MILITARY SPECIFICATION

SEALING COMPOUND, NONCURING, LOW CONSISTENCY, SILICONE, GROOVE INJECTION, FOR INTEGRAL FUEL TANKS

This specification is approved for use by the Naval Air Systems Command, Department of the Navy and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification establishes the requirements for one type of inert, permanently mastic silicone type sealing compound modified with a flow control additive, for sealing or resealing integral fuel tanks on military aircraft.

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal from a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

L-P-378	-Plastic Sheet and Strip, Thin gauge, Polyolefin
QQ-A-250/4	-Aluminum Alloy 2024, Plate and Sheet
QQ-A-250/12	-Aluminum Alloy 7075, Plate and Sheet
TT-E-751	-Ethyl Acetate, Technical

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Engineering Specifications and Standards Department (Code 9321), Naval Air Engineering Center, Lakehurst, NJ 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FEDERAL (Continued)

TT-I-735	-Isopropyl Alcohol
TT-M-261	-Methyl-Ethyl-Ketone, Technical
TT-N-97	-Naphtha, Aromatic
TT-S-735	-Standard Test Fluids, Hydrocarbon
TT-T-548	-Toluene; Technical
PPP-B-566	-Box, Folding, Paperboard
PPP-B-636	-Box, Shipping, Fiberboard
PPP-C-96	-Cans, Metal, 28 Gauge and Lighter

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MIL-C-5541	-Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-T-5624	-Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-S-6758	-Steel, Chrome - Molybdenum (4130) Bars and Reforging Stock (Aircraft Quality)
MIL-P-7105	-Pipe Threads, Taper, Aeronautical National Form, Symbol ANPT, General Requirements for
MIL-S-7720	-Steel, Corrosion Resistant (18-8) Bars, Wire and Forging Stock (Aircraft Quality)
MIL-S-7742	-Screw Threads, Standard, Optimum Selected Series, General Specification for
MIL-P-19468	-Plastic Rod Polytetrafluoroethylene, Molded and Extruded
MIL-C-27725	-Coating, Corrosion Preventive, For Aircraft Integral Fuel Tanks
MIL-P-38714	-Packaging and Packing of Two-Component Materials in Semkits
MIL-C-81706	-Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys
MIL-C-87962	-Cloths, Cleaning, for Aircraft Fuel Tanks

STANDARDS

FEDERAL

FED-STD-791 -Lubricants, Liquid Fuels and Related Products, Methods of Testing

MILITARY

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

MIL-STD-129 -Marking for Shipment and Storage

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A108-73 -Steel Bars, Carbon, Cold-Rolled Strip

ASTM D471-77 -Rubber, Property - Effect of Liquids

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

CONSOLIDATED CLASSIFICATION COMMITTEE

Uniform Freight Classification Rules

(Application for copies should be addressed to the Consolidated Classification Committee, 202 Chicago Union Station, Chicago, IL 60606.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Qualification. The integral fuel tank sealing compounds furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.3).

3.2 Material. The product shall be furnished as a one part compound, a base compound (3.2.1), modified with a flow control additive (3.2.2).

3.2.1 Base compound. The base compound shall be a permanently mastic fuel resistant polysiloxane polymer containing no solvents.

3.2.2 Flow control additive. The flow control additive shall be microspheres of a fuel resistant type polymer, or copolymer, appropriately sized to meet the requirements of this specification when added to the base compound. The manner of incorporation of the microspheres into the polymer shall be at the discretion of the supplier. However, the requirement of 3.3 shall be met.

3.3 Appearance. The modified silicone compound shall not separate. Occluded gases shall not be permitted. There shall be no lumps or agglomerate masses larger than 0.040 inch (1.0 mm) in diameter.

3.4 Physical properties. Physical properties shall be in accordance with Table I.

TABLE I. Physical properties.

Property	Requirement	Test paragraph
Specific gravity, max	1.60	4.6.1.1
Nonvolatile content, min.	98	4.6.1.2
Fuel resistance Volume change, %	Fluid 1/ #1 +1 to +40 #2 +1 to +17 #3 +1 to +12	4.6.1.3
Weight loss, % max, All fluids	5	
Adhesion to panels, All fluid	No loss of adhesion	
Adhesion, cohesive, % min.	85	4.6.1.4
Corrosion	No Corrosion	4.6.1.5

1/ Fluid designations are: #1 Jet reference fluid, #2 JP-4, #3 JP-5.

3.5 Performance properties.

3.5.1 Extrusion force. The compound shall extrude under a compressive load of 150 to 300 pounds (65 to 135 Kg) when tested as specified in 4.6.2.1.

3.5.2 Low temperature flexibility. When tested as specified in 4.6.2.2, the compound shall not crack, harden or exhibit loss of adhesion.

3.5.3 Seal efficiency. When tested as specified in 4.6.2.3, there shall be no leakage through the faying surface in excess of that specified in 4.6.2.3.4.1. The compound shall remain reinjectable.

3.5.4 Injection and reinjection properties. Specimens prepared and tested in 4.6.2.4 shall comply with the requirements listed below:

(T_0) Original injection time, seconds, max.	- 35
(T_1) Original reinjection time, seconds, max.	- as determined
(T_2) Reinjection time after fuel/heat exposures	- 50 to 200% of T_1
Volume of sealant, port #1, after reinjection	- 0.5 cc minimum

3.5.5 Large gap retention. Specimens prepared and tested as specified in 4.6.2.5 shall exhibit no sealant flow beyond the faying edge of the fixture.

3.5.6 Resistance to pressure rupture. The sealing compound when tested as specified in 4.6.2.6 shall exhibit minimum average pressure rupture as follows:

Condition	Requirement psi (kPa)
Control	5.9 (40.6) 12 inches (305 mm) of Hg
After fuel	1.7 (11.7) 3.5 inches (90 mm) of Hg
At elevated temperature 71°±1°C (160°±2°F)	1.7 (11.7) 3.5 inches (90 mm) of Hg

3.5.7 Cold flow. The change in height of the sealant column shall not exceed 30 percent when tested as specified in 4.6.2.7.

3.6 Workmanship. The sealing compound furnished under this specification shall be formulated from highest quality components described herein to meet all the requirments of this specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsiblity for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of 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.

4.1.1 Source inspection. Materials procured by the government under this specification must be source inspected, so that the material meets the quality conformance inspection (4.4) when it leaves the manufacturer's plant. In addition, samples for quality conformance shall be packaged as much as practical in the same containers used for delivery of the sealing compound.

4.2 Classification of inspections. The inspection requirements specified herein shall be classified as follows:

1. Qualification inspection (see 4.3)
2. Quality conformance inspection (see 4.4)

4.3 Qualification inspection. Qualification shall consist of all the tests specified in Table II.

TABLE II. Qualification tests.

Test	Requirement Paragraph	Test Paragraph
Specific gravity	Table I	4.6.1.1
Nonvolatile content	Table I	4.6.1.2
Fuel resistance	Table I	4.6.1.3
Adhesion	Table I	4.6.1.4
Corrosion	Table I	4.6.1.5
Extrusion force	3.5.1	4.6.2.1
Low temperature flexibility	3.5.2	4.6.2.2
Seal efficiency	3.5.3	4.6.2.3
Injection and reinjection	3.5.4	4.6.2.4
Large gap retention	3.5.5	4.6.2.5
Pressure rupture	3.5.6	4.6.2.6
Cold flow	3.5.7	4.6.2.7

4.3.1 Qualification sampling. Qualification sample shall consist of 8 - six fluid ounce (180 ml) cartridges containing 8 ounces (225 gm) minimum, by weight, of sealing compound packaged as specified by the qualifying laboratory. The containers shall be in accordance with Section 5 of this specification. The samples shall be forwarded to the Commander, Naval Air Development Center, Warminster, PA 18974, Attention: ACSTD (Code 60621) (Qualifying Laboratory). The samples shall be durably and plainly marked with the following information:

SAMPLE FOR QUALIFICATION TESTING

SEALING COMPOUND, NONCURING, LOW CONSISTENCY SILICONE, GROOVE INJECTION, FOR INTEGRAL FUEL TANKS

Name and address of manufacturer
Plant address and date sample produced
Manufacturer's part number or designation
Submitted by (name) for qualification in accordance with the requirements of MIL-S-85334 under authorization (reference authorizing letter) (see 6.3)

4.3.2 Manufacturer's data.

4.3.2.1 Test reports. Two copies of the manufacturer's certified test report, showing the material submitted conforms to all the requirements of this specification, shall be forwarded with the qualification sample. The test report shall reference the specific test methods of this specification.

4.3.2.2 Instructions for use. Two copies of the manufacturer's instructions for the use of the sealing compound shall be submitted with the qualification samples.

4.3.3 Retention of qualification. In order to retain qualification of products approved for listing on the Qualified Products List (QPL), the manufacturer shall verify by certification to the qualifying activity that his product complies with the requirements of this specification. Periodic verification by certification shall be at two year intervals from the date of original qualification. The qualifying activity may require verification by certification at intervals of less than two years from the date of initial qualification.

4.4 Quality conformance inspection.

4.4.1 Lot formation. Unless otherwise specified, a lot shall consist of all the sealing compound, formulated from the same components under essentially the same conditions and submitted for inspection at one time.

