DEPARTMENT OF AEROSPACE ENGINEERING

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UNIT IV - CRYOGENIC EQUIPMENT

Cryo pumping

Cryogenic pumps are a central element to many engineering structures and, as such, the choice of a cryopump plays a crucial role in guaranteeing their **efficiency** and optimization. What is a cryogenic pump and what types of systems can cryogenic pumps suppliers offer? Keep reading to find out in this short guide about cryogenic pumps.

The usefulness of cryogenic pumps

A cryogenic pump or a cryo pump is a type of cryogenic equipment in charge of the transfer and pressurization of liquefied gasses.

A cryopump's power depends on the freezing and boiling points of the choice of gas. As such, it is used for **cryogenic fluid applications** including LNG (liquefied natural gas), methane, ethane, propane, butane, among other substances.

The cryopump thus plays a key role in many processes involving pure and mixed industrial and technical gasses.

Some of the main applications for cryogenic pumps include:

Air separation units (ASU)

- Process and transfer applications at cryogenic temperatures
- Unloading operations from tankers
- Air separation units (ASU)
- Bunkering
- Gas transportation operations

On the other hand, it's important to differentiate cryogenic pumps from a cryo vacuum pump. The latter is a type of pump that works by **trapping** and **accumulating** gasses and **condensing** them on a cold (cryogenic) surface.

This surface is part of the pump and is meant to create high-vacuum and ultra-high vacuum conditions, which help storing the gas molecules.

It is also able to produce a **higher pumping speed** than other pumps and clean vacuum environments, avoiding the entrance of oil.

Because the cryogenic vacuum pump is based on an **accumulation system**, it must also exhaust gasses periodically and regenerate them. In order to guarantee an efficient evacuation in this ultra-high vacuum environment, this type of pump then evacuates gasses using an equilibrium pressure for adsorption of less than 10^{-8}Pa.

Some additional functioning **features** of these systems typically include:

- They are **cooled** by compressed helium, liquid nitrogen, dry ice and other options.
- **Baffles** may be added to expand the cryogenic surface for condensation.
- **Close-cycle refrigerations** are generated by two-stage cold head cylinders which are enhanced by drive unit displacer assemblies.

In what industries are cryogenic pumps used?

Marine industry

The marine industry is mainly in need of cryogenic pumps for bunkering applications related to Liquefied Natural Gas supplying processes.

Demand for this sort of system is growing as (LNG) gains traction and represents a **greener alternative** in the marine industry, which is facing the challenge of decarbonization and moving towards more sustainable energy sources.

Automotive sector

As the automotive sector advances in finding alternatives, **more sustainable fuels**, the demand for reliable cryogenic pumps suppliers grows in this industry. Accordingly, cryopumps are installed in LNG and compressed natural gas (L-CNG) refueling stations.

Industrial and manufacturing sectors

Cryogenic pumps are a crucial tool in many **industrial applications** in need for pure technical gasses stored at cryogenic temperatures. Steel production and the manufacturing of electronics are two examples of such applications.

Other sectors

Other industries in need for cryogenic pumps include the medical sector, oil fields, aerospace applications and space programs or material research processes, among others.

Types of cryogenic pumps and their differences

1. Centrifugal cryo pump

The **cryogenic centrifugal pump** (also known as receiver or generator) transforms mechanical energy of an impeller or runner into kinetic or pressure energy. Using centrifugal forces, it expels cryogenic liquids to the outside.

The centrifugal cryogenic pump is adequate for dealing with LNG, nitrogen, oxygen, ethylene, hydrogen and carbon dioxide, among other cryogenic gasses.

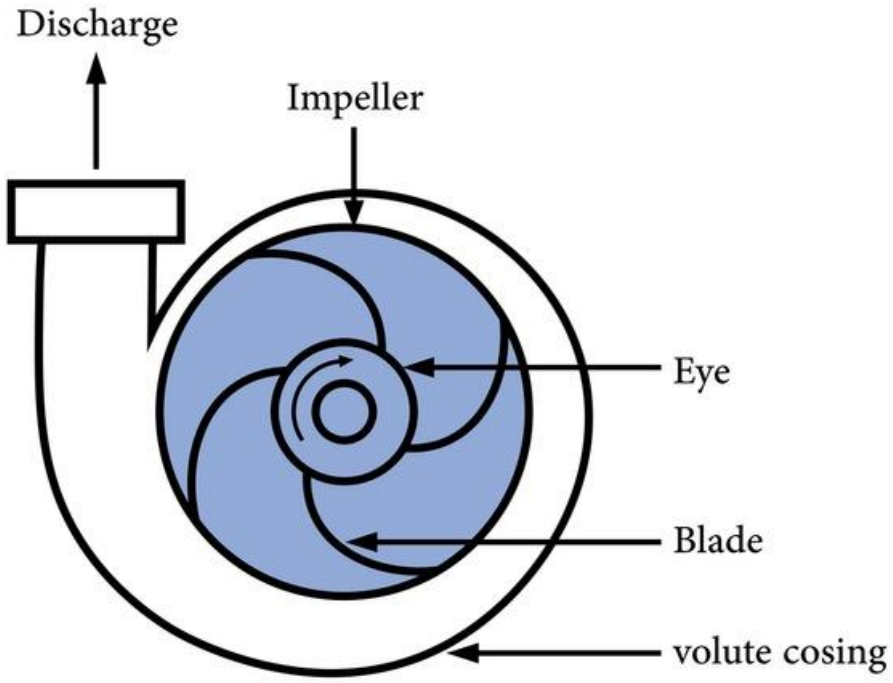
This type of cryopump includes the following **features**:

- Can be operated using **gears** and a fixed-speed motor or coupled to variable speed motors.
- They can be powered by **electric motors** with direct transmission as well as hydraulic power.
- Higher capacities and pressures can be achieved if a **yearbox** is included between the motor and the pump.
- The cold box must include a **gas-seal.**

This category may include **multiple functioning systems**, from one or two-stage pumps to stationary pumps, pumps on tankers and removable pumps.

