



HC Refrigerants treatment Systems

Potential Flammable Gases HC, A2, A2L and A3 (HC)

The interest and the application for Hydrocarbons (HC) refrigerants is growing more and more, especially now that the impact of some refrigerants on global warming has acquired an important role in the industry of refrigeration and air conditioning.

Ecological natural refrigerants such as the A2, A2L and A3 are now all available as mature technologies for most applications. It is widely recognized that these refrigerants classes are excellent in terms of performance, but also have negatives features for the environment because of their flammability.

FT srl is sensitive to the subject of the design of systems for the industrial treatment of flammable refrigerants and has developed over the years a

range of products and projects dedicated exclusively to the treatment of this class of Refrigerants. This range of products has been designed by following suitable criteria for safety in the workplace for potentially explosive environments in which they are taken as a source of explosion due to involuntary refrigerant leaks during the manufacturing processes of refrigerators.

FT srl builds specialized secure systems for testing, evacuation and charging flammable refrigerants in the circuits, providing appropriate working areas equipped with auxiliary forced extraction systems and gas leak monitoring sensors to safeguard the safety of the operators, according to existing rules on the prevention of possible explosion.

Classification of Flammable Gases

Type	Refrigerants	Safety class	PED Group
HFC	R32, R143a	A2L	1
HFO	R1234yf,	A2L	1
	R1234ze	A2L	2
Azeotrope blends	R510A ,R511A	A3	1
	R516A	A2L	Not defined
Zeotrope blend	R430A ,R431A, R432A, R433A, R433C, R435A, R436A, R436B, R441A , R443A	A3	1
	R444A, R444B, R445A, R446A, R447A, R451A , R451B,	A2L	1
	R447B, R452B, R454A, R454B, R454C, R455A, R457A, R459A, R459B, R467A, R468A	A2L	Not defined
Hydrocarbons	R170, R290, R600, R600a, R1150, R1270	A3	1
Natural (inorganic)	R702	A3	Not defined

