ASME PVHO-1–2019
(Revision of ASME PVHO-1–2016)

Safety Standard for Pressure Vessels for Human Occupancy

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Two Park Avenue • New York, NY • 10016 USA

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The next edition of this Standard is scheduled for publication in 2022.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Periodically certain actions of the ASME PVHO Committee may be published as Cases. Cases and interpretations are published on the ASME website under the Committee Pages at http://cstools.asme.org/ as they are issued.

Errata to codes and standards may be posted on the ASME website under the Committee Pages to provide corrections to incorrectly published items, or to correct typographical or grammatical errors in codes and standards. Such errata shall be used on the date posted.

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The American Society of Mechanical Engineers
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FOREWORD

Early in 1971, an ad hoc committee was formed by action of the ASME Codes and Standards Policy Board to develop design rules for pressure vessels for human occupancy. The importance of this task was soon recognized, and the ASME Safety Code Committee on Pressure Vessels for Human Occupancy (PVHO) was established in 1974 to continue the work of the ad hoc committee. Initially, this committee was to confine its activity to the pressure boundary of such systems. It was to reference existing ASME Boiler and Pressure Vessel Code (BPVC) Sections, insofar as practicable, adapting them for application to pressure vessels for human occupancy. The common practice hitherto had been to design such chambers in accordance with Section VIII, Division 1 of ASME BPVC; however, a number of important considerations were not covered in those rules. Among these were requirements for viewports and the in-service use of pressure relief valves, and special material toughness requirements. This Standard provides the necessary rules to supplement that Section, and also Section VIII, Division 2 of ASME BPVC. The user is expected to be familiar with the principles and application of the Code Sections.

ASME BPVC criteria furnish the baseline for design. In ASME PVHO-1, design temperature is limited to 0°F to 150°F (−18°C to 66°C). Supporting structure and lifting loads are given special attention. Certain design details permitted by Section VIII are excluded. A major addition is the inclusion of design rules for acrylic viewports (Section 2). The formulation of rules for these vital and critical appurtenances was one of the reasons for establishing the PVHO Committee. Finally, all chambers designed for external pressure are required to be subjected to an external pressure hydrostatic test or pneumatic test.

The 2007 edition was completely rewritten and reformatted from the 2002 edition. Section 1, General Requirements, is intended to be used for all PVHOs, regardless of use. The rules for external pressure design were expanded to include unstiffened and ring-stiffened cylinders, in addition to spheres. Other additions included Sections pertaining to application-specific PVHOs. Sections were included for medical hyperbaric systems, diving systems, submersibles, and quality assurance. The Piping Systems Section was expanded. Where possible, Mandatory Appendices were incorporated into the body of the Standard. All forms were revised to reflect the document (PVHO-1), an abbreviation denoting the corresponding section (e.g., General Requirements is GR), and the form number within that Section. An example is PVHO-1 Form GR-1.

The 2012 edition included expansions made to the General Requirements, Viewports, and Diving Systems Sections.

The 2016 edition included additional expansions made to the General Requirements, Viewports, Medical Hyperbaric Systems, and Diving Systems Sections. It included a new Nonmandatory Appendix for preparing PVHO performance-based Cases for flexible chambers. There is continuing work being accomplished by the Subcommittees in the areas of PVHOs using nonstandard materials, including nonmetallic PVHOs. A companion document (ASME PVHO-2) that covers in-service guidelines for PVHOs has been published.

The 2019 edition of PVHO-1 continues the work to address complete PVHO systems and PVHOs made from nonstandard materials. In support of this work, definitions in Mandatory Appendix II and various forms were added or updated to reflect the differences in approach to documenting the entire PVHO system as a whole rather than as single or multiple pressure vessels/chambers. Additionally, changes were made to this edition in efforts to clarify several design standards and requirements for easier understanding and implementation by all users of this Standard.

Interpretations, Code Cases, and errata to ASME PVHO-1 are published on the following ASME web page: https://cstools.asme.org/csconnect/CommitteePages.cfm?Committee=N10050000.

The 2019 edition of ASME PVHO-1 was approved and adopted by the American National Standards Institute as meeting the criteria as an American National Standard on December 4, 2019. Previous editions were published in 1977, 1981, 1984, 1987, 1993, 1997, 2002, 2007, 2012, and 2016.

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CORRESPONDENCE WITH THE PVHO COMMITTEE

General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions or a case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, PVHO Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Proposing a Case. Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

Interpretations. Upon request, the PVHO Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the PVHO Standards Committee.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may mail the request to the Secretary of the PVHO Standards Committee at the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the Inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry in one or two words.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable.
Proposed Reply(ies):	Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information:	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

Moreover, ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Standard requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the Inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Attending Committee Meetings. The PVHO Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the PVHO Standards Committee.

ASME PVHO-1–2019
SUMMARY OF CHANGES

Following approval by the ASME PVHO-1 Committee and ASME, and after public review, ASME PVHO-1–2019 was approved by the American National Standards Institute on December 4, 2019.

ASME PVHO-1–2019 includes the following changes identified by a margin note, **(19)**.

Page	*Location*	*Change*
2	1-7.1	Subparagraphs (c)(1) through (c)(3) revised
3	1-7.8	Subparagraph (c) added
4	1-7.9	Subparagraph (k) revised
8	1-7.14	Subparagraph (f) added
10	1-12	Added
12	1-13	Added
12	1-14	Added
19	2-2.1	Revised
24	2-2.8.3	Title revised
32	2-3.8	(1) First paragraph and subpara. (a) revised (2) In subpara. (b), second sentence corrected by errata to read "acrylic plastic weighing about"
32	2-3.11	Added
34	2-5.4.1	Added
35	2-6.1	Revised
36	2-7.3	Revised
42	PVHO-1 Form VP-2	Revised
89	4-1.2	(1) Former para. 4-1.2.3 redesignated as subpara. 4-1.2.2(c) (2) Paragraph 4-1.2.4 redesignated as para. 4-1.2.3 (3) Paragraph 4-1.2.5 deleted
101	Table 4-7.1-1	General Note (b) corrected by errata to read MT
103	5-1.4	Revised in its entirety
104	5-1.9	Added
104	5-2	Revised
104	5-3.2	First paragraph revised
106	Section 6	Revised in its entirety
128	Mandatory Appendix II	(1) Definitions of *air-ventilated PVHO, fabricator, manufacturer, material manufacturer, Professional Engineer,* and *systems integrator* added (2) Definitions of *fabricator of windows, manufacturer (component), manufacturer of plastic (window),* and *manufacturer (PVHO)* deleted (3) Definition of *risk* corrected by errata to read occurrence
139	Nonmandatory Appendix D	Title revised
139	D-2	Revised

Page	*Location*	*Change*
146	Nonmandatory Appendix E	Title revised
146	E-1.1	Revised
147	E-2.2	Fourth paragraph revised
149	E-2.8	Third paragraph revised
149	E-3	(1) Paragraph E-3.1 revised (2) Paragraph E-3.4 deleted
152	E-4.12	Subparagraph (f) revised
172	Table E-1.1-1	Added
176	Nonmandatory Appendix F	(1) Title for MIL-H-2815 added (2) Addresses updated (3) Publications from Naval Ordnance Safety and Security Activity and U.S. Department of Health and Human Services added

Section 1
General Requirements

1-1 INTRODUCTION

This Standard defines the requirements that are applicable to all Pressure Vessels for Human Occupancy (PVHOs) fabricated to this Standard (Sections 1 through 4) and shall be used in conjunction with specific requirements in other Sections (Sections 5 through 7, as applicable) and Mandatory Appendices of this Standard. In the event of conflict between Sections 1 through 4 and other Sections (5 through 7), the application-specific requirements from Sections 5 through 7 shall govern.

PVHOs shall be designed, fabricated, inspected, tested, marked, and stamped in accordance with the requirements of this Standard and of the ASME Boiler and Pressure Vessel Code (ASME BPVC), Section VIII, Division 1 or Division 2, unless otherwise permitted within this Standard.

In-service requirements for PVHOs are found in ASME PVHO-2.

1-2 SCOPE

1-2.1 Application

This Standard applies to all pressure vessels that enclose a human within their pressure boundary while under internal or external pressure exceeding a differential pressure of 2 psi (15 kPa). PVHOs include, but are not limited to, submersibles, diving bells, and personnel transfer capsules, as well as decompression, recompression, hypobaric, and hyperbaric PVHOs.

1-2.2 Geometry

The scope of this Standard in relation to the geometry is the pressure boundary as defined in the User's Design Specification and shall include, but not be limited to, the following:

(a) shells of revolution
(b) openings and their reinforcements
(c) nozzles and other connections
(d) flat heads
(e) quick-actuating closures
(f) vessel penetrations
(g) attachments and supports
(h) access openings
(i) viewports
(j) pressure relief devices
(k) pressure-retaining covers for vessel openings

1-2.3 Limitations

The pressure boundary of the PVHO shall be as follows:

(a) welding end connection for the first circumferential joint for welded connections
(b) the first threaded joint for screwed connections
(c) the face of the first flange for bolted, flanged connections
(d) the first sealing surface for proprietary connections or fittings

1-3 EXCLUSIONS

The following types of vessels are excluded from this Standard:

(a) nuclear reactor containments
(b) pressurized airplane cabins
(c) aerospace vehicle cabins
(d) caissons

1-4 USER REQUIREMENTS

It is the responsibility of the user, or an agent acting for the user who intends that a PVHO be designed, fabricated, inspected, tested, marked, stamped, and certified to be in compliance with this Standard, to provide or cause to be provided for such PVHO, a User's Design Specification. The User's Design Specification shall set forth the intended operating conditions of the PVHO to provide the basis for design. It shall identify the external environment to which the PVHO will be exposed, the intended function of the PVHO, mechanical loads imposed on the PVHO, specific installation requirements, and applicable codes and standards.

1-5 MANUFACTURER'S DATA REPORT

The manufacturer or a designated agent shall make design calculations and prepare a Manufacturer's Data Report stating that the design, as shown on the design drawings, complies with this Standard and the User's Design Specification.

A registered Professional Engineer, or the equivalent in other countries, shall certify that the Manufacturer's Data Report is in compliance with this Standard and the User's Design Specification.