EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 228

July 2008

ICS 75.160.20

Supersedes EN 228:2004

English Version

Automotive fuels - Unleaded petrol - Requirements and test methods

Carburants pour automobiles - Essence sans plomb - Exigences et méthodes d'essai

Kraftstoffe für Kraftfahrzeuge - Unverbleite Ottokraftstoffe - Anforderungen und Prüfverfahren

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. EN 228:2008: E

Contents

Foreword

This document (EN 228:2008) 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of an identical text or by endorsement, at the latest by January 2009, and conflicting national standards shall be withdrawn at the latest by January 2009.

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

This document supersedes EN 228:2004.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EC Directive(s).

Significant technical changes between this European Standard and the previous edition are:

— Several revised test methods have been introduced, amongst others EN 15553 being the CEN equivalent to ASTM D 1319, incorporating European specific needs.

— Table 1, and Table 2 explicitly differentiate between requirements included in the European Fuels Directive 98/70/EC [1], including Amendment 2003/17/EC [2], and other requirements.

— "Premium unleaded petrol” becomes “unleaded petrol”.

— From 2005-1-1 Member States may decide to continue to permit the marketing of unleaded regular grade petrol. This grade needs to conform to all the requirement set in Table 1 and Table 2 of this document (for unleaded grade petrol), with the exception of a minimum motor octane number (MON) of 81 and a minimum research octane number (RON) of 91. The requirements and test methods are than to be laid down in a National Annex to this document

— Following the Mandate M/344 given to CEN by the European Commission, the Standard on ethanol as a blending component for petrol, EN 15376, has been included.

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

1 Scope

This European Standard specifies requirements and test methods for marketed and delivered unleaded petrol. It is applicable to unleaded petrol for use in petrol engine vehicles designed to run on unleaded petrol.

NOTE For the purposes of this European Standard, the terms "% (*m/m*)" and "% (*V/V*)" are used to represent the mass fraction and the volume fraction respectively.

2 Normative references

The following referenced documents are indispensable for the application 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 237:2004, *Liquid petroleum products — Petrol — Determination of low lead concentrations by atomic absorption spectrometry*

EN 238:1996, *Liquid petroleum products — Petrol — Determination of the benzene content by infrared spectrometry*

EN 1601:1997, *Liquid petroleum products — Unleaded petrol — Determination of organic oxygenate compounds and total organically bound oxygen content by gas chromatography (O-FID)*

EN 12177:1998, *Liquid petroleum products — Unleaded Petrol — Determination of benzene content by gas chromatography*

EN 13016-1:2007, *Liquid petroleum products — Vapour pressure — Part 1: Determination of air saturated vapour pressure (ASVP) and calculated dry vapour pressure equivalent (DVPE)*

EN 13132:2000, *Liquid petroleum products — Unleaded petrol — Determination of organic oxygenate compounds and total organically bound oxygen content by gas chromatography using column switching*

EN 14517:2004, *Liquid petroleum products — Determination of hydrocarbon types and oxygenates in petrol — Multidimensional gas chromatography method*

EN 15376:2007, *Automotive fuels — Ethanol as a blending component for petrol — Requirements and test methods*

EN 15553:2007, *Petroleum products and related materials — Determination of hydrocarbon types — Fluorescent indicator adsorption method*

EN ISO 2160:1998, *Petroleum products — Corrosiveness to copper — Copper strip test (ISO 2160:1998)*

EN ISO 3170:2004, *Petroleum liquids – Manual sampling (ISO 3170:2004)*

EN ISO 3171:1999, *Petroleum liquids — Automatic pipeline sampling (ISO 3171:1988)*

EN ISO 3405:2000, *Petroleum products — Determination of distillation characteristics at atmospheric pressure (ISO 3405:2000)*

EN ISO 3675:1998, *Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method (ISO 3675:1998)*

