Please report all accidents and near misses. Things happen and it is important to learn from others. Environmental Health and Safety and your colleagues appreciate hearing about incidents, reviewing their causes and learning from them.

CRYOVIAL SAFETY

Cryovials are commonly used for cryogenic storage of biological materials using liquid nitrogen. Upon removal from low temperature storage, liquid nitrogen that may have seeped into the closed tube may suddenly expand (690 times) during conversion from gas to liquid phase. When not handled properly, the cryovials may explode and result in physical injuries and exposure to the vial contents. In addition, cross contamination of cells and the contents of the freezer can occur.

Visit Cryogen Use and Storage Guidelines for information on liquid nitrogen hazards, appropriate personal protective equipment, proper storage and safe use guidelines.

What Happened?

In April 2012, a cryovial with external threads and a female cap immersed in liquid nitrogen exploded in a research laboratory, exposing a researcher to risk of physical injury and to a biohazard. In July 2020, a nearly identical incident occurred. Reports of incidents elsewhere involving liquid nitrogen and cryovial explosions have resulted in significant injuries (See "more information" below).

What Went Right?

The incident was reported and an investigation followed.

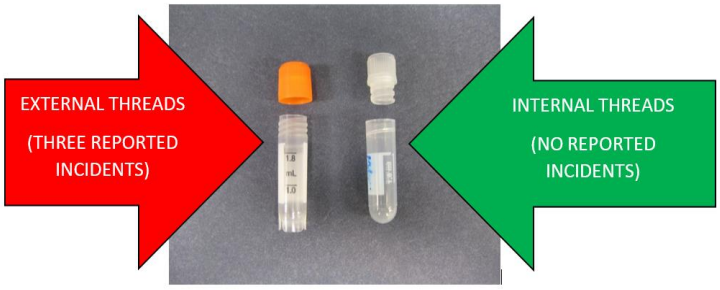
What Should Have Been Done Differently?

All incidents should be investigated to prevent a reoccurrence. During the 2012 investigation, two additional reports of exploding cryovials within the past year were shared by other laboratory members.

What Corrective Actions Have Been Taken?

The lab switched to cryovials with internal threads and male caps which have no reported incidents of explosions. See Figure 1.

FIGURE 1. EXTERNAL AND INTERNAL THREADED CRYOVIALS

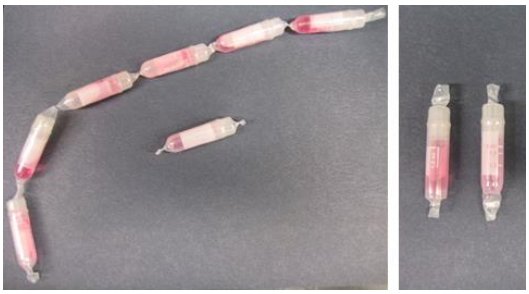


How Can Incidents Like This Be Prevented?

- Follow cryovial manufacturer instructions. Note that most manufacturers of both internal and external threaded tubes provide an alert that their tubes should NOT be immersed in liquid nitrogen due to the explosion risk.
- Store cryovials in the vapor phase only. Never store cryovials containing biohazards in the liquid phase of liquid nitrogen freezers.
- Use cryovials with internal threads and male caps when possible. See Figure 1.

- If other materials must be immersed in liquid nitrogen for storage, utilize specialized cryoflex tubing or other safety enclosures that can be heat sealed to prevent the entry of liquid nitrogen into cryovials. See Figure 2.
- If encountering cryovials immersed in liquid nitrogen, immediately place the tubes inside a sealed and unbreakable plastic container prior to thawing to contain an explosion if liquid nitrogen entry did occur. Another option is to slowly move the vials from the liquid phase to the gaseous phase over the course of 24 to 48 hours prior to removing. Contact EHS for assistance with tubes that are potentially stored in the liquid phase in a nitrogen freezer.

FIGURE 2. EXAMPLES OF HEAT SEALED CRYOVIALS FOR PROTECTION DURING STORAGE IMMERSED IN LIQUID NITROGEN



More Information

- **Yale Environmental Health and Safety**: Cryogen Use and Storage Guidelines (https://bit.ly/2ZnhkV2)
- **Yale Environmental Health and Safety**: Liquid Nitrogen Dewar Valve Failure Lessons Learned (https://bit.ly/2FhCxsP)
- **Lab Health and Safety**: Cryogenic safety hazards and what it takes to control them (https://bit.ly/35m3NRC)