SLOVENSKI STANDARD

SIST EN ISO 12213-2:2009

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Nadomeģļ a:

SIST EN ISO 12213-2:2005

Zemeljski plin - Izraļ un kompresijskega faktorja - 2. del: Izraļ un na podlagi analize molarne sestave (ISO 12213-2:2006)

Natural gas - Calculation of compression factor - Part 2: Calculation using molar-composition analysis (ISO 12213-2:2006)

Erdgas - Berechnung von Realgasfaktoren - Teil 2: Berechnungen basierend auf einer molaren Gasanalyse als Eingangsgröße (ISO 12213-2:2006)

Gaz naturel - Calcul du facteur de compression - Partie 2: Calcul à partir de l'analyse de la composition molaire (ISO 12213-2:2006)

Ta slovenski standard je istoveten z: **EN ISO 12213-2:2009**

ICS:

75.060	Zemeljski plin	Natural gas

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EUROPEAN STANDARD

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English Version

Natural gas - Calculation of compression factor - Part 2: Calculation using molar-composition analysis (ISO 12213-2:2006)

Gaz naturel - Calcul du facteur de compression - Partie 2: Calcul à partir de l'analyse de la composition molaire (ISO 12213-2:2006)

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Foreword

The text of ISO 12213-2:2006 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 12213-2:2009.

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of an identical text or by endorsement, at the latest by March 2010, and conflicting national standards shall be withdrawn at the latest by March 2010.

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Endorsement notice

The text of ISO 12213-2:2006 has been approved by CEN as a EN ISO 12213-2:2009 without any modification.

INTERNATIONAL STANDARD

ISO 12213-2

Second edition
2006-11-15

Natural gas — Calculation of compression factor —

Part 2: Calculation using molar-composition analysis

Gaz naturel — Calcul du facteur de compression —

Partie 2: Calcul à partir de l'analyse de la composition molaire

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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ISO 12213-2 was prepared by Technical Committee ISO/TC 193, *Natural gas*, Subcommittee SC 1, *Analysis of natural gas*.

This second edition cancels and replaces the first edition (ISO 12213-2:1997), Table 1 of which has been technically revised.

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*

Natural gas — Calculation of compression factor —

Part 2: Calculation using molar-composition analysis

1 Scope

ISO 12213 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.

This part of ISO 12213 specifies a method for the calculation of compression factors when the detailed composition of the gas by mole fractions is known, together with the relevant pressures and temperatures.

The method is applicable to pipeline quality gases within the ranges of pressure p and temperature T at which transmission and distribution operations normally take place, with an uncertainty of about ± 0,1 %. It can be applied, with greater uncertainty, to wider ranges of gas composition, pressure and temperature (see Annex E).

More detail concerning the scope and field of application of the method is given in ISO 12213-1.

2 Normative references

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

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

ISO 12213-1, *Natural gas — Calculation of compression factor — Part 1: Introduction and guidelines*

ISO 80000-4, *Quantities and units — Part 4: Mechanics*

ISO 80000-5, *Quantities and units — Part 5: Thermodynamics*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12213-1 apply.

4 Method of calculation

4.1 Principle

The method recommended uses an equation based on the concept that pipeline quality natural gas may be uniquely characterized for calculation of its volumetric properties by component analysis. This analysis, together with the pressure and temperature, are used as input data for the method.

The method uses a detailed molar-composition analysis in which all constituents present in amounts exceeding a mole fraction of 0,000 05 should be represented. Typically, this includes all alkane hydrocarbons up to about C_7 or C_8 together with nitrogen, carbon dioxide and helium.

For other gases, additional components such as water vapour, hydrogen sulfide and ethylene need to be taken into consideration (see Reference [1] in the Bibliography).

For manufactured gases, hydrogen and carbon monoxide are also likely to be significant components.

