Circulating Fluid Temperature Controller

Thermo-chiller Standard Type

(Only 400/460 VAC type) (Only 460 VAC type)

RoHS

Lightweight and Compact

Cooling capacity **9 kW**

Temperature stability

±0.5 °C, ±0.1 °C (460 VAC type) (When a load is stable)

Set temperature range **5 °C to 35 °C**

Max. ambient temperature **45 °C**

Indoor use

Weight 136 kg

Water-cooled refrigeration | Air-cooled refrigeration

Compatible power supplies in Europe, Asia, Oceania, North, Central and South America

- 3-phase 200 V
- 3-phase 400 V
- 3-phase 460 V

With heating function

Heating method using discharged heat makes a heater unnecessary.

Convenient functions Page 3

Timer operation function/Unit conversion function/Power failure auto-restart function/Anti-freezing operation function

Easy maintenance Page 2

Tool-less maintenance of filter

Self diagnosis function and check display Page 4

41 types of alarm codes

Communication function Page 4

Equipped with serial communication (RS232C/RS485) and contact I/Os (2 inputs and 3 outputs) as standard.

Environmental friendly

R410A as refrigerant

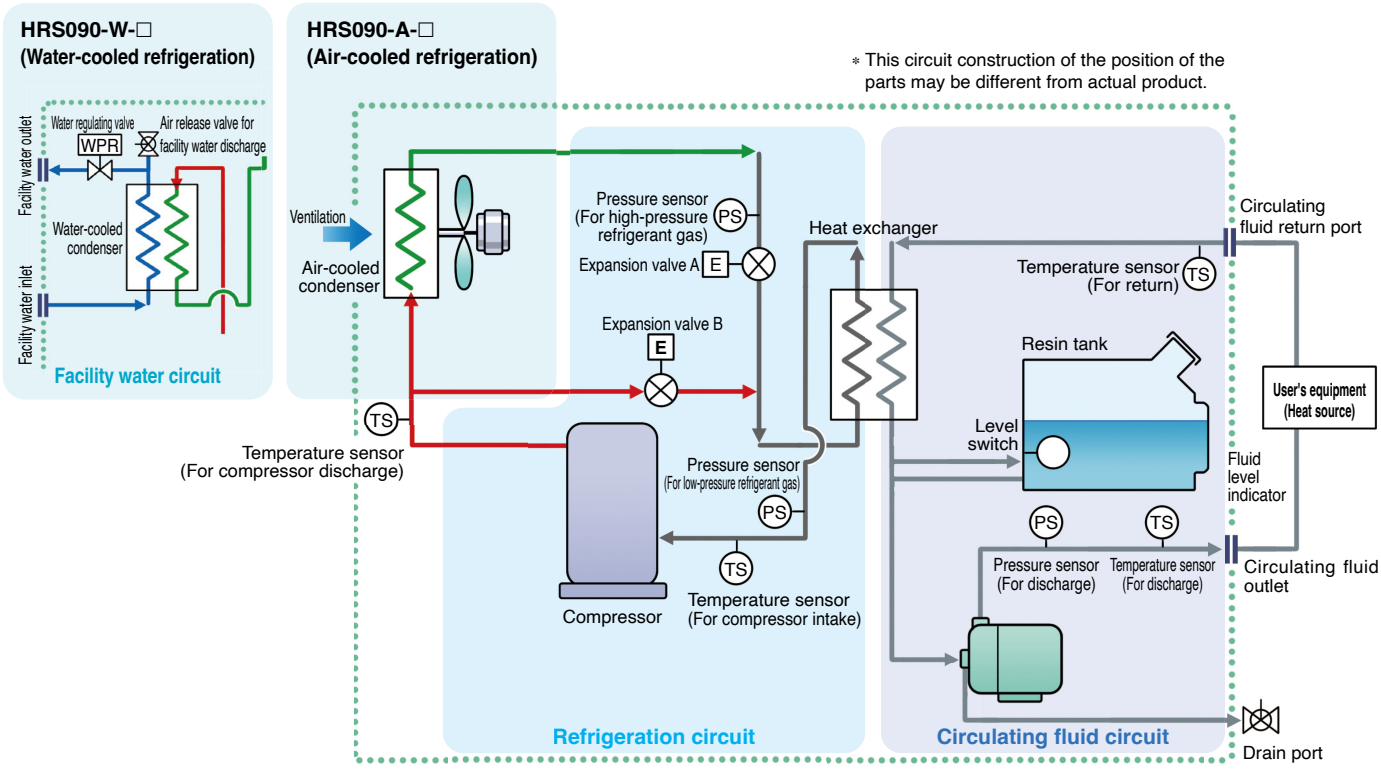
HRS090 Series

SMC

CAT.EUS40-64A-UK

Compact and lightweight

The precision temperature control method by expansion valve and temperature sensor, realized high temperature stability of ±0.5 °C and a small-size tank.



Refrigeration circuit

- The compressor compresses the refrigerant gas, and discharges the high temperature and high pressure refrigerant gas.
- In the case of air-cooled refrigeration, the high temperature and high pressure refrigerant gas is cooled down by an air-cooled condenser with the ventilation of the fan, and becomes a liquid. In the case of water-cooled refrigeration, the refrigerant gas is cooled by a water-cooled condenser with the facility water in the facility water circuit, and becomes a liquid.
- The liquefied high pressure refrigerant gas expands and its temperature lowers when it passes through expansion valve A and vaporizes by taking heat from the circulating fluid in the heat exchanger.
- The vaporized refrigerant gas is sucked into the compressor and compressed again.
- When heating the circulating fluid, the high pressure and high temperature refrigerant gas is bypassed into the evaporator by expansion valve B, to heat the circulating fluid.

Point The combination of precise control of **expansion valve A** for cooling, and **expansion valve B** for heating realized high temperature stability.

Circulating fluid circuit

- The circulating fluid discharged from the pump, is heated or cooled by the user's equipment and returns to the thermo-chiller.
- The circulating fluid is controlled to a set temperature by the refrigeration circuit, to be discharged to the user's equipment side again by the thermo-chiller.

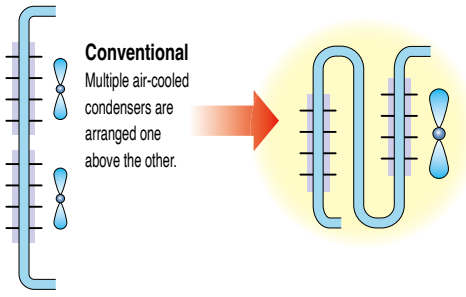
Point Since the refrigeration circuit is controlled by the signal from **2 temperature sensors (for return and discharge)**, precise temperature control of the circulating fluid can be performed. Therefore, there is no necessity of absorbing the temperature difference in the circulating fluid with a large tank capacity, and realizes high temperature stability even with a **small-size tank**. Also, contributes to space-saving.

Facility water circuit

For water-cooled refrigeration HRS□-W-□

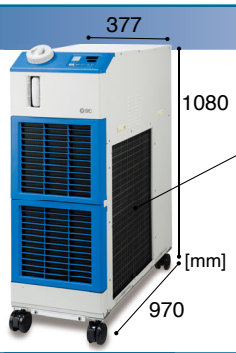
- The water regulating valve opens and closes to keep the refrigerant gas pressure consistent. The facility water flow rate is controlled by the water regulating valve.

Reduced-height double condenser structure



Conventional
Multiple air-cooled condensers are arranged one above the other.

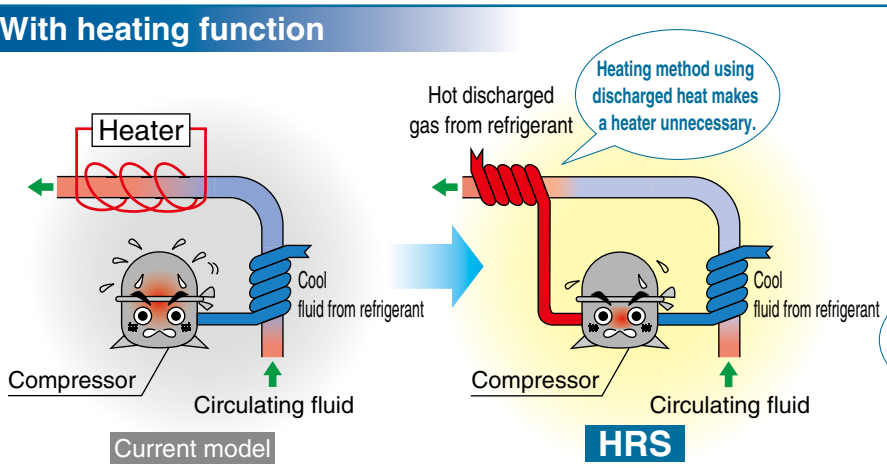
Achieved a maximum reduction in the height of the product while expanding the cooling capacity, by providing overlapped air-cooled condensers.

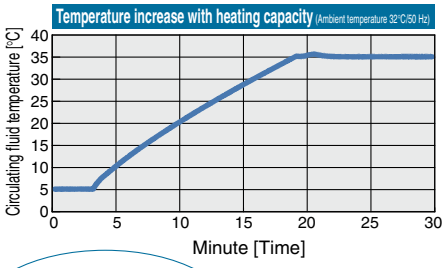


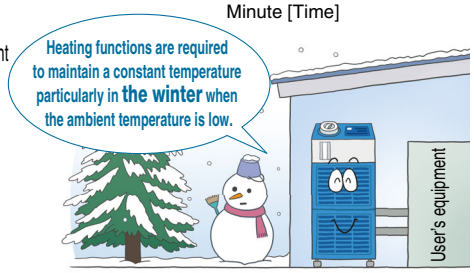
Aluminium air-cooled condenser
High heat transfer efficiency, Lightweight

Compact tank 18 L
Temperature followability control reduced the tank capacity required as a buffer.

With heating function



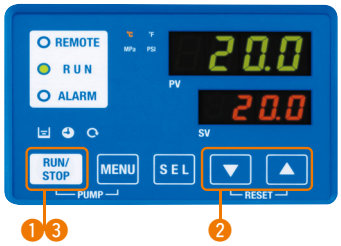




∗ This is just an example diagram.

Simple operation

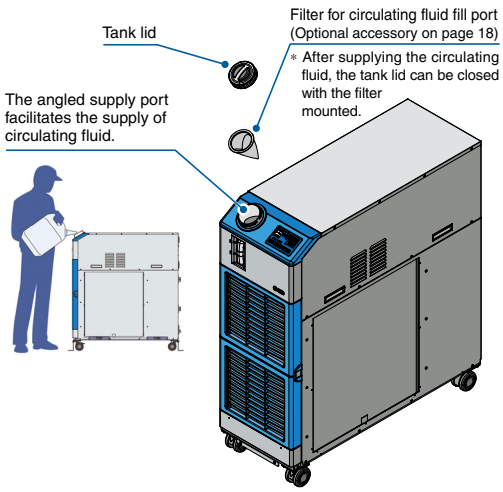
Step 1 Press the RUN/STOP key.
Step 2 Adjust the temperature setting with the ▼ / ▲ keys.
Step 3 Press the RUN/STOP key to stop.
Easy operation by these steps



Large digital display

The "large digital display" (7-segment and 4 digits) and "2 row display" provide a clearer view of the current value (PV) and set value (SV).

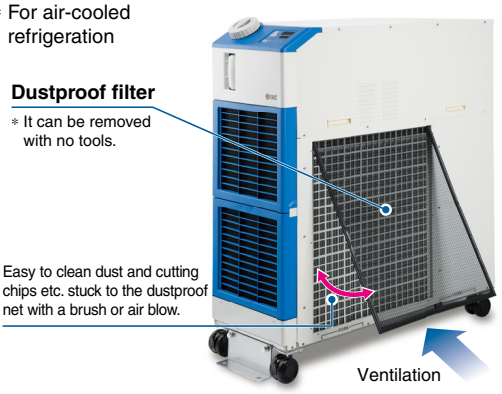
Shaped for easy supply of circulating fluid



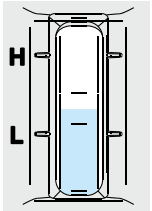
Easy cleaning of the tank

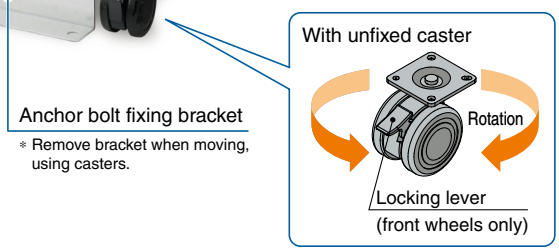
Tool-less inspection and cleaning of air-cooled condenser

∗ For air-cooled refrigeration



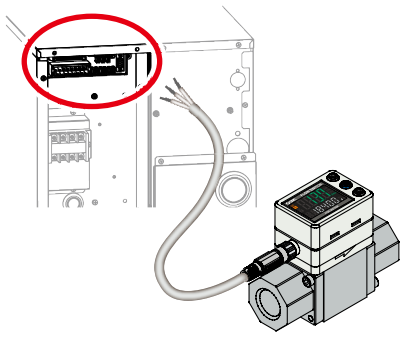
Easy check of the circulating fluid level





Power supply (24 VDC) available

Power can be supplied from the terminal block on the rear side to external switches, etc.

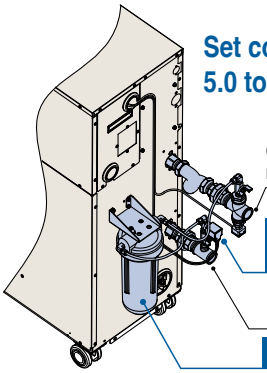


Flow switch
Refer to the Web Catalog for details.

Electric conductivity control set

(With DI filter + Solenoid valve kit for control)

The electric conductivity of the circulating fluid can be set with the controller monitor arbitrarily.



Set control range: 5.0 to 45.0 μS/cm

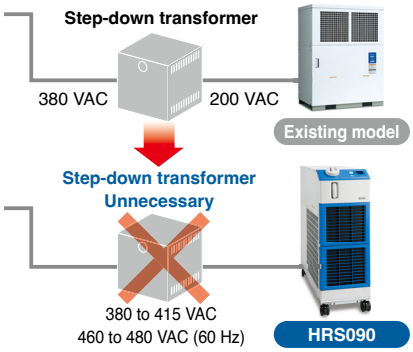
Circulating fluid return port
Solenoid valve for control
Circulating fluid outlet
DI filter

Globally compatible power supplies

(Europe, Asia, Oceania, North, Central and South America)
Transformer unnecessary (Only 400/460 VAC type)

Power supply Applicable to **200 to 230 VAC, 380 to 415 VAC, or 460 to 480 VAC**

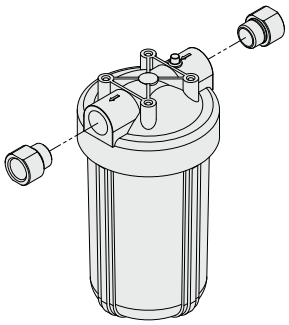
Transformers are unnecessary even when used overseas.



Particle filter set

Removes foreign matter in the circulating fluid

Effective in preventing foreign matter from entering the user's equipment and chiller



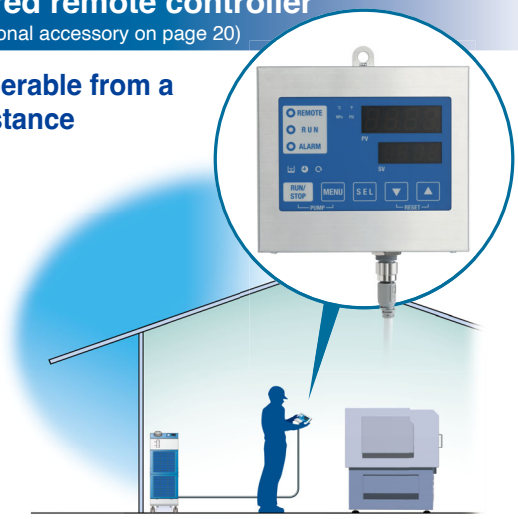
Protects the pump and condenser from foreign matter!!

- Prevents pump malfunction
- Prevents the water-cooled condenser performance from falling.

