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 SUPERSEDING
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MILITARY SPECIFICATION

FITTINGS, TANK, POWERPLANT FLUID, REMOVABLE, GENERAL SPECIFICATION FOR

1. SCOPE

1.1 Scope. This specification covers general requirement for fittings to be used on or with removable powerplant fluid tanks, internal and external, to make a complete fitting installation.

1.2 Classification. The fittings shall be of the following general types, classes, and styles, to be furnished as specified by the procuring activity.

Type I-Suitable for use with powerplant fluids as specified in 3.4.

Type II-Suitable for use with powerplant fluids as specified in 3.4.

Class A-Fully molded fittings of which all nonmetallic parts are of molded synthetic rubber. These fittings are for use with self-sealing and non-self-sealing cells.

Class B-Fabric flange fittings employing a molded synthetic rubber or synthetic rubber and fabric sealing surface and rubberized fabric flanges. These fittings are for use with non-self-sealing cells.

Class C-Metallic fittings including all tank fittings fabricated from metal; and attached to the fluid cell by bolts, screws, cement, or a molding process; and using "O" rings or gaskets to accomplish a seal. These fittings are for use with self-sealing and non-self-sealing cells.

Style 1-Fittings suitable for installation by the service field activities.

Style 2-Fittings suitable for installation by tank manufacturers.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids, form a part of this specification:

SPECIFICATIONS

FEDERAL

VV-M-561-Gasoline, Automotive/Motor Fuel M
 NN-P-515-Plywood, Container Grade
 PPP-B-566-Boxes, Folding, Paperboard
 PPP-B-585-Boxes, Wood, Wirebound
 PPP-B-591-Boxes, Fiberboard, Wood-Cleated
 PPP-B-601-Boxes, Wood, Cleated-Plywood
 PPP-B-621-Boxes, Wood, Nailed and Lock-Corner
 PPP-B-636-Boxes, Fiber
 PPP-B-676-Boxes, Set-Up, Paperboard

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JAN-P-100-Packaging and Packing for Overseas Shipment-General Specification
 MIL-P-116-Preservation, Methods of
 MIL-B-121-Barrier Material, Grease-proofed, Flexible (Waterproofed)
 MIL-B-130-Barrier-Material, Paper, Noncorrosive
 MIL-B-138-Boxes, Wood, Fiberboard-Lined for Overseas Shipment (for Weight of Contents not Exceeding 500 Pounds)
 MIL-A-148-Aluminum Foil
 MIL-G-3056-Gasoline, Automotive, Combat
 MIL-S-3136-Standard Test Fluids, Hydrocarbon and Iso-Octane
 MIL-P-4185-Paper, Tissue, Wrapping
 MIL-B-4229-Boxes; Paperboard, Metal-Stayed
 MIL-D-5028-Drawings and Data Lists: Preparation of Manufacturers

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MILITARY-Continued

MIL-J-5624 Jet Fuel, Grades JP-3, JP-4, and JP-5.
 MIL-G-5572-Gasoline, Aviation: Grades 80/87, 91/96
 MIL-O-6081-Oil, Lubrication, Jet Engine
 MIL-L-6082 Lubricating Oil, Aircraft Reciprocating (piston) Engine
 MIL-A-6091-Alcohol; Ethyl, Specially Denatured, Aircraft
 MIL-C-6529-Corrosion-Preventive Compound, Aircraft Engine
 MIL-S-7742-Screw Threads, Standard, Aeronautical
 MIL-N-8056-Nuts, Self-Locking, Free spinning, 1200° F
 MIL-T-9107-Test Reports, Preparation of
 MIL-B-10377-Box, Wood, Cleated, Veneer, Paper Overlaid
 MIL-L-10547-Liners, Case, Waterproof
 MIL-N-25027-Nuts, Self-Locking, 250° F, 550° F, and 800° F

STANDARDS

FEDERAL

FED. TEST METHOD STD. NO.
 601-Rubber, Sampling and Testing.

MILITARY

MIL-STD-10-Surface Roughness Waviness and Lay
 MIL-STD-105-Sampling Procedures and Tables for Inspection by Attributes
 MIL-STD-Marking for Shipment and Storage
 MIL-STD-130-Identification Marking of US Military Property
 MIL-STD-276-Impregnation of Porous Nonferrous Metal Castings
 MIL-STD-801-Acceptance Standards for Powerplant Fluid Tank Fittings

See Supplement 1 for list of applicable Military Standards.

PUBLICATIONS

Air FORCE-NAVY AERONAUTICAL BULLETINS
 No. 143-Specifications and Standards; Use of

No. 405-Storage Life-Aeronautical Articles

(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 documents form a part of this specification. Unless otherwise indicated, the issue in effect on data of invitation for bids shall apply.

AMERICAN SOCIETY FOR TESTING MATERIALS
STANDARD DESIGNATIONS

ASTM D429-55T-Tentative Methods of Test for Adhesion of Vulcanized Rubber to Metal

ASTM D1149-55T-Tentative Method of Test for Accelerated Ozone Cracking of Vulcanized Rubber

(Applications for copies should be addressed to the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pennsylvania.)

3. REQUIREMENTS

3.1 Preproduction. The fittings supplied under this specification shall be products which have met the requirements of the Preproduction tests specified herein.

3.2 Component parts. Assemblies of the tank fittings shall consist of one or more of the following parts:

- (a) A molded-rubber or rubber-coated flange attached to the tank wall by molding or cementing.
- (b) A sealing surface attached to the tank-fitting flange or tank wall consisting of the following:
 - (1) A metal surface where sealing is accomplished by a flat gasket or an "O" ring, or
 - (2) A molded rubber surface reinforced with metal or rubber-coated fabric, or both.
- (c) A mating sealing surface or other components necessary to complete the fitting assembly.

3.3 Selection of specifications and standards. Unless otherwise specified by the procuring activity, specifications and standards for all materials, parts, and Government certification and approval of processes and equipment,

which are riot specifically designate herein and which are necessary for the execution of this specification shall be selected in accordance with ANA Bulletin No. 143, except as provided in the following paragraph.

