Slovenský metrologický ústav
Karloveská 63, 842 55 Bratislava 4

CATALOGUE

OF CERTIFIED REFERENCE MATERIALS

CONTENT

Slovak Institute of Metrology (SMU) is the leading professional body of the state metrology system.
It has responsibility for the realisation, preservation and improving of standards and standard equipment and their international comparison to assure uniformity and accuracy of the measurement accomplished in the Slovak Republic and its international compatibility.
The mission of SMU as a main professional body in the area of the chemical metrology is providing metrology services in this area, preparation and co-ordination of certified reference materials (CRM) production.
The need for CRMs is increasing with introduction of certification and accreditation systems (e.g. according to ISO 9001 and ISO 17025 standards) and ISO/IEC recommendations to calibration and testing laboratories. For these laboratories, it is necessary to have official measurement methods and measurements including CRM traceable to national standards.

DEVELOPMENT, PREPARATION AND DISTRIBUTION OF CRM

In the process of CRM development the homogeneity and stability are evaluated according to ISO Guide 34 and ISO 17034, resp. The uncertainty of each CRM value includes stability contribution for a declared expiration time.

National standards which are used in certification measurements of CRMs:

National standard of mole fraction in gaseous phase

is based on the preparation of gas mixture of defined composition by weighing pure substances and validation of these mixtures according to ISO 6142 and ISO 6143. It serves for providing traceability of gas mixtures measurement, certification of gas mixtures as well as for metrology assurance of exhaust gases and natural gas measurements.

National standard of spectral transmittance

is based on absolute measurement of spectral transmittance and absorbance of optically permeable substances in the spectral range (180 – 800) nm. The standard provides metrology assurance for measurements of spectral transmittance and derived quantities.

National standard of refractive index

consists of the spectrogoniometer and standard prisms. It serves for spectrogoniometric measurement of the refractive index in visible range. Transfer of the refractive index scale is realised via certified reference materials or via a set of standard prisms calibrated on the national standard.

National standard of electrolytic conductivity

is based on the absolute measurement of conductivity in an electrolytic cell with calculable value of the cell constant.

National standard of pH

is based on the primary pH measurement using Harned cell, consisting of hydrogen and Ag/AgCl electrodes. The pH values are further transferred by primary certified reference materials.

National standard of amount of substance

works on the principle of equivalence of the electric charge and amount of substance described by Faraday’s law. It serves for the realisation of unit of amount of substance and its transfer by primary certified reference materials.

National standard of viscosity

consists of four sets of Ubbelohde capillary viscometers (two of 500 mm length and two of 400 mm length respectively) installed in a temperature controlled bath

National standard of density

consists of a set of quartz immersion bodies that have their volume determined by hydrostatic weighing method, performed on high precision primary balances and by means of weight standards at a defined temperature.

DEFINITIONS

Reference material (RM):
material, sufficiently homogeneous and stable with reference to specified properties, which has been established to be fit for its intended use in measurement or in examination of nominal properties.

Certified reference material (CRM):
reference material, accompanied by documentation issued by an authoritative body and providing one or more specified property values with associated uncertainties and traceabilities, using valid procedures.

Primary reference material (PRM):
reference material established using a primary reference measurement procedure.

Secondary reference material:
reference material established through calibration with respect to a primary reference material for a quantity of the same kind.

Expiry date:
A date, stated by the manufacturer and confirmed by the certifying authority, supplied together with a reference material, indicating the end of the period of validity of use of the material for reference purposes when it is stored under specified conditions.

Uncertainty of measurement:
non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used.
Unless otherwise stated, all uncertainties given in this catalogue are expanded uncertainties with coverage factor k=2.

Metrological traceability:
property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty.

Calibration:
operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication.

Measurement standard:
realization of the definition of a given quantity, with stated quantity value and associated measurement uncertainty, used as a reference.

Certified value:
value, assigned to a property of a reference material, that is accompanied by an uncertainty statement and a statement of metrological traceability, identified as such in the RM certificate.

