Chills

For the purposes of this Broadsheet, a chill is a solid shape made of a material with high thermal conductivity, which is incorporated in moulds and cores to accelerate local cooling or alter the metal structure in local areas. Chills are normally produced in grey cast iron—but silicon carbide blocks may be preferred in some instances, especially when they are positioned near ingates, where cast iron would be eroded by the metal stream. Graphite can also be used, but is less efficient than either grey iron or silicon carbide.

When are chills used?

Chills are used to

1. Eliminate porosity, by modifying the solidification pattern.
2. Produce fine graphite structures at surfaces of grey iron castings, so as to increase the hardness and improve the machined surface finish of such castings as machine-tool slideways and glass-bottle moulds.
3. Reduce the difference in cooling rates between thick and thin sections, preventing cracking and warping.
4. Produce carbide or carbide surfaces for wear-resisting applications, as in cast iron rolls and camshafts.

The term densener is sometimes used instead of chill, particularly when the application is as described in 1 and 2 above, and/or when silicon carbide blocks are used.

Types of chill

There are two types of chill

1. Direct chills
2. Internal chills

Direct chills—These are usually located on the pattern prior to producing the mould, so that when the mould is stripped the chills form part of the mould wall, wherever they are needed to accelerate the rate of cooling. They can be shaped to follow the contour of the pattern, the area on the pattern where they are to be placed usually being painted green—or marked in some other distinctive manner.

Chills are normally made of cast iron and are therefore produced by the foundry as required. Rods are frequently cast in the back of chills to provide additional support during use. To be effective, cast iron chills need to be as thick as the sections being chilled. Experience shows that silicon carbide denseners need to be twice as thick and graphite three times as thick as cast iron chills in similar applications.

The effect of a chill is sometimes deliberately reduced by having a layer of sand between it and the mould or core face.

This can be of advantage in cooling the casting without forming surface carbides, and is a technique sometimes used in the production of machine-tool slideways and heavy brake drum castings.

Internal chills—Internal chills are cast-in, and form an integral part of the casting. They are normally used in areas where shrinkage is difficult to overcome by direct chilling. There are two main types of internal chills, nail chills and spiral or spike chills, the latter being made of twisted wire.

Fig. 1 shows a casting section containing nail chills in areas susceptible to shrinkage. Nail or spiral chills can be produced in various sizes and are normally tinned. The efficiency of these chills depends upon their surface area to volume ratio. Where holes need to be drilled into areas susceptible to shrinkage, cast iron rod-chills can be incorporated and subsequently drilled out.

Problems of using chills, and their prevention

Fusion—All external chills should be coated before use, to prevent fusion with the casting. Proprietary coatings can be purchased, or acceptable alternatives are either red iron-oxide in alcohol or normal foundry blackings. Coatings should have low gas evolution and be thoroughly dried before closing and pouring the moulds.
With internal chills, using too large a chill or pouring cold metal produces inadequate bonding.

**Blowholes**—These result from the use of
1. Damp or rusty chills.
2. Undried coatings.
3. Coatings with high gas evolution.
4. Condensation on cold chills in warm greensand moulds.
A typical example of a blowhole resulting from a rusty chill is shown in Fig. 2.
Repeated use of the same direct chills can result in decarburization of the chill surfaces, oxide penetration and craze cracking. Chills should therefore be replaced when the surface has deteriorated extensively.
Blowholes can be prevented by
1. Storing chills in dry conditions and lightly coating in non-mineral oil to prevent deterioration.
2. Not using cold chills in warm greensand moulds.
3. Using dry compressed air if moulds are blown out.
4. Shotblasting chills to remove oxides.
5. Thoroughly drying coatings.
6. Venting chills, by drilling small holes to prevent gas from being trapped inside.
7. Discarding internal chills which have damaged or inadequate plating.
8. Ensuring that segmented chills are placed tightly together, to prevent liquid coatings from penetrating gaps.

**Cracking**—Cracks associated with chilled areas usually result from the use of chills having surface imperfections which restrict cooling contraction. Rapid local cooling, depending on casting design, can also introduce residual stresses sometimes resulting in cracking.

**Variations in structure**—Too large a gap between chills can result in a patchy appearance after final machining, due to variations in graphite size and matrix structure.

---

Fig. 2 Blowhole resulting from the use of a rusty chill.

*Members can obtain free copies of any BCIRA Broadsheet, from BCIRA, Alvechurch, Birmingham B48 7QB* © 1980 BCIRA, Alvechurch, Birmingham B48 7QB.