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Natural gas — Energy determination

Gaz naturel — Détermination de l'énergie

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 193, *Natural gas*.

This third edition cancels and replaces the second edition (ISO 15112:2011), which has been technically revised.

The main changes compared to the previous edition are as follows:

— Figures 7 and 8 have been redrafted;

— Clause 9 has been updated;

— Annex K has been added.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Since the early 1 800s, it has been general practice for manufactured gas and, subsequently, natural gas to be bought and sold on a volumetric basis. Much time and effort has therefore been devoted to developing the means of flow measurement.

Because of the increasing value of energy and variations in gas quality, billing on the basis of thermal energy has now become essential between contracting partners and the need to determine calorific value by measurement or calculation has led to a number of techniques. However, the manner in which calorific value data are applied to flow volume data to produce the energy content of a given volume of natural gas has been far from a standardized procedure.

Energy determination is frequently a necessary factor wherever and whenever natural gas is metered, from production and processing operations through to end-user consumption. This document has been developed to cover aspects related to production/transmission and distribution/end user. It provides guidance to users of how energy units for billing purposes are derived, based on either measurement or calculation or both, to increase confidence in results for contracting partners.

Other standards relating to natural gas, flow measurement, calorific value measurement, calculation procedures and data handling with regard to gas production, transmission and distribution involving purchase, sales or commodity transfer of natural gas can be relevant to this document.

This document contains eleven informative annexes.

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Natural gas — Energy determination

1 Scope

This document provides the means for energy determination of natural gas by measurement or by calculation, and describes the related techniques and measures that are necessary to take. The calculation of thermal energy is based on the separate measurement of the quantity, either by mass or by volume, of gas transferred and its measured or calculated calorific value. The general means of calculating uncertainties are also given.

Only systems currently in use are described.

NOTE Use of such systems in commercial or official trade can require the approval of national authorization agencies, and compliance with legal regulations is required.

This document applies to any gas-measuring station from domestic to very large high-pressure transmission.

New techniques are not excluded, provided their proven performance is equivalent to, or better than, that of those techniques referred to in this document.

Gas-measuring systems are not the subject of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
accuracy of measurement
closeness of the agreement between the result of a measurement and a true value of the measurand

[SOURCE: ISO/Guide 98-3:2008, definition B.2.14]

3.2
adjustment
<of a measuring instrument> of bringing a measuring instrument into a state of performance suitable for its use

Note 1 to entry: Adjustment may be automatic, semi-automatic or manual.

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3.3
assignment method
<energy determination> method to derive a calorific value to be applied to the gas passing specified interfaces having only volume measurements

3.4
availability
probability, at any time, that the measuring system, or a measuring instrument forming part of the measuring system, is functioning according to specifications

[SOURCE: EN 1776:1998]

3.5
bias
systematic difference between the true energy and the actual energy determined of the gas passing a gas-measuring station

3.6
calibration
set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values obtained using working standards

[SOURCE: ISO 14532:2014, definition 2.5.1.1, modified — Definition has been slightly changed and Notes to entry have been removed.]

3.7
superior 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: ISO 14532:2014, definition 2.6.4.1, modified — Definition has been slightly reworded and Notes to entry have been removed.]

3.8
inferior 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

[SOURCE: ISO 14532:2014, definition 2.6.4.2, modified — Definition has been slightly reworded and Notes to entry have been removed.]

3.9
calorific value station
installation comprising the equipment necessary for the determination of the calorific value of the natural gas in the pipeline

3.10
adjusted calorific value
calorific value measured at a measuring station compensated for the time taken for the gas to travel to the respective volume-measuring station

3.11
corrected calorific value
result of correcting a measurement to compensate for systematic error

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3.12
declared calorific value
calorific value that is notified in advance of its application to interfaces for the purpose of energy determination

3.13
representative calorific value
calorific value which is accepted to sufficiently approximate the actual calorific value at an interface

3.14
charging area
set of interfaces where the same method of energy determination is used

3.15
conversion
determination of the volume under reference conditions from the volume under operating conditions

3.16
correction
value added algebraically to the uncorrected result of a measurement to compensate for systematic error

Note 1 to entry: The correction is equal to the negative of the estimated systematic error.

Note 2 to entry: Since the systematic error cannot be known perfectly, the correction cannot be complete, see Annex I.

3.17
correction factor
numerical factor by which the uncorrected result of a measurement is multiplied to compensate for a systematic-error object

Note 1 to entry: Since the systematic error cannot be known perfectly, the correction cannot be complete, see Annex I.

3.18
determination
set of operations that are carried out on an object in order to provide qualitative or quantitative information about this object

Note 1 to entry: In this document, the term “determination” is only used quantitatively.

3.19
direct measurement
measurement of a property from quantities which, in principle, define the property

Note 1 to entry: For example, the determination of the calorific value of a gas using the thermoelectric measurement of the energy released in the form of heat during the combustion of a known amount of gas.

