

Circulating Fluid Temperature Controller

Low GWP Refrigerant Chiller

Thermo-chiller

Dual Channel Thermo-chiller for Lasers

New



GWP:146^{*1}

EU refrigerant regulations: GWP150 or more
 US refrigerant regulations: GWP700 or more
 California, US refrigerant regulations: GWP750 or more

*1 Regulation (EU) 2024/573, AIM Act 40 CFR Part 84

Environmentally friendly R454C as refrigerant

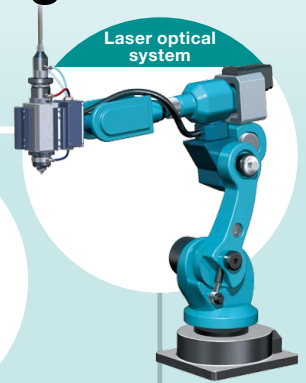
Not available for air transport

Temperatures for **2 fluid channel systems** can be controlled individually by one chiller.



Optical system **CH2**

Oscillator **CH1**



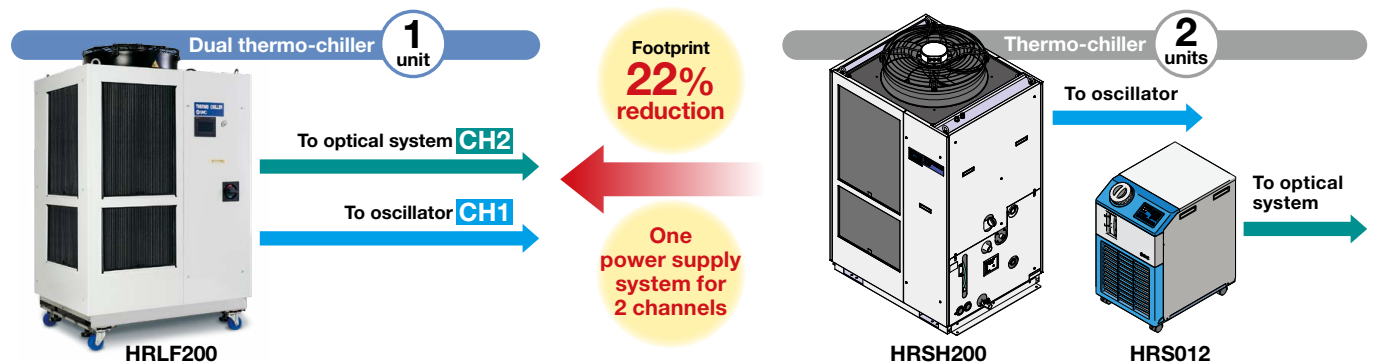
Cooling capacity [kW]	19
Temperature stability [°C]	±0.1
Set temperature range [°C]	5 to 35

Oscillator
CH1
19
±0.1
5 to 35

Optical system
CH2
1 (Max. 1.5)
±0.5
10 to 40 ^{*1}

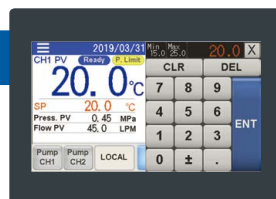
*1 CH2 ≥ CH1

Space saving, Reduced wiring



Touch panel

- Numeric keypad inputs
- Notice for alarms and maintenance
- Temperature waveform can be displayed.



Numeric keypad display

HRLF Series



CAT.ES40-80A

CONTENTS

HRLF Series **Dual Channel Thermo-chiller for Lasers**



Circulating Fluid Temperature Controller

Low GWP Refrigerant Chiller

Thermo-chiller HRLF Series

3-phase 380 to 415 VAC (50 Hz)

3-phase 380 to 480 VAC (60 Hz)

How to Order/Specifications

Air-cooled Refrigerationp. 2

Water-cooled Refrigerationp. 3

Cooling Capacityp. 4

Pump Capacityp. 4

Dimensionsp. 5

Parts Descriptionp. 7

● **Options**

CH1, CH2 Electric Conductivity Controlp. 8

CH2 High-Pressure Pump Mountedp. 8

Optional Accessoriesp. 9

● **Cooling Capacity Calculation**

Required Cooling Capacity Calculationp. 10

Precautions on Cooling Capacity Calculationp. 11

Circulating Fluid Typical Physical Property Valuesp. 11

Specific Product Precautionsp. 12

Low GWP Refrigerant Chiller

Thermo-chiller Dual Channel Thermo-chiller for Lasers

3-phase 380 to 415 VAC (50 Hz)

3-phase 380 to 480 VAC (60 Hz)

HRLF Series



How to Order

Air-cooled refrigeration

HRLF 200 - A - 40 -

	CH1	CH2
200	19 kW	1 kW

Cooling capacity

Cooling method	
A	Air-cooled refrigeration

Pipe thread type

	Rc
Nil	Rc
F	G (with Rc-G conversion fitting)
N	NPT (with Rc-NPT conversion fitting)

Power supply

40	3-phase 380 to 415 VAC (50 Hz) 3-phase 380 to 480 VAC (60 Hz)
----	--

Option

Symbol	Options
Nil	CH2 Electric conductivity control
D1*1	CH1, CH2 Electric conductivity control
T2*2	CH2 High-pressure pump mounted

*1 CH2 has electric conductivity control as standard.
*2 For details, refer to "Options" on page 8.

Specifications

Model	HRLF200-A□-40		
	CH1	CH2	
Cooling method	Air-cooled refrigeration		
Refrigerant	R454C (HFO/HFC, GWP : 146)*15		
Refrigerant charge	kg 1.7		
Control method	PID control		
Ambient temperature	°C 2 to 45		
Circulating fluid system	Circulating fluid Tap water*1, Deionized water*9		
	Set temperature range	°C 5 to 35	
	Cooling capacity*2	kW 19	
	Heating capacity*3	kW 4	
	Temperature stability*4	°C ±0.1	
	Pump capacity*13	Rated flow (Outlet pressure)	L/min 45 (0.45 MPa)
		Maximum flow rate	L/min 130
		Maximum pump head	m 55
	Settable pressure range*5	MPa 0.10 to 0.55	
	Minimum operating flow rate*6	L/min 25	
	Tank capacity	L 42	
	Bypass circuit (With valve)	Installed	
	Electric conductivity setting range	μS/cm 0.5 to 45*9	
	Particle filter nominal filtration rating (Accessory)	μm 5	
Circulating fluid outlet, circulating fluid return port	Rc1 (Symbol F: G1, Symbol N: NPT1)	Rc1/2 (Symbol F: G1/2, Symbol N: NPT1/2)	
Tank drain port	Rc3/4 (Symbol F: G3/4, Symbol N: NPT3/4)	Rc1/2 (Symbol F: G1/2, Symbol N: NPT1/2)	
Fluid contact material	Stainless steel, Copper (Heat exchanger brazing)*10, Brass*10, Bronze*10, Fluororesin, PP, PBT, POM, PU, PC, PVC, EPDM, NBR, Ion replacement resin*9	Stainless steel, Alumina ceramic, Carbon, Fluororesin, PP, PBT, POM, PU, PVC, PPS, AS, PS, EPDM, NBR, Ion replacement resin, PA*14	
Electrical system	Power supply 3-phase 380 to 415 VAC (50 Hz) Allowable voltage range ±10% (No continuous voltage fluctuation) 3-phase 380 to 480 VAC (60 Hz) Allowable voltage range +4%, -10% (Max. voltage less than 500 V and no continuous voltage fluctuation)		
	Earth leakage breaker	Rated current	A 30
		Sensitivity current	mA 30
	Rated operating current*4		A 17.4
	Rated power consumption*4		kW (kVA) 11.1 (12.0)
Noise level (Front 1 m/Height 1 m)*4		dB (A) 75	
Accessories	Operation Manual (for installation/operation) 2 pcs. (English 1 pc./Japanese 1 pc.), Particle filter set for CH1, Particle filter set for CH2, Anchor bolt fixing brackets 2 pcs. (including 6 M8 bolts)*7		
Weight (dry state)*11	kg 265		

