Carburettor technology

Tasks

The carburettor is responsible for ensuring that the fuel (petrol/oil mix) and air are mixed in the right ratios.

A mix that is too rich: If the proportion of petrol is too high the engine loses power and wastes fuel as there is insufficient oxygen available for efficient combustion.

A mix that is too lean: The evaporation of the petrol also contributes to the cooling of the engine. If the mix contains too little petrol it combusts at higher temperatures. If the engine is not able to dissipate the heat accordingly, this often leads to seizure or a hole in the piston.

The carburettor has to make exactly the right mix available in every situation (depending on revs, throttle position and environmental influences). The only variables in this context are the slide position and air pressure. This is why the 'tuning' or the 'jetting' of the carburettor (meaning the use of components that exactly match the corresponding setup) is so important. Tuning which works at sea level will be too rich at altitude as the partial pressure is lower - > resetting jets when touring.

Functionality

The carburettor makes use of the Venuri effect. This states that on passing a constriction, the fluid flows more quickly and demonstrates a lower level of pressure at the same time. On the carburettor this fluid is air which is influenced in terms of its flow through due to the tapering carburettor trumpet (Venturi). While the air rapidly flows through the trumpet in the direction of the engine, a negative pressure occurs at the constriction. This sucks in petrol from different openings in the carburettor and enriches the air that is flowing past at the same time. The different flow circuits of the petrol in the carburettor are necessary in order to supply the engine with the right amount of petrol at all slide positions and all speeds. The working areas of the individual circuits partially overlap (which makes setting the carburettor more difficult) and you have to try to achieve a balance between them that is as effective as possible.

The individual parts

1 Throttle slide: The throttle slide limits the flow of air to the engine. Its position is determined by turning the throttle while riding. For some models of carburettor, throttle slides are available that have different sized cutaways on their underside. These are responsible for the quantity of mix that is made available when accelerating.
   - No and/or small cutaway (= low proportion of air) = rich
   - Large cutaway (= high proportion of air) = lean

2 Floats and float needle valve: To be able to work effectively the carburettor requires a constant petrol level in the float chamber. For this reason it has a floater and a needle with a rubber tip. If the petrol level is too low this needle opens a valve and then closes it again when the maximum fill level is reached. The valve has to be big enough to fill the float chamber more quickly than the carburettor jets empty it. If due to an unfavourable carburettor position, because the petrol level in the tank is too low, or in the event of tuning problems, the gravitational force alone is not able to fill the float chamber, a fuel pump can help.
• A bigger float needle valve will reliably fill the float chamber, but is susceptible to cause the carburettor to vibrate or be tilted, and can easily make the carburettor overflow.
• The heavier the floater, the higher the fill level in the float chamber and the richer the mix in the fuel circuits of the carburettor.
• The height of the floater (at which the valve closes) can be adjusted by bending the clip that connects the needle and floater a little. The methods and precise details for controlling the floater height are different on every model, so proceed on a ‘trial and error’ basis.

3 Idle jet: The idle jet is primarily responsible for an equal mix when idling and with a limited opening of the slide. Apart from Dell’Orto SI (as this is the other way around), the following applies:
• Big = rich
• Small = lean

4 Mix regulating screw: Alternative to the air screw (see below). The mix regulating screw controls the amount of fuel in the idling mix. Most of the DELL’ORTO PHB carburettors have a mix regulating screw.
• Screw outwards = enrich the idling mix
• Screw inwards = make the idling mix leaner

5 Air screw: An alternative to the mix regulating screw (see above). The air screw regulates the amount of air in the idling mix. If a carburettor (e.g.: MIKUNI TMX) has an air screw, this is in front of the throttle slide.
• Screw inwards = enriches the idling mix
• Screw outwards = makes the idling mix leaner

6 Choke: If the choke is pulled on starting up the scooter, the mix is enriched. On some carburettors the size of the choke jet in the carburettor can be changed.
• Large jet = rich mix with pulled choke
• Small jet = lean mix with pulled choke

7 Main jet: The main jet primarily influences the proportion of petrol in the mix when the slide is half to completely opened.
• Big = rich
• Small = lean

