International Standard 6570/1

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Natural gas — Determination of potential hydrocarbon liquid content —
Part 1: Principles and general requirements

Gaz naturel — Détermination de la teneur en hydrocarbures liquides potentiels — Partie 1: Principes et prescriptions générales

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

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It has been approved by the member bodies of the following countries:

Australia
Belgium
Cuba
Czechoslovakia
France
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Italy
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Mexico
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Thailand
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No member body expressed disapproval of the document.

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Natural gas — Determination of potential hydrocarbon liquid content — Part 1 : Principles and general requirements

0 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 amounts 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, and 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 function of the temperature and pressure of the gas.

The amount of condensate can be determined in two different ways : by weighing or by volumetric measurement. Both methods of determination give the same result. However, some practical differences are :

- the weighing method can be operated unattended and is therefore suitable for continuous quality control;
- the volumetric method is operated manually. In this method, the hydrocarbon liquid and water separate into two distinct phases. They can be measured separately during the same test provided that the water is present in sufficient quantity, which may be the case for untreated gases.

If using the weighing method, two tests have to be executed in parallel in order to obtain the values for water and hydrocarbon liquid content (see also 6.4).

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

1 Scope and field of application

This part of ISO 6570 describes the principles of, and general requirements for, methods for the determination of the potential hydrocarbon liquid content of natural gas, or similar gas, at a given pressure and temperature.

The methods themselves are described in more detail in the two other parts of this International Standard: the weighing method being specified in ISO 6570/2 and the volumetric method being specified in ISO 6570/3.

2 References

ISO 6570/2, *Natural gas — Determination of potential hydrocarbon liquid content — Part 2 : Weighing method.*[1]

ISO 6570/3, *Natural gas — Determination of potential hydrocarbon liquid content — Part 3 : Volumetric method.*[1]

3 Principle

Determination of the quantity of 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 clause 5).

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 measuring temperature.

The liquids formed are separated from the gas flow and collected, the quantity of liquid being determined by weighing or measurement of volume, and the total volume of gas being measured.

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1) At present at the stage of draft.

4 Sampling

In order to obtain reliable results, the conditions described below shall be observed when taking samples.

4.1 General

The gas shall, preferably, be transferred directly to the measuring installation along a pipe from the transmission line or other system. Sample cylinders may, however, be used to transport the gas to the measuring installation. Thus, both direct and indirect sampling methods may be used, but, in each case, it is imperative that the gas reaching the installation is representative of that to be tested.

4.2 Conditions for representative sampling

Sampling in pipeline systems shall preferably be carried out directly after a separator to reduce the chance of any liquid being sampled with the gas.

The sample probe shall penetrate to between one-quarter and three-quarters of the diameter of the main pipeline, so that any liquid on the walls of the main pipeline cannot enter the sample probe.

If hydrocarbon mist is present in the pipeline system, the gas shall be sampled isokinetically. The isokinetic sampling probe (see annex A) in the transmission pipeline shall have a probe inlet of dimensions such that the gas velocities in the pipeline and in the probe inlet do not differ by more than 30 %.

If it is required to measure the quantity of mist separately, direct sampling shall be used (see 6.4).

4.3 Sample line

The whole sampling line shall be heated to at least 5 K above the local dew point in order to avoid condensation. The sample line shall be as short as possible (see figure 1). The sample line shall be temperature controlled at least up to the point where the line enters the measuring space. A suitable method of temperature control is described in annex C.

The gaseous sample shall be passed through a 5 µm sintered metal dust filter (6.5). If mist is present in the gas, the dynamic pressure in the sample line shall be at least 400 Pa.

4.4 Direct sampling

For direct sampling, the sampling line is connected directly to the measuring installation.

4.5 Indirect sampling

It is possible to take a sample in a cylinder and transport it to the laboratory, but the limited volume of the sample then affects the sensitivity and accuracy of the method. In order to ensure that the contents of the cylinder are representative, the cylinder shall be cleaned, dried and checked for hydrocarbon content. Prior to filling, the cylinder shall be evacuated to a pressure below 100 Pa absolute.

Taking samples from a relatively hot system into a cold cylinder causes the gas to contract and may cause condensation. Both factors increase the mass of gas in the cylinder on filling to system pressure compared with the mass of a similar volume of gas under conditions of sampling. Consequently, at the laboratory, before any gas is removed, the cylinder shall be heated for at least 24 h at a temperature at least 10 K above the gas temperature at the sampling point or at the gas/liquid separator upstream of that point, whichever is the higher. Heating is necessary in order to re-evaporate any condensed liquid in the cylinder, and it increases the pressure to above that of the system from which the sample was taken; this excess pressure provides enough gas for measurements to be made at the sampling pressure. The pressure in the cylinder shall be monitored to ensure that the safe working pressure of the cylinder is not exceeded.

