# Top Five Rarely Asked — *but Important* — Questions When Purchasing a New ULT Freezer

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When it comes to evaluating ultra-low temperature (ULT) freezers, people prioritize specific criteria over others. Some focus only on cost or energy savings, while others might prefer a particular brand. Yet others might zero in on temperature uniformity or recovery, or even how many samples it holds.

Regardless of how you weigh these criteria, there is one factor that matters above all others: sample safety. It doesn't matter how much a ULT costs, how much energy it saves, or how quickly it recovers from an open door. If it doesn't keep your valuable samples safe, it's useless.

It's likely that sample safety is at the top of your ULT features list, but it's also possible that you're not asking vital questions that will help determine which ULT is right for your operation. Whether you're responsible for evaluating ULTs or play a role in advising others on what to look for, keep these rarely asked — but important — questions in mind.

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## 1. How will the ULT's long-term maintenance requirements risk sample safety?

Compressor failure is the most common reason for an ultra-low temperature freezer to break down. Knowing that ULT compressors can be unreliable, customers actually plan for them to malfunction eventually. On average, a ULT compressor lasts about five years, which means if your ULT uses a compressor, at some point during its lifespan, it's going to stop working. Any unexpected ULT failure, such as a likely compressor failure from oil logging or wear, can threaten the safety of your priceless samples.

Since compressors are known to fail, we replaced them with the inherently reliable and field-proven Stirling engine. By replacing the compressor with the Stirling engine, we removed a significant risk to sample safety.

While the compressor itself only may cost a few hundred dollars in replacement parts, the labor involved can be several thousand dollars. Add these replacement costs to the other expenses associated with ULT downtime (including moving the samples in the failing unit to another unit for temporary storage and removing the ULT off-site for repair), and disruption from a failed compressor can be significant.

Compressor-based units also require preventive maintenance on monthly, quarterly, yearly and biennial schedules to keep them running at peak efficiency. In contrast, Stirling engine-powered units have no oil in their systems and require minimal preventive maintenance, including keeping the air intake clear and gaskets free of ice. Less maintenance reduces labor and maintenance costs, but more importantly, lowers the likelihood of a ULT failure, which will put your samples at risk.

The components in a Stirling engine-powered ULT are designed to last the life of the freezer. This technology has been proven — with over 250 million collective hours of runtime operation in Stirling's installed base and the use of this design in other applications, such as the RHESSI satellite, which was in orbit for more than 16 years.

## 2. What are your floor space and capacity requirements?

Since labs and biorepositories tend to accumulate older biological samples while continuously acquiring new ones, they often become pressed for ULT storage capacity with limited floor space. Not all ULT models offer the same storage capacity per unit or square ft/m of floor space. If you're trying to meet specific capacity requirements, you should take your floor space, freezer storage volume, door swings, ventilation clearances and HVAC load into account to ensure you have the room and cooling power for enough ULTs to meet current and future capacity demands.

Many operations have created additional freezer space through renovations or new construction when their sample storage needs eclipse their available floor space. But by replacing your large-footprint ULT with a smaller-footprint unit, including one with narrower door swings or clearances, you can increase capacity without expensive and disruptive renovations.

When evaluating ULTs, compare their exterior cabinet dimensions relative to how many samples they can hold. Also, be sure to consider the ULT's rack configuration, as some models offer higher storage density in the same footprint. Using ULTs that offer a larger storage volume in the cabinet and a smaller exterior footprint enables you to maximize your sample storage capacity without taking up too much valuable lab space. You may also need fewer freezer units to store the same volume of samples, which translates into lower capital purchasing and operating costs, as well as a smaller carbon footprint.

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## 3. What is the impact of ambient temperature on sample safety and facility infrastructure?

Depending on seasonal and climate factors, a variety of ULT freezer considerations impact ambient temperatures in your lab or biorepository. Because standard compressor-powered ULTs produce a large amount of heat, the number of units in a room, the size of the room, and the effectiveness of a facility's HVAC system all contribute to ambient room temperature and ULT efficiency and reliability.

