RIVACOLD

UK

USE AND MAINTENANCE MANUAL
MULTICOMPRESSOR PACK SYSTEMS

ENGLISH

0. CONTENTS

1. PURPOSE OF THE MANUAL

The purpose of this manual is to assist operators in placing the refrigeration unit into operation correctly, as well as to supply advice and explanations about the relevant safety regulations in force within the European Community and avoid any possible risks caused by incorrect use.

2. NORMS FOR GENERAL USE

- For a correct and safe use of the machine it is necessary to follow the instructions and guidelines stated in this manual since these refer to:
  - installation
  - starting the machine
  - machine use
  - maintenance
  - placing out of service and disposal
- *The manufacturer cannot accept any liability for damages resulting from failure to follow the instructions, advice and warnings given in this use and maintenance manual.*
- Read the labels on the machine with care. Do not cover them for any reason and replace them in the event that they become damaged.
- Keep this manual carefully.
- The manufacturer reserves the right to update this manual without any prior notice.
- The machines were designed solely for industrial and commercial refrigeration in a stable seat (the application range is quoted in the company's general catalogue). *They are not intended for any other purpose*. Any other use is to be considered improper and therefore dangerous.
- After removing the packaging, check that every part of the machine is intact; if not, contact the relevant dealer.
- Do not use the machine in atmospheres with inflammable gas or in environments where there is a risk of explosion.
- If an operating fault occurs, switch off the machine.
- Any cleaning or maintenance operations must be carried out by qualified technical staff only.
- Wash the machine with soap and water. Do not use aggressive products and never use direct or pressurised jets of water.
- Do not use the machine without its safeguards.
- Do not place liquid containers on the machine.
- Keep the machine well away from sources of heat
- Never close the service shut-off valve while the machine is operating.
- In the event of fire, use a dry-chemical extinguisher.
- Packaging material must be suitably disposed of in accordance with current laws.

Note: all machines are subjected to tests and inspections.

3. MACHINE IDENTIFICATION

All machines are fitted with an identification label (the position of which is shown in drawing. 1), containing the following information:

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- code number
- serial number
- electrical input (A)
- electrical input (W)
- refrigerant type
- power supply tension (Volt/Ph/Hz)
- maximum operating pressure value (PSHP) and (PLSB)
- machine category according to the Directive 97/23EC (PED)

N.B. The machine label, both for the version with casing and the open version, is located on the right-hand side of the base, on the longest side.

Serial number identification:

- 1st and 2nd numbers = the last two numbers of the year of production
- 3rd and 4th numbers = the week number of the year in which the machine was made
- 5th, 6th, 7th and 8th numbers = progressive number

4. MACHINE DESCRIPTION

Packs, are commercial refrigerating systems comprised of multiple compressor sets, operating in a parallel system and used at medium and low temperatures.
Packs, are complete with refrigerating accessories such as: liquid receivers, pressure relief valve, oil separator, liquid separator, mechanical suction line filters, oil line filters, liquid line filter, humidity sight-glass, service shut-off valves and, where necessary, oil vessel and oil level controls.
There are different versions:
-with casing and without condenser (Standard version)
-open (without casing and with components on view) without condenser
-open with built-in condenser
-open with separate condenser
-with casing and built-in condenser.
-with casing and separate condenser.

5. INSTALLATION

Before installing, it is necessary to make a layout of the refrigerating system; this must include the following:

a) all components of the refrigerating system (e.g. pack, evaporators, thermostatic valves, electrical panels, piping dimensions, any safety components, etc.)
b) system location
c) piping location (lay-out)

- **Installation must only be performed by qualified staff with the necessary technical requirements according to the country in which the machine is installed.**
- The machine must not be installed in a closed environment where good air flow is not guaranteed.In case this is not possible, we recommend to guarantee a proper air change (at least 150 times the ambient volume where the pack is installed) and provide the plant of an acoustic/light alarm in case of refrigerating gas leak.
- When installing a pack with integral condenser, NEVER INSTALL IT IN CLOSED ENVIRONMENTS. If the area has a roof, this must guarantee air exhaust and intake for the condenser. In the event of different installation, we recommend contacting the manufacturer.
- When installed, packs must be horizontally level with the floor, taking great attention to position the unit levelly in the case of those models where the oil level in the compressor is regulated by a balance pipe (no oil controls).
- The unit supports must be fixed to the ground with the relevant screws.
- The machine must be placed at a minimum distance of at least **1 m** from walls in order to allow

maintenance to be performed in safe conditions.

- When moving the pack, always use means that are suited to the weight of the equipment. Always use a forklift (or other hoisting means) to lift the machine.
- Avoid sudden manoeuvres which might compromise the normal operation of the system.
- For weights, please see the Rivacold catalogue.
- For compressors installed with sprung vibration damper (e.g. Bitzer compressors), before start up, it is necessary to loosen the screws and remove the washer (see the instructions here below).

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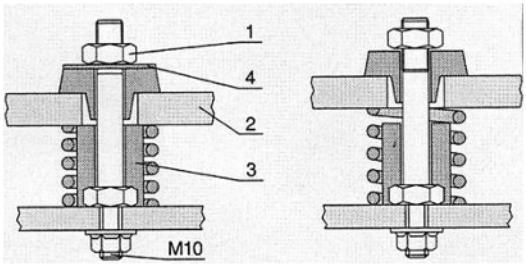
PROCEDURE FOR COMPRESSORS UNBLOCKING

TRANSPORT SAFETY DEVICES FOR MULTICOMPRESSOR PACK SYSTEMS

Type 2

During transport During operation



Before transport:

- Tighten the self-locking nut (1) untill the baseplate of the compressor (2) rests on the guide sleeve (3).

After installation:

- Loosen the nut (1) untill the slotted kasher (4) can be removed.
- Remove the slotted washer (4).

5. 1 Refrigerating connection

In order to make the connections, suction and liquid line and piping with the same diameters as the connections fitted on the machine must be provided.
The recommended diameters are valid up to a maximum length of 30m. For longer sizes, use piping diameters of a correct size to guarantee the proper gas speed or contact Rivacold's Technical Dept.

