

UNITED STATES DEPARTMENT OF COMMERCE
WASHINGTON

National Bureau of Standards
Certificate of Analyses

Standard Sample 33 d
Nickel Steel

ANALYST	C	Mn		P		S			Si	Cu	Ni	Cr	V	Mo	N
	Direct combustion	Bismuthate (FeSO ₄ -KMnO ₄)	Persulfate-Arsenite	Gravimetric (weighed as Mg ₂ P ₂ O ₇ after removal of arsenic)	Alkali-Molybdate ^a	Gravimetric (direct oxidation and precipitation after reduction of iron)	Combustion Iodate titration	Evolution (HCl sp. gr. 1.18-ZnS-iodine-theoretical sulfur titer) ^b	Perchloric acid dehydration		Weighed as nickel dimethylglyoxime	FeSO ₄ -KMnO ₄ titration		Photometric	Distillation-titration
1.....	0.172		0.543	0.006	0.005	0.010	0.011	0.010	0.259	0.122	3.56	0.148	0.002	0.248	0.011
2.....	.170	.534	.534		.006	.009	.011		1.256	.123	{ ^a 3.58 3.61 ^c 3.59	{ ^a .145 ^c .143 .139	^d 0.001	{ ^a .246 .242 .244	
3.....	.178		.538		.006		.010	.009	1.250	.126			.003		
4.....	.167	.53	.535	.005	{ ^a .005 ^d .006 .006	.010	.011		1.245	.122	{ ^a 3.56 ^c 3.57	.142	.001	.249	
5.....	.180		.547		.006		.014		.253	.123	3.60	.140	.002	.244	
Averages.....	0.173	0.532	0.539	0.006	0.006	0.010	0.011	0.010	0.253	0.123	3.58	0.143	0.002	0.246	
General average.....	0.173	0.537		0.006		0.010			0.253	0.123	3.58	0.143	0.002	0.246	

^a Precipitated at 40° C, washed with a 1-percent solution of KNO₃, and titrated with alkali standardized by the use of National Bureau of Standards acid potassium phthalate and the ratio 23 NaOH:1P.
^b Value obtained by standardizing the titrating solution by means of sodium oxalate through KMnO₄ and Na₂S₂O₃ and 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-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 H₂SO₄ dehydration. Double evaporation with intervening filtration.
^g Diethylthiocarbamate photometric method. See J.

Research NBS 47, 380 (1951) RP2265.
^h Chromium separated from the bulk of the iron in a 10-g sample by NaHCO₃ hydrolysis, oxidized with persulfate, and titrated potentiometrically with ferrous ammonium sulfate.
ⁱ Vanadium separated as in (h), oxidized with HNO₃ and titrated potentiometrically with ferrous ammonium sulfate.
^j 0.5-g sample dissolved in dilute H₂SO₄ (1:2), and solution evaporated to fumes of sulfuric acid. See J. Research NBS 43, 201 (1949) RP2021.
^k Titrating solution standardized with a standard steel.
^l Double dehydration.
^m Sulfide precipitation, KI-Na₂S₂O₃ titration.
ⁿ Dimethylglyoxime precipitate titrated with cyanide.
^o Diphenylcarbazide photometric method.
^p Vanadium precipitated with cupferron from a 10-g sample and determined by the H₂O₂-photometric method.

^q Alpha-benzoinoxime method. See BS J. Research 9, 1 (1932) RP453.
^r Absorbed in ammoniacal cadmium chloride.
^s CuS-electrolytic method.
^t Ether separation of iron on a 1-g sample. Dimethylglyoxime precipitate titrated with cyanide.
^u Vanadium separated from the bulk of the iron in a 5.0-g sample by extraction with ether, oxidized with HClO₄ and titrated by the FeSO₄-KMnO₄ procedure after addition of H₃PO₄ and K₂HPO₄, using ortho-phenanthroline ferrous perchlorate as an indicator.
^v Weighed as ammonium phosphomolybdate.
^w Polarographic method.
^x As in (h), but titrated with FeSO₄-KMnO₄.
^y Bicarbonate hydrolysis on a 30-g sample. Vanadium titrated by the (NH₄)₂S₂O₈-KMnO₄ method.

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The steel for the preparation of this standard was furnished by The Timken Roller Bearing Company.

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