Warm ambient temperatures in the rooms where ULTs are operating can have significant impacts on their performance, reliability and efficiency. Once ambient temperatures exceed 26.7°C (80°F), compressor-based systems have to work harder, which compromises efficiency and reliability, even shortening compressor lifespans.

And once ambient temperatures exceed 32.2°C (90°F), system reliability is compromised, placing samples at risk with typical compressor-based ULT units.

Stirling engine-powered ULTs use much less energy than standard compressor-based models, so these units also generate 70–75% less heat. Further, Stirling engine-powered ULTs operate safely at up to 35°C (95°F) ambient room temperatures, which maintains sample integrity in warmer rooms and throughout a much wider range of ambient conditions. Since they produce less heat, you won't have to run your HVAC system as hard as you would with a compressor-based unit. And since the Stirling engine-powered unit produces minimal heat, you can likely use the ULT in a space that doesn't already have a freezer, with no special HVAC additions. During new construction, you even can scale down your HVAC system and install a more efficient and economical solution.

## 4. Can you reduce energy and carbon footprint by storing samples at different setpoint temperatures?

While ULTs are rated for their ability to maintain temperatures of -80°C, some labs are adopting a -70°C setpoint to reduce energy use and costs, and because their samples don't have to be stored at -80°C. Labs might be interested in storing samples such as DNA at even higher temperatures, perhaps up to -20°C to -30°C. Some operations have considered segmenting long-term storage by sample type and raising their ULT setpoints (while still keeping samples safe) to reduce energy use and shrink their carbon footprint. Those labs that are considering storing samples at temperatures warmer than the -80°C threshold should look for ULTs that can safely maintain a wide range of setpoints.

Unfortunately, most compressor-based ULTs don't even have the option to raise the setpoint above -50°C. These constraints limit the options labs have to store samples at higher temperatures. Stirling ULTs maintain temperature setpoints anywhere between -86°C up to -20°C. This option gives you the flexibility to use one ULT model for a variety of needs and enables you to redeploy the ULT for other tasks with different temperature requirements without having to buy another unit.

## 5. How reliable and clean is your power?

When you think about ULT power consumption, you should consider how power reliability (including voltage anomalies), power consumption and power factor can affect your ULT's operation and your operational costs.

Power surges can happen as a result of a nearby lightning strike or from your power company restoring power after a brownout. While not a significant issue in some regions, if you operate a facility in a region with low-grade power availability, you could experience abnormalities such as brownouts, voltage/frequency variations and surges on a more frequent basis.

To combat these risks, labs often have to install expensive power conditioners to maintain voltage equilibrium. Stirling engine-powered units are brownout-tolerant and more resilient to fluctuating voltages because they can operate across a wider voltage range, so your samples won't be at risk during power fluctuations.

