NATIONAL BUREAU OF STANDARDS REPORT

EXAMINATION OF MOLTRUP STEEL TRANSFER PLATE SAMPLES

By

I. J. Feinberg
Engineering Metallurgy Section

To

Electrolytic Section
Bureau of Engraving and Printing

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

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[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D. C., 20234.

[2] Located at Boulder, Colorado, 80302.

[3] Located at 5285 Port Royal Road, Springfield, Virginia 22151.

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Examination of Moltrup Steel Transfer Plate Samples

Material: Two Moltrup steel plate samples, each 0.187 in. x 2.0 in. x 4.75 in. were submitted for examination. One sample was received in the hot rolled condition, the other hardened. Each sample was polished on one face and ground on the other. The hot rolled sample was identified as A; the hardened sample as B. The samples were representative of material procured for transfer plates and were examined to determine whether the material complied with specifications.

Chemical Analysis: A conventional chemical analysis was conducted on sample A by the NBS Analytical Chemistry Division. A copy of the report is included as addendum 1. The composition of the sample was found to comply with that detailed for AISI No. C-1031, Bureau of Engraving and Printing Specification for Steel Engraving Plates, dated January 19, 1961.

Hardness: The average hardness of 75 Rockwell B obtained on the polished surface of the hot rolled sample, A, complies with that specified in the Bureau of Engraving and Printing Specification. The results of a hardness traverse across the thickness of a section from sample B in which hardness impressions were made at intervals of approximately 0.010 inch are tabulated below:

Reading No.	Distance from Polished Surface Inch	KHN 500 g Load	Equivalent Approximate Hardness	
			Rockwell B	Rockwell C
1	0.0024	420	-	42
2	.0048	322	-	32
3	.0072	274	-	24
4	.0096	252	-	20
5	.0120	248	99	-
6	.0144	245	99	-
7	.0244	235	97	-
8	.0344	230	96	-
9	.0444	239	98	-
10	.0544	228	95	-
11	.0644	224	95	-
12	.0744	224	95	-
13	.0844	223	94	-
14	.0944	218	93	-
15	.1044	227	95	-
16	.1144	216	93	-
17	.1244	218	93	-
18	.1344	221	94	-
19	.1444	224	95	-
20	.1544	227	95	-
21	.1644	229	96	-
22	.1720	227	95	-
23	.1744	248	99	-
24	.1768	267	-	27
25	.1792	295	-	32
26	.1816	429	-	45

The hardness traverse indicated the presence of a case approximately 0.005 inch deep on both faces. It also indicated that the interior was uniformly hardened throughout inasmuch as there was no appreciable variation in hardness in the interior.

Metallographic Examination: A section of the hot-rolled sample was examined to determine the inclusion content. Uniformly distributed thin inclusions, probably manganese sulfide were found. These are shown in Figure 1. The inclusion rating using ASTM Designation E-45 as a reference is A-1 to A-2.

No evidence of ferrite banding was observed in the examination of a hot rolled longitudinal section, Figure 2a. Figure 2b shows no decarburization adjacent to the front (polished) surface of this material. No decarburizing was found adjacent to the back surface.

The hardened sample had a case, approximately 0.005 inch deep adjacent to the polished face, Figure 4.

Discussion and Conclusions: The material submitted complied with specified composition requirements. The 75 Rockwell B hardness obtained on the polished surface of the hot rolled sample complies with that specified in the Bureau of Engraving and Printing specification. Inclusion contents were low and no detrimental banding was found in examination of the hot rolled structure. This structure consisting of partially spheroidized carbides in a ferrite matrix is acceptable for the intended material application.

The case on the hardened sample is approximately 0.005 inch deep. The interior of this sample was uniformly hardened.