4.4.2 Sampling.

4.4.2.1 Physical and performance properties. Physical and performance property samples shall be randomly selected from each lot of sealing compound offered for inspection. Sufficient material shall be selected to complete the testing specified in 4.4.3.1.

4.4.2.2 Packaging.

4.4.2.2.1 Unit container. A random sample of unit containers shall be selected from each lot in accordance with Inspection Level I of MIL-STD-105 and inspected as specified in 4.4.3.2. The sample unit shall be one filled container. The lot size shall be the number of unit containers.

4.4.2.2.2 Shipping containers. Shipping containers, just prior to closure, shall be randomly selected from each lot in accordance with Inspection Level I of MIL-STD-105 for inspection as specified in 4.4.3.2. The sample unit shall be one shipping container. The lot size shall be the total number of shipping containers.

4.4.3 Quality conformance tests and examinations.

4.4.3.1 Physical and performance test properties. The sample selected as specified in 4.4.2.1 shall be tested to the requirements of Table III. Nonconformance of the sample to any of the specified requirements shall be cause to reject the lot represented by the sample.

TABLE III. Quality conformance physical and performance properties.

Requirement	Requirement Paragraph	Test Paragraph
Nonvolatile Content	Table I	4.6.1.2
Fuel resistance 1/	Table I	4.6.1.3
Adhesion	Table I	4.6.1.4
Extrusion force	3.5.1	4.6.2.1
Pressure rupture	3.5.6	4.6.2.6
Cold flow	3.5.7	4.6.2.7

1/ Using jet reference fluid only.

4.4.3.2 Packaging examination. Samples selected in accordance with 4.4.2.2.1 and 4.4.2.2.2 shall be visually examined to the applicable requirements in Table IV and all other requirements to determine conformance to Section 5 of this specification. The Acceptable Quality Level (AQL) for this inspection shall be 2.5 percent. In addition, shipping containers fully prepared for delivery shall be inspected for closure defects.

TABLE IV. Packaging examination.

Examination	Defect
Fill	Not volume or weight specified in contract (Individual containers may be replaced by properly filled containers.)
Packaging	Wrong size cans or cartridges Material or construction not as specified Components damaged, missing, or contents leaking Unit package closure incomplete or damaged Not level required by contract or purchase order
Packing	Not level required by contract or purchase order Any nonconforming component, incomplete closures Bulged or damaged shipping containers
Count	Less than specified or indicated quantity per shipping containers
Markings	Unit package and packing - Omitted, illegible, incorrect, incomplete or not in accordance with contract requirements

4.5 Test conditions.

4.5.1 Standard conditions. Standard conditions shall be 25°±1°C (77°±2°F) and a relative humidity of 50±5 percent. Unless otherwise specified, all tests shall be conducted at standard conditions.

4.5.2 Preparation of test panels and fixtures.

4.5.2.1 Surface treatment of test panels. Unless otherwise specified, all test panel areas shall have a chemical film conforming to MIL-C-5541 (The film produced from materials in accordance with MIL-C-81706). Where referenced in the test method, an 0.8 to 1.2 mil thickness of coating conforming to MIL-C-27725, Type II, Class A, shall be applied and cured for 24 hours at standard conditions of 4.5.1 plus 24 hours at 49°±1°C (120°±2°F) with a minimum relative humidity of 25 percent.

4.5.2.2 Cleaning of panels. Except where otherwise specified, panels shall be cleaned with lint free cheesecloth conforming to MIL-C-87962, using solvent formulated in accordance with Table V. Immediately after rinsing, the panels shall be wiped with a clean lint free cloth.

TABLE V. Formulation of cleaner.

Ingredient	Specification	Percent by Volume
Aromatic petroleum naphtha	TT-N-97, Type I, Grade B	50
Ethyl acetate	TT-E-751	20
Methyl-ethyl-ketone	TT-M-261	20
Isopropyl alcohol	TT-I-735	10

4.6 Test methods.

4.6.1 Physical properties.

4.6.1.1 Specific gravity. The specific gravity shall be determined in triplicate during the fuel resistance test. The weights, W_1 through W_4, of 4.6.1.3.2 shall be used as follows:

$$\text{Specific Gravity} = \frac{W_3 - W_1}{(W_2 + W_3) - (W_1 + W_4)}$$

Where: W_1 = Weight of panel in air
W_1^2 = Weight of panel in water
W_2^3 = Weight of panel and sealing compound in air
W_4 = Weight of panel and sealing compound in water

4.6.1.2 Nonvolatile content. Five to ten grams of sealing compound shall be transferred to a tared covered cup approximately three inches (75 mm) in diameter and 0.75 inch (19 mm) in depth. The specimen shall be weighed to the nearest milligram and the weight of the sealing compound calculated. The cover shall then be removed and the sealing compound heated in an air circulating oven for 24 hours at 93°±1°C (200°±2°F). It shall then be cooled in a desiccator at standard conditions (4.5.1), the cover replaced, and the specimen reweighed. The test shall be run in duplicate and the average of the results reported. The percentage of the total nonvolatile content shall be calculated as follows:

$$\text{Percent nonvolatile content} = \frac{\text{Final weight}}{\text{Initial weight}} \times 100$$

4.6.1.3 Fuel resistance. Fuel resistance test fluids shall be as follows:

Fluid #1 - Jet reference fluid (see 4.6.1.3.1)
Fluid #2 - JP-4, MIL-T-5624
Fluid #3 - JP-5, MIL-T-5624

4.6.1.3.1 Formulation of test fluid #1 (Jet reference fluid). The jet reference fluid required for conducting the fuel resistance test and fluid immersion tests of this specification shall be formulated as follows:

Toluene (TT-T-548)	30 Volumes
Cyclohexane (Technical Grade)	60 Volumes
Iso-octane (TT-S-735, Type 1)	10 Volumes
Tertiary butyl disulfide (doctor sweet)	1 Volume
Tertiary butyl mercaptan	0.015 ± 0.0015 weight percent of other four components

4.6.1.3.1.1 Jet reference fluid tests. The mercaptan sulfur content , when tested in accordance with Method 5206 of FED-STD-791, shall be 0.0050 ± 0.0005 weight percent of the jet fluid. The total sulfur content, when tested in accordance with Method 5201 of FED-STD-791, shall be 0.400 ± 0.005 weight percent of the jet fluid. The fluid should be stored out of contact with light in containers which are inert to the fluid ingredients. (Welded aluminum, nongalvanized welded steel, or glass containers are suitable.) Fluid older than 90 days shall be retested for mercaptan and total sulfur content.

4.6.1.3.2 Specimen preparation. Each of nine, 0.032 by 1.0 by 2.25 inch (0.87 by 25 by 57 mm) aluminum panels conforming to QQ-A-250/4, treated as specified in 4.5.2.1 shall be weighed to the nearest milligram in air (W_1) and in water (W_2). A mass of sealing compound 0.06 thick by 1 by 2 inches (1.5 by 25 by 50 mm) shall be applied to each of the weighed panels and, additionally, to each of nine unweighed panels coated with MIL-C-27725 material (see 4.5.2.1). The latter panels shall be visually examined. Determine the volume by reweighing the panels in air (W_3) and in water (W_4). The specific gravity (4.6.1.1) shall be calculated at this time.

4.6.1.3.3 Procedure.

4.6.1.3.3.1 Immersion. Immerse six panels (3 weighed and 3 unweighed for visual observation) in each test fluid as follows:

25 days at 49°±1°C (120°±2°F)

60 hours at 71°±1°C (160°±2°F)

6 hours at 82°±1°C (180°±2°F)

4.6.1.3.4 Panel examination. At the completion of the immersion time, the specimens shall be transferred and immersed in room temperature test fluid. The volume shall be determined within one hour by weighing in air (W_5) and in water (W_6). The procedures in accordance with ASTM D471 shall be used. Each specimen shall be visually examined for adhesion. The percent change in volume shall be determined by the following equation and the average of the three specimens reported to the nearest 0.1 percent:

$$\frac{(W_4 + W_5) - (W_3 + W_6)}{(W_2 + W_3) - (W_1 + W_4)} \times 100 = \text{Percent change in volume}$$

The samples shall be allowed to cool for 24 hours at room temperature after removal from fuel. Each specimen shall then be placed in a 38°±1°C (100°±2°F) oven for 16 hours and subsequently the temperature raised to 93°±2°C (200°±3°F) over a period of 8 hours. Maintain the oven at 93°C for 16 hours, cool to room temperature, and then weigh again in air (W_7). The percent weight change shall be determined by the following equation and the average of the three specimens reported to the nearest 0.1 percent:

$$\frac{(W_3 - W_7)}{(W_3 - W_1)} \times 100 = \text{Percent change in weight}$$

All specimens shall be inspected for evidence of hardening, cracking, powdering, or loss of adhesion.

