

FLUXANA

CERTIFICATE OF ANALYSIS

FLX-CRM 113 Cement

Mass fraction in %	Certified value ¹⁾	Uncertainty ²⁾	Traceable to
Al ₂ O ₃	5.06	0.07	NIST 1880B
CaO	63.63	0.25	SI unit kg/kg
Cr ₂ O ₃	0.007	0.002	NIST 1880B
Fe ₂ O ₃	2.75	0.03	NIST 1880B
K ₂ O	0.619	0.025	NIST 1880B
MgO	2.49	0.06	NIST 1880B
Mn ₂ O ₃	0.233	0.020	NIST 1880B
Na ₂ O	0.092	0.027	NIST 1880B
P ₂ O ₅	0.135	0.003	NIST 1880B
SiO ₂	20.98	0.09	SI unit kg/kg
SO ₃ total	2.47	0.12	NIST 1880B
SO ₄ ²⁻ as SO ₃	2.40	0.15	SI unit kg/kg
SrO	0.064	0.019	NIST 1880B
TiO ₂	0.231	0.013	NIST 1880B
ZnO	0.030	0.002	NIST 1880B
LOI	1.53	0.08	not certified, info only
S ²⁻	0.137	0.019	not certified, info only

- 1) Certified value traceable to cement NIST 1880B or SI unit kg/kg based on original sample material.
2) Expanded uncertainty U_{CRM} calculated for a confidence interval of 95% ($k=2$) based on a combined uncertainty of characterization, homogeneity and long term stability.

The sum of all oxides is 100.31%. This includes SO₃ total and LOI and excludes SO₄²⁻ as SO₃ and S²⁻.

Bedburg-Hau, 01.06.2015

Responsible Reference Materials
Dr. Barbara Schäfer

Statistics and Report
Dr. Rainer Schramm




Description of the CRM

This reference material is an industrial product and was taken directly from the production stream. The complete batch was sealed into 30g bottles. This material is normally used as cement for constructions.

Intended use

Calibration and control sample for x-ray fluorescence (XRF) analysis.

Instructions for the correct use of the CRM

This material is moisture sensitive. It can only be used without any sample pretreatment if the original seal is intact. After opening the material has to be sealed again as soon as possible to avoid any change. Otherwise it has to be ignited for minimum 1 hour at 950°C prior to use. The ignition process must result in a constant weight. The ignited material must be stored in a desiccator not longer than 24h, then reignition might be necessary. The minimum sample quantity for analysis should be 1.0g to be in agreement with the stated uncertainties.

For XRF use, ignited samples should be prepared as a fused bead, e.g. in accordance with ISO 29581-2:2010.

The following table contains the certified values $conc_{original}$ recalculated to ignited sample values $conc_{ignited}$ as obtained directly from, e.g., a fused bead by the following formula:

$$conc_{ignited} = \frac{conc_{original} * Sum}{Sum - LOI}$$

FLX-CRM 113	Certified values for ignited sample			
	mass%	conc _{ignited}	U _{CRM}	Traceable to
Al ₂ O ₃	5.14	0.07		NIST 1880B
CaO	64.61	0.25		SI unit kg/kg
Cr ₂ O ₃	0.007	0.002		NIST 1880B
Fe ₂ O ₃	2.80	0.03		NIST 1880B
K ₂ O	0.628	0.026		NIST 1880B
MgO	2.52	0.06		NIST 1880B
Mn ₂ O ₃	0.237	0.021		NIST 1880B
Na ₂ O	0.094	0.027		NIST 1880B
P ₂ O ₅	0.137	0.003		NIST 1880B
SiO ₂	21.31	0.09		SI unit kg/kg
SO ₃ total	2.51	0.13		NIST 1880B
SO ₄ ²⁻ as SO ₃				
SrO	0.065	0.019		NIST 1880B
TiO ₂	0.234	0.013		NIST 1880B
ZnO	0.030	0.002		NIST 1880B
LOI				
S ²⁻				
Sum	100.31			

Expiration of Certification

This certificate is valid, within the uncertainty specified, **until 31.05.2025**, provided the CRM is handled in accordance with instructions given in this certificate. The certification is nullified if the CRM is damaged, contaminated, or otherwise modified.

Hazardous situation

For this material an actual MSDS is available.

Level of homogeneity

In accordance with ISO Guide 35: 2006 a homogeneity study was performed. A one-way ANOVA was used to calculate the batch inhomogeneity u^2_{bb} .

$$u^2_{bb} = \frac{MS_{among} - MS_{within}}{n}$$

MS_{among}

quadratic mean of the results of homogeneity between bottle

MS_{within}

quadratic mean of the results of homogeneity within bottle

n

number of measurements per bottle

Stability

In accordance with ISO Guide 35: 2006 a stability study was performed. As a result the material was considered as stable. The uncertainty of long term stability u^2_{lts} was calculated.

