



R.J. Collins Incorporated White Paper

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Accu-Test™ Consistent Casting Ring Performance Measuring and Tracking

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Introduction

The heart of the air-casting mold is the graphite casting ring which distributes the casting gas and oil around the ring. This gas and oil combines to suspend the molten metal to form a frictionless casting surface within the mold.



Figure 1 Casting Ring

Due to the inherent nature of graphite the rings produced vary in permeability that can result in casting problems and defects. Additionally, as a casting ring ages, permeability decreases because of oil contaminants and polymerization. This plugging of the graphite pores reduces the total gas flow and uniformity of the ring over time.

R. J. Collins has developed equipment and procedures for testing the conditions of graphite rings to assure proper casting performance. From this testing, marginal and failing casting rings can be identified and removed from service before they cast scrap.

Problem Statement

The casting rings are produced from a block of graphite that varies in density and permeability. The current machining approach does not compensate for the permeability differences in a graphite ring. Therefore the casting ring is not completely uniform in distributing the gas and oil around the mold bore. If the permeability varies to a significant degree, then inadequate gas flows result which leads to casting problems and billet defects.

As the casting rings age and plug, overall permeability decreases which result in

higher pressure being needed to achieve the same desired gas flow. Once the total flow degrades to a certain threshold, then the total gas flow is not sufficient and out of air-cast defects occurs. Additionally, the “plugging of the ring” is not always uniform, thus “dead” spots develop that result in casting defects such as vertical drags and zippers.

Previous Options

When previous testing was done, only the total gas flow was considered. A rotometer was used to read the total flow which is accurate if vented to atmosphere, but not accurate when connected to molds

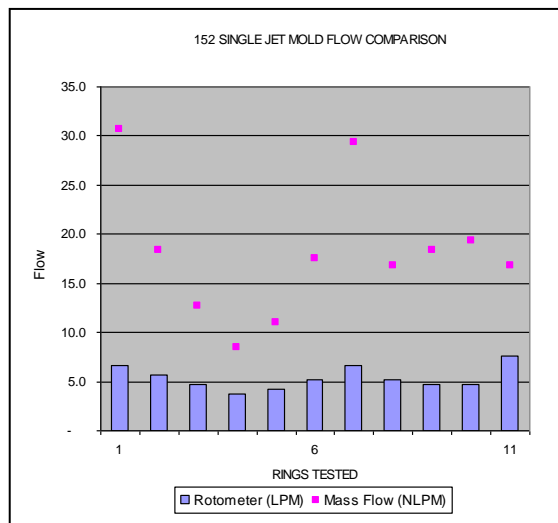


Figure 2 Mass flow compared to rotometer flow

that operate with varying back-pressures. For example, Figure 2 shows the flow rate differences when testing the same molds while using mass flow compared to a rotometer.

Also with earlier testing methods, no consideration was made to discrete regions or sectors of the ring. It was possible that the total flow met specification, yet portions of the ring

would not. One bad sector can detrimentally affect the whole mold’s performance resulting in increased billet scrap and/or bleed outs. Obviously this is a costly way to discover a faulty casting ring.



Figure 4 Billet Defect

R. J. Collins Solution

Based on years of experience, R. J. Collins has led the way to evaluate the condition of a billet mold by knowing the detailed airflow characteristics of the casting ring.

R. J. Collins research has demonstrated that permeability can vary dramatically around a casting ring. Since this is a critical factor in the performance of billet casting it is important to quantify the flow characteristics in two levels:

1. Sector Or Uniformity Flow
2. Total Ring Flow

To achieve this R. J. Collins has developed the *Accu-Test™* Billet Mold Testing System that automatically and accurately samples and records flow data for a casting ring as shown in Figure 4.



Figure 3 Accu-Test™ Billet Mold Testing System

Furthermore, the measured results are compared to standard criteria to determine if the casting ring meets specifications. This approach has opened a new level of awareness in the casthouse.

Sector Flow

Experience has shown that dividing a casting ring into 20 sectors provides

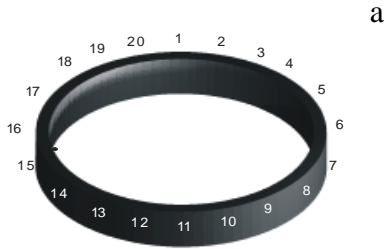


Figure 5 Casting Ring Sectors

representative sample of the uniformity of the casting ring. The gas flow is sampled in each of the 20 sectors.

