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Test Report

Verified Code:657466

Report No.:H202401183831-04EN

Customer: Lihan Cryogenics Co., Ltd

Address: 3/F, Bldg. 4. Pingshan Minqi Industrial Park, Lishan Rd., Nanshan, Shenzhen, GD518055, China

Sample Name: Cryocooler

Sample Model: TC2570

Receive
Sample Date: Fen.02,2024

Test Date: Fen.02,2024~ Mar.09,2024

Reference
Document: GB/T 2423.2-2008

Test Result: Meets MTBF 50000 hour requirement

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Issued Date: 2024/4/2

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H202401183831-04EN



Statement

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Test type	☒ Commissioning Test ☐ Routine test ☐ R&D test ☐ PV ☐ DV ☐ ECV ☐ Others_____			
Sample Source	☒ Commissioned units send sample ☐ Others:			
Sample	Model	Quantity	Sample No.	Test No.
Cryocooler	TC2570	10PCS	1#~10#	/
Sample Components and Accessories	Components: / Accessories: /			
Test with packaging or not	☐ Yes, Outer Packing _____ ☒ No			
Sample quality before test	☒ Conformity Product ☐ Non-conformity Product ☐ Prototype ☐ Others			
Abnormal condition of sample before test	No Abnormalities			
Environmental requirements	Temperature: 15.0℃~35.0℃ Relative Humidity: 25%~75% Atmospheric pressure: 86kPa~106kPa			
Test Address	Guangzhou Laboratory:163 PingyunRd., West of Huangpu Ave., Guangzhou			

Sample Information

Sample	Cryocooler
Model	TC2570
Refrigeration capacity	0.5W@77K
Rated input power	18W
Weight list	265g
Temperature control ability	±0.2K
Range of environmental temperature adaptation	-40~70℃

Note: The above sample information is provided by the client.

----- The following blanks -----

1 MTBF TEST

1.1 Test Condition

According to GB/T 2423.2-2008.

1.1.1 Test temperature: 55℃;

1.1.2 Test time: Maintain 857 hours and keep the maintenance phase in working condition.

Note: The test time is 857 hours, which is converted to actual working time, and the MTBF is 50157.831 hours. The calculation formula is shown in the appendix.

1.2 Sample Information

Sample information is shown in Table 1-1.

Table 1-1 Sample Information

Sample Name	Sample model	Quantity	Sample No.
Cryocooler	TC2570	10PCS	1#~10#

1.3 Test Requirements

According to According to the client's requirements.

After 50000 hours of MTBF, the sample performance should meet the specification requirements and there should be no fault alarms or other abnormalities.

1.4 Test Result

The test result are shown in Table 1-2.

Table 1-2 Test Result

Sample No.	Test result	Conclusion
1#	After 50000 hours of MTBF, the sample performance meets the specification requirements and there are no fault alarms or other abnormalities.	Meet the requirement
2#	After 50000 hours of MTBF, the sample performance meets the specification requirements and there are no fault alarms or other abnormalities.	Meet the requirement
3#	After 50000 hours of MTBF, the sample performance meets the specification requirements and there are no fault alarms or other abnormalities.	Meet the requirement

Continued Table 1-2 Test Result

Sample No.	Test result	Conclusion
4#	After 50000 hours of MTBF, the sample performance meets the specification requirements and there are no fault alarms or other abnormalities.	Meet the requirement
5#	After 50000 hours of MTBF, the sample performance meets the specification requirements and there are no fault alarms or other abnormalities.	Meet the requirement
6#	After 50000 hours of MTBF, the sample performance meets the specification requirements and there are no fault alarms or other abnormalities.	Meet the requirement
7#	After 50000 hours of MTBF, the sample performance meets the specification requirements and there are no fault alarms or other abnormalities.	Meet the requirement
8#	After 50000 hours of MTBF, the sample performance meets the specification requirements and there are no fault alarms or other abnormalities.	Meet the requirement
9#	After 50000 hours of MTBF, the sample performance meets the specification requirements and there are no fault alarms or other abnormalities.	Meet the requirement
10#	After 50000 hours of MTBF, the sample performance meets the specification requirements and there are no fault alarms or other abnormalities.	Meet the requirement

1.5 Test Photos



Fig.1-1 Test sample (detailed diagram)

