



Technical Standard Order

Subject: TSO-C80, FLEXIBLE AND OIL CELL MATERIAL

Technical Standards Orders for Aircraft Materials, Parts and Appliances

Part 514 which contains minimum performance standards and specifications for materials, parts, and appliances used in aircraft consists of two subparts. Subpart A contains the general requirements applicable to all Technical Standard Orders. Subpart B contains the technical standards and specifications to which a particular product must conform.

ANY TECHNICAL STANDARD ORDER MAY BE OBTAINED BY SENDING A REQUEST TO FAA, WASHINGTON 25, D.C.

Subpart A—GENERAL

§514.0 Definition of terms.

As used in this part:

(a) "Administrator" means the Administrator of the Federal Aviation Agency or any person to whom he has delegated his authority in the matter concerned.

(b) "FAA" means Federal Aviation Agency.

(c) "Manufacturer" means a person who controls the design and quality of an article produced under the TSO system, including all parts thereof and processes and services related thereto obtained from outside sources.

(d) "Article" means the materials, parts, or appliances for which approval is required

under the Civil Air Regulations for use on civil aircraft.

§514.1 Basis and purpose.

(a) *Basis.* Section 601 of the Federal Aviation Act of 1958, and §§3.18, 4a.31, 4b.18, 5.18, 6.18, 7.18, 10.21, 13.18, and 14.18 of this title (Civil Air Regulations).

(b) *Purpose.* (1) This part prescribes in individual Technical Standard Orders the minimum performance and quality control standards for FAA approval of specified articles used on civil aircraft¹, and prescribes the methods by which the manufacturer of

such articles shall show compliance with such standards in order to obtain authorization for the use of the articles on civil aircraft.

(2) The performance standards set forth in the individual Technical Standard Orders are those standards found necessary by the Administrator to assure that the particular article when used on civil aircraft will operate satisfactorily, or accomplish satisfactorily its intended purpose under specified conditions.

¹Articles may also be approved and manufactured for use on civil aircraft as a part of the type design of a type certificate for an aircraft engine or propeller.

§514.2 TSO authorization.

(a) *Privileges.* No person shall identify an article with a TSO marking unless he holds a TSO authorization and the article meets the applicable TSO standards prescribed in this part.

(b) *Letters of acceptance issued prior to July 1, 1962.* An FAA letter of acceptance of a statement of conformance issued for an article prior to July 1, 1962, is an authorization within the meaning of this part and the holder thereof may continue to manufacture such article without obtaining an additional TSO authorization, but shall comply with the requirements of §514.3 through §514.10.

(c) *Application.* The manufacturer or his duly authorized representative shall submit an application for a TSO authorization together with the following documents (See Appendix A of this subpart for sample application) to the Chief, Engineering and Manufacturing Branch, Flight Standards Division, in the region in which the manufacturer is located.²

(1) A statement of conformance certifying that the applicant has complied with the provisions of Subpart A and the article meets the applicable performance standards established in Subpart B of this part (See Appendix B

of this subpart for sample statement of conformance);

(2) Copies of the technical data required in the performance standards set forth in Subpart B of this part for the particular article;

(3) A description of his quality control system in the detail specified in §1.36 of this title (Civil Air Regulations). In complying with this provision the manufacturer may refer to current quality control data filed with the Agency, as a part of a previous application.

NOTE: When a series of minor changes in accordance with §514.5 is anticipated, the manufacturer may set forth in his application the basic model numbered article with open brackets after it to denote that suffix change letters will be added from time-to-time e.g., Model No. 100().

(d) *Issuance.* (1) Upon receipt of the application and adequate supporting documents specified in paragraph © of this section to substantiate the manufacturer's statement of conformance with the requirements of this part and his ability to produce duplicate articles in accordance with the provisions of this part, the applicant will be given an authorization to identify his article with the applicable TSO marking.

(2) If the application is deficient in respect to any requirements, the applicant shall, upon request by the Chief, Engineering and Manufacturing Branch, sub-

mit such additional information as may be necessary to show compliance with such requirements. Upon the failure of the applicant to submit such additional information within 30 days after the date of the request therefor, his application will be denied and he will be so notified by the Chief, Engineering and Manufacturing Branch.

