

National Bureau of Standards

Certificate of Analyses

OF
STANDARD SAMPLE 121A
18 CHROMIUM-10 NICKEL STEEL
(TITANIUM-BEARING)

ANALYST*	C	Mn	P	S		Si	Cr		Ti			NITROGEN					
	Direct combustion 1,300° to 1,375° C.	Persulfate-Arsenite	Gravimetric (weighed as Mg ₃ P ₂ O ₇ after removal of arsenic)	Alkali-Molybdate ^a	Gravimetric (direct oxida- tion and final precipita- tion after reduction of iron)	Combustion	Evolution (HCl sp gr 1.18- ZnS-Iodine theoretical sulfur titer) ^b	Perochloric acid dehydra- tion	COPPER H ₂ S-Cu ₂ S-CuO	NICKEL Weighed as nickel dimethyl- glyoxime	FeSO ₄ -KMnO ₄ titration		VANADIUM	MOLYBDENUM (Colorimetric)	COBALT	Gravimetric	Colorimetric
1	0.071	^c 1.27	0.023	^d 0.025	0.010	0.004	^e 0.518	0.082	10.60	18.68	^f 0.035	0.019	^g 0.090	^h 0.360	0.363	ⁱ 0.013	
2	.073	^k 1.29	.021	.022	.008	0.007	.004	.514	10.55	18.64	^m 0.039	.025	ⁿ 0.10	.38	.366	^o 0.014	
3	^p 0.074	^q 1.28	.024	.011	^r 0.012	.006	^s 0.514	^t 0.082	^u 10.56	18.68	.019	.021	^v 0.353	.35	.366		
4	.071	^w 1.26	.026	.011	.006	^x 0.511	^y 0.084	^z 10.58	18.67	.021	^{aa} 0.017	^{ab} 0.093	.362	.362			
5	^{ac} 0.075	^{ad} 1.28	.022	.013	^{ae} 0.013	^{af} 0.524	^{ag} 0.090	^{ah} 10.56	18.74	^{ai} 0.034	^{aj} 0.017	^{ak} 0.093	.362	.362			
6	^{al} 0.070	^{am} 1.28	.024	.004	^{an} 0.004	^{ao} 0.525	^{ap} 0.089	^{aq} 10.60	18.70	^{ar} 0.030	^{as} 0.022	^{at} 0.08	^{au} 0.358	^{av} 0.366	^{aw} 0.011		
	.077	1.28	.022	.013	.006	.540	.080	10.56	18.72	.04	.018	.085	.35	.366			
	^{ax} 0.070	1.27	^{ay} 0.024	^{az} 0.024	^{ba} 0.009	^{bb} 0.520	^{bc} 0.086	^{bd} 10.63	18.64	^{be} 0.03	^{bf} 0.018	^{bg} 0.085	^{bh} 0.369	^{bi} 0.363	^{bj} 0.014		
9	^{bk} 0.072	^{bl} 1.28	^{bm} 0.022	^{bn} 0.022	^{bo} 0.005	^{bp} 0.547	^{bq} 0.086	^{br} 10.59	18.73	^{bs} 0.03	^{bt} 0.018	^{bu} 0.085	^{bv} 0.369	^{bw} 0.363	^{bx} 0.014		
10	.073	^{bx} 1.27	.023	.010	^{by} 0.010	.514	^{bz} 0.086	^{ca} 10.54	18.73	^{cb} 0.040	^{cc} 0.020	^{cd} 0.093	^{ce} 0.353	^{cf} 0.363	^{cg} 0.016		
Averages	0.073	1.28	0.023	0.023	0.010	0.010	0.005	0.523	0.085	10.58	18.69	0.035	0.020	0.090	0.359	0.363	0.014
General average	0.073	1.28	0.023	0.010		0.523	0.085	10.58	18.69	0.035	0.020	0.090	0.361	0.363	0.014		

^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 23NaOH:1P.
^b Value obtained by standardizing the titrating solution by means of sodium oxalate through KMnO₄ and Na₂S₂O₃, and the use of the ratio 2I:1S.
^c Bismuthate (FeSO₄-KMnO₄) method after separation of chromium with ZnO.
^d Molybdenum-blue colorimetric method. See J. Research NBS 26, 405 (1941) RP1396.
^e Double dehydration.
^f Persulfate oxidation and potentiometric titration with ferrous ammonium sulfate solution standardized with recrystallized potassium dichromate.
^g Nitric acid oxidation and potentiometric titration with ferrous ammonium sulfate solution.
^h Ether separation ZnO-α-nitroso-β-naphthol method on a 10-g sample.
ⁱ 10-g sample dissolved in diluted H₂SO₄ and titanium precipitated with cupferron. Ignited precipitate treated with HClO₄-HF, reignited and fused in Na₂S₂O₇. Melt dissolved in tartaric-sulfuric acid solution, and the H₂S group removed. Residual iron removed as sulfide in

ammoniacal-tartrate solution. Filtrate acidified, and titanium precipitated with cupferron. Ignited precipitate corrected for V₂O₅.
^j Determination made by M. Marie Cron, by the vacuum-fusion method. See BS J. Research 7, 375 (1931) RP346.
^k Chromium removed by precipitation with NaHCO₃.
^l Perochloric acid oxidation.
^m Vanadium separated by NaOH, precipitated with Pb(NO₃)₂, reduced with HCl, and titrated with KMnO₄.
ⁿ Zinc oxide-α-nitroso-β-naphthol method.
^o Solution in HCl. Residue filtered and digested in HClO₄-H₂SO₄. Distillation-titration method. See Iron Age, 134, p 11, July 26 (1934).
^p Burned with tin at 1100° C-1300° C.
^q Chromium precipitated with ZnO.
^r Titrating solution standardized by use of a standard steel.
^s Sulfur gases absorbed in acidified starch-iodine solution, and titrated with KIO₃ solution standardized with standard steels.
^t H₂S-α-benzoinoxime-CuO method.
^u Glyoxime precipitate titrated with standard KCN solution.

^v Cupferron-mercury cathode-cupferron method. Ignited precipitate corrected for iron and vanadium.
^w KI-Na₂S₂O₃ titration.
^x Sulfur gases absorbed in NaOH-H₂O₂ solution, and excess NaOH titrated with H₂SO₄.
^y Finished by electrolysis.
^z Cupferron, phosphotungstovanadate - colorimetric method.
^{aa} Ether separation-ZnO-α-nitroso-β-naphthol method. Finished colorimetrically as cobaltioxalate complex.
^{ab} Chromium separated by precipitation as PbCrO₄.
^{ac} Chromium separated as PbCrO₄. Vanadium determined by differential titration with FeSO₄-KMnO₄ using o-phenanthroline indicator.
^{ad} Dissolved in H₂SO₄-H₂PO₄. Selenium added and solution fumed. Distillation-titration method.
^{ae} Ether-cupferron concentration. H₂O₂-HF colorimetric method.
^{af} Solution in HCl. Residue filtered and Kjeldahl digestion. Distillation-titration method.
^{ag} Burned with red lead.
^{ah} Chromium volatilized as CrO₂Cl₂.
^{ai} Ether-CrO₂Cl₂-ZnO-α-nitroso-β-naphthol method. Cobalt weighed as CoSO₄.

*LISTS OF ANALYSTS

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|---|---|
| <ol style="list-style-type: none"> 1. Ferrous Laboratory, National Bureau of Standards. John L. Hague in charge. Analysis by John P. Hewlett, Jr., and W. Chorney. 2. M. A. Frost, Vanadium-Alloys Steel Co., Latrobe, Pa. 3. R. F. Lab and R. A. Sergi, Copperweld Steel Co., Warren, Ohio. 4. W. L. Davies, Allegheny Ludlum Steel Corporation, Watervliet, N. Y. 5. R. S. Gibbs and F. B. Clardy, Norfolk Navy Yard, Portsmouth, Va. 6. D. Brown, Carnegie-Illinois Steel Corporation, Duquesne Works, Duquesne, Pa. | <ol style="list-style-type: none"> 7. C. E. Nesbitt, Carnegie-Illinois Steel Corporation, Edgar Thomson Works, Braddock, Pa. 8. L. P. Chase, Carnegie-Illinois Steel Corporation, South Works, Chicago, Ill. 9. W. Teitel, Transue and Williams Steel Forging Corporation, Alliance, Ohio. 10. ARMCO Research Laboratories, Middletown, Ohio. A. H. Thomas in charge. |
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The steel for the preparation of this standard was furnished by the Carnegie-Illinois Steel Corporation.

WASHINGTON, August 4, 1944.

LYMAN J. BRIGGS, *Director.*