



BUREAU OF ANALYSED SAMPLES LTD.

Directors:-

P.D.RIDSDALE, *B.Sc., C.Eng., M.I.M., M.R.S.C.* (Chairman)

R. P. MEERES, *B.A., (Oxon), M.R.S.C.* (Managing)

G. C. FLINTOFT, *A.C.M.A.*

BRITISH CHEMICAL STANDARD CERTIFIED REFERENCE MATERIAL

CERTIFICATE OF ANALYSIS

BCS*/SS[§] - CRM No. 215/3

0.9% CARBON STEEL

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

CO-OPERATING ANALYSTS AND FIRMS

INDEPENDENT ANALYSTS

1. COPPINS, W.C., *M.Sc., F.R.I.C.*, Ridsdale & Co Ltd., Middlesbrough.
2. SCHOLLES, P.H., *A.Met., L.R.I.C., L.I.M.*,
BISRA – The Corporate Laboratories, British Steel Corporation, Sheffield.

ANALYSTS representing MANUFACTURERS and USERS

3. BETTELLEY, J., *B.Sc., A.R.I.C.*,
G.K.N. Group Technological Centre, Wolverhampton.

4. BORROWDALE, J., *B.Sc.*, B.S.C. Redbourn Works, Scunthorpe.
5. KIDMAN, L. *A.Met., A.I.M., A.M.Inst.F.*,
B.S.C Rotherham Works, Rotherham.
6. KYLE, J.H., *A.I.M.*, W. Beardmore and Co. Ltd., Glasgow.
7. MUIR, S., B.S.C. Corby Works, Corby.
8. PRIESTLEY, I., Edgar Allen Foundry Ltd., Sheffield.

ANALYSES

Mean values – mass content in %.

Analyst No.	C	Si	Mn	P	S	Cr	Ni	Al (Total)	Cu
1	0.92	0.23	0.67	0.010	0.031	0.040	0.039	0.004	0.050
2	0.912	0.233	0.698	0.009	0.030	0.039	0.039	0.004	0.052
3	0.905	0.236	0.67	0.011	0.031	0.043	0.036	0.005	0.053
4	0.910	0.22	0.70	0.011	0.029	0.043	0.039	0.003	0.053
5	0.908	0.225	0.68	0.012	0.030	0.040	0.036	0.004	0.052
6	0.905	0.24	0.66	0.011	0.031	0.035	0.038		0.053
7	0.91	0.22	0.68	0.012	0.033	0.039	0.039	0.004	0.054
8	0.91	0.24	0.68	0.011	0.030	0.038	0.040	0.003	0.053
M_M	0.910	0.23	0.68	0.011	0.031	0.040	0.038	0.004	0.052
s _M	0.005	0.01	0.02	0.001	0.002	0.003	0.002	0.001	0.002
s _W	0.004	0.01	0.01	0.001	0.001	0.002	0.001	0.001	0.001

(Additional Information:- Analyst No. 1:- Al (Acid Sol) 0.001%, Mo 0.006%

Analyst No. 3:-Al (Acid Sol) 0.003%)

M_M: Mean of the intralaboratory means. **s_M**: standard deviation of the intralaboratory means. **s_W**: Intralaboratory standard deviation.

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	Ni	Al (Total)	Cu
M_M	0.910	0.23	0.68	0.011	0.031	0.040	0.038	0.004	0.052
C(95%)	0.005	0.01	0.02	0.001	0.002	0.003	0.002	0.001	0.001

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

*British Chemical Standard - bottles of 100g chips graded 1700 – 250µm (10 – 60 mesh) for chemical analysis.

§ Spectroscopic Standard - 38mm diameter discs for spectroscopic analysis

NOTE: The outer 2mm of the disc sample shows slight decarburisation and sparking near the outer edge should be avoided

BCS-CRM 215/3
0.9% CARBON STEEL
NOTES ON METHODS USED

CARBON

Analysts Nos. 1, 3, 6, 7 and 8 determined carbon gravimetrically using the British Standard Carbon Method 1*. No. 2 used a coulometric method. No. 4 determined carbon by infra-red gas analysis. No. 5 used a low-pressure method (Dunhill and Kent, Metallurgia, 1970, **81**, 115).
Analyst No.5 also used a thermal conductivity method and found 0.91%.

SILICON

Analysts Nos. 1, 2, 3, 4, 5 and 8 determined silicon gravimetrically according to the British Standard Silicon Method 1*. Nos. 6 and 7 used colorimetric methods depending upon the formation of molybdenum-blue.
Analysts Nos. 2 and 3 also used colorimetric molybdenum-blue methods and found 0.23% and 0.24% respectively. No. 6 also used the British Standard gravimetric method and found 0.24%.