JCGM 200:2012 International vocabulary of metrology – Basic and general concepts and associated terms (VIM), 3rd edition
ISO Guide 35:2017 Reference materials - Guidance for characterization and assessment of homogeneity and stability

SYMBOLS

U – expanded uncertainty - quantity defining an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand

u_C – combined standard uncertainty

w – mass fraction

υ – kinematic viscosity

η – dynamic viscosity

n^{20}_D – refractive index at 20°C and wavelength 589.29 nm

EXPIRY DATE

The stability of values represented by any reference material is always limited. Expiration dates are listed in the CRM certificates. Expiration dates are calculated from the certification dates. Current expiry dates of CRMs are given in price offers from SMU. Many CRMs are prepared in larger batches, in order to be always in stock. A new batch of RMs is usually prepared before the expiration date of the previous batch. A special batch can be prepared on request so that full validity period is available; price for such a batch will be calculated individually.

Type	Code	Validity period from certification (years)
Primary CRM of composition	A01, A04, A07	5
Primary CRM of composition	A02, A03, A05	10
Single element solutions	B01 to B37	2
Anion solutions	B50 to B54	2
PRM of gases	D01 to D23	2
Primary CRM of pH	E10 to E14	3
Secondary CRM of pH	E20, E21, E22, E25 E30, E31, E32, E35	2
Secondary CRM of pH	E23, E24 E33, E34	1
Electrolytic conductivity	F03 to F10 F31, F32	0.5
Electrolytic conductivity	F21 to F30, F33	1
Viscosity	G01 to G12	2
Refractive index	H01 to H07	2
CRM for UV-VIS spectrometry	J01, J01a, J03, J04	5
CRM for UV-VIS spectrometry	J02, J02a	6
Carbon steels	M01 to M03	10
Blast furnace slags	M11 to M21	15
Density	T02	1
Density	T05	2

ORDERING

Purchase orders for all CRM from our catalogue should be sent to:

Slovak Institute of Metrology
Metrology services
Karloveská 63
SK-842 55 Bratislava 4
Slovak Republic

Contacts: www.smu.sk
cenoveponuky@smu.gov.sk (requests for price proposals)
objednavky@smu.gov.sk (orders)
Tel.: +421 2 602 94 521

When placing an order please state on the order:

1. brief description of RM
2. catalogue code
3. quantity required
4. price

Warranty:

SMU warrants declared values presented in the certificates of our CRM during their validity. If a material proves to be defective, SMU must be notified within 30 days from receipt of the material and the SMU will replace this CRM or refund its price.

Toxicity and Hazards:

Due to hazardous nature of some products, they should be handled by trained personnel only and some restrictions on the delivery mode may apply.

Delivery:

CRMs will be shipped after processing the order (see also General terms and conditions). For CRMs prepared individually the delivery date will be agreed with the customer. CRM shipment's cost is paid by the customer. Subject, size, weight, and category of material limitation of shipment may apply.

CRM FOR CALIBRATION PURPOSES

Inorganic analysis

A01 to A07 - Content of the major component

Primary CRMs provide direct traceability of the chemical measurement to the SI. Their amount of substance content is certified by precision coulometric titration on the SMU standard equipment.
These CRMs are used for determination of amount content (or mass fraction) of working RMs („standard substances“). They can be used directly for either determination of concentration of volumetric solutions or their preparation, if low uncertainty is essential.
Certified value is the amount content, values recalculated to purity are given here for easy comparison.

