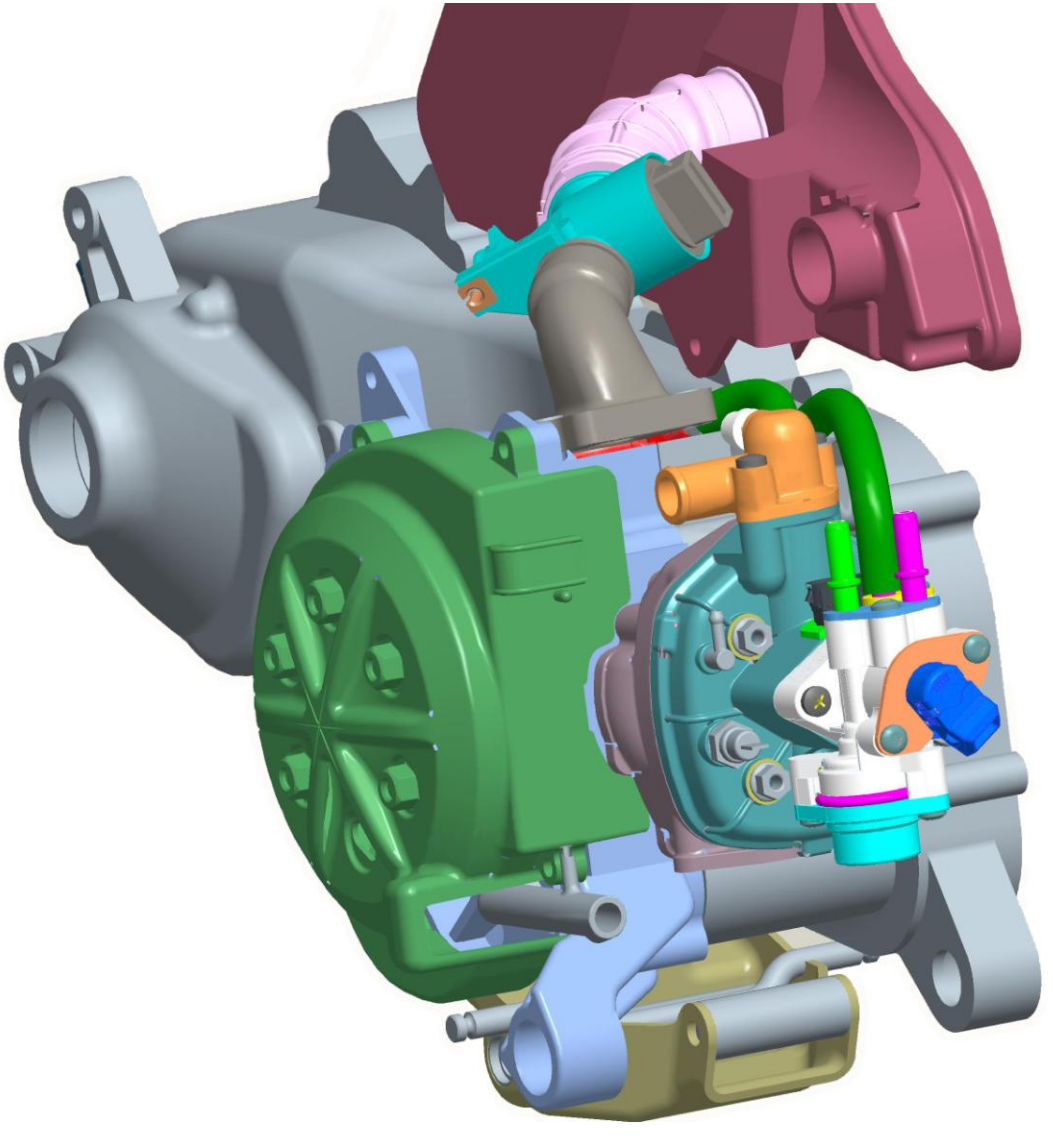
LEARNING CENTRE

Pure Jet



P = Piaggio
U = Ultra low emission
R = Research
E = Engine

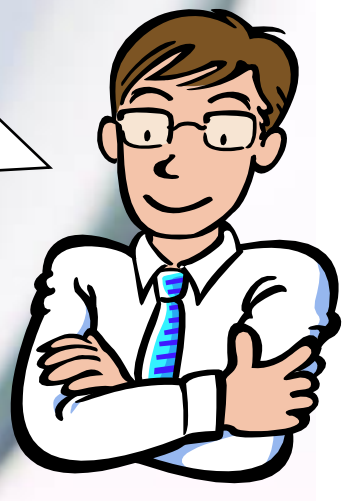
Specifications

LEARNING CENTRE

FUEL SUPPLY	**Fuel-oil mixture via automatic mixer (variable flow depending on engine speed and throttle valve opening), electric pump controlled by injection ECU, direct fuel injection in air-assisted combustion chamber.**
LUBRICATION	**Permanent, by means of variable flow oil pump depending on engine speed and throttle valve opening, by the mixture oil.**
COOLING	**Forced-circulation fluid cooling system, by means of centrifugal pump driven by crankshaft.**
INTAKE	**By means of reed valve in crankcase.**
TRANSMISSION	**With automatic expandable pulley variator, V-belt, automatic clutch, gear reduction unit.**

CONTENTS

LEARNING CENTRE



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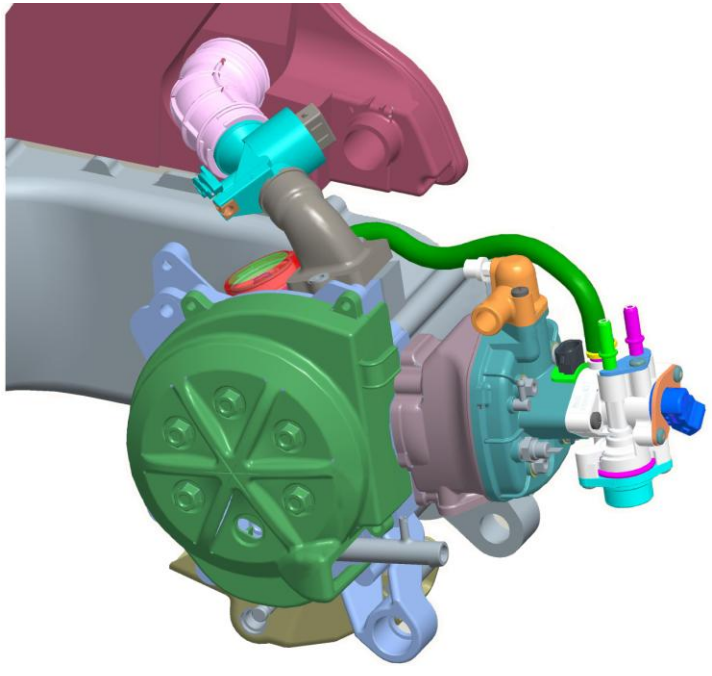
Operating principle

Operating principle



This engine allows reduced pollutant emissions as well as extremely minimised fuel and lubricant consumption.

In 2-stroke single-cylinder engines with traditional type intake, **the moving parts are only the crankshaft, the connecting rod and the piston**.

Gases flowing in and out of the cylinder are adjusted by the piston that uncovers and blocks, at the correct moment, some openings (called gaps) in the walls of the cylinder.

All four cycle phases (intake, compression, combustion and exhaust) are performed in only one crankshaft turn.

To inject the air-fuel mixture in the cylinder, there is the need of a pump, found in the crank chamber and the section of the cylinder under the piston.

The “pump case” supply is performed with air and is obtained by **filter housing, throttle body, intake joint, diaphragm with hole and support with reed valve.**

The lubrication oil is also sent into the “pump case”.

Operating principle

LEARNING CENTRE

Reed valves are devices that allow gases to flow in one direction only.

These are fully automatic one-way valves that open when the downstream pressure is lower than the upstream pressure and close (thanks to reed elasticity) as soon as such pressure difference disappears, allowing intake residues to be eliminated.

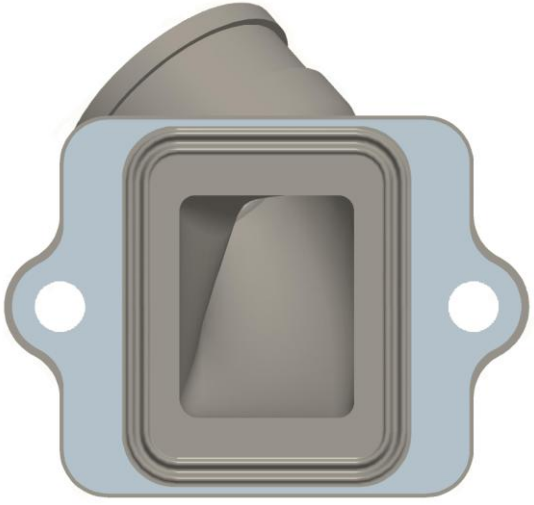
The support, as a general rule, has a typical “spike” shape, i.e. a pyramid with a rectangular base (apex angle 50 - 60) made of aluminium alloy.

It has a retainer flange with holes for the screws.

Each “petal” has a generally rectangular window through which the gases flow when the valve is open.

The metal of the support is covered with synthetic rubber to avoid direct impacts with the reed.

Reeds may be made of steel, fibreglass or carbon fibres.



Operating principle

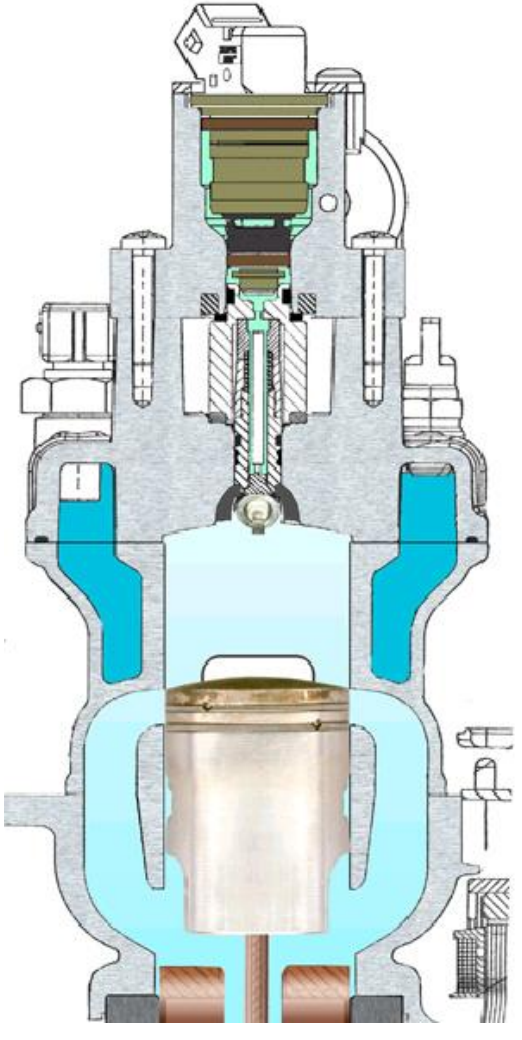
LEARNING CENTRE

The pump case is filled with air which opens the reed valve by means of the vacuum generated by the pumping of the piston and by the vacuum present at the exhaust that may be exerted on the pump case during washing.

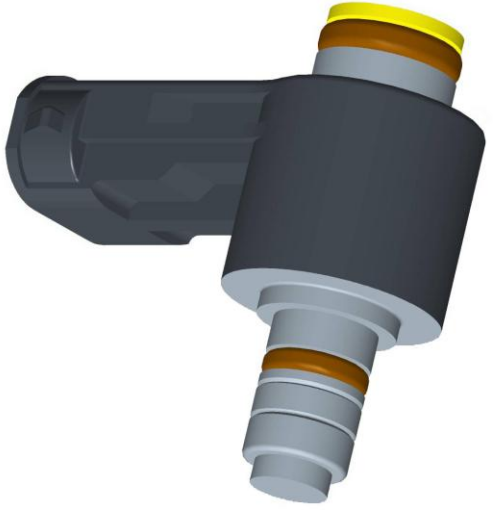
Washing the cylinder only with air eliminates the problem of cool fuel leaks transferred directly at exhaust (typical problem of traditional 2-stroke engines that leads to high unburned hydrocarbon emissions).

After been washed, the cylinder is filled with air only.

The air and the fuel are mixed directly in the cylinder once the exhaust gap is closed.



