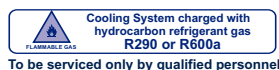


INGENIERIA DEL PRODUCTO  
HOJA DE ESPECIFICACIONES

|                                                                                 |             |               |
|---------------------------------------------------------------------------------|-------------|---------------|
| <b>DESCRIPCIÓN:</b> MANUAL DE USUARIO CONSERVADORES HORIZONTALES INGLES/FRANCES | <b>HOJA</b> | <b>CÓDIGO</b> |
| <b>MATERIAL:</b> Papel Bond 75 grs.                                             | 1 DE 1      | FP11955       |



Horizontal Freezer



MSC30  
MSC41  
MSC52  
MSC70

These models can contain any of the following suffixes in different order or combination:  
B, C, D, E, F, H, J, L, M, N, O, P, R, S, U



Metalfrio Solutions México, S.A. de C.V.  
Poniente 4, Manzana 2, Lotes 11 y 12  
Cd. Industrial C.P. 38010  
Celaya, Gto. México  
www.metalfrio.com.mx  
Customer service: +52 1 800 006 4380

**Pantone:** 282C

**Tipografía:** Arial

**Material:** Papel Bond 75 grs

**Dimensión:**

Ancho: 139.70 mm

Largo: 215.90 mm

Tolerancia:  $\pm 15$  mm

**Impresión:** offset

**Aparato de medición:**

Flexometro

Pantonera

**Nota:** El manual deberá venir sin manchas, completo, legible, sin rayones, ni rasgadas.

Se anexa muestra física.

| NO.                                                                           | MARCA O PROVEEDOR AUTORIZADO | CÓDIGO DE FABRICANTE | REVISIONES |
|-------------------------------------------------------------------------------|------------------------------|----------------------|------------|
|                                                                               |                              |                      |            |
|                                                                               |                              |                      |            |
| <b>REVISIONES: (0)</b> Se realiza crea especificación 15/07/2025 DIP3584 FGM. |                              |                      |            |
|                                                                               |                              |                      |            |
|                                                                               |                              |                      |            |
| ELABORO                                                                       | REVISO                       | AUTORIZO             |            |
|                                                                               |                              |                      |            |



Cooling System charged with  
hydrocarbon refrigerant gas  
**R290 or R600a**

To be serviced only by qualified personnel

# Horizontal Freezer



MSC30  
MSC41  
MSC52  
MSC70

These models can contain any of the following suffixes in  
different order or combination:

B, C, D, E, F, H, J, L, M, N, O, P, R, S, U



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User Manual

FP11955  
Rev. 0

## 2.- Content.

## 3.- Safety Instructions.

## 5.- Knowing the freezer: MSC.

## 6.- Baskets installation.

## 7.- Door lock installation.

## 9.- Mounting of the lids

## 10.- Use and product loading.

## 10.- Red Flame.

## 11.-Maximum load limit.

## 12.- Cleaning.

## 13.- Care/ Supply Cord Replacement/ Safety Standard For Commercial Refrigeration.

## 14.- Light servicing / Ambient room temperature limits.

## 15.- Knowing the electromechanic thermostat.

## 16.- Knowing the electronic thermostat Sollatek FCZ/Knowing the motor-control switch.

## 17.- Warranty.

## 18.- Troubleshooting.

## 20.- Symbols.

## 21.- Information General.

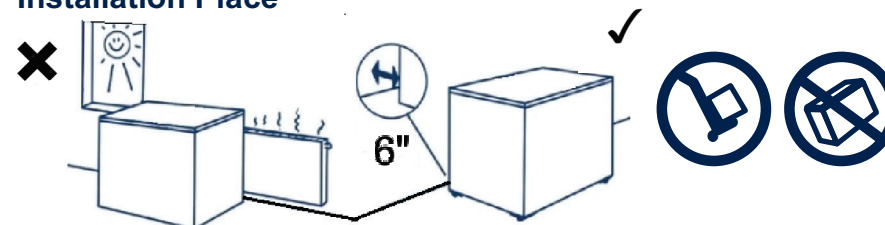
## 40.- Instructions.

Note:  
The images and the temperature control can vary depending on the model of the freezer.

## General Recommendations

- Read this manual carefully before beginning any procedure.
- Do not let the freezer be repaired by unqualified personnel.
- Freezer contains hydrocarbon refrigerant, that is flammable.
- Service should only be conducted by qualified technicians.
- Follow the electrical installation instructions.
- Periodically check the state of electrical installations.

## Installation Place



- The freezer should be installed in places with good air circulation that provide good ventilation to the condenser unit.
- It is not recommended the installation in places with high relative humidity. i.e. laundry rooms.
- A minimum distance of 6" from the side and back walls must be maintained.
- The freezer must be installed on a leveled surface for proper operation.
- The freezer should not be installed in narrow corridors, only in secure locations with easy access.
- The freezer is only for indoor use.
- When unpacking, do not tilt the freezer more than 45 degrees, to prevent clogging of compressor oil in refrigeration tubes connected to the compressor.
- Do not expose the freezer to heat sources such as stoves, ovens, greenhouses, hot walls & solar radiation (direct).
- WARNING: Keep clear of obstruction all ventilation openings in the appliance enclosure or in the structure for building-in.
- WARNING: Do not use mechanical devices or other means to accelerate the defrosting process, other than those recommended by the manufacturer.
- WARNING: Do not damage the refrigerating circuit.
- WARNING: Do not use electrical appliances inside the food/ice storage compartments unless they are of the type recommended by the manufacturer.
- This applia is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have benn given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.

## Electrical Installation

- Allowable voltage range: (Refer to the Nameplate of the freezer for the voltage rating.)

| Nominal Voltage | 127V | 220V |
|-----------------|------|------|
| Min Voltage     | 100V | 190V |
| Max Voltage     | 140V | 250V |

- Make sure that the plug is properly adjusted and connected to a dedicated outlet.
- Don't use electrical extensions cords.
- In case of needing an electrical extension cord, the installation should only be carried out if the socket has the nominal voltage output with a tolerance of  $\pm 10\%$ . The gauge of the wires must obey the following table

| Wire gauge | Distance          |                   |
|------------|-------------------|-------------------|
|            | 127V              | 220V              |
| 12 AWG     | -----             | Up to 298.5 ft    |
| 10 AWG     | Up to 62.3 ft     | 301.8 to 475.7 ft |
| 8 AWG      | 65.6 to 98.4 ft   | 479.0 to 715 ft   |
| 6 AWG      | 101.7 to 157.4 ft | -----             |

- The replacement of electrical power cables should be done by qualified technical service provider.
- If it's not possible to obtain the indicated nominal voltage with a variation of  $\pm 10\%$  (power supply instability), install a voltage regulator according to your freezer power. (consult with service center)
- The automatic defrost is regulated by an electronic control or, when appropriate, by an electromechanic thermostat.
- The freezer has a power cord with a ground terminal, make sure that the facilities have a proper outlet on the wall for this purpose. Do not use adapters or remove the ground pin.

**WARNING!** Do not use electrical appliances inside the food/ice storage compartments unless they are of the type recommended by the manufacturer.

**WARNING!** Do not use mechanical devices or other means to accelerate the defrosting process, other than those recommended by the manufacturer.

**WARNING!** Keep clear of obstruction all ventilation openings in the appliance enclosure or in the structure for building-in.

**WARNING!** Do not damage the refrigeration circuit

### Technical data of the device

- The rating plate is located on the outside of the appliance. It contains information on voltage, type and quantity of refrigerant and information on climatic classes



Operating temperature  
Below 0° F

1. Glass lid.
2. Lock with key .
3. Cabinet.
4. Thermostat.
5. Grid.
6. Light powered digital thermometer (optional).
7. Plastic feet / Castors.

Meaning of alphanumeric characters indicating the climate class of the device test room.

MSC30 CL N

Operating  
condition

-C:32°C; 65% HR  
-D:40.5°C; 75% HR

Hydrocarbon  
Refrigerant  
Gas



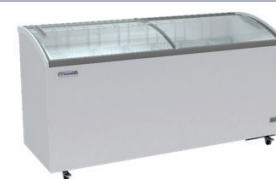
Cooling System  
loaded with  
R290

MSC30

MSC41

MSC52

MSC70



7 ft³

11 ft³

14 ft³

21 ft³

High-efficiency sliding doors made of tempered curved glass with a high efficiency hard Low-e layer.

Rounded interior corners for easier cleaning and avoid dirt collection.

Cooling system based on skin evaporator providing a uniform temperature and maximum efficiency in energy consumption.

Heavy duty castors designed to withstand the freezer weight with maximum load allowable, for easier handling of the freezer.

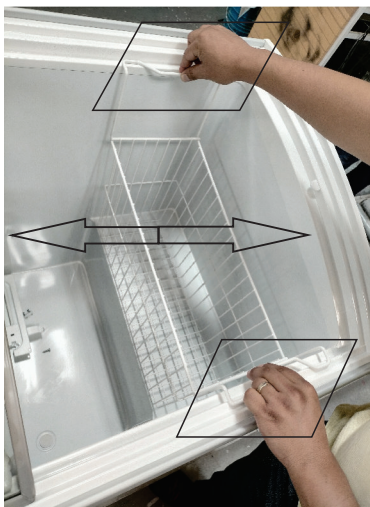
Coated wireframe baskets.



1.- Remove any original packaging and hold the basket by the brackets as shown.



