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O T T A W A

April 4, 1945.

## R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1831.

Thickness of Corrosion-Resistant Cadmium-  
Plated Coatings on Steel Bolts.



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Background:

A requisition dated March 22, 1945, was received from Mr. A. M. Toye, I.O.M.E.(1), of the Inspection Board of United Kingdom and Canada, 479 Bank Street, Ottawa, Ontario, requesting that a number of tee bolts be tested for thickness of protective coating and for resistance to salt spray. Later a verbal request was received to test one extra bolt.

The bolts were to be made of Atlas S.P.S. 245 steel.

The ones submitted for test were as follows:

- 2 bolts (numbered 1 and 2) plated with cadmium for 10 minutes.
- 2 bolts (numbered 3 and 4) plated with cadmium for 20 minutes.
- 1 bolt (numbered 5) plated with cadmium, taken at random from production.
- 1 bolt (numbered 6), unplated.
- 1 bolt (numbered 7) plated with zinc and then passivated.
- 1 bolt (additional), unplated. To be covered with graphite grease in these Laboratories.

According to specifications the cadmium-plated bolts should have coatings between 0.0005 and 0.0010 inch thick and



(Background, cont'd) -

the zinc-plated one should have a coating between 0.0002 and 0.0005 inch thick.

This present report gives thickness data only. A further report will give the results of the salt spray test when it has been completed.

Measurement Procedure:

The thickness of metal coating was determined at a number of different points on the surfaces of the tee bolts. In the case of the cadmium-plated bolts the points where thickness measurements were taken and the numbers which were given to those points are shown in Figure 1. In the case of the zinc-plated bolt they are shown in Figure 2. The Aminco-Brenner Magne-Gage was used in making the thickness measurements.

Data on Thickness Deposit:

The results of the thickness measurements are given in Table I. They were placed on a graph (see Figure 3) in which the thickness was plotted against the number of the location where the measurement was taken. The values for each tee bolt were joined by straight lines. The three heavy horizontal lines on the graph indicate the specification limits.

Table II shows the number of thickness values which were (1) within specifications, (2) higher than specifications, and (3) lower than specifications in the case of each bolt.

( Tables I and II follow,  
on Page 3.  
(Text continues on Page 4.) )



(Data on Thickness Deposit, cont'd) -

TABLE I. - Thickness of Coating at Various Points on the Tee Bolts.

No. of location on chart (Figure 1 or Figure 2)	THICKNESS, in inches					
	Bolt No. 1	Bolt No. 2	Bolt No. 3	Bolt No. 4	Bolt No. 5	Bolt No. 7
1	0.00063	0.00050	0.00158	0.00123	0.00034	0.00053
2	.00043	.00021	.00124	.00099	.00032	.00041
3	.00034	.00036	.00124	.00127	.00021	.00040
4	.00034	.00028	.00073	.00083	.00031	.00035
5	.00064	.00052	.00178	.00178	.00073	.00037
7	.00079	.00050	.00158	.00178	.00073	.00063
8	.00039	.00031	.00074	.00077	.00031	.00030
9	.00034	.00034	.00109	.00119	.00028	.00061
10	.00058	.00037	.00097	.00099	.00037	.00037
11	.00036	.00055	.00113	.00109	.00032	.00033
12	.00036	.00073	.00107	.00094	.00036	.00038

TABLE II. - Number of Thickness Values Recorded.

Bolt No.	Within specifications	Higher than specified	Lower than specified
1 (10 min.) -	4	None.	7
2 (10 min.) -	5	None.	6
3 (20 min.) -	3	8	None.
4 (20 min.) -	5	6	None.
5 (random) -	2	None.	9
7 (zinc-plated) -	8	3	None.



Conclusions:

1. There is a great variation in thickness of coating from one point to another on the surface of each bolt. This is particularly true in the case of the bolts which were plated for 20 minutes.
2. The bolts which were cadmium-plated for 10 minutes were either within or lower than specifications.
3. The bolts which were cadmium-plated for 20 minutes were either within or higher than specifications.
4. The bolt which was taken from production at random had a coat which was approximately as thick as those on the bolts which were plated for 10 minutes.
5. The measurements taken on the zinc-plated coating were either within or higher than specifications. They adhered more closely to specifications than the others did.
6. Undoubtedly, the thickness of deposit in the recessed parts of the threads will be considerably less than that determined for the prominent parts at locations 3 and 9 (see Figure 1).

