VENTING...
A LOST ART

With venting still far too often neglected today, this article provides recommendations and guidance for proper practice.

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Gas Evolution

As the mold is filled with metal, the heat preceding the metal and the heat penetrating the surface of the mold and core drives gases off from the mold and core. In general, these gases are generated at low temperatures and, because of their substantial volume, fill into the mold cavity because it offers the least immediate resistance to their flow. The gas pressures within the mold cavity are therefore increased and must be offset by the entering metal. This now makes it more difficult to fill the mold cavity, particularly during the last stages of filling after the casting has been poured, and are of little or no concern to the filling of the mold cavity. Only after these gases have developed substantial pressures will they enter the metal after the mold cavity is filled. On the other hand, the mold itself may be vented to permit the ready escape of gas. It should be noted, however, that when these vents are filled with metal, they are no longer effective as mold vents.

Usually, these vents are placed at the upper sections of the mold cavity where they also serve to indicate when the mold has been filled with metal functioning as "flow-off." If a substantial amount of gas is evolved during mold filling (such as when a core is surrounded with metal), precaution must be taken against erosion of the core or mold at the vent by the escaping gases. Also, care must be taken against distortion of the mold cavity due to the pressures involved.

The generation of gases within the mold can develop backpressures that affect the rate of mold filling even to the point of negating the designed choke in the gating system. This fact, coupled with the decreased flow rate experienced during the latter stages of the
mold filling, require that the sprue be maintained full at all times to affect the greatest possible pressure on the metal during the final stages of pouring. This is particularly significant in vertically parted molding because the volume flow rate of the metal being poured varies widely with changes in the hydraulic head, and the hydraulic head is usually quite small near the end of the pour. Incomplete filling of the mold, surging of metal flow that makes it appear that the mold cavity is filled, and entrapped gas pockets in the mold cavity may result if these precautions are not heeded.

Permeability

The screen distribution of the sand and its degree of compaction of the mold or core can significantly influence its permeability and the ease of gas flow through the sand (Table 1). Although green sand can have a permeability value as high as 110, the gas evolved during casting may be unable to pass through the sand mass rapidly enough to avoid blowholes or other related defects. A properly formed vent channel would then be required. Gas cannot pass through a sand mass as speedily and effectively as through a properly formed vent channel, regardless of the permeability of the sand. Additionally, the application of a core/mold coating greatly reduces permeability. For this reason, cores that are coated may only be able to vent through their prints—making properly designed vent passages essential. Poor vent connections and partial or complete blockage of vents increases the risk of producing castings without defects. Core prints should be a good fit into the mold, otherwise metal can penetrate into—and partly or completely block the vent channel.

Pressure buildup in the mold (backpressure) changes with grain fineness, amount of compaction and the amount and decomposition of binders and additives. These factors change the permeability of the mold, which can vary widely, thus causing pouring time to also vary due to this backpressure. This variation in pouring time is the reason for casting problems with surface finish and other related quality problems. Venting can reduce or even eliminate this pouring time variation and subsequent defects. Figure 1 illustrates the issues that must be considered when developing a venting system in both horizontally and vertically parted molds. Also listed are the defects that will occur as a result of improper venting.

How to Vent

Vents and vent locators for manual venting must be mounted directly on the pattern whenever possible. On molds that require manual venting, special instructions should accompany the process sheets as to the size, number and location of the vents. Figure 2 shows some of the locations and types of vents to be used on both horizontally and vertically parted molds.

Rod-formed vents are round, cylindrical holes or passageways that extend through the core. There are several methods for making channels or open passages in cores using rods or wire. Textile tubing is an all-purpose venting material that is suitable for use with cores/molds for baked or no-bake binder systems. The textile tubing is placed in the core or mold during its production where it remains to provide a flexible internal passage for gases to escape.

Vents can also be formed in cores

![Fig. 1. This list indicates key considerations when venting horizontally and vertically parted molds, as well as defects that can occur from the lack of venting and improper venting practices. (1995 S-M Committee Cast Facts)](image1)

![Fig. 2. These drawings illustrate some of the locations and types of vents to be used on horizontally parted (l) and vertically parted molds. (1995 S-M Committee Cast Facts)](image2)
11 Helpful Hints and Suggestions for a Successful Venting Program

It is bad practice to provide an efficient vent system and then not provide the means for the gas to escape quickly through the mold wall.

When vents are connected from core to core or core to mold, the vent apertures must be in correct alignment; otherwise partial blockage of the vent system can result in the buildup of backpressure— with a possibility of gas breakout at the connections.

The mating faces of prints must not be damaged, troweled or badly formed, otherwise when a sealant or adhesive is used, there is a possibility of gas escaping into the metal, with the formation of a blowhole and/or inclusion defect.

The use of a bent or drill or a drill running eccentrically can produce too large a vent cavity, or even break the print. An oversized hole in a small diameter print can result in a poor seating condition due to a reduction in the face area.

Fig. 3. One method of venting a core is to fix it in a tool and drill a passageway.

Vent systems must be effectively sealed from core to core or core to mold by the use of an adhesive, sealant or filler. This must be applied in such a way that it is not subsequently squeezed into the vents when cores are assembled, or when the cope mold is positioned, as this would obstruct the free escape of gas either partly or completely.

To provide an adequate vent, it is often necessary to have the vent passing right through a core, and then seal both ends and drill into the central vent through the print. The exposed holes must be plugged— either a correctly shaped piece of core, or sealant or filler—and then the material must be well dried.

All loose sand must be blown from vent passages after drilling or cutting of vents in cores and molds.

When prints are coated and do not contain a vent hole, the print face must be ground to remove all traces of the coating material. Otherwise, the permeability will be virtually nil, and the print will become ineffective for gas escape.

If a coated print contains a vent, then it is necessary to ensure that the coating does not obstruct the vent either partly or completely. The most print face should also be free from any coating material.

If vents are not employed, the largest print area possible should be obtained.

If excess sealant is applied to prints, there is increased risk of partly or completely blocking the vent when a metal vent tube is inserted.

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by:
- drilling the core freehand or holding the core in a fixture and drilling (Fig. 3);
- producing the core with a hollow interior. This is often the norm for shell cores;
- having fixed pins in the core box;
- using a vent imprint board to squeeze-in the vent system while the half-core is still in its "green" or uncured state. Vents can be formed in molds by:
- using inverted "V" or "U" strips on the pattern plate to provide vents on the parting face;
- having fixed vent rods on the pattern;
- using a vent imprint board to squeeze a vent system into the parting face.

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