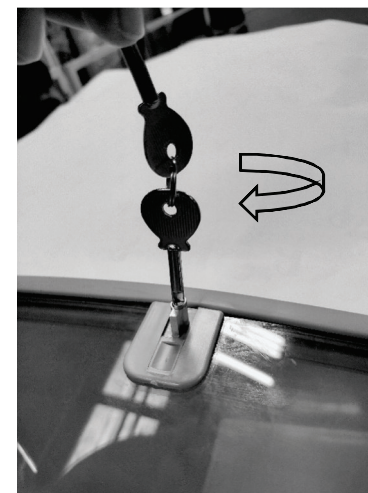
2.- Place the basket on the back and front channels as shown, then slide it to desired position.



1.- Insert the key with the lock in the plastic cover.

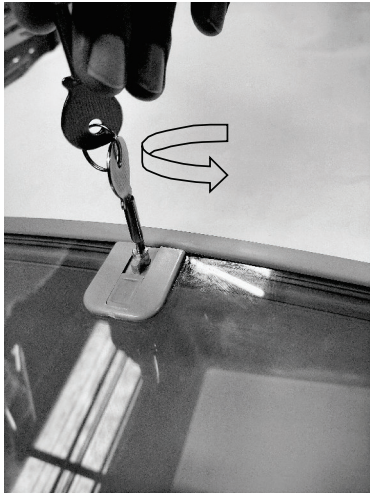


2.- To close, turn it clockwise.





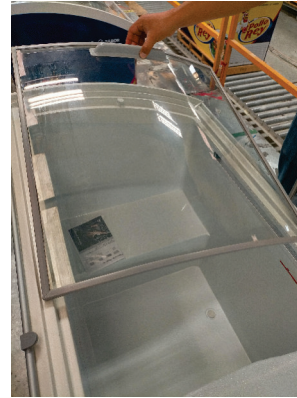
3.- To open, turn it counter clockwise.



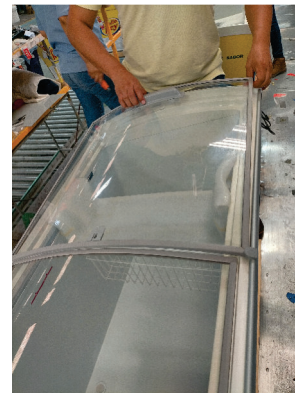
4.- Remove the key.



1.- Insert the lower lid on the frame's lower channel.



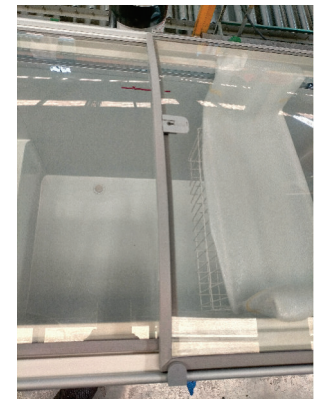
2.-Insert the upper lid on the frame's upper channel.  
NOTE: Each handle must be aligned with the pin on the sides of the frame as shown.



3.- Make sure that both lids are below the two stoppers in the center.



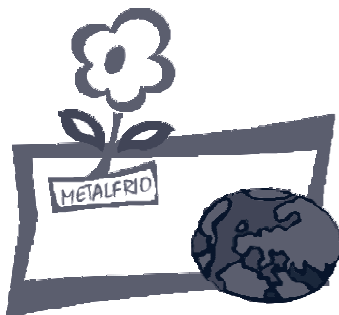
4.- Correct assembly.



When closing the lid, you need to assemble with the bottom stop



- Once the freezer is plugged to the power source, let it run empty for at least 4 hours before loading any product.
- This freezer is intended only for previously frozen products, do not load product at ambient temperature.
- Do not let the lids open for long periods of time.



Metalfrio Solutions commitment with the environment:

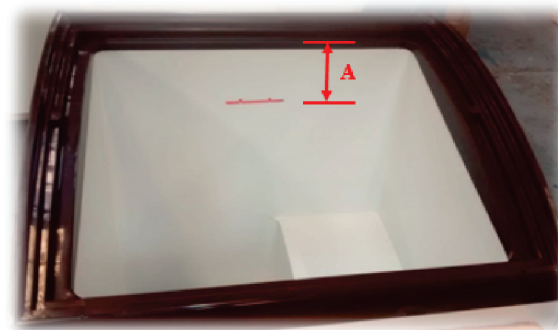
- CFC free cabinet insulation.
- Environment friendly natural refrigerant gas: Hydrocarbons (R290, R600a)

## RED FLAME

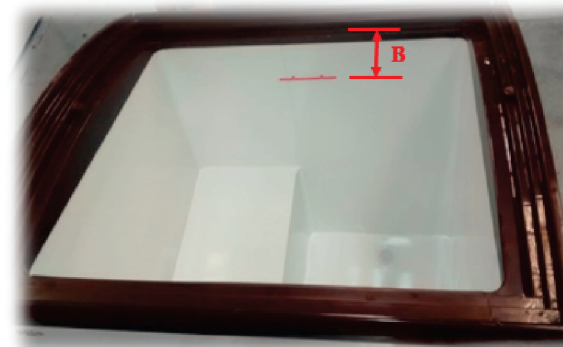
The red flame indicates the presence of very dangerous oxide gas particles in the pipe



Back



|



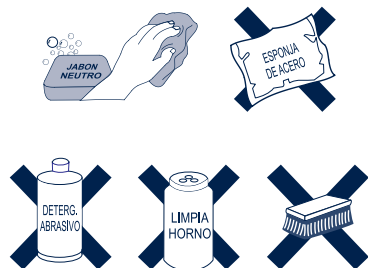
Front

Never exceed product above the maximum A & B load line mark located on the front and back of your equipment.

The overload of the freezer with product can lead to poor performance.



### External Cleaning



- The external cleaning of the equipment shall be done with a mild soap and water solution and a clean soft cloth.
- Never use detergents, abrasive sponges or steel brushes.

### Condenser

Condenser cleaning is recommended once every 2 months (vacuum)  
Use a cleaning cloth to remove the leftover lint or dust.

### Internal Cleaning

- Within the normal operation of the freezer, it is expected to find frost formation in the walls of the inner tank, when the frost layer reaches an approximate thickness of 1/4" to 3/8" it is necessary to perform a defrost.
- Relocate the frozen product into another cold room or freezer, or wrap it with insulating material.
- Unplug the freezer from the power source.
- Keep the lids open.
- Remove the frost layer with a plastic or wooden spatula sliding it parallel to the walls. Do not use metal or sharp tools.
- The use of warm water could speed up the defrost process.
- After defrost, clean the freezer with a slightly wet soft cloth using a solution of water and baking soda (1 tablespoon of baking soda per 1 liter of water), to dry the surfaces.
- Do not use water stream jet that require flushing or drainage.
- Plug the freezer again to the power source and load it with the product as it was previous to the defrost.



- **IMPORTANT:** keep the freezer plugged to the power source at all times. Do not unplug the freezer overnight as this would drive to a higher energy consumption and product spoilage.
- Do not unplug the freezer by pulling the power cord cable, instead, grab the power cord plug firmly to unplug from power source outlet.
- Be careful when relocating the freezer, to avoid risk of electric shock, unplug the power cord from the power source outlet before moving the freezer.
- Do not overload the freezer. Do not place product above load line.
- When loading the product it is recommended the leave open gaps between products in order to have better temperature distribution.
- Do not load with ambient temperature products, only previously frozen products.
- Maintain the lids properly closed.
- Periodically check the inner tank drain making sure is not clogged.
- When cleaning the inner tank **DO NOT USE SHARP OBJECTS, NEITHER PUNCTURE THE WALLS AS IT COULD CAUSE DAMAGE TO THE SKIN EVAPORATOR TUBES.**

### SUPPLY CORD REPLACEMENT

If the supply cord is damaged, it must be replaced by the manufacturer, its service agent or similarly qualified person in order to avoid a hazard."

### SAFETY STANDARD FOR COMMERCIAL REFRIGERATION

The appliance is to be installed in accordance with the Safety Standard for Refrigeration Systems, ANSI/ASHRAE 15.

"If appliance has a refrigerant charge of more than 114g for R290 or 129g for R600a, the appliance shall not be installed in public corridors or lobbies"





To replace the lamp:

1. Unplug the freezer from the power source.
2. Unplug the inlet connector of the lamp.
3. Use a screwdriver to remove screws from the plastic profile, it is screw mounted.
4. Use a spatula to pop out the lamp from the plastic profile, it is Snap-on mounted.
5. Place the new lamp by pushing it on the plastic profile until it is completely inserted.
6. Plug the inlet connector to the lamp.
7. Plug the freezer to the power source and verify the lamp works properly.

