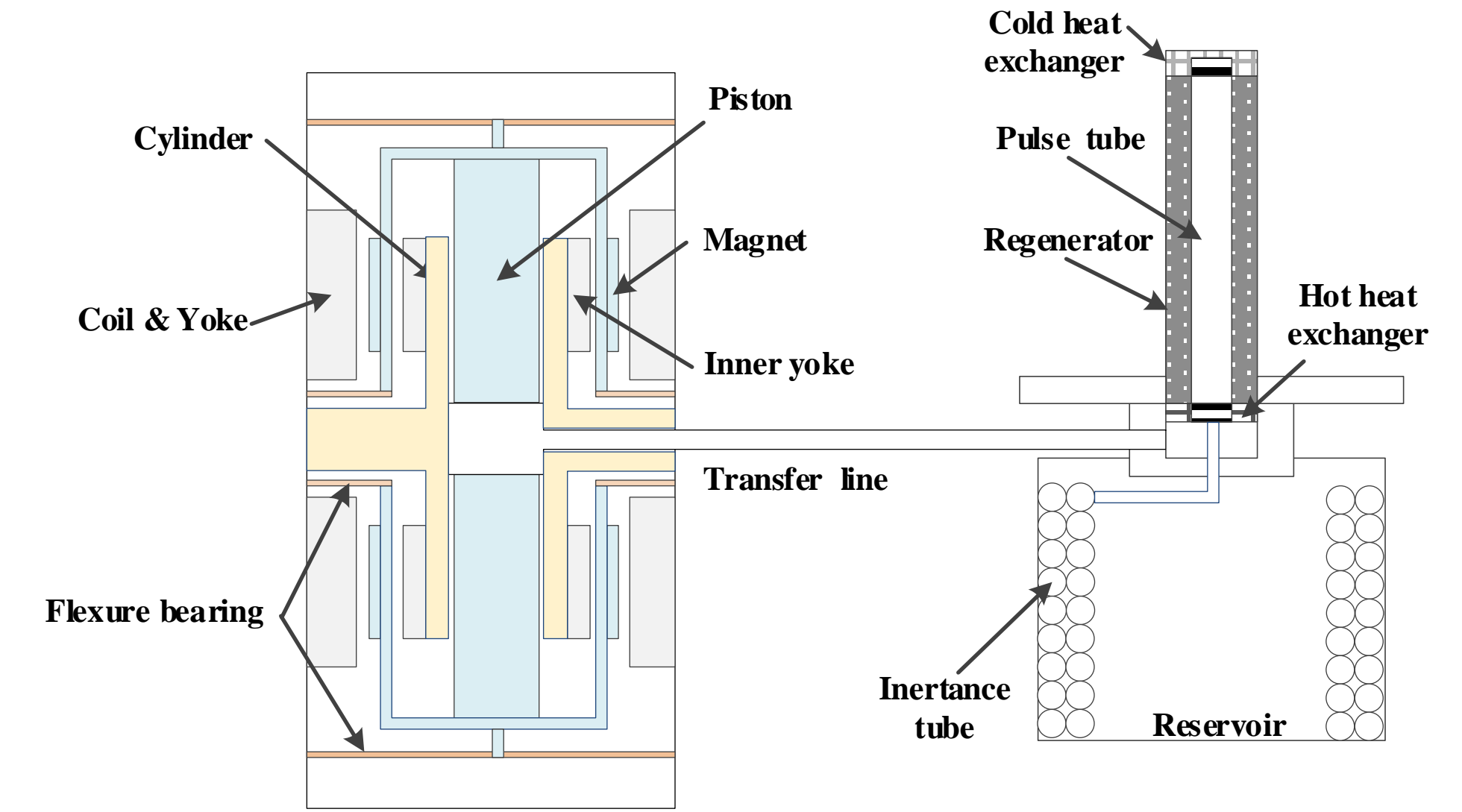


Development of Stirling-type pulse tube cryocooler

Yong-Ju Hong, Junseok Ko, Hyo-Bong Kim, Han-Kil Yeom, Sehwan In and Seong-Je Park
 Korea Institute of Machinery & Materials, Yuseong-gu, Daejeon, 34103, Korea

Design of a pulse tube cryocooler

- ◆ The linear compressor has dual-opposed piston for dynamic balancing. A moving magnet type linear motor is designed and fabricated, and this compressor could be operated with the electric power of 100 W and the frequency up to 50 Hz.
 - ✓ In moving magnet type linear motor, the coil and outer yoke is placed at the external to the pressure vessel.
 - ✓ Flexure bearings support the piston at the front and rear side with high radial stiffness.
- ◆ A single stage coaxial type pulse tube cold finger aiming at over 1.5 W at 80 K is built and tested with the linear compressor.
 - ✓ The pulse tube cold finger adopts the coaxial configuration and an inertance tube with a gas reservoir is used for a phase shift mechanism.
 - ✓ The inertance tube consists of two sections with different inner diameter and length.
 - ✓ The coiled inertance tube is assembled inside the reservoir to get ease of use of the pulse tube cryocooler.



