SLOVENSKI STANDARD

SIST EN ISO 12213-1:2005

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Zemeljski plin ï Izraļ un kompresijskega faktorja ï 1. del: Uvod in smernice (ISO 12213-1:1997)

Natural gas - Calculation of compression factor - Part 1: Introduction and guidelines (ISO 12213-1:1997)

Erdgas - Berechnung von Realgasfaktoren - Teil 1: Einführung und Leitfaden (ISO 12213 -1:1997)

Gaz naturel - Calcul du facteur de compression - Partie 1: Introduction et directives (ISO 12213-1:1997)

Ta slovenski standard je istoveten z: **EN ISO 12213-1:2005**

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75.060	Zemeljski plin	Natural gas

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English version

Natural gas - Calculation of compression factor - Part 1: Introduction and guidelines (ISO 12213-1:1997)

Gaz naturel - Calcul du facteur de compression - Partie 1: Introduction et directives (ISO 12213-1:1997)

Erdgas - Berechnung von Realgasfaktoren - Teil 1: Einführung und Leitfaden (ISO 12213-1:1997)

This European Standard was approved by CEN on 17 April 2005.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

The text of ISO 12213-1:1997 has been prepared by Technical Committee ISO/TC 193 "Natural gas" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 12213-1:2005 by CMC.

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of an identical text or by endorsement, at the latest by November 2005, and conflicting national standards shall be withdrawn at the latest by November 2005.

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

Endorsement notice

The text of ISO 12213-1:1997 has been approved by CEN as EN ISO 12213-1:2005 without any modifications.

INTERNATIONAL STANDARD

ISO 12213-1

First edition
1997-12-01

Natural gas — Calculation of compression factor —

Part 1:
Introduction and guidelines

Gaz naturel — Calcul du facteur de compression —

Partie 1: Introduction et directives

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 12213-1 was prepared by Technical Committee ISO/TC 193, *Natural gas*, Subcommittee SC 1, *Analysis of natural gas.*

ISO 12213 consists of the following parts, under the general title *Natural gas — Calculation of compression factor*:

— *Part 1: Introduction and guidelines*

— *Part 2: Calculation using molar-composition analysis*

— *Part 3: Calculation using physical properties*

Annex A forms an integral part of this part of ISO 12213. Annexes B and C are for information only.

Natural gas — Calculation of compression factor —

Part 1:
Introduction and guidelines

1 Scope

This International Standard specifies methods for the calculation of compression factors of natural gases, natural gases containing a synthetic admixture and similar mixtures at conditions under which the mixture can exist only as a gas.

The standard is in three parts: part 1 gives an introduction and provides guidelines for the methods of calculation described in parts 2 and 3.

Part 2 gives a method for use where the detailed molar composition of the gas is known. Part 3 gives a method for use where a less detailed analysis, comprising superior calorific value (volumetric basis), relative density, carbon dioxide content and (if non-zero) hydrogen content, is available.

Both methods are applicable to dry gases of pipeline quality within the range of conditions under which transmission and distribution, including metering for custody transfer or other accounting purposes, are normally carried out. In general, such operations take place at temperatures between about 263 K and 338 K (approximately – 10 °C to 65 °C) and pressures not exceeding 12 MPa (120 bar). Within this range, the uncertainty of prediction of both methods is about ± 0,1 % provided that the input data, including the relevant pressure and temperature, have no uncertainty.

NOTE — Pipeline quality gas is used in this International Standard as a concise term for gas which has been processed so as to be suitable for use as industrial, commercial or domestic fuel. Although there is no formal international agreement upon the composition and properties of a gas which complies with this concept, some quantitative guidance is provided in 5.1.1. A detailed gas quality specification is usually a matter for contractual arrangements between buyer and seller.

The method given in part 2 is also applicable (with increased uncertainty) to broader categories of natural gas, including wet or sour gases, within a wider range of temperatures and to higher pressures, for example at reservoir or underground storage conditions or for vehicular (NGV) applications.

The method given in part 3 is applicable to gases with a higher content of nitrogen, carbon dioxide or ethane than normally found in pipeline quality gas. The method may also be applied over wider ranges of temperature and pressure but with increased uncertainty.

For the calculation methods described to be valid, the gas must be above its water and hydrocarbon dewpoints at the prescribed conditions.

The standard gives all of the equations and numerical values needed to implement both methods. Verified computer programmes are available (see annex B).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 12213. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 12213 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6976:1995, *Natural gas — Calculation of calorific values, density, relative density and Wobbe index from composition*.

