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October 9th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1313.

Examination of a Steel Pontoon
Bolt Racking.

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Source of Material and Object of Investigation:

On September 30th, 1942, Lieut.-Colonel Edward C. Thorne, Director of Engineer Development, Department of National Defence (Army), Ottawa, Ontario, sent in a pontoon bolt racking for examination. It was requested^① that the physical properties of the shank be checked and also that the weld of the mild steel head on this shank be sectioned in order to ascertain the quality of the weld. The shank was stated to be a "heat-treated automotive steel" and may be SAE 5135 steel.

^① In letter, same date, File No. 5-1-66-1 (Engrs) EQ.

Chemical Analysis of Shank:

The steel shank was analysed and found to have the following composition:

	Per cent
Carbon (C)	0.31
Manganese (Mn)	0.43
Silicon (Si)	0.16
Phosphorus (P)	0.016
Sulphur (S)	0.032
Chromium (Cr)	0.95
Nickel (Ni)	3.18
Molybdenum (Mo)	None detected.
Vanadium (V)	" "

Physical Properties:

	Specified	Found
Ultimate strength, p.s.i.	107,000	174,800
Yield strength, p.s.i.	78,000	162,000*
Elongation, per cent in 2 inches	22.0	16.0
Reduction in area, per cent	50.0	49.5
Izod impact, foot pounds	60.0	32.0
Brinell hardness	-	352

* 0.2 per cent proof stress.

Macro-Examination of Welded Head:

Figure 1.



Approximately to size.

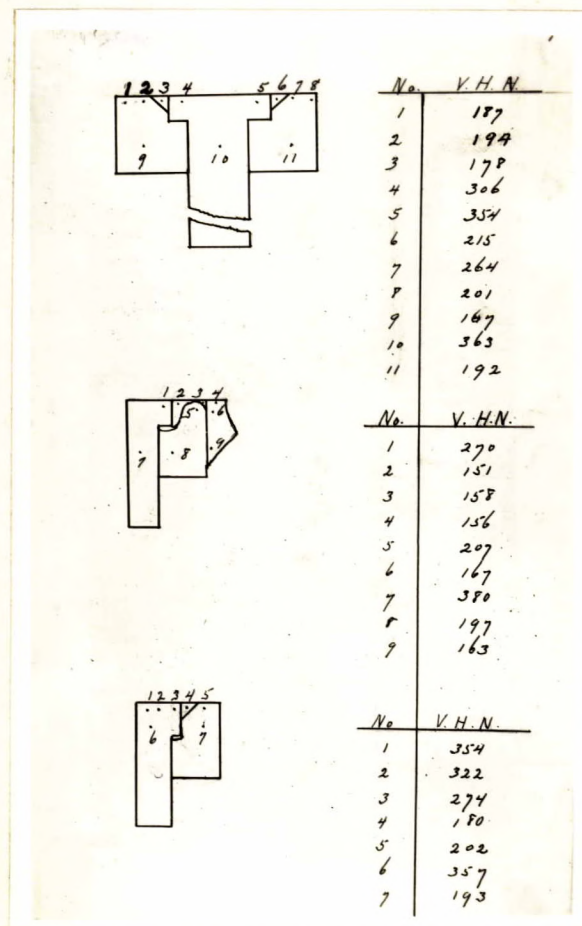
(Macro-Examination of Welded Head, cont'd) -

A cross-sectional view of the weld is shown in Figure 1 after etching in 50 per cent hydrochloric acid for 30 minutes at 175° F. In the above photograph it will be observed that the head of the shank was not fully countersunk and also that the weld metal was porous. The fillet weld is about 1/8 inch wide, instead of 1/4 inch as specified.

Hardness Tests:

A survey was carried out of the hardness of the weld metal, the racking bolt, and also the racking bolt head. The results obtained are given in Figure 2.

Figure 2.



VICKERS HARDNESS NUMBERS.

Discussion of Results:

The steel racking bolt, pontoon, was found to have the composition of an SAE 3435 steel, while the welded head consisted of a piece of cold rolled steel of SAE 1020 composition.

According to the International Nickel Company's heat-treating chart for SAE 3435 steel, one could expect to obtain the following physical properties after an oil quench from 1425° to 1475° F. at the indicated draw temperatures:

Nickel-Chromium Steel SAE 3435, Oil Quenched,
(In small sizes $\frac{1}{8}$ " to $1\frac{1}{2}$ " diameter or thickness).

Physical Properties		Draw 850° F.	1100° F.
Ultimate stress, p.s.i.	-	180,000	132,000
Yield stress, p.s.i.	-	142,000	115,000
Elongation in 2 inches, per cent	-	16.0	21.0
Reduction in area, per cent	-	57.0	65.0
Brinell hardness	-	340	255
Izod impact, foot pounds	-	32	65

The results obtained on the physical tests of the racking bolt indicate that the steel was drawn around 850° F. The properties of the steel are regarded as satisfactory. However, if greater impact properties are required it will be necessary to draw the steel at a higher temperature.

The fillet weld metal and the weld metal of the handle are quite porous. The amount of metal in the fillet weld is less than that specified. No brittle zones were observed in the hardness surveys of the weld and parent metals.

CONCLUSIONS:

The physical properties of the racking pin, although under the specified Izod and elongation limits, were considered satisfactory.

The fillet weld could be improved considerably by making a 90° Vee weld instead of the 45° Vee annular weld used.

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