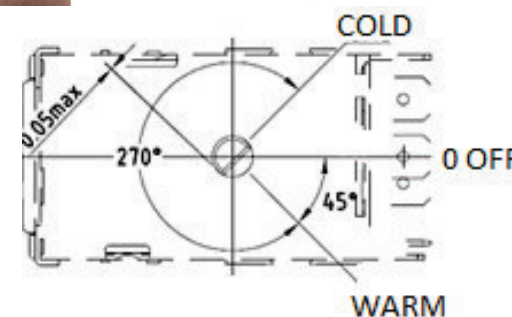
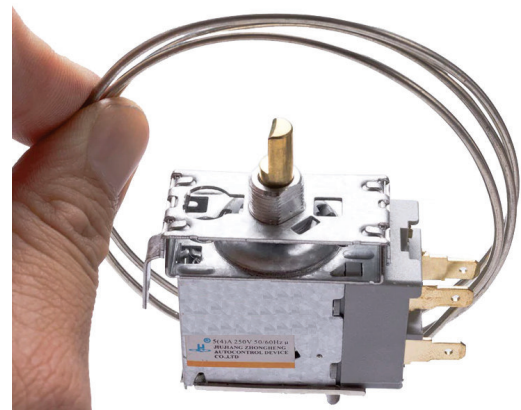


If there is any doubt regarding this procedure, call Metalfrio Solutions technical service

## AMBIENT ROOM TEMPERATURE LIMITS

This appliance is designed to operate in ambient conditions according to the climate class indicated in the nameplate.

| Test room climate class | Dry bulb temperature °F | Relative Humidity % | Dew Point °F | Water vapour mass in dry air g/kg |
|-------------------------|-------------------------|---------------------|--------------|-----------------------------------|
| 0                       | 68.0                    | 50                  | 48.7         | 7.3                               |
| 1                       | 60.8                    | 80                  | 54.7         | 9.1                               |
| 2                       | 71.6                    | 65                  | 59.4         | 10.8                              |
| 3                       | 77.0                    | 60                  | 62.1         | 12.0                              |
| 4                       | 86.0                    | 55                  | 68.0         | 14.8                              |
| 5                       | 80.6                    | 70                  | 70.0         | 15.8                              |
| 6                       | 104.0                   | 40                  | 75.0         | 18.8                              |
| 7                       | 95.0                    | 75                  | 86.0         | 27.3                              |
| 8                       | 75.0                    | 55                  | 57.7         | 10.2                              |



**IMPORTANT:** The temperature thermostat has a factory preset for the correct temperature range operation. An incorrect thermostat adjustment can lead to a deficient cooling and/or high energy consumption. Only a trained and authorized technician must make any adjustment to the thermostat.

An electromechanic thermostat is the device that controls the freezer operating temperature:

The electromechanic thermostat has a knob that can rotate in both directions: Clockwise or Counter Clockwise

1. If the knob is turned to the COLD position, the freezer will cut off at a lower temperature.

2. If the knob is turned to the WARM position, the freezer will cut off at a higher temperature.

3. In the scale dial, the largest the number is the coldest temperature.

4. **IMPORTANT:** If the knob is in position "0" the freezer will be turned OFF and the compressor will not run.



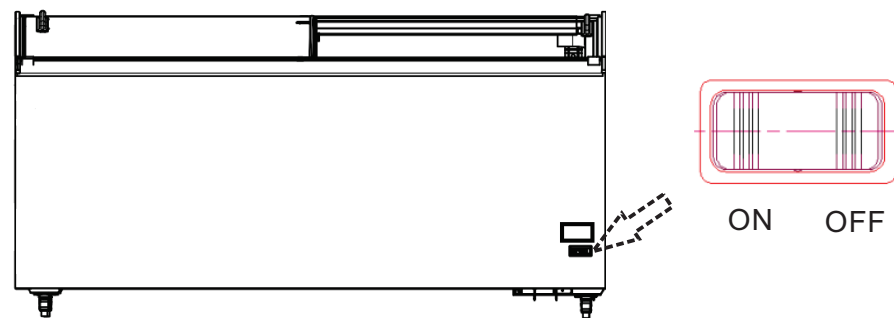
The Electronic Thermostat can be a direct replacement of the Electro Mechanic Thermostat



| FCZ LED Flashing Pattern indication |                                                                                    |
|-------------------------------------|------------------------------------------------------------------------------------|
| LED pattern                         | Meaning                                                                            |
| Continuosly ON                      | ON mode (cooling in process, good voltage, compressor ON)                          |
| Flashing 0.5 sec ON / 0.5 sec OFF   | Voltage out of range (outputs OFF)                                                 |
| Flashing 1.0 sec ON / 1.0 sec OFF   | Wait & cooling in process (temp> cut-in, waiting delay to start compressor)        |
| Flashing 2.0 sec ON / 2.0 sec OFF   | Wait & Temp <cut-in satisfied compressor OFF (Compressor starts when temp> cut-in) |
| Flashing 4.0 sec ON / 4.0 sec OFF   | Defrost mode (compressor OFF)                                                      |
| Fast flashing 1 time every 2 sec    | Probe #1 with fail                                                                 |
| Fast flashing 2 times every 2 sec   | Probe #2 with fail                                                                 |
| 3 flashes in ascending order        | The knob is in the OFF position (all outputs OFF)                                  |
| Momentarily OFF                     | Input voltage outside UVBT or OVBT limits                                          |
| Flashing 0.1 sec ON / 0.1 sec OFF   | Voltage frequency out of range (outputs OFF)                                       |

KNOWING THE MOTOR-CONTROL SWITCH

A cord-connected product with a motor having a rated output of more rated than 249 W (1/3 hp) shall be provided with a manually operated motor-control switch.



Metalfrio Solutions México SA de CV grants a warranty policy with each new unit indicating the warranty period and the conditions it covers, see customer warranty agreement.

TO MAKE YOUR WARRANTY VALID

At the time of any damage, the buyer or end user must provide the following information:

- 1.- Model
- 2.- Serial number
- 3.- Copy of the invoice
- 4.- Purchase date
- 5.- Description of the failure

The warranty service will be provided by the network of authorized Metalfrio service centers.

If it is necessary to transfer the unit to our plant, it must be approved by the commercial area in writing, and it must be delivered to the carrier. The unit must be shipped in the original packaging to avoid further damage.

THE WARRANTY DOES NOT APPLY IN THE FOLLOWING CASES

A) The warranty is limited to the repair of the refrigerator and includes the replacement of defective parts. .In no case the unit will be replaced during the repair period, which will not exceed 30 business days, except for repairs that require manufacturing of special components.

B) In no case will the repair proceed when the damage has occurred due to handling in transfers or in facilities not suitable for this units, product overload in the unit, voltage variations beyond range or any other misuse of the unit.

C) The purchaser or end user is obliged to follow the installation and operating instructions, and the premises where the units are used must fully comply with the recommended electrical installation requirements described in this manual. Failure to do so will void the warranty.

D) In the event of accidents such as fires, floods, earthquakes, or other natural events that are unrelated to the operation of the unit, the warranty will not cover for it.

NSTRUCTIONS FOR HANDLING AND/ DISPOSAL OF THE APPLIANCE

- For handling, follow the recommendations in this manual.
- For responsible final disposition please follow your local regulations.
- Recycling and final disposition centers are an option for final disposition when compliant with local regulations.

For details, check with our service staff  
Tel +52 800 006 4380



| Inspections                                                          | Posibble Causes                                                                                                                        | Procedures                                                                                                                                                              |
|----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Freezer does not turn ON.<br/>(no display on the controller)</b>  | Electric power is missing.                                                                                                             | Verify that the electrical outlet has power, connect some other device to check that it turns on.                                                                       |
|                                                                      | Freezer not connected.                                                                                                                 | Check that the power cord of the freezer is properly connected.                                                                                                         |
|                                                                      | High or low voltage variations<br>(Some units with electronic temperature control have voltage protections to prevent further damage.) | Check the voltage of the power outlet, if it is not stable, install an external voltage regulator (not supplied) with adequate capacity for the unit.                   |
|                                                                      | Defficient power outlet.                                                                                                               | Change or repair the power outlet. Or plug the unit to a good dedicated power outlet.                                                                                   |
| <b>Freezer does not cool.</b>                                        | Excess or poor distribution of the product.                                                                                            | Distribute the product evenly and always below the load line marked in the unit.                                                                                        |
|                                                                      | Too frequent door openings and/or doors opened for long time.                                                                          | Make sure door close properly. Avoid doors opening for long periods of time.                                                                                            |
|                                                                      | Freezer installed incorrectly.                                                                                                         | Observe the item "Installation place".                                                                                                                                  |
| <b>Noisy.</b>                                                        | Freezer uneven with respect to the floor.                                                                                              | Change the installation location to a leveled surface.                                                                                                                  |
|                                                                      | Freezer with its back against the wall.                                                                                                | Leave the freezer at least 6" from the wall.                                                                                                                            |
|                                                                      | When connecting the freezer after a period of inactivity, it is normal for noise to be produced at the beginning of the operation.     | Wait 60 min and recheck the noise. If persists, consult customer service.                                                                                               |
| <b>Freezer does not stop.<br/>(compressor running continuously).</b> | External heat sources affect temperature.                                                                                              | Do not install the freezer near heat sources such as stoves, or directly under the sun light.                                                                           |
|                                                                      | Door open.                                                                                                                             | Make sure th doors are closed properly. Avoid doors opening for long period of time.                                                                                    |
| <b>Freezer dos not freeze product quickly.</b>                       | Check the characteristics of the product to be preserved.                                                                              | The freezers are designed to receive previously frozen products.                                                                                                        |
|                                                                      |                                                                                                                                        | In case needed to freeze a product from ambient temperature, it will take a long period of time depending on the ambient conditions and characteristics of the product. |

Before contacting your technician, perform the suggested procedures.

| Inspections                                                    | Posibble Causes                                                                             | Procedures                                                                             |
|----------------------------------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| <b>The products are too cold.</b>                              | Thermostat knob set to coldest setting.                                                     | To confirm this, call Metalfrio's service center.                                      |
|                                                                | Faulty thermostat.                                                                          |                                                                                        |
| <b>Condensation on doors.</b>                                  | When the ambient humidity is quite high, it is normal to observe condensation on the doors. | When deemed necessary, wipe the condensation on the doors with a clean dry soft cloth. |
| <b>The lighting doesn't work.</b>                              | Freezer disconnected                                                                        | Connect your freezer to the voltage supply.                                            |
|                                                                | Voltage supply failure.                                                                     | Verify the state of the power source with a qualified technician.                      |
|                                                                | Lamp (s) and / or power driver failure.                                                     | To confirm this, call Metalfrio's servicel center.                                     |
| <b>Excessive icing on the internal walls.<br/>(evaporator)</b> | Lids are open or not entirely closed.                                                       | Ensure the lids close properly.                                                        |
|                                                                | Humidity quite high.                                                                        | Clean periodically when deemed necessary according to procedure in Page 14.            |



This marking indicate that this product shoulb not be disposed of with other household waste. To prevent possible harm to the enviroment or human health due to uncontrolled wate disposal, recycle it responsibly to promote the sustainable reuse of material resources. To return your used device, please use the return and collections system, or contact the retailer where the product was purchased for instructions on disposal.



