

RISER DESIGN BASICS FOR SHRINKING ALLOYS



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ARTICLE TAKEAWAYS:

- Riser sizes are determined based on thermal modulus and available feeding volume
- Risers are positioned to provide feed metal to distinct feeding areas
- Riser design can be automated using casting simulation tools

BASIC THEORY OF RISER DESIGN

Riser design for shrinking alloys is based on a simple premise; as metal cools and solidifies, it shrinks, or contracts. Risers must be large enough to solidify after the casting, or casting section, being fed, and must have enough volume to provide enough 'feed metal' to offset casting shrinkage. One starts by estimating the Solidification Time of a casting, based on Chvorinov's Rule:

$$t = B (V/A)^2$$

where

t = Time to complete solidification

B = Mold Constant

V = Volume of a section of the casting

A = Surface area of the same section of the casting

This can be simplified, so that solidification time is proportional to the ratio of V/A, commonly known as the geometric modulus, or just modulus. Before computers, the modulus was a fairly easy value to estimate, and a riser calculation method was developed, known as the Modulus Technique. The two key features of this technique are:

- 1) The modulus of the riser should be larger than the modulus of the casting, which encourages directional solidification, insuring that feed metal will be available to counteract shrinkage in the casting throughout solidification
- 2) The riser should have enough volume to provide the required feed metal to the casting.

Figure 1 illustrates the concept of directional solidification.

Basics of Riser Design

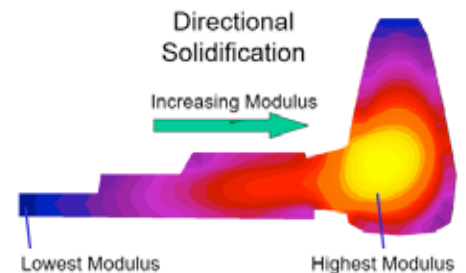


Figure 1. Directional Solidification, from Low Modulus to High Modulus.

The following example was created using the Riser Design Wizard, a part of the SOLIDCast simulation software. Much of the data input needed for riser size calculation can be extracted from simulation models. For detailed descriptions of complete design of risering components and systems, see the AFS Handbook on Basic Principles of Risering.

Unrigged Simulation

The first step is to run a simulation of the part without rigging, to determine the 'natural' pattern of solidification. Gate locations and chills may be added at this stage, if you know the locations. Typical results are shown in Figure 2.

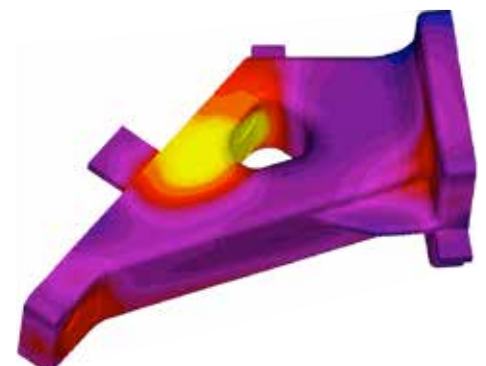


Figure 2. Unrigged Simulation Results.