- *1 Use fluid in condition below as the circulating fluid.
Tap water: Standard of The Japan Refrigeration and Air Conditioning Industry Association (JRA GL-02-1994)
- *2 ① Ambient temperature: 32°C, ② Circulating fluid: Tap water, ③ Circulating fluid temperature: CH1 20°C/CH2 25°C, ④ Circulating fluid flow rate: Rated flow, ⑤ Power supply: 400 VAC
In the case of option T2 "CH2 High-Pressure Pump Mounted", refer to pages 421 to 423.
- *3 ① Ambient temperature: 32°C, ② Circulating fluid: Tap water, ③ Circulating fluid flow rate: Rated flow, ④ Power supply: 400 VAC
- *4 ① Ambient temperature: 32°C, ② Circulating fluid: Tap water, ③ Circulating fluid temperature: CH1 20°C/CH2 25°C, ④ Load: Same as the cooling capacity, ⑤ Circulating fluid flow rate: Rated flow, ⑥ Power supply: 400 VAC, ⑦ Piping length: Shortest
- *5 With the pressure control mode by inverter. If the pressure control mode is not necessary, use the flow control function or the pump output setting function.
- *6 Fluid flow rate to maintain the cooling capacity. If the actual flow rate is lower than this, adjust the bypass valve. In the case of option T2

- "CH2 High-Pressure Pump Mounted", refer to page 8.
- *7 The anchor bolt fixing brackets (including 6 M8 bolts) are used for fixing to wooden skids when packaging the thermo-chiller. No anchor bolt is included.
- *8 Max. 1.5 kW. When 1.5 kW is applied, the cooling capacity of CH1 decreases by 0.5 kW.
- *9 For Option D1 (With electric conductivity control) only
- *10 Not included for Option D1 (With electric conductivity control)
- *11 The weight will increase by 1 kg when option "D1" (CH1, CH2 electric conductivity control) or option "T2" (CH2 high-pressure pump mounted) is selected.
- *12 The usable flow rate range is varied depending on the pump control mode. For details, refer to pump capacity curve on page 4.
- *13 In the case of option T2 "CH2 High-Pressure Pump Mounted", refer to page 8.
- *14 Included in option "T2 (CH2 High-Pressure Pump Mounted)"
- *15 R454C is a slightly flammable refrigerant. Avoid using this product in proximity to open flames.

HRLF Series Dual Channel Thermo-chiller for Lasers



How to Order

Water-cooled refrigeration

HRLF 200 - W [] - 40 - []

	CH1	CH2
200	21.5 kW	1 kW

Cooling method
W Water-cooled refrigeration

	Pipe thread type
Nil	Rc
F	G (with Rc-G conversion fitting)
N	NPT (with Rc-NPT conversion fitting)

Option

Symbol	Options
Nil	CH2 Electric conductivity control
D1*1	CH1, CH2 Electric conductivity control
T2*2	CH2 High-pressure pump mounted

*1 CH2 has electric conductivity control as standard.
*2 For details, refer to "Options" on page 8.

Power supply

40	3-phase 380 to 415 VAC (50 Hz) 3-phase 380 to 480 VAC (60 Hz)
----	--

Specifications

Model		HRLF200-W□-40		
		CH1	CH2	
Cooling method		Water-cooled refrigeration		
Refrigerant		R454C (HFO/HFC, GWP : 146)*16		
Refrigerant charge kg		1.7		
Control method		PID control		
Ambient temperature °C		2 to 45		
Circulating fluid system	Circulating fluid	Tap water*1, Deionized water*9		
	Set temperature range °C	5 to 35	10 to 40	
	Cooling capacity *2 kW	21.5	1*8	
	Heating capacity *3 kW	4	1	
	Temperature stability *4 °C	±0.1	±0.5	
	Pump capacity *13	Rated flow (Outlet pressure) L/min	45 (0.45 MPa)	10 (0.45 MPa)
		Maximum flow rate L/min	130	16*12
		Maximum pump head m	55	49
	Settable pressure range *5 MPa	0.10 to 0.55	0.10 to 0.49	
	Minimum operating flow rate *6 L/min	25	2	
	Tank capacity L	42	7	
	Bypass circuit (With valve)	Installed		
	Electric conductivity setting range μS/cm	0.5 to 45*9	0.5 to 45	
	Particle filter nominal filtration rating (Accessory) μm	5		
Circulating fluid outlet, circulating fluid return port	Rc1 (Symbol F: G1, Symbol N: NPT1)	Rc1/2 (Symbol F: G1/2, Symbol N: NPT1/2)		
Tank drain port	Rc3/4 (Symbol F: G3/4, Symbol N: NPT3/4)	Rc1/2 (Symbol F: G1/2, Symbol N: NPT1/2)		
Fluid contact material	Stainless steel, Copper (Heat exchanger brazing)*10, Brass*10, Bronze*10, Fluororesin, PP, PBT, POM, PU, PC, PVC, EPDM, NBR, Ion replacement resin*9	Stainless steel, Alumina ceramic, Carbon, Fluororesin, PP, PBT, POM, PU, PVC, PPS, AS, PS, EPDM, NBR, Ion replacement resin, PA*14		
Facility water system	Temperature range °C	5 to 35		
	Pressure range MPa	0.3 to 0.5		
	Required flow rate *15 L/min	50		
	Inlet-outlet pressure differential of facility water MPa	0.3 or more		
	Facility water inlet/outlet	Rc1 (Symbol F: G1, Symbol N: NPT1)		
Fluid contact material	Stainless steel, Copper (Heat exchanger brazing), Bronze, Brass, PTFE, NBR, EPDM			
Electrical system	Power supply	3-phase 380 to 415 VAC (50 Hz) Allowable voltage range ±10% (No continuous voltage fluctuation) 3-phase 380 to 480 VAC (60 Hz) Allowable voltage range +4%, -10% (Max. voltage less than 500 V and no continuous voltage fluctuation)		
	Earth leakage breaker	Rated current A	30	
		Sensitivity current mA	30	
	Rated operating current *4 A	16.7		
	Rated power consumption *4 kW (kVA)	10.7 (11.5)		
Noise level (Front 1 m/Height 1 m)*4 dB (A)	72			
Accessories	Operation Manual (for installation/operation) 2 pcs. (English 1 pc./Japanese 1 pc.), Particle filter set for CH1, Particle filter set for CH2, Anchor bolt fixing brackets 2 pcs. (including 6 M8 bolts)*7			
Weight (dry state)*11 kg	Approx. 255			

- *1 Use fluid in condition below as the circulating fluid.
Tap water: Standard of The Japan Refrigeration and Air Conditioning Industry Association (JRA GL-02-1994)
- *2 ① Facility water temperature: 32°C, ② Circulating fluid: Tap water, ③ Circulating fluid temperature: CH1 20°C/CH2 25°C, ④ Circulating fluid flow rate: Rated flow, ⑤ Power supply: 400 VAC
In the case of option T2 "CH2 High-Pressure Pump Mounted", refer to page 421 and 422.
- *3 ① Facility water temperature: 32°C, ② Circulating fluid: Tap water, ③ Circulating fluid flow rate: Rated flow, ④ Power supply: 400 VAC
- *4 ① Facility water temperature: 32°C, ② Circulating fluid: Tap water, ③ Circulating fluid temperature: CH1 20°C/CH2 25°C, ④ Load: Same as the cooling capacity, ⑤ Circulating fluid flow rate: Rated flow, ⑥ Power supply: 400 VAC, ⑦ Piping length: Shortest
- *5 With the pressure control mode by inverter. If the pressure control mode is not necessary, use the flow control function or the pump output setting function.