The symbols referred to in Clause 7.6 (without colours is permitted) and the information of the warning marking shall be provided as follows:

**WARNING**

**Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer.**

**The appliance shall be stored in a room without continuously operating ignition sources (for example: open flames, an operating gas appliance or an operating electric heater.**

**Do not pierce or burn.**

**Be aware that refrigerants may not contain an odour.**

In Canada, the French translations for the warnings in Clause 101.DVS.2 are as follows

**MISE EN GARDE**

**Ne pas utiliser de moyens autres que ceux recommandés par le fabricant pour accélérer le processus de dégivrage ou pour nettoyer l'appareil.**

**L'appareil doit être entreposé dans un local ne contenant pas de sources d'inflammation permanentes (flammes nues, appareil à gaz ou dispositif de chauffage électrique en fonctionnement, par exemple).**

**Ne pas percer ou brûler.**

**Attention, les fluides frigorigènes peuvent ne pas dégager d'odeur.**

The manufacturer may provide other suitable examples or may provide additional information about the refrigerant odour..

101.DVS.3.1.1 The following information shall be specified in the manual where the information is needed for the function of the manual and as applicable to the appliance:

a) information for spaces where refrigerant pipes are allowed, including statements that

i) piping material, pipe routing, and installation shall include protection from physical damage in operation and service, and be in compliance with national and local codes and standards, such as ANSI/ASHRAE 15, IAPMO Uniform Mechanical Code, ICC International Mechanical Code, or CSA B52. All field joints shall be accessible for inspection prior to being covered or enclosed;

ii) the installation of pipe-work shall be kept to a minimum;

iii) pipe-work in the case of flammable refrigerants shall not be installed in an unventilated space, if that space is smaller than Amin in Annex 101.DVU, except for A2L refrigerants where the installed pipes comply with Clause 22.115DV. In case of field charge, the effect on refrigerant charge caused by the different pipe length shall be quantified;

iv) mechanical connections made in accordance with Clause 22.115DV shall be accessible for maintenance purposes;

v) provision shall be made for expansion and contraction of long runs of piping;

vi) protection devices, piping, and fittings shall be protected as far as possible against adverse environmental effects, for example, the danger of water collecting and freezing in relief pipes or the accumulation of dirt and debris;

vii) piping in refrigeration systems shall be so designed and installed to minimize the likelihood of hydraulic shock damaging the system;

viii) steel pipes and components shall be protected against corrosion with a rustproof coating before applying any insulation;

ix) flexible pipe elements shall be protected against mechanical damage, excessive stress by torsion, or other forces, and that they should be checked for mechanical damage annually;

x) precautions shall be taken to avoid excessive vibration or pulsation;

xi) for appliances containing flammable refrigerants, the minimum floor area of the room shall be mentioned in the form of a table or a single figure without reference to a formula;

xii) after completion of field piping for split systems, the field pipework shall be pressure tested with an inert gas and then vacuum tested prior to refrigerant charging, according to the following requirements:

1) The minimum test pressure for the low side of the system shall be the low side design pressure and the minimum test pressure for the high side of the system shall be the high side design pressure, unless the high side of the system cannot be isolated from the low side of the system in which case the entire system shall be pressure tested to the low side design pressure.

2) The test pressure after removal of pressure source shall be maintained for at least 1 h with no decrease of pressure indicated by the test gauge, with test gauge resolution not exceeding 5 % of the test pressure.

3) During the evacuation test, after achieving a vacuum level specified in the manual or less, the refrigeration system shall be isolated from the vacuum pump and the pressure shall not rise above 1500 microns within 10 min. The vacuum pressure level shall be specified in the manual, and shall be the lessor of 500 microns or the value required for compliance with national and local codes and standards, which may vary between residential, commercial, and industrial buildings.





- xiii) field-made refrigerant joints indoors shall be tightness tested according to the following requirements: The test method shall have a sensitivity of 5 grams per year of refrigerant or better under a pressure of at least 0,25 times the maximum allowable pressure. No leak shall be detected.
- b) instructions how to determine the additional REFRIGERANT CHARGE and how to complete the REFRIGERANT CHARGE on the label provided by the manufacturer considering the requirements in Clause 7.1DV.5.2;
- c) the minimum rated airflow, if required by Annex 101.DVU;
- d) information for handling, installation, cleaning, servicing and disposal of refrigerant;
- e) for appliances using FLAMMABLE REFRIGERANTS, instructions shall include the REFRIGERANT CHARGE mc and minimum room area of the space  $A_{min}$ . All dimensional data shall be provided in both SI and IP units;
- f) a warning to keep any required ventilation openings clear of obstruction;
- g) a notice that servicing shall be performed only as recommended by the manufacturer;
- h) a warning that ducts connected to an appliance shall not contain a potential ignition source;
- i) for appliances relying on safety measures according to Annex 101.DVU, instructions for wiring to external ventilation;
- j) when a remote located refrigerant sensor is specified by the manufacturer, the instructions shall state when it is required and how to install and connect the sensor;
- k) for appliances using A2L REFRIGERANTS, connected via an air duct system to one or more rooms, the supply and return air shall be directly ducted to the space. Open areas such as false ceilings shall not be used as a return air duct;
- l) the following information requirements apply for connecting piping in field erected systems:
  - i) Equipment piping in the occupied space shall be installed in such a way to protect against accidental damage in operation and service.
  - ii) Precautions shall be taken to avoid excessive vibration or pulsation to refrigerating piping.
  - iii) Protection devices, piping, and fittings shall be protected as far as possible against adverse environmental effects, for example, the danger of water collecting and freezing in relief pipes or the accumulation of dirt and debris.
  - iv) Provision shall be made for expansion and contraction of long runs of piping.
  - v) Piping in REFRIGERATING SYSTEMS shall be so designed and installed to minimize the likelihood hydraulic shock damaging the system.
  - vi) Solenoid valves shall be correctly positioned in the piping to avoid hydraulic shock or pressure.
  - vii) Steel pipes and components shall be protected against corrosion with a rustproof coating before applying any insulation.
- viii) Insulation shall be suitable for use with the material being insulated.

- ix) Flexible pipe elements shall be protected against mechanical damage, excessive stress by torsion, or other forces. They should be checked for mechanical damage annually.
- x) The indoor equipment and pipes shall be securely mounted and guarded such that accidental rupture of equipment cannot occur from such events as moving furniture or reconstruction activities.
- xi) Where safety shut off valves are specified, the minimum room area may be determined based on the maximum amount of refrigerant that can be leaked as determined in Annex 101.DVU.
- xii) Where safety shut off valves are specified, the location of the valve in the REFRIGERATING SYSTEM relative to the occupied spaces shall be as described in Annex 101.DVN and Annex 101.DVU.
- xiii) Field-made refrigerant joints indoors shall be tightness tested to applicable codes and requirements.

m) For mechanical ventilation as specified in Annex 101.DVU, the air extraction opening from the room shall be located equal or below the refrigerant release point. For floor mounted units, it shall be as low as practicable. The air extraction openings shall be located in a sufficient distance from the air intake openings to prevent re-circulation to the space.

All installation instruction information required to comply with Annex 101.DVU shall be provided in the form of a table or a single figure without reference to a formula;

n) For mechanical ventilation as specified in Annex 101.DVU, the lower edge of the air extraction opening where air is exhausted from the room shall not be more than 100 mm above the floor.

The location where the mechanical ventilation air extracted from the space is discharged shall be separated by a sufficient distance, but not less than 3 m, from the mechanical ventilation air intake openings, to prevent re-circulation to the space.

101.DVS.3.1.2 The following additional information shall be specified in the manual for remote systems using safety shut off valves in installation of appliances using A2L refrigerants where the information is needed for the function of the manual and as applicable to the appliance:

- a) Safety shut off valves installation shall avoid hydraulic shock.
- b) Safety shut off valves shall not block in liquid refrigerant unless adequate relief is provided to the refrigerant system low pressure side.
- c) Where safety shut off valves are specified, the minimum room area may be determined based on the maximum amount of refrigerant that can be leaked as determined in Annex 101.DVU.1.2.
- d) Where safety shut off valves are specified, the location of the valve in the REFRIGERATING SYSTEM, relative to the occupied spaces shall be as described in Clause 101.DVU.1.4.2.

101.DVS.3.1.3 For appliances with REFRIGERANT DETECTION SYSTEMS, the instructions shall include the following:

- a) For REFRIGERANT DETECTION SYSTEMS, the function and operation and required servicing measures.
- b) For LIMITED LIFE REFRIGERANT SENSORS used in REFRIGERANT DETECTION SYSTEMS, the specified end of life and instructions for replacement.
- c) REFRIGERANT SENSORS for REFRIGERANT DETECTION SYSTEMS shall only be replaced with sensors specified by the appliance manufacture.
- d) Instruction to verify actuation of mitigation actions per Annex 101.DVU



#### 101.DVS.3.2 Unventilated areas

For appliances containing more than m1 for any refrigerating circuit, the manual shall include a statement advising that an unventilated area where the appliance using FLAMMABLE REFRIGERANTS is installed shall be so constructed that in the event of any refrigerant leak, it will not stagnate so as to create a fire or explosion hazard. This shall include:

- a) a warning that the non-FIXED APPLIANCE shall be stored in an area where the room size corresponds to the room area as specified for operation;
- b) a warning that the non-FIXED APPLIANCE shall be stored in a room without continuously operating open flames (for example an operating gas appliance) or other potential ignition sources (for example an operating electric heater, hot surfaces).

