

Marine

Gas generation and associated equipment
for naval applications



World leader in the field of air gas separation technologies with more than fifty years of experience, Air Liquide advanced Technologies is a benchmark in expertise.

Our teams design and develop systems for the production, storage, regeneration of gases and the reliquefaction of boil-off gases on board submarines and surface vessels (for civil and military marine).



Military field

Surface vessels

Air Liquide is developing units for the production of oxygen and nitrogen in a marine environment to answer your needs in:

Gaseous oxygen on-board

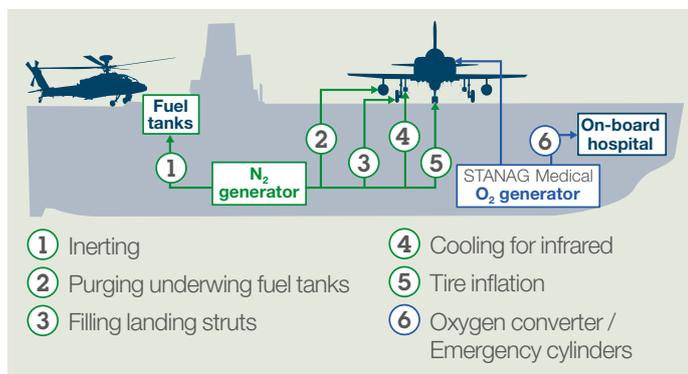
- To fill emergency egress devices and back-up cylinders for fighting aircraft
- For medical use, compliant with STANAG standards

Liquid oxygen on-board

- To fill oxygen converters for fighting aircraft

Gaseous nitrogen on-board

- To inert the jet fuel tank
- To purge hoses, pipe and external underwing fuel tanks
- To inflate tires, to fill landing struts and hydraulic system
- To cool infrared cameras and cells (optronics)



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|--------------------------------|--|
| ① Inerting | ④ Cooling for infrared |
| ② Purging underwing fuel tanks | ⑤ Tire inflation |
| ③ Filling landing struts | ⑥ Oxygen converter / Emergency cylinders |



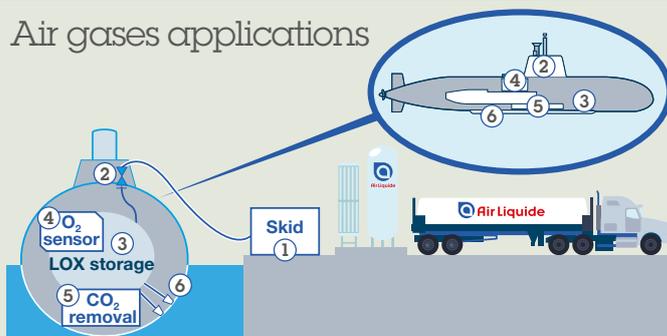
Submarines

Air Liquide has developed innovative solutions and equipment to:

- Regenerate confined atmospheres (using valves, valve boxes, hoses, oxygen regulator, oxygen removal factory...)
- Store **cryogenic oxygen** for use in **powering submarines in a dive** and supplying their crews with **breathable air**
- Provide gas utilities and equipment at dockside: tank, skid, flexible hoses



Air gases applications



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| ① Gas utilities & equipment at dockside: tank, skid, hoses | ⑤ CO ₂ removal | ⑥ Hull valve |
| ② Valve box & interconnecting hoses | | |
| ③ Cryogenic oxygen storage tank: | | |
| - Oxygen Supply Module (AIP BP or HP) fuel cell (H ₂ /O ₂) | | |
| - Supply of breathable oxygen on board | | |
| ④ Oxygen regulator | | |

Air Liquide is making innovations so that it can consolidate and broaden its offer to naval programs.

Our teams strive to provide shipbuilders with support throughout the life cycle of their projects, innovating to offer our clients the best solutions, complying with current environmental regulations.



Civil field

Cargo ships

Air Liquide provides units for gas production in a marine environment for civil surface vessels such as cargo ships to answer your needs in:

Nitrogen generation on-board

- To fill emergency egress devices and back-up cylinders for fighting aircraft
- For medical use, compliant with STANAG standards

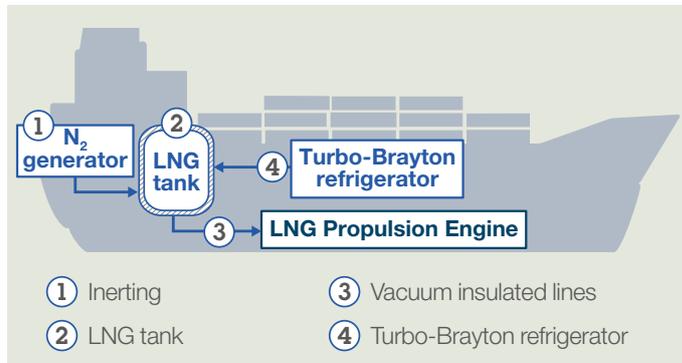
Vacuum-insulated lines for LNG pipe supply

To fill oxygen converters for fighting aircraft

LNG double shell tanks ($\leq 4,000\text{m}^3$) supply

Natural gas boil-off reliquefaction (Liquid Natural Gas)

Air Liquide's cryogenic system (Turbo-Brayton) is an optimal solution for natural gas boil-off reliquefaction (LNG) Efficient, reliable and compact, it can be integrated on bunker and carrier vessels using LNG propulsion and on LNG carrier to re-liquefy boil-off gases





Services

Air Liquide offers client support from projects start to finish, from pilot feasibility study to on-site equipment start-up.

Cryogenic fluid testing facilities that are unique in Europe are also made available for qualification testing in a naval environment.

Air Liquide's teams support their clients by offering services such as:

- Maintenance
- Maintain in operation ready condition
- Obsolescence management
- Training

At dockside and in operation.



Contacts

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The world leader in gases, technologies and services for Industry and Health, Air Liquide is present in 80 countries with approximately 65,000 employees and serves more than 3.5 million customers and patients.