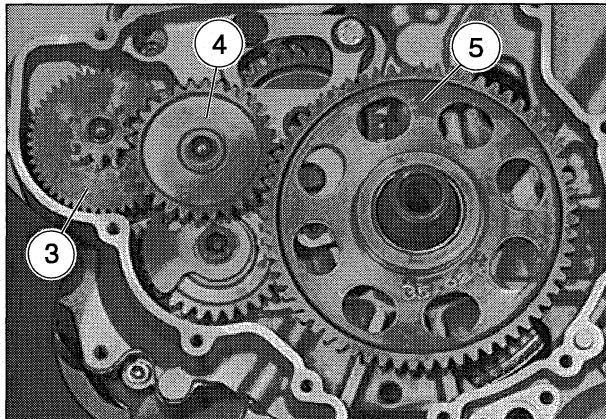
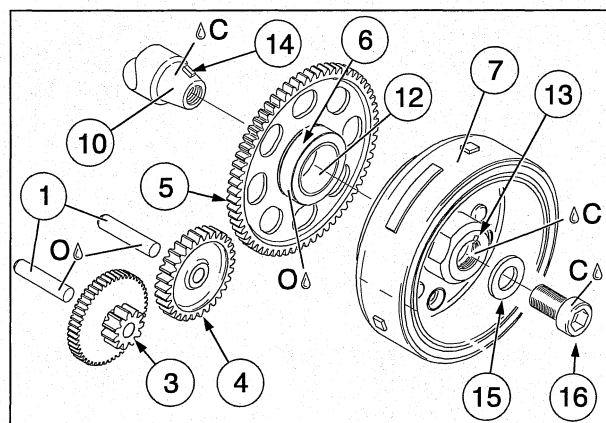
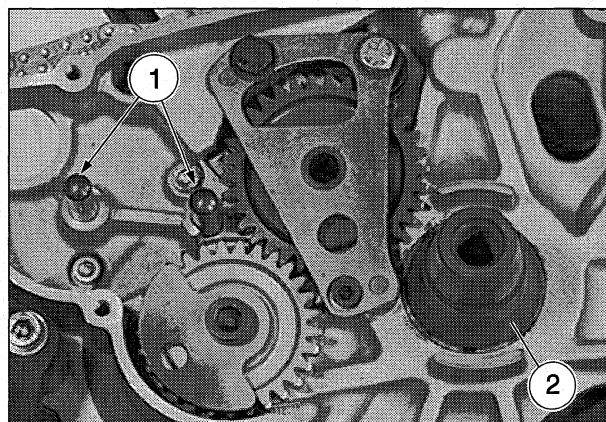
- ◆ Apply a thin layer of LOCTITE® 648 on the tapered seat (11) of the magnetic hub.

NOTE To facilitate the insertion, turn the rotor (7) until the groove (13) of the magnetic hub is aligned with the key (14) of the drive shaft.

- ◆ Install the rotor (7) on the tapered seat (10) of the drive shaft, correctly fitting the groove (13) of the magnetic hub with the key (14) of the drive shaft.
- ◆ Insert the washer (15) on the rotor screw T.C.E.I. M16 (16), apply a layer of LOCTITE® 648 on the thread, screw and tighten the rotor screw (16) on the drive shaft.

Rotor screw (16) driving torque: 130 Nm (13.0 kgm).

C = LOCTITE® 648.
O = Motor oil.



5.17 ASSEMBLING THE PISTON AND FRONT CYLINDER

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Cover the engine compartment with a cloth.
- ◆ Insert the two locating dowels (1).
- ◆ Coat the four M10 stud bolts (2) with LOCTITE® 243 and screw them onto the engine casing.

Stud bolts (2) driving torque: 15 Nm (1.5 kgm).

NOTE Various versions of pistons are used, depending on the vehicle model on which the engine is installed, see 4.32.2 (SPECIFIC FEATURES OF THE PISTONS).

- ◆ Coat the connecting rod small end and the hole of the gudgeon pin inside the piston with MOLYKOTE® G-N.
- ◆ Install the piston (3) on the connecting rod and push the gudgeon pin (4) in, using a punch suitable for the job.

⚠ CAUTION

Respect the assembly direction indicated by the reference mark made upon disassembly.

If the piston has been replaced:

