

Pistons making step

Foundry

The foundry is the beginning of the piston. At the foundry the die is prepared by heating it to operating temperature for approximately one hour. This process allows the die to readily accept the molten material when it is poured.



The material

The material used is a 10% silicon content aluminium.



The die

The dies used are 5 piece and three piece. These dies are made from cast iron with steel inserts for the gudgeon pin holes and the cores. The cores dictate the placement of the gudgeon pin and can be located to give offset pins or square pins.



The process

The process starts by heating the material to 700 degrees Celsius. This is well above the melting point of the aluminium, but below its boiling point. The material is then scooped up with a ladle from the crucible (the pot that holds the molten material). This is then poured into the die through the sprue. The material is then allowed to cool before it is removed from the die and placed into a bin of hot water. This water is used to facilitate a more even settling of the hot metal.

After the castings have had time to cool they are placed into a heat treatment plant overnight. This process tempers the casting and ensures the piston will have improved qualities.

After it is removed from the heat treatment the casting has its runner removed.

This process takes little time and is fully automated.



Pin Boring

At this stage of the piston manufacturing process the casting has the gudgeon pin hole rough machined and the locating bung machined.

The bung

This process is where the casting is machined on the base to allow placement

of the casting in other machines. This is carried out on a simple lathe.



The pin bore

Pin boring is done in conjunction with the bung turning, as one casting is removed from having the bung face machined it is placed on the pin borer. The pin borer is only a rough machining process which allows the reamer to enter the gudgeon hole later.

CNC Turning

Turning of the casting is carried out on CNC (Computer Numeric Control) machinery. This equipment is the most accurate and fastest available for this application with very tight tolerances and extremely fast spindle speeds. The castings are placed in the lathe on a bung and held in place by a solid rod through the gudgeon pin hole. A draw bolt is activated in the chuck which draws the rod toward the chuck and holds the piston in place.



The lathe is then started and the machining cycle begun. This cycle is programmed into the lathe in a basic language called G-Code (this code is not the only one available). G-Code has basic commands to tell the lathe to move to certain positions (X,Y,Z co-ordinates), at particular spindle speeds (eg

S2500 means spindle speed 2500rpm), at particular feed rates (eg G01; rapid traverse) and other commands such as M01 (repeat programme) and others. As you can see this is a simple system to learn and implement. After the piston is machined it is removed from the lathe and the part number stamped on the crown (top) of the piston.



The piston is now ready for the finishing processes.

Drilling

The first stages of the finishing process include drilling, slotting, valve and crank relieving.

Drilling

Drilling includes all oil holes in places such as the gudgeon pin bosses and oil ring grooves.

Slotting

Slotting is where slots are placed in the skirt or in the oil ring groove.

Valve relieving

This process is done on a mill and involves setting the machine up for the process, choosing the correct cutter and completing the job. Since there are so many different types of valve reliefs it is impossible to have a specialised machine set up to do one job.

Crank relieving

Crank relieving is carried out on a specialised machine which scallops the skirt of the piston to the required shape and depth by using two opposed cutters placed on a common shaft.

Grinding



This process involves the final size being machined on the piston. The grinder machines the skirt of the piston only and in the majority of cases is cam ground. Cam grinding ensures the piston will "grow" evenly in the bore of the engine. A perfectly round piston will expand unevenly during use because of the uneven placement of material in the casting (gudgeon pin bosses and ribbing used for strengthening).

Reaming



The final machining process for the piston is that of reaming. This process involves the piston being placed in a bath of oil and reamed at different sizes to reach the final size required. Since the pin boring process is only rough it is necessary to ream the pin bore a number of times to achieve the surface finish and size required. Reaming is not a fast process and is only partially automated (there are automatic feeds on the reaming machines). Tolerances achieved on the finished reamed surface is 0.4Ra.

Pin Fitting and Final Inspection

At this stage the piston is cleaned, fitted with the appropriate gudgeon pin, stamped with the pistons' oversize and any other markings, and then sent to despatch.



Despatch

Finally, the piston is wrapped and placed in the shipping container with the ring set and sent to the customer.