5 Conditions of measurement

5.1 Selection of measurement temperature and pressure

The temperature and pressure to which the sample is to be brought in the measuring installation depends on the purpose for which the measurements are made. In general, these conditions are chosen according to the temperature and pressure to which the gas is subjected in the pipeline or processing plant under investigation. Some applications are given below.

5.1.1 Pipelines

In order to determine the possible condensate formation in a pipeline system, the temperature and pressure in the measuring installation have to correspond to those conditions in the pipeline system at which maximum condensate formation occurs.

By measuring at the feeding station of a pipeline grid and at some representative outlet station over a period of time, both at the same reference pressure and temperature, the quantity of condensate formed in that grid can be determined by difference.

5.1.2 Gas delivery contracts

If the method of measurement is used for checking whether a gas is meeting a contract specification with respect to condensate formation at a delivery point, the pressure and temperature in the measuring system shall be those specified by the contract.

5.1.3 Treatment control

Proper functioning of a treatment process may be investigated by carrying out measurements periodically, all being carried out at the same temperature and pressure. In order to obtain an insight into the fluctuations of a process, the measuring temperature chosen should be several kelvins below the lowest dew point expected to be produced by the process.

5.1.4 Designing treatment installations

The quantities of condensate formed in low temperature processing systems can be predicted by simulating the process with the measuring installation. The condensable hydrocarbon content of the gas before and after treatment can be measured simultaneously (see 5.1.3).

A number of measurements can be made to obtain a complete picture of the dependence of condensation on temperature and pressure.

5.1.5 Checking other instruments

Instruments based on different measurement principles can give a figure related to potential condensate content or dew point.

The methods described in this International Standard can be used to calibrate such instruments.

5.2 Flow rate

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 5.3).

5.3 Check of proper functioning

The proper functioning of the equipment shall be checked in one or more of the following ways :

a) by using a sensitive dew point meter to verify whether the measured dew point of the outgoing gas is equal to the temperature of the cooling bath within ± 0,25 K;

b) by measurement of the temperature of the outgoing gas to verify that its temperature is equal to the bath temperature within ± 0,25 K;

c) for the weighing method, by using a checking filter as described in subclause 4.2 of ISO 6570/2.

6 Apparatus

The general arrangement of the measuring installation is shown in figures 2 and 3, which show two systems of flow and pressure regulation. All points of the installation between the end of the sample line and the point where the gas is cooled for condensation shall be maintained at a temperature at least 5 K higher than the local dew point.

6.1 Connecting tubes

Unless otherwise specified, all the gas lines shall be made of stainless steel, and shall be of internal diameter between 2 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 (see 4.3).

6.2 Heat exchanger and pressure reducer

The gas entering each pressure reducer and the reducer body shall have a temperature such that the gas temperature after pressure reduction is at least 5 K above the dew point of the gas. For this purpose, a heat exchanger (see annex B and figure 4) shall be installed immediately upstream of each reducer.

6.3 Condenser/cooling bath

The gas shall be cooled in a condenser which can, for example, be in the form of a coil of stainless steel tube.

The liquid formed shall be collected in a separator connected to the end of the condenser. The condenser and filter, if used, shall be completely immersed in a well stirred cooling bath. During measurement, the temperature at any point of the cooling bath shall not deviate from the specified value by more than ± 0,25 K.

6.4 Drying tube (optional)

If water vapour is present in a sufficiently large quantity in the gas, care should 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 leading it through a drying tube packed with anhydrous calcium sulphate or a similar water absorption agent which does not absorb hydrocarbons. In such cases the water dew point downstream of the drying tube shall be monitored to check the degree of saturation of the absorption agent. The drying tube shall be installed upstream of a 5 µm sintered metal dust filter in order to prevent particles of the drying agent entering the measuring 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 measuring conditions determined as described in ISO 6570/2 or ISO 6570/3 depending on whether the weighing or volumetric method is used.

If hydrocarbon mist is present in the sample, and a drying tube is used, the mist shall be evaporated by heating before the sample is passed through the drying tube. Alternatively, the mist can be separated from the sample upstream of the drying tube and the quantity of mist can be determined.

6.5 Dust filter

The pore size of the dust filter shall be 5 µm, the material being chosen so that no hydrocarbon liquid or gas is absorbed (for example, sintered metal). The body of the filter shall be installed so that any liquid entrained with the sample can leave the filter via the outlet.

6.6 Temperature and pressure recorders

During measurement, the following temperatures and pressures shall be recorded or monitored :

- gas temperature in the gas transmission line, or in the cylinder from which the sample is taken;
- gas temperature after pressure reduction;

- temperature of the bath;
- gas temperature in the liquid separator (if desired);
- ambient temperature;
- gas pressure before pressure reduction;
- gas pressure after pressure reduction.

