

MIL-F-8789C

1 December 1981

SUPERSEDING

MIL-F-8789B(USAF)

20 May 1964

MILITARY SPECIFICATION

FITTING END, ATTACHABLE HYDRAULIC HIGH-PRESSURE HOSE

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

1. SCOPE.

1.1 Scope. This specification covers high-pressure hydraulic and pneumatic hose attachable fitting ends (see 6.1).

1.2 Classification. The attachable end fittings are of the types to be used with hose conforming to MIL-H-8788, for fabricating hose assemblies for use in hydraulic and pneumatic system flexible lines with operating pressures of 3,000 pounds per square inch (PSI) maximum and shall be of the sizes and types specified on MS28760, MS28761, MS28780, and MS28781 (see 6.2).

2. GOVERNMENT DOCUMENTS.

2.1 Government Documents.

2.1.1 SPECIFICATIONS, STANDARDS AND HANDBOOKS

Federal Specifications

* QQ-A-225/6D	Aluminum Alloy Bar, Rod and Wire, Rolled, Drawn, or Cold Finished, 2024
QQ-A-225/9D	Aluminum Alloy Bar, Rod, Wire, And Special Shapes, Rolled, Drawn, or Cold Finished, 7075.
QQ-A-367	Aluminum Alloy Forgings
QQ-S-624	Steel Bar, Alloy, Hot Rolled and Cold Finished, (General Purpose)
QQ-S-633	Steel Bars, Carbon, Cold Finished and Hot Rolled (General Purpose)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: HQ AFLC CASO/LODS, Federal Center, Battle Creek MI 49016 by using the self-addressed Standardization Document Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 4730

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Federal Specifications (Cont)

MMM-A-260 Adhesive, Water-Resistant, (For Sealing Waterproofed Paper).

Military Specifications

* MIL-P-775 Hose, Rubber, Plastic, Fabric, or Metal (Including Tubing); and Fittings, Nozzles and Strainers, Packaging of

MIL-S-862 Steel Bar, Corrosion Resisting, and Steel Billets, Corrosion Resisting, Reforging Application.

MIL-F-5509 Fitting, Flared Tube, Fluid Connection

MIL-H-5606 Hydraulic Fluid, Petroleum Base; Aircraft, Missile, and Ordnance

MIL-H-6049 Steel, Chrome-nickel-molybdenum (8740) - Bar, Rod, and Forging Stock (for Aircraft Applications)

MIL-S-6050 Steel, Chrome-nickel-molybdenum (8630) Bar, Rod, and Forging Stock (for Aircraft Applications)

MIL-L-6082 Lubricating Oil, Aircraft Reciprocating Engine (Piston)

MIL-S-6758 Steel, Chrome-molybdenum (4130) Bars and Reforging Stock (Aircraft Quality)

MIL-H-8788 Hose, Hydraulic, High Pressure

MIL-F-18280 Fitting, Flareless Tube, Fluid Connection

Federal Standards

FED-STD-601 Rubber, Sampling and Testing

Military Standards

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-129 Marking for Shipment and Storage

* MIL-STD-453 Inspection, Radiographic

MS28760 Fitting End, Attachable, Hydraulic and Pneumatic High Pressure Hose (3,000 PSI), Flared Tube

Military Standards (Cont)

MS28761	Fitting End, Attachable, Hydraulic and Pneumatic High Pressure Hose (3,000 PSI), Flareless Tube
MS28780	Elbow, 45 Flared Tube to Hose, Attachable, Hydraulic (3,000 PSI)
MS28781	Elbow, 90 Flared Tube to Hose, Attachable, Hydraulic (3,000 PSI)
MS33514	Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal (ASG)
MS33656	Fitting End, Standard Dimensions for Flared Tube Connection and Gasket Seal

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

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

NATIONAL AEROSPACE STANDARDS COMMITTEE

* NAS 1760 Fitting End Flareless Acorn, Standard Dimensions for

(Application for copies of the above publication should be addressed to the Aerospace Industries Association of America, Inc. 1725 De Sales Street, N.W., Washington, D.C. 20036)

3. REQUIREMENTS.

3.1 Qualification. Items furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4. and 6).

3.2 Data. Unless otherwise specified in the contract or order, no data (other than reports and drawings accompanying qualification samples) are required by this specification or any of the documents referenced in section 2 herein (see 6.2).