[SOURCE: ISO 14532:2014, definition 2.2.1.2, modified — The word “that” has been replaced by “which” in the definition.]

3.20
energy
product of gas quantity (mass or volume) and calorific value under given conditions

Note 1 to entry: The energy may be called energy amount.

Note 2 to entry: Energy is usually expressed in units of megajoules.

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3.21
energy determination
quantitative determination of the amount of energy of a quantity of gas based either on measurement or calculation using measured values

3.22
energy flow rate
energy of gas passing through a cross-section divided by time

Note 1 to entry: Energy flow rate is usually expressed in units of megajoules per second.

3.23
fixed assignment
application without modification of the calorific value measured at one specific calorific-value-measuring station, or the calorific value declared in advance, to the gas passing one, or more, interfaces

3.24
gas transporter
company that conveys gas from one place to another through pipelines

3.25
gas quality tracking
determination of gas quality properties (e. g. the calorific value) at the exit points of a gas grid based on flow calculation; the calculation requires topology data, gas quality data at entry points, volume data at entry and exit points and grid pressures as input information

3.26
interface
place on a pipe used for the transportation or supply of gas at which there is a change of ownership or physical custody of gas

Note 1 to entry: Generally, an interface has an associated measuring station.

3.27
local distribution company
LDC
company that delivers gas to industrial, commercial and/or residential customers

3.28
measuring station
installation comprising all the equipment, including the inlet and outlet pipework as far as the isolating valves and structure within which the equipment is housed, used for gas measurement in custody transfer

[SOURCE: EN 1776:1998]

3.29
measuring system
complete set of measuring instruments and auxiliary equipment assembled to carry out specified measurements

[SOURCE: ISO/IEC Guide 99:2007, definition 3.2, modified — Definition has been slightly reworded.]

3.30
measuring instrument
device intended to be used for making measurements, alone or in conjunction with one or more supplementary devices

[SOURCE: ISO/IEC Guide 99:2007, definition 3.1, modified — Definition has been slightly reworded.]

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3.31
plausibility
property of a value to be within reasonable limits

3.32
producer
company that extracts raw natural gas from reservoirs which, after processing and (fiscal) measurement, is supplied as dry natural gas to the transportation system

3.33
regional distributor
company that conveys gas to local distribution companies and/or industrial, commercial or residential customers

3.34
residential customer
person whose occupied premises are supplied with gas, wholly or in part, such gas not being used for any business purpose, commercial or industrial

3.35
systematic error
mean that would result from an infinitive number of measurements of the same measurand carried out under repeatability conditions minus a true value of the measurand

3.36
traceability
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

Note 1 to entry: This chain of comparisons is called a traceability chain.

3.37
uncertainty
parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand

3.38
variable assignment
application of a calorific value for an assignment procedure based on measurement(s) at calorific value station(s) to the gas passing one, or more, interfaces

Note 1 to entry: That applied calorific value may take into account the time taken for the gas to travel from the calorific value station to the respective volume-measuring stations and other factors, to derive an average calorific value for a network, a state reconstruction of the variation of calorific values through a network, etc.

3.39
zero floating point
position in a grid conveying gas where there is a boundary with different gas qualities on either side

3.40
non-plausible data
measurement data that are obviously wrong taking into account the measurement situation at a measuring station and the gas flow situation

3.41
grid node
connection of two or more pipes in a gas grid, grid nodes typically exist at interfaces (entry/exit) or at points where the pipe geometry changes

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3.42
standard load profile
SLP
standard load profile (SLP) is a model to predict the expected hourly or daily energy consumption of customers where the reading is taken only periodically (e.g. once per year)

4 Symbols and units

Symbol	Meaning	SI unit	Customer unit
E	energy	MJ	kWh
e	energy flow rate	MJ/s	kWh/h
H	calorific value	MJ/m^3; MJ/kg	kWh/m^3

NOTE 1 Where the calorific value is in megajoules per cubic metre and the gas volume is in cubic metres, or where the calorific value is in megajoules per kilogram and the gas mass is in kilograms, then the calculated energy is in megajoules.

Where the calorific value is in kilowatt-hours per cubic metre and the gas volume is in cubic metres, or where the calorific value is in kilowatt-hours per kilogram and the gas mass is in kilograms, then the calculated energy is in kilowatt-hours.

To convert the number of megajoules to the number of kilowatt-hours, divide the number by 3,6.

M	mass	kg	t
p	pressure (absolute)	Pa, kPa	bar, mbar
Q	quantity of gas	m^3, kg	ft^3

NOTE 2 When the quantity is given in cubic metres, it is necessary that it should be qualified by temperature and pressure.

sq_v	volume flow rate	m^3/h, m^3/s	
q_m	mass flow rate	kg/s, kg/h	
T	temperature (absolute)	K	
t	time	s, h, d	s, h, d
V	volume (gas)	m^3	
Z	compression factor		
ρ	density	kg/m^3	
ϑ	temperature	°C	°F

Subscripts

i	inferior calorific value
j	number of time intervals

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