SLOVENSKI STANDARD
oSIST prEN 13016-3:2023

01-december-2023

Tekoči naftni proizvodi - Parni tlak - 3. del: Določevanje parnega tlaka in izračun ekvivalenta suhega parnega tlaka (DVPE) z uporabo trojne ekspanzijske metode

Liquid petroleum products - Vapour pressure - Part 3: Determination of vapour pressure and calculated dry vapour pressure equivalent (DVPE) (Triple Expansion Method)

Flüssige Mineralölerzeugnisse - Dampfdruck - Teil 3: Bestimmung des Dampfdruckes und des berechneten dem trockenen Dampfdruck entsprechenden Druckes (DVPE) (Dreifach-Expansionsmethode)

Produits pétroliers liquides - Pression de vapeur - Partie 3 : Détermination de la pression de vapeur et de la pression de vapeur sèche équivalente calculée (PVSE) (Méthode triple expansion)

Ta slovenski standard je istoveten z: **prEN 13016-3**

ICS:

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

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Liquid petroleum products - Vapour pressure - Part 3: Determination of vapour pressure and calculated dry vapour pressure equivalent (DVPE) (Triple expansion method)

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 19.

If this draft becomes a European Standard, 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.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 13016-3:2023) 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 document is currently submitted to the CEN Enquiry.

This document will supersede EN 13016-3:2018.

The main changes compared to the previous edition EN 13016-3:2018 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;

— updated Clause 6 Apparatus traceability requirements;

— new Annex B giving precision for 1 000 ml containers;

— new reagents in 5.4, 5.5, Clause 11 and Annex A for verification purposes.

EN 13016 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 619 [9] and ASTM D6378 [3].

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 vaporize not readily enough, resulting in difficult starting, slow warm-up and poor acceleration.

1 Scope

This document specifies a method for the determination of the vapour pressure, exerted *in vacuo*, by volatile, low viscosity petroleum products, components, ethanol blends up to 85 % (*V/V*), and feedstocks using a variable volume chamber. A dry vapour pressure equivalent (DVPE) is calculated from the vapour pressure.

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.

This procedure calculates the partial pressure of the air dissolved in the test portion during the triple expansion process. It is suitable for samples with a DVPE between 15,7 kPa and 97,6 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 [6], 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 standard, and to determine the applicability of any further restrictions for this purpose.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13016-1, *Liquid petroleum products — Vapour pressure — Part 1: Determination of air saturated vapour pressure (ASVP) and calculated dry vapour pressure equivalent (DVPE)*

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.

3.1
vapour pressure
VP
total pressure minus the partial pressure of the dissolved air in the liquid at a vapour to liquid ratio of 4:1 and at 37,8 °C

3.2
dry vapour pressure equivalent
DVPE
vapour pressure as calculated via EN 13016-1 by a correlation formula from the measured vapour pressure (VP)

Note1 to entry: This part of the European standard calculates an equivalent DVPE result by applying a correlation formula. DVPE is only applicable to a vapour to liquid ratio of 4:1 and at a test temperature of 37,8 °C.

3.3
partial pressure from dissolved air
PPA
pressure exerted in vacuum from dissolved air that escapes from the liquid phase into the vapour phase at a vapour to liquid ratio of 4:1 and at 37,8 °C

3.4
total vapour pressure
TP
pressure exerted in vacuum by air and gas containing petroleum products, components and feedstocks, and other liquids, in the absence of undissolved water at 37,8 °C

Note 1 to entry: The total vapour pressure reported at the end of the test is at a vapour to liquid ratio of 4:1.

4 Principle

Employing a measuring chamber with a built-in piston, a test portion of known volume is drawn into the measuring chamber that is temperature controlled at approximately 20 °C. After sealing the measuring chamber, the temperature of the measuring chamber is increased to the 37,8 °C test temperature simultaneously with the first expansion using the piston. Two further expansions are performed to a final test volume of five times that of the test specimen. After each expansion, the total vapour pressure is measured. The PPA from the test portion is calculated from the three resulting pressures. The vapour pressure of the test portion is calculated by subtracting the PPA from the final total vapour pressure. The calculated vapour pressure is converted to a dry vapour pressure equivalent (DVPE) by applying a correlation formula.

