

**OFF ROAD**

**aprilia**

**SXV-RXV**

**450-550**



**TECHNICAL COURSE**

# CONTENTS

aprilia

- 1 Vehicle presentation
- 2 Main characteristics
- 3 Maintenance operations
- 4 Engine
- 5 Cycle parts
- 6 Dashboard
- 7 Electrical system and Axone

30 minutes

1 hour

1 hour

6 hours

3 Hours

1 hour

2 hours

We will talk  
about...  
and do...



1

## Vehicle Presentation

2

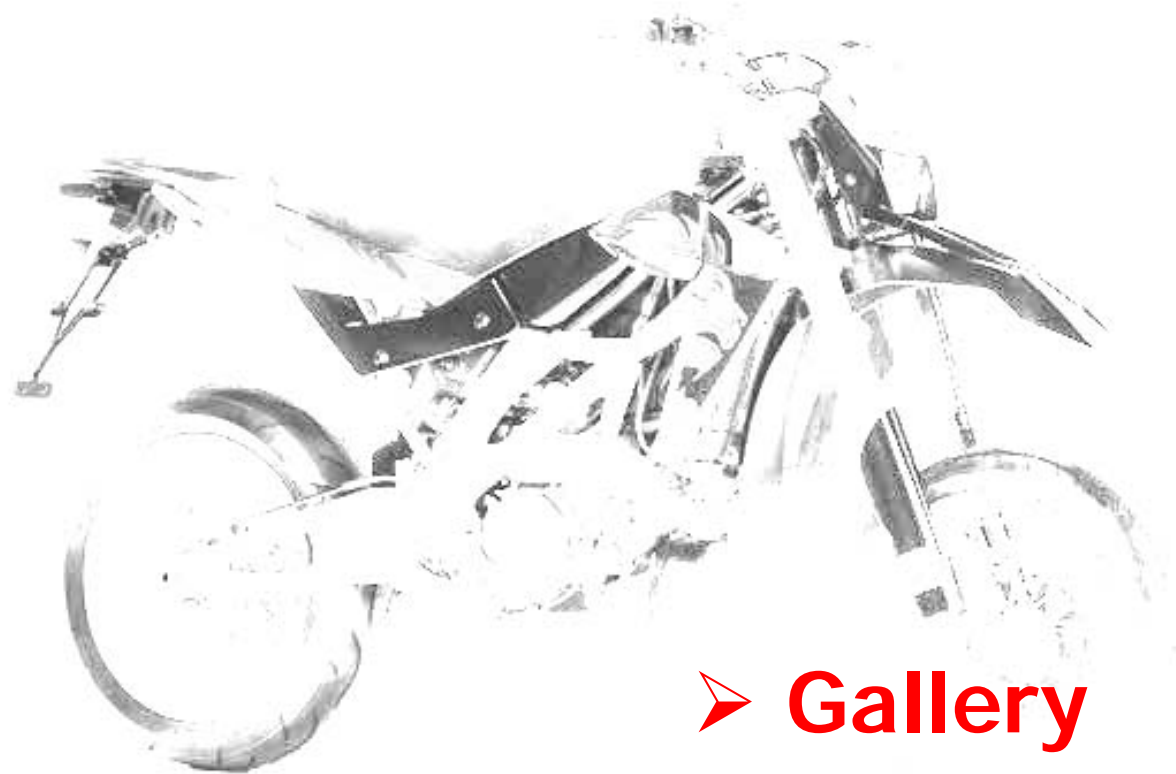
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➤ Gallery

➤ Target

# SXV

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# RXV

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# 4.5 – 5.5 2V77

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- **Vehicles designed specifically for track or off-road competition.**
- **They respect the technical characteristics required by the category rules of the main Supermotard and Enduro world championships.**
- **They are sold in 25KW reduced power conformation, Euro2 type approved for use on roads open to the public.**

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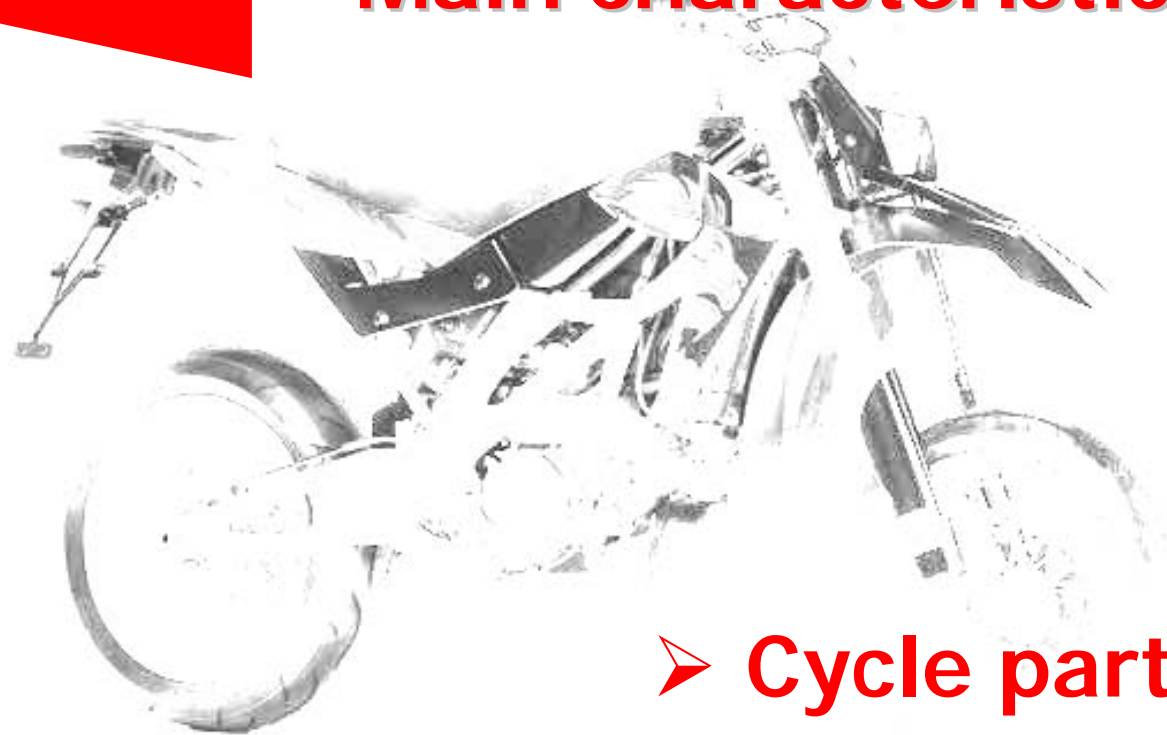
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## Main characteristics



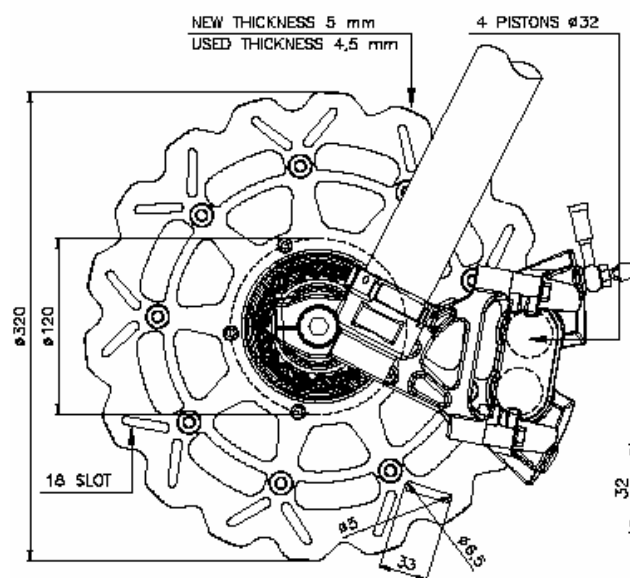
➤ **Cycle parts**

➤ **Engine**

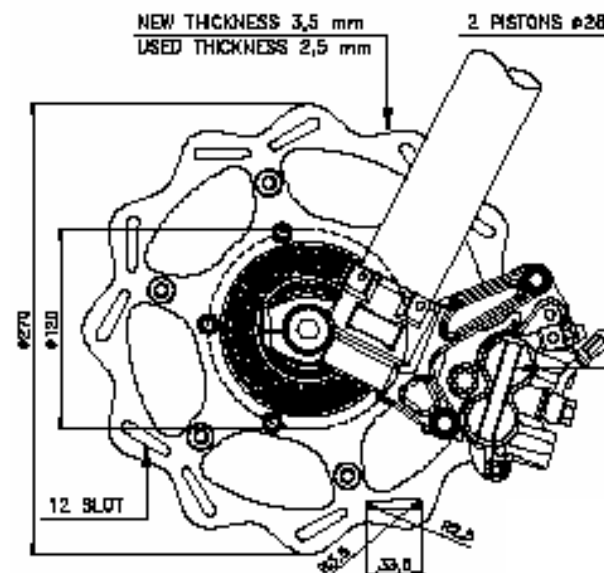
- **Frame with aluminium upright and steel tube lattice.**
- **Sachs 48 mm (SXV) – Marzocchi 45 mm (Enduro) front fork with compression and rebound hydraulic damping adjustment.**
- **Sachs rear shock with spring preload and high speed compression, low speed compression and rebound hydraulic damping.**

## ➤ Front brake:

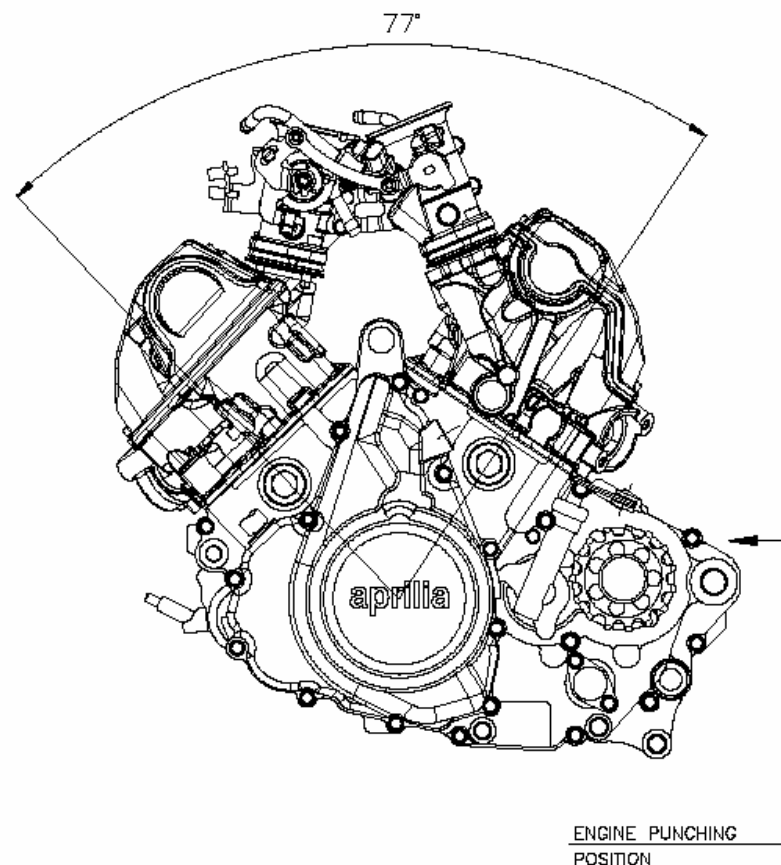
**SXV: 320mm disk – FTE radial caliper**



**RXV: 270mm disk – NISSIN radial caliper**



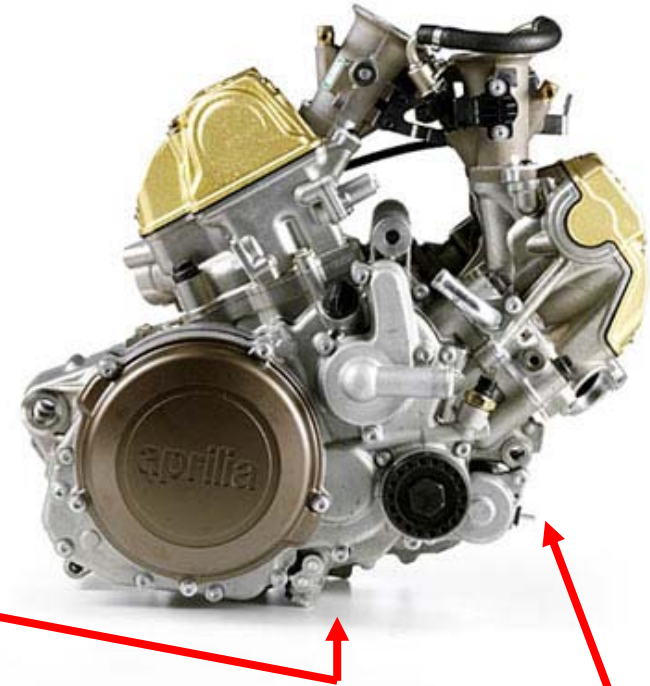
- Head-cylinder group:
- 77° V twin
- 4 titanium valves per cylinder, single overhead camshaft with decompressor.
- Head covers, clutch, flywheel in magnesium.



# Engine

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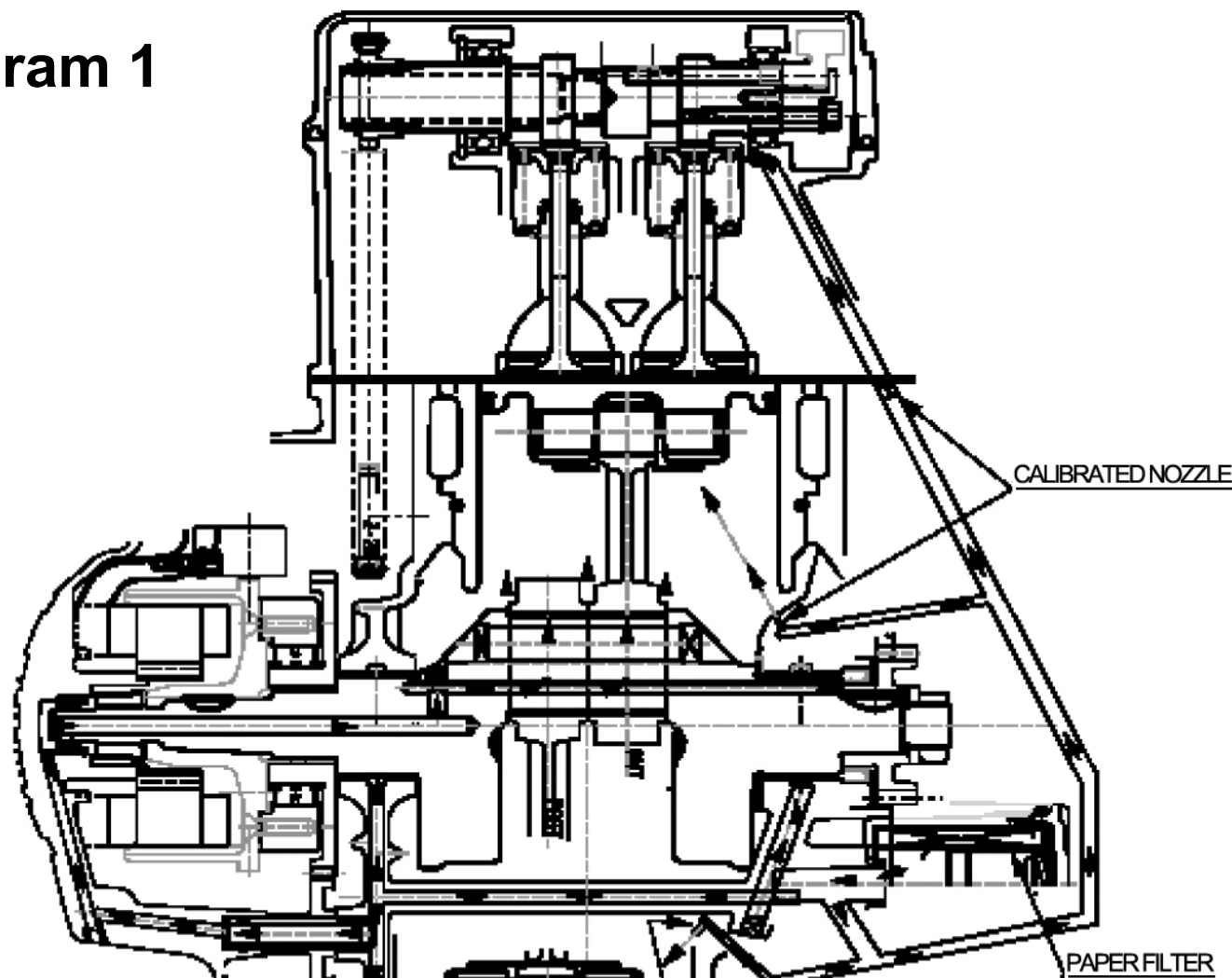
- Lubrication:
- Dry sump forced lubrication, coaxial pressure and scavenge pump.
- Overpressure valve (engine emptying)
- Non-return valve (requires pump priming)



