BRITISH STANDARD

BS 3156-11.2.3: 1986
ISO 6570-3: 1984

# Analysis of fuel gases —

## Part 11: Methods for non-manufactured gases —

## Section 11.2 Determination of potential hydrocarbon liquid content —

## Subsection 11.2.3 Volumetric method

**[ISO title: Natural gas — Determination of potential hydrocarbon liquid content — Part 3: Volumetric method]**

UDC 662.76:543

# Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Environment and Pollution Standards Committee (EPC/-) to Technical Committee EPC/46 upon which the following bodies were represented:

British Ceramic Research Association
British Gas Corporation
Cement Makers' Federation
Chemical Industries Association
Department of Energy (Gas Standards)
Department of Trade and Industry (Electronics Applications Division)
Department of Trade and Industry (Laboratory of the Government Chemist)
Department of Trade and Industry (Warren Spring Laboratory)
Electricity Supply Industry in England and Wales
GAMBICA (BEAMA Ltd.)
Institute of Petroleum
Institution of Chemical Engineers
Institution of Gas Engineers
National Coal Board
Society of Chemical Industry
Society of Glass Technology
Society of Motor Manufacturers and Traders Limited
Water-tube Boilermakers' Association

The following bodies were also represented in the drafting of the standard through subcommittees and panels:

British Compressed Gases Association
British Laboratory Ware Association

This British Standard, having been prepared under the direction of the Environment and Pollution Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 January 1986



The following BSI references relate to the work on this standard:
Committee reference EPC/46
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**Amendments issued since publication**

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# Contents

# National foreword

This Subsection of BS 3156 has been prepared under the direction of the Environment and Pollution Standards Committee. It is identical with ISO 6570-3:1984 "*Natural gas — Determination of potential hydrocarbon liquid content — Part 3: Volumetric method*", published by the International Organization for Standardization (ISO). ISO 6570-3 was prepared as a result of discussions in Technical Committee 158, Gas Analysis, in which the UK has participated.

BS 3156 was first published as a single standard in 1959 under the title "*Methods for the sampling and analysis of fuel gases*". A first revision was carried out in 1968 under the title "*Methods for the analysis of fuel gases*", Parts 1, 2 and 3 being published in that year. Parts 4 and 5 of BS 3156 were published in 1969. This new series of BS 3156, which begins at Part 10, will incorporate methods prepared by ISO/TC 158. In addition, it is intended to revise Parts 1 to 5 and published them in the new series.

**Terminology and conventions**. The text of the International Standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

Wherever the words "part of ISO 6570" appear, referring to this standard, they should be read as "Subsection of BS 3156".

The comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

In British Standards it is current practice to use the symbol "L" for litre (and its submultiples) rather than "l".

**Cross-references**

| International Standard | Corresponding British Standard |
|---|---|
| | BS 3156: *Analysis of fuel gases*<br>Part 11: *Methods for non-manufactured gases*<br>Section 11.2: *Determination of potential hydrocarbon liquid content* |
| ISO 6570-1:1983 | Subsection 11.2.1:1986 *General introduction*<br>(Identical) |
| ISO 6570-2:1984 | Subsection 11.2.2:1986 *Weighing method*<br>(Identical) |

The Technical Committee has reviewed the provisions of ISO 3601-1 which is referred to in Figure 3, and has decided that they are suitable for use in conjunction with this British Standard. Any O-ring that fits the grooves as specified in Figure 3, made of an elastomeric material, would be suitable in practice.

NOTE In Figure 2, for "Thermostatically controlled bath" read "Thermostatically controlled bath".

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

**Summary of pages**

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

## 1 Scope and field of application

This part of ISO 6570 specifies a volumetric method for the determination of the potential hydrocarbon liquid content of natural gas.

This method permits simultaneous determination of the amount of water that condenses under the conditions of the test.

The principles of, and general requirements for, methods for the determination of potential hydrocarbon liquid content are specified in ISO 6570-1. An alternative weighing method for the determination of potential hydrocarbon liquid is specified in ISO 6570-2.

## 2 References

ISO 3601-1, *Fluid systems — O-rings — Part 1: Inside diameters, cross-sections, tolerances and size identification code.*

ISO 6570-1, *Natural gas — Determination of potential hydrocarbon liquid content — Part 1: Principles and general requirements.*

ISO 6570-2, *Natural gas — Determination of potential hydrocarbon liquid content — Part 2: Weighing method.*

## 3 Principle

See ISO 6570-1.

