

A2L REFRIGERANT FLUID INSTALLATION GUIDE

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PREAMBLE

Carrier Group products are developed in compliance with the applicable European regulations.

In case of use of this equipment in a place where employees can be present, following the requirement of European directive 2009/104/CE, the employer shall also take the measures necessary to ensure that the work equipment made available to workers in the undertaking or establishment is suitable for the work to be carried out or properly adapted for that purpose and may be used by workers without impairment to their safety or health.

The aim of the present document is to help the owner of the equipment to mitigate the risk generate by its installation by using equipment with low flammability refrigerant fluids, long term alternative to HFC.

WARNING

EN 378:2016 standard establishes safety requirements to manage every potential risk.

The present guide provides advices to better understand them and help to install our unit. However, it does not purport to cover all possible configurations.

REMINDER

The standard and particularly part 3:

- Is not mandatory to apply
- Shall not replace the applicable regulatory requirements

This document is provided as a guideline only. Although all the declarations and information contained in this document are deemed to be accurate, they are presented without any kind of explicit or implicit guarantee. This presentation provides general recommendations only, which do not replace the installer's individual instructions and advice for each specific site; Carrier shall in no way be held liable if the information provided is not appropriate to a specific site and/or not compliant with the regulations in force. Carrier SCS (or any other company in the Carrier Group) shall not be held liable for actions taken by readers or users of this document which could cause unintentional damage or injury as a result of the recommendations or deductions made in this document.

The customer and the installer remain solely responsible for the obligation to access training and information, as well as complying with all applicable regulations (European, national or local). The customer and/or the installer must carry out their own risk assessment on the equipment installation and remain solely liable for this risk assessment.

This document provides advice for different types of installation sites to make it easier to understand the safety aspects relating to the risk of flammability and/or explosion and to facilitate assessment of these risks, as well as to take these into account in the risk assessment relating to the equipment installation which must be carried out by the customer and/or the installer.

INTRODUCTION

To reduce the refrigeration and air conditioning industry environmental impact, the F-Gas Regulation imposes a phase-down for the high GWP fluids.

In this context, alternative refrigerant fluids gradually replace the common HFC, such as R134a or R410A. These new refrigerants are chosen to strongly decrease the GWP and ensure a high efficiency level of the air conditioning systems.

Nevertheless, some of these new fluids, used in a pure chemical form, present some flammability characteristics. Their using requires assessing the risk introduced by their flammability properties. Those risks are the flammability risk and in some situation the explosion risk.

This document is related to the use of refrigerant belonging to the 2L class as per ISO 817, which are considered as mildly flammable.

GENERAL INFORMATION ON A2L FLUIDS

From a safety perspective, refrigerant fluids are classified according to 2 parameters:

- Toxicity
- Flammability

Classification is given by ISO 817 & EN 378 standards as shown in below table:

Safety categories of refrigerant fluids		
Flammability	Toxicity	
	Nontoxic	Toxic
Nonflammable	A1	B1
Slightly flammable	A2L	B2L
Flammable	A2	B2
Highly inflammable	A3	B3

This guide is especially dedicated to the installation of machines using R-32, R-1234ze and R-454B fluids, belonging to A2L category.

In addition to recommendations provided further in the document, all measures must be taken to prevent fluid entering inside buildings:

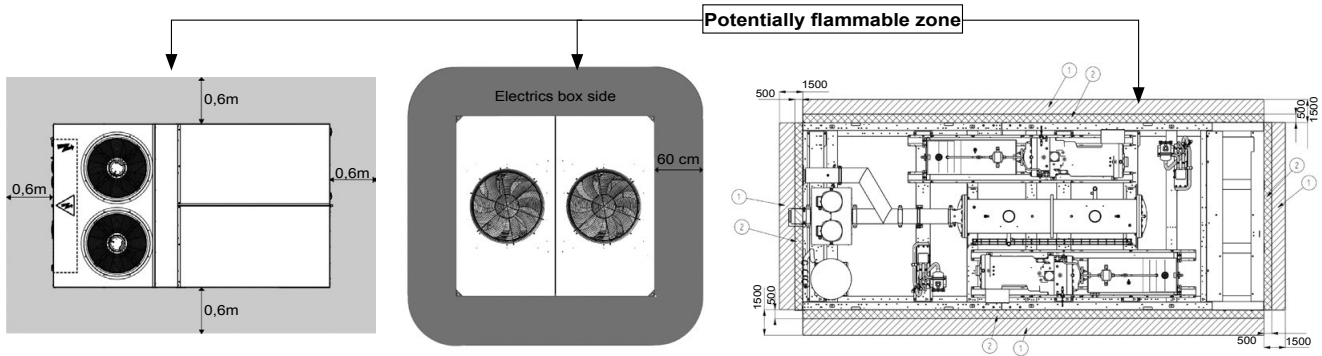
- Distance with all openings (windows, doors)
- Hydraulic circuit & external relief valve

GENERAL INFORMATION ON POTENTIALLY FLAMMABLE ZONE & IGNITION SOURCES

The full unit, including all options & accessories that are delivered by the manufacturer, has been qualified for the use with A2L refrigerant.

