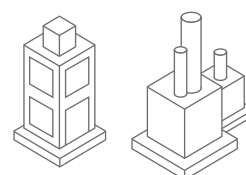




# RWS KP

**PACKAGED WATER COOLED CHILLERS WITH SEMI-HERMETIC RECIPROCATING COMPRESSORS**



Range 60-440 kW



- ▶ Liquid solution chillers.
- ▶ Packaged indoor installation.
- ▶ Semi-hermetic reciprocating ATEX compressors.
- ▶ Natural refrigerant unit with no ambintal impact.
- ▶ Minimum sound emission with maximum efficiency.
- ▶ Wide range of options.

## Use and Maintainance Handbook

Rev.1.1 10/18





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## 1. INTRODUCTION

Unit RWS Kp range are packaged liquid air cooled chillers, R290 refrigerant operating, exclusively designed for external installation.

Such units are equipped with one, two or four independent cooling circuits, as well as semi-hermetic reciprocating compressors with R290. They are suitable for cooling water applications and fluids of any type, to be used in any air conditioning system or industrial processes, in which is necessary to obtain great performance at low environmental impact.

### 1.1 Foreword

The present Handbook, originally written in Italian, was completed in accordance with the European Legislation. It contains all the necessary information for carry out without any risk of transportation, installation, start-up, operating, setting, maintenance and dismantling the unit.

All people authorized to operate with the unit, in particular, all technicians assigned to the unit maintenance, must know all information and instructions contained in this Handbook and all its attachments.

In the event of non-compliance with the instructions contained in this Handbook regarding the installation, start-up, operating, setting, maintenance and dismantling of the unit, it could be unsafe for people, could damage objects and environment.

Should you have any doubt on the correct use of these instructions, please contact the Manufacturer in order to get further clarifications. The unit has to be installed, handled, subject of maintenance, repaired and dismantled in compliance with local technical Standards.

### 1.2 General warnings

- You must have read and understood the Manual contents before starting the unit;
- This User's Manual describes the construction, operation and instructions for the unit's use and maintenance;
- The Manufacturer is relieved from any liability for damage or injury due to failure to follow instructions contained in this Manual;
- For any kind of doubts, the Manufacturer makes itself available through its skilled technical staff to provide all the information required;
- The unit should not be made to operate under different conditions from those of the design, even for short periods of time.

### 1.3 Symbols



IT POINTS OUT A NOT ALLOWED INTERVENTION, AS IT COULD PREJUDICATE THE CORRECT UNIT OPERATION



IT POINTS OUT OF AN IMPORTANT WARNING FOR THE CORRECT UNIT MANAGEMENT






IT POINTS OUT A DANGER TO PEOPLE, THINGS AND ENVIRONMENT



IT POINTS OUT ELECTRICAL RISK FOR THE PEOPLE, THING OR ENVIRONMENT.

## 1.4 Identification Tag

The unit is identified by an indelible label on the external panel of the electrical cabinet (Identification Tag). Here below an example of the Identification Tag, showing and describing all the stated informations, in compliance with the applicable European directives.

1		2		1	Manufacturer's name and address						
	TEL.+39 0543495611 FAX+39 0543 495612 Via A.Volta 49 Meldola FC ITALY			2	CE mark and the Notified Organization identification number which released the PED certification						
3	MODELLO MODEL MODÈLE MODEL	ANNO DI COSTRUZIONE / PED CATEGORIA MANUFACTURE YEAR / PED CATEGORY JAHR VON KONSTRUKT / PED KATEGORIE ANNÉ DE FABBRICA / CATEGORIE PED	<table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 5px;">2018</td> <td style="width: 20px;"></td> </tr> </table>	2018		3	Model				
2018											
4	MATRICOLA SERIAL NR N° DE SÉRIE STAMM NR	CORRENTE MAX. MAX CURRENT INPUT MAXIMALEN STROM AMPÈRES MAXIMALE	<table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 5px;">A</td> </tr> </table>	A	4	Serial number					
A											
5	ALIMENTAZIONE ELET. SUPPLY VOLTAGE ALIMENTATION ELECT. SPANNUNG	CARICA REFRIGERANTE REFRIGERANT CHARGE KALTEMITTEL CHARGE FRIGORIGÈNE	<table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 5px;">C1</td> <td style="padding: 5px;">C2</td> <td style="padding: 5px;">Kg.</td> </tr> <tr> <td style="padding: 5px;">C1</td> <td style="padding: 5px;">C2</td> <td style="padding: 5px;">CO2 Ton</td> </tr> </table>	C1	C2	Kg.	C1	C2	CO2 Ton	5	Supply voltage
C1	C2	Kg.									
C1	C2	CO2 Ton									
6	GAS REFRIGERAN REFRIGERANT RêFRIGêRANT KALTEMITTEL	ASSORBIMENTO ELET.TRICO NOMINALE PUISSANCE êLECTRIQUES NOMINALE NOMINAL ABSORBED POWER NOMINALE LEISTUNGSÂUFNAHME	<table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 5px;">kW</td> </tr> </table>	kW	6	Refrigerant					
kW											
7	PESO OPERATIVO OPERATING WEIGHT POIDS OPERATION. ARBEITSGEWICHT	CORRENTE CORTO CIRCUITO SHORT CIRCUIT CURRENT COURANT COURT-CIRCUIT STROM KURZSCHLUSS	<table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 5px;">10 kA</td> </tr> </table>	10 kA	7	Operating weight					
10 kA											
											
13	LATO BASSA PRESSIONE / LOW PRESSURE SIDE CIRCUIT BASSE PRESSION / NIEDERDRUCKSEITE	LATO ALTA PRESSIONE / HIGH PRESSURE SIDE CIRCUIT HAUTE PRESSION / HOCHDRUCKSEITE		8	Manufacture year / PED category						
14	PRESSIONE DI PROGETTO DESING PRESSURE PRESSION DE PROJET DRUCK DES PROJEKTES	PRESSIONE DI PROGETTO PS DESING PRESSURE PS PRESSION DE PROJET PS DRUCK DES PROJEKTES PS	<table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 5px;">Bar</td> </tr> </table>	Bar	9	Max current input					
Bar											
15	TEMP.MIN PROGETTO MINI DESING TEMPERATURE KLEINSTE TEMP.DES PROJEKTES TEMP.MOINORE DE PROJET	TEMP.MIN PROGETTO MINI DESING TEMPERATURE KLEINSTE TEMP.DES PROJEKTES TEMP.MOINORE DE PROJET	<table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 5px;">- 40 °C</td> </tr> </table>	- 40 °C	10	Refrigerant charge					
- 40 °C											
	MAX TEMPERATURA PROGETTO MAX DESING TEMPERATURE MAXIMALE TEMP.DES PROJEKTES MAXIMUM TEMP DE PROJET	MAX TEMPERATURAPROGETTO MAX DESING TEMPERATURE MAXIMALE TEMP.DES PROJEKTES MAXIMUM TEMP DE PROJET	<table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 5px;">+110 GAS</td> <td style="padding: 5px;">°C</td> </tr> <tr> <td style="padding: 5px;">+ 70 LIQU</td> <td></td> </tr> </table>	+110 GAS	°C	+ 70 LIQU		11	Nominal absorbed power		
+110 GAS	°C										
+ 70 LIQU											
	TARATURA ORGANO SICUREZZA SETTING OF SAFETY DEVICE MISE AU POINT DISPOSITIF DE SECURITê EINSTELLWERT SICHERHEITSELEMENT	TARATURA ORGANO SICUREZZA SETTING OF SAFETY DEVICE MISE AU POINT DISPOSITIF DE SECURITê EINSTELLWERT SICHERHEITSELEMENT	<table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 5px;">Bar</td> </tr> </table>	Bar	12	Short circuit current					
Bar											
				13	Design pressure						
				14	Min. design temperature						
				15	Max design temperature						
				16	Design pressure						
				17	Min. design temperature						
				18	Max. deign temperature						
				19	Setting of safety device						

## 1.5 Warranty

The Manufacturer guarantees the unit, in compliance with what stated on its Sales Conditions and with what explicitly agreed in the contract, if present



*The miManufacturer warranty will decay if the instructions of this Handbook won't be scupolously followed*

The Manufacturer declines any responsibility for possible damages to people, animals, things or environment due to any miss installation, maintainance or regulation, i.e. to a misuse of the equipment; it is considered a misuse any use of the unit not clearly stated in the Handbook.



*During the start-up of the unit, fill the Commissioning Report attached to the Handbook in, and send a copy to the Manufacturer in order to make the Warranty effective.*

## 1.6 Manual readership

The Manual ald all its attachments are supplied with the described unit.

The manual must be kept by the unit's Owner or by the person in charge to care for the unit, in a proper place. To this end, a plastic bag where to store the manual has been placed inside of the electric panel board of the machine, so that it can be always easily accessible for consultation and at the same time, it can be preserved in a good state.

ALL people authorized to operate with the unit, in particular, all technicians assigned to the maintainance and to charge the chiller with liquid refrigerant, must know all informations and instructions contained in this Manual.



The failure in following the instructions contained in this Handbook duing installation, operating, maintainance, repairing and disposal of it can cause damages to people, things or environment

In case the Manual is lost or deteriorated, a new copy must be requested directly to teh Manufacturer.

## 1.7 Peronnel requirement

Any intervention on the unit, especially on the cooling circuit, must be carried out by qualified and well instructed personnel, who must be suitably equipped with indiividual protective devices and trained to the refrigerant use, in compliance with current local Laws and Regulationes in force.

All the maintainance and interventions requiring personnel with different special competences (such a welders, electricians, programmers, etc.) must be supervised by personnel witha deep competence and experience on cooling circuit.

The personnel operating with refrigerant fluids must be suitably trained to achieve the competence required for a safe use of these substances. This incudes, besides those stated by current local Laws, the following competences:

- Current local Laws, Regulations and Standards concerning refrigerant knowledge;
- Deep knowing and suitable training on refrigerant and required protective devices use;
- Knowing and training on leakages prevention, as well as on cans use, leakage detection, refrigerant recycling and disposal;
- The personnel must be able to understand and apply local applicable Laws.

To keep this skills, the personnel must be regularly and periodically trained, in compliance with the local Laws in force.

## 1.8 Dangerous areas

Inside the unit, there could be areas subject to residual risks, such as:

- Devices subject to electrical voltage;
- Moving mechanical parts;
- High temperature surfaces;
- Sharp edges and sharp items;
- Components holding high pressure fluids.

If possible, dangerous components are made inaccessible by protecting them with suitable covers, which can be removed by qualified and suitably instructed personnel only.


If the a.m. protections are not present, the dangerous areas are clearly marked.

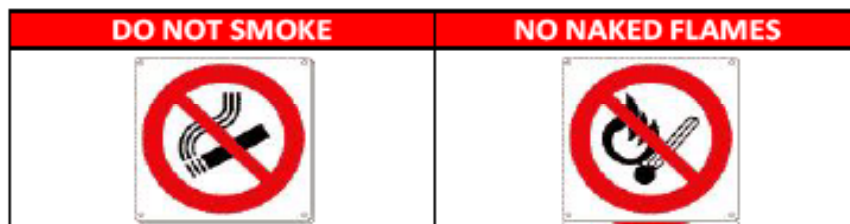
**WARNING:**  
**The refrigerant R290 (Propane) is flammable and it must be handled only by competent and responsible operators, under the conditions specified in the safety regulations in force.**



**STORAGE**

**WARNING:**  
**The gas content into the unit is flammable. The refrigerator should be stored INSIDE only.  
 Max. storage Temp. = +60,0°C**





**1.9 Tests**

Once the unit is completed, its circuit is submitted, following the directives stated in Manufacturer's Quality Warranty System, to a mechanical sealing test and a leak test to find leakages if present.

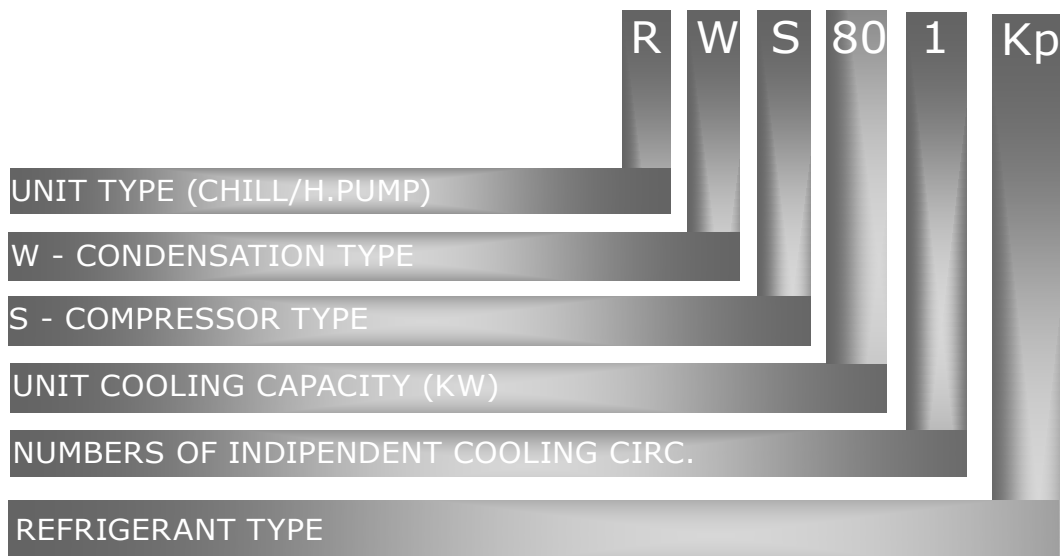
Before the shipment a complete functional test is carried out.



## 2. DESCRIPTION

### 2.1 Nomenclature

In the following scheme, it is explained the meaning of the device name acronym



\* calcolata alle condizioni acqua evaporatore a +12°C / + 7°C con una temperatura dell'acqua del condensatore 30 - 35°C

### 2.2 RWS Kc Series Version

RWS Kp Series Version are only available in Standard Version.

### 2.3 Models with partial heat recovery (RP option)

Each model RWS Kc, on demand, is available in partial condensation heat recovery; In this configuration, each cooling circuit is equipped with a refrigerant/water plates exchanger on gas discharge side. This exchanger, installed in series and upstream the air condenser, is designed to recover a part of the condensing heat (about 20%) in order to produce hot/warm sanitary water.

### 3. REFERENCE LAWS AND NORMS

Less differently stated on the order, the unit of this Handbook is manufactured in compliance with European Directive and in particular it meets the Essential Safety requirements of the following directives:

- 2014/68/EU
- 2004/108/CE (Electromagnetic Compatibility),
- 2006/42/CE (Machinery Directive),
- 2014/135/EU
- EN 378-3: 2017, Chillers and Heat Pumps – Environmental and safety requirements – Part 3: Site installation and people safety
- EN 378-4: 2017, Chillers and Heat Pumps – Environmental and safety requirements – Part 4: Operating, Maintenance, Settings
- EN 1127-1: 2011, Explosive atmospheres – Explosion prevention and protection – Part 1: Fundamentals and methodologies
- EN 13313: 2010, Chillers and Heat Pumps - Personnel skills
- EN 60079-10-1: 2016, Explosive atmospheres – Part 10-1: Places classification. Explosive atmosphere for refrigerant
- EN 60079-14: 2008, Explosive atmosphere – Part 14: Design, electrical system selection and installation
- EN 60079-17: 2014, EC (2008), Explosive atmospheres – Part 17: Electrical systems settings and maintenance
- EN 60204-1: 2016

#### 3.1 R290 Refrigerant (PROPANE)

The refrigerant used is propane (R290). Following 2014/68/EU (henceforth PED), the Refrigerant is considered a Group 1 gas (PED, art.13) which includes the dangerous fluids (Extremely flammable).

The propane, following EN 378-1, all.F is included in A3 Group (low toxicity, high inflammable).

Here below the gas propane characteristics

Chemical Name	Propane
Designation (ISO 817)	R290
Chemical Formula	C <sub>3</sub> H <sub>8</sub>
Safety Group (EN378-1)	A3
PED Classification	Group 1 Gas
Lower inflammable limit (LFL)	0,038 kg/m <sup>3</sup> – 2,1% m <sup>3</sup> /m <sup>3</sup> ( )
Higher inflammable limit (UFL)	0,177 kg/m <sup>3</sup> – 9,8% m <sup>3</sup> /m <sup>3</sup> (1)
Steam density (a 25°C, 101,3 kPa)	1,832 kg/m <sup>3</sup>
Relative density	1,56
Molecular Mass	44 kg/kmol
Normal boiling point	-42°C
Autoignition temperature	470°C
Flammability temperature	-104°C
Ozone reduction potential (ODP)	0
Global warming potential (GWP - during 100 years)	3 (CO <sub>2</sub> = 1)

Is important to notice that Propane has a higher density than air so if leaved in the atmosphere is tendency will flow downward.

#### CHEMICAL PROPANE COMPOSITION USED LIKE REFRIGERANT

Refrigerant content	≥ 99,5% by mass
Organic impurities	≤ 0,5% by mass

1,3 Butadiene (for every single insaturated multiple idrohocarbured)	≤ 5 ppm in massa
Normal.Esano	≤ 50 ppm in massa
Benzene (for each aromatic composed)	≤ 1 ppm in massa
Zolfo	≤ 2 ppm in massa
Incondensables Gas	≤ 1,5% in volume della fase vapore
Water	≤ 25 ppm in massa
Acids content	≤ 0,02 mg KOH/g per la neutralizzazione
Evaporaion residual	≤ 50 ppm in massa
Solids/Particels	Nessuno (ispezione visiva)
Evaporation temperature Glide	≤ 0,5 K
Pratical limit (EN378-1, all.F)	0,008 kg/m <sup>3</sup>
Exposure limit for acute toxicity (ATEL) / O <sub>2</sub> privation limit	0,09 kg/m <sup>3</sup>

Propane has problems with some rubber and plastic types, clorurates in particular. Will be necessary do compatibility tests on the critical materials.

## 3.2 Refrigerant and lubricating oil Safety Schede

GeneralGas®

**MATERIAL SAFETY DATA SHEET**  
 ACCORDING TO REGULATION (EC) N. 1907/2006,  
 ATTACHMENT II

GG\_GF 081  
 Revision date: November 2016  
 Pag. 1 of 15

## KRYON® 290

## SECTION 1 IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

## 1.1 Product Identifier

Commercial name : Kryon® 290: liquefied hydrocarbons to different degree of purity  
 Chemical family : hydrocarbons - alkanes  
 Other names : n-Propane; GPL; Liquefied Petroleum Gas; Hydrocarbon propellant; R 290; Dimethylmetane;  
 UN 1978  
 Chemical formula : CH<sub>3</sub>CH<sub>2</sub>CH<sub>3</sub> ; C<sub>3</sub>H<sub>8</sub>

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Uses : Refrigerant, technical and industrial uses  
 Uses advised against : intentional abuse of very high concentration of vapours, even for short periods, can produce unconsciousness or might prove fatal.

## 1.3 Details of the supplier of the safety data sheet

Company Name : General Gas S.r.l.  
 Via Aosta, 5 – Cernusco sul Naviglio – 20063 MILANO  
 Phone Number ☎ +39 02 92141835 📠 +39 02 92141841  
 Emergency telephone number +39 335 5644288  
 E-Mail ✉ [m.migliaccio@gas-tec.it](mailto:m.migliaccio@gas-tec.it)

## SECTION 2 HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

Classification according to Regulation CE n°1272/2008 , att. VI  
 Flammable gas Class 1 H220 (Extremely Flammable Gases)  
 Gas under pressure Liquefied Gas H280 (Contains gas under pressure; may explode if heated)

## 2.2 Label elements

Labelling according to Reg. CE n°1272/2008 , att. VI  
 Hazard pictograms



Hazard pictogram code  
 GHS02      GHS04

Signal word

Danger (for both)

Hazard statement

H220 Extremely Flammable Gas

H280 Contains gas under pressure; may explode if heated.

Further information: Notes H, K, U.

GENERAL STATEMENT RECOMMENDATIONS

P102 Keep out of reach of children.

PRECAUTIONARY STATEMENT PREVENTION

P210 Keep away from heat/sparks/open flames/hot surfaces. No smoking

P260 Do not breathe dust/fume/gas/mist/vapours/spray

PRECAUTIONARY STATEMENT RESPONSE

P377 Leaking gas fire: do not extinguish, unless leak can be stopped safely

P381 Eliminate all ignition sources if safe to do so

P305 + P351 + P338 IF IN EYES: Rinse cautiously with water with several minutes. Remove contact lenses. If present and easy to do. Continue rinsing.

