

U. S. DEPARTMENT OF COMMERCE

# National Bureau of Standards

## Certificate of Analyses

OF

### STANDARD SAMPLE 106A

### CHROMIUM-MOLYBDENUM-ALUMINUM STEEL

ANALYST*	C	Mn		P		S		Si	COPPER H <sub>2</sub> S-CuS-CuO	NICKEL Weighed as nickel dimethylglyoxime	Cr	Mo		Al			
	Direct combustion	Bismuthate (FeSO <sub>4</sub> -KMnO <sub>4</sub> )	Persulfate-Arsenite	Gravimetric (weighed as Mg <sub>2</sub> P <sub>2</sub> O <sub>7</sub> after removal of arsenic)	Alkali-Molybdate <sup>a</sup>	Gravimetric (direct oxidation and precipitation after reduction of iron)	Combustion	Evolution with HCl (sp. gr. 1.18) ZnS-Iodine (Raeoretical sulfur titre) <sup>b</sup>			Perchloric acid dehydration	FeSO <sub>4</sub> -KMnO <sub>4</sub> titration	VANADIUM	Gravimetric	Colorimetric	Total	Acid-insoluble (calculated as Al <sub>2</sub> O <sub>3</sub> )
1	0.350	0.542	0.539	0.015	0.017	0.016	0.017	0.253	0.156	0.278	1.14	0.002	0.199	0.202	1.08	0.011	
2	.356		.543		.017	.019	.019	<sup>m</sup> .252	<sup>n</sup> .158	.281	1.15		<sup>p</sup> .207	.209	<sup>q</sup> 1.09		
3	.354	<sup>r</sup> .55			.017		.016	.255	.148	.276	1.15			.205	1.08		
4	.355		.546		.019		.018	.26	<sup>s</sup> .16	.276	1.17			.205	<sup>t</sup> 1.07	.012	
	.355		<sup>u</sup> .544		.019		<sup>v</sup> .018	<sup>w</sup> .016	<sup>x</sup> .250	<sup>y</sup> .153	.276	1.14	<sup>z</sup> .202	.198	<sup>a</sup> 1.09	.010	
6	.360	<sup>r</sup> .548			<sup>w</sup> .018		<sup>x</sup> .018	.253	<sup>y</sup> .166	<sup>z</sup> .280	1.14			.205	<sup>b</sup> 1.09		
7	.359	<sup>z</sup> 1.549			.014	.019		.250	<sup>a</sup> .149	.269	1.14		<sup>i</sup> .199		<sup>j</sup> 1.07	.011	
8	.360	.55	.545		.017	.017	<sup>l</sup> .018	<sup>a</sup> .253	.157	.28	1.14		<sup>2</sup> .209	.203	<sup>3</sup> 1.12	.012	
9	.347		.552		<sup>d</sup> .017		<sup>x</sup> .019	.019	.257	.16	<sup>v</sup> .28	1.15		.205	<sup>4</sup> 1.07		
Averages... General	0.355	0.548	0.545	0.015	0.017	0.018	0.018	0.017	0.254	0.156	0.277	1.15	0.002	0.203	0.204	1.08	0.011
average...	0.355	0.546		0.016		0.018		0.018	0.254	0.156	0.277	1.15	0.002	0.203		1.08	0.011

<sup>a</sup> Precipitated at 40° C, washed with a 1-percent solution of KNO<sub>3</sub> and titrated with alkali standardized by the use of National Bureau of Standards acid potassium phthalate and the ratio 23NaOH:1P.  
<sup>b</sup> Value obtained by standardizing the titrating solution by means of sodium oxalate through KMnO<sub>4</sub> and Na<sub>2</sub>S<sub>2</sub>O<sub>8</sub>, and use of the ratio 21:18.  
<sup>c</sup> Solution in dilute H<sub>2</sub>SO<sub>4</sub> (1:9) and chromium removed by precipitation with ZnO.  
<sup>d</sup> Molybdenum-blue photometric method. See J. Research NBS 26, 405 (1941) RP1386.  
<sup>e</sup> Sulfuric acid dehydration.  
<sup>f</sup> Copper ammonia-complex photometric method.  
<sup>g</sup> Persulfate oxidation and potentiometric titration with ferrous ammonium sulfate solution standardized with potassium dichromate.  
<sup>h</sup> Vanadium, in a 10-g sample, separated by precipitation with NaHCO<sub>3</sub>, oxidized with HNO<sub>3</sub>, and titrated

potentiometrically with ferrous ammonium sulfate.  
<sup>i</sup> α-benzoinoxime method. See BS J. Research 9, 1 (1932) RP453.  
<sup>j</sup> NaHCO<sub>3</sub>-NaOH-Al<sub>2</sub>O<sub>3</sub> method.  
<sup>k</sup> 25-g sample treated with dilute HNO<sub>3</sub> (1:4). Aluminum determined in the separated insoluble residue.  
<sup>l</sup> Sulfur gases absorbed in acidified starch-iodine solution, and titrated with KIO<sub>3</sub> solution standardized with standard steels.  
<sup>m</sup> Nitric-sulfuric acid dehydration.  
<sup>n</sup> Diethylthiocarbamate photometric method.  
<sup>o</sup> Perchloric acid oxidation.  
<sup>p</sup> Lead molybdate method.  
<sup>q</sup> Aluminum precipitated with 8-hydroxyquinoline and titrated with KBrO<sub>3</sub>.  
<sup>r</sup> Titrated with sodium arsenite.  
<sup>s</sup> Finished by electrolysis.

<sup>t</sup> Sodium thiosulfate-sodium ammonium phosphate method.  
<sup>u</sup> Chromium volatilized as CrO<sub>2</sub>Cl<sub>2</sub>.  
<sup>v</sup> Sulfur gases absorbed in NaOH-H<sub>2</sub>O<sub>2</sub> and excess NaOH titrated with H<sub>2</sub>SO<sub>4</sub>.  
<sup>w</sup> Titrating solution standardized by use of a standard steel.  
<sup>x</sup> Sulfur gases absorbed in neutral peroxide solution and titrated with NaOH standardized with standard steels.  
<sup>y</sup> Glyoxime-potassium-cyanide method.  
<sup>z</sup> Fisher-NaOH-AlPO<sub>4</sub> method.  
<sup>1</sup> Chromium removed with NaHCO<sub>3</sub>.  
<sup>2</sup> H<sub>2</sub>S-MoO<sub>3</sub> method.  
<sup>3</sup> Iron removed with mercury cathode. Aluminum precipitated with 8-hydroxyquinoline and the precipitate ignited to Al<sub>2</sub>O<sub>3</sub>.  
<sup>4</sup> NaHCO<sub>3</sub>-NaOH-AlPO<sub>4</sub> method.

#### \*LIST OF ANALYSTS

- |  |   |
|--|---|
| 1. Ferrous Laboratory, National Bureau of Standards. John L. Hague in charge; analysis by John P. Hewlett, Jr. | 5. R. H. Maurer and H. E. Trapp, Climax Molybdenum Co., Detroit, Mich.              |
| 2. E. O. Waltz, Republic Steel Corporation, United Steel Division, Canton, Ohio.                               | 6. W. F. Lantz, Bethlehem Steel Co., Bethlehem, Pa.                                 |
| 3. Daniel Harmon, Allegheny Ludlum Steel Corporation, Dunkirk, N. Y.   | 7. C. K. Mitchell, W. B. Coleman & Co., Philadelphia, Pa.                           |
| H. Flickinger, Republic Steel Corporation, Corrigan McKinney Division, Cleveland, Ohio.                        | 8. E. R. Vance, The Timken Roller Bearing Co., Steel & Tube Division, Canton, Ohio. |
|  | 9. F. C. Young, Ford Motor Co., Dearborn, Mich.                                     |

The steel for the preparation of this standard was furnished by the Republic Steel Corporation.