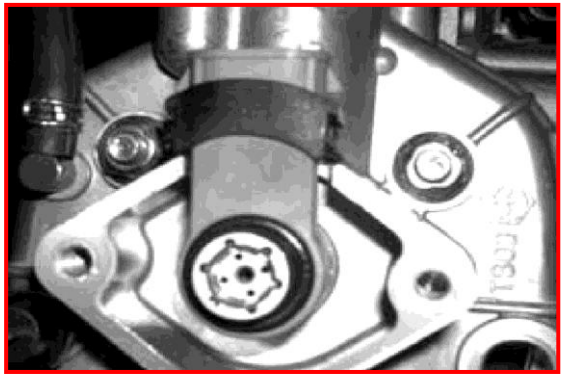
Operating principle



The electro-injector is the main component of the electropneumatic injection.
It is generally called an air injector, although in fact an air / fuel mixture is injected in the cylinder.
The ECU controls both when the air injector has to open and how long this should last.

This system allows the fuel to be finely sprayed, as transported by the air, and stratified load in the combustion chamber, after being combined in the compression and injection strokes.

At ignition, the mixture will be rich closer to the spark plug and lean in the outer area of the combustion chamber.
The air injector is managed according to the opening moment and duration.

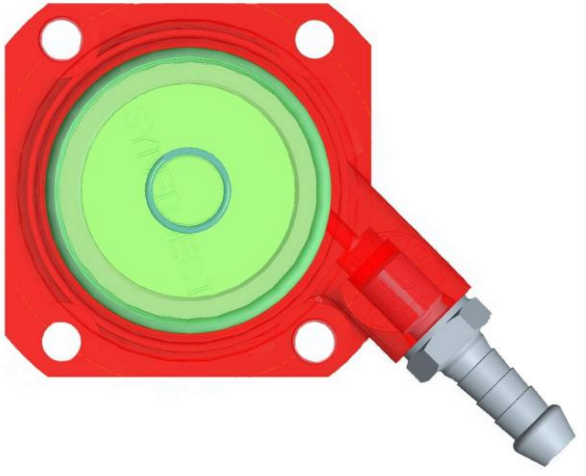


Operating principle

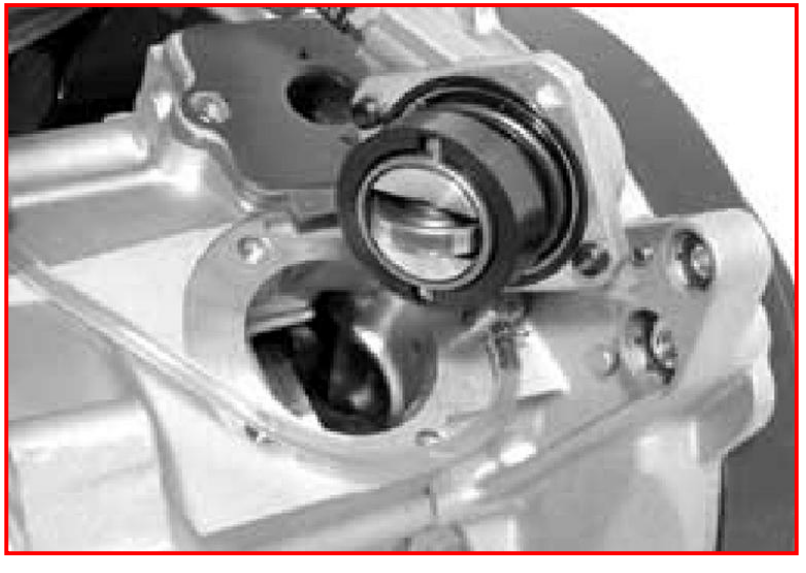
LEARNING CENTRE

The air is withdrawn into the crankcase (containing air mixed with oil) by the **positive displacement compressor** and sent to the injection support.

The compressed air sprays the fuel jet best and guarantees the jet injection pressure.



The average pressure generated by the compressor is 5 ÷ 5.5 bar.



Pumping is carried out through an alternative plunger with return spring and control roller activated by an eccentric found in the right half-shaft of the crankshaft.

The compressor is fitted with a one-way valve that manages pumping and keeps the pressure.

The injection air supply pressure remains almost constant when engine speed varies.

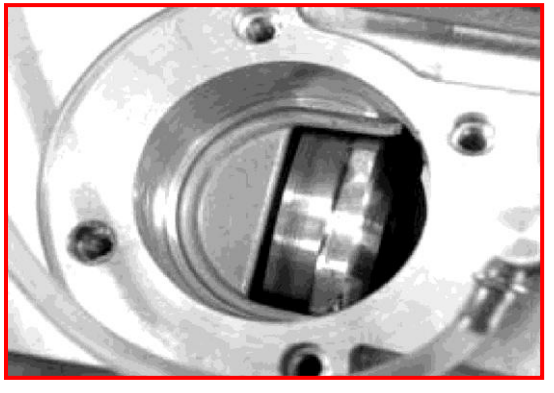
The compressor is lubricated by the oil already present in the crankcase.

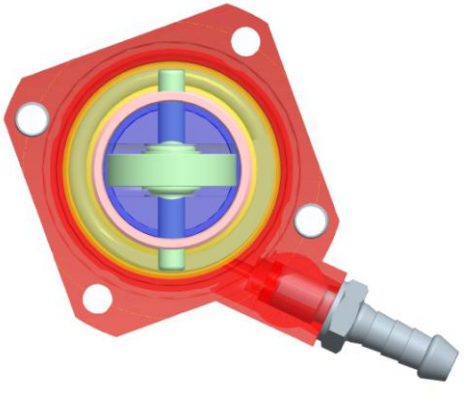
Operating principle

LEARNING CENTRE

Checks

- Check for wear and/or overheating signs on the roller that makes contact with the eccentric.
- Check that the sealing ring is not broken or flattened.
- Rotating the crankshaft, check for eccentric track is not worn and/or shows overheating signs.





The **pressure regulator**, located in the lower part of the support, operates thanks to a diaphragm and a calibrated spring and has the function of keeping a constant pressure difference between the air and the fuel circuits.

The regulator spring is calibrated at 2.5 bar.

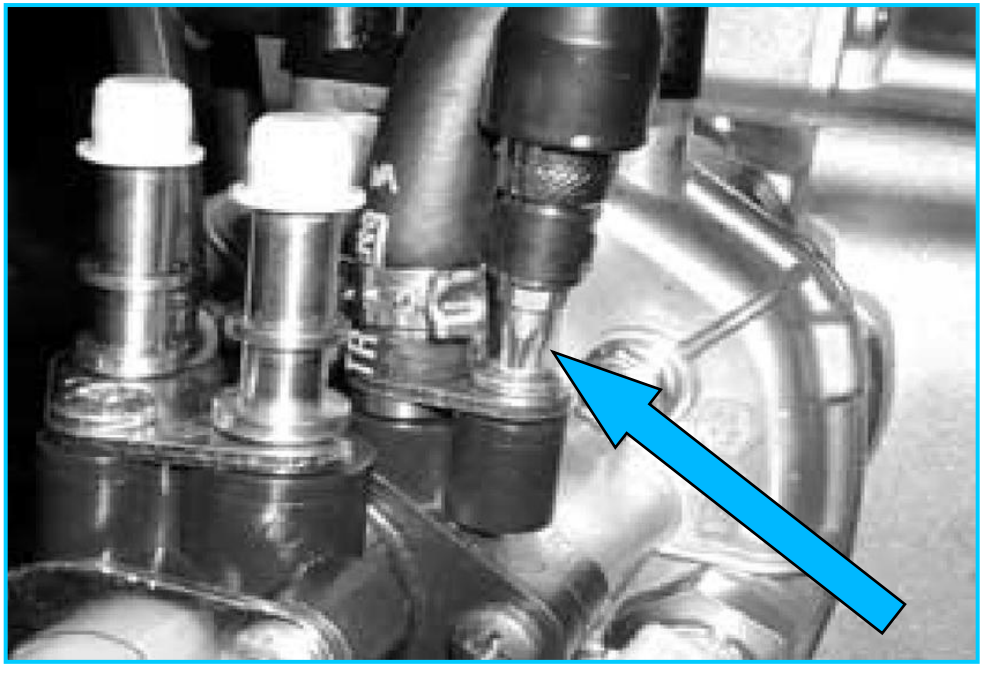
As the reference pressure derived from the air pressure to be injected (5 5.5 bar), the actual pressure of the fuel supply chamber is 7.5 8 bar.

Injector support

LEARNING CENTRE

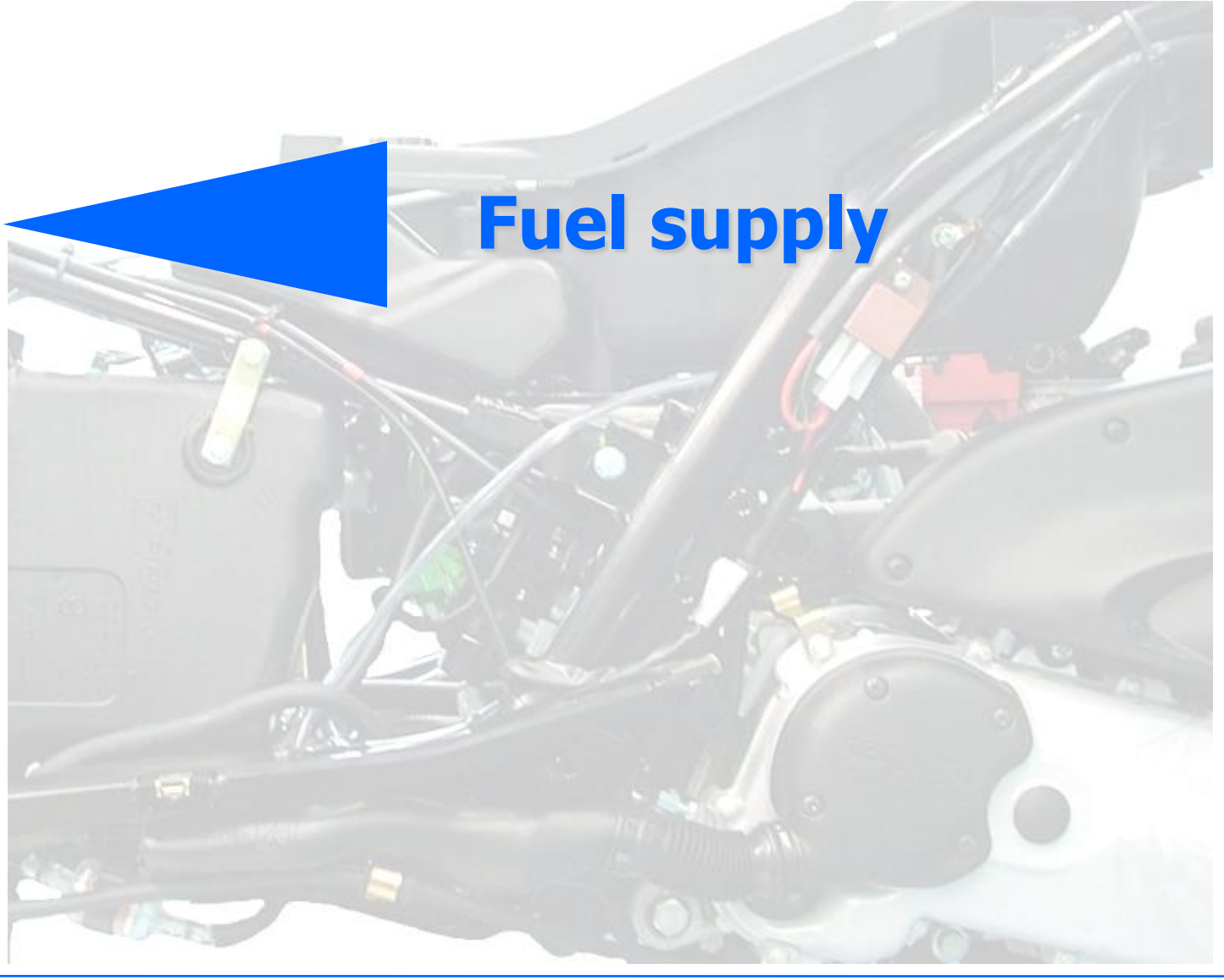
Sealing against the combustion chamber pressure is carried out by a synthetic ring called **CARBON DAM (used to prevent seeping of carbon residues caused by lubrication oil combustion),** against a traditional O-ring that makes the seal effective.

It is advisable to use top quality lubricants.



