SLOVENSKI STANDARD
SIST EN 1776:1999

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Sistemi oskrbe s plinom – Merilne naprave za zemeljski plin – Funkcionalne zahteve

Gas supply systems - Natural gas measuring stations - Functional requirements

Gasversorgung - Erdgasmeßanlagen - Funktionale Anforderungen

Alimentation en gaz - Postes de comptage de gaz naturel - Prescriptions fonctionnelles

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English version

Gas supply systems - Natural gas measuring stations - Functional requirements

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This European Standard was approved by CEN on 27 November 1998.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 234 "Gas supply", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 1999, and conflicting national standards shall be withdrawn at the latest by June 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This European Standard relates to other functional standards in the field of gas supply.

The standard is meant for use by gas professionals with enough understanding of their measurement's objectives and applicable gas techniques. A thorough understanding of this standard is highly desirable before starting the design phase of a new measuring station.

In some cases the billing is done in energy units. A part of the standard is therefore dedicated to calorific value measurement.

By nature, a measuring station is an aggregate of several components. In this standard, it is assumed that each component is in full compliance with applicable EN or ISO standards, if any.

1 Scope

This European standard specifies functional requirements for the design, construction, commissioning, operation and maintenance of new gas measuring stations for non-domestic custody transfer of natural gas as described in ISO 13686 with a design capacity equal to or greater than 500 m^3/h (at base conditions, see 4.1) and for operating pressures equal to or greater than 1 bar (gauge pressure).

NOTE: Installations using diaphragm gas meters as primary measuring instruments are not covered by this standard.

Except for safety and environmental aspects, the extent to which the requirements of this standard are applied should be justified by the economics of the measuring station. Therefore, stations with an annual throughput of equal to or smaller than 300 000 m^3 (at base conditions) are excluded from the scope of this standard.

This European Standard specifies common basic principles for gas supply systems.

Users of this European Standard should be aware that more detailed national standards and/or codes of practice may exist in the CEN member countries.

This European Standard is intended to be applied in association with these national standards and/or codes of practice setting out the above mentioned basic principles.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the next and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of those publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

prEN 1594	Gas supply systems - Pipelines for maximum operating pressure over 16 bar - Functional requirements
prEN 12186	Gas supply systems - Gas pressure regulating stations for transmission and distribution
prEN 12261	Turbine gas meters
prEN 12327	Gas supply systems - Pressure testing, commissioning and decommissioning procedures - Functional requirements
prEN 12405	Gas-volume electronic conversion devices
prEN 12480	Rotary displacement gas meters
prEN 50154	Erection of electrical installations in hazardous areas - Electrical installations in hazardous gas atmospheres (other than mines)
EN 55011	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical radio frequency equipment

EN 55013	Limits and methods of measurement of radio disturbance characteristics of broadcast receivers and associated equipment
EN 55014	Limits and methods of measurement of radio disturbance characteristics of electrical motor-operated and thermal appliances for household and similar purposes; electric tools and similar electric apparatus
EN 55015	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
EN 55020	Electromagnetic immunity of broadcast receivers and associated equipment
EN 55022	Limits and methods of measurement of radio disturbance characteristics of information technology equipment
EN 60079-10	Electrical apparatus for potentially explosive gas atmospheres - Part 10: Classification of hazardous areas
ENV 50140	Electromagnetic compatibility - Basic immunity standard - Radiated, radio-frequency electromagnetic field-immunity test
ENV 50141	Electromagnetic compatibility - Basic immunity standard - Immunity to conducted disturbances induced by radio-frequency fields
ENV 50142	Electromagnetic compatibility - Basic immunity standard - Surge immunity tests
ISO 2186	Fluid flow in closed conduits - Connections for pressure signal transmissions between primary and secondary elements
EN ISO 5167-1 +A1	Measurement of fluid flow by means of pressure differential devices - Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full (ISO 5167-1 : 1991 / AM1 : 1998)
ISO 6141	Gas analysis - Calibration gas mixtures - Certificate of mixture preparation
ISO 6142	Gas analysis - Preparation of calibration gas mixtures - Weighing methods
ISO 6143	Gas analysis - Determination of composition of calibration gas mixtures - Comparison methods
ISO 6711	Gas analysis - Checking of calibration gas mixtures by a comparison method
ISO 6974	Natural gas - Determination of hydrogen, inert gases and hydrocarbon up to C_8 - Gas chromatographic method
ISO 6975	Natural gas - Extended analysis - Gas chromatographic method
ISO 6976	Natural gas - Calculation of calorific values, density, relative density and Wobbe index from composition
ISO 6978	Natural gas - Determination of mercury
ISO/DIS 9857	Petroleum and liquid petroleum products - Continuous density measurement
ISO 10715	Natural gas - Sampling guidelines
ISO 10723	Natural gas - Performance evaluation for on-line analytical systems
ISO/DIS 12213	Natural gas - Calculation of compression factor
ISO/TR 12764	Measurement of fluid flow in closed conduits - Flowrate measurement by means of vortex shedding flowmeters inserted in circular cross section conduits running full
ISO/CD 12765	Measurement of fluid flow in closed conduits - Methods using transit time ultrasonic flowmeters
ISO 13686	Natural gas - Quality designation
IEC 801	Electromagnetic compatibility for industrial-process measurement and control equipment

