

INCH-POUND

MIL-PRF-27404C
01 October 97
SUPERSEDING
MIL-P-27404B
22 May 1979

PERFORMANCE SPECIFICATION
PROPELLANT, MONOMETHYLHYDRAZINE

This specification is approved for use by all
Departments and Agencies of the Department of Defense

1. SCOPE

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

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in
sections 3 and 4 of this specification. This section does not include
documents in other sections of this specification or recommended for
additional information or as examples. While every effort has been made to
ensure the completeness of this list, document users are cautioned that they
must meet all specified requirements documents cited in sections 3 and 4 of
this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following
specifications form a part of this document to the extent specified herein.
Unless otherwise specified, the issues of these documents are those listed in
the issue of the Department of Defense Index of Specifications and Standards
(DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

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

(Unless otherwise indicated, copies of the above specifications, and
standards are available from the Standardization Document Order Desk, 700
Robbins Avenue, Building 4D, Philadelphia PA 19111-5094).

Beneficial comments (recommendations, additions, deletions) and any pertinent
data which may be of use in improving this document should be addressed to:
Code (68) SA-ALC/SFSP, 1014 Billy Mitchell Blvd/STE 1, Kelly AFB TX 78241-
5603, by using the standardization Document Improvement Proposal (DD Form
1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 9135

DISTRIBUTION STATEMENT A. Approved for public release; distribution is
unlimited.

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM D 2276 - Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling (DoD adopted)
- ASTM E 29 - Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (DoD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia PA 19103-1187.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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.

3.2 Limiting values. The following applies to all specified limits in this specification: For purposes of determining conformance with these requirements, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right-hand digit used in expressing the specification limit according to the rounding-off method of ASTM Practice E 29 for using Significant Digits in Test Data to Determine Conformance with Specifications.

3.3 Filter. A filter with a 10-micrometer nominal and 40-micrometer 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 colorless, homogeneous liquid when examined visually by transmitted light.

TABLE I. Chemical and physical properties.

Properties	Limits	Test Paragraph
Monomethylhydrazine (percent by weight)	98.3	4.3.2
Water (percent by weight)	1.5 max	4.3.2
Particulate (milligrams per liter)	10 max	4.3.3

4. VERIFICATION

4.1 Classification of inspections. The inspections shall be classified as quality conformance inspections.

4.2 Quality conformance inspection. Unless otherwise specified (6.2), each filled shipping container shall be considered a lot and shall be sampled. Each sample shall be subjected to the visual examination described in 4.3.1 for conformance to 3.4 and to the tests described in Table I for conformance to the requirements specified in Table I.

4.2.1 Sample. A sample consists of not less than 600 mL of propellant. Unless otherwise specified, quality conformance tests shall be made on the sample of propellant taken directly from the shipping container. When required, the sample shall be forwarded to a laboratory designated by the procuring activity for subjection to the quality conformance tests specified herein. The bottle intended for sampling shall be specially cleaned and handled according to the procedure described in 4.3.3

4.2.2 Rejection. When any sample of the propellant tested in accordance with 4.3 fails to conform to the requirements specified herein, the entire lot represented by the sample shall be rejected.

4.3 Test methods.

4.3.1 Examination of product. The propellant shall be visually examined while performing test specified in 4.3.3 to determine compliance with the requirement as specified herein. Examination to ensure that the material conforms to 3.4 shall be conducted after the sample has been transferred to the 500 mL graduated cylinder.

4.3.2 Monomethylhydrazine assay and water. The propellant and water content of the sample shall be determined by the following method.

4.3.2.1 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 dichloromethane 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 mmHg for at least one hour. Cap one end of an 1/8 inch OD by 6 foot stainless steel tube and fill the tube with the prepared column packing by pouring through a small funnel attached to the other end. Tap or mechanically vibrate the tube to ensure uniform packing. When the tube is filled, plug both ends with small wads 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 $\approx 120^{\circ}\text{C}$ 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.

4.3.2.2 Analysis. Equilibrate the column with propellant by injection of two or more 5 μL samples into the inlet. If more than 30 minutes elapse between analysis, a single 5 μL injection of propellant should re-equilibrate the column. Inject 1 - 2 μL 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, ammonia, methylamine, water, and monomethylhydrazine.

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

$$\% C = \frac{A_c \times 100}{\sum A_i}$$

where

A_c = The measured area of a peak multiplied by its signal attenuation factor.

$\sum A_i$ = the sum of all of the measured areas multiplied by their respective signal attenuation factors.

$\%C$ = The weight percent of the component corresponding to A_c .

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

4.3.2.4 Equipment and reagents. The following equipment and reagents shall apply as test conditions of 4.3.2.

a. Equipment:

(1) Gas chromatograph - incorporating a thermal conductivity detector.

(2) Recorder - potentiometric strip chart, 0 - 1 millivolt, 1 second full scale response, with integrator.

(3) Tubing - stainless steel, 1/8 inch OD \times 6 feet.

(4) Hypodermic syringe - 10 μL , 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) Dichloromethane, ACS reagent grade.

(4) Helium gas conforming to MIL-P-27407.

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

4.3.3.1 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.

4.3.3.2 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.

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

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

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful but is not mandatory.)

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

6.2 Acquisition requirements. Acquisition documents must specify the following:

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- a. Title, number, and date of the specification.
- b. Issue of DoDISS to be cited in the solicitation, and, if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
- c. Method of shipment, type and capacity of containers.
- d. Quantity by weight.
- e. When a different sampling plan is required (4.2).
- f. Packaging requirements (see 5.1).

6.3 Part or identifying number (PIN). The PIN to be used propellant is M27404.

6.4 Subject term (key word listing).

Fuel
Monomethylhydrazine
Propellant
Rocket engine

6.5 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians
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Civil Agency Interest
NASA

(Project 9135-0143)