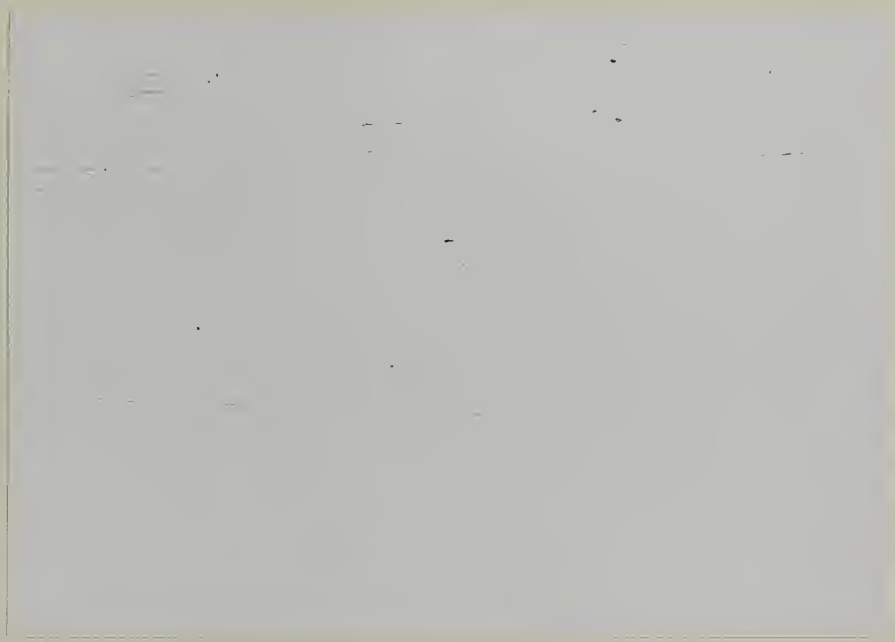
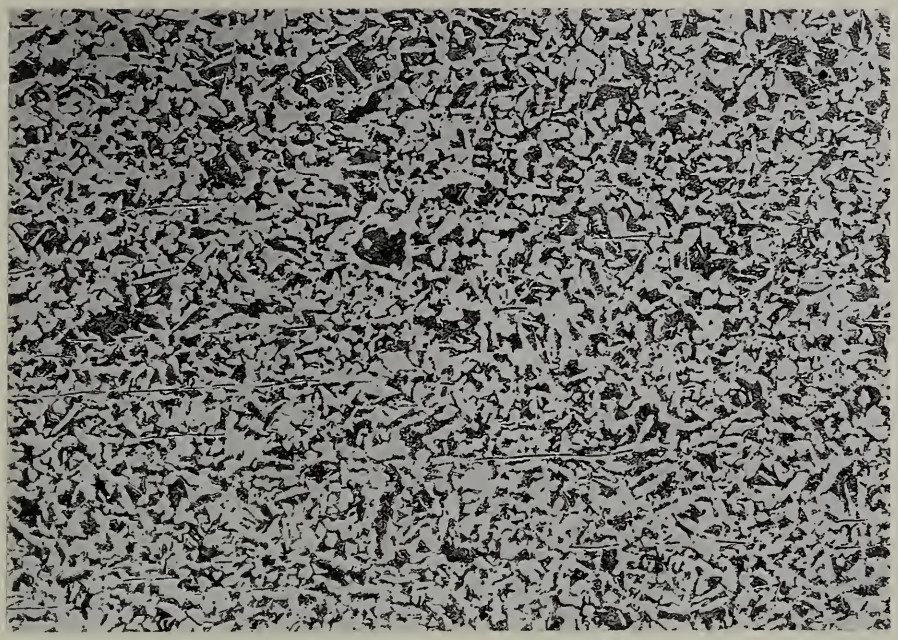


Figure 1. Thin inclusions, probably manganese sulfide, found in longitudinal section of hot rolled sample, A. Unetched. X 100



a

b

Figure 2. Microstructures of hot rolled section, sample A.

a. Shows no evidence of ferrite banding in longitudinal section. Etched with 2% picral. X 100

b. Shows no decarburization adjacent to front (polished) surface. Etched with 2% picral. X 200

