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AEROSPACE RECOMMENDED PRACTICE

SAE ARP4785 REV. A

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Leakage, Requirements and Test Methods, For Fuel Couplings, Pneumatic Couplings, Hydraulic Fittings, Quick Disconnects, and Hose Assemblies

CANCELLATION NOTICE

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1. SCOPE:

This SAE Aerospace Recommended Practice (ARP) establishes the suggested requirements and test methods for the evaluation, qualification testing, and/or acceptance testing of fuel and pneumatic couplings, quick disconnects, hydraulic fittings, and hose assemblies. The paragraphs noted herein are general words and may be modified to fit specific hardware, materials, and usage which will appear in procurement specifications.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other documents shall be the issue in effect on the date of issuance of this document.

2.1.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AS1650	Coupling Assembly, Threadless, Flexible, Fixed Cavity, Self-Bonding
AS1895	Coupling Assembly, V-Retainer, High Pressure High Temperature, Pneumatic Tube
AS1896	Coupling Assembly, Self-Sealing, One Side Only, Hydraulic

2.2 Definitions:

BURST PRESSURE RATING: The test pressure that shall be applied to fluid components without rupture. Normally this is twice the proof pressure.

EFFUSION: The escape of gas or liquid through the membrane walls of the tube or hose.

LEAKAGE: The measurable amount of fluid or gas which escapes from any part of the fluid assembly or connection.

OPERATING PRESSURE: The base line nominal pressure a component sees at service operating condition.

PROOF PRESSURE: The test pressure that a fluid fitting assembly shall be able to withstand without leakage, permanent set or deformation. Normally, this is twice the nominal operating pressure.

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3. TECHNICAL REQUIREMENTS:

The following requirement paragraphs shall define the leakage requirements for:

a. Fuel Couplings: 3.1, 4.4.1
b. Pneumatic Couplings: 3.2, 4.4.2
c. Hydraulic Fittings: 3.3, 4.4.3
d. Quick Disconnects: 3.4, 4.4.4
e. Hose Assemblies: 3.5, 4.4.5

The word "table" referenced in these paragraphs refers to the appropriately numbered table in all procurement specifications that specifies positive and negative operating, proof and burst pressure at temperature.

3.1 Fuel Couplings:

Many fuel couplings are used in pneumatic applications as well as fuel. Both liquid and pneumatic testing should be addressed. The following are suggested fuel coupling leakage paragraphs:

3.1.1 Proof Pressure and Leakage: The assembled coupling shall meet the negative and positive proof pressures listed in Table X without malfunction that would affect function, assembly, disassembly, or leakage, when tested in accordance with 4.4.1.1.

3.1.1.1 Positive Pneumatic Leakage: The assembled coupling shall withstand pneumatic pressure equal to the proof pressure for 3 min at room temperature without any visible stream of bubbles starting after 1 min at pressure when tested under water in accordance with 4.4.1.2 or other malfunction that would affect assembly or disassembly.

3.1.1.2 Negative Pneumatic Leakage: The assembled coupling shall not exhibit a decrease in negative pressure exceeding .5 in of Hg, after pressure stabilization within a period of 5 min when subjected to the negative proof pressure of Table X.

3.1.1.3 Positive Liquid Proof Pressure: The assembled coupling shall withstand liquid pressure equal to the proof pressure as specified in Table X or 3 min at room temperature without allowing the escape of liquid or external wetting from any point of the assembly, when wiped with a clean towel and the towel visually examined.

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3.1.2 Example of a paragraph using the referenced leakage paragraph. Example taken from AS1650.

3.4.2 Fuel Resistance (Aging): The assembled coupling shall not show evidence of malfunction or leakage in excess of 3.4.1.3 when subjected to high temperature fuel aging, 200 °F ± 10 °F, low temperature fuel aging, -65 °F, and air dry out, 200 °F. Testing is specified in 4.6.3.

3.2 Pneumatic Couplings:

Pneumatic couplings (V-couplings) are fairly straightforward. However, the way leakage can be measured may vary. Leakage can be measured under water and by trapping escaping bubbles over a given span of time. Another method is to measure pressure decay in which the test cell pressure is shut off and pressure in the cell is recorded over a period of time. The method shown here uses a flowmeter. Under constant pressure, air flow, if any, is recorded through the flowmeter when the downstream valve is closed and the flowmeter valves are opened (see Figure 1). Hydrostatic testing is used for V-retainer expansion evaluation and leakage and is less explosive than pneumatic testing.

