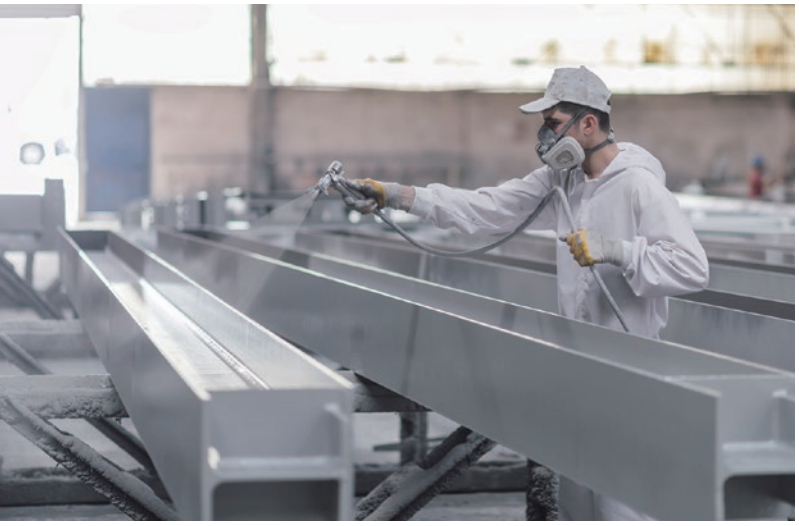
MITSUBISHI ELECTRIC

Changes for the Better

HOT WATER HEAT PUMP R454C

CAHV-R450YA-HPB



Features

1. Low-GWP refrigerant R454C

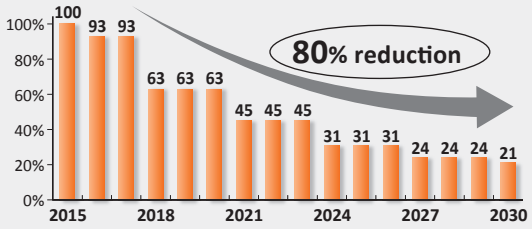
In Europe, the F-gas Regulation is implemented to prevent global warming and unwanted climate changes. The current target is to reduce the total amount of F-gases (CO_2 equivalent) by about 80% across Europe by 2030 compared to 2015.

Mitsubishi Electric offers more environmentally friendly hot water heat pumps that use the low Global Warming Potential (GWP) refrigerant R454C.

R454C

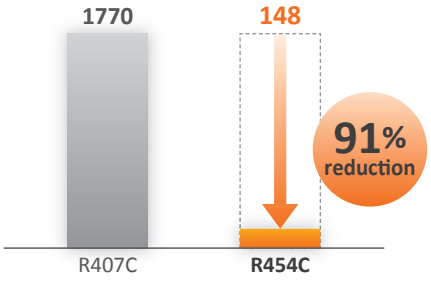
Stepped F-gas reduction schedule (CO_2 equivalent)

Reference value (100%) – average value from 2009 to 2012



*Estimates based on the version of the F-gas Regulation issued in January 2015.

Comparison of CO_2 equivalent (GWP)



The GWP of R454C refrigerant is 148. It is approximately 91% lower than the R407C refrigerant which is used in the conventional model (CAHV-P500YB-HPB)*.

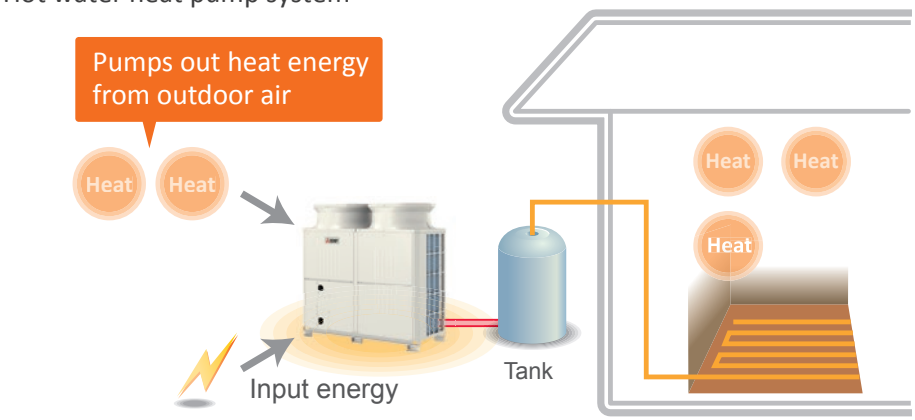
*Source: IPCC 4th assessment report.