4.6.1.4 Adhesion. Twelve 0.040 thick by 1 by 4-inch (1 by 25 by 100 mm) aluminum panels conforming to QQ-A-250/4 shall be prepared; six with chemical film conforming to MIL-C-5541 and six with coating conforming to MIL-C-27725 applied and cured in accordance with 4.5.2.1. Place a ball of sealing compound in the center one-square inch (25 mm square) section of six panels. Place another panel crosswise 90 degrees in relation to the lower panel and compress evenly to leave a 0.060 ± .005-inch (1.5±0.1 mm) thickness of sealant separating the faying surfaces and forming a crosslap specimen. Remove excess sealing compound to leave a one-inch square sealant area (25 mm square) and condition the specimen for 24 hours at standard conditions (4.5.1). Place each specimen in an

autographic tension testing machine using self-aligning grips similar to Figure 1. The machine jaw separation rate shall be 2.0 inches (50.8 mm) per minute with the force applied vertical to the crosslap faying surface until total separation occurs. The panel surfaces shall be examined and the average cohesive value reported for conformance to Table I.

4.6.1.5 Corrosion. Sealing compound shall be packed into a glass petri dish, or equal, 2 to 3 inches (50 to 75 mm) in diameter and approximately 0.5 inch (12.7 mm) deep. Two aluminum panels, each 1 by 0.5 by 0.04 inch thick (25 by 12 by 1 mm), one conforming to QQ-A-250/4 (T3), and the other conforming to QQ-A-250/12 (T6) shall be imbedded into the sealing compound in such a manner as to avoid air entrappment while situating the panels flatwise approximately 0.063 inch (1.5 mm) from the bottom of the dish. The dish containing the panels and sealing compound shall be placed in a dessicator containing a 22 percent by weight glycerine in distilled water solution to produce a 95 percent relative humidity at the test temperature of 71°±1°C (160°±2°F). The dessicator shall be closed and placed in an air circulating oven maintained at 71°±1°C (160°±2°F) for a period of 30 days ± 4 hours. The panels shall be removed from the sealing compound and examined for evidence of pitting corrosion. Discoloration or staining shall not be cause for rejection.

4.6.2 Performance tests.

4.6.2.1 Extrusion force. The extrusion plastometer shown in Figures 2 and 3 shall be packed with a hand-rolled, cylindrically shaped mass of sealing compound approximately 0.75 inch (19 mm) in diameter and 2.25 to 2.50 inches (57 to 64 mm) long. Special precaution should be taken to avoid forming air pockets in the rolled sealing compound. Sufficient fingertip pressure shall be used to force the sealing compound into intimate contact with the cylinder walls. The packed apparatus shall be stabilized for 24 hours at standard conditions (4.5.1). At the end of the stabilization period, insert the plastometer piston, center the assembly on the fixed base of a tensile testing machine, and load in compression at the constant rate of 0.100 ± 0.002 inch (2.5±0.05 mm) per minute. The maximum scale load reading (in pounds) occurring during the time the top of the piston is 1.25 to 1.00 inch (30 to 25 mm) from the top of the cylinder shall be recorded. Clean the plastometer completely after each trial. Make a blank determination on the empty plastometer and subtract the scale load obtained from the maximum scale loads obtained when the sealant was tested. The test shall be run in duplicate and the average of the results reported. Individual test results shall not deviate by more than ten percent of the average value.

NOTES:

a. The plastometer shall be maintained at standard conditions (4.5.1) during tests.

b. The rate of plastometer piston travel is very critical. The rate of head travel of the tensile machine should be checked with a dial micrometer while testing.

c. The plastic gasket should be frequently checked for wear and replaced if undersize or irregular.

d. The plastometer piston shall be removed immediately following a test to avoid permanent compression of the plastic gasket.

e. If the plastometer is not to be used for a period of five days or longer, the inside surface shall be thoroughly covered with a protective oil.

f. The plastometer shall be cleaned before use.

4.6.2.2 Low temperature flexibility. Six, 1 by 6 by 0.032-inch thick (25 by 150 by 0.87 mm) 2024-T3 bare aluminum panels conforming to QQ-A-250/4, three finished with chemical film conforming to MIL-C-5541 and three with coating conforming to MIL-C-27725 applied and cured in accordance with 4.5.2.1, shall be used. The sealing compound shall be applied to each panel in quantity sufficient that, when a metal pressing plate covered with polyethylene film conforming to L-P-378, or equivalent, having metal spacers at each corner is pressed down on each panel, the compound will completely fill the air space to an accurate thickness of 0.060 inch (1.52 mm). Excess sealing compound shall be trimmed from the exposed edges. The pressing plate and polyethylene shall be removed from the panel. The sealing compound shall be trimmed back 1 inch (25 mm) from each end of the panel.

4.6.2.2.1 Procedure. The specimens shall be conditioned at standard conditions (4.5.1) for a minimum of 24 hours, then immersed in 900 mls of jet reference fluid (4.6.1.3.1) at the conditions specified in Table VII. At the completion of fluid exposure, the specimens shall be removed from the fluid and conditioned for 16 hours at 49°±1°C (120° ±2°F); followed by 6 hours at 71°±1°C (160°±2°F); then allowed to remain at standard conditions for a minimum of 16 hours. The specimens shall then be inserted in a flexibility fixture as specified in Figures 4 and 5 so that the uncoated side will contact the contour block and weight will contact only the end of the panel. The temperature of the flexibility fixture and panels shall be reduced to -51°±1°C (-60°±2°F) and stabilized at that temperature for 2 hours. Afterwards, the specimen shall then be bent around the curved portion of the flexibility test fixture by releasing the fastening hook. The panels shall be removed and examined for conformance with 3.5.2.

4.6.2.3 Seal efficiency

4.6.2.3.1 Fixture preparation. Four seal efficiency fixtures (Figure 6) shall be prepared for each sealant. Metal washers, 0.008±0.0002 inch (0.20±0.0005 mm) shall be installed on each bolt between the plates of the assembly. The washers shall have an ID of 0.26 inch (6.6 mm) and an OD of 0.50 inch (12.7 mm). The washers on the outer circle of bolts, shall be squared so as not to extend into the groove. During assembly, the head and nut area of the inner circle of bolts shall be sealed with additional sealant to prevent spurious leakage. The bolts shall be torqued to 60-inch pounds (6.8 N.m) and sealant injected (see 4.6.2.4) into the grooves through the three injection ports, I, II, and III as follows:

a. With all ports unplugged, inject into I until a .50 inch (12.7 mm) sealant worm emerges from ports II and III.

b. Insert a plug screw into I and inject into II until a .50 inch (12.7 mm) sealant worm emerges from III.

c. Plug II, then unplug I and inject into III until a .50 inch (12.7 mm) sealant worm emerges from I.

d. Block all injection ports with plug screws.

e. Condition fixtures at standard conditions (4.5.1) at least 24 hours.

4.6.2.3.2 Air test. The prepared fixtures shall be air tested for leakage by immersing the fixture in water at 25°±1°C (77°±2°F) for 5 to 10 minutes at pressures of 10 to 15 psi (70 to 105 kPa).

4.6.2.3.3 Exposure procedure. Test fluids shall be JP-4 and JP-5 fuel conforming to MIL-T-5624. Two fixtures shall be completely filled with JP-4, and two with JP-5, taking care to eliminate any air entrappment. The fixtures shall then be placed in the pressurization/thermal chamber system (Figure 7), pressurized to 7 psi (48 kPa) and subjected to the cycling conditions specified in Table VI. Each cycle shall consist of the two phases shown in Table VI. A minimum of 5 cycles shall be conducted.

TABLE VI. Exposure conditions for seal efficiency.

Phase	Exposure conditions
1. Liquid fuel (Maintain 7 psi pressure in fixture)	24 hours @ 25±1°C (77±2°F) 72 hours @ 38±1°C (100±2°F) 5 hours @ 49±1°C (120±2°F) 1 hour @ 71±1°C (160±2°F), followed by immediate pressurization to 15 psi, hold for 2 minutes. Depressurize to atmospheric pressure. 16 hours @ 25±1°C (77±2°F). Measure fuel.
2. Fuel vapor (Approximately 10% liquid fuel)	Drain fuel. Do not allow the fixture to dry. Add 5 ml of test fluid. Pressurize to 7 psi (Maintain 7 psi in fixture) 20 hours @38±1°C (100±2°F) 3 hours @ 49±1°C (120±2°F) 1 hour @ 71±1°C (160±2°F), followed by pressure increase to 15 psi, hold for 2 minutes. Depressurize to atmospheric pressure. 16 hours @ 25±1°C (77±2°F)

4.6.2.3.4 Fixture evaluation.

4.6.2.3.4.1 Leakage. Each fixture shall be visually observed for fuel leaks during and upon the completion of each exposure condition within each phase; and at the completion of each cycle. Measure fuel content at end of each liquid fuel phase. No fuel leakage exceeding 10 percent per cycle shall occur in any one fixture in two successive cycles over the 5 cycle period. When fixtures fail, testing shall be discontinued at that point. If excessive leakage occurs in the 5th cycle, another cycle shall be completed to determine the successsive cycle leakage. Additionally, in the fuel vapor phase of the final cycle, a minimum of 10 psi shall be retained during the 15 psi/2 minute test.

4.6.2.3.4.2 Reinjectability. Upon completion of evaluation for leakage after the final cycle, the fixtures shall be reinjected with fresh sealant to ascertain reinjectability. Remove plugs from ports I & II and reinject (nozzle pressure 2800 ± 100 psi) into port #1. Sealant shall emerge within 5 minutes from port II.

