MAIN EDITION

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BRITISH CHEMICAL STANDARD CERTIFIED REFERENCE MATERIAL

CERTIFICATE OF ANALYSIS
BCS*/SS†-CRM No. 351
NICKEL ALLOY IN 718

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

The material from which this CRM was prepared was supplied by Glossop Superalloys Ltd., Glosop

CO-OPERATING ANALYSTS AND FIRMS

INDEPENDENT ANALYST

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ANALYSTS representing MANUFACTURERS and USERS

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5. HINGLE, D.N., *BSc, MSc, PhD, CChem, MRSC,*. Murex Ltd., Rainham
6. HYND, D.P., Cameron Iron Works Ltd., Livingstone
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9. SHAW, D.H., Howmet Alloys International, Exeter
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ANALYSES

Mean of 4 values – mass content in %.

Analyst No.	C*	Si	Mn	S	Al	B	Co	Cr	Cu	Fe	Mo	Nb	Ti	Ni	*P*
1	0.025	0.15	0.038	0.0005	0.53	0.0049	0.140	17.91	0.014	18.15	3.07	5.21	1.09	53.4	*0.007*
2	…	…	0.033	…	…	…	0.134	…	…	…	…	…	…	…	*…*
3	0.026	0.14	0.032	0.0007	0.53	0.0056	0.148	18.27	0.017	18.19	3.06	5.24	1.02	52.8	*0.009*
4	0.025	0.16	0.038	0.0004	0.55	0.0046	0.138	…	0.019	…	3.01	5.18	1.01	…	*…*
5	0.026	0.14	0.042	0.0008	0.52	…	0.120	18.16	0.015	…	3.14	…	1.07	53.4	*0.004*
6	…	…	…	…	…	…	…	17.92	…	18.29	…	…	…	52.7	*0.004*
7	0.026	…	0.040	…	0.60	0.0053	0.132	18.21	0.016	…	3.09	5.19	1.06	53.2	*0.006*
8	0.024	0.14	0.034	0.0008	0.51	0.0049	0.143	18.02	0.013	18.35	2.99	…	1.10	53.3	*…*
9	0.024	0.13	0.041	0.0007	0.56	…	0.130	18.27	0.016	18.39	3.04	…	…	…	*…*
10	0.023	0.15	0.036	0.0004	0.58	0.0053	0.140	18.23	0.014	18.21	3.06	5.19	1.04	53.0	*0.009*
M_M	**0.025**	**0.14**	**0.037**	**0.0006**	**0.55**	**0.0051**	**0.136**	**18.12**	**0.016**	**18.26**	**3.06**	**5.20**	**1.06**	**53.1**	*…*
s_M	0.002	0.01	0.004	0.0002	0.04	0.0004	0.009	0.16	0.002	0.10	0.05	0.03	0.04	0.3	*…*
s_W	0.001	0.01	0.002	0.0002	0.01	0.0003	0.004	0.06	0.001	0.08	0.06	0.05	0.01	0.3	*…*

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

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

Values given above in small italic type are for information only

CERTIFIED VALUES (Cv)

mass content in %

	C*	Si	Mn	S	Al	B	Co	Cr	Cu	Fe	Mo	Nb	Ti	Ni
Cv	**0.025**	**0.14**	**0.037**	**0.0006**	**0.55**	**0.0051**	**0.136**	**18.12**	**0.016**	**18.26**	**3.06**	**5.20**	**1.06**	**53.1**
C(95%)	0.001	0.01	0.003	0.0002	0.03	0.0004	0.007	0.13	0.002	0.10	0.04	0.03	0.04	0.3

***NOTE:** This certified value applies ONLY to the material supplied in the finely divided form (BCS-CRM 351). The disc sample (SS-CRM 351) was found to be marginally higher in carbon content.

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.

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NOTES ON METHODS USED

CARBON

Analyst No. 1 determined carbon by combustion and non-aqueous titration according to the British Standard Carbon Method 4*. The other Analysts used high frequency combustion with infrared absorption.

SILICON

Analysts Nos. 1, 3, 5 9 and 10 determined silicon gravimetrically. Nos.1 and 9 used perchloric acid, Nos. 3 and 10 used sulphuric acid and gelatine and No. 5 used sulphuric acid. No. 4 determined silicon by Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES) and No.8 by Flame Atomic Absorption Spectrometry (FAAS).

MANGANESE

Analysts Nos. 1, 3 and 7 determined manganese photometrically after oxidation with periodate. Nos. 2, 5, 8, 9 and 10 used FAAS. No. 4 used ICP-AES.

