Cold storage

TSX Universal Series ULT freezers: leading the way in total performance

Evaluating a ULT freezer's total performance is key to determining its reliability

Protecting your samples—and the years of research they represent—is the top priority when selecting an ultra-low temperature (ULT) freezer. To truly understand the reliability of a ULT freezer, it's essential to consider all key performance measurements. By evaluating the full scope of ULT performance, you can help ensure maximum protection for your samples and gain peace of mind knowing they are securely preserved.

Critical performance factors to consider when selecting your ULT freezer

The integrity and longevity of specimens rely heavily on the performance of ULT freezers, which must stably maintain ultra-low temperatures to help prevent degradation of samples and preserve their viability. Several key performance metrics should be considered when evaluating ULT freezers, including temperature peak variation (across set points), stability, door opening recovery time, large load recovery time, pull-down time, warmup time, and cooling capacity, while also considering energy efficiency.

Here we provide side-by-side comparisons between Thermo Scientific™ TSX™ Universal Series ULT freezers and other comparable products on the market. All the units were tested using a grid of 16 unweighted thermocouples and conducted in a controlled 20°C ambient testing chamber.

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As highlighted in Figure 1, the TSX Universal ULT freezers excel in total performance across all metrics, leading the way in performance reliability. Table 1 details how total scores were obtained. Each performance factor was given a maximum score of 3 according to the criteria in the left-hand column and then combined.
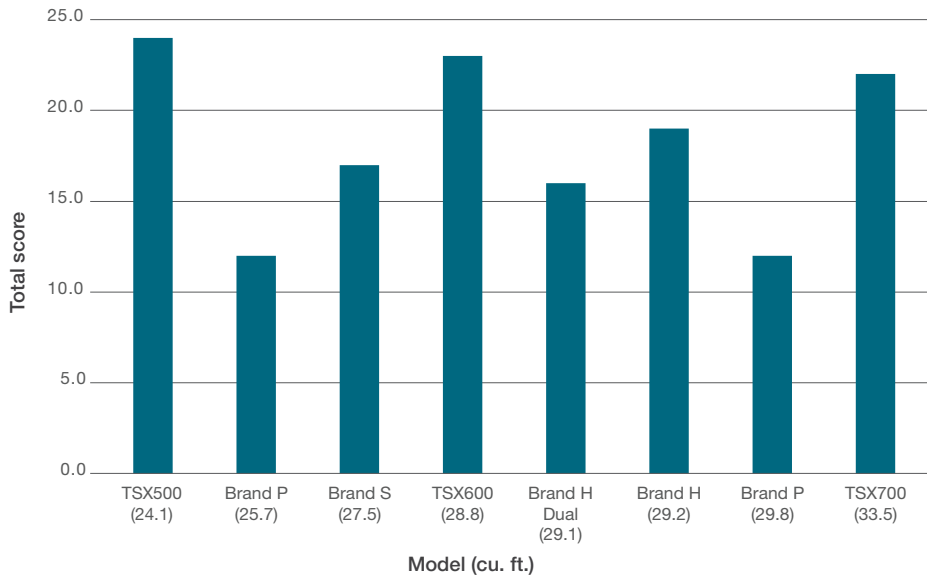
Figure 1. Summary of total scores for leading freezer brands. The TSX units excel in overall performance, highlighting the need to consider all key performance factors when evaluating different brands of ULT freezers.

Table 1. Comparison of key performance factors of ULT freezers.

|	Freezer unit model (cu. ft.)	TSX500 (24.1)	Brand P (25.7)	Brand S (27.5)	TSX600 (28.8)	Brand H Dual (29.1)	Brand H (29.2)	Brand P (29.8)	TSX700 (33.5)
3: PV <4°C, or warm side <1°C 2: PV <5°C, or warm side <2.5°C 1: PV <6°C, or warm side >2.5°C	PV (–80°C set point)*	–2.86/0.76	–1.1/2.99	–0.92/2.05	–2.67/0.77	–1.56/2.75	–2.12/1.57	–1.7/2.45	–2.87/0.48
	Score	3	1	2	3	1	2	2	3
3: PV <9°C, or warm side <5°C 2: PV <14°C, or warm side <6°C 1: PV >14°C, or warm side >6°C	PV (–50°C set point)	–4.3/4.1	–5.6/4	–0.5/2.7	–4.6/5	–6.3/2.9	–9.2/5.4	–12.7/5.2	–4.5/5.1
	Score	3	2	3	2	2	1	1	2
3: PV <0.5°C 2: PV <1°C 1: PV >1°C	Stability (°C)**	0.2	2.2	0.2	0.2	1.4	0.1	1.8	0.2
	Score	3	1	3	3	1	3	1	3
3: DOR less than 20 min 2: DOR less than 30 min 1: DOR more than 30 min	DOR time (min)† (MA‡ avg. to –75°C)	16	31	40	15	28	27	28	19
	Score	3	1	1	3	2	2	2	3
3: Less than 360 min 2: Less than 400 min 1: More than 400 min NA = 2§	10 L load recovery time (min) (avg. to –75°C)	349	395	NA	353	387	246	418	378
	Score	3	2	2	3	2	3	1	2
3: Below –90°C 2: Below –87°C 1: Above –87°C	Bottom-out temp. (°C)††	–91.9	–86.4	–85.2	–91.6	–88.5	–90	–88.4	–90.1
	Score	3	1	1	3	2	3	2	3
3: Less than 320 min 2: Less than 350 min 1: More than 350 min	Pull-down time (min)‡‡	249	306	340	282	293	279	379	310
	Score	3	3	2	3	3	3	1	3
3: More than 250 min 2: More than 200 min 1: Less than 200 min NA = 2§	Warmup time (min)§§	269	181	281	288	320	248	NA	303
	Score	3	1	3	3	3	2	2	3
	Total score	**24**	**12**	**17**	**23**	**16**	**19**	**12**	**22**