Wired remote controller

(Optional accessory on page 20)

Operable from a distance



Convenient functions (Refer to the Operation Manual for details.)

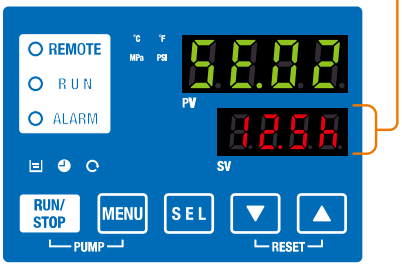
Timer operation function

Timer for ON and OFF can be set in units of 0.5 h up to 99.5 h.

Ex.) Can set to stop on Saturday and Sunday and restart on Monday morning.

Ex. SE.02 "ON timer"

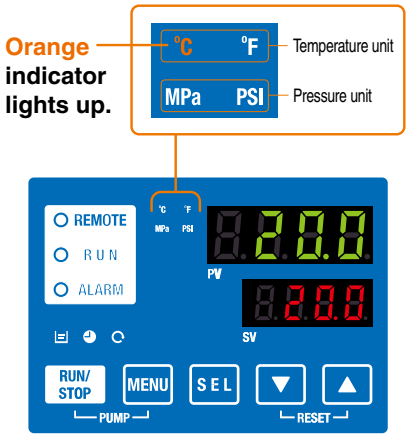
Timer The time remaining can be checked.



Unit conversion function

Temperature and pressure units can be changed.

Orange indicator lights up.



Power failure auto-restart function

Automatic restart from stoppage due to power failure etc. is possible without pressing the RUN/ STOP key and remote operation.

Anti-freezing operation function

If the temperature approaches freezing point, e.g. in winter at night, the pump operates automatically and the heat generated by the pump warms the circulating fluid, preventing freezing.

Key-lock function

Can be set in advance to protect the set values from being changed by pressing keys by mistake.

Function to output a signal for completion of preparation

Notifies by communication when the temperature reaches the pre-set temperature range.

Independent operation of the pump

The pump can be operated independently while chiller is powered off. You can check piping leak and remove the air.

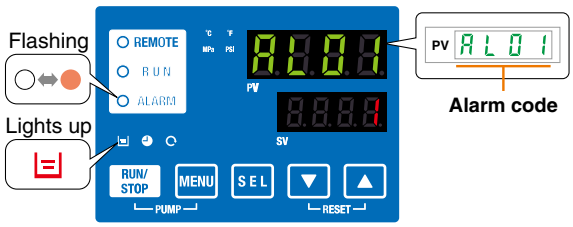
Self diagnosis function and check display

Display of individual alarm codes For details, refer to page 13.
Operation is monitored all the time by the integrated sensor.
Should any error occur, the self diagnosis result is displayed by the applicable alarm code.
This makes it easier to identify the cause of the alarm.
Can be used before requesting service.

Changeable alarm set values

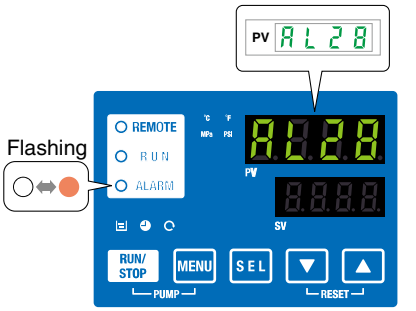
Setting item	Set value
Circulating fluid discharge temperature rise	5 to 55 °C
Circulating fluid discharge temperature drop	1 to 34 °C
Circulating fluid discharge pressure rise	0.05 to 0.6 MPa
Circulating fluid discharge pressure drop	0.05 to 0.6 MPa

Ex. AL01 “Low level in tank”



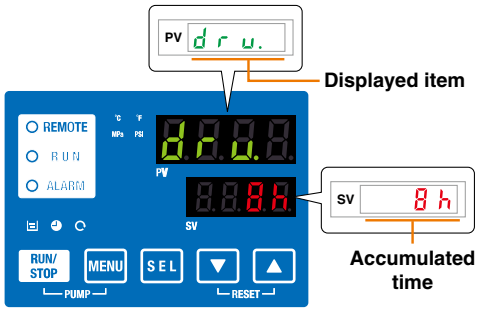
Alarm codes notify of checking times.
Notifies when to check the pump and fan motor.
Helpful for facility maintenance.
∗ The fan motor is not used in water-cooled refrigeration.

Ex. AL28 “Pump maintenance”



Check display
The internal temperature, pressure and operating time of the product are displayed.

Ex. drv. “Accumulated operating time”



Displayed item
Circulating fluid outlet temperature
Circulating fluid return temperature
Circulating fluid flow rate *1
Compressor gas temperature
Circulating fluid outlet pressure
Compressor gas discharge pressure
Compressor gas return pressure
Accumulated operating time
Accumulated operating time of pump
Accumulated operating time of fan *2
Accumulated operating time of compressor
Accumulated operation time of dustproof filter *2

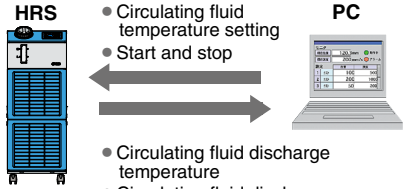
∗1 This is not measurement value. Use it for reference.
∗2 These are displayed only for air-cooled refrigeration.

Communication function

The serial communication (RS232C/RS485) and contact I/Os (2 inputs and 3 outputs) are equipped as standard.
Communication with the user’s equipment and system construction are possible, depending on the application.
A 24 V DC output can be also provided, and is available for a flow switch (SMC’s PF2W etc.).

Ex. 1 Remote signal I/O through serial communication

The remote operation is enabled (to start and stop) through serial communication.

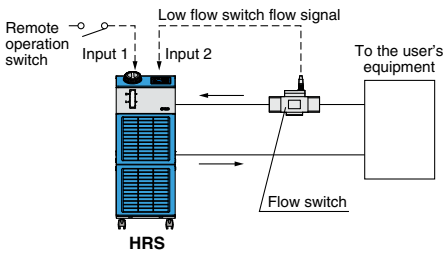


- Circulating fluid temperature setting
- Start and stop

- Circulating fluid discharge temperature
- Circulating fluid discharge pressure
- Run and stop status
- Alarm information
- Various setting information
- Preparation completion status

Ex. 2 Remote operation signal input

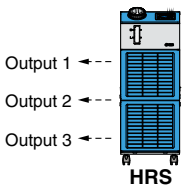
One of the contact inputs is used for remote operation and the other is used for a flow switch to monitor the flow, and their warning outputs are taken in.



Power for flow switch (24 V DC) can be supplied from thermo-chiller.

Ex. 3 Alarm and operation status (start, stop, etc.) signal output

The alarm and status generated in the product are assigned to 3 output signals based on their contents, and can be output.

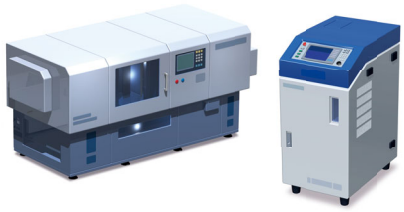


· Output setting example
Output 1: Temperature rise
Output 2: Pressure rise
Output 3: Operation status (start, stop, etc.)

Applications

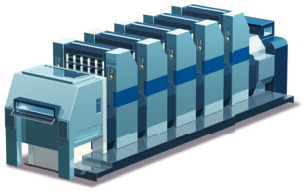
Laser beam machine/ Laser welding machine

Cooling of the laser oscillation part and power source



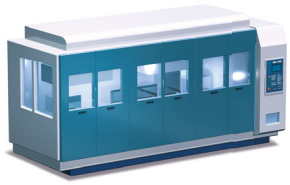
Printing machine

Temperature control of the roller



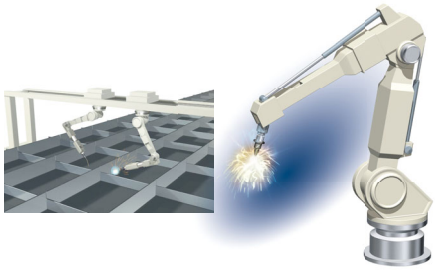
Cleaning machine

Temperature control of cleaning solution



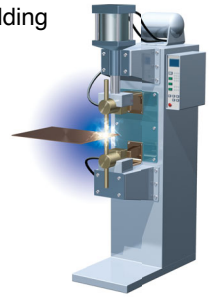
Arc welding machine

Cooling of the torch



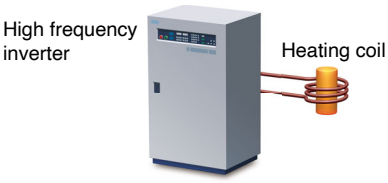
Resistance welding machine (spot welding)

Cooling of the welding head electrodes, transformers and transistors (thyristors)



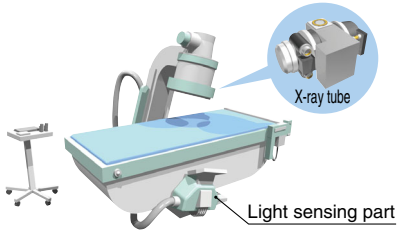
High frequency induction heating equipment

Cooling of the heating coils, high frequency power source and around inverters



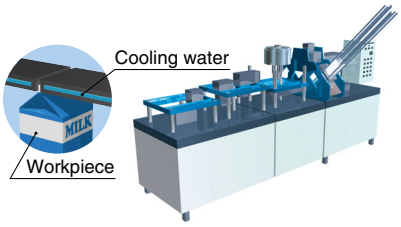
X-ray (digital) instrument

Temperature control of X-ray tube and X-ray light sensing part

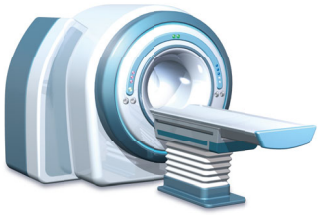


Packaging line (sealing of film and paper package)

Cooling of workpieces for bonding



MRI



Injection molding

Atomizing device (food and cosmetics)

Temperature control of sample and device

Crushing machine

Cooling of the jacket

Global Supply Network

SMC has a comprehensive network in the global market.

We now have a presence of more than 400 branch offices and distributors in 78 countries world wide such as Asia, Oceania, North/Central/South America, and Europe. With this global network, we are able to provide a global supply of our substantial range of products with the best service. We also provide full support to local factories, foreign manufacturing companies and Japanese companies in each country.

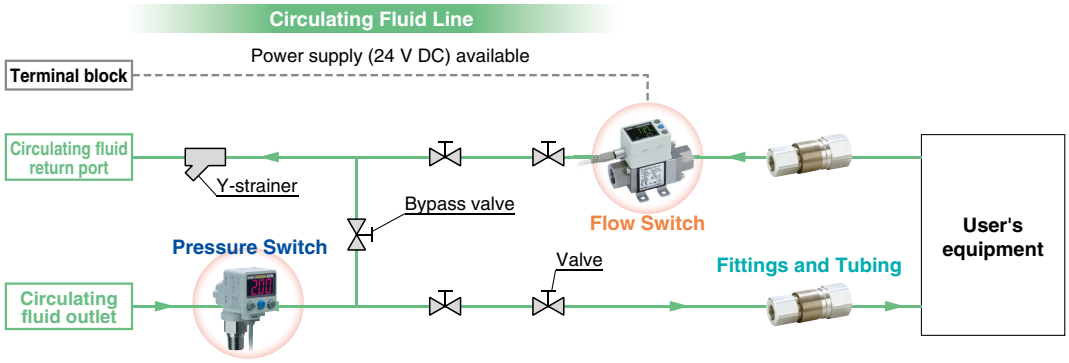
SMC Thermo-chiller Variations

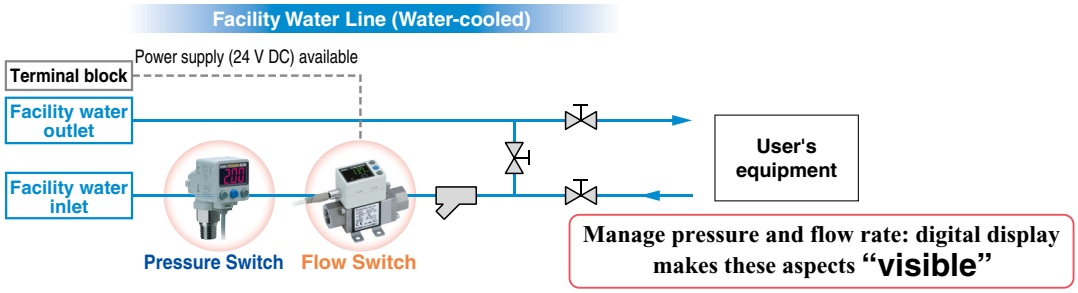
Lots of variations are available in response to the users' requirements.

Series		Temperature stability [°C]	Set temperature range [°C]	Cooling capacity [kW]												Environment	Power supply
				1.2	1.8	2.4	3	5	6	9	10	15	20	25	28		
	**HRSE Basic type**	±2.0	10 to 30	●	●	●										Indoor use	Single phase 230 VAC (50/60 Hz)
	**HRS Standard type**	±0.1	5 to 40	●	●	●	●	●	●							Indoor use	Single phase 100 to 115 VAC (50/60 Hz)* Single phase 200 to 230 VAC (50/60 Hz)
	**HRS090 Standard type**	±0.5	5 to 35							●						Indoor use	3-phase 380 to 415 VAC (50/60 Hz)
	**HRS100/150 Standard type**	±1.0	5 to 35								●	●				Outdoor installation IPX4	3-phase 380 to 415 VAC (50/60 Hz)
	**HRSH090 Inverter type**	±0.1	5 to 40							●						Indoor use	3-phase 380 to 415 VAC (50/60 Hz)
	**HRSH Inverter type**	±0.1	5 to 35								●	●	●	●	●	Outdoor installation IPX4	3-phase 200 VAC (50/60 Hz) 3-phase 200 to 230 VAC (50/60 Hz) 3-phase 380 to 415 VAC (50/60 Hz)

* Only available for lower cooling capacities.

Circulating Fluid/Facility Water Line Equipment





Manage pressure and flow rate: digital display makes these aspects "visible"

Flow Switch: Monitors flow rate and temperature of the circulating fluid.

Refer to the catalogues on **www.smc.eu**.

3-Colour Display Digital Flow Switch for Water ***PF3W***

Integrated flow adjustment valve and temperature sensor

PVC Piping

3-Colour Display Electromagnetic Type Digital Flow Switch ***LFE***

Digital Flow Switch for Deionised Water and Chemical Liquids ***PF2D***
4-Channel Flow Monitor ***PF2□200***

Pressure Switch: Monitors pressure of the circulating fluid.

Refer to the catalogues on **www.smc.eu**.

2-Colour Display High-Precision Digital Pressure Switch ***ISE80***

Pressure Sensor for General Fluids ***PSE56□***
Pressure Sensor Controller ***PSE200,300***

Fittings and Tubing

Refer to the catalogues on **www.smc.eu**.

S Coupler ***KK***

S Coupler/Stainless Steel (Stainless Steel 304) ***KKA***

Metal One-touch Fittings ***KQB2***

Stainless Steel 316 One-touch Fittings ***KQG2***

Stainless Steel 316 Insert Fittings ***KFG2***

Fluoropolymer Fittings ***LQ***

Tubing ***T□***

Series	Material
T	Nylon
TU	Polyurethane
TH	FEP (Fluoropolymer)
TD	Modified PTFE (Soft fluoropolymer)
TL	Super PFA
TLM	PFA

CONTENTS

HRS090 Series Standard Type

Thermo-chiller *HRS090 Series*

Thermo-chiller Standard Type
Air-cooled 200 V/400 V/460 V Type
HRS090 Series

(Only 400/460 VAC type) (Only 460 VAC type) RoHS

How to Order

HRS 090 – A □ – 20 – □

Cooling capacity

090	9 kW

Cooling method

A	Air-cooled refrigeration

Pipe thread type

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

Option

—	None
B∗1	With earth leakage breaker
J	With automatic fluid fill function
M	Applicable to deionized water piping
W	SI unit only

- When multiple options are combined, indicate symbols in alphabetical order.

