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SUPERSEDING
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MILITARY SPECIFICATION

TANKS, AIRCRAFT PROPULSION FLUID SYSTEM, INTERNAL, REMOVABLE, NON-SELF-SEALING

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

1. SCOPE

1.1 Scope. This specification covers internal removable, non-self-sealing, propulsion fluid system tanks, including tank fittings, for use on aircraft.

1.2 Classification. The tanks shall be of the following general types, as specified (see 6.2):

Type I - Metallic.

Type II - Nonmetallic, flexible cell construction.

Class A - Continuously supported.

Class B - Continuously supported tear resistant.

Class C - Intermittently supported.

Type III - Nonmetallic, self-supporting cell construction.

2. APPLICABLE DOCUMENTS

2.1 Government documents

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

QQ-P-416	Plating, Cadmium (Electrodeposited)
TT-S-735	Standard Test Fluids, Hydrocarbon
O-E-760	Ethyl Alcohol (Ethanol) Denatured Alcohol, and Proprietary Solvent

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ASD/ENESS, Wright-Patterson AFB, OH 45433 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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Military

MIL-C-5541 Chemical Conversion Coatings On Aluminum and Aluminum Alloys
 MIL-C-6021 Casting, Classification and Inspection of
 MIL-L-6082 Lubricating Oil, Aircraft Reciprocating Engine (Piston)
 MIL-S-7742 Screw Threads, Standard, Optimum Selected Series, General
 Specification for
 MIL-L-7808 Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
 MIL-P-8045 Plastic, Self-Sealing and Non-Self-Sealing, Tank Backing
 Material
 MIL-A-8625 Anodic Coatings, for Aluminum and Aluminum Alloys
 MIL-D-8708 Demonstration Requirements for Airplanes
 MIL-S-8879 Screw Threads, Controlled Radius Root With Increased Minor
 Diameter, General Specification for
 MIL-L-22851 Lubricating Oil, Aircraft Piston Engine (Ashless Dispersant)
 MIL-L-23699 Lubricating Oil, Aircraft Turbine Engines, Synthetic Base
 MIL-N-25027 Nut, Self-Locking, 250°F, 450°F, and 800°F, 125 KSI FTU, 60 KSI
 FTU, and 30 KSI FTU
 MIL-P-25621 Preservation, Packaging, and Packing of Rubber and Nylon Fuel,
 Oil, and Water-Alcohol Cells
 MIL-I-27686 Inhibitor, Icing, Fuel System

STANDARDS

Federal

FED-STD-151 Metals; Test Methods
 FED-STD-191 Textile Test Methods
 FED-STD-601 Rubber: Sampling and Testing
 FED-STD-791 Lubricants, Liquid Fuels, and Related Products; Methods of
 Testing

Military

DOD-STD-100 Engineering Drawing Practices
 MIL-STD-129 Marking for Shipment and Storage
 MIL-STD-130 Identification Marking of US Military Property
 MIL-STD-143 Standards and Specifications, Order of Precedence for the
 Selection of
 MIL-STD-801 Inspection and Acceptance Standards for Propulsion Fluid Cells
 and Fittings
 MIL-STD-810 Environmental Test Methods
 MIL-STD-831 Test Reports, Preparation of
 MIL-STD-889 Dissimilar Metals
 MS 20470 Rivet, Solid-Universal Head, Aluminum and Aluminum Alloy
 MS 20995 Wire, Safety or Lock
 MS 24665 Pin, Cotter
 MS 29558 Fitting, "O" Ring, Circular, Compression Type, Single Groove,
 Tank
 MS 29559 Fitting, "O" Ring, Circular, Thru Bolt Type, Single Groove,
 Tank

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MS 29560	Fitting, "O" Ring, Circular, Threaded Insert Type, Single Groove, Tank
MS 29562	Fitting, Attachment, Molded Tank, Thru Hole, Flush, "O" Ring, Rectangular, 10 x 16
MS 29563	Fitting, Attachment, Molded Tank, Flush, "O" Ring, Rectangular, 10 x 16
MS 29564	Fitting, Attachment, Molded Tank, Thru Hole, Flush, "O" Ring, Rectangular, 12 x 18
MS 29565	Fitting, Attachment, Molded Tank, Flush, "O" Ring, Rectangular, 12 X 18
MS 29566	Fitting, Attachment, Molded Tank, Thru Hole, Flush, "O" Ring, Oval, 8 x 12
MS 29567	Fitting, Attachment, Molded Tank, Thru Hole, Flush, "O" Ring, Oval 10 x 16
MS 29568	Fitting, Attachment, Molded Tank, Flush, "O" Ring, Oval
MS 33540	Safety Wiring and Cotter Pinning, General Practices for
MS 3581	Fitting, "O" Ring, General Features of Construction
MS 33649	Bosses, Fluid Connection-Internal Straight Thread
MS 33786	Fitting Installation, Flared Tube and Hose, Swivel

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting 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 issue of the document which is indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

American Society for Testing and Materials (ASTM)

ASTM D 381-64 Test for Existent Gum in Fuels by Jet Evaporation

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

2.3 Order of Precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Preproduction. This specification makes provisions for preproduction testing (see 4.3 and 6.2).

3.2 Components

3.2.1 Type I and III tanks. A tank shall consist of a fluid reservoir, complete with all fittings and attachments.

3.2.2 Type II tanks. A tank shall consist of a cell or group of cells interconnected to form a complete tank or reservoir, complete with all fittings and attachments.

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3.3 Selection of specifications and standards. Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.4 Materials. The materials used in the manufacture of non-self-sealing tanks shall be suitable for the purpose intended and shall conform to applicable Government specifications. The use of magnesium is prohibited. Where applicable Government specifications do not exist, contractor's specifications may be used provided the contractor assumes full responsibility for the use thereof. The use of contractor's specifications will not constitute waiver of Government inspection.

3.4.1 Metals. Metals shall be of the corrosion-resistant type or suitably treated to resist corrosion due to fuels, salt fog, or atmospheric conditions likely to be met in storage or normal service.

3.4.1.1 Dissimilar metals. Unless suitably protected against electrolytic corrosion, dissimilar metals in accordance with MIL-STD-889 shall not be used in intimate contact with each other.

3.4.2 Castings. Castings shall be in accordance with MIL-C-6021. Class 4 shall be applicable unless specified otherwise by the contractor or acquisition activity.

3.5 Desire

3.5.1 General. Tanks shall be designed for satisfactory service life; shall be suitable for use with the fluid for which they are intended; and shall be designed in conjunction with the containing structure to avoid a concentration of loads on splices, seams, fittings, or the location of concentrated flexure. The design of the tank assembly and aircraft structure in which it is mounted shall comprise the necessary strength to provide adequately for the stresses caused by the following:

- a. Flexing resulting from vibration
- b. Impact loads incident to take-off, taxiing, and landing (including catapulting and arresting)
- c. Positive and negative pressures associated with hydraulic surge of fluid incident, to all dynamic conditions of flight, including catapult and arrested landing, if any.
- d. Pressure loads imposed by:
 - (1) Hydrostatic head of fuel during level flight or maneuvers
 - (2) Pressurizing or inerting gases
 - (3) Proof and ultimate pressures as designated by the contractor or acquisition activity
 - (4) Hydraulic surge of fuel incident to gunfire, where type II, class B instructions are used

3.5.2 Capacity. The design capacity shall be as specified by the acquisition activity or airframe manufacturer. The capacity of types I and III tanks shall be within 1.5 percent of the total volume of the average capacity of the first 10 production tanks manufactured after preproduction approval of the tanks. For tanks in production, the head versus volume curve shall be within 1.5 percent of the calibrated head versus volume curve.

3.5.3 Weight. Emphasis shall be placed on the design to create the lowest weight tank that will meet the requirements of this specification. The weight of production tanks shall be within the following percentages of the average weight of the first 10 production tanks manufactured after preproduction approval of the tank:

- a. Type I tanks ± 2 percent
- b. Types II and III tanks ± 5 percent

If, during the production of tanks or cells, the weight consistently exceeds the tolerance on one side of the production weight, the acquisition activity or contractor shall be so informed, and all pertinent data shall be supplied including a recommendation for a new production weight, the reason for exceeding the weight tolerances, and a log of the tank or cell weight for review and establishment of a new production weight.

3.6 Construction

3.6.1 Fittings. The requirements specified herein shall apply to fuel tank fittings.

3.6.1.1 Configuration. Outlet bosses used in type I tanks shall conform to MS 33649 or MS 33786, as applicable. For types II and III tanks the fittings shall be designed and constructed in accordance with the applicable MS drawings and in conjunction with the fluid system components to insure that leakage does not occur during normal service life. Fittings shall conform to MS 29558 through MS 29560, MS 29562 through MS 29568 and MS 33581, as applicable. The through bolt fittings depicted in these drawings may be used for connections where no seal is required around the bolt.

3.6.1.2 Sealing torque. The fitting will be designed to provide a fluid tight seal with application of the tightening torque.

3.6.1.3 Threaded holes. All threaded bolt holes shall be blind and shall incorporate replaceable or repairable self-locking steel inserts.

3.6.1.4 Inserts. The locking device shall start to function not more than the equivalent of three-fourths of the diameter of the bolt from the first thread. It shall be possible to turn the bolt a minimum of two turns in the insert before the bolt becomes finger tight. The fitting and insert shall be designed so that damage beyond repair to the fitting or insert shall not occur when the maximum allowable torque as specified in table I is applied on a bolt that is bottomed out against the bottom of the bolt clearance hole or tapped hole or when applied against a bolt that is shanked out against the top thread of the bolt. It shall be possible to apply the maximum allowable torque as specified in table I against a bolt that is bridged in a manner to exert an extracting force of the insert, without extraction of the insert or damage to the insert of fitting. The insert and locking device shall have a life of at least 50 installation and removal cycles before replacement is required.

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TABLE I. Torque values (inch-pounds).

Thread size	Maximum allowable bolt torque	Locking device					
		Free spinning			Prevailing torque		Minimum Breakaway
		Tightening torque	Breakaway torque		Maximum in-stallation		
			Minimum	Maximum			
1/4-28	100	60	30	90	30	3.5	
5/16-24	225	120	60	180	60	6.5	
3/8-24	390	175	85	260	80	9.5	
7/16-20	840	475	240	715	100	14.0	
1/2-20	1,100	585	290	875	150	18.0	

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3.6.2 Screw threads. Screw threads other than those used in fittings shall meet the requirements specified herein.

3.6.2.1 Straight screw threads. All screw threads shall conform to MIL-S-7742 or MIL-S-8879. The use of pipe threads is prohibited.

3.6.2.2 Locking of threaded parts. All threaded parts shall be positively locked by safety wiring or shall employ self-locking features conforming to MIL-N-25027. Safety wire shall be corrosion-resistant steel conforming to MS 20995. The method of safety and diameter of wire shall conform to MS 33540. Cotter pins shall conform to MS 24665. Staking and the use of lockwashers shall not be permitted.

3.7 Interchangeability. All parts having the same manufacturer's part number shall be directly and completely interchangeable. Changes in manufacturer's part numbers shall be in accordance with DOD-STD-100.

3.8 Finish

3.8.1 External surfaces. The external surfaces of types II and III tanks shall be ozone resistant-or suitably protected against the action of ozone and the fluid for which the tanks are intended.

3.8.2 Steel parts. Exposed steel parts shall be of corrosion resistant steel or suitably protected to satisfy a 120-hour salt fog test conducted in accordance with MIL-STD-9810. For parts not exposed to fuel in normal use, cadmium plating in accordance with QQ-P-416, type II may be used. Parts exposed to fuel in normal use shall not be cadmium plated.