Code	CRM	Approx. purity (%)	U (k=2) (%)	Mass (g)
A01	**Amidosulphuric acid**	99.98	0.012	20
A02	**Potassium hydrogen phthalate**	99.91	0.008	25
A03	**Arsenic(III) oxide**	99.98	0.008	20
A04	**Potassium dichromate**	99.99	0.007	25
A05	**Potassium chloride**	99.99	0.013	20
A07	**TRIS**	99.91	0.027	20
A08	**Potassium iodate**	100,00	0,019	20

B01 to B37 – Single element solutions

Single element CRMs are intended for calibration purposes in measurements using instrumental techniques - AES, AAS, AFS or other analytical method. Their mass concentration is determined by refined high-accuracy titration methods and the values are traceable to SMU primary reference materials or directly to SMU standard for amount of substance. Nominal mass concentration of single element solutions is 1 $g \cdot L^{-1}$.

Code	Element	Nominal U (k=2) ($g \cdot L^{-1}$)	Matrix
B01	**Ag**	0.002	2 % HNO_3
B02	**Al**	0.002	2 % HCl
B03	**As**	0.003	4 % HNO_3
B04	**B**	0.002	H_2O
B05	**Ba**	0.002	2 % HNO_3
B06	**Bi**	0.002	10 % HNO_3
B07	**Ca**	0.002	0.5 % HNO_3
B08	**Cd**	0.002	2 % HNO_3
B09	**Co**	0.002	2 % HNO_3
B10	**Cr**	0.002	2 % HCl
B12	**Cu**	0.002	2 % HNO_3
B13	**Fe**	0.002	5 % HNO_3
B15	**Hg**	0.003	5 % HNO_3
B18	**K**	0.002	H_2O
B20	**Mg**	0.002	0.5 % HNO_3
B21	**Mn**	0.002	2 % HNO_3
B23	**Na**	0.002	H_2O
B24	**Ni**	0.002	2 % HNO3
B25	**P**	0.003	H2O
B26	**Pb**	0.002	2 % HNO3
B31	**Sn**	0.003	20 % HCl
B32	**Sr**	0.002	2 % HNO3
B35	**Tl**	0.003	2 % HNO3
B36	**V**	0.003	5 % HNO3
B37	**Zn**	0.002	2 % HNO3

Volume: 100 mL

B50 to B54 – Anion solutions

Anion CRMs are intended for calibration purposes in measurements using instrumental techniques - IC, electrophoresis, ion-selective electrode measurement or other analytical methods. Their mass concentration is determined by refined high-accuracy titration methods and the values are traceable to SMU primary reference materials or directly to SMU standard for amount of substance.

CRM code	Anion	Nominal mass concentration ($g \cdot L^{-1}$)	U (k=2) ($g.L^{-1}$)
B50	**Cl^-**	1.000	0.002
B51	**PO_4^{3-}**	1.000	0.003
B52	**SO_4^{2-}**	1.000	0.002
B53	**NO_3^-**	1.000	0.002
B54*	**NO_2^-**	1.000	0.0023

Volume: 250 mL
*100 mL

Mole fraction in gaseous phase

D01 to D23 – PRMs of selected gas mixtures

Certified reference materials of gas mixtures are prepared on the Slovak primary standard equipment for gas mixtures, keeping the newest ISO standards: ISO 6143 (2001) Gas analysis – Determination of the composition of calibration gas mixtures – Comparison methods and ISO 6142-1 (2015) Gas analysis – Preparation of calibration gas mixtures Part 1: Gravimetric method for Class I mixtures implemented at SMU working procedures. Each PRM undergoes validation process in analytical comparison against maintained appropriate set of Primary Standard Mixtures at SMU.

