

Wide temperature range test of high capacity Stirling cryocooler

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◆ Introduction

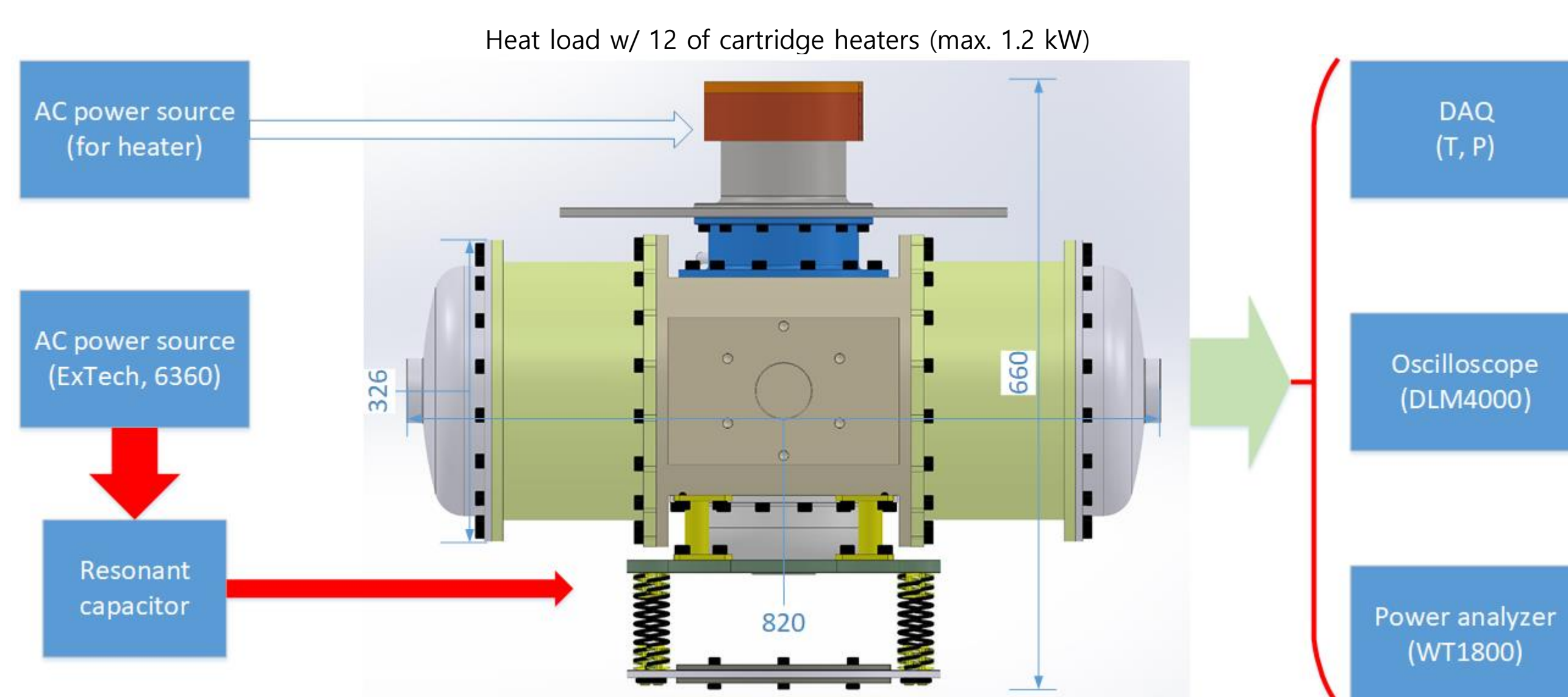


[Stirling cryocooler]

Background & Objective

- ✓ Gamma-type Stirling cryocooler driven with linear compressor is tested to investigate industrial applicability.
- ✓ Stirling cryocooler can cover wide temperature range from room temperature to its no-load temperature.
- ✓ Cooling capacity of Stirling cryocooler is controlled only by adjusting input voltage to linear compressor.
- ✓ Developed high capacity Stirling cryocooler was tested at 110, 120, 150, 190 K
 - 110, 120 K for re-liquefaction of LNG
 - 150, 190 K for industrial ultra-low freezing system

