MIL-P-27404B

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SUPERSEDING
MIL-P-27404A
20 May 1969

MILITARY SPECIFICATION
PROPELLANT, MONOMETHYLHYDRAZINE

This specification is mandatory for use by all departments and agencies of the Department of Defense.

1. SCOPE

1.1 This specification covers the requirement for monomethylhydrazine ($N_2H_3CH_3$) propellant.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Military

MIL-P-27401	Propellant Pressurizing Agent, Nitrogen
MIL-P-27407	Propellant Pressurizing Agent, Helium

STANDARDS

Military

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-172	Color Code for Containers of Liquid Propellants

REGULATIONS

AFR 71-4	Prepatation of Hazardous Materials for Military Air Shipment

(Copies of specifications, standards, drawings, and publications required by the suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Air Force Rocket Propulsion Laboratory (LKCP), Edwards AFB CA 93523, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 9135

2.2 Other Publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

Department of Transportation

49 CFR 170-190	Department of Transportation Rules and Regulations for the Transportation of Explosives and Other Dangerous Articles

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington DC 20402.)

American National Standards Institute (ANSI) Standards

ANSI Z129.1	The Precautionary Labeling of Hazardous Industrial Chemicals

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York NY 10018.)

American Society for Testing and Materials (ASTM)

ASTM E-29	Recommended Practices for Indicating Which Figures are to be Considered Significant in Specified Limiting Values.
ASTM D-2276	Particulate Contaminant in Aviation Turbine Fuels

(Copies of ASTM publications may be obtained upon application to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

Airline Tariff Publishing Company

6-D, C.A.B. #82	Official Air Transport Restricted Articles Tariff

(Application for copies should be addressed to the Airline Tariff Publishing Co., Dulles International Airport, P.O. Box 17415, Washington DC 20041.)

2.2.1 Technical safety and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.

3. REQUIREMENTS

3.1 Chemical and Physical Properties. The chemical and physical properties of the propellant shall conform to those listed in Table I when tested in accordance with the applicable test methods (4.5).

Table I. Chemical and Physical Properties

Properties	Limits	Test Paragraph
Monomethylhydrazine assay (percent by weight)	98.3 min	4.5.2
Water (percent by weight)	1.5 max	4.5.2
Particulate (milligrams per liter)	10 max	4.5.3

3.2 Limiting Values. The following applies to all specified limits in this specification: For purposes of determing conformance with these requirements, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last righthand place of figures used in expressing the limitation value, in accordance with the rounding-off method of the Recommended Practices for Indicating which Figures are to be Considered Significant in Specified Limiting Values (ASTM E-29).

3.3 Filter. A filter with a 10-micron nominal and 40 micron absolute rating shall be installed between the manufacturer's plant system and the container to be filled for delivery.

3.4 Qualitative. The propellant shall be a homogeneous liquid when examined visually by transmitted light.

4. QUALITY ASSURANCE PROVISION

4.1 Responsibility for Inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by 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 that supplies and services conform to prescribed requirements (6.3).

4.2 Classification of Tests. The inspection and testing of the propellant shall be classified as quality conformance tests.

4.3 Quality Conformance Tests. Quality conformance tests shall consist of:

(a) Individual tests 4.3.1

(b) Sampling tests 4.3.2

4.3.1 Individual Tests. The propellant shall be sampled to the following test described under 4.5.

Examination of product 4.5.1

4.3.2 Sampling Tests. The propellant shall be selected in accordance with 4.3.2.1 and subjected to the following tests as described under 4.5.

(a) Monomethylhydrazine assay 4.5.2

(b) Water 4.5.2

(c) Particulate 4.5.3

4.3.2.1 Sampling Plan.

4.3.2.1.1 Lot. A lot shall consist of one of the following:

(a) The propellant produced in not more than 24 consecutive hours from a continuous process which is used to fill shipping containers directly from the process output. A continuous process shall be the production of product by continuous input of raw materials and output of finished product by one manufacturer in one plant with no change in manufacturing conditions or materials.

(b) The propellant produced from individual runs of a batch process which is used to fill shipping containers directly from the process output. A batch process shall be the production of product from single additions of raw materials which are reacted and purified forming the product.

(c) The propellant from either or both the continuous and batch processes which is held in a single storage tank and subsequently withdrawn to fill shipping containers. The product shall be homogeneous at the time of withdrawal and shall not be added to while being withdrawn. After each addition to the storage tank the contents shall constitute a separate lot.

