O T T A W A March 27th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1193.

Examination of a Boat Trailer Wheel Springing Mechanism.

(Copy No. 1.)

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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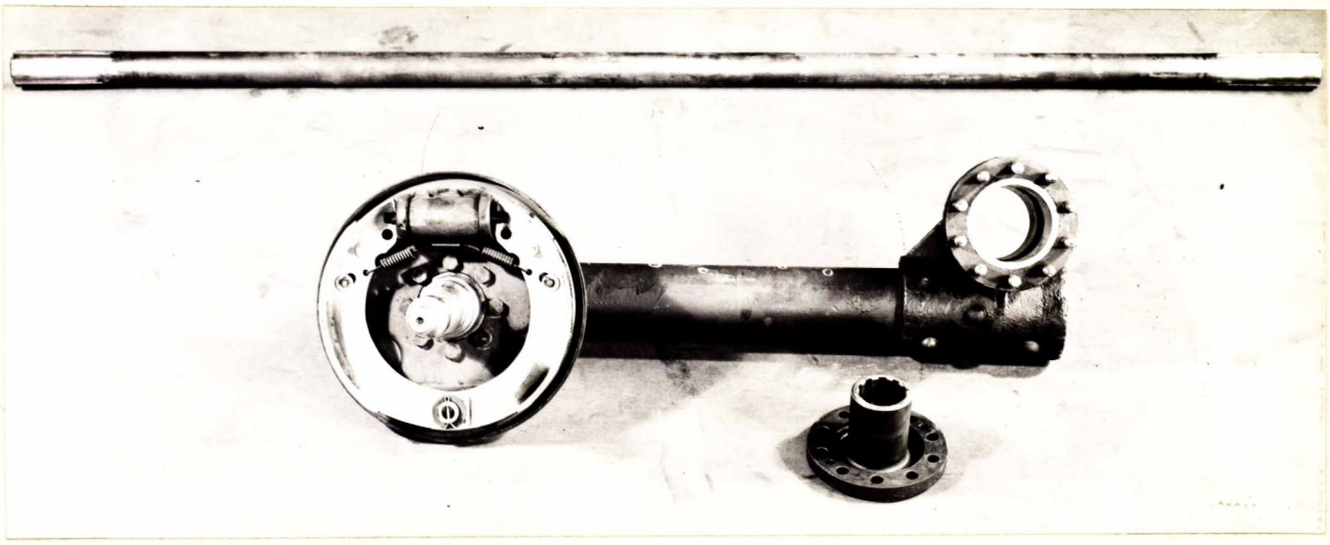
Origin of Request and Object of Investigation:

On March 18th, 1942, Mr. H. J. Patterson, of the Engineering Division of the Department of Munitions and Supply, Ottawa, Ontario, requested verbally that an examination be made of three parts of a boat trailer in order to determine their chemical and physical properties. It was understood that sufficient information was needed so that purchase specifications could be developed. It was also desirable that the sampling be done in such a manner that the service-ability of the trailer would not be impaired. The samples

(Origin of Request and Object of Investigation, cont'd) -

were received on March 19th, 1942. (See Figure 1).

Figure 1.



SUBMITTED PARTS OF BOAT TRAILER
WHEEL SPRINGING MECHANISM.

(Approximately to ⅓ size).

Chemical Analysis:

AXLE -	As Found	Specification S.A.E. 9255 Steel.
Carbon, per cent	0.54	0.50-0.60
Manganese, "	1.03	0.60-0.90
Silicon, "	2.03	1.80-2.20
Nickel, "	0.15	-
Chromium, "	Nil	-
Molybdenum, "	Nil	-
COLLAR -		**S.A.E. 4140 Steel.**
Carbon, per cent	0.50	0.35-0.45
Manganese, "	0.69	0.60-0.90
Silicon, "	0.27	0.15 min.
Sulphur, "	0.034	0.050 max.
Phosphorus "	0.017	0.04) max.
Nickel, "	0.30	-
Chromium, "	1.00	0.80-1.10
Molybdenum, "	0.21	0.15-0.25
HOLLOW SHAFT -		**S.A.E. 4140 Steel.**
Carbon, per cent	0.40	0.35-0.45
Manganese, "	0.59	0.60-0.90
Silicon, "	0.31	0.15 min.
Phosphorus, "	0.015	0.040 max.
Sulphur, "	0.038	0.050 max.
Nickel, "	0.15	-
Chromium, "	0.96	0.80-1.10
Molybdenum, "	- Not enough sample for test.	0.15-0.25

Hardness Tests:

Brinell hardness tests were made on the axle and on the hollow shaft, with successive readings being taken 9 inches apart, but in the case of the collar the Rockwell method was felt to be preferable to prevent destruction of the part.

The 347 Brinell hardness given for the collar has been obtained from the Westinghouse Electric conversion table. The averages are listed below:

	Brinell	Rockwell C.
Axle	- 444 in centre 418 at either end	
Hollow Shaft	- 241	
Collar	- 347	37

Discussion:

Axle -

From the chemical analysis the steel employed compares to S.A.E. 9255 (a spring steel) except for the slightly higher manganese content. According to the literature[@], a steel of this type should be:

(1) Normalized at 1600 to 1625° F.,
(2) Quenched in oil 1575 to 1600° F., and
(3) Tempered at 850 - 1050 to Brinell 363 - 429.

Since the above heat treatment is for large hot-formed flat springs 3/16 inch and over in thickness, or for hot coiled helical springs over $\frac{1}{2}$ inch in diameter, changes in the heat treatment to conform with the size of the axle should be left to the discretion of the producer.

It will be noted that the hardness of the axle at the centre is higher than at both ends. It is difficult to say whether this has been done so as to facilitate machining at the ends or whether this is a natural occurrence due to the fact that the metal has been tested below the surface at the ends.

Collar -

The nearest S.A.E. specification to the chemical analysis obtained for the collar is 4140.

The probability chart given in the 1941 S.A.E. Handbook shows the following heat treatment for $1\frac{1}{2}$-in. diameter bars of 4140 steel with a Brinell hardness of 347:

(1) Normalize at 1650 to 1750° F.,
(2) Quench in oil at 1525 to 1625° F., and
(3) Temper to 925° F. to obtain the Brinell hardness value, 347.

The following physical properties would then result:

Tensile strength	=	168,000 p.s.i.
Yield	=	144,000 p.s.i.
Reduction of area	=	41 per cent
Elongation	=	11 per cent.

[@] Steel and Its Heat Treatment - Bullens, Vol. II, Fourth Edition, Page 303.

(Discussion, cont'd) -

Hollow Shaft -

It was not possible to obtain a molybdenum analysis on the hollow shaft, due to insufficient sample. It is felt, however, that this is similar to S.A.E. 4140, because of the similarity in the results obtained for the hollow shaft and for the collar.

The probability chart shows that in order to obtain a Brinell hardness of 241 it is necessary to draw to 1250° F. after quenching in oil from 1525 to 1625° F.

The physical properties now obtained are as follows:

Tensile strength	-	118,000 p.s.i.
Yield	-	95,000 p.s.i.
Reduction of area	-	57 per cent
Elongation	-	18 per cent.

It must be stated that in actual production variations of the above will occur.

Conclusions:

1. A steel closely similar to S.A.E. 9255 was used for the axle and heat treatment can be based on prior experience with the latter.

2. The collar and the hollow shaft, although of different hardnesses (347 and 241 respectively), are probably of the same type of steel. The analysis shows that this closely resembles S.A.E. 4140, prior experience with which may well be used as a basis for the heat treatment of these parts.

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