For that purpose, the manufacturer complies with EN 378-2 §6.2.14 and defined potentially flammable zone using EN 60079-10-1 in order to identify where ignition sources must not be present. Then the manufacturer designed the machine so that, if the unit is used according to the instructions, there is no internal ignition source in the internal potentially flammable zone.

Thus, the only residual risk is to have an ignition source introduced in the potentially flammable zone by the user. For that purpose, the manufacturer decided to represent the external potentially flammable zone where the user must not introduce ignition source.



Above example are indicative only, please refer to each unit IOM for dedicated exact zoning.

This indication is only here to help our customer to identify the limits of the flammability risk.

But there is no risk of explosion linked to the used of A2L refrigerant due to the machine itself.

Note (the following information is provided by the manufacturer exclusively for informational purposes. The application of the following directives relies exclusively upon the user):

According to directives 2009/104/EC and 1999/92/EC, these zones might be qualified by the user as ATEX Zone based on the user's own risk analysis for which the user remains solely responsible. According to the definition of Annex I of directive 1999/92/EC, this zone might be classified Zone 2 because it might be a place in which an explosive atmosphere consisting of a mixture of air with flammable substances in the form of gas is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

In case an additional equipment is necessary (motorized valve, pump, etc...), it must be:

- Installed out of defined potentially flammable zone
- Qualified as a non-ignition source for the fluid used

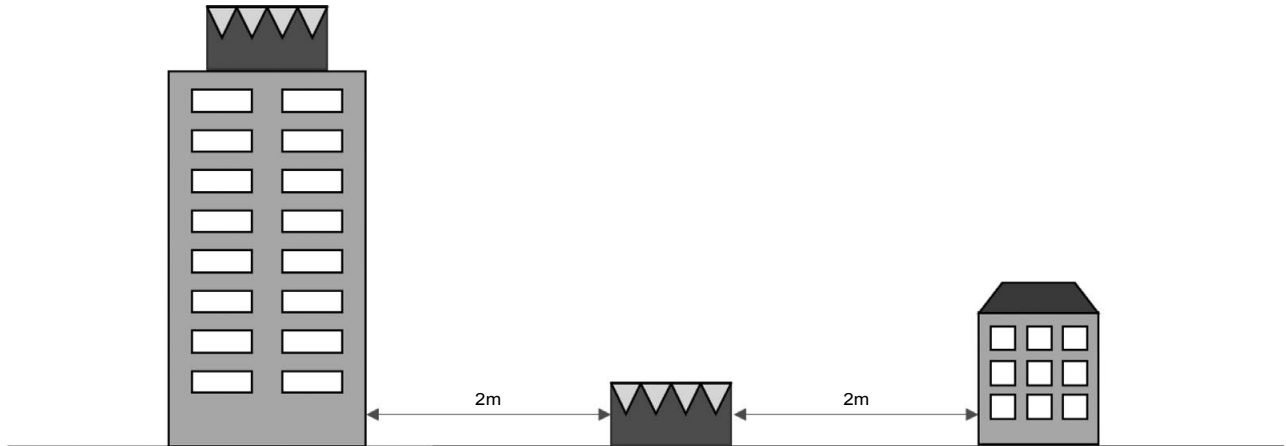
CHILLER / HEAT PUMP INSTALLATION CASES

The installation cases are the basis of the risk analysis according to the flammable risk. When the manufacturer does its risk analysis it takes into consideration the installation cases according to the definition here below that the user can take into consideration for its own risk analysis.

Choice of used solution is under responsibility of customer, depending on site specificities.

Free field installation

Unit is installed without obstacles around, avoiding accumulation of refrigerant fluid in case of leak.