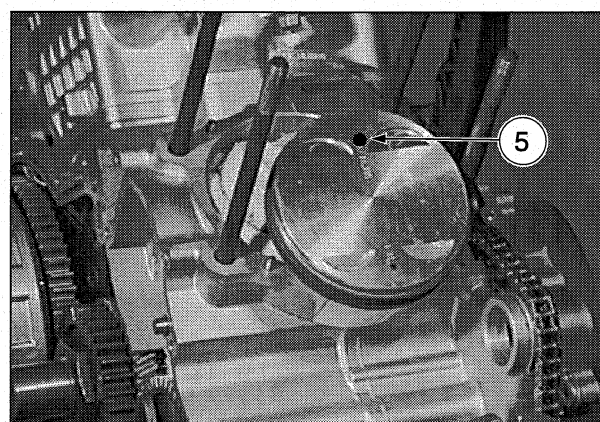
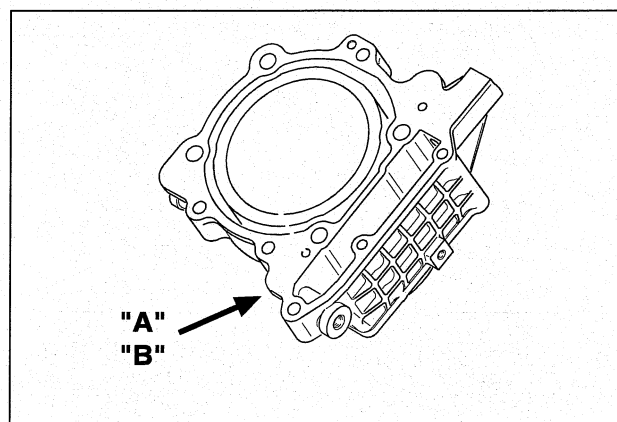
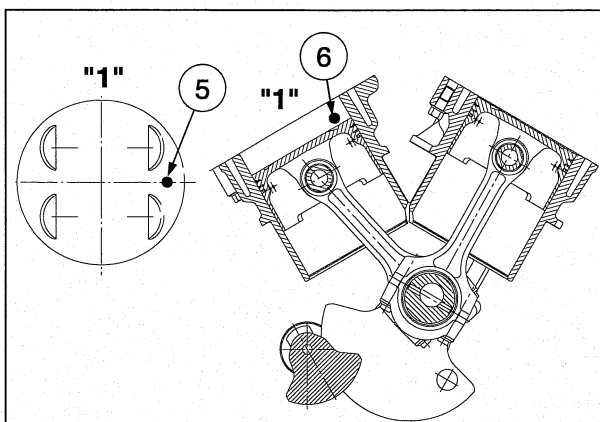
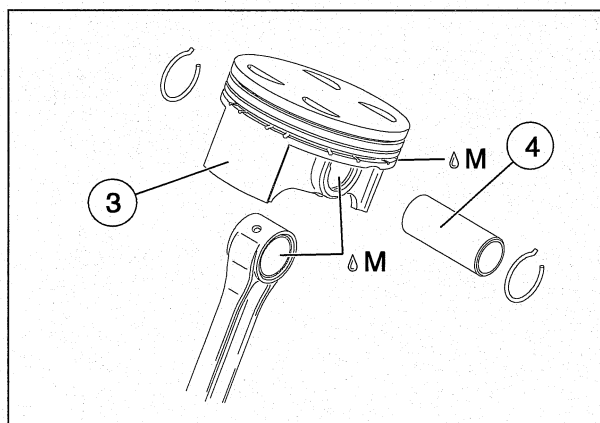
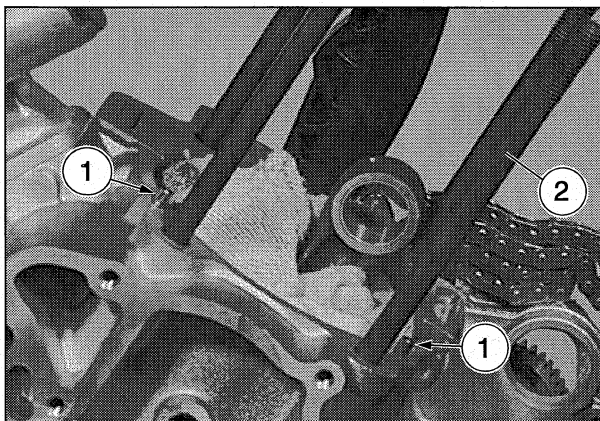
⚠ CAUTION

If a new piston is used, the "red" or "green" reference point (5) on the piston crown must face in the direction of the intake (6).

- ◆ Take special care when matching the cylinder – piston:
 - "Red" piston – cylinder "A";
 - "green" piston – cylinder "B".

NOTE The cylinders size group "A" or "B" is stamped onto the lower side of the actual cylinder in the timing chain compartment area.

Follow ►



Follow ►

⚠ CAUTION

Use new bent-end gudgeon pin seeger rings (7) only.

- ◆ Insert the two pin locks (7).

NOTE Support the piston (3).

Make sure the two gudgeon pin seeger rings are inserted perfectly in the groove of the piston and that the hook (8) is inserted in the slot of the actual piston.

- ◆ Insert the two locating dowels (9) in the cylinder.

⚠ CAUTION

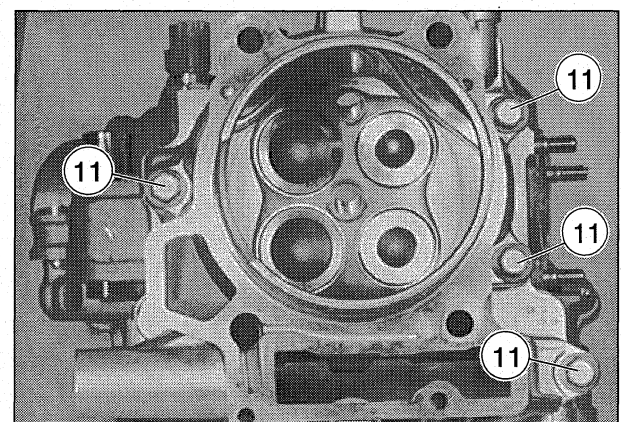
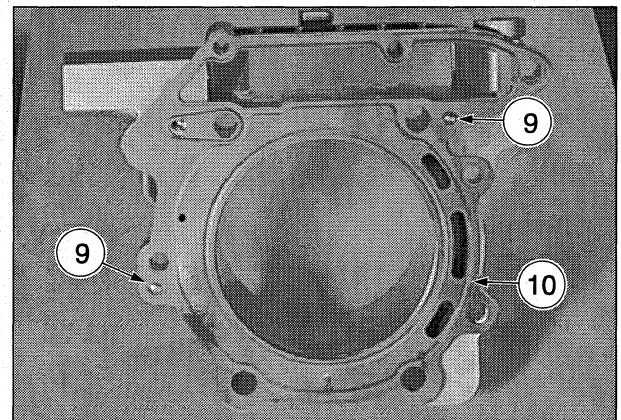
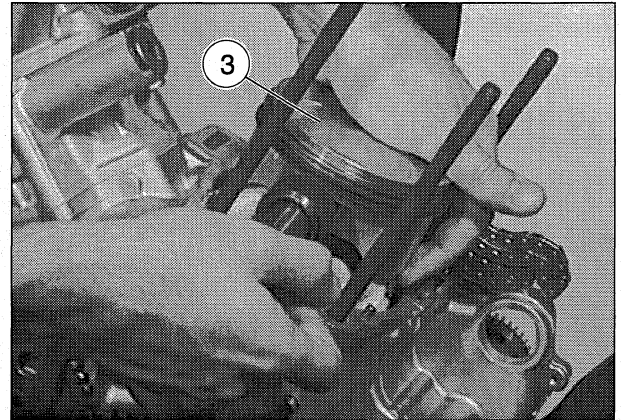
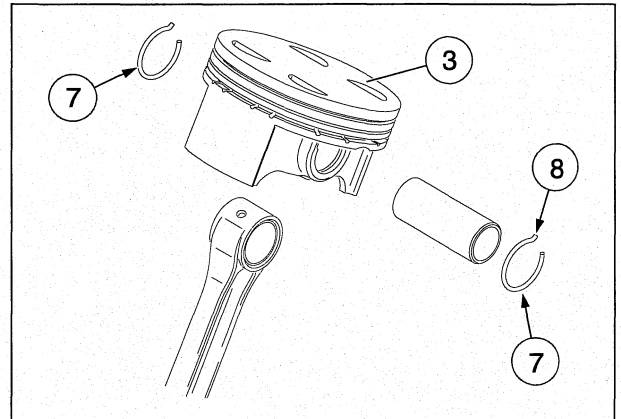
Use a new head gasket.

