

MIL-F-53040(ME)  
14 May 1984

## MILITARY SPECIFICATION

### FUEL PREMIX, METHANOL-WATER, FOR FUEL CELL POWERPLANTS

This specification is approved for use by the USA Belvoir Research and Development Center, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This specification covers methanol-water premix fuel for use in fuel cell powerplants utilized in electric power generators at various environmental conditions (see 6.1).

#### 2. APPLICABLE DOCUMENTS

##### 2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified (see 6.2), the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

#### SPECIFICATIONS

##### FEDERAL

O-M-232 - Methanol, (Methyl-Alcohol).

##### MILITARY

MIL-D-43703 - Drums, Shipping and Storage, Molded Polyethylene.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: USA Belvoir Research and Development Center, ATTN: STRBE-DS, Fort Belvoir, VA 22060 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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STANDARDS

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-129 - Marking for Shipment and Storage.
- MIL-STD-147 - Palletized Unit Loads 40 Inch X 48 Inch Pallets, Skids, Runners or Pallet Type Base.

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein.

DEPARTMENT OF TRANSPORTATION

CODE OF FEDERAL REGULATIONS

49 CFR, Parts 100-199 - Transportation.

(The Code of Federal Regulations (CFR) and the Federal Register (FR) are for sale on a subscription basis by the Superintendent of Documents, US Government Printing Office, Washington, DC 24040. When indicated, reprints of certain regulations may be obtained from the federal agency responsible for the issuance thereof.)

(Copies of specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- D 56 - Flash Point by Tag Closed Tester.
- D 512 - Test for Chloride ion in Water.
- D 516 - Test for Sulfate ion in Water.
- D 859 - Test for Silica in Water.
- D 1068 - Test for Iron in Water.
- D 1125 - Test for Electrical Conductivity and Resistivity of Water.
- D 1179 - Test for Fluoride ion in Water.
- D 1246 - Test for Iodide and Bromide in Water.
- D 1688 - Test for Copper in Water.
- D 1888 - Test for Particulate and Dissolved Matter in Water.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103)

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## AMERICAN PUBLIC HEALTH ASSOCIATION, INC.

Standard Methods for Examination of Water and Waste Water (15th Edition).

(Application for copies should be addressed to the American Public Health Association, 1015 15th Street, NW, Washington, DC 20005).

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

### 3. REQUIREMENTS

3.1 Materials. The premix fuel shall consist completely of methanol (methyl-alcohol) and water, except as otherwise specified herein.

3.1.1 Methanol. The methanol used in the premix fuel shall be Grade AA and conform to the requirements in table I of O-M-232, and so be certified.

#### 3.1.2 Water.

3.1.2.1 Chemical properties. The water used in the premix fuel shall conform to the chemical requirements set forth in table I, and so be certified.

3.1.2.2 Electrical conductivity. The electrical conductivity shall be determined in accordance with ASTM D 1125. The maximum value shall be 500  $\mu$  S/m at 25° C (77° F), and so be certified.

3.2 Premix fuel. The methanol (see 3.1.1) and water (see 3.1.2) shall be mixed together to produce a finished premix fuel containing 58.0 percent  $\pm$  1.0 percent by weight methanol, except as otherwise specified herein.

3.2.1 Mixing container. The methanol (see 3.1.1) and the water (see 3.1.2) shall be mixed in a suitable container that shall not impart additional contaminants to the fuel premix.

3.2.2 Specific gravity. The specific gravity of the premix fuel shall be 0.8981  $\pm$  0.0020 measured at 25° C (77° F) referred to water at 25° C (77° F).

3.2.3 Flash point. The flash point of the premix fuel shall not exceed 29° C (85° F) when tested as specified in ASTM D 56.

3.2.4 Containers or drums. The finished premix fuel shall be transferred to containers or drums that meet the requirements stated in section 5 of this specification.

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3.3 Workmanship. The finished premix fuel shall be clear and visually free of suspended matter and sediment in the ambient temperature range of 20° - 25° C (68° - 77° F).

