Inquiry: Under what conditions may a portable flexible polyester-jacketed, aliphatic-coated bladder with redundant zipper closures be used in construction under the rules of PVHO-1–2012?

Reply: It is the opinion of the Committee that a portable flexible polyester-jacketed, aliphatic-coated bladder with redundant zipper closures may be constructed under the requirements of PVHO-1–2012 and be marked as a PVHO when the requirements of PVHO-1–2012, with the following exceptions and additions, have been met.

1 GENERAL

The PVHO chamber is a flexible composite cylinder consisting of an inner bladder [Fig. 15-1(c)], an outer jacket [Fig. 15-1(g)], and webbing secured with mechanical safety buckles [Fig. 15-1(d)]. The bladder and jacket are closed with four overlapping zippers [Fig. 15-1(e)] that provide an initial pressure seal. Two opposing transparent windows permit viewing of the occupant [Fig. 15-1(b)]. Connections for pressurization and breathing gas are located at the ends [Fig. 15-1(a)]. The window shield (Fig. 15-2) is supported by the jacket and webbing [Fig. 15-1(f)].

The chamber is pressurized with a continuous flow of air that is expelled through a ventilation valve.

The PVHOs shall be designed, constructed, inspected, tested, marked, and installed (if applicable) to PVHO-1–2012, Sections 1 through 6, with exceptions and additions detailed in this Case.

1.1 Exclusions

The following sections/paragraphs of PVHO-1–2012 are not applicable to vessels built under this Case:

(a) subsection 1-6 and paras. 1-7.1 through 1-7.3, 1-7.5, 1-7.8, and 1-7.11 through 1-7.16
(b) subsections 2-2, 2-7, 2-8, and 2-10
(c) paras. 5-1.5 and 5-5.7
(d) paras. 6-2.8.1(a) and (b), 6-2.8.2(d), and subsection 6-3, except for para. 6-3.6.1
(e) Section 7

1.2 User’s Design Specification

A User’s Design Specification shall be provided. The User’s Design Specification shall include the following data:

(a) The maximum number of occupants is one.
(b) The maximum allowable internal working pressure (MAWP) is 15 psig (103.4 kPa).
(c) Pressurization gas is air, with an exhaust valve and overpressure relief valve.
(d) The breathing gas supplied to the occupant of the PVHO shall be through a built-in breathing system (BIBS) mask. The operator of the PVHO shall have external control of the supply of breathing gas. The operator shall ensure that sufficient gas is available for flushing the PVHO, if necessary, and there shall be sufficient emergency gas available to complete the proposed treatment safely. All exhaled gas shall leave the PVHO via an overboard dump system.
(e) The pressurization/depressurization rates shall be no greater than 1 psi/min (6.89 kPa/min).
(f) Airflow rate to maintain MAWP shall not exceed 15 standard ft³/hr (SCFH).
(g) The PVHO shall have two windows in the body of the chamber. The windows shall permit external viewing of the occupant’s head, face, chest, and arms.
(h) Maximum internal length is 91.75 in. (2.33 m).
(i) Internal diameter shall be 23 in. (0.584 m) nominal.
(j) Four overlapping zippers shall be used. Each zipper shall be able to effect a pressure seal.
(k) The design temperature limits are 0°F to 100°F (−18°C to 38°C). The design storage temperature range is −10°F to 150°F (−23°C to 66°C).
(l) The design number of pressure cycles shall not exceed 4,000 cycles.
(m) The rated life is 10 yr from the date of manufacture or on completion of 4,000 pressure cycles, whichever occurs first.
(n) Penetrators shall be located in the ends. Two breathing gas penetrators shall be compatible with the BIBS. One sensor penetrator shall be provided.
(o) Lifting handles shall be provided to allow occupant transport while under pressure.
Fig. 15-1  Typical PVHO Configuration
Fig. 15-1  Typical PVHO Configuration (Cont'd)

NOTE:
(1) Chamberlite shown enlarged for clarity.
NOTE:
(1) Anneal after forming to relieve stress.

(p) Temperature control of the environment is ambient.
(q) Fire suppression is provided by a portable fire extinguisher.
(r) No corrosion allowance is required.
(s) Bladder joining will be RF welding only. No adhesives are allowed except for sealing of exterior seams.

