

Executive summary for the EC (not part of this legislation)

‘Gas flow computers’ may be placed on the market and put into use in the Czech Republic as legally controlled measuring instruments pursuant to Act No 505/1990 on metrology, as amended. Pursuant to the Act, legally controlled measuring instruments are instruments, which are included in the list of the types of legally controlled measuring instruments (Implementing Decree No 345/2002) and, at the same time, intended (by the manufacturer/importer) for measurements of relevance to the protection of public interests in the fields of *consumer protection, contractual relations, imposition of sanctions, fees, tariffs and taxes, health protection, environmental protection, occupational safety or the protection of other public interests protected by special legislation*. This means that their purpose is similar to that used for defining legally controlled products – measuring instruments and non-automatic weighing instruments – under Directives 2014/31/EU and 2014/32/EU. The requirements of this legislation do not apply to measuring instruments not placed on the market in the Czech Republic for the above purposes, defined by Act No 505/1990 on metrology.

The subject matter of the notified legislation is to lay down metrological and technical requirements for the relevant type of legally controlled measuring instruments. This legislation also lays down the tests for the purposes of type approval and verification of this type of legally controlled measuring instruments.

(End of executive summary.)

1. -----IND- 2019 0490 CZ- EN- ----- 20191018 --- --- PROJET

PUBLIC DECREE

As the authority with substantive and territorial jurisdiction in the matter of laying down metrological and technical requirements for legally controlled measuring instruments and stipulating the testing methods for type approval and verification of legally controlled measuring instruments 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 Code of Administrative Procedure (hereinafter the ‘CAP’), the Czech Metrology Institute (hereinafter the ‘CMI’) commenced ex officio proceedings on 4 April 2016 pursuant to § 46 of the CAP, and based on the supporting documents, hereby issues the following:

I.

GENERAL MEASURE

number: 0111-OOP-C083-18

laying down metrological and technical requirements for legally controlled measuring instruments and testing methods for the type approval and verification of legally controlled measuring instruments:

‘gas flow computers’

1 Basic definitions

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

1.1

flow computer

an electronic device, which receives and processes output signals from flow meters and value converters for other inputs

1.2

flow meter

an instrument for measuring the volumetric or mass flow rate of gas

1.3

volumetric flow rate

the volume of gas flowing through the flow meter per unit of time

1.4

mass flow rate

the mass of gas flowing through the flow meter per unit of time

1.5

volume delivered or mass delivered

the volume or mass of gas that has flowed through the flow meter per unit of time

1.6

rated operating conditions

the conditions of use, for which the specified metrological characteristics of the measuring instrument lie within the defined limits

1.7

reference conditions

the conditions of use prescribed for functional tests of the measuring instrument or for comparison between the results of measurement

1.8

base conditions

the specified conditions to which the measured quantity of gas is converted

1.9

compression factor Z

the ratio of the volume of a certain quantity of gas at a specified pressure and temperature and the volume of the same quantity of gas under the same conditions calculated from the ideal gas equation state

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

2 Metrological requirements

The verification of the measuring instruments are subject to the metrological requirements applicable at the time they were put into circulation.

2.1 Rated operating conditions

2.1.1 Ambient temperature range

Gas flow computers must be capable of operating (within the limits of the maximum permissible errors) at least in the temperature range of (-10 to +40) °C.

The ambient temperature range for the gas flow computer must be specified by the manufacturer.

2.1.2 Ambient humidity range

The relative ambient humidity range must be specified by the manufacturer.

2.1.3 Reference conditions

Ambient temperature must be $(20 \pm 3) \text{ }^\circ\text{C}$ and shall not change by more than 1 °C during the test.

Relative ambient humidity must be $(60 \pm 15) \%$ and shall not change by more than 10 % during the test.

2.2 Measuring pressure transducers range

If a pressure transducer is connected to the flow computer in order to measure the static pressure of gas in the measuring system, its measuring range must be appropriate to the needs of the measurement application. An absolute gas pressure transducer must be used for absolute pressures of less than 21 bar. For absolute pressures equal to or greater than 21 bar, a pressure transducer may be used, while the average value of barometric pressure typical at the measuring system’s installation site must be entered into the flow computer.

2.3 Range of the temperature sensor with a transducer

If a temperature transducer is connected to the flow computer in order to measure the temperature of gas in the measuring system, its measuring range must be appropriate to the needs of the measurement application. The minimum gas temperature measuring range is 40 °C.

2.4 Measuring range

The measuring range of a flow computer is given by the range of the flow meter used.

2.5 Maximum permissible error

The maximum permissible errors expressed as a percentage of the measured value and related to the indicated flow rate or quantity of gas delivered are given in Table 1.

The maximum permissible errors are set separately for reference conditions and for the range of the set operating conditions.