Company Profile

Vacuum and Charging units

HC Refrigerants handling systems

Special Units

Vacuum and Charging Inletors

Refrigerant transfer pump

Pressure test units leak detectors

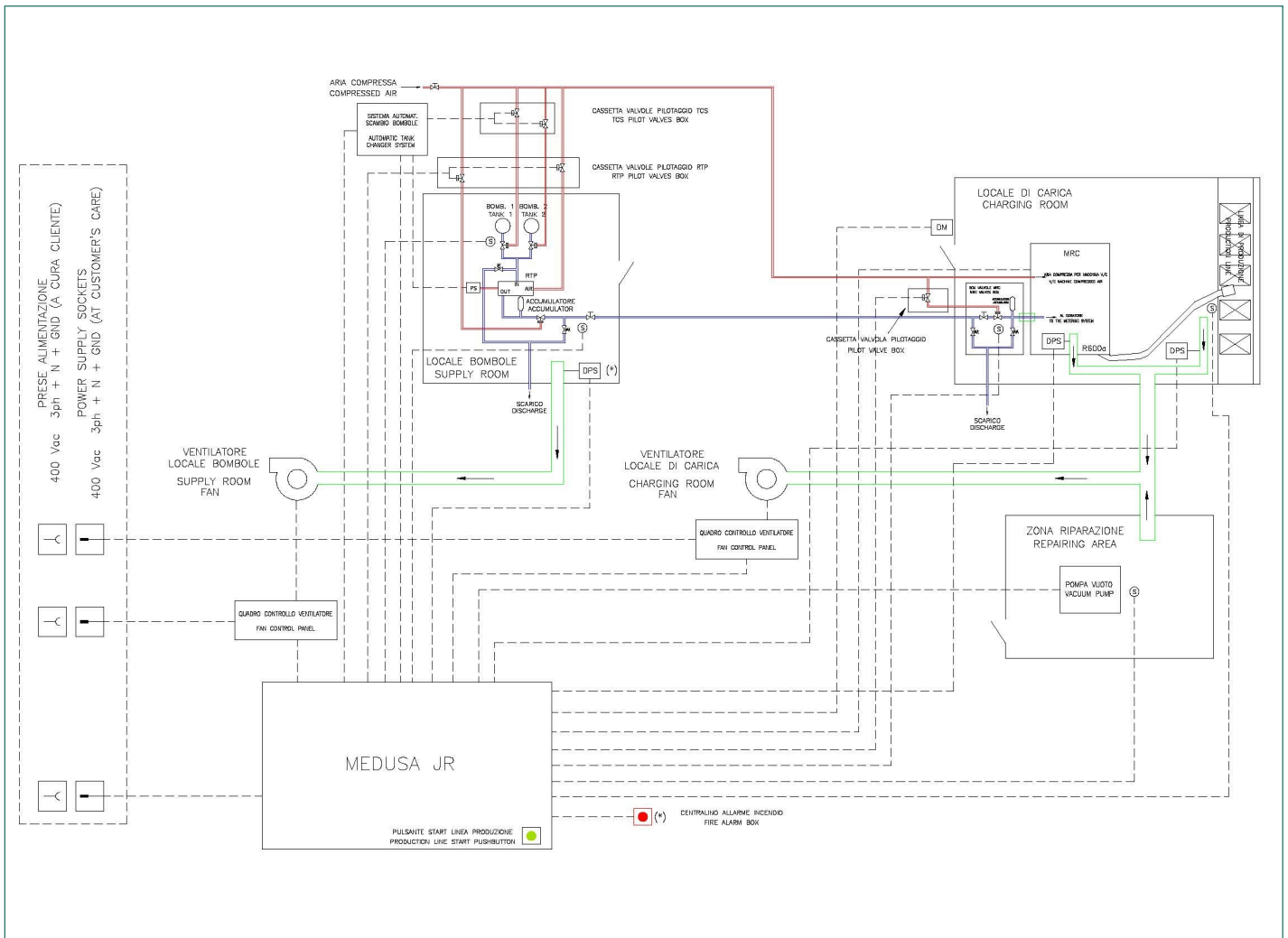
Preliminary evacuation

Electrical and functional test

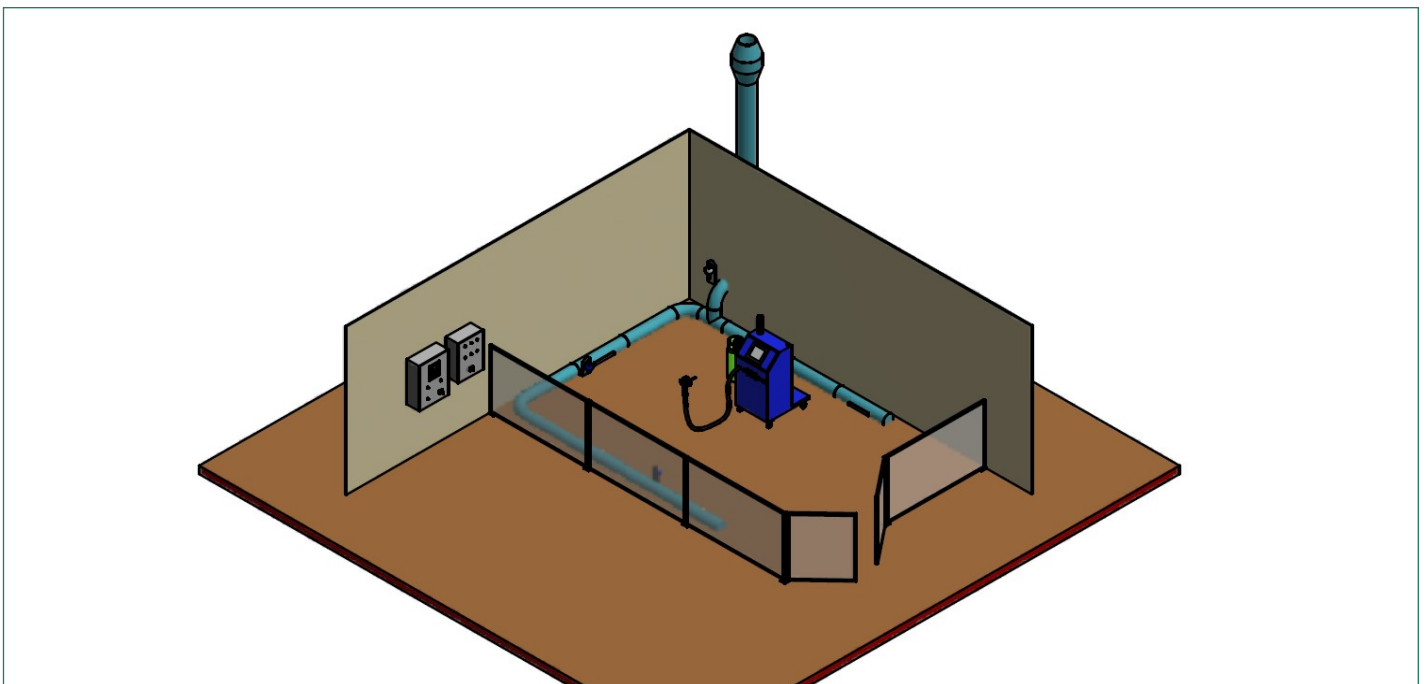
Ultrasonic tube sealers

IPCS & IPCS PLUS

HC Refrigerants treatment Systems



Full layout example of a FT HC systems installation





Description of a typical FT HC Refrigerants treatment System

The equipment for the vacuum and the charge of HC refrigerants are designed according to ATEX Directive 99/ 92/ EC, inside a proper workspace for refrigeration units to be loaded with flammable gas. Within the