NATIONAL BUREAU OF STANDARDS REPORT

10 026

EXAMINATION OF STEEL TRANSFER PLATE SAMPLE NO. 604

To

Electrolytic Section
Bureau of Engraving and Printing

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards[1] was established by an act of Congress March 3, 1901. Today, in addition to serving as the Nation's central measurement laboratory, the Bureau is a principal focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. To this end the Bureau conducts research and provides central national services in three broad program areas and provides central national services in a fourth. These are: (1) basic measurements and standards, (2) materials measurements and standards, (3) technological measurements and standards, and (4) transfer of technology.

The Bureau comprises the Institute for Basic Standards, the Institute for Materials Research, the Institute for Applied Technology, and the Center for Radiation Research.

THE INSTITUTE FOR BASIC STANDARDS provides the central basis within the United States of a complete and consistent system of physical measurement, coordinates that system with the measurement systems of other nations, and furnishes essential services leading to accurate and uniform physical measurements throughout the Nation's scientific community, industry, and commerce. The Institute consists of an Office of Standard Reference Data and a group of divisions organized by the following areas of science and engineering:

Applied Mathematics—Electricity—Metrology—Mechanics—Heat—Atomic Physics—Cryogenics[2]—Radio Physics[2]—Radio Engineering[2]—Astrophysics[2]—Time and Frequency.[2]

THE INSTITUTE FOR MATERIALS RESEARCH conducts materials research leading to methods, standards of measurement, and data needed by industry, commerce, educational institutions, and government. The Institute also provides advisory and research services to other government agencies. The Institute consists of an Office of Standard Reference Materials and a group of divisions organized by the following areas of materials research:

Analytical Chemistry—Polymers—Metallurgy — Inorganic Materials — Physical Chemistry.

THE INSTITUTE FOR APPLIED TECHNOLOGY provides for the creation of appropriate opportunities for the use and application of technology within the Federal Government and within the civilian sector of American industry. The primary functions of the Institute may be broadly classified as programs relating to technological measurements and standards and techniques for the transfer of technology. The Institute consists of a Clearinghouse for Scientific and Technical Information,[3] a Center for Computer Sciences and Technology, and a group of technical divisions and offices organized by the following fields of technology:

Building Research—Electronic Instrumentation — Technical Analysis — Product Evaluation—Invention and Innovation— Weights and Measures — Engineering Standards—Vehicle Systems Research.

THE CENTER FOR RADIATION RESEARCH engages in research, measurement, and application of radiation to the solution of Bureau mission problems and the problems of other agencies and institutions. The Center for Radiation Research consists of the following divisions:

Reactor Radiation—Linac Radiation—Applied Radiation—Nuclear Radiation.

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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 STEEL TRANSFER PLATE SAMPLE NO. 604

By

I. J. Feinberg
Engineering Metallurgy Section
Metallurgy Division

To

Electrolytic Section
Bureau of Engraving and Printing

U.S. DEPARTMENT OF COMMERCE

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Examination of Steel Transfer Plate Sample No. 604

Reference: Specification for Steel Engraving Plates, Bureau of Engraving and Printing, January 19, 1961.

Material: One 0.183 in. x 2.0 in. x 4.0 in. x 4.0 in. steel plate sample, identified as No. 604 and representative of material procured for transfer plates, was examined to determine whether the material complied with specifications. The sample examined was in the hot rolled condition and was polished on one face and ground on the other.

Chemical Analysis: A conventional chemical analysis was conducted on the sample. A copy of the report is included as addendum 1. The composition of the sample, except for a slightly higher than specified manganese content, complied with the composition detailed for AiSI C1031 in the referenced specification. It is noteworthy that the carbon content of the sample, 0.33 percent, is close to the upper limit of the 0.28 - 0.34 percent carbon range permitted.

Hardness: The average hardness of 72 Rockwell B obtained on the polished surface of the sample complies with that specified in the Bureau of Engraving and Printing Specification.

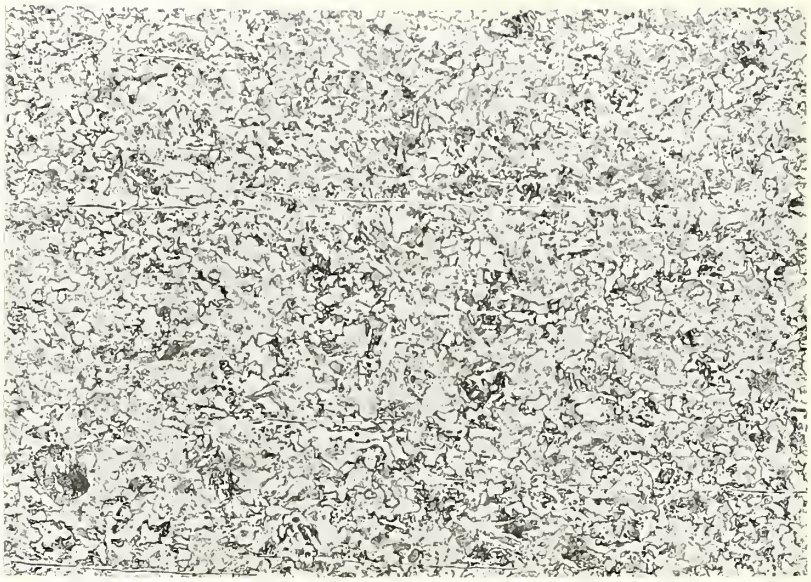
Metallographic Examination: A section of the sample was examined to determine the inclusion content. Uniformly distributed thin inclusions, probably manganese sulfide were found. These are shown in Figure 1. The inclusion rating using ASTM Designation E-45 as a reference is A-2.