EN ISO 4259:2006, *Petroleum products — Determination and application of precision data in relation to methods of test (ISO 4259:2006)*

EN ISO 5163:2005, *Petroleum products — Determination of knock characteristics of motor and aviation fuels — Motor method (ISO 5163:2005)*

EN ISO 5164:2005, *Petroleum products — Determination of knock characteristics of motor fuels — Research method (ISO 5164:2005)*

EN ISO 6246:1997, *Petroleum products — Gum content of light and middle distillate fuels — Jet evaporation method (ISO 6246:1995)*

EN ISO 7536:1996, *Petroleum products — Determination of oxidation stability of gasoline — Induction period method (ISO 7536:1994)*

EN ISO 12185:1996, *Crude petroleum and petroleum products — Determination of density — Oscillating U-tube method (ISO 12185:1996)*

EN ISO 20846:2004, *Petroleum products – Determination of sulfur content of automotive fuels– Ultraviolet fluorescence method (ISO 20846:2004)*

EN ISO 20847:2004, *Petroleum products – Determination of sulfur content of automotive fuels – Energy-dispersive X-ray fluorescence spectrometry (ISO 20847:2004)*

EN ISO 20884:2004, *Petroleum products – Determination of sulfur content of automotive fuels – Wavelength-dispersive X-ray fluorescence spectrometry (ISO 20884:2004)*

3 Sampling

Samples shall be taken as described in EN ISO 3170 or EN ISO 3171 and/or in accordance with the requirements of national standards or regulations for the sampling of unleaded petrol. The national requirements shall be set out in detail or shall be referred to by reference in a national annex to this European Standard.

In view of the sensitivity of some of the test methods referred to in this European Standard, particular attention shall be paid to compliance with any guidance on sampling containers, which is included in the test method standard.

It is essential that for sampling of unleaded petrol the containers used to take and store the samples before testing are not contaminated with lead and/or sulfur.

4 Pump marking

Information to be marked on dispensing pumps used for delivering unleaded petrol, and the dimensions of the mark shall be in accordance with the requirements of national standards or regulations for the marking of pumps for unleaded petrol. Such requirements shall be set out in detail or shall be referred to by reference in a national annex to this European Standard.

NOTE It is recommended to set marking for sulfur in a National Annex to this European Standard. The recommended designation for maximum 10 mg/kg sulfur content is “sulfur-free” in national language.

5 Requirements and test methods

5.1 Dyes and markers

The use of dyes and markers is allowed provided they do not cause harmful side effects to vehicles and fuel distribution systems.

5.2 Ethanol

Unleaded petrol may contain up to 5,0 % (*V/V*) of ethanol complying with EN 15376.

NOTE When ethanol is used as a blending component, it may contain denaturants, if required by European and national regulations. These denaturants are permitted provided they do not cause harmful side effects to vehicles and fuel distribution systems.

5.3 Additives

In order to improve the performance quality, the use of additives is allowed. Suitable fuel additives without known harmful side effects are recommended in the appropriate amount, to help to avoid deterioration of driveability and emissions control durability. Other technical means with equivalent effect may also be used.

CAUTION — Petrol shall be free from any adulterant or contaminant that may render the fuel unacceptable for use in petrol engine vehicles designed to run on unleaded petrol.

NOTE Deposit forming tendency test methods suitable for routine control purposes have not yet been identified and developed.

5.4 Phosphorus

In order to protect automotive catalyst systems, phosphorus containing compounds shall not be included in unleaded petrol.

5.5 Generally applicable requirements and test methods

When tested by the methods indicated in Tables 1 and 2, unleaded petrol shall be in accordance with the limits specified in Tables 1 and 2.

NOTE Member States may decide to continue to permit the marketing of unleaded petrol with a minimum motor octane number (MON) of 81 and a minimum research octane number (RON) of 91 as a separate grade (see Foreword).

Methods of test included as normative references in this European Standard, when updated, shall give at least the same accuracy and at least the same level of precision as the methods they replace.