Additionally, at **Cryospain** we're able to provide turnkey-type, tailor-made pumping solutions, including stationary centrifugal pumps mounted on chassis with all the required instrumentation. We also extend the life cycles of our centrifugal cryogenic pumps by using composite materials for **mechanical seals**, instead of conventional graphite seals.

The centrifugal cryogenic pump has many applications, including maritime bunkering, submerged marine fuel systems and liquid storage transferences, among others.



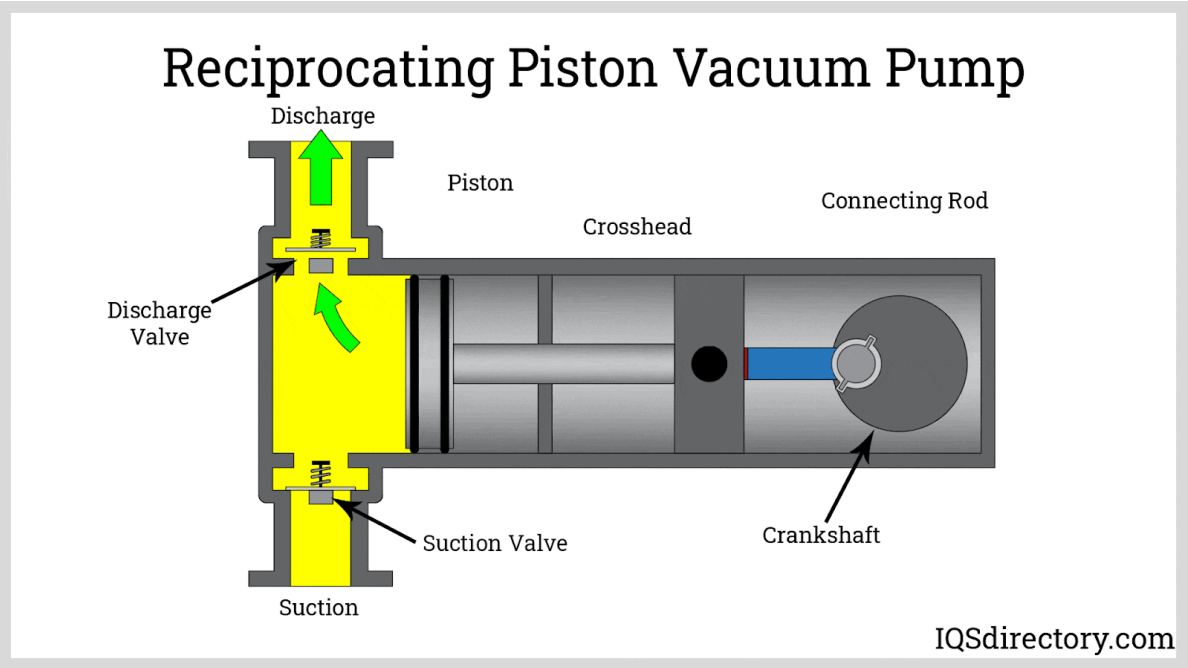
2. Piston or reciprocating cryogenic pumps

As cryogenic pumps suppliers, we also provide piston or reciprocating cryogenic pumps ranging from MRP pumps (used for the high-pressure filling of air gasses) to **specialized pumps** for the use of LNG, hydrogen, and other liquefied gasses.

Reciprocating cryo pumps compress liquids using piston movements at high pressures. This results in dislodging the fluid volume equivalent to that which it occupies during its stroke.

Reciprocating cryogenic pumps are used in **many applications**, including high-pressure LNG and air gasses applications. Both single and double electric motor systems are available, as well as single and multi-stage versions.

This type of cryopump is useful for many applications, including high-pressure pumping, and the filling of storage systems for cryogenic substances such as LNG, LN2, LH2, among others.



3. Submerged pumps

Submerged cryogenic pumps are used when **low temperatures** are needed for liquids to be transported. As a consequence, they're a common feature in the production and transport of liquid nitrogen, liquid natural gas (LNG), liquid Helium, and liquid Oxygen and in ship to ship bunkering processes.

At **Cryospain** we develop **tailored cryogenic equipment** as part of our comprehensive innovative engineering projects. We thus are in charge of supplying cryogenic equipment components and devices, including cryogenic pumps for the industry's most renowned companies.

Through our top **engineers, designers and experts,** we're able to generate efficient and optimized cryogenic equipment, customizing it to our clients' specific needs.

In terms of cryogenic pump maintenance, incorrect processes may result in poor motor performance or poor insulation, leading to repeated part replacements and consequent reduced service life. Because of this, as part of our commitment to generate the highest-quality systems, we provide **maintenance** and **after-sale services,** guaranteeing our clients' investments remain cost-efficient and our equipment is both safe and optimized at all times.