- In principle, pipes should be as short as possible. This is necessary to reduce both charge losses and the overall volume - and therefore, quantity - of the refrigerant.
- Pipe direction changes must be made using bends with a radius more than 2.5 times the diameter of the piping itself.
- For pipe fixing and distances, see EN 97/23 EC (PED).
- The suction outlet coupling to the evaporator must be comprised of a short horizontal section, followed by a siphon.
- Welds for the pipes connecting the condensing unit and the evaporator must be made after the pipes themselves have been positioned. During the brazing process, it is most important to have dry nitrogen flow through the pipes.

5. 2 Condenser installation

First of all, it is necessary to choose the condenser according to the heat to be disposed of (see the Rivacold catalogue) according to the maximum foreseen ambient temperature and the foreseen rated evaporating temperature as well.

- If the condenser is installed on a floor above the pack, it is necessary to fit a check valve between the condenser and the oil separator.
- The condenser must be installed in such a way as to be easily accessible in case of maintenance and in a properly ventilated area.

5. 3 Suction pipes

When the evaporation temperature is less than -10°C, the suction lines must be insulated using anti-condensation piping with a thickness of at least 13 mm in order to limit their overheating.

The size of the suction pipes must be decided on the basis of the fact that oil return to the compressor is mainly caused by fluid speed: pipe size must never be decided according to the size of the compressor couplings or evaporator. All systems must be designed to guarantee oil return to the compressor in all cases.

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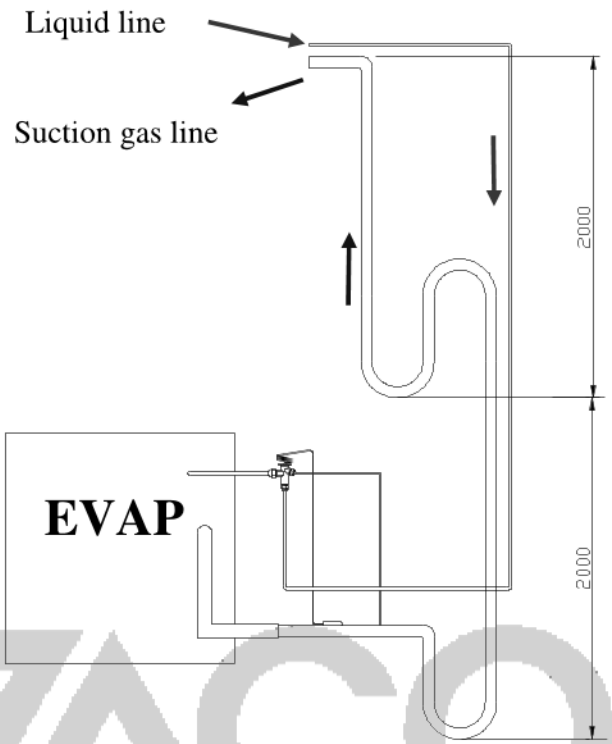
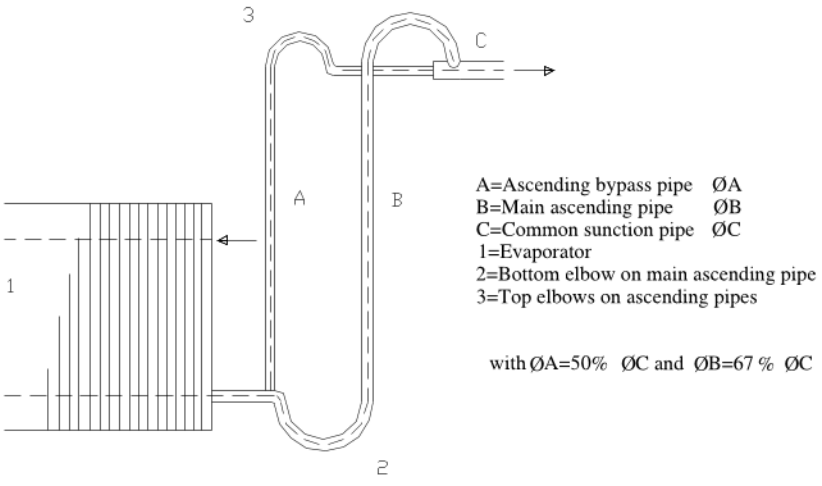
When the condensing unit is positioned above the evaporator, it is important to fit siphons along the suction line, every 2 m of difference in height, in order to guarantee oil return to the compressor (see figure 1).

FIGURE 1



When unit power is greatly reduced, for example, when 3 out of 4 compressors are idle, steam speed is one quarter of full power and oil circulation is no longer guaranteed in the ascending sections of the circuit. In this case, it is necessary to fit two parallel ascending pipes, each with different diameters (*splitting* configuration, see figure 2)

FIGURE 2



In any case, when there are horizontal sections, it is important for suction pipes to have a slope of at least 3% downwards towards the compressor.

5. 4 Adding oil

Packs are equipped with a charge in the oil vessel. When starting the machine, it is necessary to check the oil level using the relevant sight-glasses (see section 8, cleaning and maintenance).

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5. 5 Vacuum

For the correct operation of the refrigerating equipment and the duration of the compressor, it is very important the vacuum in the system to be set correctly. This will ensure that air and above all, humidity contents are below the permitted values. The introduction of new gas types has meant the use of new oils of polyester types that have high-level hygroscopic characteristics and which require more attention when setting the vacuum. We would advise setting the vacuum on both sides of the circuit. In any case the target is a vacuum of 0.14 mBar (100 µm Hg).

Important: *in order to avoid irreparable damage to compressors, never start them in vacuum conditions and without the gas charge*.

During the vacuum and charge procedure, remember to energise the solenoid valves coils present on the system.

5. 6 Refrigerant charging

After the vacuum-setting operation, the system must be charged with the type of refrigerant stated on the label or with one of the alternative types allowed. To charge the refrigerant correctly, we recommend that, after setting the vacuum, you pump part of the refrigerant into the compressors to "break the vacuum". Then start the compressors so that it sucks up the residual part of the refrigerant.

For the correct calculation of the gas charge, use the HBP and LBP gauges connected to the pressure inlets (already fitted). Operating conditions must be as stated in the catalogue.

Important: *mixtures of refrigerating gas must be charged into the system in their liquid state only.*

Charging operations must be carried out by specialist technicians only.

For charging, recovering or checking the gas, use gloves to protect against low temperatures.