∗1 200 V type only.
400/460 V type is provided with an earth leakage breaker as standard.

Power supply

20	3-phase 200 VAC (50 Hz) 3-phase 200 to 230 VAC (60 Hz)
40	3-phase 380 to 415 VAC (50/60 Hz)
46	3-phase 380 to 415 VAC (50/60 Hz) 3-phase 460 to 480 VAC (60 Hz)

Specifications

Model				HRS090-A□-20-□	HRS090-A□-40-□	HRS090-A□-46-□
Cooling method				Air-cooled refrigeration		
Refrigerant				R410A (HFC)		
Refrigerant charge			kg	1.15		
Control method				PID control		
Ambient temperature/Humidity/Altitude∗1, 2, 11			°C	Temperature: 5 to 45 °C, Humidity: 30 to 70 %, Altitude: less than 3000 m		
Circulating fluid system	**Circulating fluid**∗3			Tap water, 15 % ethylene glycol aqueous solution, Deionized water		
	Set temperature range∗2		°C	5 to 35		
	Cooling capacity 50/60 Hz∗4		kW	8.0/9.0		
	Heating capacity∗5		kW	1.7/2.2		
	Temperature stability∗6		°C	±0.5		±0.1
	Pump capacity	**Rated flow 50/60 Hz (Outlet)**∗7	l/min	29/45		
		Maximum flow rate 50/60 Hz	l/min	55/68		
		Maximum pump head	m	50		
	Minimum operating flow rate 50/60 Hz∗8		l/min	29/45		
	Tank capacity		L	18		
	Circulating fluid outlet, circulating fluid return port			Rc1 (Symbol F: G1, Symbol N: NPT1)		
	Tank drain port			Rc1/4 (Symbol F: G1/4, Symbol N: NPT1/4)		
	Fluid contact material			Stainless steel, Copper (Heat exchanger brazing), Brass, Bronze, PTFE, FKM, EPDM, PVC, NBR, POM, PE, PP, Carbon, Ceramic		
Electrical system	**Power supply**			3-phase 200 VAC (50 Hz), 3-phase 200 to 230 VAC (60 Hz) Allowable voltage range ±10 % (No continuous voltage fluctuation)	3-phase 380 to 415 VAC (50/60 Hz) Allowable voltage range ±10 % (No continuous voltage fluctuation)	3-phase 380 to 415 VAC (50/60 Hz) Allowable voltage range ±10 % (No continuous voltage fluctuation) 3-phase 460 to 480 VAC (60 Hz) Allowable voltage range +4%, −10 % (Max. voltage less than 500 V and no continuous voltage fluctuation)
	Applicable earth leakage breaker∗9	**Rated current**	A	30	20	
		Sensitivity of leak current	mA	30		
	Rated operating current 50/60 Hz∗6		A	16/18	8.4/9.1	
	Rated power consumption 50/60 Hz∗6		kW (kVA)	4.3/5.4 (5.5/6.0)	4.4/5.6 (5.8/6.3)	
Noise level (Front 1 m/Height 1 m)∗6			dB (A)	73	75	
Accessories				Alarm code list stickers 2 pcs. (English 1 pc./Japanese 1 pc.), Operation Manual (for installation/operation) 2 pcs. (English 1 pc./Japanese 1 pc.), Y-strainer (40 meshes) 25A, Barrel nipple 25A, Anchor bolt fixing brackets 2 pcs. (including four M10 bolts)∗10		
Weight (dry state)			kg	Approx. 136		

∗1 No condensation should be present.
∗2 Use a 15 % ethylene glycol aqueous solution if operating in a place where the ambient temperature and/or circulating fluid temperature is 10 °C or less.
∗3 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)
15 % ethylene glycol aqueous solution: diluted by tap water in condition above without any additives such as antiseptics.
Deionized water: Electric conductivity 1 μS/cm or higher (Electric resistivity 1 MΩ·cm or lower)
∗4 ① Ambient temperature: 32 °C, ② Circulating fluid: Tap water, ③ Circulating fluid temperature: 20 °C, ④ Circulating fluid flow rate: Rated flow, ⑤ Power supply: 200/400 VAC
∗5 ① Ambient temperature: 32 °C, ② Circulating fluid: Tap water, ③ Circulating fluid flow rate: Rated flow, ④ Power supply: 200/400 VAC
∗6 ① Ambient temperature: 32 °C, ② Circulating fluid: Tap water, ③ Circulating fluid temperature: 20 °C, ④ Load: Same as the cooling capacity, ⑤ Circulating fluid flow rate: Rated flow, ⑥ Power supply: 200/400 VAC, ⑦ Piping length: Shortest
∗7 When circulating fluid outlet port pressure = 0.5 MPa.
∗8 Fluid flow rate to maintain the cooling capacity and to keep the circulating fluid discharge pressure to 0.5 MPa or less. If the actual flow rate is lower than this, install a bypass piping.
∗9 To be prepared by the user. Option "B" (With earth leakage breaker) as well as the 400 V and the 460 V specifications have the specified earth leakage breaker built into the product.
∗10 The anchor bolt fixing brackets (including four M10 bolts) are used for fixing to wooden skids when packaging the thermo-chiller. No anchor bolt is included.
∗11 If the product is used at an altitude of 1000 m or higher, refer to "Operating Environment/Storage Environment" Item 14 "For altitudes of 1000 m or higher."

Thermo-chiller Standard Type
Water-cooled 200 V/400 V/460 V Type
HRS090 Series

(Only 400/460 VAC type) (Only 460 VAC type) RoHS

How to Order

HRS 090 − W □ − 20 − □

Cooling capacity

090	9 kW

Cooling method

W	Water-cooled refrigeration

Pipe thread type

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

Power supply

20	3-phase 200 VAC (50 Hz) 3-phase 200 to 230 VAC (60 Hz)
40	3-phase 380 to 415 VAC (50/60 Hz)
46	3-phase 380 to 415 VAC (50/60 Hz) 3-phase 460 to 480 VAC (60 Hz)

Option

—	None
B∗1	With earth leakage breaker
J	With automatic fluid fill function
M	Applicable to deionized water piping
W	SI unit only

- When multiple options are combined, indicate symbols in alphabetical order.

∗1 200 V type only.
400/460 V type is provided with an earth leakage breaker as standard.

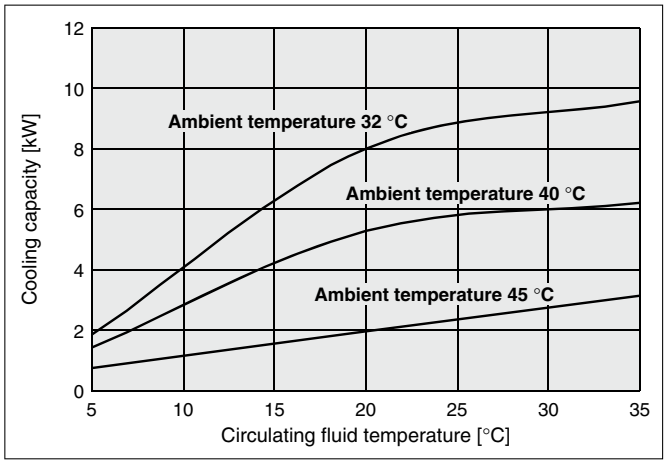
Specifications

Model				HRS090-W□-20-□	HRS090-W□-40-□	HRS090-W□-46-□
Cooling method				Water-cooled refrigeration		
Refrigerant				R410A (HFC)		
Refrigerant charge			kg	1.15		
Control method				PID control		
Ambient temperature/Humidity/Altitude∗1, 2			°C	Temperature: 5 to 45 °C, Humidity: 30 to 70 %, Altitude: less than 3000 m		
Circulating fluid system	**Circulating fluid**∗3			Tap water, 15 % ethylene glycol aqueous solution, Deionized water		
	Set temperature range∗2		°C	5 to 35		
	Cooling capacity 50/60 Hz∗4		kW	9.0/10.5		
	Heating capacity 50/60 Hz∗5		kW	1.7/2.2		
	Temperature stability∗6		°C	±0.5		±0.1
	Pump capacity	**Rated flow 50/60 Hz (Outlet)**∗7	l/min	29/45		
		Maximum flow rate 50/60 Hz	l/min	55/68		
		Maximum pump head	m	50		
	Minimum operating flow rate 50/60 Hz∗8		l/min	29/45		
	Tank capacity		L	18		
	Circulating fluid outlet, circulating fluid return port			Rc1 (Symbol F: G1, Symbol N: NPT1)		
	Tank drain port			Rc1/4 (Symbol F: G1/4, Symbol N: NPT1/4)		
	Fluid contact material			Stainless steel, Copper (Heat exchanger brazing), Brass, Bronze, PTFE, FKM, EPDM, PVC, NBR, POM, PE, PP, Carbon, Ceramic		
Facility water system	**Temperature range**		°C	5 to 40		
	Pressure range		MPa	0.3 to 0.5		
	Required flow 50/60 Hz∗11		l/min	25/25		
	Facility water pressure differential		MPa	0.3 or more		
	Facility water inlet/outlet			Rc1/2 (Symbol F: G1/2, Symbol N: NPT1/2)		
	Fluid contact material			Stainless steel, Copper (Heat exchanger brazing), Bronze, Brass, PTFE, NBR, EPDM		
Electrical system	**Power supply**			3-phase 200 VAC (50 Hz), 3-phase 200 to 230 VAC (60 Hz) Allowable voltage range ±10 % (No continuous voltage fluctuation)	3-phase 380 to 415 VAC (50/60 Hz) Allowable voltage range ±10 % (No continuous voltage fluctuation)	3-phase 380 to 415 VAC (50/60 Hz) Allowable voltage range ±10 % (No continuous voltage fluctuation) 3-phase 460 to 480 VAC (60 Hz) Allowable voltage range +4%, −10 % (Max. voltage less than 500 V and no continuous voltage fluctuation)
	Applicable earth leakage breaker∗9	**Rated current**	A	30	20	
		Sensitivity of leak current	mA	30		
	Rated operating current 50/60 Hz∗6		A	13/14	6.4/6.7	
	Rated power consumption 50/60 Hz∗6		kW (kVA)	3.3/4.2 (4.4/4.9)	3.4/4.2 (4.4/4.7)	
Noise level (Front 1 m/Height 1 m)∗6			dB (A)	65		
Accessories				Alarm code list stickers 2 pcs. (English 1 pc./Japanese 1 pc.), Operation Manual (for installation/operation) 2 pcs. (English 1 pc./Japanese 1 pc.), Y-strainer (40 meshes) 25A, Barrel nipple 25A, Anchor bolt fixing brackets 2 pcs. (including four M10 bolts)∗10		
Weight (dry state)			kg	Approx. 124		

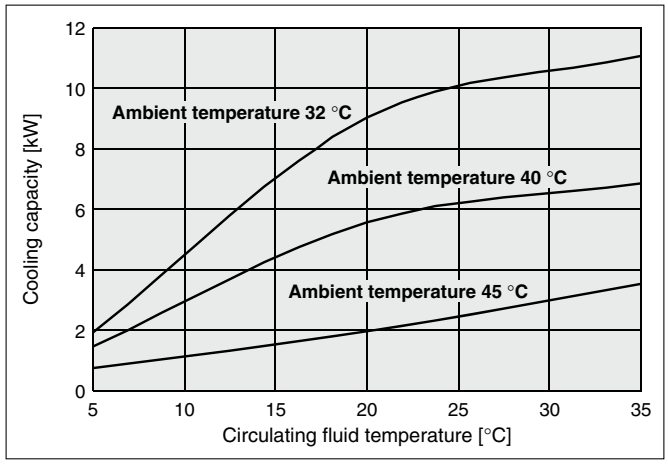
∗1 No condensation should be present.
∗2 Use a 15 % ethylene glycol aqueous solution if operating in a place where the ambient temperature and/or circulating fluid temperature is 10 °C or less. Also, when there is a possibility of the facility water being frozen, make sure to discharge all the facility water from the facility water circuit.
∗3 Use fluid in condition below as the circulating fluid. Also, when there is a possibility of the facility water being frozen, make sure to discharge all the facility water from the facility water circuit.
Tap water: Standard of The Japan Refrigeration And Air Conditioning Industry Association (JRA GL-02-1994)
15 % ethylene glycol aqueous solution: diluted by tap water in condition above without any additives such as antiseptics.
Deionized water: Electric conductivity 1 μS/cm or higher (Electric resistivity 1 MΩ·cm or lower)
∗4 ① Facility water temperature: 32 °C, ② Circulating fluid: Tap water, ③ Circulating fluid temperature: 20 °C, ④ Circulating fluid flow rate: Rated flow, ⑤ Power supply: 200/400 VAC
∗5 ① Facility water temperature: 32 °C, ② Circulating fluid: Tap water, ③ Circulating fluid flow rate: Rated flow, ④ Power supply: 200/400 VAC
∗6 ① Facility water temperature: 32 °C, ② Circulating fluid: Tap water, ③ Circulating fluid temperature: 20 °C, ④ Load: Same as the cooling capacity, ⑤ Circulating fluid flow rate: Rated flow, ⑥ Power supply: 200/400 VAC, ⑦ Piping length: Shortest
∗7 When circulating fluid outlet port pressure = 0.5 MPa.
∗8 Fluid flow rate to maintain the cooling capacity and to keep the circulating fluid discharge pressure to 0.5 MPa or less. If the actual flow rate is lower than this, install a bypass piping.
∗9 To be prepared by the user. Option "B" (With earth leakage breaker) as well as the 400 V and the 460 V specifications have the specified earth leakage breaker built into the product.
∗10 The anchor bolt fixing brackets (including four M10 bolts) are used for fixing to wooden skids when packaging the thermo-chiller. No anchor bolt is included.
∗11 The actual facility water flow rate will vary depending on the operating conditions.

Cooling Capacity

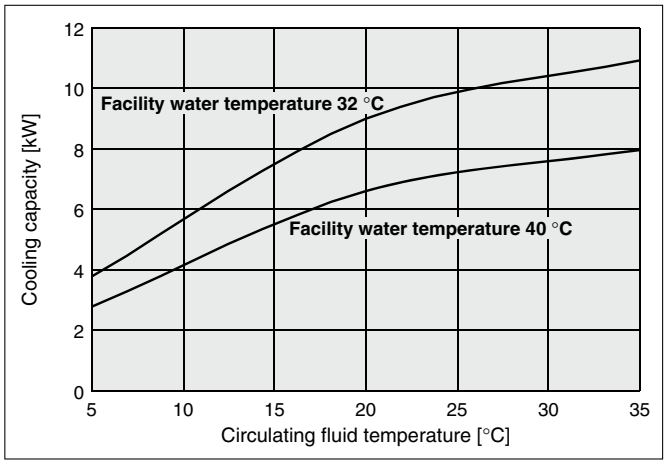
HRS090-A-20/40/46 (50 Hz)



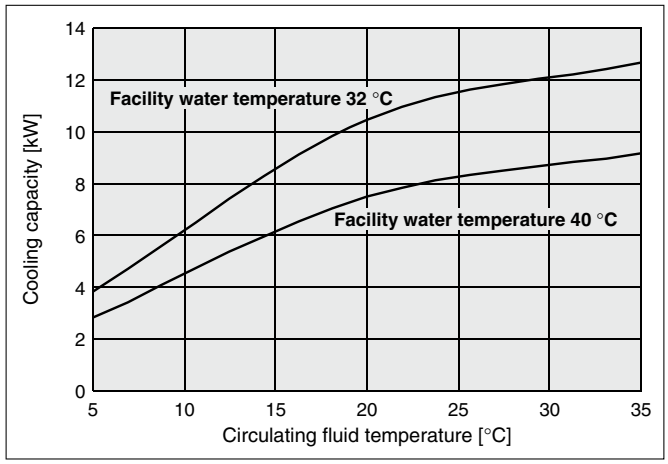
HRS090-A-20/40/46 (60 Hz)



HRS090-W-20/40/46 (50 Hz)

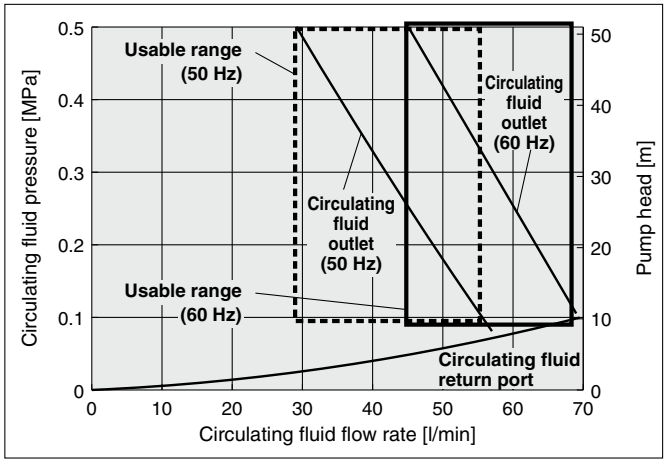


HRS090-W-20/40/46 (60 Hz)



Pump Capacity

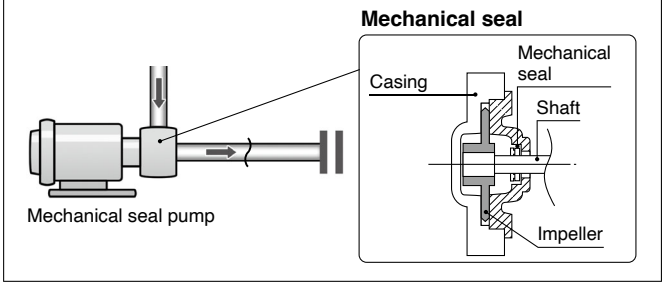
HRS090-A-20/40/46
HRS090-W-20/40/46



⚠ Caution

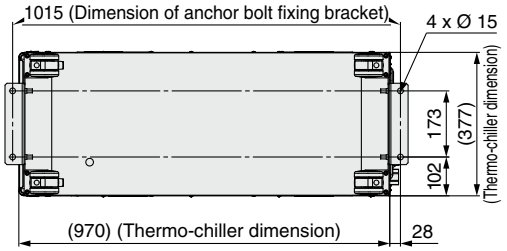
Mechanical Seal Pump

The pump used for the thermo-chiller HRS090 series uses a mechanical seal with the fixed ring and rotary ring used for the shaft seal part. If foreign matter enter the gap between the seals, this may cause a trouble such as leakage from the seal part or pump lock. Therefore, it is strongly recommended to install the particle filter in the return piping of the chiller.