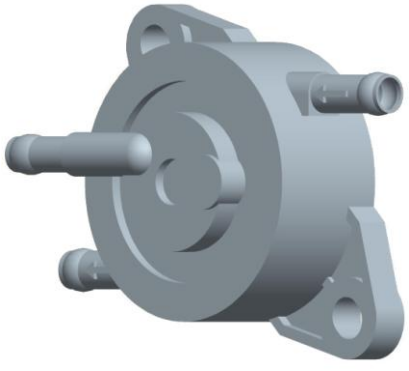
Should the air injector need refitting, the CARBON DAM sealing ring must always be a new one:

- **if a new air injector is fitted, the new carbon dam ring already comes with it;**
- **if the old air injector is refitted, replace the carbon dam ring because it gets damaged when removed.**



Fuel supply

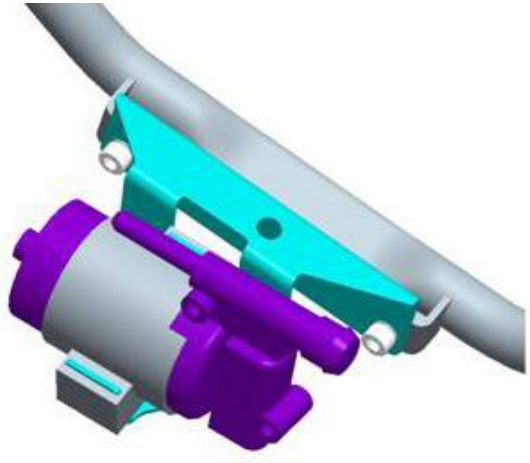
Fuel supply circuit



The fuel supply circuit ensures fuel injector pressure.

Fuel injection occurs inside the compressed air chamber at the end of the washing phase.

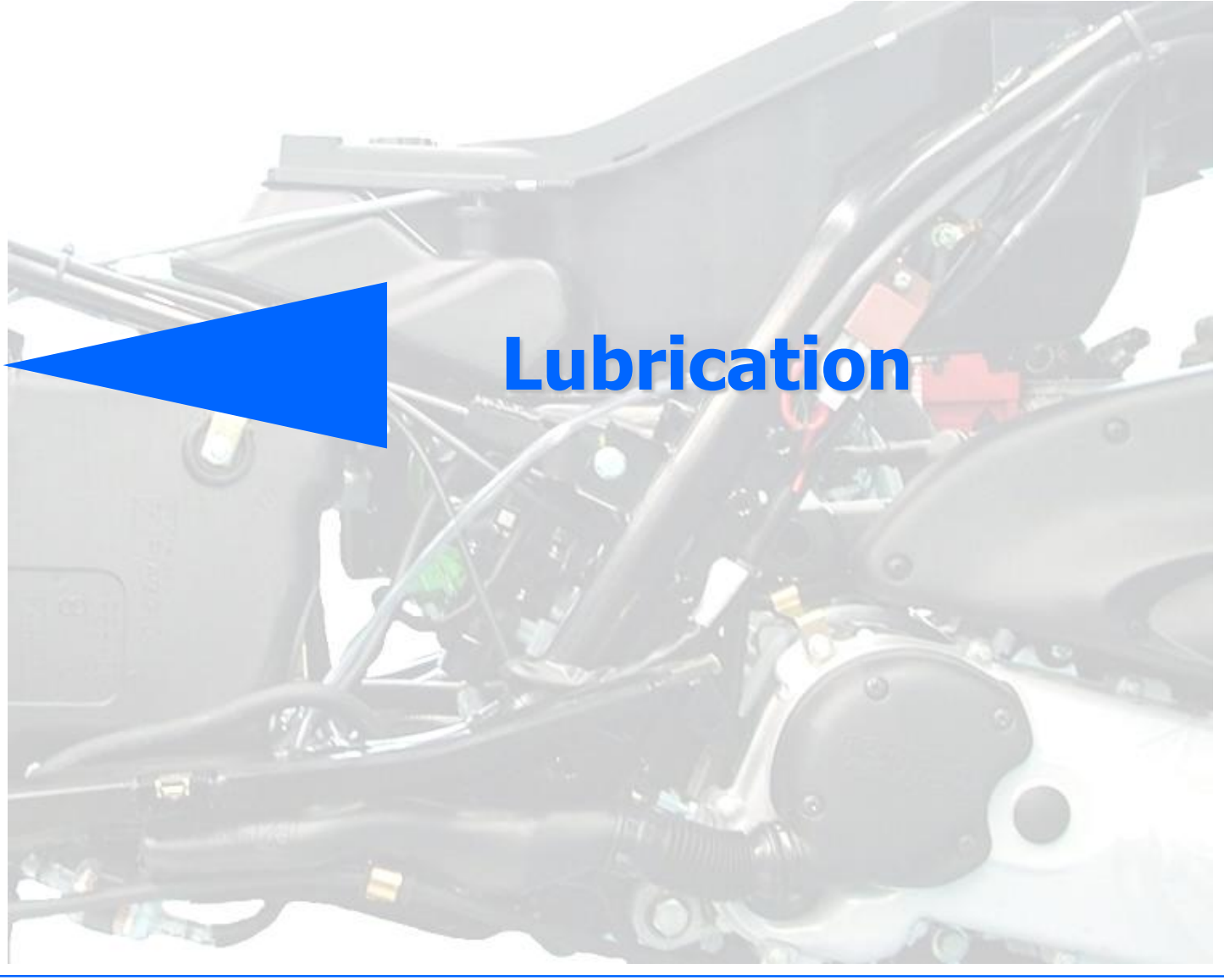
The mixture injection phase in the cylinder starts after exhaust has closed.



The self-bleeding system consists of a glass pipe that is connected from the pump inlet to the upper section of the tank and it is essential for the system.

The fuel pump operates thanks to an alternative piston and it is activated by a direct current motor.

The return conduit is at room temperature.

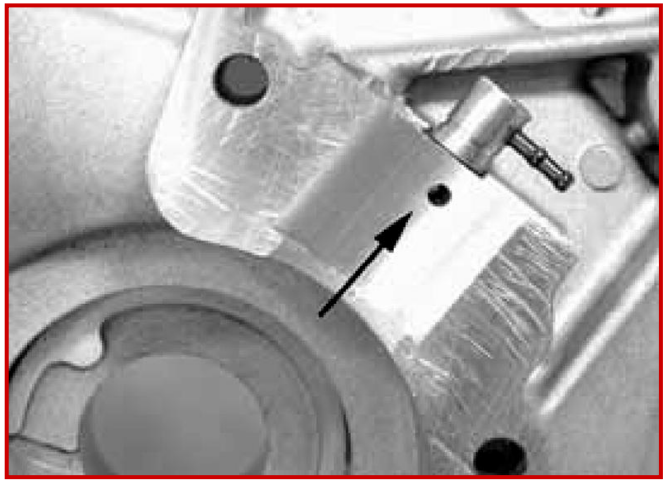


Lubrication

Lubrication

LEARNING CENTRE

Lubrication is carried out permanently by the oil from the mixture coming from the **MIXER.**



The lubrication oil is also sent into the “pump case” together with air.
This occurs through a one-way valve installed in the flywheel-side crankcase half.

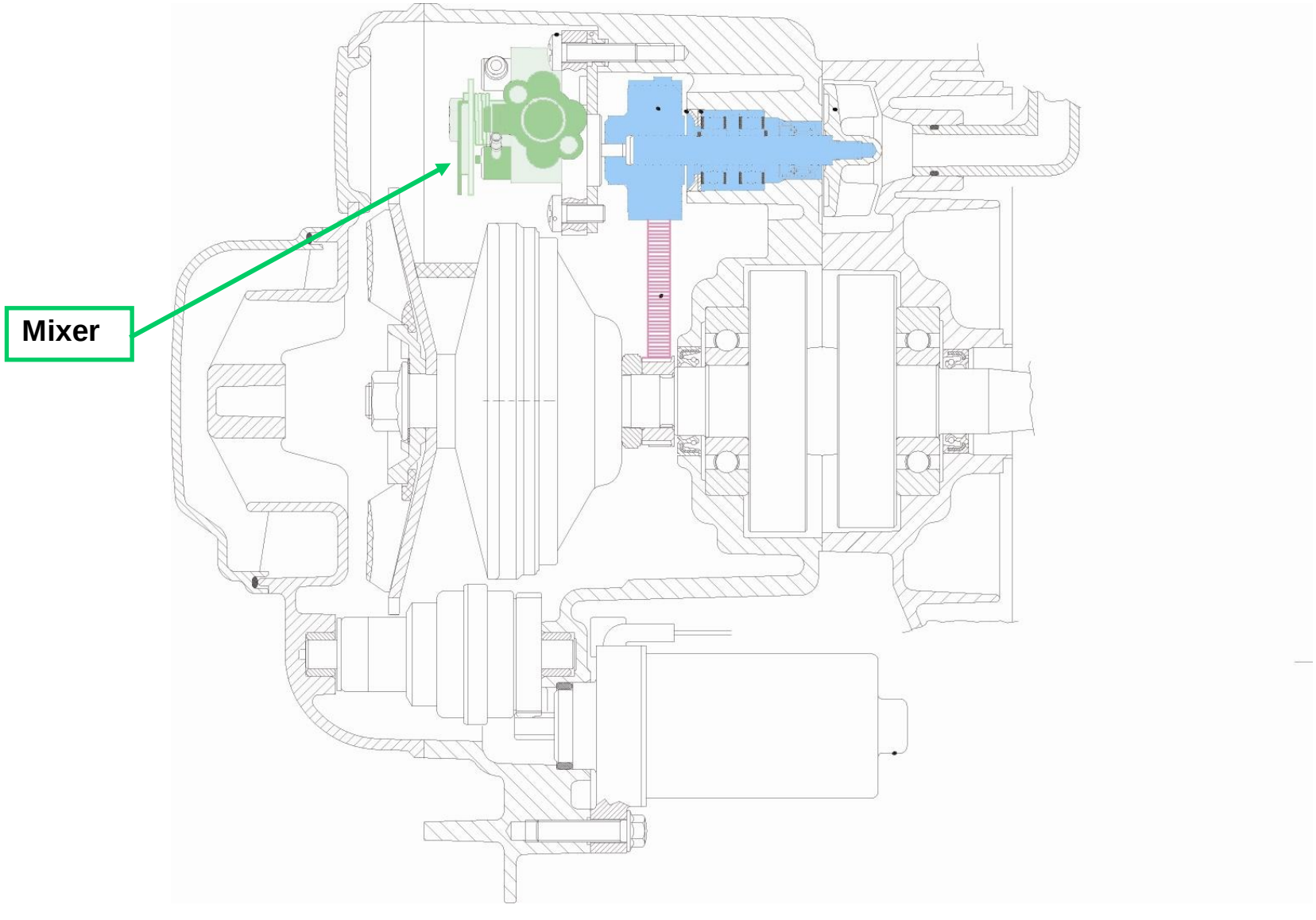
Check cleaning and efficiency of the one-way valve of the oil supply to the pump case.

Engine lubrication and piston-cylinder coupling of the positive displacement compressor is carried out by sending oil close to the compressor control roller.

The injection air also transports tiny amounts of oil.

oil intake into pump case

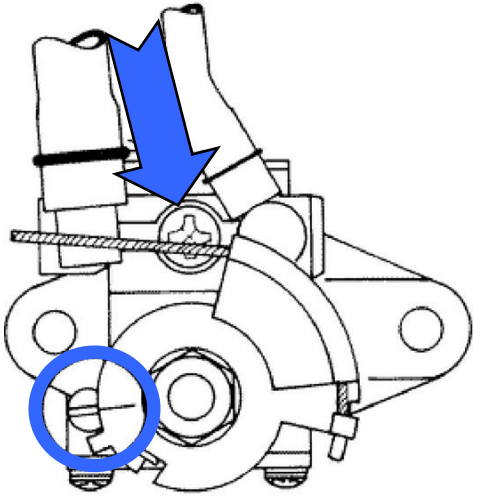
Lubrication



Mixer timing

LEARNING CENTRE

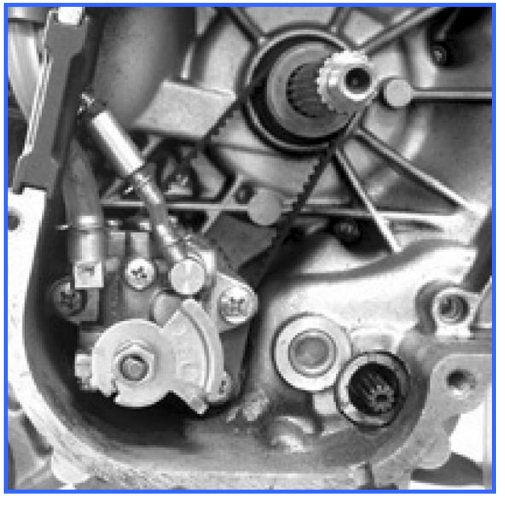
By means of the transmission set screw and with throttle control released, adjust mixer lever position as indicated in the figure.



