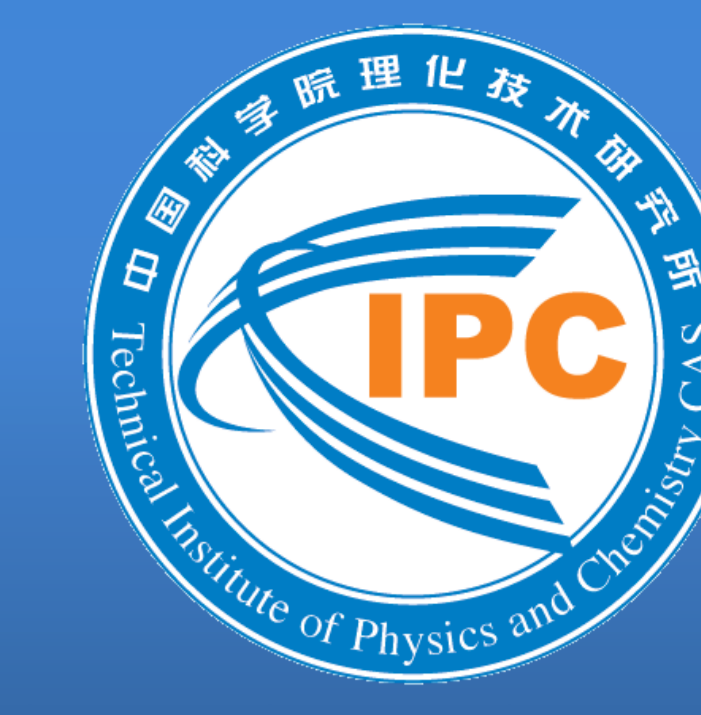




C1PoA-05 : High efficiency 40 K single-stage Stirling-type pulse tube cryocooler



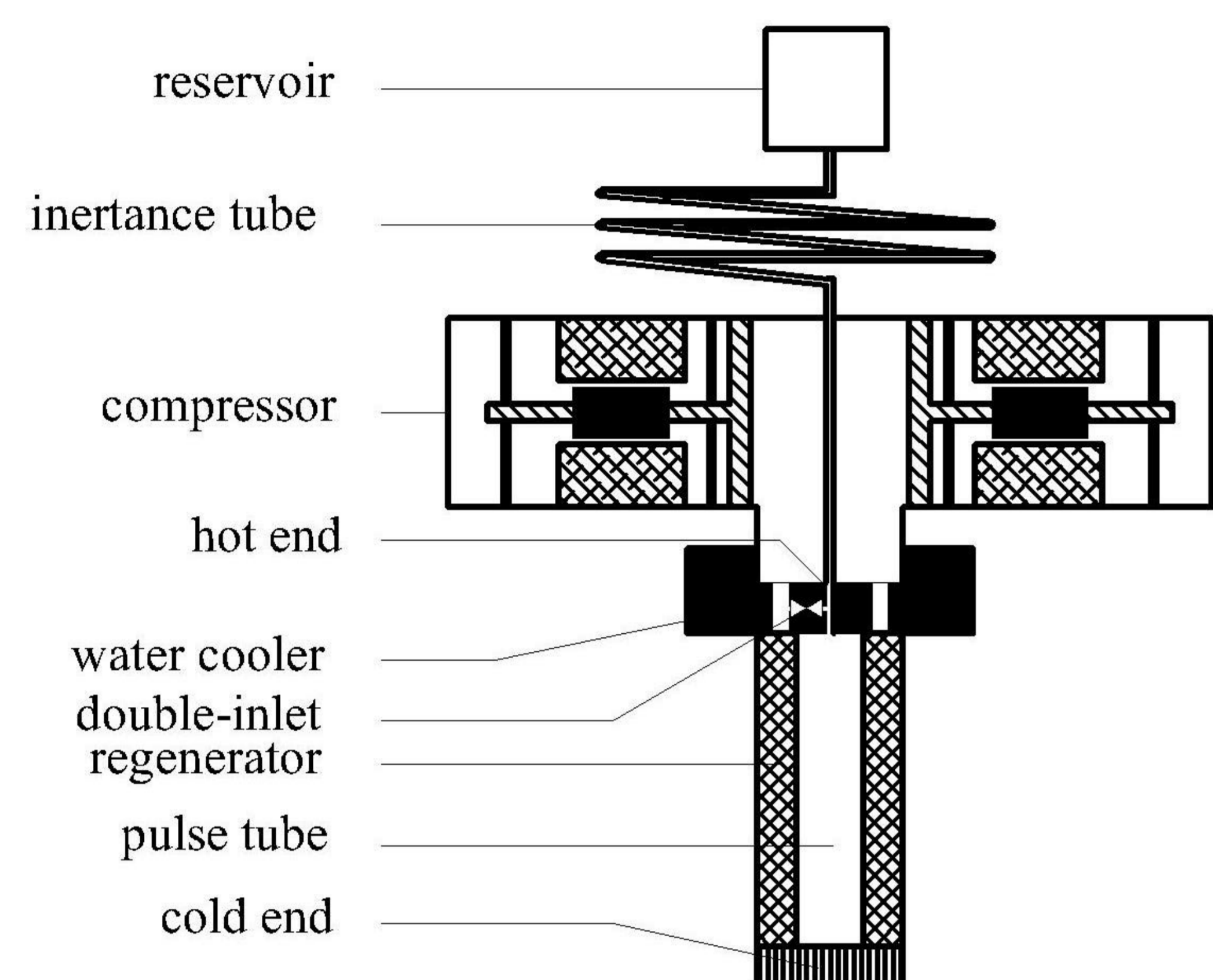
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A high efficiency single-stage Stirling-type coaxial pulse tube cryocooler (SPTC) operating at around 40 K has been designed, built and tested. The double-inlet and the inertance tubes together with the gas reservoir were adopted as the phase shifters. Under the conditions of 2.5 MPa charging pressure and 30 Hz operating frequency, the prototype has achieved a no-load temperature of 23.68 K with 330 W electric input power rejecting at 279 K. It can provide 5 W cooling capacity at 40 K when electric input power increases to 395 W, and 7.56% of relative Carnot efficiency has been realized. It takes 10 minutes for the SPTC to lower its no-load temperature at the cold head from 295 K to 40 K.

