Temperature Control Equipment

Chiller Lineup

A chiller is used to control the temperature of circulating fluid and supply it to the heat source.

Thermo-cooler *Series HRG, HRGC*

General-purpose, economy type for machine tools, etc.

- Cooling capacity: **1.1 kW to 15 kW**
- Temperature stability: **±0.5/1.0°C**

HRG

HRGC

Thermo-con *Series HEC*

High-precision temperature control type for semiconductor manufacturing equipment, medical equipment, etc.

- Cooling capacity: **140 W to 1200 W**
- Temperature stability: **±0.01°C to 0.03°C**

Thermo-chiller *Series HRS, HRZ, HRW*

High-performance type for semiconductor manufacturing equipment, etc.

Compact type *Series HRS* and Dual thermo-chiller (double inverter type) *Series HRZD* have been added!

- Cooling capacity: **1 kW to 30 kW**
- Temperature stability: **±0.1/0.3°C**

New

HRZD

New

HRS

HRZ

HRW

Thermoelectric Bath *Series HEB*

Accurately controls the temperature of liquid in the bath.

Can indirectly control the temperature of chemical bottles, test tubes, flasks, cooling coils (heat exchangers) in the constant temperature bath.

- Cooling capacity: **140 W**
- Temperature stability: **±0.01°C**

Chemical Thermo-con *Series HED*

All wetted parts are made of fluororesin.

Controls the temperature of chemicals by directly cooling and heating them.

Can directly control the temperature of chemicals such as hydrofluoric acid, sulfuric acid, ammonia water, deionized water, etc.

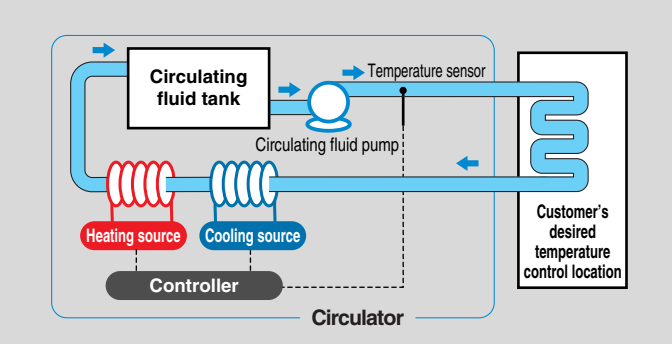
- Cooling capacity: **300 W to 750 W**
- Temperature stability: **±0.1°C**

SMC

CAT.E43C

Chiller

This equipment is used to supply the temperature-controlled circulating fluid to where customers wish to control the temperature.

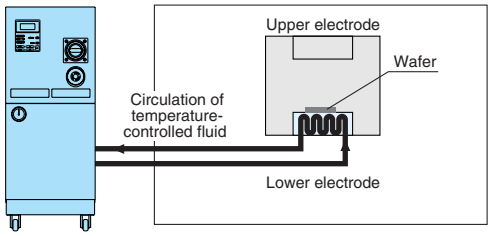


Chillers circulate a heat medium, such as water, in the device using a pump. This equipment is also known as a circulator. Chillers circulate the constant temperature circulating fluid by controlling the output from a cooling source such as a compressor, or a heating source such as a heater.

Application Examples

Semiconductor

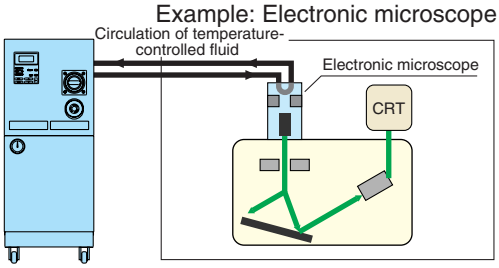
Example: Temperature control of chamber electrode



- **Etching equipment**
- **CVD equipment**
- **Spattering equipment**
- **Memory tester**

Analysis

Example: Electronic microscope

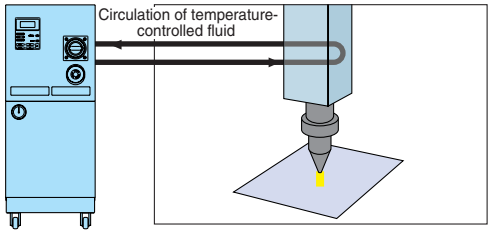


- **X-ray analytical instrument**
- **Electron microscope**
- **Gas chromatography**
- **Sugar level analytical instrument**

Prevents the distortion caused by the heat generated by the electronic gun in an electronic microscope.

Machine tool

Example: Laser machining

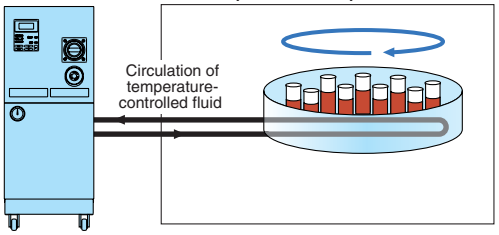


- **Laser machining**
- **Cutting tool**
- **Wire cutting**
- **Plasma welding**

Temperature-controlling the laser generating tube enables the laser wavelength to be optimised, improving the accuracy of the machined cross sectional area.

Medical

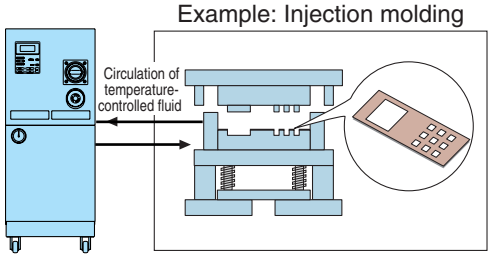
Example: Blood preservation



- **X-ray instrument**
- **MRI**
- **Blood preservation equipment**

Molding

Example: Injection molding



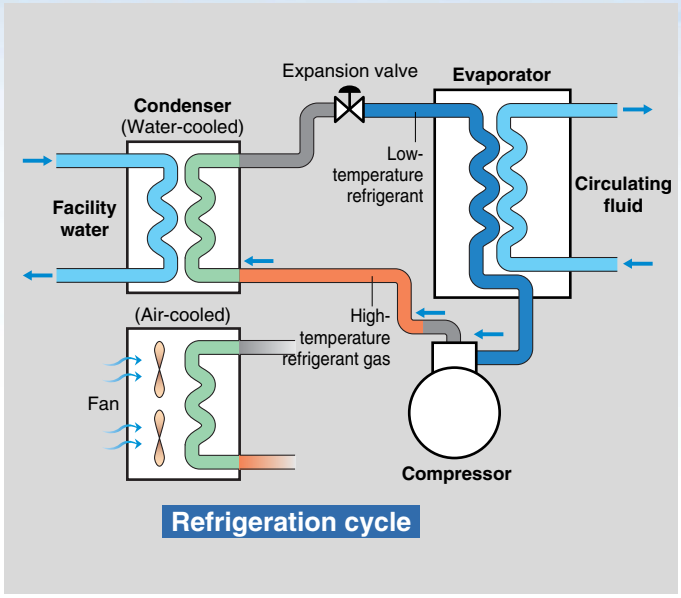
- **Plastic molding**
- **Rubber molding**
- **Injection molding**
- **Wire cable coating machine**

Temperature-controlling the mold results in improved product quality.

Three types of cooling and heating methods can be selected for a wide range of applications.

① Refrigerated — Generates low temperatures using a refrigeration cycle.

Series HRG, HRGC, HRS, HRZ



Refrigeration cycle

This equipment cools the circulating fluid by performing heat exchange with low-temperature refrigerant gas, using a built-in refrigeration circuit that circulates refrigerant.
Large-scale heat exchange can be handled compared with the Peltier type.
There are two types of heating sources: high-temperature refrigerant gas which is generated from the refrigeration circuit, and an electric heater. Both air-cooled and water-cooled types are available, depending on the condenser's cooling method.

Series HRG

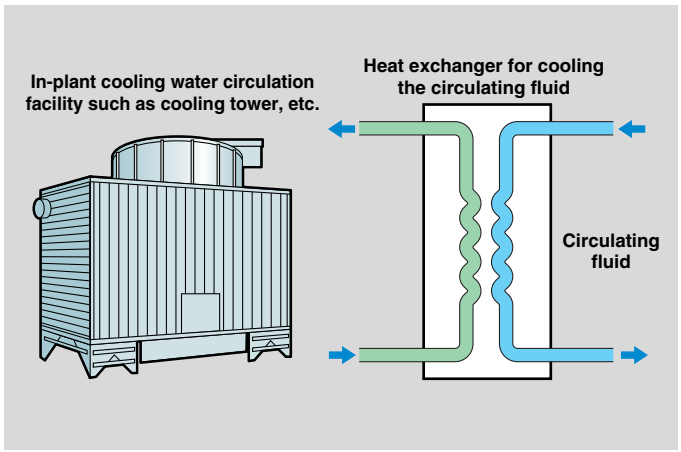
Series HRS

Series HRZ

Series HRZD

② Water-cooled — For temperature control in room temperature area

Series HRW

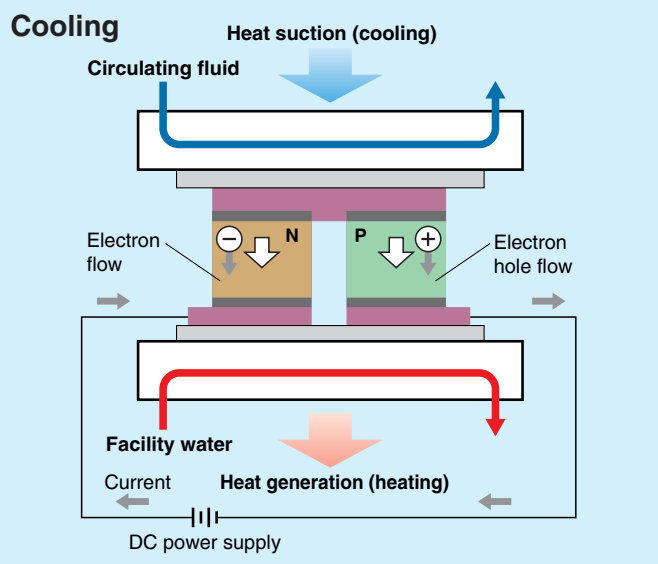


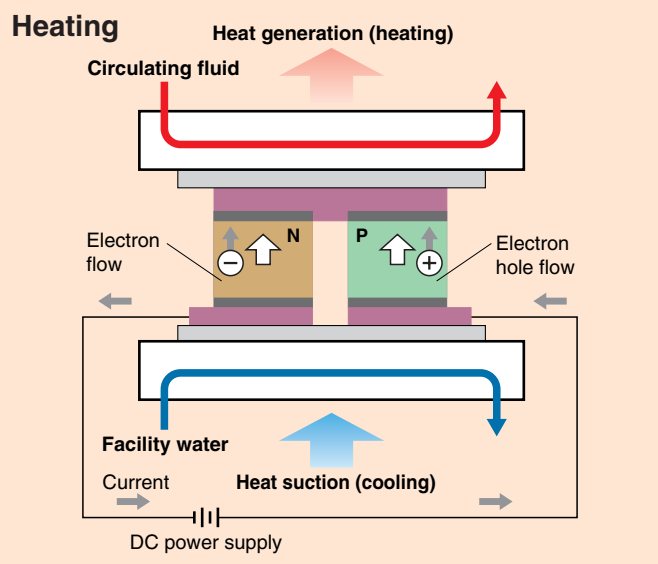
This equipment cools the circulating fluid by directly exchanging it with the cooling water in the plant. This can be used at room temperature or higher, and also used when there is a cooling water circulation facility.
Large-scale heat exchange can be performed using less energy, and the device has a compact body since a compressor is not required. An electric heater is used for heating.

Series HRW

③ Peltier-type For high-precision temperature control

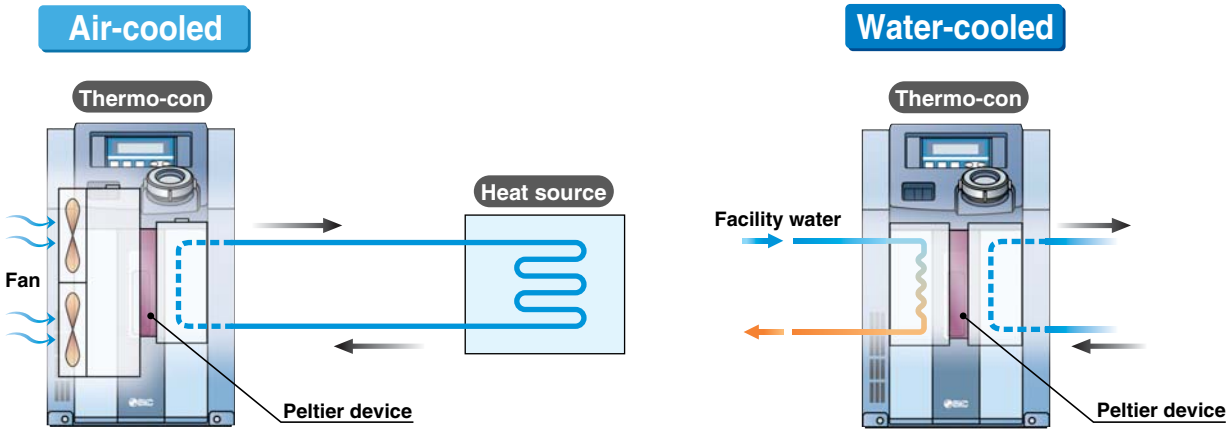
Thermo-con *Series HEC*



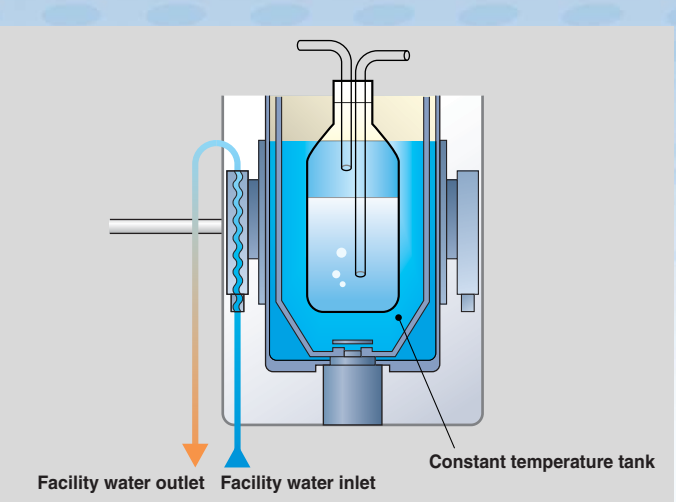


A Peltier device is a plate type element, inside which P-type semiconductors and N-type semiconductors are located alternately. If direct current is supplied to the Peltier device, heat is transferred inside the device, and one face generates heat and increases temperature while the other face absorbs heat and decreases temperature. Therefore, changing the direction of the current supplied to the Peltier device can achieve heating and cooling operation.
Temperature can be controlled very precisely because this method has a fast response and can switch quickly.
A Peltier device is sometimes called a thermo-module, thermoelement, TED (Thermo Electric Device), etc.

Series HEC



Thermoelectric Bath HEB

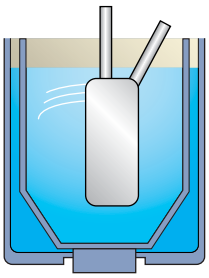


This equipment precisely controls the temperature of the fluid in the constant temperature tank. Customers can control the temperature by placing a container in the tank. Cooling and heating can be controlled precisely with the Peltier device (±0.01°).

Series ***HEB***

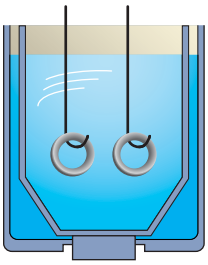
Application Examples

Semiconductor



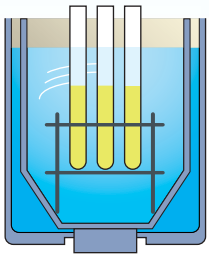
Evaporation of chemicals for MOCVD
Temperature control of diffusion gas

Various tests



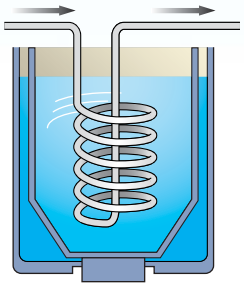
Thermal test with immersion

Physical and chemical analysis



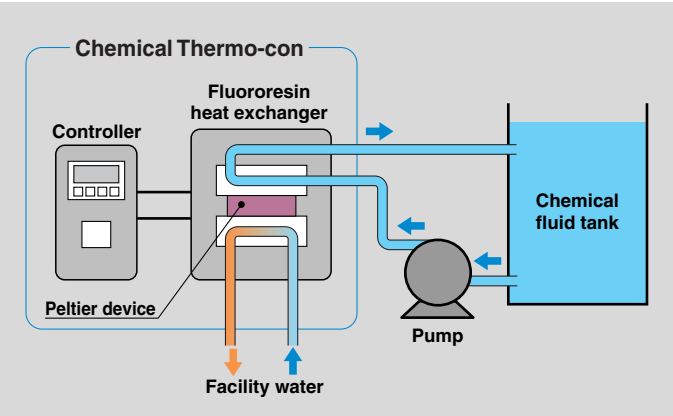
Temperature control of various samples, materials and parts

Various chemical processes



Indirect temperature control of chemicals and liquids with high viscosity

Chemical Thermo-con HED



A Chemical Thermo-con is used to control the temperature by cooling and heating chemicals through the Fluororesin heat exchanger. The temperature at the Fluororesin heat exchanger outlet can be controlled precisely to ±0.1°. The temperature of chemicals can be controlled by directly running them through since all wetted parts are made of fluororesin.
A Peltier device is used as a cooling and heating source.

Series ***HED***

∗ A pump and a chemical fluid tank must be prepared by the customer.
∗ Refer to “Applicable Fluids” on page 216 for types of chemicals. Please contact SMC if applicable fluids are unknown.

SMC Temperature Control Equipment Guide

Production of HRG001/002 and HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

● : Standard
○ : Selectable by model or option

Chiller (Circulating Fluid Temperature Controller) / Bath / Temperature Control System for Chemicals

Series	Features	Temperature range	Max. cooling capacity	Cooling method	Temperature stability	Pump capacity	Applicable fluid	Automatic water supply	Circulating fluid recovery	Inverter-controlled compressor	PID control	ON/OFF control	Learning control	Error diagnostic function	Pump inverter	Flow sensor/switch	RS-232C	RS-485	Analog I/O	DeviceNet™	With earth leakage breaker	With heater	With external switch inlet	Stainless steel wetted parts (including lid)	For deionized water piping	High-lift pump	With DI control kit	With water leakage sensor	High-temperature equipment specs.	Page
Refrigerated																														
Economy-type chiller **Thermo-cooler** ***Series HRG*** (3-phase power supply) 	● With this chiller, cooling water can be obtained anywhere it is necessary because of easy installation and easy operation. ● For a wide range of applications such as laser machine tool, analytical equipment, LCD manufacturing equipment, mold temperature control, etc.	5 to 35°C –30 to 90	15 kW	Air-cooled refrigeration, Water-cooled refrigeration	±1.0°C/ ±0.5°C	5 to 62 L/min	Clear water, Deionized water, Ethylene glycol aqueous solution				○	○					○							○			From P.1
Economy-type chiller **Thermo-cooler** ***Series HRGC*** (Single-phase power supply) CE cULus 	● With this chiller, cooling water can be obtained anywhere it is necessary because of easy installation and easy operation. ● For a wide range of applications such as mold temperature control, laser machine tool, analytical equipment, LCD manufacturing equipment, etc. ● Ideal for export equipment (single-phase 200 to 300 V) ● UL standards, CE marking	5 to 35°C –30 to 90	5 kW	Air-cooled refrigeration, Water-cooled refrigeration	±1.0°C/ ±0.5°C	5 to 62 L/min	Clear water, Deionized water, Ethylene glycol aqueous solution	○			○	○	●			○	○			○	○	○	○	○		○	○	○		From P.41
High-performance chiller/Compact type **Thermo-cooler** ***Series HRS*** CE cMETus 	● Fits into the space under a laboratory table with a compact design. 615 H x 377 W x 500 D 40 kg ● Available for single-phase 100/115 V, 200 to 230 V ● UL standards, CE marking	5 to 40°C –30 to 90	2.4 kW	Air-cooled refrigeration, Water-cooled refrigeration	±0.1°C	5 to 25 L/min	Clear water, Ethylene glycol aqueous solution	○			●		●			●	●	●				●			○	○			○	From P.69
High-performance chiller **Thermo-chiller** ***Series HRZ*** CE cULus SEMI 	● Suitable for semiconductor processing equipment with a wide variety of features such as high temperature stability, wide temperature range, failure diagnosis, external communication, etc. ● Conforming to various safety standards ● Conforming to UL, SEMI standards, CE marking	–20 to 40°C –30 to 90 20 to 90°C –30 to 90 –20 to 90°C –30 to 90	15 kW	Water-cooled refrigeration	±0.1°C	6 to 40 L/min	Fluorinated fluid, Clear water, Deionized water, Ethylene glycol aqueous solution	○	○		●		●		●	○	●	○	○	●	○		●		●	○	●		Fluorinated fluid type From P.104 Ethylene glycol type From P.107 Clear/Deionized water type From P.110
High-performance chiller **Thermo-chiller** ***Series HRZ*** **(Built-in inverter)** CE cULus SEMI 	● In addition to advanced HRZ series, energy-saving is achieved through use of a DC inverter compressor. ● A single unit covers a wide temperature range and has a large cooling capacity. ● Can respond to change of process conditions flexibly, which is suitable for semiconductor equipment with a short innovation cycle. ● Conforming to UL, SEMI standards, CE marking	–20 to 90°C –30 to 90	10 kW	Water-cooled refrigeration	±0.1°C	10 to 40 L/min	Fluorinated fluid, Clear water, Deionized water, Ethylene glycol aqueous solution		○	●	●		●	●	●		●	○	○	●	●		●		●	○	●		Fluorinated fluid type From P.112 Ethylene glycol type From P.112 Clear/Deionized water type From P.112
High-performance chiller **Dual Thermo-chiller** ***Series HRZD*** **(Built-in inverter)** CE SEMI 	● Temperature for two systems can be controlled separately by one chiller. ● More effective energy-saving is achieved through use of a DC inverter compressor and an inverter pump. ● Conforming to SEMI standards, CE marking	–30 to 90°C –30 to 90	9.5 kW x 2	Water-cooled refrigeration	±0.1°C	10 to 40 L/min	Fluorinated fluid, Ethylene glycol aqueous solution		○	●	●		●	●	●		●	●		●	●		●		●		●		From P.127
Water-cooled																														
High-performance chiller **Thermo-chiller** ***Series HRW*** (Water-cooled) CE cULus SEMI 	● Direct heat exchanger for in-plant circulating fluid ● Refrigerant-free ● Can control the temperature over a wide range since a compressor is not required. ● Suitable for semiconductor processing equipment with a wide variety of features such as high temperature stability, wide temperature range, failure diagnosis, external communication, etc. ● Conforming to UL, SEMI standards, CE marking	20 to 90°C –30 to 90	30 kW	Water-cooled (Without compressor)	±0.3°C	10 to 30 L/min	Fluorinated fluid, Clear water, Deionized water, Ethylene glycol aqueous solution		○		●		●	●	●		●	○	○	●	●		●	○	●	○	●		Fluorinated fluid type From P.140 Ethylene glycol type From P.142 Clear/Deionized water type From P.144
High-performance chiller **Thermo-chiller** ***Series HRW*** (Water-cooled) **(Built-in inverter)** CE cULus SEMI 																														
Peltier-type																														
High-precision chiller **Thermo-con** ***Series HEC*** CE cMETus ETL 	● High-precision temperature controller with a Peltier device suitable for applications that require high-precision temperature control. ● Refrigerant-free ● Highly-reliable simple construction ● Easy installation in equipment with a compact, low-vibration body ● Compatible with a wide range of power supply voltage ● Conforming to UL standards, CE marking	10 to 60°C –30 to 90	600 W	Peltier-type air-cooled	±0.01°C	1 to 10 L/min	Clear water				●		●	●	○	●	●												From P.166
			1.2 kW	Peltier-type water-cooled	±0.01°C	3 to 23 L/min	Clear water, Fluorinated fluid				●		●	●	○	●	●												From P.178
High-precision bath **Thermoelectric Bath** ***Series HEB*** CE cMETus 	● High-precision temperature control bath with a Peltier device ● Refrigerant-free ● Compact and low noise ● Minimal up-down temperature distribution with a unique agitation method	–15 to 60°C –30 to 90	140 W	Peltier-type water-cooled	±0.01°C	—	Clear water, Fluorinated fluid				●		●			●	●												From P.193
Fluororesin temperature control system for chemicals **Chemical Thermo-con** ***Series HED*** CE SEMI 	● Heat exchanger for direct temperature control with a Peltier device ● Refrigerant-free ● Compatible with a wide range of chemicals by use of a fluororesin heat exchanger ● Conforming to SEMI standards, CE marking	10 to 60°C –30 to 90	750 W	Peltier-type water-cooled	±0.1°C	—	Deionized water, Chemical				●		●	●			●	●											From P.203

Note) This table is a guide to select models.
Refer to applicable model pages for detailed specifications.

Temperature Control Equipment

CONTENTS

Circulating Fluid Temperature Controller

Production of HRG001/ 002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Refrigerated Thermo-cooler *Series HRG*

Makes cooling water easily available, anytime, anywhere.

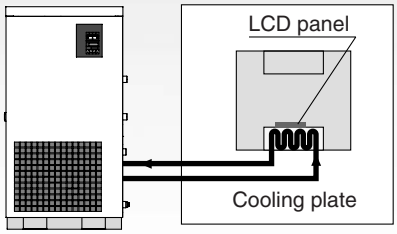
- **Cooling capacity (60 Hz):**
  1.1 kW / 2.3 kW / 4.8 kW, 9.5 kW / 14.5 kW (Air-cooled refrigeration)
  1.1 kW / 2.3 kW / 4.8 kW, 11.0 kW / 16.5 kW (Water-cooled refrigeration)
- **Temperature stability: ±1°C** (Compressor ON/OFF control) **/ ±0.5°C** (Proportional valve PID control)
- **Temperature range setting: 5 to 35°C**

Application Examples

Can be used in many applications other than those shown below. Refer to other "Application Examples" page in this catalog.

Temperature control of LCD panels

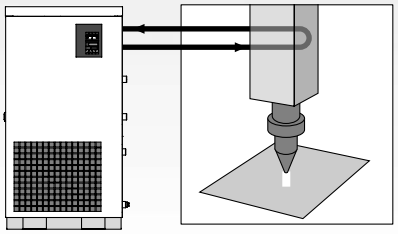
Example: Cooling an LCD panel



Can be used for cooling during transfer to processing, before and after resist coating and firing of the glass substrate.

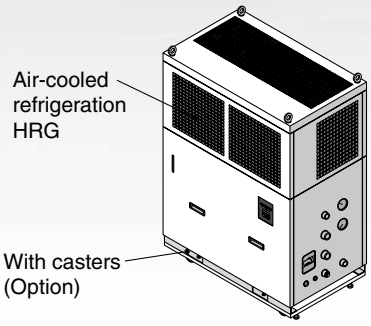
Temperature control of welding torches

Example: Laser welding



Can be used to supply cooling water to welding torches or commercially available laser welding devices, and to prevent overheating of the torch or the oscillation tube.

As a replacement for a cooling tower

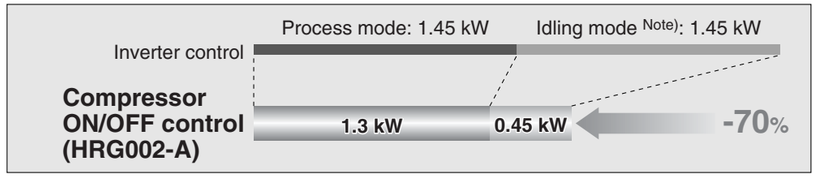


Installing extra cooling towers can be troublesome. The HRG series (air-cooled refrigeration) can be moved easily to wherever you need it, when you need it. Cooling water is supplied from the attached hose.

Energy-Saving

Power consumption: Max. 70% reduction

When the circulating fluid reaches a certain preset temperature, the compressor stops temporarily (idling stop) and the temperature is adjusted (compressor ON/OFF control). Stopping the compressor for longer periods of time and operating at low load (idling mode) reduces power consumption dramatically. Even in processes where there is heat loading, performance is at least as good as that of inverter control.

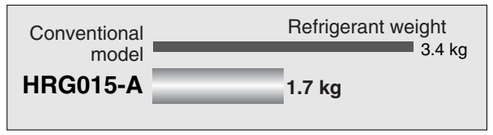


Note) Operating conditions: Process mode: Circulating fluid temperature 20°C, Heat load 2 kW
Idling mode: Circulating fluid temperature 20°C, Heat load 0 kW

- Reduced running cost
- Contribution to the environmental preservation

Refrigerant: Max. 50% (SMC comparison) reduction

Conventionally, reducing the amount of refrigerant gas has meant a reduction in cooling performance. Now, however, the HRG's use of an improved high-performance **heat exchanger** Note) makes it possible to reduce the volume of refrigerant used (refrigerant charge volume) without sacrificing cooling performance.

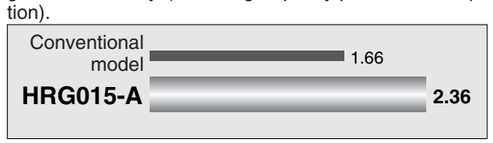


Note) HRG010-A, HRG015-A only

- More environmentally friendly

Efficiency: 42% (SMC comparison) improvement

A new high-performance **heat exchanger** Note) improves the HRG heat exchange capability, delivering greater efficiency (= cooling capacity/power consumption).



Note) HRG010-A, HRG015-A only

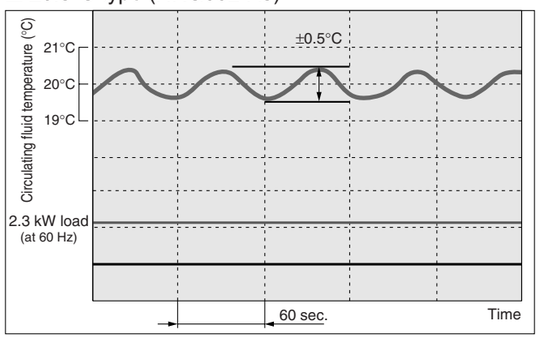
- Reduced running cost
- More environmentally friendly

High Performance

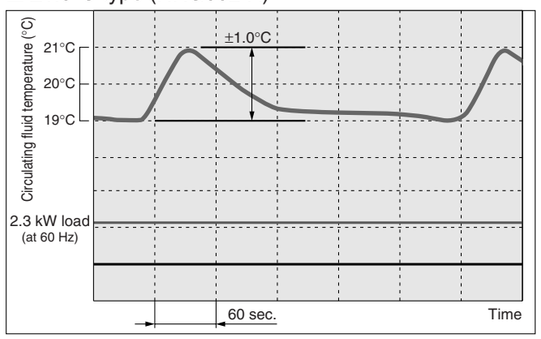
Temperature stability: ±0.5°C Note 1) 3) ±1.0°C Note 2) 3) (when a load is stable)

Two types of temperature control are provided: to ±0.5°C specifications using split flow from a three-way proportional valve, and simple temperature control to ±1.0°C specifications using the compressor ON/OFF mechanism. Choose the temperature stability that is right for your manufacturing process and method.

■ ±0.5°C type (HRG002-A5)



■ ±1.0°C type (HRG002-A)

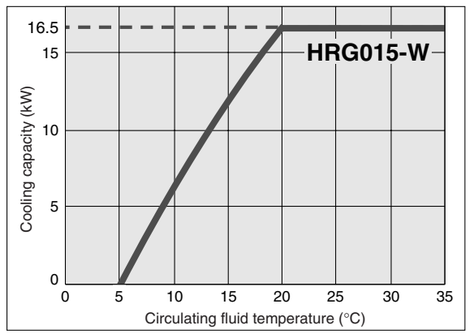


Note 1) HRG001-□5 to HRG005-□5
Note 3) The value shown applies to a stable load state with no outside interference. Actual values may vary depending on the operating conditions.

Note 2) HRG001-□ to HRG015-□

Cooling capacity: Max. 16.5 kW Note)

A maximum cooling capacity of 16.5 kW has been achieved with our air-cooled and water-cooled refrigeration ranges.



Note) HRG015-W operating at a power supply frequency of 60 Hz

Wetted parts adopt the materials compatible for various circulating fluids.

- 15% ethylene glycol aqueous solution
- Clear water, Deionized water Note)

Note) Supply water with electrical conductivity of 1 μS/cm or more. Please note that it is not possible to maintain a specific electrical conductivity.

Production of HRG001/002 will be discontinued in January 2011.
Thereafter, please select Series HRS.

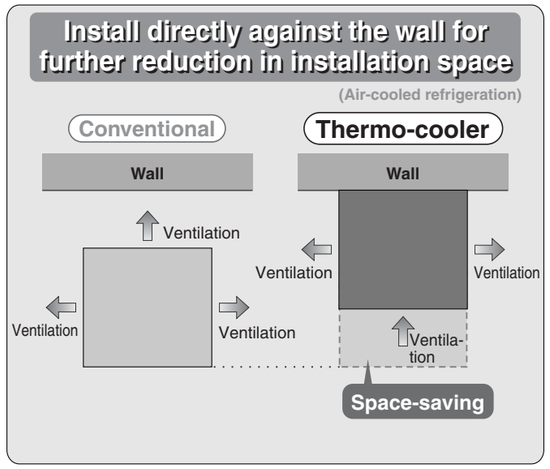
Space-Saving

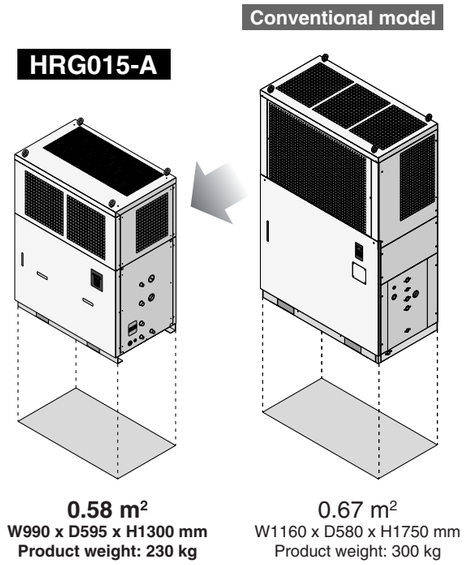
External volume: Max. 35% reduction (SMC comparison)

Weight: 23% reduction (SMC comparison)

Footprint: Max. 12% reduction (SMC comparison)

Improvements in the HRG's high-performance **heat exchanger** have enabled the size of the unit to be reduced, with corresponding reductions in weight and space needed for installation.





Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Easy Operation and Maintenance

Simple operation

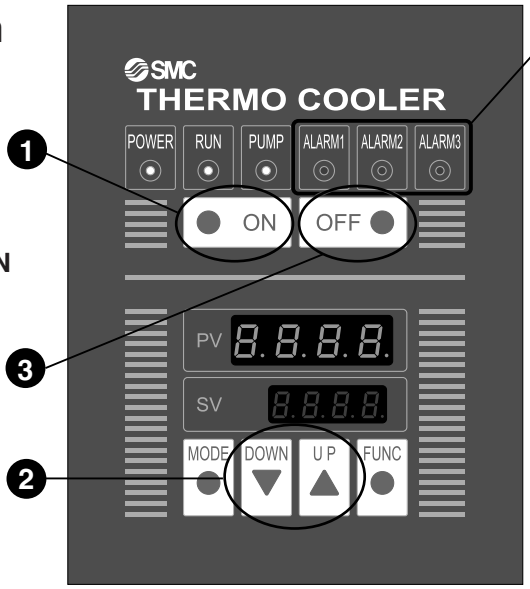
(Standard specifications)

Operation 1
Press the ON button.

Operation 2
Adjust the temperature setting with the UP/DOWN keys.

Operation 3
Press the OFF button to shut down.

What could be easier?!



With individual alarm indicators

Three separate levels of alarm indi-cators [Note] for easy faiure diagnosis.

(Supplied as standard for the HRG010-□ and HRG015-□, and as specials for the HRG001 to HRG005.)

Individual red LED alarm indicators

ALARM1 Abnormal installation status
ALARM2 Water delivery circuit error
ALARM3 Refrigeration circuit error

Note) Refer to page 24 for operation display panel and alarms.

Contact input/output signal

(Standard specifications)

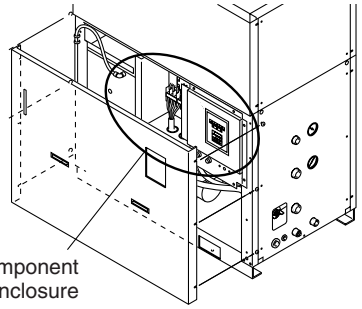
■ **Remote operation signal input**
Startup and shutdown can be remotely controlled by applying 24 VDC.

■ **Operation, shutdown, alarm signal output**
Operation, shutdown, alarm signal can be output via the relay contact.

Easy maintenance

(Standard specifications)

Components can be accessed from the front. The pump, compressor thermal relay and reset switch (for use in the case of problems with facility water supply) are located inside the electrical component enclosure.



Options

Various options are available, including with casters, breakers and communications function. Specify options according to your particular manufacturing process and method.

(Refer to pages 26 and 27 for options.)

Optional accessories

Dustproof filters for the by-pass piping set and air-cooled refrigeration are available.
These improve durability and ease of use.

(Refer to pages 28 through to 35 for optional accessories.)

Air-Cooled Refrigeration

Air-cooled refrigeration

Unlike the water-cooled refrigeration, the air-cooled refrigeration does not require a facility water, and is easy to install alongside your equipment.

Rainproof design: Enclosure IPx3

In addition to the previously available indoor installation specifications, we now offer specifications for outdoor installation. [Note]

Note) HRG010-□, HRG015-□

Communications

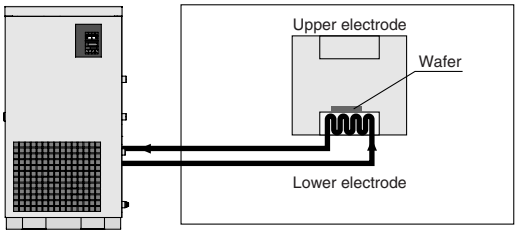
■ **Communications function (RS-485)**
(Refer to page 27 for options.)

■ **Contact input/output function**
(Refer to page 25.)

Application Examples

Semiconductor

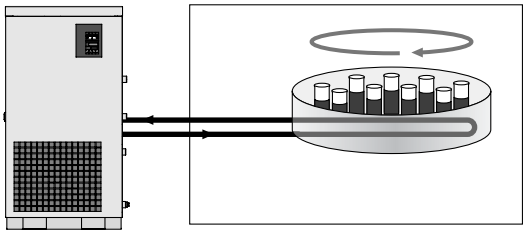
Example: Temperature control of chamber electrode



- **Etching equipment**
- **Coating equipment**
- **Spatter equipment**
- **Dicing equipment**
- **Cleaning equipment**
- **Tester, etc.**

Medical

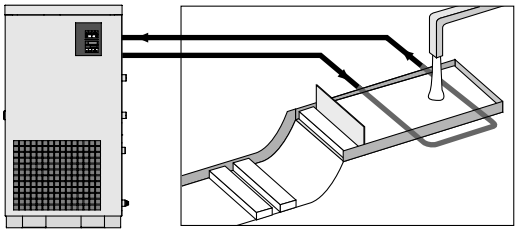
Example: Blood preservation



- **X-ray instrument**
- **MRI**
- **Blood preservation equipment**

Food

Example: Tofu (Bean curd) production

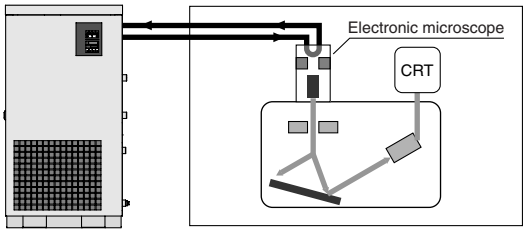


- **Bottle-cleaning machine**
- **Tofu (Bean curd) production equipment**
- **Noodle-making machine, etc.**

Water temperature control for forming tofu by mixing the boiled soybean milk and bittern.

Analysis

Example: Electronic microscope

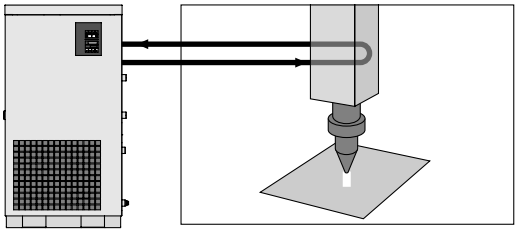


- **Electron microscope**
- **X-ray analytical instrument**
- **Gas chromatography**
- **Sugar level analytical instrument, etc.**

Prevents the distortion caused by the heat generated by the electronic gun in an electronic microscope.

Machine tool

Example: Laser machining

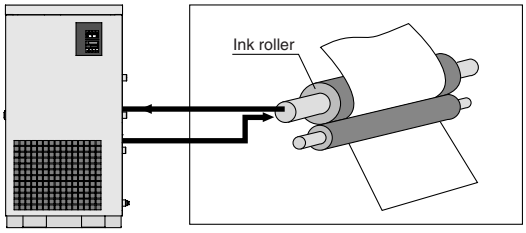


- **Wire cutting**
- **Grinder**
- **Spot welding**
- **Plasma welding**
- **Laser machining, etc.**

Temperature-controlling the laser generating tube enables the laser wavelength to be optimised, improving the accuracy of the machined cross sectional area.

Printing

Example: Printing temperature control

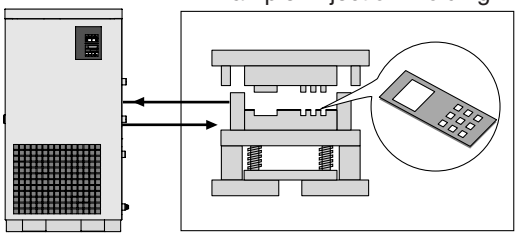


- **Offset printing machine**
- **Automatic developing machine**
- **UV equipment, etc.**

Temperature-controlling the ink roller enables to control the evaporation amount and viscosity of an ink and optimise the tint of colors.

Molding

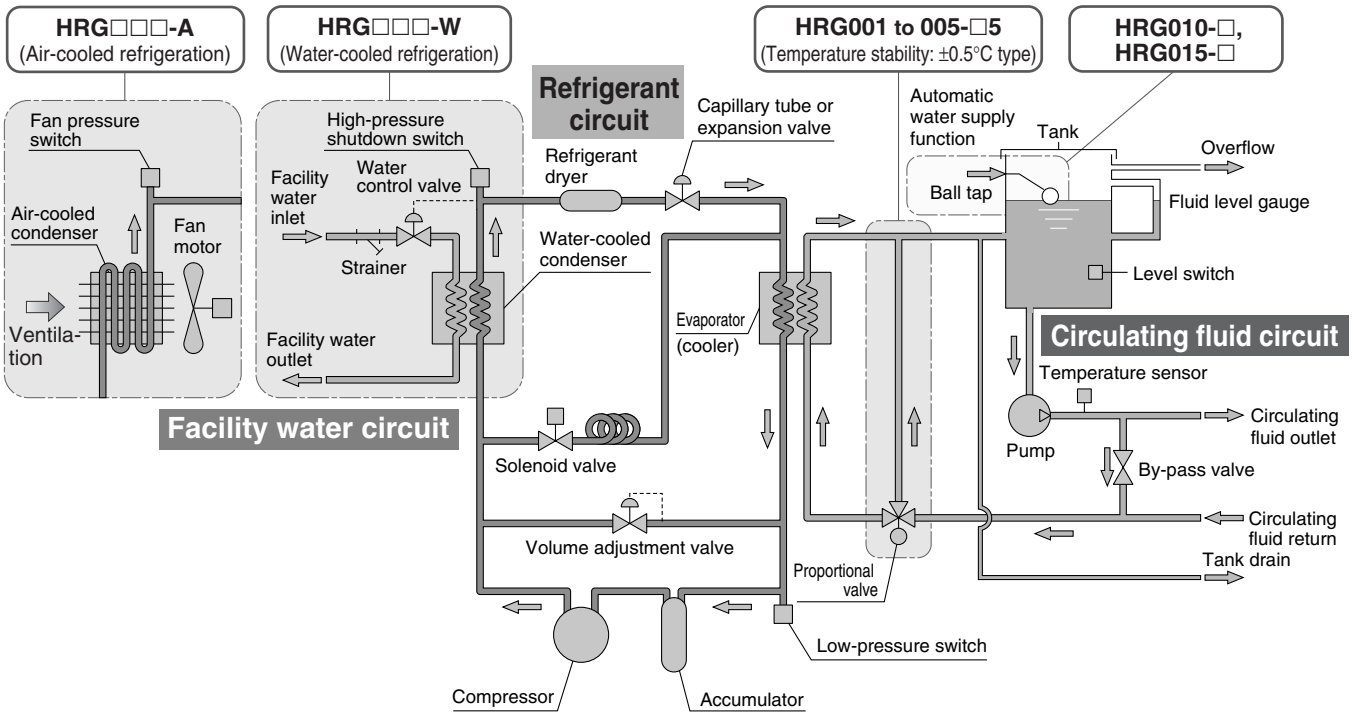
Example: Injection molding



- **Plastic molding**
- **Rubber molding**
- **Wire cable coating machine**
- **Injection molding, etc.**

Temperature-controlling the mold results in improved product quality.

Construction and Principles



Circulating fluid circuit

With the circulating pump, circulating fluid will be discharged to the customer's machine side. After the circulating fluid will cool the customer's machine side, it will heat up and return to the Thermo-cooler.

■ Temperature stability: ±0.5°C type (HRG001 to 005-□5)

If the temperature of the circulating fluid is higher than the preset temperature, the three-way proportional valve will return the circulating fluid to the cooler. If the temperature of the circulating fluid is lower than the preset temperature, the fluid will be returned directly to the tank.

When the temperature of the circulating fluid is nearly the same as the preset temperature, the temperature will be stabilized by split flow between the cooler and the tank.

Refrigerant circuit

High-temperature, high-pressure refrigerant gas compressed by the compressor is made to release heat by the condenser, and turns to liquid. As the liquefied high-pressure refrigerant passes through the capillary tube and expansion valve, it expands and cools down; as it passes through the evaporator, heat is extracted from the circulating fluid and it evaporates.

The evaporated refrigerant is once again sucked in and compressed by the compressor, and the above cycle is repeated.

When the circulating fluid is cooled sufficiently, the solenoid valve and volume adjustment valve open. These valves balance the refrigerant pressure and prevent freezing of the circulating fluid (especially clear water) in excessively cold conditions.

■ Temperature stability: ±1.0°C type (HRG□□□-□□)

If the temperature of the circulating fluid is higher than the preset temperature, the compressor starts up, and refrigerant gas flows to the evaporator (cooler). This cools the circulating fluid. If the temperature of the circulating fluid is lower than the preset temperature, the compressor shuts down, and the flow of refrigerant gas stops. At such times, the circulating fluid is not cooled, and the temperature rises.

Temperature stability is achieved by the compressor starting up and shutting down.

Facility water circuit

■ Cooling method: Water-cooled refrigeration (HRG□□□-W)

When the refrigerant gas is adequately liquefied and the circulating fluid is adequately cooled, the water control valve automatically closes the facility water circuit and adjusts the flow of facility water.

This method assures normal pressure in the compressor and reduces energy use by your facility water equipment.

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

CONTENTS

Series HRG

Model Selection

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Guide to Model Selection

1. Which is best for you: a water-cooled refrigeration or an air-cooled refrigeration?

You should base your choice on the configuration of your equipment.

Thermo-cooler series refrigeration methods

Water-cooled refrigeration ····· Requires facility water equipment (cooling tower etc.) as well as electrical power supply. This type provides stable cooling performance year round, regardless of ambient temperature changes.

Air-cooled refrigeration ····· Only electrical power supply is needed.
Facility water equipment is not necessary, so the system is easy to install wherever you need it, when you need it. Please note that ventilation or air conditioning is required to dissipate heat: for details, refer to page 36. Operating Environment/Storage Environment 3 on Specific Product Precautions 1.

Example) Customer requirement: Air-cooled refrigeration

2. How much is the temperature in degrees centigrade for the circulating fluid?

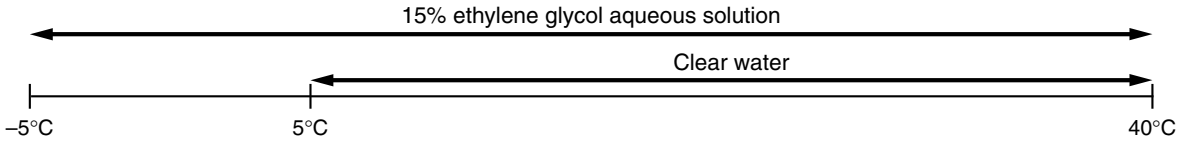
Temperature range which can be set with the Thermo-cooler

5°C to 35°C

Example) Customer requirement: 20°C

3. What kind of the circulating fluids will be used?

Relationship between circulating fluid (which can be used with the Thermo-cooler) and ambient temperature



Example) Customer requirement: Clear water

4. What power supply frequency?

Thermo-cooler power supply frequency specifications

50 Hz, 60 Hz (common use)

Example) Customer requirement: 60 Hz

5. What is the kW for the required cooling capacity?
∗ To calculate the cooling capacity, refer to pages 10 to 12.

Example) Customer requirement: 4.2 kW (Refer to example 1 (1).)

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

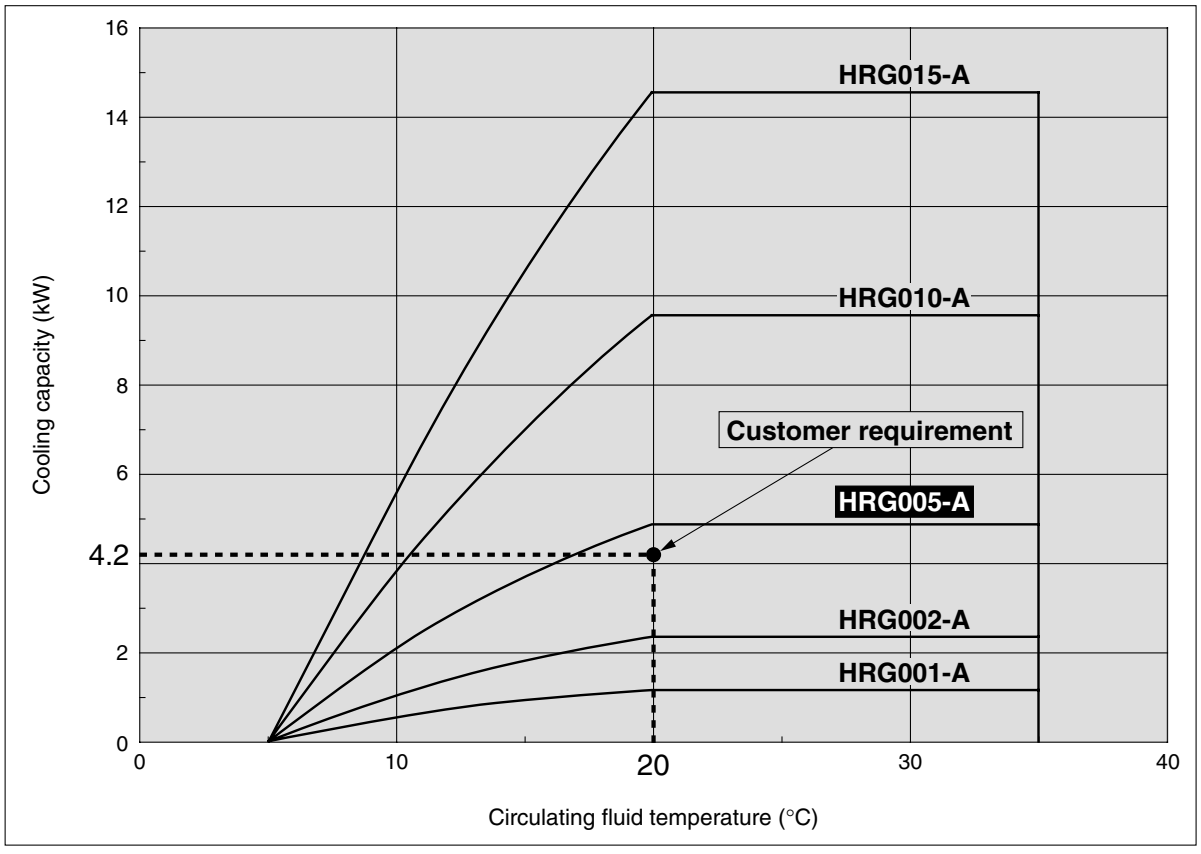
Selection

Example: Customer requirements 1 to 5

Cooling method	: Air-cooled refrigeration
Circulating fluid temperature	: 20°C
Fluid	: Clear water
Power supply frequency	: 60 Hz
Required cooling capacity	: 4.2 kW

Based on the results of 1 to 5, refer to the graph of cooling capacity of an air-cooled refrigeration Thermo-cooler at 60 Hz (page 16). On the same graph, plot the intersections between the customer's required temperature (20°C) and cooling capacity (4.2 kW). Refer to the same graph that can be used for ethylene glycol aqueous solution (15% or less.)

[Cooling Capacity Graph] Cooling Method: Air-Cooled Refrigeration, Power Supply Frequency: 60 Hz



The point plotted in the graph is the requirement from your customer. Select the Thermo-cooler models exceeding this point. In this case, select the **HRG005-A**.

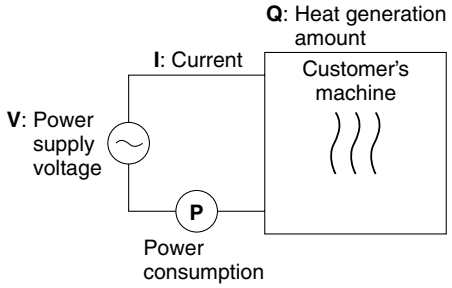
Model Selection

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Required Cooling Capacity Calculation

Example 1: When the heat generation amount in the customer's machine 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 customer's machine.∗



(1) Derive the heat generation amount from the power consumption.

Power consumption **P**: 3.5 [kW]

Q = P = 3.5 [kW]

Cooling capacity = Considering a safety factor of 20%,

3.5 [kW] x 1.2 = 4.2 [kW]

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

Power supply output **VI**: 4.1 [kVA]

Q = P = V x I x Power factor

In this example, using a power factor of 0.85:

= 4.1 [kVA] x 0.85 = 3.5 [kW]

Cooling capacity = Considering a safety factor of 20%,

3.5 [kW] x 1.2 = 4.2 [kW]

(3) Derive the heat generation amount from the output.

Output (shaft power, etc.) **W**: 2.2 [kW]

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

In this example, use an efficiency of 0.7:

$$\mathbf{= \frac{2.2}{0.7} = 3.14\ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,

3.14 [kW] x 1.2 ≈ 3.8 [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 customer facilities. Please be sure to check it carefully.

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Example 2: When the heat generation amount in the customer's machine is not known.

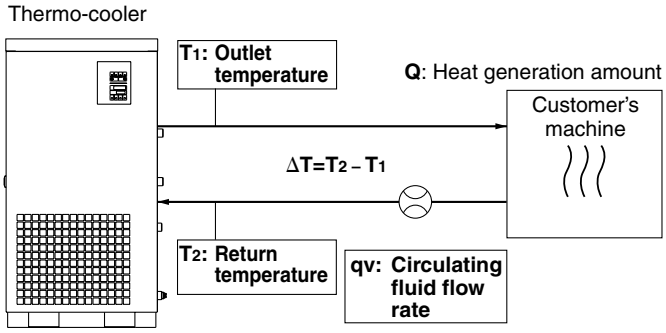
Obtaining the temperature difference between inlet and outlet by circulating the circulating fluid inside the customer's machine.

Heat generation amount by customer's machine **Q**: Unknown [kW] ([kJ/s])
Circulating fluid : Clear water*
Circulating fluid mass flow rate q_m : (= ρ x q_v ÷ 60) [kg/s]
Circulating fluid density ρ : 1 [kg/L]
Circulating fluid (volume) flow rate q_v : 25 [L/min]
Circulating fluid specific heat capacity **C** : 4.2 [kJ/(kg•K)]
Circulating fluid outlet temperature T_1 : 293 [K] (20 [°C])
Circulating fluid return temperature T_2 : 295 [K] (22 [°C])
Circulating fluid temperature difference ΔT : 2.0 [K] (= $T_2 - T_1$)
Conversion factor: minutes to seconds (SI units) : 60 [s/min]

* Refer to page 13 for the typical physical property value of clear water or other circulating fluids.

$$Q = qm \times C \times (T_2 - T_1)$$
$$= \frac{\rho \times q_v \times C \times \Delta T}{60}$$
$$= \frac{1 \times 25 \times 4.2 \times 2.0}{60}$$
$$= 3.50 \text{ [kJ/s]} \approx 3.5 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,
3.5 [kW] x 1.2 = 4.2 [kW]



Example of conventional measurement units (Reference)

Heat generation amount by customer's machine **Q**: Unknown [kcal/h] → [kW]
Circulating fluid : Clear water*
Circulating fluid weight flow rate q_m : (= ρ x q_v x 60) [kgf/h]
Circulating fluid weight: volume ratio γ : 1 [kgf/L]
Circulating fluid (volume) flow rate q_v : 25 [L/min]
Circulating fluid specific heat capacity **C** : 1.0 [kcal/(kgf•°C)]
Circulating fluid outlet temperature T_1 : 20 [°C]
Circulating fluid return temperature T_2 : 22 [°C]
Circulating fluid temperature difference ΔT : 2.0 [°C] (= $T_2 - T_1$)
Conversion factor: hours to minutes : 60 [min/h]
Conversion factor: kcal/h to kW : 860 [(kcal/h)/kW]

$$Q = \frac{qm \times C \times (T_2 - T_1)}{860}$$
$$= \frac{\gamma \times qv \times 60 \times C \times \Delta T}{860}$$
$$= \frac{1 \times 25 \times 60 \times 1.0 \times 2.0}{860}$$
$$= \frac{3000 \text{ [kcal/h]}}{860}$$
$$\approx 3.5 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,
3.5 [kW] x 1.2 = 4.2 [kW]

Model Selection

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

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 [kW] ([kJ/s])
Cooled substance	: Water
Cooled substance mass **m**	: (= ρ x **V**) [kg]
Cooled substance density ρ	: 1 [kg/L]
Cooled substance total volume **V**	: 60 [L]
Cooled substance specific heat capacity **C**	: 4.2 [kJ/(kg•K)]
Cooled substance temperature when cooling begins T_0	: 305 [K] (32 [°C])
Cooled substance temperature after t hour T_t	: 293 [K] (20 [°C])
Cooling temperature difference Δ**T**	: 12 [K] (= $T_0 - T_t$)
Cooling time Δ**t**	: 900 [s] (= 15 [min])

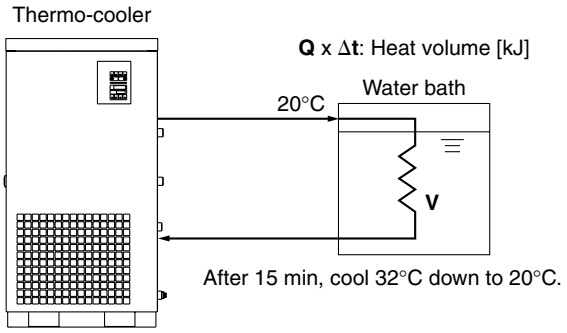
∗ Refer to page 13 for the typical physical property values by circulating fluid.

$$Q = \frac{m \times C \times (T_t - T_0)}{\Delta t} = \frac{\rho \times V \times C \times \Delta T}{\Delta t} = \frac{1 \times 60 \times 4.2 \times 12}{900}$$

$$= 3.36 \text{ [kJ/s]} \approx 3.4 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,

3.4 [kW] x 1.2 = 4.08 [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.

Example of conventional measurement units (Reference)

Heat quantity by cooled substance (per unit time) **Q**	: Unknown [kcal/h] → [kW]
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**	: 60 [L]
Cooled substance specific heat capacity **C**	: 1.0 [kcal/(kgf•°C)]
Cooled substance temperature when cooling begins T_0	: 32 [°C]
Cooled substance temperature after t hour T_t	: 20 [°C]
Cooling temperature difference Δ**T**	: 12 [°C] (= $T_0 - T_t$)
Cooling time Δ**t**	: 15 [min]
Conversion factor: hours to minutes	: 60 [min/h]
Conversion factor: kcal/h to kW	: 860 [(kcal/h)/kW]

$$Q = \frac{m \times C \times (T_t - T_0)}{\Delta t \times 860} = \frac{\gamma \times V \times 60 \times C \times \Delta T}{\Delta t \times 860} = \frac{1 \times 60 \times 60 \times 1.0 \times 12}{15 \times 860}$$

$$= \frac{2880 \text{ [kcal/h]}}{860} \approx 3.4 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,

3.4 [kW] x 1.2 = 4.08 [kW]

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Precautions on Model Selection

1. Heating capacity

If the circulating fluid is to be set at a higher temperature than room temperature, the Thermo-cooler will heat the fluid. However, the Thermo-cooler has a lower heating capacity than a dedicated heater.

2. Pump capacity

<Circulating fluid flow rate>

Pump capacity varies depending on the model selected from the HRG series. Also, circulating fluid flow varies depending on the circulating fluid discharge pressure. Consider the installation height difference between our cooler and a customer's machine and the piping resistance such as circulating fluid pipings, or piping size, or piping curves in the equipment. Check beforehand if the required flow rate is achieved using the pump capacity curves for each respective model.

<Circulating fluid discharge pressure>

Circulating fluid discharge pressure has the possibility to increase up to the maximum pressure in the pump capacity curves for the respective model. Check beforehand if the circulating fluid pipings or circulating fluid circuit of the customer's machine are fully durable against this pressure.

Circulating Fluid Typical Physical Property Values

1. This catalog uses the following values for density and specific heat capacity 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 capacity **C**: 4.2 [kJ/(kg·K)] (or, using conventional unit system of units, 1 [kcal/(kgf·°C)])

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

Water

Physical property value / Temperature	Density ρ [kg/L]	Specific heat C [kJ/(kg•K)]	Conventional unit system	
			Weight volume ratio γ [kgf/L]	Specific heat C [kcal/(kgf•°C)]
5°C	1.00	4.20	1.00	1.00
10°C	1.00	4.19	1.00	1.00
15°C	1.00	4.19	1.00	1.00
20°C	1.00	4.18	1.00	1.00
25°C	1.00	4.18	1.00	1.00
30°C	1.00	4.18	1.00	1.00
35°C	0.99	4.18	0.99	1.00

15% Ethylene Glycol Aqueous Solution

Physical property value / Temperature	Density ρ [kg/L]	Specific heat C [kJ/(kg•K)]	Conventional unit system	
			Weight volume ratio γ [kgf/L]	Specific heat C [kcal/(kgf•°C)]
5°C	1.02	3.91	1.02	0.93
10°C	1.02	3.91	1.02	0.93
15°C	1.02	3.91	1.02	0.93
20°C	1.01	3.91	1.01	0.93
25°C	1.01	3.91	1.01	0.93
30°C	1.01	3.91	1.01	0.94
35°C	1.01	3.92	1.01	0.94

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

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Thermo-cooler
Series HRG

How to Order

HRG 001 – A □ – □

Cooling capacity

001		Cooling capacity 0.9/1.1 kW (50/60 Hz)
002		Cooling capacity 1.9/2.3 kW (50/60 Hz)
005		Cooling capacity 4.5/4.8 kW (50/60 Hz)
010	-A	Cooling capacity 9.0/9.5 kW (50/60 Hz)
	-W	Cooling capacity 10.0/11.0 kW (50/60 Hz)
015	-A	Cooling capacity 13.0/14.5 kW (50/60 Hz)
	-W	Cooling capacity 14.5/16.5 kW (50/60 Hz)

Cooling method

A	Air-cooled refrigeration
W	Water-cooled refrigeration

Temperature stability

Nil	±1.0°C (Compressor ON/OFF control)
5	±0.5°C (Proportional valve PID control)

∗ Only models HRG001–HRG005 are applicable for proportional valve PID control.