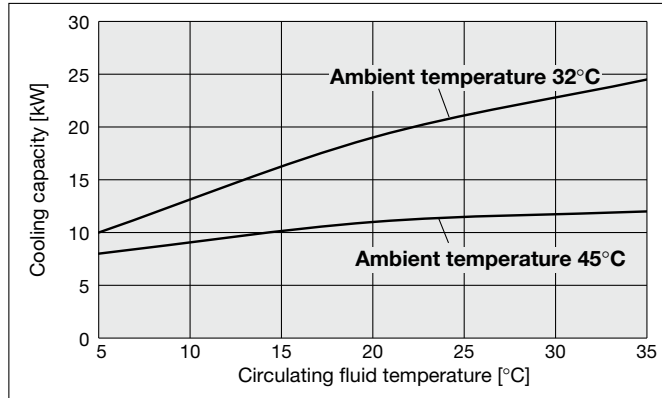
- *6 Fluid flow rate to maintain the cooling capacity. If the actual flow rate is lower than this, adjust the bypass valve. In the case of option T2 "CH2 High-Pressure Pump Mounted", refer to page 8.
- *7 The anchor bolt fixing brackets (including 6 M8 bolts) are used for fixing to wooden skids when packaging the thermo-chiller. No anchor bolt is included.
- *8 Max. 1.5 kW. When 1.5 kW is applied, the cooling capacity of CH1 decreases by 0.5 kW.
- *9 For Option D1 (With electric conductivity control) only
- *10 Not included for Option D1 (With electric conductivity control)
- *11 The weight will increase by 1 kg when option D1 "With electrical conductivity control" and option T2 "CH2 High-Pressure Pump Mounted" is selected.
- *12 The usable flow rate range is varied depending on the pump control mode. For details, refer to pump capacity curve on page 4.
- *13 In the case of option T2 "CH2 High-Pressure Pump Mounted", refer to page 8.
- *14 Included in option "T2"
- *15 The actual flow rate of facility water will fluctuate according to your operating conditions.
- *16 R454C is a slightly flammable refrigerant. Avoid using this product in proximity to open flames.

Cooling Capacity

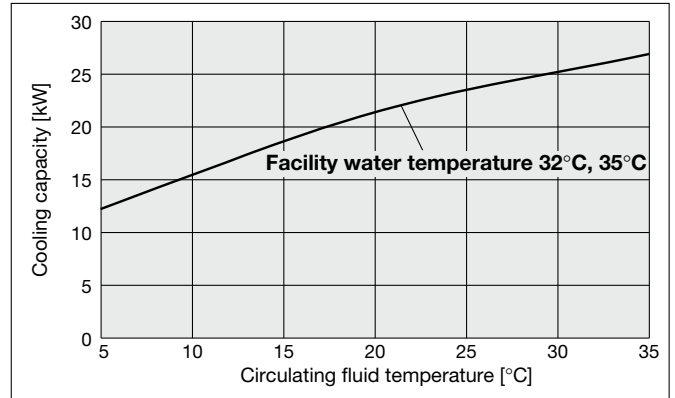
*1 This is the cooling capacity of the CH1 side when 1 kw heat load is applied to the CH2 side.

*2 Max. 1.5 kW. When 1.5 kW is applied, the cooling capacity of CH1 decreases by 0.5 kW.

HRLF200-A□-40 (CH1)*1

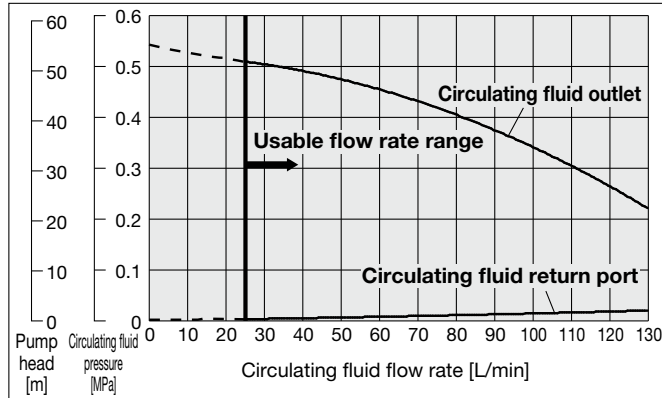


HRLF200-W□-40 (CH1)*1

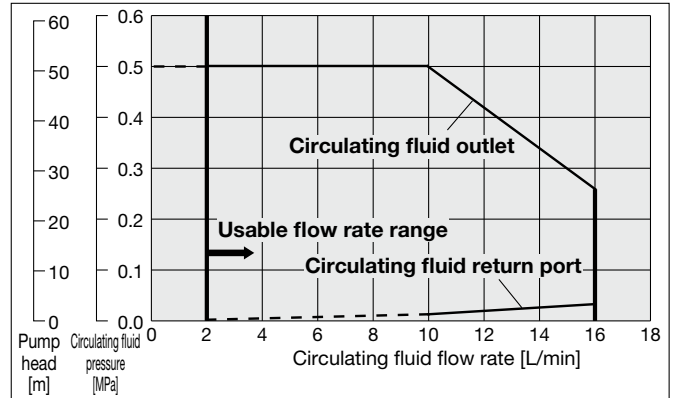


Pump Capacity

HRLF200-A/W□-40 (CH1)



