File

DEPARTMENT OF MINES AND RESOURCES

BUREAU OF MINES

CANADA

FILE COPY

Ottawa, May 10, 1948.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2049.

Porosity in a Grey Iron Casting.

(Copy No. 4.)

Bureau of Mines
Division of Metallic
Minerals

Physical Metallurgy
Research Laboratories

CANADA

DEPARTMENT
OF
MINES AND RESOURCES

Mines and Geology Branch

O T T A W A May 10, 1946.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2049.

Porosity in a Grey Iron Casting.

==========

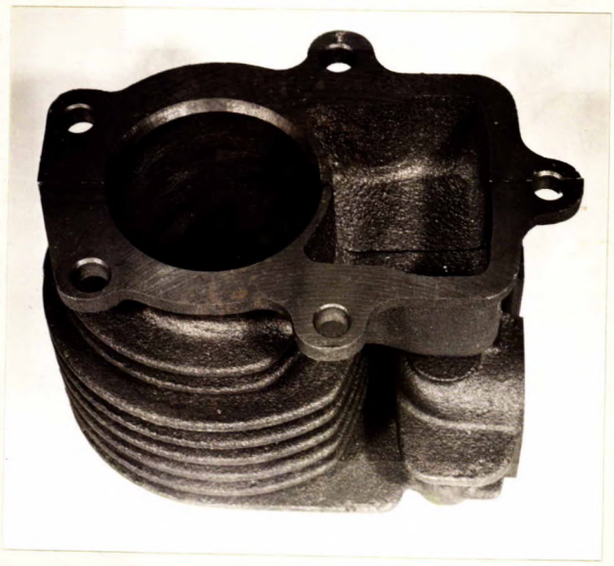
Origin of Request and Nature of Investigation:

In a letter dated April 26, 1946, Mr. H. J. Hugh, production manager of the Eureka Foundry and Manufacturing Company Limited, Woodstock, Ontario, requested an investigation of a defective grey iron cylinder casting.

The defects in the casting submitted are shown in Figure 1A. The casting appears to be porous at "A". In Mr. Hugh's letter the opinion was advanced that the defect was a blow or gas hole due to gas from the core.

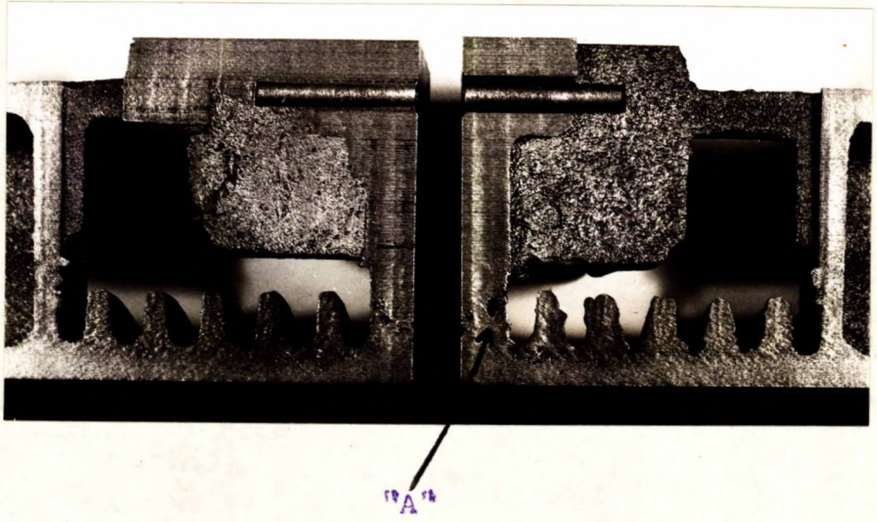
(Origin of Request and Nature of Investigation, cont'd) -

Figure 1.



CYLINDER CASTING AS RECEIVED.
(Approximately 1/2 actual size).

Figure 1A.



CYLINDER CASTING SECTIONED TO SHOW POROUS AREA.
Blow or shrink holes indicated at "A".
(Approximately 5/6 actual size).