3.3 General provisions.

3.3.1 Fittings shall be suitable for use with hose conforming to MIL-H-8788 to form flexible assemblies for use in hydraulic systems with operating pressure of 3,000 psi maximum.

3.3.2 Fittings shall conform to the applicable requirements of MIL-F-5509 for flared fittings or MIL-F-18280 for flareless fittings. When the requirements

of MIL-F-5509 or MIL-F-18280 and this specification conflict, this specification shall govern.

3.3.3 Material certification. Certificates showing conformance with the applicable material specification shall be available to the procuring activity.

3.2 Material. Hose and end fitting components shall conform to one of the following materials:

(a) Nipples and nuts, steel:

- MIL-S-6758
- MIL-S-6050
- QQ-S-633 (C1137, C1141 only)
- QQ-S-624
- MIL-S-6049

(b) Bodies, aluminum:

- QQ-A-225/6D Temper T6 or T851
- QQ-A-225/9D Temper T73
- QQ-A-367 (7049) Temper T73, T6 or T851

(c) Lock rings (when used), steel:

- MIL-S-862, class 7

3.2 Design and construction. The design and dimensions shall fall within the envelope limits shown on MS28760, MS28761, MS28780, and MS28781.

3.4 Finish. End Fittings shall be finished in accordance with the applicable standards and drawings listed in section 2 and MIL-F-5509 and MIL-F-18280.

3.4.1 Brazing. Fittings requiring brazing operations shall be brazed as specified on the applicable MS drawing. The requirements of paragraphs titled "Detailed Data" and "Retention of Radiographs" of MIL-STD-453 shall not apply to brazed steel parts.

3.5 Performance. When assembled with the specified hose, fittings shall satisfy the performance requirements specified in section 4 when subjected to the following tests:

- (a) Proof pressure (4.7.1)
- (b) Leakage (4.7.2)
- (c) Burst pressure (4.7.3)
- (d) Coupling (4.7.4)
- (e) Hydraulic fluid impulse (4.7.5)
- (f) Overtightening torque (4.7.6)
- (g) Cold temperature (4.7.7)

3.6 Identification of product.

3.6.1 Each end fitting assembly shall be identified as specified on the applicable MS standard.

3.6.1.1 Swivel nuts and fittings nipples shall be color marked in accordance with MIL-F-5509 for flared fittings and MIL-F-18280 for flareless fittings.

3.6.2 Use of MS or MIL designations. MS or MIL designations shall not be applied to a product, except for qualification test samples, nor referred to in correspondence or sales matter until notification has been received from the activity responsible for qualification that the product has been granted qualification approval.

3.7 Workmanship. Workmanship shall conform to MIL-F-5509 for flared fittings and MIL-F-18280 for flareless fittings.

4. QUALITY ASSURANCE PROVISIONS.

*4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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 supplies and services conform to prescribed requirements.

4.2 Lot. A lot shall consist of all hose end fittings of one type and size made from the same batch of material and submitted for inspection at the same time and place.

4.3 Classification of inspections. The inspection and testing of hose end fittings shall be classified as follows:

- (a) Qualification inspections(4.4)
- (b) Quality conformance inspection (4.5)

4.4 Qualification Inspection

4.4.1 Test samples. Qualification test samples shall consist of sufficient hose end fittings to permit fabrication to 10 assemblies of each size from each manufacturer's hose qualified in accordance with MIL-H-8788. Samples shall be identified as required, and forwarded to the activity responsible for qualification, designated in the letter of authorization from that activity.

4.4.2 Tests. Qualification tests of fittings shall consist of all the tests of this specification. The qualification tests shall be made on each size of fitting with all makes of hose conforming to MIL-H-8788 and of the same size as listed in QPL-8788.

4.5 Quality conformance inspection. The quality conformance inspection shall consist of examinations (4.5.1) and sampling tests (4.5.2).

4.5.1 Examinations.

4.5.1.1 Examination of product. All hose end fittings shall be visually examined to determine conformance with this specification with respect to workmanship, marking, and finish.

4.5.1.2 Examination of preparation for delivery. Preparation for delivery shall be examined for conformance to section 5.