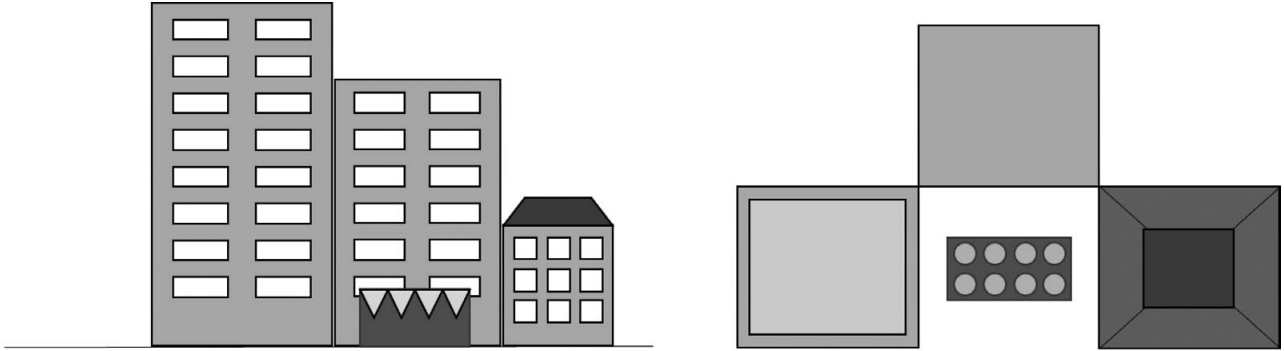


The minimum distance with building or walls is given to allow circulation of technician around the unit during maintenance. You must always refer to the unit IOM to ensure minimum installation distance is respected for your unit.

INSTALLATION CASES

Outdoor confined space installation

Small spaces



In that case, natural ventilation might be reduced, and refrigerant could accumulate within the restricted space in case of leakage event.

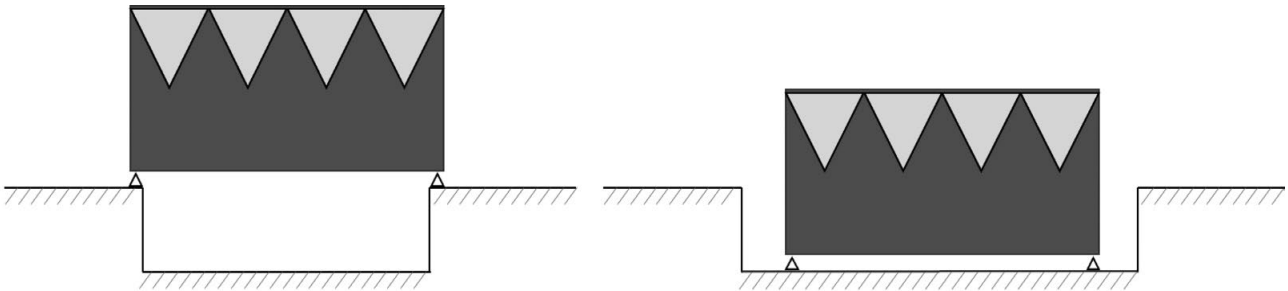
Customer must ensure accumulation of refrigerant is not possible.

Commonly used solutions (non-exhaustive list) are:

- Risk analysis demonstrating no accumulation risk
- Additional ventilation system for identified accumulative areas + leak detector
- Opening in wall at the position of the accumulation area

Choice of used solution is under responsibility of customer, depending on site specificities.

Installation over a pit



Slightly flammable fluids used by the manufacturer have a density higher than air. In case of leak, the main risk is stagnation at the lowest point.

If a unit is mounted in or over a pit, customer must ensure evacuation of gas is possible.

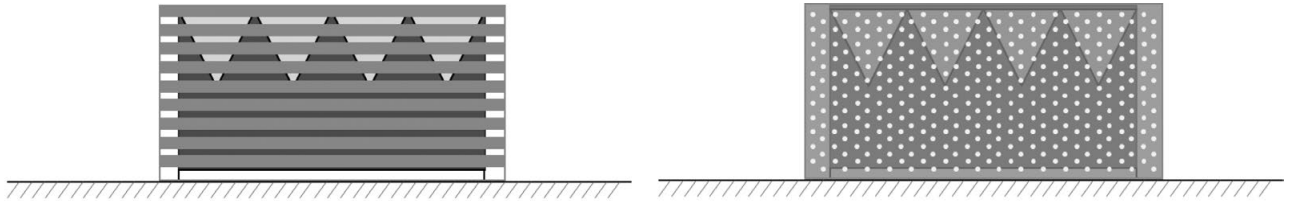
Commonly used solutions (non-exhaustive list) are:

- Vent duct
- Ventilation system + leak detector

Choice of used solution is under responsibility of customer, depending on site specificities.

INSTALLATION CASES

Acoustic package

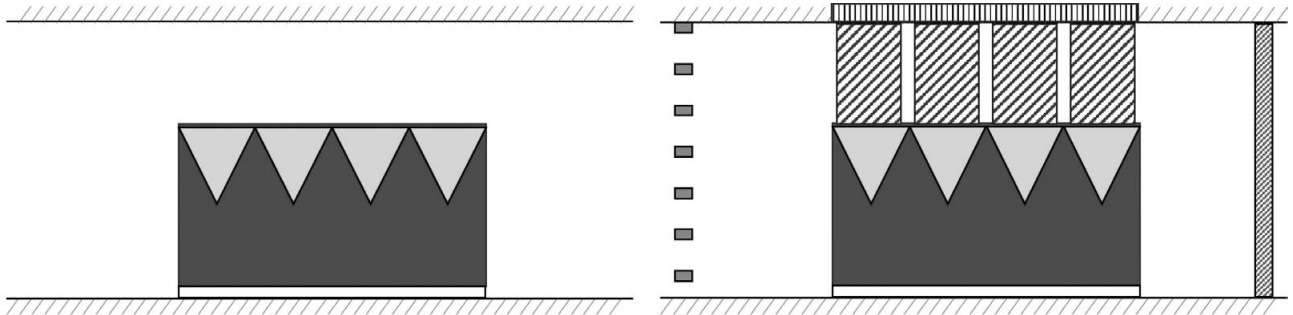


Some noise reduction systems have an impact on air circulation (packages, louvered panels, etc.).

