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OTTAWA September 18th, 1944.

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1711.

Examination of Fractured Piat Bomb.

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(Copy No. 10)

Bureau of Mines
Division of Metallic
Minerals
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Physical Metallurgy
Research Laboratories

CANADA
DEPARTMENT
OF
MINES AND RESOURCES

Mines and Geology Branch

OTTAWA September 16th, 1944.

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1711.

Examination of Fractured Piat Bomb.

Source of Material and Object of Investigation:

On September 8th, 1944, under Analysis Requisition No. O.T. 4279, one (1) Piat bomb, which had burst in firing test, was received from the Inspection Board of the United Kingdom and Canada, 70 Lyon Street, Ottawa, Ontario. It was requested that a metallurgical examination of the inner and outer tubes be carried out, in order to determine, if possible, the cause of failure.

Macro-Examination:

Figure 1 is a photograph showing the Piat bomb in the "as received" condition. The inner and outer tubings were disassembled and given a visual examination. The outer and inner tubes, together with the failed portions of these tubes, are illustrated in Figures 2 and 3. The tubes were found to have the following dimensions: *

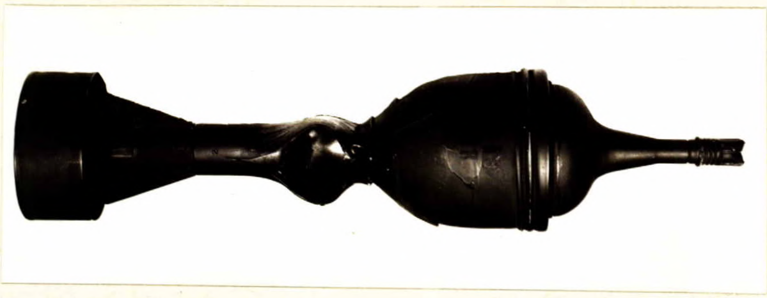
	Inner Tube	Outer Tube
Outside diameter, inches -	1.004	1.125
Wall thickness, inches -	0.065	0.070

* Measured at unaffected zones.

(Continued on next page)

(Macro-Examination, cont'd) -

Figure 1.



FRACTURED PIAT BOMB.

(Approximately 1/5 actual size).

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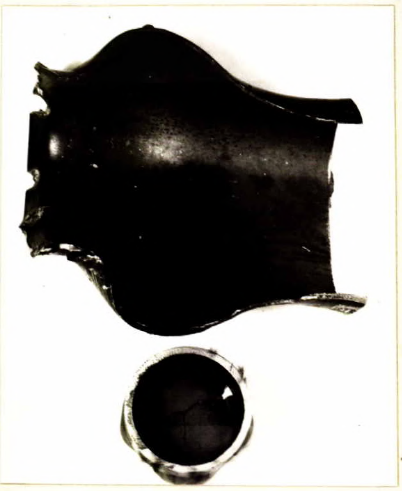
Figure 2.



OUTER TUBE.

(Approximately ½ actual size).

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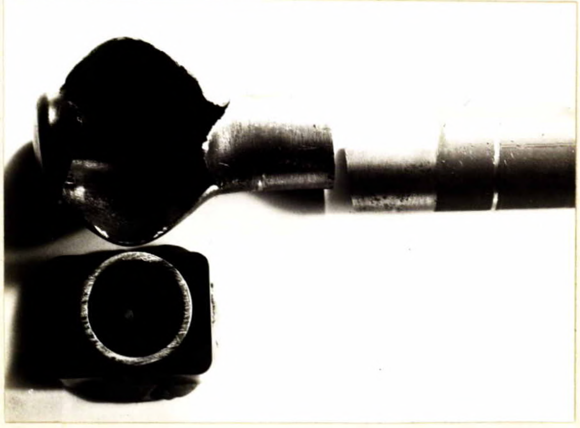
Figure 3.



INNER TUBE.