#### 101.DVS.3.3 Qualification of workers

The manual shall contain specific information about the required qualification of the working personnel for maintenance, service, and repair operations. Every working procedure that affects safety means shall only be carried out by competent persons according to Annex 101.DVT.

Examples for such working procedures are

- a) breaking into the refrigerating circuit;
- b) opening of sealed components;
- c) opening of ventilated enclosures.

#### 101.DVS.4 Information on servicing

##### 101.DVS.4.1 General

The manual shall contain specific information for service personnel according to Clauses

##### 101.DVS.4.2 to 101.DVS.4.10.

##### 101.DVS.4.2 Checks to the area

Prior to beginning work on systems containing FLAMMABLE REFRIGERANTS, safety checks are necessary to ensure that the risk of ignition is minimised. For repair to the REFRIGERATING SYSTEM, Clauses 101.DVS.4.3 to 101.DVS.4.7 shall be completed prior to conducting work on the system.

##### 101.DVS.4.3 Work procedure

Work shall be undertaken under a controlled procedure so as to minimise the risk of a flammable gas or vapour being present while the work is being performed.

##### 101.DVS.4.4 General work area

All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.

##### 101.DVS.4.5 Checking for presence of refrigerant

The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres.

Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e., nonsparking, adequately sealed, or intrinsically safe.

##### 101.DVS.4.6 Presence of fire extinguisher

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available on hand. A dry chemical or CO2 fire extinguisher should be adjacent to the charging area.

##### 101.DVS.4.7 No ignition sources

No person carrying out work in relation to a REFRIGERATING SYSTEM which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment shall be surveyed to make sure that there are no flammable hazards or ignition risks. "No Smoking" signs shall be displayed.

#### 101.DVS.4.8 Ventilated area

Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.

##### 101.DVS.4.9 Checks to the refrigerating equipment

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times, the manufacturer's maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer's technical department for assistance.

The following checks shall be applied to installations using FLAMMABLE REFRIGERANTS:

- a) the actual REFRIGERANT CHARGE is in accordance with the room size within which the refrigerant containing parts are installed;
- b) the ventilation machinery and outlets are operating adequately and are not obstructed;
- c) if an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant;
- d) marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected;
- e) refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode refrigerant containing.

components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being so corroded.

##### 101.DVS.4.10 Checks to electrical devices

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment, so all parties are advised.

Initial safety checks shall include:

- a) that capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking;
- b) that no live electrical components and wiring are exposed while charging, recovering or purging the system;
- c) that there is continuity of earth bonding.

##### 101.DVS.5 Repairs to sealed components

101.DVS.5.1 During repairs to sealed components, all electrical supplies shall be disconnected from the equipment being worked upon prior to any removal of sealed covers, etc. If it is absolutely necessary to have an electrical supply to equipment during servicing, then a permanently operating form of leak detection shall be located at the most critical point to warn of a potentially hazardous situation.

101.DVS.5.2 Particular attention shall be paid to the following to ensure that by working on electrical components, the casing is not altered in such a way that the level of protection is affected. This shall include damage to cables, excessive number of connections, terminals not made to original specification, damage to seals, incorrect fitting of glands, etc.

Ensure that the apparatus is mounted securely. Ensure that seals or sealing materials have not degraded to the point that they no longer serve the purpose of preventing the ingress of flammable atmospheres. Replacement parts shall be in accordance with the manufacturer's specifications.

##### 101.DVS.6 Repair to intrinsically safe components

Do not apply any permanent inductive or capacitance loads to the circuit without ensuring that this will not exceed the permissible voltage and current permitted for the equipment in use.

Intrinsically safe components are the only types that can be worked on while live in the presence of a flammable atmosphere. The test apparatus shall be at the correct rating. Replace components only with parts specified by the manufacturer. Other parts can result in the ignition of refrigerant in the atmosphere from a leak.

NOTE The use of silicon sealant can inhibit the effectiveness of some types of leak detection equipment. Intrinsically safe components do not have to be isolated prior to working on them.



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NOTE The use of silicon sealant can inhibit the effectiveness of some types of leak detection equipment. Intrinsically safe components do not have to be isolated prior to working on them.

#### 101.DVS.7 Cabling

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges, or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans.

#### 101.DVS.8 Detection of flammable refrigerants

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.

The following leak detection methods are deemed acceptable for all refrigerant systems.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of FLAMMABLE REFRIGERANTS, the sensitivity might not be adequate, or might need recalibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used.

Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 % maximum) is confirmed.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine can react with the refrigerant and corrode the copper pipe-work.

NOTE Examples of leak detection fluids are

– bubble method,

– fluorescent method agents.

If a leak is suspected, all naked flames shall be removed/extinguished.

If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak. Removal of refrigerant shall be according to Clause 101.DVS.9.

#### 101.DVS.9 Removal and evacuation

When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, for flammable refrigerants it is important that best practice be followed, since flammability is a consideration. The following procedure shall be adhered to:

a) safely remove refrigerant following local and national regulations;

b) purge the circuit with inert gas;

c) evacuate (optional for A2L);

d) purge with inert gas (optional for A2L);

e) open the circuit by cutting or brazing.

The refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. For appliances containing flammable refrigerants,

the system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times.

Compressed air or oxygen shall not be used for purging refrigerant systems.

For appliances containing flammable refrigerants, refrigerants purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum (optional for A2L). This process shall be repeated until no refrigerant is within the system (optional for A2L). When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place.

Ensure that the outlet for the vacuum pump is not close to any potential ignition sources and that ventilation is available.

#### 101.DVS.10 Charging procedures

In addition to conventional charging procedures, the following requirements shall be followed.

a) Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimise the amount of refrigerant contained in them.

b) Cylinders shall be kept in an appropriate position according to the instructions.

c) Ensure that the REFRIGERATING SYSTEM is earthed prior to charging the system with refrigerant.

d) Label the system when charging is complete (if not already).

e) Extreme care shall be taken not to overfill the REFRIGERATING SYSTEM.

Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

#### 101.DVS.11 Decommissioning

Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its detail. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

a) Become familiar with the equipment and its operation.

b) Isolate the system electrically.

c) Before attempting the procedure, ensure that:

i) mechanical handling equipment is available, if required, for handling refrigerant cylinders;

ii) all personal protective equipment is available and being used correctly;

iii) the recovery process is supervised at all times by a competent person;

iv) recovery equipment and cylinders conform to the appropriate standards.

d) Pump down refrigerant system, if possible.

e) If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.

f) Make sure that cylinder is situated on the scales before recovery takes place.

g) Start the recovery machine and operate in accordance with instructions.

h) Do not overfill cylinders (no more than 80 % volume liquid charge).

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

j) When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.

k) Recovered refrigerant shall not be charged into another REFRIGERATING SYSTEM unless it has been cleaned and checked.



#### 101.DVS.12 Labelling

Equipment shall be labelled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed. For appliances containing FLAMMABLE REFRIGERANTS, ensure that there are labels on the equipment stating the equipment contains FLAMMABLE REFRIGERANT.

#### 101.DVS.13 Recovery

When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.

When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labelled for that refrigerant (i.e., special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of all appropriate refrigerants including, when applicable, FLAMMABLE REFRIGERANTS. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition. Before using the recovery machine, check that it is in satisfactory working order, has been properly maintained and that any associated electrical components are sealed to prevent ignition in the event of a refrigerant release. Consult manufacturer if in doubt.

The recovered refrigerant shall be returned to the refrigerant supplier in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that FLAMMABLE REFRIGERANT does not remain within the lubricant. The evacuation process shall be carried out prior to returning the compressor to the suppliers. Only electric heating to the compressor body shall be employed to accelerate this process. When oil is drained from a system, it shall be carried out safely.

#### Annex 101.DVT (informative)

Competence of service personnel

Annex 101.DVT DR Add Annex 101.DVT as follows:

##### 101.DVT.1 General

Information of procedures additional to usual information for refrigerating appliance installation, repair, maintenance, and decommission procedures is required when an appliance with FLAMMABLE REFRIGERANTS is affected.

The training of these procedures is carried out by national training organisations or manufacturers that are accredited to teach the relevant national competency standards that may be set in legislation.

The achieved competence should be documented by a certificate.

##### 101.DVT.2 Information and training

101.DVT.2.1 The training should include the substance of the following:

101.DVT.2.2 Information about the explosion potential of FLAMMABLE REFRIGERANTS to show that flammables can be dangerous when handled without care.

101.DVT.2.3 Information about potential ignition sources, especially those that are not obvious, such as lighters, light switches, vacuum cleaners, electric heaters.

#### 101.DVT.2.4 Information about the different safety concepts:

Unventilated – Safety of the appliance does not depend on ventilation of the housing. Switching off the appliance or opening of the housing has no significant effect on the safety. Nevertheless, it is possible that leaking refrigerant may accumulate inside the enclosure and flammable atmosphere will be released when the enclosure is opened.

