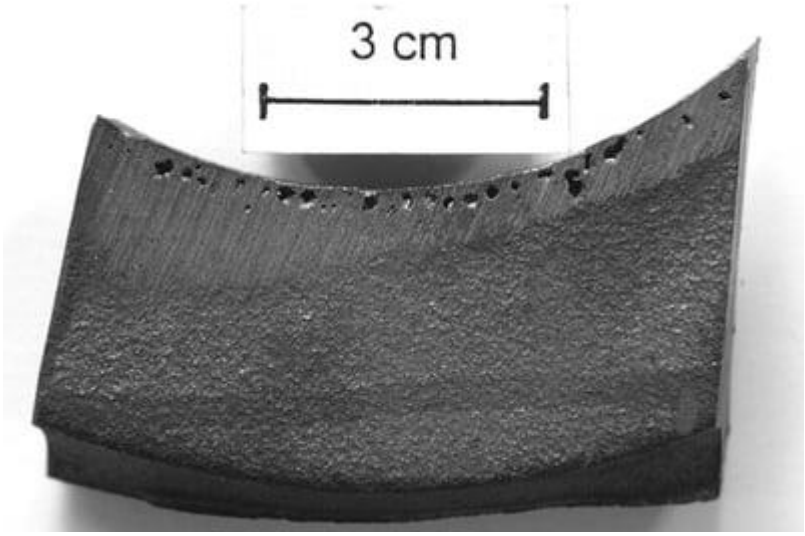
CASTING DEFECTS AND CAUSES

1. Pinholes

Pinholes, also sometimes referred to as ***porosities***, are very tiny holes (about 2 mm) usually found in the cope (upper) part of the mold, in poorly vented pockets.



They usually appear in large numbers together, either at the surface or just below the surface of the casting. They are always visible to the naked eye and don't require equipment to identify.

2. Subsurface blowhole

Blowholes, or simply blows, are larger cavities than pinholes.

A subsurface blowhole appears on the inside of a cast and usually isn't visible until after machining.

Subsurface blowholes can be difficult to detect before machining, requiring harmonic, ultrasonic, magnetic or x-ray analysis.

3. Open holes

These blowholes appear on the surface of the cast and are easier to detect than subsurface blowholes.

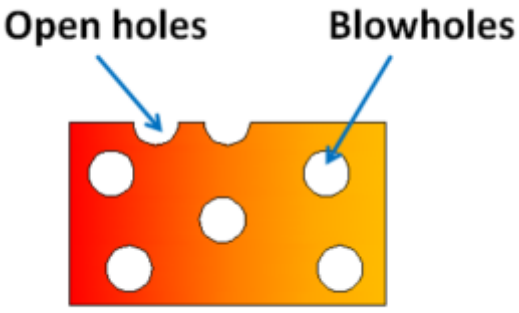
Causes and prevention of gas porosity

There are several causes of cavity defects.

- Poor venting of mold and cores
- Insufficient drying of mold and cores

How can you prevent gas porosity?

Scars are shallow blows that appear on a flat surface, while ***blisters*** are scars covered with a thin layer of metal.



- Excessive moisture content of molding sand
- Inadequate gas permeability of molding sand

Potential solutions include:

- Incorporate good fluxing and melting practices: melt metal in a vacuum, in an environment of low-solubility gases or under a flux that prevents contact with the air
- Increase gas permeability of sand: coarser sands have a higher permeability
- Increase permeability of mold and cores. Allow air and gas to escape from the mold cavity
- Dry out molds and cores before use and store dry
- Increase rate of solidification by reducing metal temperature during casting

SHRINKAGE CASTING DEFECTS AND CAUSES

Shrinkage occurs because metals are less dense as a liquid than a solid.

A shrinkage cavity is a depression in a casting which occurs during the solidification process. Shrinkage porosity appears with angular edges, compared to the round surfaces of gas porosity. Cavities might also be paired with dendritic fractures or cracks.

Large shrinkage cavities can undermine the integrity of the casting and may cause it to eventually break under stress.

Shrinkage can result in two types of casting defects.

4. Open shrinkage defects

These are open to the atmosphere. Air compensated as the shrinkage cavity forms.

Pipes are open shrinkage defects that form at the surface and burrow into the casting. ***Caved surfaces*** are shallow, open shrinkage defects that form across the surface of the casting.

5. Closed shrinkage defects

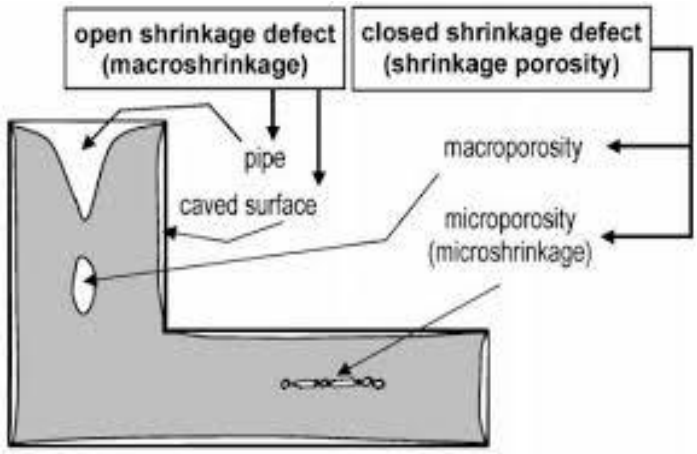
Also known as ***shrinkage porosity***, closed shrinkage defects form within the casting. Macro shrinkage can be viewed with the naked eye, but micro shrinkage cannot.