NOTE: The applicant will be issued an authorization or notified of the denial of his application within 30 days after the date of receipt of such application or, in the event that additional information has been requested, within 30 days after the date of receipt of such additional information.

§514.3 Conditions on authorizations.

The manufacturer of an article under an authorization issued under the provisions of this part shall—

(a) Manufacturer such article in accordance with the requirements of Subpart A and the performance standards contained in the applicable TSO of Subpart B of the part;

(b) Conduct the required tests and inspections, and establish and maintain a quality control system adequate to assure that such article, as

²Regional Offices are located at New York, Atlanta, Kansas City, Fort Worth, Los Angeles, Anchorage.

manufactured, meets the requirements of paragraph (a)

of this section and is in a condition for safe operation;

(c) Prepare and maintain for each type or model of such article a current file of complete technical data and records in accordance with §514.6; and

(d) Permanently and legibly mark each such article with the following information:

(1) Name and address of the manufacturer,

(2) Equipment name, or type or model designation,

(3) Weight to the nearest tenth of a pound,

(4) Serial number and/or date of manufacturer, and

(5) Applicable Technical Standard Order (TSO) number.

§514.4 Deviations.

Approval for a deviation from the performance standards established in Subpart B may be obtained only if the standard or standards for which deviation is requested are compensated for by factors or design features which provide an equivalent level of safety. A request for such approval together with the pertinent data shall be submitted by the manufacturer to the Chief, Engineering and Manufacturing Branch of the Region in which the applicant is located.

§514.5 Design changes.

(a) *By Manufacturer*—(1) *Minor changes.* The manufacturer of an article under an authorization issued pursuant to the provisions of this part may make minor design changes to the article without further approval by the FAA. In such case the changed article shall retain the original model number and the manufacturer shall forward to the Chief, Engineering and Manufacturing Branch such revised data as may be necessary for compliance with §514.2(c).

(2) *Major changes.* If the changes to the article are so extensive as to require a substantially complete investigation to determine compliance with the performance standards established in Subpart B, the manufacturer shall assign a new type or model designation to the article and submit a new application in accordance with the provisions of §514.2(c).

(b) *By persons other than the manufacturer.* Design changes to an article by a person other than the manufacturer who submitted the statement of conformance for such article are not eligible for approval under this part, unless such person is a manufacturer as defined in §514.0 and applies for authorization under §514.2(c).

NOTE: Persons other than a manufacturer may obtain approval

for design changes to a product manufactured under a TSO pursuant to the provisions of Part 18 or the applicable airworthiness regulations.

§514.6 Retention of data and records.

(a) A manufacturer holding an authorization issued pursuant to the provisions of this part shall, for all articles manufactured under such authorization on and after July 1, 1962, maintain and keep at his factory:

(1) A complete and current technical data file for each type or model of article which shall include the design drawings and specifications. This technical data shall be retained for the duration of his operation under the provisions of this part.

(2) Complete and current inspection records to show that all inspections and tests required to ensure compliance with this part have been properly accomplished and documented. These records shall be retained for at least two years.

(b) The data specified in paragraph (a) (1) of this section shall be identified and copies transferred to the FAA for record purposes in the event the manufacturer terminates his business or no longer operates under the provisions of this part.

§514.7 Inspection and examination of data, articles or manufacturing facilities.

The manufacturer shall, upon request, permit an authorized representative of the FAA to inspect any article manufactured pursuant to this part, and to observe the quality control inspections and tests and examine the manufacturing facilities and technical data files for such article.

§514.8 Service difficulties.

Whenever the investigation of an accident or a service difficulty report shows an unsafe feature or characteristic caused by a defect in design or manufacture of an article, the manufacturer shall upon the request of the Chief, Engineering and Manufacturing Branch, report the results of his investigation and the action, if any, taken or proposed by him to correct the defect in design or manufacture (e.g., service bulletin, design changes, etc.). If the defect requires a design change or other action to correct the unsafe feature or characteristic, the manufacturer shall submit to the Chief, Engineering and Manufacturing Branch, the data necessary for the issuance of an airworthiness directive containing the appropriate corrective action.