Total expanded uncertainty

The total expanded uncertainty U_{CRM} for a confidence interval of 95% ($k=2$) was calculated by taking into account the uncertainty from characterization u^2_{char} , from inhomogeneity u^2_{bb} and long term stability u^2_{lts} with the following formula:

$$U_{CRM} = k \times \sqrt{u^2_{char} + u^2_{bb} + u^2_{lts}}$$

Traceability

The analytical work performed to assess this material was carried out by the FLUXANA laboratory, which works under DIN EN ISO/IEC 17025 accreditation.

All of the results derived as part of this testing program have traceability to NIST 1880B from NIST and some additionally to the SI unit kg.

Methods used

In accordance with ISO Guide 34, we use the approach "measurement by a single (primary) method in a single laboratory". An example for this approach is also found in DIN ISO 13528:2009-01 chapter 5.4. Using

this approach, samples of the test material that is to be the new reference material are prepared first. They are tested along with CRMs or synthetic RMs using a suitable method. The assigned values X_{CRM} and their uncertainties U_{CRM} are then derived from a calibration against the certified reference values of the CRMs. The error of the calibration used can be neglected because only the differences in the results between the new reference material and the CRM or synthetic RM are part of the evaluation.

CRM used: **NIST 1880B**

Synthetic RMs made from pure chemicals by weighing

Measurement method used: ISO 29581-2:2010-03

Further information

The following table lists all results obtained for this sample material. Values in bold represent the results with the smallest uncertainty; i.e., those used for the certification.

Users who need all values traceable to a NIST CRM are provided with all results in the following table. However in comparison with the values traceable to the SI unit, they show a higher uncertainty.

For comparison with the certified values, the results of an independently performed proficiency test are also given. A detailed report is available at www.fluxana.com.

FLX-CRM 113	Traceable to		Traceable to		For Comparison	
	NIST 1880B		SI unit kg/kg		results of PT	
mass%	X_{CRM}	U_{CRM}	X_{CRM}	U_{CRM}	X_{PT}	U_{PT}
Al ₂ O ₃	5.06	0.07			5.04	0.05
CaO	63.62	0.47	63.63	0.25	63.68	0.27
Cr ₂ O ₃	0.007	0.002			0.008	0.001
Fe ₂ O ₃	2.76	0.03			2.76	0.03
K ₂ O	0.619	0.025			0.586	0.028
MgO	2.49	0.06			2.45	0.03
Mn ₂ O ₃	0.233	0.020			0.22	0.02
Na ₂ O	0.092	0.027			0.106	0.031
P ₂ O ₅	0.135	0.003			0.137	0.007
SiO ₂	20.99	0.37	20.98	0.09	21.10	0.14
SO ₃ total	2.47	0.12			2.55	0.07
SO ₄ ²⁻ as SO ₃	2.40	0.15	2.40	0.15¹⁾		
SrO	0.064	0.019			0.063	0.01
TiO ₂	0.231	0.013			0.231	0.01
ZnO	0.030	0.002			0.028	0.004
LOI	1.58	0.08	1.53	0.08¹⁾	1.47	0.06
S ²⁻					0.137	0.019
Sum (w/o SO ₄ ²⁻ +S ²⁻)	100.36				100.43	

1) U_{CRM} taken from the calculations based on NIST 1880B.

This certificate is in conformance with ISO Guide 31:2000.

FLUXANA

CERTIFICATE OF ANALYSIS

FLX-CRM 114 Cement

Mass fraction in %	Certified value ¹⁾	Uncertainty ²⁾	Traceable to
Al ₂ O ₃	6.94	0.08	NIST 1881A
CaO	51.29	0.14	SI unit kg/kg
Cr ₂ O ₃	0.005	0.003	NIST 1881A
Fe ₂ O ₃	1.37	0.15	NIST 1881A
K ₂ O	0.954	0.160	NIST 1881A
MgO	4.93	0.21	NIST 1881A
Mn ₂ O ₃	0.154	0.012	NIST 1881A
Na ₂ O	0.277	0.044	NIST 1881A
P ₂ O ₅	0.027	0.008	NIST 1881A
SiO ₂	28.61	0.26	SI unit kg/kg
SO ₃ total	4.07	0.20	not certified, info only
SO ₄ ²⁻ as SO ₃	2.50	0.02	SI unit kg/kg
SrO	0.108	0.027	NIST 1881A
TiO ₂	0.525	0.011	NIST 1881A
ZnO	0.022	0.003	NIST 1881A
LOI	1.28	0.18	not certified, info only
S ²⁻	0.676	0.182	not certified, info only

- 1) Certified value traceable to cement NIST 1881A or SI unit kg/kg based on original sample material.
 2) Expanded uncertainty U_{CRM} calculated for a confidence interval of 95% (k=2) based on a combined uncertainty of characterization, homogeneity and long term stability.