Table 1 - Requirements and test methods for unleaded petrol

Property	Units	Limits Min.	Limits Max.	Test Method [a] (See 2. Normative references)
Research octane number, RON		**95,0**	--	EN ISO 5164 [b]
Motor octane number, MON		**85,0**	--	EN ISO 5163 [b]
Lead content	**mg/l**	--	**5,0**	EN 237
Density (at 15 °C) [c]	kg/m^3	720,0	775,0	EN ISO 3675 EN ISO 12185
Sulfur content [c]	**mg/kg**	--	**50,0** (until 2008-12-31)	EN ISO 20846 EN ISO 20847 EN ISO 20884
		--	**10,0**	EN ISO 20846 EN ISO 20884
Oxidation stability	minutes	360	--	EN ISO 7536
Existent gum content (solvent washed)	mg/100 ml	--	5	EN ISO 6246
Copper strip corrosion (3 h at 50 °C)	rating	class 1		EN ISO 2160
Appearance		clear and bright		visual inspection
Hydrocarbon type content [c]	***% (V/V)***			EN 14517 EN 15553
- olefins		--	**18,0**	
- aromatics		--	**35,0**	
Benzene content [c]	***% (V/V)***	--	**1,00**	EN 238 EN 12177 EN 14517
Oxygen content [c]	***% (m/m)***	--	**2,7**	EN 1601 EN 13132 EN 14517
Oxygenates content [c]	***% (V/V)***			EN 1601 EN 13132 EN 14517
- methanol [d]		--	**3,0**	
- ethanol [e]		--	**5,0**	
- iso-propyl alcohol		--	**10,0**	
- iso-butyl alcohol		--	**10,0**	
- tert-butyl alcohol		--	**7,0**	
- ethers (5 or more C atoms)		--	**15,0**	
- other oxygenates [f]		--	**10,0**	

NOTE Requirements in bold refer to the European Fuels Directive 98/70/EC [1], including Amendment 2003/17/EC [2].

a See also 5.8.1

b A correction factor of 0,2 for MON and RON shall be subtracted for the calculation of the final result, before reporting according to the requirements of the European Directive 98/70/EC [1], including Amendment 2003/17/EC [2]. For advice on reporting see 5.7.

c See also 5.8.2

d Stabilising agents shall be added.

e Shall conform to EN 15376 (see 5.2). Stabilising agents may be necessary.

f Other mono-alcohols and ethers with a final boiling point no higher than prescribed in Table 2.

5.6 Climatically dependent requirements and test methods

5.6.1 Water tolerance

Given the known potential for some unleaded petrol to absorb water, suppliers shall ensure that no water segregation occurs under the range of climatic conditions experienced in the country concerned. When there is a risk of water separation, anti-corrosion additives shall be incorporated.

NOTE For further information on preventing contamination by water or sediment that may occur in the supply chain it is advisable to check CEN/TR 15367-2 [3].

5.6.2 Volatility requirements

To meet hot and cold vehicle driveability requirements under the European seasonal and geographical conditions, 10 volatility classes are defined as given in Table 2 and illustrated in Figure 1. Each country shall, in a national annex to this European Standard, specify which of these 10 volatility classes apply during which period of the year for defined regions of the country.

Class A shall apply during summer, starting not later than 1 May and ending not before 30 September. In countries with arctic or severe winter conditions, class B shall apply during summer, starting not later than 1 June and ending not before 31 August.

Each country shall apply one or more volatility classes with VLI (class C1, D1, E1, or F1) for the transition periods on either side of summer. Each transition period shall be a minimum of 4 weeks. When transition periods are deemed critical, the critical transition period(s) shall be a minimum of 8 weeks. During the remaining period one or more winter classes shall apply with or without VLI (class C, C1, D, D1, E, E1, F or F1).

