



# **U-3ARC TRAINING WEBINAR #13**

## **VRF-DRV AIR CONDITIONING**

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# Introduction :

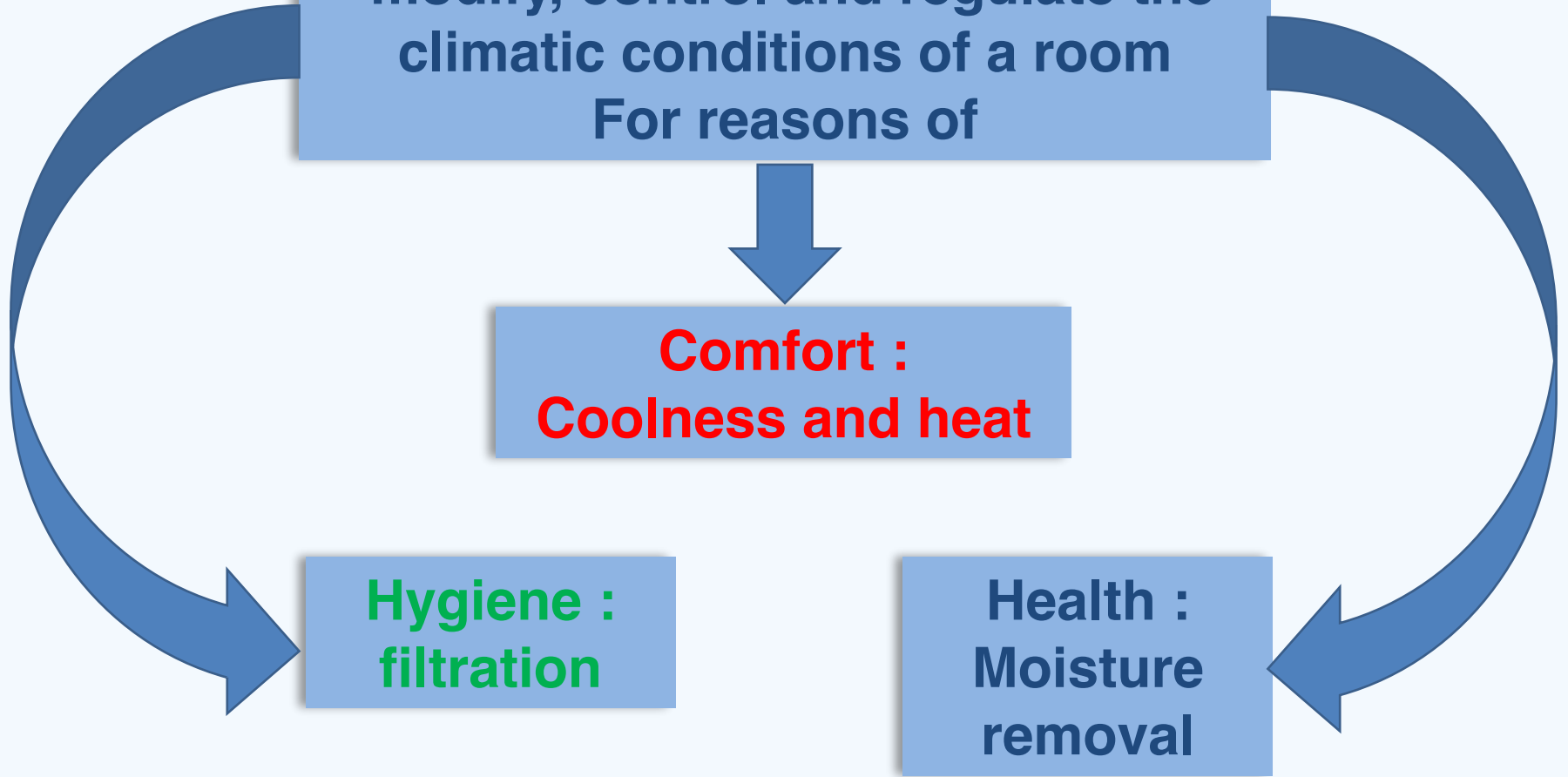


The air conditioning :  
modify, control and regulate the  
climatic conditions of a room  
For reasons of

**Comfort :**  
**Coolness and heat**

**Hygiene :**  
**filtration**

**Health :**  
**Moisture  
removal**





# Main air conditioning systems

## Direct expansion air conditioning:

- ✓ Mobile, monobloc, split air conditioners
- ✓ Multi-split air conditioners
- air conditioning
- ✓ air conditioning cabinets
- ✓ The gainables
- ✓ The roof top "roof unit"
- ✓ VRVs, VRFs or DRVs



## Air/Water conditioning:

- ✓ Chillers
- ✓ Air/Water HPs

# VRV-DRV-VRF : Que signifie et quelle différence ?



➤ **VRV** : **V**ariable **R**efrigerant **V**olume

**VRV** terminology is registered by the Japanese manufacturer "DAIKIN" as a trademark of its first system invented in 1982.

➤ **DRV** : Variable Refrigerant Flow

French-speaking manufacturers prefer to use the term

**DRV**.

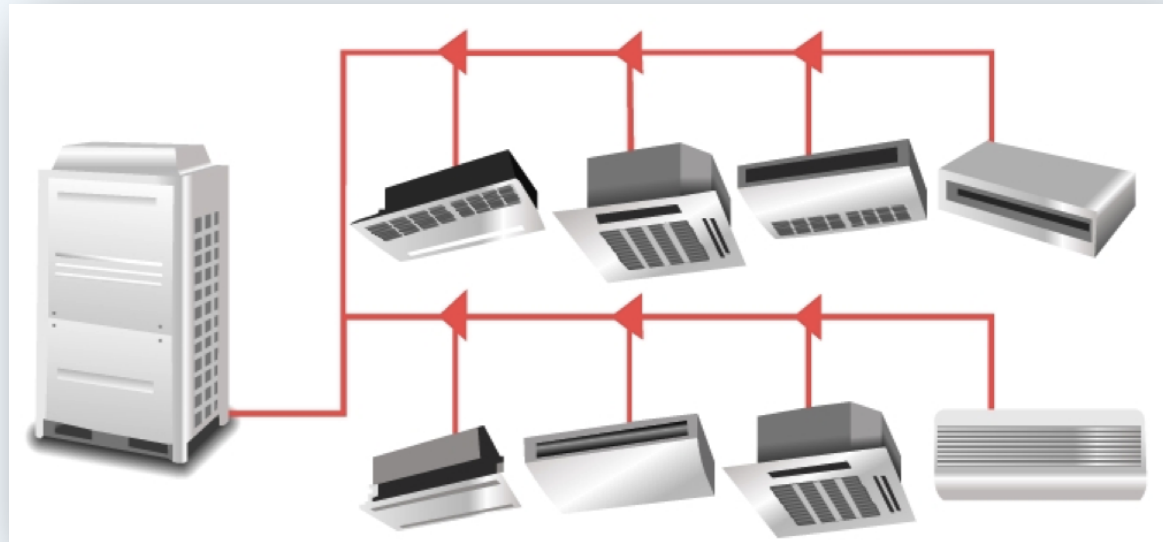
➤ **VRF** : Variable Refrigerant Flow

**VRF** is the most common term for this system and also the abbreviation that we will use for the rest of this presentation.

# Technology: VRF

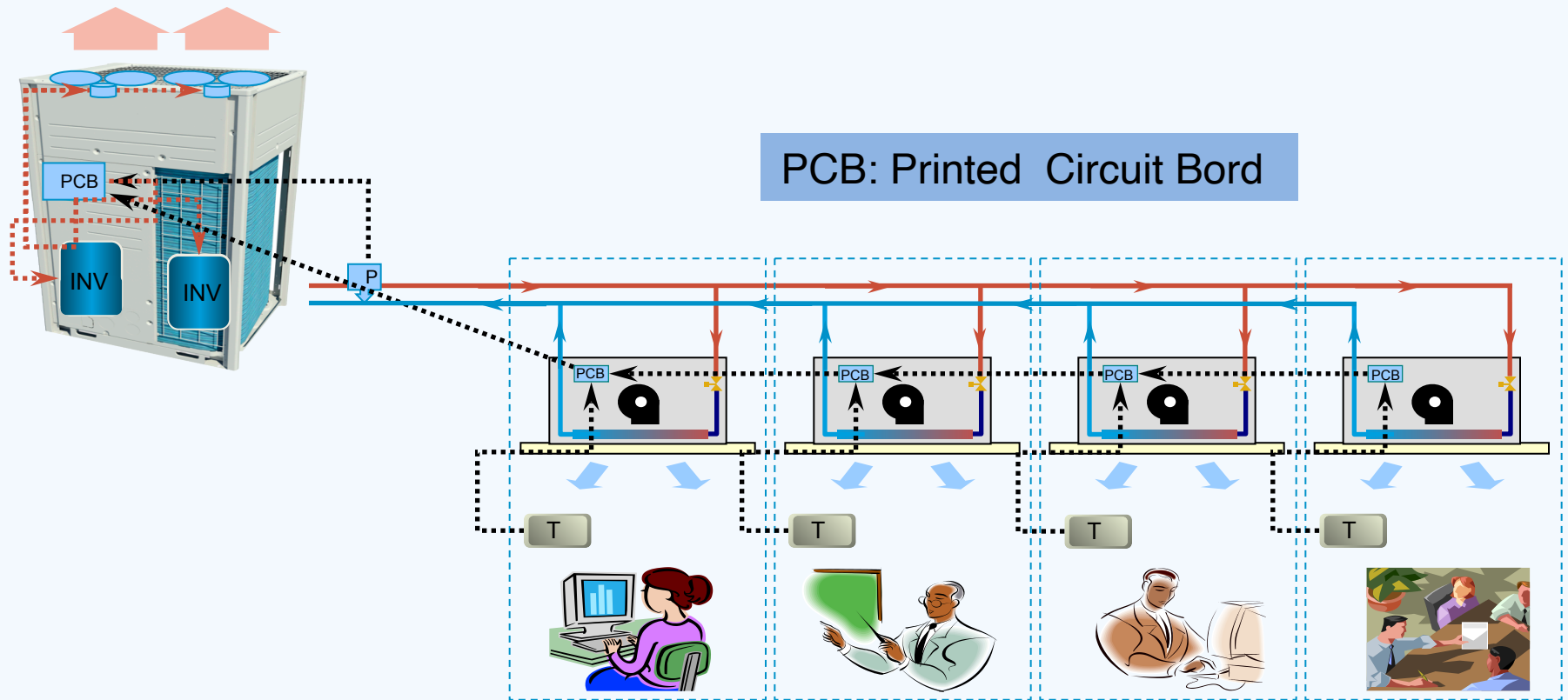


VRF technology consists of supplying from an outdoor unit(s) and via refrigeration pipes, several indoor units with a refrigerant flow rate adapted to the thermal load of the room.



