



Slovak Institute of Metrology, Karloveská 63, 842 55 BRATISLAVA 4,
The certified organisation with accredited laboratories, the prize-winner of the SR National Award for Quality 2004
Centre of chemistry ☎ / fax +421 2 602 94 521
<http://www.smu.sk>, e-mail: rm@smu.gov.sk

CATALOGUE

OF THE CERTIFIED REFERENCE MATERIALS

2011

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Slovak Institute of Metrology 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 unity 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 to affording 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 by ISO 17 025 standard 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.

The development and maintenance of standards and transfer of units of physical quantities in individual areas are assured by following centres:

- **Length and Time** – plane angle, form and surface roughness, time and frequency, acoustics quantities
- **Mass and Pressure** – mass, hydrostatic pressure of a fluid, elastic deformations, force measurement principle, change of a physical properties of pressure sensor material, viscosity, density of liquids and solids
- **Flow** – volume and flow rate of water and technical liquids, liquid volume, gas volume and its flow rate
- **Electricity** – DC and AC voltage, electrical current and resistance, electrical capacity, power and energy of AC, FR voltage and RF current
- **Ionising Radiation** – X-ray dosimetry, neutrons, activity of radionuclides, photon and electron dosimetry,
- **Chemistry** – amount of substance, electrolytic conductivity, mole fraction of selected gas mixtures, pH, spectral transmittance, refractive index, air humidity, development, preparation a distribution of the CRMs
- **Thermometry, Photometry and Radiometry** – temperature, radiation flux and intensity of irradiation

The SMU has implemented a system of quality management, certified according to ISO 9001. Individual laboratories are accredited according to ISO 17025.

THE CENTRE OF CHEMISTRY

To the calibration of CRM are used standards of the Centre as follows:

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 mole fraction in gaseous phase

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

National standard of electrolytic conductivity

is based on the absolute measurement of conductivity in an electrolytic cell with calculable value of the cell constant. The unit is further transferred by means of certified reference materials.

National standard of pH

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

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 two standard prisms, installed in air conditioned lab with temperature control and floor isolation.

Standard of air humidity

is based on principle of dew point measurement. It serves for calibration of different type of humidity meters (and gases) at laboratory temperature in range -75°C to +20°C of dew point or 0 – 100% of relative humidity.

THE REST SMU CENTRES

In addition to mentioned standards of the Chemistry centre they are also used to CRM calibration the standards of different SMU Centres:

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 temperature controlled bath

National standard of density

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

All balances and volumetric flasks used in process of CRM preparation are calibrated against national standard of mass; thermometers are traced to national standard of temperature.

Definitions

Reference material (RM):

material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Certified reference material (CRM):

reference material, accompanied by a certificate, one or more of whose property values are certified by a procedure which establishes traceability to an accurate realisation of the unit in which the property values are expressed, and for which each certified value is accompanied by an uncertainty at a stated level of confidence.

Primary reference material:

material, that is designated or widely acknowledged as reference material having the highest metrology quantities and whose value is accepted without reference to other reference material of the same quality.

Secondary reference material:

reference material, whose value is assigned by comparison with a primary reference material.

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:

parameter, associated with the result of a measurement that characterises the dispersion of the values that could reasonably be attributed to the measurand.

Traceability:

property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties.

Calibration:

Set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realised by standards.

Standard:

Material measure, measuring instrument, reference material or measuring system intended to define, realise, conserve or reproduce a unit or one or more values of a quantity to serve as a reference.

Certified value:

is the value that appears in the certificate or other documentation accompanying the material, this value having been certified by a technically valid procedure. All uncertainty values in this catalogue are expanded uncertainties ($k=2$), unless otherwise noted.

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

tel. & fax. **+421 2 602 94 521**

E-mail: rm@smu.gov.sk

Internet: www.smu.sk

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 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

CRM shipment's cost is paid by the customer. Subject, size, weight, and category of material limitation of shipment may apply.

Symbols used in the Catalogue:

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

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.

Code	CRM	Purity (%)	U (k=2) (%)	Packing (g)
A01	Amidosulphuric acid	99,977	0,004	20
A02	Potassium hydrogen phthalate	99,997	0,006	25
A03	Arsenic(III) oxide	99,975	0,008	20
A04	Potassium dichromate	99,985	0,007	25
A05	Potassium chloride	99,992	0,013	20
A07	TRIS	99,912	0,027	20



B01 to B37 – Synthetic single element solutions

Synthetic 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.