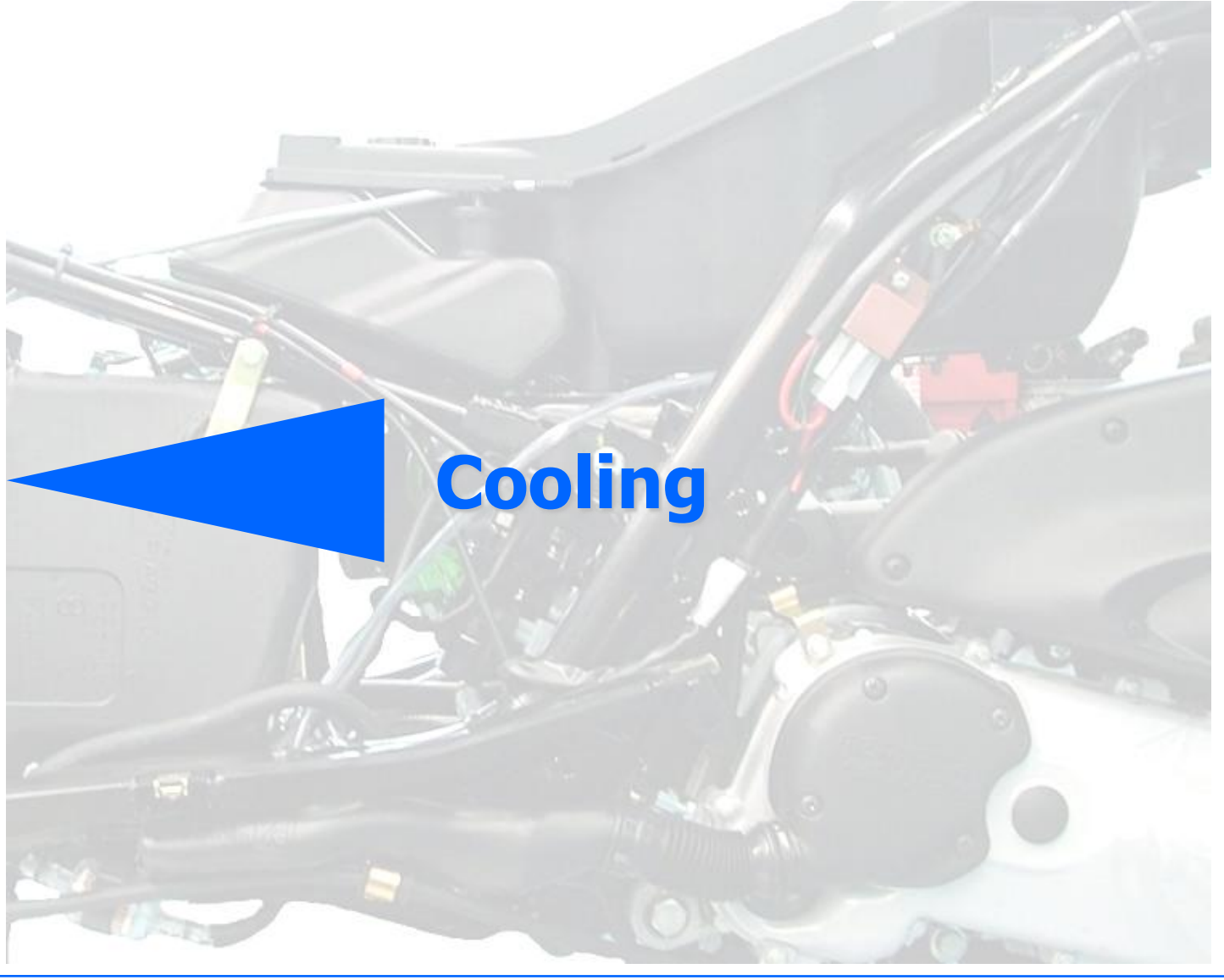
To check the correct mixer timing remove the air deflector of the transmission cover.

In case of reservoir removal or lack of oil, bleed the mixer as follows:

- with the mixer mounted on the vehicle and with engine off, disconnect the fuel pipe from the mixer, loosen the bleed screw (see arrow in figure) until oil starts flowing out;
- fasten the screw, start the engine and wait for oil to drain off the delivery pipe (previously disconnected);
- connect again the delivery pipe and fasten it with the corresponding clamp.



Mixer oil → AGIP CITY HI TEC 2T
synthetic oil for 2-stroke engines JASO FC, ISO-L-EGD)



Cooling

Cooling

LEARNING CENTRE

Forced-circulation cooling allows coolant to be sent in large quantities to the areas where it is most required for temperature purposes.

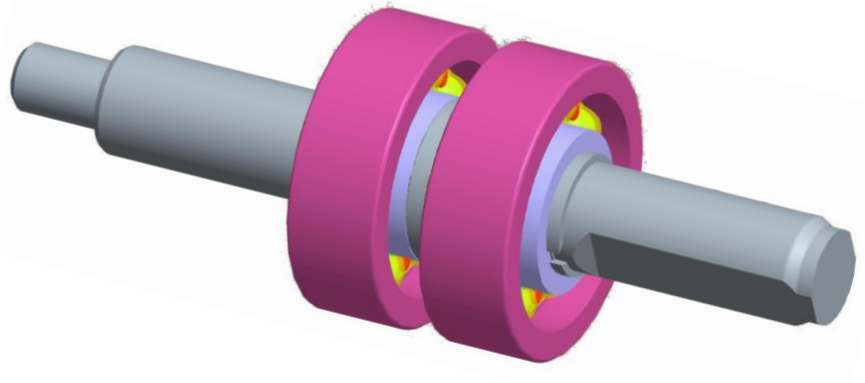
Fluid circulation (mixture of de-ionised water, antifreeze solution and anticorrosion additives) is activated by a mechanically operated centrifugal pump.

The radiator (that may be horizontal or vertical flow) is made of aluminium alloy.

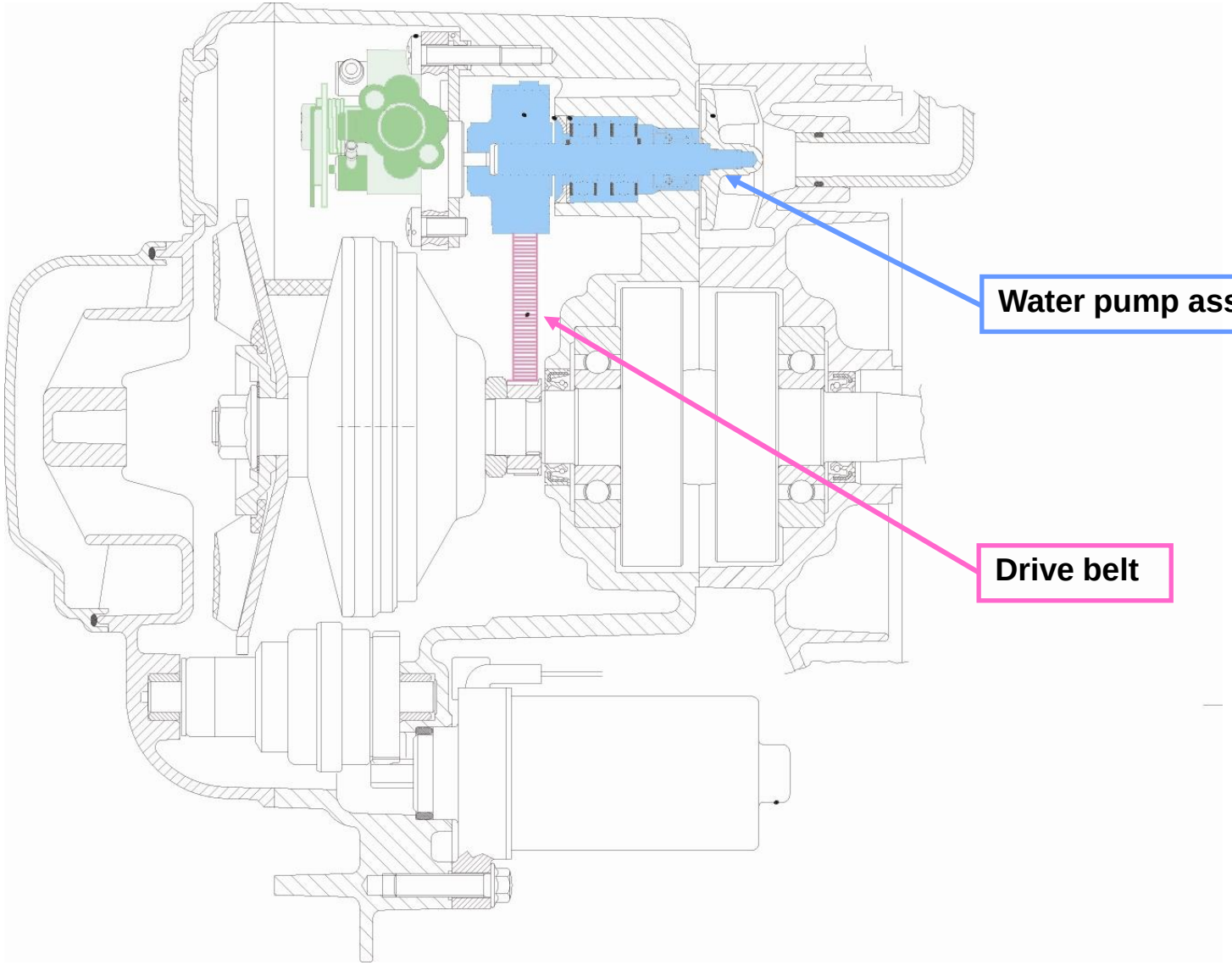
A thermostat is used to allow the engine to rapidly reach the operating temperature; its function is to adjust the mixing of water that comes from the radiator with that coming from the head-cylinder unit, and it is able to significantly contribute to accurately check the engine operating temperature, that can therefore always operate in optimal temperature conditions.

The **water pump** is activated by the crankshaft by means of a drive belt that engages the crown gear of the crankshaft to that of the pump control shaft (fitted with bearings).

During fitting operations avoid damaging the thread of the brass insert of the pump rotor or the gap of the insert of the plastic rotor.



Cooling

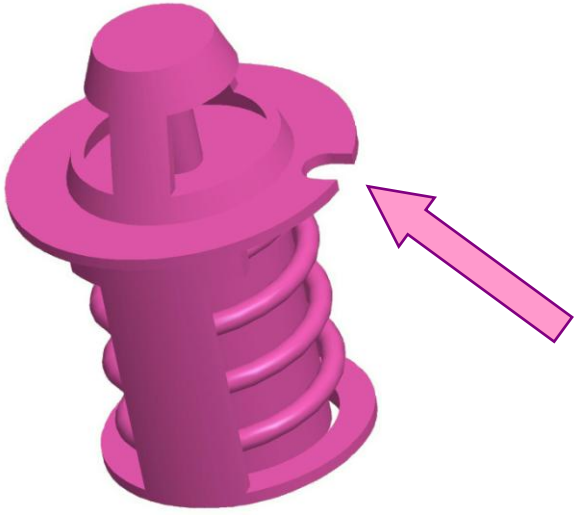


Thermostat

LEARNING CENTRE

THERMOSTAT CHECK

1) visually check that the thermostat is not damaged;
2) fill a metal container with approx. 1 litre of water;
3) immerse the thermostat and keep it at the centre of the container;
4) immerse the multimeter temperature probe close to the thermostat;
5) warm up the container using the heat gun;
6) check the temperature at which the thermostat starts to open;
7) warm up until the thermostat is fully open;
8) replace the thermostat if it does not work properly.



