

INCH-POUND

MIL-PRF-62028C

26 August 1998

SUPERSEDING

MIL-PRF-62028B

30 October 1995

PERFORMANCE SPECIFICATION

HOSE, AIR DUCT: HIGH-TEMPERATURE
FLEXIBLE, REINFORCED

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

1. SCOPE

1.1 Scope. This specification covers reinforced flexible hose used for transferring heat to crew compartments and preheating engine compartments, oil pans, batteries, fuel and coolant lines, and other components to assist in starting engines under extreme cold weather conditions (see 6.1).

1.2 Classification. The hose is classified as follows (see 6.2 and 6.3).

1.2.1 Types. The types of hoses are as follows:

<u>Type</u>	<u>Working pressure</u>
I	-5 to +5 pounds per square inch (psi)
II	-5 to +16 psi

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 4720

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1.2.2 Classes. The classes of hoses are as follows:

<u>Class</u>	<u>Operating temperature range</u>
1	-65 to +300 degrees Fahrenheit (°F).
2	-65 to +450 °F.
3	-65 to +600 °F.

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 requirement documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Non-Government publications. The following document(s) 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 issue of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D380	- Rubber Hose (DoD Adopted).
ASTM D1171	- Standard Test Method for Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens) (DoD Adopted).
ASTM G21	- Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi (DoD Adopted).

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

2.3 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.

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3. REQUIREMENTS

3.1 First article. When specified (see 6.2 and 6.4), a sample shall be subjected to first article inspection in accordance with 4.1.1.

3.2 Design, materials, and manufacturing processes. The design, materials, and manufacturing process selection is the prerogative of the contractor as long as all articles submitted to the Government fully meet the operating, interface, support and ownership, and operating environment requirements specified.

3.2.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3 Operating requirements. Each hose shall provide the following functional, operational, and performance requirements as specified in 3.3.1 through 3.3.5.

3.3.1 Leakage. The hose shall not leak more than 0.02 cubic feet of air per minute (ft^3/min), per inch (in.) of inside diameter (ID), per foot (ft) length, at the maximum working pressure as specified in table I.

TABLE I. Pressure requirements.

Type	ID (in.)	Working pressure (psi)	Proof pressure (psi)	Burst pressure (psi)
I	3	-5 to 5	10	20
II	3	-5 to 16	32	64

3.3.2 Proof and burst pressures. The hose shall withstand the proof and burst pressures as specified in table I without rupturing.

3.3.3 Vacuum resistance. While curved to a radius equal to 5 times the outside diameter (OD) of the hose, the hose shall withstand a vacuum of 10 in. of mercury without the OD being reduced more than 5 percent (%), and without the ID collapsing or separating from the balance of the hose structure.

3.3.4 Flexibility. The hose shall withstand a bending of 180 degrees ($^{\circ}$) on four points spaced 90° apart, around a rigid cylinder with a diameter equal to the ID of the hose, without permanent kinking, flattening, fracture, or deformation in excess of 2%.

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3.3.5 Collapsing resistance. The hose shall withstand a load of at least 50 pounds (lb), applied in no greater than 15 seconds for at least 5 minutes, without permanent setting, distortion, or deformation in excess 5%.

3.4 Interface requirements. Each hose shall accommodate the interface requirements as specified in 3.4.1 and 3.4.2.

3.4.1 Envelope and interface dimensions. The overall envelope and interface dimensions shall be as specified on the interface drawing(s) (see 6.2).

3.4.2 Interchangeability. All hoses shall be interchangeable with parts of other manufacturers having the same military part number.

3.5 Support and ownership requirement. Unless otherwise specified (see 6.2), identification marking shall be permanent, legible, and shall include as minimum the following:

- a. Nomenclature "HOSE, AIR DUCT"
- b. Military part number.
- c. Manufacturer's brand or firm name, or CAGE number.
- d. Manufacturer's serial numbers.
- e. Date of manufacture (month and year).
- f. Contract or order number.
- g. Symbol "US".