The customer must ensure that the acoustic system in place doesn't allow refrigerant fluid accumulation, especially low down. An alternative solution is to equip the system with a leak detector that ensures cutting the power and stopping unit operations.

Choice of used solution is under responsibility of customer, depending on site specificities.

Under shelter or covered area



Is considered under shelter an area or local that has at least one wall with opening rate $> 75\%$ with outdoor. This type of installation can be considered as an outdoor installation.

Customer must ensure accumulation of refrigerant is not possible.

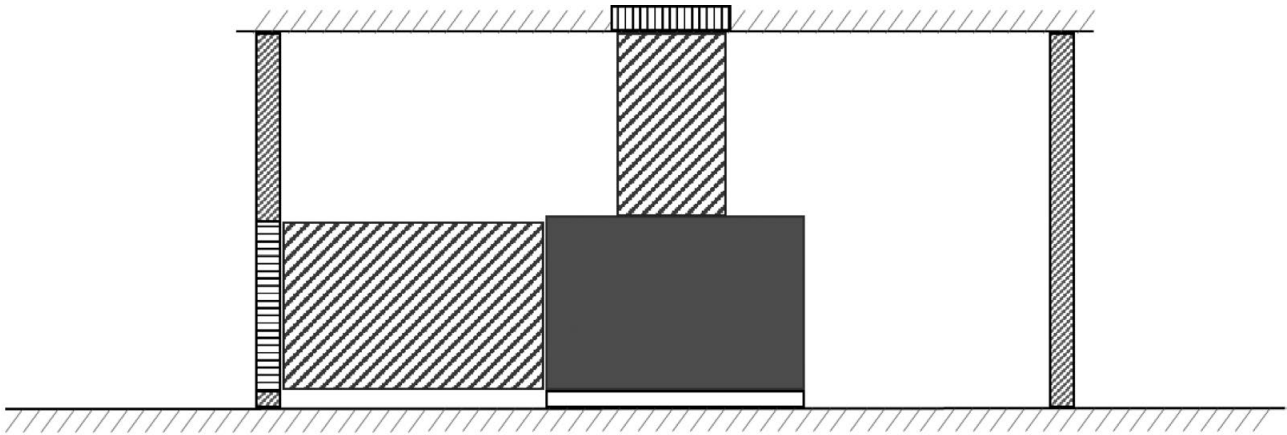
Commonly used solutions (non-exhaustive list) are:

- Risk analysis demonstrating no accumulation risk
- Permanent ventilation system avoiding gas accumulation
- Additional ventilation system for identified accumulation areas + leak detector
- Opening in wall at the position of the accumulation area

Choice of used solution is under responsibility of customer, depending on site specificities.

INSTALLATION CASES

Indoor installation

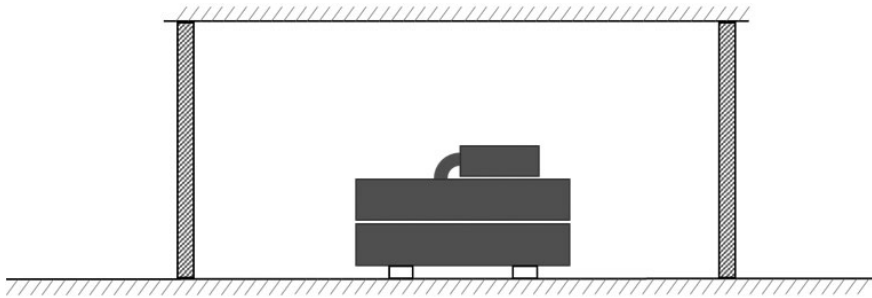


In case unit is installed in an indoor space, installation requirements provided by EN378-3 standard must be applied. In that case, the potentially flammable zone generated by the unit is enlarged vs standard potentially flammable zone that is defined for outdoor use.

All necessary protection required must be employed (detection and ventilation).

Choice of used solution is under responsibility of customer, depending on site specificities.

Indoor Unit



In case unit is installed in an indoor space, installation requirements provided by EN378-3 standard must be applied. In that case, the potentially flammable zone area generated by the unit is enlarged vs standard potentially flammable zone area that is defined for outdoor use.

All necessary protection required must be employed (detection and ventilation).