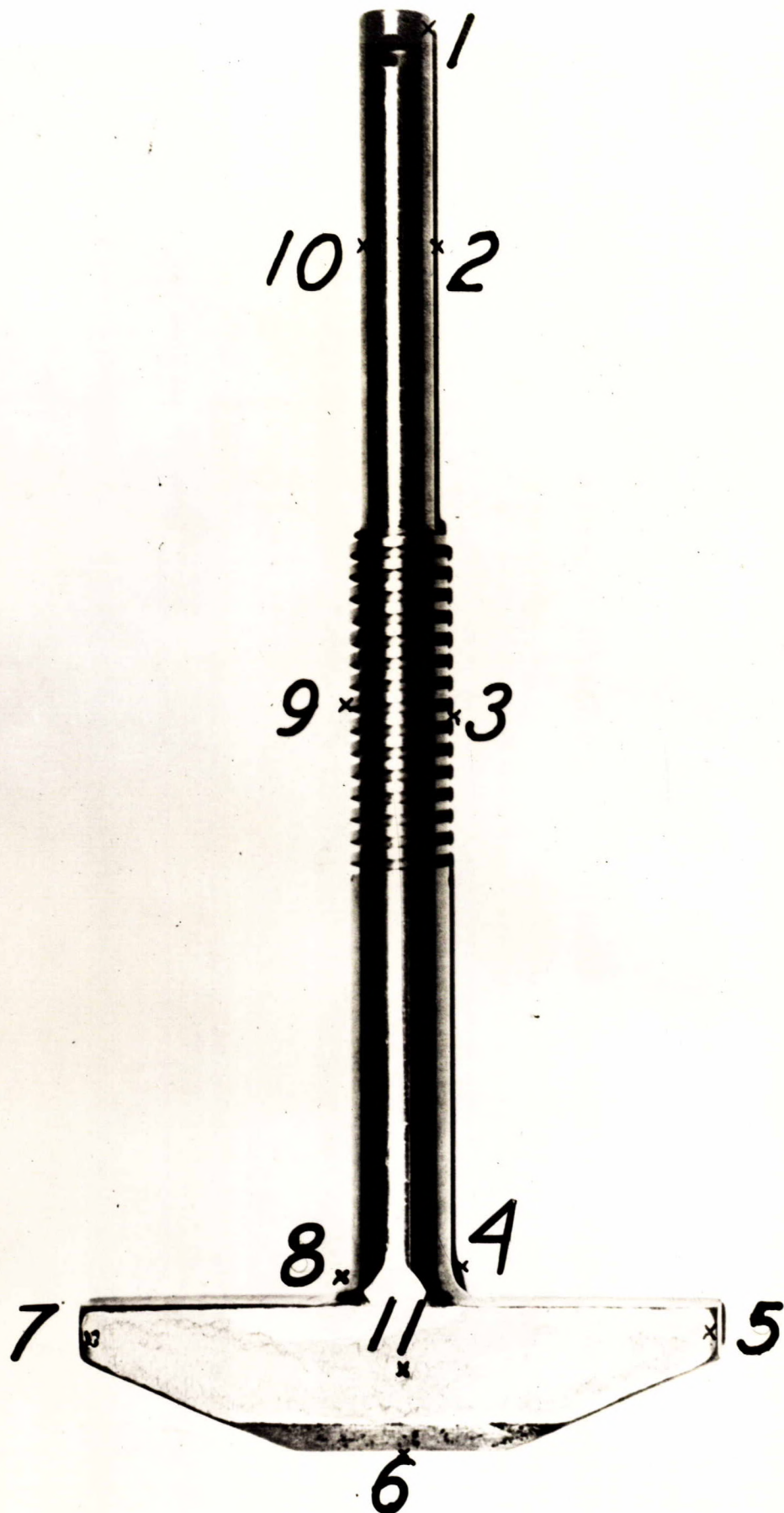
Recommendation:

It is recommended that the thickness of deposit be determined when the test bolts have been plated for about 15 minutes or, better still, when some test bolts have been plated at 13 minutes, some at 14 minutes, some at 15 minutes, and some at 16 minutes.