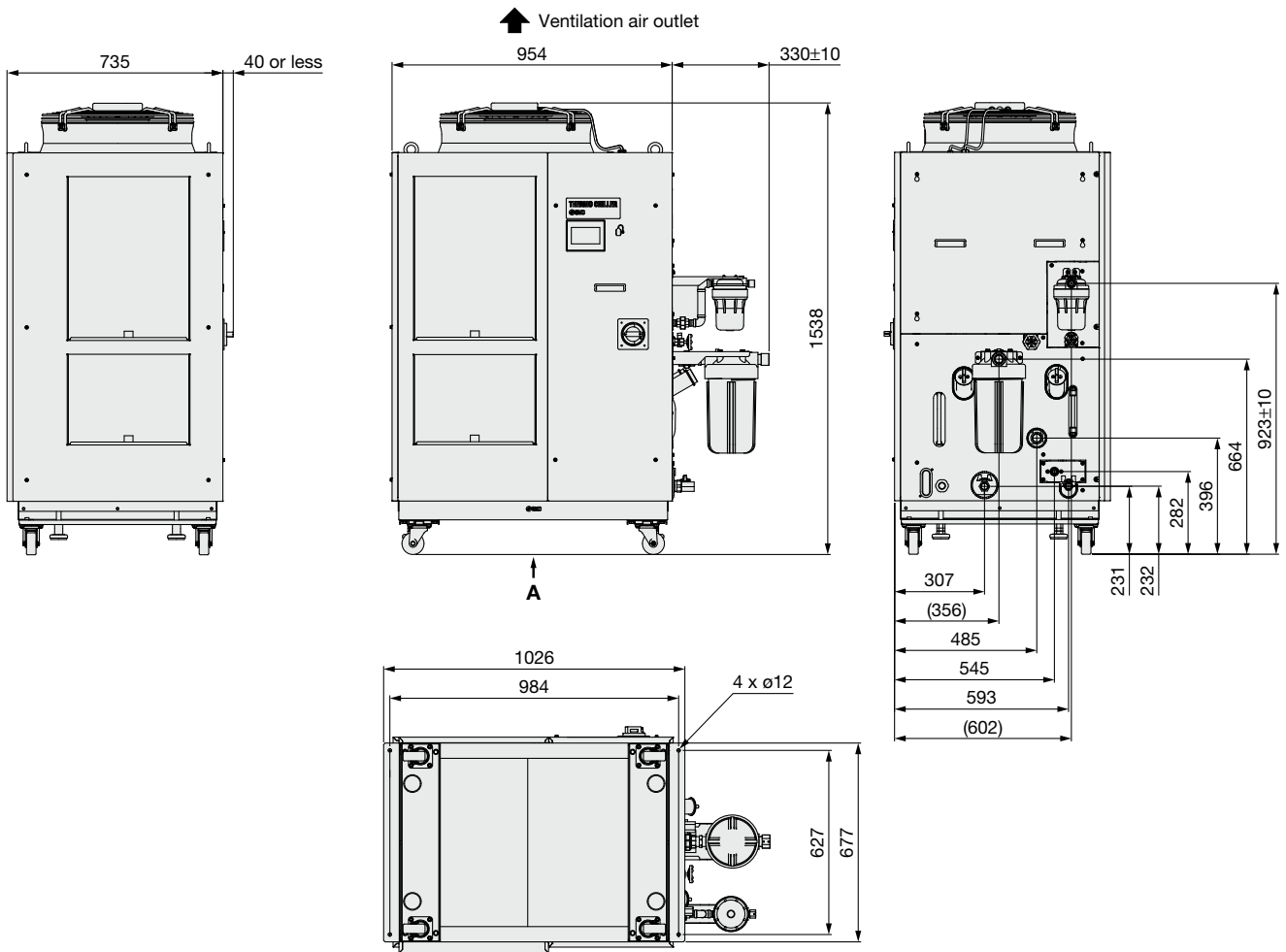
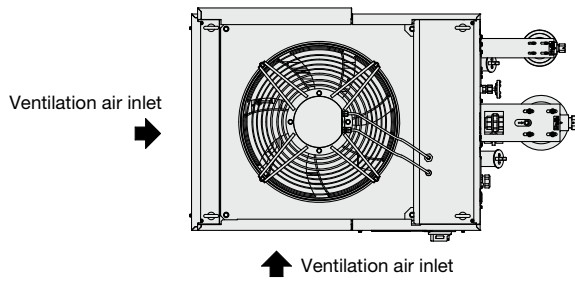
HRLF200-A/W□-40 (CH2)



* The flow rate is displayed up to 16 L/min on the chiller display.

Dimensions

HRLF200-A□-40

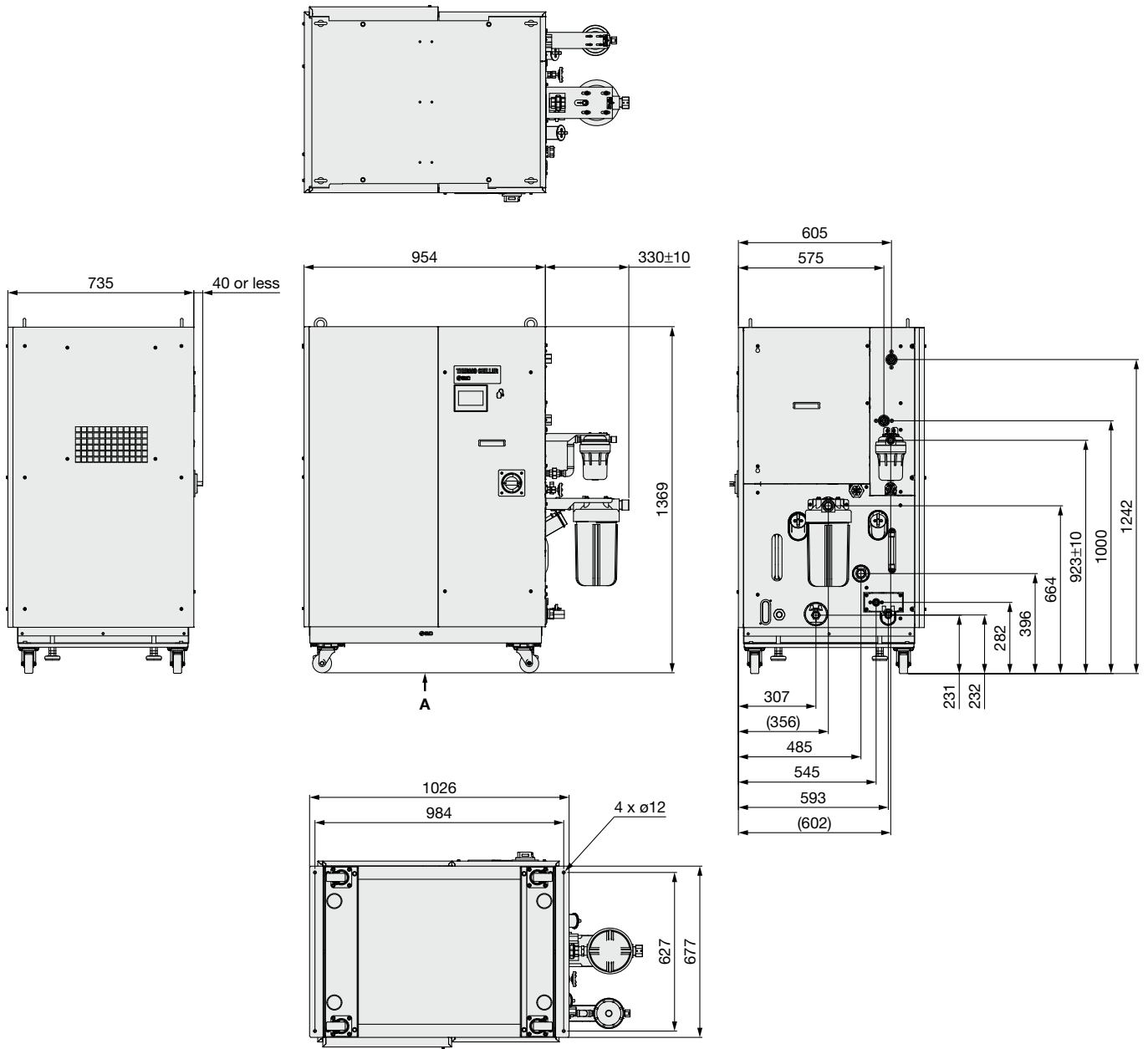


Anchor bolt mounting position (View A)

For piping port sizes, refer to the "Parts Description" on page 7.

