



شرکت ملی گاز ایران

مدیریت پژوهش و فناوری

امور تدوین استانداردها

IGS

مشخصات کیفی گاز طبیعی ایران

Specification for Iranian Natural Gas Quality



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باسلام،

به استحضار می‌رساند در جلسه ۱۶۰۰ مورخ ۱۳۹۳/۶/۹ هیأت مدیره، نامه شماره گ/۵۵۰۸۱/۰۰۰/۹۴ مورخ ۱۳۹۳/۴/۲۱ مدیر پژوهش و فناوری و رئیس شورای استاندارد در مورد تصویب نهایی استاندارد تحت عنوان مشخصات کیفی گاز طبیعی ایران به شماره استاندارد (1) IGS-M-CH-033 مطرح و با تأکید موارد ذیل مورد تصویب قرار گرفت:

۱- شرکت‌های پالایش گاز و شرکت‌های تابعه شرکت ملی نفت ملزم به رعایت کیفیت استاندارد گاز تحویلی به شبکه خطوط لوله در خروجی پالایشگاهها و خروجی کارخانه‌های گاز و گاز مایع می‌باشند.

۲- شرکت انتقال گاز ملزم به رعایت کیفیت استاندارد گاز در مبادی تحویل به شرکت‌های گاز استانی، مبادی صادراتی و مصرف کنندگان عمده می‌باشد.

۳- استاندارد موصوف به شرکت ملی صادرات گاز ارسال تا در قراردادهایی که از شبکه شرکت ملی گاز ایران صورت خواهد پذیرفت مورد استفاده قرار گیرد. ضمناً در صورت نیاز به تغییر برخی از مشخصات مذکور در قراردادهای صادرات و واردات، با هماهنگی با شرکت ملی گاز ایران امکان پذیر می‌باشد.

۴- استاندارد فوق به شرکت‌های زیرمجموعه وزارت نفت فعال در زمینه طراحی و ساخت پالایشگاه‌های آتی ارسال تا در صورتیکه گاز خروجی آنها به شبکه انتقال شرکت ملی گاز ایران اتصال خواهد یافت مورد استفاده قرار گیرد.

۵- تطابق، نظارت و کنترل کیفیت گاز تحویلی در خروجی پالایشگاهها و مبادی مصرف برعهده مدیریت دیسپچینگ می‌باشد.

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FOREWORD

This standard is intended to be mainly used by NIGC and contractors, and has been prepared based on interpretation of recognized standards, technical documents, knowledge, backgrounds and experiences in natural gas industry at national and international levels. Iranian Gas Standards (IGS) are prepared, reviewed and amended by technical standard committees within NIGC Standardization division and submitted to the NIGC's "STANDARDS COUNCIL" for approval. IGS Standards are subject to revision, amendment or withdrawal, if required. Thus the latest edition of IGS shall be checked/inquired by NIGC employees and contractors.

This standard must not be modified or altered by NIGC employees or its contractors. Any deviation from normative references and / or well-known manufacturer's specifications must be reported to Standardization division.

The technical standard committee welcomes comments and feedbacks about this standard, and may revise this document accordingly based on the received feedbacks.

GENERAL DEFINITIONS:

Throughout this standard the following definitions, where applicable, should be followed:

- 1- "STANDARDIZATION DIV." is organized to deal with all aspects of industry standards in NIGC. Therefore, all enquiries for clarification or amendments are requested to be directed to mentioned division.
- 2- "COMPANY": refers to National Iranian Gas Company (NIGC).
- 3- "SUPPLIER": refers to a firm who will supply the service, equipment or material to NIGC whether as the prime producer or manufacturer or a trading firm.
- 4- "SHALL ": is used where a provision is mandatory.
- 5- "SHOULD": is used where a provision is advised only.
- 6- "MAY": is used where a provision is completely discretionary.

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INTRODUCTION

The specification for gas quality was first documented in 2004. This standard specification replaces the previous version. The main reasons for this technical revision were:

- Changes in composition of existing gas reservoirs;
- Development of new gas resources with different gas composition;
- Expansion of export and import of natural gas;
- Modification and revamping of existing gas treating plants.

This standard specification is the result of a remarkable effort made by a specialized committee consisting of representatives of different departments of National Iranian Gas Company and representatives of Research Institute of Petroleum Industry (RIPI).

The committee started with collecting information about:

- The latest edition of international standards, references, publications, and investigation results;
- Outlet gas specification of existing gas treating plants on design basis and experimental data
- Consumer's need

The group's activities during the period involved a detailed analysis of the relevant combustion and non-combustion parameters of gas quality in order to assess the impacts of quality variations on the safe operation of appliances and the integrity and operation of gas transportation infrastructure. This included comparison of the gas quality specifications with the experimental data so that we ensure past learnings are incorporated.