2 MATERIALS

In lieu of the requirements of PVHO-1–2012, subsection 1-6 and Section 2, the materials in Table 15-1 shall be used. All of the materials shall be used in combination to meet the performance requirements of this Case. A Process Control Procedure in accordance with para. 5.7 of this Case shall identify how the materials are to be used and in what specific quantities. All materials used shall be supplied with supporting documentation consistent with the requirements of the Quality Management System detailed in section 5 of this Case. Each lot shall meet the ASTM or federal standards material specifications as indicated. Material shelf life shall be identified as being suitable for long-term storage between uses and shall not exhibit visual or performance deterioration through aging for the entire life of the PVHO.

Material test reports for the primary strength members, which are the webbing, jacket, buckles, bladder, window shield, film, and penetrator flange, shall include batch and lot information. Test conditions are 70°F ±5°F and 65% RH ±5% RH. The relevant strength data shall be recorded on the Manufacturer’s Data Report. Any changes of primary strength material shall be cause for full prototype retesting and shall be submitted as a new Case.

3 DESIGN AND FABRICATION

In lieu of PVHO-1–2012, subsection 1-7, the design and fabrication shall be in accordance with this Case and the following requirements. Any changes to the design or manufacturing procedures of the PVHO shall be cause for full prototype retesting and shall be submitted as a new Case.

3.1 Design Analysis

A stress analysis shall be performed by a Professional Engineer (PE) registered in one or more of the U.S. states or the provinces of Canada, or licensed by any other country that has equivalent licensing procedures, who is experienced in fabric composite pressure vessel design and construction.

3.2 Requirements

(a) The MAWP shall be 15 psig (100 kPa) at 100°F (38°C).
<table>
<thead>
<tr>
<th>Component</th>
<th>Material Properties</th>
<th>Test Procedure or Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base fabric</td>
<td>Polyethylene terephthalate (PET) 1,500 denier 13 oz–15 oz, thread count 35/35 threads/in.</td>
<td>. . .</td>
</tr>
<tr>
<td>Coated bladder fabric</td>
<td>39 oz/yd²–45 oz/yd² Aliphatic PU/PVC alloy</td>
<td>. . .</td>
</tr>
<tr>
<td></td>
<td>Tensile strength: Warp: 823-lb minimum</td>
<td>ASTM D751, Procedure B</td>
</tr>
<tr>
<td></td>
<td>Fill: 712-lb minimum</td>
<td>ASTM D751, Procedure B</td>
</tr>
<tr>
<td></td>
<td>Adhesion RF: 24-lb/in. minimum</td>
<td>ASTM D751</td>
</tr>
<tr>
<td></td>
<td>Low-temperature flexibility: −20°F 12 hr</td>
<td>DIN 53546</td>
</tr>
<tr>
<td></td>
<td>Flammability: oxygen index &gt; 25%</td>
<td>ASTM D2863</td>
</tr>
<tr>
<td>Polyester jacket</td>
<td>The outer cover shall be woven polyester 36 oz/yd². The fabric shall be prestretched, have multifilament warp, spun filling double twill weave, 84 × 51 count.</td>
<td>. . .</td>
</tr>
<tr>
<td></td>
<td>Breaking strength: Warp: 1,300-lb minimum</td>
<td>ASTM D5034</td>
</tr>
<tr>
<td></td>
<td>Fill: 550-lb minimum</td>
<td>ASTM D5034</td>
</tr>
<tr>
<td>Clear polyester polyurethane film window</td>
<td>Hardness: 90–95 Shore A</td>
<td>ASTM D2240</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength: 1 in. × 1 in. 5,000 lb</td>
<td>ASTM D412, Method A</td>
</tr>
<tr>
<td></td>
<td>Ultimate elongation: 400%</td>
<td>ASTM D412</td>
</tr>
<tr>
<td></td>
<td>Minimum tensile modulus at 100% elongation: 1,400 psi</td>
<td>ASTM D412</td>
</tr>
<tr>
<td></td>
<td>Minimum tear resistance: 650 lb/in.</td>
<td>ASTM D624, Die C</td>
</tr>
<tr>
<td></td>
<td>Low-temperature bending: −20°F 12 hr</td>
<td>DIN 53546</td>
</tr>
<tr>
<td></td>
<td>Film thickness: 0.052 in. — 5%</td>
<td>. . .</td>
</tr>
<tr>
<td>Acrylic window shield</td>
<td>The window shield material shall be in accordance with PVHO-1–2012 requirements. However, the window, which is a sector of a cylinder and supported by fabric and webbing, is a nonstandard window. The test program in section 4 of this Case exceeds the requirements for STPP in para. 2-2.6 of PVHO-1–2012 and is an alternative to the requirements for determination of LTPP and CPP. Thickness: ½ in.</td>
<td>. . .</td>
</tr>
<tr>
<td>Zipper closures</td>
<td>To meet federal spec CID A-A-55634A</td>
<td>OII-03 CEF P09P 54 and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OII-03 CEF P10P 54</td>
</tr>
<tr>
<td>Webbing</td>
<td>Polyester, 2.42 oz/yd, 0.07 in. thick, 2 in. wide</td>
<td>FMVSS 571.209</td>
</tr>
<tr>
<td></td>
<td>Minimum breaking strength: 6,000 lb</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Breaking strength tested to Web Sling and Tie Down Association T-4 or Fed Std 191A Method 4108</td>
<td></td>
</tr>
<tr>
<td>Safety buckle</td>
<td>Minimum breaking strength: 3,360 lb</td>
<td>FMVSS 571.209</td>
</tr>
<tr>
<td>Silicone rubber</td>
<td>Durometer 30 Shore A</td>
<td>ASTM D2240</td>
</tr>
<tr>
<td>Polyester thread</td>
<td>4 Cord (Tex 270) Type 2 Class 1; FF (Tex 90) Type 1, Class 3</td>
<td>MIL-DTL-32072</td>
</tr>
<tr>
<td>Neoprene-coated nylon</td>
<td>13 oz fabric ⅛ in. thick, 65–75 durometer, cured both sides with rubber meeting tensile strength at 300% elongation: 1,400-psi minimum</td>
<td>ASTM D2000-BC-714</td>
</tr>
<tr>
<td>Penetrator flange</td>
<td>Texin 950 aromatic polyether-based thermoplastic polyurethane with Shore D hardness of 50</td>
<td>. . .</td>
</tr>
<tr>
<td></td>
<td>Minimum tensile strength: 6,000 psi</td>
<td>ASTM D412</td>
</tr>
<tr>
<td></td>
<td>Minimum tensile strength at 100% elongation: 2,000 psi</td>
<td>ASTM D412</td>
</tr>
<tr>
<td></td>
<td>Threads of flange: aluminum 6061-7651</td>
<td>ASTM B221-02 QQ-A-200/8</td>
</tr>
<tr>
<td></td>
<td>Anodized to</td>
<td>MIL-A 8625 F Ty2, Class 2</td>
</tr>
<tr>
<td>Lifting bridle</td>
<td>If chamber is to be used as a hyperbaric stretcher, then straps and bridles shall be provided that meet ASME B30.9.</td>
<td>. . .</td>
</tr>
<tr>
<td>Aluminum load diffuser plate</td>
<td></td>
<td>SB209 6061-T6</td>
</tr>
</tbody>
</table>
(b) Temperature range shall be between 0°F and 100°F (−18°C and 38°C).

c) The MAWP shall be based on testing three prototypes to at least 6 times the MAWP.

d) The design analysis shall consider the effects of aging of the polyester jacket and longitudinal and hoop webbing, plus the effects of folding, unfolding, and long-term storage of the collapsed chamber. The design shall ensure that no damage will occur to the cloth within the composite shell by acute bending or by bending at less than the minimum bend radius of the material. Acute bending is defined as a bend in the cloth shell at an inside angle of less than 5 deg. The minimum bend radius for the cloth shall be no less than 0.05 in. (1.25 mm). Strength reduction due to sewn connections shall be based on test data and included in the analysis. Procedures shall be written as to the type of stitch, length of stitch, stitch pattern size, type and size of thread, and results from the break test.

e) All penetrators shall be located in the ends.

(f) The two windows shall be located in the body.

3.3 Design Certification

Conformance of the design of the PVHO to the requirements of PVHO-1–2012 shall be established by one of the two following procedures:

(a) A PE registered in one or more of the U.S. states or the provinces of Canada, or licensed by any other country that has equivalent licensing procedures, who is experienced in fabric composite pressure vessel design, shall certify that the PVHO was designed either by the PE or under the PE’s direct supervision, or that the PE has thoroughly reviewed a design prepared by others, and that the PVHO complies with PVHO-1–2012 and this Case.

(b) The design of the PVHO shall be reviewed by an independent third-party agency competent in PVHO systems and experienced in fabric composite design, and such an organization shall provide a certificate that the PVHO complies with PVHO-1–2012 and this Case.

3.4 Fabrication

The PVHO shall be manufactured in accordance with a detailed process control plan. The process control plan shall clearly define the details of the manufacturing steps necessary to fabricate the PVHO and shall document the fabrication process. Any anomalies found during the manufacturing process shall be fully documented and may be corrected according to the process control repair plan.

Any production testing already completed shall need to be repeated. The materials and manufacturing processes used for production units shall be identical to those used for the tested prototypes.

4 TESTING

All prototype testing shall be witnessed by an independent third-party certifying agency experienced in fabric design. In lieu of the testing requirements of PVHO-1–2012, the requirements in paras. 4.1 and 4.2 shall apply.

4.1 Prototype Testing

Deviation from established design parameters, materials of construction, or fabrication process control that affect performance of the structure shall require that a new prototype qualification test be conducted. PVHOs used for prototype testing shall not be used other than for testing.

(a) Proof Pressure Test

1. Proof pressure testing shall be conducted on a minimum of three full-scale prototype chambers. These prototypes shall be full size and of identical construction to the end item, with all fabrication completed that in any manner may affect the integrity of the pressure boundary.

2. The rated pressure shall be based on a minimum 6:1 ratio of proof pressure determined by testing three prototype chambers to at least 90 psig for 30 min. Rated pressure testing shall be performed at the most critical service temperature of 100°F (38°C).

3. The material in the primary strength members shall be tested to determine actual breaking strength. The test data shall be recorded and retained.

(b) Drop Test. A drop test of at least one PVHO on concrete shall be conducted without failure. The PVHO shall be loaded with an evenly distributed load of 200 lb (90 kg) of bagged sand and then pressurized to the rated pressure. The PVHO shall be inclined at 45 deg, elevated to a height such that the minimum distance to the concrete impact surface is 3 ft (92 cm), and then dropped. The chamber shall then be inverted (opposite end impacted) and dropped again. No damage, permanent distortion, or increased ventilation rate of the PVHO is permissible.

(c) Cyclic Pressure Test. The maximum permissible number of design cycles shall be determined by cyclic testing of a full-scale PVHO.

1. The cyclic pressure test shall be from 0 ambient to MAWP and back to 0 ambient. The PVHO shall be pressurized to MAWP, and the time when expansion ceases shall be measured. This time shall be doubled, and the greater of the doubled time or 1 min shall be used as the minimum hold time at pressure. Cyclic testing shall be performed at the most critical service temperature of 100°F (38°C).

2. The number of approved operational cycles, CA, shall be computed as

\[
CA = \left(\frac{CT}{2}\right) - 1,000
\]
where \( CT = \) total number of test cycles performed. The chamber shall be cycled for a minimum of 10,000 cycles.

(3) Every 2,000 cycles, the PVHO shall be visually inspected for damage and excessive airflow rate. The requirement for acceptance of the cyclic pressure test is that no crack (or other damage) shall be visibly detectable, using methods that are normally used for visual inspection of the applicable material. In addition, airflow rate shall not exceed 110% of normal.

(d) Creep Test. Extended-time tests of three completely assembled PVHOs that have either undergone proof pressure testing without failure or alternatively have not been previously tested shall be conducted at the most critical service temperature using the following criteria:

(1) A straight line shall be plotted using semi-log coordinates with pressure on the linear scale (y) and time on the logarithmic (x). The beginning coordinate of the line shall be the pressure at 0.1 hr and the MAWP multiplied by 9. The end coordinate on the line shall be twice the MAWP at 80,000 hr. A straight line shall be drawn through these two coordinates. This line represents the minimum pressure-time acceptance line. Failure to the left and below the pressure-time acceptance line is disallowed.

(2) A test pressure shall be applied such that the time without failure shall exceed the pressure-time acceptance line; however, the minimum time shall be at least 300 hr.

(3) If all three chambers exceed the 300 hr and minimum pressure-time acceptance line, the PVHO has acceptable creep behavior.

(e) Cold Storage Test. A cold storage test demonstrating that the chamber can be assembled and inflated at minimum operating temperature shall be conducted. The chamber shall be folded and stored for a minimum of 8 hr at \(-10^\circ\text{F} (-23^\circ\text{C})\) and then inflated to operating pressure in a period not exceeding 15 min. Repeat the cold storage test a minimum of two times. No increase in airflow rate, damage, or permanent distortion is permissible.

(f) Cycle Folding Test. A chamber shall be subjected to 4,000 cycle folding exercises. The chamber shall be unzipped and laid flat on a table at room temperature. The chamber shall have each end cap folded down flat against the opening. One end shall be folded onto itself three times. The final fold shall be lifting the folded chamber onto the end cap. This will create a size suitable for storage in the carrying case. After this is completed, it shall be unfolded to the flat position and zippers closed. Upon completion of the 4,000 cycles, the chamber shall be inspected for any defects, delamination, wear, or fracture of the zipper or body.

(g) Off-Gas Test. The off-gas requirements of subsection 1-10 of PVHO-1–2012 shall be satisfied.

(h) Puncture Test. A puncture test using a \( \frac{3}{8}\)-in. (10-mm) wide flat screwdriver shall be performed on one PVHO at MAWP. The force to puncture the bladder shall be at least 225 lb (102 kg). After the screwdriver punctures the PVHO body, there shall be no tearing or rapid decompression.

(i) Airflow Rate Test. The airflow rate to maintain MAWP shall be determined by pressurizing three PVHO prototypes to MAWP at room temperature for a period of 60 min and measuring the volume of air expelled. The average of the three volumes shall be the “normal” airflow rate used for comparison with production units.

(j) Zipper Seal Test. The chamber shall have redundant zippers that provide an initial pressure seal of the bladder. To assess adequacy of the zipper in setting the seal, one of the redundant zippers shall be engaged about one-quarter of its length. Other zippers shall be open. The chamber shall be pressurized to MAWP. Repeat for other zippers. All zippers shall generate a pressure seal to pass the zipper seal test.

4.2 Production Testing

(a) All production units shall be subjected to a pneumatic test of 1.5 times the MAWP to be held for 60 min. In addition, airflow rate shall be measured at MAWP over a 60-min period.

(b) Following testing, the PVHO shall be inspected for damage to the sealing areas. Every PVHO shall be examined visually and dimensionally. Any sign of cracks, permanent deformation, or other damage or airflow rate in excess of “normal” [see para. 4.1(i)] by more than 10% or exceeding 15 SCFH shall be cause for rejection of the PVHO.

5 QUALITY ASSURANCE PROGRAM

5.1 General

The requirements of PVHO-1–2012, Section 3 require a Quality Assurance Program (QAP) compliant to ISO 13485 be developed for the design and manufacture of the PVHO. The QAP shall comply with the requirements in paras. 5.2 through 5.14 of this Case and shall be reviewed and accepted by an independent third-party inspection agency experienced in fabric composite design.

5.2 Organization

The QAP shall describe the organizational structure, with responsibilities, authorities, and lines of communication clearly delineated. Persons shown in the QAP to be responsible for verifying the PVHO quality shall have the authority and organizational freedom to

(a) identify problems affecting quality
(b) initiate, recommend, or provide solutions to quality problems through designated channels
(c) verify implementation of solution
control further processing, delivery, or assembly of a nonconforming item, deficiency, or unsatisfactory condition until proper corrective action has been taken.

5.3 Design Control

A methodical process shall be used to develop and control the PVHO design, which includes
(a) a process for design inputs and review
(b) a requirement for formal design review
(c) a process for product configuration management and change control

5.4 Document Control

The QAP shall describe the manufacturer’s measures for ensuring that design output documents are correctly translated into manufacturing specifications, drawings, procedures, and shop/lab instructions. Considerations shall be made for reviews and approvals, including those of the purchaser. The manufacturer shall include the procedure for ensuring distribution of appropriate documents to the working areas in a timely fashion and the process for ensuring nonuse of obsolete documents.

5.5 Procurement Control

The QAP shall include the controls necessary to ensure that applicable requirements are included in procurement documents. The manufacturer shall describe the basis for source evaluation and selection and the method of objective evaluation of the quality of furnished materials, items, and services upon receipt.

5.6 Material Control

The QAP shall describe the identification applied to material and items upon receipt and shall show that this identification shall remain until the material or item is incorporated into the PVHO.

Identification shall be such that the manufacturer’s personnel can easily determine quality status, material or item type, specification, lot or part as appropriate, and job number. All material properties of production units shall meet or exceed the actual material properties of the prototype test articles.

5.7 Process Control

The QAP shall include a Process Control Procedure that will record the identification of materials and items incorporated into the PVHO and each chronological step in its manufacture, including inspection and test steps. The Process Control Procedure shall contain periodic operator and inspector signature points so that product status can be readily determined. The manufacturer shall identify critical manufacturing activities and ensure that they are accomplished by appropriately trained and qualified personnel. Inspection points shall follow the activities in the process control plan.

5.8 Inspection Control

The QAP shall include the measures used by the manufacturer to ensure that inspections are reliable. These measures shall include
(a) proper qualification of inspection personnel
(b) assurance that inspections are performed by persons other than those performing or supervising work
(c) documentation of all inspections

5.9 Test Control

The QAP shall describe the measures used to ensure that tests (including lab tests) are performed consistently and reliably. The following requirements shall be met:
(a) Tests shall be performed in accordance with written instructions stipulating acceptance criteria.
(b) Test results shall be documented.
(c) Examination, measurement, and testing equipment used for activities affecting quality shall be controlled, calibrated, and adjusted at specified periods to maintain required accuracy.
(d) Tests shall be performed by trained and qualified personnel.
(e) Tests shall be verified by persons other than those performing or supervising the test.

5.10 Control of Measuring Test and Inspection Equipment

The QAP shall describe the equipment used in inspections and tests and the measures used to ensure appropriate accuracy. Appropriate equipment shall be calibrated, and the calibration shall be traceable to standards where they exist. Where such standards do not exist, the equipment manufacturer’s recommendations shall be followed.

5.11 Control of Nonconforming Items/Materials

The QAP shall describe the measures used by the manufacturer to control materials or items that are found to be discrepant to prevent their inadvertent use. Nonconforming materials/items shall be identified. The discrepant condition(s) shall be documented. The process for determining, documenting, and verifying corrective action shall be described, including the involvement of the purchaser.

5.12 Quality Assurance Records

The QAP shall provide for quality assurance records.
(a) Records shall be specified, compiled, and maintained to furnish documentary evidence that services, materials, and completed PVHOs meet this and applicable referenced standards.
(b) Records shall be legible, identifiable, and retrievable.
(c) Records shall be protected against damage, deterioration, or loss.
(d) Requirements and responsibilities for record transmittal, distribution, retention, maintenance, and disposition shall be established and documented.

e) Records required for traceability shall be retained for a minimum of 12 yr.

5.13 Standard Repair Planning

The QAP shall describe methods for repairing discrepancies that are expected to occur during the PVHO manufacture.

5.14 Quality Assurance Overview by an Independent Third Party

An independent third-party agency shall be employed to ensure that all PVHOs produced under this Case are designed and manufactured to the requirements of PVHO-1–2012 and this Case. This includes, but is not restricted to, the following:

(a) The PVHO is designed in accordance with PVHO-1–2012 and this Case.

(b) The manufacturer is working to the requirements of the quality control system.

(c) The materials used in construction of the PVHO comply with Table 15-1 as required by PVHO-1–2012 and this Case.

(d) The manufacturing operations are conducted in accordance with approved procedures by qualified operators as required by PVHO-1–2012 and this Case.

(e) All defects are acceptably repaired.

(f) All prototype and production testing has been performed and witnessed as required by PVHO-1–2012 and this Case.

(g) The PVHO is marked in accordance with PVHO-1–2012 and this Case.

(h) A visual inspection of the PVHO is conducted to confirm that there are no material or dimensional defects.

The manufacturer shall arrange and give the third-party inspection agency free access to all facilities associated with the manufacture of the PVHO. The manufacturer shall keep the third-party inspection agency informed of the progress of the work and shall notify them reasonably in advance when PVHOs will be ready for any required tests or inspections.

