



# BUREAU OF ANALYSED SAMPLES LTD.

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4004

SPECTROSCOPIC STANDARD CERTIFIED REFERENCE MATERIAL

## CERTIFICATE OF ANALYSIS

### SS-CRM No. 111A LOW CARBON 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	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	...	0.0009	<0.0005
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	0.0004	...
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	0.0003	0.0001
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	0.0003	0.0001
<b>M<sub>M</sub></b>	<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	0.0002	0.0007	0.0001	0.0004	0.0004	0.0001	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	...	...

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

**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.

Values given above in small italic type are for information only.

Additional Information: B, Pb, Zr and Sb were determined by one or more analysts and found to be present at concentrations 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>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 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.

#### 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

#### 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

# SS-CRM 111A LOW CARBON 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 the Standard Method BS 6200:3.8.2:1991.

### SILICON

Analyst No. 1 determined silicon photometrically as silicophosphomolybdate without extraction. Nos. 2 and 6 determined silicon gravimetrically, 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 No 1, 2, 4 and 5 use ICP-OES. Nos. 3 and 6 determined phosphorus photometrically as phosphovanadomolybdate according to BS EN 10184:1992.

### SULPHUR

Analyst 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 BS6200: 3.1.4:1990.

### ARSENIC

Analysts Nos. 1, 2, 4 and 5 determined arsenic using ICP-OES. Analyst No.6 determined As 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, 4 and 5 determined nitrogen using thermal conductivity. Analyst No.6 determined nitrogen titrimetrically after distillation as ammonia according to the Standard Method BS 6200:3.22.1:1992.

### TIN

All analysts determined tin using ICP-OES.

### TITANIUM

All Analysts determined titanium using ICP-OES.

### VANADIUM

All Analysts determined vanadium by ICP-OES.

### NIObIUM

All Analysts determined niobium using ICP-OES.

### CALCIUM

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

## SS-CRM 111A

During the OES homogeneity examination of the material selected for BCS-CRM 111 and SS-CRM 111 it was noted that there were two slightly different levels of Mn content. The bars were therefore segregated into SS-CRM 111 and SS-CRM 111A. The difference was not large, but nevertheless a user might notice a slight difference between a disc of SS-CRM 111 and SS-CRM 111A. The chemical analysis was carried out on the BCS material which was made up of turnings taken equally from bars of SS-CRM 111 and SS-CRM 111A and the range of values obtained in the certification exercise is greater than the difference noted in the OES examination.

## INTENDED USE & STABILITY

SS-CRM 111A 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. The disc will remain stable provided that it is not subject to excessive heat (e.g. during preparation of the working surface).

## TRACEABILITY

The traceability of SS-CRM 111A has been established in accordance with principles of ISO Guides 30 – 35 and the International vocabulary of basic and general terms in metrology.

The characterisation of this material has been achieved by inter-laboratory study, each laboratory using the method of their choice, details of which are given above. These methods are either stoichiometric analytical techniques or methods which are calibrated against pure metals or stoichiometric compounds. Most methods used were either international or national standard methods or methods which are technically equivalent.

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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.

## 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.

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ENGLAND TS8 9EA

For BUREAU OF ANALYSED SAMPLES LTD.  
R P MEERES,  
MANAGING DIRECTOR

Preliminary Edition (SS-CRM 111)... .. March 2001  
Main Edition (SS-CRM 111)... .. July 2004  
Main Edition issued under ISO Guide 34 Accreditation as SS-CRM 111A . ... November 2010