2. Low running costs & wide operating temperature range

Hot water heat pumps absorb energy from the surrounding outdoor air and transfer it into refrigerant. Heat energy absorbed from air heats up the incoming water via the heat exchanger. The Seasonal Coefficient of Performance (SCOP) of the new CAHV is 3.57 (low temperature conditions) / 3.24 (medium temperature conditions)*, which means it can extract more than three times the input electric energy.

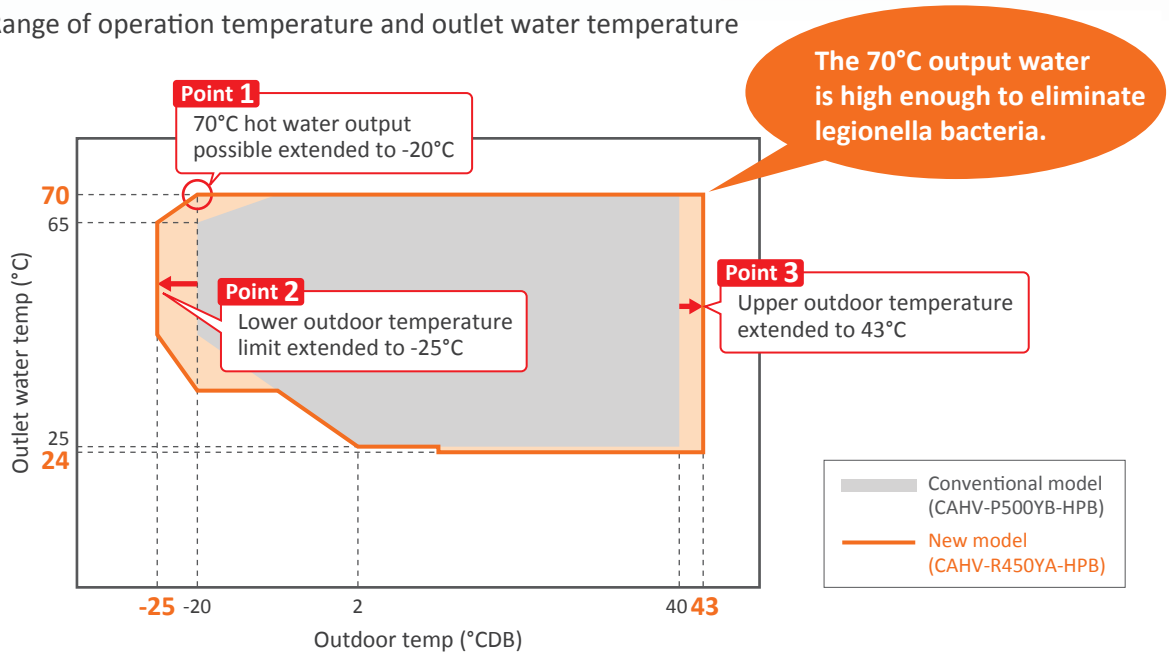
* Above values are based on Regulation (EU) No.811/2013.

Hot water heat pump system



The lower outdoor temperature limit for 70°C hot water output has been extended from -10°C in the conventional model to -20°C in the new model. The operating temperature range has also been improved from "-20°C to 40°C" to "-25°C to 43°C". It is suitable for heating and heat-retention operations.

Range of operation temperature and outlet water temperature



Various applications

Community heating

For heating applications such as radiators and underfloor heating in housing complexes.

Hotels & health center

For heating and thermal applications such as showers and swimming pools in hotels and health centers.

Factory

For applications with high heat-retention loads, such as parts washing and painting lines. The CAHV can also meet high horsepower demands by combining several units.