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1 measuring station: An installation comprising all the equipment including the inlet and outlet pipework as far as the isolating valves and any structure within which the equipment is housed, used for gas measurement in custody transfer.

3.2 measuring system: Complete set of measuring instruments and other equipment assembled to carry out specified measurements.

3.3 measuring instrument: Device intended to be used for measurements, alone or in conjunction with supplementary device(s).

EXAMPLE 1: gas meter

EXAMPLE 2: pressure sensor

EXAMPLE 3: density sensor.

3.4 master meter: Meter of known accuracy used only for comparison checks.

3.5 installation effect: Any difference in performance of a measuring instrument or of the measuring system between the calibration under reference and operating conditions.

3.6 accuracy of measurement: Closeness of the agreement between the result of a measurement and a true value of the measurand.

3.7 maximum permissible errors (of a measuring instrument): Extreme values of an error permitted by specifications, regulations, etc. for a given measuring instrument.

3.8 drift: Slow change of a metrological characteristic of a measuring instrument.

3.9 flow computer: Flow calculating device which indicates the flow rate as integrated volume or mass or energy, etc., at base conditions.

3.10 conversion device: A device consisting of a flow computer and sensors used for converting the volume (flow rate) at operating conditions into a volume (flow rate) at base conditions or to mass (flow rate) or to energy (flow rate) at base conditions, based on either pressure, temperature and gas composition, or on density, or on calorific value.

3.11 availability: Probability, at any time, that the measuring system, or a measuring instrument forming a part of the measuring system, is functioning according to specifications.

3.12 stability: Ability of a measuring system, or a measuring instrument, to perform its functions for a specified period of time.

3.13 Pressures

3.13.1 maximum operating pressure (MOP): Maximum pressure at which a system can be operated continuously under normal conditions.

NOTE: Normal conditions are: no fault in any device or stream.

3.13.2 temporary operating pressure (TOP): Pressure at which a system can be operated temporarily under control of the regulating devices.

3.13.3 maximum incidental pressure (MIP): Maximum pressure which a system can experience during a short time, limited by the safety devices.

3.13.4 design pressure: Pressure on which design calculations are based.

3.14 Temperatures

3.14.1 maximum operating temperature (T_{max}): Maximum temperature at which a system can be operated continuously under normal conditions.

NOTE: Normal conditions are: no fault in any device or stream.

3.14.2 minimum operating temperature (T_{min}): Minimum temperature at which a system can be operated.

3.15 traceability (of a measuring system): 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.

3.16 systematic error: Mean that would result from an infinite number of measurements of the same measurand carried out under repeatability conditions minus a true value of the measurand.

3.17 uncertainty: Parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand.

3.18 fail-safe: Characteristic of a device to go to a safe operating condition when a failure occurs.

4 Physical principles and general requirements

4.1 Base conditions

This standard recommends the use of 101,325 kPa and 288,15 K as base conditions for volume determination and 288,15 K as base condition for calorific value determination.

NOTE: On contractual base other temperatures may be used.

4.2 Flow measurement

Several different physical principles are used to determine gas volume or mass flows. The most commonly used techniques are included in this standard. Other methods may be used. It is the responsibility of the involved parties to

ensure that the method used is traceable, reliable and satisfies the basic gas and energy measurement requirements like accuracy, safety as well as economic criteria.

