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

workshop manual

aprilia part# 8140586

0

INTRODUCTION

TABLE OF CONTENTS

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 01 .....october 2001

0.1.1 INFORMATION ON THE UPDATING OF THE MANUAL

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

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).

0.1.2 UPDATED MANUAL GENERAL LIST

pag.#	Release
0 - 1 - 00	01
0 - 2 - 00	01
0 - 3 - 00	01
0 - 4 - 00	00
0 - 5 - 00	00
0 - 6 - 00	00
0 - 7 - 00	01
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5 - 31 - 00	00
5 - 32 - 00	00
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5 - 34 - 00	00
✐ - 1 - 00	00
✐ - 2 - 00	01
✐ - 3 - 00	01
✐ - 4 - 00	00

0.2 HOW TO CONSULT THE MANUAL

1 — *V990 engine*

2 — WORK ON THE INDIVIDUAL PARTS

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

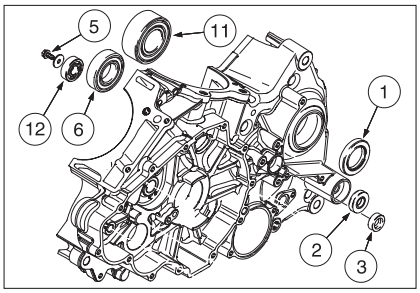
Carefully read 0.5.1 (PRECAUTIONS AND GENERAL INFORMATIONS).

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)**.

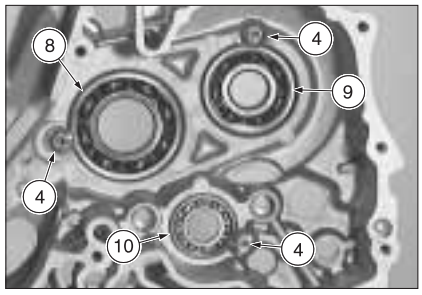
NOTE In order to avoid damaging the gasket surface, an old engine casing gasket should be placed underneath the puller plate.

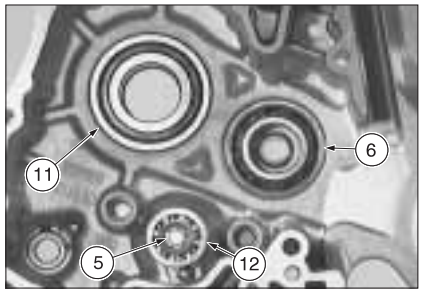
◆ Extract the ball bearings (6) of the gearbox input shaft by means of a universal extractor (7) for bearings.
◆ Remove the ball bearings using the relevant drift.

– 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.





4 — 3 — *Release 00/2001-06* — aprilia — 5 — 6 — 7 — **4** - 5 - *00*

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 01/2001-10).
– 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.

The mention to products or services supplied by third parties is made only for information purposes and it isn’t binding in any case.
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 INFORMATIONS

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

0.7 ABBREVIATIONS / SYMBOLS / INITIALS

= number
< = is less than
> = is greater than
≤ = is equal to or less than
≥ = is equal to or greater than
~ = approximately
∞ = infinity
°C = degrees Celsius (centigrade)
°F = degrees Fahrenheit
± = plus or minus
a.c. = alternating current
A = ampère
Ah = ampere per hour
API = American Petroleum Institute
HV = high voltage
AV/DC = AntiVibration Double Countershaft
bar = unit of pressure (1 bar = 100 kPa)
d.c. = direct current
cm³ = 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
PICK-UP = pick-up
BDC = bottom dead centre
TDC = top dead centre
PPC = Pneumatic Power Clutch
RIGHT SIDE = right side
SAE = Society of Automotive Engineers
TEST = diagnostics test
T.B.E.I. = convex socket head
T.C.E.I. = hexagonal socket head
T.E. = hex-head
T.P. = flat head
TSI = Twin Spark Ignition
UPSIDE-DOWN = upside-down rods
V = volt
W = watt
Ø = diameter