4.5.2 Sampling tests. A sample shall be selected from each lot in accordance with MIL-STD-105, inspection Level I, with a minimum sample of 10 fitting ends for the following tests. Samples shall conform to the requirements specified for examination of product (4.5.1.1) and shall conform to the dimensions and tolerances specified on the applicable MS standards and to the manufacturer's detail drawings of the design upon which qualification test approval was based.

- (a) Coupling.(4.7.4)
- (b) Proof pressure.(4.7.1)
- (c) Leakage(4.7.2)
- (d) Overtightening torque(4.7.6)
- (e) Cold temperature.(4.7.7)

*4.5.3 Rejection and retest. The failure of any sample to conform to the tests specified in 4.5.2 shall be cause for rejection of the lot. Once a lot (or part of a lot) has been rejected by the procuring activity (Government or commercial) before it can be resubmitted for tests, full particulars concerning the cause of previous rejection and the action taken to correct the defects in the lot shall be furnished (in writing) by the contractor.

4.6 Test conditions.

4.6.1 Preparation of specimens. Test samples shall be assembled with samples of all hose of applicable size conforming to MIL-H-8788, and each test shall be conducted on assemblies fabricated from each type of approved hose. For qualification tests, sufficient hose end fittings shall be supplied to the activity responsible for qualification to permit the fabrication of 10 assemblies of each size from each manufacturer's hose qualified in accordance with MIL-H-8788. Lengths shall be as shown in Table I.

Table I. Performance Characteristics

Hose size No.	Proof pressure psi (min)	Burst pressure psi (min)	Operating pressure psi	Bend radius inside inch (min)	Free length of hose between fittings
-4	8,000	16,000	3,000	3	12
-5	7,000	14,000	3,000	3 3/8	13 1/2
-6	7,000	14,000	3,000	5	19
-8	7,000	14,000	3,000	5 3/4	21 1/2
-10	6,000	12,000	3,000	6 1/2	25
-12	6,000	12,000	3,000	7 3/4	29
-16	5,000	10,000	3,000	9 5/8	16

4.6.2 Oil aging. In all oil aging tests in which hydraulic fluid conforming to MIL-H-5606 is specified, the fluid and hose samples shall be put into a non-pressurized closed-type container or a reflux-type condenser to prevent distillation of the volatile matter in the fluid. A batch of fluid shall not be used for more than 10 aging test. In each case, the volume of fluid used shall be sufficient to completely cover the hose. The hose shall be immersed in hydraulic fluid 7 days at a temperature of 158° ±2° F. All air must be excluded from the bore of the tube during this aging process. Oil-aged specimens shall be used in conducting the applicable tests, 4.7.1, 4.7.4, 4.7.5, and 4.7.7.

4.6.3 Air aging. Air aged samples shall be kept in air at a temperature of $158^{\circ} \pm 2^{\circ} \text{F}$ for 7 days.

4.6.4 Test fluid. Unless otherwise specified, the test fluid shall be lubricating oil conforming to MIL-L-6082, Grade 1100, or hydraulic fluid conforming to MIL-H-5606.

4.7 Test methods.

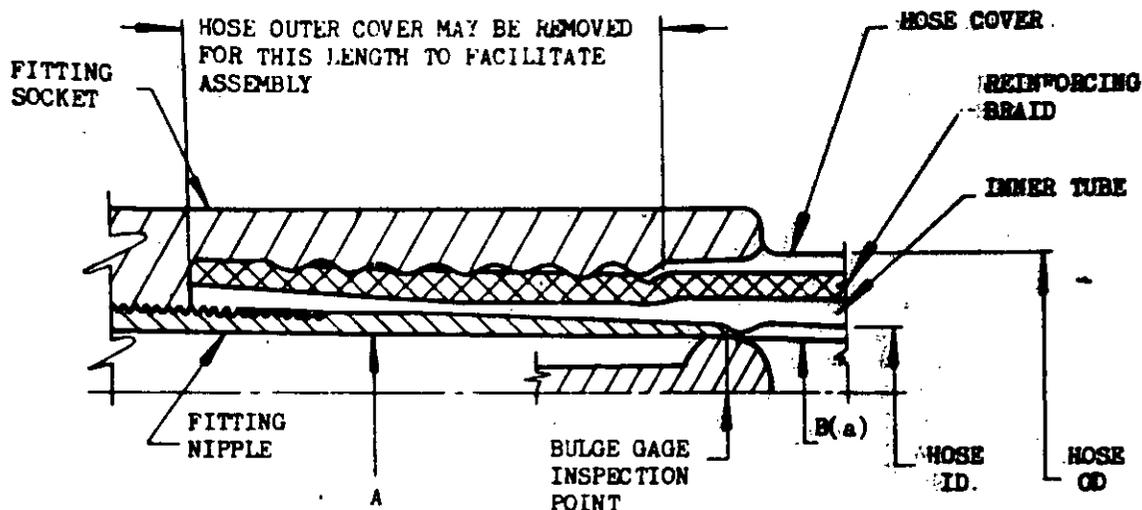
4.7.1 Proof pressure. All assemblies shall be subjected to the hydraulic proof pressure specified in Table I for a period of not less than 30 seconds nor more than 5 minutes, and there shall be no leakage or damage to the hose or end fittings. The air-and oil-aged samples prepared for the test specified in 4.7.5 shall be subjected to the hydraulic proof pressure test before and after aging.

