



**SLOVENSKI STANDARD**  
**oSIST prEN ISO 10101-3:2021**  
**01-januar-2021**

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**Zemeljski plin - Določevanje vode po Karl-Fischerjevi metodi - 3. del: Kulometrijski postopek (ISO/DIS 10101-3:2020)**

Natural gas - Determination of water by the Karl Fischer method - Part 3: Coulometric procedure (ISO/DIS 10101-3:2020)

Erdgas - Bestimmung des Wassergehaltes nach Karl Fischer - Teil 3: Coulometrisches Verfahren (ISO/DIS 10101-3:2020)

Gaz naturel - Dosage de l'eau par la méthode de Karl Fischer - Partie 3: Méthode coulométrique (ISO/DIS 10101-3:2020)

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**Ta slovenski standard je istoveten z: prEN ISO 10101-3**

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**ICS:**

75.060

Zemeljski plin

Natural gas

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# DRAFT INTERNATIONAL STANDARD

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

### Part 3: Coulometric procedure

*Gaz naturel — Dosage de l'eau par la méthode de Karl Fischer —  
Partie 3: Méthode coulométrique*

ICS: 75.060

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# Contents

	Page
Foreword.....	iv
Introduction.....	v
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Principle</b> .....	<b>1</b>
<b>5 Reagents</b> .....	<b>2</b>
5.1 Reagents specially formulated for coulometric determination.....	2
5.2 Reference solution.....	2
5.3 Commercially available dry cartridges.....	2
<b>6 Apparatus</b> .....	<b>2</b>
<b>7 Sampling</b> .....	<b>6</b>
<b>8 Procedure</b> .....	<b>6</b>
8.1 Installation.....	6
8.2 Testing the response.....	6
8.3 Measurement.....	7
8.4 Blank value determination.....	7
<b>9 Expression of the results</b> .....	<b>7</b>
9.1 Method of calculation.....	7
9.2 Precision.....	8
9.2.1 Repeatability, $r$ .....	8
9.2.2 Reproducibility, $R$ .....	8
<b>10 Test report</b> .....	<b>8</b>
<b>Bibliography</b> .....	<b>9</b>

## ISO/DIS 10101-3:2020(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.

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](http://www.iso.org/directives)).

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This document was prepared by Technical Committee [or Project Committee] ISO/TC [or ISO/PC] 193, Natural Gas, Subcommittee 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: Volumetric procedure
- Part 3: Coulometric procedure

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 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 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. (source?)

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 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.

$$m_{H_2O} = \frac{M_{H_2O} \cdot Q}{z \cdot F} \quad (1)$$

where

$z$  is the number of exchanged electrons

$M_{H_2O}$  the molecular weight of water

$F$  the Faraday constant (96485 C / mol)

$Q$  the charge which has flowed in coulombs

In the KF titration cell variant without 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 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 diaphragm, during longer downtimes no moisture can accumulate in the diaphragm, making the titration cell faster to get 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.

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

## Part 3: Coulometric procedure

### 1 Scope

This part of ISO 10101 specifies a coulometric procedure for the determination of water content by the Karl Fischer method. The method applies to natural gas and other gases which do not react with Karl Fischer (KF) reagents.

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

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

### 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:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

### 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.

## ISO/DIS 10101-3:2020(E)

### 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 standard coulometric determination two reagent solutions, an anolyte and a catholyte, are required. The anolyte is inserted into the anode space of the cell and the catholyte into the cathode space.

#### 5.2 Reference solution

The reference solution, e.g. water and methanol mixture, with a water content of 5,0 mg/l  $\pm$ 4 % or 10,0 mg/l  $\pm$ 4 %. Keep this solution in a flask sealed with a septum.

NOTE There are reference solutions commercially available. They consist of stable solvent mixtures with specific composition and precisely determined water content, supplied in airtight glass ampoules to ensure quality when opened by the end user. The exact amount of water is given on the Certificate of Analysis. Typically, the reference solutions are filled under Argon in 4 mL or 8 mL glass ampoules.

#### 5.3 Commercially available dry cartridges

For example filled with Phosphorus pentoxide.

### 6 Apparatus

#### 6.2 Diagram of the complete apparatus is shown in [Figure 1](#)

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##### 6.1.1 Titration cell, as shown in [Figure 1](#)

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##### 6.1.2 Gas inlet, with a 3-way valve as in [Figure 3](#)

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