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Gas analysis — Sampling guidelines

Analyse des gaz — Lignes directrices pour le prélèvement des échantillons

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Contents

Foreword	v
Introduction.....	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions.....	1
4 Sampling plan.....	5
5 Sampling classification	6
5.1 Sampling classification of gases	6
5.2 Sampling classification of liquefied gas.....	7
6 Technical specifications	8
6.1 Overview.....	8
6.2 General considerations for gas sampling.....	8
6.2.1 Adsorption, reaction and permeation of sampling system	8
6.2.2 Leaks and atmospheric diffusion in the sampling system.....	8
6.2.3 Leak testing of the sampling system.....	8
6.2.4 Purging of sampling system.....	9
6.2.5 Homogeneity of gas.....	12
6.2.6 Inert-gas purging.....	12
6.3 Possible condensation during compressed gas sampling.....	12
6.4 Main condensations for liquefied gas sampling.....	13
6.5 Samples that are not feasible in containers or cannot be used for analysis directly.....	13
7 Safety guidance in sampling	13
7.1 Overview.....	13
7.2 General recommendation.....	13
7.3 Specific recommendation for sampling a certain substance	14
8 Sampling devices.....	14
8.1 General provision	14
8.2 Sample container	15
8.2.1 Sample container material.....	15
8.2.2 Structure of sample container	16
8.2.3 Volume of sample container.....	19
8.3 Sample probe	19
8.4 Pressure reducer and flow controller.....	19
8.5 Sample pump.....	20
8.6 Sample line.....	20
8.6.1 Material of sample line.....	20
8.6.2 Length and diameter of sample line	20
8.7 Connecters and seals	20
8.8 Cleaning and drying of the sampling device	21
8.9 Connection of sampling devices	21
9 Sampling	21
9.1 Sampling method block diagram	21
9.1.1 Overview.....	21
9.1.2 Block diagram of compressed gas sampling method	21
9.1.3 Block diagram of liquefied gas sampling method.....	23
9.2 Quality assessment of the sampling system.....	24
9.3 Sampling from the gaseous phase and sampling after evaporation of liquefied gas	24

9.4 Direct sampling	24
9.4.1 General provisions	24
9.4.2 Direct sampling of gas in pressure receptacles	25
9.4.3 Direct sampling of gas in pipelines	25
9.5 Indirect sampling	25
9.5.1 Indirect sampling of gas in pressure receptacles	25
9.5.2 Indirect sampling of gas in pipelines	26
9.5.3 Leakage test of sample container	26
9.5.4 Storage of samples	26
9.6 Sampling records	27
Annex A (informative) Examples of estimation of the purging time and purging cycles for sampling system	28
Annex B (informative) Direct sampling for gas in pressure receptables	30
Annex C (informative) Direct sampling of gas in pipelines	33
Annex D (informative) Fill-empty sampling method	35
Annex E (informative) Evacuated-container sampling	37
Annex F (informative) Evacuated-system sampling	41
Bibliography	43

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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.

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 158 *Analysis of Gases*.

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

The determination of gas composition, impurity concentration and physical properties depends to a large extent on sampling technique. The use of correct sampling techniques is an important safety and quality critical step in gas analysis. The design, construction and selection of the sampling equipment to avoid hazardous situations and sampling errors are important and directly influence the results obtained. Any slight carelessness, in exactitude or mistake will seriously influence safety and the results obtained.

Gaseous products are stored and transported in pressure receptacles in the form of compressed or liquefied gas or through gas pipelines. The sampling methods used differ depending upon the package, composition and delivery methods.

This document provides technical guidelines for the sampling of gases in pressure receptacles and pipelines for analytical purposes.

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Gas Analysis— Sampling Guidelines

1 Scope

This document gives the basic definitions of terms and general provisions relating to sampling for gas analysis, including sampling devices, sampling methods, sampling technical considerations, and sampling safety.

This document applies to both direct and indirect sampling of gas in pressure receptacles and pipelines, including pure gases and gas mixtures. Compressed and liquefied gases are both considered.

This document applies to the sampling of processed gases and does not involve gas treatment processes.

The sampling procedures specified are not intended for the sampling of special products which are the subject of other International Standards, such as liquefied petroleum gases (ISO 4257) and gaseous natural gases (ISO 10715).

Warning — The use of this document may involve a number of hazards. This document does not specify all the safety issues associated with the use of the standard. Users of this document are responsible for establishing measures to ensure safety whilst gas sampling. All sampling activities should comply with national and local safety regulations.

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 3165, *Sampling of chemical products for industrial use — Safety in sampling*

ISO 16664, *Gas analysis — Handling of calibration gases and gas mixture — Guidelines*

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 <http://www.electropedia.org/>

3.1

gas

all materials which are present completely in gaseous form at a temperature of 20 ° C under the absolute pressure of 0,1013 MPa

Note 1 to entry: The materials here include single mediums and mixtures.

