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November 10th, 1944.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1738.

Examination of Malleable Iron Hand
Grip from Oerlikon Gun.

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Origin of Request and Object of Investigation:

On October 30th, 1944, Lieutenant W. Irwin, on behalf of the Chief Inspector of Naval Ordnance, Department of National Defence Naval Services, Ottawa, Ontario, submitted for examination a fractured malleable iron hand grip from an Oerlikon gun. He requested an investigation to determine:

- (1) If the iron had been properly annealed.
- (2) How the properties compare with those of U.S. Navy Spec. 46-I-8c.
- (3) How the physical properties of malleable iron compare with those of SAE 4640, which was originally specified for this part.

Macro-Examination:

A photograph of the fracture is shown in Figure 1. The fracture appears to be normal for this type of iron.

Chemical Analysis:

The following chemical analysis was obtained:

	<u>Per Cent</u>
Total carbon	- 1.81 [⊕]
Graphitic carbon	- 1.81 [⊕]
Manganese	- 0.36
Silicon	- 1.00
Sulphur	- 0.094
Phosphorus	- 0.139

• These figures are not too reliable due to difficulty in sampling for carbon in the malleabilized state.

Microstructure:

Figure 2 is a photomicrograph of the structure. The metal has the microstructure characteristic of commercial malleable iron.

Mechanical Tests:

A specimen cut from the casting bent through 45 degrees, as shown in Figure 3. This is normal for machined malleable iron.

The exact mechanical properties could not be obtained from the specimen submitted, as the standard 0.505-inch bar could not be cut from it. The following properties were obtained from an 0.157-inch bar:

	<u>0.157-inch Bar</u>	<u>U.S. Navy Spec. 46-I-80</u>	
		<u>Type A</u>	<u>Type B</u>
Tensile, p.s.i.	- 51,000	53,000	50,000
Yield, p.s.i.	- 39,000	35,000	32,500
Elongation	- 15 per cent in 1 inch.	16 per cent in 2 inches.	10 per cent in 2 inches.
Reduction in area	- 20 per cent	--	--

Discussion:

The chemical analysis and microstructure are normal for commercial grade malleable iron.

The exact mechanical properties of the piece submitted cannot be determined, as the results from an 0.157-inch bar are not comparable to those from an 0.505-inch bar. However, it is fairly certain that the metal would meet U.S. Navy Spec. 46-I-8c, type B. Without standard test bars it cannot be said for certain that the metal would meet type A of the same specification.

The specification for Oerlikon hand grips using SAE 4640 steel calls for a Brinell hardness of 255-302. The following mechanical properties can be expected, compared to those of malleable iron, type A:

	<u>Tensile strength, p.s.i.</u>	<u>Yield strength, p.s.i.</u>	<u>Elongation, per cent in 2 inches</u>	<u>Reduction of area, per cent</u>	<u>Izod impact, ft-lb.</u>
SAE 4640, 255 BHN -	(115,000- 130,000	95,000- 120,000	20-27	55-70	70-100
SAE 4640, 302 BHN -	(135,000- 155,000	120,000- 140,000	16-23	50-68	50-90
Malleable iron, Type A -	53,000	35,000	18	20	10

The casting failed because it was subjected to greater stresses than it could withstand.

The presence of the drain-hole shown in Figure 1 would lower the strength of the casting.

Conclusions:

1. The metal in the casting is regular commercial grade malleable iron.

2. The part failed due to overloading.

(Continued on next page)

(Conclusions, cont'd) -

3. Improved life in service could be obtained
by:

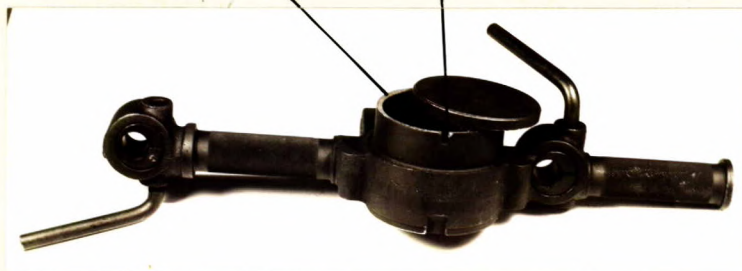
- (a) Reducing operating stresses in gun.
- (b) Design casting with heavier section.
- (c) Change to stronger metal.

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AEM:GHB.

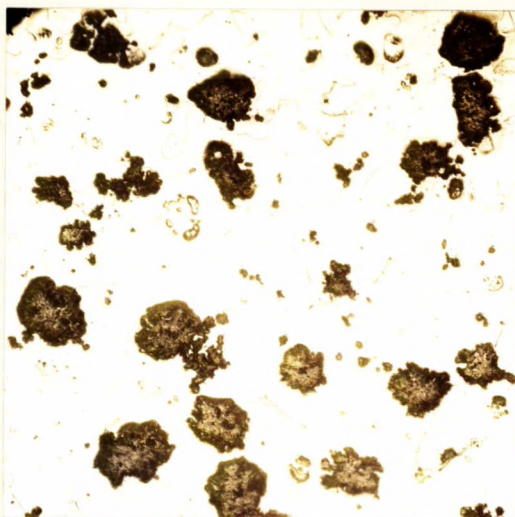
Figure 1.

Fracture Drain Hole



FRACTURED MALLEABLE IRON OERLIKON GUN HAND GRIP.

Figure 2.

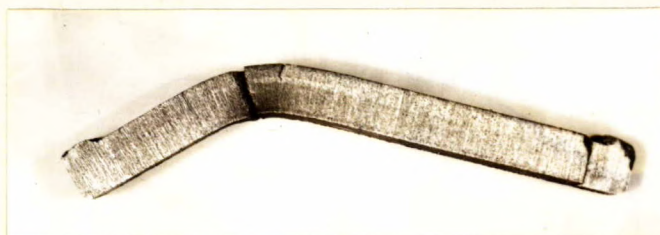


X100, Vilella's etch.

NORMAL COMMERCIAL MALLEABLE IRON.

Black graphite nodules in
a background of ferrite.

Figure 3.



BEND TEST ON SPECIMEN CUT FROM CASTING.

Specimen bent through 45°, which is
normal for machined malleable iron.