3.3.1 MS Standard parts. MS Standard parts shall be used wherever they are suitable for the purpose, and shall be identified on the drawing by their part numbers

3.4 Materials. All materials used in the tank fittings shall be sufficiently resistant to fluids listed in table I, to assure satisfactory performance throughout the specified temperature range.

TABLE I

Fitting type	Fluid specification	Temperature range (° F.)
I	MIL-J-5624..... MIL-G-5572..... VV-M-561..... MIL-G-3056..... MIL-A-6091.....	-65 to +160
	MIL-O-6081..... MIL-L-6082.....	
II	MIL-O-6081..... MIL-L-6082.....	-65 to +275

3.4.1 *Fungusproof*. Materials that are nutrients for fungi shall not be used where it is practicable to avoid them. Where used and not hermetically sealed, they shall be treated with a fungicidal agent acceptable to the procuring activity.

3.4.2 *Metals*. Metals shall be of the corrosion-resistant type or suitably treated to resist corrosion from fuels, oils, salt spray, and atmospheric conditions likely to be met in storage and normal service. Magnesium shall not be used in the construction of these fittings.

3.4.2.1 *Dissimilar metals*. When practicable, dissimilar metals shall not be used in intimate contact with each other.

3.4.2.2 *Castings*. All metallic castings used in tank-fitting assemblies shall be so fabricated that the tank fluid cannot permeate the casting and permit fluid leakage. If necessary to prevent porosity, parts shall be treated in accordance with Standard MIL-STD-276.

3.5 Design and construction. The fittings shall be designed and constructed in accordance with the applicable MS standards and specifications in conjunction with the fluid tank and component parts to insure that fluid leakage from the fitting shall not occur during normal service life. Class A fittings shall conform to Standard MS33595, MS33596, MS29550 through MS29557, and MS29572 through MS29582, as applicable. The assembly, consisting of the cell fitting and attaching parts, shall be of the necessary strength to provide adequately for the stresses caused by the following:

- (a) Flexing resulting from vibration.
- (b) Impact loads incident to takeoff, taxiing, and landing (including catapulting and arresting, where applicable).
- (c) Hydraulic surge of fluid incident to all dynamic conditions of flight.
- (d) Hydraulic surge of fluid incident to gunfire, where applicable.
- (e) Pressure loads resulting from a hydrostatic head of fluid during level flight or maneuvers, plus resulting differential venting pressure, or resulting from any neutral gases used to pressurize the cells.
- (f) The fitting assembly shall be designed in conjunction with the containing structure to avoid concentration of external loads on the fitting assembly or fluid tank.

3.5.1 *Through-bolt fittings*. Through-bolt fittings may be utilized only in connections where no seal around the bolt is required to prevent fluid leakage.

3.6 Class A fittings.

3.6.1 *Sealing surface (class A)*. The thickness of the molded sealing surface of the fitting and the total thickness variation at the sealing surface shall be as specified on the applicable MS standard.

3.6.2 *Sealing-surface flatness (class A)*. When a transparent acrylic plate of 1-inch minimum thickness is placed on the surface, and the bolts torqued to 60 percent of the nominal installation torque, 75 percent of the sealing-surface width shall be in contact with the plate. The plate shall be flat to within 0.0005 inch

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total indicator reading (TIR). Alternate procedures of equivalent sensitivity may be used if approved by the procuring activity.

3.6.3 *Sealing pressure (class A)*. Fittings shall be designed to effect a satisfactory seal when a minimum pressure of 600 psi is applied to the sealing surface. To prevent cold-flow, the maximum sealing pressure shall be not

greater than 1,000 psi. The bolts shall be so selected that when the torque required to effect the maximum pressure is applied, 75 percent of the maximum allowable torque specified in table II shall not be exceeded. Multibolt fittings utilizing $\frac{1}{4}$ -28 bolts shall be designed to be torqued between 25 and 35 inch-pounds, except when self-locking inserts are utilized.

TABLE II. *Torque Values*

[Inch-pounds]

Thread size	Maximum allowable bolt torque	Locking device				
		Tightening torque	Free spinning		Prevailing torque	
			Breakaway torque		Maximum installation	Minimum Breakaway
			Minimum	Maximum		
$\frac{1}{4}$ -28-----	100	60	30	90	30	3.5
$\frac{3}{16}$ -24-----	225	120	60	180	60	6.5
$\frac{1}{2}$ -24-----	390	175	85	260	80	9.5
$\frac{3}{8}$ -20-----	840	475	240	715	100	14.0
$\frac{1}{2}$ -20-----	1,100	585	290	875	150	18.0

3.7 Class B fittings.

3.7.1 *Wicking (class B)*. Fittings shall be so designed and constructed that fluid wickage will not occur into the tank construction.

3.7.2 *Sealing surface flatness (class B)*. Same requirement as 3.6.2.

3.7.3 *Sealing pressure (class B)*. Fittings utilizing rubberized fabric sealing surfaces shall be designed to effect a satisfactory seal when a minimum pressure of 1,200 psi is applied to the sealing surface. To prevent cold-flow, the maximum sealing pressure shall be not greater than 1,500 psi. However, fittings utilizing a rubber surface to effect a seal shall be designed for minimum and maximum pressures of 600 and 1,000 psi, respectively. Bolts shall be so selected that when the torque required to effect the maximum pressure is applied, 75 percent of the maximum allowable torque specified in table I shall not be exceeded. Multibolt fittings utilizing $\frac{1}{4}$ -28 bolts shall be designed to be torqued between 45 and 55 inch-pounds when rubberized fabric is used to effect a seal, and between 25 and 35 inch-pounds when a rubber surface is utilized, except when self-locking inserts are utilized.

3.8 Class C fittings.

3.8.1 *Assembly fittings (not cell mounted)*. See 6.3.1.

3.8.1.1 *Sealing surface flatness*.