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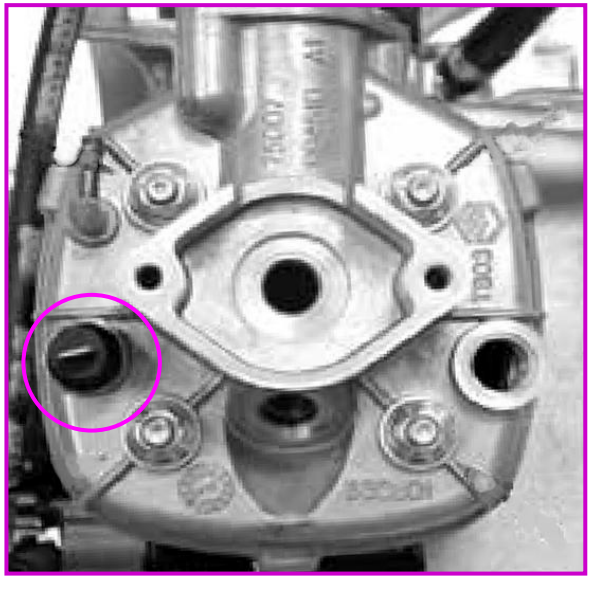
C



During fitting operations, be careful to insert the thermostat slot correctly on the reference found in the head.

Coolant

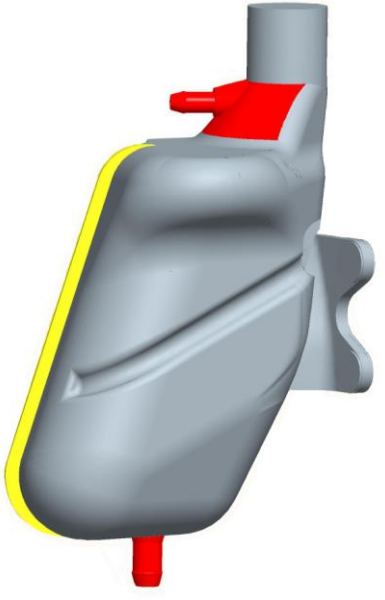
LEARNING CENTRE

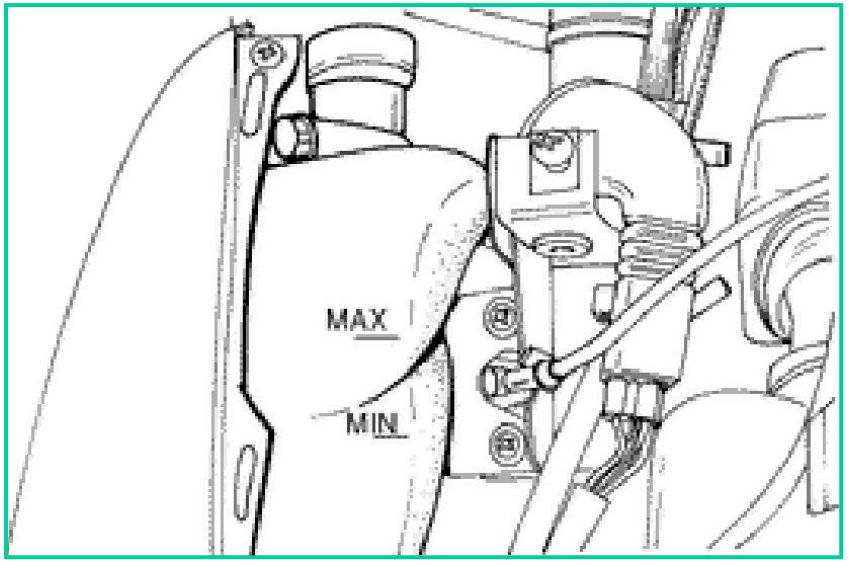
COOLANT CHECK

- Remove the front grille.

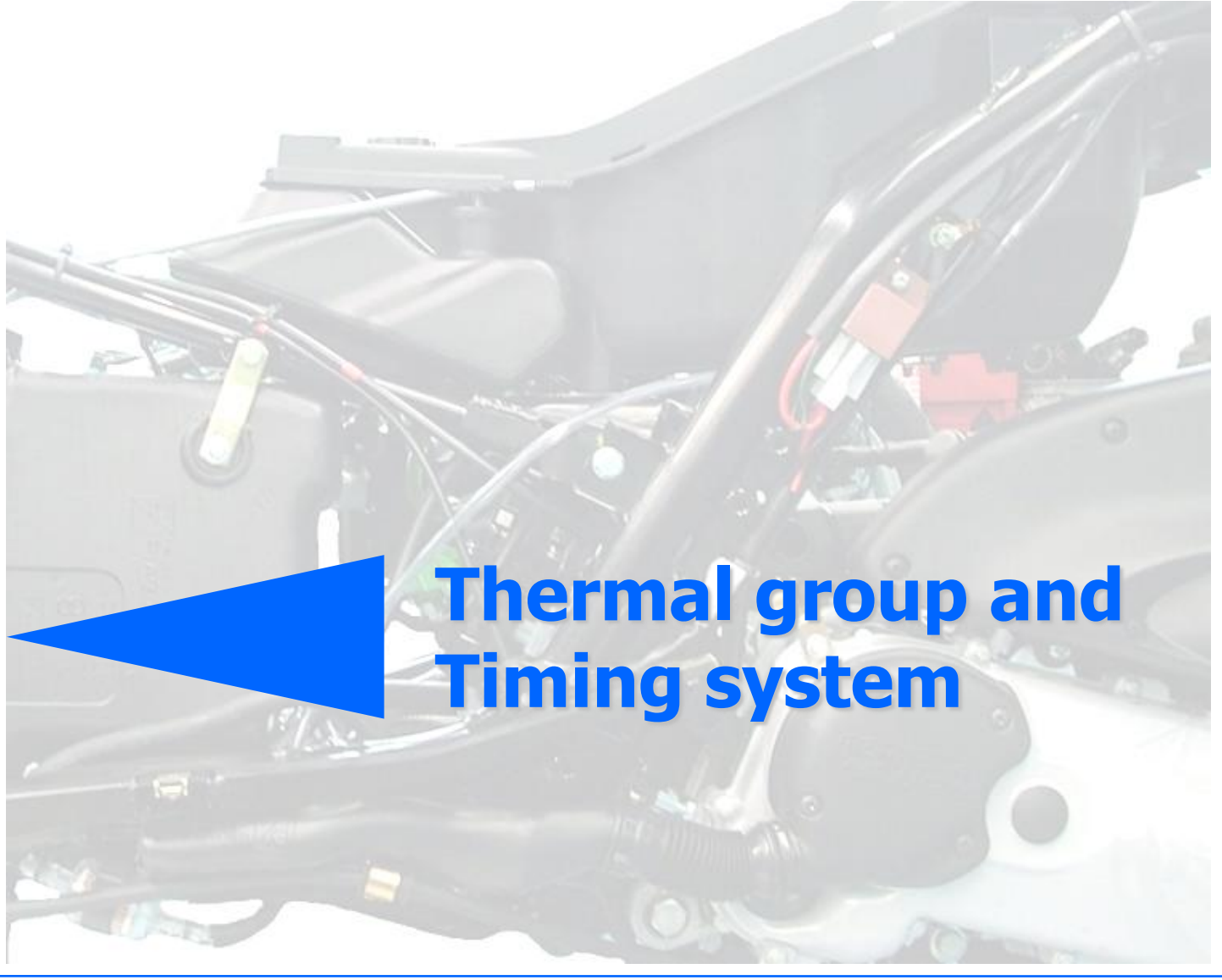
- Check that the coolant level is between the min. and max. reference marks.

- Top up, if necessary, with the recommended fluid.



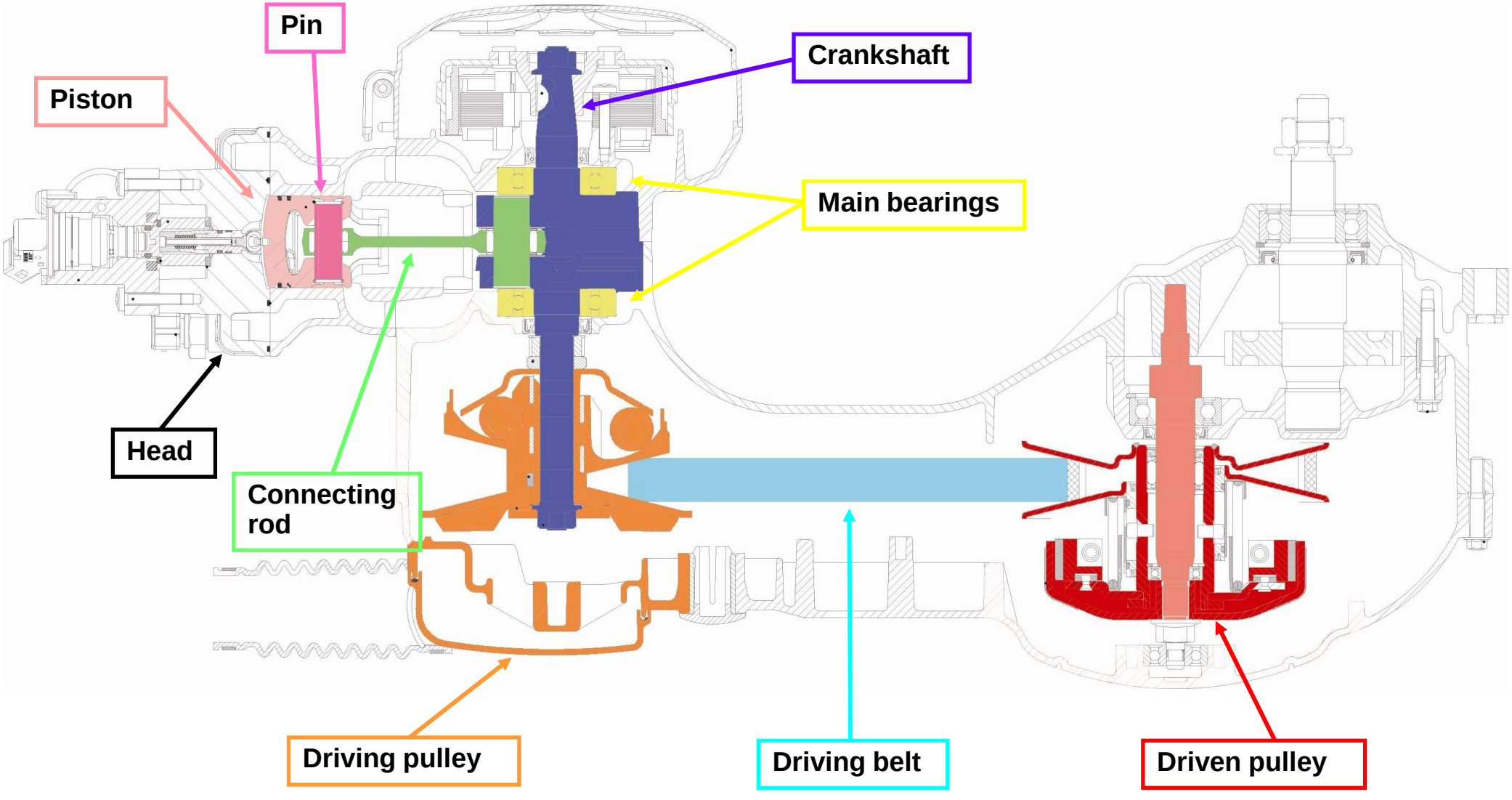


PARAFLU 11 FE coolant → (diluted)
monoethylene glycol antifreeze fluid
CUNA NC 956-16



Thermal group and Timing system

Thermal group and Timing system



Crankshaft

The crankshaft is assembled between both crankcase halves (flywheel side and transmission side) with main bearing and sealing ring.

Do not lubricate the crankshaft upon fitting it to avoid smearing the crankcase halves coupling surfaces.

To fit the main bearings and for temperature purposes, immerse the oil-coated bearings once cold and afterwards reheat the container progressively until the oil temperature is about 150 .

If the bearings are immersed in hot oil, they will get immediately damaged.