4.3.2.1.2 Sample. A sample consists of not less than 600 milliliters (ml) of propellant. Unless otherwise specified, quality conformance tests shall be made on each required sample of the propellant as it is taken directly from the shipping containers (6.3). When required, the sample shall be forwarded to a laboratory designated by the procuring activity for subjection to the quality conformance specified herein. The bottles intended for sampling shall be specially cleaned and handled in accordance with procedure described in 4.5.3.

4.3.2.1.3 Drums. The number of drums selected for sampling from each lot shall be in accordance with Table II. The propellant from each container sampled shall constitute a separate sample.

Table II. Sampling for Test

Number of containers in lot.	Number of containers to be sampled.
2-25	2
26-150	3
151-1,200	5
1,201-7,000	8

4.3.2.1.4 Portable Tanks, Cargo Tanks, and Tank Cars. Each portable tank, cargo tank, or tank car shall constitute a lot. Unless otherwise specified, the sample shall be composited into one sample when one-third portions are withdrawn from the bottom, center, and top thirds of the tank (6.3).

4.3.2.1.5 Other Containers. Unless otherwise specified, other containers of 100 gallons or less water capacity shall be sampled in accordance with 4.3.2.1.3 and other containers greater than 100 gallons water capacity shall be sampled in accordance with 4.3.2.1.4 (6.3).

4.4 Rejection. When any sample of the propellant tested in accordance with 4.5 fails to conform to the requirements specified herein, the entire lot represented by the sample shall be rejected (6.3).

4.5 Test Methods.

4.5.1 Examination of Product. The propellant shall be visually examined while performing test specified in 4.5.3 to determine compliance with the requirement specified herein. Examination to insure that the material conforms to paragraph 3.4 shall be conducted after the sample has been transferred to the 500-ml graduated cylinder.

4.5.2 MMH Assay and Water. The propellant assay and water content shall be determined by the folowing method.

4.5.2.1 Column Preparation. Weigh 5 grams of polyethylene glycol 400 and 45 grams of 60/80 mesh Fluoropak 80 into separate beakers. Dissolve the polyethylene glycol 400 in a volume of reagent grade methylene chloride which is approximately one-half the volume of the Fluoropak 80. Pour the Fluoropak 80 into the polyethylene glycol 400 solution with gentle stirring. Spread the resulting damp powder in a tray and dry the mixture in a vacuum oven at 100°C and less than 50 mm Hg for at least one hour.

Cap one end of an 1/8 inch O.D. by 6 foot stainless steel tube and fill the tube with the prepared column packing by puring through a small funnel attached to the other end. Tap or mechanically vibrate the tube to insure uniform packing. When the tube is filled, plug both ends with a small wad of glass wool, bend the column to the configuration required by the column oven, and connect the column to the inlet fitting in the oven. Condition the column with carrier gas flowing and the oven set at ≈120°C for one hour. After conditioning the column connect the other end to the detector and set the carrier gas flow to approximately 25 ml/min, and the column oven to 100°C. The inlet and detector temperatures, if separately heated, shall be set to 100°C and 150°C, respectively. The detector current should be set to a nominal sensitivity value recommended for helium by the instrument manufacturer. The column temperature and carrier gas flow may be adjusted by the analyst to provide adequate component resolution for minimum analysis time.

4.5.2.2 Analysis. Equilibrate the column with propellant by injection of two or more 5 microliter samples into the inlet. If more than 30 minutes elapse between analyses a single 5 microliter injection of propellant should reequilibrate the column. Inject 1-2 microliters of propellant for analysis and record the areas of all peaks in the chromatogram. Each analysis should require less than 15 minutes for elution of all components. The elution order of possible sample components is as follows: Air, NH_3, methylamine, water, and monomethylhydrazine.

4.5.2.3 Calculations. The following formula shall be used to calculate the percent by weight of each component appearing in the chromatogram.

$$\%C = \frac{A_c}{\Sigma Ai} \times$$

where: Ac = the measured area of a peak multiplied by its signal attentuation factor.

ΣA_1 = the sum of all of the measured areas multiplied by their respective signal attenuation factors.

%C = the weight percent of the component corresponding to Ac

Assumption: The thermal conductivities of all components in the sample are equal.