3.6 Operating environment requirements. Each hose shall operate under the following environmental conditions as specified in 3.6.1 through 3.6.5, and with the exception of 3.6.5, shall subsequently meet the performance requirements of 3.3.1 and 3.3.2.

3.6.1 High-temperature. The hose shall function at maximum temperatures per applicable class (see 1.2.2) without becoming brittle, cracking, or breaking.

3.6.2 Low-temperature. The hose shall be capable of functioning at temperatures down to -65°F without delaminating, cracking, or breaking.

3.6.3 Vibration. The hose shall withstand a constant double amplitude vibration of 0.060 in., applied for at least 50 hours parallel to the hose axis, and for at least 50 hours perpendicular to the hose axis, with the frequency cycling between 10 and 55 cycles per second in 1 minute cycles, without delaminating, cracking, or breaking.

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3.6.4 Fungus resistance. The hose shall resist microbial attack in environments conducive to spore germination and growth (air temperature between 35 and 100°F and relative humidity between 60 and 100%).

3.6.5 Ozone resistance. The hose shall withstand at least 72 hours of exposure at $104 \pm 2^\circ\text{F}$, with a partial ozone pressure of 50 ± 5 millipascals (mPa), without cracking or breaking.

4. VERIFICATION

4.1 Classification of inspection. The inspection conditions specified herein are classified as follows:

- a. First article inspection (see 4.1.1).
- b. Conformance inspection (see 4.1.2).

4.1.1 First article inspection. First article inspection shall be performed on the first nine production-representative units of an order when a first article sample is required (see 3.1). Inspection shall include all the verifications listed in table II and shall be in the order as specified in table III.

TABLE II Verification methods.

Title	Requirement	Verification	Title	Requirement	Verification
Operating requirements	3.3	4.3.3	Support and ownership requirement	3.5	4.3.5
Leakage	3.3.1	4.3.3.1	Operating environment requirements	3.6	4.3.6
Proof & burst pressures	3.3.2	4.3.3.2	High temperature	3.6.1	4.3.6.1
Vacuum resistance	3.3.3	4.3.3.3	Low temperature	3.6.2	4.3.6.2
Flexibility	3.3.4	4.3.3.4	Vibration	3.6.3	4.3.6.3
Collapsing resistance	3.3.5	4.3.3.5	Fungus resistance	3.6.4	4.3.6.4
Interface requirements	3.4	4.3.4	Ozone resistance	3.6.5	4.3.6.5
Envelope and interface dimensions	3.4.1	4.3.4			
Interchangeability	3.4.2	4.3.4			

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TABLE III. Order of first article inspection.

Sample number	Title	Sample number	Title
1	Flexibility Collapsing resistance	5	Vibration Leakage Proof & burst pressures
2	Low temperature Leakage Proof & burst pressures	6, 7, 8	Fungus resistance Leakage Proof & burst pressures
3	High temperature Leakage Proof & burst pressures	9	Ozone resistance
4	Interface and envelope dimensions Interchangeability Support and ownership Vacuum resistance		

4.1.2 Conformance inspection. Conformance inspection shall include the verifications as specified in table II as defined in the contractual sampling plan (see 6.2 and 6.5).

4.2 Order of inspection. First article inspection sequence shall be as specified in table III. Other testing may be in any order except that the environmental requirements verifications (see 4.3.6) shall precede the leakage (see 4.3.3.1) and the proof and burst pressure (see 4.3.3.2) tests.

4.3 Verification methods. The types of verification methods included in this section are visual, inspection, measurement, sample tests, full-scale demonstration tests, simulation, modeling, engineering evaluation, component properties analysis, and similarity to previously approved or previously qualified designs.

4.3.1 Verification alternatives. The manufacturer may propose alternative test methods, techniques, or equipment, including the application of statistical process control, tool control, or cost-effective sampling procedures, to verify performance. See the contract for alternatives that replace verifications required by this specification.

4.3.2 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be conducted under the following conditions:

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- a. Air temperature: $77 \pm 10^{\circ}\text{F}$
- b. Barometric pressure: 28.5 (+2,-3) in. mercury.
- c. Relative humidity: $50 \pm 30\%$.