4.2 The AGA8-92DC equation

The compression factor is determined using the AGA8 detailed characterization equation (denoted hereafter as the AGA8-92DC equation). This is an extended virial-type equation. The equation is described in AGA Report No. 8[1]. It may be written as

$$Z = 1 + B\rho_\mathrm{m} - \rho_\mathrm{r} \sum_{n=13}^{18} C_n^* + \sum_{n=13}^{58} C_n^* \left(b_n - c_n k_n \rho_\mathrm{r}^{k_n}\right) \rho_\mathrm{r}^{b_n} \exp\left(-c_n \rho_\mathrm{r}^{k_n}\right) \tag{1}$$

where

Z is the compression factor;

B is the second virial coefficient;

ρ_m is the molar density (moles per unit volume);

ρ_r is the reduced density;

b_n, c_n, k_n are constants (see Table B.1);

C_n^* are coefficients which are functions of temperature and composition.

The reduced density ρ_r is related to the molar density ρ_m by the equation

$$\rho_\mathrm{r} = K^3 \rho_\mathrm{m} \tag{2}$$

where K is a mixture size parameter.

The molar density can be written as

$$\rho_\mathrm{m} = p/(ZRT) \tag{3}$$

where

p is the absolute pressure;

R is the universal gas constant;

T is the absolute temperature.

Z is calculated as follows: first the values of B and C_n^* (n = 13 to 58) are calculated, using relationships given in Annex B. Equations (1) and (3) are then solved simultaneously for ρ_m and Z by a suitable numerical method (see Figure B.1).

4.3 Input variables

The input variables required for use with the AGA8-92DC equation are the absolute pressure, absolute temperature and molar composition.

The composition is required, by mole fraction, of the following components: nitrogen, carbon dioxide, argon, methane, ethane, propane, *n*-butane, methyl-2-propane (iso-butane), *n*-pentane, methyl-2-butane (iso-pentane), hexanes, heptanes, octanes, nonanes, decanes, hydrogen, carbon monoxide, hydrogen sulfide, helium, oxygen and water.

NOTE If the mole fractions of the heptanes, octanes, nonanes and decanes are unknown, then use of a composite C_{6+} fraction may be acceptable. The user should carry out a sensitivity analysis in order to test whether a particular approximation of this type degrades the result.

All components with mole fractions greater than 0,000 05 shall be accounted for. Trace components (such as ethylene) shall be treated as given in Table 1.

If the composition is known by volume fractions, these shall be converted to mole fractions using the method given in ISO 6976. The sum of all mole fractions shall be unity to within 0,000 1.

4.4 Ranges of application

4.4.1 Pipeline quality gas

The ranges of application for pipeline quality gas are as defined below:

absolute pressure	0 MPa	$\leqslant$	p	$\leqslant$	12 MPa
temperature	263 K	$\leqslant$	T	$\leqslant$	338 K
superior calorific value	30 MJ·m^{-3}	$\leqslant$	H_S	$\leqslant$	45 MJ·m^{-3}
relative density	0,55	$\leqslant$	d	$\leqslant$	0,80

The mole fractions of the natural-gas components shall be within the following ranges:

methane	0,7	$\leqslant$	x_{CH_4}	$\leqslant$	1,00
nitrogen	0	$\leqslant$	x_{N_2}	$\leqslant$	0,20
carbon dioxide	0	$\leqslant$	x_{CO_2}	$\leqslant$	0,20
ethane	0	$\leqslant$	$x_{C_2H_6}$	$\leqslant$	0,10
propane	0	$\leqslant$	$x_{C_3H_8}$	$\leqslant$	0,035
butanes	0	$\leqslant$	$x_{C_4H_{10}}$	$\leqslant$	0,015
pentanes	0	$\leqslant$	$x_{C_5H_{12}}$	$\leqslant$	0,005
hexanes	0	$\leqslant$	x_{C_6}	$\leqslant$	0,001
heptanes	0	$\leqslant$	x_{C_7}	$\leqslant$	0,000 5