

English version

Automotive fuels - Unleaded petrol - Requirements and test methods

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

Kraftstoffe für Kraftfahrzeuge - Unverbleite Ottokraftstoffe -
Anforderungen und Prüfverfahren

This European Standard was approved by CEN on 29 October 1999.

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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 replaces EN 228:1998.

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of an identical text or by endorsement, at the latest by May 2000, and conflicting national standards shall be withdrawn at the latest by May 2000.

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 changes between this European Standard and the previous edition are:

- Requirements of the European Fuels Directive 98/70/EC have been included on lead, sulfur, benzene, aromatics, olefins, oxygenates, VP, E100, E150 as well as references to test methods, including years of publication;
- The informative annex A has been updated;
- Requirements have been modified to reflect changes in petrol composition required or induced by the above Directive as well as changes in the car population: density, volatility classes, VLI, VP, E70, E100, and FBP. E180 has been deleted.

In this standard annex A is informative.

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 respectively the mass fraction and the volume fraction.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the 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.

EN 237:1996, *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 oxygen content by gas chromatography (O-FID).*

EN ISO 2160, *Petroleum products - Corrosiveness to copper - Copper strip test.*

EN ISO 3170, *Petroleum liquids - Manual sampling.*

EN ISO 3171, *Petroleum liquids - Automatic pipeline sampling.*

prEN ISO 3405:1998, *Petroleum products - Determination of distillation characteristics.* (ISO/DIS 3405:1998)

EN ISO 3675, *Crude petroleum and liquid petroleum products - Laboratory determination of density or relative density - Hydrometer method.*

EN ISO 4259:1995, *Petroleum products - Determination and application of precision data in relation to methods of test.* (ISO 4259:1992, including Cor. 1:1993)

EN ISO 6246, *Petroleum products - Gum content of light and middle distillate fuels - Jet evaporation method.*

EN ISO 7536, *Gasoline - Determination of oxidation stability - Induction period method.*

EN ISO 8754:1995, *Petroleum products - Determination of sulfur content - Energy-dispersive X-ray fluorescence method.* (ISO 8754:1992)

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

EN ISO 12185, *Crude petroleum and petroleum products - Determination of density - Oscillating U-tube method.*

prEN 13016-1:1997, *Liquid petroleum products - Vapour pressure - Part 1: Determination of air saturated vapour pressure (ASVP).*

prEN 13132:1998, *Liquid petroleum products - Unleaded petrol - Determination of organic oxygenate compounds and total organically bound oxygen content by gas chromatography using column switching.*

EN ISO 14596:1998, *Petroleum products - Determination of sulfur content - Wavelength dispersive X-ray fluorescence method.* (ISO 14596:1998)

EN 24260:1994, *Petroleum products and hydrocarbons - Determination of sulfur content - Wickbold combustion method.* (ISO 4260:1987)

EN 25163:1993, *Motor and aviation-type fuels - Determination of knock characteristics - Motor method.* (ISO 5163:1990)

FN 25164:1993, *Motor fuels - Determination of knock characteristics - Research method.* (ISO 5164:1990)

ASTM D 1319:1995, *Hydrocarbon types in liquid petroleum products by Fluorescent Indicator Adsorption.*

ASTM D 1613:1991, *Volatile solvents and chemical intermediates - Determination of acidity - Titration method.*

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 test are not contaminated with lead.

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.

5 Requirements and test methods

5.1 Dyes and markers

The use of dyes and markers is allowed.

5.2 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.

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

5.3 Phosphorus

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

5.4 Acidity

To adequately limit the acidity of the petrol, the acidity of fuel ethanol used as a blendstock shall not exceed 0,007 % (*m/m*) (as acetic acid) when tested in accordance with ASTM D 1613:1991.

5.5 Generally applicable requirements and test methods

When tested by the methods indicated in tables 1 and 2, premium grade unleaded petrol and regular grade unleaded petrol respectively shall be in accordance with the limits specified in tables 1 and 2.

