

PVHO VIEWPORTS

What the Window User Needs to Know to comply with ASME PVHO-2-2012

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Window User: the party who owns, maintains and / or operates the Pressure Vessel for Human Occupancy (PVHO).

Window User Responsibilities

- Provide window designer with service conditions.
- Protect the window from damage.
- Ensure window is used as designed.
- Determine the window's safe service life.
- Keep records on all windows.
- Establish and maintain an inspection program.
- Establish and maintain an inspector qualification procedure.
- Ensure that inspectors, both internal and 3rd party, meet the qualifications stated in PVHO-2-2012.

Under ASME PVHO-2-2012 there are two types of required inspections to insure occupant safety:

- Operational viewport inspection (OVI).
- Maintenance viewport inspection (MVI).

The operational viewport inspection is done prior to each pressurization of the PVHO. If the PVHO is pressurized more than once per day, the viewports need only be inspected prior to the first pressurization of that day. The objective of the operational viewport inspection is to examine each viewport component and document signs of damage or deterioration. The Inspection shall include the following:

- (a) *Windows*. Inspect for signs of crazing, discoloration, cracks, chips, scratches, gouges, burns, or pits. If flaws are detected, their size, location, and population shall be recorded and compared to the allowable limits listed in Tables 2-4.1-1 through 2-4.1-4 of PVHO-2-2012. Windows with defects exceeding these allowable limits shall be taken out of service.
- (b) *Flanges, Retaining Rings, and Bolts*. Inspect for mechanical damage, corrosion, and deformation. If flaws are detected, their type, size, and location shall be recorded and compared to the allowable limits listed in the facility's inspection

program. If any flaw exceeds the facility's stated limits or as directed by the facility's safety director the PVHO shall be taken out of service.

- (c) *Seats and Seals*. Inspect for mechanical damage, corrosion, extrusion, and irregularities. If flaws are detected, their type, size, and location shall be recorded and compared to the allowable limits listed in the facility's inspection program. If any flaw exceeds the facility's stated limits or as directed by the facility's safety director the PVHO shall be taken out of service.

Paraphrased from PVHO-2-2012 section 2-4.1

The maintenance viewport inspection is done on a schedule specific to your PVHO. The requirements are laid out in PVHO-2-2012. The inspection itself has the same objectives as the OVI and covers the same components as the OVI, but is more comprehensive and is done by an inspector with the next level of qualification from that of the operational viewport inspector. Special optical and measuring devices are often used during this inspection. At the discretion of the inspector, components of a viewport may need to be removed for a more detailed inspection. PVHO-2 Form VP-1, Viewport Inspection is completed and signed by the inspector.

We will assume that the decision has been made that the "Maintenance Viewport Inspection" will be outsourced.

- Window fabricator.
- 3rd party organization.
- Representative of your management company.

The window user is responsible for selecting a competent contractor to provide these services.

The window user is also responsible for establishing a policy and schedule for meeting the requirements of the Maintenance Viewport Inspection.

If your facility does choose to do this inspection, much more education and resources will need to be acquired.

Staff Training Module (OVI specific)

- This can be a self learning packet or lecture.
 - The training needs to be facility specific.
 - The training also needs to include how the facility policy and inspection schedule was established.
- The validation method should include a test and observation by the hyperbaric safety director.

Facility Policy and Inspection Schedule

- It needs to meet the minimum requirements set forth in ASME PVHO-2-2012 based on your facility's unique circumstances.
 - Service environment
 - Service life of the window(s). (< or > design life)
 - Window type(s).

- Chamber manufacturer's guidelines.
- It needs to address both inspections.

Documentation (keep for service life + 1 yr)

- Folder for each window, containing:
 - Original PVHO-1 documentation package.
 - Fabrication Certification.
 - Design Certification.
 - Material Manufacturer's Certification.
 - Material Certification.
 - ASME PVHO-2-2012 Forms. (Provided by qualified inspector)
 - PVHO-2 Form VP-1, Viewport Inspection.
 - PVHO-2 Form VP-2, Acrylic Window Repair Certification for Windows Repaired by the User (or His Authorized Agent).
 - PVHO-2 Form VP-3, Acrylic Window Repair Certification for Severely Damaged Windows. (consists of 2 pages)
 - PVHO-2 Form IV-1-1, Material Testing Certification for Repair by Spot Casting.
 - PVHO-2 Form IV-1-2, Annealing Process Certification.
 - PVHO-2 Form IV-5-1, Pressure Testing Certification.
 - PVHO-2 Form VI-1, Material Testing Certification for Continued Service.
 - PVHO-2 Form VI-2, Material Testing Evaluation for Continued Service.
- Independent Forms (Provided by you, the window user)
 - Operational viewport inspection tracking form.
 - Window and viewport damage and deterioration tracking form.
 - Any other facility specific forms related to the viewports.