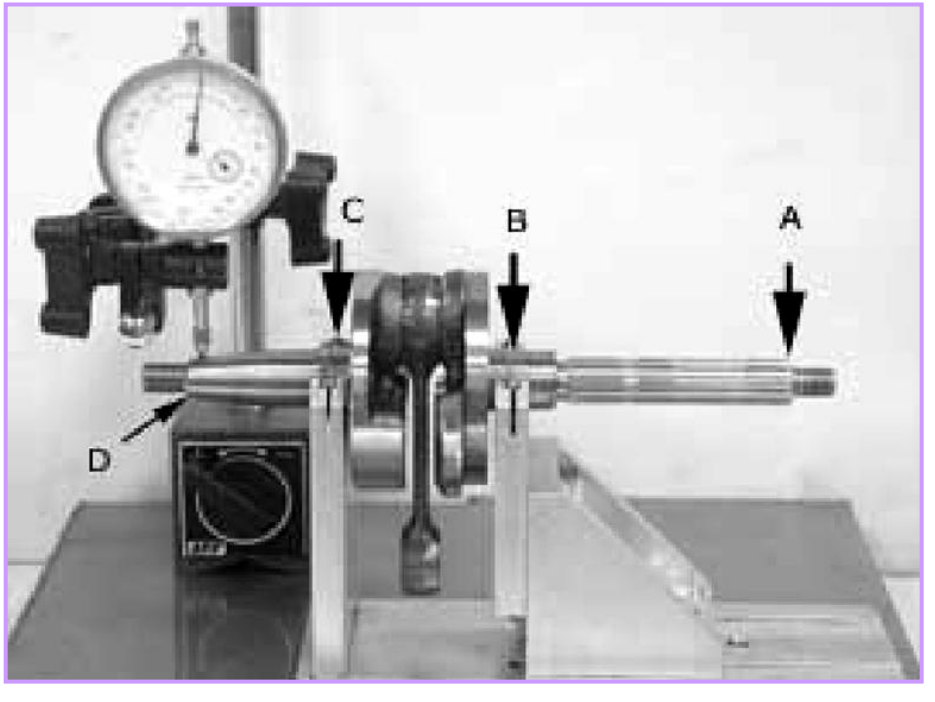
Crankshaft: alignment check

LEARNING CENTRE

Eccentricity of surfaces of diameters “A” – “B” – “C” ≤ 0.03 mm

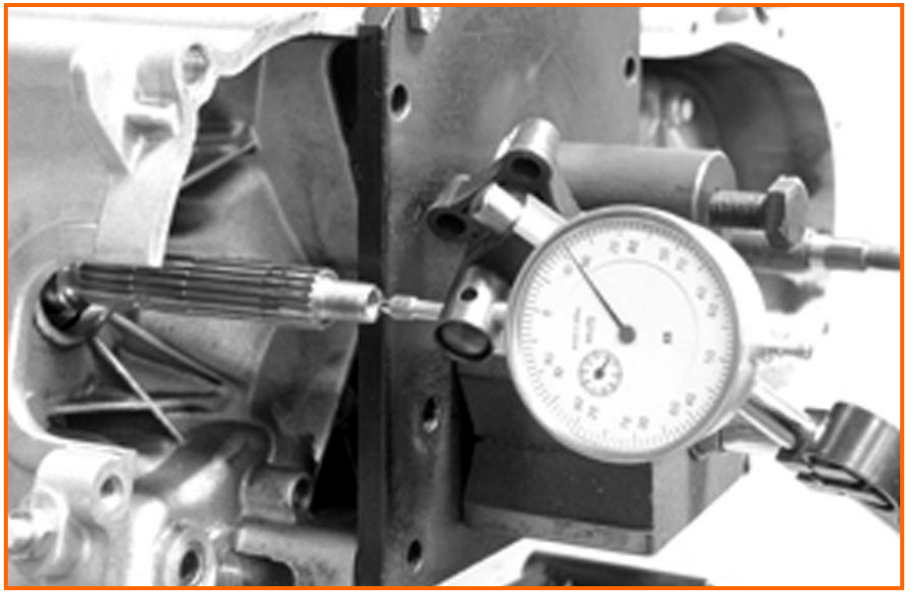
Eccentricity of surface of diameter “D” ≤ 0.02 mm

If eccentricity is slightly above prescribed levels, straighten the shaft by acting on the counterweights with a shim or by closing them on a vice fitted with aluminium bushings.



Crankshaft: axial clearance check

LEARNING CENTRE



- **Axial clearance with warm crankcase** → **0.10 0.12 mm**
- **Axial clearance with cold crankcase** → **0.06 0.08 mm**
- **LIMIT VALUE with cold crankcase** → **0.02 0.03 mm**

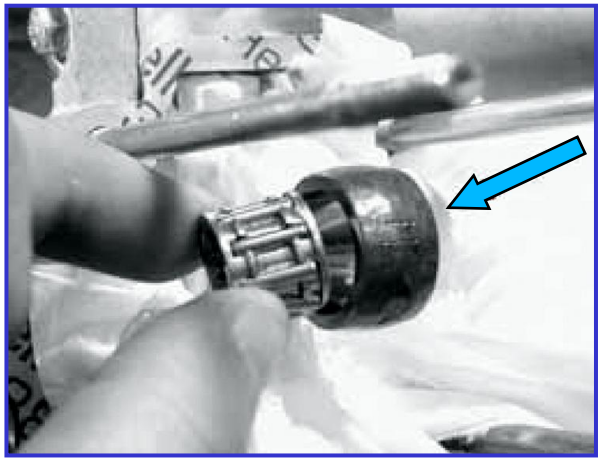
If after measurement this is not within the limit value, repeat the crankcase coupling procedure.

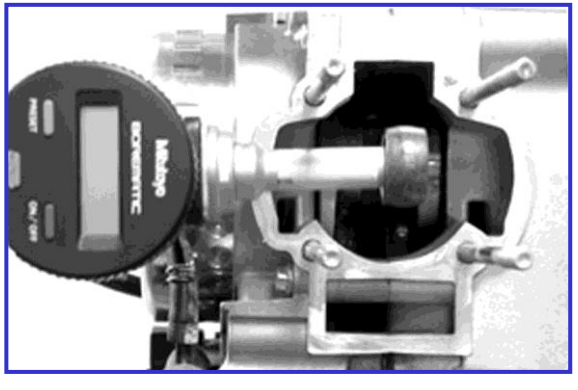
Connecting rod

The crankshaft is supplied including a connecting rod fitted on the crankpin.

The rod small end is fitted with a roller unit (ball retainers).

Check that the roller unit is not worn and/or faulty; otherwise, replace it.





Use a bore meter for inside diameters to measure the rod small end diameter.

Standard diameter: $17\ ^{-0.001}_{+0.011}$ **mm**

If the rod small end diameter exceeds the standard diameter or if the rod small end is worn and/or overheated, replace the crankshaft.

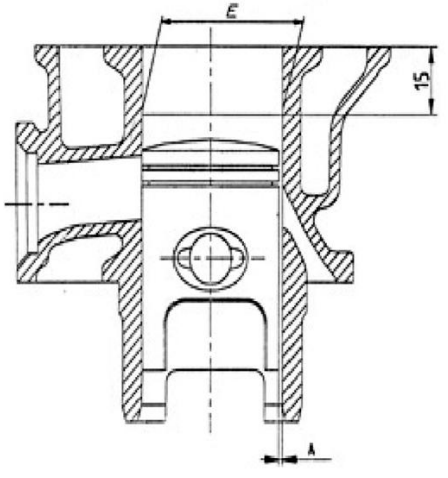
Cylinder

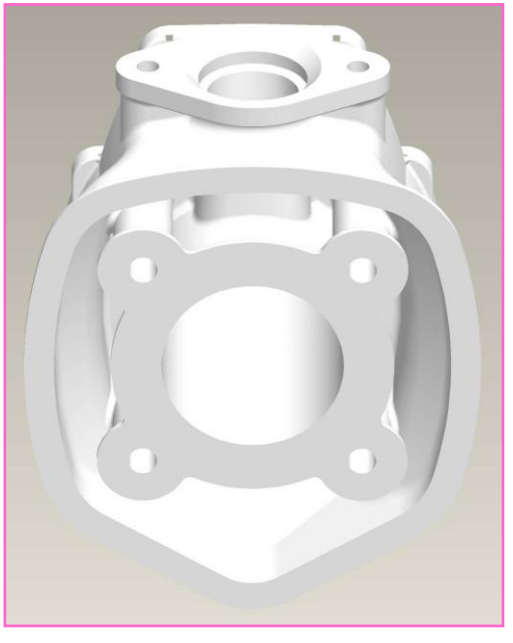
The **CYLINDER**, like the piston, is supplied in 2 categories - "**M – N**" - depending on the diameter.
For coupling classification, refer to the corresponding table in the Service Station Manual.

- Check that the cylinder does not seize; otherwise, replace it or fix it respecting the allowed oversizes.

- Use a bore meter to measure the inside diameter of the cylinder.

- Check cylinder diameter at 15 mm from the head supporting surface.



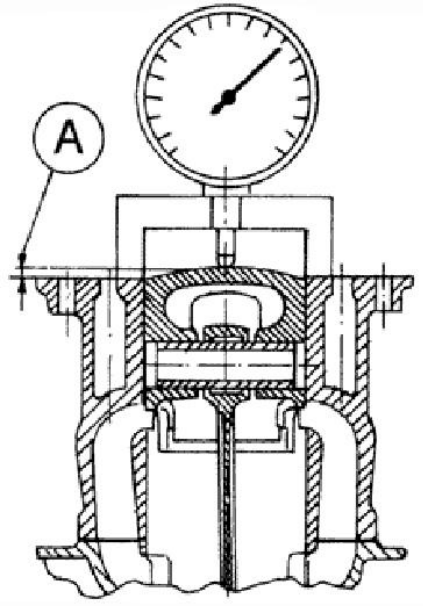


- Check that the coupling surface with the head is not worn and/or deformed.

Cylinder: base gasket

LEARNING CENTRE

By properly identifying the cylinder base gasket thickness, an adequate compression ratio is kept.

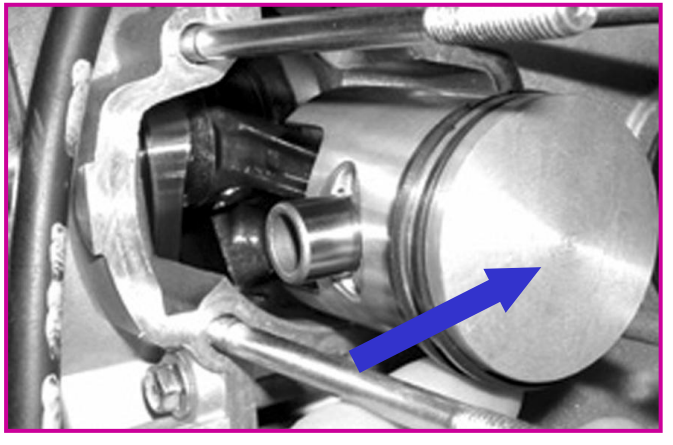


3 examples of cylinder base gasket (cylinder-crankcase gasket) according to the TDC value measured:

- shimming: 2.80 3.04 mm → gasket thickness: 0.4 mm
- shimming: 3.05 3.24 mm → gasket thickness: 0.6 mm
- shimming: 3.25 3.48 mm → gasket thickness: 0.8 mm

Piston

- The **PISTON**, like the cylinder, is supplied in 2 categories - "**O – P**" - according to diameter.
- For coupling classification, refer to the corresponding table in the Service Station Manual.
- The letter is found at the centre of the piston crown (blue arrow).
- Measure the piston outside diameter perpendicular to the pin axis.
- Upon fitting the piston on the cylinder, pay attention that the arrow stamped on the piston crown is facing towards the cylinder exhaust gap.



PISTON CHECKS

Piston bearing diameter

Standard diameter: $12\ ^{-0.007}_{+0.012}$ **mm**

Piston-pin coupling clearance

Standard clearance: 0.002 0.011 mm

Piston: sealing rings

LEARNING CENTRE

- Take note of the assembly positions of rings so as not to invert their position in case they are re used.
- Pay attention not to damage the sealing rings when removing them.

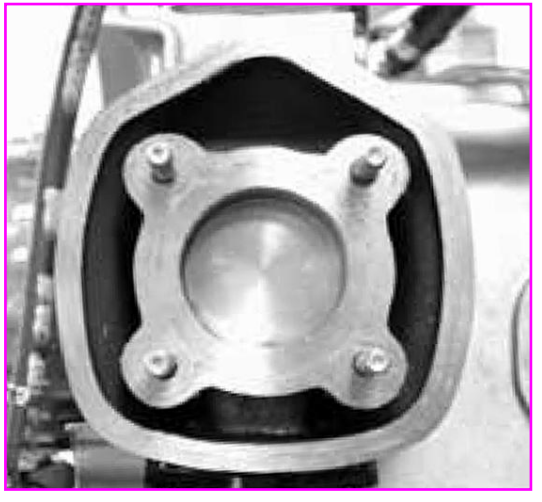
- Check sealing rings opening using a thickness gauge.
- **Max clearance allowed: 0.10 0.25 mm**
- If higher values than those prescribed are found, replace the rings.