TABLE I. Chemical characteristics and test methods.WATER

Characteristics	Maximum Value (PPM) <u>1/</u>	ASTM Test Method
Bromide and Iodide	0.10	D 1246
Chloride	0.20	D 512
Fluoride	0.20	D 1179
Sulfate	1.00	D 516
Sulfide	0.50	<u>2/</u>
Copper	0.25	D 1688
Iron	0.25	D 1068
Silica	1.00	D 859
Particulate & Dissolved Matter	10.00	D 1888

1/ Parts per million equivalent to milligrams per liter.

2/ The methylene blue photometric method to be used for the determination of sulfide is found in: "Standard Methods for the Examination of Water and Waste Water", 15th Edition, p 447-448, Method No. 427 C (1980).

## 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the contractor may utilize his own facilities or any other commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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4.1.1 Certification of inspection results. The contractor is responsible for providing certification of all chemical and physical results obtained (see 3.).

4.2 Classification of inspection. The inspection requirements specified herein are classified as follows:

- a. Quality conformance inspection (see 4.3).
- b. Inspection of packaging (see 4.4).

4.3 Quality conformance inspection.

4.3.1 Lot. A lot shall consist of an indefinite quantity of methanol-water premix solution made during one production operation.

4.3.2 Sampling.

4.3.2.1 Containers. From each lot, two containers shall be selected. From one container a 3.785 L (one gallon) sample shall be taken and marked No. 1. From the other container a 3.785 L (one gallon) sample shall be taken and marked No. 2. Samples No. 1 and No. 2 shall be placed in separate, clean, dry, stoppered, glass containers.

4.3.3 Tests. Samples selected as specified in 4.3.2 shall be tested as specified in 4.3.3.1 and 4.3.3.2.

4.3.3.1 Test - sample No. 1.

- a. Specific gravity. Determine the specific gravity with a pycnometer of about 50 ml capacity or any other method accurate to the fourth decimal place. Nonconformance to 3.2.2 shall constitute failure of the test.
- b. Flash point. The flash point of each lot shall be determined by ASTM D 56 (see 3.2.3).

4.3.3.2 Test - sample No. 2.

Distillation. Separate the methanol-water mix by fractional distillation. Place 100 mL of the methanol-water mix into a 200 mL round bottom flask. Connect the round bottom flask to a fractionating column packed with stainless steel sponge. Place adapter with a thermometer and side arm connected to a condenser with a receiving flask on the fractionating column. Apply heat gradually to the 200 mL flask and distill slowly to effect efficient separation. When the temperature begins to drop sharply without applying additional heat, remove the heat source and allow to cool. The water fraction remaining in the 200 mL flask shall then be tested for conformance to table I and 3.1.2.2. Nonconformance to table I and 3.1.2.2 shall constitute failure of this test and be cause for rejection of the lot represented by this sample.

NOTE: Extreme care must be taken to insure the sample is kept in a tightly closed container before testing. The methanol-water mixture will absorb water from the air and produce erroneous results.

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**4.4 Inspection of packaging.****4.4.1 Quality conformance inspection of pack.**

4.4.1.1 Unit of product. For the purpose of inspection, a filled container shall be considered a unit of product. When containers are palletized, a single pallet load shall be considered a unit of product.

4.4.1.2 Sampling. Sampling for examination shall be in accordance with MIL-STD-105.

4.4.1.3 Examination. Samples selected in accordance with 4.4.1.2 shall be examined for the following defects. AQL shall be 2.5 percent defective.

101. Unit containers not as specified.
102. Container outage not as specified.
103. Containers not palletized in accordance with referenced documents when palletization is specified.
104. Marking not as specified.
105. Labels not as specified.

**5. PACKAGING**

5.1 Unit pack. Unless otherwise specified, the methanol-water premix shall be furnished in polyethylene drums conforming to MIL-D-43703, size 1 or size 4 as specified (see 6.2). When specified (see 6.2), the methanol-water shall be contained in government furnished containers (see 6.3). All containers must meet the applicable provisions of 49 CFR, parts 100-199 for the particular contents specified herein.

5.1.1 Outage. Containers shall not be filled to actual capacity. Allowance shall be made for a 4 percent expansion in volume when filled under ambient conditions of 20-25° C (68-77° F).

