



# BUREAU OF ANALYSED SAMPLES LTD.

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Certificate No. Q3993

SPECTROSCOPIC STANDARD CERTIFIED REFERENCE MATERIAL

## CERTIFICATE OF ANALYSIS SS-CRM No. 111 LOW CARBON 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	Co	Cu	N	Sn	Ti	V	Nb	Ca
1	0.0269	0.0260	0.1498	0.0035	0.0055	0.0193	0.0010	0.0394	0.0351	0.0021	0.0146	0.0170	0.0035	...	0.0005	...	<i>0.0009</i>	<i>&lt;0.0005</i>
2	0.0261	0.0245	0.1534	0.0027	0.0055	0.0200	0.0008	0.0393	0.0323	0.0011	0.0142	0.0170	0.0033	0.0016	0.0005	0.0011	<i>0.0004</i>	...
3	0.0248	0.0264	0.1547	0.0038	...	0.0193	...	0.0392	0.0359	...	0.0148	0.0166	...	0.0014	...	0.0008	...	...
4	0.0257	0.0246	0.1568	0.0036	0.0057	0.0202	0.0006	0.0402	0.0348	0.0016	0.0146	0.0172	0.0036	0.0012	0.0003	0.0010	<i>0.0003</i>	<i>0.0001</i>
5	0.0247	0.0241	0.1562	0.0030	0.0050	0.0195	0.0010	0.0370	0.0343	0.0020	0.0132	0.0178	0.0034	0.0016	...	...	...	...
6	0.0264	0.0262	0.1602	0.0033	0.0051	0.0200	0.0008	0.0370	0.0364	0.0015	0.0152	0.0168	0.0030	0.0016	0.0004	0.0008	<i>0.0003</i>	<i>0.0001</i>
<i>M<sub>M</sub></i>	<b>0.0258</b>	<b>0.0253</b>	<b>0.1552</b>	<b>0.0033</b>	<b>0.0054</b>	<b>0.0197</b>	<b>0.0008</b>	<b>0.0387</b>	<b>0.0348</b>	<b>0.0017</b>	<b>0.0144</b>	<b>0.0171</b>	<b>0.0034</b>	<b>0.0015</b>	<b>0.0004</b>	<b>0.0009</b>	...	...
<i>s<sub>M</sub></i>	0.0009	0.0010	0.0035	0.0004	0.0003	0.0004	0.0002	0.0014	0.0014	0.0004	0.0007	0.0004	0.0002	0.0002	0.0001	0.0002	...	...
<i>s<sub>w</sub></i>	0.0004	0.0014	0.0006	0.0002	0.0001	0.0007	0.0001	0.0004	0.0004	0.0001	0.0004	0.0002	0.0002	0.0002	0.0001	0.0001	...	...

*M<sub>M</sub>*: Mean of the intralaboratory means; *s<sub>M</sub>*: Standard deviation of the intralaboratory means, *s<sub>w</sub>*: 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 B, 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	Co	Cu	N	Sn	Ti	V
<b>Certified M<sub>M</sub></b>	<b>0.0258</b>	<b>0.0253</b>	<b>0.155</b>	<b>0.0033</b>	<b>0.0054</b>	<b>0.0197</b>	<b>0.0008</b>	<b>0.0387</b>	<b>0.0348</b>	<b>0.0017</b>	<b>0.0144</b>	<b>0.0171</b>	<b>0.0034</b>	<b>0.0015</b>	<b>0.0004</b>	<b>0.0009</b>
C(95%)	0.0010	0.0011	0.004	0.0004	0.0004	0.0005	0.0003	0.0015	0.0015	0.0005	0.0008	0.0005	0.0002	0.0002	0.0001	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	Co	Cu	N	Sn	Ti	V
µg/g	4.9	2.1	2.2	<0.3	<0.3	0.8	<0.3	0.7	<0.3	<0.3	0.3	0.4	5.0	0.5	<0.3	0.3

**SS-CRM 111**  
**LOW CARBON 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 and 6 determined silicon gravimetrically after dehydration with perchloric acid according to BS 6200: 3.26.1: 1995. Nos. 3, 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, 3, 4 and 5 determined chromium using ICP-OES. Analyst No. 6 used Flame Atomic Absorption Spectrometry (FAAS).

**MOLYBDENUM**

Analysts Nos. 1, 2, 4 and 5 determined molybdenum using ICP-OES. Analyst No.6 used FAAS.

**NICKEL**

Analysts Nos. 1, 2, 3, 4 and 5 determined nickel using ICP-OES. Analyst No. 6 used FAAS.

**ALUMINIUM**

Analysts Nos. 1, 2, 3, 4 and 5 determined aluminium using ICP-OES. Analyst No. 6 used 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 diethylthiocarbamate 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, 4 and 5 determined nitrogen using thermal conductivity. Analyst No. 6 determined nitrogen titrimetrically after distillation as ammonia.

**TIN**

All Analysts determined tin using ICP-OES.

**TITANIUM**

All Analysts determined titanium using ICP-OES.

**VANADIUM**

All Analysts determined vanadium using ICP-OES.

**NIOBIUM**

*All Analysts used ICP-OES.*

**CALCIUM**

*Analyst No. 1 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., <i>BSc, CChem, MRSC,</i> | Ridsdale & Co. Ltd., Middlesbrough. |
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## 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 111

## 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  $\mu\text{g/g}$ , 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 finished 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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