4.6.2.4 Injection and reinjection properties. The injection equipment used in this test and to prepare seal efficiency fixtures shall be the Grover Model 223, or equal, sealant gun equipped with the tip as shown in Figure 8. Nozzle pressure of the gun shall be calibrated and maintained at 2800±100 psi(193 ±7 MPa). Nine fixtures, in accordance with Figure 9, shall be assembled with 0.25-inch (6 mm) bolts. Installation of .005 inch (0.20 mm) washers shall be in accordance with 4.6.2.3.1.

The bolts shall be torqued to 40 inch-pounds (4.5 N.m). Three fixtures shall be used to determine both original injection time (T_0) and initial reinjection time (T_1). The remaining six fixtures shall be used for reinjection time after conditioning (T_2) in fuel (3 fixtures) and dry heat (3 fixtures).

4.6.2.4.1 Procedure. Stabilize the injection equipment and three fixtures at standard conditions, 4.5.1, for at least 4 hours. Inject the sealing compound into the channels from port No. 1 to port No. 2. Trigger the gun and simultaneously actuate a timer (0.2 sec increments) until the sealant has emerged flush with the surface of port No. 2. Insert plugs and hold the fixtures at standard conditions for at least 16 hours. Record the average original injection time, T_0. Allow the sealant gun to recover (or rest) for a minimum of 15 minutes before each succeeding injection. Mark visual indicator portion of the sealant gun at the 1/4 stroke point and at the 3/4 stroke point. Inject sealant into port No. 2 and, when the plunger reaches the 1/4 stroke mark, simultaneously activate the timer and determine the elapsed time for the plunger to travel from the 1/4 to the 3/4 mark. Record the reinjection time as T_1. Repeat the above test on the other two fixtures and record the average T_1. The T_1 value shall be used to calculate the percent change in reinjection time in 4.6.2.4.2.

4.6.2.4.2 Exposure conditions. Six fixtures shall be injected from port No. 1 to port No. 2 and the plug screw inserted. The fixtures shall be immersed in JP-4 fuel and exposed as specified in Table VII. The three remaining fixtures shall be exposed to dry air as specified in Table VII. Upon completion of the exposure periods, the fixtures shall be removed from the test environment and cooled to standard conditions (4.5.1) for a minimum of 4 hours. The fuel exposed specimens shall be placed in fresh fuel during that period. The fixture shall be reinjected from port No. 2 to port No. 1, as in 4.6.2.4.1 for obtaining T_1, and record the average reinjection time after conditioning (T_2). Reinjection change shall be calculated using the following equation:

$$\text{Reinjection change (\%)} = \frac{T_2}{T_1} \times 100$$

4.6.2.4.3 Volume determination. The sealant extruded from port #1 during the reinjection operation (4.6.2.4.2) shall be carefully removed flush from the surface of the fixture and weighed to the nearest milligram. The volume of material shall be calculated using the obtained weight and specific gravity value determined in 4.6.1.1.

TABLE VII Immersion and dry heat conditions.

Immersion time (hours)	Immersion temperature
120	49°±1°C (120°±2°F)
plus 60	71°±2°C (160°±3°F)
plus 6	82°±2°C (180°±3°F)

tested by magnetic particle inspection may require stripping at the terminals

4.6.2.5 Large gap retention. Two fixtures (Figure 9) shall be assembled as specified in 4.6.2.4 except that 0.010 inch (.25 mm) washers shall be used. The sealant shall be injected as specified for original injection time (T_0) of 4.6.2.4. Conformance to 3.5.5 shall be noted.

4.6.2.6 Pressure rupture. The sealing compound shall be packed into nine blowout specimens (Figure 10), taking care to eliminate air entrappment. The specimens shall be stabilized at standard conditions (4.5.1) for a minimum of 24 hours. Excess sealing compound shall be trimmed from the surfaces of the specimen.

4.6.2.6.1 Control procedures. One specimen shall be mounted in the pressure rupture (Figure 10). One air hose bib of the apparatus shall be connected to a manometer, the other to a variable pressure source. The test temperature shall be 25°±1°C (77°±2°F). Starting at atmospheric pressure, the pressure on the apparatus shall be uniformly increased at the rate of one inch (25.4 mm) of mercury per 15 seconds until failure occurs. Failure shall be indicated by a rapid drop in pressure. The pressure applied at the time of failure shall be recorded. Test two additional specimens in the same manner. The average failure pressure of the three specimens shall be reported to the nearest 0.5 inch (12.7 mm) of mercury.

4.6.2.6.2 Fuel exposure. Three specimens shall be immersed in jet reference fluid at the conditions specified in Table VII. After fuel exposure cool specimens to standard conditions (4.5.1) in fresh fluid for 4 hours. The specimens shall be removed from the fluid one at a time and tested as specified in 4.6.2.6.1.

4.6.2.6.3 Dry heat exposure. The remaining 3 specimens shall be tested as described in 4.6.2.6.1 except that the fixture and specimen shall be placed in an oven at 71°±1°C (160°±2°F) and allowed to stabilize for 15 minutes after the specimen reaches 71°C. Failure shall be indicated by a rapid drop in pressure.

4.6.2.7 Cold flow. Sufficient sealant shall be used to prepare a rectangular shaped specimen approximately 1.5 inch high with a 0.5 inch square cross section. Care should be taken to avoid air entrappment The specimen shall be placed on a flat surface with the longest dimension vertical. After 24 hours at standard conditions, the height of the specimen shall be measured and the percent change in height calculated. The test shall be run in duplicate.

5. PACKAGING

5.1 Packaging. Packaging shall be Level A or Commercial as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Unit package.

5.1.1.1.1 Cartridges. The compound shall be packaged by weight in 6 fluid ounce (180 ml) sectional type cartridges conforming to MIL-P-38714. The filled cartridges, in quantities as specified in 6.2, shall be packaged in a close-fitting box conforming to PPP-B-636 or PPP-B-566. Each cartridge shall be inserted in a full height cell formed by slotted fiberboard or polystyrene partitions. The box shall be closed in accordance with the appendix to the box specification.

5.1.1.1.2 Metal containers. The compound furnished in suitable quantities as specified (see 6.2) shall be packaged in a container conforming to PPP-C-96, Type V, Class 1. The amount of compound contained in each can shall fill the container to approximately three-fourths of its capacity.

5.1.1.2 Intermediate packaging. Intermediate packaging is not required.

5.1.2 Commercial. The sealing compound shall be packaged in standard commercial containers of the size and kind commonly used, which will afford the degree of protection required for shipment to the first receiving activity and immediate use.

5.2 Packing. Packing shall be Level A or Commercial as specified (see 6.2).

5.2.1 Level A.

5.2.1.1 Cartridges. The unit packages of cartridges as specified (see 5.1.1.1.1) shall be packed in a box conforming to PPP-B-636, class weather resistant. The box shall be closed and strapped in accordance with the appendix to the box specification. The gross weight of the box shall not exceed the weight limitations of the box specification.

5.2.1.2 Metal containers. The compound shall be packed in accordance with the appendix to PPP-C-96 as specified for overseas shipment.

5.2.2 Commercial. The compound packaged in accordance with 5.1 shall be packed to afford protection against damage during direct shipment from the source of supply to the first receiving activity for immediate use. Containers shall comply to the Uniform Freight Classification Rules or other regulations applicable to the mode of transportation.

5.3 Marking. In addition to markings required by the contract or order, the interior packages and shipping containers shall be marked in accordance with MIL-STD-129 and shall include the following information:

Sealing Compound, Non-Curing, Silicone, Groove
Injection for Integral Fuel Tanks
Specification number
Manufacturer's name and address
Manufacturer's batch identification
Quantity contained
Contract number
Date of manufacture

6. NOTES

6.1 Intended use. The noncuring sealing compound covered by this specification is intended for sealing or resealing integral fuel tanks designed for groove-injection type sealing subjected to a service temperature range of -51°C to +71°C (-60°F to +160°F) as indicated by the cycle specified in 4.6.2.3. The operating temperatures and pressures, specified herein, do not necessarily reflect the ultimate service capability of the sealing compound.

6.2 Ordering data. Procurement documents shall specify the following:

a. Title, number, and date of this specification

b. Quantity desired in pounds or ounces (see 5.1)

c. Size and type of unit package required (see 5.1.1.1)

d. Levels of packaging, and packing required (see 5.1 and 5.2)

e. Any special marking required in addition to 5.3

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time set for openings of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have been so listed by that date. The attention of suppliers is called to this requirement and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they might be eligible to be awarded contracts or orders. The activity responsible for the Qualified Products List is the Naval Air Systems Command, Washington, DC 20361; however, information pertaining to qualification of products may be obtained from the Commander, Naval Air Development Center, Warminster, PA 18974, Attn: ACSTD (Code 60621).