Structural parameters



The schematic of the developed single-stage SPTC



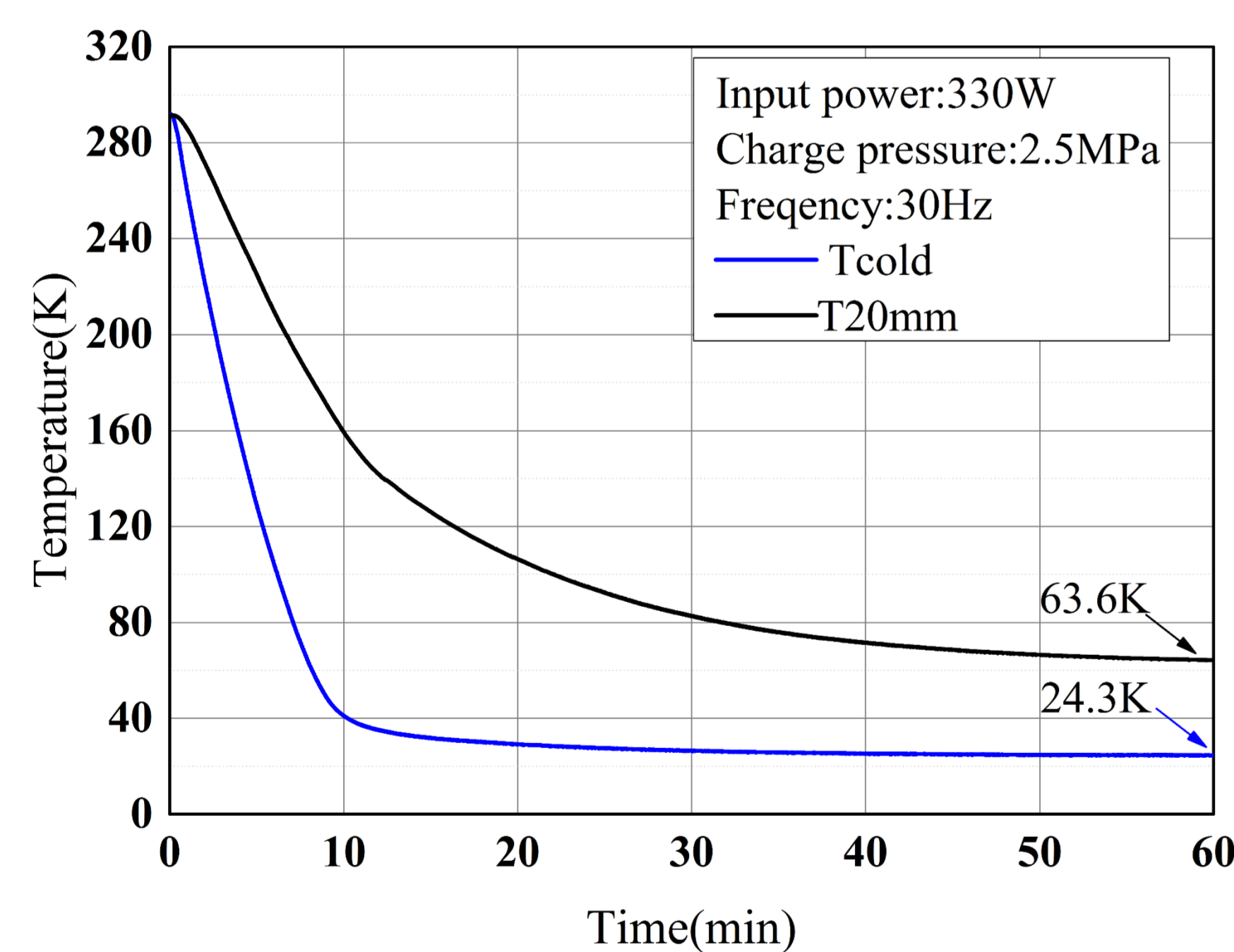
Parameters	Values
Diameter of piston	40 mm
amplitude	10 mm
Mass of piston	2.1 Kg
Compression volume	58.5 cc
Buffer volume	2*0.92 L
Maximum pressure	3.5 MPa
Mass	17 Kg