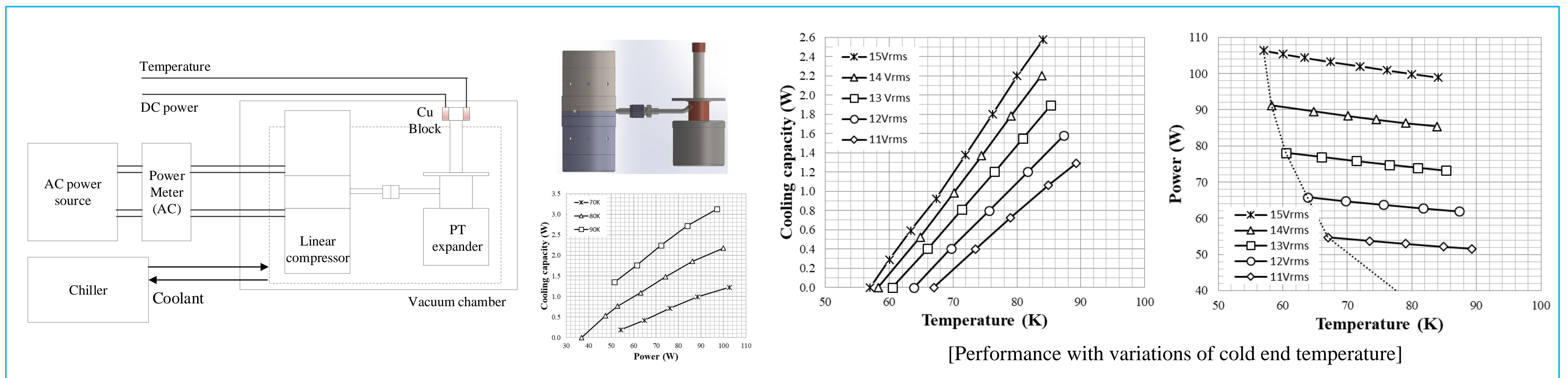
[Schematic diagram of the pulse tube cryocooler]

Parameter	Values	Unit
Operating temperature	80	K
Operating frequency	50	Hz
Diameter of compressor	79	mm
Length of compressor	176.8	mm
Max. swept vol. of comp.	5.6	cc
Thrust constant of motor	10.0	N/A
Diameter of cold finger	19	mm
Length of pulse tube	181	mm
Regenerator	#400 stainless steel screens	
Porosity of regenerator	0.685	
Reservoir volume	172	cc

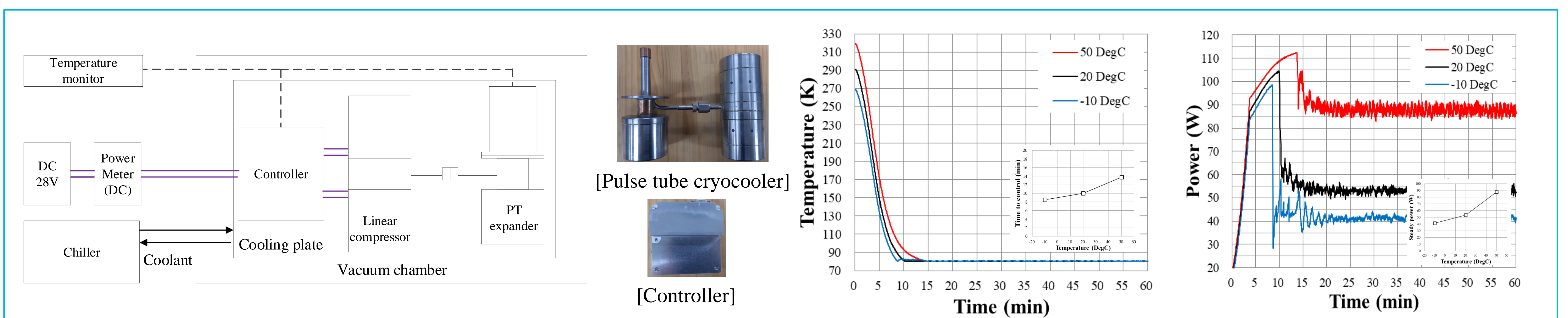
[Parameters of the pulse tube cryocooler]

Performance of the pulse tube cryocooler

- ◆ Under the conditions of 50 Hz operating frequency and heat rejection temperature of 293 K, the pulse tube cryocooler has achieved a cooling power of 2.2W at 80K with 99.8 W of input power and no load temperature of 57 K.



- ◆ In thermal vacuum environment, cool-down tests of the pulse tube cryocooler with the controller were performed.
 - ✓ The Dewar was installed on the cold end of the pulse tube, which has a slip-on configuration and a thermal load of approximately 500 mW.
 - ✓ Tests were performed at the cooling water's temperature of 263, 293 and 323 K
 - ✓ The pulse tube cryocooler was operated using a dedicated controller driven by a DC power (28 VDC).
 - ✓ It takes 15 minutes for the pulse tube cryocooler to lower the temperature of the Dewar from 323K to 80K.



- ◆ Several tests were performed to qualify the thermal, mechanical and electrical performance of the pulse tube cryocooler.
 - ✓ Random and sinusoidal vibration / Shock test
 - ✓ Thermal vacuum cycle test
 - ✓ EMI and irradiation