

EXISTING STANDARDS AND THE NEED FOR LIQUID AND GASEOUS ALTERNATIVE FUELS STANDARDS

Summary

Since the mid 1990s, resulting from concerns on climate change and its connection to the emission of greenhouse gases, the main interest in alternative fuels has been concentrated on fuels from biomass or rather carbon dioxide neutral fuels. Autumn 2001 the European Commission presented a draft communication and two directive proposals concerning the promotion of using bio fuels and other renewable fuels and also on the taxation of bio fuels. In May 2003 a directive for promotion of bio fuels and other renewable fuels came into force. On the basis of acquired information and own work the contribution involves review of national standards concerning alternative motor fuels. In connection with gradual introduction of the alternative motor fuels, research and development in this field in the time of anticipation of the European standards generation is presented.

Introduction and purpose of the work

In Europe is expected the traffic increasing and thus produced CO₂ emissions growth by about 50% to 1,1 billion of tons in 2010. About 84% of this amount originates from the road traffic. Also application of biogenous fuels will effect this development [1, 2]. The necessary condition for the increased application of the alternative fuels is working-up of the appropriate standards, reflecting the motor technical requirements, and also legally ensuring the mutual compensations in case the problems with the motor fuel would lead to the motors damage [3, 4, 5, 6].

Methods, scientific innovation and relevance

Summarization and analysis of information on existing national and European Standards and continuing work on liquid and gaseous alternative motor fuels. Determination of anticipated standard priorities.

The basic summarization for further research needs:

- the realization of more sophisticated system for the alternative motor fuels quality ensuring with regard to the combustion motors manufacturers demand,
- the determination of technical-technological requirements for manufacturers and also for development of referential motor fuel for type registration at appropriate testing stations of the combustion motors.

Results

At present in Europe are the following standards regarding the alternative motor fuels [5, 6].

National standards – Pre-standard

SS 155437 Motor fuels – Fuel alcohols for high-speed diesel engines (Sweden).

SS 155501 Fuel for kitchen appliances and heating – Fuel alcohol (Sweden).

SS 155438 Motor Fuels – Biogas as fuel for high-speed otto engines (Sweden).

ČSN 65 65 11 Fermentative denaturalized ethanol for application in automotive petrol (Czech Republic).

ČSN 65 65 08 Automotive fuels – Diesel fuel containing rapeseed oil methyl ester above 30% (Czech Republic).

ČSN 65 65 09 Automotive fuels - Diesel emulsion (Czech Republic).

ČSN 38 61 10 CNG (Czech Republic).

"Pre-standard" (Vornorm) specification for the use of especially prepared/refined rapeseed oil in engines that are specially adapted for the use of vegetable oils, in particular rapeseed oil. These adapted engines are mainly found in agricultural tractors, harvesting machines, etc. (DIN FAM Germany).

NC 637-01 Water in diesel fuel emulsion for motor vehicles - Requirements and test methods (Italy).

NC 637-02 Fatty Acid methyl esters (FAME) blends at 20-30% (V/V) in diesel fuel - Requirements and test methods (Italy).

ISO standards

ISO 14687 Hydrogen fuels – Product specification.

ISO 15403 Natural gas – Designation of the quality of natural gas for use a compressed fuel for vehicles.

ISO 9162 Petroleum products – Fuels (class F) – Liquefied petroleum gases - Specifications.

CEN Workshop Agreements (CWAs) (ongoing work) [5]

CEN/WS 15 - Bio-ethanol (E85) as an automotive fuel [9].

CEN/WS 19 - Water in diesel fuel emulsions for use in internal combustion engines.

In Fig. 1 is presented an overview of the alternative liquid motor fuels and blending components which are being significantly used at present and which would be used in future in even more considerable measure.

