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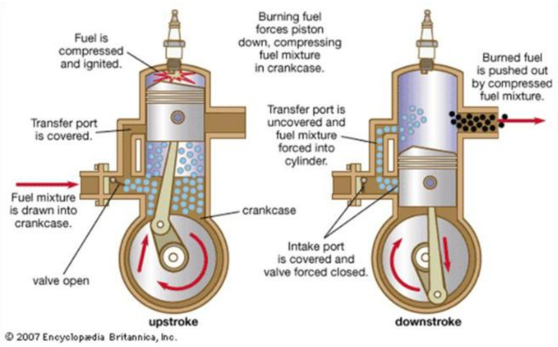
Chapter 4 – Reed Valve

4.1 Introduction

Early two-stroke engines didn't use reed torques. Intake was controlled by the opening and closing of the piston. However, despite there being no restriction on incoming flow, which would have been ideal, the engine only performed well near the peak torque zone. Starting and idling were unstable, as the opening also allows some of the pressure created by the piston as it descends to pass through, causing the flow to reverse and the mixture to exit through the carburetor. If the mixture passes through the carburetor twice, it draws twice as much fuel, which explains the uneven idle.



Over time, it was discovered that using a bypass between the engine and the carburetor could improve flow control, preventing some of the pressure from escaping through the carburetor. The first reed torques

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were fragile, broke easily, and didn't seem to be the solution. However, it was discovered that the problem lay in the way the reeds were attached. They typically broke at the end where they were attached. What happened was that they always bent in the same place, close to where they were screwed in. A restrictor was then added, which prevented the reed from bending in the same place and allowed it to open gradually and curvedly, avoiding stress at the same point. There's a myth that the restrictor serves to limit the reed's opening, but its main function is to prevent it from breaking.

But the stainless-steel blades still broke, causing severe engine damage. Until Yamaha discovered that adding a layer of rubber composite to the base of the

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torque wrench prevented the blades from colliding with the aluminum, thus preventing fractures.

This is another myth, as the rubber is there more to cushion the impact of the petal than to improve the seal.

Over time, new materials emerged, such as plastics and fibers that are still used today.

Several material and thickness tests were performed until the most suitable one was found. Very thin materials are lightweight, but at high RPM they deform and fail to seal due to vibration. Very thick materials are inflexible and significantly increase flow

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restriction. Carbon fiber has come to solve many problems, as it is highly rigid and can be manufactured with thinner, lighter thicknesses. The ideal thickness depends on the application and should be tested, but it will range from 0.3 to 0.4 mm.

DOPPLER fibra 0.32mm

0.30mm, 0.35mm and 0.40mm carbon reed valve

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4.2 Materials

Stainless steel: Avoid using it, as steel is heavier and exposes the engine to the risk of breakage in the event of a blade fracture.

Fiberglass: Excellent value for money. In addition to being cheap and easy to find, they are light and flexible, adapting very well to light and moderate preparations.

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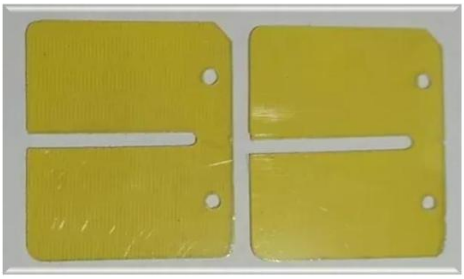

Carbon fiber: The best material available today, allowing for thin, lightweight construction with high mechanical strength. Use in heavy-duty applications where high RPMs are the focus.

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4.3 Ideal Size

Michael Forrest stated that the biggest bottleneck in two-stroke engine fuel flow will always be reed torque, as the engine needs to have a pressure lower than atmospheric to flex the reeds and admit the mixture. This means that reed torque is what limits the intake of mixture into the crankcase, as the reeds are normally closed. For air to enter, a force must be exerted on the reeds to open them. According to him, the carburetor is not and never has been a detractor of engine flow. If we use a smaller carburetor, air will pass through it more quickly, but not impede it.

Therefore, the ideal vane torque setting will depend on the application. For tuned engines, we prefer larger torque settings to minimize flow restriction. However, we need to be aware that whenever we increase the torque setting, we also increase the vanes. And it's important to understand that the larger the vanes, the more difficult they will be to open and close. To correct this, we prefer larger torque settings, but with smaller and more numerous blades. In the photo to the side, we see a torque setting with 16 blades.

