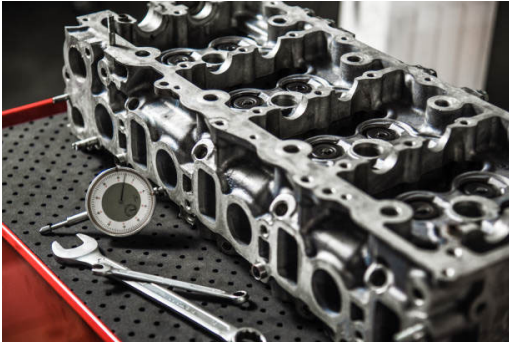


CYLINDER HEAD

➤ Function



"The cylinder head is a component of an internal combustion engine that sits on top of the engine block. The main function is to close off the cylinders and create a combustion chamber.

Fuel and air are mixed and ignited by the spark plugs to create a controlled explosion in combustion chamber, which generates power to move the vehicle. The cylinder head is designed to withstand the high temperatures and pressures generated during the combustion.

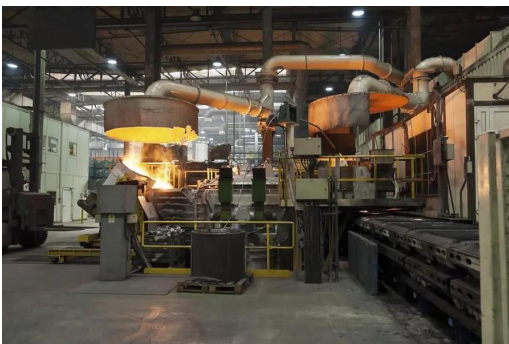
The cylinder head also contains intake and exhaust ports that regulate the flow of fuel and air in and exhaust gases out of the engine. In addition, it houses the valves, which open and close to regulate the flow mentioned.

The cylinder head is typically made of aluminum or cast iron and is attached to the engine block by bolts and gaskets. It is an essential part of the engine and plays a critical role in its proper operation."

➤ Classification

"Cylinder heads can be classified based on various factors, such as the type of engine, the number of cylinders, the arrangement of valves, and the type of fuel delivery system. Here are some common classifications:

1. Based on the engine type: such as gasoline or diesel types cylinder head, depending on the fuel used.
2. Based on the number of cylinders: such as single-cylinder, twin-cylinder, four-cylinder, six-cylinder, or more cylinder head.
3. Based on the valve arrangement: such as OHV (overhead valve), OHC (overhead cam), or DOHC (dual overhead cam) cylinder head, depending on the location and number of camshafts in the engine.
4. Based on the fuel delivery system: such as carbureted or fuel-injected cylinder head.



5. Based on the combustion chamber shape: such as wedge-shaped, hemispherical, or pentroof-shaped cylinder head.

6. Based on the material: such as iron or aluminum cylinder head. Aluminum heads are typically lighter and provide better heat dissipation, which improves engine performance.

The classification of cylinder heads can vary according to the engine manufacturer and the type of vehicle application."

➤ Manufacturing process

"The process to produce a cylinder head can vary depending on the type required, the material used and the manufacturing process. Here are some common steps in the manufacturing process:

1. Design: This requires an engineer to create a 3D model of the cylinder head by CAD software, ensuring that the head meets the precise specifications required by the engine manufacturer.
2. Casting: This involves the creation of a mold, which is filled with molten metal, typically aluminum or iron. Once the metal has solidified, the mold is removed, leaving the finished cylinder head.
3. Machining: the head shall be machined to ensure that it meets the precise specifications required by the engine manufacturer. This involves the use of a CNC machine to remove any excess material and create the necessary features, such as the valve seats and the combustion chamber.
4. Finishing: this process include cleaning, polishing, and painting. The final step ensures that the cylinder head is not only functional but also aesthetically pleasing.
5. Inspection: Before the cylinder head is assembled into the engine, it must be thoroughly inspected to ensure that it meets the required quality standards. This involves measuring and testing the cylinder head for any defects that could cause issues in the engine.



Overall, the process of producing a cylinder head requires a high degree of precision and expertise at every stage of the manufacturing process."

