BUREAU OF ANALYSED SAMPLES LTD

BRITISH CHEMICAL STANDARD CERTIFIED REFERENCE MATERIAL

CERTIFICATE OF ANALYSIS

BCS-CRM No. 533

CONTAINER GLASS

Prepared under rigorous laboratory conditions and, AFTER CERTIFICATION ANALYSIS IN GREAT BRITAIN, BELGIUM, GERMANY, ITALY, JAPAN AND TURKEY, issued by the Bureau of Analysed Samples Ltd and the Society of Glass Technology.

ANALYSES

Mean of 4 values - mass content in %. All results relate to the dried (105°C) sample.

Analyst	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	BaO	Na_2O	K_2O	TiO_2	SO_3	Cr_2O_3
1	72.5625	1.4200	0.0190	9.5425	2.2775	0.0023	13.6200	0.0298	0.0385	0.2225	*0.0004*
2	72.8500	1.4593	…	9.6770	2.2180	…	13.5938	…	…	…	…
3	…	1.5360	0.0175	9.8275	2.1450	0.0023	13.5350	0.0275	0.0373	0.2333	*<0.003*
4	72.2173	1.4348	0.0213	9.7133	2.1018	…	13.6205	0.0280	0.0408	0.2108	…
5	…	1.4750	0.0205	9.6798	2.1975	…	13.7753	0.0320	0.0438	0.2230	*<0.003*
6	…	1.4900	…	…	…	0.0024	…	0.0245	0.0378	…	*0.0004*
7	72.4250	1.4415	0.0188	9.6883	2.1863	0.0023	13.7400	…	0.0386	0.2194	*<0.001*
8	72.7650	1.5111	0.0169	9.5226	2.1477	0.0024	13.6704	0.0320	0.0392	0.2256	*<0.0015*
9	72.6482	1.3707	0.0209	9.5501	2.1109	0.0029	13.7001	0.0342	0.0377	…	*<0.005*
10	…	…	…	…	…	…	13.4675	0.0268	…	…	…
11	72.6825	1.3875	0.0200	9.7100	2.2325	…	13.7250	0.0300	0.0400	…	*<0.002*
12	72.6250	1.4050	0.0180	9.6475	2.1850	0.0025	13.7375	0.0308	0.0408	0.2290	*<0.005*
13	…	1.4974	0.0184	9.6628	2.1058	0.0022	…	0.0271	0.0365	0.1999	*0.0003*
14	…	1.4413	…	…	2.0323	0.0025	…	…	…	0.2227	*0.0003*
15	72.3300	1.3825	…	9.6763	2.1875	…	13.6983	…	0.0403	…	*<0.01*
M_M	**72.5673**	**1.4466**	**0.0191**	**9.6581**	**2.1637**	**0.0024**	**13.6570**	**0.0293**	**0.0393**	**0.2207**	
s_M	0.2065	0.0508	0.0015	0.0853	0.0653	0.0002	0.0921	0.0028	0.0020	0.0100	
s_W	0.1172	0.0257	0.0011	0.0644	0.0290	0.0003	0.0737	0.0007	0.0011	0.0115	

Additional Information: Analyst Nos 1, 4 and 5 determined LOI and reported values of 0.238%, 0.274% and 0.425% respectively. Analysts Nos. 4 and 15 analysed P_2O_5 by XRF and found 0.015% and <0.01%. Analyst No. 4 determined Mn_3O_4, also by XRF and found 0.009%. Analyst No. 7 used the same technique to determine CeO and reported 0.053%.

M_M: Mean of the laboratory mean values. **s_M**: standard deviation of the laboratory mean values. **s_W**: average within laboratory standard deviation.

CERTIFIED VALUES (Cv)

mass content in %

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	BaO	Na_2O	K_2O	TiO_2	SO_3
Cv	**72.57**	**1.447**	**0.0191**	**9.66**	**2.16**	**0.0024**	**13.66**	**0.0293**	**0.0393**	**0.221**
C(95%)	0.16	0.030	0.0011	0.06	0.04	0.0002	0.06	0.0020	0.0013	0.008
Minimum Weight (g)	0.5	0.25	0.25	0.25	0.25	0.25	0.1	0.25	0.25	0.25

The half width confidence interval, C(95%), is an expression of the uncertainty of the certified value.

$C(95\%) = \frac{t \times s_M}{\sqrt{n}}$ 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.

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.

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(The current edition is available at www.basrid.co.uk)

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NOTES ON METHODS USED

SILICA

Most Analysts determined silica gravimetrically, No. 1 with polyethylene oxide after JIS R3101, No. 7 determining the residual silica by Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES) and No.9 after dehydrating with hydrochloric acid whilst No. 12 followed ASTM C169. Analysts Nos. 2, 4, 11 and 15 used X-Ray Fluorescence Spectrometry (XRF) with a fused bead, No. 4 following BS EN ISO 12677.

ALUMINA

Analyst No. 1 determined alumina using the complexometric titration with ethylenediaminetetraacetic acid (EDTA) described in JIS R3101, Analysts Nos. 2, 4, 5, 11 and 15 used XRF with a fused bead, No.4 following BS EN ISO 12677. Analysts Nos. 3, 6, 7, 12 and 14 all used ICP-OES whilst Nos. 8, 9 and 13 used Flame Atomic Absorption Spectrometry (FAAS).