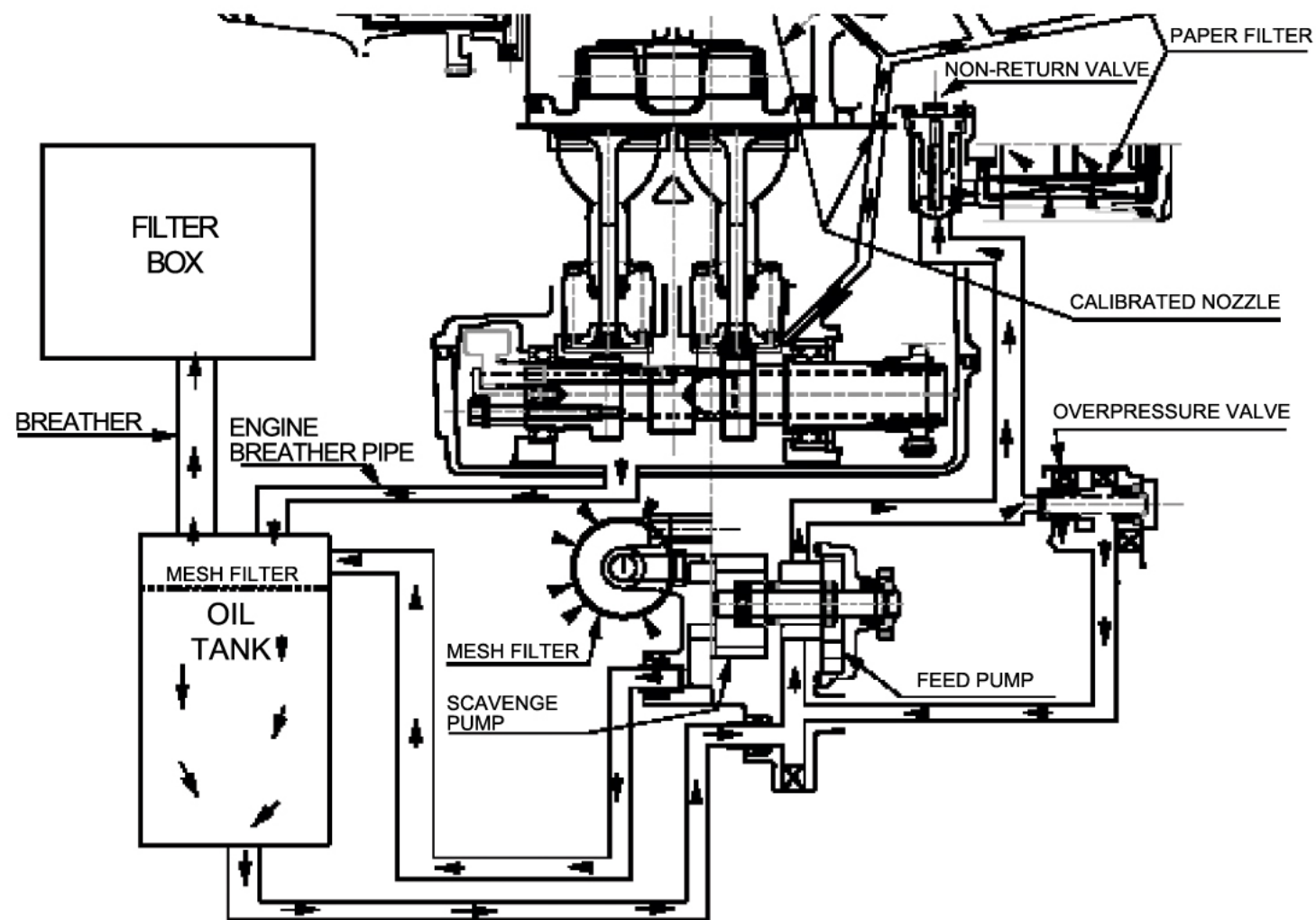
# Engine

aprilia

## Lubrication diagram 1



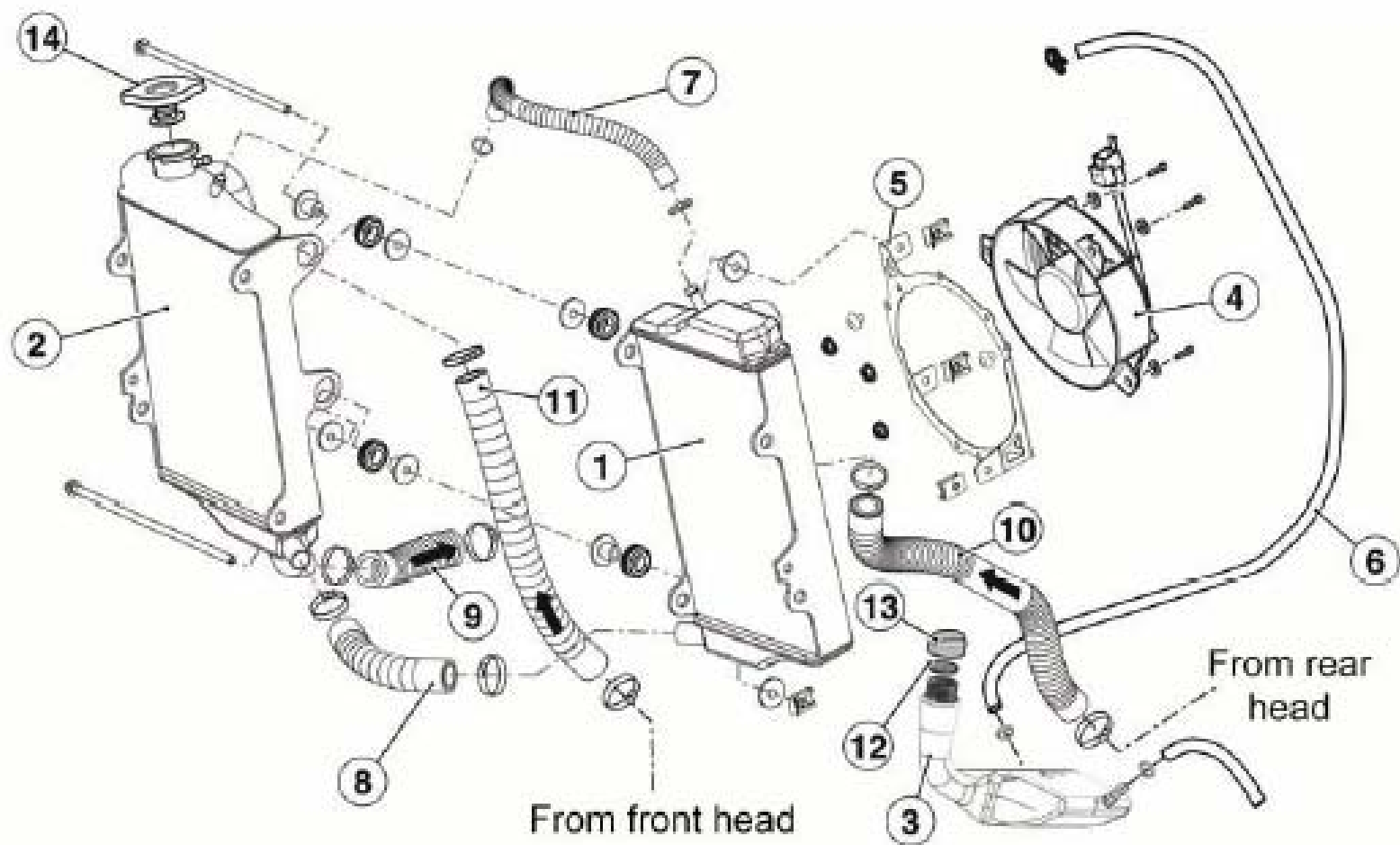
## Lubrication 2



# Engine

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## Cooling diagram



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## Maintenance operations

➤ Run-In

➤ Coupons

➤ Special tools

➤ Main operations



- **From 0 to 3 hours of running: keep the vehicle in reduced power conformation and do not exceed 8000 rpm**
- **From 2 to 15 hours of running: the vehicle can be used in free conformation (the warranty expires); do not exceed 75% throttle turn; avoid reaching engine speeds where the rev-limiter cuts in:**

**SXV 450: 12500 rpm**

**SXV 550: 12000 rpm**

**RXV 450: 11500 rpm**

**RXV 550: 11000 rpm**

**Depending on type of use:**

- **Competition use: Every 15 hours of running**
- **Sport use: Every 30 hours of running**
- **Road use (motorcycle code): Every 3000 km**

# Special Tools



	code	name	notes
1	9100838	Valve spring pusher tool	
2	8140179	Valve fitting/removal bow	Use bow for rotax V990
3	9100839	Flywheel extractor	
4	9100943	Piston pin extractor	With fittings for 4.5 and 5.5
5	9100841	Engine mount	V990 engine mount adapter plate
6		Clutch housing tool	Use tool for Minarelli 660 engine
7	8140838	Rotor clamping	Use tool for Minarelli 660 engine
8	9100844	Crankshaft clamping	Pin for clamping crankshaft for timing
9	9100942	Right crankcase support	
10	9100840	Crankshaft bush pusher	With notch for coupling directon
11	9100884	Crankshaft bush extractor	
12	9100885	Gearbox main/right- transmission/left	Inside right and left half casing (bearings on main shaft right and transmission shaft left)
13	9100886	Gearbox transmission/right-main left	Inside right and left half casing (bearings on main shaft left and transmission shaft right)
14	9100887	Right casing desmodrom pusher	On right inside casing
15	9100888	Oil pump oil seal pusher	Inside right casing
16	9100889	Timing transmission crankshaft pusher	On outside right casing
17	9100890	Crankshaft oil seal pusher	On outside right casing

**In green, the tools already existing for other Aprilia vehicles**

# Special Tools

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	codice	nome	note
18	9100938	Left casing support	With support references (3) and (2) and transmission shaft bearing support adjustable in h=5 mm for motard vers. (+ high for wide wheel) and enduro
19	9100892	Desmo. left casing + wheel hub	On left inside casing
20	9100893	Left timing transmission pusher	On left outside casing
21	9100894	Transmission shaft oil seal pusher	On left outside casing, approx. 0.5 with respect to hole area
22	9100895	Coolant pump oil seal pusher	On right clutch casing for flush fitting; there are 2 oil seals (coolant and oil), one on the pump cover and the other on the clutch casing (press from outside)
23	9100897	Cylinder barrel extractor	
24	9100843	Crankshaft pinion clamping	
25	9100898	Swing-arm cage pusher	
26	9100900	Swing-arm linkage cage pusher	on one side for flush assembly; on the other for centering (where there is single bearing)
27	9100903	Marzocchi d.45 fork oil seal	
28	9100904	Sachs d.48 fork oil seal	
29	8127819	Walbro cable for Axone	
	8140595	Axone 230V50Hz battery charger	For countries with 220V, 50 Hz power supply
	8202311	Axone 110V60Hz battery charger	For countries with 110V, 60 Hz power supply
	8104520	Axone/PC connection cable	Optional cable for upgrading Axone via PC. The kit for online upgrading is supplied together with the Axone

**In green, the tools already existing for other Aprilia vehicles**

## Engine oil change

➤ **Empty the entire system (via the overpressure valve)**



➤ **Fill the tank with 800cc of oil; prime the circuit, filling the filter; run the engine then top-up to level.**

## Air filter change

- **Make sure the tank holding cable does not touch the battery + pole.**
- **Ensure the correct position of the cable glands and tightening of the filter box fins.**
- **Pay attention to the position of the fuel/pump union (it could break if pressed against the filter box cover).**
- **In case of a fall, oil will enter the airbox (from the engine breather pipe): replace the filter and clean the airbox.**

## Minimum adjustment

After bringing the engine to working temperature, the minimum must be set at 1900 +/- 100 rpm by means of the knob located on the airbox, corresponding to about 5 +/- 1 ° throttle opening.



## Cylinder balancing

**Disconnect the tube connecting the two intake ducts and connect a differential pressure gauge (use tubes of equal section and length).**



# Main operations

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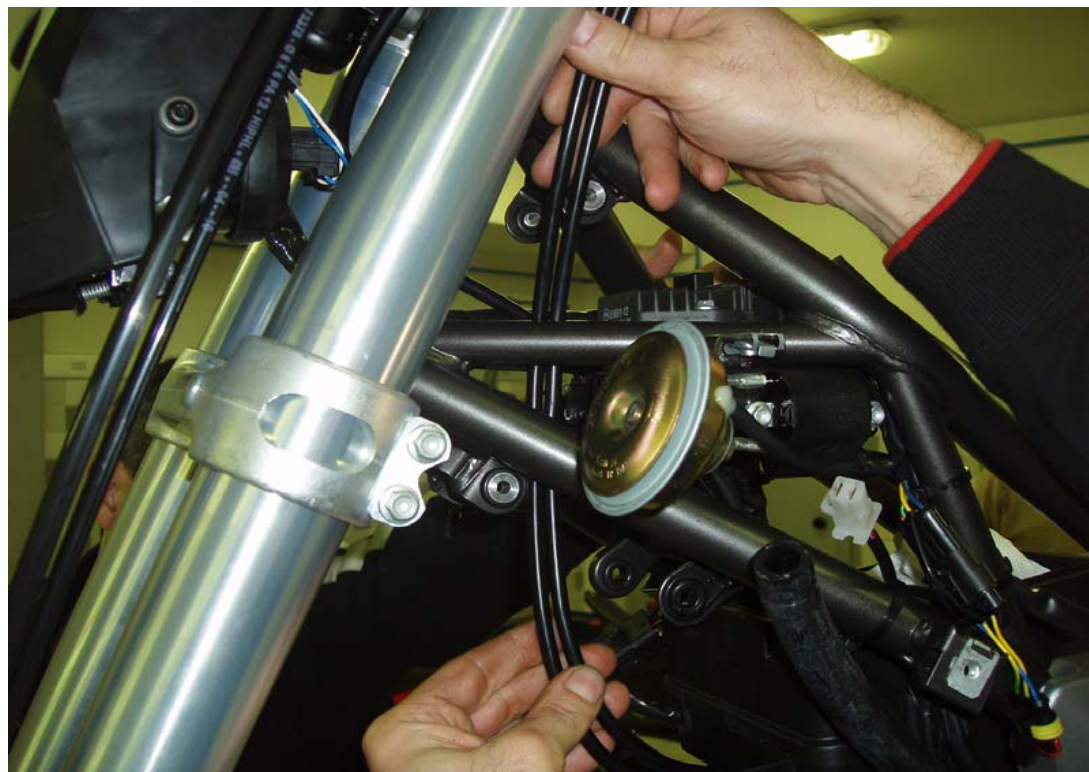
**If the vacuums are not balanced, loosen the unmatched screw on the front cylinder body and adjust the position of the rear cylinder throttle until obtaining correct balance.**



## Throttle cable adjustment

➤ Adjust the throttle cables with every coupon service, and after every maintenance operation (pay attention to the return).

➤ Test opening and return with the handlebar turned all the way to the right. In case of doubt, check the cable paths.