Option

Nil	None
A	With casters
B	With earth leakage breaker
C	With communications function (RS485)

∗ Refer to pages 26 and 27 for the specifications of each option.

Specifications

HRG001, 002, 005

Model			HRG001		HRG002		HRG005	
Cooling method			Air-cooled refrigeration	Water-cooled refrigeration	Air-cooled refrigeration	Water-cooled refrigeration	Air-cooled refrigeration	Water-cooled refrigeration
Refrigerant			R407C (HFC)					
Control method			Compressor ON/OFF control or Proportional valve PID control					
Ambient temperature/humidity Note 1)			Temperature: –5 to 40°C, Humidity: 30 to 70%RH					
Circulating fluid system	Circulating fluid Note 2)		Clear water, Deionized water, 15% ethylene glycol aqueous solution					
	Temperature range setting Note 1)	(°C)	5 to 35					
	Cooling capacity Note 3)	(50/60 Hz) (kW)	0.9/1.1 (at 20°C)	0.9/1.1 (at 20°C)	1.9/2.3 (at 20°C)	1.9/2.3 (at 20°C)	4.5/4.8 (at 20°C)	4.5/4.8 (at 20°C)
	Heating capacity Note 4)	(kW)	—	—	—	—	—	—
	Temperature stability Note 5)	(°C)	±1.0 (Compressor ON/OFF control), ±0.5 (Proportional valve PID control)					
	Pump capacity Note 6)	(50/60 Hz) (MPa)	0.14/0.19 (at 8/10 L/min, total lifting height 8/9 m)		0.14/0.19 (at 10/10 L/min, total lifting height 11/16 m)		0.2/0.26 (at 24/32 L/min, total lifting height 14/15 m)	
	Rated flow Note 7)	(50/60 Hz) (L/min)	8/10		10/10		24/32	
	Tank capacity	(L)	10				20	
	Port size		Rc1/2					
	Wetted parts material		Stainless steel, Brass, PE, PVC, PPE, Copper brazing (Heat exchanger)				Stainless steel, PE, PVC, Brass, Copper brazing (Heat exchanger)	
Facility water system	Temperature range	(°C)	—	5 to 32	—	5 to 32	—	5 to 32
	Pressure range	(MPa)	—	0.2 to 0.5	—	0.2 to 0.5	—	0.2 to 0.5
	Required flow rate Note 8)	(50/60 Hz) (L/min)	—	10/12	—	12/15	—	27/28
	Port size		—	Rc1/2	—	Rc1/2	—	Rc1/2
	Wetted parts material		Stainless steel, Brass, PVC, Copper brazing (Heat exchanger)					
Electrical system	Power supply		3-phase 200 VAC 50 Hz, 3-phase 200 to 220 VAC 60 Hz Allowable voltage fluctuation ±10%					
	Applicable earth leakage breaker capacity Note 9)	(A)	5		10		20	
	Rated operating current (50/60 Hz)	(A)	2.85/2.85	2.6/2.65	5.0/5.5	4.2/4.3	8.0/9.5	6.3/7.8
	Rated power consumption (50/60 Hz)	(kW)	0.66/0.82	0.56/0.72	1.0/1.25	0.84/1.0	1.75/2.35	1.45/2.0
	Remote operation signal input		Remote startup with 24 VDC, 8 mA applied, shutdown at 0 VDC					
	Operation signal output		Relay contact output (switch closed when operating, switch open when stopped, switch open when shut down)					
	Alarm stop signal output		Relay contact output (switch closed when alarm is turned off, switch open when alarm is turned on, switch closed when shut down)					
	Alarm		Refer to page 24.					
Weight Note 10)		(kg)	70		75		120	115

Note 1) It should have no condensation.
During seasons or in locations where the ambient temperature is likely to fall below freezing point, please use aqueous ethylene glycol solution.

Note 2) If clear water is used, please use water that conforms to Water Quality Standards of the Japan Refrigeration and Air Conditioning Industrial Association (JRA GL-02-1994 cooling water system - circulating type - make-up water). If deionized water is used, supply water with electrical conductivity of 1 μS/cm or more (or electrical resistivity of 1 MΩ·cm or less).
If ethylene glycol aqueous solution is used, maintain the concentration at 15%.

Note 3) ① Ambient temperature: 32°C, Facility water temperature: 25°C (water-cooled refrigeration), ② Circulating fluid temperature: 20°C, ③ Circulating fluid flow rate: Values at circulating fluid rated flow rate.

Note 4) Thermo-cooler specifications do not have heating capability.

Note 5) Value with a stable load without turbulence in the operating conditions. It may be out of this range depending on operating conditions.

Note 6) The capacity at the Thermo-cooler outlet when the circulating fluid temperature is at 20°C.

Note 7) Required flow rate for cooling capacity or maintaining the temperature stability.
When used below the rated flow, open the standard by-pass valve and maintain a circulating fluid flow rate equivalent to the rated flow.
Also, use the individually sold, "By-pass Piping Set" (Refer to pages 28 through to 35).

Note 8) Required flow rate when a load for the cooling capacity is applied at a facility water temperature of 32°C.

Note 9) Purchase an earth leakage breaker with current sensitivity of 30 mA separately. (A product with an optional earth leakage breaker (option B) is also available. Refer to "How to Order".)

Note 10) Weight in the dry state without circulating fluids

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Specifications

HRG010/015

Model		HRG010		HRG015	
Cooling method		Air-cooled refrigeration	Water-cooled refrigeration	Air-cooled refrigeration	Water-cooled refrigeration
Refrigerant		R407C (HFC)			
Control method		Compressor ON/OFF control			
Ambient temperature/humidity Note 1)		Temperature: –5 to 40°C, Humidity: 30 to 70%RH			
Circulating fluid system	**Circulating fluid** Note 2)	Clear water, Deionized water, 15% ethylene glycol aqueous solution			
	Temperature range setting Note 1) **(°C)**	5 to 35			
	Cooling capacity Note 3) **(50/60 Hz) (kW)**	9.0/9.5 (at 20°C)	10.0/11.0 (at 20°C)	13.0/14.5 (at 20°C)	14.5/16.5 (at 20°C)
	Heating capacity Note 4) **(kW)**	—	—	—	—
	Temperature stability Note 5) **(°C)**	±1.0			
	Pump capacity Note 6) **(50/60 Hz) (MPa)**	0.29/0.33 (at 37/49 L/min, total lifting height 25/25 m)		0.28/0.31 (at 42/53 L/min, total lifting height 25/25 m)	
	Rated flow Note 7) **(50/60 Hz) (L/min)**	37/49		42/53	
	Tank capacity (L)	40		60	
	Port size	Rc3/4			
	Wetted parts material	Stainless steel, Brass, PVC, Nylon 12, Polyurethane, Copper brazing (Heat exchanger)		Stainless steel, Brass, PVC, Nylon 12, Polyurethane, Copper brazing (Heat exchanger)	
Facility water system	**Temperature range (°C)**	—	5 to 32	—	5 to 32
	Pressure range (MPa)	—	0.3 to 0.5	—	0.3 to 0.5
	Required flow rate Note 8) **(50/60 Hz) (L/min)**	—	33/34	—	38/40
	Port size	—	Rc1/2	—	Rc3/4
	Wetted parts material	Stainless steel, Brass, Synthetic rubber, Copper brazing (Heat exchanger)			
Electrical system	**Power supply**	3-phase 200 VAC 50 Hz, 3-phase 200 to 220 VAC 60 Hz Allowable voltage fluctuation ±10%			
	Applicable earth leakage breaker capacity Note 9) **(A)**	40		60	
	Rated operating current (50/60 Hz) (A)	14/16	12/12.5	21/22	18/19
	Rated power consumption (50/60 Hz) (kW)	4.0/5.0	3.2/3.8	5.5/6.7	4.7/5.8
	Remote operation signal input	Remote startup with 8 mA input at 24 VDC, shutdown at 0 VDC			
	Operation signal output	Relay contact output (switch closed when operating, switch open when stopped, switch open when shut down)			
	Alarm stop signal output	Relay contact output (switch closed when alarm is turned off, switch open when alarm is turned on, switch closed when shut down)			
	Alarm	Refer to page 24.			
Weight Note 10) **(kg)**		205	200	230	220

Note 1) It should have no condensation.
During seasons or in locations where the ambient temperature is likely to fall below freezing point, please use aqueous ethylene glycol solution.

Note 2) If clear water is used, please use water that conforms to Water Quality Standards of the Japan Refrigeration and Air Conditioning Industrial Association (JRA GL-02-1994 cooling water system - circulating type - make-up water). If deionized water is used, supply water with electrical conductivity of 1 μS/cm or more (or electrical resistivity of 1 MΩ·cm or less).
If ethylene glycol aqueous solution is used, maintain the concentration at 15%.

Note 3) ① Ambient temperature: 32°C, Facility water temperature: 25°C (water-cooled refrigeration), ② Circulating fluid temperature: 20°C, ③ Circulating fluid flow rate: Values at rated circulating fluid flow rate.

Note 4) Thermo-cooler specifications do not have heating capability.

Note 5) Value with a stable load without turbulence in the operating conditions. It may be out of this range depending on operating conditions.

Note 6) The capacity at the Thermo-cooler outlet when the circulating fluid temperature is 20°C.

Note 7) Required flow rate for cooling capacity or maintaining the temperature stability.
When used below the rated flow, open the standard by-pass valve and maintain a circulating fluid flow rate equivalent to the rated flow.
Also, use the individually sold, "By-pass Piping Set" (Refer to pages 28 through to 35).

Note 8) Required flow rate when a load for the cooling capacity is applied at a facility water temperature of 32°C.

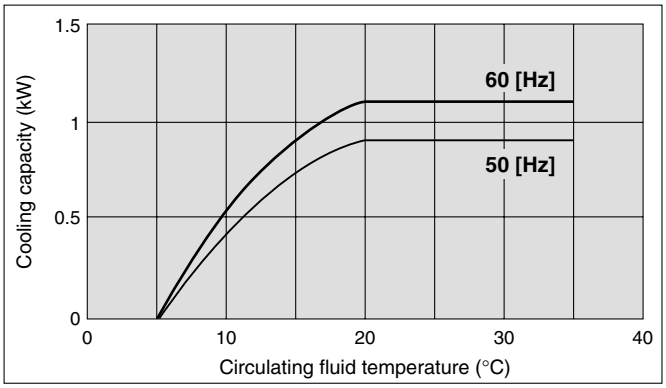
Note 9) Purchase an earth leakage breaker with current sensitivity of 30 mA separately. (A product with an optional earth leakage breaker (option B) is also available. Refer to "How to Order".)

Note 10) Weight in the dry state without circulating fluids

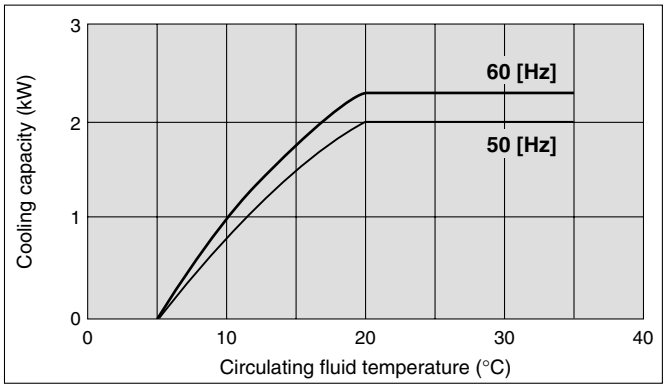
Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Cooling Capacity

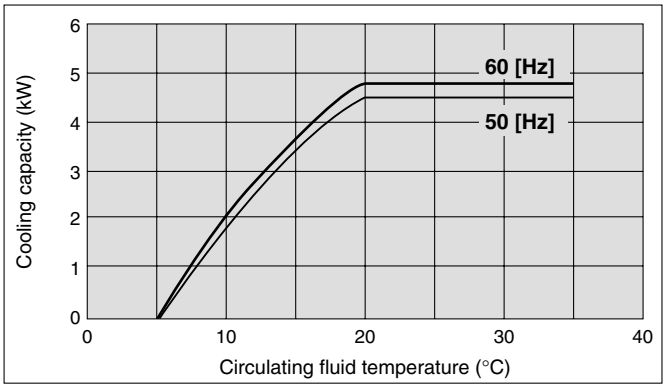
HRG001-A/001-W



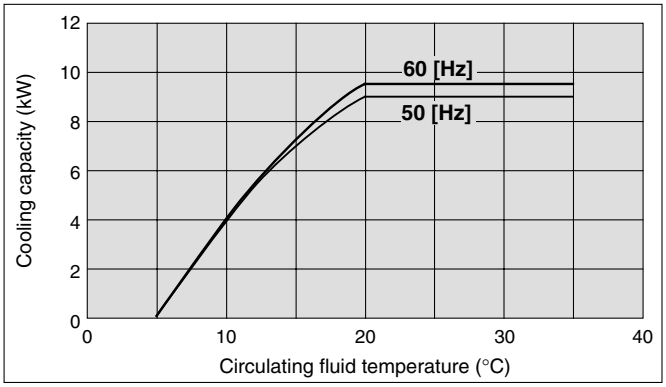
HRG002-A/002-W



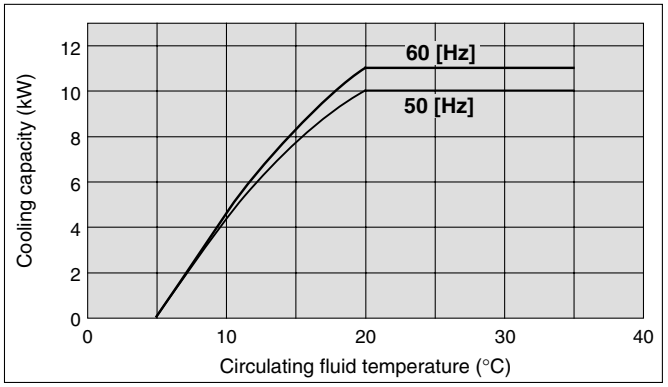
HRG005-A/005-W



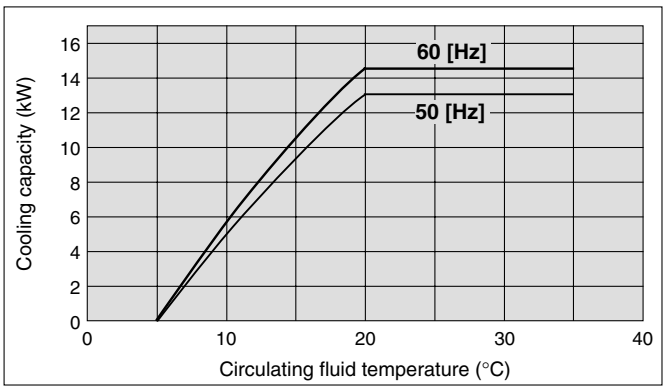
HRG010-A



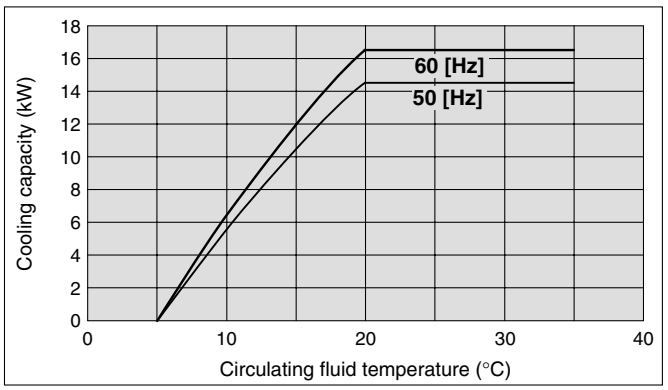
HRG010-W



HRG015-A



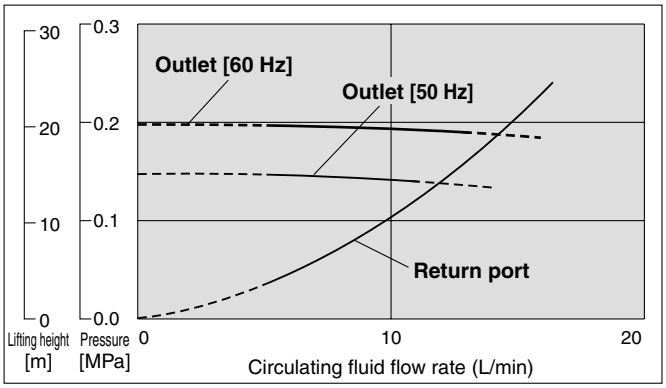
HRG015-W



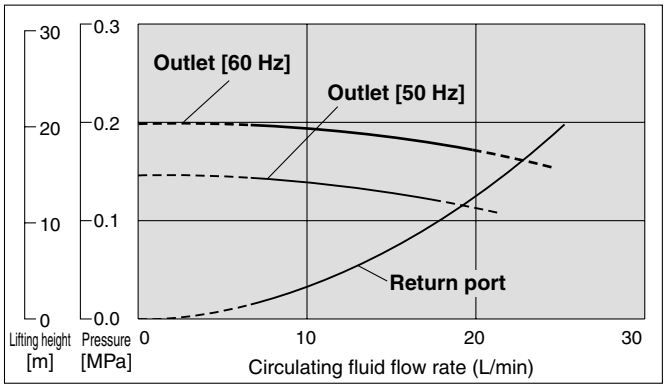
Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Pump Capacity

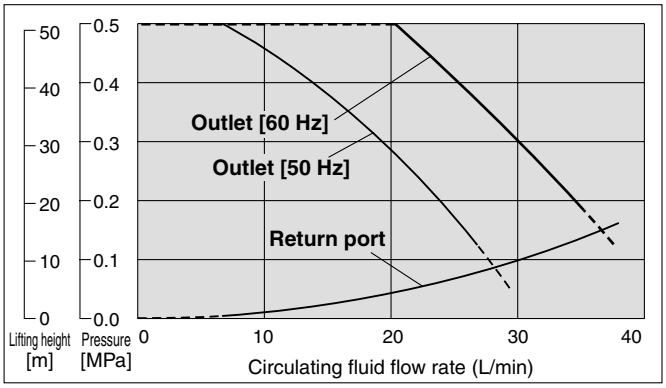
HRG001-A/001-W



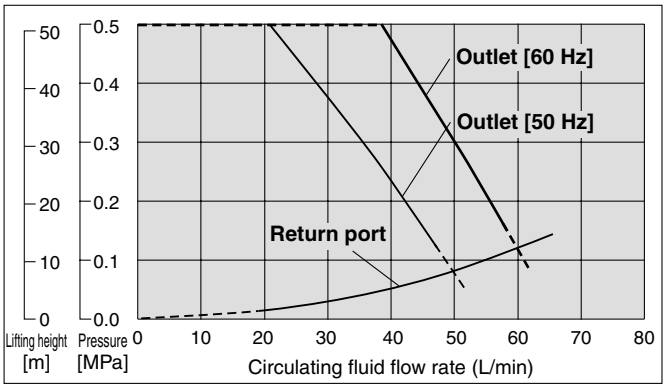
HRG002-A/002-W



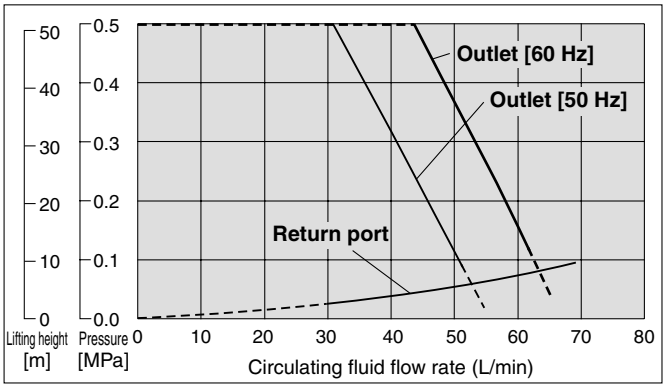
HRG005-A/005-W



HRG010-A/010-W

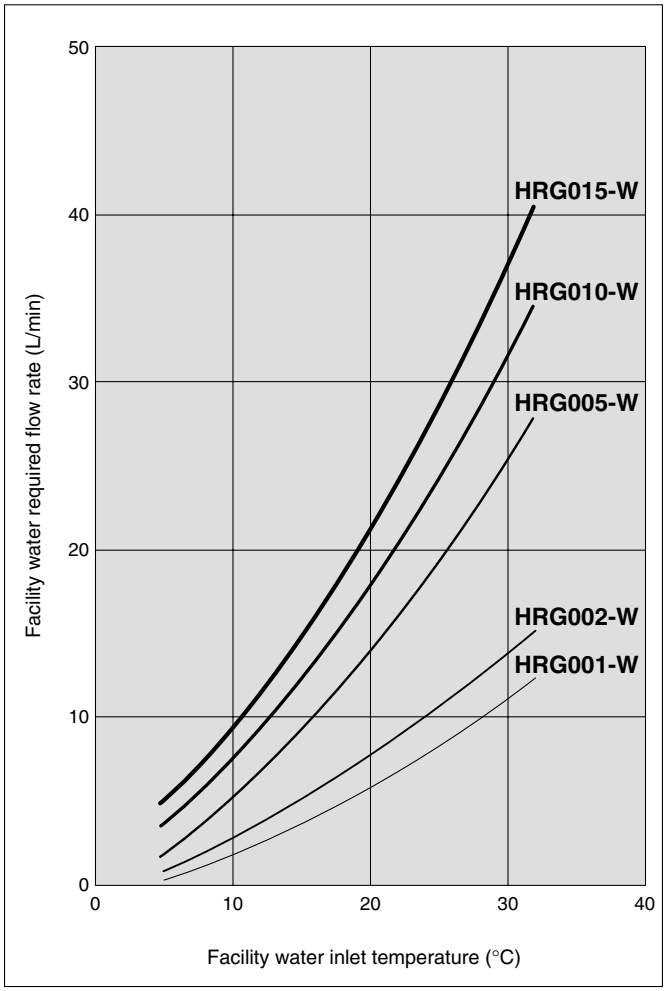


HRG015-A/015-W



∗ For all common models, temperature stability will decline in the flow rate range where circulating fluid is deduced (dotted line). Also, in this range, the circulating fluid outlet pressure will exceed the maximum operating pressure (0.5 MPa) (HRG005 to HRG015).

Facility Water Required Flow Rate

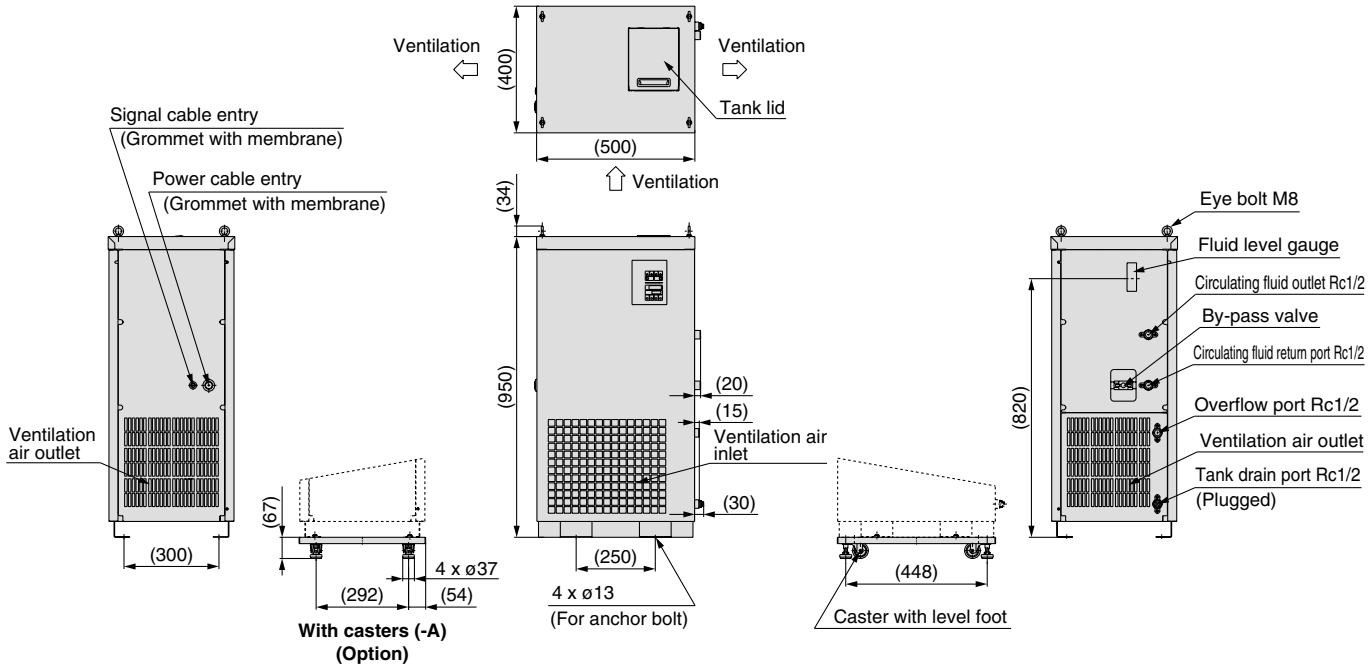


∗ This is the required flow rate of facility water at the rated cooling capacity and circulating fluid flow, operating at 60 Hz, when the facility water inlet temperature is between 5°C and 32°C.

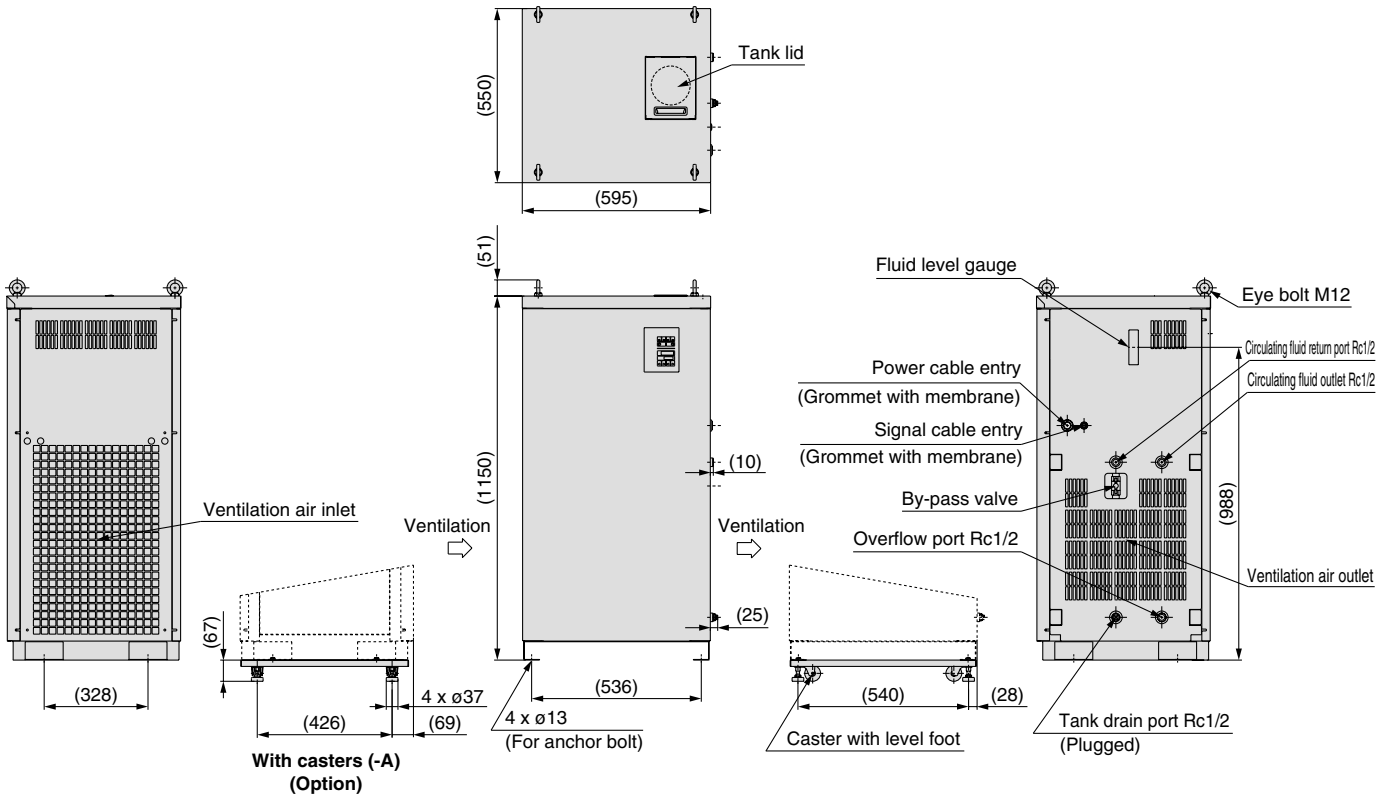
Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Dimensions: Air-Cooled Refrigeration

HRG001-A (-A)/002-A (-A)



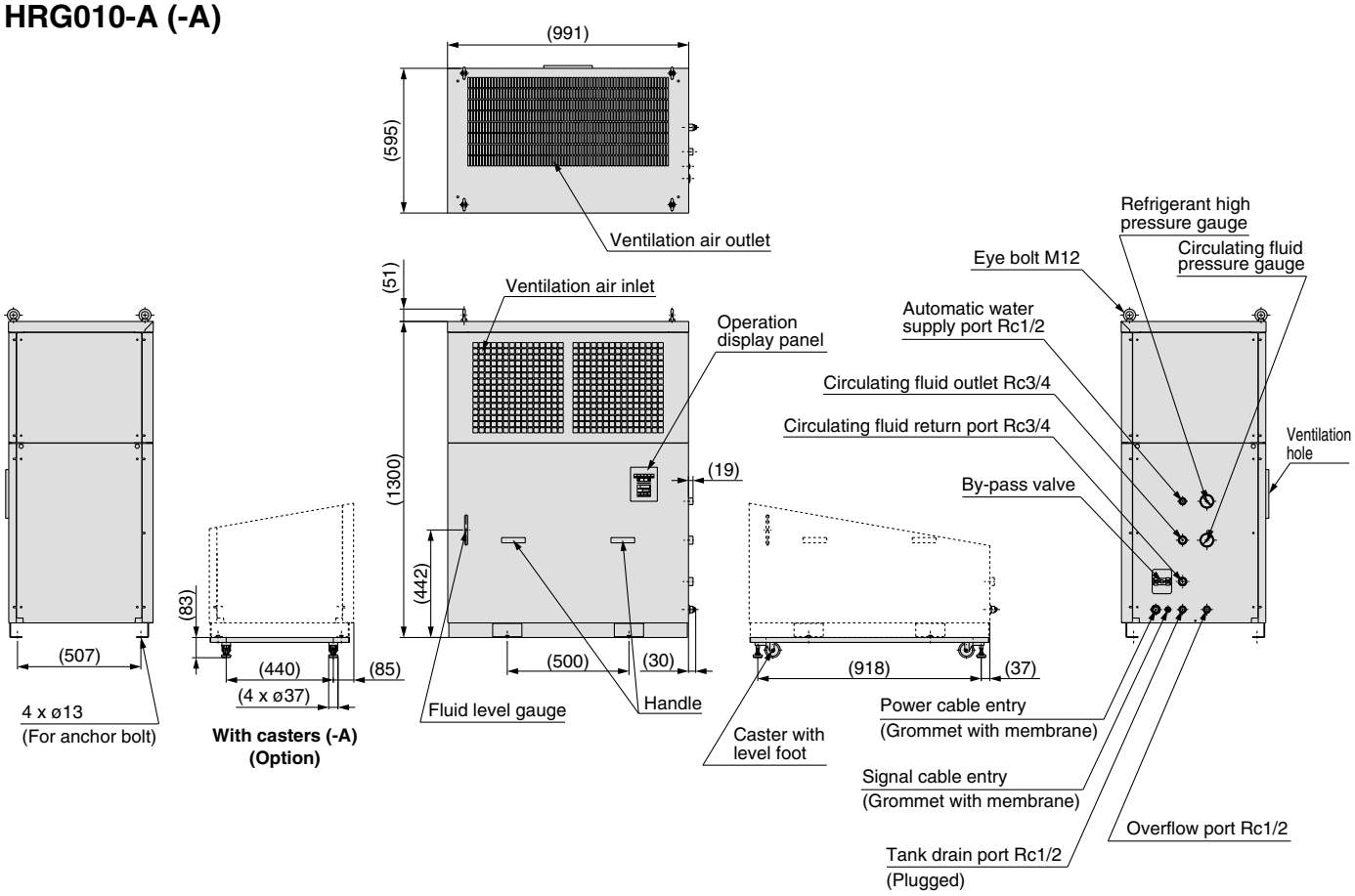
HRG005-A (-A)



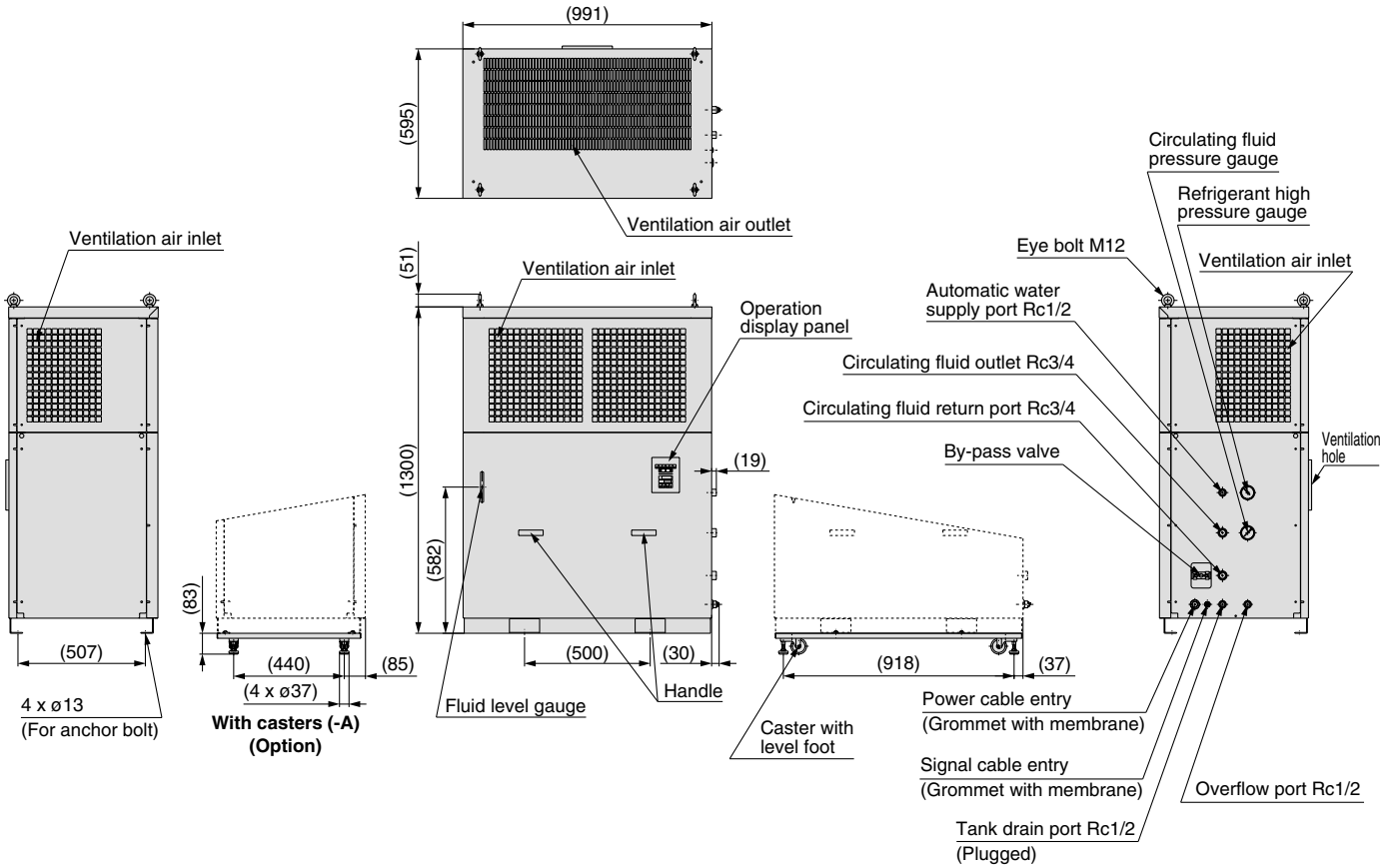
Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Dimensions: Air-Cooled Refrigeration

HRG010-A (-A)



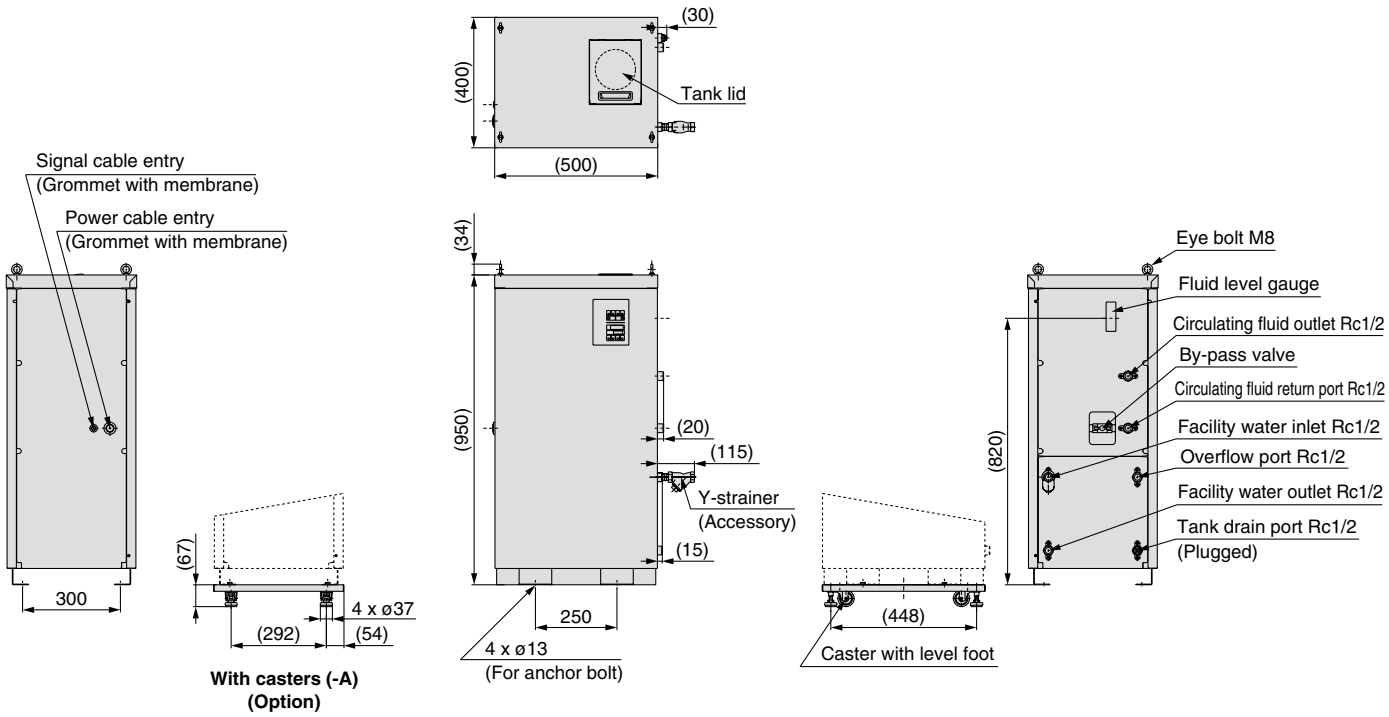
HRG015-A (-A)



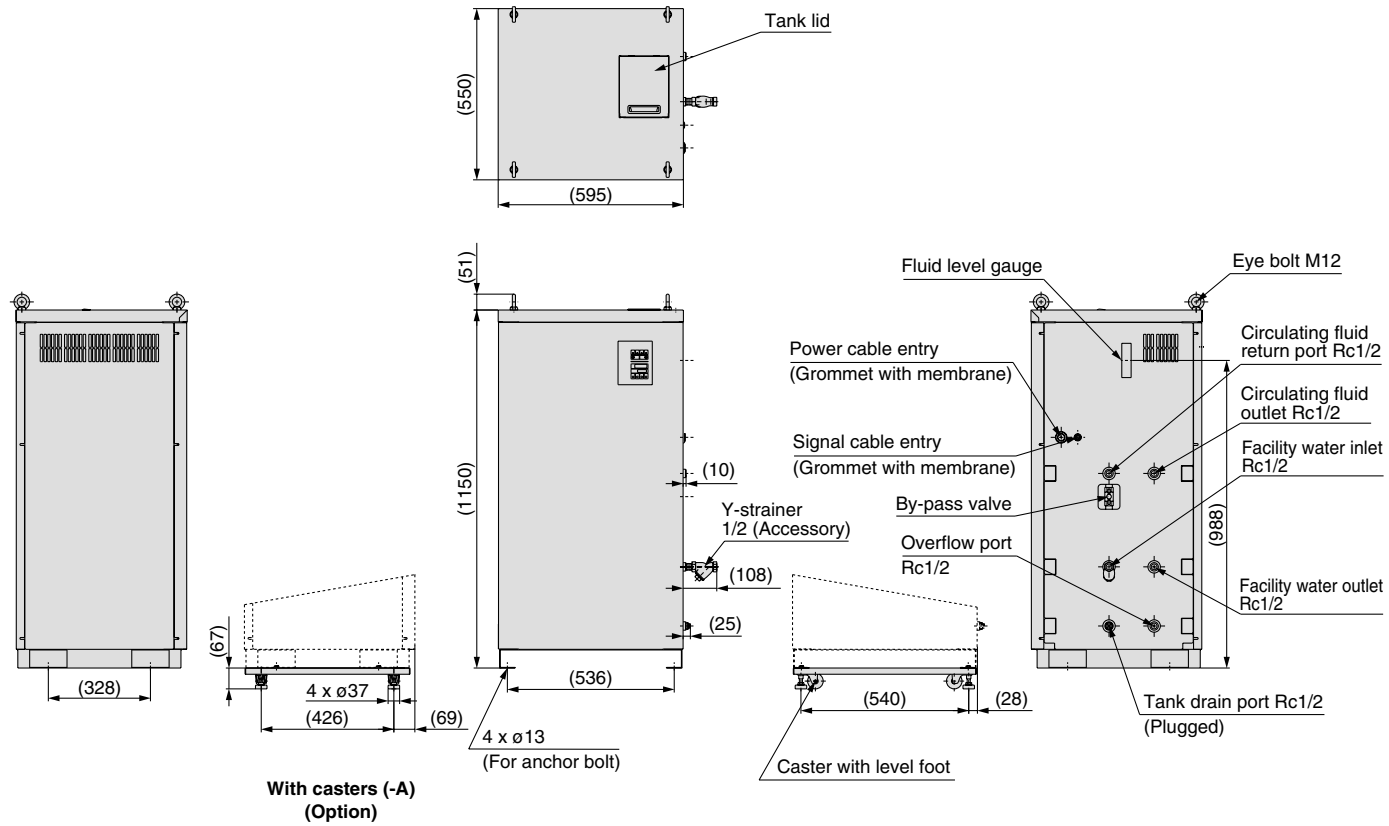
Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Dimensions: Water-Cooled Refrigeration

HRG001-W (-A)/002-W (-A)



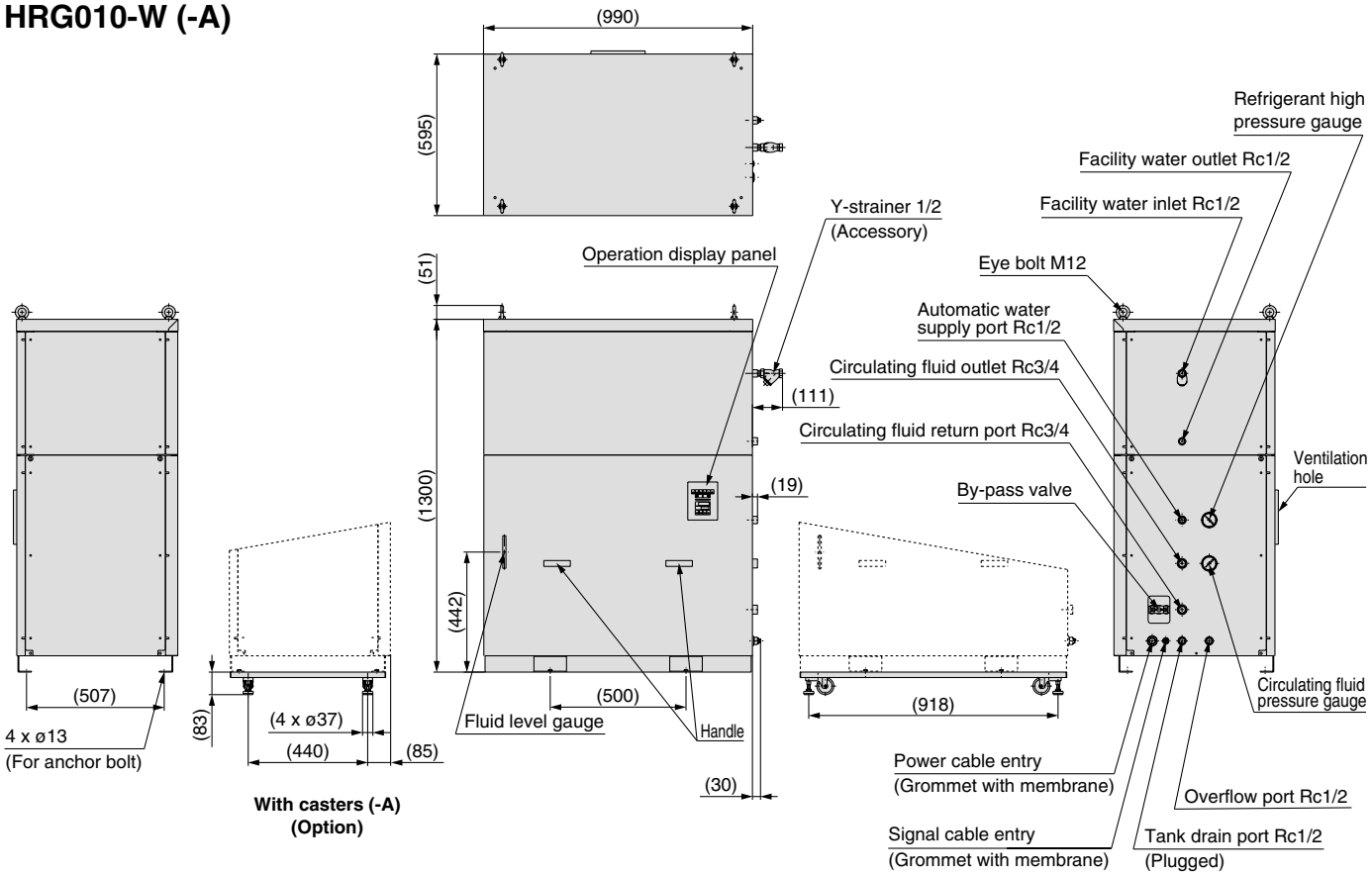
HRG005-W (-A)



Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

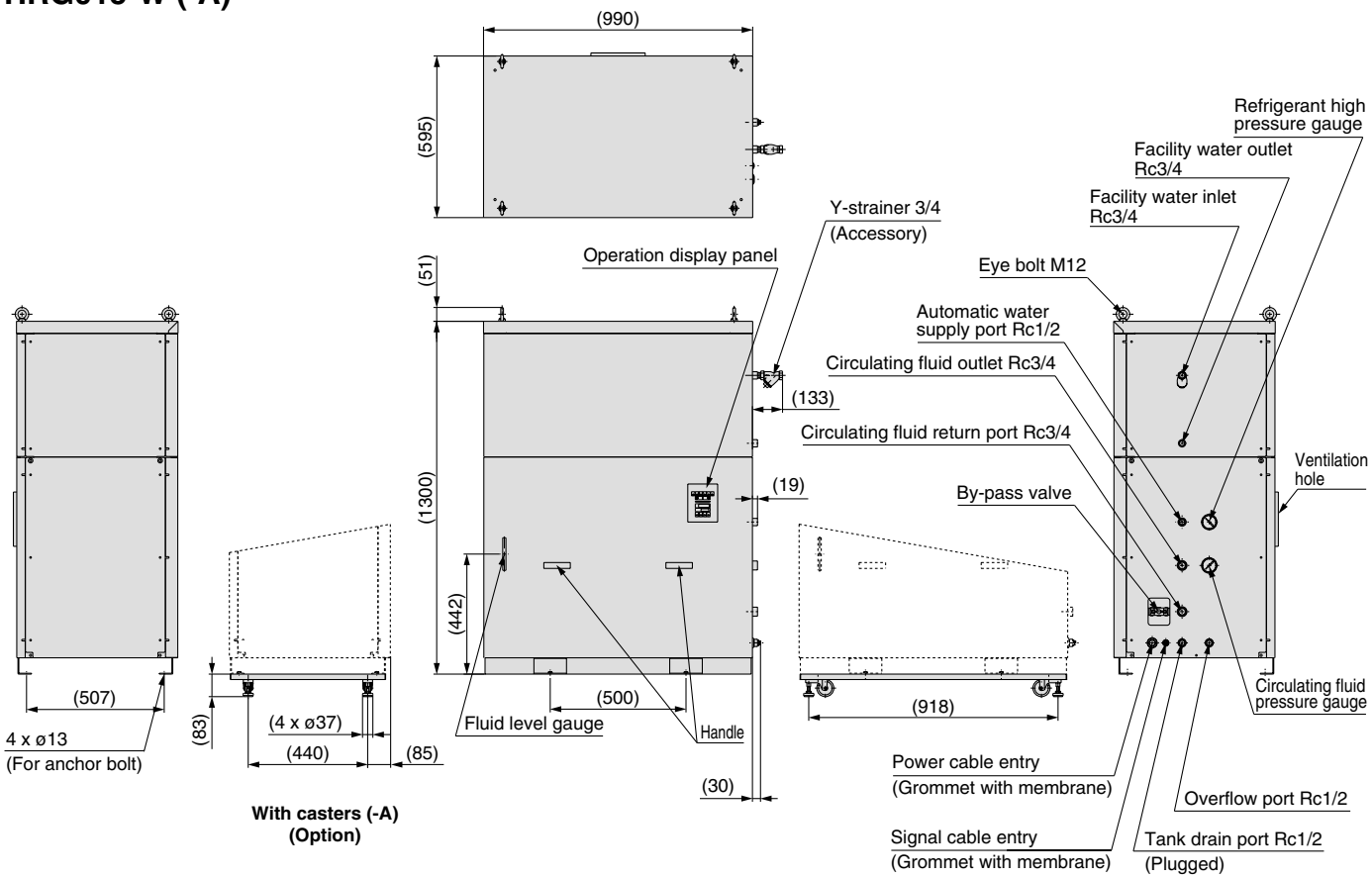
Dimensions: Water-Cooled Refrigeration

HRG010-W (-A)



With casters (-A) (Option)

HRG015-W (-A)

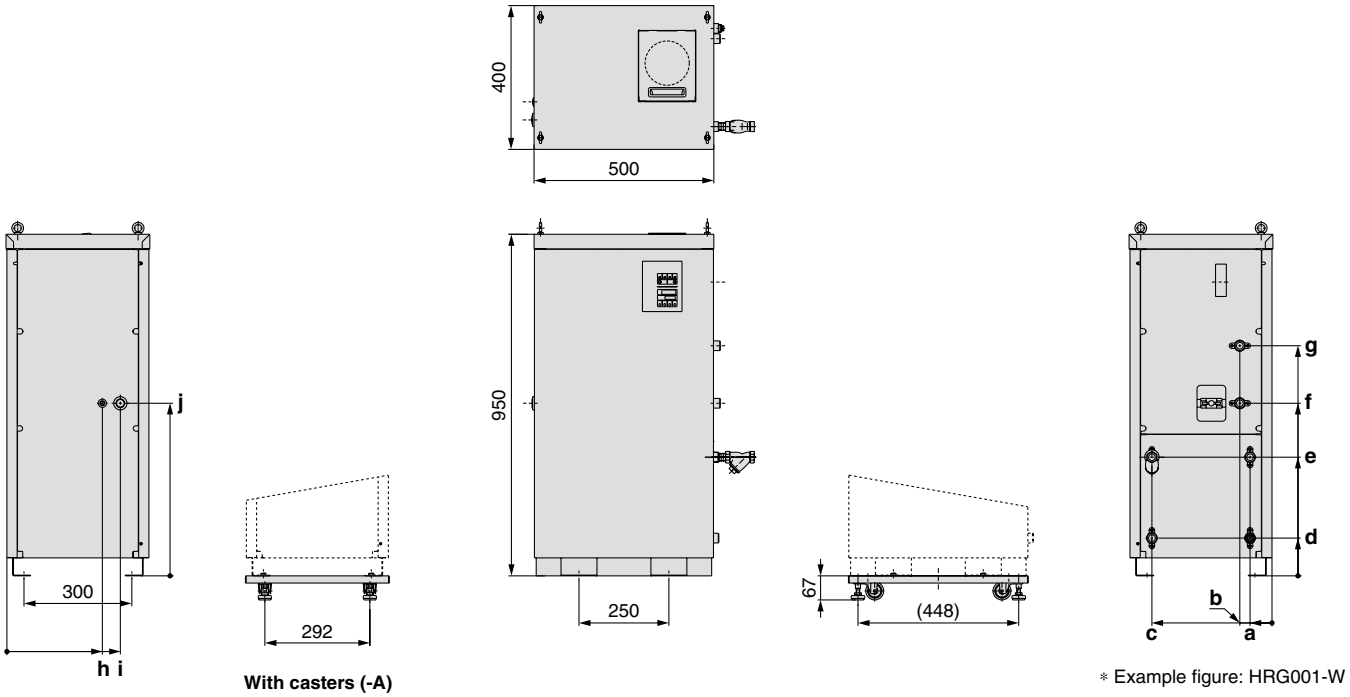


With casters (-A) (Option)

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Piping Connection and Installation Dimensions

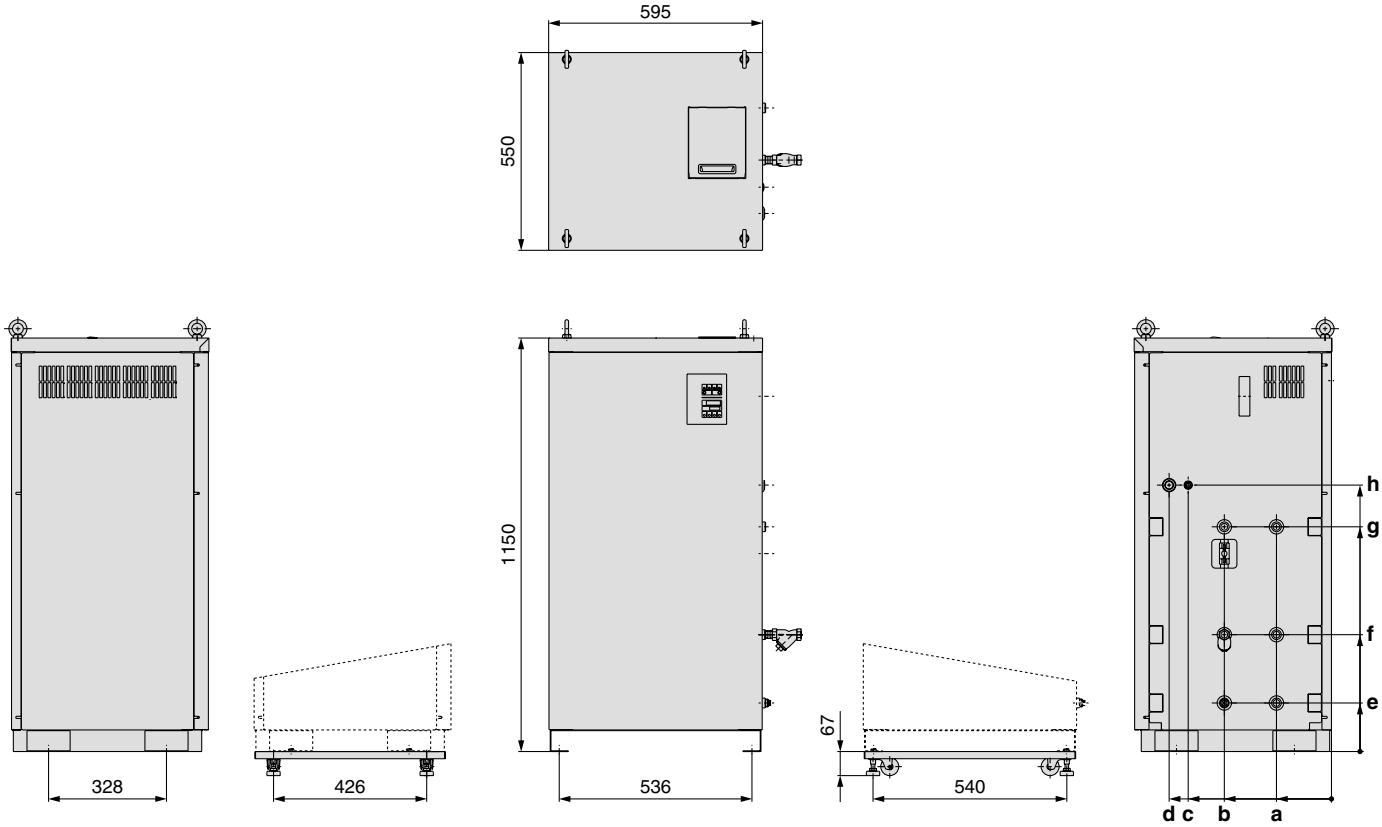
HRG001/002



With casters (-A) (Option)

∗ Example figure: HRG001-W

HRG005

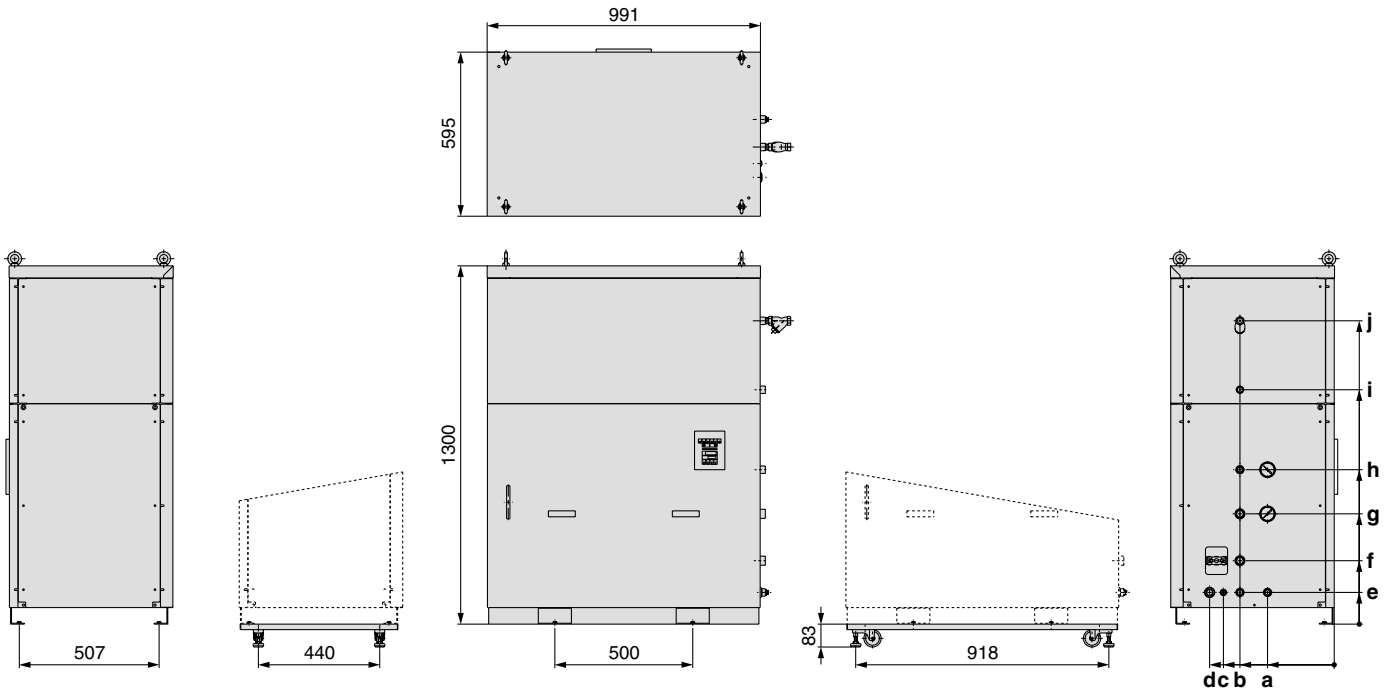


∗ Example figure: HRG005-W

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Piping Connection and Installation Dimensions

HRG010/015



∗ Example figure: HRG010-W

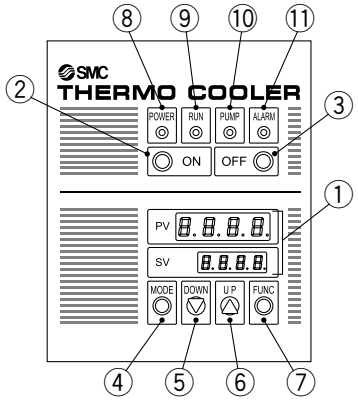
(mm)

Model	a	b	c	d	e	f	g	h	i	j
HRG001-A	61	94.5	—	105	330	480	640	265.5	315.5	480
HRG001-W	61	94.5	334	105	330	480	640	265.5	315.5	480
HRG002-A	61	94.5	—	105	330	480	640	265.5	315.5	480
HRG002-W	61	94.5	334	105	330	480	640	265.5	315.5	480
HRG005-A	153	298	398.5	451.5	135	—	625	741		
HRG005-W	153	298	398.5	451.5	135	325	625	741		
HRG010-A	242	342	402	452	115	230	400	560	—	—
HRG010-W	242	342	402	452	115	230	400	560	850	1100
HRG015-A	242	342	402	452	115	230	400	560	—	—
HRG015-W	242	342	402	452	115	230	400	560	850	1100

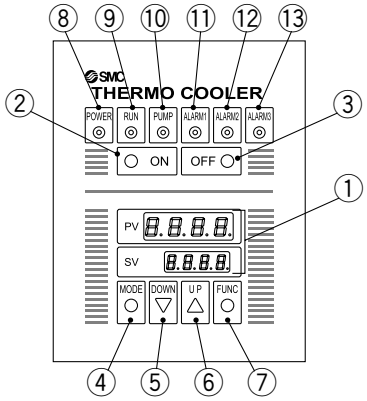
Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Operation Display Panel

HRG001/002/005



HRG010/015



No.	Description		Function	
			HRG001/002/005	HRG010/015
①	**7-segment display screen**	**PV**	Displays the current temperature of the circulating fluid outlet.	
		SV	Displays the set temperature of the circulating fluid outlet.	
②	**[ON] switch**		Starts the operation.	
③	**[OFF] switch**		Stops the operation.	
④	**[MODE] key** Note 1)		Changes the display between the temperature and control value Note 1).	
⑤	**[DOWN] key**		Reduces the set temperature of the circulating fluid outlet.	
⑥	**[UP] key**		Increases the set temperature of the circulating fluid outlet.	
⑦	**[FUNC] key** Note 2)		Activates functions Note 2) that have been set.	
⑧	**[POWER] indicator**		Lights up when the power is being supplied to the unit.	
⑨	**[RUN] indicator**		Lights up when the unit is running.	
⑩	**[PUMP] indicator**		Lights up when the pump is running independently, or when the main unit is running.	
⑪	**[ALARM] indicator, [ALARM1] indicator**		Lights up when ALARM is active.	Lights up when ALARM 1 is active.
⑫	**[ALARM2] indicator**			Lights up when ALARM 2 is active.
⑬	**[ALARM3] indicator**			Lights up when ALARM 3 is active.

Note 1) All control values used in normal operation are displayed, but are locked and cannot be changed. It is not necessary to unlock these values except during maintenance.
Note 2) However, functions are not set. Pressing this key will have no effect.