Review of basic qualitative indicators for blended motor Diesel fuel with content of rapeseed oil fatty acids (FARME) above 30 % is presented in table 1. The changes can be divided into two parts. One change is similar to the motor Diesel fuel and regards the sulphur content; other changes extend possibilities of biofuels utilization for fatty acids methyl esters in accordance with EN 14214. The requirements for that fuel are identical with those for motor Diesel fuel and are extended by the acidity number, different is water content and sulphur content for low-sulphur fuel (40 mg.kg⁻¹ instead 50 mg.kg⁻¹).

In table 2 are presented general requirements and methods tested for fermentative denatured ethanol determined for application in automotive petrol.

In May was accepted for approval the material CEN workshop agreement “Automotive fuels – Ethanol E85 – Re-

quirements and test methods” for blend of 70 – 75 % v/v ethanol + higher alcohols with 14 – 30 % v/v premium grade unleaded petrol as specified in EN 228. This CEN Workshop Agreement has been drafted and approved by a Workshop of representatives of interested parties, the constitution of which is indicated in the foreword of this Workshop Agreement [9].

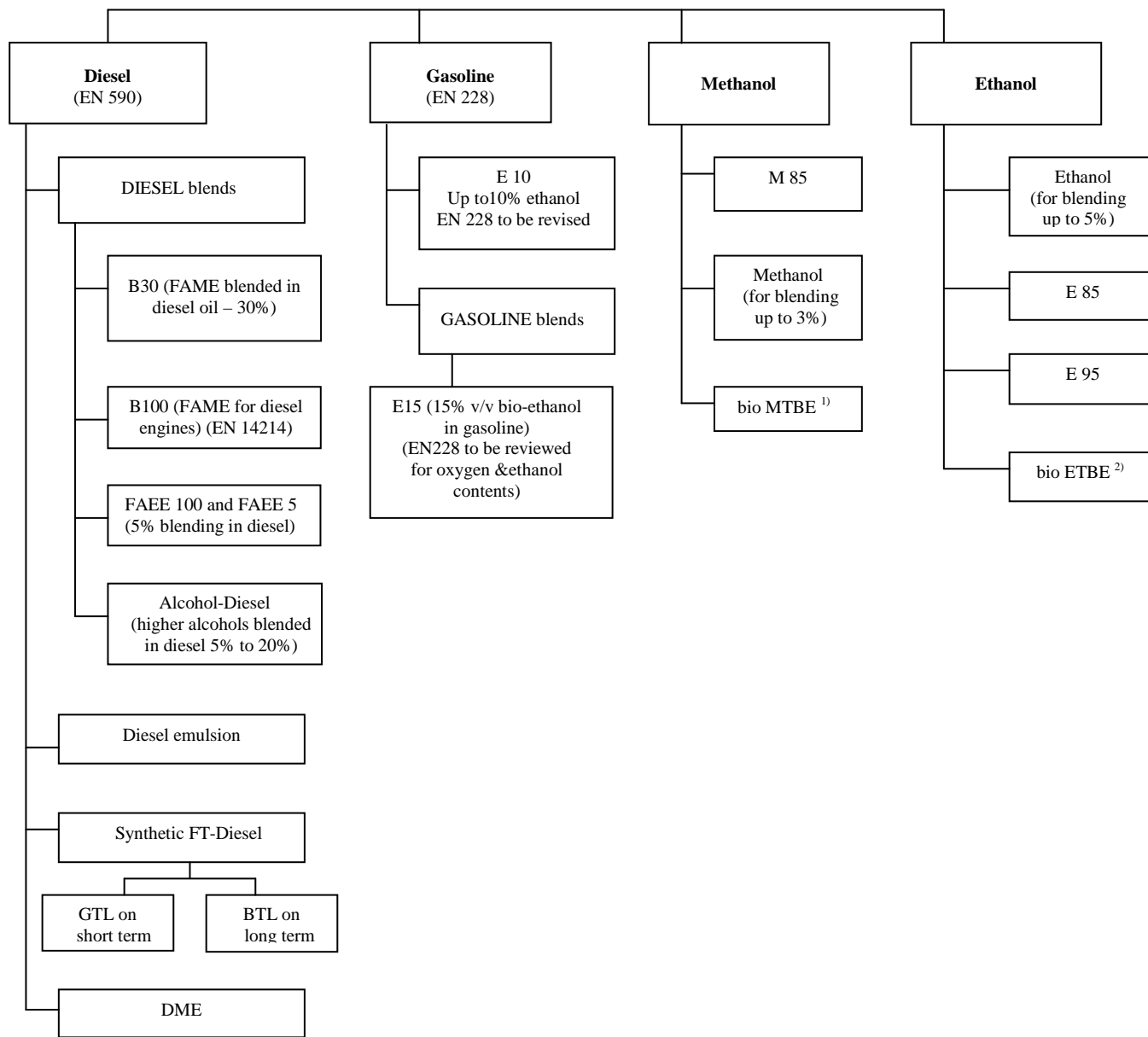


Fig. 1. Alternative liquid motor fuels and blending components [5]

¹⁾ methyl-tertio-butyl-ether, ²⁾ ethyl-tertio-butyl-ether

Table 1. Comparison of selected indicators of blended motor Diesel fuel with FARME content above 30% by the standard ČSN 65 6508 [7] from 2003 and anticipation of changes since 2006