Preparing activity
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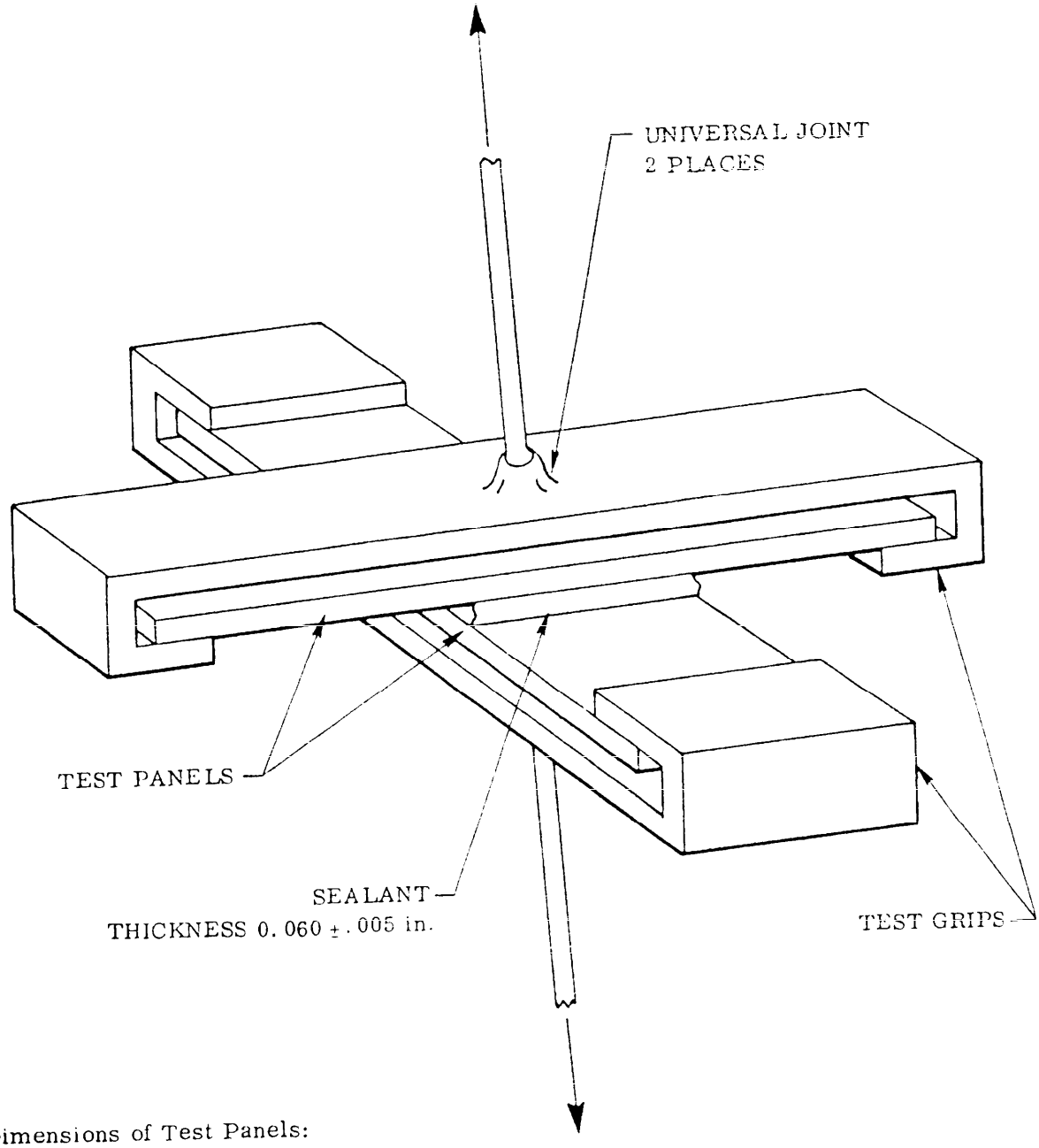
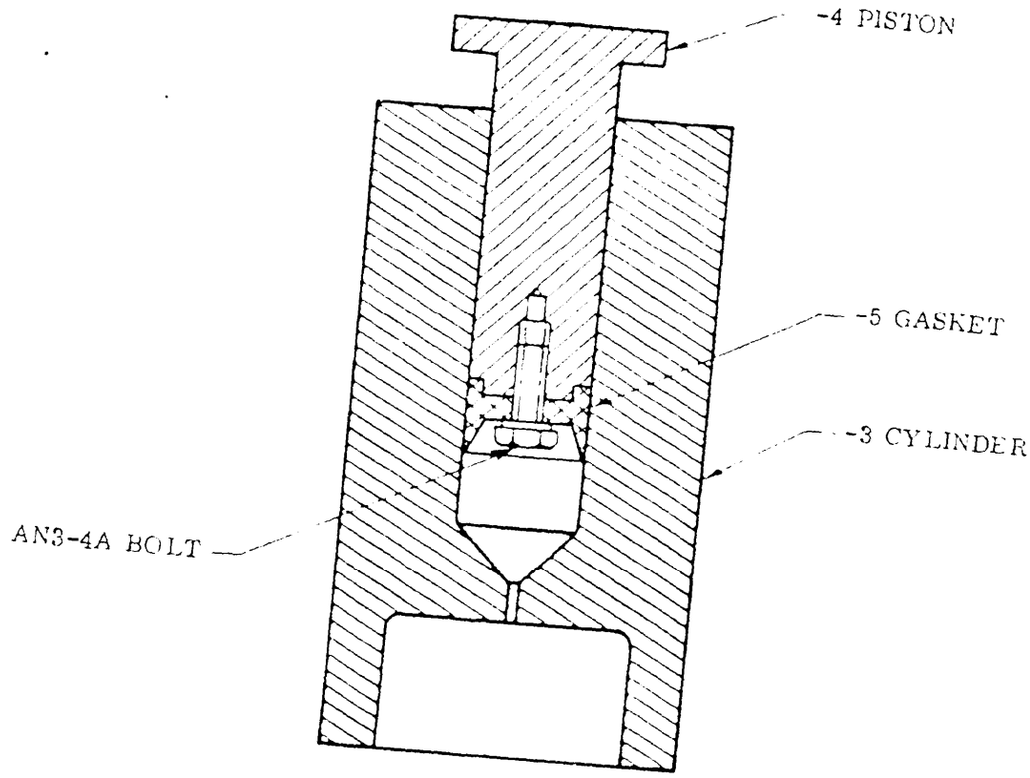
(Project No. 8030-N071)



Dimensions of Test Panels:
- 0.040 inches thick
- 1 inch wide
- 4 inches long
- Tolerances for all dimensions ±0.005

Aluminum conforming to QQ-A-250/4

Figure 1. Adhesion test fixture.



NOTES:

1. Material of -3 Cylinder to be 4130 Steel Bar, MIL-S-6758
   Heat Treat 180,000 to 200,000 psi
2. Material of -4 Piston to be 1020 Steel Bar, ASTM A108
   Case Harden 0.032 Deep
   Case Rockwell A55 min
   Core Strength 55,000 min
3. Material of -5 Gasket to be Plastic Rod, MIL-P-19468
4. Machine finish all surfaces $\sqrt{250}$ except as noted
5. Tolerances to be ±0.005, except as noted
6. Dimensions are in inches

Figure 2. Extrusion plastometer.

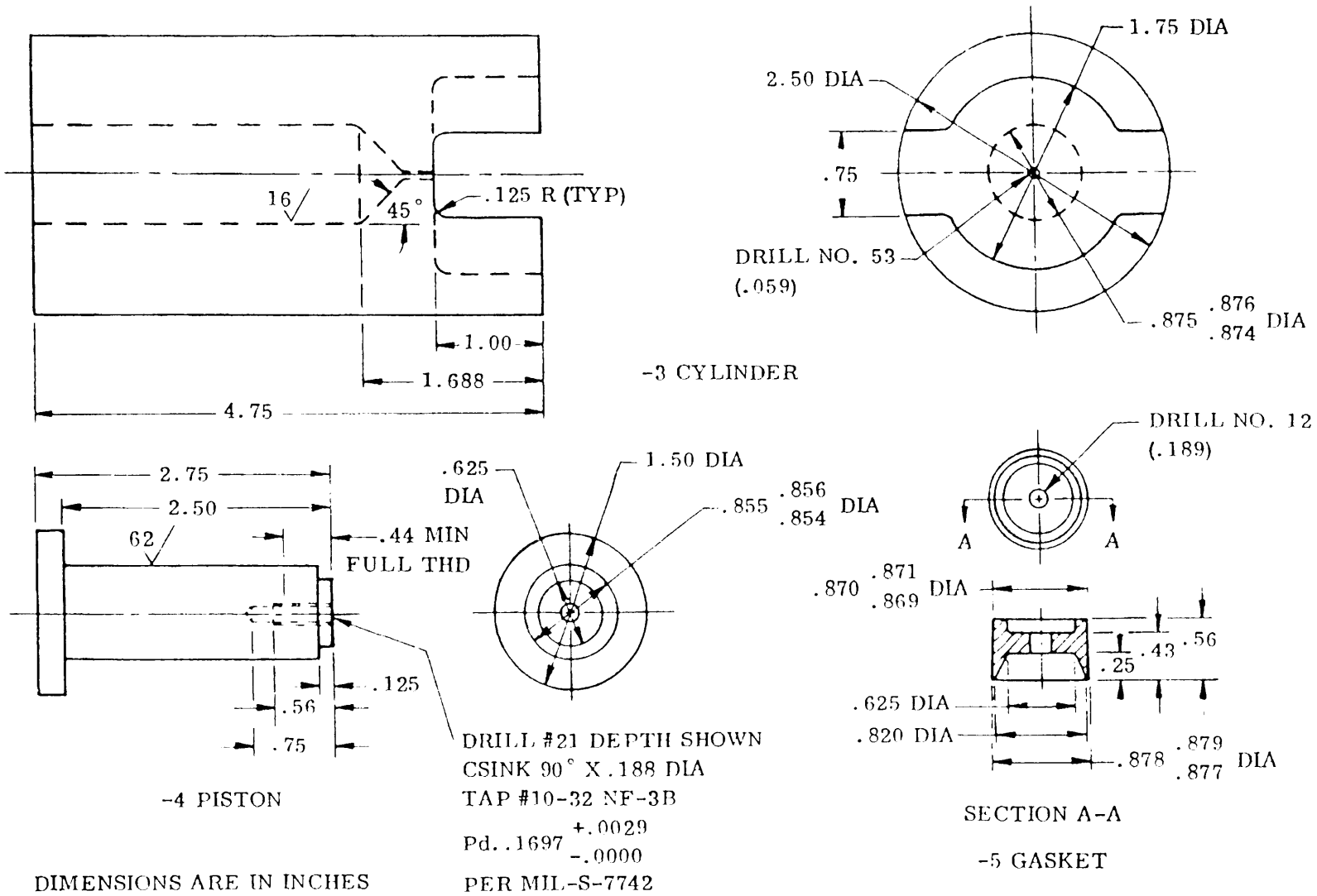


Figure 3. Extrusion plastometer detail.