No evidence of ferrite banding was observed in the examination of a longitudinal section, Figure 2a. Figure 2b shows no decarburization adjacent to the front (polished) surface of this material. No decarburization was found adjacent to the back surface. The microstructure of the sample is composed essentially of partially spheroidized carbides in a ferrite matrix, Figure 3.

Discussion and Conclusions: The plate sample complied with composition requirements except for a manganese content that is slightly higher than that specified. However, the composition is considered to be acceptable for the intended material use.

The carbon and manganese contents of the sample approximate the upper limits of acceptability. Therefore, this plate material may exhibit greater hardenability than that experienced with previously procured material with a lower carbon and/or manganese content. The 72 Rockwell B hardness obtained on the polished surface of this 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 essentially of partially spheroidized carbides in a ferrite matrix is acceptable for the intended material application.

Figure 1. Thin inclusions, probably manganese sulfide, found in longitudinal section of plate sample No. 604. Unetched. X 100.



a

b

Figure 2. Microstructures of hot rolled plate sample No. 604.

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.

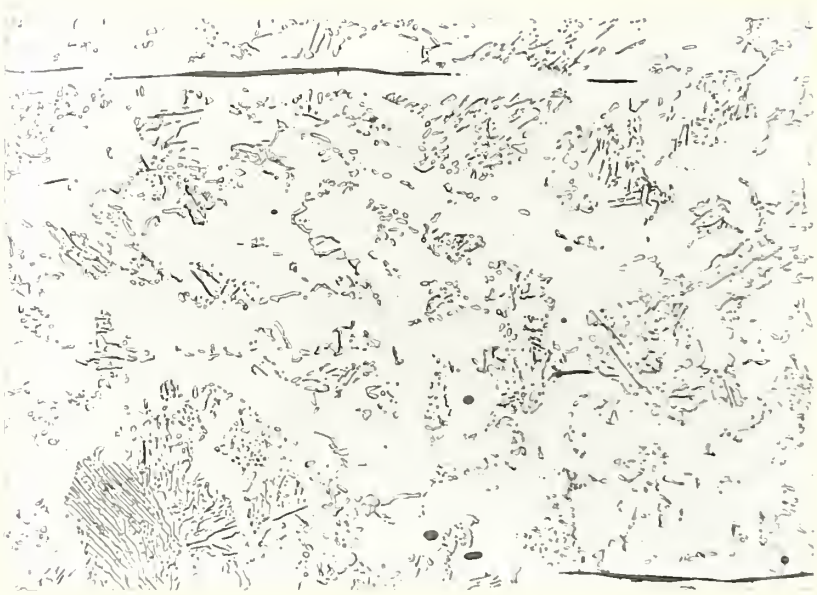


Figure 3. Microstructure observed in hot rolled plate sample No. 604. Ferrite (white) and partially spheroidized carbides. Etched with 2% picral. X 500.

Addendum 1

VALUE ENGINEERING COMPANY
Materials Evaluation Laboratory
2316 Jefferson Davis Highway
Alexandria, Virginia 22301

CERTIFICATE OF TEST RESULTS

Material . .Steel Sample "604". . . . . No. of Samples . . 1 . . .
Submitted By . . National Bureau of Standards . . . . . Date Submitted 3/14/69. . . . .
Tests Performed . . Chemical Analysis . . . . . .

CHEMICAL ANALYSIS

Al		Mg		Pb		Zn	
C	0.33	Mn	0.65	S	0.018		
Cr		Mo		Si	0.20		
Cu		Ni		Sn			
Fe		P	0.011	Ti			

Analysis Performed By . . . . . In accordance with . . . . . .
. . . . . .

TENSILE TEST

Sample No.	Yield Strength, psi	Tensile Strength, psi	Per Cent Elongation in...Inches	Per Cent Reduction In Area

Test Conducted By . . . . . In accordance with . . . . . .
. . . . . .

HARDNESS

Sample or Position No.	Hardness	Sample or Position No.	Hardness

Test Conducted By . . . . . In accordance with . . . . . .
. . . . . .
Comments . . . . . .
. . . . . .
. . . . . .

Approved By . . . . H. P. Weinberg . . . . .
. . . . H. P. Weinberg . . . . .
. . . . Laboratory Director . . . . .

ML-1
USCOMM-NBS-DC

Date . . . March 25, 1969 . . . . . .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