

PUBLIC DECREE

As the authority with substantive and territorial jurisdiction in the matter of laying down metrological and technical requirements for specified measuring instruments and stipulating test methods for their type approval and verification pursuant to § 14(1) of Act No 505/1990, on metrology, as amended (hereinafter the ‘Metrology Act’), and in accordance with the provisions of § 172 et seq. of Act No 500/2004, the Administrative Code (hereinafter the ‘AC’), the Czech Metrology Institute (hereinafter the ‘CMI’) commenced ex officio proceedings on 30 October 2019 pursuant to § 46 of the AC, and, based on supporting documents, issues the following:

I

MEASURE OF A GENERAL NATURE

number: 0111-OOP-C103-26

laying down metrological and technical requirements for specified measuring instruments, including test methods for type approval, verification and checking of specified measuring instruments:

‘accuracy class A graduated cylinders used for volume checks’

1. Definitions

For the purposes of this Measure of a General Nature, the terms and definitions pursuant to VIM and VIML¹ and the following shall apply:

1.1

volumetric glassware

a glass measuring instrument calibrated for a specific volume of liquid, which is indicated by a gauge mark or scale, and which is used for volume checking

¹ TNI 01 0115 International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (VIM) and International Vocabulary of Terms in Legal Metrology (VIML) are part of the technical harmonisation compendium ‘Terminology in the field of metrology’, which is publicly accessible at www.unmz.cz.

1.1.1

graduated cylinder

a glass cylinder used to determine the volume of a liquid by filling it to the gauge mark (marked with the symbol 'In')

1.1.2

meniscus

the curved surface of a liquid in a tube, whose shape depends on the liquid's surface tension

1.1.3

nominal volume

the highest volume value marked on a graduated cylinder

1.1.4

actual volume

the value of the volume of a graduated cylinder obtained through measurement

1.1.5

reference temperature

temperature at which the graduated cylinder contains the marked nominal volume (20 °C or 27 °C)

1.1.6

volume

the volume of a graduated cylinder is defined as the volume of water at 20 °C, expressed in millilitres, which the cylinder contains when filled to the upper dividing line. In the exceptional cases where the reference temperature is set at 27 °C, this value replaces 20 °C.

1.1.7

unit of volume

the unit of volume is the millilitre (ml), which is equivalent to a cubic centimetre (cm³)

1.1.8

maximum permissible error (MPE) of volume

the maximum permitted deviation from the nominal volume value of the volumetric glassware

2. Metrological requirements

2.1 Maximum permissible errors (MPE)

The measured volume of deionised water² must not differ from the nominal value by more than the maximum permissible error (hereinafter 'MPE') specified in Table 1. These errors represent the MPE at any point of the scale, as well as the maximum permissible difference between errors at any two points.

² The use of distilled water is also permitted.

Table 1 – Dimensions, scale graduation and MPE for accuracy class A graduated cylinders, types 1a and 1b

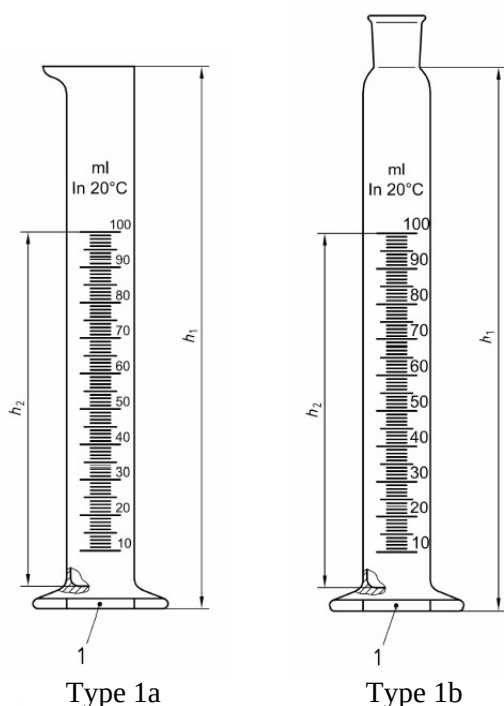
Nominal volume (ml)	Total height h_1 (mm) max.	Distance from the upper graduation line to the upper edge of the cylinder (mm) min.	Internal height to the upper graduation line h_2 (mm) min.	Scale graduation (ml)	Volume of the lowest interval on the scale (ml) max.	MPE ($\pm$ ml)
5	115	20	55	0,1	1,0	0.05
10	140	20	65	0,2	1,4	0.1
25	170	25	85	0,5	2,5	0.25
50	200	30	110	1	5	0.5
100	260	35	145	1	10	0.5
250	335	40	200	2	26	1
500	390	45	250	5	50	2.5
1 000	470	50	310	10	100	5
2 000	570	50	380	20	200	10

3. Technical requirements

3.1 Specifications of accuracy class A graduated cylinders

The following types of graduated cylinders are specified (see Figure 1):

- tall form with a spout (type 1a),
- tall form with a stoppered neck (type 1b),



Key:

h_1 total height

h_2 internal height to the upper graduation line

1 hexagonal or circular base

Figure 1 – Types of graduated cylinders

3.2 Material of the measuring instrument

The graduated cylinder must be made of glass of hydrolytic resistance class not lower than HGB 3. The glass must be free from visible defects and free from internal stress.

