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Considering that we increased the height of the cylinder, we will also have a greater distance between the piston and the cylinder head.

We can fix this in two ways:

Making a pass at the top of the cylinder: We can lower the height of the cylinder with a plane at any engine grinding shop.

Machining the head: We can machine the head and lower the squish so that it fits inside the cylinder and corrects the height.

Chapter 10 – Cylinder – Piston

10.1 Introduction

The piston is a critical item in a two-stroke engine and is usually the one that will suffer damage if errors are made during normal use or when preparing the engine.

It's made of aluminum due to its weight, as it travels inside the engine, accelerating and decelerating at incredible speeds. We have a speed of 20 m/s as a physical limit to how much it can accelerate, unless we use high-quality materials in its construction. Exceeding this speed limit can cause it to fracture and break.

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Some manufacturers use a ceramic coating called Cerakote . It's applied to reduce friction between the piston and cylinder. However, it's important to be aware that this coating has a lifespan and that the piston needs to be replaced after a certain amount of use. This practice of replacing pistons and rings is common in karts due to their extreme use.

10.2 Features

Pistons have two unusual features:

Taper: The entire piston is conical. When the piston compresses the mixture and combustion occurs, its top is exposed to high temperatures from the flame front. As we know, all material expands when heated. If the piston crown had the same clearance as the bottom of the cylinder, it would seize, as this clearance is typically centesimal. This is why the piston has a larger clearance at the top, which is around 1 to 2

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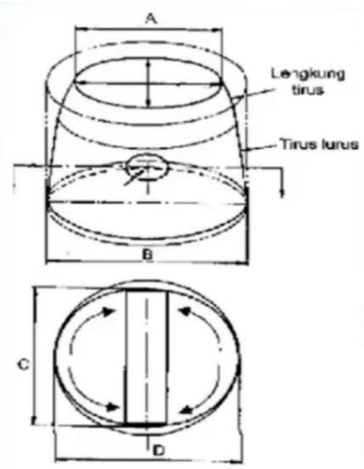
tenths of a millimeter relative to its skirt. This taper depends on several factors, such as material type, piston diameter, and piston height. As the piston descends, the head can transfer heat downward and cool itself through the contact of its sides with the cylinder. We need to understand that this clearance is larger when the engine is cold, and the calculation for measuring the clearance size assumes a hot engine. With this in mind, we need to understand that, until the engine warms up, there will be excessive clearance and that accelerating the engine to high rpm is not recommended. In performance engines, it is recommended to preheat the engine before increasing the revs to higher speeds.



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Ovality: Piston ovality also relates to the thermal expansion of the aluminum. Note that there's more material on the sides where the pin holes are located than on the front and back of the piston. Since there's more material there, it will also expand more. The extent of ovality depends on the type of material and the amount of aluminum in the pin area and ranges from a few hundredths to tenths of a millimeter, depending on the piston diameter.

10.3 Number of rings

Pistons are available with one or two rings. The difference lies in the engine's operating speed. Engines operating at low-revving torque require two rings, as combustion pressure can leak through the ring gap before the piston actually descends.

For engines operating at higher engine speeds, the piston speed is so high that there is no time for compression to leak and the piston is already on its way down.

I suggest using pistons with two rings for engines that work up to 10,000 RPM and one ring for engines above that.

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10.4 Failures

We can diagnose engine failures through the signals left on the piston, and we will now look at some of them.

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Piston melting is caused by several reasons:

1. Lean mixture: A lean mixture generates a hotter and faster flame front, which reaches the piston faster than it normally would. For this reason, it's crucial to get the mixture right, as we learned in the carburetion section.
2. Excessive compression ratio: a compression ratio higher than specified generates pre-ignition, which advances the flame front and causes overheating of the combustion chamber;
3. Advanced ignition timing: an ignition timing that is advanced beyond what is necessary generates a flame front before it should be and overheats the combustion chamber.
4. Squish speed too high: Excessive squish speeds cause pre-ignition and consequently an increase in chamber temperature.

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A stuck piston can be caused by two factors:

1. Lack of oil or insufficient oil: normally when we find a stuck and completely scratched piston, it is a sign that the engine has been running dry,

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that is, without oil or with a smaller quantity than specified for the application of that project.

2. Overheating: An engine may run incorrectly for a period of time, causing the internal temperature to rise to such an extent that the oil film evaporates. This can cause complete or partial piston seizure. When the piston is marked on all four corners, it means it has heated up and expanded to the point where it seizes where the cylinder expands least, which is at the studs' position. Overheating can be caused by the same reasons we saw in the previous failure, but at a lower intensity, so much so that it doesn't melt the piston but overheats the engine until failure occurs. Causes include a lean mixture, excessive rate, advanced ignition timing, and squish speeds above the limit.

Piston crown corrosion is caused by detonation or pre-ignition and ultimately results in a blasting effect on the piston crown. Detonation in this case isn't severe

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enough to result in a major failure, but over time it leaves an unmistakable mark. Pre-ignition, on the other hand, originates from a hot spot within the chamber, such as carbon residue that becomes incandescent and is sufficient to burn the mixture before the spark generated by ignition.

Piston breakage is caused by excessive clearance between the piston and the cylinder. This error is common when the cylinder is rebuilt and the regrind shop miscalculates the correct clearance for the assembly. I recommend always checking the clearance before shutting down the engine. Consult the service manual for specifications.

