AEROSPACE STANDARD

AS85421™ REV. C

Issued 1998-07
Revised 2021-05

Superseding AS85421B

Fittings, Tube, Fluid Systems, Separable, Beam Seal, 3000/4000 psi, General Specification for

FSC 4730

RATIONALE

Corrected error to sample numbers in burst test (4.6.3); modified periodic control testing procedures/tests (4.4.3); clarified flexure Tables 2A, 2B, and 2C; and added new tubing material options to Table 1.

1. SCOPE

1.1 Scope

This specification covers the design requirements and test procedures for separable beam seal fittings which includes end fittings (see 2.3.4), fitting bodies (see 2.3.7), and boss fittings (see 2.3.2) for use in aerospace fluid systems. Design requirements are for class 3000 in corrosion resistant steel (15-5 PH, 17-4 PH CRES) only and for class 4000 in titanium alloy (Ti) and corrosion and heat-resistant steel (nickel alloy 718 CRES) only. Definition of fittings and related terms are defined in 2.3.

1.2 Classification

Fittings shall be of the following type and pressure classes of the hydraulic system as specified below:

1.2.1 Type

As defined in hydraulic system specifications AS5440 and AS8775.

a. Type II System: Temperature range -65 to +275 °F (-54 to +135 °C).

b. Type IV System: Temperature range -65 to + 630 °F (nickel alloy 718 fittings only).

1.2.2 Pressure Classes

a. Class 3000: 3000 psi (21000 kPa) nominal operating pressure where the cutout pressure at the main pressure controlling device is 3000 psig (21000 kPa) ± 15%.

b. Class 4000: 4000 psi (28000 kPa) nominal operating pressure where the cutout pressure at the main pressure controlling device is 4000 psig (28000 kPa) ± 15%.

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For more information on this standard, visit
https://www.sae.org/standards/content/AS85421C

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 publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA). www.sae.org.

AMS4921	Titanium Bars, Wire, Forgings, and Rings Commercially Pure 70 ksi (483 MPa) Yield Strength
AMS4928	Titanium Alloy Bars, Wire, Forgings, Rings, and Drawn Shapes 6Al - 4V Annealed
AMS4946	Titanium Alloy Tubing, Seamless, Hydraulic 3Al - 2.5V, Texture Controlled Cold Worked, Stress Relieved
AMS4965	Titanium Alloy, Bars, Wire, Forgings, and Rings 6.0Al - 4.0V Solution Heat Treated and Aged
AMS5561	Steel, Corrosion and Heat-Resistant, Welded and Drawn or Seamless and Drawn Tubing 9.0Mn - 20Cr - 6.5Ni - 0.28N High Pressure Hydraulic
AMS5581	Nickel Alloy, Corrosion and Heat-Resistant, Seamless or Welded Tubing 62Ni – 21.5Cr – 9.0Mo – 3.7Cb (Nb) Annealed
AMS5637	Steel, Corrosion Resistant, Bars and Wire 18Cr - 9.0Ni (302) Solution Heat Treated, Cold Drawn and Stress Relieved 125 ksi (862 MPa) Tensile Strength
AMS5643	Steel, Corrosion-Resistant, Bars, Wire, Forgings, Mechanical Tubing, and Rings 16Cr - 4.0Ni - 0.30Cb (Nb) - 4.0Cu Solution Heat Treated, Precipitation Hardenable
AMS5656	Steel, Corrosion Resistant, Bars, Wire, Forgings, Extrusions, and Rings 9.0Mn - 20Cr - 6.5Ni - 0.27N Solution Heat Treated
AMS5659	Steel, Corrosion-Resistant, Bars, Wire, Forgings, Rings, and Extrusions 15Cr – 4.5Ni - 0.30Cb (Nb) - 3.5Cu
AMS5663	Nickel Alloy, Corrosion and Heat-Resistant, Bars, Forgings, and Rings 52.5Ni - 19Cr - 3.0Mo - 5.1Cb (Nb) - 0.90Ti - 0.50Al - 18Fe Consumable Electrode or Vacuum Induction Melted 1775 °F (968 °C) Solution and Precipitation Heat Treated
AIR1377	Fire Test Equipment for Flexible Hose and Tube Assemblies
ARP1185	Flexure Testing of Hydraulic Tubing Joints and Fittings
AS603	Impulse Testing of Hydraulic Hose, Tubing, and Fitting Assemblies
AS1055	Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings, and Similar System Components
AS1376	Alternate Dimensions, Center Body Section, Shape Fluid Fitting, Design Standard
AS1576	Fittings, Welded, Hydraulic, Titanium, Corrosion Resistant Steel and Nickel, 3000 psi Hydraulic
AS1701	Lubricant, Solid Film

AS4207 Fitting End, External Thread, Beam Seal, Design Standard

AS4208 Fitting End, Bulkhead, External Thread Beam Seal, Design Standard

AS4459 Fittings, Tube, Fluid System 3000 psig (21 000 kPa) Rated Pressure, Externally Swaged, Specification for

AS4510/2 Fittings, Weld to Beam, Seal, Fluid Connection

AS5272 Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting, Procurement Specification

AS6279 Standard Practice for Production, Distribution, and Procurement of Metal Stock

AS8879 Screw Threads - UNJ Profile, Inch Controlled Radius Root with Increased Minor Diameter

AS85421/1 Fitting End, Standard Dimensions for Dynamic Beam Seal, Male

AS85421/2 Fitting End, Standard Dimensions For, Bulkhead, Dynamic Beam Seal, Male

2.1.2 U.S. Government Publications

Copies of these documents are available online at https://quicksearch.dla.mil.

MIL-HDBK-505 Definitions of Item Levels, Item Exchangeability, Models and Related Terms

MIL-PRF-5606 Hydraulic Fluid, Petroleum Base; Aircraft, Missile and Ordnance

MIL-PRF-7808 Lubricating Oil, Synthetic Base, For Aircraft Turbine Engines

MIL-PRF-83282 Hydraulic Fluid, Fire-Resistant, Synthetic Hydrocarbon Base, Aircraft, Metric, NATO Code Number H-537

MIL-STD-129 Marking for Shipment and Storage (Part 1 of 4 Parts)

MIL-STD-1916 DoD Preferred Method for Acceptance of Product

MIL-STD-2073-1 DoD Standard Practice for Military Packaging Requirements

2.1.3 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada, 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

ASME B46.1 Surface Texture

ASME Y14.35M Provision Engineering Drawing and Associated Documents

2.1.4 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D1974 Fiberboard Shipping Containers, Methods of Closing, Sealing, and Reinforcing, Standard Practice for

ASTM D3951 Packaging, Commercial

ASTM D6251/D6251M Standard Specification for Wood-Cleated Panel Board Shipping Boxes

2.1.5 PRI Publications

Available from Performance Review Institute, 161 Thorn Hill Road, Warrendale, PA 15086-7527, Tel: 724-772-1616, www.pri-network.org.

PD1100	NADCAP – Program Requirements
PD2001	Tasks & Procedures of the Qualification Product Management Council
PD2101	Qualified Management Product Council for Qualified Products Group
AC7112	Nadcap Audit Criteria for Fluid Systems Component Manufacturers
AC7112/2	Nadcap Audit Criteria for Fittings and Other Machined Components
PRI-QPL-AS85421	Qualified Products List, Fittings (QPL), Tube, Fluid Systems, Separable, Beam Seal, 3000/4000 psi

2.1.6 AIA Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, www.aia-aerospace.org.

NAS874	Caps and Plugs, Protective, Dust and Moisture Seal

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA). www.sae.org.

AS5440	Hydraulic Systems, Military Aircraft, Design and Installation Requirements For
AS8775	Hydraulic System Components, Aircraft and Missiles, General Specification For

2.3 Definitions

2.3.1 BEAM SEAL FITTING

These are a class of separable fittings which are designed to mate with a standardized 8-1/2 degree male end (AS85421/1; or AS85421/2; or AS4207; or AS4208). The name comes from the female sealing system which employs an elastic “beam” which acts as a dynamic lip type seal. A secondary, axially very stiff seal also mates on the 8-1/2 degree male face to allow for developing high torque induced preloads while providing a deflection limit to the elastic primary seal.

2.3.2 BOSS FITTING

Boss fitting as used herein is defined as the fitting that connects to AS5202, AS1300 ring-locked type boss or equivalent.

2.3.3 CONNECTOR

Connector as used herein is defined as a replaceable component which connects end fittings, bosses, or ports by means of threads. Generally these components are end fittings with internal or external threads and fitting bodies.

2.3.4 END FITTING

End fitting as used herein is defined as fitting permanently attached to tubing end. An end fitting with an internally threaded nut is defined as a female end fitting. An end fitting with an externally threaded end is defined as a male end fitting.

2.3.5 FAILURE

Failure as used herein is defined as any deformation that would contribute to seal leakage or would promote premature fatigue breakage, unless otherwise determined to be due to a tubing defect.

2.3.6 FITTING ASSEMBLY

Fitting assembly as used herein is defined as the end fittings attached to the appropriate tubing with necessary connectors to conform to proper test sample (see 4.3.1 and Table 4).

2.3.7 FITTING BODY

Fitting body as used herein is defined as a replaceable component which connects male or female end fittings, bosses, or ports by means of threads. Generally these fittings are unions, adapters, 45 and 90 degree elbows, tees, and crosses.

2.3.8 LEAKAGE

Leakage as used herein is defined as the escape of fluid (gaseous or liquid) 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 or boss.

2.3.9 LOT

A lot is defined as parts consist of all parts of a given part number made from the same batch of material and processed at the same time.

2.3.10 TORQUE

Torque as used herein is defined as the necessary loads (or assembly stresses) to ensure the sealing of the end fitting of the fitting body.

3. TECHNICAL REQUIREMENTS

3.1 Qualification

The fittings and fitting bodies furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 4.3 and 6.5).

3.1.1 Product Qualification

Fittings, nuts, and sleeves furnished under this specification shall be representative of products which have been qualified to the requirements of 4.3. This includes the starting raw stock form that was used for qualification. After successful qualifications are performed, the corresponding QPLs will indicate either “BAR STOCK” or “FORGING” (which includes either one-step oversized forging or near-net (standard) forging).

3.1.1.1 Successful qualifications performed with fittings processed from bar-stock does not qualify the OCM to manufacture same part numbered parts from oversized forgings or standard near-net forgings. Dimensional requirements shall be per AS1376. Grain orientation for fitting bodies machined from bar-stock shall follow the (L) longitudinal axis across the runs on tee shapes (parallel with the major axis) or follow the longest major axis on elbow or cross shapes (parallel with the longest axis) in accordance with AS6279.

3.1.1.2 Successful qualifications performed with fittings processed from near-net forgings also qualifies the OCM to manufacture same part numbers parts from “one-step” oversize forgings per 3.1.1.2.1, but does not qualify the OCM to manufacture same part numbered parts from bar-stock. If the shaped fitting (elbow, tee, cross) includes one or more ends that are “standard” sized (end sized according to the forging size), and one or more ends that are “reduced” size (end sized smaller than forging size), this shall be considered same as being qualified and manufactured from a standard sized near-net forging.

3.1.1.2.1 An alternate qualification method for manufacture from forgings will be successful qualifications performed with fittings processed from “one-step” oversize forgings. Successful qualification using “one-step” oversized forgings also qualifies the OCM for manufacturing from near-net forgings as per 3.1.1.2, but does not qualify the OCM to manufacture same part numbered parts from bar-stock. A “one-step” oversize forging is defined as a forging for a shaped fitting (elbow, tee, cross) that is one size larger than the largest fitting end size. For small size fittings dash 03 through dash 05, this means a dash 04 forging is acceptable to manufacture a dash 03 fitting, a dash 05 forging is acceptable for a dash 04 fitting, and a dash 06 forging is acceptable for a dash 05 fitting. For large size fittings dash 06 through dash 14, this means a dash 08 forging is acceptable to manufacture a dash 06 fitting, a dash 10 forging is acceptable for a dash 08 fitting, a dash 12 forging is acceptable for a dash 10 fitting, a dash 14 forging is acceptable for a dash 12 fitting, and a dash 16 forging is acceptable for a dash 14 fitting. For extra-large size fittings dash 16 and dash 20, up to a dash 20 forging is acceptable to manufacture a dash 16 fitting, and up to a dash 24 forging is acceptable for a dash 20 fitting. These are the only fitting/oversize forging combinations allowed for this alternate method of qualification and manufacture. Dimensional specifics per AS1376 are required.

3.1.1.3 All products shall conform to this procurement specification and shall be approved in accordance with the requirements of PD2001 and PD2101 for listing in the PRI Qualified Products List (QPL) PRI-QPL-AS85421. See http://www.eAuditNet.com.

3.1.2 Manufacturer Qualification

A manufacturer producing a product in conformance to this procurement specification shall be accredited in accordance with the requirements of PD2101, PD1100, AC7112, and AC7112/2 and will be listed in the PRI Qualified Manufacturers List (QML).

3.2 Material

3.2.1 Fittings

The material used shall be titanium alloys and corrosion resistant steels as specified in Table 1. The corrosion resistant steel fittings are designed for class 3000 system. The nickel alloy 718 CRES fittings are designed for class 4000 system, but may be used in both class 3000 and class 4000 systems. The titanium fittings are designed for class 4000, but may be used in both class 3000 and class 4000 systems. The material shall be heat treated, as required, and have surface protection to meet the test requirements of this specification. Recycled materials shall be utilized to the maximum extent possible provided the materials used conform to the applicable material specifications.

3.2.2 Tubing

The tubing used for the fabrication of the test fitting assemblies shall be in accordance with Tables 1 and 2.

Table 1 - Fitting and tubing materials

Item Name	Titanium (Class 4000)	CRES (Class 3000)	CRES (Class 4000)
Nuts Internally Threaded	AMS4965	AMS5643 or AMS5659 Condition H1075	AMS5663
Fitting Bodies	AMS4965, AMS4928 (Bars or Forgings)	AMS5643 or AMS5659 Condition H1075 or AMS5656 or AMS5663 (Bars or Forgings)	AMS5663 (Bars or Forgings)
Tubing	AMS4945, AMS4946, or AS5620	AMS5561	AMS5581
Swivel Wires	AMS5637 Coated with Solid Film Lubricant per AS5272 Type I or Type II; or AS1701 Type III or Type IV		AMS5637 Coated with Solid Film Lubricant per AS1701 Type IV

Table 2 - Fitting and tubing data and stress level for flexure test

Table 2A - 3000 psi CRES tubing sizes and bending stresses (AMS5643, AMS5659, AMS5656)

Tube Size	Tube Wall	Endurance Point Bending Stress 10 million cycles, min (psi)	Data Point 1 Bending Stress 50000 cycles, min (psi)	Data Point 2 Bending Stress 100000 cycles, min (psi)	Data Point 3 Bending Stress 1000000 cycles, min (psi)
-03	0.020	24000	37460	33630	27550
-04	0.020	24000	37460	33630	27550
-05	0.020	24000	37460	33630	27550
-06	0.020	22000	34720	31270	25560
-08	0.026	20000	31000	28000	23260
-10	0.033	18000	28000	25220	20940
-12	0.039	16000	24950	22400	18600
-14	N/A	---	---	---	---
-16	0.052	15000	23400	20980	17400
-20**	0.065	15000	23400	20980	17400
-24**	0.039*	15000	23400	20980	17400

Table 2B - 4000 psi nickel alloy tubing sizes and bending stresses (AMS5663)

Tube Size	Tube Wall	Endurance Point Bending Stress 10 million cycles, min (psi)	Data Point 1 Bending Stress 50000 cycles, min (psi)	Data Point 2 Bending Stress 100000 cycles, min (psi)	Data Point 3 Bending Stress 1000000 cycles, min (psi)
-03	0.020	24000	37460	33630	27550
-04	0.020	24000	37460	33630	27550
-05	0.024	24000	37460	33630	27550
-06	0.028	22000	34720	31270	25550
-08	0.039	20000	31000	28000	23260
-10	0.049	18000	28000	25220	20940
-12	0.056	16000	24950	22400	18600
-14	N/A	---	---	---	---
-16	0.075	15000	23400	20980	17400
-20**	0.094	15000	23400	20980	17400
-24**	0.058*	15000	23400	20980	17400

Table 2C - 4000 psi titanium tubing sizes and bending stresses (AMS4928, AMS4965)

Tube Size	Tube Wall	Endurance Point Bending Stress 10 million cycles, min (psi)	Data Point 1 Bending Stress 50000 cycles, min (psi)	Data Point 2 Bending Stress 100000 cycles, min (psi)	Data Point 3 Bending Stress 1000000 cycles, min (psi)
-03	0.020	20000	31000	28000	23260
-04	0.020	19000	29540	26630	22090
-05	0.020	18000	28000	25220	20940
-06	0.028	18000	28000	25220	20940
-08	0.035	17000	26470	23800	19780
-10	0.044	17000	26470	23800	19780
-12	0.052	17000	26470	23800	19780
-14	0.061	16000	24950	22400	18600
-16	0.070	15000	23400	20980	17400
-20**	0.088	13000	20340	28200	15060
-24**	0.054*	13000	20340	28200	15060

Legend:
* Sizes are for return lines only. Maximum pressure is half the operating pressure.
**Sizes -20 and -24 were originally designated as -21 and -25 on revision A of this specification. These sizes will not connect with the original -20 and -24 fittings. See 6.4 for additional information.

NOTES:

1. All test assembly wall thicknesses and lengths are shown in Tables 2 and 4.

2. Bending stress values specified are the axial stresses as measured by the strain gage when the test specimen is deflected by the test machine and with no fluid pressure applied (see 4.6.6).

3. For test purposes, tubing diameters and wall thicknesses shall be per Table 2. If different tube thicknesses are used for aircraft design, additional tests may be required. For use of tubing wall thickness less than 0.020 inch (0.5 mm), special approval must be obtained from the contracting activity.

3.3 Design and Construction

3.3.1 Configuration and Dimensions

The configuration and dimensions shall conform to requirements of this document and the design requirements specified on the applicable specification sheets of AS85421/1 through AS85421/17. If the center body section of shaped fitting is machined from bar or oversized forging (in lieu of standard near-net forging) it shall conform to AS1376, Table 4.

3.3.2 Drill Offset

On fittings where the fluid passage is drilled from each end, the offset between the drilled holes at the meeting point of the drills shall not exceed 0.015 inch (0.4 mm). Angular misalignment shall not exceed 2 degrees.

3.3.3 Reduction in Fluid Passage (Bore) Cross-Section

Straight and nonreducer shape fittings shall be bored throughout the passage such that a ball having a diameter, 0.020 inch (0.5 mm) less than the minimum specified bore shall pass through the passage. For nonstraight and nonreducer shape fittings (such as crosses, tees, elbows, etc.) the cross-sectional area at the junction of the fluid passage shall not be smaller than the cross-sectional area of the smallest passage.

3.3.4 Tube Attachment

The method of joining the tubing to the end fitting (brazing, welding, mechanical attachment, swaging, etc.) shall not adversely affect the properties, strength, or geometry of tubing or end fitting. The joint shall be of a quality compatible with the design and performance requirements of this specification and shall permit inspection by direct measurement, X-ray, or other means.

3.3.5 Installation Tooling

Size of tool envelope required to install fittings on tubing in aircraft shall be kept to a minimum. The wrench flats or pads of the fittings shall permit use of standard wrenches.

3.3.6 Fitting Body Design

Fitting body shall be designed to prevent failure (see 2.3.5) of sealing surfaces. The sealing interface shall be integral with the fittings. Removable seals are not permitted. Prior to assembly, the female nut shall be pulled back in such position that the threaded end of the nut is flush within ±0.0625 inch (±1.59 mm) of the outer beam surface. When assembled the fitting body to maximum torque (see 2.3.10) the gap between the threaded end of the nut and hex face of the male fitting body shall be a minimum of 0.030 inch (0.8 mm).

3.3.7 Fitting Body Interface

All male and female end fittings shall be tested using fitting bodies with end configurations conforming to the design standards AS85421/1 and AS85421/2. All male fitting bodies tested shall be interchangeable with male fitting bodies dimensioned as shown in the design standards.

3.3.8 Threads

All threads shall be in accordance with AS8879. The surface finish of the thread flanks shall be 63 μin Ra per ASME B46.1. Internal threads shall be coated with solid film lubricant per AS5272 Type I or Type II. External (male) threads shall not be coated, except as required for port type fittings of the Ring Locked type or with ends per AS930.

3.3.9 Solid Film Lubricant

3.3.9.1 Female threads shall be coated as shown below:

- Type II Systems (-65 to +275 °F) use AS5272 Type 1 or Type 2 solid film lubricant
- Type IV Systems (-65 to +630 °F) use AS1701 Type IV solid film lubricant

3.3.9.2 Male threads shall not be coated except as required on certain port type fittings, see 3.3.8.

3.3.9.3 Male sealing surfaces shall be coated with solid film lubricant as shown below:

- Type II Systems (-65 to +275 °F) use AS5272 Type 1 or Type 2 solid film lubricant
- Type IV Systems (-65 to +630 °F) use AS1701 Type IV solid film lubricant
- No overspray in fitting bores allowed

3.3.9.4 Female Sealing Surfaces

- No coating shall be used

3.3.9.5 Swivel Wires – see Table 1 for solid film lubricant requirements.

3.4 Performance

The fitting assemblies (see 2.3.6) shall meet the performance requirements of 3.4.1 through 3.4.8.

3.4.1 Proof Pressure

The fitting assembly shall withstand pressure equal to twice the nominal operating pressure of the system for 5 minutes without leakage, evidence of permanent deformation, or other malfunction that shall affect assembly or disassembly using the torque values per Table 3 when tested in accordance with 4.6.2.

Table 3 - Torque requirements

Fitting Size		03	04	05	06	08	10	12	14	16	20	24
Minimum Torque	in-lb	97	151	173	270	432	594	756	918	1242	1512	1620
	N-m	11	17	20	31	49	67	85	104	140	171	183
Maximum Torque	in-lb	108	168	192	300	480	660	840	1020	1380	1680	1800
	N-m	12	19	22	34	54	75	95	115	156	190	203

3.4.2 Burst Pressure

The fitting assembly shall not rupture or leak (no more than allowable) at any pressure less than or equal to four times the nominal operating pressure. The test shall be conducted in accordance with 4.6.3 for a minimum of 5 minutes at burst pressure. The fitting assembly shall not have to meet any disassembly or assembly requirements after this test.

3.4.3 Thermal Shock

The fitting assembly shall withstand the temperature and pressure when tested in accordance with 4.6.4 without leakage, evidence of permanent deformation, or other malfunction that shall affect assembly or disassembly of the fitting.

3.4.4 Impulse

The fitting assembly shall withstand 200000 impulse pressure cycles without leakage (see 2.3.8) from the fitting or the fitting-tube junction when tested in accordance with 4.6.5.

3.4.5 Flexure

When tested in accordance with 4.6.6 the test sample shall not leak from the sealing surface or tube interface prior to achieving the minimum required number of cycles for the bending stresses specified in Table 2.

3.4.6 Repeated Connection

The fitting assembly shall withstand 25 repeated connections at the minimum and maximum torque values specified in Table 3 when tested in accordance with 4.6.7 without:

a. Leakage at any of the pressure tests of 4.6.7.

b. Inability to assemble the fitting to the point of interface by hand.

c. Nut deformation preventing engagement of nut hex with open end wrench.

d. Backing out of the swivel wire, when wired-on nuts are used, see 4.6.7 for special test assembly configuration requirements to check wired-on nuts and for back-out limits.

3.4.7 Pneumatic Leakage

The fitting assembly shall withstand pneumatic pressure equal to the maximum operating pressure for 5 minutes at room temperature without any visible bubbles starting after 1 minute at pressure or other malfunction that would affect assembly or disassembly using the minimum torque values specified in Table 3 when tested in accordance with 4.6.8.

3.4.8 Fire

The fitting assembly shall withstand a 2000 °F (1093 °C), 4500 btu/h (1320 W) flame for 15 minutes when tested in accordance with 4.6.9. Heat input shall be measured by a 0.500 inch (12.7 mm) copper tube per AIR1377. There shall be no leakage detected by visual observation or failure of the test assembly prior to the specified time.

3.5 Part Numbering of Interchangeable Parts

All parts having the same design activity CAGE CODE (Contracting and Government Entity) and part number shall be interchangeable as defined in MIL-HDBK-505. The item identification and part number requirements of ASME Y14.35M shall govern the design activity part numbers and changes thereto.

3.6 Dimensions and Tolerances

All pertinent dimensions, threads, and tolerances, where interchangeability, operation, or performance of the fitting may be affected, shall be as specified on the AS drawings or specification sheets.

3.7 Weight

Fitting weights shall not exceed to those values shown on the applicable specification sheets.

3.8 Identification of Product

All fittings shall be identified in accordance with 3.8.1 and 3.8.2.

3.8.1 Marking Method

Marking shall be impressed, embossed, laser etched, or electrochemical etched in a location and in a manner not detrimental to the fitting. Where practical, markings shall remain visible, after fitting is installed.

3.8.2 Markings

All end fittings and fitting bodies shall be marked with the manufacturer's name or trademark, the material identification code, and complete part number as detailed in the applicable part standard. If space permits, the manufacturer's part number and the manufacturer's CAGE CODE shall be marked to ensure positive identification. The manufacturer's part number and drawing number shall be the same.

3.9 Workmanship

Remove all burrs and break all sharp edges. Sealing surfaces shall be free of detrimental, radial, and spiral tool marks. Unless a finer finish is specified on applicable drawings, sealing surfaces shall be smooth to a finish of 45 μin Ra, as defined in ASME B46.1. All other machined surfaces shall be smooth to 125 μin Ra. Unmachined surfaces, such as forging surfaces and bar stock flats, shall be free of cracks, laps, and seams.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examination and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for Compliance

All items must meet all requirements of Sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements; however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material (see 6.3).

4.2 Classification of Inspection

The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.3).

b. Quality conformance inspection (see 4.4).

4.3 Qualification Inspection

The qualification inspection shall consist of the inspection methods conducted in the order shown in Table 4 for the applicable assembly styles (see Figure 1). Classes 3000 and 4000 beam seal fittings furnished under this specification will have two distinct types of sealing attachment designs: (1) "Non-Hybrid" - Separable Beam Seal (100% threaded interfaces) and (2) "Hybrid" - Beam Seal threaded interfaces to permanent tube attachment designs (i.e., swage or weld/braze). This specification (AS85421) in addition to AS4459 and AS1576 or AS4510/2 qualifies both types of fitting design attachments. There is no specification covering the internally swaged fitting process at the time of this writing. Such fittings must meet all applicable requirements of this document (AS85421) only.

4.3.1 Non-Hybrid - Separable Beam Seal

The qualification inspection shall consist of the inspection methods conducted in the order shown in Table 4 for the applicable separable fitting styles (see Figure 1, Styles A, B, and C Assemblies).

4.3.2 Hybrid - Beam Seal Threaded Interfaces to Permanent Tube Attachment

Figure 1, Assembly Styles A, B, and C illustrates permanent tube attachment designs (swage or braze/weld types). The permanent tube attachment and separable beam seal designs, on the same fittings, have additional qualification inspection requirements contained in AS85421 (brazed), AS1576 (weld) or AS4510/2 (weld), and AS4459 (swage) specifications per 4.3.2.1 and 4.3.2.2.

4.3.2.1 Qualification of hybrid swaged (internal and external swaged) tube attachment and separable beam seal fitting designs shall meet or exceed the qualification inspection requirements of both AS85421 and AS4459 (see Tables 4 and 5).

4.3.2.2 Qualification of hybrid braze/weld tube attachment and separable beam seal fitting designs shall meet or exceed the qualification inspection requirements of both AS85421 and AS4510/2. Previous qualification to both AS85421 and AS1576 is acceptable for 3000 psi CRES qualifications only (see Tables 4 and 5).

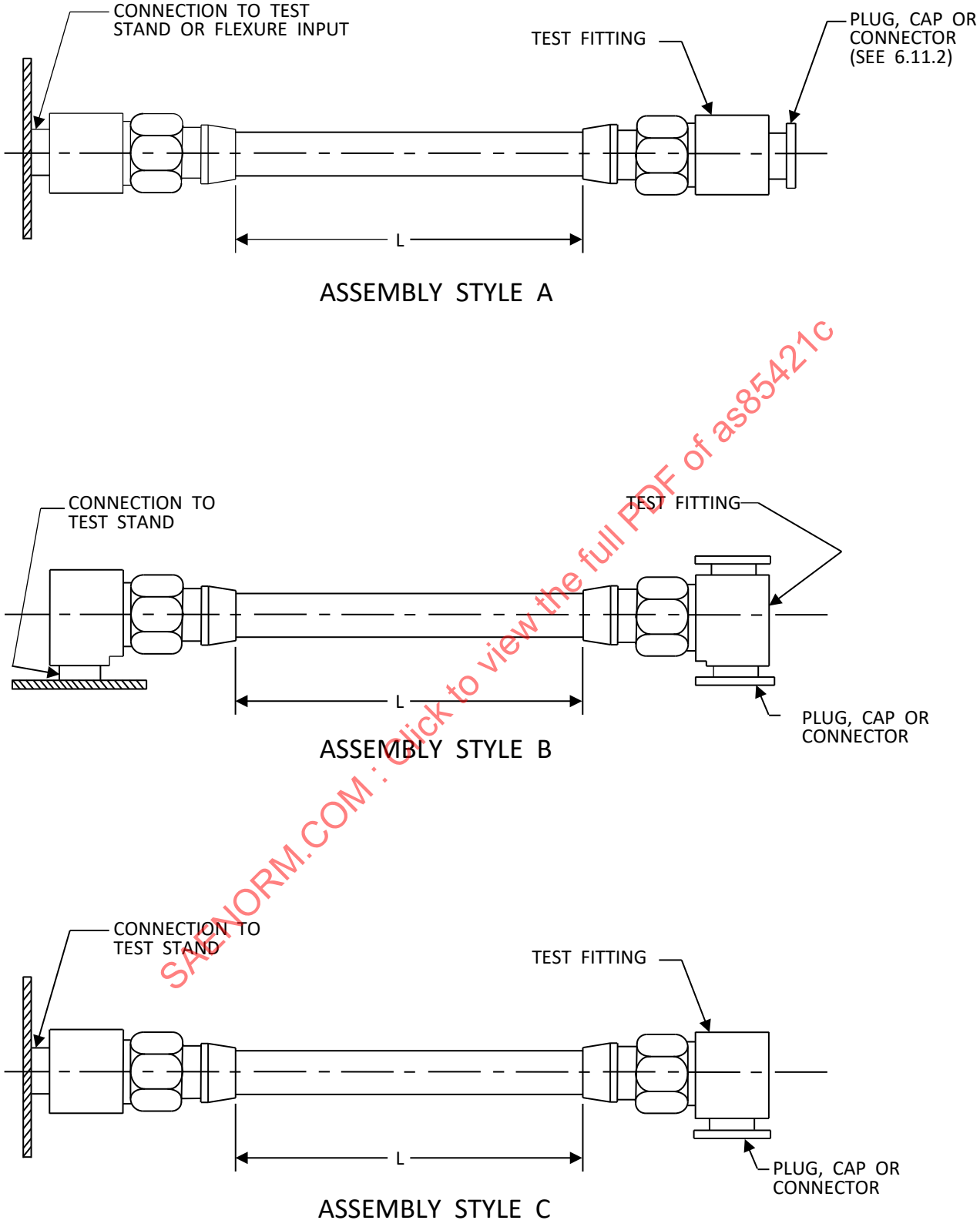

Figure 1 - Fitting assembly styles for testing

Table 4 - Fitting assemblies

Assembly Numbers	* 1-4	5-6	7-14	15-16	17-18
Assembly Style (see Figure 1)	C	A	A	A	B
Length (see Figure 1)	9 inches	9 inches	Per ARP1185	9 inches	9 inches
Qualification Test (Perform in Sequence)	4.6.1 4.6.2 4.6.7 4.6.5	4.6.1 4.6.8 4.6.2 4.6.4 4.6.3	4.6.1 4.6.2 4.6.6	4.6.1 4.6.2 4.6.9	4.6.1 4.6.2 4.6.3
Periodic Control Test (Perform in Sequence) See 4.4.3	4.6.7 4.6.2 (tube assembly or fitting samples only may be tested)				
* For QPL Qualification, two samples with 90 degree elbows and two samples with bulkhead tees. See also the wired-on nut requirement of 4.6.7. For Periodic Control Tests, sample size requirements are per 4.4.3.					

Table 5 - Qualification inspection requirements

Fitting Type	Class 3000	Class 4000
Hybrid (Swage and Separable)	AS85421 and AS4459	AS85421 and AS4459
Hybrid (Weld and Separable)	AS85421, AS4510/2 and AS1576	AS85421 and AS4510/2
Hybrid (Braze and Separable)	AS85421	AS85421
Non-Hybrid (Separable only)	AS85421	AS85421

4.3.3 Test Sample for the Qualifying Activity

The contractor shall submit to the qualifying activity sixteen untested sample fitting assemblies for each size and tubing type in accordance with Table 4 (see 6.3). Threaded fittings designed for permanent attachment to adjacent tubing shall be assembled in accordance with the joint design feature (swage, braze, or weld). The inspection shall be in accordance with 4.6.1. These samples are for the purpose of independent testing by PRI, if such testing is deemed necessary, see 4.1.

4.3.4 Retention of Qualification

The retention of qualification shall consist of certification by the manufacturer to demonstrate compliance of the qualified fittings with the requirements of this specification. Certification shall be signed by a responsible official of management, attesting that the listed product(s) is still available from the listed plant, can be produced under the same conditions as originally qualified (i.e., same process, materials, construction, design, manufacturer's part number or designations), and meets the requirements of the current issue of the specification. Certification shall be conducted at intervals not exceeding 2 years. The activity responsible for certification approval is the qualifying activity (see 6.5).

4.4 Quality Conformance Inspection

The following tests shall be conducted from each lot of fittings submitted for inspection. The test sequence shall be in accordance with Table 6 (see 6.3).

a. Non-destructive test (see 4.4.2)

Table 6 - Quality conformance test

Test	Design Requirement Paragraph	Inspection Method Paragraph
Non-destructive test Examination of product	3.4.1	4.4.2

4.4.1 Inspection Sampling

Unless otherwise specified in the contract or purchase order, sample fittings from each lot shall be selected at random in accordance with MIL-STD-1916. For non-destructive test, the sample inspection shall be level II at an Acceptable Quality Level (AQL), as specified in the contract.

4.4.2 Non-Destructive Test

The non-destructive test shall be conducted in accordance with the examinations of 4.6.1 and 4.4.2.1.

4.4.2.1 Preparation for Delivery

All end fittings, fitting bodies, and fitting assemblies shall be visually examined to ascertain that their preparation for delivery shall be in accordance with Section 5 of this specification.

4.4.3 Periodic Control Tests

Periodic control tests (see Table 4) shall be conducted every twelve months to maintain PRI-QPL-AS85421 listings. The purpose of the periodic control test is to ensure manufacturing processes are maintained at the level as when parts were qualified. Each material in the manufacturer's QPL listing shall be tested. Three samples (any tube assembly style or fitting assembly style) each of two sizes shall be tested; one size selected from the range of sizes 03 to 10, and one size selected from the range of sizes 12 to 20. This test is required regardless of production quantities, including if no fittings in a particular material of size range were manufactured in the prior year. Periodic testing may be conducted at the manufacturer's facility. Manufacturer accreditation to ISO 17025 or PRI witnessing is not required (for periodic testing). The following tests shall be conducted on each sample in the order specified. The same test samples may be used for all tests:

a. Repeated Connection per 4.6.7 except test may be modified as follows:

The pneumatic test is required only after the first torque tightening operation and the final (25th) tightening operation. The test samples shall be assembled at either minimum torque or maximum torque and after every fifth tightening operation, the torque shall be switched from minimum to maximum and vice versa until the twenty fifth (25th) tightening operation is achieved.

b. Proof Pressure Test per 4.6.2.

Test results shall be submitted to PRI for review. Failure to submit Periodic Control Test data to PRI when requested will result in the manufacturer's QPL listing to be removed pending receipt and approval of the test data. If data is not received within 6 months of the requested date additional testing may be required, including possible requalification. Test reporting shall be done using the AS85421 Periodic Control Test Summary format shown in Appendix A. First periodic test data submission shall be due 12 months after initial listing onto corresponding AS85421 QPLs.

4.4.4 Failure of Sampling Test or Periodic Tests

When fittings fail to pass a sampling test, the entire lot (see 2.3.9) represented by the sample shall be rejected. The reason for the failures shall be reported (see 6.3).

4.5 Test Conditions

4.5.1 Test Fluids

The test fluids used shall be MIL-PRF-83282 or MIL-PRF-5606, with exception of Type IV System Burst Pressure Test which shall use water.

4.5.2 Test Temperature

All tests except the burst pressure test, the thermal shock test, the impulse test, and the fire test shall be conducted at an ambient temperature of 60 °F (16 °C) to 100 °F (38 °C) and a fluid temperature of 60 °F (16 °C) to 170 °F (77 °C).

4.6 Inspection Methods

4.6.1 Examination of Product

All end fittings, fitting bodies, and fitting assemblies from each lot shall be examined to determine conformance with this specification and the applicable standards with respect to material, design, dimensions, finish, marking, and workmanship.

4.6.1.1 Material Inspection

Fitting and tubing material shall meet the requirements of 3.3. The chemical analysis, mechanical properties, and heat treatment shall be in accordance with the material specifications shown in Table 1.

4.6.2 Proof Pressure Test

Fitting assemblies shall be connected to a pressure source with one end free to move and proof pressure tested at a pressure value equal to two times the nominal operating pressure for a minimum period of 5 minutes. Use minimum torque values for both ends. Rate of pressure rise shall be 20000 psi ± 5000 psi (140000 kPa ± 35000 kPa) per minute. The exterior of the test fitting assembly including the fitting tube joint shall be clean and dry and show no evidence of test fluid prior to testing. At the end of the test, wipe the exterior of fitting assembly with a clean, dry towel and examine for evidence of leakage. Any evidence of fluid on a clean dry towel, after wiping the test connection, shall constitute failure of the test.

4.6.3 Burst Pressure Test

Fitting assemblies shall be connected to a pressure source and burst pressure tested at a pressure value equal to four times the nominal operating pressure. Use minimum torque values for both ends. The pressure shall be increased at a rate of 20000 psi ± 5000 psi (140000 kPa ± 35000 kPa) per minute until the assembly bursts, leaks or four times the operating pressure is obtained. Test samples 5 and 6 shall be tested at the ambient temperature (see 4.5.2), and test samples 17 and 18 shall be tested at the maximum rated temperature of 275 °F (135 °C) ±10% for Type II Systems, and 630 °F (332 °C) ±10% for Type IV Systems. No more than one drop of fluid at the joint (both the beam seal end and tube attachment end) is permissible.

4.6.4 Thermal Shock Test

Use MIL-PRF-5606 hydraulic fluid for this test. The fitting assembly shall be mounted in a high temperature test set up with one end free to move. A typical test set up is shown in Figure 2. After the test fitting is filled with hydraulic fluid, the ambient temperature of the test chamber shall be reduced to -65 °F ± 2 °F (-54 °C ± 1 °C) for a minimum of 2 hours. At the end of this period, while the test chamber is still at -65 °F (-54 °C), test fluid at 275 °F ± 5 °F (135 °C ± 3 °C) shall be suddenly introduced into the test assembly at a minimum pressure of 50 psi (350 kPa). Within 15 seconds after the hot fluid has filled the fitting assembly, a proof pressure test shall be performed in accordance with 4.6.2.

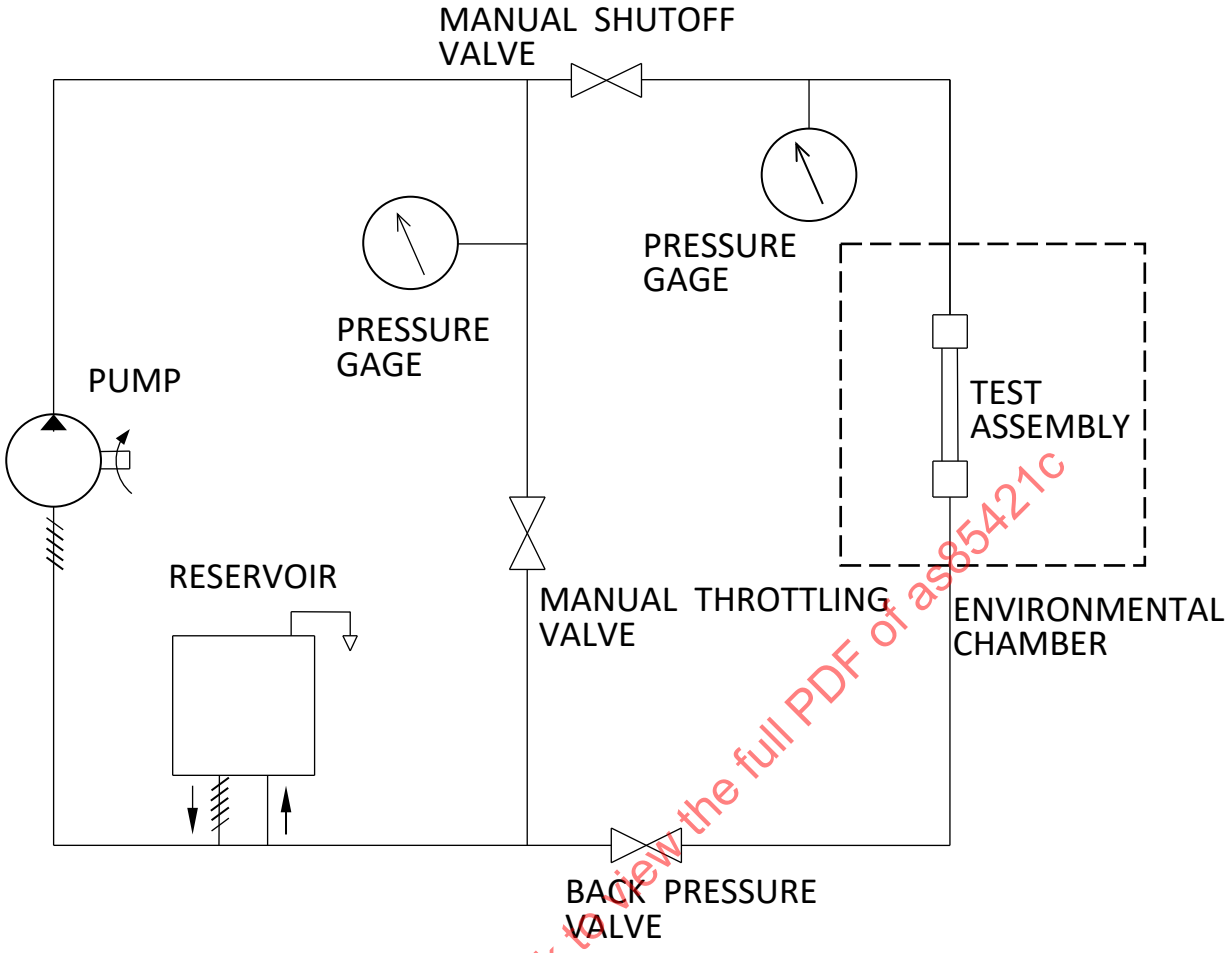

Figure 2 - Typical setup for thermal shock testing

4.6.5 Impulse Test

Test fitting assemblies shall be tested in accordance with AS603 with the following deviations or additions. Fittings for return line sizes as designated in Table 2 shall not be impulse tested.

a. Duration of test: 200000 cycles minimum.

b. Temperature: 275 °F (135 °C) ±10% for 200000 cycles for Class II; or 400 °F (204 °C) ±10% for 200000 cycles for Class IV.

c. Cycling rate: 70 cpm ± 5 cpm.

d. Wave form: Per AS603.

e. Surge peaks: 140 to 157% of nominal operating pressure.

f. Assembly torque: Minimum torque value per Table 3.