- ◆ Fit the head gasket (10) in place.
- ◆ Place the preassembled head in the cylinder and tighten it on with the four shouldered T.E. screws (11).

- **Non-painted cylinder version:**
Screws (11) driving torque: 29 Nm (2.9 kgm).
- **Painted cylinder version:**
Screws (11) driving torque: 27 Nm (2.7 kgm).

- ◆ Apply a coat of LOCTITE® 574 on the casing around the gasket surface of the cylinder base gasket in the area of the line separating the two sections of the casing.
- ◆ Apply the cylinder base gasket on the casing.
- ◆ Oil the piston and the respective piston rings.
- ◆ Turn the piston rings so that the meeting ends of the three rings are staggered by approx. 120°.

Follow ►



Follow ►

NOTE Have the appropriate special tool **OPT** to hand:

- **aprilia** part# 8140186 (piston ring compression tool) (12).

- ◆ Lower the ring compressor (12) or piston ring pliers over the piston to preload the piston rings.
- ◆ Place the chain tightener shoe (13) in the chain compartment of the cylinder (14) and push the cylinder over the piston so that the ring compressor is pushed down.
- ◆ Remove the ring compressor (12).
- ◆ Insert the timing chain (15) through the cylinders chain compartment.

NOTE The timing chain can be guided inside using an O-ring or similar device to aid assembly.

- ◆ Place the cylinder (14) on the engine casing, pushing it in all the way.
- ◆ Oil the thread of the stud bolts (2) and the contact surfaces.

NOTE Screw on the M10 T.E. nuts (16) and M6 T.C.E.I. screws (17) evenly and gradually, working in a crisscross pattern.

- ◆ Secure the cylinder together with the head with the four M10 T.E. nuts (16) and two M6 T.C.E.I. screws (17).

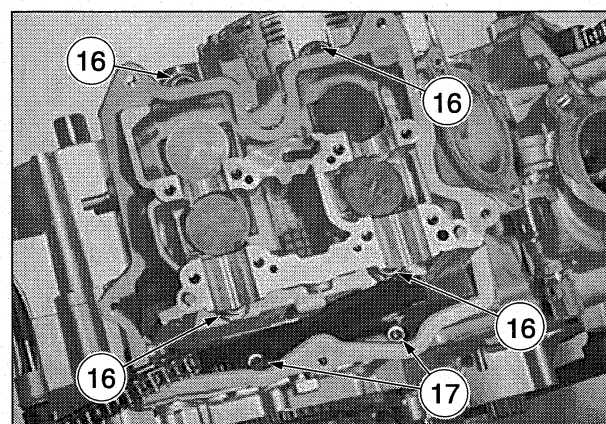
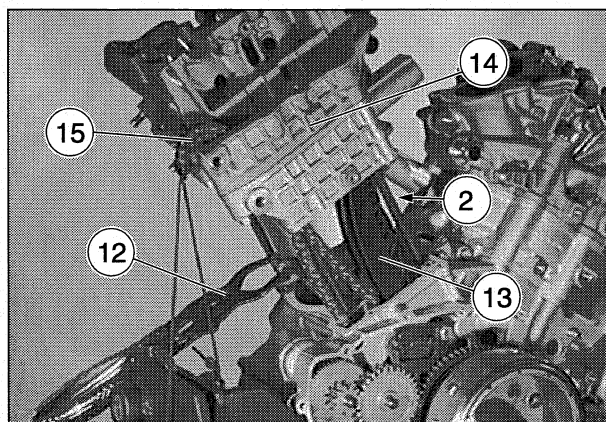
Non-painted head version:

- four M10 hex-head nuts (16), driving torque 58 Nm (5.8 kgm);
- two M6 T.C.E.I. screws (17), driving torque 12 Nm (1.2 kgm).

Painted head version:

- two M10 hex-head nuts (16), external, driving torque 53 Nm (5.3 kgm);
- two M10 hex-head nuts (16), chain compartment side, driving torque 58 Nm (5.8 kgm);
- two M6 T.C.E.I. screws (17), driving torque 12 Nm (1.2 kgm).

M = MOLYKOTE® G-N.



5.18 ASSEMBLING THE FRONT HEAD CAMSHAFTS

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Adjust the valve clearance, see 5.12 (ADJUSTING VALVE CLEARANCE).

NOTE Various versions of camshaft are used, depending on the vehicle model on which the engine is installed, see 4.26.1 (SPECIFIC FEATURES OF THE CAMSHAFTS).

- ◆ Oil the housings of the exhaust camshaft (1) and intake camshaft (2).
- ◆ Coat the cams with MOLYKOTE® G-N and insert the camshafts in the head.

NOTE Tighten the camshaft U bolt gradually, starting from the inside and working in a crisscross pattern.

- ◆ **RSV RSV R SL** Fasten the U bolt of the camshaft (3) with the seven washers (4) and seven M6x30 T.C.E.I. screws (5).
- ◆ **RST ETV** Fasten the main U bolt of the camshaft (3) with the four washers (4) and the eight T.C.E.I. screws M6x30 (5).

Screws (5) driving torque: 11 Nm (1.1 kgm).