4.7.2 Leakage. Two unaged assemblies shall be subjected to 70 percent of the hydraulic burst pressure specified in Table I for 5 minutes. Test fluid shall be water or hydraulic fluid conforming to MIL-H-5606. The pressure shall then be reduced to zero, after which it shall be raised to 70 percent of the specified burst pressure for a final 5 minute check. The fitting ends shall be carefully checked during this period, and there shall be no evidence of leakage through the fittings, no fitting movement, or other fitting malfunction. After completion of the test on these samples, they shall be subjected to the test specified in 4.7.3 and these pressures recorded.

*4.7.3 Burst pressure. Two unaged assemblies shall be subjected to the hydraulic burst pressure specified in Table I within 24 hours after assembly of the end fittings to the hose. Test fluid shall be water or hydraulic fluid conforming to MIL-H-5606. The end fittings shall not leak, burst, or blow off the hose at any pressure less than the burst pressure of Table I. The burst pressure test shall be conducted in accordance with Method 10511 of FED-STD-601, except that pressure shall be applied at the rate of 25,000 +0, -10,000 psi per minute. During this test, one end of the test assembly shall be free.

4.7.4 Coupling. All samples prepared for test specified in 4.7.5 shall be checked for bulging of inner tube and reduction of fitting nipple ID caused by the attachment of the end fitting. The measurement shall be taken on aged assemblies with a ball-end-type gage. The diameter of the ball shall be 0.001 +0, -0.001 inch under minimum bulge diameter specified in Figure 1. The weight of such gage in ounces shall be equal to the dash number of the size hose for which designed. In taking the measurement, the gage shall be placed inside the end of the hose assembly at bulge gage inspection point shown on Figure 1, without lubrication and without pushing it through. The gage shall fall through the section at the end of the fitting insert in the hose under its own weight.