8 Mixer tube: Before the mix is sucked into the carburettor funnel the petrol made available by the main jet is mixed with air in the body of the carburettor in order to break it up into small particles. On some carburettors it is possible to vary the size of the mixer tube. The diameter of the mixer tube and the design of the jet needle are interrelated.
• Big mixer tube diameter / thin needle = rich
• Small mixer tube diameter / thick needle = lean

9 Jet needle: The mixer tubes on modern carburettors (not SI) work in combination with a conical needle that is attached to the throttle slide. This connection regulates the flow of petrol on throttle slides that are partially opened. The needle normally has a clip on its thicker end, the position of which is decisive for how far it is immersed in the mixer tube. The clip positions are normally numbered from top to bottom (lean > rich). The top position is often designated as ‘T1’. There are needles with different diameters of the cylindrical part (Ø A), different lengths of the tapering part (Ø C) and different diameters of the tip (Ø B).

The cylindrical part of the needle determines the mixing ratio when the throttle slide is opened approx. ¼. The bigger the Ø A, the leaner the mix.

With a slide opened between ¼ and ¾, the diameter of the needle tip determines the composition of the mix. With constant values of A and C the following also applies here: the bigger the Ø B, the leaner the mix.

If both diameters (A and B) remain the same, a change to the length of C affects the point in time at which the mix is enriched. The longer C is, the earlier the enriching phase begins. Changing the clip position on the needle can also influence the field of action, C.
• Clip below = rich
• Clip above = lean
• Thin needle = rich
• Thick needle = lean

Overview of jet needles

<table>
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<tr>
<th>Jet needles</th>
<th>Ø A</th>
<th>Ø B</th>
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<td>2.48</td>
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<td>D45 PHBL/VHST*ally</td>
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Main air correction jet: The older Dell’Orto SI carburettors do not have a jet needle. The flow of petrol here is controlled by the air pressure only. They are also fitted with a main correction jet which is located above on the jet block above the mixer tube and the main jet.

- Large main jet = lean at low number of revs and limited slide opening
- Small main jet = rich at low number of revs and limited slide opening

Power jet: Some carburettors have another circuit which guides the petrol directly from the float chamber through a hose into the venturi of the carburettor. This circuit can be influenced either by the corresponding jet in the carburettor trumpet (frequently above) or a regulating screw. If the jet is positioned above the slide, this means that the fuel circuit only becomes active if the flow speed of the air in the carburettor is very high: This is the case if the slide is opened to a wide extent and at high revs. The power jet can be combined with a slightly smaller main jet in order to achieve the formation of an improved mix at low revs, and to ensure enough petrol is still available at high revs.

- Large power jet = rich at high number of revs / wide slide opening
- Small power jet = lean at high number of revs / wide slide opening

What carburettor for what area of use?

Stating the ideal size of carburettor for a certain size of engine or tuning stage is difficult. When viewed realistically it depends less on the performance of the engine than how you want to use it:

- **Standard size:** If you want an efficient, durable engine with a good air filter system, the original carburettor and/or a well tuned carburettor which largely corresponds with the corresponding engine is not a bad choice. If you drive a 130cc cylinder on a 50cc smallframe, for instance, you can use the standard (19mm or 20mm) carburettor and intake manifolds from the 125cc smallframe. A standard carburettor will not enable the scooter to achieve top performances, but e.g. a 210cc Malossi cylinder and a 24 series SI carburettors provide a reliable setup that looks totally original and can still provide over 20 PS.

- **24-30mm:** For scooters >125cc in this area you can find a good compromise between performance, consumption and everyday usability. The larger the throttle slide in proportion to the engine performance, the smaller the vacuum effect that occurs at low revs. It is more difficult to set the carburettor. This circuit can be influenced either by the corresponding jet in the carburettor trumpet (frequently above) or a regulating screw. If the jet is positioned above the slide, this means that the fuel circuit only becomes active if the flow speed of the air in the carburettor is very high: This is the case if the slide is opened to a wide extent and at high revs. The power jet can be combined with a slightly smaller main jet in order to achieve the formation of an improved mix at low revs, and to ensure enough petrol is still available at high revs.