**Table 1 - Generally applicable requirements and test methods
for premium grade unleaded petrol**

Property	Units	Limits		Test method ^a
		Minimum	Maximum	
Research octane number, RON		95,0	--	EN 25164:1993
Motor octane number, MON		85,0	--	EN 25163:1993
Lead content	mg/l	--	5	EN 237:1996
Density (at 15 °C) ^b	kg/m ³	720	775	EN ISO 3675 EN ISO 12185
Sulfur content ^b	mg/kg	--	150	EN ISO 14596:1998 EN ISO 8754:1995 EN 24260:1994
Oxidation stability	minutes	360	--	EN ISO 7536
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	% (V/V)			
- olefins ^{c, d, e}		--	18,0	ASTM D 1319:1995
- aromatics ^{c, d, e}		--	42,0	ASTM D 1319:1995
Benzene content ^b	% (V/V)	--	1,0	EN 12177:1998 EN 238:1996
Oxygen content ^b	% (m/m)	--	2,7	EN 1601:1997 prEN 13132:1998
Oxygenates content ^b	% (V/V)			EN 1601:1997 prEN 13132:1998
- methanol ^f		--	3	
- ethanol ^g		--	5	
- iso-propyl alcohol		--	10	
- iso-butyl alcohol		--	10	
- tert-butyl alcohol		--	7	
- ethers (5 or more C-atoms)		--	15	
- other oxygenates ^h		--	10	
^a See also 5.7.1 ^b See also 5.7.2 ^c The content of oxygenate compounds shall be determined in order to make the corrections according to clause 13.2 of ASTM D 1319:1995. ^d When Ethyl-tert-butyl ether (ETBE) is present in the sample, the aromatic zone shall be determined from the pink brown ring downstream of the red ring normally used in the absence of ETBE. The presence or absence of ETBE can be concluded from the analysis described in note c. ^e For the purpose of this standard ASTM D 1319:1995 shall be applied without the optional deparaffinisation step. Therefore clause 6.1, 10.1 and 14.1.1 shall not be applied. ^f Stabilising agents shall be added. ^g Stabilising agents may be necessary. ^h Other mono-alcohols and ethers with a final boiling point no higher than prescribed in table 4.				

**Table 2 - Generally applicable requirements and test methods
for regular grade unleaded petrol**

Property	Units	Limits		Test Method ^a
		Min.	Max.	
Research octane number, RON		ⁱ	--	EN 25164:1993
Motor octane number, MON		ⁱ	--	EN 25163:1993
Lead content	mg/l	--	5	EN 237:1996
Density (at 15 °C) ^b	kg/m ³	720	775	EN ISO 3675 EN ISO 12185
Sulfur content ^b	mg/kg	--	150	EN ISO 14596:1998 EN ISO 8754:1995 EN 24260:1994
Oxidation stability	minutes	360	--	EN ISO 7536
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 - olefins ^{c, d, e} - aromatics ^{c, d, e}	% (V/V)	--	21,0 42,0	ASTM D 1319:1995 ASTM D 1319:1995
Benzene content ^b	% (V/V)	--	1,0	EN 12177:1998 EN 238:1996
Oxygen content ^b	% (m/m)	--	2,7	EN 1601:1997 prEN 13132:1998
Oxygenates content ^b - methanol ^f - ethanol ^g - iso-propyl alcohol - iso-butyl alcohol - tert-butyl alcohol - ethers (5 or more C atoms) - other oxygenates ^h	% (V/V)	--	3 5 10 10 7 15 10	EN 1601:1997 prEN 13132:1998
^a See also 5.7.1 ^b See also 5.7.2 ^c The content of oxygenate compounds shall be determined in order to make the corrections according to clause 13.2 of ASTM D 1319:1995. ^d When Ethyl-tert-butyl ether (ETBE) is present in the sample, the aromatic zone shall be determined from the pink brown ring downstream of the red ring normally used in the absence of ETBE. The presence or absence of ETBE can be concluded from the analysis described in note c. ^e For the purpose of this standard ASTM D 1319:1995 shall be applied without the optional deparaffinisation step. Therefore clauses 6.1, 10.1 and 14.1.1 shall not be applied. ^f Stabilising agents shall be added. ^g Stabilising agents may be necessary. ^h Other mono-alcohols and ethers with a final boiling point no higher than prescribed in table 4. ⁱ RON and MON shall be specified in a national annex to this European Standard.				

5.6 Climatically dependent requirements and test methods

5.6.1 Water tolerance

Given the known potential for some motor gasolines 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.

5.6.2 Volatility requirements

The volatility requirements of petrol shall be controlled by limits on the properties given in table 3.

Table 3 - Properties for volatility requirements

Property	Unit	Limits
Vapour pressure (DVPE)	kPa	min./max.
Percentage evaporated at 70 °C, E70	% (V/V)	min./max.
Percentage evaporated at 100 °C, E100	% (V/V)	min./max.
Percentage evaporated at 150 °C, E 150	% (V/V)	min.
Final Boiling Point, FBP	° C	max.
Distillation residue	% (V/V)	max.
Vapour Lock Index, VLI (VLI = 10 VP + 7 E70)		max.

To meet hot and cold vehicle driveability requirements under the European seasonal and geographical conditions, 10 volatility classes are defined as given in table 4 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 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).