Ventilated enclosure – Safety of the appliance depends on ventilation of the housing. Switching off the appliance or opening of the enclosure has a significant effect on the safety. Care should be taken to ensure sufficient ventilation before.

Ventilated room – Safety of the appliance depends on the ventilation of the room. Switching off the appliance or opening of the housing has no significant effect on the safety. The ventilation of the room should not be switched off during repair procedures.

#### 101.DVT.2.5 Information about refrigerant detectors:

a) Principle of function, including influences on the operation.

b) Procedures, how to repair, check, or replace a refrigerant detector or parts of it in a safe way.

c) Procedures, how to disable a refrigerant detector in case of repair work on the refrigerant carrying parts.

101.DVT.2.6 Information about the concept of sealed components and sealed enclosures according to IEC 60079-15

#### 101.DVT.2.7 Information about the correct working procedures:

a) Commissioning

i) Ensure that the floor area is sufficient for the REFRIGERANT CHARGE or that the ventilation duct is assembled in a correct manner.

ii) Connect the pipes and carry out a leak test before charging with refrigerant.

iii) Check safety equipment before putting into service.

b) Maintenance

i) Portable equipment is to be repaired outside or in a workshop specially equipped for servicing units with FLAMMABLE REFRIGERANTS.

ii) Ensure sufficient ventilation at the repair place.

iii) Be aware that malfunction of the equipment can be caused by refrigerant loss and a refrigerant leak is possible.

iv) Discharge capacitors in a way that won't cause any spark. The standard procedure to short circuit the capacitor terminals usually creates sparks.

v) Reassemble sealed enclosures accurately. If seals are worn, replace them.

vi) Check safety equipment before putting into service.

c) Repair

i) Portable equipment is to be repaired outside or in a workshop specially equipped for servicing units with FLAMMABLE REFRIGERANTS.

ii) Ensure sufficient ventilation at the repair place.

iii) Be aware that malfunction of the equipment can be caused by refrigerant loss and a refrigerant leak is possible.

iv) Discharge capacitors in a way that won't cause any spark.

v) When brazing is required, the following procedures shall be carried out in the following order:





- 1) Safely remove the refrigerant following local and national regulations. If the recovery is not required by national regulations, drain the refrigerant to the outside. Take care that the drained refrigerant will not cause any danger. In doubt, one person should guard the outlet. Take special care that drained refrigerant will not float back into the building.
  - 2) Purge the refrigerant circuit with oxygen free nitrogen.
  - 3) Evacuate the refrigerant circuit.
  - 4) Purge the refrigerant circuit with nitrogen for 5 min (not required for A2L refrigerants).
  - 5) Evacuate again (not required for A2L refrigerants).
  - 6) Remove parts to be replaced by cutting or brazing.
  - 7) Purge the braze point with nitrogen during the brazing procedure required for repair.
  - 8) Carry out a leak test before charging with refrigerant.
- vi) Reassemble sealed enclosures accurately. If seals are worn, replace them.
- vii) Check safety equipment before putting into service.
- d) Decommissioning
- i) If the safety is affected when the equipment is put out of service, the REFRIGERANT CHARGE is to be removed before decommissioning.
  - ii) Ensure sufficient ventilation at the equipment location.
  - iii) Be aware that malfunction of the equipment can be caused by refrigerant loss and a refrigerant leak is possible.
  - iv) Discharge capacitors in a way that will not cause any spark.
  - v) Remove the refrigerant. If the recovery is not required by national regulations, drain the refrigerant to the outside. Take care that the drained refrigerant will not cause any danger. In doubt, one person should guard the outlet. Take special care that drained refrigerant will not float back into the building.
  - vi) When FLAMMABLE REFRIGERANTS except A2L REFRIGERANTS are used,
    - 1) Evacuate the refrigerant circuit.
    - 2) Purge the refrigerant circuit with nitrogen for 5 min.
    - 3) Evacuate again.
    - 4) Fill with nitrogen up to atmospheric pressure.
    - 5) Put a label on the equipment that the refrigerant is removed.
- e) Disposal
- i) Ensure sufficient ventilation at the working place.
  - ii) Remove the refrigerant. If the recovery is not required by national regulations, drain the refrigerant to the outside. Take care that the drained refrigerant will not cause any danger. In doubt, one person should guard the outlet. Take special care that drained refrigerant will not float back into the building.
  - iii) When FLAMMABLE REFRIGERANTS are used,
    - 1) Evacuate the refrigerant circuit.
    - 2) Purge the refrigerant circuit with oxygen free nitrogen.
    - 3) Evacuate again (not required for A2L refrigerants).
    - 4) Cut out the compressor and drain the oil.
    - iv) Cut out the compressor and drain the oil

#### Annex 101.DVU

(normative)

#### A2L Refrigerant Requirements

Annex 101.DVU DR Add Annex 101.DVU as follows:

#### 101.DVU.1 General

When an A2L flammable refrigerant is used in a field-erected system made up of partial units, the requirements for installation space of appliance and/or additional requirements are determined according to the following and as required by Annex 101.DVG.

- a) The refrigerant charge (mc) used in the appliance;
- b) The releasable charge (mrel) of the appliance;
- c) The maximum charge (mmax) allowed in the space;
- d) The minimum area of the space (Amin);
- e) The Lower Flammability limit (LFL) as given by the value based on the WCF – Worst Case Formulation as defined in ISO 817;
- f) The installation location;
- g) The type of ventilation of the location or the appliance;
- h) Construction;
- i) Refrigerant detection and mitigation means (air circulation, ventilation, shut-off valves, etc.).

Symbol mc denotes the refrigerant charge of a single refrigerating system or single refrigerating circuit. Where multiple refrigerating systems or refrigerating circuits are servicing the same space, each refrigerating system or circuit refrigerant charge shall be evaluated independently.

Symbol mrel denotes the releasable charge of a single refrigerating appliance or refrigerant circuit defined as Clause 101.DVU.1.3.

#### 101.DVU.1.1 Additional construction requirements of partial system and piping with A2L refrigerants

101.DVU.1.1.1 The compressor, pressure-relief device, or pressure vessel type refrigerant containing components of the refrigerating system shall be in locations other than the occupied space or in compliance with charge limits given by Clauses 101.DVU.1.5 and 101.DVU.1.6.

NOTE Pressure vessel means any refrigerant-containing part of a REFRIGERATING SYSTEM other than

- a) Compressors;
- b) pumps;
- c) component parts of sealed absorption systems;
- d) evaporators, each separate section of which does not exceed 15 L of refrigerant containing volume;
- e) coils.
- f) piping and its valves, joints, and fittings;
- g) control devices; and
- h) pressure-containing components (including headers) having an internal diameter or largest cross sectional dimension not greater than 152 mm.

101.DVU.1.1.2 Refrigerant distribution assemblies and associated piping shall meet all applicable requirements of this Standard.

101.DVU.1.1.3 Refrigeration systems shall use only permanent joints indoors, except for site-made joints directly connecting the appliance to the refrigerant piping, or factory mechanical joints in compliance with ISO 14903 that at pressure of no less than the refrigerant saturation pressure at 25 °C have no leak when checked with an instrument having a sensitivity of 3g/y or less.

101.DVU.1.1.4 Refrigerant containing parts in the appliance shall be protected from damage in the event of catastrophic failure of moving parts, e.g., belts on belt drive fans. Fan assemblies in compliance with Clause 101.DVU.1.1.7, other than belts on belt drive fans, do not need to be guarded against catastrophic failure.





101.DVU.1.1.5 Systems where the appliance interconnecting pipes are installed in the occupied space, piping shall be designed and installed in such a way that these pipes are protected against accidental damage.

101.DVU.1.1.5.1 Interconnected piping shall comply with ANSI/ASHRAE 15 installation requirements.

101.DVU.1.1.5.2 Piping in the occupied space shall have a charge mc or mrel as calculated by Clause 101.DVU.1.1.3 and no more than mmax calculated per Clause 101.DVU.1.6.

factory. There shall be no leak when checked with an instrument having a sensitivity of 3g/yr or less when tested at 75 % of the maximum allowable pressure.

101.DVU.1.1.7 The maximum evaporator, condenser, or mitigation fan operating speed shall be less than 90 % of the maximum allowable fan speed as specified by the manufacturer of the fan wheel.

If a maximum allowable fan speed has not been established, the fan wheel shall be tested as follows:

a) The fan wheel shall be operated continuously at 120 % of maximum speed allowed by the controls for 10 d. There shall be no structural failure of the fan.

b) If non-metallic fans have a thermal index rating of 65°C or greater in accordance with UL 746B, preconditioning is not required.

c) If non-metallic fans have a thermal index rating less than 65°C in accordance with UL 746B, or no thermal index rating for the materials is available, specimens shall be preconditioned by aging at 90°C for 168 h. The samples shall not have more than a 50-percent reduction of the unconditioned property values for items 1 – 4 below when tested in accordance with CAN/CSA-C22.2 No 0.17 and UL 746A:

- 1) tensile strength;
- 2) flexural strength;
- 3) Izod impact; and
- 4) tensile impact..

101.DVU.1.2 Releasable charge (mrel) determination

101.DVU.1.2.1 General

The maximum releasable charge shall be considered to be the largest value as calculated by Clauses 101.DVU.1.2.2 to 101.DVU.1.2.3 multiplied by 1.30. The maximum releasable charge shall be calculated using the internal volume of all interconnecting tubing and all refrigeration appliances “downstream” of the safety shut-off valves. Internal volume of tubing shall be determined by multiplying the length of tubing times the internal volume per length specified in Table 101.DVU.1.

