MAIN EDITION

British Chemical Standards

issued by

Bureau of Analysed Samples, Ltd.

Directors (1962-65):—
P. D. RIDSDALE, *B.Sc., A.I.M.*, (Managing)
B. BAGSHAWE, *A. Met., F.I.M., M.Inst.F.*
C. GILDON, *F.C.A.*

Certificate of Analyses

B.C.S. No. 327 (S.S. No. 57)
MILD STEEL (Second Residual Series)

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

The standard bars were specially prepared by Edgar Allen and Co. Ltd., Sheffield.

ANALYSES

Analyst No.	Mn %	Cu %	V %	Co %	Al (Total) %	Al (Acid sol.) %	Pb %	B %	Sb %	C %	Si %	S %	P %
1	..	..	0·13	..	0·023	*0·017*	0·010	..	..	*0·22*	*0·56*	*0·010*	*0·020*
2	..	..	..	0·006	0·016	*0·014*	0·009	..	0·032	..	..	..	..
3	0·16	0·15	0·13	0·006	0·020	*0·011*	0·012	0·004$_0$	0·032	*0·23*	*0·56*	*0·011*	*0·017*
4	0·16	0·16	..	0·006	0·021	*0·014*	..	..	..	..	..	..	..
5	..	..	..	..	..	..	0·010	0·003$_0$	0·034	..	..	..	..
6	..	..	..	..	0·020	*0·011*	..	..	..	..	..	..	..
7	..	0·16	..	..	..	..	..	..	..	..	..	..	..
8	..	..	..	0·006	..	..	..	..	..	..	..	..	..
9	..	..	0·14	..	..	..	0·011	..	..	..	..	..	..
10	..	0·16	..	..	0·020	*0·013*	0·011	..	..	..	..	..	..
11	0·16	..	..	..	0·018	*0·017*	..	..	..	..	..	..	..
12	..	0·16	..	..	..	..	..	..	..	..	..	..	..
13	0·16	..	0·14	..	..	..	..	..	..	*0·24*	*0·55*	*0·008*	*0·020*
14	..	..	..	..	..	..	..	0·002$_5$	..	..	..	..	..
15	..	..	0·14	..	0·020	*0·014*	0·011	..	..	..	..	..	..
16	..	..	..	0·006	..	..	..	..	..	..	..	..	..
17	0·16	0·16	..	..	..	..	..	..	..	..	..	..	..
18	0·16	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	0·019	*0·013*	0·010	0·003$_0$	0·031	..	..	..	..
20	0·16	..	..	..	..	..	..	..	..	..	..	..	..
21	..	..	..	0·006	..	..	0·010	0·002$_5$	0·034	..	..	..	..
22	0·16	..	..	..	..	..	..	..	..	..	..	..	..
23	..	..	..	..	..	..	0·010	0·003$_0$	..	..	..	..	..
24	..	..	0·14	..	0·020	*0·014*	..	..	..	..	..	..	..
25	..	0·16	..	..	..	..	..	0·003$_5$	..	..	..	..	..
26	..	..	..	0·006	..	..	..	..	..	..	..	..	..
27	..	..	..	..	..	..	0·011	..	..	..	..	..	..
Average	**0·16**	**0·16**	**0·14**	**0·006**	**0·020**	..	**0·010**	**0·003**	**0·033**	..	..	..	..

The above figures are those which each Analyst has decided upon after careful verification
Figures in bold type standardized, figures in small italic type only approximate

The following additional information has also been supplied:-
BRYSON, W. R. International Nickel Ltd., Birmingham Al (Total) 0·020%, Al (Acid sol.) 0·015%.

[P.T.O.

CO-OPERATING ANALYSTS AND FIRMS

REFEREE ANALYSTS—INDEPENDENT

1. British Iron and Steel Research Association (per P. H. Scholes, *A.Met.*), Sheffield.
2. Clarke, W. E., *F.R.I.C.*, British Cast Iron Research Association, Birmingham.
3. Coppins, W. C., *M.Sc.*, *A.R.I.C.*, Ridsdale & Co. Ltd., Middlesbrough.

