MAIN EDITION

BUREAU OF ANALYSED SAMPLES LTD.

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Certificate No. Q3993

SPECTROSCOPIC STANDARD CERTIFIED REFERENCE MATERIAL

CERTIFICATE OF ANALYSIS

SS-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.

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	

M_M: Mean of the intralaboratory means; s_M: Standard deviation of the intralaboratory means, s_W Intralaboratory 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.

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
Certified M_M	**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 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.

THROUGHOUT BATCH COMPOSITIONAL VARIABILITY

	C	Si	Mn	P	S	Cr	Mo	Ni	Al	As	B	Co	Cu	N	Nb	Sn	Ti	V
µg/g	23.9	13.9	44.2	<0.3	<0.3	16.4	6.4	4.5	4.0	0.4	<0.3	<0.3	4.6	0.8	<0.3	0.6	<0.3	0.9

PTO

SS-CRM 112
LOW ALLOY STEEL

NOTES ON METHODS USED

CHEMICAL ANALYSIS

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

CO-OPERATING ANALYSTS AND FIRMS

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.

DESCRIPTION OF SAMPLE

The sample is available in pieces 44mm in diameter and either 19mm or 50mm long.
It is also available in chip form as BCS-CRM 112.

THROUGHOUT BATCH COMPOSITIONAL VARIABILITY

Samples taken from all the bars used in the preparation of this SS-CRM have been examined using optical emission spectrometry. The throughout batch compositional variability is obtained after the statistical elimination of instrumental and sample preparation variables. This is given in the table as the standard deviation, in µg/g, for each element certified in this CRM.

The results quantify the homogeneity of the material used to prepare this SS-CRM.

INTENDED USE & STABILITY

This SS-CRM is intended for establishing and checking the calibration of Optical Emission and X-Ray Spectrometers for the analysis of similar materials. The "as received" working surface of the sample should be linished before use to remove any protective coating. It will remain stable provided that it is not subject to excessive heat (e.g., during preparation of the working surface).

TRACEABILITY

The traceability of this SS-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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