P337 + P313 If eye irritation persists: get medical advice/attention

PRECAUTIONARY STATEMENT STORAGE

P410 + P412 Protect from sunlight. Do not expose to temperature exceeding 50°C/122°F.

**KRYON® 290**

P403 Store in well place

PRECAUTIONARY STATEMENT DISPOSAL

P501 Dispose of contents/containers in accordance with local regulation

ADDITIONAL PHRASES OF THE MANUFACTURER

- To be used far away from sparkles, open fire, heating sources, functioning electrical devises.

- Explosive mixtures may occur in not well- ventilated environments.

**2.3**

**Other hazards**

Liquefied gas under pressure, extremely flammable, explosion hazard with air when released in closed or restricted environments. Simple asphyxiant gas, it is dangerous because it displaces oxygen in the atmosphere. High concentration of vapors may cause narcotic effects.

When released, the liquid poured out of the container quickly evaporates absorbing heat, mixing itself with air and producing an explosive mixture, causing fire danger and/or explosion with air. The contact with liquid phase causes frostbite.

This gas is heavier than air and it spreads close to the ground and it accumulates in restricted areas (sewer, basements, unloading areas...). It is invisible but it produces fog by wet air .

A strong heating of the container (i.e. by fire) should cause a remarkable volume and pressure increase of the liquid with burst danger of the relevant container. In this case the product may decompose producing CO<sub>2</sub> (carbon dioxide) and CO (carbon monoxide highly toxic).

According to the criteria of the REACH regulation, no substance like PBT, vPvB.

**SECTION 3 COMPOSITION/INFORMATION ON INGREDIENTS**

**3.1**

**Substances**

Information on ingredients/Dangerous components according to Reg. CE 1272/2008

Propane ≥ 95%

n° CAS 74-98-6 n° EINECS 200-827-9 n° CE 601-003-00-5 n° REACH 01-2119486944-21-xxxx

Hazard pictograms



Hazard pictogram code

GHS02 GHS04

Flammable gas, hazard class 1 H220 extremely flammable gas

Gas under pressure: Liquefied gas H280 contains gas under pressure; may explode if heated.

INCI name: Propane

isobutane ≤ 5%

n° CAS 75-28-5 n° EINECS 200-857-2 n° CE 601-004-00-0 n° REACH 01-2119485395-27-xxxx

Hazard pictograms



Hazard pictogram code

GHS02 GHS04

Flammable gas, hazard class 1 H220 extremely flammable gas

Gas under pressure: Liquefied gas H280 contains gas under pressure; may explode if heated.

INCI name: isobutane

n-Butane ≤ 5 %

n° CAS 106-97-8 n° EINECS 203-448-7 n° CE 601-004-00-0 n° REACH 01-2119474691-32-xxxx



Hazard pictogram code

GHS02 GHS04

### KRYON® 290

Flammable gas, hazard class 1 H220 extremely flammable gas  
 Gas under pressure: Liquefied gas H280 contains gas under pressure; may explode if heated.  
 INCI name: n-Butane  
 It does not contain other products and/or impurity which may influence the product classification

#### SECTION 4 FIRST AID MEASURES

##### 4.1 Description of first aids measures

- GENERAL** : Observe the measures for personal protection. Do not attempt to rescue injured(s) by exposure to the substance without adequate personal protective equipment and without having examined all the security precautions (isolating potential sources of fire ignition ...). Remove injured(s) from contaminated and/or dangerous area and provide fresh air. Keep injured(s) at rest position and under surveillance. Remove immediately contaminated clothes. In case of prolonged exposure to the substance it is essential medical assistance. Before entering in contaminated areas check that the atmosphere is not flammable or oxygen deficient and in any case, use appropriate protective equipment.
- INHALATION** : Take interested people in the open air. If the victim is not breathing, give artificial respiration. If breathing is difficult administer oxygen. In any case keep the injured(s) warm and seek immediate medical advice.
- SKIN EXPOSURE** : The skin that has been in contact with the liquid become gray or white and can be covered of blisters. Remove, if possible, clothes while showering with warm water. Do not to rub frozen injured parts as skin damage may occur. As soon as possible, wet the area with warm water, and, if necessary, cover with sterile gauzes and wrap in a blanket. Seek immediate medical advice.
- INGESTION** : The ingestion of the product is an unlikely event. Consult a doctor as soon as possible.
- EYES EXPOSURE** : Irrigate gently with many water with open eyelids (remove contact lenses, if the situation is possible) and seek, as soon as possible, medical attention preferably an ophthalmologist.

##### 4.2 Most important symptoms and effects, both acute and delayed

High concentrations may cause asphyxiation. Symptoms may include loss of consciousness, without the person realizing it. Accidental rapid evaporation of liquid may cause cold burns.

##### 4.3 Indication of any immediate medical attention and special treatment needed

Seek immediate medical attention of emergency specialist. It is a gas that removes oxygen from the atmosphere. Not known specific antidotes  
 Providing medical treatments depending on the symptoms and keep the people involved under surveillance.

#### SECTION 5 FIREFIGHTING MEASURES

##### 5.1 Extinguishing media

- APPLICABLE EXTINGUISHING MEDIA** : Powder fire extinguisher, carbon dioxide or foam.
- UNSUITABLE EXTINGUISHING MEDIA** : Direct water jets.  
 Use of water and foam combined.

##### 5.2 Special hazards arising from the substance or mixture

Heat increasing cause an increase of pressure into the drums: they can get deformed and, in severe conditions, can explode.  
 The best anti-fire practice is to let the released gas burn, if it is not possible immediately to intercept the gas flow. Pay attention to possible explosive re-ignitions of the fired gas.  
 Use jet of water for cooling fire-exposed tanks, cylinders, buildings and machineries.  
 The gas is heavier than air and flammable or explosive mixtures of steam/air may occur. Protect from sources of ignition/firing.

##### SPECIFIC RISKS DERIVED FROM THE EXPOSITION

Combustion products are: COx and hydrocarbons partially unburned where their exposure can give severe risks for health.

**KRYON® 290**

**5.3 Advice for firefighters**

The special equipment for firefighter operators must include fire retardant clothing, helmets, visors, gloves and in severe conditions breathing apparatus. See reference to norms UNI EN 145 and UNI EN 372.  
 Protect with jet of water all people working at fire extinguishment.  
 Use jet of water for cooling fire-exposed tanks, cylinders, buildings and machineries.  
 Limited fire may be extinguished by the recommended fire extinguisher. Before entering in the contaminated area, check by the explosimeter the gas concentration that must be lower than 10% of LEL (the lower explosiveness limit of the substance is 2.4%)  
 For massive fires in large areas, keep under control using jet fractioned water launches, in upwind position, when it is not possible to intercept the gas flow. Disperse possible gas clouds using nebulized water or fractioned water jets.

**SECTION 6 ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Inform the emergency team.  
 Evacuate the risk area.  
 Remove ignition sources and if possible, without risk, stop the flow gas at the origin. Assure the correct grounding of all devices. Leakage of liquid produces a huge quantity of flammable vapours, heavier than the air, which may propagate up to ignition source far away (i.e. sewer, drainage channels, watercourses...)  
 The use of specific sensors are recommended to detect flammable gas or vapours.  
 Use nebulized water jets to dissipate gas or vapors, when possible.  
 Pay attention to symptoms of fatigue or dizziness. Anyway it is possible to get exposure to dangerous gas concentrations without any meaning symptom.  
 Electrostatic charges may cause gas explosion in case of liquid leakages.  
 Personal protective equipment is requested for all operators. Skin and eyes must be protected.  
 Storage far away from flames and sparkles. Do not smoke. Provide appropriate ventilation of environment and ground.  
 If required, communicate the event to the competent authorities in accordance with governmental/local regulations

**6.2 Environmental precautions**

Provide for warnings to all persons situated in downwind areas concerning fire and explosion hazards and if necessary foresee the evacuation. Avoid that the gas enter in discharge or ventilation channels (explosion risk). Safety electrical equipment must be only used. Keep away from ignition sources. Do not smoke. Provide for a good ventilation and let the evaporate the substance, for a better dispersion.  
 Note that vapours are heavier than the air.  
 Inform the competent Authorities according to the local regulations and (if available) according to the external emergency plan

**6.3 Methods and material for containment and cleaning up**

Provide good ventilation and allow product to evaporate, encouraging the dispersion and if necessary, wash with water and/or suitable detergent, avoiding use of solvents.  
 The substance is completely dispersed in the atmosphere

**6.4 Reference to other sections**

For all individual safety/protection devices, see section 8.

**SECTION 7 HANDLING AND STORAGE****7.1 Precautions for safe handling**

Follow all procedures for the proper storage/handling of flammable substances and all the instructions required for the gas under pressure.  
 Apply all necessary measures to prevent the accumulation of electrostatic charges.  
 The substance tends to form explosive mixtures with air and vapours, heavier, tend to spread along the ground to accumulate in confined areas. Keep away from heat/sparks/open flames/hot surfaces. No smoking. Use anti-sparking tools. Work in well ventilated places.  
 Do not disperse in the environment.  
 During transfer operations, mixing and storage, care for the proper grounding of equipment and implement all necessary measures to prevent the accumulation of electrostatic charges.

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use compressed air during loading and unloading operations. Avoid sucking of water/moisture. The whole operating system (tanks, pipes, equipments...) should be specific for the operation to be performed and provided with security systems/devices to be tested periodically in accordance with current regulations. Include the use of valves or similar devices to prevent backflow. Use appropriate labeling to allow easy identification of the contents of the piping (refer to norm UNI 5634). Wear personal protective equipment, avoiding the use of synthetic fabric clothing. Avoid contact with skin. Do not eat, drink or smoke while using the substance. Wash hands thoroughly after handling. Do not re-use contaminated clothing

#### 7.2 Conditions for safe storage, including any incompatibilities

Do not operate or store near sources of ignition. The equipment and electrical systems must be adequate to safety, and in accordance with current legislation. Store the product in a cool dry place, away from heat sources and away from sunlight. Keep away from sources of ignition. No smoking. Keep away from oxidizing agents, strong acid or alkaline products. Containers must meet the requirements of the standards for pressure equipments. The mobile recipients must comply with all requirements of the ADR. Store cylinders in dry, well-ventilated area away from heat sources and direct sunlight, and flammable materials. Handle cylinders with a suitable means avoiding that they could collide each other. Keep cylinders upright and drums in horizontal position firmly secured and with the protection of the valve mounted. Do not drag or roll cylinders and protect them against possible crashes. Keep separated the filled cylinders from the empty. If case of doubts, contact the supplier of the substance.

Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Check the system with leak detection solution, never with flame. If possible, turn leaking containers so that gas escapes rather than liquid. Have appropriate extinguishing equipment in the storage area (i.e. sprinkler system, portable fire extinguishers). After use, close the main valve of the cylinder, replace valve protection cap. Mark card duly filled, drained, where appropriate, with inert gas (ex. nitrogen).

All inspection, cleaning, checking, maintenance operations, must be performed by qualified personnel using appropriate personal protective equipment and draining with an inert gas (eg. nitrogen) all areas where they have to operate. Evaluate through appropriate instruments oxygen content and the degree of flammability. Keep away from heat/sparks/open flames/hot surfaces and observe the recommendations for storage combined.

Temperature class of materials: T2  
 Suitable materials for the work structures: mild steel.

#### 7.3 Specific end use(s)

See section 1.2.

### SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

#### 8.1 Control Parameters

It is suggested to work in conditions of natural or explosion-proof mechanical ventilation to make sure that the substance does not exceed 25% of the LEL (lower explosion limit in air 2.4%). The concentrations of hazardous occupational inhalation, in addition to which it is foreseeable harm from exposure, are supplied from the tables ACGIH TLV 2010 as follows:  
 TLV TWA concentration weighted average of 8 hours per working day (chronic exposure), to which nearly all workers may be repeatedly exposed day after day without adverse effects:  
 1000 ppm (1800 mg/m<sup>3</sup>).

ACGIH also recommends that the exposure limit values of biologically inert particles without a TLV value is kept below 3 mg/m<sup>3</sup> for breathable particles, below 10 mg / m<sup>3</sup> for inhaled.  
 For the conditions of monitoring/control, it is suggested to refer to the in force legislation.

**DNEL (DERIVED NO-EFFECT LEVEL) AND DMEL (DERIVED MINIMUM EFFECT LEVEL):**  
 Not derived because the substance does not contain components harmful to health  
 It is suggested to follow the values according to the exposure limits listed above for all applications.

**PNEC(S) VALUES (PREDICTED NO-EFFECT CONCENTRATION):**

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### PNEC VALUES IN WATER (CONTINUOUS RELEASE):

Not derived as the substance does not contain environmentally hazardous compounds.

### PNEC VALUES IN WATER (INTERMITTENT RELEASE)

Not derived as the substance does not contain environmentally hazardous compounds.

### PNEC VALUE FOR SOIL:

Not derived as the substance does not contain environmentally hazardous compounds.

### PNEC VALUES FOR SEDIMENTATION:

Not derived as the substance does not contain environmentally hazardous compounds.

### PNEC VALUES IN SEWAGE TREATMENT PLANTS:

Not derived as the substance does not contain environmentally hazardous compounds.

## 8.2

### Exposure Controls

Current legislation requires that all chemicals should be taken into consideration for their health risks and as consequence provide appropriate control measures to prevent or reduce exposure control. All this involves a series of control operations (substitution, general ventilation, containment, work methods, changes in process or activity) that must be considered before the use of personal protective equipment Any personal protective equipment should be conform to specific standards or regulations, appropriate for the use, compatible with the substance to be handled and kept in good condition.

#### INDIVIDUAL PROTECTION MEASURES

##### EYES/FACE PROTECTION

Use shielding glasses, visor or face shield to protect against liquid splittings.

Make reference to UNI EN 166. There must be a device to wash eyes with water .



##### SKIN PROTECTION

Hand: In case of possible contact with the skin, use gloves made of leather/crust (i.e. characterized by neoprene, PVA, nitrile), heat resistant/thermo insulating for any emergency. Wear gloves after thorough hand washing. Gloves should be replaced at the first sign of wear. The choice of protective gloves depends on the conditions of use, and must take account of the manufacturer's instructions and knowledge on the part of the operator regarding its own allergies. Make reference to UNI EN 374.



Other: Use suitable work clothing material, antistatic complete documents to cover also the upper and lower limbs. Change immediately in case of contamination, if conditions permit, and wash before reuse. Keep good personal hygiene practices and take care of clothing. Change work clothes at the first sign of wear. Make reference to UNI EN 465, EN 466, EN 467.



In confined areas it is suggested to use the respirators with AX filter (brown for vapours and organic gases); in case of high concentrations of gases and vapours use breathing apparatus (UNI EN 529)



##### THERMIC DANGERS

See the section "Skin protection"

##### ENVIRONMENTAL EXPOSURE CONTROLS

There's no further information. Also refer to Section 6.



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**SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES**

**9.1 Information on basic physical and chemical properties**

Appearance	: Liquefied Gas under pressure
Color	: Clear
Odour	: Characteristic
Odour threshold	: Not determined
pH	: Not applicable
Melting point /freezing point	: -188°C
Initial boiling point and boiling range	: -42.1°C
Flash point	: -104°C
Evaporation rate	: Not applicable. The substance is extremely volatile at room temperature
Flammability (solid, gas)	: Not applicable. The substance is extremely volatile at room temperature
Upper/lower flammability or explosive limits	: Lower 2.4% Upper 9.5%
Vapour pressure	: 7.3 bar g at 20°C
Vapour density at 20°C	: 0.508 Kg/L (liquid) 1.815 kg/m <sup>3</sup> (vapour)
Relative density (aria=1)	: More than 1
Solubility(ies)	: < 0.1 g/L at 20°C
Partition coefficient: n-octanol/water (log Pow)	: 2.35
Auto-ignition temperature	: 490°C
Decomposition temperature	: Not applicable
Viscosity	: 11x10 <sup>-5</sup> Pa x s at 15°C (liquid phase)
Explosive properties	: Not classified explosive under normal conditions of use
Oxidising properties	: Not classified explosive under normal conditions of use

**9.2 Other Information**

Suitability materials	: Dissolve fats and attacks natural rubber. Compatible with metallic materials
VOC content (CE)	: 100 %

**SECTION 10 STABILITY AND REACTIVITY**

<b>10.1 Reactivity</b>	: The substance is stable under normal operating conditions of work, and when used for its intended uses.
<b>10.2 Chemical Stability</b>	: This substance is stable in relation to its physical and chemical properties under normal operating conditions of work, and when used for its intended uses.
<b>10.3 Possibility of Hazardous Reactions</b>	: The substance is stable under normal operating conditions of work, and when used for its intended uses. Contact with strong oxidizers (peroxides, chromates, chlorates, perchlorates ...) or other substances (nitrates, liquid oxygen, fluorine...) can form explosive mixtures with air and can cause a fire hazard under particular conditions (sources of ignition). The presence of strong acids or alkalis can cause corrosion of the containers with the consequent leakage of the substance.
<b>10.4 Conditions to Avoid</b>	: Avoid the heat of the product and its containers. Avoid rapid decompression of the containers. Avoid spills and leakages. Avoid the accumulation of the substance in confined spaces. Keep away from strong

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oxidizing agents, strong acids or alkalis. Keep away from heat/sparks/open flames/hot surfaces. No smoking. Avoid the accumulation of electric charges.  
 Avoid shocks, falls, friction conditions of the containers with the consequent formation of friction and/or sparks.  
 Avoid exposure of containers at high temperatures or direct sunlight (above 50° C).

- 10.5 Incompatible Materials** : Strong oxidising agents. Strong acids and alkalis.
- 10.6 Hazardous decomposition products** : The substance is stable under normal operating conditions of work and do not decompose when used for its intended uses. In case of fire and explosion of the container it is possible the formation of not completely combusted organic compounds such as carbon monoxide.

## SECTION 11 TOXICOLOGICAL INFORMATION

**11.1 Information on Toxicological Effects**

Literature data concerning toxicological studies on short-chain alkanes (C1-C4), point out that they are poorly absorbed because they are as vapor phase at room temperature. If the exposure implies an absorption (as in higher concentrations), it would not be particularly relevant: there is little evidence of metabolism, because if this substance were absorbed, normally would be rapidly exhaled.

In addition, on the base of conducted studies, it would appear that the absorption increase with the increasing of molecular weight.

Un-branched molecules would be more easily absorbed than branched and aromatic molecules would be more easily absorbed than paraffin.

The main toxicological studies were carried out on rats.

## ACUTE TOXICITY

At room temperature and atmospheric pressure, it is a clear odorless gas.

Therefore, the information concerning the acute oral and inhalation are not particularly relevant.

## ACUTE TOXICITY - ORAL

In accordance with point 2 of Annex XI of EC Regulation No. 1907/2006 (REACH), such testing may be omitted, as the substance is present in a gas phase at room temperature and atmospheric pressure. Extremely volatile and flammable at room temperature, it tends to form explosive mixtures with air. A high risk of fire or explosion would be associated with any significant concentrations test.

## ACUTE TOXICITY - INHALATION

LC50 rat [inhalation]: 658 mg/L 4 h (literature value)

Without prior mark - related to substance: butane

## Main studies for propane:

LC50 rat (male/female) [15 minutes]: 800000 ppm

LC50 rat (male/female) [15 minutes]: 14442738 mg/m<sup>3</sup>

LC50 rat (male/female) [15 minutes]: 1443 mg/L

[Source: Clark DG and Tiston DJ (1982)]

Vapours may cause narcotic effects.

High concentrations in the inhaled air can lead to unconsciousness and asphyxiation due to lack of oxygen.

## ACUTE TOXICITY - SKIN

In accordance with point 2 of Annex XI of EC Regulation No. 1907/2006 (REACH), such testing may be omitted, as the substance is present in a gas phase at room temperature and atmospheric pressure. Extremely volatile and flammable at room temperature, it tends to form explosive mixtures with air. A high risk of fire or explosion would be associated with any significant concentrations test.