CRM code	Element	Mass concentration (g.L ⁻¹)	U (k=2) (g.L ⁻¹)	Matrix
B01	Ag	1,000	0,002	2 % HNO ₃
B02	Al	1,000	0,002	2 % HCl
B03	As	1,000	0,002	2 % HNO ₃
B04	B	1,000	0,002	H ₂ O
B05	Ba	1,000	0,002	2 % HNO ₃
B06	Bi	1,000	0,002	10 % HNO ₃
B07	Ca	1,000	0,002	2 % HNO ₃
B08	Cd	1,000	0,002	2 % HNO ₃
B09	Co	1,000	0,002	2 % HNO ₃
B10	Cr	1,000	0,002	2 % HCl
B12	Cu	1,000	0,002	2 % HNO ₃
B13	Fe	1,000	0,002	5 % HNO ₃
B15	Hg	1,000	0,002	5 % HNO ₃
B18	K	1,000	0,002	H ₂ O
B20	Mg	1,000	0,002	2 % HNO ₃
B21	Mn	1,000	0,002	2 % HNO ₃
B23	Na	1,000	0,002	H ₂ O
B24	Ni	1,000	0,002	2 % HNO ₃
B25	P	1,000	0,002	H ₂ O
B26	Pb	1,000	0,002	2 % HNO ₃
B31	Sn	1,000	0,002	20 % HCl
B32	Sr	1,000	0,002	2 % HNO ₃
B35	Tl	1,000	0,002	2 % HNO ₃
B36	V	1,000	0,002	5 % HNO ₃
B37	Zn	1,000	0,002	2 % HNO ₃

Packing: 100 mL



B50 to B53 – 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 titration methods and the values are traceable to SMU standard for amount of substance. Matrix is water.

CRM code	Anion	Mass concentration (g.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	0,002

Packing: 250 mL



Mole fraction in gaseous phase

D11 to D16 – 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 (2001) Gas analysis – Preparation of calibration gas mixtures – Gravimetric method 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)	$U_{rel} (k=2)$ (%)
D11	CO, CO ₂ , propane in N ₂	CO ₂	0,06 - 0,14	0,40 - 0,25
		CO	0,005 - 0,035	0,40 - 0,3
		propane	0,0002 - 0,002	0,80 - 0,40
D12	CO ₂ in N ₂		0,0008 - 0,18	0,40 - 0,20
D13	CO in N ₂		0,001 - 0,20	0,40 - 0,20
D14	propane in N ₂		0,001 - 0,2	0,50 - 0,30
D15	ethanol in N ₂		0,000075 - 0,0008	0,70 - 0,50
D16	natural gas	methane	0,83 - 0,99	0,25
		ethane	0,0025 - 0,09	0,25 - 0,20
		propane	0,001 - 0,026	0,35 - 0,25
		n-butane	0,0001 - 0,0036	0,50 - 0,30
		iso-butane	0,0001 - 0,0033	0,50 - 0,30
		n-pentane	0,00002 - 0,00053	0,50 - 0,40
		iso-pentane	0,00002 - 0,00053	0,50 - 0,40
		neopentane	0,00001 - 0,00024	1,5 - 1,0
		n-hexane	0,0001 - 0,0005	1,0 - 0,50
		CO ₂	0,0004 - 0,16	0,35 - 0,20
		N ₂	0,007 - 0,13	0,30 - 0,20
D21	SO ₂ v N ₂		0,000001 - 0,01	1,2
D22	NO v N ₂		0,000001 - 0,0001	1,2
D23	NO ₂ vo vzduchu		0,000001 - 0,0001	1,5

Packing: aluminium cylinders with inner volume 5 dm³ at 13 MPa. Natural gas is delivered at only 5 MPa. SMU provides for all these PRMs 2 years warranty.

D01 to D06 – Secondary RMs of selected gas mixtures

SMU offers certification measurement of gas mixtures from commercial producers to provide traceable certified values to primary standard. RMs are compared against maintained appropriate set of Primary Standard Mixtures at SMU.

Gas mixtures are used first of all for type approvals and validation of exhaust gas analysers and of breath analysers, calibrations of gas mixtures analysers for air and emissions monitoring and for calibrations of gas chromatographs for determination of natural gas components.