◆ Specifications and experimental setup



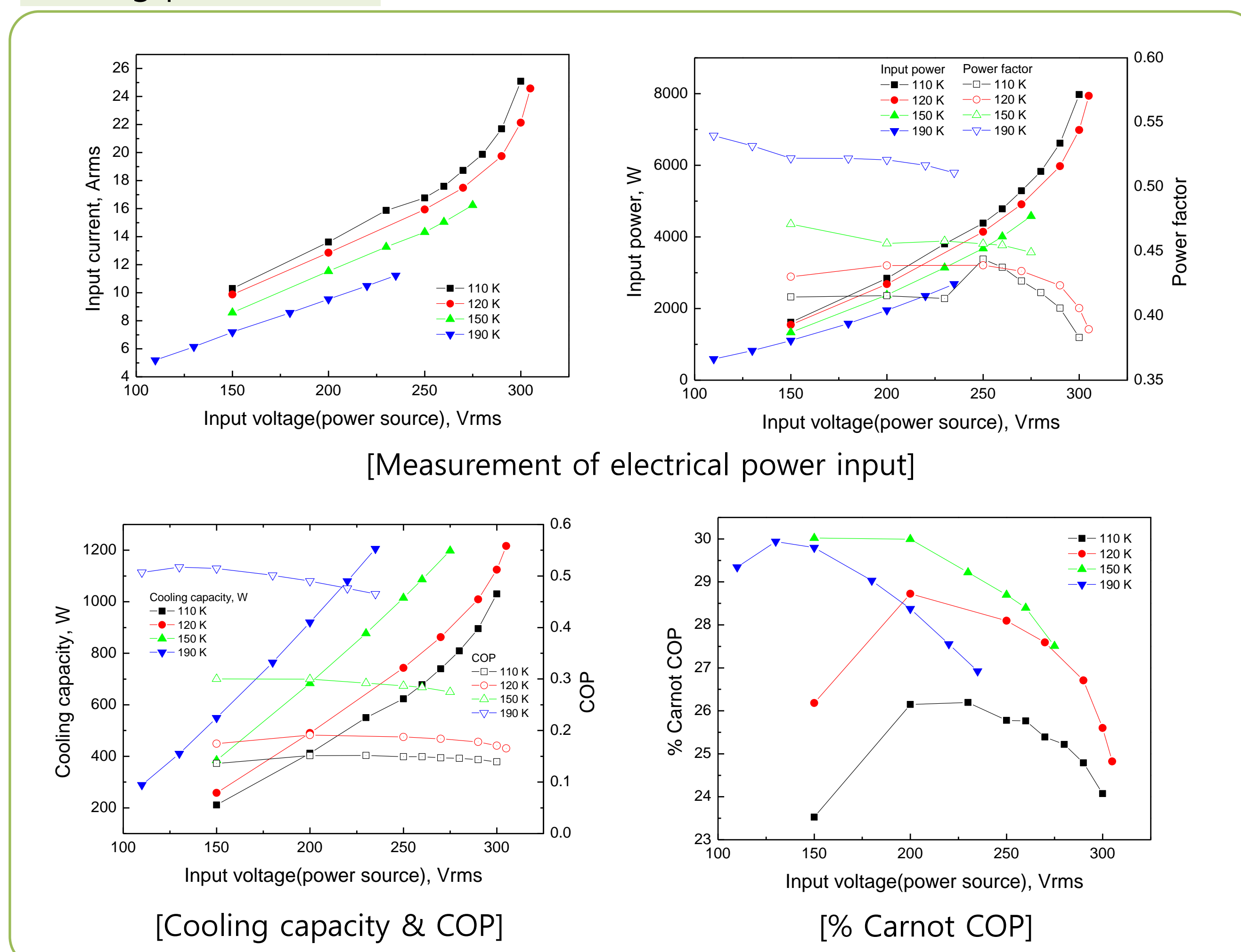
[Experimental setup for cooling performance test of Stirling cryocooler]

Linear motor	Rated power = 9 kW (45 Hz) Parallel connection of two identical linear motor
Piston	Diameter = 96 mm
Displacer	Diameter = 83 mm
Regenerator	OD(130), ID(86), sintered random fiber(STS316L)
Cold/Warm end H.X.	Slit type, water cooled for warm-end H.X.
Charging P. & operating freq.	2500 kPa, 45 Hz