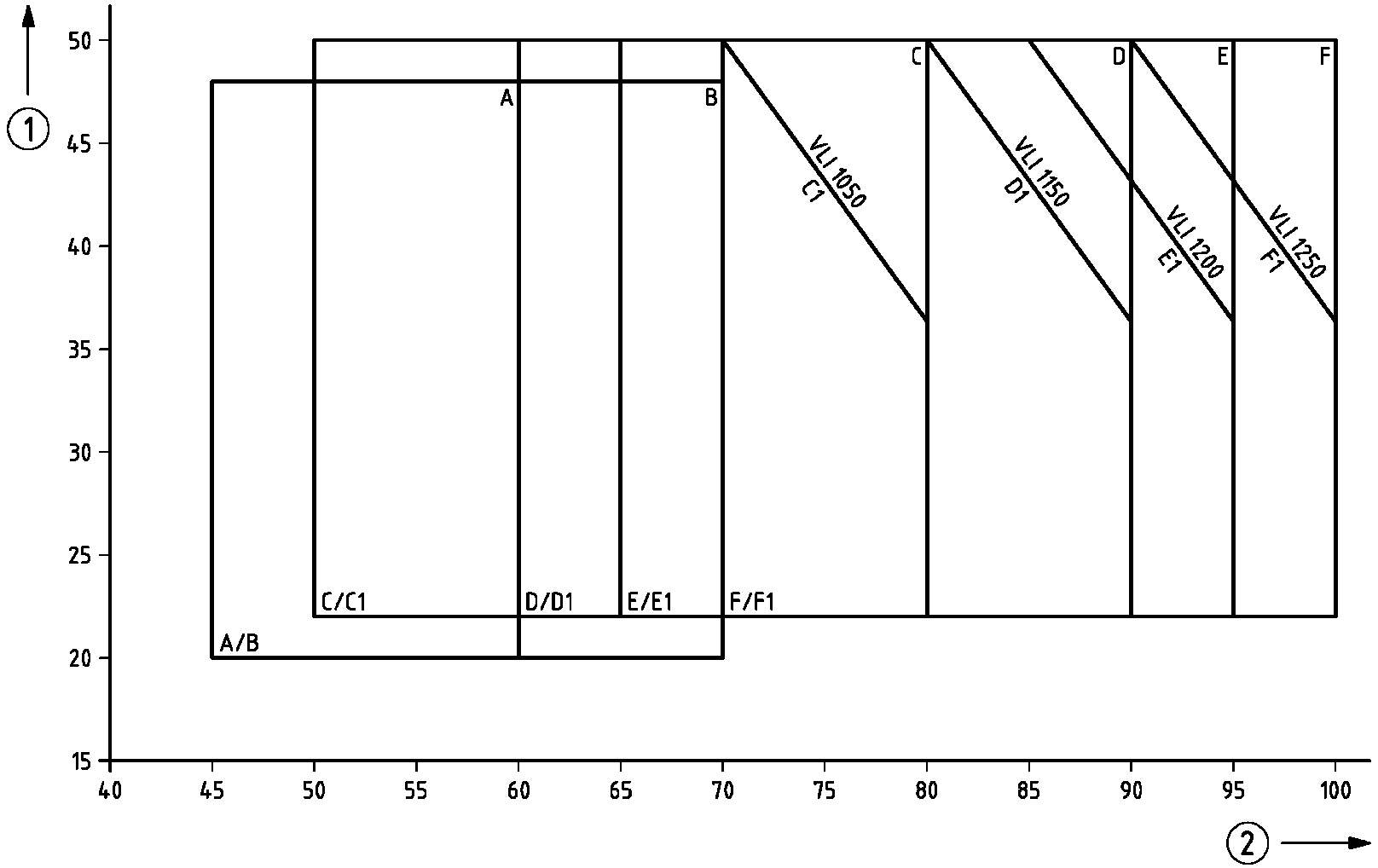
Table 2 - Volatility classes

Property	**Units**	**Limits**						**Test method** [a]
		class A	class B	class C/C1	class D/D1	class E/E1	class F/F1	(See 2. Normative references)
Vapour pressure (VP)	kPa, min. **kPa, max.**	45,0 **60,0**	45,0 **70,0**	50,0 80,0	60,0 90,0	65,0 95,0	70,0 100,0	EN 13016-1 [b]
% evaporated at 70°C, E70	% (*V/V*), min. % (*V/V*), max.	20,0 48,0	20,0 48,0	22,0 50,0	22,0 50,0	22,0 50,0	22,0 50,0	EN ISO 3405
% evaporated at 100°C, E100	**% (*V/V*), min.** % (*V/V*), max.	**46,0** 71,0	**46,0** 71,0	**46,0** 71,0	**46,0** 71,0	**46,0** 71,0	**46,0** 71,0	EN ISO 3405
% evaporated at 150°C, E150	**% (*V/V*), min.**	**75,0**	**75,0**	**75,0**	**75,0**	**75,0**	**75,0**	EN ISO 3405
Final Boiling Point (FBP)	°C, max.	210	210	210	210	210	210	EN ISO 3405
Distillation residue	% (*V/V*), max.	2	2	2	2	2	2	EN ISO 3405
Vapour Lock Index (VLI) (10 VP + 7 E70)	index, max.	--	--	C --	D --	E --	F --	
Vapour Lock Index (VLI) (10 VP + 7 E70)	index, max.			C1 1050	D1 1150	E1 1200	F1 1250	

NOTE Requirements in bold refer to the European Fuels Directive 98/70/EC [1], including Amendment 2003/17/EC [2]

a See also 5.8.1

b Dry Vapour Pressure Equivalent (DVPE) shall be reported



Key

1 percentage evaporated at 70 °C (E70) in % (*V/V*)

2 vapour pressure (VP) in kPa

Summer classes: A, B

Winter classes: C, D, E, F

Transition classes: C1, D1, E1, F1

Figure 1 - Relation between VP, E70 and VLI for the ten different volatility classes

5.7 Octane reporting

To prevent any misinterpretation in the reported results, the following reporting is recommended

— *RON*m, being the measured Research Octane Number according to EN ISO 5164,

— *MON*m, being the measured Motor Octane Number according to EN ISO 5163,