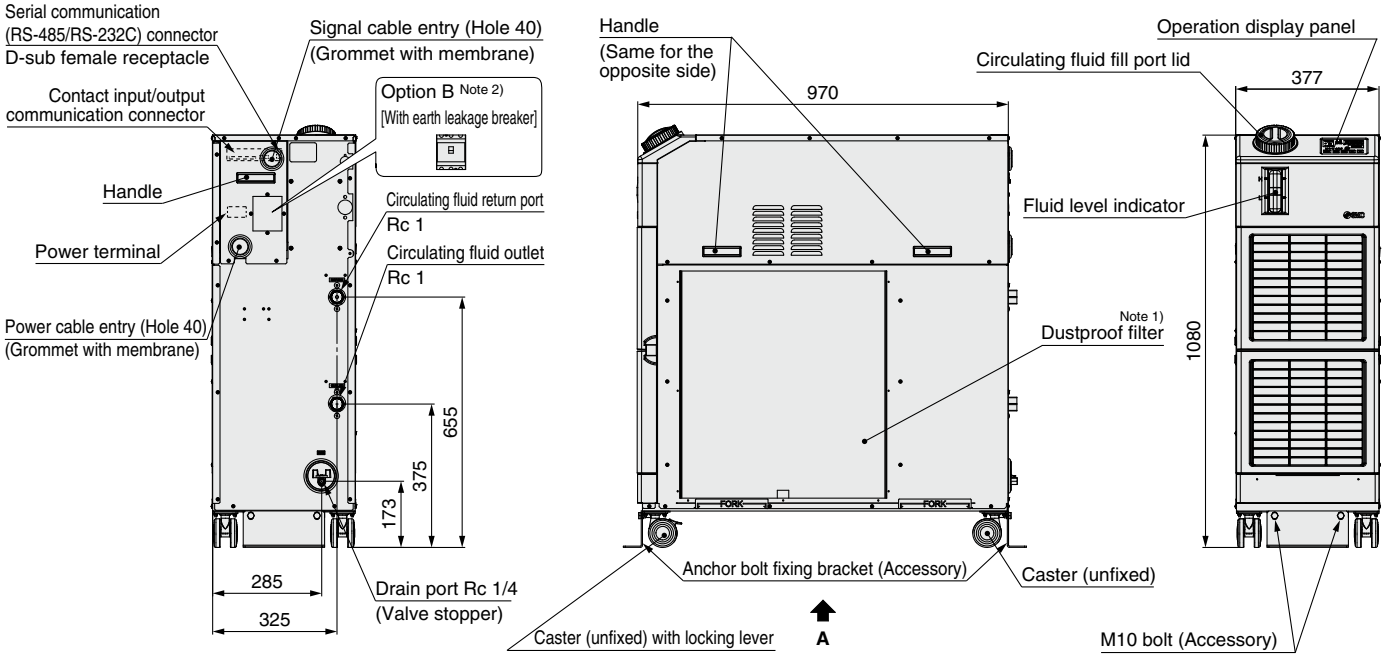


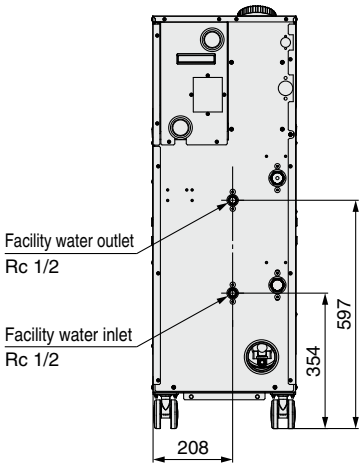
Dimensions

HRS090-□-20/40/46



Anchor bolt fixing position
View A



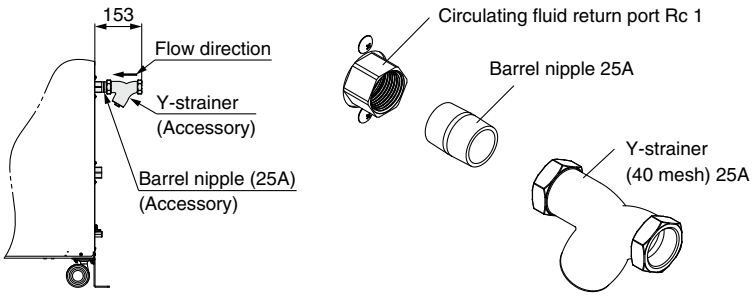


For water-cooled type

Note 1) The water-cooled type is not equipped with a dustproof filter.
Note 2) 400 V type is provided with an earth leakage breaker "-B" as standard.

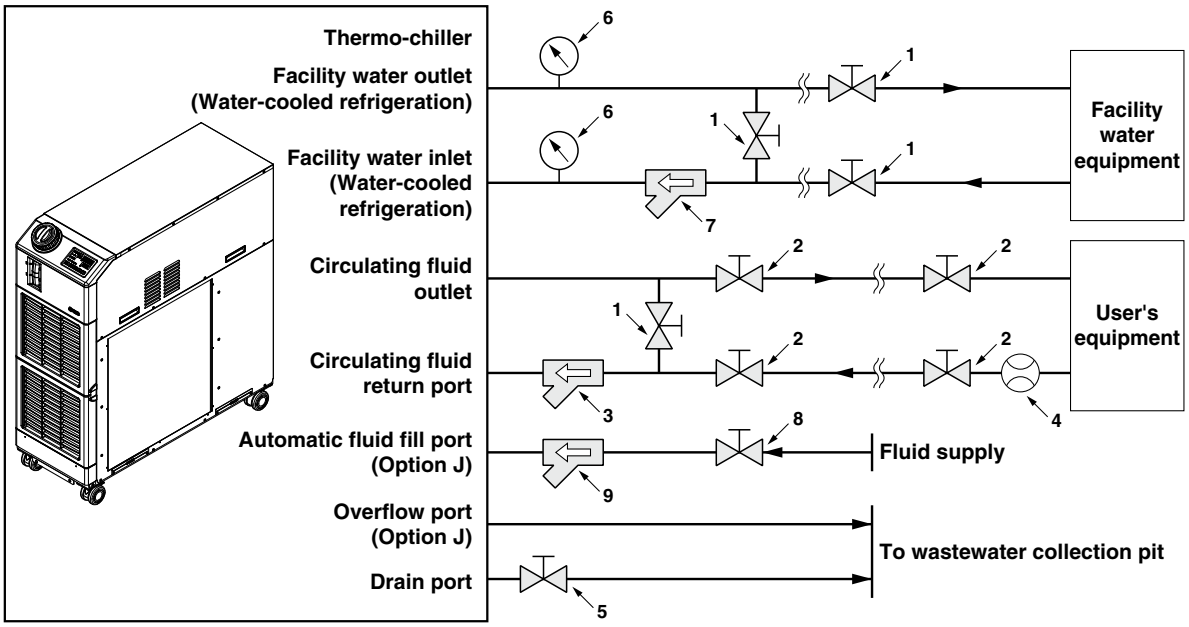
Accessory: Y-strainer mounting view

∗ Mount it by yourself on the circulating fluid return port.



Recommended External Piping Flow

External piping circuit is recommended as shown below.



No.	Description	Size	Recommended part no.	Note
1	Valve	Rc1/2	—	—
2	Valve	Rc1	—	—
3	Y-strainer	Rc1 #40	Accessory	Install either the strainer or filter. If foreign matter with a size of 2 0 μm or more are likely to enter, install the particle filter. For the recommended filter, refer to the optional accessory HRS-PF005.
	Filter	Rc1 20 μm	HRS-PF005∗1	
4	Flow meter	—	—	Prepare a flow meter with an appropriate flow range.
5	Valve (Part of thermo-chiller)	Rc1/4	—	—
6	Pressure gauge	0 to 1.0 MPa	—	—
7	Y-strainer	Rc1/2 #40	—	Install either the strainer or filter. If foreign matter with a size of 2 0 μm or more are likely to enter, select the particle filter, and then prepare it.
	Filter	Rc1/2 20 μm	—	
8	Valve	Rc3/8	—	—
9	Y-strainer	Rc3/8 #40	—	Install either the strainer or filter. If foreign matter with a size of 2 0 μm or more are likely to enter, install the particle filter.
	Filter	Rc3/8 20 μm	FQ1011N-10-T020-B-X61∗1	

∗1 The filter shown above cannot be directly connected to the thermo-chiller. Install it in the user's piping system.

Cable Specifications

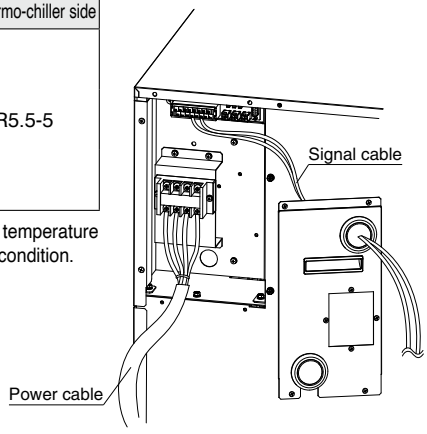
Power Cable Specifications

Applicable model	Rated value for thermo-chiller			Power cable examples	
	Power supply	Applicable breaker rated current	Terminal block screw diameter	Cable size	Crimped terminal on the thermo-chiller side
HRS090-□□-20	3-phase 200 VAC (50 Hz) 3-phase 200 to 230 VAC (60 Hz)	30 A	M5	4 cores x 5.5 mm² (4 cores x AWG10) ∗ Including grounding cable	R5.5-5
HRS090-□□-40	3-phase 380 to 415 VAC (50/60 Hz)	20 A			
HRS090-□□-46	3-phase 380 to 415 VAC (50/60 Hz) 3-phase 460 to 480 VAC (60 Hz)				

∗ An example of the cable specifications is when two kinds of vinyl insulated wires with a continuous allowable operating temperature of 70 °C at 600 V, are used at an ambient temperature of 30 °C. Select the proper size of cable according to an actual condition.

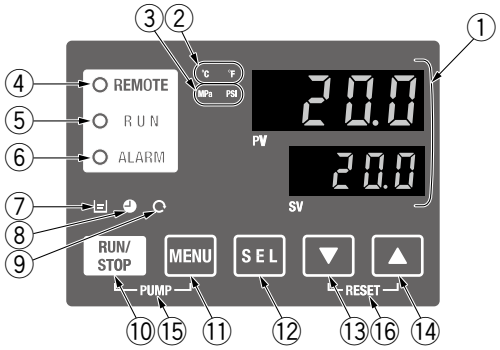
Signal Cable Specifications

Terminal specifications		Cable specifications
Terminal block screw diameter	Recommended crimped terminal	0.75 mm² (AWG18) Shielded cable
M3	Y-shape crimped terminal 1.25Y-3	



Operation Display Panel

The basic operation of this unit is controlled through the operation display panel on the front of the product.



No.	Description	Function	
①	**Digital display (7 segment, 4 digits)**	PV	Displays the circulating fluid current discharge temperature and pressure and alarm codes and other menu items (codes).
		SV	Displays the circulating fluid discharge temperature and the set values of other menus.
②	**[°C] [°F] lamp**	Equipped with a unit conversion function. Displays the unit of displayed temperature (default setting: °C).	
③	**[MPa] [PSI] lamp**	Equipped with a unit conversion function. Displays the unit of displayed pressure (default setting: MPa).	
④	**[REMOTE] lamp**	Enables remote operation (start and stop) by communication. Lights up during remote operation.	
⑤	**[RUN] lamp**	Lights up when the product is started, and goes off when it is stopped. Flashes during stand-by for stop or anti-freezing function, or independent operation of the pump.	
⑥	**[ALARM] lamp**	Flashes with buzzer when alarm occurs.	
⑦	**[⊟] lamp**	Lights up when the surface of the fluid level indicator falls below the L level.	
⑧	**[◕] lamp**	Equipped with a timer for start and stop. Lights up when this function is operated.	
⑨	**[↻] lamp**	Equipped with a power failure auto-restart function, which restarts the product automatically after stopped due to a power failure. Lights up when this function is operated.	
⑩	**[RUN/STOP] key**	Makes the product start or stop.	
⑪	**[MENU] key**	Shifts the main menu (display screen of circulating fluid discharge temperature and pressure) and other menus (for monitoring and entry of set values).	
⑫	**[SEL] key**	Changes the item in menu and enters the set value.	
⑬	**[▼] key**	Decreases the set value.	
⑭	**[▲] key**	Increases the set value.	
⑮	**[PUMP] key**	Press the [MENU] and [RUN/STOP] keys simultaneously. The pump starts running independently to make the product ready for start-up (release the air).	
⑯	**[RESET] key**	Press the [▼] and [▲] keys simultaneously. The alarm buzzer is stopped and the [ALARM] lamp is reset.	

List of Function

No.	Function	Outline
1	**Main display**	Displays the current and set temperature of the circulating fluid, discharge pressure of the circulating fluid. Changes the circulating fluid set temperature.
2	**Alarm display menu**	Indicates alarm number when an alarm occurs.
3	**Inspection monitor menu**	Product temperature, pressure and accumulated operating time can be checked as daily inspection. Use these for daily inspection.
4	**Key-lock**	Keys can be locked so that set values cannot be changed by operator error.
5	**Timer for operation start/stop**	Timer is used to set the operation start/stop.
6	**Signal for the completion of preparation**	A signal is output when the circulating fluid temperature reaches the set temperature, when using contact input/output and serial communication.
7	**Offset function**	Use this function when there is a temperature offset between the discharge temperature of the thermo-chiller and user's equipment.
8	**Reset after power failure**	Start operation automatically after the power supply is turned on.
9	**Key click sound setting**	Operation panel key sound can be set on/off.
10	**Changing temp. unit**	Temperature unit can be changed. Centigrade (°C) ⇔ Fahrenheit (°F)
11	**Changing pressure unit**	Pressure unit can be changed. MPa ⇔ PSI
12	**Data reset**	Functions can be reset to the default settings (settings when shipped from the factory).
13	**Accumulation time reset**	Reset function when the pump, the fan or the compressor is replaced. Reset the accumulated time here.
14	**Anti-freezing function**	Circulating fluid is protected from freezing during winter or at night. Set beforehand if there is a risk of freezing.
15	**Warming-up function**	When circulating fluid temperature rising time at starting needs shortening during winter or at night, set beforehand.
16	**Alarm buzzer sound setting**	Alarm sound can be set to on/off.
17	**Alarm customizing**	Operation during alarm condition and threshold values can be changed depending on the alarm type.
18	**Communication**	This function is used for contact input/output or serial communication.