§514.9 Noncompliance.

Whenever the Administrator finds that a manufacturer holding an authorization issued pursuant to the provisions of this part has identified an article by a TSO marking and that such article does not meet the applicable performance standards of this part, the Administrator may, upon notice thereof to the manufacturer, withdraw the manufacturer's authorization and, where necessary, prohibit any further certification or operation of a civil aircraft upon which such article is installed until appropriate corrective action is taken.

§514.10 Transferability and duration.

An authorization issued pursuant to the provisions of this part shall not be transferred and is effective until surrendered, or withdrawn, or otherwise terminated by the Administrator.

APPENDIX A
SAMPLE APPLICATION FOR
TSO AUTHORIZATION

(Date)
(Addressed to: Chief, Engineering and Manufacturing Branch, Federal Aviation Agency, Region.)

Application is hereby made for authorization to use the Technical Standard Order procedures.

Enclosed is a statement of conformance for the article to be produced under TSO-C_____.

The required quality control data¹ are transmitted: (herewith) (under separate cover).

Signed_____

APPENDIX B
SAMPLE STATEMENT OF
CONFORMANCE

(Date)
(Addressed to: Chief, Engineering and Manufacturing Branch, Flight Standards Division, Federal Aviation Agency.)

The undersigned hereby certifies that the article listed below by model, type of part number has been tested and meets the performance standards of Technical Standard Order C_____. In addition all other applicable provisions of Part 514 of the Regulations of the Administrator have been met.

The technical data required by the TSO in the quantity specified are transmitted: (herewith) (under separate cover).

Authorization to use TSO identification on the article is requested.

Signed_____

¹Reference may be made to data already on file with the FAA.

§ 514.86 *Flexible fuel and oil cell material – TSO-C80.*

(a) *Applicability.* Minimum performance standards are hereby established for flexible fuel and oil cell liner material. New types of flexible fuel and oil cell material manufactured after the effective date of this section for use in civil aircraft of the United States shall meet the standards specified in the Federal Aviation Agency Standard, “Flexible Fuel and Oil Cell Material”, dated August 1, 1963.^{1/}

(b) *Marking.* In lieu of the marking requirements of § 514.3(d), flexible fuel and oil cell material shall be legibly and permanently marked with the following information:

- (1) Name and address of the manufacturer;
- (2) Type of fluid for which approved i.e. fuel, or MIL-L-7808 oil;
- (3) For oil cell material, the minimum and maximum temperature limit;
- (4) For oil cell material, the oil dilution suitability;
- (5) Month and year manufactured; and
- (6) Applicable Technical Standard Order (TSO) number.

(c) *Data requirements.* In accordance with the provisions of § 514.2, the manufacturer shall furnish to the Chief, Engineering and Manufacturing Branch, Flight Standards

Division, Federal Aviation Agency, in the region in which the manufacturer is located, the following technical data:

(1) Six copies of the manufacturer's end product typical assembly instructions and limitations;

(2) Six copies of the recommended installation procedures, limitations, restrictions, or other conditions pertinent to a satisfactory installation;

(3) Six copies of the instructions for the inspection, repair and storage of material and/or cells including age limits on material and/or cells including ate limits on material, i.e. shelf life and service time;

(4) Six copies of the following descriptive information:

(i) construction number and description (ply by ply) of the construction buildup complete with weight and gage of each ply,

(ii) support means (type of fastener and locations),

(iii) total weight per square foot of cell constructions, and

(iv) total thickness of cell construction; and

(5) One copy of the manufacturer's test report.

(d) *Effective date.* May 26, 1964.

^{1/} Copies may be obtained upon request addressed to Publishing and Graphics Branch, Inquiry Section, MS-158, Federal Aviation Agency, Washington 25, D.C.

August 1, 1963

**FEDERAL AVIATION AGENCY STANDARD
FOR
FLEXIBLE FUEL AND OIL CELL MATERIAL**

1.0 Purpose: To specify minimum requirements for flexible fuel and oil cell material intended for use in fuel and oil tanks of aircraft.