**Table 101.DVU.1**  
**Tube volume per unit length**

| Tube OD |       | Tube internal volume per unit length |                      |
|---------|-------|--------------------------------------|----------------------|
| mm      | in    | m <sup>3</sup> / m                   | ft <sup>3</sup> / ft |
| 6.35    | 0.250 | 1.77E-05                             | 2.05E-04             |
| 7.94    | 0.313 | 3.10E-05                             | 3.59E-04             |
| 9.53    | 0.375 | 4.80E-05                             | 5.55E-04             |
| 12.7    | 0.500 | 9.29E-05                             | 1.08E-03             |
| 15.9    | 0.625 | 1.49E-04                             | 1.73E-03             |
| 19.1    | 0.750 | 2.14E-04                             | 2.48E-03             |
| 22.2    | 0.875 | 2.96E-04                             | 3.43E-03             |
| 25.4    | 1.000 | 3.89E-04                             | 4.50E-03             |
| 28.6    | 1.125 | 5.03E-04                             | 5.82E-03             |
| 31.8    | 1.250 | 6.23E-04                             | 7.21E-03             |
| 38.1    | 1.500 | 9.10E-04                             | 1.05E-02             |
| 41.3    | 1.625 | 1.08E-03                             | 1.25E-02             |
| 54.0    | 2.125 | 1.88E-03                             | 2.18E-02             |
| 66.7    | 2.625 | 2.89E-03                             | 3.35E-02             |

NOTE Values in IP units are for reference only.

#### 101.DVU.1.2.2 Releasable charge in cooling mode

The releasable charge in the cooling mode shall be in accordance with the following:

$$M_{rel} = (L_{vap} \times TD_{vap} \times \rho_{vap}) + (L_{liq} \times TD_{liq} \times \rho_{liq}) + (IV_{unit} \times \rho_{mix}) + (6,8g / s \times T_{resp} / 1000)$$

where

Lvap is the total length of vapor interconnecting tubing from safety shut-off valves to each refrigerating appliance in m;

Lliq is the total length of liquid interconnecting tubing from safety shut-off valves to each refrigerating appliance in m;

TDvap is the tube volume per length of tube diameter of the vapor interconnecting tubing determined from Table 101.DVU.1 in m3 /m;

TDliq is the tube volume per length of tube diameter of the liquid interconnecting tubing determined from Table 101.DVU.1 in m3/m;

pvap is the vapor refrigerant density in the cooling mode when operating at 35 °C ODDb (Out Door Dry Bulb Temperature) and DB/WB established from the evaporator leaving air temperature, if not given use of 0 °C/–10 °C for Medium Temperature Appliance and –20 °C/–30 °C for Low Temperature Appliance in kg/m3;



$\rho_{liq}$  is the liquid refrigerant density in the cooling mode when operating at 35 °C ODDB (Out Door Dry Bulb Temperature) and DB/WB established from the evaporator leaving air temperature, if not given use of 0 °C/–10 °C for Medium Temperature Appliance and –20 °C/–30 °C for Low Temperature Appliance in kg/m<sup>3</sup>;  
 $\rho_{mix}$  is the refrigerant density assuming 80 % liquid and 20 % vapor.  $\rho_{mix} = 0,8 \cdot \rho_{liq} + 0,2 \cdot \rho_{vap}$  in kg/m<sup>3</sup>;

$IV_{unit}$  is the total internal volume of the refrigeration appliance including coil(s), headers, tubing and all refrigerant containing parts of the unit that is downstream of the safety shut-off valve as determined by the manufacturer, m<sup>3</sup>;

$T_{resp}$  is the assumed response time for refrigeration detection system and associated mitigation measures in s, which shall be 30 s.

#### 101.DVU.1.2.3 Releasable charge in off/standby/defrost mode

The releasable charge in the cooling off mode  $m_{off}$ , shall be in accordance with the following:

$$m_{rel} = (L_{vap} \times TD_{vap} \times \rho_{vap}) + (L_{liq} \times TD_{liq} \times \rho_{liq}) + (IV_{unit} \times \rho_{off}) + (6,8g/s \times T_{resp} / 1000)$$

where

$\rho_{off}$  is the refrigerant density assuming 80 % liquid and 20 % vapor at 21C saturation conditions in kg/m<sup>3</sup>;

$L_{vap}$  is the total length of vapor interconnecting tubing from safety shut-off valves to each refrigerating appliance in m;

$L_{liq}$  is the total length of liquid interconnecting tubing from safety shut-off valves to each refrigerating appliance in m;

$TD_{vap}$  is the tube volume per length of tube diameter of the vapor interconnecting tubing determined from Table 101.DVU.1 in m<sup>3</sup>/m;

$TD_{liq}$  is the tube volume per length of tube diameter of the liquid interconnecting tubing determined from Table 101.DVU.1 in m<sup>3</sup>/m;

$\rho_{vap}$  is the vapor refrigerant density in the cooling mode when operating at 35 °C ODDB (Out Door Dry Bulb Temperature) and DB/WB established from the evaporator leaving air temperature, if not given use of 0 °C/–10 °C for Medium Temperature Appliance and –20 °C/–30 °C for Low Temperature Appliance in kg/m<sup>3</sup>;

$\rho_{liq}$  is the liquid refrigerant density in the cooling mode when operating at 35 °C ODDB (Out Door Dry Bulb Temperature) and DB/WB established from the evaporator leaving air temperature, if not given use of 0 °C/–10 °C for Medium Temperature Appliance and –20 °C/–30 °C for Low Temperature Appliance in kg/m<sup>3</sup>;

$\rho_{mix}$  is the refrigerant density assuming 80 % liquid and 20 % vapor.  $\rho_{mix} = 0,8 \cdot \rho_{liq} + 0,2 \cdot \rho_{vap}$  in kg/m<sup>3</sup>;

$IV_{unit}$  is the total internal volume of the refrigeration appliance including coil(s), headers, tubing and all refrigerant containing parts of the unit that is downstream of the safety shut-off valve as determined by the manufacturer, m<sup>3</sup>;

$T_{resp}$  is the assumed response time for refrigeration detection system and associated mitigation measures in s, which shall be 30 s.

101.DVU.1.3 Additional Instructions for partial systems with A2L refrigerants  
 101.DVU.1.3.1 The following additional information shall be specified in the instruction manual for partial units using A2L refrigerants.

101.DVU.1.3.2 Instructions for positioning of Solenoid Valves in the field-installed interconnecting refrigerant piping

101.DVU.1.3.2.1 Solenoid valves shall be correctly positioned in the piping to avoid hydraulic shock.

101.DVU.1.3.2.2 Solenoid valves shall not block in liquid refrigerant unless adequate relief is provided to the refrigerant system low pressure side.

101.DVU.1.3.3 Where safety shut-off valves are specified for use in the field-installed interconnecting refrigerant piping, instructions for calculating the minimum room area based on the maximum amount of refrigerant that can be leaked as determined in Clause 101.DVU.1.5 or 101.DVU.1.6 whichever is applicable.

101.DVU.1.3.4 Where safety shut off valves are required in the field-installed interconnecting refrigerant piping, the installation location of the valve in the REFRIGERATING SYSTEM, relative to the occupied spaces shall be provided.

101.DVU.1.3.5 Instructions for installation and protection of field-installed Interconnecting refrigerant piping shall be provided for compliance with Clause 101.DVU.1.1.5.

101.DVU.1.3.6 Instructions for operation, positioning, and use of refrigerant sensor or detector as specified in Annex 101.DVP or 101.DVQ.

101.DVU.1.3.6.1 Factory installed refrigerant sensors or detectors shall not be disconnected.

101.DVU.1.3.6.2 Field installed refrigerant sensors shall be correctly positioned and tested per Annex 101.DVQ.

101.DVU.1.4 Safety shut-off valves for direct systems

101.DVU.1.4.1 Installation and operation

101.DVU.1.4.1.1 Safety shut-off valves, if required on PARTIAL UNITS by Annex 101.DVG, shall be factory-installed, except as noted in Clause 101.DVG.10.4 for evaporator units installed in walk-in cooler/freezers.

101.DVU.1.4.1.2 When safety shut-off valves are activated by the refrigerant detection system, the valves shall close and remain closed until corrective action is taken.

101.DVU.1.4.2 Location

Safety shut-off valves shall be located in such a way such that leaks upstream of the safety shut off valve shall not enter the internal volume of the partial unit and in a space with a room volume large enough so that the maximum refrigerant charge complies with Clause 101.DVU.1.7 or shall be located outside. Safety shut off valves shall be positioned to enable access for maintenance by an authorized person.

101.DVU.1.4.3 Design

101.DVU.1.4.3.1 General

Safety shut-off valves shall be evaluated for use with the appliance.

Safety shut-off valves shall comply with Clauses 101.DVU.1.4.3.2 to 101.DVU.1.4.3.7. Seat leakage rates shall be determined in accordance with Clause 101.DVU.1.4.3.3. Safety shut-off valves shall be normally closed and shall be electronically controlled.

101.DVU.1.4.3.2 The safety shut-off valve control system shall be non-self-resetting. The safety shut-off valve control system shall require a manual reset operation. Remote reset without verification of corrective action shall not be allowed.

101.DVU.1.4.3.3 Seat leakage test

The safety shut-off valve shall have a maximum seat leakage at all test conditions of less than or equal to 0,01 kg/hr.  
 Compliance is checked by test.



