

# **★**FILLING SOLUTIONS Industrial and medical gases







### The Cryostar Group

Specialising in equipment and expertise for industrial gas, LNG, hydrocarbons and clean energy, Cryostar is an international company, which exports more than 95% of its products and serves customers worldwide.

Founded in 1966, Cryostar is present on all continents, supported by its business centres and subsidiaries. Today the company combines the resources and competencies of a local network with decentralised customer facing team, with its management and research headquarters based in France.

Cryostar delivers pumps, turbines, compressors, heat exchangers, automatic filling and refueling stations, natural gas liquefaction/regasification plants and power plants to customers with the most demanding requirements. Cryostar's innovative solutions have a proven track record of improving customers' process performances.



Cryostar has always been at the forefront of cryogenic technology. In 1967, it was the first company in Europe to produce cryogenic distribution pumps for liquefied air gases.

It is in this spirit of consistently bringing innovative solutions to customers that Cryostar Automation has developed its packaged solutions for industrial gas.

### Think global, act local

To stay close to its customers around the globe, Cryostar has established several Business & Service Centres and collaborates with experienced local agents and distributors.



### Cylinder filling stations division



From feasibility studies to fully automated turnkey filling stations:

- Global engineering: feasibility study, production optimization, risks analysis, P&IDs, layout, isometrics, scope of supplies for customer's subcontractors, electrical schemes, etc.
- Design of production facilities from tanks to filling racks
- On-site construction supervision and subcontractors coordination
- Commissioning
- Training
- After sales and services

### Our scope of supply

Based on its experience of more than 40 years in industrial and natural gas applications, Cryostar is able to supply its customers with a wide range of equipment for filling stations along with global engineering and project management.

Cryostar's whole station range integrates medical validations (GAMP) and complies with explosive atmosphere regulations (ATEX), HAZOP studies, risk assessments (FMEA) and weights and measures approvals (OIML).

Each product is pre-tested to ensure customer performance expectations are met. Cryostar also takes care of the installation supervision, commissioning, training and operates technical audit, maintenance, repairs and site refurbishment around the world.



### High performance test facility

Each Cryostar product is subject to a pneumatic test with nitrogen, using Cryostar's high technology test facility. Cryostar provides a test report together with its instruction and operating manuals, offering customers guaranteed performances.



### Turnkey high pressure cylinder filling station



### 1- High pressure pumping equipment

Cryostar has been a recognized cryogenic pump manufacturer since 1966, with a reciprocating pumps installed base of 4,000 units worldwide.

#### Pump main advantages

- Very low gas losses
- Easy maintenance
- Low maintenance costs
- Short cool down time
- Good efficiency
- Sufficiently low NPSH

#### For small stations





#### SDPD

Reciprocating pump typically used for 200 bar cylinder filling Flow: up to 10 l/min Pressure: up to 420 bar Power: up to 11 kW Available in Duplex/Triplex configurations -CE Marked-

### For medium to large stations



#### MRP

Oil lubricated reciprocating pump typically used for 300 bar cylinder filling at 15°C

Flow: up to 24.5 l/min Pressure: up to 500 bar Power: up to 37 kW Available in Duplex/Triplex configurations -CE Marked-



PD 3000

Vertical reciprocating pump typically used for 300 bar cylinder filling at 15°C Flow: up to 15.6 l/min Pressure: up to 6,000 PSIG Power: up to 18 kW

### For LCO<sub>2</sub> & LN<sub>2</sub>O applications



### PPC

Reciprocating pump typically used for LCO<sub>2</sub> and LN<sub>2</sub>O cylinder filling Flow: up to 18 l/min Pressure: up to 120 bar Power: up to 12 kW -CE Marked-



#### Atmospheric vaporizers

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The Cryostar high pressure vaporizers with aluminium finned outer tubes and high strength stainless steel inner tubes allow gas vaporization through ambient air heat exchange.

Different models with an operating pressure up to 500 bar are available, depending on the flow requirements of your filling station:

- Available in 1.5m; 3m; 5m height
- Outlet temperature = ambient temperature -15°C
- Suitable up to 8h continuous operation
- Available with PED certificate

#### **Options:**

- Cold filling system to lower cylinder temperature
- Automatic switch-over system





#### **Electrical heaters**

Gas is heated by 6 or 9 heating elements located in the trim-heater body.

Three different heating levels can be achieved.

The heaters are available in the following sizes:

- 15 kW
- 20 kW
- 30 kW
- 40 kW
- 90 kW

15 kW-30 kW: 220 V or 380 V power supply. 40 kW-90 kW: 380 V power supply.