ISO 13443:1996, *Natural gas — Standard reference conditions*.

3 Definitions

For the purposes of the various parts of this International Standard, the following definitions apply.

3.1 compression factor, Z: The ratio of the volume of an arbitrary mass of gas, at a specified pressure and temperature, to the volume of the same mass of gas under the same conditions as calculated from the ideal-gas law, as follows:

$$Z = V_m(\text{real}) / V_m(\text{ideal}) \quad \text{. . . (1)}$$

where $V_m(\text{ideal}) = RT/p$ . . . (2)

Thus, $Z(p, T, y) = pV_m(p, T, y)/(RT)$ . . . (3)

where

- p is the absolute pressure;
- T is the thermodynamic temperature;
- y is a set of parameters which uniquely characterizes the gas (in principle, the latter may be the complete molar composition or a distinctive set of dependent physico-chemical properties, or a mixture of both);
- V_m is the molar volume of the gas;
- R is the molar gas constant in coherent units.

The compression factor is a dimensionless quantity usually close to unity.

NOTE — The terms “compressibility factor” and “Z-factor” are synonymous with compression factor.

3.2 density, ρ: The mass of a given quantity of gas divided by its volume at specified conditions of pressure and temperature.

3.3 molar composition: The term used when the proportion of each component in a homogeneous mixture is expressed as a mole (or molar) fraction, or mole (molar) percentage, of the whole.

Thus the mole fraction x_i of component i is the ratio of the number of moles of component i in a given volume of a mixture to the total number of moles of all the components in the same volume of the mixture. One mole of any chemical species is the amount of substance which contains the relative molecular mass in grams. A table of recommended values of relative molecular masses is given in ISO 6976.

For an ideal gas, the mole fraction (or percentage) is identical to the volume fraction (or percentage), but this is not in general a sufficiently accurate approximation to real-gas behaviour for the purposes of this International Standard.

3.4 molar calorific value, H**:** The amount of heat which would be released by the complete combustion in air of the hydrocarbons in one mole of natural gas in such a way that the pressure at which the reaction takes place remains constant and all the products of combustion are returned to the same specified temperature 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 the specified temperature.

Note that the molar calorific value only includes the hydrocarbons in the natural gas, i.e. inert components (primarily nitrogen, carbon dioxide and helium) and other combustible components (such as hydrogen and carbon monoxide) are excluded.

The specified temperature is 298,15 K (25 °C) and the reference pressure is 101,325 kPa.

The term “molar heating value” is synonymous with “molar calorific value”.

3.5 superior calorific value, H_S (volumetric basis)**:** The amount of heat which would be released by the complete combustion in air of all the combustible components in unit volume of natural gas in such a way that the pressure at which the reaction takes place remains constant and all the products of combustion are returned to the same specified temperature 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 the specified temperature.

Note that the superior calorific value includes all the combustible components in the natural gas.

The reference temperature at which the volume is measured is 273,15 K (0 °C) and the specified temperature at which combustion takes place is 298,15 K (25 °C). The reference pressure is 101,325 kPa.

NOTE — Annex D of part 3 of this International Standard gives conversion factors which enable superior calorific values and relative densities determined at other reference or specified temperatures, and other reference pressures, including the ISO standard reference conditions (see ISO 13443), to be used as input data for the calculation method described.

The terms “gross”, “higher”, “upper” and “total calorific value” and “heating value” are synonymous with “superior calorific value”.

3.6 relative density, d**:** The ratio of the mass of a given volume of natural gas to the mass of dry air of standard composition which would be contained in the same volume at the same reference conditions of pressure and temperature.

The relative density includes all the components of the natural gas.

NOTE — The standard composition of dry air is given in ISO 6976.

In this International Standard, the reference temperature is 273,15 K (0 °C) and the reference pressure is 101,325 kPa (see note in 3.5).

The term “specific gravity” is synonymous with “relative density”.

3.7 uncertainty of a predicted compression factor, $\pm \Delta Z$**:** The range of values $Z - \Delta Z$ to $Z + \Delta Z$ within which the (unknown) true value is expected to lie with a confidence level of 95 %. This uncertainty may be expressed either as an absolute value or as a percentage.

Estimates of the 95 % confidence limits are, to the extent that this is practicable, established by comparison of test data of low uncertainty with calculated values of Z.

4 General principles

The methods recommended use equations which are based on the concept that any natural gas may be uniquely characterized for calculation of its volumetric properties either by component analysis or by an appropriate and distinctive set of measurable physical properties. These characteristics, together with the pressure and temperature, are used as input data for the methods.