

Stirling Ultracold SU780XLE ULT Freezer: Independently Reviewed

THE RESULTS ARE IN!

Laboratories are energy intensive environments, with most departments running a wide variety of equipment. Whilst some of this equipment can be switched off when not in use (e.g., drying cabinets and autoclaves), other equipment must stay on 24/7, such as fridges and ULT freezers.

There are a few simple steps to maximise the efficiency of laboratory fridges and freezers, such as cleaning filters regularly, replacing damaged door seals, and using inventory management systems. However, an older generation or aging ULT freezer could be consuming an eye watering 30 kWh/day! And even a new model could be using as much electricity as the average UK household.^{1,2}

Top tip for purchasing sustainably!

Look beyond the initial purchase cost of a ULT freezer and consider its life-time operating costs which factor in purchase costs as well as running costs (i.e. energy usage, HVAC impact), service, maintenance and repair costs (affected by warranty period), and expected life span.



Within our [Sustainable Solutions](#) portfolio, we feature Stirling Ultracold's ULT freezers. Rather than traditional compressor-based refrigeration, these ULTs incorporate a free-piston Stirling engine which provides efficient continuous modulated cooling. Their SU780XLE 780L unit has recently been put through its paces by independent laboratory sustainability specialist, Green Light Laboratories.

Here's what we've learnt...

The SU780XLE ULT freezer:

- 1 Delivers market leading energy efficiency.**
- 2 Offers high-capacity storage and space efficiency.**
- 3 Demonstrates superior recovery on door opening.**
- 4 Is cold; really cold!**

Read on to find out more.

Please get in touch to discuss your requirements or if you would like to review any of the findings in more detail: enquiries@medlinescientific.com.

Benefit 1: The SU780XLE ULT freezer delivers excellent market leading energy efficiency.

An old ULT freezer could be using as much as 10-30 kWh/day, when set at -80 °C.¹ Whereas a newer unit would be expected to consume 7-12 kWh/day (setpoint -80 °C) and 5-10 kWh/day (setpoint -70 °C).^{1,3,6} Stirling Ultracold's SU780XLE freezer can run on as little as 6.67 kWh/day at -75 °C (Weighted Average).⁴

During independent testing at the University of Bristol, in typical laboratory conditions (ambient of 23 °C, ± 1.5 °C), energy usage of the SU780XLE is around 8.86 kWh/day (setpoint -80 °C), see Figure 1.

However, an even more useful figure to consider is a freezer's W/L/Day consumption which calculates a unit's energy usage according to its capacity, and allows end users to compare like for like. Here, the Stirling Ultracold freezer also demonstrates excellent efficiency. See Figure 1.

Figure 1: SU780XLE energy consumption at three setpoints

Set Temperature (°C)	Energy Consumption	W/L/Day
-80	8.864 kWh/day	11.89
-75	7.744 kWh/day	10.39
-70	6.710 kWh/day	9.00

Data supplied by Green Light Laboratories. kWh = kilowatt hour; W/L/D = Watts per litre per day

Top tip for energy conservation!

Consider increasing the set temperature of your freezer from -80 °C to -70 °C. In the case of the SU780XLE, this saves 25%: at -70 °C energy usage is only 6.71 kW/day (or 9.00 W/L/Day). See Figure 1.

Compared with traditional compressor-based ULT freezers, the SU780XLE generates up to 70–75% less heat.⁵ This reduced heat output lowers the demand on the building's air conditioning/ventilation systems and should offer organisations further energy saving.

Benefit 2: The SU780XLE ULT freezer offers high-capacity storage and space efficiency.

Rather than compressor-based cooling, the SU780XLE freezer incorporates a patented Stirling engine which is space efficient and leaves more room for storing samples. Currently, the SU780XLE offers the largest m³ storage capacity per m² of floor space available on the market.⁵

With standard racking, the SU780XLE accommodates up to 600 2" boxes and with optional high-density racking, 700* 2" boxes can be stored. Such high-density sample storage means that labs may be able to purchase fewer freezers while also saving valuable lab space.

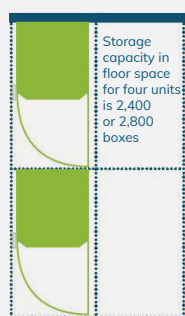
As a percentage of its gross/external volume, the SU780XLE freezer ranked 1st for 'usable capacity as a % of footprint' in Green Light Laboratories 2022 SWOT Analysis Case Study.⁶ This means it will allow laboratories to store more samples before they need to purchase additional units.

Data supplied by Green Light Laboratories.

But what if you need more than one freezer?

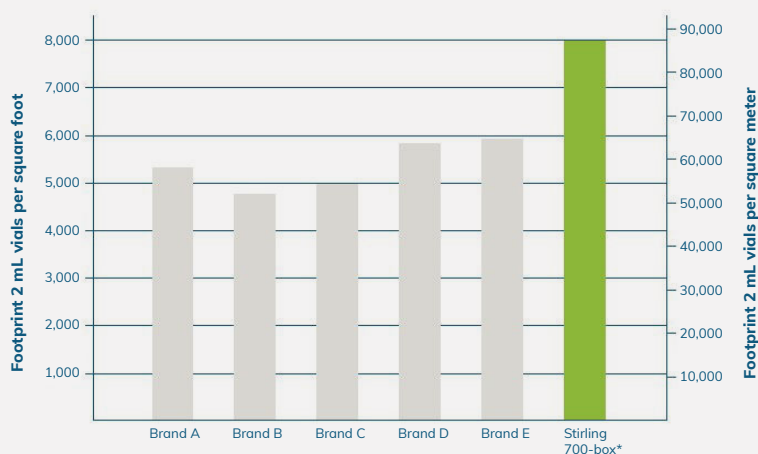
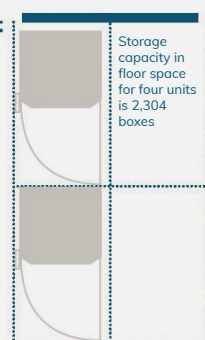
The SU780XLE has a smaller clearance for door swing than some models on the market. In addition, its upper-side air venting allows freezers to be positioned closer to walls without extra clearance for air flow. Taken together, these benefits enable organisations to maximise use of their lab space and make the SU780XLE a great choice for creating high-density storage environments.

