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Certificate No. Q3993

BRITISH CHEMICAL STANDARD CERTIFIED REFERENCE MATERIAL

CERTIFICATE OF ANALYSIS BCS-CRM No. 114 LOW ALLOY STEEL

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

ANALYSES

Mean of 4 values - mass content in %.

Lab No.	C	Si	Mn	P	S	Cr	Mo	Ni	Al	As	B	Co
1	0.4012	0.2990	0.4212	0.0043	0.0044	0.1975	0.1851	1.4939	0.0806	0.0022	0.0006	0.0179
2	0.4168	0.2847	0.4143	0.0051	0.0044	0.1867	0.1866	1.5197	0.0818	0.0023	0.0008	0.0178
3	0.4004	0.3031	0.4216	0.0041	0.0047	0.1889	0.1807	1.5045	0.0746	...	0.0007	0.0168
4	0.4023	0.3004	0.4155	0.0040	0.0047	0.1848	0.1787	1.4993	0.0785	0.0030	0.0008	0.0167
5	0.3970	...	...	...	0.0052	...	...	...	...	...	...	...
6	...	0.2910	0.3995	0.0041	0.0050	0.1844	0.1878	1.4888	0.0745	0.0026	0.0009	0.0160
7	0.4025	0.2917	0.4218	0.0050	0.0041	0.1800	0.1836	1.5055	0.0771	0.0024	0.0007	0.0172
M_M	0.4034	0.2950	0.4157	0.0044	0.0046	0.1871	0.1838	1.5020	0.0779	0.0025	0.0008	0.0171
<i>s_M</i>	0.0069	0.0070	0.0086	0.0005	0.0004	0.0059	0.0035	0.0108	0.0031	0.0003	0.0001	0.0007
<i>s_w</i>	0.0077	0.0020	0.0026	0.0003	0.0003	0.0022	0.0019	0.0071	0.0010	0.0003	0.0001	0.0003

Lab No.	Cu	N	Nb	Sn	Ti	V	Zr	Pb	W	Ca	Sb
1	0.3639	0.0044	0.0043	0.0458	0.0099	0.0096	0.0055	...	<0.001	<0.0001	<0.0025
2	0.3656	0.0040	0.0043	0.0381	0.0098	0.0078	0.0043	0.0002	...	...	...
3	0.3537	0.0042	0.0039	0.0406	0.0092	0.0087	0.0053	<0.0001	0.0004	<0.0001	0.0002
4	0.3589	0.0045	0.0039	0.0409	0.0093	0.0082	0.0053	<0.0004	<0.0006	<0.001	0.0022
5	...	0.0041	...	...	...	...	...	...	...	...	...
6	0.3633	...	0.0043	0.0402	0.0097	0.0088	0.0055	<0.001	...	<0.0001	<0.001
7	0.3546	0.0046	0.0045	0.0420	0.0094	0.0082	0.0049	<0.0001	...	<0.0001	0.0002
M_M	0.3600	0.0043	0.0042	0.0413	0.0096	0.0086	0.0051	...	...	...	...
<i>s_M</i>	0.0051	0.0003	0.0003	0.0026	0.0003	0.0007	0.0005	...	...	...	...
<i>s_w</i>	0.0018	0.0002	0.0004	0.0008	0.0005	0.0004	0.0004	...	...	...	...

M_M: Mean of the intralaboratory means. *s_M*: standard deviation of the intralaboratory means. *s_w*: intralaboratory standard deviation.
Values given above in small italic type are for information only.

CERTIFIED VALUES

mass content in %

	C	Si	Mn	P	S	Cr	Mo	Ni	Al	As	B	Co	Cu
M_M	0.403	0.295	0.416	0.0044	0.0046	0.187	0.184	1.502	0.078	0.0025	0.0008	0.0171	0.360
C(95%)	0.007	0.008	0.009	0.0005	0.0004	0.006	0.004	0.012	0.004	0.0004	0.0001	0.0008	0.005

	N	Nb	Sn	Ti	V	Zr
M_M	0.0043	0.0042	0.041	0.0096	0.0086	0.0051
C(95%)	0.0003	0.0003	0.003	0.0003	0.0008	0.0005

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.

This material is also available in disc form as SS-CRM 114

BCS-CRM No. 114
LOW ALLOY STEEL
NOTES ON METHODS USED

CARBON: Analyst No. 1 determined carbon using non-aqueous titration according to the Standard Method BS 6200:3.8.2:1991. The other Analysts used high frequency combustion-infrared absorption.

SILICON: Analysts Nos. 1, 2, 3 and 7 determined silicon gravimetrically, Nos. 1, 2 and 7 after dehydration with perchloric acid and No. 3 after a sulphuric acid dehydration. Analyst No. 4 used a molybdenum blue photometric method, whilst Analyst No. 6 used Inductively Coupled Plasma Optical-Emission Spectrometry (ICP-OES).