Code	PRM of gas mixture	Component	Mole fraction range (mol/mol)	U_{rel} (k=2) (%)
D01, D11	**CO, CO_2, propane in N_2**	**CO_2**	0.06 - 0.14	0.35 - 0.20
		CO	0.005 - 0.035	0.40 - 0.25
		propane	0.0001 - 0.002	0.80 - 0.40
D02, D12	**CO_2 in N_2**		0.0008 - 0.20	0.30 - 0.20
D03, D13	**CO in N_2**		0.00001 - 0.20	1.0 - 0.20
D04, D14	**propane in N_2**		0.0001 - 0.01	0.50 - 0.20
D05, D15	**ethanol in N_2**		0.000075 - 0.0008	1,0 - 0.70
D06, D16	**natural gas**	**Methane**	0.70 - 0.98	0.20
		Ethane	0.005 - 0.10	0.5 - 0.3
		Propane	0.001 - 0.020	0.5 - 0.4
		n-butane	0.0005 - 0.010	0.6 - 0.4
		iso-butane	0.0005 - 0.010	0.6 - 0.4
		n-pentane	0.0002 - 0.002	0.8 - 0.5
		iso-pentane	0.0002 - 0.002	0.8 - 0.5
		neopentane	0.0002 – 0.002	3.4
		n-hexane	0.0001 - 0.001	0.8 - 0.50
		CO_2	0.005 - 0.05	0.5 - 0.4
		N_2	0.005 - 0.10	0.5 - 0.3
D21	**SO_2 v N_2**		0.00001 – 0.0001	1.5-1.0
D22	**NO v N_2**		0.00001 – 0.0001	1.5-1.0
D23	**NO_2 in Air**		0.00001 – 0.0001	2.5-2,0
D20	**stack gases**	**CO_2**	0,05-0,20	0,2-0,2
		CO	0,00001-0,00100	0,7-0,4
		Propane	0,000001-0,00010	1,0-1,0
		NO	0,00001-0,00100	1,5-1,0
		SO_2	0,00001-0,00100	1,5-1,0

D90, D113	**biogas**	**Methane**	0,35-0,95	0,15-0,15
		Ethane	0,00002-0,00500	0,84-0,84
		Propane	0,00002-0,00500	0,80-0,80
		CO_2	0,04-0,45	0,33-0,33
		N_2	0,04-0,25	0,16-0,16
		H_2	0,002-0,030	1,64-1,64
		O_2	0,002-0,015	0,86-0,86

Packing: Filling to the own aluminium cylinders with inner volume 5 dm^3 at 10 MPa. Natural gas is delivered at only 5 MPa. SMU provides for all these PRMs 2 years warranty.

On request, other mole fractions or mixtures with other components can be prepared.

Aluminium cylinders with inner volume 5 dm^3

CRMs of PHYSICOCHEMICAL PROPERTIES

pH

The buffers are intended for the calibration of pH instruments and for calibration of working buffers.

E10 to E14 – Primary buffers

The value of the primary buffers is determined by primary measurement in Harned cells using hydrogen and Ag/AgCl electrodes on the National standard of pH.

Code	Type	Nominal pH at 25˚C	U (k=2)
E10	**Tetraoxalate**	1.68	0.005
E11	**Oxalate**	4.00	0.005
E12	**Phosphate**	7.00	0.005
E13	**Borate**	9.18	0.005
E14	**Carbonate**	10.00	0.005

Volume: 5 × 20 mL

E20 to E25 – Secondary buffers

The value of secondary buffers is traceable to primary buffers.

Code	Type	Nominal pH at 25°C	U (k=2)
E20	**Tetraoxalate**	1.68	0.02
E21	**Oxalate**	4.00	0.02
E22	**Phosphate**	7.00	0.02
E23*	**Borate**	9.18	0.02
E24*	**Carbonate**	10.00	0.02
E25*	**Succinate**	5.00	0.02

Volume: 150 mL
*125 mL

E30 to E35 – Secondary buffers

Code	Type	Nominal pH at 25°C	U (k=2)
E30	**Tetraoxalate**	1.68	0.02
E31	**Oxalate**	4.00	0.02
E32	**Phosphate**	7.00	0.02
E33	**Borate**	9.18	0.02
E34	**Carbonate**	10.00	0.02
E35	**Succinate**	5.00	0.02

Volume: 500 mL

Electrolytic conductivity

CRM are designed for the traceability of working RMs of the conductivity or the calibration of working conductivity meters. The CRMs consist of KCl or HCl aqueous solutions.