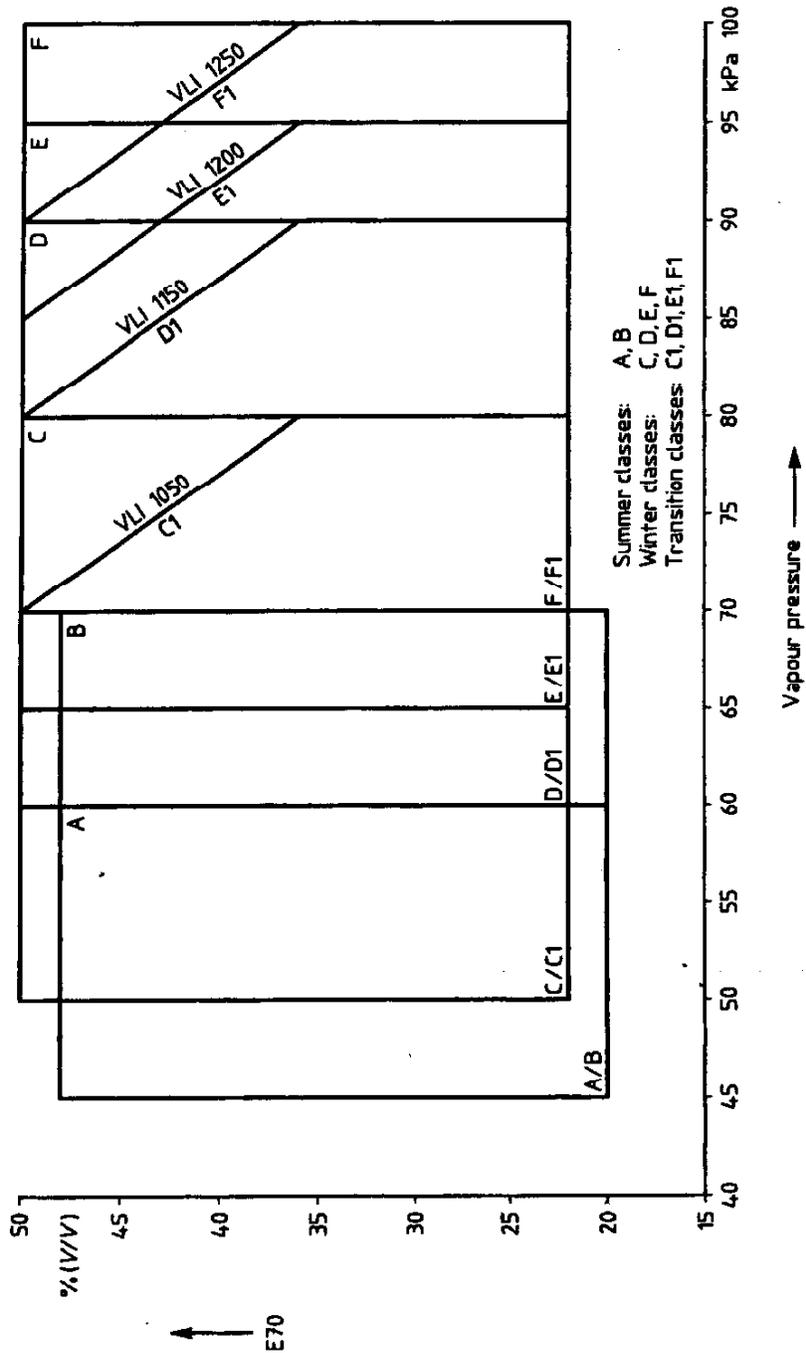


Figure 1 - Relation between VP, E70 and VLI for the ten different volatility classes

Table 4 - Volatility classes

Property	Units	Limits						Test method ^a
		class A	class B	class C/C1	class D/D1	class E/E1	class F/F1	
Vapour pressure	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	prEN 13016-1:1997 (DVPE)
% 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	prEN ISO 3405:1998
% 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	prEN ISO 3405:1998
% evaporated at 150 °C, E150	% (V/V), min.	75,0	75,0	75,0	75,0	75,0	75,0	prEN ISO 3405:1998
Final Boiling Point FBP	°C,max.	210	210	210	210	210	210	prEN ISO 3405:1998
Distillation residue	% (V/V), max.	2	2	2	2	2	2	prEN ISO 3405:1998
VLI (10 VP + 7 E70)	index, max.	--	--	C	D	E	F	
VLI (10 VP + 7 E70)	index, max.			C1 1050	D1 1150	E1 1200	F1 1250	

^a See also 5.7.1

5.7 Precision and dispute

5.7.1 All test methods referred to in this European Standard include a precision statement. In cases of dispute, the procedures described in EN ISO 4259:1995 for resolving the dispute, and interpretation of the results based on test method precision shall be used.

5.7.2 In cases of dispute concerning sulfur content, EN ISO 14596:1998 shall be used.
In cases of dispute concerning benzene content, EN 12177:1998 shall be used.
In cases of dispute concerning oxygen and oxygenates content, EN 1601:1997 shall be used.
In cases of dispute concerning density, EN ISO 3675 shall be used.

Annex A

(Informative)

Bibliography

- A.1 Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC.