

**BS EN 27941 :
1994
BS 2000 :
Part 405 : 1994
ISO 7941 : 1988**

Methods of test for

Petroleum and its products

Part 405. Commercial propane and butane - Analysis by gas chromatography

(Identical with IP 405/94)

The European Standard EN 27941 : 1993 has the status of a
British Standard

UDC 665.725.3/.4:543.544

National foreword

This British Standard, having been prepared under the direction of the Petroleum Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 31 March 1994. It is the English language version of EN 27941 : 1993 *Commercial propane and butane - Analysis by gas chromatography*, published by the European Committee for Standardization (CEN), which endorses ISO 7941 : 1988, published by the International Organization for Standardization (ISO).

This British Standard supersedes BS 7276 : 1990, which is withdrawn.

Due to the implementation of ISO 7941 : 1988 as a European Standard and as a Part of BS 2000, this British Standard has been given a different number to BS 7276 : 1990. However, there are no other differences between this British Standard and BS 7276 : 1990.

BS 2000 comprises a series of test methods for petroleum and its products that are published by the Institute of Petroleum (IP) and have been accorded the status of a British Standard. Each method should be read in conjunction with the preliminary pages of 'IP Standard methods for analysis and testing of petroleum and related products' which gives details of the BSI/IP agreement for publication of the series, provides general information on safety precautions, sampling and other matters, and lists the methods published as Parts of BS 2000.

The numbering of the Parts of BS 2000 follows that of the corresponding methods published in 'IP Standard methods for analysis and testing of petroleum and related products'. Under the terms of the agreement between BSI and the Institute of Petroleum, BS 2000 : Part 405/BS EN 27941 will be published by the IP (in 'Standard methods for analysis and testing of petroleum and related products' and as a separate publication). BS 2000 : Part 405 : 1994 is thus identical with IP 405/94.

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

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The following BSI references
relate to the work of this
standard:

Committee reference PTC/13
Announcement in *BSI News*
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Descriptors: Petroleum products, hydrocarbons, liquefied petroleum gases, commercial propane, commercial butane, chemical analysis, chromatography

English version

Commercial propane and butane - Analysis by gas chromatography (ISO 7941:1988)

Propanes et butanes commerciaux - Analyse
par chromatographie en phase gazeuse
(ISO 7941:1988)

Handelsübliches Propan und Butan -
Gaschromatographische Analyse
(ISO 7941:1988)

This European Standard was approved by CEN on 1993-10-20. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

The European Standards exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Foreword

This European Standard is the endorsement of ISO 7941:1988. Endorsement of ISO 7941 was recommended by Technical Committee CEN/TC 19 "Methods of test and specifications for petroleum products" under whose competence this European Standard will henceforth fall.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 1994, and conflicting national standards shall be withdrawn at the latest by April 1994.

The standard was approved and in accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

Endorsement notice

The text of the International Standard ISO 7941:1988 was approved by CEN as a European Standard without modification.

Commercial propane and butane — Analysis by gas chromatography

WARNING: Safety precautions — When testing LPG it is essential to observe suitable safety precautions and any regulations applicable to installations, apparatus and storage. Particular attention shall be given to the following.

- a) LPG can cause serious burns from the cold, and the liquid should not be allowed to contact the skin. When sampling LPG, goggles and gloves must be worn.
- b) Discharge of LPG can give rise to static electricity and it is essential to connect containers to "earth" prior to and during discharge.

If hydrogen is used as a carrier gas, special safety precautions shall be taken. More particularly, the hydrogen line shall be carefully tested for leaks, especially in the oven.

1 Scope and field of application

This International Standard specifies a gas chromatographic method for the quantitative determination of hydrocarbons in liquefied petroleum gas (LPG), excluding components whose concentrations are below 0,1 % (m/m). It is applicable to the analysis of propane, butane and their commercial mixtures, which may include saturated and unsaturated C₂, C₃, C₄ and C₅ hydrocarbons. It does not apply to "on-line" chromatography.

2 References

ISO 565, *Test sieves — Woven metal wire cloth, perforated plate and electroformed sheet — Nominal sizes of openings.*

ISO 4257, *Liquefied petroleum gases — Method of sampling.*¹⁾

3 Principle

Physical separation by gas chromatography. Identification of the components by passing a standard reference mixture or pure hydrocarbons through the column, or by comparison with relative retention volumes of typical chromatograms. Calculation of concentrations of components by measuring peak areas and applying correction factors.