area flames or wells are not allowed, and smoking is prohibited. The area is delimited by walls and ventilation ducts. For security reasons, sources of potential danger to the fire ignition should be placed not less than 2-3 meters from the perimeter of the work area.

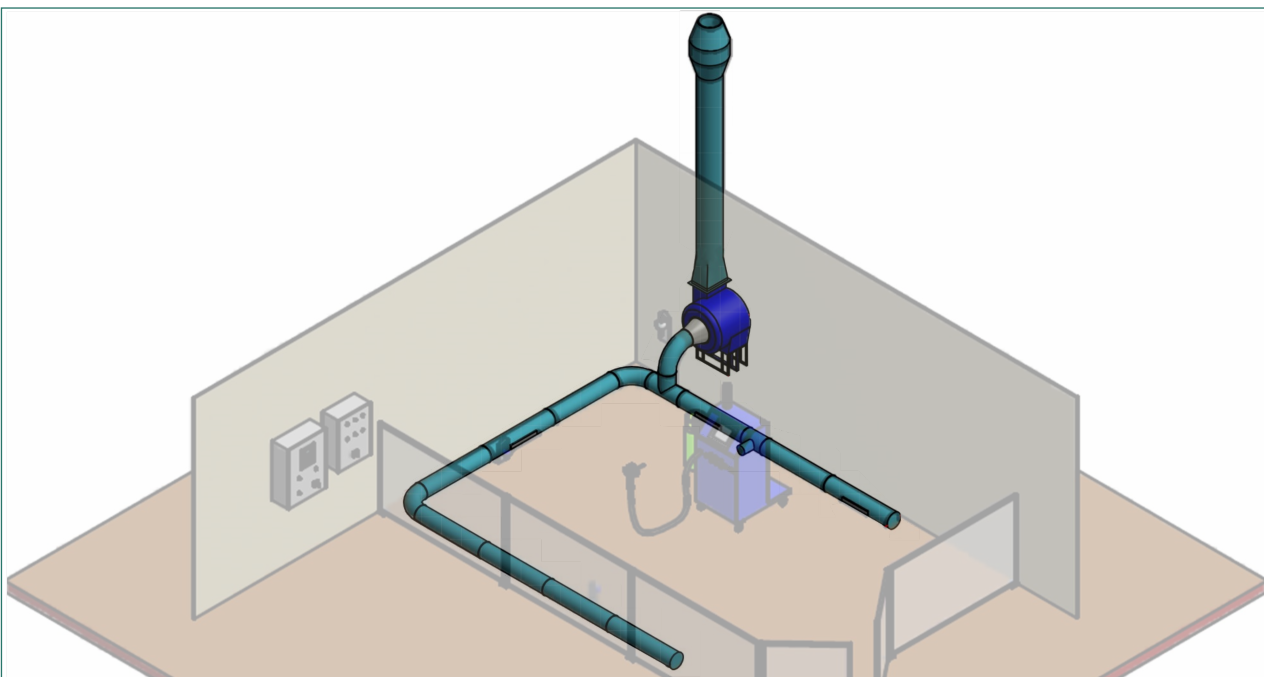
Usually a limited working area is provided by an enclosure in which, the cooling units to be processed are moved inside through a sliding door. The same door is the access point to the work area for the authorized staff. The door can be controlled by timer controlled microswitches. The size of the charging area is approximately 20 m² and is enclosed by 1 m high fireproof panels, which are

also supplied by FT srl.

