



SLOVENSKI STANDARD

SIST EN 13016-1:2024

01-september-2024

Nadomešča:
SIST EN 13016-1:2018

Tekoči naftni proizvodi - Parni tlak - 1. del: Določanje z zrakom nasičenega parnega tlaka (ASVP) in izračunanega enakovrednega tlaka suhega zraka (DVPE)

Liquid petroleum products - Vapour pressure - Part 1: Determination of air saturated vapour pressure (ASVP) and calculated dry vapour pressure equivalent (DVPE)

Flüssige Mineralölerzeugnisse - Dampfdruck - Teil 1: Bestimmung des luftgesättigten Dampfdruckes (ASVP) und des berechneten dem trockenen Dampfdruck entsprechenden Druckes (DVPE)

Produits pétroliers liquides - Pression de vapeur - Partie 1 : Détermination de la pression de vapeur saturée en air (PVSA) et de la pression de vapeur sèche équivalente calculée (PVSE)

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Ta slovenski standard je istoveten z: EN 13016-1:2024

ICS:

17.100	Merjenje sile, teže in tlaka	Measurement of force, weight and pressure
75.160.20	Tekoča goriva	Liquid fuels

SIST EN 13016-1:2024

en,fr,de

EUROPEAN STANDARD

EN 13016-1

NORME EUROPÉENNE

EUROPÄISCHE NORM

June 2024

ICS 75.160.20

Supersedes EN 13016-1:2018

English Version

Liquid petroleum products - Vapour pressure - Part 1: Determination of air saturated vapour pressure (ASVP) and calculated dry vapour pressure equivalent (DVPE)

Produits pétroliers liquides - Pression de vapeur -
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Bestimmung des luftgesättigten Dampfdruckes (ASVP)
und des berechneten dem trockenen Dampfdruck
entsprechenden Druckes (DVPE)

This European Standard was approved by CEN on 22 April 2024.

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This European Standard exists 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 CEN-CENELEC Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 13016-1:2024) has been prepared by Technical Committee CEN/TC 19 “Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin”, the secretariat of which is held by NEN.

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 December 2024, and conflicting national standards shall be withdrawn at the latest by December 2024.

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

This document supersedes EN 13016-1:2018.

The main changes compared to the previous edition EN 13016-1:2018 are listed below:

- updated safety warning;
- revised 15.1 to include 250 ml and 1 000 ml sample details;
- updated 15.2 and 15.3 text;
- new Annex C giving precision for 1 000 ml containers.

The EN 13016 series consists of the following parts, under the general title *Liquid petroleum products — Vapour pressure*:

- Part 1: Determination of air saturated vapour pressure (ASVP) and calculated dry vapour pressure equivalent (DVPE);
- Part 2: Determination of absolute pressure (AVP) between 40 C and 100 C;
- Part 3: Determination of vapour pressure and calculated dry vapour pressure equivalent (DVPE) (Triple Expansion Method).

This part is based on and developed in parallel with IP 394 [9] and ASTM D5191 [5].

Any feedback and questions on this document should be directed to the users’ national standards body.

A complete listing of these bodies can be found on the CEN website. According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

EN 13016-1:2024 (E)**Introduction**

Vapour pressure is used as a classification criterion for the safe handling and carriage of petroleum products, feedstocks and components; it has a relationship to the potential for hydrocarbon emissions, under uncontrolled conditions, and thus is the subject of environmental scrutiny.

Vapour pressure limitations are often imposed to prevent pump cavitation during transfer operations.

Vapour pressure is one measure of the volatility characteristics of fuels used in many differing types of engines with large variations in operating temperatures. Fuels having a high vapour pressure can vaporize too readily in the fuel handling systems, resulting in decreased flow to the engine and possible stoppage by vapour lock. Conversely, fuels of low vapour pressure can vaporize not readily enough, resulting in difficult starting, slow warm-up and poor acceleration.

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1 Scope

This document specifies a method for the determination of the air saturated vapour pressure (ASVP) (total vapour pressure), exerted *in vacuo*, by volatile, low viscosity petroleum products, components, ethanol blends up to 85 % (V/V), and feedstocks containing air. A dry vapour pressure equivalent (DVPE) can be calculated from the air containing vapour pressure (ASVP) measurement.

The conditions used in the test described in this document are a vapour-to-liquid ratio of 4:1 and a test temperature of 37,8 °C.

The equipment is not wetted with water during the test, and the method described is therefore suitable for testing samples with or without oxygenates; no account is taken of dissolved water in the sample.