3.2.1 Hydrostatic Pressure: The joint shall show no evidence of permanent deformation, permanent set, or leakage sufficient to form a drop when subjected to the pressures of Table X, at room temperature with water or hydraulic oil as a fluid medium.

3.2.2 Static Leakage: The joint consisting of the coupling, flanges, and seal shall show no evidence of leakage in excess of 0.01 SCFM (0.000765 lb dry air per minute) per inch of tube outside diameter when subjected to operating pressure or evidence of external wetting sufficient to form a drop (for hydrostatic tests).

3.3 Hydraulic Fittings:

Hydraulic fittings, similar to fuel couplings, have many uses. Both pneumatic and liquid leakage should be evaluated.

3.3.1 Pneumatic Pressure and Leakage (Operating Pressure): The fitting assembly shall withstand pneumatic pressure equal to the operating pressure for 3 min at ambient temperature without any visible stream of bubbles starting after 1 min at pressure when tested in accordance with 4.4.3.1.1. Any visible stream of bubbles or other malfunction that would affect assembly or disassembly shall constitute a failure of this test.

3.3.2 Liquid Leakage and Proof Pressure: The fitting or fitting assembly when subjected to proof pressure specified herein, shall not allow the escape of fluid or external wetting sufficient to form a drop, from any point of the fitting assembly including the fitting-tube junction. This junction is defined to include one tube outside diameter in length beyond the fitting envelope. The envelope is the area from free parent tube material to free parent tube material, boss, or fittings. Any evidence of fluid on a clean dry towel, after wiping the test connection, shall constitute a failure of this test.

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3.4 Quick Disconnects:

Quick disconnects, like fuel couplings and fittings, can be used in both pneumatic and liquid applications. The difference is that leakage has to be measured, coupled, and uncoupled.

3.4.1 Leakage - Liquid Units: There shall be no external leakage, sufficient to form a drop, in the coupled or uncoupled condition, when pressurized to the high and low pressures specified in 4.4.4.1.1 and 4.4.4.1.2. Fluid loss (spillage) detected during the coupling and uncoupling operation, as specified in Table X and 4.4.4.1, is not considered to be external leakage.

3.4.2 Leakage Pneumatic Units (Operating Pressure): There shall be no leakage in excess of (TBD) when subjected to pneumatic testing in the coupled or uncoupled condition. Brief escape of pressure (spillage) during uncoupling shall not be considered leakage. Testing is specified in 4.4.4.2.

3.4.3 Vacuum Leakage: The coupled or uncoupled coupling halves shall not exhibit a decrease in vacuum level, within a period of 5 min, when subjected to an internal vacuum of 10 in of Hg. Testing is specified in 4.4.4.3.

3.5 Hose Assemblies:

Hose assemblies have complex leakage requirements. The fittings and/or couplings attached to the hose must be evaluated with the hose as well as the fitting to hose junction. Metallic hoses have no effusion requirement so the assembly can be evaluated as a tube assembly. Nonmetallic hoses must be evaluated for effusion. Effusion may vary on the same hose when the hose assembly is subjected to qualification testing. The amount of effusion variation will range depending on the hose design.

3.5.1 Metallic Hose Assemblies:

3.5.1.1 Pneumatic Leakage (Operating Pressure): The hose assembly shall withstand pneumatic pressure equal to the maximum operating pressure as specified in 4.4.5.1.1.1 for 5 min at room temperature without any visible stream of bubbles starting after 1 min at pressure when tested in accordance with 4.4.5.1.1.1. Any visible random bubbles or stream of bubbles or other malfunction that would affect assembly or disassembly shall constitute a failure of this test.

3.5.1.2 Pneumatic Leakage (Proof Pressure): The hose assembly shall withstand pneumatic pressure equal to the proof pressure as specified in 4.4.5.1.1.2 for 5 min at room temperature without any visible stream of bubbles starting after 1 min at pressure when tested in accordance with 4.4.5.1.1.2. Any visible random bubbles or stream of bubbles or other malfunction that would affect assembly or disassembly shall constitute a failure of this test.