4. Markings on the measuring instrument

The measuring instruments must be clearly and visibly marked with the following information:

- a) the manufacturer's name or mark;
- b) the nominal volume with the unit of measurement;
- c) accuracy class A;
- d) the symbol 'In' indicating that the product has been calibrated to contain volume;
- e) the reference temperature;
- f) the maximum permissible error;
- g) the type of glass.

5. Type approval

Graduated cylinders are not subject to type approval.

6. Initial verification

The initial verification of a graduated cylinder includes the following activities:

- a) visual inspection;
- b) inspection of dimensions and scale division according to Table 1;
- c) a test of the accuracy of the nominal volume.

6.1 Visual inspection

During the visual inspection of a graduated cylinder, the following is verified:

- a) the completeness, accuracy, durability and legibility of the markings;
- b) the appearance and functional condition of the graduated cylinder;
- c) scale division and volume at the lowest scale interval according to Table 1.

If the graduated cylinder fails the visual inspection, no further tests are carried out.

6.2 Inspection of dimensions and scale division

The dimensions of graduated cylinders must correspond to the values specified in Table 1.

If the graduated cylinder does not pass the inspection of dimensions, no further tests are carried out.

6.3 Test of nominal volume accuracy

The accuracy test of the nominal volume of the graduated cylinder is carried out using the gravimetric method.

6.3.1 Environmental conditions

The laboratory must be protected from the adverse effects of vibrations, direct sunlight, rapid temperature changes and unstable environmental conditions.

The temperature of the environment in which the graduated cylinders are tested must be within the range of (17 to 23) °C and the ambient temperature must not change by more than ± 1 °C during the test. The relative humidity must be within the range of (30 to 80) %. The graduated cylinders must be

conditioned for at least 2 hours to the ambient temperature at which the tests are carried out. The temperature change in the laboratory during conditioning must not be greater than 1 °C/h.

Weighing scales must be placed on a vibration-damped (preferably double) table.

The light source must provide diffuse light in order to accurately determine the position of the meniscus.

If the environmental conditions do not meet the required parameters, the tests described below are not carried out.

6.3.2 Preparation

The graduated cylinders are washed with detergent before the test and thoroughly rinsed with a stream of water and deionised water². Other auxiliary glassware must be degreased in the same way. Graduated cylinders are containers designed to contain volume (In); therefore, before the test, they are dried in a drying oven at a maximum temperature of 80 °C until completely dry.

6.3.3 Determination of the volume of graduated cylinders

First, the mass of the empty and dried graduated cylinder m_1 is determined. In addition, taring may also be performed. The graduated cylinder is filled with deionised water² approximately 2 mm above the tested gauge mark and placed in an upright position. The correct level (meniscus) is adjusted by removing deionised water² with an auxiliary pipette so that the plane passing through the upper edge of the mark is horizontally tangential to the lowest point of the meniscus, the viewing direction being in the same plane.

Once the correct level has been reached, the water droplets above the tested gauge mark are removed. The filled cylinder is placed on the weighing scale and its mass m_2 is determined. The mass of the volume of deionised water² m_i is determined by calculating the mass difference ($m_i = m_2 - m_1$). A second repetition of the nominal volume test can be performed by adding a sufficient amount of deionised water to the graduated cylinder after the first measurement² and repeating the meniscus adjustment and weighing. The initial mass of the dry cylinder or the tare is therefore used repeatedly.

The weighing must be carried out quickly. Immediately after weighing, the temperature of the deionised water², the air temperature and humidity, and the barometric pressure are measured.

Volume is determined at the nominal volume and must include at least three repetitions.

6.3.4 Processing of accuracy test results

The measured values are converted according to the formulae given below.

The volume V_i corresponding to the determined mass m_i is calculated using a correction factor Z , which includes the corresponding deionised water density² for the measured temperature during weighing, the buoyancy correction and the temperature correction, if the test temperature is not equal to 20 °C and the manufacturer indicates a coefficient of volumetric temperature expansion γ ($\gamma = 3 \times \alpha$, where α is the coefficient of linear thermal expansion) for the material from which the volumetric glassware is made.