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➤ **Cylinder head**

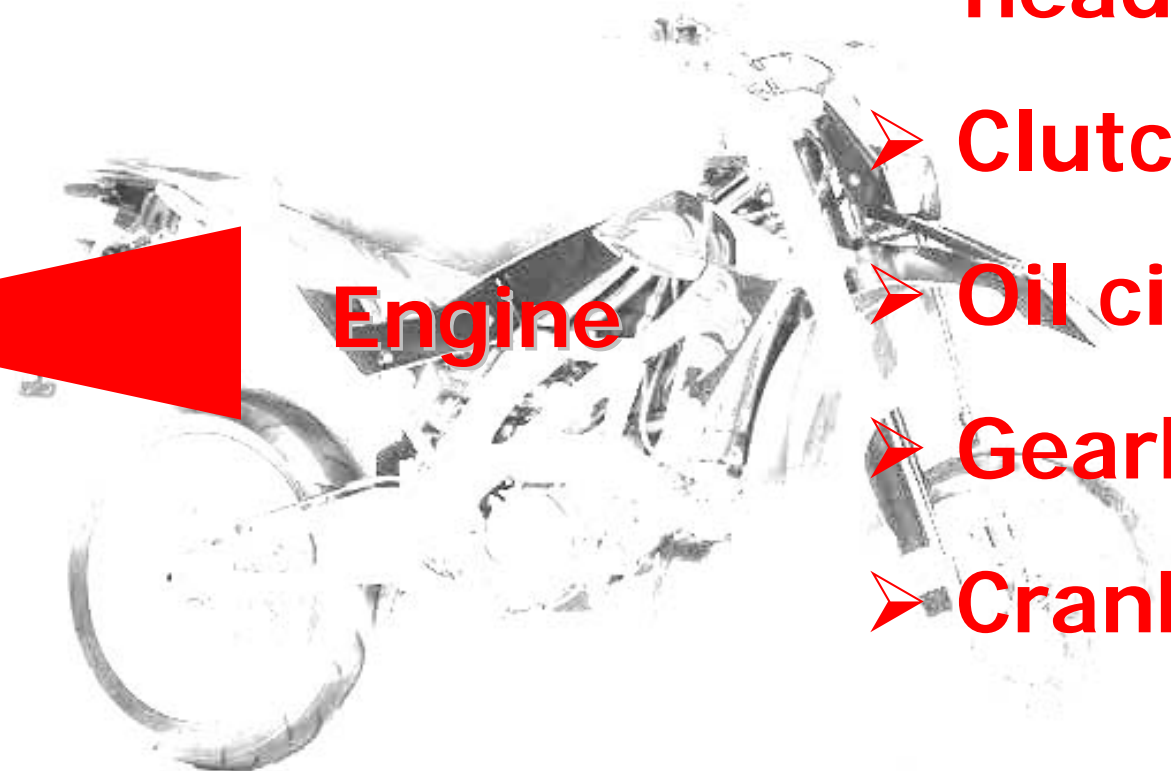
➤ **Clutch**

➤ **Oil circuit**

➤ **Gearbox**

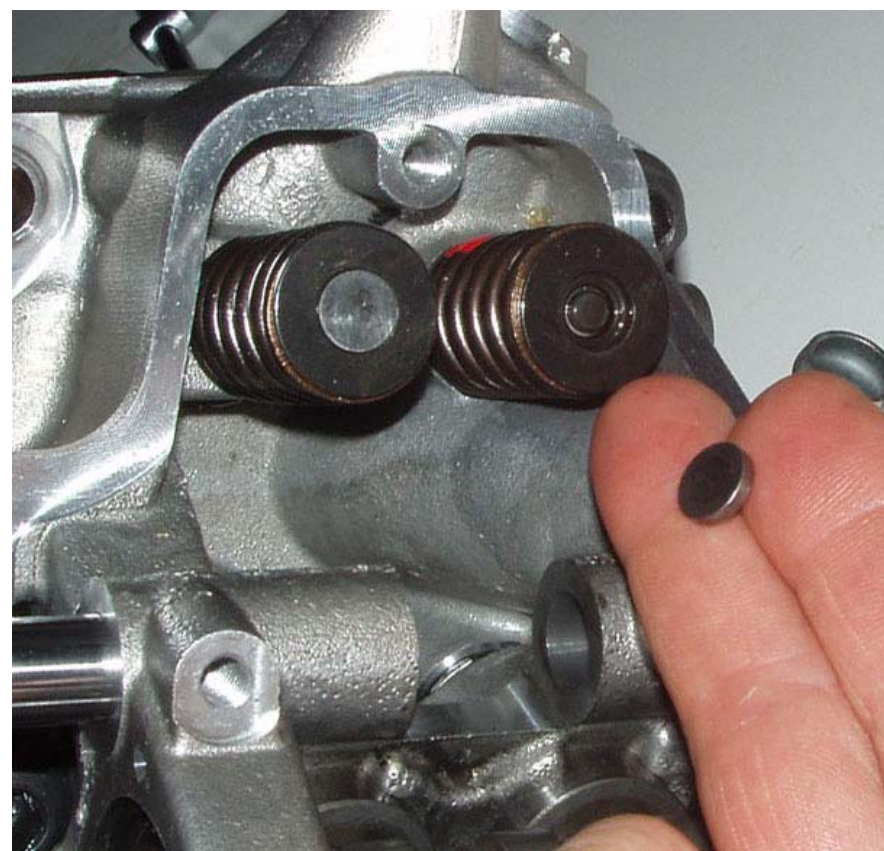
➤ **Crankcase**

**Engine**



## Valve clearance adjustment

- To adjust the valve clearances (0.10 in – 0.20 ex) insert the correct shim on the valve stem.
- Titanium valves: not grindable.



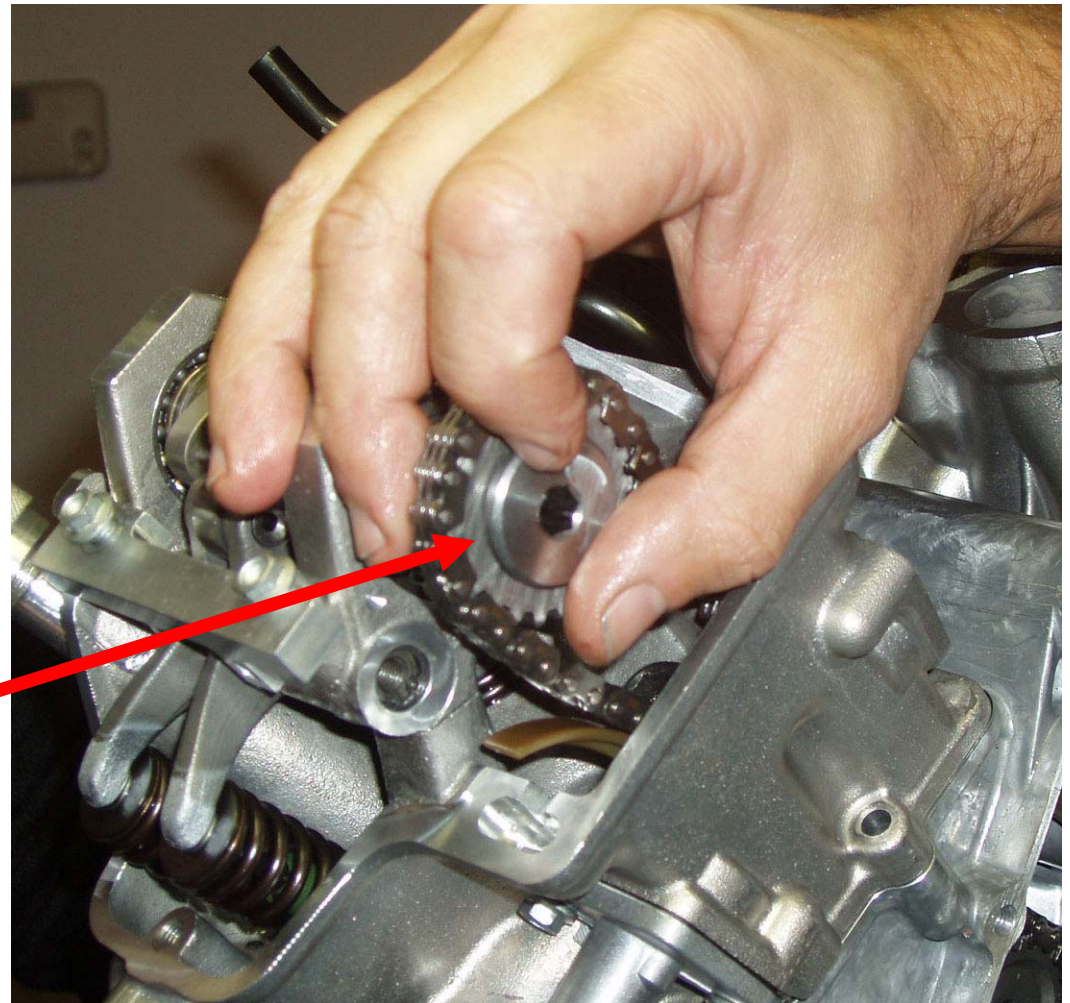
## Timing system

- **Remove the chain tensioners before removing the camshaft gears**
- **Refit the chain tensioners before doing the timing**



## Cams

- The camshafts are different: the rear cylinder has aligned cams whereas the front cylinder has the exhaust cam opposed
- The screw of the front camshaft gear has a left thread

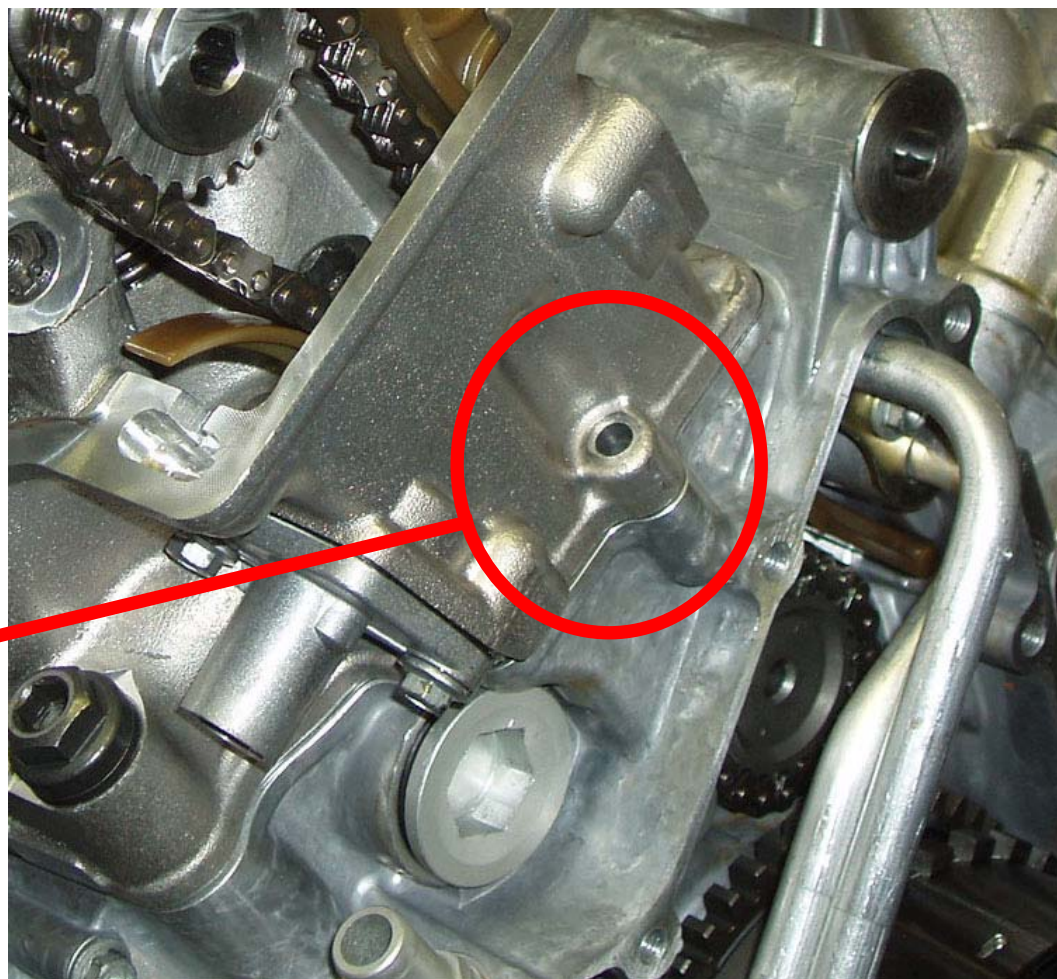


# Cylinder head

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## Cylinder head

- When refitting, apply Loctite 510 under the gasket, at the couplings of the two casings.
- The head has 5 connection screws: the 6mm side screw must be removed first and tightened last



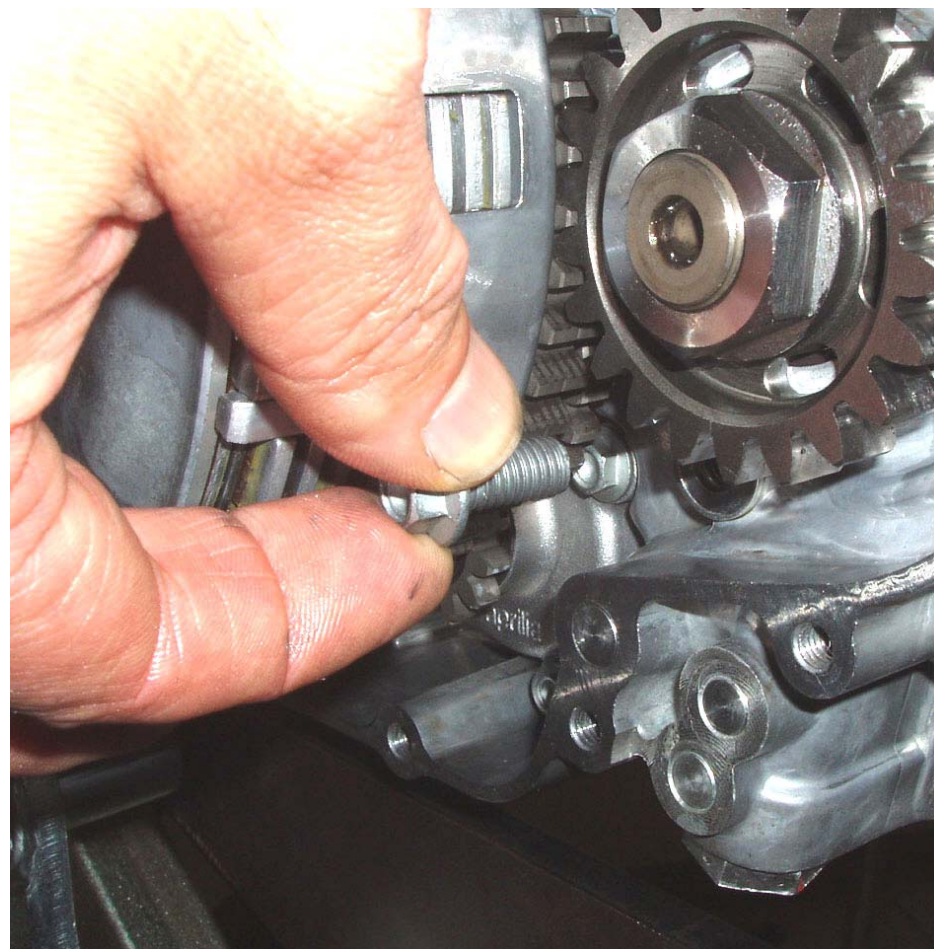
# Cylinder head

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## Timing

- To clamp the crankshaft, remove the screw in the photo and use the pin code 9100844.