Code	secondary RM of gas mixture	Component	Mole fraction range (mol/mol)	$U_{rel} (k=2)$ (%)
D01	CO, CO ₂ , propane in N ₂	CO ₂	0,06 - 0,14	0,50 - 0,35
		CO	0,005 - 0,035	0,90 - 0,40
		propane	0,0002 - 0,002	1,0 - 0,60
D02	CO ₂ in N ₂		0,0008 - 0,18	0,50 - 0,30
D03	CO in N ₂		0,001 - 0,20	0,50 - 0,30
D04	propane in N ₂		0,001 - 0,02	0,70 - 0,50
D05	ethanol in N ₂		0,000075 - 0,0008	1,2 - 0,80
D06	natural gas	methane	0,83 - 0,99	0,50
		ethane	0,0025 - 0,09	1,1 - 0,40
		propane	0,001 - 0,026	1,0 - 0,40
		n-butane	0,0001 - 0,0036	0,90 - 0,50
		iso-butane	0,0001 - 0,0036	0,90
		n-pentane	0,00002 - 0,00053	1,1 - 0,60
		iso-pentane	0,00003 - 0,00053	0,80 - 0,40
		neopentane	0,00001 - 0,00024	3
		n-hexane	0,0001 - 0,0005	1,1 - 0,60
		CO ₂	0,0004 - 0,16	0,95 - 0,25
N ₂	0,007 - 0,13	0,50 - 0,30		

In case of interest about any other mole fractions or mixtures with other components, please contact Laboratory of Gases.



aluminium cylinders with inner volume 5 dm³

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 the definition measuring on Harned's cell using a hydrogen electrode on the National standard of pH.

Code	Type	pH at 25°C	U (k=2)
E10	Tetraoxalate	1,679	0,005
E11	Oxalate	4,000	0,005
E12	Phosphate	7,000	0,005
E13	Borate	9,180	0,005
E14	Carbonate	10,000	0,005

Packing: Glass ampoules; Volume: 5 × 20 mL



E20 to E24 – Secondary buffers

The value of secondary buffers is traceable to primary buffers.

Code	Type	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

Packing: Plastic bottle; Volume: 150 mL;

E30 to E34 – Secondary buffers

Code	Type	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

Packing: Plastic bottle; Volume: 500 mL;



Electrolytic conductivity

are designed for the calibration of working conductivity meters or for calibration of working RMs of the conductivity. Basic components of the solutions are KCl or HCl and H₂O.

F03 to F10 –Primary CRMs of the electrolytic conductivity

The value of primary reference materials of electrolytic conductivity is determined by the primary measuring on the National standard of electrolytical conductivity.

Code	Electrolytic conductivity (S·m ⁻¹)	U (k=2) (S·m ⁻¹)	Basic component	Temperature coefficient (K ⁻¹)
F03	2	0,0010	HCl	0,0145
F04	1	0,00050	HCl	0,0145
F05	0,5	0,00025	HCl	0,0145
F06	0,2	0,00010	HCl	0,0145
F07	0,1	0,000050	HCl	0,0145
F08	0,05	0,000050	HCl	0,0145
F09	0,02	0,000040	HCl	0,0146
F10	0,01	0,000020	HCl	0,0147

Packing: 250 mL HDPE bottles



F21 to F33 –Secondary CRMs of the electrolytic conductivity

The value of the electrolytic conductivity of solution is traceable to primary certified reference materials of SMU.

Code	Electrolytic conductivity ($S \cdot m^{-1}$)	U (k=2) ($S \cdot m^{-1}$)	Basic component	Temperature coefficient (K^{-1})
F21	10	0,020	KCl	0,0178
F22	5	0,010	KCl	0,0186
F23	2	0,0040	KCl	0,0190
F24	1	0,0020	KCl	0,0192
F25	0,5	0,0010	KCl	0,0193
F26	0,2	0,00040	KCl	0,0193
F27	0,1	0,00020	HCl	0,0145
F28	0,05	0,00015	HCl	0,0145
F29	0,02	0,000060	HCl	0,0146
F30	0,01	0,000030	HCl	0,0147
F31	0,005	0,000025	HCl	0,0149
F32	0,0084	0,000010	HCl	0,0147
F33	0,1411	0,0020	HCl	0,0145

Packing: 250 mL HDPE bottles



Density

T02 and T05 – Secondary CRMs of density

are used for calibration of working standards and field measuring instruments. The certified values are traceable to the primary SMU standard of density.

Code	Type	ρ (kg.L ⁻¹)				U (k=2) (kg.L ⁻¹)
		15 °C	20 °C	25 °C	30 °C	
T02	Ethanol	0,80968	0,80539	0,80108	0,79670	0,00030
T05	Mineral oil	0,84175	0,83826	0,83476	0,83126	0,00050

Packing: 100 mL



Viscosity

G01 to G13 – Secondary CRMs of viscosity

These CRMs are intended for the calibration of working viscosity meters of kinematic and dynamic viscosity.