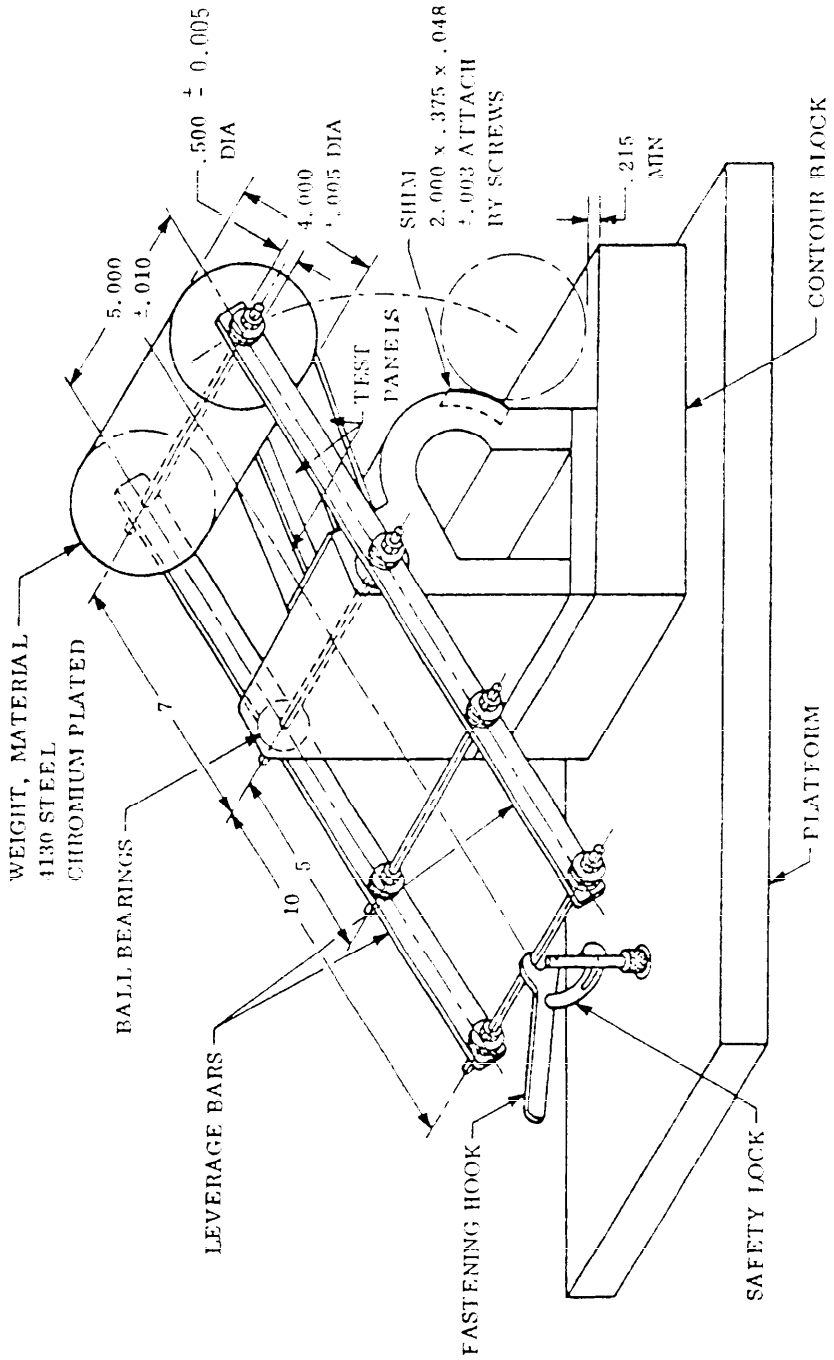
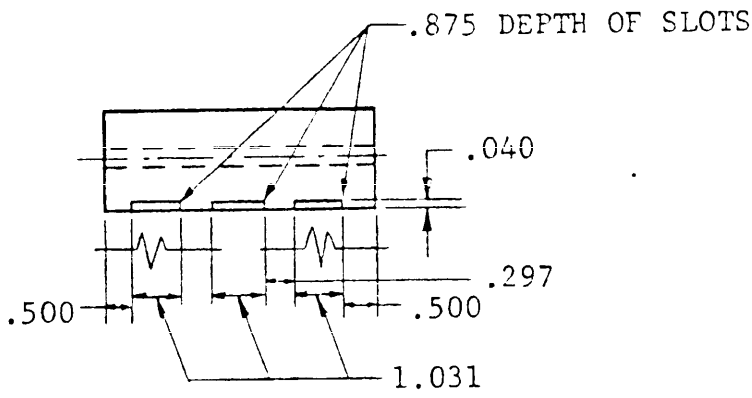
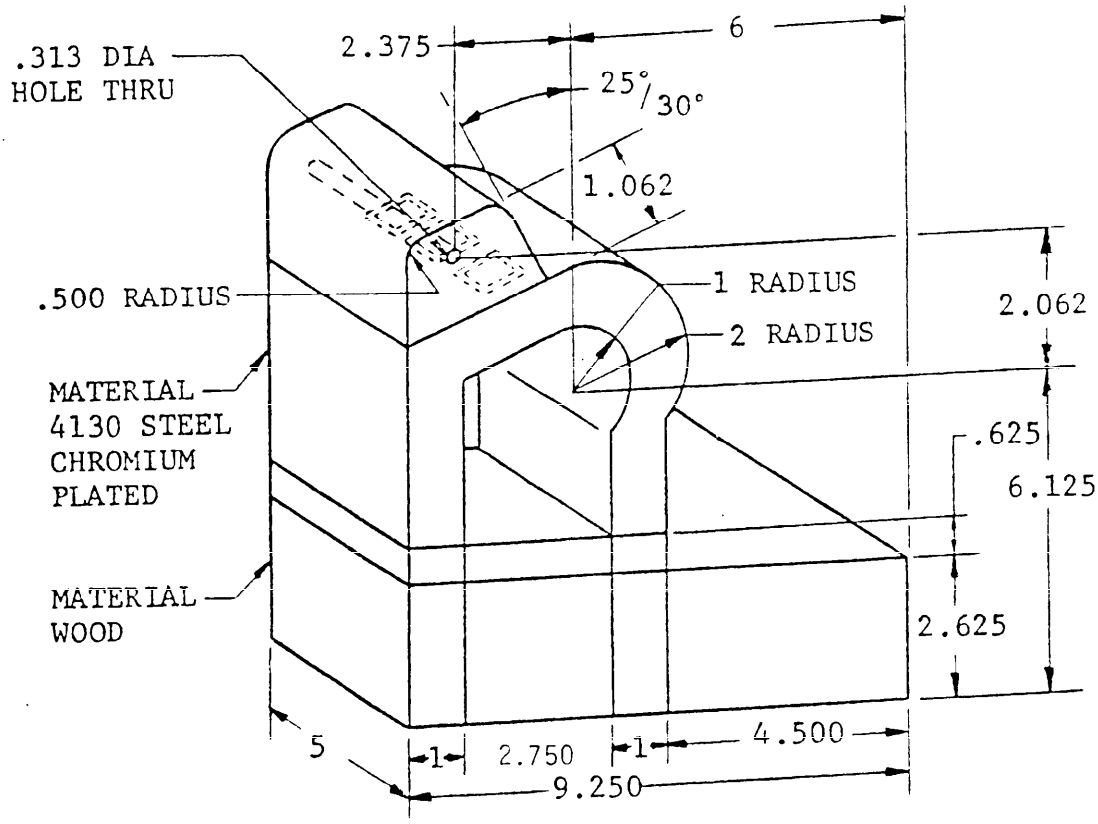


Figure 4. Low temperature flexibility apparatus.

