Danish Methanol Association

IEA-AMF Annex 56 Methanol as Motor Fuel – Annex 1 Flex Fuel Kits

Figure 1. ETHANOL FLEX E85® Ethanol Conversion Kit. Fully Automatic Digital 3-Cylinders E85 Ethanol Conversion Kit with Cold Start Assist. Made in France.

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France approves Flex Fuel Kits.

On Friday 15th December, the French Ministry for Environment and Energy published the bylaw setting forth the terms to approve Superethanol-E85 conversion systems for petrol-powered vehicles to also use Superethanol-E85. Being subject to less taxation because of its environmental edge, Superethanol-E85 is the cheapest fuel on the French market. This has brought plug and play Flex Fuel Kits on the market. They can be installed by laymen in a matter of minutes virtually without the need for tools. Example. *"ETHANOL FLEX E85® Ethanol Conversion Kit allows to run any gasoline vehicle either on Ethanol E85 (also known as Bioethanol) or unleaded petrol 95/98 and save up to 40% of your fuel budget on every tank fill in France"*.

Such kits have been on the US market for some years - for example, Flex Fuel U.S., original manufactured by Chrysler and approved 2006 by EPA for certain cars. In Sweden, BSR Svenska AB has obtained approval of their kit (SAAB only). The same for StepOne Tech Ltd. in Finland. In France, we find the FlexFuel Compagny with their DriveCleanBox, Ethanol Flex - E85 Ethanol Conversion Kits from Artline International SARL and now quite a few others.