Through-the-seat leakage shall be measured, at the valve outlet port, at 2, 50, 100, and 125 percent of the maximum allowable system pressure as determined in Annex 101.DVJ applied to the valve inlet for 5 min at each test pressure. The maximum leakage rate over the 5 min duration shall be measured and recorded for each test pressure. The test shall be performed for both liquid state and vapour state. The inlet pressure shall be applied with a test medium corresponding to the intended fluid service of the sample valve. The vapour state working fluid during test may be air. The liquid state working fluid during test may be water. If the test working fluid is refrigerant, at least 3 °C superheat shall be used for vapour and at least 2 °C subcooling shall be used for liquid.

#### 101.DVU.1.4.3.4 Safety shut-off valve requirements

Electrical contacts, terminals, and solenoids shall be adequately protected from damage and expected atmospheric conditions. Safety shut-off valves shall be capable of operating in a temperature range from at least 10 °K below the minimum design evaporator temperature to 60 °C. Safety shut-off valves shall be capable of fully closing within 30 s of being energized, at any normal operating pressure or condition.

#### 101.DVU.1.4.3.5 Body leakage test

A pressure equal to 150 percent of the maximum rated pressure shall be applied through the safety shut-off valve, with the valve body open, and maintained for 5 min minimum, with no external leakage or damage to the safety shut-off valve, when checked with an instrument having a sensitivity of 3g.yr or less. No permanent distortion of any valve component shall be allowed after the pressure is released. The test working fluid may be refrigerant, water, or any suitable hydraulic fluid.

#### 101.DVU.1.4.3.6 Marking

Safety shut-off valves shall be marked with the following, and all markings shall be legible and durable:

- a) manufacturer's name or trade name;
- b) model designation;
- c) type of fluid service;
- d) approved direction of flow;
- e) electrical ratings; and
- f) rated working pressure.

#### 101.DVU.1.4.3.7 Manufacturing and production test

All production safety shut-off valves shall be tested to confirm rated seat leakage is not exceeded.

#### 101.DVU.1.5 Maximum refrigerant charge

$$m_{\max} = 0,25 \times LFL \times H \times A$$

For spaces exceeding 250 m<sup>2</sup>, room area (A) shall be 250 m<sup>2</sup>, or the required minimum room area  $A_{\min}$  of the installed appliance with the refrigerant charge  $m_c$  shall be in accordance with the following:

$$A_{\min} = m_c / (0,25 \times LFL \times H)$$

where

$m_{\max}$  is the maximum refrigerant charge in kg;

$m_c$  is the total refrigerant charge in the refrigeration system in kg;

$LFL$  is the lower flammability limit in kg/m<sup>3</sup>;

$H$  is the room height in m but not more than 2,2 m

$A$  is the room area in m<sup>2</sup>;

$A_{\min}$  is the required minimum room area in m<sup>2</sup>.

If safety shut-off valves in compliance with Clause 101.DVU.1.4 are applied to limit the releasable charge, the releasable charge ( $m_{rel}$ ) as determined in Clause 101.DVU.1.2 shall be used to determine the minimum room size  $A_{\min}$  by replacing ( $m_c$ ) in the equation for  $A_{\min}$  with ( $m_{rel}$ ).

#### 101.DVU.1.6 Maximum refrigerant charge when employing circulation or ventilation

The maximum refrigerant charge of the installed appliance shall be in accordance with the following:

$$m_{\max} = 0,5 \times LFL \times H \times A$$

For spaces exceeding 250 m<sup>2</sup>, room area (A) shall be 250 m<sup>2</sup>, or the required minimum room area  $A_{\min}$  of the installed appliance with the refrigerant charge  $m_c$  shall be in accordance with the following:

$$A_{\min} = m_c / (0,5 \times LFL \times H)$$

$m_{\max}$  is the maximum refrigerant charge in kg;

$m_c$  is the total refrigerant charge in the refrigeration system in kg;

$LFL$  is the lower flammability limit in kg/m<sup>3</sup>;

$H$  is the room height in m but not more than 2,2 m;

$A$  is the room area in m<sup>2</sup>;

$A_{\min}$  is the required minimum room area in m<sup>2</sup>.



If safety shut-off valves in compliance with Clause 101.DVU.1 are applied to limit the releasable charge, the releasable charge ( $m_{rel}$ ) as determined in Clause 101.DVU.1.2 shall be used to determine the minimum room size  $A_{min}$  by replacing ( $m_c$ ) in the equation for  $A_{min}$  with ( $m_{rel}$ ).

#### 101.DVU.1.7 Mechanical ventilation – General

101.DVU.1.7.1 When the mass of the refrigerant in the entire refrigeration system is  $> m_2$  and  $\leq m_3$ , COMPRESSOR UNITS, CONDENSING UNITS, and CONDENSER UNITS to be installed indoors shall be marked "Ventilation shall be provided as indicated in the installation instructions".

101.DVU.1.7.2 When the mass of the refrigerant in the entire refrigeration system is  $> m_2$  and  $\leq m_3$ , COMPRESSOR UNITS, CONDENSING UNITS, and CONDENSER UNITS to be installed indoors shall be provided with installation instructions that indicate the following (through Clause 101.DVU.1.7.5):

Ventilation shall be made to a place where sufficient air is available to dilute the leaked refrigerant, such as outdoors or a large space. An indoor space used to exhaust the ventilation air shall have sufficient volume, including the volume of the room in which the appliance is installed, to ensure that the maximum refrigerant charge specified in Clause 101.DVU.1.6 is not exceeded.

When ventilation is activated by the refrigerant detection system, the following actions shall be taken:

a) For all appliances equipped with a fan, the fan shall be switched on to provide the minimum circulation airflow in accordance with Clause 101.DVU.1.8.2.

b) The compressor operation shall be disabled, unless the compressor operation reduces the leak rate or in the case of a multiple circuits, when the leak circuit is isolated by shut-off valves and the operation of the system is not affected.

The mechanical ventilation and appliance air circulation shall continue for a minimum of 5 min after the refrigerant detection system resets.

#### 101.DVU.1.7.3 Required ventilation airflow

$$Q_{min} = 30(m_c - m_{max}) / LFL, \text{ not to exceed } Q_{min} - 486 / LFL$$

Where:

$Q_{min}$  is the minimum mechanical ventilation in m<sup>3</sup>/h;

$m_c$  is the refrigerant system charge in kg;

$m_{max}$  is the maximum charge as determined in Clause 101.DVU.1.6;

LFL is the lower flammability limit in kg/m<sup>3</sup>;

30 is a constant

NOTE the limit of 486/LFL is based on an 35 kW system with 0,45 kg/kW charge = 15,8 kg charge. For appliances without air circulation fans,  $m_{max}$  shall be set to zero.

#### 101.DVU.1.7.4 Mechanical ventilation openings

For mechanical ventilation, the lower edge of the air extraction opening where air is exhausted from the room shall not be more than 100 mm above the floor.

The location where the mechanical ventilation air extracted from the space is discharged shall be separated by a sufficient distance, but not less than 3 m, from the mechanical ventilation air intake opening to prevent re-circulation to the space.

#### 101.DVU.1.7.5 Operation of mechanical ventilation

Mechanical ventilation shall be operated continuously or shall be switched on by a refrigerant detection system.

If the mechanical ventilation is operated continuously, other than for short periods of maintenance on service, the airflow shall be detected continuously or monitored continuously. Within 10 s in the event that the airflow is reduced, the following actions shall be taken:

- The compressor operation shall be disabled, unless the compressor operation reduces the leak rate or in the case of a multiple circuits, when the leak circuit is isolated by shut-off valves and the operation of the system is not affected.
- The user shall be warned if the airflow is reduced.

#### 101.DVU.1.8 Circulation airflow

##### 101.DVU.1.8.1 General

Where mechanical ventilation is required, circulation airflow for the for the purpose of mixing the air in the room shall also be provided.

The circulation airflow shall operate continuously or be turned on by a refrigerant detection system. The minimum air velocity and the minimum air flow shall be as follows:

$$Q_{min} = 135 \times CAP$$

$$v_{min} = 2$$

Where:

$Q_{min}$  is the minimum airflow in m<sup>3</sup>/h;

CAP is the nominal capacity specified by the manufacturer in kW of cooling of the appliance;

$v_{min}$  is the minimum air velocity in m/s;

135 is a constant m<sup>3</sup>/h per kW cooling capacity (CAP)

The unit circulation airflow velocity ( $v$ ) shall be calculated as the air flow divided by the nominal face area of the outlet, the grill area shall not be deducted.

Compliance shall be checked by testing.





Where a single remote refrigerant detection system sensor is used in a room with multiple units, all units in the room which do not have a dedicated refrigerant detection system shall take the same action.

### 101.DVU.1.8.2 Continuous circulation airflow

The fan shall run continuously, other than for short periods for maintenance and service.

The airflow shall be detected continuously or monitored continuously. Within 10 s in the event that the airflow is reduced the following actions shall be taken:

- a) the compressor operation shall be disabled, unless the compressor operation reduces the leak rate or in the case of a multiple circuits, when the leak circuit is isolated by shut-off valves and the operation of the system is not affected;
- b) the user shall be warned that airflow is reduced—

Special instructions for appliances employing flammable refrigerant:d.

### 101.DVU.1.8.3 Circulation airflow initiated by a refrigerant detection system

When any refrigerant detection system is activated in accordance with Annex 101.DVP (Refrigerant Detector annex) in response to a detected leak into the space, all appliances in the space containing the refrigerant detection system, that are served by the same compressor(s) all take the following actions and continue for at least five minutes after the REFRIGERATION DETECTION SYSTEM has reset:

- a) The fan(s) shall be switched on.
- b) The compressor operation shall be disabled, unless the compressor operation reduces the leak rate or in the case of a multiple circuits, when the leak circuit is isolated by shut-off valves and the operation of the system is not affected.