Dimensions

HRLF200-W□-40

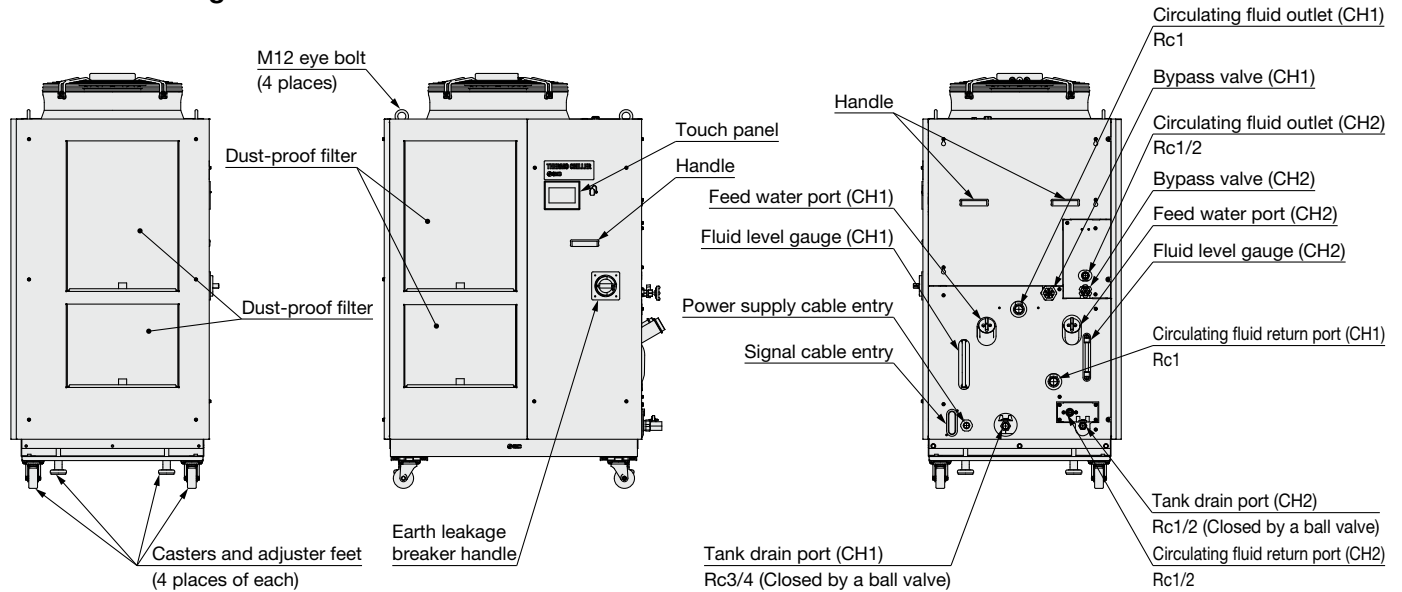


Anchor bolt mounting position (View A)

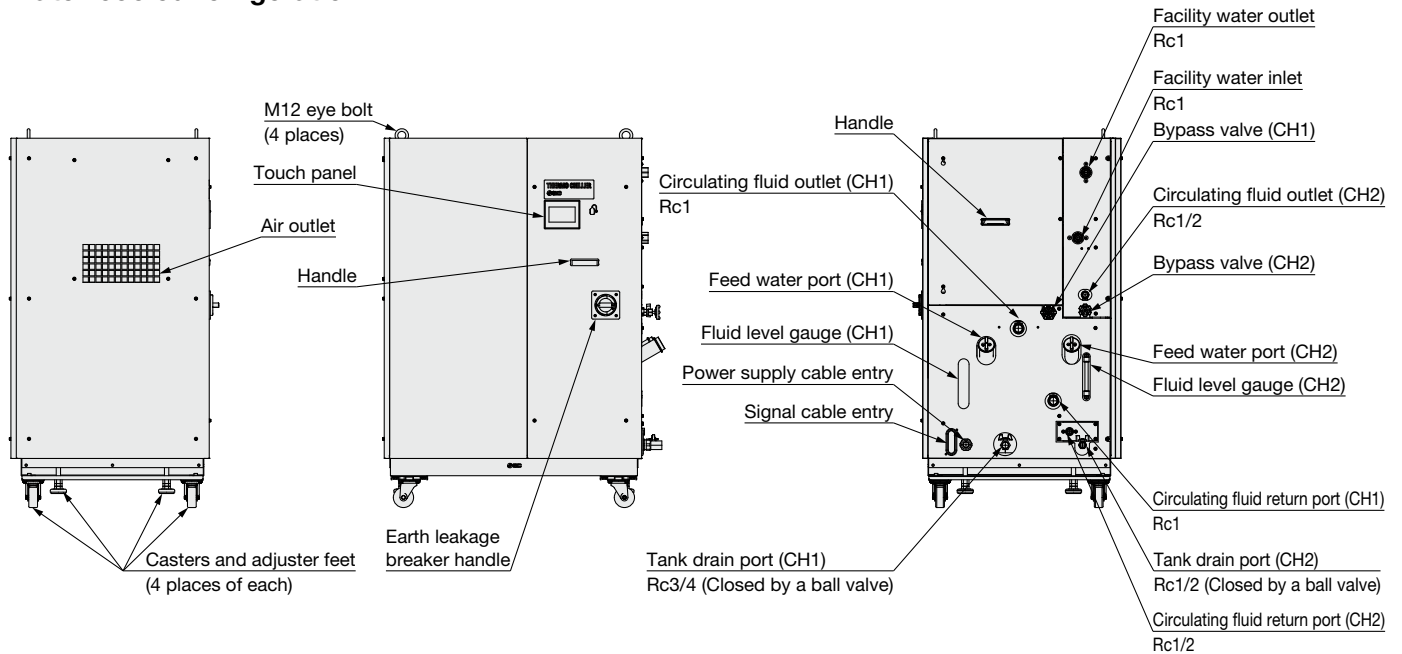
For piping port sizes, refer to the "Parts Description" on page 7.

Parts Description

Air-cooled refrigeration



Water-cooled refrigeration



HRLF Series Options

* Options have to be selected when ordering the thermo-chiller. It is not possible to add them after purchasing the unit.

D1 Option symbol

CH1, CH2 Electric Conductivity Control

HRLF - - 40 - D1

● CH1, CH2 Electric conductivity control

- For the standard model, only CH2 has electric conductivity control. However, if option "D1" is selected, CH1 also has electric conductivity control.
- Contact material of the circulating fluid circuit is made from non-copper materials.

T2 Option symbol

CH2 High-Pressure Pump Mounted

HRLF - - 40 - T2

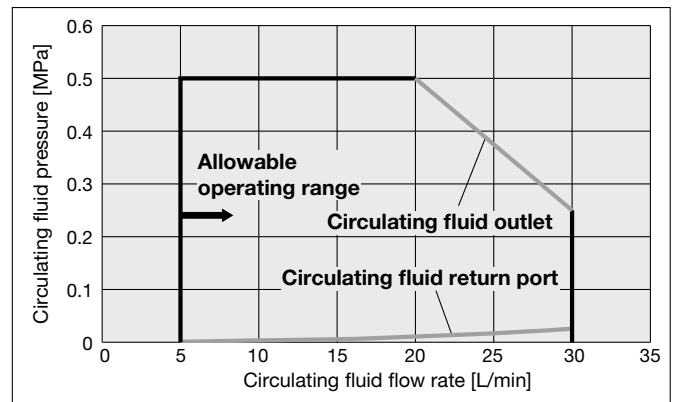
● CH2 High-pressure pump mounted

Possible to choose a high-pressure pump in accordance with user's piping resistance
Total cooling capacity of CH1 and CH2 will decrease by heat generated in the pump.

Applicable model		HRLF <input type="checkbox"/> - A/W <input type="checkbox"/> - 40 - T2	
		CH1	CH2
Pump	Rated flow rate (Outlet) L/min	Same as standard product	20 (0.45 MPa)
	Maximum flow rate L/min	Same as standard product	30
	Maximum pump head m	Same as standard product	Same as standard product
Minimum operating flow rate L/min	Same as standard product	5	
Tank capacity L	Same as standard product	Same as standard product	
Cooling capacity W	It differs from the standard cooling capacity. Refer to the table below for the details.		