3.8.3 Aluminum-alloy parts. If aluminum-alloy parts, except those which are fully molded inserts, fail to meet a 120-hour salt fog test conducted in accordance with FED-STD-151, method 811, such parts shall be anodized in accordance with MIL-A-8625 or treated in accordance with MIL-C-5541. If required for electrical bonding, the film may be removed locally.

3.9 Performance. Tanks shall satisfy the applicable performance requirements when subjected to the tests specified in section 4.

3.9.1 Temperature range. Tanks shall be suitable for operation throughout an ambient temperature range of -65°F to +160°F (-54°C to +71°C) and fluid temperature ranges of:

- a. Oil tanks (normal system) -65°F to +275°F (-54°C to +135°C)
- b. Oil tanks (hot oil system) -65°F to +325°F (-54°C to +163°C)
- c. Water-alcohol -15°F to +160°F (-26°C to +71°C); -65°F to +160°F (-54°C to +71°C) without fluid
- d. Fuel -65°F to +135°F (-54°C to +57°C)

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3.10 Markings. Each assembly part shall be marked with its part number which shall be the same as the drawing number of that part or assembly. An assembly consists of parts that are permanently fastened together by welding, brazing, molding, soldering, or riveting. Exceptions to this marking are those parts that do not have a suitable or sufficient surface for a part number.

3.10.1 Location of part numbers. The part number shall, when practicable, be located to permit its being read after assembly in the complete unit. The marking shall be such that it will not be effaced or obliterated as a result of service usage during the life of the part.

3.10.2 Access door covers. Unless otherwise specified, the exterior surface of all access door covers shall be durably and legibly marked, OUTSIDE.

3.10.3 Installation torque. The proper torque values for installing the tank in the aircraft and for attachment of fuel lines, interconnects, vent lines, fuel pumps, valves, access doors, and other fuel system components shall be durably and legibly marked on or adjacent to each fitting or fuel system component involved, on the side to which the torque wrench is applied. In tanks where all torque values are the same the proper torque value shall be stenciled in a conspicuous place.

3.11 Identification of product. Equipment, assemblies, and parts shall be marked for identification in accordance with MIL-STD-130 and shall include:

- a. Reorder by Part No. _____ (insert current aircraft contractor part no.)
- b. Federal stock number _____
- c. Aircraft model(s) and cell location
- d. Fluid suitability (fuel, oil, water/alcohol)
- e. Manufactured _____ (month and year)
- f. Construction No.
- g. Tank manufacturer
- h. Tank manufacturer Part No. _____
- i. Weight empty _____ (actual)
- j. MIL-T-6396E, Type _____ Class _____(if applicable)
- k. Contract or order no.

3.11.1 Nameplate. The nameplate shall be located on the tank in such a position that when the tank is installed in the aircraft, the nameplate is visible with the minimum possible disruption of the fuel cell installation.

3.12 Age. Types II and III tanks shall be not more than 2 years old from date of manufacture to installation in the aircraft or 1 year prior to delivery to the acquisition activity.

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3.13 Cleaning. The tanks shall be thoroughly cleaned of rubber particles, dirt, sand, metal chips, welding flux, or other foreign material while being assembled and after final assembly.

3.14 Workmanship. For all tanks, workmanship shall be in accordance with manufacturing practice covering this type of equipment. Neither spot welding nor riveting through the tank wall shall be permitted on type I tanks. The acceptable quality level of workmanship for type II tanks shall be in accordance with MIL-STD-801.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, 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 Classification of inspections. The examining and testing of tanks shall be classified as:

- a. Preproduction inspections (4.3)
- b. Quality conformance inspections (4.4)

4.3 Preproduction inspections. The preproduction inspections shall consist of phase I and phase II tests.

4.3.1 Phase I preproduction test (Types II and III tanks only). Phase I preproduction tests are those tests accomplished on samples of the constructions (see 6.4.5) to be used in the manufacture of non-self-sealing tanks. Phase I tests shall be conducted by the acquisition activity or the tank manufacturer at a place named by the applicable acquisition activity. The phase I preproduction tests shall be as listed in table II and described in 4.6.

4.3.1.1 Phase I test samples (types II and III tanks only). Phase I test samples shall consist of:

- a. Two type II, class A and class C; four type II, class B; and two type III test tanks with outside dimensions of 24 by 30 by 30 inches containing the necessary fittings. Fitting design shall be approved by the contractor or the acquisition activity for preproduction tests.
- b. Eight metal side panels (type II tanks only).
- c. Eight sheets of backing material 27 by 30 inches and two sheets of backing material 30 by 30 inches, conforming to type I of MIL-P-8045 or a material approved by the applicable acquisition activity.

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- d. Three 12- by 12-inch samples of composite cell construction.
- e. One sample of inner layer ply, without barrier, approximately 900 square inches in area, including seam.
- f. Two samples 6- by 6-inch inner layer ply, without barrier.
- g. Three permeability samples as specified in 4.6.12.
- h. One 12- by 12-inch sample of outer ply.

These samples shall not be preplasticized with fluid prior to testing.

TABLE II. Phase I tests (types II and III tanks).

Tests	Para. No.	Oil	Fuel	Water- alcohol
Leakage <u>1/</u>	4.6.1.5	x	x	x
Aging	4.6.5	x	-	-
Slosh	4.6.8	x	x	x
Stand test (phase I)	4.6.9	x	x	x
Humidity	4.6.10	x	x	x
Fluid resistance of exterior surface	4.6.11	x	x	x
Permeability	4.6.12	-	x	-
Fuel contamination	4.6.13	-	x	-
Oil dilution resistance <u>2/</u>	4.6.14	x	-	-
Inner liner strength	4.6.15	x	x	x
Seam adhesion	4.6.16	x	x	x
Puncture resistance	4.6.17	x	x	x
Impact resistance <u>3/</u>	4.6.18	x	x	x
Gunfire (phase I) <u>4/</u>	4.6.19	x	x	-

x Indicates test applicable
 Indicates test not applicable

1/ Upon completion of the leakage test, tests may be run in any order desired.

2/ Applies only to oil tanks to be used on aircraft employing an oil dilution system.

3/ This test applicable to type III tank, only.

4/ This test applicable to type II, class B tanks, only.

4.3.2 Phase II preproduction tests (all types). Phase II preproduction tests are those tests accomplished on full-scale tanks or portions thereof, at the discretion of the acquisition activity. The preproduction tests are listed in table III and described in 4.6. Unless otherwise specified, the tests shall be conducted in the sequence listed.

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TABLE III. Phase II tests.

Tests	Para. No.	Tank Types		
		I	II	III
Examinations	4.6.1	x	x	x
Handling (type II tanks only)	4.6.20	-	x	-
Installation	4.6.21	x	x	x
Capacity	4.6.4	x	-	x
Simultaneous slosh and vibration 1/	4.6.6	x	x	x
Vibration	4.6.7	x	-	x
Slosh 2/	4.6.8	-	x	-
Low temperature leakage	4.6.22	x	x	x
Stand test (phase II)	4.6.23	-	x	x
Accelerated loads test	4.6.25	x	x	x
Proof pressure (types I and III tanks)	4.6.26	x	-	x
Burst pressure (types II and III tanks)	4.6.27	x	-	x
Fitting tests	4.6.28	x	x	x
Flight	4.6.29	x	-	x
Gunfire (phase II)	4.6.24	-	x 3/	-

x Indicates test applicable

- Indicates test not applicable

- 1/ Simultaneous slosh and vibration tests not mandatory for type II tanks, classes A and B.
- 2/ Slosh test not required when simultaneous slosh and vibration test is conducted.
- 3/ Type II, class b tanks only.

4.3.2.1 Phase II test samples (all types). Phase II test samples shall consist of one or more full-scale tanks or portions thereof. The tank or tanks shall be of an approved construction (see 6.4.6). The tanks shall be designed to fit a specific location in a specific aircraft. Three or more typical fitting assemblies (2-5 inches diameter) for testing in accordance with 4.6.28.2 and 4.6.28.3 will be required for all combinations of fitting design, flange design, and tank attachment methods not previously approved.

4.3.3 Test report. A test report, prepared in accordance with MIL-STD-831, shall be furnished by the tank manufacturer to the acquisition activity (see 6.2.2). The test report shall verify compliance with the requirements and tests specified herein. A single copy shall be provided unless otherwise specified by the acquisition activity. The report shall contain all necessary details of the construction [materials, material arrangements, and manufacturing methods (mold/mandrel, joint designs, fittings, fitting attachment methods, and other necessary included techniques)]. The materials shall be identified, ply-by-ply, in generic terms only. For each material, the tank manufacturer's materials and processing specifications will be identified by code numbers. The intended tank type(s) and class(es) and fluid(s) suitability shall be stated.

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4.3.3.1 Variation of basic construction. Variation of a basic construction which has been granted preproduction approval shall be indicated by a suitable dash number or lettering system. Details of each variation shall be submitted to the acquisition activity which, at its discretion, may extend preproduction approval to the variation.

4.4 Quality conformance inspections. The quality conformance inspections shall consist of individual tests and sampling tests.

4.4.1 Individual tests. Each fuel tank shall be subjected to:

- a. Examination of product 4.6.1.1
- b. Workmanship 4.6.1.2
- c. Dimensional 4.6.1.3
- d. Weight 4.6.1.4
- e. Leakage 4.6.1.5

4.4.2 Sampling tests

4.4.2.1 Types I and III tank construction. Unless otherwise specified, one tank shall be selected from the first 100 tanks or less, plus one tank from each 1,000 tanks thereafter or fraction thereof, on the contract or purchase order, and shall be subjected to:

- a. Capacity 4.6.4
- b. Proof pressure
(types I and III tanks) 4.6.26
- c. Burst pressure
(types I and III tanks) 4.6.27
- d. Simultaneous slosh
and vibration 4.6.6
- e. Low temperature
leakage 4.6.22

4.4.2.2 Type II tank construction. Production fuel tanks shall be subjected to the stand test in accordance with 4.6.2 and the following schedule. For the purpose of this sampling plan, each part number shall be treated as a separate order in determining the applicable sampling requirement. If failures occur, corrective action shall be taken to correct the discrepancy (see 4.4.2.4):

- a. For orders over 100
 - (1) sample 10 tanks completely at random out of the first lot of 25
 - (2) sample 10 tanks completely at random out of the next lot of 50
 - (3) one at random out of each additional lot of 15

b. For orders of 50 to 100

(1) sample 10 tanks completely at random out of the first lot of 25

(2) one at random out of each additional lot of 15

c. For orders of less than 50

(1) sample 10 tanks completely at random (for orders of 10 tanks or less, all tanks shall be tested)

4.4.2.3 Dissection test (types II and III tanks only). The contract or purchase order shall specify whether the dissection test is to be a periodic sampling test or a contingency option.

4.4.2.3.1 Dissection test (sampling plan). The dissection test will normally be designated as a mandatory sampling test for tanks incorporating newly developed materials or manufacturing processes. For this test, tanks selected at random and at a frequency specified in the contract or purchase order shall be dissected in accordance with figure 1 and subjected to the dissection test of 4.6.3.

4.4.2.3.2 Dissection test (contingency option). During tank acquisitions in which the dissection test is not required as part of a periodic sampling plan, the contractor or acquisition activity may invoke a dissection test as a contingency option in the event that other acceptance tests, or service uses disclose chronic deficiencies in materials or manufacturing processes (see 4.4.2.4), or when questions regarding the acceptability of tanks cannot be resolved by non-destructive tests. Tanks to be dissected shall be selected by the contractor or acquisition activity, dissected as shown in figure 1, and tested as required in 4.6.3.