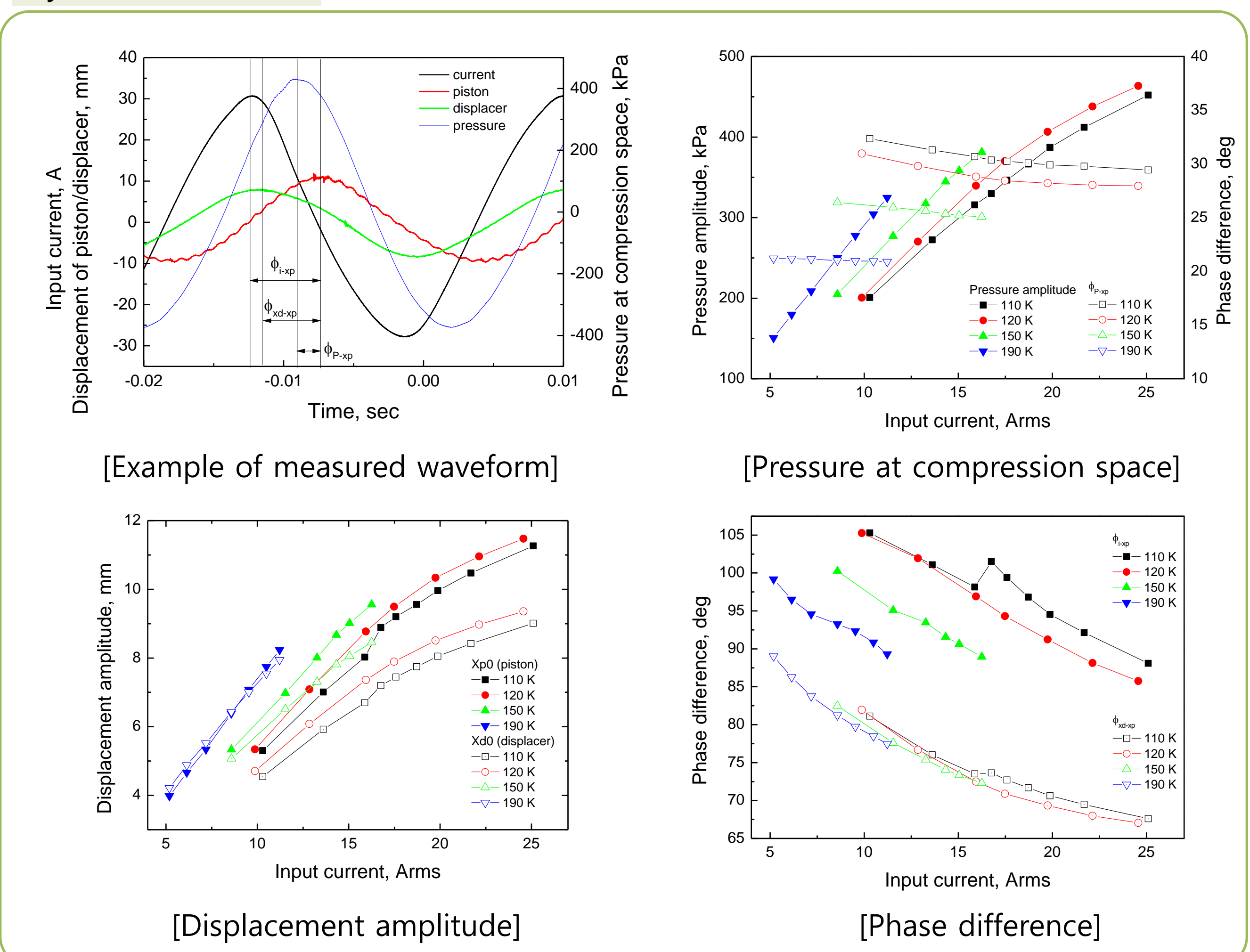
- Silicon diode sensor(DT670A) for temperature of cold head
- Accelerometer for displacement of piston and displacer
- Dynamic pressure sensor for compression space

◆ Experimental Results

Cooling performance



Dynamic behavior



◆ Summary

- A high capacity Stirling cryocooler is tested at 110, 120, 150, 190 K with maximum heat load of 1.2 kW.
- The measured COP increases as operating temperature and its value is 0.15, 0.19, 0.29, 0.50 at 110, 120, 150, 190 K respectively.
- % Carnot COP is 24 ~ 30 %, and it slightly increases as operating temperature.
- The dynamic behavior of cooler is discussed with the measured waveform
 - Displacement of piston and displacer and pressure amplitude increase as operating temperature
 - Phase difference between piston and displacer is not much affected by operating temperature.