SLOVENSKI STANDARD
oSIST prEN 16726:2014

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Infrastruktura za plin - Kakovost zemeljskega plina - Skupina H

Gas infrastructure - Quality of natural gas - Group H

Gasinfrastruktur - Beschaffenheit von Erdgas - Gruppe H

Infrastructures gazières - Qualité du gaz naturel - Groupe H

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ICS:

75.060	Zemeljski plin	Natural gas

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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Contents

Foreword

This document (prEN 16726:2014) has been prepared by Technical Committee CEN/TC 234 “Gas infrastructure”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

The need for a European Standard concerning the specification of the quality of gases of group H of the second family as classified in EN 437 is derived from the mandate M/400 issued to CEN by the European Commission.

According to this mandate the goal is to define standards that are as wide as possible within reasonable costs. This means that the standards enhance the free flow of gas within the internal EU market, in order to promote competition and security of supply minimizing the negative effects on gas infrastructure and gas networks, efficiency and the environment and allow the maximum number of appliances to be used without compromising safety.

1 Scope

This European standard specifies gas quality characteristics, parameters and their limits, for gases classified as group H, as in EN 437:2003+A1:2009.

This standard does not cover gases conveyed on isolated networks or gases prior to their entry in a transmission network in Europe.

This European standard is applicable to gases that are to be transmitted, stored, distributed and used.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 6326-1, *Natural gas — Determination of sulfur compounds — Part 1: General introduction*

EN ISO 6326-3, *Natural gas — Determination of sulfur compounds — Part 3: Determination of hydrogen sulfide, mercaptan sulfur and carbonyl sulfide sulfur by potentiometry*

EN ISO 6326-5, *Natural gas — Determination of sulfur compounds — Part 5: Lingener combustion method*

EN ISO 6327, *Gas analysis — Determination of the water dew point of natural gas — Cooled surface condensation hygrometers*

EN ISO 6974-1, *Natural gas — Determination of composition with defined uncertainty by gas chromatography — Part 1: General guidelines and calculation of composition*

EN ISO 6974-2, *Natural gas — Determination of composition with defined uncertainty by gas chromatography — Part 2: Uncertainty calculations*

EN ISO 6974-3, *Natural gas — Determination of composition with defined uncertainty by gas chromatography — Part 3: Determination of hydrogen, helium, oxygen, nitrogen, carbon dioxide and hydrocarbons up to C_8 using two packed columns*

EN ISO 6974-4, *Natural gas — Determination of composition with defined uncertainty by gas chromatography — Part 4: Determination of nitrogen, carbon dioxide and C1 to C5 and C6+ hydrocarbons for a laboratory and on-line measuring system using two columns*

EN ISO 6974-5, *Natural gas — Determination of composition with defined uncertainty by gas chromatography — Part 5: Determination of nitrogen, carbon dioxide and C1 to C5 and C6+ hydrocarbons for a laboratory and on-line process application using three columns*

EN ISO 6974-6, *Natural gas — Determination of composition with defined uncertainty by gas chromatography — Part 6: Determination of hydrogen, helium, oxygen, nitrogen, carbon dioxide and C_1 to C_8 hydrocarbons using three capillary columns* EN ISO 6975, *Natural gas — Extended analysis — Gas-chromatographic method*

EN ISO 6976, *Natural gas — Calculation of calorific values, density, relative density and Wobbe index from composition*

EN ISO 10101-1, *Natural gas — Determination of water by the Karl Fischer method — Part 1: Introduction*

EN ISO 10101-2, *Natural gas — Determination of water by the Karl Fischer method — Part 2: Titration procedure*

EN ISO 10101-3, *Natural gas — Determination of water by the Karl Fischer method — Part 3: Coulometric procedure*

EN ISO 13443, *Natural gas — Standard reference conditions*

EN ISO 15970, *Natural gas — Measurement of properties — Volumetric properties: density, pressure, temperature and compression factor*

EN ISO 15971, *Natural gas — Measurement of properties — Calorific value and Wobbe index*

EN ISO 18453, *Natural gas — Correlation between water content and water dew point*

EN ISO 19739, *Natural gas — Determination of sulfur compounds using gas chromatography*

ISO 23874, *Natural gas — Gas chromatographic requirements for hydrocarbon dewpoint calculation*

ISO/TR 12148, *Natural gas — Calibration of chilled mirror type instruments for hydrocarbon dewpoint (liquid formation)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
gas distribution network
pipeline network including piping above and below ground and all other equipment necessary to supply the gas to the consumers

Note to entry: The terms of "system" and "network" are often interchanged and can therefore be considered synonymous.

