



BUREAU OF ANALYSED SAMPLES LTD.

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BRITISH CHEMICAL STANDARD CERTIFIED REFERENCE MATERIAL

CERTIFICATE OF ANALYSIS

BCS-CRM No. 214/2 (ECRM 152-1)

Mn - Mo STEEL

Prepared under rigorous laboratory conditions and, AFTER CERTIFICATION ANALYSIS IN GREAT BRITAIN, issued by the Bureau of Analysed Samples Ltd.

CO-OPERATING ANALYSTS

INDEPENDENT ANALYSTS

- 1 ATKINSON, C.D., *AMet*, Sheffield Testing Works Ltd., Sheffield.
2 COPPINS, W.C., *MSc, ARIC*, Ridsdale & Co Ltd., Middlesbrough.

ANALYSTS representing MANUFACTURERS and USERS

- 3 BOOTH, J., *BSc*, Park Gate Iron & Steel Co. Ltd., Rotherham.

- 4 GLEDHILL, P.K., *BMet, PhD*, Dorman Long (Steel) Ltd.,
Central Research Dept., Middlesbrough.
5. HOLIDAY, J.D.,
Lancashire Steel Manufacturing Co. Ltd., Manchester.
6. KYLE, J., *AIM*, William Beardmore & Co Ltd., Glasgow.
7. METHAM, E., Jessop Saville Ltd., Sheffield.
8. STATHAM, R.F., *AMet, AIM*, Samuel Fox & Co. Ltd., Stocksbridge.

ANALYSES

Mean of 4 values – mass content in %.

Analyst No.	C	Si	Mn	P	S	Cr	Mo	Ni	Cu
1	0.39	0.17	1.62	0.033	0.042	0.09	0.26	0.14	0.21
2	0.40	0.17	1.62	0.030	0.042	0.09	0.27	0.15	0.21
3	0.39	0.18	1.60	0.033	0.045	0.10	0.26	0.15	0.22
4	0.39	0.19	1.62	0.033	0.044	0.09	0.25	0.15	0.21
5	0.40	0.19	1.59	0.032	0.042	0.09	0.27	0.16	0.20
6	0.39	0.19	1.59	0.033	0.044	0.09	0.25	0.15	0.21
7	0.40	0.18	1.61	0.029	0.042	0.09	0.26	0.13	0.22
8	0.39	0.18	1.61	0.030	0.043	0.09	0.25	0.15	0.21
M_M	0.39	0.18	1.61	0.032	0.043	0.09	0.26	0.15	0.21
<i>S_M</i>	0.01	0.01	0.02	0.002	0.001	0.01	0.01	0.01	0.01

Additional Information: Analyst No. 2: determined V and found <0.01%

M_M: Mean of the intralaboratory means. **S_M**: standard deviation of the intralaboratory means.

Values given above in small italic type are for information only.

The above figures are those which each Analyst has decided upon after careful verification.

CERTIFIED VALUES

mass content in %

	C	Si	Mn	P	S	Cr	Mo	Ni	Cu
M_M	0.39	0.18	1.61	0.032	0.043	0.09	0.26	0.15	0.21
C(95%)	0.01	0.01	0.02	0.002	0.001	0.01	0.01	0.01	0.01

The half width confidence interval $C(95\%) = \frac{t \times S_M}{\sqrt{n}}$ where "t" is the appropriate Student's t value and "n" is the number of acceptable mean values

For further information regarding the confidence interval for the certified value see ISO Guide 35:1989 section 4.

DESCRIPTION OF SAMPLE

Bottles of 100g chips graded 1700 – 250µm (10 – 60 mesh) for chemical analysis.

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Mn - Mo STEEL

NOTES ON METHODS USED

CARBON

All Analysts except Nos. 1, 4 and 5 determined carbon gravimetrically by combustion using the Standard method B.S. 1121: Part 11: 1967 or similar methods. Analysts Nos. 1 and 5 used high frequency combustion-infrared absorption. No. 4 determined carbon titrimetrically by the Ströhlein method.

Analyst No. 8 also used a low-pressure method (Cook and Speight, Analyst, 1956, **81**, 144) and found 0.39%.