Installation

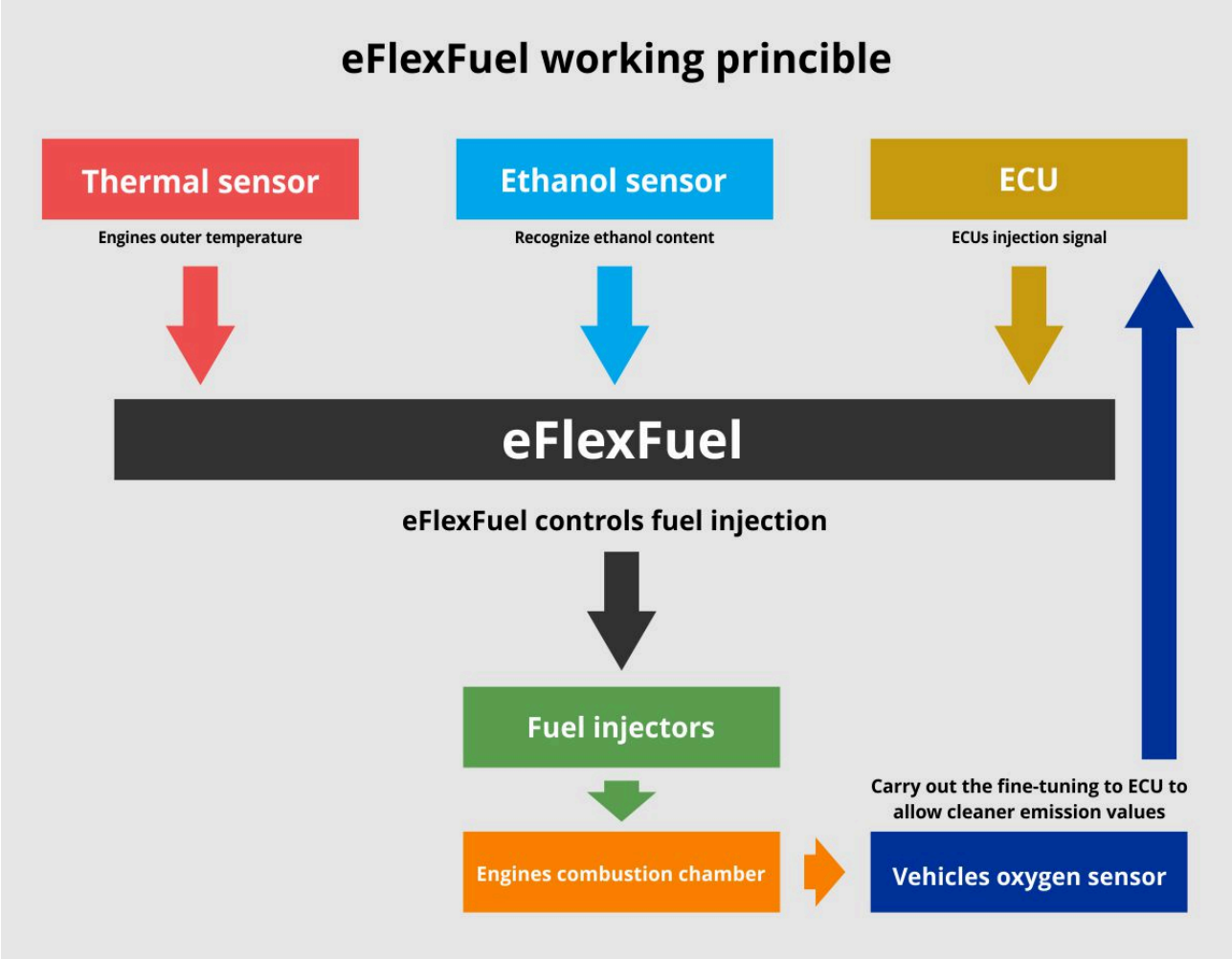

Figure 2. The eFlexFuel working principle illustrates the application of a Flex Fuel Sensor as well as an exterior thermometer. Some kits are simplified by omitting the Flex Fuel Sensor.

These kits vary slightly in simplicity with varying installation from a few minutes to a couple of hours. Bosch offers a supplementary Flexstart, a complete Fuel Rail System with preheating to improve cold start in frosty weather. Bosch claims their systems are media-resistant for ethanol and methanol applications.

The simplest Flex fuel kit installs as a plug and play device in the vehicles fuel Injection system, by means of rerouting the signal from the Electronic Control Unit (ECU) to the fuel injectors. Takes less than 25 minutes to install. There are no wires to cut or solder. They offer cold starting assistance technology with built in temperature sensor. After installation vehicle will become a Flex Fuel vehicle able to run high alcohol blends and regular gasoline and any blends.

A Fully Automatic Digital 3-Cylinders E85 Ethanol Conversion Kit with Cold Start Assistance Kit “Ethanol E85 3-Cylinders” at 150 € is installed in our test car, although the engine is running fine on neat methanol and any petrol blend.

Vapor pressure.

The most recent Danish Gasoline 95, EN 228 Danish BOB specification (Base Oxygenate Blendstock), edition no. 4 of 16. June 2014 vapor pressure range DVPE for winter quality (1/10-30/4) is 60,0-88,0 kPa (8,7 – 12,8 psi), intermediate quality (1/5-31/5 & 1/9-30/9) is 40,0-88,0 kPa (5,8-12,8 psi) and summer quality (1/6-31/8) is 40,0 – 63,0 kPa (5,8 – 9,1 psi).

Methanol has a low vapor pressure, in fact too low for cold start in cold weather. The problem is corrected by adding petrol. 15% petrol is, however, not always enough, hence the interest in Flex Fuel Kits and FlexStart.