It is a direct expansion multi-zone air conditioning system.

# VRF: how does it work?



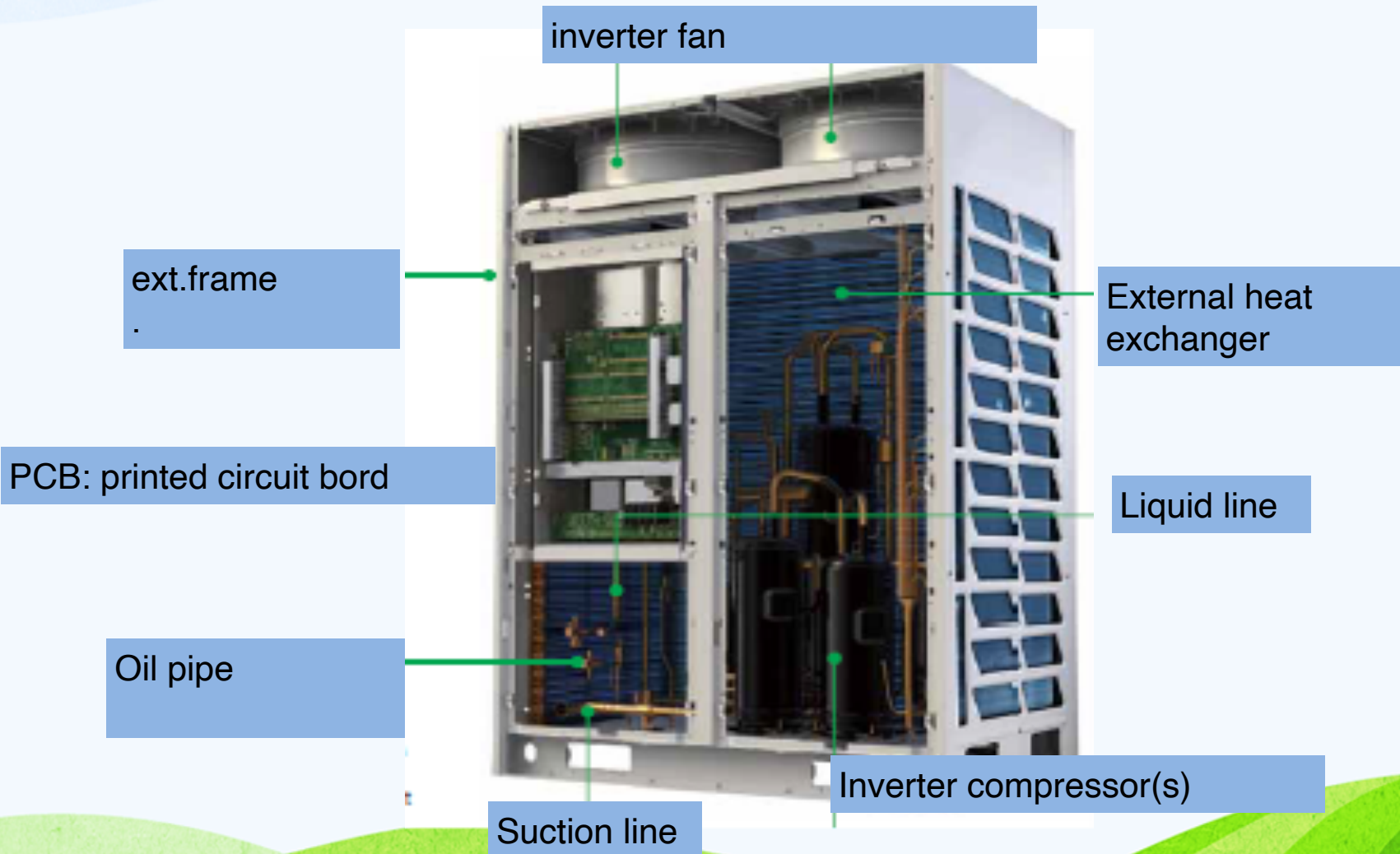


# VRF system components

# VRF system components



## □ The outdoor unit:

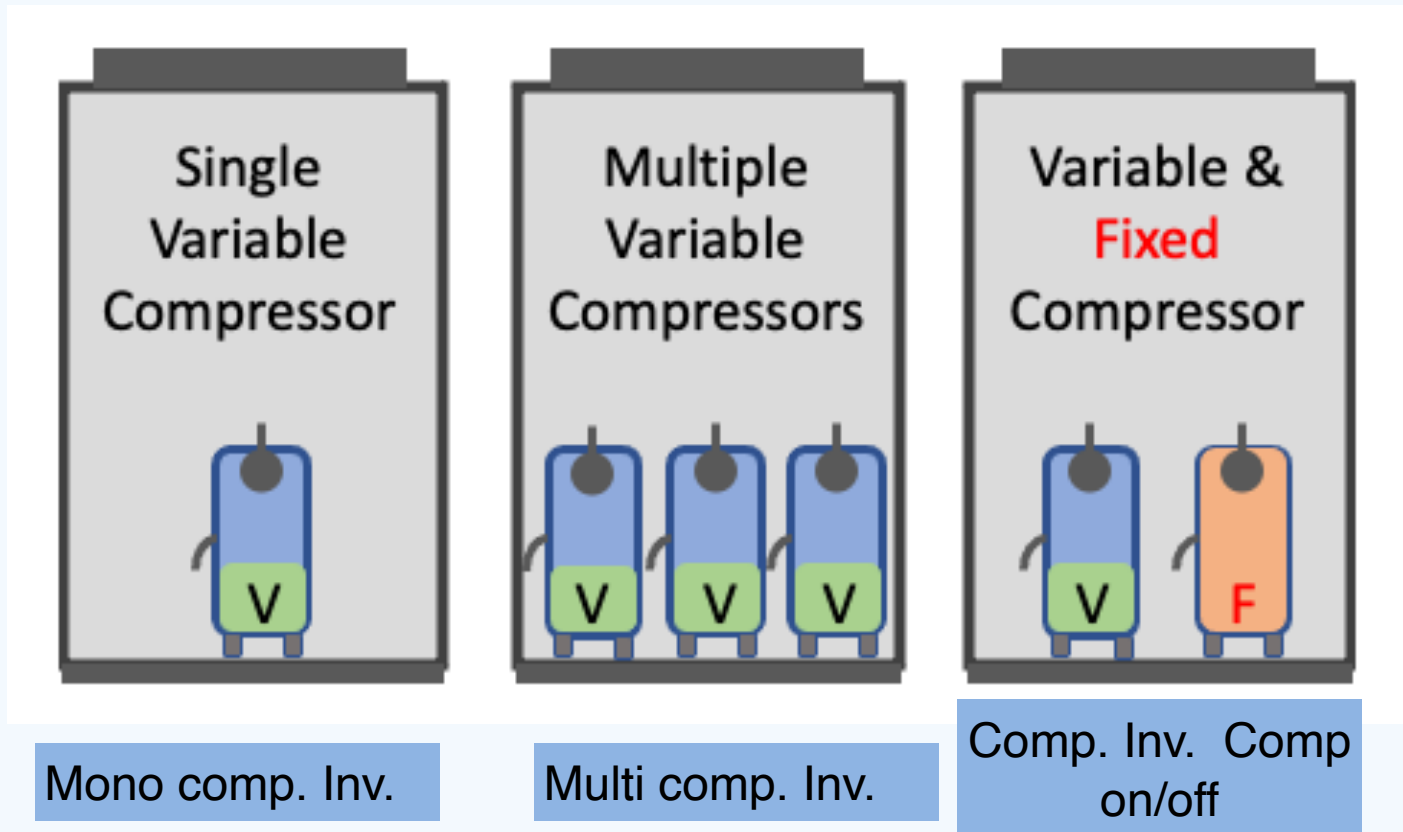






# VRF : Main components

- ❑ **The outdoor unit:** configuration of compressors/ Units



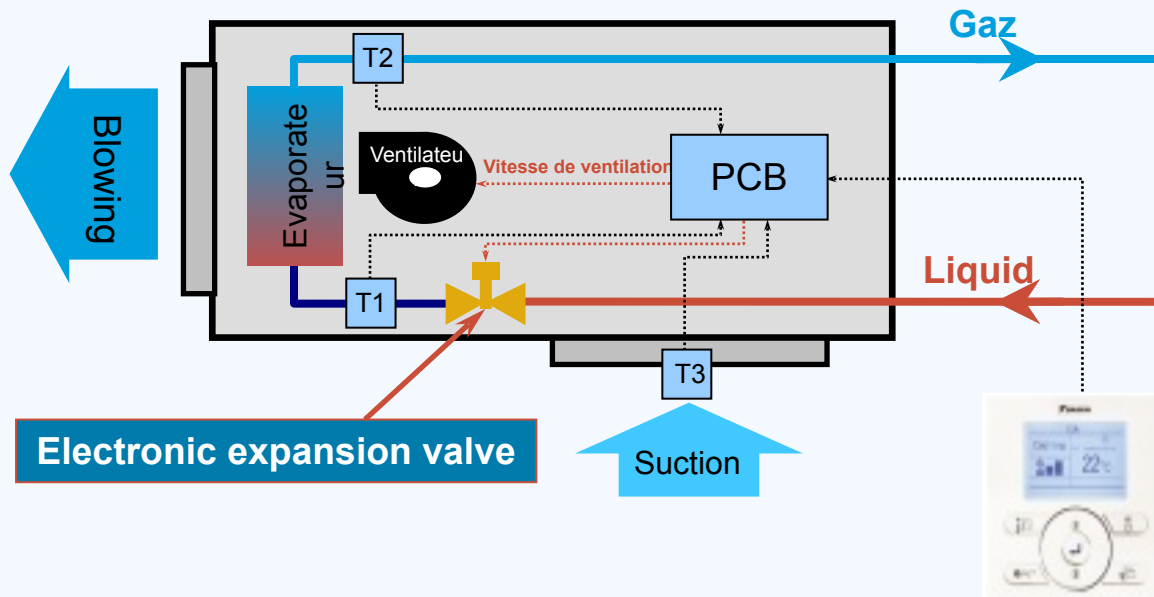


# VRF :Main components

## ❑ The indoor unit:

Exchanger, fan, air filter, electronic expansion valve...

A correct supply of the evaporator in FF thanks to an expansion valve electronics regulated according to superheat ( $T_2 - T_1$ )



# VRF : Main components



## ❑ Refrigeration piping:

Insulated refrigeration grade copper piping network.