The sum of all oxides is 100.55%. This includes SO₃ total and LOI and excludes SO₄²⁻ as SO₃ and S²⁻.

Bedburg-Hau, 01.06.2015

Responsible Reference Materials

Dr. Barbara Schäfer



Statistics and Report

Dr. Rainer Schramm



Description of the CRM

This reference material is an industrial product and was taken directly from the production stream. The complete batch was sealed into 30g bottles. This material is normally used as cement for constructions.

Intended use

Calibration and control sample for x-ray fluorescence (XRF) analysis.

Instructions for the correct use of the CRM

This material is moisture sensitive. It can only be used without any sample pretreatment if the original seal is intact. After opening the material has to be sealed again as soon as possible to avoid any change. Otherwise it has to be ignited for minimum 1 hour at 950°C prior to use. The ignition process must result in a constant weight. The ignited material must be stored in a desiccator not longer than 24h, then reignition might be necessary. The minimum sample quantity for analysis should be 1.0g to be in agreement with the stated uncertainties.

For XRF use, ignited samples should be prepared as a fused bead, e.g. in accordance with ISO 29581-2:2010.

The following table contains the certified values $conc_{original}$ recalculated to ignited sample values $conc_{ignited}$ as obtained directly from, e.g., a fused bead by the following formula:

$$conc_{ignited} = \frac{conc_{original} * Sum}{Sum - LOI}$$

FLX-CRM 114	Certified values for ignited sample		
	conc _{ignited}	U _{CRM}	Traceable to
Al₂O₃	7.03	0.09	NIST 1881A
CaO	51.95	0.14	SI unit kg/kg
Cr₂O₃	0.005	0.003	NIST 1881A
Fe₂O₃	1.39	0.15	NIST 1881A
K₂O	0.966	0.162	NIST 1881A
MgO	4.99	0.22	NIST 1881A
Mn₂O₃	0.156	0.012	NIST 1881A
Na₂O	0.281	0.045	NIST 1881A
P₂O₅	0.028	0.008	NIST 1881A
SiO₂	28.98	0.26	SI unit kg/kg
SO₃ total			
SO₄²⁻ as SO₃			
SrO	0.109	0.028	NIST 1881A
TiO₂	0.532	0.011	NIST 1881A
ZnO	0.023	0.003	NIST 1881A
LOI			
S²⁻			

Expiration of Certification

This certificate is valid, within the uncertainty specified, **until 31.05.2025**, provided the CRM is handled in accordance with instructions given in this certificate. The certification is nullified if the CRM is damaged, contaminated, or otherwise modified.

Hazardous situation

For this material an actual MSDS is available.

Level of homogeneity

In accordance with ISO Guide 35: 2006 a homogeneity study was performed. A one-way ANOVA was used to calculate the batch inhomogeneity u^2_{bb} .

$$u^2_{bb} = \frac{MS_{among} - MS_{within}}{n}$$

MS_{among}

quadratic mean of the results of homogeneity between bottle

MS_{within}

quadratic mean of the results of homogeneity within bottle

n

number of measurements per bottle

Stability

In accordance with ISO Guide 35: 2006 a stability study was performed. As a result the material was considered as stable. The uncertainty of long term stability u^2_{lts} was calculated.

Total expanded uncertainty

The total expanded uncertainty U_{CRM} for a confidence interval of 95% ($k=2$) was calculated by taking into account the uncertainty from characterization u^2_{char} , from inhomogeneity u^2_{bb} and long term stability u^2_{lts} with the following formula:

$$U_{CRM} = k \times \sqrt{u^2_{char} + u^2_{bb} + u^2_{lts}}$$

Traceability

The analytical work performed to assess this material was carried out by the FLUXANA laboratory, which works under DIN EN ISO/IEC 17025 accreditation.

All of the results derived as part of this testing program have traceability to NIST 1881A from NIST and some additionally to the SI unit kg.

Methods used

In accordance with ISO Guide 34, we use the approach "measurement by a single (primary) method in a single laboratory". An example for this approach is also found in DIN ISO 13528:2009-01 chapter 5.4. Using

this approach, samples of the test material that is to be the new reference material are prepared first. They are tested along with CRMs or synthetic RMs using a suitable method. The assigned values X_{CRM} and their uncertainties U_{CRM} are then derived from a calibration against the certified reference values of the CRMs. The error of the calibration used can be neglected because only the differences in the results between the new reference material and the CRM or synthetic RM are part of the evaluation.

CRM used: **NIST 1881A**

Synthetic RMs made from pure chemicals by weighing

Measurement method used: ISO 29581-2:2010-03

Further information

The following table lists all results obtained for this sample material. Values in bold represent the results with the smallest uncertainty; i.e., those used for the certification.