NOTE

NOTE

GENERAL INFORMATION 1

GENERAL INFORMATION

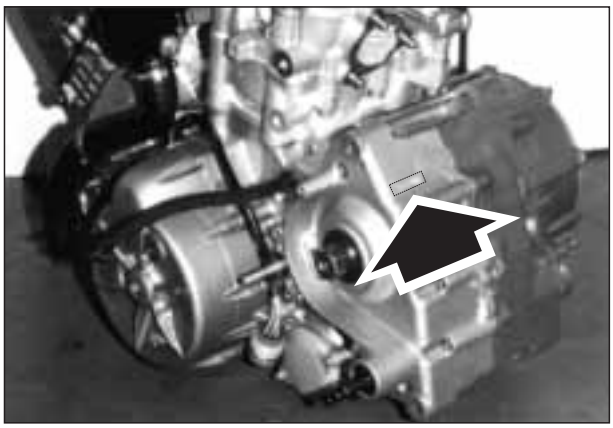
1

TABLE OF CONTENTS

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.

NOTE

NOTE

TECHNICAL INFORMATION 2

SERVICE AND SETTING UP

TABLE OF CONTENTS

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

Follow ▶

Follow ▶

ENGINE	
Spark advance	At start: 5° before TDC, additional advance depending on specific consumption levels
Starter motor gear ratio	i= 49/9 * 30/11 * 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 * 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
	1ª	31/60 = 1: 1.935	14/35 = 1: 2.50	17/42 = 1: 2.470	11.948
	2ª		16/28 = 1: 1.750		8.368
	3ª		19/26 = 1: 1.368		6.543
	4ª		22/24 = 1: 1.090		5.216
	5ª		23/22 = 1: 0.956		4.573
	6ª		27/23 = 1: 0.851		4.073
# sprocket teeth			17		

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

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

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

Follow ▶

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FUEL SUPPLY SYSTEM	
Type	electronic injection
Choke RSV RSV R SL RST	Ø 51 mm
Choke ETV	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) RSV RSV R SL RST	12 V – 400 W (350 W for models RSV RSV R up to 2000)
Generator (with permanent magnet) ETV	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): IP 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): IP Bimol Grease 481, IP 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): IP 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): IP ECOBLU -40 °C or Agip COOL.