The volumes of hydrocarbon liquid (and water if present) formed from given volumes of gas passed through the installation at a specific temperature and pressure are measured directly and the potential hydrocarbon liquid content is derived from a graphical presentation of the results. The volume of any condensed water may be derived in a similar manner.

## 4 Apparatus

**WARNING — The apparatus shall comply with relevant safety regulations.**

The general arrangement of the measuring installation is shown in Figure 1.

The measuring installation shall meet the general requirements set out in ISO 6570-1.

The separator specified in **4.2** is intended for use at maximum working pressure of 8 MPa. The actual equipment used shall have been tested to an appropriate higher maximum pressure in accordance with the requirements of national safety regulations and shown to be safe.

In addition, the following equipment is required.

**4.1** *Cooling coil*

The cooling coil shall consist of copper tubing 4 m long, of external diameter 6 mm and internal diameter 4,5 mm, preferably packed with 2 mm phosphor-bronze balls.

**4.2** *Separator* (see Figure 2 and Figure 3)

The separator assembly (see Figure 2) shall consist of:

An upper small vertical chamber surrounded by a constant temperature bath controlled to ± 0,25 K. The lower end is connected to a sight glass, of polymethyl methacrylate, having a central tube of restricted width half way up which a reference point is marked (see detail Figure 3). This in turn is connected to a lower chamber, of appropriate capacity to collect the condensate formed, surrounded by a constant temperature bath controlled to a temperature 5 to 10 K lower than that of the upper chamber.

NOTE The specified separator and filter designs have been tested at a pressure of 12 MPa.

**4.3** *Mercury displacement pump*

A calibrated mercury displacement pump with a scale graduated in 0,01 ml divisions, with the possibility of estimating to 0,001 ml, shall be used.

**4.4** *Back pressure regulator*

The back pressure regulator shall be suitable for the pressures to be used.

**4.5 Equipment** for checking of proper functioning (see subclause **5.3** of ISO 6570-1).

## 5 Sampling

The general conditions for representative sampling set out in ISO 6570-1 shall be complied with.

## 6 Procedure

Connect a nitrogen cylinder to the apparatus using a heated line, and set the thermostat of the bath containing the cooling coil to the desired temperature. Raise the mercury level in the sight glass using the displacement pump, set the back pressure regulator, and pressurize the system with nitrogen. Check for any leaks using soap-solution and carry out any necessary repairs.

NOTE If a sufficiently large sample is available, it may be used for checking for leaks instead of the nitrogen.

Reduce the mercury level to below the sight glass, and close the valve to the mercury pump. Vent to reduce the pressure in the installation and adjust the temperature of the lower chamber to at least 5 K below that of the cooling coil. Evacuate the system and slowly introduce the sample, allowing the gas to slowly flow through the apparatus (control the gas flow using the back pressure regulator and the fine control valve). Open the valve to the mercury pump, and raise the mercury level in the sight glass by means of the displacement pump.

As gas flows through the installation, adjust in turn the levels of the water-liquid hydrocarbon and liquid hydrocarbon-gas interfaces to the reference level in the sight glass and record the mercury pump and gas-meter readings for each adjustment. Record the temperatures of the bath containing the cooling coil and the gas entering the measuring equipment.

Note the flow rates through the installation and the thermostatically controlled bath and the dew point temperatures of the gas leaving the separator. The gas leaving the separator should be in equilibrium; this may be checked, for example, by measuring the hydrocarbon dew point.

## 7 Expression of results

Convert the pump readings to liquid volumes and correct the gas volumes to standard conditions (273,15 K and 101 325 Pa). From a series of readings, plot the volumes of gas against the volumes of liquid.

After initial scatter, due to wetting of the walls of the installation, the values should give a straight line, the slope of which gives the volume of liquid, condensate or water, condensed under the conditions in the separator.

Express the results as the ratio of the volume of liquid per unit volume of gas. The recommended unit is $cm^3/m^3$.

An example of results obtained from a sample in a cylinder is given in Annex A and of the results obtained from a sample taken by direct sampling are given in Annex B.