3. Low maintenance & design flexibility

Clean and safe

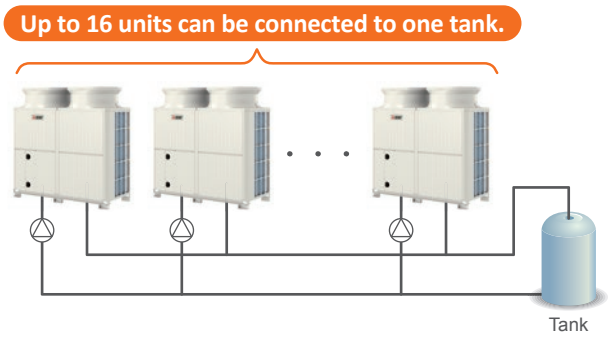
The hot water heat pump system runs on electricity only. It does not require the safety measures and periodic inspections required for gas and other combustion appliance-mounted systems, and does not generate toxic substance such as NOx.

Rotation function

When two or more units are in the system, the unit runs alternately, ensuring an optimum product lifecycle for both component units.

Multi-unit installation

The number of outdoor units can be adjusted from 1 to 16 according to the tank storage capacity.



Wide variety of external input / output

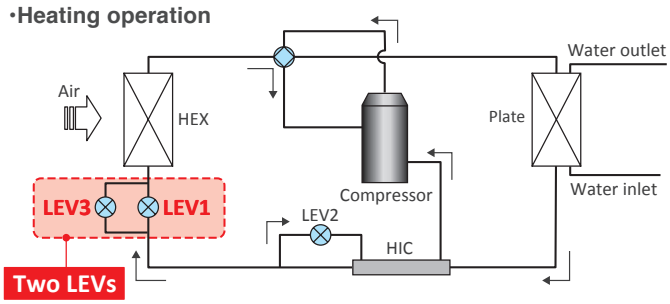
Various system configurations are available.
· Two external output for backup heater
· Analog input to control capacity
· Defrost signal
* Refer to the Data Book for other functions.

Key technologies

Refrigerant circulation and pressure control with two LEVs

The R454C refrigerant is a lower pressure refrigerant than R407C, which is used in the conventional model, and R410A, which is commonly used in air conditioners. Because low-pressure refrigerants have a low refrigerant density, securing circulation volume can be challenging especially when the refrigerant circuit pressure drops due to low outdoor temperatures or other conditions.

Linear expansion valves (LEVs) before heat exchanger (HEX) were increased from one to two and placed in parallel. The opening of LEV1, which focuses on securing the refrigerant circulation volume, and LEV3, which focuses on controlling the refrigerant pressure, are controlled respectively to control the refrigerant circulation.



New compressor has been developed

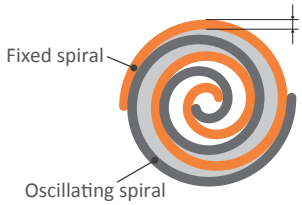
Highlights of the new compressor

- ☑ New spiral structure
- ☑ Flash injection circuit
- ☑ Expanded inverter frequency control lower limit

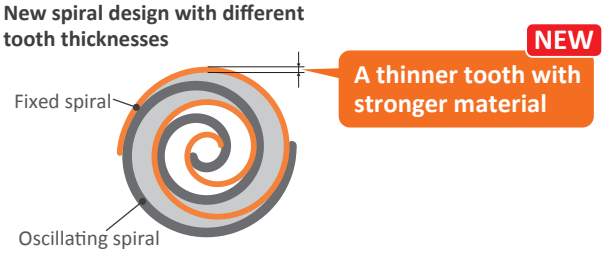
New spiral structure

The low density of R454C refrigerant requires an increased amount of refrigerant to be discharged from the discharge section. The new compressor uses a new material for the fixed spiral section, which enables the tooth to be thinner while maintaining their strength. The height of the teeth has also been lengthened. This synergistic effect has resulted in a 15% increase in the extrusion volume from the discharge section compared to the conventional model (assuming the scroll section of the old and new compressors has the same volume).