All meters require both operating density and base density to convert their primary output related to volume at operating conditions to the volumes at base conditions or individual gas component masses and then energy on which commercial transactions are based. Operating density and base density can be measured continuously or can be calculated from gas composition. Calculation of density also requires continuous measurement of temperature and pressure.

Equations are given in annex C.

4.3 Calorific value measurement

The most commonly used techniques for measuring the calorific value of a mass or volume of gas are calorimetry and gas chromatography. Both techniques determine the calorific value of a mass or volume of gas at base conditions.

Details on calorific value measurement are given in clause 6.

4.4 Energy measurement

The output of a measuring system might be in energy units. The energy is the product of the gas quantity and its corresponding calorific value.

4.5 Security of supply

Usually, gas delivery is a continuous process.

If an unintended cessation of gas flow can cause a safety hazard or operational problems the station shall be such that a failure of the measuring system will not stop the gas flow. Extra equipment may be added to improve the security of supply.

4.6 Environmental conditions

4.6.1 General

Gas measuring stations shall be designed, constructed and located such that risk and nuisance to the environment of the station and its operation are kept within acceptable limits.

4.6.2 Environmental noise levels

The operator shall ensure that the environmental noise levels during operation meet locally established limits. In addition no design changes or modifications shall be undertaken which cause the established noise limits to be exceeded.

4.6.3 Work area noise

The operator of the measuring station shall ensure that proper care is taken to prevent noise generated hazards for his personnel.

4.6.4 Ambient temperature

Certain types of equipment such as computers and other electronic devices can operate properly only within a limited temperature range. Where such equipment requires a temperature controlled environment to maintain accuracy the operator shall ensure that the requirements are met.

4.6.5 Ambient pressure

At certain measuring stations, particularly those where gas processing is undertaken, some buildings may require a positive internal pressure to prevent ingress of gas to the interior. The operator shall ensure that for such buildings the requirements are met.

4.6.6 Venting

The design and operation of the station shall be such that the venting of gas to the atmosphere is kept to a mimimum. This shall be assessed during the design stage.

4.7 Safety

4.7.1 Management responsibility

Safety is a management responsibility which implies that all personnel involved in construction, startup, operation and maintenance of the measuring station shall be competent and have adequate safety training. Different areas of responsibility shall be defined.

4.7.2 Warning notices

Warning notices shall be positioned and maintained on, or adjacent to, the measuring system and, additionally, to call attention to any special features of the system.

An easily visible notice shall be positioned and maintained on or near the measuring system to indicate the action to be taken in the event of an escape of gas.

Note: See legal requirements, if any.

4.7.3 Safety procedures

The operator of the measuring station shall have approved safety procedures for the operation and maintenance of the system.

If a measuring station is included in a plant requiring a hazard operation study (HAZOP) the measuring station shall be considered in this study.

4.8 Quality system

During the design and construction phases, quality assurance is essential to ensure the basic integrity of the installation. During operation basic integrity shall be preserved until the installation is de-commissioned.

Any party involved in design, construction, commissioning, operation and maintenance should maintain an appropriate quality management system considering the presence of hazardous areas. Such a system should be agreed on between the parties and may be based e.g. on the EN ISO 9000 series. Inspection and testing of the installation are responsibilities of the operator of the station. National regulations may require that the inspection and testing have to be witnessed and accepted by independent experts.

5 Design and construction

5.1 Design

5.1.1 General

All requirements refering to design, construction and safety shall be in accordance with prEN 12186, as far as appropriate.

5.1.1.1 Measuring stations shall be designed such that the correct functioning is ensured for all specified pressure and temperature ranges (i e MOP, TOP, MIP, minimal pressure at station entrance, T_{min}, T_{max}, ambient temperature) as well as impurities, dusts or condensates present in the gas.

5.1.1.2 A measuring system may be installed as an independent installation or in a station together with other systems.

EXAMPLE: as part of a pressure regulating station.

5.1.1.3 The measuring station shall be designed such that it operates in a fail-safe manner even in the case of an accident. In case of emergency, it shall be possible to shut down the station safely.

5.1.1.4 In general the measuring system should be located in a building, a cabinet or a shelter, but may be installed in the open air, unless such an installation unduly affects the operation or the accuracy.

5.1.1.5 Locations where checking and calibration take place shall have appropriate and stable environmental conditions and shall be free of vibration, so that the checking and calibration may be carried out with the required accuracy.

5.1.1.6 If there is any risk of undesirable reverse flow, the installation of a check valve or similar device to prevent incorrect registration of gas, shall be considered.

