ANSI/AIAA S-081B-2018
(Revision of AIAA S-081A-2006)

Standard

Space Systems—Composite Overwrapped Pressure Vessels

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American National Standard

Space Systems—Composite Overwrapped Pressure Vessels

Sponsored by

American Institute of Aeronautics and Astronautics

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Abstract

This standard establishes baseline requirements for the design, analysis, fabrication, test, inspection, operation, and maintenance of composite overwrapped pressure vessels (COPVs). These COPVs are used for pressurized, hazardous, or nonhazardous liquid or gas storage in space systems including spacecraft and launch vehicles. This standard is applicable to COPVs constructed with a metal liner and a carbon fiber/polymer overwrap.

American National Standard

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Foreword

This version of S-081 was developed as an industry consensus to represent accepted practices for the design, analysis, fabrication, test, inspection, operation, and maintenance of composite overwrapped pressure vessels (COPVs) in space systems.

This version of S-081 was developed in collaboration with manufacturers, launch-site operators, range safety authorities, and individuals affiliated with universities and government entities.

The key elements in the revised version of this standard are as follows:

- Reformatted the requirements to align with ANSI/AIAA S-080A-2018, Space Systems—Metallic Pressure Vessels, Pressurized Structures, and Pressure Components
- Updated the requirements for liner design and verification including requirements for damage tolerance life (formerly referred to as safe life) and leak before burst
- Articulated the responsibility of the owner, manufacturer, and procuring authority
- Organized the requirements into separate sections for design, analysis, and test
- Added a design requirements verification matrix
- Added sections to identify the manufacturing, quality assurance, and operations and maintenance requirements
- Added requirements for maximum mass and required volume
- Expanded the requirements for stability
- Added requirements for quantifiable reliability and a failure modes and effects analysis
- Identified requirements associated with reuse
- Articulated requirements for data documentation
- Incorporated loading spectra into the service life
- Added references to ASTM standards for inspection.

The AIAA Aerospace Pressure Vessels (APV) Committee on Standards (CoS) was initially formed in March 1996 as a working group within the AIAA Structures Committee on Standards with an emphasis on inclusion of aerospace prime companies, pressure vessel suppliers, and all applicable government agencies. Deliberations focused on adapting the standard to address commercial procurement of aerospace composite pressure vessels.

The current members of the AIAA APV CoS appreciate the valuable input from several original members, and express their gratitude to past committee members and reviewers whose contributions over many years have resulted in an improved standard. At the time of approval of this document, members of the APV CoS were:

Michael Kezirian, Chair	University of Southern California
Nathanael Greene, Co-Chair	NASA Johnson Space Center
Alejandro Vega, Co-Chair	U.S. Air Force

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Jerry Widmar	NASA Johnson Space Center
Paul Wilde*	Federal Aviation Administration
Steven Wilson	United Launch Alliance
Robert Wingate*	NASA Marshall Space Flight Center
Kamil Wlodarczyk	Orbital ATK

NOTE Names marked with an asterisk participated as Observer, nonvoting member.

The above consensus body approved this document in December 2017.

The AIAA Standards Executive Council (Allen Arrington, Chairperson) accepted the document for publication in March 2018.

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1 Scope

This standard establishes baseline requirements for the design, analysis, manufacturing, test, and operation of composite overwrapped pressure vessels (COPV) used for aerospace systems such as spacecraft and launch vehicles.

Requirements for COPVs levied from other authorities (such as Range Safety, FAA, DOT, etc.) may also be applicable. Specific applications, particularly those involving human spaceflight, may have additional requirements. There may also be additional requirements for hardware elements that are not addressed by this document, such as the presence of a propellant management device or diaphragm. The full set of these requirements should be identified before the design process begins and should be addressed through all stages of the lifecycle.

1.1 Purpose

These requirements are intended to assure the safety and enhance the success of the operation of a COPV in an aerospace system.

1.2 Applicability

This standard is applicable only to COPVs containing a metallic liner and constructed with a carbon fiber/polymer matrix overwrap.

COPVs that include a fiberglass overwrap layer that serves only to protect the vessel from impact damage are permitted.

A companion standard, ANSI/AIAA S-080A Space Systems—Metallic Pressure Vessels, Pressurized Structures, and Pressure Components, is applicable to spaceflight metallic pressurized hardware.

1.3 Designation of Responsibilities

This section identifies the responsibilities for the key agents: owner, procuring authority, and manufacturer.

It is noted that the owner and procuring authority may be the same entity.

The procuring authority and the manufacturer may also be the same entity, in which case additional consideration should be given regarding independent oversight.

1.3.1 Owner

The owner establishes the system level requirements. The owner develops the aerospace system incorporating the COPV to meet these system level requirements. The owner performs the system analysis on the aerospace system to identify the operational envelope, establishing the design requirements. The owner is responsible for determining the criticality of the aerospace system.

The owner is responsible for reviewing and approving any tailoring of requirements including the use of a document revision other than what is specified in Section 3.

The owner specifies options provided in the standard before contracting with the manufacturer. For example, the burst factor (Section 5.2.1) and design safety factor (Section 5.2.4) are established. In addition, for the conditions established in Section 5.1.2, there may be options for the liner design and verification approach (Section 6.1).

The owner is responsible for recognizing the certification of trained COPV visual inspectors and the approval and implementation of the damage control plan.

The owner has the responsibility for approving engineering source approved (ESA) processes and subsequent changes. The owner should solicit engineering input prior to accepting ESA process changes.