4.5.2.4 Equipment and Reagents. The following equipment and reagents shall apply as test conditions of 4.5.2.

(a) Equipment

(1) Gas chromatograph: equipped with a thermal conductivity detector.

(2) Recorder: potentiometric strip chart, 0-1 millivolt, 1 second F.S. response, with integrator (mechanical or electronic).

(3) Tubing: stainless steel, 1/8 inch O.D. x 6 feet.

(4) Hypodermic syringe: 10 microliter, fixed needle.

(5) Regulator: helium, to fit the cylinder.

(6) Standard Screens: 60 mesh and 80 mesh.

(7) Vacuum oven, capable of 100°C.

(b) Reagents

(1) Fluoropak 80, Analabs, Inc., 80 Republic Dr., North Haven, CT., 06473, or equivalent.

(2) Polyethylene glycol 400; or equivalent.

(3) Methylene chloride: ACS reagent grade.

(4) Helium gas: conforming to Mil-P-27407.

4.5.3 Particulate. The propellant sample shall be tested for contamination in accordance with ASTM D-2276, Method A, with the following exceptions.

4.5.3.1 Mix the sample thoroughly by shaking the sample container. Immediately pour 500 ml of the sample into a clean 500 ml graduated cylinder. Use this 500 ml of propellant for the particulate analysis.

4.5.3.2 Use a solvent resistant filter disc made from such materials as Millipore LSWP 04700, (Mitex-Teflon), Millipore URWP 04700, (Solvinert), or Gelman VF-6 (Fluoride-Metricel), plain white, 10 ± 3 microns, 47 mm diameter instead of the filter specified in ASTM D-2276.

4.5.3.3 The drying oven temperature shall be 158°F (70°C) instead of the 194°F (90°C) specified in Method D-2276. The oven should be placed in a fume hood or other suitable location to insure clean laboratory air.

4.5.3.4 Filtered isopropyl alcohol shall be used for rinsing the sample bottle and filter holder instead of petroleum ether specified in Method D-2276. Water should not be used.

4.6 Preparation for Delivery Inspection. The preservation, packaging, packing, and marking for shipment and storage of the propellant shall be inspected to determine compliance with the requirement of section 5 of this specification.

5. PREPARATION FOR DELIVERY

5.1 Packaging. The propellant shall be packaged in containers as specified by the procuring activity (6.3). Packaging shall comply with the requirements of the Department of Transportation (DOT) Regulations 49CFR 170-190, or an exception in accordance with 49CFT 107.101 obtained by the shipper in conjunction with the Commander, Headquarters Military Traffic Management and Terminal Service, Attn: Safety Division (TES), Washington DC 20315. Products to be shipped by military air will be in compliance with AFR 71-4. Products to be shipped by commercial air will be in compliance with the Official Air Transport Restricted Articles Tariff #6-9, C.A.B. #82.

5.1.1 Approved Drums. Drums which are approved by DOT for this propellant shall conform to DOT specifications 5, 5A, 5C, or 17E (single trip) of Types 304 or 347 stainless steel with fixed heads only and bungs not over 2.3 inches diameter.

5.1.2 Other Containers. Other containers of any type which do not presently have DOT approval shall conform to the requirements of DOT special permit.

5.2 Preparation of Containers. Prior to filling, the contractor shall establish the condition of all containers to insure that they are free from contamination and suitable for shipment and storage. Contractor owned containers shall be cleaned and repaired by the contractor at his own cost. Leased or government owned containers shall be cleaned and repaired in accordance with the schedule established in the contract or purchase order (6.3). Internal inspections on cargo tanks or tank cars used in exclusive continuous service need be made only upon initial entry into that service or at any required retest or overhaul.

5.2.1 Cleaning and Repair. Unless otherwise provided for in the contract or purchase order, any physical damage to containers which would endanger safe transportation of the propellant shall be repaired prior to reuse. If evidence of internal contamination is found, the containers shall be recleaned by a suitable method to remove the contamination (6.3).

5.2.2 Gaskets. Gaskets used to seal container openings shall be polytetrafluorethylene or other material compatible with the propellant and approved for use by the procuring activity (6.3). The contractor shall assure that all gaskets are serviceable and furnish new gaskets when necessary so that a tight seal is assured.

5.3 Filling. Containers shall not be entirely filled. Sufficient space shall be left in each container to assure that no leakage or distortion of the container occurs as specified by DOT requirements. After filling of containers, the space above the liquid level shall be filled with contractor furnished nitrogen conforming to MIL-P-27401, Type I, at not less than atmospheric pressure.