— *RON* being the measured Research Octane Number according to EN ISO 5164, corrected according to this European Standard, and

— *MON* being the measured Motor Octane Number according to EN ISO 5163, corrected according to this European Standard,

where:

RON = *RON*m - 0,2, and

MON = *MON*m - 0,2.

5.8 Precision and dispute

5.8.1 Resolution of disputes

All test methods referred to in this European Standard include a precision statement. In cases of dispute, the procedures for resolving the dispute and interpretation of the results based on test method precision, described in EN ISO 4259, shall be used.

5.8.2 Arbitration test methods

In cases of dispute concerning density, EN ISO 3675 shall be used.

In cases of dispute concerning sulfur content, EN ISO 20847 is unsuitable as an arbitration method

In cases of dispute on hydrocarbon type content, EN 14517 shall be used.

In cases of dispute concerning benzene content, EN 238 is unsuitable as an arbitration method.

In cases of dispute concerning oxygen content, EN 1601 shall be used.

In cases of dispute concerning oxygenates content, EN 13132 is unsuitable as an arbitration method.

In cases of dispute concerning methanol content, EN 1601 shall be used [4].

Bibliography

[1] *Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC*

[2] *Directive 2003/17/EC of the European Parliament and of the Council of 3 March 2003 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC*

[3] CEN/TR 15367-2, *Petroleum products - Guide for good housekeeping – Part 2. Automotive petrol fuels*

[4] CEN/TR 15745, *Liquid petroleum products – Determination of hydrocarbon types and oxygenates via multidimensional gas chromatography method – Round Robin research report*