5. 7 Leakage check

A system can operate correctly over time and for the entire lifetime of the compressor only if all instructions for a correct installation are followed. These include the absence of refrigerant leaks. It has been estimated that leaks of 10% of the refrigerant charge during 15 years of compressor operation still guarantee a good level of operation of the refrigerating system. With the new types of gas (R134a, R404a and mixtures), the possibilities of refrigerant leaks through welding or connections that have not been carried out correctly increase because of the reduced molecular dimensions of these gases. For these reasons, it is very important that welding is checked for leakages using methods and equipment that are suitable for the type of refrigerant gas in use.

5. 8 Crankcase heater

Whenever the compressor operates in ambient temperatures of less than +5°C, it is compulsory to use a crankcase heater in order to avoid the build-up of liquid in the lower side of the compressor during stoppages. Furthermore, it is necessary to choke the condenser, for example, by reducing its air capacity (i.e.: by means of a speed regulator).

5. 9 Pressure switches

The pack may be fitted with different types of pressure switch:

- General high- and low-pressure switch
- Alarm pressure switches to change compressor control from electronic to mechanical one
- Low-pressure switches on each compressor used in mechanical mode
- Safety high-pressure switches on each compressor
- Pressure switches to choke the condenser fans
- Differential oil pressure switches on the compressor (where required).

5. 10 Timers

The timers on the unit serve to delay switching over from electronic to mechanical operation when the relevant pressure switch signals an electronic alarm. They also serve to prevent the compressors from switching on and off too suddenly when operating in mechanical mode.

5. 11 Pressure relief valves on the liquid receiver

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Machines are equipped with a pressure relief valve on the low and high-pressure sides. Valve settings are shown on the valves themselves and are calculated according to the EN 13136 Directive.

5. 12 Electrical panel

The electrical panel has the following functions:

- Main switch with door lock
- Safeguard with fuses for all loads
- Indicator lights to show mains power, function and alarms
- Compressors protected by means of thermal relays
- Power supply transformer for control circuits
- Provision for general maximum and minimum pressure switches
- Provision for maximum pressure switches on each compressor

Emergency system for electronic card failure **(remember to set the "mechanical operation switch" to the "off" position)** : in the event that there is an electronic control failure, during unit operations there may be an increase in pressure on the suction line. The electronic alarm pressure switch will detect the failure and trigger the timer, which, at the end of the count, will switch operations over from electronic to mechanical (**important note**: If, during the count, suction pressure returns to below the maximum pressure value for which the alarm pressure switch is set, the timer will return to zero and electronic operation will be resumed). During mechanical operation, the low-pressure switches connected to each compressor will control the start of each one; **this control can also be obtained manually by setting the "mechanical operation switch" to the "on" position.**

- The electrical panel contains an electronic controller with different functions:
  - Adjustment by means of a pressure probe or temperature probe
  - Piloting compressor operations, including compressor revolution algorithms, to allow uniform wear
  - Management of alarms: general high and low, thermal alarms on compressors, high pressure on compressors and mechanical mode operation.

5. 13 Electrical connection

To make the electrical connections correctly, proceed as follows

- Make the connections as shown in the annexed wiring diagram.
- Fit a differential thermomagnetic switch between the power line and the electrical panel on board the machine. Make sure that the mains voltage is the same as that shown on the plate on the pack (permitted tolerance: 10% of rated voltage).
- **NOTE: the differential thermomagnetic switch must be placed next to the pack so as to be easily seen by a technical engineer in case of maintenance.**
- Use a power cable to connect the differential thermomagnetic switch to the door lock disconnector on the machine.
- The power cable section must be suited to the electrical input of the pack.
- The law requires that the system be earthed; therefore, it is necessary to connect it to an efficient earthing system.
- Never perform any maintenance operations while the pack is energised.
- **Important: SCROLL** compressors compress in one set revolution direction, but the three-phase motors that drive them will rotate in both directions, according to the phase connections to the terminals. It is important, therefore, to **check the correct compressor revolution direction.** This is checked by monitoring the drop in suction pressure and the rise in discharge pressure when the compressor is started. Reverse revolution will produce a sound level that is higher than the one produced by the correct revolution direction and an electrical input that is higher than that quoted in the catalogue. We advise you to fit a protection device for inverted

phases (available as an OPTIONAL extra), which will intervene in the event that the phases are not correctly connected.

- ***Any liability deriving from failure to respect the above instructions will not be accepted.***

6. SAFEGUARDS

The system is fitted with safeguards to protect against abnormal conditions for both the pressure and power circuits.

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6. 1 Excess pressure inside the refrigerating circuit

The safeguard against excess pressure inside the refrigerating circuit during discharge, which as well as compromising system operation, can also be dangerous to personnel, has two intervention steps:

- When the pressure reaches values in excess of acceptable conditions – values set according to the characteristics of the refrigerant used, the size of the system, and the characteristics of the compressor – the maximum pressure switch, which is factory set, will intervene to shut down the system. System operations may only be restored manually and only after the cause of the failure has been solved. In some systems, the maximum pressure switch is incorporated into a double pressure switch that has both minimum and maximum pressure functions
- In the event that, due to an anomaly, the maximum pressure switch fails to operate or in the event that the circuit, even when idle, is accidentally subjected to exceptional temperatures, there is a pressure relief valve or for smaller powered systems, a fusible plug. The intervention of these devices, which must be fitted to any pressure appliance by law, causes the refrigerant charged into the system to leak out, either wholly or in part, which must be considered an exceptional event.

6. 2 Refrigerant pressure defect

Refrigerant of defective quality, incorrect thermostat adjustments and gas leaks that reduce the refrigerant charge are all causes that may cause the suction pressure to fall below permitted design levels.

This is not dangerous for operators but it causes a drastic fall in the thermodynamic performance of the system and may cause the compressor to break.

In the event that pressure falls to below set values, the minimum pressure switch will enter into operation. As already mentioned, this switch may be incorporated into the maximum pressure switch.

This intervention also blocks the compressor motor, but not permanently. If pressure on the suction side begins to rise again, the appliance will again enable the motor to start. Of course, this is acceptable if the problem is transitory but will require a maintenance intervention if the problem occurs repeatedly.

6. 3 Insufficient compressor lubrication

This is found in all compressor systems where lubrication is pump operated (inside the compressor). The intervention of this device is delayed in order to filter pressure oscillations at compressor start-up. It is manually reset, using the button on the front panel of the instrument, which may and should be used after waiting for 15 minutes.

Of course, it will be immediately necessary to check the oil level.

