IMMERGAS

USER'S MANUAL

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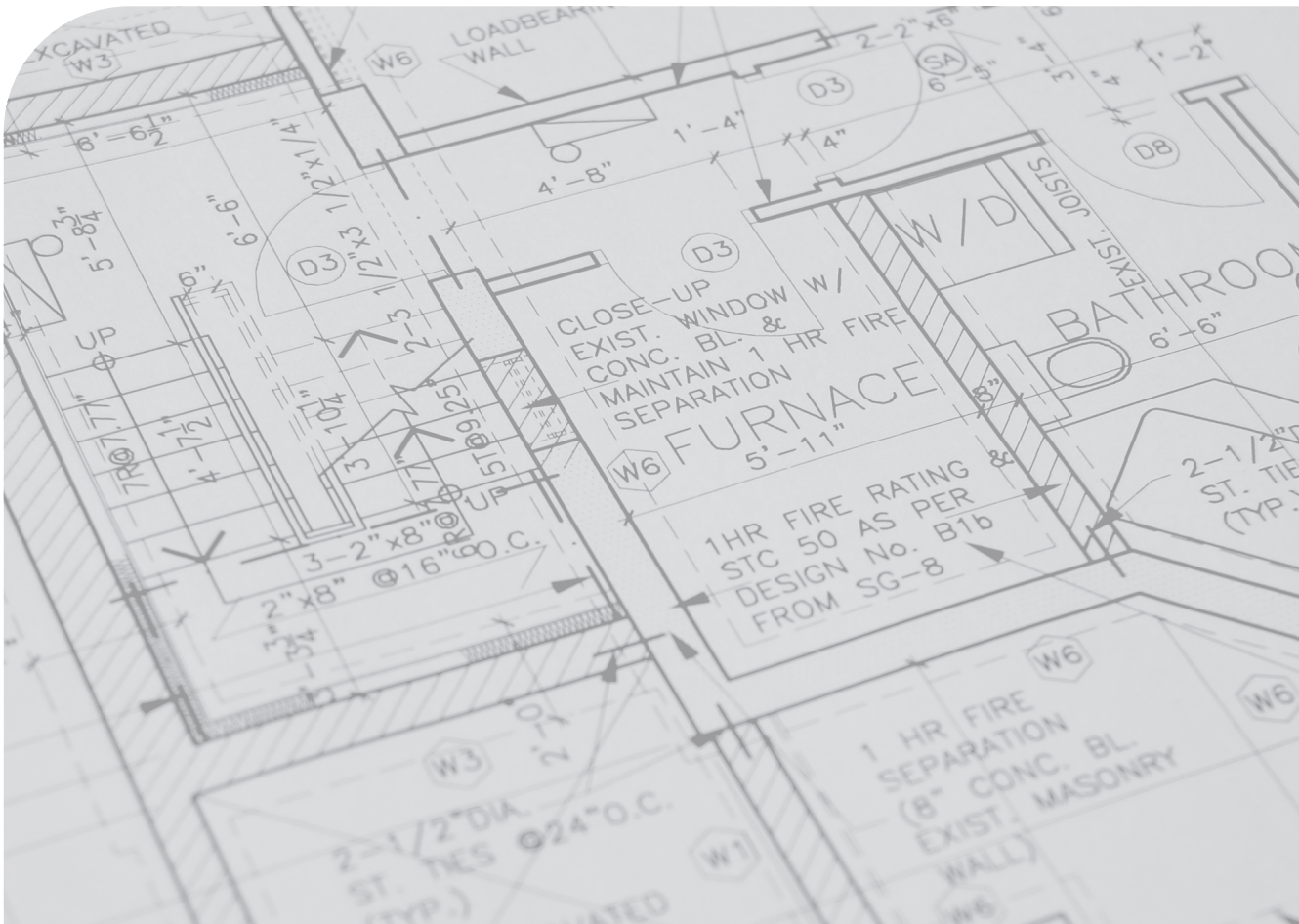
**Safety Manual**