Table 1 – Maximum permissible errors

Indication	Reference conditions	Rated operating conditions
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Indication of measured flow rate or measured quantity of gas delivered ^{a)}	±0.50 %	±1.00 %
Indication of calculated flow rate or calculated quantity of gas delivered ^{b)}	±0.20 %	±0.30 %
Indication of the quantities measured using analogue signal – temperature ^{c)}	±0.10 %	±0.20 %
Indication of quantities measured using analogue signal – pressure and other quantities ^{d)}	±0.20 %	±0.50 %
^{a)} The values of input quantities are simulated using measuring instruments or input simulators. ^{b)} The input values are entered as constants. ^{c)} Refers to thermodynamic temperature expressed in degrees Kelvin. ^{d)} Refers to the value measured.		

2.6 Gas flow computer software

The software used in the flow computer must be identifiable (software version) and validated using a validated checking program.

2.7 Analogue inputs of gas flow computers

The analogue inputs of gas flow computers must comply with the requirements given in Table 1.

3 Technical requirements

3.1 Design requirements

All essential components of gas flow computers must be designed in a manner which ensures that the measurement accuracy of the connected flow rate sensor is not degraded.

Flow computers must be capable of withstanding the external environment for which they are intended and obtain satisfactory results in the relevant electromagnetic compatibility tests. If they are intended for use in potentially explosive atmospheres, they shall also be covered by a valid approval for this purpose.

In the case of gas flow computers whose connected elements may be disassembled or replaced, all connections and interfaces between the flow computer and these elements must be secured.

Any interfaces and connections allowing for the connection of additional devices shall not affect the metrological characteristics of the flow computer.

3.2 Indicating device

Gas flow computers must be equipped with a display. The display must be readable within an angle of 15° from the perpendicular to the plane of the window. If the indicating device does not use all digits to indicate cumulative values, every unused digit to the left of the highest significant digit shall indicate zero.

3.2.1 Main indications

The flow computer must be capable of indicating the following on the indicating device:

- the calculated gas flow rate at measurement conditions;
- the calculated gas flow rate at base conditions;
- the volume of delivered gas at measurement conditions;
- the volume of delivered gas at base conditions;

- e) warning indications and alarms.

3.2.2 Additional indications

In addition, the gas flow computer must be capable of indicating or displaying the following parameters, either on the indicating device or a permanently attached information plate with indelible markings, or an external attached indicating device or a combination of the above:

- a) the values of the totalisers;
- b) the method of calculation of the delivered quantity of gas;
- c) conversion to units of energy for fuel gases;
- d) parameters of the gas flow sensor;
- e) parameters of the measured gas (e.g. compression factors, the isentropic exponent, dynamic viscosity, critical gas variables);
- f) methods for calculating the parameters of the measured gas;
- g) base condition values;
- h) the values of the measured quantities (e.g. pressure p and temperature t at measurement conditions);
- i) the version of the flow computer software used, including the checksum.

The identification and units of every quantity or parameter that can be indicated must be clearly displayed on or near the flow computer display.

3.3 Warning indications and alarms

Gas flow computers must be capable of detecting:

- that any of the measured or calculated values are outside the specified ranges,
- that the instrument is operating outside the limits of validity of the computing algorithm;
- that any of the electrical signals are outside the range of the input of the flow computer;
- an expiring battery.

With the exception of the indication of an expiring battery, as long as such a defective operation is detected by the flow computer, any further increase of the volume of gas delivered is not permitted. The volume of delivered gas may continue to increase only if it is possible to accurately identify the quantity that has passed through during the period of defective operation, for example by means of additional 'error volume of delivered gas'.

The resetting of a triggered alarm must only be possible if the cause of the alarm has been eliminated. Resetting must be secured against unauthorised access.

If the flow computer is capable of estimating the quantity of gas passed through the measuring system during the duration of the faulty condition(s), measures must be taken to prevent confusion between estimated values and the values measured during the period without a faulty condition or conditions. The estimated values must be stored in memory and indicated separately.

After the cause for the interruption, alarm or failure no longer exists and the stored values are restored, the gas flow computer must be capable of restarting automatically.

It must be impossible to change the parameters used in the processing of measurements or intended to identify the constituent parts of the system, except by a person authorised to make such changes. There must be a way of monitoring these parameters. Any change to these parameters must either require seals to be broken, or must be recorded by the flow computer together with an identifier specific to the person making the change and the date of the change.

3.4 Flow meter error correction

The gas flow computer may be equipped with flow meter error correction functions. If this function is activated and used, it must be ensured that the flow meter's error curve is relevant to the actual operating conditions at the flow meter's site of installation. This means that the flow meter must be verified under conditions close to those under which it is used in application at the installation site and preferably using the gas used at the installation site, unless the type approval certificate allows another method.