Should it be necessary to change this pressure switch, it is most important to replace it with a switch of the same make and type or to ask the manufacturer of the compressor about other permitted makes/types.

For systems with semi-hermetic screw compressors, secure oil return to the compressor and therefore, adequate internal lubrication is guaranteed by a flow switch fitted to the oil return line from the separator to the compressor. The signal is brought back to an electronic module and its intervention is delayed by a timer in order to prevent flow settling oscillations after the compressor is restarted.

6. 4 Electronic control malfunction

In the event of compressor electronic control malfunction, the control pressure switches and

pressure probes will detect the malfunction and, after a certain amount of time, enable the mechanical control mode.

7. SIGNALS

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Besides the lit signals and instruments installed on the panel board of the electrical panel, which can be seen on the wiring diagram and in the annexed documents, the circuit includes visual indicators. To access these indicators, on those units for outdoor installation, it may be necessary to remove one or more of the metal panels that close the condensing unit structure.
These panels are slotted in and to remove them, they must be lifted and pulled outwards. It may be necessary to unscrew any fastening screws.
It is advisable always to refit the panels with care, as they have the important role of conveying the flow of condenser cooling air.

7. 1 Liquid passage indicator

This is a transparent gauge that is installed along the liquid line to give an idea of the current charge. When systems are at running speed, the flow must be continual and free of foam or gas bubbles.
In the event that there is notable turbulence or the presence of gas, wait a few minutes before correcting the charge: the problem may be a transitory one, caused by the rapid opening of a thermostatic valve.

7. 2 Humidity signals

Looking at the passage indicator, it is possible to see a coloured element that shows whether the refrigerant is dry or if it contains humidity.
On the basis of the colour of the element, which varies, and of the indications in the specific instructions, it is possible to identify the water content in p.p.m.
In the "CAUTION" stage it is necessary to replace the cartridges in the drier filters.
In the "ALARM" stage, it is necessary to:

- Stop the system immediately
- Recover the entire refrigerant charge and send it to the relevant disposal centre
- Recover the entire oil charge and send it to the relevant disposal centre
- Fill with new oil which must be anhydrous
- Replace the filter cartridges
- Reset the vacuum
- Recharge the system.

7. 3 Oil level indicator

This is fitted to the compressor crankcase and also shows the maximum and minimum permitted oil levels. The oil level should be checked when the system has been running steadily for a few hours and after the motor compressor has been stopped, in order to allow the oil level to stabilise inside the crankcase.
We recommend repeating this check twice more, at distances of 40 minutes apart. In the event that more oil is required, only ever use the type of oil shown on the data plate or in the relevant documentation. This rule must be respected.

7. 4 Pressure gauges

These are fitted to the unit for visually checking pressures of the various parts of the circuit:

- Hermetic and semi-hermetic compressors without oil pump: pressure gauge on the high- and low-pressure sides;
- Semi-hermetic compressors with oil pump: pressure gauge on the high- and low-pressure sides as well as on the oil pump.

These are special gauges with dual scales – pressure and temperature – for different types of refrigerant. They are usually slotted in above the electrical panel of the unit. In the event of units to be installed outdoors, to view the pressure gauges it is necessary, with the due caution, to remove the protection panel in front of the electrical panel door. For special cases, they may be located with the pressure switches on special brackets between the unit uprights.

7. 5 Motor thermal relays

All electric motors fitted on our machines are protected against short-circuit and overload; more specifically, this means all motors with three-phase power to compressors and fan motors (with power input in excess of 0.5 kW).
Protection against overloads for three-phase motors is supplied by thermal relays with variable calibration and automatic or manual reset (see figure 3).
During the production of its machines, the manufacturer takes every care to safeguard, first and foremost, the maintenance of the products inside the cold room in optimum conditions and therefore, **the automatic reset of the devices named here above is preferable.**
Important notice: Setting the rest to manual means that a technical engineer is required to intervene each time that the relay is triggered. If this intervention is not performed in time, it could lead to the deterioration of the products being stored.

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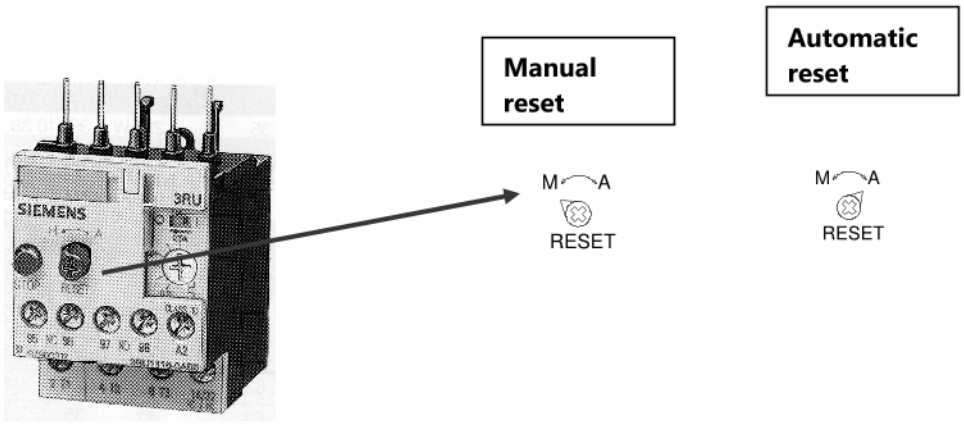
FIGURE 3



8. STARTING THE UNIT

Before taking the pack to running speed, it is necessary to perform various checks at the moment of start-up:

8. 1 Compressor crankcase pre-heating

At least 12 hours before starting the compressors, it is necessary to switch on the crankcase heaters in order to prevent the risk of diluting the lubricating oil with the refrigerant.
Set the main disconnector to ON and the line output disconnector to OFF.
For units to be installed outdoors, in areas where minimum ambient temperatures are extremely low, it is also possible to fit heaters - with the same function as the crankcase heaters – to the suction manifold and oil vessel tank.

8. 2 Caution

Check once again that the refrigerating and electrical circuits have been correctly completed and, in particular, that the equipment has been correctly earthed.
Make sure that all shut-off valves on the refrigerating circuit have been opened and that those which are shunted to the outside, which must be fitted with caps, are closed.
Check that the voltage between the terminals, phases and neutral is as required.