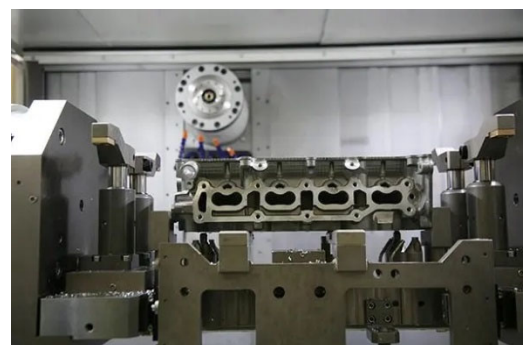
➤ **Material**

The main material used for cylinder head is typically a type of cast iron or aluminum alloy. The choice of material depends on factors such as the engine's performance requirements, weight limitations, and cost considerations. Aluminum alloy is often preferred for high-performance engines due to its lightweight and excellent heat transfer properties, while cast iron may be used for more general applications due to its durability and lower cost. Some modern engines may also use composite materials or other advanced materials for the cylinder head.

➤ **Processing equipment**

"Cylinder heads are typically produced using specialized machines that can accurately shape and finish the complex contours of the head. Some of the main production machines used for producing cylinder heads include:

1. CNC machines: use programmed instructions to move and shape cutting tools, enabling precise and repeatable machining of complex parts like cylinder heads.
2. Milling machines: to cut and shape metal parts, including cylinder heads. Horizontal milling machines, which use a horizontal spindle to move the cutting tool, are commonly used for cylinder head production.
3. Grinding machines: to finish cylinder head surfaces to the required level of smoothness and flatness. Cylinder head gaskets require a perfectly smooth and flat surface for sealing.



4. Valve seat and guide machines: to precisely shape and finish the valve seats and guides in the cylinder head. This is critical for ensuring proper valve operation and sealing.
5. Cleaning machines: to remove any debris, grease or oil from the cylinder head before it is assembled into the engine. This is important to prevent any contamination that could damage the engine or reduce its performance.



Overall, the manufacturing process for cylinder heads involves several machines working in tandem to create precise and reliable components."

➤ Testing

"The main inspection equipment for producing cylinder head includes:

1. Coordinate Measuring Machine (CMM): CMM is a precision measuring device that accurately measures the geometrical characteristics of the cylinder head. It is used to ensure that the cylinder head meets the required design specifications and tolerances.
2. Surface Roughness Tester: This equipment measures the surface roughness of the cylinder head. It is used to ensure that the surface finish of the cylinder head is within the acceptable range.
3. Hardness Tester: It checks the hardness of the cylinder head. It is used to ensure that the cylinder head has the required strength and toughness.
4. Ultrasonic Testing: Ultrasonic testing is a non-destructive testing technique that uses high-frequency sound waves to detect internal defects in a material. It is used to detect any internal defects in the cylinder head.
5. Optical Comparator: Optical comparators are used for dimensional inspection and measurement of the cylinder head. They use magnifying lenses and light sources to produce a highly magnified image of the part being measured.

Overall, these inspection equipment ensure that the produced cylinder head is of high quality and meets the required specifications."



➤ Failure Mode

"Some possible failure modes and causes of cylinder head failure include:

1. Cracks: Cracks can appear in the cylinder head due to excessive heat, pressure, or vibration as well as manufacturing defects or stress concentration.
2. Warping or distortion: Warping or distortion is due to overheating, uneven heating, or faulty installation.
3. Leaking gasket: Gasket failure can result in oil or coolant leaks, which can cause engine damage. This can occur due to overheating, improper installation, or using an incorrect gasket.
4. Valve seat recession: Over time, the valve seats in the cylinder head can wear, leading to reduced compression and power loss.
5. Corrosion: Corrosion can occur due to exposure to moisture, salt, or other corrosive substances.



6. Erosion: Erosion can occur due to the flow of hot gases over the surfaces of the cylinder head, especially in high-performance engines.
7. Detonation or pre-ignition: Detonation or pre-ignition can damage the cylinder head due to excessive pressure or heat.
8. Fatigue failure: Cylinder heads can fail due to repeated thermal and mechanical stress, leading to fatigue failure.

To prevent such failure modes from taking place, proper installation, maintenance and regular inspection of the engine should be carried out."