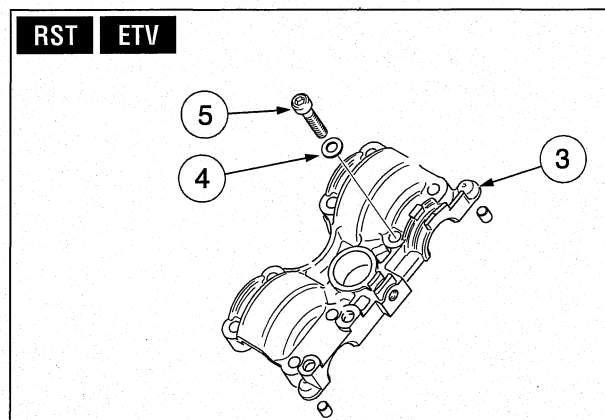
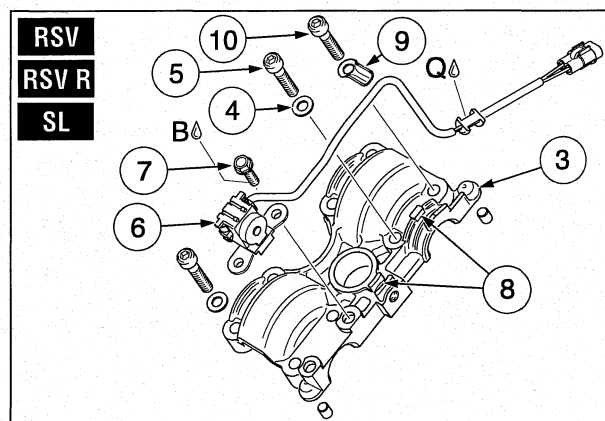
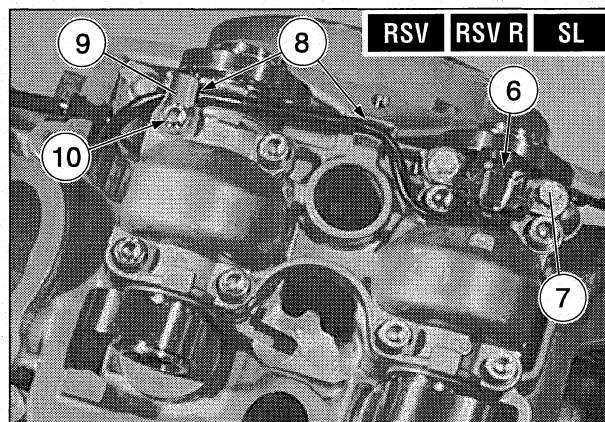
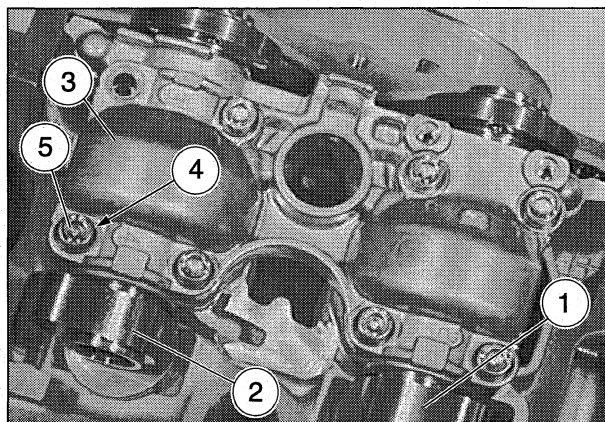
- ◆ **RSV RSV R SL** Fit the camshaft sensor (6) and secure it in place with two M5 Taptite screws (7), fastening them with a coat of LOCTITE® 243.

Screws (7) driving torque: 4 Nm (0.4 kgm).

- ◆ **RSV RSV R SL** Insert the camshaft sensor cable in the guide race (8) and fasten it with the cable clamp (9) and M6X30 T.C.E.I. screw (10).

Screw (10) driving torque: 11 Nm (1.1 kgm).

B = LOCTITE® 243.
M = MOLYKOTE® G-N.
Q = SILASTIC 732 RTV.



5.19 ASSEMBLING THE FRONT HEAD TIMING CONTROL UNIT (PART TWO)

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

NOTE The driving shaft must be retained at TDC of the front cylinder, see 3.7 (DISASSEMBLING FRONT CYLINDER TIMING DRIVE ASSEMBLY).

- ◆ Turn the camshafts so that the cam lobes (1) point away from each other.
- ◆ Fit the drive gear (2) in the exhaust camshaft (3) and line up the holes.

NOTE The drive gear of the exhaust camshaft has a transducer (4) for the camshaft sensor.

- ◆ Turn the timing gear (2) with the exhaust camshaft until the "EX" reference mark (5) faces the centre of the intake camshaft.
- ◆ Place the timing chain (6) over the timing gear (2).

NOTE The timing chain must be taught on the traction side (7).

- ◆ Secure the timing gear with the three M6 T.C.E.I. screws (8), coating them with LOCTITE® 243.

Screws (8) driving torque: 11 Nm (1.1 kgm).

- ◆ Engage the second timing gear (9) in the timing chain so that the "IN" reference mark (10) faces the "EX" reference mark (5) on the timing gear of the exhaust camshaft.
- ◆ In this position, push the timing gear (9) onto the intake camshaft and line up the holes of the timing gear with those on the camshaft.
- ◆ Secure the timing gear (9) with the three M6 T.C.E.I. screws (11), coating them with LOCTITE® 243.

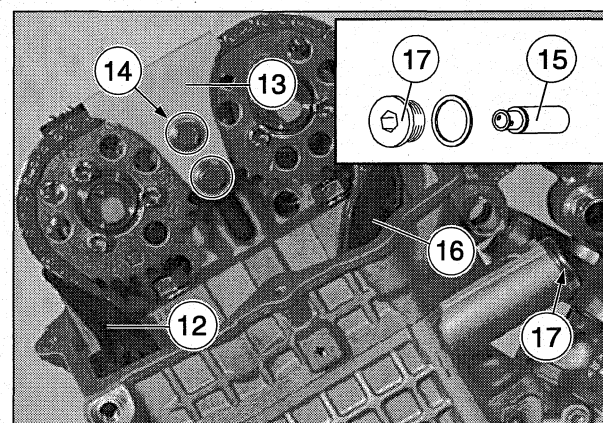
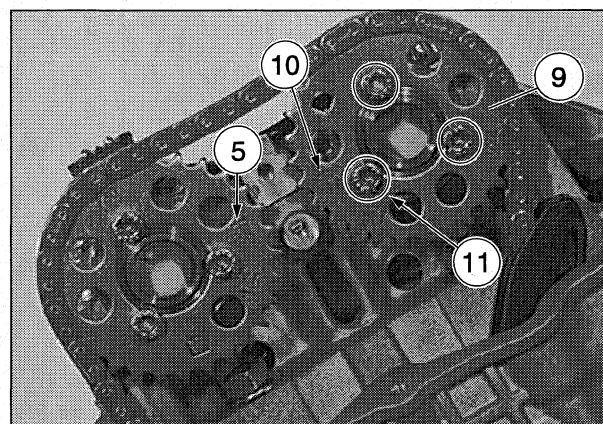
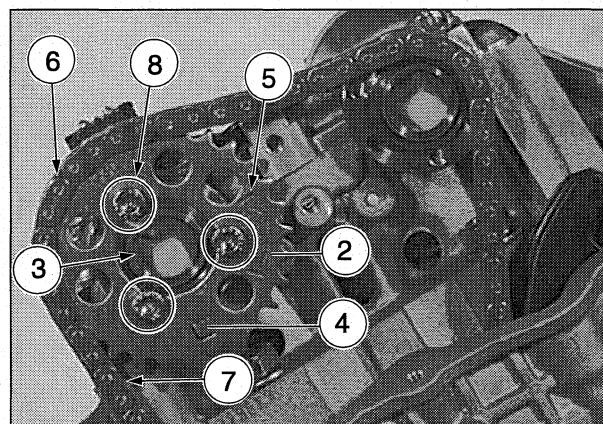
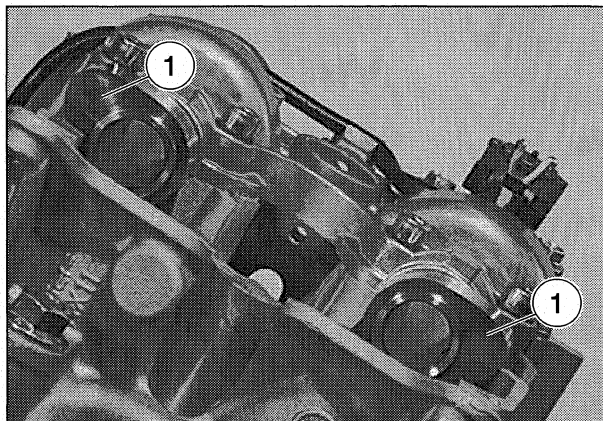
Screws (11) driving torque: 11 Nm (1.1 kgm).

