

METALLURGICAL EXAMINATION OF MATERIAL FROM A CAST IRON SWEEP
TEE PIECE WHICH FRACTURED UNDER PRESSURE.

ITEM NO. D. S. 399.

FURNESS SHIPBUILDING CO. LTD.

YARD NO. 388 WHALE FACTORY.

MATERIAL FOR EXAMINATION.

This consisted of a complete flange machined and drilled, which had fractured as shown on the accompanying sketch A supplied by the Shipbuilders. The fracture showed no evidence of porosity or other unsoundness. It was not possible to determine precisely where fracture commenced, but it was noted that there was no appreciable departure from section which might have induced failure.

HARDNESS.

A number of hardness impressions were taken from various positions on the face of flange and these showed only a negligible variation in hardness; the actual Brinell values ranged from 218 to 217.

TENSILE TEST.

A standard tensile specimen machined .564" dia x .25" area x 2" acting length gave figures as under:-

Max. Stress)	9.3
Tons per sq. inch.)	

This result suggested nothing abnormal. The fracture indicated a reasonably fine grained iron and this was confirmed when fracturing the unstrained end of the specimen.

CHEMICAL COMPOSITION.

A sample from the position shown on sketch B enclosed was submitted to Messrs. Pattinson & Stead, Middlesbrough, who reported the following analysis.

Combined Carbon	.655%
Graphitic Carbon	2.345
Manganese	.325
Silicon	2.102
Sulphur	.076
Phosphorus	1.245

Messrs. Pattinson & Stead's certificate is included
herewith.

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This analysis can be considered reasonably satisfactory for a casting of this type. It could be argued that the content of Manganese is slightly on the low side, but this is more than offset by the low contents of Silicon and Phosphorus.

MICROSCOPICAL EXAMINATION.

Sections were cut from the flange in way of, and including, the fracture and these were examined both before and after etching. Micrographs have been prepared and are enclosed herewith. It should be explained that Micrograph No. 791 x 120 diameters illustrates the polished and unetched condition and shows the distribution of the Graphitic (uncombined) Carbon which is fairly normal for an Iron of this type. Micrographs Nos. 792 and 793 show areas from the same section at magnifications of 500. This section was etched with a saturated solution of Picric Acid in alcohol and again nothing abnormal was revealed. The black areas are those containing the Graphitic Carbon; the (combined carbon) Pearlite, is shown as lamellae easily recognised by its resemblance to mother of pearl when viewed by oblique illumination. The half tones remote from the graphite, seen best on the right of Micrograph No. 793, indicate areas rich in Phosphorus (the Iron-Phosphide eutectic) while finally, certain white areas located near the graphite, are practically carbonless or Ferrite zones.

As indicated these micrographs reveal nothing to which exception could be taken and are such as could reasonably be expected from a grey cast iron of the composition and tenacity shown in the report.

SUMMARY.

There is no evidence to suggest that the material of this casting was of unsuitable quality and in my view therefore the reason for the failure must be looked for elsewhere.



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It is established that so far as the scantlings of the Tee piece are concerned no question of strength is involved.

There appears to be some doubt as to whether the pipe line was effectively drained prior to the admission of the steam. It is clear that failure to ensure complete drainage would induce water hammer and it may well be that the reason for the failure lies in that direction.

Louis Ripley

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Enclosures.

Sketch A - Tee piece etc.
Sketch B - Flange
Certificate of Analysis
Micrographs.



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