F03 to F10 and F21 to F33 – CRMs of the electrolytic conductivity

The value of the electrolytic conductivity of solutions is measured on the National standard of electrolytic conductivity.

Code	Nominal electrolytic conductivity		U (k=2)	Base component	Temperature coefficient
	($S \cdot m^{-1}$)	($\mu S \cdot cm^{-1}$)	($S \cdot m^{-1}$)		(K^{-1})
F03	**2**	20000	0.0020	HCl	0.0145
F04	**1**	10000	0.0010	HCl	0.0145
F05	**0.5**	5000	0.00050	HCl	0.0145
F06	**0.2**	2000	0.00020	HCl	0.0145
F07	**0.1**	1000	0.00010	HCl	0.0145
F08	**0.05**	500	0.00010	HCl	0.0145
F09	**0.02**	200	0.000040	HCl	0.0146
F10	**0.01**	100	0.000020	HCl	0.0147
F21	**10**	100000	0.020	KCl	0.0178
F22	**5**	50000	0.010	KCl	0.0186
F23	**2**	20000	0.0040	KCl	0.0190
F24	**1**	10000	0.0020	KCl	0.0192
F25	**0.5**	5000	0.0010	KCl	0.0193
F26	**0.2**	2000	0.00040	KCl	0.0193
F27	**0.1**	1000	0.00020	HCl	0.0145
F28	**0.05**	500	0.00015	HCl	0.0145
F29	**0.02**	200	0.000060	HCl	0.0146
F30	**0.01**	100	0.000030	HCl	0.0147
F31	**0.005**	50	0.000025	HCl	0.0149
F32	**0.0084**	84	0.000025	HCl	0.0147
F33	**0.1411**	1411	0.00028	HCl	0.0145

Volume: 250 mL

Density

T02 and T05 – Secondary CRMs of density

CRMs are used for calibration of working standards and field measuring instruments. The certified values are traceable to the primary SMU standard of density. Actual values of density at temperatures 15, 20, 25, and 30°C are given in the CRM certificate.

Code	Type	Nominal density ($kg \cdot dm^{-3}$)	U (k=2) ($kg \cdot dm^{-3}$)
		20°C	
T02	**Ethanol**	0.808	0.0004
T05	**Mineral oil**	0.836	0.0004

Volume: 100 mL

Viscosity

G01 to G12 – Secondary CRMs of viscosity

These CRMs are intended for the calibration of working viscosity meters of kinematic and dynamic viscosity.
Nominal values of kinematic and dynamic viscosity:
Relative expanded uncertainty $U_{rel}(k=2)$: 1%

Code	20°C		40°C	
	υ ($mm^2 \cdot s^{-1}$)	η (mPa·s)	υ ($mm^2 \cdot s^{-1}$)	η (mPa·s)
G01	2.3	1.9	1.7	1.3
G03	6.7	5.6	4.0	3.3
G04	41	37	17	15
G05	82	71	31	26
G05a	140	130	47	41
G06	250	220	75	66
G08	730	650	180	160
G09	1300	1100	290	260
G11	8200	7400	1400	1300
G12	15000	13000	2300	2100

Volume: 100 mL

Refractive index

H01 to H07 – CRMs of refractive index

CRMs are intended for calibration and measurement validation of refractometers.

Code	Material	n^{20}_D	U (k=2)
H01	**1-butanol**	1.3992	0.00005
H02	**p-xylene**	1.4958	0.00005
H03	**monobromobenzene**	1.5598	0.00005
H04	**1 - bromonaphthalene**	1.6579	0.00005
H05	**oil B01**	1.4929	0.00005
H06	**oil JYO**	1.4464	0.00005
H07	**medicinal oil**	1.4669	0.00005

Volume: 1 mL

Absorbance /spectral transmittance and associated quantities

J01 – Wavelength scale for UV-VIS spectrometry – Water solution of holmium oxide

CRM is intended for the calibration of the wavelength scale of spectrometers in the UV-VIS spectral range.