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Figure 1.



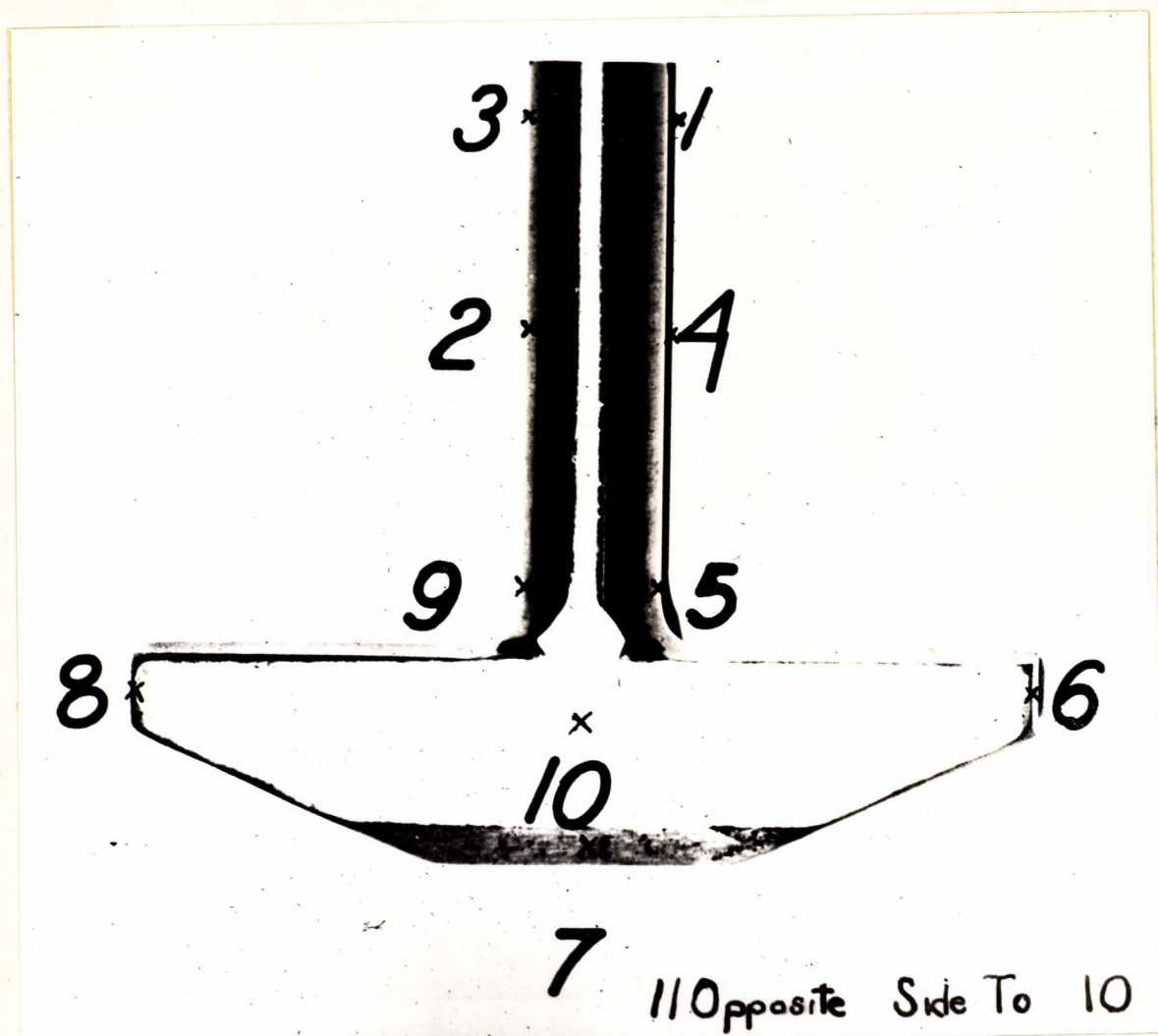
12 Opposite Side To 11

PHOTOGRAPH OF TEE BOLT PLATED WITH CADMIUM, SHOWING  
LOCATIONS WHERE THICKNESS MEASUREMENTS WERE TAKEN.

(Approximately 4/5 actual size).