Users who need all values traceable to a NIST CRM are provided with all results in the following table. However in comparison with the values traceable to the SI unit, they show a higher uncertainty.

For comparison with the certified values, the results of an independently performed proficiency test are also given. A detailed report is available at www.fluxana.com.

FLX-CRM 114	Traceable to		Traceable to		For Comparison	
	NIST 1881A		SI unit kg/kg		results of PT	
mass%	X_{CRM}	U_{CRM}	X_{CRM}	U_{CRM}	X_{PT}	U_{PT}
Al ₂ O ₃	6.94	0.08			6.94	0.09
CaO	51.35	0.37	51.29	0.14	51.19	0.29
Cr ₂ O ₃	0.005	0.003			0.009	0.002
Fe ₂ O ₃	1.37	0.15			1.44	0.03
K ₂ O	0.954	0.160			0.903	0.031
MgO	4.93	0.21			4.84	0.05
Mn ₂ O ₃	0.154	0.012			0.148	0.014
Na ₂ O	0.277	0.044			0.260	0.031
P ₂ O ₅	0.027	0.008			0.024	0.004
SiO ₂	28.66	0.30	28.61	0.26	28.70	0.16
SO ₃ total					4.07	0.20
SO ₄ ²⁻ as SO ₃	2.58 ¹⁾	0.02	2.50	0.02 ³⁾		
SrO	0.108	0.027			0.102	0.013
TiO ₂	0.525	0.011			0.518	0.014
ZnO	0.022	0.003			0.022	0.005
LOI	1.38 ²⁾	0.18	1.28	0.18 ³⁾	1.02	0.06
S ²⁻					0.676	0.182
Sum (w/o SO ₄ ²⁻ +S ²⁻)					100.18	

1) Traceable to NIST 1880B. 2) Traceable to NIST 1888B.

3) U_{CRM} taken from calculations based on NIST CRM.

This certificate is in conformance with ISO Guide 31:2000.

FLUXANA

CERTIFICATE OF ANALYSIS

FLX-CRM 115 Cement

Mass fraction in %	Certified value ¹⁾	Uncertainty ²⁾	Traceable to
Al ₂ O ₃	8.13	0.08	NIST 1881A
CaO	53.93	0.22	SI unit kg/kg
Cr ₂ O ₃	0.004	0.004	NIST 1881A
Fe ₂ O ₃	0.972	0.143	NIST 1881A
K ₂ O	0.612	0.087	NIST 1881A
MgO	2.93	0.12	NIST 1881A
Mn ₂ O ₃	0.214	0.035	NIST 1881A
Na ₂ O	0.194	0.050	NIST 1881A
P ₂ O ₅	0.073	0.006	NIST 1881A
SiO ₂	27.29	0.06	SI unit kg/kg
SO ₃ total	3.90	0.26	not certified, info only
SO ₄ ²⁻ as SO ₃	2.41	0.02	SI unit kg/kg
SrO	0.117	0.014	NIST 1881A
TiO ₂	0.610	0.018	NIST 1881A
ZnO	0.008	0.004	NIST 1881A
LOI	1.56	0.08	not certified, info only
S ²⁻	0.611	0.340	not certified, info only

1) Certified value traceable to cement NIST 1881A or SI unit kg/kg based on original sample material.

2) Expanded uncertainty U_{CRM} calculated for a confidence interval of 95% ($k=2$) based on a combined uncertainty of characterization, homogeneity and long term stability.

The sum of all oxides is 100.55%. This includes SO₃ total and LOI and excludes SO₄²⁻ as SO₃ and S²⁻.

Bedburg-Hau, 01.06.2015

Responsible Reference Materials

Dr. Barbara Schäfer



Statistics and Report

Dr. Rainer Schramm



Description of the CRM

This reference material is an industrial product and was taken directly from the production stream. The complete batch was sealed into 30g bottles. This material is normally used as cement for constructions.

Intended use

Calibration and control sample for x-ray fluorescence (XRF) analysis.

Instructions for the correct use of the CRM

This material is moisture sensitive. It can only be used without any sample pretreatment if the original seal is intact. After opening the material has to be sealed again as soon as possible to avoid any change. Otherwise it has to be ignited for minimum 1 hour at 950°C prior to use. The ignition process must result in a constant weight. The ignited material must be stored in a desiccator not longer than 24h, then reignition might be necessary. The minimum sample quantity for analysis should be 1.0g to be in agreement with the stated uncertainties.

For XRF use, ignited samples should be prepared as a fused bead, e.g. in accordance with ISO 29581-2:2010.