Branch / Refnet



Collector



copper tubing



# Areas of application of the VRF system



# VRF : Fields of application

## ❑ The Mini VRFs:

air conditioning of small units (residences, shops, services, etc.)

Cooling capacity **16 kW** (6 HP), Cooling only or Reversible.

Up to **8** indoor units of multiple choice.



# VRF : Fields of application



## ❑ The VRF Commercial range:

Central air conditioning of large units; hotels, resorts commercial...

Wide choice of outdoor units, even UTAs.

Possibility of mounting  
from 2 to 64 U. Int. we  
have a single  
installation.

Possibility of assembling  
groups ext. Up to 48 HP  
"135KW" / VRF circuit.



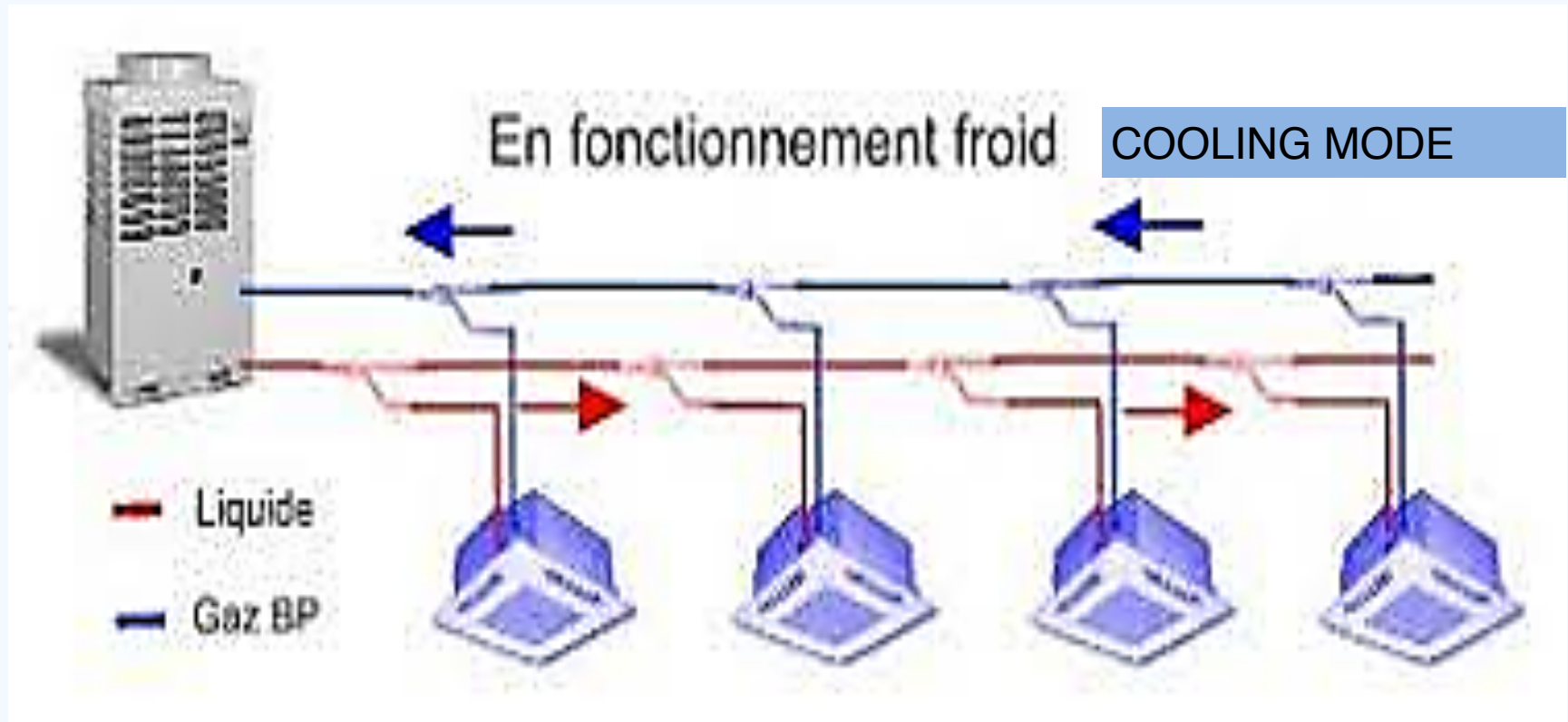


# The different configurations of the VRF system



# VRF: The different configurations

## ❑ The VRF 2 Cooling Tubes Only:

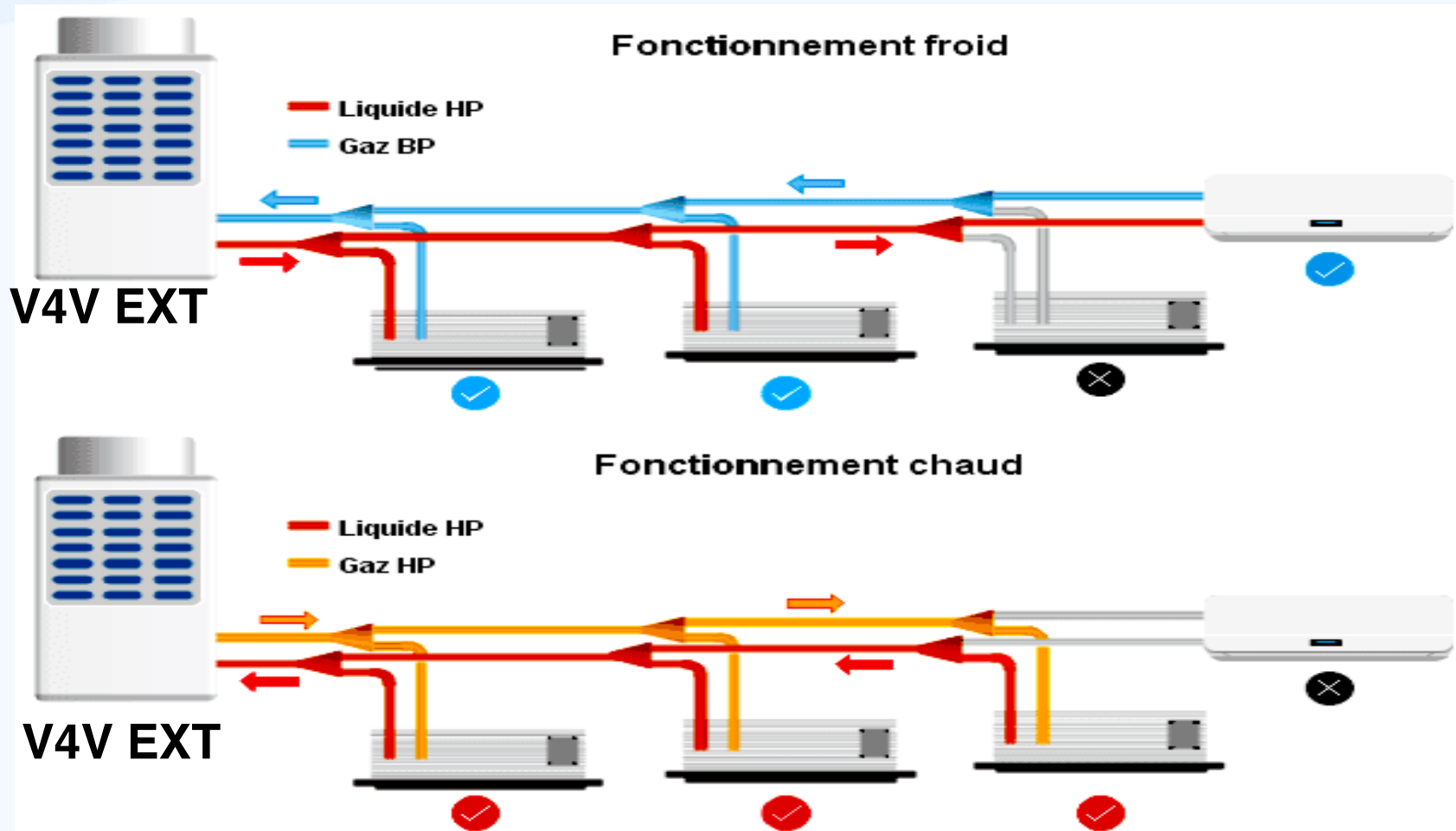






# VRF: The different configurations

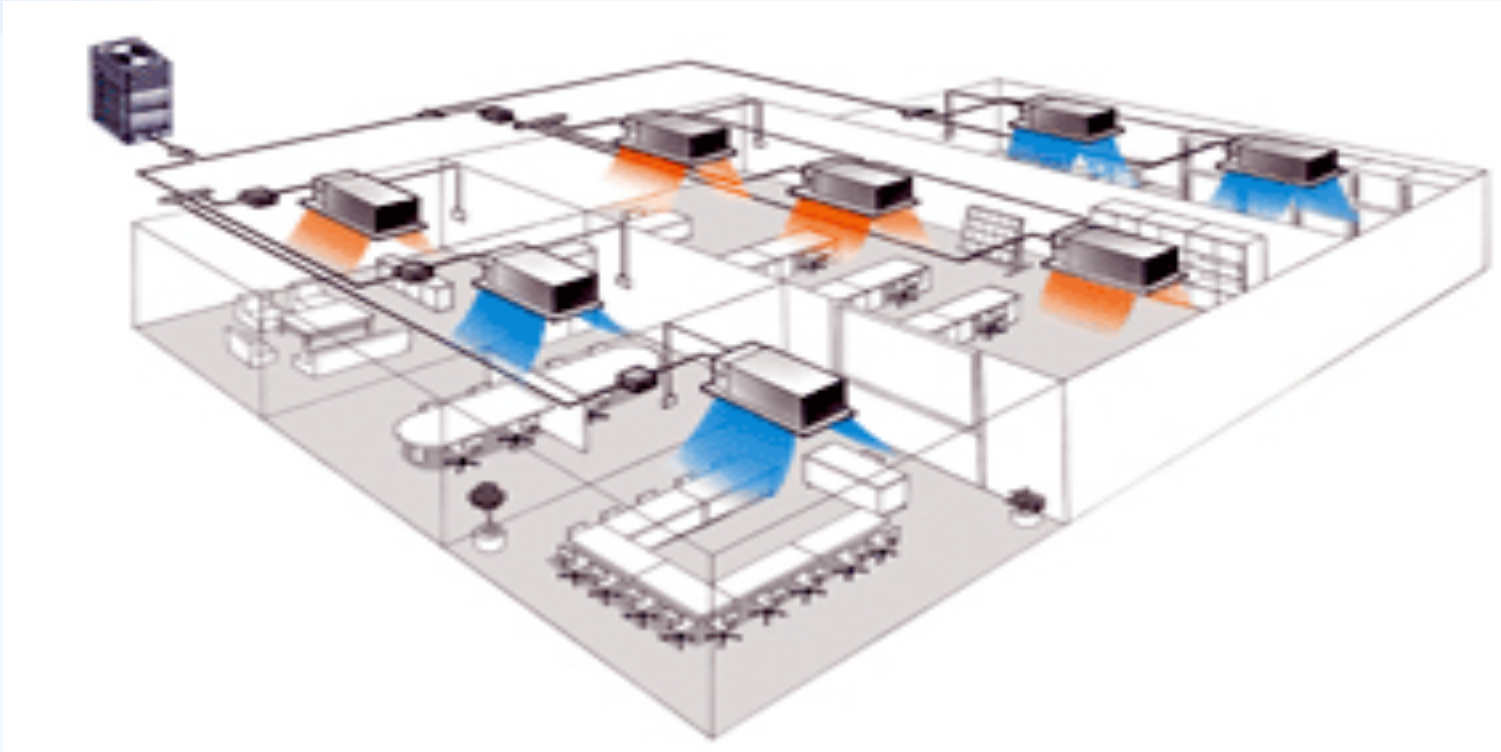
❑ The VRF 2-Pipe Reversible Hot or Cold “Heat Pump”:





# VRF: The different configurations

❑ The 3-pipe VRF Energy Recovery « Heat Recovery »:

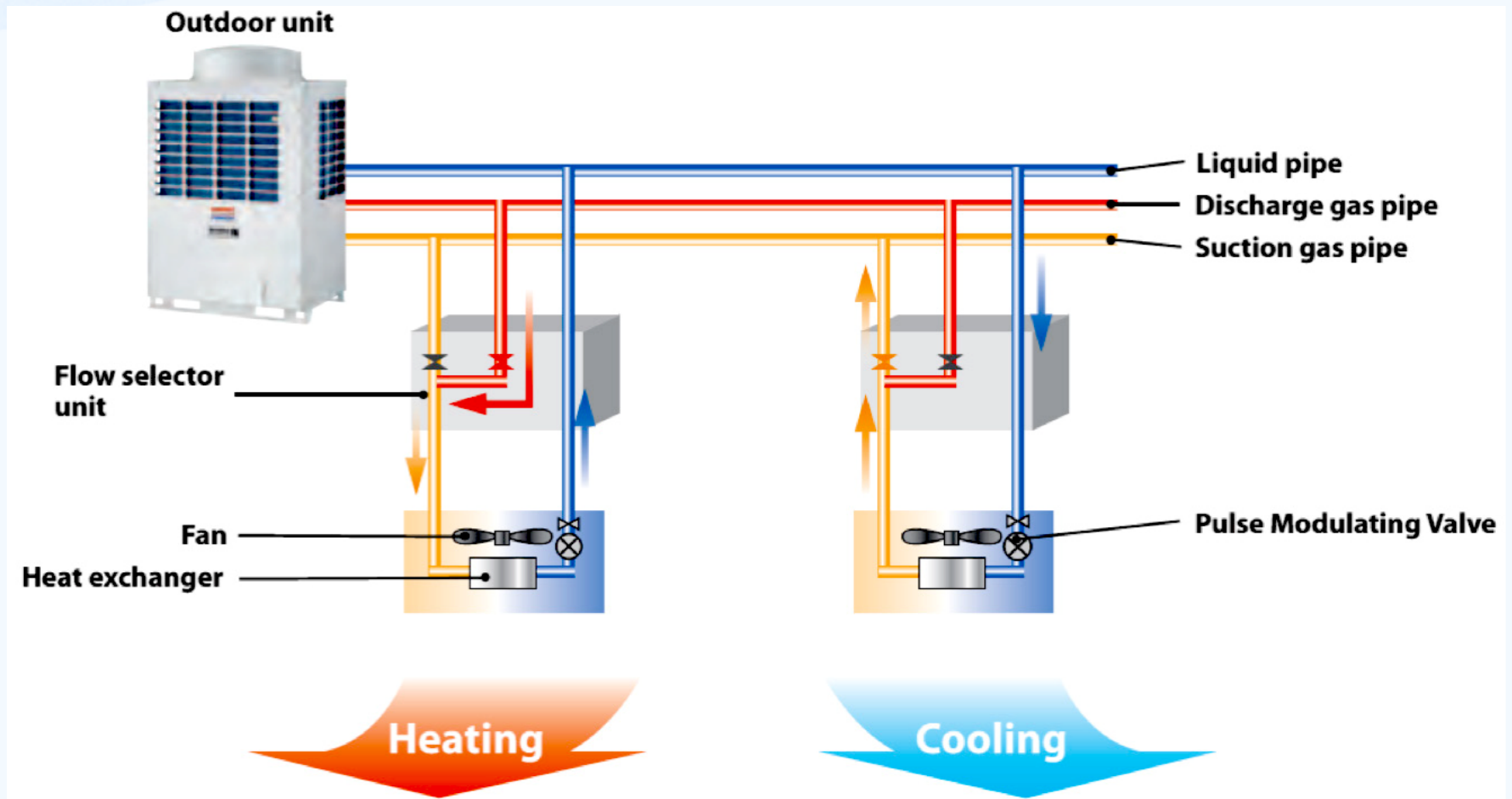


each indoor unit is independent and can either **heat** or **cool** simultaneously on the same production unit.



# VRF: The different configurations

□ The 3-pipe VRF Energy Recovery « Heat Recovery »:

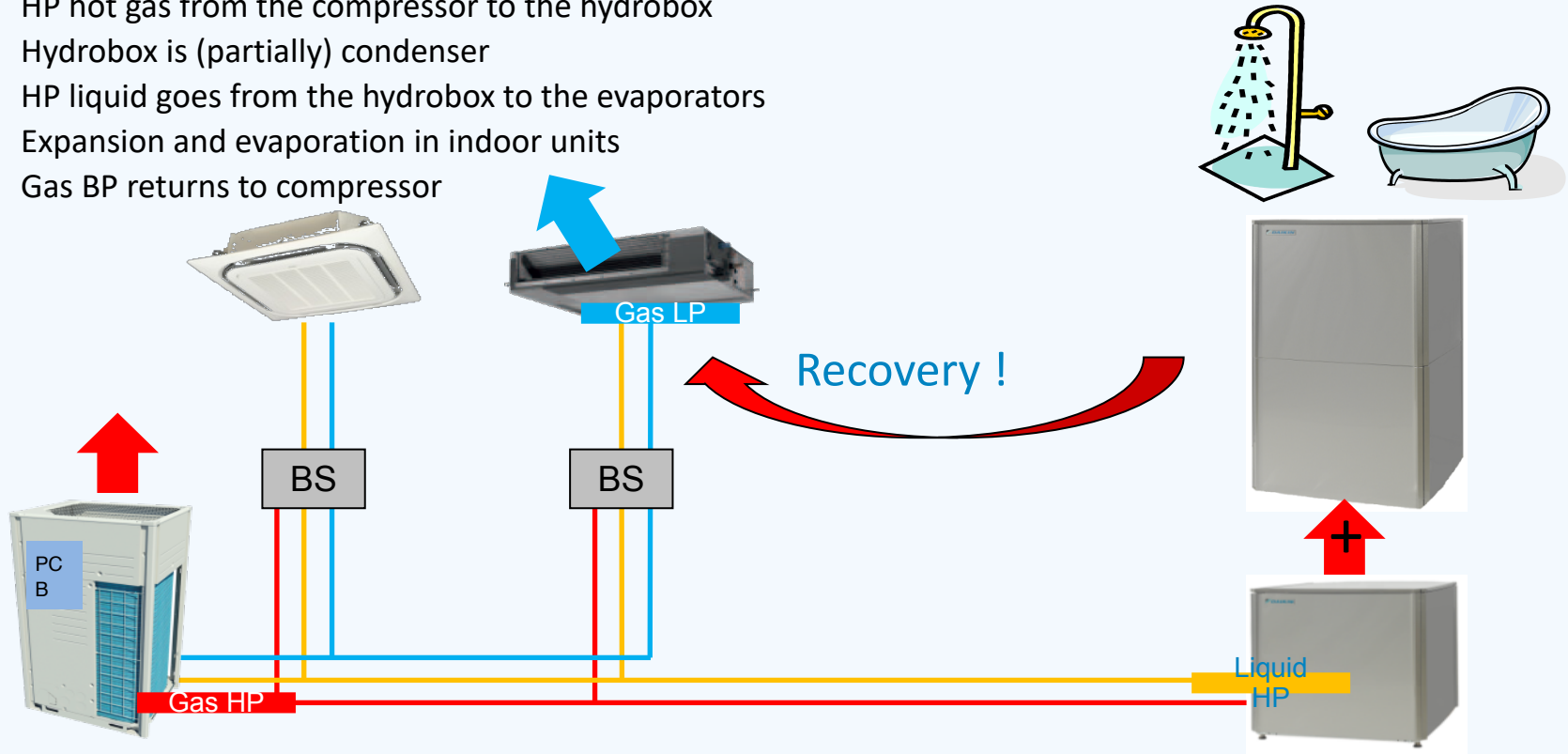




# VRF: The different configurations

## ❑ The VRF 3-pipe Energy Recovery “DHW Production”:

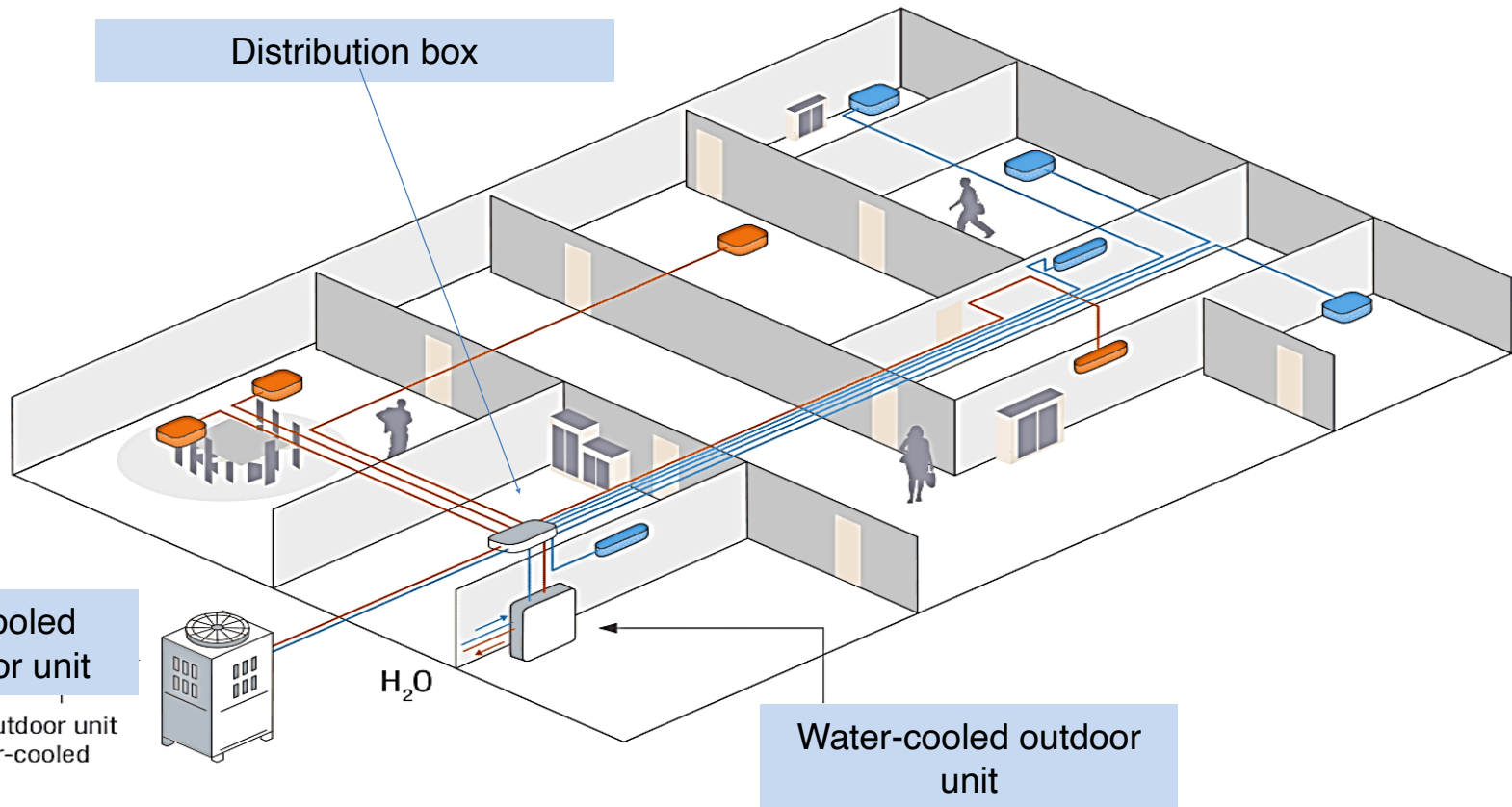
1. Compression
2. HP hot gas from the compressor to the hydrobox
3. Hydrobox is (partially) condenser
4. HP liquid goes from the hydrobox to the evaporators
5. Expansion and evaporation in indoor units
6. Gas BP returns to compressor





# VRF: The different configurations

□ The 2-tube VRF Energy Recovery « Heat Recovery »:

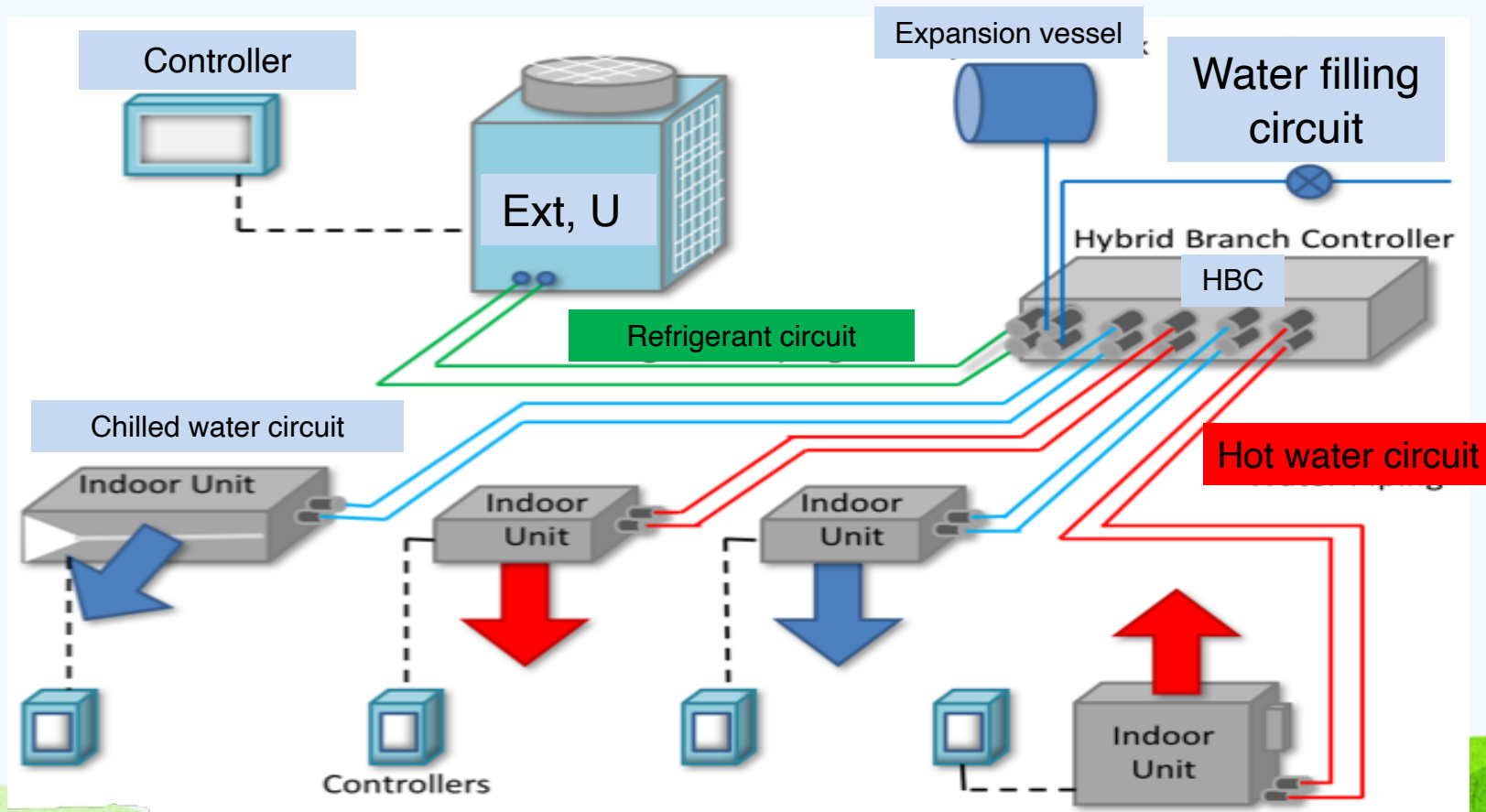




# VRF: The different configurations

## ❑ The 2-tube VRF "Hybrid" Energy Recovery:

The hybrid solution uses water in the majority of the piping to transfer simultaneous heating and cooling





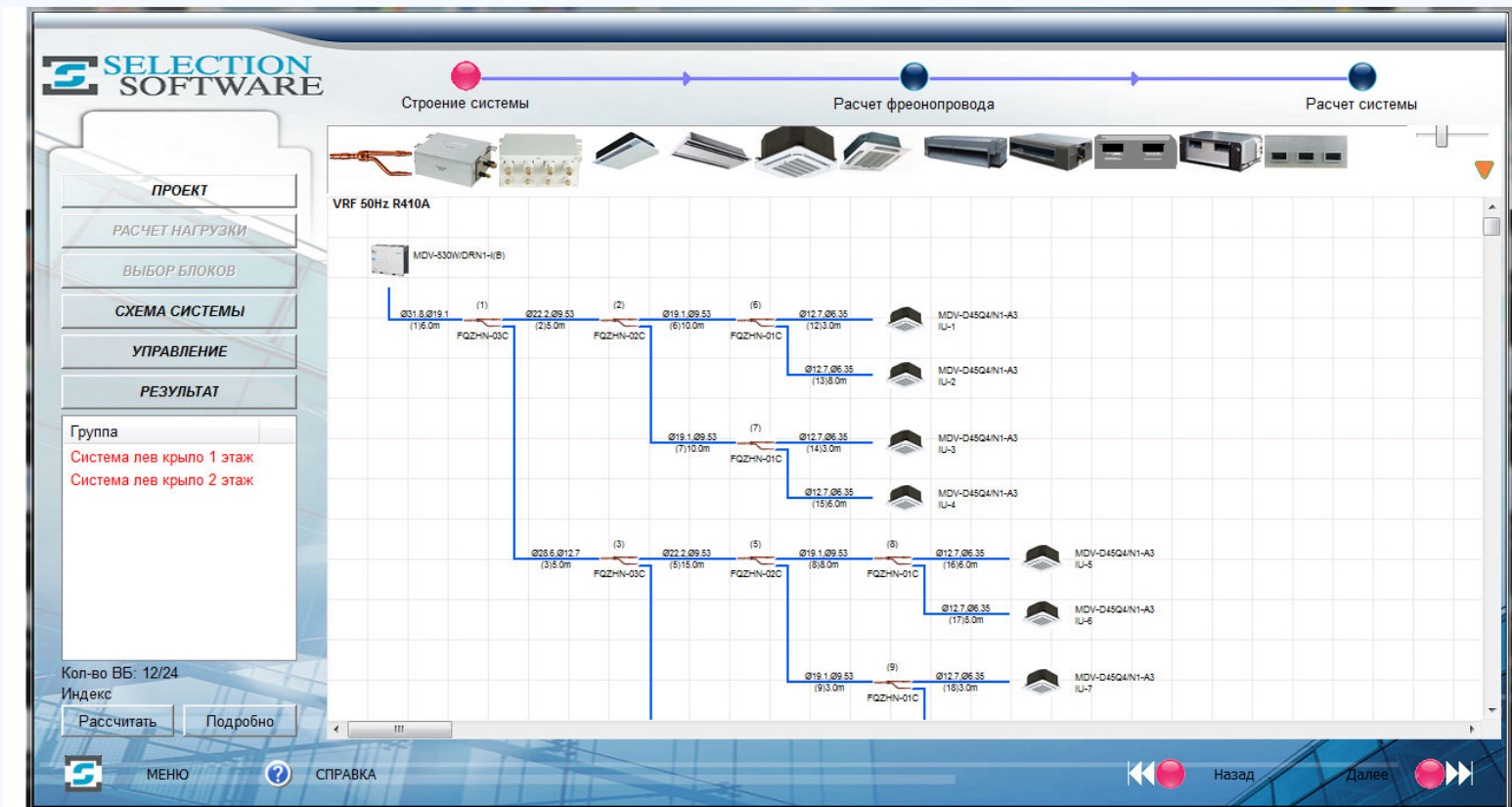
# VRF Installation and Implementation



# VRF : Installation and Implementation

## □ Selection "manufacturer software":

selection of groups and indoor units, determination of sections and refnets...