Alarm/Alarm Indicators and Explanation

The 6 basic temperature controller alarms are displayed on the operation display panel with alarm indicators (red LED). Operation stops if an alarm is active, assuring safety. When the source of the problem has been eliminated, the equipment must be restarted.

■ Explanation of Alarms (HRG001/002/005)

Indicator	Alarm	Operation status	Main reason
[ALARM]	Prevention of reverse electrical current to the pump and compressor	Stop	Power supply to this unit is incorrect.
	Low level of fluid in tank	Stop	Level switch activated because fluid level in tank fell below LOW.
	Interrupted or abnormal facility water supply Note 1)	Stop	Pressure switch activated because inadequate heat dissipation caused refrigerant pressure to rise.
	Circulating fluid temperature abnormally high	Stop	Temperature sensor activated because circulating fluid temperature became too high.
	Overload of pump	Stop	Circulation pump overload relay activated.
	Overheating of fan motor Note 2)	Stop	Fan motor thermostat activated.
	Overload of compressor	Stop	Compressor overload relay activated.

■ Explanation of Alarms (HRG010/015)

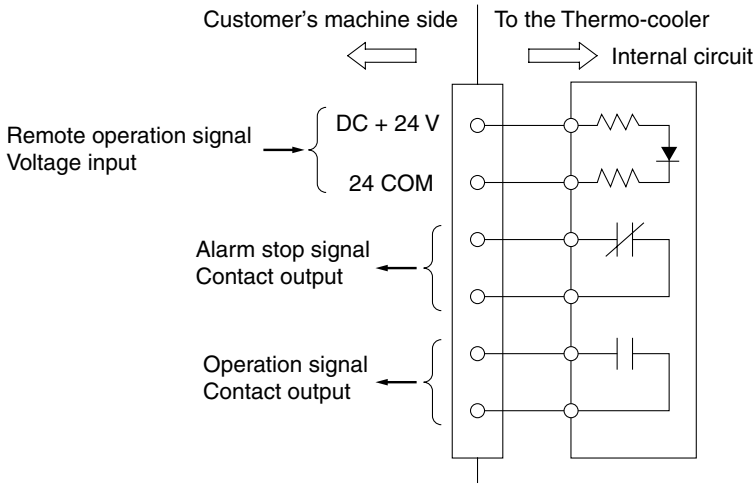
Indicator	Alarm	Operation status	Main reason
Note 3) [ALARM1]	Prevention of reverse electrical current to the pump and compressor	Stop	Power supply to this unit is incorrect.
	Low level of fluid in tank	Stop	Level switch activated because fluid level in tank fell below LOW.
	Interrupted or abnormal facility water supply Note 1)	Stop	Pressure switch activated because inadequate heat dissipation caused refrigerant pressure to rise.
Note 4) [ALARM2]	Circulating fluid temperature abnormally high	Stop	Temperature sensor activated because circulating fluid temperature became too high.
	Overload of pump	Stop	Circulation pump overload relay activated.
Note 5) [ALARM3]	Overheating of fan motor Note 2)	Stop	Fan motor thermostat activated.
	Overload of compressor	Stop	Compressor overload relay activated.

Note 1) Only for water-cooled refrigeration (HRG□□□-W)
Note 2) Only for air-cooled refrigeration (HRG□□□-A)
Note 3) ALARM 1 lights up when power supply is turned on but operation has not commenced due to abnormal installation status: incorrect installation or inadequate preparation.
Note 4) ALARM 2 lights up if a water delivery circuit error occurs after operation has begun.
Note 5) ALARM 3 lights up if a refrigeration circuit error occurs after operation has begun.

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Contact Input/Output Function

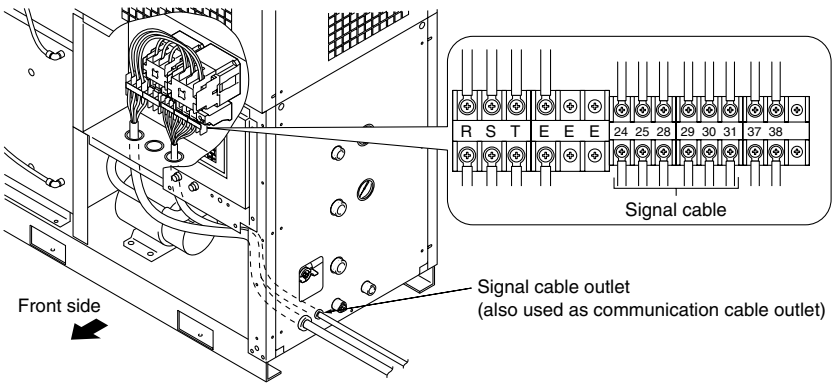
The Thermo-cooler is equipped with terminals that allow remote start/stop, and enable output of an operation signal or abnormal status stop signal. These should be used for synchronizing startup and shutdown with your other equipment, or when adding new patrol lights or buzzers. However, the contact output volume is limited, so please add patrol lights and/or buzzers for special relays (for amplification) if they are necessary.

Item		Specifications				
		HRG001	**HRG002**	**HRG005**	**HRG010**	**HRG015**
Connector type		M3 terminal block				
Remote operation signal input	Signal type	DC voltage input				
	Input voltage range	24 VDC ±5 V				
	Input current	0.5 to 8 mA				
	Terminal number Note)	1 (24 VDC), 2 (24 VCOM)		24 (24 VDC), 25 (24 VCOM)		
Alarm stop signal output	Signal type	Non-voltage contact output				
	Contact capacity	250 VAC, 1 A (Resistance load)				
	Terminal number Note)	3, 4		28, 29		
Operation signal output	Signal type	Non-voltage contact output				
	Contact capacity	250 VAC, 1 A (Resistance load)				
	Terminal number Note)	5, 6		30, 31		
Circuit diagram						

Note) For terminal numbers shown in the diagram, please refer to the terminal numbers for each type of signal listed in the table.

Input/output signal connection location

Remove the front panel and connect a signal cable to the terminal block inside the electrical component enclosure.



Other Features

● **Automatic water supply function (Built-in ball tap)**

The tank contains a built-in ball tap for water supply valve).

By installing a water supply connection, you can automatically keep the water level at its rated position (halfway between HI and LOW).

∗ HRG001 to 005-□□-X034
∗ HRG010/015 standard specifications

● **Modified product with remote operation signal**

Remote operation is possible with a contact input. No need for DC power supply.

∗ HRG001 to 015-□□-X071

● **Anti-freezing function**

This function detects the circulating fluid temperature. 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.

∗ HRG010/015 standard specifications

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Series HRG
Options

Note) Options have to be selected when ordering the Thermo-cooler. It is not possible to add them after purchasing the unit.

A **Option symbol**

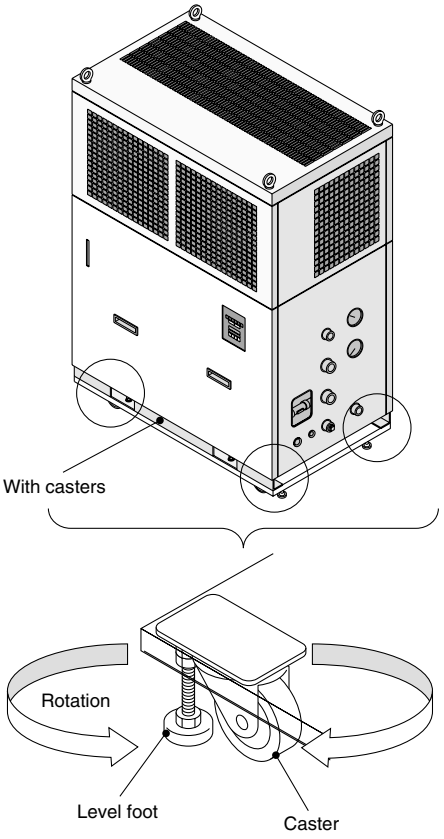
With Casters

HRG□□□−□□−A

A: With casters

The casters allow easy movement when delivering the equipment for installation or when altering the production area. A level foot may be used instead of a brake.

Applicable model	HRG001-□□-A	HRG002-□□-A	HRG005-□□-A		HRG010-□-A		HRG015-□-A	
Level foot height adjustment range (mm)	0 to 10				0 to 15			
Product weight (kg)	75	80	130	125	220	215	245	235
Product height (mm)	1017		1217		1383			



Caster mounting location

Rotating casters with level foot at the four corners are attached to the caster bases.

B **Option symbol**

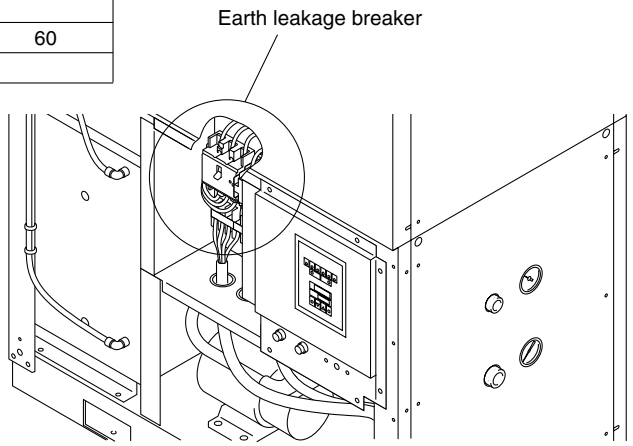
With Earth Leakage Breaker

HRG□□□−□□−B

B: With earth leakage breaker

In the event of a short circuit, overcurrent or overheating, the earth leakage breaker will automatically shut off the power supply. The power supply can be switched on or off easily from the main unit.

Applicable model	HRG001-□□-B	HRG002-□□-B	HRG005-□□-B	HRG010-□-B	HRG015-□-B
Pole number	3				
Rated current sensitivity (mA)	30				
Rated shutdown current (A)	5	10	20	40	60
Short circuit display method	Mechanical button				



Breaker mounting location

Remove the front panel. The breaker is mounted inside the electrical component enclosure.

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

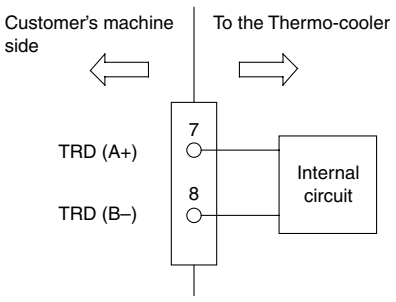
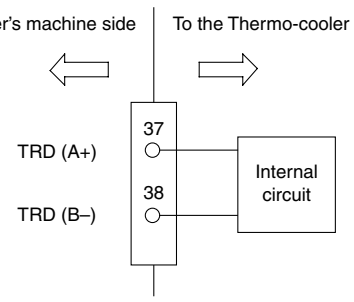
C Option symbol

With Communications Function (RS-485)

HRG□□□-□□-C

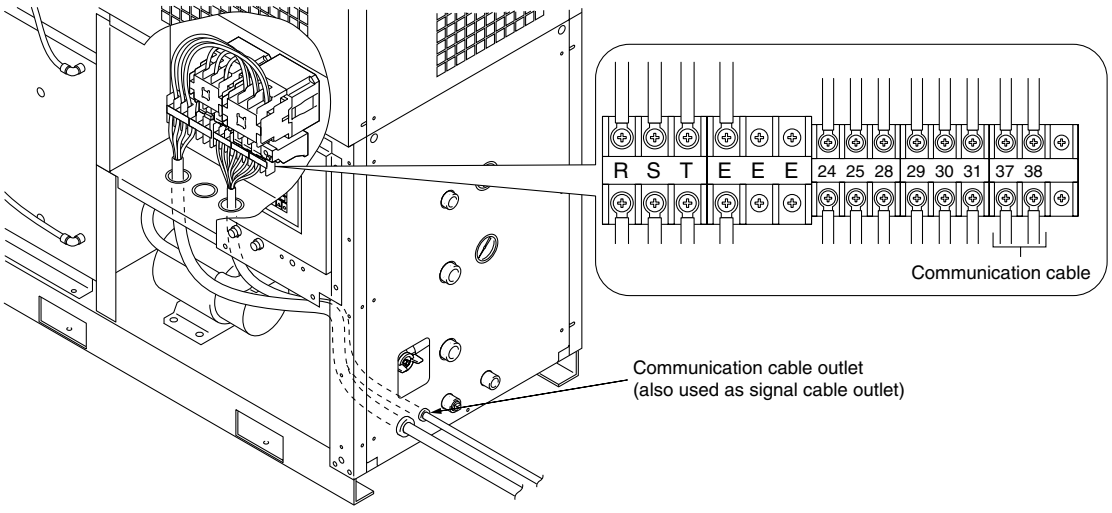
With communications function (RS-485)

With a host PC programmed in accordance with your manufacturing processor method, the communications function allows you to set (write) or monitor (read) the circulating fluid temperature.
<Writing>
Circulating fluid temperature setting (SV)
<Readout>
Circulating fluid present temperature (PV)
Circulating fluid temperature setting (SV)

Applicable model	**HRG001-□□-C**	**HRG002-□□-C**	**HRG005-□□-C**	**HRG010-□-C**	**HRG015-□-C**
Connector no.	7 (TRD+), 8 (TRD–)		37 (TRD+), 38 (TRD–)		
Connector type (on this product side)	M3 terminal block				
Standards	EIA RS-485 compliant				
Protocol	Special protocol: For details, refer to the Communications Specifications document.				
Circuit diagram					

Communication connection location

Remove the front panel, and connect your communication cable to the terminal block mounted inside the electrical component enclosure.



Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Optional Accessories

Note) Please order separately. Necessary to be fitted by the customer.

Specifications

Description	Description	Specifications	Applicable Thermo-cooler
Dustproof filter set 	For preventing a decline in the performance of air-cooled refrigerated Thermo-coolers, even in a dusty atmosphere.	Maximum ambient temperature 40°C	HRG001-A□ to 015-A
By-pass piping set 	For preventing the pump from overloading at low flow rates when the maximum Thermo-cooler operating pressure of 0.5 MPa is exceeded.	Circulating fluid temperature range 5°C to 35°C	HRG001-A□ to 015-A HRG001-W□ to 015-W
Separately installed power transformer 	Power supply and voltage for those other than the standard.	Maximum ambient temperature 40°C (Relative humidity 85% or less)	HRG001-A□ to 015-A HRG001-W□ to 015-W
Foundation bolt set 	For fixing the Thermo-cooler to the foundation. Easy to use – just drive in the core rod.	Stainless steel	HRG001-A□ to 015-A HRG001-W□ to 015-W
Piping adapter 	For converting the thread type used in the connection port of the Thermo-cooler.	Copper alloy	HRG001-A□ to 015-A HRG001-W□ to 015-W

How to Order

[Dustproof filter set]

HRG − FL ☐

Applicable Thermo-cooler

Symbol	Applicable Thermo-cooler	Quantity per set
001	HRG001-A□ HRG002-A□	1
005	HRG005-A□	1
010	HRG010-A	1
015	HRG015-A	(Large) 1 (Small) 2

Note) Refer to page 30 for dimensions and page 34 for mounting.

[By-pass piping set]

HRG − BP ☐

Applicable Thermo-cooler

Symbol	Applicable Thermo-cooler	Set pressure (Blow pressure)
001	HRG001-□□ HRG002-□□	0.12 [MPa]
005	HRG005-□□	0.30 [MPa]
010	HRG010-□	0.31 [MPa]
015	HRG015-□	0.32 [MPa]

Note) Refer to page 31 for dimensions and pages 34 and 35 for mounting and flow-rate characteristics.

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

How to Order

[Separately installed power transformer]

IDF-TR □ - □

Volume

Symbol	Applicable Thermo-cooler	Volume
1700	HRG001-□□	1.7 kVA
4000	HRG002-□□	4 kVA
7000	HRG005-□□	7 kVA
14000	HRG010-□	14 kVA
18000	HRG015-□	18 kVA

Power supply voltage

Symbol	Inlet voltage	Outlet voltage	Type
5	220 VAC (50 Hz) 220 to 240 VAC (60 Hz)	200 VAC (50 Hz) 200 to 220 VAC (60 Hz)	3-phase single
6	380, 400, 415 VAC (50 Hz) 380 to 440 VAC (60 Hz)		
7	440, 460 VAC (50 Hz) 440 to 500 VAC (60 Hz)		
8	220, 240, 380, 400, 415, 440 VAC (50/60 Hz)	200 VAC (50/60 Hz)	3-phase double

Note) Refer to page 32 for dimensions.

[Foundation bolt set]

IDF-AB □

Size

Symbol	Applicable Thermo-cooler	Material	Quantity per set
500	HRG001-□□ HRG002-□□ HRG005-□□	Stainless steel	4
501	HRG010-□ HRG015-□		

Note) Refer to page 33 for dimensions.

[Piping adapter]

IDF-AP □

Size

Symbol	Applicable Thermo-cooler	Thread type and port size		Material	Quantity per set
		Male side **A**	Female side **B**		
601	HRG001-□□ HRG002-□□ HRG005-□□ HRG010-□ HRG015-□	R1/2	NPT1/2	Copper alloy	2
603	HRG010-□ HRG015-□	R3/4	NPT3/4		

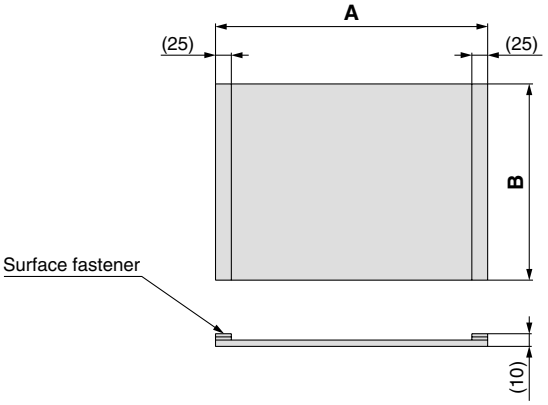
Note) Refer to page 33 for dimensions. Specify the quantity of units necessary for use with your piping system.

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

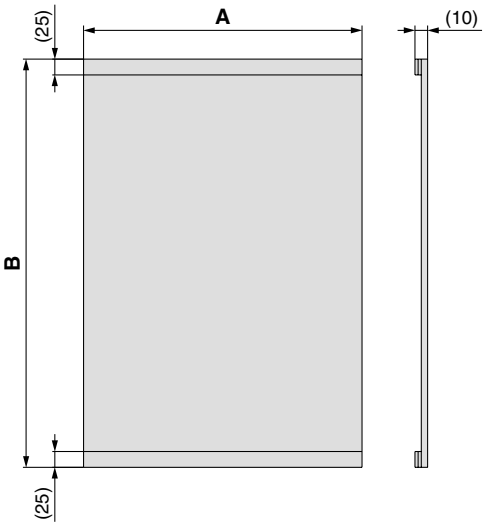
Dimensions

[Dustproof filter set]

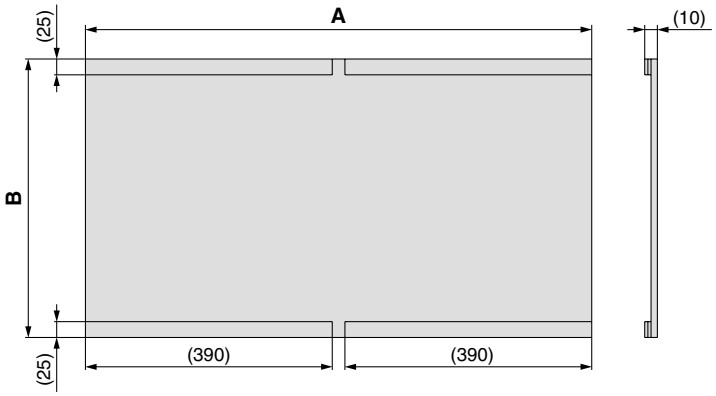
HRG-FL001



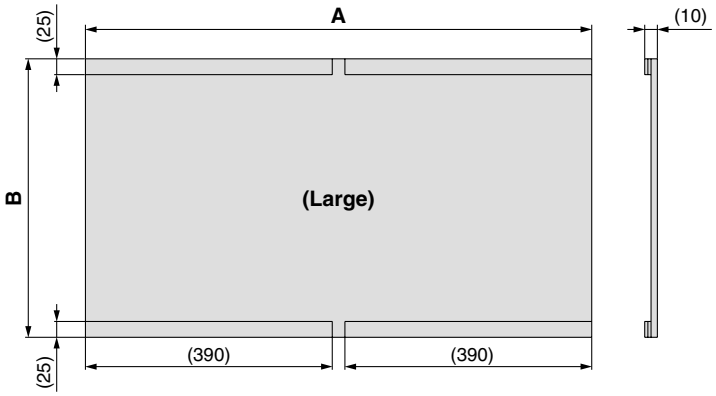
HRG-FL005

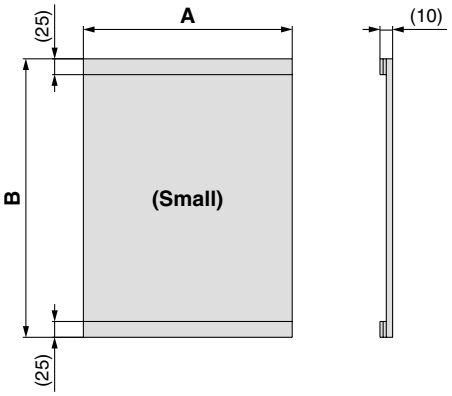


HRG-FL010



HRG-FL015





(mm)

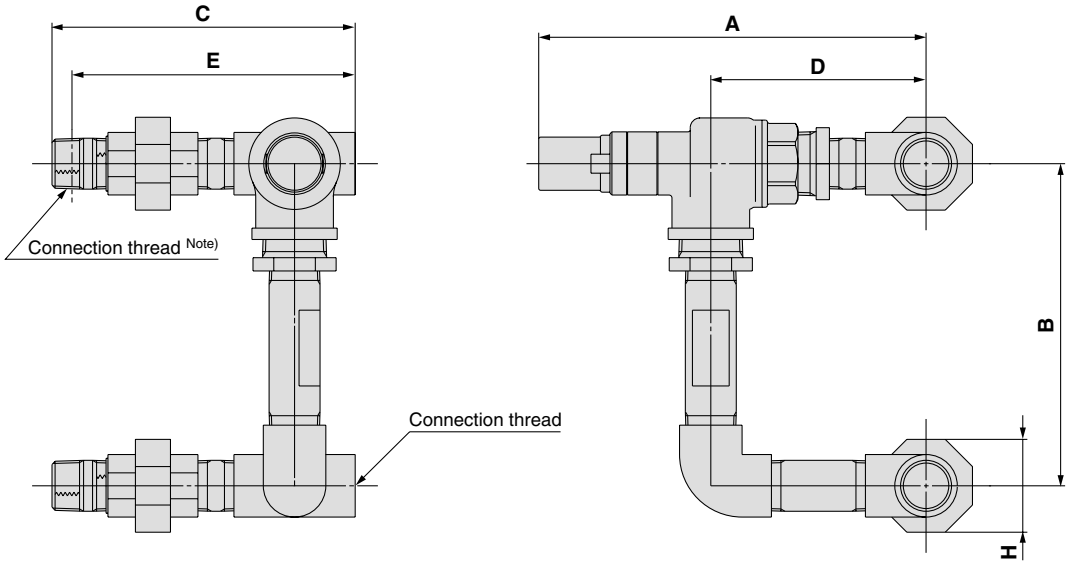
Part no.	A	B	C	Quantity per 1 set
HRG-FL001	430	310	10	1
HRG-FL005	440	645	10	1
HRG-FL010	880	440	10	1
HRG-FL015	(Large) 880 (Small) 330	(Large) 440 (Small) 440	(Large) 10 (Small) 10	(Large) 1 (Small) 2

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

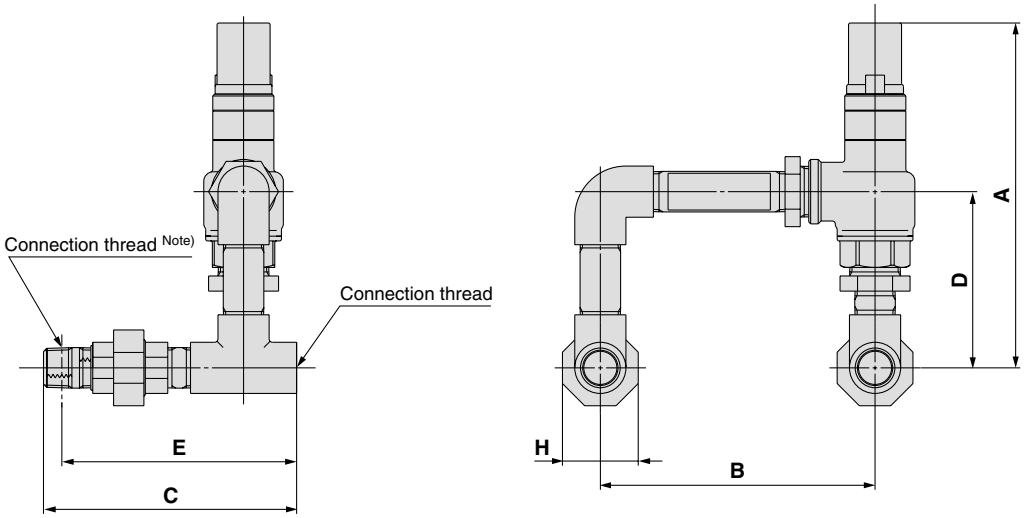
Dimensions

[By-pass piping set]

HRG-BP001 HRG-BP010 HRG-BP015



HRG-BP005



(mm)

Part no.	Connection thread R, Rc	A	B	C	D	E	H (Width across flats)	Weight (kg)
HRG-BP001	1/2	168	160	120	84	109	40	2
HRG-BP005	1/2	182	145	120	93	109	40	2
HRG-BP010	3/4	206	170	150	114	138	49	2.6
HRG-BP015	3/4	236	170	150	122	138	49	3.2

Note) The connection thread of the nipple comes with PTFE seal tape.

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

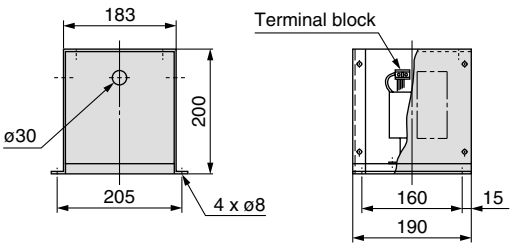
Dimensions

[Separately installed power transformer]

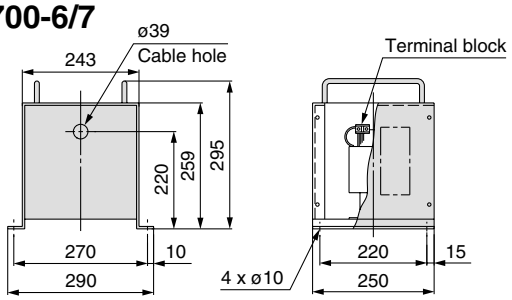
Specifications

Transformer part no.	Applicable Thermo-cooler	Volume	Type	Inlet voltage	Outlet voltage
IDF-TR1700-5	HRG001-□□	1.7 kVA	3-phase single	220 VAC (50 Hz) 220 to 240 VAC (60 Hz)	200 VAC (50 Hz) 200 to 220 VAC (60 Hz)
IDF-TR1700-6				380, 400, 415 VAC (50 Hz) 380 to 440 VAC (60 Hz)	
IDF-TR1700-7				440, 460 VAC (50 Hz) 440 to 500 VAC (60 Hz)	
IDF-TR4000-5	HRG002-□□	4 kVA		220 VAC (50 Hz) 220 to 240 VAC (60 Hz)	
IDF-TR4000-6				380, 400, 415 VAC (50 Hz) 380 to 440 VAC (60 Hz)	
IDF-TR4000-7				440, 460 VAC (50 Hz) 440 to 500 VAC (60 Hz)	
IDF-TR7000-8	HRG005-□□	7 kVA	3-phase double	220, 240, 380, 400, 415, 440 VAC (50/60 Hz)	200 VAC (50/60 Hz)
IDF-TR14000-8	HRG010-□	14 kVA			
IDF-TR18000-8	HRG015-□	18 kVA			

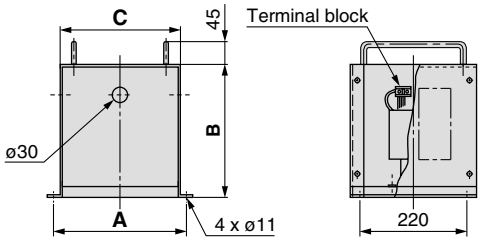
IDF-TR1700-5



IDF-TR1700-6/7



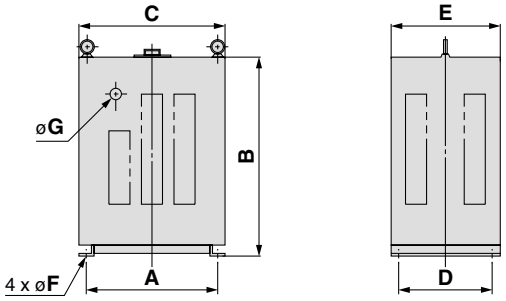
IDF-TR- ☐ -5/6/7



(mm)

Transformer part no.	A	B	C	Weight (kg)
IDF-TR4000-5	275	259	240	14
IDF-TR4000-6	355	299	320	35
IDF-TR4000-7	355	299	320	42

IDF-TR- ☐ -8



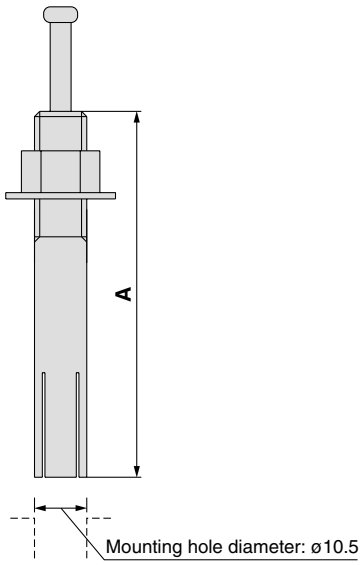
(mm)

Transformer part no.	A	B	C	D	E	F	G	Weight (kg)
IDF-TR7000-8	360	540	400	260	300	11	30	94
IDF-TR14000-8	400	650	450	300	350	13	40	152
IDF-TR18000-8	400	650	450	300	350	13	40	179

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Dimensions

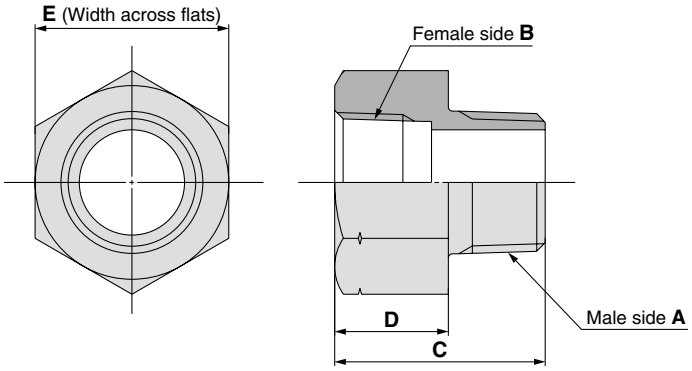
[Foundation bolt set]



(mm)

Part no.	Applicable Thermo-cooler	Nominal thread size	A	Quantity per set
IDF-AB500	HRG001-□□ HRG002-□□ HRG005-□□	M10	50	4
IDF-AB501	HRG010-□ HRG015-□		70	4

[Piping adapter]



(mm)

Part no.	Applicable Thermo-cooler	Thread type and port size		C	D	E	Quantity per set
		Male side A	Female side B				
IDF-AP601	HRG001-□□ HRG002-□□ HRG005-□□ HRG010-□ HRG015-□	R1/2	NPT1/2	38	23	26	2
IDF-AP603	HRG010-□ HRG015-□	R3/4	NPT3/4	43	23	32	2

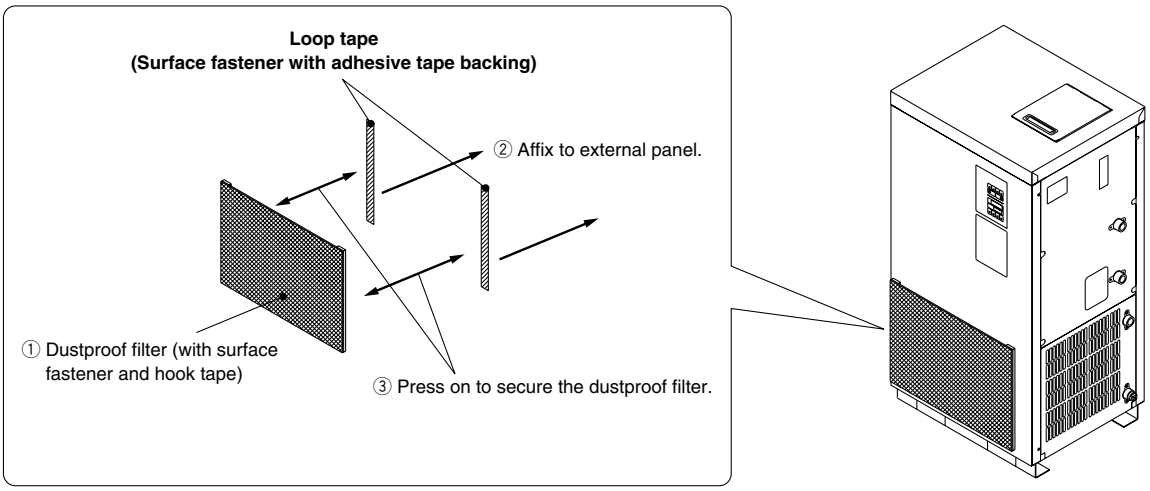
Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Mounting Example

Note) Please order separately. Necessary to be fitted by the customer.

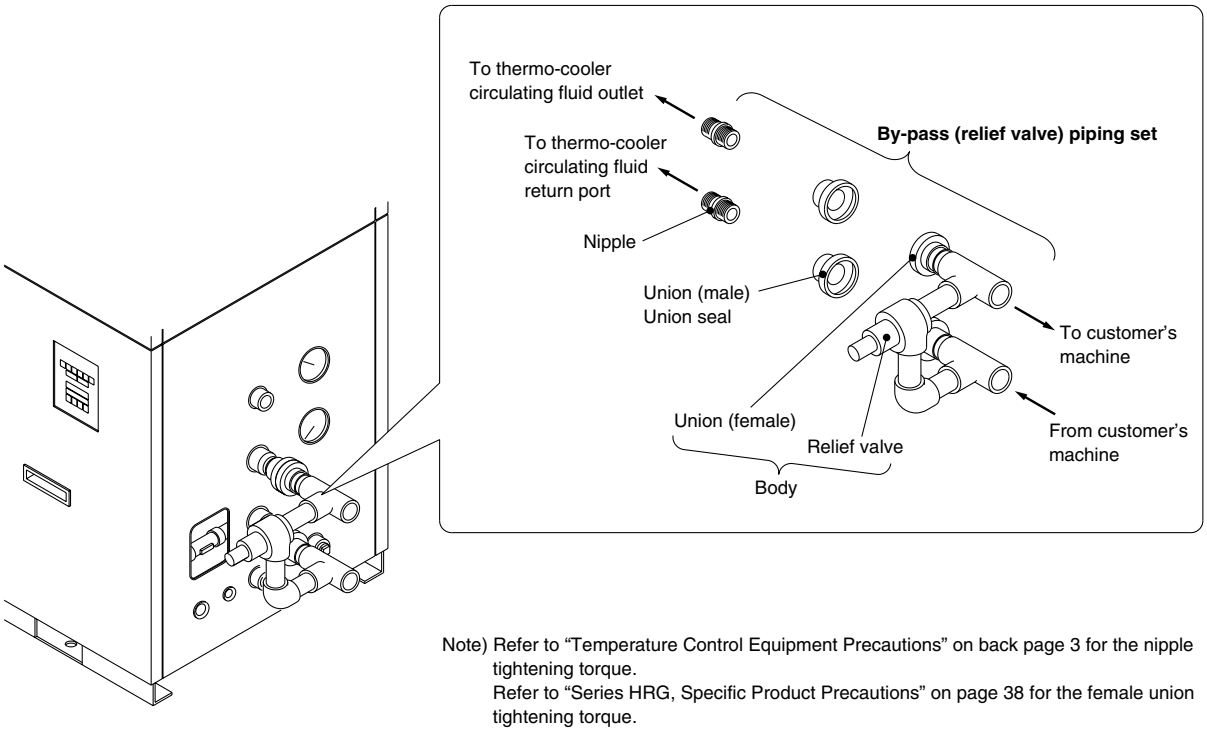
[Dustproof filter set]

① This dustproof filter is secured with hook-and-loop tape. This is sewed onto the male side of the surface fastener, and has adhesive tape backing for fixing to the female side.
② Remove the paper covering of the adhesive tape and affix the loop tape to the external panel of the ventilation hole on the Thermo-cooler.
③ Simply press the hook tape on to the loop tape to mount the dustproof filter.



[By-pass piping set]

① This set consists of a body with assembly of relief valve and union (female), along with a nipple, union (male) and union seal.
② To mount, screw the union (male) and nipple onto the circulating fluid outlet and circulating fluid return port of the Thermo-cooler.
③ Next, place the union seal between the union (male) and union (female) of the body, and gently tighten screw on tentatively (manually), in the appropriate mounting direction for the model used (refer to Operation Manual), paying attention to the direction of flow of the body (relief valve).
④ Finally, tightly fasten the union (female) of the body to the union (male) tightly. Note)

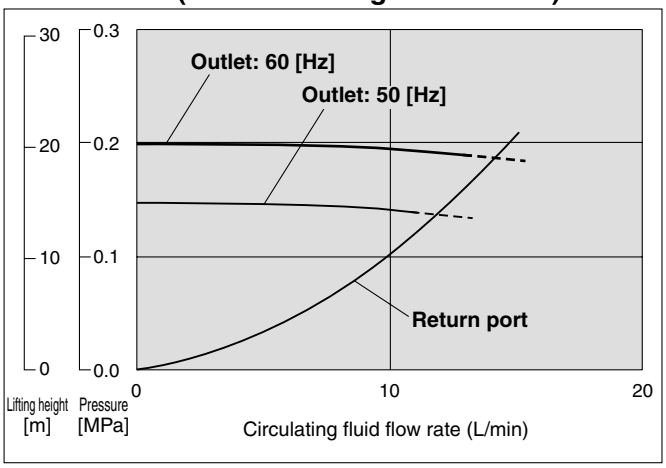


Note) Refer to "Temperature Control Equipment Precautions" on back page 3 for the nipple tightening torque.
Refer to "Series HRG, Specific Product Precautions" on page 38 for the female union tightening torque.

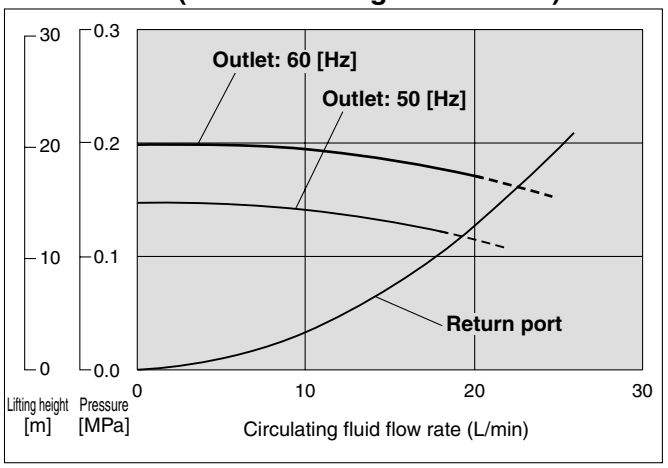
Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

[Pump capacity for each Thermo-cooler after mounting the by-pass piping set]

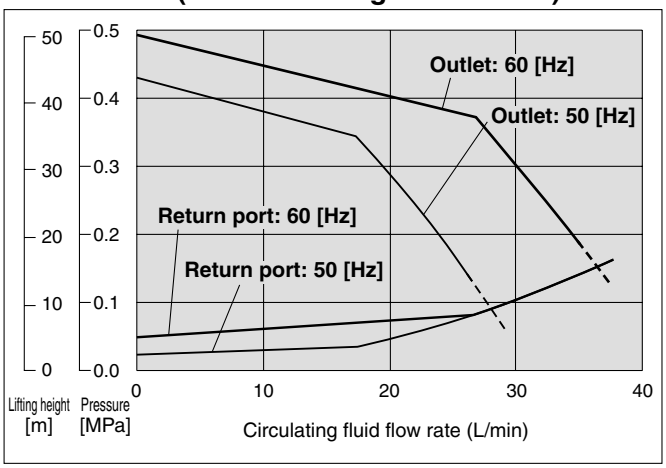
HRG001-□□ (After mounting HRG-BP001)



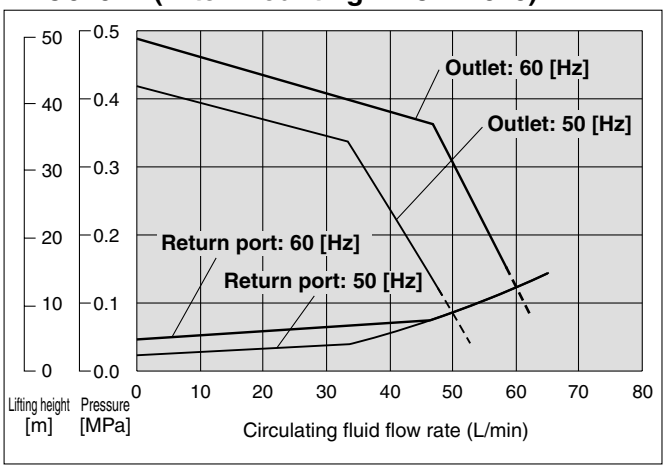
HRG002-□□ (After mounting HRG-BP001)



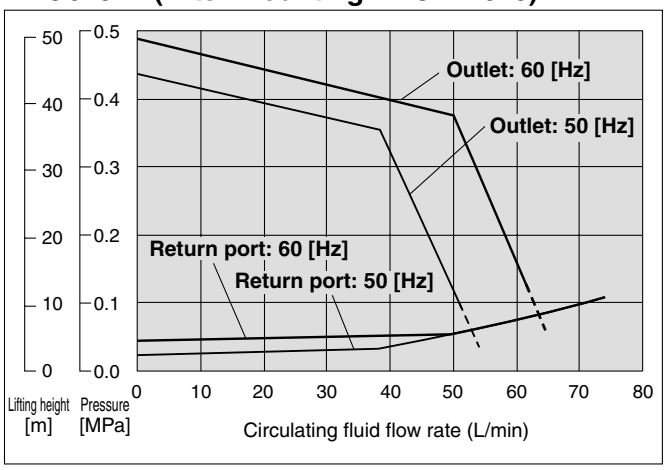
HRG005-□□ (After mounting HRG-BP005)



HRG010-□ (After mounting HRG-BP010)



HRG015-□ (After mounting HRG-BP015)



Series HRG
Specific Product Precautions 1

Production of HRG001/ 002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Be sure to read this before handling.
Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Design

⚠Warning

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

1. Confirm the specifications of the single unit (contents of this catalog) and thoroughly consider the adaptability between the customer'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 customer's operating condition. Also, the customer 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.

Selection

⚠Warning

1. Model selection

For selecting a model of Thermo-cooler, it is required to know the heat generation amount of a customer's machine.
Obtain the heat generation amount, referring to the model selection example on pages 8 and 9 before selecting a model.

2. Indication of model number

Select the cooling method and temperature stability depending on the customer's application.

Handling

⚠Warning

1. 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 because it will lead to a breakdown.

1. Environment like written in "Temperature Control Equipment Precautions".
2. Locations where spatter will adhere to when welding.
3. Locations where it is likely that the leakage of flammable gas may occur.
4. Locations having a large quantity of dust.
   If it is necessary to use the unit in an environment where there is a risk of the fin portion of the air-cooled condenser becoming clogged, please use the dustproof filter set (sold separately).

2. Install in an environment where the unit will not come into direct contact with rain or snow.

(HRG001 to HRG005)
These models are for indoor use only.
Do not install outdoors where rain or snow may fall on them.
(HRG010/015)
These models are built to rainproof enclosure IPx3, but are not completely waterproof to rain, etc. (as with IPx4 or higher).
To prolong the lifespan of this equipment, we recommend installation under an awning or other shelter.

Operating Environment/Storage Environment

⚠Warning

3. Conduct ventilation and cooling to discharge heat.

(Air-cooled refrigeration)
The heat which is cooled down through air-cooled condenser is discharged.
When using in a room which is shut tightly, ambient temperature will exceed the specification range stipulated in this catalog, which will activate the safety detector and stop the operation.
In order to avoid this situation, discharge the heat outside of a room by ventilation or cooling facilities.

Circulating Fluid

⚠Caution

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

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

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

Overly high concentrations can overload the pump, and cause safety protection devices to commence operation, stopping the operation of the unit.
Low concentrations, however, can lead to freezing at cold temperatures and cause the Thermo-cooler to break down.

4. When using clear water as a circulating fluid, use water that conforms to the appropriate water quality standards.

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

Clear 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
Standard item	pH (at 25°C)	—	6.8 to 8.0
	Electrical 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.

5. It is possible to use or supply the unit with deionized water, but it is not possible to maintain specific resistance.

When using deionized water, make sure to supply water with an electrical conductivity of 1 μS/cm or more. (In case of electrical resistivity, it should be 1 MΩ•cm or less.) However, it is not possible to maintain electrolyte concentration, as elements of the parts coming into contact with fluid may dissolve.

(HRG001/002)

1. A magnet pump is used as a circulating pump for the lubricating liquid.

It is particularly impossible to use liquid including metallic powder such as iron powder.

Series HRG
Specific Product Precautions 2

Production of HRG001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Be sure to read this before handling.
Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Transportation/Transfer/Movement

⚠ Warning

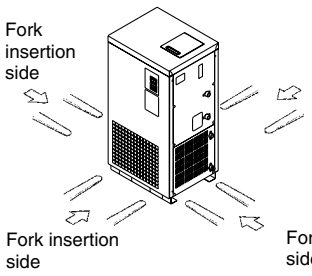
1. Transportation by forklift (HRG001 to 015)

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

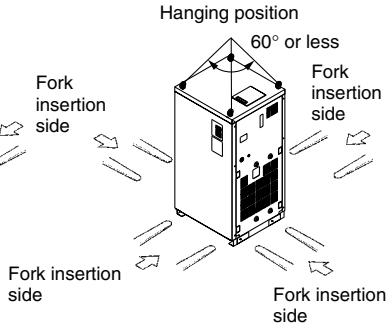
2. Hanging transportation (HRG005 to 015)

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

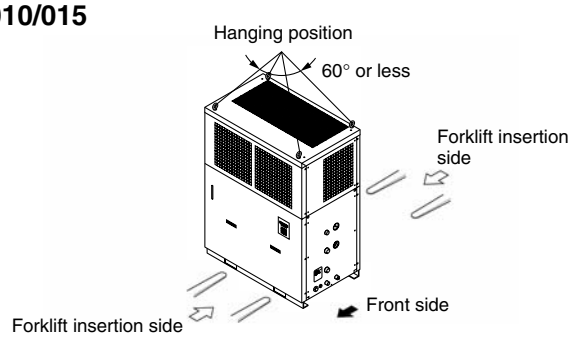
HRG001/002



HRG005



HRG010/015



(When using optional casters HRG□□□-□□-A)

1. Transportation by casters

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

Mounting/Installation

⚠ Warning

1. Do not place heavy objects on top of this propiping, or step on it.
The external panel can be deformed and danger can result.

2. Do not directly touch the edge of the external panel when removing and installing it.
It may cause injury. Be sure to wear protective gloves.

(When using optional casters HRG□□□-□□-A)

3. Lower the level foot and do not move.
Be sure to lower all four level foot to the level of the floor.

⚠ Caution

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

2. Secure with bolts, anchor bolts, etc.
Fasteners such as bolts or anchor bolts should be tighten with the recommended torque shown below.

Fixing Thread Tightening Torque

Connection thread	Applicable tightening torque N•m
M5	3
M6	5.2
M8	12.5
M10	24.5
M12	42

(When using optional accessories/dustproof filter set)

1. Use the attached surface fastener (with adhesive tape) to affix the dustproof filter to the panel of the Thermo-cooler.

2. Mounting the filter will create a certain amount of resistance to ventilation that will reduce the volume of airflow.
For this reason, be sure to keep the ambient temperature at 40°C or less.

3. Depending on the installation height of the Thermo-cooler and/or the cooled substrates, circulating fluid may overflow from the tank lid or overflow outlet.
In particular, avoid overflow from the lid of the built-in tank by installing with a height difference of 10 m or less.
Be sure to pipe the overflow outlet to a wastewater collection pit, etc.

Series HRG
Specific Product Precautions 3

Production of HRG001/ 002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Be sure to read this before handling.
Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Piping

⚠ Caution

1. **Regarding the circulating fluid pipings, consider carefully the suitability for shutoff pressure, temperature and circulating fluid.**
   If the operating performance is not sufficient, the pipings may burst during operation.
2. **For the circulating fluid pipings, use clean pipings which have no dust, piping debris or other foreign objects inside the pipings, and blow with air prior to undertaking any piping works.**
   If piping debris or other foreign objects remain inside the circulating fluid circuit, it can result in blockage, insufficient cooling or damage to the pump impeller.
3. **Select the piping port size which can exceed the rated flow.**
   For the rated flow, refer to the pump capacity table.
4. **When tightening at the circulating fluid inlets and outlets, tank drain port or overflow outlet of this product, use a pipe wrench to clamp the connection ports.**
5. **For the circulating fluid piping connection, install a drain pan and wastewater collection pit just in case the circulating fluid may leak.**
6. **While cleaning the inside of the tank, attach a valve to the tank drain outlet to drain the circulating fluid (clear water).**
7. **This product series consists of circulating fluid temperature controllers 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.

(Water-cooled refrigeration HRG□□□-W□)

1. **When tightening at the facility water inlets and outlets of this product, use a pipe wrench to clamp the connection ports.**
2. **Install by-pass piping.**
   This product has a built-in water control valve, so when the refrigeration circuit is stopped, facility water does not flow out in order to save energy.
   For this reason, by-pass piping is necessary for conducting maintenance of your facility water equipment, so be sure to install it.

(HRG010/015)

1. **When tightening at the water supply ports of this product, use a pipe wrench to clamp these ports.**
   This product has a built-in ball (float) tap. If you attach it to the faucet of a sink, etc. it will automatically supply water to the rated fluid level of the tank (halfway between HIGH and LOW.)
2. **Supply water at a pressure of 0.5 MPa or less.**
   If the water supply pressure is too high, the pipes may burst during use. Proceed with caution.

(When using optional accessories/by-pass piping set)

1. **In order to prevent foreign objects from entering during shipment, a polyethylene cap is attached to the inlets and outlets.**
   Remove these caps before piping.
2. **Pay attention to the flow direction of the relief valve.**
   Refer to the mounting example shown in the separate operating manual for the by-pass piping set when mounting.
3. **Tighten to the applicable torque shown below when tightening the cap nut (female) of the union.**

Union (Female) Tightening Torque

Nominal size	Applicable tightening torque N•m
Rc1/2	64 to 125
Rc3/4	106 to 208

Electrical Wiring

⚠ Warning

1. **Never change the set value of the safety instrument.**
   If the set value is changed, it will likely cause a breakdown or cause the product to catch on fire.
2. **Before wiring, be sure to cut the power supply.**
   Never perform any job while the product is energized.
3. **When connecting the power, confirm the phase sequence (R, S, T) of the three-phase AC power supply.**
   An incorrect phase sequence will cause the anti-reversal safety protection device to be activated, and the unit will fail to operate. If this occurs, switch the two wires to the correct phase sequence.
4. **Secure the cable so that its force, etc. is not applied to the terminal connector parts.**
   When the connection or attachment is incomplete, it will likely lead to an electrical shock, a fire, etc.
5. **Grounding should never be connected to a water line, gas line or lightning rod.**
6. **Multiple wiring is dangerous because it will lead to heat generation or cause a fire.**

⚠ Caution

1. **Power supply, signal cable and connecting terminal should be prepared by the customer.**
2. **In the event of wiring the signal for operation/stop commands (remote control), use caution regarding the correct polarity (+, –) of 24 VDC.**

(When using the HRG□□□-□□-C with optional communications function)

1. **Communication cables and adapters should be prepared by the customer.**
   Prepare parts that conform to the connector specifications of your host computer.
2. **Pay attention to the polarity (TRD+, TRD–) when connecting communication cables.**

Series HRG
Specific Product Precautions 4

Production of HRG001/ 002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Be sure to read this before handling.
Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Facility Water Supply

⚠ Warning

(Water-cooled refrigeration HRG□□□-W□)

1. Before startup, be sure to open the valve of your facility water equipment.
Prepare before startup, so that facility water can flow when the fitted water control valve (facility water control valve) opens during operation.

2. Supply pressure of 0.5 MPa or less.
If the supply pressure is high, it will cause water leakage.

3. Be sure to prepare your utilities so that the pressure of the Thermo-cooler facility water outlet is at 0 MPa (atmospheric pressure) or more.
If the facility water outlet pressure becomes negative, the internal facility water piping may collapse, and proper flow control of facility water will be impossible.

Operation

⚠ Warning

1. Confirmation before operation
1. The fluid level of a tank should be within the specified range of "HIGH" and "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 a customer'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.
3. Handling of by-pass valve
At the time this product is shipped from our factory, the by-pass valve is fully open.
Operation with it fully closed will cause the circulating fluid outlet pressure to increase high and it may safely stop in order to prevent the pump's operation from overloading.
When operating for the first time after installation, be sure to operate it with the by-pass valve fully open.

2. Confirmation during operation
1. Adjust the by-pass valve.
Monitor the external piping, pressure gauge, or flow meter mounted on the equipment from the customer's side, in order to adjust the open angle of the by-pass valve, so that the required pressure or flow can be obtained.
2. Confirm 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 a customer's machine 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 equipment immediately.
After pushing the (OFF) switch, be sure to turn off the power supply breaker.

(When using optional accessories/by-pass piping set)

1. Do not adjust or change the preset pressure.
When persons other than experts carry out adjustments, leakage can occur from the shaft seal of the adjustment screw. Proceed with caution.

Operation

⚠ Caution

1. The temperature set value can be written to EEPROM, but only up to approx. 1 million times.
Especially when using communication function, save data with STOR before stoppage, and do not carry out frequent saving (STOR) of temporary setting values.

Operation Restart Time

⚠ 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.

Protection Circuit

⚠ Caution

1. 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%.
- The order of the 3-phase power supply, R, S, T is different.
- In case the water level inside the tank is reduced abnormally.
- Facility water is not supplied. (HRG□□□-W)
- Transfer pressure of the circulating fluid is too high.
- Circulating fluid temperature is too high.
- Compared to the cooling capacity, the heat generation amount of a customer's machine is too high.
- Ambient temperature is too high. (40°C or higher)
- Refrigerant pressure is too high.
- Ventilation hole is clogged with dust or dirt. (Especially HRG□□□-A)

Maintenance

⚠ Warning

1. Do not operate the switch with wet hands or touch electrical parts. This will lead to an electrical shock.

2. Do not splash water directly on this product for cleaning.
This will lead to an electrical shock or a fire.

3. When the panel was removed for the purpose of inspection or cleaning, mount the panel after works were done.
If the panel is still open, or running the equipment with the panel removed, it may cause an injury or electric shocks.

4. When cleaning the air-cooled condenser, do not touch the fin directly.
This may lead to injuries.

Series HRG
Specific Product Precautions 5

Production of HRG001/ 002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Be sure to read this before handling.
Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Maintenance

⚠ Caution

<Periodical inspection every one month>

(Air-cooled refrigeration HRG□□□-A□)

1. Clean the ventilation hole

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

(When using optional accessories/dustproof filter set)

1. Clean the dustproof filter.

To prevent dirt or clogging of the dustproof filter from leading to a decline in heat-releasing performance of the air-cooled condenser, clean or wash it regularly.

2. Remove the filter from the Thermo-cooler before cleaning it.

Do not directly splash water on the filter to clean it while it is still attached to the Thermo-cooler.
This can lead to electric shock or fires in the main unit of the Thermo-cooler.

<Periodical inspection every three months>

1. Inspect the circulating fluid.

1. When using clear water or deionized water
   - Replacement of clear water or deionized water
     Failure to replace the clear water or deionized water can lead to the development of bacteria or algae. Replace it regularly depending on your usage conditions.
   - Tank cleaning
     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 measurement device to confirm that the concentration does not exceed 15%.
   Dilute or add as needed to adjust the concentration.

2. Check the water quality of facility water.

Regarding the water quality standards for facility water, refer to "Temperature Control Equipment Precautions".

<Periodical inspection every six months>

(HRG005-□□, HRG010-□, HRG015-□) Note 1)

1. Inspect the circulating fluid.

1. Remove the panel and inspect if there is abnormal leakage from the pump's mechanical seal.
2. Leakage amount of a mechanical seal
   Leakage of the mechanical seal cannot be completely avoided due to its construction (rotating machine).
   Although this amount of leakage is stipulated as 3 (cc/h) or less (reference value) according to the JIS standard, replace the mechanical seal when the amount of leakage is 0.3 (cc/h) or greater.
   Also, as a guide for periodically replacement, the operation hours is 6000 to 8000 hours. (normally 1 year) Note 2)

Note 1) In the case of the HRG001/002, because the pump included in the unit is a magnet pump with no rotating shaft seal, it is not necessary to inspect the mechanical seal (rotating shaft seal).

Note 2) In placing an order of mechanical seal set (service parts), inform us of the complete model number and the production lot number of the product in use.

<Periodical inspection during the winter season>

1. Keep the pump operating.

(HRG001-□□ to HRG005-□□)

- **Continue operating the pump repeatedly.**
  The heat generated by the pump will prevent freezing.

(HRG010-□, HRG015-□)

- **Keep the power supply running (POWER light on, RUN light off), and fully open the valves in the circulating fluid piping.**
  If the circulating fluid temperature falls below 3°C, the pump will start operating automatically. The heat generated by the pump operation will warm up the circulating fluid. When the temperature rises above 5°C, the pump will stop automatically. Consequently, the circulating fluid temperature is kept between 3°C and 5°C to avoid being frozen.

2. Make water-removal arrangements beforehand.

In extremely cold weather conditions, the heat generated by the pump as described above may not be enough to prevent freezing.
If you expect these kind of conditions, remove the circulating fluid (especially clear water or deionized water) beforehand.

3. Consult a professional.

For additional methods to prevent freezing (such as commercially available tape heaters, etc.), consult a professional for advice.

Production of HRGC001/ 002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Refrigerated Thermo-cooler *Series* HRGC

Makes cooling water easily available, anytime, anywhere.

- Worldwide in voltage: Single phase 200 to 230 VAC, 50/60 Hz
- International standards: CE cULus
- Energy saving: Stop-idling function (±1°C type)
  Automatic facility-water-saving function (water-cooled)
- Environmentally friendly: RoHS, Refrigerant R407C
- Selectable performance: Temperature stability ±1°C (Compressor ON/OFF control), ±0.5°C (Proportional valve PID control)
- Easy installation: No need for facility water (air-cooled), Caster, By-pass valve and Strainer (water-cooled), Stainless steel drain pan available as standard equipment, No need for power supply for remote operation
- Easy maintenance: "Alarm code" display, Accessible from the front electric control panel

A variety of "Options" and "Optional Accessories" (Pages 59 to 64)

Options

- With earth leakage breaker
- With communications function (RS-485)
- With communications function (RS-232C)
- With water leakage sensor
- With heater
- With automatic water supply function
- With external switch inlet
- Stainless steel wetted parts for circulating fluid
- High-lift pump
- With DI control kit

Optional accessories

- Dustproof filter set
- By-pass piping set
- DI (deionized water) filter
- Insulating material for DI (deionized water) filter

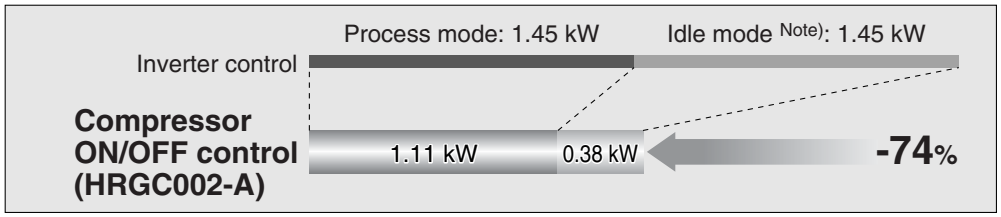
- **Cooling capacity (60 Hz):**
  1.1 kW/2.3 kW/4.8 kW (Air-cooled refrigeration/Water-cooled refrigeration)
- **Temperature stability: ±1°C (Refrigerator ON/OFF control)/**
  ±0.5°C (Proportional valve PID control)
- **Temperature range setting: 5 to 35°C**

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Energy-Saving and Environmentally Friendly

Power consumption: Max. 74% reduction

When the circulating fluid reaches a certain preset temperature, the compressor stops temporarily (idling stop) and the temperature is adjusted even in processes where there is heat loading, performance is at least as good as that of inverter control.

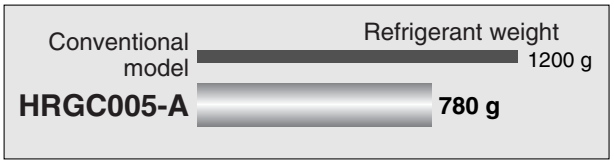


Note) Operating conditions: Process mode: Circulating fluid temperature 20°C, Heat load 2 kW
Idle mode: Circulating fluid temperature 20°C, Heat load 0 kW

- Reduced running cost
- Contribution to the environmental preservation

Refrigerant: 35% reduction (SMC comparison)

Conventionally, reducing the amount of refrigerant gas has meant a reduction in cooling performance. Now, however, the use of an improved high-performance **heat exchanger** Note) makes it possible to reduce the volume of refrigerant used (refrigerant charge volume) without sacrificing cooling performance.



Note) HRGC005-A only

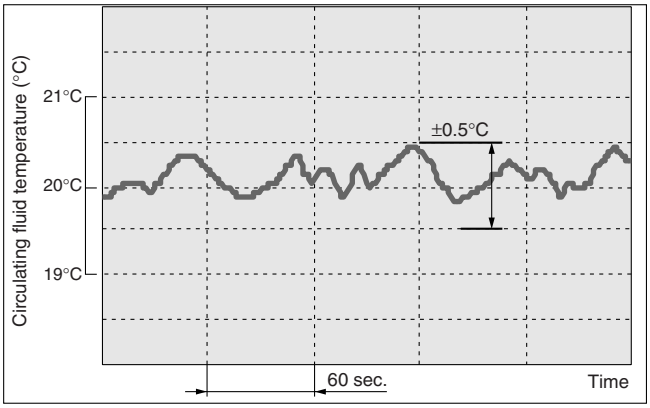
- More environmentally friendly

Selectable Performance

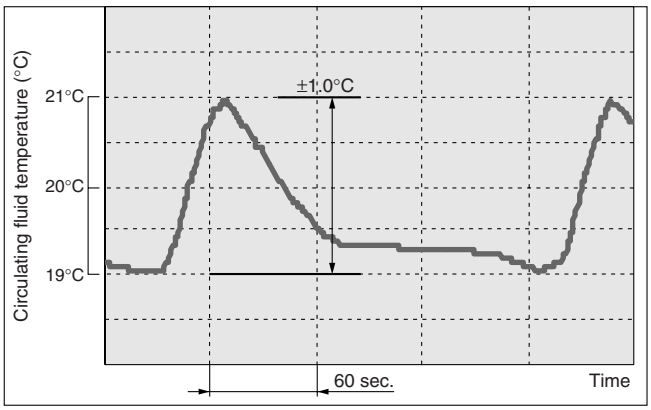
Temperature stability: ±0.5°C Note 1) 3) ±1.0°C Note 2) 3) (when a load is stable)

Two types of temperature control are provided: to ±0.5°C specifications using split flow from a three-way proportional valve, and simple temperature control to ±1.0°C specifications using the compressor ON/OFF mechanism. Choose the temperature stability that is right for your manufacturing process and method.

■ ±0.5°C type (**HRGC002-A5**)



■ ±1.0°C type (**HRGC002-A**)



Note 1) HRGC001-□5 to HRGC005-□5 only
Note 2) HRGC001-□ to HRGC005-□
Note 3) The value shown applies to a stable load state with no outside interference. Actual values may vary depending on the operating conditions.