SILICON

All Analysts determined silicon gravimetrically, all except No.1 by dehydration with perchloric acid, in most cases according to the Standard method B.S. 1121: Part 10: 1967. Analyst No. 1 dehydrated by evaporation with both hydrochloric acid and aqua regia.

Analysts Nos. 4 and 6 also used photometric methods depending on the formation of molybdenum blue and found 0.18% in each case.

MANGANESE

Analysts Nos. 1, 2, 3, 5, and 8 determined manganese titrimetrically. Nos. 1 and 2 used direct Analoid methods whilst Nos. 3, 5 and 8 used BS 1121: Part 16: 1949, which includes a zinc oxide separation. Nos. 4, 6 and 7 used photometric methods after oxidation with periodate,; Nos. 4 and 6 according to BS 1121: Part 23: 1951.

Analyst No. 6 also used a direct titrimetric method and found 1.59%. No. 7 also used a volumetric method involving oxidation with bismuthate and found 1.61%.

PHOSPHORUS

Analyst Nos. 1 and 6 determined phosphorus titrimetrically after precipitation as phosphomolybdate. Nos. 2, 3, 4, and 5 determined phosphorus gravimetrically by precipitation as phosphomolybdate according to the Standard method B.S. 1121: Part 9: 1948, Nos. 2 and 5 finishing gravimetrically as lead molybdate and Nos. 3 and 4 finishing titrimetrically. Nos. 7 and 8 used a photometric method with phosphovanadomolybdate, No. 8 according to BS 1121: Part 45: 1966.

SULPHUR

All Analysts determined sulphur gravimetrically. Nos. 2 and 8 first carried out a chromatographic separation on an alumina column (Nydahl, Anal. Chem. **1954**, **26**, 580). Nos. 3, 4, 5, 6 and 7 used BS 1121: Part 1: 1966.

Analysts Nos. 4, 6, 7 and 8 also used combustion methods and found 0.046%, 0.043%, 0.039% and 0.044% respectively.

CHROMIUM

Analysts Nos. 1, 2, 3, 5 and 7 determined chromium titrimetrically; Nos. 1 and 5 according to BS 1121: Part 13: 1954 and No. 2 by oxidation with persulphate and direct titration with Fe(II). Nos. 4, 6 and 8 used a photometric method with diphenylcarbazide, according to BS 1121: Part 24: 1952.

Analyst No. 1 also used a photometric method with diphenylcarbazide and found 0.08%. Analyst No. 8 also used the titrimetric method BS 1121: Part 13: 1954 and found 0.10%.

MOLYBDENUM

All Analysts except Nos. 1 and 5 determined molybdenum photometrically as the oxythiocyanate, Nos. 2, 4 and 8 according to BS 1121: Part 48 :1966. Analysts Nos. 1 and 5 used gravimetric methods after precipitation with α -benzoin oxime.

Analysts Nos. 1 and 5 also used photometric methods with thiocyanate and found 0.26% in each case.

NICKEL

Analysts Nos. 1, 3, 5, 6 and 8 determined nickel titrimetrically with potassium cyanide/silver nitrate after separation with dimethylglyoxime. No.2 separated with dimethylglyoxime, dissolved the precipitate and boiled with excess Fe(III).The resultant Fe(II) was titrated with dichromate. Nos. 4 and 7 used a photometric method with dimethylglyoxime, No. 4 following BS 1121: Part 6: 1948.

COPPER

Analysts Nos. 1, 5 and 7 determined copper titrimetrically after precipitation with sodium thiosulphate, No. 5 used BS 1121: Part 4: 1956. All other Analysts determined copper photometrically; Nos. 2, 4 and 6 used *bis*-cyclohexanone oxalyldihydrazone whilst Nos. 3 and 8 used 2-2' diquinolyl according to BS 1121: Part 36: 1956.

VANADIUM

Vanadium was determined titrimetrically with Fe(II), after oxidation with permanganate.

Traceability: The majority of Analysts calibrated using pure metals, metal oxides or primary chemicals.

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For BUREAU OF ANALYSED SAMPLES LTD.
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Preliminary Edition February 1967
Main Edition May 1968
Main Edition(Revised with C(95%), and s_M values for each certified element) September 2004