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INDEX

# 1 SAFETY MEASURES

## 1.1 GENERAL WARNINGS

**Read the safety precautions before operation and installation.**
**Incorrect installation due to failed application of that provided in these instructions can cause serious damage or injury.**

- Installation of pipes must be reduced to a minimum.
- The pipe must be protected against damage.
- Areas in which refrigerant pipes comply with national standards on gas.
- Mechanical pipe connections must be accessible for maintenance purposes.
- The mechanical connections of the pipes are not allowed in-wall/floor.
- When mechanical ventilation is required, the vents must be kept clear of obstacles.
- When disposing of the product, please observe national standards, properly processed.
- Anyone intervening on or opening the refrigerant circuit must be in possession of a valid certificate, issued by an accredited body in the sector attesting their ability to safely manage refrigerants, in compliance with the acknowledged specifications of the sector of reference.
- Maintenance and repairs that require the assistance of other specialised personnel must be carried out under the supervision of a person capable of using flammable refrigerants.
- Do not use tools to speed up the defrost process or to clean, unless recommended by the manufacturer.
- The appliance must be stored in such a way as to avoid mechanical damage, in a well-ventilated environment and without ignition sources in continuous operation (for example: open flames, gas appliance or electric heater in operation).
- Pay particular attention that foreign substances (such as oil, water, etc.) do not enter the pipes. Furthermore, when installing the pipes, be careful to seal the opening by crushing it, using adhesive tape, etc.
- Do not puncture or burn.
- Bear in mind that refrigerants might not emit odours.
- All operational procedures involving safety measures must only be carried out by a professionally qualified company.
- The appliance must be kept in a well ventilated area, whose dimensions match those specified for its correct operation.
- Joints must be tested with detection equipment with a capacity of 5g/year of refrigerants or better, with the appliance stopped or operational, or under a pressure at least equivalent to that in stop conditions or under operational conditions after installation.
- The outdoor unit is designed for outdoor installation only, in a well ventilated area. Th installation room for the indoor unit must observe the minimum surface area requirements (Amin in $m^2$) shown in the following table:

| Refrigerant type | Installation height $H_0$ (m) | Charge quantity in kg | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1,224 | 1,836 | 2,448 | 3,672 | 4,896 | 6.12 | 7,956 |
| R32 | 0.6 | | 29 | 51 | 116 | 206 | 321 | 543 |
| | 1.0 | | 10 | 19 | 42 | 74 | 116 | 196 |
| | 1.8 | | 3 | 6 | 13 | 23 | 36 | 60 |
| | 2.2 | | 2 | 4 | 9 | 15 | 24 | 40 |

For specific information on the amount of refrigerant gas, please refer to the label applied on the unit.

**NOTE:**
- For products loaded on the field, the Amin can be calculated based on the installed refrigerant charge (which must not exceed the maximum refrigerant charge specified by the manufacturer).
- If the installation room of the appliance has a surface smaller than Amin, the additional safety measures prescribed by UNI EN 378 are required.

# 2 INSTRUCTIONS FOR MAINTENANCE

## 2.1 GENERAL MAINTENANCE WARNINGS

**1. Control of the area**
Before starting work on systems containing flammable refrigerants, safety checks must be performed to guarantee that the risk of ignition is reduced to a minimum. To repair the cooling system, the following precautions must be taken before intervening on the system.

**2. Work procedure**
The operations must be carried out following a controlled procedure so as to minimise the risk of the presence of flammable gases or vapours during execution. The technical personnel in charge of operation, supervision and maintenance of air conditioning systems must be adequately instructed and competent on their tasks. The operations must only be carried out with suitable tools in case of doubts, consult the tool manufacturer for use with flammable refrigerants).

**3. General work area**
Maintenance personnel and those working in the vicinity must be instructed on the nature of the job carried out. Operations in confined spaces must be avoided. The area around the working space must be properly marked off. Make sure that the conditions inside the area have been made safe thanks to the control of the flammable material.