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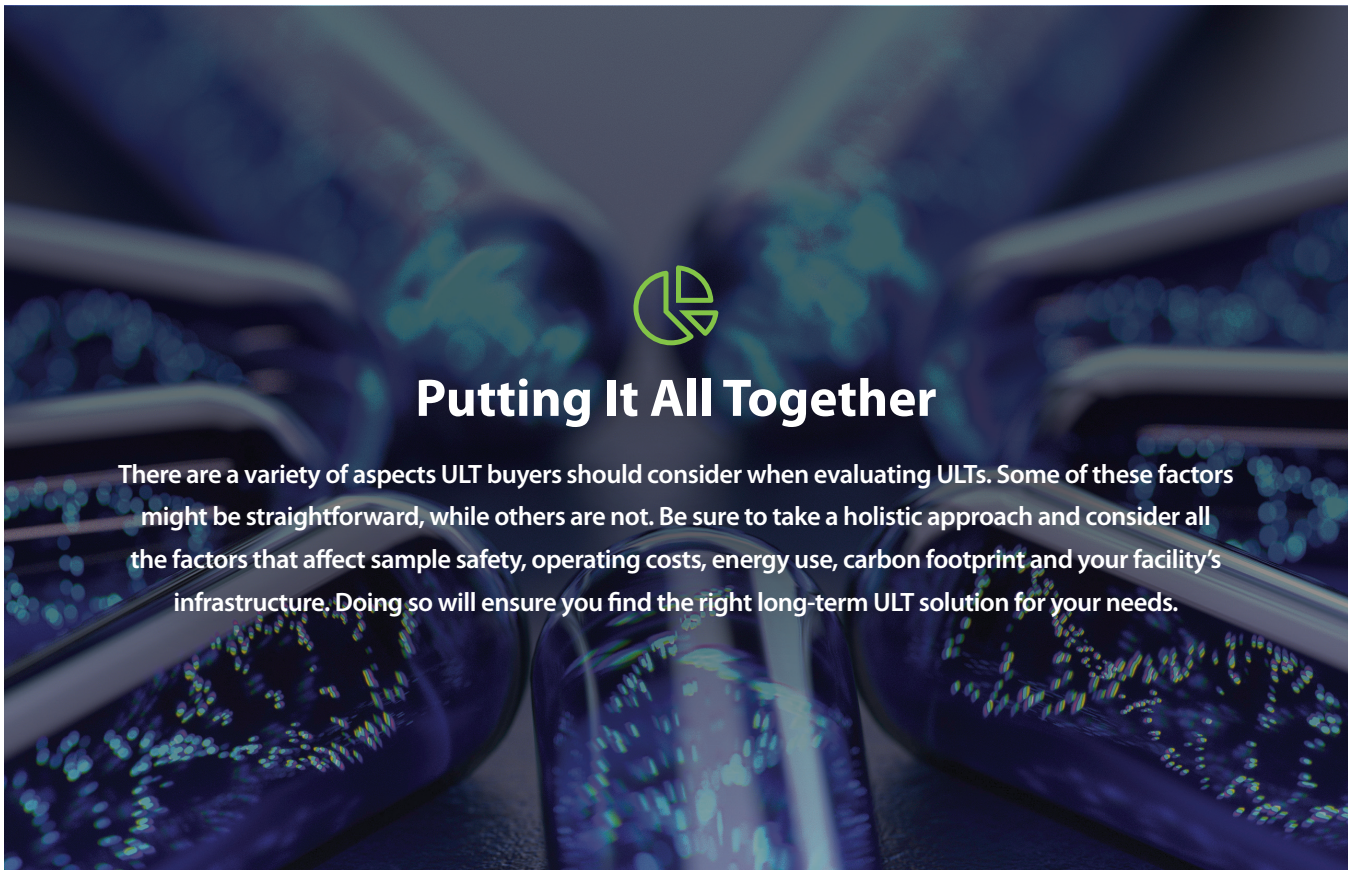
Since using a Stirling engine-powered unit consumes less power and gives off less heat than most compressor-based units, you won't have to generate as much backup power to keep your samples safe if the lights go out, so you can store less diesel fuel on-site (if you use a diesel generator to produce backup power). In addition, HVAC units will not have to work as hard to keep the area cool, allowing you to downsize or not run the units as hard as before, reducing energy use further.

You also should consider the power factor of your ULT model. Power factor is the ratio of the real power absorbed by the load to the apparent power flowing in the circuit. While power factor doesn't impact the amount of power your ULT uses, it can affect the cost you pay per kWh. A lower power factor means you could pay a higher utility rate (although your rate ultimately depends on your contract with your utility provider).

*Diesel power generators are used by many research facilities for backup power of vital ULT storage and other equipment in the event of a power outage.*



## Putting It All Together

**There are a variety of aspects ULT buyers should consider when evaluating ULTs. Some of these factors might be straightforward, while others are not. Be sure to take a holistic approach and consider all the factors that affect sample safety, operating costs, energy use, carbon footprint and your facility's infrastructure. Doing so will ensure you find the right long-term ULT solution for your needs.**

Learn more about optimizing your next ultra-low storage investment and contact a Stirling Ultracold representative at **stirlingultracold.com/solutions/financial-savings.**

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