The following table contains the certified values $conc_{original}$ recalculated to ignited sample values $conc_{ignited}$ as obtained directly from, e.g., a fused bead by the following formula:

$$conc_{ignited} = \frac{conc_{original} * Sum}{Sum - LOI}$$

FLX-CRM 115	Certified values for ignited sample		
	conc _{ignited}	U _{CRM}	Traceable to
Al ₂ O ₃	8.26	0.08	NIST 1881A
CaO	54.79	0.23	SI unit kg/kg
Cr ₂ O ₃	0.004	0.004	NIST 1881A
Fe ₂ O ₃	0.987	0.145	NIST 1881A
K ₂ O	0.622	0.088	NIST 1881A
MgO	2.98	0.13	NIST 1881A
Mn ₂ O ₃	0.217	0.035	NIST 1881A
Na ₂ O	0.197	0.051	NIST 1881A
P ₂ O ₅	0.074	0.007	NIST 1881A
SiO ₂	27.72	0.06	SI unit kg/kg
SO ₃ total			
SO ₄ ²⁻ as SO ₃			
SrO	0.119	0.014	NIST 1881A
TiO ₂	0.620	0.018	NIST 1881A
ZnO	0.008	0.004	NIST 1881A
LOI			
S ²⁻			

Expiration of Certification

This certificate is valid, within the uncertainty specified, **until 31.05.2025**, provided the CRM is handled in accordance with instructions given in this certificate. The certification is nullified if the CRM is damaged, contaminated, or otherwise modified.

Hazardous situation

For this material an actual MSDS is available.

Level of homogeneity

In accordance with ISO Guide 35: 2006 a homogeneity study was performed. A one-way ANOVA was used to calculate the batch inhomogeneity u^2_{bb} .

$$u^2_{bb} = \frac{MS_{among} - MS_{within}}{n}$$

MS_{among}

quadratic mean of the results of homogeneity between bottle

MS_{within}

quadratic mean of the results of homogeneity within bottle

n

number of measurements per bottle

Stability

In accordance with ISO Guide 35: 2006 a stability study was performed. As a result the material was considered as stable. The uncertainty of long term stability u^2_{lts} was calculated.

Total expanded uncertainty

The total expanded uncertainty U_{CRM} for a confidence interval of 95% ($k=2$) was calculated by taking into account the uncertainty from characterization u^2_{char} , from inhomogeneity u^2_{bb} and long term stability u^2_{lts} with the following formula:

$$U_{CRM} = k \times \sqrt{u^2_{char} + u^2_{bb} + u^2_{lts}}$$

Traceability

The analytical work performed to assess this material was carried out by the FLUXANA laboratory, which works under DIN EN ISO/IEC 17025 accreditation.

All of the results derived as part of this testing program have traceability to NIST 1881A from NIST and some additionally to the SI unit kg.

Methods used

In accordance with ISO Guide 34, we use the approach "measurement by a single (primary) method in a single laboratory". An example for this approach is also found in DIN ISO 13528:2009-01 chapter 5.4. Using

FLUXANA® GmbH & Co. KG, Borschelstr. 3, D-47551 Bedburg-Hau, Germany

Your supplier for XRF Application Solutions

this approach, samples of the test material that is to be the new reference material are prepared first. They are tested along with CRMs or synthetic RMs using a suitable method. The assigned values X_{CRM} and their uncertainties U_{CRM} are then derived from a calibration against the certified reference values of the CRMs. The error of the calibration used can be neglected because only the differences in the results between the new reference material and the CRM or synthetic RM are part of the evaluation.

CRM used: **NIST 1881A**

Synthetic RMs made from pure chemicals by weighing

Measurement method used: ISO 29581-2:2010-03

Further information

The following table lists all results obtained for this sample material. Values in bold represent the results with the smallest uncertainty; i.e., those used for the certification.

Users who need all values traceable to a NIST CRM are provided with all results in the following table. However in comparison with the values traceable to the SI unit, they show a higher uncertainty.

For comparison with the certified values, the results of an independently performed proficiency test are also given. A detailed report is available at www.fluxana.com.

FLX-CRM 115	Traceable to		Traceable to		For Comparison	
	NIST 1881A		SI unit kg/kg		results of PT	
mass%	X_{CRM}	U_{CRM}	X_{CRM}	U_{CRM}	X_{PT}	U_{PT}
Al ₂ O ₃	8.13	0.08			8.12	0.08
CaO	54.05	0.41	53.93	0.22	53.78	0.28
Cr ₂ O ₃	0.004	0.004			0.008	0.003
Fe ₂ O ₃	0.972	0.143			1.06	0.02
K ₂ O	0.612	0.087			0.594	0.028
MgO	2.93	0.12			2.87	0.04
Mn ₂ O ₃	0.214	0.035			0.200	0.021
Na ₂ O	0.194	0.050			0.179	0.027
P ₂ O ₅	0.073	0.006			0.071	0.007
SiO ₂	27.39	0.16	27.29	0.06	27.32	0.19
SO ₃ total					3.90	0.26
SO ₄ ²⁻ as SO ₃	2.49 ¹⁾	0.02	2.41	0.02³⁾		
SrO	0.117	0.014			0.11	0.013
TiO ₂	0.610	0.018			0.597	0.016
ZnO	0.008	0.004			0.01	0.002
LOI	1.67 ²⁾	0.08	1.56	0.08³⁾	1.32	0.06
S ²⁻					0.611	0.340
Sum (w/o SO ₄ ²⁻ +S ²⁻)					100.13	

1) Traceable to NIST 1880B. 2) Traceable to NIST 1888B.