The method described is suitable for testing air saturated samples with a DVPE between 15,5 kPa and 106,0 kPa; vapour pressures outside this range can be measured, but the precision has not been determined.

This document is applicable to fuels containing oxygenated compounds up to the limits stated in the relevant Council Directive 85/536/EEC [10], and for ethanol-fuel blends up to 85 % (V/V) ethanol.

NOTE For the purposes of this document, the terms “% (m/m)” and “% (V/V)” are used to represent the mass and volume fractions, respectively.

WARNING — The use of this document can involve hazardous materials, operations and equipment. This document does not purport to address all of the safety problems associated with its use. It is the responsibility of users of this document to take appropriate measures to ensure the safety and health of personnel prior to application of the document, and to determine the applicability of any other restrictions for this purpose.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 3170, *Petroleum liquids — Manual sampling (ISO 3170)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org>

3.1

air saturated vapour pressure

ASVP

observed pressure exerted in vacuo consisting of the partial pressure of petroleum products, components and feedstocks, in the absence on non-dissolved water, and the partial pressure of dissolved air

3.2

dry vapour pressure equivalent

DVPE

vapour pressure equivalent value calculated by a statistical correlation formula to a dry Reid vapour pressure as measured by ASTM D4953 [4]

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4 Principle

A cooled air saturated sample of known volume is injected into a thermostatically controlled evacuated chamber, or into a chamber that is evacuated by means of a moveable piston after sample introduction, the internal volume of which is five times that of the total test portion introduced into the chamber. After injection into the chamber, the sample is allowed to reach thermal equilibrium at the test temperature 37,8 °C. The resulting total pressure in the chamber is equivalent to the vapour pressure of the sample and the partial pressure of the dissolved air and is measured using a pressure sensor and indicator. The measured total vapour pressure can be converted to a dry vapour pressure equivalent (DVPE) by use of a correlation formula.

5 Reagents and materials

5.1 General

Use chemicals of 99 % (*m/m*) minimum purity for samples for verification of apparatus.

5.2 Pentane

5.3 2,2 Dimethylbutane

5.4 2,3 Dimethylbutane

5.5 Cyclopentane

5.6 Toluene

6 Apparatus

6.1 Instrument

6.1.1 The instrument shall conform to the general requirements given in 6.1.2 to 6.1.6 and be installed, operated and maintained in accordance with the manufacturer's manual.

NOTE Full details of suitable instruments are not given because of differences in the way that the basic principles are applied by individual manufacturers.

6.1.2 The system shall be configured to enable the test chamber to be evacuated and isolated, the sample to be drained, and the system flushed and purged as necessary.

6.1.3 The test chamber shall be vacuum-tight, with a provision for introducing the sample, and shall be capable of containing between 5 ml and 50 ml of liquid and vapour with an accuracy of ≤ 1 %.

6.1.3.1 The accuracy of the 4:1 vapour to liquid ratio used in this test method shall be within 3,95:1 and 4,05:1.

6.1.3.2 The test chamber shall be capable of controlling the temperature of the sample to achieve the specified test temperature to within $\pm 0,1$ °C.

6.1.3.3 Temperature measuring device, a sensor with a resolution of $\leq 0,1$ °C and an accuracy of $\leq 0,1$ °C. A calibration/verification in accordance with the metrological traceability requirements of EN ISO/IEC 17025 ¹ is recommended.

¹ National Standards for metrological traceability can apply.

NOTE The test chambers used in the instruments that generated the precision statements were constructed from either aluminium or stainless steel.

6.1.3.4 Test chambers with capacities less than 5 ml or greater than 50 ml may be used but the precision of the method can be affected.

6.1.4 The apparatus shall be capable of measuring the vapour pressure of small samples of petroleum products, components and feedstocks up to, at least, 130,0 kPa, by means of a pressure transducer.

6.1.4.1 Pressure transducer having a minimum measuring range from 0 kPa to 130 kPa, with an accuracy of $\leq 0,8$ kPa and a resolution of $\leq 0,1$ kPa. A calibration/verification in accordance with the metrological traceability requirements of EN ISO/IEC 17025 ¹ is recommended.

6.1.5 If a vacuum pump is required for use with the instrument, it shall be capable of reducing the pressure in the test chamber to less than 0,01 kPa absolute.

6.1.6 If a vacuum-tight syringe or similar equipment is required for measuring or injecting the required volume of sample into the test chamber, it shall be sized appropriately to the required sample size with an accuracy of at least 1 %.