Wavelength of minimum spectral transmittance of specific bands of Ho(III) solution with a 1 cm light path cell at 20°C to 30°C:

Band width (nm)	Band number and corresponding wavelength in nm													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0.1 - 5	241	250	278	288	333	345	360	386	416	451	468	485	537	641

Volume: 10 mL

Complete list of values of the wavelengths for different spectral band widths (0.1 nm, 0.2 nm, 0.5 nm, 1.0 nm, 2.0 nm, 3.0 nm, 4.0 nm, 5.0 nm) and their corresponding uncertainties (from 0.031 nm for bandwidths 0.1 nm to 0.84 nm for bandwidth 5 nm) is given in the certificate provided with the CRM.

J01a – Wavelength scale for UV-VIS spectrometry – Water solution of neodymium oxide

CRM is intended for the calibration of the wavelength scale of spectrometers in the VIS spectral range as a supplement to J01 for wavelength higher than 575 nm.

Wavelength of minimum spectral transmittance of specific bands of Nd(III) solution at different spectral band widths with a 1 cm light path cell at 20°C to 30°C:

Band width (nm)	Band number and corresponding wavelength in nm						
	1	2	3	4	5	6	7
0.1 - 5	575	679	731	740	794	801	865

Volume: 10 mL

Complete list of values of the wavelengths for different spectral band widths (0.1 nm, 0.2 nm, 0.5 nm, 1.0 nm, 2.0 nm, 3.0 nm, 4.0 nm, 5.0 nm) and their corresponding uncertainties (from 0.049 nm to 0.075 nm) is given in the certificate provided with the CRM.

J02 – Absorbance scale for UV-VIS spectrometry – Water solution of potassium dichromate

CRM is intended for the calibration of the absorbance scale of spectrometers in the UV-VIS spectral range.

Absorbance of solutions with a 1 cm light path cell at 25°C for spectral bandwidth 1 nm and for different wavelengths:

Solution No.	Nominal absorbance at given wavelength				
	235 nm	257 nm	313 nm	345 nm	350 nm
1	0.24	0.28	0.09	0.21	0.21
2	0.49	0.57	0.19	0.42	0.42
3	0.74	0.86	0.28	0.63	0.64
4	0.99	1.15	0.38	0.84	0.85
5	1.24	1.44	0.48	1.06	1.07

Volume: 6 × 10 mL

Complete list of values of absorbances and their corresponding uncertainties (from 0.0010 to 0.0034) is given in the certificate provided with the CRM.

J02a – Absorbance scale for UV-VIS spectrometry – Water solution of potassium dichromate

CRM is intended for the calibration of the absorbance scale of spectrometers in the UV-VIS spectral range.

Absorbance of solutions with a 1 cm light path cell at 25°C for wavelength 430 nm and for spectral bandwidth 1 nm and 2 nm:

Wavelength (nm)	Spectral bandwidth (nm)	Solution Nr.	Nominal absorbance	Expanded uncertainty (k=2)
430	**1**	**1**	0.30	0.0012
		2	0.62	0.0023
		3	0.95	0.0036
		4	1.28	0.0036
430	**2**	**1**	0.30	0.0012
		2	0.62	0.0024
		3	0.95	0.0036
		4	1.28	0.0037

Volume: 5 × 20 mL

Complete list of values of absorbances and their corresponding uncertainties is given in the certificate provided with the CRM.

J03 – Absorbance scale for UV-VIS spectrometry – Water solutions of cobalt and nickel ions

CRM is intended for the calibration of the absorbance scale of spectrometers in the UV-VIS spectral range.

Absorbance of solution with a 1 cm light path cell at 25°C for different wavelengths and spectral bandwidths:

Spectral bandwidth	Solution No.	Nominal absorbance at given wavelength			
		302 nm	395 nm	512 nm	678 nm
1 nm	1	0.29	0.28	0.28	0.10
	2	0.61	0.59	0.58	0.22
	3	0.94	0.90	0.89	0.34

Volume: 4 × 10 mL

Complete list of values of absorbances and their corresponding uncertainties (from 0.0020 to 0.0092) is given in the certificate provided with the CRM.