8. 3 Compressor revolution check

The revolution direction of reciprocating compressors is not important, while for screw or scroll compressors, it must be checked.
For systems with these types of compressor, before starting the unit:

- Close the suction shut-off valve
- Start the compressor, observing the pressure gauge connected to the compressor on the low-pressure side
- As the pressure indicated on the pressure gauge increases or lowers, proceed as follows:

The correct revolution direction is shown by a lowering of the pressure shown on the gauge. If this does not occur, invert two of the three phases upstream of the compressor contactors and repeat the test. It is also necessary to check that the phase sequence controller has been correctly

connected since, in the event of an incorrect power supply to the compressor, it should not allow the system to be started.

8. 4 Fan revolution direction check

It is necessary to check the revolution direction of the fans when the three-phase motors are fitted and, according to the unit model, on:

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- Air-cooled evaporators
- Condenser
- Compressor cooling heads
- Oil cooling fin coils
- Other specific equipment with three-phase fan-motors

When performing this check, make sure that the airflow direction is such that it guarantees the correct operation of the appliance. If this is not the case, invert two of the three power conductors upstream of the relevant contactor, taking care not to affect the revolution direction of other system motors.

8. 5 Panel closure check (for units for outdoor installation)

Make sure that the panels on the condensing unit structure are closed correctly to prevent problems with the correct use of condenser cooling air

8. 6 Maximum pressure switch check

Disable the condenser fan motors, fit a pressure gauge to the high-pressure side if not already available and check the increase in pressure caused by the lack of condensation, making sure that the system is stopped at the set level of the pressure switch.
This operation should be supervised carefully in order to be able to stop the system in due time if the pressure switch fails to intervene.
Once this operation has been terminated, open the shut-off valve fully.

8. 7 Minimum pressure switch check

Fit a pressure gauge to the suction line, if not already connected.
Very slowly close the shut-off valve on the liquid line; watch the suction pressure drop and check the level at which the minimum pressure switch intervenes, which should be the same as the set value.
Once this operation has been terminated, open the shut-off valve fully.

8. 8 Oil differential pressure switch check

When the system is idle, switch off the power, open the electrical panel, and remove the power fuses for the compressor line.
Start the system and make sure that the compressor contactor has been energized.
Wait for the remote switch to be released by the intervention of the differential pressure switch, which will detect no pressure. The maximum time limit for this may be 120".
After a few minutes, press the reset button, replace the fuses and start the system as normal.

8. 9 Refrigerant charge check

Once running conditions have been reached, it is advisable to check the regular flow of refrigerant using the relevant indicator on the liquid line.

8. 10 Lubricating oil return check

We also recommend checking the level of the oil in the crankcase. The oil should show no excess foaming.

8. 11 Mechanical filters on the suction line

Pack with multiple compressor sets, operating in a parallel system are equipped with mechanical filters on the suction line.
These may be used both at the first start-up and while degassing the circuit, by inserting the relevant filter cartridges.
To fit or replace filters, proceed as follows:

- Close the inlet and compressor suction shut-off valves
- Discharge and recover the refrigerant fluid trapped between the shut-off valves
- Replace or clean the filters as required
- Close the filter container with care and if possible, replace the gasket
- Set the vacuum for the volume concerned
- Open all shut-off valves, but only when the correct vacuum has been reached and maintained.

8. 12 Suction filtering when starting the system for the first time

Before starting the system for the first time, we recommend inserting cartridges in the circuit. These must be checked after approx. four hours of operation and cleaned in the event they contain impurities. They must then be checked at regular intervals until all impurities have been removed.
At this point, it is best to close the filter without a cartridge in order to eliminate a cause of charge loss.

8. 13 Maintaining running speed – Prolonged stoppages, restarting

We recommend that the system be kept at running speed.
We can say that the expected operating time is increasingly higher with a reduced number of stoppages out of service.

8. 14 Maintaining automatic control

The system is under automatic control and will stop as soon as the set temperature is reached.
We recommend stopping the system and switching off the power when it is going to remain out of use for more than 10 days running.

8. 15 Closing the refrigerant shut-off valves

Closing the refrigerant shut-off valves, which may be considered a good thing when the system is to remain idle for long periods, can be dangerous since it may cause a large quantity of refrigerant to become trapped between shut-off valves. Since this fluid is sensitive to temperature – even caused by sunlight - it may reach dangerous pressure levels leading to explosions where manoeuvres bypass safety devices – valves or fusible plugs.
It is possible to close the two shut-off valves (suction and discharge) on the compressor, as long as it is certain that all refrigerant has been discharged from the crankcase. This is done by repeating the vacuum stop manoeuvre. It is necessary to make sure than no one can start the machine while the shut-off valves are closed.

8. 16 Excessive ambient temperature

In the event of placing the machine out of service, it is necessary to also take precautions to prevent it from reaching excessive temperatures (above the limit of 50°C).
Excessive temperatures can cause pressure increases of the refrigerant in the system, leading to pressure relief valve intervention and loss of charge.

8. 17 Advance energising

This important preliminary operation is to be carried out with the crankcase pre-heating procedure.

8. 18 Controls and precautions

The procedure described previously for starting the system must be repeated, taking all of the relevant precautions.

9. TECHNICAL DATA

All RIVACOLD multicompressor pack systems are supplied under nitrogen pressure. More than one evaporator may be connected to each pack, in compliance with refrigeration rules of course. In any case, it is necessary to select single components with care.
The following is a refrigerating diagram for the evaporator section

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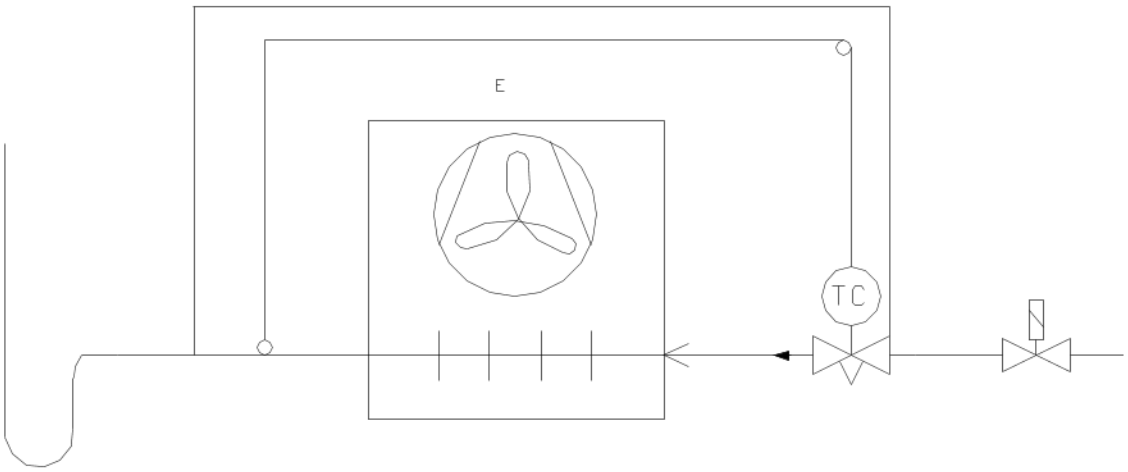

The following tables contain the main technical data for multicompressor packs.