Qualitative indicator		Unit	2003	2006	Test method
FARME content (FAME) ^{†)}	min.	% m/m	31	31	EN 14078
Sulphur content	max.	mg.kg ⁻¹	250	40 10	EN 20846
Density		kg.m ⁻³	820 – 860	820 – 860	EN ISO3675
Distillation curve 95% (V/V) over-distilled at temperature	max.	°C	360	360	EN ISO 3405
Water content	max.	mg.kg ⁻¹	300	300	EN 12937
Acid value	max.	mg KOH.g ⁻¹	0,20	0,20	EN ISO 660
Cloud point class F	max.	°C	-8	-8	EN 23015
Cetane number	min.	-	51	51	EN ISO5165
Polyaromatics content	max.	% (V/V)	11	11	EN 12916

^{†)} since 2006 FAME

Table 2. General requirements and testing methods for fermented anhydrous denatured spirit determined for direct blending with the automotive petrol or for production of ethyl (t-butyl) ether (ETBE) according to ČSN 65 6511 [8]

Property	Unit	Limits		Test method
		min.	max.	
Appearance		clear, without opacity and sediments		ČSN 66 0805
Ethanol content before denaturing	% (V/V)	99,7	-	ČSN 66 0805
Water content	% (V/V)	-	0,39	ČSN ISO 760, ČSN ISO 1388-1
Density (at 20 °C)	kg.m ⁻³	791	-	ČSN ISO 758, ČSN 66 0805
Ethanol content after denaturing	% (V/V)	95,6	-	Regulation No. 82/2000 of the Ministry of Agriculture, Article I, § 2 (1)c) by method of gaseous chromatography
Free acids content	mg.le ^{-1 +)}	-	50	ČSN ISO 1388-3,4; ČSN EN 228
Evaporation residue	mg.le ^{-1 +)}	-	15	ČSN 66 0805
Denaturing agent content	% (V/V)	2,0	4,0	Not determined, producer is liable for denaturing according to appropriate legal regulation.