Reference Library

- ASME PVHO-2-2012.
- Chamber manufacturer's operations & maintenance manuals.
- Staff training module for operational viewport inspection.
- Facility policy and inspection schedule.
- Various independent articles.
 - Safety course, conference handout or journal article.

Other Reference Sources

- Chamber manufacturer's technical support staff.
- Industry peers.
- Facility's hyperbaric safety director.

Let's Start the Operational Viewport Inspection

- Recap: The focus of the inspection is to determine if there is any damage or deterioration to the viewport that may affect its structural integrity.
 - Windows: Inspect for signs of crazing, discoloration, cracks, chips, scratches, gouges, burns, or pits. If flaws are detected, their size, location, and population shall be recorded and compared to the allowable limits listed in Tables 2-4.1-1 through 2-4.1-4 of PVHO-2-1012. Windows with defects exceeding these allowable limits shall be taken out of service
 - Flanges, Retaining Rings, and Bolts: Inspect for mechanical damage, corrosion, and deformation
- Seats and Seals: Inspect for mechanical damage, corrosion, extrusion, and irregularities.

We Need a Few Tools

- Portable high intensity light (non-heat producing).
- Depth micrometer, feeler gauge, finger nail, and/or sample block showing maximum allowable flaws.
- Machinist ruler.

Clean Viewport Components, Especially the Window, Will Speed Up Your Inspection

- Dust, dirt or a smug can be mistaken for a flaw.
- Plastic covers are good insurance, but may also skew your findings.
- Only use approved cleaners.

Lighting is Very Important

- A bright handheld inspection light is a must (non-heat producing).
- A dark room works best.
- You don't want to be back lit as a minimum.

Inspect Each Window Along With the Other Viewport Components

- Shine the light at different angles to find what angle works best.
- Inspect the full surface area of both the high pressure and low pressure faces.
- Inspect the full thickness of the window for internal flaws.

If Flaws Are Detected:

- Determine severity of flaw.
 - Superficial (no action required).
 - Significant (red tag until repaired or replaced).
 - Nonrepairable (red tag until replaced).
- The limits should be in your facility's policy book.

If Flaws Are Detected: (cont.)

– Example depth limits of window flaws: Flat or Conical Frustum

Window Type =	B cyl.	HPS	LPS
Pit	0.03"	0.02t"	0.01"
Scratch/gouge	0.01"	0.02t"	0.01"
Crazing/cracking	0.01"	0.02t"	0.01"

Key: B cyl = Group B cylinders under internal pressure
HPS = High pressure surface
LPS = Low pressure surface
t = window thickness

* Data taken from ASME PVHO-2-2012, Table 2-4.1-2 Limits for Blemishes or Flaws on Window Surfaces

- Document findings
 - If the limits are not exceeded: Use the facility generated form for recording and tracking damage and deterioration to the viewports.
 - Record: Date, location, flaw type, depth, width and length.
 - If the limits are exceeded: That lock needs to be taken out of service until the specific viewport component in question has been repaired or replaced.
- Depth/Width Perspective
 - 21 lb. copy paper is 0.004"
 - A typical business card is about 0.01"
 - 1/64" < 0.016"
 - A cereal box is about 0.02"

Window Flaws Can Be Caused By:

- External mechanical damage.
- Heat.
- Solvents and solvent-vapors.
- Age.
- Ultraviolet light (wave length < 320 nm).
- X-rays.
- Pressure (amount, comp. rate, duration, previous loads, # of cycles).
- Pressure (combined with- heat, solvents & vapors, age and UV).

Damage To Other Components Of The Viewport Can Be Caused By:

- External mechanical damage.
- Deterioration of protective coatings leading to corrosion of unprotected material.
- Uneven or leaking pressure leading to extrusion of seats and seals.

* Don't under estimate your responsibility as the Window User.