3.8.1.1.1 *Sealing surface flatness (free state)*. Surface shall be so designed that the variation in flatness of the sealing surface in a free state shall not exceed 0.001 inch TIR. The surface shall be normal to the centerline of the fitting within 1 degree.

3.8.1.1.2 *Sealing surface flatness (gasket installed)*. When a transparent acrylic plate of 1 inch minimum thickness is placed on the surface with the appropriate gasket installed, and the bolts torqued to 60 percent of the nominal installation torque, 75 percent of the sealing-surface width (minimum surface across which fuel must travel to reach atmosphere) shall be in contact with the plate. The plate shall be flat to within 0.0005 inch TIR. Alternate procedures of equivalent sensitivity may be used if approved by the procuring activity.

3.8.1.2 *"O" ring groove depth*. When attached to a rigid plate that is flat and parallel within 0.0005 inch TIR, the depth of the groove shall be within the tolerances specified in the

applicable MS standard as measured from the plate. The attaching load shall not exceed 50 percent of the minimum fitting installation torque.

3.8.1.3 *Deflection*. No permanent set of the interconnectors shall occur when 150 percent of the maximum installation torque or maximum allowable torque per table II, whichever is smaller, is applied.

3.8.1.4 *Sealing torque ("O" ring seals)*. Threaded members in fittings shall be so selected that the installation torque will be between 50 and 75 percent of the maximum allowable torque specified in table II.

3.8.2 *Cell mounted fitting*. See 6.3.2.

3.8.2.1 *"O" ring fitting*. See 6.3.3.

3.8.2.1.1 *"O" ring groove depth*. Requirements the same as 3.8.1.2.

3.8.2.1.2 *Sealing surface flatness ("O" ring or "O" ring sections bonded)*. Flat sealing surfaces on fittings that are to be used with "O" ring or gaskets consisting of partial "O" ring sections bonded to metal shall be measured as described in 3.8.1,2 and shall be flat to within 0.001 inch TIR.

3.8.2.1.3 *Deflection*. Same requirements as 3.8.1.3

3.8.2.1.4 *Sealing torque*. Same requirements as 3.8.1.4.

3.8.2.2 *Gasket fittings*. See 6.3.4.

3.8.2.2.1 *Sealing surface flatness*. Flat sealing surfaces on fittings using compressible, unattached fittings shall be flat within 0.015 inch TIR when measured while manually restrained on a plate which is flat within 0.001 inch TIR. The gasket fitting must also meet the requirements of 3.8.1.1.2.

3.8.2.2.2 *Deflection*. Same requirements as 3.8.1.3.

3.8.2.2.3 *Sealing pressure*. These fittings shall also meet the requirements of 3.7.3.

3.8.3 *Wicking*. Fittings shall be designed and constructed so that fluid wicking will not occur into the tank construction.

3.9 *Boltholes*.

3.9.1 *Alignment*. The centerline through the boltholes shall be normal to the plane of the sealing surface of the fitting within 1 degree. If inserts are used, the axis of the insert bolt-

hole shall be normal to the plane of the sealing surface of the fitting within 1 degree.

3.9.2 *Threaded holes*. All threaded bolt-holes shall be blind and shall include tapped steel inserts or equivalent except where no seal around bolt is required to prevent fluid leakage.

3.10 *Inserts*.

3.10.1 *Bottoming*. Inserts shall be so designed that when a bolt which is of sufficient threaded length to prevent shanking and is lubricated with test fluid, is in contact with the bottom of the insert, and the maximum allowable torque, as specified in table II, is applied, the bolt shall not damage, rotate, breakthrough, or push out the bottom.

3.10.2 *Shanking*. The insert shall be so designed that it will not be damaged beyond repair when the bolt is shanked out against the top thread of the insert when torqued to the maximum allowable torque values of table II.

3.10.3 *Pulling out*. Inserts shall be so installed in the metallic casting or stamped ring that when the insert is bridged by washers or suitable means, a bolt engaged 1 diameter, and the maximum allowable torque, as specified in table II, is applied, the insert shall not pull out or rotate, nor shall the insert threads be damaged.

3.10.4 *Locking devices*. Self-locking inserts shall be used in all "O" ring fittings. Self-locking devices maybe used in fitting bolts and fitting inserts for other types of fittings. Free spinning devices shall not be used with sealing surfaces subject to cold flow. The following requirements shall be met.

3.10.4.1 *Location*. The locking device shall start to function not more than the equivalent of $\frac{3}{4}$ of the diameter of the bolt from the first thread. It shall be possible to turn the bolt a minimum of 2 turns in the insert before the bolt becomes finger-tight.

3.10.4.2 *Endurance life and torque variation*. Locking devices used with "O" ring fittings shall have sufficient endurance life to withstand 50 removal and installation cycles without the nominal friction torque value varying by more than ± 50 percent. Locking devices used with all other fittings shall have sufficient endurance life to withstand a total of 15 removal and installation cycles without the frictional torque

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value varying by more than ± 3 inch-pounds. Locking devices of the prevailing torque type shall, in addition to the above requirements, be within the applicable values of table II.

3.10.4.3 *Inserts*. Bolts or inserts incorporating self-locking devices shall, in addition to meeting the above requirements, meet the applicable requirements of 3.10.1, 3.10.2, and 3.10.3.

3.10.5 *Replacement*. Inserts shall be so fabricated that it will be practicable, in the event of damaged insert threads, to replace the threaded portion of the insert or the entire insert. This repair shall not reduce the sealing-surface area, change the thread size, or, when applicable, affect the self-locking characteristics.

3.11 *Screw threads*. Screw threads shall conform to Specification MIL-S-7742, class UNF-2B, or 3B. This requirement is not applicable to the locking portion of self-locking inserts.

3.12 *Bolt size*, Bolts utilized in Wings shall be no smaller than $\frac{1}{4}$ -28.

3.13 *Studs*. The use of studs shall not be allowed on multibolt fittings.