## SKIN CORROSION/IRRITATION

In accordance with point 2 of Annex XI of EC Regulation No. 1907/2006 (REACH), such testing may be omitted, as the substance is present in a gas phase at room temperature and atmospheric pressure. Extremely volatile and flammable at

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room temperature, it tends to form explosive mixtures with air. A high risk of fire or explosion would be associated with any significant concentrations test. Literature data regarding dose-response studies in humans have shown that propane and butane are not irritant and corrosive for skin and mucous membranes. Contact with the liquefied gas can produce frostbite.

**SERIOUS EYE DAMAGE/SERIOUS EYE IRRITATION**

In accordance with point 2 of Annex XI of EC Regulation No. 1907/2006 (REACH), such testing may be omitted as the substance is present in a gas phase at room temperature and atmospheric pressure. Extremely volatile and flammable at room temperature, it tends to form explosive mixtures with air. A high risk of fire or explosion would be associated with any significant concentrations test. Contact with the liquefied gas can produce frostbite.

**SKIN OR RESPIRATORY SENSITIZATION**

**RESPIRATORY SENSITIZATION**

From available data, the substance is not classified as sensitizing. In inhaled acute/repeated toxicity test made on rats, no adverse effects was observed in the respiratory tract that could justify any classification as irritant to the respiratory route.

**SKIN SENSITIZATION**

In accordance with point 2 of Annex XI of EC Regulation No. 1907/2006 (REACH), such testing may be omitted, as the substance is present in a gaseous state at room temperature and atmospheric pressure. Extremely volatile and flammable at room temperature, it tends to form explosive mixtures with air. A high risk of fire or explosion would be associated with significant concentrations in any test. Contact with the liquefied gas can produce frostbite.

**GERM CELL MUTAGENICITY**

From in vitro and animal experiments, there is not evidence of genotoxicity. In addition, the substance may contain impurities such as 1,3-butadiene at concentrations of less than 0.1% and therefore is not classified as mutagenic according to the legislation on dangerous substances.

Genetic toxicity in vitro - Main studies for propane

Ames test in Salmonella typhimurium [OECD 471]

No evidence of mutagenic action

Metabolic activation: with or without

Method: Mutagenicity (Salmonella typhimurium - reverse mutation test)

[Source: WC Thomas and CJ Kirwin (1980)]

**CARGINOGENITY**

No evidence of carcinogenicity. At the present state of knowledge, the results of tests for mutagenicity and toxicity with repeated administration, no carcinogenic effect should be expected. In addition, the substance may contain impurities such as 1,3-butadiene at concentrations lower than 0.1% and therefore is not classified as a carcinogen under the legislation on dangerous substances.

**REPRODUCTIVE TOXICITY**

Literature data have shown no consistent evidence of toxicity to fertility and therefore the substance is not classified as toxic for reproduction according to the legislation on dangerous substances.

Screening for toxicity inherent the reproduction/growth

Inhalation rat (male/female)

Number of exposure: daily

NOAEL (No Observed Adverse Effect Level) parents: 21,641 mg/L

NOAEL F1: 21,641 mg / L

Method: OECD TG 422

In animal studies (OCSE 422, research screening) there were no evidence of damaging effects on the fetus

**GROWTH TOXICITY/TERATOGENICITY**

Literature data have shown no consistent evidence of growth toxicity/teratogenicity: the main impurities of the substance shall ensure that it is not classified as toxic to reproduction according to the legislation on dangerous substances.

Inhalation rat (male/female)

Number of exposure: daily

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NOAEL (No Observed Adverse Effect Level) parents: 21,641 mg/L  
 NOAEL maternal: 21,641 mg/L  
 Method: OECD TG 422  
 In animal studies (OCSE 422, research screening) there were no evidence of damaging effects on growth.

**SPECIFIC TARGET ORGAN TOXICITY (STOT) - SINGLE EXPOSURE**  
 No information is available

**SPECIFIC TARGET ORGAN TOXICITY (STOT) - REPEATED EXPOSURE**

**Oral**

In accordance with point 2 of Annex XI of EC Regulation No. 1907/2006 (REACH), such testing may be omitted, as the substance is present in a gaseous state at room temperature and atmospheric pressure. Extremely volatile and flammable at room temperature, it tends to form explosive mixtures with air. A high risk of fire or explosion would be associated with significant concentrations in any test.

**Skin**

In accordance with point 2 of Annex XI of EC Regulation No. 1907/2006 (REACH), such testing may be omitted, as the substance is present in a gaseous state at room temperature and atmospheric pressure. Extremely volatile and flammable at room temperature, it tends to form explosive mixtures with air. A high risk of fire or explosion would be associated with significant concentrations in any test.

**Inhalation**

From studies conducted for a period of 6 weeks on male and female rats, were not observed neurological, hematological, or clinical effects. At doses of 12,000 ppm male animals showed a 25% decrease in weight during the first week of exposure.

The lowest concentration at which adverse effects were observed (LOAEC) in this study is 12,000 ppm (equivalent to 21,641 mg/m<sup>3</sup>).

**DANGERS IN CASE OF ASPIRATION**

Not applicable. The substance at room temperature and atmospheric pressure, is a colorless gas.

**OTHER INFORMATION**

Under normal operating conditions the substance can be safely used as above mentioned. However, the deliberate abuse of high concentrations of vapors, even for short periods, may result in unconsciousness state or be fatal. No specific information on neurotoxicity test is available.

## SECTION 12 ECOLOGICAL INFORMATION

### 12.1 Toxicity

At present situation data on aquatic toxicity have shown no toxic phenomena from the environmental and ecological point of view and were not derived PNEC(S) for fresh waters, sea waters, sediments and soils. At room temperature and atmospheric pressure, the substance is gaseous, colorless and odorless, very volatile and practically insoluble in water: in accordance with column 2 of Annexes VII and VIII of the REACH Regulation, the acute toxicity tests (acute toxicity for the aquatic environment, chronic toxicity for the aquatic environment, toxicity on the ground) can't be performed if exist the conditions to indicate that the aquatic toxicity is unlikely.

Regarding the influence on the treatment of waste waters, there are no specific actions to be performed because the substance occurs at room temperature and atmospheric pressure, in the gaseous state, which is extremely volatile and practically insoluble in water.

**TOXICITY FOR FISHES**

According to the chemical and physical properties of the substance above mentioned, literature data have shown no toxicity phenomena, unlikely due to its volatility.

**TOXICITY FOR DAPHNIA**

According to the chemical and physical properties of the substance above mentioned, literature data have shown no toxicity phenomena, unlikely due to its volatility.

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**SECTION 1 IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING**

**1.1 Product Identifier**

Commercial name	: Kryon® 290: liquefied hydrocarbons to different degree of purity
Chemical family	: hydrocarbons - alkanes
Other names	: n-Propane; GPL; Liquefied Petroleum Gas; Hydrocarbon propellant; R 290; Dimethylmetane; UN 1978
Chemical formula	: CH <sub>3</sub> CH <sub>2</sub> CH <sub>3</sub> ; C <sub>3</sub> H <sub>8</sub>

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Uses	: Refrigerant, technical and industrial uses
Uses advised against	: intentional abuse of very high concentration of vapours, even for short periods, can produce unconsciousness or might prove fatal.

**1.3 Details of the supplier of the safety data sheet**

Company Name	: General Gas S.r.l. Via Aosta, 5 – Cernusco sul Naviglio – 20063 MILANO
Phone Number	☎ +39 02 92141835 📠 +39 02 92141841
Emergency telephone number	+39 335 5644288
E-Mail	✉ <a href="mailto:m.migliaccio@gas-tec.it">m.migliaccio@gas-tec.it</a>

**SECTION 2 HAZARDS IDENTIFICATION**

**2.1 Classification of the substance or mixture**

Classification according to Regulation CE n°1272/2008 , att. VI  
 Flammable gas Class 1 H220 (Extremely Flammable Gases)  
 Gas under pressure Liquefied Gas H280 (Contains gas under pressure; may explode if heated)

**2.2 Label elements**

Labelling according to Reg. CE n°1272/2008 , att. VI  
 Hazard pictograms



Hazard pictogram code  
 GHS02      GHS04

Signal word  
 Danger (for both)  
 Hazard statement

H220 Extremely Flammable Gas  
 H280 Contains gas under pressure; may explode if heated.  
 Further information: Notes H, K, U.

**GENERAL STATEMENT RECOMMENDATIONS**

P102 Keep out of reach of children.

**PRECAUTIONARY STATEMENT PREVENTION**

P210 Keep away from heat/sparks/open flames/hot surfaces. No smoking

P260 Do not breathe dust/fume/gas/mist/vapours/spray

**PRECAUTIONARY STATEMENT RESPONSE**

P377 Leaking gas fire: do not extinguish, unless leak can be stopped safely

P381 Eliminate all ignition sources if safe to do so

P305 + P351 + P338 IF IN EYES: Rinse cautiously with water with several minutes. Remove contact lenses. If present and easy to do. Continue rinsing.

P337 + P313 If eye irritation persists: get medical advice/attention

**PRECAUTIONARY STATEMENT STORAGE**


P410 + P412 Protect from sunlight. Do not expose to temperature exceeding 50°C/122°F.

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**SECTION 13 DISPOSAL CONSIDERATIONS**

- 13.1 Waste Treatment Methods** :
- Follow all in force applicable local laws.  
 The gas should be disposed of with appropriate devices (torches) equipped with not backfire systems.  
 Avoid the formation of explosive mixtures with air: do not discharge into areas where its accumulation could be dangerous.  
 For this product it is no possible assign a specific code number of the waste by the user (producer of the waste) that has the responsibility to choose the most appropriate code based on actual use of the product and any alterations and contaminations (Ref. Directive 2001/118/EC).  
 The code number of the waste must be decided in accordance with the European Waste List (Decision on EU waste 200/532/CE index) in accordance with specific companies for the disposal factories/producers/National Authorities.  
 Regarding the containers, there is no disposal problem as they are normally rechargeable.  
 In case of emergency disposal, burn the contents with appropriate safety precautions under a supervision of a qualified technician and observing local regulations. No longer reusable containers must be drained with water or inert gas.
- To dispose of empty containers and/or full:  
 Code for the empty package: CER 15.01.04  
 Code for the full package: CER 15.01.10  
 Refer to authorized Bodies for waste disposal or for the packaging regeneration.  
 Don't make any kind of physical operation (drilling, cutting, burning ...) on containers that aren't drained.  
 Contact supplier in case of further information.

**SECTION 14 TRANSPORT INFORMATION**

- 14.1 UN Number**  
 1978  
 Pictogram ADR/RID, IMDG, IATA
- 
- 2.1: Flammable gas
- 14.2 UN Proper Shipping Name**  
 Propane, 2.1, (B/D)
- 14.3 Transport Hazard Class(es)**  
 ROAD/RAIL TRANSPORT (ADR/RID)  
 Class 2  
 Classification code 2F : Hazard label 2.1  
 Hazard identification number 23  
 Tunnel restriction code (ADR)  
 B / D: Transit prohibited in tunnels of category B and C for transport in tankers.  
 Transit forbidden through tunnels of category D and E.  
 Description of goods (technical name) Propane, 2.1, (B/D)  
 SHIPPING (IMDG)  
 Class 2.1  
 EMS F-D, S-U : Marine pollutant No  
 Description of goods (technical name) Propane, 2.1, (B/D)  
 AIR TRANSPORT (ICAO/IATA)  
 Class 2.1  
 Not be carried on passenger flights. Cargo aircraft only: permission. ERG-Code 10L  
 Description of goods (technical name) Propane, 2.1, (B/D)

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**14.4 Packaging Group**

ROAD/RAIL TRANSPORT (ADR/RID)  
 Packaging Instructions - General: P200  
 SHIPPING (IMDG) PACKING GROUP IMO  
 Packaging Instructions: P200  
 AIR TRANSPORT (ICAO/IATA)  
 Packaging Instructions: 200

**14.5 Environmental Hazards**

The substance is not classified as dangerous in accordance with the dispositions ADR, RID IMDG, ICAO/IATA.  
 Emergency Schedule (EmS) - Fire : F-D  
 Emergency Schedule (EmS) - Spillage: S-U- Instructions  
 Marine pollutant: No  
 Packaging Instructions:: 200

**14.6 Special Precautions for User**

The packages must not be transported in the same place where is present the driver of vehicles.  
 The cylinders must be kept upright and the drums kept in horizontal position and carried only in a safe position, preferably on a vehicle in a well ventilated or open trucks.  
 Avoid transport on vehicles where the load space is not separated from the place where is present the driver.  
 Make sure the driver is informed of the potential hazards of the load and he knows what to do in case of accident or emergency.  
 Before to start a transport:  
 - Be assured that containers are firmly secured.  
 - Be assured that the cylinder valves are closed and that loss will not occur.  
 - Be assured that the valve protection device, where provided, is properly mounted.  
 - Be assured for an adequate ventilation.  
 - Compliance with applicable regulations.

**14.7 Transport in Bulk according to Annex II of MARPOL73/78 and the IBC Code**

For the in bulk transports, follow the MARPOL 73/78 Annex II and IBC Code where applicable.

**SECTION 15 REGULATORY INFORMATIONS****15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**

Authorization under REACH (Regulation EC 1907/2006 and subsequent amendments):  
 the substance is not in the list of substances of very high concern (SVHC) candidate authorization.  
 Regulation EC 1272/2008 and subsequent amendments (CLP/GHS)

## OTHER EU DIRECTIVES:

Category Seveso (Directive 96/82/EC and Dir 105/2003/CE and subsequent amendments) of Annex I Part 1.  
 Dangerous Chemical Agent (Directive 98/24/EC) and subsequent amendments

## MAIN BIBLIOGRAPHY

ADR 2011 European Agreement on the transport of dangerous goods by road  
 AGCIH 2009 American Conference of Governmental Industrial Hygienists  
 European Chemical Substances Information System ESIS - IUCLID Dataset  
 IATA / ICAO 2008 International Air Transport Association - International Civil Aviation Organisation  
 2008 IMDG International Maritime Dangerous Goods Code  
 NIOSH National Institute for Occupational Health and Safety - Registry of Toxic Effects of Chemical Substances  
 QSAR: Quantitative Structure Activity Relationship  
 IUCLID International Uniform Chemical Information Database.

**15.2 Chemical Safety Assessments**

Assessment was performed on Chemical Safety  
 All information contained in sections 11 and 12 are extracted from IUCLID database.

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SECTION 16 OTHER INFORMATION

Texts of danger phrases warnings

H220: Extremely flammable gas

H280 Contains gas under pressure; may explode if heated

Dangers that may arise for the improper use are mainly those relating to a fire or explosion or asphyxiation in the event of not fired leakages in confined areas.

It is absolutely necessary that all operators and users of LPG are well informed and trained on the precautions to be taken for the safe handling and use.

Workers must be trained according to their specific duties according to relevant laws.

Formation and training of workers on chemical agents should be conducted according to Directive 98/24/EC.

KEY TO ACRONYMS

CSR = Chemical Safety Report

DNEL = Derived no-effect level

DMEL = Derived Minimum effect levels

EC50 = Median effective concentration

IC50 = Inhibitory concentration, 50%

LC50 = Lethal concentration, 50%

LD50 = Median lethal dose

PNEC = Predicted no effect environmental concentration

PBT = Persistent, bio accumulative and toxic

CNS = Central nervous system

STOT = Specific target organ toxicity

(STOT) RE = Specific target organ toxicity Repeated

(STOT) SE = Specific target organ toxicity Single exposure

TLV® TWA = Threshold Limit Value-Time Weighted Average

STEL TLV® = Threshold Limit Value-limit for a short time of exposure

vPvB = Very persistent and very bio accumulative

**Note H (Table 3.1):**

The classification and label shown for this substance applies to the hazard or hazards indicated by the hazard statement or hazard statements in combination with the hazard classification shown. The requirements of Article 4 of Regulation (EC) No 1272/2008 on supplier of this substance apply to all other hazard classes, differentiations and categories. The final label shall follow the requirements of section 1.2 of Annex I to Regulation (EC) No 1272/2008

**Note K:**

The classification as a carcinogen or mutagen need not apply if it can be shown that the substance contains less than 0.1% w/w 1,3 butadiene (EINECS No 203-450-8). If the substance is not classified as a carcinogen or mutagen, at least the precautionary statements (P102-) P210-P403 should apply. This note applies only to certain complex oil-derived substances in Part 3 of the Annex VI to Regulation (EC) No 1272/2008

**Note U (Table 3.1):**

When put on the market gases have to be classified as 'Gases under pressure', in one of the groups compressed gas, liquefied gas, refrigerated liquefied gas or dissolved gas. The group depends on the physical state in which the gas is packaged and therefore has to be assigned case by case.

Revision Date: 29.11.2016

The revision became necessary following the application of the EC Regulation 1907/2006 (REACH) and subsequent changes incorporated as amended Annex II of EU Regulation 453/2010 and in accordance with EC Regulation 1272/2008 (CLP).

The sixteen paragraphs have all been changed.



## KRYON® 290

This Safety Data Sheet has been compiled in accordance with the applicable European Directives and is applicable to all countries that have translated the Directives within their national legislation. The information contained in this sheet is based on the knowledge available to us at the date of the last version. The user must ensure the suitability and completeness of the information in relation to the specific use of the product. You should not interpret this document as a guarantee for any specific property of the product. Because the use of the product does not fall under our direct control, it is the user's duty to observe the laws and regulations in force regarding hygiene and safety under its own responsibility. They are not responsible for improper use.

**End of document.**



# SAFETY DATA SHEET

According to Regulation (EC) No. 1907/2006 (REACH) Article 31, Annex II as amended.

## SECTION 1: Identification of the substance/mixture and of the company/undertaking

### 1.1 Product identifier

**Product name:** FRASCOLD® 150PAG

### 1.2 Relevant identified uses of the substance or mixture and uses advised against

**Identified uses:** Refrigeration Compressors only

### 1.3 Details of the supplier of the safety data sheet

#### Supplier

**Company Name:** FRASCOLD SPA  
**Address:** Via Barbara Melzi, 103/105  
20027 RESCALDINA (MI) Italy

**Telephone:** (39) 0331-742201  
**E-mail contact:** Frascold@Frascold.it

### 1.4 Emergency telephone number:

FOR TRANSPORT EMERGENCY CALL CHEMTREC (+1) 703 527 3887 (LUBRIZOL)

## SECTION 2: Hazards identification

### 2.1 Classification of the substance or mixture

The product has been classified according to the legislation in force.

#### Classification according to Regulation (EC) No 1272/2008 as amended.

Chronic hazards to the aquatic environment      Category 3      H412: Harmful to aquatic life with long lasting effects.

The full text for all H-phrases is displayed in section 16.

### 2.2 Label elements according to Regulation (EC) No 1272/2008 as amended

**Signal Words:** not applicable

**Hazard Statement(s):** H412: Harmful to aquatic life with long lasting effects.

#### Precautionary Statement

**Disposal:** P501: Dispose of contents/container to an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product characteristics at time of disposal.

#### Supplemental label information

EUH208: Contains:  
N-1-naphthylaniline  
May produce an allergic reaction.

### 2.3 Other hazards:

None identified.

## SECTION 3: Composition/information on ingredients

SDS\_GB-FRASCOLD® 150PAG

## 3.2 Mixtures

## Regulation No. 1272/2008.

Chemical name	Concentration	EC No.	REACH Registration No.	M-Factor:	Notes
N-1-naphthylaniline	0.25 - 1%	201-983-0			

600, 700 and 900 ECHA List Numbers do not have any legal significance; rather they are purely technical identifiers and are displayed for informational purposes only.

## Classification Regulation No. 1272/2008.

Chemical name	Classification	Notes
N-1-naphthylaniline	STOT RE 2; H373 Skin Sens. 1B; H317 Acute Tox. 4; H302 Aquatic Acute 1; H400 Aquatic Chronic 1; H410	

The full text for all H-phrases is displayed in section 16.

See Section 15 for Regulation (EC) No. 1907/2006 REACH Article 59(1), Candidate List (Substances of Very High Concern (SVHC))

<b>SECTION 4: First aid measures</b>
--------------------------------------

## 4.1 Description of first aid measures

- Inhalation:** Remove exposed person to fresh air if adverse effects are observed.
- Eye contact:** Any material that contacts the eye should be washed out immediately with water. If easy to do, remove contact lenses.
- Skin Contact:** Wash skin thoroughly with soap and water. If skin irritation or rash occurs: Get medical attention. Launder contaminated clothing before reuse.
- Ingestion:** Call a POISON CENTER/doctor/.../if you feel unwell.