OILO-UK

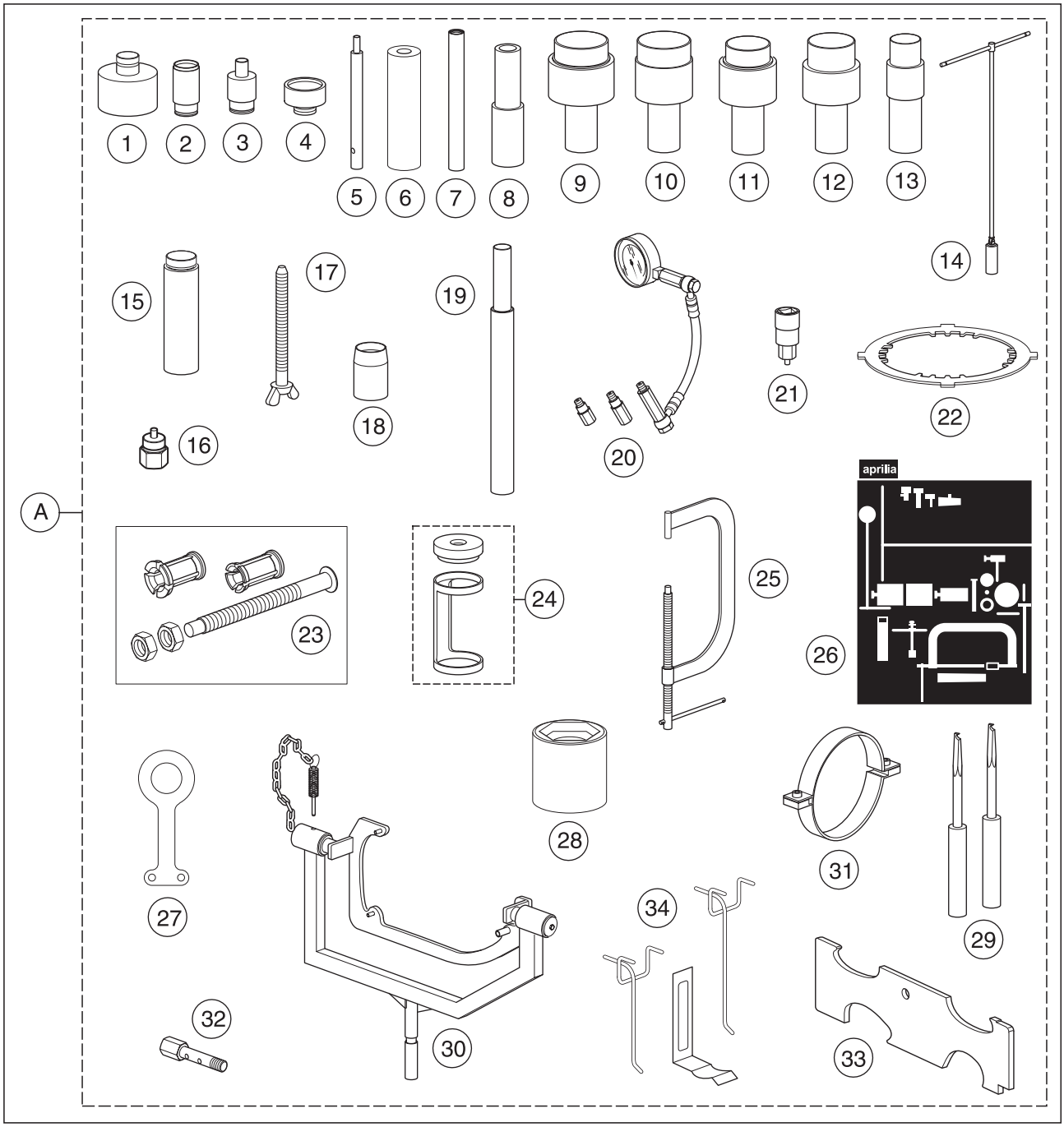
2.3 SPECIAL TOOLS OPT

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

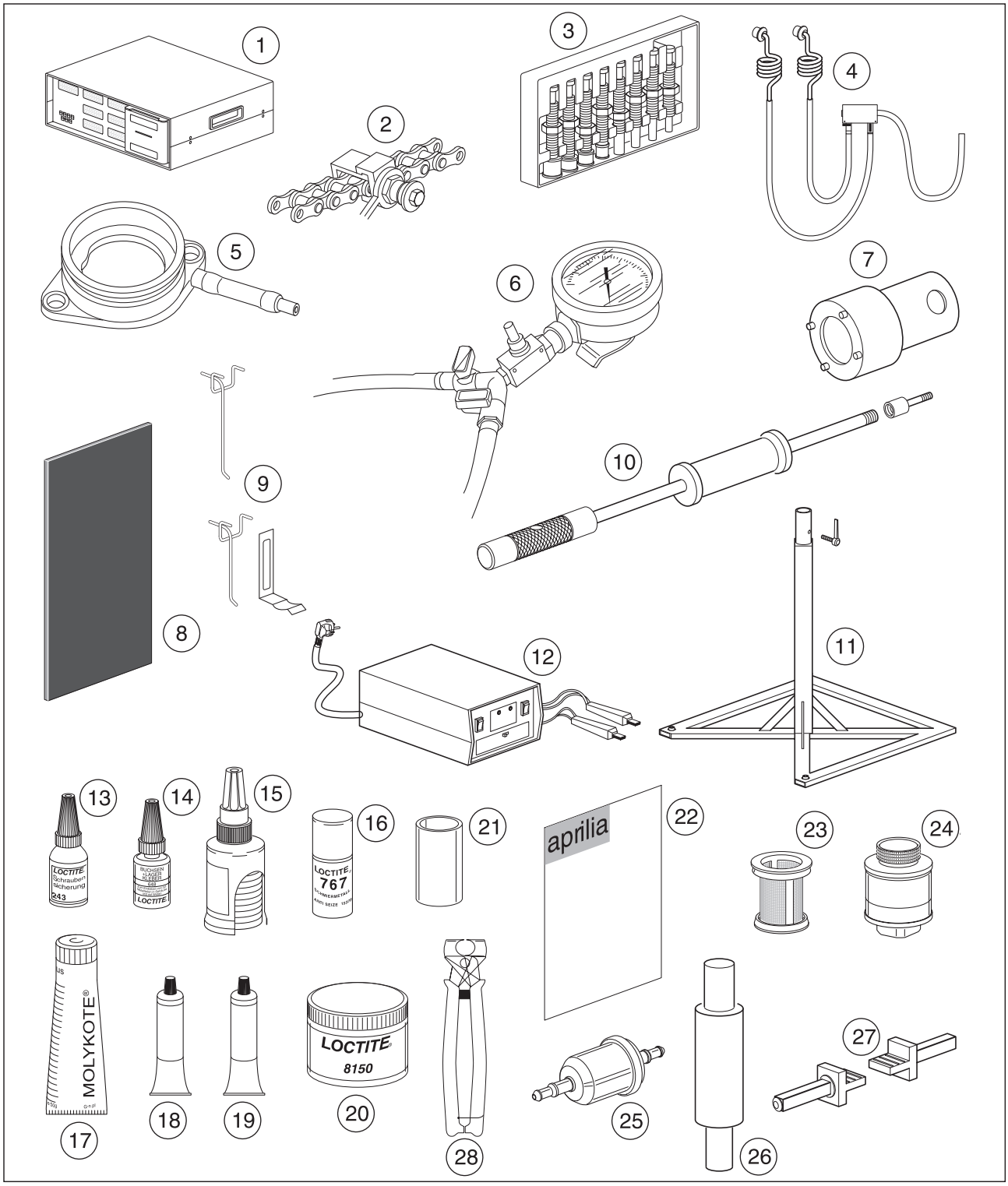
Before using the special tools, consult any documents attached.