## 8 Sources of error

In addition to the sources of error specified in ISO 6570-1, that of particular concern in the volumetric method is the temperature of the lower liquid container. If this is too high, gassing will occur in the condensed liquid. To avoid this it is essential that the temperature difference between the separator bath and the lower container bath specified in clause **4** be maintained.

## 9 Test report

The test report shall include the following information:

a) a reference to this part of ISO 6570;

b) all the information necessary for the complete identification of the sample;

c) the results obtained;

d) details of any operation not specified in this part of ISO 6570, or ISO 6570-1, or regarded as optional, together with details of any incidents likely to have affected the results.

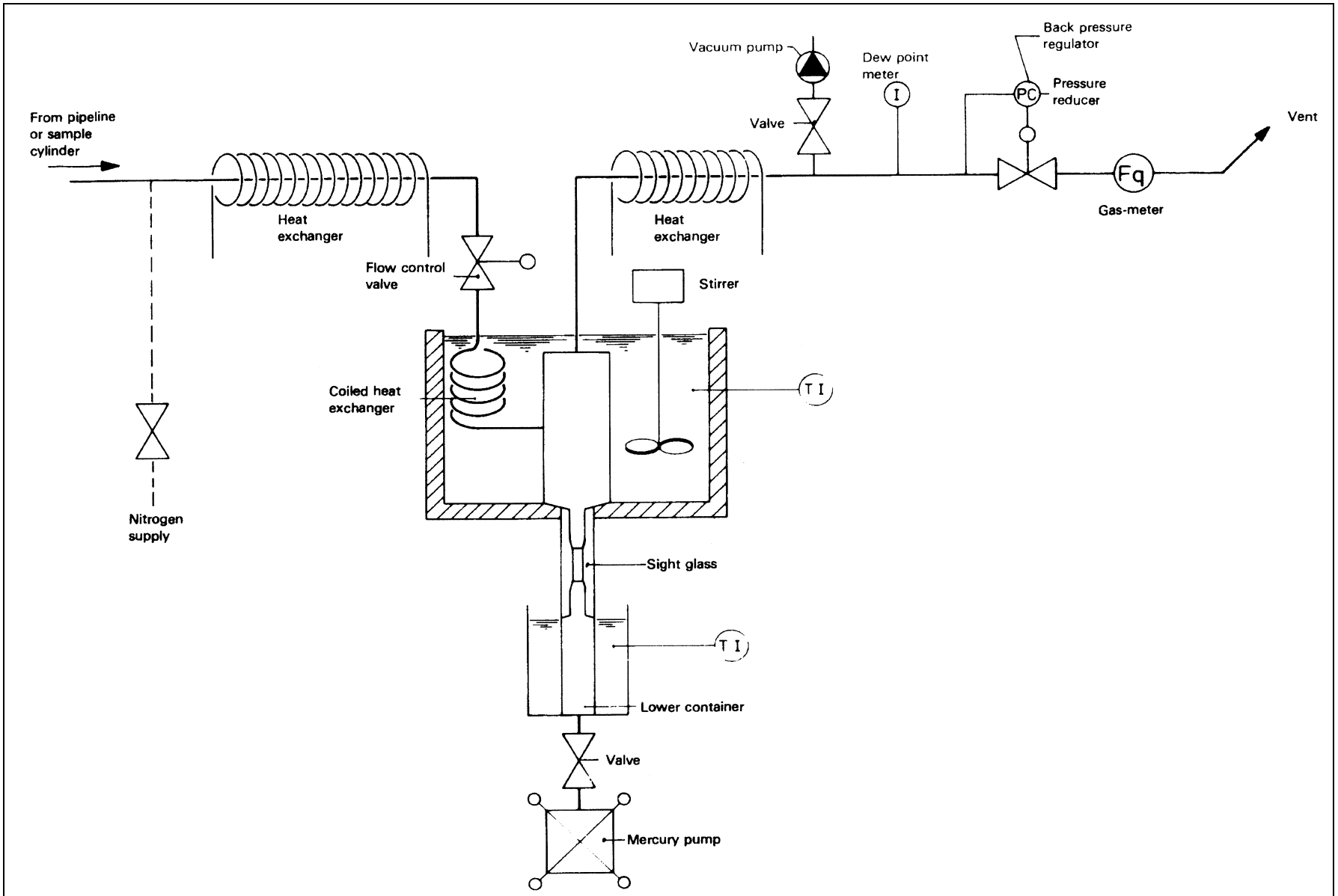



**Figure 1 — General arrangement of the measuring installation**

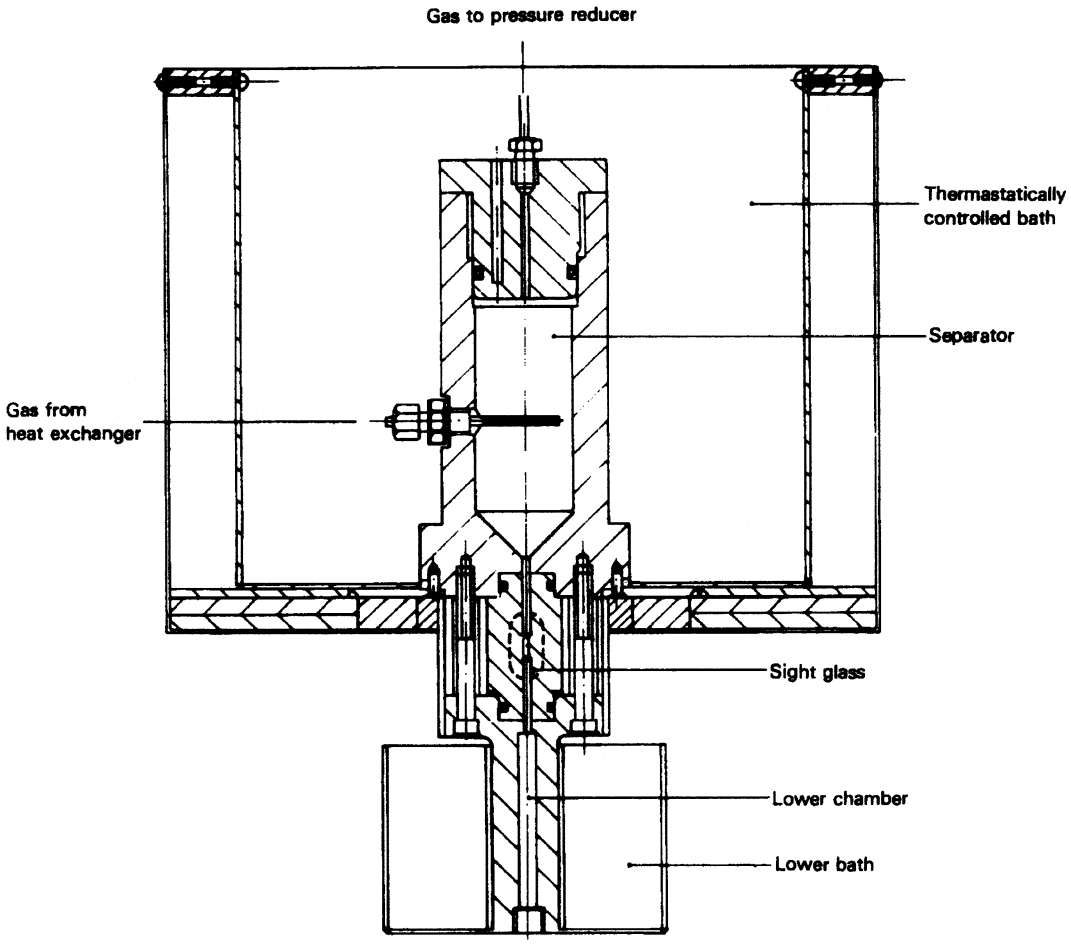
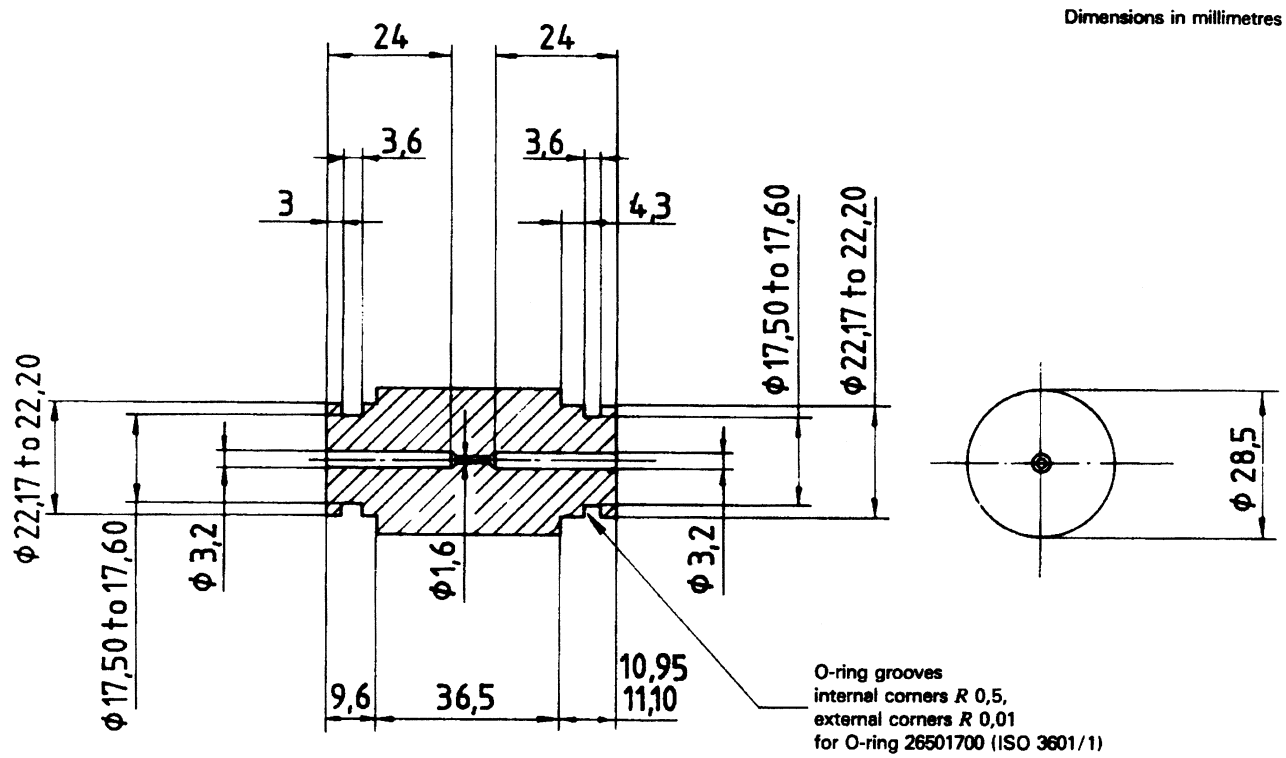