Spiral design with equal tooth thicknesses used in the conventional model



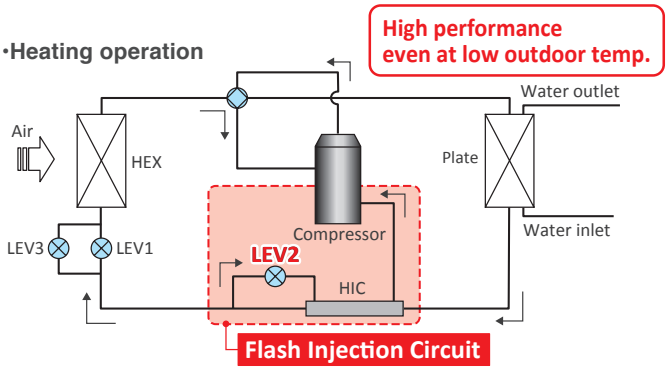
New spiral design with different tooth thicknesses



Flash injection circuit

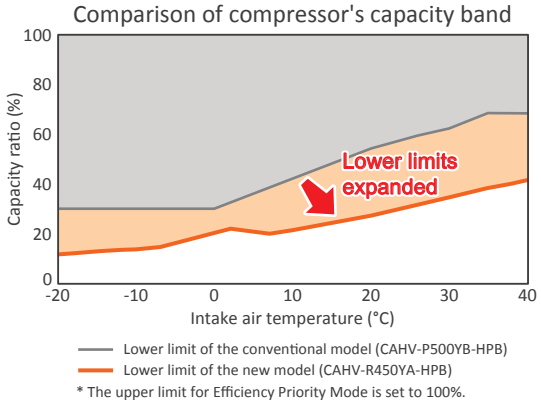
The flash injection circuit is a Mitsubishi Electric technology used in air conditioner for cold climates. The CAHV also adopts this circuit to help units produce high-temperature water even at low outdoor temperatures.

Liquid refrigerant, whose pressure is reduced by the LEV2, exchanges heat in the HIC circuit and becomes gas-liquid two-phase refrigerant. This two-phase refrigerant flows into the injection port in the compressor for controlling the increase of the discharge temperature. Therefore the optimal amount of refrigerant can be provided to the system via the compressor.



Expanded inverter frequency control lower limit

The new compressor has an expanded lower limit of the frequency control range compared to the conventional model. This expanded lower-limit control helps minimize thermo ON/OFF frequency during low-load operations, such as in intermediate seasons, and improves energy efficiency.



Controller

Individual remote controller

• PAR-W31MAA

PAR-W31MAA offers an easy-to-see full-dot and backlit LCD display. Basic operations, such as ON/OFF, mode switching, water temperature setting and schedule setting, can be performed. Up to 16 units can be controlled with one remote controller.

PAR-W31MAA

Major functions

Operation/ setting	ON/OFF
	Hot water/Heating/HeatingECO/Anti-freeze
	Snow/regular
	Demand
	Scheduled operation (daily/weekly)
Display	Operation mode
	Current water temperature
	Error code

