

**BRITISH STANDARD**

**BS EN 116 :  
1998  
BS 2000 :  
Part 309 : 1998**

**Methods of test for**

# **Petroleum and its products**

## **Part 309. Diesel and domestic heating fuels - Determination of cold filter plugging point**

**(Identical with IP 309/99)**

The European Standard EN 116 : 1997 has the status of a  
British Standard

## National foreword

This British Standard was published under the authority of the Materials and Chemicals Sector Board and comes into effect on 18 May 1998. It is the English language version of EN 116 : 1998 *Diesel and domestic heating fuels - Determination of cold filter plugging point*, published by the European Committee for Standardization (CEN).

This British Standard supersedes EN 116:1981 / BS 6188:1982, which is withdrawn.

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 309/BS EN 116 will be published by the IP (in 'Standard methods for analysis and testing of petroleum and related products and British Standard 2000 Parts' and as a separate publication). BS 2000 : Part 309 : 1998 is thus identical with IP 309/99.

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

© The Institute of Petroleum  
& BSI 1998

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

Committee reference PTI/13  
Draft for public comment no:  
94/108715 DC

Descriptors: diesel fuel, heating fuel, tests, cold filter plugging point, CFPP

English version

## Diesel and domestic heating fuels - Determination of cold filter plugging point

Combustibles pour moteurs diesel et pour installations de chauffage domestique - Détermination de la température limite de filtrabilité

Dieselmotoren und Haushaltheizöle - Bestimmung des Temperaturgrenzwertes der Filtrierbarkeit

This European Standard was approved by CEN on 16 October 1997.

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.

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 Central Secretariat has the same status as the official versions.

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



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 has been prepared by Technical Committee CEN/TC 19 "Petroleum products, lubricants and related products", the secretariat of which is held by NNI.

This European Standard supersedes EN 116:1981.

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 May 1998, and conflicting national standards shall be withdrawn at the latest by May 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Significant technical differences between this European Standard and the first edition of EN 116 are that an automated method is described in addition to, and fully equivalent with, the manual method, provisions are included for the use of certified reference materials for verification and calibration purposes and that the air flow rate in the vacuum regulator has been changed to 15 l/h from (3 to 4) l/h.

In this standard annex A is normative.

## 1 Scope

This European Standard specifies a method for the determination of the cold filter plugging point (CFPP) of diesel and domestic heating fuels (see 3.1) using either manual or automated test equipment. The manual test equipment and automated test equipment are both suitable for referee purposes.

This European Standard is applicable to distillate fuels, including those containing a flow-improving or other additive, intended for use in diesel engines and domestic heating installations.

The results obtained from the method specified in this European Standard are suitable for estimating the lowest temperature at which a fuel will give trouble-free flow in the fuel system.

**NOTE :** In the case of diesel fuels the results are usually close to the temperature of failure in service except when the fuel system contains, for example, a paper filter installed in a location exposed to the weather or if the filter plugging temperature is more than 12 °C below the cloud point of the fuel. Domestic heating installations are usually less critical and often operate satisfactorily at temperatures somewhat lower than those indicated by the test results.

The difference in results obtained from the sample "as received" and after heat treatment at 45 °C for 30 min can be used to investigate complaints of unsatisfactory performance under low temperature conditions.

**WARNING :** The use of this standard may involve hazardous materials, operations and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

## 2 Normative references

This European Standard incorporates, by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ISO 3170      Petroleum liquids - Manual sampling

ISO 3171      Petroleum liquids - Automatic pipeline sampling

## 3 Definition

For the purposes of this standard, the following definition applies :

**3.1 cold filter plugging point (CFPP):** Highest temperature at which a given volume of fuel fails to pass through a standardized filtration device in a specified time, when cooled under standardized conditions.

## 4 Principle

A test portion of the fuel is cooled under the specified conditions and is drawn into a pipette under a controlled vacuum through a standardized wire mesh filter. The procedure is repeated, as the fuel continues to cool, for each 1 °C below the first test temperature. Testing is continued until the amount of wax crystals which have separated out of solution is sufficient to stop or slow down the flow so that the time taken to fill the pipette exceeds 60 s or the fuel fails to return completely to the test jar before the fuel has cooled by a further 1 °C.

The indicated temperature at which the last filtration was commenced is recorded as the cold filter plugging point.

## 5 Reagents and materials

5.1 Heptane, clean commercial or reagent grade.

5.2 Acetone

5.3 Lintless filter paper,  $(5 \pm 1) \mu\text{m}$  retention<sup>1)</sup>.

5.4 Certified reference materials.

NOTE : Certified reference materials may be obtained from the Commission of the European Communities. Community Bureau of Reference, DG XII, Rue de la Loi 200, B-1049 Brussels, who can be contacted to obtain further information.

## 6 Apparatus

6.1 Manual equipment

6.1.1 General

The equipment, as detailed in 6.1.2 to 6.1.14, shall be arranged as shown in figure 1.

6.1.2 Test jar, cylindrical, of clear glass, flat bottomed, with an internal diameter of  $(31,5 \pm 0,5)$  mm, a wall thickness of  $(1,25 \pm 0,25)$  mm and a height of  $(120 \pm 5)$  mm. The jar shall have a permanent mark at the 45 ml level.

NOTE : Test jars of the required dimensions may be obtained by selection from jars conforming to ISO 3016<sup>2)</sup>, which specifies wider tolerances.