Fitting clearances

LEARNING CENTRE

CYLINDER - PISTON Clearance

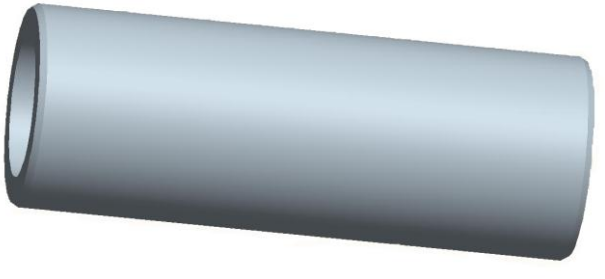
Standard diameter: **0.047 0.061 mm**

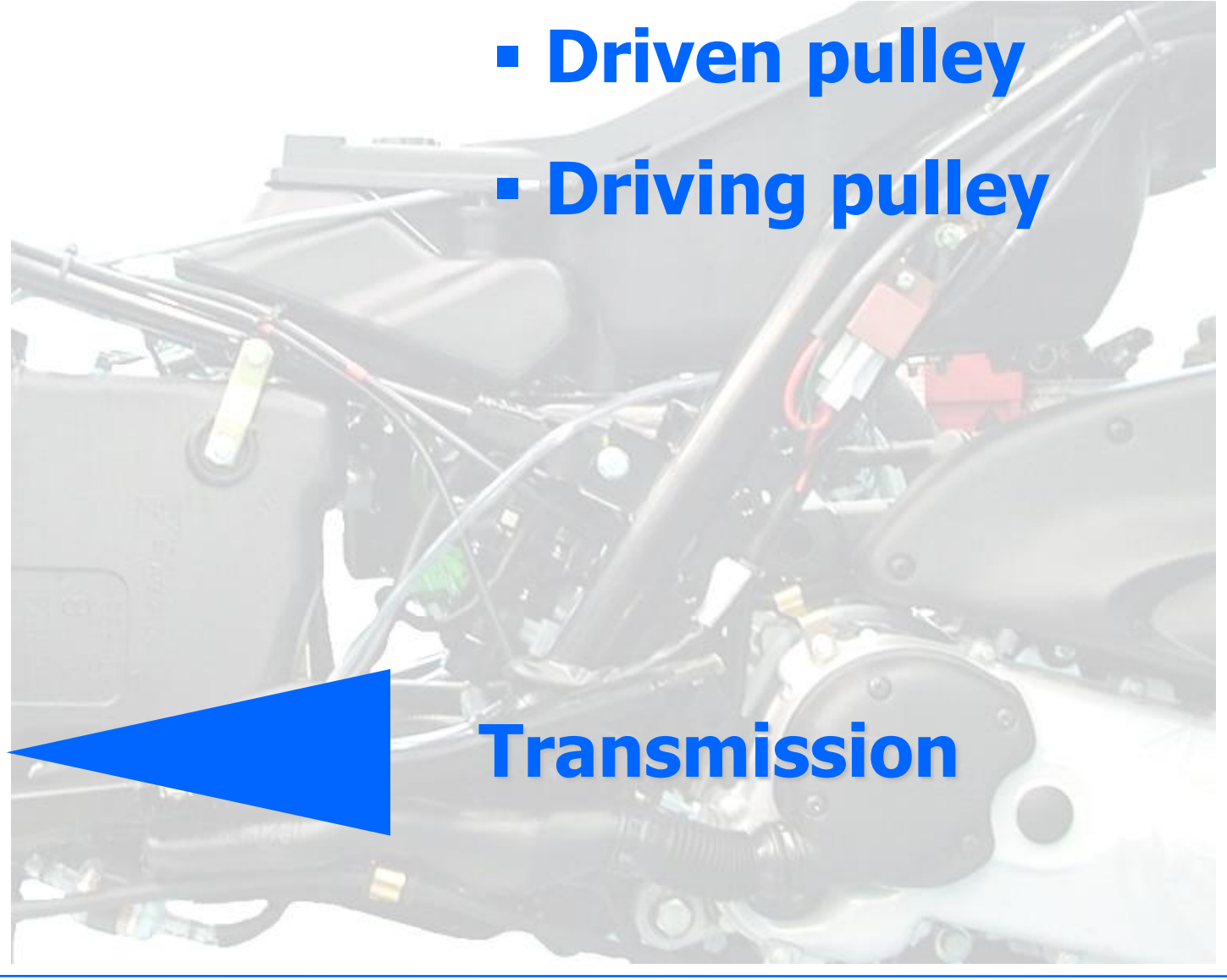


PIN Check

Check the outside diameter of the pin using a micrometer

Standard diameter: **12** $^{+\ 0.001}_{+\ 0.005}$ **mm**

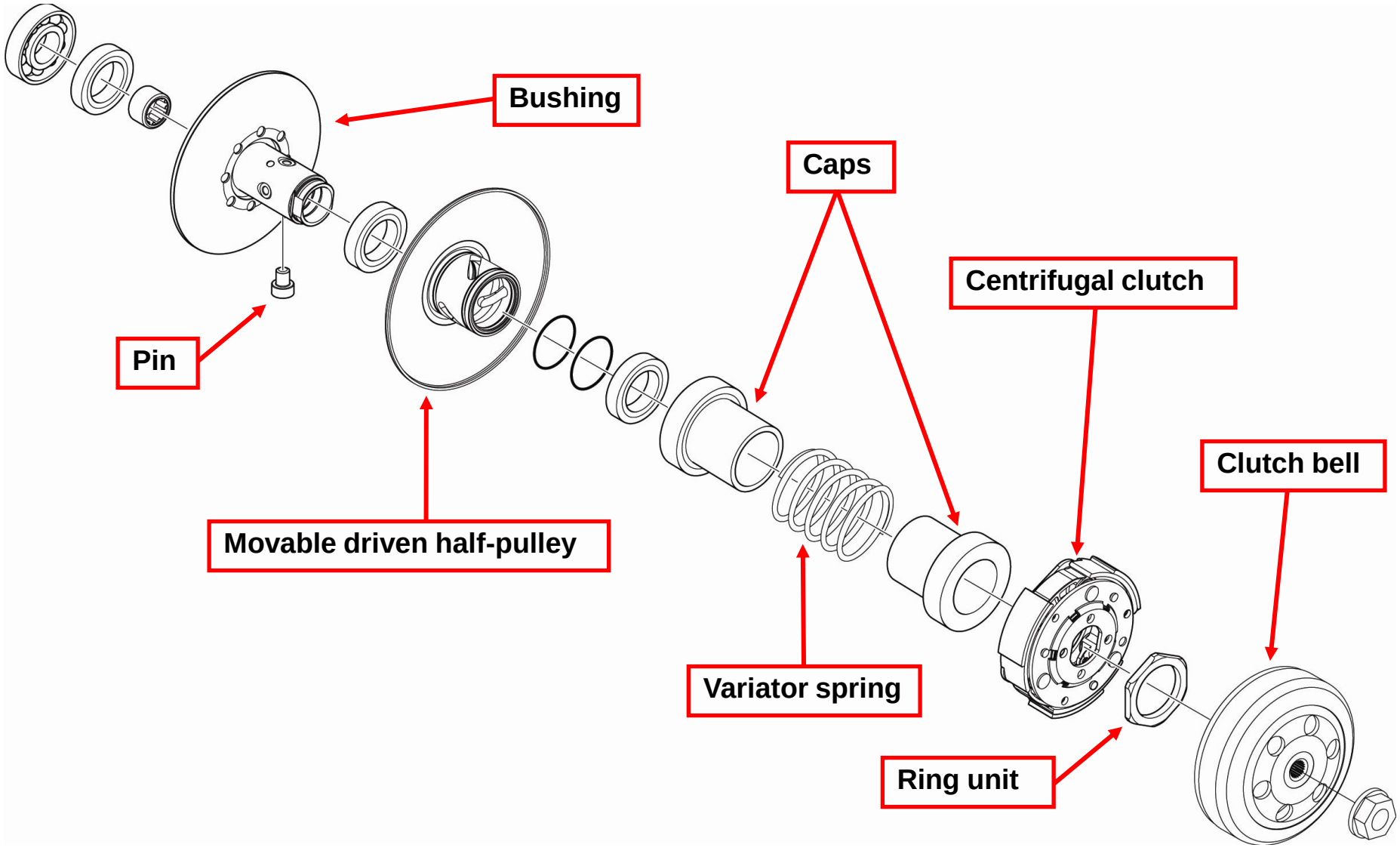




- Driven pulley
- Driving pulley

Transmission

Driven pulley



Driven pulley

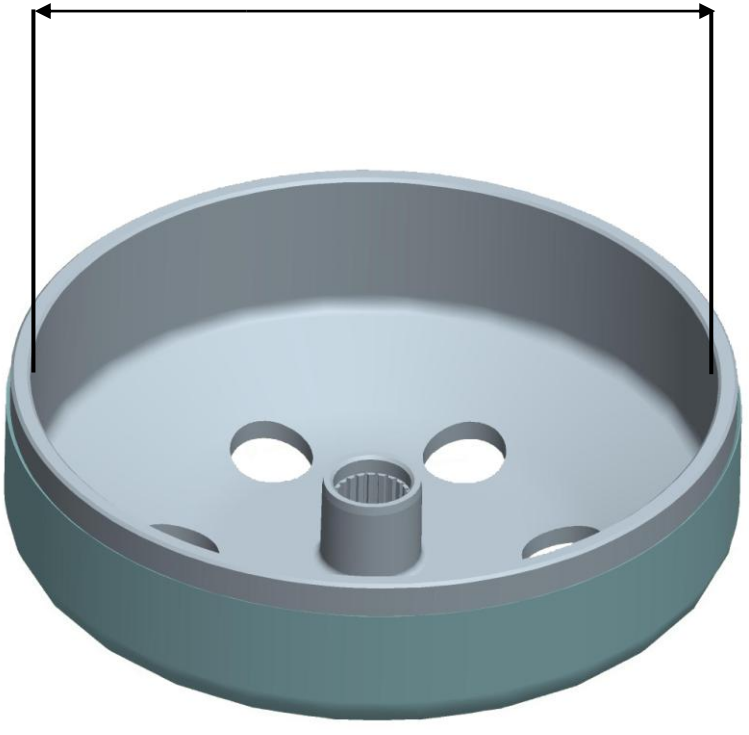
LEARNING CENTRE

- Check that the clutch bell is not worn and/or damaged.

Measure the inside diameter of the clutch bell:

STANDARD VALUE Ø **107** $^{+0}_{+0.2}$ **mm**

MAX. VALUE: Ø 107.5 mm



Check the eccentricity measured:

MAX VALUE: 0.20 mm

Driven pulley

LEARNING CENTRE

Clutch friction material

Check the thickness of the clutch masses friction material:

Minimum thickness allowed: 1 mm

Masses must exhibit no lubricant traces.

Upon running-in, masses must exhibit a central faying surface and must not differ one from the other.

Different conditions can cause the clutch to clutch slippage.

Do not open the masses using tools so as to prevent a variation in the return spring load.