Centralized remote controller

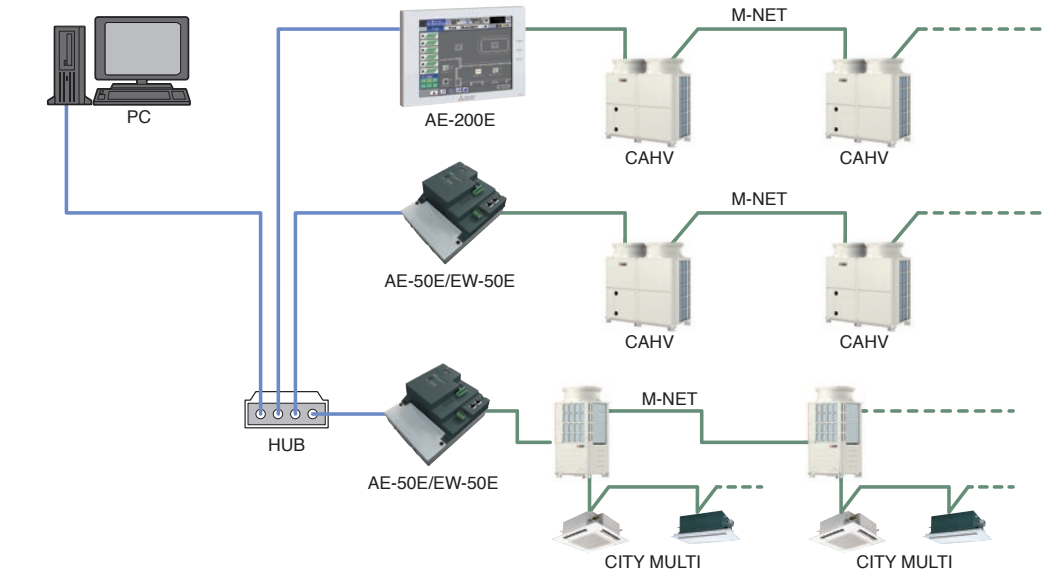
• AE-200E / AE-50E / EW-50E

The CAHV-R450YA-HPB(-BS) is connectable to the AE-200E that centrally controls up to 50 units or 50 systems connected via M-NET.

Major functions

Operation/ setting	ON/OFF
	Hot water/Heating/HeatingECO/Anti-freeze
	Snow/regular
	Scheduled operation (daily/weekly/annual)
Display	Operation mode
	Current water temperature
	Error code

System configuration



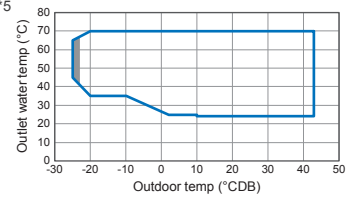
Optional parts

Description	Model
Y type STRAINER 40A	YS-40A
Representative water temperature sensor	TW-TH16-E

Specifications

Model			CAHV-R450YA-HPB (-BS)
Power source			3-phase 4-wire 380-400-415V 50/60Hz
Capacity(EN14511) *1		kW	40.0
		kcal/h	34,400
		Btu/h	136,480
	Power input	kW	14.03
	Current input	A	23.7-22.5-21.7
	COP (kW/kW)		2.85
	SCOP Low/Medium		3.57/3.24
Capacity(EN14511) *2		kW	35.0
		kcal/h	30,100
		Btu/h	119,420
	Power input	kW	20.13
	Current input	A	34.0-32.3-31.1
	COP (kW/kW)		1.74
Maximum current input		A	44.0-41.8-40.3
Water pressure drop *1			10.2kPa (1.47 psi)
Temperature range *5	Outlet water temperature		24-70ºC 75.2-158ºF
	Outdoor temperature	D.B.	-25-43ºC -13-109.4ºF
Circulating water volume range *6			1.5m³/h-15.0m³/h
Sound pressure level (measured 1 m below the unit in an anechoic room) *1 *4		dB (A)	64
Sound pressure level (measured 1 m below the unit in an anechoic room) *3 *4		dB (A)	72
Water pipe diameter and type	Inlet	mm (in)	38.1(Rc1 1/2"),housing type joint
	Outlet	mm (in)	38.1(Rc1 1/2"),housing type joint
Extemal finish			Acrylic painted steel sheet <Munsell 5Y 8/1 or similar>
Extemal dimensions H × W × D		mm	1710 x 1750 x 740
Net weight		kg (lb)	359 (791)
Design pressure	R454C	MPa	3.85
	Water	MPa	1.0
Drawing number	Wiring		KW94C870
	External appearance		KW94C397
Heat exchanger	Water-side		Copper brazed stainless steel sheet
	Air-side		Plate fins and copper tubes
Compressor	Type		Inverter scroll hermetic compressor
	Manufacturer		MITSUBISHI ELECTRIC CORPORATION
	Starting method		Inverter
	Motor output	kW	12.1
	Lubricant		FVC32EA
Fan	Air flow rate m³/min	m³/min	150 × 2
		L/s	2500 × 2
		cfm	5297 × 2
	External static pressure		10 Pa (1 mm H2O)
	Type and quantity		Propeller fan x 2
	Control and driving mechanism		Inverter control, direct driven by motor
	Motor output kW	kW	0.92 x 2
HIC (Heat inter-changer) circuit			Copper pipe
Protection devices	High pressure		High-pressure sensor and switch set at 3.85 MPa (643 psi)
	Inverter circuit		Overheat and overcurrent protection
	Compressor		Overheat protection
	Fan motor		Thermal switch
Defrosting method			Auto-defrost mode (Reversed refrigerant cycle)
Refrigerant	Type and factory charge	kg	R454C, 9.0 kg
	Flow and temperature control		LEV and HIC circuit