3) U_{CRM} taken from calculations based on NIST CRM.

This certificate is in conformance with ISO Guide 31:2000.

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FLX-CRM 116 Cement

Mass fraction in %	Certified value ¹⁾	Uncertainty ²⁾	Traceable to
Al ₂ O ₃	9.11	0.13	NIST 1881A
CaO	50.05	0.08	SI unit kg/kg
Cr ₂ O ₃	0.005	0.002	NIST 1881A
Fe ₂ O ₃	0.86	0.12	NIST 1881A
K ₂ O	0.693	0.129	NIST 1881A
MgO	4.47	0.20	NIST 1881A
Mn ₂ O ₃	0.238	0.035	NIST 1881A
Na ₂ O	0.201	0.049	NIST 1881A
P ₂ O ₅	0.034	0.007	NIST 1881A
SiO ₂	30.81	0.20	SI unit kg/kg
SO ₃ total	3.14	0.24	not certified, info only
SO ₄ ²⁻ as SO ₃	1.22	0.02	SI unit kg/kg
SrO	0.091	0.036	NIST 1881A
TiO ₂	0.690	0.011	NIST 1881A
ZnO	0.015	0.004	NIST 1881A
LOI	-0.394	0.315	not certified, info only
S ²⁻	0.737	0.249	not certified, info only

1) Certified value traceable to cement NIST 1881A or SI unit kg/kg based on original sample material.

2) Expanded uncertainty U_{CRM} calculated for a confidence interval of 95% ($k=2$) based on a combined uncertainty of characterization, homogeneity and long term stability.

The sum of all oxides is 100.02%. This includes SO₃ total and LOI and excludes SO₄²⁻ as SO₃ and S²⁻.

Bedburg-Hau, 01.06.2015

Responsible Reference Materials

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Statistics and Report

Dr. Rainer Schramm



Description of the CRM

This reference material is an industrial product and was taken directly from the production stream. The complete batch was sealed into 30g bottles. This material is normally used as cement for constructions.

Intended use

Calibration and control sample for x-ray fluorescence (XRF) analysis.

Instructions for the correct use of the CRM

This material is moisture sensitive. It can only be used without any sample pretreatment if the original seal is intact. After opening the material has to be sealed again as soon as possible to avoid any change. Otherwise it has to be ignited for minimum 1 hour at 950°C prior to use. The ignition process must result in a constant weight. The ignited material must be stored in a desiccator not longer than 24h, then reignition might be necessary. The minimum sample quantity for analysis should be 1.0g to be in agreement with the stated uncertainties.

For XRF use, ignited samples should be prepared as a fused bead, e.g. in accordance with ISO 29581-2:2010.

The following table contains the certified values $conc_{original}$ recalculated to ignited sample values $conc_{ignited}$ as obtained directly from, e.g., a fused bead by the following formula:

$$conc_{ignited} = \frac{conc_{original} * Sum}{Sum - LOI}$$

FLX-CRM 116	Certified values for ignited sample			
	mass%	$conc_{ignited}$	U_{CRM}	Traceable to
Al₂O₃	9.08	0.13		NIST 1881A
CaO	49.85	0.08		SI unit kg/kg
Cr₂O₃	0.005	0.002		NIST 1881A
Fe₂O₃	0.860	0.123		NIST 1881A
K₂O	0.690	0.129		NIST 1881A
MgO	4.45	0.20		NIST 1881A
Mn₂O₃	0.237	0.035		NIST 1881A
Na₂O	0.200	0.049		NIST 1881A
P₂O₅	0.034	0.007		NIST 1881A
SiO₂	30.69	0.20		SI unit kg/kg
SO₃ total				
SO₄²⁻ as SO₃				
SrO	0.091	0.036		NIST 1881A
TiO₂	0.687	0.011		NIST 1881A
ZnO	0.015	0.004		NIST 1881A
LOI				
S²⁻				

Expiration of Certification

This certificate is valid, within the uncertainty specified, **until 31.05.2025**, provided the CRM is handled in accordance with instructions given in this certificate. The certification is nullified if the CRM is damaged, contaminated, or otherwise modified.

Hazardous situation

For this material an actual MSDS is available.