Closed shrinkage defects usually appear at the top of hot spots, or isolated pools of hot liquid.

Prevent shrinkage cavities by improving casting structure

Alloys always shrink when changing from molten to solid. This is because the density of a casting alloy in the molten state is lower than that in the solid state.

You should expect some shrinkage during solidification. Factor a shrinkage allowance into the pattern design before casting.



You can prevent shrinkage casting defects by improving the overall casting structure:

- Design a running (gate) system with risers that ensure a continuous flow of molten metal
- Increase local heat dissipation by inserting internal chills, cooling ribs or cooling coils
- Reduce casting temperature to limit the total volume deficit

MOLD MATERIAL CASTING DEFECTS AND CAUSES

Mold material casting defects are related to the mold material, which is most commonly sand. You and your supplier can typically address these casting defects and causes by modifying the mold.

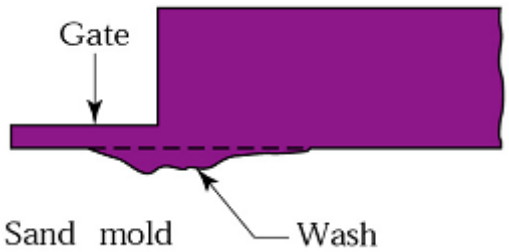
6. Cuts and washes

Cuts and washes are areas of excess metal. These appear when the molten metal erodes the molding sand.

A cut appears as a low projection along the surface of the drag face, decreasing in height as it extends from one side of the casting to the other.

Causes and prevention of cuts and washes

Cuts and washes can be caused by molten metal flowing at a high velocity, causing too much metal to flow through the gate.



You can prevent cuts and washes easiest by:

- Designing the gating system properly
- Improving mold and core strength
- Adding more binders to the facing and core sand

7. Fusion

Fusion occurs when sand grains fuse with molten metal. It appears as a thin crust with a brittle, glassy appearance firmly adhered to the casting.

Causes and prevention of fusion

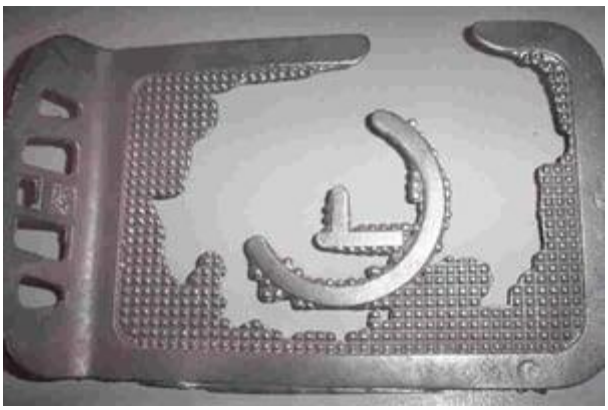
Two main factors can cause fusion:

- Low refractoriness of clay or sand
- Too high pouring temperature of molten metal

Refractoriness is the ability of the molding material to resist the temperature of the liquid so it doesn't fuse with the metal. Silica sand has the highest refractoriness.
Improving the refractoriness of the molding material and/or reducing the pouring temperature of the molten metal will help prevent fusion.

8. Run out

Run out is when liquid metal leaks out of the mold, leading to an incomplete or missing casting.



A faulty mold or flask is responsible for run out.

Prevention of run out and incomplete castings

To prevent this casting defect, design the casting mold with precision. Inspect and replace any defective molds before casting.

High temperatures can lead to excess wear and tear of the mold. Use quality raw materials for your mold that can resist high temperatures.

9. Swells

Swells are an enlargement of the casting. Swells typically take on the shape of a slight, smooth bulge on the vertical face of castings.

Causes and prevention of swells

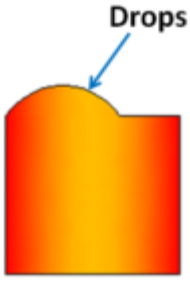
Swell is usually caused by improper or soft ramming of the mold or a low strength mold.

Molds should be built to withstand liquid metal pressure. Otherwise, the mold wall may give way or move back, causing swelling.

Using a strong, properly rammed mold prevents swells.

10. Drops

Drops occur when pieces of sand fall into metal casting when it's still liquid. Drops appear as an irregularly shaped projection on the cope (top) surface of a casting.



Causes and prevention of drops

Four potential causes for drops and their preventions include:

- **Low sand strength:** Use sand of a higher strength if this your culprit
- **Soft ramming:** Provide harder ramming
- **Insufficient fluxing of molten metal**: Properly fluxing molten metal removes impurities
- **Insufficient reinforcement of sand projections in the cope**: Reinforce sand projections using nails o