2.0 Scope: This standard covers the requirements of fuel and oil cell material in which hydrostatic loads are resisted by the structure of the cavity or tank and not by the cell material itself.

3.0 General Requirements:

3.1 Materials. Samples of flexible fuel and oil cell materials and construction techniques shall be subjected to and satisfy the following tests prescribed under paragraph 4.0.

4.0 Tests. The applicable tests for substantiating flexible fuel and oil cell material and construction techniques are indexed below in Table I.

TABLE I

<i>Tests</i>	<i>Par. No.</i>	<i>Oil</i>	<i>Fuel</i>
Leakage ¹	5.0	X	X
Aging	6.0	X	—
Slosh	7.0	X	X
Stand	8.0	X	X
Humidity	9.0	X	X
Fluid Resistance of Exterior Surfaces	10.0	X	X
Permeability	11.0	—	X
Fuel Contamination ²	12.0	—	X
Oil Dilution Resistance	13.0	X	—
Inner Liner Strength	14.0	X	X

¹ Tests may be run in any order desired after completion of the leakage test.

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

<i>Tests</i>	<i>Par. No.</i>	<i>Oil</i>	<i>Fuel</i>
Seam Adhesion	15.0	X	X
Puncture Resistance	16.0	X	X
Low Temperature Leakage	17.0	X	X

4.1 Test Samples. Test samples shall consist of the following:

a. Two cells with outside dimensions of 24x30x30 inches containing fittings representative of those used in tank construction for airframe installation. One cell to be used for stand test (par. 8.0), the other for all other cell tests.

b. Two 12x12 inch samples of composite cell construction. One for humidity test (par. 9.0), the other for puncture test (par. 16.0).

c. One sample of inner layer ply, without barrier, approximately 900 square inches in area including seam for inner liner strength test (par. 14.0) and seam adhesion test (par. 15.1).

d. One sample 6x6 inch inner layer ply, without barrier for all other inner layer tests.

e. Two permeability samples as specified in paragraph 11.0.

None of these samples shall be preplasticized with fluid prior to testing.

4.2 Test Fluids. Unless otherwise specified, the following test fluids shall be used in testing the different tanks.

a. Fuel Tank: Test fluid conforming to MIL. Spec. MIL-S-3136,³ Type III.

b. Oil Tank : Oil conforming to MIL. Spec. MIL-L-6802,³ Grade 1100.

³ Copies may be obtained from the Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia 20, Pennsylvania, Code CDS.

c. Oil Tank: Oil conforming to MIL Spec. MIL-L-7808,³

5.0 Leakage. Each cell, with all openings sealed and with the minimum of external support necessary to maintain the cell shape, shall be subjected to an internal air pressure of 2.0 p.s.i. The cell shall then be completely submerged in water or completely covered with soapy water. Leakage indicated by air bubbles in the water or soapy water solution shall be caused for rejection. Alternate methods of checking leakage may be used if approved by the Administrator.

6.0 Aging.

6.1 Test Conditions. The maximum temperature capability of oil cell material shall be selected by the manufacturer and stated as a limitation under § 514.86(c)(2). During the tests, the test fluid temperature shall be uniformly maintained throughout the cell.

6.1.1 Test Duration. This test shall be conducted for a period of 200 hours.

6.1.2 Test Procedure. The cell shall be filled with 80 gallons of either test fluid 4.2b. or c. as applicable, At the end of the test period, the cell shall show no sign of deterioration or other unsatisfactory conditions.

7.0 Slosh.

7.1 Test Conditions. The following test conditions shall prevail during slosh test.

7.1.1 Rocking Angle. The slosh-rocking angle shall be 30 degrees total, approximately 15 degrees on either side of the horizontal position.

7.1.2 Mounting Axis. The cell shall be mounted in such a manner that the 24 inch dimension is vertical. This position shall be known as the horizontal position.

7.1.3 Fluid Temperatures. The temperature of the fluid during the slosh test shall be as shown in the table below:

Test Fluid Temperatures

<i>Test Fluid</i>	<i>Temperatures</i>
Fuel	135°±10° F.
Oil	Maximum temperature (°±10° F.) selected by manufacturer and stated as a limitation

7.1.4 Test Duration. This test shall be run as follows:

- Slosh for 25 hours at 16 to 20 c.p.m., or
- Slosh for 40 hours at 10 to 16 c.p.m.

