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Natural gas — Determination of potential hydrocarbon liquid content — Gravimetric methods

Gaz naturel — Détermination de la teneur en hydrocarbures liquides potentiels — Méthodes gravimétriques

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

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

International Standard ISO 6570 was prepared by Technical Committee ISO/TC 193, *Natural gas*, Subcommittee SC 1, *Analysis of natural gas*.

This first edition cancels and replaces ISO 6570-1:1983 and ISO 6570-2:1984, which have been technically revised.

Annexes A to D of this International Standard are given for information only.

Introduction

Under certain conditions, higher hydrocarbons present in natural gas or similar gases may condense and the condensate formed can cause difficulties in the operation of gas transport and distribution systems.

Dew-point measurements, by condensation on a mirror, may give an indication of the conditions under which condensation starts. However, these measurements give no further information about the amount of liquid to be expected under operating conditions.

For proper operation of transport and distribution systems, a knowledge of the quantities of condensate formed as a function of temperature and pressure is required. This knowledge is also required for the design of production and treatment systems as well as for subsequent handling and disposal of the liquid.

The methods described in this International Standard are intended for the determination of the quantity of hydrocarbon condensate formed from a natural gas or similar gas as a function of the temperature and pressure of the gas.

Instruments based on different measurement principles can give a figure related to potential condensate content or dew point. The dew point can only be determined by performing measurements at different temperatures followed by extrapolation of the measurements to a potential hydrocarbon liquid content (ρ_{PHLC}) value of zero. The methods described in this International Standard can be used to calibrate such instruments.

Natural gas — Determination of potential hydrocarbon liquid content — Gravimetric methods

WARNING — The use of this International Standard may involve hazardous materials, operations and equipment. This International Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this International Standard to establish appropriate safety and health practices and to determine the applicability or regulatory limitations prior to use.

1 Scope

This International Standard describes the principles of, and general requirements for, two gravimetric methods for the determination of the potential hydrocarbon liquid content of natural gas, or similar gas, at a given pressure and temperature. Two methods are specified in this International Standard to determine the amount of condensate in a sample gas:

- Method A: a manual weighing method;
- Method B: an indirect automatic weighing method based on the indication of the pressure difference caused by the accumulation of condensate in a vertical tube.

The manual weighing method is a reference method for the indirect automatic method (Method B). The indirect automatic method (Method B) is suitable for semi-continuous control.

NOTE Unless otherwise specified, gas volumes are in cubic metres at 273,15 K and 101,325 kPa.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 6976:1995, *Natural gas — Calculation of calorific values, density, relative density and Wobbe index from composition*

ISO 10715:1997, *Natural gas — Sampling guidelines*

ISO 12213-1:1997, *Natural gas — Calculation of compression factor — Part 1: Introduction and guidelines*

ISO 12213-2:1997, *Natural gas — Calculation of compression factor — Part 2: Calculation using molar-composition analysis*

ISO 12213-3:1997, *Natural gas — Calculation of compression factor — Part 3: Calculation using physical properties*

3 Principle

Determination of the quantity of hydrocarbon condensate which can be formed at a pressure (p) and a temperature (T) by passing a representative sample of the gas through an apparatus where it is first brought to the pressure (p) and then cooled to the temperature (T).

The temperature and pressure are selected according to the specific application (see annex A).

Prior to reducing the pressure of the sample of gas to that required for the determination, the gas is heated, so that, after pressure reduction, the temperature is well above the dew-point temperature of the gas. Downstream of the reducer, the sample is cooled isobarically in a cooling bath to the required measurement temperature.

The quantity of liquid accumulated during the measurement period is determined by either direct manual weighing of the collected liquid or weighing of the condensate cyclone separator at the start and at the end of a measurement period (Method A).

Alternatively, the quantity of liquid accumulated in a vertical measuring tube may be determined automatically (indirect automatic weighing) by indication of the pressure difference caused by the liquid accumulated in a vertical measuring tube.

4 Apparatus requirements

WARNING — The instrumentation used for this method shall comply with local legal regulations for application in hazardous areas.

4.1 Measurement installation

The general arrangement is shown in Figure 1. Examples of the line-up of the apparatus are given in annex B.

4.1.1 Gas-line connecting tubes, made of stainless steel with an internal diameter ranging between 2 mm and 4 mm.

If mist is present in the gas, all tubing up to the point where the mist is evaporated or separated shall have an internal diameter compatible with that of the sample line (4.1.2).

4.1.2 Sample line, the length of which is kept to a minimum and temperature-controlled along its length to at least the point where it enters the part of the installation where the measurement is made.

An example of a sample line is given in Figure 2.

The sample line can be heated by fitting a plastic hose concentrically around the line through which water flows at the desired temperature. For this purpose, a temperature-controlled bath can be used from which the water to be circulated is drawn and to which it returns after circulation. The minimum temperature of the sample line can be checked easily by measuring the return temperature. The sample valve and its vicinity shall be heated or at least thermally insulated.

4.1.3 Drying tube (optional), for eliminating water vapour present in sufficiently large quantities in the gas.

Care shall be taken to avoid interferences with the determination of potential hydrocarbon liquid content.

Under certain conditions, the presence of water vapour can lead to the formation of hydrate which is detrimental to the determination. It is, therefore, necessary that the water dew point of the sample be lowered by passing it through a drying tube packed with anhydrous calcium sulfate or a similar water absorption agent which does not absorb hydrocarbons. In such cases, it is necessary to monitor the water dew point downstream to the drying tube so as to check the degree of saturation of the absorption agent. Install the drying tube upstream of a dust filter in order to prevent particles of the drying agent from entering the measurement installation.