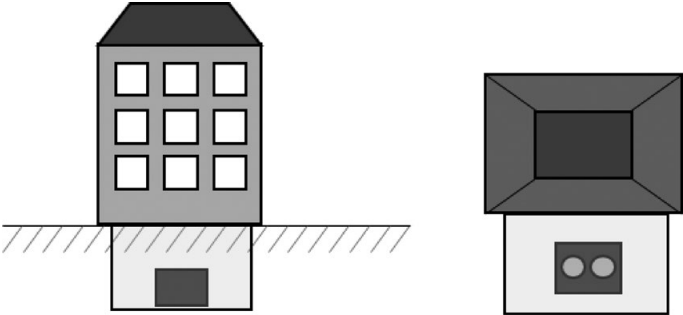
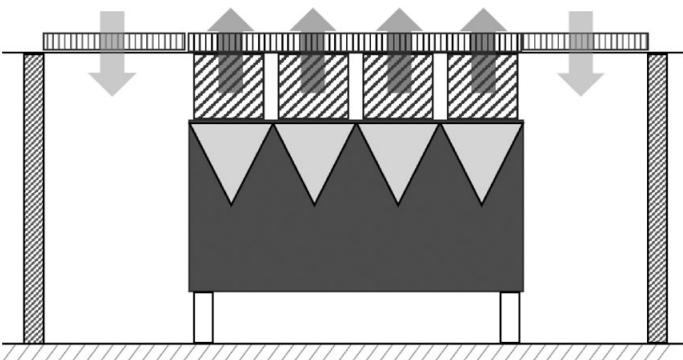
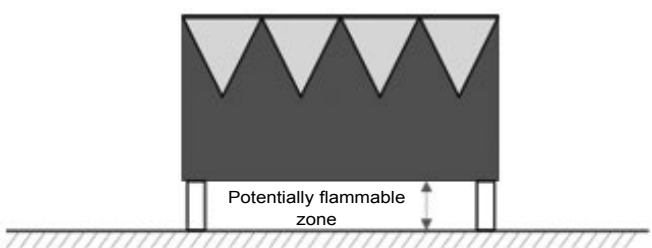
Choice of used solution is under responsibility of customer, depending on site specificities.

INSTALLATION CASES

Variants and corresponding installation

You may not be in the exact same cases as presented previously.

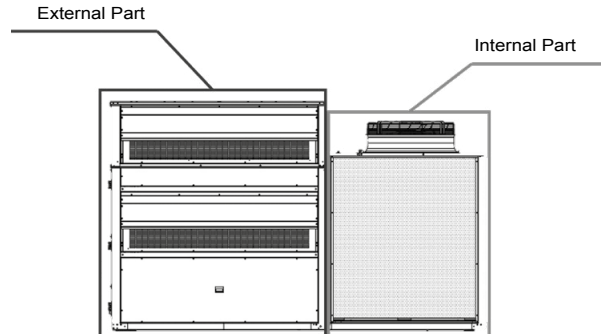
Here is a list of existing cases and the corresponding installation types to report in this document.

Variant	Installation case to report to
<p>Sunken courtyard</p> 	<p>Depending on the courtyard dimensions and clearance around the unit:</p> <ul style="list-style-type: none"> • Free field installation or • Installation over/in a pit
<p>Room with inlet/outlet only from the ceiling</p> 	<p>Should be considered as:</p> <ul style="list-style-type: none"> • Indoor unit
<p>Unit mounted on platform</p> 	<p>Flammable risk area below the unit depends on ventilation:</p> <ul style="list-style-type: none"> • Good ventilation: can be considered as free field installation a potentially flammable zone dimension is the same than on unit side • Lack of ventilation: should be considered as installation over/in a pit a Flammable risk area extends down to the floor

ROOFTOP INSTALLATION CASES

The rooftop units are designed to be usually installed outdoors, in a free field-type, well ventilated area but also be placed inside a technical room.

The rooftop is a packaged unit with two parts: the external part in contact with the outdoor air flow and the internal part in contact with the air of the occupied space and the outdoor air through the extraction and fresh air damper connection.



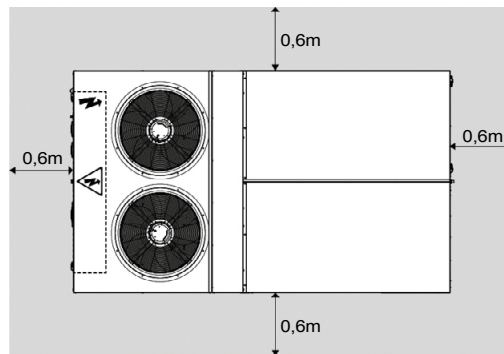
Difference between external and internal part of the rooftop must be done to identify a leakage event in the installation. This clarification is done to identify where the leak event is placed in every situation because of it is managed on different ways. Different scenarios may happen:

- If the leak event is placed in the external part of the rooftop, the leak is produced in the zone where the unit is placed, usually outdoors. If the machine is placed inside a technical room, the leak could affect the room.
- If the leak event is placed in the internal part of the rooftop, the leak may affect the inside of the building through the ducts system. If the unit is placed inside a technical room, the leak could affect the room through the extraction and fresh air damper connection.