### 3- High pressure line control equipment

The Cryostar line control panels are designed to control the following features:

- Line pressure
- Vaporizer outlet temperature
- Buffer pressure
- Buffer valve opening
- Air instrument supply on N<sub>2</sub> line

They are available in two different models:

- The Discharge Gas Control Panel (DGCP) for temperature and pressure control only
- The Buffer Skid for temperature, pressure, and buffer control

#### Options for the Buffer Skid:

- Air instrument supply option
- Secondary gas supply option (for small components filling)

#### Main advantages :

- Pump life time improvement by reducing its start and stop cycles
- Filling time reduction
- Can be used as a secondary gas source for the minor components of your mixtures (not exceeding 20%)
- Avoid line overpressure by absorbing the liquid gas trapped inside the vaporizer when stopping the pump





### 4- Gas filling equipment

### Gas filling skids

The filling skids are equipped with all valves and instruments required to fill cylinders with the highest accuracy, safety and efficiency. Cryostar supplies single gas, double mono gas or mixture filling systems.

All Cryostar filling skid equipment are CTE or BAM approved for  $O_2$  filling, or ATEX approved for explosive gases.



The mixing systems are composed of:

- Gas entry modules (up to 6 gas in entry and B&B options)
- Mixing skids with regulation and bypass valve
- Filling modules with hidden time filling possibility (up to 6 modules)
- Safety valve modules for multiple pressure fillings
- Vacuum module integrating the vacuum pump and all its equipment

#### Standard method:

Correlation by pressure temperature with automatic adjustment

#### Options:

• Gravimetric method with coriolis flow meter or by weight method using a scale

• Shared vacuum if gas compatibility

#### Gas filling racks

The filling racks can fill batches of 8, 10, 12 or 16 bottles (can be adapted according to your pallets).

Cryostar's filling racks are composed of:

#### • A structure in aluminium

Integrating a platform well adapted to the operator's ergonomics for the manipulation of cylinder connectors, stairs for access to the walkways, and supports for filling panel interfaces.

## • A tray supporting the flexible hoses or the lyres (adapted to different cylinder heights)

Height adjustable tray with pneumatic actuator allows cylinder release before their removal by forklift.



Connections to cylinders is by flexible hoses or by stainless steel lyres. Each flexible hose or lyre can be isolated by an angle valve certified BAM or CTE.

The type of connectors is defined according to national standards.

#### • A protection cage

The operator is secured by a protection cage made in transparent polycarbonate or Komadur (M1 fire resistant).

This cage is locked in low position throughout the cycle time. Any forced manipulation stops the current cycle.

A lifting table to fill small cylinder heights can be adapted inside the filling rack.

### Mobile filling stations

#### Bring your production to your customers...



Cryostar supplies high quality reciprocating pumps with low maintenance costs:

- High safety and reliability with Cryostar standard scope of supply
- Digital technology used for all sensors (temperature, pressure)



- All interconnections are supplied in stainless steel, Monel or copper, upon request
- All pressure valves approved according to PED regulations which applies in the European Community
- All equipment included onto a compact skid pre-tested in our workshop
- Ready to be connected to a storage tank (customer-specified tank)
- 20" container designed for the pumps (liquid or gas filling skid), the vaporizer and the heating system if required

• 40" container dedicated to the filling racks, electricity and the operating control area for the operators

### **5- Liquid filling system (LCO**<sub>2</sub> / LN<sub>2</sub>O, etc.)

#### Semi-automatic

- Semi-automatic filling
- Weight typed by the operator onto the scale interface (the last weight typed is kept in memory)
- Filling stops automatically when weight is reached
- Manual vent to atmosphere

#### Fully-automatic

• Predefined recipes in the system

• The operator chooses a recipe and all filling steps are done automatically (vent to atmosphere,

purge, vacuum, filling, end)

• All the events are stored in the supervision unit allowing the full traceability of the cycles





### 6- Supervision system

### Architecture of automatic plant

#### Supervision unit

• Visualization in real time (processes, defaults, total operating time display of the entire filling station including medical, industrial or specific gases)

- Recipe builders, configuration software (systems, operators, batch numbers, type of vessels...)
- Possibility to link our filling system to an ERP (SAP, AS400...) upon request
- Full traceability with research filters (events during cycles, analysis reports, defaults, etc. can be exported and exploited by Excel software)
- Oscilloscope, production tools, statistics tools...
- Remote maintenance access through the supervision PC

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Vacuum PS-4

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Time remaining : Threshold waiting :

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### 7- PLC control system

### Filling Operator Panel (FOP)

• Management of 1 mixing system and up to 6 filling modules (hidden time modules or single gas filling system) and 3 vacuum pumps per FOP

- Filling systems visualization (overview or in details)
- Interaction with operators (friendly and easy to use interface)
- Acknowledgement of defaults







### Pump Control Panel (PCP)

• Management of all the equipment located in the cryogenic area: piston pumps, centrifugal pumps, vaporization, buffer management, etc.