3.14 *Interchangeability*. All fittings having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance. All fittings bearing different manufacturer's part numbers, but manufactured to the same MS standard shall be directly and completely interchangeable with each other with respect to installation and performance, and shall be suitably marked with the applicable MS part number. Unless otherwise specified by the procuring activity, changes in manufacturers' part numbers shall be governed by the drawing number requirements of Specification MIL-D-5028.

3.15 *Performance*. The fittings shall be satisfactory when subjected to the applicable tests of section 4. (See 4.5.3.)

3.16 *Finish and condition of cure*.

3.16.1 *Style 1*. The fittings shall be buffed and suitable for installation in tanks in the field without any further cure. In addition, access-door cover fittings shall be treated with

a compound, approved by the procuring activity, to prevent the cover fittings from cohering to their frames.

3.16.2 *Style 2*. The fittings shall be buffed and cured to the extent specified by the tank manufacturer. In addition, access-door cover fittings shall be treated with a compound, approved by the procuring activity, to prevent the cover fittings from cohering to their frames.

3.17 *Manufacturer's drawings*. Manufacturer's detailed drawings shall be submitted to the procuring activity for approval prior to starting the construction of fittings to be submitted for Preproduction testing. The requirements of the approved manufacturer's drawings or of the procuring activity's drawings are applicable as requirements of this specification.

3.18 *Marking*.

3.18.1 *MS part number*. The MS part number and the type of fittings shall be legibly molded or stamped in characters at least 0.12 inch high in the surface of the fittings in the position shown on the applicable MS standard.

3.18.2 *Identification of product*. The fittings shall be marked for identification in accordance with Standard MIL-STD-130. Style I fittings shall include the date of manufacture.

3.18.3 *Handhole covers and access doors*. The exterior surface of all covers shall be durably and legibly marked "OUTSIDE."

4. QUALITY ASSURANCE PROVISIONS

4.1 Unless otherwise specified herein, the supplier is responsible for the performance of all inspection requirements prior to submission for Government inspection and acceptance. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. Inspection records of the examinations and tests shall be kept complete and available to the Government as specified in the contract or order.

4.1.1 *Classification of tests*. The inspection and testing of fittings shall be classified as follows:

- (a) Preproduction tests: (See 4.2.)
- (b) Acceptance tests: (See 4.3.)

4.2 *Preproduction testing*.

4.2.1 *Preproduction test samples.* The Preproduction test samples shall consist of fittings representative of production items. They shall be tested at a laboratory designated by the procuring activity or, when so stated in the contract, at the contractor's plant under the supervision of the procuring activity. The Preproduction test samples shall consist of the following:

Class A and class B fittings:

- (a) Six test slabs, rubber-stock, 0.75 ± 0.005 by 6 by 6 inches.
- (b) one test slab, rubber stock, 0.500 ± 0.005 by 6 by 6 inches.
- (c) Four fittings of the same part number. Fitting inside diameter shall be within 2 to 5 inches.
- (d) Ten ASTM adhesion test specimens as specified in ASTM Method D429-55T.

Class C fittings:

- (a) Four fittings of the same part number. Fitting inside diameter shall be within 2 to 5 inches,

Note: The rubber stock used in the test shall be that which adheres to metal. The method of test, A or B, of ASTM Method D429-55T shall be reported. Each of the above samples of fittings shall include all the necessary mating parts, and that part of the fitting which is tank mounted shall be mounted in a panel of tank material 24 by 24 inches square to provide a complete fitting installation for test purposes.

4.2.2 *Preproduction tests.* Preproduction tests shall consist of all the tests of this specification, as described under 4.5, "Test methods," in the order listed. Fittings shall be subjected to all applicable Preproduction tests except as noted in 4.5.3.1.1 and 4.5.3.1.3. Any or all of the Preproduction tests may be repeated upon the other fittings if deemed necessary by the procuring activity.

4.2.3 *Preproduction test report.* When Preproduction tests are conducted at a contractor's plant, a test report shall be prepared in accordance with Specification MIL-T-9017. Three copies of the report shall be furnished to the procuring activity.

4.3 *Acceptance tests.* Acceptance tests shall consist of Individual tests and Sampling tests.

4.3.1 *Individual tests.* Each fitting shall be subjected to the following tests, as described under 4.5, "Test methods," of this specification:

- (a) Inspection (4.5.1)
- (b) Surface blemishes (4.5.1.1)

4.3.2 *Sampling tests.*

4.3.2.1 *Sampling plan A, dimensional inspection (nondestructive).* Fittings of each class and type shall be selected at random and subjected to the Detailed inspection specified in 4.5.1.2. Dimensional inspection shall be in accordance with Standard MIL-STD-105, and the classification of characteristics shall be subject to the approval of the Government representative. Acceptable quality levels (AQL) of 1 percent shall be employed for major characteristics and 2.5 percent for minor characteristics.

4.3.2.1.1 *Lot (Sampling plan A).* A lot shall consist of a group of fittings of the same class and type, manufactured under essentially the same conditions, and submitted for acceptance at the same time.

4.3.2.2 *Sampling plan B, adhesion (destructive).* The number of fittings to be subjected to the test specified in 4.5.2.6.1.2 shall be as specified in the appendix of Standard MIL-STD-105, inspection level L3, acceptance number of zero; on lot sizes of 15 or less, inspection level L1 shall apply.

4.3.2.2.1 *Lot (Sampling plan B).* A lot shall consist of a group of fittings of the same class and type, manufactured in the same week under essentially the same conditions, and submitted for acceptance at the same time.

4.4 *Test conditions.* If the test methods specified herein do not truly represent the fitting environment, for example, temperatures resulting from aerodynamic heating in excess of + 160° F, the test shall be modified as agreed upon by the contractor and the procuring activity to simulate operating conditions. The test conditions shall be as described in Fed. Test Method Std. No. 601 unless the above conditions are applicable.

4.4.1 *Test fluid.* Unless otherwise specified, the test fluids used in conducting tests described herein shall conform to the applicable test media described in Method 6001 of Fed. Test Method Std. No. 601.

