

# CERTIFIED REFERENCE MATERIALS

CMI Reference Material Producer

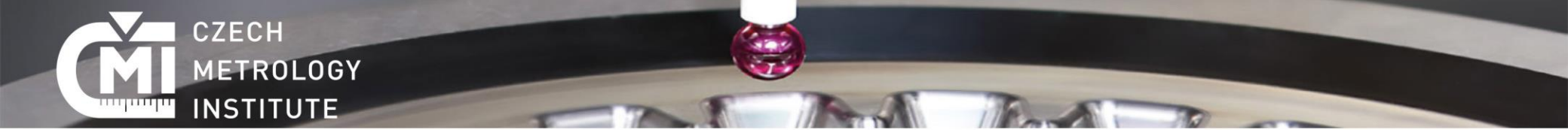
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Certified reference materials (CRMs), defined in detail in ISO Guide 30 and the International Dictionary of Metrology VIM, play important role as standards for quality control and metrological traceability of products, for validation of analytical measurement methods or for calibration of instruments. Reference materials are particularly important in the field of analytical chemistry. Since most analytical instruments work on the principle of comparison with a known standard, they require a sample of known composition (reference material) for their accurate calibration. Certified reference materials are produced according to strict manufacturing procedures and differ from conventional laboratory reagents by their certification and the metrological traceability of the data to SI units. Quality management systems involving accreditation of laboratories according to national and international accreditation/certification standards, such as EN ISO/IEC 17025, require metrological traceability to certified reference materials wherever possible.

CZECH METROLOGY INSTITUTE is accredited  
by Czech Accreditation Institute as Reference  
Material Producer No. 7502 according to  
international ISO standard 17034:2016 „General  
requirements for the competence of reference  
material producers“.



## DEFINITIONS

ISO Guide 30:2015, 2.1.1

**Reference material (RM)** – material, sufficiently homogeneous and stable with respect to one or more specified properties, which has been established to be fit for its intended use in a measurement process

Note 1 to entry: RM is a generic term.

Note 2 to entry: Properties can be quantitative or qualitative, e.g. identity of substances or species.

Note 3 to entry: Uses may include the calibration of a measurement system, assessment of a measurement procedure, assigning values to other materials, and quality control.

Note 4 to entry: ISO/IEC Guide 99:2007 has an analogous definition (5.13), but restricts the term “measurement” to apply to quantitative values. However, Note 3 of ISO/IEC Guide 99:2007, 5.13 (VIM), specifically includes qualitative properties, called “nominal properties”.

ISO Guide 30:2015, 2.1.2

**Certified reference material (CRM)** – reference material (RM) characterized by a metrologically valid procedure for one or more specified properties, accompanied by an RM certificate that provides the value of the specified property, its associated uncertainty, and a statement of metrological traceability

Note 1 to entry: The concept of value includes a nominal property or a qualitative attribute such as identity or sequence. Uncertainties for such attributes may be expressed as probabilities or levels of confidence

Note 2 to entry: Metrologically valid procedures for the production and certification of RMs are given in, among others, ISO Guides 34 and 35.

Note 3 to entry: ISO Guide 31 gives guidance on the contents of RM certificates.

Note 4 to entry: ISO/IEC Guide 99:2007 has an analogous definition (5.14).

## DEFINITIONS

ISO Guide 30:2015, 2.1.5

**Primary measurement standard** – measurement standard that is designated or widely acknowledged as having the highest metrological qualities and whose property value is accepted without reference to other standards of the same property or quantity, within a specified context

Note 1 to entry: See also ISO/IEC Guide 99:2007.

ISO Guide 30:2015, 2.1.6

**Secondary measurement standard** – measurement standard whose property value is assigned by comparison with a primary measurement standard of the same property or quantity

Note 1 to entry: See also ISO/IEC Guide 99:2007.

## CRM ORDERS

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## CRM of gas mixtures (primary standards)

Matrix:	Characteristics/range:			Pressure cylinder with volume:	Expiration:
Synthetic natural gas	methane	70 – 98	cmol/mol	5 – 40 L	36 months
	ethane	0.4 – 10	cmol/mol		
	propane	0.1 – 2	cmol/mol		
	i-butane	0.04 – 0.1	cmol/mol		
	n-butane	0.04 – 0.1	cmol/mol		
	neo-pentane	0.02 – 0.2	cmol/mol		
	i-pentane	0.02 – 0.2	cmol/mol		
	n-pentane	0.02 – 0.2	cmol/mol		
	n-hexane	0.01 – 0.1	cmol/mol		
	carbon dioxide	0.1 – 5	cmol/mol		
nitrogen	0.2 – 10	cmol/mol			
Ethanol in nitrogen	ethanol	50 – 800	µmol/mol	5 – 40 L	36 months

The uncertainty of the certified material consists of the contribution of uncertainty of the gravimetric preparation, the purity of the initial materials and the contribution of uncertainty of the reference material stability.

The expanded uncertainty of measurement is the product of the standard uncertainty of measurement and a coefficient  $k$  corresponding to a coverage probability of approximately 95 %, which for a normal distribution corresponds to the coverage factor of  $k = 2$  and is in accordance with the JCGM GUM-6:2020 document.

The primary CRMs of the gas mixtures were prepared by the primary gravimetric method. The certified gas mixture value is traceable to the CMI primary mass standard.



## CRM of pH aqueous buffer solutions (secondary standards)

CRM code	pH nominal value	U (k=2)	Composition	Packaging	Expiration
p321	2.000	0.020	potassium tetraoxalate + potassium oxalate	250 mL	6 months
p341	4.000	0.020	potassium hydrogen phthalate	250 mL	6 months
p370	6.865	0.020	potassium dihydrogen phosphate + disodium hydrogen phosphate	250 mL	6 months
p371	7.000	0.020	potassium dihydrogen phosphate + disodium hydrogen phosphate	250 mL	6 months
p390	9.180	0.020	disodium tetraborate	250 mL	6 months

The uncertainty of the certified material consists of the repeatability of the pH buffer solution measurement, the contribution of the homogeneity and the stability of the reference material.

The reported expanded uncertainty of measurement is the product of the standard uncertainty of measurement and a coefficient  $k$  corresponding to a coverage probability of approximately 95 %, which for a normal distribution corresponds to the coverage factor of  $k = 2$  and is in accordance with the JCGM GUM-6:2020 document.

The pH of aqueous buffer solutions was determined by a secondary method, by direct comparison of the buffer value with the primary CRM in a differential-potentiometric cell fitted with standard hydrogen electrodes.

The certified pH value of the buffer is traceable to the CMI primary pH standard consisting of an assembly of 5 Harned electrochemical cells without transference, standard hydrogen electrodes, reference silver/silver chloride electrodes, multimeter, barometer and water bath.

## CRM of electrolytic conductivity (secondary standards)

CRM code	Nominal value $S\ m^{-1}$	U (k=2)	Composition	Packaging	Expiration
k22	10.86	0.82 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months
k23	10.00	0.81 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months
k28	5.00	0.62 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months
k32	2.00	0.55 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months
k33	1.282	0.48 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months
k34	1.000	0.43 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months
K37	0.500	0.44 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months
K39	0.1413	0.31 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months
k40	0.1408	0.31 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months

## CRM of electrolytic conductivity (secondary standards)

CRM code	Nominal value $S\ m^{-1}$	U (k=2)	Composition	Packaging	Expiration
k48	0.1000	0.35 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months
k41	0.0500	0.50 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months
k43	0.0100	1.2 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months
k44	0.0084	1.4 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months
k45	0.0050	2.2 %	potassium chloride aqueous solution	250, 500, 1000 mL	12 months

The uncertainty of the certified material consists of the contribution of the measurement repeatability, the secondary standard and the homogeneity and the stability of the reference material.

The reported expanded uncertainty of measurement is the product of the standard uncertainty of measurement and a coefficient  $k$  corresponding to a coverage probability of approximately 95 %, which for a normal distribution corresponds to the coverage factor of  $k = 2$  and is in accordance with the JCGM GUM-6:2020 document

Secondary RMs are measured on the CMI secondary Jones-type electrolytic conductivity standard, with a traceability to the CMI primary electrolytic conductivity standard.

The primary standard is traceable to the CMI national standard of length, to the CMI national standard of impedance, and to the CMI national standard of temperature.

