O T T A W A August 21st, 1941.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1074.

Examination of Defective
Wheel Clamping Bolt.

=================

BUREAU OF MINES
DIVISION OF METALLIC MINERALS

ORE DRESSING AND
METALLURGICAL LABORATORIES

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

O T T A W A   August 21st, 1941.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1074.

Examination of Defective
Wheel Clamping Bolt.

Origin of Material:

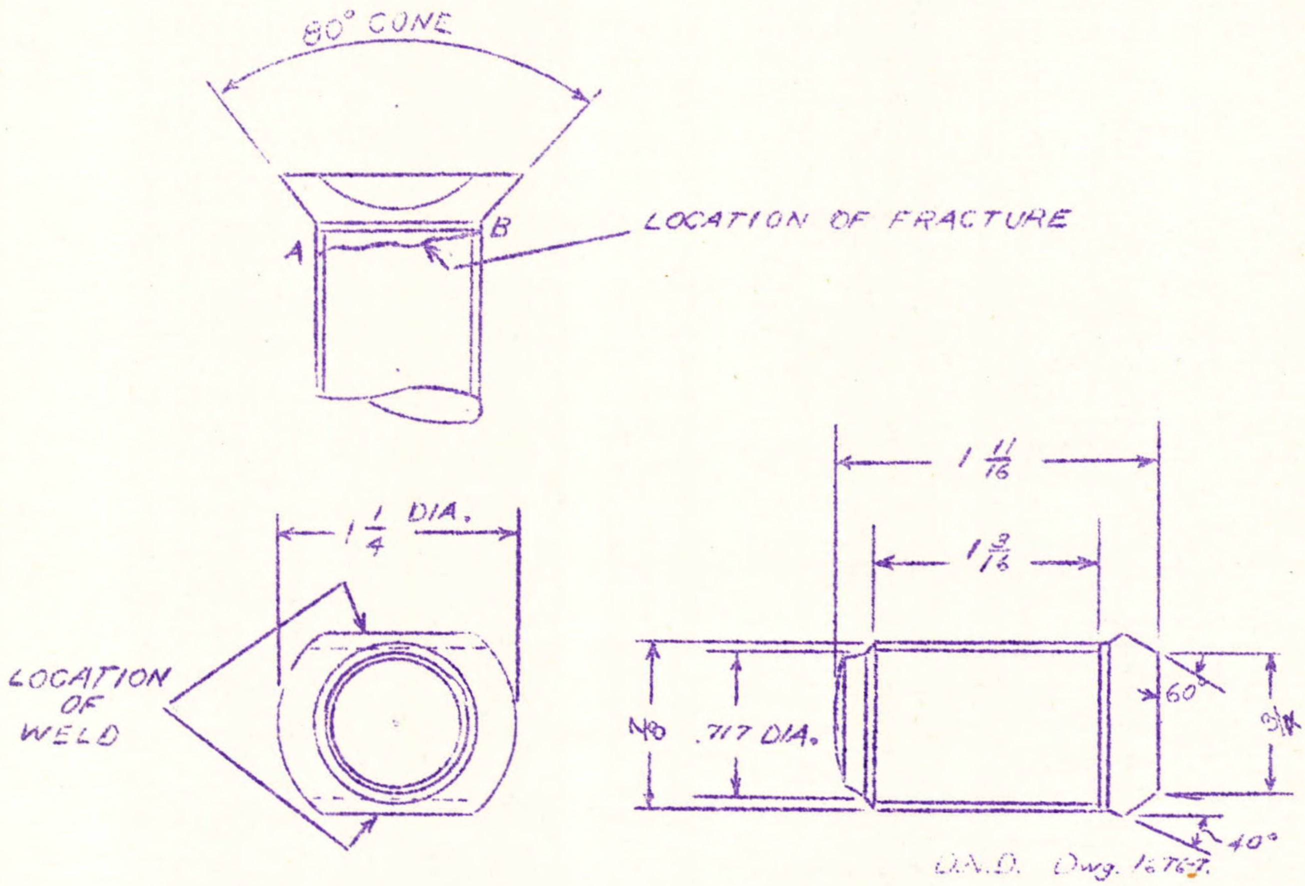
On August 8th, 1941, two broken wheel clamping bolts and one new bolt, together with a letter enclosing two blueprints of the parts, were received from Mr. H. J. Stevenson, Director of Engineering, Automotive Production Branch, Department of Munitions and Supply, Ottawa, Ontario. Mr. Stevenson requested an examination and comparison of these bolts.

Hardness tests were performed on one broken bolt and the other one was cut up for micro-examination.

Specifications for Bolts:

Dimensions -

Figure 1.



CLAMPING BOLT.

Chemical Specifications* -

		Per cent
Carbon	-	0.25-0.30
Manganese	-	0.4 - 0.6
Silicon	-	0.3 max.
Sulphur	-	0.04 "
Phosphorus	-	0.04 "

*(NOTE: S.A.E. 1030 is optional.)

Physical Specifications -

Max. stress	-	34 to 45 tons s.i.
Yield	-	20 tons/sq.in., minimum.
Elongation	-	25 per cent minimum.
Reduction of area,	-	50 per cent minimum.
Impact	-	25 ft. lb. minimum.

Nature of Problem:

A broken bolt, fractured at AB (see Figure 1), and a new bolt were received for comparison.

Hardness Tests:

		V. H. N.
Defective bolt, at break	-	193
" " , at threaded end	-	232
New bolt	-	148

Chemical Analysis:

	Defective Bolt	New Bolt
Carbon, per cent	0.30	0.29
Manganese, per cent	0.53	0.49
Silicon, "	0.18	0.07
Sulphur, "	0.025	0.035
Phosphorus, "	0.014	0.010

Microstructure:

Figure 2.

X100, nital etch.
DEFECTIVE BOLT.

Annealed Structure.

Figure 3.

X100, nital etch.
NEW BOLT.

Quenched and Drawn.

DISCUSSION:

The most variable factor affecting the quality of these bolts is the welding operation. At the weld the metal will probably be in the normalized condition, due to being heated above the critical point and then air-cooled. Therefore any increase in physical properties due to cold work or heat treatment will be nullified at the head of the bolt by the welding operation. If failures occur with good welding practice, it may be advisable to use a higher-strength steel in the normalized condition.

The new bolt has been quenched and drawn. This would result in a tougher metal than that obtained by annealing or normalizing. For low-carbon steel parts, the greatest impact resistance is obtained by quenching and drawing.

Unfortunately the welded head was not available for examination, but hardness tests showed that the metal was 35 V. H. N. softer at the fracture than in the body of the bolt.

From the limited information at hand the following tentative conclusions can be drawn, subject, of course, to modification when more information is available.

Conclusions:

1. The bolts examined are made of S. A. E. 1025 steel, as specified.

2. The broken bolt was normalized, or annealed; the new bolt was quenched and drawn.

3. Welding will probably nullify the effects of cold work and/or heat treatment in the bolt head, leaving it

(Conclusions, cont'd) -

with an annealed structure in the final assembly.

4. Stronger steels may be advantageously substituted for S. A. E. 1025, provided they are used in the normalized condition. Some of these are given below, in order of increasing strength:

S. A. E. X1025
" 1030
" 1035
" 1040

5. Oxide inclusions shown in Figure 3 constitute "undue segregations or impurities" which are prohibited in the specification for this material.

0000000000000
00000
0

HHF:PES.