5.1.2 Design criteria

5.1.2.1 Table B.1 shows a guideline for the instrumentation for different sizes of measuring systems depending on flow rates.

5.1.2.2 The measuring system selected shall be sufficiently accurate to reduce random and systematic errors to such a level that contractual or legal obligations are fulfilled and that can be justified on technical and economic reasons.

5.1.2.3 Care should be given to avoid pulsating flow and vibrations (resonance). See A.2.

5.1.2.4 The contractual availability of gas flow may require a station by-pass. The number of parallel runs should be such that the maximum flowrate can be measured with one meter out of service whilst the rest of the meters operate within their specifications.

5.1.2.5 If there is a meter run for series connection this shall tie into the main runs upstream and downstream of the required upstream and downstream straight length of the meter.

5.1.2.6 In general it is necessary to insert at least one upstream isolating valve and one downstream isolating valve for each meter run.

5.1.2.7 Where quick acting valves are included in the installation or where the differential pressure across the inlet valve of a meter can exceed 1 bar consideration should be given to provide a small bore bypass. The bypass should be controlled by a slow acting valve to facilitate the pressurization of the meter and associated pipework to avoid damage to the gas meter. If a bypass of the meter is fitted, it should be possible to check it for tightness.

EXAMPLE: by a double block and bleed arrangement or a special valve with a similar check possibility.

5.1.2.8 Depending on size and requirements of the measuring station and in order to increase the availability of the results of measurement the important instruments and/or measuring systems should be duplicated by instruments operating independently. The criteria for this shall be agreed upon between the involved parties.

5.1.2.9 Use of odorants shall not affect the performance of the measuring system.

5.1.2.10 Any peripheral equipment connected to the measuring system shall be designed such that it does not interfere with the measuring process. If odorant injection and measurement are both located in the same station, then the odorant injection should be downstream of the primary measuring instrument. Oscillations in gas pressure and flow caused by a flow regulator or similar, which could affect the primary measuring instrument accuracy, should be minimized at the design stage.

5.1.2.11 The gas temperature in meter running with upstream installed preheaters, shall be maintained within an acceptable range of the set temperature at normal operating conditions and flowrates between 5 % and 100 % of the nominal capacity. The acceptable range of the set temperature will depend on the temperature range specified for the primary measuring instrument and conversion device.

5.1.2.12 Local readouts, recorders and supervisory instrumentation may be connected to a telecommunication system.

5.1.3 Station equipment

According to needs a measuring station is equipped with the following main components:

- measurement equipment to determine the volume, mass or energy flow
- equipment to determine the gas properties
- isolating valves
- monitoring systems, such as recorders and loggers
- pipework, thermal insulation, gaskets and joints
- filters and separators
- equipment for preheating the gas flow
- equipment to reduce the noise level
- equipment for controlling the flow
- change-over equipment to select the appropriate number of meter runs to meet the actual load of the station
- equipment to prevent hydrate and ice formation
- pulsation and vibration damping equipment
- other components.

5.1.4 Station capacity

The design shall be based on the minimum and maximum values for

- volume, mass or energy flow rate
- design pressure and operating pressure
- gas and ambient temperature
- the components of the gas.

5.1.5 Measuring system

5.1.5.1 General

Each measuring station shall be equipped with the instrumentation required for measuring/calculating the variables needed to meet the accuracy requirements.

The measuring system consists of a gas meter and in general also of a conversion device with sensors for the various parameters needed for the determination of the delivered quantity. Depending on the components of the system the output can be:

- volume
- mass
- energy.

In some cases it can be sufficient to use a fixed value for temperature, pressure and gas composition for conversion (see annex C).

Due regard shall be given to possibilities by which field maintenance, checking and recalibration can be carried out.

5.1.5.2 Gas meters

Rotary displacement meters shall comply with prEN 12480, turbine meters with prEN 12261, orifice plate systems with EN ISO 5167-1 +A1. Other types of meters may be used, if their fitness for purpose is documented.

EXAMPLE 1: vortex meters

EXAMPLE 2: ultrasonic meters

The meter shall be selected so that under foreseeable fault conditions within the installation, the maximum working pressure for which the meter has been designed and tested is not exceeded. The meter shall operate satisfactorily over all specified ranges of pressure, temperature and flow.

When selecting a meter annex B should be considered.