- ◆ Insert the chain guide shoe (12) as far as it will go.
- ◆ Fit the chain guide bracket (13) and secure it with the two M6 spacer screws (14).

Screws (14) driving torque: 11 Nm (1.1 kgm).

- ◆ Oil the chain tightener (15) and fit it in the cylinder with the closed end facing the chain tightener shoe (16).
- ◆ Screw on the M18x1 T.E. screw (17) complete with seal.

Screws (17) driving torque: 20 Nm (2.0 kgm).



5.20 ASSEMBLING THE VALVE COVER

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ **RSV RSV R SL** Coat the cable (1) and rubber element (2) of the camshaft sensor with SILASTIC 732 RTV.
- ◆ Grease the head cover gasket (3) and insert it in the groove on the head cover (4).
- ◆ Place the head cover on the front head and on the rear head, securing it with the five M6 spacer screws (5).

Screws (5) driving torque: 9 Nm (0.9 kgm).

- ◆ Secure the intake flange (6) with the two M8 T.C.E.I. screws (7) and respective washers.

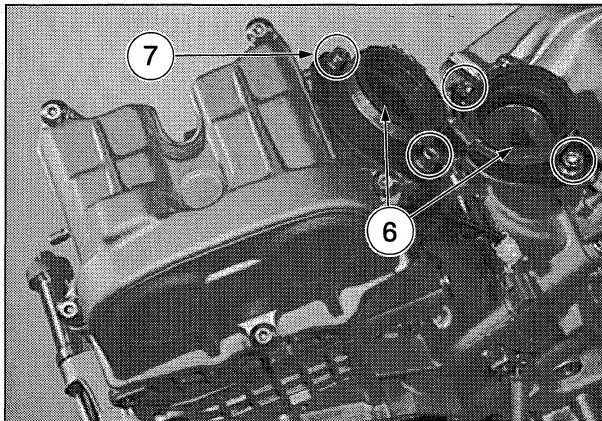
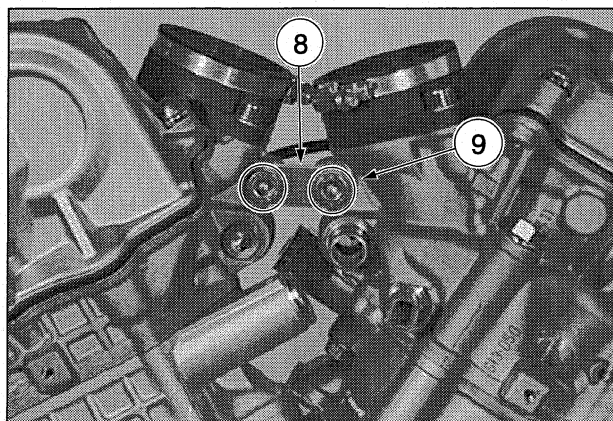
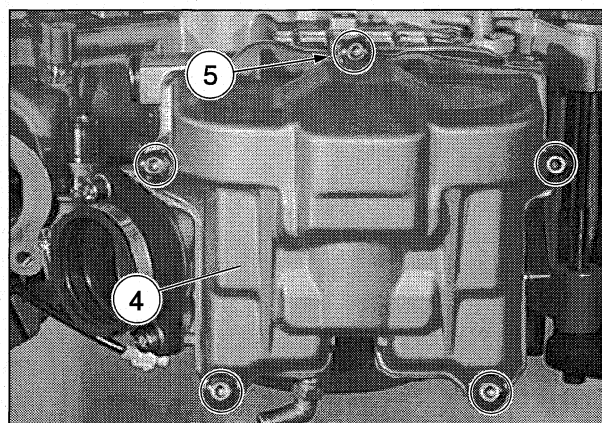
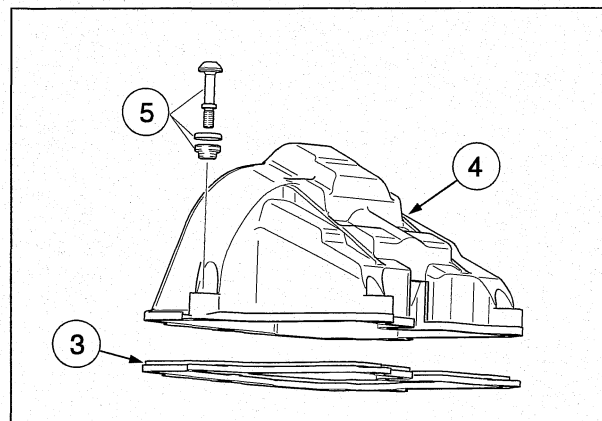
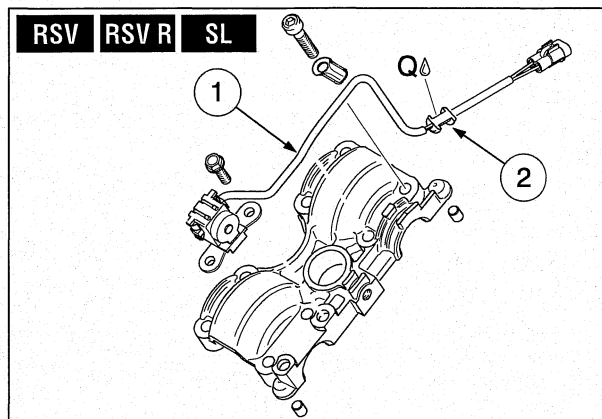
Screws (7) driving torque: 19 Nm (1.9 kgm).

