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O T T A W A September 29th, 1943.

R E P O R T
of the
ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1503.

Examination of Steel Stampings from the
Stewart-Warner-Alemite Corporation
of Canada, Belleville, Ontario.

Bureau of Mines
Division of Metallic
Minerals

Ore Dressing
and Metallurgical
Laboratories

CANADA

DEPARTMENT
OF
MINES AND RESOURCES
Mines and Geology Branch

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Origin of Samples and Object of Investigation:

Two steel stampings, each with three draws and a piercing at the foot of each draw, were submitted on September 15th, 1943, by Mr. B. W. McKee of the Stewart-Warner-Alemite Corporation of Canada, Limited, Belleville, Ontario. Both of these stampings, said to have been made from $\frac{1}{4}$ hard, cold-rolled sheet steel, had cracked in some of their drawn areas. Request was made for an examination to determine whether the failures were caused by defective material or by faulty plant operations.

Macro-Examination:

A view of one of the plates as received, showing failures in two of the drawn areas, is given in Figure 1.

Figure 1.

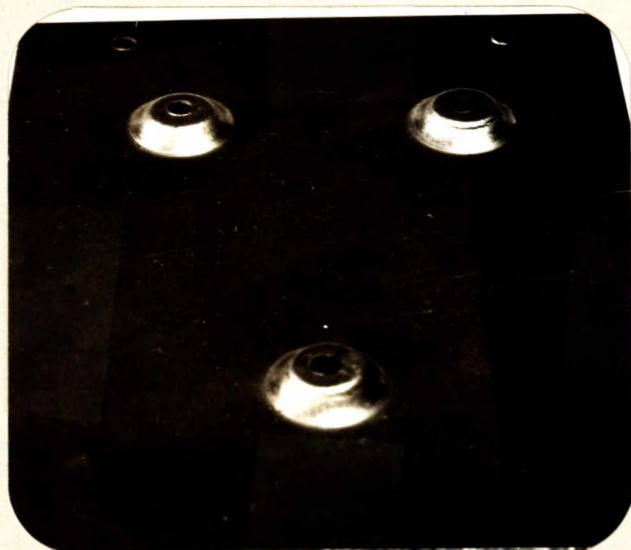


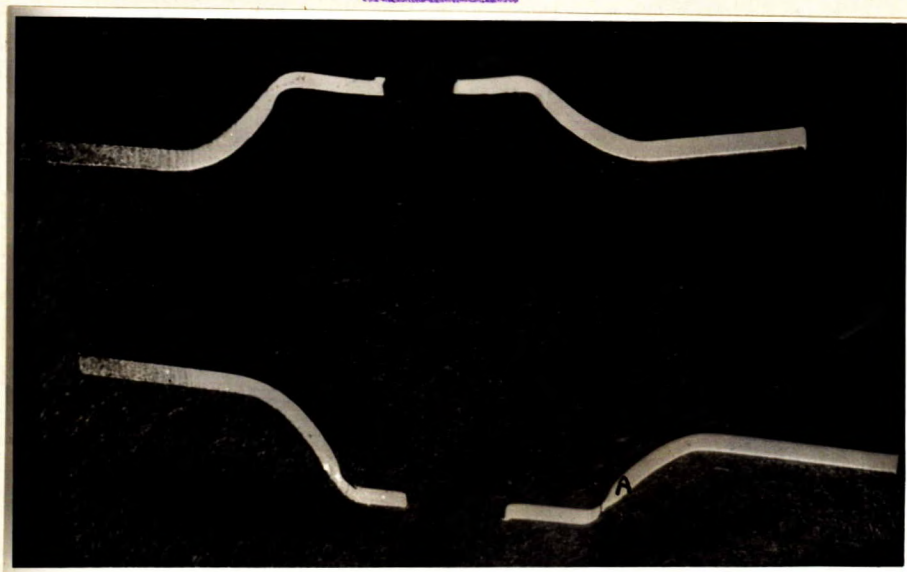
PLATE AS RECEIVED.

(Approximately 5/6 size).

Note crack in upper right draw and crack in bottom draw (slightly out of focus).

It was noticed that the same two draws in each of the plates submitted were fractured; the third, in both cases, was satisfactory. When a section was cut through one of the fractured draws the metal was seen to have "necked down" considerably at the failure (see Figure 2).

Figure 2.



(Approximately 3 times size).

Note "necking down" at fracture.

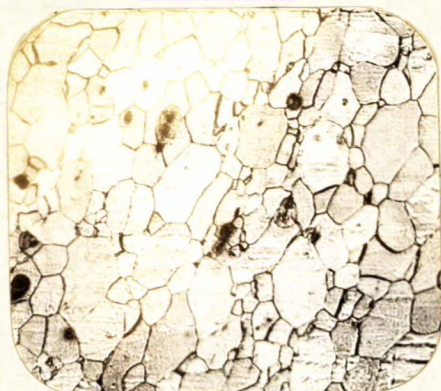
Physical Examination:

Hardness tests of the plates (using the Vickers method with a 10-kilogram load) showed that they had, in unstrained portions, a Vickers hardness of 105.

Micro-Examination:

Cross-sections from a failed and a satisfactory draw were mounted in bakelite, polished, and etched with a 5 per cent solution of ammonium persulphate in water. The ferritic grain size of both samples was found to be the same (see Figures 2 and 3). No extraordinary metallurgical defects that might have caused failure or variable performance in the same sheet were found.

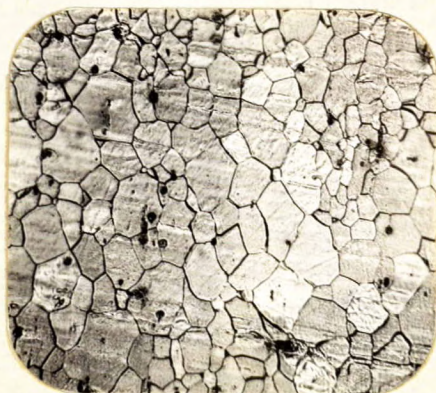
Figure 3.



X100, Ammonium Persulphate etch.

SATISFACTORY DRAW.

Figure 4.



X100, Ammonium Persulphate etch.

FAILED DRAW.

Discussion of Results:

The fact that the same two draws fractured in both plates would, of itself, seem to indicate that failure was caused by faulty plant operation rather than by defects in the metal.

By using conversion tables the 105 Vickers hardness of this sheet is seen to correspond to about 61 Rockwell 'B' hardness. Since, according to the American Society for Metals Handbook, 1939, the hardness of $\frac{1}{4}$ hard sheet should be Rockwell 'B' 65 ± 5 , the sheet used in these stampings meets the hardness requirements. This, as well as the fact that the metal "necked down" considerably at the point of failure, indicates that age embrittlement was not the cause of failure.

Microstructure examination failed to reveal any difference between satisfactory and cracked draws.

Conclusion:

This examination indicates that failure was caused by mechanical defects in fabrication rather than by metallurgical deficiencies in the metal itself.

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