In units with refrigerant R-454B, due to the nature of this refrigerant (A2L fluid), potentially flammable zones have been identified and positioned around the units, as shown in the diagram opposite.

The potentially flammable zones, as defined, must only be entered by suitably trained personnel equipped with the appropriate detection material and tools for working in a flammable zone.

An example of a defined potentially flammable zone of 0.6 meters around is shown below:



Never apply an open flame or live steam to a refrigerant container. Dangerous overpressure can result.

In case of combustion of refrigerant, do not clean combustion by-products with water, the mixture is highly corrosive.

External part of the rooftop

The leak event can occur in the external part. For the following installation cases, recommendations will be provided for the external section. All measures must be taken to prevent fluid entering inside building, for example the distance with all opening (window, doors, etc.).

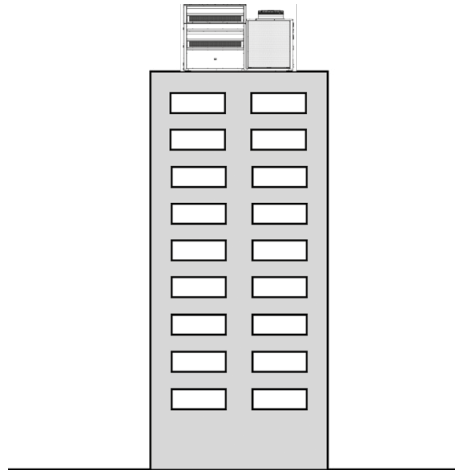
In the potentially flammable zones the presence of ignition sources (electrical power source, mobile phone or any other heat source) is prohibited, even temporarily. They also cannot be installed in or near the duct network of the unit.

In these zones, the installation of fresh air vent or extractors of the building is also prohibited.

Free field installation

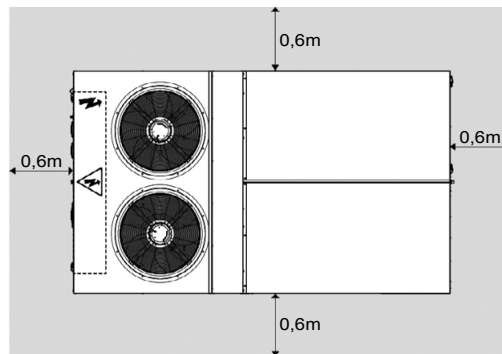
Rooftop is installed without obstacles around, avoiding accumulation of refrigerant fluid in case of leak.

ROOFTOP INSTALLATION CASES



The minimum distance with building or walls is given to allow circulation of technician around the unit during maintenance. You must always refer to the unit IOM to ensure minimum installation distance is respected for your unit.

Do not install ignition sources inside the potentially flammable area generated by the unit. Please refer to unit IOM for dedicated exact zoning. The following image shows an example of potentially flammable zone, the size of this zone must be checked with the IOM.

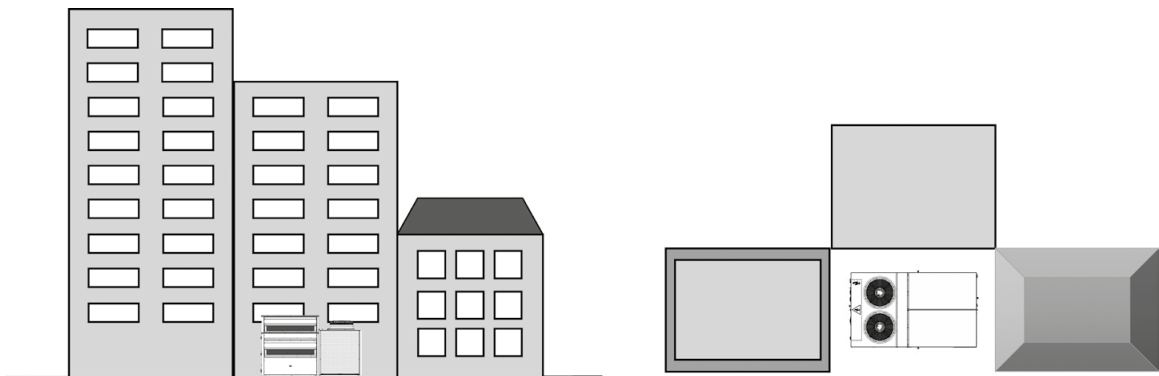


In case additional equipment is necessary (for example, an electrical power source), it must be:

- Installed out of defined flammable area
- Qualified as a non-ignition source for the fluid used

Outdoor confined space installation

Small spaces



In that case, natural ventilation might be reduced, and refrigerant could accumulate within the restricted space in case of leakage event. Customers must ensure no accumulation of refrigerant is possible.