FERRIC OXIDE

Analysts Nos. 1, 3, 7, 12 and 13 all determined ferric oxide by ICP-OES; Nos. 4, 5 and 11 used XRF with a fused bead, No. 4 following BS EN ISO 12677 and Nos. 8 and 9 used FAAS.

CALCIUM OXIDE

Analyst No. 1 determined calcium oxide complexometrically with EDTA, following JIS R3101. Analysts Nos. 2, 4, 5, 11 and 15 used XRF with a fused bead, No.4 following BS EN ISO 12677. Analysts Nos. 3, 7, 9 and 12 used ICP-OES whilst Nos. 8 and 13 used FAAS.

MAGNESIUM OXIDE

Analyst No 1 determined magnesium oxide by titrating with EDTA, according to JIS R3101. Analysts Nos. 2, 4, 5, 11 and 15 all used XRF, No. 4 using BS EN ISO 12677. Nos. 3, 7, 9, 12 and 14 all used ICP-OES with Nos. 8 and 13 using FAAS.

BARIUM OXIDE

With the exception of Analyst No. 9, who used FAAS, all of the Analysts determined barium oxide by ICP-OES.

SODIUM OXIDE

Analysts Nos. 1, 8, 9, 10 and 12 determined sodium oxide by FAAS. Analysts Nos. 2, 4, 5, 11 and 15 used XRF, No. 4 after BS EN ISO 12677 and Nos. 3 and 7 used ICP-OES.

POTASSIUM OXIDE

Analysts Nos. 1, 8, 9 and 10 used FAAS to determine potassium oxide. Nos. 3, 12 and 13 used ICP-OES and Nos. 4, 5 and 11 used XRF, No. 4 using BS EN ISO 12677. Analyst No. 6 used flame emission spectrometry.

TITANIUM DIOXIDE

Apart from Analysts Nos. 4, 5 and 11, who used XRF (No.4 following using the method in BS EN ISO 12677), all the Analysts determined titanium dioxide by ICP-OES.

SULPHUR TRIOXIDE

Analysts Nos. 1, 3, 7, 12, 13 and 14 all determined sulphur trioxide using ICP-OES. Analysts Nos. 4 and 5 used XRF, No. 4 after BS EN ISO 12677 and No. 8 an acid-base titration following combustion in a stream of oxygen.

CHROMIUM OXIDE

With the exception of Analysts Nos. 5, 11 and 15, who used XRF, and No.9, who used FAAS, all of the Analysts determined chromium oxide using ICP-OES.

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CO-OPERATING ANALYSTS

1	AKIYAMA, R.,	AGC Inc., Yokohama, Japan.
2	BLUNDELL, P.,	ALS Inspection UK, Prescot.
3	CARPENTIER, J-M.,	INISMa-CRIBC, Mons, Belgium.
4	SHAW, D.,	Lucideon, Stoke-on-Trent.
5	GRIMSLEY, L.,	Malvern Panalytical, Tollerton.
6	JAMIESON, S. N, *MSc, CChem, MRSC,*	NSG European Technology Centre Ltd., Lathom.
7	UCHIYAMA, K.,	Nippon Sheet Glass Co. Ltd., Itami, Japan.
8	ATKINSON, M. J.,	Pattinson & Stead (2005) Ltd., Middlesbrough.
9	JONES, S.J., *BSc, CChem, MRSC,*	Ridsdale & Co. Ltd., Middlesbrough.
10	WALTHER-RÄUSCHER, A.,	Schott AG, Corporate Research & Technology Development, Mainz, Germany.
11	HAMAEKERS, H.,	Sibelco, Dessel, Belgium.
12	SCARPA, M.,	Stazione Sperimentale Del Vetro S.C.P.A. - The Glass Research Centre, Murano, Venezia, Italy.
13	MERCAN, P.,	Research Centre, Turkiye Sis eve Cam Fabrikalari AS, Is Kuleleri Kule, Turkey.
14, 15	ASHTON, A.,	GTS, Sheffield.

DESCRIPTION OF SAMPLE

British Chemical Standard BCS-CRM 533 is sold in the form of glass pieces, in approximately 25g units.

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 533 as defined in ISO 17034, is fully responsible for assigning the certified values and their uncertainties in accordance with ISO Guide 35.

INTENDED USE

BCS-CRM 533 is intended for the verification 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 not less than the minimum weight stated on the certificate for that element, this being the lowest sample mass used by any of the Co-operating Analysts contributing to the certified value. Users of this material should be aware that the use of a smaller sub-sample size may invalidate the certified values and the associated 95% confidence limits.

The sample should be mixed thoroughly before each use.

STABILITY

This CRM will remain stable provided the pieces of glass are stored in a cool dry atmosphere.

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 BCS-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 533 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 representative samples taken from the batch and found to be acceptable. Homogeneity 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

The analytical sample was prepared by grinding representative samples of the raw material which were then mixed and subdivided. Each analyst received a representative sample of the bulk material, and the Certified Values accurately represent the chemical composition of the BCS-CRM. The user should be aware that the results so obtained may not be directly comparable with those obtained from the glass pieces.

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
R P Meeres,
Managing Director

UKAS REFERENCE MATERIALS
4004

9 CHURCHILL WAY
CHAPELTOWN
SHEFFIELD
ENGLAND
S35 2PY
Email: info@sgt.org
Website: www.sgt.org
A VASHNEYA
President

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