3.5 Input from the flow meter

The flow computer must have an input that can process the signal from the connected flow meter. It is permissible for a single flow computer to process signals from multiple connected flow meters, if its design is adapted for this purpose.

3.6 Methods for the calculation of the compression factor

Only generally accepted and validated methods may be used for the calculation of gas compression factors.

The compression factors or their ratio or constant values must be used in the flow computer whenever it is clear that the static (absolute) pressure value in the measuring system can reach 4 bar.

3.7 Software

Software critical for metrological characteristics of the gas flow computer must be validated, readily identifiable and secured. Evidence of any intervention in the software must be available.

Access to change the software must only be obtainable by using a password or a code that can be updated, or by using a specified device after breaking the official verification mark.

3.8 Security

The flow computer must be constructed in such a way that any intervention able to influence the results of measurement will cause visible damage to the flow computer or its official marks, or activate an alarm, which must be stored in the event register memory.

If access to the authorised or approved settings of the flow computer is secured in electronic form, the following requirements must be fulfilled:

- a) access must only be obtainable by using a password or a code that can be updated or by using a specified device;
- b) the last intervention must be registered in the flow computer's memory; at least 100 interventions must be registered, including the date and time of the intervention and specific identification of the intervention;
- c) it must be possible to obtain access to the intervention(s) registered in the memory. It shall not be possible to erase or overwrite the memory without breaking the official mark or using the security password or code.

All connections and interfaces between the flow computer and the connected elements of the measuring system must be secured.

3.9 Degree of protection provided by enclosure

The gas flow computer shall, by means of suitable construction, provide sufficient protection against contact with dangerous parts, infiltration of foreign particles and water ingress corresponding to the use specified by the manufacturer. The degree of protection provided by the enclosure must be indicated.

3.10 Potentially explosive atmospheres

Gas flow computers intended for use in potentially explosive atmospheres shall comply with the requirements specified in the relevant regulations.

3.11 Electromagnetic compatibility

Gas flow computers shall either not be affected by electrical or electromagnetic interference or shall respond to it in a defined manner (for example by reporting an error, inhibiting measurement, etc.). In addition, they may not emit unwanted electromagnetic fields.

4 Instrument markings

The markings must be placed so that they are clearly visible and must be permanent under normal conditions of use of the flow computer.

4.1 Statutory markings

At least the following information must be indicated on every gas flow computer:

- a) the identification mark or name of the manufacturer;
- b) type designation;
- c) the year of manufacture;
- d) the serial number;
- e) the type approval mark.

A label with the following information may be affixed to a gas flow computer:

- f) the version of the applied computer software;
- g) the parameters of the measured gas;
- h) the ranges of the input sensors used.

4.2 Placement of the official mark

A suitable place must be provided for affixing the official mark(s). The placement of the marks must be specified in the type approval certificate.

The access to any elements or communication ports of the flow computer by means of which the measuring system's metrological parameters may be changed must be appropriately secured.

5 Type approval of the measuring instrument

5.1 Overview of the tests

The process of type approval of a gas flow computer comprises the following tests and activities:

- a) external inspection;
- b) accuracy test under reference conditions;
- c) test of resistance to limit ambient temperatures;
- d) dry heat test;
- e) damp heat test;
- f) test of the effect of supply voltage;
- g) test of the effect of short-time DC power variations;
- h) test of the effect of fast transient/burst disturbances;

- i) test of the effect of surges;
- j) test of the effect of the electromagnetic field;
- k) test of the effect of electrostatic discharge;
- l) test of the effect of conducted disturbances induced by radio-frequency fields;
- m) test of the effect of power frequency magnetic fields;
- n) test of the effect of short-term AC power variations;
- o) vibration resistance test;
- p) shock resistance test;
- q) stability test;
- r) test of warning functions and error states;
- s) test of the protection provided by enclosure.

5.2 External inspection

The following shall be assessed by external inspection of the gas flow computer:

- the completeness of the required technical documentation;
- the conformity of the metrological and technical characteristics specified by the manufacturer in the documentation with the requirements of this regulation specified in Articles 2 and 3;
- the completeness and condition of the gas flow computer according to the prescribed technical documentation;
- conformity of the version of the measuring instrument's calculator software with the version specified by the manufacturer.

5.3 Test conditions during type approval

5.3.1 Requirements for test equipment and validation means

Measuring instruments used as testing equipment shall have valid metrological traceability. The expanded measurement uncertainty (for $k = 2$) of the test equipment must be less than or equal to $\frac{1}{4}$ of the maximum permissible error of the tested measuring instrument or $\frac{1}{4}$ of the maximum permissible error of the relevant analogue input. Control programs must have a valid validation certificate for all the calculation methods used.