Certified values of kinematic and dynamic viscosity:

Code	20°C				40°C			
	ν (mm ² .s ⁻¹)	U (mm ² .s ⁻¹)	η (mPa.s)	U (mPa.s)	ν (mm ² .s ⁻¹)	U (mm ² .s ⁻¹)	η (mPa.s)	U (mPa.s)
G01	2,363	0,019	1.879	0,019	1,660	0,013	1,296	0,013
G03	5,765	0,046	4,839	0,048	3,501	0,028	2,939	0,029
G04	41,213	0,330	36,435	0,360	16,86	0,13	14,68	0,15
G05	86,21	0,69	77,57	0,78	29,66	0,27	26,30	0,29
G06	294,3	2,6	261,7	2,9	86,57	0,78	75,90	0,83
G08	720,7	6,5	649,2	7,1	180,7	1,6	159,5	1,8
G09	1240	12	1121	13	285,9	2,9	254,9	3,1
G11	7880	79	7133	86	1342	13	1198	14
G12	14549	145	13175	158	2257	23	2013	24

Note: ν - kinematic viscosity

η - dynamic viscosity

Packing: 100 mL



Refractive index

H01 to H07 – CRMs of refractive index

CRMs are intended for calibration and measurement validation of refractometers.

Code	Material	n_D^{20}	U (k=2)
H01	1-butanol	1,39937	0,00005
H02	p-xylene	1,49590	0,00005
H03	monobromobenzene	1,55983	0,00005
H04	1 - bromonaphthalene	1,65793	0,00005
H05	oil B01	1,49289	0,00005
H06	oil JYO	1,44639	0,00005
H07	medicinal oil	1,46685	0,00005

Packing: 1ml



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 at different spectral band widths with a 1 cm light path cell at 20°C to 30°C:

Band No.	Wavelength in nm for spectral bandwidths								
	0.1 nm	0.2 nm	0.5 nm	1.0 nm	2.0 nm	3.0 nm	4.0 nm	5.0 nm	11.0 nm
1	241,03	241,04	241,11	241,22	241,27	241,26	241,36	241,65	-
2	249,84	249,84	249,89	249,98	250,16	250,24	250,39	250,70	-
3	278,21	278,20	278,22	278,21	278,24	278,25	278,31	278,56	-
4	287,07	287,08	287,14	287,29	287,65	287,79	288,03	288,48	-
5	333,54	333,52	333,53	333,54	333,49	333,40	333,33	333,35	-
6	345,56	345,52	345,50	345,43	345,40	345,37	345,30	345,31	-
7	361,34	361,34	361,34	361,29	361,14	361,03	360,96	361,00	359,1
8	385,42	385,43	385,53	385,69	385,86	385,99	386,11	386,37	-
9	416,09	416,10	416,15	416,32	416,58	416,75	416,82	416,98	417,1
10	-	-	-	451,39	451,30	451,23	451,22	451,31	451,3
11	467,81	467,82	467,84	467,86	467,92	468,03	-	-	-
12	485,26	485,27	485,27	485,29	485,29	485,20	485,18	485,24	485,5
13	536,48	536,49	536,52	536,61	536,89	537,09	537,30	537,54	538,8
14	640,48	640,48	640,50	640,55	640,79	641,05	641,20	641,40	642,5
U(k=2)	0,031	0,030	0,036	0,031	0,035	0,051	0,067	0,083	0,50

Packing: 10 mL

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 No.	Wavelength in nm for spectral bandwidths							
	0.1 nm	0.2 nm	0.5 nm	1.0 nm	2.0 nm	3.0 nm	4.0 nm	5.0 nm
1	575,178	575,169	575,138	575,025	574,880	574,979	575,121	575,224
2	679,036	679,036	679,036	679,058	679,144	679,266	679,404	679,475
3	731,593	731,598	731,606	731,660	731,895	732,369	-	-
4	740,038	740,038	740,035	740,047	740,158	740,378	740,631	740,901
5	794,151	794,142	794,135	794,133	794,086	794,148	794,315	794,642
6	801,401	801,406	801,398	801,349	801,119	800,888	800,626	-
7	865,264	865,265	865,230	865,190	864,923	864,602	864,499	864,507
U(k=2)	0,074	0,067	0,057	0,054	0,049	0,061	0,075	0,072