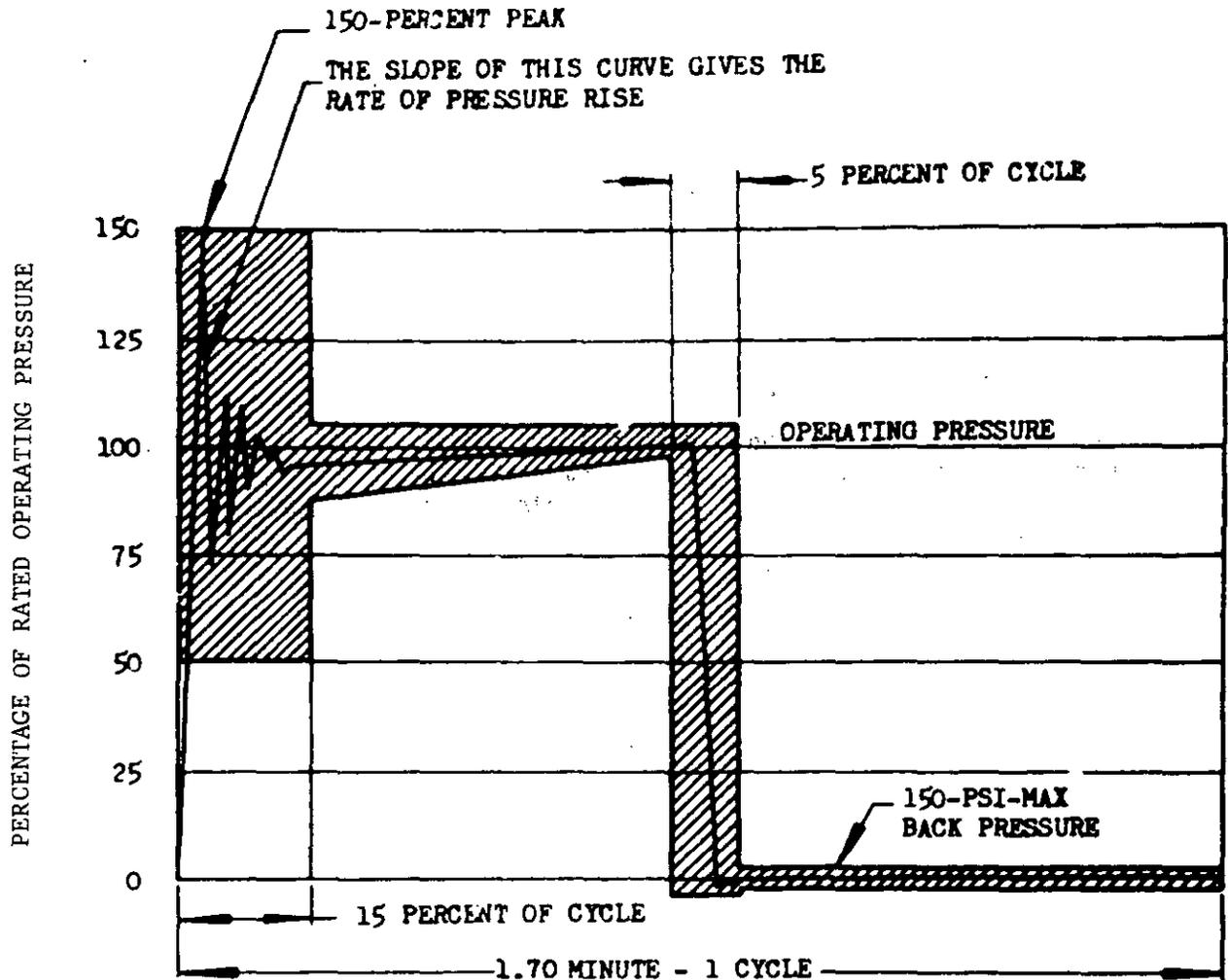
4.7.5 Hydraulic fluid impulse. For qualification tests, four hose assemblies of lengths specified in Table I shall be subjected to the impulse cycles specified in Table II. Two of these samples shall be air aged and two shall be oil aged. All assemblies shall be subjected to the applicable proof pressure specified in Table I prior to impulsing. These assemblies shall be connected to manifolds installed in a testing machine which will produce dynamic pressure impulses in the inlet manifold of the magnitudes, frequency, and number of cycles as shown by the graph on Figure 2. Electronic measuring devices shall be used to measure and indicate the impulse pressures.



FITTING SIZE	A DIA (MIN)	B(a) DIA (MIN)
- 4	.146	.146
- 5	.177	.177
- 6	.271	.271
- 8	.365	.365
-10	.455	.455
-12	.568	.568
-16	.778	.778

(a) B DIA INDICATES BOTH THE MIN PERMISSIBLE BULGE DIAMETER OF THE INNER TUBE AND THE MINIMUM NIPPLE ID OF THE FITTING, WHEN THE FITTING IS ASSEMBLED WITH THE HOSE.

FIGURE 1. Minimum bulge of hose inner tube when fittings are assembled with hose conforming to MIL-H-8788



THE CURVE SHOWN ABOVE IS THE APPROXIMATE PRESSURE-TIME CYCLE DETERMINED TO BE OF PROPER SEVERITY FOR IMPULSE TESTING OF HYDRAULIC HOSE. ALTHOUGH IT IS MANDATORY ONLY THAT PRESSURE PEAK RISES TO 150 PERCENT OF THE OPERATING PRESSURE AT SOME POINT PRIOR TO LEVELING OFF AT RATED PRESSURE, IT IS CONSIDERED HIGHLY DESIRABLE THAT THE PRESSURE-TIME CURVE BE CONFINED TO THE SHADED AREA INDICATED. ONE VERY DESIRABLE BENEFIT TO BE GAINED IN THIS MANNER IS THAT RESULTS OF TESTS PERFORMED ON DIFFERENT TEST MACHINES WILL BE MORE NEARLY COMPARABLE.