Commonly used solutions (non-exhaustive list) are:

- Risk analysis demonstrating no accumulation risk
- Additional ventilation system for identified accumulation areas + leak detector
- Opening in wall at the position of the accumulation area

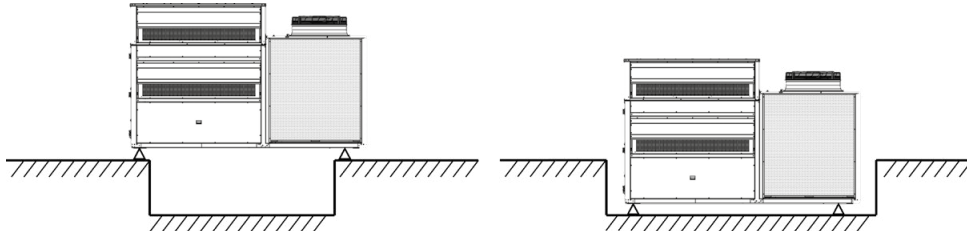
ROOFTOP INSTALLATION CASES

Choice of solution is the responsibility of the customer and the individual site specification.

In case additional equipment is necessary (for example, an electrical power source), it must be:

- Installed out of defined flammable area
- Qualified as a non-ignition source for the fluid used

Installation over a pit



Slightly flammable fluids used have a density higher than air. In case of leak, the main risk is stagnation at the lowest point.

If a unit is mounted in or over a pit, customer must ensure evacuation of gas is possible.

Commonly used solutions (non-exhaustive list) are:

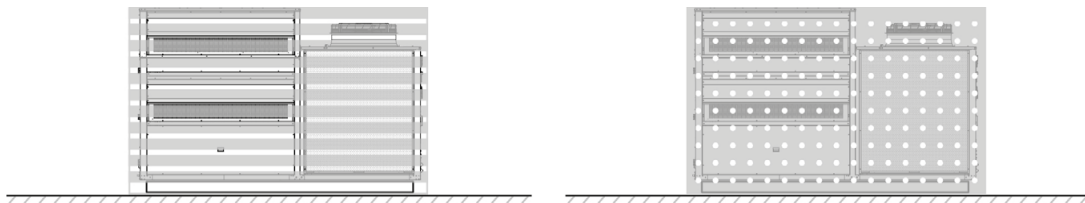
- Vent duct
- Ventilation system + leak detector

Choice of solution is the responsibility of the customer and the individual site specification.

In case an additional equipment is necessary (for example, an electrical power source), it must be:

- Installed out of defined potentially flammable area
- Qualified as a non-ignition source for the fluid used

Acoustic package



Some noise reduction systems have an impact on air circulation (packages, louvered panels, etc.).

The customer must ensure that the acoustic system in place does not allow refrigerant fluid accumulation, especially low down.

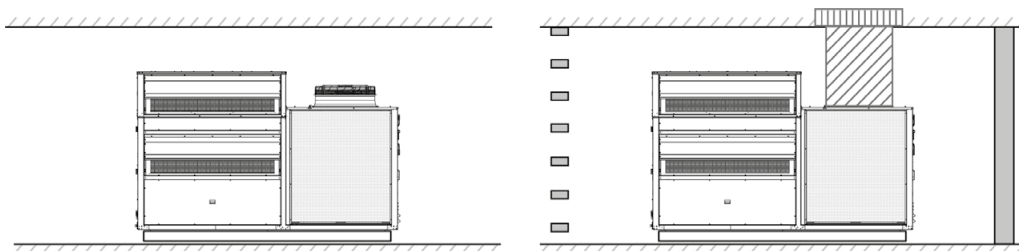
An alternative solution is to equip the system with a leak detector that ensures cutting the power and stopping unit operations.

Choice of solution is the responsibility of the customer and the individual site specification.

In case an additional equipment is necessary (electrical power source, etc.), it must be:

- Installed out of defined flammable area
- Qualified as a non-ignition source for the fluid used

Under shelter or covered area



Under shelter is an area or location open to atmosphere or where if enclosed it is longest wall has an opening size of > 75% to outside. Under EN 378-3 standard this type of installation can be considered as an outdoor installation.

Customer must still ensure accumulation of refrigerant is not possible.