# VRF : Installation and Implementation

## ❑ Installation of outdoor units:

Respect the clearances and ensure good ventilation



Not enough space for maintenance



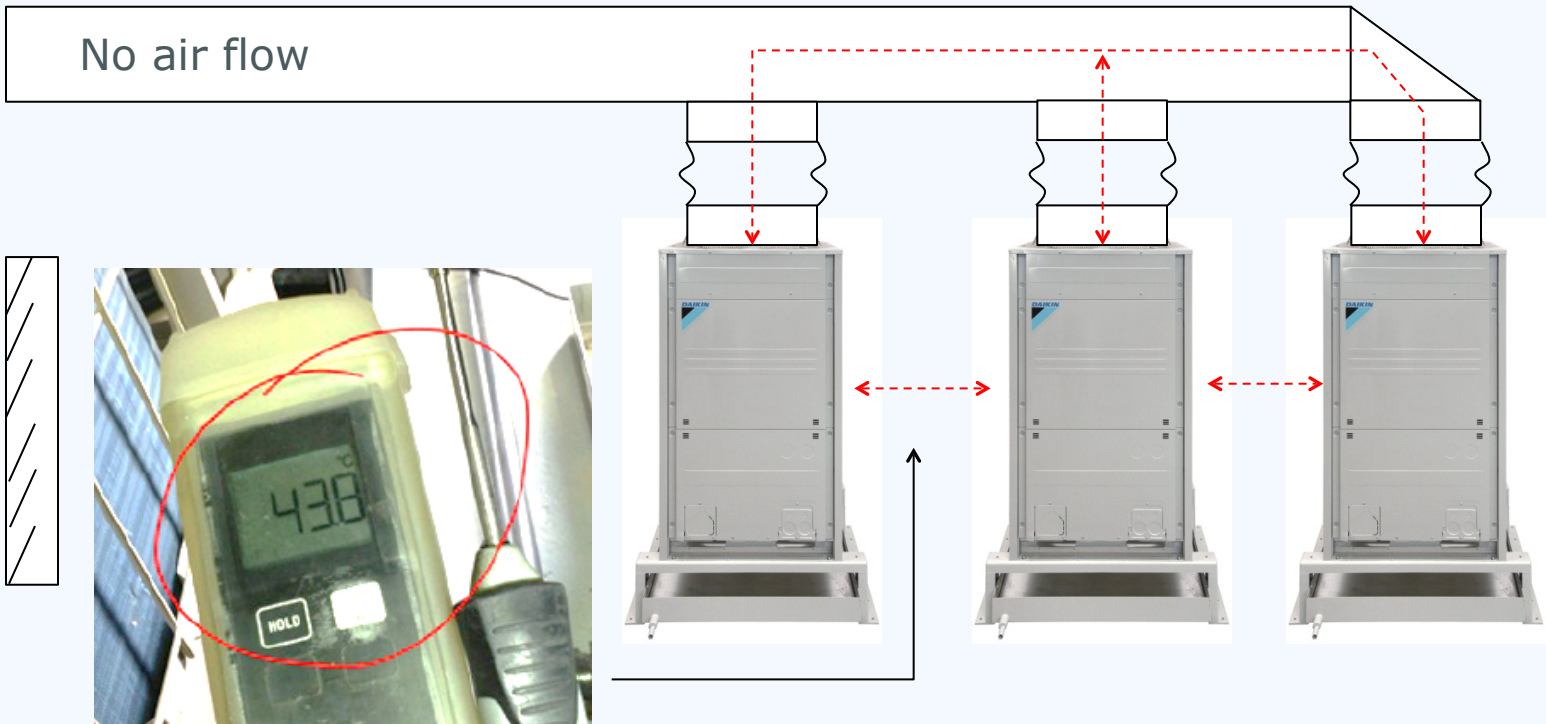
Unable to do maintenance on this unit



# VRF : Installation and Implementation

## ❑ Installation of outdoor units:

Respect the clearances and ensure good ventilation

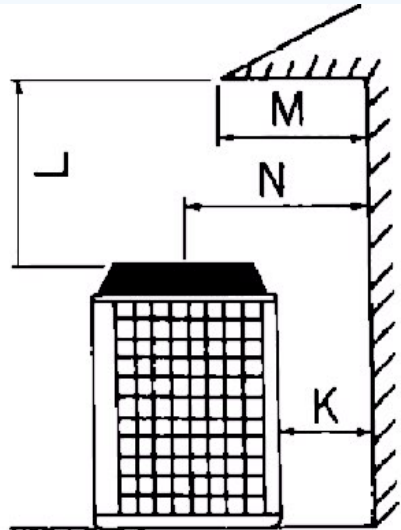


**Only one duct should be installed on each fan.**



# VRF : Installation and Implementation

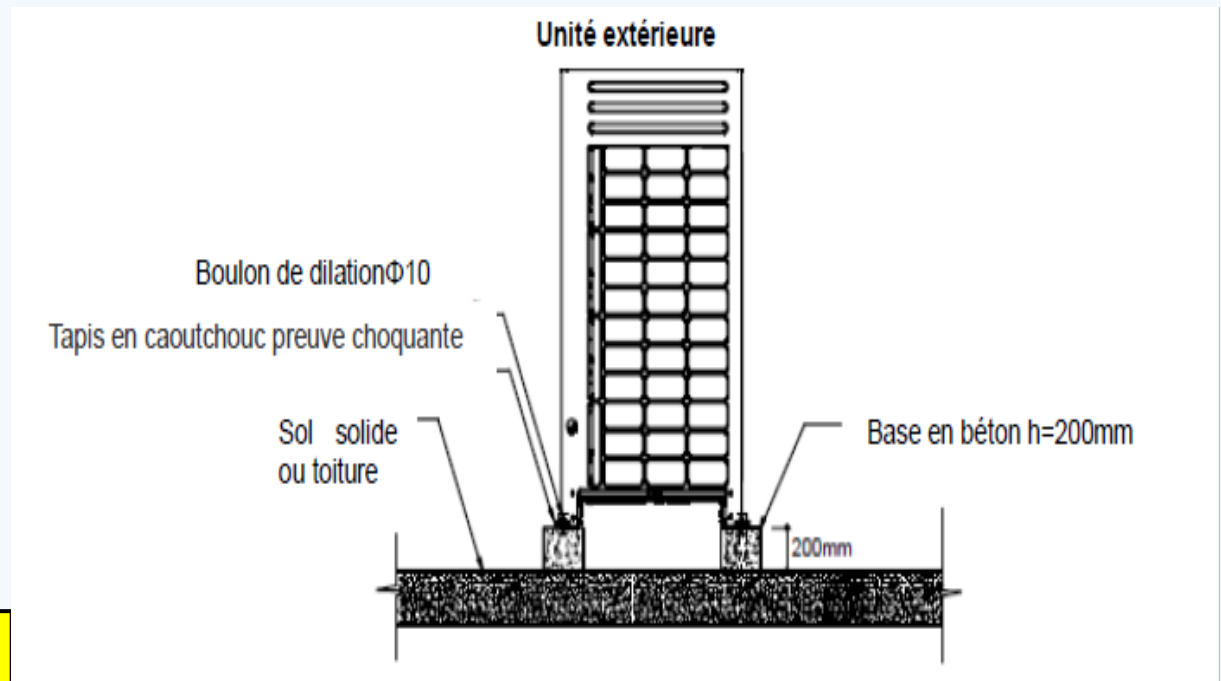
## ❑ Installation of outdoor units:



Installation under the eaves

If  $L \geq 1m$  then  $N$  must be  $\geq M$

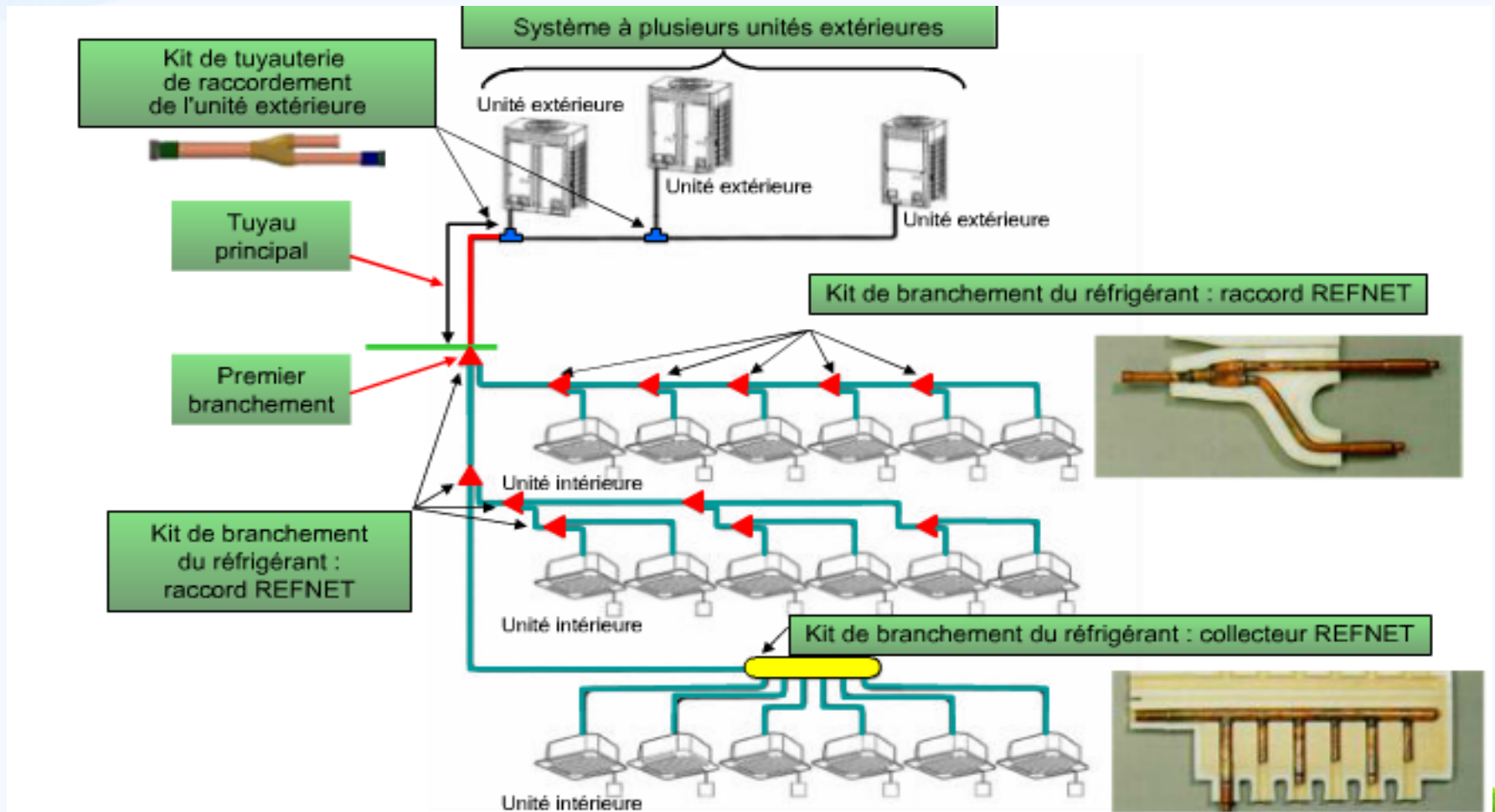
If  $L < 1m$  then  $K$  must be  $\geq M$