Level of homogeneity

In accordance with ISO Guide 35: 2006 a homogeneity study was performed. A one-way ANOVA was used to calculate the batch inhomogeneity u^2_{bb} .

$$u^2_{bb} = \frac{MS_{among} - MS_{within}}{n}$$

MS_{among}

quadratic mean of the results of homogeneity between bottle

MS_{within}

quadratic mean of the results of homogeneity within bottle

n

number of measurements per bottle

Stability

In accordance with ISO Guide 35: 2006 a stability study was performed. As a result the material was considered as stable. The uncertainty of long term stability u^2_{lts} was calculated.

Total expanded uncertainty

The total expanded uncertainty U_{CRM} for a confidence interval of 95% ($k=2$) was calculated by taking into account the uncertainty from characterization u^2_{char} , from inhomogeneity u^2_{bb} and long term stability u^2_{lts} with the following formula:

$$U_{CRM} = k \times \sqrt{u^2_{char} + u^2_{bb} + u^2_{lts}}$$

Traceability

The analytical work performed to assess this material was carried out by the FLUXANA laboratory, which works under DIN EN ISO/IEC 17025 accreditation.

All of the results derived as part of this testing program have traceability to NIST 1881A from NIST and some additionally to the SI unit kg.

Methods used

In accordance with ISO Guide 34, we use the approach "measurement by a single (primary) method in a single laboratory". An example for this approach is also found in DIN ISO 13528:2009-01 chapter 5.4. Using

this approach, samples of the test material that is to be the new reference material are prepared first. They are tested along with CRMs or synthetic RMs using a suitable method. The assigned values X_{CRM} and their uncertainties U_{CRM} are then derived from a calibration against the certified reference values of the CRMs. The error of the calibration used can be neglected because only the differences in the results between the new reference material and the CRM or synthetic RM are part of the evaluation.

CRM used: **NIST 1881A**

Synthetic RMs made from pure chemicals by weighing

Measurement method used: ISO 29581-2:2010-03

Further information

The following table lists all results obtained for this sample material. Values in bold represent the results with the smallest uncertainty; i.e., those used for the certification.

Users who need all values traceable to a NIST CRM are provided with all results in the following table. However in comparison with the values traceable to the SI unit, they show a higher uncertainty.

For comparison with the certified values, the results of an independently performed proficiency test are also given. A detailed report is available at www.fluxana.com.

FLX-CRM 116	Traceable to		Traceable to		For Comparison	
	NIST 1881A		SI unit kg/kg		results of PT	
mass%	X_{CRM}	U_{CRM}	X_{CRM}	U_{CRM}	X_{PT}	U_{PT}
Al ₂ O ₃	9.11	0.13			9.06	0.10
CaO	50.05	0.35	50.05	0.08	49.86	0.32
Cr ₂ O ₃	0.005	0.002			0.007	0.003
Fe ₂ O ₃	0.864	0.123			0.966	0.023
K ₂ O	0.693	0.129			0.662	0.028
MgO	4.47	0.20			4.40	0.05
Mn ₂ O ₃	0.238	0.035			0.221	0.023
Na ₂ O	0.201	0.049			0.208	0.036
P ₂ O ₅	0.034	0.007			0.029	0.004
SiO ₂	30.88	0.25	30.81	0.20	30.71	0.18
SO ₃ total					3.14	0.24
SO ₄ ²⁻ as SO ₃	1.30 ¹⁾	0.020	1.22	0.02 ³⁾		
SrO	0.091	0.036			0.081	0.012
TiO ₂	0.690	0.011			0.683	0.018
ZnO	0.015	0.004			0.016	0.003
LOI	-0.337 ²⁾	0.455	-0.394	0.315 ³⁾	-0.164	0.175
S ²⁻					0.737	0.249
Sum (w/o SO ₄ ²⁻ +S ²⁻)					99.89	

1) Traceable to NIST 1880B. 2) Traceable to NIST 1888B.

3) U_{CRM} taken from calculations based on NIST CRM.

This certificate is in conformance with ISO Guide 31:2000.

FLUXANA

CERTIFICATE OF ANALYSIS

FLX-CRM 117 Cement

Mass fraction in %	Certified value ¹⁾	Uncertainty ²⁾	Traceable to
Al ₂ O ₃	7.68	0.09	NIST 1881A
CaO	54.22	0.11	SI unit kg/kg
Cr ₂ O ₃	0.004	0.005	NIST 1881A
Fe ₂ O ₃	1.37	0.16	NIST 1881A
K ₂ O	0.916	0.113	NIST 1881A
MgO	2.95	0.17	NIST 1881A
Mn ₂ O ₃	0.193	0.031	NIST 1881A
Na ₂ O	0.223	0.046	NIST 1881A
P ₂ O ₅	0.035	0.010	NIST 1881A
SiO ₂	28.05	0.09	SI unit kg/kg
SO ₃ total	3.49	0.14	not certified, info only
SO ₄ ²⁻ as SO ₃	1.80	0.03	SI unit kg/kg
SrO	0.098	0.018	NIST 1881A
TiO ₂	0.564	0.012	NIST 1881A
ZnO	0.024	0.003	NIST 1881A
LOI	0.402	0.251	not certified, info only
S ²⁻	0.602	0.395	not certified, info only

1) Certified value traceable to cement NIST 1881A or SI unit kg/kg based on original sample material.