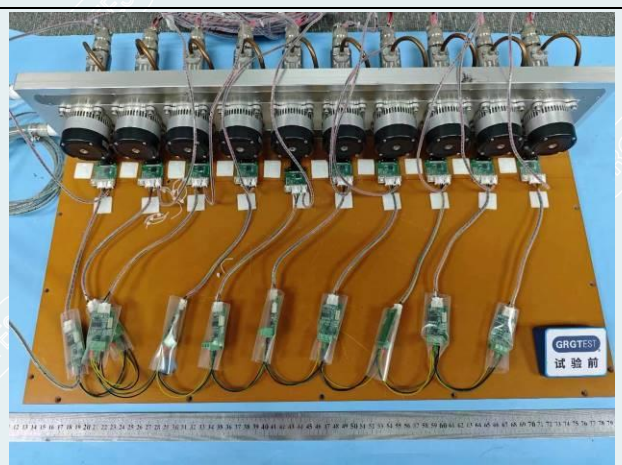
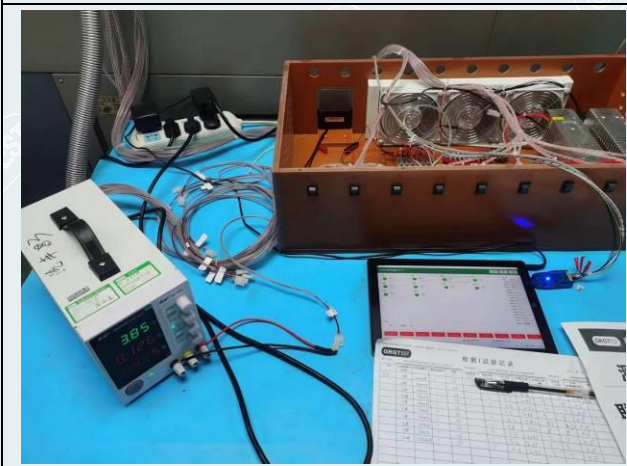


Fig.1-2 Test sample (1#~10#)

	
Fig.1-3 Test erection	Fig.1-4 Temperature front
	/
Fig.1-5 857 hour functional inspection	/

2 Test Instrument & Equipment

List of Instrument for Testing Equipment					
No.	Testing Item	Instrument/Equipment	Type	Serial No.	Calibration Valid Date
1	MTBF TEST	High and low temperature humidity and heat test chamber	NTH408-70A	17050716	2024-01-18~2025-01-17
		DC power supply	SP-3010	515989	2023-07-22~2024-07-21

Appendix

1、Evaluation conclusion

1.1 Statistical Test Plan

According to GB/T 5080.7-1986, in order to evaluate the mean time between failures (MTBF), a timed end test plan 5:4 was selected to conduct the test. The test plan is as follows:

Table 1 Test Plan Parameters Table

Scheme number	Discriminating risks		During the test bench (MTBF)	Number of truncated failures
	α	β		
5: 4	10%	10%	1.1	3

According to Table 1, the actual test time is $1.1 \times \text{MTBF}/\text{number of test bench sets}$.

At the same time, if the confidence level is 0.85, according to the chi square table, the actual test time is $3.79 \times 1.1 \times \text{MTBF}/\text{number of test bench sets} = 4.169 \times \text{MTBF}/\text{number of test bench sets}$.

1.2 Accelerated testing methods

The Arrhenius model is suitable for temperature stress accelerated life testing. According to Appendix C-1 of GB/T 17215.9311-2017, the calculation method for the acceleration factor AF is shown in Equation (1), and the conversion method for the life under service conditions and the life under test conditions is shown in Equation (2).

$$AF = \frac{L_{Use}}{L_{Accelerated}} = e^{\frac{E_a}{k_B} \left(\frac{1}{T_U} - \frac{1}{T_A} \right)} \quad (1)$$

$$L_{Use} = AF \times L_{Accelerated} \quad (2)$$

Among them,

k_B - Boltzmann constant $8.617385 \times 10^{-5} \text{eV/K}$;

E_a - activation energy of a chemical reaction, i.e. activation energy, in eV;

T_U - thermodynamic temperature under operating conditions, in K, where the thermodynamic temperature is equal to the Celsius temperature value+273.15;

T_A - thermodynamic temperature under experimental conditions, in K, where the thermodynamic temperature is equal to the Celsius temperature value+273.15;

L_{Use} - lifespan under usage conditions;

$L_{Accelerated}$ - Life under test conditions.

According to Appendix C-2 of GB/T 17215.9311-2017, E_a is taken as a typical value of 0.9eV.

Therefore, based on the actual working temperature of the product being 25 °C and the experimental working temperature being 55 °C, the acceleration factor AF is 24.4.

1.3 Evaluate conclusion

According to the above, the test time is 857 hours, which is equivalent to the actual working time,

i.e. MTBF:

$$MTBF = 24.4 * 857 * 10 / 4.169 = 50157.831 \text{ hours}$$

Due to $MTBF = 50157.831 \text{ hours} > 50000 \text{ hours}$, it meets the requirements.

----- End of Report -----