

Tanks Inside Of Buildings – to Vent or Not to Vent, That is the Question

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Some TankTalk readers may consider it inappropriate to misuse a common stanza from the Shakespeare play “The Tragedy of Hamlet” and I hope the title doesn’t offend you or inhibit your enjoyment of the arts. However, the title paraphrases a question that is commonly asked of ICC staff because of the issues surrounding AST installations inside of buildings.

The storage of flammable and combustible liquids in ASTs inside of buildings requires the fire code official to apply more rigorous provisions from the 2012 *International Fire Code*[®] (IFC[®]) and NFPA 30, *Flammable and Combustible Liquids Code*. For tanks designed to store liquids with a closed cup flash point temperature below 200°F (Class I, II and IIIA liquids) at atmospheric pressure, the requirements are justified because flammable and combustible liquids exhibit much higher heat release and burning rates when compared to many ordinary combustibles found in buildings. One of the requirements pertains to the termination of normal vent and emergency vent of ASTs inside buildings, and that’s the subject of this article.

TINBIDS (Tanks **I**nside of **B**uildings) are fairly common in commercial development projects. Over the past 10-15 years, the demand for standby power systems that provide an alternative source of electrical energy to computer servers and similar equipment has increased dramatically. Designers commonly specify engine-driven generators with integral sub-base ASTs to limit the floor area of the standby power source. The TINBID requirements in Chapter 57 of the 2012 IFC become applicable when any AST containing Class I, II or IIA liquids is installed indoors. The IFC requires a construction permit to install a TINBID as well as an operational permit to ensure that it is properly maintained in accordance with all of the IFC requirements.

Normal Venting

In addition to the requirements for tank construction, volume limits and overfill protection, the IFC has requirements for terminating a TINBID’s normal vent and emergency vent. The purpose of the normal vent is to maintain the pressure inside of the tank when liquids are introduced into or are withdrawn. All storage tanks are designed to resist the vacuum and positive pressures generated when liquid is introduced into or withdrawn. Improperly sizing a tank’s normal vent or obstruction the vent can cause excessive negative pressure to generate inside the tank, causing the tank to collapse into itself. IFC Section 5704.2.7.3 has a number of provisions to ensure the normal vents are properly terminated. For Class I, II and IIIA liquids the IFC requires termination of the normal vent outside the building. It should be located at least 12 feet above the finished ground level and a minimum of 5 feet from building openings and lot lines that can be built upon. The 12-foot elevation of the vent is necessary to ensure that the surrounding air mixes with the vapor being exhausted from the tank so the atmosphere is maintained below 25% of the liquid’s lower flammable limit.

PV vents are required by IFC Section 5704.2.7.3.2 on the normal vents of TINBIDS containing Class IB or IC liquids to limit the potential release of flammable vapors. A PV vent only operates when product is withdrawn or added to the tank. In lieu of a PV vent, the 2012 IFC will now permit the installation of in-

pool fire exposure. The tank may provide protection elements as a unit or may be an assembly of components, or a combination thereof. Exception 2 of IFC Section 5704.2.7.4 allows the emergency vent to be terminated inside the building when the tank is storing Class II or IIIA combustible liquids. For Class IIIB combustible liquids, the emergency vent has always been permitted to be terminated indoors.

The code was revised based on calculation of vapor pressure of ultra low sulfur diesel stored in a UL 2085 AST. As a condition of listing a protected AST, UL 2085 prohibits the thermocouple measuring the primary containment from exceeding a maximum temperature of 400°F. Vapor pressure calculations determined that at 400°F, the vapor pressure of the diesel is below the 2.5 PSIG opening pressure specified in NFPA 30, Section 22.7.3.10.1. Based on the fire-resistance and insulating quality of the materials used in the fabrication of protected ASTs, the emergency vent for these tanks storing Class II and IIIA liquids will not operate inside a building.

INSERT FIGURE 1

The change in Section 5704.2.7.4 was developed in response to a code change that was approved in 2009 IFC. IFC Section 603.3.1 was modified to allow increased quantities of fuel oil inside of a building without changing the occupancy to a Hazardous occupancy. The requirements in the 2009 IFC permit up to 3,000 gallons of fuel oil inside a building when:

1. The fuel oil is stored in a Protected AST,
2. The entire floor housing the TINBID is protected by a NFPA 13 compliant automatic sprinkler system,
3. The fuel oil piping system is designed and constructed in accordance with the *International Mechanical Code*, and
4. The PAST is located not more than 2 stories below the building's grade plane.

Readers seeking additional information about changes to the 2012 IFC are encouraged to purchase the *Significant Changes to the 2012 IFC*. This four-color illustrated soft cover provides a detailed analysis of the purpose and intent of the significant code changes to the 2012 IFC. The book can be purchased from the ICC Book Store at

<http://www.iccsafe.org/Store/Pages/Product.aspx?category=15065&cat=ICCSafe&id=7404X12>

ABOUT THE AUTHOR

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NOTE TO EDITOR: Please crop out the person on the right. It's my boss and he didn't write the article. But he's a cool guy, just like Wayne.