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3.5.2 Nonmetallic Hose With Fittings:

3.5.2.1 Pneumatic Leakage and Effusion (Operating Pressure): The hose assembly, including the hose and fittings, shall show no evidence of leakage in excess of 4.0 cm^3/ft for a minimum of 5 min during initial check out test prior to the 1 h test per 4.4.5.2.1. The hose length shall be measured from seal point to seal point ±.125 in. Leakage after testing shall not exceed 8.0 cm^3/ft when tested in accordance with 4.4.5.2.1. Any evidence of leakage from the hose or fitting, hose burst, fitting blow-off, or any other evidence of malfunction that would affect assembly or disassembly shall constitute a failure of this test.

3.5.2.2 Liquid Leakage: The hose assembly shall not show evidence of external leakage or wetting sufficient to form a drop when subjected to two pressure cycles of 70% of minimum room temperature burst pressure when tested in accordance with 4.4.5.2.2.

4. QUALITY ASSURANCE:

4.1 Responsibility for Inspection:

The responsibility for inspection shall be specified in the procurement specification.

4.2 Classification of Test:

The classification of tests, appearing in the procurement specification, shall be classified as:

a. Qualification test
b. Quality conformance and test verification

The procurement specification shall specify which tests noted herein shall be included in 4.2 (a) and (b).

4.2.1 Test Report: The procurement specification shall specify the requirements for test reports.

4.2.2 Sampling Instructions: The procurement specification shall specify the requirements, tests, and number of test samples in tabular form.

4.3 Test Conditions:

The procurement specification shall specify test pressure, test temperature, and test fluids.

4.4 Inspection Methods:

The following test paragraphs shall define the test methods for determining leakage:

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4.4.1 Fuel Couplings:

4.4.1.1 Proof Pressure: Test specimens shall be installed as shown in Figures 1 and 2 and subjected to Table X positive and negative proof pressures in conjunction with and as specified in other tests.

4.4.1.2 Positive Pneumatic Proof Pressure: Test specimens shall be placed in a protective enclosure, submerged under water and proof pressure tested to the Table X positive value for a minimum of 3 min. Measurements shall be made starting after a 1 min stabilization period. The test fluid shall be dry compressed air or nitrogen.

4.4.1.3 Negative Pneumatic Proof Pressure: Test specimens shall be dry and free of fuel or test fluid vapors. The connection between the test specimen and vacuum pump shall be .5 in nominal hose or tube size and shall not exceed a length of 10 ft. A stop valve shall be installed between the test specimen and the vacuum pump. Pressure at room temperature (-65 °F to 80 °F) shall be measured within 6 in of the test specimen. A negative proof pressure equal to or greater than the Table X specified pressure shall be maintained for 15 min. The stop valve shall then be closed and the pressure shall be monitored for 5 min.

4.4.1.4 Positive Liquid Proof Pressure: Test specimens shall be dry on the exterior by wiping with a clean towel and proof pressure tested to the Table X positive value for not less than 3 min and not more than 5 min. The test fluid shall be as specified in other tests or may be water. At the conclusion of the test the specimen shall again be wiped with a clean dry towel and the towel visually examined for evidence of test fluid.

4.4.2 Pneumatic Couplings (V-couplings):

4.4.2.1 Hydrostatic Pressure: Prior to performing any pneumatic pressure testing, the test specimen shall be enclosed in a protective enclosure and hydrostatically pressurized to the test pressure of Table X and 3.2.1 at room temperature as follows:

The coupling shall be assembled on the flanges (including seal) and the assembly shall be filled with water or hydraulic oil. The coupling shall be torqued to the value specified on the coupling standard. The assembly shall be pressurized to one-half the test pressure specified in Table X. The pressure shall then be released. The coupling half expansion of each segment shown in Figure 3 shall be measured and recorded. The joint shall be repressurized to the values in Table X and the expansion as shown in Figure 3 shall be measured and recorded. The differential expansion shall not exceed the values in Table X. The pressure shall be released. The expansion shall again be measured and shall not exceed the initial expansion.