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4.4.2 *Methods of tests.* Unless otherwise specified, the methods used in conducting tests described herein shall conform to the applicable method of Fed. Test Method Std. No. 601.

4.4.3 *Test jig.* The test setup for the vibration phase shall be in accordance with figure 1; however, the setup of figure 2 may be modified for this use if approved by the procuring activity.

4.5 Test methods.

4.5.1 *Inspection.* Each fitting submitted for acceptance under contract shall be carefully examined to determine conformance to all the requirements of this specification for which no specific tests are described, and to determine conformance to manufacturer's approved material, fabrication specifications, and drawings.

All critical dimensional characteristics shall be inspected.

4.5.1.1 *Surface blemishes.* Surface blemishes such as flow cracks, porosity, blisters, pockmarks, and tears shall be inspected to inspection standards approved by the procuring activity.

4.5.1.2 *Detailed inspection (for samples only).* The fittings shall be inspected to determine conformance to the dimensions of the applicable drawings.

4.5.2 *Physical-property test (classes A and B).*

4.5.2.1 *Physical properties.* Rubber stocks used for Class A fittings and the sealing surfaces of Class B fittings shall have the physical properties listed in table III when tested in accordance with the methods indicated in table III.

TABLE III. *Physical properties of rubber stock, as received*

Property	Federal Test Method Std. No. 601 Method No.	Value	
		Type I	Type II
Hardness, \pm Shore A durometer points.....	3021	as recd	as recd
Tensile strength, min psi.....	4111	1,500	1,500
Ultimate elongation, min percent.....	4121	300	300
Compression set, max percent.....	3311	40 at 158° $\pm 2^\circ$ F	70 at 212° $\pm 2^\circ$ F
	ASTM method No.		
Adhesion, min psi.....	D429-55T Method A or B	Compound failure	Compound failure
Ozone resistance.....	D1149-55T	No cracking	No cracking

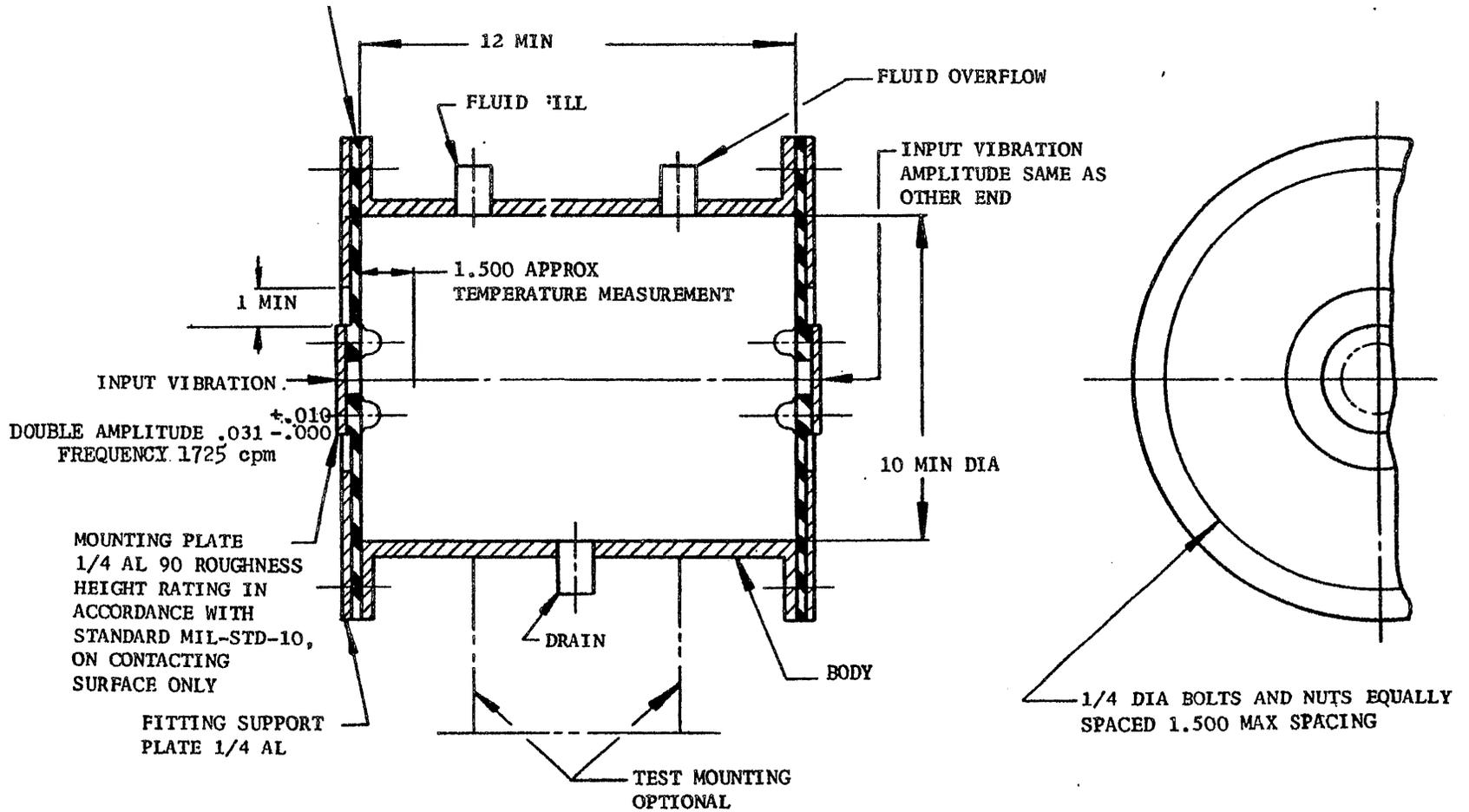
4.5.2.2 *Fluid aging.*

4.5.2.2.1 *Fuel aging.* Specimens of rubber stocks for type I fittings shall be subjected to immersion in medium No.6 fluid for 72 hours. After aging, the specimen shall be tested for the physical properties listed in table III, within 3 minutes after removal. Calculation of tensile strength and adhesion shall be based on the cross-section areas of the specimen before immersion.