Imagine you want to light a fire and come across a large pot lid. As you shake it, you realize you have difficulty moving it quickly, and to do so, you'll have to exert a lot of effort. This is due to air displacement, and the larger the lid, the harder it will be to move. The same goes for the blades; the larger they are, the harder they

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will be to move. They may seem small, but when the motor is at 13,000 RPM, the blades open and close 216 times per second.

Knowing this, we need to understand that smaller blades will move faster and benefit high RPMs without compromising low and mid-range RPMs. We also need to understand that the higher the torque and the more blades it contains, the less the blades will have to open to allow the same mass of air/fuel to flow. This means that, if they open less, the distance to close again will be shorter. This allows them to work faster and with less effort, as they bend less.

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4.4 Drivers

Whenever possible, use a flow control valve, as it not only improves flow direction but also takes up unnecessary space within the pyramid. In the countless dynamometer tests I've conducted, the flow control valve always provides benefits.

4.5 Preparing the vane torque

Modern reed torque wrenches already come with every possible improvement. However, older ones can be improved to increase flow.

In the photo below, we can see the dotted line, increasing the flow area. Be careful not to remove so much material that the reed no longer seals. After finishing the work, remove the burrs to allow perfect contact between the petals and the torque.

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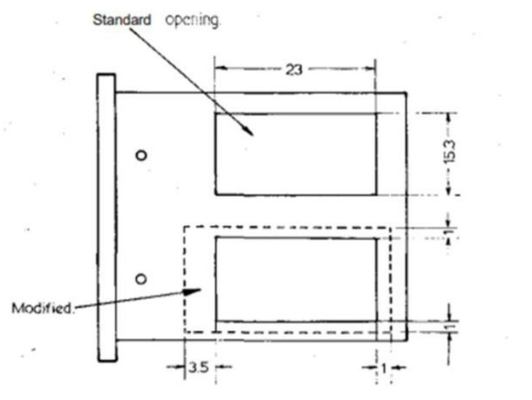

4.6 Limiters

Some reed wrenches have smooth, hole-free stops. Imagine joining two wet surfaces and trying to quickly separate them. You'll notice how difficult it is. The same thing happens when the reed touches the stop; it tends to get stuck, preventing it from closing quickly. To solve this, we can drill holes in the stops, just like the wrench below.

Be careful to remove any remaining drilling burrs from the restrictors, as they can damage the blades. The restrictors can be opened until they touch the crankcase, fitting snugly against the aluminum walls, which typically have a similar shape. However, be aware that your reeds don't open as wide as you might think; they only open about 2 to 3 mm at high RPM due to the limited time they have for this function. The mixture

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passes through this small opening at high speed to compensate for all the air and fuel mass your engine requires. This is why Michael Forrest warns that the biggest restrictor in the fuel system will always be reed torque.

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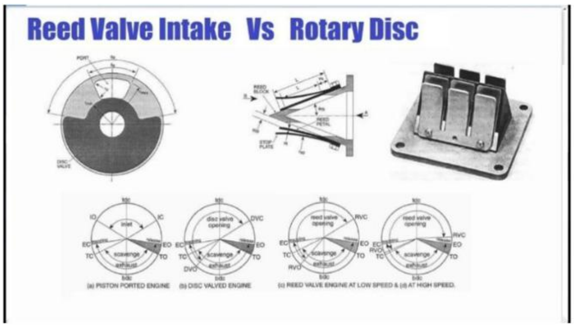
4.7 Piston port x vane torque x rotating disc

We won't cover the rotary disc here, as it has fallen into disuse due to its high manufacturing cost and its performance is comparable to that of current vane torques due to technological advancements. So much so that most modern high-performance engines use vane torque.

But for information purposes, the rotating disc performs best close to the engine's maximum torque range, where it is working at its maximum efficiency and at this point, the disc will be 100% open, without any restrictions.

Vane torque, on the other hand, performs better before and after the torque band, improving the power curve. This is because torque has the ability to "sense" the lower induction pressure and leave the path open to flow. The diagram below illustrates the differences in how they operate.



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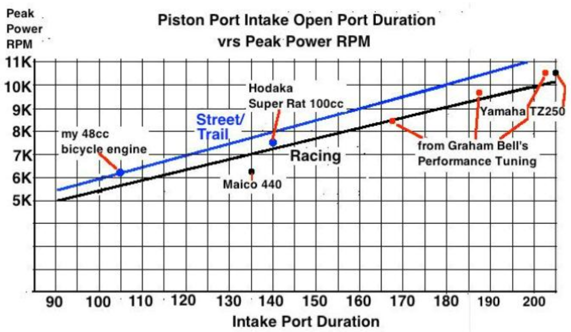
In the image below you can see some suggestions for piston duration port , that is, piston-controlled intake inlet, with trail and racing application for several different RPMs.