5.3.2 Test conditions

Ambient temperature during the test must be within the range of $(20 \pm 3) ^\circ\text{C}$. Changes in ambient temperature throughout the test may not exceed $1 ^\circ\text{C}$.

Relative ambient humidity must be within the range of $(60 \pm 15) \%$. Ambient relative humidity may not change by more than 10% during the test.

These reference conditions must be complied with during accuracy tests of the gas flow computer.

5.4 Functional tests

5.4.1 Accuracy test under reference conditions

5.4.1.1 Accuracy test of the calculator software

The data calculated by the gas flow computer shall be checked at least at five points evenly spaced over the whole range. If multiple variables enter the calculation, various combinations of these variables must be checked. For each input, at least three points evenly spaced over the whole range of the given quantity shall be chosen. For other quantities, values close to their operating points shall be chosen.

The error of the value calculated by the flow computer shall not exceed the maximum permissible errors given in Table 1.

5.4.1.2 Test of accuracy of the analogue inputs

The data on the gas flow computer's analogue inputs shall be checked at least at five points (including points close to the lower and upper limits of the measuring range) evenly spaced over the whole range.

The error on the flow computer's analogue inputs may not exceed the maximum permissible errors given in Table 1.

5.4.2 Test of resistance to limit ambient temperatures

When testing the gas flow computer for resistance to limit temperatures, it shall be subjected to an accuracy test at ambient limit temperatures at points specified according to paragraph 5.4.1.

The ambient temperature value shall correspond to the lower and upper ambient temperature limits specified in 2.1.1 or by the manufacturer.

At each test point and each measurement, the error must be within the maximum permissible errors specified for operating conditions according to Table 1.

After the tests, all sub-functions of the measuring instrument must operate correctly.

5.4.3 Damp heat test

The gas flow computer shall be exposed to the effect of a constant temperature equal to the upper limit temperature of the environmental class and to a constant relative humidity of 93 % for a period of four days. Condensation of water may not occur on the measuring instrument during the test.

At each phase of the test, the gas flow computer shall be subjected to an accuracy test according to paragraph 5.4.1 at a limited number of points, namely:

- a) at reference conditions (before the increase of temperature),
- b) at the end of the upper limit temperature phase,
- c) at reference conditions (after the decrease of temperature).

At each test point and each measurement, before, during and after the test, the error must be within the maximum permissible errors for the reference conditions or, if applicable, the specified operating conditions, according to Table 1.

After the tests, all sub-functions of the measuring instrument must operate correctly.

5.4.4 Damp heat test, cyclic test

The gas flow computer shall be exposed to cyclic temperature variation between temperature at reference conditions and the upper limit temperature of the environmental class. Humidity must be maintained above 95 % during the temperature change and the low temperature phases and above 93 % during the upper limit temperature phases. Condensation of water may occur on the measuring instrument during the test.

At each phase of the test, the gas flow computer shall be subjected to an accuracy test according to paragraph 5.4.1 at a single test point chosen inside the specified field of measurement of the gas flow computer, namely:

- a) at reference conditions (before the cyclic variations),
- b) at reference conditions (after the cyclic variations).

At each test point and each measurement, before and after the test, the error must be within the maximum permissible errors specified for reference conditions in Table 1.

After the tests, all sub-functions of the measuring instrument must operate correctly.

5.4.5 Test of the effect of supply voltage

The test consists of exposing the test equipment to the effect of fluctuation of power conditions while the test equipment operates.

When testing gas flow computers for the effect of fluctuations in the magnitude of supply voltage, the measuring instrument shall operate as designed and its error must be within the maximum permissible errors given in Table 1.

- a) In the case of gas flow computers powered by an AC power supply with one nominal voltage U_N and one nominal frequency f_N , the test shall be carried out sequentially for the following pairs of set points: $[p_{\min}, T_{\min}]$; $[p_{\max}, T_{\min}]$; $[p_{\max}, T_{\max}]$; $[p_{\min}, T_{\max}]$ at power conditions sequentially set to:

Order	Frequency	Voltage
1	f_N	$1.10U_N$
2	f_N	$0.85U_N$
3	$1.02 f_N$	U_N
4	$0.98 f_N$	U_N

- b) In the case of gas flow computers powered by AC power mains with a range of nominal voltages from U_{N1} to U_{N2} and one nominal frequency f_N , the test shall be carried out sequentially for the following pairs of set points: $[p_{\min}, T_{\min}]$; $[p_{\max}, T_{\min}]$; $[p_{\max}, T_{\max}]$; $[p_{\min}, T_{\max}]$ at power conditions sequentially set to:

Order	Frequency	Voltage
1	f_N	$1.10U_N$
2	f_N	$0.85U_N$
3	$1.02 f_N$	U_N
4	$0.98 f_N$	U_N

- c) In the case of gas flow computers powered by external DC voltage with a range from U_{N1} to U_{N2} , the test shall be carried out sequentially for the following pairs of set points: $[p_{\min}, T_{\min}]$; $[p_{\max}, T_{\min}]$; $[p_{\max}, T_{\max}]$; $[p_{\min}, T_{\max}]$ at power conditions sequentially set to U_{N1} and U_{N2} .