# VRF : Installation and Implementation

❑ **Installation of the piping:** the different branches



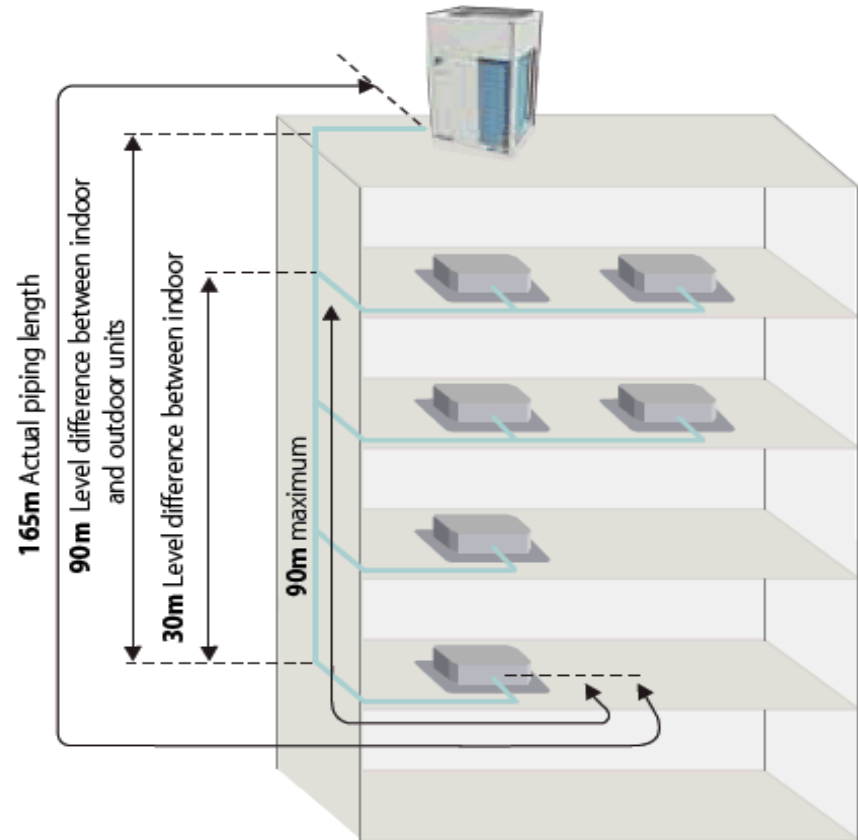


# VRF : Installation and Implementation

## ❑ Installation of the piping: length/height limits

- ❖ Max distance IU-EU: 165m (190m equivalent)
- ❖ Max height difference IU-EU: 90m
- ❖ Max height difference UI-UI: 30m
- ❖ Total length: 1.000m




Note: Certain limitations are applicable depending on the type of indoor units chosen, pipe diameters, etc. Consult the technical manuals.





# VRF : Installation and Implementation

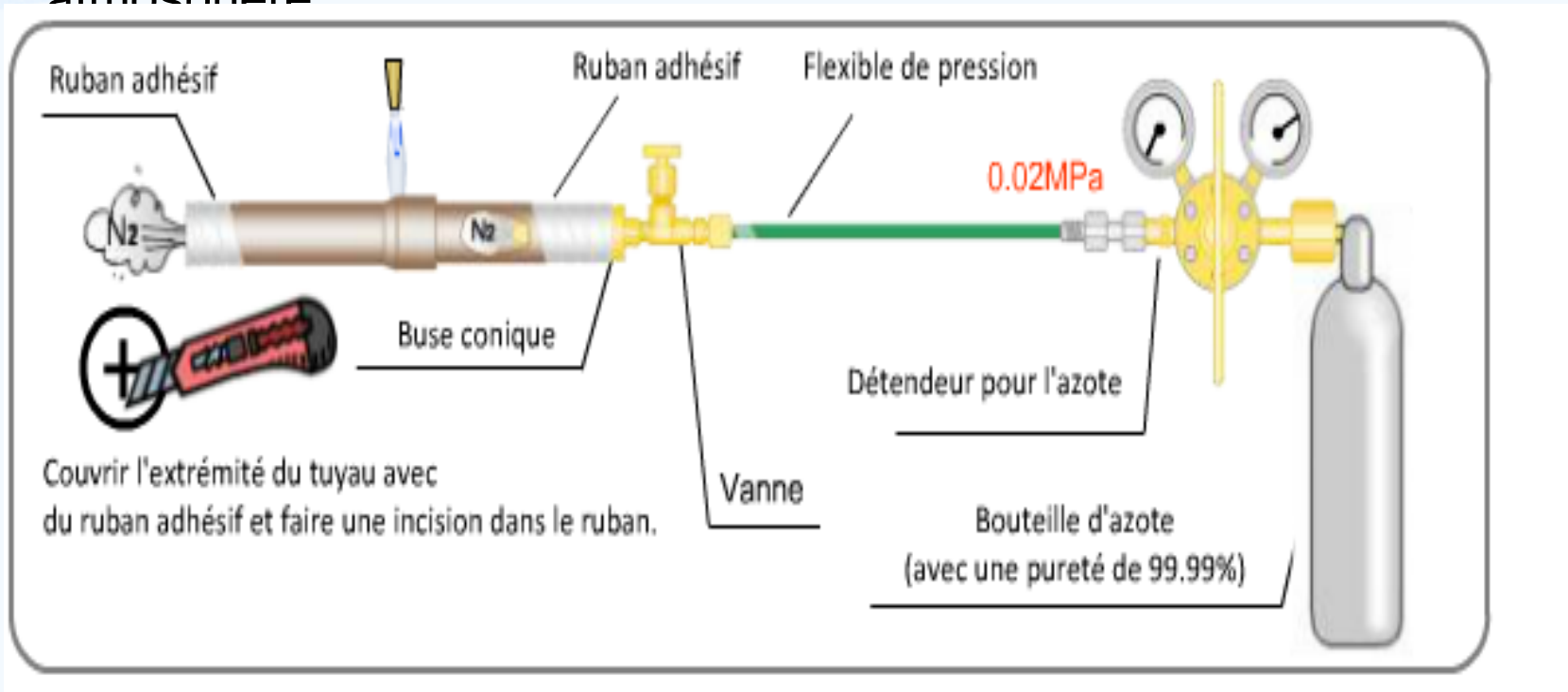
## ❑ Installation of the piping: General rules

Sec	Propre	Étanche
Pas d'eau, ni d'humidité à l'intérieur	Pas de poussières, ni de contaminants à l'intérieur	Pas de fuites de réfrigérant
		



# VRF : Installation and Implementation

- Installation of the piping: brazing under nitrogen atmosphere



Adjust the pressure from 0.2 to 0.4 bar  
"manufacturers recommendations"



# VRF: Installation and Implementation

**❑ Installation of the piping:** brazing under nitrogen atmosphere



Nitrogen-free brazing

Brazing with Nitrogen

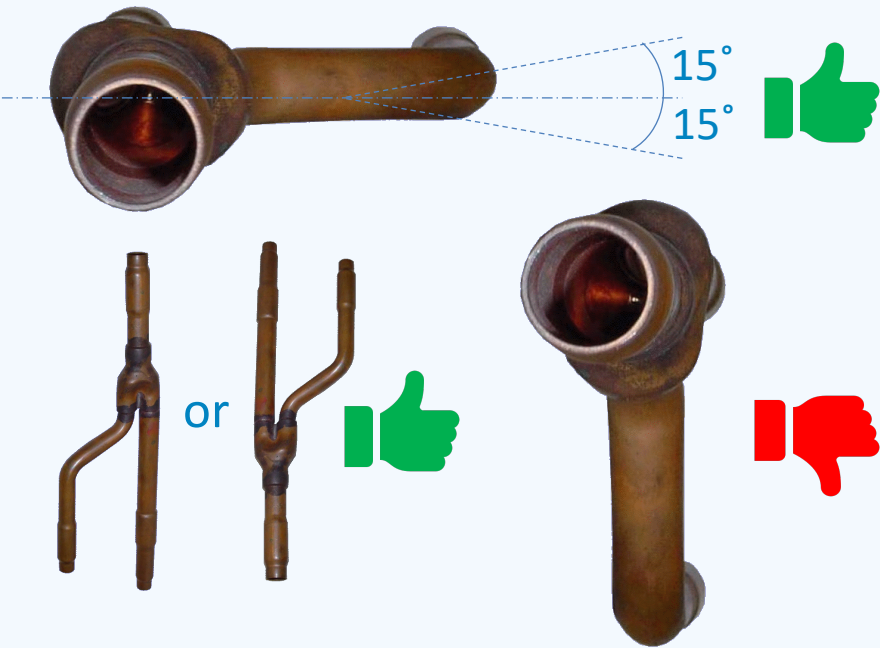




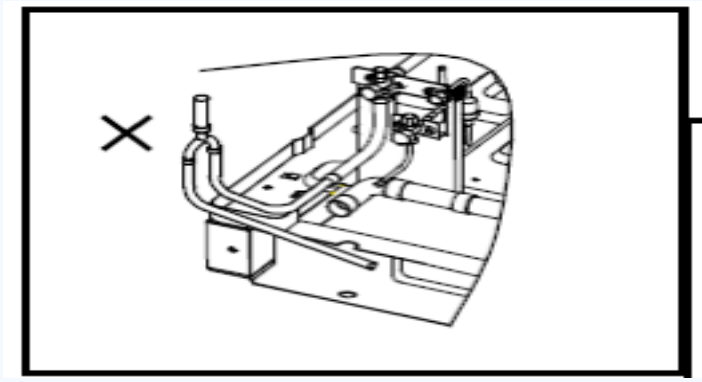
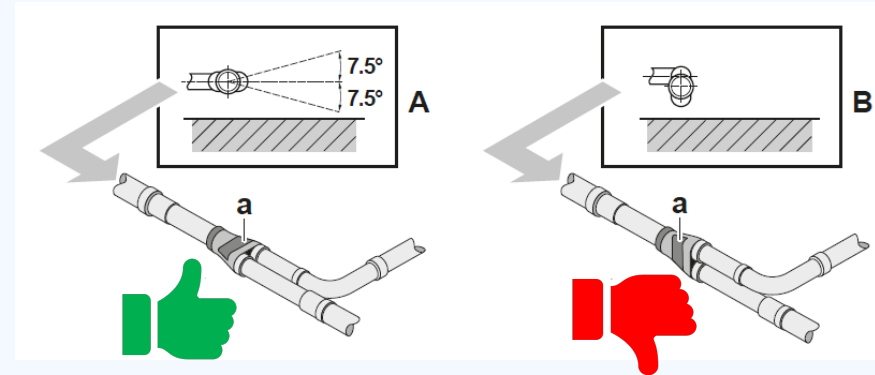