Material compatible with a wide variety of circulating fluids is used for wetted parts.

- 15% ethylene glycol aqueous solution
- Clear water, Deionized water Note)

Note) Supply water with electrical conductivity of 1 μ S/cm or more.
However, the same level of electrical conductivity cannot be maintained.
An optional DI control kit (option Y) is available to maintain electrical resistance. Refer to page 62 for details.

Easy Installation and Maintenance

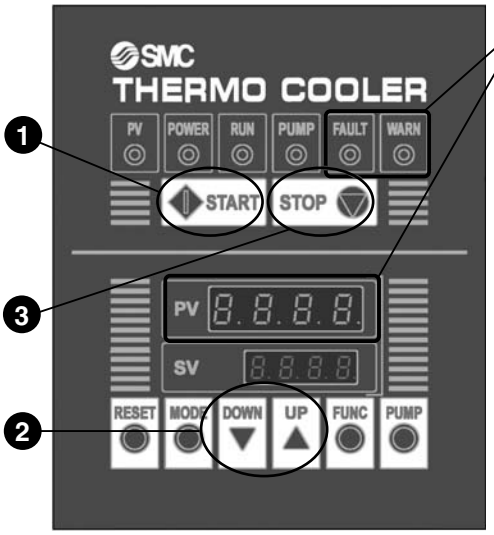
Simple operation

Operation ❶
Press the START button.

Operation ❷
Adjust the temperature setting with the UP/DOWN keys.

Operation ❸
Press the STOP button to shut down.

What could be easier?!



With alarm code indicators

Fault, Warn and alarm code indicators for easy failure diagnosis

- Fault (FAULT) indicator (red LED)
- Warning (WARN) indicator (yellow LED)

Note) Refer to page 57 for operation display panel and alarms.

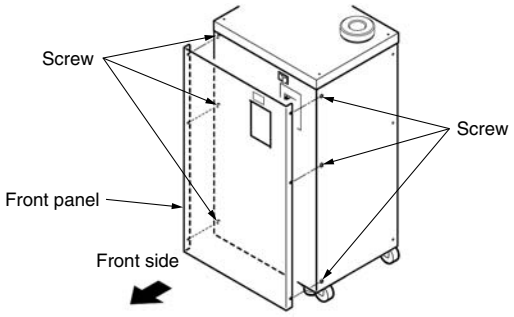
Contact input/output signal

■ Remote operation signal input
No need for power supply. Startup and shutdown can be remotely controlled.

■ Operation, shutdown, alarm signal output
Operation, shutdown, alarm signal can be output via the relay contact.

Easy maintenance

Checking the electrical component parts accessible from the front side. Reset switches such as pump, compressor thermal relay are located inside the electrical component enclosure.

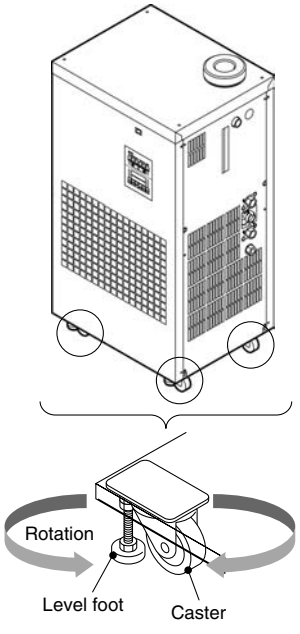


Optional accessories

Dustproof filters for the air-cooled refrigeration and by-pass piping set for preventing pressure increase are available. These improve durability and ease of use.
(Refer to pages 63 and 64 for optional accessories.)

Caster available as standard equipment

Can be used when the Thermo-cooler is carried onto the floor or moved to change the layout. Also, there is a level foot which can be used as a brake.



Options

- With earth leakage breaker
- With communications function (RS-485)
- With communications function (RS-232C)
- With water leakage sensor
- With heater
- With automatic water supply function
- With external switch inlet
- Stainless steel wetted parts for circulating fluid
- High-lift pump
- With DI control kit

(Refer to pages 59 to 62 for options.)

Air-Cooled Refrigeration

Air-cooled refrigeration

Unlike the water-cooled refrigeration, the air-cooled refrigeration does not require a facility water, and is easy to install alongside your equipment.

Communications

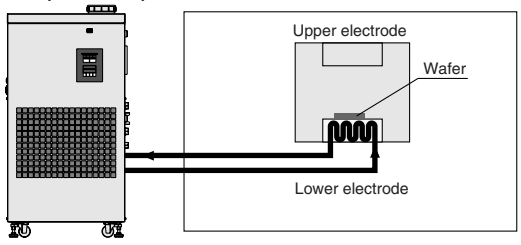
■ Communications function (RS-485, RS-232C)
(Refer to pages 59 to 62 for options.)

■ Contact input/output function
(Refer to page 58.)

Application Examples

Semiconductor

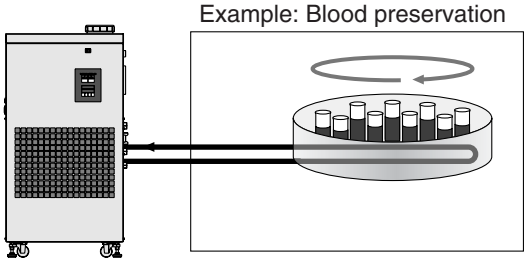
Example: Temperature control of chamber electrode



- **Etching equipment**
- **Spatter equipment**
- **Cleaning equipment**
- **Coating equipment**
- **Dicing equipment**
- **Tester, etc.**

Medical

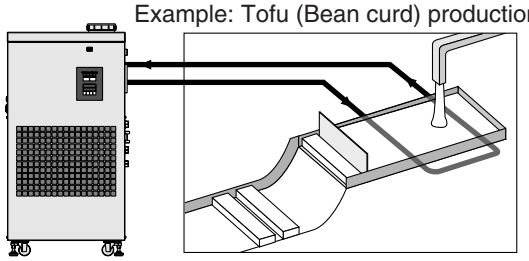
Example: Blood preservation



- **X-ray instrument**
- **MRI**
- **Blood preservation equipment**

Food

Example: Tofu (Bean curd) production

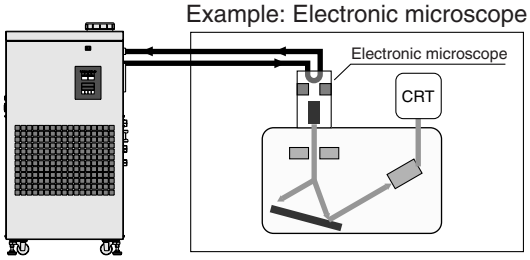


- **Bottle-cleaning machine**
- **Tofu (Bean curd) production equipment**
- **Noodle-making machine, etc.**

Water temperature control for forming tofu by mixing the boiled soybean milk and bittern

Analysis

Example: Electronic microscope

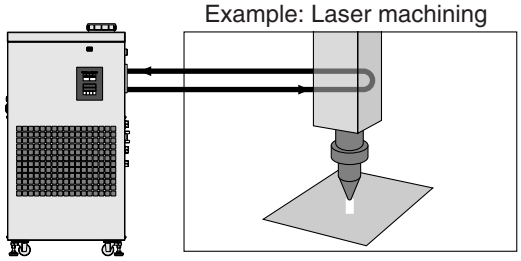


- **Electron microscope**
- **X-ray analytical instrument**
- **Gas chromatography**
- **Sugar level analytical instrument, etc.**

Prevents the distortion caused by the heat generated by the electronic gun in an electronic microscope.

Machine tool

Example: Laser machining

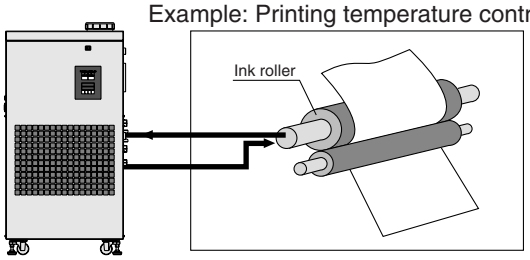


- **Wire cutting**
- **Grinder**
- **Spot welding**
- **Plasma welding**
- **Laser machining, etc.**

Temperature-controlling the laser generating tube enables the laser wavelength to be optimised, improving the accuracy of the machined cross sectional area.

Printing

Example: Printing temperature control

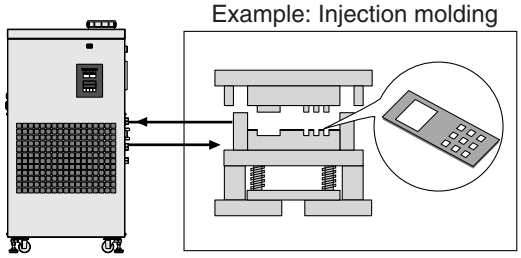


- **Offset printing machine**
- **Automatic developing machine**
- **UV equipment, etc.**

Temperature-controlling the ink roller enables to control the evaporation amount and viscosity of an ink and optimise the tint of colors.

Molding

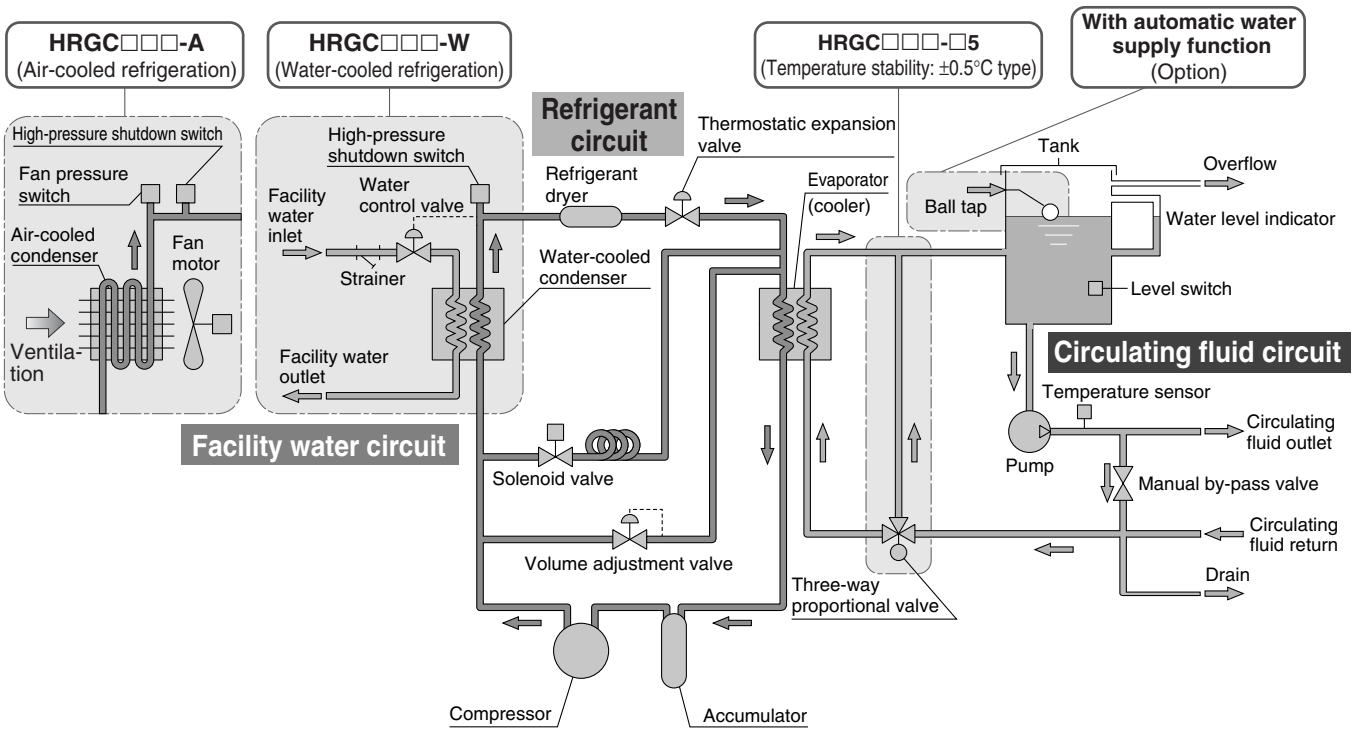
Example: Injection molding



- **Plastic molding**
- **Rubber molding**
- **Wire cable coating machine**
- **Injection molding, etc.**

Temperature-controlling the mold results in improved product quality.

Construction and Principles



Circulating fluid circuit

With the circulating pump, circulating fluid will be discharged to the customer's machine side. After the circulating fluid will cool the customer's machine side, it will heat up and return to the Thermo-cooler.

■ Temperature stability: ±0.5°C type (HRGC□□□-□5)

If the temperature of the circulating fluid is higher than the preset temperature, the three-way proportional valve will return the circulating fluid to the cooler. If the temperature of the circulating fluid is lower than the preset temperature, the fluid will be returned directly to the tank.

When the temperature of the circulating fluid is nearly the same as the preset temperature, the temperature will be stabilized by split flow between the cooler and the tank.

Refrigerant circuit

High-temperature, high-pressure refrigerant gas compressed by the compressor is made to release heat by the condenser, and turns to liquid. As the liquefied high-pressure refrigerant passes through the thermostatic expansion valve, it expands and cools down; as it passes through the evaporator, heat is extracted from the circulating fluid and it evaporates.

The evaporated refrigerant is once again sucked in and compressed by the compressor, and the above cycle is repeated.

When the circulating fluid is cooled sufficiently, the solenoid valve and volume adjustment valve open. These valves balance the refrigerant pressure and prevent freezing of the circulating fluid in excessively cold conditions.

■ Temperature stability: ±1.0°C type (HRGC□□□-□)

If the temperature of the circulating fluid is higher than the preset temperature, the compressor starts up, and refrigerant gas flows to the evaporator (cooler). This cools the circulating fluid. If the temperature of the circulating fluid is lower than the preset temperature, the compressor shuts down, and the flow of refrigerant gas stops. At such times, the circulating fluid is not cooled, and the temperature rises.

Temperature stability is achieved by the compressor starting up and shutting down.

Facility water circuit

■ Cooling method: Water-cooled refrigeration (HRGC□□□-W)

When the refrigerant gas is adequately liquefied and the circulating fluid is adequately cooled, the water control valve automatically closes the facility water circuit and adjusts the flow of facility water.

This method assures normal pressure in the compressor and reduces energy use by your facility water equipment.

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

CONTENTS

Series HRGC

Series HRGC
Model Selection

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Guide to Model Selection

1. Which is best for you: a water-cooled refrigeration or an air-cooled refrigeration?

You should base your choice on the configuration of your equipment.

Thermo-cooler series refrigeration methods

Water-cooled refrigeration ·····

Requires facility water equipment (cooling tower etc.) as well as electrical power supply. This type provides stable cooling performance year round, regardless of ambient temperature changes.

Air-cooled refrigeration ·····

Only electrical power supply is needed.

Facility water equipment is not necessary, so the system is easy to install wherever you need it, when you need it.

(Note that ventilation or air conditioning is required to dissipate heat: For details, refer to page 65, Specific Product Precautions 1, Operating Environment/Storage Environment 3.)

Example) Customer requirement: Air-cooled refrigeration

2. How much is the temperature in degrees centigrade for the circulating fluid?

Temperature range which can be set with the Thermo-cooler

5°C to 35°C

Example) Customer requirement: 20°C

3. What power supply frequency?

Thermo-cooler power supply frequency specifications

50 Hz, 60 Hz (common use)

Example) Customer requirement: 60 Hz

4. What is the kW for the required cooling capacity?
∗ To calculate the cooling capacity, refer to Example 1 to 3.

Example) Customer requirement: 4.2 kW (Refer to Example 1 (1).)

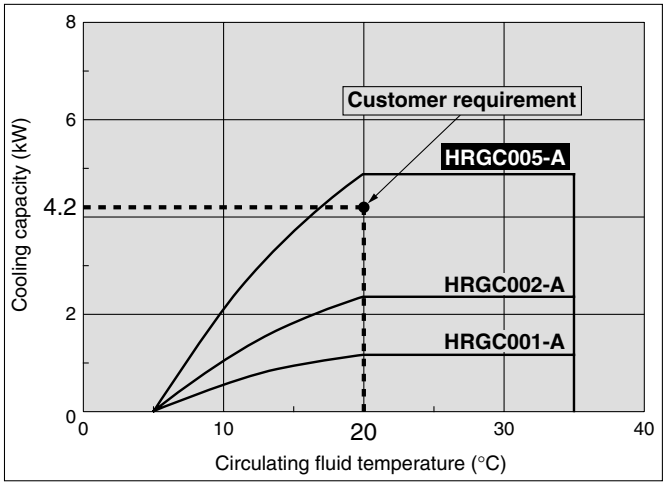
Selection

Example: Customer requirements 1 to 4

Cooling method : Air-cooled refrigeration
Circulating fluid temperature: 20°C
Power supply frequency : 60 Hz
Required cooling capacity : 4.2 kW

Based on the results of 1 to 4, refer to the graph of cooling capacity of an air-cooled refrigeration Thermo-cooler at 60 Hz (page 53). On the same graph, plot the intersections between the customer's required temperature (20°C) and cooling capacity (4.2 kW).

[Cooling Capacity Graph] Cooling Method: Air-cooled Refrigeration, Power Supply Frequency: 60 Hz



The point plotted in the graph is the requirement from your customer. Select the Thermo-cooler models exceeding this point. In this case, select the **HRGC005-A**.

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Required Cooling Capacity Calculation

Example 1: When the heat generation amount in the customer's machine 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 customer's machine.∗

(1) Derive the heat generation amount from the power consumption.

Power consumption **P**: 3.5 [kW]

Q = P = 3.5 [kW]

Cooling capacity = Considering a safety factor of 20%,

3.5 [kW] x 1.2 = 4.2 [kW]

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

Power supply output **VI**: 4.1 [kVA]

Q = P = V x I x Power factor

In this example, using a power factor of 0.85:

= 4.1 [kVA] x 0.85 = 3.5 [kW]

Cooling capacity = Considering a safety factor of 20%,

3.5 [kW] x 1.2 = 4.2 [kW]

(3) Derive the heat generation amount from the output.

Output (shaft power, etc.) **W**: 2.2 [kW]

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

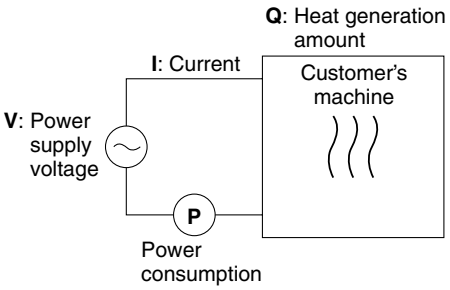
In this example, use an efficiency of 0.7:

$$= \frac{2.2}{0.7} = 3.14\ [kW]$$

Cooling capacity = Considering a safety factor of 20%,

3.14 [kW] x 1.2 ≈ 3.8 [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 customer facilities.
Please be sure to check it carefully.



Example 2: When the heat generation amount in the customer's machine is not known.

Obtain the temperature difference between inlet and outlet by circulating the circulating fluid inside the customer's machine.

Heat generation amount by customer's machine **Q**	: Unknown [kW] ([kJ/s])
Circulating fluid	: Clear water∗
Circulating fluid mass flow rate q_m	: (= ρ x q_v ÷ 60) [kg/s]
Circulating fluid density ρ	: 1 [kg/dm³]
Circulating fluid (volume) flow rate q_v	: 25 [dm³/min]
Circulating fluid specific heat capacity **C**	: 4.2 [kJ/(kg•K)]
Circulating fluid outlet temperature T_1	: 293 [K] (20 [°C])
Circulating fluid return temperature T_2	: 295 [K] (22 [°C])
Circulating fluid temperature difference ΔT	: 2.0 [K] (= $T_2 - T_1$)
Conversion factor: minutes to seconds (SI units)	: 60 [s/min]

∗ Refer to page 50 for the typical physical property values of clear water or other circulating fluids.

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

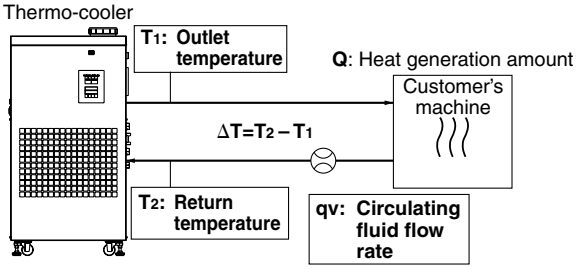
$$= \frac{\rho \times q_v \times C \times \Delta T}{60}$$

$$= \frac{1 \times 25 \times 4.2 \times 2.0}{60}$$

$$= 3.50\ [kJ/s] \approx 3.5\ [kW]$$

Cooling capacity = Considering a safety factor of 20%,

3.5 [kW] x 1.2 = 4.2 [kW]



Example of conventional measurement units (Reference)

Heat generation amount by customer's machine **Q**	: Unknown [kcal/h] → [kW]
Circulating fluid	: Clear water∗
Circulating fluid weight flow rate q_m	: (= ρ x q_v x 60) [kgf/h]
Circulating fluid weight volume ratio γ	: 1 [kgf/L]
Circulating fluid (volume) flow rate q_v	: 25 [L/min]
Circulating fluid specific heat capacity **C**	: 1.0 [kcal/(kgf•°C)]
Circulating fluid outlet temperature T_1	: 20 [°C]
Circulating fluid return temperature T_2	: 22 [°C]
Circulating fluid temperature difference ΔT	: 2.0 [°C] (= $T_2 - T_1$)
Conversion factor: hours to minutes	: 60 [min/h]
Conversion factor: kcal/h to kW	: 860 [(kcal/h)/kW]

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

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

$$= \frac{1 \times 25 \times 60 \times 1.0 \times 2.0}{860}$$

$$= \frac{3000\ [kcal/h]}{860}$$

$$\approx 3.5\ [kW]$$

Cooling capacity = Considering a safety factor of 20%,

3.5 [kW] x 1.2 = 4.2 [kW]

Model Selection

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

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 [kW] ([kJ/s])
Cooled substance : Water
Cooled substance mass **m** : (= ρ x **V**) [kg]
Cooled substance density ρ : 1 [kg/dm^3]
Cooled substance total volume **V** : 60 [dm^3]
Cooled substance specific heat capacity **C** : 4.2 [kJ/(kg•K)]
Cooled substance temperature when cooling begins T_0 : 305 [K] (32 [°C])
Cooled substance temperature after t hour T_t : 293 [K] (20 [°C])
Cooling temperature difference ΔT : 12 [K] (= $T_0 - T_t$)
Cooling time Δt : 900 [s] (= 15 [min])

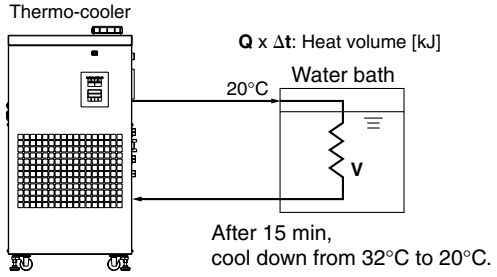
∗ Refer to the lower right for the typical physical property value by circulating fluid.

$$Q = \frac{m \times C \times (T_t - T_0)}{\Delta t} = \frac{\rho \times V \times C \times \Delta T}{\Delta t} = \frac{1 \times 60 \times 4.2 \times 12}{900}$$

$$= 3.36 \text{ [kJ/s]} \approx 3.4 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,

3.4 [kW] x 1.2 = 4.08 [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.

Example of conventional measurement units (Reference)

Heat quantity by cooled substance (per unit time) **Q**: Unknown [kcal/h] → [kW]
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** : 60 [L]
Cooled substance specific heat capacity **C** : 1.0 [kcal/(kgf•°C)]
Cooled substance temperature when cooling begins T_0 : 32 [°C]
Cooled substance temperature after t hour T_t : 20 [°C]
Cooling temperature difference ΔT : 12 [°C] (= $T_0 - T_t$)
Cooling time Δt : 15 [min]
Conversion factor: hours to minutes : 60 [min/h]
Conversion factor: kcal/h to kW : 860 [(kcal/h)/kW]

$$Q = \frac{m \times C \times (T_t - T_0)}{\Delta t \times 860} = \frac{\gamma \times V \times 60 \times C \times \Delta T}{\Delta t \times 860} = \frac{1 \times 60 \times 60 \times 1.0 \times 12}{15 \times 860}$$

$$= \frac{2880 \text{ [kcal/h]}}{860} \approx 3.4 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,

3.4 [kW] x 1.2 = 4.08 [kW]

Precautions on Model Selection

1. Heating capacity

When the circulating fluid temperature is set above room temperature, it needs to be heated due to heat generation of a pump in the Thermo-cooler. However, the Thermo-cooler has a lower heating capacity than a dedicated heater.

2. Pump capacity

<Circulating fluid flow rate>

Pump capacity varies depending on the model selected from the HRGC series. Also, circulating fluid flow varies depending on the circulating fluid discharge pressure. Consider the installation height difference between the thermo-cooler and a customer's machine, and the piping resistance such as circulating fluid pipings, or piping size, or piping curves in the equipment. Check beforehand if the required flow rate is achieved using the pump capacity curves for each respective model.

<Circulating fluid discharge pressure>

Circulating fluid discharge pressure has the possibility to increase up to the maximum pressure in the pump capacity curves for the respective model. Check beforehand if the circulating fluid pipings or circulating fluid circuit of the customer's machine are fully durable against this pressure.

Circulating Fluid Typical Physical Property Values

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

Density ρ: 1 [kg/dm^3]
(or, using conventional unit system, weight volume ratio γ = 1 [kgf/L])
Specific heat capacity **C**: 4.19 [kJ/(kg·K)]
(or, using conventional unit system, 1 [kcal/(kgf·°C)]

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

Water

Physical property value / Temperature	Density ρ [kg/dm^3]	Specific heat C [kJ/(kg•K)]	Conventional unit system	
			Weight volume ratio γ [kgf/L]	Specific heat C [kcal/(kgf•°C)]
5°C	1.00	4.20	1.00	1.00
10°C	1.00	4.19	1.00	1.00
15°C	1.00	4.19	1.00	1.00
20°C	1.00	4.18	1.00	1.00
25°C	1.00	4.18	1.00	1.00
30°C	1.00	4.18	1.00	1.00
35°C	0.99	4.18	0.99	1.00

15% Ethylene Glycol Aqueous Solution

Physical property value / Temperature	Density ρ [kg/L]	Specific heat C [kJ/(kg•K)]	Conventional unit system	
			Weight volume ratio γ [kgf/L]	Specific heat C [kcal/(kgf•°C)]
5°C	1.02	3.91	1.02	0.93
10°C	1.02	3.91	1.02	0.93
15°C	1.02	3.91	1.02	0.93
20°C	1.01	3.91	1.01	0.93
25°C	1.01	3.91	1.01	0.93
30°C	1.01	3.91	1.01	0.94
35°C	1.01	3.92	1.01	0.94

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

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Thermo-cooler
Series HRGC

How to Order

HRGC 001 – A □ □ – □

Cooling capacity

001	Cooling capacity 0.9/1.1 kW (50/60 Hz)
002	Cooling capacity 1.9/2.3 kW (50/60 Hz)
005	Cooling capacity 4.5/4.8 kW (50/60 Hz)

Cooling method

A	Air-cooled refrigeration
W	Water-cooled refrigeration

Temperature stability

Nil	±1.0°C
5	±0.5°C

Option

Nil	None
B	With earth leakage breaker
C	With communications function (RS-485)
S	With communications function (RS-232C)
E	With water leakage sensor
H	With heater
J	With automatic water supply function
K	With external switch inlet
M	Stainless steel wetted parts for circulating fluid
T	High-lift pump
Y	With DI control kit

∗ Refer to pages 59 to 62 for the specifications of each option.

Piping thread type

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

Options and Combinations

Symbol Note 1) / Option Note 2) / Size	B With earth leakage breaker	C Note 3) With communications function (RS-485)	S Note 3) Note 5) With communications function (RS-232C)	E With water leakage sensor	H Note 4) With heater	J With automatic water supply function	K Note 5) With external switch inlet	M Note 4) Stainless steel wetted parts for circulating fluid	T High-lift pump	Y Note 4) With DI control kit
HRGC001-□ (Temperature stability ±1.0°C)	●	●	●	●	●	●	●	●	●	●
HRGC001-□5 (Temperature stability ±0.5°C)	●	●	●	●	—	●	●	—	●	—
HRGC002-□ (Temperature stability ±1.0°C)	●	●	●	●	●	●	●	●	●	●
HRGC002-□5 (Temperature stability ±0.5°C)	●	●	●	●	—	●	●	—	●	—
HRGC005-□ (Temperature stability ±1.0°C)	●	●	●	●	●	●	●	●	—	●
HRGC005-□5 (Temperature stability ±0.5°C)	●	●	●	●	—	●	●	—	—	—

Note 1) When multiple options are combined, indicate symbols in alphabetical order.
Note 2) Refer to pages 59 to 62 for details on options.
Note 3) Option C (with communications function (RS-485)) and option S (with communications function (RS-232C)) cannot be combined.
Note 4) Option M (stainless steel wetted parts for circulating fluid) and option Y (with DI control kit) cannot be combined.
When combined with option H (with heater), circulating fluid temperature will be between 5°C and 35°C.
Note 5) Option K (with external switch inlet) and option S (with communications function (RS-232C)) cannot be combined.

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Specifications (Refer to the product specifications for details.)

HRGC001/002/005

Model		HRGC001		HRGC002		HRGC005	
Cooling method		Air-cooled refrigeration	Water-cooled refrigeration	Air-cooled refrigeration	Water-cooled refrigeration	Air-cooled refrigeration	Water-cooled refrigeration
Refrigerant		R407C (HFC)					
Control method		Compressor ON/OFF control or Proportional valve PID control					
Ambient temperature/humidity Note 1)		Temperature: 5 to 40°C, Humidity: 30 to 70%RH					
Circulating fluid system	**Circulating fluid** Note 2)	Clear water, Deionized water, 15% ethylene glycol aqueous solution					
	Circulating method	For externally sealed circuit					
	Temperature range setting Note 1) **(°C)**	5 to 35					
	Cooling capacity Note 3) **(50/60 Hz) (kW)**	0.9/1.1 (at 20°C)	0.9/1.1 (at 20°C)	1.9/2.3 (at 20°C)	1.9/2.3 (at 20°C)	4.5/4.8 (at 20°C)	4.5/4.8 (at 20°C)
	Heating capacity Note 4) **(kW)**	—	—	—	—	—	—
	Temperature stability Note 5) **(°C)**	±1.0 (Compressor ON/OFF control), ±0.5 (Proportional valve PID control)					
	Pump capacity Note 6) **(50/60 Hz) (MPa)**	0.13/0.18 (at 10 L/min)				0.21/0.32 (at 23 L/28 L/min)	
	Rated flow Note 7) **(50/60 Hz) (L/min)**	10/10				23/28	
	Tank capacity (L)	Approx. 10				Approx. 20	
	Port size	Rc1/2					
	Wetted parts material	Stainless steel, PPE, PVC, Copper brazing (Heat exchanger), Bronze, Brass					
Facility water system	**Temperature range (°C)**	—	5 to 32	—	5 to 32	—	5 to 32
	Pressure range (MPa)	—	0.3 to 0.5	—	0.3 to 0.5	—	0.3 to 0.5
	Required flow rate Note 8) **(50/60 Hz) (L/min)**	—	10/12	—	10/12	—	27/28
	Port size	—	Rc1/2	—	Rc1/2	—	Rc1/2
	Wetted parts material	Stainless steel, PVC, Copper brazing (Heat exchanger), Bronze, Brass					
Electrical system	**Power supply**	Single-phase 200 to 230 VAC 50/60 Hz Allowable voltage fluctuation ±10%					
	Applicable earth leakage breaker capacity Note 9) **(A)**	15		15		30	
	Maximum operating current (A)	8.1	7.8	8.6	8.0	17.2	14.1
	Rated power consumption Note 11) **(50/60 Hz) (kW)**	0.76/0.82	0.68/0.73	1.13/1.20	0.89/0.98	2.07/2.23	1.76/1.83
	Remote operation signal input	Relay contact input (operates when the switch is closed, stops when the switch is opened)					
	Operation signal output	Relay contact output (switch closed when operating, switch open when stopped, switch open when shut down)					
	Alarm stop signal output	Relay contact output (switch closed when alarm is turned off, switch open when alarm is turned on, switch closed when shut down)					
	Alarm	Refer to page 57.					
Weight Note 10) **(kg)**		75	75	75	75	110	110

Note 1) It should have no condensation.
During seasons or in locations where the ambient temperature is likely to fall below freezing point, please consult SMC separately.

Note 2) If clear water is used, please use water that conforms to Water Quality Standards of the Japan Refrigeration and Air Conditioning Industrial Association (JRA GL-02-1994 cooling water system - circulating type - make-up water).
Deionized water can be used only for supply water. Supply water with electrical conductivity of 1 μS/cm or more (or electrical resistivity of 1 MΩ·cm or less). An optional DI control kit (option Y) is available to maintain electrical resistance. Refer to page 62 for details. If ethylene glycol aqueous solution is used, maintain the concentration at 15%.

Note 3) ① Ambient temperature: 32°C, Facility water temperature: 25°C (water-cooled refrigeration), ② Circulating fluid temperature: 20°C, ③ Circulating fluid flow rate: Values at rated circulating fluid flow rate.

Note 4) Thermo-cooler specifications do not have heating capability.
(When heating capability is required, use a product with an optional heater (option H). Refer to page 59 for details.)

Note 5) Outlet temperature when the circulating fluid is rated flow, and the circulating fluid outlet and return port are directly connected. Installation environment and the power supply are within specification range and stable.

Note 6) The capacity at the Thermo-cooler outlet when the circulating fluid temperature is at 20°C.

Note 7) Required flow rate for cooling capacity or maintaining the temperature stability.
When used below the rated flow, open the standard manual by-pass valve and maintain a circulating fluid flow rate equivalent to the rated flow. Also, use the by-pass piping set sold separately.

Note 8) Required flow rate when a load for the cooling capacity is applied at a facility water temperature of 25°C.

Note 9) Purchase an earth leakage breaker with current sensitivity of 30 mA separately. (A product with an optional earth leakage breaker (option B) is also available. Refer to page 59.)

Note 10) Weight in the dry state without circulating fluids

Note 11) In case of compressor ON/OFF control. For other conditions, refer to Note 3).

Accessories (Enclosed)

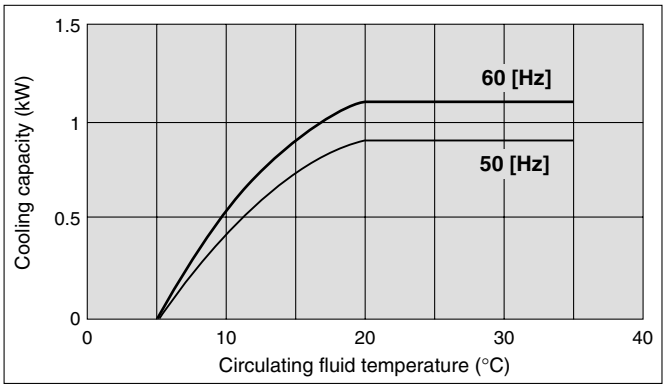
Content	Applicable model
Eye bolt M12 (4 pcs.)	HRGC005
Y-type strainer (1 pc.)	Water-cooled type

• Eye bolts are included in HRGC005. (Not assembled)
• A Y-type strainer is included in the water-cooled type. (Not assembled)

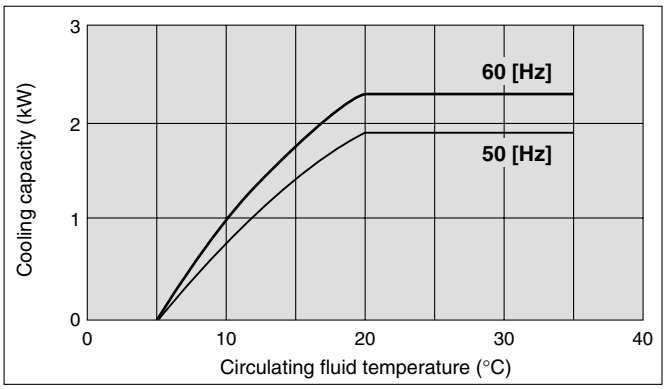
Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Cooling Capacity

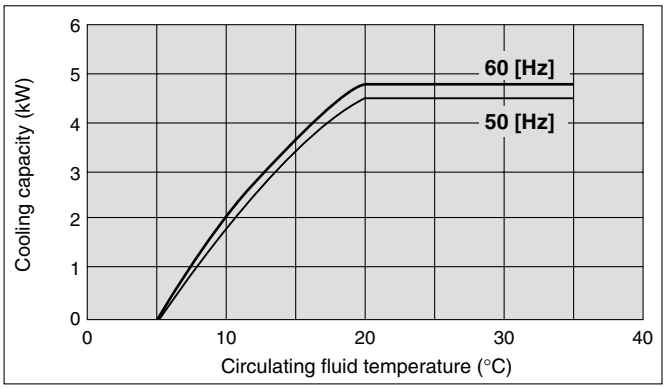
HRGC001-A/001-W



HRGC002-A/002-W

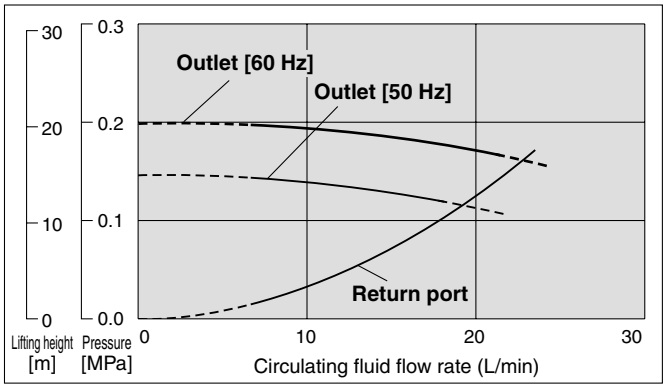


HRGC005-A/005-W

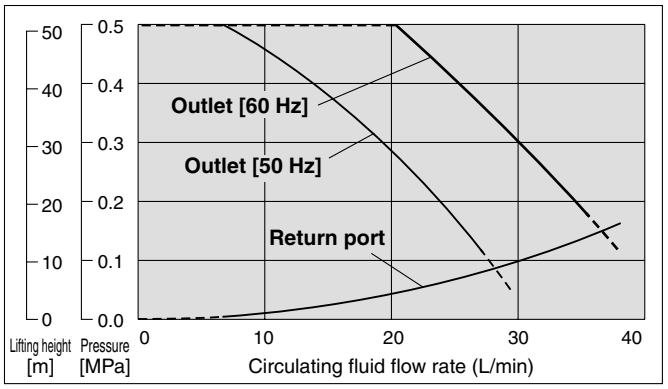


Pump Capacity

HRGC001-A/001-W
HRGC002-A/002-W

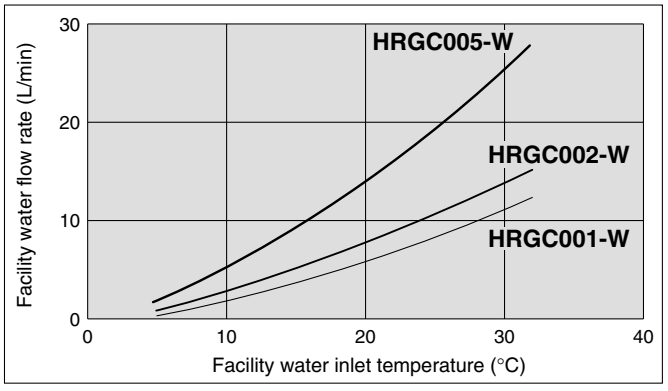


HRGC005-A/005-W



∗ For all common models, temperature stability will decline in the flow rate range where circulating fluid is deduced (dotted line).

Facility Water Flow Rate

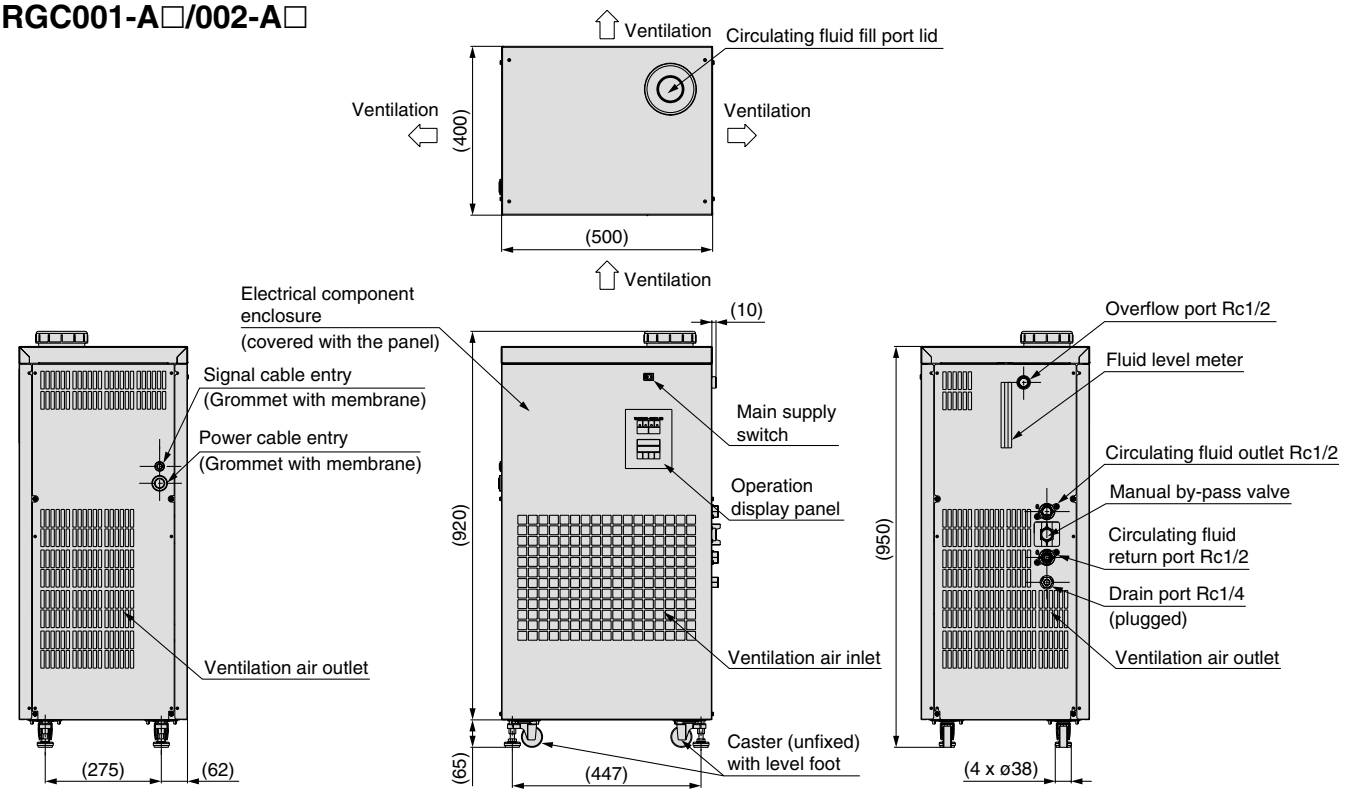


∗ This is the flow rate of facility water at the rated cooling capacity and circulating fluid flow, operating at 60 Hz.

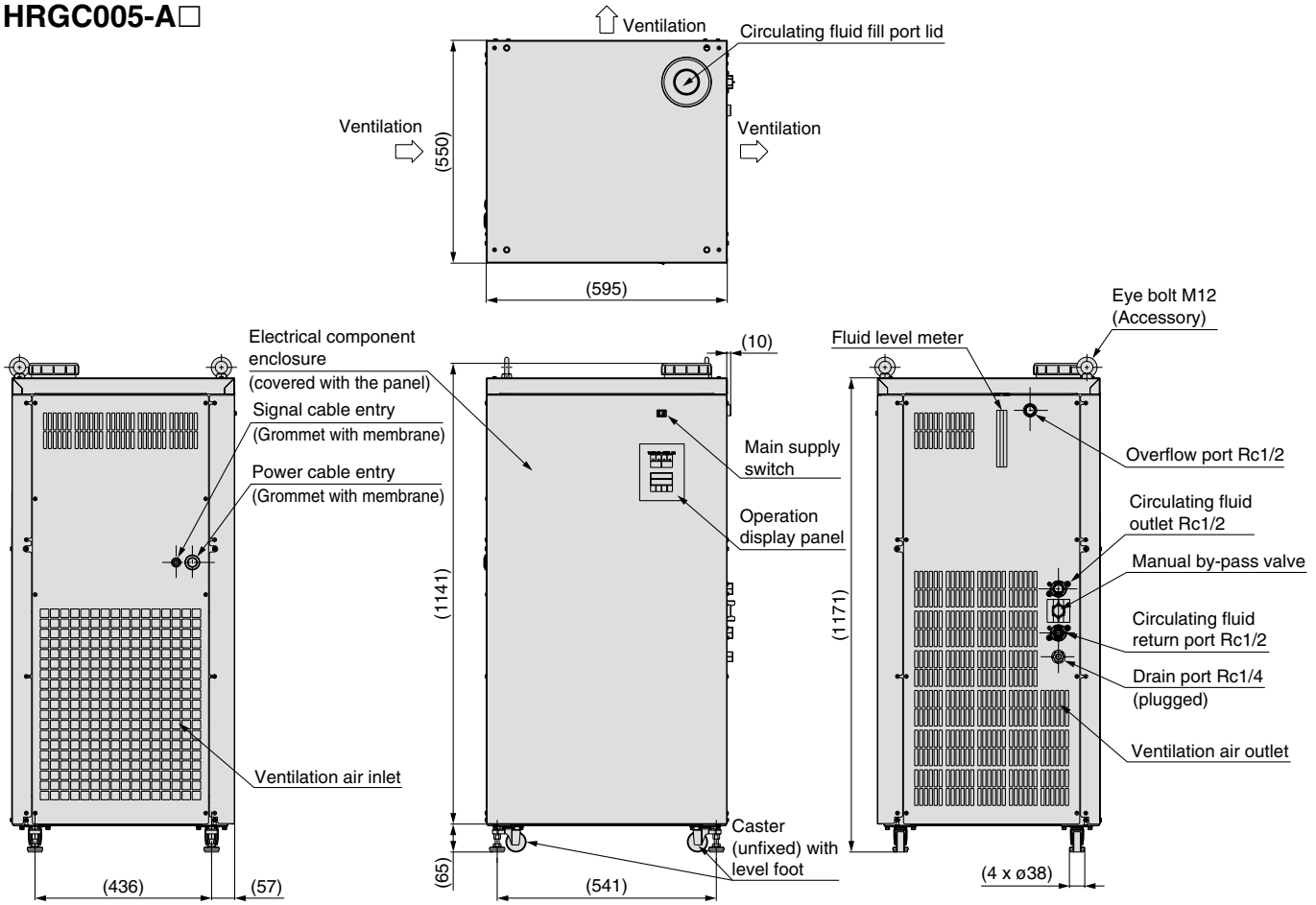
Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Dimensions: Air-Cooled Refrigeration

HRGC001-A□/002-A□



HRGC005-A□

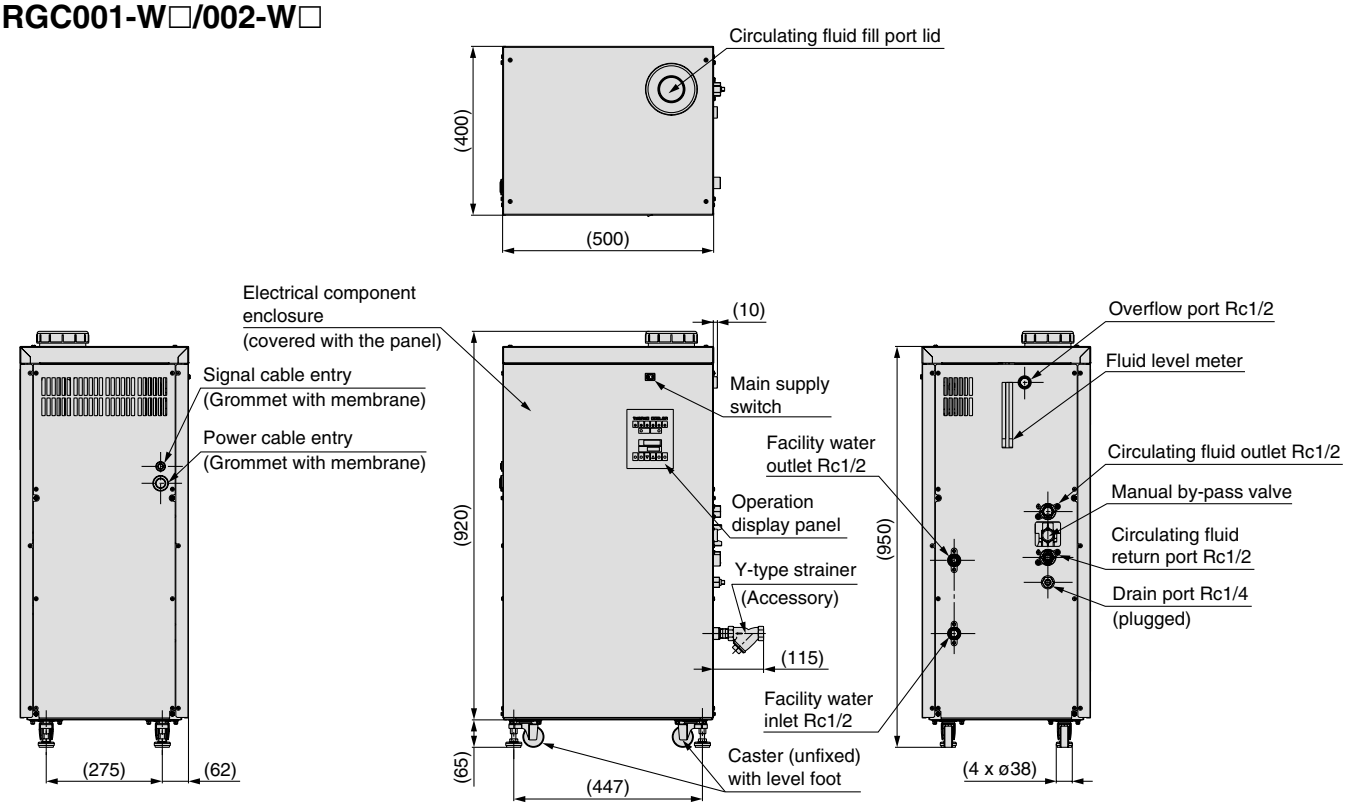


Eye bolts included. (Not assembled)

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

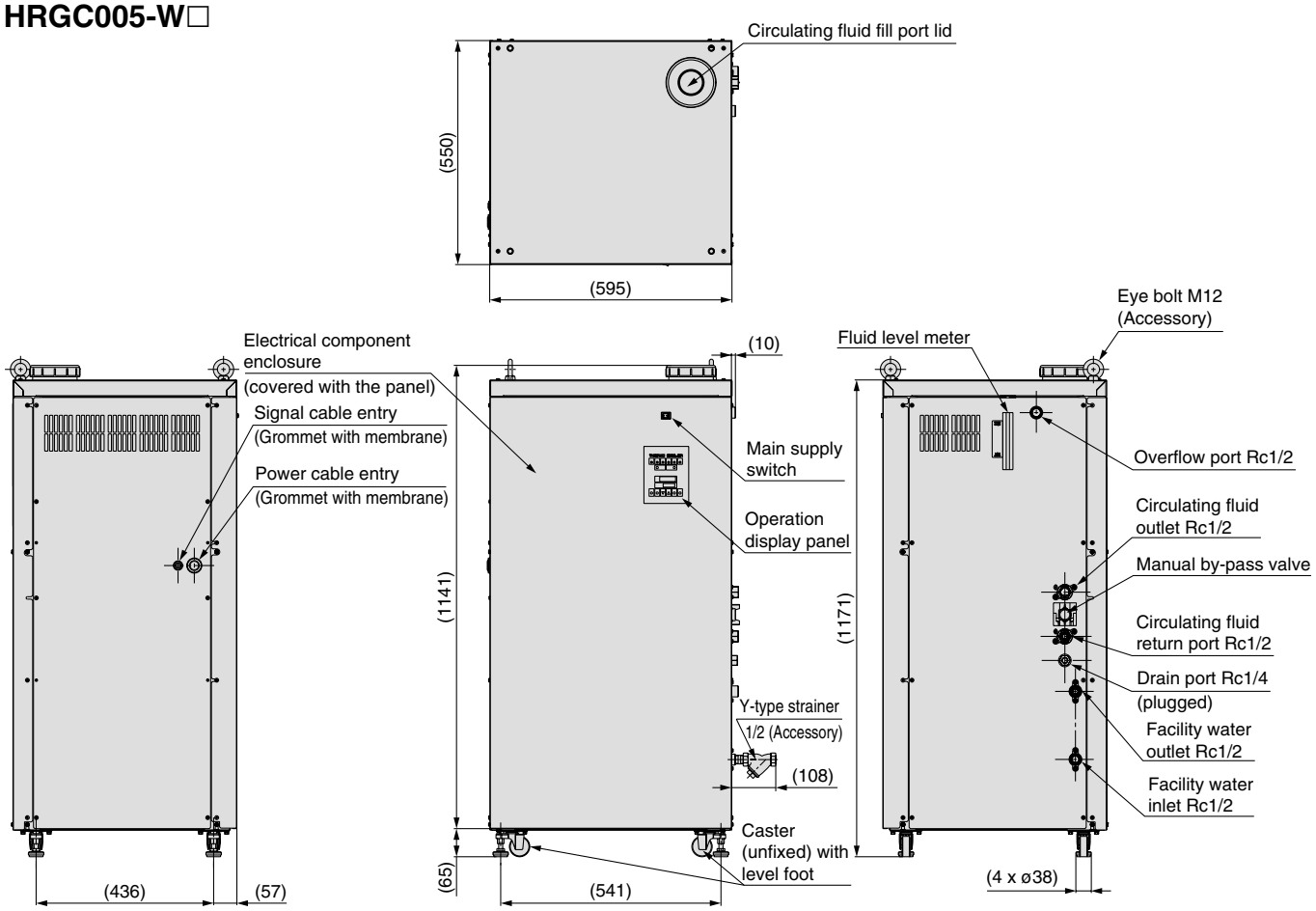
Dimensions: Water-Cooled Refrigeration

HRGC001-W□/002-W□



Y-type strainer included. (Not assembled)

HRGC005-W□

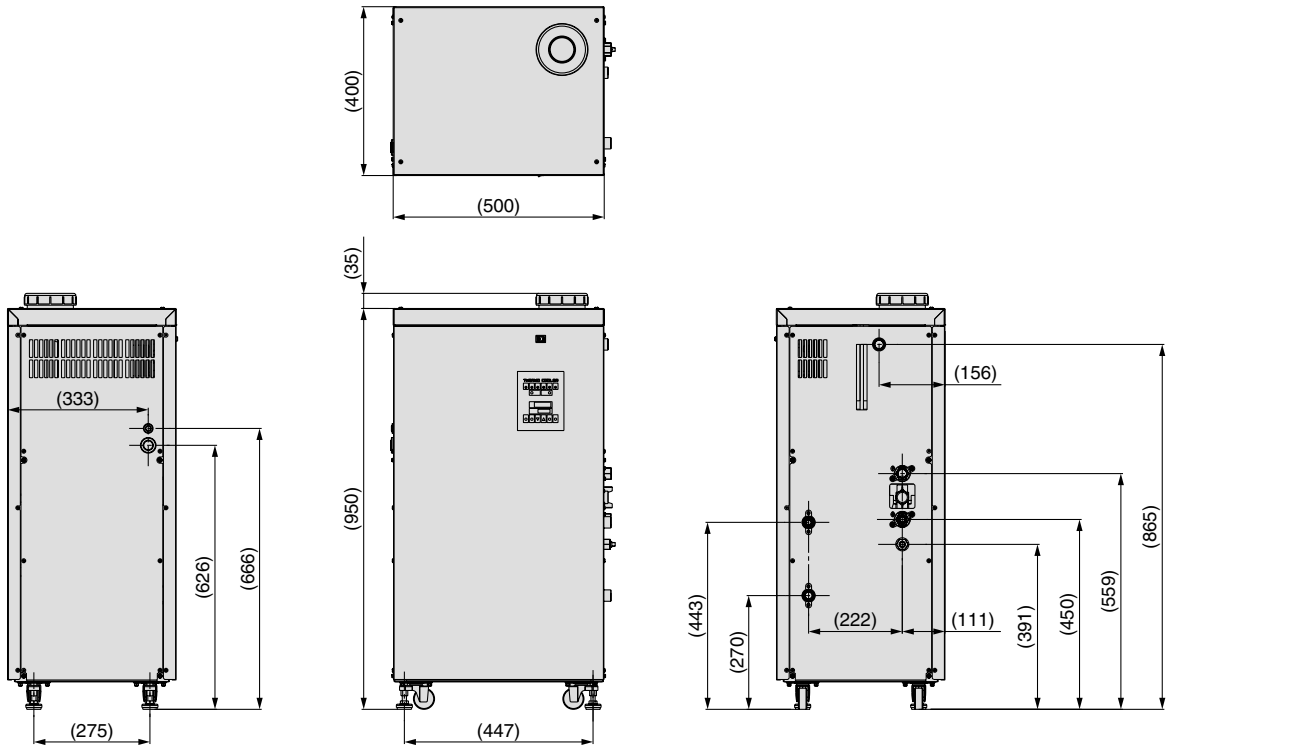


Y-type strainer and eye bolts included. (Not assembled)

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

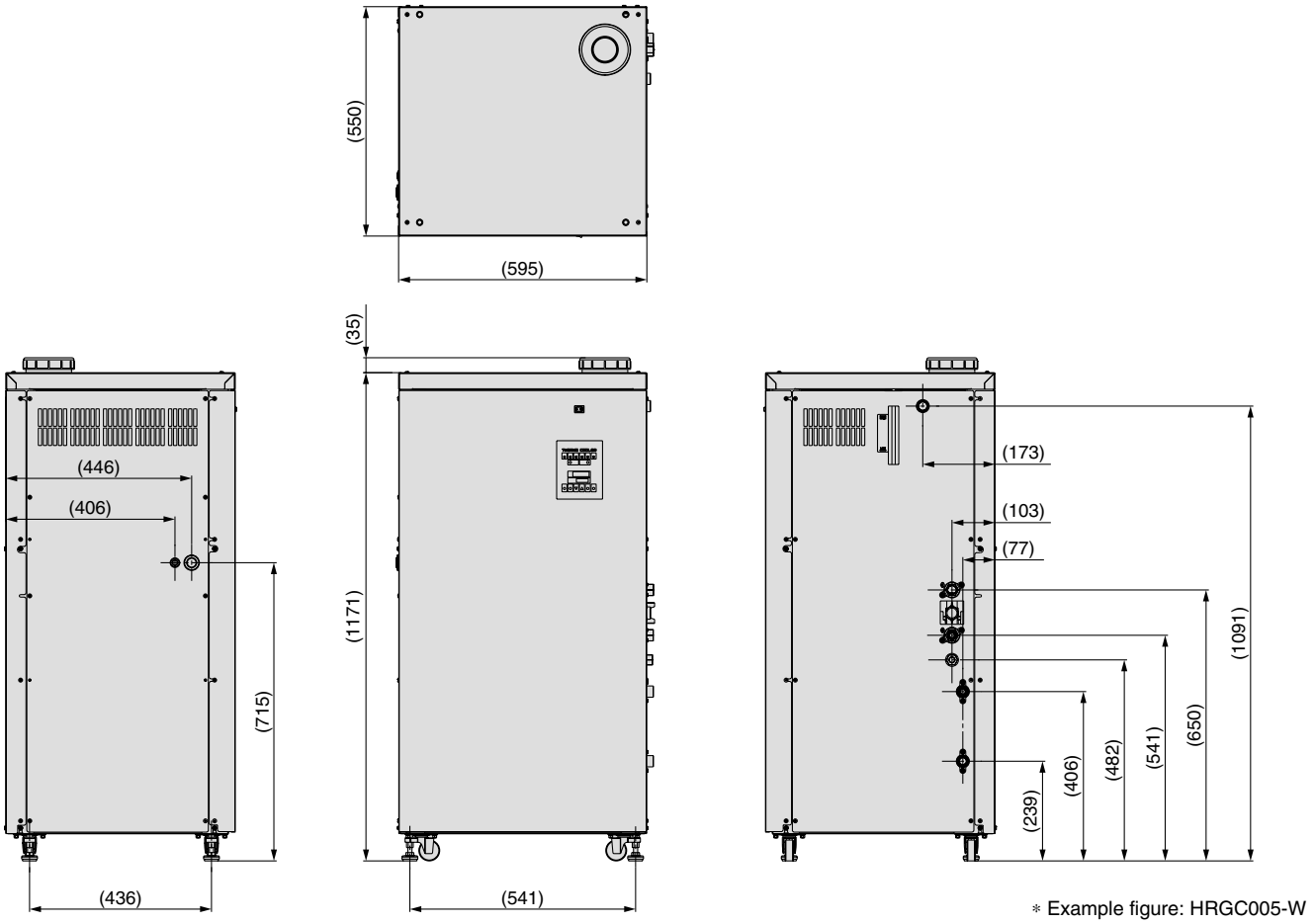
Piping Connection and Installation Dimensions

HRGC001/002



∗ Example figure: HRGC001-W

HRGC005



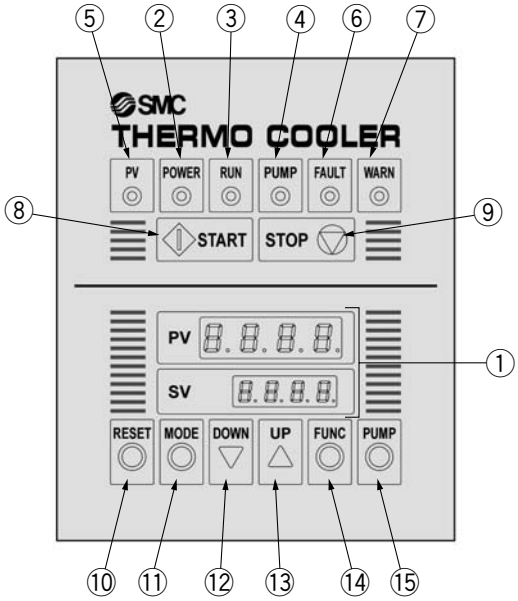
∗ Example figure: HRGC005-W

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Operation Display Panel

HRGC001/002/005

The basic operation of this unit is controlled through the operation display panel on the front of the product.
This operation display panel is common to all models.



No.	Description	Function	
①	**Digital display PV/SV**	**PV**	Displays the circulating fluid temperature. Displays the alarm code when an alarm is active.
		SV	Displays the set temperature of the circulating fluid.
②	**[POWER] indicator**	Lights up when the power is supplied.	
③	**[RUN] indicator**	Lights up when the [START] key is pressed.	
④	**[PUMP] indicator**	Lights up when the pump is running.	
⑤	**[PV] indicator**	Lights up when the circulating fluid temperature is displayed.	
⑥	**[FAULT] indicator**	Lights up when the emergency error occurs, and stops the operation.	
⑦	**[WARN] indicator**	Lights up when the warning error occurs, and continues the operation.	
⑧	**[START] key**	Starts the operation.	
⑨	**[STOP] key**	Stops the operation.	
⑩	**[RESET] key**	Resets the alarm.	
⑪	**[MODE] key**	Changes settings such as the offset function, etc.	
⑫	**[DOWN] key**	Decreases the set temperature.	
⑬	**[UP] key**	Increases the set temperature.	
⑭	**[FUNC] key**	Changes the display between the circulating fluid temperature and optional functions.	
⑮	**[PUMP] key**	Operates the pump independently while pressed.	

Alarm/Alarm Indicators and Explanation

The 6 basic temperature controller alarms are displayed on the PV of the operation display panel with their alarm codes, as well as the fault (FAULT) indicator (red LED) and warning (WARN) indicator (yellow LED).
When the source of the problem has been eliminated, the equipment must be restarted.

