

Standard

Space Systems – Composite Overwrapped Pressure Vessels (COPVs)

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American National Standard

Space Systems - Composite Overwrapped Pressure Vessels (COPVs)

Sponsored by

American Institute of Aeronautics and Astronautics

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American National Standards Institute

Abstract

This standard establishes baseline requirements for the design, fabrication, test, inspection, operation, and maintenance of composite overwrapped pressure vessels (COPVs) used for pressurized, hazardous or non-hazardous, liquid or gas storage 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.

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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. James B. Chang was the principle 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. It is not being replaced by a series of American National Standards including this one.

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, pressure vessel suppliers, and all interested government agencies. Deliberations focused heavily on adapting the standard to address commercial procurement of aerospace pressure vessels. 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: (* Member of the Editing Committee)

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 Harold Beeson (NASA White Sands Test Facility)
 Celia Blum (Lockheed Martin Michoud)
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1 Scope

1.1 Purpose

This standard establishes baseline requirements for the design, fabrication, test, inspection, operation, and maintenance of composite overwrapped pressure vessels (COPVs) used for pressurized, hazardous or non-hazardous, liquid or gas storage 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 metal-lined COPVs used for space flight. A companion standard, ANSI/AIAA S-080-1998, shall be used for the metallic liner, as specified in the body of this standard. Throughout this document, the term COPV is used specifically for a metal-lined COPV. Specialized pressurized equipment such as batteries, heat pipes, cryostats, and sealed containers are not included.

It is not the intent of this document to infer that COPVs with non-metal liners are not acceptable for aerospace applications. It is expected that COPVs with non-metal liners will reflect equivalent design, manufacture, test, safety, and use requirements as those for metal-lined COPVs, as applicable.

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

2 Reference Documents

The latest issues of the following documents are referenced for establishing pressure vessel designs, analyses, demonstrations, and tests.

2.1 Government Documents

Mil-Hdbk-17, Polymer Matrix Composites, Three Volumes

2.2 Non Government Documents

ANSI/AIAA S-080-1998, Space Systems - Metallic Pressure Vessels, Pressurized Structures, and Pressure Components

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 below take precedence:

A Basis Allowable: The mechanical strength values such that 99% of the population will meet or exceed the specified values with a confidence level of 95%.

Acceptance Tests: The required formal tests conducted on 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 loads (stresses) commonly correspond to the statistically based minimum ultimate strength, buckling strength, and yield strength, as applicable.

Autofrettage: A sizing pressure operation where pressure driven deflection is used to plastically yield the metal liner into the overlying composite in order to induce initial stress states in the metal liner and composite.