4.3.3 Operating requirements verifications. Complete each verification under 4.3.3.

4.3.3.1 Leakage. A 3 in. hose shall be pressurized with air to the maximum working pressure as specified in table I for a period of 1 minute. The leakage rate shall not exceed $0.02 \text{ ft}^3/\text{min}$, per in. of inside diameter (ID), per ft length.

4.3.3.2 Proof and burst pressures. The hose shall be tested in accordance with ASTM D380 at the proof and burst pressures as specified in table I. The hose shall not rupture during testing.

4.3.3.3 Vacuum resistance. A 36 in. length of hose shall be assembled with end couplings. One end shall be closed in such a manner as to prevent leakage of air, and the other end shall be connected to a vacuum pump. The hose shall then be subjected to a vacuum of 10 in. of mercury while curved to a radius equal to 5 times the OD of the hose for a period of 5 minutes. Subsequent to testing, the OD of the hose shall not have been reduced by more than 5%, and the ID shall neither have collapsed nor have been separated from the balance of the hose structure.

4.3.3.4 Flexibility. The hose shall be marked at four points spaced 90° apart around the external perimeter. The hose shall then be bent successively on each of the four marked points at 180° around a rigid cylinder with a diameter equal to the ID of the hose. Subsequent to testing, there shall be no evidence of permanent kinking, flattening, fracturing, or deformation in excess of 2%.

4.3.3.5 Collapsing resistance. A 6 in. longitudinal section of a 36 in. test specimen shall be subjected to a load of 50 lb applied in 15 seconds for a period of 5 minutes. When the load is removed, there shall be no evidence of permanent setting, distortion, or deformation in excess of 5%.

4.3.4 Interface requirements verification. Use one or more of the methods outlined in 4.3.1 to verify that the envelope and interface dimensions are in accordance with applicable drawings (see 6.2), and that interchangeability between different assemblies having the same military part number is assured.

4.3.5 Support and ownership requirements verification. Unless otherwise specified (see 6.2), visually verify that the hose is permanently and legibly marked with the following information:

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- a. Nomenclature "HOSE, AIR DUCT"
- b. Military part number.
- c. Manufacturer's brand or firm name, or CAGE number.
- d. Manufacturer's serial numbers.
- e. Date of manufacture (month and year).
- f. Contract or order number.
- g. Symbol "US".

4.3.6 Operating environment requirements verification. Complete each verification under 4.3.6.

4.3.6.1 High-temperature resistance. The hose shall be subjected to an internal flow of air at the maximum temperature per applicable class (see 1.2.2). The air flow shall be maintained for a period of 72 hours with the ambient temperature at room temperature. Subsequent to testing, there shall be no evidence of brittle material, cracks, or breaks.

4.3.6.2 Low-temperature resistance. The hose shall be tested in accordance with ASTM D380 at -65°F. Subsequent to testing, there shall be no evidence of delamination, cracks, or breaks.

4.3.6.3 Vibration resistance. The hose shall be vibrated with a constant applied double amplitude of 0.060 in., with the frequency cycling between 10 and 55 cycles per second, in 1 minute cycles. The vibration shall be parallel to the hose axis for 50 hours, and then perpendicular to the hose axis for another 50 hours. Subsequent to testing, there shall be no evidence of delamination, cracks, or breaks.

4.3.6.4 Fungus resistance. The hose shall be tested in accordance with ASTM G21 and shall show no evidence of fungal growth. For first article testing, sample number 6 shall be tested for 30 days, number 7 for 60 days, and number 8 for 90 days. At the completion of the 90 day test, sample number 8 shall be subjected to and pass the tests as specified in 4.3.3.1 and 4.3.3.2.

4.3.6.5 Ozone resistance. The hose shall be subjected to the applicable test as specified in ASTM D1171. Subsequent to testing, there shall be no evidence of cracks or breaks.

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 material 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

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packaging activity within the Military Department of 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.)