FIGURE 2. *Dynamic pressure impulses*

When under impulse, the hose shall be bent to a "U" shape with a bend radius as specified in Table I, and both ends connected to a rigid support with the exception of the -16 size which shall be tested without surge peaks in a straight position with one end free. The test fluid shall conform to MIL-H-5606, except that up to 25 percent of oil conforming to MIL-L-6082 may be added to the test fluid, and shall be held at a temperature of $120^{\circ} \pm 20^{\circ}$ F measured in the manifold. Leakage, burst, or coupling blowoff shall be evidence of failure. The minimum impulse cycles shall be as specified in Table II.

Table II. Impulse Cycles

Size	Minimum impulse cycles	Minimum average impulse cycles ¹	Maximum impulse cycles that can be used to compute average ²
4-----	100,000	-----	-----
5-----	100,000	-----	-----
6-----	100,000	-----	-----
8-----	75,000	100,000	150,000
10-----	50,000	75,000	100,000
12-----	35,000	50,000	70,000
16-----	45,000	55,000	75,000

¹Average of four test assemblies.

²When test assemblies impulse cycles are averaged, the maximum cycles that can be used to compute the average shall not exceed the figures given in this column.

4.7.6 Overtightening torque. The flared type end fittings of an assembly shall be subjected to the following test by assembling on a fitting end of steel construction in accordance with MS33656. The fitting shall be lubricated with oil conforming to MIL-L-6082, or hydraulic fluid conforming to MIL-H-5606 prior to this test. The fitting shall be tightened to the appropriate overtightening-torque value listed below for each size and loosened. This sequence shall be repeated 15 times. After this sequence, there shall be no evidence of failure or deformation of the fitting assembly, and the swivel nut shall be free enough to permit turning on the nipple by hand. Overtightening torque shall also be applied to an assembly having the flareless type end fitting by assembling on a fitting end of steel construction in accordance with MS33514 or NAS1760. Lubrication test sequence and conditions for the flareless fittings are the same as mentioned above for the flared-type fittings. Overtightening torque of the flareless fitting will be accomplished by first tightening the nut, finger tight, to the fitting and then turning the nut an additional one-half turn.

Size	Overtightening Torque (in-lb)
-4160
-5240
-6300
-8560
-10700
-121,000
-161,550

4.7.7 Cold temperature. Two assemblies of adequate lengths shall be used. One assembly shall be oil-aged and the other shall be unaged. Both samples shall be filled with hydraulic fluid conforming to MIL-H-5606 and shall be placed in a cold chamber, the temperature of which can be controlled within $-65^{\circ} + 2^{\circ}$ F and allowed to remain for 24 hours. The assembly shall be proof tested after removal from the cold chamber, and any leakage at the end fitting shall be evidence of failure of the end fitting. The -16 size may be tested at -40° F in lieu of -65° F.

5. PACKAGING.

5.1 Preservation and packaging.

*5.1.1 Preservation and packaging shall be Level A or C, as specified (6.2), in accordance with MIL-P-775.

*5.2 Packing.

*5.2.1 Packing shall be Level A, B, or C, as specified (6.2), in accordance with MIL-P-775.

5.3 Marking of shipments. Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES.

6.1 Intended use. The fitting ends covered by this specification are intended for use on hose conforming to MIL-H-8788, to fabricate flexible hose assemblies for use in hydraulic flexible lines. Fittings covered by this specification may be procured by the Government for fabrication of high-pressure hose assemblies. These fittings are not intended to be reused.

6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Sizes (see 1.2).
- (c) Data requirements (see 3.2).
- (d) Levels of preservation, packaging, and packing (see 5.1 and 5.2).

6.3. Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractors is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the San Antonio Air Materiel Area Service Engineering, ATTN: MMIR Kelly AFB, Texas 78241, and information pertaining to qualification of products may be obtained from that activity.

*6.4 Reclaimed materials. The use of reclaimed materials shall be encouraged to the maximum extent possible.

6.5 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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Air Force - 99

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C. REASON FOR RECOMMENDED CHANGE(S)

2. REMARKS

SUBMITTED BY (Printed or typed name and address — Optional)

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DATE

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