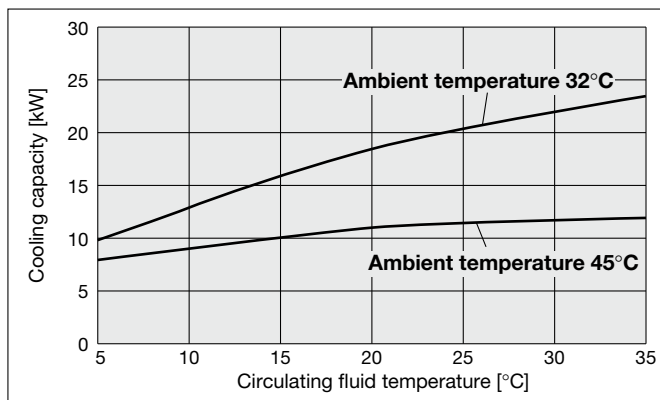
Pump Capacity

HRLF - A/W - 40 - T2

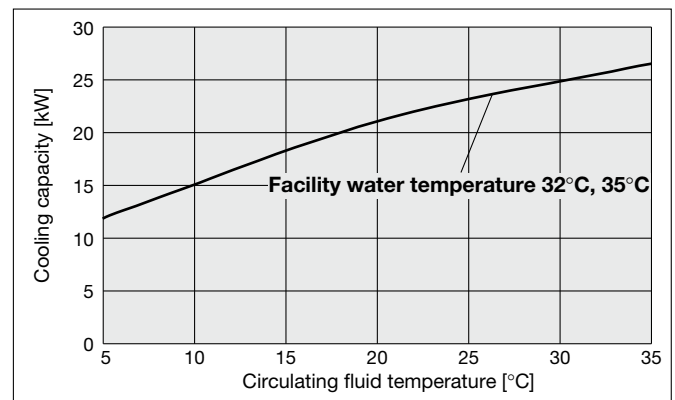


Cooling Capacity

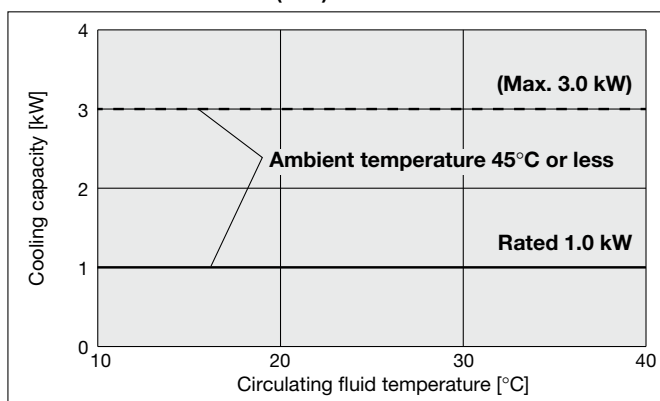
HRLF200-A - 40 - T2 (CH1)*



HRLF200-W - 40 - T2 (CH1)*1



HRLF - A/W - 40 - T2 (CH2)*2



*1 This is the cooling capacity of the CH1 side when 1 kW heat load is applied to the CH2 side.

*2 Up to 3.0 kW. However, when 3.0 kW heat load is applied, the cooling capacity of CH1 will decrease by 2.0 kW.

HRLF Series

Optional Accessories

Consumables List

Part no.	Description	Qty.	Note
HRS-S0213	Dustproof filter (Lower)	1	For HRLF200-A: 2 pcs. are used per unit.
HRS-S0214	Dustproof filter (Upper)	1	For HRLF200-A: 2 pcs. are used per unit.
HRS-PF006	Particle filter element	1	Common to each model: For CH1
EJ202S-005X11	Particle filter element	1	Common to each model: For CH2
HRR-DF001	DI filter replacement cartridge	1	Common to each model: For CH2
HRR-DF002	DI filter replacement cartridge	1	Common to each model: For CH1 Option D1 only

Cooling Capacity Calculation

Required Cooling Capacity Calculation

Example 1: When the heat generation amount in the user's equipment is known.

The heat generation amount can be determined based on the power consumption or output of the heat generating area — i.e. the area requiring cooling — within the user's equipment.*1

① Derive the heat generation amount from the power consumption.

Power consumption **P**: 20 [kW]

$$Q = P = 20 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%, $20 \text{ [kW]} \times 1.2 = 24 \text{ [kW]}$

② Derive the heat generation amount from the power supply output.

Power supply output **VI**: 20 [kVA]

$$Q = P = V \times I \times \text{Power factor}$$

In this example, using a power factor of 0.85:

$$= 20 \text{ [kVA]} \times 0.85 = 17 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,

$$17 \text{ [kW]} \times 1.2 = 20.4 \text{ [kW]}$$

③ Derive the heat generation amount from the output.

Output (shaft power, etc.) **W**: 13 [kW]

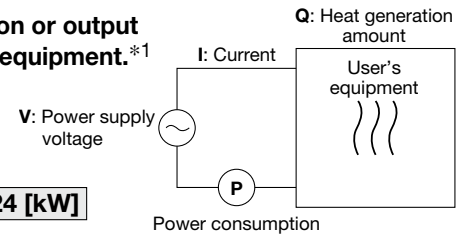
$$Q = P = \frac{W}{\text{Efficiency}}$$

In this example, using an efficiency of 0.7:

$$= \frac{13}{0.7} = 18.6 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,

$$18.6 \text{ [kW]} \times 1.2 = 22.3 \text{ [kW]}$$



*1 The examples above calculate the heat generation amount based on the power consumption. The actual heat generation amount may differ due to the structure of the user's equipment. Be sure to check it carefully.

④ Calculate based on the laser output.

Laser output power 6 [kW], conversion efficiency 30%

The oscillator's power consumption is,

$$6 \text{ [kW]} \div 0.3 = 20 \text{ [kW]}$$

The cooling capacity required for the oscillator is,

$$20 \text{ [kW]} - 6 \text{ [kW]} = 14 \text{ [kW]}$$

Considering a safety factor of 20%,

$$14 \text{ [kW]} \times 1.2 = 16.8 \text{ [kW]}$$

Example 2: When the heat generation amount in the user's equipment is not known.

Obtain the temperature difference between inlet and outlet by circulating the circulating fluid inside the user's equipment.

Heat generation amount by user's equipment **Q** : Unknown [W] (J/s)
 Circulating fluid : Tap water*1
 Circulating fluid mass flow rate **qm** : (= $\rho \times qv \div 60$) [kg/s]
 Circulating fluid density ρ : 1 [kg/L]
 Circulating fluid (volume) flow rate **qv** : 70 [L/min]
 Circulating fluid specific heat **C** : 4.186×10^3 [J/(kg·K)]
 Circulating fluid outlet temperature **T1** : 293 [K] (20 [°C])
 Circulating fluid return temperature **T2** : 297 [K] (24 [°C])
 Circulating fluid temperature difference ΔT : 4 [K] (= $T_2 - T_1$)
 Conversion factor: minutes to seconds (SI units): 60 [s/min]

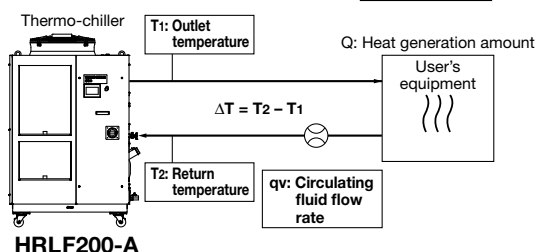
$$Q = qm \times C \times (T_2 - T_1)$$

$$= \frac{\rho \times qv \times C \times \Delta T}{60} = \frac{1 \times 70 \times 4.186 \times 10^3 \times 4.0}{60}$$

$$= 19535 \text{ [J/s]} \approx 19535 \text{ [W]} = 19.5 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,

$$19.5 \text{ [kW]} \times 1.2 = 23.4 \text{ [kW]}$$



Example of conventional units (Reference)

Heat generation amount by user's equipment **Q**: Unknown [cal/h] → [W]
 Circulating fluid : Tap water*1
 Circulating fluid weight flow rate **qm** : (= $\rho \times qv \times 60$) [kgf/h]
 Circulating fluid weight volume ratio γ : 1 [kgf/L]
 Circulating fluid (volume) flow rate **qv** : 70 [L/min]
 Circulating fluid specific heat **C** : 1.0×10^3 [cal/(kgf·°C)]
 Circulating fluid outlet temperature **T1**: 20 [°C]
 Circulating fluid return temperature **T2**: 24 [°C]
 Circulating fluid temperature difference ΔT : 4 [°C] (= $T_2 - T_1$)
 Conversion factor: hours to minutes : 60 [min/h]
 Conversion factor: kcal/h to kW : 860 [(cal/h)/W]

$$Q = \frac{qm \times C \times (T_2 - T_1)}{860}$$

$$= \frac{\gamma \times qv \times 60 \times C \times \Delta T}{860}$$

$$= \frac{1 \times 70 \times 60 \times 1.0 \times 10^3 \times 4.0}{860}$$

$$= \frac{16800000 \text{ [cal/h]}}{860}$$

$$\approx 19534 \text{ [W]} = 19.5 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,

$$19.5 \text{ [kW]} \times 1.2 = 23.4 \text{ [kW]}$$

Required Cooling Capacity Calculation

Example 3: When there is no heat generation, and when cooling the object below a certain temperature and period of time.