Parameters of liner compressor

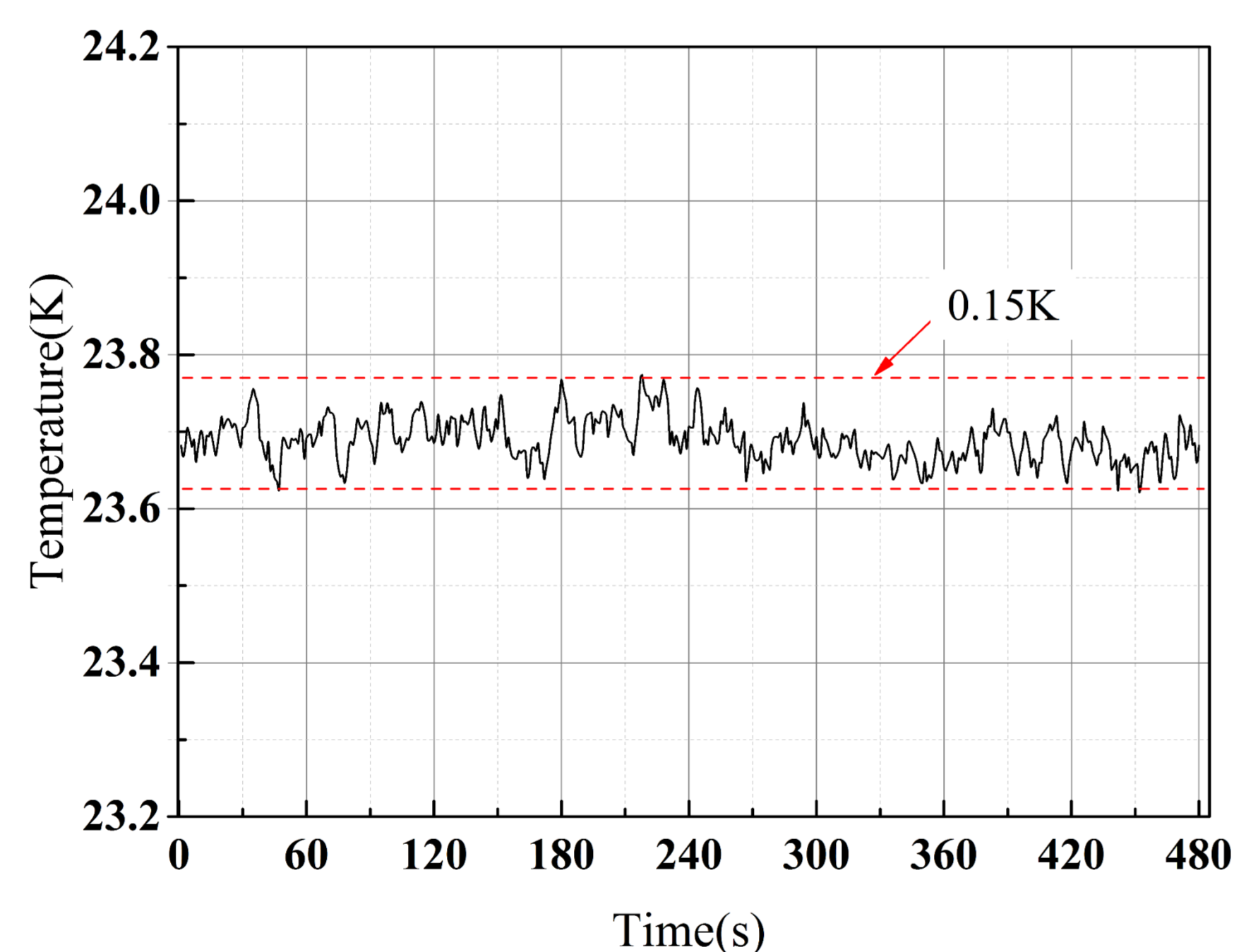
Parameters	Values (mm)
Regenerator	Φ26*30(300# stainless steel screen)
	Φ26*43(400# stainless steel screen)
	Φ26*21(500# stainless steel screen)
Flow straightener	80# copper screen
Pulse tube	Φ11.7*104
Inertance tube	Φ2*1200+Φ3*1800+Φ4*2200
Gas reservoir	600cc