The conducted studies consider all areas of gas industry, including gas processing/conditioning, transmission, distribution, utilization, and strategies for environmental protection. The initial draft was then distributed to various department of NIGC to get their feedbacks.

Then the committee began to review the received feedbacks and revised the content of the mentioned draft.

NIGC has been supplying high quality natural gas to its consumers and a very important mission has been providing clean and non-pollutant gas to preserve air quality.

1. SCOPE

This standard covers specifications which are applied to:

- The natural gas delivered from gas treating plants to the pipeline networks, any point of pipeline transmission networks, and the designated points to main industries power plants and all CGS/TBS;
- Basis for designing future natural gas treating plants;
- Reference for export and/or import gas contracts.

Natural gas with the quality described in this standard specification may be used for:

- Residential consumption;
- Commercial consumption;
- Industrial utilization;
- Fuel in natural gas vehicles (CNG);
- As a feed for chemical or petrochemical complexes;
- As a reduction agent in steel industry;
- Natural gas appliances and equipment.

Natural gas complying with this standard specification would be safe (non-corrosive and non-toxic) and suitable for the aforementioned usages. However, it may not be necessarily suitable to other usages (not mentioned here).

This standard specification provides chemical composition, physical properties, test/calculation methods and interchangeability indices. Informative literatures are also supplied in Annexes.

Note 1: Specification of importing natural gas is subject to contractual requirements between buyer and seller and these may include agreed variations or excursion from this standard specification.

Note 2: Natural gas vehicles requiring compression to higher pressures than the maximum transmission pressure may require to use a gas dryer to remove moisture from the gas to prevent liquid water or hydrate formation.

Note 3: This standard specification does not cover the existing export contracts.

2. SIGNIFICANCE AND USE

The objective of this standard specification is to provide buyers, transporters, and industrial/residential consumers of natural gas with a product that is safe to use and handle, and to provide quality assurance for designers and manufacturers of appliances, equipment, and vehicles which use natural gas. Also, this standard specification is useful for designers of natural gas treating plants that choose processes to achieve the gas quality described in this standard specification.

3. REFERENCES

Documents referred to in this standard specification are listed in Section 3.1 as normative references.

For additional information on natural gas characteristics in this standard specification, refer to documents listed in Annex G.

3.1 Normative References

Throughout this standard specification the following standards are referred to. The editions of these standards that are in effect of the time of issuing this standard specification (2014) shall form part of this standard specification. The applicability of changes in standards that occur after the date of this standard specification shall be mutually agreed upon by the NIGC and the buyers and/or consumers.

ASTM D 1072 (2006) "Test Method for Total Sulfur in Fuel Gases by Combustion and Barium Chloride Titration"

ASTM D 1142 (2006) "Test Method for Water Vapor Content of Gaseous Fuels by Measurement of Dew-Point Temperature"

ASTM D 1826 (2003) "Test Method for Calorific (Heating) Value of Gases in Natural Gas Range by Continuous Recording Calorimeter"

ASTM D 1945 (2003) "Test Method for Analysis of Natural Gas by Gas Chromatography"

ASTM D 1988 (2006) "Test Method for Mercaptans in Natural Gas Using Length-Of-Stain Detector Tubes"

ASTM D 3588 (2003) "Practice for Calculating Heat Value, Compressibility Factor, and Relative Density of Gaseous Fuels"

ASTM D 4084 (2007) "Test Method for Analysis of Hydrogen Sulfide in Gaseous Fuels (Lead Acetate Reaction Rate Method)"

ASTM D 4810 (2006) "Test Method for Hydrogen Sulfide in Natural Gas Using Length-of-Stain Detector Tubes"

ASTM D 4984 (2006) "Test Method for Carbon Dioxide in Natural Gas Using Length-Of-Stain Detector Tubes"

ASTM D 5287 (2002) "Practice for Automatic Sampling of Gaseous Fuels"

ASTM D 5454 (2004) "Test Method for Water Vapor Content of Gaseous Fuels Using Electronic Moisture Analyzers"

ASTM D 6228 (2003) "Test Method for Determination of Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatography and Flame Photometric Detection"

ASTM D 6667 (2004) "Test Method for Determination of Total Volatile Sulfur in Gaseous Hydrocarbons and Liquefied Petroleum Gases by Ultraviolet Fluorescence"

GPA 2261 (1999) "Analysis for Natural Gas and Similar Gaseous Mixture by Gas Chromatography"

GPA 2286 (1995) "Tentative Method of Extended Analysis for Natural Gas and Similar Gaseous Mixture by Temperature Programmed Gas Chromatography"

UOP 212 (2009) "Test Method for Determination of Hydrogen Sulfide and Mercaptan Sulfur in Hydrocarbon Gases by Potentiometric Titration"

4. DEFINITIONS

For the purposes of this standard specification, the following definitions and explanations apply.