Before the error is established, the supply voltage must be stabilised at the set value.

- d) In the case of gas flow computers powered by external batteries, the test shall be carried out sequentially for the following pairs of set points: $[p_{\min}, T_{\min}]$; $[p_{\max}, T_{\min}]$; $[p_{\max}, T_{\max}]$; $[p_{\min}, T_{\max}]$ at power conditions sequentially set to U_{\min} and U_{\max} , where U_{\min} and U_{\max} are values of voltage specified by the manufacturer of the test equipment.

Before the error is established, the supply voltage must be stabilised at the set value.

5.4.6 Test of the effect of short-time DC power variations

The test consists of exposing the test equipment to the effects of short-term DC power variations while the test equipment operates.

Before the application of the disturbance, the error on volume at a single point chosen inside the specified field of measurement of the gas flow computer must be established. The error before the application of the disturbance must be within the maximum permissible errors at reference conditions given in Table 1.

The test shall be carried out sequentially for the following dips and short interruptions:

Order	Residual voltage	Duration
1	0 % U_T	$\frac{1}{2}T$
2	0 % U_T	$1T$
3	70 % U_T	$25T$
4	0 % U_T	$250T$

where U_T is the equipment's rate voltage and T is the power frequency period.

U_T shall be determined as follows:

- a) If a single rated supply voltage is specified for the test equipment, this value shall be used.
- b) If a range of rated voltages is specified for the test equipment and this range does not exceed 20 % of the lower value of the supply voltage range, then any single voltage from the specified range shall be used as the rated supply voltage.
- c) If a range of rated voltages is specified for the test equipment and this range exceeds 20 % of the lower value of the supply voltage range, then the test procedure must be repeated for both the lower and the upper voltage limits specified.

For each combination of test voltage and period of duration, 3 disturbances shall be applied at an interval of 10 seconds or longer. Each series of failures must begin gradually at phase angles of 0° , 90° , 180° and 270° , except for the failure with a duration of $250T$, where the test may only be conducted at 0° .

When testing the effect of variations in the magnitude of supply voltage, in the case of gas flow computers, the measuring instrument shall operate as designed and the difference between the errors recorded before and during the application of the disturbance may not exceed the maximum permissible errors at reference conditions given in Table 1, with the exception of disturbances with a duration of $250T$, in which the activation of the test equipment's safety and warning devices in accordance with Article 3.3 of this regulation is considered to be an acceptable response to the disturbance applied.

5.4.7 Test of the effect of fast transient/burst disturbances

The test consists of exposing the test equipment to the effect of fast transient/burst disturbances while the test equipment is operating.

Before the application of the disturbance, the error on volume at a single point chosen inside the specified field of measurement of the gas flow computer must be established. The error before the application of the disturbance must be within the maximum permissible errors at reference conditions given in Table 1.

The gas flow computer's resistance to fast transient/burst disturbances shall be tested using burst pulses of ± 2 kV on the terminals for connecting AC or DC mains power and ± 1 kV on the terminals for connecting AC mains power that are not connected to DC mains power and on signal, communication and control lines longer than 3 metres. The pulse repetition frequency shall be 5 kHz, the burst disturbance repetition interval shall be 300 ms and the total duration of the test for each of the inputs and one pulse polarity shall be at least 1 minute.

When testing the effect of fast transient/burst disturbances, in the case of gas flow computers, the measuring instrument shall operate as designed and the difference between the errors recorded before and during the application of the disturbance may not exceed the maximum permissible errors at reference conditions given in Table 1.

5.4.8 Test of the effect of surges

The test consists of exposing the test equipment to the effect of a surge while the test equipment operates.

Before the application of the disturbance, the error on volume at a single point chosen inside the specified field of measurement of the gas flow computer must be established. The error before the application of the disturbance must be within the maximum permissible errors at reference conditions given in Table 1.

The gas flow computer's immunity to surges shall be tested using a surge of $t_r/t_h = 1.2/50$ (8/20) μs and max. voltage of ± 2 kV asymmetrically and ± 1 kV symmetrically on AC or DC main supply inputs and ± 1 kV asymmetrically or ± 0.5 kV symmetrically on signal, communication and control lines longer than 30 m or lines placed (even partially) outside buildings regardless of their length. For each polarity and each test voltage level, 3 pulses shall be applied. The pulse repetition period shall be 1 minute or longer.

When testing the effect of surges, in the case of gas flow computers, the measuring instrument shall operate as designed and the difference between the errors recorded before and during the application of the disturbance shall not exceed the maximum permissible errors at reference conditions given in Table 1.