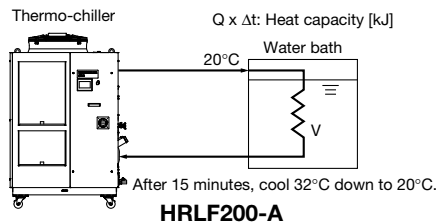
Heat quantity by cooled substance (per unit time) **Q** : Unknown [W] ([J/s])
 Cooled substance : Water
 Cooled substance mass **m** : (= $\rho \times V$) [kg]
 Cooled substance density ρ : 1 [kg/L]
 Cooled substance total volume **V** : 250 [L]
 Cooled substance specific heat **C** : 4.186×10^3 [J/(kg·K)]
 Cooled substance temperature when cooling begins **T₀** : 305 [K] (32 [°C])
 Cooled substance temperature after t hour **T_t** : 293 [K] (20 [°C])
 Cooling temperature difference ΔT : 12 [K] (= $T_0 - T_t$)
 Cooling time Δt : 900 [s] (= 15 [min])

* Refer to the following for the typical physical property values by circulating fluid.

$$Q = \frac{m \times C \times (T_0 - T_t)}{\Delta t} = \frac{\rho \times V \times C \times \Delta T}{\Delta t}$$

$$= \frac{1 \times 250 \times 4.186 \times 10^3 \times 12}{900} = 13953 \text{ [J/s]} \approx 14.0 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,
 $14.0 \text{ [kW]} \times 1.2 = 16.8 \text{ [kW]}$



Example of conventional units (Reference)

Heat quantity by cooled substance (per unit time) **Q** : Unknown [cal/h] → [W]
 Cooled substance : Water
 Cooled substance weight **m** : (= $\rho \times V$) [kgf]
 Cooled substance weight volume ratio γ : 1 [kgf/L]
 Cooled substance total volume **V** : 250 [L]
 Cooled substance specific heat **C** : 1.0×10^3 [cal/(kgf·°C)]
 Cooled substance temperature when cooling begins **T₀** : 32 [°C]
 Cooled substance temperature after t hour **T_t** : 20 [°C]
 Cooling temperature difference ΔT : 12 [°C] (= $T_0 - T_t$)
 Cooling time Δt : 15 [min]
 Conversion factor: hours to minutes : 60 [min/h]
 Conversion factor: kcal/h to kW : 860 [(cal/h)/W]

$$Q = \frac{m \times C \times (T_0 - T_t)}{\Delta t \times 860} = \frac{\gamma \times V \times 60 \times C \times \Delta T}{\Delta t \times 860}$$

$$= \frac{1 \times 250 \times 60 \times 1.0 \times 10^3 \times 12}{15 \times 860}$$

$$\approx 13953 \text{ [W]} = 14.0 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,
 $14.0 \text{ [kW]} \times 1.2 = 16.8 \text{ [kW]}$

* This is the calculated value by changing the fluid temperature only. Thus, it varies substantially depending on the water bath or piping shape.

Precautions on Cooling Capacity Calculation

1. Heating capacity

When the circulating fluid temperature is set above room temperature, it needs to be heated by the thermo-chiller. The heating capacity depends on the circulating fluid temperature. Consider the radiation rate and heat capacity of the user's equipment and check beforehand if the required heating capacity is provided.

2. Pump capacity

<Circulating fluid flow rate>

Circulating fluid flow rate varies depending on the circulating fluid discharge pressure. Consider the installation height difference between the thermo-chiller and the user's equipment, and the piping resistance such as circulating fluid pipings, or piping size, or piping curves in the machine. Check beforehand if the required flow is achieved, using the pump capacity curves.

<Circulating fluid discharge pressure>

Circulating fluid discharge pressure has the possibility to increase up to the maximum pressure in the pump capacity curves.

Check beforehand if the circulating fluid pipings or circulating fluid circuit of the user's equipment are fully durable against this pressure.

Circulating Fluid Typical Physical Property Values

1. This catalog uses the following values for density and specific heat in calculating the required cooling capacity.

Density ρ : 1 [kg/L] (or, using conventional units, weight volume ratio $\gamma = 1$ [kgf/L])

Specific heat **C**: 4.19×10^3 [J/(kg·K)] (or, using conventional units, 1×10^3 [cal/(kgf·°C)])

2. Values for density and specific heat change slightly according to temperature shown below. Use this as a reference.

Water

Physical property value Temperature	Density ρ [kg/L]	Specific heat C [J/(kg·K)]	Conventional units	
			Weight volume ratio γ [kgf/L]	Specific heat C [cal/(kgf·°C)]
5°C	1.00	4.2×10^3	1.00	1×10^3
10°C	1.00	4.19×10^3	1.00	1×10^3
15°C	1.00	4.19×10^3	1.00	1×10^3
20°C	1.00	4.18×10^3	1.00	1×10^3
25°C	1.00	4.18×10^3	1.00	1×10^3
30°C	1.00	4.18×10^3	1.00	1×10^3
35°C	0.99	4.18×10^3	0.99	1×10^3
40°C	0.99	4.18×10^3	0.99	1×10^3



HRLF Series Specific Product Precautions 1

Be sure to read this before handling the products. Refer to the back cover for safety instructions. For temperature control equipment precautions, refer to the “Handling Precautions for SMC Products” and the “Operation Manual” on the SMC website: <https://www.smcworld.com>

Design

Warning

1. This catalog shows the specifications of a single unit.

- 1) Check the specifications of the single unit (contents of this catalog) and thoroughly consider the adaptability between the user's system and this unit.
- 2) Although a protection circuit as a single unit is installed, prepare a drain pan, water leakage sensor, discharge air facility, and emergency stop equipment, depending on the user's operating conditions. Also, the user is requested to carry out a safety design for the whole system.

2. When attempting to cool areas that are open to the atmosphere (tanks, pipes), plan your piping system accordingly.

When cooling open-air external tanks, arrange the piping so that there are coil pipes for cooling inside the tanks and to carry back the entire flow volume of circulating fluid that is released.

3. Use non-corrosive material for circulating fluid contact parts.

Using corrosive materials such as aluminum or iron for fluid contact parts such as piping may cause clogging or leakage in the circulating fluid circuit. Provide protection against corrosion when you use the product.

4. This product uses a slightly flammable refrigerant (R454C). Avoid using this product in proximity to open flames.

Ensure compliance with local laws and regulations regarding the use and application of this product.