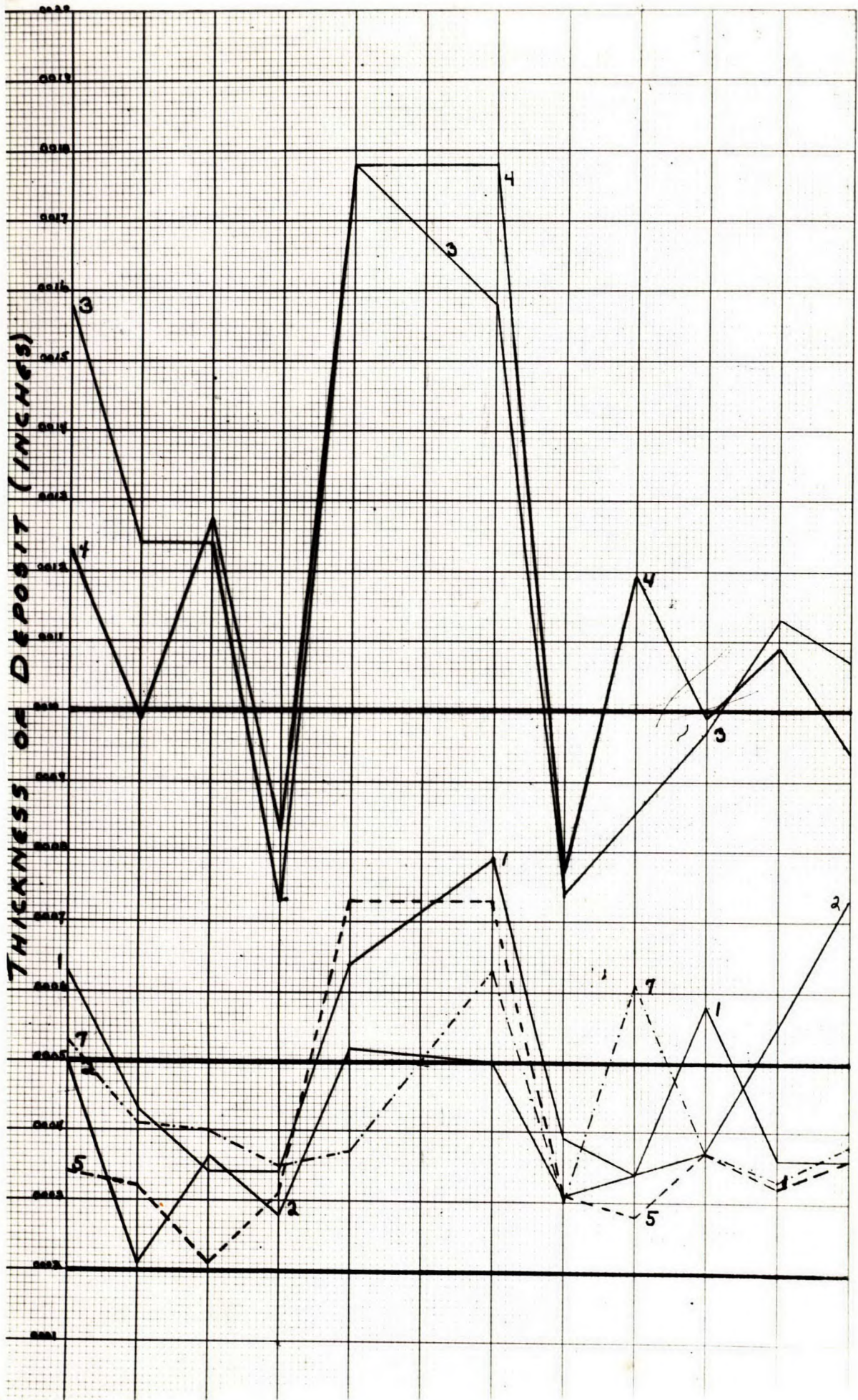


Figure 2.



PHOTOGRAPH OF TEE BOLT PLATED WITH ZINC AND PASSIVATED,  
SHOWING LOCATIONS WHERE THICKNESS MEASUREMENTS WERE TAKEN.





GRAPH SHOWING THICKNESS OF COATING AT VARIOUS LOCATIONS ON THE DIFFERENT TEE BOLTS TESTED.