

Turbo-Brayton cryogenic systems

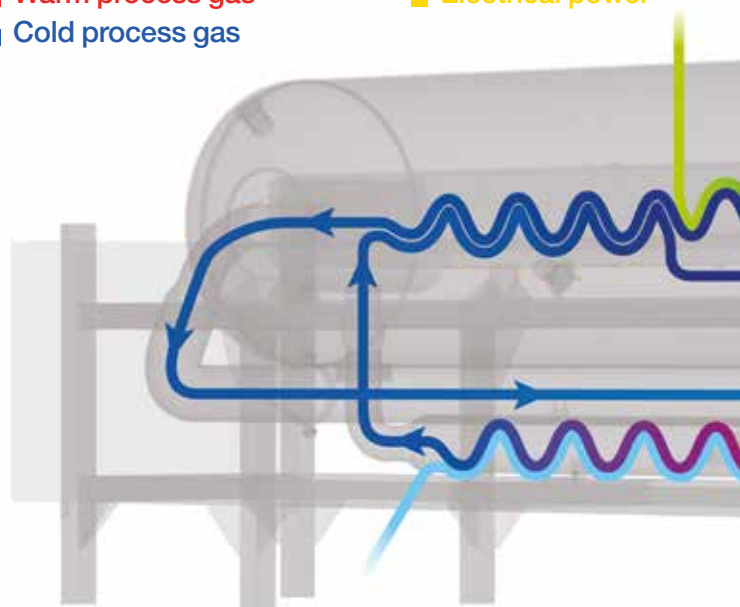
An innovative solution for refrigeration and liquefaction
from 25K to 200K





Reverse Turbo-Brayton principle

- Gas from/to customer
- Water
- Warm process gas
- Electrical power
- Cold process gas



Thanks to the development of several technological bricks, Air Liquide designs and manufactures innovative Turbo-Brayton cryogenic systems.

Air Liquide's teams answers to customer's specific needs with a global approach, using a procedure that combines advice, solution design, test, risk and cost control, to propose the most fitting liquefaction or refrigeration solution.

Applications

Refrigeration

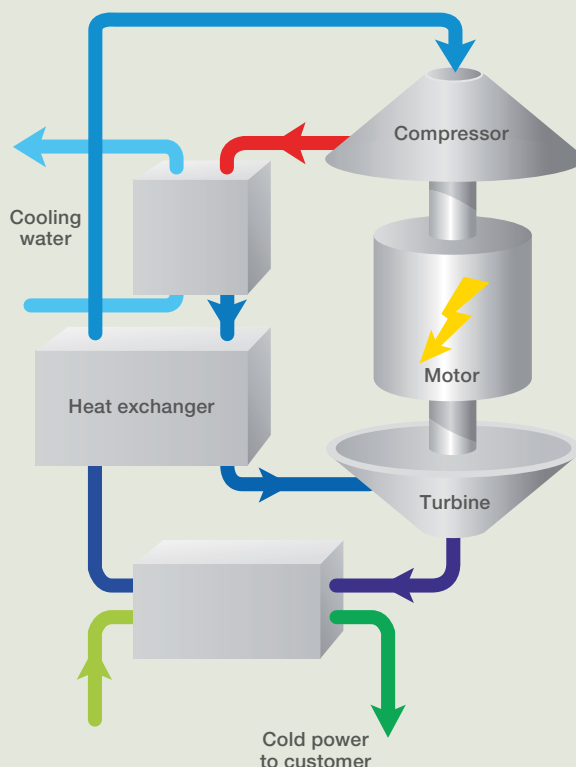
- Specific refrigeration between 25K and 200K adapted to customer's applications
- HTS (High Temperature Superconductivity) cooling: FCL (Fault Current Limiter), coil, motor, generator, cable, etc.
- Cryogenic gas purification and/or separation

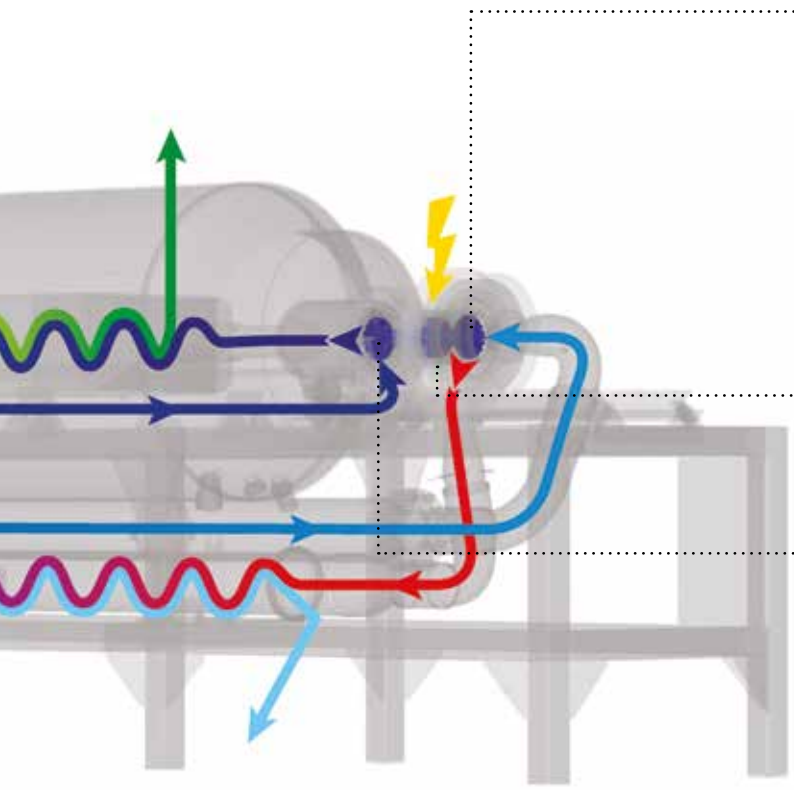
Liquefaction

- Air, nitrogen, oxygen, methane, argon, xenon...
- Biogas
- Boil off reliquefaction: CnHm, LNG, LN₂, Ar, O₂...

