FILECOPY

File .

OTTAWA Octo

October 8th, 1943.

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1512.

Examination of Four Sets of Steel Washers made to Drawings A=2314 and A=2315.

> יוולאיי אינער א אינער אינער

(Copy No. 10.)

Sivision of Metallic Minerale

ure pressing and retailurgical Laboratories

.

ines and Geology Branch

OTTAWA October 8th, 1943,

HE DIS HE SOBUTO LI

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1512.

Examination of Four Sets of Steel Washers made to Drawings A=2314 and A=2315.

Origin of Request and Object of Investigation:

On September 20th, 1943, four sets of steel washers were submitted for examination. The accompanying Requisition No. 597 (AEDB Lot No. 384, Report No. 23 50 Div. 2), from the Consultant to the Director of Metallurgy, Army Engineering Design Branch, Department of Munitions and Supply, Ottawa, Ontario, described the material as follows:

12 new washers made to Drawing No. A=2314,
12 new washers made to Drawing No. A=2315,
3 broken washers made to Drawing No. A=2315,
4 unbroken washers made to Drawing No. A=2315.

Chemical Analysis:

Two sets of washers (Nos, 1 and 2) were analysed. The results were as follows:

	Set No. 1		Set No. 2.	
		- Per c	eent -	
Carbon	-	0,42	0,26	
Silicon		0.16	Trace.	
Manganese	-	0.69	0,46	
Sulphur		0,039	0,041	
Phosphorus	-	0,023	0,010	

Hardness Measurements:

Hardness measurements made on the four sets of washers gave the following results:

Set No.	(<u>10-kg. load</u>)	Rockwell "B"
1	- 256	102
2	- 201	93
3	146	80
4	- 198	92

Micro-Examination:

The four sets of washers were examined under the microscope in the unetched condition. No defect of importance was found. The specimens were then etched in 2 per cent nital solution. The structures are all ferritic and pearlitic. Washer Set No. 1 contains less free ferrite than the others (see Figure 1). Figure 2 is characteristic of the microstructure in Sets Nos. 2 and 4. Figure 3 shows the microstructure in Washer Set No. 3. Note the smaller amount of ferrite present as compared with that shown in Figure 2.

Discussion of Results:

Chemical Analysis -

The higher-carbon Set No. 1 material would be expected to be stronger than the lower-carbon steel in Set No. 2. The silicon content of Set No. 1 steel shows that it has been (Discussion of Results, cont'd) -

killed, The absence of silicon from Set No. 2 material indicates that it is of the rimming type.

Hardness Measurements -

While the thicker washers are harder than the thinner ones, a considerable difference was observed between the unbroken and broken sets of the latter (the broken being considerably softer). Since neither material is sufficiently hard to be brittle, the failure of the soft washers because of their consequently lower tensile strength is understandable.

Micro-Examination -

The microscopic examination confirmed the results of chemical analysis and hardness tests; the higher carbon and harder material containing considerably less ferrite. For the broken washers (Figure 3) the lower ferrite content as compared to the unbroken material (Figure 2) indicates fairly definitely that its carbon content is greater. The lower hardness of this material is also consistent with this assumption. It is true that, for a given carbon content, the rate of cooling may alter the amount of free ferrite. However, the nature of the ferrite found in the present case indicates that the rate of cooling is not responsible for the difference in free ferrite present.

CONCLUSION:

The washer failures encountered are considered to be due to the use of material of too low strength. Adoption of a higher-carbon steel, such as was found in some of the washers submitted, is recommended.



X250, nitel atch.

SHOWING THE MICROSTRUCTURE OF THE WASHERS MADE TO DRAWING A-2314. Figure 2



X250, mital etch.

SHOWING THE MICROSTRUCTURE OF AN UNBROKEN WASHER MADE TO DRAWING A-2315.

Figure 3.



X250, nital etch.

SHOWING THE MICROSTRUCTURE A BROKEN WASHER MADE TO DRAWING A-2315.

-

ACTA washi chan a tanan tang ang a sang ang a sang