(Approximately ½ actual size).

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Chemical Analysis:

The results of chemical analysis of the inner and outer tubes, together with the specified compositions, are given in the following table:

		INNER TUBING		OUTER TUBING	
		Specified*	Found	Specified*	Found
		- Per Cent -			
Carbon	-	0.05-0.15	0.08	0.28-0.40	0.35
Manganese	-	0.50 max.	0.34	0.30-0.70	0.59
Silicon	-	0.10 max.	Trace.	0.25 max.	0.15
Phosphorus	-	0.05 max.	0.011	0.05 max.	0.015
Sulphur	-	0.05 max.	0.038	0.05 max.	0.030

* British Standard Specification IN. B. No. 59A. based on R/188.B.

Hardness Tests:

The hardness of the tubes was determined by the Vickers method, using a 10-kilogram load. The following Vickers hardness numbers were obtained:

		VICKERS HARDNESS NUMBERS	
		At Fracture	Unaffected Zone
Inner tube	-	155	105
Outer tube	-	188	170

Microscopic Examination:

Sections of the outer and inner tubes were mounted in bakelite, polished, and examined under the microscope in the unetched condition. The steels were found to be fairly clean. The steels were then etched in 2 per cent nital and re-examined. The structures of the inner and outer tubes are shown respectively in Figures 4 and 5, photomicrographs at X100 magnification. The structure consists of pearlite, the iron-iron-carbide constituent (the dark etching material), and ferrite, the iron constituent (the light material). No decarburization was observed in the outer tubing. However, some was noted in the inner tubing, as

(Microscopic Examination, cont'd) -

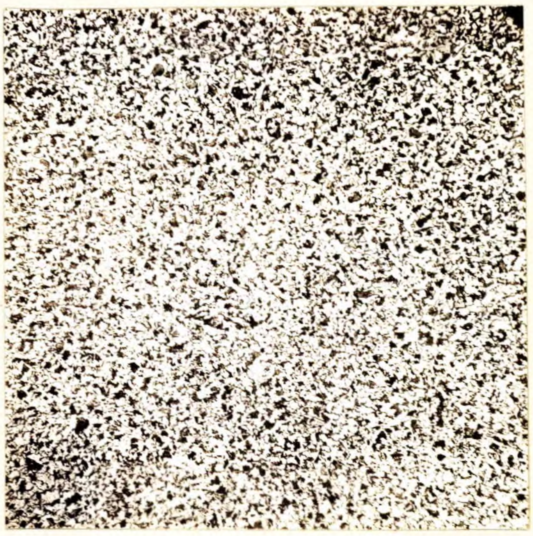
well as grain growth at the surface (see Figure 4).

Figure 4.

X100, etched in
2 per cent nital.

INNER TUBING.

Figure 5.



X100, etched in
2 per cent nital.

OUTER TUBING.

Discussion of Results:

The chemical composition of the tubes was found to be within the limits given in British Standard Specification IN. B. No. 59A.

The hardness of the outer tube in the unaffected zone would indicate that it would have the specified tensile strength. Compression tests previously carried out in these Laboratories on tubes of the same hardness and composition met the compression strength requirements of the specification. It is, therefore, most likely that the outer tubing would meet the requirements of this test.

The large grains at the outer surface of the inner tube are most probably due to the effect of cold work. There is also evidence of slight decarburization. Since the failure of the

(Discussion of Results, cont'd) -

tube was brought about by an explosive force, it is not thought that the latter defect would contribute to the cause of failure. The structure of tubes indicate that they both received a normalizing heat treatment and, apart from the slight decarburization of the inner tube, noted above, the heat treatment appeared to be quite satisfactory.

Conclusion:

There is no evidence to indicate that failure of these tubes in the firing test was due to any metallurgical defect.

It is concluded, then, that failure must have been due to the fact that the tubing was subjected to stresses greater than called for in the specification.

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