**4.2 Most important symptoms and effects, both acute and delayed:** See section 11.

## 4.3 Indication of any immediate medical attention and special treatment needed

- Hazards:** No data available.
- Treatment:** Treat symptomatically.

<b>SECTION 5: Firefighting measures</b>
-----------------------------------------

**General Fire Hazards:** No unusual fire or explosion hazards noted.

## 5.1 Extinguishing media

**Suitable extinguishing media:** CO<sub>2</sub>, dry chemical, foam, water spray, water fog.

**Unsuitable extinguishing media:** Not determined.

**5.2 Special hazards arising from the substance or mixture:** See section 10 for additional information.

## 5.3 Advice for firefighters

**Special fire fighting procedures:** No data available.

**Special protective equipment for fire-fighters:** Recommend wearing self-contained breathing apparatus.

#### SECTION 6: Accidental release measures

- 6.1 Personal precautions, protective equipment and emergency procedures:** Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Keep unauthorized personnel away. See Section 8 of the SDS for Personal Protective Equipment.
- 6.2 Environmental Precautions:** Avoid release to the environment. Do not contaminate water sources or sewer. Prevent further leakage or spillage if safe to do so.
- 6.3 Methods and material for containment and cleaning up:** Dike far ahead of larger spill for later recovery and disposal. Pick up free liquid for recycle and/or disposal. Residual liquid can be absorbed on inert material.
- 6.4 Reference to other sections:** See sections 8 and 13 for additional information.

#### SECTION 7: Handling and storage:

- 7.1 Precautions for safe handling:** Avoid breathing dust/fume/gas/mist/vapors/spray. Avoid contact with eyes, skin, and clothing. Observe good industrial hygiene practices. Provide adequate ventilation. Wear appropriate personal protective equipment. Wash hands thoroughly after handling. Contaminated work clothing should not be allowed out of the workplace. Launder contaminated clothing before reuse. Avoid environmental contamination.
- Maximum Handling Temperature:** Not determined.
- 7.2 Conditions for safe storage, including any incompatibilities:** Store away from incompatible materials. See section 10 for incompatible materials.
- Maximum Storage Temperature:** Not determined.
- 7.3 Specific end use(s):** End uses are listed in an attached exposure scenario when one is required.

#### SECTION 8: Exposure controls/personal protection

##### 8.1 Control Parameters

###### Occupational Exposure Limits

None of the components have assigned exposure limits.

##### 8.2 Exposure controls

###### Appropriate engineering controls:

No special requirements under ordinary conditions of use and with adequate ventilation.

###### Individual protection measures, such as personal protective equipment

###### General information:

Use personal protective equipment as required.

###### Eye/face protection:

If contact is likely, safety glasses with side shields are recommended.

**Skin protection**

<b>Hand Protection:</b>	Suitable gloves can be recommended by the glove supplier.
<b>Other:</b>	Gloves, coveralls, apron, boots as necessary to minimize contact. Do not wear rings, watches or similar apparel that could entrap the material.
<b>Respiratory Protection:</b>	Consult with an industrial hygienist to determine the appropriate respiratory protection for your specific use of this material. A respiratory protection program compliant with all applicable regulations must be followed whenever workplace conditions require the use of a respirator.
<b>Hygiene measures:</b>	Observe good industrial hygiene practices. Avoid contact with skin. Contaminated work clothing should not be allowed out of the workplace.
<b>Environmental Controls:</b>	No data available. See section 6 for details.

<b>SECTION 9: Physical and chemical properties</b>
----------------------------------------------------

**9.1 Information on basic physical and chemical properties****Appearance**

<b>Physical state:</b>	liquid
<b>Form:</b>	liquid
<b>Color:</b>	Colorless to yellow
<b>Odor:</b>	Mild
<b>Odor Threshold:</b>	No data available.
<b>pH:</b>	No data available.
<b>Freezing point:</b>	No data available.
<b>Boiling Point:</b>	No data available.
<b>Flash Point:</b>	260 °C (Cleveland Open Cup)
<b>Evaporation Rate:</b>	No data available.
<b>Flammability (solid, gas):</b>	No data available.
<b>Upper/lower limit on flammability or explosive limits</b>	
<b>Flammability Limit - Upper (%):</b>	No data available.
<b>Flammability Limit - Lower (%):</b>	No data available.
<b>Vapor pressure:</b>	No data available.
<b>Vapor density (air=1):</b>	No data available.
<b>Relative density:</b>	0.995 (15.6 °C)
<b>Solubility(ies)</b>	
<b>Solubility in Water:</b>	Soluble
<b>Solubility (other):</b>	No data available.
<b>Partition coefficient (n-octanol/water):</b>	No data available.
<b>Autoignition Temperature:</b>	No data available.
<b>Decomposition Temperature:</b>	No data available.
<b>Viscosity:</b>	153 mm <sup>2</sup> /s (40 °C); 23.5 mm <sup>2</sup> /s (100 °C)
<b>Explosive properties:</b>	No data available.
<b>Oxidizing properties:</b>	No data available.
<b>VOC Content:</b>	No data available.

**Other information**

SDS\_GB-FRASCOLD® 150PAG

<b>Bulk density:</b>	8.29 lb/gal (25 °C)
<b>Pour Point Temperature:</b>	-34 °C

## SECTION 10: Stability and reactivity

<b>10.1 Reactivity:</b>	No data available.
<b>10.2 Chemical Stability:</b>	Material is stable under normal conditions.
<b>10.3 Possibility of hazardous reactions:</b>	Will not occur.
<b>10.4 Conditions to avoid:</b>	None known.
<b>10.5 Incompatible Materials:</b>	Strong acids. Strong oxidizing agents. Strong bases.
<b>10.6 Hazardous Decomposition Products:</b>	Thermal decomposition or combustion may generate smoke, carbon monoxide, carbon dioxide, and other products of incomplete combustion.

## SECTION 11: Toxicological information

### Information on likely routes of exposure

<b>Inhalation:</b>	No data available.
<b>Ingestion:</b>	May be harmful if swallowed.
<b>Skin Contact:</b>	No data available.
<b>Eye contact:</b>	No data available.

### 11.1 Information on toxicological effects

#### Acute toxicity

##### Oral

Product: Swallowing material may cause irritation of the gastrointestinal lining, nausea, vomiting, diarrhea, and abdominal pain.

Not classified for acute toxicity based on available data.

##### Dermal

Product: Not classified for acute toxicity based on available data.

##### Inhalation

Product: Not classified for acute toxicity based on available data.

##### Skin Corrosion/Irritation:

Product: Not classified as a primary skin irritant.

##### Serious Eye Damage/Eye Irritation:

Product: Remarks: Not classified as a primary eye irritant.

##### Respiratory sensitization:

No data available

##### Skin sensitization:

N-1-naphthylaniline Classification: Skin sensitizer (Literature)

**Specific Target Organ Toxicity - Single Exposure:**  
No data available

Aspiration Hazard:  
No data available

**Chronic Effects**

**Carcinogenicity:**  
No data available

**Germ Cell Mutagenicity:**  
N-1-naphthylaniline  
Negative for mutagenicity studies but did induce a slight increase in unscheduled DNA synthesis in human cells and a significant increase in sister chromatid exchange rates after incubation in rat liver S9 fraction.

**Reproductive toxicity:**  
No data available

**Specific Target Organ Toxicity - Repeated Exposure:**  
N-1-naphthylaniline  
Oral: Target Organ(s): Blood

**SECTION 12: Ecological information**

**12.1 Ecotoxicity**

**Fish**

N-1-naphthylaniline  
LC 50 (Rainbow Trout, 4 d): 0.44 mg/l

**Aquatic Invertebrates**

N-1-naphthylaniline  
EC 50 (Water flea (Daphnia magna), 2 d): 0.32 mg/l  
EC 50 (Water flea (Daphnia magna), 21 d): 0.06 mg/l  
NOEC (Water flea (Daphnia magna), 21 d): 0.025 mg/l

**Toxicity to Aquatic Plants**

N-1-naphthylaniline  
EC 50 (Alga, 3 d): 0.25 mg/l

**Toxicity to soil dwelling organisms**

No data available

**Sediment Toxicity**

No data available

**Toxicity to Terrestrial Plants**

No data available

**Toxicity to Above-Ground Organisms**

No data available

**Toxicity to microorganisms**

N-1-naphthylaniline  
EC 50 (Sludge, 0.1 d): > 10,000 mg/l

**12.2 Persistence and Degradability**

SDS\_GB-FRASCOLD® 150PAG

**Biodegradation**

N-1-naphthylaniline Oxygen depletion 0 % (28 d, OECD TG 301 C)

**BOD/COD Ratio**

No data available

**12.3 Bioaccumulative Potential****Bioconcentration Factor (BCF)**

N-1-naphthylaniline Bioconcentration Factor (BCF): 2,691.53 (Measured)

**Partition Coefficient n-octanol / water (log Kow)**

N-1-naphthylaniline Log Kow: 4.2 (Read across)

**12.4 Mobility:**

No data available

**12.5 Results of PBT and vPvB assessment**

No data available

**12.6 Other Adverse Effects:**

No data available.

**SECTION 13: Disposal considerations****13.1 Waste treatment methods****Disposal methods:**

Treatment, storage, transportation, and disposal must be in accordance with applicable Federal, State/Provincial, and Local regulations. Dispose of packaging or containers in accordance with local, regional, national and international regulations. Empty container contains product residue which may exhibit hazards of product.

**Contaminated Packaging:**

Container packaging may exhibit hazards.

**SECTION 14: Transport information****ADR**

Not regulated.

**IMDG**

Not regulated.

**IATA**

Not regulated.

**14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**

None known.

Shipping descriptions may vary based on mode of transport, quantities, temperature of the material, package size, and/or origin and destination. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material. For transportation, steps must be taken to prevent load shifting or materials falling, and all relating legal statutes should be obeyed. Review classification requirements before shipping materials at elevated temperatures.

**SECTION 15: Regulatory information****15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture:**

SDS\_GB-FRASCOLD® 150PAG



## EU Regulations

### **Regulation (EC) No. 2037/2000 Substances that deplete the ozone layer:**

None present or none present in regulated quantities.

### **Regulation (EC) No. 850/2004 on persistent organic pollutants:**

None present or none present in regulated quantities.

### **Regulation (EC) No. 689/2008 Import and export of dangerous chemicals:**

None present or none present in regulated quantities.

### **Regulation (EC) No. 1907/2006, REACH Article 59(1). Candidate List:**

None present or none present in regulated quantities.

### **Regulation (EC) No. 1907/2006, REACH Annex XIV Substances subject to authorisation, as amended:**

None present or none present in regulated quantities.

### **Regulation (EC) No. 1907/2006 Annex XVII Substances subject to restriction on marketing and use:**

None present or none present in regulated quantities.

### **Directive 2004/37/EC on the protection of workers from the risks related to exposure to carcinogens and mutagens at work.:**

None present or none present in regulated quantities.

### **Directive 92/85/EEC: on the safety and health of pregnant workers and workers who have recently given birth or are breast feeding.:**

None present or none present in regulated quantities.

### **Directive 96/82/EC (Seveso II): on the control of major accident hazards involving dangerous substances:**

None present or none present in regulated quantities.

### **EU. Regulation No. 166/2006 PRTR (Pollutant Release and Transfer Registry), Annex II: Pollutants:**

None present or none present in regulated quantities.

### **Directive 98/24/EC on the protection of workers from the risks related to chemical agents at work:**

None present or none present in regulated quantities.

## Inventory Status

### Australia (AICS)

All components are in compliance with chemical notification requirements in Australia.

### Canada (DSL/NDSL)

All components are in compliance with the Canadian Environmental Protection Act and are present on the Domestic Substances List.

### China (IECSC)

All components of this product are listed on the Inventory of Existing Chemical Substances in China.

### European Union (REACH)

To obtain information on the REACH compliance status of this product, please e-mail REACH@SDSInquiries.com.

### Japan (ENCS)

All components are in compliance with the Chemical Substances Control Law of Japan.

### Korea (ECL)

All components are in compliance in Korea.

### New Zealand (NZIoC)

All components are in compliance with chemical notification requirements in New Zealand.

**Philippines (PICCS)**

All components are in compliance with the Philippines Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990 (R.A. 6969).

**Switzerland (SWISS)**

All components are in compliance with the Environmentally Hazardous Substances Ordinance in Switzerland.

**Taiwan (TCSCA)**

All components of this product are listed on the Taiwan inventory.

**United States (TSCA)**

All components of this material are on the US TSCA Inventory.

*The information that was used to confirm the compliance status of this product may deviate from the chemical information shown in Section 3.*

**15.2 Chemical safety assessment:**

No Chemical Safety Assessment has been carried out.

<b>SECTION 16: Other information</b>
--------------------------------------

**Key literature references and sources for data:**

Internal company data and other publically available resources.

**Wording of the H-statements in section 2 and 3:**

H302	Harmful if swallowed.
H317	May cause an allergic skin reaction.
H373	May cause damage to organs through prolonged or repeated exposure.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.
H412	Harmful to aquatic life with long lasting effects.

**Issue Date:**

08.02.2016

**Disclaimer:**

As the conditions or methods of use are beyond our control, we do not assume any responsibility and expressly disclaim any liability for any use of this product. Information contained herein is believed to be true and accurate but all statements or suggestions are made without warranty, expressed or implied, regarding accuracy of the information, the hazards connected with the use of the material or the results to be obtained from the use thereof. Compliance with all applicable federal, state, and local regulations remains the responsibility of the user.

## 4. COSTRUCTION FEATURES

RWS Kp Series units are designed for indoor installations, are equipped with high efficiency plates exchangers and semi-hermetic reciprocating compressors.

There are units operating with 1, 2 or 4 independent cooling circuits in single configuration.

To grant the unit's functioning to the maximum safety conditions, all the cooling circuits components (excepting the condensing coil) are installed inside a closed technical cabinet, separate from external.

The technical cabinet, is provided of an air extraction system which will active in the case

Il vano tecnico a sua volta, è dotato di un sistema di estrazione dell'aria che si attiva nel caso in cui venga rilevata da un apposito sensore ATEX la presenza di propano all'interno del vano tecnico. Contemporaneamente vengono disattivati tutti i dispositivi elettrici ad eccezione del ventilatore AREX di estrazione di emergenza. In questo modo le eventuali fughe di gas possono essere controllate e convogliate esternamente o all'interno di vani privi di qualsiasi tipo di innesco che possa provocarne l'accensione.

### 4.1 Frame

The structure is made of base and frame manufactured in high-thickness galvanized steel elements, assembled with stainless steel rivets. All the external galvanized steel surface are powder-coated with color RAL7035. The structural elements are firmly fixed making the frame very strong and able to support all the unit components and absorb any mechanical stress due to handling and running of the unit.

### 4.2 Compressors

The compressors are semi-hermetic type, specifically designed and optimized for operation with hydrocarbons and manufactured according to safety requirements for application in zone classified for presence of flammable gas as per Directive ATEX 2014/34/UE. The electrical motor foreseen for low current inrush (PW option) is complete with thermal protection module (installed inside the electric board). The lubrication system is of forced type, equipped with oil filters and connections for lubricant pressure detection and occurs through a high pressure pump. Each compressor, operating on a single independent circuit, is installed on rubber buffers and equipped with vibration dampers, shut-off valve on suction and discharge side, ATEX compliant electronic differential switch for oil level control, ATEX compliant oil crankcase heater and temperature probe in discharge to control the compressor discharge temperature.

### 4.3 Safety gas sensor

The units of the RWS KP series are equipped with a sensor positioned in the technical compartment that detects the presence of propane gas; the intervention set is set at a gas concentration corresponding to  $0.1 * LFL$  ( $LFL = 0.038 \text{ kg / m}^3$ ). If the sensor detects the presence of refrigerant as a result of a leak, the exhaust fan is started from the technical compartment and all remaining motors and actuators are switched off. For ordinary and extraordinary maintenance of the sensor refer to the specific manual on the machine

### 4.4 User side exchanger

User's side exchanger of plate type realized in ASI 316, with single or double circuit, with channels and patented manifold which allow to reach a high heat exchange coefficient. Their design helps a uniform water distribution compatibly with the pressure drops. It is supplied with close cell insulating material covering. Moreover the exchanger is provided with a safety water flow switch that doesn't allow the unit operation in case of low water flow to the exchanger. On refrigerant side the maximum working pressure is established at 28 relative bar.

### 4.5 Regenerative exchanger

To assure an appropriate value of gas overheating on compressor suction side and a correct temperature of lubricant oil, each cooling circuit is equipped with a plate regenerative exchanger. This exchanger subcools the liquid leaving the condensing part and overheats gas leaving the evaporator, assuring at the same time both absence of liquid on compressor suction side and increasing the efficiency of the whole cooling circuit.

## 4.6 Electrical board

Electric board is built in compliance with 61439-1 Norms. All the components of the control system and the components necessary for start and thermal protection of electrical motors are installed inside the cabinet, all factory tested and wired. The electric board has a watertight structure, equipped with cable glands IP65/66 and ventilation system to keep the internal volume in overpressure compared to external environment. In this way the possible refrigerant leaks can not enter inside and come into contact with possible source of ignition. Moreover, inside the electric board are installed all the control and power devices, the microprocessor with keyboard and display to show available function, lock-door main switch, isolation transformer to feed auxiliary circuits, automatic switches, fuses and contactors for compressors and fan motors, terminal for cumulative alarms and remote ON/OFF, control terminal box for spring type, possibility of interface with BMS management system. The unit is foreseen to block the electric power supply if no ventilation of compressor compartment is assured. The ventilation lack is controlled by means of differential switches that work as airflow switch.

## 4.7 Cooling circuit

Each cooling circuit is equipped with:

- Service valve for refrigerant injection;
- Anti-freeze probe;
- Shut-off valve on liquid line;
- Sight-glass;
- Dehydrating filter;
- Safety valve on high pressure side by conveying outside;
- Mechanical thermostatic valve;
- Adjustable pressure switch;
- High and low pressure gauges;
- Solenoid valve on liquid line.



All the components of cooling circuit are suitable to work with the hydrocarbons and particularly with propane. Some of them have ATEX certification.

## 4.8 Control system

The control of the unit is made by management software stored on the electronic microprocessor.

Microprocessor is made of:

- An electronic control card with a terminal board for transmission parameters, and the activation of the command devices;
- An user interface card with setting buttons and display for visualization of the operation status and the alarm messages.