2.3.1 ENGINE TOOLS



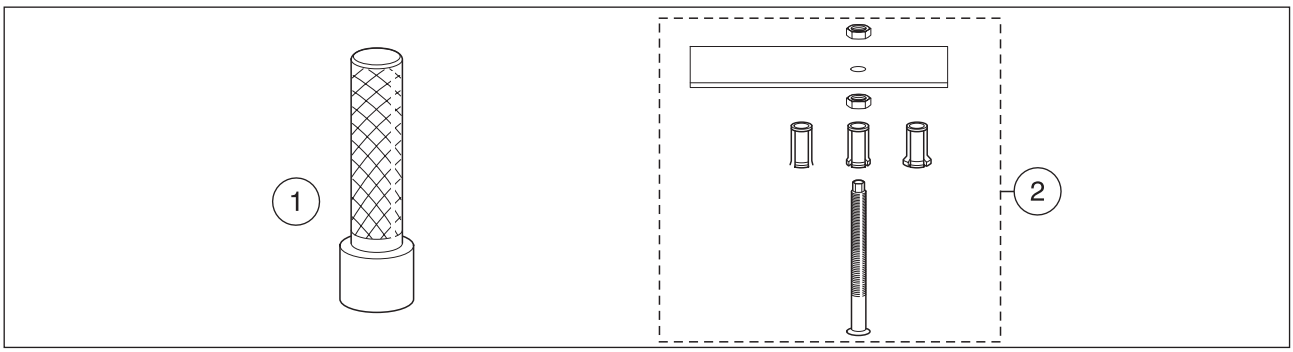
Pos.	**aprilia** part# (tool description and function)
A	**8140175** (complete tool kit for engine including)
1	**0277680** (gearshift secondary shaft oil seal assembly pad)
2	**0277660** (secondary countershaft oil seal assembly pad)
3	**0277670** (coolant pump shaft housing oil seal assembly pad)
4	**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 vacuometer)
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 cm^3)]
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 TP 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)

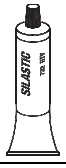
xxxxxxx N.A. = not available

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 anticorodal 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

aprilia part# (product)	Description of use
aprilia part# 8116050 (engine oil) (*)	– 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.
aprilia part# 0897651 [LOCTITE® 243 blue (10 cm³)] (**)	– 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.
aprilia part# 0898011 (fluorescent green LOCTITE® 275) (**)	– On the thread of the cylinder coolant inlet and outlet pipes.
aprilia part# xxxxxxx N.A. (LOCTITE® 572)	– 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)] (**)	– 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) (**)	– Assembly of plugs for checking CO on exhaust pipes.
aprilia part# 0899784 (LOCTITE® 574 orange) (**)	– 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) (**)	– 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)]	– 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)] (**)	– 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)	– Assembly of clutch pump control rod. – On intermediate timing gear thrust washer. – Upper countershaft oil seal. – Starter motor gear.
aprilia part# xxxxxxx N.A. (alcohol)	– 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.