4.4.2.4 Rejection and retest. When a defective sample unit occurs, acceptance of all units after the last group of accepted units shall be withheld until the extent and cause of failure have been determined and appropriately corrected. Sampling shall then return to highest rate applicable. In the event that chronic deficiencies are disclosed, the contingency option of 4.4.2.3.2 may be invoked to assist in resolution of the problems.

4.5 General test conditions. Unless otherwise specified by the acquisition activity, the following general test conditions, in addition to the test conditions specified in the particular tests, shall apply during the tests performed in accordance with this specification.

4.5.1 Test fluids. Except when water is specified, the following test fluids, as specified, shall be used in testing the different kinds of tanks:

a. Fuel tank: Unless otherwise specified, test fluid conforming to TT-S-735, type III.

b. Oil tank: Unless otherwise specified, oil conforming to MIL-L-22851, MIL-L-23699 or MIL-L-7808, whichever is applicable.

c. Water-alcohol tank: A mixture of 50 percent water and 50 percent alcohol, by volume, conforming to O-E-760, unless otherwise specified.

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4.5.2 Tank mounting structure

4.5.2.1 Type II tanks. The mounting structure shall be the applicable portion of the actual aircraft structure with the fuel tank installation identical to the actual aircraft installation. In the case of the stand test, a simulated structure may be used.

4.5.2.2 Types I and III tanks. The mounting structure shall be either the applicable portion of the actual aircraft structure or a simulated structure. If a simulated structure is used, it shall duplicate the shape, dimensions, and material of the tank supporting structure in the aircraft. The necessary stops, cushions, hangers, and pads, identical with those used in the finished aircraft, for mounting and supporting the tank, shall be provided. The test tank shall be capable of being installed and removed in the mounting structure in an identical manner to that used in the actual aircraft installation.

4.5.3 Support jig. The jig shall support the tank mounting structure as specified in 4.5.2 to simulate the actual aircraft installation. The support jig shall be a strongly constructed framework of metal, suitable for carrying the mounted sample tank and designed for bolting to the vibrator and rocker assembly. The jig framework shall be sufficiently rigid to prevent the possibility of additional stresses being imposed on the mounted tank owing to flexure of the jig framework.

4.6 Inspection methods

4.6.1 Examinations

4.6.1.1 Examination of product. Each tank 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 with approved manufacturer's material, fabrication, and inspection specification, and applicable drawings.

4.6.1.2 Workmanship. Each tank shall be inspected to determine that the workmanship conforms to MIL-STD-801.

4.6.1.3 Dimensional. A check shall be made on each tank to insure that all dimensions critical to the installation are within the dimensional tolerances established by the contractor or acquisition activity. The tolerances specified for this test shall not conflict with the capacity requirements specified in 3.5.2.

4.6.1.4 Weight. The weight of each finished tank shall be checked to determine compliance with 3.5.3.

4.6.1.5 Leakage. The tank, with all openings sealed and with a minimum of external support necessary to maintain the tank shape, shall be subjected to the internal air pressure specified in the manufacturer's approved inspection specification. Then the tank shall be completely submerged in water or covered with soapy water. Leakage, as indicated by the presence of air bubbles forming in the water or soapy water solution, shall be cause for rejection. If approved by the acquisition activity, other acceptable leakage tests include a ~~hydrostatic~~-ammonia test or an unconfined liquid stand test using the approved test fluid applied at room temperature for 24 hours with a head

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pressure on the bottom of the tank which is mutually satisfactory to both the tank and the airframe manufacturer. Alternate leakage tests acceptable to the acquisition activity may also be used.

4.6.2 Stand test (sampling). Type II tanks selected in accordance with 4.4.2.2 shall be collapsed and held strapped for 30 minutes in a position comparable to that required for installation in its respective aircraft cavity. Then the tank shall be adequately supported and filled with the applicable test fluid as specified in 4.5.1 and stand tested for 15 days. A brown paper liner in the cavity and a staining agent in the test fluid shall be used for leak detection. A stand pipe shall be used to insure that all internal surfaces are in contact with fuel. Upon completion of the tests the tank shall be examined for evidence of leakage or other failure.

4.6.3 Dissection test. The sectioned portion of each tank selected as specified in 4.4.2.3 shall be examined for conditions outlined in MIL-STD-801.

4.6.4 Capacity. The capacity of the finished tank shall be checked to determine compliance with 3.5.2.

4.6.5 Aging

4.6.5.1 Oil tank, normal system (275°F)(135°C). For this test, the tank shall be filled to its normal level with the applicable oil specified in 4.5.1.b, and shall stand at 275°F (135°C) for 200 hours. At the end of this period, the tank shall show no signs of deterioration or other unsatisfactory condition as a result of the test.

4.6.5.2 Oil tank, hot oil system (375°F) (163°C). For this test, the tank shall be filled to its normal level with the applicable oil specified in 4.5.1.b, and shall stand at 325°F (163°C) for 200 hours. At the end of this period, the tank shall show no signs of deterioration or other unsatisfactory condition as a result of the test.

4.6.6 simultaneous slosh and vibration

4.6.6.1 Test conditions

4.6.6.1.1 Vibrator and rocker assembly. These tests shall be conducted on a vibrator and rocker assembly of a design acceptable to the acquisition activity

4.6.6.1.2 Vibration speed For testing a tank intended for installation in an aircraft propelled entirely or partially by a reciprocating engine(s), the rotational speed of the eccentric weights shall be 87 to 90 percent of the normal rated crankshaft speed of the engine used. For testing all other aircraft tanks, the rotational speed of the eccentric weights shall be 1940 to 2000 revolutions per minute.

4.6.6.1.3 Vibration displacement. The throw of the eccentric weights on the vibration machine shall be adjusted to produce a total displacement of 0.032 to 0.042 inch, measured at points of inherent rigidity on the tank (such as points along the seams or near mounting points).

4.6.6.1.4 Alternate vibration frequency and displacement. Where the above frequencies and displacements are not applicable, the tank shall be vibrated at a frequency and displacement specified by the contractor or acquisition activity.

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4.6.6.1.5 Mounting axis. The tank shall be mounted in such a manner as to simulate pitching in the actual aircraft. Special fixtures, such as baffles, may also be tested, if applicable, by mounting in another position for a portion of the test time.

4.6.6.1.6 Slosh rocking angle. The slosh rocking angle shall be 30 degrees total, approximately 15 degrees on either side of the horizontal position.

4.6.6.2 Test duration. Test duration and procedure shall be:

- a. Vibrate for 25 hours at 16 to 20 slosh cycles per minute (cpm) or
- b. Vibrate for 25 hours at 10 to 16 slosh cpm with 15 hours of additional slosh at 10 to 16 slosh cpm.

4.6.6.3 Type I tanks. The test tank, complete with all caps, vents, gages, fittings, the nameplate, and other parts or accessories that will be mounted on or in the aircraft, shall be mounted in the support jig and installed on the vibrator and rocker assembly. In addition, all lines attached to the tank in the actual aircraft installation shall be included. The minimum length of these lines shall be that length in the actual aircraft installation from the tank to the first support. (For testing of tanks which incorporate reticulated foam or similar materials, see 4.6.6.5). The test specimen shall be filled two-thirds-full with water and simultaneously slosh and vibration tested in accordance with applicable conditions specified in 4.6.6.1. The temperature of the test fluid shall be as specified in table IV. This test shall be conducted with the test specimen subjected to a pressure equivalent to the maximum operating pressure encountered in any prescribed flight conditions. At the conclusion of this test, the test specimen shall be filled with the applicable test fluid specified in 4.5.1, and thoroughly inspected for leakage or other evidence of failure such as sagged panels or buckled plates which shall be cause for rejection.

TABLE IV. Test fluid temperature.

Test fluid	Temperature
Fuel	135°F \pm 10°F (57°C \pm 6°C)
Oil	275°F \pm 5°F or 325°F \pm 5°F (135°C \pm 3°C or 163°C \pm 3°C)
Water	Ambient
Water-alcohol	135°F \pm 10°F (57°C \pm 6°C)

4.6.6.4 Types II and III tanks. The test tank, complete with all caps, vents, gages, fittings, the nameplate, and other parts or accessories that will be mounted on or in the aircraft, shall be mounted in the support jig and installed on the vibrator and rocker assembly. In addition, all lines attached to the tank in the actual aircraft installation shall be included. The minimum length of these lines shall be that length in the actual aircraft installation from the tank to the first support. The interior of each compartment shall be completely lined with brown paper and held in place with a suitable adhesive. (For testing of tanks which incorporate reticulated foam or similar materials, see 4.6.6.5.) The test specimen shall be filled two-third-full with the applicable test fluid as specified in 4.5.1 containing a suitable dye. In addition, for fuel tanks, twice the sump capacity of water shall be added to the tank. For oil tanks employed in aircraft using an oil dilution system, 30 percent by volume of fluid conforming to TT-S-735, type III, shall be added to

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the test fluid. The tank shall be simultaneously slosh and vibration tested in accordance with the applicable conditions specified in 4.6.6.1. The temperature of the test fluid shall be as specified in table IV. This test shall be conducted with the test specimen subjected to a pressure equivalent to the maximum operating pressure encountered in any prescribed flight conditions. At the conclusion of this test, the test specimen shall be filled with the applicable test fluid as specified in 4.5.1 and thoroughly inspected for leakage or other evidence of failure.

4.6.6.5 Special baffling materials. Tanks incorporating reticulated foam or similar materials for fire and explosion protection shall have the material removed during the slosh, vibration, or slosh and vibration tests described herein. If deemed necessary by the contractor or acquisition activity, a second slosh test with the foam installed will be conducted.

4.6.7 Vibration. A tank shall be tested in accordance with the procedure specified in 4.6.6.3 or 4.6.6.4, as applicable, except:

- a. The tank shall not be sloshed.
- b. The tank shall be completely filled with test fluid.

The tank shall be vibrated for 10 minutes using the applicable test conditions specified.

4.6.8 Slosh

4.6.8.1 Phase I slosh. A test cube shall be tested in accordance with the procedure specified in 4.6.6.4, except that this cube shall not be subjected to vibration. The cube shall be sloshed for 25 hours at 16 to 20 cpm. Type III cubes shall be supported in a manner specified by the contractor of acquisition activity. Type II cubes shall be installed in the Gun Fire test structure with the test structure rigidly mounted to the slosh table. For type II, class C cubes, the backing board on the four sides shall be removed so that the sides of the cube are supported by the hat sections of the structure.

4.6.8.2 Phase II slosh. A tank shall be tested in accordance with the procedure specified in 4.6.6.4, except that the tank shall not be subjected to vibration. The tank shall be sloshed for 25 hours at 16 to 20 slosh cpm, or 40 hours at 10 to 16 slosh cpm.

4.6.9 Stand test (phase I). The stand test shall be conducted on the second test cube. Type II test cubes shall be installed in a test structure which has been lined with brown paper. For class C cubes the backing board for the four side panels shall be omitted so that the cube is draped across the hat section in this area. Type III cubes shall be covered with brown paper and tested in an unsupported condition. The cubes shall be filled with the applicable test fluid as specified in 4.5.1 containing a staining agent. After 90 days there shall be no evidence of leakage or other failure. An alternate method of detecting leakage is acceptable, if approved by the contractor or acquisition activity.

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4.6.10 Humidity. Samples of the composite construction, the inner liner ply and the outer ply shall be subjected to a relative humidity of 95 ± 2 percent and a minimum temperature of 160°F (71°C) for 30 days. The following criteria shall be used to determine suitability of the samples following the test:

- a. Composite construction - There shall be no corrosion, peeling, cracking warping, blistering, delamination or discoloration.
- b. Inner liner and outer ply samples allowable change from original properties -
 - TENSILE ± 45 percent
 - ELONGATION ± 30 percent
 - SHORE A HARDNESS ± 15 points

4.6.11 Fluid resistance of exterior surfaces. The test cube shall be placed in a container sufficiently large to permit immersion to one-half the depth of the cube in the applicable test fluid as specified in 4.5.1. The tank shall be immersed for 72 hours at the ambient temperature. The tank shall then be removed and examined. The exterior surface of the tank construction shall show no unsatisfactory swelling, separation, blistering, dissolution, or other deterioration.