6.7 Gas meter

After reduction to atmospheric pressure, the volume of the gas shall be determined by passing it through a gas meter.

If necessary, the gas shall be heated again before pressure reduction to avoid blocking of the needle valve by condensation. A calibrated wet or dry gas meter can be used, and should be checked for accuracy from time to time. For small volumes, a gasometer or a mercury sealed piston gas meter should be used. The choice of gas meter should be made taking into account the desired accuracy and flow rate and the nature of the gas.

The volume of gas measured should be corrected for temperature and pressure if their values, throughout the measuring period, are substantially different from standard conditions (273,15 K and 101 325 Pa).

6.8 Heated cabinet

In the case of indirect sampling, a heated cabinet is necessary. It shall be of the appropriate form to contain the sample cylinder and to be heated to at least 10 K above the highest gas temperature which may occur at, or upstream of, the filling point (see 4.5).

7 Procedure

The quantity of condensate collected in the separator shall be determined by weighing or by measurement of its volume. The methods are described in detail in ISO 6570/2 and ISO 6570/3.

8 Sources of error

The most important sources of error are as follows.

8.1 Gas leakage

Gas leaks may arise in the connections between the liquid separator and the gas meter. In particular, the safety valve upstream of the gas meter shall be checked for leaks from time to time.

8.2 Variations in bath temperature and gas pressure

The bath temperature and the gas pressure may vary during the measurement, and recording or monitoring is therefore essential.

8.3 Premature condensation

Premature condensation can be caused by the gas having too low a temperature after reduction to the measurement pressure.

8.4 Measurement of gas volume

Inaccurate measurement of the gas volume is a source of error.

Annex A

Isokinetic sampling probe

(This annex forms an integral part of the Standard.)

The isokinetic sampling probe (see figure 5) is introduced into the pipeline through a threaded connector in such a way that the inlet of the sampling probe faces the gas flow. The connector can be mounted either directly on the conduit or on a full bore valve of diameter 25 mm or more, attached to the main conduit. Nozzles with different entry diameters can be screwed into the probe, so that, at any gas velocity in the transmission pipeline, an approximately isokinetic sample can be obtained.

The depth of insertion of the probe into the pipeline can be varied in order to meet the requirement specified in 4.2.

Annex B

Heat exchanger

(This annex forms an integral part of the Standard.)

The heat exchanger (see figure 4) shall be installed directly before the pressure reducer.

Water from a bath maintained at the required temperature shall be circulated through it. For this purpose, a thermostatically controlled bath shall be provided. Similarly, water can be used for heating the reducer body wrapped with a plastic hose.

Annex C

Temperature-controlled sample line

(This annex is given for information only and does not form part of the Standard.)

The heating of the sample line can be obtained by fitting a plastic hose concentrically around the line. Water at the desired temperature then circulates through the hose.

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 return temperature gives an easy check of the minimum temperature of the sample line. The sample valve and its vicinity shall be heated or at least insulated.