5.4 Labeling and Marking. Each container shall be marked, labeled, and placarded in accordance with MIL-STD-129 and the applicable tariff or exemption. In addition, an identification tag, precautionary label, and container color code shall be used.

5.4.1 Identification Tag. Unless otherwise specified in the contract or purchase order, an identification tag impervious to climatic conditions shall be wired to the outlet port of each container and shall contain the following information: Propellant name, specification number with revision letter, type number (if applicable), FSN number, quantity, name of manufacturer, name of contractor (if different from manufacturer), and date of manufacture (6.3).

5.4.2 Precautionary Label. A precautionary label prepared in accordance with ANSI Standard Z 129.1 shall be applied to each drum (6.6).

5.4.3 Container Color Code. Unless otherwise specified by the procuring activities, each drum shall be color coded in accordance with MIL-STD-172 (6.3). The exact name identification to be marked on the outside of the container shall be "Monomethylhydrazine". Any other name identification shall be obliterated by removing or overpainting.

6. NOTES

6.1 Intended Use. The propellant covered by this specification is intended for use as a fuel in rocket engines.

6.2 Definition.

6.2.1 Particulate. The undissolved solids retained on a 10-micron filter membrane.

6.3 Ordering Data. Procurement documents should specify the following:

(a) Title, number, and date of this specification.

(b) Method of shipment, type, and capacity of containers (5.1).

(c) Quantity by weight in pounds (avoirdupois).

(d) When inspection requirements are to be performed by other than the supplier (4.1).

(e) When disposition of rejected product has to be specified (4.4).

(f) When cleaning and repair schedule is required for leased or Government owned containers (5.2).

(g) When approval of gasket material is required (5.2.2).

(h) When identification tag is other than as specified (5.4.1).

(i) When cleaning and repair provisions are other than specified (5.2.1).

(j) When waiver on quality conformance tests on each sample is granted (4.3.2.1.2).

(k) When variation in sampling method is granted (4.3.2.1.4 and 4.3.2.1.5).

(l) When container color code is waived (5.4.3).

(m) That two copies of the test report, signed by the contractor's representative, listing values obtained on all tests (qualitative values where method provides), should accompany each shipment delivered to the consignee. In addition, one copy should be furnished the AFRPL (LKCP), Edwards, California 93523.

6.4 Highway Safety. To promote safety in the transportation of propellants in interstate commerce by motor vehicle, the shipper should assure that each driver possesses an MCA Chem-Card-Transportation Emergency Guide No. CC11. A complete manual of cards or the individual cards are available from the Manufacturing Chemists' Association, 1825 Connecticut Avenue, N.W., Washington DC 20009.

6.5 Precautionary Labels. Precautionary labels are prepared in accordance with ANSI Standard Z 129.1. For those propellants which do not have specifically prescribed labels, the principles for the preparation of the labels are used. There does not have to be exact agreement between labels from different sources as long as the intent of the manual is complied with.

6.6 Pollution Control. U.S. Public Laws dictate increased effort to improve air, land, and water pollution control of toxic propellant vapors, leaks, spills, and disposal during all phases of manufacture, transfer, storage, and transportation operations. The manufacturer/supplier is enjoined to approach the appropriate pollution control district to mutually resolve all problem areas, and to develop adequate control and disposal methods for situations which are likely to develop in any of the phases.

Custodians:

Army - MI
Navy - AS
Air Force - 12

Reviewing Activities

Air Force - 19, 68
NASA

Preparing Activity:

Air Force - 12

Civilian Agency Interest:

NASA

Project No. 9135-0085

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

OMB Approval
No 22-R255

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DOCUMENT IDENTIFIER AND TITLE
MIL-P-27404B, Propellant, Monomethylhydrazine

NAME OF ORGANIZATION AND ADDRESS

CONTRACT NUMBER

MATERIAL PROCURED UNDER A
☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1 HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?
A GIVE PARAGRAPH NUMBER AND WORDING

B RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2 COMMENTS ON ANY DOCUMENT REQUIREMENT CONSIDERED TOO RIGID

3 IS THE DOCUMENT RESTRICTIVE?
☐ YES ☐ NO *(If "Yes", in what way?)*

4 REMARKS

SUBMITTED BY *(Printed or typed name and address - Optional)*

TELEPHONE NO

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