

UNITED STATES DEPARTMENT OF COMMERCE
WASHINGTON 25, D. C.

National Bureau of Standards

Certificate of Analyses

Standard Sample 12G Basic Open-Hearth Steel, 0.4% Carbon

| ANALYST | C | Mn | P | | S | | | Si | Cu | Ni | Cr | V | Mo | N |
|----------------------|-------------------|---------------------|--|-------------------------------|--|-----------------------------|---|------------------------------|---|--------------------|---------------------------------------|--------------------|--------------|------------------------|
| | Direct combustion | Persulfate-Arsenite | Gravimetric (weighed as $Mg_2P_2O_7$ after removal of arsenic) | Alkali-Molybdate ^a | Gravimetric (direct oxidation and precipitation after reduction of iron) | Combustion Iodate titration | Evolution with HCl (1+1) ZnS-Iodine (theoretical sulfur titer) ^b | Persulfuric acid dehydration | | Photometric | $FeSO_4$ -KMnO ₄ titration | | Colorimetric | Distillation-titration |
| 1..... | 0.391 | ^c 0.718 | 0.013 | ^d 0.014 | 0.029 | ^e 0.029 | 0.030 | ^f 0.186 | ^g 0.128 | ^h 0.060 | ⁱ 0.048 | ^j 0.002 | 0.011 | ^k 0.003 |
| 2..... | .390 | .718 | .016 | .015 | .032 | .032 | .031 | ^m .192 | ⁿ .121 | .061 | ^o .050 | ^p .001 | .007 | .003 |
| 3..... | .386 | .712 | | .010 | | .026 | | .187 | ^q .126 | .059 | ^r .049 | | .013 | |
| 4..... | ^a .399 | ^t .717 | | ^u .017 | | ^v .028 | | .180 | ^w .126 | .061 | ^x .042 | ^y .002 | .010 | ^z .003 |
| | .382 | .715 | | ^d .015 | .032 | .032 | | .191 | ^{z1} .124 | ^{z2} .059 | .045 | ^{z3} .003 | .010 | .004 |
| 5..... | .385 | .713 | .014 | .013 | .029 | .030 | | ^{m,f} .185 | { ^{z4} .127 ^{z5} .126} | .061 | .048 | ^{z6} .002 | .009 | .004 |
| Average..... | 0.389 | 0.716 | 0.014 | 0.014 | 0.030 | 0.030 | 0.030 | 0.187 | 0.125 | 0.060 | 0.046 | 0.002 | 0.010 | 0.003 |
| General average..... | 0.389 | 0.716 | 0.014 | | 0.030 | | | 0.187 | 0.125 | 0.060 | 0.046 | 0.002 | 0.010 | 0.003 |

* Precipitated at 40° C, washed with a 1-percent solution of KNO₃ and titrated with alkali standardized by the use of acid potassium phthalate and the ratio 23 NaOH:1P.

^b Value obtained by standardizing the titrating solution with sodium oxalate through KMnO₄ and Na₂S₂O₈ and the use of the ratio 21:1S.

^c Potentiometric titration.

^d Molybdenum-blue photometric method. See J. Research NBS 26, 405 (1941) RP1386.

^e 1-g sample burned in oxygen at 1,425° C and sulfur dioxide absorbed in starch-iodine solution. Iodine liberated from iodide by titration, during the combustion, with standard KIO₃ solution. Titer based on 93 percent of the theoretical factor.

^f Double dehydration with intervening filtration.

^g Diethyldithiocarbamate photometric method. See J. Research NBS 47, 380 (1951) RP2265.

^h Weighed as nickel dimethylglyoxime.

ⁱ Chromium separated from the bulk of the iron in a 10-g sample by hydrolytic precipitation with NaHCO₃,

oxidized with persulfate, and titrated potentiometrically with ferrous ammonium sulfate.

^j Vanadium separated as in (i), oxidized with HNO₃ and titrated potentiometrically with ferrous ammonium sulfate.

^k Sulfuric acid digestion for 4 hr. of a 1-g sample. See J. Research NBS 43, 201 (1949) RP2021.

^l Titrating solution standardized by use of a standard steel.

^m Sulfuric acid dehydration.

ⁿ Finished by electrolysis.

^o Diphenylcarbazide photometric method.

^p Colorimetric method.

^q Iron precipitated with an excess of NH₄OH in a nitric acid-persulfate solution. Copper determined by electrolysis in an aliquot portion of the filtrate.

^r Persulfuric acid oxidation, titration with FeSO₄-K₂Cr₂O₇, diphenylamine sulfonate indicator.

^s Differential gasometric method.

^t Periodate photometric method.

^u Molybdenum-blue photometric method. Colored complex extracted into iso-butyl alcohol and measured at 730 millimicrons.

^v Sulfur gases absorbed in H₂O₂ and H₂SO₄ titrated with standard NaOH using brom-cresol purple indicator.

^w Neo-cuproine photometric method.

^x Chromate-photometric method.

^y NaHCO₃ hydrolysis followed by mercury cathode. Vanadium determined by the phosphotungstovanadate photometric method.

^z Finished photometrically with Nessler's reagent.

^{z1} Copper precipitated with Na₂S₂O₃. Iodide-thiosulfate titration.

^{z2} Dimethylglyoxime precipitate titrated with cyanide.

^{z3} Nitric acid oxidation, potentiometric titration with ferrous ammonium sulfate.

^{z4} H₂S-CuS-CuO.

^{z5} Diethyldithiocarbamate-color complex extracted with CCl₄ and measured at 460 mμ.

^{z6} As in (j), but titrated with FeSO₄-K₂Cr₂O₇.

List of Analysts

1. Ferrous Laboratory, National Bureau of Standards, J. I. Shultz, in charge. Analysis by J. R. Spann, E. June Maienthal, and A. Skapars.
2. H. V. Reddinger, Bethlehem Steel Co., Johnstown Plant, Johnstown, Pa.
3. E. J. Ineman, Industrial Chemical and Metallurgical Analysis, Inc., Cleveland, Ohio.
R. Ralston, J. W. Fulton, R. J. Londergan, J. P.

- Broyles, and A. M. Hunt. Distribution Transformer Department Insulation Laboratory, General Electric Co., Pittsfield, Mass.
5. E. O. Waltz, Republic Steel Corp., Steel Division, Canton, Ohio.
6. L. I. Stead, E. F. Sadewasser, J. W. Swatts, and E. H. Tull. The Youngstown Sheet and Tube Co., Indiana Harbor Works, East Chicago, Ind.

The steel for the preparation of this standard was furnished by the Bethlehem Steel Company, Johnstown, Pa.

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