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First edition

Natural gas — Odorization

Gaz naturel — Odorisation

PROOF/ÉPREUVE

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Contents

Page

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 of 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 www.iso.org/iso/foreword.html.

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

This first edition ISO/TS 16922 cancels and replaces the first edition (ISO/TR 16922:2013), which has been technically revised.

The main changes are as follows:

— modification of the structure of the Technical Report, new clauses: 4.1, 4.2, 4.3, 5.1, Clause 7, 7.1, 7.1.1, 7.1.2, 7.1.3, 7.3, 7.3.1, 7.3.2, 7.3.3, 7.3.4, 7.3.5;

— modification of 7.2.

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.

Introduction

Processed natural gas normally has little or no odour. For safety reasons distributed natural gas is therefore be odorized, to permit the detection of the gas by smell.

The odorization is predominantly a safety measure for the user of natural gas. Odorized natural gas needs to be recognized by the characteristic smell.

This document may also be applied to other gases used in gas supply as e.g. biomethane, blends containing hydrogen, regasified LNG or LBG, LPG for conditioning in gas supply, etc.

Natural gas — Odorization

1 Scope

This document gives the specifications and guidelines for the methods to be used in the odorization of natural gas and other methane rich gases delivered through natural gas networks to gas applications under a safety point of view.

This document also specifies the principles for the odorization technique (including handling and storage of odorants) and the control of odorization of natural gas and other methane rich gases.

NOTE The general requirements for odorants, and the physical and chemical properties of commonly used odorants are specified in ISO 13734.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this Technical Specification. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this Technical Report are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 5492, *Sensory analysis — Vocabulary*

ISO 14532, *Natural gas — Vocabulary*

3 Terms and definitions

For the purposes of this Technical Specification, the terms and definitions given in ISO 5492 and ISO 14532 and the following apply:

3.1.1
odorant content
content of the odorant either in the gas or in air expressed as its mass concentration, volume fraction or mole fraction

3.1.2
odour perception
awareness of the effect of volatile substances by the olfactory organ

3.1.3
odour character
distinctive and identifiable feature of an odour or flavour

3.1.4
odour intensity
magnitude of the perceived odour

3.1.5
masking
phenomenon by which one or more constituents in the gas stream can change or reduce the *odour intensity* (3.1.4) and/or the *odour character* (3.1.3) of the odorized gas

3.1.6
fading of odorant
phenomenon where adsorption, absorption or chemical reactivity of the odorant result in loss of odorant across the network

4 General requirements

4.1 Necessary odorant addition

Because safety is paramount in the gas industry, it could be assumed that the stronger the odour of gas, the better. However, an upper limit is usually set to avoid unjustified leakage complaints already caused by the small volume of unburnt gas escaping during ignition of the burner. An excessive odorization level can also lead to a slight and permanent gas smell related to micro leaks that cannot be localized and sealed. This could lead to habituation of the customer with the eventuality of a late reaction when actual leaks occur. Gas odorization is in most countries a legal or regulation requirement that specifies that natural gas in air be readily detectable by odour at a concentration of 20 % (safety factor of 5) of the lower flammability limit (LFL). The LFL of natural gas is normally taken as a volume fraction of natural gas in air of 4 % to 5 %. However, local regulations may specify other odorization rules.

NOTE Consider potential masking issues when blending natural gas with other gases (e.g. biomethane, LPG), the odour being either naturally present or artificially added.

4.2 Requirements and parameters for consideration when selecting an odorant

Information about different odorants is given in ISO 13734:2013, Annex A.

Various parameters are considered when selecting an odorant:

— Typical odour character that is intense, unpleasant and universally associated with gas

— Physical properties: Freezing point, boiling point, vapour pressure

— Stability:

  — Stability with respect to oxidation in network:

  Mercaptans being more reactive than sulfides, they tend to form less odorous disulfides in presence of rust, thus lowering odorization efficiency.

  — Stability in storage:

  Some chemicals developed for odorization displaying reactive function can undergo hazardous polymerization reaction if not stabilized adequately. Such reaction could occur in storage tank or within injection system.

— Toxicity

— Environmental issues

— Gas quality: wet gas, presence of other sulphur compounds or network displaying condensates will generate odorant scrubbing or cross contamination that may affect odorant efficiency

— Odorization practice in the region:

  — Centralized / decentralized

  — Odorization technique: (some odorants may not be compatible with Bypass odorizers, etc.)

— Network material (Carbon steel, plastics)

The level of the odorant added, that determines the odour intensity, is based on different factors whereof not all are based on measurement, as e.g. local experience. The typical objective is that the population with a functional sense of smell will be able to smell odorized gas before its concentration reaches the specified limit (typically 20 % LFL) and thus takes the appropriate measures to protect itself. Different approaches are applied to define and estimate the concentration of odorant required to achieve this effect.

The odour intensity of an odorant for natural gas or a gas is best determined by the human olfactory organ.

4.3 Public awareness

In some countries, local regulations require the operators to follow a public awareness program, which may include specific information about the risk of gas and guidance for leak recognition. The use of scratch-and-sniff cards containing the encapsulated odorant or other carriers is also frequently used in a number of countries, but other kind of smell samples are also encountered.

In the case of changing the odour character of the gas odorant, the need to provide adequate information to the members of the public and gas users should be considered.

5 General remarks on odorant behaviour

5.1 Masking and fading of odorants

Temporary fading in a new gas distribution system or after changing the odorant requires specific monitoring and can need temporary supplemental odorization or other measures (e.g. preconditioning).

Some components, e.g. present in some natural gases or biogases may react on or with the odorant applied, resulting in a major loss of smell of the odorant either by masking effects or by chemical reaction.