4.5.2.2.2 *Alcohol aging.* Specimens of rubber stock for type I fittings shall be subjected

to immersion in alcohol conforming to Specification MIL-A-6091 for 48 hours. After aging, the specimen shall be tested for the physical properties listed in table IV within 3 minutes after removal. Calculation of tensile strength and adhesion shall be based on the cross-section areas of the specimen before immersion.

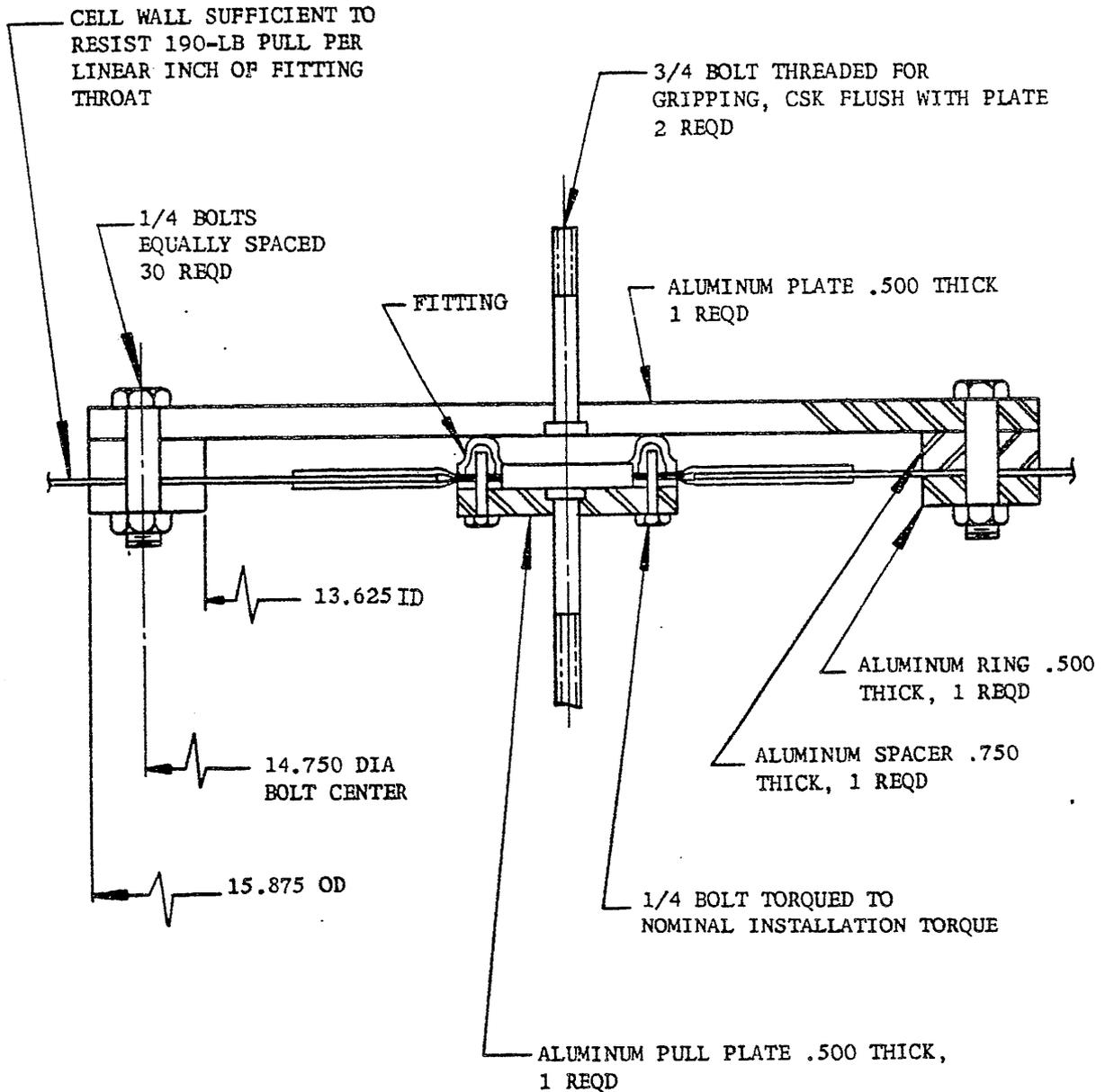
4.5.2.3 *Oil aging.* Specimens of type I and type II fitting rubber stocks shall be subjected to immersion in medium No. 1 oil at temperatures of 215° F and 275° F, respectively, for 70 hours. After this aging, the specimens shall



ALL RADII SHALL BE .031 MIN.
IT IS OPTIONAL TO TEST TWO FITTINGS SIMULTANEOUSLY.
DIMENSIONS IN INCHES.

FIGURE 1. *Vibration test setup.*

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DIMENSIONS IN INCHES.

FIGURE 2. Fitting pullout test setup.

be removed from the oil, wiped dry, allowed to stand in fresh oil at room temperature for 4 hours, and the physical properties listed in table V shall be determined.

4.5.2.4 Types I and II fitting rubber stocks shall be subjected to a 7-day Geer oven cycle at $158^{\circ} \pm 2^{\circ}$ F. After cooling for at least 16 hours in air, the physical properties listed in table VI shall be determined.

4.5.2.5 Ozone resistance. The ozone resist-

ance shall be determined in accordance with ASTM Method D1149-55T. The test specimens shall consist of strips $0.075 \pm .005$ by 1.0 by 6.0 inches stretched 10 percent longitudinally and held in this condition for the duration of the test. The samples shall not crack when exposed to an ozone concentration of 50 parts per 100 million for 30 minutes at $100^{\circ} \pm 2^{\circ}$ F. A 7-power magnifying glass shall be used to examine the samples.