[Source: EN 1594:2013, 3.11, modified]

3.2
gas transmission network
pipeline network including piping above and below ground and all other equipment necessary to supply the gas to the gas distribution networks and some industrial consumers

Note 1 to entry: The terms of "system" and "network" are often interchanged and can therefore be considered synonymous.

Note 2 to entry: The terms of "transportation" and "transmission" are often interchanged and can therefore be considered synonymous.

[Source: EN 1594:2013, 3.13, modified]

3.3
isolated network
network where production, transmission, distribution and utilization of gas are combined

[Source: EASEE-gas CBP 2005-001-02-3, Introduction 2nd para, modified]

3.4
dry network
gas network in which no liquid water is present

3.5
entry point
point at which gas enters a gas distribution or gas transmission system

3.6
cross-border point
point at which national obligations governing a gas transmission system change from one country to another

3.7
gas quality
attribute of gas defined by its composition and its physical properties

[Source: ISO 14532:2005, 2.1.1.14, modified]

3.8
gross calorific value
energy released as heat by the complete combustion in air of a specified quantity of gas, in such a way that the pressure p_1 at which the reaction takes place remains constant, and all the products of combustion are returned to the same specified temperature t_1 as that of the reactants, all of these products being in the gaseous state except for water formed by combustion, which is condensed to the liquid state at t_1

[Source: EN ISO 14532:2005, 2.6.4.1, modified]

3.9
relative density
quotient of the mass of a gas, contained within an arbitrary volume, and the mass of dry air of standard composition (defined in EN ISO 6976[22]) which would be contained in the same volume at the same reference conditions

[Source: EN ISO 14532:2005, 2.6.3.2]

3.10
wobbe index
calorific value, on a volumetric basis, at specified reference conditions, divided by the square root of the relative density at the same specified metering reference conditions

Note to entry: In the absence of any qualifier, the term "Wobbe index" is taken to mean the gross Wobbe index.

[Source: EN ISO 14532:2005, 2.6.4.4, modified]

3.11
total sulfur
total concentration of sulfur in gas

[Source: Source: EN ISO 14532:2005, 2.5.3.3.17, modified]

3.12
mercaptan
organic sulfur compound with the general formula R-SH (where R is the alkyl group), either naturally present or added as an odorant to gas

[Source: EN ISO 14532:2005, 2.5.3.3.9]

3.13
mercaptan sulfur
concentration of sulfur bonded in the form of a mercaptan in gas

[Source: EN ISO 14532:2005, 2.5.3.3.10, modified]

3.14
water dew point temperature
temperature above which no condensation of water occurs at a specified pressure

[Source: EN ISO 14532:2005, 2.6.5.1.1]

3.15
hydrocarbon dew point temperature
temperature above which no condensation of hydrocarbons occurs at a specified pressure

[Source: EN ISO 14532:2005, 2.6.5.2.1]

3.16
maximum operating pressure
maximum pressure at which a network can be operated continuously under normal conditions

Note to entry: Normal conditions are: no fault in any device or stream.

(Source: EN 1594:2013, 3.2.3, modified)

3.17
Methane Number
MN
rating indicating the knocking characteristics of a fuel gas

[Source: EN ISO 14532:2005, 2.6.6.1]

3.18
odorisation
addition of odorants to gas (normally odourless) to allow gas leaks to be recognized by smell at trace levels (before accumulating to dangerous concentrations in air)

[Source: ISO 14532:2005, 2.8.1, modified]

3.19
odorant
"strong" smelling organic chemical or combination of chemicals (e.g. sulfur compounds) added to fuel gases to impart a characteristic and distinctive (usually disagreeable) warning odour so as to enable the detection of gas leaks by smell

[Source: ISO 14532:2005, 2.8.2]

4 Reference conditions

Unless stated otherwise all volumes are for the real dry gas at ISO Standard Reference conditions of 15 °C and 101,325 kPa.