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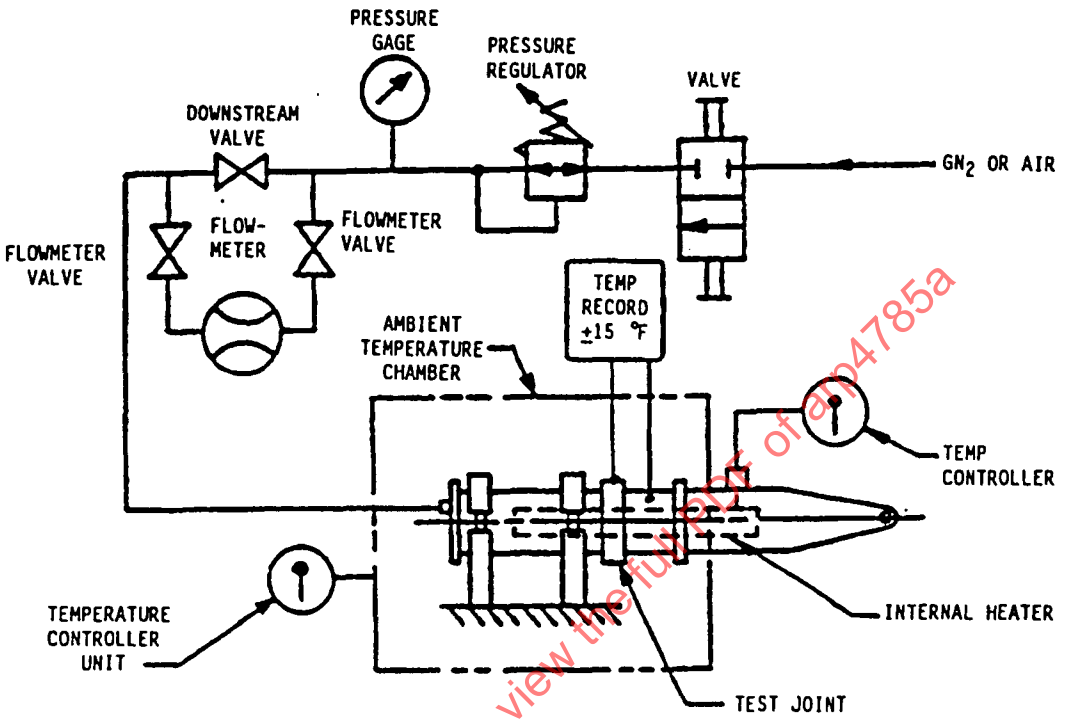

FIGURE 1 - Schematic of Test Setup for Pneumatic Tests

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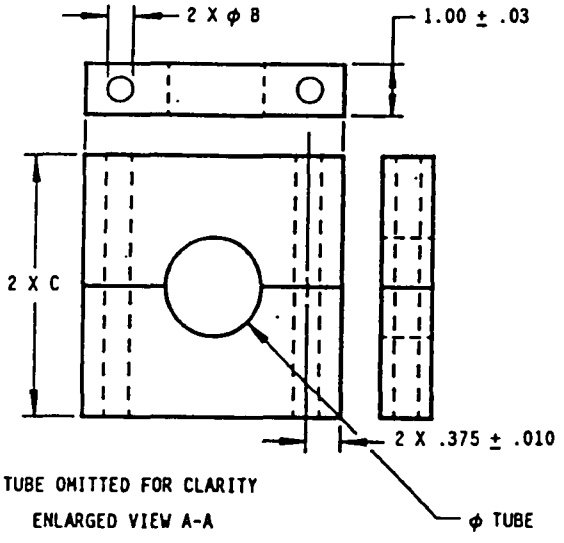

TABLE 1 - Clamp Block Dimensions

Tube	B ±.005	C ±.03
.50	.375	2.00
1.00	.375	2.50
1.50	.375	3.00
2.00	.500	3.50
2.50	.500	4.00
3.00	.500	4.50
4.00	.500	5.50
5.50	.500	7.00