On the internal perimeter of the working area, an extraction system is installed, which provides the necessary air exchange, so as to keep under control the concentration of hazardous gas. The HC vacuum and charging machine, with one / two injectors, is placed Inside of this work space.

The refrigerant tank in use, can be installed inside a different area and it can deliver the refrigerant to the charging station by means of a Refrigerant Transfer Pump systems (RTP). The devices to check the environmental safety are installed in the vicinity of the outer walls of the charging area, while the ventilation unit with variable speed is located on the perimeter wall of the plant, in correspondence of the charging area.

Ventilation layout example of a FT HC systems installation



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HC Refrigerants handling Systems

FT System components for HC refrigerants handling

FT srl can supply a full and customizable components package that composes a full HC system.

Every FT srl component system follows the Electrical security normative (EN60529, EN60204-1), Hydraulic mechanics and working places safety normative.

FT srl component systems are delivered with relevant test certification and user manual that describes all the necessary steps to follow in order

to work with high performance and safe conditions during use and maintenance. Each component system has been designed according to standardized production and testing procedures.

In this section follows a short description of the functional characteristic of every FT srl component systems. For more details please refer to the relevant technical table.

Example of a FT HC systems installation

iRockall HC (Vacuum and flammable refrigerant charging system)

1

Air ducts for Eolo (Extraction system)

3

Medusa (Monitoring and Gas Extracting System)

2

Non flammable panels

4





Vacuum and Charging Machine (iRockall HC)

iRockall HC performs the vacuum formation, a preliminary test leaks and, Refrigerant charge (in liquid status) on the circuits. The HC machine is designed to work inside a potential dangerous area classified as zone 2, according to the CEI EN 60079-10 normative.

iRockall HC is provided with a unique cabinet internally divided in two different volumes: *The Electrical Unit* and *the Hydraulic Unit*, that are separated by an *Intermediate Empty Space*.

Electrical Unit - Contains all the electrical components such as the power supply and safety relays to limit possible current shortcuts conditions. The electrical unit is also equipped with a door microswitch in order to cut the power supply of the unit when the door is open.

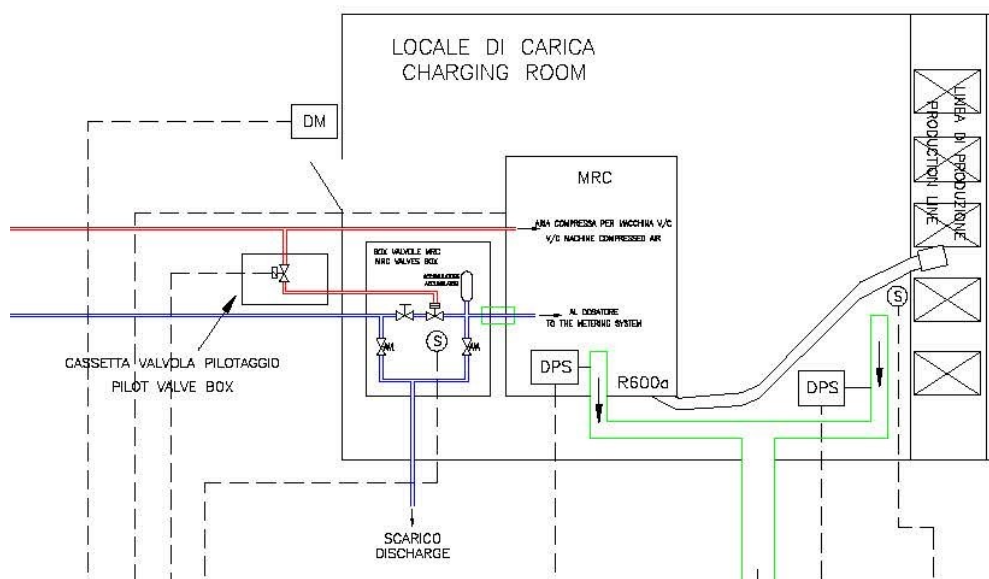
Intermediate Empty space - This component separates the electrical unit from the hydraulic unit. This gap ensures perfect insulation between the two subunits.