10. PRESSURE RELIEF VALVE

10. 1 Warnings and limits of use

We recommend that the pressure relief valve be replaced in the event that it intervenes; during the drainage; the build-up of component and piping operating residues on the valve seal may make the seal loose the next time that the valve is closed.

- Before replacing the valve, check that, in the intervention area, the system is neither pressurised or at a high temperature.

10. 2 Valve setting maintenance/inspection

WARNING! No maintenance is foreseen for pressure relief valves. Removal of the cap or tampering with the seal is considered unauthorised changes to the factory settings, which will make the manufacturer's guarantee null and void.

Safety valve inspections are reserved to specialist bodies and are governed by specific laws and standards, according to the country of use.

10. 3 Expected life

We recommend having the pressure relief checked every 5 years.

11. CLEANING AND MAINTENANCE

- Cleaning and maintenance may only be carried out by qualified technical engineers.
- Before performing any operation, make sure that the electricity is disconnected.
- **Important note:** At the end of maintenance, replace all previously removed safeguards
- **In the event that machine parts need replacing, they have to be replaced by items exactly the same to the originals ones**

Maintenance description	Frequency
Filter efficiency check After 60 hours of compressor operation, replace the suction filters; repeat this step and if the filter is clean, it is possible to remove it all together, an operation that will increase unit efficiency.	Monthly
Oil level check After a sufficient period of steady compressor operation (**approx. 2 hours of operation**) under the conditions for which the system was designed, it is necessary to check the oil indicator which, according to versions, is located on the oil tank (where fitted) or on the oil manifold (if there is no tank), and to top up the oil if necessary. Make sure that the oil circuit is not blocked by checking the indicators located near to the compressors. Repeat this step after 60 compressor operation hours. The type of oil used in each compressor is listed in TABLE 2.	Monthly
Replace the lubricant.This serves to remove any impurities from the flow of refrigerant and lubricant, remaining in the system or which have built up in the housing.	100 hours
Replace the lubricant charge to guarantee original viscosity characteristics.	10000 hours
Controls and safety check Check the working order of all control and safety equipment.	Monthly
Electrical contacts condition check Clean the fixed and mobile contacts of each contactor and replace if they show any signs of wear.	Monthly
Electrical terminals connection check Check that all electric terminals, both on electrical panels and terminal boards, are properly connected; also check carefully that all fuse elements are correctly clamped.	Monthly
Oil and refrigerant leak check: Visually check the entire refrigerating circuit, even inside the machines, for any traces of refrigerant leaks, which are also signalled by traces of lubricant oil. Intervene in due time and check further in case of doubt.	Monthly
Checking for refrigerant leaks:	
for systems with a refrigerant charge of less than 3 kg	Annually
for systems with a refrigerant charge of more than 3 kg	Every six months
where a leak is such that it is necessary add refrigerant for more than 10% of the total gas charge, it must be repaired within 30 days of its detection.	-
Crankcase heater check Check the working order of the crankcase heater. If necessary, measure the continuity with the relevant instruments.	Monthly
Earthing efficiency check Check the terminal strip of the earthing system and test its efficiency using the relevant instruments.	Monthly
Condenser cleaning The surface of the condenser must be completely free and the airflow must not be obstructed by dust or other material that has been deposited on the condenser. The condenser can be cleaned using a jet of compressed air, blowing from the inside in the opposite direction to air suction intake. In some periods, especially spring, cleaning operations must be brought forward due to a greater number of impurities in the air.	Monthly

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Refrigerant humidity check Check the regular flow of refrigerant in the indicator on the liquid line. Next, carefully check the colour of the element which is sensitive to humidity through the indicator on the liquid line. Green means dry; yellow means humidity. In the event of humidity, stop the machine immediately, replace the filter on the liquid line and replace both the refrigerant and the oil charges. Repeat this check after 3 days of operation.	Every four months
Compressor noise level check Check the noise level of the compressor. This check must be performed with caution, as it has to be carried out while the system is operating. Check for ticking or vibrations that result from breakdowns or excessive mechanical friction between moving parts.	Every four months
• **Important note:** at the end of maintenance operations, replace any safeguards that were removed. • Do not remove the pressure relief valve without first recovering the gas.	

	POSSIBLE CAUSES	SOLUTIONS
A	**The compressor does not start up and does not release a humming sound**	
	1 Lack of voltage. Start-up relay with open contacts.	1 Check the supply line or substitute the relay.
	2 Thermal protector is intervening.	2 Check the electrical connections.
	3 Loose electrical connections or wrong electrical connections.	3 Tighten the connections or carry them out again in compliance to the electrical wiring diagram.
B	**The compressor does not start up (but releases a humming sound) and the thermal protector intervenes**	
	1 Wrong electrical connections.	1 Re-do the connections.
	2 Low voltage supply to the compressor.	2 Identify the cause and eliminate it.
	3 Faulty start-up of the condenser.	3 Identify the cause and replace the condenser.
	4 The relay doesn't close.	4 Identify the cause and substitute the relay if necessary.
	5 The winding on the electrical motor is interrupted or in short circuit.	5 Substitute the compressor.
C	**The compressor starts up, but the relay doesn't open**	
	1 Wrong electrical connections.	1 Check the electrical circuit.
	2 Low voltage supply to the compressor.	2 Identify the cause and eliminate it.
	3 Relay blocked in closure.	3 Identify the cause and eliminate it.
	4 Excessive discharge pressure.	4 Identify the cause and substitute the relay if necessary.
	5 The winding on the electrical motor is interrupted or in short circuit.	5 Replace the compressor.
D	**Intervention of the thermal protector**	
	1 Low voltage supply to the compressor (unbalanced phases on the tri-phase motors).	1 Identify the cause and eliminate it.
	2 Defective thermal protector.	2 Check its characteristics and replace it if necessary.
	3 Defective electric-run condenser.	3 Identify the cause and eliminate it.
	4 Excessive discharge pressure.	4 Check the ventilation and any potential restrictions or obstructions in the system circuit.
	5 High suction pressure.	5 Check the sizing of the system. Replace the condensing unit with a more powerful one, if necessary.
	6 Overheated compressor, hot return gas.	6 Check the refrigerant load; if need be, repair the loss and add gas if necessary till the charge stated in the label.
	7 Winding of the compressor motor in short circuit.	7 Replace the compressor.
E	**The compressor starts up and circulates, the functioning cycles are of brief duration**	
	1 Thermal protector.	1 See previous point (thermal protector intervention).
	2 Thermostat.	2 Small differential; correct the regulation.
	3 Intervention of the high pressure switch, due to the insufficient cooling of the condenser.	3 Check the correct functioning of the motor fan or clean the condenser.
	4 Intervention of the high pressure switch, due to the excessive load of refrigerant gas.	4 Reduce the load of refrigerant gas.
	5 Intervention of the low pressure switch, due to the scarce load of refrigerant gas.	5 Repair the loss and add refrigerant gas.
	6 Intervention of the low pressure switch, due to the restriction or clogging of the expansion valve.	6 Replace the expansion valve.