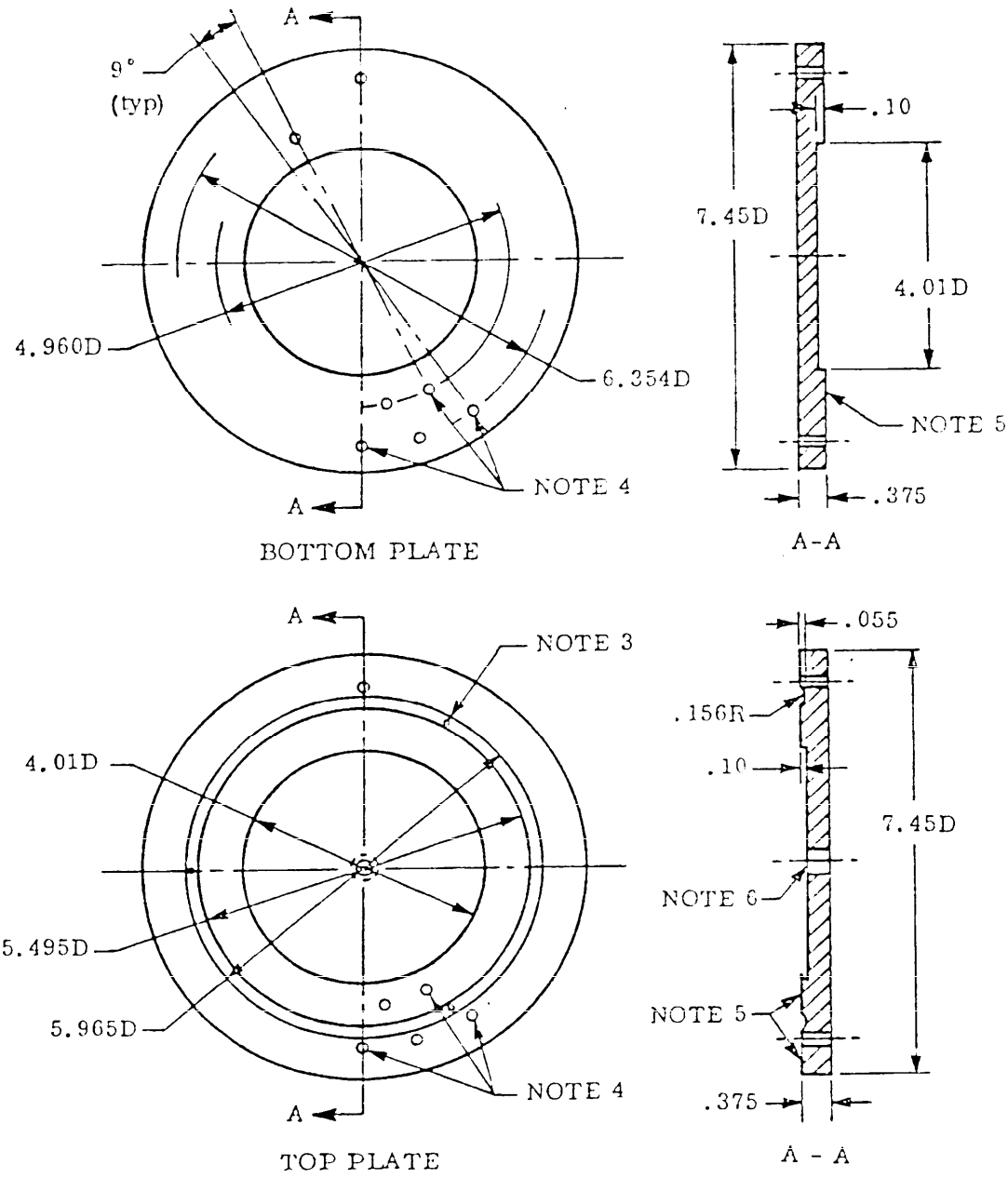


VIEW SHOWING SLOTS FOR PANELS



DIMENSIONS IN INCHES.

Figure 5. Contour block.



NOTES:

1. Material - .375 aluminum plate, 2024-T851 per QQ-A-250/4.
2. Tolerances: .XX ± .010, .XXX ± .005, hole diam. ±.002, angles ± 0°15'
3. Hole centered on groove 3 places thru top plate at 120° intervals. (Csink 100° x .164 diam. on side opposite groove. Tap 8-32 UNC-3B thru per MIL-S-7742. Install appropriate size set screw.)
4. .25 diam. hole (40 places thru each plate to match)
5. Surface indicated shall be flat within .001 max.
6. Drill and tap for 1/4 NPT.
7. Dimensions are in inches.

Figure 6. Seal efficiency test fixture

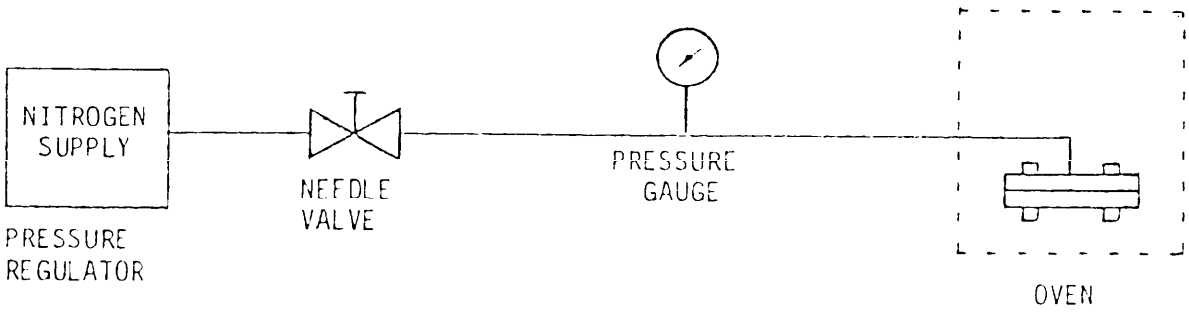
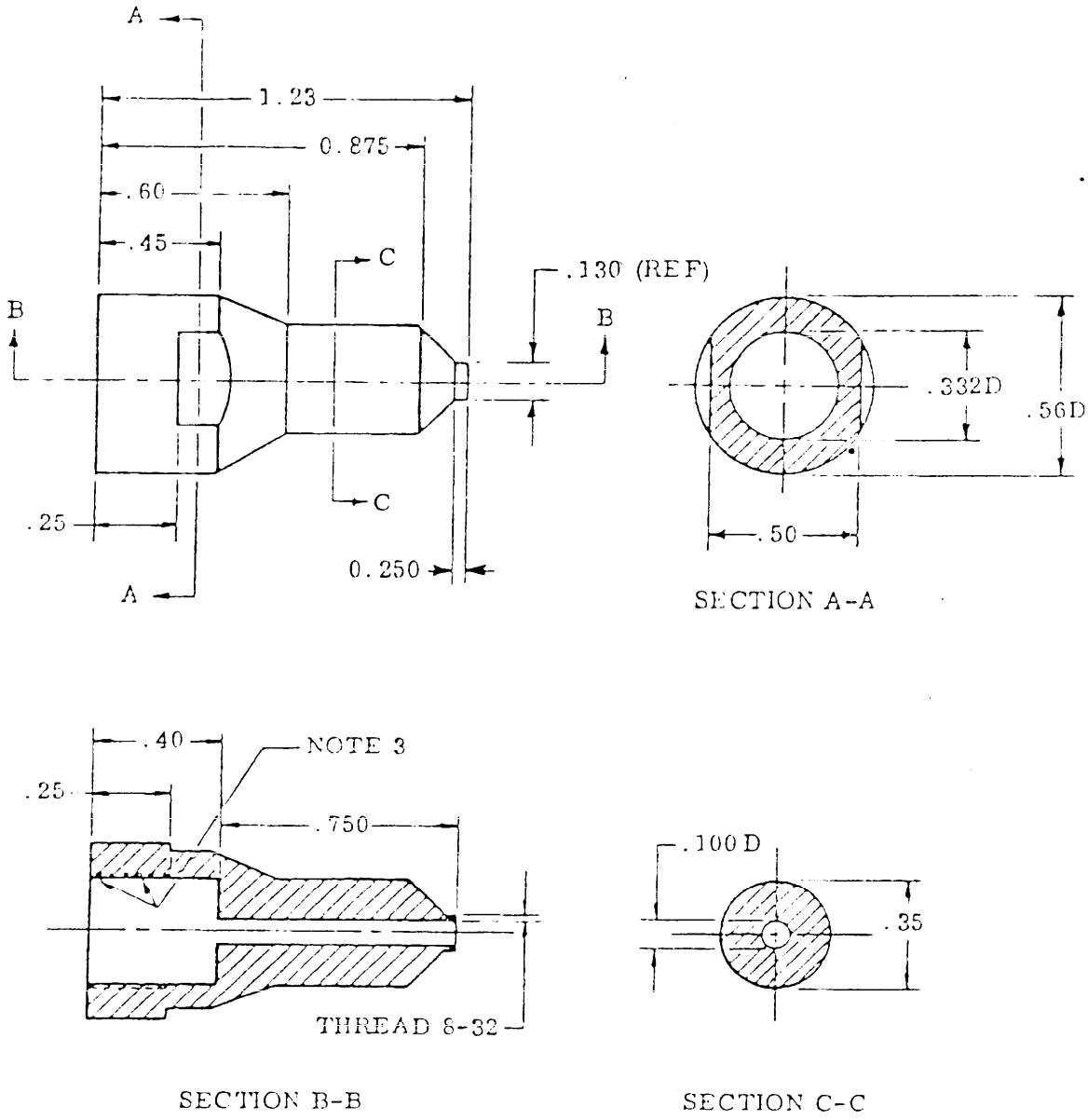


