Second edition
2022-08

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

Part 1: General requirements

Gaz naturel — Dosage de l'eau par la méthode de Karl Fischer — Partie 1: Exigences générales

Reference number
ISO 10101-1:2022(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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 10101-1:1993), which has been technically revised.

The main changes are as follows:

— Clause 2 and Bibliography were revised;

— New fixed structure numbering inserted.

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 method for the determination of moisture has several practical advantages compared to other methods for moisture determination, such as accuracy, speed and selectivity.

The Karl Fischer method is selective for water, because the titration reaction itself consumes water.

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.

KF titration is essentially based on the Bunsen reaction used for the determination of sulphur dioxide in aqueous solution:

$$2H_2O + SO_2 + I_2 \rightarrow H_2SO_4 + 2HI$$

If an excess of sulphur dioxide with simultaneous neutralization of the sulphuric acid formed shift the reaction equilibrium to the right, the Bunsen reaction can also be used for the determination of water. Karl Fischer used pyridine as (neutralization) base, thus developing the classical KF reagent. This was a solution of iodine and sulphur dioxide in a solvent mixture of pyridine and methanol[9]. The fact that the pyridine contained in the reagent has a strong unpleasant odour and toxicity and the reaction runs stoichiometrically only within a certain pH range led to the revision of the KF reagents[9]. Scholz formulated the following KF reaction based on imidazole:

$$CH_3OH + SO_2 + RN \rightarrow [RNH]SO_3CH_3$$

where RN = Base.

$$H_2O + I_2 + [RNH]SO_3CH_3 + 2RN \rightarrow [RNH]SO_4CH_3 + 2[RNH]I$$

Volumetric KF titration is preferably used for the determination of large amounts of water in the range of 1 mg to 100 mg[10]. Coulometry, however, is a micro-method which is particularly well suited for determination of quantities of water from 10 µg to 10 mg[10]. In coulometric water determination, iodine is not added in the form of a titrating solution but rather directly produced from a iodine-containing solution by an anodic oxidation reaction[9]. 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.