* PV = peak variation, or the temperature fluctuation samples are subjected to in a freezer. For example, the TSX500 model ranges from –2.86°C on the cold side to 0.76°C on the warm side for a PV of 3.62°C.
** Stability = PVs at individual locations in the cabinet over the course of an entire test period. † DOR time = door opening recovery time, the amount of time required to get the average temperature back below the safe temperature. ‡ MA = maintenance action. § NA = data not available, receiving an average score. †† Bottom-out temp. = the lowest average temperature a system can achieve and maintain.
‡‡ Pull-down time = the amount of time required to go from ambient temperature to –80°C. §§ Warmup time = the amount of time it takes for the average temperature to exceed a temperature limit of –50°C after the cooling system is disabled.

TSX Universal Series ULT freezers—built to perform, designed to protect

TSX Universal Series freezers owe their exceptional performance to our innovative V-Drive cooling technology. Unlike standard compressors, which toggle between full power and no power, the universal V-Drive compressor adjusts its speed dynamically based on cooling needs, as demonstrated in Figure 2. This helps TSX Universal Series ULT freezers deliver:

- **More stable sample storage**—38% tighter peak temperature variation, helping to ensure that your valuable samples remain consistently within optimal conditions

- **Faster recovery after access**—52% quicker recovery time after door openings, helping minimize disruptions to the environment of your samples

- **Rapid cooling for urgent needs**—41% faster pull-down time to reach −80°C, enabling you to quickly prepare for critical applications

- **Lower operating costs**—33% reduction in energy consumption, helping you save on energy bills while reducing your lab's environmental footprint

Data based on Thermo Scientific™ TSX600 Series units.
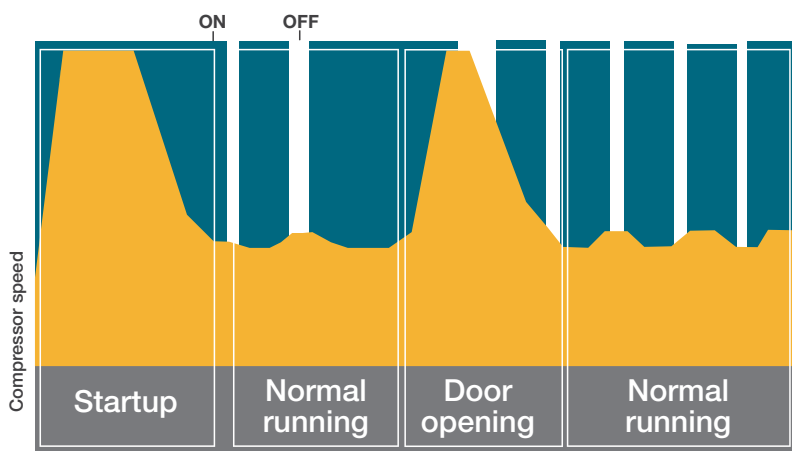
Figure 2. V-Drive variable speed vs. standard compressors. As shown in blue (ON) and white (OFF), standard compressors toggle between full power and no power, which may cause energy surges, temperature fluctuations, and increased wear. In contrast, the V-Drive compressor (demonstrated in orange) adjusts its speed variably to achieve optimal cooling capacity while maximizing energy efficiency.

Conclusion

Selecting the right ULT freezer is about more than just keeping samples cold—it's about safeguarding the integrity of years of research. To make an informed decision, users should evaluate critical performance metrics such as temperature peak variation, stability, door opening recovery time, large load recovery time, pull-down time, warmup time, and cooling capacity, while also considering energy efficiency. Being consistently strong in all these criteria helps ensure fast, consistent, and reliable performance across various usage types and lab conditions.

TSX Universal Series ULT freezers consistently outperform comparable products across all these metrics, as we show here in side-by-side comparisons. With innovative universal V-Drive cooling technology, TSX Universal Series freezers are built to deliver performance you can depend on, helping ensure your samples remain securely preserved under optimal conditions while minimizing costs and environmental impact.

Ultimately, TSX Universal Series freezers offer what matters most: peace of mind that your valuable samples are protected every step of the way.

Learn more at **thermofisher.com/tsxuniversal**