**CAUTION: remember to tighten the screw before closing the clutch cover.**

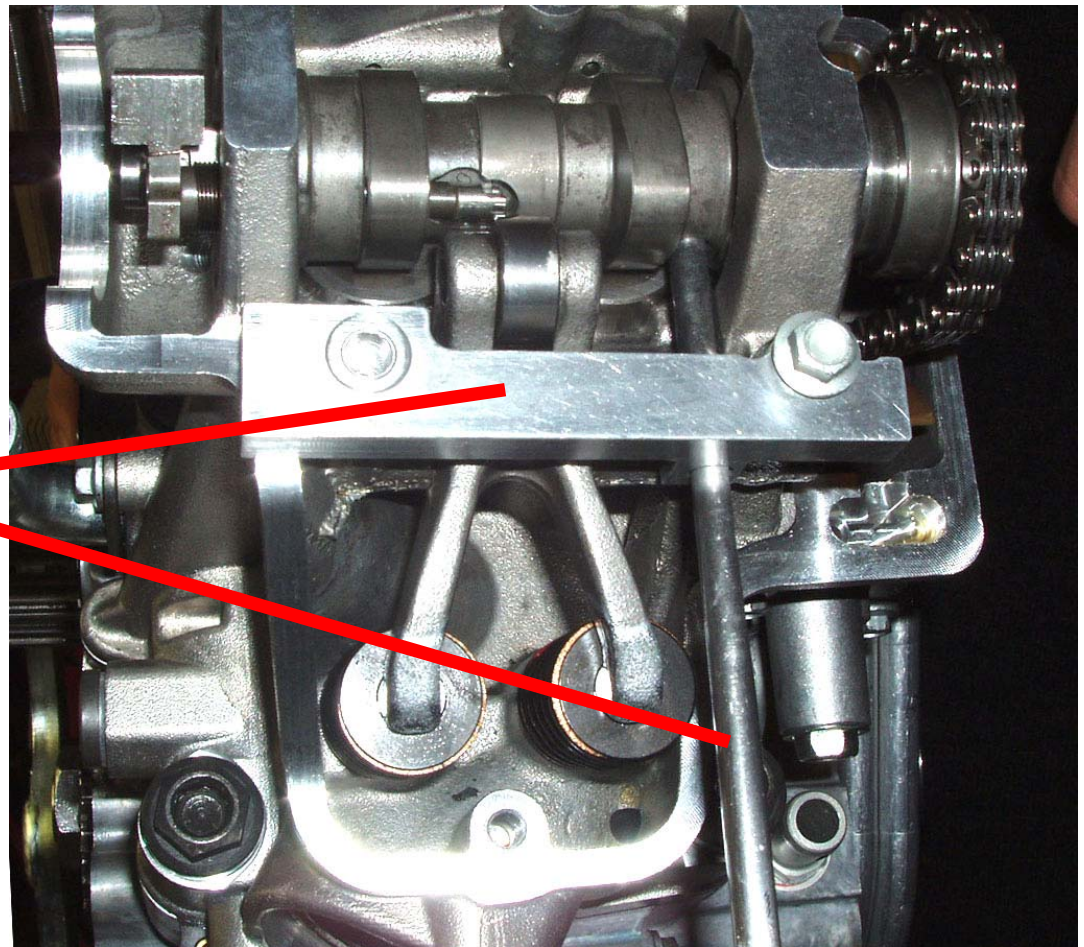


# Cylinder head

**aprilia**

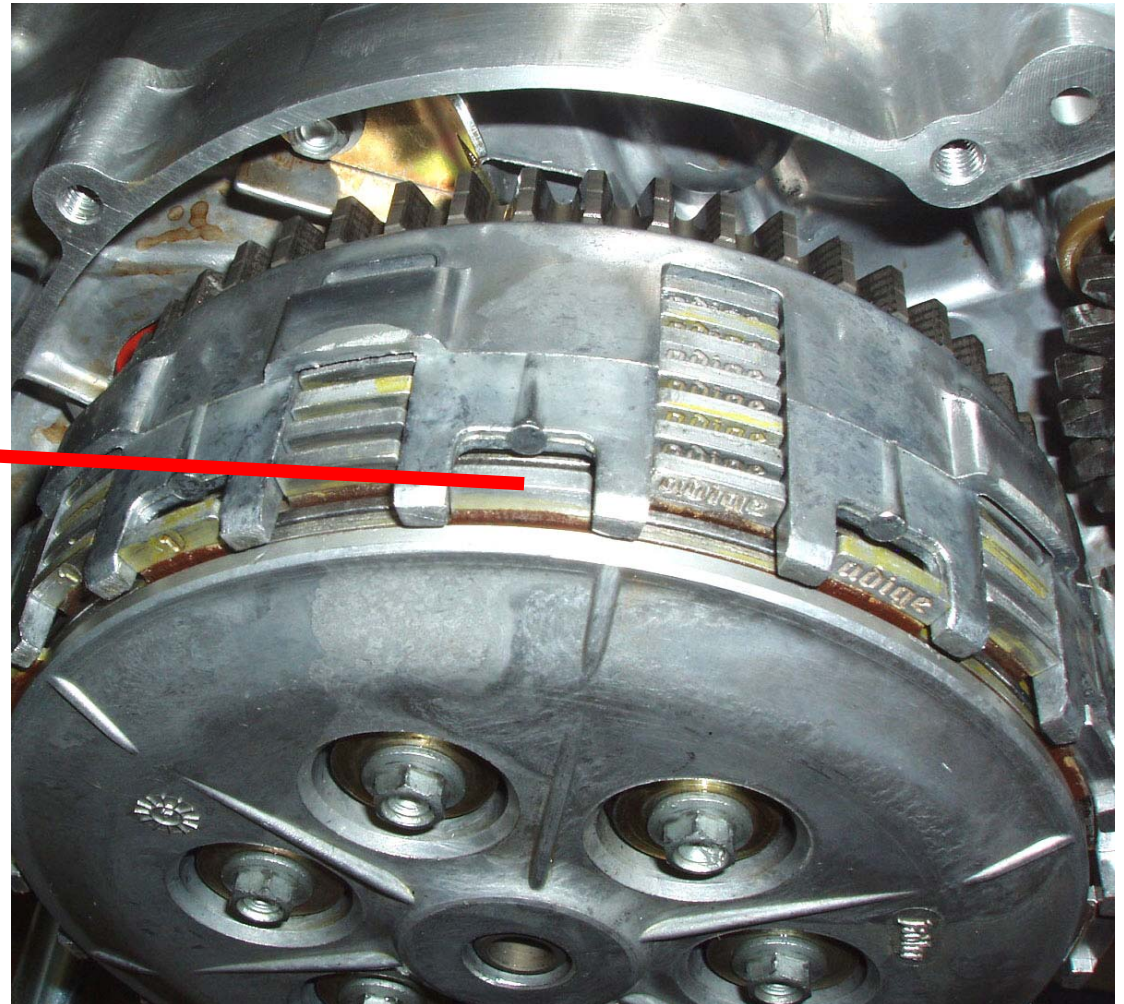
## Timing

- To align the camshafts, use the special tool code 0000000



## Clutch Plates

- The packed plates are all the same, and all must be aligned except the outside plate which must be misaligned.
- There five 2mm and two 1.5mm steel plates. The two thinnest plates go first and last.



# Oil circuit

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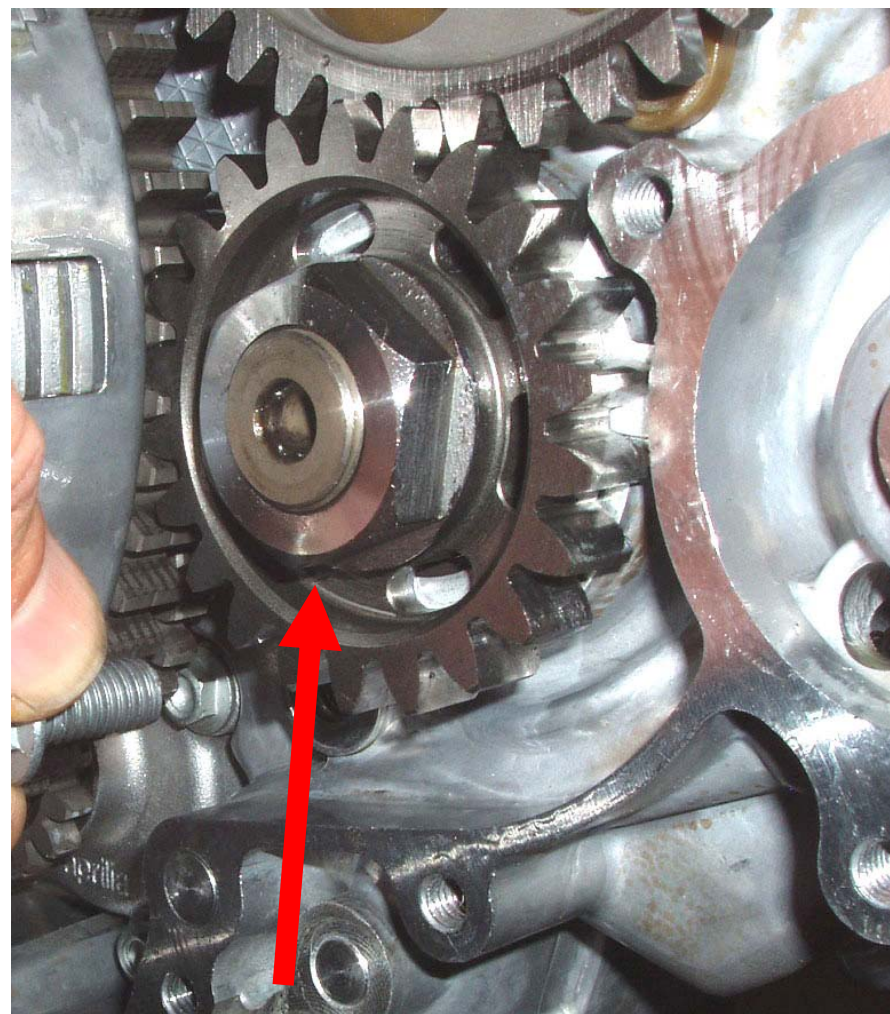
- The oil pump is of the coaxial two-stage trochoidal type. The external rotor (pressure) has a longer shaft coupling pin. The inside pump (scavenge) has the shorter pin.
- The head oil delivery pipes are in aluminium, in the section inside the flywheel cover: they must not be forced.



# Crankcase opening

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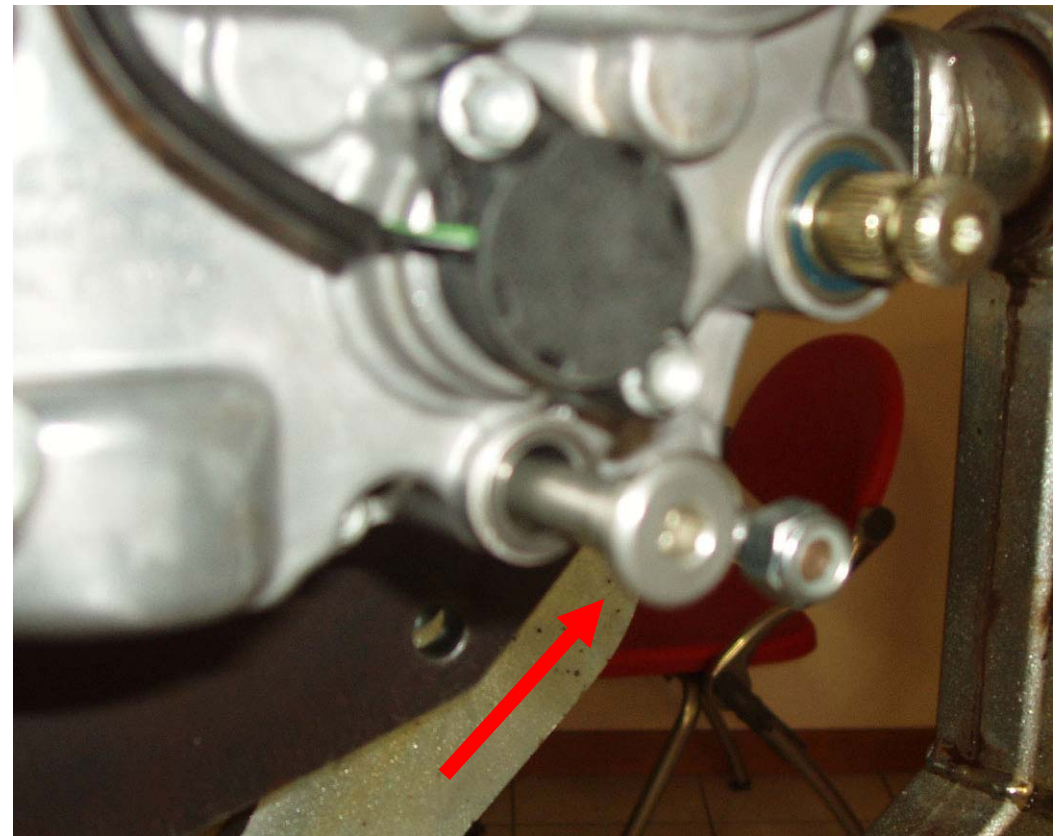
- **CAUTION:** the nut of the primary has a left thread.
- There is shim under the gear of the primary: the steel part must be towards the crankcase.



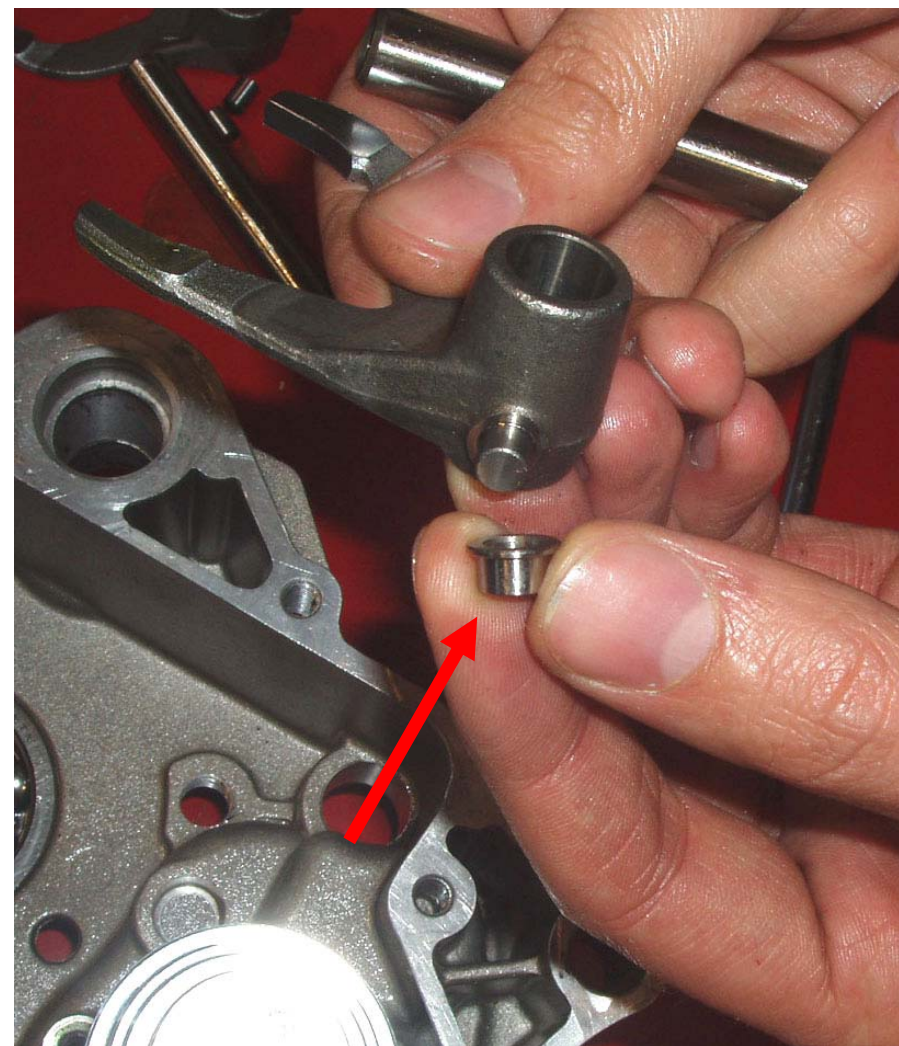
# Crankcase opening

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- **There are 16 screws joining the two casings: 14 on the flywheel side, 1 on the clutch side and 1 is the gearbox oil plug.**



- **Pay attention to the sliding bushings on the fork control pin (the desmodromic drum is in aluminium)**



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➤ Fork

➤ Rear shock

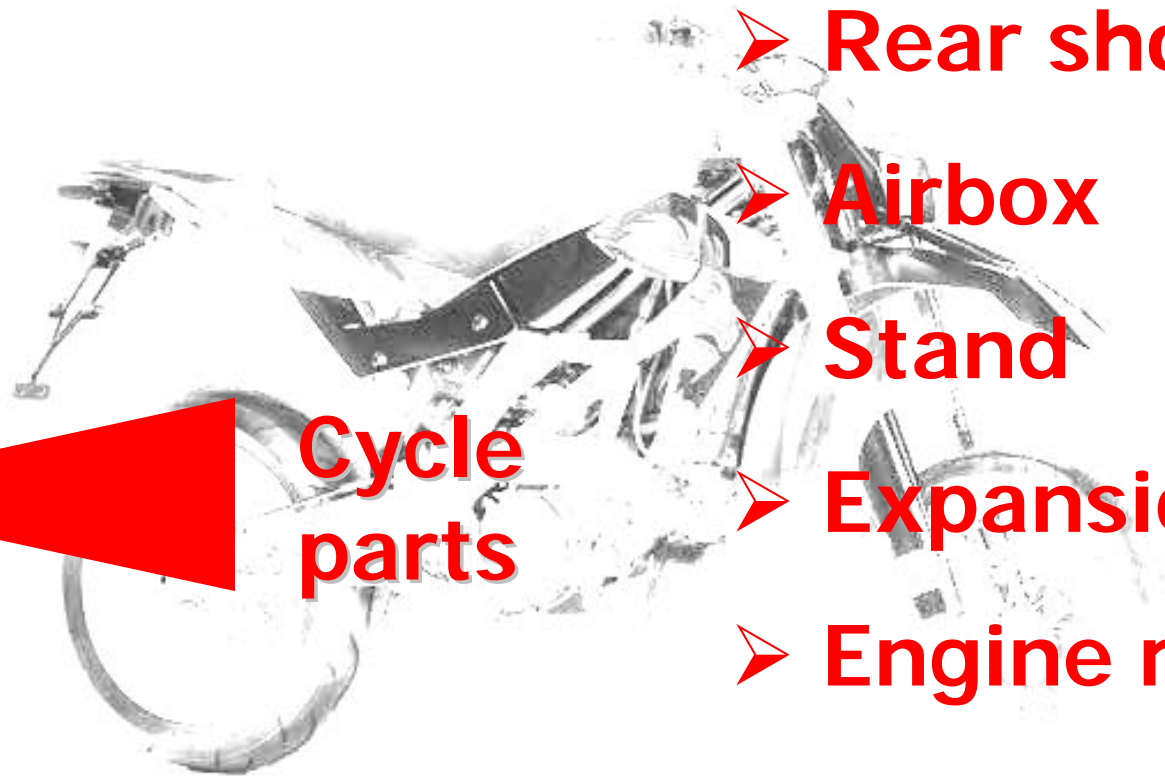
➤ Airbox

➤ Stand

➤ Expansion tank

➤ Engine removal

Cycle  
parts



# Fork

The Aprilia logo, consisting of the word "aprilia" in white lowercase letters on a red rectangular background.

	<b>SXV</b>	<b>RXV</b>
<b>Type</b>	<b>Sachs Ø 48 mm</b>	<b>Marzocchi Ø 45 mm</b>
<b>Oil quantity</b>	<b>125 mm of air</b>	<b>100 mm of air</b>
<b>Oil type</b>	<b>SAE 10W</b>	<b>SAE 7.5W</b>
<b>Compression damping</b>	<b>10 clicks</b>	<b>12 clicks</b>
<b>Rebound damping</b>	<b>10 clicks</b>	<b>12 clicks</b>
<b>Leg projection</b>	<b>Level with cap</b>	<b>1 notch</b>

➤ Adjustments are always understood as from the "fully closed" position

# Rear shock

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➤ In addition to the normal adjustments, there is a knob for setting high speed compression hydraulic damping (6).



# Rear shock

The Aprilia logo, consisting of the word "aprilia" in white lowercase letters on a red rectangular background.

	<b>SXV</b>	<b>RXV</b>
<b>Preloaded spring length</b>	245mm	473 mm
<b>Rebound damping</b>	13 clicks	23 clicks
<b>Low speed compression damping</b>	16 clicks	Fully open
<b>High speed compression damping</b>	Fully open	Fully open

➤ Adjustments are always understood as from the "fully closed" position

- Operate with maximum cleanliness when the airbox is open.
- When refitting, ensure correct positioning of the air intakes.



