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A DISCUSSION OF M85 (85% METHANOL) FUEL SPECIFICATIONS AND THEIR SIGNIFICANCE

An SAE Cooperative Research Report

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SECTION 1

SAE COOPERATIVE RESEARCH PROGRAM PROJECT GROUP 3

This report is a product of the SAE Cooperative Research Program, Project Group 3 (see Annex 1).

The Group operates in accordance with the 1984 Cooperative Research Act and was formed by the Oxygenated Fuels Task Force, which is comprised of automotive engineering executives from Ford, GM and Chrysler. The Task Force identifies and prioritizes potential pre-competitive cooperative research programs to operate under the administration of SAE.

The specific scope of Project Group 3 is to develop and exchange information relative to M85 fuels.

SAE Project Group 3, by this document, does not necessarily endorse the specifications included herein. They are included for information.

SECTION 2

BACKGROUND

Fleet trials of the use of methanol as the main constituent of vehicle fuel, rather than a blending component, began in California in the early 1980's in an effort to reduce pollution and decrease dependence on foreign oil. These vehicles used methanol with hydrocarbon primers added to reduce cold start and driveability problems and to minimize safety concerns (see Section 7). Fuel composition evolved to M85, a mixture of 85 volume percent methanol and 15 volume percent hydrocarbons such as gasoline. Early retrofitted vehicles experienced numerous driveability, fuel system durability, and engine durability problems. Vehicles redesigned for M85 operation have performed better with improved materials and engine calibration for fuel methanol. More than 600 of these vehicles were produced during the 1980's and accumulated 30 million miles in fleet operation by 1990.

As the use of fuel methanol in fleet vehicles increased, the disadvantage of methanol's lower energy density was demonstrated through limited driving range. This lower fuel economy, along with the lack of methanol refueling stations, emphasized that the private sector would need a vehicle that could operate on either methanol or gasoline. The fuel flexible vehicle, which can operate on gasoline, methanol or a gasoline/methanol mixture, became possible through the development of the optical fuel sensor in the 1970's by the Netherlands Research Institute for Road Vehicles, a division of Netherlands TNO¹. The optical fuel sensor determines the percentage of methanol in the fuel, which allows for adjustments to the air-fuel ratio. In addition to optical sensors, alternative sensor technologies are being developed and are being applied by the major automobile manufacturers in fuel flexible vehicles. These vehicles can be transition vehicles which will permit the development of a methanol refueling infrastructure.

Many private testing facilities at automotive companies, petroleum companies and government agencies have M85 dispensing equipment. However, only two organizations, the California Energy Commission (CEC) and Sun Refining and Marketing Company, have developed programs to make M85 commercially available. Both programs have card access systems to prevent fueling of vehicles which are not capable of operating on fuel methanol.

In 1991, there are 26 stations in California which dispense M85 as part of the California Energy Commission demonstration program. Six petroleum companies are participating in the program:

- Arco (10 stations)
- Beacon (1 station)
- Chevron (8 stations)
- Exxon (3 stations)
- Mobil (1 station)
- Shell (3 stations).

CEC plans to expand the number of stations to approximately 60 with additional participation from Exxon and Mobil. The M85 fuel available at these stations is blended in tank trucks with methanol from the California Methanol Fuel Reserve and commercial gasoline.

Approximately 100 vehicles are involved with this demonstration program. During 1992, approximately 2,400 foreign and domestic vehicles will be added to the Program, the majority of which are part of government fleets.

In 1990, Sun Refining and Marketing Company installed M85 refueling equipment at 2 locations: Dearborn, Michigan and Washington, DC. The company plans to install M85 dispensing equipment in 1991 at a third location north of Detroit. Approximately 25 Ford fuel flexible vehicles use the Dearborn station and 20 government vehicles use the Washington facility. The M85 fuel at these locations is blended and tested at the company's research facility.