4.1 Natural Gas

Natural gas is a gaseous form of petroleum obtained from underground sources and consisting of a complex mixture of hydrocarbons, primarily methane, but generally also including ethane, propane and higher hydrocarbons in much smaller amounts. It generally also includes some inert gases, such as nitrogen and carbon dioxide, plus minor amounts of trace constituents.

Natural gas remains in the gaseous state under the temperature and pressure conditions normally found in service. It is produced by processing raw gas or from liquefied natural gas and, if required, blended to give a gas suitable for direct use.

In this standard specification natural gas means the natural gas delivered from gas treating plants to the pipeline networks.

4.2 Liquefied Natural Gas (LNG)

LNG is natural gas that has been liquefied for storage or transportation purposes. Liquefied natural gas is revaporized and introduced into pipelines for transmission and distribution as natural gas.

4.3 Compressed Natural Gas (CNG)

CNG is highly compressed (though not liquefied) natural gas in high-pressure containers that is used extensively as fuel for automobiles, trucks, and buses. Small amounts of natural gas are also transported overland in high-pressure containers.

4.4 Substitute Natural Gas

Manufactured or blended gas with properties that makes it interchangeable with natural gas. Substitute natural gas is sometimes called synthetic natural gas.

4.5 Raw Gas

Unprocessed gas taken from well heads through gathering lines to gas treating plants.

4.6 Inert Gas

Component that exists predominantly in a gaseous state at standard conditions and which does not contribute to the measured heating value of the gas. Inert gas includes but is not limited to carbon dioxide, nitrogen, oxygen and noble gases.

Note: It is recognized that oxygen is not chemically inert, but as a component of natural gas, it acts to dilute the hydrocarbon content and does not add to the measured heating value.

4.7 Oil

Hydrocarbon and other liquids that is non-volatile at atmospheric conditions.

NOTE: Oil is likely to consist principally of compressor lubricating and seal oil but can include other liquids such as glycol and heavy components of gas condensates.

4.8 Local Distribution System

The gas mains and services which supply natural gas directly to consumers.

4.9 Gas Quality

The quality of a natural gas is defined by its composition and the following physical properties:

Calorific value, Wobbe Index, Density, Compression factor, Relative density, Dew points.

4.10 Standard Conditions

The preferred reference conditions are referred to as standard reference conditions and denoted by the subscript “s” (see ISO 13443):

$P_s = 101.325 \text{ kPa}$ Standard Pressure

$T_s = 15.56 \text{ }^\circ\text{C} (60 \text{ }^\circ\text{F}) = 288.71 \text{ K}$ Standard Temperature

4.11 Normal Conditions

The conditions are referred to as normal conditions and denoted by the subscript “n”:

$P_n = 101.325 \text{ kPa}$ Normal Pressure

$T_n = 0^\circ \text{C} = 273.15 \text{ K}$ Normal Temperature

4.12 Heating Values

It is divided into two types: Higher heating value and Lower heating value, defined as follows (see ISO 6976).

4.12.1 Higher heating value

The amount of heat which would be released by the complete combustion in air of a specified quantity of 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 above mentioned temperature. The above mentioned pressure and temperature must be specified.

Note: Higher heating value is also known as 'gross heating value' or 'superior heating value'.

4.12.2 Lower heating value

The amount of heat which would be released by the complete combustion in air of a specified quantity of 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.

The above mentioned pressure and temperature must be specified for both higher and lower heating values, which differ by the heat of condensation of water formed by combustion, can be specified on a molar, mass or volumetric basis. For the volumetric basis the pressure and temperature shall be stated at standard reference conditions calorific values can also be stated as dry or wet, depending on the water vapor content of the gas prior to combustion. Normally, the heating value is expressed as the higher heating value, dry value specified on a volumetric basis under standard reference conditions.

Note: Lower heating value is also known as 'net heating value' or 'inferior heating value'.

The difference between 'higher heating value' and 'lower heating value' is in the latent heat of condensation of water vapor produced during combustion.

4.13 Density

The mass of a gas divided by its volume at specified pressure and temperature.