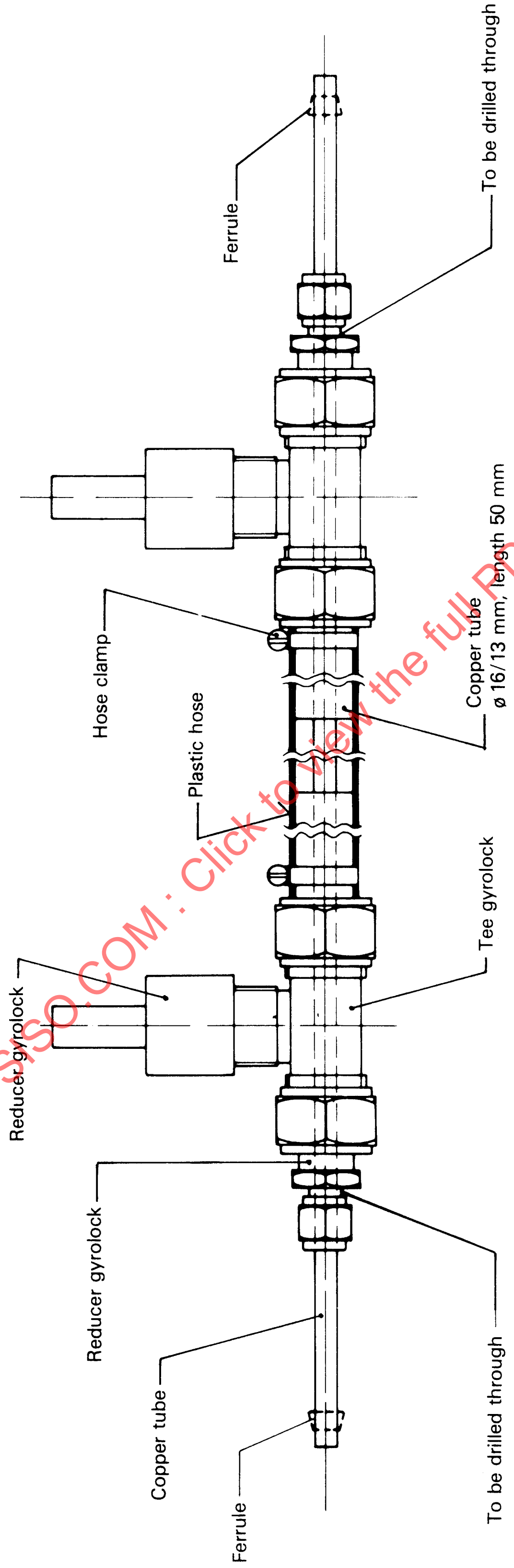

Figure 1 — Example of temperature-controlled sampling line

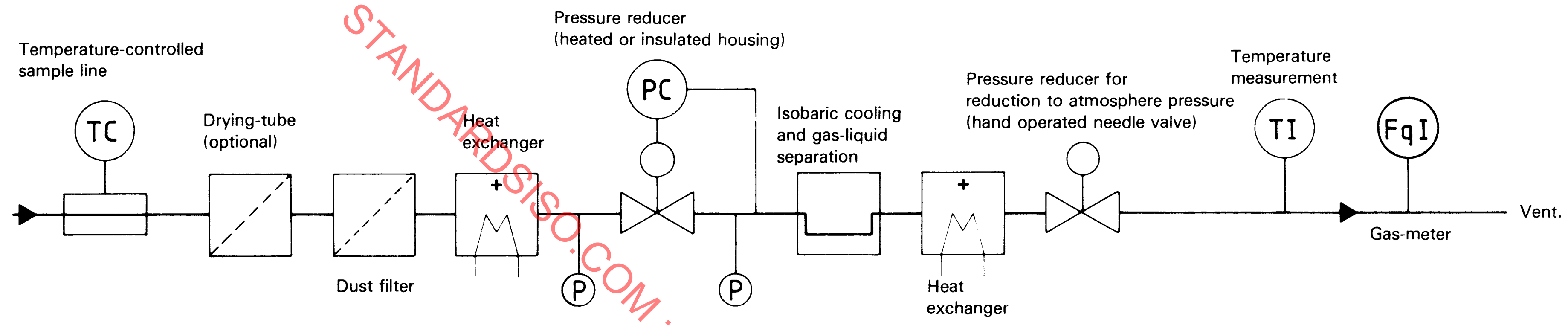

Figure 2 — Principle of measuring method (pressure control upstream of the cooling bath)

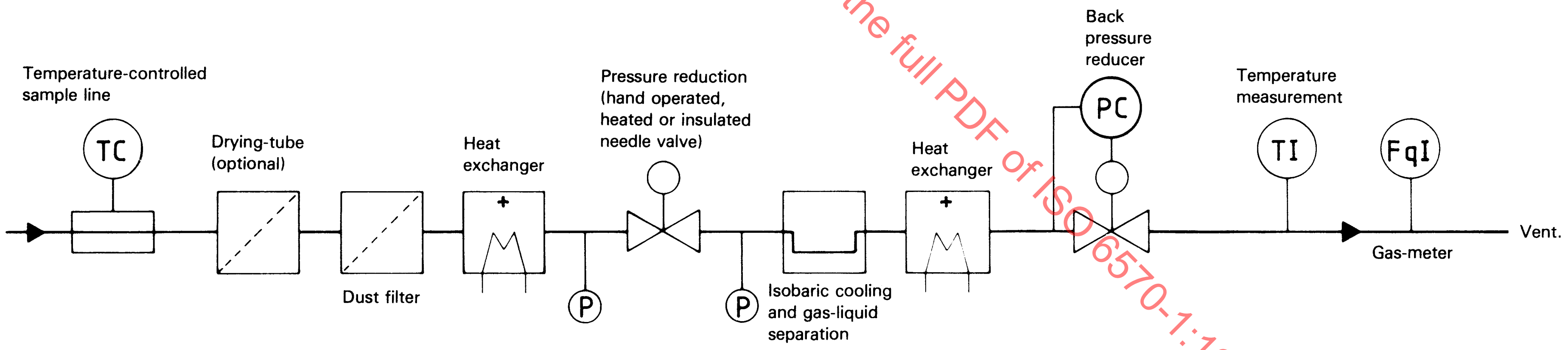

Figure 3 — Principle of measuring method (pressure control downstream of the cooling bath)