*1 Under normal heating conditions at the outdoor temperature of 7°CDB/6°CWB (44.6°FDB/42.8°FWB), the outlet water temperature of 45°C (113°F), and the inlet water temperature of 40°C (104°F)
*2 Under normal heating conditions at the outdoor temperature of 7°CDB/6°CWB (44.6°FDB/42.8°FWB) and the outlet water temperature of 70°C (158°F)
*3 Under normal heating conditions at the outdoor temperature of 7°CDB/6°CWB (44.6°FDB/42.8°FWB) when the unit is set to the "Capacity Priority" mode through the dry NC-contact
*4 The sound pressure level is a value measured in an anechoic room in accordance with the conventional method in JRA 4060.
*5



Outdoor temp. -25°CDB/Outlet water temp. 45 to 65°C
(Outdoor temp. -13°FDB/Outlet water temp. 113 to 149°F)
Outdoor temp. -20°CDB/Outlet water temp. 35 to 70°C
(Outdoor temp. -4°FDB/Outlet water temp. 95 to 158°F)
Outdoor temp. 43°CDB/Outlet water temp. 24 to 70°C
(Outdoor temp. -109°FDB/Outlet water temp. 75.2 to 158°F)

*Do not start up the unit at or below the outdoor temperature of -23°C

*6 4.0-15.0m³/h under the following conditions.
a. When the outdoor temperature is below 0°C.
b. When the outlet water temperature is 30°C or below AND the outdoor temperature is 6°C or below.

Fluorinated Greenhouse Gases Information

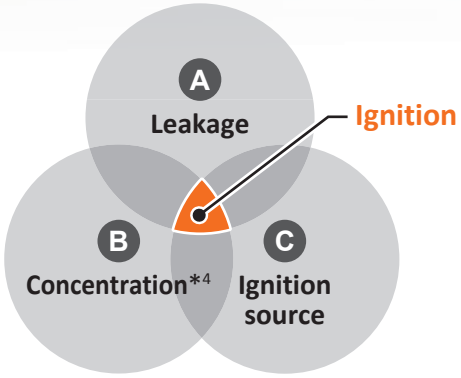
Model Name	Refrigerant		Factory charged	
	type	GWP	Weight [kg]	CO_2 equivalent [t]*
CAHV-R450YA-HPB(-BS)	R454C	148	9.0	1332

* Above values are based on Regulation (EU) No.517/2014.

Safe handling of R454C

R454C refrigerant properties

Under the conditions shown below, there is a possibility that R454C could burn.



	R454C	R407C
Chemical formula	$CH_2F_2/C_3H_2F_4$	$CH_2F_2/CHF_2CF_3/CH_2FCF_3$
Composition (blend ratio wt. %)	R32/R1234yf (21.5/78.5 wt%)	R32/R125/R134a (23/25/52 wt%)
Ozone depletion potential(ODP)	0	0
Global warming potential(GWP) *1	148	1770
LFL(kg/m3) *2	0.293	–
Flammability *3	Lower flammability(2L)	No flame propagation(1)

*1 IPCC 4th assessment report
*2 LFL : Lower flammable limit EN 378-1:2016+A1:2020
*3 IEC60335-2-40 : 2018
*4 R454C consistency is higher than LFL and lower than UFL.

Be sure to observe the following three points to use R454C safely.

WARNING

A Do not leak refrigerant.

<Installation>
- Vacuum drying should be done. Do not release refrigerant into the atmosphere unnecessarily.
- Follow "Installation points of charging refrigerant."

<Repair/Removal>
- Refrigerant should be recovered.

B Prevent concentration.

- Follow “Installation restrictions.”

C Keep ignition sources away from the unit.

- Do not braze pipes that contain refrigerant. Before brazing, refrigerant should be recovered.
- Do not install the unit while electricity is on. Turn off electricity and check using a tester.
- Do not smoke during work and transportation.

Note: R454C emit toxic gas when exposed to naked flame.

Installation restrictions

General restrictions

WARNING

Do not install the unit where combustible gas may leak.

- If combustible gas accumulates around the unit, fire or explosion may result.

