U. S. DEPARTMENT OF COMMERCE
WASHINGTON, D. C. 20234
NATIONAL BUREAU OF STANDARDS
PROVISIONAL CERTIFICATE OF ANALYSIS (REVISED)
WHITE-CAST IRON STANDARDS
FOR
OPTICAL EMISSION AND X-RAY SPECTROSCOPIC ANALYSES

NBS No. 1/	1176	1177	1178	1179	1180	1181	1182	1183
Type	Piston Ring	Wear Plate	Die	Brake Drum	Mold	Special 1	Special 2	Special 3
Element								
				Percent				
C 2/	3.47	2.74	3.11	3.35	3.28	3.63	1.97	3.05
Mn	0.63	0.37	0.86	0.64	1.12	1.32	0.45	0.91
P	.42	.61	$.11_5$	.23	0.05_5	0.29	.85	.011
S	.061	.037	.026	$.16_5$	.086	.052	.046	.025
Si	3.19	.88	1.91	1.34	3.04	2.54	.31	1.76
Cu	0.76	$.08_7$	0.16	0.41	0.20	1.47	.49	1.01
Ni	$.05_5$	2.97	2.25	1.31	.044	0.11	.22	0.53
Cr	.51	1.39	0.89	0.23	.14	2.04	.029	$.07_7$
V	.17	0.00_5	$.01_7$	$.03_6$	.26	0.11	$.06_0$	.080
Mo	.59	1.49	.94	.31	$.15_5$	$.04_2$	$.01_8$	$.02_9$
Ti	.20	0.08_0	.17	$.03_0$	.53	(.04)	.034	.009
As	.008	(0.0_1)	.024	($.0_5$)	.060	.067	(.15)	.17
Sb	(.3) 3/	($.1_+$)	.11	.11	.063	.005	(.004)	(.005)
Sn	.006	(.02)	.086	.12	$.02_5$	.041	.016	$.15_5$
Co	.006	$.10_5$	.060	.031	$.03_5$	.012	.004	.017
Te	($.01_4$)	($.01_4$)	(.004)	($.02_4$)	($.02_4$)	($.02_5$)	(.009)	($.02_2$)
B	($.00_1$)	($.02_5$)	($.1_1$)	(.05)	($.00_2$)	($.001_4$)	(.009)	(.006)
Bi	.007	.017	.013	$.004_5$	$.002_5$	$.002_7$	.006	.016
Zr	(<.01)	(<.01)	($.01_4$)	(<.01)	(<.01)	($.02_5$)	($.01_0$)	$.12_4$
Pb	.002	.002	$.00_4$	.013	$.004_3$	(.008)	$.004_6$	$.005_5$
Al	(<.01)	(<.01)	($.01_6$)	(<.01)	($.04_0$)	($.01_5$)	(<.01)	($.01_7$)

1/ Size and metallurgical condition: Samples are approximately 1 1/4 in. square and 3/4 in. thick; they were chill-cast white by a rapid unidirectional solidification technique and the addition of innoculants, when necessary, and were given a stress relief heat treatment at 1100°F for one hour (this is below the graphitizing temperature).

2/ Standard 1180 contains some free graphite (approximately 0.1%); the other standards contain less than 0.01 percent).

3/ Values in parentheses are not certified, but are given for information on the composition.

CERTIFIED PORTION: The certified portion for each sample is that extending upward 5/16 in. from the chill cast or test surface (the largest surface opposite the numbered surface) as received. This portion only was analyzed in the cooperative program for certification.

(OVER)

The material for each standard was melted and cast at the Naval Research Laboratory, Washington, D. C. High-purity metals were used either directly or in the preparation of master alloys. Approximately 350-pound heats were melted in a high-frequency induction furnace and individual samples were chill-cast simultaneously in a special mold placed on a massive water-cooled plate to provide rapid unidirectional solidification. The six surfaces of each sample were finished by machine grinding.

The homogeneity of the standard samples was investigated by metallographic studies, by optical and x-ray spectroscopic analysis, and by chemical analysis at the National Bureau of Standards. In addition, a large amount of cooperative testing was performed by: W. R. Kennedy, American Cast Iron Pipe Co., Birmingham, Ala.; A. Goldblatt, Chicago Spectro Service, Chicago, Ill.; M. D. Cooper, General Motors Corp., Research, Warren, Mich.; and M. E. McKinney, International Harvester Co., Chicago, Ill.

Samples for analysis were obtained by careful breaking of brittle segments cut from the certified portion of representative samples in a mortar with a pestle. Chemical analyses for C, Mn, P, S, Si, Cu, Ni, Cr, V, and Mo were made by J. I. Shultz, June Maienthal, and T. W. Freeman, Standard Reference Materials Section, National Bureau of Standards; R. Elder and R. Deas, American Cast Iron Pipe Co., Birmingham, Ala.; R. Loranger, General Motors Corp., Research, Warren, Mich.; D. Walter and Ove Mylting, Naval Research Laboratory, Washington, D. C.; and D. J. Henderson, Roll and Machine Works, and L. M. Melnick, Applied Research Laboratory, U. S. Steel Corp.

The results for Ti, As, Sb, Sn, Co, Te, B, Bi, Zr, Pb, and Al were obtained in the Analytical Chemistry Division, National Bureau of Standards, as follows: R. Alvarez (spectrochemical), Co in 1181 and Zr in 1183; B. Bendigo (chemical), As, Co, Bi, Pb, and Al; R. Burke (chemical), Zr; R. Deardorf (chemical), B; H. Dilworth (spectrochemical), Ti, As, Sb, Sn, Co, and Pb; June Maienthal (chemical), Sb, Bi, Pb; J. Shultz (chemical), Ti and Sn; G. W. Smith (activation), Te; and R. Wolford (chemical), Pb. In addition, Bi results were obtained from General Motors Corp., Research, Warren, Mich., R. Loranger (chemical), and A. Ottolini (spectrochemical).

CAUTIONS:

1. Determinations made on other than the chill cast or test surface are not recommended because of the unidirectional solidification structure.
2. The white-chill cast standards are designed for calibration in the analysis of samples prepared in the same manner; samples prepared by other casting techniques or having other than a white structure may result in considerable bias.
3. Because the samples exhibit a structure change with respect to columnar grain size both among standards and from bottom to top of the certified portion of the samples, the surface preparation for x-ray spectroscopic analysis may be critical. (A metallographic polishing technique is recommended).
4. Because of the poor heat conductivity of the white irons, differences in volatility rates for certain elements in emission spectroscopic analysis may occur depending on the location of the burn and the source parameters.
5. Since the indentation in marking the NBS number on the sample is shallow, care will be required in the laboratory to maintain the identity among standards. The user is further cautioned against re-marking the samples by any stamping process, since this may crack the samples.

Washington, D. C. 20234
August 26, 1964
(Supersedes Certificate of April 21, 1961)

W. W. Meinke, Chief
Analytical Chemistry Division