5.1.5.3 Conversion devices

If the measurement is done under operating conditions a conversion device shall be fitted to the measuring system. The output of this device may be in volume, mass or energy units at base conditions.

Volume conversion devices shall comply with prEN 12405. Other types of conversion devices may be used if their fitness for purpose is documented.

5.1.5.4 Additional equipment

The measuring system may be fitted with pulse transmitters to generate pulses proportional to measured gas mass or volume for transmission to other equipment such as totalizers, recorders or telemetry equipment. Transmitter range and pulse significance shall be suitable for the application.

Results of measurement may be displayed, recorded and logged as analogue or digital data and may be recorded or stored by suitable devices as function of time or volume.

5.1.6 Layout of pipework

The internal diameter of the pipework of the measuring station should be calculated for gas velocities not higher than 20 m/s.

For the inlet velocity profile 7.2.2 shall be taken into acccount.

5.2 Construction of measuring stations

5.2.1 General

Meters and the associated instrumentation are precision devices and as such they shall be handled with care. They should be stored in a clean dry condition, taking due regard of the manufacturer's recommendations on stacking and handling. The meter inlet and outlet connections shall be protected to prevent ingress of foreign material and moisture and shall remain so prior to installation.

The installation of all instruments shall ensure a proper readable indication.

Metrological tappings shall not be used for any other purposes.

5.2.2 Gas meter installation

Gas meter pipework shall be installed and supported in such a manner to avoid undue stress being placed upon the gas meter connections e.g. by supporting them. Easy removal and replacement of the gas meter shall be possible. In general temporary commissioning filters/sieves shall be positioned upstream of any straight lengths of pipe which precede the gas meters.

5.2.3 Corrosion protection

All components of the measuring station shall be resistant to or protected against, corrosion. For this purpose paint coating or a local cathodic protection system may be used.

5.2.4 Temperature

5.2.4.1 Any temperature sensor shall comply with prEN 12405.

5.2.4.2 For meters other than rotary displacement or orifice meters, thermowells shall be located downstream of the meter in order to avoid velocity profile disturbances at the meter inlet.

5.2.4.3 Whenever a thermowell is installed, consideration shall be given to fit in a spare thermowell for use during calibration. If a spare is fitted for calibration, it should be at an angle to the primary thermowell.

5.2.4.4 To ensure good temperature measurement, thermowells should protrude into the pipework to about one third of the nominal bore. However, on large diameter pipes (larger than 300 mm, where resonant vibrations of the thermowell are known to be a problem) the design of the thermowell can restrict the depth of insertion. In this case little accuracy will be lost provided the thermowells protrude at least 75 mm into the gas flow.

5.2.4.5 In order to ensure that the measured temperature at the thermowell is the same as that of the gas passing through the meter, it can be necessary to insulate the external part of the thermowell and the pipework for a suitable distance downstream and/or upstream of the meter. The necessity to do so depends for a large part on the expected differences in gas and ambient temperature in a specific measuring station and on the desired accuracy.

5.2.4.6 If fitted, thermowells shall be protected against ingress of water and should be filled with a heat conducting material.

5.2.5 Pressure and differential pressure

5.2.5.1 Any pressure sensor shall comply with prEN 12405.

5.2.5.2 In order to ensure accurate measuring care shall be given to the installation of pressure and differential pressure sensors. In case of a gas meter other than an orifice plate, the pressure shall be taken from the meter pressure tapping, marked p_m.

5.2.5.3 The mounting shall be according to ISO 2186 and to the manufacturer's specifications and mechanical stress shall not be imported to the sensor by the installation nor by the sensing lines. Low points in the sensing lines to the sensors shall be avoided so that liquid or dirt cannot collect in them and cause false pressure readings.

5.2.5.4 The sensor shall be installed to be free from mechanical vibration.

5.2.5.5 Field maintenance, checking and recalibration require, among others, the possibility to isolate the sensor from the line and to apply a reference test pressure.

The pressure connections for differential pressure sensors should preferably be separated from all other pressure connections. However, pressure and differential pressure sensors may have a common connection.

In order to avoid errors in the pressure measurement, sensing lines and sampling lines shall not be combined. In all cases the pressure connection to the sensor shall incorporate a valve which will permit maintenance without the need to shut down the whole installation. It should be capable of being sealed in the open position to prevent unauthorized isolation which could affect the overall accuracy.