- ◆ Secure the support bracket (8) with the two M10 T.C.E.I. screws (9), fasten the two M10 nuts and apply LOCTITE® 243.

Screws (9) driving torque: 40 Nm (4.0 kgm).

B = LOCTITE® 243.

Q = SILASTIC 732 RTV.



5.21 ASSEMBLING THE IGNITION COVER

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Where necessary, insert the locating dowel (1).

NOTE Use a new gasket (2).

- ◆ Apply the gasket (2).

NOTE Have the appropriate special tool **OPT** to hand:
– **aprilia** part# 0277252 (flywheel magneto cover removal tool) (3).

- ◆ Screw the tool (3) onto the ignition cover.
- ◆ Fit the ignition cover on the casing and screw it on with the twelve M6 T.C.E.I. screws (5).

Screws (5) driving torque: 11 Nm (1.1 kgm).

- ◆ Remove the tool (3) and tighten the plastic closing screw (6) complete with O-ring.
- ◆ Screw on the four spark plugs inside the two heads using the special spanner.

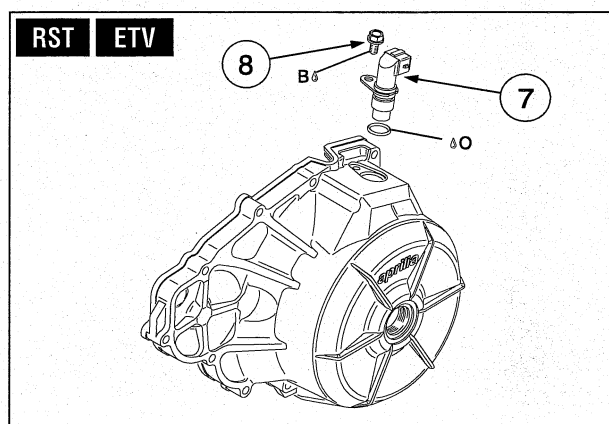
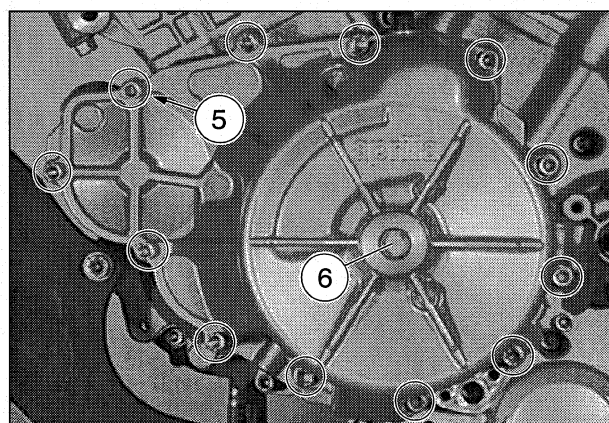
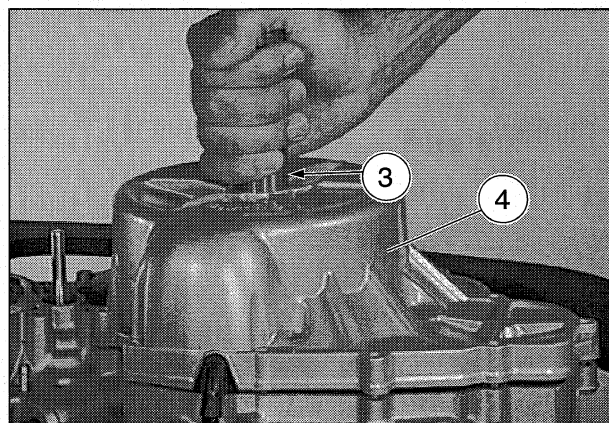
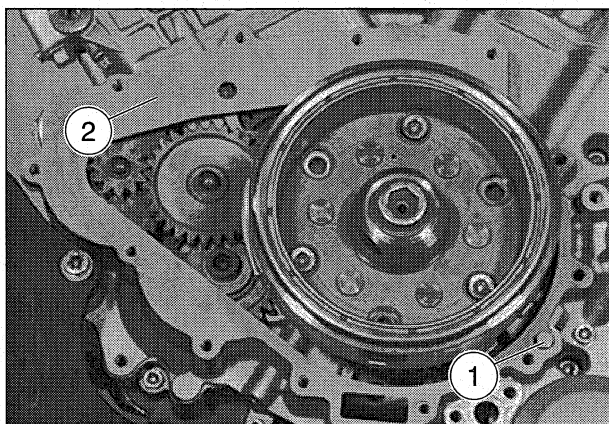
Spark plugs driving torque: 18 Nm (1.8 kgm) (with head cold and thread not lubricated).

- ◆ **RST** **ETV** If previously removed, install the camshaft position sensor (7) complete with properly lubricated sealing ring.
- ◆ Apply **LOCTITE**® 243 and tighten the fastening screw (8).

Screw (8) driving torque: 10 Nm (1.0 kgm).

B = **LOCTITE**® 243.

O = Motor oil.



5.22 ASSEMBLING THE CLUTCH HOUSING

Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Remove the threaded bolt (1) for retaining the shaft at TDC.
- ◆ Insert the two locating dowels (2).
- ◆ Fit the gasket (3) in place.

NOTE Use a new gasket.

- ◆ Coat the end of the driving shaft (4) and end of the countershaft (5) with MOLYKOTE® G-N.
- ◆ Fit the clutch cover (6), complete with coolant pump, on the casing.

NOTE Turn the impeller (8) to enable the tothing of the pump gear (7) to mate with the tothing of the coolant pump idler gear (9).

NOTE Fit the seal (13) on the M8x65 T.C.E.I. screw (12).

- ◆ Screw the clutch cover (6) using:
 - 11 M6 x 35 screws (10);
 - 3 M8 x 55 screws (11);
 - 1 M8 x 65 screw (12) complete with seal (13).

Driving torque:

- M6 T.C.E.I. screws (10) 11 Nm (1.1 kgm);
- M8 T.C.E.I. screw (11) (12) 19 Nm (1.9 kgm).

