

# Cryogenics for optronics

Joule-Thomson miniature cryo-coolers



A wide range of solutions to quickly cool below 100K: infrared detectors and electronic components on the ground, on board and under harsh conditions.



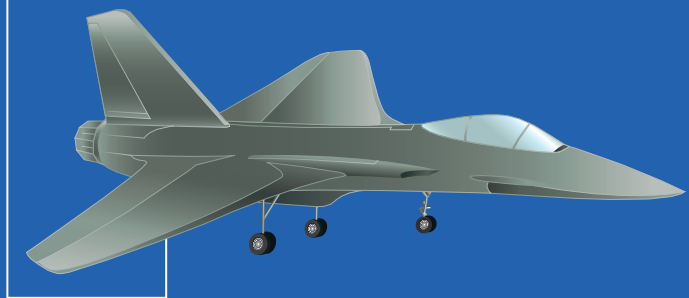


**O**ur Joule-Thomson range comprises cryo-coolers that differ in terms of refrigerant capacity, cool-down time and autonomy, specific to each customer's application.

All cryo-coolers are designed to work in conditions of harsh environmental stress such as defense systems.

## Applications

- Thermal imagers
- Missile seekers
- Radar



## Two technologies of cryo-coolers

- Single flow: fast cooling capacity (from 77 K to 100 K)
- Dual flow: faster cooling capacity and optimization of gas consumption

These two technologies of miniature cryo-coolers can be combined with our gas storage, supply and regulation components to perform a complete cryogenic cooling function.

## Cryo-coolers composition

- A heat exchanger in which the high pressure gas is pre-cooled in counterflow by the expanded low pressure cold gas
- An expansion outlet of fixed cross-section (single flow devices), or dual cross-section (dual flow devices)
- Differential contraction valve for rapid cool-down of a significant thermal mass



Air Liquide is a world leader in gases, technologies and services for Industry and Health with more than 50 years of technical, industrial and commercial experience in mechanical cold production, liquefaction, storage and distribution of cryogenic fluids at very low temperatures: a benchmark in expertise.

Our teams address the specific needs of each customer using a global approach that combines consulting, design and commissioning, to offer the most fitting solution.

## Air Liquide advantages

- Specialist in very low temperature technologies for more than 50 years: pulse-tube, dilution systems, liquefaction, refrigeration, etc.
- Management of the entire cold production chain for optronics: gas storage, supply and regulation systems, Joule-Thomson miniature cryo-coolers, etc.
- Involved in many aeronautical programs, space activities and scientific research
- Know-how and support of an international group
- High production rate capabilities

## Key benefits

- ✓ Very fast cool-down time (up to 1 s)
- ✓ Long autonomy
- ✓ No electronic components
- ✓ Simple and customizable design
- ✓ Good temperature stability
- ✓ Few moving parts
- ✓ Long operating lifetime
- ✓ Easy integration
- ✓ ITAR free



## Main technical features

- Cooling operations based on different types of gas: argon, nitrogen, air and mixtures
- Dewar diameter: 3.3 mm, 5.18 mm, 7.23 mm or 11.17 mm (or on request)
- Thermal mass to be cooled: from 15J to 300J (or on request)
- Heat loss: from 130mW to 200mW (or on request)
- Very low induced vibration level

	<i>Single flow JT</i>	<i>Dual flow JT</i>
<i>Cool-down time at 20°C</i>	< 2 s	< 10 s
<i>Cryogenic temperature</i>	100 K	95 K
<i>Typical autonomies</i>	> 10 s	> 1 mn
<i>Main applications</i>	Thermal imagers, missile seekers, radar	

## References

- 15,000 Mistral ground-to-air missile coolers
- 7,000 Magic 1 and 2 air-to-air missile coolers

## Contacts

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A world leader in gases, technologies and services for Industry and Health, Air Liquide is present in 73 countries with approximately 67,100 employees and serves more than 3.9 million customers and patients.