

Certificate of Analysis

Standard Reference Materials 461-468 and 1161-1168

Spectrographic Ingot Iron and Low-Alloy Steel Standards

The 400 Series consists of rods 5.6 mm (7/32 in) in diameter and 100 mm (4 in) long. These are designed for use in optical emission spectrometric methods of analyses.

The 1100 Series consists of disks 32 mm (1 1/4 in) in diameter and 19.1 mm (3/4 in) thick. These are designed for use in both optical emission and x-ray fluorescence spectrometric methods of analyses.

NBS No.	461 1161	462 1162	463 1163	464 1164	465 1165	466 1166	467 1167	468 1168
Designation	Low-Alloy Steel A	Low-Alloy Steel B	Low-Alloy Steel C	Low-Alloy Steel D	Ingot Iron E	Ingot Iron F	Low-Alloy Steel G	Low-Alloy Steel H
Element	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
C	0.15	0.40	0.19	0.54	0.037	0.065	0.11	0.26
Mn	.36	.94	1.15	1.32	.032	.11 ₃	.27 ₅	.47
P	.053	.045	0.031	0.017	.008	.012	.033	.023
S	.019	.019	.022	.021	.010	.009	.009	.020
Si	.047	.28	.41	.48	.029	.025	.26	.075
Cu	.34	.20	.47	.094	.019	.033	.067	.26
Ni	1.73	.70	.39	.13 ₅	.026	.051	.088	1.03
Cr	0.13	.74	.26	.078	.004	.011	.036	0.54
V	.024	.058	.10	.29 ₅	.002	.007	.041	.17
Mo	.30	.080	.12	.029	.005	.011	.021	.20
Sn	.022	.066	.013	.043	.001	.005	.10	.009
Ti	(.01) ¹	.037	.010	.004	.20	.057	.26	.011
B	.0002	.000 ₅	.0012	.005	.000 ₁	(.000 ₂)	(.000 ₂)	.009
As	.028	.046	.10	.018	.010	.014	.14	.008
W	.012	.053	.10 ₅	.022	(.001)	(.006)	.20	.077
Zr	(<.005)	.063	.20	.010	(.002)	(<.005)	.094	(<.005)
Nb	.011	.096	.19 ₅	.037	(.001)	.005	.29	.006
Ta	.002	.036	.15	.069	.001	.002	.23	.005
Al	(.005)	.02 ₃	.027	.005	.19	.01 ₅	.16	.04 ₂
Co	.26	.11	.01 ₃	.028	.008	.04 ₆	.07 ₄	.16
Pb	(.003)	.006	.012	.020	(<.0005)	(.001 ₃)	.000 ₆	(<.0005)
Ag	(.001 ₅)	(<.0002)	(<.0002)	(.003 ₀)	(.0002 ₅)	(.0004 ₅)	(.004 ₀)	(<.0002)
Ge	(.001 ₅)	(.003 ₀)	(.002 ₅)	(.001 ₅)	(.003 ₅)	(.003 ₀)	(.003 ₀)	(.001 ₀)
O	(.02 ₀)	(.006)	(.007)	(.006)	(.003)	(.005)	(.004)	(.004)
N	(.00 ₆)	(.008)	(.00 ₆)	(.007)	(.005)	(.00 ₆)	(.004)	(.00 ₆)

¹ Values in parenthesis are not certified, but are given for information on the composition.

Caution: Because these standards contain a graded composition for more than 20 elements, care must be observed in their use to make certain that element lines and internal standard lines are free from interference. All of the analytical points certified have been made to fit a smooth analytical curve at the National Bureau of Standards.

Washington, D.C. 20234
 August 1, 1981
 (Revision of Certificate
 dated 5-5-65)

George A. Uriano, Chief
 Office of Standard Reference Materials

Material for each standard was melted in a one-ton induction furnace at the Naval Research Laboratory and cast into a single ingot. The base material was furnished by Armco Steel Corp. and U. S. Steel Corp. Each ingot was processed by Republic Steel Corp. by forging to a slab having one dimension of the cross section four times that of the other dimension. After cropping top and bottom, the slab was cut lengthwise and the center section corresponding to one-fourth of the original ingot was discarded. The two slab portions were hot rolled to oversize rods and centerless ground to size. About 900 pounds of finished rods were obtained for each standard as follows: 100 pounds of rods $7/32$ in. in diameter from the outer sections near the bottom of the original ingot; 400 pounds of rods $1\frac{1}{4}$ in. in diameter from the outer sections near the middle of the original ingot that is currently certified; and 400 additional pounds of rods $1\frac{1}{4}$ in. in diameter which will be issued later as a renewal standard for the 1100 series.

Homogeneity testing was performed by spectrochemical and chemical analyses at the National Bureau of Standards both in slab form and in finished sample form and was found satisfactory for the elements certified.

Chemical analyses and chemical-spectrographic analyses were made on millings cut from the cross section of the 400 and 1100 series rods by the National Bureau of Standards, and on the 1100 series rods by chemical laboratories of the following: American Cast Iron Pipe Co., Armco Steel Corp., Bethlehem Steel Co., Crucible Steel Co. of America, Electro Metallurgical Co., General Motors Corp., Timken Roller Bearing Co., and the U. S. Steel Corp. The values for silver and germanium are the results of spectroscopic determinations only at the National Bureau of Standards. Oxygen and nitrogen values are the result of vacuum fusion determinations at the National Bureau of Standards and at the Research Laboratory of the Jones & Laughlin Steel Corp.