4.14 Relative Density

Often called specific gravity, it is the mass of natural gas, dry or wet, per unit volume divided by the mass of an equal volume of dry air; both at the same specified pressure and temperature (see ISO 6976).

4.15 Wobbe Index

The Wobbe Index is a measure of the heat input to gas appliances, derived from the orifice flow equation. It is defined as the higher heating value of the gas, always on a volume basis, divided by the square root of the corresponding relative density. The heat input for different natural gas compositions is the same if they have the same Wobbe Index and are used under the same gas pressure (see ISO 6976).

4.16 Compression Factor

The compression factor Z is the quotient of the volume of an arbitrary mass of gas, at a specified pressure and temperature, and that of the same gas under the same conditions as calculated from the ideal gas law the terms compressibility factor and Z -factor are synonymous with compression factor (see ISO 12213-1).

4.17 Cricondenbar

The highest pressure at which liquid and vapor phased can exist at equilibrium in a multi component system.

4.18 Cricondenthem

The highest temperature at which liquid and vapor phased can exist at equilibrium in a multi component system.

4.19 Critical Temperature

For a pure component, the maximum temperature at which the component can exist as a liquid. Above this temperature, the fluid is a gas and cannot be liquefied regardless of the pressure applied.

4.20 Critical Pressure

The vapor pressure of a substance at its critical temperature.

4.21 Critical Density

The density of a substance at its critical temperature and critical pressure.

4.22 Retrograde Region

That area inside phase envelope where condensation of liquid occurs by lowering pressure or increasing temperature.

4.23 Retrograde Condensation (Vaporization)

Condensation or vaporization that is the reverse of usual behavior. Condensation caused by a decrease in pressure or increase in temperature. Vaporization caused by an increase in pressure or decrease in temperature can only occurs in mixtures.

4.24 Dehydration

The act or process of removing water from gases or liquids.

4.25 Hydrate

A hydrate is a solid formed by the physical combination of water molecules and certain of the molecules contained in gas. It is solid like true ice but processes different characteristics.

4.26 Dew Point

The temperature at any given pressure, or pressure at any given temperature, at which liquid initially condenses from a gas or vapor. It is specifically applied to the temperature at which water vapor starts to condense from a gas mixture (water dew point), or at which hydrocarbons start to condense (hydrocarbon dew point).

4.26.1 Water Dew Point

The dew point defines the temperature above which no condensation of water occurs at a specified pressure.

For any pressure lower than the specified pressure there is no condensation of water vapor at this temperature (see ISO 6327).

4.26.2 Hydrocarbon Dew Point

The dew point defines the temperature above which no condensation of hydrocarbons occurs at a specified pressure at a given dew point, there is a pressure range within which condensation occurs except at one point, the cricondentherm.

4.27 Total Sulfur

Total amount of sulfur found in natural gas.

Note: The total amount of sulfur, both organic and inorganic i.e. hydrogen sulfide, sulfur oxides, mercaptans, carbonyl sulfides, ... , may be determined by an analytical method not differentiating between individual sulfur compounds combustion methods.

4.28 Molar Composition

The molar composition of a gas is the term used when the proportion of each component is expressed as a molar (or mole) fraction, or molar (mole) percentage, of the whole thus the mole fraction, x_i , of component i is the quotient of the number of moles of component i and the number of moles of the whole mixture present in the same arbitrary volume. One mole of any chemical species is the amount of substance which has 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 (percentage), but this relationship cannot in general be assumed to apply to real gas behavior.

4.29 Gas Composition

The concentrations of the major and minor components and trace constituents in natural gas as analyzed.

- The major components of a gas are specified as volumetric, molecular or mass proportions in percentage. They also determine the allocation of the fuel gases to the gas families.
- The minor components of a gas can be present as a gas, liquid or solid. The concentration is specified in mg/m^3 , cm^3/m^3 (also vppm), mg/kg (also ppm) for the majority of gas secondary substances, or a specification can be used which relates to the behavior of the gas during transport.

4.30 Gas Analysis

The use of test methods and other techniques for determining the gas composition, as stated in this standard specification.

4.31 Limit

The value beyond which the specified characteristic or concentration of the component is not permitted to vary.

4.32 Maximum Allowable Operating Pressure (MAOP)

The maximum pressure at which a pipeline may be operated.

4.33 Interchangeability

A measure of the degree to which the combustion characteristics of one gas resemble those of another gas. Two gases are said to be interchangeable when one gas may be substituted for the other without affecting the operation of gas burning appliances or equipment. Interchangeability can be defined as the ability of a distributed natural gas to be substituted by another without the need for adjustment at the customers' equipment. The appliances will continue to operate safely and satisfactorily.