4 Definitions

4.1 correction factor: A factor applied to account for the fact that equal amounts of different components produce unequal signals in the detector.

4.2 peak: The portion of the chromatogram recording the detector response while a component is eluted from the column.

4.2.1 peak area: The area bounded by the peak and the baseline.

4.2.2 peak height: The distance between the peak maximum and the baseline.

4.2.3 peak width: The segment of the baseline intercepted by the tangents drawn at the inflection point of each side of the peak.

The **peak width at half height** is the segment of a line drawn parallel to the baseline at half the peak height which is intercepted by the peak sides.

If the baseline is seen to be sloping from the horizontal, both measurements are of the projection of these segments onto the horizontal axis.

4.2.4 peak resolution: The extent to which the peaks of two components overlap or are separated. It is expressed by means of the equation in 6.3.3. Values below 1 imply overlapping; values above 1 imply separation of the components.

4.3 Retention

4.3.1 adjusted retention time [or volume]: The time elapsed [or the volume of gas emerged from the column] between the moment of elution of unretained components (e.g. air or methane) and the moment of elution of the component in question, both referring to peak maxima.

1) To be published.

When a flame ionization detector is used, the air peak time may be calculated from uncorrected retention times of three consecutive normal paraffins as follows:

$$t_0 = \frac{t_1 t_3 - t_2^2}{t_1 + t_3 - 2t_2}$$

where

t_0 is the retention time for the unretained component;

t_1 is the retention time for component 1;

t_2 is the retention time for component 2;

t_3 is the retention time for component 3.

4.3.2 relative retention: The ratio of the adjusted retention time [or volume] of a component to that of a standard reference component.

4.4 internal normalization technique: The technique by which the concentration of a component is found by comparing its corrected peak area (the product of its peak area and correction factor) with the sum of the corrected peak areas of all components.

5 Materials

5.1 Carrier gas

Hydrogen (see **warning** on page 1), helium or nitrogen, free of hydrocarbons, oxygen and water impurities.

5.2 Reference gases

Pure gases or a mixture of gases with certified compositions, boiling in the LPG range.

6 Apparatus

6.1 General

Apparatus for gas phase chromatography, or chromatograph, containing the following main elements and satisfying the requirements defined in 6.2 to 6.7:

- device for the control of the flow of carrier gas;
- injection device (see 6.2);
- oven with suitable column or columns;
- detector (see 6.4);
- recorder and, generally, integrator or computer (see 6.5).

6.2 Injection device

A liquid sample valve capable of delivering a liquid test portion of 0,5 to 1 μ l, or a gaseous sample valve capable of delivering a gaseous test portion of up to 0,5 ml.

6.3 Column

The types of column described in this clause have been found suitable and are recommended. Other columns may be used provided that the resolution performance quoted in 6.3.3 is achieved and provided that the relative retentions of other hydrocarbons are well known.

6.3.1 Column material

The column should be made from glass, copper, stainless steel or aluminium tubing and have the following dimensions and form.

6.3.1.1 Dimensions

- For commercial propane, 8 m of di-*n*-butyl maleate packing + 3 m of $\beta\beta'$ -oxy-dipropionitrile packing.
- For commercial butane, 8 m of di-*n*-butyl maleate.
- For both applications, alternatively 6 m of sebaconitrile (1,8-dicyano-octane) packing.

Tubing with an internal diameter between 2 mm and 5 mm is recommended. The external diameter of the tubing should be appropriate to the chromatograph.

6.3.1.2 Form

Any suitable coil shape that will fit into the oven without acute bends.

6.3.2 Packing

6.3.2.1 Solid support

Chromosorb P¹⁾, acid washed and sieved to obtain the portion between 180 μ m and 250 μ m (see ISO 565).

6.3.2.2 Stationary phase

Chemical identity:

- di-*n*-butyl maleate and $\beta\beta'$ -oxy-dipropionitrile [see 6.3.1.1 a) and 6.3.1.1 b)]
- sebaconitrile (1,8-dicyano-octane) [6.3.1.1 c)]

1) Chromosorb P is the trade-name of a commercially available product. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.