**4. Control of the presence of refrigerant.**
The area must be checked with a suitable refrigerant detector before and during the jobs, to guarantee that the technician is aware of the potentially flammable atmospheres. Make sure that the leak detection equipment used is suitable for use with flammable refrigerants, namely does not generate sparks, is properly sealed or inherently safe.

**5. Presence of a fire extinguisher**
If hot operations on cooling equipment or on associated parts need to be carried out, suitable fire extinguishers must be available close at hand. Have a dry powder or $CO_2$ fire extinguisher available near the charging area.

**6. No source of ignition**
Any operation on the cooling system which entails exposure to any pipe containing or which has contained flammable refrigerant must be carried out without using any source of ignition which can pose a risk of fire or explosion. All possible sources of ignition, including cigarette smoke, must be kept sufficiently far from the place of installation, repair, removal and disposal, because flammable refrigerant could be released in the surrounding area during these operations. Before starting the intervention, you must inspect the surrounding area to make sure there are no hazards linked to flammable materials or fire ignition risks. Affix "'NO SMOKING" signs.

**7. Ventilated area**
Before opening the system or performing hot operations, make sure that the area is outdoors or properly ventilated. Adequate ventilation must be maintained throughout the intervention. Ventilation must safely release the dispersed refrigerant and preferably eject it into the outside atmosphere.

**8. Controls on cooling system**
When replacing electric components, make sure they are suitable for the purpose and comply with the correct specifications. Constantly follow the maintenance and service instructions supplied by the manufacturer. In case of doubts, contact the manufacturer's technical service for help. The following checks must be made for systems using flammable refrigerants:

- The amount of refrigerant loaded complies with the dimensions of the room in which the parts containing the refrigerant are installed.
- The devices and vents work properly and are not obstructed.
- If an indirect cooling circuit is used, the secondary circuits must be controlled to check for the presence of refrigerant; the marking on the appliance must remain visible and legible.
- Illegible marking and signs must be corrected.
- Cooling pipes and components must be installed in a position where they are unlikely to be exposed to any substance that can corrode components containing refrigerants, unless they are made of materials inherently resistant to corrosion or have been adequately protected against it.

**9. Checks on electrical devices**
Repair and maintenance operations on electric components must include initial safety checks and inspection procedures of the components. If a fault occurs that could endanger safety, do not connect any electric power source to the circuit until it has been resolved in a satisfactory way. If it is not possible to immediately resolve the fault, but the system needs to keep running, a temporary solution must be found. Report the situation to the appliance owner so that all parties are informed.

**The initial safety checks must include the following operations:**

- Check that the condensers are discharged. This check must be done safely to avoid possible sparks.
- Make sure that there are no live components or cables during charging, recovery or purging of the system.
- Ascertain the continuity of the earthing connection.

**10. Repairs on sealing components**

**10.1** While repairing sealing components, all connections to the power supply must be disconnected from the equipment on which you are working before removing any watertight closure, etc. If it is absolutely necessary that power be connected to the equipment during maintenance, install a leak detection system that works permanently at the most critical point to detect any potentially hazardous situation.

**10.2** Pay special attention to the following to make sure that, while working on electric components, the enclosure is not changed in such a way as to compromise the protection level. This includes damage to cables, an excessive number of connections, terminals non-conforming to the original specifications, damage to sealing gaskets, incorrect assembly of cable glands, etc.

- Make sure that the device is fixed securely.
- Make sure that the sealing gaskets or materials are not degraded to such a point as to no longer prevent the ingress of flammable atmospheres. The spare parts must comply with the specifications of the manufacturer.

**NOTE:** the use of silicone sealants could inhibit the effectiveness of some types of leak detection equipment. Inherent safety components must not be insulated before use.

**11. Repair of inherently safe components**

Do not apply permanent inductive or capacitive loads to the circuit without having checked that they do not exceed the voltage and current allowed for the equipment in use. Inherently safe components are the only ones on which it is possible to work when live in the presence of a flammable atmosphere. The test device must have the nominal correct value. Only replace the components with the parts specified by the manufacturer. Other components can ignite a fire due to the presence of refrigerant in the atmosphere owing to a leak.

