

POSITION STATEMENT

ROOFS OVER HYDROGEN STORAGE SYSTEMS

Question

When are roofs allowed over compressed gas hydrogen storage systems?

Answer

Roofs are allowed over compressed gas hydrogen storage systems only under certain conditions.

Permanent American Society of Mechanical Engineers (ASME) or U.S. Department of Transportation (DOT) storage vessels (hydrogen gas receivers) are not allowed to be located under a roof, unless all vent valves, pressure relief valves, rupture disks, and other hydrogen vent lines are connected to a vent stack that is designed and extended above the roof line in accordance with CGA G-5.5, *Standard for Hydrogen Vent Systems* [1].

All roofs shall have high point vents.

Tube trailers with individual pressure relief devices (PRDs) are not allowed to have any kind of roof over them because the PRDs are not connected to a CGA G-5.5 approved vent stack that vents above the roof line [1].

The prohibition of roofs does not apply to hydrogen equipment enclosures as defined in NFPA 2, *Hydrogen Technologies Code* [2]. These enclosures are self-contained and have venting systems. The prohibition of roofs does not apply to cylinder storage under wall/roof combinations that comply with the weather protection requirements of section 6.7 of NFPA 2—2023 [2].

NOTE—All hydrogen storage requirements are now resident in NFPA 2 as of the 2023 edition and are no longer extracted from NFPA 55.

Reasons

The concern in regards to roofs over hydrogen storage systems is that a hydrogen gas leak can accumulate under the rooftop, ignite, and then explode. Such an incident took place killing the delivery vehicle driver and causing extensive site damage. This incident demonstrates that even a small confinement of the hydrogen fire can cause a detonation and pressure rise from the detonation resulting in injury to personnel and damage to property.

NFPA 2—2023 requires that gas hydrogen systems be vented in accordance with CGA G-5.5. Chapter 7 of NFPA 2—2023 regulates gas hydrogen storage systems: “7.1.16 GH₂ Venting Systems. Hydrogen-venting systems serving pressure relief devices discharging GH₂ to the atmosphere shall be in accordance with CGA G-5.5, *Hydrogen Vent Systems*” [2].

Although the wording in Chapter 7 of NFPA 2—2023 speaks only to venting from PRDs, the intent is to apply CGA G-5.5 to all vents. Chapter 8 of NFPA 2—2023 regulates liquid hydrogen storage systems and has the following, more inclusive wording about hydrogen vents: “8.3.1.2.2.3 Hydrogen venting systems discharging to the atmosphere shall be in accordance with CGA G-5.5, *Hydrogen Vent Systems*” [2].

CGA G-5.5—2021 has the following wording about the vent system, which is put into practice through the use of vent stacks that dispose of hydrogen at an elevation above equipment and people: “5.1 Hydrogen discharges. Discharges of gaseous hydrogen shall be disposed of through an engineered vent system. The gaseous hydrogen is discharged into the air at the exit of the vent system. The discharge may be either manually controlled or by automatic control devices on the storage system. Typical system discharge devices include:

- purging of piping or components;
- manual vent valves;

- pressure control devices such as back pressure regulators or control valves; and
- PRD activation.” [1].

These requirements apply to hydrogen vented from any source (liquid or gas hydrogen) and from any device including manual valves, automatic valves, PRDs, or back pressure regulators.

The code requirements indicate that hydrogen should not be released directly to atmosphere and shall always go to a vent stack where the final release is at an elevation above equipment and personnel.

A vent system that is designed in accordance with CGA G-5.5 will direct major releases of hydrogen from PRDs and vent valves to a safe location above the roof and thus into free air [1]. Smaller leaks from fittings should be minor in number and in size of release, therefore being small enough not to create a detonation underneath the roof if vented at the high point.

References

Unless otherwise specified, the latest edition shall apply.

[1] G-5.5, *Standard for Hydrogen Vent Systems*, Compressed Gas Association. www.cganet.com

[2] NFPA 2, *Hydrogen Technologies Code*, National Fire Protection Association. www.nfpa.org

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NOTE—Technical changes from the previous edition are underlined.

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