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BRITISH CHEMICAL STANDARD CERTIFIED REFERENCE MATERIAL

CERTIFICATE OF ANALYSIS

BCS* /SS[†] -CRM No. 466/1

AUSTENITIC STAINLESS STEEL

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

The Material for this CRM was specially cast by Firth Vickers Foundry Ltd., and was forged and rolled by Sheffield Forgemasters Ltd.

ANALYSES

Mean of 4 values — mass content in %

Analyst No.	C	Si (Total)	Mn	P	S	Cr	Mo	Ni	As	B	Nb	Pb	Sn	Ta
1	0.063	0.509	0.698	0.021	0.016	17.65	2.19	8.64	0.018	0.0025	0.032	0.0014	0.0053	0.0002
2	0.066	0.490	0.700	0.020	0.016	17.64	2.21	8.58	-	-	-	-	-	-
3	0.064	0.507	0.692	0.020	0.015	17.66	2.20	8.56	0.016	-	-	0.0018	-	-
4	0.060	0.504	0.704	0.019	0.014	17.62	2.18	8.56	0.017	0.0022	0.030	0.0014	0.0046	0.0004
5	0.060	0.510	0.684	0.020	0.016	17.62	2.18	8.66	0.016	-	0.032	0.0014	0.0048	0.0004
6	0.063	0.505	0.710	0.020	0.017	17.66	2.21	8.58	-	0.0022	0.025	0.0015	0.0056	-
7	0.061	0.504	0.700	0.020	0.016	17.65	2.18	8.64	-	-	-	-	-	-
8	0.062	-	-	0.021	0.018	17.75	2.19	8.57	0.020	0.0025	0.028	0.0012	0.0048	0.0002
9	-	0.514	0.700	-	-	17.62	-	8.64	-	-	-	-	-	-
10	-	-	-	-	-	-	-	8.64	-	0.0027	-	-	-	-
M_M	0.062	0.505	0.698	0.020	0.016	17.65	2.19	8.61	0.017	0.0024	0.029	0.0014	0.0050	0.0003
<i>S_M</i>	<i>0.002</i>	<i>0.007</i>	<i>0.008</i>	<i>0.001</i>	<i>0.001</i>	<i>0.04</i>	<i>0.01</i>	<i>0.04</i>	<i>0.002</i>	<i>0.0002</i>	<i>0.003</i>	<i>0.0002</i>	<i>0.0004</i>	-

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

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

*British Chemical Standard — chips graded 1700-250 μ m (10-60 mesh) for chemical analysis

†Spectroscopic Standard — discs 38 mm x 19 mm thick for spectroscopic analysis

CO-OPERATING ANALYSTS AND FIRMS

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AUSTENITIC STAINLESS STEEL

NOTES ON METHODS USED

CARBON

Analysts Nos. 1, 2, 3, 6, and 8 determined carbon by high frequency combustion/infrared absorption. Nos. 4, 5 and 7 used non-aqueous titration according to the British Standard Carbon Method 4*.

SILICON

All analysts determined silicon gravimetrically by dehydration with perchloric acid, according to the British Standard Silicon Method 1*.

MANGANESE

Analysts Nos. 1 and 5 determined manganese by FAAS. Nos. 2 and 9 determined manganese titrimetrically after a zinc oxide separation according to the British Standard Manganese Method 1*. The remaining analysts used photometric methods, Nos. 3, 4 and 6 after oxidation with potassium periodate according to the British Standard Manganese Method 2*, No. 7 after oxidation with ammonium persulphate/silver nitrate.

PHOSPHORUS

All analysts except No. 2 determined phosphorus photometrically as phosphovanadomolybdate according to the British Standard Phosphorus Method 2*. No. 2 used a titrimetric method after separation as phosphomolybdate.

SULPHUR

Analysts Nos. 1, 2, 3, 5, 6 and 8 determined sulphur by combustion methods. All except No. 5 used high frequency combustion/infrared absorption. No. 5 absorbed in hydrogen peroxide and titrated with borate. Nos. 4 and 7 determined sulphur gravimetrically according to the British Standard Sulphur Method 1*.

CHROMIUM

All analysts determined chromium by titration with ammonium ferrous sulphate after oxidation with ammonium persulphate/silver nitrate. All except No. 5 used the British Standard Chromium Method 1*. No. 5 used the Analoid Method No. 37.

MOLYBDENUM

Analysts Nos. 1 and 3 determined molybdenum using FAAS. All other analysts determined molybdenum photometrically as oxythiocyanate, Nos. 2, 4, 7 and 8 according to the British Standard Molybdenum Method 1*, Nos. 5 and 6 according to Analoid Method No. 42.

NICKEL

Analyst No.1 determined nickel using FAAS. Nos. 2, 3, 4, 5 and 8 determined nickel by titration after separation with dimethylglyoxime. Nos. 2 and 3 titrated with potassium cyanide solution according to the British Standard Nickel Method 1*. Nos. 4 and 5 dissolved the precipitate in dilute sulphuric acid, boiled with excess of ferric sulphate and titrated with dichromate solution (Analoid Method No. 62). No. 8 titrated with EDTA. Nos. 6 and 7 used dimethylglyoxime photometric methods. Nos. 9 and 10 determined nickel gravimetrically with dimethylglyoxime.

ARSENIC

Analysts Nos. 1, 3 and 4 determined arsenic photometrically with silver diethyldithiocarbamate after separation of arsenic as arsine by reduction with zinc. Nos 5 and 8 determined arsenic photometrically as molybdenum blue. No. 5 extracted the arsenic as iodide into chloroform (Fogg et al., Analyst, 1972, 97, 657) and No. 8 as chloride (Nall, Analyst, 1971, 65, 398).

BORON

All analysts determined boron photometrically; Nos. 1, 6, 8 and 10 with curcumin and No. 4 with dianthrimide. Analyst No.1 also determined boron fluorimetrically with Thoron and obtained a mean value of 0.0025%. Analyst No. 6 also determined boron by ICP-AES and obtained a value of 0.0020%.

NIObIUM

Analysts. Nos. 1, 4, 5 and 8 determined niobium photometrically with PAR after separation with phenylarsonic acid. No. 6 extracted niobium as thiocyanate into acidified acetone and completed photometrically according to the British Standard Niobium Method 1*.

LEAD

Analysts Nos. 1, 3, 4, 5 and 6 determined lead by AAS. No. 3 separated lead by extraction with sodium diethyldithiocarbamate into 4-methylpentan-2-one. Nos. 4 and 5 separated lead as the iodide with a solution of TOPO in 4-methylpentan-2-one. Nos. 4 and 6 completed using ETA-AAS. No. 8 determined lead photometrically with dithizone according to the British Standard Lead Method 3*.

TIN

Analysts Nos. 1, 5 and 6 determined tin using FAAS. No. 5 separated tin as the iodide with a solution of TOPO in 4-methylpentan-2-one. No. 4 used ETA-AAS. No. 8. determined tin titrimetrically after separation as sulphide according to the British Standard Tin Method 1*.

TANTALUM

All analysis determined tantalum photometrically according to the British Standard Tantalum Method 1*.

Abbreviations

ETA-AAS : Electrothermal atomisation-atomic absorption spectrometry
FAAS : Flame atomic absorption spectrometry
ICP-AES : Inductively coupled plasma - atomic emission spectrometry
TOPO : Tri-octyl phosphine oxide
PAR : 4-(2-Pyridylazo) - resorcinol

*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, 2 Park Street, London, W1A 2BS.

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