2) Expanded uncertainty U_{CRM} calculated for a confidence interval of 95% ($k=2$) based on a combined uncertainty of characterization, homogeneity and long term stability.

The sum of all oxides is 100.23%. This includes SO₃ total and LOI and excludes SO₄²⁻ as SO₃ and S²⁻.

Bedburg-Hau, 01.06.2015

Responsible Reference Materials

Dr. Barbara Schäfer



Statistics and Report

Dr. Rainer Schramm



Description of the CRM

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Intended use

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The following table contains the certified values $conc_{original}$ recalculated to ignited sample values $conc_{ignited}$ as obtained directly from, e.g., a fused bead by the following formula:

$$conc_{ignited} = \frac{conc_{original} * Sum}{Sum - LOI}$$

FLX-CRM 117	Certified values for ignited sample		
	CONC _{ignited}	U _{CRM}	Traceable to
Al ₂ O ₃	7.72	0.09	NIST 1881A
CaO	54.44	0.11	SI unit kg/kg
Cr ₂ O ₃	0.004	0.005	NIST 1881A
Fe ₂ O ₃	1.37	0.16	NIST 1881A
K ₂ O	0.920	0.113	NIST 1881A
MgO	2.96	0.17	NIST 1881A
Mn ₂ O ₃	0.194	0.031	NIST 1881A
Na ₂ O	0.224	0.046	NIST 1881A
P ₂ O ₅	0.035	0.010	NIST 1881A
SiO ₂	28.16	0.09	SI unit kg/kg
SO ₃ total			
SO ₄ ²⁻ as SO ₃			
SrO	0.099	0.018	NIST 1881A
TiO ₂	0.567	0.012	NIST 1881A
ZnO	0.024	0.003	NIST 1881A
LOI			
S ²⁻			

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$$u^2_{bb} = \frac{MS_{among} - MS_{within}}{n}$$

MS_{among}

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quadratic mean of the results of homogeneity within bottle

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number of measurements per bottle

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In accordance with ISO Guide 35: 2006 a stability study was performed. As a result the material was considered as stable. The uncertainty of long term stability u^2_{lts} was calculated.

Total expanded uncertainty

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$$U_{CRM} = k \times \sqrt{u^2_{char} + u^2_{bb} + u^2_{lts}}$$

Traceability

The analytical work performed to assess this material was carried out by the FLUXANA laboratory, which works under DIN EN ISO/IEC 17025 accreditation.

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CRM used: **NIST 1881A**

Synthetic RMs made from pure chemicals by weighing

Measurement method used: ISO 29581-2:2010-03

Further information

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FLX-CRM 117	Traceable to		Traceable to		For Comparison	
	NIST 1881A		SI unit kg/kg		results of PT	
mass%	X_{CRM}	U_{CRM}	X_{CRM}	U_{CRM}	X_{PT}	U_{PT}
Al ₂ O ₃	7.68	0.09			7.68	0.10
CaO	54.34	0.36	54.22	0.11	54.26	0.30
Cr ₂ O ₃	0.004	0.005			0.007	0.003
Fe ₂ O ₃	1.37	0.16			1.46	0.02
K ₂ O	0.916	0.113			0.871	0.038
MgO	2.95	0.17			2.88	0.05
Mn ₂ O ₃	0.193	0.031			0.181	0.017
Na ₂ O	0.223	0.046			0.205	0.025
P ₂ O ₅	0.035	0.010			0.030	0.005
SiO ₂	28.14	0.17	28.05	0.09	28.12	0.15
SO ₃ total					3.49	0.14
SO ₄ ²⁻ as SO ₃	1.87 ¹⁾	0.03	1.80³⁾	0.03		
SrO	0.098	0.018			0.092	0.013
TiO ₂	0.564	0.012			0.556	0.016
ZnO	0.024	0.003			0.023	0.004
LOI	0.402 ²⁾	0.251	0.345³⁾	0.251	0.215	0.097
S ²⁻					0.602	0.395
Sum (w/o SO ₄ ²⁻ +S ²⁻)					100.08	

1) Traceable to NIST 1880B. 2) Traceable to NIST 1888B.

3) U_{CRM} taken from calculations based on NIST CRM.

This certificate is in conformance with ISO Guide 31:2000.