

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 ₂ P ₂ O ₇ after removal of arsenic) | Alkali-Molybdate * | Gravimetric (direct oxidation and precipitation after reduction of iron) | Combustion Iodate titration | Evolution with HCl (1+1) ZnS-Iodine (theoretical sulfur titer) ^b | Perchloric acid dehydration | | Photometric | FeSO ₄ -KMnO ₄ titration | | Colorimetric | Distillation-titration |
| 1..... | 0.391 | ^o 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 | ^o 1.718 | .016 | .015 | .032 | ^e 0.032 | .031 | ^m .192 | ⁿ .121 | .061 | ^o .050 | ^p .001 | .007 | .003 |
| 3..... | .386 | ^o 1.712 | | ^l 0.010 | | ^e 0.026 | | .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 0.015 | .032 | ^e 0.032 | | .191 | ^{z1} .124 | ^{z2} 0.059 | .045 | ^{z3} 0.003 | .010 | .004 |
| 6..... | .385 | ^o 1.713 | .014 | ^l 0.013 | .029 | ^e 0.030 | | ^{m,f} .185 | { ^{z4} .127 ^{z5} .126} | .061 | .048 | ^{z6} 0.002 | .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 2I: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-iodide 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 Diethylthiocarbamate 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 Perchloric 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} Diethylthiocarbamate-color complex extracted with CCl₄ and measured at 460 mμ.
^{z6} As in (j), but titrated with FeSO₄-K₂Cr₂O₇.

List of Analysts

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

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