Packing: 10 mL

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.	Absorbance \pm U (k = 2) at given wavelength				
	235 nm	257 nm	313 nm	345 nm	350 nm
1	0,2444 \pm 0,0015	0,2849 \pm 0,0017	0,0960 \pm 0,0013	0,2116 \pm 0,0013	0,2132 \pm 0,0012
2	0,4908 \pm 0,0030	0,5721 \pm 0,0013	0,1923 \pm 0,0010	0,4233 \pm 0,0010	0,4269 \pm 0,0010
3	0,7390 \pm 0,0016	0,8614 \pm 0,0020	0,2886 \pm 0,0013	0,6350 \pm 0,0028	0,6409 \pm 0,0018
4	0,9895 \pm 0,0023	1,1532 \pm 0,0024	0,3853 \pm 0,0015	0,8469 \pm 0,0019	0,8554 \pm 0,0019
5	1,2411 \pm 0,0023	1,4467 \pm 0,0026	0,4821 \pm 0,0020	1,0589 \pm 0,0029	1,0703 \pm 0,0034

Packing: 6 \times 10 mL

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	Solutions No.	Absorbance \pm U (k = 2) at given wavelength			
		302 nm	395 nm	512 nm	678 nm
1 nm	1	0,2783 \pm 0,0010	0,2869 \pm 0,0010	0,2845 \pm 0,0010	0,1083 \pm 0,0010
	2	0,5763 \pm 0,0018	0,5839 \pm 0,0019	0,5784 \pm 0,0016	0,2206 \pm 0,0011
	3	0,8705 \pm 0,0028	0,8812 \pm 0,0019	0,8733 \pm 0,0016	0,3336 \pm 0,0010
11 nm	1		0,2857 \pm 0,0056	0,2863 \pm 0,0026	0,1101 \pm 0,0030
	2		0,5797 \pm 0,0058	0,5804 \pm 0,0032	0,2233 \pm 0,0032
	3		0,8724 \pm 0,0060	0,8726 \pm 0,0036	0,3361 \pm 0,0028

Packing: 4 \times 10 ml

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)	Specific absorption coefficient ($\text{dm}^3 \cdot \text{g}^{-1} \cdot \text{cm}^{-1}$)	U(k = 2) ($\text{dm}^3 \cdot \text{g}^{-1} \cdot \text{cm}^{-1}$)
255	1,049	0,07
258	0,460	0,026
260	0,260	0,016
265	0,0562	0,0040

Packing: 10 g



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	Content (%)	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

Packing: 150 g



M11 to M21 – Blast-furnace slag's

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 (7-1-011, 7-1-013, 7-1-014 and 7-1-015) prepared in synthetic way

Component Code	SiO ₂		CaO		MgO		Al ₂ O ₃		Fe total		MnO		TiO ₂	
	Mass fraction (%)	U (%)	Mass fraction (%)	U (%)	Mass fraction (%)	U (%)	Mass fraction (%)	U (%)	Mass fraction (%)	U (%)	Mass fraction (%)	U (%)	Mass fraction (%)	U (%)
M11 7-1-005	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 7-1-006	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 7-1-007	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 7-1-008	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 7-1-009	32,8	0,3	49,6	0,2	1,1	0,1	9,2	0,2			0,60	0,04	0,38	0,04
M16 7-1-010	44,0	0,3	31,2	0,3	0,73	0,04	7,94	0,06	5,5	0,1	3,40	0,06	0,91	0,03
M17 7-1-011	21,9	0,3	29,4	0,5	17,5	0,5	24,0	0,2						
M18 7-1-012	51,4	0,5	0,57	0,04			45,2	0,2			0,06	0,01		
M19 7-1-013	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 7-1-014	33,57	0,06	30,1	0,3	9,3	0,2	24,0	0,2						
M21 7-1-015			28,0	0,2	9,2	0,2	14,5	0,1	1,68	0,09	0,58	0,02		

Packing: 75 g



Blast-furnace slag's

Other areas of quality control

N01 – Amidosulphuric acid for trace analysis

CRM is intended for validation of measurement methods.

Certified values of elements:

Element	Mass fraction ($\mu\text{g.g}^{-1}$)	U (k=2) ($\mu\text{g.g}^{-1}$)	Element	Mass fraction ($\mu\text{g.g}^{-1}$)	U (k=2) ($\mu\text{g.g}^{-1}$)
Cd	6,5	0,8	Fe*	9,5	4,4
Cu	4,7	0,6	Zn*	2,0	0,6
Pb	5,4	0,6			

Note: * information values

Packing: 10 g