5.4.9 Test of the effect of electromagnetic fields

The test consists of exposing the test equipment to the effects of electromagnetic fields while the test equipment operates.

Before the application of the disturbance, the error on volume at a single point chosen inside the specified field of measurement of the gas flow computer must be established. The error before the application of the disturbance must be within the maximum permissible errors at reference conditions given in Table 1.

The test shall be conducted in the frequency range of 80 MHz to 2,000 MHz in an electromagnetic field with a strength of 10 V/m (the value of the unmodulated carrier). The carrier is amplitude modulated at a depth of 80 %, the modulation signal being a sine wave at a frequency of 1 kHz. The frequency step of the test field wobble shall not be more than 1 %; the delay period for each frequency shall not be less than the time needed to examine the test equipment or for the test equipment to respond to the disturbance; it may not be shorter than 0.5 seconds in any case. The test field is applied to all sides of the enclosure of the test equipment.

When testing the effect of electromagnetic fields, in the case of gas flow computers, the measuring instrument shall operate as designed and the difference between the errors recorded before and during the application of the disturbance may not exceed the maximum permissible errors at reference conditions given in Table 1.

5.4.10 Test of the effect of electrostatic discharge

The test consists of exposing the test equipment to the effects of electrostatic discharges while the test equipment operates.

Before the application of the disturbance, the error on volume at a single point chosen inside the specified field of measurement of the gas flow computer must be established. The error before the application of the disturbance must be within the maximum permissible errors at reference conditions given in Table 1.

The test shall be carried out using a contact discharge of 8 kV or an air discharge of 15 kV.

The discharges shall be applied to the enclosure of the test equipment and the coupling plane adjacent to the test equipment.

When testing the effect of electrostatic discharge, in the case of gas flow computers, the measuring instrument shall operate as designed and the difference between the errors recorded before and during the application of the disturbance shall not exceed the maximum permissible errors at reference conditions given in Table 1.

5.4.11 Test of the effect of conducted disturbances induced by radio-frequency fields

The test consists of exposing the test equipment to the effects of conducted disturbances induced by radio-frequency fields while the test equipment operates.

Before the application of the disturbance, the error on volume at a single point chosen inside the specified field of measurement of the gas flow computer must be established. The error before the application of the disturbance must be within the maximum permissible errors at reference conditions given in Table 1.

The test shall be conducted in the frequency range of 0.15 MHz to 80 MHz at an open circuit voltage of 10 V (the value of the unmodulated carrier). The carrier is amplitude modulated at a depth of 80 %, the modulation signal being a sine wave at a frequency of 1 kHz. The frequency step of the test field wobble shall not be more than 1 %; the delay period for each frequency shall not be less than the time needed to examine the test equipment or for the test equipment to respond to the disturbance; it may not be shorter than 0.5 seconds in any case. The disturbances shall be applied to signal lines longer than 3 metres, all DC mains inputs and outputs and all AC mains inputs and outputs, as well as functional earth connections.

When testing the effect of conducted disturbances induced by radio-frequency fields, in the case of gas flow computers, the measuring instrument shall operate as designed and the difference between the errors recorded before and during the application of the disturbance may not exceed the maximum permissible errors at reference conditions given in Table 1.

5.4.12 Test of the effect of power frequency magnetic fields

The test consists of exposing the test equipment to the effects of the magnetic field while the test equipment operates.

Before the application of the disturbance, the error on volume at a single point chosen inside the specified field of measurement of the gas flow computer must be established. The error before the application of the disturbance must be within the maximum permissible errors at reference conditions given in Table 1.

The test shall be conducted at a frequency of 50 Hz or 60 Hz in a magnetic field with a strength of 100 A/m for a permanently acting field and 1,000 A/m for a short-acting field (exposure time 1 s to 3 s). The test field shall be applied to all sides of the enclosure of the test equipment using a coil positioned so that the test equipment is in the centre of the coil (immersion method).

When testing the effect of electromagnetic fields, in the case of gas flow computers, the measuring instrument shall operate as designed and the difference between the errors recorded before and during the application of the disturbance may not exceed the maximum permissible errors at reference conditions given in Table 1.

5.4.13 Test of the effect of short-time AC power variations

The test consists of exposing the test equipment to the effects of short-term AC power variations while the test equipment is operating.

The test only applies to low voltage DC power supplied to the ports from external DC supply mains. It does not apply to flow computers powered by, for example, an internal battery.

Before the application of the disturbance, the error on volume at a single point chosen inside the specified field of measurement of the gas flow computer must be established. The error before the application of the disturbance must be within the maximum permissible errors at reference conditions given in Table 1.

