EESTI STANDARD EVS-EN ISO 10101-3:2022

Natural gas - Determination of water by the Karl Fischer method - Part 3: Coulometric procedure (ISO 10101-3:2022)

EESTI STANDARDI EESSÕNA | NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 10101-3:2022 sisaldab Euroopa standardi EN ISO 10101-3:2022 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 10101-3:2022 consists of the English text of the European standard EN ISO 10101-3:2022.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 05.10.2022.	Date of Availability of the European standard is 05.10.2022.
Standard on kättesaadav Eesti Standardimis-ja Akrediteerimiskeskusest.	The standard is available from the Estonian Centre for Standardisation and Accreditation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

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Natural gas - Determination of water by the Karl Fischer method - Part 3: Coulometric procedure (ISO 10101-3:2022)

Gaz naturel - Dosage de l'eau par la méthode de Karl Fischer - Partie 3: Méthode coulométrique (ISO 10101-3:2022)

Erdgas - Bestimmung des Wassergehaltes nach Karl Fischer - Teil 3: Coulometrisches Verfahren (ISO 10101-3:2022)

This European Standard was approved by CEN on 26 August 2022.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN ISO 10101-3:2022) has been prepared by Technical Committee ISO/TC 193 "Natural gas" in collaboration with Technical Committee CEN/TC 238 “Test gases, test pressures, appliance categories and gas appliance types” the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2023, and conflicting national standards shall be withdrawn at the latest by April 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 10101-3:1998.

Any feedback and questions on this document should be directed to the users’ national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

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Endorsement notice

The text of ISO 10101-3:2022 has been approved by CEN as EN ISO 10101-3:2022 without any modification.

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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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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*, Subcommittee SC 1, *Analysis of natural gas*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 238, *Test gases, test pressures, appliance categories and gas appliance types*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 10101-3:1993), which has been technically revised.

The main changes are as follows:

— Clause 2 and Bibliography were revised;

— new fixed structure numbering inserted;

— Subclause 9.2 Measurement of uncertainty was added.

A list of all parts in the ISO 10101 series can be found on the ISO website.

Introduction

Water vapour may be present in natural gas due to, for example, natural occurrence in the well production stream, the storage of gas in underground reservoirs, transmission or distribution through mains containing moisture or other reasons.

The Karl Fischer (KF) titration can be divided into two basic techniques – depending on the application range – volumetric and coulometric KF titration. The two analysis techniques differ in the mode of iodine addition or generation. Volumetric KF titration is preferably used for the determination of large amounts of water in the range of 1 mg to 100 mg. Coulometry, however, is a micro-method which is particularly well suited for determination of quantities of water from 10 µg to 10 mg.

Modern KF coulometers cover a range from 10 µg to 200 mg of water. Usually a resolution of 0,1 µg of water is achieved.

In coulometric water determination, iodine is not added in the form of a titrating solution but rather directly produced from an iodine-containing solution by an anodic oxidation reaction. The high analytic precision at low absolute water quantities makes coulometric KF titration particularly well suited for determination of the water content in aqueous gases.

Coulometric KF titration can be subdivided according to two distinct designs of the analysis cell: Cells with and without diaphragm. In both variants, the measuring cells are made of a titration vessel tightly sealed to prevent moisture ingress. The sample gas is passed directly through a glass frit into the KF titration cell. Thus, absorption of moisture from the environment is prevented and the gas finely dispersed. The fine distribution of the gas in the hygroscopic KF solution provides a large surface for material exchange, so that the water contained in the gas can be fully absorbed by the solution and then titrated. In the version with a diaphragm, the cell is divided into a large anode and a small cathode compartment, each filled with different reagents. Spatial separation is achieved by means of the diaphragm. In both compartments platinum electrodes are installed, via which a working current is passed through the titration cell. Due to the applied current, at the anode iodine is formed, which immediately reacts with the absorbed water from the gas sample. When all the water has been consumed by the reaction, an excess of iodine is formed that will be detected voltametrically, ending the titration. The amount of electricity consumed can be used to directly calculate, using Faraday's law, the quantity of water.

$$m_{\mathrm{H_2O}} = \frac{M_{\mathrm{H_2O}} \cdot Q}{z \cdot F}$$

where

z	is the number of exchanged electrons;
$M_{\mathrm{H_2O}}$	the molecular weight of water;
F	the Faraday constant (96 485 C/mol);
Q	the charge which has flowed in C.

In the KF titration cell variant without a diaphragm there is no separation between the anode and cathode chambers. Thus, for the filling of the cell only one reagent is needed and used. In order to prevent direct reduction of iodine at the cathode, the cathode and anode are spatially separated from each other by a large distance. The use of the cell without a diaphragm has the advantage that the titration cell is easier to clean and only one reagent is consumed, whose replacement can be completely automated. In addition, unlike in cells with a diaphragm, during longer downtimes no moisture can accumulate in the diaphragm, making the titration cell faster to become operational. For the measurement of extremely low water contents (few ppm of water), the leading KF equipment manufacturers recommend, despite these advantages, use of a KF coulometer with diaphragm. For practical implementation, however, this adds possible sources of error, complication and prolongation of the measurement times.

WARNING — Local safety regulations should be taken into account, when the equipment is located in hazardous areas.

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

Part 3: Coulometric procedure

1 Scope

This document specifies a coulometric procedure for the determination of water content by the Karl Fischer method. The method is applicable to natural gas and other gases which do not react with Karl Fischer (KF) reagents.

It applies to water concentrations between 5 mg/m^3 and 5 000 mg/m^3. Volumes are expressed at temperature of 273,15 K (0 °C) and a pressure of 101,325 kPa (1 atm).

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 10101-1, *Natural gas — Determination of water by the Karl Fischer method — Part 1- Introduction*

ISO 14532, *Natural gas — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14532 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/

4 Principle

A measured volume of gas is passed through the titration cell, where the water is absorbed by the anodic solution. The iodine required for the reaction with the water in the sample is generated in situ (in the titration beaker) using a reagent solution containing iodide. The quantity of electricity is directly proportional to the mass of iodine generated and hence to the mass of water determined.

The principle and chemical reactions of the Karl Fischer method are given in ISO 10101-1.

5 Reagents

5.1 Reagents specially formulated for coulometric determination.

The reagent does not need to be standardised, as coulometry is an absolute method. For a coulometric determination in the case of a cell with a diaphragm, two reagent solutions, an anolyte and a catholyte,