- Acknowledgement of defaults
- Straightforward, user-friendly interface



### 8- Analysis system

#### Manual or automatic analysis bay

Cryostar integrates analyzers according to Pharmacopoeia's regulations for medical applications:

- Paramagnetic (O<sub>2</sub> title)
- Chromatography ( $N_2$ ,  $N_2$ O titles + ppm CO<sub>2</sub> in  $N_2$ O, ppm CO in  $N_2$ O & CO<sub>2</sub>, ppm CH<sub>4</sub>,  $C_2H_2$ ,  $C_2H_4$ ,  $C_2H_6$  in  $O_2$ )
- Infrared (CO<sub>2</sub> title, ppm CO<sub>2</sub> and CO in air,  $O_2 \& N_2$ )
- Electrochemical (ppm O<sub>2</sub>)
- Electrolytic (ppm H<sub>2</sub>O)
- Fluorescence UV (ppm SO<sub>2</sub>/S total)
- Chemiluminescence (ppm NOX)

### Cryostar filling stations features

#### Higher safety devices

Velocity control inside the pipe (pump speed / proportional or regulating valves)
Automatic control of all the line parameters (temperatures / pressures)

 Filling racks with protection cages / check of the flexible hoses connections before filling by using the vacuum pump
 Adapted ventilated area and use of

equipment suitable for ATEX zones

• Atmosphere control

#### Friendly to use systems

- Easy and friendly operator interface "touch screen" using local language
- Secured system reducing human error

#### Downtime reduction

• Combined control: automatic or manual mode (bypass of the PLC whilst keeping the same safety level)

- Remote control access (maintenance, production, control in real time)
- 24h/7d maintenance line (hotline number access with Cryostar's commitment to call back within an hour)
- Availability of components

#### Where customers save money...

Storage area	TANK MONITORING	10% product losses reduction
Pumping area	AUTOMATIC MANAGEMENT	30% pump life time improvement
Vaporizer area	BUFFER FILLING	40% pump life time improvement
		15% to 30% productivity increase
	COLD FILLING SYSTEM	Filling time reduction (T° cylinder < 60°C)
		Lower working pressure
Filling area	HIDDEN TIME FILLING	20% capacity increase Higher flexibility
	FILLING RACKS	Fully secured filling racks
	FILLING SYSTEMS	20% to 40% operational cost reduction
	TRACEABILITY	Events during the cycles: defaults production





### Quality

Cryostar complies with the following standards:

- ISO 9001 2008 quality assurance system certified by TÜV Rheinland company
- ISO 14001 2004 quality assurance system certified by TÜV Rheinland company
- OHSAS 18001 2007 certified by TÜV Rheinland company
- Directive Pressure Equipment 97/23/CE: Module H and H1
- Quality Assurance Management such as:
  - Audit, measure and analysis of the processes
  - Definition and guarantee of the compulsory procedures: management of the procedures, inputs and product non conformities, internal audits, corrective actions, preventive actions
  - Product conformity guarantee
  - Guarantee of the conformity and quality assurance system improvement



### Research & Development

- Cylinder filling by gravimetric measurement with a coriolis flow meter
- Medical validation for complete filling station following "IGC Doc 99/03/E"
- Automatic links with customers ERP and barcode/chip traceability
- ATEX validation for explosive gases filling station ( $H_2$ ,  $CH_4$ ,  $C_2H_4$ , etc.)
- Cryostar CSV15 valve DN15 PN 420 approved BAM + CTE or regulation valves
- Filling speed control by a VFD on each pump
- Cold filling system allowing the gas temperature drop and faster filling, even at warm ambient temperature
- Multi language interface allowing easy translation of the control system
- Remote control system

### Cryostar also supports the following industries

• Process Machinery: throughout its history, Cryostar has always been a pioneer in serving the air separation plants industry, including multi stage vertical pumps, oil or generator loaded expanders, and other equipment.

• Distribution Equipment: centrifugal and reciprocating pumps, cylinder filling and gas supply systems, LNG/LCNG/LH<sub>2</sub> fueling stations, etc.

• Clean Energy: Cryostar's Clean Energy product range was set up in response to an increasing demand for clean and carbon-free energy generation. It covers a variety of applications such as pressure let down, geothermal plants, waste heat and natural gas liquefaction.

• LNG Transport & Terminals: Cryostar is the leading supplier of combined cryogenic machinery for LNG carrier cargo handling systems, i.e. boil-off gas compressors, gas heaters and vaporizers and on board re-liquefaction units.

### Service

Customer service is at the heart of Cryostar's priorities. Our company offers a wide range of high quality services designed specifically to provide our customers with expert knowledge and skills starting at the very first contact. This ensures that we provide the optimal solution in terms of efficiency, safety and long-term cost effectiveness before, during and after the sale.

★ Before: thousands of hours have been invested to ensure Cryostar is at the cutting edge of technology, setting the standards of the future. Behind this is a group of highly qualified, experienced engineers, exploiting advanced computer technology and testing equipment to ensure Cryostar is a byword for quality and safety.

**\*** During: Cryostar owns the world's most sophisticated inhouse test stand for pumps and turbines.

★ After: spare-parts, in-house repairs, training sessions, consulting and on-site services.



\* \* \* Contact us: CryostarCustomerService@cryostar.com \* \* \*

### Training

Cryostar's training centre has a highly qualified staff of engineers, travelling around the globe to customer sites or business centres, where they train equipment users to get the most out of Cryostar technologies.

\*\*\* Contact us: CryostarTrainingCenter@cryostar.com \*\*\*

For contact details of Cryostar locations worldwide, please visit www.cryostar.com/locations/ or contact us by email : fillingsolutions@cryostar.com