The test shall be carried out sequentially for the following dips and short interruptions:

Order	Residual voltage	Duration
1	0 % <i>U</i>	10 ms

2	0 % U	30 ms
3	70 % U	300 ms
4	0 % U	1,000 ms

where U is the rated voltage of the device.

The steps of the test at a residual voltage of 0 % U must be conducted when simulating both a disconnection of power supply (high impedance state) and a line short-circuit (low impedance state).

U shall be determined as follows:

- a) If a single rated supply voltage is specified for the test equipment, this value must be used.
- b) If a range of rated voltages is specified for the test equipment and this range does not exceed 20 % of the lower value of the supply voltage range, then any single voltage from the specified range shall be used as the rated supply voltage.
- c) If a range of rated voltages is specified for the test equipment and this range exceeds 20 % of the lower value of the supply voltage range, then the test procedure must be repeated for both the lower and the upper voltage limits specified.

For each combination of test voltage and period of duration, three disturbances shall be applied at an interval of 10 seconds or longer.

When testing the effect of variations in the magnitude of supply voltage, in the case of gas flow computers, the measuring instrument must operate as designed and the difference between the errors recorded before and during the application of the disturbance may not exceed the maximum permissible errors at reference conditions given in Table 1, with the exception of disturbances with a duration of 1 second, in which the activation of the test equipment's safety and warning devices in accordance with Article 3.3 of this regulation is considered to be an acceptable response to the disturbance applied.

5.4.14 Vibration resistance test

During the test of resistance to vibration, before and after being exposed to effects of vibrations, the gas flow computer shall be subjected to the accuracy test at reference conditions according to paragraph 5.4.1 at a limited number of points. While exposed to vibrations, the gas flow computer does not operate.

At each test point and each measurement, the error before and after the test must be within the maximum permissible errors specified for the reference conditions.

After the test of resistance to vibrations has been conducted, all sub-functions of the measuring instrument shall operate correctly.

5.4.15 Shock resistance test

During the test of resistance to shocks, before and after being exposed to effects of shocks, the gas flow computer shall be subjected to the accuracy test at reference conditions according to paragraph 5.4.1 at a single test point chosen inside the specified field of measurement of the gas flow computer.

At each test point and each measurement, the error before and after the test must be within the maximum permissible errors specified for the reference conditions.

After the test of resistance to shocks has been conducted, all sub-functions of the measuring instrument must operate correctly.

5.4.16 Stability test

During the stability test, the gas flow computer shall be exposed to:

- the test of accuracy at reference conditions according to paragraph 5.4.1;

- the effect of 2 cyclic changes in ambient temperature between the minimum and maximum temperatures of the environmental class.

A cyclic ambient temperature change consists of exposing the measuring instrument to the maximum ambient temperature of the environmental class for 1 week and then exposing the measuring instrument to the minimum ambient temperature of the environmental class for 1 week. The changes between the maximum and minimum temperatures must be made in steps of $10 \text{ K}\cdot\text{h}^{-1}$.

After stabilisation at reference conditions for a period of 24 hours, the accuracy test at reference conditions according to paragraph 5.4.1 must be conducted again.

At each test point and each measurement, the absolute value of the difference between the error before and after the stability test may not exceed $\frac{1}{2}$ of the maximum permissible error at reference conditions given in Table 1.

After the stability test has been conducted, all sub-functions of the measuring instrument must operate correctly.

5.4.17 Test of warning functions and error states

The test shall be conducted by simulating the relevant atypical state. It consists of achieving a set of points (simulated states) by increasing and decreasing the chosen parameter in order to verify that warning or error messages are triggered and that the gas flow computer continues to operate correctly and records the quantity of gas delivered under these states.

The warning or error messages must be fully identifiable. The flow computer shall record the cause, date, start hour and end hour of the warning message and must be capable of recording these messages in an appropriate manner. The alarm indications shall remain active until the intervention by an authorised person.

5.4.18 Test of the protection provided by enclosure

The degree of protection by enclosure of a gas flow computer designed for outdoor use which is not intended for installation in a weather-proof cabinet must be at least IP 65.

During the tests of protection by enclosure, the gas flow computer does not operate.

After the tests of protection by enclosure have been conducted, all sub-functions of the measuring instrument shall operate correctly.

6 Initial verification

The initial verification of gas flow computers shall consist of the following tests:

- a) visual inspection;
- b) accuracy test;
- c) test of compatibility of the gas flow computer with the measuring system.

6.1 Visual inspection

The purpose of the visual inspection is to check that:

- the measuring instrument submitted for verification conforms to the approved type;
- the measuring instrument is not mechanically damaged;
- the content and implementation of markings and inscriptions correspond to the information and requirements specified in the type approval certificate for the measuring instrument.

If the measuring instrument fails to meet the visual inspection requirements, no further tests will be performed.