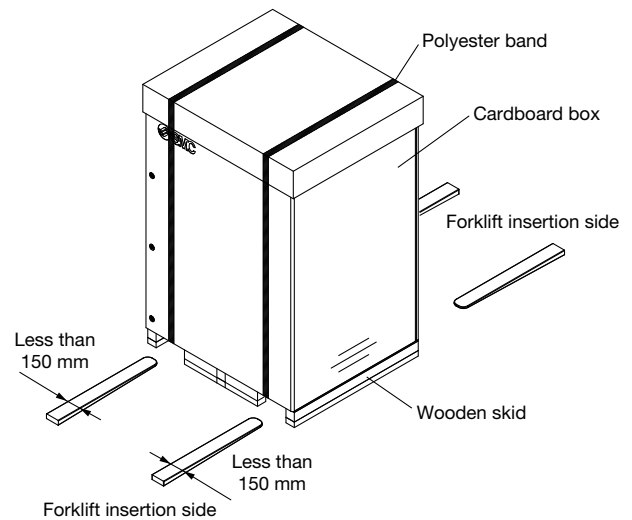


Transportation / Carriage / Movement

Warning

1. This product will require an acceptance with the product not unloaded from the truck, and the user will need to unload the product by himself. Prepare a forklift.

The product will be delivered in the packaging shown below.



<Weights and Dimensions When Packaged>

Model	Weight [kg]	Dimensions [mm]
HRLF200-A□-40	344	Height 2020 x Width 1200 x Depth 893
HRLF200-W□-40	334	

2. Transporting with forklift

- 1) A licensed driver should drive the forklift.
- 2) The proper place to insert the tines of the forklift differs depending on the model of cooler. Check the insert position, and be sure to drive the fork in far enough for it to come out the other side.
- 3) Be careful not to bump the fork to the cover panel or piping ports.



HRLF Series

Specific Product Precautions 2

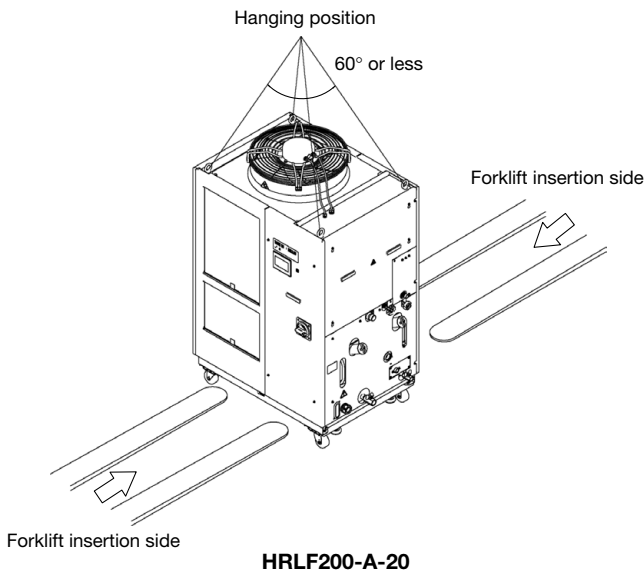
Be sure to read this before handling the products. Refer to the back cover for safety instructions. For temperature control equipment precautions, refer to the “Handling Precautions for SMC Products” and the “Operation Manual” on the SMC website: <https://www.smcworld.com>

Transportation / Carriage / Movement

Warning

3. Hanging transportation

- 1) Crane manipulation and slinging work should be done by an eligible person.
- 2) Do not grip the piping on the right side or the handles of the panel.
- 3) When hanging by the eye bolts, be sure to use a 4-point hanging method. For the hanging angle, use caution regarding the position of the center of gravity and hold it within 60°.



4. Transporting with casters

- 1) This product is heavy and should be moved by at least two people.
- 2) Do not grip the piping port on the right side or the handles of the panel.
- 3) When transporting using a forklift, be sure not to let it hit the casters or adjusters, and drive the fork all the way through until it comes out the other side.
- 4) Do not get across steps with casters.

5. This product cannot be transported by air as this product uses a slightly flammable refrigerant (R454C).

Caution

If this product is to be transported after delivery, please use the original packaging the product was delivered in. If other packaging is to be used, carefully package the product so as to prevent the product from incurring any damage during transport.

Refrigerant with GWP reference

Refrigerant	Global Warming Potential (GWP)		
	Regulation (EU) 2024/573, AIM Act 40 CFR Part 84	Fluorocarbon Emissions Control Act (Japan) GWP value labeled on products	GWP value to be used for reporting the calculated amount of leakage
R134a	1,430	1,430	1,300
R404A	3,922	3,920	3,940
R407C	1,774	1,770	1,620
R410A	2,088	2,090	1,920
R448A	1,386	1,390	1,270
R454C	146	145	146

- *1 This product is hermetically sealed and contains fluorinated greenhouse gases.
- *2 For refrigerant type used in this product, refer to the product specifications.

Temperature Control Equipment

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of “**Caution**,” “**Warning**” or “**Danger**.” They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC), and other safety regulations.

Safety Instructions

- Danger** : **Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
- Warning** : **Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
- Caution** : **Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

Compliance Requirements

1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.
2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulations of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

Limited warranty and Disclaimer/ Compliance Requirements

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”.

Read and accept them before using the product.

Limited warranty and Disclaimer

- 1. Period**
The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.
- 2. Scope**
For any failure reported within the warranty period which is clearly our responsibility, replacement parts will be provided. In that case, removed parts shall become the property of SMC.
This guarantee applies only to our product independently, and not to any other damage incurred due to the failure of the product.
- 3. Content**
The following situations are out of scope of this warranty.
 1. The product was incorrectly installed or connected with other equipment.
 2. The product was modified or altered in construction.
 3. The failure was a secondary failure of the product caused by the failure of equipment connected to the product.
 4. The failure was caused by a natural disaster such as an earthquake, typhoon, or flood, or by an accident or fire.
 5. The failure was caused by operation different from that shown in the Operation Manual or outside of the specifications.
 6. The checks and maintenance specified (daily checks and regular checks) were not performed.
 7. The failure was caused by the use of circulating fluid or facility water other than those specified.
 8. The failure occurred naturally over time (such as discoloration of a painted or plated face).
 9. The failure does not affect the functioning of the product (such as new sounds, noises and vibrations).
 10. The failure was due to the “Installation Environment” specified in the Operation Manual.
- 4. Disclaimer**
 1. Expenses for daily and regular checks
 2. Expenses for repairs performed by other companies
 3. Expenses for transfer, installation and removal of the product
 4. Expenses for replacement of parts other than those in this product, or for the supply of liquids
 5. Inconvenience and loss due to product failure (such as telephone bills, compensation for workplace closure, and commercial losses)

For warranted repair, please contact the supplier you purchased this product from.

Warning

1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

3. SMC products cannot be used beyond their specifications. They are not developed, designed, and manufactured to be used under the following conditions or environments. Use under such conditions or environments is not allowed.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Use for nuclear power, railways, aviation, space equipment, ships, vehicles, military application, equipment affecting human life, body, and property, combustion equipment, entertainment equipment, emergency shut-off circuits, press clutches, brake circuits, safety equipment, etc., and use for applications that do not conform to standard specifications such as catalogs and operation manuals.
3. Use for interlock circuits, except for use with double interlock such as installing a mechanical protection function in case of failure. Please periodically inspect the product to confirm that the product is operating properly.


Caution

SMC develops, designs, and manufactures products to be used for automatic control equipment, and provides them for peaceful use in manufacturing industries.

Use in non-manufacturing industries is not allowed.

Products SMC manufactures and sells cannot be used for the purpose of transactions or certification specified in the Measurement Act of each country.

The new Measurement Act prohibits use of any unit other than SI units in Japan.

 **Safety Instructions** Be sure to read the “Handling Precautions for SMC Products” (M-E03-3) and “Operation Manual” before use.