MAIN EDITION

BUREAU OF ANALYSED SAMPLES LTD

Directors:
R. P. MEERES, *BA (Oxon), MRSC* (Managing)
G. C. FLINTOFT, *ACMA CGMA* (Company Secretary)
J. C. MEERES
M. S. TAYLOR *PhD, CChem, MRSC*

4004

BRITISH CHEMICAL STANDARD CERTIFIED REFERENCE MATERIAL

CERTIFICATE OF ANALYSIS
BCS-CRM No. 112
LOW ALLOY STEEL

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

CO-OPERATING ANALYSTS

ANALYSTS representing MANUFACTURERS and USERS

1. Crook D. and Symonds, J., Corus Strip Products, Llanwern.
2. O'Sullivan, P., Corus Strip Products Port Talbot.
3. Raw, M. and Snowden, Miss Y.A., Corus Construction and Industrial, Scunthorpe.
4. Fox, G., Corus Engineering Steels, Stocksbridge.
5. Raw, M and Richmond, Mrs H., Corus Construction and Industrial, Teesside.

INDEPENDENT ANALYST

6. Page-Gibson, J.E., *BSc, CChem, MRSC,* Ridsdale & Co. Ltd., Middlesbrough.

ANALYSES

Mean of 4 values – mass content in %

Lab. No	C	Si	Mn	P	S	Cr	Mo	Ni	Al	As	B	Co	Cu	N	Nb	Sn	Ti	V	*Ca*
1	0.3940	0.3010	0.4385	0.0045	0.0030	1.2445	0.1960	…	0.0167	0.0021	0.0005	0.0176	0.1535	0.0025	0.0065	…	0.0100	0.0092	*<0.0005*
2	0.3943	0.2873	0.4315	0.0041	0.0023	1.2318	0.1840	1.4583	0.0165	0.0026	…	0.0176	0.1508	0.0022	0.0077	0.0087	0.0102	0.0093	…
3	0.3971	0.2908	0.4340	0.0044	…	…	0.1893	…	0.0145	…	0.0007	0.0174	0.1450	…	0.0065	0.0083	…	0.0084	*0.0002*
4	0.3896	0.2790	0.4371	0.0044	0.0031	1.2302	0.1909	1.4449	0.0138	0.0022	0.0008	0.0168	0.1471	0.0026	0.0062	0.0085	0.0096	0.0087	*0.0001*
5	0.3903	0.2897	0.4372	0.0043	0.0024	1.2500	0.1818	1.4681	0.0137	0.0015	…	0.0177	0.1498	0.0023	0.0070	0.0092	0.0104	0.0087	…
6	0.3970	0.2863	0.4398	0.0041	0.0023	1.2256	0.1976	1.4706	0.0134	0.0022	0.0009	0.0176	0.1472	0.0026	0.0051	0.0084	0.0100	0.0087	*0.0002*
M_M	**0.3937**	**0.2890**	**0.4364**	**0.0043**	**0.0026**	**1.2364**	**0.1899**	**1.4605**	**0.0148**	**0.0021**	**0.0007**	**0.0175**	**0.1489**	**0.0024**	**0.0065**	**0.0086**	**0.0100**	**0.0088**	
s_M	0.0032	0.0072	0.0031	0.0002	0.0004	0.0102	0.0063	0.0117	0.0015	0.0004	0.0002	0.0003	0.0031	0.0002	0.0009	0.0004	0.0003	0.0003	
s_W	0.0010	0.0023	0.0016	0.0003	0.0002	0.0040	0.0008	0.0059	0.0009	0.0001	0.0001	0.0004	0.0012	0.0002	0.0006	0.0002	0.0005	0.0002	

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

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.

Additional information: The elements Pb, Zr and Sb were determined by one or more Analysts and found to be present at contents of <10µg/g

CERTIFIED VALUES

mass content in %

	C	Si	Mn	P	S	Cr	Mo	Ni	Al	As	B	Co	Cu	N	Nb	Sn	Ti	V
Cv	**0.394**	**0.289**	**0.436**	**0.0043**	**0.0026**	**1.236**	**0.190**	**1.461**	**0.0148**	**0.0021**	**0.0007**	**0.0175**	**0.149**	**0.0024**	**0.0065**	**0.0086**	**0.0100**	**0.0088**
C(95%)	0.004	0.008	0.004	0.0002	0.0005	0.013	0.007	0.019	0.0016	0.0005	0.0003	0.0003	0.004	0.0003	0.0010	0.0005	0.0004	0.0003

The half width confidence interval **C**(95%) = $\frac{t \times s_M}{\sqrt{n}}$ where "t" is the appropriate two sided Student's t value at the 95% confidence level for "n" acceptable mean values

For further information regarding the confidence interval for the certified value see ISO Guide 35:2006 sections 6.1 and 10.5.2

NB: Although widely accepted within the industry "mass content in %" is neither an SI nor an IUPAC supported quantity. Multiplication of the certified value (Cv) by 10^4 will yield the value in µg/g

BCS-CRM 112
LOW ALLOY STEEL
NOTES ON METHODS USED

CARBON
Analysts Nos. 1, 2, 4 and 5 determined carbon by high frequency combustion and infrared absorption. Analysts Nos. 3 and 6 determined carbon using non-aqueous titration according to BS 6200: 3.8.2: 1991

SILICON
Analyst No. 1 determined silicon photometrically as silicophosphomolybdate without extraction. Nos. 2, 3 and 6 determined silicon gravimetrically after dehydration with perchloric acid according to BS 6200: 3.26.1: 1995. Nos.4 and 5 used Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES.)