4.6.12 Permeability

4.6.12.1 Test apparatus. The test apparatus shall consist of:

- a. A permeability cup and ring constructed as shown on figure 2.
- b. A nylon solution to be used for sealing the test disk to the permeability cup.

4.6.12.2 Preparation of test specimen. The test samples shall be prepared utilizing a manufacturing method similar to production and shall be given a cure equivalent to that used in production. Two test samples consisting of the inner liner and fuel barrier (if required) or the total construction shall be used. The samples shall be conditioned 24 hours at $73.5^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($23^{\circ}\text{C} \pm 3^{\circ}\text{C}$) and a relative humidity of 50-60 percent prior to test. A nylon solution or other suitable sealing liquid may be applied to the face of the cup flange and sample edge. The inside or inner liner surface shall be exposed to the fuel.

4.6.12.3 Method of conducting test. Permeability cups, prepared as specified in 4.6.12.2, shall be placed in a suitable rack in a constant temperature of $70^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($21^{\circ}\text{C} \pm 3^{\circ}\text{C}$) and relative humidity of 40 ± 5 percent. After allowing 1 hour for equilibrium, the cup shall be weighed to the nearest 0.005 gram and placed in the rack with the face of the cup facing upward. The cup shall be kept at the above constant temperature for 24 hours, then weighed to check for seal integrity. If necessary, the bolts shall be retorqued at this weighing and at subsequent weighings. The cup shall be inverted (test disk down) in a rack that permits free access of air to the test disk. Cups shall be weighed at the end of the third, fifth, and eighth day after inverting. Defective films or leaks caused by faulty assembly will usually be found when making the weighing on the third day. The diffusion rate calculation shall be made on the fifth- to the eighth-day period and expressed as fluid ounces per square foot per 24 hours. The permeability shall be less than 0.025 fluid ounce per square foot per 24 hours for each sample tested.

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NOTE: Diffusion expressed in fluid ounces per square foot per 24 hours equal the gram loss of the test specimen per 24 hours multiplied by a factor which is defined as:

$$K = \frac{144}{(\text{sp. gr.}) (29.573) (3.142) R^2}$$

Where sp. gr. = specific gravity of test fluid at 77°F (25°C).

R = inside radius of test cup expressed in inches.

Alternate test methods may be used if approved by the acquisition activity. A test apparatus utilizing a grooved mounting flange with mating head in the retainer ring has been found to yield more consistent results for some materials.

4.6.13 Fuel contamination

4.6.13.1 Nonvolatile gum residue. A 5-gram sample of the inner layers, up to the barrier, shall be diced up into approximately 0.062 inch squares and placed in a flask containing 250 milliliter (ml) of test fluid conforming to TT-S-735, type III, and allowed to stand for 48 hours at 77°F ± 5°F (25°C ± 3°C). The contaminated test fluid shall be decanted off and the nonvolatile gum residue determined by method 3302, FED-STD-791, (ASTM D381-64) except that the total evaporation time shall be 45 minutes. The nonvolatile material shall not exceed 60 milligrams (mg) per 100 ml or the contaminated fluid.

4.6.13.2 Stoved gum residue. The beakers containing the nonvolatile material shall be placed in an appropriate bath maintained constantly at a temperature of 572°F ± 9°F (300°C ± 5°C) for 30 minutes. After cooling in a closed container, the beakers shall be weighed. The stoved gum residue shall not exceed 20 mg per 100 ml of the contaminated fluid, after necessary corrections have been made for preformed gums originally present in the test fluid.

4.6.14 Oil dilution resistance. Tensile and elongation tests, before and after immersion in the oil diluted 30 percent by volume with test fluid conforming to TT-S-735, type III, shall be made on the inner layer ply in accordance with FED-STD-601, methods 4111 and 4121, respectively. The test specimens shall be immersed for 48 hours at room temperature. The tensile properties shall be reduced no more than 40 percent from the original values and the shore A durometer hardness shall vary no more than 15 points from the original value.

4.6.15 Inner liner strength

4.6.15.1 Gum inner liner strength. The tensile strength of the gum inner layer ply, without barrier, shall be determined in accordance with FED-STD-601, method 4111, before and after immersion in TT-S-735, type III test fluid for 72 hours at a temperature of 135°F ± 3°F (57°C ± 2°C). The tensile strength shall also be determined before and after immersion in a solution of 25 percent MIL-I-27686 inhibitor and 75 percent water, by volume; for 72 hours at a temperature of 135°F ± 3°F (57°C ± 2°C). The tensile strength reduction shall be reported to the contractor or acquisition activity. The strength shall be reduced no more than 50 percent for fuel immersion and 20 percent for water immersion calculated on the basis of the original cross-sectional area.

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4.6.15.2 Fabric inner liner strength. The tensile strength of the fabric inner layer ply, without barrier, shall be determined in accordance with FED-STD-191, method 5100 before and after immersion in TT-S-735, type III test fluid, for 72 hours at a temperature of $135^{\circ}\text{F} \pm 3^{\circ}\text{F}$ ($57^{\circ}\text{C} \pm 2^{\circ}\text{C}$). Also, the tensile strength shall be determined before and after immersion in a solution of 25 percent MIL-I-27686 inhibitor and 75 percent water, by volume, for 72 hours at a temperature of $135^{\circ}\text{F} \pm 3^{\circ}\text{F}$ ($57^{\circ}\text{C} \pm 2^{\circ}\text{C}$). The tensile strength reduction shall be reported. The tensile strength shall be reduced no more than 20 percent for fuel immersion and 50 percent for water immersion calculated on the basis of the original cross-sectional area.

4.6.16 Seam adhesion. The seam adhesion of the inner layer ply to itself before and after immersion in TT-S-735, type III test fluid, for 72 hours at a temperature of $135^{\circ}\text{F} \pm 3^{\circ}\text{F}$ ($57^{\circ}\text{C} \pm 2^{\circ}\text{C}$) shall be tested within 4 hours along the length of the seam by the strip-back method, using a jaw separation rate of 2 inches per minute in accordance with FED-STD-601, method 8011. Where the adhesion of the seam is less than the strength of the material, the adhesion shall be a minimum of 6 pounds per inch.

4.6.16.1 Seam adhesion (alternate procedure). As an alternate procedure to the above, the seam adhesions of the inner layer ply to itself may be tested by cutting a strip of inner layer material 1-inch wide, having a seam made in the same manner as is used in the tanks submitted under 4.3.1.1. This seam shall be perpendicular to and midway in the length of the strip. When a tensile load has been applied parallel to the length of the strip of sufficient magnitude to break the strip, there shall be no failure of the seam.

4.6.17 Puncture resistance. A tank wall shall be fastened in a specimen holder in accordance with figure 3. A piercing instrument with its end conforming to figure 3 shall be forced against the tank wall at approximately the center of the area enclosed by the specimen holder. The rate of travel of the piercing instrument shall not exceed 20 inches per minute. The force required to puncture the tank shall be no less than 15 pounds.

4.6.18 Impact resistance. One 12- by 12-inch panel shall be so clamped in a hardwood frame that the area of unsupported panel is at least 120 square inches. A steel ball weighing 0.5 pound shall be dropped on the panel from a height of 10 feet. The impact blow shall be approximately at the center of the area of the panel, which shall be horizontal at the time of the impact. No delamination, rupture, or cracking of the panel shall occur.

4.6.19 Gunfire phase I). Type II, class B sample cubes shall be subjected to gunfire tests when installed in a jig as shown on figure 4. The temperature shall be measured by a thermometer or thermocouple immersed in the fluid. The test cubes shall be mounted 75 feet from the gun. All entrance rounds shall be fired into the cube space occupied by the fluid. A nonmetallic yaw plate may be used for tumbled entrances. The following gunfire schedule shall be used:

Round 1: One .50 caliber projectile 90 degrees to the cube surfaces
3/4-to full tumble.

Round 2: One .50 caliber AP projectile 45 degrees to the cube surface,
straight in, with exit.

Round 3: One 20 millimeter (mm) AP 90 degrees to the cube surface with
exit.

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4.6.19.1 Gunfire tests. Fuel cubes shall be subjected to low and normal temperature gunfire tests. Oil cubes shall be subjected only to a normal temperature gunfire test.

4.6.19.1.1 Low temperature gunfire (fuel cube). The first fuel cube shall be sloshed as specified in 4.6.8. Then the fuel shall be removed and the cube air dried at a temperature of $155^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($68^{\circ}\text{C} \pm 3^{\circ}\text{C}$) for a period of 48 hours. The cube shall then be filled three-fourths-full with TT-S-735, type I fluid or with a fluid of comparable specific gravity and which is satisfactory to the contractor of the acquisition activity. The tank and liquied shall then be so cooled that, at the time of firing, the temperature of the fluid and the cube will be $-40^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($-40^{\circ}\text{C} \pm 3^{\circ}\text{C}$).

4.6.19.1.2 Normal temperature gunfire (fuel cube) The second fuel cube shall be sloshed as specified in 4.6.8. Then the fuel shall be removed and the cube air dried at a temperature of $155^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($68^{\circ} \pm 3^{\circ}\text{C}$) for a period of 48 hours. The cube shall then be filled with water. The temperature of the water at the time of test shall be 50°F to 100°F (10°C to 38°C).

4.6.19.1.3 Normal temperature gunfire (oil cube). Oil cubes shall be sloshed as specified in 4.6.8. The fluid shall be removed. (Hot air drying is not required.) The cube shall be filled with MIL-L-6082, grade 1100 oil, or a liquid having camparable specific gravity. The temperature of the fluid at the time of test shall be 50°F to 100°F (10°C to 38°C).

4.6.19.2 Evaluation

- a. The low temperature gunfire test shall produce no larger than a 4-inch-diameter tear for each entry and exit.
- b. The normal temperature gunfire test shall produce no larger than a 3-inch-diameter tear for each entry and exit.
- c. There shall be no tears which do not radiate from the bullet hole which cannot be accounted for by shrapnel or structure.

4.6.20 Handling (type II tanks only). Prior to installation of the tank or tanks in the test structure, it shall be folded and unfolded 40 times in accordance with standard procedure for shipment. The tank or tanks shall then be installed and removed from the test structure five times. Applicable service procedures shall be followed in tank installation and removal. All fittings shall be fastened to corresponding structure and interconnect fittings upon each installation in the test structure. The tanks shall be in a satisfactory condition upon completion of these tests and shall pass the leakage test specified in 4.6.1.5.

4.6.21 Installation. The tank shall be checked in the applicable test structure. The location of all fittings and the tank dimensions shall be within the allowable tolerances.

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4.6.22 Low temperature leakage

4.6.22.1 Type I, II, and III fuel and oil tanks. The procedure specified herein shall be used for types I, II, and III fuel and oil tanks, after the testing specified in 4.6.6. The tank shall be emptied and the interior of the cavity in which the tank is installed shall be lined with brown paper, except for type I tanks which shall, instead, have all joints, seams, and fittings covered with brown paper to aid in determining leakage.

a. 135°F (57°C) soak: If the fitting installations were not disassembled at the conclusion of the test specified in 4.6.6, the soak time during the slosh and vibration test may be considered as part of this soak period. The tank shall be completely filled with applicable fluid containing a satisfactory staining agent and allowed to stand for 7 days at 135°F \pm 10°F (57°C \pm 5°C).