5.2 Palletization. When specified (see 6.2) unit containers (except 208 L [55 gallon] drums) shall be palletized in accordance with MIL-STD-147.

5.3 Marking (see 6.4). Marking shall be in accordance with MIL-STD-129 and 49 CFR Parts 100-199.

5.3.1 Special marking. In addition to the markings specified in 5.3, the following special markings shall also be applied. These markings shall be on labels applied to the containers with methanol-water resistant adhesive. The labels shall have a plastic overlay or be coated over the entire outer surface with a clear coating which is resistant to weather and methanol-water premix.

5.3.1.1 Warning label. This label shall be 125.0 mm by 228.6 mm (5 inches by 9 inches), have red lettering on a white background and read as follows:

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WARNING FLAMMABLE  
FLAMMABLE LIQUID FLASH POINT          F  
KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAMES  
GROUND UNIT WHEN REFUELING  
WARNING HARMFUL IF SWALLOWED  
MAY BE ABSORBED THROUGH THE SKIN, WEAR PROTECTIVE CLOTHING  
REPLACE CAP PROMPTLY AFTER FUEL TRANSFER IS COMPLETED  
IMPROPER SEAL WILL RESULT IN SIGNIFICANT ALTERATION OF THE METHANOL-WATER RATIO

5.3.1.2 Information label. This label shall be 88.9 mm by 228.6 mm (3-1/2 inches by 9 inches), have black lettering on a white background and read as follows:

METHANOL-WATER FUEL  
FOR USE ONLY WITH METHANOL FUEL CELL POWER UNIT  
DO NOT MIX WITH GASOLINE, JP-4, OR DIESEL FUEL

6. NOTES

6.1 Intended use. This fuel premix is intended for use in start up, test, and operation of fuel cell powerplants in the ambient temperature range of -54° C (-65° F) to 52° C (125° F), at any relative humidity.

6.2 Ordering data. Purchasers should select the preferred options offered herein and include the following information in procurement documents:

- a. Title, number, and date of this specification.
- b. Date of issue of DoDISS applicable and exceptions thereto (see 2.1.1).
- c. Size and type container required (see 5.1).
- d. Quantity of premix fuel required. The unit of purchase is the U.S. gallon.
- e. When certification of inspection results is required (see 4.1.1).
- f. When Government furnished containers are to be used (see 5.1).
- g. When palletization is required (see 5.2).

6.3 Government furnished property. The contracting officer should arrange to furnish the property specified in 5.1 when required (see 6.2).

6.4 Marking the degrees of protection (see 5.3). The requirements specified in section 5 for packaging of the methanol-water premix are the minimum acceptable. For the purpose of marking for shipment, the degrees of protection shall be as deemed appropriate by the contracting officer (A/A, B/B or commercial/commercial).

Custodian:  
Army - ME

Preparing activity  
Army - ME

Review activity:  
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Project 6810-AB27





## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

*(See Instructions - Reverse Side)*

1. DOCUMENT NUMBER MIL-F-53040(ME)	2. DOCUMENT TITLE Fuel Premix, Methanol-Water, for Fuel Cell Powerplants
3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION <i>(Mark one)</i> <input type="checkbox"/> VENDOR  <input type="checkbox"/> USER  <input type="checkbox"/> MANUFACTURER  <input type="checkbox"/> OTHER <i>(Specify):</i> _____
b. ADDRESS <i>(Street, City, State, ZIP Code)</i>	
5. PROBLEM AREAS	
a. Paragraph Number and Wording:	
b. Recommended Wording:	
c. Reason/Rationale for Recommendation:	
6. REMARKS	
7a. NAME OF SUBMITTER <i>(Last, First, MI) - Optional</i>	b. WORK TELEPHONE NUMBER <i>(Include Area Code) - Optional</i>
c. MAILING ADDRESS <i>(Street, City, State, ZIP Code) - Optional</i>	8. DATE OF SUBMISSION <i>(YYMMDD)</i>

**INSTRUCTIONS:** In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

**NOTE:** This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

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