AEROSPACE STANDARD

AS7510™ **REV. B**

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Superseding AS5830A

Coupling Assembly, Threadless, Flexible, Self-Locking,
Fixed Cavity, High Conductivity, Self-Bonding, Part Specification

RATIONALE

Address safety issue, to require testing of weakest link components when there are design and/or hardware step size changes. Clarify goal posting of size ranges without having to perform 100% testing of all sizes. Revise interchangeability statement.

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TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

For more information on this standard, visit
https://www.sae.org/standards/content/AS7510B/

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1. SCOPE

This SAE Aerospace Standard (AS) defines the requirements for a threadless, flexible, high conductive, self-bonding coupling assembly which, when installed on defined ferrules, provides a flexible connection for joining ducting and components in pressurized fluid systems. The assembled coupling is designed to provide interchangeability of parts and components between qualified manufacturers for use from -65 to +265 °F at 130 psi nominal operating pressures and for the service life of the aircraft system.

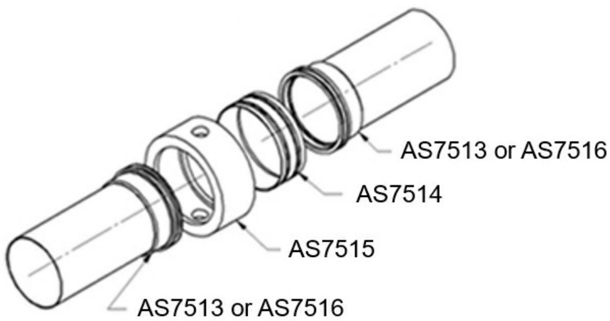


Figure 1 - Assembled flexible coupling; exploded view

FAR 23.954, FAR 25.603, FAR 25.605, FAR 25.609, FAR 25.613, FAR 25.901, FAR 25.954, and FAR 25.981 certification requirements have identified the need for high-current capable flexible fluid assembled couplings. The coupling assembly does not require inspection or maintenance to remain current capable for the life of the aircraft.

This specification provides two test philosophies necessary for low-pressure couplings:

1. Electromagnetic effects/lightning testing of assembled couplings to demonstrate both lightning conducted current and electrostatic capabilities are retained through simulated service life test sequences to meet commercial airplane FAR 25.981 certification requirements.

2. Grouping and goal posting of coupling test specimens based on size and material similarities.

The assembled coupling's intended application and usage is for, but not limited to, commercial and military aircraft. Components defined herein and qualified to the performance capabilities and regulatory compliance requirements will support their use in fuel and other fluid conveyance systems.

This specification requires manufacturers to be qualified and accredited to Performance Review Institute (PRI)/Nadcap requirements.

1.1 Equipment Description and Functionality

The assembled couplings may be used in pressurized and unpressurized sections of the aircraft, including fuel tanks, strut and pylon, cabin areas, flight deck, and cargo compartments. It is critical that components delivered following qualification by the manufacturers be produced with the same documented processes subject to approved revisions to ensure the post-qualified products meet the same part performance requirements as those originally qualified.

The performance requirements and testing constraints within this specification were developed using aircraft system OEM and supplier experiences and guidance for aircraft fuel component and system usage provided in ARP8615.

Due to materials and production processes, O-rings have functional life limitations and may necessitate replacement over the functional life of the assembled coupling.

Table 1 shows system operating conditions and functional limits based on material and functional capabilities.

The static internal pressure requirements for the assembled couplings are listed in Table 3.

Table 1 - Assembled coupling functional limits

Material	Size Range	Positive System Pressure (psi)	Negative System Pressure (in Hg)	Ambient Temperature Range (°F)	Fluid Temperature Range (°F)
Aluminum	-08 to -64	130	Varies—See Table 3	-65 to 265	-65 to 265

It is important to simulate the wear and damage experienced by the assembled coupling in service if it is to remain electrical current capable for the life of the aircraft. The test procedures in this specification simulate a worst-case wear and damage condition for the assembled couplings based on a 20 to 30 year service life.

CAUTION: Although visually similar, AS7510 parts are not compatible with AS1650 parts. AS7510 parts should not be intermixed with AS1650 parts. Intermixing between AS7510 and AS1650 does not produce a qualified joint and may result in loss of electrical bonding, excessive fluid leakage, and/or part damage.

The assembled coupling shall be capable of handling electrical currents for waveforms of ARP5412, as described in 4.5.5. The design, component functionality reviews, failure mode and effects analysis (FMEA), fault tree analysis (FTA), redundancy analysis, and qualification test results of the assembled coupling shall provide validation for use in fluid systems requiring FAR 23.954, FAR 25.603, FAR 25.605, FAR 25.609, FAR 25.901, FAR 25.954, and FAR 25.981 certification review.

The assembled coupling shall not present any condition where a single point failure will result in the loss of the functional, fluid handling, or electrostatic capabilities of the device, or compromise the flight safety of the aircraft. The regulations establish requirements such that the failure of a single component or part of an assembly shall not result in the loss of the functional capabilities of the assembled coupling nor cause an electrical spark of sufficient energy to ignite a flammable fuel mixture. The architecture and design of the coupling shall provide redundant or separated features for locking and hinge to ensure a part failure does not lead to loss of the assembled coupling capabilities.

1.2 Manufacturer's Responsibility

The qualified manufacturer for this specification shall have overall responsibility for:

a. Design.

b. Test.

c. Manufacture.

d. Qualification.

e. Satisfactory operation of the equipment as required for certification by various airworthiness authorities, including the Federal Aviation Administration (FAA), European Joint Aviation Authority (JAA), European Aviation Safety Agency (EASA), Civil Airworthiness Administration (CAA), and similar administrations.

Qualified manufacturers shall control, maintain, and document product processes for all aspects of the production and assembly of their respective parts. The documentation shall include the processes and procedures of sub-tier manufacturers. Manufacturers are responsible for the processes, products, and product quality provided by part and process manufacturing of their assembled couplings. Manufacturers shall provide process control documents for Nadcap audit review upon request.

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.

AMS-QQ-A-200/3 Aluminum Alloy 2024, Bar, Rod, Shapes, Tube, and Wire, Extruded

AMS-QQ-A-225/6 Aluminum Alloy, 2024, Bar, Rod, and Wire; Rolled, Drawn, or Cold Finished

AMS-R-25988 Rubber, Fluorosilicone Elastomer, Oil-and-Fuel-Resistant, Sheets, Strips, Molded Parts, and Extruded Shapes

AMS-WW-T-700/3 Tube, Aluminum Alloy, Drawn, Seamless, 2024

AMS-WW-T-700/6 Tube, Aluminum Alloy, Drawn, Seamless, 6061

AMS2770 Heat Treatment of Wrought Aluminum Alloy Parts

AMS4081 Aluminum Alloy Tubing, Hydraulic, Seamless, Drawn, Round, 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061-T4), Solution Heat Treated and Naturally Aged

AMS4083 Aluminum Alloy Tubing, Hydraulic, Seamless, Drawn, Round, 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061-T6), Solution and Precipitation Heat Treated

AMS4120 Aluminum Alloy, Rolled or Cold Finished Bars, Rods, and Wire, 4.4Cu - 1.5Mg - 0.60Mn (2024), Solution Heat Treated and Naturally Aged (T4), Solution Heat Treated, Cold Worked, and Naturally Aged (T351)

AMS4339 Aluminum Alloy, Rolled or Cold Finished Bars and Rods, 4.4Cu - 1.5Mg - 0.60Mn (2024-T851), Solution Heat Treated, Cold Worked, and Artificially Aged

ARP926 Fault/Failure Analysis Procedure

ARP4761 Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment

ARP5412 Aircraft Lightning Environment and Related Test Waveforms

ARP5416 Aircraft Lightning Test Methods

ARP5580 Recommended Failure Modes and Effects Analysis (FMEA) Practices for Non-Automobile Applications

ARP8615 Fuel System Components: General Specification for

AS478 Identification Marking Methods

AS568 Aerospace Size Standard for O-Rings

AS1650	Coupling Assembly, Threadless, Flexible, Fixed Cavity, Self-Bonding, Procurement Specification
AS4060	Tube Fitting Swaged Joint, Roller Expander, Manual Process, Requirements for
AS5449/1	Clamp Assembly, Saddle Type, Cushioned, Fuel and Petroleum Based Hydraulic Fluid
AS5836	Fitting End, Threadless-Flexible, Fixed Cavity, Current Carrying, Self Bonding, Male and Female Design Standard
AS7511	Assembled Coupling Envelope, Threadless - Flexible, Fixed Cavity, Current Carrying, Self Bonding, Envelope Dimensions
AS7512	Coupling Components, Threadless, Flexible, Fixed Cavity, Current Carrying, Self Bonding, Kit of Parts
AS7513	Male Ferrule, Threadless, - Flexible, Fixed Cavity, Current Carrying, Self Bonding, Swaged
AS7514	Sleeve, Threadless, Flexible, Fixed Cavity, Current Carrying, Self Bonding
AS7515	Coupling Assembly, Threadless, Flexible, Fixed Cavity, Current Carrying, Self Bonding
AS7516	Male Ferrule, Threadless - Flexible, Fixed Cavity, Self-Bonding, Butt Welded
AS9100	Quality Management Systems - Requirements for Aviation, Space, and Defense Organizations
AS9103	Aerospace Series - Quality Management Systems - Variation Management of Key Characteristics

2.1.2 AIAA Publications

Available from American Institute of Aeronautics and Astronautics, 1801 Alexander Bell Drive, Suite 500, Reston, VA 20191-4344, Tel: 703-264-7500, www.aiaa.org.

AIAA S-102.4	Performance-Based Failure Reporting, Analysis and Corrective Action System (FRACAS) Requirements

2.1.3 ANSI Accredited Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ANSI/ASQ Z1.4	Sampling Procedures and Tables for Inspection by Attributes
ANSI/NCSL Z540.3	Calibration Laboratories and Measuring and Test Equipment
ISO/IEC 17025	General requirements for the competence of testing and calibration laboratories

2.1.4 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-Y14.5-1M	Mathematical Definition of Dimensioning and Tolerancing Principles

2.1.5 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 B117 Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM B211 Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire

ASTM D1193 Standard Specification for Reagent Water

ASTM D6210 Standard Specification for Fully-Formulated Propylene Glycol-Base Engine Coolant for Heavy-Duty Engines

2.1.6 AWS Publications

Available from American Welding Society, 8669 NW 36 Street, #130, Miami, FL 33166-6672, Tel: 1-800-443-9353 or 305-443-9353, www.aws.org.

AWS D17.1/D17.1M Specification for Fusion Welding for Aerospace Applications

2.1.7 NAS Publications

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

NAS1787 Clamp, Tube Mounting

2.1.8 PRI Publications

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

AC7112 Nadcap Audit Criteria for Fluid Systems Component Manufacturers

AC7112/3 Nadcap Audit Criteria for Couplings and Formed Sheet Metal Products

OP2007 QPL Program Operating Procedure

PD1100 Nadcap Program Requirements

PD2000 PRI-QPL Program Requirements

PD2001 Manufacturer Request for Product Approval and Qualification Process

2.1.9 U.S. Government Publications

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

14 CFR Code of Federal Regulations, Aeronautics and Aerospace

AC25.981-1D Advisory Circular, Fuel Tank Ignition Source Prevention Guidelines

MIL-DTL-5541 Military Specification, Chemical Conversion Coatings on Aluminum and Aluminum Alloys

MIL-HDBK-831 Preparation of Test Reports

MIL-PRF-680 Degreasing Solvent (Stoddard Solvent)

MIL-PRF-5606	Hydraulic Fluid
MIL-PRF-7024	Calibrating Fluids, Aircraft Fuel System Components
MIL-PRF-8625	Anodic Coatings for Aluminum and Aluminum Alloy
MIL-PRF-83282	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base
MIL-STD-129	Military Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-810	Environmental Test Methods
MIL-STD-889	Dissimilar Metals
MMPDS	Metallic Materials Properties Development and Standardization
VV-P-236	Petrolatum, Technical

2.2 Definitions

ASSEMBLED COUPLING: The combination of a coupling assembly, sleeve, and ferrules joined together to complete a connection between two ducts.

ASSEMBLED COUPLING COMPONENTS: The combination of individual parts that comprise the assembled coupling between ducts. For example: An AS7514 sleeve, an AS7515 coupling assembly, and two O-ring seals.

COMPLETE TEST ASSEMBLY: The combination of two or three duct assemblies, one or two test specimens, and end plugs as defined by each test for the purpose of verifying compliance to specified requirements.

COUPLING COMPONENTS: A kit of parts grouped together to simplify part ordering. For example: AS7514 sleeve and AS7515 coupling assembly.

DEACTIVATED COMPONENTS: Features or individual parts that are deliberately made inoperable or removed from the assembly and is used in showing compliance to FAR 25.901 and FAR 25.981.

DESIGN FAILURE MODE AND EFFECTS ANALYSIS (DFMEA): Structured approach to discovering potential failures that may exist within the design of a product or process. Refer to ARP5580.

DUCT ASSEMBLY: A thin wall hollow cylinder for low-pressure fluid use with ferrule fittings attached by welding or roller swaging operations.

ELECTROMAGNETIC EFFECTS (EME)/LIGHTNING (IN-DIRECT EFFECTS): Any physical effects to the aircraft and/or equipment due to the direct attachment of a lightning channel and/or conduction of lightning current.

EXTREMELY IMPROBABLE: Qualitative: So unlikely that it is not anticipated to occur during the entire operational life of an entire system or fleet of airplanes. Quantitative: Probability of occurrence per operational hour is less than 1×10^{-9}.

FERRULE: A machined part that provides for a fluid-tight attachment to ducts by welding or swaging within a low-pressure system. For example: AS7513 and AS7516.

FITTINGS: Components attached to the duct detail ends, including flanges and ferrules.

FORESEEABLE: Able to be foreseen or predicted; that which may be reasonably anticipated. An event or condition is foreseeable if the physics of the failure can be defined and the occurrence of the failure during the exposure period in question cannot be acceptably ruled out.

INTERCHANGEABILITY: The ability to select components for assembly at random and fit them together within proper tolerances. The ability to replace one part with another part without affecting function or life of the assembly.

LATENT (FAILURE): A failure of a component, device, equipment, or system that has not yet manifested but whose triggering event or root cause has already occurred.

MANUFACTURER: A PRI-approved manufacturer of coupling component(s) and ferrules that is included on the Nadcap QML.

MANUFACTURING PROCESS CONTROL DOCUMENT (MPCD): A document requested by this specification that provides the processing requirements unique to a manufacturer, facility, or division and their sub-tier manufacturers and vendors that define the complete manufacturing and assembly processes from raw material acceptance to final acceptance test procedures and packaging instructions.

NATIONAL AEROSPACE AND DEFENSE CONTRACTORS ACCREDITATION PROGRAM (Nadcap): A global cooperative accreditation program for aerospace engineering, defense, and related industries.

NOMINAL PRESSURE: The pressure at which the component is rated to safely operate for its expected service life.

OPERATING PRESSURE: The generalized or documented pressure at which the system typically functions based on system design and capabilities.

PERFORMANCE REVIEW INSTITUTE (PRI): The independent organization that reviews qualification test plans and test reports and audits suppliers for their ability to manufacture certain classes of aerospace standard parts and assemblies.

QUALIFIED MANUFACTURERS LIST (QML): A list of part manufacturers that are accredited by Nadcap to manufacture specific types of parts.

QUALIFIED PRODUCT LIST (QPL): A list of part standards and manufacturers that are approved by PRI to manufacture specified products.

REDUNDANCY: Repetition of parts, features, or part functions to provide a backup in case of failure of the primary part.

ROLLER SWAGE: Forced permanent radial deformation of a tube or duct into inside diameter grooves of an end fitting or ferrule, with an internally applied tool of mandrel mounted rollers.

SEALS: O-ring seals are not part of qualification except for providing a fluid seal during the assembled coupling qualification testing. See 3.1.1.6 for specific information pertaining to seals.

SINGLE POINT FAILURE: The failure of any one component of the assembled coupling that could result in the functional loss of the assembled coupling or its current carrying capability. Such a failure could be the loss or partial loss of a common hinge or latch pin, a hinge plate, latch pawl, a bonding spring, or any part in the design of the assembled coupling components.

STATISTICAL PROCESS CONTROL (SPC): A method of quality control that uses statistical methods. SPC is applied in order to monitor and control a process to ensure that it operates at its full potential.

SYSTEM PRESSURE: Nominal pressure capability of the fluid system. It may or may not be the same as the operating pressure.

TEST SPECIMEN: The assembled coupling components under test. In a complete test assembly, these would be the assembled coupling components between the ducts, not including the end caps or end fittings on the duct assemblies.

UNAIDED EYE: For visual inspections, the unaided eye allows for the individual to use prescription correction with up to 3X magnification.

VISUAL/TACTILE LATCH INDICATOR (VTLI): A non-metallic, non-structural device on the clamshell assembly that demonstrates the coupling is properly installed and latched, verifiable by sight or touch. The VTLI does not provide a secondary latch or clamshell locking capability.

WELDING (FROM LIGHTNING STRIKE EVENT): The micro-fusion of two adjacent components by the rapid transfer of electrical current across the point of contact.

3. TECHNICAL REQUIREMENTS

3.1 Design and Fabrication

FAA CFR 14 product and operational focus, FAR 23.954, FAR 25.603, FAR 25.605, FAR 25.609, FAR 25.613, FAR 25.901, FAR 25.954, and FAR 25.981 have identified the need for high-current capable low-pressure flexible fluid couplings with controlled assembly and manufacturing processes. The coupling assembly does not require inspection or maintenance to remain current capable for the life of an aircraft.

Table 2 is a general reference for end users of AS7510 assembled couplings and how this specification supports compliance to the listed FARs. Table 2 is meant to be a reference only, and end users are ultimately responsible for reviewing the specification in its entirety to ensure all airframe and regulatory requirements for their specific application are met.

Table 2 - FAR method of compliance reference

CFR14/ FAR	Method of Compliance			Comments
	Test	Analysis	Design	
23.954	X			All test groups. See Table 6 of this specification.
25.603	X	X	X	All test sequences support compliance. See 4.6 of this specification for qualification by analysis requirements.
25.605		X		See 4.6 of this specification.
25.609	X			Tests: Life cycle (w/ EME), non-life cycle, dynamic shear, pressure impulse/corrosion, vibration.
25.613	X	X	X	Detail part standards specify primary component's materials used per metallic materials properties development and standardization (MMPDS). All test sequences support compliance. See 4.6 of this specification for qualification by analysis requirements.
25.901	X	X		Life cycle, non-life cycle, and fatigue load cycling test groups require testing in fully compliant (2X structural redundancy) and deactivated structural configurations simulating single point failure of primary structural component. See 4.2 and 4.6 of this specification.
25.954	X			All test groups. See Table 6 of this specification.
25.981	X	X		Life cycle, non-life cycle, and fatigue load cycling test groups require testing in fully compliant (2X structural redundancy) and deactivated structural configurations simulating single point failure of primary structural component. Life cycle, non-life cycle, and standalone vibration test groups include pre- and post-test sequence EME testing or continuous electrical bonding in a vibratory environment to validate electrical bonding throughout coupling assembly's service life. See 4.2 and 4.6 of this specification.

The assembled coupling shall be designed such that no single failure shall prevent continuous electrical bonding, sealing, and performance required within this document.

The coupling shall be designed such that there are no electrically isolated metallic components. All metallic components within the AS7515 coupling assembly and AS7514 sleeve must be electrically grounded back to the adjacent ferrules of the coupled joint.

The assembly shall be a lightweight, flexible connection for fuel, vent, drain, and other fluid systems using the basic principles of O-ring sealing at the temperatures and pressures identified in Table 1.

Assembled coupling components shall remain leak free throughout the effective life of the coupling assembly. System and installation variations will ultimately affect seal wear and subsequent seal performance. See 4.1.3 for additional information.

NOTE: Sealing integrity is validated through all test sequences in this document. Tests that subject the assembled coupling to angular displacements within the operational limitations of Figure 2 shall remain leak free throughout testing. Structural tests that subject the assembled coupling to angular displacements outside the operational limitations of Figure 2 may have some degree of leakage during those specific tests. Sealing integrity shall be validated following those tests in a fixture that constrains the assembled coupling to the operational limitations of Figure 2. See 4.1.3 for additional information.

Assembled couplings shall be capable of operating in a pressure system with nominal operating conditions listed in Table 3 with associated system pressure variations without the loss of conductivity during the test sequences.

The assembly shall be designed to function in fluid systems with:

1. Up to 4 degrees of angular misalignment between the duct centerlines (2 degrees at each duct), and

2. System maximum design separation (ferrule-to-ferrule gap) per Table 3 with 0-degree misalignment, as illustrated in Figure 2.

The 4 degrees maximum design misalignment with male ferrules is to accommodate duct installation tolerances and airframe flexibility. The assembled couplings are to be designed for system axial alignment. It should be noted that whenever possible, installations should be at 0 degrees misalignment to account for in-service flexibility.

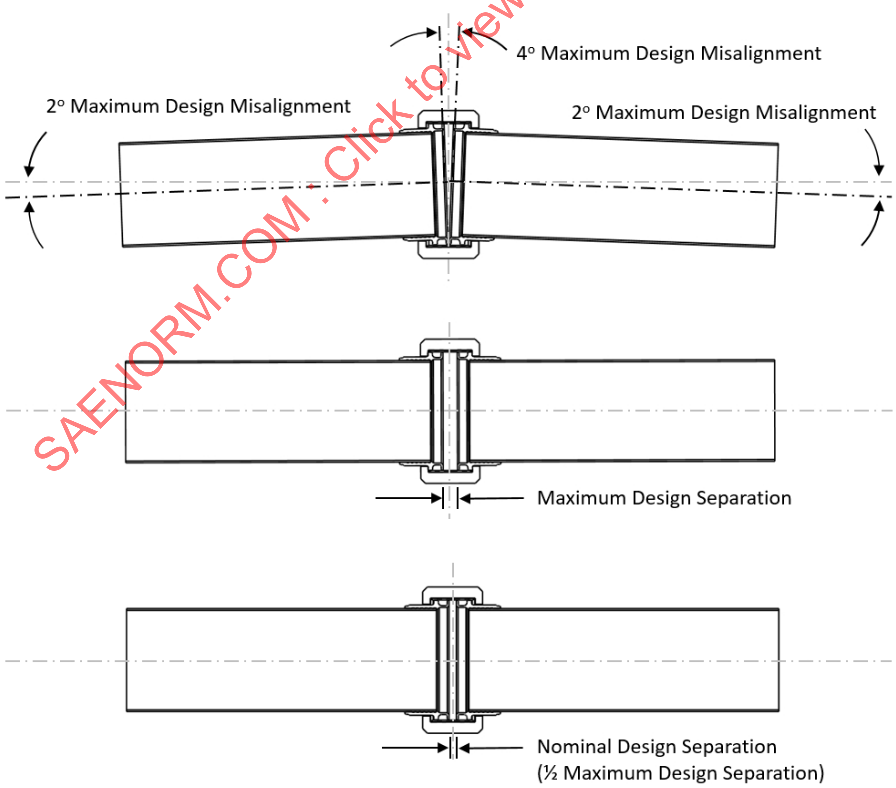


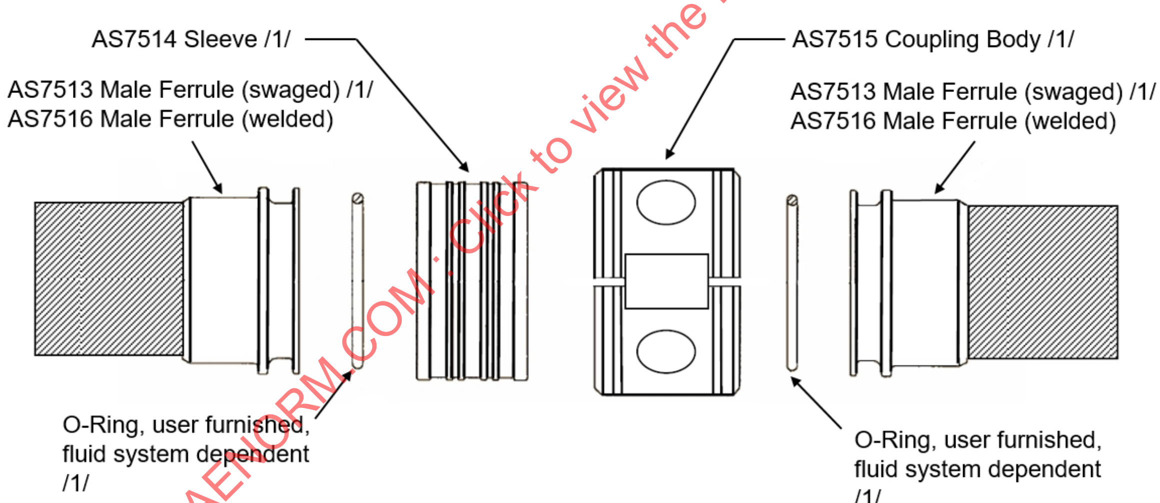
Figure 2 - Assembled coupling design installation limits

Table 3 - Coupling physical requirements

<table>
<tr><th>Dash Size Ref</th><th>Duct Size Inches Ref</th><th>Operating Pressure Nominal Negative (-) in Hg</th><th>Operating Pressure Nominal Positive (+) psig</th><th>Proof Pressure Minimum Negative (-) in Hg</th><th>Proof Pressure Minimum Positive (+) psig</th><th>Burst/ Rupture Pressure Minimum psig</th><th>AS568 O-ring Dash Size Ref</th><th>Maximum Design Separation Inches</th></tr>
<tr><td>-08</td><td>0.500</td><td rowspan="8">24</td><td rowspan="13">130</td><td rowspan="8">24</td><td rowspan="13">260</td><td rowspan="13">390</td><td>-015</td><td rowspan="11">0.28</td></tr>
<tr><td>-10</td><td>0.625</td><td>-017</td></tr>
<tr><td>-12</td><td>0.750</td><td>-117</td></tr>
<tr><td>-16</td><td>1.000</td><td>-215</td></tr>
<tr><td>-20</td><td>1.250</td><td>-218</td></tr>
<tr><td>-24</td><td>1.500</td><td>-222</td></tr>
<tr><td>-28</td><td>1.750</td><td>-224</td></tr>
<tr><td>-32</td><td>2.000</td><td>-226</td></tr>
<tr><td>-36</td><td>2.250</td><td rowspan="5">10</td><td rowspan="5">10</td><td>-228</td></tr>
<tr><td>-40</td><td>2.500</td><td>-230</td></tr>
<tr><td>-48</td><td>3.000</td><td>-234</td></tr>
<tr><td>-56</td><td>3.500</td><td>-238</td><td>0.31</td></tr>
<tr><td>-64</td><td>4.000</td><td>-242</td><td>0.34</td></tr>
</table>

3.1.1 Assembled Coupling

The components of the assembled coupling are illustrated in Figure 3 and listed in Table 4.



/1/ Configuration used in qualification testing of this specification

Figure 3 - Assembled coupling configurations

Table 4 - Coupling components

Description	Standard Part Number	Comment	Qualification Method
Ferrule fitting end design standard	AS5836 (config) (size)	Seal cavity design standard	N/A
Assembled coupling components	AS7512	Kit of parts	N/A
Ferrule	AS7513 (material) (size) AS7516 (material) (size)	Male, swaged Male, welded	Qualified by test Qualified by similarity
Sleeve	AS7514 (material) (size)	--	Qualified by test
Coupling assembly	AS7515 (material) (size)	Coupling assembly	Qualified by test
O-ring	Compound per 3.1.1.6, sizes in accordance with AS568 and Table 3	--	N/A

3.1.1.1 Ferrule

Ferrules shall conform to AS7513 and AS7516 for standard sizes, as specified in Table 4, and contain the fixed O-ring cavity. The design of the O-ring cavity shall be in accordance with AS5836.

NOTE 1: The AS7513 swage ferrules have shorter height (larger internal diameter duct stops) than AS5833 and AS5838 part standards for all sizes. The change was necessary to improve swage operations for thin wall ducting. Refer to the detail part standards for proper part number callout.

NOTE 2: The AS7516 welded ferrules have longer duct interface length to the mating duct than the original AS5837 and AS5839 part standards for all sizes. The change was necessary to improve weld prep and interference with the ferrule skirt. Refer to the detail part standards for proper part number callout.

Attachment of the ferrule to the test ducting shall be by mechanical roller swaging in accordance with AS4060.

Ferrule material is defined by the part standards. Ferrule-duct combinations shall comply with MIL-STD-889.

3.1.1.2 Sleeve

The sleeve shall conform to AS7514 and is designed principally for hoop stresses and to affect sealing when constrained by the AS7515 coupling assembly. The outer surface of the sleeve shall be designed with a center groove that shall provide a smooth conductive surface which shall facilitate an electrostatic bond with the coupling assembly. Refer to part details specification for specific surface treatments.

3.1.1.3 Coupling Assembly

Coupling assemblies shall conform to AS7515 and shall be structurally capable of withstanding the axial loads and shear loads generated by external and applied loads associated with internal test pressures at the maximum angular and axial displacements.

Materials for structural components where their functionality is not protected by redundant components or features shall be listed by material and temper within MMPDS.

Design of the hinge and latch assemblies shall provide component separation or linkage to ensure functional redundancy such that failure of any one component, hinge, latch pawl, connecting pins, or attachments shall not lead to the loss of functional, structural, electrical bonding, or EME capabilities of the assembled coupling.

NOTE: Users of AS7515 coupling assemblies and AS7514 sleeves shall verify that their specific application's axial vibration requirements do not exceed the vibration test limits in 4.2.1 and 4.2.2.

The coupling assemblies shall be designed to be installed by hand. Following proper installation, the coupling assembly shall be capable of rotating and angular movement about the ferrules and sleeve.

In addition to providing an electrostatic bond to all internal components of the coupling assembly, it shall also provide a redundant electrostatic bond path between the sleeve (AS7514) and each of the adjacent ferrules.

Lightning current conduction capabilities without coupling-induced ignition sources shall be as specified in 4.5.5. The installed coupling body shall be capable of being rotated around the ferrules and sleeve without creating coupling-induced ignition sources below the currents listed in 4.5.5.

The coupling assembly shall include a non-metallic, non-conductive VTLI that confirms a closed and latched condition with the pawls fully latched and seated. The VLTI is not a primary or secondary locking feature and shall not be used or identified as a primary or secondary latch mechanism.

NOTE: No failure of any component of the coupling assembly (AS7515) shall result in the loss of mechanical, fluid transfer, or electrostatic capabilities of the assembled coupling. Hinge mechanisms and the latching mechanisms shall be of multicomponent design to ensure that the coupling body halves remain connected in the event of a single point component failure.

3.1.1.4 VTLI Influence

The VTLI shall not be used or take credit as a primary or secondary latch for the coupling assembly. The VTLI shall indicate a properly installed coupling assembly. The VTLI shall show the latch pawls fully engaged and indicate a properly installed coupling. The VTLI shall not influence the capability of the assembled coupling to pass the qualification tests. This requirement shall be validated on all sizes being qualified by subjecting the assembled coupling to specified test criteria with the VTLI unlatched.

The VTLI device shall be designed with features that verify the coupling assembly is properly installed and latched by both sight and touch.

The VTLI device shall be designed to prevent the VTLI from being secured in its "closed" position in a way that allows a false indication of the coupling being latched, when the coupling assembly is installed over the sleeve and ferrules but is not fully latched.

The VTLI device shall be designed to allow manipulation to the indication of a latched condition, with one hand.

Particular tests where VTLI influence may impact test output shall specify VTLI configuration (latched/unlatched or removed).

3.1.1.5 Coupling Components

The coupling components, AS7512, is a kit of parts consisting of the coupling assembly (AS7515) and the sleeve (AS7514). Assembled coupling components are provided to simplify drawing callouts. Ferrules are not considered integral to the assembled coupling components because they are typically specified on duct fabrication drawings and vary according to the attachment method.

3.1.1.6 Seals

O-ring seals are not considered a part of this specification except for coupling qualification test requirements. For qualification purposes, all O-rings shall conform to AMS-R-25988, Type 1, Class 1, Grade 70, with sizes in accordance with Table 3. O-ring seals shall be lubricated with petrolatum jelly in accordance with VV-P-236 or equivalent.

Test specimens may be disassembled to allow for inspection or for replacement of damaged O-rings.

Following a failure of an O-ring, care must be taken upon removal to retain debris and contaminants from previous testing. Manufacturers shall provide an explanation of the failure with pictures and detailed test report records of disassembly and contaminants.

3.1.2 Dimensions

The assembly envelope dimensions shall be as specified in AS7511.

Part dimensions shall be as specified in the applicable AS part standards. Dimensions specified on the related coupling part standards shall apply after the application of plating or coating.

3.1.3 Weights

The individual components of the coupling shall meet the weight requirements listed on the applicable AS part standards.

3.1.4 Identification of Product

3.1.4.1 Part Mark

Parts produced to this standard shall be marked for identification in accordance with MIL-STD-130 as specified on the applicable AS standard or drawing.

3.1.4.2 Color Identification

Colors shall be defined by the individual part standards. Color coatings shall not inhibit conductivity between component parts defined by the specification. Individual part design must provide electrical conductivity and color identification where necessary.

3.1.5 Workmanship

Coupling components shall be manufactured and finished in accordance with commercially accepted practices and processes necessary for qualification as a Nadcap-qualified manufacturer in accordance with AC7112/3.

3.1.6 Cleaning

The coupling components as supplied shall be free of oil, grease, dirt, metal chips, or any other foreign material, both internally and externally.

3.1.7 Materials and Finishes

Materials and finishes for the components shall be those designated on the applicable AS part standard and shall be uniform in quality, free from defects, suitable for service, consistent with good manufacturing practice, and in conformance with the applicable specifications and requirements stated herein.

Castings shall not be used for components required for structural integrity.

3.1.7.1 Fungus Resistance

Components of the assembled coupling shall be constructed of materials and finishes that are not nutrients for fungi and do not deteriorate over time to become fungus nutrients. The equipment shall be constructed so that its suitability and resistance can be demonstrated, either by materials analysis or by test in accordance with MIL-STD-810, Method 508.4.

3.1.8 Interchangeability

Until further notice, interchangeability of different suppliers' coupling and sleeve components is to be determined by the end user. If interchangeability has not been evaluated by the end user, then the sleeve and coupling combinations used must be from the same manufacturer.

3.1.9 Production Acceptance Testing

The manufacturers shall complete production acceptance testing prior to shipment of all pre- and post-qualification production parts. The testing shall include dimensional and product performance tests as defined by the individual part standards. The acceptance tests are listed in Table 5.

Table 5 - Component production acceptance tests

Standard Number	Description	Acceptance Test Requirements
AS7515	Coupling assembly	Manufacturer design envelope, weight, and electrostatic bonding /1/
AS7513	Ferrule	N/A
AS7516		
AS7514	Sleeve	

/1/ Electrical bond shall be performed across the coupling body and between the sleeve and adjacent ducts. The resistance value shall be recorded in lieu of a pass or fail indication in accordance with 4.5.2 of this specification.

If requested by PRI and/or customers, the manufacturer shall submit copies of completed production acceptance test reports.

3.2 Quality Assurance

Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection and test requirements as specified herein and allowed by PD1100 and OP2007 Appendix G.

3.3 Requirements for Qualification

Assemblies furnished under this specification shall meet the requirements of this document. Suppliers that qualify in accordance with this specification shall be placed on a PRI QPL for the following specifications (all sizes and variations):

AS7511 Assembled Coupling, Threadless-Flexible, Fixed Cavity, High Conductivity, Self-Bonding, Envelope Dimensions

AS7512 Assembled Coupling Components, Threadless-Flexible, Fixed Cavity, High Conductivity, Self-Bonding, Envelope Dimensions

AS7513 Male Ferrule, Threadless - Flexible, Fixed Cavity, Current Carrying, Self-Bonding, Swaged

AS7514 Sleeve, Threadless - Flexible, Fixed Cavity, Current Carrying, Self-Bonding

AS7515 Coupling Assembly, Threadless - Flexible, Fixed Cavity, Current Carrying, Self-Bonding

AS7516 Male Ferrule, Threadless - Flexible, Fixed Cavity, Self-Bonding, Butt Welded (Qualified by Similarity)

If a supplier chooses to limit their qualification to a specific size, option, or part standard, then each and every size, option, or part standard selected must be subjected to every Category 1 and Category 2 testing from Table 6. Subsequent QPL placement shall only include the specific size, option, or part standard that was qualified.

EXAMPLE 1: If a supplier chooses to limit their qualification to a range of sizes, options, or part standards, then the supplier must complete Category 1 testing from Table 6 on all sizes in the size range, except as noted. The supplier must also complete Category 2 testing from Table 6 on the smallest size in the size range down to size -16 minimum, and the largest size in the desired size range. If the supplier's latching and/or hinging primary and redundant load carrying components subassembly is not identical in definition, manufacturing, material, and configuration across the size spectrum being qualified or a non-parametric coupling structural design step increase is used, then the smaller coupling size next to the non-parametric design step size change occurrence shall also complete the Category 2 testing listed in Table 6.

NOTE: If a range of sizes are being qualified which includes the -40 size, the supplier must perform all Category 1 and all Category 2 testing from Table 6 on size -40.

EXAMPLE 2: A supplier wishes to qualify size AS7515A32 only. The supplier shall complete all Category 1 and Category 2 testing from Table 6 on size -32.

EXAMPLE 3: A supplier wishes to pursue QPL placement for AS7515A08 through AS7515A32 only. The supplier must complete Category 1 testing from Table 6 on all sizes in the size range. The supplier must also complete Category 2 testing on sizes -16 and -32, provided all latching and hinging primary and redundant load carrying components are identical in definition, manufacturing, material, and configuration for all sizes -08 through -32. If the supplier's latching and/or hinging primary and redundant load carrying components are not identical across the size spectrum being qualified (-08 through -32) or a non-parametric coupling structural design step increase is used, then the smaller coupling size next to the non-parametric design step size change occurrence shall also be subjected to Category 2 testing from Table 6.

EXAMPLE 4: A supplier wishes to pursue QPL placement for all part standards and sizes except size -40. The supplier shall complete Category 1 testing from Table 6 on all sizes. The supplier must also perform all Category 2 testing on sizes -16 and -64, provided all latching and hinging primary and redundant load carrying components are identical in definition, manufacturing, material, and configuration for all sizes -08 through -64. If the supplier's latching and/or hinging primary and redundant load carrying components are not identical across the size spectrum being qualified (-08 through -64) or a non-parametric coupling structural design step increase is used, then the smaller coupling size next to the non-parametric design step size change occurrence shall also be subjected to Category 2 testing from Table 6.

EXAMPLE 5: A supplier wishes to pursue QPL placement for all part standards and sizes, including size -40. The supplier shall complete Category 1 testing from Table 6 on all sizes. The supplier must also perform all Category 2 testing on sizes -16, -40, and -64, provided all latching and hinging primary and redundant load carrying components are identical in definition, manufacturing, material, and configuration for all sizes -08 through -64. If the supplier's latching and/or hinging primary and redundant load carrying components are not identical across the size spectrum being qualified (-08 through -64) or a non-parametric coupling structural design step increase is used, then the smaller coupling size next to the non-parametric design step size change occurrence shall also be subjected to Category 2 testing from Table 6.

Welded versions of the ferrules shall be qualified by similarity as this specification does not qualify the attachment method of ferrules to tubes.

3.3.1 Manufacturer's Qualification

A manufacturer producing a product in conformance to this procurement specification shall be accredited in accordance with the requirements of PD1100 and the appropriate operating procedures of PD2000 and shall be listed in a PRI QML for this type of product.

3.3.2 Product Qualification

All products shall conform to the requirements of this specification and shall be approved in accordance with the requirements of PD2001 and PD2101 for listing in a PRI QPL.

It is the manufacturer's responsibility to ensure the manufacturing process maintains the as-qualified product quality and performance for its production life.

3.3.3 Change Approval

Refer to PD2101.

3.3.4 Qualification by Analysis

Analysis cannot be used as rationale to replace any requirements of Section 4 of this specification.

3.3.5 Dissimilar Materials

Materials shall possess adequate corrosion-resistance characteristics or shall be suitably protected by the use of finishes to resist corrosion caused by such conditions as dissimilar metal combinations, moisture, salt spray, and high-temperature deterioration.

Dissimilar materials are defined by MIL-STD-889.

3.3.6 FAA Requirements

In addition to those previously referenced or specified within this specification, the suppliers test report will support showing compliance by physical testing (that may exceed those specified within this specification), by analysis (that may also exceed what is required by this specification), or by design to Title 14 CFR Part 25 Federal Aviation Requirements:

FAR 25.603	Materials
FAR 25.605	Fabrication Methods
FAR 25.609	Protection of Structure
FAR 25.613	Material Strength Properties and Material Design Values
FAR 25.901	Installation
FAR 25.954	Fuel System Lightning Protection
FAR 25.981	Fuel Tank Ignition Prevention

To support showing compliance to FAR 25.901 and FAR 25.981, the assembled coupling must show design and component redundancy to ensure that any single component failure will not lead to failure of the functional, structural, electrical bonding, or EME capabilities throughout the design life of the coupling assembly.

See Table 2.

NOTE: Refer to the corresponding aircraft advisory circular (AC) for information and guidance on compliance with the listed airworthiness standards.

4. QUALIFICATION TESTING

4.1 General Test Conditions

4.1.1 Assembly of Test Specimens

AMS-R-25988 O-rings with sizes per AS568 shall be used for all specimens.

O-ring seals shall be lubricated with petrolatum United States Pharmacopeia (USP) grade or equivalent.

O-rings may be replaced as necessary and shall be documented in the test report. All coupling debris shall remain untouched when the O-ring is replaced. The O-ring groove shall be cleaned with isopropyl alcohol and a lint-free wipe prior to installation of the replacement O-ring.

O-ring failures do not necessarily constitute a test failure unless the O-ring is damaged by a degraded part.

4.1.2 Test Fluid

The test fluid shall be any of the following:

a. Propylene glycol per ASTM D6210, or equivalent, mixed in a 65% or greater solution with deionized water.

b. Stoddard safety solvent per MIL-PRF-680 or MIL-PRF-7024.

c. Hydraulic fluid per MIL-PRF-5606 or MIL-PRF-83282.

4.1.3 Test Fluid Leakage Limits During Testing

For all tests, except dynamic shear and static shear, test fluid leakage shall not exceed one detached drop of test fluid over the specific test being run. If leakage exceeds one detaching drop, the test shall be paused, and the assembled coupling disassembled for inspection. See 3.1.1.6 for additional information. O-ring seals are not part of this qualification and, provided there is no structural failure of any component, may be changed and replaced with new if required. Full details, including any wear observed and number of cycles or time on test, shall be fully documented in the test report. A structural failure of any component within the joint is cause for failure.

For dynamic shear and static shear tests only, leakage may exceed the one detaching drop limit, as these tests will subject the coupling to angular displacements greater than the operational limitations of Figure 2. At no time shall leakage adversely affect testing integrity. For example, pressure profiles and pressure rise and fall rates must remain within testing requirements. Seal inspection and maintenance may be required over the duration of these tests. See 3.1.1.6 for additional information.

4.1.4 Ambient Test Conditions

All testing ambient conditions shall be recorded in the test report.

4.1.5 General Tolerances

4.1.5.1 Pressure Measurements

Unless otherwise specified, positive pressure measurements shall have a tolerance of the lesser of -0/+5 psig or +10% of specified test pressure full scale. Negative pressures, as measured in inches Hg shall be equal to or greater than the specified value by +10%.

4.1.5.2 Temperature Measurements

Unless otherwise specified, the test specimens and fluid shall be maintained within +10, -0 °F of specified temperatures for positive temperatures and +0, -10 °F of specified temperatures for negative temperatures. Ambient temperature measurements shall be taken at a location that is reflective of where the complete test assembly resides for specific tests.

4.1.5.3 Time Measurements

Unless otherwise specified, time measurements shall have a tolerance of +2%/-0% of the specified value within the specified units (of time).

4.1.6 Qualification Calibration

Quality control and calibration, as a minimum, shall comply, respectively, with AS9100 and ANSI/NCSL Z540.3.

4.1.7 Test Inspection Methods

All inspections shall be performed with the unaided eye.

4.2 Qualification Performance Testing and Sequences

Qualification performance testing is divided into four groups:

- Life cycle and non-life cycle environmental exposure (life cycle: see Table 7, non-life cycle: see Table 8)
  - The purpose of the life cycle test sequence is to simulate multiple lifetimes of standard aircraft usage and environmental exposure and wear. Continuous electrical bonding and lightning strike performance are validated at various points in the group's test sequence. Testing assists in showing compliance to FAR 25.981, FAR 25.954, and FAR 25.901 and is also demonstrated by testing in compliant, deactivated latch, and deactivated hinge configurations simulating single point failure of the primary load carrying components in both hinge and latch sides of the coupling assembly.
  - The purpose of the non-life cycle test sequence is to simulate multiple lifetimes of standard aircraft usage and environmental exposure and wear. Continuous electrical bonding and lightning strike performance are validated at various points in the group's test sequence. Whereas the life cycle test sequence exposes coupling assemblies to broad 4X design life cycle exposures, the non-life cycle sequence fills the parametric gaps across the size group by completing critical tests to assist in showing compliance to FAR 25.981, FAR 25.954, and FAR 25.901.
- Standalone vibration (see Table 9)
  - The random and windmilling vibration test is intended to ensure the assembled coupling properly functions in areas requiring extended distances between support clamps or in environments exposed to extreme vibration. Specimens shall not rupture nor show evidence of leakage in excess of the limits specified in 4.1.3 at any point during the testing.
- Static load capability (see Table 10)
  - Test coupling assemblies shall be subjected to static shear and static tensile loads specified in the static load test group.
- Fatigue load cycling (dynamic shear: see Table 11, pressure impulse fatigue: see Table 12)
  - Complete test assemblies shall be subjected to dynamic shear testing in both compliant and deactivated hinge and deactivated latch configurations.
  - Complete test assemblies shall be subjected to pressure impulse fatigue testing in compliant configurations.

Within each test group are unique test sequences with prescribed tests. All specified tests in each test sequence must be performed in the order shown in Table 6.

Physical testing shall be performed on coupling sizes and quantities in the configurations shown in Table 6 and subsequent subsections of 4.2.

Table 6 - Qualification performance testing and sequence

		Life & Non life Environmental Exposure				Stand Alone Vibration		Static Load Capability		Fatigue Load Cycling			
Category		2	2	2	1	1	1	1	1	2	2	2	1
Test Sequence Identifier		Life Cycle (i) /3/	Life Cycle (ii) /3/	Life Cycle (iii) /3/	Non-Life Cycle /3/	High Energy Random /4/	Wide Span Random & Windmilling	Static Shear	Static Tensile	Dynamic Shear (i)	Dynamic Shear (ii)	Dynamic Shear (iii)	Pressure Impulse Fatigue
Coupling assembly configuration		(compliant)	(deactivated Hinge)	(deactivated Latch)	(compliant)	(compliant)	(compliant)	(compliant)	(compliant)	(compliant)	(deactivated Hinge)	(deactivated Latch)	(compliant)
Specific Sizes Tested		16, 40, 64	16, 40, 64	16, 40, 64	08, 10, 12 20, 24, 28 32, 36, 48, 56	08, 10, 12, 16 20, 24, 28, 32, 36, 40	08, 10, 12, 16 20, 24, 28, 32 36, 40, 48, 56, 64	08, 10, 12, 16, 20, 24, 28, 32, 36, 40, 48, 56, 64	08, 10, 12, 16, 20, 24, 28, 32, 36, 40, 48, 56, 64	16, 40, 64	16, 40, 64	16, 40, 64	08, 10, 12, 16 20, 24, 28, 32 36, 40, 48, 56, 64
Complete Test Assembly Configuration		(a)	(a)	(a)	(a)	(a)	(b)	(c)	n/a	(a) or (a-1)	(a) or (a-1)	(a) or (a-1)	(d)
Number of Sizes tested		3	3	3	10	10	13	13	13	3	3	3	13
Quantity of Coupling Assemblies by size per Complete Test		2	2	2	2	2	1	1	1	2	2	2	1
Number of Complete Test Assemblies per size		2	1	1	2	1	2	3	3	2	2	2	3
Number of Coupling Assemblies per size qualified by test		4	2	2	4	2	2	3	3	4	4	4	3
Quantity of Test Duct Assemblies per Complete Test Assembly		3	3	3	3	3	2	2	0	3	3	3	2
Total number of Test Duct Assemblies		18	9	9	60	30	52	78	0	18	18	18	78
Total number of test Coupling Assemblies		12	6	6	40	20	26	39	39	12	12	12	39
Tests	**AS7510 Section**												
Examination Of Product	4.5.1	1	1	1	1	1	1	1	1	1	1	1	1
Electrical Bonding	4.5.2	2	2	2	2	2	2			2	2	2	2
Pressure Leakage	4.5.3	3	3	3	3	3	3			3	3	3	3
Proof Pressure (positive and negative - specific	4.5.4	4	4	4	4	4	4			4	4	4	4
Continuous Electrical bonding	4.5.13	5	5	5	5	5	5						
Lightning Strike	4.5.5	6	6	6									
Sinusoidal Resonance Survey & Dwell	4.5.6	7	7	7	6								
Windmilling Functionality	4.5.15	8	8	8	7								
Electrical bonding (<10-Ohms)	4.5.2	9	9	9									
High Temperature	4.5.7	10	10	10									
Low Temperature	4.5.8	11	11	11									
Pressure Impulse Fatigue	4.5.9												5(50k cycles)
Corrosion	4.5.10												6
Pressure Impulse Fatigue	4.5.9	12 (110k cycles)	12 (110k cycles)	12 (110k cycles)									7(50k cycles)
Electrical bonding (<10-Ohms)	4.5.2	13	13	13									
Repeated Assembly (100 cycles)	4.5.11	14	14	14									
Dynamic Shear	4.5.12	15 (110k cycles)	15 (110k cycles)	15 (110k cycles)						5(330k cycles)	5(330k cycles)	5(330k cycles)	
Electrical bonding	4.5.2									6	6	6	8
Continuous Electrical bonding	4.5.13	16	16	16									
Lightning Strike	4.5.5	17	17	17									9 /1/
Random Vibration (High Energy)	4.5.14.1					6							
Random Vibration (Wide Span)	4.5.14.2						6						
Windmilling Vibration (Wide Span)	4.5.15.1						7						
Windmilling Functionality	4.5.15					7							
Continuous Electrical bonding	4.5.13					8	8						
Static Tensile w/ continuous electrical bonding	4.5.16								2				
Static Shear w/ continuous electrical bonding	4.5.17							2					
Proof (positive only) & Burst Pressure	4.5.4	18	18	18		9	9			7	7	7	10
Post-test Electrical Bonding	4.5.2	19	19	19		10	10			8	8	8	11
Re-examination of Product	4.5.1	20	20	20		11	11	3	3	9	9	9	12

/1/ Only sizes -16, -40, and -64 require post Pressure Impulse Fatigue Lightning Testing
/2/ The actual sizes which are subjected to Category 2 tests are defined in Paragraph 3.3. Additional testing may be required.
/3/ If Life Cycle Testing (Category 1) is performed on a given size in a partial qualification, then Non-Life Cycle Testing (Category 2) is not required for that size.
/4/ Category 1, High Energy Random Vibration is not applicable to sizes -48, -56 or -64 (there is no requirement to test these sizes).

4.2.1 Life and Non-Life Environmental Exposure Test Group

There shall be no cleaning of complete test assemblies throughout this test group and sequences other than the minimum required if a seal change is necessary (see 4.1.3).

NOTE: Users of AS7515 coupling assemblies and AS7514 sleeves shall verify that their specific application's axial vibration requirements do not exceed the vibration test limits in 4.2.1 and 4.2.2.

4.2.1.1 Life Cycle Test Sequence

Table 7 gives a full detail of the life cycle test sequence with required fixtures for each of the tests within each sequence. Each test coupling assembly must complete its respective test sequence in its entirety, start to finish, without having to be replaced.

Table 7 - Life cycle test sequence detail

Test Sequence Identifier Test Coupling Configuration		Life Cycle (i) (compliant)	Life Cycle (ii) (deactivated Hinge)	Life Cycle (iii) (deactivated Latch)	
Complete Test Assembly Configuration		(a)	(a)	(a)	
Sizes Tested		16, 40, 64 /1/ /2/	16, 40, 64 /1/ /2/	16, 40, 64 /1/ /2/	Totals
Number of Sizes tested		3	3	3	3
Quantity of Coupling Assemblies by size per Complete Test Assembly		2	2	2	2
Number of Complete Test Assemblies per size		2	1	1	4
Number of Coupling Assemblies per size qualified by test sequence		4	2	2	8
Quantity of Test Duct Assemblies per Complete Test Assembly		3	3	3	3
Total number of Test Duct Assemblies		18	9	9	36
Total number of test Coupling Assemblies		12	6	6	24
Tests	**AS7510 Section**				**Test Fixture & Configuration**
Examination of Product	4.5.1	1	1	1	n/a
Electrical Bonding	4.5.2	2	2	2	Life Cycle (-1)
Pressure Leakage	4.5.3	3	3	3	Life Cycle (-1)
Proof Pressure	4.5.4	4	4	4	Life Cycle (-1)
Continuous Electrical Bonding (Y & X Axis)	4.5.13.1	5	5	5	Life Cycle (-1)
Lightning Strike	4.5.5	6	6	6	Lightning Fixture (-1)
Sinusoidal Resonance Survey & Dwell (Y & X Axis)	4.5.6	7	7	7	Life Cycle (-2)
Windmilling Functionality (Y & X Axis)	4.5.15.2	8	8	8	Life Cycle (-2)
Electrical Bonding (<10-Ohms)	4.5.2	9	9	9	Life Cycle (-1)
High Temperature	4.5.7	10	10	10	n/a
Low Temperature	4.5.8	11	11	11	n/a
Pressure Impulse (110k cycles)	4.5.9	12	12	12	Life Cycle (-2)
Electrical Bonding (<10-Ohms)	4.5.2	13	13	13	Life Cycle (-1)
Repeated Assembly (100 cycles)	4/5/11	14	14	14	Life Cycle (-2)
Dynamic Shear (110k cycles)	4/5/12	15	15	15	Dynamic Shear
Continuous Electrical Bonding (Y & X Axis)	4.5.13.1	16	16	16	Life Cycle (-1)
Lightning Strike	4.5.5	17	17	17	Lightning Fixture (-1)
Proof & Burst Pressure (positive only)	4.5.4	18	18	18	Life Cycle (-1)
Post-test Electrical Bonding	4.5.2	19	19	19	Life Cycle (-1)
Re-examination of Product	4.5.1	20	20	20	n/a

/1/ The actual sizes which are subjected to Category 2 tests are defined in Paragraph 3.3. Additional testing may be required.
/2/ If Life Cycle Testing (Category 1) is performed on a given size in a partial qualification, then Non-Life Cycle Testing (Category 2) is not required for that size.

4.2.1.2 Non-Life Cycle Test Sequence

Table 8 gives a full detail of the non-life cycle test sequences with required fixtures for each of tests within the sequence. Each test coupling assembly must complete its respective test sequence in its entirety, start to finish, without having to be replaced.

NOTE: If Life Cycle Testing (Category 1) is performed on a given size in a partial qualification, then Non-Life Cycle Testing (Category 2) is not required for that size.

Table 8 - Non-life cycle test sequence detail

Test Sequence Identifier		Non-Life Cycle	
Test Coupling Configuration		(compliant)	
Test Cell Assembly Configuration		(a)	
Sizes Tested		08, 10, 12 20, 24, 28 32, 36, 48, 56	
Number of Sizes tested		10	
Quantity of Coupling Assemblies by size per Complete Test Assembly		2	
Number of Complete Test Assemblies per size		2	
Number of Coupling Assemblies per size qualified by test sequence		4	
Quantity of Test Duct Assemblies per Complete Test Assembly		3	
Total number of Test Duct Assemblies		60	
Total number of test Coupling Assemblies		40	
Tests	**AS7510 Section**		**Test Fixture & Configuration**
Examination of Product	4.5.1	1	n/a
Electrical Bonding	4.5.2	2	Life Cycle (-1)
Pressure Leakage	4.5.3	3	Life Cycle (-1)
Proof Pressure	4.5.4	4	Life Cycle (-1)
Continuous Electrical Bonding (Y & X Axis)	4.5.13.1	5	Life Cycle (-1)
Sinusoidal Resonance Survey & Dwell (Y & X Axis)	4.5.6	6	Life Cycle (-2)
Windmilling Functionality (Y & X Axis)	4.5.15.2	7	Life Cycle (-2)
Pressure Impulse	4.5.9	8	Life Cycle (-2)
Electrical Bonding (<10-Ohms)	4.5.2	9	Life Cycle (-1)
Repeated Assembly (100 cycles)	4.5.11	10	Life Cycle (-2)
Continuous Electrical Bonding (Y & X Axis)	4.5.13.1	11	Life Cycle (-1)
Lightning Strike	4.5.5	12	Lightning Fixture (-1)
Proof & Burst Pressure (positive only)	4.5.4	13	Life Cycle (-1)
Post-test Electrical Bonding	4.5.2	14	Life Cycle (-1)
Re-examination of Product	4.5.1	15	n/a

4.2.2 Stand Alone Vibration Test Group

NOTE: Users of AS7515 coupling assemblies and AS7514 sleeves shall verify that their specific application's axial vibration requirements do not exceed the vibration test limits in 4.2.1 and 4.2.2.

4.2.2.1 Random and Windmilling Vibration Test Sequence

Table 9 gives a full detail of the random and windmilling vibration test sequence with required fixtures for each of tests within the sequence. Each test coupling assembly must complete its respective test sequence in its entirety, start to finish, without having to be replaced.

Table 9 - Random and windmilling vibration test sequence detail

Test Sequence Identifier		Hi Energy Random /1/ /2/		Wide Span Random & Windmilling	
Test Coupling Configuration		(compliant)		(compliant)	
Test Cell Assembly Configuration		(a)		(b)	
Sizes Tested		08, 10, 12, 16 20, 24, 28, 32, 36, 40		08, 10, 12, 16 20, 24, 28, 32 36, 40, 48, 56, 64	Totals
Number of Sizes tested		10		13	-
Quantity of Coupling Assemblies by size per Complete Test Assembly		2		1	-
Number of Complete Test Assemblies per size		1		2	-
Number of Coupling Assemblies per size qualified by test sequence		2		2	2
Quantity of Test Duct Assemblies per Complete Test Assembly		3		2	-
Total number of Test Duct Assemblies		30		52	82
Total number of test Coupling Assemblies		20		26	46
Tests	**AS7510 Section**		**Test Fixture & Configuration**		**Test Fixture & Configuration**
Examination of Product	4.5.1	1	n/a	1	n/a
Electrical Bonding	4.5.2	2	Life Cycle (-2)	2	R&W Vibration
Pressure Leakage	4.5.3	3	Life Cycle (-2)	3	R&W Vibration
Proof Pressure	4.5.4	4	Life Cycle (-2)	4	R&W Vibration
Continuous Electrical Bonding (Y Axis)	4.5.13.2	5	Life Cycle (-2)		-
Continuous Electrical Bonding (Y Axis)	4.5.13.3		-	5	R&W Vibration
Random Vibration - High Energy Random (Y-Axis)	4.5.14.1	6	Life Cycle (-2)		-
Random Vibration - Wide Span Random (Y-Axis)	4.5.14.2		-	6	R&W Vibration
Windmilling Vibration (Y Axis)	4.5.15.1		-	7	R&W Vibration
Windmilling Functionality (Y Axis)	4.5.15.2	7	Life Cycle (-2)		-
Continuous Electrical Bonding (Y Axis)	4.5.13.2	8	Life Cycle (-2)		-
Continuous Electrical Bonding (Y Axis)	4.5.13.3		-	8	R&W Vibration
Proof & Burst Pressure (positive only)	4.5.4	9	Life Cycle (-2)	9	R&W Vibration
Post-test Electrical Bonding	4.5.2	10	Life Cycle (-2)	10	R&W Vibration
Re-examination of Product	4.5.1	11	n/a	11	n/a

/1/ The actual sizes which are subjected to Category 2 tests are defined in Paragraph 3.3. Additional testing may be required.
/2/ Category 1, High Energy Random Vibration is not applicable to sizes -48, -56 or -64 (there is no requirement to test these sizes).

4.2.3 Static Load Capability Test Group

4.2.3.1 Static Shear Load (with Internal Pressure) and Static Tensile Test Sequence

Table 10 gives a full detail of the static load capability test group, including static shear and static tensile test sequences, with required fixtures for each of test within each test sequence. Each test coupling assembly must complete its respective test sequence in its entirety, start to finish, without having to be replaced.

Table 10 - Static load capability test group detail

Test Sequence Identifier		Static Shear		Static Tensile	
Test Coupling Configuration		(compliant)		(compliant)	
Test Cell Assembly Configuration		(c)		N/A	
Sizes Tested		08, 10, 12, 16 20, 24, 28, 32 36, 40, 48, 56, 64		08, 10, 12, 16 20, 24, 28, 32 36, 40, 48, 56, 64	Totals
Number of Sizes tested		13		13	13
Quantity of Coupling Assemblies by size per Complete Test		1		1	1
Number of Complete Test Assemblies per size		3		3	3
Number of Coupling Assemblies per size qualified by test		3		3	3
Quantity of Test Duct Assemblies per Complete Test		2		0	-
Total number of Test Duct Assemblies		78		0	78
Total number of test Coupling Assemblies		39		39	78
Tests	**AS7510 Section**		**Test Fixture & Configuration**		**Test Fixture & Configuration**
Examination of Product	4.5.1	1	n/a	1	n/a
Static Tensile w/ continuous electrical bonding	4.5.16		-	2	Static Tensile
Static Shear w/ continuous electrical bonding	4.5.17	2	Static Shear		-
Re-examination of Product	4.5.1	3	n/a	3	n/a

4.2.4 Fatigue Load Cycling Test Group

4.2.4.1 Dynamic Shear Test Sequence

Table 11 gives a full detail of the dynamic shear test sequence with required fixtures for each of test within each test sequence. Each test coupling assembly must complete its respective test sequence in its entirety, start to finish, without having to be replaced.

Table 11 - Dynamic shear test sequence

Test Swim Lane Identifier		Dynamic Shear (i)	Dynamic Shear (ii)	Dynamic Shear (iii)	
Test Coupling Configuration		(compliant)	(deactivated Hinge)	(deactivated Latch)	
Test Cell Assembly Configuration		(a) or (a-1)	(a) or (a-1)	(a) or (a-1)	
Sizes Tested		16, 40, 64 /1/	16, 40, 64 /1/	16, 40, 64 /1/	Totals
Number of Sizes tested		3	3	3	3
Quantity of Coupling Assemblies by size per Complete Test		2	2	2	2
Number of Complete Test Assemblies per size		2	2	2	6
Number of Coupling Assemblies per size qualified by test		4	4	4	12
Quantity of Test Duct Assemblies per Complete Test Assembly		3	3	3	3
Total number of Test Duct Assemblies		18	18	18	54
Total number of test Coupling Assemblies		12	12	12	36
Tests	**AS7510 Section**				**Test Fixture & Configuration**
Examination of Product	4.5.1	1	1	1	n/a
Electrical Bonding	4.5.2	2	2	2	Life Cycle (-1)
Pressure Leakage	4.5.3	3	3	3	Life Cycle (-1)
Proof Pressure	4.5.4	4	4	4	Life Cycle (-1)
Dynamic Shear	4/5/12	5 (330k cycles)	5 (330k cycles)	5 (330k cycles)	Dynamic Shear
Electrical Bonding (<10-Ohms)	4.5.2	6	6	6	Life Cycle (-1)
Proof & Burst Pressure	4.5.4	7	7	7	Life Cycle (-1)
Post-test Electrical Bonding	4.5.2	8	8	8	Life Cycle (-1)
Re-examination of Product	4.5.1	9	9	9	n/a

/1/ The actual sizes which are subjected to Category 2 tests are defined in Paragraph 3.3. Additional testing may be required.

4.2.4.2 Pressure Impulse Fatigue Test Sequence

Table 12 gives a full detail of the pressure impulse fatigue sequence with required fixtures for each of test within each test sequence. Each test coupling assembly must complete its respective test sequence in its entirety, start to finish, without having to be replaced.

Table 12 - Pressure impulse fatigue test sequence

Test Sequence Identifier		Pressure Impulse Fatigue	
Coupling assembly configuration		(compliant)	
Specific Sizes Tested		08, 10, 12, 16 20, 24, 28, 32 36, 40, 48, 56, 64	
Complete Test Assembly Configuration		(d)	
Number of Sizes tested		13	
Quantity of Coupling Assemblies by size per Complete Test Assembly		1	
Number of Complete Test Assemblies per size		3	
Number of Coupling Assemblies per size qualified by test sequence		3	
Quantity of Test Duct Assemblies per Complete Test Assembly		2	
Total number of Test Duct Assemblies		78	
Total number of test Coupling Assemblies		39	
Tests	**AS7510 Section**		**Test Fixture & Configuration**
Examination of Product	4.5.1	1	n/a
Electrical Bonding	4.5.2	2	Pressure Impulse
Pressure Leakage	4.5.3	3	Pressure Impulse
Proof Pressure (positive and negative - specific order)	4.5.4	4	Pressure Impulse
Pressure Impulse Fatigue	4.5.9	5(50k cycles)	Pressure Impulse
Corrosion	4.5.10	6	n/a
Pressure Impulse Fatigue	4.5.9	7(50k cycles)	Pressure Impulse
Electrical Bonding	4.5.2	8	Pressure Impulse
Lightning Strike	4.5.5	9 /1/	Lightning Strike (-2)
Proof (positive only) & Burst Pressure	4.5.4	10	Pressure Impulse
Post-test Electrical Bonding	4.5.2	11	Pressure Impulse
Re-examination of Product	4.5.1	12	n/a

/1/ Only sizes -16, -40, and -64 require post Pressure Impulse Fatigue Lightning Testing

4.3 Complete Test Assembly Configurations

Qualification performance testing shall use complete test assemblies as defined in 4.3 and its subsections.

Each complete test assembly shall have full AS9102 first article inspection reports showing traceability and compliance to the requirements of this specification and adjacent part detail standards where applicable and retained by the supplier while listed on the QPL.

Each complete test assembly configuration described in 4.3 is fully defined in Appendix A with detailed design and manufacturing requirements.

4.3.1 Configuration (a)

To be used in life cycle, non-life cycle, and high energy random vibration test sequences.

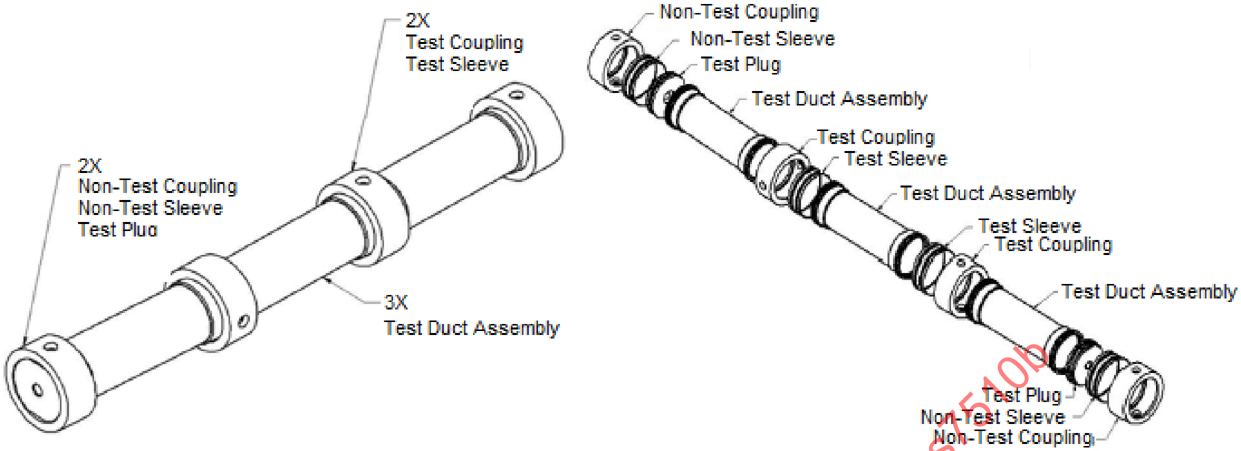


Figure 4 - Life cycle configuration (a) complete test assembly (as assembled and exploded views)

4.3.1.1 Configuration (a-1)

To be used in dynamic shear fatigue test sequences.

NOTE: Configuration (a-1) is the same as Configuration (a) with the added optional reinforcement slug installed.

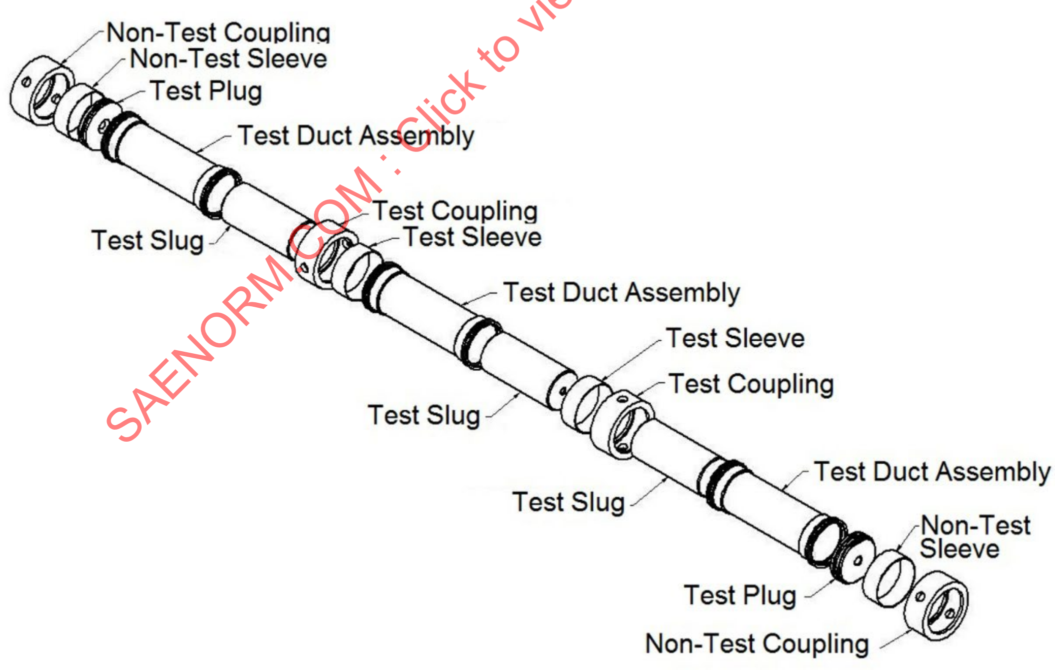


Figure 5 - Dynamic shear test configuration (a-1) complete test assembly (exploded view)

4.3.2 Configuration (b)

To be used in random and windmilling vibration testing.

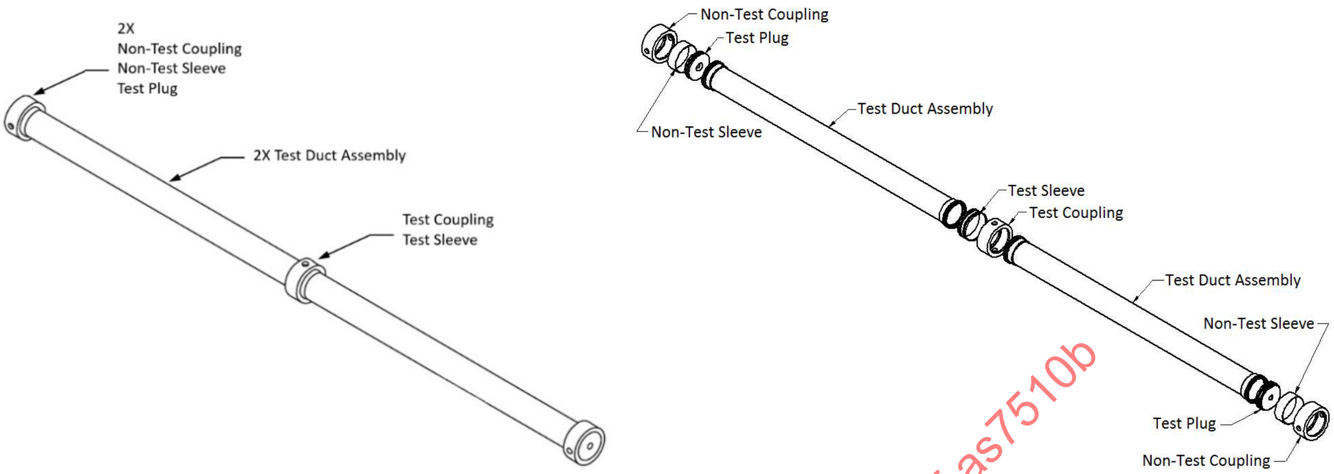


Figure 6 - Random and windmilling test configuration (b) complete test assembly (as assembled and exploded views)

4.3.3 Configuration (c)

To be used in static shear testing.

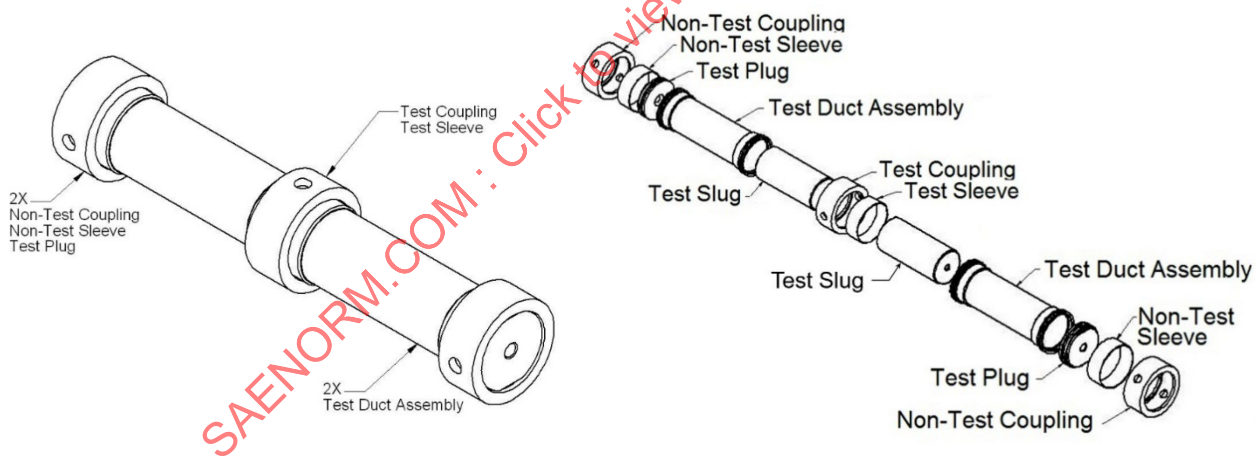


Figure 7 - Static shear test configuration (c) complete test assembly (as assembled and exploded views)

4.3.4 Configuration (d)

To be used in pressure impulse fatigue testing.

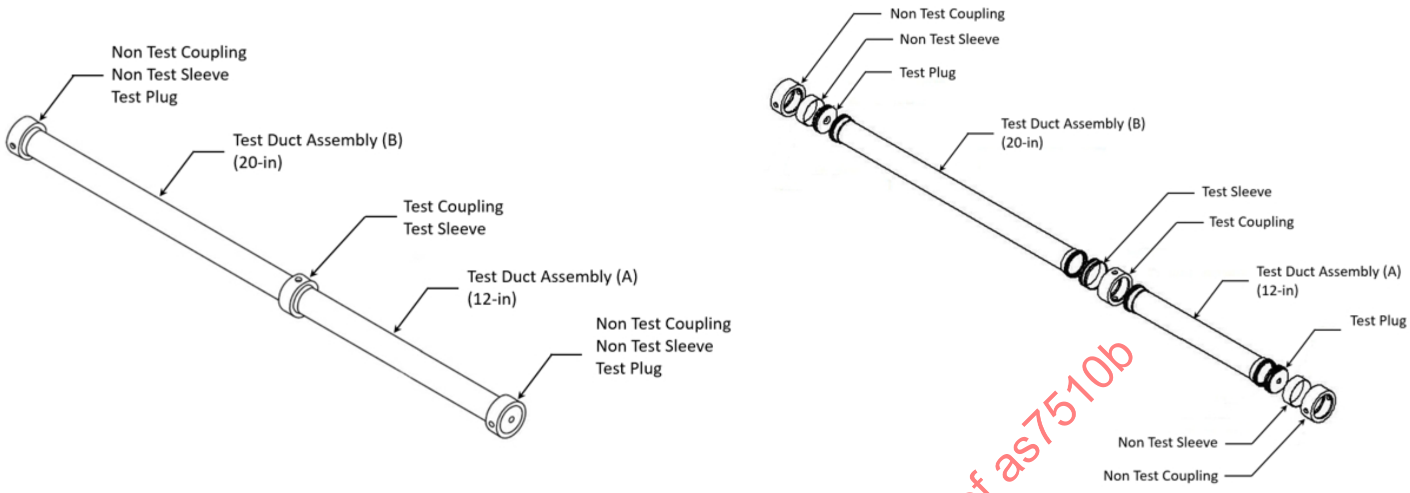


Figure 8 - Pressure impulse test configuration (d) complete test assembly (as assembled and exploded views)

4.4 Test Fixture Configurations

Qualification performance testing shall use the test fixtures as defined in 4.4 and its subsections.

Each test fixture assembly described in 4.4 is fully defined in Appendix B with detailed design and manufacturing requirements.

Each qualification test fixture assembly shall have complete inspection reports showing compliance to all requirements.

4.4.1 Life and Non-Life Environmental Exposure Test Fixture (See Figure 10 for Configurations -1 and -2)

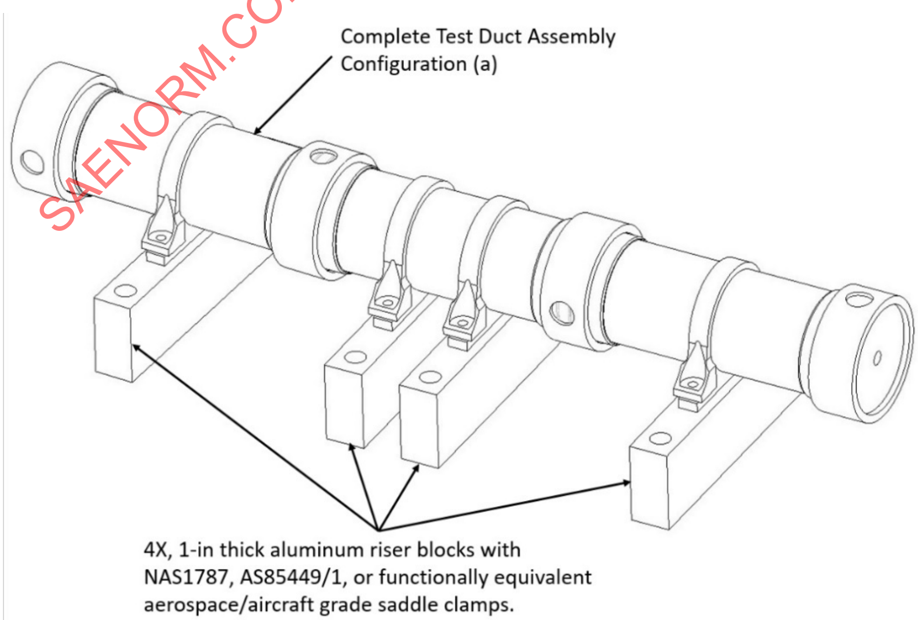


Figure 9 - Life cycle and non-life cycle test fixture

Solid nylon clamp blocks or other aircraft-quality saddle clamps may be substituted where NAS1787 or AS85449/1 does not apply (size 08).

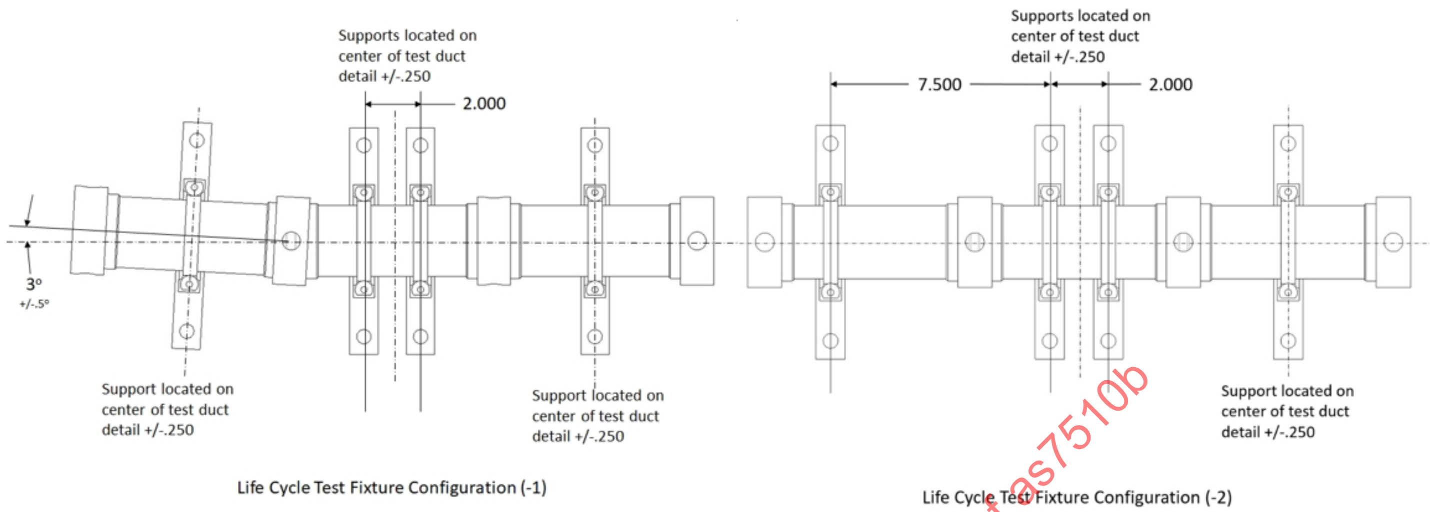


Figure 10 - Life and non-life environmental exposure test fixture configurations (-1) and (-2)

4.4.2 Lightning Strike Test Fixtures

Configuration (-1) to be used with life and non-life environmental exposure test sequences.

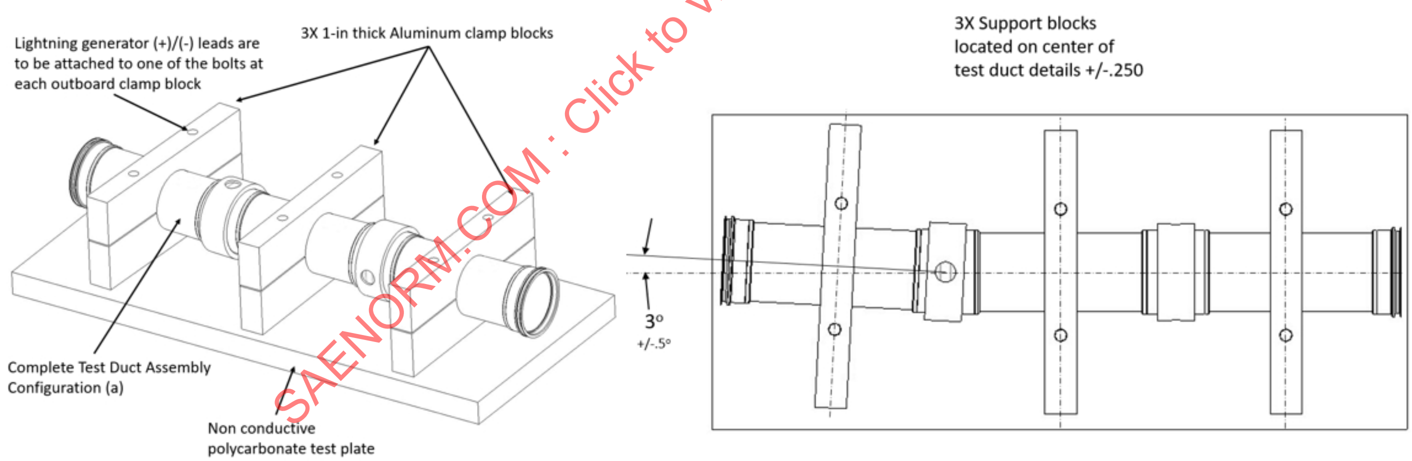


Figure 11 - Lightning strike test fixture, configuration (-1)

Configuration (-2) to be used with fatigue load cycling, pressure impulse fatigue test sequence.

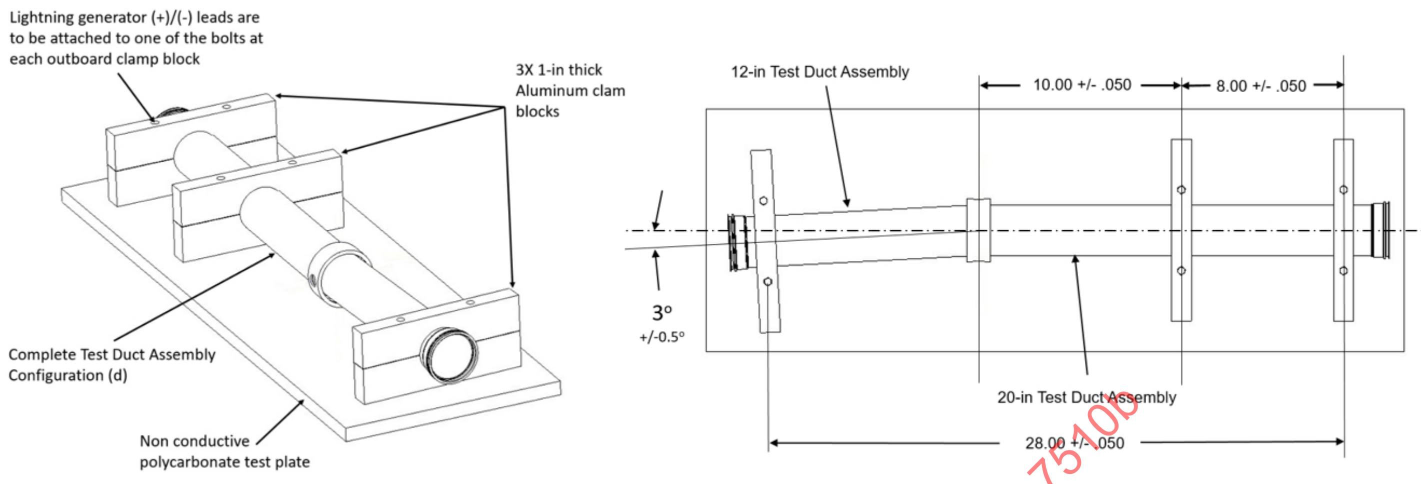


Figure 12 - Lightning strike test fixture, configuration (-2)

4.4.3 Random Vibration and Windmilling Vibration Test Fixture

Solid nylon clamp blocks or other aircraft-quality saddle clamps may be substituted where NAS1787 or AS85449/1 does not apply (size 08).

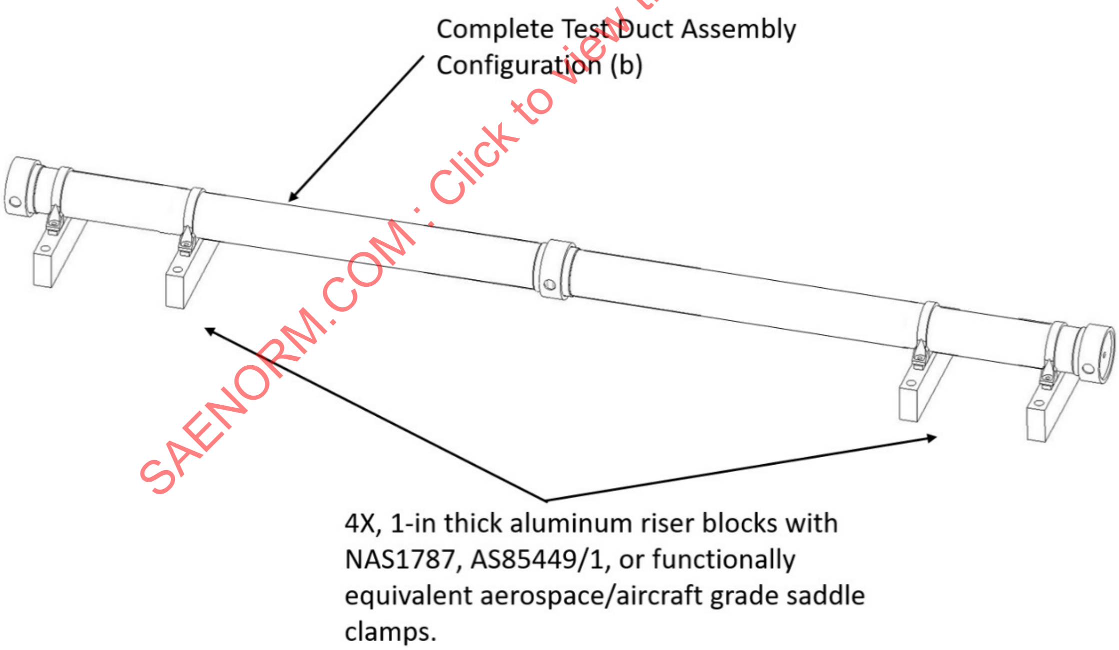


Figure 13 - Random vibration and windmilling vibration test fixture

Dash	Dia	Clamp Spacing A +0.125/-0.000
-08	0.500	20.000
-10	0.625	22.000
-12	0.750	25.000
-16	1.000	27.500
-20	1.250	29.500
-24	1.500	30.500
-28	1.750	31.500
-32	2.000	32.000
-36	2.250	33.000
-40	2.500	34.000
-48	3.000	34.000
-56	3.500	34.000
-64	4.000	34.000

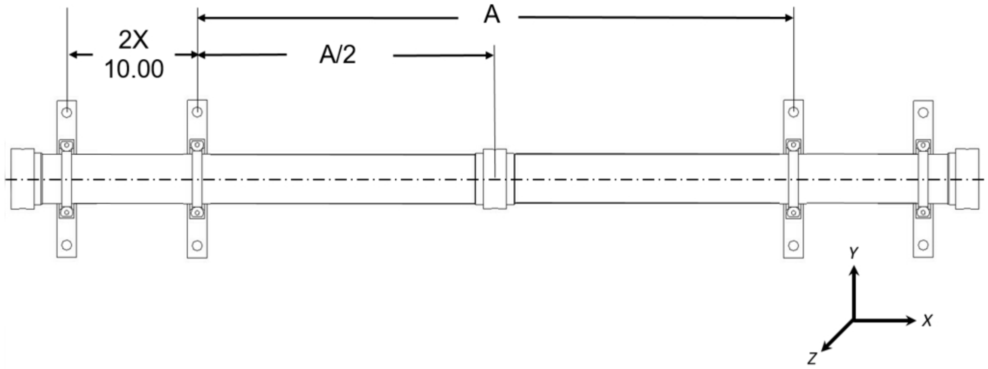


Figure 14 - Random vibration and windmilling vibration test fixture clamp spacing

4.4.4 Static Shear Test Fixture Assembly

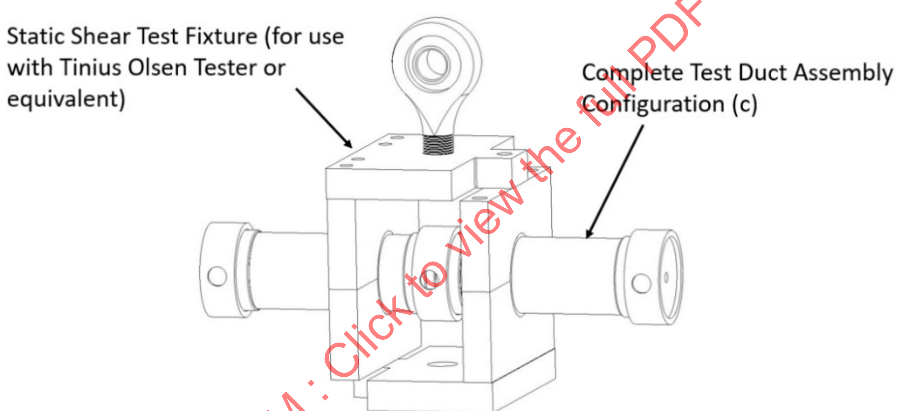


Figure 15 - Static shear test fixture assembly

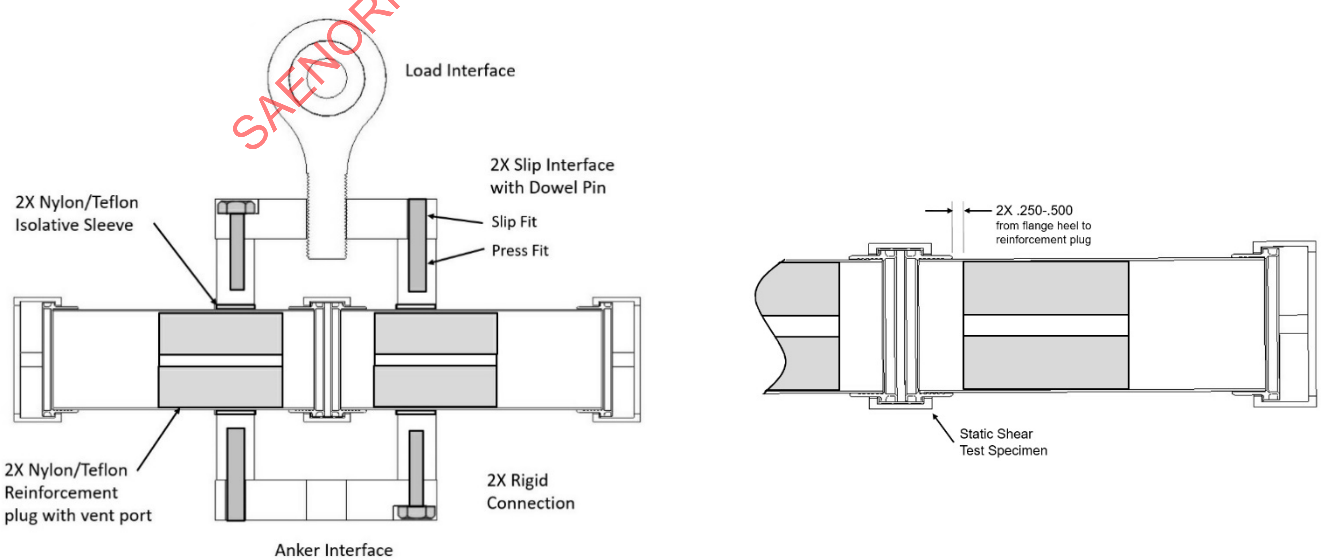


Figure 16 - Static shear test fixture assembly setup

4.4.5 Static Tensile Test Fixture Assembly

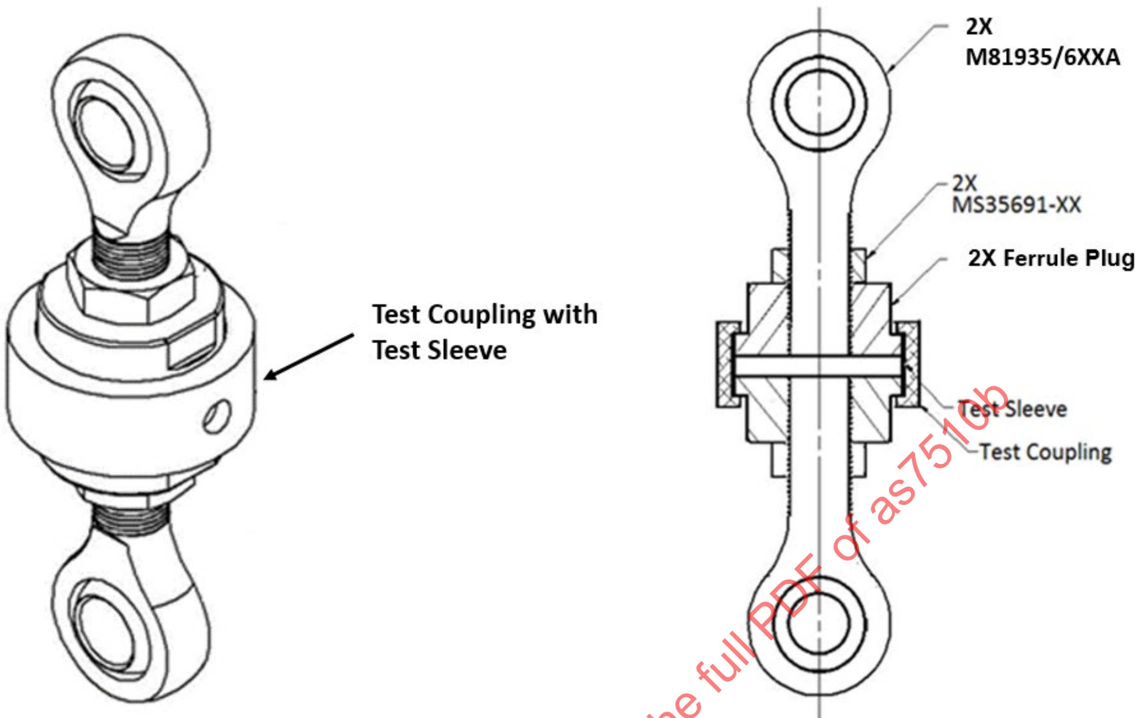


Figure 17 - Static tensile test fixture assembly

4.4.6 Dynamic Shear Test Fixture Assembly

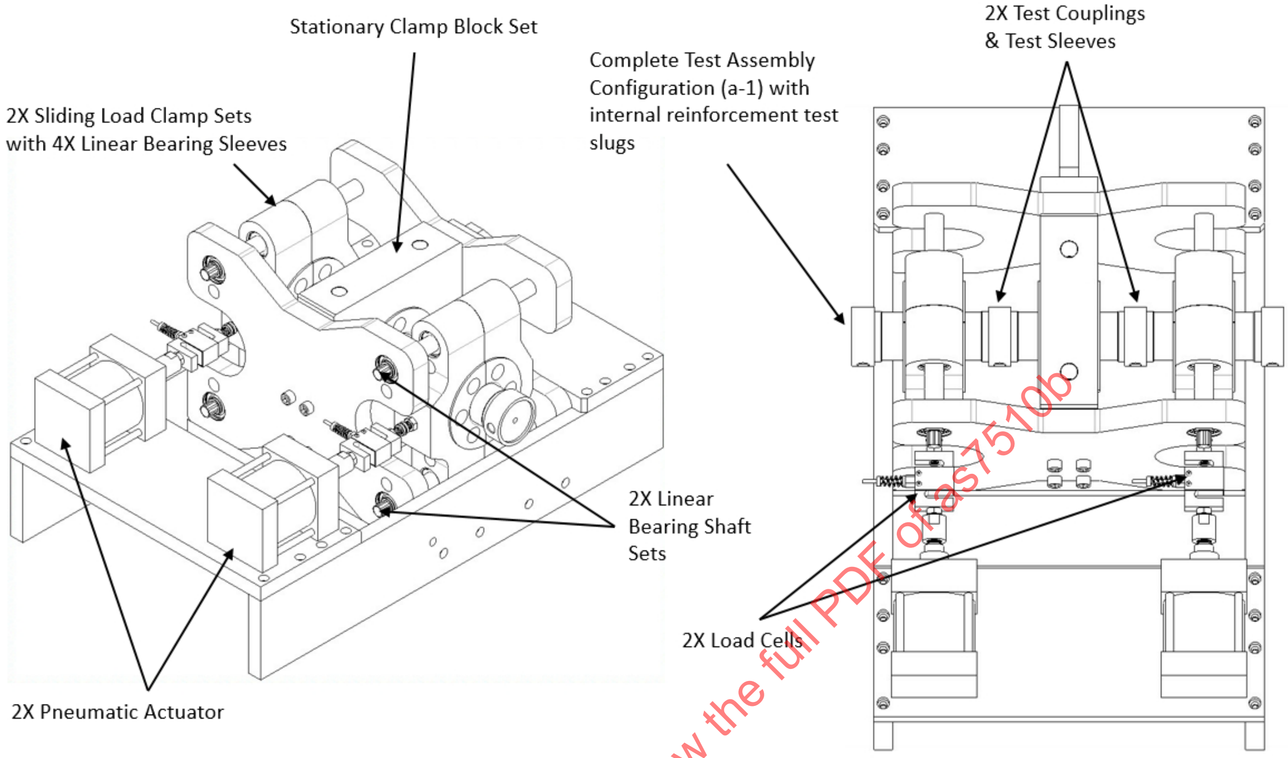


Figure 18 - Dynamic shear test fixture assembly

4.4.7 Pressure Impulse Test Fixture Assembly

Solid nylon clamp blocks or other aircraft-quality saddle clamps may be substituted where NAS1787 or AS85449/1 does not apply (size 08).

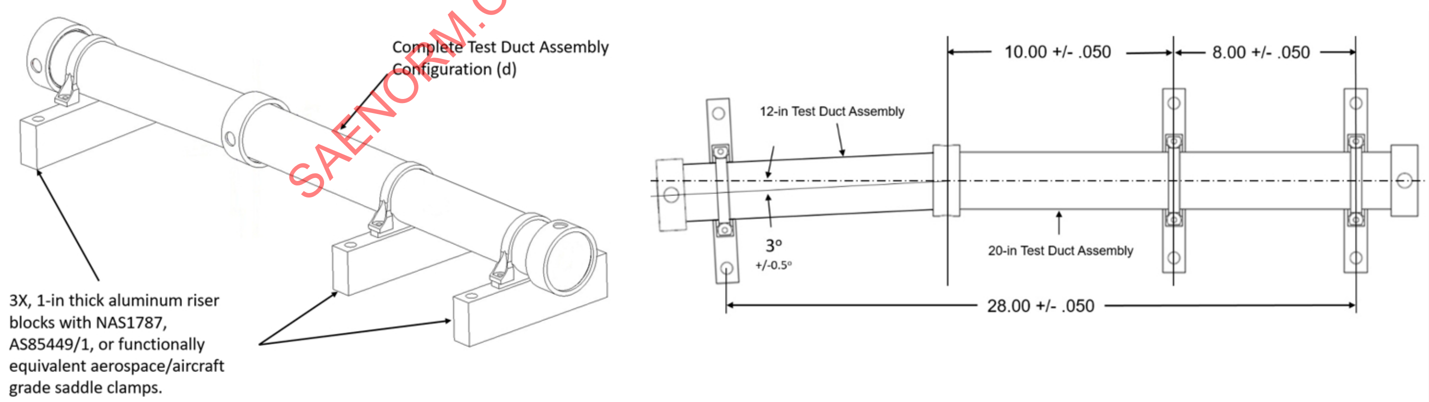


Figure 19 - Pressure impulse test fixture assembly

4.5 Performance Tests

4.5.1 Examination of Product

4.5.1.1 Pre-Testing Examination of Product

Each assembly or part shall be visually and dimensionally inspected to determine compliance with this specification and applicable standard with respect to material, size, and workmanship. Dimensional aspects shall be recorded for each test specimen, assembled coupling components, and each test duct assembly (and subcomponents) in accordance with AS9100 first article inspection report guidance.

4.5.1.2 Post-Test Re-Examination of Product

After all physical testing has been completed, all assembled coupling components shall be evaluated for wear, degradation, and/or physical damage. Evaluation can include but shall not be limited by dimensional measurements of critical features and/or coupling assembly components and their critical features, detailed visual inspection, and non-destructive inspections. All findings shall be recorded and documented with supporting photographic evidence.

4.5.1.3 Periodic Inspection of Test Fixtures

At supplier-defined intervals during testing, all test fixtures shall be visually inspected for signs of damage or wear. Indications of wear or other possible issues may result in additional inspection(s) at the supplier's discretion.

4.5.2 Electrical Bonding

The electrical continuity of the coupling (tube-to-tube and sleeve to each tube), as shown in Figure 20, must be demonstrated with a micro-ohm meter using a maximum test current of 1 A.

Electrical resistance measurement equipment shall be a four-wire type digital micro-ohm meter using a maximum test current of 1 A. It must have a minimum accuracy of ±(25% ± 2.5 μΩ).

For each bonding check, the first reading shall be recorded and then the coupling assembly shall be rotated 180 degrees and a second reading shall also be recorded. The resistance measurement shall not exceed 1.0 Ω for each specimen at the start of qualification testing. The resistance measurement shall not exceed 10.0 Ω at any time during or after subsequent testing.

The complete test assembly may be installed (but not required to be for this test) into the correct test fixture, as required by test sequence details of 4.2.

Electrical bonding testing shall be performed while the VTLI is in the unlatched or removed configuration.

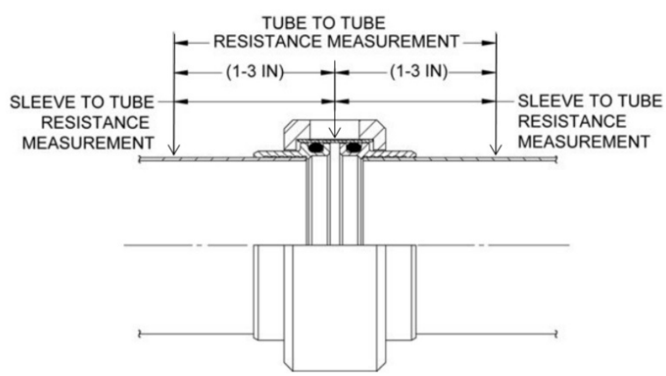


Figure 20 - Electrical bonding setup

4.5.3 Pressure Leakage

Where required, the complete test assembly shall be installed in the appropriate test fixture referenced in 4.2 of this specification and pressurized with dry shop air or bottled nitrogen (no test fluid) to the operating pressure values in Table 3. Once the pressure has been stabilized, it shall be isolated from the pressure source via a stop valve and held at the specified pressure for a minimum of 5 minutes. During this period, the specimens shall show no sign of decrease in pressure or any external sign of permanent deformation that would prevent the equipment from performing its intended function.

Pressure leakage testing shall be performed while the VTLI is in the unlatched or removed configuration.

4.5.4 Proof (Positive and Negative) and Burst Pressure

4.5.4.1 Positive Proof Pressure

Where required by 4.2, complete test assemblies shall be installed in the appropriate test fixture referenced in 4.2 and pressurized with dry shop air or bottled nitrogen (no test fluid) to the proof pressure values in Table 3. Once the pressure has been stabilized, it shall be isolated from the pressure source via a stop valve and held at the specified pressure for a minimum of 5 minutes. During this period, the specimens shall show no sign of decrease in pressure or any external sign of permanent deformation that would prevent the equipment from performing its intended function.

Positive proof pressure testing shall be performed while the VTLI is in the unlatched or removed configuration.

Continuous (dynamic) measurement of resistance values across the coupling, to verify bond path integrity, shall be accomplished from the start of the proof pressure test up to and including the 5-minute dwell period of the testing. The highest electrical resistance across the coupling that occurs during testing, when measured from tube to tube, shall be recorded in the test report and shall not exceed 10 Ω at any time, as defined in 4.5.2 of this specification. Any coupling which does not maintain bond path shall be rejected as a failure.

4.5.4.2 Negative Pneumatic Pressure

Where required by 4.2, complete test assemblies shall be installed, empty of test fluid, in the appropriate test fixture referenced in 4.2 of this specification and subjected to the negative pressure values shown in Table 3. Once the pressure has been stabilized, it shall be isolated from the vacuum pump via a stop valve and held at the specified pressure for a minimum of 5 minutes. During this period, the specimens shall show no sign of increase in pressure or any external sign of permanent deformation that would prevent the equipment from performing its intended function.

Negative proof pressure testing shall be performed while the VTLI is in the unlatched or removed configuration.

4.5.4.3 Burst Pressure

Where required by 4.2, complete test assemblies shall be installed in the appropriate test fixture referenced in 4.2, filled with test fluid per 4.1.2, and pressurized with test fluid to the burst pressure values in Table 3. Once the pressure has been stabilized, it shall be held for a minimum of 1 minute. During this period, the specimens shall show no sign of leakage sufficient to form a detaching drop or any external sign of permanent deformation that would prevent the equipment from performing its intended function.

Burst pressure testing shall be performed while the VTLI is in the unlatched or removed configuration.

Continuous (dynamic) measurement of resistance values across the coupling, to verify bond path integrity, shall be accomplished from the start of the burst pressure test up to and including the 1-minute dwell period of the testing. The highest electrical resistance across the coupling that occurs during testing, when measured from tube to tube, shall be recorded in the test report and shall not exceed 10 Ω at any time, as defined in 4.5.2 of this specification. Any coupling which does not maintain bond path shall be rejected as a failure.

4.5.5 Lightning

The coupling assembly shall be designed to withstand predicted lightning transients over the service life of the coupling without the creation of an ignition source.

The installed coupling assembly shall be designed to be capable of being rotated around the ferrules and sleeve without creating coupling-induced ignition sources below the currents specified in this section.

The coupling assembly shall be designed such that any foreseeable failure conditions shall be addressed within the design and that no foreseeable failure shall affect the ability of the coupling to meet lightning strike performance requirements specified in this section.

Lightning strike testing shall be accomplished in multiple sequences to address new assembled coupling performance and aged/worn/corroded coupling assemblies as specified in the life and non-life environmental exposure and fatigue load cycling (pressure impulse fatigue) test groups in 4.2, Tables 7, 8, and 10.

All lightning testing shall be performed at ambient test conditions in accordance with 4.1.4.

The coupling assembly shall be tested and exhibit no ignition within or across couplings, and no ignition of a flammable gaseous mixture, either internally or externally, when exposed to reduced current Components B and C of ARP5412 while tested in accordance with the requirements of ARP5416, Section 7.

Reduced current Component B shall be a unipolar waveform with a peak amplitude of 400 A (±10%) and a charge transfer of 1 C (±20%) in 5 ms.

Reduced current Component C shall be a unipolar waveform with a current amplitude of 40 A (±10%) and a charge transfer of 20 C (±20%) in 0.5 second (±10%).

For the life and non-life environmental exposure test group, the test setup shall have one specimen providing point contact between the tube ferrule flanges with a 3.0- to 3.5-degree angular misalignment of the ferrule flanges. The remaining specimen shall be mounted with a gap of 0.090 inch (±0.030 inch) with 0 degrees angular misalignment. The complete test assembly shall be supported in the lightning test fixture assembly configuration (-1) in accordance with 4.4.2 of this specification.

For fatigue load cycling, pressure impulse fatigue test group/sequence, the test setup shall have one specimen providing point contact between the tube ferrule flanges with a 3.0-degrees ± 0.5-degree angular misalignment of the ferrule flanges. The complete test assembly shall be supported in the lightning test fixture assembly configuration (-2) in accordance with 4.4.2 of this specification.

Lightning testing shall be performed by placing the required lightning test fixture with a complete test assembly in a test chamber using an ignitable fuel (gas) mixture per ARP5416, Section 7.

Prior to each lightning strike (current pulse), the flow rate of the ignitable fuel (gas) mixture shall be recorded to ensure that the test chamber is filled with enough gas to displace the volume of the chamber at least five times. Ensure that the ignitable fuel mixture is present inside the test specimen tube as well as in the test chamber.

Each specimen shall be subjected to three reduced current Component B and C pulses as defined above. The current values and waveform of each current pulse will be monitored, recorded, and included in the final test report. The ignition of the explosive gas in the test chamber will be monitored. Any ignition of the explosive gas is cause for investigation.

NOTE: Digital or film photography or videography may be used to capture each current pulse event through clear windows in the test chamber (only if present). Although the image is not the ultimate pass or fail criterion, it may be used to assist in the event the gas ignites. If the image can clearly show that the spark/arc occurred off and away from the coupled joint, the test may be dispositioned as inconclusive, and the same specimen may be retested. However, if the image shows no clear spark/arc and evidence of sparking/arcing and/or welding cannot be visually detected on examination of the test specimen, the test sequence will be dispositioned as inconclusive, and a new complete test assembly must be resubjected to the complete test sequence as defined in 4.2 of this specification.

Ignition of the gas mixture with corresponding evidence of arcing and sparking in or around the coupled joint shall constitute a failure.

After each current pulse, the gas mixture shall be ignited by a 200 µJ spark ignition device in accordance with ARP5416. Commanded ignition of the gas mixture shall complete the pass criteria for the complete test assembly for that individual lightning strike. If the gas mixture fails to ignite on command, the test shall be dispositioned inconclusive, and the current pulse must be repeated.

Following each successfully passed current pulse, the spark box shall be opened, and the test specimens shall be lightly articulated to break any weld points that may have occurred. After articulation, the test chamber shall be closed and refilled with an ignitable fuel (gas) mixture, per ARP5416, of sufficient volume to displace the volume of the test chamber at least five times.

4.5.6 Sinusoidal Resonance Survey and Dwell

The coupling assembly shall be designed to perform properly as defined in this specification, without structural failure, deformation, or leakage in accordance with 4.1.3, degradation of the bond path across the coupling, or degradation of lightning strike performance, when exposed to sinusoidal resonance dwell vibration levels as defined in Table 13 of this specification for the dwell times defined in Table 14.

Table 13 - Sinusoidal resonance dwell vibration levels

Frequency	Amplitude or Acceleration Level
5- 14 Hz	0.100-inch double amplitude minimum
14- 24 Hz	±1 G
24- 90 Hz	0.036-inch double amplitude minimum
90-2000 Hz	±15 G

Table 14 - Sinusoidal resonance dwell times

Number of Identified Resonance Frequencies	0	1	2	3	4
Total dwell times at resonance points minimum (minutes)	0	30	60	90	120
Cycling time minimum (minutes)	180	150	120	90	60
Total test time	180	180	180	180	180

The test setup and fixture assembly, life cycle test fixture configuration (-2), as defined in 4.2 and 4.4, shall be filled with test fluid per 4.1.2 and pressurized to the maximum operating pressure of 130 psi, as specified in Table 3, to fully extend the coupling interfaces prior to tightening of clamps.

All vibration testing shall be performed at ambient test conditions in accordance with 4.1.4.

All sinusoidal resonance survey and dwell testing shall be performed in both the y and x axes, as shown in Figure 21.

Sinusoidal resonance survey and dwell testing shall be performed with the VTLI in the unlatched configuration.

Accelerometers rigidly mounted on the test fixture and test specimens shall be used to control input acceleration forces and determine response amplitudes, as shown in Figure 21. The test setup shall have at least two response accelerometers attached to (or as close to) the ferrules of one of test coupling assemblies, to be close to the coupling assembly in line with the vector of motion. At least two control accelerometers shall be attached to the clamp blocks adjacent to the test specimens and shall utilize control channel averaging to establish control input.

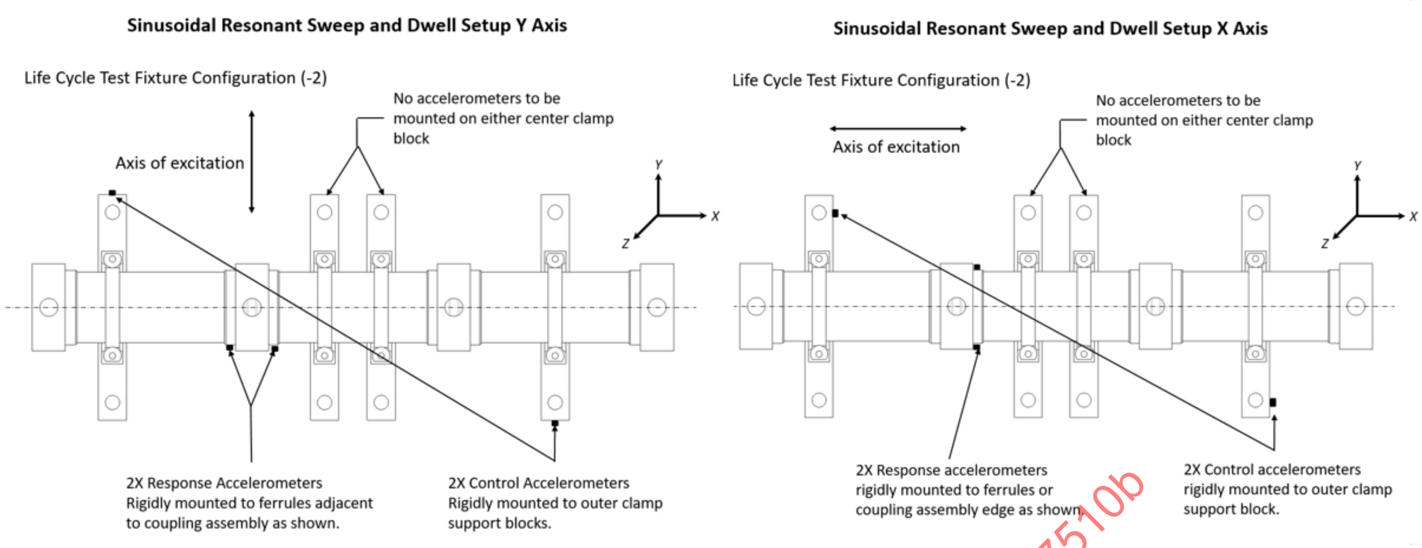


Figure 21 - Sinusoidal resonance survey and dwell test setup

For the sinusoidal resonance survey and dwell vibration tests, the vibration frequency tolerance shall be the greater of ±2% or ±0.5 Hz. Sinusoidal vibration amplitude tolerance shall be ±10%.

The following data shall be recorded and documented for the duration of the testing:

a. Input: Plots of the vibration input spectra and test level.

b. Response: Plots of the vibration response spectra for the test axis and test level.

c. Transmissibility: Frequency response plots of transmissibility (response/input) versus frequency for the equipment response points. Frequencies associated with minimum performance or other frequencies selected for resonance dwell points shall be clearly identified.

d. Chronological report: The report shall contain a clear description of the test being performed and shall include all pertinent information concerning the conduct of test, equipment performance, and identification. Description of failures and/or degradation occurring during the vibration testing shall be fully documented as well as the remedial action taken.

e. A photograph shall be taken of the test specimens in the test fixture, clearly labeled to show the input and response accelerometers and direction of the test axes.

The test coupling assemblies shall be installed in a random rotational orientation of the suppliers' choice and shall be free to rotate from that orientation throughout the test.

To ensure vibration energy is directed on-axis for maximum results, transverse motion relative to the test axis at the input control accelerometers shall be no more than 10% of the total applied vibration.

An initial resonance survey shall be conducted in the axis being tested, as shown in Figure 21, for each complete test assembly specified in 4.2. The resonance survey shall be a logarithmic frequency sweep from 5 to 2000 Hz at a sweep rate not to exceed 1.0 octave per minute. The amplitude shall be 0.024-inch double amplitude minimum or ±2.0 G, whichever is less.

Resonant frequencies shall be noted and recorded with the modes of each resonance described. A resonant frequency is defined by a transmissibility value of two or more. Transmissibility is defined as the ratio of output/input (response/control).

Following the resonance survey, each complete test assembly shall be subjected to frequency cycling and resonance dwells in that same axis. Frequency cycling shall be a logarithmic frequency sweep from 5 to 2000 to 5 Hz, with amplitude levels in accordance with Table 13 at a sweep rate not to exceed 1.0 octave per minute. Frequency cycling with dwells at identified resonance frequencies times shall be in accordance with Table 14 (30-minute dwell at each resonance frequency). If more than four resonance frequencies are identified, only the four frequencies with the greatest transmissibility levels shall be used for resonance dwell.

During resonance dwell, the input frequency shall be periodically retuned or adjusted to ensure maximum response amplitude. The interval between retuning and/or adjustment shall be no more than 5 minutes.

Test coupling assemblies shall not exhibit leaking beyond the limitations of 4.1.3, structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly throughout testing.

4.5.7 High-Temperature Aging

Where required by 4.2, complete test assemblies shall be filled with test fluid and exposed to high-temperature aging. Complete test assemblies shall be placed in a suitable closed chamber heated to a stabilized air temperature of +265 °F minimum (275 °F maximum). Each complete test assembly shall be filled with test fluid and pressurized to maximum operating pressure (130 psig), as defined in Table 3, and heated to a stabilized temperature of +265 °F (-0 °F/+10 °F) for 12 hours.

The test period shall begin after a 1-hour transition period to reach stabilized temperature and pressure. Test coupling assemblies shall not exhibit leaking beyond the limitations of 4.1.3, structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly throughout testing.

4.5.8 Low-Temperature Aging

Where required by 4.2, complete test assemblies shall be filled with test fluid and exposed to low-temperature aging. Complete test assemblies shall be placed in a suitable closed chamber cooled to a stabilized air temperature of -65 °F (-10 °F/+0 °F). Each complete test assembly shall be filled with test fluid and pressurized to maximum operating pressure (130 psig), as defined in Table 3, and cooled to a stabilized temperature of -65 °F (-10 °F/+0 °F) for 8 hours.

The test period shall begin after a 1-hour transition period to reach stabilized temperature and pressure. Test coupling assemblies shall not exhibit leaking beyond the limitations of 4.1.3, structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly throughout testing.

4.5.9 Pressure Impulse Fatigue Testing

Where required by 4.2, complete test assemblies shall be installed into the specified test fixture and subjected to internal pressure impulse testing.

The test setup and fixture assembly, as defined in 4.3.4, Figure 8, and 4.4.7, Figure 19, shall be filled with test fluid per 4.1.2 and pressurized to the maximum operating pressure of 130 psi, as specified in Table 3, to fully extend the coupling interfaces prior to tightening of clamps.

All pressure impulse testing shall be performed at ambient test conditions in accordance with 4.1.4.

For all pressure impulse fatigue testing, test fluid leakage shall not exceed limits specified in 4.1.3.

Test parameters are significantly greater than those actually found in aircraft installations, and, therefore, support clamps may fail during testing. In the event saddle clamps fail, testing shall be paused, and the failed clamp replaced with new. The clamp replacement shall be thoroughly recorded in the test log, being sure to address what clamp failed, when it failed, and the failure mode (to include pictures). A failed clamp does not constitute a test failure.

For the fatigue load cycling test group (pressure impulse fatigue test sequence), complete test assemblies (configuration (d), defined by Figure 8) shall be installed into the pressure impulse test fixture assembly per Figure 19. One of the three tested coupling assemblies shall be rotationally orientated such that the coupling's split plane (the plane defined by passing through the center of the axial centerline of the coupling and parallel to the surface of the coupling halves that are joined by the latching and hinge mechanisms) shall be parallel to the plane of angle formed by the two centerlines of the adjacent test duct assemblies. Another of the three tested coupling assemblies shall have the rotational orientation such that the split plane is perpendicular to the angle formed by the two centerlines of the adjacent test duct assemblies. These two couplings shall be monitored and adjusted to maintain that same rotational orientation through all 100000 cycles. They shall also be identified in a manner as to not get switched or mixed after corrosion testing. It is acceptable to use a rotational restraint, tape, or other. However, the mechanism used to restrain rotational movement through testing shall not impede or affect the load being reacted by the coupling. The third coupling assembly shall be installed in a random rotational orientation of the suppliers' choice and shall be free to rotate from that orientation throughout the test.

The test fixture and complete test assembly shall be plumbed to a pressure supply system capable of achieving the required impulse pressure profile and provide pressure traces to document the pressure impulses.

The test fixture and complete test assembly may be mounted vertically or horizontally.

The impulse profile shall conform to Figure 22. The upper and lower pressure limits are bounded by the gray shaded area. The supplier's pressure impulse traces must fall within this area.

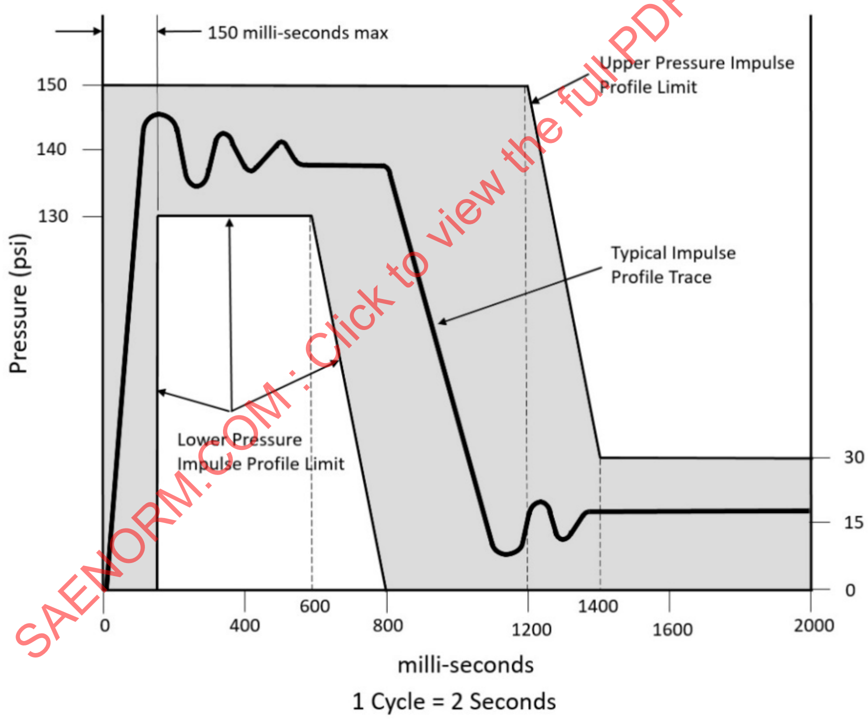


Figure 22 - Pressure impulse profile trace (typical)

For the life cycle environmental exposure test group, complete test assemblies (configuration (a), defined by Figure 4) shall be installed into the life cycle test fixture configuration (-2) per Figure 10. The assembled coupling shall withstand 110000 pressure impulse cycles without evidence of visual yielding (under 10X visual inspection), structural degradation or cracking, or malfunction of any component within the coupling assembly throughout testing.

For the non-life environmental exposure test group, complete test assemblies (configuration [a], defined by Figure 4) shall be installed into the life cycle test fixture configuration (-2) per Figure 10. The assembled coupling shall withstand 165000 pressure impulse cycles without evidence of visual yielding (under 10X visual inspection), structural degradation or cracking, or malfunction of any component within the coupling assembly throughout testing.

For the fatigue load cycling test group (pressure impulse fatigue test sequence), complete test assemblies shall be exposed to two 50000-pressure impulse cycle tests separated by corrosion testing in accordance with 4.5.10. The assembled coupling shall withstand all 100000-pressure impulse cycles without evidence of visual yielding (under 10X visual inspection), structural degradation or cracking, or malfunction of any component within the coupling assembly throughout testing.

NOTE: For the fatigue load cycling test group (pressure impulse fatigue test sequence), it is important to mark and monitor the 10.00-inch dimension during testing. Slippage of the tubes in the saddle clamps will result in an out of tolerance condition for the 3-degree angle.

For both test groups—life and non-life environmental exposure and fatigue load cycling (pressure impulse fatigue test sequence)—the test report shall include a minimum of three pressure traces for each test segment. One at the beginning and end of testing and one at approximately 50% completion.

4.5.10 Corrosion Testing

Where required by 4.2, complete test assemblies shall be subjected to corrosion testing. Test specimens in the fatigue load cycling test group (pressure impulse fatigue test sequence) shall be subjected to one 146-hour period of saltwater immersion corrosion testing followed by a 2-hour dry period.

Complete test assemblies shall be full of test fluid per 4.1.2 and pressurized to the maximum operating pressure (130 psig), as defined in Table 3.

Test specimens shall be immersed in a 5% ± 1% salt solution in accordance with ASTM B117 at 150 °F for a minimum of 146 hours. ASTM B117 does not include temperature/density data to the extent of 150 °F. Therefore, density shall be verified before test at ambient test conditions (68 °F +10 °F/-0 °F).

The complete test assemblies shall then be removed from the saltwater solution and dried by heating in a separate oven for 2 hours in 150 °F air. The oven shall be vented, and forced convection shall not be used.

Following the 2-hour drying time, the complete test assemblies shall be completely rinsed in water compliant to ASTM D1193 Type IV reagent. As much salt residue shall be removed as possible. Use of a soft, non-metallic brush and/or agitation is permitted.

NOTE: Ensure the location for each clamshell is carefully marked on the clamshell and test article so that the clamshells can be reinstalled in their original locations after cleaning.

After all salt solution and residue have been rinsed from the complete test assemblies, a thorough visual inspection shall be performed. The coupling assemblies may be removed for inspection purposes; however, they must be replaced in the identical orientation they were in at the beginning of corrosion testing. Record both in writing and with photographs the location and extent of any surface finish, material, or mechanical degradation caused by the corrosion test.

Following the visual inspection and reassembly of the coupling, perform an electrical bonding check in accordance with 4.5.2.

4.5.11 Repeated Assembly

Where required by 4.2, test specimens shall be installed onto one (optional if left- or right-hand) side of the life cycle test fixture configuration (-2) then unlatched and removed from the ferrules and sleeve, reinstalled, and latched 100 times.

All repeated assembly testing shall be performed at ambient test conditions in accordance with 4.1.4.

The unlatching and latching operations shall include the VTLI device. The ferrules and sleeve shall not be separated during this test.

Test coupling assemblies shall not exhibit structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly throughout testing.

4.5.12 Dynamic Shear Testing

Where required by 4.2, complete coupling assemblies shall be subjected to dynamic shear fatigue testing. The purpose of this test sequence is to validate the fatigue performance of the latching and hinging mechanisms within the coupling assembly. Testing shall include compliant coupling assemblies, and couplings with deactivated hinge components and deactivated latch components.

This test will simulate the load and dynamics of an unsupported 90-degree elbow, as illustrated in Figure 23. Although this routing configuration should be avoided by system designers, it has shown to be applied in both legacy and new aircraft fuel system designs.

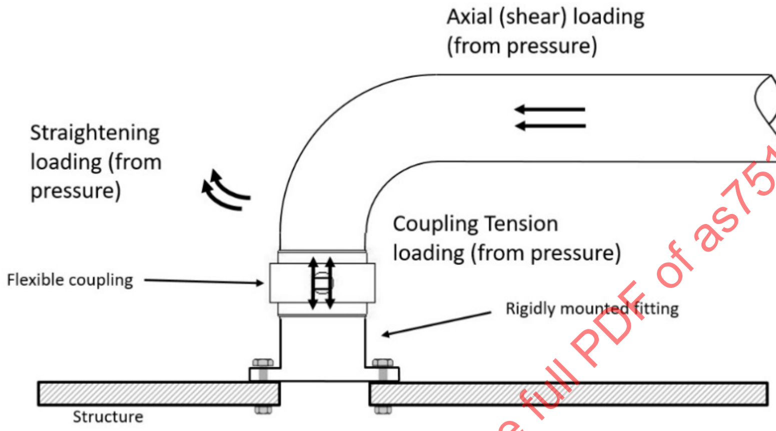


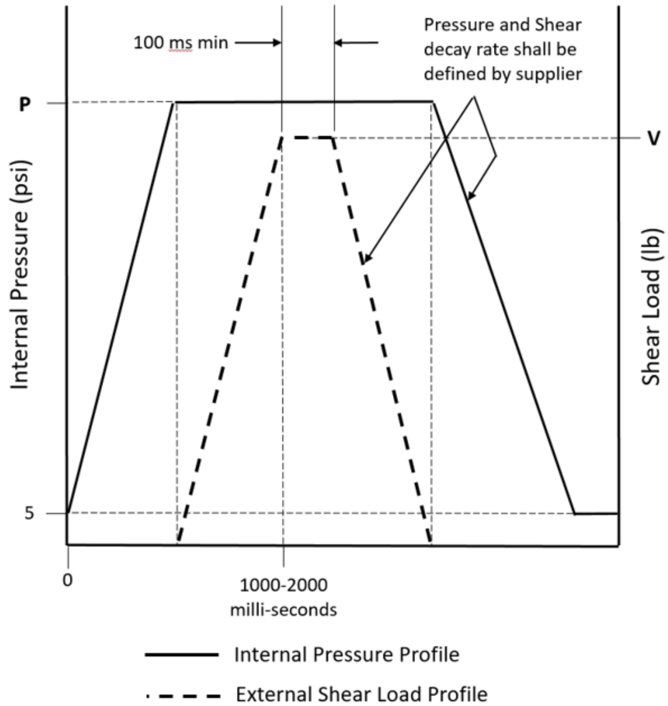
Figure 23 - Unsupported 90-degree elbow loading

The dynamic shear test fixture assembly is designed to simulate the tension and hoop loads caused by the axial component of internal pressure followed by the external shear component of the elbow's straightening and the perpendicular shear (axial) component from internal pressure and the system's subsequent linear movement.

Complete test assemblies, configuration (a) or (a-1), shall be installed into the dynamic shear test fixture assembly and subjected to a sequenced composite load profile with an internal pressure component and an external shear load component. The composite profile is shown in Figure 24.

Complete test assemblies, configuration (a) or (a-1), under the life cycle test sequence shall be subjected to 110000 cycles of dynamic shear load compliant to the composite load profile shown in Figure 24. Test coupling assemblies shall not exhibit leaking beyond the limitations of 4.1.3, structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly throughout testing.

Complete test assemblies, configuration (a) or (a-1), under the fatigue load cycling group, dynamic shear test sequence, shall be subjected to 330000 cycles of dynamic shear load compliant to the composite load profile shown in Figure 24. Test coupling assemblies shall not exhibit leaking beyond the limitations of 4.1.3, structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly throughout testing.



Dash	Dia	Internal Pressure P +8/-0 psig	Shear Load V +3/-2 lb
-08	0.500	122	23
-10	0.625	122	36
-12	0.750	122	51
-16	1.000	122	89
-20	1.250	122	140
-24	1.500	122	201
-28	1.750	122	271
-32	2.000	122	355
-36	2.250	122	461
-40	2.500	122	560
-48	3.000	122	467
-56	3.500	122	467
-64	4.000	122	467

Figure 24 - Dynamic shear test, composite load profile

Composite load profile description: At time t = 0 ms, the internal pressure shall start at 5 (+1/-3) psig. Once the internal pressure stabilizes at 122 (+8/-0) psig, the external shear load component will start and must reach full load V by time t = 1000 ms minimum, 2000 ms maximum. The shear load V must be held within +3/-2 pounds for a minimum of 100 ms. During this 100 ms dwell, the internal pressure must be stabilized to 122 +8/-0 psig. After the 100 ms dwell, the shear load will decay back to zero (-0/+5 pounds) at a supplier-defined rate. Finally, after the shear component has been removed, the internal pressure will decay down to 5 (+1/-3) psig at a supplier-defined rate.

Compliant and deactivated couplings shall not exhibit leaking beyond the limitations of 4.1.3, structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly for a minimum of 330000 complete cycles, as previously described and shown in Figure 24.

All testing shall be performed at ambient test conditions in accordance with 4.1.4.

All testing shall be performed with the VTLI in the unlatched or removed configuration.

Testing cycle rate shall not exceed 40 cpm. Actual cycle rate must be included in the test report.

For testing purposes, the +3/-2 pounds tolerance of Figure 24 shear loads may be adjusted to accommodate adjacent test equipment limitations, provided the resulting tolerance band is more conservative than that specified in Figure 24. For example, an adjusted tolerance band of +10/-0 shall be considered more conservative.

NOTE: For dynamic shear testing only, suppliers may insert structural reinforcing plugs into each tube ID of test configuration (a), as illustrated in Figure 25.

The reinforcing inserts must fit snug against the inner surface of the tubes and be able to adequately support the tubing to prevent tube buckling during dynamic shear testing. Because there are end ferrules installed on the tubes, the reinforcing inserts will have to be able to collapse to clear the ferrules during installation, and then be able to be expanded to provide sufficient tubing reinforcement. Also, the reinforcing inserts must be able to allow test fluid to flow into and fill the test specimens and allow the test article and test specimens to be fully pressurized.

Reinforcing inserts may be constructed from aluminum, Nylon 6/6, or Delrin. Supporting hardware may be steel or other material adequate to maintain structural integrity and functionality.

Reinforcing inserts shall not extend into the swage roller contact area under the ferrules.

For the center tube, one long insert or two shorter inserts may be used. For the outer tubes, one insert may be used and may extend outboard beyond the width of the dynamic load block-set to the end cap ferrule or truncate at the outboard edge of the dynamic load block-set.

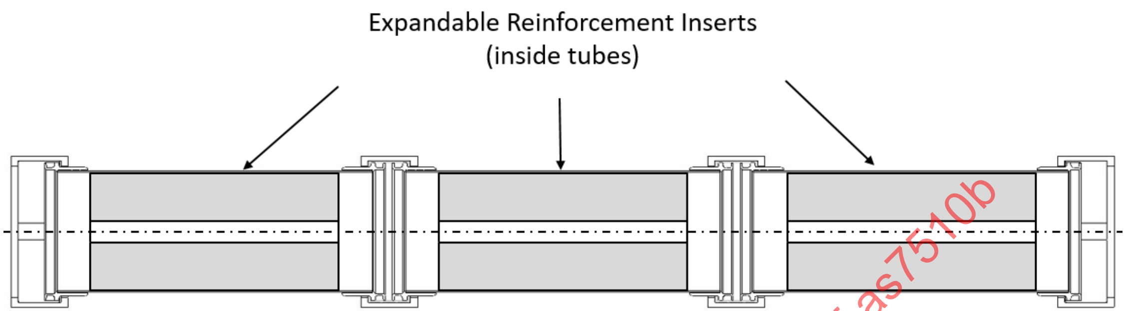


Figure 25 - Dynamic shear test reinforcement insert placement (optional)

Complete test assemblies shall be assembled into the dynamic shear test fixture assembly with one test specimen having the latch oriented at the 12 o'clock position (vertical orientation) and the other test specimen having the latch oriented 90 degrees offset from the latch on the other test specimen (at the 3 o'clock or 9 o'clock position or horizontal orientation).

Loosely install the complete test assembly filled with test fluid into the dynamic shear test fixture assembly and apply an initial 122 (+8/-0 psig) internal pressure and hold. While pressurized, tighten the center static and adjacent dynamic clamp block-sets.

Figure 26 shows an example of a supporting system to drive the dynamic shear test fixture assembly. Figure 26 is for reference purposes only. Suppliers ultimately can use their own perspective system design and equipment that produces a compliant composite load profile shown in Figure 24.

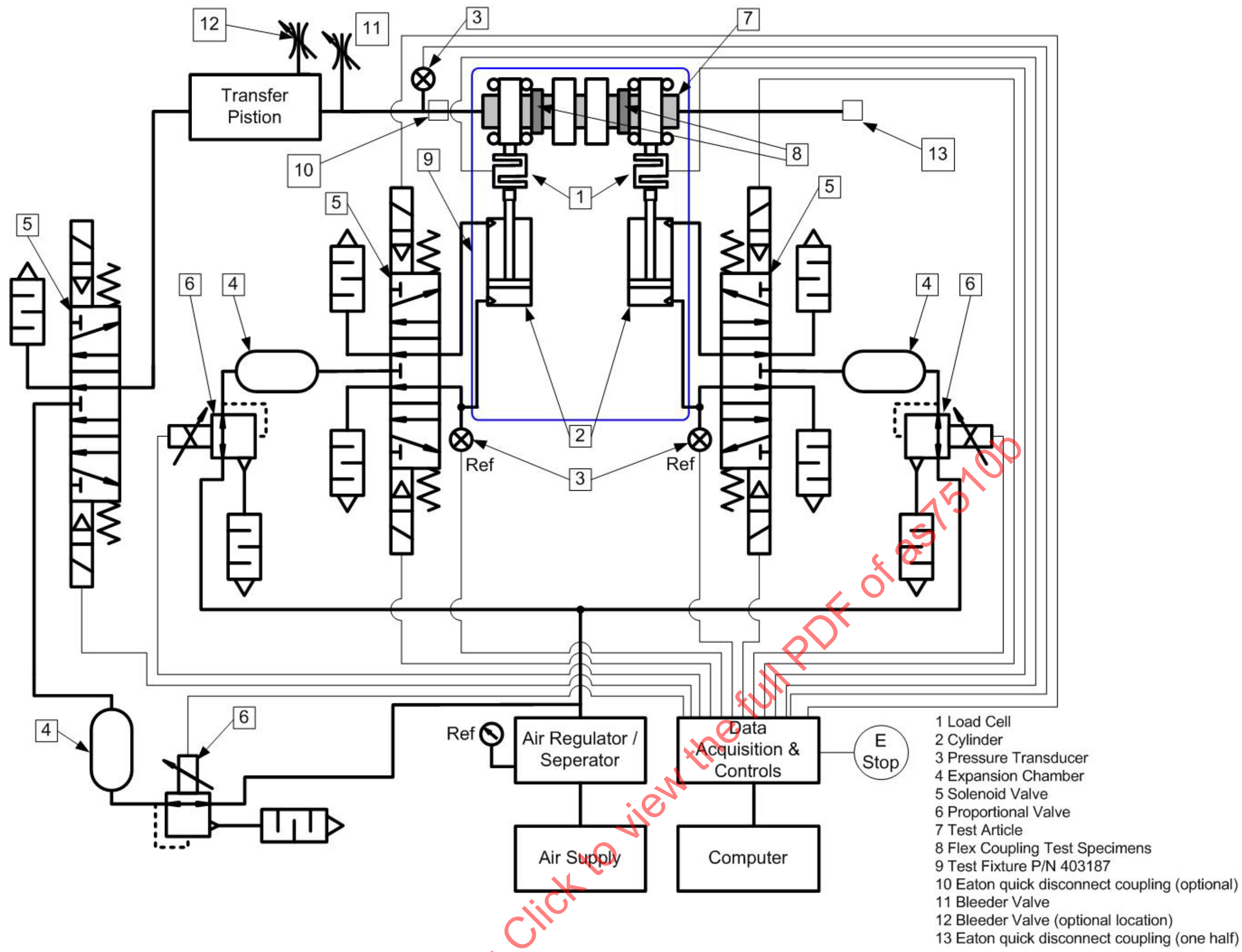


Figure 26 - Dynamic shear system schematic example

NOTE: After testing starts, coupling assemblies shall be free to rotate on their own accord without rotationally reorientation through testing.

The test report shall include composite load traces showing compliance to Figure 24 at the beginning of testing (<100 cycles) and at the end of testing (within last 100 cycles) for each complete test assembly tested. Suppliers are required to demonstrate compliance to Figure 24 throughout testing. Composite load traces are to be taken at supplier-chosen intervals sufficient enough to show low probability of non-compliance to Figure 24 and kept by the suppliers. The report shall only include traces at the beginning and end of testing, as specified.

At the end of testing, if used, carefully remove the reinforcement inserts from the complete test assembly.

4.5.13 Continuous Electrical Bonding

Coupling assemblies shall be designed to maintain continuous electrical conductivity across the coupled joint throughout its life while exposed to distinct vibratory dynamic environments. This shall be validated by monitoring electrical resistance while testing to reduced amplitude random vibration levels that align with typical in-wing service conditions paired with unique system installation configurations.

There are three separate and unique continuous electrical bonding test levels attached to the following test sequences:

1. Life cycle and non-life cycle (see 4.5.13.1).

2. High energy random (see 4.5.13.2).

3. Wide span random and windmilling (see 4.5.13.3).

Electrical resistance measurement equipment shall be a four-wire type digital micro-ohm meter using a maximum test current of 1 A. It must have data acquisition capabilities to support a rate of 1/second minimum and have a minimum accuracy of ±(25% ± 2.5 μΩ).

The following data shall be recorded and documented for the duration of the testing:

a. Input: Plots of the vibration input spectra and test level.

b. Response: Plots of the vibration response spectra for the test axis and test level.

c. Chronological report: The report shall contain a clear description of test being performed and shall include all pertinent information concerning the conduct of test, equipment performance, and identification. Description of failures and/or degradation occurring during the vibration testing shall be fully documented as well as the remedial action taken.

d. A photograph shall be taken of the test specimens in the test fixture, clearly labeled to show the input and response accelerometers and direction of the test axes.

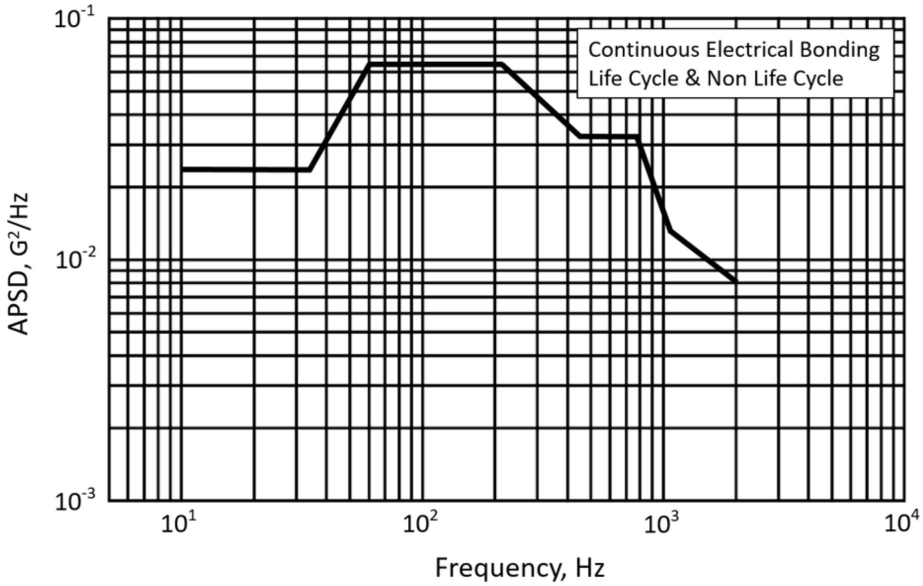
e. Time plots of continuous electrical bonding data for entire test time at a data sampling rate of 1/second minimum for each coupling assembly.

All vibration testing shall be performed at ambient test conditions in accordance with 4.1.4.

Continuous electrical bonding testing shall be performed with the VTLI in the unlatched or removed configuration.

4.5.13.1 Continuous Electrical Bonding - Life Cycle and Non-Life Cycle

Where required by 4.2, complete test assemblies, configuration (a), shall be installed into the life cycle test fixture assembly, configuration (-1), and exposed to 15 minutes minimum per axis of random vibration in both the x and y axes, as shown in Figures 27 and 28. Continuous electrical resistance measurements shall be recorded throughout the duration of testing.



Frequency (Hz)	APSD (G²/Hz)
10	0.024
35	0.024
60	0.064
210	0.064
450	0.032
800	0.032
1100	0.0144
2000	0.008
G(RMS)	**7.0**

Figure 27 - Continuous electrical bonding random vibration spectrum, life cycle and non-life cycle

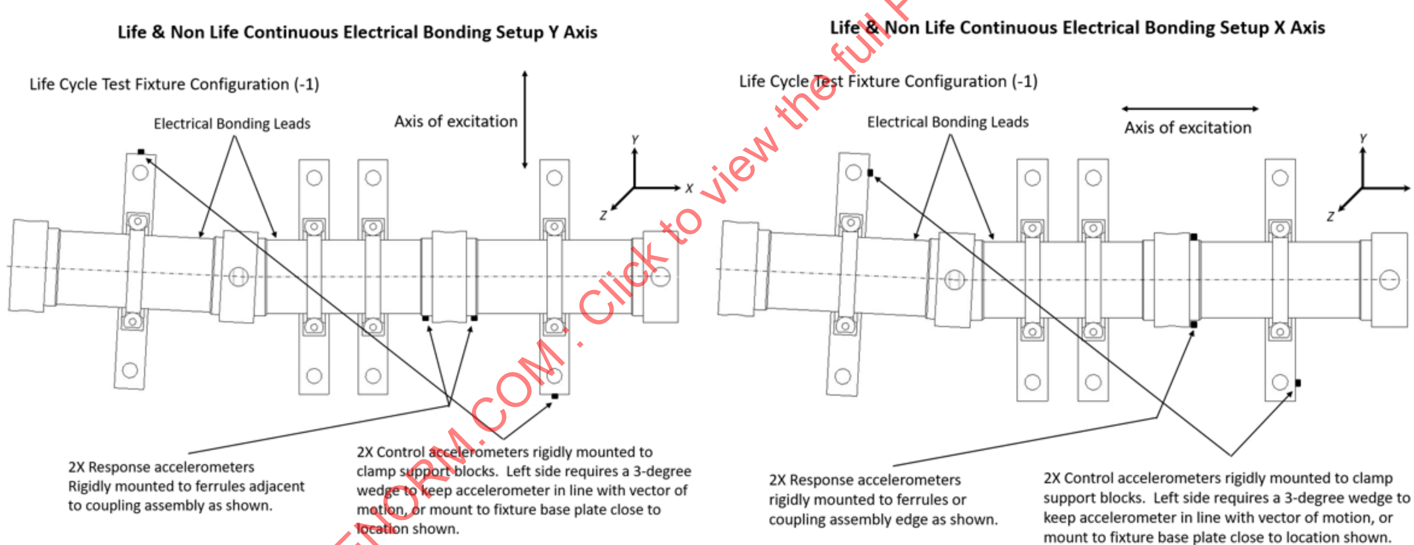


Figure 28 - Continuous electrical bonding test setup, life cycle and non-life cycle

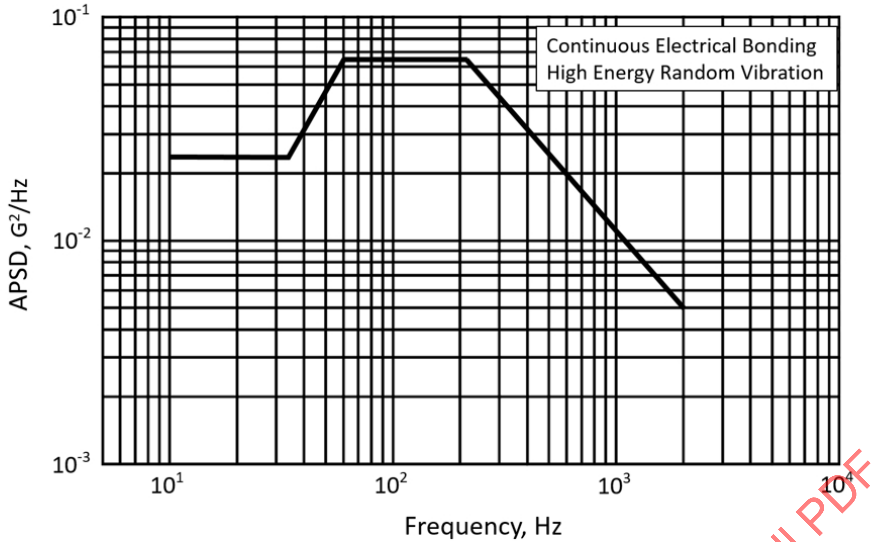
For the first 7.5 minutes, the setup shall conform to Figure 28. Testing shall then be paused, and the two response accelerometers shall be moved from the straight coupling to the adjacent 3-degree coupling installation, and the electrical leads shall be moved to the straight coupling, and testing shall resume for the second 7.5 minutes.

Each 7.5-minute test shall be divided such that 50% of the run time is unpressurized (filled with test fluid) and 50% pressurized to 130 psig (filled with test fluid).

Neither coupling shall show open-circuit conditions or electrical resistance values at any time during test greater than 10 Ω. In addition, couplings shall not exhibit leaking beyond the limitations of 4.1.3, structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly during testing.

4.5.13.2 Continuous Electrical Bonding - High Energy Random Vibration

Where required by 4.2, configuration (a) shall be installed into the life cycle test fixture assembly, configuration (-2), and exposed to 15 minutes minimum per axis of random vibration in the y-axis only (transverse axis), as shown in Figures 29 and 30. Continuous electrical resistance measurements shall be recorded throughout the duration of testing.



Frequency (Hz)	APSD (G^2/Hz)
10	0.024
35	0.024
60	0.064
210	0.064
2000	0.008
G(RMS)	**6.6**

Figure 29 - Continuous electrical bonding random vibration spectrum, high energy random

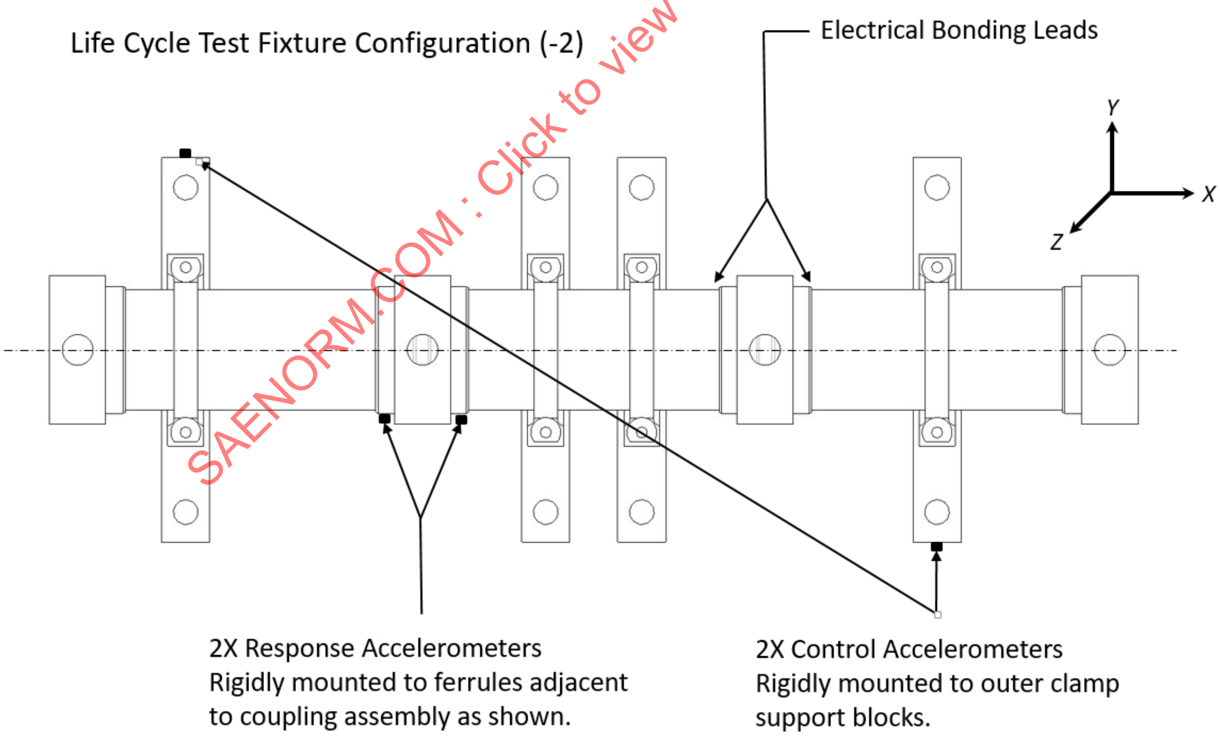


Figure 30 - Continuous electrical bonding test setup, high energy random vibration

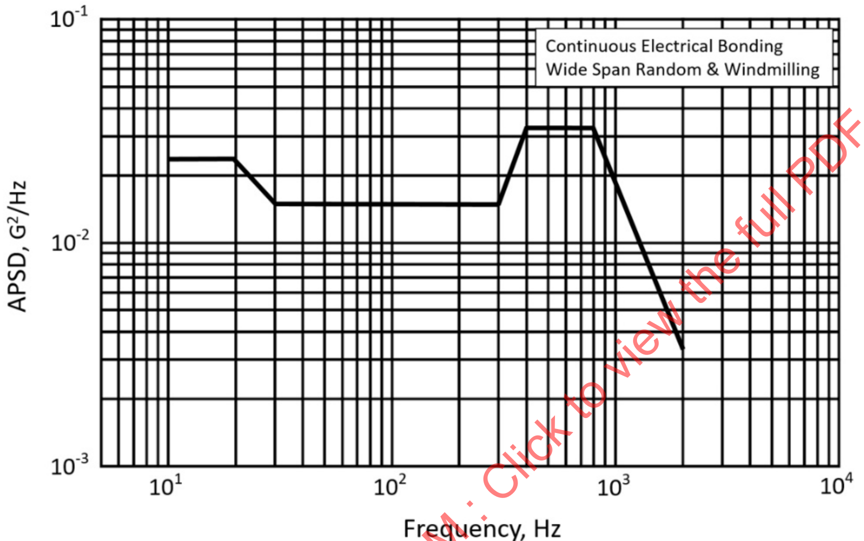
For the first 7.5 minutes, the setup shall conform to Figure 30 where the electrical bonding leads shall be connected across the right-hand side coupling installation. Testing shall then be paused, and the electrical bonding leads shall be moved to the left-hand side coupling installation, and the testing shall resume for the second 7.5 minutes.

Each 7.5-minute test shall be divided such that 50% of the run time is unpressurized (filled with test fluid) and 50% pressurized to 130 psig (filled with test fluid).

Neither coupling shall show open-circuit conditions or electrical resistance values at any time during test greater than 10 Ω. In addition, couplings shall not exhibit leaking beyond the limitations of 4.1.3, structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly during testing.

4.5.13.3 Continuous Electrical Bonding, Wide Span Random and Windmilling

Where required by 4.2, configuration (b) shall be installed into the random vibration and engine blade loss vibration test fixture and exposed to 15 minutes minimum of random vibration in the y-axis (transverse), as shown in Figures 31 and 32. Continuous electrical resistance measurements shall be recorded throughout the duration of testing.



Frequency (Hz)	APSD (G^2/Hz)
10	0.024
20	0.024
30	0.016
300	0.016
400	0.032
800	0.032
2000	0.0032
G(RMS)	**5.7**

Figure 31 - Continuous electrical bonding random vibration spectrum, wide span random and windmilling

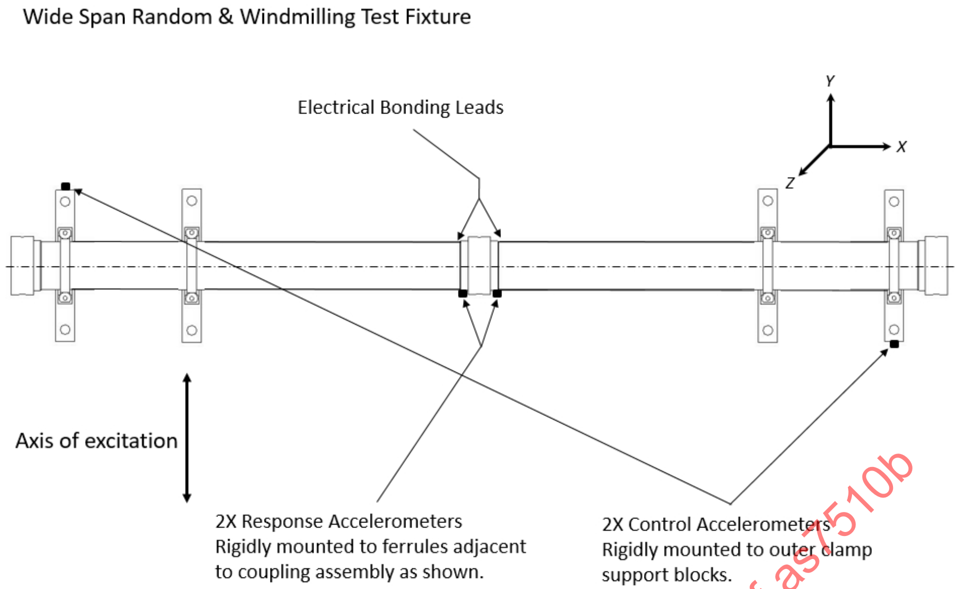


Figure 32 - Continuous electrical bonding test setup, wide span random and windmilling

The test setup shall conform to Figure 32. Testing shall be divided into two 7.5-minute sequences, where one 7.5-minute test is unpressurized (filled with test fluid) and the second is pressurized to 130 psig (filled with test fluid).

The coupling shall not show open-circuit conditions or an electrical resistance value at any time during test greater than 10 Ω. In addition, coupling shall not exhibit leaking beyond the limitations of 4.1.3, structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly during testing.

4.5.14 Random Vibration

Test parameters are significantly greater than those actually found in aircraft installations, and, therefore, supporting saddle clamps may fail during testing. In the event saddle clamps fail, testing shall be paused, and the failed clamp replaced with new. The clamp replacement shall be thoroughly recorded in the test report, being sure to address what clamp failed, when it failed, and the failure mode (to include pictures). A failed clamp does not constitute a test failure.

The following data shall be recorded and documented for all random vibration testing (applicable for both high energy random and wide span random vibration testing):

a. Input: Plots of the vibration input spectra and test level.

b. Response: Plots of the vibration response spectra for the test axis and test level.

c. Transmissibility: Frequency response plots of transmissibility (response/input) versus frequency for the equipment response points. Frequencies associated with minimum performance or other frequencies selected for resonance dwell points shall be clearly identified.

d. Chronological report: The report shall contain a clear description of test being performed and shall include all pertinent information concerning the conduct of test, equipment performance, and identification. Description of failures and/or degradation occurring during the vibration testing shall be fully documented as well as the remedial action taken.

e. A photograph shall be taken of the test specimens in the test fixture, clearly labeled to show the input and response accelerometers and direction of the test axes.

All random vibration testing shall be performed with the VTLI in the unlatched or removed configuration.

To ensure vibration energy is directed on-axis for maximum results, transverse motion relative to the test axis at the input control accelerometers shall be no more than 10% of the total applied vibration.

All random vibration testing shall be performed at ambient test conditions in accordance with 4.1.4.

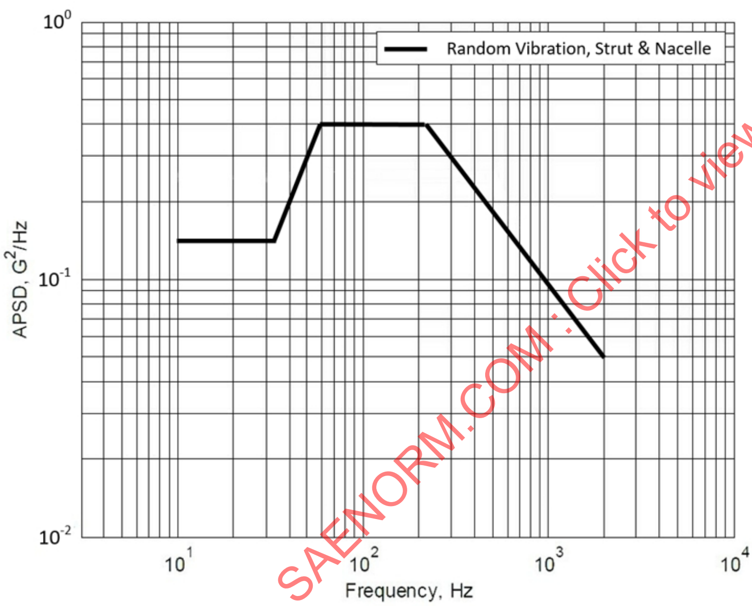
For the random vibration tests, the vibration frequency tolerance shall be the greater of ±2% or ±0.5 Hz. Random vibration amplitude tolerance shall be ±10%.

4.5.14.1 High Energy Random Vibration

Smaller size coupling assemblies (-40 and smaller) shall be designed to withstand high energy random vibration spectra similar to those found on general aircraft strut and nacelle installations. Generally, coupling designs that are qualified in these high energy vibration environments can also be installed throughout other high energy locations in the aircraft.

For this test sequence, sizes -40 and smaller shall be subjected to a 16.6 G_{rms} random vibration test level, as defined in Figure 33.

Where required by 4.2 under standalone vibration test group, high energy random vibration testing, complete test assemblies, configuration (a), shall be installed into the life and non-life environmental exposure test fixture assembly, configuration (-2), in accordance with 4.4.1 and Figure 34.



Frequency (Hz)	PSD (G^2/Hz)
10	0.15
35	
60	0.40
210	
2000	0.05
G (RMS) = 16.6	

Figure 33 - High energy random vibration spectra

Rotational orientation of the two test coupling assemblies is optional and shall not be controlled or constrained during testing.

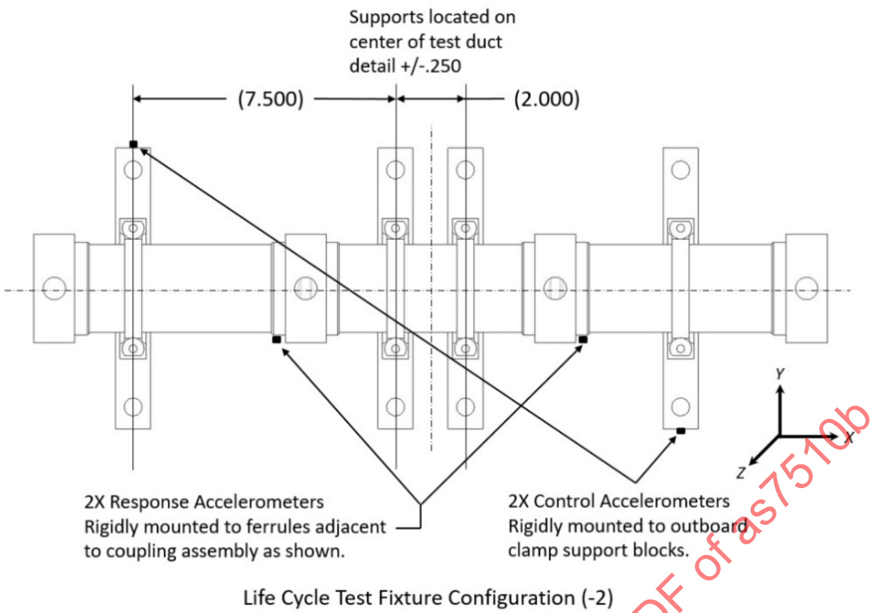


Figure 34 - High energy random vibration test setup

Accelerometers rigidly mounted on the test fixture and test specimen shall be used to control input acceleration forces and determine response amplitudes, as shown in Figure 34. The test setup shall have at least two response accelerometers attached to (or as close to) the ferrules of the test coupling assembly, to be close to the coupling assembly in line with the vector of motion. Two control accelerometers shall be attached to the outboard riser blocks and shall utilize control channel averaging to establish control input.

Complete test assemblies, configuration (a), shall be subjected to a total of 5 hours minimum of high energy random vibration (16.6 G_{rms}) defined by Figure 33 in the y-axis only, as shown in Figure 34. For the first 2.5 hours minimum, complete test assemblies shall be empty of test fluid and unpressurized.

For the final 2.5 hours minimum, complete test assemblies shall be full of test fluid, have all air bled out, and be pressurized to the maximum operating pressure of 130 psig, as specified in Table 3, to fully extend the coupling interfaces prior to tightening of clamps.

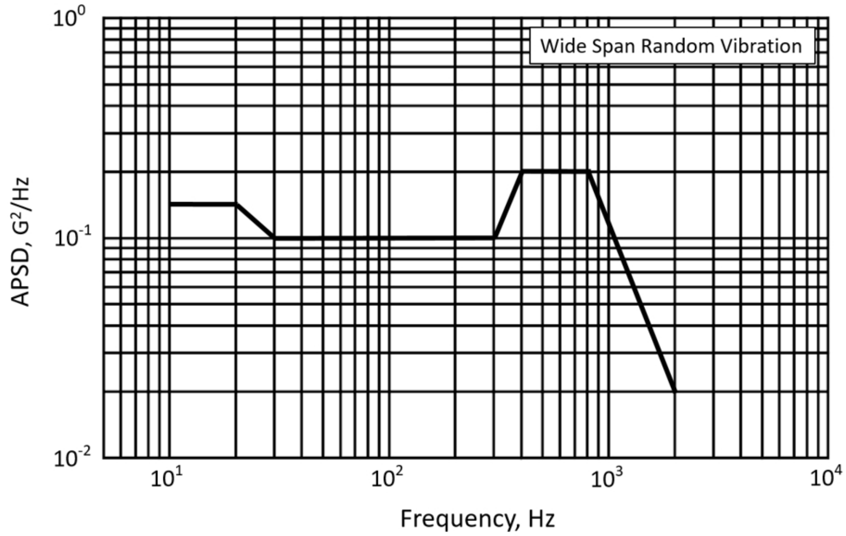
Test coupling assemblies shall not exhibit leaking beyond the limitations of 4.1.3, structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly throughout testing.

4.5.14.2 Wide Span Random Vibration

Coupling assemblies shall be designed to withstand random vibration spectra similar to those found on general aircraft center wing and other wide-span installations. Generally, coupling designs that are qualified in these high energy vibration environments can also be installed throughout other locations in the aircraft.

For this test sequence, coupling assemblies shall be subjected to a 14.3 G_{rms} random vibration test level, as shown in Figure 35.

Where required by 4.2 under standalone vibration test group, wide span random vibration testing, complete test assemblies, configuration (b), shall be installed into the random vibration and engine blade loss vibration test fixture in accordance with 4.4.3 and Figure 36.



Frequency (Hz)	APSD (G²/Hz)
10	0.15
20	0.15
30	0.1
300	0.1
400	0.2
800	0.2
2000	0.02
G(RMS)	**14.3**

Figure 35 - Wide span random vibration spectra

Accelerometers rigidly mounted on the test fixture and test specimens shall be used to control input acceleration forces and determine response amplitudes, as shown in Figure 36. The test setup shall have at least two response accelerometers attached to (or as close to) the ferrules of the test coupling assembly, to be close to the coupling assembly in line with the vector of motion. Two control accelerometers shall be attached to the outboard riser blocks and shall utilize control channel averaging to establish control input.

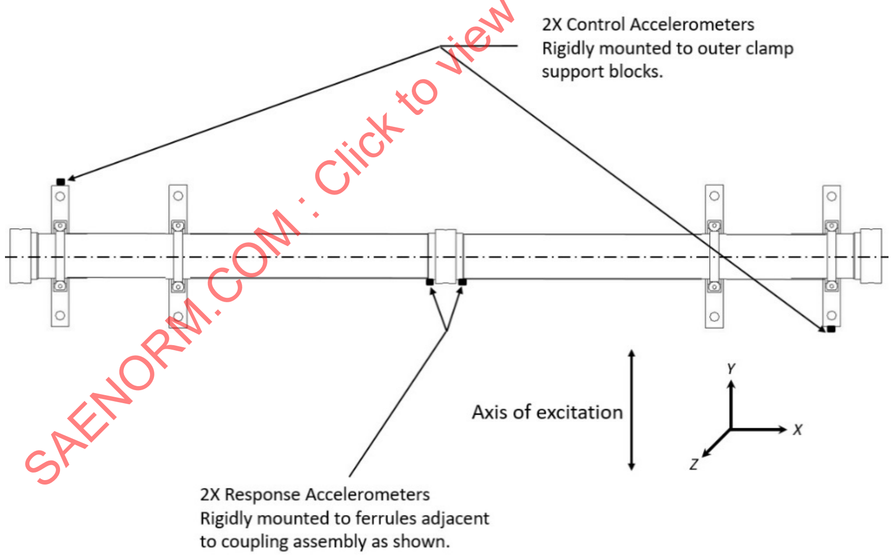


Figure 36 - Wide span random and windmilling vibration test setup

Of the two test coupling assemblies, the first shall be rotationally orientated such that the coupling's split plane (the plane defined by passing through the center of the axial centerline of the coupling and parallel to the surface of the coupling halves that are joined by the latching and hinge mechanisms) shall be parallel to the plane of motion. The second of the two shall have the split plane perpendicular to the plane of motion. The couplings shall not be restrained and allowed to freely rotate throughout wide span random vibration testing.

Complete test assemblies, configuration (b), shall be subjected to a total of 5 hours minimum of wide span random vibration (14.3 G_{rms}) defined by Figure 35 in the y-axis only, as shown in Figure 36. For the first 2.5 hours, complete test assemblies shall be empty of test fluid and unpressurized. Suppliers may combine wide span random and windmilling vibration testing such that following the unfilled and unpressurized random sequence, the test may proceed to windmilling (see 4.5.15.1) to test in the same unfilled and unpressurized state. Following that, the testing shall be picked back up where left off on the wide span random sequence.

For the final 2.5 hours minimum, complete test assemblies shall be full of test fluid, have all air bled out, and be pressurized to the maximum operating pressure of 130 psig, as specified in Table 3, to fully extend the coupling interfaces prior to tightening of clamps. In a similar manner, suppliers may skip sequence and complete windmilling vibration in the filled and pressurized configuration.

Test coupling assemblies shall not exhibit leaking beyond the limitations of 4.1.3, structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly throughout testing.

4.5.15 Windmilling Vibration

Coupling assemblies shall be designed to withstand low-frequency, large-displacement sinusoidal vibrations similar to an engine blade loss event.

Test parameters are significantly greater than those actually found in aircraft installations, and, therefore, support clamps may fail during testing. In the event saddle clamps fail, testing shall be paused, and the failed clamp replaced with new. The clamp replacement shall be thoroughly recorded in the test report, being sure to address what clamp failed, when it failed, and the failure mode (to include pictures). A failed clamp may constitute a test failure, and the test report shall identify implications of the clamp failure on the assembled coupling.

For windmilling vibration tests, the vibration frequency tolerance shall be the greater of ±2% or ±0.5 Hz. Sinusoidal vibration amplitude tolerance shall be ±10%.

The following data shall be recorded and documented for the duration of the testing:

a. Input: Plots of the vibration input spectra and test level.

b. Response: Plots of the vibration response spectra for the test axis and test level.

c. Transmissibility: Frequency response plots of transmissibility (response/input) versus frequency for the equipment response points. Frequencies associated with minimum performance or other frequencies selected for resonance dwell points shall be clearly identified.

d. Chronological report: The report shall contain a clear description of test being performed and shall include all pertinent information concerning the conduct of test, equipment performance, and identification. Description of failures and/or degradation occurring during the vibration testing shall be fully documented as well as the remedial action taken.

e. A photograph shall be taken of the test specimens in the test fixture, clearly labeled to show the input and response accelerometers and direction of the test axes.

All windmilling vibration testing shall be performed at ambient test conditions in accordance with 4.1.4.

Windmilling vibration testing shall be performed with the VTLI in the unlatched or removed configuration.

To ensure vibration energy is directed on-axis for maximum results, transverse motion relative to the test axis at the input control accelerometers shall be no more than 10% of the total applied vibration.

4.5.15.1 Wide Span Windmilling Vibration

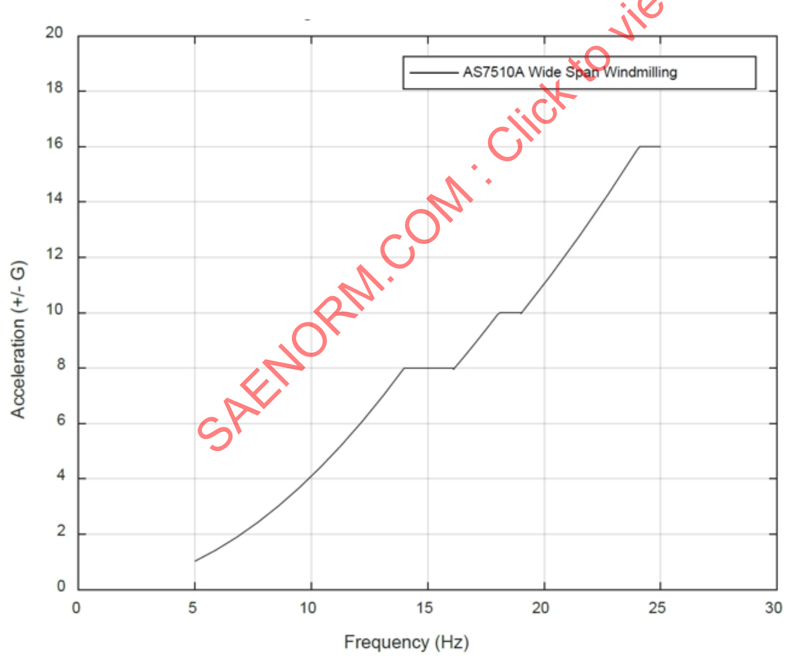
Where required by 4.2, complete test assemblies shall be installed into the random vibration and engine blade loss vibration test fixture in accordance with 4.4.3 and Figure 36. Section 4.4.3 shows the test fixture assembly configuration and minimum distance between support clamps (Dimension A) and coupling placement.

For each size, two complete test assemblies, configuration (b), shall be subjected to the full sinusoidal profile shown in Figure 37 with an upsweep followed by an immediate downsweep. Each complete test assembly shall be subjected to two of these upsweep/downsweep tests. One shall be with the complete test assembly filled with test fluid and pressurized to maximum operating pressure (130 psig), as defined in Table 3, to fully extend the coupling interfaces prior to tightening of clamps. The second will be with the complete test assembly empty and unpressurized (the order of pressurized versus unpressurized is irrelevant).

Accelerometers rigidly mounted on the test fixture and test specimens shall be used to control input acceleration forces and determine response amplitudes, as shown in Figure 36. The test setup shall have at least two response accelerometers attached to (or as close to) the ferrules of the test coupling assembly, to be close to the coupling assembly in line with the vector of motion. Two control accelerometers shall be attached to the outboard riser blocks and shall utilize control channel averaging to establish control input.

Of the two test coupling assemblies, the first shall be rotationally orientated such that the coupling's split plane (the plane defined by passing through the center of the axial centerline of the coupling and parallel to the surface of the coupling halves that are joined by the latching and hinge mechanisms) shall be parallel to the plane of motion. The second of the two shall have the split plane perpendicular to the plane of motion. The couplings shall not be restrained and allowed to freely rotate throughout windmilling vibration testing.

Complete test assemblies shall be exposed to a sinusoidal sweep profile compliant to Figure 37. The sweep shall start at 5 Hz and climb to 25 Hz then fall back to 5 Hz at a rate not to exceed 3 Hz per minute in both the uphill and downhill sweeps.



Frequency (Hz)	Amplitude
5-14	0.8 inch DDA
14-16	+/- 8.0 G
16-18	0.6 inch DDA
18-19	+/- 10 G
19-24	0.54 inch DDA
24-25	+/- 16 G

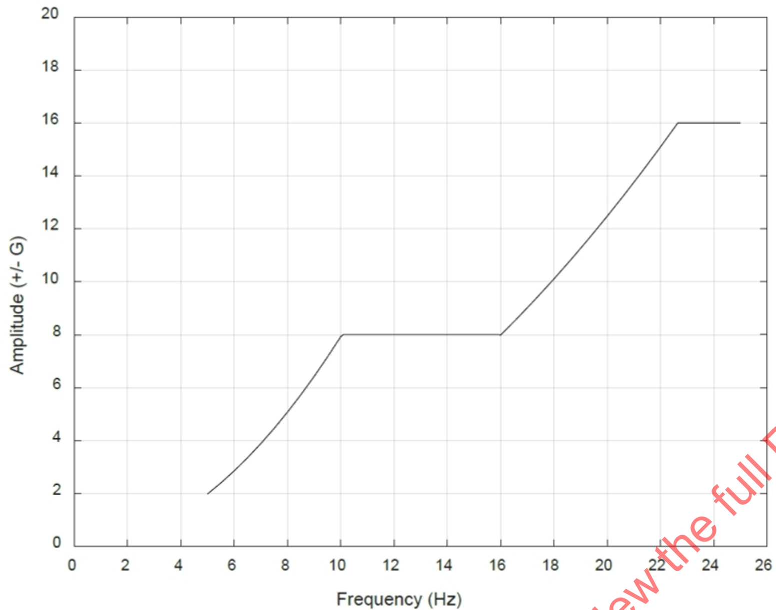
DDA = Double Displacement Amplitude also referred to as Peak to Peak displacement

Figure 37 - Wide span windmilling sinusoidal functionality test level

Test coupling assemblies shall not exhibit leaking beyond the limitations of 4.1.3, structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly throughout testing.

4.5.15.2 Windmilling Functionality

Where required by 4.2, complete test assemblies shall be installed into the life cycle test fixture, configuration (-2), in accordance with Figure 10 and subjected to the full sinusoidal windmilling functionality vibration spectrum shown in Figure 38. Windmilling functionality testing shall be performed in both the y (transverse) and x (axial) axes (see Figure 21) for life and non-life test sequences. Testing shall be performed in only the y (transverse) axis (see Figure 21) for the high energy random test sequence.



Frequency (Hz)	Amplitude
5-10	1.55 inch DDA
10-16	+/- 8.0 G
16-22.6	0.61 inch DDA
22.6-25	+/- 16 G

DDA = Double Displacement Amplitude also referred to as Peak to Peak displacement

Figure 38 - Life cycle, non-life cycle, and high energy random windmilling functionality test level

Each complete test assembly shall be subjected to the full sinusoidal profile shown in Figure 38 with an upsweep followed by an immediate downsweep. Each complete test assembly shall be subjected to two of these upsweep/downsweep tests. One shall be with the complete test assembly filled with test fluid and pressurized to maximum operating pressure (130 psig), as defined in Table 3, prior to tightening of clamps to fully extend coupling interfaces. The second will be with the complete test assembly empty and unpressurized (the order of pressurized versus unpressurized is irrelevant).

Accelerometers rigidly mounted on the test fixture and test specimens shall be used to control input acceleration forces and determine response amplitudes, as shown in Figure 21. The test setup shall have at least two response accelerometers attached to (or as close to) the ferrules of the test coupling assembly, to be close to the coupling assembly in line with the vector of motion. Two control accelerometers shall be attached to the outboard riser blocks and shall utilize control channel averaging to establish control input.

Of the two test coupling assemblies per complete test assembly, one shall be rotationally orientated such that the coupling's split plane (the plane defined by passing through the center of the axial centerline of the coupling and parallel to the surface of the coupling halves that are joined by the latching and hinge mechanisms) shall be parallel to the plane of motion. The second of the two shall have the split plane perpendicular to the plane of motion. The couplings shall not be restrained and allowed to freely rotate throughout windmilling vibration testing.

Complete test assemblies shall be exposed to a sinusoidal sweep profile compliant to Figure 38. The sweep shall start at 5 Hz and climb to 25 Hz then fall back to 5 Hz at a rate not to exceed 3 Hz per minute in both the uphill and downhill sweeps.

Test coupling assemblies shall not exhibit leaking beyond the limitations of 4.1.3, structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly throughout testing.

4.5.16 Static Tensile

Where required by 4.2, assembled couplings shall be installed into the static tensile test fixture assembly, as shown in Figure 39, and subjected to tensile limit and tensile ultimate loads defined in Table 15. Electrical resistance shall be recorded continuously from start of test to finish and shall not at any time exceed 10 Ω.

The coupling assemblies shall be structurally designed to safely sustain the tensile limit loads specified in Table 15, typically associated with internal burst pressures as defined in Table 3, for a period of 3 minutes minimum.

Coupling assemblies shall also be capable of sustaining the tensile ultimate loads defined in Table 15, typically associated with exterior catastrophic forces that may yield the adjacent tubes of the joint in tension, for a period of 30 seconds minimum.

Electrical resistance shall be measured with equipment as required in 4.5.2.

All static tension testing shall be performed at ambient test conditions in accordance with 4.1.4.

All static tension testing shall be performed with the VTLI in the unlatched or removed configuration.

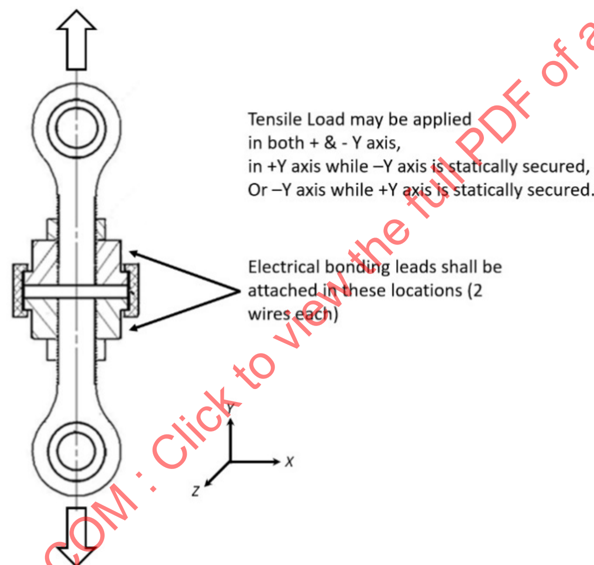


Figure 39 - Static tensile test setup

Table 15 - Static tensile limit and ultimate load requirements

Dash	Dia	Tensional Limit Load (lb) (+10%/-0% lb)	Tensional Ultimate Load (lb) (+10%/-0% lb)
-08	0.500	60	1453
-10	0.625	99	1838
-12	0.750	148	2223
-16	1.000	273	2993
-20	1.250	437	3762
-24	1.500	639	4532
-28	1.750	865	6600
-32	2.000	1141	7562
-36	2.250	1456	8524
-40	2.500	1788	11351
-48	3.000	2605	13660
-56	3.500	3574	15970
-64	4.000	4697	18279

Testing shall start when the applied tensile load is 0 to 5 pounds (pure tensile). The load shall be increased at a rate not to exceed 0.030 in/min until the tensile limit load has been reached. At this point, testing shall pause, and the coupling assembly shall hold this load without visual (unaided eye) structural degradation or visual yielding, cracking, or malfunction of any component within the coupling assembly throughout the tensile limit load dwell of 3 minutes minimum.

After the tensile limit load dwell, the tensile load shall be reduced to zero and the coupling assembly removed for visual inspection. Test coupling assemblies shall not exhibit structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly. Record any and all observations in the test report.

Following tensile limit load dwell inspection, coupling assemblies shall be reinstalled onto the static tensile load test fixture assembly, as illustrated in Figure 39. Ultimate tensile load testing shall start when the applied tensile load is 0 to 5 pounds (pure tensile). The load shall be increased at a rate not to exceed 0.030 in/min until the tensile ultimate load has been reached. At this point, testing shall pause, and the coupling assembly shall hold this load without exceeding 10 Ω electrical resistance and show no visual evidence (unaided eye) of cracking, fracture, or malfunction of any component within the coupling assembly throughout the ultimate load dwell of 30 seconds minimum.

After the tensile ultimate load dwell, the tensile load shall be reduced to zero and the coupling assembly removed for visual inspection. Test coupling assemblies shall not exhibit structural fracture or visual signs (under 10X visual inspection) of cracking of any component within the coupling assembly. Record any and all observations in the test report.

Each test, both limit and ultimate, shall include test load profile traces plotting displacement against time and corresponding load at displacement (double vertical axis with displacement and load with time on horizontal axis).

Each test, both limit and ultimate, shall include the highest electrical resistance measured during test (continuous measurement).

4.5.17 Static Shear

Where required by 4.2, complete test assemblies, configuration (c), shall be installed into the static shear test fixture assembly, as shown in 4.4.4 and Figures 15 and 16, then subjected to shear limit and shear ultimate loads defined in Table 16 in both pressurized and unpressurized configurations. Electrical resistance shall be recorded continuously from start of test to finish and shall not at any time exceed 10 Ω.

Table 16 - Static shear limit and ultimate loads and pressures

Dash	Dia	Shear Limit Load V (lb) (+10%/-0% lb)	Limit Pressure (psi) (+10/-0 psi)	Shear Ultimate Load V (lb) (+10%/-0% lb)	Ultimate Pressure (psi) (+10/-0 psi)
-08	0.500	30	130	55	260
-10	0.625	45		85	
-12	0.750	60		115	
-16	1.000	105		205	
-20	1.250	160		320	
-24	1.500	230		460	
-28	1.750	315		630	
-32	2.000	410		820	
-36	2.250	525		1050	
-40	2.500	640		1280	
-48	3.000	920		1840	
-56	3.500	1255		2505	
-64	4.000	1270		2541	

The coupling assemblies shall be structurally designed to safely sustain the shear limit loads while pressurized and unpressurized, as specified in Table 16, typically associated with internal burst pressures, as defined in Table 3, for a period of 3 minutes minimum.

Coupling assemblies shall also be capable of sustaining the shear ultimate loads while pressurized and unpressurized, as defined in Table 16, typically associated with exterior catastrophic forces that may yield the adjacent tubes of the joint in shear, for a period of 30 seconds minimum.

Electrical resistance shall be measured with equipment as required in 4.5.2.

All static shear testing shall be performed at ambient test conditions in accordance with 4.1.4.

All static shear testing shall be performed with the VTLI in the unlatched or removed configuration.

Complete test assemblies shall be filled with test fluid and installed into the static shear test fixture assembly, as shown in 4.4.4, Figures 15 and 16. Micro-ohm meter leads shall be attached to the complete test assembly, as shown in Figure 20. Prior to tightening of clamp blocks, complete test assemblies shall be pressurized to the maximum operating pressure of 130 psig, as specified in Table 3, to fully extend the coupling interfaces.

Leakage limits of 4.1.3 do not apply to static shear testing. Test cells are allowed to leak at whatever rate they will, provided internal pressure requirements are met. No-pressure testing does not adequately energize the seal to retain test fluid. Additionally, limit and ultimate loading subjects the sealing interfaces to contact angles beyond design intent. The purpose of this test is to validate the structural integrity of the coupling assembly in a pure shear load environment.

The test procedure shall be as follows:

a. Reduce the internal pressure to 0 psi. The rotational orientation of the coupling shall first have the coupling split plane (the plane defined by passing through the center of the axial centerline of the coupling and parallel to the surface of the coupling halves that are joined by the latching and hinge mechanisms) horizontal, as shown in Figure 40. Test sequence begins when the applied shear load is 0 to 5 pounds pure shear while the complete test assembly is filled with test fluid and no internal pressure. Shear load shall be applied at a rate not to exceed 0.030 in/min until the shear limit load has been reached. At this point, testing shall pause, and the coupling assembly shall hold this load without electrical resistance above 10 Ω, visual (unaided eye) structural degradation or visual yielding, cracking, or malfunction of any component within the coupling assembly throughout the shear limit load dwell of 3 minutes minimum.

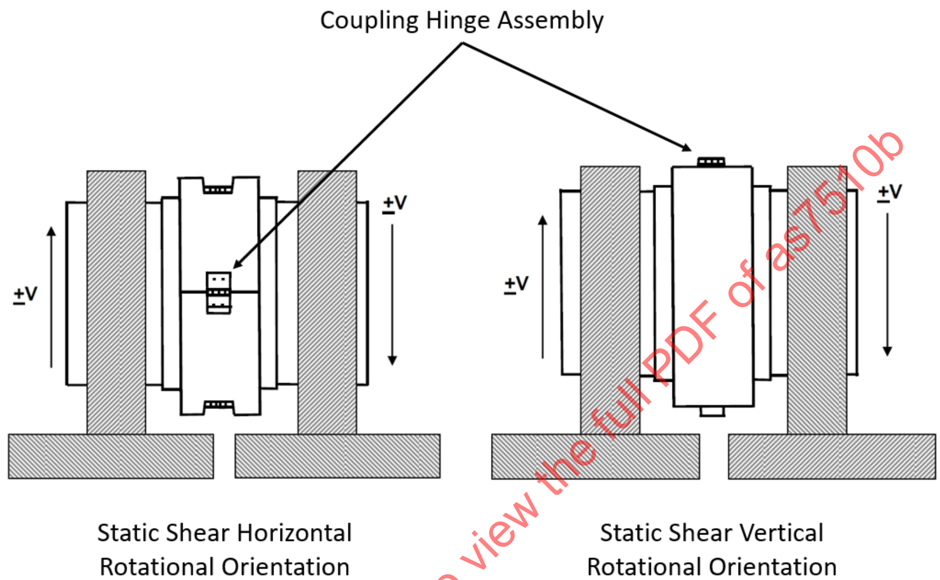


Figure 40 - Static shear coupling rotational orientation

b. After the unpressurized shear limit load dwell, the applied load shall be reduced to zero and the coupling assembly visually inspected for any signs of damage and/or malfunction. Test coupling assemblies shall not exhibit structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly. Record any and all observations in the test report.

c. The coupling assembly shall be reinstalled and rotated such that the coupling split plane is in the vertical orientation, as shown in Figure 40, and unpressurized shear limit load test repeated (steps a and b).

d. On completion of shear limit load testing in the unpressurized configuration in both horizontal and vertical orientations, the entire shear limit load sequence (steps a through c) shall be repeated while the complete test assembly is pressurized to the limit pressure shown in Table 16.

e. Using the same coupling assembly, reduce the internal pressure to 0 psi. The rotational orientation of the coupling shall first have the coupling split plane (the plane defined by passing through the center of the axial centerline of the coupling and parallel to the surface of the coupling halves that are joined by the latching and hinge mechanisms) horizontal, as shown in Figure 40. Test sequence begins when the applied shear load is 0 to 5 pounds pure shear while the complete test assembly is filled with test fluid and no internal pressure. Shear load shall be applied at a rate not to exceed 0.030 in/min until the shear ultimate load has been reached. At this point, testing shall pause, and the coupling assembly shall hold this load without electrical resistance above 10 Ω, visual (unaided eye) structural degradation or visual yielding, cracking, or malfunction of any component within the coupling assembly throughout the shear ultimate load dwell of 30 seconds minimum.

f. After the unpressurized shear ultimate load dwell, the applied load shall be reduced to zero and the coupling assembly visually inspected for any signs of damage and/or malfunction. Test coupling assemblies shall not exhibit structural degradation or visual yielding (under 10X visual inspection), cracking, or malfunction of any component within the coupling assembly. Record any and all observations in the test report.

g. The coupling assembly shall be reinstalled and rotated such that the coupling split plane is in the vertical orientation, as shown in Figure 40, and unpressurized shear ultimate load test repeated (steps e and f).

h. On completion of shear ultimate load testing in the unpressurized configuration in both horizontal and vertical orientations, the entire ultimate load sequence (steps e through g) shall be repeated while the complete test assembly is pressurized to the ultimate pressure shown in Table 16.

Each test, both limit and ultimate, pressurized and unpressurized, shall include test load profile traces plotting displacement against time and corresponding load at displacement (double vertical axis with displacement and load with time on horizontal axis).

Each test, both limit and ultimate, pressurized and unpressurized, shall include the highest electrical resistance measured during test (continuous measurement).

4.6 Qualification Test Report

Suppliers' qualification test reports should align with the guidelines of MIL-HDBK-831. Paper-submitted copies shall be in accordance with MIL-HDBK-831 Section 5 where applicable. Submitted electronic copies shall apply the guidelines where applicable and should be submitted in a non-editable electronic format (e.g., PDF).

Specifically, a supplier's qualification test documentation should include, but may not be limited by, the following:

a. Abstract and/or scope shall contain an intent statement(s) and full description of what's included in the document. In addition, the identification of the agency responsible for the test report with the name or title and address of a point of contact person or persons who can provide technical information or answer questions concerning the testing and the report.

b. Table of contents to include appendices and glossary if applicable.

c. A complete requirements compliance matrix that identifies every requirement of this specification with corresponding method of compliance (qualification by analysis, qualification by demonstration/design, qualification by test) with a qualification test report section.

d. Full (forward and backward) traceability of qualification test assemblies. Forward traceability shall include complete test assembly configuration and supplier-assigned serialization with corresponding designation to a specific test group and test sequence with final disposition of each serialized complete test assembly (pass, fail, or omitted with detailed rationale). Backward traceability shall include full AS9100 FAI reports for the top-level complete test assembly showing compliance to the requirements of Appendix A. Include each subcomponent of the coupling assembly and its FAI report to include material certification.

e. Full FAI reports for every test fixture assembly including detail subcomponents with material certification showing full compliance to the requirements of Appendix B.

f. Qualification by analysis section that includes detailed narratives on coupling assembly design features that assist in showing compliance to:

1. FAR 25.603 - Materials

(a) Dissimilar metals and galvanic analysis.

2. FAR 25.605 - Fabrication Methods

3. FAR 25.613 - Material Strength Properties and Material Design Values

(a) Materials for structural components where their functionality is not protected by redundant components or features shall be listed by material and temper within MMPDS.

4. FAR 25.901 - Installation

5. FAR 25.981 - Fuel Tank Ignition Prevention

(a) Redundant electrical bond pathways.

(b) Redundant structural components.

6. Fungus Resistance

Qualification by analysis may also include DFMEA, process failure mode and effects analysis (PFMEA), finite element analysis (FEA), FTA, and other information the supplier feels adequate and/or required to demonstrate compliance with (a) through (f). Also refer to applicable FAA ACs for compliance guidance as/if necessary.

g. Each and every physical test for each complete test assembly shall be fully documented to include:

1. Pictorial description (with labels as necessary) that fully describes each test setup with corresponding complete test assembly and/or test coupling assembly installed. Photographs should include all test support equipment and general description of specific test area.

2. Complete and detailed test report to include specific test, date, test technician, and location. Test report entries shall be as periodic as necessary to document all details of testing.

3. Full disclosure and identification (company and physical address of actual test location) of the agency responsible for each test with the name and title of a point of contact person or persons who can provide technical information or answer questions concerning the testing and the specific test report section.

4. Actual measured quantitative data shall be recorded. Any revisions or deletions shall be done by crossing out the original data, not erasing it, so that it is still legible. Revisions or deletions should be signed and dated by the person making the changes. Calculated data shall be presented with the formula used for calculation and with the identification of all terms.

5. The identification of all test support and measuring equipment with copies of current calibration certification with the next date of calibration.

6. Test requirements and actual test conditions and results for each test; temperature, pressure, total cycles, voltage, current, resistance values, etc.

7. Quality assurance verified critical to quality attributes of the test setup and or test fixture assembly shown in 4.3.

8. Any and all additional test data requirements specified in 4.5 (by test).

h. Final examination of test hardware to include description of the wear, weld marks, and damage to each test specimen with photographic records of all test specimens following all testing.

i. Any test specimens that did not meet the performance requirements shall be included in a list of failures with complete documented failure mode and root cause(s) with subsequent corrective action(s) (FRACA).

j. All test specimens subjected to qualification testing shall not be shipped as part of a contract or order and shall be retained by the supplier for a minimum of 3 years after the manufacturer has been listed on the PRI QPL.

5. PREPARATION FOR DELIVERY

5.1 Packaging

All parts and assemblies shall be packaged as necessary to prevent damage, corrosion, or deterioration during shipment or storage.

5.2 Marking

Interior and exterior containers shall be marked in accordance with MIL-STD-129 and AS478.

5.2.1 Packaging Identification

The date of packaging shall be marked on all interior and exterior containers.

6. NOTES

The parts and assemblies described in this specification are intended for joining tubing in aircraft fuel, vent, or other fluid systems where the designed operating pressure, temperature, electrical resistance, and lightning protection levels of the assembled coupling are within the requirements of this specification. Aluminum alloy clamshell bodies, sleeves, and ferrules are intended for use with aluminum alloy tubing systems in temperatures up to 265 °F maximum.

6.1 Ordering Data

The procurement documents should specify:

a. Title and number of this specification.

b. The applicable “AS” part number.

c. Size.

d. Data requirements (see 3.1.9).

e. Applicable packaging and identification (see 5.1 and 5.2) and any special packaging features requested.

6.2 Revision Indicator

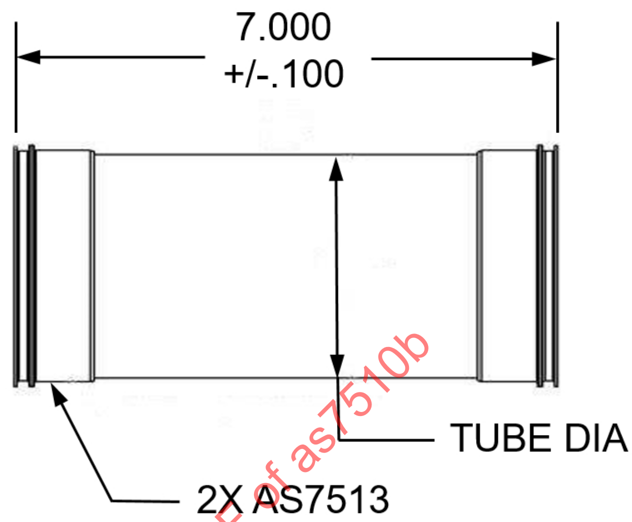
A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY SAE G-3, AEROSPACE COUPLINGS, FITTINGS, HOSE, TUBING ASSEMBLIES COMMITTEE

APPENDIX A - COMPLETE TEST ASSEMBLY DETAIL COMPONENT DEFINITION

A.1 CONFIGURATION (A) AND (C) TEST DUCT ASSEMBLY DETAIL

Dash	Dia	Tube Wall
-08	0.500	0.028
-10	0.625	0.028
-12	0.750	0.028
-16	1.000	0.028
-20	1.250	0.028
-24	1.500	0.028
-28	1.750	0.035
-32	2.000	0.035
-36	2.250	0.035
-40	2.500	0.042/0.049
-48	3.000	0.042/0.049
-56	3.500	0.042/0.049
-64	4.000	0.042/0.049

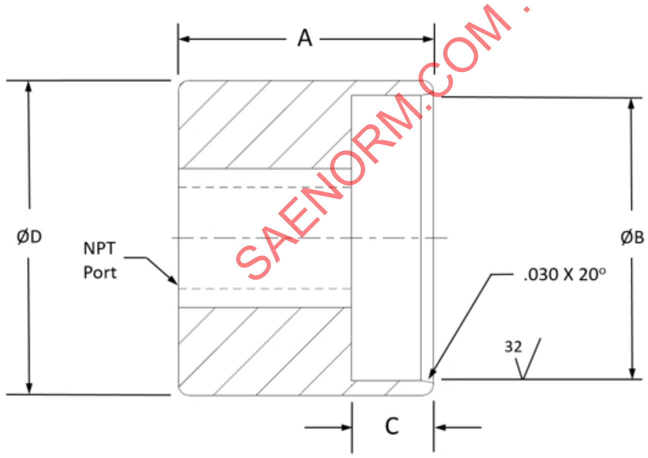


Tube material shall be 6061-T6 compliant to AMS4081 or AMS-WW-T-700/6. Tubing may be purchased as -T4 compliant to AMS4083 or AMS-WW-T-700/6 then heat treated to -T6 in accordance with AMS2770.

Prior to end fitting attachment, tubing shall be conversion coated in accordance with MIL-DTL-5541 Class 3.

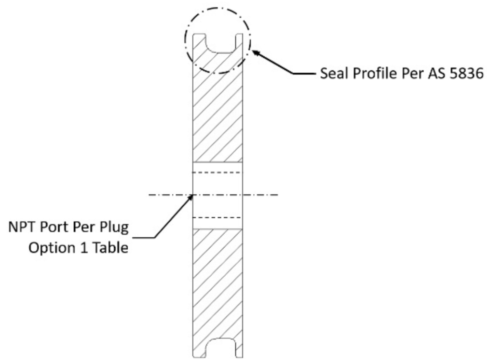
Attach (2X) AS7513 ferrules by roller swaging in accordance with AS4060 or equivalent supplier-specific process that achieves minimum 85% swage groove fill (average).

Test plug option (used on all configurations) reference: This option does not require the use of non-tested sleeve and additional seal.

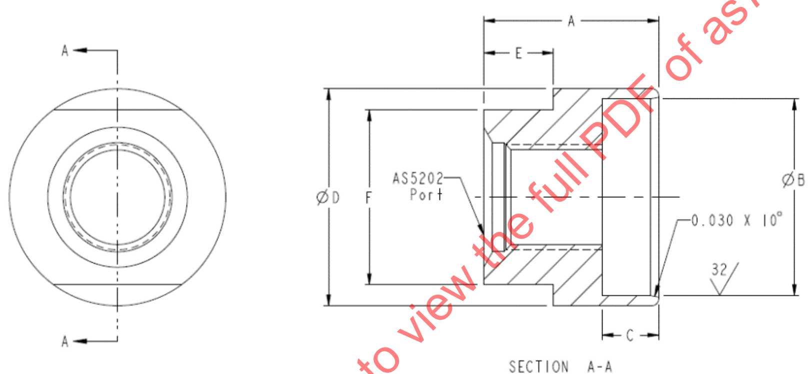


Dash	Dia	A +/- .005	ØB +/- .002	C + .005 / - .000	ØD +/- .002	NPT Port
-08	0.500	0.627	0.703	0.203	0.775	1/8-27
-10	0.625	0.627	0.828	0.203	0.900	1/8-27
-12	0.750	0.731	1.009	0.255	1.081	1/8-27
-16	1.000	0.811	1.290	0.295	1.362	1/4-18
-20	1.250	0.811	1.537	0.295	1.609	1/4-18
-24	1.500	0.811	1.807	0.295	1.879	1/4-18
-28	1.750	0.811	2.059	0.295	2.131	3/8-18
-32	2.000	0.855	2.332	0.317	2.404	3/8-18
-36	2.250	0.855	2.582	0.317	2.654	3/8-18
-40	2.500	0.855	2.832	0.317	2.908	3/8-18
-48	3.000	0.855	3.332	0.317	3.412	3/8-18
-56	3.500	0.945	3.848	0.347	3.934	3/8-18
-64	4.000	0.975	4.354	0.347	4.446	3/8-18

Test plug option 2 (used on all configurations) reference: This option requires the use of a non-tested sleeve and seal.



Test plug option 3 (used on all configurations) reference: This option does not require the use of non-tested sleeve and additional seal.



Dash	Dia	A ±0.005	ØB ±0.005	C +0.005/0	ØD ±0.002	AS5202 Port	E ±0.010	F ±0.010
-8	0.500	0.627	0.703	0.203	0.775	AS5202-04	0.250	0.625
-10	0.625	0.627	0.828	0.203	0.9	AS5202-04	0.250	0.750
-12	0.750	0.731	1.009	0.255	1.081	AS5202-04	0.250	0.875
-16	1.000	0.811	1.29	0.295	1.362	AS5202-06	0.250	1.000
-20	1.250	0.811	1.537	0.295	1.609	AS5202-06	0.250	1.250
-24	1.500	0.811	1.807	0.295	1.879	AS5202-06	0.250	1.500
-28	1.750	0.811	2.059	0.295	2.131	AS5202-08	0.250	1.750
-32	2.000	0.855	2.332	0.317	2.404	AS5202-08	0.375	2.000
-36	2.250	0.855	2.582	0.317	2.654	AS5202-08	0.375	2.250
-40	2.500	0.855	2.832	0.317	2.908	AS5202-08	0.375	2.500
-48	3.000	0.855	3.332	0.317	3.412	AS5202-08	0.375	3.000
-56	3.500	0.945	3.848	0.347	3.934	AS5202-08	0.375	3.500
-64	4.000	0.975	4.354	0.347	4.446	AS5202-08	0.375	4.000

Notes apply to all three plug options:

Plug material shall be aluminum 2024-T8, -T851, -T8510, or -T8511 per AMS-QQ-A-225/6, AMS4120, AMS4339, AMS-QQ-A-200/3, AMS-WW-T-700/3, or ASTM B211.

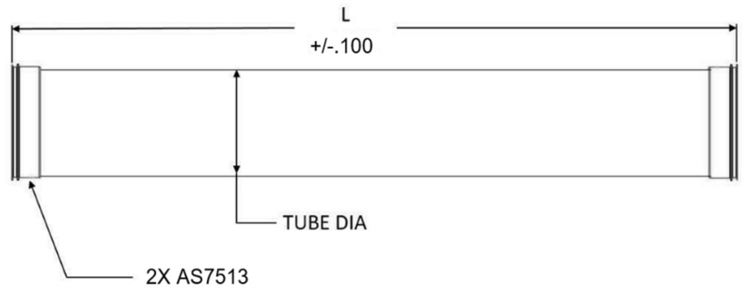
Unless otherwise specified, all edges shall be broken 0.010 to 0.020 and corners radius'd 0.010 to 0.015.

Anodize per MIL-PRF-8625 Type II Class 2 Color RED.

NPT port as shown is optional based on test and complete test cell assembly requirements. NPT ports may also be capped/plugged with appropriate aluminum standard hardware as/if required to meet test requirements.

A.2 CONFIGURATION (B) TEST DUCT ASSEMBLY DETAIL

Dash	Dia	Tube Wall	Length, L (OAL)
-08	0.500	0.028	21.8
-10	0.625	0.028	22.8
-12	0.750	0.028	24.4
-16	1.000	0.028	25.7
-20	1.250	0.028	26.7
-24	1.500	0.028	27.2
-28	1.750	0.035	27.7
-32	2.000	0.035	28.0
-36	2.250	0.035	28.5
-40	2.500	0.042/0.049	29.0
-48	3.000	0.042/0.049	29.0
-56	3.500	0.042/0.049	29.0
-64	4.000	0.042/0.049	29.0



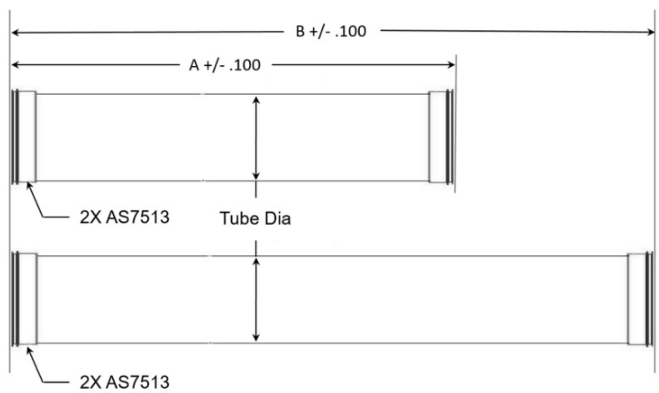
Tube material shall be 6061-T6 compliant to AMS4081 or AMS-WW-T-700/6. Tubing may be purchased as -T4 compliant to AMS4083 or AMS-WW-T-700/6 then heat treated to -T6 in accordance with AMS2770.

Prior to end fitting attachment, tubing shall be conversion coated in accordance with MIL-DTL-5541, Class 3.

Attach (2X) AS7513 ferrules by roller swaging in accordance with AS4060 or equivalent supplier specific process that achieves minimum 85% swage groove fill (average).

A.3 CONFIGURATION (D) TEST DUCT DETAIL

Dash	Dia	Tube Wall	Length Tube A (EOP-EOP)	Length Tube B (EOP-EOP)
-08	0.500	0.028	12.00	20.00
-10	0.625	0.028	12.00	20.00
-12	0.750	0.028	12.00	20.00
-16	1.000	0.028	12.00	20.00
-20	1.250	0.028	12.00	20.00
-24	1.500	0.028	12.00	20.00
-28	1.750	0.035	12.00	20.00
-32	2.000	0.035	12.00	20.00
-36	2.250	0.035	12.00	20.00
-40	2.500	0.042/0.049	12.00	20.00
-48	3.000	0.042/0.049	12.00	20.00
-56	3.500	0.042/0.049	12.00	20.00
-64	4.000	0.042/0.049	12.00	20.00



Tube material shall be 6061-T6 compliant to AMS4081 or AMS-WW-T-700/6. Tubing may be purchased as -T4 compliant to AMS4083 or AMS-WW-T-700/6 then heat treated to -T6 in accordance with AMS2770.

Prior to end fitting attachment, tubing shall be conversion coated in accordance with MIL-DTL-5541, Class 3.

Attach (2X) AS7513 ferrules by roller swaging in accordance with AS4060 or equivalent supplier specific process that achieves minimum 85% swage groove fill (average).

APPENDIX B - TEST FIXTURE ASSEMBLY DRAWINGS

B.1 LIFE CYCLE AND NON-LIFE CYCLE TEST FIXTURE TOP ASSEMBLY

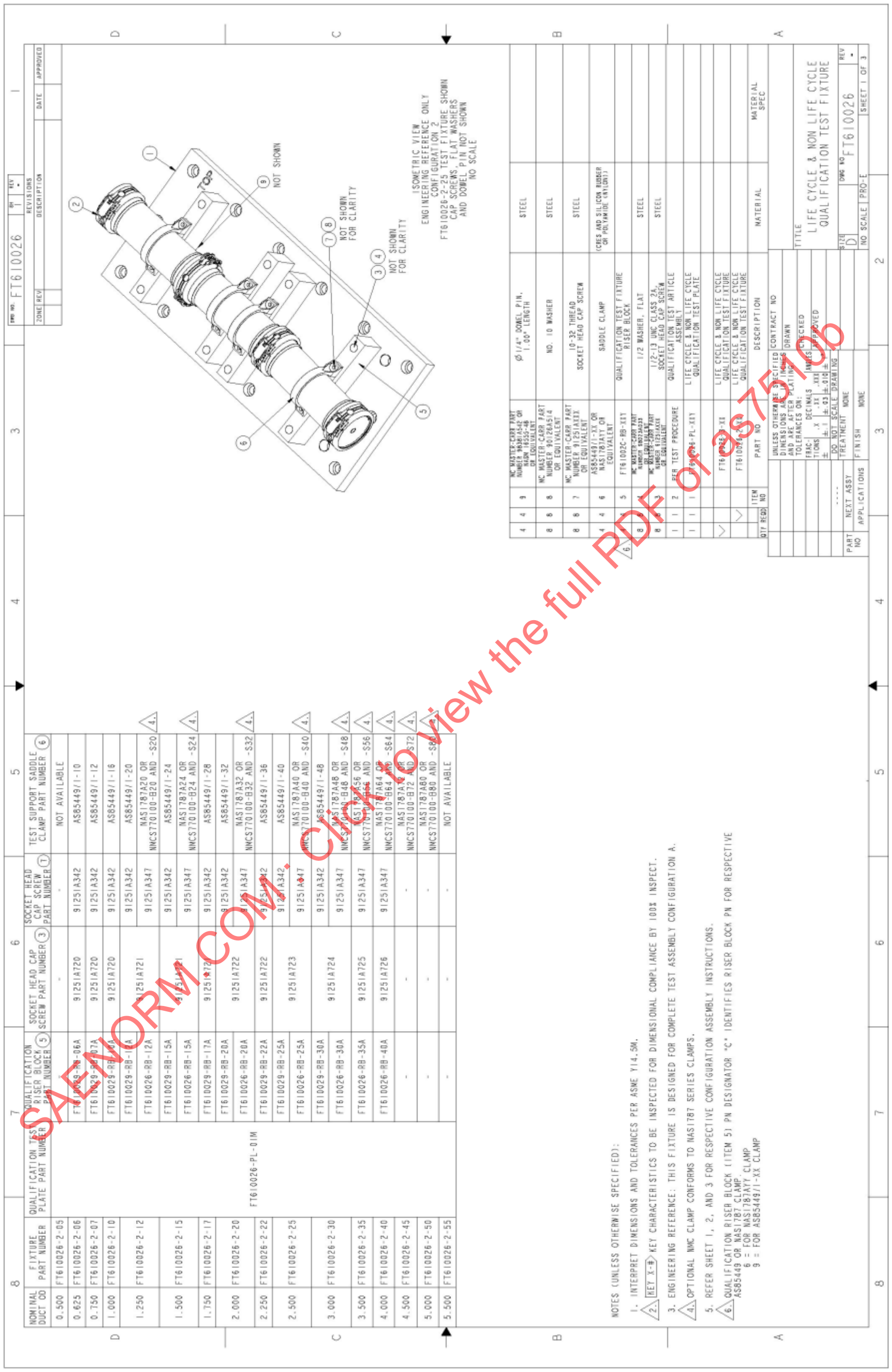
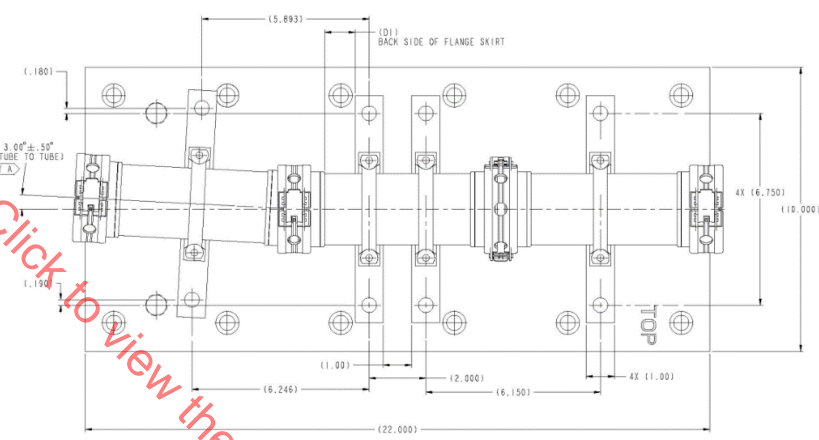


TABLE 2: DISTANCE BETWEEN CLAMP FACE AND BACK SIDE OF FLANGE SKIRT (REF)

DUCT OD	DI
0.500	1.296
0.625	1.296
0.750	1.246
1.000	1.196
1.250	1.196
1.500	1.134
1.750	1.134
2.000	1.104
2.250	1.073
2.500	1.073
3.000	1.073
3.500	1.043
4.000	0.860



NOTES:
RECOMMENDED ASSEMBLY INSTRUCTIONS: FOR CONFIGURATION FT610026-2-XX

B1. PRIOR TO ASSEMBLY, ENSURE THAT ALL PARTS ARE FREE OF DEBRIS & GREASE. CLEAN WITH ISOPROPYL ALCOHOL AS REQUIRED.

B2. USE LOCATOR PIN (ITEM 9) TO POSITION AND INSTALL RISER BLOCKS (ITEM 5) ON FIXTURE PLATE (ITEM 1) USING 1/2" CAP SCREWS (ITEM 3) AND WASHERS (ITEM 4) IN THE CORRECT LOCATION USING ANGLED OFFSET BOLT PATTERN. TORQUE CAP SCREWS TO 50 FT-LBS.

B3. PLACE THE BOTTOM HALF (BASE) OF THE SADDLE CLMAP (ITEM 6) ON THE RISER BLOCKS (ITEM 5) AND ALIGN WITH BOLT HOLES USING THE BOLT PATTERN.

B4. PLACE TEST ARTICLE (ITEM 2) INTO THE BOTTOM HALF (BASE) OF THE SADDLE CLAMP (ITEM 6). ALIGN THE BACK SIDE OF FLANGE SKIRT OF CENTER TEST TUBE WITHIN REFERENCE DIMENSION "DI" AS SHOWN PER TABLE 2 ABOVE. END TUBES WILL BE FULLY EXTENDED.

B5. INSTALL THE TOP HALF (STRAP) OF THE SADDLE CLAMP (ITEM 6) USING THE 10-32 CAP SCREW (ITEM 7) AND WASHERS (ITEM 8) PER PART LIST TABLE (FINGER TIGHT). TORQUE TO 32 IN-LBS. PRIOR TO TORQUEING, ENSURE KEY CHARACTERISTICS DIMENSIONS AS SHOWN (REFER TO DI DIMENSION PER TABLE 2).

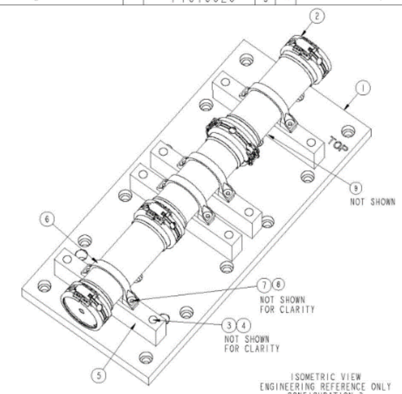
B6. FIXTURING ALLOWS VARIANCE IN ANGULATION OF TUBES. MEASURE AND RECORD ALL KEY CHARACTERISTICS. IF ANY DIMENSIONS ARE OUT OF REQUIREMENT REPEAT SETUP STEPS AS NEEDED AND/OR CONTACT COGNIZANT ENGINEER.

B7. COMPLETE SETUP CHECKLIST AND RETAIN AS NEEDED.

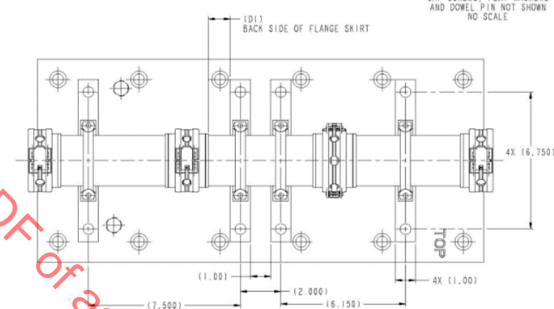
DWG NO. FT610026 SHEET 2 OF 3 REV -

DWG NO. FT610026 SH 3 REV -

NOMINAL DUCT OD	FIXTURE PART NUMBER	QUALIFICATION TEST PLATE PART NUMBER	QUALIFICATION RISER BLOCK PART NUMBER (5)	SOCKET HEAD CAP SCREW PART NUMBER (3)	SOCKET HEAD CAP SCREW PART NUMBER (7)	TEST SUPPORT SADDLE CLAMP PART NUMBER (6)	
0.500	FT610026-3-05	FT610026-PL-01M	-	-	-	NOT AVAILABLE	
0.625	FT610026-3-06		FT610029-RB-06A	91251A720	91251A342	AS85449/1-10	
0.750	FT610026-3-07		FT610029-RB-07A	91251A720	91251A342	AS85449/1-12	
1.000	FT610026-3-10		FT610029-RB-10A	91251A720	91251A342	AS85449/1-16	
1.250	FT610026-3-12		FT610029-RB-12A	91251A721	91251A342	AS85449/1-20	
			FT610026-RB-12A		91251A347	NAS1787A20 OR NMCS770100-B20 AND -S20	4.
1.500	FT610026-3-15		FT610029-RB-15A	91251A721	91251A342	AS85449/1-24	
			FT610026-RB-15A		91251A347	NAS1787A24 OR NMCS770100-B24 AND -S24	4.
1.750	FT610026-3-17		FT610029-RB-17A	91251A721	91251A342	AS85449/1-28	
2.000	FT610026-3-20		FT610029-RB-20A	91251A722	91251A342	AS85449/1-32	
			FT610026-RB-20A		91251A347	NAS1787A32 OR NMCS770100-B32 AND -S32	4.
2.250	FT610026-3-22		FT610029-RB-22A	91251A722	91251A342	AS85449/1-36	
2.500	FT610026-3-25		FT610029-RB-25A	91251A723	91251A342	AS85449/1-40	
			FT610026-RB-25A		91251A347	NAS1787A40 OR NMCS770100-B40 AND -S40	4.
3.000	FT610026-3-30		FT610029-RB-30A	91251A724	91251A342	AS85449/1-48	
			FT610026-RB-30A		91251A347	NAS1787A48 OR NMCS770100-B48 AND -S48	4.
3.500	FT610026-3-35		FT610026-RB-35A	91251A725	91251A347	NAS1787A56 OR NMCS770100-B56 AND -S56	4.
4.000	FT610026-3-40		FT610026-RB-40A	91251A726	91251A347	NAS1787A64 OR NMCS770100-B64 AND -S64	4.
4.500	FT610026-3-45		-	-	-	NAS1787A72 OR NMCS770100-B72 AND -S72	4.
5.000	FT610026-3-50		-	-	-	NAS1787A80 OR NMCS770100-B80 AND -S80	4.
5.500	FT610026-3-55		-	-	-	NOT AVAILABLE	



ISOMETRIC VIEW
ENGINEERING REFERENCE ONLY
CONFIGURATION 3
FT610026-3-25 TEST FIXTURE SHOWN
CAP SCREWS, FLAT WASHERS
AND DOWEL PIN NOT SHOWN
NO SCALE



NOTES:
RECOMMENDED ASSEMBLY INSTRUCTIONS: FOR CONFIGURATION FT610026-3-XX

C1. PRIOR TO ASSEMBLY, ENSURE THAT ALL PARTS ARE FREE OF DEBRIS & GREASE. CLEAN WITH ISOPROPYL ALCOHOL AS REQUIRED.

C2. USE LOCATOR PIN (ITEM 9) TO POSITION AND INSTALL RISER BLOCKS (ITEM 5) ON FIXTURE PLATE (ITEM 1) USING 1/2" CAP SCREWS (ITEM 3) AND WASHERS (ITEM 4) IN THE CORRECT LOCATION USING THE BOLT PATTERN. TORQUE CAP SCREWS TO 50 FT-LBS.

C3. PLACE THE BOTTOM HALF (BASE) OF THE SADDLE CLMAP (ITEM 6) ON THE RISER BLOCKS (ITEM 5) AND ALIGN WITH BOLT HOLES USING THE BOLT PATTERN.

C4. PLACE TEST ARTICLE (ITEM 2) INTO THE BOTTOM HALF (BASE) OF THE SADDLE CLAMP (ITEM 6). ALIGN THE BACK SIDE OF FLANGE SKIRT OF CENTER TEST TUBE WITHIN REFERENCE DIMENSION "D1" AS SHOWN PER TABLE 2 (SEE SHEET 2). END TUBES WILL BE FULLY EXTENDED.

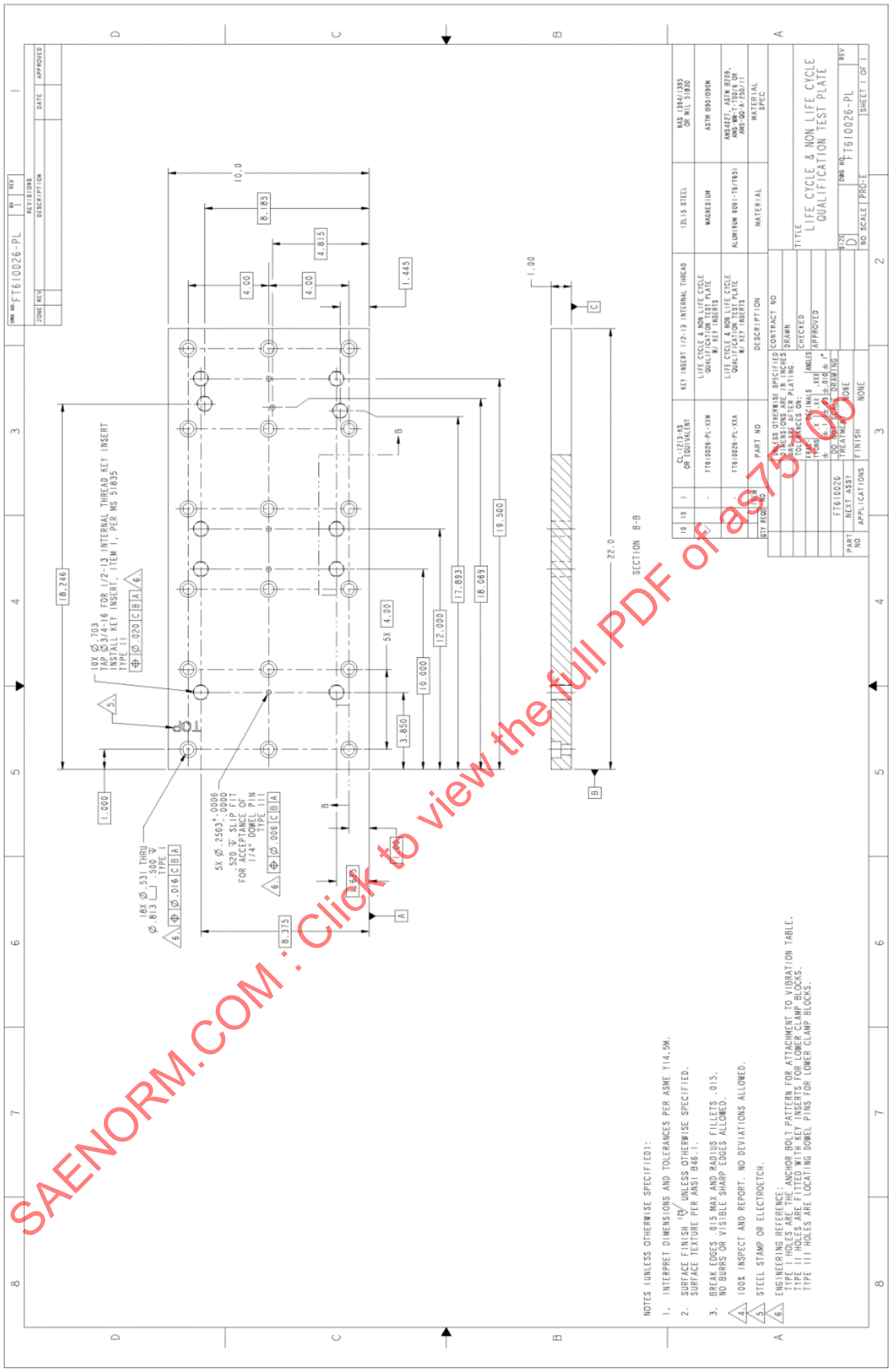
C5. INSTALL THE TOP HALF (STRAP) OF THE SADDLE CLAMP (ITEM 6) USING THE 10-32 CAP SCREW (ITEM 7) AND WASHERS (ITEM 8) PER PART LIST TABLE (FINGER TIGHT). TORQUE TO 32 IN-LBS. PRIOR TO TORQUEING, ENSURE KEY CHARACTERISTICS DIMENSIONS AS SHOWN. (REFER SHEET 2 FOR D1 DIMENSION PER TABLE 2).

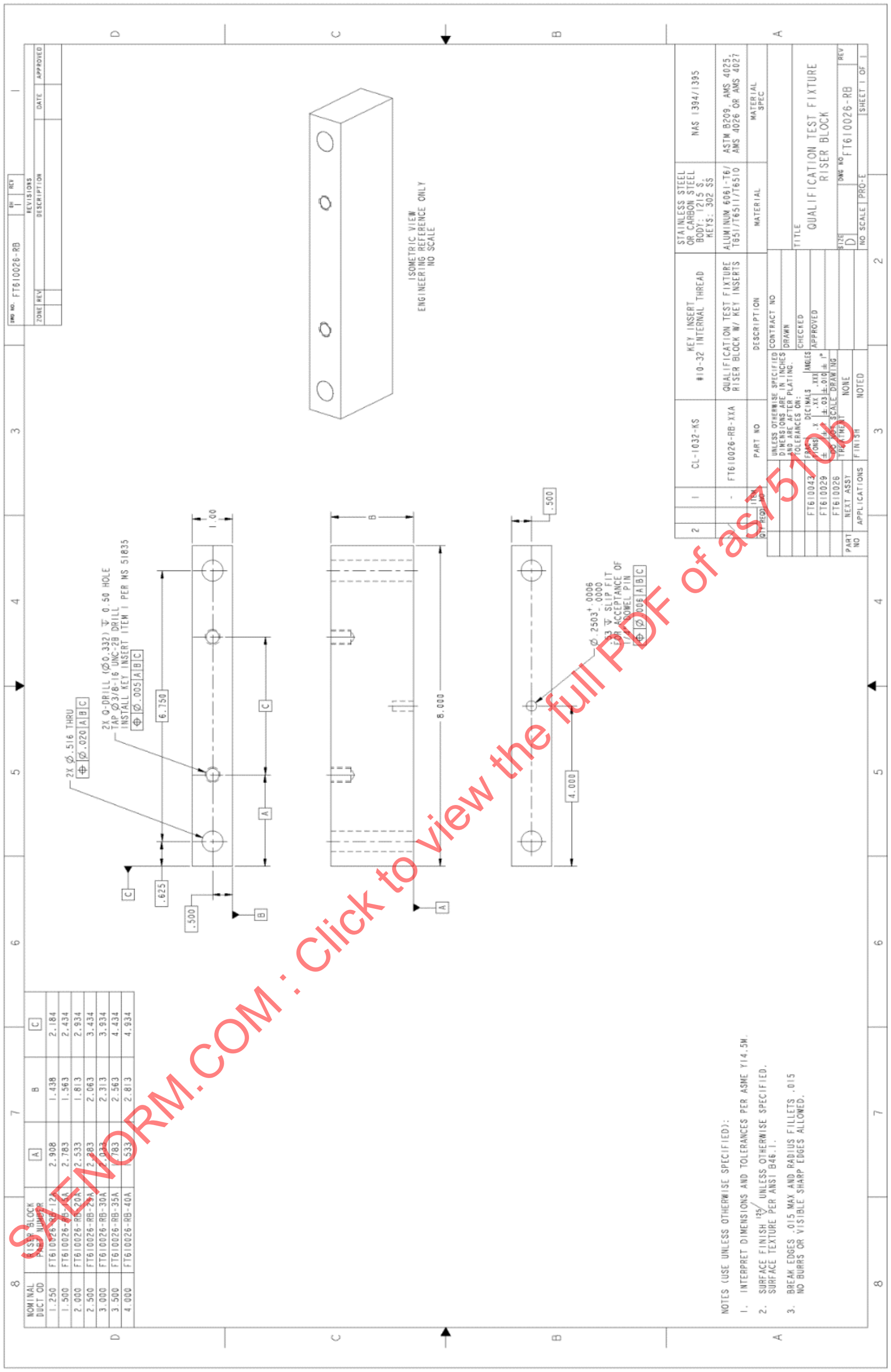
C6. FIXTURING ALLOWS VARIANCE IN PLACEMENT OF TUBES. MEASURE AND RECORD ALL KEY CHARACTERISTICS. IF ANY DIMENSIONS ARE OUT OF REQUIREMENT REPEAT SETUP STEPS AS NEEDED AND/OR CONTACT COGNIZANT ENGINEER.

C7. COMPLETE SETUP CHECKLIST AND RETAIN AS NEEDED.

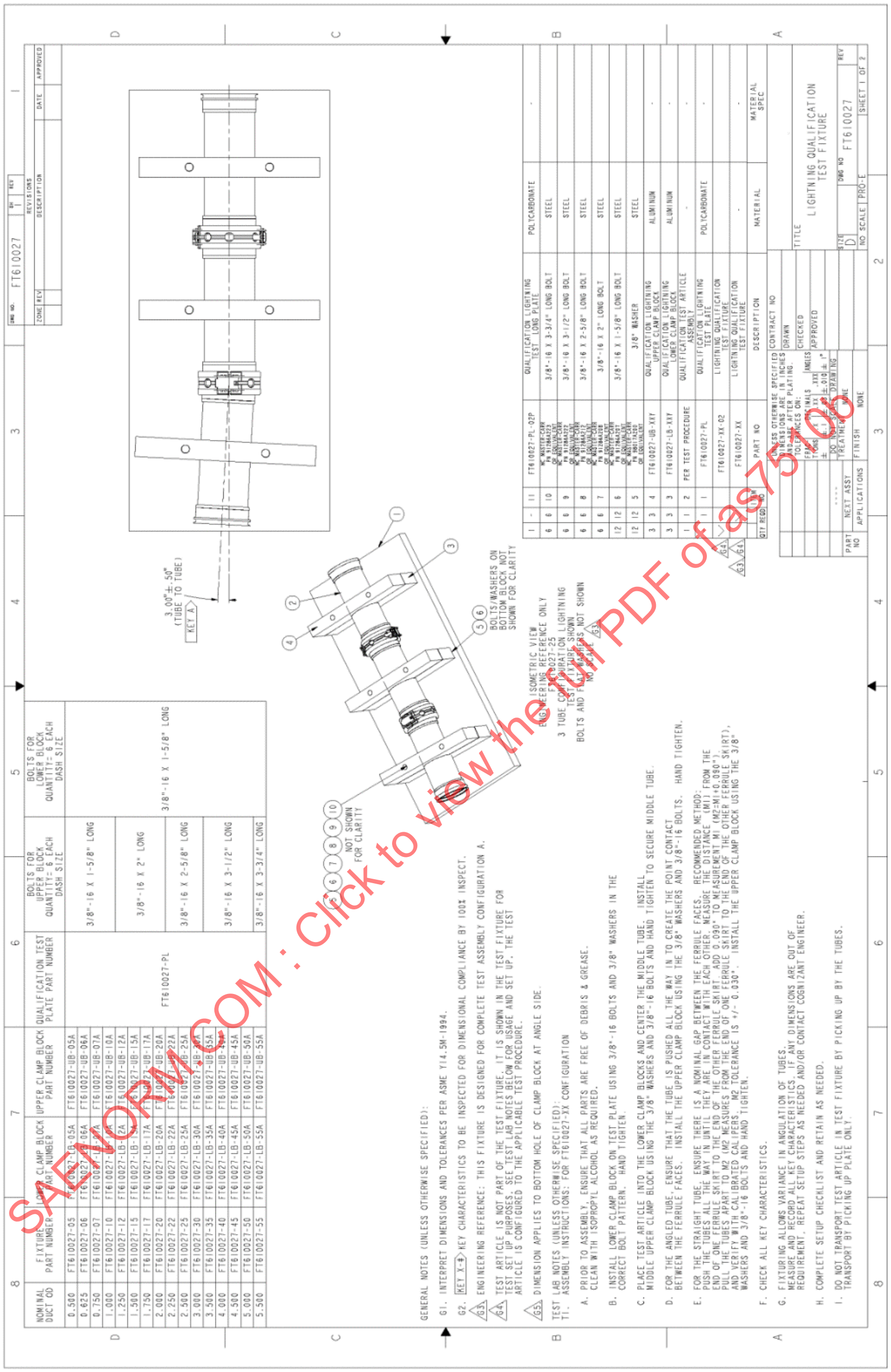
DWG NO. FT610026 REV - SHEET 3 OF 3 PRO

B.2 LIFE CYCLE AND NON-LIFE CYCLE TEST FIXTURE SUBCOMPONENT DRAWINGS

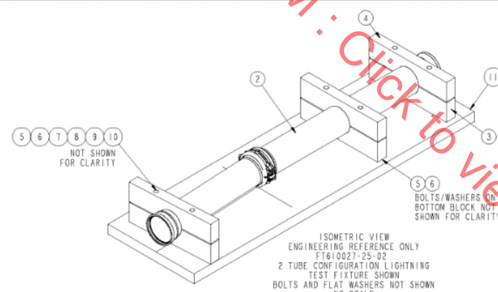



ISOMETRIC VIEW
ENGINEERING REFERENCE ONLY
NO SCALE
NOMINAL DUCT OD | RISER BLOCK PART NUMBER | A | B | C
1.250 FT610026-RB-12A 2.908 1.438 2.184
1.500 FT610026-RB-15A 2.783 1.563 2.434
2.000 FT610026-RB-20A 2.533 1.813 2.934
2.500 FT610026-RB-25A 2.283 2.063 3.434
3.000 FT610026-RB-30A 2.313 3.934
3.500 FT610026-RB-35A 2.563 4.434
4.000 FT610026-RB-40A 2.813 4.934
NOTES (USE UNLESS OTHERWISE SPECIFIED):
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M.
2. SURFACE FINISH 125 UNLESS OTHERWISE SPECIFIED. SURFACE TEXTURE PER ANSI B46.1.
3. BREAK EDGES .015 MAX AND RADIUS FILLETS .015 NO BURRS OR VISIBLE SHARP EDGES ALLOWED.
CL-1032-KS KEY INSERT #10-32 INTERNAL THREAD STAINLESS STEEL OR CARBON STEEL BODY: 1215 SS KEYS: 302 SS NAS 1394/1395
FT610026-RB-XXA QUALIFICATION TEST FIXTURE RISER BLOCK W/ KEY INSERTS ALUMINUM 6061-T6/T651/T6511/T6510 ASTM B209, AMS 4025, AMS 4026 OR AMS 4027
QUALIFICATION TEST FIXTURE RISER BLOCK
FT610026-RB

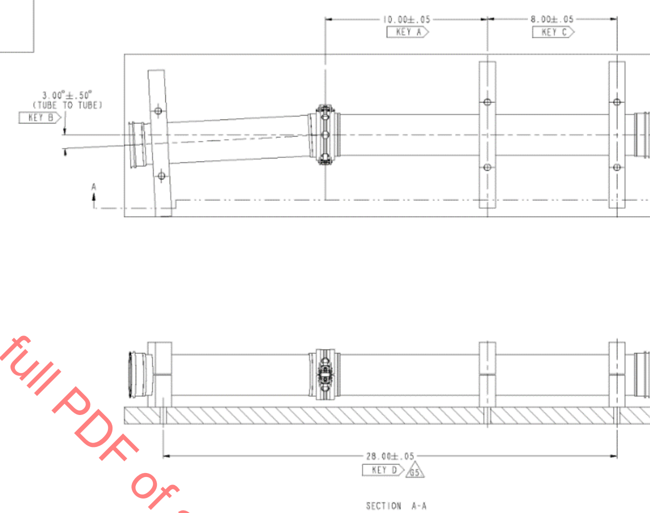
B.3 LIGHTNING STRIKE TEST FIXTURE TOP ASSEMBLY



NOMINAL DUCT OD	FIXTURE PART NUMBER	LOWER CLAMP BLOCK PART NUMBER	UPPER CLAMP BLOCK PART NUMBER	QUALIFICATION TEST PLATE PART NUMBER	BOLTS FOR UPPER BLOCK QUANTITY= 6 EACH DASH SIZE	BOLTS FOR LOWER BLOCK QUANTITY= 6 EACH DASH SIZE
0.500	FT610027-05-02	FT610027-LB-05A	FT610027-UB-05A	FT610027-PL-02P	3/8"-16 X 1-5/8" LONG	3/8"-16 X 1-5/8" LONG
0.625	FT610027-06-02	FT610027-LB-06A	FT610027-UB-06A			
0.750	FT610027-07-02	FT610027-LB-07A	FT610027-UB-07A			
1.000	FT610027-10-02	FT610027-LB-10A	FT610027-UB-10A			
1.250	FT610027-12-02	FT610027-LB-12A	FT610027-UB-12A		3/8"-16 X 2" LONG	
1.500	FT610027-15-02	FT610027-LB-15A	FT610027-UB-15A			
1.750	FT610027-17-02	FT610027-LB-17A	FT610027-UB-17A			
2.000	FT610027-20-02	FT610027-LB-20A	FT610027-UB-20A			
2.250	FT610027-22-02	FT610027-LB-22A	FT610027-UB-22A		3/8"-16 X 2-5/8" LONG	
2.500	FT610027-25-02	FT610027-LB-25A	FT610027-UB-25A			
3.000	FT610027-30-02	FT610027-LB-30A	FT610027-UB-30A			
3.500	FT610027-35-02	FT610027-LB-35A	FT610027-UB-35A		3/8"-16 X 3-1/2" LONG	
4.000	FT610027-40-02	FT610027-LB-40A	FT610027-UB-40A			
4.500	FT610027-45-02	FT610027-LB-45A	FT610027-UB-45A			
5.000	FT610027-50-02	FT610027-LB-50A	FT610027-UB-50A			
5.500	FT610027-55-02	FT610027-LB-55A	FT610027-UB-55A		3/8"-16 X 3-3/4" LONG	



ISOMETRIC VIEW
ENGINEERING REFERENCE ONLY
FT610027-25-02
2 TUBE CONFIGURATION LIGHTNING
TEST FIXTURE SHOWN
BOLTS AND FLAT WASHERS NOT SHOWN
NO SCALE



SECTION A-A

TEST LAB NOTES (UNLESS OTHERWISE SPECIFIED):
T2. ASSEMBLY INSTRUCTIONS: FOR FT610027-XX-YY CONFIGURATION

A. PRIOR TO ASSEMBLY, ENSURE THAT ALL PARTS ARE FREE OF DEBRIS & GREASE. CLEAN WITH ISOPROPYL ALCOHOL AS REQUIRED.

B. INSTALL LOWER CLAMP BLOCK (ITEM 3) ON TEST PLATE (ITEM 11) USING 3/8"-16 BOLTS AND 3/8" WASHERS IN THE CORRECT BOLT PATTERN. HAND TIGHTEN.

C. PLACE TEST ARTICLE (ITEM 2) INTO THE LOWER CLAMP BLOCKS (ITEM 3).

D. ALIGN THE CENTER OF COUPLER WITH THE VERTICAL INDEX MARK ON TEST PLATE (ITEM 1).

E. AT ANGLED SIDE, ENSURE THAT THE TUBES ARE PUSHED ALL THE WAY IN TO CREATE THE POINT CONTACT BETWEEN THE FERRULE FACES.

F. INSTALL UPPER CLAMP BLOCKS (ITEM 4) USING THE 3/8" WASHERS AND 3/8"-16 BOLTS HAND TIGHTEN.

G. CHECK ALL KEY CHARACTERISTICS.

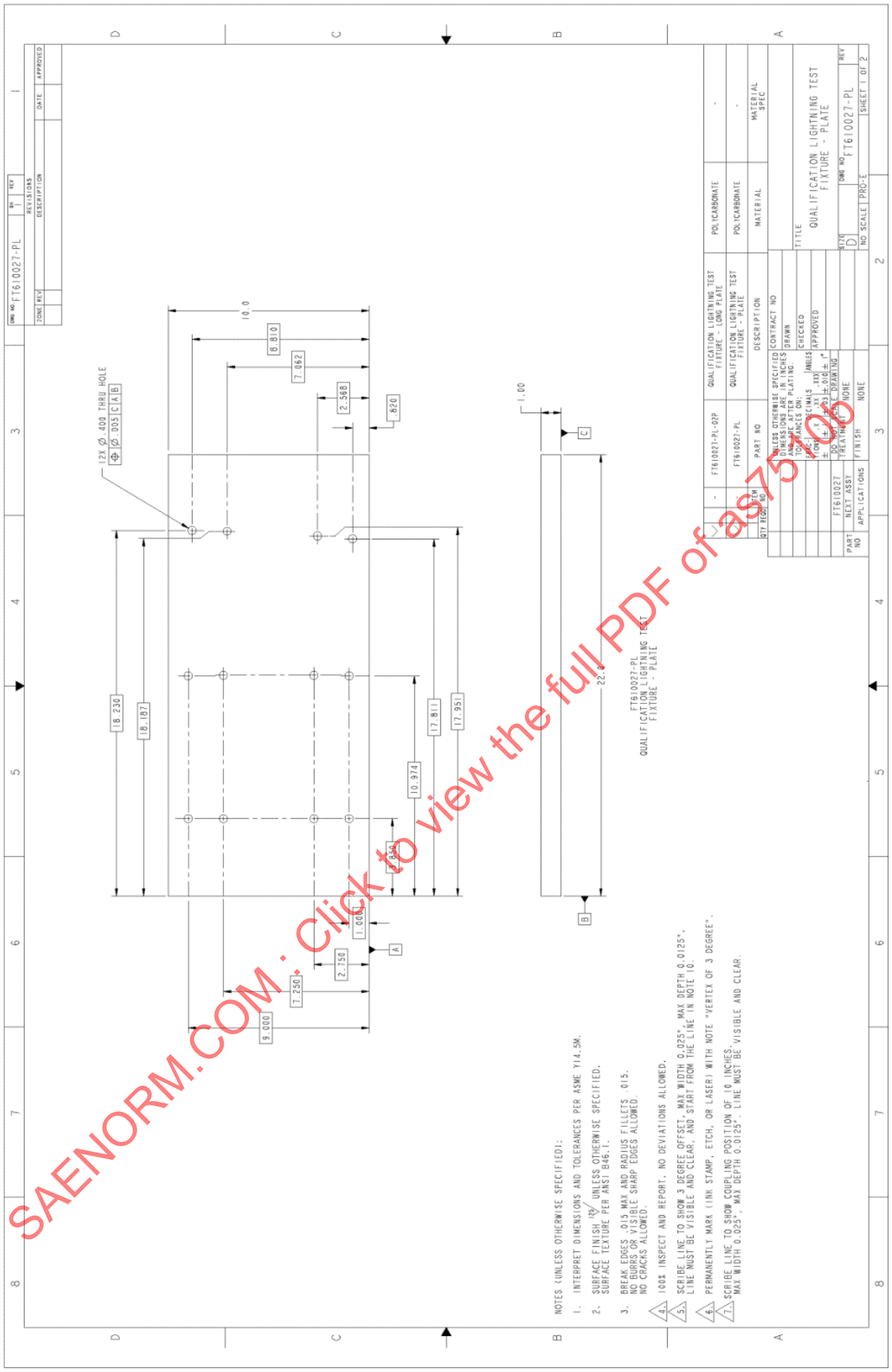
H. FIXTURING ALLOWS VARIANCE IN ANGULATION OF TUBES. MEASURE AND RECORD ALL KEY CHARACTERISTICS. IF ANY DIMENSIONS ARE OUT OF REQUIREMENT, REPEAT SETUP STEPS AS NEEDED AND/OR CONTACT COGNIZANT ENGINEER.

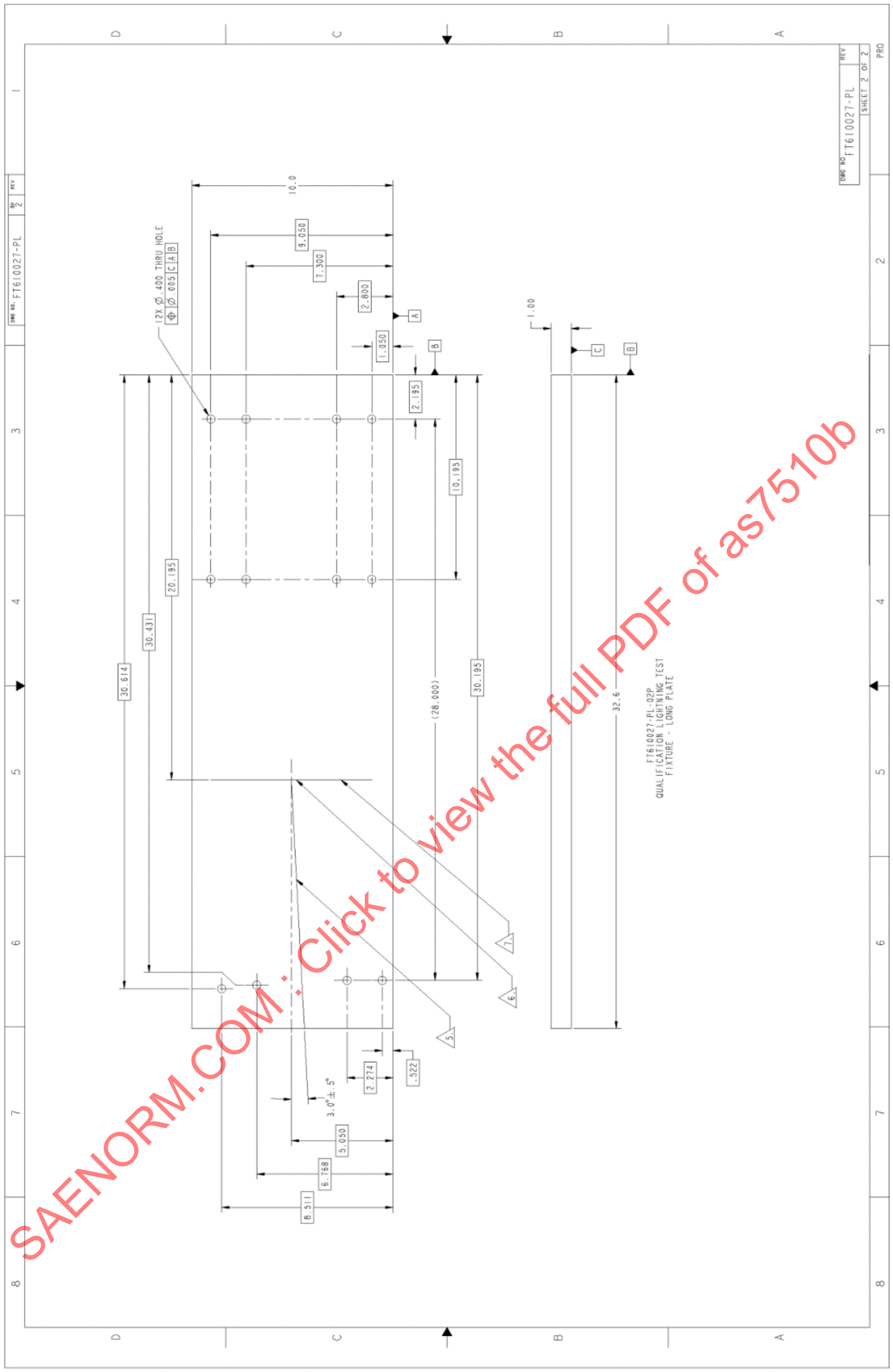
I. COMPLETE SETUP CHECKLIST AND RETAIN AS NEEDED.

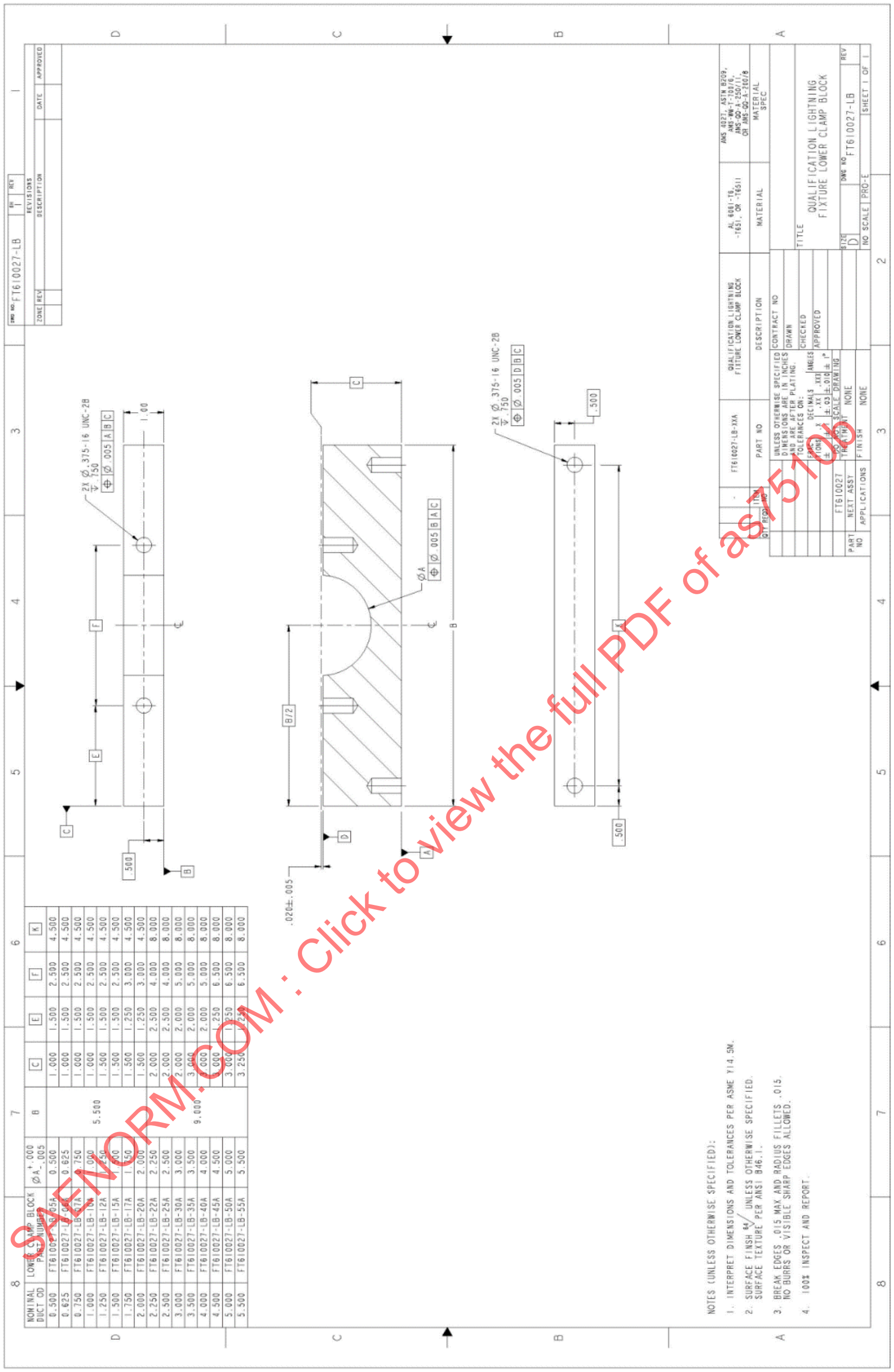
J. DO NOT TRANSPORT TEST ARTICLE IN TEST FIXTURE BY PICKING UP BY THE TUBES. TRANSPORT BY PICKING UP PLATE ONLY.

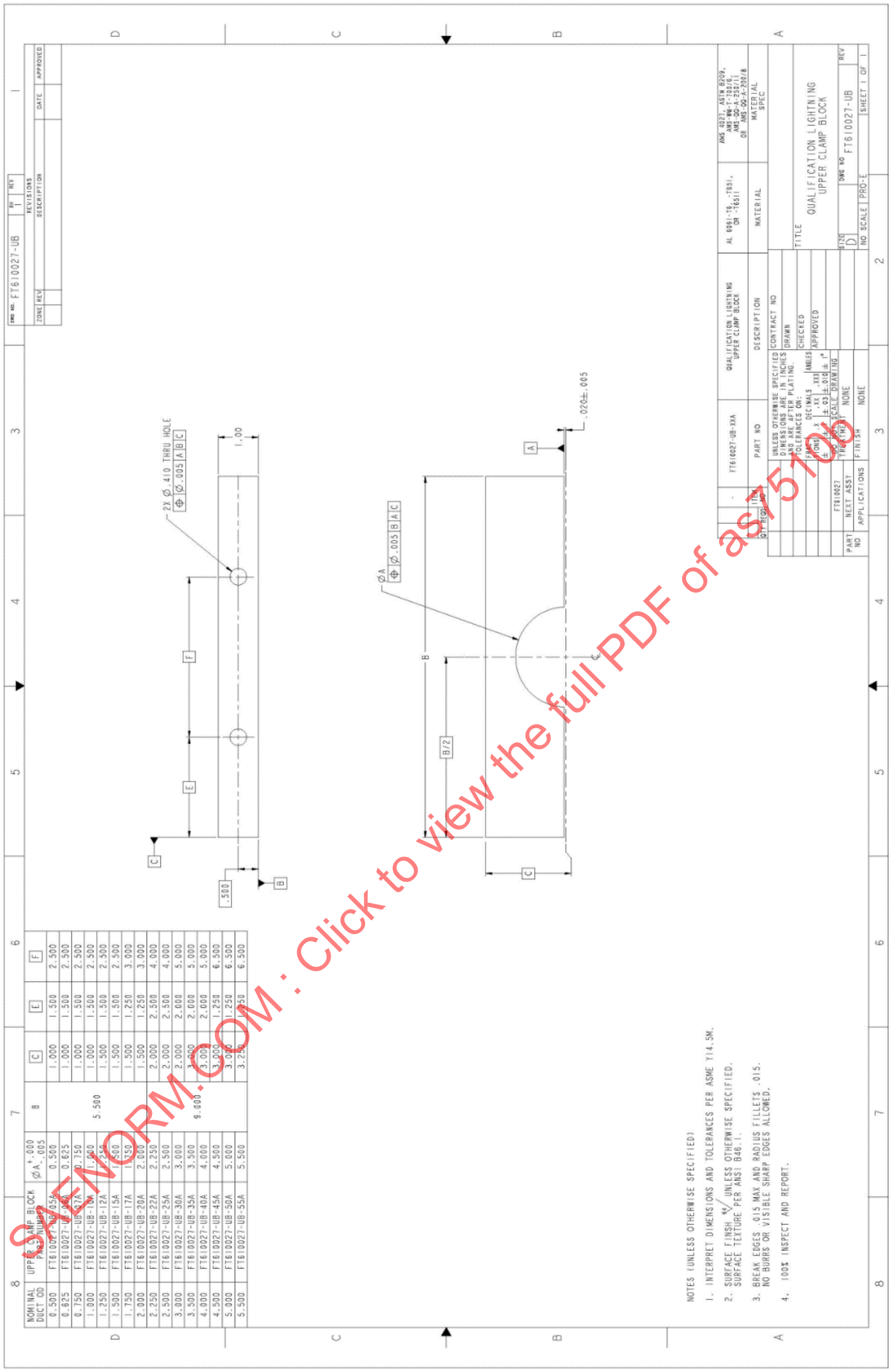
DWG NO. FT610027 SHEET 2 OF 2

B.4 LIGHTNING STRIKE TEST FIXTURE SUBCOMPONENT DRAWINGS




FT610027-PL-02P
QUALIFICATION LIGHTNING TEST
FIXTURE - LONG PLATE
12X ⌀.400 THRU HOLE
FT610027-PL


QUALIFICATION LIGHTNING FIXTURE LOWER CLAMP BLOCK
FT610027-LB
NOTES (UNLESS OTHERWISE SPECIFIED):
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M.
4. 100% INSPECT AND REPORT.


QUALIFICATION LIGHTNING UPPER CLAMP BLOCK
FT610027-UB
2X Ø .410 THRU HOLE
NOTES (UNLESS OTHERWISE SPECIFIED)
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M.
3. BREAK EDGES .015 MAX AND RADIUS FILLETS .015. NO BURRS OR VISIBLE SHARP EDGES ALLOWED.
4. 100% INSPECT AND REPORT.

B.5 RANDOM VIBRATION AND WINDMILLING VIBRATION TEST FIXTURE TOP ASSEMBLY

NOMINAL DUCT OD	FIXTURE PART NUMBER	QUALIFICATION TEST PLATE PART NUMBER	RISER BLOCK PART NUMBER (5)(7)	LOWER CLAMP BLOCK PART NUMBER	UPPER CLAMP BLOCK PART NUMBER	SOCKET HEAD CAP (3) SCREW PART NUMBER	SOCKET HEAD CAP (7) SCREW PART NUMBER	TEST SUPPORT SADDLE (6) CLAMP PART NUMBER (5)	FIXED CLAMP BLOCK USED (2)	(L) +.125/-.000	D ±.050 (2)
0.500	FT610055-05	FT610055-PL-M	FT610056-RB-XXXXA	-	-	91251A720	91251A342	TA09114HIR08NB	B	20.000	8.656
0.625	FT610055-06		FT610029-RB-06A	-	-	91251A720	91251A342	AS85449/1-10		22.000	9.656
0.750	FT610055-07		FT610029-RB-07A	-	-	91251A720	91251A342	AS85449/1-12		25.000	11.106
1.000	FT610055-10		FT610029-RB-10A	-	-	91251A720	91251A342	AS85449/1-16		27.500	12.306
1.250	FT610055-12		FT610029-RB-12A	-	-	91251A721	91251A342	AS85449/1-20		29.500	13.306
			FT610026-RB-12A	-	-		91251A347	NAS1787A20 OR NMCS770100-B20 AND -S20			
1.500	FT610055-15		FT610029-RB-15A	-	-	91251A721	91251A342	AS85449/1-24	A	30.500	13.744
			FT610026-RB-15A	-	-		91251A347	NAS1787A24 OR NMCS770100-B24 AND -S24			
1.750	FT610055-17		FT610029-RB-17A	-	-	91251A721	91251A342	AS85449/1-28		31.500	14.244
2.000	FT610055-20		FT610029-RB-20A	-	-	91251A722	91251A342	AS85449/1-32		32.000	14.464
			FT610026-RB-20A	-	-		91251A347	NAS1787A32 OR NMCS770100-B32 AND -S32			
2.250	FT610055-22		FT610029-RB-22A	-	-	91251A722	91251A342	AS85449/1-36		33.000	14.933
2.500	FT610055-25		FT610029-RB-25A	-	-	91251A723	91251A342	AS85449/1-40		34.000	15.433
			FT610026-RB-25A	-	-		91251A347	NAS1787A40 OR NMCS770100-B40 AND -S40			
			FT610056-RB-XXXXA	-	-		91251A342	-			
3.000	FT610055-30		FT610029-RB-30A	-	-	91251A724	91251A342	AS85449/1-48	B	34.000	15.433
			FT610026-RB-30A	-	-		91251A347	NAS1787A48 OR NMCS770100-B48 AND -S48			
			FT610056-RB-XXXXA	-	-		91251A342	-			
3.500	FT610055-35		FT610026-RB-35A	-	-	91251A725	91251A347	NAS1787A56 OR NMCS770100-B56 AND -S56		34.000	15.388
			FT610056-RB-XXXXA	-	-		91251A342	-			
4.000	FT610055-40		FT610026-RB-40A	-	-	91251A726	91251A347	NAS1787A64 OR NMCS770100-B64 AND -S64		34.000	15.190
			FT610056-RB-XXXXA	-	-		91251A342	-			

NOTES (UNLESS OTHERWISE SPECIFIED):

1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
2. KEY X-# KEY CHARACTERISTICS TO BE INSPECTED FOR DIMENSIONAL COMPLIANCE BY 100% INSPECT.
3. ENGINEERING REFERENCE: THIS FIXTURE IS DESIGNED FOR COMPLETE TEST ASSEMBLY CONFIGURATION B.
4. QUALIFICATION TEST FIXTURE ASSEMBLY PART NUMBERING SCHEME: "FT610055-XX".
   XX = TUBE SIZE (IN TENTHS)
5. USE NAS1787, AS85449/1 OR FUNCTIONALLY EQUIVALENT AEROSPACE/AIRCRAFT GRADE SADDLE CLAMPS. OPTIONAL NMC CLAMP CONFORMS TO NAS1787 SERIES CLAMPS.
6. REFER SHEET 2 FOR RESPECTIVE CONFIGURATION ASSEMBLY INSTRUCTIONS.
7. QUALIFICATION RISER BLOCK (ITEM 5) PN DESIGNATOR "C" IDENTIFIES RISER BLOCK PN FOR RESPECTIVE AS85449 OR NAS1787 CLAMP.
   6 = FOR NAS1787AYY CLAMP
   9 = FOR AS85449/1-XX CLAMP
   FOR OTHER FUNCTIONALLY EQUIVALENT AEROSPACE/AIRCRAFT GRADE SADDLE CLAMPS USE FT610056-RB.

QTY REQD	ITEM NO	PART NO	DESCRIPTION	MATERIAL	MATERIAL SPEC
4	10	FT610056-RB-XXXXA (7)	QUALIFICATION TEST FIXTURE RISER BLOCK		
4	9	MC MASTER-CARR PART NUMBER 98381A542 OR NASM 16555-48 OR EQUIVALENT	Ø 1/4" DOWEL PIN, 1.00" LENGTH	STEEL	
8	8	MC MASTER-CARR PART NUMBER 90126A514 OR EQUIVALENT	NO. 10 WASHER	STEEL	
8	7	MC MASTER-CARR PART NUMBER 91251AXXX OR EQUIVALENT	10-32 THREAD SOCKET HEAD CAP SCREW	STEEL	
4	6	AS85449/1-XX OR NAS1787AYY OR EQUIVALENT (7)(5)	SADDLE CLAMP		
4	5	FT61002C-RB-XXY (7)	QUALIFICATION TEST FIXTURE RISER BLOCK		
8	4	MC MASTER-CARR PART NUMBER 98023A033 OR EQUIVALENT	1/2 WASHER, FLAT	STEEL	
8	3	MC MASTER-CARR PART NUMBER 91251AXXX OR EQUIVALENT	1/2-13 UNC CLASS 2A, SOCKET HEAD CAP SCREW	STEEL	
1	2	PER TEST PROCEDURE	QUALIFICATION TEST ARTICLE ASSEMBLY		
1	1	FT610055-PL-M	WINDMILLING VIBRATION TEST FIXTURE - PLATE		
		FT610055-XX	QUALIFICATION WINDMILLING VIBRATION TEST FIXTURE		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND ARE AFTER PLATING. TOLERANCES ON: FRACTIONS ± ; DECIMALS .X ±.1, .XX ±.03, .XXX ±.010; ANGLES ± 1°

DO NOT SCALE DRAWING

TREATMENT NONE; FINISH NONE

PART NO; NEXT ASSY; APPLICATIONS

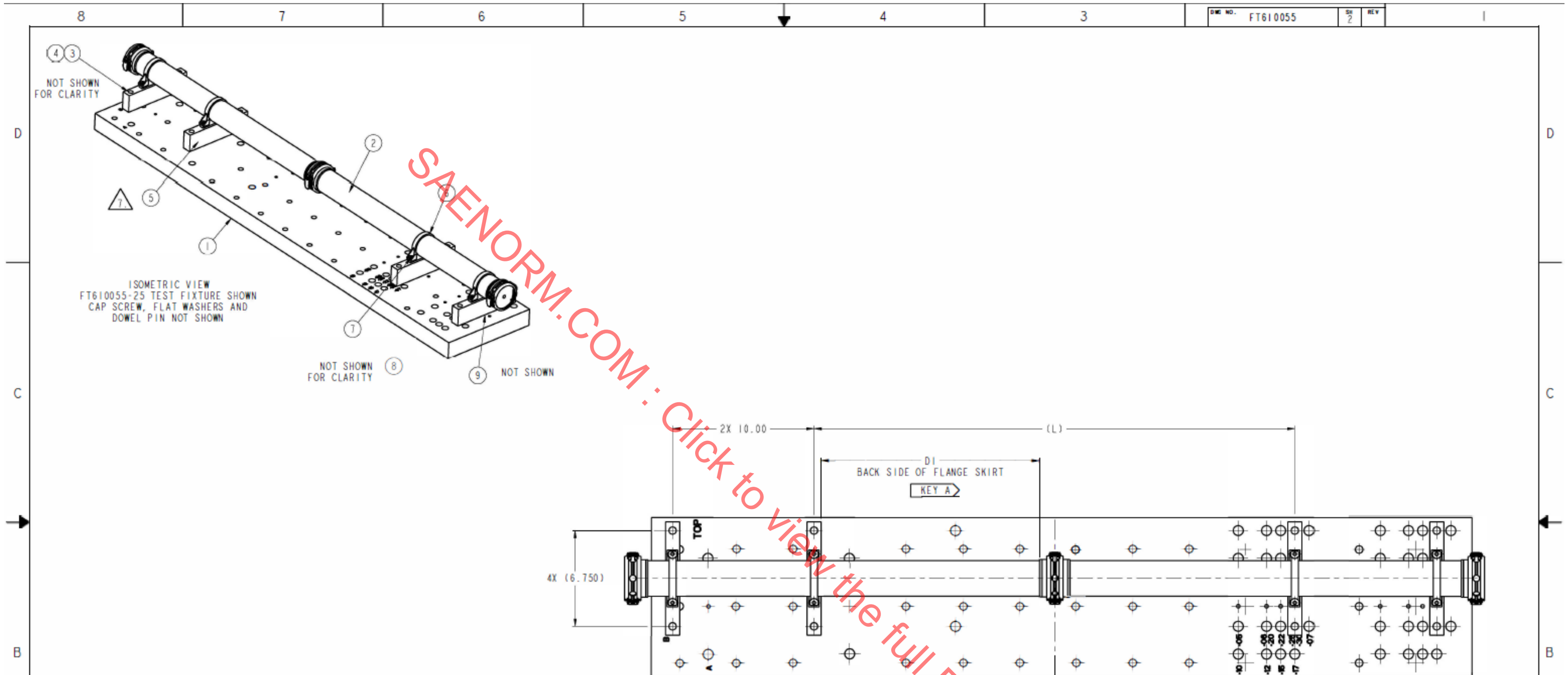
CONTRACT NO; DRAWN; CHECKED; APPROVED

TITLE: QUALIFICATION WINDMILLING VIBRATION TEST FIXTURE

SIZE D; CAGE CODE; DWG NO FT610055; REV; NO SCALE; PRO-E; SHEET 1 OF 2

DWG NO. FT610055; SH 1; REV

REVISIONS: ZONE | REV | DESCRIPTION | DATE | APPROVED



NOTES:
RECOMMENDED ASSEMBLY INSTRUCTIONS:

A1. PRIOR TO ASSEMBLY, ENSURE THAT ALL PARTS ARE FREE OF DEBRIS & GREASE. CLEAN WITH ISOPROPYL ALCOHOL AS REQUIRED.

A2 USE LOCATOR PIN (ITEM 9) TO POSITION AND INSTALL RISER BLOCKS (ITEM 5) ON FIXTURE PLATE (ITEM 1) USING 1/2" CAP SCREWS (ITEM 3) AND WASHERS (ITEM 4) IN THE CORRECT LOCATION USING BOLT PATTERN. TORQUE CAP SCREWS TO 50 FT-LBS. LOCATE CLAMP BLOCKS TO STAMPED DASH NUMBER ON TEST PLATE FOR RESPECTIVE DUCT SIZE.

A3. PLACE THE BOTTOM HALF (BASE) OF THE SADDLE CLMAP (ITEM 6) ON THE RISER BLOCKS (ITEM 5) AND ALIGN WITH BOLT HOLES USING THE BOLT PATTERN.

A4. PLACE TEST ARTICLE (ITEM 2) INTO THE BOTTOM HALF (BASE) OF THE SADDLE CLAMP (ITEM 6). ALIGN THE CENTER OF THE COUPLER WITHIN KEY CHARACTERISTICS DIMENSION "DI" AS SHOWN. DI DIMENSION DEFINES LOCATION OF COUPLER AT CENTER BETWEEN TWO END RISER BLOCKS WHEN END TUBES FULLY EXTENDED.

A5. INSTALL THE TOP HALF (STRAP) OF THE SADDLE CLAMP (ITEM 6) USING THE 10-32 CAP SCREW (ITEM 7) AND WASHERS (ITEM 8) PER PART LIST TABLE (FINGER TIGHT). TORQUE TO 32 IN-LBS. PRIOR TO TORQUEING, ENSURE KEY CHARACTERISTICS DIMENSIONS AS SHOWN.

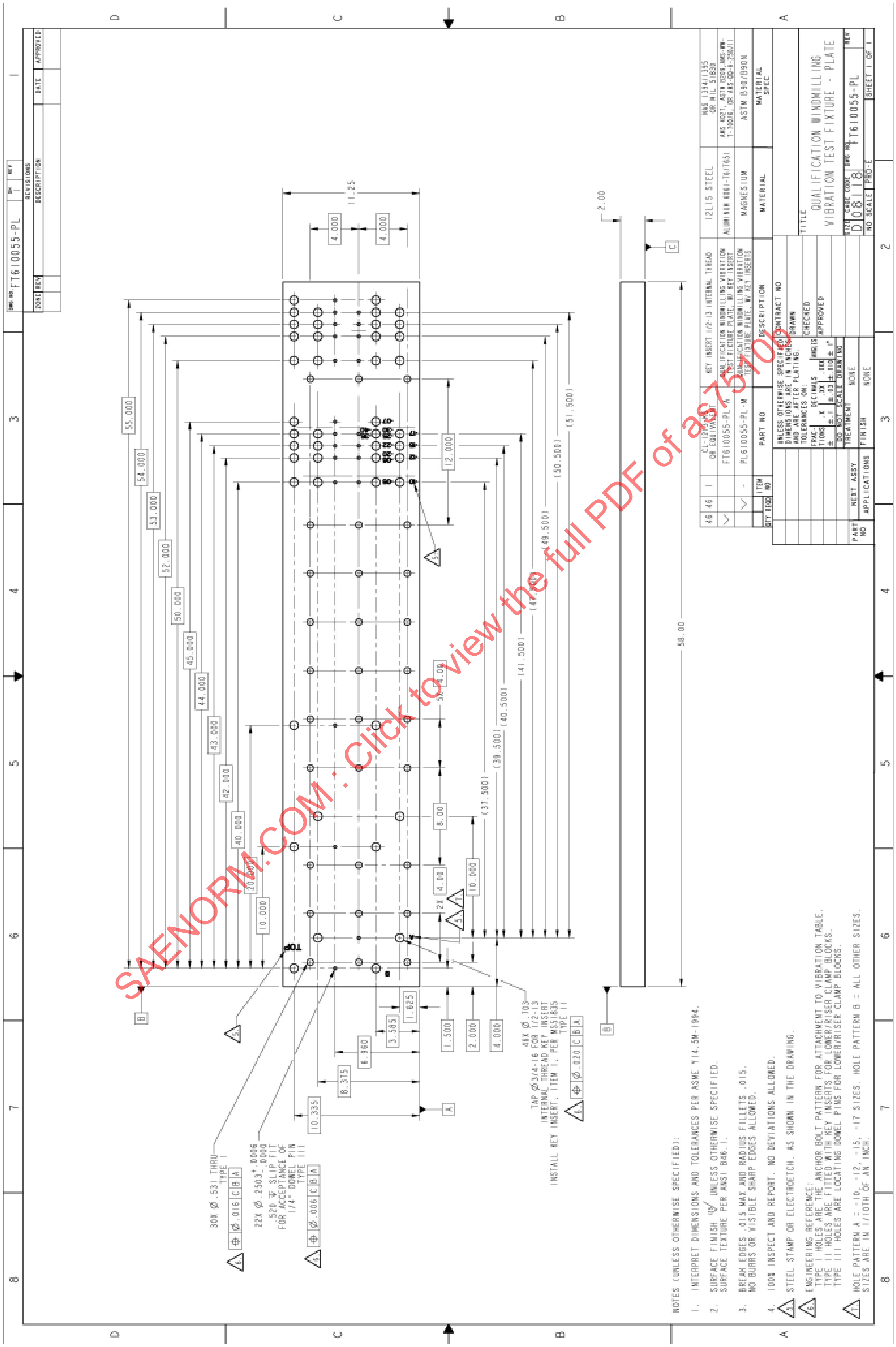
A6. FIXTURING ALLOWS VARIANCE IN PLACEMENT OF TUBES. MEASURE AND RECORD ALL KEY CHARACTERISTICS. IF ANY DIMENSIONS ARE OUT OF REQUIREMENT REPEAT SETUP STEPS AS NEEDED AND/OR CONTACT COGNIZANT ENGINEER.

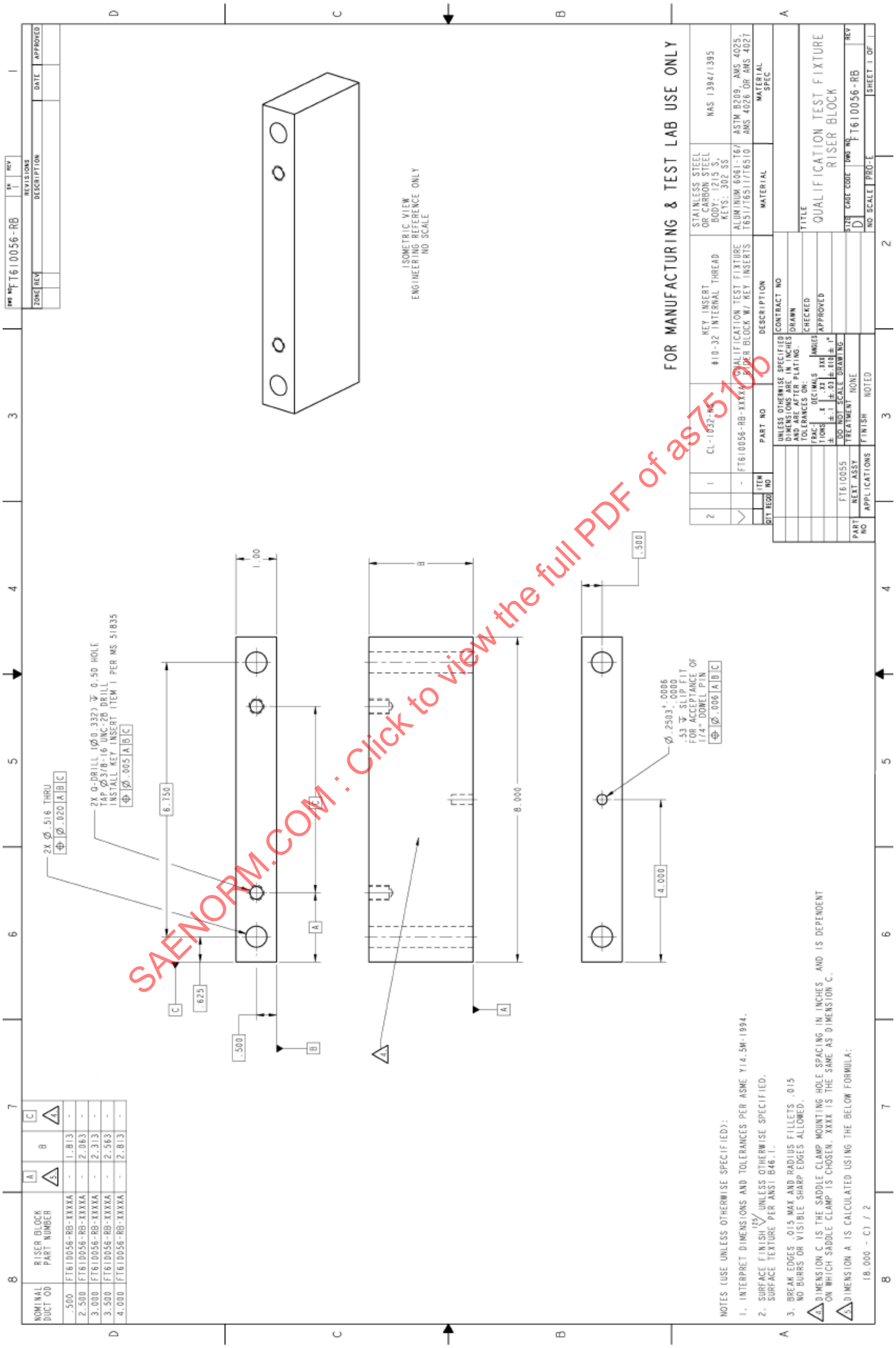
A7. COMPLETE SETUP CHECKLIST AND RETAIN AS NEEDED.

SIZE D	CAGE CODE	DWG NO FT610055	REV
NO SCALE	PRO-E		SHEET 2 OF 2

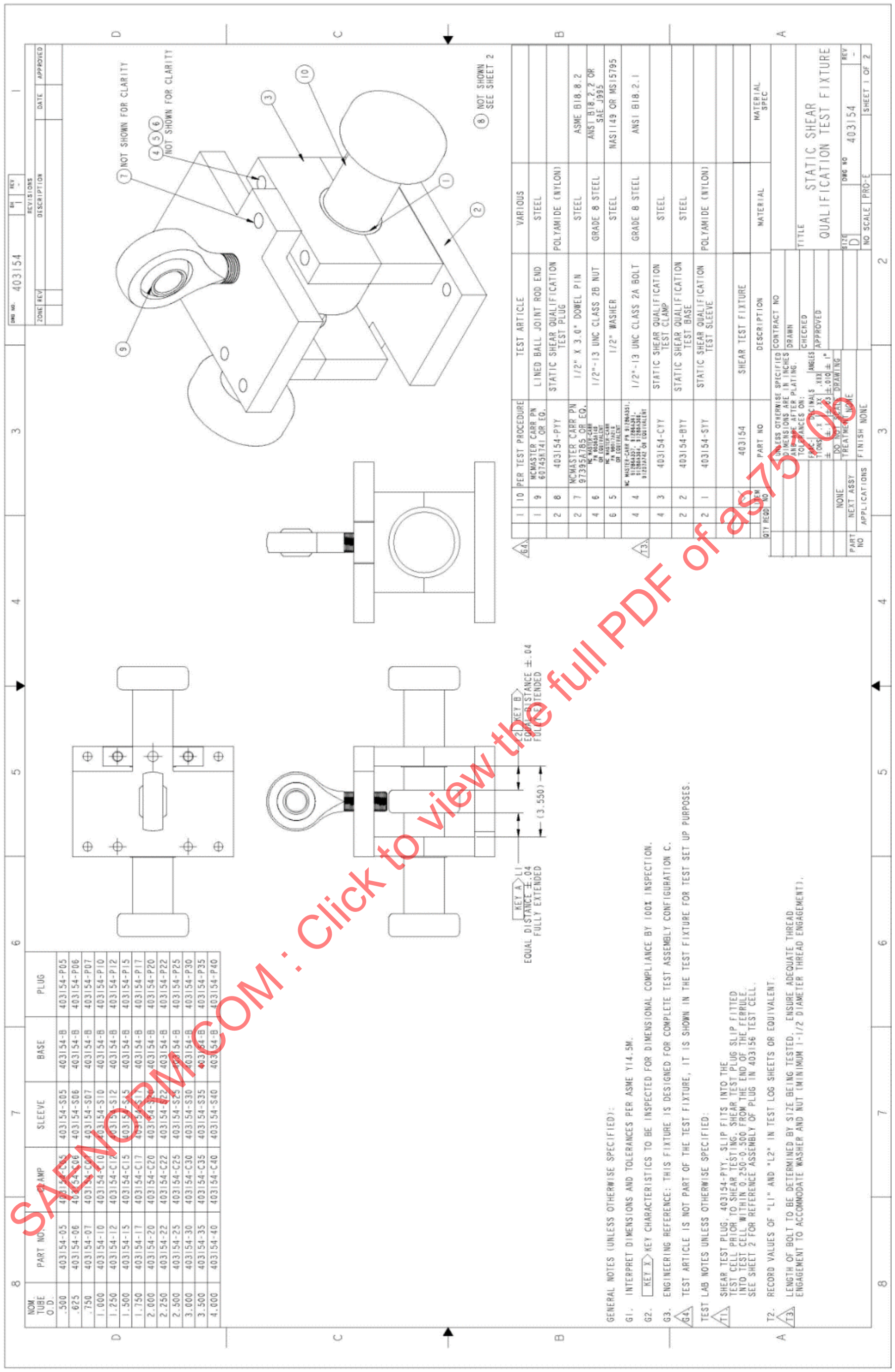
DRAWN
CHECKED
PRO

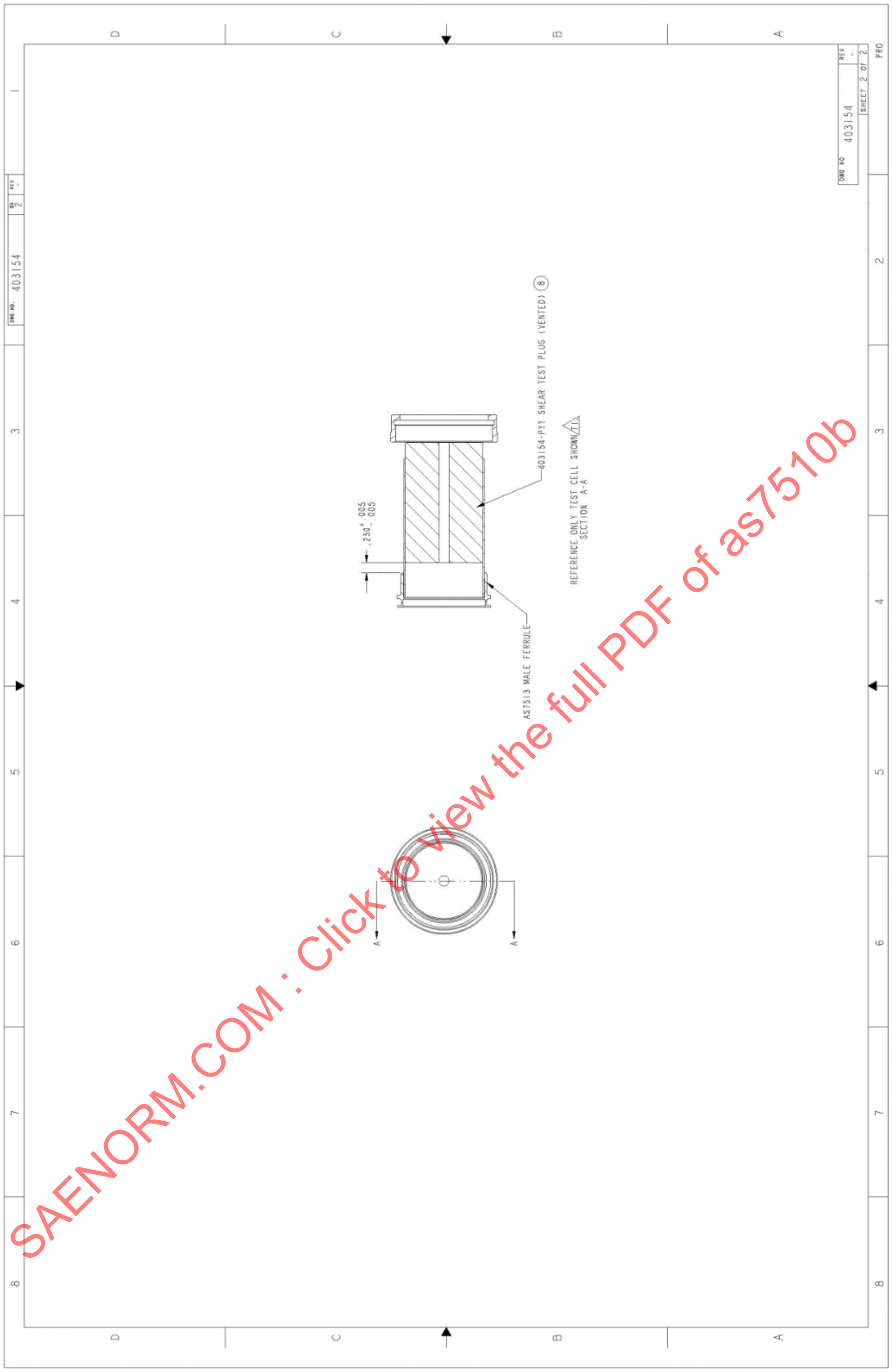
B.6 RANDOM VIBRATION AND WINDMILLING VIBRATION TEST FIXTURE SUBCOMPONENT DRAWINGS



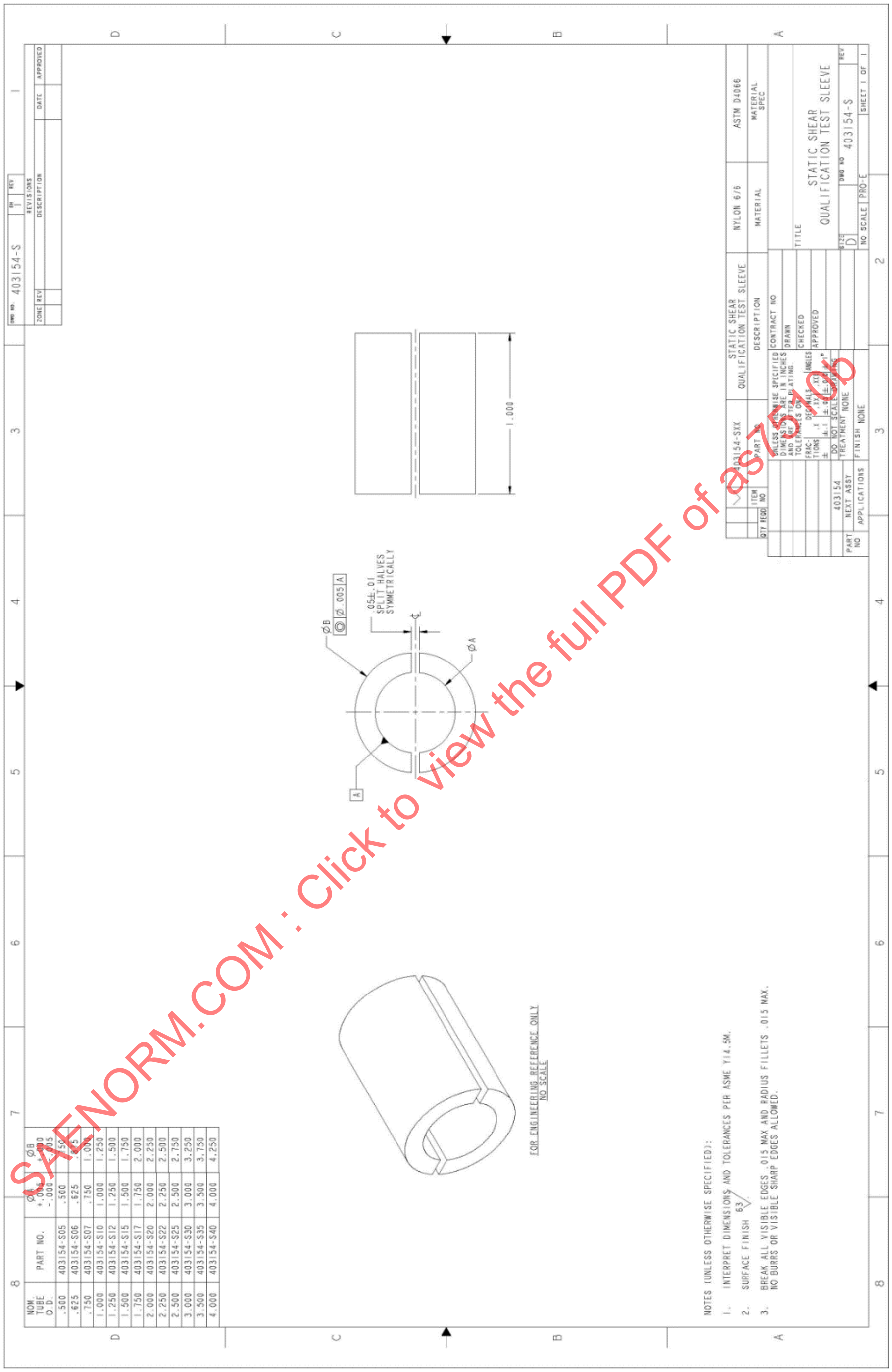

FOR MANUFACTURING & TEST LAB USE ONLY
ISOMETRIC VIEW
ENGINEERING REFERENCE ONLY
NO SCALE
2X Ø.516 THRU
2X Q-DRILL (Ø0.332) ⊽ 0.50 HOLE
TAP Ø3/8-16 UNC-2B DRILL
INSTALL KEY INSERT ITEM 1 PER MS 51835
Ø.2503 +.0006 -.0000
.53 ⊽ SLIP FIT
FOR ACCEPTANCE OF
1/4" DOWEL PIN
6.750
8.000
4.000
1.00
.500
.625
KEY INSERT
#10-32 INTERNAL THREAD
QUALIFICATION TEST FIXTURE
RISER BLOCK W/ KEY INSERTS
STAINLESS STEEL
OR CARBON STEEL
ALUMINUM 6061-T6/
T651/T6511/T6510
NAS 1394/1395
ASTM B209, AMS 4025,
AMS 4026 OR AMS 4027
QUALIFICATION TEST FIXTURE
RISER BLOCK
FT610056-RB
FT610055
NOMINAL DUCT OD
RISER BLOCK PART NUMBER
NOTES (USE UNLESS OTHERWISE SPECIFIED):
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
2. SURFACE FINISH 125 UNLESS OTHERWISE SPECIFIED.
SURFACE TEXTURE PER ANSI B46.1.
3. BREAK EDGES .015 MAX AND RADIUS FILLETS .015
NO BURRS OR VISIBLE SHARP EDGES ALLOWED.
4 DIMENSION C IS THE SADDLE CLAMP MOUNTING HOLE SPACING IN INCHES AND IS DEPENDENT
ON WHICH SADDLE CLAMP IS CHOSEN. XXXX IS THE SAME AS DIMENSION C.
5 DIMENSION A IS CALCULATED USING THE BELOW FORMULA:
(8.000 - C) / 2

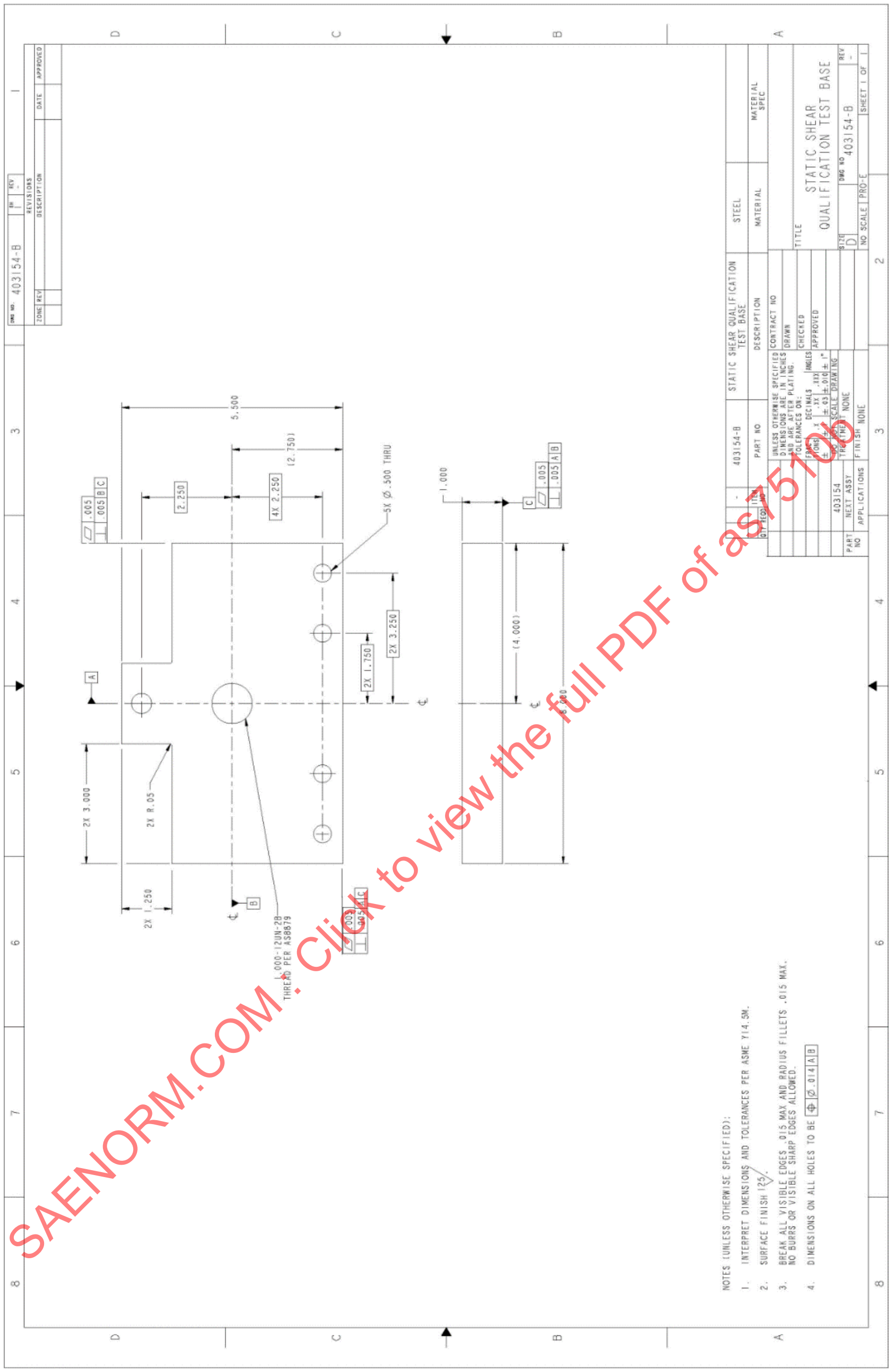
B.7 STATIC SHEAR TEST FIXTURE TOP ASSEMBLY

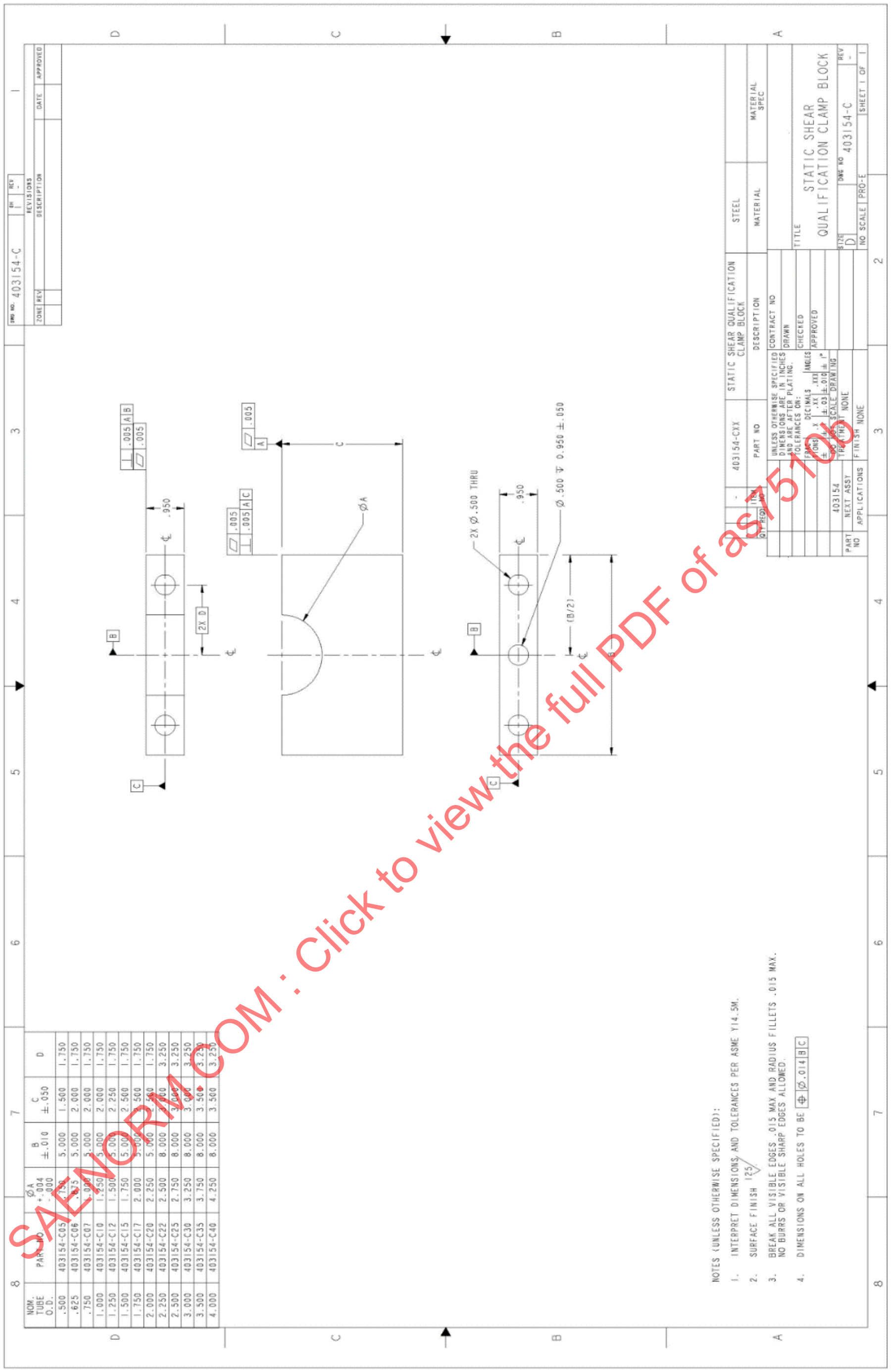


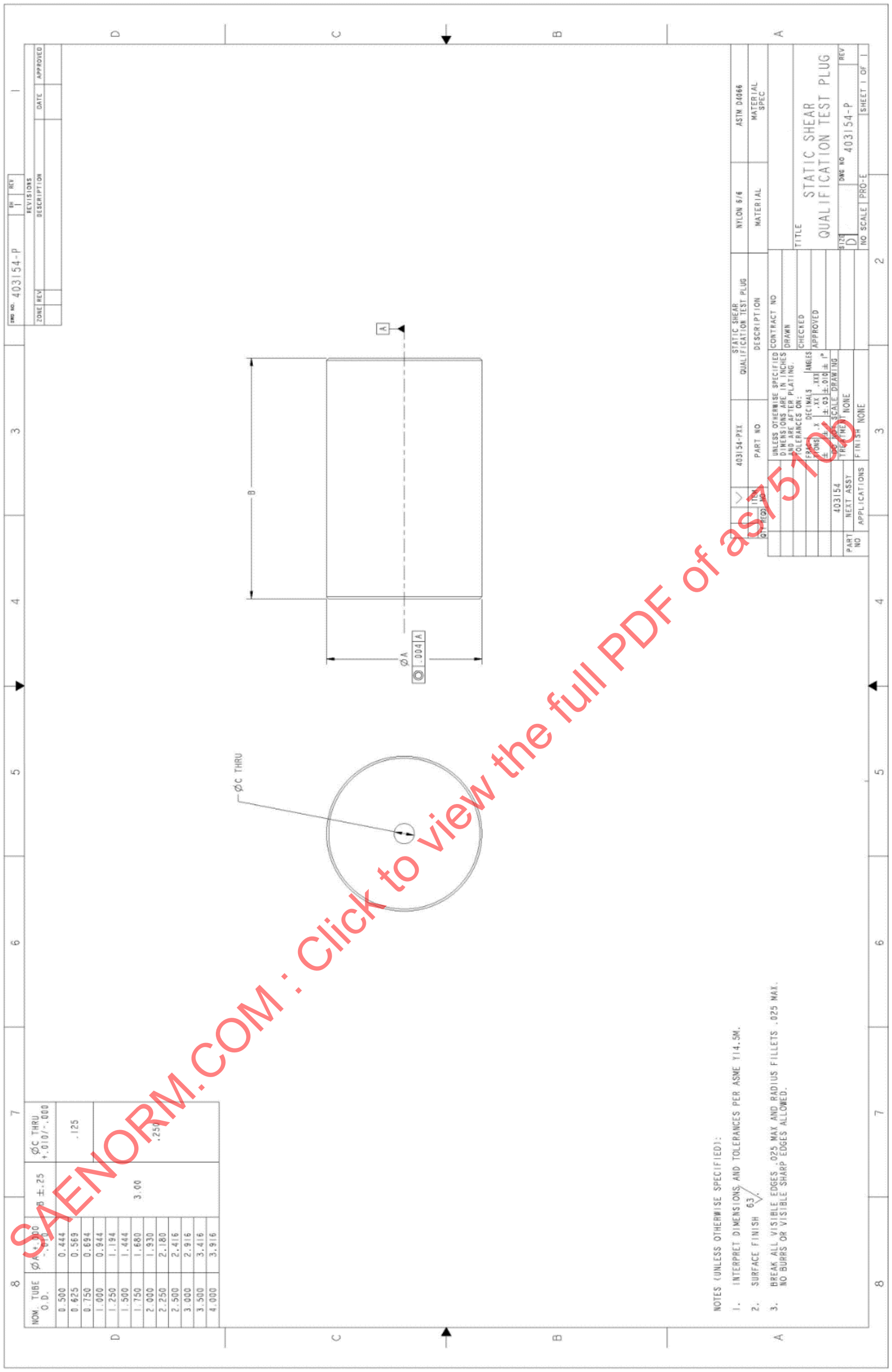

403154-PYY SHEAR TEST PLUG (VENTED)
AS7513 MALE FERRULE
REFERENCE ONLY TEST CELL SHOWN
SECTION A-A
403154
SHEET 2 OF 2

B.8 STATIC SHEAR TEST FIXTURE SUBCOMPONENT DRAWINGS

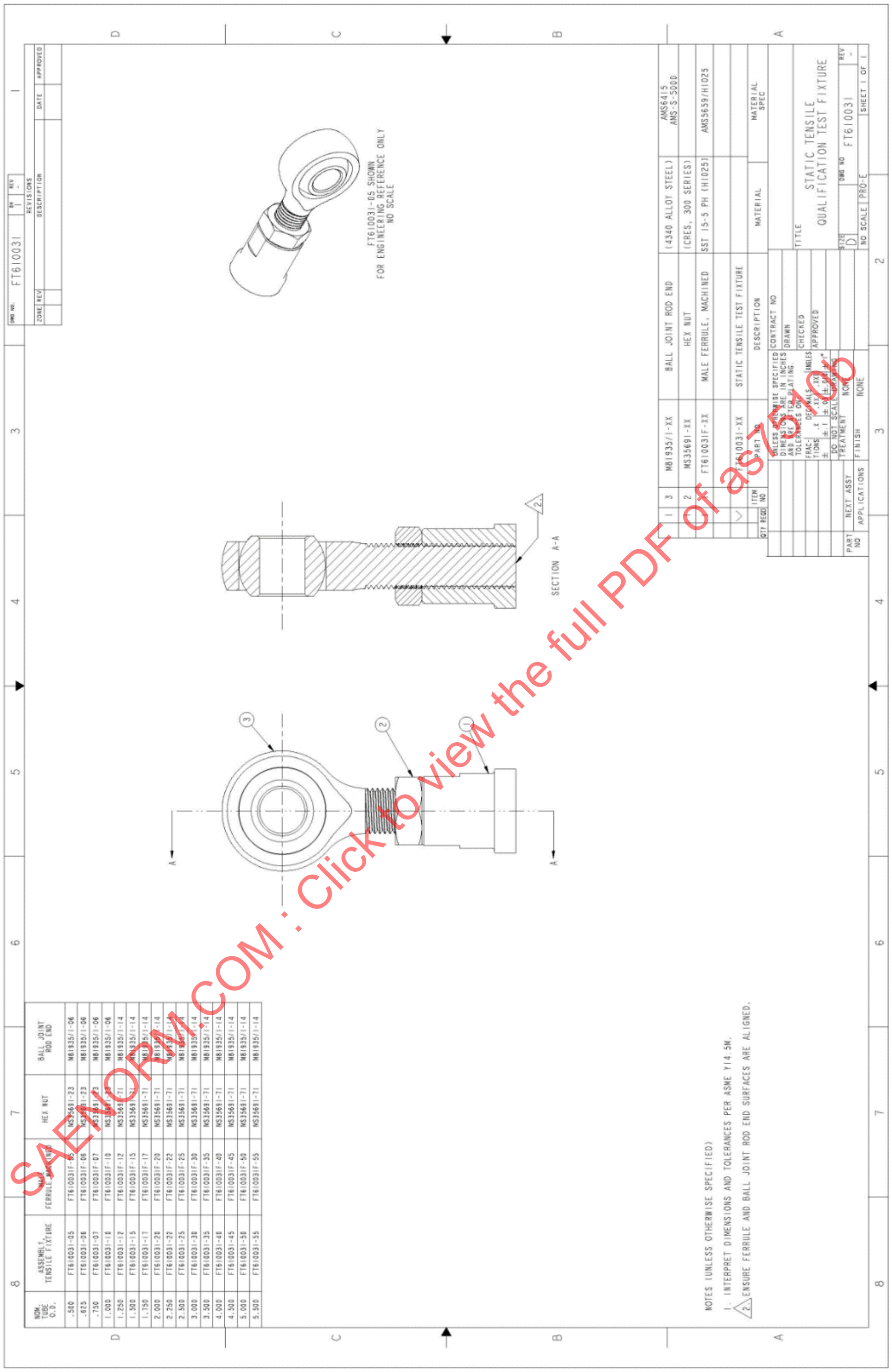



STATIC SHEAR QUALIFICATION TEST BASE
DWG NO 403154-B
403154-B
STEEL
5X Ø.500 THRU
1.000-12UN-2B THREAD PER AS8879
NOTES (UNLESS OTHERWISE SPECIFIED):
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M.
2. SURFACE FINISH 125.
3. BREAK ALL VISIBLE EDGES .015 MAX AND RADIUS FILLETS .015 MAX. NO BURRS OR VISIBLE SHARP EDGES ALLOWED.
4. DIMENSIONS ON ALL HOLES TO BE ⌖ Ø.014 A B

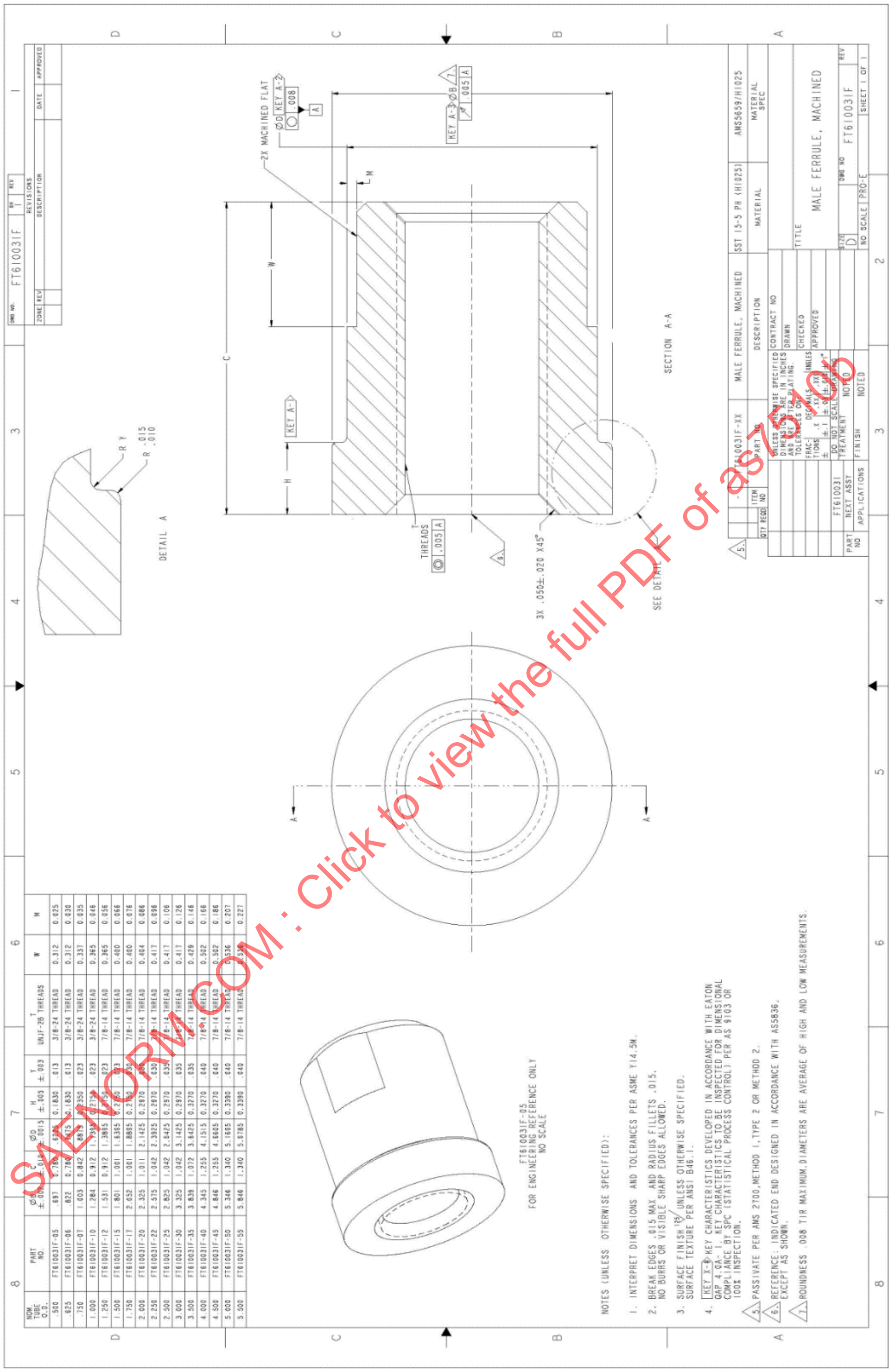

STATIC SHEAR QUALIFICATION CLAMP BLOCK
403154-C
STEEL


STATIC SHEAR QUALIFICATION TEST PLUG
403154-P
NYLON 6/6
ASTM D4066
ØC THRU
NOTES (UNLESS OTHERWISE SPECIFIED):
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M.
2. SURFACE FINISH 63
3. BREAK ALL VISIBLE EDGES .025 MAX AND RADIUS FILLETS .025 MAX. NO BURRS OR VISIBLE SHARP EDGES ALLOWED.

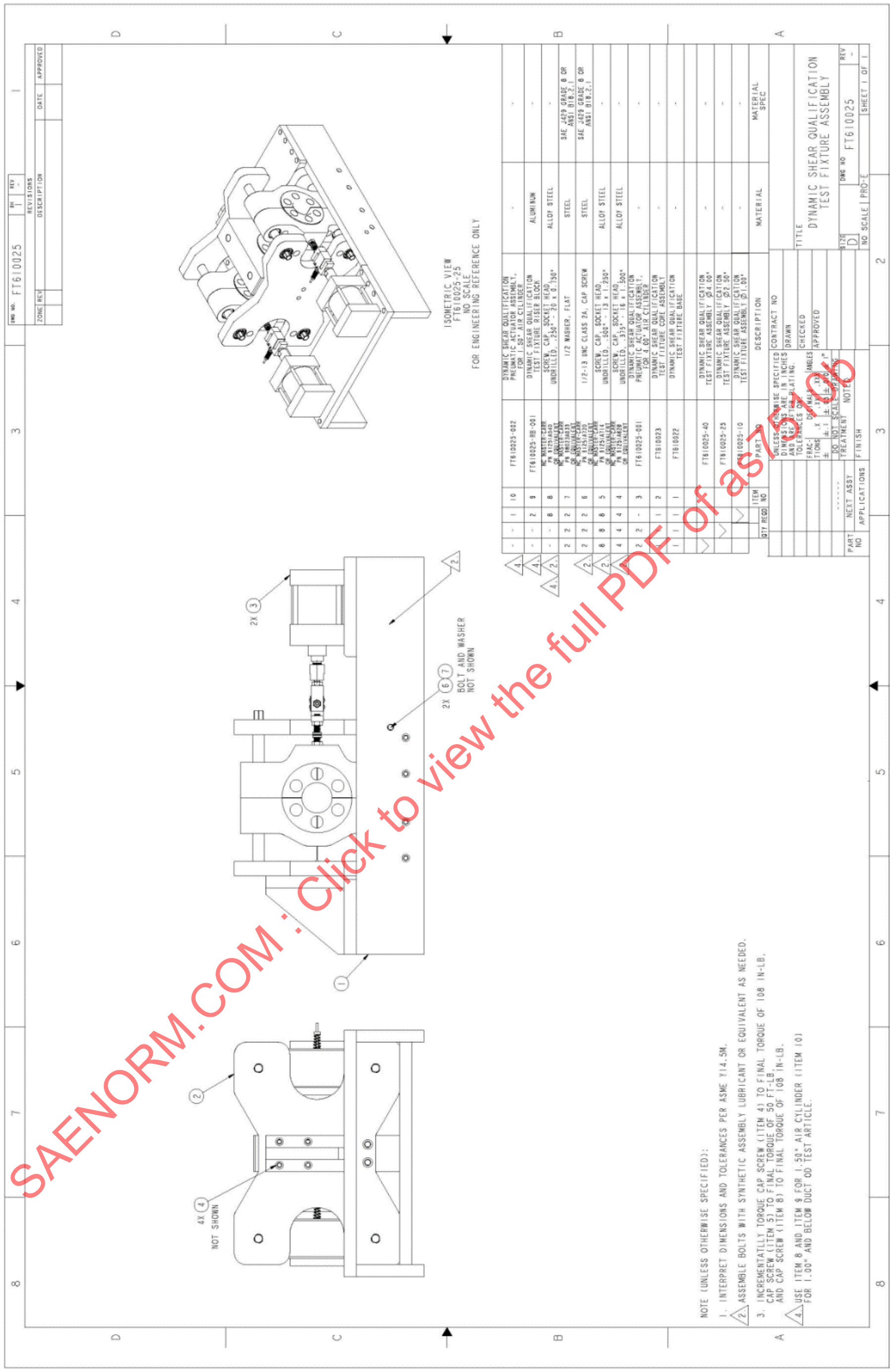
B.9 STATIC TENSILE TEST FIXTURE TOP ASSEMBLY



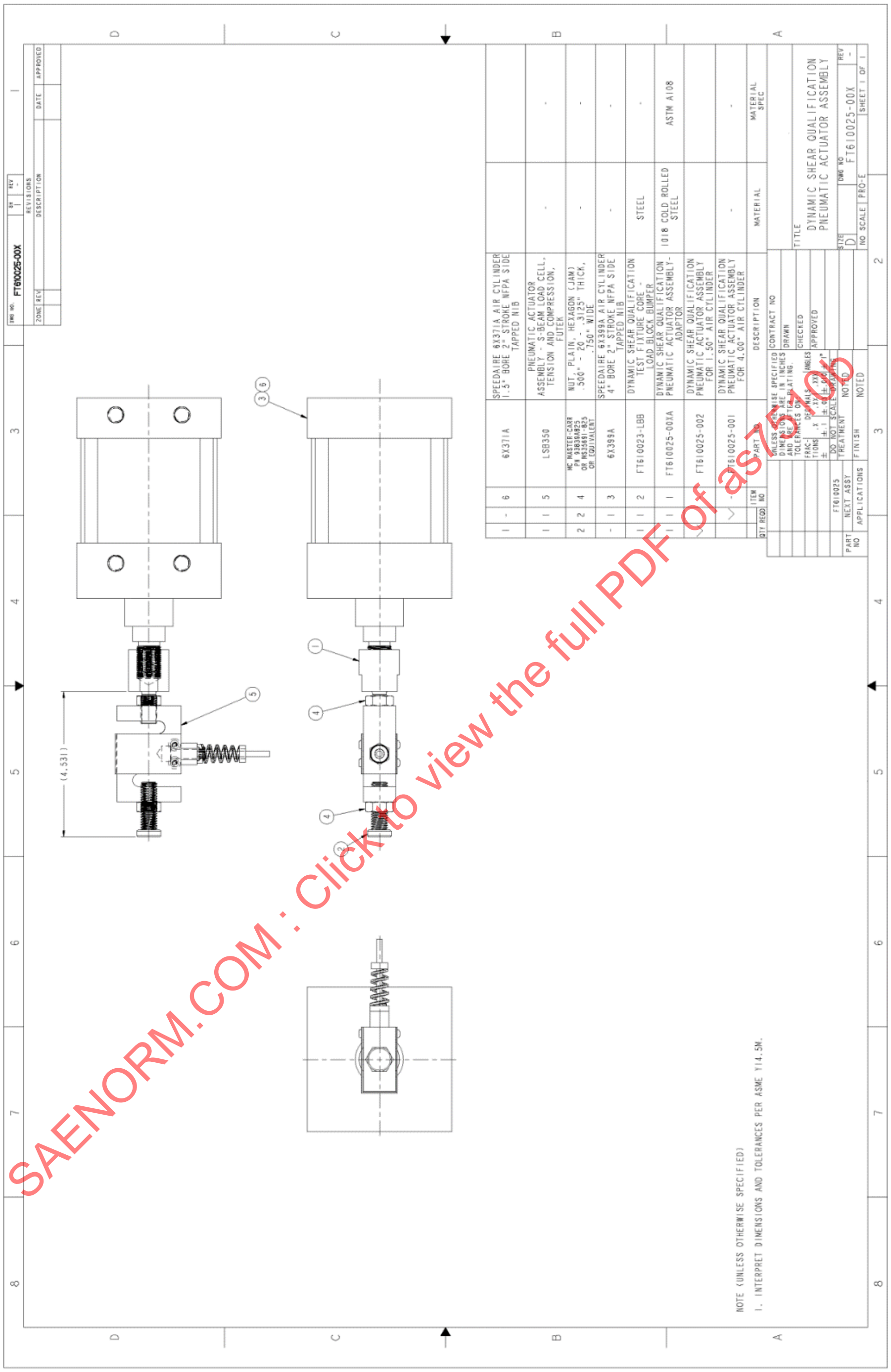
B.10 STATIC TENSILE TEST FIXTURE SUBCOMPONENT DRAWINGS

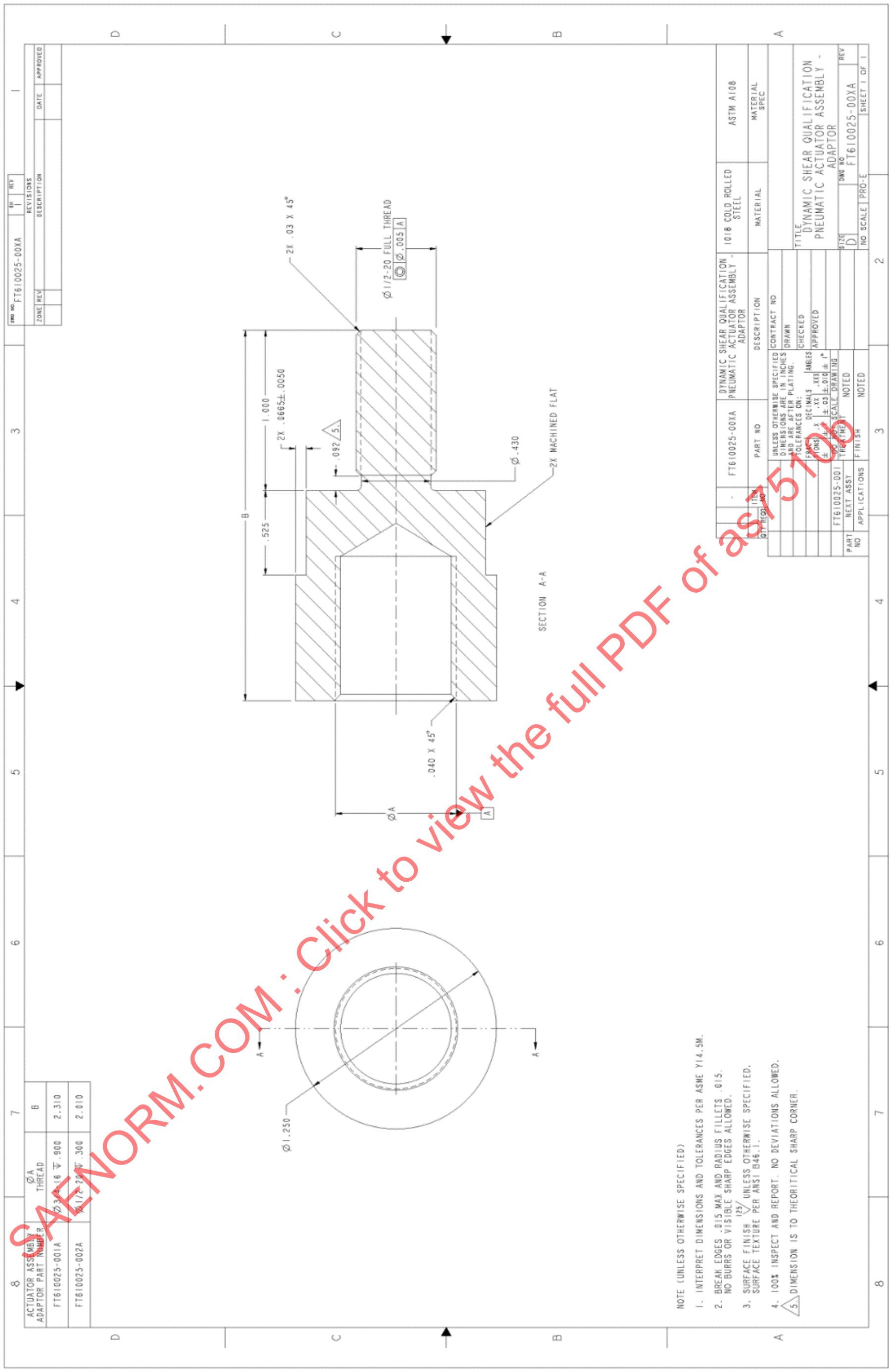


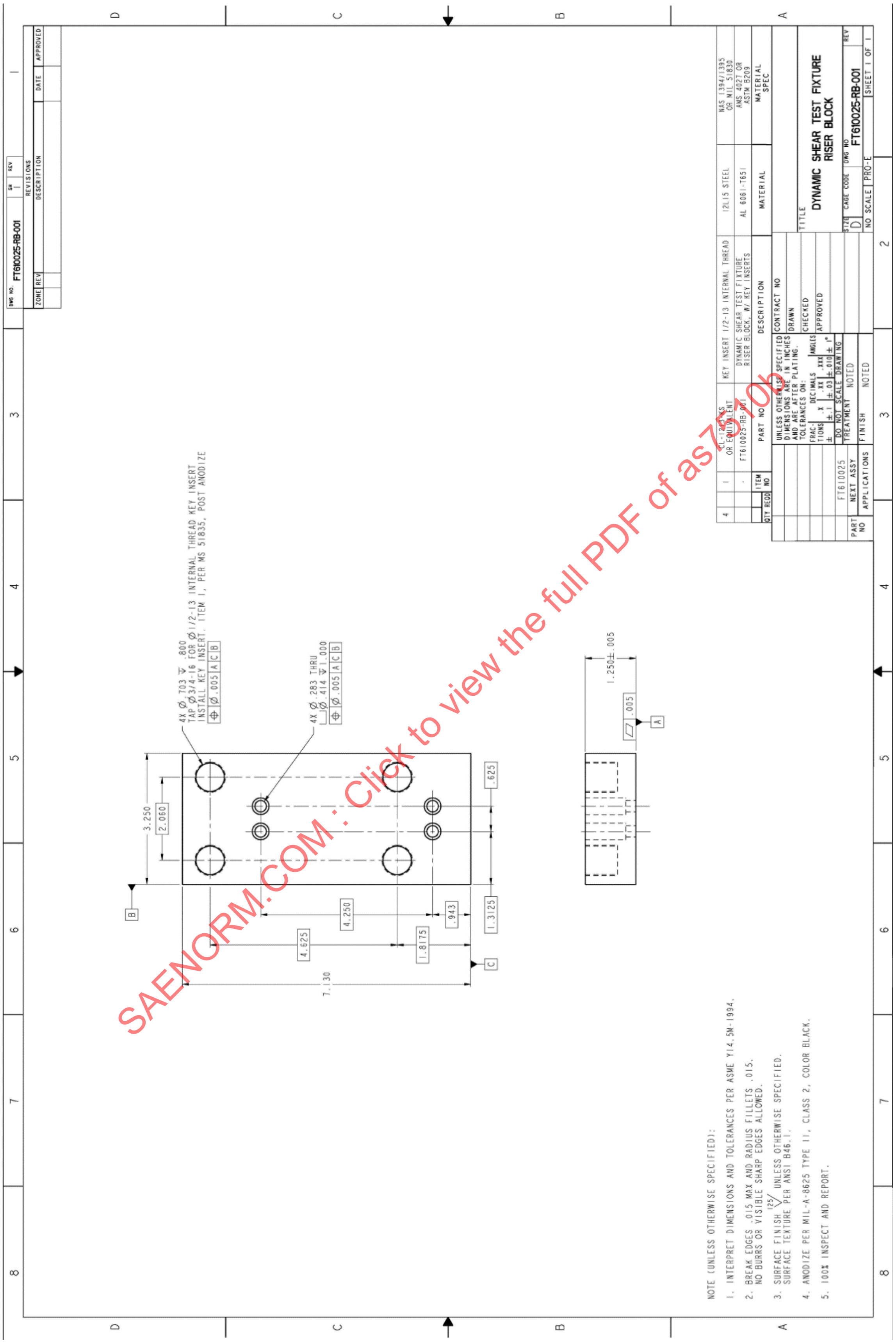
B.11 DYNAMIC SHEAR TEST FIXTURE TOP ASSEMBLY



B.12 DYNAMIC SHEAR TEST FIXTURE SUBCOMPONENT DRAWINGS



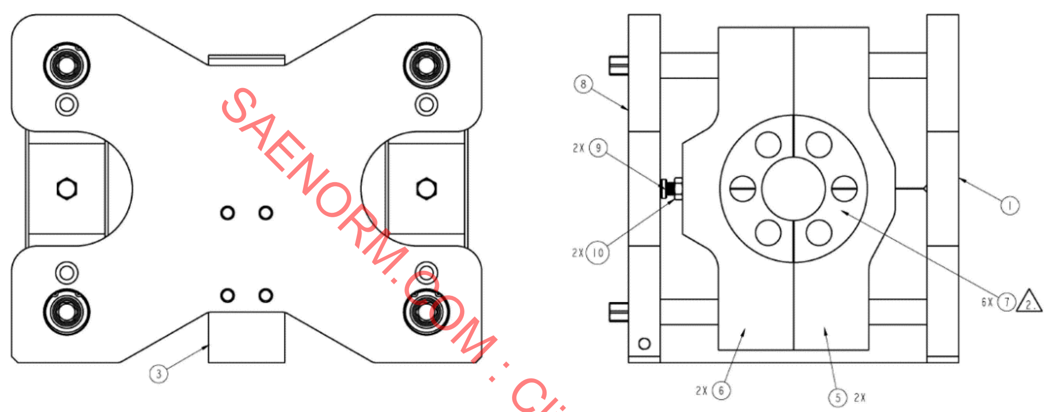

DYNAMIC SHEAR QUALIFICATION PNEUMATIC ACTUATOR ASSEMBLY - ADAPTOR
FT610025-00XA
1018 COLD ROLLED STEEL
ASTM A108
SECTION A-A
2X MACHINED FLAT
Ø1/2-20 FULL THREAD
Ø1.250
Ø.430
.040 X 45°
2X .03 X 45°
1.000
.525
NOTE (UNLESS OTHERWISE SPECIFIED)
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M.
4. 100% INSPECT AND REPORT. NO DEVIATIONS ALLOWED.
5 DIMENSION IS TO THEORETICAL SHARP CORNER.


DYNAMIC SHEAR TEST FIXTURE
RISER BLOCK
FT610025-RB-001
NOTE (UNLESS OTHERWISE SPECIFIED):
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
2. BREAK EDGES .015 MAX AND RADIUS FILLETS .015. NO BURRS OR VISIBLE SHARP EDGES ALLOWED.
3. SURFACE FINISH 125 UNLESS OTHERWISE SPECIFIED. SURFACE TEXTURE PER ANSI B46.1.
4. ANODIZE PER MIL-A-8625 TYPE II, CLASS 2, COLOR BLACK.
5. 100% INSPECT AND REPORT.
4X Ø.703 ↧ .800 TAP Ø3/4-16 FOR Ø1/2-13 INTERNAL THREAD KEY INSERT. INSTALL KEY INSERT, ITEM 1, PER MS 51835, POST ANODIZE
4X Ø.283 THRU
Ø.414 ↧ 1.000
3.250
2.060
4.625
4.250
7.130
1.8175
.943
1.3125
.625
1.250±.005
.005
KEY INSERT 1/2-13 INTERNAL THREAD
12L15 STEEL
NAS 1394/1395 OR MIL 51830
DYNAMIC SHEAR TEST FIXTURE RISER BLOCK, W/ KEY INSERTS
AL 6061-T651
AMS 4027 OR ASTM B209
QTY REQD
ITEM NO
PART NO
DESCRIPTION
MATERIAL
MATERIAL SPEC
FT610025
NEXT ASSY
APPLICATIONS
TREATMENT NOTED
FINISH NOTED
DO NOT SCALE DRAWING
NO SCALE
PRO-E
SHEET 1 OF 1

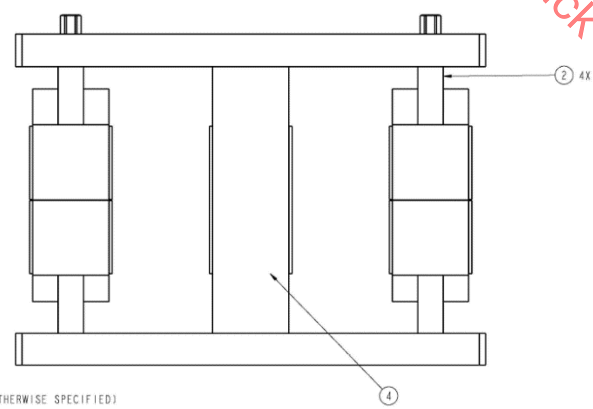
DWG NO.	SH	REV
FT610023 AS7510	1	

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED



NOMINAL DUCT OD	⚠2 LOAD BLOCK PLUG PART NUMBER
.500	FT610023-LBP-05
.625	FT610023-LBP-06
.750	FT610023-LBP-07
1.000	FT610023-LBP-10
1.250	FT610023-LBP-12
1.500	FT610023-LBP-15
1.750	FT610023-LBP-17
2.000	FT610023-LBP-20
2.250	FT610023-LBP-22
2.500	FT610023-LBP-25
3.000	FT610023-LBP-30
3.500	FT610023-LBP-35
4.000	FT610023-LBP-40
4.500	FT610023-LBP-45
5.000	FT610023-LBP-50
5.500	NOT REQUIRED



NOTES	QTY REQD	ITEM NO	PART NO	DESCRIPTION	MATERIAL	MATERIAL SPEC
⚠3 ⚠4	4	13	MC MASTER-CARR PN 91251A720 OR EQUIVALENT	SOCKET HEAD CAP SCREWS .5000" - 13 UNC x 2.000"	STAINLESS STEEL	-
⚠3 ⚠4	6	12	MC MASTER-CARR PN 91251A724 OR EQUIVALENT	SOCKET HEAD CAP SCREWS .500" - 13 UNC x 3.000"	STAINLESS STEEL	-
⚠3 ⚠4	4	11	MC MASTER-CARR PN 91251A714 OR EQUIVALENT	SOCKET HEAD CAP SCREWS .5000" - 13 UNC x 1.250"	STAINLESS STEEL	-
	2	10	MC MASTER-CARR PN 93839A825 OR EQUIVALENT	NUT, PLAIN, HEXAGON (JAM) .500"-20-.3125" THICK-.750"	-	-
	2	9	FT610023-LBB	DYNAMIC SHEAR TEST FIXTURE CORE - LOAD BLOCK BUMPER	-	-
⚠5	1	8	FT610023-FPA	DYNAMIC SHEAR TEST FIXTURE CORE - FRONT PLATE ASSEMBLY	-	-
⚠2	6	7	FT610023-LBP-XX	DYNAMIC SHEAR TEST FIXTURE CORE - LOAD BLOCK PLUG	AL 6061-T651	AMS 4027 OR ASTM B209
⚠5	2	6	FT610023-LBA-A	DYNAMIC SHEAR TEST FIXTURE CORE - LOAD BLOCK ASSEMBLY - A	-	-
⚠5	2	5	FT610023-LBA-B	DYNAMIC SHEAR TEST FIXTURE CORE - LOAD BLOCK ASSEMBLY - B	-	-
	1	4	FT610023-SBA-A	DYNAMIC SHEAR TEST FIXTURE CORE - STATIONARY BLOCK ASSEMBLY - A	-	-
	1	3	FT610023-SBA-B	DYNAMIC SHEAR TEST FIXTURE CORE - STATIONARY BLOCK ASSEMBLY - B	-	-
	4	2	FT610023-LBR	DYNAMIC SHEAR TEST FIXTURE CORE - LINEAR BEARING ROD	AL 6061-T651	ASTM B209 OR AMS 4027
	1	1	FT610023-BP	DYNAMIC SHEAR TEST FIXTURE CORE - BASE PLATE	AL 6061-T651	ASTM B209 OR AMS 4027
	✓	-	FT610023	DYNAMIC SHEAR TEST FIXTURE CORE ASSEMBLY	-	-

NOTE (UNLESS OTHERWISE SPECIFIED)

1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.

⚠2 USE FT610023-LBP-XX PER MATING DUCT OD. FOR DUCT OD 5.500, FT610023-LBP-XX IS NOT REQUIRED.

⚠3 ASSEMBLE BOLTS WITH SYNTHETIC ASSEMBLY LUBRICANT OR EQUIVALENT AS NEEDED.

⚠4 INCREMENTATLLY TORQUE BOLTS, ITEM 11, ITEM 12 AND ITEM 13 TO FINAL TORQUE OF 50 FT-LB.

⚠5 USE OF LOCTITE 660 IS OPTIONAL AS INSTRUCTED ON FT610023-FPA (ITEM 8), FT610023-LBA-A (ITEM 6) AND FT610023-LBA-B (ITEM 5). IF APPLIED, ENSURE FREE MOVEMENT OF LOAD BLOCK ASSEMBLIES (ITEM 5 AND ITEM 6) OVER LINEAR ROD (ITEM 2).

PART NO	FT610025 NEXT ASSY	APPLICATIONS

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND ARE AFTER PLATING. TOLERANCES ON: FRAC-TIONS ± ; DECIMALS .X ±.1, .XX ±.03, .XXX ±.010; ANGLES ± 1°

DO NOT SCALE DRAWING

TREATMENT: NOTED

FINISH: NOTED

CONTRACT NO

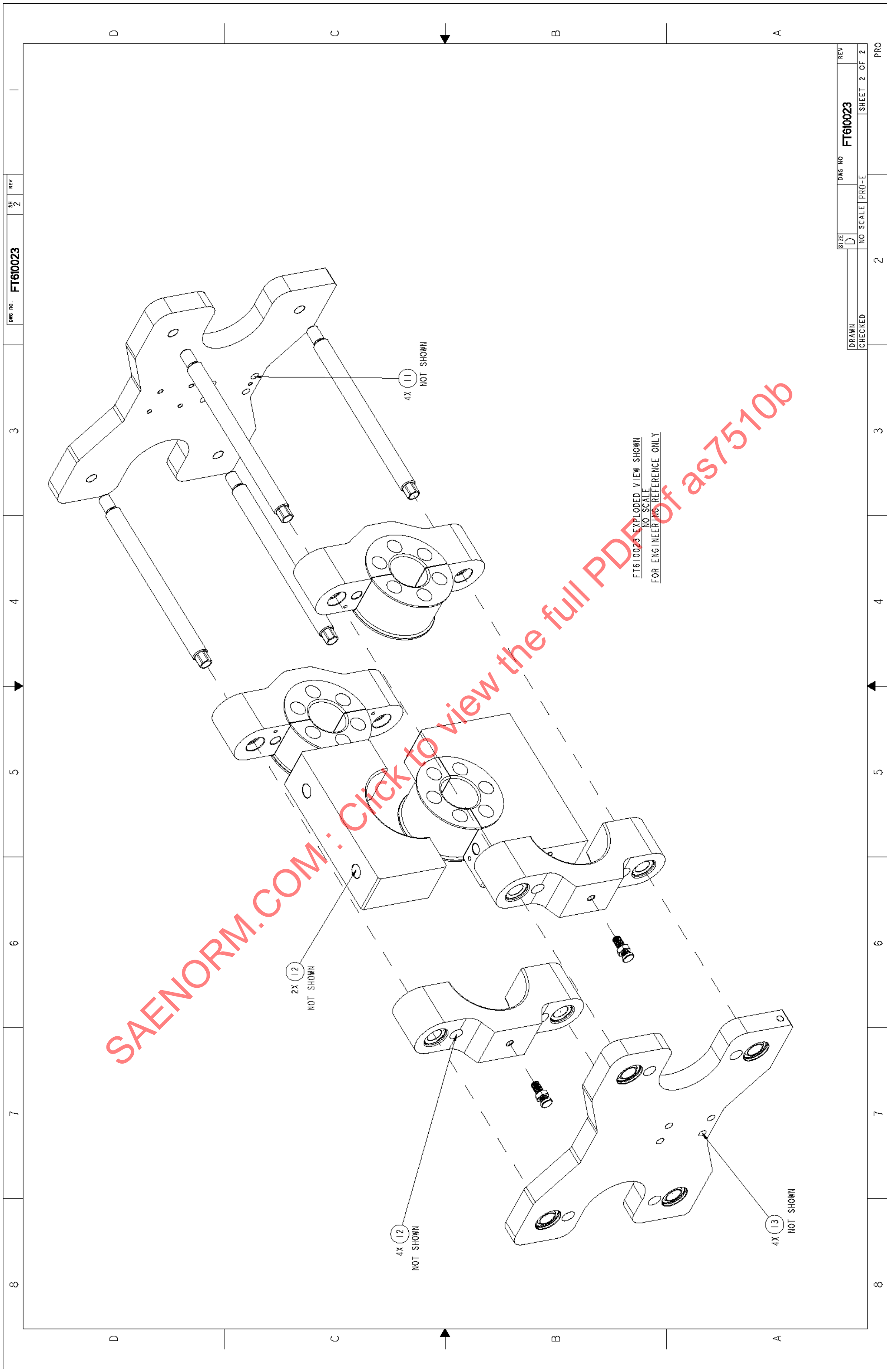
DRAWN

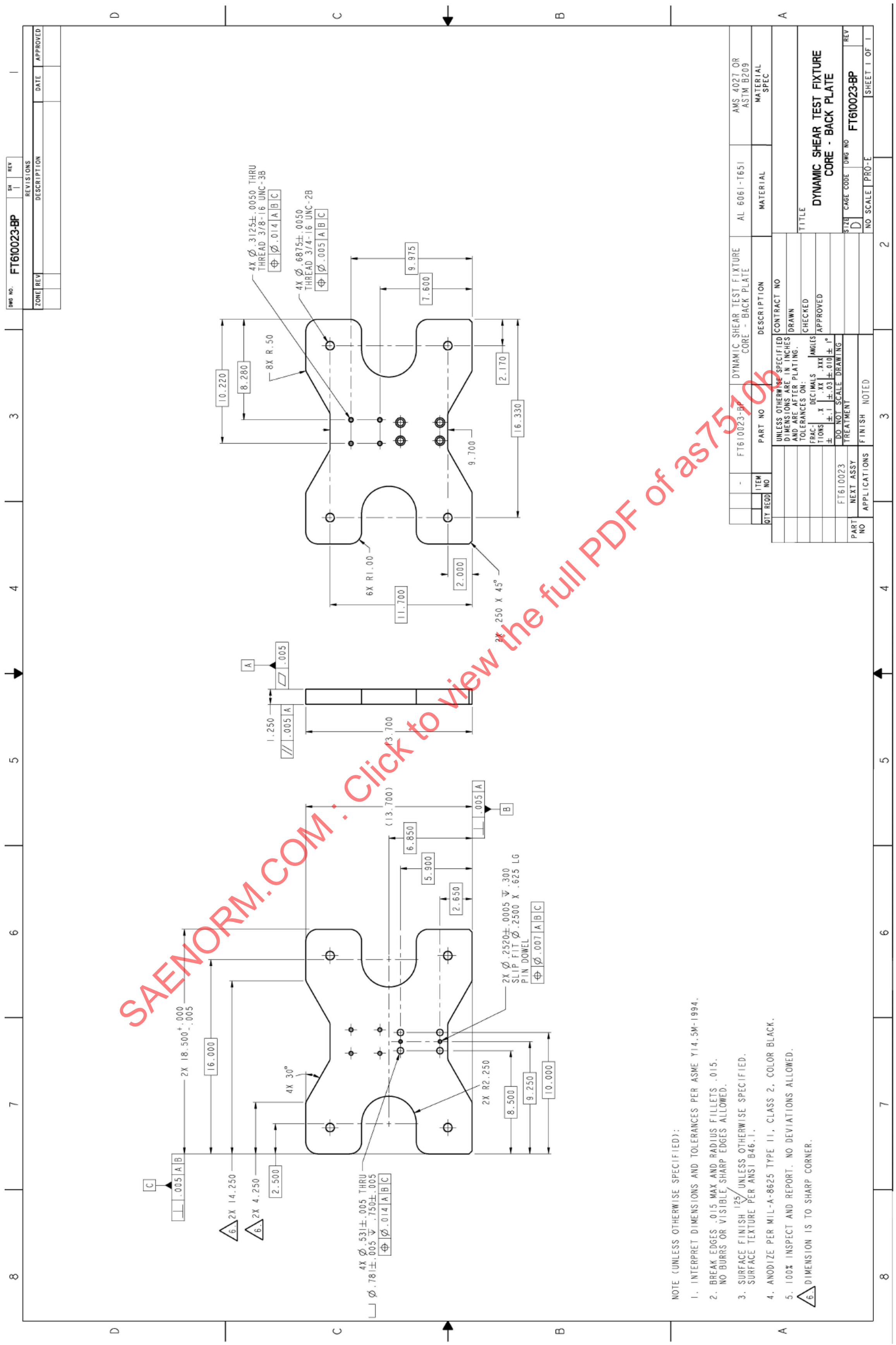
CHECKED

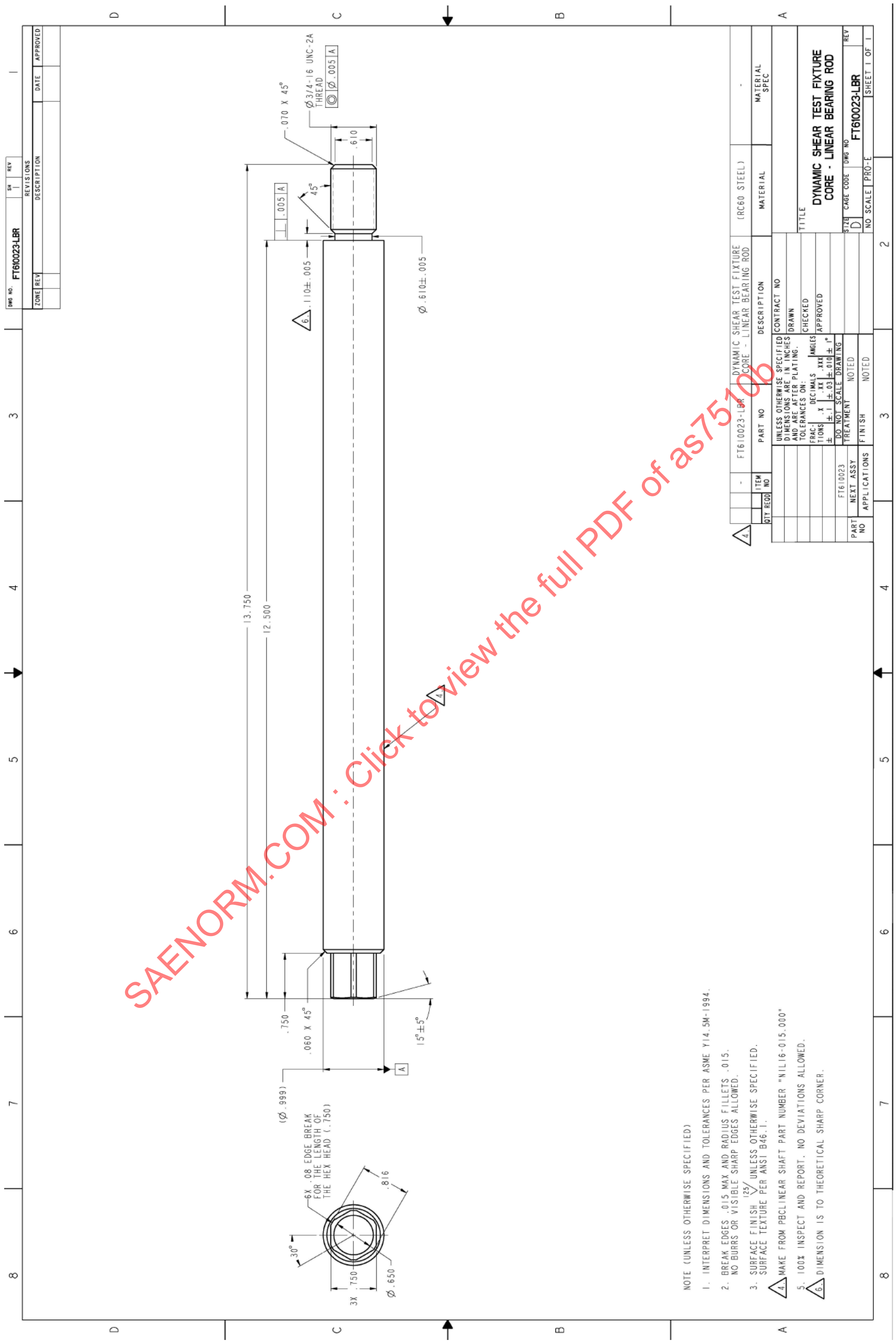
APPROVED

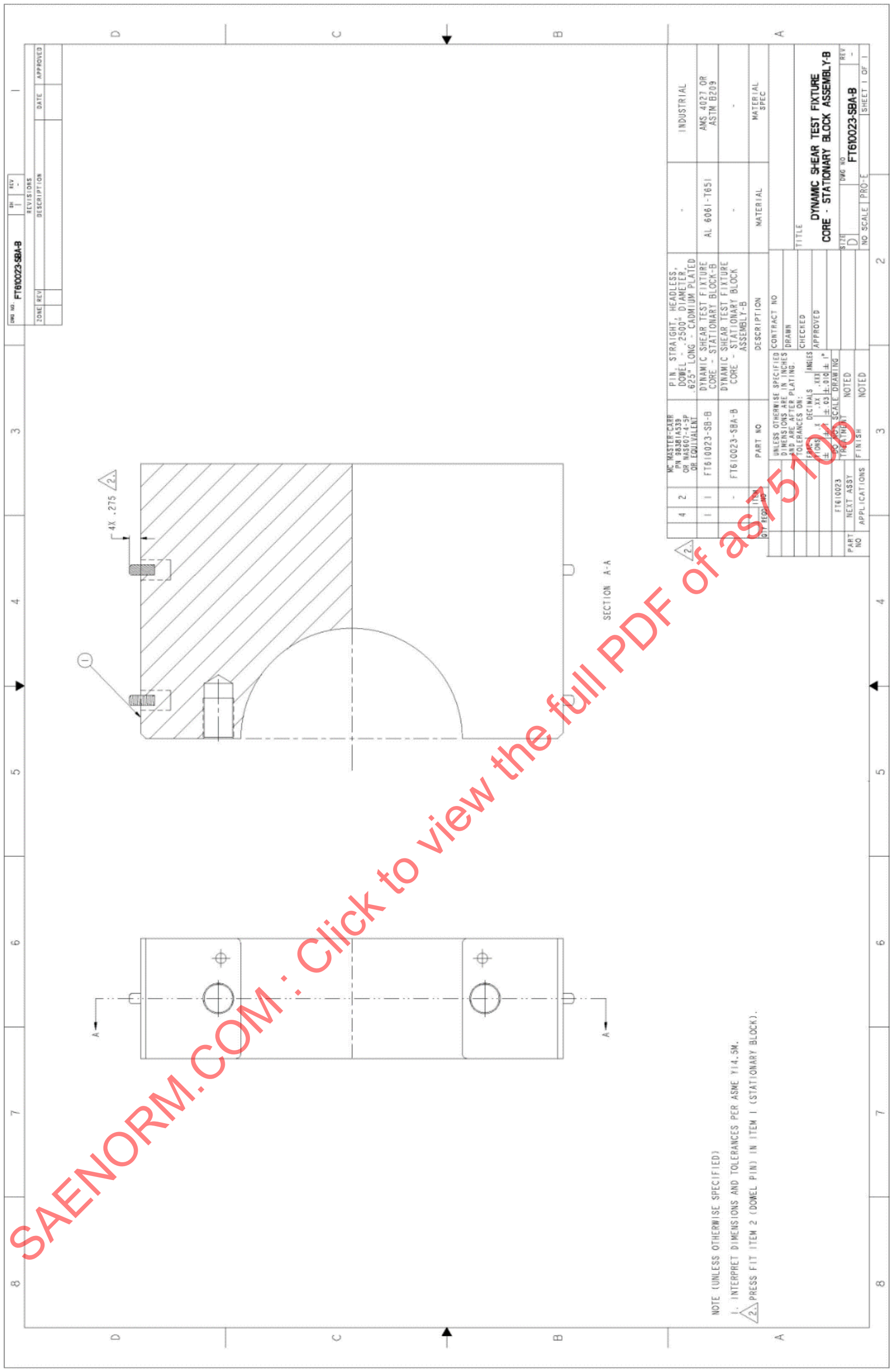
TITLE: DYNAMIC SHEAR TEST FIXTURE CORE ASSEMBLY

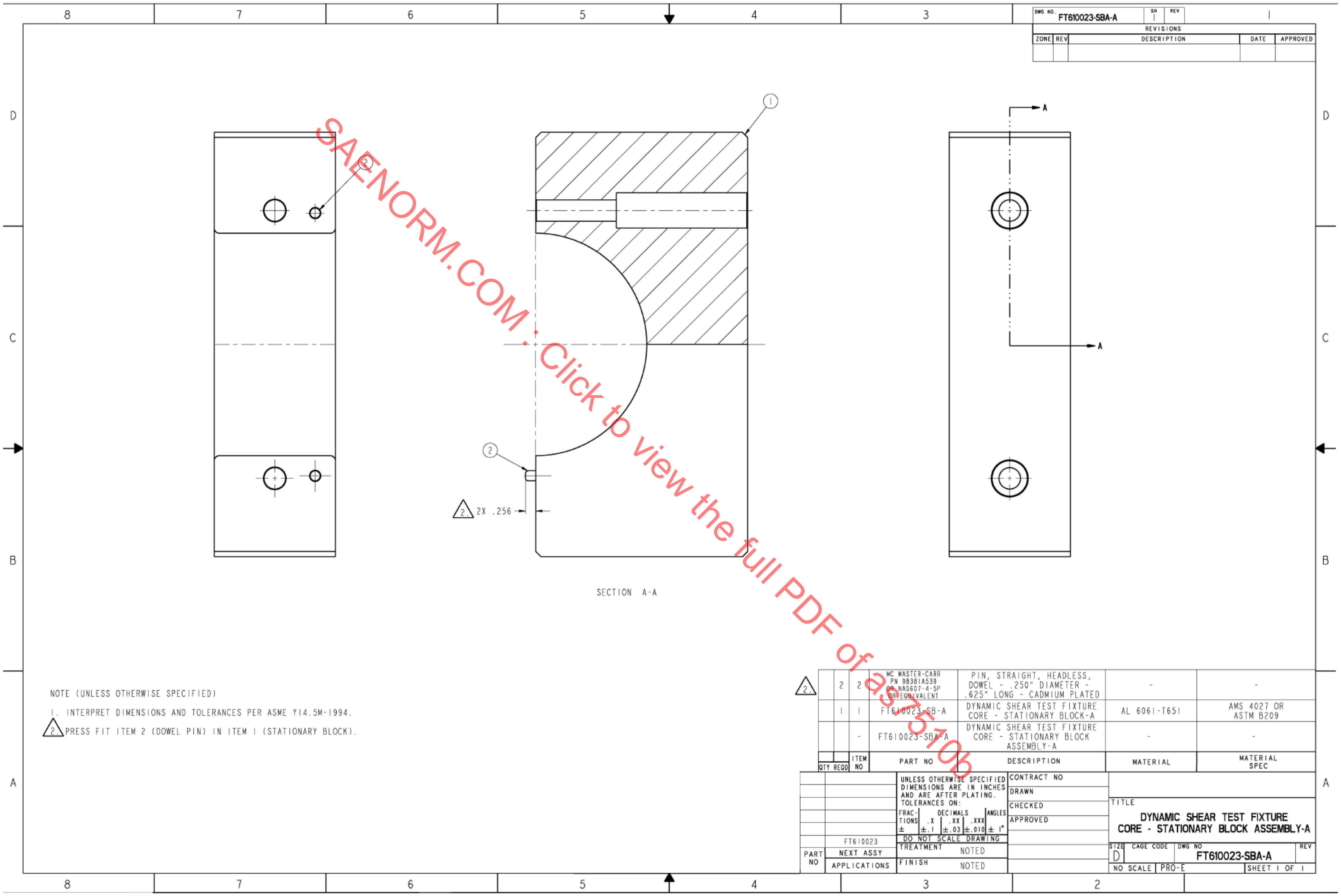
SIZE	CAGE CODE	DWG NO	REV
D		FT610023	
NO SCALE	PRO-E		SHEET 1 OF 2


FT610023 EXPLODED VIEW SHOWN
NO SCALE
FOR ENGINEERING REFERENCE ONLY
4X 11 NOT SHOWN
2X 12 NOT SHOWN
4X 12 NOT SHOWN
4X 13 NOT SHOWN
DWG NO FT610023
SHEET 2 OF 2
NO SCALE
PRO-E
SIZE D
DRAWN
CHECKED


FT610023-BP
REVISIONS
DYNAMIC SHEAR TEST FIXTURE CORE - BACK PLATE
AL 6061-T651
AMS 4027 OR ASTM B209
MATERIAL SPEC
FT610023
NEXT ASSY
APPLICATIONS
NO SCALE
PRO-E
SHEET 1 OF 1
NOTE (UNLESS OTHERWISE SPECIFIED):
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
2. BREAK EDGES .015 MAX AND RADIUS FILLETS .015. NO BURRS OR VISIBLE SHARP EDGES ALLOWED.
3. SURFACE FINISH 125 UNLESS OTHERWISE SPECIFIED. SURFACE TEXTURE PER ANSI B46.1.
4. ANODIZE PER MIL-A-8625 TYPE II, CLASS 2, COLOR BLACK.
5. 100% INSPECT AND REPORT. NO DEVIATIONS ALLOWED.
6 DIMENSION IS TO SHARP CORNER.


NOTE (UNLESS OTHERWISE SPECIFIED)
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
2. BREAK EDGES .015 MAX AND RADIUS FILLETS .015. NO BURRS OR VISIBLE SHARP EDGES ALLOWED.
3. SURFACE FINISH 125 UNLESS OTHERWISE SPECIFIED. SURFACE TEXTURE PER ANSI B46.1.
4 MAKE FROM PBCLINEAR SHAFT PART NUMBER "NIL16-015.000"
5. 100% INSPECT AND REPORT. NO DEVIATIONS ALLOWED.
6 DIMENSION IS TO THEORETICAL SHARP CORNER.
6X .08 EDGE BREAK FOR THE LENGTH OF THE HEX HEAD (.750)
(Ø.999)
30°
.816
3X .750
Ø.650
.750
.060 X 45°
15°±5°
A
13.750
12.500
.110±.005
Ø.610±.005
.005 A
45°
.070 X 45°
Ø3/4-16 UNC-2A THREAD
Ø.005 A
.610
DWG NO. FT610023-LBR
REVISIONS
ZONE REV DESCRIPTION DATE APPROVED
SH REV
DYNAMIC SHEAR TEST FIXTURE CORE - LINEAR BEARING ROD
FT610023-LBR
(RC60 STEEL)
QTY REQD ITEM NO PART NO DESCRIPTION MATERIAL MATERIAL SPEC
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND ARE AFTER PLATING. TOLERANCES ON:
FRAC-TIONS ± DECIMALS .X ±.1 .XX ±.03 .XXX ±.010 ANGLES ±1°
DO NOT SCALE DRAWING
TREATMENT NOTED
FINISH NOTED
CONTRACT NO
DRAWN
CHECKED
APPROVED
FT610023
NEXT ASSY
PART NO
APPLICATIONS
TITLE
DYNAMIC SHEAR TEST FIXTURE CORE - LINEAR BEARING ROD
SIZE D CAGE CODE DWG NO FT610023-LBR REV
NO SCALE PRO-E SHEET 1 OF 1


DYNAMIC SHEAR TEST FIXTURE
CORE - STATIONARY BLOCK ASSEMBLY-B
FT610023-SBA-B
SECTION A-A
4X .275
NOTE (UNLESS OTHERWISE SPECIFIED)
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M.
2. PRESS FIT ITEM 2 (DOWEL PIN) IN ITEM 1 (STATIONARY BLOCK).
PIN, STRAIGHT, HEADLESS-DOWEL - .2500 DIAMETER, .625 LONG - CADMIUM PLATED
DYNAMIC SHEAR TEST FIXTURE CORE - STATIONARY BLOCK-B
AL 6061-T651
AMS 4027 OR ASTM B209
INDUSTRIAL
FT610023-SB-B
PART NO
DESCRIPTION
MATERIAL
MATERIAL SPEC


SECTION A-A
2X .256
NOTE (UNLESS OTHERWISE SPECIFIED)
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
2 PRESS FIT ITEM 2 (DOWEL PIN) IN ITEM 1 (STATIONARY BLOCK).
2 | 2 | MC MASTER-CARR PN 98381A539 OR NAS607-4-5P OR EQUIVALENT | PIN, STRAIGHT, HEADLESS, DOWEL - .250" DIAMETER - .625" LONG - CADMIUM PLATED | - | -
1 | 1 | FT610023-SB-A | DYNAMIC SHEAR TEST FIXTURE CORE - STATIONARY BLOCK-A | AL 6061-T651 | AMS 4027 OR ASTM B209
- | - | FT610023-SBA-A | DYNAMIC SHEAR TEST FIXTURE CORE - STATIONARY BLOCK ASSEMBLY-A | - | -
QTY REQD | ITEM NO | PART NO | DESCRIPTION | MATERIAL | MATERIAL SPEC
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND ARE AFTER PLATING. TOLERANCES ON:
FRAC-TIONS ± | DECIMALS .X ±.1 .XX ±.03 .XXX ±.010 | ANGLES ± 1°
DO NOT SCALE DRAWING
TREATMENT NOTED
FINISH NOTED
CONTRACT NO
DRAWN
CHECKED
APPROVED
FT610023
NEXT ASSY
APPLICATIONS
PART NO
TITLE
DYNAMIC SHEAR TEST FIXTURE
CORE - STATIONARY BLOCK ASSEMBLY-A
SIZE D
CAGE CODE
DWG NO FT610023-SBA-A
REV
NO SCALE
PRO-E
SHEET 1 OF 1
DWG NO. FT610023-SBA-A
REVISIONS
ZONE REV DESCRIPTION DATE APPROVED