ROOFTOP INSTALLATION CASES

Commonly used solutions (non-exhaustive list) are:

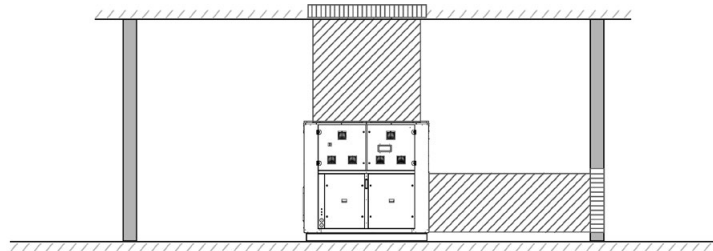
- Risk analysis demonstrating no accumulation risk
- Permanent ventilation system avoiding gas accumulation
- Additional ventilation system for identified accumulation areas + leak detector
- Opening in wall at the position of the accumulation area

Choice of solution is the responsibility of the customer and the individual site specification.

In case an additional equipment is necessary (electrical power source, etc.), it must be:

- Installed out of defined flammable area
- Qualified as a non-ignition source for the fluid used

Indoor installation



In case units are installed in an indoor space, installation requirements provided by EN378-3 standard must be applied.

All necessary protection required must be employed (leak detection and adequate ventilation).

Choice of solution is the responsibility of the customer and the individual site specification.

In case additional equipment is necessary (motorized valve, pump, et), it must be:

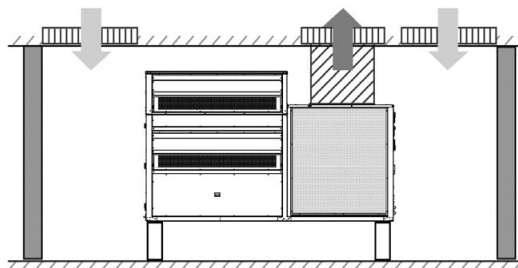
- Installed out of defined flammable area
- Or qualified as a non-ignition source for the fluid used

Variants and corresponding installation

The site examples shown in this document are for illustration purposes only and will differ in practice.

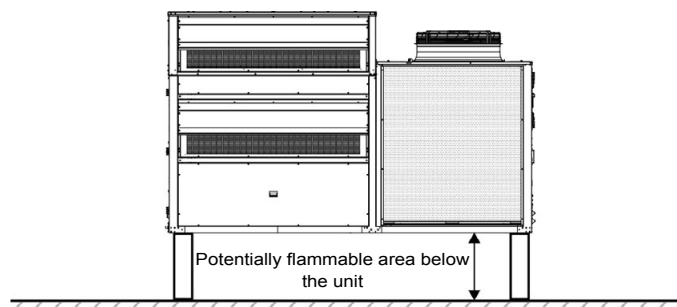
Below are further examples with corresponding installation comments.

Room with inlet/outlet only from the ceiling



It should be considered as indoor installation.

Unit mounted on platform



ROOFTOP INSTALLATION CASES

Flammable area below the unit depends on ventilation:

- Good ventilation: can be considered as free field installation → flammable area dimension is the same than on unit side
- Lack of ventilation: should be considered as installation over/in a pit → flammable area extends down to the floor

Internal part of the rooftop

The leak event can take place in the internal section. In this case the installation requirements provided by EN 378-3 standard must be applied. All necessary protection required must be employed (leak detection and adequate ventilation).

Minimum construction area

According to the EN-378-1 standard a minimum room surface is required depending on the refrigerant charge by circuit. For more details, see IOM.

- According to C.2. of EN 378-1 and considering the charge limit will not be more than $m^2 \times 1,5$, the calculation is as follows:

$$A_{\min} = m^2 / (2,5 \times \text{LFL}^{5/4} \times h_0)^2$$

m is the refrigerant charge amount in the system in kg

LFL is the Lower Flammable Limit in kg/m^3 . This value must be taken from the Supplier Datasheet.

h_0 is the height factor of the appliance:

- 0,6 for floor location
- 1,8 for wall mounted
- 1,0 for window mounted
- 2,2 for ceiling mounted

- According to C.3. OF en 378-1 and considering the charge limit is not more than $m^3 \times 1,5$, the calculation as follows:

$$A_{\min} = m / (\text{QLMV} \times h)$$

m is the refrigerant charge amount in the system in kg

QLMV is the quantity limit with minimum ventilation

h is the heigh of supply air flow to the room in m; max 2,2 m according the EN-378 standard

Periodical sealing control

This maintenance period depends on the refrigerant charge of CO_2 equivalent by circuit and the existence or not of leakage detection system. For more information, see IOM and your local regulations.

LEAK DETECTOR ADDITIONAL INFORMATION

Position recommendation

It is recommended to position leak detector(s) at the lowest point of the identified accumulation area.

Leak detector option for chiller

The option “Input contact for refrigerant leak detection” is only an information available through the unit controller.

The unit won't have any alarm logic linked to the signal.

The unit won't stop if signal corresponds to a leak detected.

It is customer responsibility to use that signal through site building management system or any other way if he wants to use it for safety.

Leak detector for rooftop indoor

For more details about the position, characteristics and logic operation of the leak detector see the IOM.

The internal part of the rooftop includes a leak detector with infrared and self-calibration.