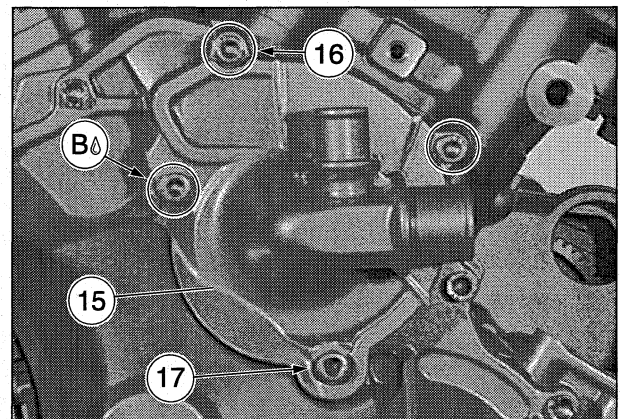
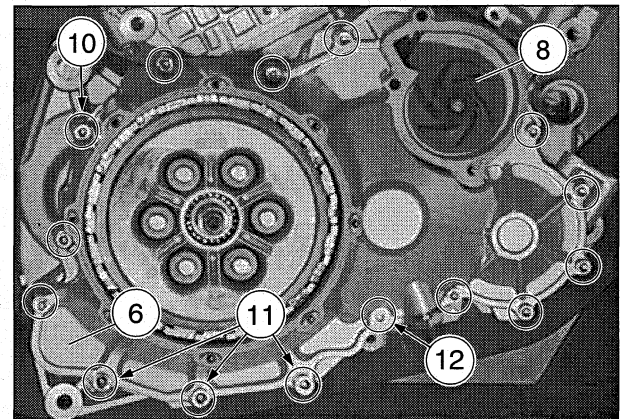
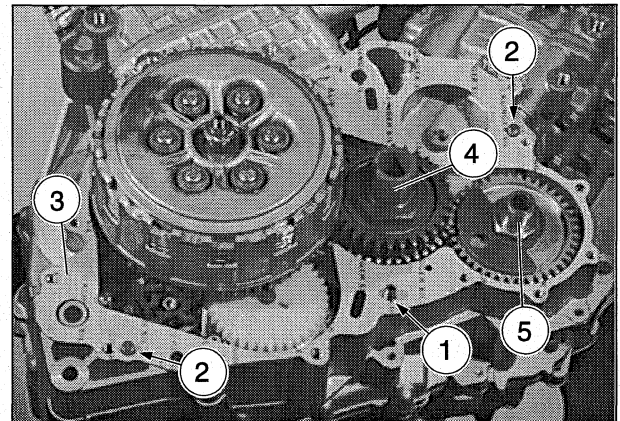
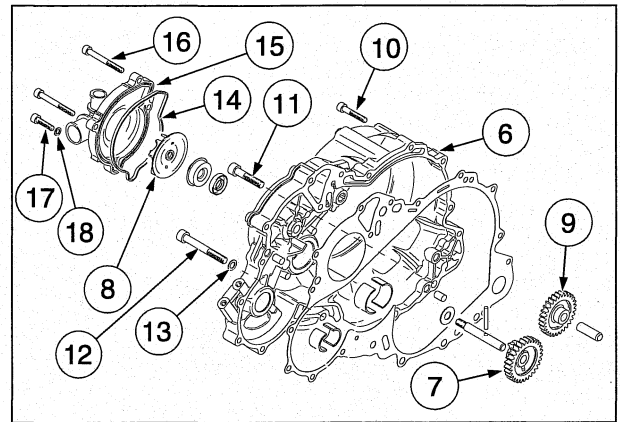
NOTE Fit the seal (18) on the M6x25 T.C.E.I. screw (17) (coolant drain plug).

- ◆ Insert the shaped seal (14) in the coolant pump casing (15) and fit it together with the clutch cover, securing it with the four M6 T.C.E.I. screws (16) (17).
- Coat the M6 x 55 screw in the centre of the cover with LOCTITE® T.C.E.I. 243.

- 3 M6 x 55 screws (16);
- 1 M6 x 25 screw (17) complete with seal (18).

Screws (16) (17) driving torque: 11 Nm (1.1 kgm).

Follow ►



Follow ►

- ◆ Fit the washer (19), support cup (20), diaphragm (21), cup (22) and spring washer (23) on the clutch disengaging shaft (24) and secure them with an M12 stop nut (25) previously coated with LOCTITE® 648.

Nut (25) driving torque: 30 Nm (3.0 kgm).

CAUTION

In order to tighten the stop nut, the diaphragm (21) must not be fixed in the clutch cover retainers (26).

NOTE Fit the support cup (20) and cup (22) on the clutch disengaging shaft with the rounded edge (27) facing out.

