INTERNATIONAL STANDARD

ISO 10101-1

First edition
1993-10-01

Corrected and reprinted
1995-12-15

Natural gas — Determination of water by the Karl Fischer method —

Part 1: Introduction

Gaz naturel — Dosage de l'eau par la méthode de Karl Fischer —

Partie 1: Introduction

Reference number
ISO 10101-1:1993(E)

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.

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.

International Standard ISO 10101-1 was prepared by Technical Committee ISO/TC 193, *Natural gas*, Sub-Committee SC 1, *Analysis of natural gas*.

ISO 10101 consists of the following parts, under the general title *Natural gas — Determination of water by the Karl Fischer method*:

— *Part 1: Introduction*

— *Part 2: Titration procedure*

— *Part 3: Coulometric procedure*

Annex A of this part of ISO 10101 is for information only.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland
Printed in Switzerland

Natural gas — Determination of water by the Karl Fischer method —

Part 1: Introduction

WARNING — Local safety regulations must be taken into account, when the equipment is located in hazardous areas. Due to the toxicity and odour of pyridine, the user should ensure that there is adequate ventilation.

1 Scope

This part of ISO 10101 specifies general requirements for the determination of water in natural gas using the Karl Fischer method. ISO 10101-2 and ISO 10101-3 specify two individual methods of determination, a titration procedure and a coulometric procedure, respectively.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 10101. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 10101 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6712:1982, *Gas analysis — Sampling and transfer equipment for gases supplying an analytical unit.*

ISO 10101-2:1993, *Natural gas — Determination of water by the Karl Fischer method — Part 2: Titration procedure.*

ISO 10101-3:1993, *Natural gas — Determination of water by the Karl Fischer method — Part 3: Coulometric procedure.*

3 Principle

Reaction of water present in the test sample with iodine and sulfur-dioxide in a pyridine/methanol mixture (Karl Fischer reagent).

3.1 Principle of the first method (ISO 10101-2)

A measured volume of gas is passed through a cell containing a relatively small volume of absorbent solution. Water in the gas is dissolved in the absorbent solution and subsequently titrated with Karl Fischer reagent, the endpoint being detected voltametrically.

3.2 Principle of the second method (ISO 10101-3)

A measured volume of gas is passed through a cell containing anhydrous, previously titrated, anodic solution. The iodine required for the titration of the dissolved water is coulometrically produced from the iodide present in the solution by the reaction

$$2I^- \rightarrow I_2 + 2e^-$$

4 Reactions and interferences

$$CH_3OH + SO_2 + R_3N \rightarrow$$

$$[R_3NH]SO_3CH_3$$

$$H_2O + I_2 + [R_3NH]SO_3CH_3 + 2R_3N \rightarrow$$
$$[R_3NH]SO_4CH_3 + 2[R_3NH]I$$

NOTE 1 Methanol may be replaced by 2-methoxyethanol (ethylene glycol monomethylether) and pyridine (R_3N) may be replaced by any other suitable basic nitrogen compound.

Various gas components react with the Karl Fischer reagent and can give rise to erroneous results. Such components are oxidizing and reducing agents, e.g. hydrogen sulfide, mercaptans and certain basic nitrogeneous substances.

Hydrogen sulfide and mercaptans are present in some natural gases. If their concentration is less than 20 % of the water content, interference due to their presence shall be corrected as follows:

$$\varrho(H_2O)_a = \varrho(H_2O) - \frac{9\varrho(S \text{ as } H_2S)}{16} - \frac{9\varrho(S \text{ as RSH})}{32}$$

where

$\varrho(H_2O)_a$ is the actual water content, in milligrams per cubic meter at 273,15 K (0 °C) and 101,325 kPa (1 atm);

$\varrho(H_2O)$ is the observed or measured water content, in milligrams per cubic meter at 273,15 K (0 °C) and 101,325 kPa (1 atm);

$\varrho(S \text{ as } H_2S)$ is the measured sulfur as hydrogen sulfide, in milligrams per cubic meter at 273,15 K (0 °C) and 101,325 kPa (1 atm);

$\varrho(S \text{ as RSH})$ is the measured sulfur as mercaptans in the gas, in milligrams per cubic meter at 273,15 K (0 °C) and 101,325 kPa (1 atm).

At higher contents of H_2S and RSH this method is not applicable.

NOTE 2 The sulfur present as hydrogen sulfide and mercaptans can be determined by potentiometric titration (see ISO 6362-3) or by any other suitable method.

5 Sampling

Carry out sampling according to the general sampling guidelines given in ISO 6712. During sampling, ensure that the temperature of the gas stream is above the dew-point temperature. If necessary the sampling equipment should be heated.

All parts in contact with the gas shall be of steel or glass. The ends of pipes shall fit securely together and the connecting pieces shall be made of fluoroelastomers.

Annex A
(informative)

Bibliography

[1] ISO 760:1978, *Determination of water — Karl Fischer method (General method).*

[2] ISO 6326-3:1989, *Natural gas — Determination of sulfur compounds — Part 3: Determination of hydrogen sulfide, mercaptan sulfur and carbonyl sulfide sulfur by potentiometry.*

[3] FISCHER, K. Neues Verfahren zur massanalytischen Bestimmung des Wassergehaltes von Flüssigkeiten und festen Körpern. *Angewandte Chemie* **48** (1935), 26, p. 394.

[4] KAESLER, H. Direkte Bestimmung des Wassergehaltes in Gasen nach Karl Fischer. *gwf-gas/erdgas* **125** (1984), 3, pp. 125-131.

[5] SCHOLZ, E. *Karl Fischer Titration, Methoden zur Wasserbestimmung.* Springer-verslag, Berlin, Heidelberg, 1984.

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ICS 75.060

Descriptors: natural gas, gas analysis, chemical analysis, determination of content, water, Karl Fischer method, generalities.

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