6 MARKING

(a) In lieu of PVHO-1–2012, subsection 1-9, the external surface of the jacket shall be permanently marked with stencil, close to one end, with the data required in PVHO-1–2012, para. 1-9.1, and the following (sample) designation:

\[
15-\text{PVHO (C15)}-\text{HTI}-0001-2009
\]

where

\[
\begin{align*}
15 & = \text{rated pressure, psig} \\
\text{PVHO (C15)} & = \text{PVHO designator and Case number} \\
\text{HTI} & = \text{manufacturer's initials} \\
0001 & = \text{manufacturer’s unique identification for the PVHO} \\
2009 & = \text{year of manufacture}
\end{align*}
\]

(b) The jacket of the PVHO shall be labeled to indicate

1. maximum operating pressure is 15 psig (100 kPa)

2. operating temperature range [min./max.: 0°F (−18°C)/100°F (38°C)]

3. storage temperature range [min./max.: −10°F (−23°C)/150°F (66°C)]

4. allowable life is 4,000 cycles

5. airflow rate to maintain operating pressure is 15 SCFH

6. expiration date (10 yr from date of manufacture)

(c) The marking shall state, CHAMBER CANNOT BE USED AFTER EXPIRATION DATE, and there shall be cautionary notes that the chamber should not be exposed to direct sunlight or UV light sources for an extended period and diver treatment is not recommended; the chamber is for emergency use only. The following notice shall also be marked on the PVHO: NOT FOR HOSPITAL USE, HEALTH CARE FACILITIES, INCLUDING NURSING HOMES, LIMITED-CARE FACILITIES, OR CLINICS.

(d) The following restriction shall be conspicuously marked at the inlet port: PRESSURIZE WITH AIR ONLY (23.5% O₂ max.).

(e) The vessel shall also display the following notices:

1. ATTENDANT REQUIRED AT ALL TIMES.

2. ITEMS THAT CAN BE DANGEROUS INSIDE A CHAMBER (SUCH AS FLAMMABLE ITEMS, OPEN FLAMES, HAND WARMERS, AND ELECTRONIC DEVICES) ARE PROHIBITED.

3. CHAMBER SHALL BE OPERATED BY QUALIFIED PERSONNEL.

7 DOCUMENTATION

Form GR-1 in PVHO-1–2012 shall be replaced with PVHO-1 Case 15 Form, Manufacturer’s Data Report for Pressure Vessels for Human Occupancy. All other documentation requirements of paras. 1-7.9, 5-1.3, 6-1.4, and 6-2.11 shall be complied with.

The definition of “lot” for fabricator’s testing requirements and traceability is the amount of homogeneous run of material made at the same time in a predetermined quantity (i.e., yards or pounds) and the specific quantity received from such lot. Each lot shall, as far as practical, consist of units of product of a single type, grade, class, size, and composition; manufactured under essentially the same conditions and at essentially the same time.
1. Manufactured and certified by

2. Manufactured for

3. Vessel identification (manufacturer's serial no.) (year built)

4. The design, construction, workmanship, and chemical and physical properties of all parts meet the applicable material specifications of PVHO-1–2012 and Case No. 15.
   The ultimate strength of the webbing at 100°F is __________, the jacket is __________, the buckle is __________, the bladder is __________, the penetrator flange is __________, and the film is __________.

5. Window shield: Certification Reports, properly identified and signed by the window fabricator, are attached for the acrylic material.

6. Manufactured for a maximum allowable working pressure of 15 psig (103.4 kPa), a maximum working temperature of 100°F (38°C), and a pneumatic internal test pressure of 22.5 psig (155 kPa) and maximum of 4,000 cycles.
   Ten-year life ending __________.

7. Design analysis conducted by

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**CERTIFICATION OF DESIGN, FABRICATION, AND QUALITY ASSURANCE**

User's Design Specification on file at__________________________

Manufacturer's Design Report on file at__________________________

Prototype test program attested by______________________________

Quality Assurance Program reviewed by__________________________

Fabrication documentation reviewed by __________________________

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**CERTIFICATION OF COMPLIANCE**

We certify that the statements made in this report are correct and that all details of the design, material, construction, and workmanship of this vessel conform to the ASME Safety Standard for Pressure Vessels for Human Occupancy (PVHO-1) and PVHO Case 15.

Date________________ Company name______________________________ Signed ____________________