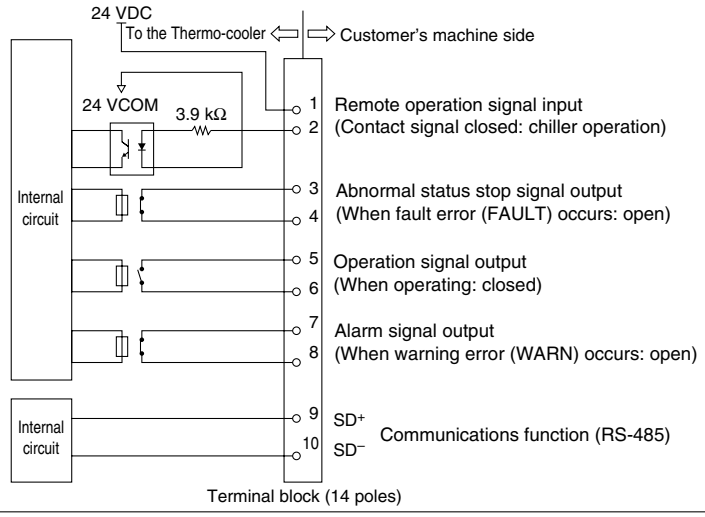
■ Explanation of Alarms (HRGC001/002/005)

Indicator	Alarm	Operation status	Main reason
[FAULT]	Low level of fluid in tank	Stop	Level switch activated because fluid level in tank fell below LOW.
	Rise in coolant pressure	Stop	Pressure switch activated because inadequate heat dissipation caused refrigerant pressure to rise.
	Circulating fluid temperature abnormally high	Stop	Temperature sensor activated because circulating fluid temperature became too high. (fixed at 40°C)
	Overload of pump	Stop	Circulation pump overload relay activated.
	Overload of compressor	Stop	Compressor overload relay activated.
[FAULT/WARN]	Abnormal circulating fluid temperature	Stop/Continue	Circulating fluid temperature is out of the customer's preset range.

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Contact Input/Output Function

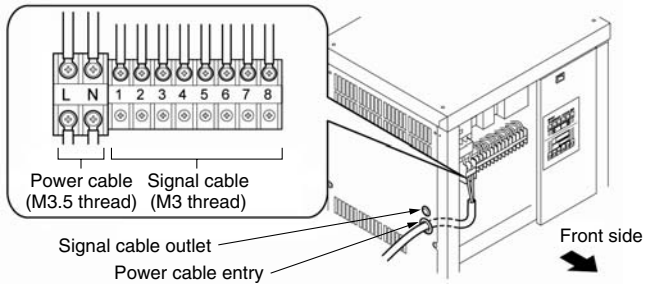
The Thermo-cooler is standard-equipped with terminals that allow remote start/stop, and enable output of an operation signal, abnormal status stop signal or alarm signal. These should be used for synchronizing startup and shutdown with your other equipment, or when adding new warning indicators or buzzers. However, the contact output volume is limited, so please add warning lamps and/or buzzers for special relays (for amplification) if they are necessary.

Item		Specifications		
		HRGC001	**HRGC002**	**HRGC005**
Connector type		M3 terminal block		
Remote operation signal input	Signal type	Relay contact input (Remote start when the contact signal is closed, Remote stop when the contact signal is open.)		
	Input voltage range	24 VDC±10% (Power supply is provided on the Thermo-cooler side.)		
	Input current	Max. 35 mA		
	Terminal number	1 (24 VDC), 2 (24 VCOM)		
Abnormal status stop signal output	Signal type	Relay contact output (When fault error (FAULT) occurs: open)		
	Contact capacity	250 VAC, 1 A (Resistance load)		
	Terminal number	3, 4		
Operation signal output	Signal type	Relay contact output (When operating: closed)		
	Contact capacity	250 VAC, 1 A (Resistance load)		
	Terminal number	5, 6		
Warning signal output	Signal type	Relay contact output (When warning error (WARN) occurs: open)		
	Contact capacity	250 VAC, 1 A (Resistance load)		
	Terminal number	7, 8		
Communications function (RS-485) Note)	Communication standard	EIA standard RS-485 compliant		
	Information orientation	Half duplex		
	Synchronization method	Asynchronous communication		
	Terminal number	9, 10		
Circuit diagram				

Note) Serial communication is optional. Refer to "Options" on page 59.

Input/output signal connection location

Remove the front panel, and connect a signal cable to the terminal block inside the electrical component enclosure.



Other Feature

Anti-freezing function

This function detects the circulating fluid temperature. 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.

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Series HRGC
Options 1

Note) Options have to be selected when ordering the Thermo-cooler. It is not possible to add them after purchasing the unit.

Option symbol

B With Earth Leakage Breaker

HRGC□□□-□□-B

With earth leakage breaker

In the event of a short circuit, overcurrent or overheating, the earth leakage breaker will automatically shut off the power supply.

Breaker mounting location
Remove the front panel. The breaker is mounted inside the electrical component enclosure.

Option combination (○: Available, ×: Not available, ●: Possible, but specification needs to be modified partially.)

Symbol	5	B	C	E	H	J	K	M	S	T	Y
Option	Temperature stability ±0.5°C	With earth leakage breaker	With communications function (RS-485)	With water leakage sensor	With heater	With automatic water supply function	With external switch inlet	Stainless steel wetted parts for circulating fluid	With communications function (RS-232C)	High-lift pump	With DI control kit
Combination possibility with options	○		○	○	●	○	○	○	○	●	○

Applicable model	HRGC001-□□-B	HRGC002-□□-B	HRGC005-□□-B
Pole number	2		
Rated current sensitivity (mA)	30		
Rated shutdown current (A)	15/20 Note)		30
Short circuit display method	Mechanical button		

Note) When option H or T is included.

Option symbol

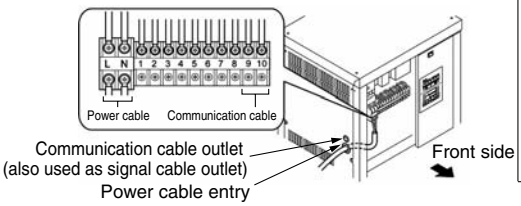
C With Communications Function (RS-485)

HRGC□□□-□□-C

With communications function (RS-485)

The communications function allows you to set (write) or monitor (read) the circulating fluid temperature.
<Writing> Circulating fluid temperature setting (SV)
<Readout> Circulating fluid present temperature (PV)
Circulating fluid temperature setting (SV)

Communication connection location
Remove the front panel, and connect your communication cable to the terminal block mounted inside the electrical component enclosure.



Option combination (○: Available, ×: Not available, ●: Possible, but specification needs to be modified partially.)

Symbol	5	B	C	E	H	J	K	M	S	T	Y
Option	Temperature stability ±0.5°C	With earth leakage breaker	With communications function (RS-485)	With water leakage sensor	With heater	With automatic water supply function	With external switch inlet	Stainless steel wetted parts for circulating fluid	With communications function (RS-232C)	High-lift pump	With DI control kit
Combination possibility with options	○	○		○	○	○	○	○	×	○	○

Applicable model	HRGC001-□□-C	HRGC002-□□-C	HRGC005-□□-C
Connector no.	9 (SD+), 10 (SD−)		
Connector type (on this product side)	M3 terminal block		
Standards	EIA standard RS-485 compliant		
Protocol	Special protocol: For details, refer to the Communications Specifications document.		
Circuit diagram	To the Thermo-cooler / Customer's machine side; Internal circuit; 9 SD+; 10 SD−		

Option symbol

E With Water Leakage Sensor

HRGC□□□-□□-E

With water leakage sensor

This built-in water leakage sensor can detect fluid leakage in the product and stop its operation.

Option combination (○: Available, ×: Not available, ●: Possible, but specification needs to be modified partially.)

Symbol	5	B	C	E	H	J	K	M	S	T	Y
Option	Temperature stability ±0.5°C	With earth leakage breaker	With communications function (RS-485)	With water leakage sensor	With heater	With automatic water supply function	With external switch inlet	Stainless steel wetted parts for circulating fluid	With communications function (RS-232C)	High-lift pump	With DI control kit
Combination possibility with options	○	○	○		○	○	○	○	○	○	○

Applicable model	HRGC001-□□-E	HRGC002-□□-E	HRGC005-□□-E
Water leakage detection method	Infrared reflection		
Water leakage detectable amount (L)	1 L or more		
Protection function	Activates if water leaks in the product or an abnormal stop occurs.		

Option symbol

H With Heater

HRGC□□□-□□-H

With heater

This built-in heater can heat up circulating fluid and adjust it at high temperatures.
It can raise the circulating fluid temperature quickly, even when the initial temperature is low in winter. It can be also used to heat the fluid.

Option combination (○: Available, ×: Not available, ●: Possible, but specification needs to be modified partially.)

Symbol	5	B	C	E	H	J	K	M	S	T	Y
Option	Temperature stability ±0.5°C	With earth leakage breaker	With communications function (RS-485)	With water leakage sensor	With heater	With automatic water supply function	With external switch inlet	Stainless steel wetted parts for circulating fluid	With communications function (RS-232C)	High-lift pump	With DI control kit
Combination possibility with options	×	○	○	○		○	○	●	○	○	●

Applicable model	HRGC001-□-H	HRGC002-□-H	HRGC005-□-H
Heater capacity	0.6 kW		
Temperature control method	Proportional valve PID control, heating and cooling control of heater P control, or refrigerator and heater ON/OFF control Note 1)		
Temperature setting range	5 to 60°C or 5 to 35°C Note 1)		5 to 35°C
Temperature stability	±1.0°C Note 2)		
Protection function	Thermal fuse		

Note 1) When selecting option M or Y
Note 2) Temperature stability ±0.5°C specification cannot be selected.

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Series HRGC
Options 2

Note) Options have to be selected when ordering the Thermo-cooler. It is not possible to add them after purchasing the unit.

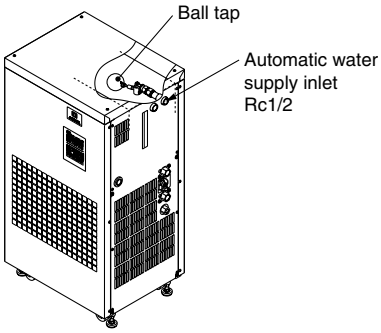
J Option symbol

With Automatic Water Supply Function

HRGC□□□-□□-J

With automatic water supply function

By installing this at the automatic water supply inlet, circulating fluid can be easily supplied to the product using a built-in ball tap for water supply.



Option combination (○: Available, ×: Not available, ●: Possible, but specification needs to be modified partially.)

Symbol	5	B	C	E	H	J	K	M	S	T	Y
Option	Temperature stability ±0.5°C	With earth leakage breaker	With communications function (RS-485)	With water leakage sensor	With heater	With automatic water supply function	With external switch inlet	Stainless steel wetted parts for circulating fluid	With communications function (RS-232C)	High-lift pump	With DI control kit
Combination possibility with options	○	○	○	○	○		○	○	○	○	○

Applicable model	HRGC001-□□-J	HRGC002-□□-J	HRGC005-□□-J
Water supply method	Built-in ball tap for automatic water supply		
Water supply pressure (MPa)	0.2 to 0.5		
Water supply capacity (L/min)	2 or more (at 0.2 MPa)		

K Option symbol

With External Switch Inlet

HRGC□□□-□□-K

With external switch inlet

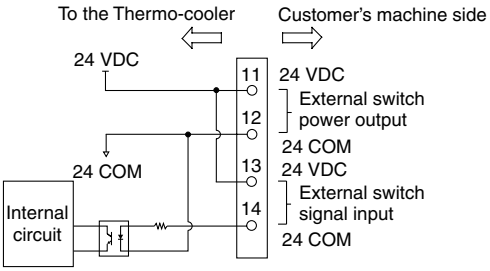
This can supply power to external switches (flow switch, etc.) for alarms, and send signals indicating abnormalities from the switch to the product.

If an abnormality signal is input from the external switch, the product will respond as follows:

- The product will continue operating (if already in operation).
- Alarm light turns on.
- Alarm signal is output.
- Alarm is displayed.

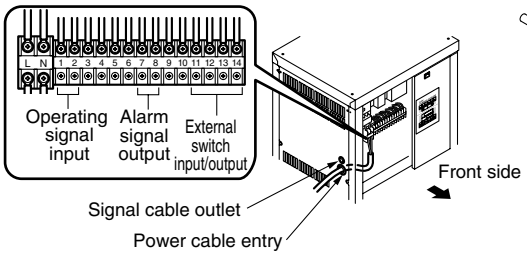
Option combination (○: Available, ×: Not available, ●: Possible, but specification needs to be modified partially.)

Symbol	5	B	C	E	H	J	K	M	S	T	Y
Option	Temperature stability ±0.5°C	With earth leakage breaker	With communications function (RS-485)	With water leakage sensor	With heater	With automatic water supply function	With external switch inlet	Stainless steel wetted parts for circulating fluid	With communications function (RS-232C)	High-lift pump	With DI control kit
Combination possibility with options	○	○	○	○	○	○		○	×	○	○

Applicable model	HRGC001-□□-K	HRGC002-□□-K	HRGC005-□□-K
External switch signal input	Contact input or PNP open collector input (voltage at OFF: 24 VDC; current at ON: 35 mA or less)		
External switch power output	Power supply voltage 24 VDC ±10% 5 W to 20 W		
Circuit diagram			

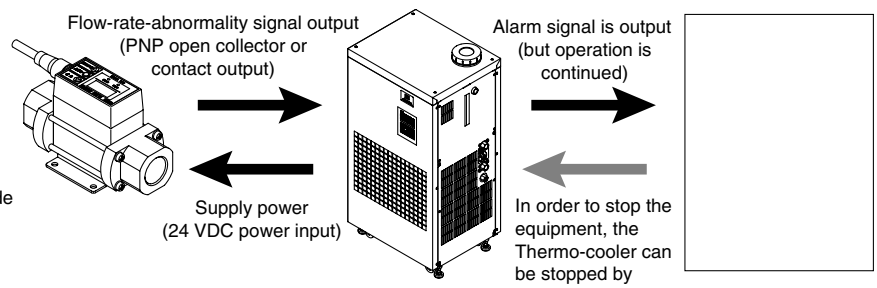
Wiring Connection Location

Remove the front panel, and connect your communication cable to the terminal block mounted inside the electrical component enclosure.



Application Examples

When monitoring flow with a flow-rate switch



SMC

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

M Option symbol

Stainless Steel Wetted Parts for Circulating Fluid

HRGC□□□-□□-M

Stainless steel wetted parts for circulating fluid

By changing the material of the wetted parts in the circulating fluid circuit to stainless steel, deionized water with electrical resistance of 2 MΩ or less. (electrical conductivity of 0.5 μS/cm or more) can be used. (However, heat exchanger is made of copper brazing.)

Option combination (○: Available, ×: Not available, ●: Possible, but specification needs to be modified partially.)

Symbol	5	B	C	E	H	J	K	M	S	T	Y
Option	Temperature stability ±0.5°C	With earth leakage breaker	With communications function (RS-485)	With water leakage sensor	With heater	With automatic water supply function	With external switch inlet	Stainless steel wetted parts for circulating fluid	With communications function (RS-232C)	High-lift pump	With DI control kit
Combination possibility with options	×	○	○	○	●	○	○		○	○	×

Applicable model	HRGC001-□-M	HRGC002-□-M	HRGC005-□-M
Temperature range setting	5 to 35°C Note 1)		
Temperature stability	±1.0°C Note 2)		
Circulating fluid type	Clear water, Deionized water Note 3), 15% ethylene glycol aqueous solution		
Wetted parts material for circulating fluid	Stainless steel, Copper brazing (Heat exchanger), PVC		

Note 1) This cannot be used in circulating fluid temperatures of 35°C or higher, even when option H is selected.
Note 2) Temperature stability ±0.5°C specifications cannot be selected.
Note 3) Use deionized water with electrical resistance 2 MΩ·cm or less (electrical conductivity of 0.5 μS/cm or more).

S Option symbol

With Communications Function (RS-232C)

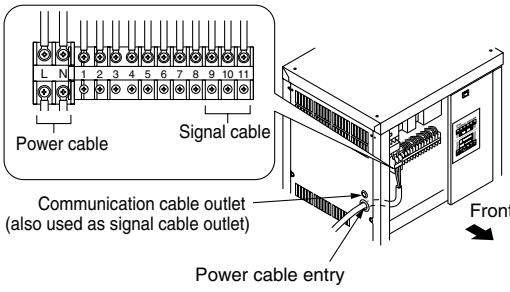
HRGC□□□-□□-S

With communications function (RS-232C)

With a host PC programmed in accordance with your manufacturing processor method, the communications function allows you to set (write) or monitor (read) the circulating fluid temperature.
<Writing> Circulating fluid temperature setting (SV)
<Readout> Circulating fluid present temperature (PV)
Circulating fluid temperature setting (SV)

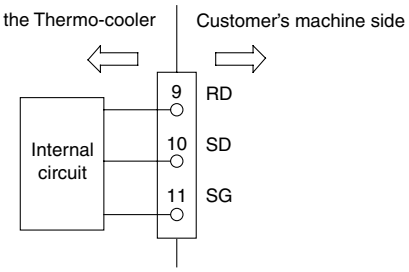
Communication connection location

Remove the front panel, and connect your communication cable to the terminal block mounted inside the electrical component enclosure.



Option combination (○: Available, ×: Not available, ●: Possible, but specification needs to be modified partially.)

Symbol	5	B	C	E	H	J	K	M	S	T	Y
Option	Temperature stability ±0.5°C	With earth leakage breaker	With communications function (RS-485)	With water leakage sensor	With heater	With automatic water supply function	With external switch inlet	Stainless steel wetted parts for circulating fluid	With communications function (RS-232C)	High-lift pump	With DI control kit
Combination possibility with options	○	○	×	○	○	○	×	○		○	○

Applicable model	HRGC001-□□-S	HRGC002-□□-S	HRGC005-□□-S
Connector no.	9 (RD), 10 (SD), 11 (SG)		
Connector type (on this product side)	M3 terminal block		
Standards	EIA standard RS-232C compliant		
Protocol	Special protocol: For details, refer to the Communications Specifications document.		
Circuit diagram			

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Series HRGC
Options 3

Note) Options have to be selected when ordering the Thermo-cooler. It is not possible to add them after purchasing the unit.

T Option symbol

High-lift Pump

HRGC□□□-□□-T

T High-lift pump

Possible to choose a high-lift pump in accordance with customer's piping resistance.
Cooling capacity may decrease by heat generated in the pump (For HRGC005 as standard).

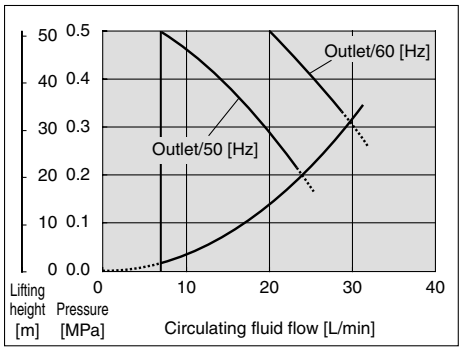
Option combination (○: Available, ×: Not available, ●: Possible, but specification needs to be modified partially.)

Symbol	5	B	C	E	H	J	K	M	S	T	Y
Option	Temperature stability ±0.5°C	With earth leakage breaker	With communications function (RS-485)	With water leakage sensor	With heater	With automatic water supply function	With external switch inlet	Stainless steel wetted parts for circulating fluid	With communications function (RS-232C)	High-lift pump	With DI control kit
Combination possibility with options	×	●	○	○	○	○	○	○	○		○

Applicable model	HRGC001-□-T	HRGC002-□-T	HRGC005-□-T
Cooling capacity (50/60 Hz)	0.6/0.6 kW Note)	1.6/1.8 kW Note)	
Pump capacity (50/60 Hz)	0.31/0.41 MPa (at 18/22 L/min)		

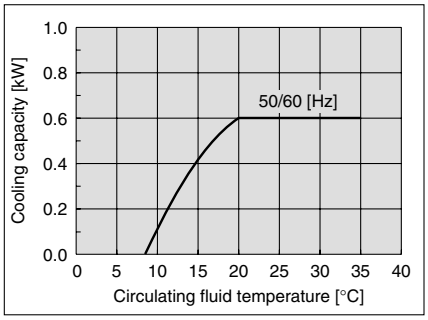
Note) Cooling capacity may decrease as pump power increases.

Pump Capacity

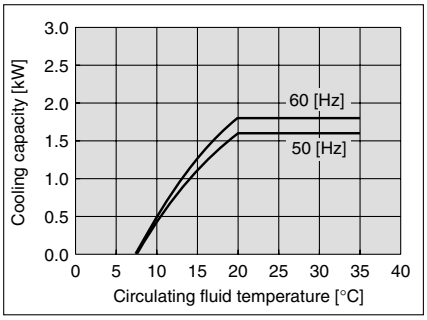


Cooling Capacity

HRGC001-□-T



HRGC002-□-T



Y Option symbol

With DI Control Kit

HRGC□□□-□□-Y

Y With DI control kit

This option adds a function to control the electrical resistance of circulating fluid to the stainless steel wetted parts for the fluid. By using this with a DI (deionized water) filter (sold separately), the electrical resistance of the circulating fluid can be maintained at a constant level.

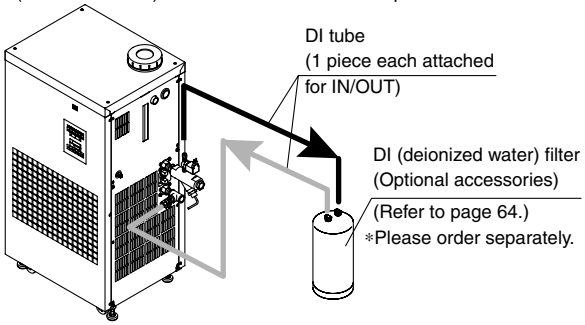
Option combination (○: Available, ×: Not available, ●: Possible, but specification needs to be modified partially.)

Symbol	5	B	C	E	H	J	K	M	S	T	Y
Option	Temperature stability ±0.5°C	With earth leakage breaker	With communications function (RS-485)	With water leakage sensor	With heater	With automatic water supply function	With external switch inlet	Stainless steel wetted parts for circulating fluid	With communications function (RS-232C)	High-lift pump	With DI control kit
Combination possibility with options	×	○	○	○	●	○	○	×	○	○	

Applicable model	HRGC001-□-Y	HRGC002-□-Y	HRGC005-□-Y
Temperature range setting	5 to 35°C Note 1)		
Temperature stability	±1.0°C Note 2)		
Circulating fluid type	Clear water, Deionized water Note 3), 15% ethylene glycol aqueous solution		
Wetted parts material for circulating fluid	Stainless steel, Copper brazing (Heat exchanger), PVC		
DI display range	0 to 20 MΩ·cm Note 3)		
DI setting range	0.00 to 2.00 MΩ·cm Note 4)		
DI circuit rated flow	1.5 L/min		
DI alarm	Max. DI level, Min. DI level, Selectable from Max. to Min.		
DI alarm operation	Can choose whether to stop or continue operation when alarm activates		

Note 1) This cannot be used in circulating fluid temperatures of 35°C or higher, even when option H is selected.
Note 2) Temperature stability ±0.5°C specification cannot be selected.
Note 3) Use deionized water with electrical resistance of 2 MΩ·cm or less. (electrical conductivity of 0.5 μS or more)
Note 4) The DI filter is needed to control the DI level. (SMC Part No.: HRZ-DF001) Please purchase additionally because the DI (deionized water) filter is not included in this option.

∗Install the DI (deionized water) filter outside the Thermo-chiller for piping. Secure the space for installing the DI (deionized water) filter on the rear side of the Thermo-cooler.
∗It may go outside of the temperature stability range of ±1.0°C when this option is used in some operating conditions.



Optional Accessories 1

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Note) Please order separately. Necessary to be fitted by the customer.

Dustproof Filter Set

Prevents performance degradation when using air-cooled refrigeration Thermo-coolers in dusty or contaminated environments.

• Maximum ambient temperature: 40°C

How to Order

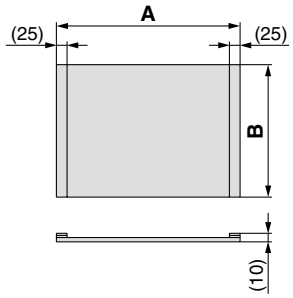
HRGC−FL□

Applicable Thermo-cooler

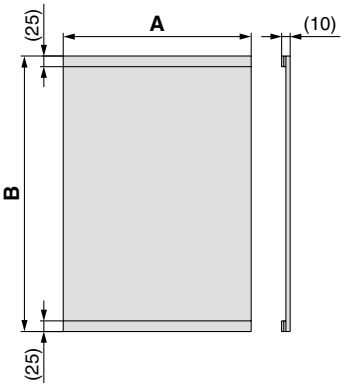
Symbol	Applicable Thermo-cooler	Quantity per set
001	HRGC001-A□ HRGC002-A□	1
005	HRGC005-A□	1

Dimensions

HRGC-FL001



HRGC-FL005

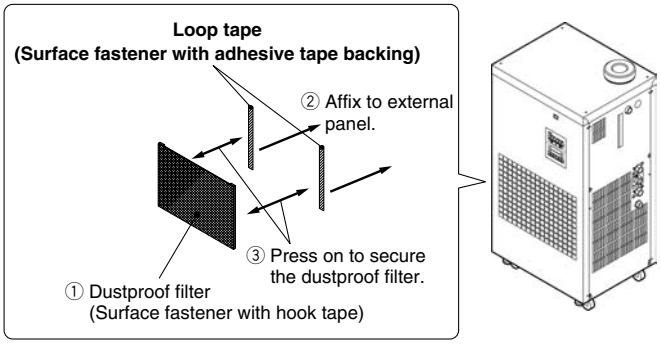


(mm)

Part no.	A	B	Quantity per set
HRGC-FL001	475	310	1
HRGC-FL005	430	530	1

Mounting Example

① This dustproof filter is secured with hook-and-loop tape. This is sewed onto the male side of the surface fastener, and has adhesive tape backing for fixing to the female side.
② Remove the paper covering of the adhesive tape and affix the loop tape to the external panel of the ventilation hole on the Thermo-cooler.
③ Simply press the hook tape on to the loop tape to mount the dustproof filter.



By-pass Piping Set

This prevents the occurrence of pump overload that exceeds the maximum operating pressure of the Thermo-cooler at low flow rate.

• Use circulating fluid in 5 to 60°C temperature range

How to Order

HRGC−BP□

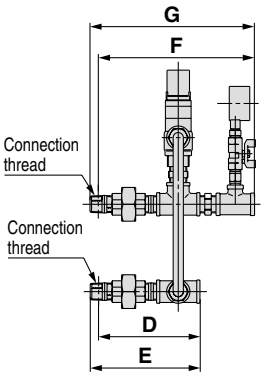
Applicable Thermo-cooler

Symbol	Applicable Thermo-cooler	Wetted parts material	Pressure setting range (50/60 Hz) Note)
001	HRGC001-□ HRGC002-□	Bronze, PTFE, Stainless steel	0.12 to 0.13/ 0.16 to 0.18 MPa
001G	HRGC001-□ HRGC002-□	PTFE, Stainless steel	
005	HRGC005-□ HRGC00□-□-T	Bronze, PTFE, Stainless steel	0.22 to 0.48/ 0.29 to 0.48 MPa
005G	HRGC005-□ HRGC00□-□-T	PTFE, Stainless steel	

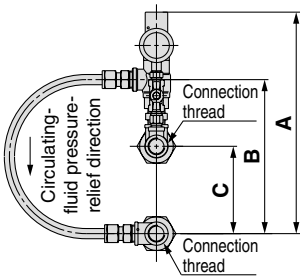
Note) The pressure of the by-pass piping set can be adjusted by the customer.

Dimensions

HRGC-BP005(G)



HRGC-BP001(G)

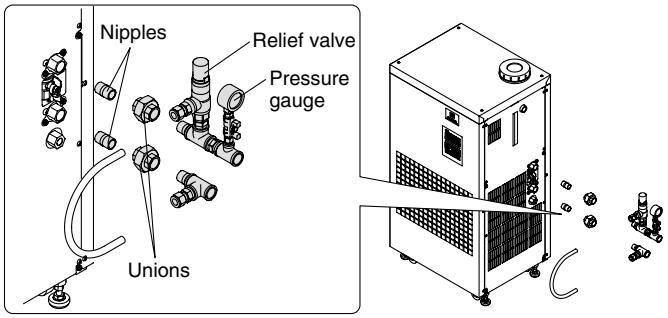


(mm)

Part no.	A	B	C	D	E	F	G
HRGC-BP001(G)	275	195	110	130	140	200	210
HRGC-BP005(G)	300	210	110	130	140	200	210

Mounting Example

A pressure relief valve and pressure gauge can be mounted on the body with unions and nipples.



Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Optional Accessories 2

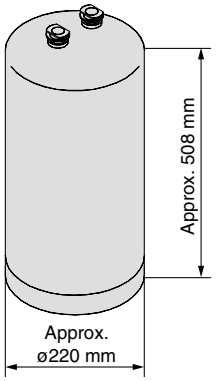
Note) Please order separately. Necessary to be fitted by the customer.

DI (Deionized Water) Filter

This is the ion replacement resin to maintain the electrical resistivity of the circulating fluid.
Customers who selected the DI control kit (option Y) need to purchase the DI (deionized water) filter separately.

Part no.	Applicable model
HRZ-DF001	Common for all models which can select the DI control kit. (option Y)

Note) The DI (deionized water) filters are consumable. Depending on the status (electrical resistivity set value, circulating fluid temperature, piping volume, etc.), product life cycles will vary accordingly.

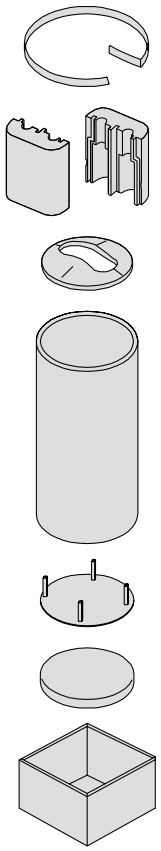


Weight: Approx. 20 kg

Insulating Material for DI (Deionized Water) Filter

When the DI (deionized water) filter is used at a high-temperature, we recommend that you use this insulating material to protect the radiated heat from the DI (deionized water) filter or possible burns. When the DI filter is used at a low-temperature, we also recommend that you use this to prevent heat absorption from the DI (deionized water) filter and to avoid forming condensation.

Part no.	Applicable model
HRZ-DF002	Common for all models which can select the DI control kit. (option Y)



Series HRGC
Specific Product Precautions 1

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back page 2 to 5 for Temperature Control Equipment Precautions.

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Design

⚠ Warning

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

1. Confirm the specifications of the single unit (contents of this catalog) and thoroughly consider the adaptability between the customer'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 customer's operating condition. Also, the customer 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.

Selection

⚠ Warning

1. Model selection

For selecting a model of Thermo-cooler, it is required to know the heat generation amount of a customer's machine.
Obtain the heat generation amount, referring to the model selection example on page 48 before selecting a model.

2. Indication of model number

Select the cooling method and temperature stability depending on the customer's application.

Handling

⚠ Warning

1. 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 because it will lead to a breakdown.

1. Environment like written in "Temperature Control Equipment Precautions".
2. Locations where spatter will adhere to when welding.
3. Locations where it is likely that the leakage of flammable gas may occur.
4. Locations having a large quantity of dust.
   If it is necessary to use the unit in an environment where there is a risk of the fin portion of the air-cooled condenser becoming clogged, use the dustproof filter set (sold separately).
5. A place in which water freezes. If such an environment is unavoidable, please contact SMC.

2. Install in an environment where the unit will not come into direct contact with rain or snow. (HRGC001 to HRGC005)

These models are for indoor use only.
Do not install outdoors where rain or snow may fall on them.

3. Conduct ventilation and cooling to discharge heat.

(Air-cooled refrigeration)
The heat which is cooled down through air-cooled condenser is discharged.
When using in a room which is shut tightly, ambient temperature will exceed the specification range stipulated in this catalog, which will activate the safety detector and stop the operation.
In order to avoid this situation, discharge the heat outside of a room by ventilation or cooling facilities.

4. The Thermo-cooler is not designed for a clean room. It generates particles internally.

Circulating Fluid

⚠ Caution

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

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

Circulating Fluid

⚠ Caution

3. When using ethylene glycol aqueous solution, maintain a maximum condensation of 15%.

Overly high concentration aqueous solution will overload to the pump and activates the safety interlock, which may stop the operation. On the other hand, if the concentration is too low, the aqueous solution freezes at low temperature, which may cause malfunction in the product.

4. When using clear water as a circulating fluid, use water that conforms to the appropriate water quality standards.

Use clear water (including diluted ethylene glycol aqueous solution) that satisfies the quality standard shown below.

Clear 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
Standard item	pH (at 25°C)	—	6.8 to 8.0
	Electrical 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.

5. Deionized water can be used (as supply water), but resistivity cannot be maintained.

When supplying water, use deionized water with electrical conductivity of 1 μS/cm or more (electrical resistivity of 1 MΩ·cm or less). However, since components of the wetted part will be released in water, electrolyte concentration cannot be maintained.

(HRGC001/002)

1. A magnet pump is used as a circulating pump for the circulating liquid.

It is particularly impossible to use liquid including metallic powder such as iron powder.

Transportation/Transfer/Movement

⚠ Warning

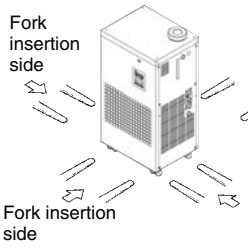
1. Transportation by forklift (HRGC001 to HRGC005)

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

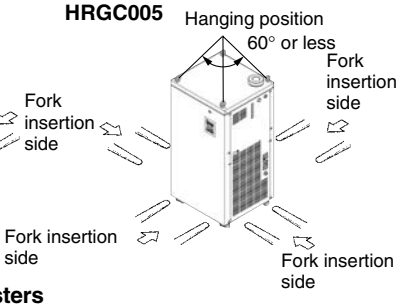
2. Hanging transportation (HRGC005)

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

HRGC001/002



HRGC005



3. Transportation by casters

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

Series HRGC
Specific Product Precautions 2

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back page 2 to 5 for Temperature Control Equipment Precautions.

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Mounting/Installation

⚠ Warning

1. Do not place heavy objects on top of this product or step on it.
The external panel can be deformed and danger can result.

2. Do not directly touch the edge of the external panel when removing and installing it.
It may cause injury. Be sure to wear protective gloves.

3. Lower the level foot and do not move.
Be sure to lower all four level feet to the level of the floor.

⚠ Caution

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

2. Secure with bolts, anchor bolts, etc.
Fasteners such as bolts or anchor bolts should be tighten with the recommended torque shown below.

Fixing Thread Tightening Torque

Connection thread	Applicable tightening torque N•m
M3	0.63
M4	1.5
M5	3
M6	5.2

Connection thread	Applicable tightening torque N•m
M8	12.5
M10	24.5
M12	42

(When using optional accessories/dustproof filter set)

1. Use the attached surface fastener (with adhesive tape) to affix the dustproof filter to the panel of the Thermo-cooler.

2. Mounting the filter will create a certain amount of resistance to ventilation that will reduce the volume of airflow.
For this reason, be sure to keep the ambient temperature at 40°C or less.

3. Depending on the installation height of the Thermo-cooler and/or the cooled substrates, circulating fluid may overflow from the tank lid or overflow outlet.
In particular, avoid overflow from the lid of the built-in tank by installing with a height difference of 10 m or less.
Be sure to pipe the overflow outlet to a wastewater collection pit, etc.

Piping

⚠ Caution

1. Regarding the circulating fluid pipings, consider carefully the suitability for shutoff pressure, temperature and circulating fluid.
If the operating performance is not sufficient, the pipings may burst during operation.

2. For the circulating fluid pipings, use clean pipings which have no dust, piping debris or other foreign objects inside the pipings, and blow with air prior to undertaking any piping works.
If piping debris or other foreign objects remain inside the circulating fluid circuit, it can result in blockage, insufficient cooling or damage to the pump impeller.

3. Select the piping port size which can exceed the rated flow.
For the rated flow, refer to the pump capacity table.

4. When tightening at the circulating fluid inlets and outlets, tank drain port or overflow outlet of this product, use a pipe wrench to clamp the connection ports.

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

6. While cleaning the inside of the tank, attach a valve to the tank drain outlet to drain the circulating fluid (clear water).

7. This product series consists of circulating fluid temperature controllers 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.

Piping

⚠ Caution

(Water-cooled refrigeration HRGC□□□-W□)

1. When tightening at the facility water inlets and outlets of this product, use a pipe wrench to clamp the connection ports.

2. Install by-pass piping.
This product has a built-in water control valve, so when the refrigeration circuit is stopped, facility water does not flow out in order to save energy. For this reason, by-pass piping is necessary for conducting maintenance of your facility water equipment, so be sure to install it.

Electrical Wiring

⚠ Warning

1. Never change the set value of the safety instrument.
If the set value is changed, it will likely cause a breakdown or cause the product to catch on fire.

2. Before wiring, be sure to cut the power supply.
Never perform any job while the product is energized.

3. Secure the cable so that its force, etc. is not applied to the terminal connector parts.
When the connection or attachment is incomplete, it will likely lead to an electrical shock, a fire, etc.

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

5. Multiple wiring is dangerous because it will lead to heat generation or cause a fire.

⚠ Caution

1. Power supply, signal cable and connecting terminal should be prepared by the customer.

(When using the HRGC□□□-□□-C with optional communications function)

1. Communication cables and adapters should be prepared by the customer.
Prepare parts that conform to the connector specifications of your host computer.

2. Pay attention to the polarity when connecting communication cables.

Facility Water Supply

⚠ Warning

(Water-cooled refrigeration HRGC□□□-W□)

1. Before startup, be sure to open the valve of your facility water equipment.
Prepare before startup, so that facility water can flow when the fitted water control valve (facility water control valve) opens during operation.

2. Supply pressure of 0.5 MPa or less.
If the supply pressure is high, it will cause water leakage.

3. Be sure to prepare your utilities so that the pressure of the Thermo-cooler facility water outlet is at 0 MPa (atmospheric pressure) or more.
If the facility water outlet pressure becomes negative, the internal facility water piping may collapse, and proper flow control of facility water will be impossible.

Operation

⚠ Warning

1. Confirmation before operation

1. The fluid level of a tank should be within the specified range of "HIGH" and "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 a customer'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.

Series HRGC
Specific Product Precautions 3

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back page 2 to 5 for Temperature Control Equipment Precautions.

Production of HRGC001/002 will be discontinued in January 2011. Thereafter, please select Series HRS.

Operation

⚠ Warning

3. Handling of by-pass valve
   At the time this product is shipped from our factory, the by-pass valve is fully open.
   Operation with it fully closed will cause the circulating fluid outlet pressure to increase high and it may safely stop in order to prevent the pump's operation from overloading.
   When operating for the first time after installation, be sure to operate it with the by-pass valve fully open.

2. Confirmation during operation

1. Adjust the by-pass valve.
   Monitor the external piping, pressure gauge, or flow meter mounted on the customer's machine side, in order to adjust the open angle of the by-pass valve, so that the required pressure or flow can be obtained.
2. 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 a customer's machine 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 equipment immediately.
After pushing the (OFF) switch, be sure to turn off the power supply breaker.

⚠ Caution

1. The temperature set value can be written to EEPROM, but only up to approximately one million times.

Especially when using communication function, save data with STOR before stoppage, and do not carry out frequent saving (STOR) of temporary setting values.

Operation Restart Time

⚠ 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.

Protection Circuit

⚠ Caution

1. 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.
- Facility water is not supplied. (HRGC□□□-W)
- Transfer pressure of the circulating fluid is too high.
- Circulating fluid temperature is too high.
- Compared to the cooling capacity, the heat generation amount of a customer's machine is too high.
- Ambient temperature is too high. (40°C or higher)
- Refrigerant pressure is too high.
- Ventilation hole is clogged with dust or dirt. (Especially HRGC□□□-A)

Maintenance

⚠ Warning

1. Do not operate the switch with wet hands or touch electrical parts. This will lead to an electrical shock.

2. Do not splash water directly on this product for cleaning. This will lead to an electrical shock or a fire.

3. When the panel was removed for the purpose of inspection or cleaning, mount the panel after works were done.

If the panel is still open, or running the equipment with the panel removed, it may cause an injury or electric shocks.

4. When cleaning the air-cooled condenser, do not touch the fin directly.

This may lead to injuries.

Maintenance

⚠ Caution

<Periodical inspection every one month>

(Air-cooled refrigeration HRGC□□□-A□)

1. Clean the ventilation hole

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

(When using optional accessories/dustproof filter set)

1. Clean the dustproof filter.

To prevent dirt or clogging of the dustproof filter from leading to a decline in heat-releasing performance of the air-cooled condenser, clean or wash it regularly.

2. Remove the filter from the Thermo-cooler before cleaning it.

Do not directly splash water on the filter to clean it while it is still attached to the Thermo-cooler.
This can lead to electric shock or fires in the main unit of the Thermo-cooler.

<Periodical inspection every three months>

1. Inspect the circulating fluid.

1. When using clear water
   - Replacement of clear water
     Failure to replace the clear water can lead to the development of bacteria or algae. Replace it regularly depending on your usage conditions.
   - Tank cleaning
     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 measurement device to confirm that the concentration does not exceed 15%.
   Dilute or add as needed to adjust the concentration.

2. Check the water quality of facility water.

Regarding the water quality standards for facility water, refer to "Temperature Control Equipment Precautions".

<Periodical inspection every six months>

(HRGC005-□□) Note 1)

1. Inspect the circulating fluid.

1. Remove the panel and inspect if there is abnormal leakage from the pump's mechanical seal.
2. Leakage amount of a mechanical seal
   Leakage of the mechanical seal cannot be completely avoided due to its construction (rotating machine).
   This amount of leakage is stipulated as 3 (cc/h) or less (reference value) according to the JIS standard.
   Also, as a guide for periodically replacement, the operation hours is 6000 to 8000 hours. (normally 1 year) Note 2)

Note 1) In the case of the HRGC001/002, because the pump included in the unit is a magnet pump with no rotating shaft seal, it is not necessary to inspect the mechanical seal (rotating shaft seal).

Note 2) In placing an order of mechanical seal set (service parts), inform us of the complete model number and the production lot number of the product in use.

<Periodical inspection during the winter season>

1. Keep the power supply running (POWER light on, RUN light off), and fully open the valves in the circulating fluid piping.

If the circulating fluid temperature falls below 3°C, the pump will start operating automatically. The heat generated by the pump operation will warm up the circulating fluid. When the temperature rises above 5°C, the pump will stop automatically.
As a result, the circulating fluid maintains a temperature of between 3°C and 5°C, preventing freezing.

2. Make water-removal arrangements beforehand.

In extremely cold weather conditions, the heat generated by the pump as described above may not be enough to prevent freezing.
If you expect these kind of conditions, remove the circulating fluid (especially clear water or deionized water) beforehand.

3. Consult a professional.

For additional methods to prevent freezing (such as commercially available tape heaters, etc.), consult a professional for advice.

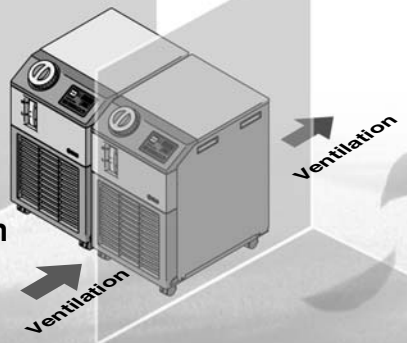
Circulating Fluid Temperature Controller

Thermo-chiller Compact type *Series HRS*

CE RoHS cMETus

Space-saving

Installation close to a wall is possible on both sides.



Addition of options and optional accessories

- **Options**
  - With earth leakage breaker
  - With automatic water supply function
  - Applicable to DI water (deionized water) piping
  - High-lift pump
  - High-temperature environment specifications
- **Optional accessories**
  - By-pass piping set
  - Power cable (for Single-phase 100/115 VAC)
  - DI filter set
  - Piping conversion fitting (for Option)

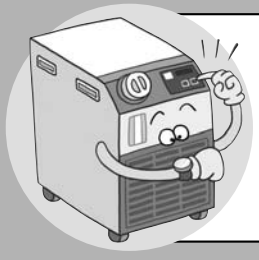
Light-weight **40 kg**

Fits neatly under a laboratory work bench.

- Cooling capacity (60 Hz): **1300 W/1900 W/2400 W**
- Temperature stability: **±0.1°C**
- Temperature range setting: **5 to 45°C** (High-temperature environment specifications)

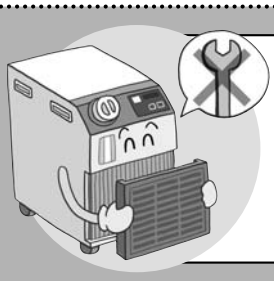
Power supply available all over the world

- **Single-phase 200 to 230 VAC (50/60 Hz)**
- **Single-phase 100 VAC (50/60 Hz), 115 VAC (60 Hz)**



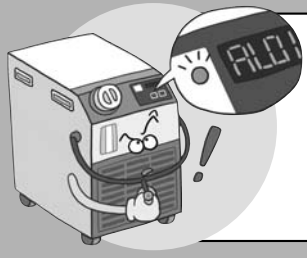
Convenient functions

- Timer operation function
- Low tank level detecting function
- Power failure auto-restart function
- Anti-freezing operation function



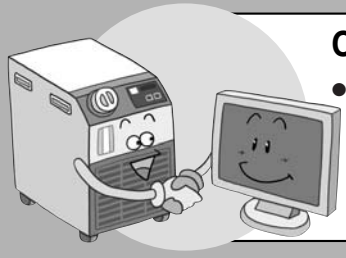
Easy maintenance

- Tool-less maintenance of filter



Self diagnosis function and check display

- 35 types of alarm codes



Communication function

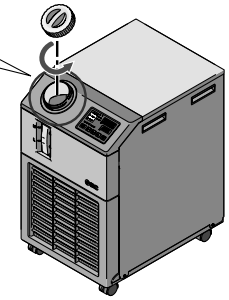
- Equipped with serial communication (RS232C, RS485) and contact I/Os (2 inputs and 3 outputs) as standard.

Environmental friendly **R407C as refrigerant**

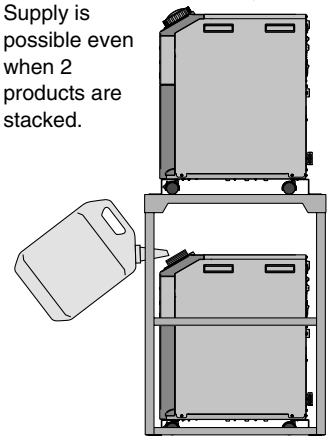
Features

Shaped for easy supply of circulating fluid

The angled supply port facilitates the supply of circulating fluid.



Supply is possible even when 2 products are stacked.



Operation display panel

Alarm codes notify when to check the pump and fan motor.

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).

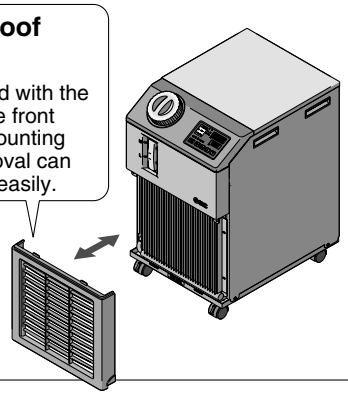
Simple operation

Step ❶ Press the RUN/STOP keys.
→ Step ❷ Adjust the temperature setting with the ▼ ▲ keys.
→ Step ❸ Press the RUN/STOP key to stop.
Easy operation by these steps

Tool-less maintenance of filter

Dustproof filter

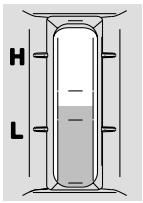
Integrated with the grill of the front panel. Mounting and removal can be done easily.



Options

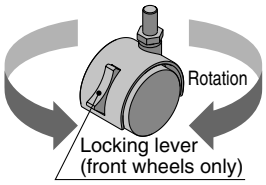
- With automatic water supply function
- Applicable to DI water (deionized water) piping
- High-lift pump

Easy check of the circulating fluid level



With unfixed caster

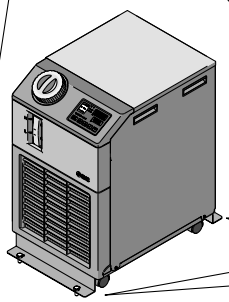
Useful for transportation onto a floor or moving to change arrangement.



Adoption of the magnet pump*

No fluid leakage because the seal-less pump is used

* When the option, high-lift pump, is selected, the mechanical seal pump is chosen.



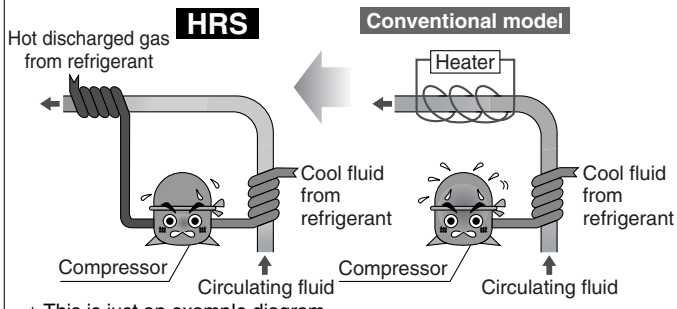
Optional accessories

Anti-quake bracket

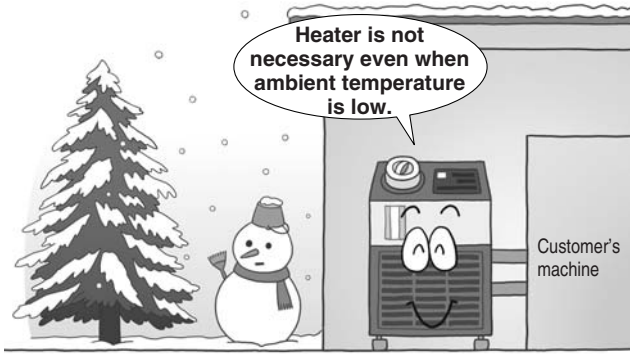
Used to fix to a floor or base.

With heating function

Heating method using discharged heat makes a heater unnecessary.

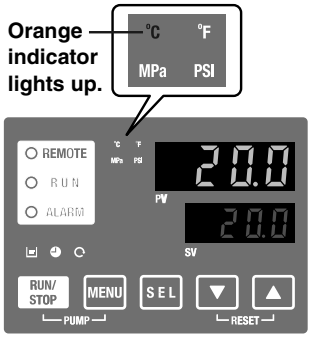


* This is just an example diagram.
Refer to "Construction and Principles" on page 74 for piping.



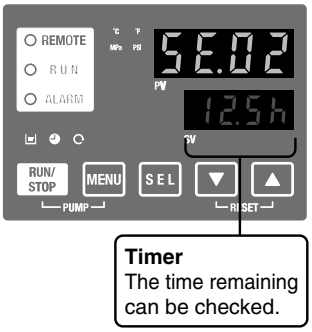
Convenient Functions

■ Unit conversion function
The unit can be changed between °C and °F and MPa and PSI.

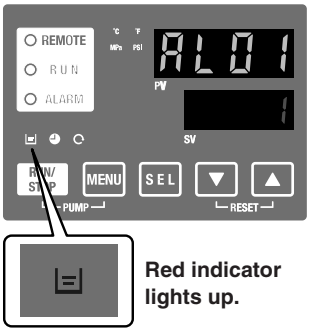


■ Timer operation function
Timer for ON and OFF can be set in units of 0.5 h up to 99.5 h.
Ex.) Can set to stop on Saturday and Sunday and restart on Monday morning.

Ex. SE.02 "ON timer"



■ Low tank level detecting function
The reduction of the fluid level in the tank is notified by alarm code.



■ 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.

■ 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.

■ 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.

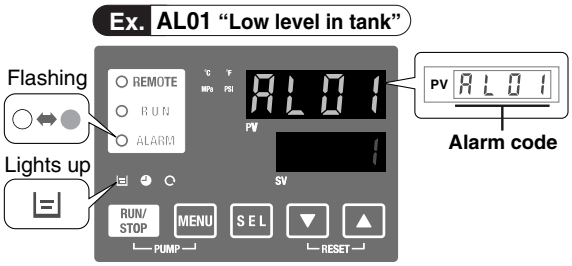
Self Diagnosis and Check Display for Easy Maintenance

Display of 35 types of alarm codes
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 from 35 types.
This makes it easier to identify the cause of the alarm.
Can be used before requesting service.

Changeable alarm set values

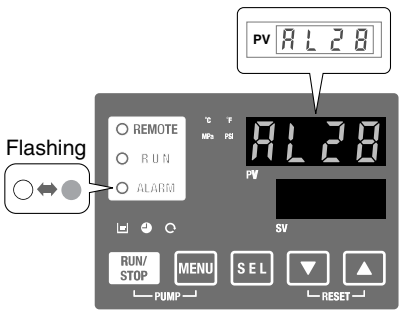
Setting item	Set value
Circulating fluid discharge temperature rise	5 to 48°C
Circulating fluid discharge temperature drop	1 to 39°C
Circulating fluid discharge pressure rise	0.05 to 0.75 MPa
Circulating fluid discharge pressure drop	0.05 to 0.18 MPa

Ex. AL01 "Low level in tank"



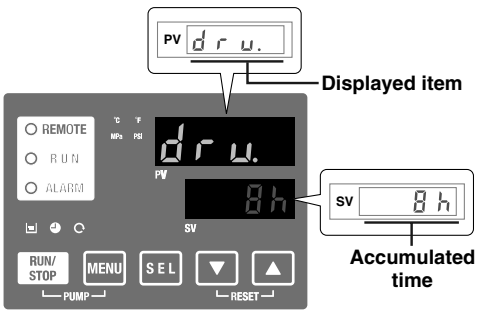
Alarm codes notify of checking times.
Notifies when to check the pump and fan motor.
Helpful for facility maintenance.
* The fan motor is not used in water-cooled refrigeration.

Ex. AL28 "Pump maintenance"



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

Ex. drv. "Accumulated operating time"



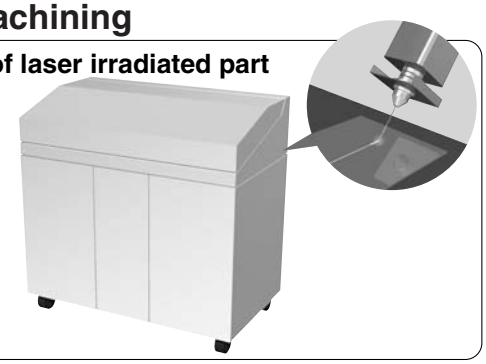
Displayed item
Circulating fluid outlet temperature
Circulating fluid return temperature
Compressor gas temperature
Circulating fluid outlet pressure
Compressor gas discharge pressure
Compressor gas return pressure
Accumulated operating time
Accumulated operating time of pump
Accumulated operating time of fan motor *
Accumulated operating time of compressor

* These are displayed only for air-cooled refrigeration.

Application Examples

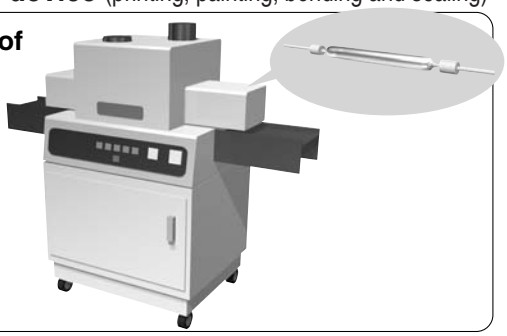
Laser machining

- **Cooling of laser irradiated part**



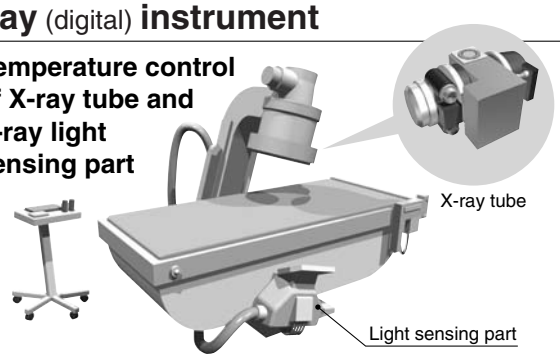
UV curing device (printing, painting, bonding and sealing)

- **Cooling of UV lamp**



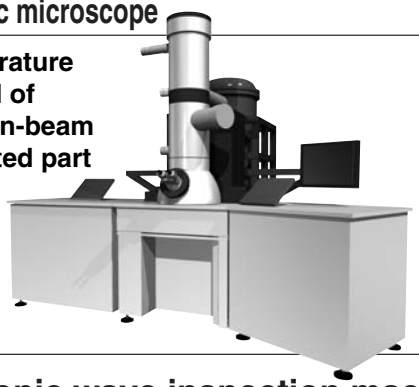
X-ray (digital) instrument

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



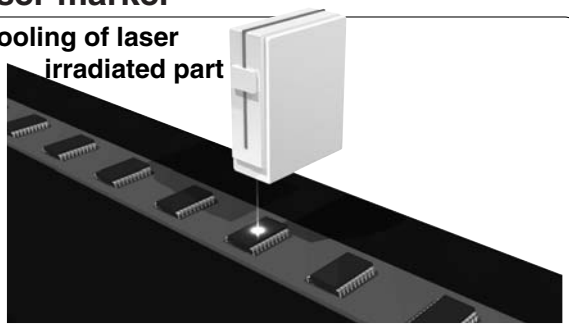
Electronic microscope

- **Temperature control of electron-beam irradiated part**



Laser marker

- **Cooling of laser irradiated part**

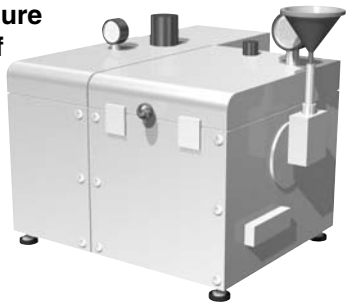


Ultra sonic wave inspection machine

- **Temperature control of ultra sonic wave laser part**

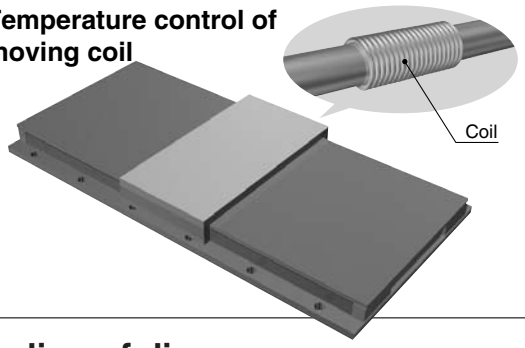
Atomizing device (food and cosmetics)

- **Temperature control of sample and device**



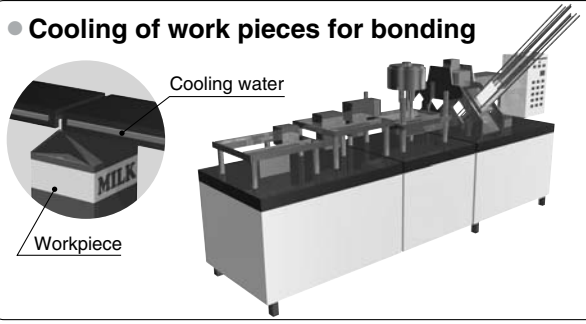
Linear motor

- **Temperature control of moving coil**

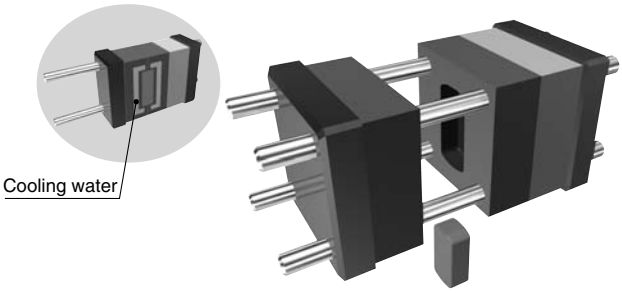


Packaging line (sealing of film and paper package)

- **Cooling of work pieces for bonding**

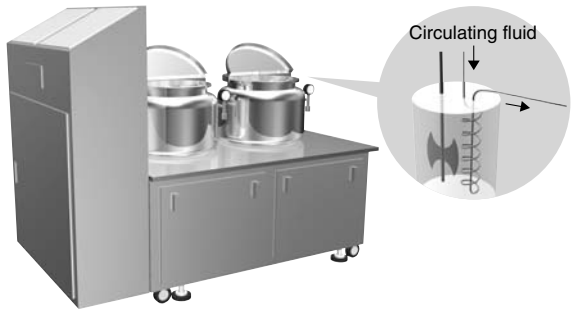


Cooling of die

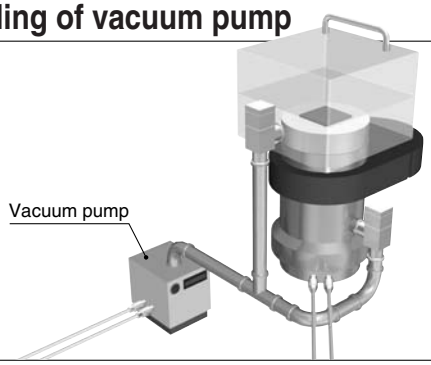


Application Examples

Temperature control of paint material

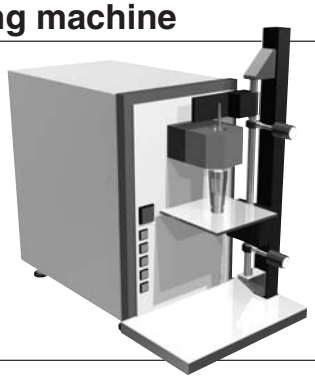


Cooling of vacuum pump



Shrink fitting machine

- Cooling of workpiece

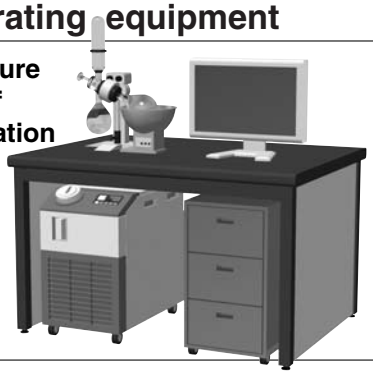


Gas cylinder cabinet

- Temperature control inside cabinet

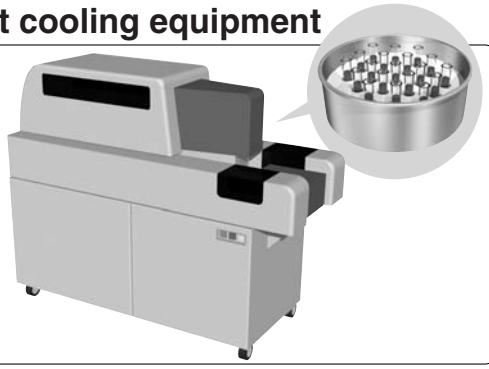
Concentrating equipment

- Temperature control of concentration fluid



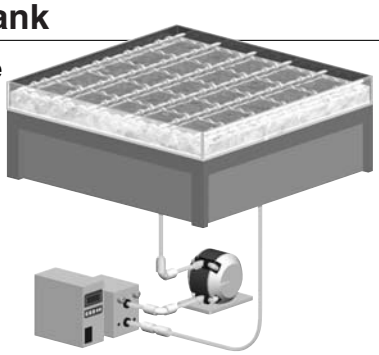
Reagent cooling equipment

- Tempera-ture control of reagent

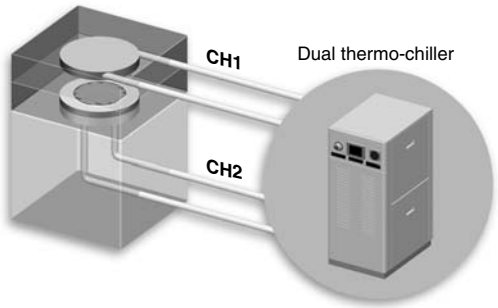


Cleaning tank

- Temperature control of cleaning tank

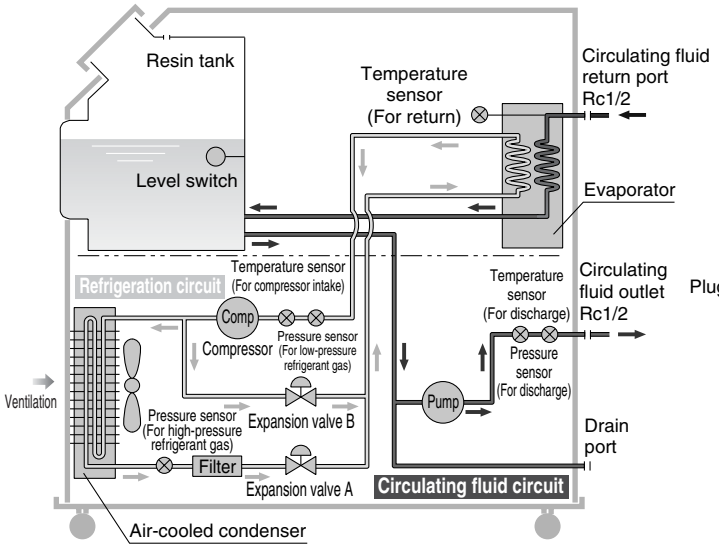


Temperature control of chamber electrode

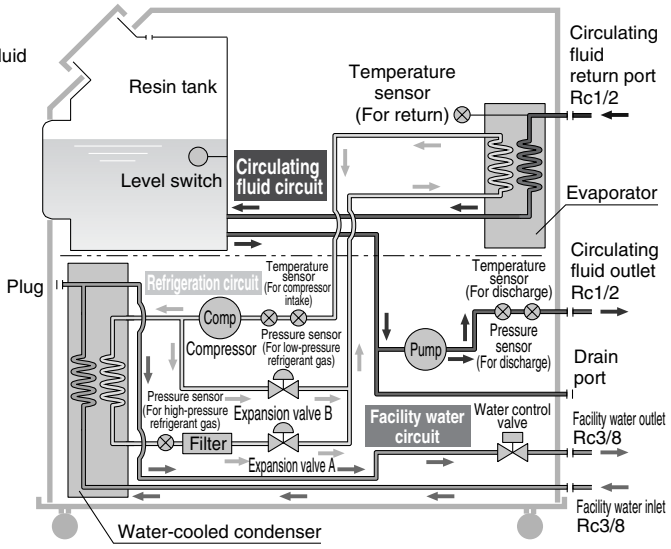


Construction and Principles

■ Air-cooled HRS□-A-□



■ Water-cooled HRS□-W-□



Circulating fluid circuit

With the circulating pump, circulating fluid will be discharged to the customer's machine side. After the circulating fluid will cool the customer's machine side, it will heat up and return to the Thermo-chiller.