Unless stated otherwise all gross calorific values and gross Wobbe indices are for the real dry gas at ISO reference conditions of 15 °C (combustion) and 15 °C and 101,325 kPa (metering).

In assessing compliance with this European standard parameters should be determined directly at ISO standard reference conditions. If the properties are only available at other reference conditions and the actual gas composition is not known then conversion to ISO standard reference conditions shall be carried out using the procedure described in EN ISO 13443.

5 Requirements

With the exception of Wobbe index, gas compliant with the requirements of Table 1 shall be considered acceptable for conveyance, whilst gas not compliant with these requirements may not be considered acceptable for conveyance.

For Wobbe index gas not compliant with the limit range in Table 1 may not be considered acceptable for conveyance. However, gas that is compliant with the limit range could not be acceptable for conveyance in some gas networks in some countries. Thus the implementation of this European standard shall be subject to national assessment of the ability to accept all or part of the gases compliant with this European standard, taking into account its end-use.

NOTE The Wobbe index range in Table 1 will not always allow gas flow throughout Europe due to local differences.

Table 1 — Requirements

Parameter	Unit	Limits		Relevant standards
		Min.	Max.	
Wobbe index	MJ/m^3	46,44	54,00	EN ISO 6976, EN ISO 15971
Relative density	no unit	0,555	0,70	EN ISO 6976, EN ISO 15970
Total sulfur without odorant	mg/m^3	not applicable	20	EN ISO 6326-5, EN ISO 19739
Hydrogen sulfide + Carbonyl sulfide (as sulfur)	mg/m^3	not applicable	5	EN ISO 6326-1, EN ISO 6326−3, EN ISO 19739
Mercaptan sulphur without odorant	mg/m^3	not applicable	6	EN ISO 6326-3, EN ISO 19739
Oxygen	mol/mol	not applicable	0,001 % or 1% (see below)	EN ISO 6974-3, EN ISO 6974−6, EN ISO 6975
	At network entry points and cross border points between CEN member states the maximum mole fraction of oxygen shall be no more than 0,001 % mol/mol. However, at entry points where the gas entering will not flow to another member state's network through a cross border point, a higher National limit of up to 1 % mol/mol may be applied, provided that the network is a dry network and not connected to installations sensitive to higher levels of oxygen, e.g. underground storage systems.			
Carbon dioxide	mol/mol	not applicable	2,5 % or 4% see below	EN ISO 6974-1 to -6, EN ISO 6975
	At network entry points and cross border points between CEN member states the maximum mole fraction of carbon dioxide shall be no more than 2,5 % mol/mol. However, at entry points where the gas entering will not flow to another member state's network through a cross border point, a higher National limit of up to 4 % mol/mol may be applied, provided that the network is a dry network and not connected to installations sensitive to higher levels of carbon dioxide, e.g. underground storage systems.			

Table 1 *(continued)*

Parameter	Unit	Limits		Relevant standards
		Min.	Max.	
Hydro carbon dew point temperature from 0,1 to 7 MPa absolute pressure	°C	not applicable	-2	EN ISO 23874, ISO 12148,
Water dew point temperature at 7 MPa absolute pressure or at absolute maximum operating pressure if less than 7 MPa	°C	not applicable	-8	EN ISO 6327, EN ISO 18453, EN ISO 10101-1 to -3
Methane number	no unit	65	not applicable	see normative Annex A
Contaminants	The gas shall not contain constituents other than listed in Table 1 to the extent that it cannot be transported, stored and/or utilized without quality adjustment or treatment			

Test methods other than those listed in the relevant standards column in Table 1 may be applied, provided their fitness for purpose can be demonstrated.

For sulfur, water and hydrocarbon dew point temperature, hydrogen as well as sampling reference additional information is given in the dedicated Annexes B to E.

Annex A
(normative)

Calculation of methane number of gaseous fuels for engines

A.1 Introduction

The methane number of a gaseous fuel can be calculated from its composition according to several different methods, all of which can give different results. For the purposes of compliance with this European standard the methodology described in this Annex shall be employed.

The method is based on the original data of the FVV research program performed by AVL /1/ but employs amendments implemented in 2005 and 2011 by MWM. These amendments have been unpublished until the publication of this European standard.