TABLE IV. *Physical Properties After Fluid Aging*

Property	Federal test method standard No. 601 method No.	Value
Hardness, max total change in Shore A durometer points.	3021	-20.
Tensile strength, min percent of as-received value.	4111	50.
Ultimate elongation, min percent of as-received value.	4121	50.
Volume swell in medium No. 6 ¹ fluid by gravimetric determination, max percent.	6211	30.
Volume change in medium No. 4 ¹ fluid after 72 hours aging and 4 hours hot-air dryout at 158° F, max percent.	6211	-10.
	ASTM Method No.	
Adhesion, min.-----	D429-55T Method A or B	Compound failure.

¹ Use Specification MIL-A-6091 for alcohol aging test in lieu of the fluid specified.

TABLE V. *Physical Properties After Oil Aging.*

Property	Federal test method standard No. 601 method No.	Value
Hardness, max Shore A durometer points-----	3021	90
Tensile strength, min percent of as-received value-----	4111	75
Ultimate elongation, min percent of as-received value-----	4121	30
Volume change, max percent--	6211	+10 -20

4.5.2.6 Adhesion.

4.5.2.6.1 Adhesion to metal.

4.5.2.6.1.1 *Fitting stock.* The adhesion of fitting rubber stock to the applicable metals shall be determined by ASTM Method D429-55T Method A or B on specimens as received and within 5 minutes after immersion for 7 days in the referenced test fuels.

TABLE VI. *Physical Properties After Oven Aging*

Property	Federal test method standard No. 601 method No.	Value
Hardness, max change in Shore A durometer points.	3021	+20.
Tensile strength, min percent of as-received value.	4111	90.
Ultimate elongation, min percent of as-received value.	4121	60.
90-degree bend over 1/8 in. dia rod.	-----	No cracking.

4.5.2.6.1.2 *Fittings.* Unless otherwise specified by the procuring activity, fittings shall be subjected to adhesion tests in accordance with ANA Bulletin No. 439.

4.5.3 Fitting assembly tests.

4.5.3.1 Type I fittings.

4.5.3.1.1 *Fluid resistance and extreme temperature.* That part of the fitting containing the rubber seal or gasket material shall be assembled to a mating aluminum plate 1/4 inch thick maximum having a surface roughness of 90 roughness height rating in accordance with Standard MIL-STD-10 simulating an actual installation. The bolt or bolts required to make the assembly shall be lubricated with JP-4 fuel conforming to Specification MIL-J-5624, and the nominal installation torque specified by the manufacturer shall be applied. The fitting assembly, mounted in a vibration jig conforming to figure 1, shall be subjected to the fuel resistance and extreme temperature test described in table VII. A second fitting assembly will be used for the test described in table VIII. Any indication of fluid leakage, deterioration, or damage shall constitute failure unless it can be shown that the leakage was caused by "O" ring failure. In case of "O" ring failure, the "O" ring may be replaced and the test continued.

4.5.3.1.2 *Wicking.* The system shall be filled with JP-4 fuel conforming to Specification MIL-J-5624, shall contain a suitable staining agent, and be pressurized to 5 psi. The fitting, with sealing plate, may be removed from the

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TABLE VII. Fuel Resistance and Extreme Temperature (Type I Fittings Only)

Cycle	Test fluid	Temp (F)	Pressure (psig)	Time	Vibration	Instructions
1.....	MIL-S-3136 (Type III).....	+135°	0	3 days.....	No.....	Fitting assembled.
2.....	Air.....	{ +158° ± 2° }	0	1 day.....	No.....	Fitting assembled.
3.....	MIL-S-3136 (Type III).....	+135°	5	3 days.....	No.....	Fitting assembled.
4.....	Dry air.....	{ +158° ± 2° }	0	20 hours.....	No.....	
5.....	JP-4.....	Room	5	1 day.....	No.....	
6.....	Dry air.....	{ +158° ± 2° }	0	120 hours.....	Yes.....	{ Vibrate for first 24 hrs.
7.....	MIL-S-3136 (Type I).....	-65°	0	24 hours.....	No.....	
8.....	MIL-S-3136 (Type I).....	-65°	5	48 hours.....	Yes.....	Vibrate for last 24 hrs only.

TABLE VIII. Fluid Resistance and Extreme Temperature (Types I and II)

Cycle	Test fluid	Temperature (F)		Pressure (psig)	Time	Vibration	Instructions
		Type I fitting	Type II fitting				
1.....	No. 1 oil.....	+215°	+275°	0	3 days.....	No.....	Fitting assembled.
2.....	Air.....	{ +158° ± 2° }	{ +158° ± 2° }	0	1 day.....	No.....	Fitting assembled.
3.....	No. 1 oil.....	+215°	+275°	5	3 days.....	No.....	Fitting assembled to installation torque
4.....	Dry air.....	{ +158° ± 2° }	{ +158° ± 2° }	0	20 days.....	No.....	
5.....	(¹).....	Room	Room	5	1 day.....	No.....	
6.....	Dry air.....	{ +158° ± 2° }	{ +158° ± 2° }	0	120 hours.....	Yes.....	Vibrate for first 24 hrs only.
7.....	(¹).....	-65°	-65°	0	24 hours.....	No.....	
8.....	(¹).....	-65°	-65°	5	48 hours.....	Yes.....	Vibrate for last 24 hrs only.

¹ Medium No. 1 fluid diluted 40% with medium No. 4 fluid.

vibration jig to accomplish this test. The system shall remain under pressure at ambient temperatures for 30 days. Brown paper or talc shall be used for determination of fitting leakage. There shall be no deterioration, fitting delamination, or fuel leakage.

4.5.3.1.3 Pullout test. A fitting shall be built into a flat panel that will sustain at least 190 lbs per linear inch. The system shall be mounted in a test jig and subjected to a tension load at the rate of 2 inches per minute. A minimum pull value of 190 pounds per linear inch of the fitting throat shall be applied. The test setup shall be similar to figure 2. There shall be no failure of any portion of the fitting or its means of attachment to the flat panel.

shall be tested to the requirements of 3.10. Six inserts shall be used for each test. Additional fittings shall be used if required. Failure shall be because for rejection.