7.1.5 Test Procedure. The test cell complete with filler cap, vents and typical outlet fittings shall be installed in a suitable mounting structure, then mounted on the support jig and rocker assembly. Sections of flexible hose shall be connected to the vent and outlet flexible hose shall be connected to the vent and outlet fittings. The other end of each of these sections shall be rigidly attached to the support jig. The hoses shall be installed and supported in a manner representative of an actual installation in an aircraft.

The tank mounting structure is to be representative of an actual aircraft fuel cell compartment. Recommendations of the cell manufacturer for supporting or mounting the fuel cell in the aircraft fuel cell compartment are to be incorporated. The interior of the support jig shall be completely lined with brown paper held in place by a suitable adhesive.

The test specimen shall be filled two-thirds full with the applicable test fluid containing a suitable dye. For fuel cells, one-half gallon of water shall also be added. For oil cells intended for use in aircraft using an oil dilution system, 30 percent by volume of fluid 4.2a. shall be added to the test fluid. At the conclusion of this test, the test specimen shall be completely filled with the applicable test fluid

and thoroughly inspected for leakage or other evidence of failure.

8.0 Stand Test. This test shall be conducted on the second test cell as provided for in paragraph 4.1a. The test cell may be installed in the support structure used for the slosh test or a similar structure which is lined with brown paper. The cell shall be filled with the appropriate test fluid containing a satisfactory staining agent. There should be no leakage or evidence of other failure at the end of 90 days under these conditions.

9.0 Humidity. A 12x12-inch sample of the composite cell construction shall be subjected for a total period of 15 days to the following 24-hour test cycle.

a. 8 hours at $130^{\circ}\pm 3^{\circ}$ F. and 100 percent relative humidity.

b. 4 hours cooling to approximately $70^{\circ}\pm 3^{\circ}$ F.

c. 8 hours at $70^{\circ}\pm 3^{\circ}$ F. and 100 percent relative humidity.

d. 4 hours heating to $130^{\circ}\pm 3^{\circ}$ F.

There shall be no corrosion, peeling, cracking, warping, blistering, delamination or discoloration of the cell after this period.

10.0 Fluid Resistance of Exterior Surfaces. The cell shall be placed in a container sufficiently large to permit immersion to one-half the depth of the cell in the applicable test fluid. The cell shall be immersed for 24 hours at ambient temperature, after which it will be removed and examined. The exterior surface of the cell construction shall show no unsatisfactory swelling separation, blistering, dissolution, or other deterioration.

11.0 Permeability.

11.1 Test Apparatus. The test apparatus shall consist of the following:

a. Two permeability cups and rings constructed in accordance with Figure 1.

b. A nylon solution shall be used for sealing the test disk to the permeability cup.

11.1.1 Preparation of Test Specimens.

The uncured inner liner shall be applied to a 10x10 inch piece of corrugated fiberboard coated on one side with a suitable water soluble breakaway agent. The exposed surface of the inner liner shall be coated with prime cement and barrier resin (if required) in accordance with applicable manufacturing specifications. The assembly shall be wrapped with cellophane and covered with a suitable waterproof bag.

The assembly shall be vulcanized as in normal production. After vulcanizing, the waterproof bag and cellophane shall be removed and the inner liner shall be removed from the fiberboard using water as necessary. Free moisture shall be wiped from the assembly and it shall be conditioned 24 hours at a constant temperature of $77^{\circ}\pm 5^{\circ}$ F. and a relative humidity of 40 ± 5 percent. Two 2.5-inch diameter disks shall be cut from the vulcanized panel. One hundred ml. Of test fluid specified in paragraph 4.2a. shall be placed in each of the permeability cups. Nylon solution shall be applied to the face of the cup flanges covering the area inside the bolt circle. The nylon solution shall be allowed to come almost to dryness, then the test disks shall be applied to the cups with the barrier, if any, facing outward. The assemblies shall be completed by attaching the bolting rings and tightening the bolts in accordance with the following schedule:

<i>Inner Liner Type</i>	<i>Bolt Torque</i>
Gum stock	5 to 10 in.-lb.
Coated fabrics	15 to 20 in.-lb.
Unsupported plastic films	20 to 25 in.-lb.