The method requires input of composition in the form of volume fractions at reference conditions of 0°C and 101.325 kPa and expressed as a percentage. Composition is more likely to be available either as mole fraction (e.g., in the natural gas transmission and distribution industry) or as mass fraction (e.g., in the automotive fuel industry) and conversion to volume fraction shall be performed using the methods in EN ISO 14912 Gas analysis — Conversion of gas mixture composition data.

Numerical examples are provided so as to enable software developers to validate implementations of the methodology described in this annex. As an aid to validation, a relatively large number of decimal places has been retained. For expression of the final result rounding to zero decimal points is recommended.

A.2 Calculation of methane number

A.2.1 Applicability

The method described in this European Standard is applicable to gaseous fuels comprising the gases listed in A.2.2 a), together with nitrogen and carbon dioxide. The numerical examples provided in this annex are appropriate to gases of the second family and hence consider mixtures comprising methane, ethane, propane, butane, nitrogen and carbon dioxide. Hydrogen is also included in one example because of the growing interest in injection of hydrogen into gas pipelines.

Oxygen and water vapour shall be ignored and the fuel gas composition shall be calculated on a dry, oxygen-free basis.

A.2.2 General approach

The methane number of a gaseous fuel is calculated from its composition in five steps. The steps are outlined below and discussed more fully in turn in A.3. Additional examples are discussed in A.4 and A.5. A.6 provides results of calculations for further software validation purposes.

a) The composition of the gaseous fuel is simplified by converting it into an inert-free mixture comprising the combustible compounds carbon monoxide, ethylene, propylene, hydrogen sulphide, hydrogen, propane, ethane, butane and methane.

   For gases of the second family conveyed in pipeline systems carbon monoxide, ethylene, propylene, hydrogen sulphide are unlikely to be present at concentrations that would impact on methane number and can be ignored.

b) The simplified mixture is sub-divided further into a number of partial ternary mixtures. The number and particular partial ternary mixtures chosen is decided by inspection of available ternary systems in a given order, including those systems that contain the relevant combustible compounds. Selection is ceased when all combustible compounds are contained in at least two ternary systems.

c) The composition and fraction of the selected partial mixtures is adjusted iteratively so as to minimise the difference between the methane numbers of each partial mixture.

d) The methane number of the simplified mixture is determined from the weighted average of the methane number of the selected partial mixtures.

e) Finally, the methane number of the gaseous fuel is calculated by correcting the methane number of the simplified mixture to allow for the presence of inerts in the original fuel gas.

A.3 Example 1: H-gas

A.3.1 Simplification of the composition of the gaseous fuel

The description of the calculation is illustrated by reference to an H-gas of composition shown in Table A.1. The composition of the gas (Table A.1, Column 1) is simplified by increasing the quantity of butanes to allow for the presence of butadiene, butylene, pentanes and hydrocarbons of carbon number greater than 5. The adjustment made is as follows:

— Butadiene and butylene are replaced with an equivalent amount of butanes by multiplying their quantities by 1.

— Pentanes are replaced with an equivalent amount of butanes by multiplying the quantity of pentanes by 2.3.

— Hydrocarbons of carbon number greater than 5 (“hexanes+”) are replaced with an equivalent amount of butanes by multiplying the quantity of hexanes+ by 5.3.

In the case of Example 1 the quantity of butanes is:

i) *0.2100 + 0.1900 + (0.0400 + 0.0500) x 2.3 + 0.0600 x 5.3*

ii) *0.9250 (Table A.1, Column 2)*

The simplified mixture is then re-normalised to 100% (Table A.1, Column 3).

A.3.2 Selection of the ternary systems

A.3.2.1 Ternary mixtures

The ternary mixtures are chosen from the following list:

A1: Methane – Hydrogen – Ethane

A2: Propane – Ethane – Butane

A3: Hydrogen – Propane - Propylene

A4: Methane – Ethane – Propane

A5: Methane – Hydrogen – Propane

A6: Methane – Hydrogen – Butane

A7: Methane – Propane – Butane

A8: Methane – Ethane – Butane

A9: Methane – Ethylene – Butane

A10: Methane – Hydrogen Sulphide – Butane

A11: Methane – Ethane – Hydrogen Sulphide

A12: Methane – Propylene