	POSSIBLE CAUSES	SOLUTIONS
F	**The compressor operates uninterruptedly or for long periods**	
	1 Scarce load of refrigerant gas.	1 Repair the loss and add refrigerant gas till the charge stated in the label.
	2 Thermostat with contacts locked in closure.	2 Replace the thermostat.
	3 System not sufficiently sized in function of the load.	3 Replace the system with a more powerful one.
	4 Excessive load to cool or insufficient insulation.	4 Reduce the load and improve insulation, if possible.
	5 Evaporator covered with ice.	5 Perform defrosting till the charge stated in the label
	6 Restriction in the system circuit.	6 Identify the resistance and eliminate it.
	7 Clogged condenser.	7 Clean the condenser.
G	**Electric-run condenser damaged, interrupted, or in short circuit**	
	1 Wrong electric-run condenser.	1 Replace the condenser with the correct type.
H	**Start-up relay defective or burnt out**	
	1 Wrong relay.	1 Replace the relay with the correct one.
	2 Relay mounted in the incorrect position.	2 Re-assemble the relay in the correct position.
	3 Wrong lectric-run condenser.	3 Replace the condenser with the correct type.
I	**Cold-room temperature too high**	
	1 Thermostat regulated too high.	1 Regulate it correctly.
	2 Undersized expansion valve.	2 Replace the expansion valve with a suitable one.
	3 Undersized evaporator.	3 Replace it, increasing the surface of the evaporator.
	4 Insufficient air circulation.	4 Improve air circulation,
L	**Frosted suction piping**	
	1 Expansion valve with excessive passage of gas or oversized.	1 Adjust the valve or substitute it with a correctly sized one.
	2 Expansion valve locked in open position.	2 Clean the valve of foreign substances and replace it, if necessary.
	3 Evaporator fan does not work.	3 Identify the cause and eliminate it.
	4 Gas load too high.	4 Reduce the load.

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13. DISPOSAL

If the machine is placed out of service, it is necessary to disconnect it from the mains. The gas contained inside the system must not be dispersed into the environment. The compressor oil is subjected to differentiated waste collection regulations; therefore, we recommend that you do not dispose of the unit as normal iron scrap but that you use a special collection centre, as per the standards and regulations in force.

14 OPTIONAL ITEMS

- **Condenser (integrated or remote)**
- **Soundproofing**
  - Standard: with acoustic insulation sheet (thickness 20mm)
  - Residential: with acoustic insulation sheet (thickness 30mm) and PVC reinforcements
- **For other components or applications that are not listed in the standard features, contact Technical Department**
- **Packing**

15. TABLE 1: COMPRESSOR OIL

MANUFAC-TURER	REFRIGERANT	MODEL	VISCOSITY AT 40°C (cSt)	LUBRICANT OIL (2 ALTERNATIVES)
FRASCOLD	R134a-R507A-R22-R404A-R407C	A/B/D/F/Q/S/V/Z/W	32	ICEEMCARATE RL32S – TOTALFINAELF ACD32

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DORIN	CFC-HCFC	K5.....CC K6.....CC K7.....CC	46	SUNISO 4GS – Texaco Capella S46
	HFC		46	Mobil EAL Arctic 46 – ICI Emkarate RL 46 S
	CFC-HCFC	All excluding K5.....CC K6.....CC K7.....CC	32	SUNISO 3GS – Texaco Capella S32
	HFC		32	Mobil EAL Arctic 32 ICI Emkarate RL 32 S
COPELAND	CFC-HCFC	ZR/ /2D/3D/4D//6D/ 8D /4S/6S/8S	32	SUNISO 3GS.-.Texaco WF32.
	HFC	ZF/ZS/ZB /2D/3D/4D//6D/ 8D/4S/6S/8S	32	Mobil EAL Arctic 22 CC – ICI Emkarate RL 32 CF
BITZER	R134a – R404A – R407A – R407B – R507 – R22	Piston compressor	32	BSE 32 – ICI RL 32 S
	R134a – R22	For special applications (*)	55	BSE 55 – ICI RL 68 S
DANFOSS	R134a	SC	22	Polyolester - ICI Emkarate
	R404A	SC	32	Polyolester - ICI Emkarate
U.H.	R134a – R404A – R407C R404A R22	Tutti BT Tutti	32 32 68	8685030 POE 8685015 POE 8685012 MINERALE

(*) FOR R134A IN THE EVENT OF MOBILE REFRIGERATION AND STATIONARY INSTALLATION, FOR CONDENSING TEMPERATURES >55°C.
FOR GAS R22 IN THE EVENT OF CONDITIONING AND COOLING THROUGH LIQUID INJECTION (CIC) WITH A SINGLE-STAGE COMPRESSOR.

