O T T A W A August 30th, 1940.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 893.

Report on Steel Helmet submitted by
Department of National Defence,
Ottawa, Ontario.

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
ORE DRESSING AND
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CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH
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Object of Investigation:

A steel helmet which had failed in the firing test was submitted for examination by H. H. Bleakney, Metallurgist, Department of National Defence, Ottawa, Ontario, on August 19th, 1940. This hat had passed the

usual magnet test.

In order to find out the difference between good and poor helmets, a hat which had passed both magnet and firing tests and could therefore be considered satisfactory was obtained for comparison.

Macro-Examination:

The good helmet had a smoother surface than the one which failed.

Micro-Examination:

For comparison, sections from both helmets were taken from identical locations. The surface examined was parallel to the base.

The surface of the metal is shown in Figures 1 and 2. Note the indentations in the surface of the poor helmet.

Figure 1.

100X.
Good helmet.

Figure 2.

100X.
Poor helmet.

(Micro-Examination, cont'd) -

The structure of the metal after etching is shown in Figures 3 and 4:

Figure 3. Figure 4.

100X. (Nital etch). 100X. (Nital etch).
Good helmet. Poor helmet.

Both specimens have been subjected to cold working. This is indicated by slip planes in the crystals.

Chemical Analysis:

Carbon	-	0.98 per cent
Manganese	-	12.63 "
Phosphorus	-	0.052 "

Sample decarburized somewhat in drilling.

Hardness Tests:

Good helmet	-	412	Vickers hardness number.
Poor helmet	-	388	" " "

Discussion of Results:

The hardnesses of both of these helmets have been increased by cold working. Part of this may have occurred when the bullet struck the helmet, but it is probable that most of the cold working was done in the cold rolling and forming operations.

Both steels are fine-grained. The good helmet (transverse section) appears to be finer-grained than the poor helmet (longitudinal section parallel to rolling direction). The grain size is affected by the hot rolling temperature, as well as the pouring temperature when the ingot is poured. The good helmet has more grains per inch of thickness than has the poor helmet. This would seem to indicate that control of grain size is important in the manufacture of helmets.

The greatest difference between helmets was in the surface condition. Surface pits in the good helmet were 0.0062 inch deep (max.). On the surface of the poor helmet some pits 0.0437 inch in depth can be seen. Resistance to impact would be lowered by cavities in the surface of the metal.

Recommendations:

1. Some control should be exercised over the quality of the surface. Rough sheets should be discarded.
2. Hardness tests should be used to evaluate the amount of cold work in the steel.

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