



State Fire Marshal's Alert

February 22, 2006

University Campus Liquid Nitrogen Cylinder Explosion

Recently, a compressed gas cylinder exploded in a state university campus laboratory. The explosion was attributed to dangerous alterations that had been made to the cylinder. To help prevent similar gas cylinder-related incidents, universities shall, at a minimum:

- Repair, replace or remove from service leaking, damaged, or corroded compressed gas cylinders or systems.
- Implement and sustain a preventative maintenance program for all compressed gas cylinders and systems. A preventative maintenance program shall include periodic inspection of all cryogenic fluid storage systems and replacement of pressure relief valves every five years, ensuring the valve is set as required by the tank design. A record of the inspection should be prepared and provided to the user or the authority having jurisdiction upon request.
- Ensure that an individual trained in tank usage be in attendance at all times cryogenic fluid is transferred from one container to another.
- All service, repair, modification, or removal of valves, pressure-relief devices, or other container appurtenances shall be performed in accordance with National Fire Protection Association (NFPA) Standard 55 and the Compressed Gas Association (CGA) guidelines (<http://www.cganet.com/Publication.asp?mode=c>).



Figure 1 -Effect of Explosion on Dewar Cylinder Compared to unaffected cylinder

Incident Specifics



Figure 2 - Hallway Outside Laboratory Showing Explosion Damage

At approximately 3:00 a.m. on Thursday, January 12, 2006, an explosion occurred in a state university chemistry building laboratory, causing substantial building damage. The explosion resulted from a rupture in a liquid nitrogen (Dewar) cylinder. The cylinder was originally constructed and tested in December 1980.

The State Fire Marshal's Office, in cooperation with the university's environmental health & safety office, conducted an investigation that included an assessment of the building damage and reconstruction of the events leading to the explosion. The resulting examination revealed catastrophic failure of the cylinder. The failure permitted rapid expansion of the nitrogen gas, blowing out the bottom of the tank and propelling the cylinder upwards.

The examination revealed that the cylinder's pressure release valve and rupture disc had been replaced by two brass plugs. Without these two features in place, the cylinder's rupture-prevention function became compromised. During the investigation, lab students related that the bottom portion of the cylinder had been frosting for approximately twelve to eighteen months, suggesting to them that the cylinder was "leaking". It is speculated that

the tank was relieving normal excessive pressure through an old leaking gasket on the top of the tank (the actual pressure-relief function had been plugged). Approximately twelve hours prior to the explosion, one of the students replaced the leaking gasket and refilled the cylinder. As the old gasket that helped relieve internal pressure had been replaced, the now full cylinder was completely sealed. The cylinder ruptured when its internal pressure rose above 1,000 psi.

The catastrophic failure of the nitrogen cylinder was a direct result of the removal and subsequent plugging of the internal tank pressure relief devices. The cylinder was modified by inexperienced and unidentified person(s) resulting in the eventual failure of the cylinder. It could not be determined when the modifications took place.



Figure 3 - Inside the Laboratory after Explosion