GOVERNMENT DEPARTMENT

4. Edwards, F. H., *B.Sc.*, Bragg Laboratory, Naval Ordnance Inspection Establishment, Sheffield.

ANALYSTS representing MAKERS and USERS

5. Bagshawe, B., *A.Met.*, *F.I.M.*, *M.Inst.F.*, Brown-Firth Research Laboratories, Sheffield.
6. Ballantyne, E. K., Colvilles Ltd., Cambuslang, Glasgow.
7. Booth, J., *B.Sc.*, The Park Gate Iron & Steel Co. Ltd., Rotherham.
8. Chirnside, R., *F.R.I.C.*, General Electric Co. Ltd., Wembley.
9. Craven, S. W., *A.M.C.T.*, *F.I.M.*, I.C.I. Ltd., Mond Division, Northwich.
10. Davidson, G. A., *A.M.C.T.*, *A.I.M.*, Ford Motor Company Ltd., Dagenham.
11. Dunnill, P. B., *B.Sc.*, Steel Peech & Tozer, Rotherham.
12. Elwell, W. T., *F.R.I.C.*, Imperial Metal Industries (Kynoch) Ltd., Birmingham.
13. Gardner, L. E., *A.Met.*, *F.I.M.*, Edgar Allen & Co. Ltd., Sheffield.
14. Gentry, C. H. R., *B.Sc.*, *F.R.I.C.*, Mullard Radio Valve Co., Mitcham.
15. Harrison, T. S., *B.Sc.*, *Ph.D.*, *B.Met.*, *F.R.I.C.*, Appleby-Frodingham Steel Company, Scunthorpe.
16. Hobson, J. D., *B.Sc.*, *Ph.D.*, *A.Met.*, *F.R.I.C.*, *F.I.M.*, Hadfields Ltd., Sheffield.
17. Hunter, D. P., *A.I.M.*, Steel Company of Wales Ltd., Newport.
18. Jackson, L., *A.Met.*, Workington Iron & Steel Co., Workington.
19. Kidman, L., *A.Met.*, *A.I.M.*, *A.M.Inst.F.*, English Steel Corporation Ltd., Sheffield.
20. Kyle, J. William Beardmore & Co. Ltd., Glasgow.
21. Moxon, R., G. K. N. Group Research Laboratory, Wolverhampton.
22. Murray, G. Brown Bayley Steels Ltd., Sheffield.
23. Padget, G., *A.Met.*, United Steel Companies Ltd., Research and Development Dept., Rotherham.
24. Postlethwaite, R, T., Samuel Fox & Co. Ltd., Stocksbridge, near Sheffield.
25. Shanahan, C. E. A., *B.Sc.*, *F.R.I.C.*, *F.I.M.*, R. Thomas & Baldwins Ltd., Central Research Laboratories, Aylesbury.
26. Taylor, L. N., Samuel Osborn & Co. Ltd., Sheffield.
27. Thomson, J. H. G., *B.Sc.*, The British Aluminium Co. Ltd., Research Laboratory, Gerrards Cross.

B.C.S. No. 327 (S.S. No. 57)
MILD STEEL (Second Residual Series)

NOTES ON METHODS USED

MANGANESE

Analysts Nos. 3 and 20 determined manganese volumetrically after oxidation with persulphate/silver nitrate; No. 3 used the Analoid method No. 53. The other Analysts determined manganese colorimetrically after oxidation with periodate or persulphate/silver nitrate; Nos. 4, 11 and 17 used the Standard absorptiometric method B.S. 1121: Part 23: 1951.

Analyst No. 4 also determined manganese by atomic-absorption spectrophotometry and found 0·16%. No. 11 used two alternative methods (a) colorimetric determination after oxidation with persulphate/silver nitrate, (b) volumetric determination after a zinc oxide separation; the results were 0·17% and 0·16% respectively. No. 17 also used the Analoid volumetric method No. 32 and found 0·15%. No. 20 also used the Standard absorptiometric method and found 0·16%.

COPPER

All Analysts determined copper colorimetrically. Nos. 3, 7, 10 and 12 used the Standard absorptiometric method B.S. 1121: Part 36: 1956 which depends on extraction of the 2-2′ diquinolyl complex with amyl alcohol. Nos. 17 and 25 used the same reagent without amyl alcohol extraction (Shanahan and Jenkins, Analyst, **1961**, **86**, 166). No. 4 used the *bis*-cyclohexanone oxalyldihydrazone method (Haywood and Sutcliffe, Analyst, **1956**, **81**, 651).

Analysts Nos. 3 and 10 also used the *bis*-cyclohexanone oxalyldihydrazone method and found 0·15% and 0·16% respectively.

VANADIUM

Analyst No. 1 determined vanadium colorimetrically as phosphovanadotungstate (Scholes, Analyst, **1957**, **82**, 525). All other Analysts determined vanadium volumetrically. No. 3 used the Analoid method No. 34. Nos. 9, 13 and 15 used the Standard method B.S. 1121: Part 25: 1956. No. 13 carried out a preliminary mercury-cathode separation. No. 24 carried out a mercury-cathode separation, then precipitated vanadium with cupferron and completed by titration with amonium ferrous sulphate.

Analyst No. 15 also used a modification of the Standard method employing a potentiometric end-point and found 0·14%. No. 24 also used a direct method without separating iron and found 0·14%.