11.1.2 Test Procedure. Permeability cups prepared as specified above shall be placed in a suitable rack in a constant temperature of $77^{\circ}\pm 5^{\circ}$ F. and a relative humidity of 40 ± 5 percent.

After allowing 1 hour for equilibrium, the cups shall be weighed to the nearest 0.005 gram and placed in the rack with the faces of the cups facing upward (test disks up). The cups shall be kept at the above constant temperature for 24 hours, then weighed to check for seal integrity. The bolts shall be retorqued if necessary. The cups shall then be inverted (test disks down) in a rack that permits free access of air to the test disks.

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 day to eighth day period and expressed as fluid-ounces per square foot per 24 hours. The permeability shall be less than 0.025 fluid ounces per square foot per 24 hours for each sample tested.

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

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

Where sp.gr. = Specific gravity of test fluid at 77° F.

R = Inside radius if test cup expressed in inches.

12.0 Fuel Contamination.

12.1 Nonvolatile Gum Residue. A five gram sample of the inner layers up to the barrier, shall be diced up into approximately 0.062 inch squares and placed in a flash containing 250 mi. of test fluid as specified in paragraph 4.2a. and allowed to stand for 48 hours at 77°±5° F.

The contaminated test fluid shall be decanted off, and the nonvolatile gum residue determined by method 3302 of Federal Test

Method Standard No. 791,⁴ ASTM D381-54T, except that the total evaporation time shall be 45 minutes. The nonvolatile material shall not exceed 60 milligrams per 100 mi. of the contaminated fluid.

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

13.0 Oil Dilution Resistance. Tensile and elongation tests shall be made on the inner layer ply according to the methods described in Federal Test Method Standard No. 601,⁵ Methods 4111 and 4121, respectively. Before and after the tests the test specimens shall be immersed for 48 hours at room temperature in the appropriate oil diluted 30 percent by volume with test fluid specified in paragraph 4.2a. The tensile properties shall not be reduced more than 40 percent from the original values, and the Shore A durometer hardness shall not vary more than 15 points from the original value.

14.0 Inner Liner Strength.

14.1 Gum Inner Liner Strength. The strength of the gum inner layer ply, without

⁴ Copies may be obtained from the Business Service Center, General Services Administration, Region 3, Seventh and D Streets, SW., Washington, D.C. 20553, for \$1.75 per copy. Make checks payable to General Services Administration.

⁵ Copies may be obtained from the Business Service Center, General Services Administration, Region 3, Seventh and D Streets, SW., Washington, D.C. 20553, Federal Test Method Standard No. 601, \$2.00 per copy, and Specification CCC-T-191, \$1.75 per copy. Make checks payable to General Services Administration.

barrier, shall be determined in accordance with Federal Test Method Standard No. 601,⁵ Method 4111 before and after immersion in the test fluid specified in paragraph 4.2a. for 72 hours at a temperature of $135^{\circ}\pm 3^{\circ}$ F. The tensile strength shall also be determined before and after immersion in water for 72 hours at a temperature of $135^{\circ}\pm 3^{\circ}$ F. The tensile strength shall not be reduced more than 50 percent for fuel immersion and 20 percent for water immersion calculated on the basis of the original cross-sectional area.

14.2 Fabric Inner Liner Strength. The tensile strength of the fabric inner layer ply, without barrier, shall be determined in accordance with Specification CCC-T-191,⁵ Method 5100 before and after immersion in test fluid specified in paragraph 4.2a. for 72 hours at a temperature of $135^{\circ}\pm 3^{\circ}$ F. The tensile strength shall also be determined before and after immersion in water for 72 hours at a temperature of $135^{\circ}\pm 3^{\circ}$ F. The tensile strength shall not be reduced more than 20 percent for fuel immersion and 50 percent for water immersion calculated on the basis of the original cross-sectional area.