Stirling Ultracold ULT 4 ULT Freezers



In the overhead view configuration shown, the same number of Stirling freezers store up to 47% more samples per square foot/meter.

High-efficiency compressor-based ULT 4 ULT Freezers



Data supplied by Stirling Ultracold.

Benefit 3: The SU780XLE demonstrates superior recovery on door opening.

Frequent and prolonged freezer door openings can lead to ice build-up and the consumption of more electricity. To work more sustainably, whenever possible, laboratories should reduce the frequency and duration of door openings. This can be done by keeping samples organised, ideally with an inventory management system. In most instances, the addition of freezer racking will increase storage capacity, as well as improve organisation and temperature stability.⁷

Top tip for working sustainably!

Knowing where your samples are located allows you to plan what needs to be removed, from where, within the freezer, before opening the door. Even storing frequently used samples near the front of the freezer and clearing out old samples and reagents can help.

The SU780XLE will complement these 'good practices' with its superior temperature recovery. During independent testing, this model demonstrated efficient and 'best in class' temperature recovery.⁶ Even with 9 x 60 second door openings, the freezer used less than 10 kW/day (setpoint -70 °C).³

Figure 2: SU780XLE energy consumption at three setpoints

The energy consumption at the three temperature setpoints and the energy cost of carrying out two timed door openings (60 seconds and 90 seconds) at each setpoint.

Set Temperature (°C)	Energy Consumption	W/L/Day	60s and 90s Energy Cost
-80	8.864 kWh/day	11.89	0.767 kWh
-75	7.744 kWh/day	10.39	1.097 kWh
-70	6.710 kWh/day	9.00	1.200 kWh

Data supplied by Green Light Laboratories.

Other independent studies conducted by Green Light Laboratories indicate that adding freezer racking should further improve performance by reducing the amount that the temperature rises within each compartment when the door is opened.⁷

The Stirling engine delivers continuous, modulated cooling which eliminates on/off cycling that compressor-based models use to regulate temperature. This results in more consistent temperatures (within ± 1 °C at steady state⁵) and enables quick return to -80 °C after door opening.⁶

Benefit 4: The SU780XLE is cold; really cold!

It's an easy assumption to make that a ULT freezer set to -80 °C, will be -80 °C on the inside. However, the interior temperature of a ULT freezer can vary from top-to-bottom, front-to-back, and from model-to-model.

Figure 3 demonstrates that the SU780XLE delivers high temperature performance. During independent testing, the warmest temperature was -83.5 °C at a setpoint of -80 °C. Even at setpoint -70 °C, the Stirling freezer is an ultra-cold -71.5 °C or below at all probe locations (full data available on request).

Figure 3: SU780XLE temperature performance at -80 °C

Probe Location	Highest (°C)	Lowest (°C)	Mean (°C)
Compartment 1 Back	-84.1	-84.2	-84.2
Compartment 1 Middle	-83.5	-83.7	-83.6
Compartment 2 Middle	-88	-88.2	-88.2
Compartment 3 Sample	-90.2	-90.3	-90.1
Compartment 3 Middle	-90.2	-90.4	-90.4
Compartment 4 Middle	-90.6	-90.8	-90.8
Compartment 5 Middle	-90.1	-90.4	-90.3
Compartment 6 Middle	-88	-88.1	-88
Compartment 6 Front	-87.2	-87.4	-87.3

Data supplied by Green Light Laboratories.

Top tip for sample security!

Think about choosing colour-coded freezer racking, which can facilitate freezer sharing and aid emergency protocol i.e. which samples are most critical and should be saved first in an emergency.⁸

In Conclusion:

Thanks to the study carried out by Green Light Laboratories, we can be confident that the SU780XLE ULT freezer has earned its place in our Sustainable Solutions portfolio. It provides laboratories with high performance, excellent energy and space efficiency, and high-capacity storage.

Please get in touch to discuss your requirements or if you would like to review any of the findings in more detail: enquiries@medlinescientific.com.



1. The Cambridge Green Challenge: 2019
2. Average household electricity usage GB by region | Statista
3. STIRLING ULTRACOLD SU780XLE – Green Light Laboratories: 2022
4. Manufacturer data: SU780XLE Technical Data Sheet Stirling Ultracold.pdf
5. Manufacturer data: SU780XLE Product Information Sheet Stirling Ultracold.pdf
6. Stirling Ultracold Freezer SWOT – Green Light Laboratories: 2022
7. ULT FREEZER RACKING STUDY – PART II Green Light Laboratories: 2019
8. CO2 and LN2 backup systems available. We recommend an independent external monitoring system for customers storing high-value and/or critical samples.

* To keep the vacuum release port unobstructed on the SU780XLE, it's recommended that one box be removed. This will reduce storage capacity to 699 2-inch boxes in the high-density configuration.

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