The electronic control card manages different devices installed on the unit, according to the values of the working parameters, by having following main functions:

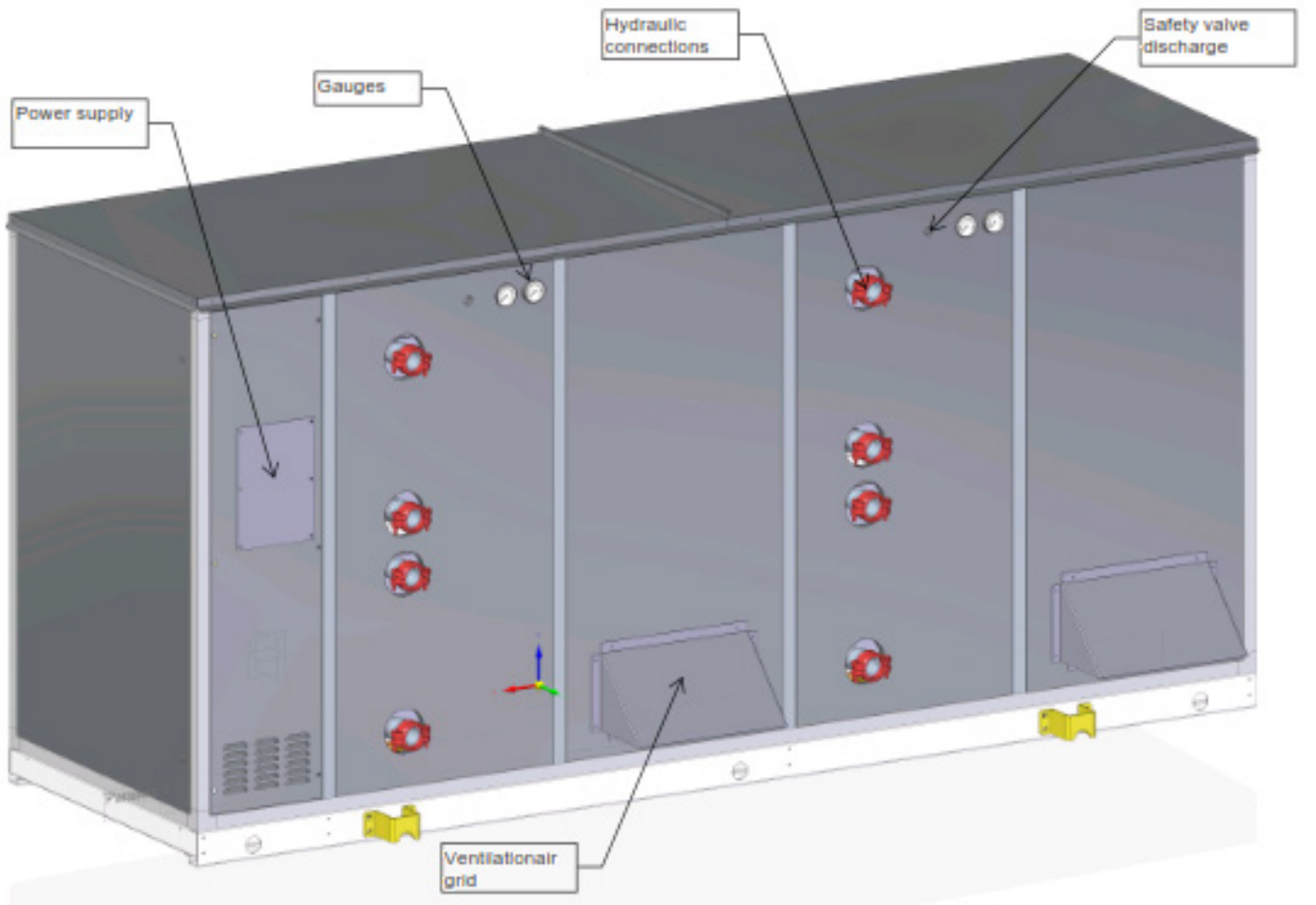
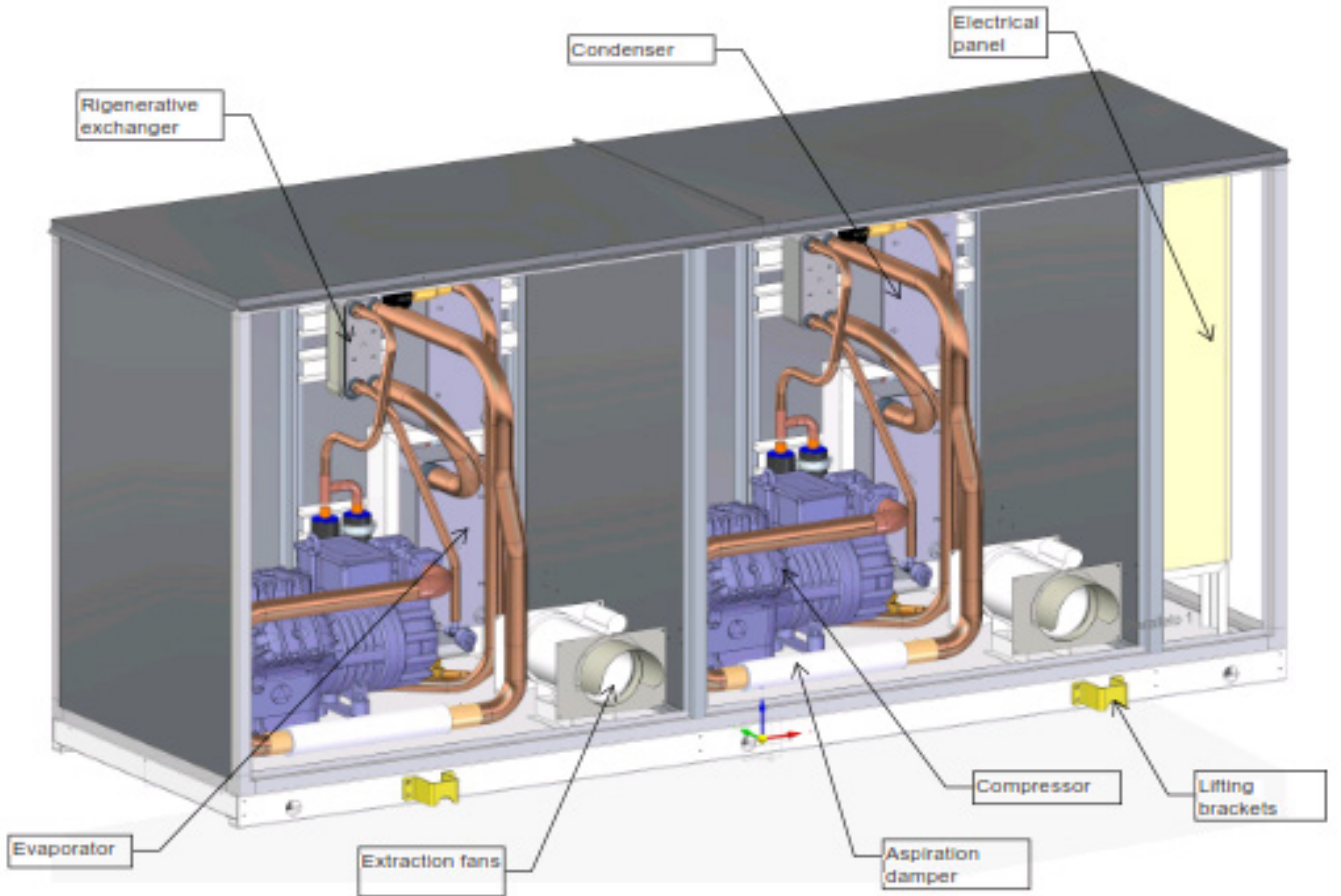
- Unit ON/OFF from keypad or from remote
- Alert and alarm status management and storage

Interface user display for the microprocessor allows, among other things, to visualize following informations:

- Set parameters for regulation;
- Functioning variables values;
- Digital and analogue input and output status;
- Operation unit status;
- Alerts and alarms

Possibility to interface to EMS/BMS system

4.9 Main components / options

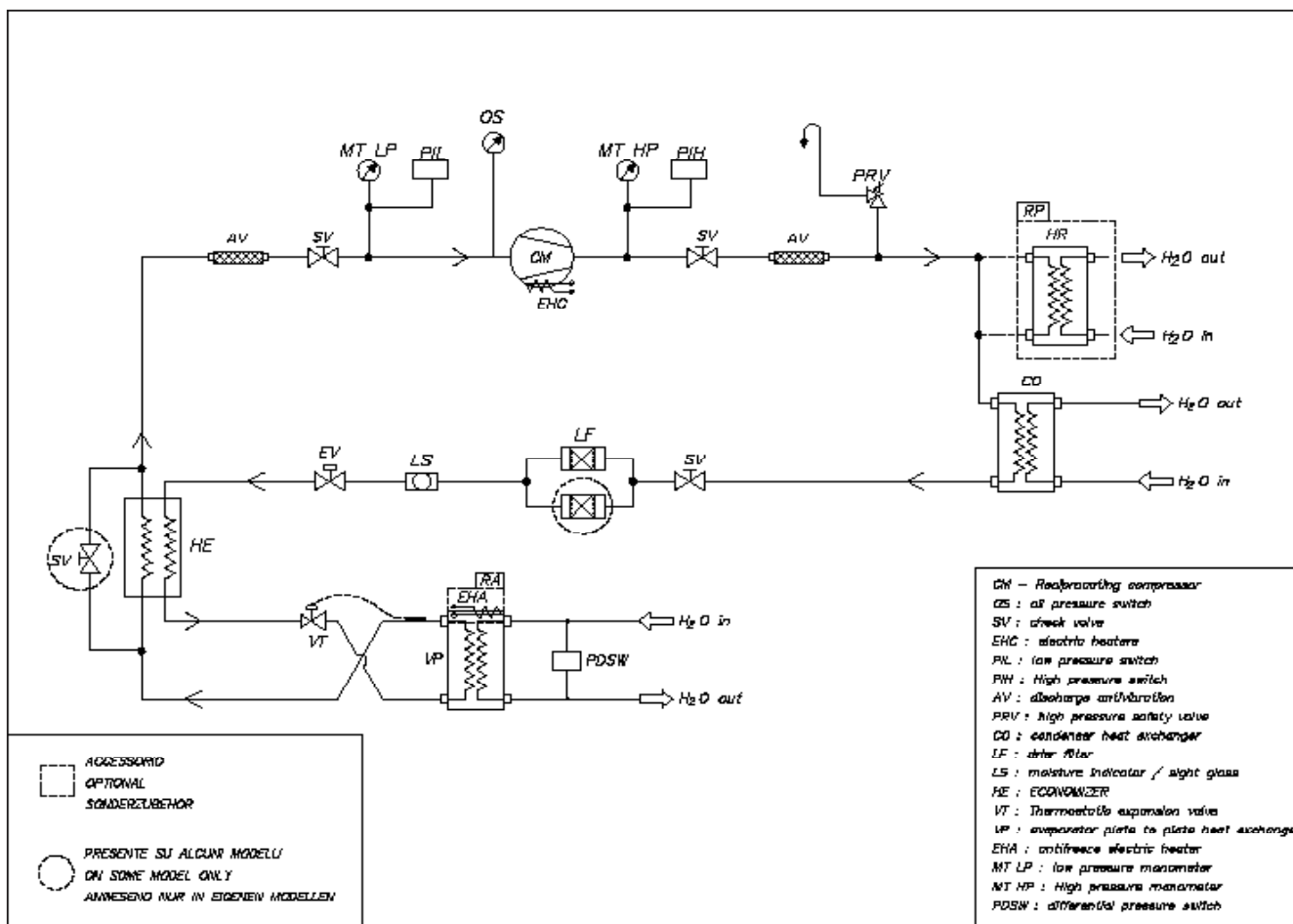


## 4.10 Options

A	Amperometer: Electrical device to measure the absorbed electrical current intensity.
AE	Electrical power different than standard: Especially 230V three phase, 460V three phase, frequencies 50/60 Hz.
CS	Compressors inrush counter: Electromechanical device positioned inside the electrical board, recording the total inrush starts of compressors.
G2	2 steps capacity load: Available from the unit RWS 601 Kp to the unit RWS 1701 Kp.
G4	4 steps capacity load: Available from the unit RWS 2002 Kp to the unit RWS 3502 Kp.
G8	8 steps capacity load: Available for the unit RWS 4304 Kp.
I1	Victaulic insulation on pump side: Insulation of the joints by close-cell polyurethane material, to prevent condensation, pump side.
I2	Victaulic insulation buffer tank side: Insulation of the joint by close-cell polyurethane material, to prevent condensation, buffer tank side.
IH	RS485 Serial Interface: Electronic card to be connected to the microprocessor to allow connection of the units to supervisory system, for a remote control and monitoring of the unit. (Alternative to IH LON or IWG).
IH-LON	Protocol Serial Interface: Electronic card to be connected to the microprocessor to allow connection of the units to supervision system with LON Protocol, for a remote control and monitoring of the unit. (Alternative IH or IWG).
IM	Seawood packing: Fumigated seawood case and protection bag with hygroscopic salts, suitable for long sea transport.
IWG	SNMP or TCP/IP Protocol Serial Interface: Electronic card to be connected to the microprocessor to allow connection of the unit to supervision system with SNMP or TCP/IP protocol, for a remote control and monitoring of the unit. (Alternative to IH or IH LON).
MF	Phase monitor: Electronic device that checks the correct sequence and/or the lack of one of the three phase, switching off the unit if necessary.
PA	Rubber-type vibration damper: Bell-shaped vibration damper support for insulating the unit (supplied in kit), made of base and bell in galvanized steel and natural rubber mixture.
PM	Spring-type vibration dampers: Spring vibration damper support, for insulating the unit (supplied in kit), mainly indicated for installation in difficult and aggressive environments. Made of two steel plates containing a suitable quantity of harmonic steel springs.
PQ	Remote microprocessor: Remote terminal, allowing to display the temperature and humidity values detected by probes, the alarm digital inputs, the outputs and the remote ON/OFF of the unit, to charge and program of the parameters, the sound signal and the display of the present alarms.
PW	Part-Winding: Equipment for step compressors starting, reducing of about 35% the inrush current of each compressor.
RA	Anti-freeze heater on evaporator: Electrical heater installed on evaporator, in order to prevent freezing, provided with thermostat
RF	Power factor correction system Cosfi >0,9: Electrical device made by suitable condenser for compressor rephasing that ensure a Cosfi value >0,9, so to reduce absorption from electrical network.
RL	Compressors overload relays: Electromechanical protection devices against compressor's overload.
RP	Partial Heat Recovery: Of condensing heat through a refrigerant/water plate exchanger (desuperheater) always in series to the compressors. It is used when you want to partially recover condensing heat capacity for production of sanitary water.
RV	Personalized frame painting in alternative RAL color.
V	Voltmeter: Electrical device measuring the electrical voltage of the unit power supply.
VB	Brine version: Unit suitable for working with evaporator outlet water temperature lower than 0°C. A 20mm evaporator insulation will be provided.

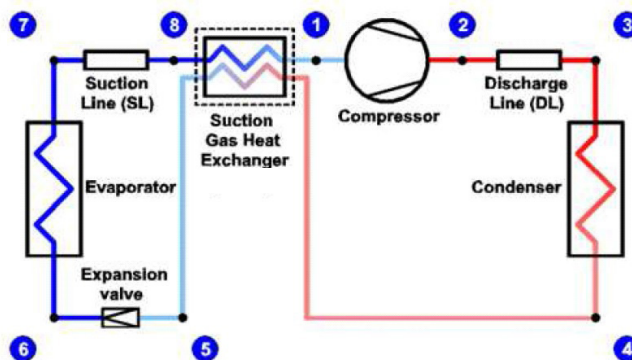
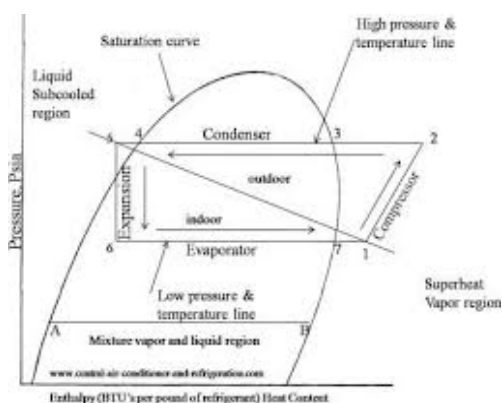


### 5. STANDARD UNIT FUNCTIONAL DIAGRAM



### 5.1 Cooling circuit Description

Here below is represented the cooling circuit for chilled water production.



The suction gas (1) is compressed and discharged into the discharge side (2). The discharge side line takes the refrigerant to the condenser inlet (3). The sub-cooled and condensed refrigerant in condenser outlet (4) it is taken to the liquid side entrance of the regenerative heat exchanger (sub-cooler).

The output condition (5) will be different from the condition (4). From the expansion valve outlet (6) the refrigerant is led to the evaporator. The liquid refrigerant becomes superheated gas at the evaporator outlet (7) and returns to the compressor's suction, overheated after passing through the regenerative heat exchanger (side gas).

## 6. INSTALLATION

Storage conditions, temperatures : -30 / +60 °C

### 6.1 Water composition

The guide below is an attempt to give a picture of the corrosion resistance of stainless steels and brazing materials in tap water at room temperature. In the table a number of important chemical components are listed, however the actual corrosion is a very complex process influenced by many different components in combination. This table is therefore a considerable simplification and should not be overused!

**EXPLANATIONS:**

- + Good resistance under normal conditions
- 0 Corrosion problems may occur especially when more factors are valued 0
- Use is not recommended

WATER CONTENT	CONCENTRATION (mg/l or ppm)	TIME LIMITS Analyze before	Plate Material			Brazing Material		
			AISI 304	AISI 316	254 SMO	COPPER	NICKEL	STAINLESS STEEL
Alkalinity (HCO <sub>3</sub> <sup>-</sup> )	< 70	Within 24 h	+	+	+	0	+	+
	70-300		+	+	+	+	+	+
	> 300		+	+	+	0+	+	+
Sulphate <sup>IV</sup> (SO <sub>4</sub> <sup>2-</sup> )	< 70	No limit	+	+	+	+	+	+
	70-300		+	+	+	0-	+	+
	> 300		+	+	+	-	+	+
HCO <sub>3</sub> <sup>-</sup> / SO <sub>4</sub> <sup>2-</sup>	> 1.0	No limit	+	+	+	+	+	+
	< 1.0		+	+	+	0-	+	+
Electrical conductivity	< 10 µS/cm	No limit	+	+	+	0	+	+
	10-500 µS/cm		+	+	+	+	+	+
	> 500 µS/cm		+	+	+	0	+	+
pH <sup>IV</sup>	< 6.0	Within 24 h	0	0	0	0	+	0
	6.0-7.5		+	+	+	0	+	+
	7.5-8.0		+	+	+	+	+	+
	> 8.0		+	+	+	0	+	+
Ammonium (NH <sub>4</sub> <sup>+</sup> )	< 2	Within 24 h	+	+	+	+	+	+
	2-20		+	+	+	0	+	+
	> 20		+	+	+	-	+	+
Chlorides (Cl <sup>-</sup> ) <small>Please also see table below</small>	< 100	No limit	+	+	+	+	+	+
	100-200		0	+	+	+	+	+
	200-300		-	+	+	+	+	+
	> 300		-	-	+	0+	+	-
Free chlorine (Cl <sub>2</sub> )	< 1	Within 5 h	+	+	+	+	+	+
	1-5		-	-	0	0	+	-
	> 5		-	-	-	0-	+	-
Hydrogen sulfide (H <sub>2</sub> S)	< 0.05	No limit		+	+	+	+	+
	> 0.05			+	+	0-	+	+
Free (aggressive) carbon dioxide (CO <sub>2</sub> )	< 5	No limit	+	+	+	+	+	+
	5-20		+	+	+	0	+	+
	> 20		+	+	+	-	+	+
Total hardness (°dH)	4.0-8.5	No limit	+	+	+	+	+	+
Nitrate <sup>V</sup> (NO <sub>3</sub> <sup>-</sup> )	< 100	No limit	+	+	+	+	+	+
	> 100		+	+	+	0	+	+
Iron <sup>III</sup> (Fe)	< 0.2	No limit	+	+	+	+	+	+
	> 0.2		+	+	+	0	+	+
Aluminium (Al)	< 0.2	No limit	+	+	+	+	+	+
	> 0.2		+	+	+	0	+	+
Manganese <sup>II</sup> (Mn)	< 0.1	No limit	+	+	+	+	+	+
	> 0.1		+	+	+	0	+	+

<sup>IV</sup> Quinols and nitrites acts as inhibitors for pitting corrosion caused by chlorides in pH neutral environments

<sup>IV</sup> In general low pH (below 6) increase corrosion risk and high pH (above 7.5) decrease the corrosion risk

<sup>IV</sup> Fe<sup>3+</sup> and Mn<sup>2+</sup> are strong oxidants and may increase the risk for localized corrosion on stainless steels

<sup>IV</sup> In combination with leaching material copper

<sup>IV</sup> Cl<sub>2</sub> above 150ppm increase the risk of scaling

CHLORIDE CONTENT	MAXIMUM TEMPERATURE				
	30°C	60°C	90°C	120°C	150°C
- 10 ppm	00 304	00 304	00 304	00 304	00 316
- 25 ppm	00 304	00 304	00 304	00 316	00 316 <sup>IV</sup>
- 50 ppm	00 304	00 304	00 316	00 316	T1 / 254 0MO
- 100 ppm	00 316	00 316	00 316	00 316 <sup>IV</sup>	T1 / 254 0MO
- 150 ppm	00 316	00 316	00 316 <sup>IV</sup>	T1 / 254 0MO	T1 / 254 0MO
- 300 ppm	00 316	00 316 <sup>IV</sup>	T1 / 254 0MO	T1 / 254 0MO	T1 / 254 0MO
- 300 ppm	T1 / 254 0MO	T1 / 254 0MO	T1 / 254 0MO	T1 / 254 0MO	T1 / 254 0MO



## 6.2 Transport and handling

According to EN 378-1, the unit can be classified as an indirect closed system (par. 4.1.3 and 4.4.2.1, fig. 2).

Refrigerant type and charge are written on the unit Identification Tag.