Refrigeration circuit

High-temperature, high-pressure refrigerant gas compressed by the compressor is made to release heat by the condenser, and turns to liquid. As the liquefied high-pressure refrigerant passes through the expansion valve A, it expands and cools down; as it passes through the evaporator, heat is extracted from the circulating fluid and it evaporates.
The evaporated refrigerant is once again sucked in and compressed by the compressor, and the above cycle is repeated. The expansion valve B is open to heat the circulating fluid.

Facility water circuit

(For water-cooled refrigeration HRS□-W-□)

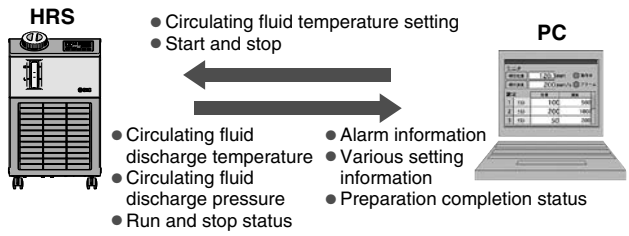
The water control valve opens and closes to keep the refrigerant gas pressure consistent. The facility water flow rate is controlled by the water control valve.

Communication Function

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

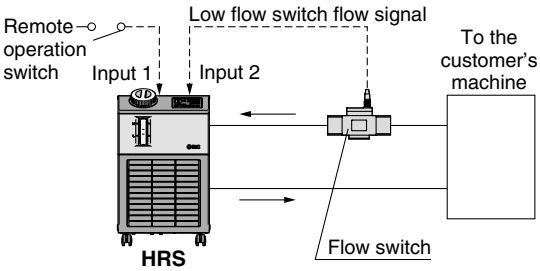
Ex. 1 **Remote signal I/O through serial communication**

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



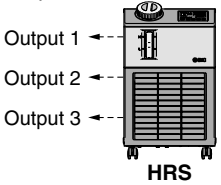
Ex. 2 **Remote operation signal input**

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.



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.)

CONTENTS

Series HRS

Thermo-chiller Compact Type

Series HRS

How to Order

Single-phase 100/115 VAC **HRS 018 – A □ – 10 – □**

Cooling capacity

012	Cooling capacity 1100/1300 W (50/60 Hz)
018	Cooling capacity 1500/1700 W (50/60 Hz)

Cooling method

A	Air-cooled refrigeration
W	Water-cooled refrigeration

Pipe thread type

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

Option

Symbol	Option
Nil	None
B	With earth leakage breaker
J	With automatic water supply function
M	Applicable to DI water (deionized water) piping

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

Power supply Note)

Symbol	Power supply
10	Single-phase 100 VAC (50/60 Hz) 115 VAC (60 Hz)

Note) UL standard: Applicable to 60 Hz only

Specifications

∗ There are different values from standard specifications. Refer to page 83 for details.

Model		HRS012-A□-10	HRS012-W□-10	HRS018-A□-10	HRS018-W□-10
Cooling method		Air-cooled refrigeration	Water-cooled refrigeration	Air-cooled refrigeration	Water-cooled refrigeration
Refrigerant		R407C (HFC)			
Control method		PID control			
Ambient temperature/humidity Note 2)		Temperature: 5 to 40°C, Humidity: 30 to 70%			
Circulating fluid system	**Circulating fluid** Note 3)	Clear water, 15% ethylene glycol aqueous solution Note 5)			
	Temperature range setting Note 2) **(°C)**	5 to 40			
	Cooling capacity Note 4) **(50/60 Hz) (W)**	1100/1300		1500/1700	
	Temperature stability Note 6) **(°C)**	±0.1			
	Pump capacity Note 7) **(50/60 Hz) (MPa)**	0.13/0.18 (at 7 L/min)			
	Rated flow Note 8) **(50/60 Hz) (L/min)**	7/7			
	Tank capacity (L)	Approx. 5			
	Port size	Rc1/2			
	Wetted parts material	Stainless steel, Copper (Heat exchanger brazing), Bronze, Alumina ceramic, Carbon, PP, PE, POM, FKM, EPDM, PVC			
Facility water system Note 1)	**Temperature range (°C)**	—	5 to 40	—	5 to 40
	Pressure range (MPa)	—	0.3 to 0.5	—	0.3 to 0.5
	Required flow rate Note 12) **(50/60 Hz) (L/min)**	—	8	—	12
	Inlet-outlet pressure differential of facility water (MPa)	—	0.3 or more	—	0.3 or more
	Port size	Rc3/8			
	Wetted parts material	Stainless steel, Copper (Heat exchanger brazing), Bronze, Synthetic rubber			
Electrical system	**Power supply**	Single-phase 100 VAC (50/60 Hz), 115 VAC (60 Hz) Allowable voltage range ±10%			
	Circuit protector (A)	15			
	Applicable earth leakage breaker capacity Note 9) **(A)**	15			
	Rated operating current (50/60 Hz) (A)	7.5/8.3		7.7/8.4	
	Rated power consumption Note 4) **(50/60 Hz) (kVA)**	0.7/0.8		0.8/0.8	
Noise level Note 10) **(50/60 Hz) (dB)**		58/55			
Accessories		Fitting (for drain outlet) 1 pc., Input/output signal connector 1 pc., Power supply connector 1 pc., Operation manual (for installation/operation) 1, Quick manual (with a clear case) 1, Alarm code list sticker 1, Ferritic core (for communication) 1 pc.			
Weight Note 11) **(kg)**		40			

Note 1) For water-cooled refrigeration
Note 2) It should have no condensation.
Note 3) If clear water is used, use water that conforms to Water Quality Standards of the Japan Refrigeration and Air Conditioning Industrial Association (JRA GL-02-1994 cooling water system - circulating type - make-up water).
Note 4) ① Ambient temperature: 25°C, ② Circulating fluid temperature: 20°C, ③ Rated circulating fluid flow rate, ④ Circulating fluid: Clear water, ⑤ Facility water temperature: 25°C
Note 5) Use a 15% ethylene glycol aqueous solution if operating in a place where the circulating fluid temperature is 10°C or less.
Note 6) Outlet temperature when the circulating fluid flow is rated flow, and the circulating fluid outlet and return port are directly connected. Installation environment and the power supply are within specification range and stable.
Note 7) The capacity at the Thermo-chiller outlet when the circulating fluid temperature is 20°C.
Note 8) Required flow rate for cooling capacity or maintaining the temperature stability.
The specification of the cooling capacity and the temperature stability may not be satisfied if the flow rate is lower than the rated flow.
Note 9) Purchase an earth leakage breaker with current sensitivity of 15 mA or 30 mA separately. (A product with an optional earth leakage breaker (option B) is also available. Refer to page 83.)
Note 10) Front: 1 m, height: 1 m, stable with no load, Other conditions → Note 4)
Note 11) Weight in the dry state without circulating fluids
Note 12) Required flow rate when a load for the cooling capacity is applied at a circulating fluid temperature of 20°C, and rated circulating fluid flow rate and facility water temperature of 25°C.

How to Order

Single-phase 200 to 230 VAC **HRS 018 − A □ − 20 − □**

Cooling capacity

012	Cooling capacity 1100/1300 W (50/60 Hz)
018	Cooling capacity 1700/1900 W (50/60 Hz)
024	Cooling capacity 2100/2400 W (50/60 Hz)

Cooling method

A	Air-cooled refrigeration
W	Water-cooled refrigeration

Pipe thread type

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

Power supply Note)

Symbol	Power supply
20	Single-phase 200 to 230 VAC (50/60 Hz)

Note) UL standard: Applicable to 60 Hz only

Option

Symbol	Option
Nil	None
B	With earth leakage breaker
J	With automatic water supply function
M	Applicable to DI water (deionized water) piping
T	High-lift pump Note 1)
G	High-temperature environment specifications Note 2)

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

Note 1) The cooling capacity reduces about 300 W from the value in the catalog.
Note 2) Air-cooled 200 V type only

Specifications

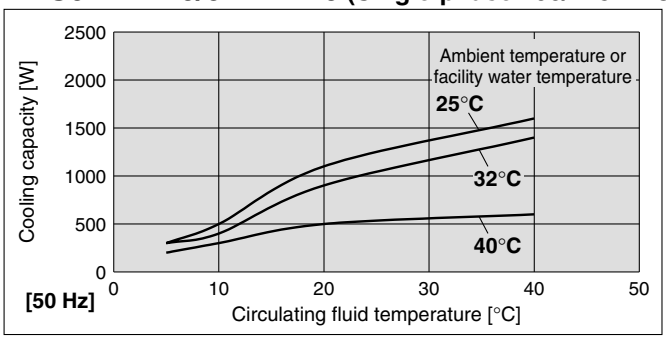
∗ There are different values from standard specifications. Refer to page 83 for details.

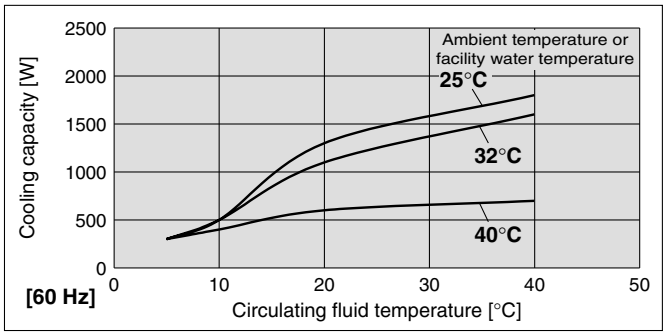
Model		HRS012-A□-20	HRS012-W□-20	HRS018-A□-20	HRS018-W□-20	HRS024-A□-20	HRS024-W□-20
Cooling method		Air-cooled refrigeration	Water-cooled refrigeration	Air-cooled refrigeration	Water-cooled refrigeration	Air-cooled refrigeration	Water-cooled refrigeration
Refrigerant		R407C (HFC)					
Control method		PID control					
Ambient temperature/humidity Note 2)		Temperature: 5 to 40°C, High-temperature environment specifications (option): 5 to 45°C, Humidity: 30 to 70%					
Circulating fluid system	**Circulating fluid** Note 3)	Clear water, 15% ethylene glycol aqueous solution Note 5)					
	Temperature range setting Note 2) **(°C)**	5 to 40					
	Cooling capacity Note 4) **(50/60 Hz) (W)**	1100/1300		1700/1900		2100/2400	
	Temperature stability Note 6) **(°C)**	±0.1					
	Pump capacity Note 7) **(50/60 Hz) (MPa)**	0.13/0.18 (at 7 L/min)					
	Rated flow Note 8) **(50/60 Hz) (L/min)**	7/7					
	Tank capacity (L)	Approx. 5					
	Port size	Rc1/2					
	Wetted parts material	Stainless steel, Copper (Heat exchanger brazing), Bronze, Alumina ceramic, Carbon, PP, PE, POM, FKM, EPDM, PVC					
Facility water system Note 1)	**Temperature range (°C)**	—	5 to 40	—	5 to 40	—	5 to 40
	Pressure range (MPa)	—	0.3 to 0.5	—	0.3 to 0.5	—	0.3 to 0.5
	Required flow rate Note 12) **(50/60 Hz) (L/min)**	—	8	—	12	—	14
	Inlet-outlet pressure differential of facility water (MPa)	—	0.3 or more	—	0.3 or more	—	0.3 or more
	Port size	Rc3/8					
	Wetted parts material	Stainless steel, Copper (Heat exchanger brazing), Bronze, Synthetic rubber					
Electrical system	**Power supply**	Single-phase 200 to 230 VAC (50/60 Hz) Allowable voltage range ±10%					
	Circuit protector (A)	10					
	Applicable earth leakage breaker capacity Note 9) **(A)**	10					
	Rated operating current (50/60 Hz) (A)	4.6/5.1		4.7/5.2		5.1/5.9	
	Rated power consumption Note 4) **(50/60 Hz) (kVA)**	0.9/1.0		0.9/1.0		1.0/1.2	
Noise level Note 10) **(50/60 Hz) (dB)**		60/61					
Accessories		Fitting (for drain outlet) 1 pc., Input/output signal connector 1 pc., Power supply connector 1 pc., Operation manual (for installation/operation) 1, Quick manual (with a clear case) 1, Alarm code list sticker 1, Ferritic core (for communication) 1 pc.					
Weight Note 11) **(kg)**		43					

Note 1) For water-cooled refrigeration
Note 2) It should have no condensation.
Note 3) If clear water is used, use water that conforms to Water Quality Standards of the Japan Refrigeration and Air Conditioning Industrial Association (JRA GL-02-1994 cooling water system - circulating type - make-up water).
Note 4) ① Ambient temperature: 25°C, ② Circulating fluid temperature: 20°C, ③ Rated circulating fluid flow rate, ④ Circulating fluid: Clear water, ⑤ Facility water temperature: 25°C
Note 5) Use a 15% ethylene glycol aqueous solution if operating in a place where the circulating fluid temperature is 10°C or less.
Note 6) Outlet temperature when the circulating fluid flow is rated flow, and the circulating fluid outlet and return port are directly connected. Installation environment and the power supply are within specification range and stable.
Note 7) The capacity at the Thermo-chiller outlet when the circulating fluid temperature is 20°C.
Note 8) Required flow rate for cooling capacity or maintaining the temperature stability.
The specification of the cooling capacity and the temperature stability may not be satisfied if the flow rate is lower than the rated flow.
Note 9) Purchase an earth leakage breaker with current sensitivity of 30 mA separately. (A product with an optional earth leakage breaker (option B) is also available. Refer to page 83.)
Note 10) Front: 1 m, height: 1 m, stable with no load, Other conditions → Note 4)
Note 11) Weight in the dry state without circulating fluids
Note 12) Required flow rate when a load for the cooling capacity is applied at a circulating fluid temperature of 20°C, and rated circulating fluid flow rate and facility water temperature of 25°C.

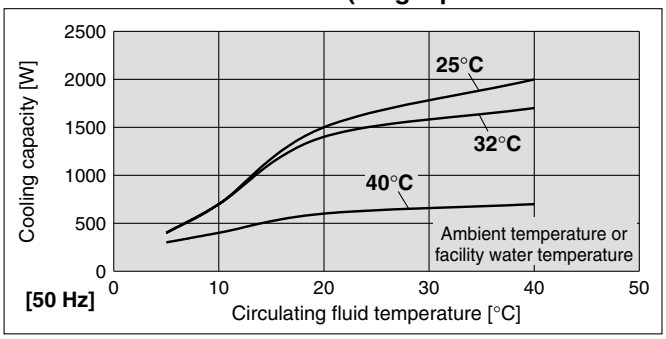
Cooling Capacity

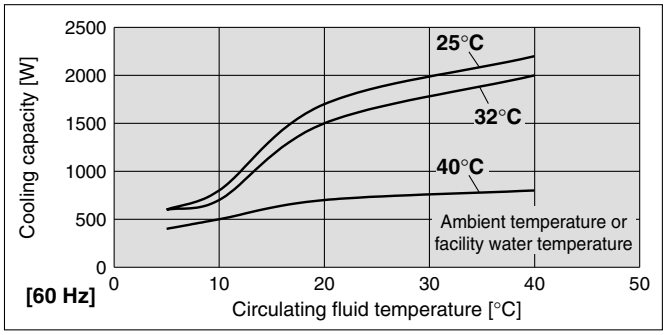
HRS012-A-10/012-W-10 (Single-phase 100/115 VAC)



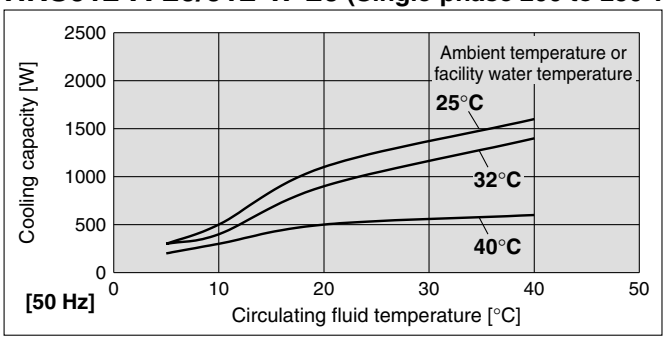


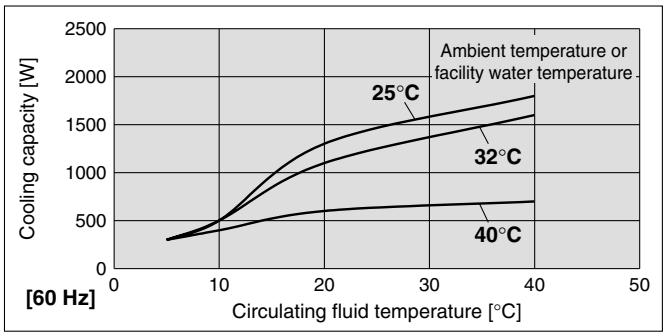
HRS018-A-10/018-W-10 (Single-phase 100/115 VAC)



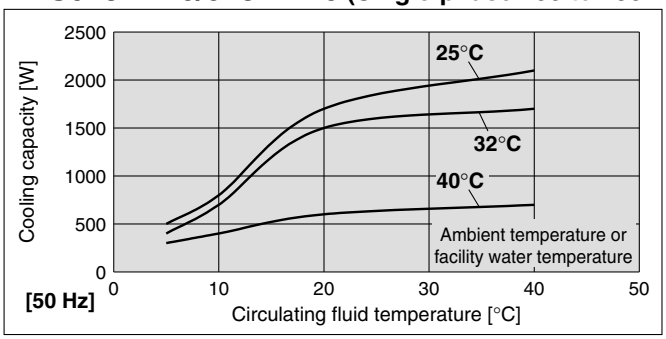


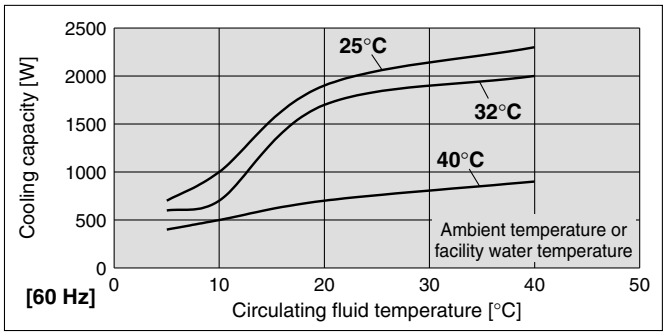
HRS012-A-20/012-W-20 (Single-phase 200 to 230 VAC)



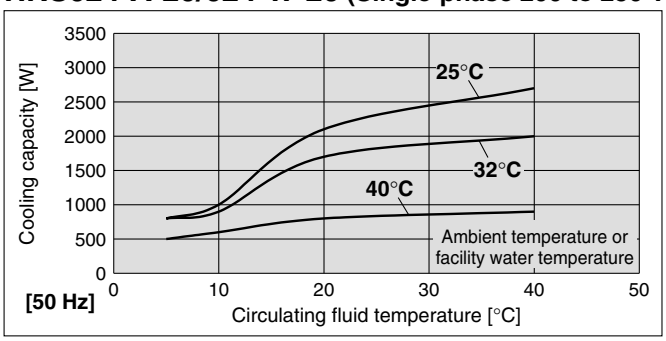


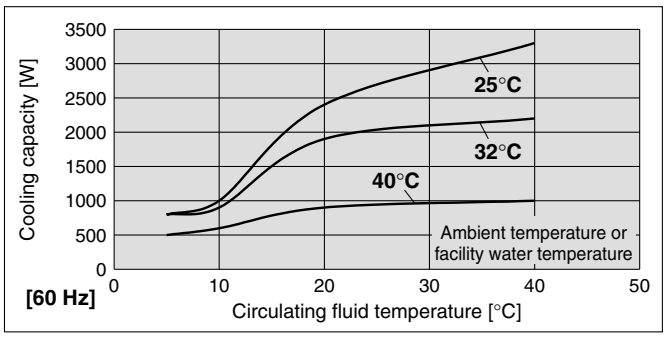
HRS018-A-20/018-W-20 (Single-phase 200 to 230 VAC)





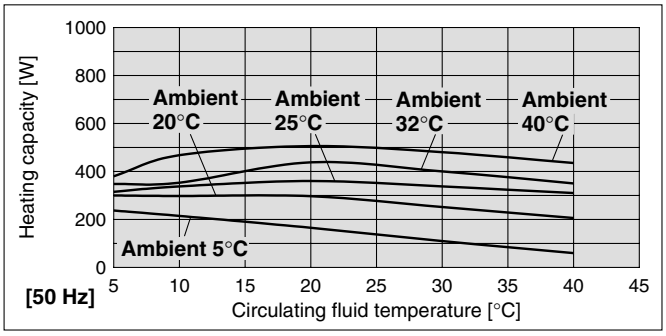
HRS024-A-20/024-W-20 (Single-phase 200 to 230 VAC)

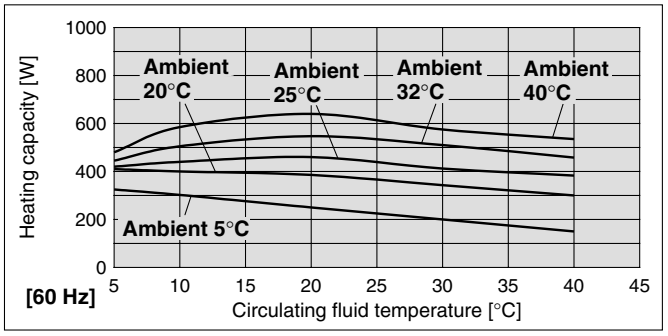




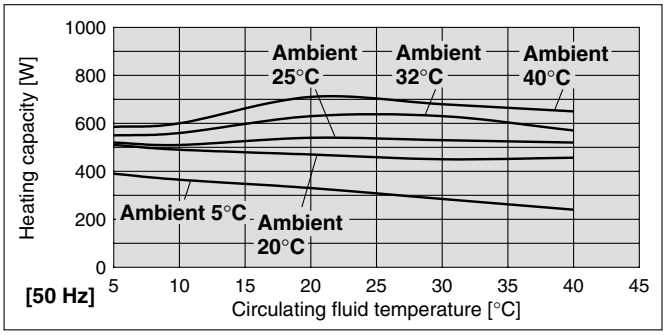
Heating Capacity

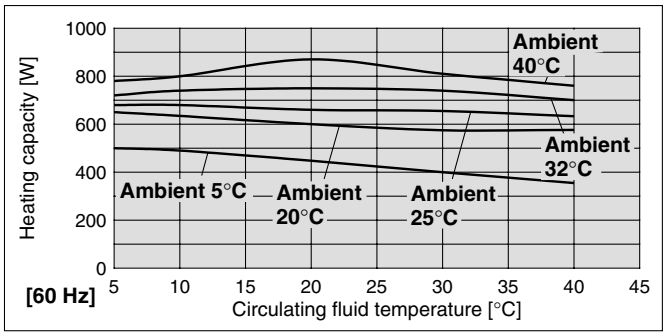
HRS$^{012}_{018}$-$^{A}_{W}$-10 (Single-phase 100/115 VAC)





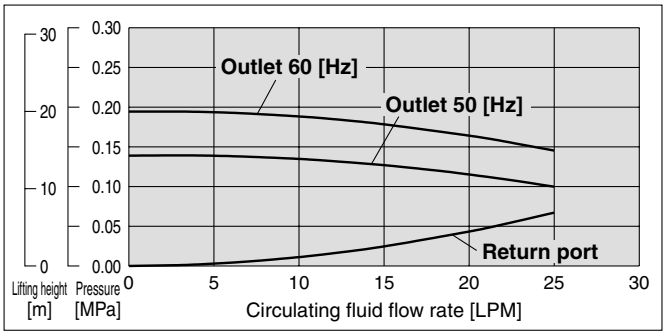
HRS$^{012}_{018}$-$^{A}_{W}$-20 (Single-phase 200 to 230 VAC)



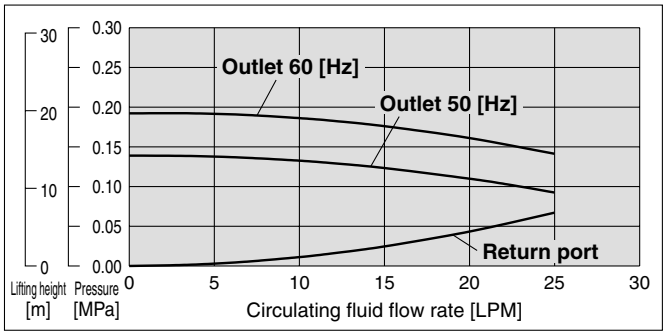


Pump Capacity

HRS$^{012}_{018}$-$^{A}_{W}$-10 (Single-phase 100/115 VAC)

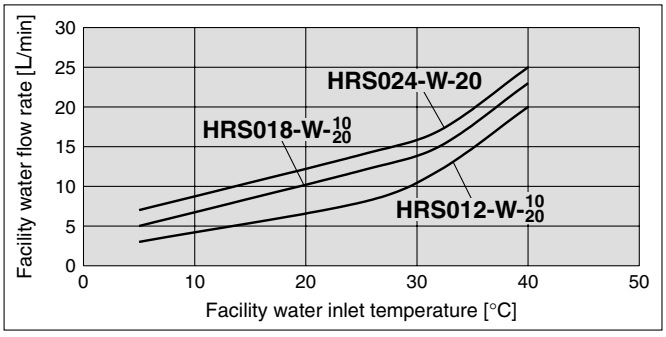


HRS$^{012}_{018}$-$^{A}_{W}$-20 (Single-phase 200 to 230 VAC)



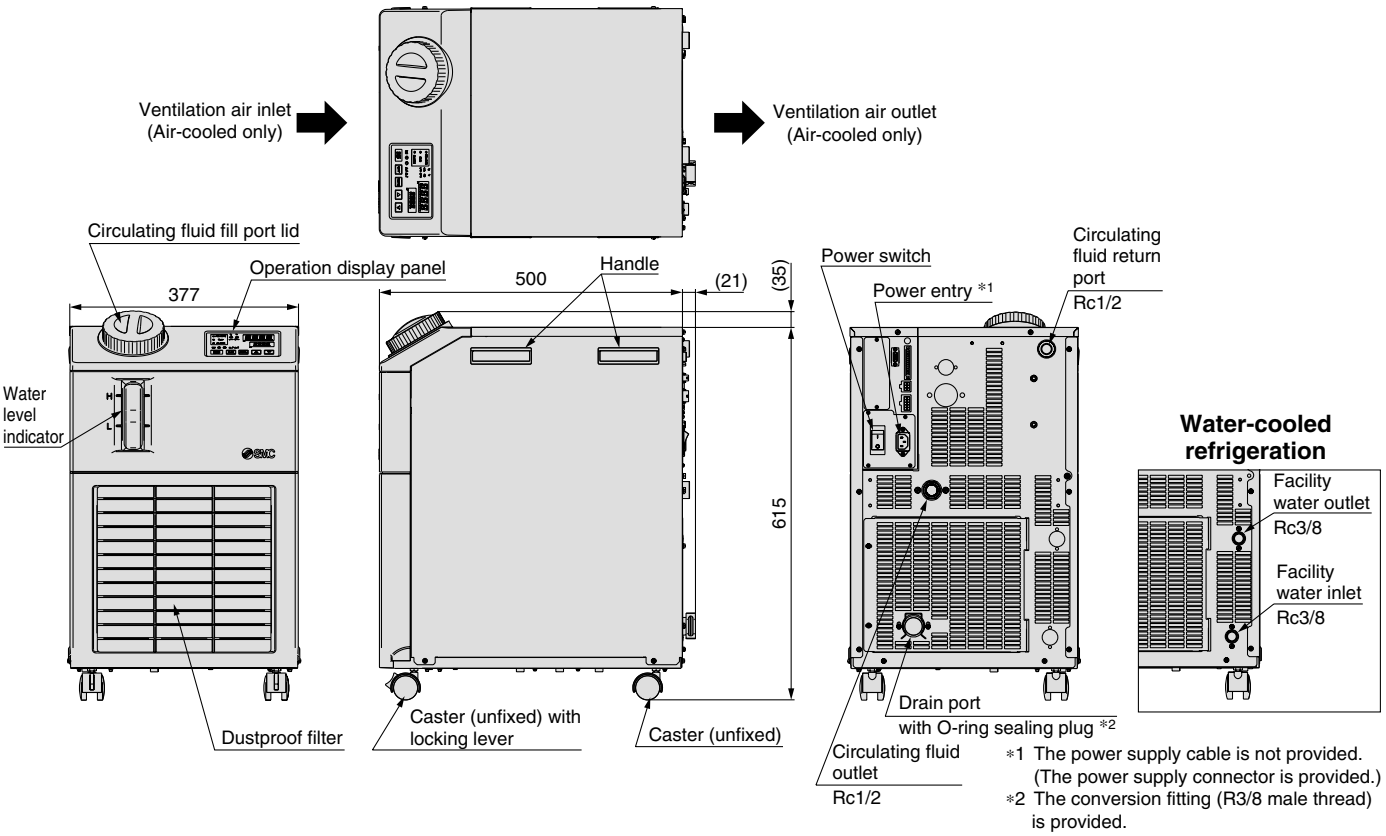
Required Facility Water Flow Rate

HRS012-W-$^{10}_{20}$, HRS018-W-$^{10}_{20}$, HRS024-W-20



∗ This is the facility water flow rate at the circulating fluid rated flow rate and the cooling capacity listed in the "Cooling Capacity" specifications.

Dimensions



*1 The power supply cable is not provided. (The power supply connector is provided.)
*2 The conversion fitting (R3/8 male thread) is provided.

Mounting/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. Secure with bolts, anchor bolts, etc.

Fasteners such as bolts or anchor bolts should be tighten with the recommended torque shown below.

Fixing Thread Tightening Torque

Connection thread	Applicable tightening torque (N·m)
M3	0.63
M4	1.5
M5	3
M6	5.2

Connection thread	Applicable tightening torque (N·m)
M8	12.5
M10	24.5
M12	42

Piping

⚠Caution

1. Regarding the circulating fluid pipings, consider carefully the suitability for shutoff pressure, temperature and circulating fluid.

If the operating performance is not sufficient, the pipings may burst during operation.

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 circulating fluid inlets and outlets, drain port or overflow outlet of this product, use a pipe wrench to clamp the connection ports.

Piping

⚠Caution

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 consists of circulating fluid temperature controllers 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.

Electrical Wiring

⚠Warning

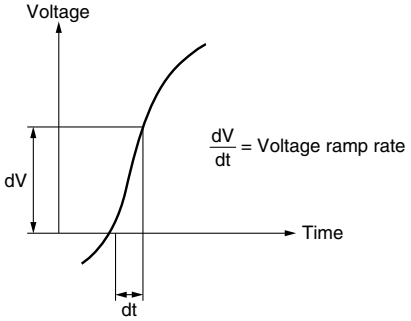
1. Grounding should never be connected to a water line, gas line or lightning rod.

⚠Caution

1. Communication cables should be prepared by the customer.

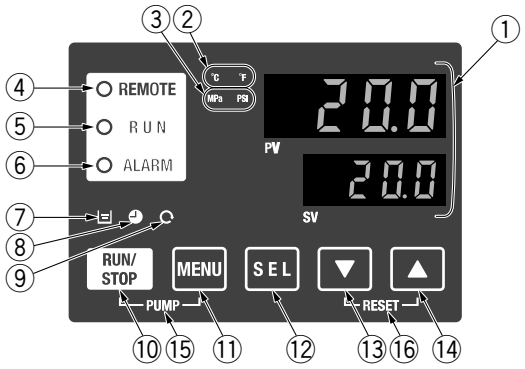
2. Ensure a stable power supply with no voltage surges and distortion.

In particular, operating failure can result when the voltage ramp rate (dV/dt) exceeds 40 V/200 μ sec at the zero cross-over point.



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 and 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] indicator**	Equipped with a unit conversion function. Displays the unit of display temperature (default setting: °C).	
③	**[MPa] [PSI] indicator**	Equipped with a unit conversion function. Displays the unit of display pressure (default setting: MPa).	
④	**[REMOTE] indicator**	Enables remote operation (start and stop) by communication. Lights up during remote operation.	
⑤	**[RUN] indicator**	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] indicator**	Flashes with buzzer when alarm occurs.	
⑦	**[⊟] indicator**	Lights up when the surface of the fluid level indicator falls below the L level.	
⑧	**[◕] indicator**	Equipped with a timer for start and stop. Lights up when this function is operated.	
⑨	**[↻] indicator**	Equipped with a power failure auto-restart function, which restarts the product automatically after stopped due to a power failure, is provided. 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] indicator is reset.	

Alarm

This unit has 35 types of 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.

Alarm code	Alarm message	Operation status
AL01	Low level in tank	Stop*1
AL02	High circulating fluid discharge temperature	Stop
AL03	Circulating fluid discharge temperature rise	Continue*1
AL04	Circulating fluid discharge temperature drop	Continue*1
AL05	High circulating fluid return temperature (60°C)	Stop
AL06	High circulating fluid discharge pressure	Stop
AL07	Abnormal pump operation	Stop
AL08	Circulating fluid discharge pressure rise	Continue*1
AL09	Circulating fluid discharge pressure drop	Continue*1
AL10	High compressor intake temperature	Stop
AL11	Low compressor intake temperature	Stop
AL12	Low super heat temperature	Stop
AL13	High compressor discharge pressure	Stop
AL15	Refrigerating circuit pressure (high pressure side) drop	Stop
AL16	Refrigerating circuit pressure (low pressure side) rise	Stop
AL17	Refrigerating circuit pressure (low pressure side) drop	Stop
AL18	Compressor overload	Stop
AL19*2	Communication error*2	Continue*1

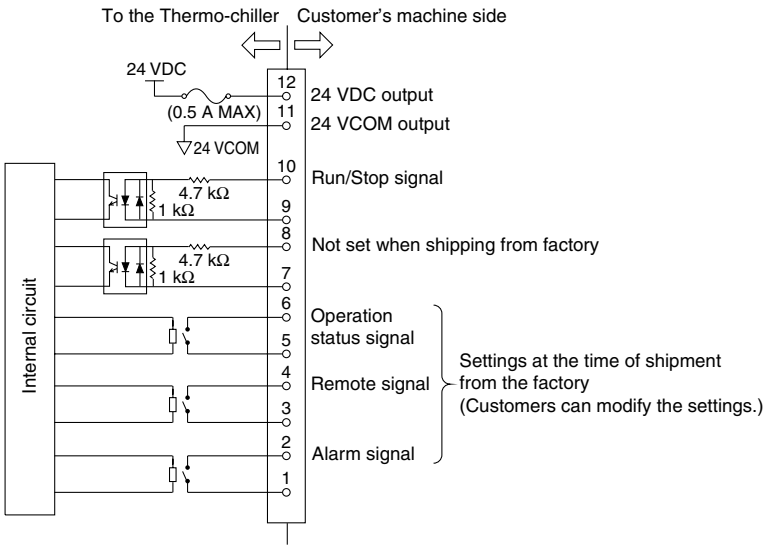
Alarm code	Alarm message	Operation status
AL20	Memory error	Stop
AL21	DC line fuse cut	Stop
AL22	Circulating fluid discharge temperature sensor failure	Stop
AL23	Circulating fluid return temperature sensor failure	Stop
AL24	Compressor intake temperature sensor failure	Stop
AL25	Circulating fluid discharge pressure sensor failure	Stop
AL26	Compressor discharge pressure sensor failure	Stop
AL27	Compressor intake pressure sensor failure	Stop
AL28	Pump maintenance	Continue
AL29	Fan motor maintenance*3	Continue
AL30	Compressor maintenance	Continue
AL31*2	Contact 1 input signal detection	Stop*1
AL32*2	Contact 2 inputs signal detection	Stop*1
AL33*4	Water leakage	Stop*1
AL34*4	Electrical resistance rise	Continue
AL35*4	Electrical resistance drop	Continue
AL36*4	Electrical resistance sensor failure	Continue

∗1 "Stop" or "Continue" are default settings. Customers can change them to "Continue" and "Stop". For details, read the Operation Manual.
∗2 "AL19, AL31, AL32" are disabled in the default setting. If this function is necessary, it should be set by the customer referring to the Operation Manual.
∗3 For water-cooled models, the alarm is not activated.
∗4 This alarm function can be used when the option (sold separately) is used.

Please download the Operation Manual via our website. http://www.smcworld.com

Communication Function

Contact Input/Output

Item		Specifications
Connector type (to the product)		MC 1,5/12-GF-3,5
Input signal	Insulation method	Photocoupler
	Rated input voltage	24 VDC
	Operating voltage range	21.6 VDC 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)
Output voltage		24 VDC ±10% 0.5 A Max
Circuit diagram		

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

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.

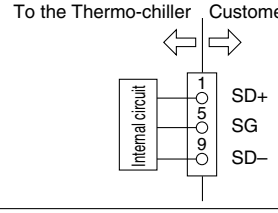
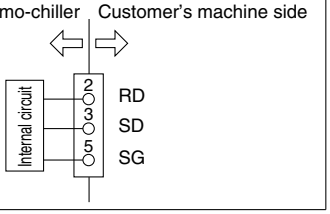
Writing

Run/Stop
Circulating fluid temperature setting (SV)

Readout

Circulating fluid present temperature (PV)
Circulating fluid discharge pressure (SV)
Electrical resistance ∗1
Status information
Alarm occurrence information

∗1 When optional electrical resistance sensor set is used

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.
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.smcworld.com

Series HRS
Options 1

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

B Option symbol

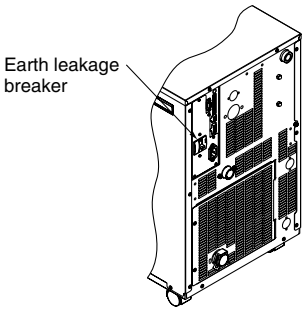
With Earth Leakage Breaker

HRS□□-□□-□-B

With earth leakage breaker

In the event of a short circuit, overcurrent or overheating, the earth leakage breaker will automatically shut off the power supply.

Symbol	HRS□□-□□-□-B
Rated current sensitivity (mA)	30
Rated shutdown current (A)	15 (Single-phase 100/115 VAC) 10 (Single-phase 200 to 230 VAC)
Short circuit display method	Mechanical button



J Option symbol

With Automatic Water Supply Function

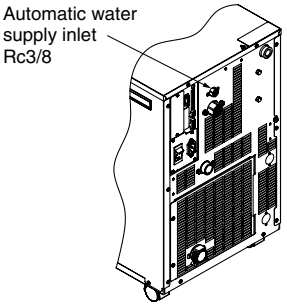
HRS□□-□□-□-J

With automatic water supply function

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

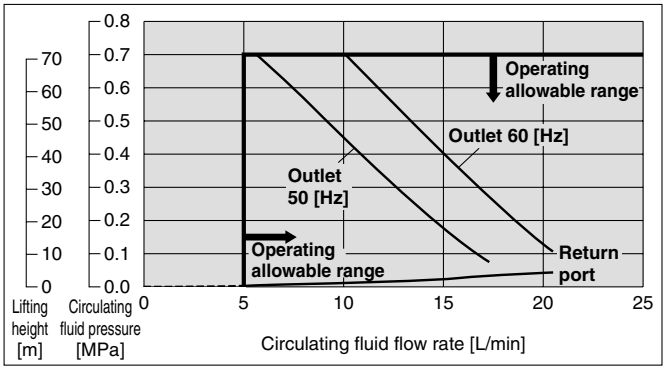
Symbol	HRS□□-□□-J
Water supply method	Built-in solenoid valve for automatic water supply
Water supply pressure (MPa)	0.2 to 0.5

∗ When the option, with automatic water supply function, is selected, the weight increases by 1 kg.

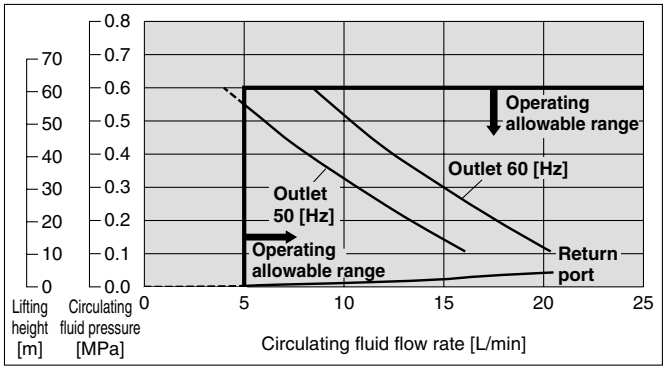


Pump Capacity

HRS□□-□□-20-T



HRS□□-□□-20-MT



M Option symbol

Applicable to DI Water (Deionized Water) Piping

HRS□□-□□-□-M

Applicable to DI water (Deionized water) piping

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

Symbol	HRS□□-□□-□-M
Wetted parts material for circulating fluid	Stainless steel (including heat exchanger brazing), Alumina ceramic, Carbon, PP, PE, POM, FKM, EPDM, PVC

∗ No change in external dimensions.

T Option symbol

High-lift Pump

HRS□□-□□-20-T

High-lift pump

Possible to choose a high-lift pump in accordance with customer's piping resistance.
Cooling capacity may decrease by heat generated in the pump.
Power supply 200 V type only.

Symbol		HRS□□-□□-20-T/MT
Pump capacity	-T	[50 Hz] 0.44 MPa at 10 L/min [60 Hz] 0.40 MPa at 14 L//min
	-MT Note 1)	[50 Hz] 0.32 MPa at 10 L/min [60 Hz] 0.32 MPa at 14 L//min
Circuit protection device		15 A (10 A for standard)
Recommended earth leakage breaker capacity		15 A
Cooling capacity Note 2)		The cooling capacity reduces about 300 W from the value in the catalog. (due to an increase in the heat generation of the pump)

Note 1) -MT: Applicable to DI water (deionized water) piping + High-lift pump
Note 2) Cooling capacity may decrease as pump power increases.
Note 3) When the option, high-lift pump, is selected, the weight increases by 6 kg.
∗ No change in external dimensions.

Series HRS
Options 2

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

G Option symbol

High-temperature Environment Specifications

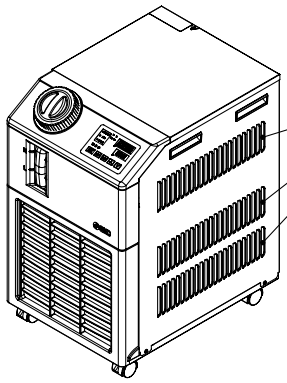
HRS□□□-A□-20-G

High-temperature environment specifications

Makes use at ambient temperatures up to 45°C possible.
Also increases cooling capacity at ambient temperature of 32°C.
(Cooling capacity is equal to standard products at ambient temperatures of less than 32°C.)

Applicable model	HRS□□□-A□-20-G
Cooling method	Air-cooled refrigeration
Power supply	Single-phase 200 to 230 VAC (50/60 Hz)

∗ No change in external dimensions.

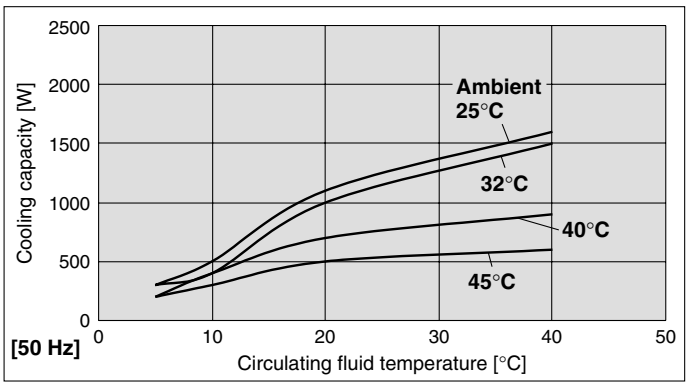


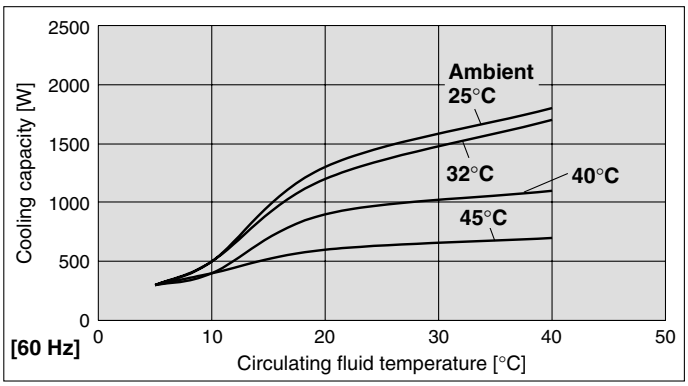
Ventilation slots are added to side panels (on both sides).

∗ Ventilation slots are added to Thermo-chiller side panels. For this reason, please provide 300 mm of ventilation space next to the side panels (do not install with sides touching walls).
∗ UL compliance pending.

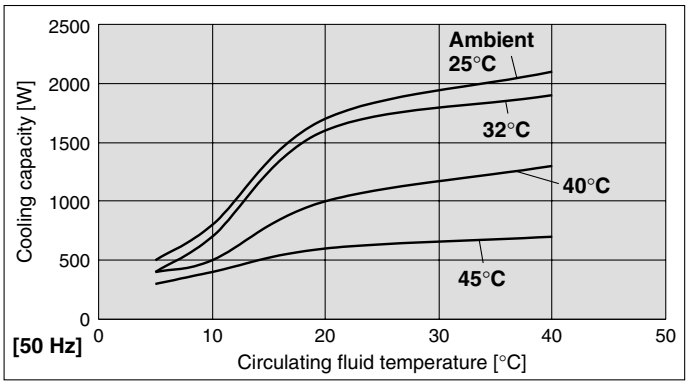
Cooling Capacity

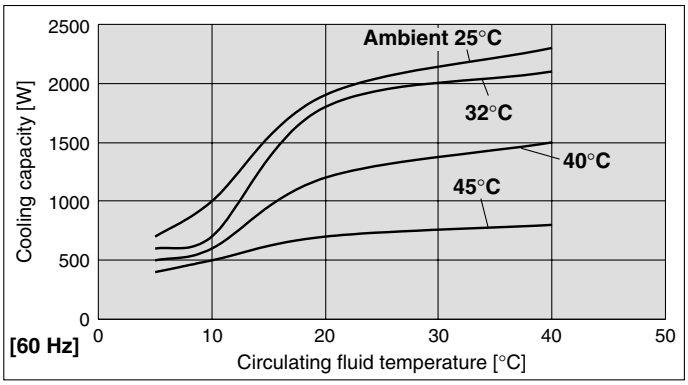
HRS012-A□-20-G



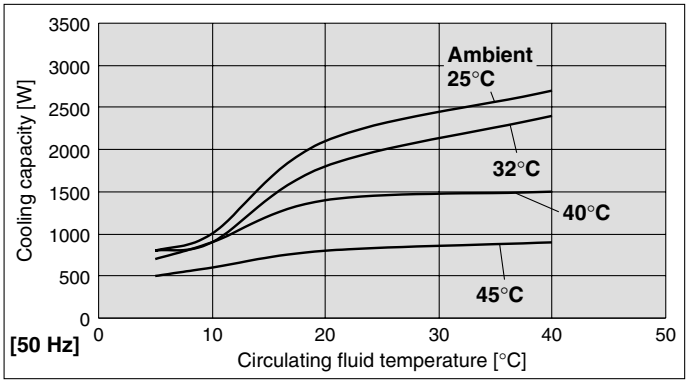


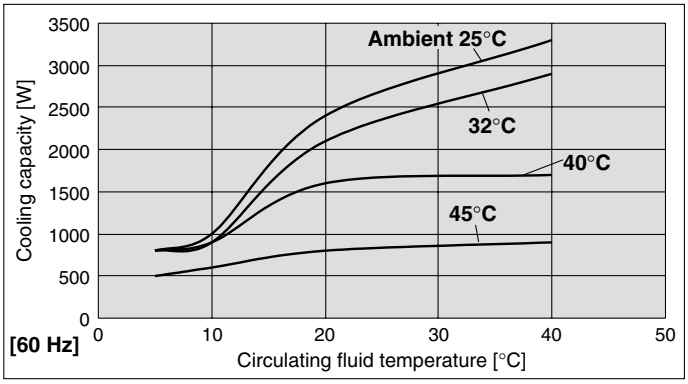
HRS018-A□-20-G





HRS024-A□-20-G



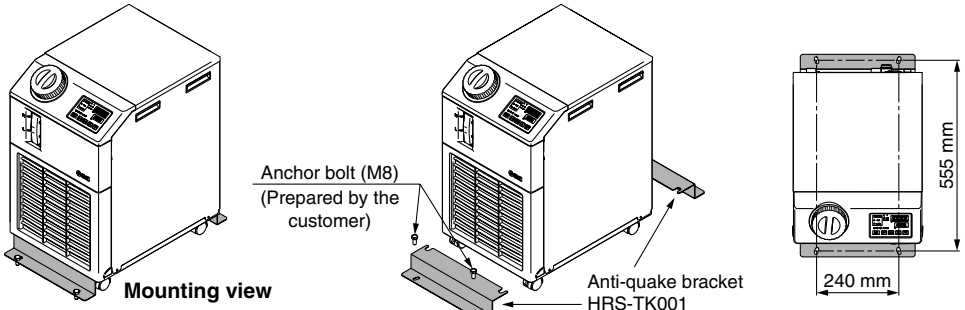


Optional Accessories 1

① Anti-quake Bracket

Bracket for earthquakes
Prepare the anchor bolts (M8) which are suited to the floor material by the customer. (Anti-quake bracket thickness: 1.6 mm)

Part No.	HRS-TK001 (for Single Unit)



Mounting view

② Piping Conversion Fitting (for Air-Cooled Refrigeration)

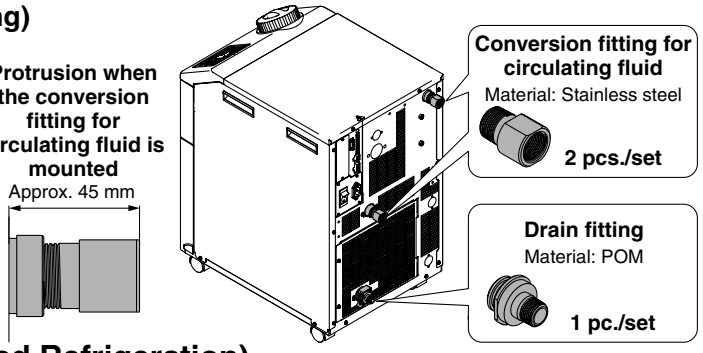
(Conversion fitting for circulating fluid + Drain fitting)
HRS012-A□-□, HRS018-A□-□, HRS024-A□-□

This fitting changes the port size for circulating fluid from Rc1/2 to G1/2 or NPT1/2.
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.	HRS-EP001	G thread conversion fitting set
Part No.	HRS-EP002	NPT thread conversion fitting set

When the options, with automatic water supply function "-J", or high-lift pump "-T" are selected, purchase ④ piping conversion fitting (for option), too.

Protrusion when the conversion fitting for circulating fluid is mounted
Approx. 45 mm



③ Piping Conversion Fitting (for Water-Cooled Refrigeration)

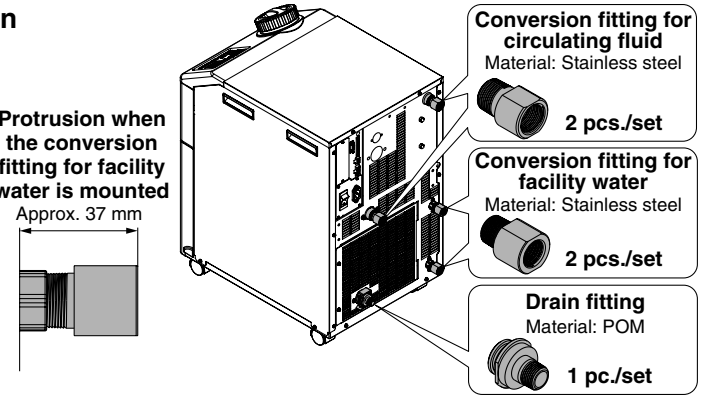
(Conversion fitting for circulating fluid + Conversion fitting for facility water + Drain fitting)
HRS012-W□-□, HRS018-W□-□, HRS024-W□-□

This fitting changes the port size for circulating fluid from Rc1/2 to G1/2 or NPT1/2 and for facility water from Rc3/8 to G3/8 or NPT3/8.
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.	HRS-EP003	G thread conversion fitting set
Part No.	HRS-EP004	NPT thread conversion fitting set

When the options, with automatic water supply function "-J", or high-lift pump "-T" are selected, purchase ④ piping conversion fitting (for option), too.

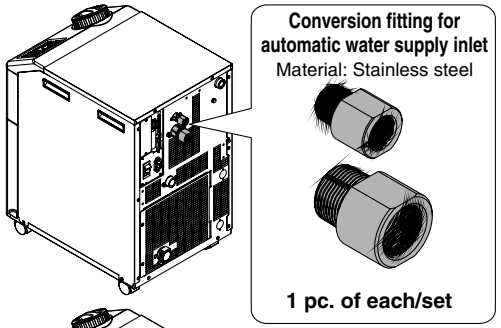
Protrusion when the conversion fitting for facility water is mounted
Approx. 37 mm



④ Piping Conversion Fitting (for Option)

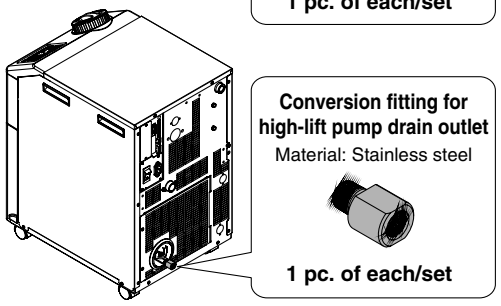
This fitting changes the port size for option-J "With Automatic Water Supply Function" from Rc3/8, Rc3/4 to G3/8, G3/4 or NPT3/8, NPT3/4.
It is not necessary to purchase this when pipe thread type F or N is selected in "How to Order" since it is included in the product.

Part No.	HRS-EP005	G thread conversion fitting set (for automatic water supply inlet)
Part No.	HRS-EP006	NPT thread conversion fitting set (for automatic water supply inlet)



This fitting changes the port size for drain outlet for option-T "High-lift Pump" from Rc1/4 to G1/4 or NPT1/4.
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.	HRS-EP007	G thread conversion fitting set (for high-lift pump drain outlet)
Part No.	HRS-EP008	NPT thread conversion fitting set (for high-lift pump drain outlet)

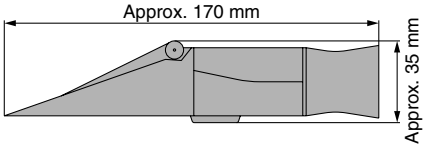


Optional Accessories 2

⑤ Concentration Meter

This meter can be used to control the concentration of ethylene glycol aqueous solution regularly.

Part No.	HRZ-BR002

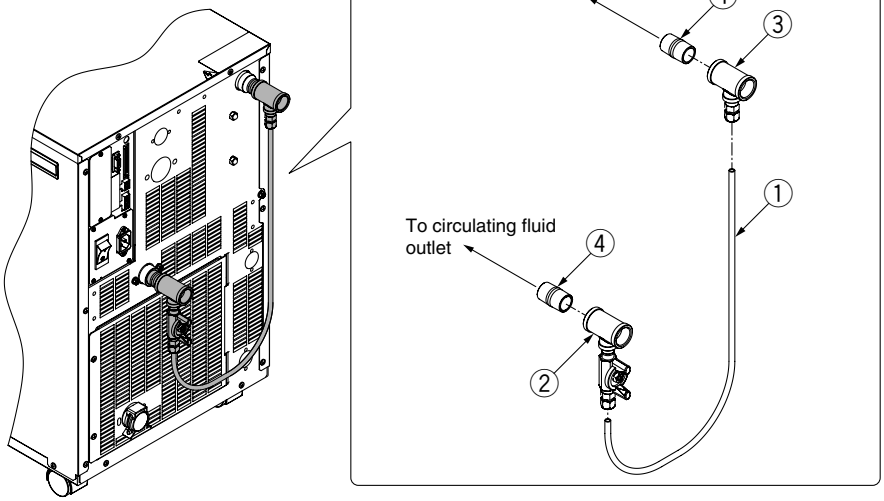


⑥ By-pass Piping Set

Note) To be mounted by the customer.

When the circulating fluid goes below the rated flow (7 L/min), cooling capacity will be reduced and the temperature stability will be badly affected. In such a case, use the by-pass piping set.
A high-lift pump option is also available.

Part No.	HRS-BP001



Parts List

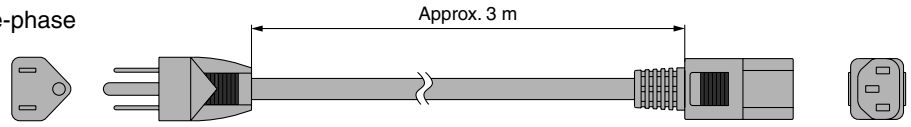
No.	Description
①	By-pass tube (700 mm) (Part no.: TL0806)
②	Outlet piping (with ball valve)
③	Return port piping
④	Nipple (Size: 1/2) (2 pcs.)

⑦ Power Supply Cable (for Single-phase 100/115 VAC Type)

This power supply cable is for the single-phase 100/115 VAC power supply type.

∗ Not applicable for the 200 V type.

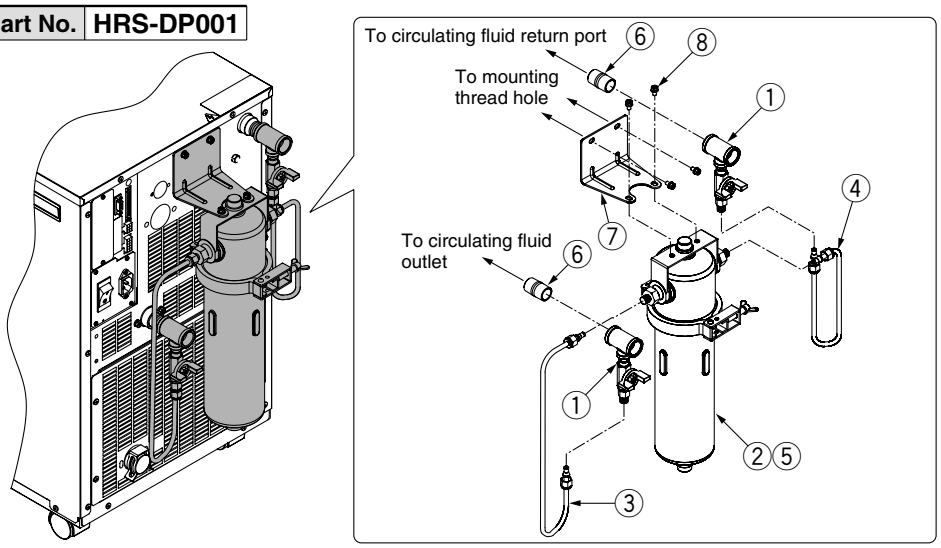
Part No.	HRS-CA001



⑧ DI Filter Set

It is possible to keep electrical resistance by flowing the circulating fluid to the ion replacement resin (DI filter).
The set parts are in order to install DI filter to by-pass circuit and flow the fixed rate of the circulating fluid to DI filter.
It is not to control the value of electrical resistance. (Replacement cartridge: HRS-DF001)

Part No.	HRS-DP001



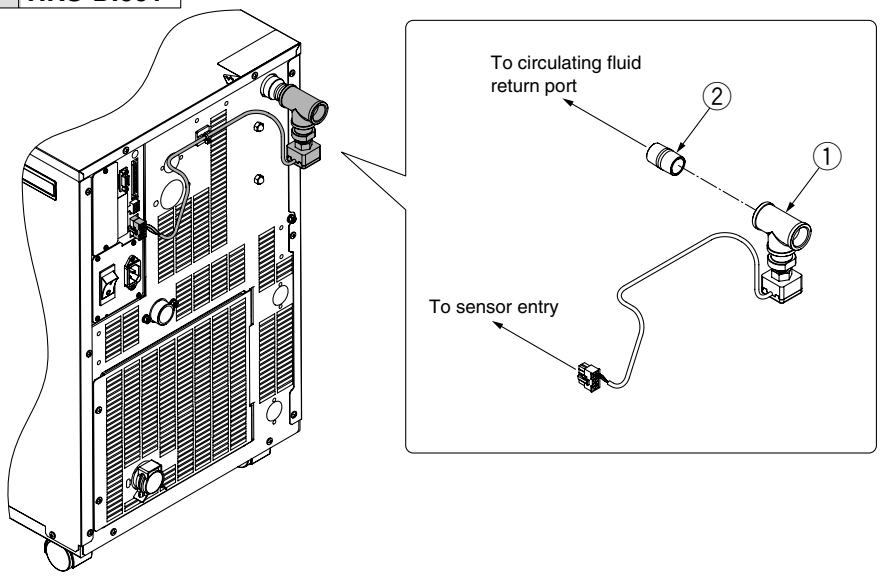
Parts List

No.	Description
①	Branch line (2 pcs.)
②	DI filter case
③	DI filter inlet tube
④	DI filter outlet tube
⑤	DI filter cartridge (Part no.: HRS-DF001)
⑥	Nipple (Size: 1/2) (2 pcs.)
⑦	Mounting bracket
⑧	Mounting screw (M6 screw, 2 pcs.) (M5 screw, 2 pcs.)

⑨ Electrical Resistance Sensor Set

Electrical resistance value of the circulating fluid (display range: 0 to 4.5 MPa) can be displayed on the Thermo-chiller operation display panel. It is possible to set alarms for the upper- and lower-limit electrical resistance values. Readout using serial communications (RS-485/RS-232C) can be performed as well. Use in combination with the DI Filter Set (HRS-DP001) or By-pass Piping Set (HRS-BP001) is also possible.
This set is not for controlling the electrical resistance value.

