SLOVENSKI STANDARD
SIST-TP CEN/TR 16435:2013

01-januar-2013

Tekoči naftni proizvodi - Linijsko namešavanje oksigenatov skladno z zahtevami EN 228

Liquid petroleum products - Oxygenates blending in line with actual EN 228 requirements

Flüssige Mineralölerzeugnisse - Zumischung von sauerstoffhaltigen Verbindungen entsprechend den bestehenden Anforderungen nach EN 228

Produits pétroliers liquides - Oxygenates blending par exigences actuelles d'EN 228

Ta slovenski standard je istoveten z: CEN/TR 16435:2012

ICS:

75.160.20 Tekoča goriva Liquid fuels

SIST-TP CEN/TR 16435:2013 en

TECHNICAL REPORT
RAPPORT TECHNIQUE
TECHNISCHER BERICHT

CEN/TR 16435

October 2012

ICS 91.100.01

English Version

Liquid petroleum products - Oxygenates blending in line with actual EN 228 requirements

Produits pétroliers liquides - Oxygenates blending par exigences actuelles d'EN 228

Flüssige Mineralölerzeugnisse - Zumischung von sauerstoffhaltigen Verbindungen entsprechend den bestehenden Anforderungen nach EN 228

This Technical Report was approved by CEN on 25 September 2012. It has been drawn up by the Technical Committee CEN/TC 19.

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

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Ref. No. CEN/TR 16435:2012: E

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Foreword

This document (CEN/TR 16435:2012) 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.

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1 Scope

This Technical Report provides information to the blender on all the effects when blending oxygenates and alcohols in order to fulfil legal limitations put in place through the revised Fuels Quality Directive and in order to remain in line with EN 228 unleaded petrol requirements.

This Technical Report is published as background information.

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

2 Background

The purpose of this Technical Report is to provide guidance when blending oxygenates while meeting the requirements of EN 228:2012 [3] for both oxygenates and oxygen content as listed in Table 1 and Table 2 of that European Standard.

Selected properties of some commonly used oxygenates and examples of six oxygenated blends are reported to demonstrate the relationship between the concentration of oxygenated blending components and oxygen content.

The data given in this document are based on the properties of pure chemical products. If impurities, by-products or unreacted feedstocks are present in the oxygenates, these data may differ slightly from those for commercial oxygenates.

3 General issues

The relationship between oxygenate contents expressed in % (*m/m*) and %(*V/V*) depends on the density of the individual components and their possible non-linear interactions (effects such as volume change) when blended.

Changes in density can be caused by variations in the composition of the oxygenate components (e.g. the purity of the oxygenate) as well as by the measurement temperature. These density changes will also be reflected in the % (*V/V*) range of the final product. This means that the limits for oxygenate content in % (*V/V*) will depend on all of these variations so that accurate limits are not very easily specified in practical terms.

Therefore, accurate relationships between the oxygenates content in % (*V/V*) and the oxygen content in % (*m/m*) can only be given when all of the influencing factors are precisely described.

4 Reference data

Tables 1 and 2 of EN 228:2012 list the different oxygenates that are allowed for blending in petrol for which reference data [4, 5, 6, 7] are given in Table 1 below.

NOTE 1 Table 1 and its requirements also include other oxygenates: other mono-alcohols and ethers with a final boiling point not higher than 210 °C. Reference data have not been included.

NOTE 2 Reference data have been included for several ethers even though they all fall under the single definition and limits of "ethers (five or more C atoms)".

Table 1 — Selected properties of petrol and some oxygenates

Component	Abbreviation	Formula	Density at 15 °C *kg/m³*	Molecular weight *g/mol*	Oxygen content *% (m/m)*
Unleaded petrol	EN 228	C_xH_y	720 - 775	100 - 105	0,0
Methanol	MeOH	C_1H_4O	795,8	32,04	49,93
Ethanol	EtOH	C_2H_6O	794,8	46,07	34,73
Isopropyl Alcohol	IPA	C_3H_8O	789,4	60,10	26,62
Tertiary Butyl Alcohol	TBA	$C_4H_{10}O$	810,6	74,12	21,59
Isobutyl Alcohol	IBA	$C_4H_{10}O$	789,5	74,12	21,59
Methyl Tertiary Butyl Ether	MTBE	$C_5H_{12}O$	745,3	88,15	18,15
Ethyl Tertiary Butyl Ether	ETBE	$C_6H_{14}O$	745,0	102,18	15,66
Tertiary Amyl Methyl Ether	TAME	$C_6H_{14}O$	775,2	102,18	15,66
Tertiary Amyl Ethyl Ether	TAEE	$C_7H_{16}O$	750,0	116,20	13,77

5 Blend examples

There are a wide range of blending choices that may be chosen between alcohols and ethers. For the purposes of this document, the following 'selection' criteria have been adopted:

— the petrol density is assumed to be 750 kg/m³;

— blends of more than two oxygenates are not considered;

— among the alcohols, only ethanol has been considered;

— among the ethers, only ETBE has been considered;

— oxygen content is maximized at 2,7 % (*m/m*) for E5 and at 3,7 % (*m/m*) for E10;

— a maximum ETBE content case, corresponding to 22 % (*V/V*) in E10, is not included in these examples;

— a 5 % (*V/V*) EtOH case is considered both for E5 and E10 grades in order to provide an "across-grades" comparison;

— a ~1:1 alcohol/ether blend is included to represent a "co-blending" option.

Using these criteria, six different blending examples are provided in Table 2, three for E5 and three for E10 blends.

Table 2 — Examples of different oxygenate blends

	Oxygenate Blends		Oxygen	EtOH		ETBE	
Example	**Name**	**Type**	% (*m/m*)	% (*V/V*)	% (*m/m*)	% (*V/V*)	% (*m/m*)
1	E5	EtOH only	1,84	5,00	5,30	0	0
2	E5	ETBE only	2,7	0	0	17,36	17,24
3	E5	5 % (*V/V*) EtOH & ETBE	2,7	5,00	5,30	5,53	5,49
4	E10	EtOH only	3,68	10,00	10,60	0	0
5	E10	5% (*V/V*) EtOH & ETBE	3,70	5,00	5,30	11,96	11,88
6	E10	7 % (*m/m*) ETBE & EtOH	3,70	7,07	7,50	7,05	7,00

The relationship between the volume percentage of an oxygenate component as a function of its mass percentage (and vice versa) is as described below when the densities of the finished blend and one of the two blending components are known:

$$\mu_O = \varphi_O \, \delta_O / \delta_P \quad (1)$$

$$\varphi_O = \mu_O \, \delta_P / \delta_O \quad (2)$$

where

μ_O = mass fraction of the oxygenated component in the final blend, expressed in % (*m/m*)

φ_O = volume fraction of the oxygenated component in the final blend, expressed in % (*V/V*)

δ_O = density of the oxygenated component

δ_P = density of petrol