OSHA® FactSheet

Safely Performing Hot Work on Hollow or Enclosed Structures in Shipyards

Hot work performed on hollow or enclosed structures on a vessel or shoreside can present hazards to both workers and the vessel or facility. OSHA's regulations detail safe practices during hot work on these types of structures; however, these requirements only apply to shipyard work and to vessel repair outside of shipyards. Hot work includes welding, burning, brazing, or the use of powder-actuated tools or similar fire- or spark-producing operations (e.g., cutting with abrasive or metal blades) (29 CFR 1915.4; 29 CFR 1915.11; 29 CFR 1915.54).

Hollow or Enclosed Structures

Hollow or enclosed structures are objects that employees work on but are not large enough for them to enter. These structures are not vented to the atmosphere and are normally hollow, but they may be filled with foam or a preservative to prevent corrosion. Hollow or enclosed structures come in a variety of sizes and shapes. Examples aboard vessels include skegs, masts, booms, rudders, support stanchions, pipe stanchions, hatches or railings. Shoreside, these structures include crane legs and supports, drums, mooring bitts and tanks. Whether an object is a hollow or enclosed structure is determined by the employer and by the employee doing the hot work. (29 CFR 1915.54)

Hollow or enclosed structures are not the same as tanks or confined and enclosed spaces, which workers can enter. Work performed in such spaces must comply with different requirements in 29 CFR 1915, Subpart B.

Explosion and Fire Hazards

During hot work on hollow or enclosed structures, workers may be exposed to a range of hazards such as flammable, toxic, corrosive, or irritant gases, liquids, or residues; high pressure or vacuum effects due to fluctuating temperatures; and combustible preservatives. However, particular attention should be given to the following known hazards:

- ***Explosive atmosphere*** – Where hot work becomes an ignition source, which if combined with an explosive atmosphere may result in an explosion.
- ***Flammable material*** – When a hollow or enclosed structure is filled with a flammable material, it could either catch fire or release toxic vapors. An example of this is insulating foam. This commonly used material can catch fire and release noxious gases.

Figure 1. A hollow area under a mooring bitt.

Sources of Flammable/Explosive Atmospheres

Flammable or explosive atmospheres in hollow or enclosed structures can result from many sources. Examples of such sources include:

- Painting and sealing the internal metal of a structure. Several paints are dissolved in highly toxic and flammable solvents with flash points below 80 degrees Fahrenheit. When the structure is sealed following the application of such paint, the concentration of solvent vapors rises, creating an explosive atmosphere.

- Frequent application of preservative coatings to prevent corrosion. Similar to certain paints used in the marine industry, many of these coatings are dissolved in highly toxic and flammable solvents. When the preservative is applied with no ventilation, this can present an unforeseen hazard. This is especially true with rudders and skegs.
- Rusting metal caused by oxidation, which can create an explosive atmosphere due to the release of hydrogen gas.
- The release of carbon monoxide gas during welding operations. When welding on a hollow or enclosed structure, carbon monoxide can accumulate to a high enough concentration to become explosive.
- Leaks from an adjacent space, such as a cargo tank, containing a flammable liquid or gas. If the flammable liquid or gas enters the internal space of a hollow or enclosed structure, an explosion can occur when an ignition source, such as welding, is introduced.

Note: The presence of any combination of the above listed examples may cause an explosive atmosphere. For a hollow structure filled with foam or a similar material, atmospheric testing may not indicate an explosive atmosphere. However, that does not mean that a hazard may not exist. Special precautions such as venting, pressure washing, or the use of inert gas to displace any flammable gas should be taken to prevent fires from starting when performing hot work on this material. Employers should consult with a shipyard competent person (SCP) or an National Fire Protection Association (NFPA)-certified Marine Chemist before beginning hot work.

Internal Atmosphere Testing

Hollow or enclosed structures must be tested to determine if an explosive atmosphere is present before hot work is begun. OSHA standards require that a qualified individual, such as a SCP, or a NFPA-certified Marine Chemist, inspect the structure and test it for the presence of flammable liquids or vapors (29 CFR 1915.54(c)). Hollow or enclosed structures must be made safe during the application of heat by use of cooling, venting or other similar measures (29 CFR 1915.54(d)). During such testing the internal atmosphere should be sampled either from designated sampling ports (e.g., vent plug), or by drilling a small hole into the structure. If a sampling hole is drilled, be careful not to overheat the drill bit. This is particularly important since drilling is being done into an unknown atmosphere. Applying a lubricant, such as cutting oil or soapy water, to the drill bit can help keep it from overheating.

Figure 2. Hollow skegs.

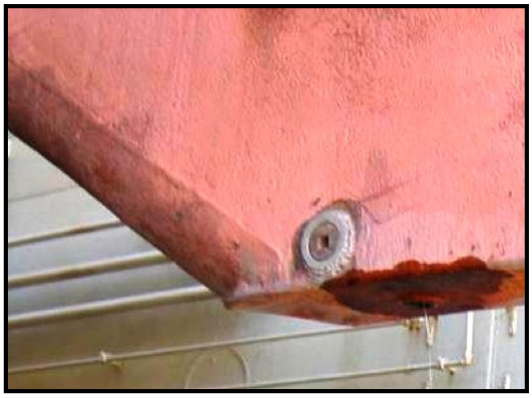

Figure 3. A vent plug indicating leaking product.

Eliminating Explosive Atmospheres

If, after testing, an explosive atmosphere is found to exist there are several ways to eliminate this hazard. The easiest method is to drill another vent hole, away from the first, and ventilate with compressed air at volumes and flow rates sufficient to eliminate the explosive gas, or at a minimum a concentration below 10% of the lower explosive limit (29 CFR 1915.12(b); 29 CFR 1915.14; 29 CFR 1915.54).

However, in some cases, such as when an oil-based preservative has been applied or a flammable liquid has entered the space, another way to eliminate the hazard may be needed. This can be done by purging the space with an inert gas, such as carbon dioxide or nitrogen. This is only to be done by a qualified individual with the necessary experience (e.g., competent person, or NFPA-certified Marine Chemist).

Where insulated foam or a similar material is located within a hollow or enclosed structure, it may be necessary to purge the area with an inert gas, use special welding methods, or cold cut the void and remove the foam.

Once a qualified individual has determined that the hazard has been eliminated, workers may proceed with hot work operations. Depending on the length of the hot work, it is a good practice to occasionally test the atmosphere to ensure that safe conditions still exist.

For more information:

29 CFR 1915, Subparts A, B, D, and I

www.osha.gov/SLTC/etools/shipyard/index.html

CPL 02-01-051, 29 CFR 1915, Subpart B, May 20, 2011

Marine Chemist Association, Inc.
www.MarineChemist.org

American Industrial Hygiene Association
www.aiha.org

Note: States with OSHA-approved state plans may have different requirements. See www.osha.gov.

DSG FS-3586 03/2013