# Stand

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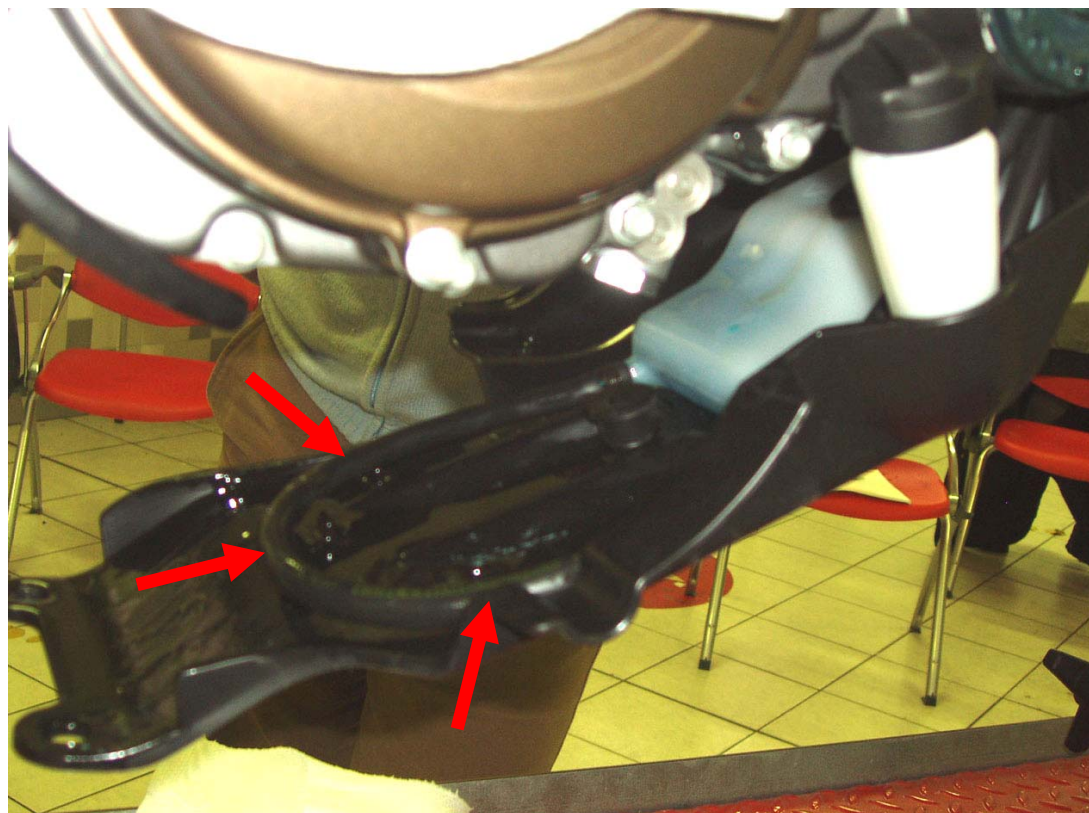
- The side stand is of the automatic return type (without safety sensor).
- For sports use, fix the safety elastic behind the left side panel.



# Expansion tank

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➤ The tube connecting the radiators and expansion tank must be positioned on the special seats to avoid squashing.



# Engine mounts

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➤ On the bottom engine coupling pin there are several shims that differ between left and right and from vehicle to vehicle. Check the number and position during removal.



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➤ Dashboard and scroll button

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➤ LCD

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➤ Dashboard setting

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**Dashboard**

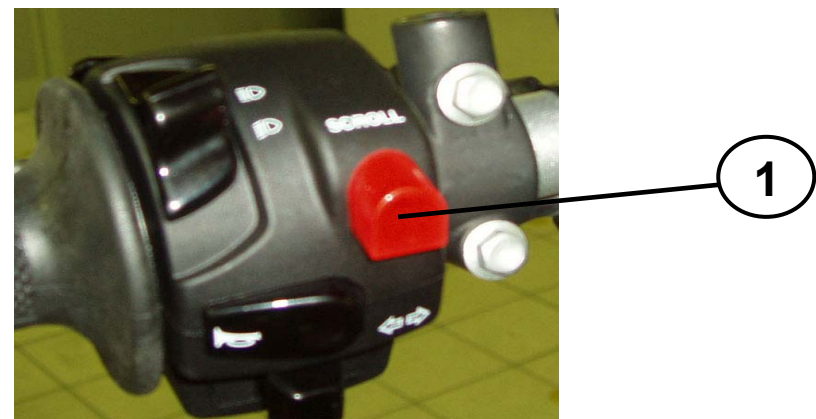
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# The dashboard and scroll button

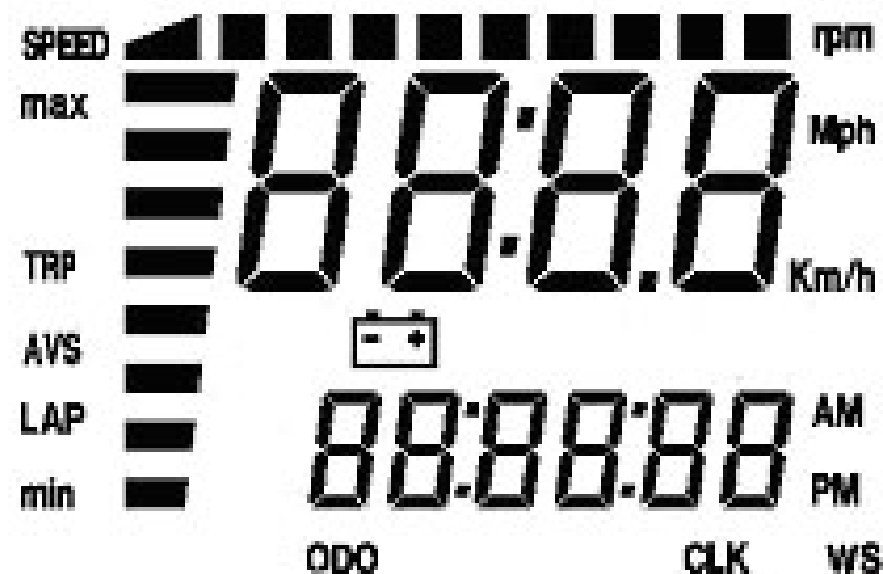
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1. SCROLL button
2. Neutral light, green
3. Engine oil pressure warning light, red
4. Engine management indicator light.
5. Multifunction digital display.
6. Fuel reserve warning light, orange
7. High beam indicator light, blue
8. Turn indicators light, green
9. Overrev warning light



## DASHBOARD FUNCTIONS

1. SPEED
2. ODO
3. TRP
4. AVS
5. LAP (in format hh:mm:ss or mm:ss:1/10ss)
6. CLK
7. TACHOMETER (graphic or numerical)
8. MAX SPEED
9.  Indicates low battery



## ➤ **Overrev setting:**

**On the TACHOMETER screen, press MODE and SCROLL at the same until it shows - - - -. Release and then set the required value by repeatedly pressing the SCROLL button.**

## ➤ **Setting Km/h – Mph**

**Keep the SCROLL button pressed, turn the key and wait until the message “WS” is displayed, then release the SCROLL button.**

**Press the SCROLL button using short presses to go to the various functions; press the SCROLL button using long presses to return to the modified page.**

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- Sensors - Actuators
- Fuel injection
- Axone



**Fuel injection –  
Electrical system**

# Sensors and actuators

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## SENSORS

### BASE

Crankshaft position sensor

Throttle position sensor

### CORRECTION

Intake air temperature sensor

Coolant temperature sensor

Atmospheric pressure sensor (inside the control unit)

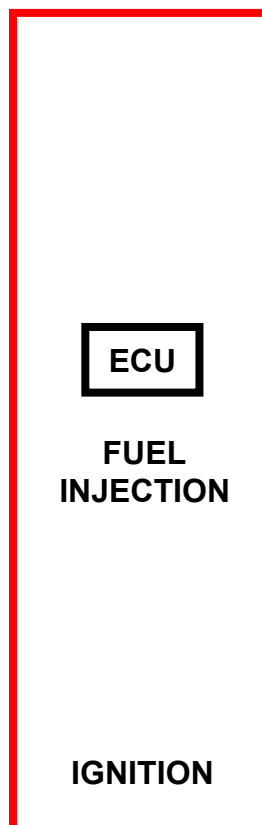
### OTHER SENSORS

Tip over sensor

Speed sensor

Gear sensor

MAP alpha/n



## ACTUATORS

Ignition coils

*Fuel injectors*

Fuel injection system relay

*High beam/low beam relay (activation for value above 800 rpm)*

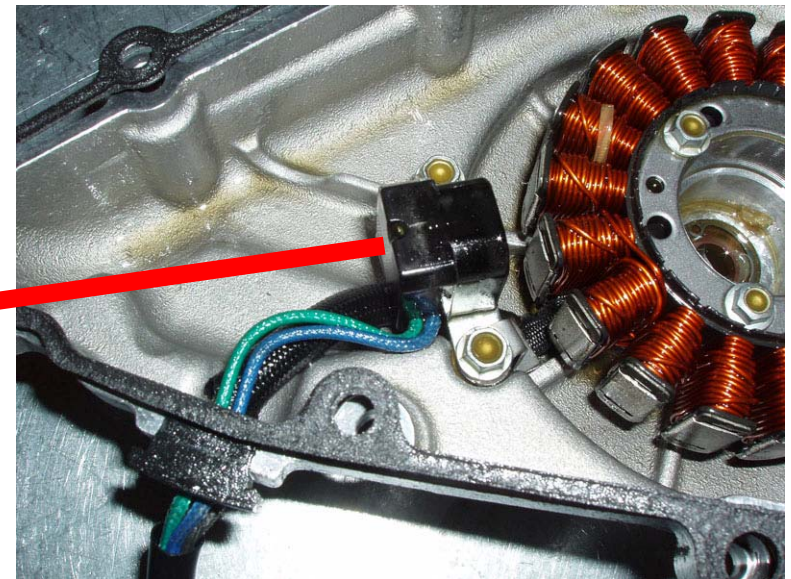
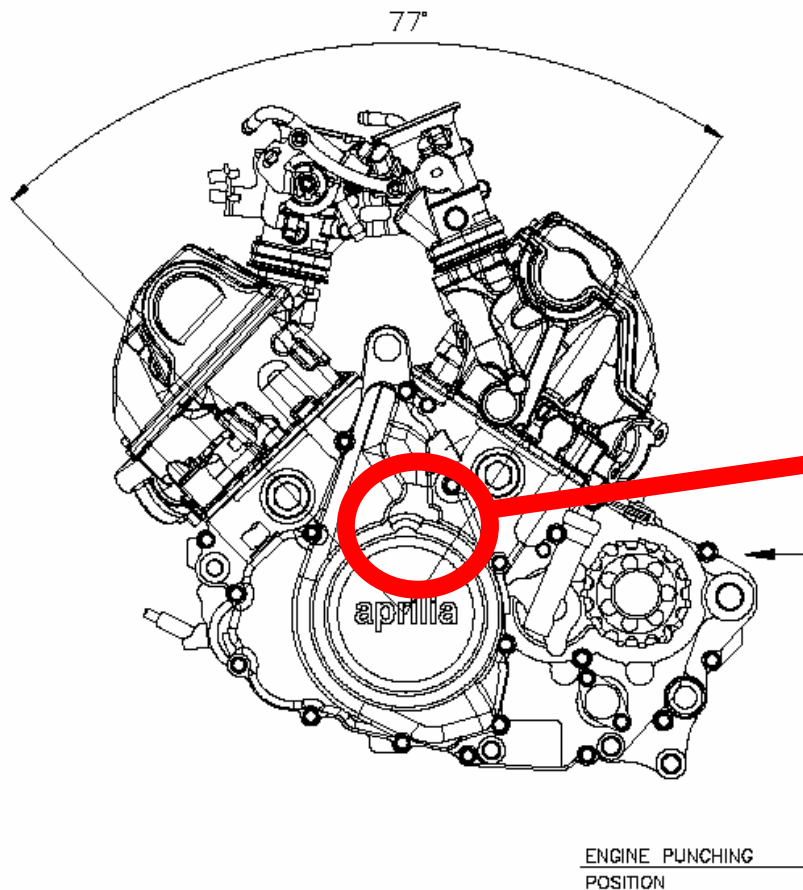
*Cooling fan relay*

Other

**RX-TX lines for communication with Axone**

# Crankshaft position sensor

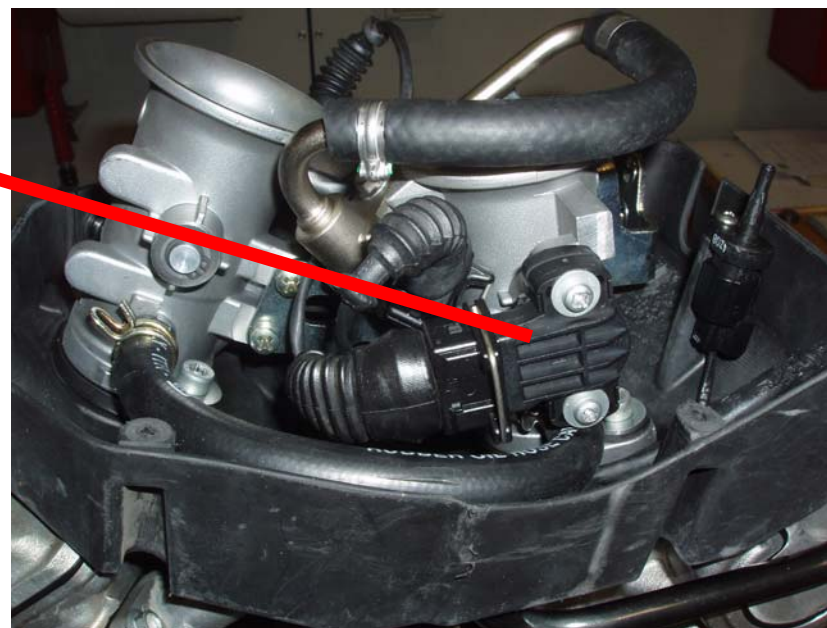
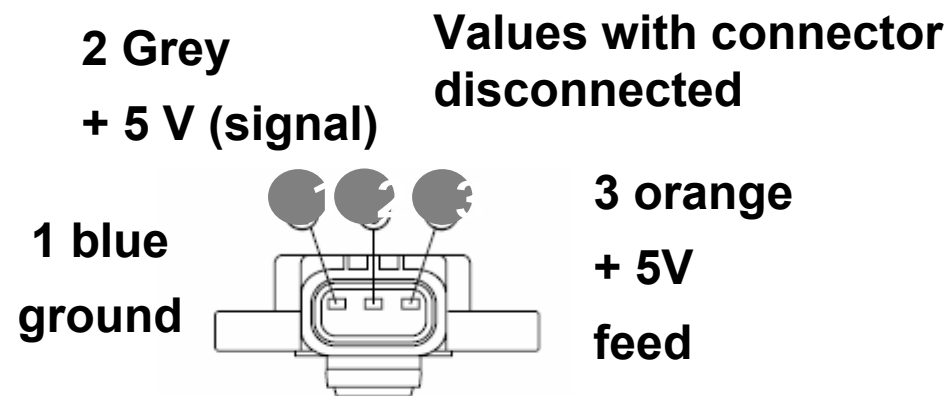
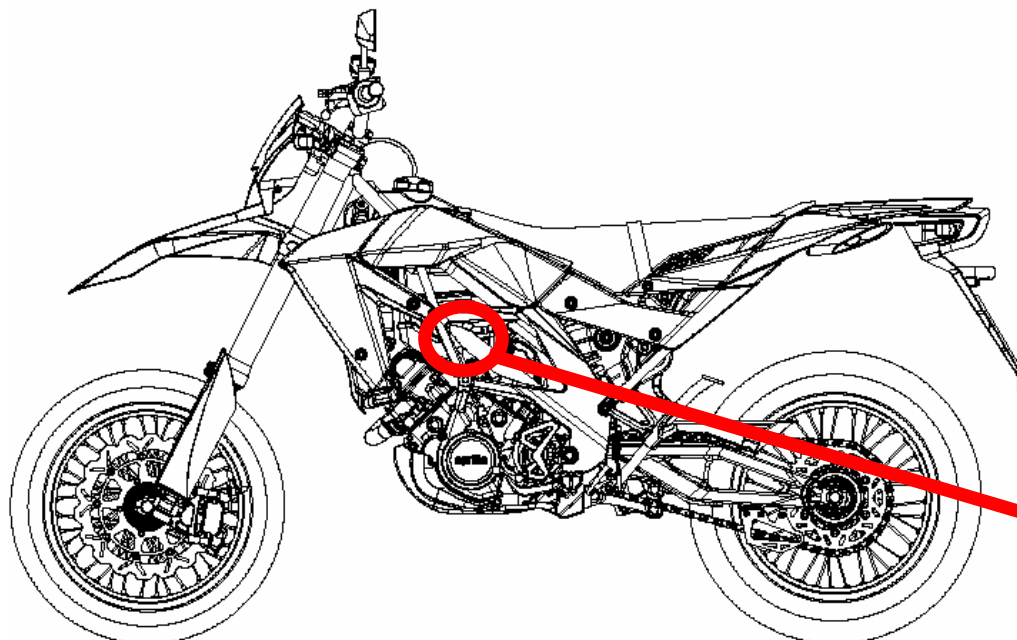
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**Crankshaft position sensor resistance:  
500 +/- 20 %  $\Omega$  at 20°C**