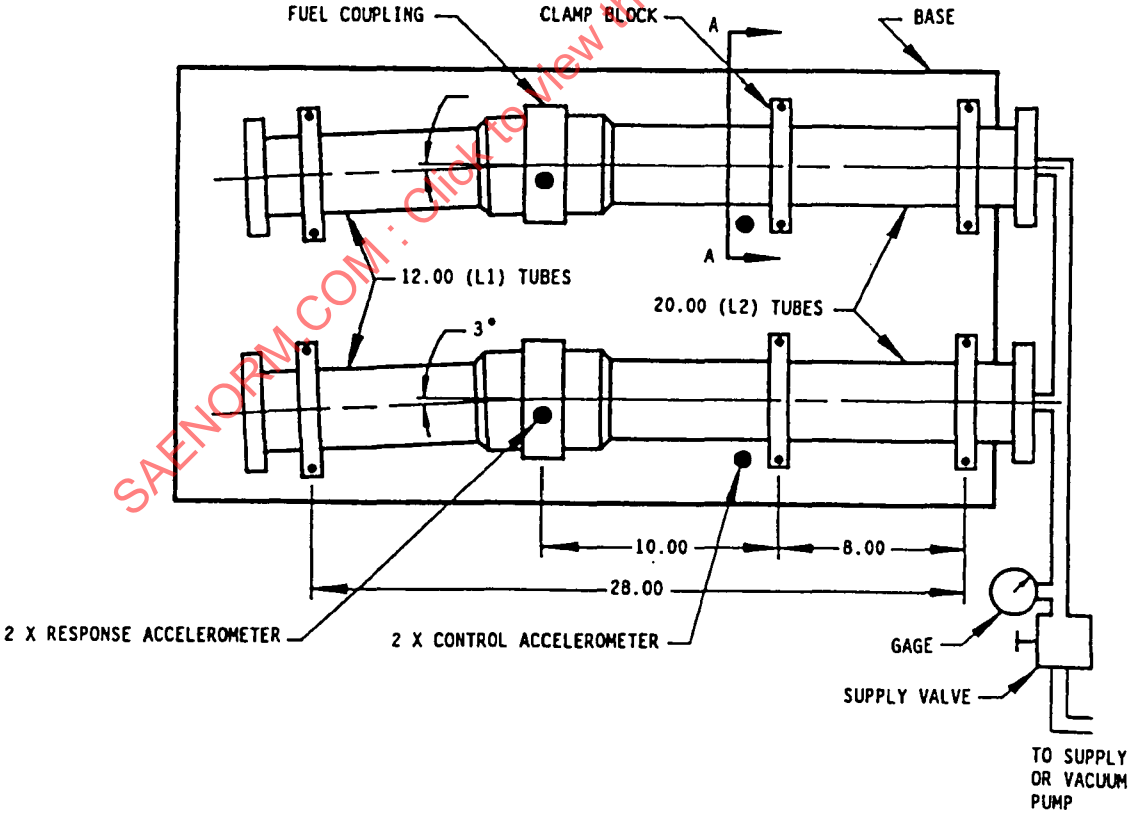

FIGURE 2 - Fuel Resistance, Vibration, Interchangeability of Parts, Proof and Burst Pressure Test Setup

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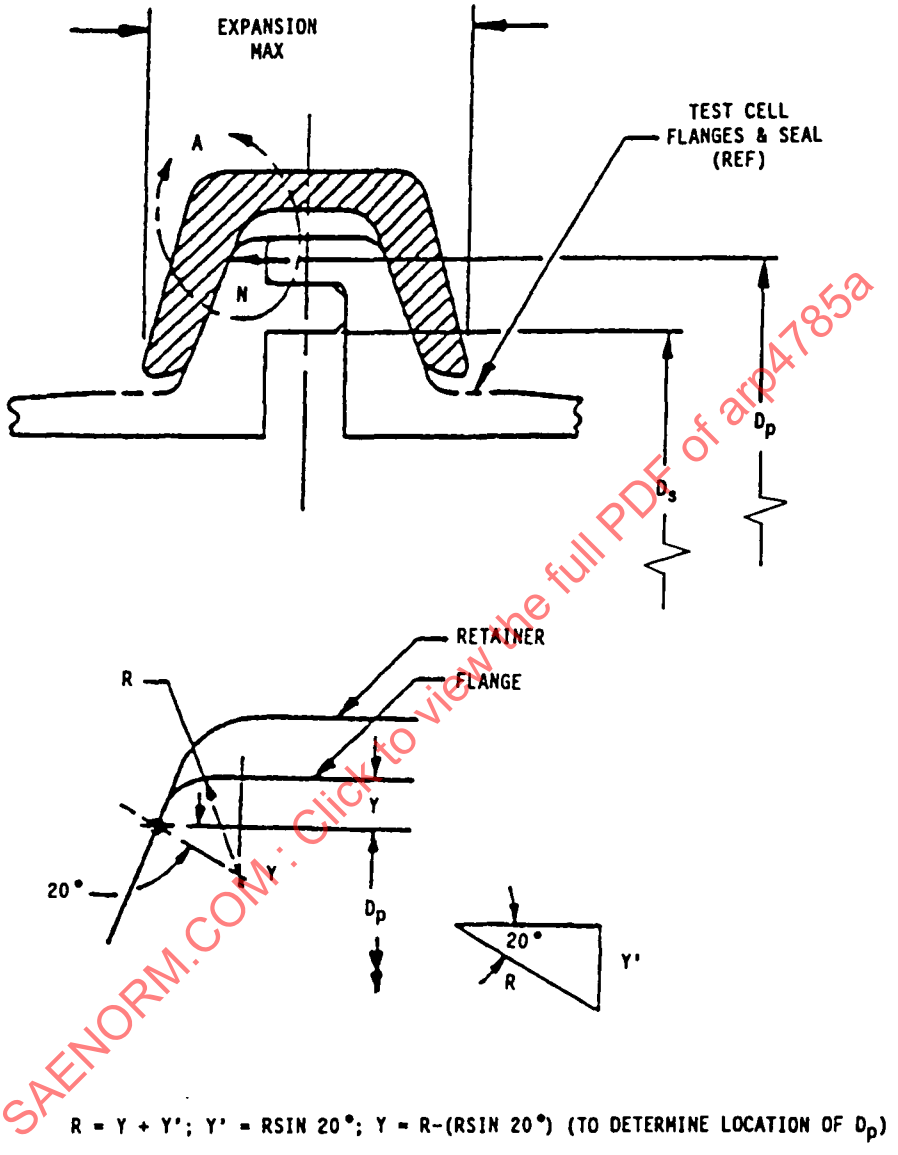

FIGURE 3 - Hydrostatic Test

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4.4.2.1.1 Hydrostatic Pressure - Alternate Test and Acceptance Test: Prior to performing any pneumatic pressure testing, the specimen shall be enclosed in a protective enclosure and hydrostatically pressurized to the test pressure of Table X and 3.2.2 at room temperature as follows:

The coupling shall be assembled on the test fixture per Figure 4 and the assembly shall be filled with water or hydraulic oil. The coupling shall be torqued to the value specified on the coupling standard if the self-locking nut is employed. Free running brass nuts may be used, but the value to which these nuts are torqued shall be as stated on the coupling standard, minus 40 lb-in. The assembly shall be pressurized to one-half the test pressure specified in Table X. The pressure shall then be released. An initial measurement of the midspan coupling half width, dimension ("expansion max") in Figure 3, shall be made and recorded. An initial measurement of the fixture at "/5/, Figure 4, shall be made and recorded. The joint shall be repressurized to the values in Table X and the expansion of the test fixture as shown in Figure 4 shall be measured while the joint remains pressurized and recorded. The differential expansion of the test fixture shall not exceed the values in Table X. The pressure shall be released. The midspan coupling half width shall be remeasured and recorded and shall not exceed the initial measurement value.

4.4.2.2 Static Operating and Proof Pressure Leakage Test: The test specimen shall be mounted on a test fixture and installed as shown in Figure 1. The test specimen shall be pressurized with air or gaseous nitrogen by allowing the pressurizing medium to flow through a flowmeter while maintaining the required test pressures by means of a manually operated control valve placed between the pressure source and pressure gage. Any flow occurring after the required pressure has been reached, within the test specimen, shall be measured as leakage through the specimen. While at ambient temperature, the test specimen shall be slowly pressurized to operating pressure of Table X. After the pressure within the specimen has stabilized, the pressure shall be maintained for a period of 15 min. The specimen leakage rate shall be monitored and recorded while at operating pressure and ambient temperature.

The internal pressure shall be slowly increased to two times the operating pressure of Table X. After the pressure within the specimen has stabilized, the proof pressure shall be maintained for a period of 15 min. The specimen leakage rate shall be monitored and recorded while at proof pressure and ambient temperature.