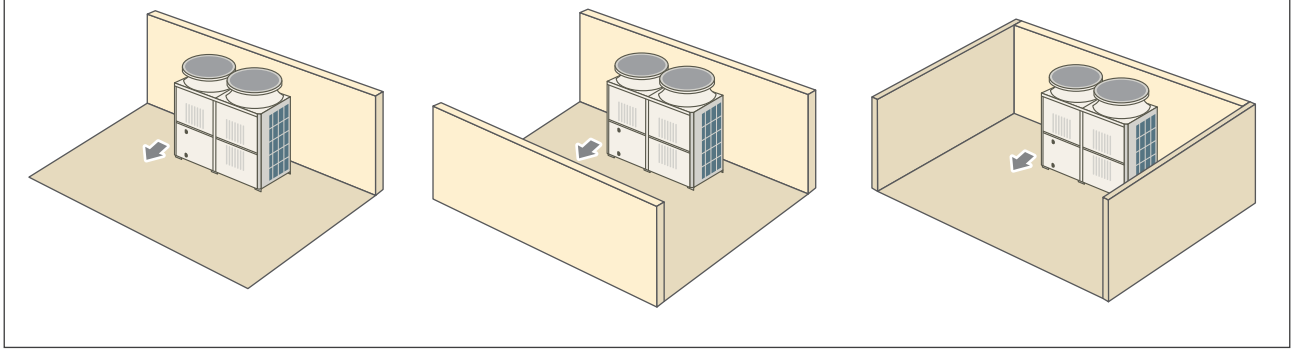
- Provide sufficient space around the unit for effective operation, efficient air movement, and ease of access for maintenance.
- All restrictions mentioned in this manual apply not only to new installations but also to relocations and layout changes.
- Refer to the Installation manual for other precautions on installation.

Installation space requirement

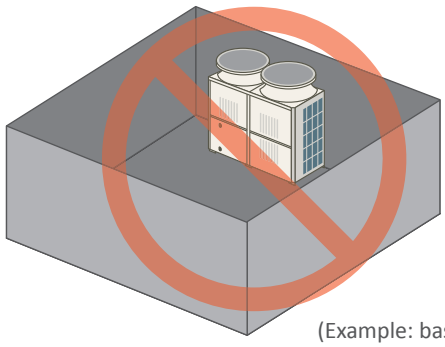
- Do not install the unit inside a building such as the basement or machine room, where the refrigerant may stagnate.
- Install the unit in a place where at least one of four sides is open.