6.2 Test conditions during verification

6.2.1 Test equipment

The equipment referred to in Article 5.3.1 must be used for the test of metrological characteristics.

6.2.2 Test conditions

The tests shall be subject to the requirements under Article 5.3.2.

6.3 Accuracy tests

6.3.1 Accuracy test of the calculator software

The calculation software must be tested using validated programs for the relevant calculation methods. The data calculated by the gas flow computer shall be checked at least at three points evenly spaced over the whole range. If multiple variables enter the calculation, various combinations of these variables must be checked. For each input, at least three points evenly spaced over the whole range of the given quantity shall be chosen. For other quantities, values close to their operating points shall be chosen.

The error of the value calculated by the flow computer shall not exceed the maximum permissible errors given in Table 1.

6.3.2 Test of accuracy of the analogue inputs

The tests of the analogue inputs must be conducted using reference measuring instruments with uncertainties not exceeding $\frac{1}{4}$ the maximum permissible errors of the relevant analogue inputs.

The data on the gas flow computer's analogue inputs shall be checked at least at five points (including points close to the lower and upper limits of the measuring range) evenly spaced throughout the whole range.

The error on the flow computer's analogue inputs may not exceed the maximum permissible errors given in Table 1.

6.3.3 Test of compatibility of the gas flow computer with the measuring system

The test of compatibility of the gas flow computer with the measuring system shall be performed at the installation site of the system for measuring the delivered quantity of gas.

The test shall demonstrate compatibility between the gas flow computer and other elements of the system for measuring the delivered quantity of gas.

Before the flow computer is put into use, the metrological parameter settings must be checked in the flow computer's calculator software, including a check that the parameters are set correctly in relation to the actual design of the measuring system.

Based on the elements of the measuring system identified at the site of installation and their metrological parameters, the overall uncertainty of the measurement of gas flow by the measuring system or the accuracy class of the system for measuring the gas flow rate must be determined.

For applications where the Q_{\min} parameter has yet to be determined, this parameter must be determined as part of the test of compatibility with the elements of the measuring system used and the level of compliance with the installation requirements.

The Q_{\min} parameter must be entered in the flow computer by means of the flow rate value or the corresponding differential pressure value. Then the measuring system may not be permanently operated below this minimum flow rate.

7 Subsequent verification

The subsequent verification procedure is identical to that for initial verification under Chapter 6 except for the test of compatibility of the gas flow computer with the measuring system (chapter 6.3.3), which is not conducted during subsequent verification.

8 Measuring instrument examination

When examining 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 7 shall be followed. The maximum permissible errors used shall be the maximum permissible errors set for operating conditions pursuant to Table 1.

9 Notified standards

For the purposes of specifying metrological and technical requirements for measuring instruments and specifying the testing methods for their type approval and verification arising from this General Measure, 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 attached to the relevant measures, together with the General Measure, in a manner accessible to the public (at www.cmi.cz).

Compliance with notified standards or parts thereof shall be considered, to the extent and under the conditions laid down in this General Measure, as compliance with those requirements laid down in this measure to which these standards or parts thereof apply.

Compliance with notified standards is one way of demonstrating compliance with the requirements. These requirements may also be satisfied using another technical solution guaranteeing the same or higher level of protection of legitimate interests.

II.

GROUND S

The CMI issues this General Measure laying down metrological and technical requirements for legally controlled measuring instruments and tests for type approval, verification and examination of legally controlled measuring instruments – ‘gas flow computers’ – in accordance with § 14(1)(j) of the Metrology Act to implement § 6(2), § 9(1) and (9), and § 11a(3) of the Metrology Act.

Under item 1.3.11(j) in the Annex ‘List of the Types of Legally Controlled Measuring Instruments’ to Implementing Decree No 345/2002 specifying the measuring instruments whose verification is mandatory and measuring instruments subject to type approval, as amended, this type of measuring instruments is classified as instruments subject to mandatory verification.

This legislation (General Measure) 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.

INSTRUCTIONS

In accordance with § 173(2) CAP, no appeals may be made regarding general measures.

In accordance with the provisions of § 172(5) CAP, decisions on objections are final, and appeals may not be made against them.

Compliance of general measures with legislation may be subject to a review process in accordance with §§ 94 to 96 CAP. A party to the proceedings may initiate review proceedings to be conducted by the administrative authority which issued this General Measure. If the administrative authority finds no reason to commence the review proceedings, it shall communicate and provide grounds for this fact within 30 days. Pursuant to § 174(2) CAP, a ruling on the commencement of review proceedings may be issued within three years of the entry into force of the general measure.

IV.

ENTRY INTO FORCE

This General Measure shall enter into force on the fifteenth day following the date of posting it on the official notice board (§ 24d of the Metrology Act).

Czech Metrology Institute
Director General

Posted on:

Removed on:

Entry into force: