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Standard

Space Systems – Metallic Pressure Vessels, Pressurized Structures, and Pressure Components

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American National Standard

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Sponsored by

American Institute of Aeronautics and Astronautics

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Abstract

This Standard provides requirements for the analysis, design, manufacture, qualification, and acceptance for flight of metallic pressure vessels, pressurized structures, and pressure components for use in space systems. The document includes specific requirements addressing pressure vessels with hazardous and non-hazardous failure modes and special pressurized equipment such as batteries, heat pipes, cryostats, and pressure components.

American National Standard

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Foreword

This document was prepared following a draft military standard, Mil-Std-1522B (USAF), dated 14 July 1995, entitled "Requirements for Design and Operation of Pressurized Missile and Space Systems," developed by The Aerospace Corporation, El Segundo, California, under USAF contract F04701-88-C-0089. J.B. Chang was the principal investigator of this development effort. This contract was administered by the Air Force Space and Missile Systems Center (AF/SMC), Los Angeles, California. Dr. L. C-P Huang was the Air Force Project Manager. That military standard was never released officially. This American National Standard is intended to replace the current military standard.

Under the sponsorship of National Aeronautics and Space Administration (NASA) Headquarters, technical staff from Jet Propulsion Laboratory (JPL), Pasadena, California, also participated in the development of Mil-Std-1522B. Dr. M.C. Lou was the team leader.

The AIAA Aerospace Pressure Vessel Standard Working Group operates within the AIAA Structures Committee on Standards. It was formed in March 1996 with an emphasis on inclusion of aerospace prime companies, pressurized system suppliers, and all interested government agencies. Deliberations focused heavily on adapting the standard to address commercial procurement of aerospace pressurized systems. One of the goals of the project was to provide a performance standard which could be used by commercial launch operators in seeking licenses from the US Department of Transportation. Another goal was to assist the US Department of Defense in its transition to procuring aerospace hardware on a commercial basis to the maximum extent possible.

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At the time of approval of this Standard, the AIAA Aerospace Pressure Vessel Standards Working Group included the following members:

Harold Beeson (NASA White Sands Test Facility)
Robert Breaux (Kaiser Compositek)
James Chang (Aerospace Corporation)
Ralph Eberhardt (Lockheed Martin Astronautics)
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Louis Huang (US Air Force Space & Missile Systems Center)
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Stewart Jackson (FAA)
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Michael Miller (Hughes Space & Communications)
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Kirk Sneddon (Arde, Inc.)
Bobby Webb (USAF 45th Space Wing)

The document was approved by the AIAA Structures Committee on Standards on December 2, 1998.

The document was accepted for publication by the Standards Executive Council on January 19, 1999.

This American National Standard is technically equivalent to ISO 146231-1, "Space systems - Pressure vessels and pressurized structures – Part 1: Metallic hardware."

1. Scope

1.1 Purpose

This standard establishes baseline requirements for the design, fabrication, test, inspection, operation and maintenance of the metallic pressurized hardware used in space systems such as spacecraft and launch vehicles. These requirements when implemented on a particular system, will assure a high level of confidence in achieving safe and reliable operation.

1.2 Application

This standard is applicable to space flight metallic pressurized hardware. Included are all pressure vessels, pressurized structures, batteries, heat pipes, cryostats, sealed containers, and pressure components such as lines, fittings, and hoses made of metals. A companion standard, AIAA-S-081, is applicable to space flight composite overwrapped pressure vessels (COPV).

The requirements specified in this standard may be tailored to specific programs with the agreement of the appropriate approval authority.

2. Reference Documents

The latest issue of the following are references for this standard.

Mil-Hdbk-5 *Metallic Materials and Elements for Aerospace Vehicle Structures*

Code of Federal Regulations - Title 49, Code of Federal Regulations (CFR)
Department of Transportation (DoT) CFR

American Society of Mechanical Engineers *ASME Boiler and Pressure Vessel Code, Section VIII, Divisions 1 and 2.*

CINDAS/USAF CRDA Handbook Operation, Purdue University, Lafayette, Indiana.
Aerospace Structural Metals Handbook and Damage Tolerance Design Handbook,

3. Vocabulary

The following definitions of significant terms are provided to ensure precision of meaning and consistency of usage In the event of a conflict, the definitions listed here apply.

"A" Basis Allowable: The mechanical strength values guaranteed by the material producers/ suppliers such that at least 99% of the material they produce/supply will meet or exceed the specified values with a 95% confidence level.

Acceptance Tests: The required formal tests conducted on the flight hardware to ascertain that the materials, manufacturing processes, and workmanship meet specifications and that the hardware is acceptable for intended usage.

Allowable Load (Stress): The maximum load (stress) that can be accommodated by a structure (material) without rupture, collapse, or detrimental deformation in a given environment. Allowable stresses are commonly the statistically based ultimate strength, buckling strength, and yield strength, respectively.

Applied Load (Stress): The actual load (stress) imposed on the structure in the service environment.

"B" Basis Allowable: The mechanical strength values specified by material producers/suppliers such that at least 90% of the materials they produce/supply will meet or exceed the specified values with a 95% confidence level.

Brittle Fracture: A type of catastrophic failure mode in structural materials that usually occurs without prior plastic deformation and at extremely high speed. The fracture is usually characterized by a flat fracture surface with little or no shear lips (slant fracture surface) and at average stress levels below those of general yielding.

Burst Factor (BF): A multiplying factor applied to the maximum expected operating pressure (MEOP) to obtain the design burst pressure.

Burst Pressure: The pressure level at which rupture or unstable fracture of the pressurized hardware occurs.

Component: A functional unit that is viewed as an entity for the purpose of analysis, manufacturing, maintenance, or record keeping.