Methods of Test:

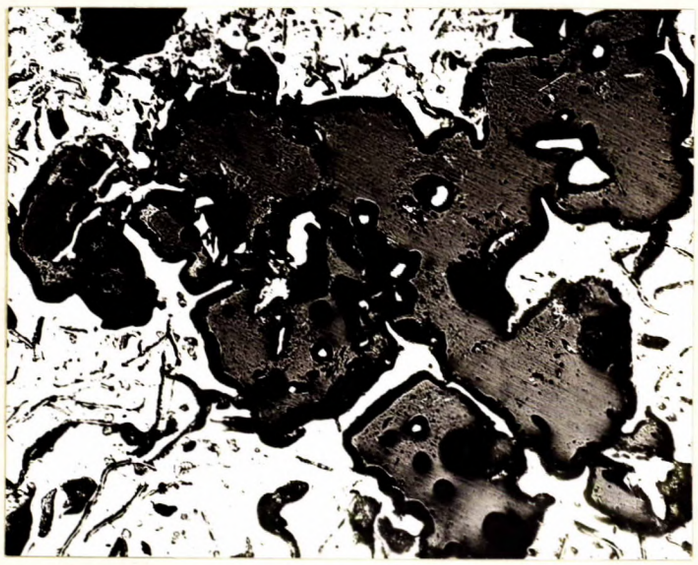
1. A photograph of the casting is shown in Figure 1.
2. Drillings were taken for chemical analysis.
3. Sections were prepared for micro-examination.
4. Hardness tests were made.

Chemical Analysis:

		Per Cent
Carbon	-	3.16
Silicon	-	2.56
Manganese	-	0.54
Sulphur	-	0.142
Phosphorus	-	0.360
Nickel	-	Nil.
Chromium	-	"
Molybdenum	-	"

Photomicrographs:

Figure 2.



X100, unetched.

SHOWING SHAPE OF CAVITIES.

Cavities are filled with bakelite.

Figure 3.

X100, unetched.

SHOWING PATTERN OF GRAPHITE FLAKES, CORRESPONDING TO A.S.T.M. CLASSIFICATION SIZE 4, TYPE A.

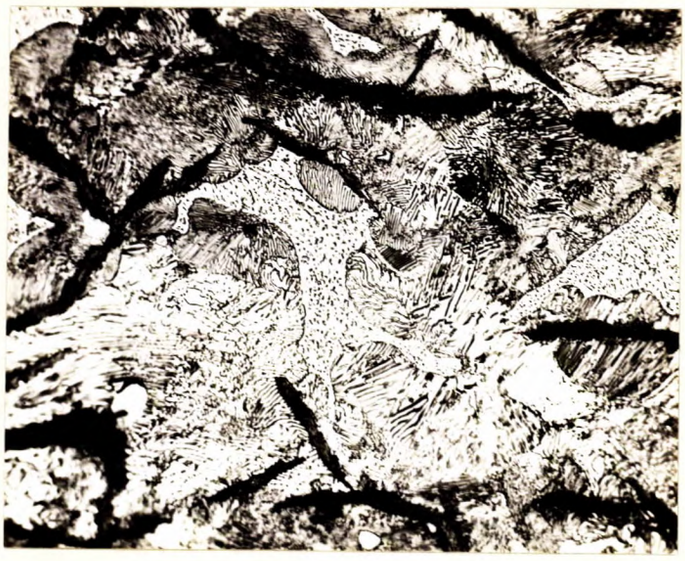
Figure 4.

X500, nital etch.

Note large amount of free ferrite (white areas).

-

Figure 5.



X500, nital etch.

Note areas of phosphide eutectic.

-

Hardness Tests:

Tests on the machined surfaces indicated a Brinell hardness number of 170.

DISCUSSION:

1. The casting examined is softer than usually recommended for cylinder iron.

2. The cavities in the casting do not appear to be caused by gas.

3. It is felt that the cavities are "soft iron" shrinkage spots. Soft iron with a high silicon content has a tendency to have porous areas similar to the casting examined.

4. Without further knowledge of the foundry conditions, it is not possible to say what part gating, moulding, pouring temperatures, and core properties have in aggravating the shrinkage condition.

5. Usually, casting defects occur due to the co-incidence of several undesirable conditions. The only way to arrive at the cure is to keep track of such variables as