Hydraulic Unit - It is generally composed of:

- Refrigerant supply line
- Refrigerant pipes
- Refrigerant metering system (Volumetric or by RTP automatic dosator)
- Injector refrigerant line
- Pneumatic vacuum pump for internal vacuum of the injector.
- Sensor to detect refrigerant leaks
- Sensor to detect internal forced ventilation

All components for each line of refrigerant charge are connected by quick couplings types, Hansen or Faster, which simplify the replacement procedure of every component, making the process easier and safer. Each line is also controlled by two normally closed valves, one on the injector and the other on the refrigerant metering system, which limits the amount of refrigerant lost, in case of leakage or malfunction of the sealing devices.

Charging Room Layout



HC Refrigerants treatment Systems

Medusa Monitoring System

The **monitoring system Medusa** represents the central control and command of the entire plant for the handling of refrigerant gases. It is composed by an electrical panel with an electronic control unit and gas concentration detection sensors which are installed inside the charging area. One of the sensors is installed directly inside the Vacuum and Charging Unit. The Medusa system provides control to a forced ventilation system (see EOLO system) so to enhance the airflow rate in the presence of dangerous concentrations.

The Medusa system controls the power supply for the Vacuum and Charging unit and the related Refrigerant Transfer pumps which is connected to the delivery line. The power supply is regulated in real time according to the continuous monitoring of the refrigerant concentration detected from the sensors and the ventilation level detected from related differential pressure switches installed on the ventilation circuit of charging area.

The system also alerts the operators and supplies additional ventilation when the gas concentration reaches 15% of the Lower Flammability. The system will cut power to the vacuum and charge system, putting it in a stand-by mode, if the con-

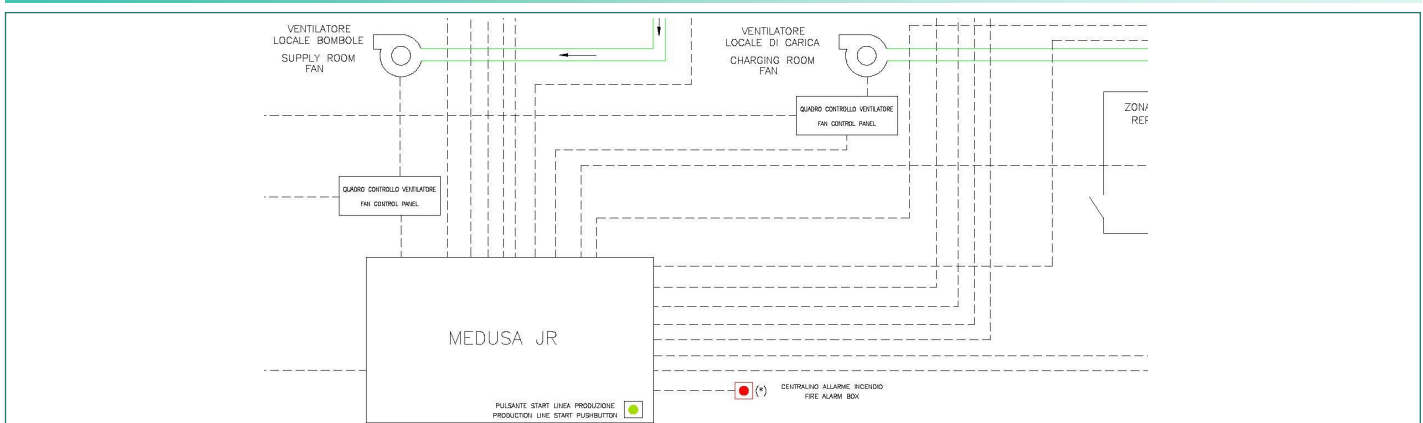
centration exceeds 30% of the Lower Flammability. The warning sound and lighting is available with remote columns to signal the operators to leave the working area. In the presence of fire in the charging area the operator must activate the fire prevention device to totally disconnect the whole charging plant .

After the level of concentration has decreased below the threshold value, the system must be manually reset by the operator.

Medusa is also supplied with:

- Box_VALV_ETNA placed in the charging area, each box is equipped with a valve
- Pneumatically operated barrier with related pilot valve, manual valve, safety valve and accumulator
- Safety valves for the refrigerant lines.
- Box_VALV_SR placed in the supply room, with sectioning valves controlled manually or by a solenoid, to stop the delivery of refrigerant in case of need.
- Fire alarm box, placed in proximity of the two doors of the storage box
- Differential pressure switch for continuous efficiency check of the forced ventilation
- Column indicating abnormal concentration of hazardous gas
- Door/fan Alarm indicators

Medusa Monitoring System Layout





Extraction System Eolo

Eolo extraction system consists of a sound-proof / multispeed fan in Ex execution, with rate capacity up to more than 3500 m³/h, controlled by smart inverter.