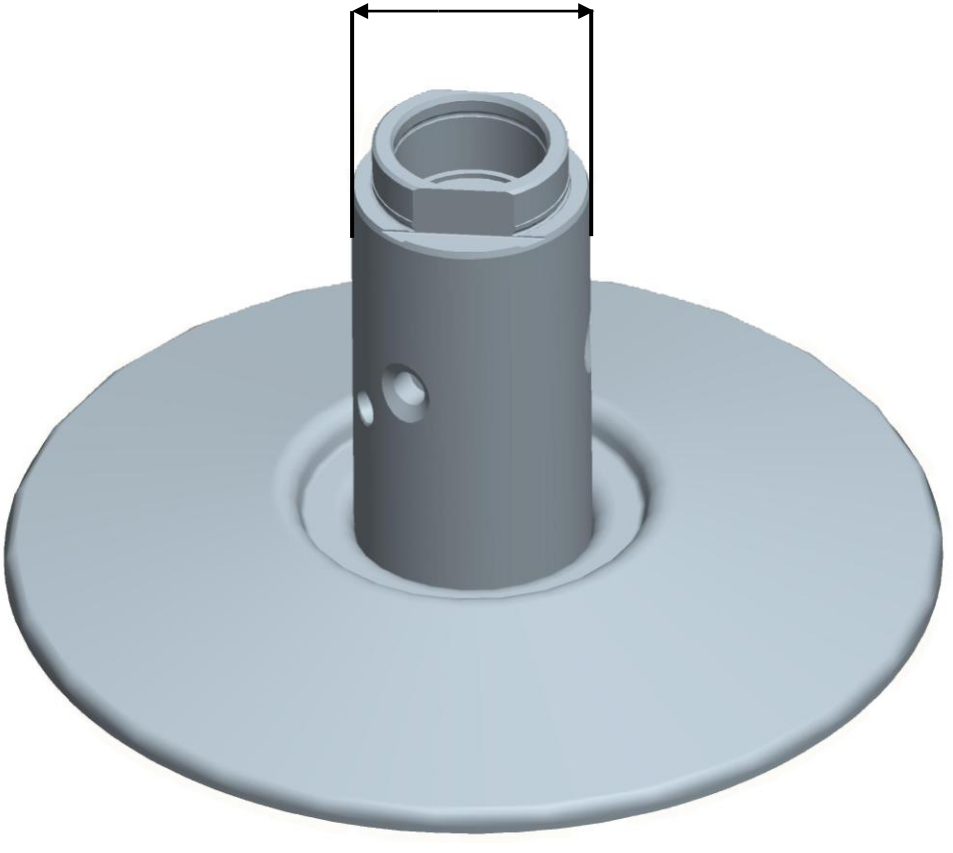
Fixed driven half-pulley

LEARNING CENTRE

Pulley bushing outside diameter

- Min allowed Ø 33.96 mm

- Standard value Ø 33.965 33.985 mm

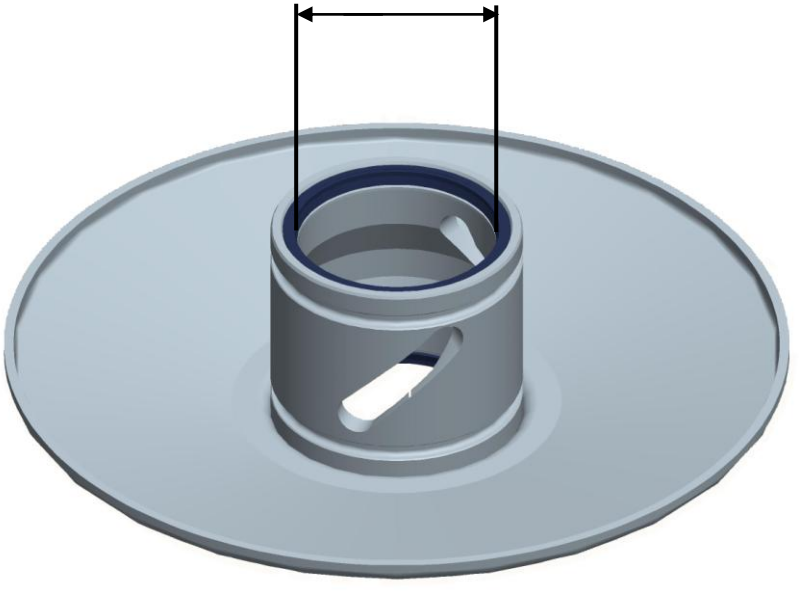


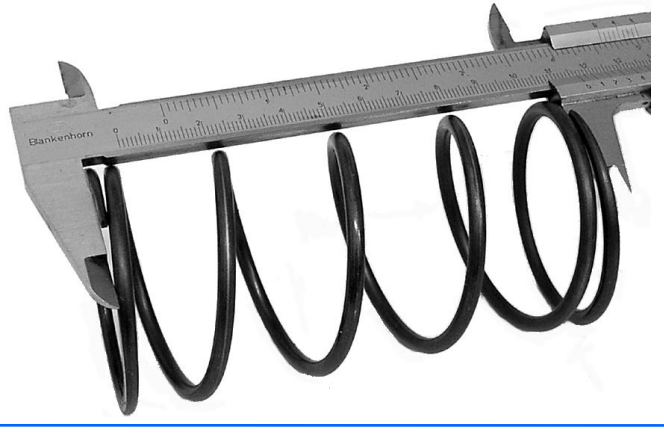
Movable driven half-pulley

LEARNING CENTRE

Movable half-pulley bushing inside diameter:

- MAX ALLOWED Ø 34.08 mm.

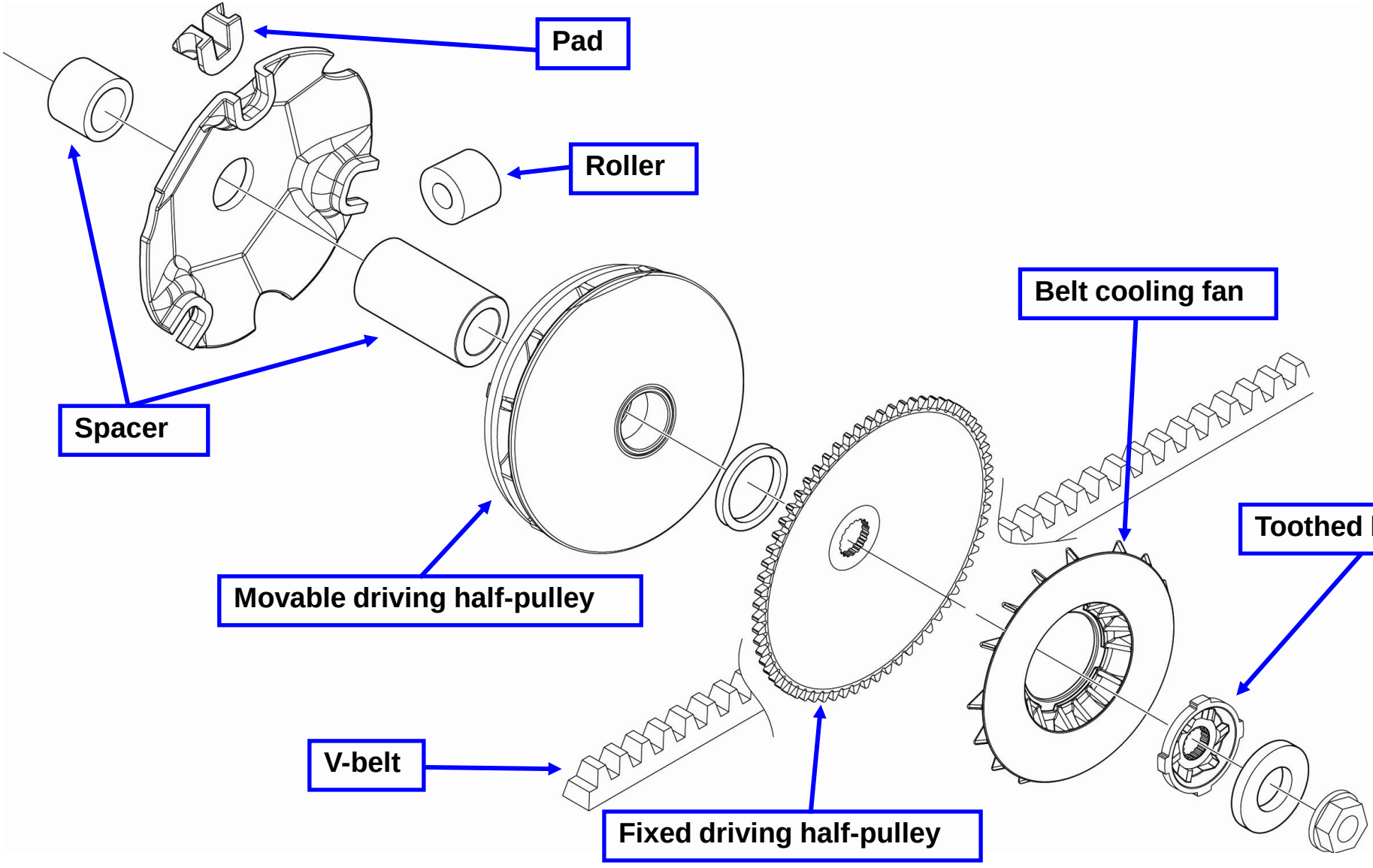




Unloaded spring length size

- STANDARD LENGTH: 110 mm

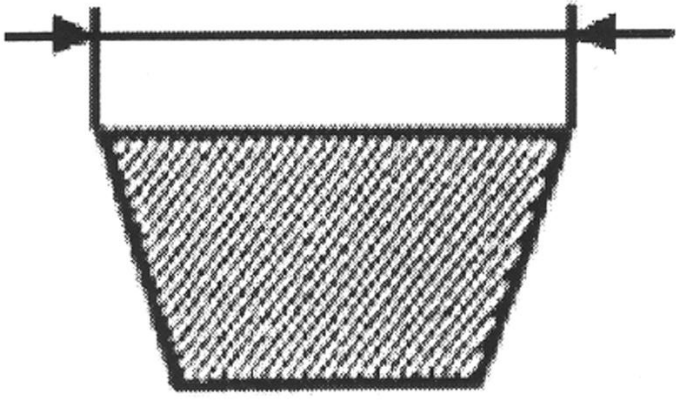
Driving pulley



Driving belt

LEARNING CENTRE

- Check that the driving belt is not damaged and does not have cracks in the toothing groove.
- Check belt width **MINIMUM WIDTH: 17.5 mm**



It is good practice to always fit the belt so that the words can be read, in the case the belt does not show a specific fitting side.

It is of utmost importance that when the driving pulley unit is fixed, the belt is free inside so as to avoid making an incorrect tightening (with possible subsequent damage to the crankshaft knurling).

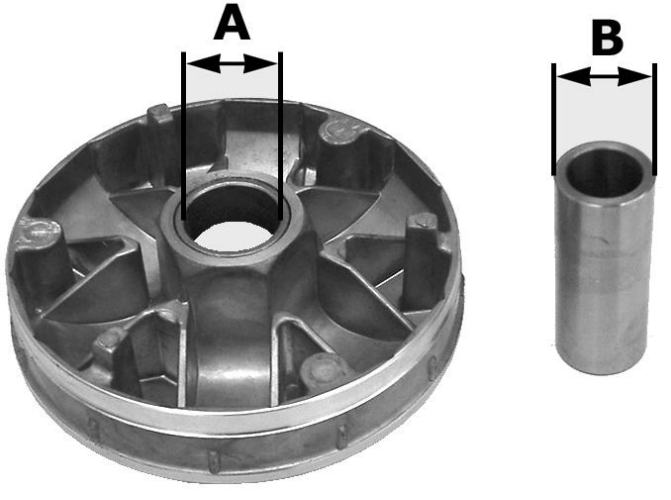
Transmission: Driving pulley

LEARNING CENTRE

Check that the internal bushing is not abnormally worn and measure the inside diameter “A”:

Max. diameter allowed: Ø 20.12 mm

Standard diameter: Ø 20.021 mm



DO NOT LUBRICATE OR CLEAN THE BUSHING !

Measure the outside diameter “B” of the pulley sliding bushing:

Min. diameter allowed: Ø 19.95 mm

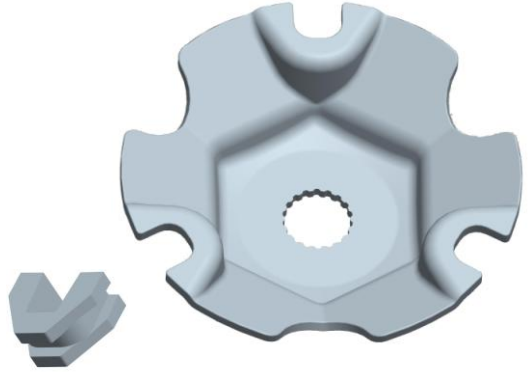
Standard diameter: Ø 19.959 mm

Transmission: Driving pulley

LEARNING CENTRE

Check that the rollers are not damaged and/or worn:

- **Min. diameter allowed: Ø 18.5 mm**
- **Standard diameter: Ø 18.9 mm**

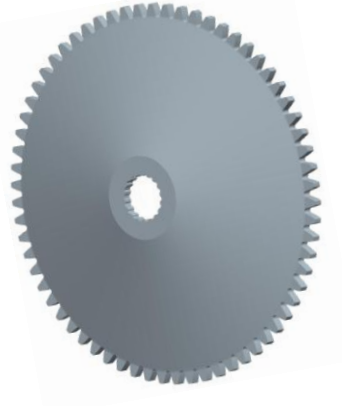


Check that the guide sliders for the roller contrast plate are not worn.

Check that roller housings or surfaces in contact with the belt on both half-pulleys (fixed and movable) are not worn.

Toothed bushing

Belt cooling fan



Fixed driving half-pulley

Pure Jet

P = Piaggio
U = Ultra low emission
R = Research
E = Engine