5.2 Seals and membranes

Liquid odorants may cause severe swelling or even dissolution of organic materials such as plastics, elastomeric seals and lubricants. Therefore, in odorization equipment and for joints close to the points where the liquid odorant is injected into the line, only sealing materials should be used which are compatible with liquid odorants. This information is normally supplied by the manufacturer of the odorant (see ISO 13734).

5.3 Pipelines

The low odorant concentrations used for odorization of natural gas do not compromise the integrity of plastic pipes, seals or diaphragms in gas transportation, distribution and utilization.

When starting gas distribution through new gas lines or when changing the odorant it may take some time to reach the required odorant concentration at the end of the line. This may result from the odorant being sorbed on the pipe wall, by pipe dust, rust and incrustations or by gas condensates (odour fading). The degree of sorption depends on several factors, for example the condition of the pipe grid, the pressure, the temperature, the flow velocity and the physico-chemical properties of odorants.

5.4 Buried pipeline

Odorized gases leaking from gas lines in the ground may lose odorants by sorption in the soil. Sorption and oxidation of odorants may vary with moisture content and the type of soil. Degradation of odorants by microorganisms may also occur.

6 Safety precautions

6.1 Handling of odorants

WARNING — Odorants should be handled according to their actual characteristics and prevailing regulations.

IMPORTANT — All relevant safety precautions being observed when handling odorants, employees should be instructed periodically. Odorants are irritating, harmful and flammable. Therefore, the specific material safety data sheet should be read prior to handling liquid odorants. All safety precautions should be strictly observed and followed.

A minimum level of safety may be achieved by the following recommendations:

— Concentrated vapours of odorants may cause short-term acute health problems, such as dizziness, headache, nausea and irritation of throat, nose and eyes. Therefore protection, for example with a filter containing activated charcoal or a respirator, is common use. Any extended exposure without respiration protection need to be avoided.

— When handling odorants, suitable personal protective equipment (eye-, face-, body-protection, gloves) and safe-handling procedures of the odorant are recommended. If, in spite of the use of personal protection equipment, liquid odorant contacts the skin or the eyes, wash the affected spot as first aid, immediately with plenty of water. If an eye comes in contact with liquid odorant, consult a physician immediately.

6.2 Spill management and remediation

WARNING — Undiluted oxidants should never be brought into contact with odorants: RISK OF EXPLOSION!

There are several possibilities to eliminate the nuisance caused by the strong odour of spilled odorants.

— For odour mitigation, deodorants may be used, which normally do not change the chemical properties of the odorant. Therefore, health risks will not be eliminated. For larger amounts of spilled odorants these masking compounds are not suitable.

— Minor quantities of spilled odorants (surface cleaning) can be treated with different options:

  — oxidized to less smelling compounds utilizing a procedure incorporating the spraying of diluted solutions of an oxidant such as 5 % by mass of sodium hypochlorite or 5 % by mass of hydrogen peroxide, preferably under the addition of detergents. This procedure should account for the corrosive and reactive nature of these oxidants.

  — neutralized with enzymatic solutions, only effective for some odorants (e.g. mercaptans)

— Larger quantities of spilled or leaked odorants should be sorbed by sorbents (activated charcoal) and disposed of in tightly shut containers. Small remainders should be treated as minor quantities.

These sorbents or soil contaminated by odorants should be treated according to prevailing regulations.

Commercial products are also available to mask and/or mitigate odorant spillage. These products are generally available through the odorant manufacturer.

For the cleaning of pipework, containers and parts of the odorizing equipment the use of alcohols (isopropanol, technical ethanol) is an option. The used cleaning solution are to be disposed according to prevailing regulations.

6.3 Transportation and storage

Odorants are delivered in corrosion-resistant containers suitable for transport and/or storage according to prevailing regulations. Odorant containers need to be accompanied by a safety data sheet conforming to the requirements of all prevailing regulations.

The use of the proper sealing materials is according to the type of odorant, sulfurous or acrylic.

To avoid nuisance when stationary odorant tanks are refilled, vapour equalization lines for gas phase transfer between storage and transportation tanks are recommended. Lines for transfer equipped with automatic shutoff valves are recommended, where possible. Connections and valves preferably have minimum dead volume.

Storage rooms for odorant containers are best cool, dry and well ventilated. Extended impact of the sun increase of the internal pressure of odorant containers during transport and/or storage.

Storage containers and the odorizing plant may be in the same room. Odorants jointly with any easily inflammable substance is best to be avoided.

7 Odorization technique

7.1 Odorization of pipeline networks

7.1.1 Odorization of transmission pipelines

Centralized odorization is performed at the entry point of gas into the transmission network (i.e. LNG terminal, interconnection points, etc.). Its advantages are:

— the installation, operation and maintenance of sophisticated equipment to automate and monitor each odorizer is simpler and results in better uniformity of the odorant concentration in the gases;

— it allows a uniform gas odour throughout a region.

Its disadvantages are

— the odorants may have to be removed from the gas supplied to some industrial consumers, and

— odorized gas is delivered to industrial consumers that may not need it because other safety measures may be provided to recognize gas leaks (e.g. gas sensors for these industrial processes).

7.1.2 Odorization of distribution pipelines

Decentralised odorization is performed typically at the entry points of the distribution networks, including biomethane injection points. Advantages for decentralized odorization are:

— odorant concentrations can be adjusted to the specific conditions of the local distribution grid (new pipes or old pipes with deposits),

— the sulfur content of gas for industrial use or the environmental effects of odorants on some types of underground storage are not increased by odorization by avoiding unnecessary odorization.

Disadvantages of decentralized odorization are

— the multiplicity of odorization stations, generally close to populated areas,

— generation of transportation of odorant on road or rail, and

— handling of odorant by a multitude of personnel,

— low gas flow is more difficult to follow up in odorant dosage.