The control system is regulated by a special electrical panel, interfaced with the Medusa monitoring system and with the charging unit iRockall HC.

The ventilation delivered by the Eolo system is routed in a pipe appropriately sized according to the factory layout. If the ventilation system stops working (broken fan motor, accidental clogging ducts etc...), the Medusa system activates a procedure for shutting down of the refrigerant pumping systems and the refrigerant charging machine as it no longer guarantees safety.

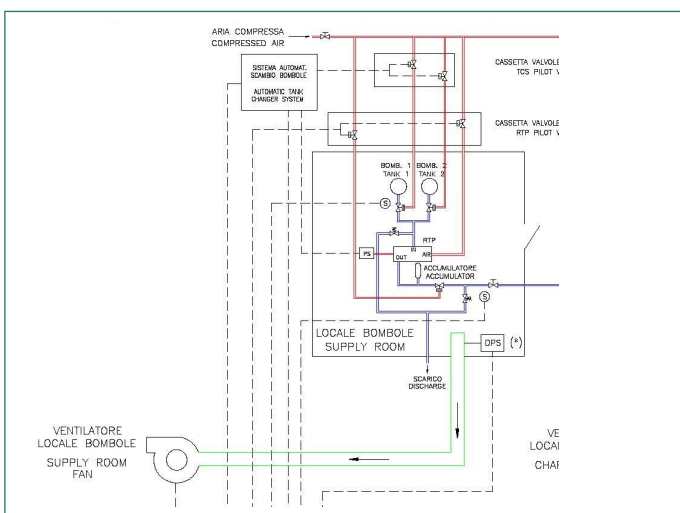
The control of the operation takes place by means of differential pressure switches connected to the Medusa system that is set to detect the presence of airflow in the potentially more critical

ventilation areas.

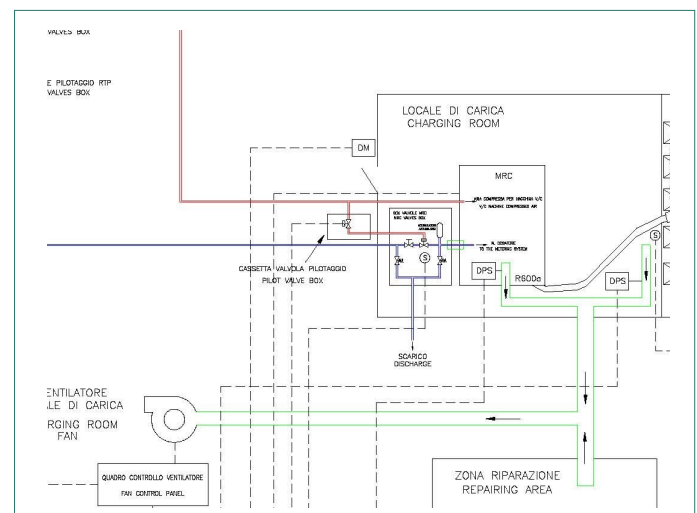
Operational Constraints of the Eolo System:

- The fan must always be in operation at the lower operating speed, when the machines are in operation, so as to maintain a continuous change of air in the working area
- the ventilation flow rate is set to the maximum speed when one or more sensors detect a gas concentration greater than 15% of the Lower Flammability.
- The fan continues to run at full capacity even when, exceeded the threshold of 30% of the Lower Flammability, the power to the charging unit is cut and an emergency situation is signalled.