Figure 1

Correct installation



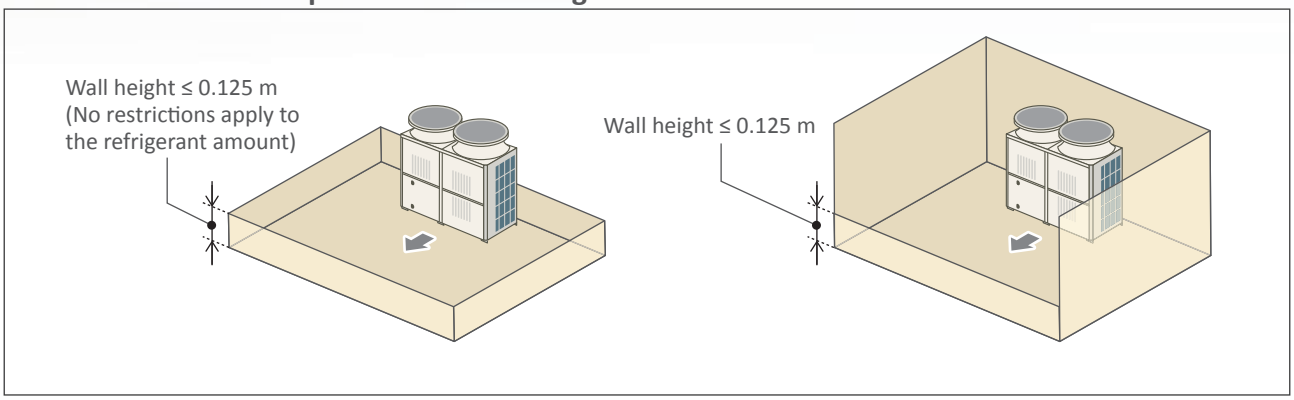
Incorrect installation



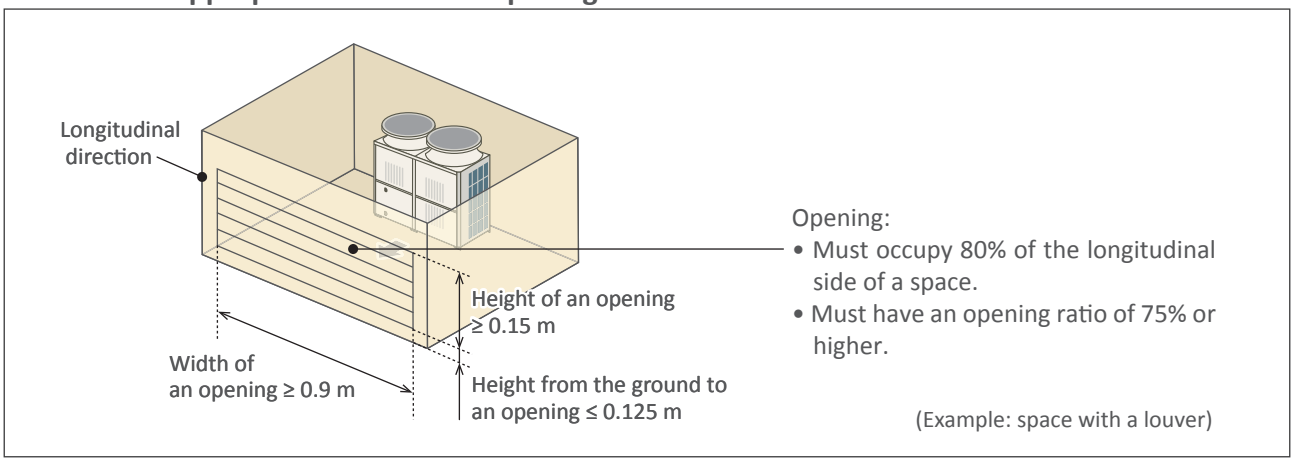
(Example: basement)

If the unit needs to be installed in a space where all four sides are blocked, confirm that one of the following situations (A or B) is satisfied.

A. Install the unit in a space with a wall height of ≤ 0.125 m.



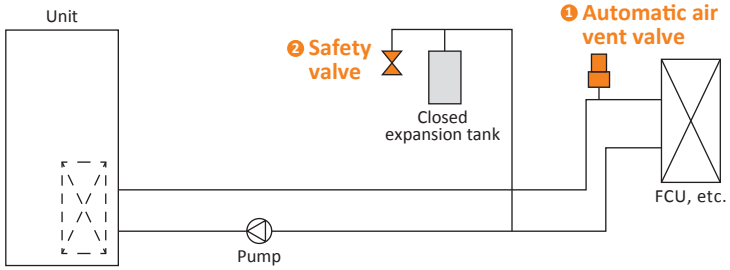
B. Create an appropriate ventilation opening.



Regulatory requirements for safety

See below for information on installing a safety device on hot water heat pump system.

* Safety devices shall be regularly inspected, maintained, and replaced in accordance with relevant laws, regulations, and the instructions of the manufacturers.
* The requirements listed below were established based on IEC60335-2-40 (Edition 6.0) G.G.6. See the original standards for further information on selecting a safety device.



Required items

❶ Automatic air vent valve
❷ Safety valve

Note
* In the event of a failure of the waterside heat exchanger in the unit, the refrigerant may leak from the automatic air vent valve or safety valve, so install it in a place where the refrigerant will not accumulate, such as outdoors.

MEMO

⚠Warning

■ Do not use refrigerant other than the type indicated in the manuals provided with the unit and on the nameplate.
- Doing so may cause the unit or pipes to burst, or result in explosion or fire during use, repair, or at the time of disposal of the unit.
- It may also be in violation of applicable laws.
- MITSUBISHI ELECTRIC CORPORATION cannot be held responsible for malfunctions or accidents resulting from the use of the wrong type of refrigerant.

■ Our air-cooled Condensing Units contain a fluorinated greenhouse gas, R454C (GWP:148). This GWP value is based on Regulation (EU) No. 517/2014 from IPCC 4th edition.

MITSUBISHI ELECTRIC CORPORATION

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