# VRF : Installation and Implementation

## ❑ Installation of the piping: Installation of refnets



Refnet of horizontal or vertical branch subsets



Refnet horizontal branching groups

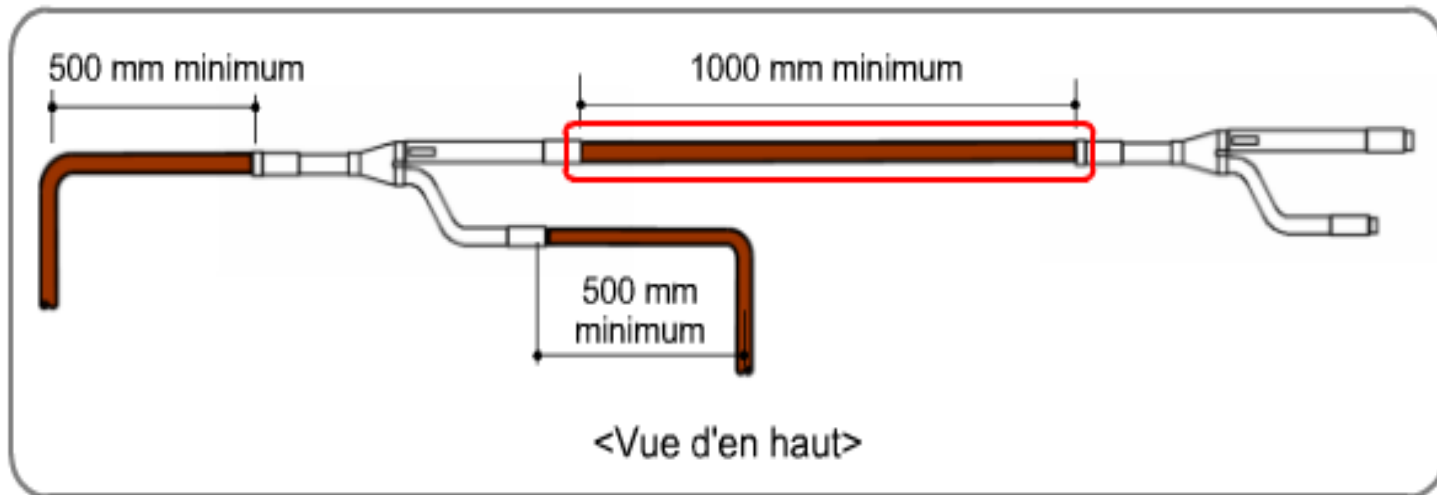


# VRF : Installation and Implementation

## Installation of the piping: Installation of refnets

- Si la tuyauterie doit être courbée avant ou après le raccord REFNET, la courbure doit être faite à 500 mm minimum du raccord REFNET.
- Créer un tronçon droit de 1000 mm minimum entre les raccords REFNET .

<Raisons> Dans certains cas, une tuyauterie courbée trop près du raccord REFNET peut causer des bruits étranges, et, donc, conduire à des plaintes.

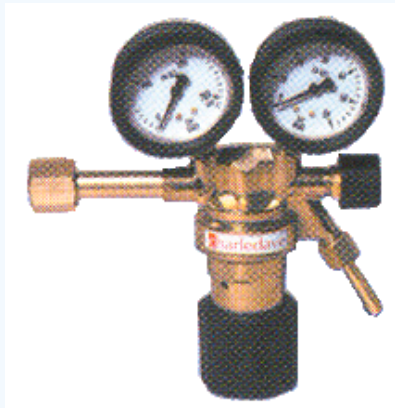




# VRF : Installation and Implementation

## ❑ Installation leak test:

- Check that the valves on the unit side are properly closed
- Carry out a first test at a pressure of 5 bar for a minimum of 5 minutes
- Raise the pressure to 10 bar and check for a minimum of 10 minutes
- Raise the pressure to 40 bar for 24 hours



Allowable pressure drop =  $0.1 \times (\theta \text{ start of test} - \theta \text{ end of test})$



# VRF : Installation and Implementation

## ❑ The vacuum draw:

- ✓ Use a vacuum pump with adequate flow rate for the volume to be emptied.
- ✓ Connect the vacuum pump to the liquid and vapor lines.
- ✓ Generally the vacuum is reached at a pressure of -755mmHg (-1 bar).
- ✓ The vacuum should be maintained for 1 hour.





# VRF : Installation and Implementation

## ❑ Refrigerant charge:

- ✓ Outdoor units come pre-charged in FF
- ✓ An additional FF is necessary depending on the length and section of the piping.
- ✓ Start by calculating the additional charge in FF.
- ✓ For R410A, charge in the liquid phase
- ✓ Always use a scale to check the quantity to be loaded





# VRF : : Installation and Implementation

## ❑ Refrigerant charge:

$$R(\text{kg}) = (L1 \times m1) + (L2 \times m2) + (L3 \times m3) \dots$$

R: additional quantity of refrigerant to be added to the initial charge.

L1: total length of section S1 (meter)

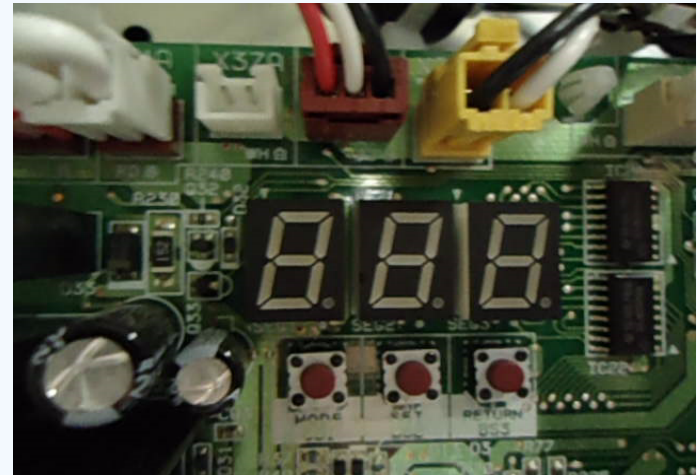
M1: mass of FF for one meter of S1 (Kg/m) to be deduced from the following table.

R410A			
Diamètre du tuyau de liquide	Equivalent de réfrigérant pour la longueur de tuyau d'1m (kg/m)	Diamètre du tuyau de liquide	Equivalent de réfrigérant pour la longueur de tuyau d'1m (kg/m)
φ6.4	0.023	φ19.1	0.270
φ9.5	0.060	φ22.2	0.380
φ12.7	0.120	φ25.4	0.520
φ15.9	0.170	φ28.6	0.680



# VRF : Installation and Implementation

## ❑ Automatic charging:





# VRF

## Advantages and disadvantages

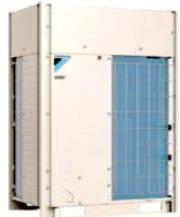




# VRF : Benefits

✓ **Simplicity and space saving:**

## Building Blocks



**Unité  
extérieure**

+



**Unité  
intérieure**

+



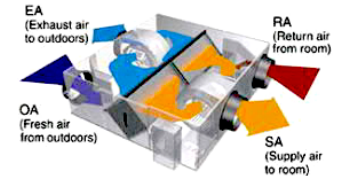
**Tuyauterie**

+



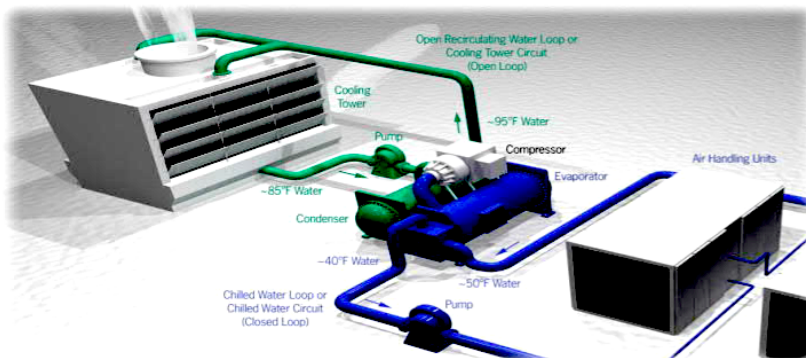
**Contrôles**

+



**Ventilation**

OR



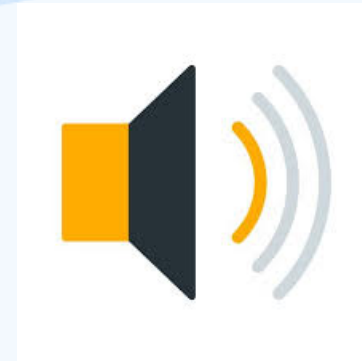
**Gaines  
Vannes  
+ Contrôles  
Balancement  
Etc.**

**COMPLEXE**



# VRF : Benefits

- ✓ Low acoustic level:  
inverter technology



- ✓ Multiple use, cooling, heating, DHW production



- ✓ Remarkable energy  
efficiency "COP > 4"

# VRF : The inconvenients



✓ High cost.



✓ Complex installation and commissioning.

✓ Non-ecological system due to the use of a large quantity of refrigerant





**END FIRST PART**  
**THANK YOU FOR YOUR ATTENTION**