3.2

compressed gas

gas which, when packaged under pressure for transport, is entirely gaseous at all temperatures above – 50 °C

Note 1 to entry: This category includes all gases with a critical temperature less than or equal to – 50 °C.

[SOURCE: ISO 10286:2015, 705]

3.3

liquified gas

gas which, when packaged under pressure for transport, is partially liquid at temperatures above – 50 °C

[SOURCE: ISO 10286:2015, 706]

3.4

high pressure liquefied gas

gas with a critical temperature between – 50 °C and + 65 °C

[SOURCE: ISO 10286:2015, 708]

3.5

low pressure liquefied gas

gas with a critical temperature above + 65 °C

[SOURCE: ISO 10286:2015, 707]

3.6

toxic gas

gas which is known to be so toxic or corrosive to humans to pose a health hazard or which is presumed to be toxic or corrosive to humans because it has a LC₅₀ value for acute toxicity equal to or less than 5000 ml/m³ (ppm)

Note 1 to entry: Other risks such as tissue corrosiveness are sometimes associated.

[SOURCE: ISO 10286:2015, 716]

3.7

gas in pressure receptacles

gas stored in cylinders, tube, pressure drums, tanks and other pressure receptacles, and no fresh gas replenished into the receptacles

3.8

gas in pipelines

gas delivered in pipelines during the production process

3.9

sampling device

components that comprise the sampling system mainly include sample lines, pressure regulators/reducers, flow controllers, connectors and sample containers

3.10

sampling system

gas transmission and control system constructed by gas storage container or sample point of gas in pipelines and various sampling devices

3.11**representative sample**

a sample assumed to have the same composition as the material sampled when the latter is considered as a homogeneous whole

[SOURCE: ISO 6206:1979, 3.1.4]

3.12**direct sampling**

sampling in situations where there is a direct connection between the gas to be sampled and the analytical unit

[SOURCE: ISO 10715:1997, 2.1]

3.13**indirect sampling**

sampling in situation where there is no direct connection between the gas to be sampled and the analytical unit

[SOURCE: ISO 10715:1997, 2.7]

3.14**sampling plan**

the planned procedure of selection, withdrawal and preparation of a sample or samples from a lot to yield the required knowledge of the characteristic(s) from the final sample so that a decision can be made regarding the lot

[SOURCE: ISO 6206:1979, 3.1.5]

3.15**spot sampling**

indirect sampling from a specific part of the stream of material with a certain volume at a specific time

3.16**incremental sampling**

indirect sampling by collecting a series of spot samples into a combined sample

3.17**continuous sampling**

direct sampling taken continuously from a stream of material with a constant flow rate in a certain period of time

3.18**intermittent sampling**

direct sampling from a stream of material with predetermined intervals

3.19**ullage/outage**

the space in the container not occupied by the material, or the distance between the material surface and a fixed reference point at the top of the container

NOTE 1 to entry: This volume allows room for expansion.

[SOURCE: ISO 6206:1979, 3.3.14]

3.20

sampling error

that part of the total estimation error of a characteristic due to known and acceptable deficiencies in the sampling plan

[SOURCE: ISO 6206:1979, 3.4.10]

3.21

incremental sampler

a sampler which accumulates a series of spot samples into one composite sample

[SOURCE: ISO 10715:1997, 2.6]

3.22

low-pressure gas

gases with a pressure between 0 and 0,2 MPa at sampling temperature

NOTE 1 to entry: Except for special provisions, all pressures mentioned in this standard are gauge pressures.

3.23

high-pressure gas

gases with a pressure exceeding 0,2 MPa at sampling temperature

3.24

lag time

time taken for a representative sample to enter the instrument

[SOURCE: ISO 11042-2:1996, 3.5.1.1]

3.25

sample container

a container for collecting the gas sample when indirect sampling is necessary

[SOURCE: ISO 10715:1997, 2.14]

3.26

sample line

conduit to transfer a sample of gas from the sample place to the analytical unit or sample container

Note 1 to entry: Another word used for sample line is transfer line.

[SOURCE: ISO 14532:2014, 2.3.2.5]

3.27

sample probe

device inserted into the gas pipelines so that a representative sample of the flowing gas can be taken. The sample probe will have a conduit to convey the sample from the flowing gas to a point external to the pipeline

[SOURCE: ISO 14532:2014, 2.3.2.6]

3.28

sampling point

a point in the gas stream where a representative sample can be collected

[SOURCE: ISO 10715:1997, 2.17]

3.29**filling ratio**

ratio of the mass of gas to the mass of water at 15 °C that would fill completely a pressure receptacle fitted ready for use

Note 1 to entry: Synonyms are filling factor and filling degree, often expressed in kg/l or similar.