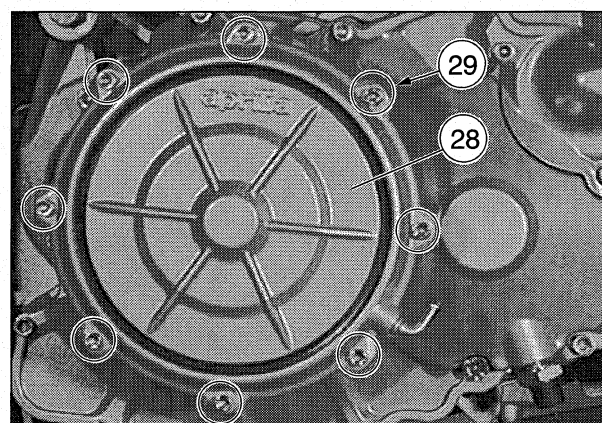
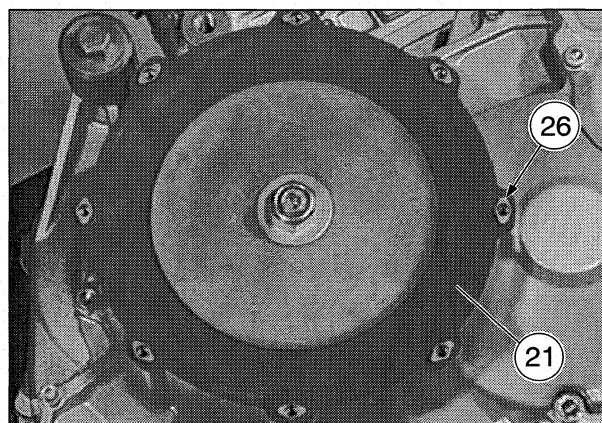
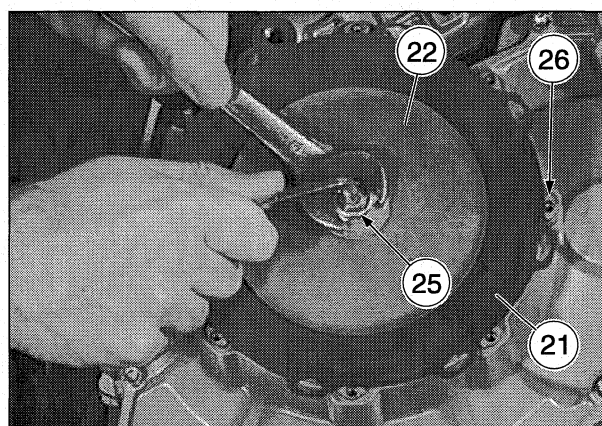
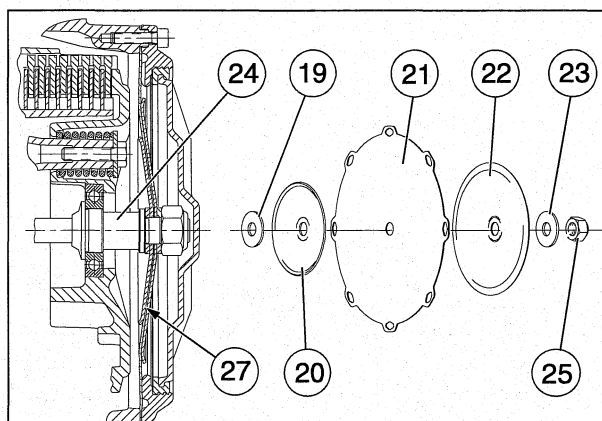
NOTE Hold the diaphragm (21) still on the clutch disengaging shaft (24), using a bent hexagon-head driver.

- ◆ Rotate the complete clutch disengaging shaft (24) and fasten the diaphragm (21) in the clutch cover retainers (26).

- ◆ Insert the preassembled diaphragm disc (28) and secure it with the eight M5 T.C.E.I. screws (29).

Screws (29) driving torque: 5 Nm (0.5 kgm).

B = LOCTITE® 243.



5.23 ASSEMBLING THE STARTER MOTOR

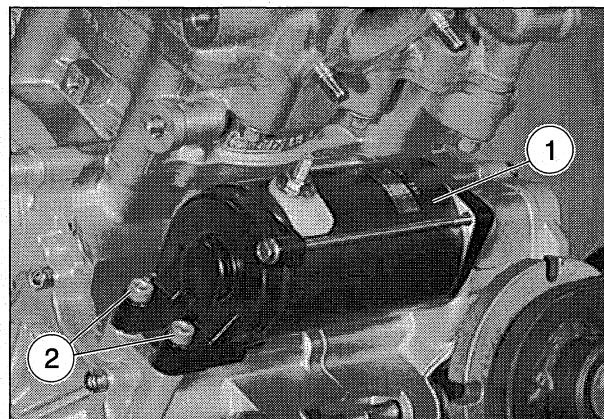
Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

- ◆ Grease the starter motor gear.
- ◆ Coat the starter motor flanged housing with MOLYKOTE® G-N.
- ◆ Centre the starter motor (1) in the casing, pushing it all the way in and securing it with the two M6 T.C.E.I. screws (2).

Screws (2) driving torque: 11 Nm (1.1 kgm).

M = MOLYKOTE® G-N.

N = Lubricating grease.



5.24 INSTALLING THE ENGINE OIL FILTER

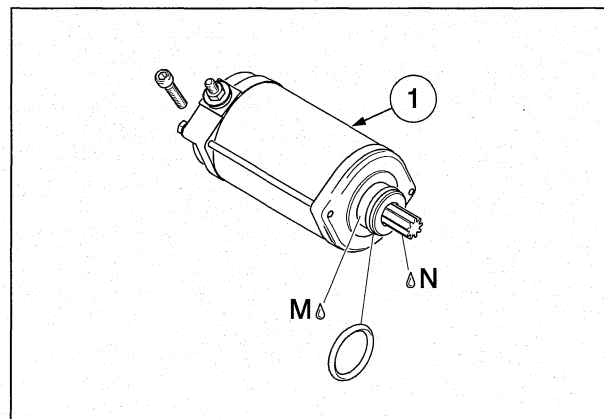
Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

⚠ CAUTION

Do not use filters that have already been used.

- ◆ Spread an oil film on the sealing ring (3) of the new engine oil filter.
- ◆ Fit the new engine oil filter (4).
- ◆ Put back the cover (5), screw and tighten the two screws (6).

Screws (6) driving torque: 11 Nm (1.1 kgm).



5.25 REFITTING THE WHOLE ENGINE ON THE FRAME

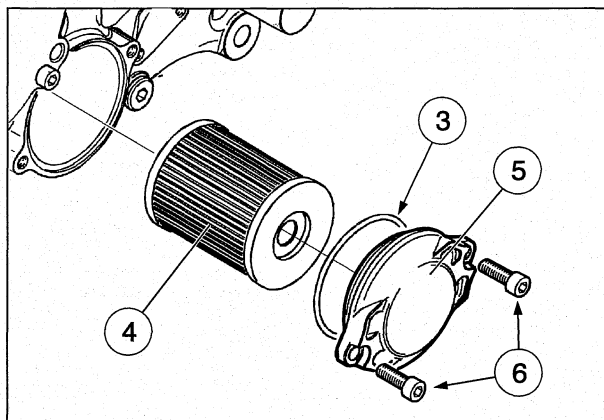
See 0.4.1 (VEHICLE WORKSHOP MANUALS).

5.26 ENGINE CHECKS SUBSEQUENT TO REASSEMBLY

See 0.4.1 (VEHICLE WORKSHOP MANUALS).

5.27 TROUBLESHOOTING

NOTE For the engine troubleshooting, see 0.4.1 (VEHICLE WORKSHOP MANUALS), since it is possible to run the engine and therefore to find out any anomaly only when the engine has been reinstalled on the vehicle.



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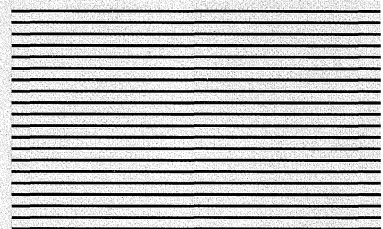
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