16 TABLE 2:LEGEND PRESSURE SWITCHES, PRESSURE GAUGE, COMPRESSORS, TRANSDUCERS AND TEMPERATURE BROBE - KEY		
	DESCRIPTION	**-**
1	AUTOMATIC GENERAL HBP-PRESSURE SWITCH	**PSH**
2	MANUAL GENERAL HBP-PRESSURE SWITCH	**PZH**
3	MANUAL GENERAL HBP-PRESSURE SWITCH (SAFETY)	**PZHH**
4	AUTOMATIC GENERAL LBP PRESSURE-SWITCH	**PSL**
5	DUAL PRESSURE SWITCH : AUTOMATIC HBP; AUTOMATIC LBP	**PSH/PSL**
6	DUAL PRESSURE SWITCH : MANUAL HBP; AUTOMATIC LBP	**PZH/PSL**
7	DUAL PRESSURE SWITCH : MANUAL HBP; MANUAL LBP	**PZH/PZL**
8	COMPRESSOR ELECTRONICS ALARM PRESSURE SWITCH	**PEL**
9	CONDENSER ELECTRONICS ALARM PRESSURE SWITCH	**PEH**
10	COMPRESSOR PSH 1,2,3….HBP-PRESSURE SWITCH	**PSH1._**
11	LOW PRESSURE CONTROL PRESSURE SWITCH (1,2,3)	**PPL1._**
12	FAN-MOTOR CONTROL PRESSURE SWITCH 1,2,3…	**PPH1._**
13	DIFFERENTIAL OIL COMPRESSOR PRESSURE SWITCH 1,2,3…	**POx 1._**
14	HOT GAS FUNCTION SAFETY PRESSURE SWITCH	**PGH**
15	PUMP DOWN PRESSURE SWITCH	**PDL1._**
PRESSURE GAUGE - KEY		
1	GENERAL HBP PRESSURE GAUGE MH 1,2,3	**MH_**
2	GENERAL LBP PRESSURE GAUGE ML 1,2,3	**ML_**
3	OIL PRESSURE GAUGE ON COMPRESSOR MO1,2,3	**MO_**
COMPRESSORS - KEY		
1	COMPRESSOR N°1,2,3	**M1…**
TRANSDUCERS - KEY		
1	HBP TRANSDUCER BPH1,2,3….	**BPH_**
2	LBP TRANSDUCER BPL 1,2,3….	**BPL_**
3	CONDENSER FAN SPEED VARIATOR	**BPV_**
TEMPERATURE PROBE - KEY		
1	DISCHARGE TEMPERATURE PROBE	**STH**
2	SUCTION TEMPERATURE PROBE	**STL**

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TABELLA SEGNALETICA UTILIZZATA / SYMBOLS USED / TABLEAU SIGNAUX UTILISES
TABLA DE SEÑALIZACIÓN UTILIZADA / TABELLE VERWENDETER SIGNALE

	Obbligatorio/ Obligatory/ Obligatoire/ Obligatorio / Obligatorisch: LEGGERE IL MANUALE D' ISTRUZIONI / READ THE INSTRUCTION MANUAL LIRE LE MODE D'EMPLOI / LEER EL MANUAL DE INSTRUCCIONES DIE BEDIENUNGSANLEITUNG LESEN
	Avvertimento / Warning / Avertissement / Advertencia / Hinweis : RISCHIO DI ALTE TEMPERATURE / RISK OF HIGH TEMPERATURES RISQUE DE HAUTES TEMPÉRATURES / RIESGO DE ALTAS TEMPERATURAS GEFAHR DURCH HOHE TEMPERATUREN
	Avvertimento / Warning / Avertissement / Advertencia / Hinweis : SCARICO DI GAS CALDI O DANNOSI NELLA NORMALE AREA DI LAVORO DISCHARGE OF HOT OR HARMFUL GASES INTO THE NORMAL WORKING AREA ÉCHAPPEMENT GAZ CHAUDS OU NOCIFS DANS LA ZONE DE TRAVAIL HABITUELLE DESCARGA DE GASES CALIENTES O DAÑINOS EN LA NORMAL ZONA DE TRABAJO ABLASSEN VON HEISSEM ODER SCHÄDLICHEM GAS IN DEN NORMALEN ARBEITSBEREICH
	Avvertimento / Warning / Avertissement / Advertencia / Hinweis : RISCHIO DI BASSE TEMPERARURE / RISK OF LOW TEMPERATURES RISQUE DE BASSES TEMPÉRATURES / RIESGO DE BAJAS TEMPERATURAS GEFAHR DURCH NIEDRIGE TEMPERATUREN
	Avvertimento / Warning / Avertissement / Advertencia / Hinweis : RISCHIO DI SCOSSA ELETTRICA / RISK OF ELECTRIC SHOCKS RISQUE DE SECOUSSE ÉLECTRIQUE / RIESGO DE DESCARGA ELÉCTRICA GEFAHR DURCH STROMSCHLAG
	DISPOSITIVO DI AVVIAMENTO STARTING DEVICE DISPOSITIF DE MISE EN MARCHE DISPOSITIVO DE ARRANQUE STARTVORRICHTUNG
	DISPOSITIVO DI AVVIAMENTO E DI ARRESTO STARTING AND STOPPING DEVICE DISPOSITIF DE MISE EN MARCHE ET D'ARRÊT DISPOSITIVO DE ARRANQUE Y DE PARADA START- UND STOPPVORRICHTUNG
	SENSO DI ROTAZIONE ROTATION DIRECTION SENS DE ROTATION SENTIDO DE ROTACIÓN DREHRICHTUNG
	RIFORNIMENTO DI OLIO OIL SUPPLY RAJOUT D'HUILE ABASTECIMIENTO DE ACEITE AUFFÜLLEN VON ÖL
	RIFORNIMENTO DI REFRIGERANTE REFRIGERANT SUPPLY RAJOUT DE RÉFRIGÉRANT ABASTECIMIENTO DE REFRIGERANTE AUFFÜLLEN VON KÜHLMITTEL


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REGISTRO MANUTENZIONE/MAINTENANCE TIME-SHEET/REGISTRE ENTRETIEN
REGISTRO MANTENIMIENTO/WARTUNGSVERZEICHNIS

DATA DATE DATE FECHA DATUM	DESCRIZIONE INTERVENTO INTERVENTION DESCRIPTION DESCRIPTION INTERVENTION DESCRIPCIÓN INTERVENCIÓN WARTUNGSBESCHREIBUNG	FIRMA OPERATORE OPERATOR SIGNATURE SIGNATURE OPÉRATEUR FIRMA INSTALADOR UNTERSCHRIFT


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