**12. Wiring**

Check that wiring is not subject to wear, corrosion, excessive pressure, vibrations, sharp edges or other adverse environmental effects. The check must also take into account the effects of aging or of continuous vibrations coming from sources such as compressors or fans.

**13. Detection of flammable refrigerants**

When looking for or detecting refrigerant leaks, under no circumstances must you use potential sources of ignition. Do not use halide leak detectors (or any other detector that uses naked flames).

**14. Leak detection methods**

The following leak detection methods are deemed acceptable for systems containing flammable refrigerants. Electronic leak detectors must be used to detect flammable refrigerants, but their sensitivity might not be adequate or require recalibration (leak detectors must be calibrated in a refrigerant-free area). Make sure that the detector is not a potential source of ignition and that it is suitable for the refrigerant. The leak detection appliance must be set at an LFL (lower flammability limit) percentage of the refrigerant and calibrated for the refrigerant used; the appropriate percentage of gas is confirmed (25% at maximum). Leak detection fluids are suitable for use with the majority of refrigerants, but detergents containing chlorine must not be used as this can react with the refrigerant and corrode the copper pipe. If there is a suspected leak, all naked flames must be removed or put out. If a refrigerant leak requiring braze welding is found, all of the refrigerant must be recovered by the system or isolated (by means of shut off valves) in a part of the system away from the leak. The system must then be purged with oxygen-free nitrogen (OFN), both before and during braze welding.

**15. Removal and emptying**

When intervening on the refrigerant circuit to perform repairs or for any other purpose, conventional procedures must be followed. However, for flammable refrigerants, best practice must be observed as flammability is a factor to take into consideration. You must proceed as follows:

- Remove the refrigerant.
- Purge the circuit with inert gas
- Empty.
- Purge the circuit with inert gas once again.
- Open the circuit by cutting or braze welding.

The refrigerant must be retrieved in specific recovery cylinders. The system must be purged with oxygen-free nitrogen to make the unit safe. This process might need to be repeated several times. Compressed air or oxygen must not be used for this operation.
Cleaning is done by interrupting the vacuum condition in the system with oxygen-free nitrogen and continuing to fill it until operating pressure is reached, then discharging into the atmosphere and, lastly, re-creating the vacuum condition.

This process must be repeated until there is no more refrigerant in the system. When oxygen-free nitrogen is used, the system must be vented until reaching atmospheric pressure to allow the operation. This operation is absolutely necessary if the pipe requires braze welding. Make sure that the outlet for the vacuum pump is not close to sources of ignition and that it is ventilated.

**16. Charging procedure**

In addition to the standard charging procedure, the following requirements must be met:

- The operations must only be carried out with adequate instruments. If in doubt, consult the manufacturer of instruments used with flammable refrigerants.
- Make sure that no contamination occurs between different refrigerants when using equipment to charge the refrigerant. The pipes, both flexible and rigid, must be as short as possible to minimise the amount of refrigerant therein.
- The cylinders must be kept upright.
- Make sure that the cooling system is earthed before charging the refrigerant.
- Label the system when the charge is completed (if it is not already).
- Paying the utmost attention not to overfill the cooling system.
- Before recharging the system, it must undergo a pressurised leak test with oxygen-free nitrogen. Perform the leak test after charging, but before putting the system into service. Perform a further check to make sure there are no leaks before finishing the job.