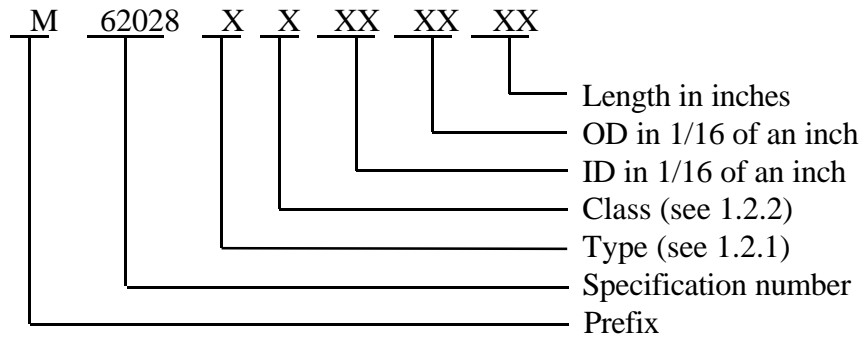
6.1 Intended use. The hose covered by this specification is intended for use in heat-transfer applications in military vehicles. The hoses covered by this specification are military unique because they must be able to operate satisfactorily at ambient temperatures ranging from -65°F to +600°F. Commercial components are not designed to withstand such extreme environmental conditions and would experience failure.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type and class of the hose required (see 1.2).
- c. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2).
- d. If first article inspection is required (see 3.1 and 6.4).
- e. Specification of interface drawing(s) (see 3.4.1 and 4.3.4).
- f. If identification marking is other than as specified (see 3.5 and 4.3.5).
- g. Specification of contractual sampling plan (see 4.1.2 and 6.5).
- h. If inspection conditions are other than as specified (see 4.3.2).
- i. Packaging requirements (see 5.1).
- j. Part or identifying number (see 6.3).

6.3 Part or Identifying Number (PIN). The PINs to be used for hoses acquired to this specification are created as follows:

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Example: M6202823010572

Signifies: Type II, class 3, 1/16 in. ID, 5/16 in. OD, 72 in. in length.

6.4 First article. When requiring a first article inspection, contracting documents should provide specific guidance to offerors. This guidance should cover whether the first article is a first article sample, a first production item, or the number of test items. These documents should also include specific instructions regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Pre-solicitation documents should provide Government waiver rights for samples for first article inspection to bidders offering a previously acquired or tested product. Bidders offering such products who wish to rely on such production testing must furnish evidence with the bid that prior Government approval is appropriate for the pending contract.

6.5 Conformance inspection. Affordable conformance inspection with confidence varies depending upon a number of procurement risk factors. Some of these factors include: Contractor past performance, government schedules and budget, product material and design maturity, manufacturing capital equipment and processes applied, the controlled uniformity of those processes applied, labor skill and training, and the uniformity of measuring processes and techniques. During the solicitation, contracting documents should indicate those tests desired from table II and their designated frequency based on a risk assessment for the procurement.

6.6 Subject term (key word) listing.

Crew compartments
 Engine compartments
 Heat transfer
 Preheating

6.7 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.

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Custodians:
Army - AT
DLA - CC

Preparing Activity:
Army - AT

(Project 4720-0215)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of 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.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-PRF-62028C

2. DOCUMENT DATE (YYMMDD)
980826

3. DOCUMENT TITLE

Hose, Air Duct: High Temperature, Flexible, Reinforced

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)
(1) Commercial
(2) AUTOVON
(If applicable)

7. DATE SUBMITTED
(YYMMDD)

8. PREPARING ACTIVITY

a. NAME

b. TELEPHONE (Include Area Code)
(1) Commercial
(810) 574-8745

(2) AUTOVON
786-8745

c. ADDRESS (Include Zip Code)

Commander
U.S. Army Tank-automotive and Armaments Command
ATTN: AMSTA-TR-E/BUE
Warren, MI 48397-5000

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:
Defense Quality and Standardization Office
5203 Leesburg Pike, Suite 1403
Falls Church, VA 22041-3466
Telephone (703) 756-2340 AUTOVON 289-2340