Parameters of the cryocooler

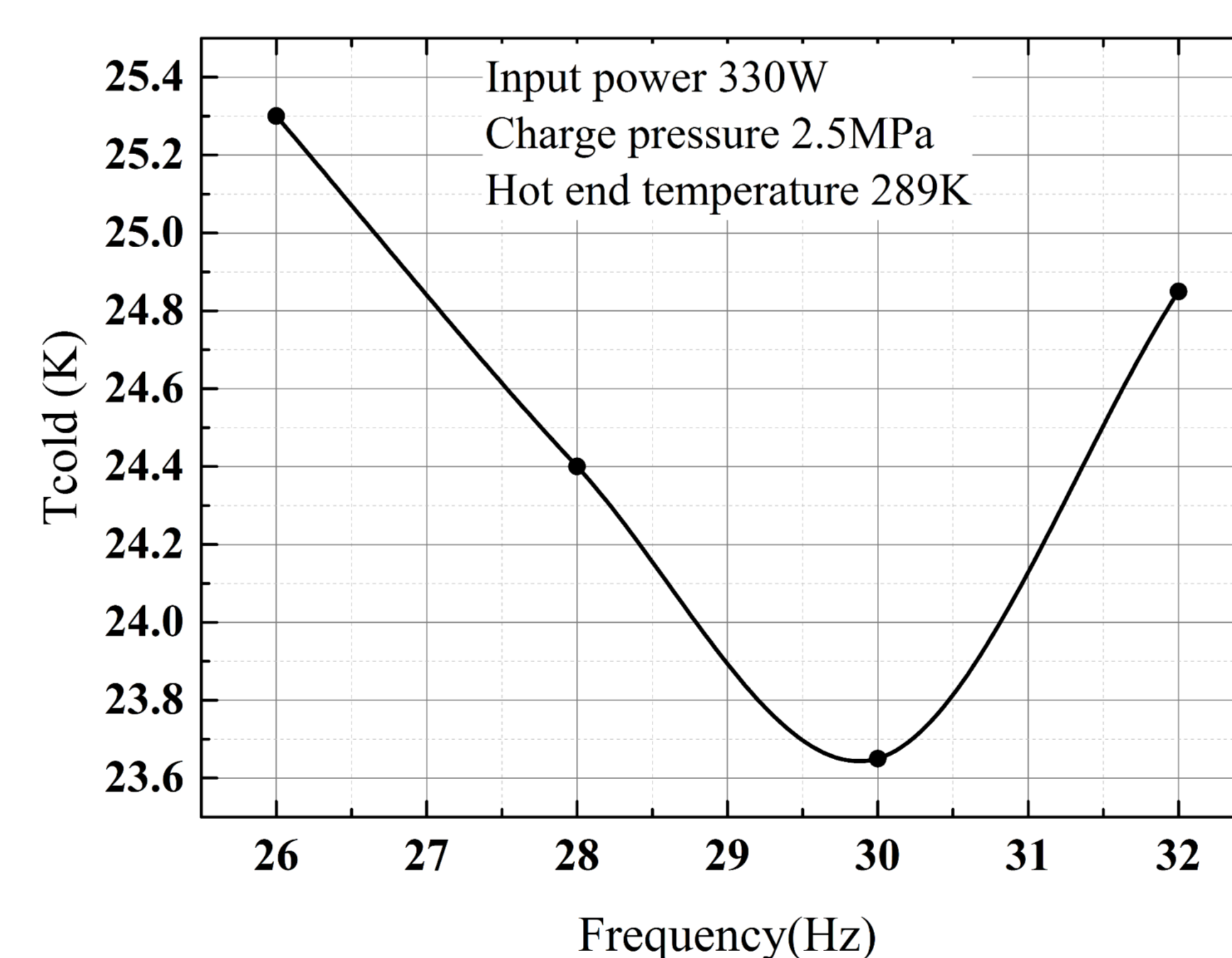
Test results



