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REPORT NO. 710/38

AD-A953 790

710/38

THE GOGAN BRINELL HARDNESS TESTING MACHINE

BY

D. J. MARTIN
1st Lt. Ord. Dept.

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March 27, 1935
WATERTOWN ARSENAL
WATERTOWN, MASS.

REPORT 710/38-1

THE GOGAN BRINELL HARDNESS TESTING MACHINE.

The second column of figures in Table I is incorrect because of the fact that the wrong conversion chart was furnished.

A corrected copy of Table I is inclosed herewith. It should be substituted for Table I in all copies of Report 710/38. Figure I and the first paragraph on page 3 no longer apply. They should be deleted.

The conclusions reached and the recommendations offered are not affected by these changes.

Respectfully submitted:



D. J. Martin
1st Lt., Ord. Dept.

March 27, 1935

The Gogan Brinell Hardness Testing Machine

References:- W. A. Ex. Order 48-A17: O.O. 381/12832 -
Cleveland D. O. O: W. A. 470.5/1119:
W. A. 470.5/1123.

The use of the Gogan Brinell Hardness Testing Machine manufactured by the Gogan Machine Corp. was recommended to this arsenal as a rapid and accurate means for hardness measurement, especially with reference to acceptance tests of armor plate. The manufacturer's literature pertaining to this machine is attached to the original copy of this report.

Five small pieces of steel ground on one surface and with ordinary surface scale on the other, were shipped to the Cleveland District Ordnance Office for Gogan test. After testing they were returned to this arsenal for standard Brinell measurement.

Identification of the five samples is as follows:

<u>Marking</u>	<u>Sample Identification</u>
M5	WD 1035 steel, "as rolled"
2 Ger-1	12 m.m. German Armor Plate
2-445-2	W.A. Armor Plate - face hardened
4-444-1	W. A. " " " "
FA4-328A6	WD 1045 steel, annealed

The hardnesses reported by the Cleveland District Ordnance Office and the true Brinell Hardnesses determined at this arsenal are shown in Table I:

Table I
Brinell and Gogan Hardness Measurements

<u>Specimen</u>	<u>Gogan No.</u> *	<u>Brinell Hardness-from Gogan- Brinell Conversion Chart</u> *	<u>True Brinell Hardness</u> W. A.
M5 (punch mark surface)	56.7	171	*165
M5 (unmarked)	57.9	168	*164
2 Ger-1 (stamped side)-(unfinished)	28.9	453	--
2 Ger-1 (unstamped)-(surface ground)	28.7	459	*502
2-445-2 (stamped)-(unfinished)	27.1	509	600
2-445-2 (unstamped)-(surface ground)	31.5	385	*379
4-444-1 (stamped)-(unfinished)	33.2	350	300
4-444-1 (unstamped)-(surface ground)	27.5	496	*598
FA4-328A6 (stamped)-(unfinished)	45.7	222	--
FA4-328A6 (unstamped)-(surface ground)	45.2	226	*229

* - Average of 5 or 6 determinations

It is evident that the Brinell hardness, as indicated from the Gogan-Brinell conversion chart, is markedly different from the actual Brinell hardness. The relation of these two measurements is shown in Figure 1, using only points taken as averages for at least five readings on each machine.

Variations from the average, among the individual readings, with the two machines were studied to obtain an idea of the relative accuracy of the two machines. For this study the actual Gogan numbers (without any conversion) were used for the Gogan Machine, and the diameters of the Brinell impressions in millimeters, were used for the Brinell Machine. These two basic figures should be more suitable for comparison than arbitrary numbers taken from some conversion chart. The results obtained are shown in Table II:

Table II

Accuracy Comparison - Brinell vs Gogan Machines

Specimen	Average Reading		Max. Variation		Max. Var. as % of Av. Reading		Mean Variation		Mean Var. as % of Av. Reading	
	Gogan	Brinell	Gogan	Brinell	Gogan	Brinell	Gogan	Brinell	Gogan	Brinell
M5	56.7	4.67	2.3	.05	4.1	1.1	.7	.022	1.2	.47
M5	57.9	4.68	2.7	.05	4.7	1.1	.9	.024	1.6	.51
*2 Ger-1	28.9	--	2.3	--	8.0	--	.5	--	1.7	--
2 Ger-1	28.7	2.73	.7	.10	2.4	3.7	.2	.033	0.7	1.2
*2-445-2	27.1	--	1.5	--	5.5	--	.45	--	1.6	--
2-445-2	31.5	3.14	.9	.15	2.9	4.8	.25	.056	0.8	1.8
*4-444-1	33.2	--	4.7	--	14.2	--	1.7	--	5.1	--
4-444-1	27.5	2.51	1.5	.15	5.5	6.0	.35	.026	1.3	1.0
*FA4-	45.7	--	2.4	--	5.8	--	.75	--	1.6	--
FA4-	45.2	3.99	1.5	.05	3.3	1.3	.47	.014	1.0	.35

* - Unfinished surface: all other results from ground surfaces.

The following observations of interest are suggested from a study of Table II:

- (a) The Brinell Machine appears to be more accurate for testing soft materials (M5 and FA4-);
- (b) The Gogan Machine seems somewhat better than the Brinell for materials of the order of hardness of armor plate;
- (c) The difference in accuracy of the two machines for testing armor plate (2 Ger-1, 2-445-2 and 4-444-1) is very slight;
- (d) The Gogan Machine is very much less accurate on commercial mill surfaces than on ground surfaces, as should be expected.

On surfaces prepared as it is now necessary to prepare for Brinell impressions the Gogan Machine is just as accurate as the Brinell Machine and, if desired by the Ordnance Department or the contractor, its use should be permitted. As applied for routine inspection of light armor plate the Gogan Machine - or other machines of the same type and equal quality - should offer a distinct advantage in time required for testing, which should be less than half of the time required for an equal number of Brinell tests.

The maximum variation on unfinished surfaces with the Gogan Machine was about 100% greater than on

ground surfaces. This variation is too great to permit the use of the machine on commercial surfaces of armor plate without preliminary preparation by grinding or other surfacing methods. The results obtained on the three armor plate samples are re-stated in Table III to bring out these differences.

Table III
Comparison of Results on Finished and
Unfinished Surfaces

 Gogan Hardness Testing Machine

 Armor Plate Samples

Specimen

<u>Ground Surface</u>	<u>Max. Variation - %</u>	<u>Mean Variation - %</u>
2 Ger-1	2.4	0.7
2-445-2	2.9	0.8
4-444-1	5.5	1.3
Commercial Surfaces,		
<u>Not Finished</u>		
2 Ger-1	8.0	1.7
2-445-2	5.5	1.6
4-444-1	14.2	5.1

The suitability of the 50- point Brinell range now permitted under Spec: AXS-54, Rev. 2, must be questioned. For hardness values from 550 to 650 Brinell this range permits a variation of about 4.0% in the actual reading of the diameter of the Brinell impression, in millimetres. Table II shows that this is, in most cases, less than the maximum variation to be expected in testing any single plate. Due to the shape of the diameter-hardness curve a 50 point range allows a variation of 5-6% in the actual readings in the Brinell hardness range from 350 to 450. Even in this range the permitted variation is not much in excess of the probable maximum variation in any one plate.

Until these conditions are made more satisfactory it is difficult to set up a proposed standard for the use of the Gogan Machine. For the present, however, it is suggested that the manufacturer of light armor plate might be permitted to specify a Gogan hardness number to which he desires to work; and that the mean of three readings at each of two places on each plate, for all plates in any given lot so selected shall be required to be within 2%, plus or minus, of the specified hardness.