The correction factor Z is calculated according to the following formula:

$$Z = \left(\frac{1}{\rho_{\text{water}} - \rho_{\text{air}}} \right) \times \left(1 - \frac{\rho_{\text{air}}}{8} \right) \times (1 - \gamma \times (t - 20)) \quad (6.1)$$

where: ρ_{vzduchu} is the air density determined from mean values of atmospheric pressure and air temperature during weighing (g/ml);

ρ_{vody}	the density of deionised water ² corresponding to the mean value of the temperature recorded during weighing (g/ml);
γ	the coefficient of volumetric thermal expansion of the material from which the graduated cylinder is made;
t	the temperature of deionised water ² during weighing (°C).

Air density is calculated according to the following formula:

$$\rho_{\text{air}} = \frac{0.34848 \times p_{\text{atm}} - 0.009 \times RH \times \exp(0.061 \times t_a)}{1000 \times (t + 273.15)} \left(\frac{\text{g}}{\text{ml}} \right) \quad (6.2)$$

where:..... t_a is the air temperature (°C);

p_{atm} the atmospheric pressure (hPa);

RH the relative humidity (%).

The density of deionised water² is calculated according to the following formula:

$$\rho_{\text{water}} = a_5 \times \left[1 - \frac{(t + a_1)^2 \times (t + a_2)}{a_3 \times (t + a_4)} \right] \left(\frac{\text{g}}{\text{ml}} \right) \quad (6.3)$$

where:..... $a_1 = -3.983\,035$ °C;

$a_2 = 301.797$ °C;

$a_3 = 522\,528.9$ (°C)²;

$a_4 = 69.348\,81$ °C;

$a_5 = 0.999\,974\,950$ g/ml; and

t is the temperature of deionised water² (°C).

The volume V_i is calculated using the formula:

$$V_i = m_i \times Z \quad (6.4)$$

6.4 Marking of the measuring instrument with the official mark

Graduated cylinders that have met the requirements of tests carried out in accordance with this Measure of a General Nature shall be marked with an official mark by engraving, etching, sandblasting, printing or any other suitable method that ensures the durability and legibility of the marking.

7. Subsequent verification

Subsequent verification of accuracy class A graduated cylinders is not carried out.

8. Checking of the measuring instrument

When checked, the measuring instrument is subject to the requirements that were applicable at the time it was put into circulation.

When checking measuring instruments pursuant to § 11a of the Metrology Act at the request of a person who may be affected by incorrect measurement, the procedure under Chapter 6 is followed, except for the last sentence of Article 6.1. The test must always be performed if it is technically feasible. The maximum permissible errors specified in Chapter 2 shall apply.

9. Notified standards

For the purposes of specifying the metrological and technical requirements for measuring instruments and the testing methods for their type approval and verification arising from this Measure of a General Nature, the CMI shall notify Czech technical standards, other technical standards or technical documents of international or foreign organisations, or other technical documents containing more detailed technical requirements (hereinafter ‘notified standards’). The CMI shall publish a list of these notified standards associated with the relevant measure, together with the Measure of a General Nature, in a publicly accessible manner (at www.cmi.cz).

Compliance with notified standards or parts thereof is considered, to the extent and under the conditions stipulated by a general measure, to be compliance with the requirements stipulated by this measure to which these standards or parts thereof apply.

Compliance with a notified standard is one of the ways to demonstrate compliance. These requirements may also be met by using another technical solution guaranteeing an equivalent or higher level of protection of legitimate interests.

II. G R O U N D S

Pursuant to § 14(1)(j) of the Metrology Act, and for the implementation of § 6(2), § 9(1) and (9) and § 11a(3) thereof, the CMI has issued this Measure of a General Nature laying down metrological and technical requirements for specified measuring instruments and tests for their type approval and verification – ‘accuracy class A graduated cylinders used for volume checks’.

Decree No 345/2002 specifying measuring instruments for mandatory verification and measuring instruments subject to type approval, as amended, classifies this type of measuring instruments under item 1.3.3 in the annex entitled ‘List of the types of specified measuring instruments’ as measuring instruments subject to type approval and verification.

This legislation (Measure of a General Nature) was notified in accordance with Directive (EU) 2015/1535 of the European Parliament and of the Council of 9 September 2015 laying down a procedure for the provision of information in the field of technical regulations and of rules on Information Society services.

III. I N S T R U C T I O N S

In accordance with § 173(2) AC, no appeal may be lodged against measures of a general nature.

Pursuant to § 172(5) AC, a decision on objections cannot be appealed against.

Compliance of a measure of general nature with legislation may be assessed in review proceedings pursuant to § 94 to § 96 AC. A party to the proceedings may submit a motion for the initiation of review proceedings to the administrative authority that issued the measure of a general nature. If the administrative authority finds no reason to commence the review proceedings, it shall notify the applicant thereof, stating the reasons, within 30 days. Pursuant to Article 174(2) AC, a ruling on the commencement of review proceedings may be issued within three years of the effective date of the measure of a general nature.

IV.
E F F E C T I V E D A T E

This Measure of a General Nature comes into effect on the fifteenth day following the date of posting it on the official notice board (§ 24d of the Metrology Act).

Director General of the Czech Metrology Institute