Fuel tanks shall be filled with TT-S-735, type III fluid; oil tanks shall be filled with the oil to be used in the service aircraft, except oil tanks employed in aircraft using an oil dilution system, where 30 percent by volume of TT-S-735, type III fluid shall be added to the oil.

b. 155°F (68°C) air dryout: The tank shall then be emptied and subject to an air dryout at 155°F \pm 5°F (68°C \pm 3°C) for 7 days.

c. -65°F (-54°C) soak: The tank shall then be completely refilled with the applicable fluid containing a satisfactory staining agent, cooled to -65°F \pm 5°F (-54°C \pm 3°C) and allowed to remain at this temperature a minimum of 3 days. The test fluid in contact with the inner liner and fittings shall have reached -65°F (-54°C) prior to the 3-day period. The tank shall be suitably instrumented to monitor the temperature of the fuel in the tank. For fuel tanks, the test fluid shall be TT-S-735, type I; for oil tanks, the fluid shall be the oil used in the service aircraft, except for oil tanks employed in aircraft using an oil dilution system where 30 percent of TT-S-735, type I fluid shall be added to the oil.

d. Examination: The tank shall then be brought back to room temperature, drained, and examined internally and externally for any unsatisfactory conditions or indications of fluid leakage.

4.6.22.2 Types I, II, and III water-alcohol tanks. The procedure specified herein shall be used for types I, II, and III water-alcohol tanks, after the testing specified in 4.6.6. The tank shall be emptied and the interior of the cavity in which the tank is installed shall be completely lined with brown paper, except for type I tanks which shall, instead, have all joints, seams, and fitting covered with brown paper to aid in determining leakage.

a. 135°F (57°C) soak: The tank shall be refilled with the applicable test fluid specified in 4.5.1, containing a satisfactory staining agent, and allowed to stand for a period of 7 days at a temperature of 135°F \pm 10°F (57°C \pm 5°C).

b. 155°F (68°C) air dryout: The tank shall then be emptied and subjected to an air dryout at 155°F \pm 5°F (68°C \pm 3°C) for 7 days.

c. -65°F (-54°C) soak: Following the air dryout, the empty tank shall be cooled to a temperature of -65°F \pm 5°F (-54°C \pm 3°C) and allowed to remain at this temperature for a minimum period of 3 days.

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d. -15°F (-26°C) soak: The tank shall then be filled with the applicable test fluid specified in 4.5.1, containing a satisfactory staining agent, cooled to a temperature of $-15^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($-26^{\circ}\text{C} \pm 3^{\circ}\text{C}$), and allowed to remain at this temperature for a minimum period of 3 days. The outside layer of water-alcohol shall have reached -15°F (-26°C) prior to start of the 3-day period.

e. Examination: The tank shall then be drained and examined externally and internally for any unsatisfactory conditions or indications of fluid leakage.

4.6.23 Stand test (phase II). Upon completion of the low temperature leakage test (4.6.22) for type II tanks, the cavity shall be completely lined with brown paper. For type III tanks, the tanks shall be prepared as specified by the acquisition activity for the detection of leakage. The tank shall be emptied and refilled with the applicable test fluid, as specified in 4.5.1, containing a satisfactory staining agent. The tank shall be allowed to stand at ambient temperature for a period of 30 days at which time the tank shall be drained and examined for any unsatisfactory condition or indication of fluid leakage. All joints, seams, and fittings shall be covered with brown paper to aid in determining leakage. An alternate method of detecting leakage during this test is acceptable, if approved by the acquisition activity.

4.6.24 Gunfire (phase II). Only type II, class B tanks which exceed 150 gallons in capacity shall undergo the phase II gunfire test. For this test, the tank shall be mounted in the actual structure for which it is designed. The tank shall then be filled three-fourths-full with water. The number of rounds of .50 caliber AP ammunition to be fired will be determined on the basis of one round for each 30 gallons of tank capacity up to a maximum of 6 rounds. In addition to the .50 caliber gunfire, one round of 20 mm AP shall be fired. All shots shall be so placed as to be compatible with the aircraft installation and the combat ability of the aircraft. No bursts shall be fired and the test shall be conducted at ambient temperatures. This test shall produce no larger than a 4-inch-diameter tear for each entry and exit. There shall be no tears which do not radiate from a bullet hole which cannot be accounted for by shrapnel or structure.

4.6.25 Accelerated loads test. The tank assembly, consisting of the tank and tank structure shall be mounted in a support jig that provides support equivalent to the aircraft structure for which it is designed and subjected to the applicable dynamic load tests specified herein to simulate the aircraft design accelerations including the appropriate magnification factors. The tank shall be tested at fill levels of 25, 50, 75, and 100 percent of the rated capacity. Tanks of pressurized systems shall be subjected to the normal operating pressures for the condition being tested, except where unpressurized conditions are considered more critical. Deflections on various parts of the tank structure including the areas surrounding components within the cell shall be measured during the test.

4.6.25.1 Accelerated loads test to design limit load. The tank assembly shall be subjected to 100 percent design limit accelerations at the four fill levels and pressurized conditions to determine the most critical condition. Then the tank shall be subjected to 100 load applications at this critical condition applicable to Navy Aircraft only. For Air Force and Army aircraft one application at each fill level is required. There shall be no evidence of failure, leakage or chaffing of the cell or components. Further, the deflection of the cell shall be such that there will be no contact with the tank or aircraft components.

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4.6.25.2 Accelerated loads test to design ultimate load. The tank assembly shall be subjected to one application of load at 150 percent of the design limit load at the most critical condition. There shall be no evidence of failure, leakage, or deflection that contacts the tank or aircraft components.

4.6.25.3 Accelerated loads test of carrier based aircraft to design limit load. Following the tests of 4.6.25.1 and prior to the tests of 4.6.25.2, the tank assembly shall be subjected to 100 percent design limit accelerations simulating catapult launched and arrested landings at the specified fill levels and pressurized conditions to determine the most critical catapult launch and arrested landing condition. Then, the tank shall be subjected to 100 load applications at the critical catapult launch condition and 100 load applications at the critical arrested landing condition. There shall be no evidence of failure, leakage or chaffing of the cell or components. Further, the deflection of the cell shall be such that there will be no contact with the tank or aircraft components.

4.6.25.4 Accelerated loads test of carrier based aircraft to design ultimate load. The tank assembly shall be subjected to one application of load at 150 percent of the design limit load at both the most critical catapult launch and the Host critical arrested landing condition. There shall be no evidence of failure, leakage or deflection that contacts the tank or aircraft components.

4.6.26. Proof pressure (types I and III tanks). After all air has been bled from the tank and the necessary ports plugged, hydrostatic pressure equal to 1.33 times the maximum operating pressure shall be applied to the sample tank and held for a minimum of 2 minutes. Any evidence of permanent set, distortion, or failure of any kind shall be cause for rejection. Water may be used for this test.

4.6.27 Burst pressure types I and III tanks). All air shall be bled from the tank and the necessary ports plugged. Hydrostatic pressure shall then be applied to the tank. This pressure shall be at least 2.0 times the maximum operating pressure. Evidence of permanent set or distortion shall be permitted, but any evidence of rupture shall be cause for rejection. Water may be used for this test.

4.6.28 Fitting tests. Basic integrity of the fittings shall be demonstrated during the phase II test as specified in table III. In addition, the following tests shall be conducted:

4.6.28.1 Insert tests. Six inserts shall be used for each of the following tests. These tests may be conducted on fitting rings other than those used in tests specified in 4.6.28.2 and 4.6.28.3.

4.6.28.1.1 Bottoming. A bolt of sufficient threaded length to prevent shanking shall be lubricated with JP-4 or test fluid and engaged with the insert until the bottom of the bolt is in contact with the bottom of the insert or tapped hole. The maximum allowable torque as specified in table I shall be applied to the bolt. The bolt shall then be removed and the insert and fitting shall be inspected for damage. Any evidence of damage to the insert or fitting or any rotation of the insert shall constitute failure.

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4.6.28.1.2 Shanking. A bolt with the threaded length short enough to prevent bottoming, shall be shanked out against the top thread of the insert and the maximum allowable torque as specified in table I applied. The insert shall not pull out or rotate and there shall be no damage to the insert threads.

4.6.28.1.3 Insert pull out. The insert shall be bridged by washers or other suitable spacers in such a manner that an extracting force will be exerted on the insert when a bolt is inserted and tightened. The length of the spacer in relation to the bolt shall permit engagement of the bolt with the insert to a depth of approximately 1 diameter. The bolt shall be torqued to the maximum allowable torque specified in table I. The insert shall not pull out or rotate nor shall the insert threads be damaged.

4.6.28.1.4 Endurance (self locking inserts only). For this test a bolt length will be selected which will permit engagement of the bolt with the insert to a depth approximately equal to that for an actual aircraft installation. The bolt shall be installed and removed a total of 50 times. At the beginning and at the end of the test, the torque values shall comply with table I.

4.6.28.2 Fluid resistance and extreme temperature. Two fitting assemblies for each basic design used in the tank being qualified shall be built into panels of the same construction as the tanks mounted in a vibration jig conforming to figure 5 and subjected to the fuel resistance and extreme temperature test as specified in tables V and VI. Brown paper or talc shall be used for the determination of fitting leakage. There shall be no visual evidence of deterioration, delamination or leakage. The panel may be reinforced with a fabric collar in the area of the clamping ring.

4.6.28.3 Fitting pull-out test. A fitting shall be built into a flat panel that will sustain at least 190 pounds 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 6. There shall be no failure of any portion of the fitting or its means of attachment to the flat panel.

4.6.29 Flight. Flight tests of internal jettisonable fuel tanks shall conform to MIL-D-87038 for all acquisition.

5. PACKAGING

5.1 Preservation, packaging and packing.

5.1.1 Type I tanks. Preservation, packaging and packing of type I tanks shall be as specified in the contract or purchase order (see 6.2).

5.1.2 Type I and III tanks. Preservation, packaging and packing of type II and III tanks shall be in accordance with MIL-P-25621, level A, B, or C, as specified in the contract or purchase order (see 6.2).

5.2 Marking of shipments. Markings shall conform to MIL-STD-129 and MIL-P-25621.

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TABLE V. Fluid resistance of fittings (type II and III fuel tanks).

Cycle	Test Fluid	Temp	Gage Pressure	Time	Vibration	Instructions
1	TT-S-735 (Type III)	+135°F (+57°C)	0	3 days	No	At beginning of test, fitting shall be torqued to installation torque. Retorquing shall not be permitted.
2	Air	+158°F ±20°F (+70°C ±10°C)	0	1 day	No	
3	TT-S-735 (Type III)	+135°F (+57°C)	1/	3 days	No	
4	Dry Air	+158°F ±20°F (+70°C ±10°C)	0	20 hours	No	Vibrate for first 24 hours.
5	JP-4	Room	1/	1 day	No	
6	Dry Air	+158°F ±20°F (+70°C ±10°C)	0	120 hours	Yes	
7	TT-S-735 (Type I)	-65°F (-54°C)	0	24 hours	No	Vibrate for last 24 hours only.
8	TT-S-735 (Type I)	-65°F (-54°C)	1/	48 hours	Yes	

1/ Proof pressure as defined by contract.

TABLE VI. Fluid resistance of fittings (type II and III oil tanks).