Part No.	HRS-DI001



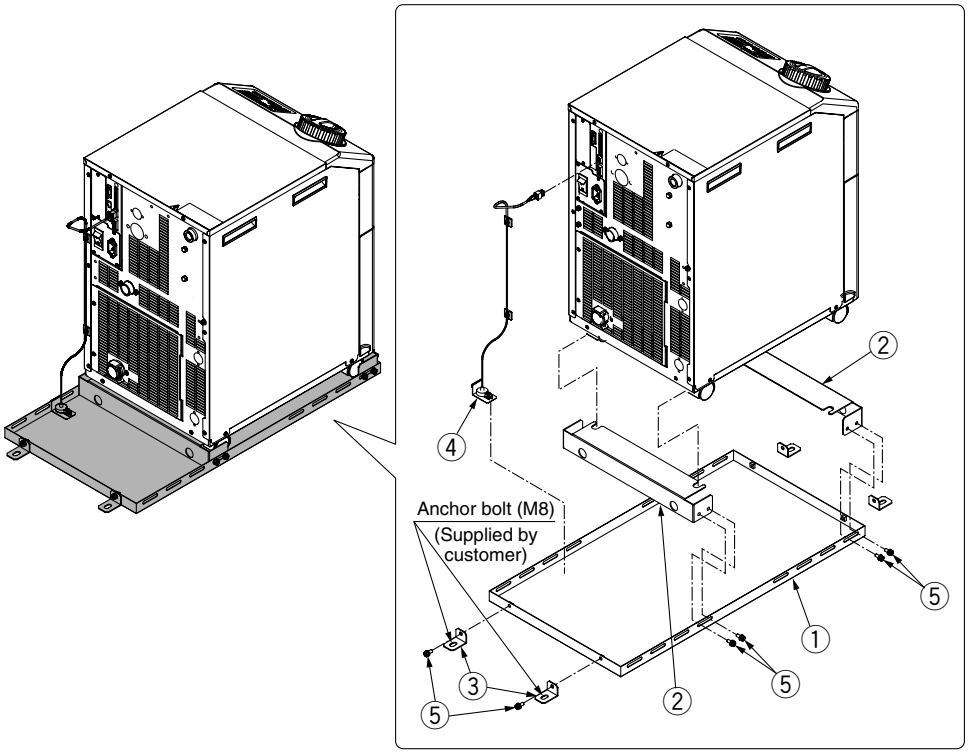
Parts List

No.	Description
①	Electrical resistance sensor
②	Nipple (Size: 1/2) (1 pc.)

⑩ 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. Anchor bolt (M8) suitable for the flooring material should be prepared separately by the customer.

Part No.	HRS-WL001



Parts List

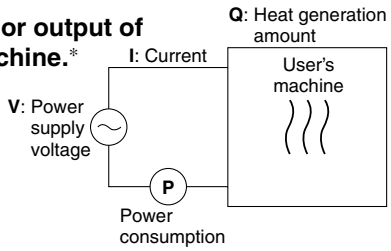
No.	Description
①	Drain pan
②	Thermo-chiller fixing bracket (2 pcs.)
③	Drain pan fixing bracket (4 pcs.)
④	Water leakage sensor
⑤	Bracket fixing screw (M6 screw, 12 pcs.)

Series HRS
Cooling Capacity Calculation

Required Cooling Capacity Calculation

Example 1: When the heat generation amount in the customer's machine 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 customer's machine.*



(1) Derive the heat generation amount from the power consumption.

Power consumption **P**: 1000 [W]

Q = P = 1000 [W]

Cooling capacity = Considering a safety factor of 20%,

1000 [W] x 1.2 = 1200 [W]

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

Power supply output **VI**: 1.0 [kVA]

Q = P = V x I x Power factor

In this example, using a power factor of 0.85:

= 1.0 [kVA] x 0.85 = 0.85 [kW] = 850 [W]

Cooling capacity = Considering a safety factor of 20%,

850 [W] x 1.2 = 1020 [W]

(3) Derive the heat generation amount from the output.

Output (shaft power, etc.) **W**: 800 [W]

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

In this example, use an efficiency of 0.7:

$$= \frac{800}{0.7} = 1143 \text{ [W]}$$

Cooling capacity = Considering a safety factor of 20%,

1143 [W] x 1.2 = 1372 [W]

* 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 customer's machine. Please be sure to check it carefully.

Example 2: When the heat generation amount in the customer's machine is not known.

Obtain the temperature difference between inlet and outlet by circulating the circulating fluid inside the customer's machine.

Heat generation amount by customer's machine **Q**	: Unknown [W] ([J/s])
Circulating fluid	: Clear water*
Circulating fluid mass flow rate q_m	: (= ρ x q_v ÷ 60) [kg/s]
Circulating fluid density ρ	: 1 [kg/dm^3]
Circulating fluid (volume) flow rate q_v	: 10 [dm^3/min]
Circulating fluid specific heat capacity **C**	: 4.2 x 10^3 [J/(kg·K)]
Circulating fluid outlet temperature T_1	: 293 [K] (20 [°C])
Circulating fluid return temperature T_2	: 295 [K] (22 [°C])
Circulating fluid temperature difference ΔT	: 2.0 [K] (= $T_2 - T_1$)
Conversion factor: minutes to seconds (SI units)	: 60 [s/min]

* Refer to page 89 for the typical physical property value of clear water or other circulating fluids.

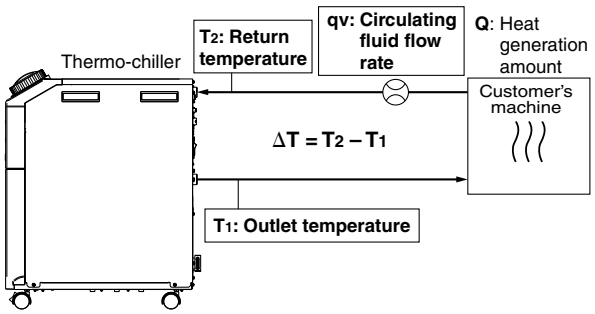
$$Q = q_m \times C \times (T_2 - T_1)$$

$$= \frac{\rho \times q_v \times C \times \Delta T}{60} = \frac{1 \times 10 \times 4.2 \times 10^3 \times 2.0}{60}$$

$$= 1400 \text{ [J/s]} \approx 1400 \text{ [W]}$$

Cooling capacity = Considering a safety factor of 20%,

1400 [W] x 1.2 = 1680 [W]



Example of conventional measurement units (Reference)

Heat generation amount by customer's machine **Q**	: Unknown [cal/h] → [W]
Circulating fluid	: Clear water*
Circulating fluid weight flow rate q_m	: (= ρ x q_v x 60) [kgf/h]
Circulating fluid weight volume ratio γ	: 1 [kgf/L]
Circulating fluid (volume) flow rate q_v	: 10 [L/min]
Circulating fluid specific heat capacity **C**	: 1.0 x 10^3 [cal/(kgf·°C)]
Circulating fluid outlet temperature T_1	: 20 [°C]
Circulating fluid return temperature T_2	: 22 [°C]
Circulating fluid temperature difference ΔT	: 2.0 [°C] (= $T_2 - T_1$)
Conversion factor: hours to minutes	: 60 [min/h]
Conversion factor: kcal/h to kW	: 860 [(cal/h)/W]

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

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

$$= \frac{1 \times 10 \times 60 \times 1.0 \times 10^3 \times 2.0}{860}$$

$$= \frac{1200000 \text{ [cal/h]}}{860}$$

$$\approx 1400 \text{ [W]}$$

Cooling capacity = Considering a safety factor of 20%,

1400 [W] x 1.2 = 1680 [W]

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** : 20 [dm^3]
Cooled substance specific heat capacity **C** : 4.2 x 10^3 [J/(kg·K)]
Cooled substance temperature when cooling begins T_0 : 305 [K] (32 [°C])
Cooled substance temperature after t hour T_t : 293 [K] (20 [°C])
Cooling temperature difference ΔT : 12 [K] (= $T_0 - T_t$)
Cooling time Δt : 900 [s] (= 15 [min])

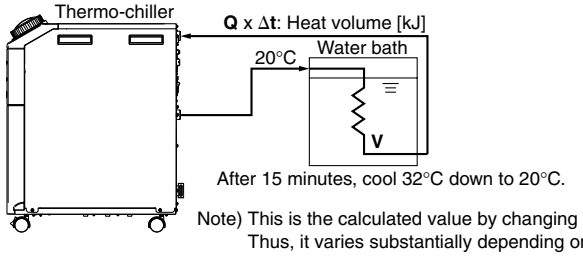
∗ Refer to the following for the typical physical property values by circulating fluid.

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

$$= \frac{1 \times 20 \times 4.2 \times 10^3 \times 12}{900} = 1120 \text{ [J/s]} \approx 1120 \text{ [W]}$$

Cooling capacity = Considering a safety factor of 20%,

1120 [W] x 1.2 = 1344 [W]



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

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** : 20 [L]
Cooled substance specific heat capacity **C** : 1.0 x 10^3 [cal/(kgf·°C)]
Cooled substance temperature when cooling begins T_0 : 32 [°C]
Cooled substance temperature after t hour T_t : 20 [°C]
Cooling temperature difference ΔT : 12 [°C] (= $T_0 - T_t$)
Cooling time Δt : 15 [min]
Conversion factor: hours to minutes : 60 [min/h]
Conversion factor: kcal/h to kW : 860 [(cal/h)/W]

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

$$= \frac{1 \times 20 \times 60 \times 1.0 \times 10^3 \times 12}{15 \times 860}$$

$$\approx 1120 \text{ [W]}$$

Cooling capacity = Considering a safety factor of 20%,

1120 [W] x 1.2 = 1344 [W]

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 customer's machine 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 a customer's machine, 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 customer's machine are fully durable against this pressure.

Circulating Fluid Typical Physical Property Values

1. This catalog uses the following values for density and specific heat capacity 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 capacity **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 capacity 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. Please contact circulating fluid supplier for details.

Series HRS
Specific Product Precautions 1

Be sure to read this before handling.
Refer to back page 1 for the Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Design

⚠ Warning

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

1) Confirm the specifications of the single unit (contents of this catalog) and thoroughly consider the adaptability between the customer'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 customer's operating condition. Also, the customer 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.

Selection

⚠ Warning

1. Model selection

For selecting a model of Thermo-chiller, it is required to know the heat generation amount of a customer's machine.
Obtain the heat generation amount, referring to "Cooling Capacity Calculation" on pages 88 and 89 before selecting a model.

Handling

⚠ Warning

1. 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 because it will lead to a breakdown.

1) Environment like written in "Temperature Control Equipment Precautions".
2) Locations where spatter will adhere to when welding.
3) Locations where it is likely that the leakage of flammable gas may occur.
4) Locations having a large quantity of dust.
5) A location in which water freezes.
If such a location is unavoidable, please contact SMC.

2. Install in an environment where the unit will not come into direct contact with rain or snow.

These models are for indoor use only.
Do not install outdoors where rain or snow may fall on them.

Operating Environment/Storage Environment

⚠ Warning

3. Conduct ventilation and cooling to discharge heat.
(Air-cooled refrigeration)

The heat which is cooled down through air-cooled condenser is discharged.
When using in a room which is shut tightly, ambient temperature will exceed the specification range stipulated in this catalog, which will activate the safety detector and stop the operation.
In order to avoid this situation, discharge the heat outside of a room by ventilation or cooling facilities.

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

Circulating Fluid

⚠ Caution

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

2. When using clear water as a circulating fluid, use water that conforms to the appropriate water quality standards.

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

Clear 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
Standard item	pH (at 25°C)	—	6.8 to 8.0
	Electrical 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.

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

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. A magnet pump is used as a circulating pump for circulating fluid.

It is particularly impossible to use liquid including metallic powder such as iron powder.

Series HRS
Specific Product Precautions 2

Be sure to read this before handling.
Refer to back page 1 for the Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Facility Water Supply

⚠ Warning

(Water-cooled refrigeration)

1. Supply pressure of 0.5 MPa or less.
If the supply pressure is high, it will cause water leakage.

2. Be sure to prepare your utilities so that the pressure of the Thermo-chiller facility water outlet is at 0 MPa (atmospheric pressure) or more.
If the facility water outlet pressure becomes negative, the internal facility water piping may collapse, and proper flow control of facility water will be impossible.

Operation

⚠ Warning

1. Confirmation before operation

1) The fluid level of a tank should be within the specified range of "HIGH" and "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 a 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.

2. Confirmation during operation

• Check the circulating fluid temperature.
The operating temperature range of the circulating fluid is between 5 and 40°C.
When the amount of heat generated from a customer's machine 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 pushing the [OFF] switch, be sure to turn off the power switch.

Operation Restart Time

⚠ 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.

Protection Circuit

⚠ Caution

1. 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 a customer's machine is too high.
• Ambient temperature is too high. (40°C or higher)
• Refrigerant pressure is too high.
• Ventilation hole is clogged with dust or dirt.

Maintenance

⚠ Caution

<Periodical inspection every one month>

1. Clean the ventilation hole

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

<Periodical inspection every three months>

1. Inspect the circulating fluid.

1) When using clear water
• Failure to replace the clear water can lead to the development of bacteria or algae. Replace it regularly depending on your usage conditions.
• Tank cleaning
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 freezing when the product is stopped, release the circulating fluid in advance.

2. Consult a professional.

For additional methods to prevent freezing (such as commercially available tape heaters, etc.), consult a professional for advice.

Refrigerated Thermo-chiller *Series HRZ*

- **Type of circulating fluid:** Fluorinated fluids/Ethylene glycol aqueous solution/ Clear water, Deionized water
- **Temperature range setting:** **–20** to **40**°C/**20** to **90**°C/**–20** to **90**°C
- **Cooling capacity:** **1** kW/**2** kW/**4** kW/**8** kW/**10** kW to Max.**15** kW
- **Temperature stability:** ±**0.1**°C
- **Refrigerant:** **R404A** (HFC)/**R134a** (HFC)

More effective energy-saving is achieved through use of a DC inverter compressor and an inverter pump.

Inverter type
Power consumption
1.1 kWh/h
Facility water
2 L/min

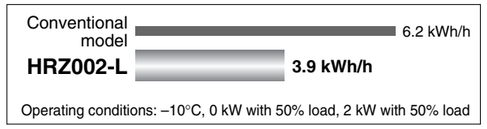
● **International standards:** CE cULus® SEMATECH S2-93, S8-95 SEMI Standard S2-0703, S8-0701, F47-0200

Energy-Saving

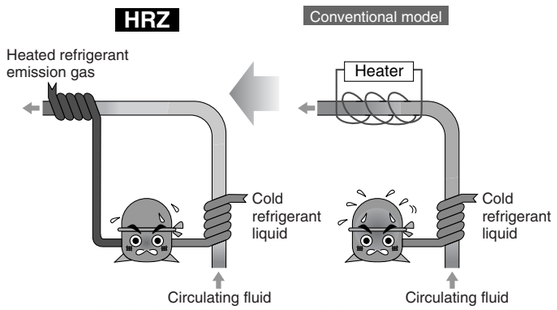
Power consumption:

Max. 40% reduction (SMC comparison)

In addition to the optimum control of the expansion valve by the original controller, by recycling the heat emitted from the facility water, power consumption is dramatically reduced.



- Reduced running cost
- Contribution to the environmental preservation

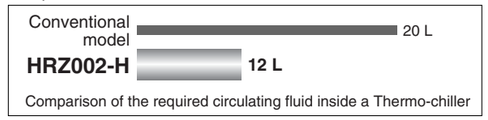


* This illustration is for an image only. For piping systems, refer to "Construction and Principles" on page 98.

Circulating fluid:

Max. 40% reduction (SMC comparison)

Enhanced temperature control technology and the dual tank construction achieved the reduced circulating fluid required for operation.

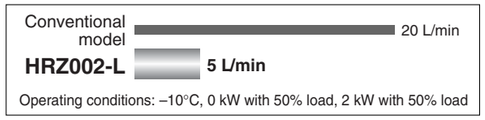


- Reduced initial cost
- Contribution to the environmental preservation

Facility water:

Max. 75% reduction (SMC comparison)

Enhanced performance of a heat exchanger, recycle use of the emitted heat and the reduced power consumption achieved the reduced facility water amount.



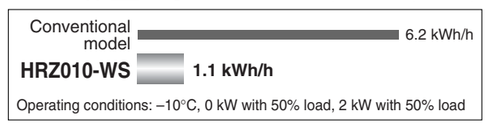
- Reduced facilities investment
- Space saved facility water equipment
- Reduced running cost

Double Inverter Type

More effective energy-saving is achieved through use of a DC inverter compressor and an inverter pump.

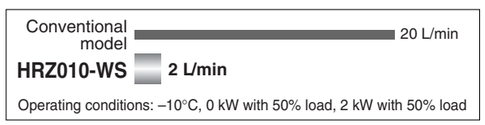
Power consumption:

Max. 82% reduction (SMC comparison)



Facility water:

Max. 90% reduction (SMC comparison)

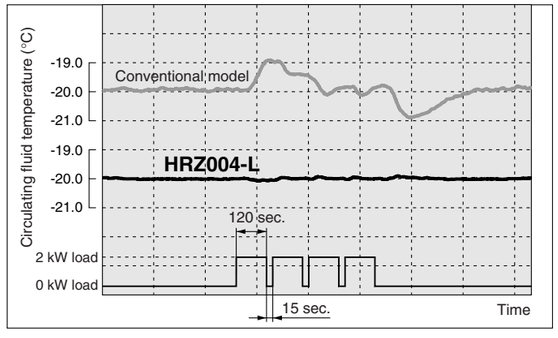


High Performance

Temperature stability: ±0.1°C

(when a load is stable)

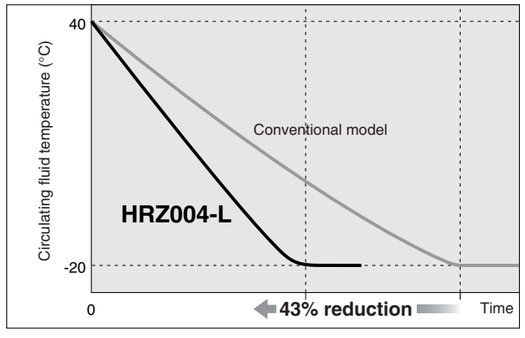
Enhanced temperature control technology achieved ±0.1°C temperature stabilities when a load is stable.



Cooling time: Max. 43% reduction

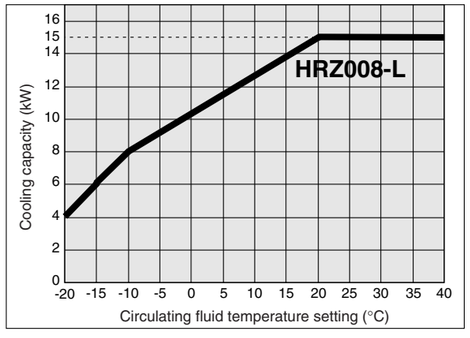
(SMC comparison)

Special temperature control technology achieved the utmost performance, resulting in the reduced cooling time.



Cooling capacity: Max. 15 kW

Up to 15 kW cooling capacity achieved.



SMC

Space-Saving

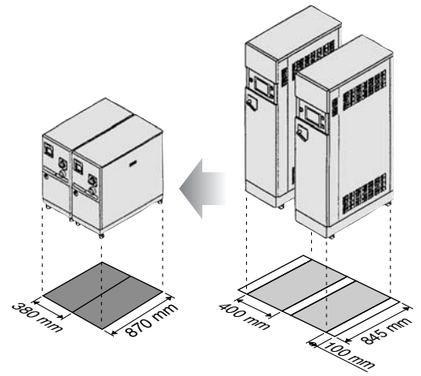
Installation area:

Max. 29% reduction (SMC comparison)

By emitting the heat from the rear side, ventilation slits on the side are unnecessary offering reduced installation space.

Conventional model: Body space: W400 mm x D845 mm
Ventilation space: 100 mm

HRZ008-H: Body space: W380 mm x D870 mm
Ventilation space: 0

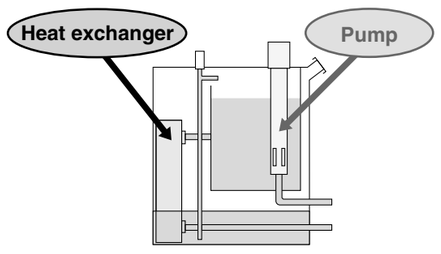


HRZ008-H 0.66 m² Conventional model 0.93 m²

Leakless

All in tank

Housing the pump or heat exchanger inside the tank has eliminated any external leakage of the circulating fluid.



Communications

- Contact input/output signal
- Serial RS-485 communication
- Analog communication (Refer to "Options" on page 122.)
- DeviceNet communication (Refer to "Options" on page 122.)

DeviceNet™

Wetted parts adopt the materials compatible for various circulating fluids.

(Stainless steel, EPDM, etc.)

- Fluorinated fluids: **Flourinert™ FC-3283, FC-40**
  GALDEN® HT135, HT200
- 60% ethylene glycol aqueous solution
- Deionized water/Clear water

Regarding the fluid other than the above, please contact SMC.
Flourinert™ is a trademark of 3M. GALDEN® is a registered trademark of Solvay Solexis, Inc.

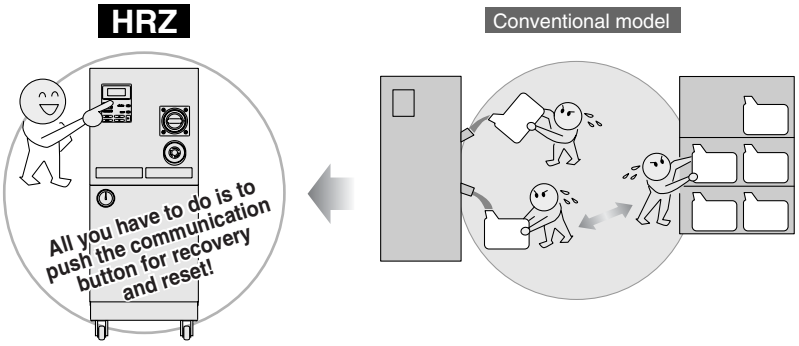
SMC

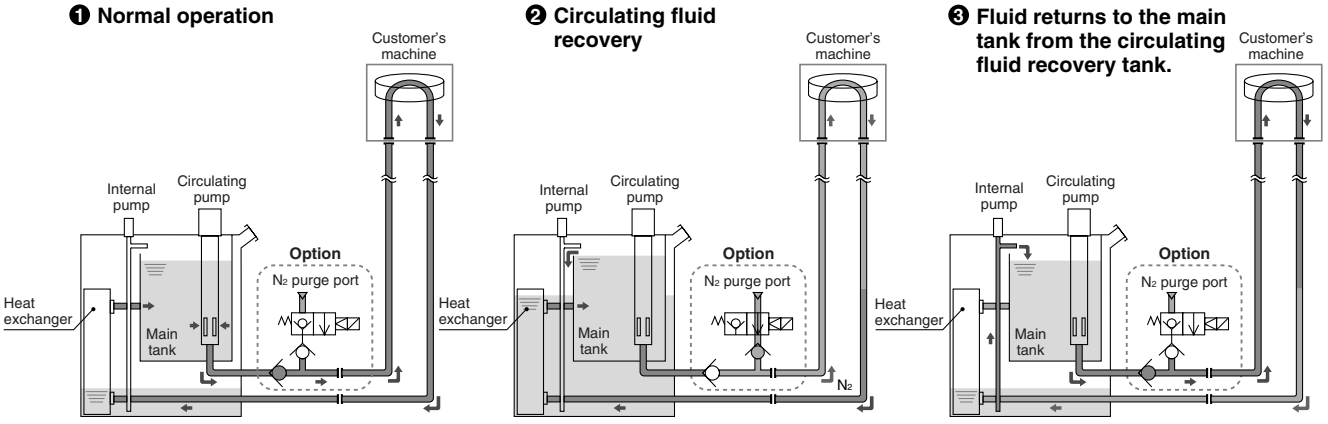
Easy Maintenance

Circulating fluid automatic recovery function (Refer to “Options” on page 123.)

Circulating fluid inside a Thermo-chiller tank can be recovered automatically. (Recovery volume: 15 L to 17 L)

- Reduced maintenance time
- Faster operation
- Reduced circulating liquid loss by evapolation or spill



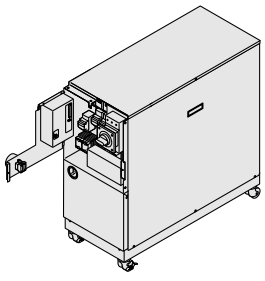


Circulating fluid electrical resistance ratio control function (Refer to “Options” on page 122.)

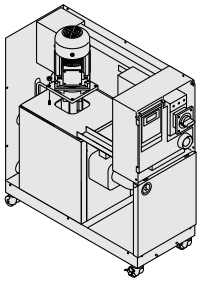
(DI control kit)

Easy maintenance

- Checking the electrical component parts accessible from the front side only



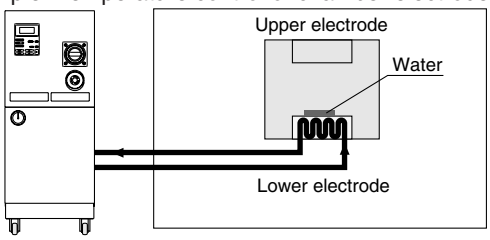
- Possible to replace the maintenance parts (such as a pump) without removing the pipings and discharging the circulating fluid.
- Various alarm displays (Refer to page 118.)



Application Examples

Semiconductor

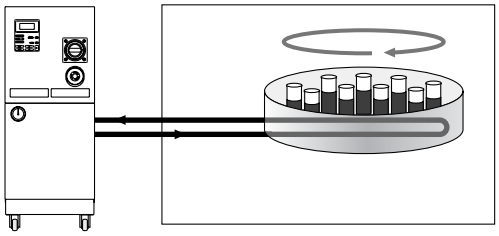
Example: Temperature control of chamber electrode



- **Etching equipment**
- **Spatter equipment**
- **Cleaning equipment**
- **Coating equipment**
- **Dicing equipment**
- **Tester, etc.**

Medical

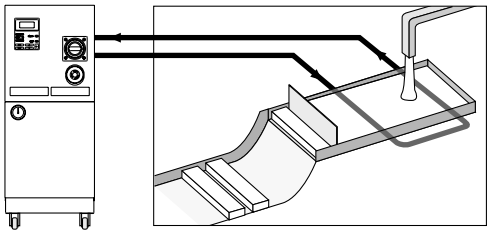
Example: Blood preservation



- **X-ray instrument**
- **MRI**
- **Blood preservation equipment**

Food

Example: Tofu (Bean curd) production

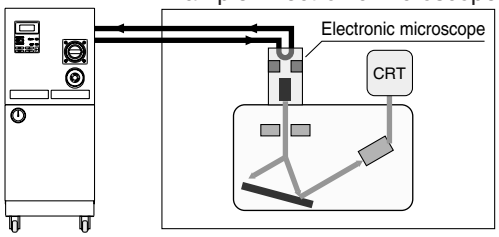


- **Bottle-cleaning machine**
- **Tofu (Bean curd) production equipment**
- **Noodle-making machine, etc.**

Water temperature control for forming tofu by mixing the boiled soybean milk and bittern

Analysis

Example: Electronic microscope

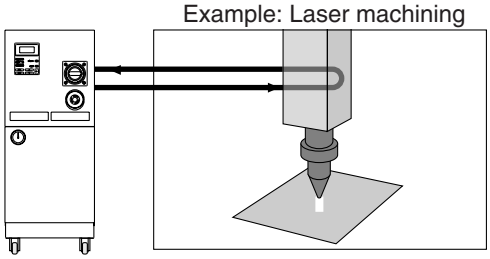


- **Electron microscope**
- **X-ray analytical instrument**
- **Gas chromatography**
- **Sugar level analytical instrument, etc.**

Prevents the distortion caused by the heat generated by the electronic gun in an electronic microscope.

Machine tool

Example: Laser machining

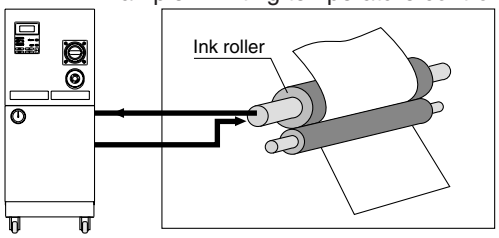


- **Wire cutting**
- **Grinder**
- **Spot welding**
- **Plasma welding**
- **Laser machining, etc.**

Temperature-controlling the laser generating tube enables the laser wavelength to be optimised, improving the accuracy of the machined cross sectional area.

Printing

Example: Printing temperature control

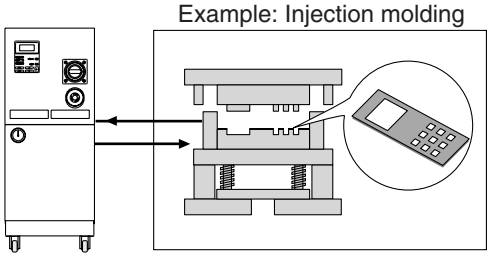


- **Offset printing machine**
- **Automatic developing machine**
- **UV equipment, etc.**

Temperature-controlling the ink roller enables to control the evaporation amount and viscosity of an ink and optimise the tint of colors.

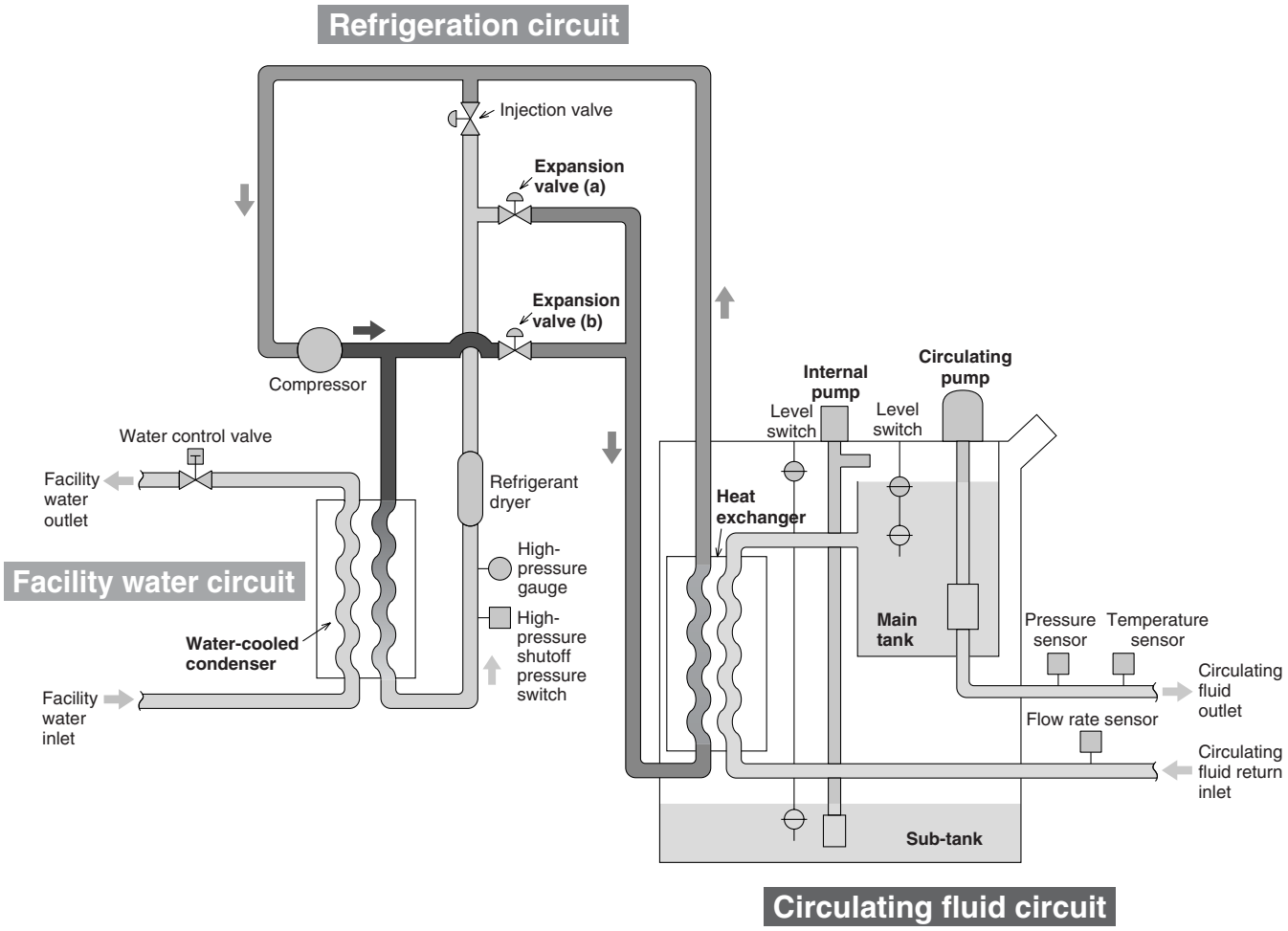
Molding

Example: Injection molding



- **Plastic molding**
- **Rubber molding**
- **Wire cable coating machine**
- **Injection molding, etc.**

Temperature-controlling the mold results in improved product quality.



Circulating fluid circuit

With the **circulating pump**, circulating fluid will be discharged to the customer's machine side. After the circulating fluid will heat or cool the customer's machine side, it will be returned to the **main tank** via the **heat exchanger**.
A **sub-tank** is not used under the normal operation. It will be used when a circulating fluid is recovered from the customer's machine side.
The **internal pump** is used to transfer a circulating fluid from the **sub-tank** to the **main tank**. (Refer to "Circulating fluid automatic recovery" function on page 96.

Refrigeration circuit

When the circulating fluid temperature is rising higher than the set temperature, open the **expansion valve (a)** to introduce refrigerant gas at a lower temperature to the **heat exchanger**. With this, the circulating fluid will be cooled down.
Oppositely, when the circulating fluid is getting lower against the set temperature, open the **expansion valve (b)** and introduce refrigerant gas at a high temperature without going through the **water-cooled condenser** to the **heat exchanger**. With this heat, the circulating fluid will be heated.

CONTENTS

Series HRZ

Series HRZ
Model Selection

Guide to Model Selection

1. How much is the temperature in degrees centigrade for the circulating fluid?

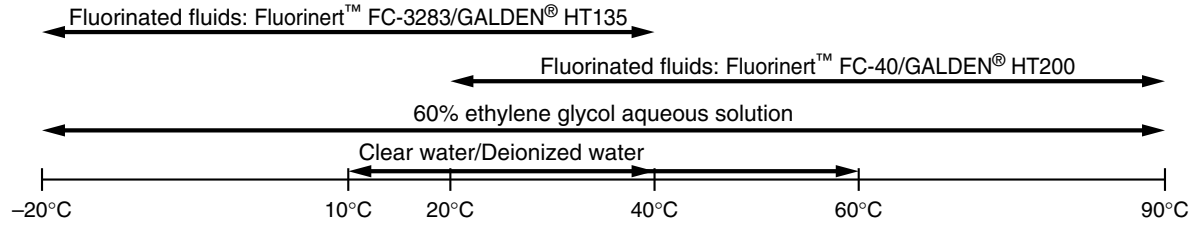
Temperature range which can be set with the Thermo-chiller

L : –20°C to 40°C (“L2” (clear water, deionized water specification) can be set 10°C to 40°C.)
H : 20°C to 90°C
W: –20°C to 90°C (Select “W” only when the temperature ranges of “L” or “H” are not applicable. HRZ010-W2S (clear water, deionized water specification) can be set 10°C to 60°C.)

Example) Customer requirement: 50°C (→ Temperature range 20°C to 90°C, “H” type will be appropriate.)

2. What kind of the circulating fluids will be used?

Relationship between circulating fluid (which can be used with the Thermo-chiller) and temperature



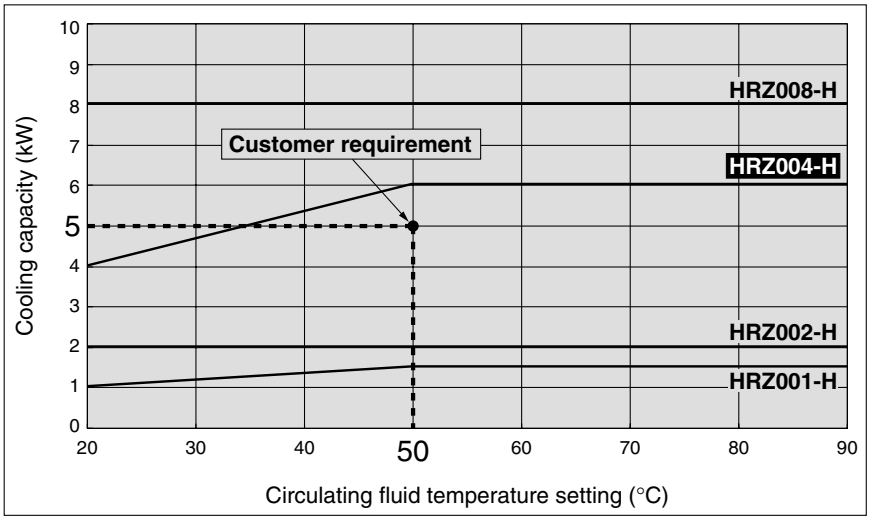
Example) Customer requirement: Fluorinated fluids

Based on the results 1. and 2., Cooling capacity relating “Fluorinated fluids” and “Temperature range 20°C to 90°C” is shown on page 105.

3. What is the kW for the required cooling capacity?
∗ To calculate the cooling capacity, referring to the following pages.

Example) Customer requirement: 5 kW → **Plot the point of intersection between the operating temperature (50°C) and the cooling capacity (5 kW) in the cooling capacity graph.**

[Cooling Capacity Graph] Circulating Fluid: Fluorinated Fluids, Temperature Range: 20 to 90°C



The point plotted in the graph is the requirement from your customer. Select the Thermo-chiller models exceeding this point. In this case, select the **HRZ004-H**.

Required Cooling Capacity Calculation

Example 1: When the heat generation amount in the customer's machine is known.

Heat generation amount Q: 3.5 kW

Cooling capacity = Considering a safety factor of 20%, **3.5 x 1.2 = 4.2 kW**

Example 2: When the heat generation amount in the customer's machine is not known.

Obtain the temperature difference between inlet and outlet by circulating the circulating fluid inside the customer's machine.

Heat generation amount **Q**	: Unknown
Circulating fluid temperature difference Δ**T** (= **T2** – **T1**)	: 6.0°C (6.0 K)
Circulating fluid outlet temperature **T1**	: 20°C (293.15 K)
Circulating fluid return temperature **T2**	: 26°C (299.15 K)
Circulating fluid flow rate **L**	: 20 L/min
Circulating fluid	: Fluorinated fluid
	Density γ: 1.80 x 10^3 kg/m^3
	Specific heat **C**: 0.96 x 10^3 J/(kg•K) (at 20°C)

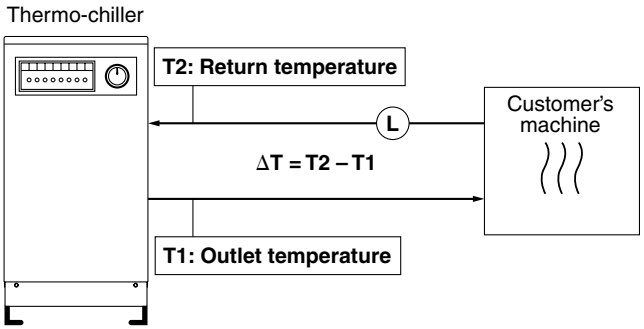
∗ Refer to page 103 for the typical physical property values by circulating fluid.

$$Q = \frac{\Delta T \times L \times \gamma \times C}{60 \times 1000}$$

$$= \frac{6.0 \times 20 \times 1.80 \times 10^3 \times 0.96 \times 10^3}{60 \times 1000}$$

= 3456 W = 3.5 kW

Cooling capacity = Considering a safety factor of 20%,
3.5 x 1.2 = 4.2 kW



Example of conventional measurement units (Reference)

Unknown
6.0°C
20°C
26°C
1.2 m^3/h
Fluorinated fluid
Density γ: 1.80 x 10^3 kg/m^3
Specific heat **C**: 0.23 kcal/kg•°C (at 20°C)

∗ Refer to page 103 for the typical physical property values by circulating fluid.

$$Q = \frac{\Delta T \times L \times \gamma \times C}{860}$$

$$= \frac{6.0 \times 1.2 \times 1.80 \times 10^3 \times 0.23}{860}$$

= 3.5 kW

Cooling capacity = Considering a safety factor of 20%,
3.5 x 1.2 = 4.2 kW

Model Selection

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.

Cooled substance total volume **V** : 60 L
Cooling time **h** : 15 min
Cooling temperature difference Δ**T**: {20°C (20 K) / (40°C – 20°C → 20°C)
Circulating fluid : Fluorinated fluid
Density γ: 1.80 x 10^3 kg/m^3
Specific heat **C**: 0.96 x 10^3 J/(kg•K) (at 20°C)

∗ Refer to page 103 for the typical physical property values by circulating fluid.

$$\mathbf{Q = \frac{\Delta T \times V \times \gamma \times C}{h \times 60 \times 1000}}$$

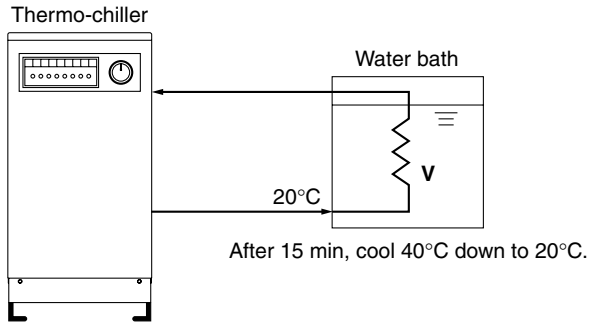
$$\mathbf{= \frac{20 \times 60 \times 1.80 \times 10^3 \times 0.96 \times 10^3}{15 \times 60 \times 1000}}$$

= 2304 W = 2.3 kW

Cooling capacity = Considering a safety factor of 20%,

2.3 x 1.2 = 2.8 kW (When the circulating fluid temperature is 20°C.)

(In this case, selected Thermo-chiller model will be either HRZ002-L or HRZ004-H.)



After 15 min, cool 40°C down to 20°C.

Example of conventional measurement units (Reference)

0.06 m^3
0.25 h
20°C
Fluorinated fluid
Density γ: 1.80 x 10^3 kg/m^3
Specific heat **C**: 0.23 kcal/kg•°C (at 20°C)

∗ Refer to page 103 for the typical physical property values by circulating fluid.

$$\mathbf{Q = \frac{\Delta T \times V \times \gamma \times C}{h \times 860}}$$

$$\mathbf{= \frac{20 \times 0.06 \times 1.80 \times 10^3 \times 0.23}{0.25 \times 860}}$$

= 2.3 kW

Cooling capacity = Considering a safety factor of 20%,

2.3 x 1.2 = 2.8 kW (When the circulating fluid temperature is 20°C.)

(In this case, selected Thermo-chiller model will be either HRZ002-L or HRZ004-H.)

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

Precautions on Model Selection

1. Heating capacity

When setting the circulating fluid temperature at a higher temperature than the room temperature, the circulating fluid temperature will be heated with the Thermo-chiller. Heating capacity varies depending on the model of the HRZ series. Also, the heating capacity varies depending on the circulating fluid temperature. Consider the heat radiation amount or thermal capacity of the customer's machine. Check beforehand if the required heating capacity is provided, based on the heating capacity graph for the respective model.

2. Pump capacity

<Circulating fluid flow rate>

Pump capacity varies depending on the model selected from the HRZ series. Also, circulating fluid flow varies depending on the circulating fluid discharge pressure. Consider the installation height difference between our Thermo-chiller and a customer's machine, 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 for each respective model.

<Circulating fluid discharge pressure>

Circulating fluid discharge pressure has the possibility to increase up to the maximum pressure in the pump capacity curves for the respective model. Check beforehand if the circulating fluid pipings or circulating fluid circuit of the customer's machine are fully durable against this pressure.

Circulating Fluid Typical Physical Property Values

∗ The above shown are reference values.
Please contact circulating fluid supplier for details.

Fluorinated Fluids

Physical property value / Temperature	Density γ	Specific heat C	
	[kg/m^3] [g/L]	[J/(kg•K)]	([kcal/kg•°C])
–10°C	1.87 x 10^3	0.87 x 10^3	(0.21)
20°C	1.80 x 10^3	0.96 x 10^3	(0.23)
50°C	1.74 x 10^3	1.05 x 10^3	(0.25)
80°C	1.67 x 10^3	1.14 x 10^3	(0.27)

60% Ethylene Glycol Aqueous Solution

Physical property value / Temperature	Density γ	Specific heat C	
	[kg/m^3] [g/L]	[J/(kg•K)]	([kcal/kg•°C])
–10°C	1.10 x 10^3	3.02 x 10^3	(0.72)
20°C	1.08 x 10^3	3.15 x 10^3	(0.75)
50°C	1.06 x 10^3	3.27 x 10^3	(0.78)
80°C	1.04 x 10^3	3.40 x 10^3	(0.81)

Water

Density γ: 1 x 10^3 [kg/m^3] [g/L] **Specific heat C: 4.2 x 10^3 [J/(kg•K)] (1.0 [kcal/kg•°C])**

Thermo-chiller Fluorinated Fluid Type

Series HRZ

SEMI

How to Order

Fluorinated Fluid Type **HRZ 001 – L – □**

Cooling capacity

Symbol	Cooling capacity
001	1 kW
002	2 kW
004	4 kW
008	8 kW

Temperature range setting

Symbol	Temperature range setting	1 kW	2 kW	4 kW	8 kW
L	–20 to 40°C	●	●	●	●
H	20 to 90°C	●	●	●	●
W	–20 to 90°C	—	●	—	●

Option (Refer to pages 122 and 123.)

Nil	None
C	Analog communication
D	DeviceNet communication
N	NPT fitting
Z	Circulating fluid automatic recovery

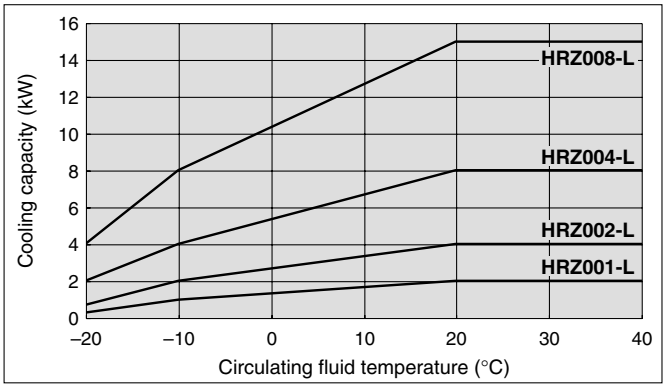
Specifications (For details, please consult our "Product Specifications" information.)

	Model	HRZ001-L	HRZ002-L	HRZ004-L	HRZ008-L	HRZ001-H	HRZ002-H	HRZ004-H	HRZ008-H	HRZ002-W	HRZ008-W
Cooling method		Water-cooled refrigeration									
Refrigerant		R404A (HFC)									
Control system		PID control									
Ambient temp./humidity Note 1)		Temperature: 10 to 35°C, Humidity: 30 to 70%RH									
Circulating fluid system	**Circulating fluid** Note 2)	Fluorinert™ FC-3283/GALDEN® HT135				Fluorinert™ FC-40/GALDEN® HT200				• –20 to 40°C: Fluorinert™ FC-3283/GALDEN® HT135 • 20 to 90°C: Fluorinert™ FC-40/GALDEN® HT200	
	Temp. range setting Note 1) **(°C)**	–20 to 40				20 to 90				–20 to 90	
	Cooling capacity Note 3) **(kW)**	1.0 (at –10°C)	2.0 (at –10°C)	4.0 (at –10°C)	8.0 (at –10°C)	1.0 (at 20°C)	2.0 (at 20°C)	4.0 (at 20°C)	8.0 (at 20°C)	2.0 (at 20°C)	8.0 (at 20°C)
	Heating capacity Note 3) **(kW)**	2.8 (at –10°C)	3.2 (at –10°C)	3.6 (at –10°C)	5.9 (at –10°C)	2.3 (at 20°C)	2.6 (at 20°C)	2.8 (at 20°C)	3.0 (at 20°C)	2.3 (at 20°C)	3.3 (at 20°C)
	Temp. stability Note 4) **(°C)**	±0.1									
	Pump capacity Note 5) **(50/60 Hz) (MPa)**	0.45/0.65 (at 20 L/min)			0.65/0.95 (at 30 L/min)	0.40/0.60 (at 20 L/min)	0.45/0.65 (at 20 L/min)				
	Rated flow Note 6) **(L/min)**	20			30	20					
	Main tank capacity Note 7) **(L)**	Approx. 15			Approx. 22	Approx. 12	Approx. 15				
	Sub-tank capacity Note 8) **(L)**	Approx. 16			Approx. 17	Approx. 15	Approx. 16				
	Port size	Rc3/4									
	Wetted parts material	Stainless steel, EPDM, Copper brazing (Heat exchanger), PPS, Silicone, Fluororesin									
Cooling water system	**Temperature range (°C)**	10 to 25									
	Pressure range (MPa)	0.3 to 0.7									
	Required flow rate Note 9) **(50/60 Hz) (L/min)**	5/5	6/6	15/22	18/23	3/4	5/6	9/10	13/14	6/7	13/14
	Port size	Rc1/2									
	Wetted parts material	Stainless steel, EPDM, Copper brazing (Heat exchanger), Silicone, Brass									
Electrical system	**Power supply**	3-phase 200 VAC 50 Hz, 3-phase 200 to 208 VAC 60 Hz Allowable voltage fluctuation ±10%									
	Breaker capacity (A)	30			60	20		30			
	Rated current (A)	20		25	46	14		23			
	Alarm	Refer to page 118.									
	Communications	Contact input/output (D-sub 25 pin) and Serial RS-485 (D-sub 9 pin) (Refer to pages 116 and 117.)									
Weight Note 10) **(kg)**		170		175	275	145		170			
Safety standards		UL, CE marking, SEMI (S2-0703, S8-0701, F47-0200), SEMATECH (S2-93, S8-95)									

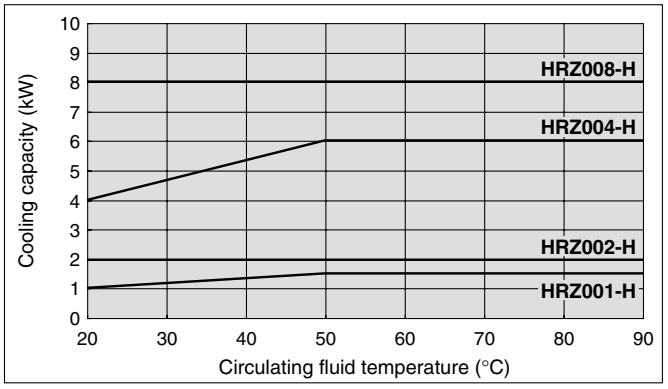
Note 1) It should have no condensation.
Note 2) Fluorinert™ is a trademark of 3M and GALDEN® is a registered trademark of Solvay Solexis, Inc. Regarding the fluid other than the above, please contact SMC.
Note 3) ① Facility water temperature: 25°C, ② Circulating fluid flow rate: Values at rated circulating fluid flow rate. Values common for 50/60 Hz.
Note 4) Value with a stable load without turbulence in the operating conditions. It may be out of this range depending on operating conditions.
Note 5) The capacity at the Thermo-chiller outlet when the circulating fluid temperature is 20°C.
Note 6) Required flow rate for cooling capacity or maintaining the temperature stability. When used below the rated flow, use the individually sold, "By-pass Piping Set" (Refer to page 119).
Note 7) Minimum volume required for operating only the Thermo-chiller. (Circulating fluid temperature: 20°C, including the Thermo-chiller's internal pipings or heat exchanger)
Note 8) Preliminary space volume without main tank capacity. Available for collecting the circulating fluid inside an external piping or for preliminary injection.
Note 9) Required flow rate when a load for the cooling capacity is applied at a facility water temperature of 25°C.
Note 10) Weight in the dry state without circulating fluids

Cooling Capacity

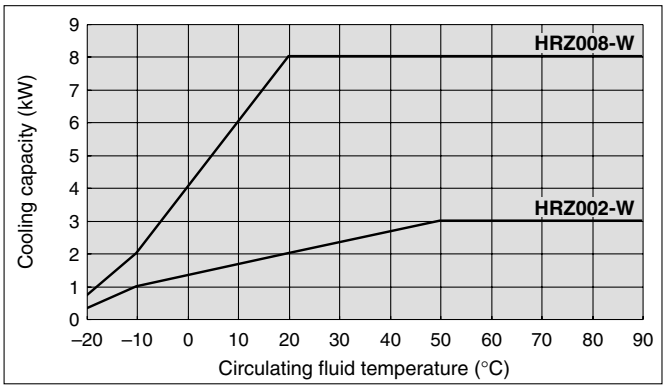
HRZ001-L/002-L/004-L/008-L



HRZ001-H/002-H/004-H/008-H

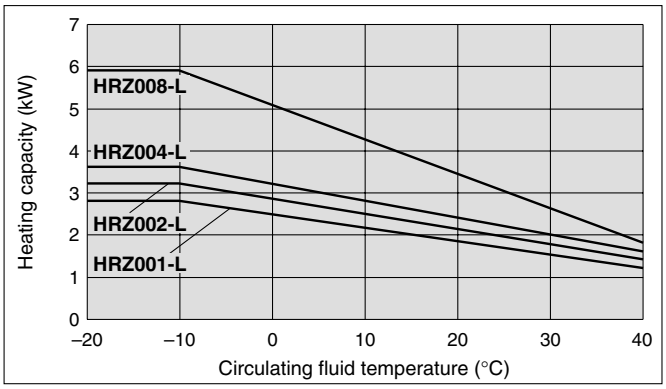


HRZ002-W/008-W

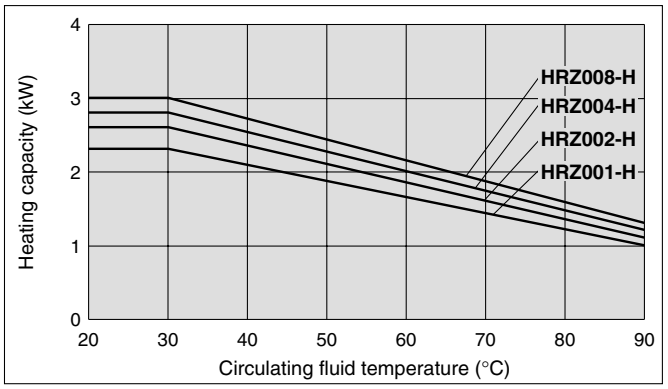


Heating Capacity

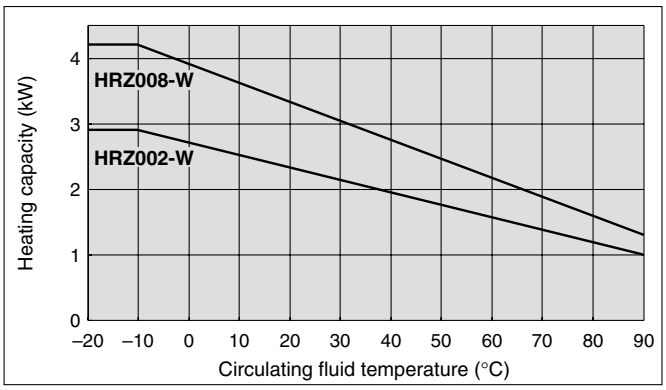
HRZ001-L/002-L/004-L/008-L



HRZ001-H/002-H/004-H/008-H

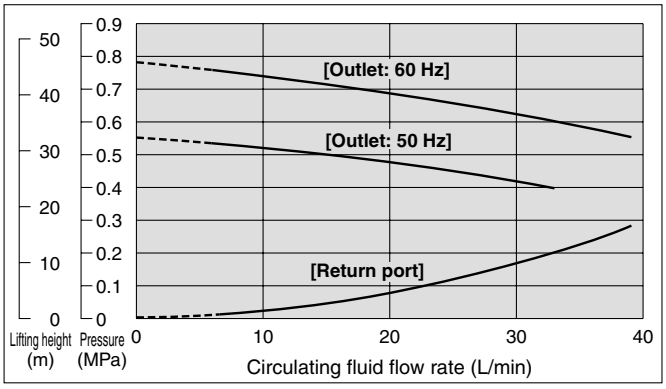


HRZ002-W/008-W

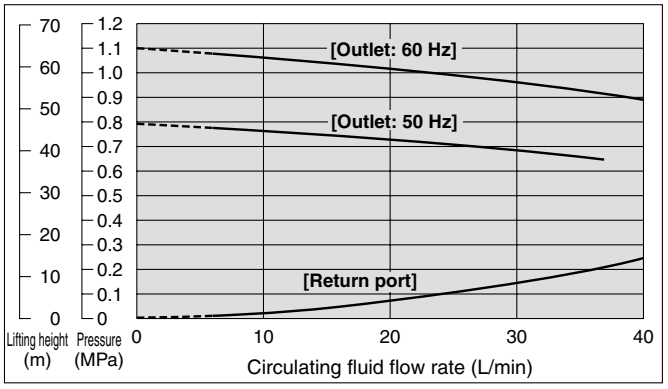


Pump Capacity (Thermo-chiller Outlet)

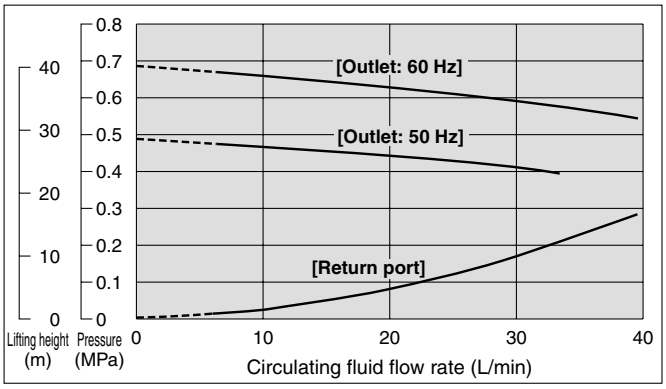
HRZ001-L/002-L/004-L



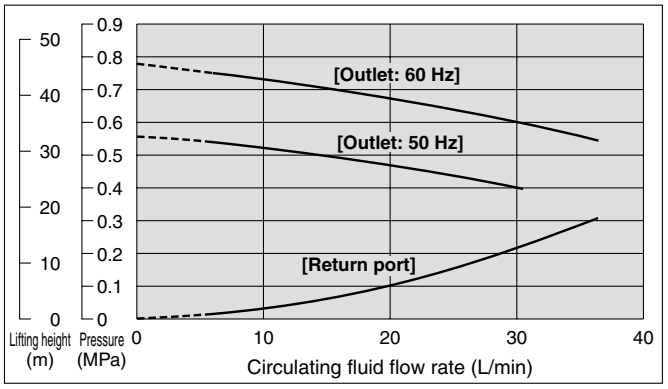
HRZ008-L



HRZ001-H/002-H



HRZ004-H/008-H
HRZ002-W/008-W



∗ When the circulating fluid flow is below 6 L/min, the in-built operation stop alarm will be activated. It is not possible to run the equipment. (common for all models)

Thermo-chiller Ethylene Glycol Type
Series HRZ

SEMI

How to Order

Ethylene Glycol Type **HRZ 001 – L 1 –**

Cooling capacity

Symbol	Cooling capacity
001	1 kW
002	2 kW
004	4 kW
008	8 kW

Temperature range setting

Symbol	Temperature range setting	1 kW	2 kW	4 kW	8 kW
L	–20 to 40°C	●	●	●	●
H	20 to 90°C	●	●	●	●
W	–20 to 90°C	—	●	—	●

Ethylene glycol type

Option (Refer to pages 122 and 123.)

Nil	None
C	Analog communication
D	DeviceNet communication
N	NPT fitting
Y	DI control kit
Z	Circulating fluid automatic recovery

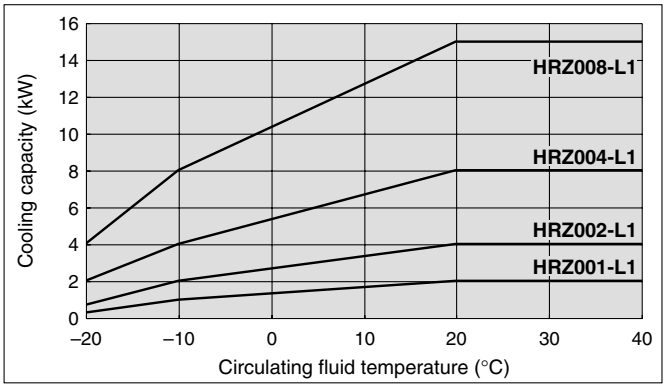
Specifications (For details, please consult our "Product Specifications" information.)