# Throttle position sensor

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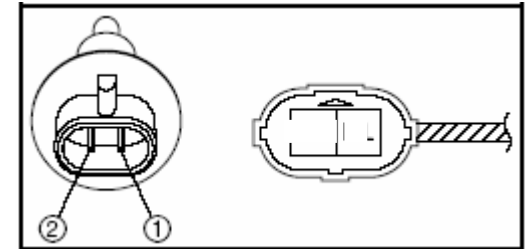
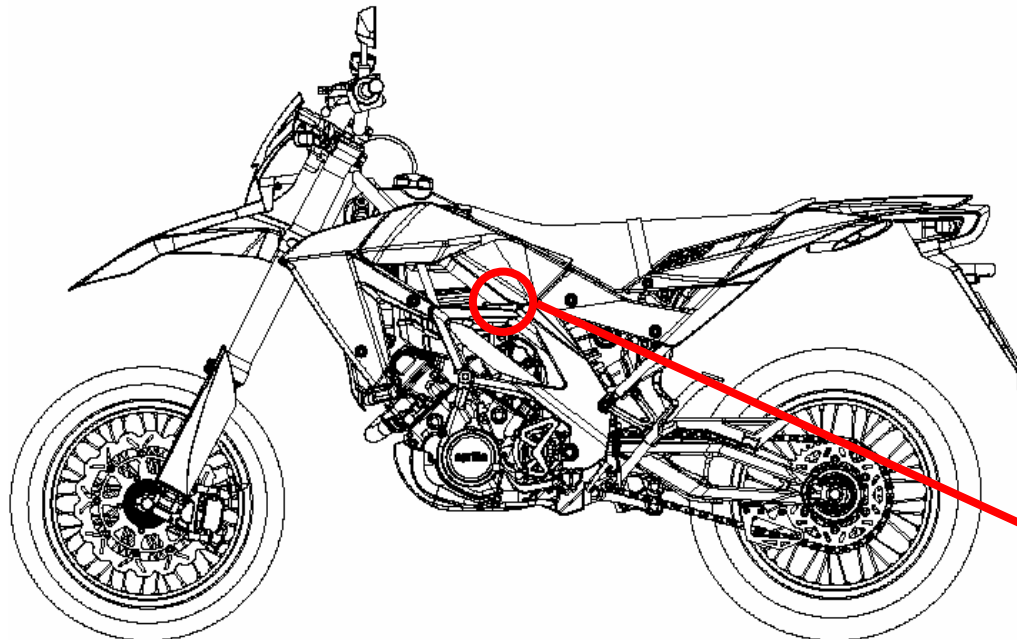
**Non-slotted sensor: serves learning of throttle position by means of Axone (see detail in Axone chapter)**

**Maximum resistance of throttle position sensor:**

**From 4.0 to 6.0 k $\Omega$  at 20° C**

# Intake air temperature sensor

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**Resistance of intake air temperature sensor,  
positioned inside airbox:**

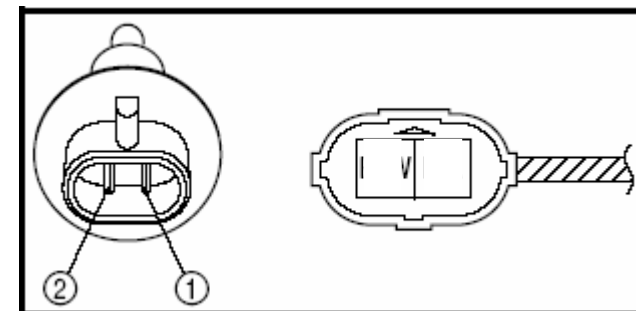
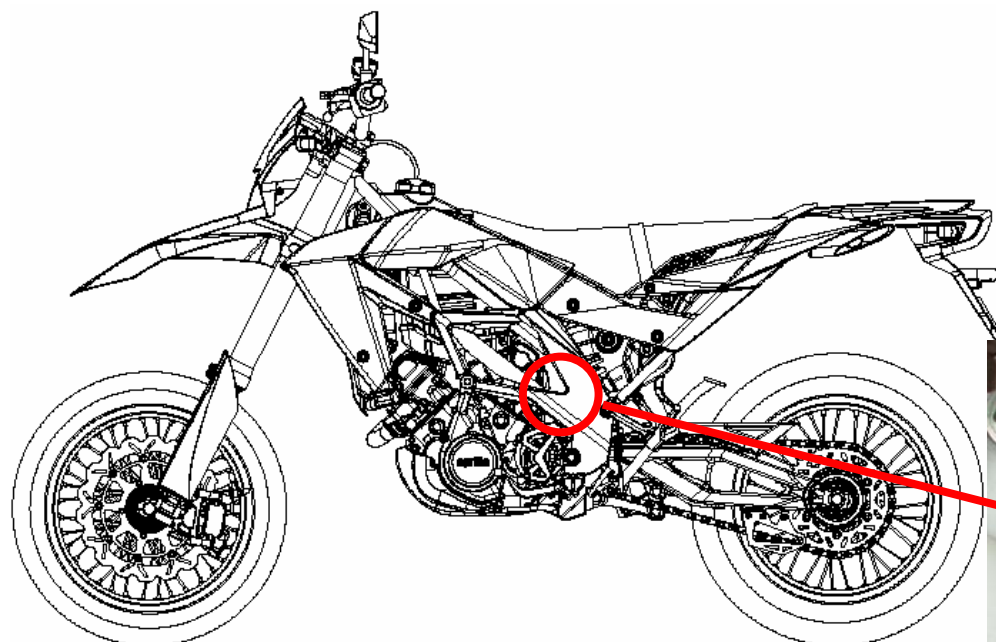
**6 +/- 0.6 k $\Omega$       at 0 °C**

**0.29 - 0.39 k $\Omega$       at 80 °C**



# Coolant temperature sensor

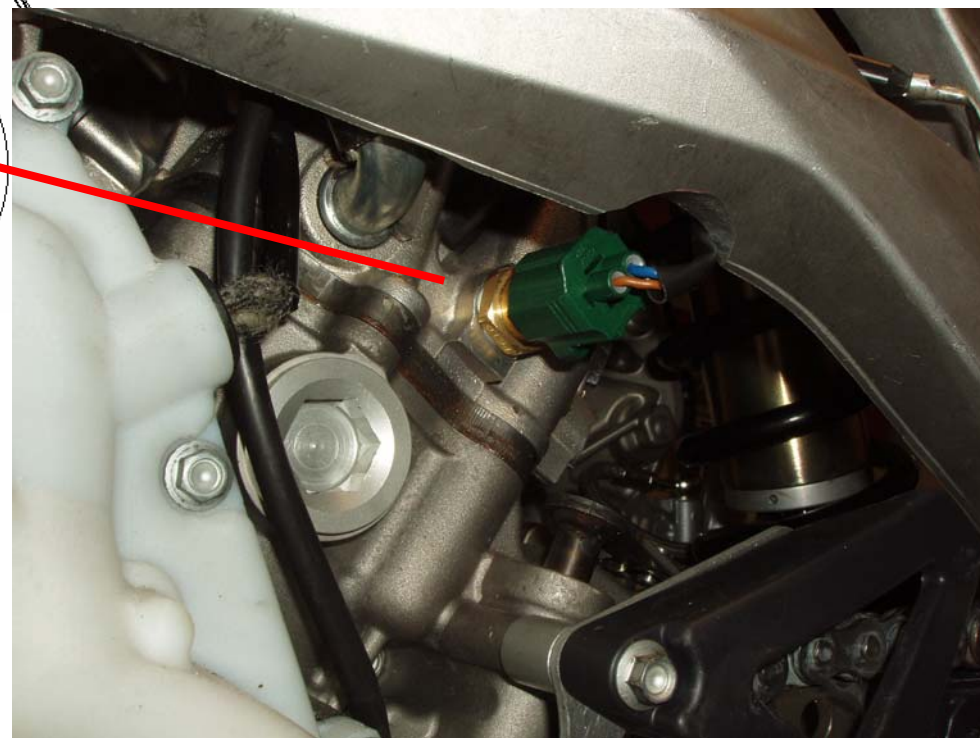
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**Resistance of coolant temperature sensor:**

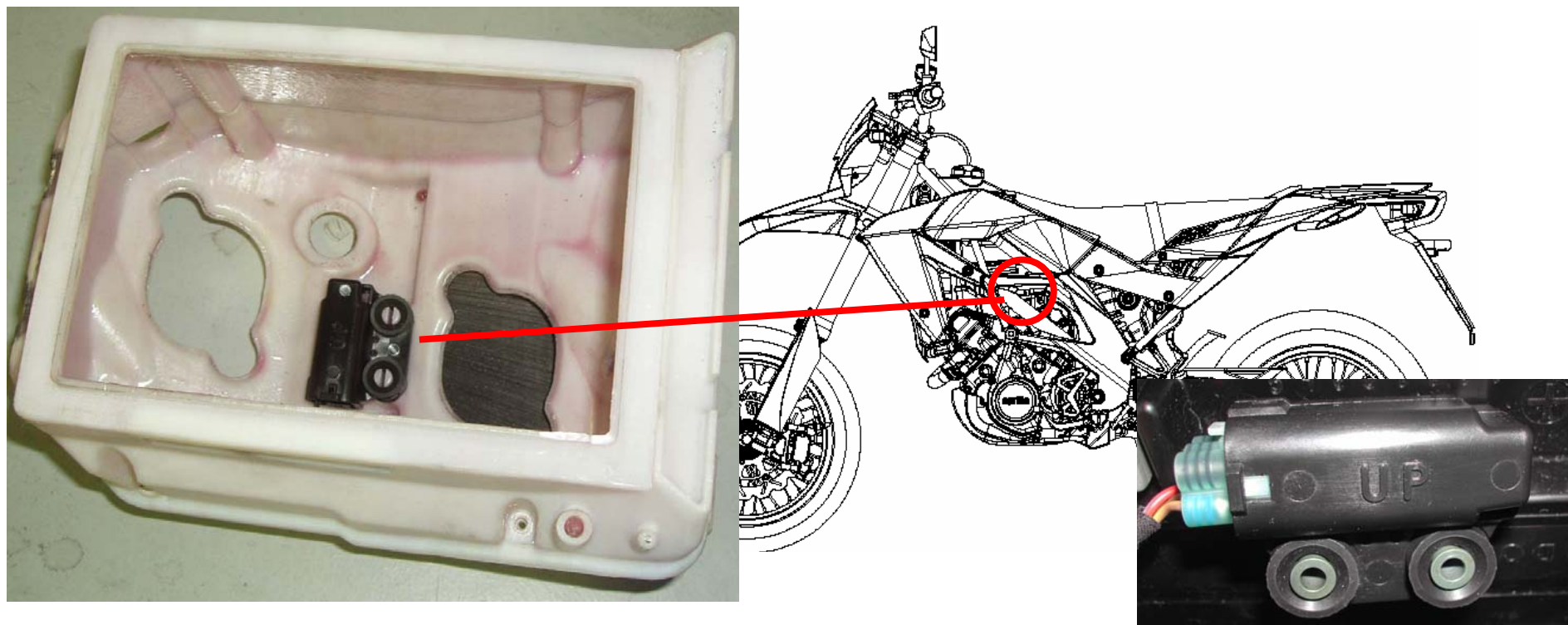
**2.45 k $\Omega$  +/- 0.14 at 20 °C**

**0.32 k $\Omega$  at 80 °C**



# Tip over sensor

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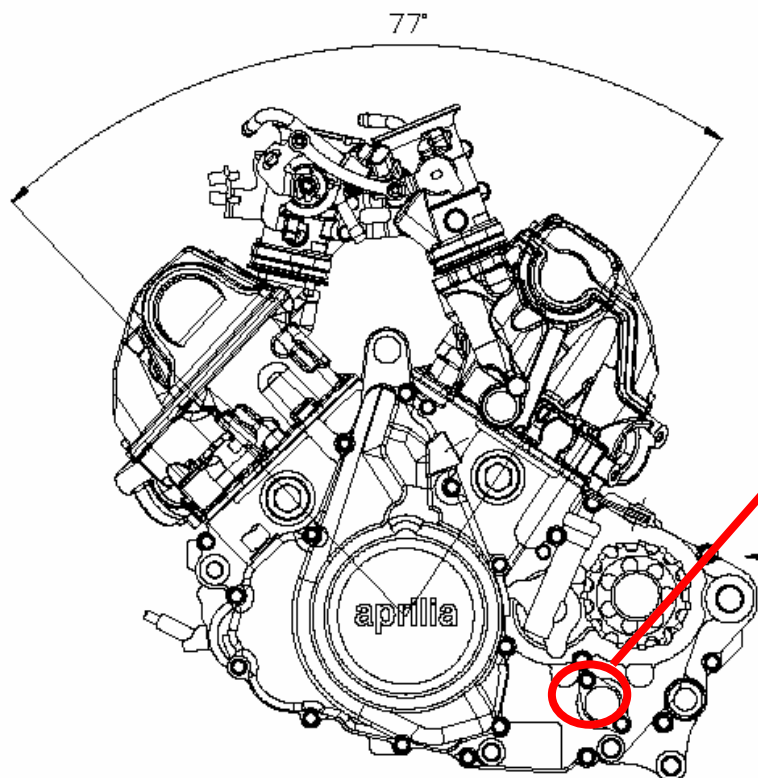
**It is positioned inside the filter box**

**The 3 connection cables are ground, control unit 5V feed, signal: normal pos. 0.4 – 1.4 V, reversed pos. (65 +/- 10° from the vertical) 3.7 – 4.4 V.**

**If disconnected, unlike mechanical sensors it does NOT allow starting of the vehicle.**

# Gear sensor

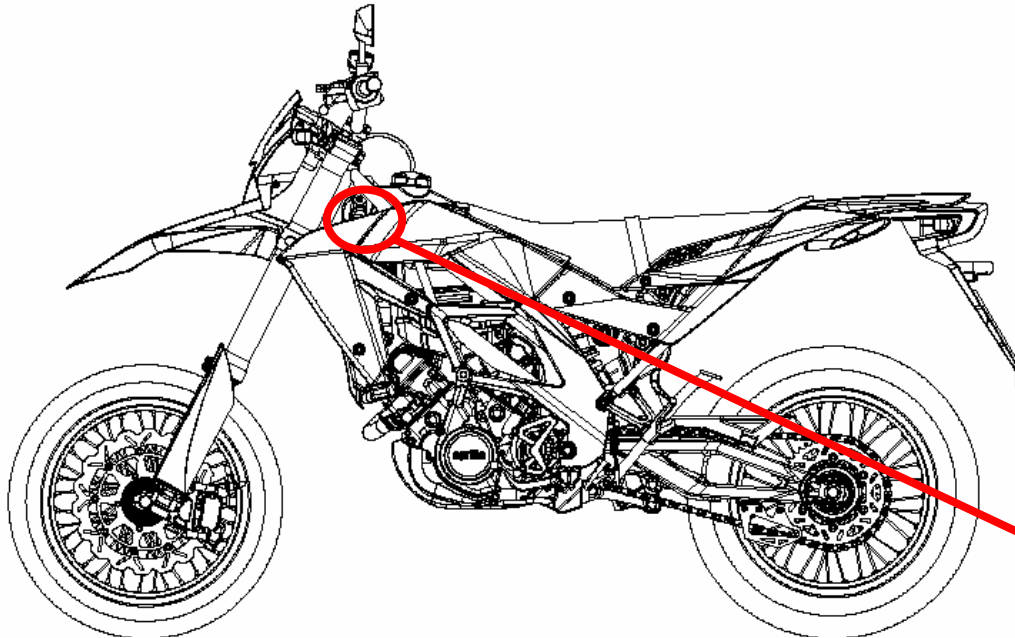
**aprilia**



GEAR	resist (ohm)	voltage (V)
Rn	470 +/-4.7	1.5
R1	270 +/-2.7	1.0
R2	680 +/- 6.8	1.9
R3	1000 +/-10	2.3
R4	1500 +/-15	2.8
R5	2700 +/-27	3.4