4.8 Final Considerations

In my experience, whenever we increase the reed stroke size, add better reeds, and add direction switches, the results are positive. A practical example is a Husqvarna TC300 I received from a friend that was having tuning issues, skyrocketing at low RPM. I determined the problem was the Vforce torque manifold, which was warped and not sealing properly. This causes backflow at low RPM, where the mixture ends up back in the carburetor, passing through the venturi twice, and becoming too rich. The engine loses low RPM, and the only way to maintain idle is to raise the carburetor gate to maintain idle. However, when

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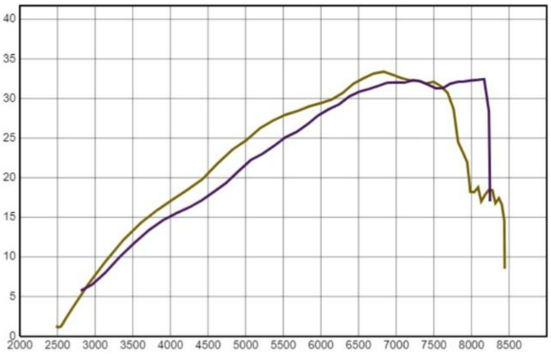
accelerating and releasing throttle, because the engine 's gate is too high, the engine doesn't return to idle and accelerates, as if you were still accelerating. But before changing the reed torque, I ran it on the dyno for reference. Unfortunately, we couldn't find the original torque wrench to replace it, and since he had planned a trail of another 100km and was eager to participate, I adapted a much smaller original RD350 reed torque wrench. The bike's low revs were resolved, and then I ran it on the dyno to check the power loss. Nothing other than the reed torque was changed, so the loss is a practical result of what the torque size and number of reeds generate in a two-stroke engine.



Husqwarna 300 reed torque in brown against original RD350 in blue.

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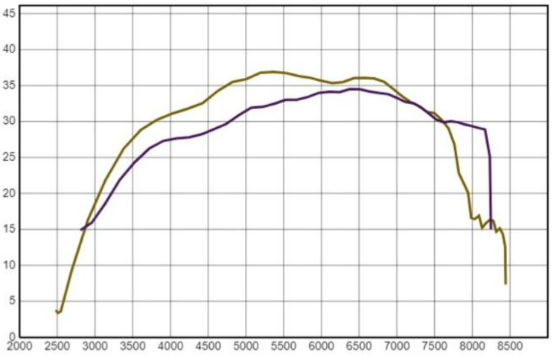
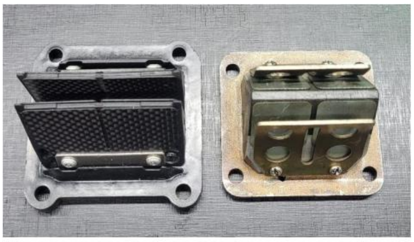


Husqwarna 300 reed torque in brown against original RD350 in blue.



VForce Reed Torque (KTM 300 Line) vs. Stock RD350 The power difference wasn't that noticeable, but the torque changed significantly. I felt a big difference in how the engine accelerated the roller with VForce torque and how much it took to accelerate the roller on the dyno with the lower torque. The bike's owner felt a significant loss when he first tested it, but he was aware

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of the workaround we had to implement. It's better to lose power than to run with the engine over-revving, risking failure. He managed the long trail without any problems, and I'm waiting for him to bring me the bike and new torque so we can regain all the power that engine can deliver.

Chapter 5 – Cylinder Head

The squish band we call Squish has many functions as we will see below:

CRUSHING BAND

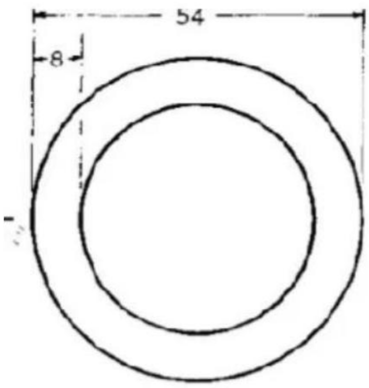

Fig. 2.4 A 50% squish band.