---

1) Durrieux 120 and Whatman No. 3 are examples of suitable products available commercially. This information is given for convenience of the users of this European Standard and does not constitute an endorsement by CEN of these products.

2) ISO 3016: Petroleum products - Determination of pour point.

**6.1.3 Jacket**, brass, watertight, cylindrical, flat bottomed, to be used as an air bath. It shall have an inside diameter of  $(45 \pm 0,25)$  mm, an outside diameter of  $(48 \pm 0,25)$  mm and a height of  $(115 \pm 3)$  mm (see figure 2).

**6.1.4 Insulating ring**, made from oil-resistant plastics or other suitable material, to be placed in the bottom of the jacket (6.1.3) to provide insulation for the bottom of the test jar. It shall fit closely inside the jacket and have a thickness of  $(6^{+0,3}_0)$  mm (see figure 3).

**6.1.5 Spacers** (two), approximately 5 mm thick, made from oil-resistant plastics or other suitable material, to be placed as shown in figure 1 around the test jar (6.1.2) to provide insulation for the test jar from the sides of the jacket. The spacers shall fit closely to the test jar and closely inside the jacket. The use of incomplete rings each with a 2 mm circumferential gap will accommodate variations in test jar diameter. The spacers and insulating ring may be made as a single part as shown in figure 3.

**6.1.6 Supporting ring**, of oil-resistant plastics or other suitable non-metallic, non-absorbent, oil-resistant material, used to suspend the jacket (6.1.3) in a stable and upright position in the cooling bath and to provide a concentric location for the stopper (6.1.7). A design is shown in figure 4 for guidance but this may be modified to suit the cooling bath.

**6.1.7 Stopper**, of oil-resistant plastics or other suitable non-metallic, non-absorbent, oil-resistant material, to fit the test jar and the support ring is shown in figure 5. It shall have three holes to accommodate the pipette (6.1.8), the thermometer (6.1.9) and to allow venting of the system. If necessary, when using the high-range thermometer, the upper part of the stopper shall be locally grooved to permit the thermometer [6.1.9 a)] to be read down to a temperature of  $-30\text{ }^{\circ}\text{C}$ .

A pointer shall be fitted to the upper surface of the stopper to facilitate location of the thermometer in relation to the bottom of the test jar. A spring wire clip shall be used to retain the thermometer in the correct position.

#### **6.1.8 Pipette with filter unit**

**6.1.8.1** A pipette of clear glass with a calibration mark corresponding to a contained volume of  $(20 \pm 0,2)$  ml at a point  $(149 \pm 0,5)$  mm from the bottom of the pipette (see figure 6). It shall be connected to the filter unit (6.1.8.2).

**6.1.8.2** A filter unit (see figure 7) containing the following elements.

a) a brass body, with a threaded cavity that houses the wire mesh holder. The cavity shall be fitted with an O-ring of oil-resistant plastics. The internal diameter of the central tube shall be  $(4 \pm 0,1)$  mm;

b) a brass screw cap to connect the upper part of the body of the filter unit (6.1.8.2) to the lower part of the pipette (6.1.8.1) to ensure a leak-free joint. An example of satisfactory connection is shown in figure 7;

c) a disc, 15 mm diameter, of plain weave stainless steel wire mesh gauze with a nominal aperture size of  $45\text{ }\mu\text{m}$ . The nominal diameter of the wire shall be  $0,15\text{ mm}$ .

the tolerance for the size of an individual aperture shall be as follows:

- 1) no aperture size shall exceed the nominal size by more than 22  $\mu\text{m}$ ;
- 2) the average aperture size shall be within  $\pm 3,1 \mu\text{m}$  of the nominal size;
- 3) not more than 6 % of the apertures shall be above the nominal size by more than 13  $\mu\text{m}$ .

NOTE : The requirements for the wire mesh are taken from ISO 3310-1<sup>3)</sup>, to which reference may be made for methods for testing the gauze.

d) a filter holder of brass, in which the disc of wire mesh gauze [6.1.8.2 c)] is firmly clamped by a retaining ring pressed into the filter holder. The diameter of the exposed part of the gauze shall be  $(12^{+0,1}_0)$  mm (see figure 8);

e) a brass cylinder, threaded on the outside, that can be screwed into the cavity of the body [6.1.8.2 a)] to clamp the filter holder [6.1.8.2 d)] against the O-ring [6.1.8.2 a)]. The lower end shall have four slots to allow the test portion to flow into the filter unit.

### 6.1.9 Thermometers

The following thermometers are required:

- a) high-range thermometer, range -38 °C to +50 °C, for measuring cold filter plugging point down to -30 °C;
- b) low-range thermometer, range -80 °C to +20 °C, for measuring cold filter plugging point below -30 °C;
- c) cooling bath thermometer, range -80 °C to +20 °C.

Thermometers conforming to the essential requirements set out in annex A to this standard shall be used.

### 6.1.10 Cooling bath

The type of cooling bath is optional, but it shall be of a shape and size suitable for containing the jacket (6.1.3) in a stable and upright position at the required depth.

The bath shall be fitted with a cover with one or more holes in it to accommodate the supporting ring (6.1.6). The jacket (6.1.3) may be fixed permanently in the lid.

The bath temperature shall be maintained at the required value by a refrigeration unit or by the use of suitable freezing mixtures, ensuring a homogenous temperature in the bath by stirring or other means of agitation.

---

3) ISO 3310-1: Test sieves - Technical requirements and testing - Part 1: Metal cloth