If the presence of water vapour does not lead to hydrate formation, the drying tube may be omitted and the amount of water formed under the measurement conditions determined.

If hydrocarbon mist is present in the sample, and a drying tube is used, ensure that the mist is evaporated by heating before allowing the sample to pass through the drying tube.

4.1.4 Dust filter, preferably of a 5 µm pore size, which does not adsorb hydrocarbons.

4.1.5 Heat exchangers, pressure regulators and controllers, installed on the gas line with the heat exchanger immediately upstream to each pressure regulator so as to ensure that the gas temperature after pressure reduction remains at least 5 K above the dew point.

The pressure controller can be placed upstream or downstream from the cooling bath in the measurement installation (see annex B).

4.1.5.1 Heat exchanger (see example in Figure 3), through which water, maintained at the required temperature, is circulated from a thermostatically controlled bath so as to maintain the temperature constant in the gas line.

4.1.5.2 Pressure regulator and **pressure controller**, to ensure the maximum variation from its set-point with the pressure measurement in the gas/liquid cyclone separator is ± 10 kPa.

4.1.6 Measurement instruments for temperature and pressure, capable of recording or monitoring the following:

a) gas temperature and pressure in the gas/liquid cyclone separator;

b) ambient temperature and pressure;

c) gas temperature in the gas transmission line, or in the cylinder from which the sample is taken (optional);

d) gas temperature after pressure reduction (optional);

e) temperature of the bath (optional);

f) gas pressure before pressure reduction (optional);

g) gas pressure after pressure reduction (optional).

If proven experimentally that the difference between the temperature of the gas in the cyclone separator and the temperature of the cooling bath is less than 0,1 K, the temperature of the cooling bath may be measured instead. The pressure can be measured in the sample line just before or just after the cyclone separator.

4.1.7 Gas flow meter, capable of making either mass or volumetric measurements for either wet or dry gas. If a mass flow meter is used, it is necessary that the density of the gas be known.

The flow rate of the gas passing through the installation is limited by the cooling capacity of the bath, the heat transmission between the cooling coil and bath and the temperature drop to which the sample is subjected. The flow rate shall, therefore, be limited to a value that will ensure that the gas is cooled to the bath temperature (see 4.1.9.3).

Check the accuracy of the meter at regular intervals. The choice of gas meter shall be made taking into account the required accuracy, flow rate and the nature of the natural gas. The maximum permissible error in the flow meter shall be ± 1 % of the measured value.

The measured values shall be corrected for temperature and pressure if the values vary during the course of the period of measurement from reference conditions (273,15 K and 101,325 kPa).

4.1.8 Heated cabinet, used in the case of indirect sampling, of the appropriate shape to contain the sample cylinder and capable of heating to at least 10 K above the temperature at the sampling point (see 5.5).

4.1.9 Condenser/separator apparatus, consisting of a cooling coil connected at the end to a cyclone separator where condensates are collected (see Figure 4).

The cooling coil and cyclone separator are completely immersed in the cooling bath. The difference in temperature between the cooling bath and the gas/liquid cyclone separator shall not exceed 0,1 K.

4.1.9.1 Cooling coil, possibly in the form of a coil of stainless steel tubing and meeting the following design characteristics:

a) capable of providing turbulent flow throughout the measurements;

b) capable of maintaining the temperature difference between the gas leaving the cooling coil and the temperature of cooling bath to less than 0,25 K;

c) capable of maintaining pressure difference over the cooling coil not exceeding 1 kPa so as to ensure isobaric conditions;

d) having an internal diameter between 2 mm and 4 mm.

NOTE These specifications can be met for example with a cooling coil of 2,5 m length and a gas flow of 1 m^3/h.

4.1.9.2 Cyclone separator, permanently connected to the cooling coil, with a specific inlet diameter enabling sufficient centrifugal action to be obtained as the sample gas enters the cyclone separator barrel.

EXAMPLE A cyclone separator having an inlet diameter of 1 mm can meet these requirements. A provision can be made for measuring or recording the gas temperature in the barrel.

For the indirect automatic condensate measurement (Method B) a vertical measuring tube is mounted at the bottom of the cyclone separator. A weighing device (4.1.10.2) is connected to the bottom of the measuring device. This differential pressure transducer is connected to one side at the bottom of the measuring tube and to the other side at the lower part of the cyclone separator. Thus, the pressure difference between both sides of the transducer is a measure for the mass of the liquid in the measuring tube. At the bottom of the measuring tube there is also a drain line connected. This drain is opened at regular time intervals to release the collected condensate from the measuring tube.

NOTE For the weighing device an accurate differential pressure gauge should be used (see 4.1.10.2).

4.1.9.3 Cooling bath, well stirred, capable of completely immersing the cooling coil (4.1.9.1) and cyclone separator (4.1.9.2) as well as maintaining the temperature at any point of the bath by less than 0,25 K.

Proper operation of the cooling bath should be checked as follows.

a) Use a sensitive dew-point meter to verify that the measured dew point of the outgoing gas is equal to the temperature of the cooling bath within 0,25 K. This gives information on the performance of the gas cooler as well as on the efficiency of the gas/liquid cyclone separator.

b) Measure the temperature of the outgoing gas to verify that its temperature is equal to the bath temperature within 0,25 K. This procedure gives only information on the performance of the cooling coil and bath.

4.1.10 Measurement devices, consisting of one of the following:

4.1.10.1 Balance (Method A), capable of weighing to the nearest 0,01 g for masses of at least 2 kg.

4.1.10.2 Differential pressure gauge (Method B), capable of measuring pressure differences to the nearest 1 mg/m^3 (normalized) and having a lower detection limit of 5 mg/m^3 (normalized).