The location of the unit has to be chosen taking into account the load limits imposed by the EN 378-1, att. C and, in particular, as provided in the tab. C.1 for refrigerant A3 Group.

In this case, the unit is designed to be installed outdoors areas realized following Norms in force (EN 378-1 , EN60079-1).

Systems must be checked every 6 months, to ensure that measures taken to prevent the spread of explosive atmosphere are efficient.

The unit must be handled by experienced staff, provided with suitable equipment for te unit's weight and size. During handling, the unit must always be kept upright, in other words with base frame parallel to the ground.



The company in charge of transport is always responsible for any damage of the goods that have been entrusted. Before installing and preparing the unit for commissioning it is necessary to make a detailed visual inspection to verify the integrity of the packaging and the unit for damage or oil and refrigerant loss. Also make sure that the unit corresponds to what is required when ordering.



Any damage or claims will have to be forwarded to the Manufacturer and the carrier within 8 days from good receipt.



Whether one or more components are damaged, do not start up the unit and immediatly inform the Manufacturer about the problem, agreeing with him what action to take.



It is suggested to remove the packaging on site. Site handling must be done with care, without using unit components as handholds. It is essential to avoid any damage during handling of the unit



The hydraulic circuit must be completely emptied before moving the unit



Unit's lifting must be vertical, preferably made with a forklift. Use a spreader beam if belts or ropes are used for slinging, making sure there is no pressure on the units upper edges or on the packaging.

### WARNING:

The unit's gas is flammable.

Unit can be installed only outdoor and far away from any potential source of ignition and covered from direct sunlight.



### 6.3 Positioning

The installation of the unit must be done at the Owner in charge and will have to be executed under his responsibility. A correct installation requires a project by a professional and the realization by expert personnel with the necessary information.



In the environment where the unit is installed, there must not be any aggressive substances, not substances that are incompatible with copper, carbon steel, aluminium and other materials used for producing the unit. In case of doubt, it will be necessary to carry out specific chemical analyses and send to Manufacturer, so as to find all necessary solutions and measures.

Installation of the unit must be done in compliance with local Laws and Regulations.

Before proceeding with positioning, it is necessary to verify that:

- The basement is capable to sustain in a stable way the weight of the unit in working configuration;
- Around the unit is enough space for ordinary and extraordinary maintenance as shown in the figure 3.2;
- Hydraulic and electric connections have been properly arranged.



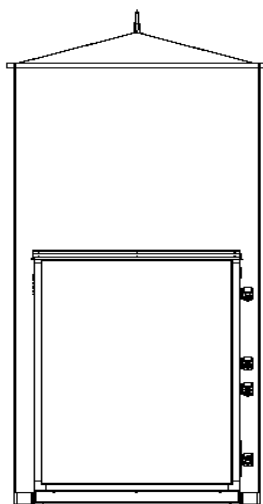
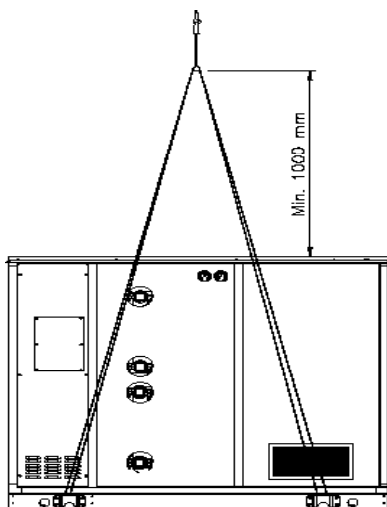
The unit frame in operation must be horizontal, a max inclination of 5° in length and width direction is anyway acceptable.

Unit does not requires any special base, as it can be simply installed on the basement.

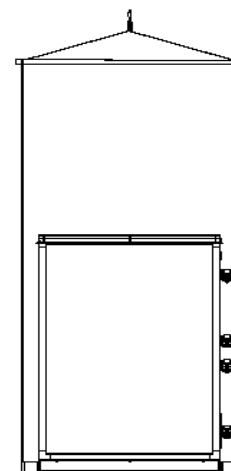
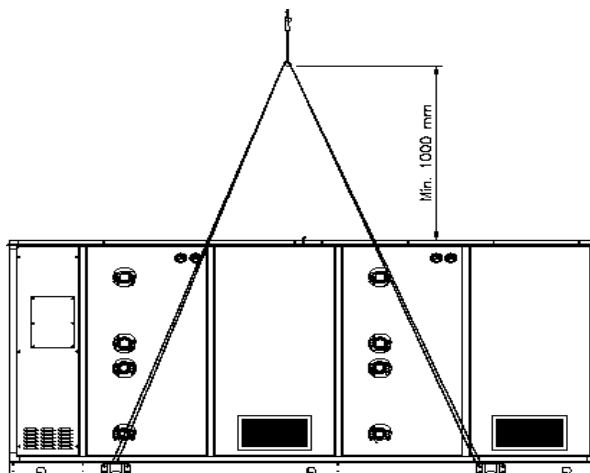
### 6.4 Lifting Diagram

If the lifting is done by pullers or ropes, it will be necessary to avoid any pressure on the unit that may cause damages or breakings.

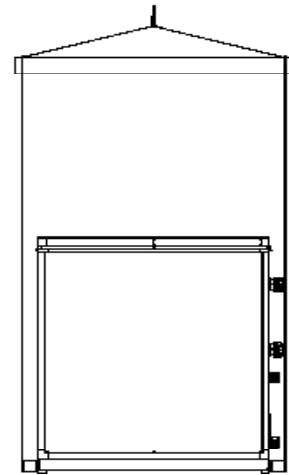
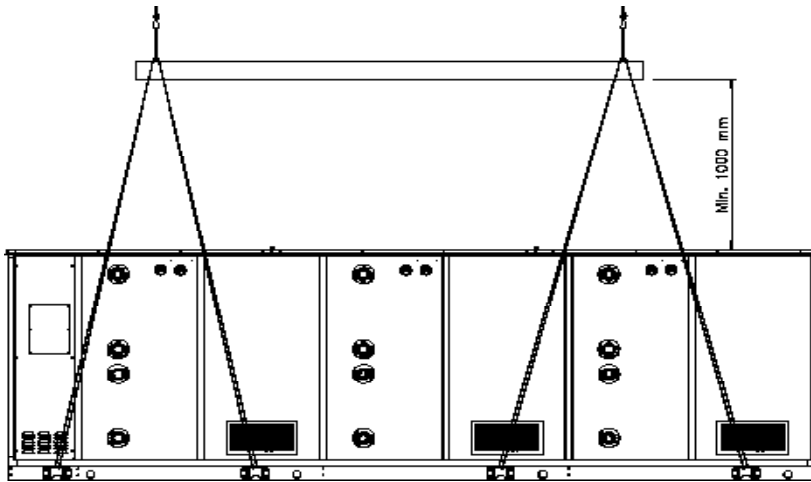
ONE FAN MODELS



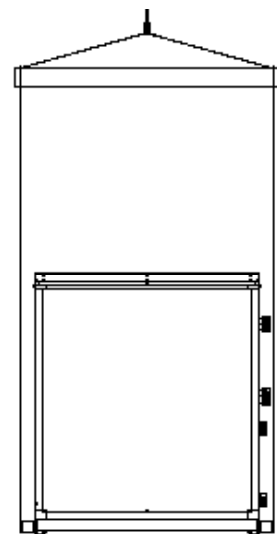
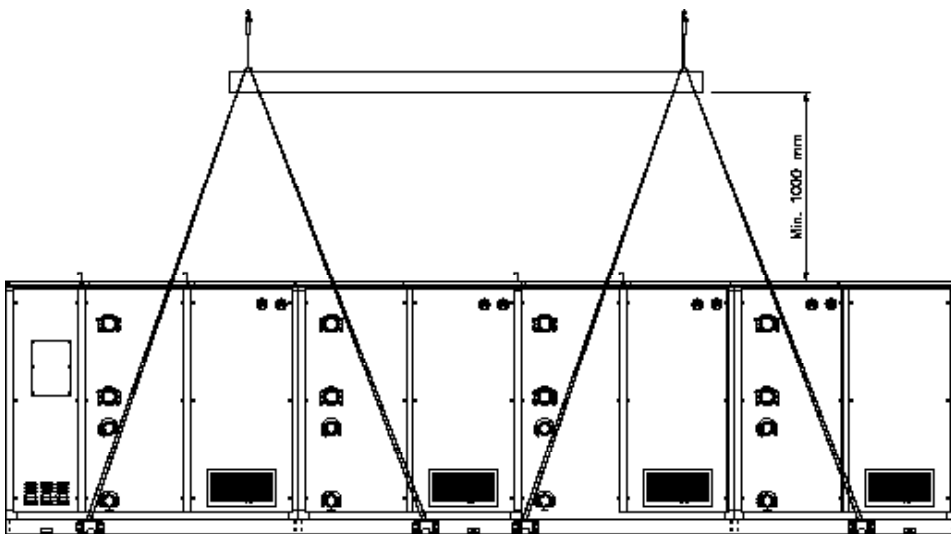
TWO FANS MODELS



3 FANS MODELS

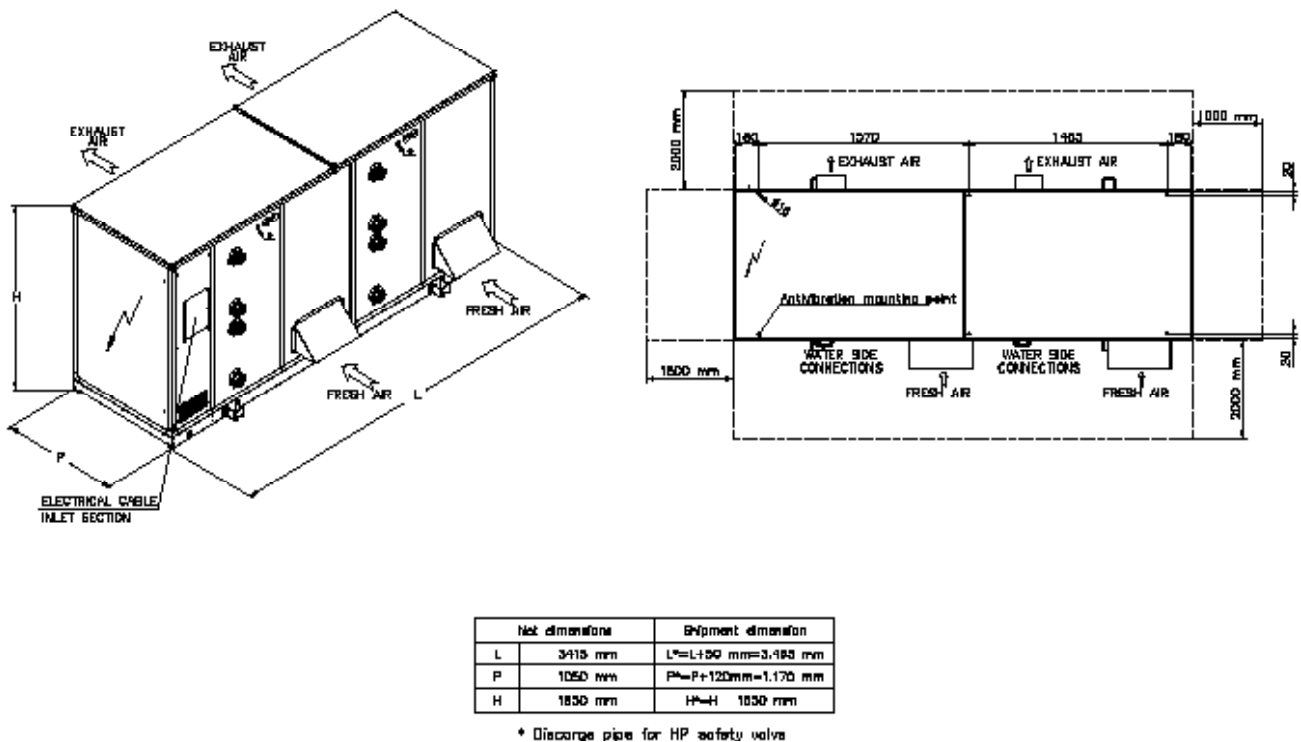
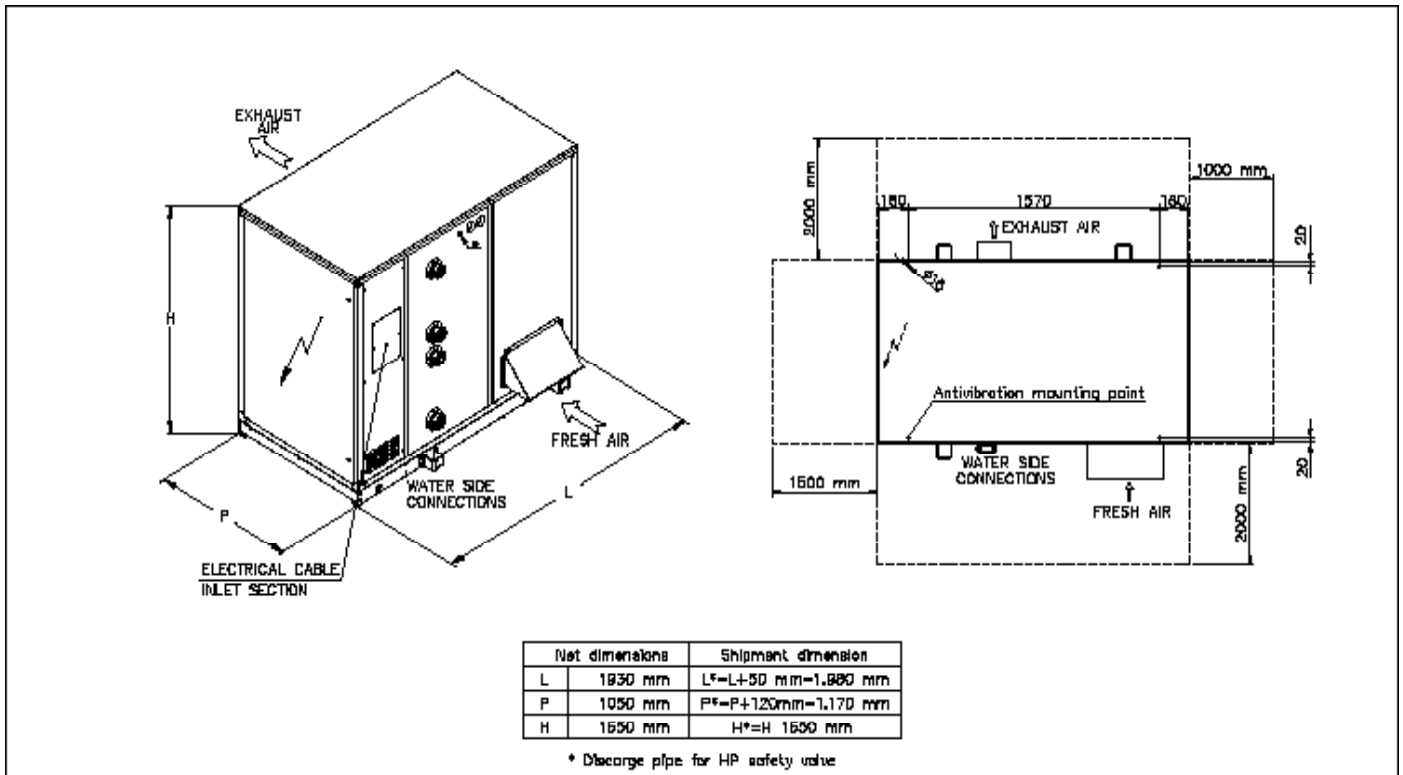


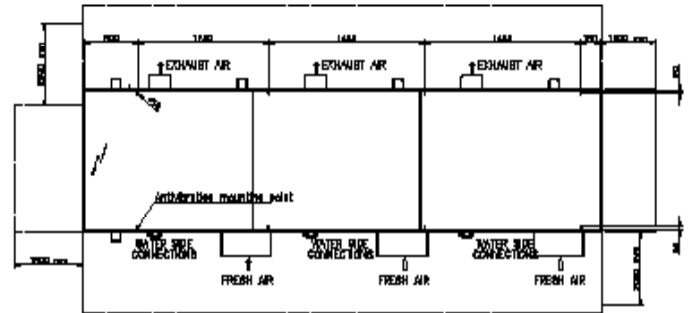
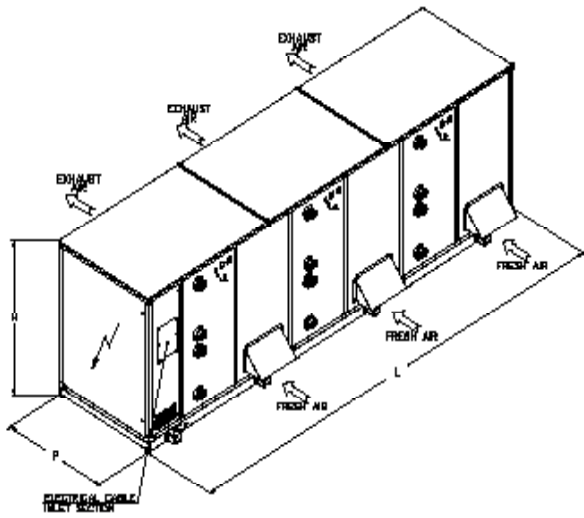
4 FANS MODELS



## 6.5 RWS Kp Dimensionals, services areas and point load table

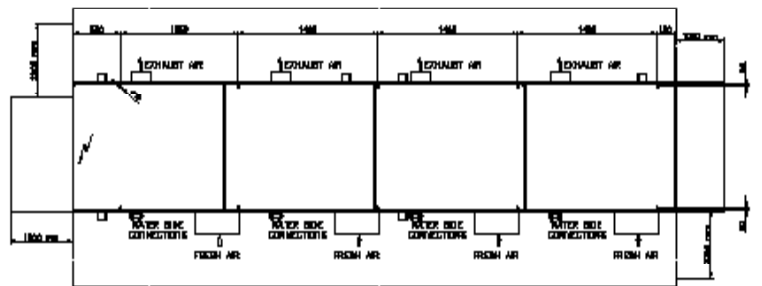
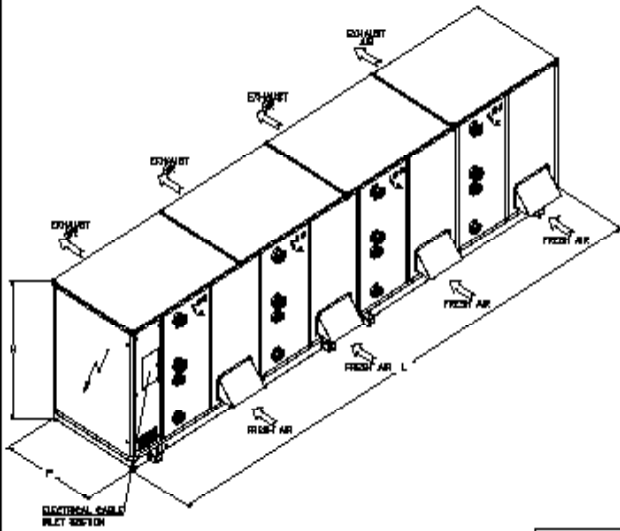
Here below the dimensional drawings indicating the service areas, the total weight of the units in its standard configurations and of weight distribution of the same on the various points of support for the base vibration dampers.





Net dimensions	Shipment dimension
L 4800 mm	L*=L+50 mm=4850 mm
P 1200 mm	P*=P+120mm=1320 mm
H 1650 mm	H*=H 1650 mm

\* Discharge pipe for HP safety valve



Net dimensions	Shipment dimension
L 4345 mm	L*=L+50 mm=4395 mm
P 1200 mm	P*=P+120mm=1320 mm
H 1650 mm	H*=H 1650 mm

\* Discharge pipe for HP safety valve

## 7. HYDRAULIC CIRCUIT

The unit is designed to be connected to a chilled and/or hot water distribution network, depending on chillers. Piping must be made by expert personnel



The fluid may not contain any aggressive substances, or substances that are incompatible with copper, carbon steel, aluminium and other material used for producing the unit. In case of any doubt, it will be necessary to carry out specific chemical analyses and send the result to the Manufacturer, so as to find all necessary solutions and measures.

The hydraulic system must be sized by a professional, and realized by qualified personnel, in compliance with local Regulations in force.



Diameters of the hydraulic connections are stated in the following Table.  
Piping diameters must be sized to keep circuit pressure drop within acceptable limits.

