

Stirling Cryocooler

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- ⇒ Stirling cryocooler is a machine that creates cold environment and composed of a set of a compressor, an expander and heat exchangers.
- ⇒ The Stirling cryocooler generally adopts Helium as a working gas and it can readily reach the temperature below -200°C.
- ⇒ The technology can be utilized for various temperature ranges (from under -200°C to -15°C) and cooling capacities (from under W-class to kW-class).

Client / Market

- Stirling cryocooler can be applied in various fields depending on operating temperature and required cooling capacity.
 - Infrared (IR) thermal imaging sensor cooling device for military and space
 - Cooling systems for superconducting power applications (superconducting cable, superconducting fault current limiter; SFCL, superconducting transformer)
 - Small-scale LNG liquefaction/re-liquefaction (-160°C) system
 - Ultra-low temperature refrigerator for bio storage
 - Low GWP (global warming potential) refrigerant-applied refrigeration/freezing system

Necessity of this Technology

- Stirling cryocooler has the highest efficiency among low-power cryocoolers.
- The cryocooler accompanied with an oil-free linear compressor is completely free from a clogging problem so that it possesses high mechanical work conversion efficiency with no valve loss and promises long operation life. There is no risk of breakdown due to impurities hardening under an extremely low temperature below -60°C.
- The system can be compact as all components-compressor, expander and heat exchangers-are a single unit.

Technical Differentiation

- Stirling cryocooler technologies on various types
 - By compressor : rotary compressor, linear compressor
 - By piston and displacer arrangement : alpha-type, beta-type, gamma-type
 - Our work group has remarkably worked and secured toward on a 'free piston Stirling cooler (FPSC)' accompanied by a linear compressor.
- Cooler design that considers electro-magnetic, thermo-hydraulic and dynamic characteristics for the entire cooler development process
- Ease of temperature and capacity controlling under an extensive temperature range with high turn-down ratio
- This technology utilizes Helium as a refrigerant with GWP (global warming potential) of zero so that it agrees to the Paris Agreement.

DESIRED PARTNERSHIP

Technology Transfer

Licensing

Joint Research

Other



TECHNOLOGY READINESS LEVEL [TRL]

- Research, basic explanation
- Project concept or idea development
- Technology idea verification
- Prototype development
- Trial product production/evaluation in similar environment
- Pilot field demonstration
- Development and optimization of commercial model
- Commercial product demonstration
- Mass production and initial market launch

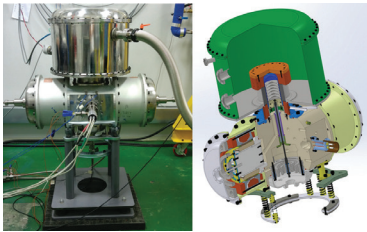
Excellence of Technology

- Development of Stirling cryocooler for infrared (IR) thermal imaging sensor cooling
 - Rotary compressor and linear compressor adopted Stirling cryocooler with cooling capacity of 0.4~1.0 W (at -200°C)Development of Stirling cooler
 - Development of day-night observation facilities for military use and tank panoramic sight
 - Approval for military use following the development and operation test based on the military standards
- Development of high-power Stirling cryocooler for superconducting power application cooling system
 - kW-class linear compressor driven Stirling cryocooler for liquid nitrogen cooling
 - Ease of miniaturization and maintenance compared to conventional cryocooler driven with crank-cam reciprocating compressor lubrication involved
 - Performance test of 2 kW (at -200°C) verified through the liquid nitrogen (LN₂) circulation test

Stirling Cryocooler for Sensor Cooling



High-power Stirling Cryocooler



Current Intellectual Property Right Status

KNOW-HOW

- Linear motor design and optimization technology for Stirling cryocooler
- Compressor and low-temperature expansion device optimization technology
- Stirling cryocooler dynamics and thermal design, layout creation and assembly technology
- Stirling cryocooler operation control and performance analysis technology
- Development technologies for various operating temperatures and cooling capacities