SECTION 3

M85 SPECIFICATIONS

3.1 ASTM Proposed M85 Specification

In 1989 an ASTM Task Force was charged with the development of a proposed specification for Fuel Methanol for Automotive Spark-Ignition Engines. With the knowledge that such a specification would be a very dynamic document because of the developing nature of M85 technology, the committee has attempted to gain approval of the proposed specification as a document for information only. This would allow the specification to be printed while allowing time for development and refinement of analytical procedures and better basis for performance related specifications.

Table 3.1 is a summary of the current proposal as balloted to ASTM in June 1991. As a proposed specification, the document has a two-year life span.

3.2 MVMA Emissions Certification M85 Specification

The MVMA Emissions Certification M85 Specification is a blend recommended for use in emissions testing of methanol-capable vehicles (see Table 3.2):

Common methanol fuel specifications are needed to introduce a level of consistency in test fuels among vehicle manufacturers, test laboratories and fuel suppliers, and to assure repeatability of test results. Normally, certification test fuel specifications would be established after analyzing a broad based sampling of commercially available fuels. However, at this time it is not possible to evaluate a wide range of commercially available methanol fuels. Attachment II is the recommended specification for emissions certification M85 fuel, consistent with and equivalent to a blend derived from chemical grade methanol and certification grade gasoline meeting the specifications of 40 CFR 86.113-82a.

MVMA also recommends a mileage accumulation fuel for durability testing:

a blend of chemical grade methanol and mileage accumulation gasoline...and fuel additives such as anti-oxidants, corrosion inhibitors, metal deactivators and detergents be allowed by the final, more general, specifications².

3.3 CEC M85 Specification

The CEC Advisory M85 Specification is described in "M85 Fuel Survey. California 1989 (1990 Motor Vehicle Manufacturers Association of the United States Inc.)" (see Table 3.3).

TABLE 3.1 - ASTM PROPOSED M85 SPECIFICATION

PROPERTY	SPECIFICATION
Methanol+ Higher Alcohols, Vol.%, Min., GC	85
Higher Alcohols, Max Vol. %	2
Hydrocarbon, Vol. % GC	13-15 ^(A)
Vapor Pressure kPa (psi), D4953	Summer: 48-62 (7.0-9.0) ^(B) Intermediate: 62-75 (9.0-11.0) Winter: 75-90 (11.0-13.0)
Luminosity	Shall produce a luminous flame ^(C) throughout the entire burn duration.
Acidity, Wt. %, Max, D1613	0.005
Nonvolatile Matter, mg/100 mL, Max	5
Total Chloride, Wt. %, Max, D2988	0.0002
Lead Content, g/L, Max, D3237	0.002
Phosphorous Content, g/L, Max, D3231	0.0002
Appearance	The product shall be visibly free of suspended or precipitated contaminants (clear and bright). This shall be determined at indoor ambient temperatures unless otherwise agreed upon between the supplier and the purchaser.
Water, Wt. %, Max, D1744	0.5
Sulfur Content, Wt. %, Max, D3120	0.01
Distillation Residue, %, Max, D86	--
Particulate Content, g/L, Max, D2276	--

^(A) The specification does not control the composition of the hydrocarbons added to the fuel methanol. However, the hydrocarbons shall be stable, noncorrosive, and be in the boiling range of spark-ignition engine fuel as specified in D4814. No minimum aromatics content is specified because the luminosity limit controls flame visibility. The hydrocarbons may contain aliphatic ethers as blending components as are customarily used for motor fuel.

^(B) Summer class volatility shall be used in those geographical areas and times indicated for A, A/B, B/A and B volatility class fuels in Table 2 of D-4814. Intermediate class volatility shall be used in those areas and times for B/C, C/B, C, C/D and D/C volatility fuels. Winter class shall be used for those geographical areas and times indicated for D, D/E, E/D, and E volatility fuels.

^(C) In general, it has been established that unleaded gasoline having a 30 to 40 V% aromatic content when used as the hydrocarbon portion of M85 will result in an M85 fuel which will meet the key requirement of a clearly visible flame throughout most of a burn. However, the luminosity performance is dependent on the aromatic makeup of the hydrocarbon portion.