MANGANESE
Analysts Nos. 1, 2, 4 and 5 used ICP-OES. Nos. 3 and 6 determined manganese photometrically after oxidation with potassium periodate according to BS 6200: 3.18.2: 1995.

PHOSPHORUS
Analysts Nos. 1, 2, 4 and 5 used ICP-OES. Nos. 3 and 6 determined phosphorus photometrically as phosphovanadomolybdate according to BS EN 10184:1992

SULPHUR
Analysts Nos. 1, 2, 4 and 5 determined sulphur using high frequency combustion and infrared absorption. Analyst No. 6 determined sulphur using oxidation/reduction titration after combustion.

CHROMIUM
Analysts Nos. 1, 2, 4 and 5 determined chromium using ICP-OES. Analyst No. 6 determined chromium titrimetrically after oxidation with persulphate according to BS EN 24937:1991

MOLYBDENUM
Analysts Nos. 1, 2, 4 and 5 determined molybdenum using ICP-OES. Analyst No.6 determined Molybdenum photometrically as oxythiocyanate according to BS 6200:3.19.1:1985.

NICKEL
Analysts Nos. 2, 4 and 5 determined nickel using ICP-OES. Analyst No. 6 determined nickel titrimetrically after separation with dimethylglyoxime (Analoid Method No. 62).

ALUMINIUM
Analysts Nos. 1, 2, 3, 4 and 5 determined aluminium using ICP-OES. Analyst No. 6 used Flame Atomic Absorption Spectrometry (FAAS) according to BS 6200: 3.1.4:1990.

ARSENIC
Analysts Nos. 1, 2, 4 and 5 determined arsenic using ICP-OES. Analyst No. 6 determined arsenic photometrically with silver diethyldithiocarbamate after separation as arsine.

COBALT
All Analysts determined cobalt by ICP-OES.

COPPER
Analysts Nos. 1, 2, 3, 4 and 5 determined copper using ICP-OES. Analyst No. 6 used FAAS according to BS EN 24943:1990

NITROGEN
Analysts Nos. 1, 2, 3, 4 and 5 determined nitrogen using thermal conductivity. Analyst No. 6 determined nitrogen titrimetrically after distillation as ammonia.

NIOBIUM
All analysts determined niobium using ICP-OES.

TIN
All Analysts determined tin using ICP-OES.

TITANIUM
All Analysts determined titanium using ICP-OES.

VANADIUM
All Analysts determined vanadium using ICP-OES.

CALCIUM
Analyst No. 1 and 3 determined calcium using ICP-OES. Analysts Nos. 4 and 6 used FAAS

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LOW ALLOY STEEL

DESCRIPTION OF SAMPLE

BCS-CRM 112 is a low alloy steel supplied in bottles of 100g chips nominally graded 1700 – 250µm (10 – 60 mesh) for chemical analysis. The sample is also available in pieces of 44mm diameter as SS-CRM 112.

The preparation of representative samples for chemical analysis and the certification by co-operative analysis was undertaken by Bureau of Analysed Samples Ltd (BAS).

BAS is a United Kingdom Accreditation Service (UKAS) Accredited Reference Material Producer, No 4004, and, as the Producer of BCS-CRM 112 as defined in ISO Guide 34:2009 section 3.1, is fully responsible for assigning the certified values and their uncertainties in accordance with ISO Guides 34:2009 and 35:2006.

This material was originally certified in 2001, before BAS achieved accreditation to ISO Guide 34 in 2006. However, following an extensive review of the certification of this BCS-CRM, it has been established that the procedures used were exactly the same as those which have since been accredited and that therefore BCS-CRM 112 can be issued under the ISO Guide 34 Accreditation.

INTENDED USE

This sample is intended for uses such as the verification of the accuracy and repeatability of analytical methods, such as those used by the participating laboratories, for the calibration of analytical instruments, for establishing values for secondary reference materials and for training purposes.

In order to ensure that a fully representative sample is taken users should take a minimum sub-sample size of 1.0g. Users of this material should be aware that the use of a smaller sub-sample size will invalidate the certified values and the associated 95% confidence limits.

The sample should be mixed thoroughly before each use.

STABILITY

BCS-CRM 112 will remain stable provided that the bottle remains sealed and is stored in a dry atmosphere. When the bottle has been opened the lid should be secured immediately after use.

TRACEABILITY

The characterisation of this material has been achieved by chemical analysis involving inter-laboratory study, each laboratory using the method of their choice, details of which are given above.

Most of the analytical methods used in the characterisation of this CRM were either international or national standard methods or methods which are technically equivalent. All laboratories used either stoichiometric analytical techniques or methods which were calibrated predominantly against pure metals or stoichiometric compounds, ensuring traceability of the individual results to the SI.

MEASUREMENT UNCERTAINTY

The uncertainty of each of the certified values of BCS-CRM 112 has been established by multiplying the standard error arising from the chemical analysis by the appropriate two sided Student's t value at the 95% confidence level for the number of results. Homogeneity has been assessed on the bulk material and has been found to be acceptable. It has not, therefore, been included in the calculated measurement uncertainty. The stability of this CRM and its transportation also make negligible contributions to the overall uncertainty of the certified values.

COMMUTABILTY

BCS-CRM 112 is intended to be used in the same physical form as that used by the participating analysts and therefore commutability is not of relevance in respect of this CRM.

Further information and advice on this or other Certified Reference Materials or Reference Materials produced by Bureau of Analysed Samples Ltd may be obtained from the address below.

NEWHAM HALL
NEWBY
MIDDLESBROUGH
ENGLAND
TS8 9EA
email: enquiries@basrid.co.uk
Website: www.basrid.co.uk

For BUREAU OF ANALYSED SAMPLES LTD.
R P MEERES,
Managing Director

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