[SOURCE: ISO 10286:2015, 747]

3.30**continuous purging method**

purging method by continually purging the sampling system with sample gases

3.31**fill-empty cycle purging method**

purging method by sequentially filling and emptying the sampling system repeatedly with the gas to be sampled

3.32**evacuation-gas purging cycles**

purging method by evacuating the sampling system

3.33**sampling from the gaseous phase**

sampling from the gaseous phase of the liquefied gas

3.34**sampling from the liquid phase**

sampling from the liquid phase of the liquefied gas

3.35**sampling in liquid form**

the process that takes a sample in liquid form directly from the liquid phase of the liquefied gas

3.36**sampling after evaporation**

the process that takes a sample in gaseous form by vaporizing the sample from the liquid phase of the liquefied gas

3.37**liquid valve**

a device fitted to an analyser for the direct sampling of liquefied gas in liquid form, which can keep the liquefied gas to be collected in completely liquid phase

4 Sampling plan

A feasible and complete sampling plan should be developed before sampling.

For a sampling plan, first determine the sampling type (clause 5), then consider techniques of sampling (clause 6), to determine the appropriate sampling process (clause 9) and sampling devices (clause 8) and sampling safety (clause 7), and then sampling (clause 9).

The scheme for sampling plan is shown in Figure 1.

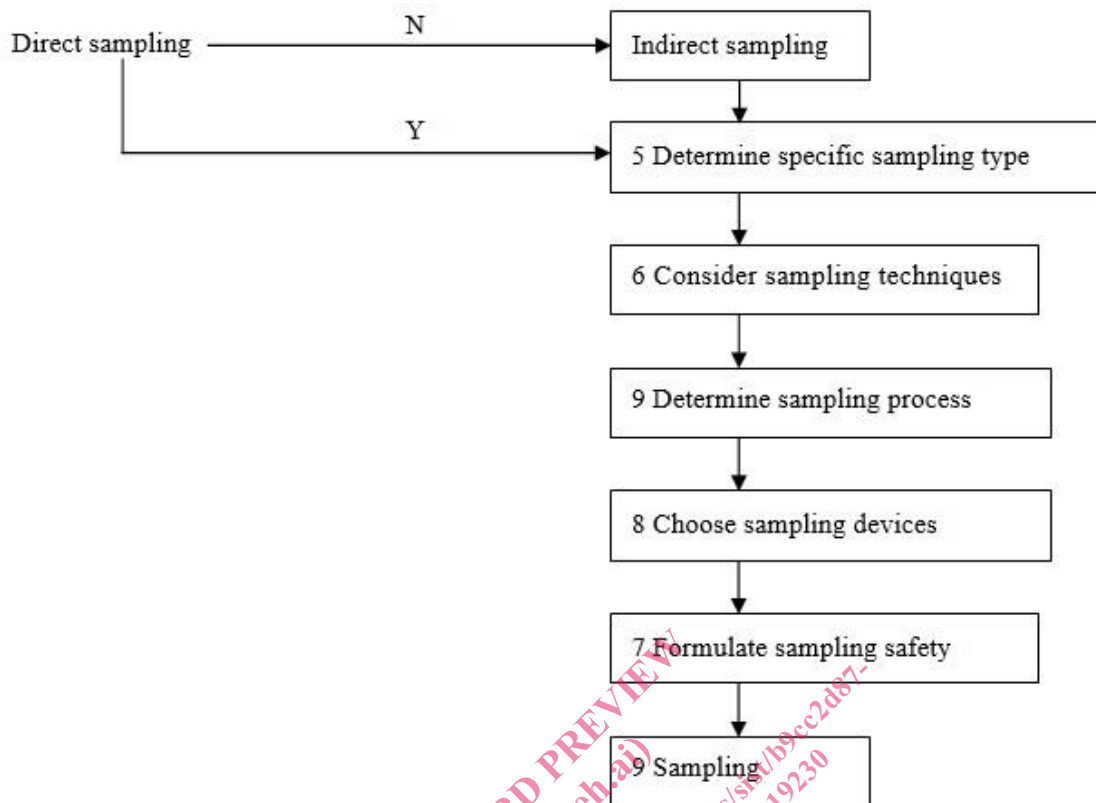


Figure 1—Scheme of sampling plan

5 Sampling classification

5.1 Sampling classification of gases

In this document, the sampling classification is based on whether the gas is connected to the analyser. In addition, the sampling methods vary among different gas packaging, storage methods and sampling purposes.

Direct sampling, if possible, is strongly recommended. In the case of indirect sampling, the potential loss of component during the time between sampling and analysis should be studied and incorporated in the uncertainty budget.

In general, for gas in pressure receptacles the internal composition is relatively uniform and constant.

For gases in pipelines the purpose and controls required dictate the type of sampling used. The design of a sampling plan should consider whether the objectives of sampling are to:

- Determine the instantaneous gaseous composition
- Determine an average composition over a specified time interval
- Establish changes in concentration by repeated sampling over a specified time
- Pass continuous samples into the analyser to measure both limit and average composition

A flow chart detailing the gas sampling classification is shown in Figure 2.