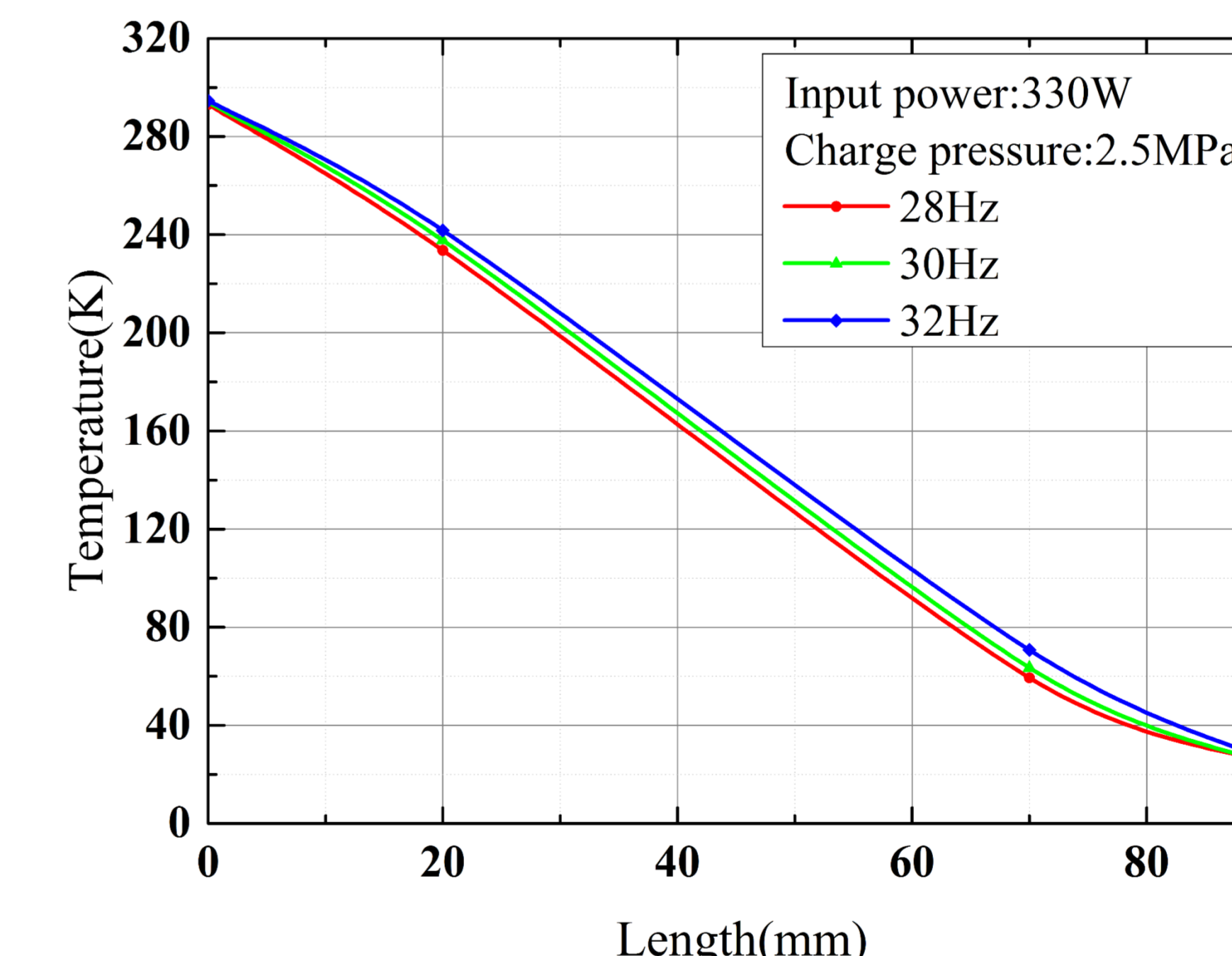
The cooling curve of the developed cryocooler



