Guide to running-system design—basic systems and components

This is the first of a series of BCIRA Broadsheets to be issued under the title: *Guide to running-system design.*

The soundness and quality of castings are dictated largely by the running, gating, and feeding systems employed. For any casting, there are normally several good alternative designs of running-system; the best choice depends on various production factors.

**Requirements of a running-system**

A good running-system should fulfil the following functions:

1. Introduce the molten metal into the mould cavity at a rate, and at locations, consistent with the avoidance of defects.
2. Prevent ladle slag and dross from entering the mould casting cavity.
3. Avoid the production of dross due to turbulent metal-flow conditions.
4. Avoid mould and core erosion by impingement or high metal velocities.
5. Ensure the minimum weight of running-system, in relation to casting weight, consistent with sound casting production.
6. Promote such a temperature distribution as to achieve maximum soundness and freedom from residual stress.

**Components of a running-system**

The *pouring-basin* (bush or cup) is the receptacle into which the molten metal is poured from the ladle; it directs the molten metal into the running system. It can be moulded or cut into the cope mould, or separately produced, and designed to be placed on the top of the cope mould.

The *sprue* or *downgate* is a vertical passage through which molten metal passes from the pouring-basin to the runner.

The *runner* channels metal from the base of the sprue to the ingates; it may contain a slag trap, and it may be a part of the feeding system.

The *ingate* directs metal from the runner into the mould casting cavity.

The *feeder head* provides a reservoir of molten metal to compensate for any metal shrinkage and mould-dilatation effects in the mould casting cavity.

The *riser* is an opening, leading from the mould cavity. It can indicate that the mould has been filled; be used to relieve pressure developed in the mould cavity; and function as a 'flow-off' or 'run-off', by allowing molten metal to 'flow off' when the mould cavity is full, so removing any cold or dirty metal. A riser of small diameter is sometimes called a 'whistler'.

**Running-systems**

There are two basic types of running-system: *pressurized,* and *non-pressurized.*

In pressurized systems the total of the cross-sectional areas of the ingates is less than the cross-sectional area of the sprue (i.e. ingates act as a choke).

In non-pressurized systems the total of the cross-sectional areas of the ingates is greater than that of the sprue (i.e. unchoked systems).

Both systems are in general use for the production of iron castings, but for each casting the choice must be made carefully. The main characteristics of both systems are given in the table.

**Main characteristics of running-systems.**

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<tr>
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<th>Pressurized</th>
<th>Non-pressurized</th>
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<tr>
<td>Provide greater protec-</td>
<td>Hinder uniform flow.</td>
<td></td>
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<td>tection against slag</td>
<td>Allow possible incom-</td>
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<td>entering the mould.</td>
<td>plete filling of the</td>
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<td>Promote uniform flow.</td>
<td>system, which may</td>
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<td>Promote higher veloci-</td>
<td>cause dross formation.</td>
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<td>ties of metal entering</td>
<td>Have larger ingates,</td>
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<td>mould casting cavity,</td>
<td>more difficult to re-</td>
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<td>so increasing risk of</td>
<td>move during fettling.</td>
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<td>mould and core erosion,</td>
<td>Promote low metal</td>
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<td>and metal turbulence.</td>
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<td>danger of mould and</td>
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<td>core erosion, and met-</td>
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Gating ratio

The relative sizes of the sprue, runner and ingates may be defined in terms of the gating ratio (sprue exit area): (total runner area): (total ingate area).

The runner and ingate areas are the sum of the cross-sectional areas of the individual runners and ingates.

A gating ratio of 3:5:2 means that in the particular running-system the total ingate area is 2/5 of the total runner area and 2/3 of the sprue area.

Example of gating ratios.

1

Area of sprue = A
Total runner area = B
Total ingate area = 2C
Gating ratio = A:B:2C

2

Area of sprue = A
Total runner area = 2B (as metal flow is divided at base of sprue)
Total ingate area = 2C
Gating ratio = 2B:2C

Recommended further reading

1. AFS: TRAINING & RESEARCH INSTITUTE
   Basic principles of gating.
   Basic principles of risering.

2. RUDDLE (R.W.)
   The solidification of castings.

3. INSTITUTE OF BRITISH FOUNDRYMEN
   Runner systems: report of sub-committee TS54,

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