

Types of Chamber Cooling Systems

The two major types of chamber cooling systems are expendable refrigerants and mechanically cooled.

Expendable Refrigerants

Expendable refrigerants are liquid/gases that can be injected directly into the space being cooled or into heat exchangers, similar to mechanical systems. As the liquid enters the chamber (directly or through a fin coil) it absorbs heat and flashes to a gas. The gas is then vented out of the chamber and should be ducted outdoors. The two most popular refrigerants are liquid nitrogen (LN₂) and liquid carbon dioxide (CO₂). Cryogenic temperatures down to -184°C (-300°F) can be achieved with LN₂. CO₂ on the other hand can only achieve temperature down to -68°C (-90°F). Both of these gases are environmental safe and can be vented to the atmosphere. Note: it is imperative that the gases be vented outdoors. These gases displace oxygen and asphyxia can occur if the chamber is not properly vented.

Types of Mechanical Cooling Systems

Mechanically-cooled refrigeration systems are fundamentally the same as those used in home refrigerators. They utilize a compressor and circulate a refrigerant around a closed loop system. The ultimate low temperature required by your testing determines the type of refrigeration system needed.

Single Stage

Single-stage refrigeration systems typically can pull the temperature in the chamber down to -34°C (-30°F). Some manufacturers rate their single stage systems down to -40°C (-40°F). However, due to the refrigerant used there is very little cooling capacity available at -40°C and can be difficult to achieve. For continuous operation at -40°C and below most manufacturers recommend a cascade refrigeration system.

Cascade

Cascade refrigeration systems have two separate refrigeration systems working to cool the chamber down to an ultimate low of -73°C (-100°F) and -85°C on industrial freezer models. The first stage refrigeration system cools and condenses the refrigerant in the second stage. The second stage refrigerant flows through an evaporator located in the chamber which cools the air. These systems can become very complex depending on your application.

Tundra®

The Tundra refrigeration system is a patented, single-stage refrigeration system that can efficiently cool the chamber down to -45°C (-50°F). It utilizes a common refrigerant and is able to operate continuously at -40°C. Since most low temperature environmental testing is done at -40°C, it is a good alternative to buying a cascade system. It uses less energy (up to 40% less) and is less complex than a cascade system. There are also fewer parts compared to the cascade system which means lower maintenance & utility costs over time. At warmer temperatures, this system can also handle large live load conditions generated from testing electronics.