Cycle	Test Fluid	Temperature		Gage Pressure	Time	Vibration	Instructions
1	TT-S-735 (Type IV)	+215°F (+102°C)	+275°F (+135°C)	0	3 days	No	At beginning of test, fitting shall be torqued to installation torque. Retorquing shall not be permitted.
2	Air	+158°F ±2°F (+70°C ±1°C)	+158°F ±2°F (+70°C ±1°C)	0	1 day	No	
3	TT-S-735 (Type IV)	+215°F (+102°C)	+275°F (+135°C)	2/	3 days	No	
4	Dry Air	+158°F ±2°F (+70°C ±1°C)	+158°F ±2°F (+70°C ±1°C)	0	20 hours	No	Vibrate for first 24 hours only.
5	1/	Room	Room	2/	1 day	No	
6	Dry Air	+158°F ±2°F (+70°C ±1°C)	+158°F ±2°F (+70°C ±1°C)	0	120 hours	Yes	
7	1/	-65°F (-54°C)	-65°F (-54°C)	0	24 hours	No	Vibrate for last 24 hours only.
8	1/	-65°F (-54°C)	-65°F (-54°C)	2/	48 hours	Yes	

1/ TT-S-735 (type IV) diluted 40 percent with TT-S-735 (type I)

2/ Proof pressure as defined by contract

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6. NOTES

6.1 Intended use. Removable non-self-sealing engine fluid system tanks are intended for use in aircraft as a means for carrying engine fluids such as oil, fuel, cooling fluids, or water injection fluids. Fuel tanks are intended for use with all grades of aircraft engine fuel.

6.2 Ordering data.

6.2.1 Acquisition documents. Acquisition documents should specify:

- a. Title, number, and date of this specification.
- b. Model designation of the aircraft.
- c. Name of the tank manufacturer.
- d. Part number, type, class of tank and fluid suitability desired (see 1.2 and 4.5.1).
- e. Applicable level of preservation, packaging, and packing for type I tanks (see 5.1.1).
- f. Applicable levels of preservation, packaging, and packing for types II and III tanks (see 5.1.2).
- g. Where the preproduction test samples should be sent, the activity responsible for testing, and instructions concerning the submittal of test reports (see 4.3).
- h. Statement indicating if dissection test is to be imposed as a sampling test or as a contingency option (see 4.4.2.3).

6.2.2 Contract data requirements. When this specification is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DAR 7-104.9(n)(2) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification is cited in the following paragraph:

Paragraph No.	Data Requirement	Applicable DID No.	Option
4.3.3	Reports, Test	DI-T-2072	

(Copies Of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.3 Preproduction inspection

6.3.1 Requests for information. Requests for information pertaining to the preproduction inspections should be addressed to Wright-Patterson AFB OH 45433, Attn: ASD/ENFEF; or Naval Air Systems Command, Washington, DC 20360, Attn: (ESSD) Code ES.

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

6.4.1 Contractor. This term refers to the aircraft contractor.

6.4.2 Manufacturer. This term and the terms tank manufacturer and supplier are used interchangeably to indicate the particular plant where the tank is manufactured.

6.4.3 Acquistion activity. This term refers to any acquisition activity.

6.4.4 Service life. Based upon past experience, it appears that the normal tank service life is equivalent to that of the aircraft in which they are installed.

6.4.5 Construction. This term means a specified combination of materials, material arrangements, and manufacturing methods (mold/mandrel, joint designs~ and other necessary included techniques).

6.4.6 Approved construction. This term means a construction that has been granted phase I preproduction test approval and consists of a specified combination of materials, material arrangements, and manufacturing methods (mold/mandrel, joint designs, and other necessary included techniques) that have been successfully demonstrated during phase I preproduction tests.

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

Custodians:

Army - AV
Navy - AS
Air Force - 11

Preparing activity:

Air Force - 11

Project No. 1560-0119

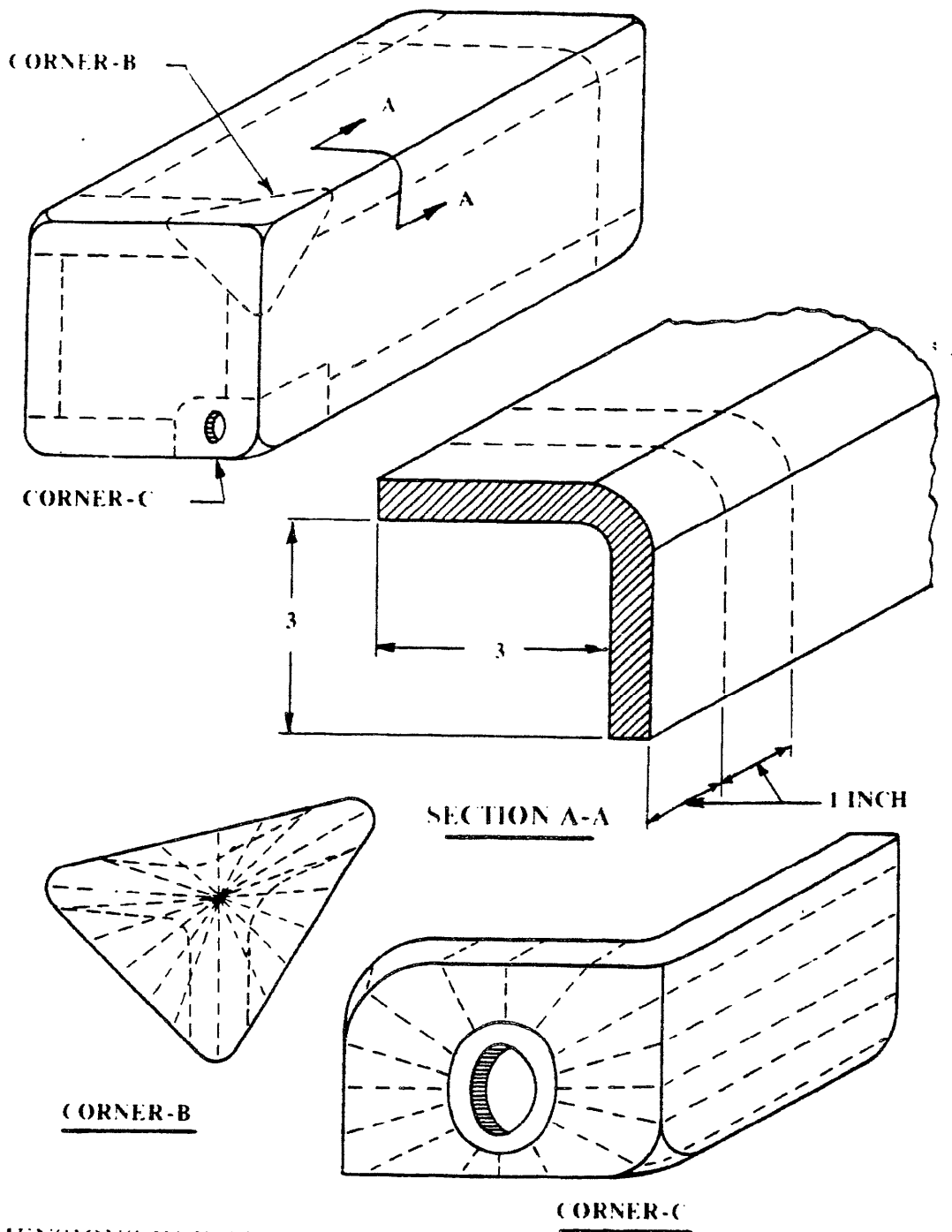
Review activities:

Air Force - 99, 80

User activities:

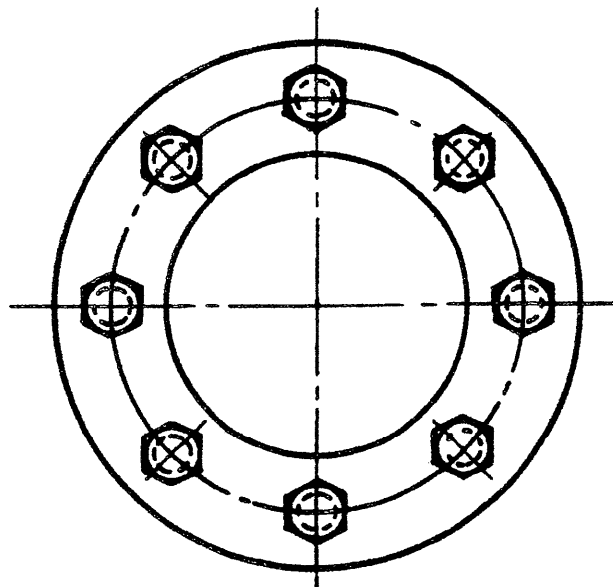
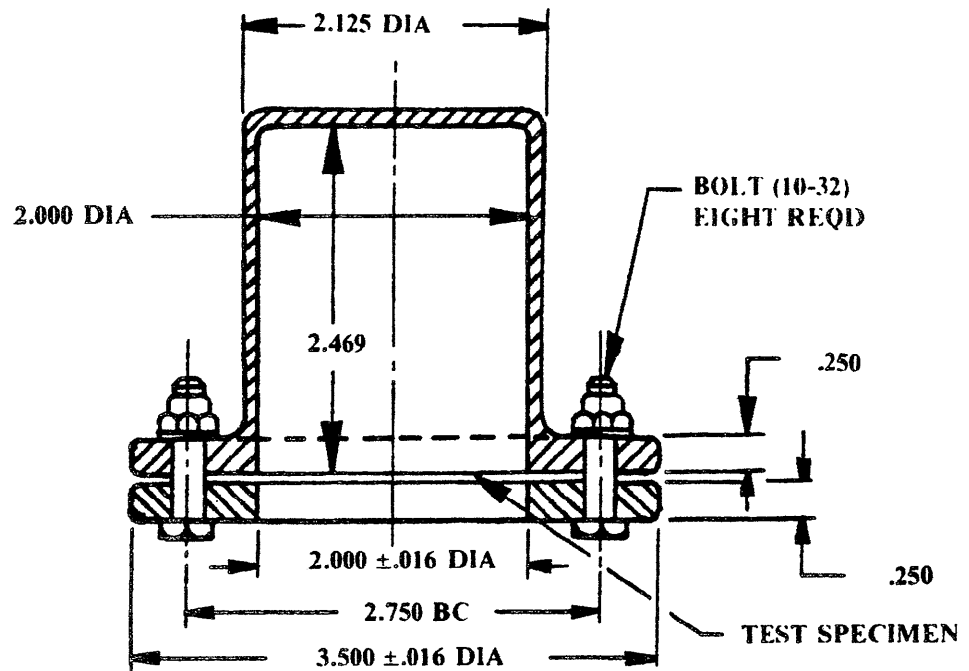
Army - ME

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DIMENSIONS IN INCHES.
CUT ON DOTTED LINES.