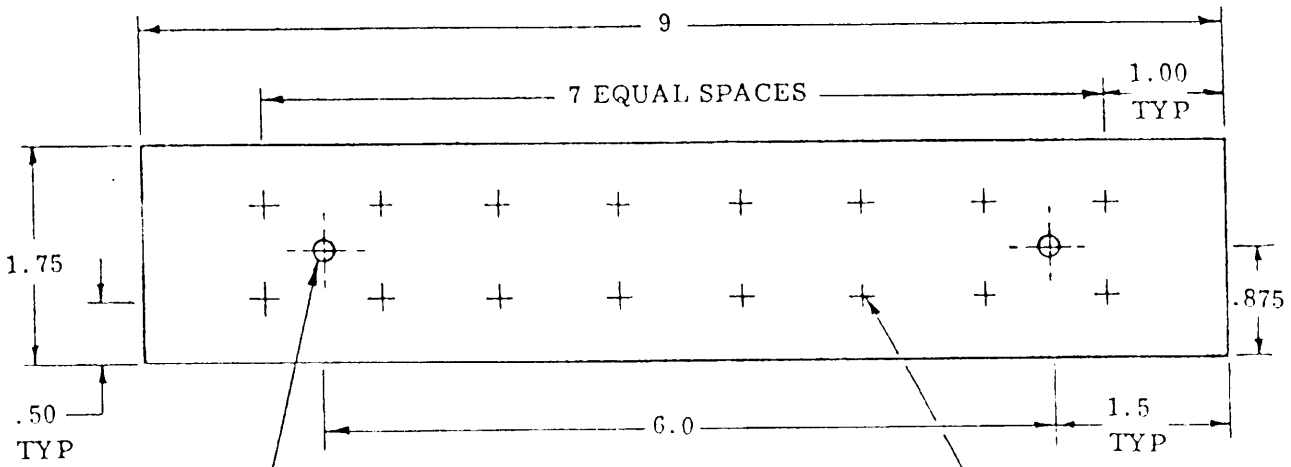
FIGURE 7. Pressure/Thermal system



NOTES:

1. Material - Steel rod per MIL-S-7720 Composition 303 Condition A.
2. Tolerances: .XX±.010, .XXX±.002
3. TAP 1/8 NPT. Countersink 100° by 0.375 diameter.
4. Dimensions are in inches.

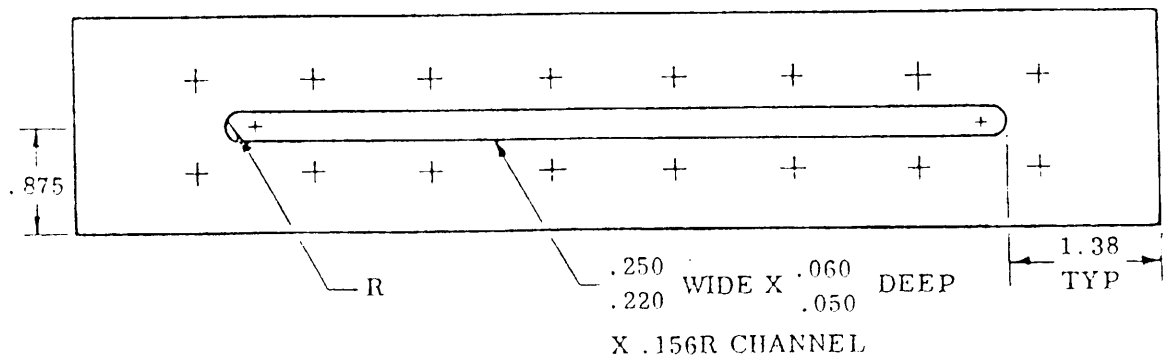
FIGURE 8. Injection tip



TAP 8-32 UNC-3B (THRU)
PER MIL-S-7742
TYPICAL 2 PLACES
NAS 1081-08A2N SCREW

TOP PLATE
.250 THICK QQ-A-250/4
ALUM ALLOY 2024-T81

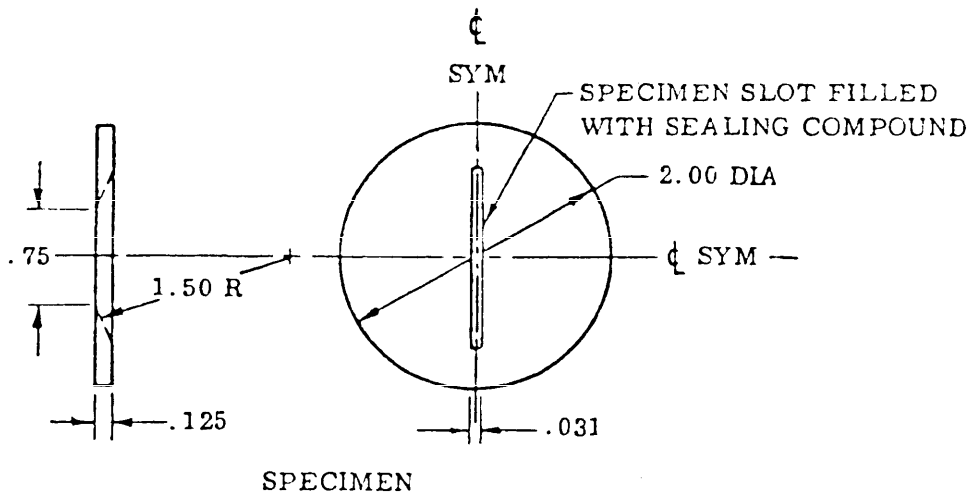
.250 DIA HOLE
(16 PLACES THROUGH
BOTH PLATES)



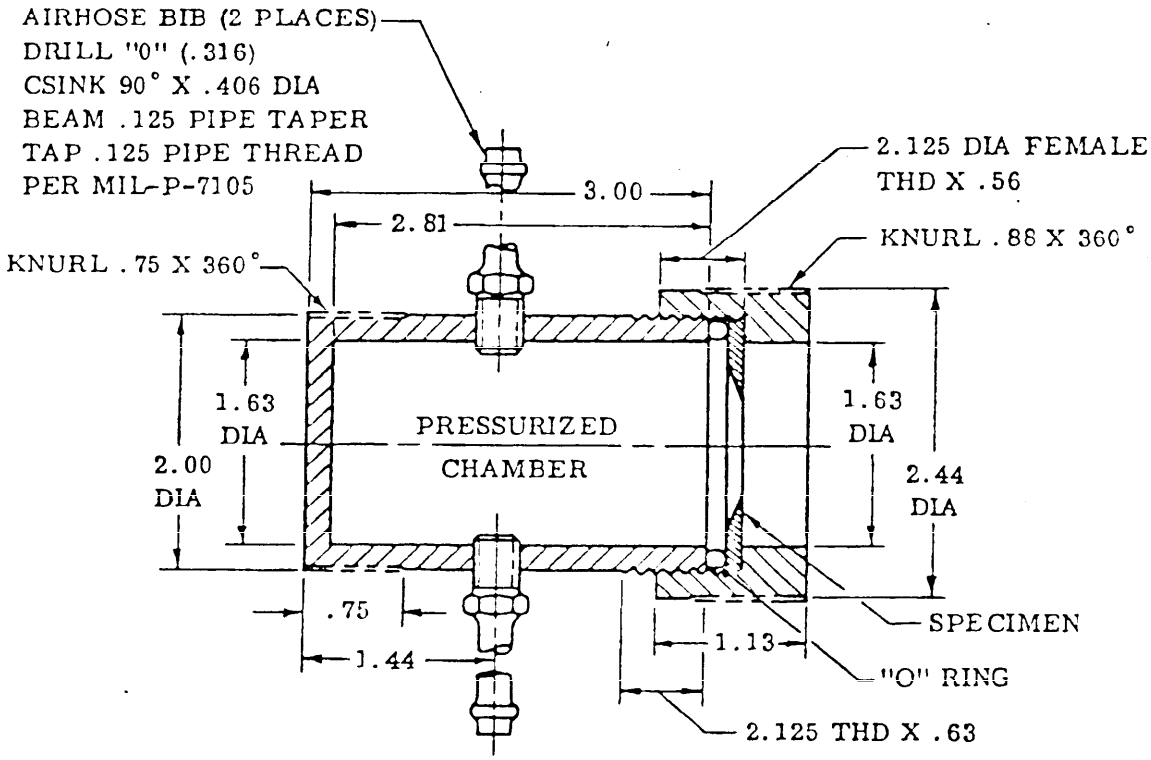
X .156R CHANNEL

DIMENSIONS ARE IN INCHES
TOLERANCES: .XX ±0.010, .XXX ±0.005

BASE PLATE
.250 THICK QQ-A-250/4
ALUM ALLOY 2024-T81



SPECIMEN



DIMENSIONS ARE IN INCHES.
TOLERANCES: .XX ±0.01, .XXX ±0.005

Figure 10. Pressure Rupture Fixture

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