SULPHUR

Analyst No. 1 determined sulphur gravimetrically as the sulphate after chromatographic separation on alumina. The other analysts used high frequency combustion with infrared absorption.

ALUMINIUM

Analysts Nos. 1, 5, 8, 9 and 10 determined aluminium by FAAS. Nos. 3 and 7 determined aluminium gravimetrically as the oxinate after mercury cathode and cupferron separations. No. 4 used ICP-AES.

BORON

Analysts Nos. 1, 3, 7, 8 and 10 determined boron photometrically. Nos. 1, 3 and 8 with curcumin. Nos. 7 and 10 with 1.1 dianthrimide. No. 4 used ICP-AES.

COBALT

Analysts Nos. 1, 2, 5, 7, 8, 9 and 10 determined cobalt by FAAS. No. 3 determined cobalt photometrically with nitroso-R-salt. No. 4 used ICP-AES.

CHROMIUM

All Analysts determined chromium titrimetrically with ammonium ferrous sulphate, No. 6 after oxidation with perchloric acid, the other Analysts after oxidation with persulphate/silver nitrate. No. 10 used potentiometric end point detection.

COPPER

All Analysts except No. 4 determined copper by FAAS. No. 4 used ICP-AES.

IRON

Analysts Nos. 1, 6, 8 and 10 determined iron titrimetrically with potassium dichromate after reduction with stannous chloride, Nos. 1, 6 and 10 after separation of the iron by precipitation as the hydroxide. No. 3 determined iron photometrically with thiocyanate. No. 9 used FAAS.

Analyst No. 8 also determined iron by FAAS and obtained a mean value of 18.51%

MOLYBDENUM

Analysts Nos. 1, 3, 7, 9 and 10 determined molybdenum photometrically as the oxythiocyanate, all except No. 9 after extraction of the complex. No. 4 used ICP-AES. Nos. 5 and 8 used FAAS.

NIOBIUM

Analysts Nos. 1, 3 and 10 determined niobium gravimetrically as the oxide, No. 10 following ion exchange separation. No. 4 used ICP-AES. No. 7 determined niobium photometrically with 4-(2-pyridylazo)-resorcinol (PAR).

TITANIUM

Analysts Nos. 1, 3, 7, 8 and 10 determined titanium photometrically, Nos. 1, 7, 8 and 10 with diantipyrylmethane and No. 3 with hydrogen peroxide. No. 4 used ICP-AES and No. 5 used FAAS.

Analyst No. 7 also used FAAS and obtained a mean value of 1.07%.

NICKEL

Analysts Nos. 1, 5 and 7 determined nickel gravimetrically with dimethylglyoxime. Nos. 3, 6, 8 and 10 determined nickel titrimetrically, Nos. 3 and 8 with EDTA, Nos. 6 and 10 cyanometrically.

Analyst No. 7 also determined nickel photometrically and obtained a mean value of 53.36%

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NOTES ON METHODS USED

PHOSPHORUS

All analysts determined phosphorus photometrically. Nos. 1, 3 and 10 separated phosphorus by precipitation as ferric phosphate and using selective fluoride complexation determined phosphorus as molybdenum blue (according to ISO/DP 9388). The other analysts determined phosphorus as phosphovanadomolybdic acid according to the British Standard Phosphorus Method 2. No. 5 did not extract the complex.*

* Methods for Sampling and Analysis of Iron, Steel and other Ferrous Metals, B.S. Handbook No. 19, first published i1970 by the British Standards Institute, 2 Park St., London W1A 2BS

DESCRIPTION OF SAMPLE

*The BCS material is supplied in bottles of 100g chips graded 1700 – 250µm (10 – 60 mesh) for chemical analysis.

†The SS-CRM material is a Spectroscopic Standard and is supplied as discs 41mm dia x 13mm thick for spectroscopic analysis.

INTENDED USE & STABILITY

This sample is intended for the verification of analytical methods, such as those used by the participating laboratories, for the calibration of analytical instruments in cases where the calibration with primary substances (pure metals or stoichiometric compounds) is not possible and for establishing values for secondary reference materials.

It will remain stable provided that the bottle remains sealed and is stored in a cool, dry atmosphere. When the bottle has been opened the lid should be secured immediately after use.

TRACEABILITY

The traceability of this CRM is ensured by the use of either stoichiometric analytical techniques or methods which are calibrated against pure metals or stoichiometric compounds.

This Certified Reference Material has been prepared in accordance with the recommendations specified in ISO Guides 30 to 35, available from the International Standards Organisation in Geneva.

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For BUREAU OF ANALYSED SAMPLES LTD.

P.D. RIDSDALE,
Chairman

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