Alarm

This unit has alarms as standard, and displays each of them by its alarm code on the PV screen with the [ALARM] lamp ([LOW LEVEL] lamp) lit up on the operation display panel. The alarm can be read out through communication.

Code	Alarm message
AL01	Low level in tank
AL02	High circulating fluid discharge temp.
AL03	Circulating fluid discharge temp. rise
AL04	Circulating fluid discharge temp. drop
AL05	High circulating fluid return temp.
AL06	High circulating fluid discharge pressure
AL07	Abnormal pump operation
AL08	Circulating fluid discharge pressure rise
AL09	Circulating fluid discharge pressure drop
AL10	High compressor intake temp.
AL11	Low compressor intake temp.
AL12	Low super heat temp.
AL13	High compressor discharge pressure
AL15	Refrigeration circuit pressure (high pressure side) drop
AL16	Refrigeration circuit pressure (low pressure side) rise

Code	Alarm message
AL17	Refrigeration circuit pressure (low pressure side) drop
AL18	Compressor running failure
AL19	Communication error
AL20	Memory error
AL21	DC line fuse cut
AL22	Circulating fluid discharge temp. sensor failure
AL23	Circulating fluid return temp. sensor failure
AL24	Compressor intake temp. sensor failure
AL25	Circulating fluid discharge pressure sensor failure
AL26	Compressor discharge pressure sensor failure
AL27	Compressor intake pressure sensor failure
AL28	Pump maintenance
AL29	Fan maintenance
AL30	Compressor maintenance
AL31	Contact input 1 signal detection

Code	Alarm message
AL32	Contact input 2 signal detection
AL37	Compressor discharge temp. sensor failure
AL38	Compressor discharge temp. rise
AL40	Dustproof filter maintenance Note)
AL41	Power stoppage
AL42	Compressor waiting
AL43	Fan failure Note)
AL45	Compressor over current
AL47	Pump over current
AL50	Incorrect phase error
AL51	Phase board over current

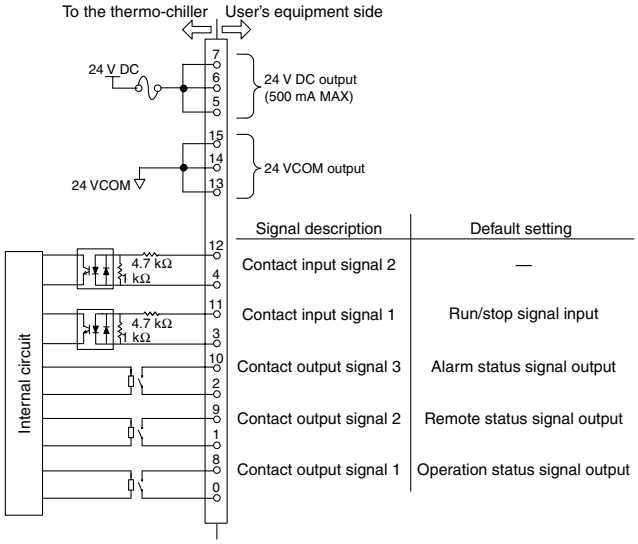
Note) Does not occur on the product of water-cooled refrigeration type.

∗ For details, read the Operation Manual.

For details, refer to the Operation Manual. Please download it via our website, http://www.smc.eu

Communication Function

Contact Input/Output

Item		Specifications
Connector type		M3 terminal block
Input signal	**Insulation method**	Photocoupler
	Rated input voltage	24 VDC
	Operating voltage range	21.6 to 26.4 VDC
	Rated input current	5 mA TYP
	Input impedance	4.7 kΩ
Contact output signal	**Rated load voltage**	48 VAC or less/30 VDC or less
	Maximum load current	500 mA AC/DC (resistance load)
	Minimum load current	5 VDC 10 mA
Output voltage		24 VDC ±10 % 500 mA MAX (No inductive load)
Circuit diagram		

∗ The pin numbers and output signals can be set by user. For details, refer to the Operation Manual for communication.

Serial Communication

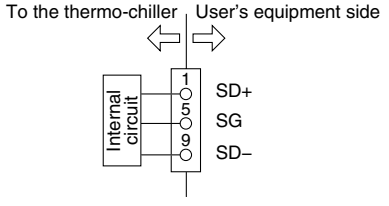
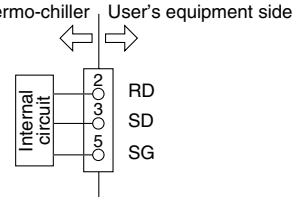
The serial communication (RS-485/RS-232C) enables the following items to be written and read out.
For details, refer to the Operation Manual for communication.

Writing

Run/Stop
Circulating fluid temperature setting (SV)

Readout

Circulating fluid present temperature
Circulating fluid discharge pressure
Status information
Alarm occurrence information

Item	Specifications	
Connector type	D-sub 9-pin, Female connector	
Protocol	Modicon Modbus compliant/Simple communication protocol	
Standards	EIA standard RS-485	EIA standard RS-232C
Circuit diagram		

∗ The terminal resistance of RS-485 (120 Ω) can be switched by the operation display panel. For details, refer to the Operation Manual for communication. Do not connect other than in the way shown above, as it can result in failure.

Please download the Operation Manual via our website, http://www.smc.eu

HRS090 Series
Options

Note) Select the option when ordering the thermo-chiller because the option cannot be added after purchasing the unit.

B Option symbol

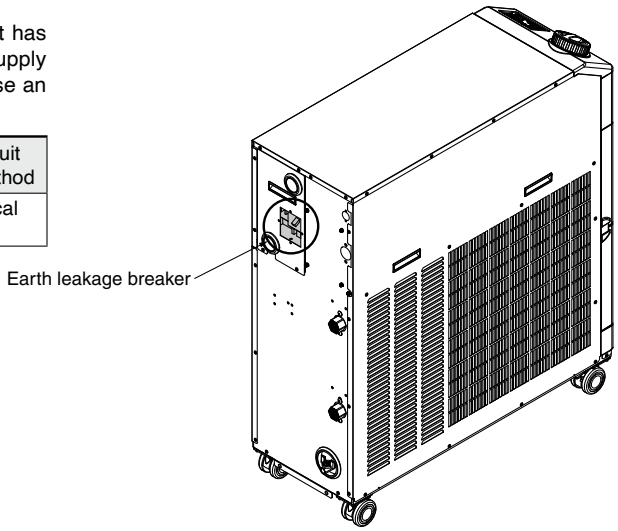
With Earth Leakage Breaker

HRS090−□□−20−B

With earth leakage breaker

A leakage breaker is built in to automatically stop the supply power when it has short-circuit, over current or electrical leakage. (For models with power supply specification '- 4 0 ' or '- 4 6 ', it is not necessary to select this option because an earth leakage breaker is equipped as standard.)

Applicable model	Rated current [A]	Sensitivity of leak current [mA]	Short circuit display method
HRS090-□□-20-B	30	30	Mechanical button



∗ 400/460 V type is equipped as standard.

J Option symbol

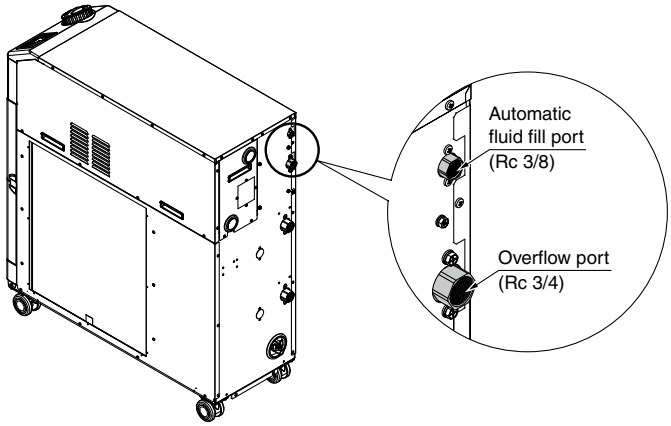
With Automatic Fluid Fill Function

HRS090−□□−□−J

With automatic fluid fill function

By installing this at the automatic fluid fill port, the circulating fluid can be automatically supplied to the product using a built-in solenoid valve for filling fluid while the circulating fluid is decreasing.

Applicable model	**HRS090-□□-□-J**
Fluid fill method	Built-in solenoid valve for automatic fluid filling
Fluid fill pressure [MPa]	0.2 to 0.5
Feed water temperature [°C]	5 to 40



M Option symbol

Applicable to Deionised Water Piping

HRS090−□□−□−M

Applicable to deionised water piping

Contact material of the circulating fluid circuit is made from non-copper materials.

Applicable model	**HRS090-□□-□-M**
Contact material for circulating fluid	Stainless steel (including heat exchanger brazing), SiC, Carbon, PP, PE, POM, FKM, NBR, EPDM, PVC, PTFE

∗ No change in external dimensions.

W Option symbol

SI Unit Only

HRS090−□□−□−W

SI unit only

The circulating fluid temperature and pressure are displayed in SI units [MPa/°C] only.
If this option is not selected, a product with a unit selection function will be provided by default.

∗ No change in external dimensions

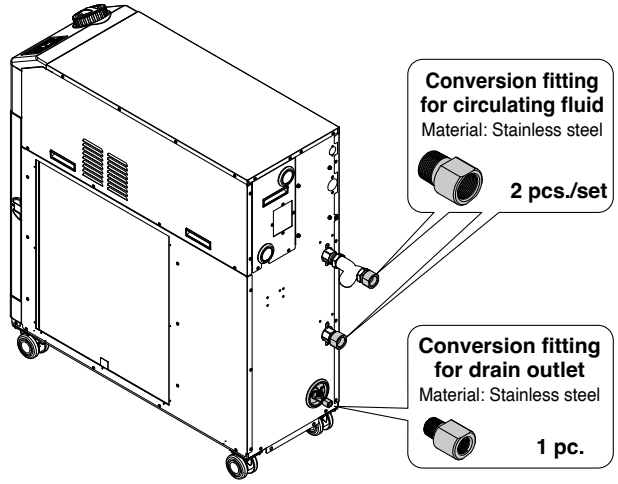
HRS090 Series
Optional Accessories

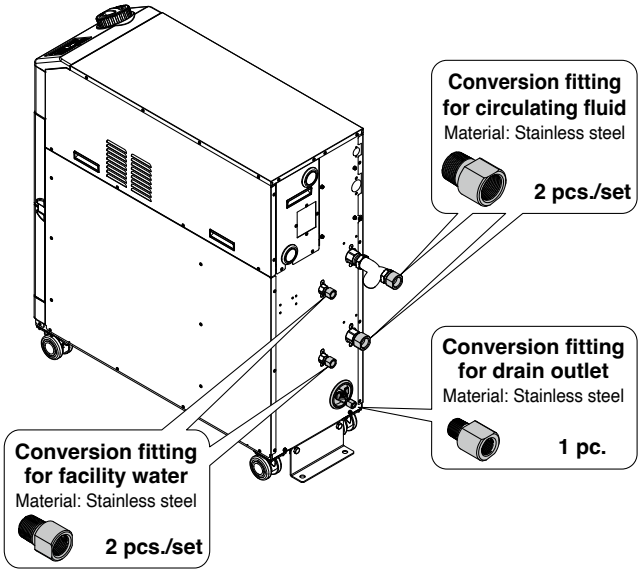
① Piping Conversion Fitting

This is a fitting to change the port from Rc to G or NPT.
· Circulating fluid outlet, Circulating fluid return port Rc 1 → NPT 1 or G 1
· Drain port Rc 1/4 → NPT 1/4 or G 1/4
(It is not necessary to purchase this when pipe thread type F or N is selected in "How to Order" since it is included in the product.)

Part no.	Contents	Applicable model
HRS-EP018	NPT thread conversion fitting set	**HRS090-A-40**
HRS-EP019	G thread conversion fitting set	

Part no.	Contents	Applicable model
HRS-EP022	NPT thread conversion fitting set	**HRS090-W-40**
HRS-EP023	G thread conversion fitting set	





When option J (With automatic fluid fill function) is included, use the following part numbers.
· Automatic fluid fill port Rc3/8 → NPT3/8 or G3/8
· Overflow port Rc3/4 → NPT3/4 or G3/4

∗ The conversion fittings for circulating fluid outlet/return port, drain port, facility water inlet/outlet (for water-cooled refrigeration) are also included.

Part no.	Contents	Applicable model
HRS-EP020	NPT thread conversion fitting set	**HRS090-A-20/40/46-J**
HRS-EP021	G thread conversion fitting set	

Part no.	Contents	Applicable model
HRS-EP024	NPT thread conversion fitting set	**HRS090-W-20/40/46-J**
HRS-EP025	G thread conversion fitting set	

② Bypass Piping Set

When the circulating fluid goes below the minimum operating flow rate (as shown below), cooling capacity will be reduced and the temperature stability will be badly affected. Use the bypass piping set to ensure a circulating fluid flow rate of the minimum operating flow rate or more.

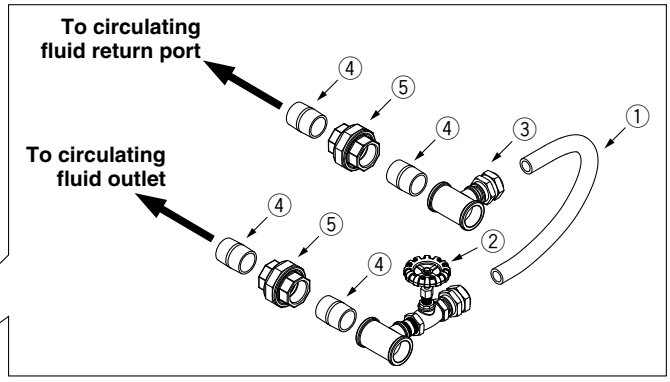
Bypass Piping Set

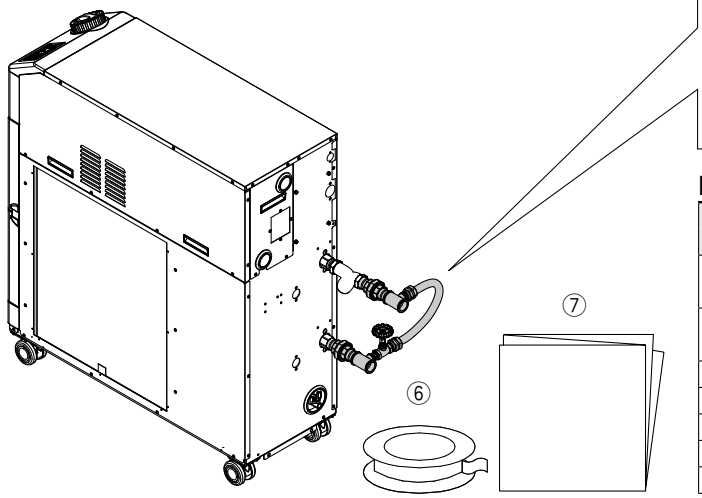
Part no.	Applicable model	Minimum operating flow rate (50/60 Hz) [l/min]
HRS-BP005	**HRS090-□□-20/40/46**	29/45

Bypass Piping Set (Stainless Steel)

Part no.	Applicable model	Minimum operating flow rate (50/60 Hz) [l/min]
HRS-BP011	**HRS090-□□-20/40/46**	29/45

∗ When selecting option "M," the HRS-BP011 is recommended.