Supply Room Ventilator Layout



Charging Room Ventilator Layout



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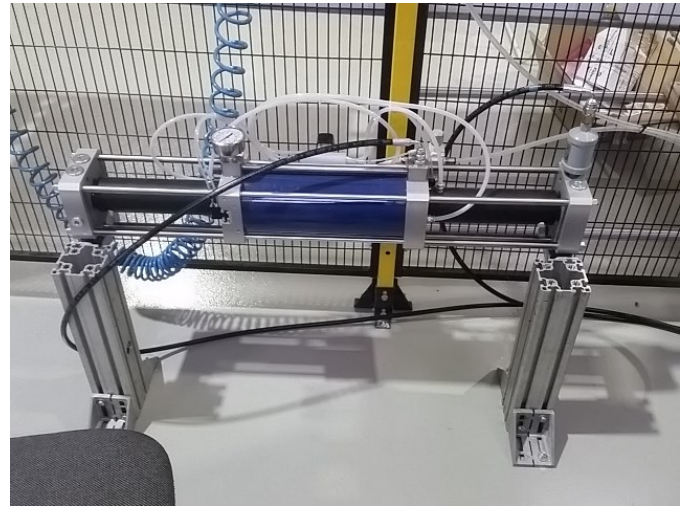
Refrigerant Transfer Pump (RTP)

The **Refrigerant Transfer Pumps** are volumetric pumps with cylindric movement designed to pressurize and transfer the refrigerant in the liquid state. The RTP is driven by means of compressed air.

The pumps are installed close to a tank or storage systems from which they draw the refrigerant fluid thanks to the cylinders moved by compressed air and proper pneumatic valves. After that the fluid is compressed in liquid state and transferred to the refrigerant charging machine.

The RTP is connected to the refrigerant line by means of unidirectional valves that avoid the fluid return towards the pump. As all the Refrigerant fluids tend to increase their specific volume with temperature increases, some instances of uncontrolled pressure increase can appear due to the incompressibility of the fluid itself.

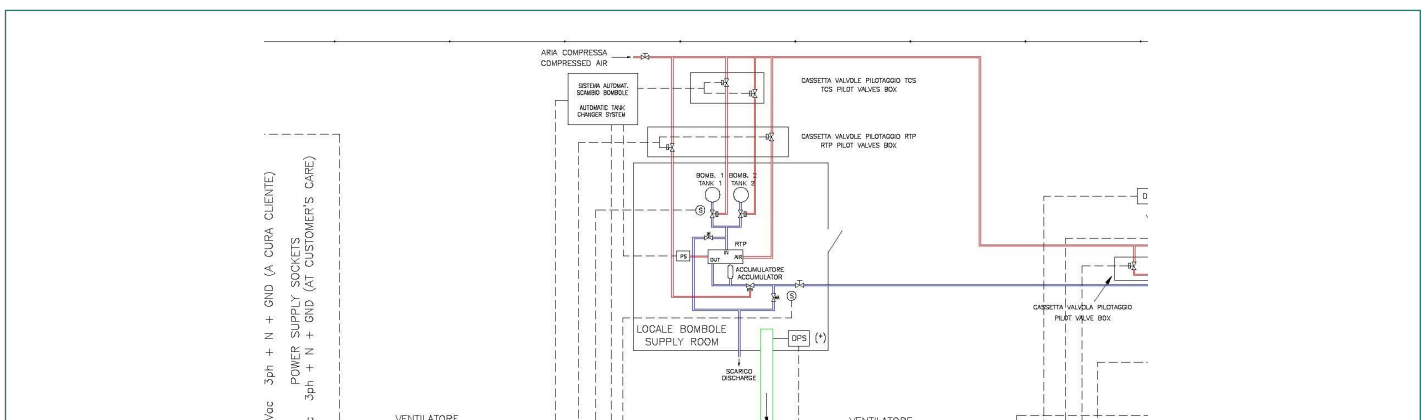
The RTPs have a safety valve set to 40 Bar that allows exhaust on the ventilation circuit eventual overpressure events on the refrigerant delivery line.



The device is integrated on iRockall HC /B.



Medusa Monitoring System Layout





Automatic Tank Changer System (TCS)

TCS system is used to automatically replace the supply of refrigerant gas to the transfer pump by switching from the empty tank to a full one. This system is activated when the RTP pump starts to repeat the extraction cycle at a frequency much higher than the normal conditions, which indicates the lack of refrigerant in the cylinder.

In this situation a sensor sends an electrical signal to the TCS which closes an electrical contact, also shown on the electronic control unit.

The TCS automatically emits an alarm sound when the current tank is about to become empty and must be replaced with a full tank. The alarm sound is also emitted with a red alarm light that can optionally be installed in a remote location.

As soon as the TCS detects an empty tank it will:

- close the pneumatic valve of the empty tank aspiration line and switch the suction line to the full tank by opening the related pneumatic valve
- signal the procedure to follow to restart the suction process from the full tank.

Charging Room Ventilator Layout