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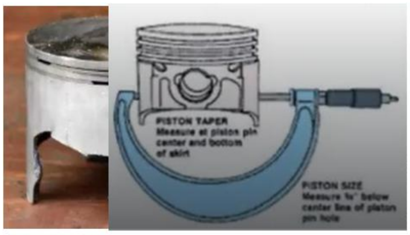
Cylinders with Nikasil or hard chrome already come with the correct clearance from the factory, but it's always recommended to check it whenever possible. I've seen domestic cylinders with incorrect clearance. Excessive clearance allows the piston to "slam" the skirt against the cylinder, creating fractures that will eventually lead to breakage.

The piston is always measured by the skirt, at the front and rear, since, as we saw earlier, it is oval and smaller on the sides. Always measure 10 mm above the skirt. The piston is measured with a micrometer and the cylinder with a caliper. Any reputable grinding shop has both of these measuring instruments and can calibrate your cylinder and piston.



10.5 Piston preparation

Let's start preparing the piston by chamfering the ring groove.

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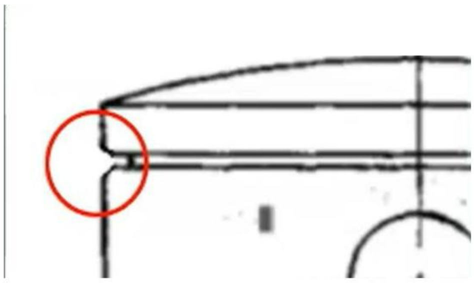
This chamfer serves to prevent the ring from getting stuck on the edge of the groove if any piston material were to move and close the opening.

Another benefit is that we create an oil deposit close to the ring, which benefits lubrication and sealing between the ring and the cylinder. We can make this chamfer on a lathe or with a file with a triangular profile.



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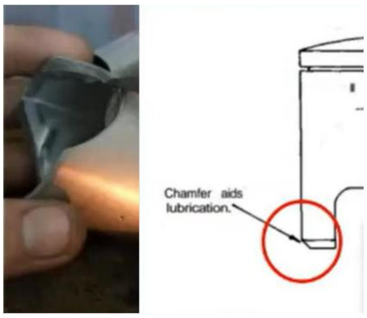
Next, we'll chamfer the entire diameter of the piston skirt. This chamfer serves to force oil into the piston for lubrication whenever the piston descends. This improves lubrication between the piston and cylinder, as well as bringing oil to the ring and improving sealing. This chamfer can be made on a lathe or with a grinder. Pistons without this chamfer end up closing the ring and preventing it from working properly, as part of the piston's material is dragged along during the upstroke and downstroke, creating a barrier that closes the ring. If the piston already has the chamfer, there's no need to do it.



Another important point in cylinder preparation is to observe, when the intake port is through the crankcase, whether the piston skirt obstructs the mixture flow, as shown in the photo below. If this is the case, remove the cylinder and mark the rear opening of the cylinder skirt on the piston with a pen.

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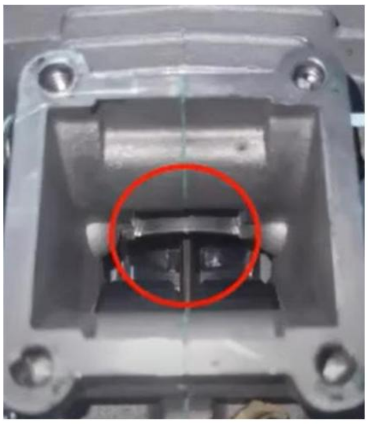

Using the grinder, carefully remove material from the piston skirt to avoid letting it slip and scratching the piston. After that, re-chamfer the oil inlet between the piston and cylinder and finish the final step.

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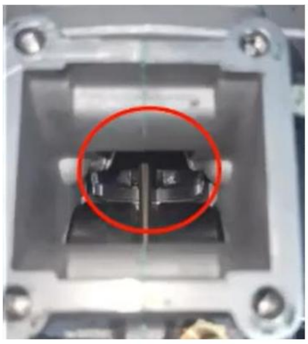
After this, reassemble the engine and check that the passage is clear. This improves the flow to the rear window when the piston descends and when a vacuum is created in the cylinder due to suction from the exhaust diffuser.



The “piston holes," as they're called, are lubrication holes for double-hung escape windows. These holes lubricate and cool the window partition, extending the life of the ring.

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These holes do not have a specific height position, but they do have an exact horizontal position, as they need to be exactly aligned with the window beam, otherwise we will lose mixture to the exhaust and not lubricate the beam.

To make the correct marking, assemble the engine and through the exhaust port outlet, mark the position of the stud on the piston with an overhead projector pen.

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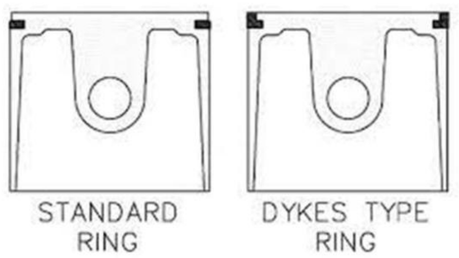
Chapter 11 – Cylinder: Rings

11.1 Types

Rings come in a variety of shapes, models, materials, and fit types. Let's first discuss the types available. Basically, they don't vary much in shape, except for the Dykes type, which has an L-shape. This model has a higher side and receives compression from the combustion chamber to increase cylinder sealing, as the pressure applied to the internal part forces it against the cylinder wall.



The others are flat and do not change their geometry much.