Testing is done using a constant standard gas reference pressure. Precise measurement of gas flow through a specified area from each sector is measured using a mass flow meter, not a rotometer.

Total Ring Flow

Precise measurement of the total casting ring gas flow is also done by a mass flow meter. This insures accurate gas flow reading regardless of the temperature or pressure drop across the graphite rings

Test Results

Test measurements are compared to a standard change out criteria specification. Any sector performing below the standard is considered a “weak point” and the ring is replaced.

Figure 6 graphically demonstrates the results with color coding



indicating red sector as faulty.

Figure 6 Sector results

Tracking Performance

An important feature of testing is a comparison of results over the life of the casting ring from new to used conditions. Comparing the total flow and uniformity data allows prediction of failure. Figure 6 shows sample data for a ring after several casts.

Sector	Flow Rate (NLPM)			
	New	100 casts	200 casts	300 casts
1	0.83	0.50	0.33	0.21
2	0.54	0.32	0.22	0.14
3	0.39	0.23	0.16	0.10
4	0.48	0.29	0.19	0.12
5	0.38	0.23	0.15	0.10
6	0.48	0.29	0.19	0.12
7	0.48	0.29	0.19	0.12
8	0.34	0.20	0.14	0.09
9	0.20	0.12	0.08	0.05
10	0.18	0.11	0.07	0.05
11	0.27	0.16	0.11	0.07
12	0.61	0.37	0.24	0.15
13	0.53	0.32	0.21	0.13
14	0.31	0.19	0.12	0.08
15	0.79	0.47	0.32	0.20
16	0.40	0.24	0.16	0.10
17	0.55	0.33	0.22	0.14
18	0.42	0.25	0.17	0.11
19	0.48	0.29	0.19	0.12
20	0.65	0.39	0.26	0.16

Figure 7 Sample data

Accu-Test™ Billet Mold Testing System

The R. J. Collins, *Accu-Test™* Billet Mold Testing System, automatically measures and displays the total and sector flow of a mold. The tester is fully automated and has an optional PC interface and software program that keeps track of all testing for data storage and analysis purposes. The software has

graphing capabilities so that testing data can be easily and effectively displayed as shown in Figure 8.

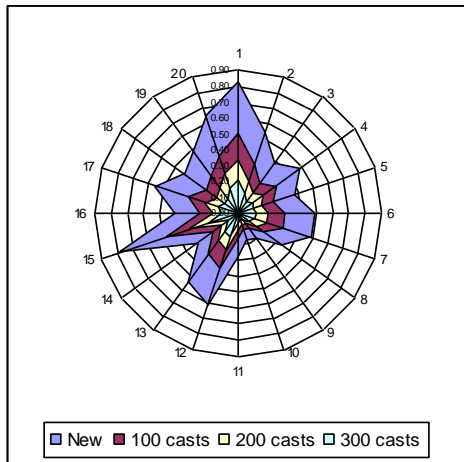


Figure 8 Test Data Graph

Accu-Test™ Graphite Ring Testing System

The new Accu-Test™ Graphite Ring Testing System measures the uniformity airflow of a graphite ring before it is installed into a mold. The graphite ring is the heart



Figure 9 Accu-Test™ Graphite Ring Testing System

and Achilles heel of the air-casting process and is only tested at 4 points when manufactured. This system provides the airflow uniformity flow every 25 mm (1”) around the inside diameter of the graphite ring to make sure it is within specification before it is installed into a mold. The uniformity data is converted, displayed and stored on a computer using software included with the system. This software program stores all testing data by size and

graphite ring number and displays a graph showing the uniformity airflow of all tests taken. Start-up assistance is recommended with this product and includes the software disk and cables necessary to connect to the USB port of a customer supplied computer.

Benefits

Prevent Scrap Billet

Prevent scrap billet by identifying and replacing casting rings before they fail. The cost of a new casting ring is less than scrap recycling and associated costs.

Maximum Casting Ring Life

Get maximum life from casting rings by knowing their true condition. When to replace rings is based on accurate data, not instinct or unreliable visual inspection.

Casting Ring QC Check

By using the tester, all new casting rings can be checked for quality before going into service. Then again after they are removed from service for any reason they can be compared to the original test values.

Summary

R. J. Collins is focused on the details of casting rings and offers an analytical approach to measure the condition of casting rings. By following the R. J. Collins approach and using the *Accu-Test™* Billet Mold Testing System and *Accu-Test™* Graphite Ring Testing System, casting operations can be assured to run at optimal performance, achieve maximum ring life at a minimum cost.