NOTE For liquids containing very low levels of high vapour pressure contaminants, which behave like a gas, this test method that determines the PPA and gases, can lead to wrong results since the partial pressure of the contaminants will be included in the PPA.

5 Reagents and materials

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

5.1 Pentane[1)].

5.2 2,2-Dimethylbutane[1)].

5.3 2,3-Dimethylbutane[1)].

5.4 Cyclopentane[1)] (≥ 98 % purity).

1) Annex A provides an accepted reference value (ARV) for this material.

5.5 Toluene[1)], used mixed with Pentane.

6 Apparatus

6.1 Instrument

NOTE This document does not give full details of instruments suitable for carrying out this test. Details on the installation, operation and maintenance of each instrument can be found in the manufacturer's manual.

6.1.1 General, apparatus suitable for this test method employs a small volume, cylindrically shaped measuring chamber with associated equipment to control the chamber temperature at 37,8 °C. The measuring chamber assembly contains a movable piston to allow sample introduction into the measuring chamber, and expansion in three predefined volume steps, to a final 4:1 vapour to liquid ratio. A pressure transducer is incorporated in the piston. The measuring chamber contains an inlet/outlet valve combination for test portion introduction and expulsion. The piston and the valve combination are at the same temperature as the measuring chamber to avoid any condensation or excessive evaporation. The apparatus rinses the measuring chamber with the next sample to be tested, or a solvent if required.

6.1.2 Measuring chamber assembly, approximately 5 ml total test volume (liquid and vapour) with a moveable piston to provide a vapour to liquid ratio of 4:1, at the end of the test.

6.1.2.1 The accuracy of this 4:1 vapour to liquid ratio shall be within 3,95:1 and 4,05:1.

6.1.2.2 The volumes used in the calculations for vapour and partial pressures shall be accurate to within 1 % of the total test volume of the measuring chamber.

6.1.2.3 The chamber shall be capable of retaining a vacuum within 1 kPa for 300 s at the total test volume position of the piston.

6.1.2.4 The maximum dead volume with the piston at its lowest position shall be less than 1 % of the total test volume.

The measuring chamber and piston used in generating the precision and DVPE correlation formula were constructed of nickel plated aluminium, and stainless steel and/or brass respectively with a total volume of 5 ml. Measuring chambers with different capacities and materials may be used, but the precision and DVPE correlation formula have not been determined.

6.1.2.5 The test chamber shall be vacuum-tight, with a provision for introducing the sample.

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

6.1.2.6 Temperature measuring device, a sensor with a resolution of ≤ 0,1 °C and an accuracy of ≤ 0,1 °C. A calibration/verification in accordance with the metrological traceability requirements of EN ISO/IEC 17025 [2] is recommended.

6.1.3 The apparatus shall be capable of measuring the vapour pressure of small samples of petroleum products, components and feedstocks up to, at least, 200 kPa by means of a pressure transducer.

[2] National standards for metrological traceability can apply.

6.1.3.1 Pressure transducer, having a minimum measuring range from 0 kPa to 200 kPa with an accuracy of ≤ 0,2 kPa and a resolution of ≤ 0,1 kPa. A calibration/verification in accordance with the metrological traceability requirements of EN ISO/IEC 17025 [2] is recommended.

6.2 Vacuum pump, capable of reducing the pressure in the measuring chamber to less than 0,01 kPa absolute, for use during calibration checks.

6.3 Vacuum gauge, covering at least the range 0,01 kPa to 0,67 kPa, with accuracy and resolution ≤ 0,1 kPa. A calibration/verification in accordance with the metrological traceability requirements of EN ISO/IEC 17025 [2] is recommended.

6.4 Barometer, capable of measuring absolute barometric pressure with an accuracy of ≤ 0,1 kPa and a resolution of ≤ 0,01 kPa. A calibration/verification in accordance with the metrological traceability requirements of EN ISO/IEC 17025 [2] is recommended.

6.5 Test portion container, made of a suitable material with a screw cap, or a syringe (see manufacturer's instructions).

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

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 [3]. 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 (6.6).

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 Measurement chamber rinsing (9.2) and vapour pressure determinations are made on the first test portion withdrawn from the sample container. Do not use the remaining sample in the container

[3] National Standards for the sampling of the product can apply.