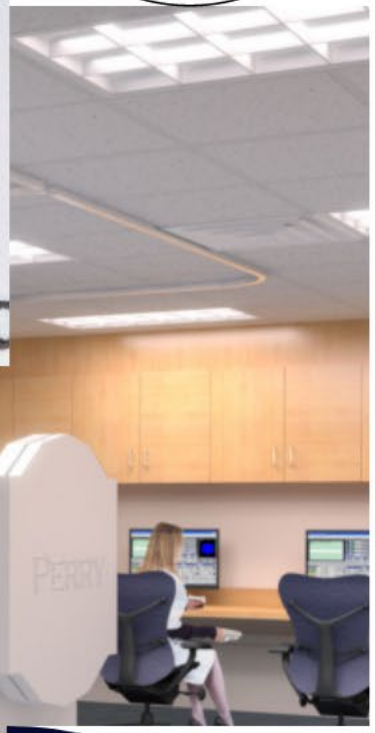

Chamber Inspections

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SerenaGroup
Building the Nation's Leading Wound Care Team

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PVHO

- PVHO stands for Pressure Vessel for Human Occupancy which is a vessel that encloses a human or animal within its pressure boundary while it is subject to internal or external pressure that exceeds 2 psi differential pressure, according to ASME (American Society of Mechanical Engineers).
- PVHO’s include, but are not limited to submersibles, diving bells, personal transfer capsules, decompression chambers, recompression chambers, hyperbaric chambers, high altitude chambers, and medical hyperbaric oxygenation facilities.
- Specialized Inspectors perform the detailed maintenance we are going to discuss but this will help to give us all a better understanding of how the chambers work.

Operational

- PVHO’s must be constructed in accordance with ASME PVHO-1 and PVHO-2. These codes adopt section VIII and therefore the vessels should bear a “U” or “U2” ASME stamping.
- Cast and ductile iron fittings are not allowed.
- Due to the human occupancy element, a person should be in attendance to monitor the PVHO, when in operation, in the event there is an incident.
- Because of the human occupancy element, these vessels should have a depressurization rate less than 145 PSI/sec.
- The installation should be such that there is adequate clearance to inspect the PVHO properly. In some applications such as underground tunneling, it may be impossible to perform a complete external inspection.

Internal Inspections

- Where existing openings permit, perform a visual internal inspection of the vessel. We are looking for obvious cracks, be sure to note areas that are subject to high stress such as welds, welded repairs, head-to-shell transitions, sharp interior corners, and interior surfaces opposite external attachments or supports.
- The vessel should be free of corrosion, damage, dents, gouges, or other damage. All openings leading to external fittings or controls should be free from obstruction.
- All exhaust inlets should be checked to prevent a chamber occupant from inadvertently blocking the opening.

External Inspection

- The inspector should closely examine the external condition of the pressure vessel for corrosion, damage, dents, gauges, or other damage.
- The lower half and the bottom portions of insulated vessels should receive special focus, as condensation or moisture may gravitate down the vessel shell and soak into the insulation, keeping it moist for long periods of tie. Penetration locations in the insulation or fireproofing such as saddle supports, sphere support legs, nozzles, and fittings should be examined closely for potential moisture ingress paths. When moisture penetrates the insulation, the insulation may work in reverse, holding moisture in the insulation and/or near the vessel shell.
- Insulated vessels that are run on intermittent basis or that have been out of service require close scrutiny. In general, a visual inspection of the vessels insulated surfaces should be conducted once per year.

External Inspection Continued

- The most common and superior method to inspect for suspected corrosion under insulation (GUI) damage is to completely or partially remove the insulation for visual inspection. The method most commonly utilized to inspect for GUI without insulation removal is by x-ray and isotope radiography (film or digital) or by real time radiography, utilizing imaging scopes and surface profilers. The real time imaging tools will work well if the vessel geometry and insulation thickness allow. Other less common methods to detect the GUI include specialized electromagnetic methods (pulsed eddy current and electromagnetic waves) and long-range ultrasonic techniques (guided waves).
- There are several methods to detect moisture-soaked insulation, which is often the beginning for potential GUI damage. Moisture probe detectors, neutron backscatter, and thermography are tools that can be used for GUI moisture screening.
- Proper surface treatment (coating) of the vessel external shell and maintaining weather tight external insulation are the keys to prevention of GUI damage.

Are you still awake?!

There’s going to be a quiz…

Inspection of Parts and Appurtenances (piping systems, pressure gauge, bottom drain)

As previously mentioned, cast iron is not allowed on PVHO's and shall be replaced with parts fabricated with other suitable materials, in accordance with ASME code section II.
If valves or fittings are in place, check to ensure that these are complete and functional.
The inspector shall note the pressure indicated by the gauge and compare it with other gauges on the same system. If the pressure gauge is not mounted on the vessel itself, it should be ascertained that the gauge is installed on the system in such a manner that it correctly indicates actual pressure in the vessel.

Inspection of Parts and Appurtenances Continued

The inspector shall verify the vessel is provided with a drain opening.
The system should have a pressure gauge designed for at least the most severe condition of coincident pressure in normal operation. This gauge should be clearly visible to the person adjusting the setting of the pressure control valve. The graduation on the pressure gauge shall be graduated to not les than 1.5 times the MAWP of the vessel.
Provisions should be made to calibrate pressure gauges or to have them checked against the standard test gauge.
Any vents and exhaust should be piped at least 10 feet from any air intake.
Venting should be provided at all high points of the piping system.

Inspection of Viewports/ Windows

- Each window should be individually identified and marked in accordance with PVHO-1.
- If there are any penetrations through windows, they must be circular.
- Windows must be free of crazing, cracks, and scratches.
- Windows and viewports have a maximum interval for seat/seal inspection and refurbishment. Documentation should be checked to ensure compliance with PVHO-2, Table 7.1.3.

Inspection of Pressure Relief Device

- Pressure relief devices must have a quick opening manual shutoff valve installed between the chamber and the pressure relief device, with a frangible seal in place, within easy access to the operator.
- The pressure relief device shall be constructed in accordance with ASM Code Section VIII.
- The discharge from the pressure relief device must be piped outside to a safe point of discharge.
- Rupture disks may be used only if they are in series with a pressure relief valve, or when there is less than 2 cubic feet of water volume.
- Verify that the safety valve is periodically tested either manually by raising the disk from the seat or by removing and testing the valve on a test stand.

Acceptance Criteria (PVHO Certified Technician Only)

- The following forms are required to be completed:
  - Form PVHO-1 Manufacturer's Data Report for Pressure Vessels for Human Occupancy
  - Form PVHO-2 Fabrication Certification for Acrylic Windows
  - All PVHO's under the jurisdiction of the U.S. Coast Guard must also comply with 46 CFR Part 197

Now that we've reviewed what the chamber inspectors do, what are our jobs to ensure our chambers are properly maintained?

Daily Maintenance

1. Inspect acrylic for cracks, nicks, discoloration, scratches, or crazing.
2. Inspect the chamber door latching mechanism for ease of operation and positive latching.
3. Inspect door cam – clean and lightly lubricated with Halocarbon grease.
4. Inspect door seal – clean/no cracks or nicks.
5. Inspect chamber cleanliness, clean if necessary.
6. Inspect the electrical ground – tight no breaks in wire/ connection tight
7. Check all control knobs – tight/proper settings
8. Check for proper communications – volume and clarity
9. Inspect 02 In/Out lines – tight/no kinks/no leaks
10. Inspect all gauges – lenses not damaged, pointers not off (visual only)

Weekly Maintenance

1. Turn on chamber system
2. Set rate to 5
3. Adjust vent control to minimum vent
4. Adjust pressure to 3 PSIG – let stabilize at 3 PSIG
5. Adjust pressure to 29 PSIG – let stabilize at 29 PSIG
6. Adjust vent control to minimum vent to 125 LPM
7. Ensure pressure is maintained at 3 ATA (29 PSIG)
8. Turn system off
9. Press and hold Exhaust By-Pass button. CHAMBER SHOULD DEPRESS TO BELOW 1 PSIG IN LESS THAN 2 MINUTES
10. Note time to decompress
11. Check continuity on patient ground strap (less than 1 ohm +/- .009)
12. Inspect clean/exhaust muffler (clean if necessary)
13. Inspect/clean chamber hull


QUIZ!

1.

True or False: Because of the human occupancy element, these vessels should have a depressurization rate less than 145 PSI/sec.

Answer: True

2.

True or False: The inspector should closely examine the condition of the pressure vessel for corrosion, damage, dents, gouges or other damage.

Answer: True

3.

True or False: In general, a visual inspection of the vessel's insulated surfaces should be conducted once per year.

Answer: True

4.

Question: If a patient is at 2.0 ATA and you decompress the chamber at a rate of 5.0 PSI/min, how long will it take the patient to decompress?

Answer: 3 minutes

5.

True or False: Pressure relief devices must have a quick opening manual shut off valve installed between the chamber and the pressure relief device, with a frangible seal in place, within easy access to the operator.

Answer: True

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