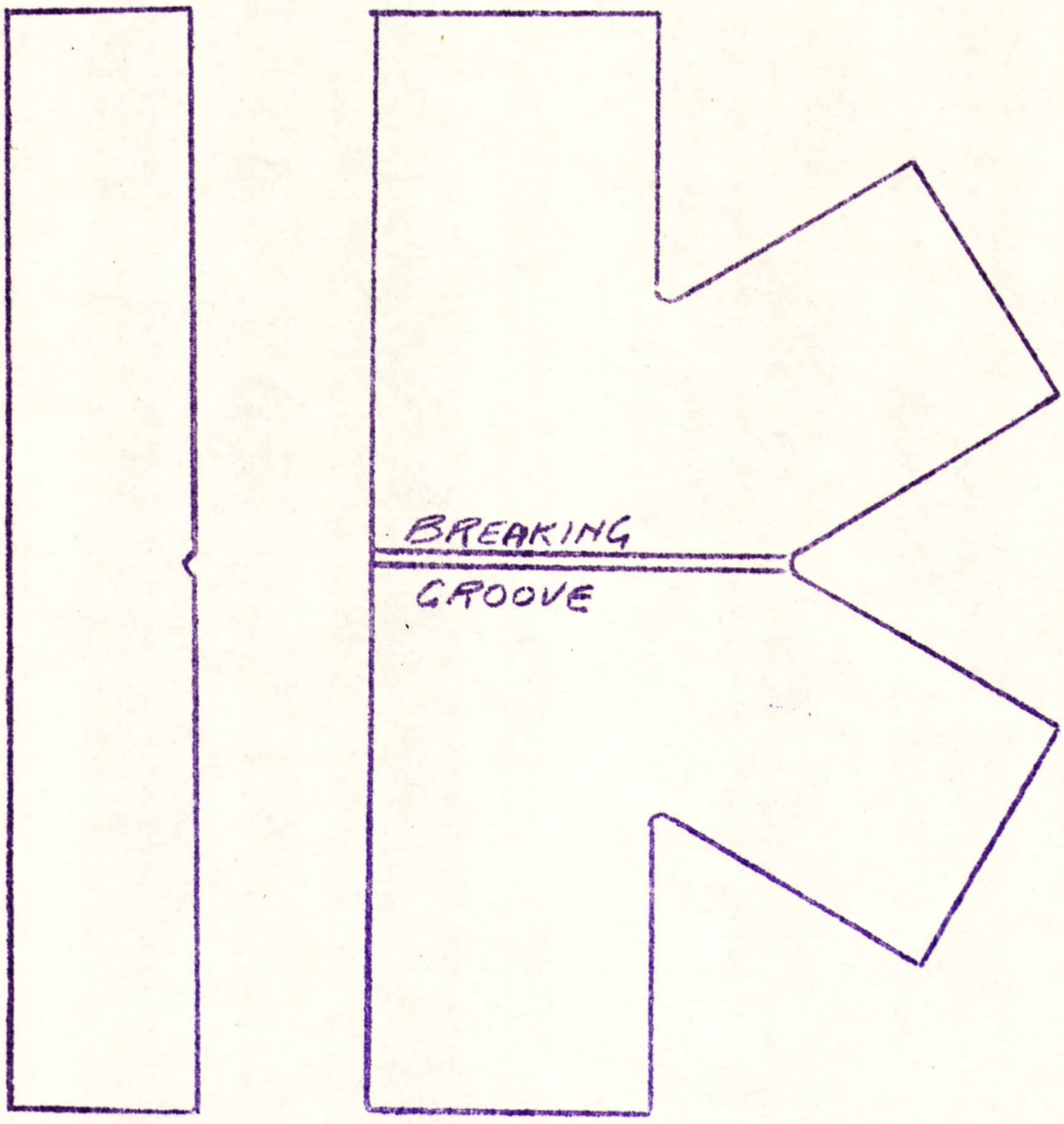
- pouring temperature,
- pouring time,
- mould hardness,
- core hardness,
- permeability of mould and core,
- fins on the casting (Metal runout: "leakers" or "bleeders" are often a cause of porosity),
- shrinkage property of the iron,
- and many others.

The tendences of iron to form shrinkage cavities can be measured by the "K" casting, a sketch of which is shown in Figure 6.

(Figure 6 follows,)
(on Page 6.)

(Discussion, concluded) -

Figure 6.



SHRINKAGE TEST CASTING.

(Actual size).

Recommendations:

1. It is recommended that the hardness of these cylinder castings be increased to 190-200 Brinell. Lowering the silicon content to 2.30 to 2.45 per cent, and possibly raising the manganese to 0.60 to 0.70 per cent, would help in making a closer-grained iron. This change in analysis would increase the hardness without causing any difficulty in machining. Such an iron would also possess better wearing qualities, which would be advantageous in cylinder walls.

2. If the amount of gas generated by the core is not already known, it is suggested that tests be made to measure this important foundry variable. Core gas measurements, made daily, provide a very useful check upon core mixing and baking. Underbaked cores may generate as much as three times more gas than will properly baked cores.

oooooooooooo
oooooooo
oo

HHF:LB.