6.2 Cooling equipment, iced-water bath or refrigerator, capable of cooling the samples and any syringes (6.1.6) used, to a temperature of between 0 °C and 1 °C, where a suitably safe refrigerator should be used with highly volatile petroleum products.

6.3 Barometer, capable of measuring atmospheric pressure within an accuracy of $\leq 0,1$ kPa or better. A calibration/verification in accordance with the metrological traceability requirements of EN ISO/IEC 17025 ¹ is recommended.

6.4 Vacuum gauge, covering at least the range 0,01 kPa to 0,67 kPa, with an accuracy and resolution of $\pm 0,1$ kPa. A calibration/verification in accordance with the metrological traceability requirements of EN ISO/IEC 17025 ¹ is recommended.

7 Sampling

7.1 Due to the extreme sensitivity of vapour pressure measurements to losses through evaporation and the resulting changes in composition, the utmost precaution and the most meticulous care shall be taken in the drawing and handling of samples.

7.2 Samples shall be drawn in accordance with EN ISO 3170 ². However, the water displacement technique shall not be used.

The drawing of samples using automatic techniques, such as those described in EN ISO 3171 [2], is not recommended unless the technique has been proven not to lose light ends from the product or component being sampled. Loss of light ends can affect the vapour pressure measurement.

7.3 For routine testing, the sample shall be supplied in a sealed container, constructed of suitable material, of at least 250 ml capacity. The container shall be a minimum of 70 % (V/V) full of sample at the time of receipt. See also 15.1.

7.4 Protect samples from excessive temperatures, as soon as possible, prior to testing. This can be accomplished by storage in the cooling equipment (6.2).

² National Standards for the sampling of the product under test can apply.

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7.5 Samples in leaking containers shall not be considered for testing, but shall be discarded and new samples obtained.

8 Sample preparation

8.1 The vapour pressure determination shall be the first test on a sample. For referee testing, only one test portion shall be taken from the container; for routine testing, it is permitted for further samples to be taken from the same container 8.2 and to 8.6 shall be followed.

NOTE An ASTM precision evaluation in 2003 [7] indicated that when a second test portion was taken from a 250 ml sample container, a slight loss of vapour pressure was observed.

8.2 Before the sample container is opened, place it in the cooling equipment (6.2) and allow sufficient time for the container and contents to cool to between 0 °C and 1 °C. Sufficient time to reach this temperature may be ensured by direct measurement of the temperature of a similar liquid in a similar container placed in the same bath at the same time as the sample.

8.3 With the sample at 0 °C to 1 °C, remove the container from the cooling equipment and wipe dry with an absorbent material. Unseal the container (if it is not transparent) and examine the sample content.

8.4 The sample content shall be 70 % (V/V) to 80 % (V/V) of the container capacity. Discard the sample if its volume is less than 70 % (V/V) of the container capacity. If the container is more than 80 % (V/V) full, pour out a sufficient amount of sample to bring the container contents within the 70 % (V/V) to 80 % (V/V) range. Under no circumstances shall any sample be returned to the container if it has been previously poured out. Reseal the container and return it to the cooling equipment (6.2).

8.5 To ensure that the sample is air saturated, remove the container from the cooling equipment when the sample is at 0 °C to 1 °C. Wipe the container dry with absorbent material, unseal it quickly and reseal it immediately taking care that no water enters, and shake vigorously. Return to the cooling equipment for a minimum of 2 min.

8.6 Repeat 8.5 two more times. Return the sample to the cooling equipment until commencing the test.

9 Preparation of apparatus

9.1 Prepare the instrument for operation in accordance with the manufacturer's instructions.

9.2 Prepare the test chamber, as required to avoid contamination of the test portion, according to the manufacturer's instructions. Where an evacuated chamber is used, visually determine from the instrument display that the test chamber pressure is stable and does not exceed 0,1 kPa. When the pressure is not stable, or exceeds this value, check that no traces of volatile components are present in the chamber from a previous sample or check the calibration of the pressure transducer.

9.3 If a syringe is used for injection of the test portion, cool it to between 0 °C and 1 °C in the cooling equipment (6.2) before drawing in the sample. Avoid water contamination of the syringe reservoir by suitably sealing the outlet of the syringe during the cooling process.

10 Calibration of apparatus

10.1 Pressure transducer

10.1.1 Check the calibration of the pressure transducer at 37,8 °C, or at a temperature as recommended by the manufacturer, when required as indicated from the quality control or reference fluid checks. The