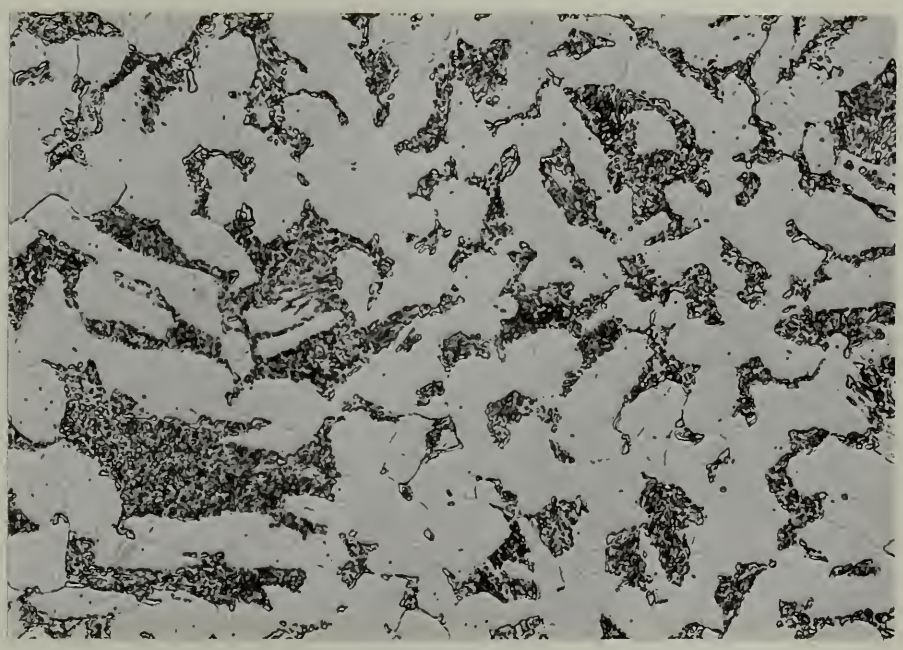


Figure 3. Microstructure observed in hot rolled sample, A. Ferrite (white) and partially spheroidized carbides. Etched with 2% picral. X 500

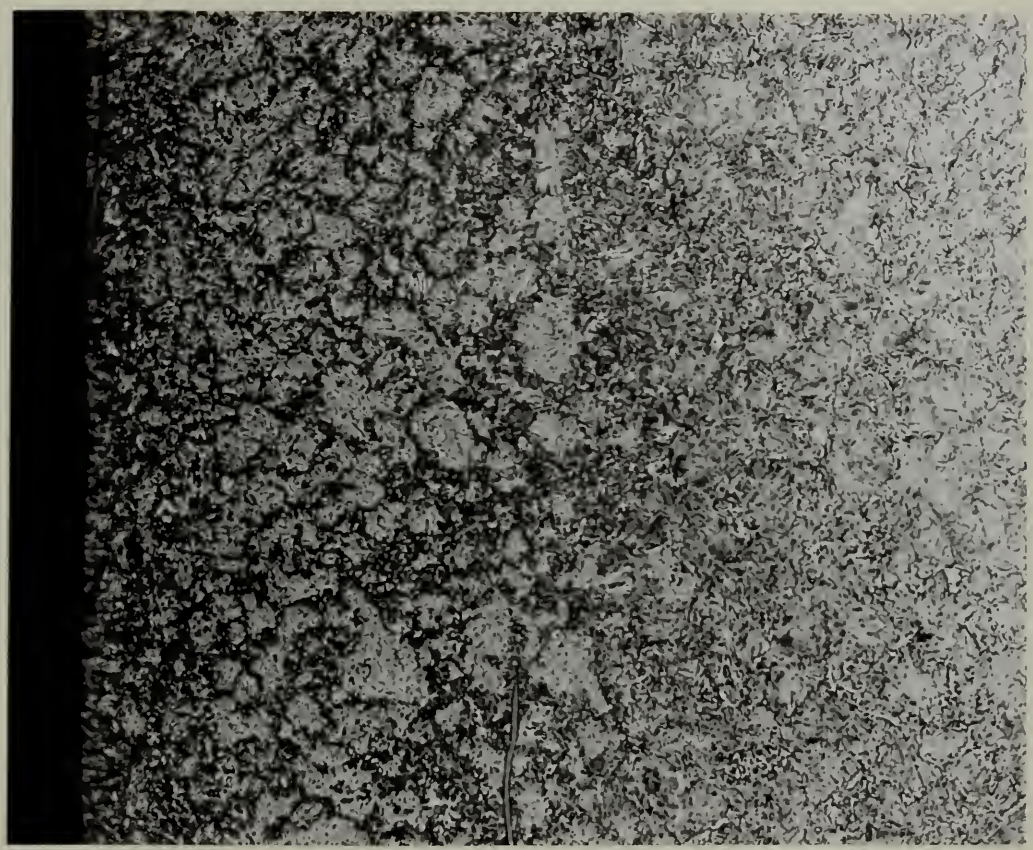


Figure 4. Microstructure of hardened sample, B, adjacent to front (polished) face. Case shown is approximately 0.005 inch deep. Etched with 2% picral. X 500

FORM NBS-348
(12-65)

Addendum 1

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON, D.C. 20234

REPORT OF ANALYSIS

Moltrup Plate A

Requested by I. J. Feinberg, 312.01
Project 3120641, Req. No. 8316

Element	%
Carbon	0.32
Manganese	.48
Silicon	.20
Phosphorus	.006
Sulfur	.02

The sample was analyzed by ASTM methods.

John R. Baldwin

John R. Baldwin, Chemist

John K. Taylor

John K. Taylor, Chief
Microchemical Analysis Section
Analytical Chemistry Division

February 5, 1968

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