^{+) le} – liter of ethanol

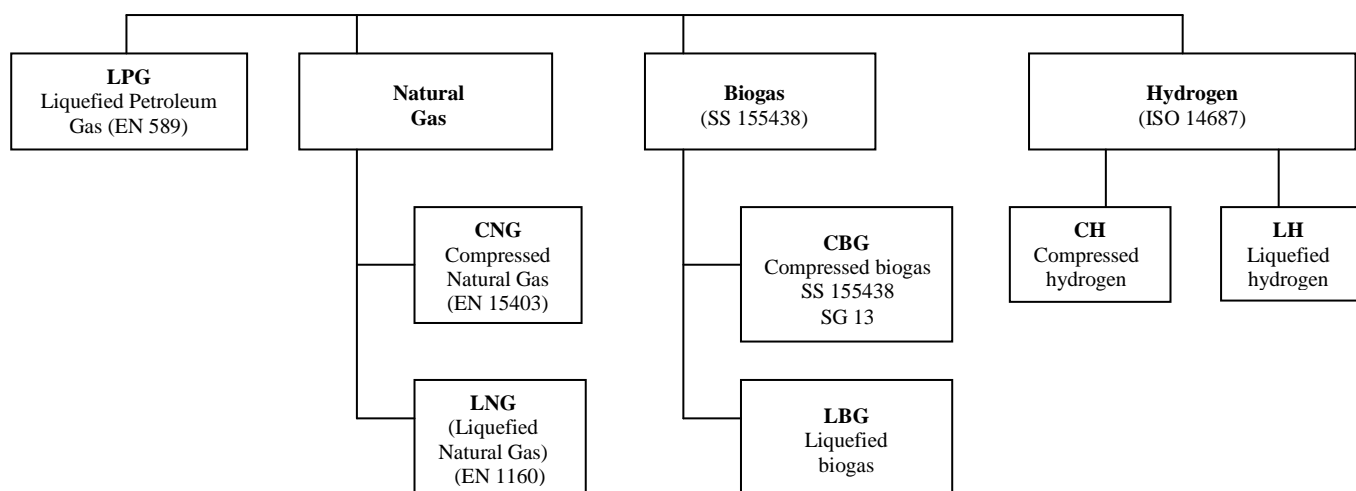


Fig. 2. Alternative gaseous automotive fuels [5]

By [5, 6], among the liquid fuels which could be interesting for the European standards (EN) belong:

Blending in diesel fuel

- 30% FAME in diesel fuel.
- 5% FAEE (Fatty Acid Ethyl Ester) in diesel fuel.

Use in diesel engines

- Diesel emulsions.
- Neat FAEE (FAEE 100).
- 95% ethanol plus additives (E 95).
- Synthetic FT-diesel (Fischer-Tropsch synthetic diesel fuel produced from shifted and cleaned natural gas or from shifted and cleaned gasified biomass).
- Blends of alcohols/alcohol derivatives in diesel fuel.
- Dimethyl ether (DME).

Blending in gasoline

- Up to 15% bio ethanol in gasoline (E15).
- 85% bio-ethanol in gasoline (E85).
- Methanol for blending up to 3% in gasoline.

Use in gasoline engines (otto engines)

- E10.

There is also a certain interest in revised standards for alternative fuels that can be blended in diesel fuel or that can be used in diesel engines.

This need for revised or new standards is mostly focused on the short term (5 years). When it comes to blending of 30% biodiesel / FAME in diesel fuel, blending of synthetic diesel from biomass in diesel fuel, and also regarding DME, the interest tends to be moved a little bit towards a 10 years time horizon. Interest in M85 is for 20 years from now.

In Fig. 2 is presented overview of alternative gaseous automotive fuels.

Gaseous alternative fuels for which there might be an interest in new EN-standards in the future are [5]:

- Compressed Biogas (CBG) (methane produced from anaerobic digested biomass).
- Compressed Natural Gas (CNG).

Concerning hydrogen (both in compressed and liquefied form) CEN is waiting for an EC mandate for a feasibility study on this topic. It is not possible to fully foresee the fu-

Table 3: Standardization priorities for alternative liquid fuels for stationary applications [5]

Alternative liquid fuels for stationary applications	Priorities (years)				Comments
	Existing standards (EN-, ISO- and/or national standards)	0-5 years time horizon	5-10 years time horizon	10-20 years time horizon	
Methanol		X			
- Methanol blends				X	
Ethanol		X			
- Ethanol blends (up to E80+M20)	SS 155501	X			
Bio based fuel oils					
- FAME	EN 14213				
- FAEE		X			
- Tall pitch oil		X			
- Pyrolysis oil				X	
Others				X	vegetables oils

Table 4: Standardization priorities for alternative gaseous fuels for stationary applications [5]

Alternative gaseous fuels for stationary applications	Priorities (years)				Comments
	Existing standards (EN-, ISO- and/or national standards)	0-5 years time horizon	5-10 years time horizon	10-20 years time horizon	
Commercial LPG	ISO 9162				For the moment the ISO standard is sufficient
Biogas		X			
Hydrogen	ISO 14687				Waiting for an EC mandate
DME			X		

ture need for hydrogen standards before the mandate is given and the result of the study is presented.

