

## U. S. Department of Commerce

## National Bureau of Standards

## Certificate of Analyses

## Standard Sample 160

## 19 Chromium—9 Nickel—3 Molybdenum Steel

| ANALYST              | C                 | Mn                | P                                                                                                              |                               | S                                                                                |                    | Si                         | Ni                 | Cr                | VANADIUM           | Mo                                 |                                        | COBALT<br>Zinc oxide- $\alpha$ -nitroso-<br>$\beta$ -naphthol | NITROGEN<br>Solution—Distillation |                                                |
|----------------------|-------------------|-------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------|----------------------------------------------------------------------------------|--------------------|----------------------------|--------------------|-------------------|--------------------|------------------------------------|----------------------------------------|---------------------------------------------------------------|-----------------------------------|------------------------------------------------|
|                      | Direct combustion |                   | Gravimetric<br>(weighed<br>as<br>Mg <sub>3</sub> P <sub>2</sub> O <sub>7</sub><br>after removal of<br>arsenic) | Alkali-molybdate <sup>a</sup> | Gravimetric (direct oxidation<br>and precipitation after reduc-<br>tion of iron) | Combustion         | Perchloric aciddehydration |                    |                   |                    | COPPER<br>H <sub>2</sub> S-CuS-CuO | Weighted as nickel<br>dimethylglyoxime |                                                               |                                   | FeSO <sub>4</sub> -KMnO <sub>4</sub> titration |
| 1.....               | 0.043             | <sup>b</sup> .69  | 0.012                                                                                                          | <sup>c</sup> 0.012            | 0.008                                                                            | <sup>d</sup> 0.010 | <sup>e</sup> 1.14          | 0.050              | 8.94              | <sup>f</sup> 19.12 | <sup>g</sup> 0.035                 | <sup>h</sup> 2.95                      | 2.93                                                          | 0.064                             | <sup>i</sup> 0.029                             |
| 2.....               | .047              | <sup>i</sup> .69  |                                                                                                                | .011                          |                                                                                  | <sup>d</sup> .008  | 1.13                       | <sup>k</sup> .06   | <sup>l</sup> 8.89 | <sup>f</sup> 19.12 |                                    | <sup>m</sup> 2.97                      | 2.94                                                          |                                   |                                                |
| 3.....               | .040              | <sup>n</sup> .70  | <sup>o</sup> 0.010                                                                                             | .013                          | .010                                                                             |                    | 1.15                       | <sup>p</sup> 0.050 | 8.92              | 19.11              |                                    | <sup>m</sup> 2.94                      |                                                               |                                   | <sup>q</sup> 0.030                             |
| 4.....               | .045              | <sup>r</sup> .67  |                                                                                                                | <sup>o</sup> .011             | .012                                                                             | <sup>s</sup> .011  | 1.14                       | <sup>t</sup> .053  | <sup>l</sup> 8.90 | <sup>u</sup> 19.13 | <sup>v</sup> .041                  |                                        | 2.98                                                          | <sup>w</sup> .054                 | <sup>q</sup> .025                              |
| 5.....               | .044              | <sup>x</sup> .65  |                                                                                                                | .015                          |                                                                                  | <sup>s</sup> .009  | 1.12                       |                    | <sup>y</sup> 8.89 | <sup>u</sup> 19.09 |                                    |                                        | 3.00                                                          |                                   |                                                |
| 6.....               | .047              | <sup>x</sup> .66  |                                                                                                                | .013                          |                                                                                  | <sup>s</sup> .012  | 1.11                       | <sup>z</sup> .057  | <sup>y</sup> 8.90 | <sup>u</sup> 19.16 |                                    | <sup>m</sup> 2.92                      |                                                               |                                   |                                                |
| 7.....               | .043              | <sup>z</sup> 1.66 |                                                                                                                | <sup>o</sup> .012             |                                                                                  | <sup>d</sup> .011  | 1.10                       | <sup>z</sup> .047  | <sup>l</sup> 8.88 | 19.12              |                                    | <sup>b</sup> 2.93                      | 2.91                                                          |                                   |                                                |
| 8.....               | .045              |                   |                                                                                                                | .012                          |                                                                                  | <sup>d</sup> .012  | <sup>e</sup> 1.13          | .055               | 8.88              | <sup>f</sup> 19.13 |                                    | <sup>b</sup> 2.96                      |                                                               |                                   |                                                |
| Average..            | 0.044             | 0.68              | 0.011                                                                                                          | 0.012                         | 0.010                                                                            | 0.010              | 1.13                       | 0.053              | 8.91              | 19.12              | 0.038                              | 2.95                                   | 2.95                                                          | 0.059                             | 0.028                                          |
| General<br>average.. | 0.044             | 0.68              | 0.012                                                                                                          |                               | 0.010                                                                            |                    | 1.13                       | 0.053              | 8.91              | 19.12              | 0.038                              | 2.95                                   |                                                               | 0.059                             | 0.028                                          |

<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 23 NaOH:1P.

<sup>b</sup> Bicarbonate-bismuthate-FeSO<sub>4</sub>-KMnO<sub>4</sub> titration method.

<sup>c</sup> Molybdenum-blue photometric method.

<sup>d</sup> 1-g sample burned in oxygen at 1425° C, and sulfur dioxide absorbed in starch-iodine solution. Iodine liberated from iodide by titration, during the combustion, with standard KIO<sub>3</sub> solution based on 93 percent of the theoretical factor.

<sup>e</sup> Double dehydration with intervening filtration.

<sup>f</sup> Persulfate oxidation and potentiometric titration with ferrous ammonium sulfate standardized with potassium dichromate.

<sup>g</sup> Nitric acid oxidation, potentiometric titration with ferrous ammonium sulfate.

<sup>h</sup>  $\alpha$ -Benzoinoxime method. See BS J. Research 9, 1 (1932) RP453.

<sup>i</sup> Semimicro-distillation-titration method. 0.5-g sample fumed 4 hours with H<sub>2</sub>SO<sub>4</sub>.

<sup>j</sup> Bismuthate-HgNO<sub>3</sub> potentiometric titration method.

<sup>k</sup> Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> precipitation-electrolytic method.

<sup>l</sup> Dimethylglyoxime precipitation-cyanide titration.

<sup>m</sup> H<sub>2</sub>S-MoO<sub>3</sub>.

<sup>n</sup> CrO<sub>2</sub>Cl<sub>2</sub>-bismuthate method.

<sup>o</sup> Weighed as ammonium phosphomolybdate.

<sup>p</sup> KI-Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> titration method.

<sup>q</sup> Allen method. Solution in diluted HCl (1-1).

<sup>r</sup> Periodate photometric method.

<sup>s</sup> Burned with tin, and iodate solution standardized on standard steels.

<sup>t</sup> Diethylthiocarbamate photometric method.

<sup>u</sup> Perchloric acid oxidation.

<sup>v</sup> Differential titration with KMnO<sub>4</sub>, using  $\alpha$ -phenanthroline indicator.

<sup>w</sup> Cobalt chloride-photometric method.

<sup>x</sup> ZnO-persulfate-arsenite method.

<sup>y</sup> Dimethylglyoxime-nickel oxide method.

<sup>z</sup> H<sub>2</sub>S-alpha benzoinoxime-CuO method.

<sup>1</sup> Chromium volatilized as CrO<sub>2</sub>Cl<sub>2</sub>. Manganese oxidized with persulfate and titrated with arsenite-nitrite solution.

<sup>2</sup> CuCNS-cupric chloride photometric method.

## List of Analysts

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E. U. CONDON, *Director*.

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