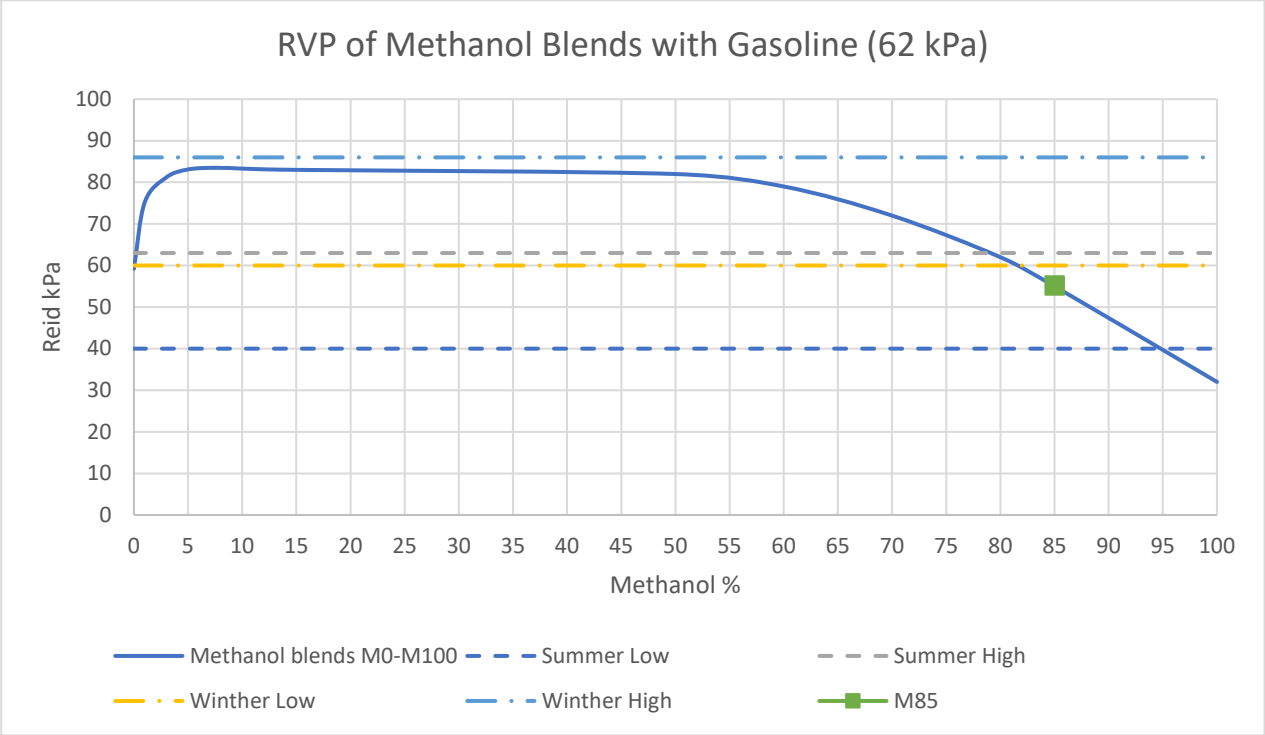

Figure 3. Data Source Methanol Institute for M0-M15; ASTM D5797-17 for M51-M85

Vapor pressure of M85 with various BOB according to ASTM D5797-17:

5 psi BOB (34,5 kPa):	6,5 psi (44,8 kPa)
7 psi BOB (48,3 kPa):	7,1 psi (50,0 kPa)
7,8 psi BOB (53,8 kPa):	7,3 psi (50,3 kPa)
9 psi BOB (62,0 kPa):	8,0 psi (55,2 kPa)
10 psi BOB (68,9 kPa):	8,3 psi (57,2 kPa)
11,5 psi BOB (79,3 kPa):	9,1 psi (62,7 kPa)
13,5 psi BOB (93,1 kPa):	9,9 psi (68,3 kPa)
15 psi BOB (103 kPa):	10,8 psi (74,6 kPa)
Summer BOB 5,8 – 9,1 psi:	6,6 – 8,0 psi (45,6 – 55,5 kPa)
Winther BOB 8,7 -12,8 psi:	7,9 – 9,7 psi (54,3 – 66,6 kPa)

The ASTM D5797-17 curves allow the blender who knows the vapor pressure of his gasoline blendstock to achieve a required vapor pressure of the final blend.

y = 0,4357x + 4,0834, where y=psi of M85 and x=psi of BOB. One kPa = 0.145037738 psi.

The vapor pressure increases the more petrol until approximately 50% - 95 % petrol, then the pressure declines. The biggest change of RVP occurs by increasing methanol from nothing to 3%. The increase can be counteracted by lowering the content of butane.

A flex fuel kit from Artline International SARL at €150 has an integrated cold-start system with an internal temperature sensor, capable of starting the engine in very low temperatures. A FlexStart system from Bosch – an Original Equipment (OE) only - comes with a complete heated fuel rail.

Initial experience.

Route	Fuel	Motor	Tail pipe CO_2 g/km	c	Hn	km/h	MJ/km	CO g/km	NO_x g/km
RDE Aarhus	M85	Standard.	118,1	0,4428	23,244	51,1	1,69	0,14	2,02
RDE Aarhus	M85	Flex Fuel	118,2	0,4428	23,244	49,0	1,69	0,44	0,63
WLTP Dyno	M85	Flex Fuel	108,6	0,4428	23,244	46,9	1,55	0,32	0,55
WLTP Dyno	M85	Standard	106,7	0,4428	23,244	46,7	1,53	0,12	1,51

The motor is running smooth and quiet.

Motor light may light up permanently. Vehicle Stability Control (VSC) light may do so also, but is turned off when the engine stops. In China, Methanol kits are sold, which should be tested as a perhaps better alternative kit.

If the petrol content goes below 15%, it may cause cold start problems even with the kit mounted. The motor may start, but it is difficult to keep it running until the car is on the road. When warm, there is no restart problems.