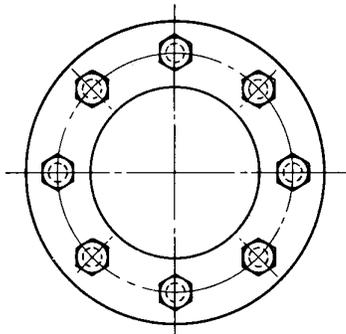
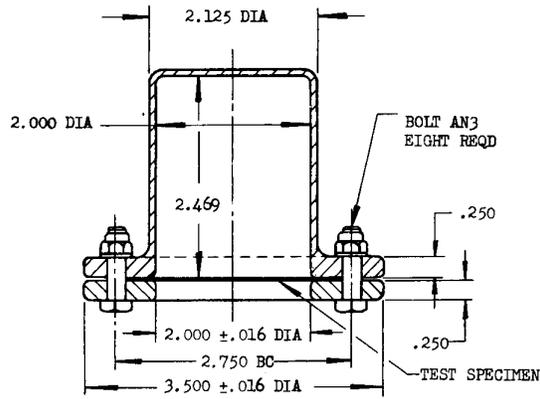
15.0 Seam Adhesion. The seam adhesion of the inner layer ply to itself before and after immersion in the test fluid specified in paragraph 4.2a for 72 hours at a temperature of $135^{\circ}\pm 3^{\circ}$ F. shall be tested within 4 hours along the length of the seam by the strip back method using a jay separation rate of 2 inches per minute in accordance with Federal Test Method Standard No. 601,⁵ Method 8001. Where the adhesion of the seam is less than the strength of the material, the adhesion shall be minimum of 6 pounds per inch.

15.1 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 one inch wide having a seam

made in the same manner as is used in the tanks submitted under paragraph 4.1a. This seam shall be perpendicular to and midway in the length of the strip. When a tensile load has been applied of sufficient magnitude to break the strip, there shall be no failure of the seam.

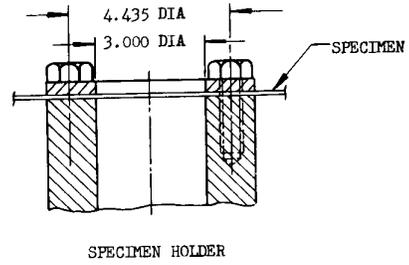
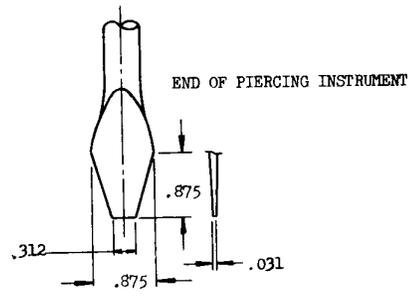
16.0 Puncture Resistance. A cell wall shall be fastened in a specimen holder in accordance with Figure 2. A piercing instrument with its end conforming to Figure 2 shall be forced against the cell wall at approximately the center of the area enclosed by the specimen holder. The force required to puncture the cell shall not be less than 15 pounds.

17.0 Low Temperature Leakage. The cell supporting structure cavity shall be lined with brown paper and the cell installed in the structure. The cell shall be completely filled with the appropriate test fluid containing a staining agent and allowed to stand for seven days at $135^{\circ}\pm 10^{\circ}$ F. The cell shall then be emptied and subjected to an air dry out at $155^{\circ}\pm 5^{\circ}$ F. for seven days. The cell shall then be completely refilled with the appropriate test fluid containing a straining agent, cooled to $-65^{\circ}\pm 5^{\circ}$ F. and allowed to stand at this temperature a minimum of three days. The test fluid in contact with the cell inner liner shall have reached -65° F. prior to the start of the three-day period. The cell shall be instrumented by placing thermo-couples against the inside surface of the cell liner, one within six inches of the top surface on one side panel and the other within six inches of the bottom surface on the opposite side panel. At the end of the three-day period, the cell shall be brought back to room temperature, drained and examined internally and externally for fluid leakage or other evidence of failure. Any indication of failure shall be cause for rejection.



DIMENSIONS IN INCHES

FIGURE 1. Permeability cup assembly



DIMENSIONS IN INCHES.

FIGURE 2. Piercing instrument and specimen holder