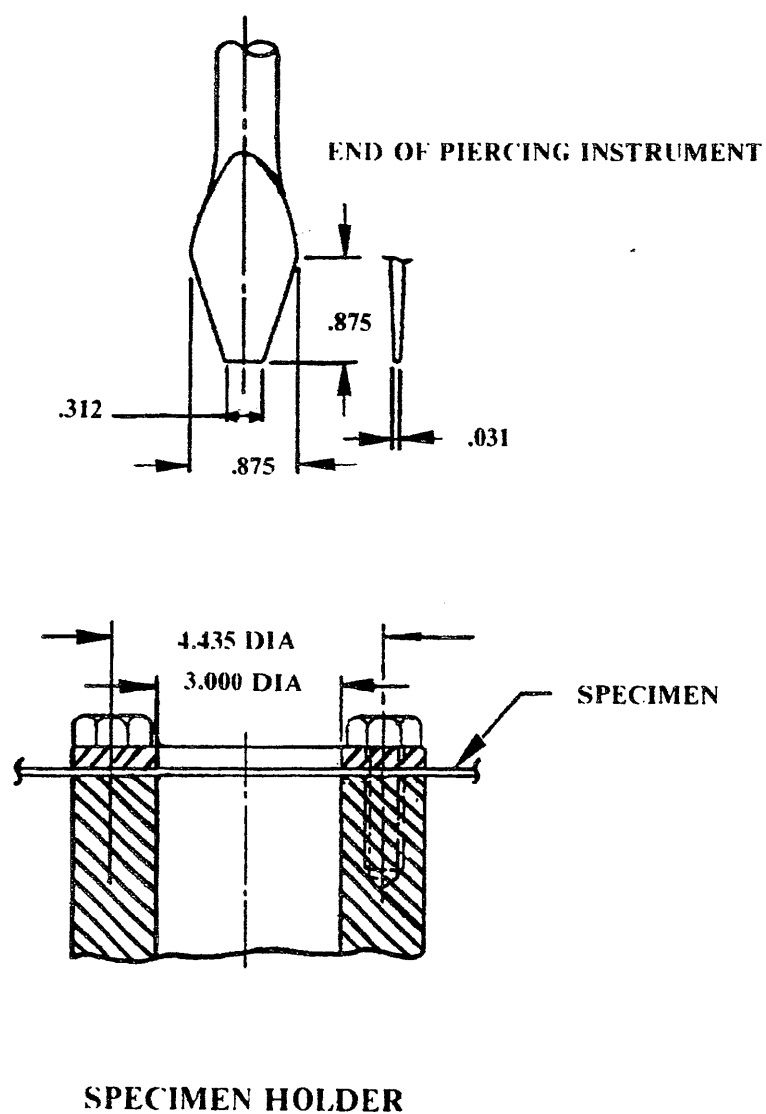
FIGURE 1. Location of cuts for dissection sample.



DIMENSIONS IN INCHES.

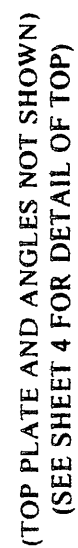
FIGURE 2. Permeability cup assembly.

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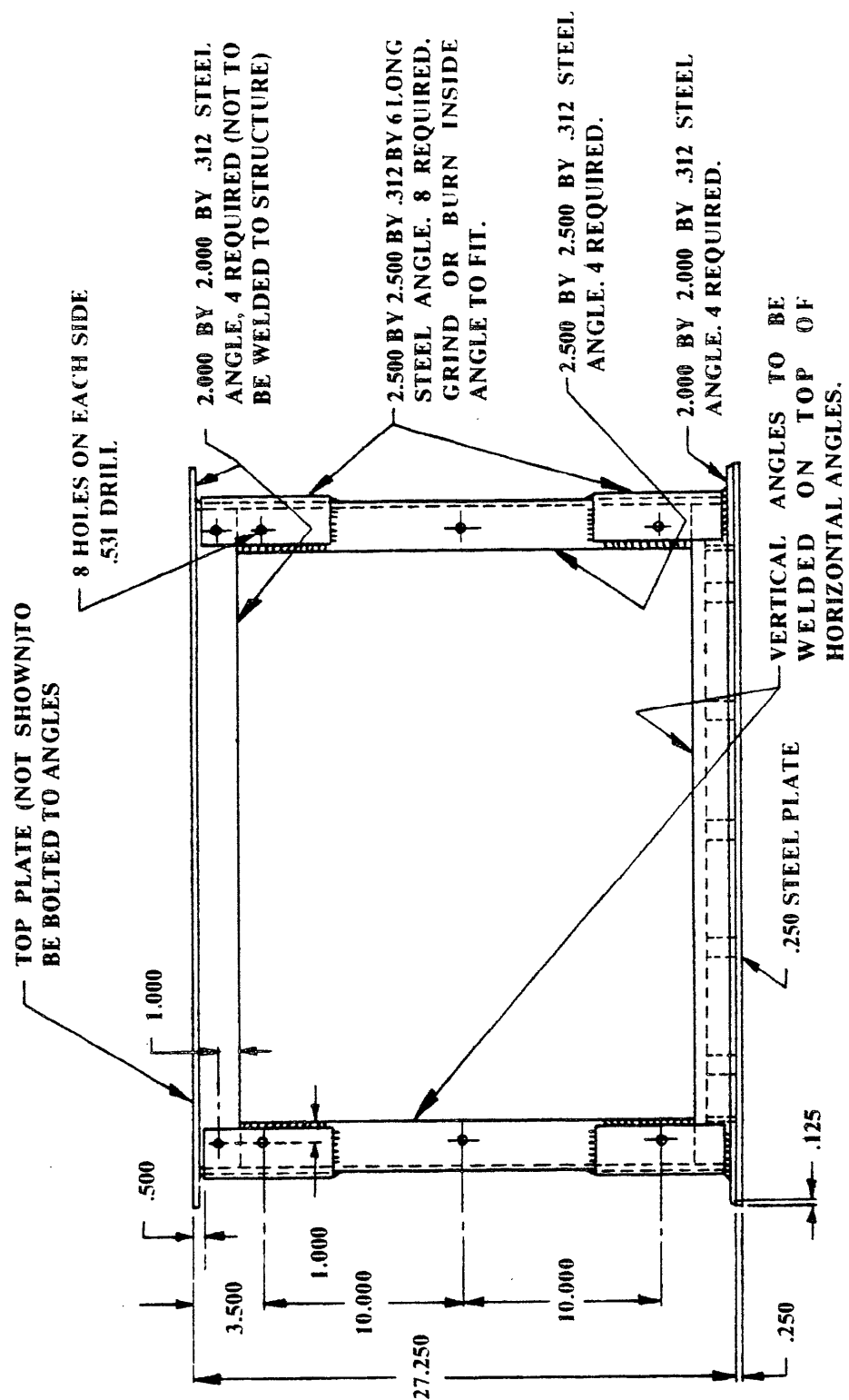
DIMENSIONS IN INCHES.

FIGURE 3. Piercing instrument and specimen holder.



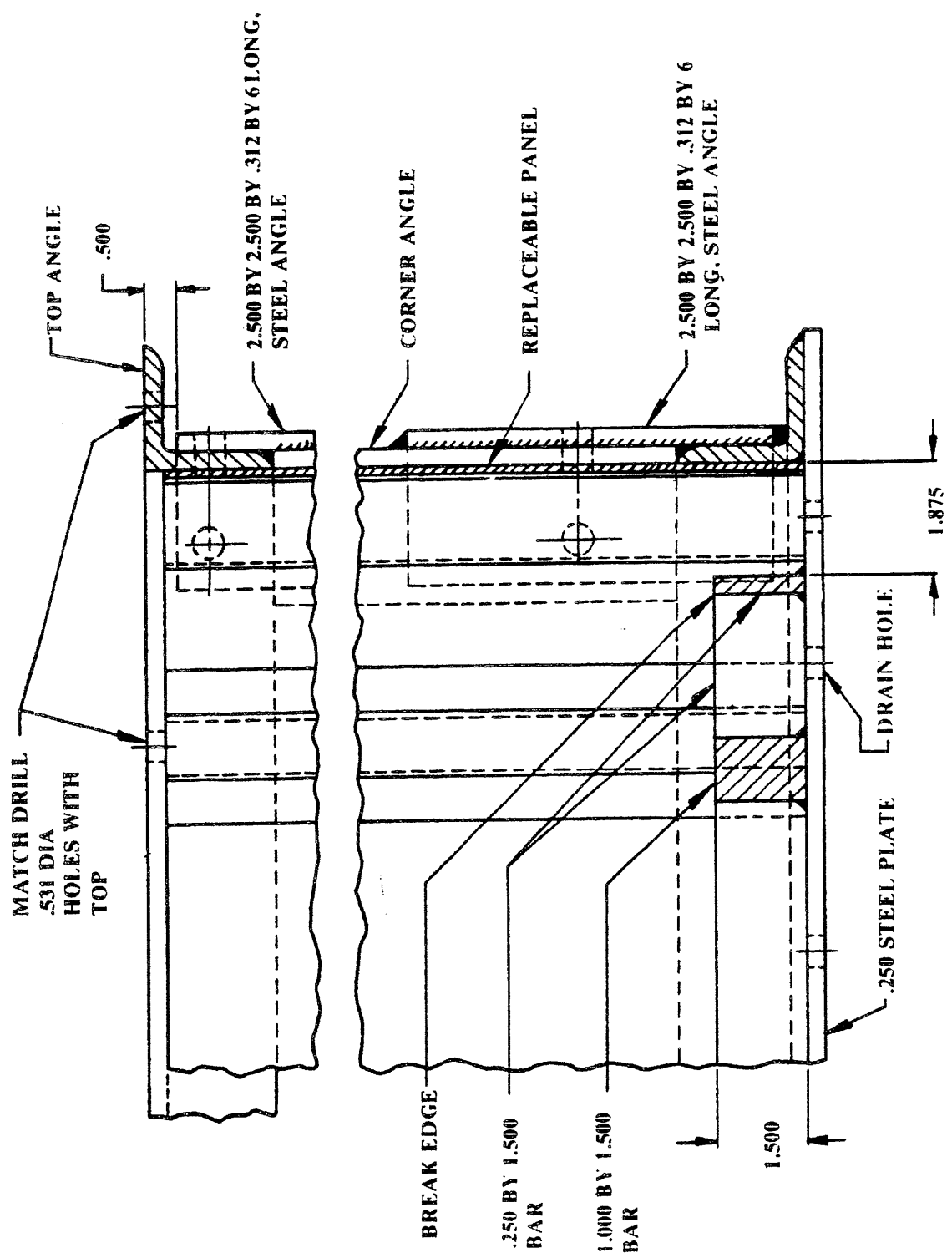
DIMENSIONS IN INCHES. TOLERANCES, DECIMALS $\pm .016$.

FIGURE 4. Gunfire test structure (sheet 1).



DIMENSIONS IN INCHES. TOLERANCES, DECIMALS $\pm .016$.

FIGURE 4. Gunfire test structure (sheet 2). -- Continued



SECTION A-A
DIMENSIONS IN INCHES. TOLERANCES, DECIMALS $\pm .016$.