**17. Decommissioning**

Before starting this procedure, it is essential that technical personnel have full knowledge of the equipment and its features. It is good practice that all refrigerants be recovered safely. Before performing the operation, an oil and refrigerant sample must be taken if an analysis is needed before reusing the recovered refrigerant. The power supply must be available before starting the operation.

a) Become familiar with the equipment and how it works.

b) Electrically insulate the system.

c) Before starting the procedure, make sure that:

• there is mechanical handling equipment available for refrigerant cylinders, if necessary;

• all personal protective equipment is available and used properly;

• the recovery operation is supervised at all times by a skilled person;

• the recovery equipment and the cylinders comply with relevant standards.

d) Empty the cooling system, if possible.

e) If a vacuum condition cannot be achieved, use a manifold so that the refrigerant can be removed from the different parts of the system.

f) Make sure that the cylinder is placed on the scale before proceeding with recovery.

g) Start the recovery machine and operate it according to the manufacturer's instructions.

h) Do not overfill the cylinders. No more than 70% of the liquid volume. The liquid density of the refrigerant with a reference temperature of 50 °C.

i) Do not exceed the maximum working pressure of the cylinder, not even temporarily.

j) Once the cylinders have been filled correctly and the process is finished, make sure that the cylinders and equipment are removed immediately from the site and that all shut-off valves of the equipment have been closed.

k) The recovered refrigerant must not be charged into other cooling systems unless it has been recycled or regenerated.

**18. Labelling**

The appliance must be labelled declaring that it has been decommissioned and the refrigerant emptied. The label must bear date and signature. Make sure that the equipment is labelled, indicating that it contains flammable refrigerant.

**19. Recovery**

When the refrigerant is removed from a system, for maintenance or disassembly, it is recommended to remove all of it safely.
When the refrigerant is transferred to cylinders, make sure that only cylinders for recovery of refrigerant are used. Make sure that there is a proper amount of cylinders available to hold all of the refrigerant charged in the system. You must use cylinders designed for recovered refrigerant and labelled for that refrigerant (for example specific cylinders for recovery refrigerant). The cylinders must be equipped with pressure and shut-off valves in good conditions.
The recovery cylinders must be empty and, if possible, cooled before the recovery operation. The recovery equipment must be in good working order with a series of instructions relating to the equipment at hand and must be suitable for the recovery of flammable refrigerants. Furthermore, a set of scales calibrated in good conditions must be available.
The flexible hoses must be complete with disconnection couplings without leaks and in good conditions. Before using the recovery machine, check that it is in good conditions, that it has undergone proper maintenance and that the relative electric components are watertight to avoid the risk of ignition in case of refrigerant leaks. Contact the manufacturer if in doubt.
The recovered refrigerant must be treated according to local legislation in the appropriate recovery cylinder and the relative waste transfer note must be drafted.
Do not mix refrigerants in recovery units and above all not inside the cylinders.
If compressors or compressor oils must be removed, make sure that they have been evacuated to an acceptable level to guarantee that no flammable refrigerant remains in the lubricant. To speed up this process, you may heat only the compressor housing with an electric radiator.
Oil must be emptied from the system in safe conditions.

**20. Transport, marking and storage of the unit**

1. Transport of equipment containing flammable refrigerants.

- Conformity with transport regulations.

2. Marking of the equipment with signs.

- Conformity with local standards.

3. Disposal of equipment using flammable refrigerants.

- Conformity with national standards.

4. Deposit of equipment/appliances.

- The equipment must be stored in compliance with the manufacturer's instructions.

5. Storage of packaged equipment (unsold).

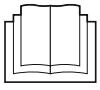
- The protection of the storage packaging must be built in such a way that any mechanical damage to the equipment inside the packaging does not cause a leak of the refrigerant charge. The maximum number of pieces of equipment authorised to be stored together shall be determined by local standards.

## 2.2 SYMBOLS INDICATED ON INDOOR OR OUTDOOR UNIT

**WARNING**
This symbol indicates that this appliance used a flammable refrigerant. The leakage of refrigerant and its exposure to external sources of ignition pose a fire hazard.

**CAUTION**
This symbol indicates that service personnel must handle this equipment while referring to that indicated in the installation manual.

**CAUTION**
This symbol indicates that information is available such as the user manual or installation manual.



**CAUTION**
This symbol indicates to carefully read the user manual.

**CAUTION:** Fire Hazard.

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