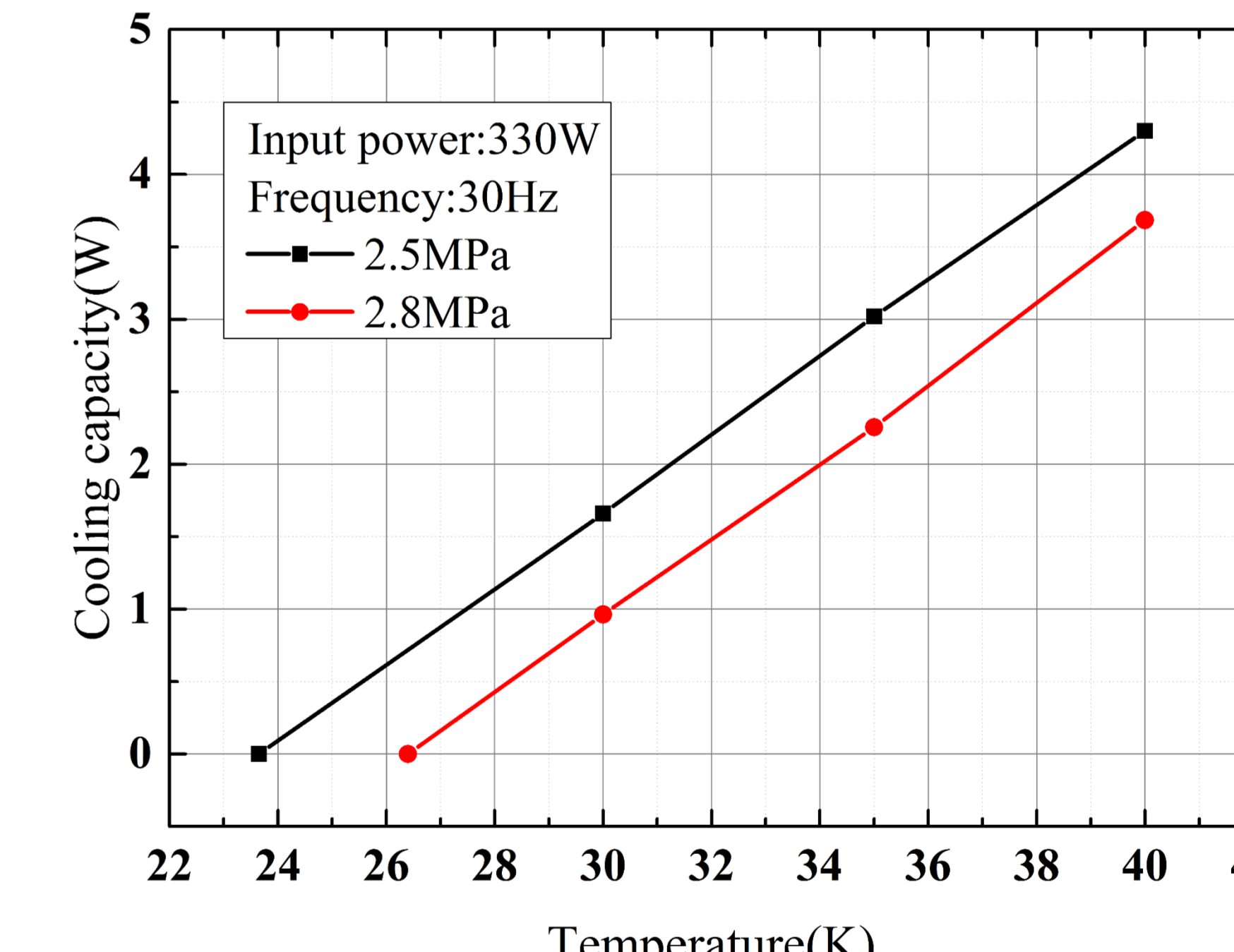
Temperature stability of the cold head



Effect of operating frequency on the temperature of cold head



Effect of operating frequency on the temperature distribution



Cooling capacity of the developed SPTC

Conclusions

- A high efficiency single-stage Stirling-type coaxial pulse tube cryocooler driven by a linear dual-opposed compressor has been designed, manufactured and tested.
- It takes 10 minutes for the SPTC to lower its no-load temperature at the cold head from 295 K to 40 K.
- it can provide a cooling capacity of 3.02 W/35 K or 4.3 W/40 K with a charging pressure of 2.5 MPa and an input power of 330 W.
- A cooling capacity of 5 W/40 K can be achieved when the input power increases to 395 W, and 7.56% of relative Carnot efficiency has been realized.

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