Parts List

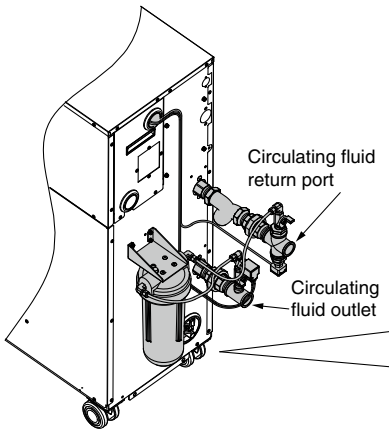
No.	Description	Fluid contact material		Qty.
		HRS-BP005	**HRS-BP011**	
①	Hose (I.D.: 15 mm)	PVC	PVC	1 (Approx. 700 mm)
②	Outlet piping assembly (With globe valve)	Stainless steel, Brass, Bronze	Stainless steel	1
③	Return piping assembly	Stainless steel, Brass	Stainless steel	1
④	Nipple (Size: 1 inch)	Stainless steel	Stainless steel	4
⑤	Union (Size: 1 inch)	Stainless steel	Stainless steel	2
⑥	Sealant tape	PTFE	PTFE	1
⑦	Operation Manual	—	—	1

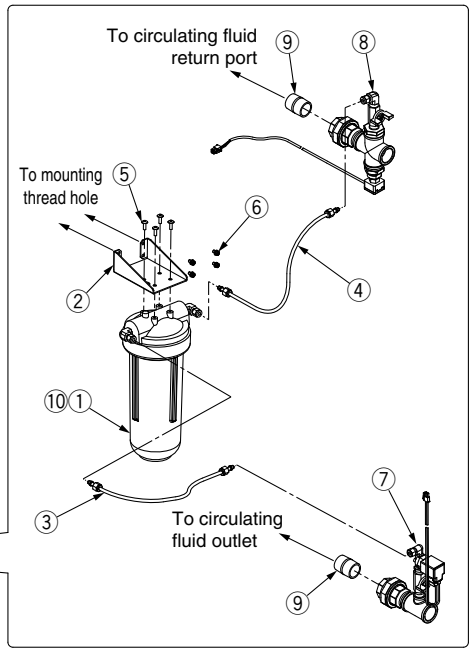
③ Electric Conductivity Control Set

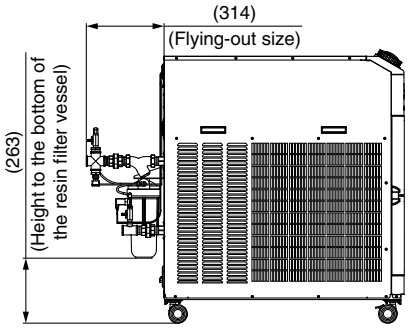
The set indicates and controls the electric conductivity of the circulating fluid. Refer to the Operation Manual for details.

Part no.	Applicable model
HRS-DI007	**HRS090-□□-20/40/46**

Measurement range of electric conductivity	2.0 to 48.0 μS/cm
Set range of electric conductivity target	5.0 to 45.0 μS/cm
Set range of electric conductivity hysteresis	2.0 to 10.0 μS/cm
Operating temperature range (Circulating fluid temperature)	5 to 60 °C
Power consumption	400 mA or less







Parts List

No.	Description	Fluid contact material	Qty.
①	DI filter vessel	PC, PP	1
②	Mounting bracket	—	1
③	DI filter inlet tube	PFA, POM	1
④	DI filter outlet tube	PFA, POM	1
⑤	Tapping screw (M5 screw)	—	4
⑥	Mounting screw (M5 screw)	—	4
⑦	DI control piping assembly	Stainless steel, EPDM	1
⑧	DI sensor assembly	Stainless steel, PPS	1
⑨	Nipple (Size: 1 inch)	Stainless steel	2
⑩	DI filter cartridge (Part no.: HRS-DF001)*1	PP, PE	1

*1 The product should be replaced when it can no longer preserve the electrical conductivity set value.

④ Particle Filter Set

Removes foreign matter in the circulating fluid. This set cannot be directly connected to the thermo-chiller. Install it in the user's piping system. Refer to the Operation Manual for details.

Particle Filter Set

HRS−PF005−H

Accessory

Symbol	Accessory
—	None
H	With handle

Fluid	Tap water
Max. operating pressure	0.65 MPa
Operating temperature range	5 to 35 °C
Nominal filtration accuracy	5 μm
Installation environment	Indoors

Parts List

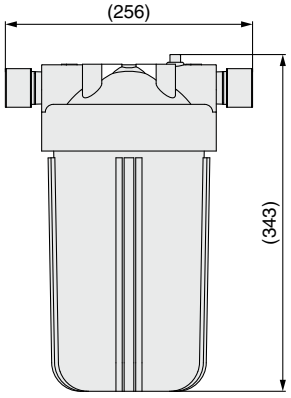
No.	Description	Material	Qty.	Note
①	Body	PC, PP	1	—
②	Element*1	PP	1	—
③	Extension piece	Stainless steel	2	Conversion from NPT to Rc
④	Handle	—	1	When -H is selected
⑤	Sealant tape	PTFE	1	—

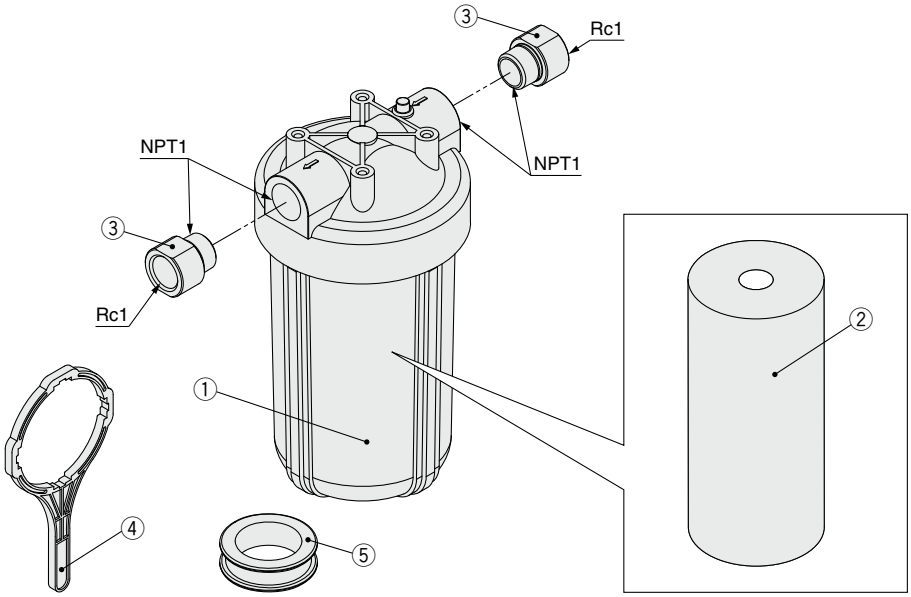
*1 The product should be replaced when the pressure drop reaches 0.1 MPa.

Replacement Element

HRS−PF006

The product should be replaced when the pressure drop reaches 0.1 MPa.



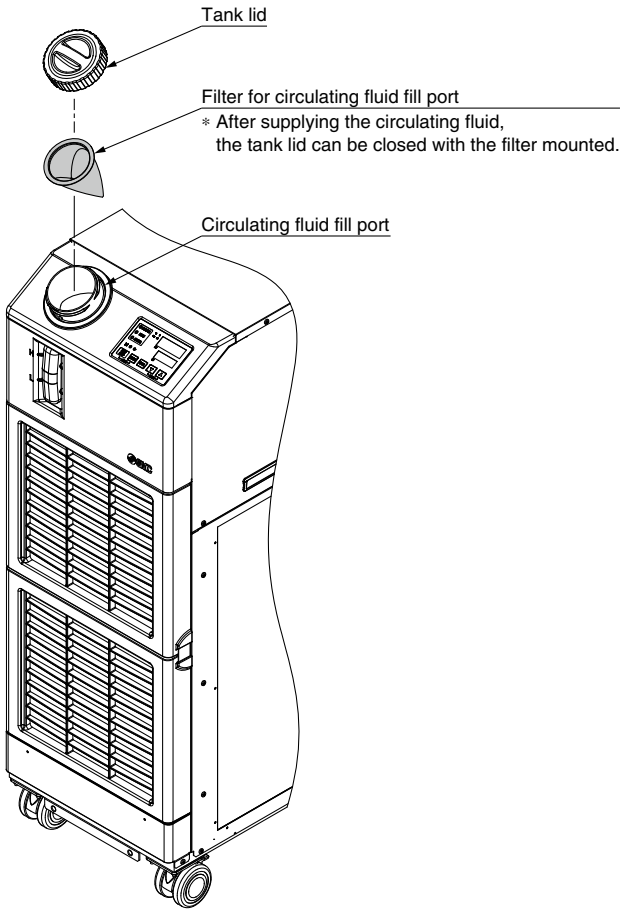


⑤ Filter for Circulating Fluid Fill Port

Prevents foreign matter from entering the tank when supplying the circulating fluid. Can be used just by fitting into the circulating fluid fill port.

■ Filter for circulating fluid fill port
HRS-PF007

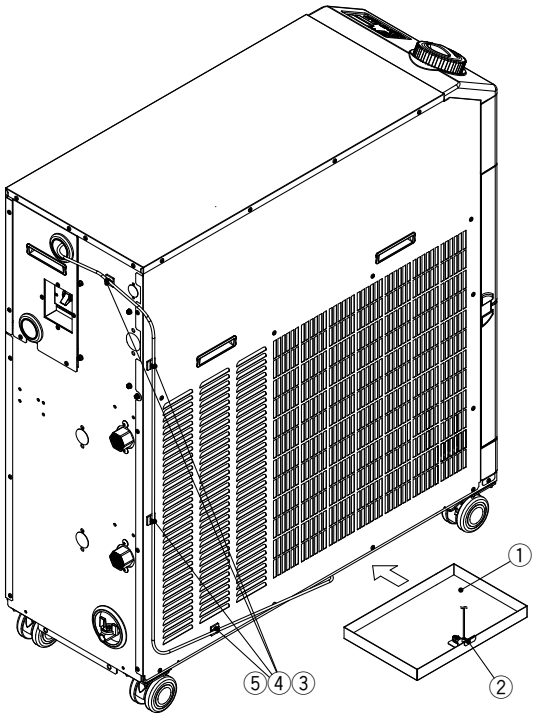
Material	Stainless steel 304, Stainless steel 316
Mesh size	200



⑥ Drain Pan Set (With Water Leakage Sensor)

Drain pan for the thermo-chiller. Liquid leakage from the thermo-chiller can be detected by mounting the attached water leakage sensor. Align the drain pan with the hole in the bottom of the thermo-chiller for installation.

Part no.	Applicable model
HRS-WL003	**HRS090-□□-20/40/46**



Parts List

No.	Description
①	Drain pan
②	Water leakage sensor
③	Extension cable
④	Binding band (4 pcs.)
⑤	Cable fixture (4 pcs.)

⑦ Wired Remote Controller

When the wired remote controller is connected to the thermo-chiller, the operation start/stop setting or the set temperature can be changed from a place apart from the thermo-chiller. For details, refer to the Operation Manual.

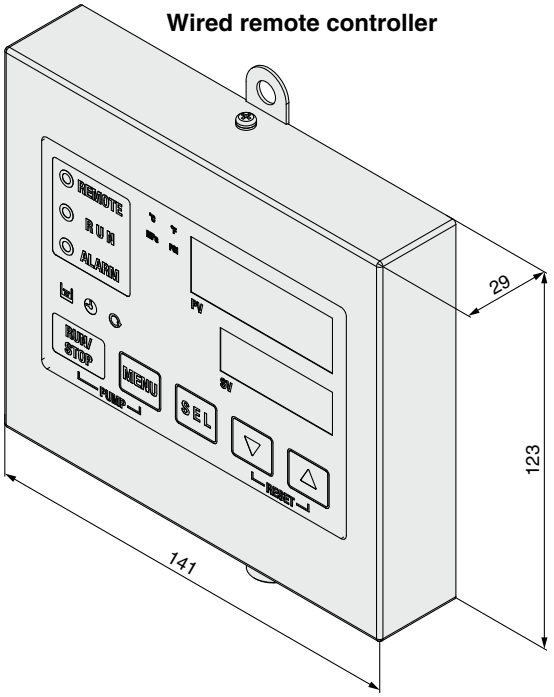
Wired Remote Controller

HRS-CV004-1

Accessories

Symbol	Accessories
—	None
1	With cable (Approx. 20 m)
2	With cable (Approx. 50 m)
3	With cable (Approx. 100 m)

Wired remote controller



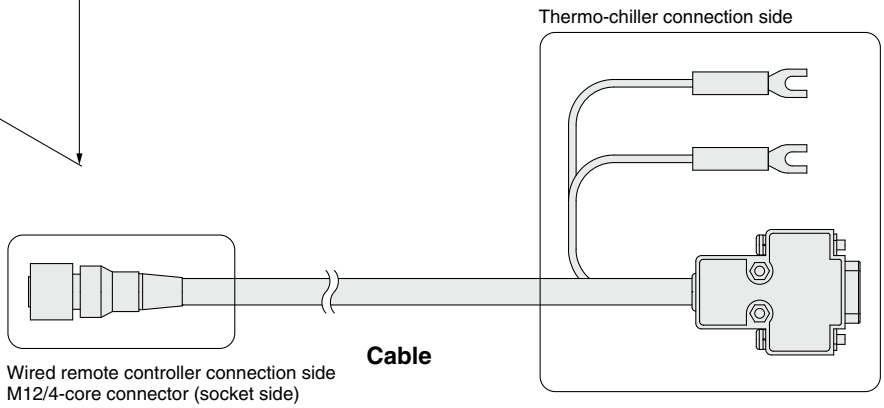
Displayed items

Circulating fluid discharge temperature
Circulating fluid discharge set temperature
Circulating fluid discharge pressure
Circulating fluid electric conductivity*1
Circulating fluid flow rate
Alarm code*2

*1 Only when the electric conductivity control set is used.
*2 Only when an alarm occurs. The alarm cannot be reset with the remote controller. Be sure to reset the alarm with the thermo-chiller main unit.

Operable items

Operation start/stop
Circulating fluid temperature setting
Alarm sound stop
Key-lock
Key operation sound ON/OFF
Digital display brightness adjustment
Alarm sound ON/OFF



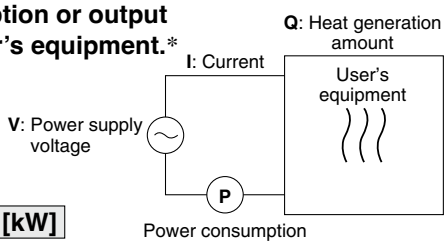
* To use the wired remote controller, the thermo-chiller main unit setting is needed.
* Use the wired remote controller indoors.
* Pass the cable through the duct, etc. so that it is not exposed to rain water or direct sunlight.

HRS090 Series
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 **Derive the heat generation amount from the power consumption.**

Power consumption **P**: 7 [kW]

Q = P = 7 [kW]

Cooling capacity = Considering a safety factor of 20 %, **7 [kW] x 1.2 =** **8.4 [kW]**

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

Power supply output **VI**: 8.8 [kVA]

Q = P = V x I x Power factor

In this example, using a power factor of 0.85:

= 8.8 [kVA] x 0.85 = 7.5 [kW]

Cooling capacity = Considering a safety factor of 20 %,

7.5 [kW] x 1.2 = **9.0 [kW]**

③ **Derive the heat generation amount from the output.**

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

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

In this example, using an efficiency of 0.7:

$$\mathbf{= \frac{5.1}{0.7} = 7.3\ [kW]}$$

Cooling capacity = Considering a safety factor of 20 %,

7.3 [kW] x 1.2 = **8.8 [kW]**

* The above examples 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.

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*
Circulating fluid mass flow rate **qm**	: (= ρ x **qv** ÷ 60) [kg/s]
Circulating fluid density ρ	: 1 [kg/L]
Circulating fluid (volume) flow rate **qv**	: 35 [l/min]
Circulating fluid specific heat **C**	: 4.186 x 10^3 [J/(kg·K)]
Circulating fluid outlet temperature $\mathbf{T_1}$	: 293 [K] (20 [°C])
Circulating fluid return temperature $\mathbf{T_2}$	: 296 [K] (23 [°C])
Circulating fluid temperature difference Δ**T**	: 3 [K] (= $\mathbf{T_2 - T_1}$)
Conversion factor: minutes to seconds (SI units)	: 60 [s/min]

* Refer to page 12 for the typical physical property value of tap water or other circulating fluids.