**The control unit detects the gear engaged, thanks to the gear sensor**

**Sensor fed at approx. 4.5 V by the control unit (with connector disconnected)**



**A single type of control unit for all vehicles**

# ECU connections

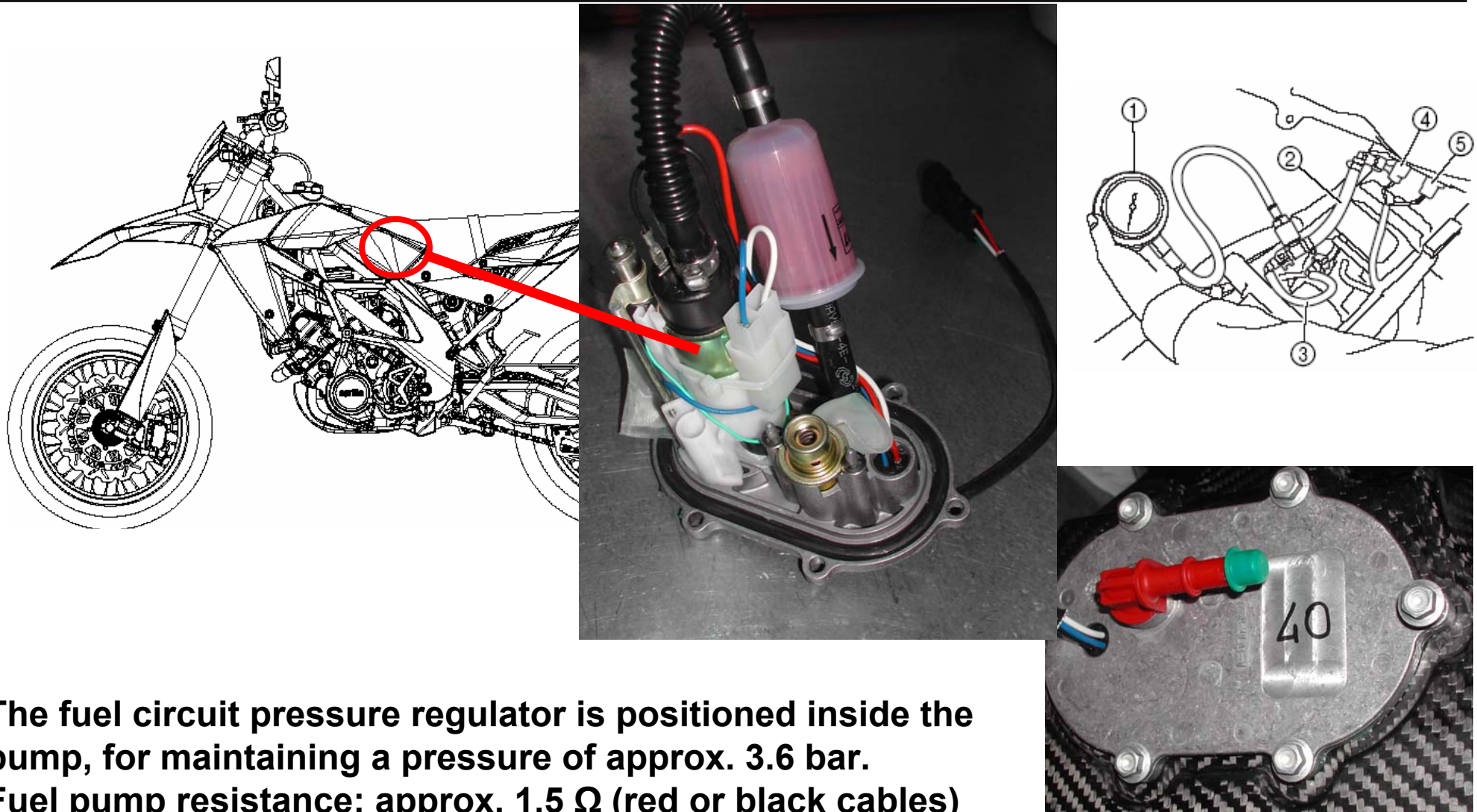


Lights relay on the left of control unit; fuel injection relay on the right

PIN	NAME	PIN	NAME
1	coil 1 ground	18	for remapping control unit
2	fuel injection ground	19	gear sensor
3	lambda probe signal	20	air temperature signal
4	engine kill (ground)	21	ground
5	digital line for Axone	22	tip over sensor signal
6	pick up -	23	speed sensor signal
7	ground	24	-
8	supply voltage	25	output speed signal
9	supply voltage	26	fuel injection relay
10	coil 2 ground	27	-
11	lambda probe feed	28	lights relay
12	throttle signal	29	-
13	engine temperature signal	30	throttle and tip over sensor feed
14	digital line for Axone	31	fuel injector 1 ground
15	pick up +	32	fuel injector 2 ground
16	tachometer signal for dashboard	33	fan ground
17	EFI indicator light	34	fuel pump ground

# Fuel pump

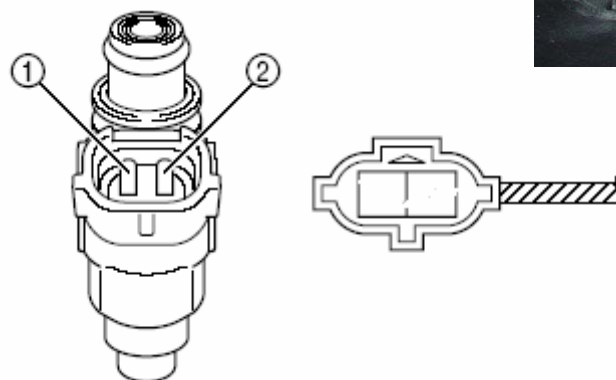
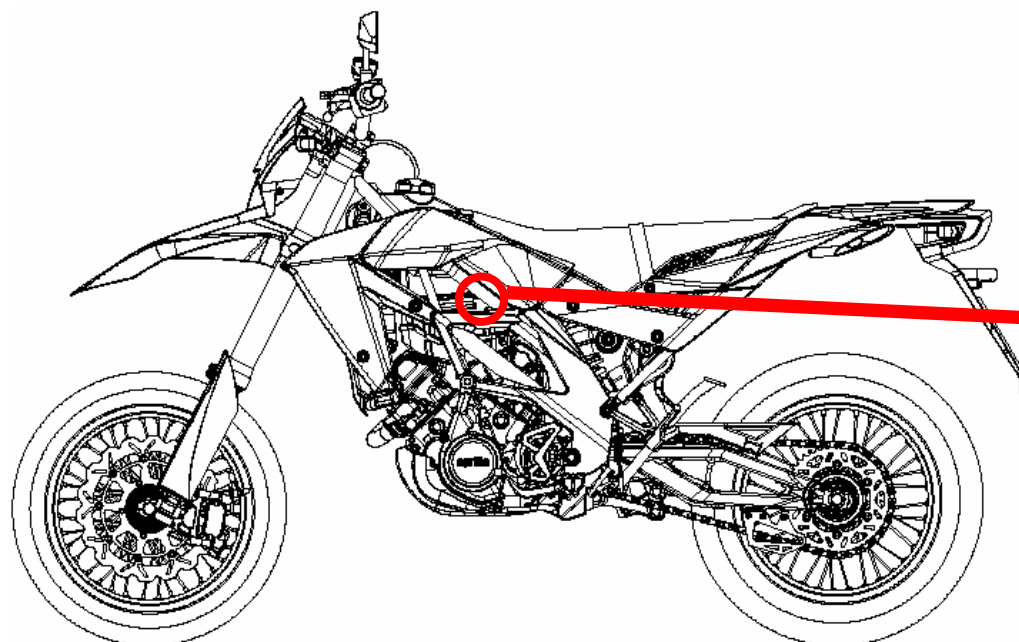
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The fuel circuit pressure regulator is positioned inside the pump, for maintaining a pressure of approx. 3.6 bar.  
Fuel pump resistance: approx. 1.5  $\Omega$  (red or black cables)

# Fuel injector

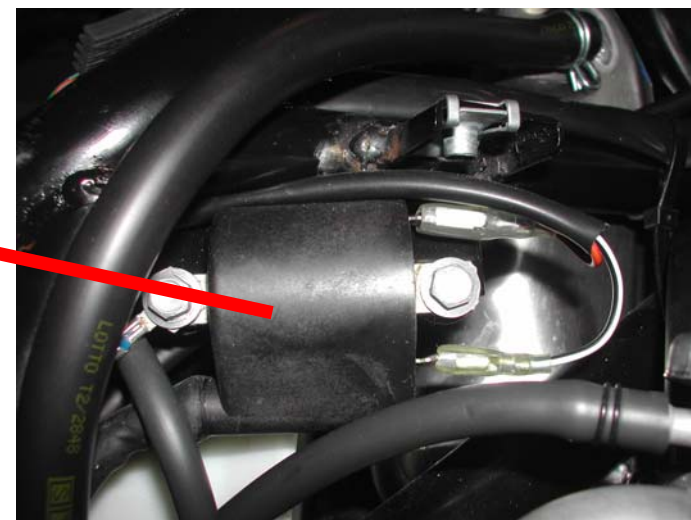
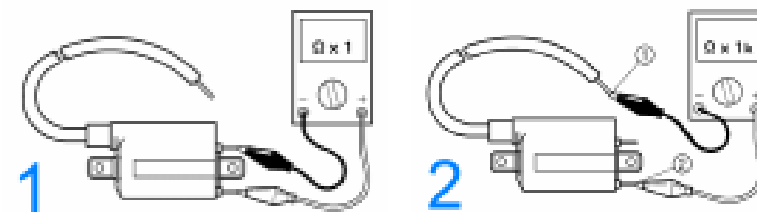
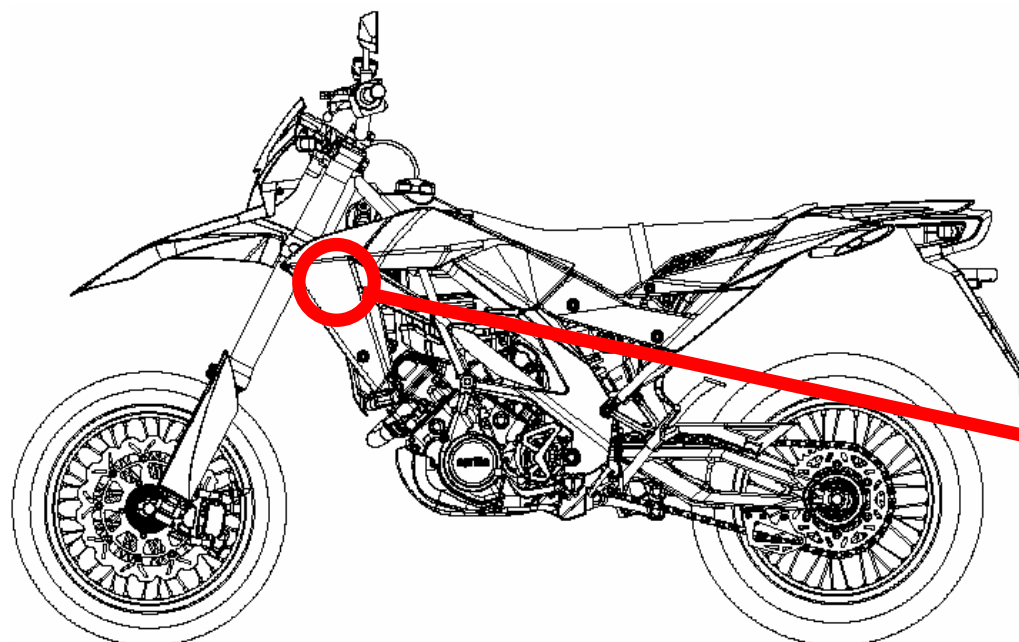
**aprilia**



**Fuel injector resistance**  
**12  $\Omega$  a 20 °C**

# Ignition: coils

**aprilia**



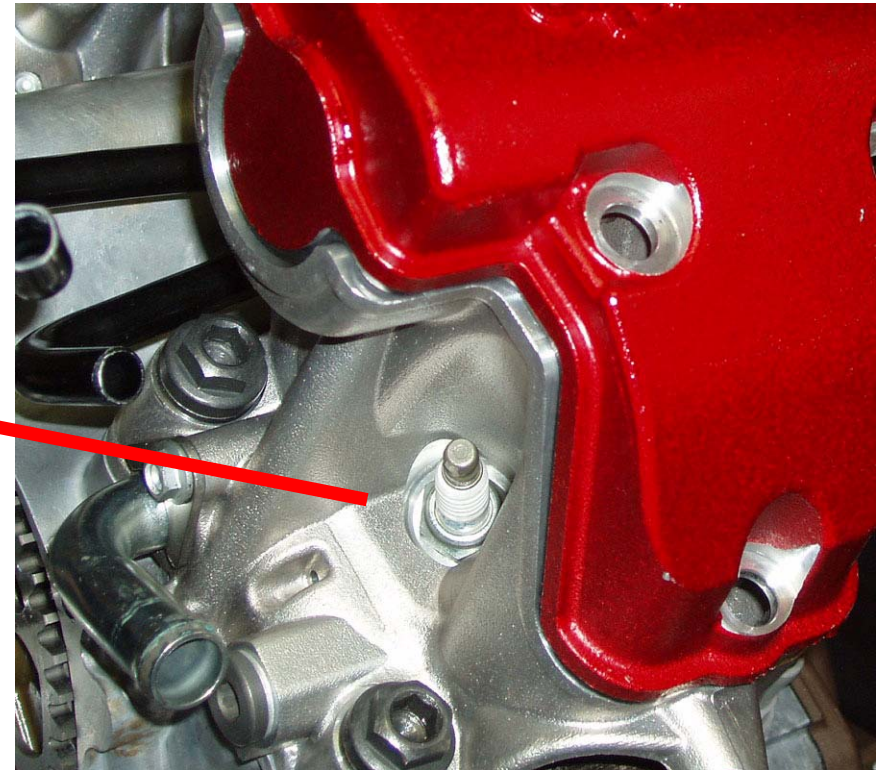
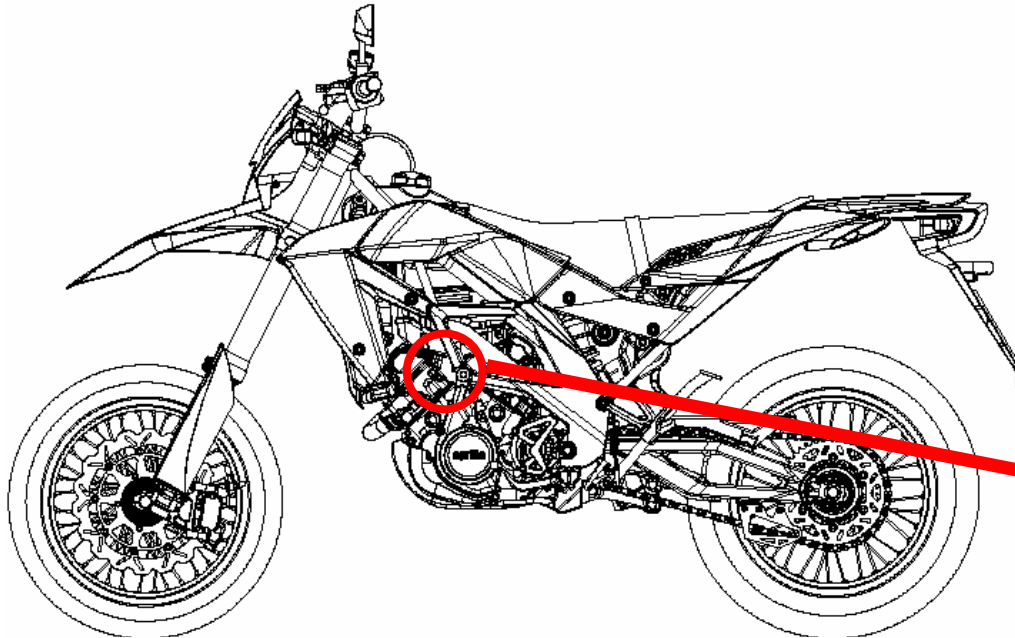
**1 Primary coil resistance  $3.5 \Omega \pm 15\%$  at  $20^\circ\text{C}$**

**2 Secondary coil resistance  $20.1 \text{ k}\Omega \pm 15\%$  at  $20^\circ\text{C}$**

**The spark plug cap has a resistance of approx.  $5 \text{ k}\Omega (\pm 25\%)$  at  $20^\circ\text{C}$**

# *Ignition: spark plug*

**aprilia**



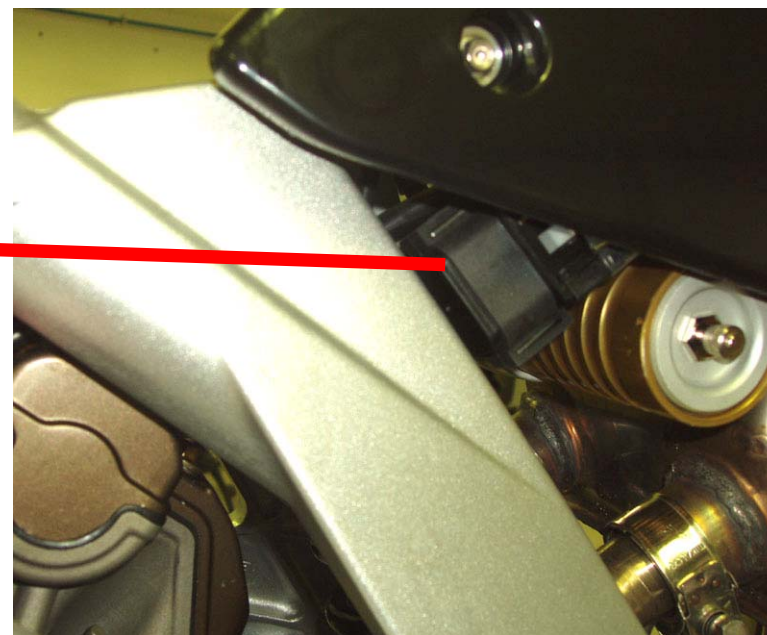
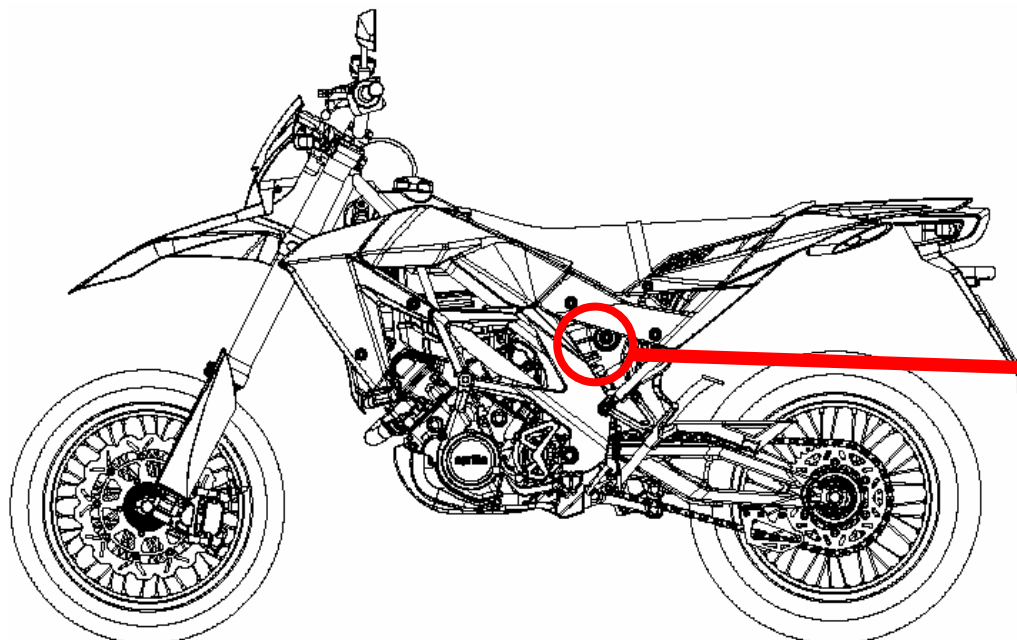
**MANUFACTURER: NGK**