The internal pressure shall then be reduced and maintained at operating pressure. The internal temperature control within the specimen shall be adjusted to maintain the elevated operating temperature of 1200 °F ± 15 °F. An additional soak time of 20 min minimum shall be allowed after the temperature has been reached to assure stabilization of the test specimen.

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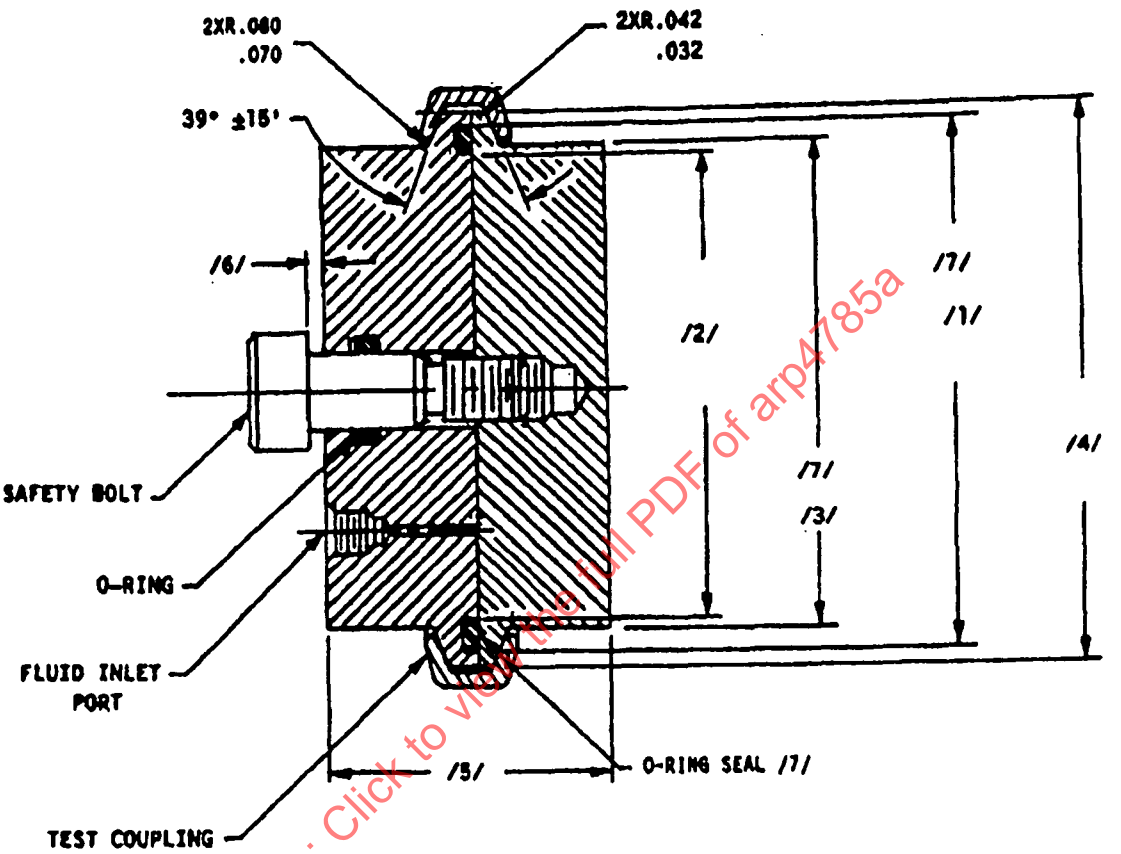

NOTES:

/1/ ϕF PER AS1895/12/ OR /14/.
/2/ ϕC -.150 MIN PER AS1895/12/ OR /14/.
/3/ ϕA PER AS1895/12/ OR /14/.
/4/ ϕD PER AS1895/12/ OR /14/.
/5/ FIXTURE EXPANSION DIMENSION.
/6/ STOP DIMENSION = 2X MAX ALLOWABLE EXPANSION PER TABLE 4.
/7/ O-RING DIMENSIONS CHOSEN MUST YIELD SAME LOAD OR N_p AS ACTUAL JOINT WHEN PRESSURIZED.

FIGURE 4 - Hydrostatic Proof Pressure Test Fixture

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