5.2.6 Density

5.2.6.1 Density sensors for operating conditions

Density sensors, where fitted, shall comply with ISO/DIS 9857.

Any differences between the operating conditions (temperature, pressure) in the pipework and in the sampling line shall be compensated for. Care shall be given to provide each density sensor with dry and clean sample gas.

In case of a gas meter other than an orifice plate, the sample gas flow to the density sensor shall be taken from the meter pressure tapping, marked p_m. For orifice plates the upstream pressure tapping is recommended in EN ISO 5167-1 +A1.

Any sample gas flow to the density sensor shall be so low that it has no influence on other measurement.

In case of meters other than rotary displacement meters, density sensors built into the pipework shall be located downstream of the gas meter to avoid velocity profile disturbances at the meter inlet. If this cannot be achieved, the meter should be calibrated including its upstream pipework.

The sampling line from the p_m tapping to the density sensor shall be as short as possible. The line shall be thermally insulated to minimize any ambient temperature effect.

In order to ensure that the measured density at the density sensor is the same as that of the gas passing through the gas meter, it can be necessary to insulate the external part of the density sensor and the pipework for a suitable distance

upstream and downstream of the gas meter. The necessity to do so depends for a large part on the expected differences in gas and ambient temperature in a specific measuring station and on the desired accuracy.

The density sensor shall be free from excessive mechanical vibration to ensure that additional measurement deviations will be kept within the limits of uncertainty of the calibration method.

Field maintenance, checking and recalibration require, among others, the possibility to isolate the density sensor from the pipework and to apply a reference test pressure or to evacuate the density sensor. If the actual density is to be calculated from the gas pressure and temperature and the gas composition for checking purposes, a possibility to measure pressure and temperature and to take a representative gas sample shall be available.

The density sensor shall contain provision for the temperature of the gas inside the cell to be measured in order to confirm that there is no difference between the gas temperature in the pipework and in the density sensor . Measured temperature difference should be compensated by a correction.

5.2.6.2 Density sensors for base conditions

Each tapping for the measurement of density at base conditions shall be designed for the gas sample to be taken from the flowing gas at a representative point. Guidelines for the design and operation of sampling systems are described in ISO 10715.

To avoid delay time in sample flow, the sampling line to each density sensor for the measurement of the density at base conditions shall be as short as possible and shall have a small diameter (typically 6 mm to 10 mm).

Care shall be given to provide each density sensor with dry and clean sample gas.

Due regard shall be given to possibilities by which field maintenance, checking and recalibration can be carried out. That requires the possibility to isolate the density sensor from the pipework and to apply a reference test gas. Double block and bleed valves should be used.

Any sample gas flow to the density sensor shall be so low that it has no influence on other measurement.

5.2.7 Additional equipment

5.2.7.1 Other components shall not impair the metrological operation of the measuring station.

Example: heater, filter, valves

5.2.7.2 Meter isolating and bypass valves should be fitted with a position indicator and also clear indication of the direction of operation for opening or closing the valve should be given. Such valves (valves of double block and bleed type) shall be designed for leakage testing while the valves are in place. To operate a valve there should be the option to install an actuator. However, it shall be possible to operate the valve by hand or by local operation of the actuator under all circumstances.

5.2.7.3 If dust and/or fluids may influence the results of measurement, suitable filters and/or separators shall be installed upstream the measuring system.

5.2.7.4 If pressure reduction or flow control cause hydrate or ice formation which might affect the operation of the measuring station, a heater or other suitable equipment such as a methanol injection system shall be installed.

5.2.7.5 During normal operation of the measuring station bypassing the measuring system is not permitted. The bypass valve should normally be of a type that is capable of operating slowly to facilitate smooth gas flow control, if the meter is put into or taken out of operation.

5.2.7.6 Where a meter bypass is installed it shall be secured in the closed position. A notice should be fitted adjacent to the valve giving the necessary instructions to the operator for its use in an emergency.

Provision shall be made for the depressurization of a measuring system.

5.2.8 Electrical equipment

The electrical equipment shall comply with the applicable European standards.

The possible hazardous area shall be classified according to EN 60079-10. In the case where a hazardous area exists any electrical installation there shall comply with prEN 50154.

6 Calorific value measurement

6.1 General

Various techniques can be used to get calorific values, both by indirect and direct measurement methods. Based on results of measurement calorific values for billing purposes can also be calculated within a grid for places, where measurement is not economical.