**TYPE: CR8EB**

**CAP RESISTANCE: 5 K $\Omega$**

# ***Starter motor relay***

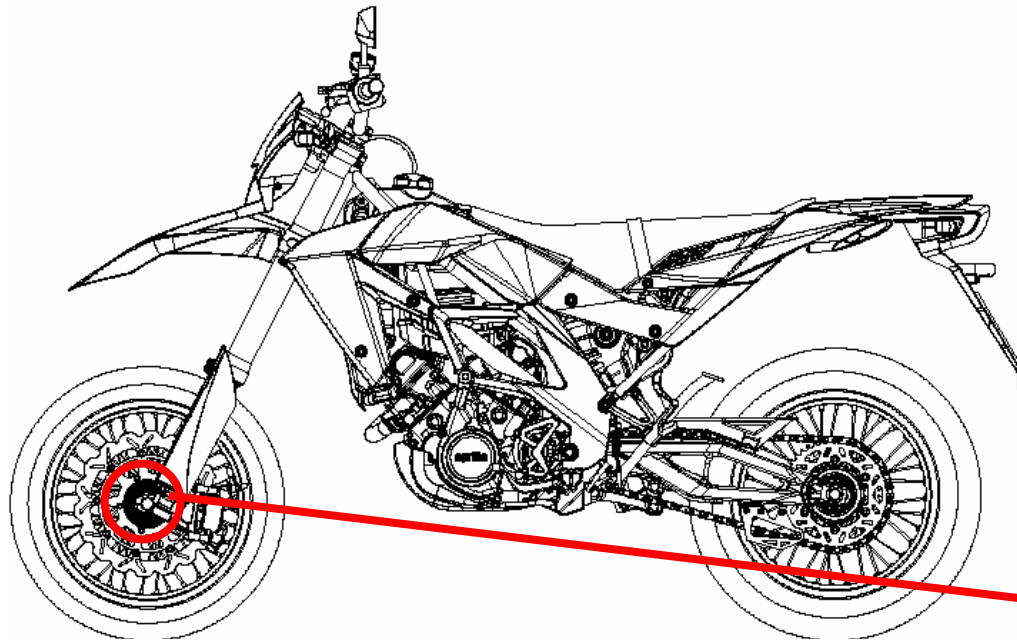
**aprilia**



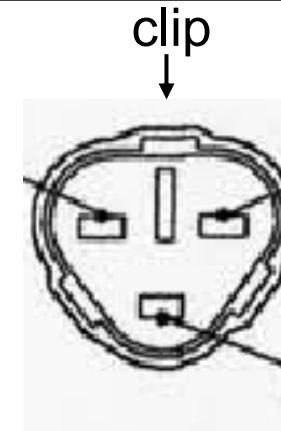
**Relay induction coil resistance:  $4.4 \Omega \pm 10\%$  at  $20\text{ }^{\circ}\text{C}$**

# Vehicle speed sensor

**aprilia**

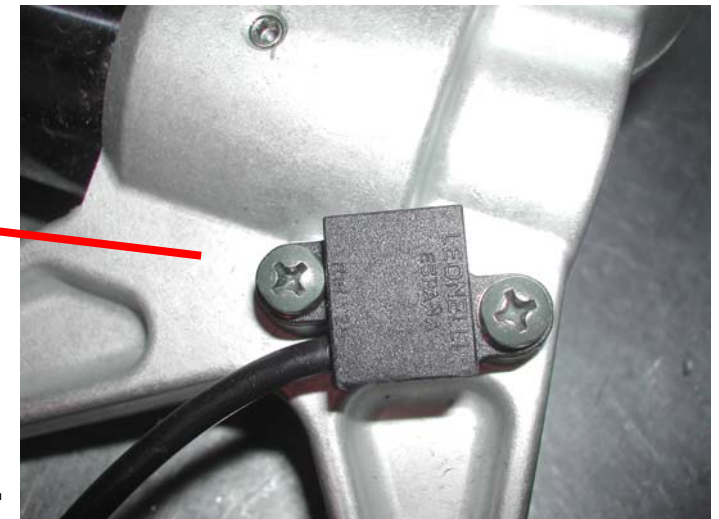


**+12 V**  
**red-brown**



**Signal +5V**  
**Yellow-brown**

**Ground**  
**blue**



**Hall effect sensor.**

**The above voltages are read with connector disconnected.**

**With connector connected the signal decreases “by steps” to 0.5 V near the screws.**

**The distance between the sensor and the bolt surface must be: 1.5 +0.7/-0.9 mm**

**As of version 5.0.5, software is available for FUEL INJECTION self-diagnosis (dialogue with control unit).**

**REPROGRAMMING (mapping upgrading) with mapping upgrades and specific mapping according to vehicle use will be available' from version 5.0.6 and subsequent.**

# Axone: connection cable

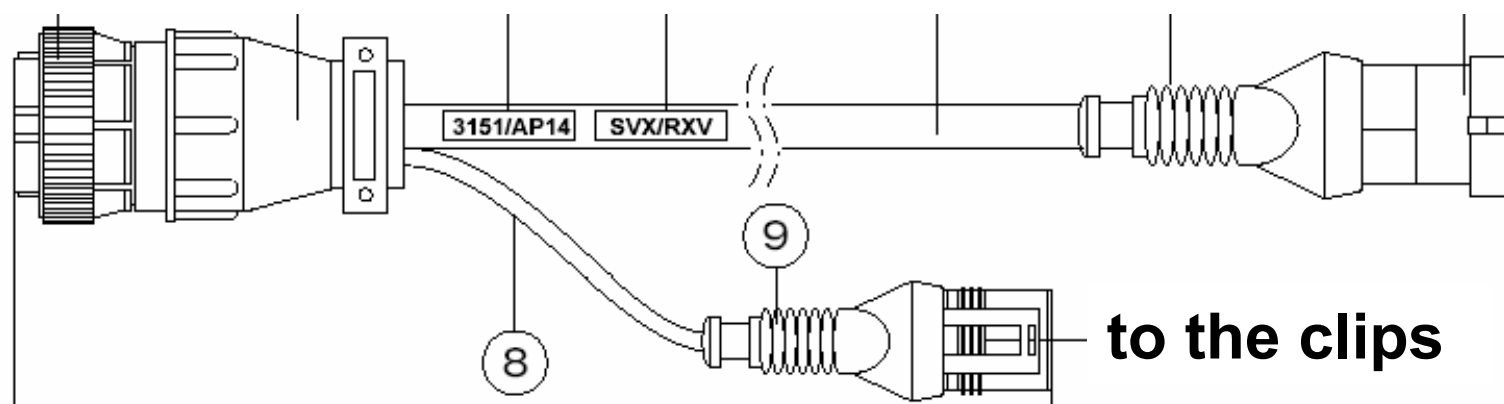
**aprilia**

With this control unit, instead of the usual cable for self-diagnosis, it is necessary to use the

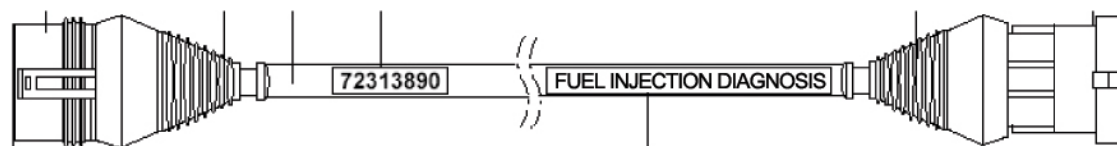
**“ Walbro cable for Axone”**

**code 8127819 (code Texa AP014)**

**It consists of a cable**



**and a connection**

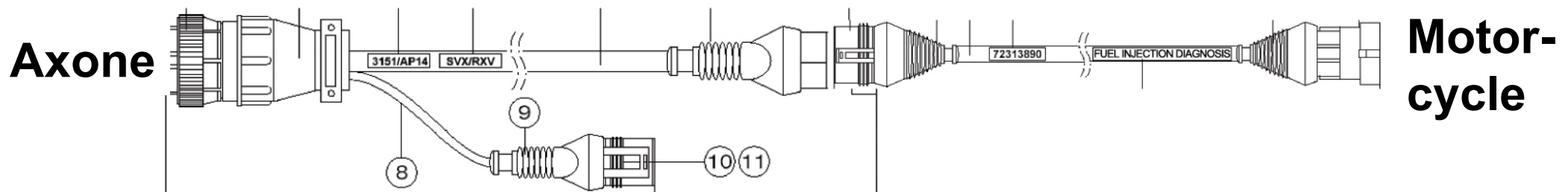


# Axone: connection cable

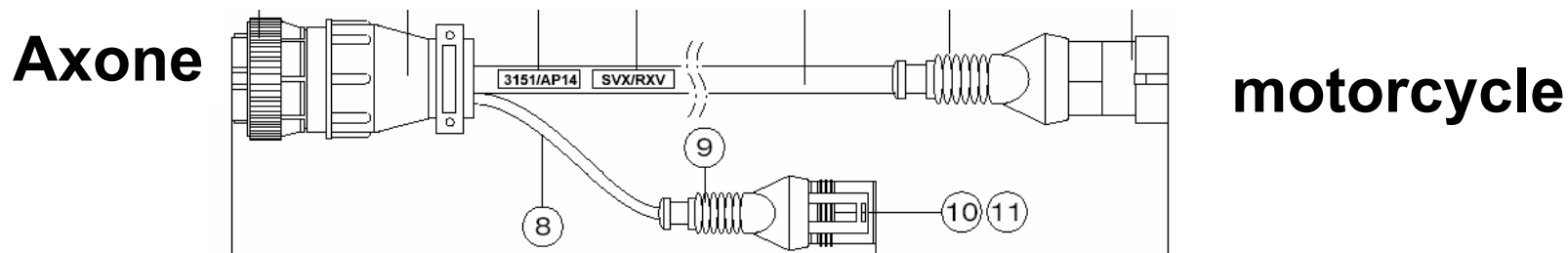
**aprilia**

They must be used as follows:

➤ both (cable + connection) for FUEL INJECTION

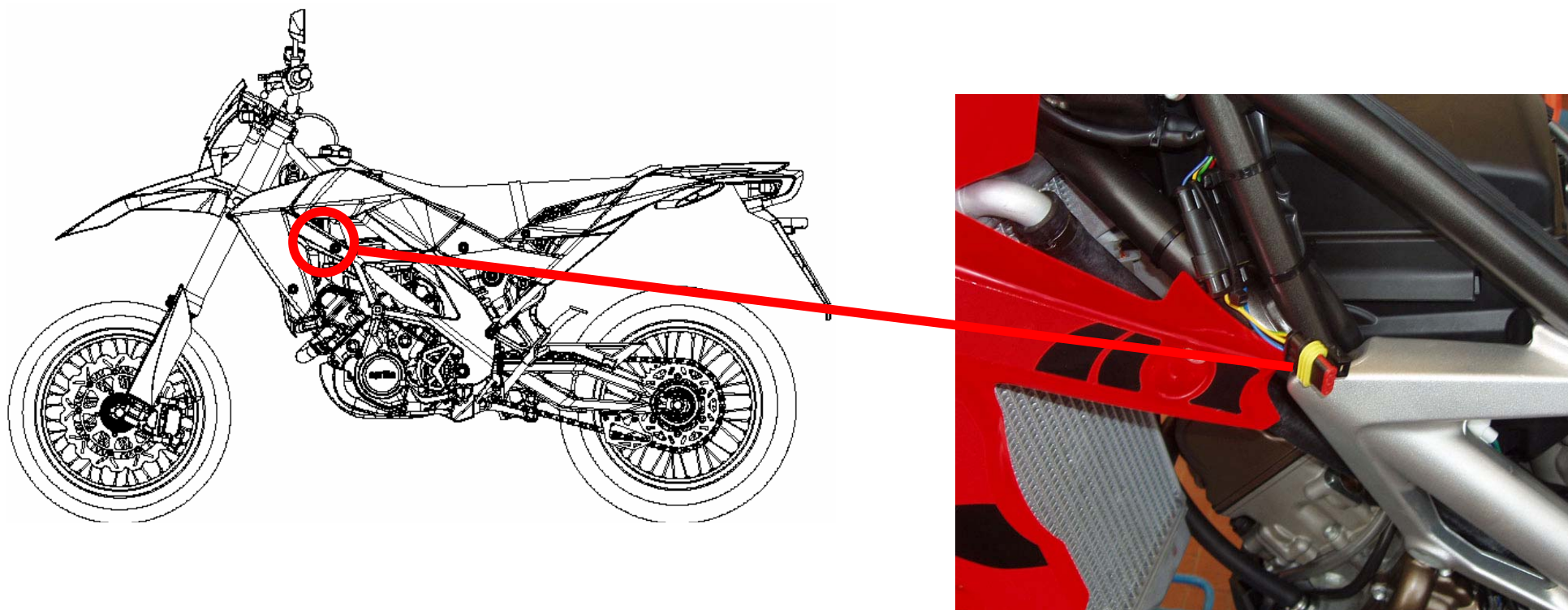


➤ only the cable for REPROGRAMMING



# ***Axone: connector position***

**aprilia**



**The connector is positioned on the left side at the front area of the vehicle.**



**The screen shows:**

- **frame number**
- **engine number**
- **control unit initialization date**

**Also the code of the mapping in the control unit is also shown.**

**When loaded in the control unit, the mappings, as files and identification, will be with 5 numbers of type: 14001.**



The first number identifies vehicle type

- 1. for SXV
- 2. for RXV

The second number identifies displacement

- 4. for 450
- 5. for 550

From the third to fifth numbers

Mapping identification progressive number

Therefore, for example, the mapping 14001 will indicate:

SXV 450 map 001

# ***Axone: engine parameters screen***



**In addition to the classic parameters (engine speed, intake air temperature, fuel injection times) the screen also gives the settings of parameters modifiable from the ... “adjustable parameters” screen that will be seen later and the parameter “Running time” expressed in hhmm (hours and minutes):  
this is the engine running time (rpm > 0)**

# ***Axone: device status screen***

**aprilia**



**The screen only shows the status of the “tip over sensor”:**

- **if in correct position it indicates “Normal”**
- **if tipped over it indicates “Tip over”**
- **if disconnected it indicates .....?**

**In the second and third cases the vehicle cannot be started**



**A distinction between current and stored errors is not provided for: Errors are always indicated by the message MEM.**

**To know if an error is present or stored check the fuel injection system malfunction LED on the dashboard; if lit, the error is present ; if off, the error is stored.**

**Also, some errors (coils, fuel injectors, throttle,...) are read only when the engine is switched on.**

# ***Axone: errors screen***

**aprilia**

**Self-diagnosis of:**



- **Throttle sensor**
- **Intake air temperature sensor**
- **Coolant temperature sensor**
- **Atmospheric pressure sensor**
- **Main fuel injection relay (feed to fuel pump, injectors, coils and fans)**
- **Lights relay**
- **Battery voltage**
- **Fuel Injectors**
- **Coils**



**Errors are not detected by the control unit if the following circuits and respective devices have malfunctions:**

- Vehicle speed (signal from sensor)**
- Tip over sensor (only the sensor status is shown on the “Device status” screen)**
- Fuel pump (activation by control unit)**
- Fan (activation by control unit)**

## ***Axone: device activation screen***

**aprilia**

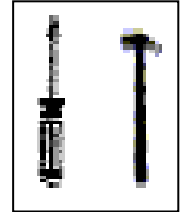


**The screen only shows the “cancel errors” function which cancels errors from the control unit memory.**

**The vehicle's devices cannot be activated.**

## ***Axone: adjustable parameters screen***

**aprilia**

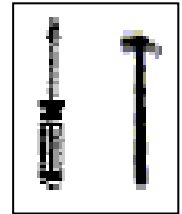


- **Minimum throttle position self-learning**
- **Maximum throttle position self-learning**

**Unlike the usual fuel injection systems, self-learning must be carried out with the twist-grip released (at minimum) and with it fully turned (maximum opening)**

# ***Axone: adjustable parameters screen***

**aprilia**



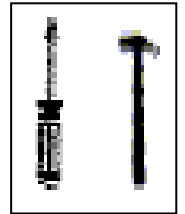
- **CO minimum adjustment**
- **Fuel injection time correction**

**Fuel injection times can be modified in the minimum range and for any engine speed value (max. adjustment +/- 5%)**

**The standard value for both parameters is: 1.00**

# ***Axone: adjustable parameters screen***

**aprilia**

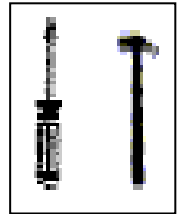


- **Wheel circumference**
- **Wheel signals**

**The above parameters can be set for correct indication of vehicle speed.**

## ***Axone: adjustable parameters screen***

**aprilia**



**In case of control unit drawn from spare parts warehouse, following must be carried out:**

- **Throttle self-learning operation (min + max)**
- **Setting of correct wheel circumference and no. of screws for circumference**
- **Entering of vehicle mapping**

**The frame, engine number and activation date can no longer be entered.**