Respectfully submitted,

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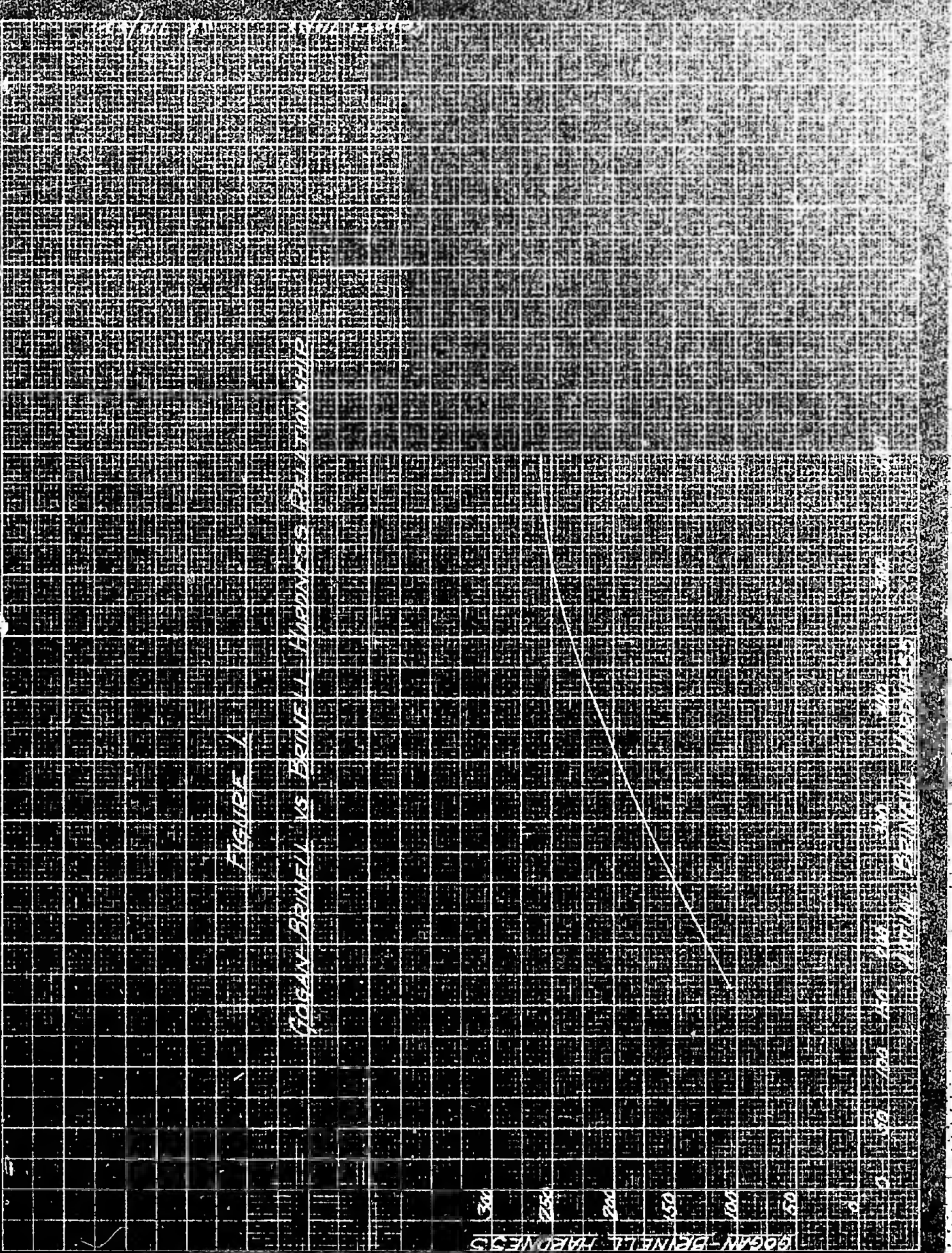


FIGURE 1

ROGAN-BENNETT VS BRIDE L. HODGES, JR.

ROGAN-BENNETT, HADONEST

ROGAN-BENNETT, HADONEST