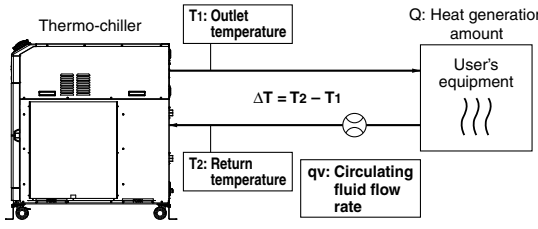
$$\mathbf{Q = qm \times C \times (T_2 - T_1)}$$

$$\mathbf{= \frac{\rho \times qv \times C \times \Delta T}{60} = \frac{1 \times 35 \times 4.186 \times 10^3 \times 3.0}{60}}$$

$$\mathbf{= 7325\ [J/s] \approx 7325\ [W] = 7.3\ [kW]}$$

Cooling capacity = Considering a safety factor of 20 %,

7.3 [kW] x 1.2 = **8.8 [kW]**



HRS090-A

Example of conventional measurement units (Reference)

Heat generation amount by user's equipment **Q**	: Unknown [cal/h] → [W]
Circulating fluid	: Tap water*
Circulating fluid weight flow rate **qm**	: (= ρ x **qv** x 60) [kgf/h]
Circulating fluid weight volume ratio γ	: 1 [kgf/L]
Circulating fluid (volume) flow rate **qv**	: 35 [l/min]
Circulating fluid specific heat **C**	: 1.0 x 10^3 [cal/(kgf·°C)]
Circulating fluid outlet temperature $\mathbf{T_1}$	: 20 [°C]
Circulating fluid return temperature $\mathbf{T_2}$	: 23 [°C]
Circulating fluid temperature difference Δ**T**	: 3 [°C] (= $\mathbf{T_2 - T_1}$)
Conversion factor: hours to minutes	: 60 [min/h]
Conversion factor: kcal/h to kW	: 860 [(cal/h)/W]

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

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

$$\mathbf{= \frac{1 \times 35 \times 60 \times 1.0 \times 10^3 \times 3.0}{860}}$$

$$\mathbf{\approx 7325\ [W] = 7.3\ [kW]}$$

Cooling capacity = Considering a safety factor of 20 %,

7.3 [kW] x 1.2 = **8.8 [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** : (= ρ x **V**) [kg]
Cooled substance density ρ : 1 [kg/L]
Cooled substance total volume **V** : 150 [L]
Cooled substance specific heat **C** : 4.186 x 10^3 [J/(kg·K)]
Cooled substance temperature when cooling begins T_0 : 303 [K] (30 [°C])
Cooled substance temperature after t hour T_t : 293 [K] (20 [°C])
Cooling temperature difference Λ**T** : 10 [K] (= $T_0 - T_t$)
Cooling time Λ**t** : 900 [s] (= 15 [min])

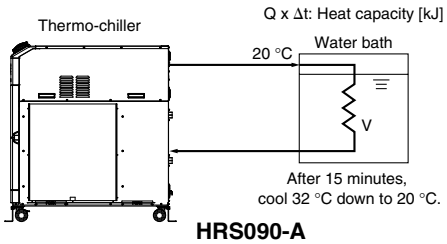
∗ Refer to the following for the typical physical property values by circulating fluid.

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

$$= \frac{1 \times 150 \times 4.186 \times 10^3 \times 10}{900} = 6977 \text{ [J/s]} \approx 7.0 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20 %,

7.0 [kW] x 1.2 = 8.4 [kW]



HRS090-A

Example of conventional measurement units (Reference)

Heat quantity by cooled substance (per unit time) **Q** : Unknown [cal/h] → [W]
Cooled substance : Water
Cooled substance weight **m** : (= ρ x **V**) [kgf]
Cooled substance weight volume ratio γ : 1 [kgf/L]
Cooled substance total volume **V** : 150 [L]
Cooled substance specific heat **C** : 1.0 x 10^3 [cal/(kgf·°C)]
Cooled substance temperature when cooling begins T_0 : 30 [°C]
Cooled substance temperature after t hour T_t : 20 [°C]
Cooling temperature difference Λ**T** : 10 [°C] (= $T_0 - T_t$)
Cooling time Λ**t** : 15 [min]
Conversion factor: hours to minutes : 60 [min/h]
Conversion factor: kcal/h to kW : 860 [(cal/h)/W]

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

$$= \frac{1 \times 150 \times 60 \times 1.0 \times 10^3 \times 10}{15 \times 860}$$

$$\approx 6977 \text{ [W]} = 7.0 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20 %,

7.0 [kW] x 1.2 = 8.4 [kW]

Note) 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 catalogue uses the following values for density and specific heat in calculating the required cooling capacity.

Density ρ: 1 [kg/L] (or, using conventional unit system, weight volume ratio γ = 1 [kgf/L])
Specific heat **C**: 4.19 x 10^3 [J/(kg·K)] (or, using conventional unit system, 1 x 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 unit system	
			Weight volume ratio γ [kgf/L]	Specific heat C [cal/(kgf·°C)]
5 °C	1.00	4.2 x 10^3	1.00	1 x 10^3
10 °C	1.00	4.19 x 10^3	1.00	1 x 10^3
15 °C	1.00	4.19 x 10^3	1.00	1 x 10^3
20 °C	1.00	4.18 x 10^3	1.00	1 x 10^3
25 °C	1.00	4.18 x 10^3	1.00	1 x 10^3
30 °C	1.00	4.18 x 10^3	1.00	1 x 10^3
35 °C	0.99	4.18 x 10^3	0.99	1 x 10^3
40 °C	0.99	4.18 x 10^3	0.99	1 x 10^3

15 % Ethylene Glycol Aqueous Solution

Physical property value / Temperature	Density ρ [kg/L]	Specific heat C [J/(kg·K)]	Conventional unit system	
			Weight volume ratio γ [kgf/L]	Specific heat C [cal/(kgf·°C)]
5 °C	1.02	3.91 x 10^3	1.02	0.93 x 10^3
10 °C	1.02	3.91 x 10^3	1.02	0.93 x 10^3
15 °C	1.02	3.91 x 10^3	1.02	0.93 x 10^3
20 °C	1.01	3.91 x 10^3	1.01	0.93 x 10^3
25 °C	1.01	3.91 x 10^3	1.01	0.93 x 10^3
30 °C	1.01	3.91 x 10^3	1.01	0.94 x 10^3
35 °C	1.01	3.91 x 10^3	1.01	0.94 x 10^3
40 °C	1.01	3.92 x 10^3	1.01	0.94 x 10^3

Note) The above shown are reference values. Contact circulating fluid supplier for details.

HRS090 Series
Specific Product Precautions 1

Be sure to read this before handling. Refer to the back cover for Safety Instructions. For Temperature Control Equipment Precautions, refer to "Handling Precautions for SMC Products" and the Operation Manual on the SMC website, http://www.smc.eu

Design

⚠ Warning

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

1. Check the specifications of the single unit (contents of this catalogue) and thoroughly consider the adaptability between the user's system and this unit.
2. Although the 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 condition. Also, the user is requested to carry out the 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 materials for fluid contact parts of circulating fluid.

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

4. The facility water outlet temperature (water-cooled type) may increase up to around 60 °C.

When selecting the facility water pipings, consider the suitability for temperature.

Selection

⚠ Warning

Model selection

For selecting a model of thermo-chiller, it is required to know the heat generation amount of the user's equipment. Obtain the heat generation amount, referring to "Cooling Capacity Calculation" on pages 21 and 22 before selecting a model.

Handling

⚠ Warning

Thoroughly read the Operation Manual.

Read the Operation Manual completely before operation, and keep this manual available whenever necessary.

Operating Environment / Storage Environment

⚠ Warning

1. Do not use in the following environment as it will lead to a breakdown.

1. Outdoors
2. In locations where water, water vapor, salt water, and oil may splash on the product.
3. In locations where there are dust and particles.
4. In locations where corrosive gases, organic solvents, chemical fluids, or flammable gases are present. (This product is not explosion proof.)
5. In locations where the ambient temperature/humidity exceeds the limits as mentioned below or where condensation occurs.
   During transportation/storage: -15 °C to 50 °C, 15 % to 85 %
   (But as long as water or circulating fluid are not left inside the pipings)
   During operation: 5 °C to 45 °C, 30 % to 70 %
   (However, use a 15 % ethylene glycol aqueous solution if operating in a place where the ambient temperature or circulating fluid temperature is 10 °C or less.)
6. In locations where condensation may occur.
7. In locations which receive direct sunlight or radiated heat.
8. In locations where there is a heat source nearby and the ventilation is poor.
9. In locations where temperature substantially changes.
10. In locations where strong magnetic noise occurs.
    (In locations where strong electric fields, strong magnetic fields and surge voltage occur.)
11. In locations where static electricity occurs, or conditions which make the product discharge static electricity.
12. In locations where high frequency occurs.
13. In locations where damage is likely to occur due to lightning.
14. In locations at altitude of 3000 m or higher (Except during storage and transportation)
    * For altitude of 1000 m or higher
    Because of lower air density, the heat radiation efficiencies of the devices in the product will be lower in the location at altitude of 1000 m or higher. Therefore, the maximum ambient temperature to use and the cooling capacity will lower according to the descriptions in the table below.
    Select the thermo-chiller considering the descriptions.
    ① Upper limit of ambient temperature: Use the product in ambient temperature of the described value or lower at each altitude.
    ② Cooling capacity coefficient: The product's cooling capacity will lower to one that multiplied by the described value at each altitude.

Altitude [m]	① Upper limit of ambient temperature [°C]	② Cooling capacity coefficient
Less than 1000 m	45	1.00
Less than 1500 m	42	0.85
Less than 2000 m	38	0.80
Less than 2500 m	35	0.75
Less than 3000 m	32	0.70

15. In locations where strong impacts or vibrations occur.
16. In locations where a massive force strong enough to deform the product is applied or a weight from a heavy object is applied.
17. In locations where there is not sufficient space for maintenance.
18. Bevelled place
19. Insects or plants may enter the unit.

2. The product is not designed for clean room usage. It generates particles internally.

HRS090 Series
Specific Product Precautions 2

Be sure to read this before handling. Refer to the back cover for Safety Instructions. For Temperature Control Equipment Precautions, refer to "Handling Precautions for SMC Products" and the Operation Manual on the SMC website, http://www.smc.eu

Transportation / Carriage / Movement

⚠ Warning

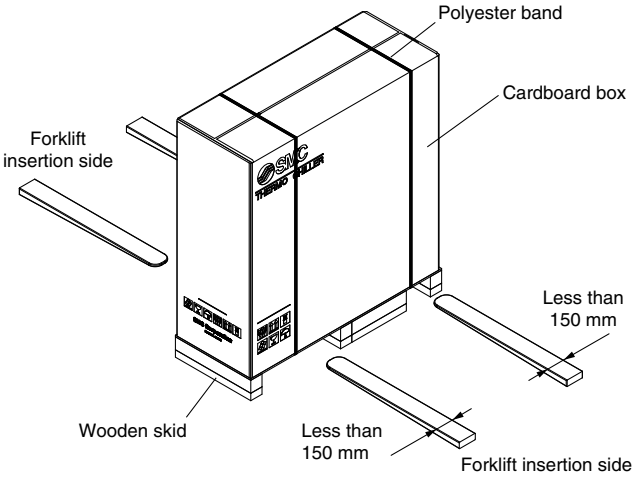
1. This product is heavy. Pay attention to safety and position of the product when it is transported, carried and moved.

2. Read the Operation Manual carefully to move the product after unpacking.

⚠ Caution

1. Never put the product down sideway as this may cause a failure.

The product will be delivered in the packaging shown below.

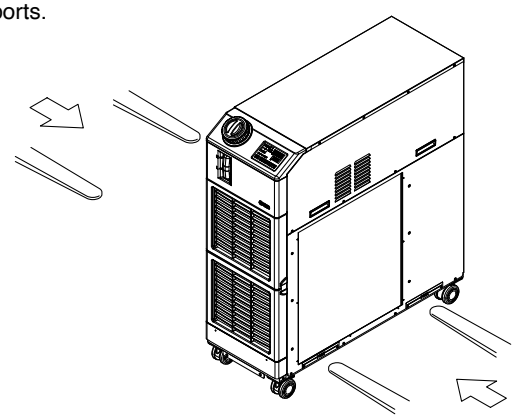


<When packaged>

Model	Weight [kg]	Dimensions [mm]
HRS090-A-20/40/46	163	Height 1290 x Width 470 x Depth 1180
HRS090-W-20/40/46	151	

2. Moving with forklift

1. A licensed driver should drive the forklift.
2. Insert the fork to the place specified on the label. The fork should reach through to the other side of the product.
3. Be careful not to bump the fork to the cover panel or piping ports.



3. Moving with casters

1. This is a heavy product. Make sure this product is lifted by at least two people to avoid falling.
2. Do not grip the piping port on the back side or the handles of the panel.
3. Do not pass over bumps etc. with the casters.

Installation

⚠ Warning

1. Do not use the product outdoors.

2. Do not place heavy objects on top of this product, or step on it.

The external panel can be deformed and danger can result.

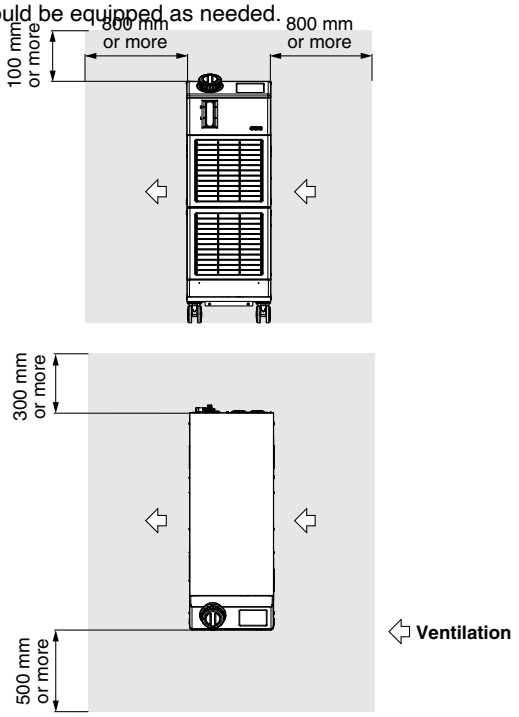
⚠ Caution

1. Install on a rigid floor which can withstand this product's weight.

2. Refer to the Operation Manual for this product, and secure an installation space that is necessary for the maintenance and ventilation.

<Air-cooled refrigeration>

1. The air-cooled type product exhausts heat using the fan that is mounted to the product. If the product is operated with insufficient ventilation, ambient temperature may exceed 45 °C, and this will affect the performance and life of the product. To prevent this ensure that suitable ventilation is available (see below).
2. For installation indoors, ventilation ports and a ventilation fan should be equipped as needed.



3. If it is impossible to exhaust heat from the installation area indoors, or when the installation area is conditioned, provide a duct for heat exhaustion to the air outlet port of this product for ventilation. Do not mount the inlet of the duct (flange) directly to the air vent of the product, and keep a space larger than the diameter of the duct. Additionally, consider the resistance of the duct when making the air vent port for the duct.

<Heat radiation amount/Required ventilation rate>

Model	Heat radiation amount [kW]	Required ventilation rate [m³/min]	
		Differential temp. of 3 °C between inside and outside of installation area	Differential temp. of 6 °C between inside and outside of installation area
HRS090-A-20/40/46	17	290	145

HRS090 Series
Specific Product Precautions 3

Be sure to read this before handling. Refer to the back cover for Safety Instructions. For Temperature Control Equipment Precautions, refer to "Handling Precautions for SMC Products" and the Operation Manual on the SMC website, http://www.smc.eu

Piping

⚠ Caution

1. Regarding the circulating fluid and facility water pipings, consider carefully the suitability for temperature, circulating fluid.