The priority list below shows that for the coming 5 years, there is an interest in a standard on biogas for vehicle use. The need for a similar CNG standard may arise 5 to 10 years from now.

Liquid alternative fuels for which there might be an interest in new EN-standards in the future are - table 3.

The overview of alternative gaseous fuels priorities for stationary applications is evident from table 4.

Conclusions

The base for all standardization is that there is a demand for standards. The demand for standards on alternative fuels will emerge when the demand of alternative fuels will increase. Such an increase is expected to come in the next 10 years. When the use of alternative fuels increases substantially, they have to be made available on the consumer market, in addition to the restricted use in captive fleets` tests. To enable a market introduction of alternative fuels, they have to be generally accepted by engine and vehicle manufacturers and fuel distributors. Such an acceptance requires standards for these alternative fuels. More or less over the whole fuel spectrum there is a great interest in having new standards on alternative fuels for automotive use and in revising existing alternative fuel standards. In most cases, new or revised standards on alternative automotive fuels will be necessary in the coming 5 years. For just a few of them, the need will arise in 5 to 10 years or even later.

The interest in new or revised standards on automotive fuels will be focused on:

0 to 5 years:

- Alcohols and alcohol derivatives in diesel fuel
- Compressed biogas

- Ethanol blended up to 10 % in gasoline
- Ethanol fuel (E95 with additives for diesel engines)
- FAEE and FAEE blended up to 5 % in diesel fuel.

The interest in new standards on automotive fuels in a longer term will be focused on:

5 to 10 years:

- Compressed natural gas
- DME
- Ethanol blended up to 15 % in gasoline
- FAME blended up to 30 % in diesel fuel
- Liquefied biogas
- Methanol (M100) as blending component in gasoline
- Synthetic diesel produced from natural gas or gasified biomass.

10 to 20 years

- Methanol blended up to 85 % in gasoline (M85).

Work on diesel emulsions and on ethanol (E85) for flexible fuel vehicles is almost finalized as CEN workshop agreements. For ethanol to be blended in gasoline (up to 5 %), CEN/TC 19 has initiated work to prepare an EN-standard, by a mandate from the EC. Existing ISO standards and national standards may be helpful in future CEN work on standardization of alternative fuels. The existing standards can for example be used as starting point for the work in a CEN/TC working group or in a workshop agreement. Future work on the production of standards for liquid and gaseous alternative automotive fuels can be done in existing Technical Committees, primarily in CEN's Technical Committee number 19 (CEN/TC 19) "Petroleum Products, Lubricants and Related Products". However, to accelerate

the process and to avoid delay, the option to use the workshop agreement instrument as a starting point for the production of standards for alternative automotive fuels might be taken into consideration. There is also a certain interest in standards on alternative fuels for stationary applications. For liquid fuels the need for standards is spread over a 20 years period, while for the gaseous fuels the interest concerns a 10 years time period.

The interest in new standards on fuels for stationary applications in the coming 5 years is focused on:

0 to 5 years

- Biogas
- Ethanol and ethanol blends
- FAEE
- Tall pitch oil
- Methanol.

5 to 10 years

- DME
- Pyrolysis oil
- Other bio based oils.

10 to 20 years

- Methanol blends.

Existing ISO standards, as well as national standards might be helpful in future CEN work on the standardization of alternative fuels for stationary applications. These standards could be used as starting point for the work in a CEN/TC working group or in a workshop agreement. In addition to the fact that the workshop agreement instrument can be used, it seems necessary to investigate the need and possibility to enlarge the scope of CEN/TC 19 or to establish a dedicated TC or a BT/Task Force to accommodate alternative fuels for stationary applications.

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