

U. S. DEPARTMENT OF COMMERCE

# National Bureau of Standards

## Certificate of Analyses

OF  
STANDARD SAMPLE 72 D  
CHROMIUM-MOLYBDENUM STEEL

ANALYST*	C	Mn		P		S			Si	COPPER H <sub>2</sub> S-CuS-CuO	NICKEL Weighed as nickel dimethylglyoxime	Cr	VANADIUM	Mo	
	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 final precipitation in reduced solution)	Combustion	Evolution with HCl (sp. gr. 1.18) ZnS-Iodine (theoretical sulfur titre)	Sulfuric acid dehydration			FeSO <sub>4</sub> -KMnO <sub>4</sub> titration		Gravimetric	Colorimetric
1	0.306	<sup>c</sup> 0.536	0.533	0.015	<sup>d</sup> 0.015	0.009	<sup>e</sup> 0.010	0.011	<sup>f</sup> 0.277	0.040	0.125	<sup>g</sup> 1.03	<sup>h</sup> 0.005	<sup>i</sup> 0.207	0.209
2	.310		.538	.017	<sup>d</sup> .017	<sup>j</sup> .011	<sup>k</sup> .012		<sup>l</sup> .279	<sup>m</sup> .046	<sup>n</sup> .128	<sup>o</sup> 1.02			.211
3	.311		<sup>p</sup> .539		<sup>q</sup> .017		<sup>r</sup> .011		<sup>l</sup> .279	<sup>m</sup> .040	<sup>s</sup> .125	<sup>t</sup> 1.03			.212
	.310	<sup>u</sup> .536	.540	.018	.011	<sup>v</sup> .012	<sup>w</sup> .012		<sup>l</sup> .277	<sup>x</sup> .039	<sup>s</sup> .123	<sup>t</sup> 1.02		<sup>i</sup> .208	.209
	.313		.537	.018	<sup>q</sup> .018		<sup>e</sup> .013		<sup>l</sup> .268	<sup>y</sup> .039	<sup>s</sup> .125	<sup>t</sup> 1.03			.205
6														<sup>i</sup> .214	.212
Averages	<b>0.310</b>	<b>0.536</b>	<b>0.537</b>	<b>0.016</b>	<b>0.017</b>	<b>0.010</b>	<b>0.011</b>	<b>0.011</b>	<b>0.276</b>	<b>0.041</b>	<b>0.125</b>	<b>1.03</b>	<b>0.005</b>	<b>0.210</b>	<b>0.210</b>
General average	<b>0.310</b>	<b>0.537</b>		<b>0.017</b>			<b>0.011</b>		<b>0.276</b>	<b>0.041</b>	<b>0.125</b>	<b>1.03</b>		<b>0.210</b>	

<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 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 2I:1S.  
<sup>c</sup> Chromium removed by selective precipitation with NaHCO<sub>3</sub>.  
<sup>d</sup> Molybdenum-blue photometric method. See J. Research NBS **26**, 405 (1941) RP1386.  
<sup>e</sup> 1-g sample burned in oxygen at 1400° C, and sulfur dioxide absorbed in starch-iodine solution. Iodine liberated from iodide by titration, during the combustion,

tion, with standard KIO<sub>3</sub> solution based on 93 percent of the theoretical factor.  
<sup>f</sup> Double dehydration with intervening filtration.  
<sup>g</sup> Persulfate oxidation and potentiometric titration with ferrous ammonium sulfate.  
<sup>h</sup> Vanadium separated from the bulk of iron in a 10-g sample by selective precipitation with NaHCO<sub>3</sub>, then 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> Ether separation, BaSO<sub>4</sub> method.  
<sup>k</sup> As in (e), except sample burned at 2150° F with tin, and iodate solution standardized with standard steels.  
<sup>l</sup> Perchloric acid dehydration.

<sup>m</sup> Thiosulfate precipitation, KI-Na<sub>2</sub>S<sub>2</sub>O<sub>8</sub> titration.  
<sup>n</sup> Dimethylglyoxime precipitation, cyanide titration.  
<sup>o</sup> Persulfate oxidation.  
<sup>p</sup> Chromium removed by ZnO precipitation.  
<sup>q</sup> Titrating solution standardized by use of standard steels.  
<sup>r</sup> As in (e), except sample burned at 2350° F, and iodate solution standardized against standard steels.  
<sup>s</sup> Dimethylglyoxime photometric method.  
<sup>t</sup> Perchloric acid oxidation.  
<sup>u</sup> Arsenite titration.  
<sup>v</sup> As in (k), except sample burned at 2400° F.  
<sup>w</sup> Absorbed in ammoniacal cadmium chloride.  
<sup>x</sup> Copper-ammonia-complex photometric method.  
<sup>y</sup> Diethylthiocarbamate photometric method.

### \*LIST OF ANALYSTS

1. Ferrous Laboratory, National Bureau of Standards, John L. Hague in charge. Analysis by J. I. Shultz, R. A. Watson, and C. Litsey.
2. E. O. Waltz, Republic Steel Corp., Canton Steel Division, Canton, Ohio.
3. C. G. Hummon, Sheffield Steel Corporation, Kansas City, Mo.
4. G. W. Madsen and C. V. Rooney, Geneva Steel Co., Geneva, Utah.
5. J. F. O'Mara, Great Lakes Steel Corp., Ecorse, Detroit, Mich.
6. R. H. Maurer, Climax Molybdenum Co., Detroit, Mich.

The steel for the preparation of this standard was furnished by the Climax Molybdenum Company.