FIGURE 4. Gunfire test structure (sheet 3). - Continued

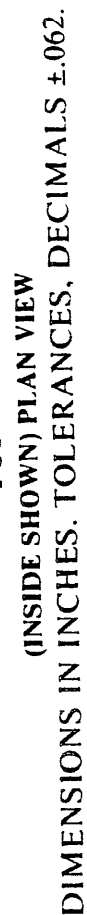
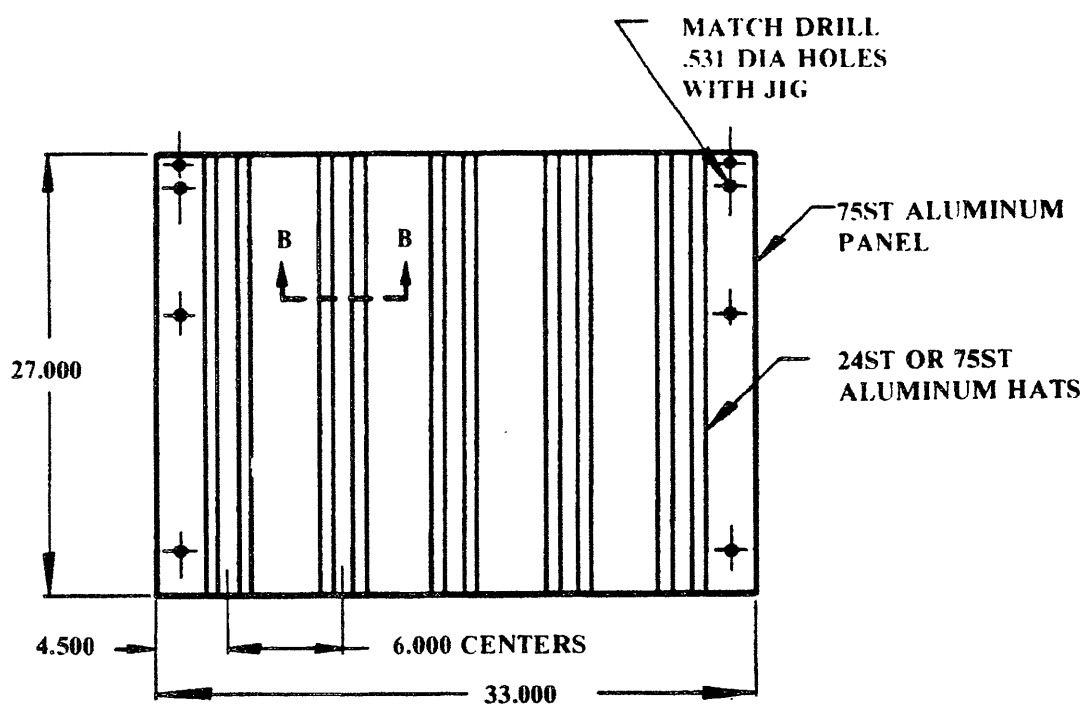
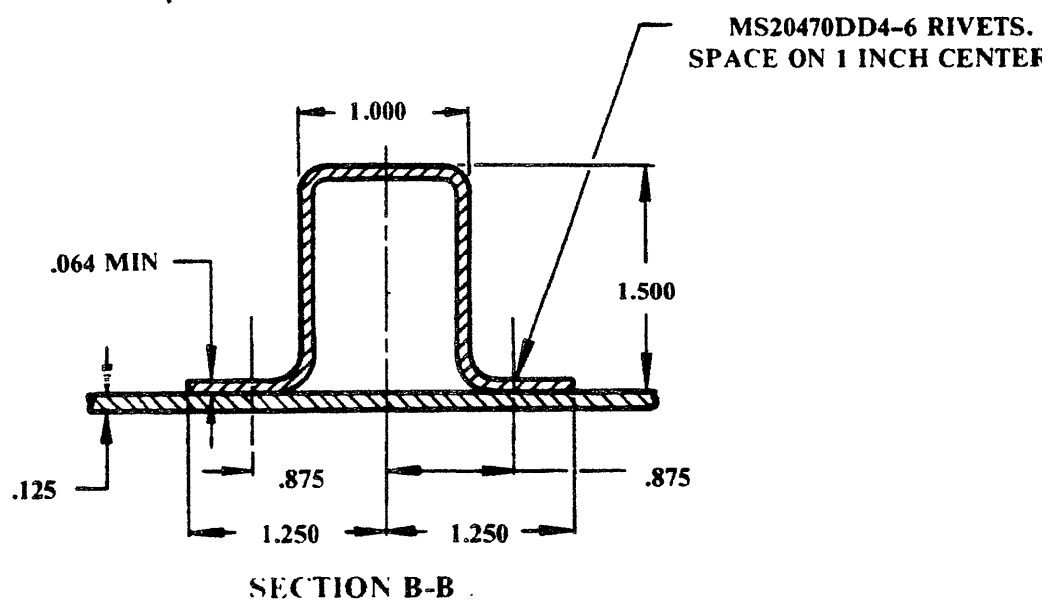


FIGURE 4. Gunfire test structure (sheet 4). - Continued

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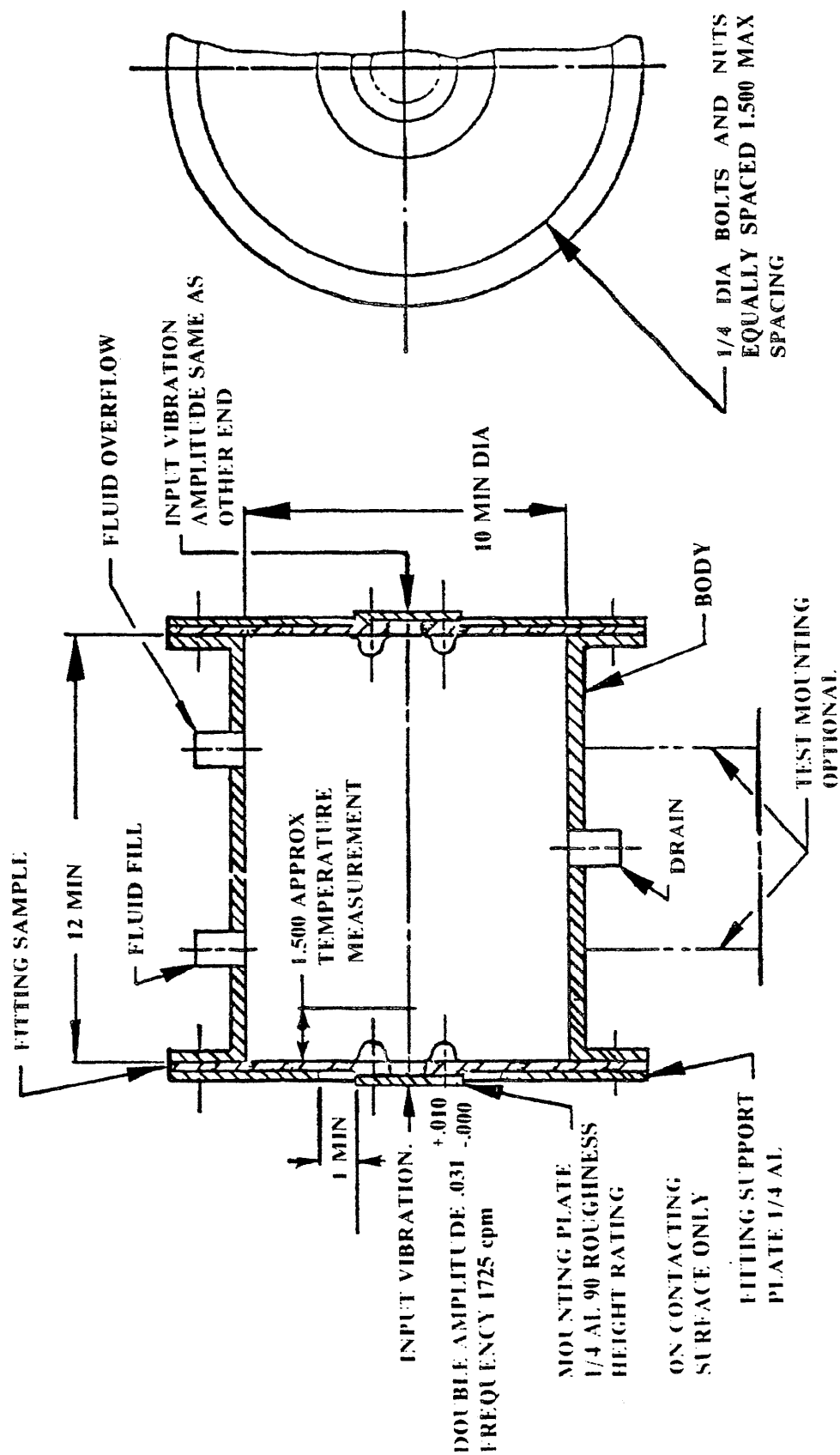
REPLACEABLE PANEL - 4 REQUIRED PER STRUCTURE



DIMENSIONS IN INCHES. TOLERANCES, DECIMALS $\pm .062$.

FIGURE 4. Gunfire test structure (sheet 5). - Continued

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

FIGURE 5. Vibration test setup.

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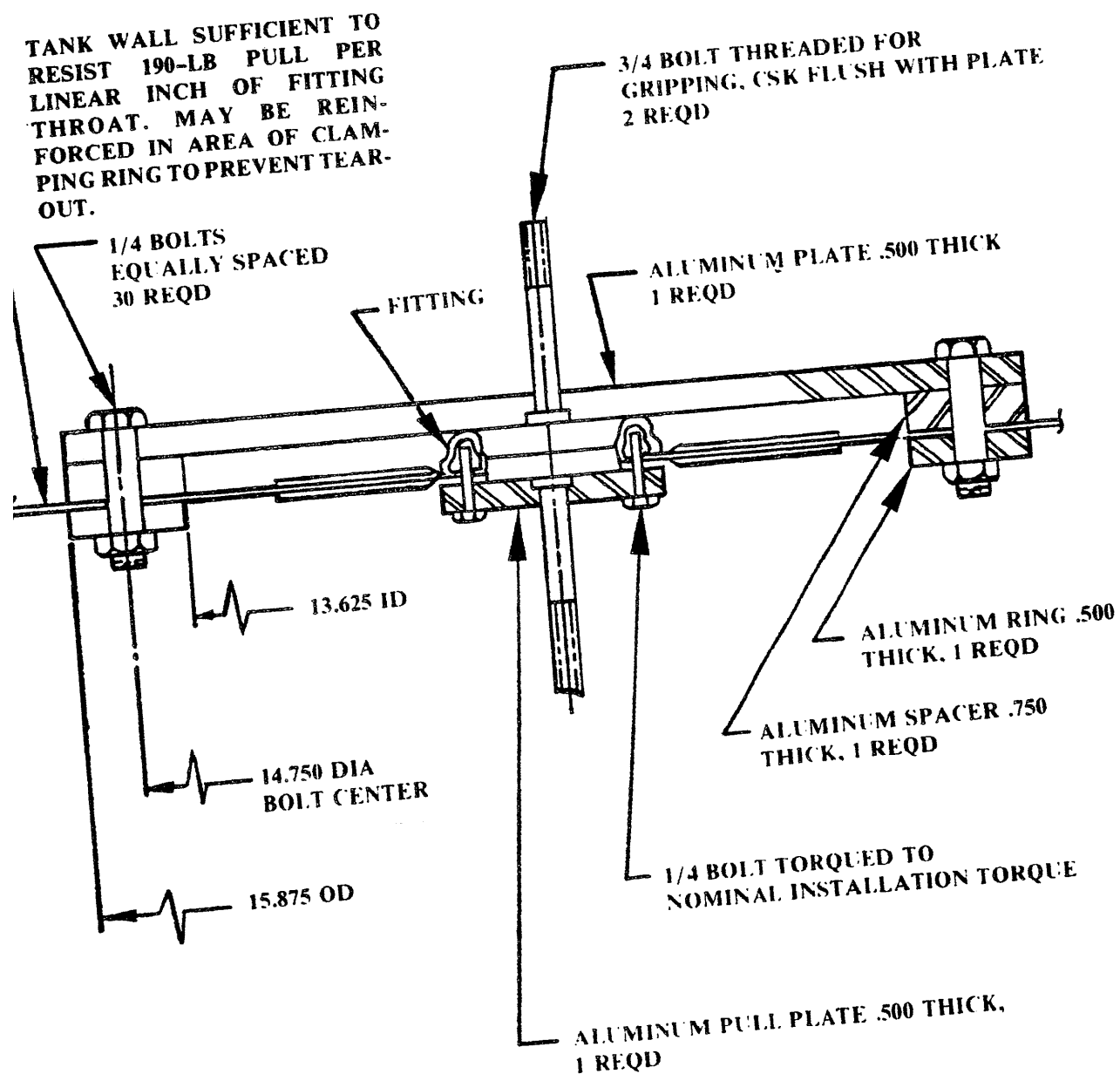


FIGURE 6. Fitting pullout test setup.

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MIL-T-6396E

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4. TYPE OF ORGANIZATION (Mark one)

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VENDOR

☐

USER

☐

MANUFACTURER

☐

OTHER (Specify): _____

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5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

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8. DATE OF SUBMISSION (YYMMDD)