If the operating performance is not sufficient, the pipings may burst during operation. Using corrosive materials such as aluminum or iron for fluid contact parts such as piping may cause clogging or leakage in the circulating fluid and facility water circuits. Provide protection against corrosion when you use the product.

2. Select the piping port size which can exceed the rated flow.

For the rated flow, refer to the pump capacity table.

3. When tightening at the drain port of this product, use a pipe wrench to clamp the connection ports.

4. For the circulating fluid piping connection, install a drain pan and wastewater collection pit just in case the circulating fluid may leak.

5. This product series are constant-temperature fluid circulating machines with built-in tanks.

Do not install equipment on your system side such as pumps that forcibly return the circulating fluid to the unit. Also, if you attach an external tank that is open to the air, it may become impossible to circulate the circulating fluid. Proceed with caution.

6. The facility water flow rate is adjusted automatically according to the operating conditions.
In addition, the facility water return temperature is 60 °C at maximum.

Circulating Fluid

⚠ Caution

1. Avoid oil or other foreign objects entering the circulating fluid.

2. When water is used as a circulating fluid, use tap water that conforms to the appropriate water quality standards.

Use tap water that conforms to the standards shown below (including water used for dilution of ethylene glycol aqueous solution).

Tap Water (as Circulating Fluid) Quality Standards

The Japan Refrigeration and Air Conditioning Industry Association
JRA GL-02-1994 "Cooling water system – Circulation type – Make-up water"

	Item	Unit	Standard value	Influence	
				Corrosion	Scale generation
Standard item	pH (at 25 °C)	—	6.0 to 8.0	○	○
	Electric conductivity (25 °C)	[μS/cm]	100* to 300*	○	○
	Chloride ion (Cl^-)	[mg/l]	50 or less	○	
	Sulfuric acid ion (SO_4^{2-})	[mg/l]	50 or less	○	
	Acid consumption amount (at pH4.8)	[mg/l]	50 or less		○
	Total hardness	[mg/l]	70 or less		○
	Calcium hardness ($CaCO_3$)	[mg/l]	50 or less		○
	Ionic state silica (SiO_2)	[mg/l]	30 or less		○
Reference item	Iron (Fe)	[mg/l]	0.3 or less	○	○
	Copper (Cu)	[mg/l]	0.1 or less	○	
	Sulfide ion (S_2^-)	[mg/l]	Should not be detected.	○	
	Ammonium ion (NH_4^+)	[mg/l]	0.1 or less	○	
	Residual chlorine (Cl)	[mg/l]	0.3 or less	○	
	Free carbon (CO_2)	[mg/l]	4.0 or less	○	

* In the case of [MΩ·cm], it will be 0.003 to 0.01.
- ○: Factors that have an effect on corrosion or scale generation.
- Even if the water quality standards are met, complete prevention of corrosion is not guaranteed.

3. Use an ethylene glycol aqueous solution that does not contain additives such as preservatives.

Circulating Fluid

⚠ Caution

4. When using ethylene glycol aqueous solution, maintain a maximum concentration of 15 %.

Overly high concentrations can cause a pump overload.
Low concentrations, however, can lead to freezing when circulating fluid temperature is 10 °C or lower and cause the thermo-chiller to break down.

5. When deionized water is used, the electric conductivity should be 1 μS/cm or higher (Electric resistivity: 1 MΩ·cm or lower).

Electrical Wiring

⚠ Warning

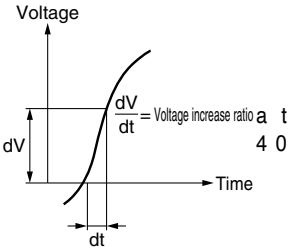
Grounding should never be connected to a water line, gas line or lightning rod.

⚠ Caution

1 . Power supply and communication cables should be prepared by user.

2 . Provide a stable power supply which is not affected by surge or distortion.

If the voltage increase ratio (dV/dt) the zero cross should exceed V/ 2 0 0 μsec., it may result in a malfunction.



HRS090 Series
Specific Product Precautions 4

Be sure to read this before handling. Refer to the back cover for Safety Instructions. For Temperature Control Equipment Precautions, refer to "Handling Precautions for SMC Products" and the Operation Manual on the SMC website, http://www.smc.eu

Electrical Wiring

⚠ Caution

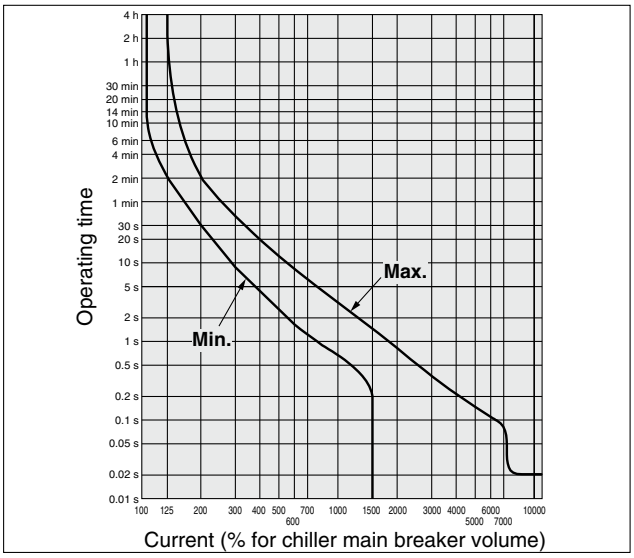
When Option "-B" (With earth leakage breaker) or the HRS090-□-40/46-□ is selected

3 . This product is installed with a breaker with the following operating characteristics.

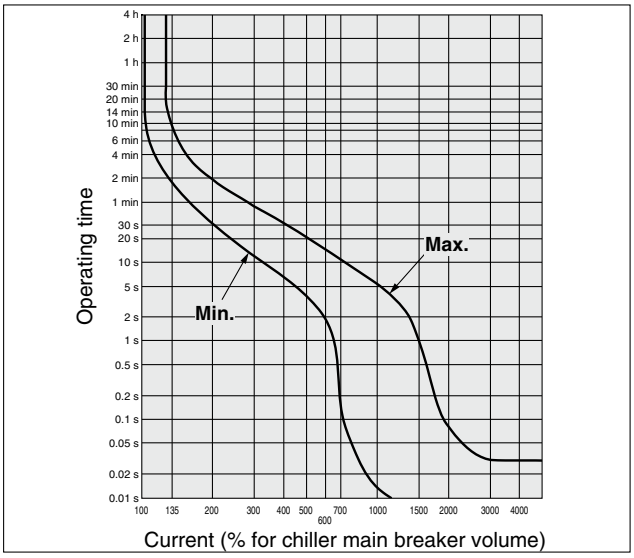
For the user's equipment (inlet side), use a breaker whose operating time is equal to or longer than the breaker of this product. If a breaker with shorter operating time is connected, the user's equipment could be cut off due to the inrush current of the motor of this product.

Option B [With earth leakage breaker]

HRS090-□-40-□



HRS090-□-46-□



Facility Water Supply

⚠ Warning

<Water-cooled refrigeration>

1. The water-cooled refrigeration type thermo-chiller radiates heat to the facility water. Prepare the facility water system that satisfies the heat radiation and the facility water specifications below.

■Required facility water system

<Heat radiation amount/Facility water specifications>

Model	Heat radiation [kW]	Facility water specifications
HRS090-W□-□	17	Refer to "Facility water system"

2. When using tap water as facility water, use tap water that conforms to the appropriate water quality standards.

Use tap water that conforms to the standards shown below.
If the water quality standards are not met, clogging or leakage in the facility water piping, or other problems such as refrigerant leakage, etc., may result.

Tap Water (as Facility Water) Quality Standards

The Japan Refrigeration and Air Conditioning Industry Association
JRA GL-02-1994 "Cooling water system – Circulation type – Circulating water"

	Item	Unit	Standard value	Influence	
				Corrosion	Scale generation
Standard item	pH (at 25 °C)	—	6.5 to 8.2	○	○
	Electric conductivity (25 °C)	[μS/cm]	100*1 to 800*1	○	○
	Chloride ion (Cl^-)	[mg/L]	200 or less	○	
	Sulfuric acid ion (SO_4^{2-})	[mg/L]	200 or less	○	
	Acid consumption amount (at pH4.8)	[mg/L]	100 or less		○
	Total hardness	[mg/L]	200 or less		○
	Calcium hardness ($CaCO_3$)	[mg/L]	150 or less		○
	Ionic state silica (SiO_2)	[mg/L]	50 or less		○
Reference item	Iron (Fe)	[mg/L]	1.0 or less	○	○
	Copper (Cu)	[mg/L]	0.3 or less	○	
	Sulfide ion (S_2^-)	[mg/L]	Should not be detected.	○	
	Ammonium ion (NH_4^+)	[mg/L]	1.0 or less	○	
	Residual chlorine (Cl)	[mg/L]	0.3 or less	○	
	Free carbon (CO_2)	[mg/L]	4.0 or less	○	

*1 In the case of [MΩ·cm], it will be 0.001 to 0.01.
- ○: Factors that have an effect on corrosion or scale generation.
- Even if the water quality standards are met, complete prevention of corrosion is not guaranteed.

3. Set the supply pressure between 0.3 to 0.5 MPa. Ensure a pressure difference at the facility water inlet/outlet of 0.3 MPa or more.

If the supply pressure is high, it will cause water leakage. If the supply pressure and pressure difference at the facility water inlet/outlet is low, it will cause an insufficient flow rate of the facility water, and poor temperature control.

HRS090 Series
Specific Product Precautions 5

Be sure to read this before handling. Refer to the back cover for Safety Instructions. For Temperature Control Equipment Precautions, refer to "Handling Precautions for SMC Products" and the Operation Manual on the SMC website, http://www.smc.eu

Operation

⚠ Warning

1. Confirmation before operation

1) The fluid level of a tank should be within the specified range of H (High) and L (Low). When exceeding the specified level, the circulating fluid will overflow.
2) Remove the air.
Conduct a trial operation, looking at the fluid level.
Since the fluid level will go down when the air is removed from the user's piping system, supply water once again when the fluid level is reduced. When there is no reduction in the fluid level, the job of removing the air is completed.
Pump can be operated independently.

2. Confirmation during operation

- Check the circulating fluid temperature.
The operating temperature range of the circulating fluid is between 5 and 35 °C.
When the amount of heat generated from the user's equipment is greater than the product's capability, the circulating fluid temperature may exceed this range. Use caution regarding this matter.

3. Emergency stop method

- When an abnormality is confirmed, stop the machine immediately. After stopping operation, disconnect the power supply from the user's equipment.

Operation Restart Time/Operation and Suspension Frequency

⚠ Caution

1. Wait five minutes or more before restarting operation after it has been stopped. If the operation is restarted within five minutes, the protection circuit may activate and the operation may not start properly.

2. Operation and suspension frequency should not exceed 10 times per day. Frequently switching between operation and suspension may result in the malfunction of the refrigeration circuit.

Protection Circuit

⚠ Caution

If operating in the below conditions, the protection circuit will activate and an operation may not be performed or will stop.

- Power supply voltage is not within the rated voltage range of ±10 %.
- In case the water level inside the tank is reduced abnormally.
- Circulating fluid temperature is too high.
- Compared to the cooling capacity, the heat generation amount of the user's equipment is too high.
- Ambient temperature is too high. (Check the ambient temperature in the specifications.)
- Ventilation hole is clogged with dust or dirt.

Maintenance

⚠ Caution

<Periodical inspection every one month>

Clean the ventilation hole.

If the dustproof filter of water-cooled type product becomes clogged with dust or debris, a decline in cooling performance can result.
In order to avoid deforming or damaging the dustproof filter, clean it with a long-haired brush or air gun.

<Periodical inspection every three months>

Inspect the circulating fluid.

1. When using tap water or deionized water
   - Replacement of circulating fluid
   Failure to replace the circulating fluid can lead to the development of bacteria or algae. Replace it regularly depending on your usage conditions.
   - Tank cleaning (same as the HRS series)
   Consider whether dirt, slime or foreign objects may be present in the circulating fluid inside the tank, and carry out regular cleanings of the tank.
2. When using ethylene glycol aqueous solution
   Use a concentration meter to confirm that the concentration does not exceed 15 %.
   Dilute or add as needed to adjust the concentration.

<Periodical inspection during the winter season>

1. Make water-removal arrangements beforehand.

If there is a risk of the circulating fluid and facility water freezing when the product is stopped, release the circulating fluid and facility water in advance.

2. Consult a professional.

This product has an "anti-freezing function" and "warming-up function." Read the Operation Manual carefully, and if any additional anti-freezing function (e.g. tape heater) is needed, ask for it from the vendor.

■ Refrigerant with GWP reference

Refrigerant	Global warming potential (GWP)		
	Regulation (EU) No 517/2014 (Based on the IPCC AR4)	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

* This product is hermetically sealed and contains fluorinated greenhouse gases (HFC). When this product is sold on the market in the EU after January 1, 2017, it needs to be compliant with the quota system of the F-Gas Regulation in the EU.
* See specification table for refrigerant used in the product.

⚠ Safety Instructions

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) [1], and other safety regulations.

⚠ **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.

1) ISO 4414: Pneumatic fluid power – General rules and safety requirements for systems and their components.
ISO 4413: Hydraulic fluid power – General rules and safety requirements for systems and their components.
IEC 60204-1: Safety of machinery – Electrical equipment of machines. (Part 1: General requirements)
ISO 10218-1: Robots and robotic devices - Safety requirements for industrial robots - Part 1: Robots.
etc.

⚠ 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 catalogue 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. Do not service or attempt to remove product and machinery/ equipment until safety is confirmed.
1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. Our products cannot be used beyond their specifications.
Our products are not developed, designed, and manufactured to be used under the following conditions or environments.
Use under such conditions or environments is not covered.
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, fuel 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 catalogues 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

We develop, design, and manufacture our products to be used for automatic control equipment, and provide them for peaceful use in manufacturing industries.
Use in non-manufacturing industries is not covered.
Products we manufacture and sell cannot be used for the purpose of transactions or certification specified in the Measurement Act.
The new Measurement Act prohibits use of any unit other than SI units in Japan.

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. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first. [2] Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided. This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.
3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalogue for the particular products.

2) Vacuum pads are excluded from this 1 year warranty.
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered. Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

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.

SMC Corporation (Europe)

Austria	+43 (0)2262622800	www.smc.at	office@smc.at
Belgium	+32 (0)33551464	www.smc.be	info@smc.be
Bulgaria	+359 (0)2807670	www.smc.bg	office@smc.bg
Croatia	+385 (0)13707288	www.smc.hr	office@smc.hr
Czech Republic	+420 541424611	www.smc.cz	office@smc.cz
Denmark	+45 70252900	www.smcdk.com	smc@smcdk.com
Estonia	+372 651 0370	www.smcee.ee	info@smcee.ee
Finland	+358 207513513	www.smc.fi	smcfi@smc.fi
France	+33 (0)164761000	www.smc-france.fr	supportclient@smc-france.fr
Germany	+49 (0)61034020	www.smc.de	info@smc.de
Greece	+30 210 2717265	www.smchellas.gr	sales@smchellas.gr
Hungary	+36 23513000	www.smc.hu	office@smc.hu
Ireland	+353 (0)14039000	www.smcautomation.ie	sales@smcautomation.ie
Italy	+39 03990691	www.smcitalia.it	mailbox@smcitalia.it
Latvia	+371 67817700	www.smc.lv	info@smc.lv
Lithuania	+370 5 2308118	www.smclt.lt	info@smclt.lt
Netherlands	+31 (0)205318888	www.smc.nl	info@smc.nl
Norway	+47 67129020	www.smc-norge.no	post@smc-norge.no
Poland	+48 222119600	www.smc.pl	sales@smc.pl
Portugal	+351 214724500	www.smc.eu	apoioclientept@smc.smces.es
Romania	+40 213205111	www.smcromania.ro	smcromania@smcromania.ro
Russia	+7 (812)3036600	www.smc.eu	sales@smcru.com
Slovakia	+421 (0)413213212	www.smc.sk	office@smc.sk
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UK	+44 (0)845 121 5122	www.smc.uk	sales@smc.uk
South Africa	+27 10 900 1233	www.smcza.co.za	zasales@smcza.co.za

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