### RWS KP VERSION

RWS Kp UNIT							
MODEL	601 Kp	801 Kp	1301 Kp	1601 Kp	1701 Kp	2002 Kp	2302 Kp
Evaporator hydraulic connections	2 x 2" Victaulic	2 x 2" Victaulic	2 x 2 1/2" Vict.	2 x 2 1/2" Vict.	2 x 2 1/2" Vict.	2 x 2 1/2" Vict.	2 x 2 1/2" Vict.
Condenser hydraulic connections	2 x 1" M GAS	2 x 1" M GAS	2 x 1" M GAS	2 x 1" M GAS	2 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS

RWS Kp UNIT						
MODEL	2502 Kp	2802 Kp	3002 Kp	3302 Kp	3502 Kp	4304 Kp
Evaporator hydraulic connections	2 x 2 1/2" Vict.	2 x 2 1/2" Vict.	2 x 3" Victaulic	2 x 3" Victaulic	2 x 3" Victaulic	4 x 2 1/2" Vict.
Condenser hydraulic connections	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS

Here below some general indications, to be followed, in order to complete hydraulic circuit.

- Choose the piping path so as to contain, as much as possible, pressure drops;
- Position and clamp piping so as to allow inspection and servicing;
- The material used for realizing the plant must have a nominal pressure not less than PN6 water side;
- During plant installation, you must take all necessary precautions to avoid dirt and debris in the piping;
- Circulation water pump must be able to provide requested water flow with a suitable head pressure against the pressure drops of the circuit in all possible operating conditions;
- Hydraulic circuit must work at a pressure between 1,5 and 6 bar, so it is necessary to equip it with one or more membrane expansion vessels, with adequate volume and pre-charge pressure.



In case the hydraulic circuit has been designed to work at pressure lower than 1,5 bar (for example, open circuit plants) or higher than 6 bar, it will be necessary to inform the Manufacturer, with whom it will be possible to plan different measures to solve the problem.

- The plant must be protected by a safety valve of adequate size, and setting pressure not higher than 6 bar.
- Along the circuit, in particular on the highest points, there must be all necessary devices for air discharge;
- Plant must be equipped, in appropriate points, with connections for emptying;
- System must be equipped with connections for filling with water and, if foreseen, with antifreeze substances;
- At the end of the procedures to build the circuit, it must be cleaned with suitable substances, to avoid that dirt or debris comes inside and causes damages or anomalies during working period;
- For the connection of the units to the hydronic plant, make sure to use indicated areas in the attached drawing.



During leakages search, the plant must not be subjected to a pressure higher than 6 bar.

## 7.1 Hydraulic circuit connection

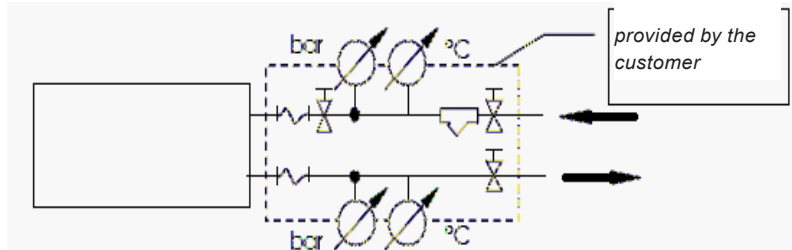
Connections of the unit to the hydraulic circuit must be executed by an expert and qualified technician, in compliance with local Regulations in force.



*It is important that connection of the unit to the plant is executed so that refrigeration fluid circulates across the evaporator in the right direction. On this purpose, piping must be connected by following the indications close to the connections on the unit.*

For the reconnection of the pipes to the evaporator, it is advisable to respect following indications:

- Connect the piping as shown here below;



- To avoid transmission of vibrations and to allow thermal dilatation, you must install anti-vibration filets on pipings;
- To avoid particles and dirt coming inside, it is necessary to install on the unit inlet a mechanical washable filter, with dimension not higher than 2mm and with adequate nominal diameter to contain pressure drop;
- It is advised to insert shut-off valves before and after of the filter, so as to make quicker and easier the necessary cleaning procedures;
- Positioning of thermometers and gauges close to the inlet and outlet connections, make it easier to verify if it works properly;
- The cooling water plant must be covered by anti-condensing, closed-cell material, with thermal insulation features, steam tightness, of adequate thickness to the worst possible conditions, during operation and during stops;
- For the connection of the units to the hydraulic plant, it is necessary to use provided connections indicated in the drawing attached to the Manual;
- Once the building of the circuit and the installation have been completed, it is necessary to have a tightness test, so as to identify any eventual leak and repair them, before filling and startup.



*After check of the tightness of the system executed with water, if the plant is started after a long time, of if the external temperature is close to 0°C or less, it will be necessary to remove some water from the circuit or to insert an adequate quantity of antifreeze liquid.*



You must be sure that compressors of the units can start only after the operation of the evaporator water circulation pumps. This is possible, for example, by using an electrical interblock.

## 7.2 Filling the hydraulic circuit

Once the hydraulic system has been realized, the connection of the units and the tightness of the system have been assured, you must proceed with filling the circuit, through the following steps:

- Open all present purge valves;
- Connect the circuit to an hydraulic supply network, possibly in a permanent way, through an automatic filling unit with a manometer, as well as non-return valves;
- If the circuit works on an antifreeze mix, add the correct amount of antifreeze fluid, based on the volume of the plant and the concentration to achieve;
- Charge water in the plant through the filling unit;
- Verify all present air discharge valves, by closing them, when there is no more air inside, but only water;
- Once all purge valves are closed, continue to charge water, until a pressure between 1,5 and 6 bar is reached;
- Stop charging water, activate circulation pump, and make them work hours, so to let the air flow to higher points provided with purges;
- Switch off the pumps and discharge the air which has eventually accumulated, by opening all purge valves one by one;
- Charge water in the circuit so as to bring pressure to its original value;
- Repeat steps from g) to i) until all purge valves expel only water.

## 7.3 Use of antifreeze solutions

In case it is possible that, during working period, fluid temperature goes down to 4°C or, during stops, can get close to 0°C, it will be necessary to introduce in the hydraulic circuit an antifreeze mixture, with a freezing point sufficiently lower than the minimum temperature.



Some liquids are harmful if ingested, or may cause irritations if coming to contact with skin and mucus. Therefore, when handling such substances, it is necessary to respect safety indications on the container and its related working instructions, or, anyway, it is always advisable to wear protection glasses and rubber gloves.

Therefore, it is necessary to make sure that such substances never get to mouth.



It is forbidden to use aggressive antifreeze mixes, or incompatible with copper, carbon steel and other materials of the plant.

Here below, we indicated freezing temperatures for different ethylene glycol concentration in water. Values on this table are an indication and must be used only as a reference. In some cases, suppliers may deliver the product in a solution, therefore it is necessary to refer to dilution percentages indicated by the antifreeze fluid supplier.

	ETHYLENE GLYCOL CONCENTRATION IN SOLUTION (MASS [KG / KG])							
	5%	10%	15%	20%	25%	30%	35%	40%
Volume concentration (l/l)	4,4%	8,9%	13,6%	18,1%	22,9%	27,7	32,6	37,5
Freezing temperature (°C)	-1,4	-3,2	-5,4	-7,8	-10,7	-14,1	-17,9	-22,3

The use of mixtures with glycol concentration lower than necessary, may cause freezing and breaking of the hydraulic circuit and, in particular, of the evaporator. The use of unnecessarily high concentrations, instead, may lead to a reduction of unit performance and, in particular, of its energy efficiency. Fluid in the hydraulic circuit must be periodically analyzed, and especially during the beginning of the cold season, to verify its composition and its concentration. All fluid present in the plant will have to be replaced within the period indicated by the producer of the antifreeze mixture, or at least each two years.



It is absolutely forbidden to discharge the antifreeze mixture in the environment; it must be therefore disposed by experts (disposal services), in compliance with the Laws and local Regulations.



### 8. FREON SAFETY VALVES

Into the compressors cabinet are installed the freon safety valves, must be singularly carried out by metal pipings, up to altitude at least e mt above it. The pipes must have a diameter not less than that of the safety valves discharge.

The outlet of the pipings must be conformed so to avoid the rainwater, snow, ice and dirt may accumulate and reduce the valves discharge flow rate. Valve discharge must be operated at an adequate distance from other devices plants or sources (at least 3mt).

In case of freon valves intervention, the discharged refrigerant must not accidentally enter inside of buildings.



Refrigerant coming out from the safety valves is at high pressure, high temperature and at high speed. The flow may cause damages to objects and people



The opening of the safety valves is signalled by a noise, whose intensity may cause damages to the hearing of the people nearby..

In any case, any piping on teh discharge of the safety valves must be installed in compliance with Laws and Regulations in force.

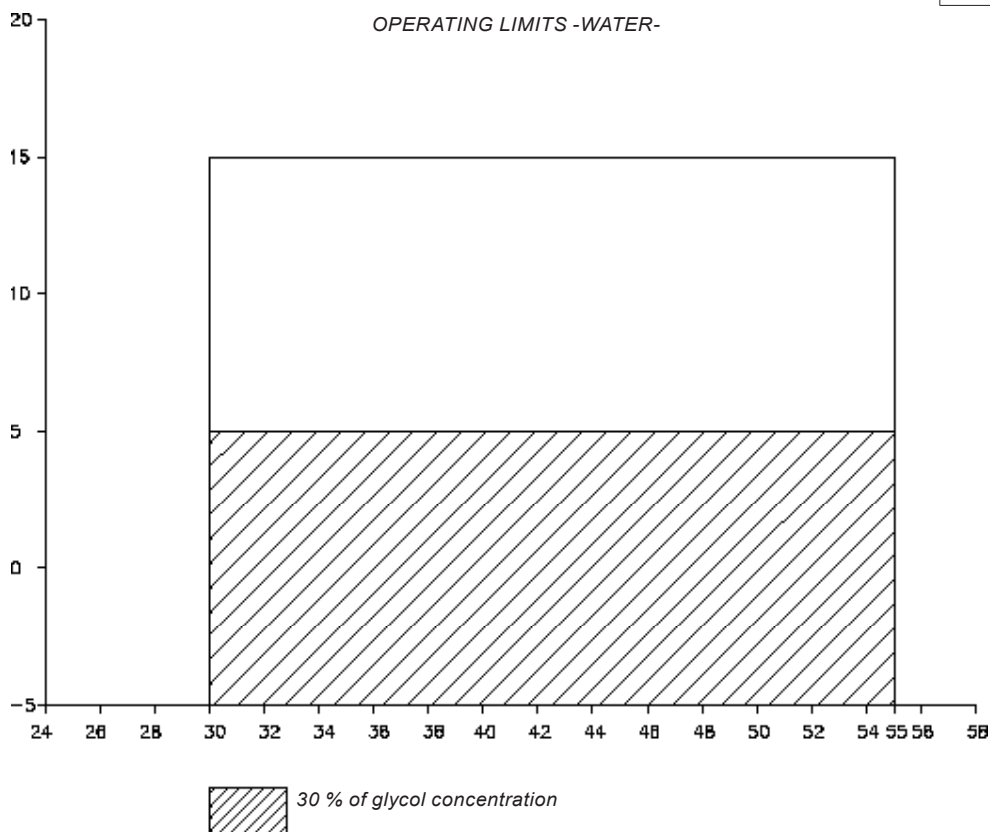
### 9. APPLICATION RANGE

The nominal water flow of teh standard unit indicated in this Manual, refers to a Delta T of 5K between the inlet and outlet water temperature depending on the cooling capacity. The maximum flow on each unit can be calculated by considering a Delta t of 3K depending on the desing cooling capacity (higher flow values could cause noise and vibration with consequent damages to teh evaporator); while the minimum flow rate can be calculated considering a Delta T of 7°K, always in relation to the design cooling capacity (lower flow capacity values could cause lower outlet temperatures with the conseuent intervention of safety and stop devices of the machine).

1. For different applications, contact the Customer Service
2. Lower temperatures could cause unit malfunctionig;
3. Higher temperatures can enable the safety device and stop teh unit
4. If the unit works with water temperatures lower than 5°C ( on teh evaporator outlet), besides using a water/ethylene glycol mixture, it is necessary to reset the antifreeze thermostat (always 4°C above the mixture freezing point) and the set-point according to the desired temperature and to the temperature difference to the evaporator.

\* In the free-cooling version in considered a ethylene percentage of 30%

OPERATING LIMITS RWS Kp - PURE WATER -	
Out evaporator temperature	Out condenser temperature
from 5 °C to 15 °C	from 30°C to 55 °C



## 10. ELECTRICAL CONNECTIONS

The electrical plant for the unit power supply must be dimensioned by a certified professional and realized by qualified personnel, on charge of the Owner, in compliance with local Regulations in force.

Unit power supply cable must be protected by an automatic switch of suitable size and characteristics, as well as compliant with local Regulations in force.

The system must be realized so that it is possible to cut off power supply, without interrupting other services such as lighting, ventilation, alarms and safety system.

Any operation on the electrical circuit of the units, must be carried out by expert and adequately qualified personnel, in compliance with laws and local Regulations in force.



Before operating on electrical system, it is necessary to read the wiring diagram attached to the Manual.



You must verify that tension and frequency are the ones indicated on the unit and on the wiring diagram attached to the Manual.



You must use a power supply cable of adequate section and length as short as possible, to avoid excessive voltage drops.

### 10.1 Connection of the electrical power supply

The units must be powered by a 4 wire cable (3phases + GND), if tension of power supply is 400V / 3 ph / 50Hz + GND. Special power supply may be possible on demand (verify on the unit and electrical diagram).

Connect the phases to the inlet clamp of the main switch and the earth conductor to the suitable clamp. Use a power supply cable of adequate section (and length as short as possible, to avoid excessive voltage drops).

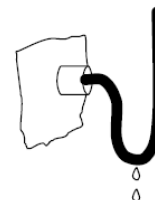
Protect the cable with an automatic switch of adequate size and characteristics. The section of the power supply cable and the size of the automatic switch, can be detected on the attached components table, on which the size of the general switch is also indicated.

The position of the inlet for the power supply cable is indicated on the dimensional diagram of the unit attached to the Manual. The cable entry must be adequately protected in compliance with local Regulations in force

In the case where the power cable entry is on top of the unit, you must perform a "bend-breaking drop", as shown in the picture.



Before operating on the electrical plant, you must visually verify that all circuits of the unit have not been damaged during transport. Specifically, it is necessary to verify that all screws of single clamps have been properly tightened and that cable isolation is correct and well preserved.



Conductors for the power supply cable phases must be connected to the free clamps entering the main switch; Earth conductor will be fixed to the clamp, which has been especially developed (and identified by PE symbol).

### 10.2 User terminal box connection

It's available a user terminal box in which you will find free contacts for:

- General alarm (1);
- Unit remote ON/OFF (2).

Please read wiring diagram to verify the exact numbering of the corresponding clamps.

Inside of the electrical board, a terminal box is available, in which you will find digital and analogue signals, concerning operation of the units. Since the configuration of the terminal box may vary from unit to unit, it is necessary to refer to the wiring diagram attached to the Manual.



As an example, you will find here below an image representing the clamps provided for the free contacts described below.



(1)	Digital input (free contact)	U2-30	Remote ON/OFF: Open = unit OFF Closed = unit ON
(2)	Digital output (free contact)	U9-U10	General alarm: NO contact (Closed = Alarm)
	Digital output (free contact)	U10-U11	General alarm: NC contact (Open = Alarm)

If, at the end of the inversion of all phases, it is detected that some components run in the incorrect way, it will be necessary to verify, and eventually correct the conductor sequence, for the single user, as described in previous paragraph.

If the water pump is not controlled by the unit's microprocessor, we recommend connecting an auxiliary contact of the contactor to the pump clamps remote ON/OFF arranged in the electrical board (see attached diagram), so that the unit can start only when the pump is running.

### 10.3 Correct power supply phase sequence check

The rotation sense of all electrical motors installed on the units (fans, pumps) is checked and harmonized during the factory test (except for units that cannot be switched on, for example, due to a special power supply).

Once the wiring has been executed, it is necessary to verify that the phases have been connected in the correct way. On this purpose, please make sure that all electrical motors run in the correct direction.

For units with triphase power supply, in case the rotation direction of some components is incorrect, you must assume that all motors rotate in the incorrect way and, therefore, it will be necessary to disconnect two conductors of the power supply line and invert the position, on the inlet clamps entering to the main switch.



To avoid wiring errors you must not connect any other conductors on the main switch besides the two involved in the operation.

If, at the end of the inversion of all phases, it is detected that some components run in the incorrect way, it will be necessary to verify, and eventually correct the conductor sequence, for the single user, as described in previous paragraph.

## 11. OPERATION



Before startup, it is necessary that personnel is instructed, also through the Manual, about the construction, management, operation and servicing of the units, safety measures, and legislation to comply with, any individual protection devices to be prepared, features and indications to handle the refrigerant

The unit is provided of forced ventilation of the compressors cabinet, leave always the main switch in ON position.  
Positioning in OFF only in unit's maintenance cases

### 11.1 Intended use

The unit must not be used for different than those explicitly provided in the Manual.

In particular, the unit must not be used:

- In areas under fire or explosion risk,
- In the presence of any aggressive substances, nor substances that are incompatible with copper, carbon steel and stainless steel;

### 11.2 Documentation

If the refrigerant charge is higher than 3Kg, the Owner of the unit must fulfil a Unit Register (here in after: Register), in compliance with EN 378-4, par. 4.3

In such document, following information about the unit must be indicated:

- Details for all servicing and repair jobs;
- Quantity and type of charged refrigerant (new, reconditioned or recycled) and quantity of replaced refrigerant on each occasion;
- Analysis of reconditioned refrigerant, whose result, if available, must be stored in the Register;
- Origin of reconditioned refrigerant;
- Any modification and substitution of system components;
- Results of all scheduled tests;
- Data storing for all relevant inactivity periods.

The Register must be held by the Owner, so that an update copy is always available for personnel during servicing and check operation on the unit.

### 11.3 Preliminary checks

Before start-up the unit must be visually checked by an expert technician, including following checks:

- Detection of any damage eventual occurred during transportation, storage or handling;
- Comparison of installation with electrical and hydraulic diagram;
- Check safety devices and related documentation;
- Certificates check, of the identification tags and, in general, of provided documentation;
- Verify that accessible pipings cannot cause any accidental harm to the public;
- Check the power supply has adequate size and characteristics, in relation to the charge necessity;
- Check the placing and the status of the valves and of the interception valves;
- Check integrity of supports and of the fixing devices;
- Check the quality of the soldering, of the brazing and other junction;
- Check the adequacy of the protections against mechanical damage, heat and moving organs;
- Check the accessibility for inspection, servicing and the reparation of main components;
- Check presence and status of the thermal and steam insulation.

Before starting the unit, one must verify that following conditions are respected:

- The chiller is positioned on a structure that can sustain it in a stable way;
- Grounding has been properly executed and connected to an efficient electrical system;
- The earth ground network is executed correctly and connected to a efficient plant;
- The power supply line is protected by an automatic switch of suitable size and characteristics;
- Close to the water inlet connection to the units, a mechanical filter of suitable dimensions and features must be installed; a mechanical filter of suitable dimensions and features must be installed.



*It is necessary to verify periodically the cleaning status of the mechanical filter to avoid that an excessive pressure drop may reduce the fluid flow to be cooled.*

- The hydraulic plant has been filled in the correct way and air completely removed;



*During unit operation, pressure in the hydraulic circuit must be always between 1,5 and 3,5 bar.*

- Hydraulic connections have been correctly executed and do not have any leak;
- The refrigerate fluid freely circulates and in the correct direction, across the evaporator;
- The refrigerant fluid flow corresponds to the designed one;
- Compressors shut-offs and along the cooling circuit (open or closed) according to the operation mode;
- If necessary, a mix of antifreeze fluid must be present in the requested concentration;
- The regulation temperature value and of the anti-freeze alarm, on the microprocessor, have been set on the correct values;
- The designed flow to the evaporator must be granted;
- The hydraulic circuit valves are open;
- All safety conditions have been respected;
- The wiring has been correctly executed;
- Tension is within a 10% tolerance than the nominal one of the units;
- Shutting of all electrical and hydraulic connections has been properly executed.

## 11.4 First start-up

First start-up of the units must be executed by a technician authorized by the Manufacturer.