4.5.3.2 Type II fittings.

4.5.3.2.1 Fitting assembly. That part of the fitting containing the rubber Seal or gasket material shall be assembled to a mating aluminum plate ¼ inch thick maximum having a surface roughness of 90 roughness height rating in accordance with Standard MIL-STD-10 simulating an actual installation. The bolt or bolts required to make the assembly shall be lubricated with JP-4 fuel conforming to Specification MIL-J-5624, and the nominal installation

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turque specified by the manufacturer shall be applied. The fitting assembly, mounted in a vibration jig conforming to figure 1, shall be subjected to the applicable fluid resistance test described in table VII. by indication of fluid leakage, deterioration, or damage shall constitute failure unless it can be shown that the leakage was caused by "O" ring failure. In case of "O" ring failure the "O" ring may be replaced and the test continued.

4.5.3.2.2 *Pullout test.* Same procedure and requirements at 4.5.3.1.3.

4.5.3.2.3 *Insert test.* Same procedure and requirements as 4.5.3.1.4.

4.6 *Inspection of preparation for delivery.* The Inspector shall ascertain that the preparation for delivery of tank fittings conform to the requirements of section 5 of this specification.

5. PREPARATION FOR DELIVERY.

5.1 Levels of preservation and packaging.

5.1.1 *Level A.* Each fitting shall be preserved and packaged in accordance with Specification MIL-P-116, Method 1C and overpackaged in containers conforming to Specification MIL-B-4229, PPP-B-566, PPP-B-676 or PPP-B-636. Corrosion preventive compound shall conform to Specification MIL-C-6529 when its use is approved.

5.1.2 *Level B-limited military package (for domestic shipment with maximum storage of 180 days).* Fittings shall be preserved and packaged in accordance with manufacturer's commercial practice. Unit quantities shall be as specified by the procuring activity. Packaging material in direct contact with unprotected surfaces susceptible to damage by corrosion shall conform to Specification MIL-B-121, MIL-P-4185, MIL-A-148, or MIL-B-130.

5.1.3 *Level C-minimum military package (for domestic shipment with immediate use at initial destination).* Fittings shall be preserved and packaged in accordance with manufacturer's commercial practice.

5.2 Levels of packing.

5.2.1 *Level A.* Fitting preserved and packaged as specified in 5.1.1 shall be packed in overseas type. shipping containers, conforming to Specifications PPP-B-591, PPP-B-621,

PPP-B-636, MIL-B-138, PPP-B-585, PPP-B-601 or MIL-B-10377. Plywood, when used shall be Type I or II, Class 2 conforming to Specification NN-P-515. Shipping containers shall have case liners conforming to Specification MIL-L-10547 and appendix thereto. Case liners for boxes conforming to Specification PPP-B-636 may be omitted, provided all joints of the boxes are sealed with tape as specified in the box specification. The gross weight of each container shall not exceed 200 pounds. The gross weight of fiberboard containers shall not exceed the weight limitations of the applicable container specification. Containers shall be closed and strapped in accordance with the applicable container specification and appendix thereto.

5.2.2 *Level B.* Fittings, preserved and packaged as specified in 5.1.1 or 5.1.2 shall be packed in domestic-type shipping containers conforming to Specifications PPP-B-636, PPP-B-585, PPP-B-591, PPP-B-601, PPP-B-621 or MIL-B-10377. The gross weight of each shipping container shall not exceed 200 pounds. Fiberboard boxes shall not exceed the limitations of the applicable box specification. (containers shall be closed and strapped in accordance with the applicable container specification and appendix thereto. When fiberboard containers are used, the fiberboard shall meet the requirements of table I of Specification PPP-B-636.

5.3 *Physical protection.* Cushioning, blocking, bracing, and bolting as required shall be in accordance with Specification JAN-P-100, except that for domestic shipments, waterproofing requirements for cushioning materials and containers shall be waived. Drop tests of Specification JAN-P-100 shall be waived for levels B and C.

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

6. NOTES

6.1 *Intended use.* This specification covers the requirements for fittings for fluid tanks used in conjunction with powerplants.

6.2 *Ordering data.* Requisitions, contracts, and orders should state the quantity, type,

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class, style, and the part number of the fitting desired. If the fittings are to be packed for overseas shipment it shall be so stated. The procuring officer shall state the unit quantities for packaging. (See 1.2.)

6.2.1 *Preproduction tests.* The procurement document should specify that four fittings will be required as preproduction samples and that these preproduction samples will be subjected to the Preproduction tests to determine conformance to the requirements of the specification. Contracts, purchase orders, and invitation for bids should specify where the Preproduction test samples should be sent, the activity responsible for testing, and instructions concerning the submittal of the test reports. Approval of a preproduction sample of a given part number fitting, which has been submitted for approval as a specific type and class fitting, will constitute approval for future application of that fitting and fittings of the same design.

6.3 Definitions. For purposes of this specification the following definitions are applicable.

6.3.1 *Assembly fittings.* Assembly fittings are defined as metallic parts used to complete the assembly of cell mounted fittings to surrounding structure or other cells.

6.3.2 *Cell mounted fittings.* Cell mounted fittings are defined as those fittings which are

attached to the cell wall by bolts, screws, cement, or a vulcanizing process.

6.3.3 *"O" ring fittings.* Fittings of this type shall use seals conforming functionally to the requirements of Specification MIL-P-5315 and dimensionally to Standard MS29513. Gaskets consisting of partial "O" ring sections bonded to metal may be used provided they meet the requirements of this specification.

6.3.4 *Gasket fittings.* Fittings of this type shall use seals of flat sheet configuration utilizing a combination of synthetic rubber and other materials conforming to the requirements of Specifications MIL-G-6183 and MIL-A-7021.

Notice: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Custodians:

Army-Transportation Corps
Navy-Bureau of Aeronautics
Air Force

Preparing activity:
Air Force.

