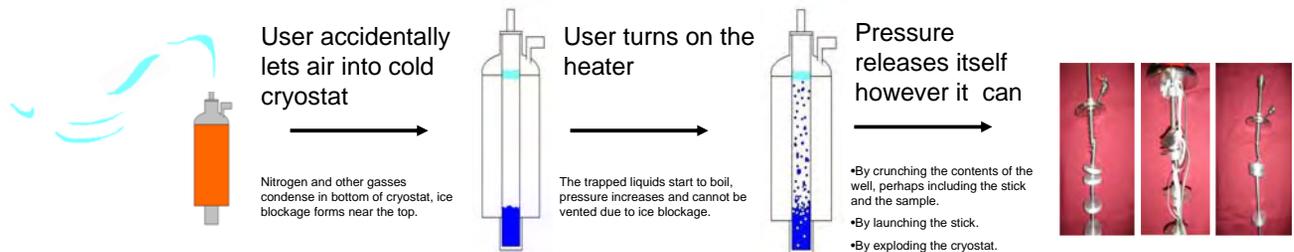


How to keep a stick out of your face

Preventing cryostats from icing up and damaging samples, launching sample sticks, exploding, or other inconveniences.

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This situation is dangerous!!!!

We propose introducing a simple vent tube that allows the excess pressure to vent out of a check valve at the end of the sample stick, but...

Will the vent tube itself ice up and become blocked?

We outfit a closed-cycle refrigerator with two types of vent tube:



•Tube completely open, could potentially form an ice blockage inside.

•With a specially-developed cryogenic burst disc that seals the end of the tube until pressure reaches the bursting pressure of about 40psig at 77K.



Pressure-relief valve

¼-turn multi-purpose valve

Pressure gauge



Test stick installed, cooled to base, and opened to air

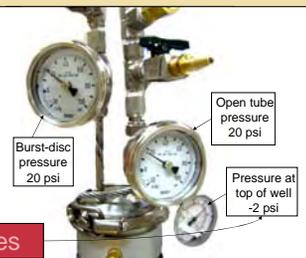
Cryostat vent opened to warm, humid air (connected to a still)

Humid air cryopumped into cold cryostat... on purpose.

To do this test, we needed to create a hazardous situation, but to do so in as safe a manner as possible. The second tube with a burst disc was included as a back-up safety feature, but we don't want a burst disc in the final design.

When confident that a blockage had been formed, we adjusted the temperature setpoint to 90K with the heater at full power (100W).

As temperature increased, pressure built as indicated by the open-tube pressure gauge. But the pressure at the top of the well, which is what the user would see, remained low.



When pressure reached 20psi, the relief valve opened and pressure was vented.

This is what a user sees

The test was successfully repeated two more times. An ice blockage never formed in the vent tube.

Mission Accomplished!!!

Our vision for the future is to incorporate the vent tube and relief valve into the existing sample stick.

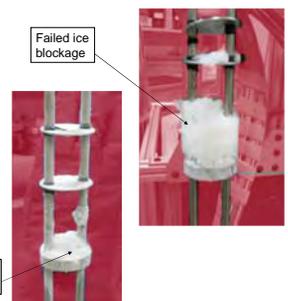
Lessons Learned



Water remaining in cryostat after failed attempt at forming an ice blockage

➤ It is rather difficult to form a robust ice blockage. Most often the ice gave way before pressure climbed high enough to trigger the relief valve.

- Humid air is essential to the formation of an ice blockage
- It is possible to leave a cryostat open to air for hours and still not form enough ice to adhere the stick to the sample well.
- Even if the stick is stuck in the well, you probably don't have a complete ice-blockage.
- A valve on the vent tube as well as a gauge is very handy for ascertaining the existence of an ice blockage, and should be included in the final design.



If you want something messed up properly, get help from a user.