COBALT

Analysts Nos. 2 and 8 determined cobalt colorimetrically with 2-nitroso-1-naphthol. No. 2 used the method of Rooney (Metallurgia, **1958**, **58**, **205**; **1960**, **62**, 175) and No. 8 that of Claasen and Daamen (Anal. Chim. Acta., **1955**, **12**, **547**). The remaining Analysts determined cobalt colorimetrically with nitroso-R-salt according to the Standard method B.S. 1121: Part 42: 1961.

ALUMINIUM (Total)

Analysts Nos. 1, 4, 6, 10, 11, 15 and 19 determined total aluminium colorimetrically with eriochromecyanine after removal of iron (Scholes and Smith, Analyst, **1958**, **83**, 615). No. 2 dissolved the sample in hydrochloric acid and determined aluminium polarographically by a modification of Rooney's method (Analyst, **1958**, **83**, 546). Nos. 3 and 24 determined total aluminium by methods involving mercury cathode separation, precipitation of vanadium with cupferron and volumetric determination of aluminium as the oxinate; No. 3 followed the procedure of the Standard method B.S. 1121: Part 35: 1955.

Analyst No. 24 also used the Scholes and Smith method and found 0·020%.

ALUMINIUM (Acid Sol.)

All Analysts except No. 2 dissolved the sample with 12·5% sulphuric acid and determined aluminium colorimetrically with eriochromecyanine (Scholes and Smith, Analyst, 1958, **83**, 615). No. 2 dissolved in dilute hydrochloric acid (50% v/v) and determined aluminium polarographically by a modification of Rooney's method (Analyst, 1958, **83**, 546).

LEAD

Analyst No. 1 determined lead spectrographically using both solid electrodes and a solution method. Nos. 2 and 27 determined lead polarographically; No. 2 used the method of Rooney (Analyst, **1958**, **83**, **83**). The other Analysts determined lead colorimetrically with dithizone. Nos. 3, 9, 10, 21 and 23 used direct methods after solvent extraction of the iron with amyl acetate or amyl acetate/methyl *iso*-butyl ketone mixture. Nos. 5, 15 and 19 used a method which included solvent extraction of the iron followed by separation of the lead into chloroform as the diethyldithiocarbamate.

Analyst No. 10 also used Rooney's polarographic method and found 0·011%.

BORON

All Analysts determined boron colorimetrically. Nos. 3 and 5 used a direct carmine method. Nos. 14 and 19 separated boron by ion-exchange and determined it with dianthrimide (B.I.S.R.A. Methods of Analysis Committee, J. Iron Steel Inst., 1958, **189,** 227). No. 23 used a direct dianthrimide method without separation. No. 21 used a solvent extraction method in which the fluoroborate ion was converted to a coloured complex with monomethylthionine and extracted into 1:2-dichloroethane. No. 25 separated boron by distillation and determined it by the curcumin method (Borrowdale, Jenkins and Shanahan, Analyst 1959, **84,** 426).

ANTIMONY

All Analysts except No. 5 determined antimony colorimetrically with rhodamine B. No. 2 separated the antimony by co-precipitation with manganese dioxide, while Nos. 3 and 19 used a direct method (Kidman and Waite, Metallurgia, 1962, **66,** 143). No. 21 used both the manganese dioxide co-precipitation method and a direct method. No. 5 separated antimony by deposition of Cu_2Sb on copper foil and determined it colorimetrically as iodide.

CARBON

Analyst No. 1 determined carbon conductimetrically using the Wösthoff apparatus. Nos. 3 and 13 determined carbon gravimetrically by the Standard method B.S. 1121: Part 11: 1948.

SILICON

Analysts No. 1 and 13 determined silicon colorimetrically as molybdenum-blue; No. 1 used an AutoAnalyzer. No. 3 determined silicon gravimetrically using a nitro-sulphuric acid method (Dicks and Clarke, B.C.I.R.A. Journ., 1962, **10,** 303).

SULPHUR

Analysts Nos. 1 and 3 determined sulphur by combustion. No. 1 used the Wösthoff apparatus and completed conductimetrically; No. 3 completed volumetrically by titration with iodide/iodate. No. 13 used the Standard gravimetric method B.S. 1121: Part 1A: 1957.

PHOSPHORUS

Analyst No. 1 determined phosphorus colorimetrically as molybdenum-blue using an AutoAnalyzer. Nos. 3 and 13 determined phosphorus volumetrically.

BUREAU OF ANALYSED SAMPLES, LTD.

per P. D. Ridsdale,
Managing Director,
December, 1965

Newham Hall,
Middlesbrough,
England.

Kd. & Fd. 65/4972