*Before commissioning the unit, for the first time or after a long period of inactivity, you must verify that the parameters set on the microprocessor respond to the requested working conditions.*

To start-up the unit, you must turn the general switch to ON position, to supply power to the unit. Then, it will be necessary to push ON/OFF button on the microprocessor keyboard, by turning it into ON.

If the remote ON/OFF contact is closed, any circulation pump controlled by the microprocessor will start.

After a delay time, whose value can be set on microprocessor, fans will start and, later on, each compressor according to the requested cooling power to satisfy the necessary heat load and, later, each compressor based on the necessary cooling power to satisfy present thermal load.

Once the unit has reached a stable operation status, the technician performing the start-up will have to detect the operation parameters and verify that:

- High pressure safety pressure switches, are installed, properly set and correctly working;
- The setup pressure value on the external safety valves is correct and equivalent to the one stated;
- There are no refrigerant leaks.

The detected data needs to be registered on the first start-up module, attached to the Manual.



*A copy of the first start-up module, filled out in all applicable fields, must be transmitted to the Manufacturer, to make the Warranty effective.*



During the first start-up procedure, the technician must verify that the safety devices (high and low pressure switches, regulation thermostat, condensing pressure regulation device, etc...) are properly working.

## 11.5 Winter stop

If you believe that during unit stop, ambient temperature can go lower or close to 0°C, it will be necessary to introduce in the hydraulic circuit an antifreeze mixture with a freezing point sufficiently lower than minimum forecast temperature.

In some cases, to avoid risk of freezing, it is preferable to completely discharge water from the cooling circuit. In this case, before filling it up again, it will be necessary to proceed with cleaning.

## 11.6 Switching off

To switching off the unit, you must press ON/OFF button on the microprocessor keypad, by pressing OFF.

If you think the unit is switched off for longer than 24 hours, it is necessary to turn the main switch to OFF position to cut off the power supply.

In some cases, to avoid the risk of freezing, it is preferable to completely discharge water from the cooling circuit. In this case, before filling it up again, it will be necessary to proceed with cleaning.

## 11.7 Microprocessor regulations

To modify parameter values, it will be necessary to follow indications on the microprocessor documentation attached to the Manual.



Value modification of the set parameters must be exclusively executed by skilled technicians and, in any case, upon authorisation of the Manufacturer. The set of incorrect values, in fact, may allow unit operation at different conditions from the possible ones and, consequently, may cause damages to the unit and the plant.

## 12. MAINTAINANCE



The Owner must make sure that the unit undergoes proper maintenance, as indicated in the Manual in compliance with Laws and Regulations in force.



Equipment maintenance must be carried out by qualified and trained personnel, provided with personal protective equipment, as requested by local Laws and Regulations in force.

To perform any intervention that requires the cooling circuit opening, the following procedure has to be respected:

- 1) At least 4 hours before the maintenance switch on the crankcase heater;
- 2) Recovering the refrigerant by use a certificate tank;
- 3) Perform the circuit vacuum;
- 4) Fluxing the circuit with inertial gas (azote)
- 5) Cut the pipes with an orbital blade.

In general, anyone handling the refrigerant must be equipped, at least, with protective glasses and gloves.

Machine maintenance must be carried out in a way that:

- a) The risk of accidents for people and of damage to things is minimal;
- b) No damage occurs to system components
- c) The system's operation and readiness are not compromised;
- d) Any refrigerant leaks are identified and fixed;
- e) Power consumption is minimal.

Maintenance operations which do not require specific refrigeration knowledge (for instance, cleaning of the condensing coil fins), may be carried out by qualified personnel appointed by the Owner.

During maintenance operations, only authorized personnel may stand close to the unit.

During maintenance operations, it is necessary to check the conditions of labels and warnings on the system and its components; unreadable writing must be replaced.

The unit may not be modified in any way, nor any of its parts can be replaced without prior explicit authorization by the Manufacturer.



Before carrying out any kind of work on the machine, it is necessary to cut off the power supply from the electric panel, by turning the main switch to the OFF position.



Inside the unit there can be areas with high voltage. Access to such areas may be carried out only by qualified and trained personnel, authorized as provided by local Laws and Regulations in force.



Components surfaces on the compressor's discharge and on the liquid refrigerant line may reach high temperatures and touching them may cause burnings.



On board the unit there are sharp parts and cutting edges which, if accidentally hit, may cause cuts or scratches.



*In case of any doubt on the kind of malfunction detected or on actions to be taken to solve it, please contact the Manufacturer.*



Smoking is forbidden while performing maintenance operation on the unit.

### 12.1 Scheduled maintenance

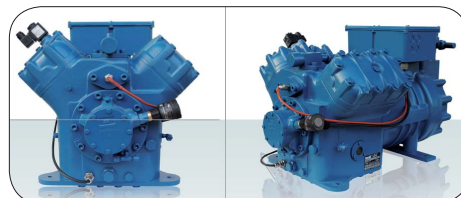


The Owner must make sure that the unit undergoes proper maintenance, as indicated in the Manual in compliance with Laws and Regulations in force.



Equipment maintenance must be carried out by qualified and trained personnel, equipped with personal protective equipment, as provided by Laws and Regulations in force.

**WARNING:**  
**The refrigerant R290 (Propane) is flammable and it must be handled only by competent and responsible operators, under the conditions specified in the safety regulations in force.**



The Owner must make sure that the unit is periodically inspected, also on-site, adequately maintained, according to the type, size, age and use of the system, and to the identifications contained on the Manual and also in compliance with local Laws and Regulations in force.

If leak detection instruments are installed on the system, they must be inspected at least once a year, to make sure that they work properly.

During operating lifetime, the unit must undergo inspections and controls based on Laws and local Regulations in force. Specifically, if there are no stricter specifications, it will be necessary to follow the indications of the following Table (see EN 378-4, att.D), with reference to the described cases.

SITUATION	Sight inspection	Pressure test	Leak detection
A	X	X	X
B	X	X	X
C	X		X
D	X		X
A	Inspection following an intervention, with possible effects on mechanical resistance, or after a change of purpose, or after a two-year stop or longer, it will be necessary to replace all components that are no longer suitable. Please do not make any verification at pressure higher than the design ones.		
B	Inspection after a repair, or significant modification of the system or its components. Check can be limited to the involved parts, but if a refrigerant leak is detected, it will be necessary to search for leaks in the entire system.		
C	Inspection following installation of the unit in a different position than the original one. If any effect on mechanical resistance may occur, please make reference to point A.		
D	Refrigerant leak detection following an evidence-based leak suspect. The system must be examined to detect leaks through direct measures (such as system that can detect it) or indirect ones (for example, by examination of the working parameters), by concentrating on the most likely leak areas (for example the joints).		



## 12.2 Semi-hermetic compressors maintenance

Before working on the cooling circuit, to replace the compressors or the oil contained in them, you will need to run the crankcase heater for at least four hours to perform the vacuum and purge the compressor with dry nitrogen, to avoid that the refrigerant dissolved in the oil, at pressure and ambient temperature, can give rise to an explosive atmosphere in the nearness of the oil surface.

The operating pressure and the periodic check of lubricant level are sufficient guarantees for a reliable compressor's service life according to the declared performances.

Maintenance interventions required are:

- Replacing the lubricant after 100 working hours from the first start-up of the compressor to remove impurities remaining in the circuit;
- Replacement of lubricant every 10'000 working hours to restore the original features of viscosity.

All the replacement of the lubricant operations must be carried out when the compressor is stopped.

For the replacement of the lubricant the normale equipments supplied to reach refrigerator technician are required, such as for example:

- ATEX CERTIFIED vacuum pump;
- Lubricant pump by hand;
- Flexible pipes with swivel connections and open valve;
- Counter torque wrench.



WARNING: Do not lose any bolt or compressor cap.

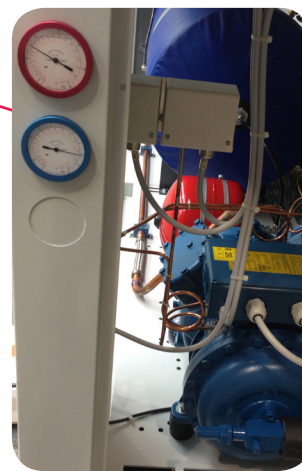
- Close the discharge valve;
- Slowly open the shut-off valve;
- Remove the oil drain plug;
- Allow to flow all the lubricant in an appropriate container.



The lubricant is polluting the environment and is considered a hazardous waste. So it should then be transported and disposed of according to local regulations.

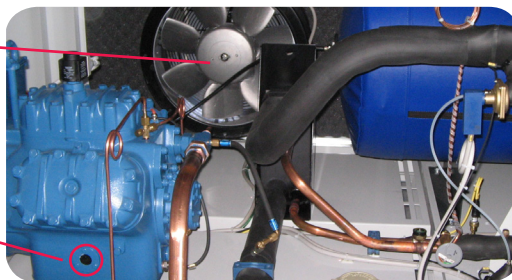
- Well close the oil drain plug and close the shut-off valve;
- Remove the oil fill cap in place and apply a Schrader service valve;
- Remove the cap from the service valve and connect the manual oil charge pump;
- Introduce the correct quantity of oil in the compressor pump by acting the head pump;
- Disconnect the pump from service valve;
- Connect the vacuum pump to the Schrader service valve;
- Start the pump and create a vacuum for at least 15 minutes;
- Reposition the cap and close the shut-off valve.

ATEX GAUGES



ATEX FAN

CHECK SIGHTGLASS OIL LEVELS



Failure of the proper procedure may cause severe damage to both the compressor and operator.

- Start the compressor and check oil level after 15-20 minutes of operation;

The level at which the lubricant deposits during the compressor operation is strongly influenced by the compression ratio and therefore by the working temperature. Whereas the acceptable minimum level is 1/4 oil of sight glass, the maximum level should not be higher than 3/4 of the sight glass.



### 12.3 Leak detection

If no stricter requirements are present, the unit will have to be checked for leaks at least every 3 months.

If, during the check, a suspect for a refrigerant leak arises, (es. after cooling capacity reduction, or after overheating or subcooling tests), it will be necessary to detect it with adequate devices, repair it and proceed with a new tightness test, in compliance with national Legislation in force.

The result of the check and the adopted measures must be stated on the Register.

Personnel working on refrigerant leak detection must not use open flames, or any flame source. Refrigerant leaks must be detected and repaired as soon as possible, by certified personnel in conformity with Laws and local Regulations in force.

### 12.4 Safety pressure switch check

If no stricter requirements are present, the safety high pressure switches must be inspected on site at least each twelve months, to verify that they have been well configured and that they work properly, and that they are also installed in compliance with applicable Laws.

### 12.5 Safety valves check

If no stricter requirements are present, external safety valves must be inspected on site at least each twelve months to check their tightness.

If a leak is detected, the valve has to be replaced.

Each five years, valves must be inspected to verify that they are in good state and that the working pressure, printed on the valve, is readable, that they are installed and that they have suitable characteristics to guarantee system safety in compliance with Regulations in force.

### 12.6 Fluid to be cooled check / Condenser fluid check

Refrigerant/liquid exchanger fluid must be inspected at least each six months, to check composition and detect any refrigerant presence.

### 12.7 Noise and vibration check

You must check at least monthly, that the unit does not make any unusual noises and that pipings are not subject to unusual vibration that may cause breaking.

### 12.8 Filter check

You must check that filter in-and-outlet temperature are the same; if the difference between is higher than 2°K please replace it.

### 12.9 Periodic servicing operations

OPERATION	PERIODICITA'				
	Daily	Monthly	Every 2 months	Every 6 months	Once a year
<b>ELECTRICAL SYSTEM AND CONTROL DEVICES</b>					
Check that the unit properly works and that there are no alarms	X				
Visual inspection of the unit		X			
Check the noise and vibration of the unit		X			
Check functionality of safety devices and interlocks				X	
Check performance of the unit				X	
Check electrical absorption or various components (compressors, fans, etc.)				X	
Check power supply tension				X	
Check cable fixing in each terminal				X	
Check integrity of the cable insulation					X
Check state and operation of the contactors					X
Check microprocessor and display operation		X			
Check microprocessor parameter values					X
Clean electrical and electronic components from any dust					X
Check probe and transducer operation and calibration					X
Check refrigerant level evaporator probe					X
Check the calibration of refrigerant level evaporator probe					X
<b>COOLING COIL, FANS AND COOLING CIRCUIT</b>					
Visual inspection of the coil		X			
Clean the finned coil					X
Check water flow		X			
Check noise and vibration for fans		X			
Check fan tension				X	
Check fans electrical connections					X
Check operation and calibration for fan speed regulation system *					X
Check there is no air in the cooling circuit		X			
Check the filter				X	
<b>COMPRESSORS</b>					
Visual inspection		X			
Check compressor vibrations and noise		X			
Check compressor supply tension				X	
Check compressor electrical connections					X
Check compressor cable status and their fixing inside terminal boxes				X	

Monthly and Daily procedures may be executed by Owner of the plant. Other services works have to be executed by certified and trained personnel.



It is forbidden to touch the unit barefoot or with wet or humid body parts.

It is forbidden to perform any clearing operation, before having disconnected the unit from the electrical supply network, by turning the general switch on OFF.



Operations on the cooling circuit must be executed by adequately trained and qualified technicians, certified in compliance with Laws and local Regulations in force.



When one operates on the units, it is necessary to use individual protection devices. Specifically, it is necessary to wear at least protective glasses, gloves, helmet and anti injury shoes.

## 12.10 Trouble Shooting

The detection of failure occurring during the operation is made by the microprocessor, which besides signaling alarms, also shows the active failure kind. The hereafter table reports the most common miss-functioning, and for each one of the most common causes and possible solutions.

In case of alarm, before any intervention, verify that:

- Working conditions are the expected ones, and in any case, compatible with the unit working limits;
- All the electrical cables of the involved components are firmly connected to their terminals (refer to the enclosed wiring diagram);
- The set values for the involved parameters are compatible with the real working conditions (refer to the enclosed microprocessor Handbook).

FAILURE	PROBABLE CAUSE	SUGGESTED ACTIONS
<b>1. Unit is not working</b>	a. Electrical board is not power supply	Check each phase Voltage in the power supply line Check that main switch is closed (position ON)
	b. Auxiliary circuit is not power supplied 240V / 24V	Check the fuses of the Auxiliary circuit (see wiring diagram), and the Phase monitor (if present)
	c. Microprocessor doesn't start the unit	Check microprocessor's electrical connections Check temperature set value
	d. External consent to the unit start is missing	Check that the remote ON/OFF contact is closed (see wiring diagram) Enable consent to the unit start from user board (display)
<b>2. Chilled water temperature too high</b>	a. Unit is not working	See point 1
	b. The calibration on ControlSystem is incorrect	Check the Control System calibration
	c. Compressor is not working	See point 7
	d. The compressor yield is not sufficient	See point 7 and 8
	e. The Control System is not working	Check the microprocessor Handbook
	f) Thermal load higher than expected	Check the thermal load

FAILURE	PROBABLE CAUSE	SUGGESTED ACTIONS
<b>3. Cooled water temperature too low</b>	a. The calibration of Control System is incorrect	Check the calibration of Control System
	b. The Control System is not working	Check the microprocessor Handbook
	c. The water chilled flow is too low	See point 4
<b>4. Chilled water flow non-compliant</b>	a. Hydronic pump is not working	Check the electrical connections of the pump
	b. Pressure drop in the hydraulic system is higher than estimated	Check the pressure drop in the circuit and compare it with the pump head pressure
	c. The pump heat protection is activated	Check the pump winding electric resistance; after reset, check tension end electric absorption
	d. Obstruction presence in the hydraulic system	Make sure filter are not clogged; check the shut-off valves on the circuit are open
	e. Air in the hydraulic circuit	Remove any residual air from the valves arranged in the hydraulic circuit
<b>5. High pressure switch is activated</b>	a. The high pressure switch is not set properly or is defective (if present)	Check the setting and functionality of the system for condensing control
	b. OFF condenser line pump	Check intervention of the internal overload protection for the fans that are not working, replace the defective fans
	c. High pressure switch is not set properly	Replace high pressure switch
	d. Condensing air flow is not sufficient or heat exchanger is dirty	Check for absence of occlusions or dirty in the coils
	e. Check the presence of incondensable gases	Check the status of liquid sight glass and/or check pressure/condensing temperature, empty the circuit, execute vacuum and charge refrigerant gas correctly
<b>6. Low pressure switch is activated</b>	a. Low pressure switch is not set properly	Replace low pressure switch
	b. Too low suction pressure	Check the probes and thermostatic valve (see point 10)
<b>7. The compressor is not working</b>	a. Automatic switch is activated	Riarmare l'interruttore automatico, verificare assorbimenti elettrici
	b. Compressor internal heat protection is activated	Verificare che i parametri di funzionamento rientrino nei valori nominali, verificare il surriscaldamento della valvola di espansione e modificarlo.
	c. The contactor is not working	Controllare i contatti e la bobina del contattore
	d. Thermostatic expansion/electronic valve is closed	Controllare gli organi della valvola
	e. Normal operation with too frequent start and stop due to activation of safety low pressure switch. Bubbles in sight glass	Low refrigerant charge, find the leak in the circuit, intercept the components, execute vacuum and charge refrigerant gas correctly until the sight glass is without bubbles inside
	f. Suction pressure is too low; dehydrating filter is frozen	Clogged filter, replace it
	g. The compressor motor is burnt out	Replace the compressor

FAILURE	PROBABLE CAUSE	SUGGESTED ACTIONS
<b>8. Compressor is noisy</b>	a. Suction line is very cold (unusual)	Check overheating and expansion valve blocked in position too open
	b. Liquid return to the compressor	Compressor suction valve is blocked, replace it (if present)
		Check functionality and overheating of the expansion valve.
<b>9. Compressor low suction pressure</b>	c. Compressor is damaged	Replace the compressor
	a. Bubble presence in sight glass	Check the refrigerant charge
	b. No refrigerant flow through the expansion valve	Check the expansion valve
	c. Discharge pressure too low	Check the probes and/or expansion valve
	d. Decreasing of cooling capacity	Check of expansion valve bulb and control of correct operation
	e. Overheating too high	Too high drop of gas/water exchanger, check correct functioning of thermostatic valve
	f. Refrigerant filter clogged	Check refrigerant filter, check temperature, replace if necessary
g. Thermostatic valve defective or not set properly	Check that overheating of the thermostatic valve is correct. Check integrity of the thermostatic elements	
<b>10. High discharge compressor pressure</b>	a. Water temperature across condenser is too high	Check for any recirculation and reflux of condensation water
	b. Low condensing water flow	Check that there is no impediment to the free flow of water to the finned exchanger
	c. Suction pressure too high	Check the thermal load
	d. Plates condenser escluded	Remove the occluding material
	e. Refrigerant level on circuit too high: condenser partially flooded	High refrigerant subcooling: discharge some refrigerant from the circuit
	f. Air non-condensable or gas in the circuit	There are bubbles in the sight glass. The compressor discharge side is high: the circuit has to be discharged and recharged after the vacuum execution.
<b>11. Compresor discharge pressure too low</b>	a. Condensing pressure control system is not efficiency	See point 9
	b. Suction presure is too low	
<b>12. Probe alarm</b>	a. The probe corresponding to the alarm code is faulty or disconnected	Check the probe connection and functionality. Replace the probe if is necessary.

### 13. EXTRAORDINARY MAINTAINANCE

Repairs of the units will have to be executed by adequately qualified and informed personnel, equipped with individual protection devices, in conformity with Laws and local Regulations in force.



No modifications to the unit or components replacement are allowed without explicit Manufacturer authorization.

Procedures carried out by personnel with different skills (such as welders, electricians, programmers, etc.) must be executed under the supervision of personnel with the necessary refrigeration skills.



*During brazing and welding procedures, one must remove parts that might be damaged by heat and protect them by wrapping components with wet clothes.*



*When interventions that require dismantling of valves or interception valves, it is advisable to replace joints with new ones.*

### 14. DEMOLITION AND DISPOSAL

At unit's disposal the different components the unit is made of must be devided and sent to the waste separated collection. This operation must be done by a specialized firm, in compliance with current environmental Laws.



In case of the unit has worked wit antifreeze mixture, it is necessary to collect all the fluid contained in the unit and deliver to an authorized waste center.



It is forbidden to waste the antifreeze solution of the unit in the environment.





