MAIN EDITION

BUREAU OF ANALYSED SAMPLES LTD

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4004

BRITISH CHEMICAL STANDARD CERTIFIED REFERENCE MATERIAL

CERTIFICATE OF ANALYSIS

BCS-CRM No. 161/4

0.8% CARBON STEEL

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

CO-OPERATING ANALYSTS

INDEPENDENT ANALYSTS

1	CROCKER, F.,	Pattinson and Stead (2005) Ltd., Middlesbrough.
2	JONES, S.J., *BSc, CChem, MRSC*	Ridsdale & Co. Ltd., Middlesbrough.

ANALYSTS representing MANUFACTURERS and USERS

3	CROOK, D. G., *MRSC, TIFireE*	Corus Strip Products, Llanwern, Newport.
4	FOX, G,	Corus Testing Solutions, Stocksbridge.
5	DE WEERDT, MISS J.A & TEN BRAS, P.	Corus Strip Products, IJmuiden, Holland.
6	RAW, M.,	Corus Testing Solutions, Redcar.
7	SNOWDEN, MISS Y. A.,	Corus Testing Solutions, Scunthorpe.
8	WILSON, J.,	Allvac Ltd., Sheffield.

ANALYSES

Mean of 4 values - mass content in %.

Analyst No.	C	Si	Mn	P	S
1	0.8156	0.2021	0.5070	0.0108	0.0099
2	0.8149	0.1991	0.4999	0.0103	0.0095
3	0.8204	0.2102	0.5110	0.0117	0.0097
4	0.8163	0.2026	0.5057	0.0099	0.0094
5	0.8195	0.2043	0.5047	0.0104	0.0098
6	0.8185	…	…	…	0.0097
7	0.8153	0.1955	0.4928	0.0101	0.0090
8	0.8143	0.2018	0.5069	0.0105	0.0097
M_M	**0.8169**	**0.2022**	**0.5040**	**0.0105**	**0.0096**
s_M	0.0023	0.0046	0.0060	0.0006	0.0003
s_W	0.0031	0.0029	0.0033	0.0003	0.0003

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.

CERTIFIED VALUES (Cv)

mass content in %

	C	Si	Mn	P	S
Cv	**0.817**	**0.202**	**0.504**	**0.0105**	**0.0096**
C(95%)	0.002	0.005	0.006	0.0006	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 161/4
0.8% CARBON STEEL
NOTES ON METHODS USED

CARBON

Analysts Nos. 1 and 2 used the non-aqueous titration method described in BS 6200:3.8.2:1991, No. 1 standardised with benzoic acid and No. 2 with calcium carbonate. Analysts Nos. 3, 4, 5 and 8 used infrared absorption methods following combustion, Nos. 3 and 5 according to ISO 9556:2001. Analyst No. 3 calibrated with sucrose and No. 5 with sodium carbonate. Analysts Nos. 6 and 7 determined carbon by thermal conductivity after combustion, No. 6 calibrating with barium carbonate and No. 7 with calcium carbonate.

SILICON

Analysts Nos. 1, 2, 3 and 8 determined silicon gravimetrically after dehydration with perchloric acid. Analysts Nos. 4 and 7 used Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES), calibrating with pure silicon solution. Analyst No. 5 determined silicon photometrically as molybdenum blue without extraction, calibrating with silica.

MANGANESE

Analyst No. 1 determined manganese by Flame Atomic Absorption Spectrometry (FAAS), calibrating with pure manganese. Analysts Nos. 2 and 8 determined manganese photometrically as Mn (VII) after oxidation with periodate, No. 2 calibrating with pure manganese. Analysts Nos. 3, 4, 5 and 7 used ICP-OES, No. 5 according to ISO 10278 and calibrating with potassium permanganate. Analyst No. 3 calibrated with manganese and Nos. 4 and 7 calibrated with a pure manganese solution.

PHOSPHORUS

Analysts Nos. 1, 2 and 8 determined phosphorus photometrically as phosphovanadomolybdate after extraction. Analysts Nos. 1 and 2 calibrated with potassium dihydrogen orthophosphate. Analysts Nos. 3, 4 and 5 used ICP-OES, Nos. 3 and 4 calibrating with a pure phosphorus solution and No. 5 calibrating with potassium hydrogen phosphate. No. 7 calibrated with dihydrogen ammonium phosphate.

SULPHUR

Analyst No. 1 determined sulphur by acidimetric titration after combustion, calibrating with potassium sulphate. Analyst No. 2 determined sulphur gravimetrically as barium sulphate and the remaining analysts used infrared absorption after combustion, No. 3 according to BS 6200:3.28.1:1985 (ISO 4935-1980), calibrating with potassium sulphate. Analysts Nos. 5, 6, and 7 calibrated with potassium sulphate.

DESCRIPTION OF SAMPLE

BCS-CRM 161/4 was cast as 120mm square billets and forged and rolled to 44mm diameter black rolled bar from which turnings of a nominal grading of 1700 – 250µm (10 – 60 mesh) were prepared by Bureau of Analysed Samples Ltd. which were then packed into bottles of 100g.

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

Bureau of Analysed Samples Ltd is a United Kingdom Accreditation Service (UKAS) Accredited Reference Material Producer, No 4004, and, as the Producer of BCS-CRM 161/4 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.

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 161/4 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 161/4 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 161/4 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.

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Preliminary Edition …. …. ….