Question 6: Is it permissible to remove an underground tank and reinstall it aboveground if an emergency vent is added?

Answer: No. The tank construction requirements for underground and aboveground tanks are different, and the lack of an emergency vent is only one differentiating aspect of the design criteria.

Even if an emergency vent is retrofitted onto a steel underground tank, it is still not permissible to re-use the tank aboveground because underground steel tanks are constructed in accordance with UL 58 and aboveground steel tanks must be constructed in accordance with UL 142, which is not an equivalent design standard. Likewise, nonmetallic underground tanks are not designed for use aboveground, and fire codes via reference to NFPA 30 have numerous restrictions on the use of any nonmetallic tank for aboveground storage of flammable and combustible liquids, regardless of whether such tanks are designed for aboveground use.

For these reasons, NFPA 30, Chapter 21 specifically prohibits re-use of underground tanks in aboveground locations and vice versa.

Question 7: Where tanks are installed inside of a building, are there any special requirements related to vent installation?

Answer: Many, and they're changing. Generally, codes require vents for tanks containing flammable and combustible liquids that are installed in buildings, including storage tanks, day tanks on pumps and generators, etc., to be extended to discharge outside. Such a requirement is contained in NFPA 30 Chapters 22 and 27 and in Chapter 34 of the IFC. While this may seem rather straightforward, it isn't.

With respect to normal venting, vent flows for tanks in buildings tend to be low enough that extending a vent pipe can be done without causing excessive backpressure. Care must be taken to ensure that there are no low points that could accumulate liquid, which could come from condensation inside the pipe or from unintended sources, or other obstructions. Any blockage of the pipe could result in excessive backpressure or vacuum inside of the tank. Because the vent pipe must be arranged to generally drain back to the tank's vent opening, provisions must also be made to prevent accumulation of any liquid on top of a venting device, which could impede operation.

With respect to emergency vents, similar precautions against obstruction are needed, but the situation becomes far more serious. UL 142 specifies the minimum diameter for an emergency vent based on a maximum permissible nipple length (pipe connecting the tank shell to the emergency vent opening or vent device) of one foot. When an emergency vent opening must be extended to the building exterior, the additional length through which vapor must flow to escape the tank will lead to excessive back-pressure on the tank if the vent pipe diameter is inadequate. In a worst-case scenario of a fire engulfing a tank with a large surface area, vent flows would be enormous and backpressure from an under-sized vent pipe could cause the tank to rupture.

In addition to the pipe diameter, fittings used to make turns are also a concern because they too are a factor in backpressure calculation.

An early calculation procedure for determining the needed vent size for an extension of vent piping was published in Crane Technical Paper No. 410 in 1957. Other procedures and/or computer programs to execute the calculations may now be available, but the Crane procedure is still valid.

Answer: UL listed venting devices (and various other tank appurtenances) will indicate that they are listed in accordance with UL 142. However, it is interesting to note that UL 142 is devoid of testing criteria to be used in evaluating these devices. Accordingly, when one sees a UL listing mark on a manufactured venting device, there is no way to readily know what tests that device was subjected to in order to earn its listing. Has the device been subjected to operational cycling, corrosion testing (important for tanks located near the ocean), freeze/thaw cycles, fire exposure...? No published standard documents the minimum requirements.

Instead, for these devices, UL uses unpublished (non-consensus) guidelines that are developed by UL staff, perhaps with selected outside input. The only way to find out what tests were done on a particular device is to ask the device manufacturer for a copy of the UL listing report, which should provide this information.

Access to detailed testing requirements is becoming even more important as alternative fuels that contain alcohol continue to increase in popularity. For tanks containing fuels with significant alcohol content, vent seals must be resistant to alcohol vapors because a flame traveling past a failed seal into a tank's vapor space poses a fire or explosion risk if the vapors in the space are in the flammable range, certainly a possibility with fuels containing alcohol. However, don't assume that UL specifically evaluates pressure-vacuum (P-V) venting devices with respect to their ability to perform as flame arresters...normally, they don't, even though fire codes recognize P-V vents in lieu of flame arresters on flammable and combustible liquid storage tanks. Designers and inspectors need consider whether reviewing the listing report for a particular valve installation is necessary to ensure compatibility of the valve with stored liquids.

UL is beginning the process of developing a standard that will hopefully, at some point, provide published criteria detailing the testing requirements for vents and other tank appurtenances. Given that some of these devices are essential to safety and that they are installed on many tanks, this seems to be an appropriate step. The time frame for completion of that project has not been formally established.