MANGANESE: Analysts Nos. 1, 4 and 7 determined manganese photometrically after oxidation with potassium periodate. Analysts Nos. 2, 3 and 6 used ICP-OES

PHOSPHORUS: Analyst No 1 determined phosphorus photometrically as phosphovanadomolybdate with extraction according to the Standard Method BS EN 10184. Analysts Nos. 2, 3 and 6 used ICP-OES whilst Analysts Nos. 4 and 7 determined phosphorus photometrically as phosphovanadomolybdate without extraction.

SULPHUR: Analyst No.1 determined sulphur gravimetrically according to the Standard Method BS 1 6200:3.26. Analyst No.6 determined sulphur by combustion, according BS 7020:7.2. The other analysts used high frequency combustion infrared absorption.

CHROMIUM: All Analysts, except No. 7, determined chromium by ICP-OES. Analyst No. 7 used Flame Atomic Absorption Spectrometry (FAAS).

MOLYBDENUM: All Analysts, except No. 7, determined molybdenum by ICP-OES. Analyst No. 7 used a photometric method with thiocyanate in the presence of Sn (II).

NICKEL: All Analysts, except No. 7, used ICP-OES. Analyst No.7 titrated with EDTA.

ALUMINIUM: Analysts Nos. 1, 2, 3, 4 and 6 used ICP-OES. Analyst No. 7 used FAAS.

ARSENIC: Analyst No. 1 determined arsenic photometrically with silver diethyldithiocarbamate after separation as arsine, according to BS EN 10212:1996. Analysts Nos. 2 and 4 used ICP-OES and Analyst No.6 used hydride generation atomic absorption spectrometry. Analyst No. 7 determined arsenic photometrically as molybdenum blue.

BORON: All Analysts, except Nos. 2 and 7, determined boron photometrically with curcumin, No.1 according to BS EN 10200. Analyst No. 2 determined boron by ICP-OES and No. 7 used dianthrimide to determine the boron photometrically.

COBALT: All Analysts, except No. 7, determined cobalt by ICP-OES. No.7 used FAAS.

COPPER: All Analysts, except No. 7, determined copper by ICP-OES. No.7 used FAAS.

NITROGEN: Analyst No. 1 determined nitrogen using an acidimetric titration after distillation, according to the Standard Method BS 6200:3.22.1:1992. The remaining Analysts used thermal conductivity after decomposition in a graphite crucible.

NIObIUM: All Analysts, except No. 7, determined niobium using ICP-OES. Analyst No. 7 determined niobium photometrically with 4-(2 pyridylazo)-resorcinol.

TIN: All analysts, except No.7, used ICP-OES. Analyst No.7 determined tin by FAAS.

TITANIUM: Analysts Nos. 1, 2, 3, and 6 determined titanium by ICP-OES. Analysts Nos. 4 and 7 determined titanium photometrically using diantipyrylmethane.

VANADIUM: All Analysts, except No. 7, determined vanadium by ICP-OES. Analyst No. 7 used FAAS.

ZIRCONIUM: All Analysts, except No. 7 determined zirconium by ICP-OES. Analyst No. 7 used a xylenol orange photometric method.

LEAD: Analysts Nos. 2 and 6 determined lead by ICP-OES. Nos. 3 and 4 used FAAS and Analyst No. 7 used electrothermal atomic absorption spectrometry (ETAAS)

TUNGSTEN: All Analysts used ICP-OES

CALCIUM: Analysts Nos. 1, 3 and 4 used FAAS, Analyst No.6 used ICP-OES and Analyst No. 7 used ETAAS

ANTIMONY: Analyst No. 1 used FAAS, Analysts Nos. 3 and 7 used hydride generation atomic absorption spectrometry and Analysts Nos. 4 and 6 used ICP-OES

CO-OPERATING ANALYSTS

INDEPENDENT ANALYST

- 1 PAGE-GIBSON, J.E., *BSc, CChem, MRSC* Ridsdale & Co. Ltd., Middlesbrough.

ANALYSTS representing MANUFACTURERS and USERS

- 2 CROOK, D., Corus Strip Products, Llanwern.
3 FOX, G., Corus Engineering Steels, Stocksbridge.
4 WEERDT, Miss J A., BRAS, P.W. ten & GULDEMOND, Dr D., Corus Staal BV, IJmuiden.
5 RICHMOND, Mrs H., & RAW, M., Corus Construction and Industrial, Redcar.
6 SNOWDEN, Miss Y.A. and RAW, M., Corus Construction and Industrial, Scunthorpe.
7 WILSON, J., Allvac Ltd., Sheffield.

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. If the contents should become discoloured (e.g. oxidised) by atmospheric contamination they should be discarded.

TRACEABILITY

The traceability of this BCS-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.
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