J04 – Heterochromatic stray light for UV-VIS spectrometry – Potassium iodide

CRM is intended for the calibration of heterochromatic stray light in the UV region for wavelength of 260 nm and spectral bandwidth 0.2 nm.

The specific absorption coefficient of water solutions with 1 cm light path cell at 23.5°C for spectral bandwidth 0.2 nm:

Wavelength (nm)	Nominal specific absorption coefficient ($dm^3 \cdot g^{-1} \cdot cm^{-1}$)	U (k = 2) ($dm^3 \cdot g^{-1} \cdot cm^{-1}$)
255	1.05	0.07
258	0.46	0.026
260	0.26	0.016
265	0.05	0.0040

Mass: 10 g

Complete list of values of specific absorption coefficients and their corresponding uncertainties is given in the certificate provided with the CRM.

CRM FOR QUALITY CONTROL

Metallurgy

M01 to M03 – Carbon steel

CRMs are intended for validation of methods for determination of carbon and sulphur in carbon steels and for calibration of instruments for determination of carbon and sulphur.

Certified values of elements:

Code	Element	Mass fraction (%)	U (k=2) (%)
M01	**C**	0.090	0.004
	S	0.057	0.004
M02	**C**	1.34	0.02
	S	0.007	0.002
M03	**C**	5.63	0.04
	S	0.008	0.002

Mass: 150 g

M11 to M21 – Blast-furnace slags

These CRMs are used in metallurgical and chemical industry, civil engineering and geology for quality control of chemical methods of individual components analysis. Raw materials of these CRMs present original blast furnace slags except four CRMs (M17, M19, M20, M21) which were specially prepared.

Component	SiO_2		CaO		MgO		Al_2O_3		Fe total		S total		MnO		TiO_2	
Code	Mass fraction (%)	U (%)	Mass fraction (%)	U (%)	Mass fraction (%)	U (%)	Mass fraction (%)	U (%)	Mass fraction (%)	U (%)	Mass fraction (%)	U (%)	Mass fraction (%)	U (%)	Mass fraction (%)	U (%)
M11	35.3	0.3	38.8	0.3	12.0	0.3	10.0	0.2	0.21	0.04	-	-	0.47	0.05	0.32	0.03
M12	38.5	0.2	-	-	16.8	0.4	7.05	0.08	0.59	0.05	-	-	1.24	0.03	0.34	0.03
M13	39.0	0.2	31.2	0.5	18.9	0.3	6.2	0.1	0.55	0.06	-	-	0.78	0.03	0.39	0.03
M14	39.1	0.2	42.1	0.4	6.1	0.2	8.4	0.1	0.30	0.05	-	-	0.73	0.03	0.30	0.03
M15	32.8	0.3	49.6	0.2	1.1	0.1	9.2	0.2	-	-	1.17	0.08	0.60	0.04	0.38	0.04
M16	44.0	0.3	31.2	0.3	0.73	0.04	7.94	0.06	5.5	0.1	0.14	0.03	3.40	0.06	0.91	0.03
M17	21.9	0.3	29.4	0.5	17.5	0.5	24.0	0.2	-	-	-	-	-	-	-	-
M18	51.4	0.5	-	-	-	-	45.2	0.2	-	-	-	-	0.06	0.01	-	-
M19	20.3	0.2	28.7	0.2	8.0	0.1	38.6	0.2	1.12	0.03	-	-	0.26	0.03	0.78	0.04
M20	33.57	0.06	30.1	0.3	9.3	0.2	24.0	0.2	-	-	-	-	-	-	-	-
M21	-	-	28.0	0.2	9.2	0.2	14.5	0.1	1.68	0.09	-	-	0.58	0.02	-	-

Mass: 75 g