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Types of carburettor

- **Down-draught carburettor:** Largeframe carburettors such as the SI series from DELL’ORTO, on which the air flows vertically instead of horizontally.

- **Drum carburettors:** These carburettors – PHB and SHB carburettors – are reliable and manufactured in a straightforward and economic design. That is why many scooters were fitted with them as standard in the past.

- **Flat slide carburettors:** These carburettors were developed to minimise the space beneath the slide and therefore omit the turbulence which had previously limited the maximum air flow. They therefore perform considerably better than the drum carburettors of the same size, e.g. DELL’ORTO VHST, MIKUNI TMX, ...

- **Oval bore:** If the Venturi funnel of a carburettor is higher than it is wide this is often called an oval bore. The advantage of this is that the Venturi area is configured progressively with increasing slide opening. This combines the advantages of smaller carburettors (clean mixing when slide is only opened a little) with the advantages of the bigger carburettors (higher flow volume). Modern versions also use other venturi shapes (heart or similar) in order to further strengthen this effect, e.g. DELL’ORTO VHST 34QD.

(Tech Tip: Carburettor technology)

- **Main air correction jet**
- **Mikuni Powerjet**

Toni, SIP answers:

**How can I work out the right size of carburettor?**

Does size matter? The biggest carburettor isn’t always the best one either. With a carburettor that is too big, the suction effect fails when the throttle slide is opened suddenly and the engine floods. The suction capability of the crank case influences the size of carburettor. It depends on the stroke and the pumping capability of the piston. And there is also the so-called K-factor: Touring scooter or racing bike? Roughly 0.7-0.9 is a good start.

This formula is normally used to work out the size of the carburettor:

\[ d = k \cdot \sqrt{V_h + n} \]

- \( d \) = carburettor diameter in mm
- \( k \) = k-factor between approx. 0.7-0.9
- \( V_h \) = cylinder capacity in litres
- \( n \) = RPM max. power

On a MALOSSI 210cc cylinder with a periphery such as an SIP Performance exhaust, reed valve manifolds, long stroke shaft, etc., this value results:

\[ d = 0.9 \cdot \sqrt{0.22 \cdot 6000} \]

\[ d = 32.7 \text{ mm} \]

(Text: Sticky)
**Intake manifolds**

The intake manifold creates the connection between the carburettor and engine. It is possible to distinguish between disc valve intake manifolds (crankshaft controls opening times) and reed valve manifolds (the low pressure in the crank case opens the reed valve plate and is therefore responsible for the feed in of the mix, irrespective of the intake control timing of the crankshaft).

Suction via the crank case induction generally means a long intake duct that ensures greater torque and can also be a good choice for touring engines.

Long intake control timing can also be offset in this way and it is possible to gain control of the ‘blowback’ (refer to crankshafts). A reed valve manifold is also an option if the disc valve intake on the crankcase is damaged. The TASSINARI reed valve with 8 petals, for instance, offers optimum flow conditions and setup options for high-end tuners.

A direct intake manifold is positioned directly on the cylinder which offers the advantage of a short intake duct and very direct throttle response. Another special design is the dual intake manifolds, which make sense in some engine layouts and ensure optimum filling.

**Air filter**

As its name suggests, the principal task of the air filter is to filter the intake air of dirt particles which could cause serious damage in the cylinder. The flow of the gas – petrol mix can be influenced through the design of the air filter or suction funnel. Noise dampening is also one of the tasks of an air filter.

**Petrol & oil**

Petrol is the lifeblood of the engine and octane and additives are to an engine what vitamins are to us humans. Therefore we always recommend driving with 95 octane petrol, or better ‘Super Plus’ 98 octane. As the new E10 petrol can damage the sensitive oil seals because of the aggressive ethanol that it contains, we do not recommend its use on vintage scooters. On enquiry, the manufacturer, PIAGGIO, approved the use of E10 petrol for vehicles first manufactured during or after the year 2000. An especially important component on two-stroke engines is fuel oil. Partly or fully synthetic oils are favourable to straightforward mineral oils every time. At the petrol station you are likely to find few high quality oils at inflated prices. With our SIP Formula products, we stock high quality oils at consistently reasonable prices.