MANGANESE

Analysts Nos. 1, 4, and 6 determined manganese volumetrically after oxidation with persulphate/silver nitrate. No. 1 used the Analoid Method No. 53. Nos. 2, 3, 5, 7 and 8 determined manganese colorimetrically after oxidation with periodate according to the British Standard Manganese Method 2*.

PHOSPHORUS

Analysts Nos. 1, 2, 3, 5 and 8 determined phosphorus colorimetrically as phosphovandomolybdic acid according to the British Standard Phosphorus Method 2*. Nos. 4, 6 and 7 precipitated the phosphorus as ammonium phosphomolybdate and completed volumetrically.
Analyst No.3 also used a volumetric method and found 0.011%. No. 4 also determined phosphorus gravimetrically after precipitation as phosphomolybdate and completed volumetrically.

SULPHUR

Analysts Nos. 1, 3, 5 and 8 determined sulphur gravimetrically. Nos. 1, 5 and 8 used the British Standard Sulphur Method 1*. No. 3 separated the sulphur chromatographically on an alumina column (Nydahl, Anal. Chem., 1954, **26**, 580) before precipitating it as barium sulphate. Nos. 2, 4, 6 and 7 determined sulphur by combustion in oxygen; No. 2 completed colorimetrically, Nos. 4, 6 and 7 volumetrically.
Analyst No. 2 also determined sulphur by combustion followed by measurement of electrical conductivity and found 0.029%. No. 3 also used the British Standard gravimetric method and found 0.031%. No.5 also determined sulphur volumetrically after combustion and found 0.030%.

CHROMIUM

Analysts Nos. 1, 2, 4, 5, 6, 7 and 8 determined chromium colorimetrically with diphenylcarbazide. Nos. 1 and 7 carried out preliminary separations of the iron with sodium hydroxide (No.1 used the Analoid Method No. 51), whereas Nos. 2, 4, 5, 6, and 8 used the British Standard Chromium Method 2*. No. 3 determined chromium by atomic absorption spectroscopy (Thomerson and Price, Analyst, 1971, **96**, 321).
Analyst No. 3 also used the British Standard colorimetric method and found 0.043%. No. 4 also used an atomic absorption method and found 0.044%.

NICKEL

Analysts Nos. 1, 4, 5, 7 and 8 determined nickel colorimetrically with dimethylglyoxime. No. 1 used a large sample weight and carried out a preliminary ether separation of the bulk of the iron. Nos. 4, 5, 7, and 8 used the British Standard Nickel Method 3*. Nos. 2 and 3 determined nickel by atomic absorption spectroscopy. No. 6 separated nickel with dimethylglyoxime and completed cyanometrically.
Analyst No. 3 determined nickel colorimetrically with dimethylglyoxime and found 0.035%. No.4 also used an atomic absorption method and found 0.037%.

ALUMINIUM (TOTAL)

Analysts Nos. 1, 3, 5, 7 and 8 determined total aluminium colorimetrically with eriochrome cyanine. Nos. 1, 3, 7 and 8 made preliminary separations of the iron by mercury cathode electrolysis according to British Standard Aluminium Method 3*. No. 5 determined aluminium in the presence of iron after reduction with ascorbic acid. Nos. 2 and 4 used atomic absorption spectroscopy.
Analyst No. 4 also determined aluminium by emission spectroscopy and found 0.004%.

COPPER

Analysts Nos. 1, 2, 4, 5, 7 and 8 determined copper colorimetrically with 2, 2'-diquinolyl according to the British Standard Copper Method 3*. No.3 determined copper by atomic absorption spectroscopy. No. 6 used a colorimetric method utilising *bis*-cyclohexanone oxalyldihydrazone.
Analyst No. 3 also used the British Standard colorimetric method and found 0.054%. No. 4 also used an atomic absorption method and found 0.053%. No. 5 also determined copper colorimetrically with *bis*-cyclohexanone oxalyldihydrazone and found 0.054%.

ALUMINIUM (ACID SOLUBLE)

Both Analysts used similar methods to those employed for total aluminium except that the acid insoluble residue was filtered off and discarded.

MOLYBDENUM

Molybdenum was determined colorimetrically after extraction of the oxythiocyanate complex into butyl acetate (Analoid Method No. 63).

* Methods for Sampling and Analysis of Iron, Steel and Other Ferrous Metals, B.S. Handbook No. 19, first published 1970 by the British Standards Institution, London.

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

NEWHAM HALL
MIDDLESBROUGH
ENGLAND

For BUREAU OF ANALYSED SAMPLES LTD.
P.D. RIDSDALE,
Chairman

<i>Preliminary Edition</i>	October, 1972
<i>Main Edition</i>	July 1973
<i>Main Edition (revised with C(95%), s_M and s_W values for each certified element).....</i>	April 2003