**Figure 2 — Detail of separator and associated equipment**




NOTE All surfaces to be finished smooth and free from toolmarks.

**Figure 3 — Details of sight glass**

## Annex A Example of results obtained for a sample from a cylinder

### A.1 Sample details

Bottle A 2492, sampled from separator operating at 0,34 MPa and 345 K.

Dew point of gas leaving cylinder at 0,34 MPa:

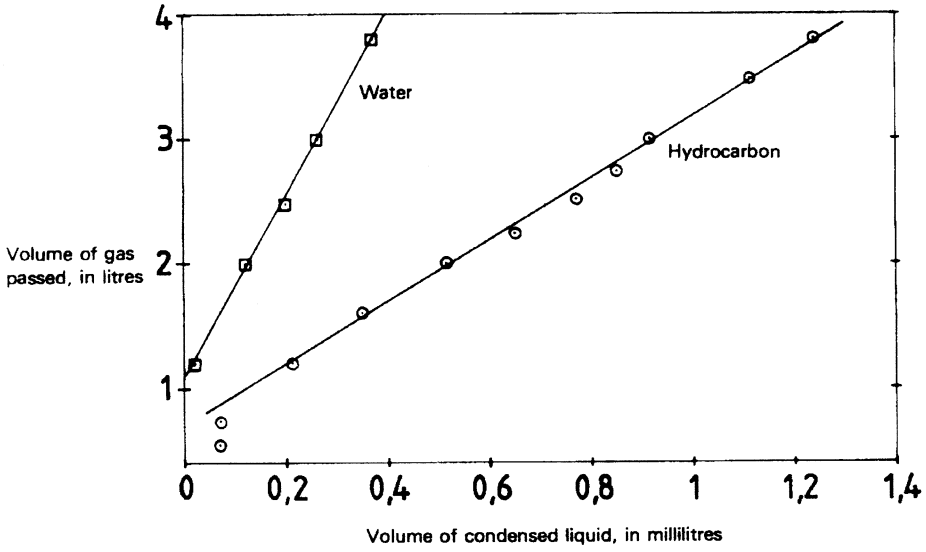
hydrocarbon: 345 K

water: 344 to 345 K

### A.2 Results

| Time of day | Volume of gas passed[a] I | Bath temperature K | Dew point K | Volume of condensed liquid ml | |
|---|---|---|---|---|---|
| | | | | Hydrocarbon | Water |
| 10:00 | 0,55 | 303,0 | 303,0 | 0,07 | |
| | 0,75 | 303,2 | | 0,072 | 0,02 |
| | 1,20 | 303,1 | 303,2 | 0,215 | |
| | 1,60 | 303,0 | | 0,345 | |
| 10:26 | 2,00 | 303,0 | 303,0 | 0,515 | 0,121 |
| | 2,25 | 302,8 | | 0,650 | |
| 10:32 | 2,50 | 302,9 | 302,8 | 0,768 | 0,20 |
| | 2,75 | 303,1 | | 0,853 | |
| 10:39 | 3,00 | 303,0 | 303,0 | 0,925 | 0,263 |
| | 3,50 | 303,0 | | 1,112 | |
| 10:50 | 3,80 | 303,1 | | 1,240 | 0,365 |

[a] Corrected to standard conditions.




From the slope of the graph

— potential liquid hydrocarbon content $4{,}05 \times 10^{-4}$ ($V/V$)

— potential water (as liquid) content $1{,}38 \times 10^{-4}$ ($V/V$)

## Annex B Example of results obtained for a sample taken by direct sampling from a pipeline

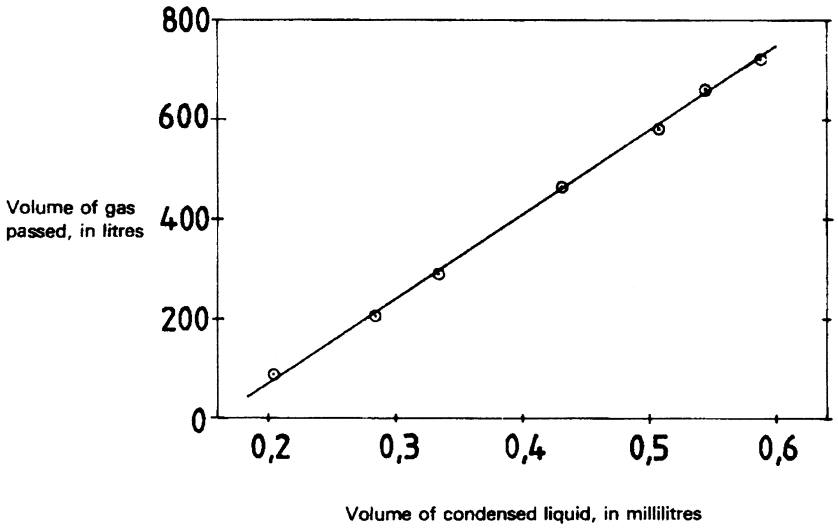
### B.1 Sample details

Line pressure: 6,9 MPa.

Gas with a hydrocarbon dew point of 278 K, cooled to a dew point of 273,5 to 274,0 K.

### B.2 Results

| Time of day | Pressure MPa | Bath temperature K | Dew point K | Volume of liquid ml | Gas-meter reading I | Volume of gas passed I |
|---|---|---|---|---|---|---|
| 11:04 | 6,90 | 260,0 | | 0,181 | 3 960 | |
| | 6,90 | 260,0 | 273,5 | 0,205 | 4 047 | 87 |
| | 6,90 | 260,5 | 274,0 | 0,283 | 4 163 | 203 |
| 11:25 | 6,90 | 260,0 | 274,0 | 0,334 | 4 250 | 290 |
| | 6,90 | 260,3 | 273,5 | 0,433 | 4 423 | 463 |
| 11:47 | 6,90 | 260,0 | 274,0 | 0,507 | 4 540 | 580 |
| | 6,90 | 260,3 | | 0,544 | 4 625 | 665 |
| 12:00 | 6,90 | | 274,0 | 0,589 | 4 680 | 720 |




From the slope of the graph, potential liquid hydrocarbon content:

$5{,}9 \times 10^{-7}$ (*V*/*V*)

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# Publications referred to

See national foreword.

# BSI — British Standards Institution

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