Innovation

Air Liquide's innovative reverse Turbo-Brayton process essential innovation concerns the assembly of all active elements on a single shaft.





1 Centrifugal compressor



- High efficiency
- Oil-free

2 High-speed synchronous motor and active magnetic bearings



- Direct drive
- No gear box
- High compacity
- Contact free
- Unsurpassed lifetime

3 Centripetal expander



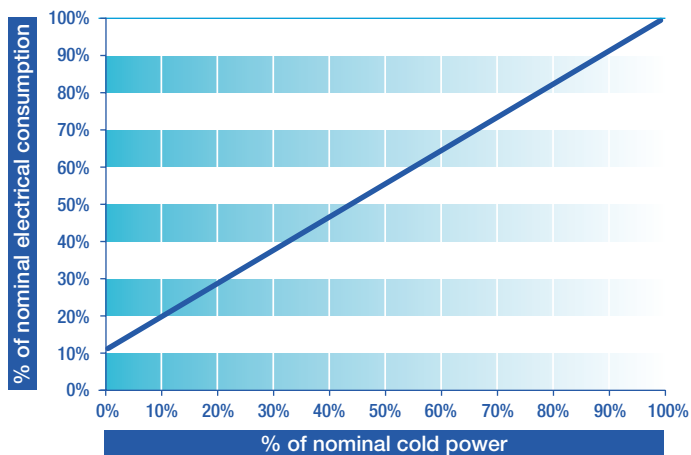
- More than 50 years experience in the design and manufacture of expanders
- High efficiency

Benefits

High efficiency solution

Air Liquide's Turbo-Brayton cryogenic systems are designed to be both **energy efficient** and **flexible**.

- Cryogenic expander power recovery
- Centrifugal compressors and expanders
- Direct drive motors
- Motor's speed adjusts automatically to match the load and operating conditions



Care free systems

One of Air Liquide's key concern is to deliver a product that guarantees ease of installation, a high availability as well as a high reliability in order to keep your production up and running.

High availability and reliability

- Designed to be maintenance free
- 100% oil free
- 100% contact free
- No downtime
- Factory tested before shipping

Ease of installation and operation

- Plug & play
- Packaged system
- Small foot print
- Remote control
- Low noise level
- No compressed air required

Low life cycle cost

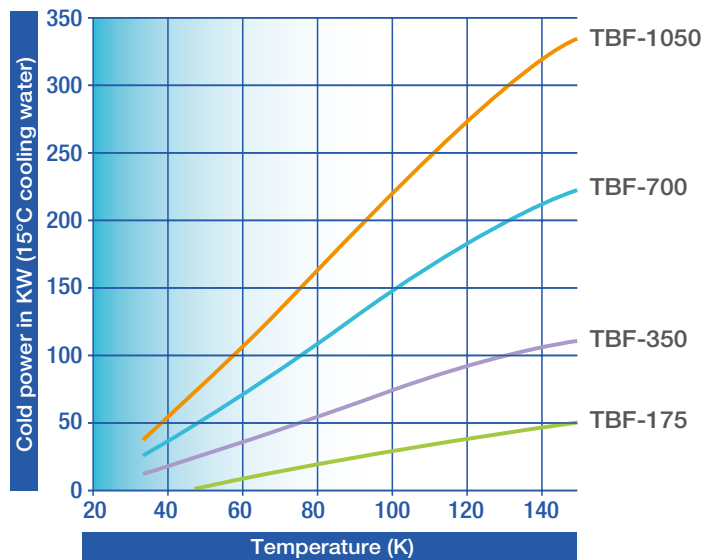
All Air Liquide's solutions are developed to set costs at their lowest level, taking into account all phases of the product's life cycle:

- Installation
- Operation: energy saving
- Maintenance-free for 5 years
- Fast payback



From standard to on-demand systems

Turbo-Brayton range



On-demand

- Specific architectures
- Extension of the temperature range down to 20K

Options

Options can be added to fully satisfy customer's need:

- Cryogenic circulator LN₂, GH₂, GN₂, GHe integrated on the refrigerator
- Liquefaction and refrigeration of fluids up to 70bars
- Containerized system
- Air-cooled system
- Heat recovery (building heating, customer process needs,...)

Some references of the Turbo-Brayton application

- Onboard the International Space Station (ISS), 2006
- HTS cable supraconductivity, 2017 (TBF-175)
- HTS cable supraconductivity, 2016 (TBF-350)
- LNG reliquefaction offshore, 2015-2017-2018 (TBF-350)
- LNG reliquefaction offshore, 2016-2018 (TBF-1050)



Contacts

Air Liquide
Advanced Technologies

2, rue de Clémencière
BP 15 – 38360 Sassenage, France
Phone: +33 4 76 43 62 11
E-mail: gcom.alat@airliquide.com
www.advancedtech.airliquide.com

www.airliquide.com



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