Model		HRZ001-L1	HRZ002-L1	HRZ004-L1	HRZ008-L1	HRZ001-H1	HRZ002-H1	HRZ004-H1	HRZ008-H1	HRZ002-W1	HRZ008-W1
Cooling method		Water-cooled refrigeration									
Refrigerant		R404A (HFC)									
Control system		PID control									
Ambient temp./humidity Note 1)		Temperature: 10 to 35°C, Humidity: 30 to 70%RH									
Circulating fluid system	**Circulating fluid** Note 2)	60% ethylene glycol aqueous solution									
	Temp. range setting Note 1) **(°C)**	–20 to 40				20 to 90				–20 to 90	
	Cooling capacity Note 3) **(kW)**	1.0 (at –10°C)	2.0 (at –10°C)	4.0 (at –10°C)	8.0 (at –10°C)	1.0 (at 20°C)	2.0 (at 20°C)	4.0 (at 20°C)	8.0 (at 20°C)	2.0 (at 20°C)	8.0 (at 20°C)
	Heating capacity Note 3) **(kW)**	2.5 (at –10°C)	2.9 (at –10°C)	3.4 (at –10°C)	6.1 (at –10°C)	1.8 (at 20°C)	2.1 (at 20°C)	2.5 (at 20°C)	3.0 (at 20°C)	2.2 (at 20°C)	3.3 (at 20°C)
	Temp. stability Note 4) **(°C)**	±0.1									
	Pump capacity Note 5) **(50/60 Hz) (MPa)**	0.25/0.40 (at 20 L/min)				0.25/0.35 (at 20 L/min)		0.25/0.40 (at 20 L/min)			
	Rated flow Note 6) **(L/min)**	20									
	Main tank capacity Note 7) **(L)**	Approx. 15			Approx. 22	Approx. 12		Approx. 15			
	Sub-tank capacity Note 8) **(L)**	Approx. 16			Approx. 17	Approx. 15		Approx. 16			
	Port size	Rc3/4									
	Wetted parts material	Stainless steel, EPDM, Copper brazing (Heat exchanger), PPS, Silicone, Fluororesin									
Cooling water system	**Temperature range (°C)**	10 to 25									
	Pressure range (MPa)	0.3 to 0.7									
	Required flow rate Note 9) **(50/60 Hz) (L/min)**	5/5	6/6	15/22	18/23	3/4	5/6	9/10	13/14	5/7	13/14
	Port size	Rc1/2									
	Wetted parts material	Stainless steel, EPDM, Copper brazing (Heat exchanger), Silicone, Brass									
Electrical system	**Power supply**	3-phase 200 VAC 50 Hz, 3-phase 200 to 208 VAC 60 Hz Allowable voltage fluctuation ±10%									
	Breaker capacity (A)	30			60	20		30			
	Rated current (A)	19		26	46	14		23			
	Alarm	Refer to page 118.									
	Communications	Contact input/output (D-sub 25 pin) and Serial RS-485 (D-sub 9 pin) (Refer to pages 116 and 117.)									
Weight Note 10) **(kg)**		170		175	275	145		170			
Safety standards		UL, CE marking, SEMI (S2-0703, S8-0701, F47-0200), SEMATECH (S2-93, S8-95)									

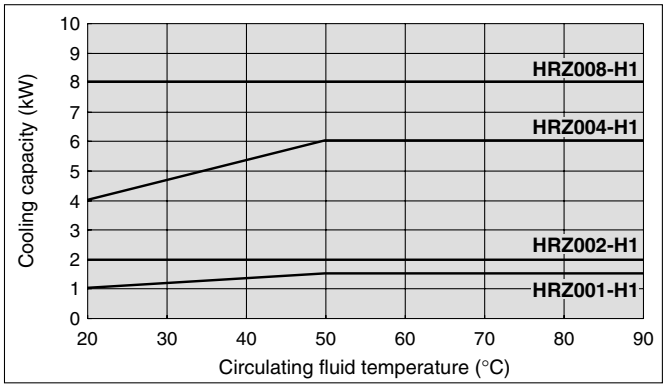
Note 1) It should have no condensation.
Note 2) Dilute pure ethylene glycol with clear water. Additives such as preservatives cannot be used.
Note 3) ① Facility water temperature: 25°C, ② Circulating fluid flow rate: Values at rated circulating fluid flow rate. Values common for 50/60 Hz.
Note 4) Value with a stable load without turbulence in the operating conditions. It may be out of this range when a DI control kit (option Y) is used or in some other operating conditions.
Note 5) The capacity at the Thermo-chiller outlet when the circulating temperature is 20°C.
Note 6) Required flow rate for cooling capacity or maintaining the temperature stability. When used below the rated flow, use the individually sold, "By-pass Piping Set" (Refer to page 119).
Note 7) Minimum volume required for operating only the Thermo-chiller. (Circulating fluid temperature: 20°C, including the Thermo-chiller's internal pipings or heat exchanger)
Note 8) Preliminary space volume without main tank capacity. Available for collecting the circulating fluid inside an external piping or for preliminary injection.
Note 9) Required flow rate when a load for the cooling capacity is applied at a facility water temperature of 25°C.
Note 10) Weight in the dry state without circulating fluids

Cooling Capacity

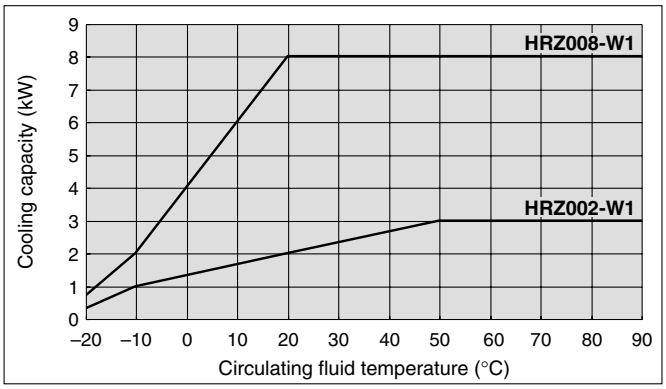
HRZ001-L1/002-L1/004-L1/008-L1



HRZ001-H1/002-H1/004-H1/008-H1

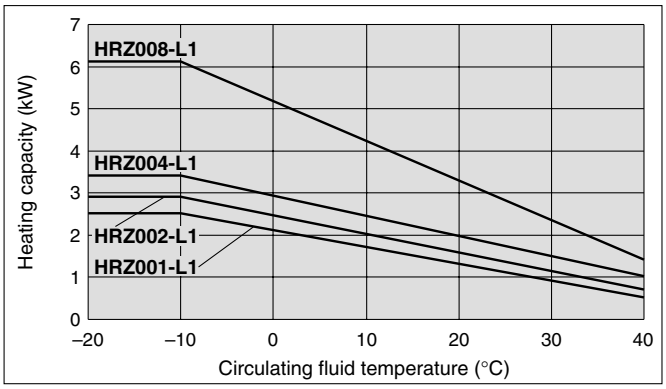


HRZ002-W1/008-W1

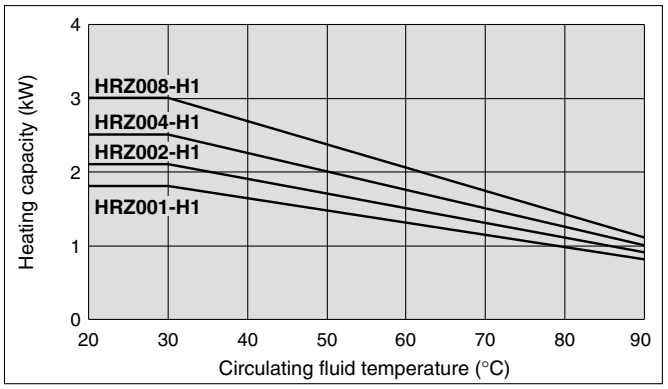


Heating Capacity

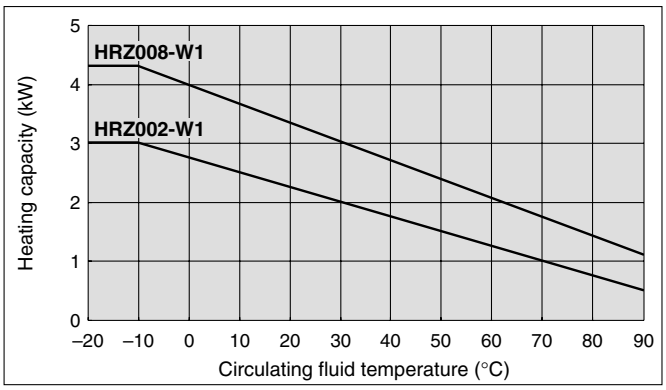
HRZ001-L1/002-L1/004-L1/008-L1



HRZ001-H1/002-H1/004-H1/008-H1

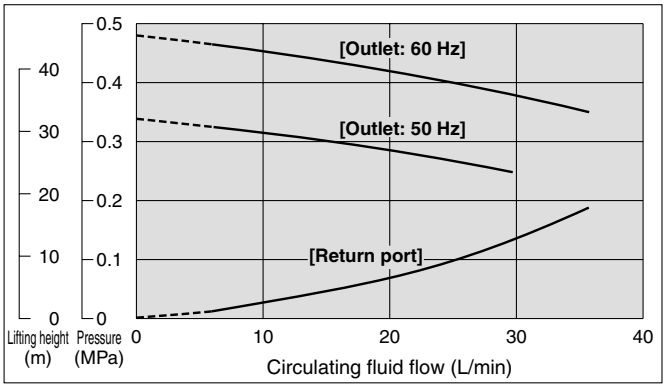


HRZ002-W1/008-W1

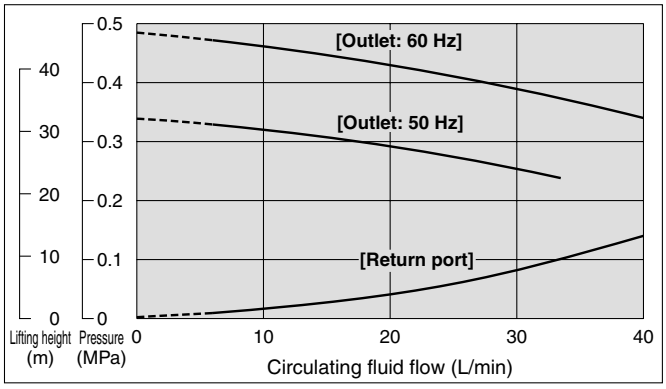


Pump Capacity (Thermo-chiller Outlet)

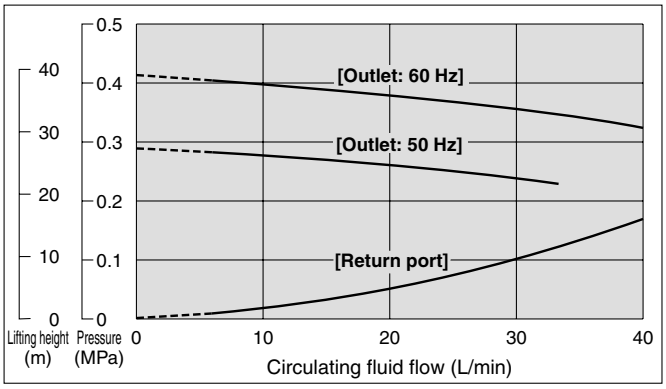
HRZ001-L1/002-L1/004-L1
HRZ004-H1/008-H1
HRZ002-W1/008-W1



HRZ008-L1



HRZ001-H1/002-H1



∗ When the circulating fluid flow is below 6 L/min, the in-built operation stop alarm will be activated. It is not possible to run the equipment. (common for all models)

Thermo-chiller Clear/Deionized Water Type

Series HRZ

SEMI

How to Order

Clear/Deionized Water Type **HRZ 001 – L 2 –**

Cooling capacity

Symbol	Cooling capacity
001	1 kW
002	2 kW
004	4 kW
008	8 kW

Option (Refer to pages 122 and 123.)

Nil	None
C	Analog communication
D	DeviceNet communication
N	NPT fitting
Y	DI control kit
Z	Circulating fluid automatic recovery

Temperature range setting

Symbol	Temperature range setting	1 kW	2 kW	4 kW	8 kW
L	10 to 40°C	●	●	●	●

Clear/Deionized water type

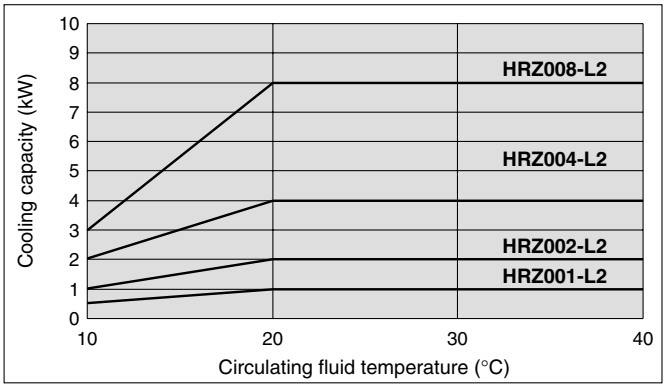
Specifications (For details, please consult our "Product Specifications" information.)

Model		HRZ001-L2	HRZ002-L2	HRZ004-L2	HRZ008-L2
Cooling method		Water-cooled refrigeration			
Refrigerant		R134a (HFC)			
Control system		PID control			
Ambient temperature/humidity Note 1)		Temperature: 10 to 35°C, Humidity: 30 to 70%RH			
Circulating fluid system	**Circulating fluid** Note 2)	Clear water, Deionized water			
	Temperature range setting Note 1) **(°C)**	10 to 40			
	Cooling capacity Note 3) **(kW)**	1.0 (at 20°C)	2.0 (at 20°C)	4.0 (at 20°C)	8.0 (at 20°C)
	Heating capacity Note 3) **(kW)**	0.90 (at 20°C)	0.98 (at 20°C)	1.15 (at 20°C)	1.25 (at 20°C)
	Temperature stability Note 4) **(°C)**	±0.1			
	Pump capacity Note 5) **(50/60 Hz) (MPa)**	0.25/0.38 (at 20 L/min)			
	Rated flow Note 6) **(L/min)**	20			
	Main tank capacity Note 7) **(L)**	Approx. 15			
	Sub-tank capacity Note 8) **(L)**	Approx. 16			
	Port size	Rc3/4			
	Wetted parts material	Stainless steel, EPDM, Copper brazing (Heat exchanger), PPS, Silicone, Fluororesin			
Cooling water system	**Temperature range** **(°C)**	10 to 25			
	Pressure range **(MPa)**	0.3 to 0.7			
	Required flow rate Note 9) **(50/60 Hz) (L/min)**	5/5	6/6	15/22	18/23
	Port size	Rc1/2			
	Wetted parts material	Stainless steel, EPDM, Copper brazing (Heat exchanger), Silicone, Brass			
Electrical system	**Power supply**	3-phase 200 VAC 50 Hz, 3-phase 200 to 208 VAC 60 Hz Allowable voltage fluctuation ±10%			
	Breaker capacity **(A)**	30			
	Rated current **(A)**	19			
	Alarm	Refer to page 118.			
	Communications	Contact input/output (D-sub 25 pin) and Serial RS-485 (D-sub 9 pin) (Refer to pages 116 and 117.)			
Weight Note 10) **(kg)**		170			
Safety standards		UL, CE marking, SEMI (S2-0703, S8-0701, F47-0200), SEMATECH (S2-93, S8-95)			

Note 1) It should have no condensation.
Note 2) If clear water or deionized water is used, please use water that conforms to Water Quality Standards of the Japan Refrigeration and Air Conditioning Industry Association (JRA GL-02-1994/cooling water system - circulation type - make-up water). The minimum electrical conductivity of the deionized water used as the fluid should be 0.5 μS/cm (or electrical resistivity 2 MΩ•cm at maximum).
Note 3) ① Facility water temperature: 25°C, ② Circulating fluid flow rate: Values at rated circulating fluid flow rate. Values common for 50/60 Hz.
Note 4) Value with a stable load without turbulence in the operating conditions. It may be out of this range when a DI control kit (option Y) is used or in some other operating conditions.
Note 5) The capacity at the Thermo-chiller outlet when the circulating fluid temperature is 20°C.
Note 6) Required flow rate for cooling capacity or maintaining the temperature stability. When used below the rated flow, use the individually sold, "By-pass Piping Set" (Refer to page 119).
Note 7) Minimum volume required for operating only the Thermo-chiller. (Circulating fluid temperature: 20°C, including the Thermo-chiller's internal pipings or heat exchanger)
Note 8) Preliminary space volume without main tank capacity. Available for collecting the circulating fluid inside an external piping or for preliminary injection.
Note 9) Required flow rate when a load for the cooling capacity is applied at a facility water temperature of 25°C.
Note 10) Weight in the dry state without circulating fluids

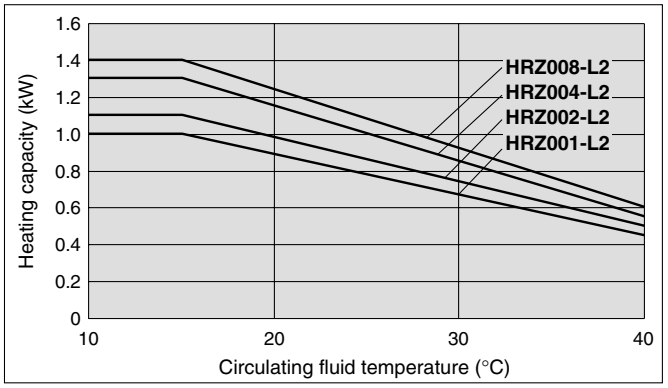
Cooling Capacity

HRZ001-L2/002-L2/004-L2/008-L2



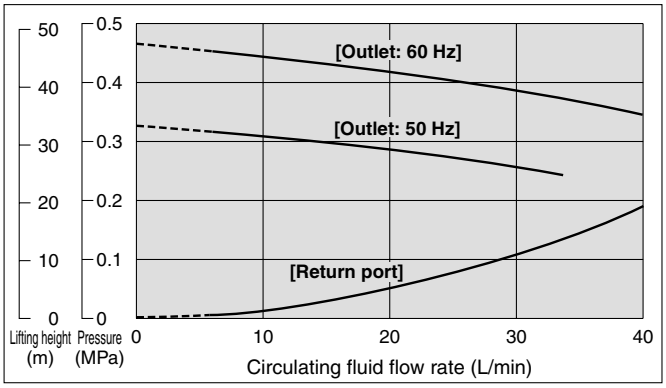
Heating Capacity

HRZ001-L2/002-L2/004-L2/008-L2



Pump Capacity (Thermo-chiller Outlet)

HRZ001-L2/002-L2/004-L2/008-L2



∗ When the circulating fluid flow is below 6 L/min, the in-built operation stop alarm will be activated. It is not possible to run the equipment. (common for all models)

Thermo-chiller Double Inverter Type
Series HRZ

SEMI

How to Order

Double Inverter Type **HRZ 010 – W ☐ S – ☐**

Cooling capacity

Symbol	Cooling capacity
010	10 kW

Circulating fluid type

Symbol	Circulating fluid type	Temperature range setting
Nil	Fluorinated fluids	–20 to 90°C
1	Ethylene glycol aqueous solution	–20 to 90°C
2	Clear water/Deionized water	10 to 60°C

Double inverter type

Option (Refer to pages 122 and 123.)

Nil	None
C	Analog communication
D	DeviceNet communication
N	NPT fitting
Y*	DI control kit
Z	Circulating fluid automatic recovery

* Not equipped to the fluorinated fluid type.

Specifications

Model			HRZ010-WS	HRZ010-W1S	HRZ010-W2S
Cooling method			Water-cooled refrigeration		
Refrigerant			R404A (HFC)		
Control system			PID control		
Ambient temperature/humidity Note 1)			Temperature: 10 to 35°C, Humidity: 30 to 70%RH		
Circulating fluid system	**Circulating fluid** Note 2)		• –20 to 40°C: Fluorinert™ FC-3283/GALDEN® HT135 • 20 to 90°C: Fluorinert™ FC-40/GALDEN® HT200	60% ethylene glycol aqueous solution	Clear water, Deionozed water
	Temperature range setting Note 1)	**(°C)**	–20 to 90		10 to 60
	Cooling capacity Note 3)	**(kW)**	10 (at 20°C)	10 (at 20°C)	9 (at 20°C)
	Heating capacity Note 3)	**(kW)**	5.0 (at 20°C)	4.5 (at 20°C)	2.5 (at 20°C)
	Temperature stability Note 4)	**(°C)**	±0.1 (In cases when the circulating fluid discharge port and the return port are directly connected)		
	Pump capacity Note 5)	**(MPa)**	Max. 0.72 (at 20 L/min)	Max. 0.40 (at 20 L/min)	Max. 0.38 (at 20 L/min)
	Rated flow Note 6)	**(L/min)**	20		
	Flow range Note 7)	**(L/min)**	10 to 40 (With flow control function by inverter)		
	Main tank capacity Note 8)	**(L)**	Approx. 15		
	Sub-tank capacity Note 9)	**(L)**	Approx. 16		
	Port size		Rc3/4		
	Wetted parts material		Stainless steel, EPDM, Copper brazing (Heat exchanger), PPS, Silicone, Fluororesin		
Cooling water system	**Temperature range**	**(°C)**	10 to 30		10 to 25
	Pressure range	**(MPa)**	0.3 to 0.7		
	Required flow rate Note 10)	**(50/60 Hz) (L/min)**	15/15		
	Port size		Rc1/2		
	Wetted parts material		Stainless steel, EPDM, Copper brazing (Heat exchanger), PPS, Silicone, Brass		
Electrical system	**Power supply**		3-phase 200 VAC 50 Hz, 3-phase 200 to 208 VAC 60 Hz Allowable voltage fluctuation ±10%		
	Breaker capacity	**(A)**	30		
	Rated current	**(A)**	26	25	25
	Alarm		Refer to page 118.		
	Communications		Contact input/output (D-sub 25 pin) and Serial RS-485 (D-sub 25 pin) (Refer to pages 116 and 117.)		
Weight Note 11)		**(kg)**	165		
Safety standards			UL, CE marking, SEMI (S2-0703, S8-0701, F47-0200), SEMATECH (S2-93, S8-95)		

Note 1) It should have no condensation.

Note 2) Fluorinert™ is a trademark of 3M and GALDEN® is a registered trademark of Solvay Solexis, Inc. Dilute pure ethylene glycol with clear water. Additives such as preservatives cannot be used. If clear water or deionized water is used, please use water that conforms to Water Quality Standards of the Japan Refrigeration and Air Conditioning Industry Association (JRA GL-02-1994/cooling water system - circulation type - make-up water). The minimum electrical conductivity of the deionized water used as the fluid should be 0.5 μS/cm (or electrical resistivity 2 MΩ•cm at maximum).

Note 3) ① Facility water temperature: 25°C, ② Circulating fluid flow rate: Values at rated circulating fluid flow rate. Values common for 50/60 Hz.

Note 4) Valuee with a stable load without turbulence in the operating conditions. It may be out of this range when a DI control kit (option Y) is used or in some other operating conditions.

Note 5) The capacity at the Thermo-chiller outlet when the circulating fluid temperature is 20°C.

Note 6) Required flow rate for cooling capacity or maintaining the temperature stability. When used below the rated flow, use the individually sold, "By-pass Piping Set" (Refer to page 119).

Note 7) May not be able to control with the set value depending on the piping specification in the customer side.

Note 8) Minimum volume required for operating only the Thermo-chiller. (Circulating fluid temperature: 20°C, including the Thermo-chiller's internal pipings or heat exchanger)

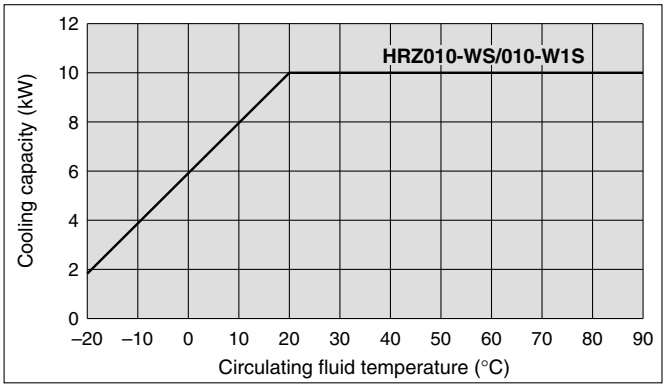
Note 9) Preliminary space volume without main tank capacity. Available for collecting the circulating fluid inside an external piping or for preliminary injection.

Note 10) Required flow rate when a load for the cooling capacity is applied at a facility water temperature of 25°C.

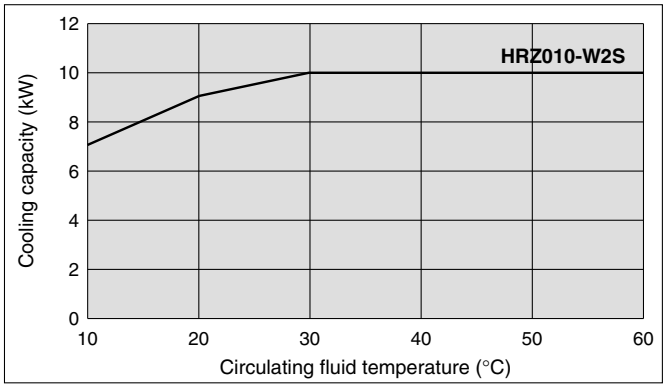
Note 11) Weight in the dry state without circulating fluids

Cooling Capacity

HRZ010-WS/010-W1S

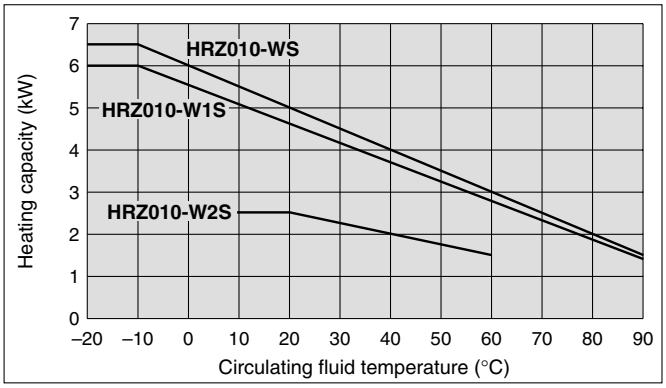


HRZ010-W2S



Heating Capacity

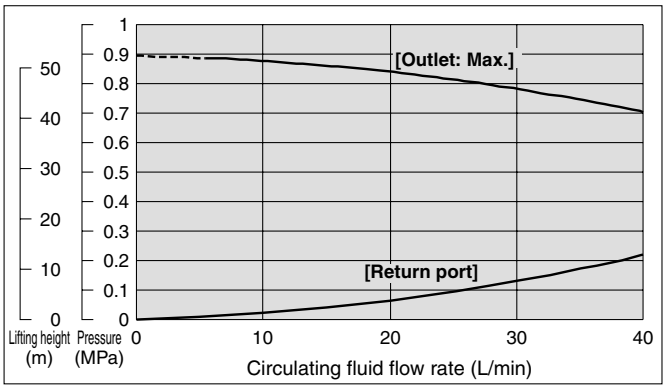
HRZ010-WS/010-W1S/010-W2S



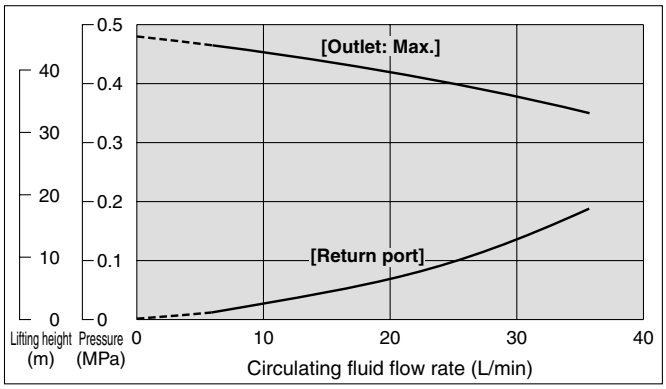
∗ When pump inverter is operating at frequency of 60 Hz (maximum).

Pump Capacity (Thermo-chiller Outlet)

HRZ010-WS

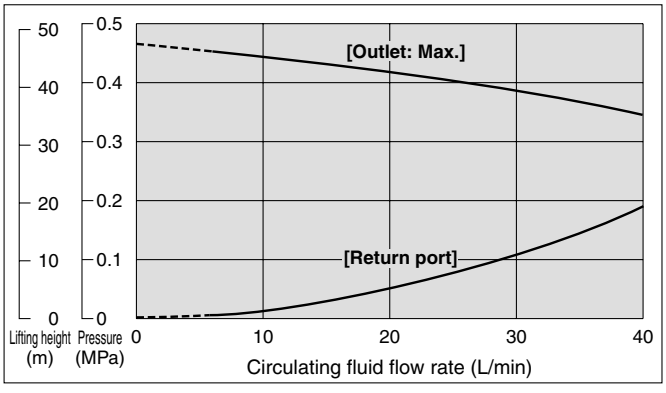


HRZ010-W1S



∗ The pump capacity of the HRZ010-W1S is same as that of the HRZ001-L1 group on page 109.
∗ The pump capacity of the HRZ010-W2S is same as on page 111.

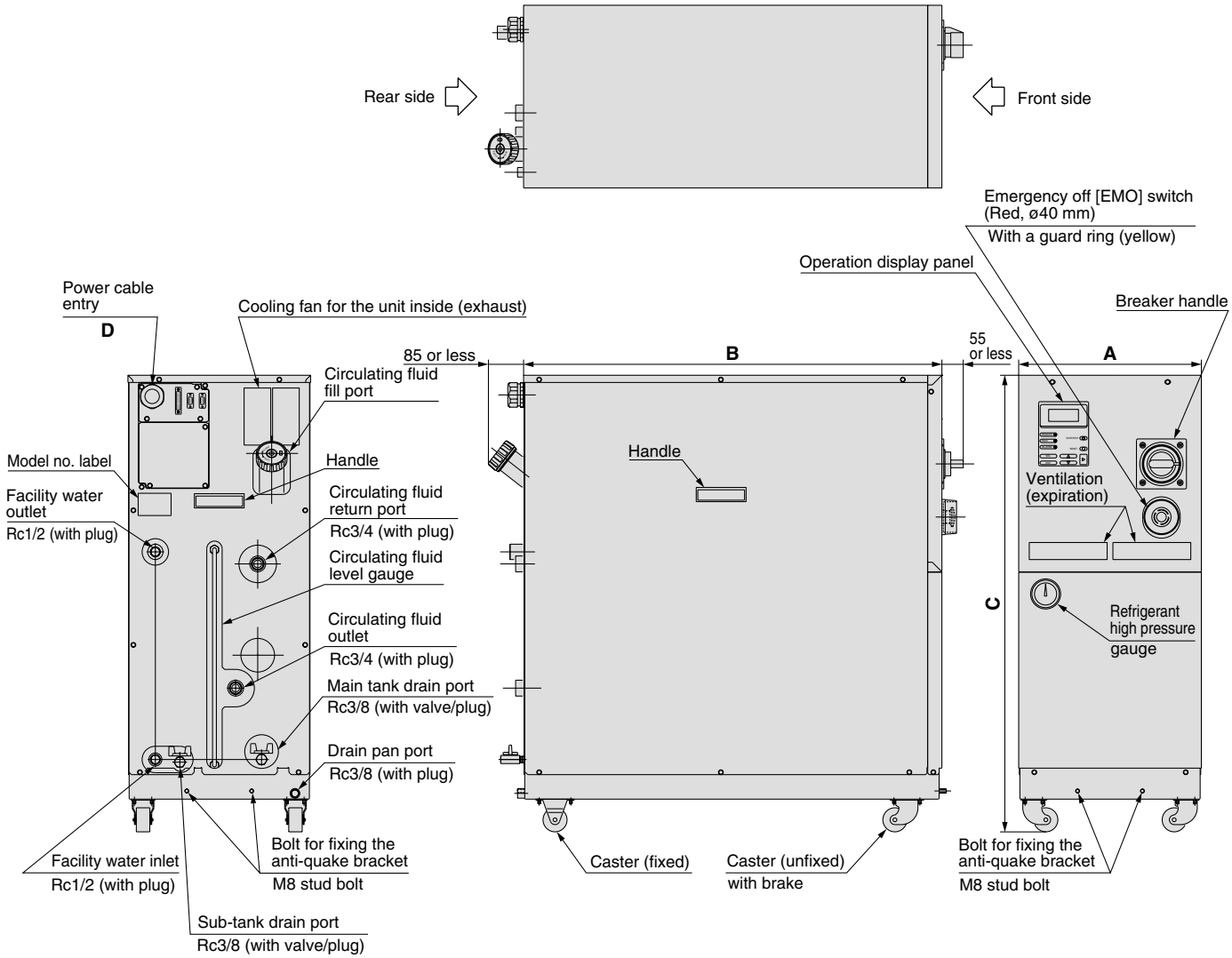
HRZ010-W2S



∗ When the circulating fluid flow is below 6 L/min, the in-built operation stop alarm will be activated. It is not possible to run the equipment. (common for all models)
∗ With flow control function by inverter

Common Specifications

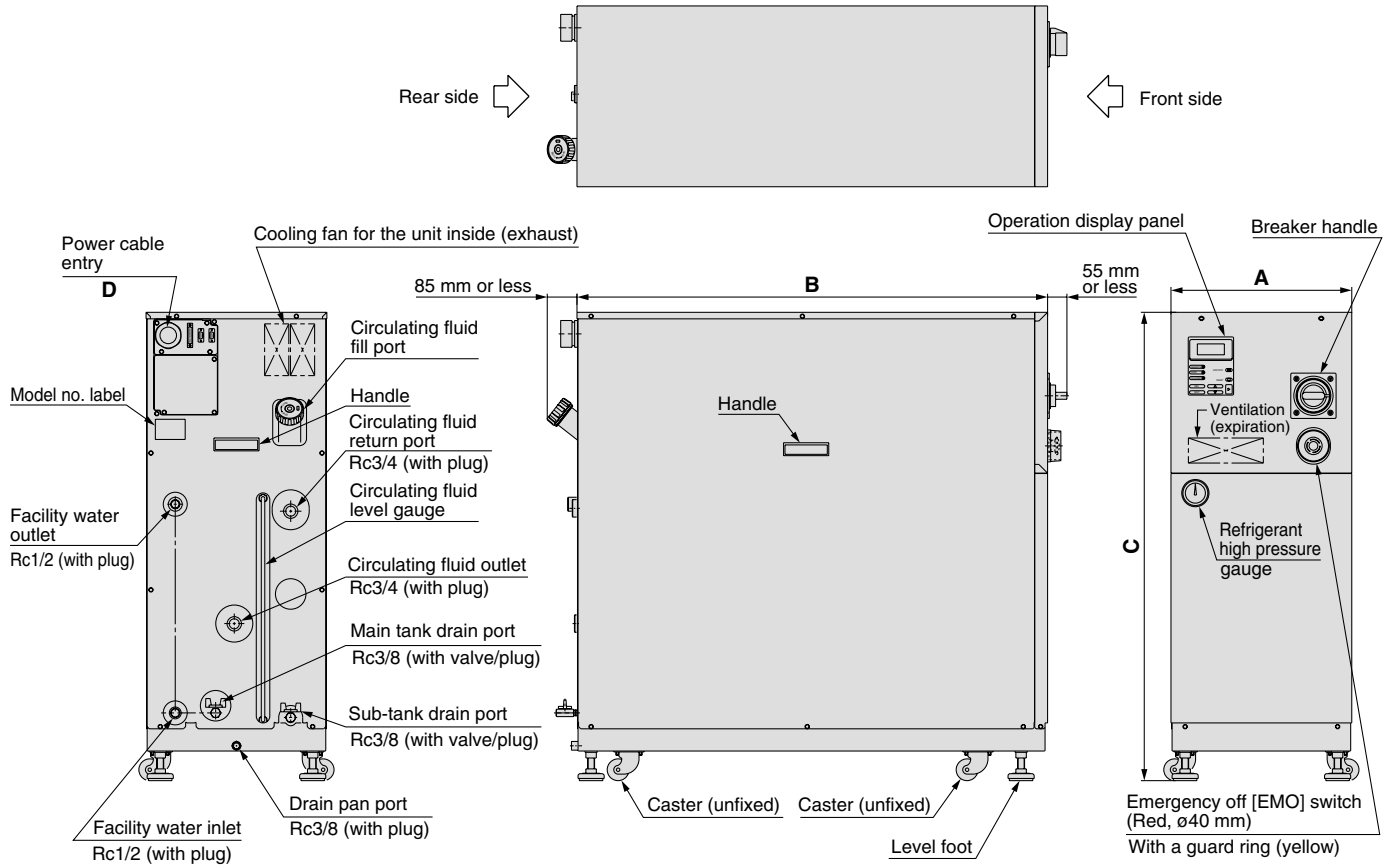
Dimensions

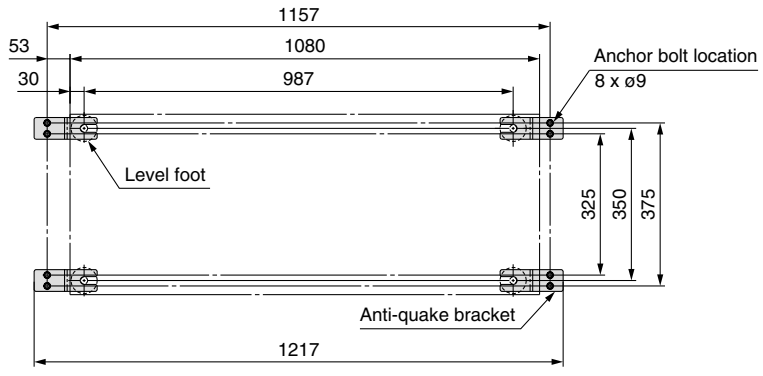


(mm)

Model			A	B	C	D
Fluorinated fluid type	Ethylene glycol type	Clear/Deionized water type				
HRZ001-H **HRZ002-H**	**HRZ001-H1** **HRZ002-H1**	—	380	870	860	ø18.5 to 20.5
HRZ001-L **HRZ002-L, W** **HRZ004-L, H** **HRZ008-H, W** **HRZ010-WS**	**HRZ001-L1** **HRZ002-L1, W1** **HRZ004-L1, H1** **HRZ008-H1, W1** **HRZ010-W1S**	**HRZ001-L2** **HRZ002-L2** **HRZ004-L2** **HRZ008-L2** **HRZ010-W2S**	380	870	950	ø18.5 to 20.5

(Dimensional tolerance of A, B, and C: ±10 mm)





Anti-quake bracket mounting position (Dimensional tolerance: ±5 mm)

∗ Anchor bolts (M8, 8 pcs.) which are suitable for the floor material should be prepared by the customer.

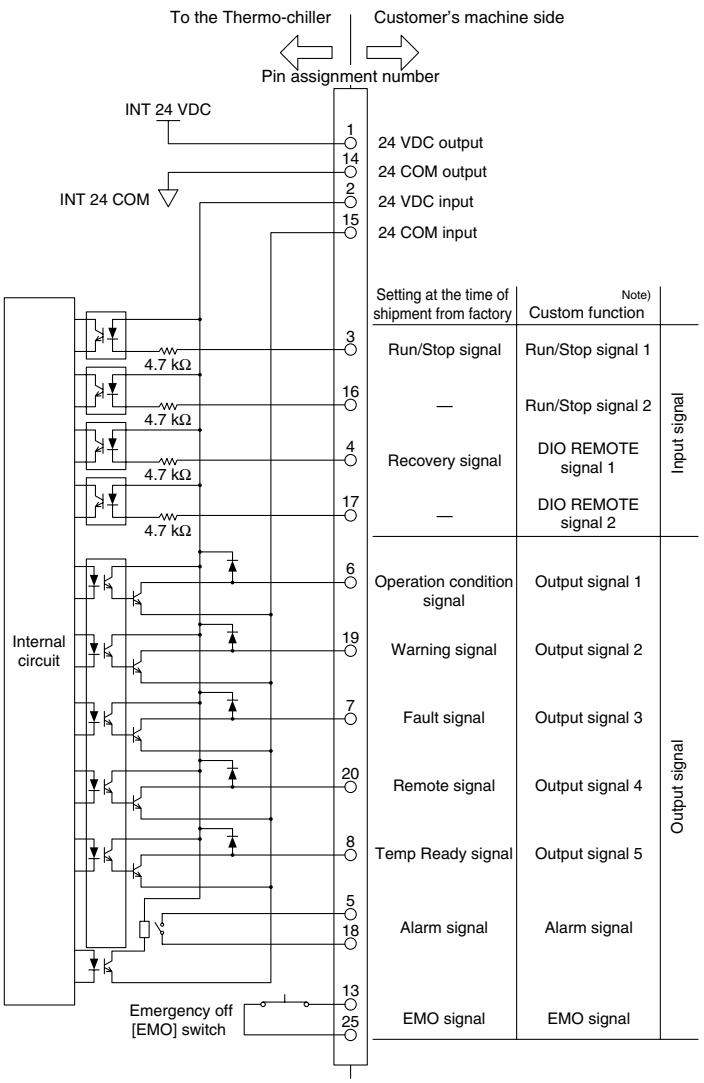
(mm)

Model		A	B	C	D
Fluorinated fluid type	Ethylene glycol type				
HRZ008-L	**HRZ008-L1**	415	1080	1075	ø35.0 to 38.0

(Dimensional tolerance of A, B, and C: ±10 mm)

Communication Function (For details, please consult our “Communication Specifications” information.)

Contact Input/Output

Item		Specifications
Connector no.		P1 (Refer to the next page for connector location)
Connector type (on this product side)		D-sub 25 P type, Female connector
Fixing bolt size		M2.6 x 0.45
Input signal	Insulation method	Photocoupler
	Rated input voltage	24 VDC
	Operating voltage range	21.6 VDC to 26.4 VDC
	Rated input current	5 mA TYP
	Input impedance	4.7 kΩ
Open collector output signal	Insulation method	Photocoupler
	Rated load voltage	24 VDC
	Operating load voltage range	21.6 VDC to 26.4 VDC
	Maximum load current	80 mA
	Leakage current	0.1 mA or less
	Surge protection	Diode
Contact output signal (Alarm signal)	Rated load voltage	48 VAC or less/24 VDC or less
	Maximum load current	500 mA AC/DC (resistance load)
Contact output signal (EMO signal)	Rated load voltage	48 VAC or less/24 VDC or less
	Maximum load current	800 mA AC/DC (resistance load/inductive load)
Circuit diagram		

Note) The custom function is equipped for contact input/output. Using the custom function enables the customer to set the signal type for contact input/output or pin assignment numbers. For details, please consult “Communication Specifications” information.

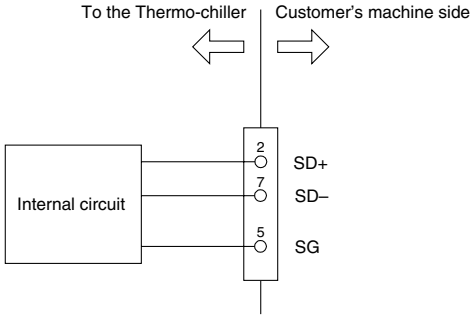
Serial RS-485

The serial RS-485 enables the following items to be written and read out.

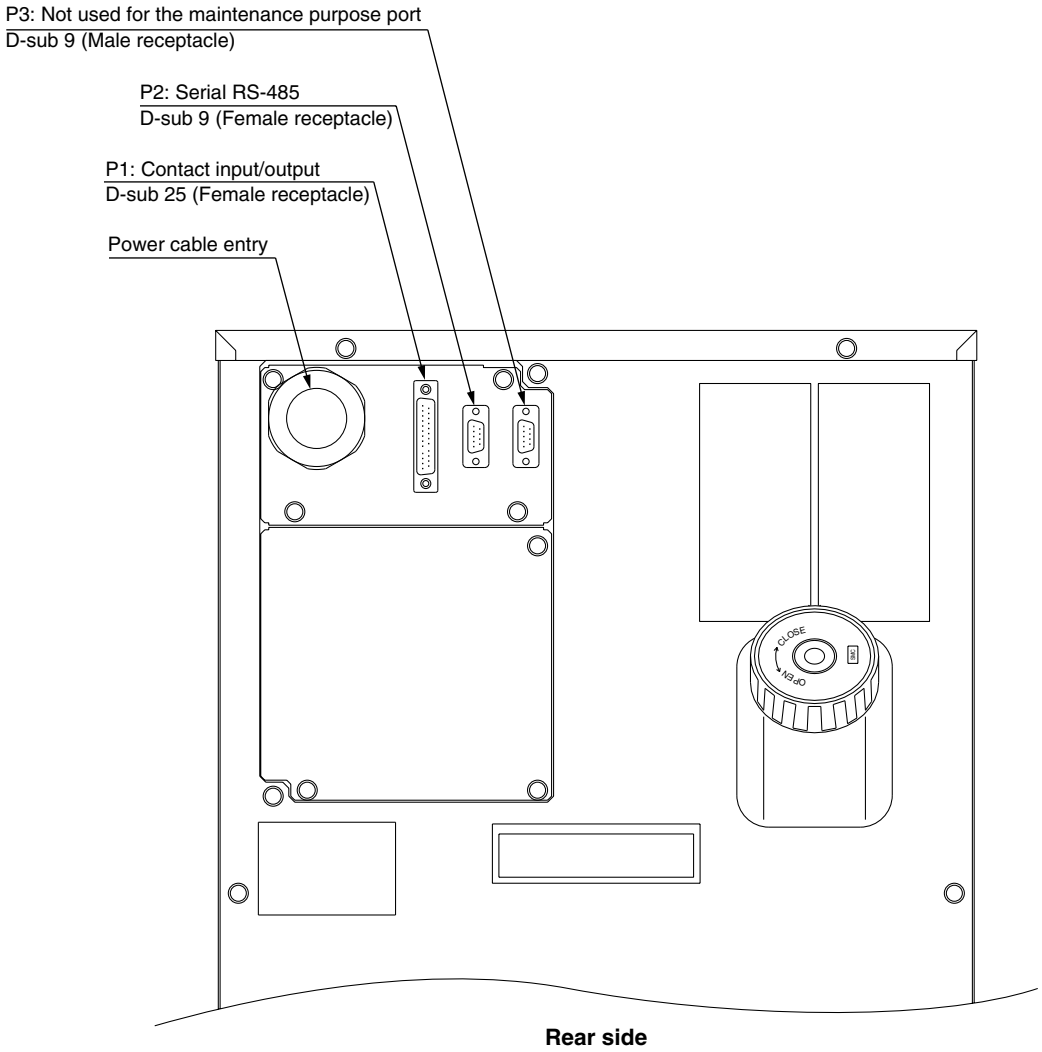
<Writing>
Run/Stop
Circulating fluid temperature setting
Circulating fluid automatic recovery start/stop

<Readout>
Circulating fluid present temperature
Circulating fluid flow
Circulating fluid discharge pressure
Circulating fluid electrical resistivity *2
Alarm occurrence information
Status (operating condition) information

*1 Only when the circulating fluid automatic recovery function (option Z) is selected.
*2 Only when the DI control kit (option Y) is selected.

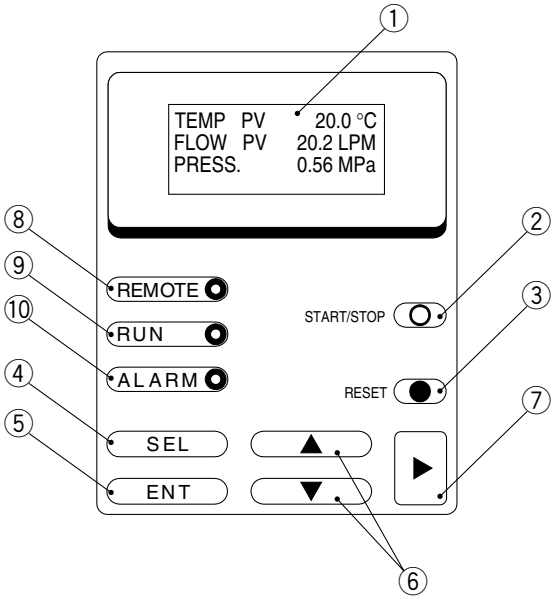
Item	Specifications
Connector no.	P2
Connector type (on this product side)	D-sub 9 P type, Female connector
Fixing bolt size	M2.6 x 0.45
Standards	EIA RS485
Protocol	Modicon Modbus
Circuit diagram	

Connector location



Rear side

Operation Display Panel



No.	Description	Function
①	**LCD**	Operating condition of this unit/Circulating fluid discharge temperature/Circulating fluid flow/ Circulating fluid discharge pressure/Setting value/Alarm message, etc. are displayed.
②	**[START/STOP] key**	Starts/Stops the operation.
③	**[RESET] key**	Stops the alarm buzzing. Resets the alarm.
④	**[SEL] key**	Switches the display.
⑤	**[ENT] key**	Decides the settings.
⑥	**[▲] [▼] key**	Moves the cursor and changes the setting values.
⑦	**[▶] key**	Moves the cursor.
⑧	**[REMOTE] indicator**	Lights up when the unit is in the remote status.
⑨	**[RUN] indicator**	Lights up when the unit is in the operating status.
⑩	**[ALARM] indicator**	Lights up when the unit is alarming.

Alarm

This unit can display 27 kinds of alarm messages as standard. Also, it can read out the serial RS-485 communication.

Alarm code	Alarm message	Operation status	Main reason
01	Water Leak Detect FLT	Stop	Liquid deposits in the base of this unit.
02	Incorrect Phase Error FLT	Stop	The power supply to this unit is incorrect.
03	RFGT High Press FLT	Stop	Pressure in the refrigeration circuit has exceeded the limitation.
04	CPRSR Overheat FLT	Stop	Temperature inside the compressor has increased.
05	Reservoir Low Level FLT	Stop	The amount of circulating fluid is running low.
06	Reservoir Low Level WRN	Continue	The amount of circulating fluid is running low.
07	Reservoir High Level WRN	Continue	Filling the circulating fluid too much.
08	Temp. Fuse Cutout FLT	Stop	Temperature of the circulating fluid tank is raised.
09	Reservoir High Temp. FLT	Stop	Temperature of the circulating fluid has exceeded the limitation.
11	Reservoir High Temp. WRN	Continue	Temperature of the circulating fluid has exceeded the limitation set by the customer.
12	Return Low Flow FLT	Stop	The circulating fluid flow has gone below 6 L/min.
13	Return Low Flow WRN	Continue	The circulating fluid flow has gone below the limitation set by the customer.
14	Heater Breaker Trip FLT	Stop	Protection device for the electric circuit of the heater is activated.
15	Pump Breaker Trip FLT	Stop	Protection device for the electric circuit of the circulating pump is activated.
16	CPRSR Breaker Trip FLT	Stop	Protection device for the electric circuit of the compressor is activated.
17	Interlock Fuse Cutout FLT	Stop	Overcurrent is flown to the control circuit.
18	DC Power Fuse Cutout WRN	Continue	Overcurrent has flowed to the (optional) solenoid valve.
19	FAN Motor Stop WRN	Continue	Cooling fan inside the compressor has stopped.
20	Internal Pump Time Out WRN	Continue	The internal pump continuously run for more than a certain period of time.
21	Controller Error FLT	Stop	The error occurred in the control systems.
22	Memory Data Error FLT	Stop	The data stored in the controller of this unit went wrong.
23	Communication Error WRN	Continue	The serial communications between this unit and customer's system has been suspended.
24	DI Low Level WRN	Continue	DI level of the circulating fluid has gone below the limitation set by the customer. (Option)
25	Pump Inverter Error FLT	Stop	An error has occurred in the inverter for the circulating pump. The alarm is only for the HRZ010-W□S.
26	DNET Comm. Error WRN	Continue	The DeviceNet communications between this unit and customer's system has been suspended. (Only for DeviceNet communication specification - option D)
27	DNET Comm. Error FLT	Stop	An error has occurred in the DeviceNet communication system of this unit. (Only for DeviceNet communication specification - option D)
28	CPRSR INV Error FLT	Stop	An error has occurred in the inverter for the compressor. The alarm is only for the HRZ010-W□S.

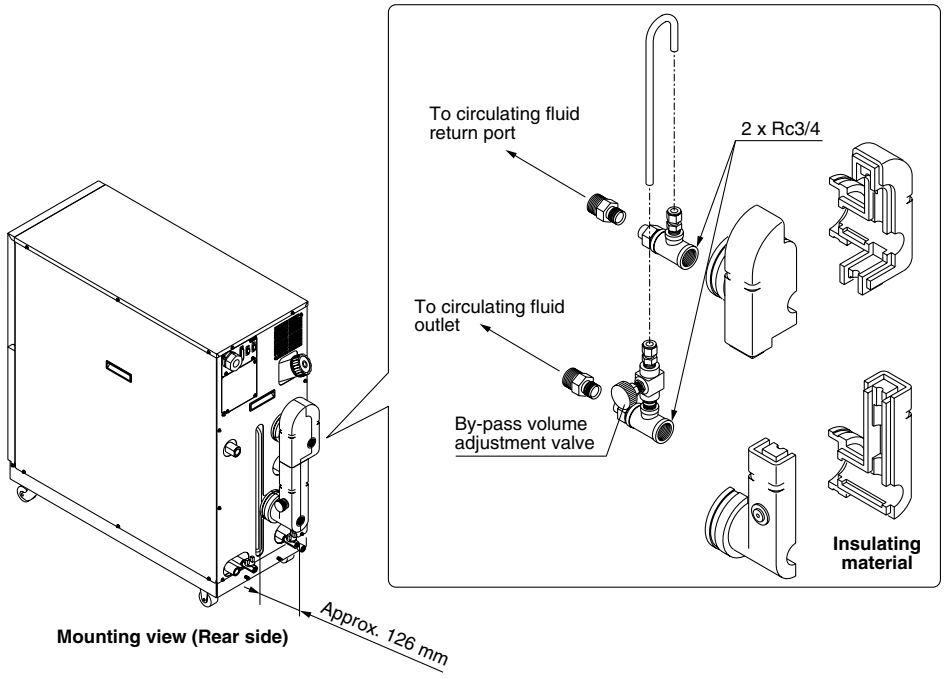
Optional Accessories 1

By-pass Piping Set

Note) Necessary to be fitted by the customer.

When the circulating fluid goes below the rated flow, cooling capacity will be reduced and the temperature stability will be badly affected.
In such a case, use the by-pass piping set.

Part no.	Applicable model
HRZ-BP001	HRZ001-H/HRZ001-H1 HRZ002-H/HRZ002-H1
HRZ-BP002	HRZ001-L/HRZ001-L1 HRZ001-L2 HRZ002-L/HRZ002-L1 HRZ002-L2 HRZ004-L/HRZ004-L1 HRZ004-L2 HRZ008-L2 HRZ004-H/HRZ004-H1 HRZ008-H/HRZ008-H1 HRZ002-W/HRZ002-W1 HRZ008-W/HRZ008-W1 HRZ010-WS HRZ010-W1S HRZ010-W2S
HRZ-BP008	HRZ008-L/HRZ008-L1



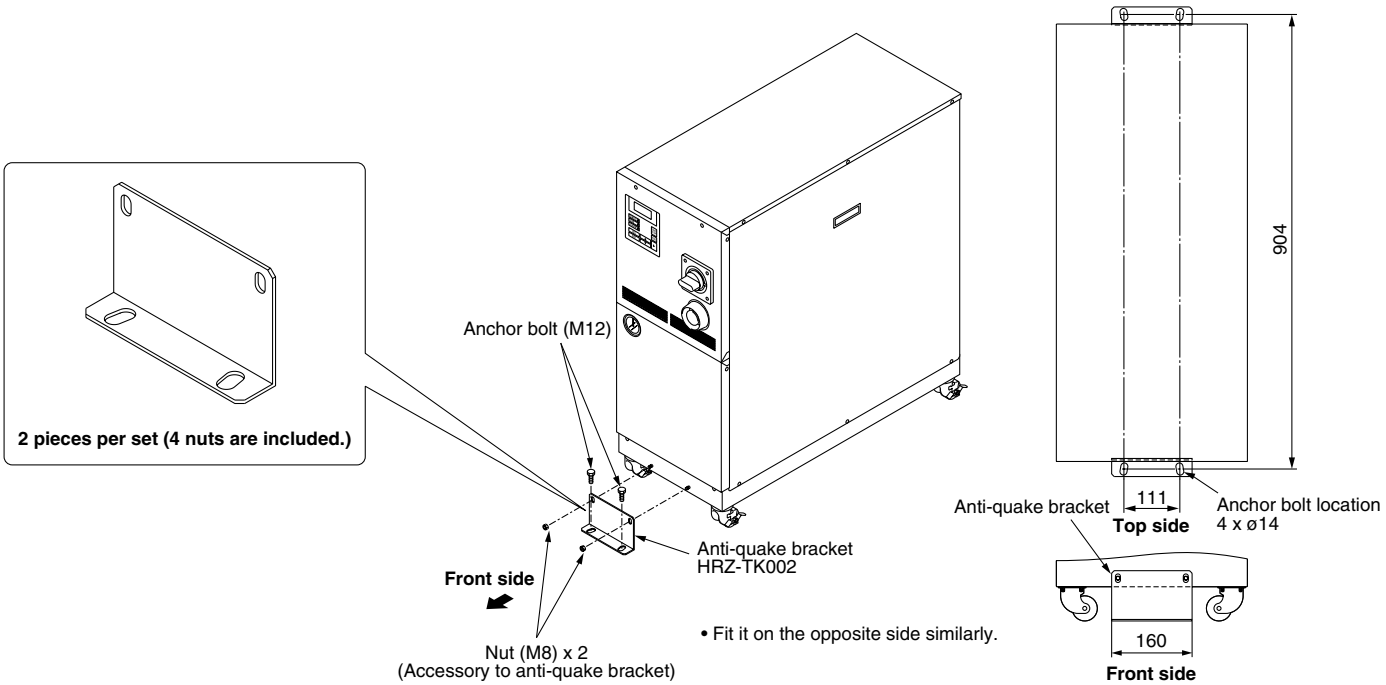
Mounting view (Rear side)

Anti-quake Bracket

Bracket for earthquakes
Prepare the anchor bolts (M12) which are suited to the floor material by the customer.

Part no.	Applicable model
HRZ-TK002	HRZ001-L□/HRZ002-L□/HRZ004-L□/HRZ008-L2 HRZ001-H□/HRZ002-H□ HRZ004-H□/HRZ008-H□ HRZ002-W□/HRZ008-W□/HRZ010-W□S

Note 1) 2 pieces per set (for 1 unit) (HRZ-TK-002)
Note 2) Anti-quake bracket is attached as standard. (HRZ008-L, HRZ008-L1)

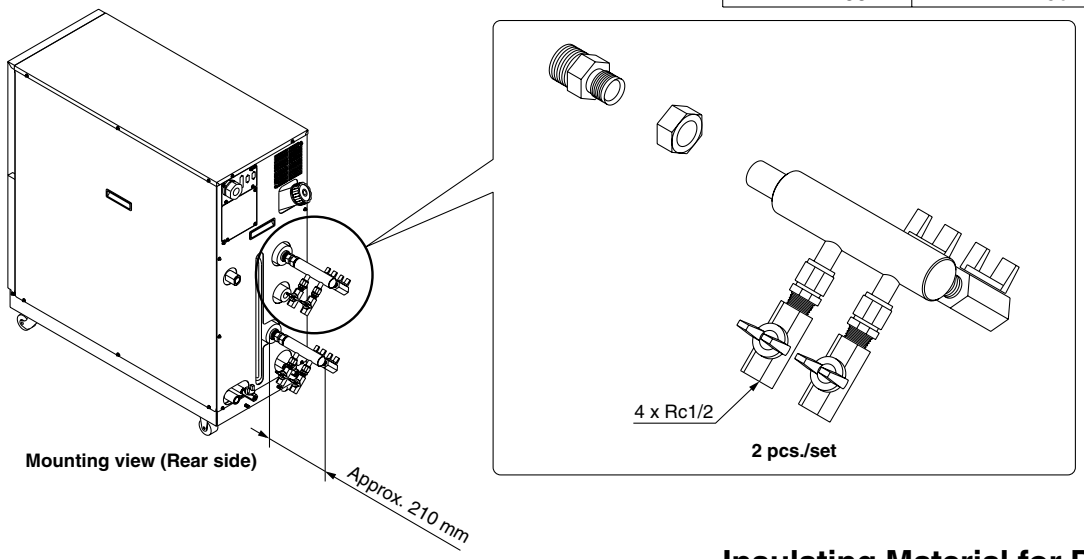


Optional Accessories 2

4-Port Manifold

4-branching the circulating fluid enables 4 temperature controls at the maximum with the 1 unit Thermo-chiller.

Part no.	Applicable model
HRZ-MA001	Common for all models

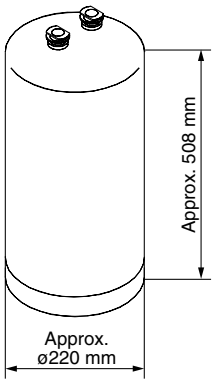


DI Filter

This is the ion replacement resin to maintain the electrical resistivity of the circulating fluid.
Customers who selected the DI control kit (option Y) need to purchase the DI filter separately.

Part no.	Applicable model
HRZ-DF001	Common for all models which can select the DI control kit. (option Y)

Note) The DI filters are consumable. Depending on the status (electrical resistivity set value, circulating fluid temperature, piping volume, etc.), product life cycles will vary accordingly.

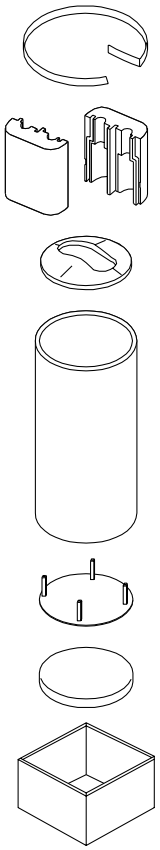


Weight: Approx. 20 kg

Insulating Material for DI Filter

When the DI filter is used at a high-temperature, we recommend that you use this insulating material to protect the radiated heat from the DI filter or possible burns. When the DI filter is used at a low-temperature, we also recommend that you use this to prevent heat absorption from the DI filter and to avoid forming condensation.

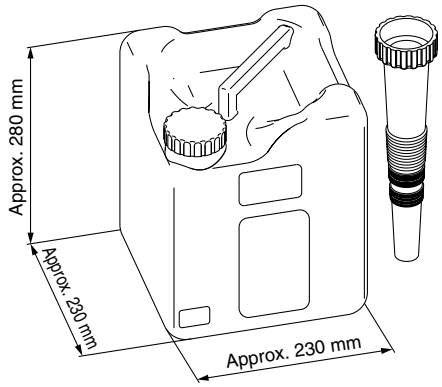
Part no.	Applicable model
HRZ-DF002	Common for all models which can select the DI control kit. (option Y)



60% Ethylene Glycol Aqueous Solution

This solution can be used as a circulating fluid for ethylene glycol-type Thermo-chillers. (Capacity: 10 L)

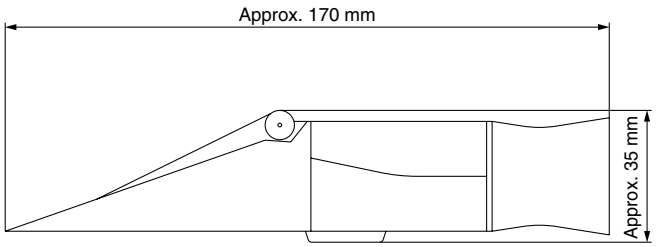
Part no.	Applicable model
HRZ-BR001	Common for all ethylene glycol-type models



Concentration Meter

This meter can be used to control the condensation of ethylene glycol solution regularly.

Part no.	Applicable model
HRZ-BR002	Common for all ethylene glycol-type models



Series HRZ
Options

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

C Option symbol: Analog Communication

HRZ□□□-□□-C

Analog communication

In addition to the standard contact input/output signal communication and the serial RS-485 communication, analog communication function can be added.
The analog communication function enables to write and read out the following items.

<Writing>
Circulating fluid temperature setting

<Readout>
Circulating fluid present temperature
Electrical resistivity*

* Only when the DI control kit (option Y) is selected.

Scaling voltage - circulating fluid temperature can be set arbitrarily by the customer.
For details, please consult our "Communication Specifications" information.

D Option symbol: DeviceNet Communication

HRZ□□□-□□-D

DeviceNet communication

DeviceNet™

In addition to the standard contact input/output signal communication and the serial RS-485 communication, DeviceNet function can be added.
DeviceNet function enables to write and read out the following items.

<Writing>
Run/Stop
Circulating fluid temperature setting
Circulating fluid automatic recovery start/stop*1

<Readout>
Circulating fluid present temperature
Circulating fluid flow
Circulating fluid discharge pressure
Electrical resistivity*2
Alarm occurrence information
Status (operating condition) information

*1 Only when the circulating fluid automatic recovery function (option Z) is selected.
*2 Only when the DI control kit (option Y) is selected.

For details, please consult our "Communication Specifications" information.

N Option symbol: NPT Fitting

HRZ□□□-□□-N

NPT fitting

An adapter is included to change the connection parts of circulating fluid piping and facility water piping to NPT thread type. The adapter must be installed by the customer.

Y Option symbol: DI Control Kit

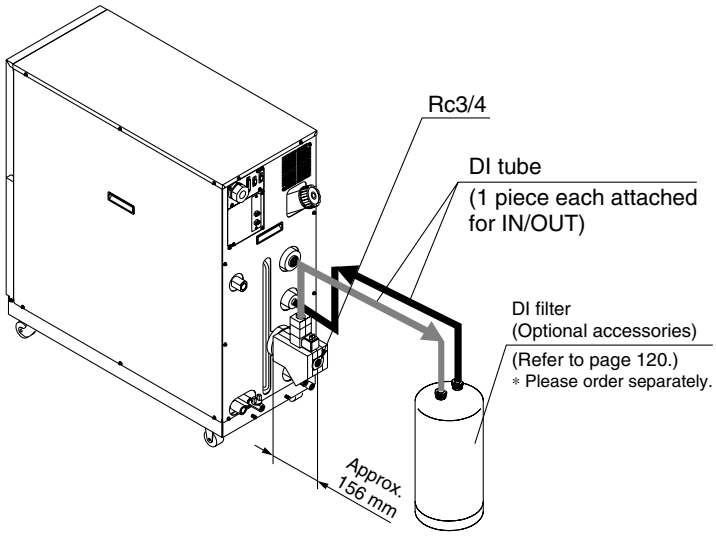
HRZ□□□-□□-Y

DI control kit

Select this option if you want to maintain the electric resistance ratio (DI level) of the circulating fluid at a certain level. However, some components have to be fitted by the customer. For details, refer to specification table for this option.
Please note that this is not applicable to the fluorinated liquid type.

Applicable model		HRZ00□-L1-Y HRZ00□-H1-Y HRZ00□-W1-Y HRZ010-W1S-Y	HRZ00□-L2-Y HRZ010-W2S-Y
Allowable circulating fluid	—	60% ethylene glycol aqueous solution	Deionized water
DI level display range	MΩ•cm	0 to 20	
DI level set range	MΩ•cm	0 to 2.0 Note)	
DI level reduction alarm set range	MΩ•cm	0 to 2.0	

Note) The DI filter is needed to control the DI level. (SMC Part No.: HRZ-DF001)
Please purchase additionally because the DI filter is not included in this option. Also, if necessary, additionally purchase the insulating material for the DI filter. (SMC Part No.: HRZ-DF002)



* Install the DI filter outside the thermo-chiller for piping. Secure the space for installing the DI filter on the rear side of the Thermo-chiller.
* It may go outside of the temperature stability range of ±0.1°C when this option is used in some operating conditions.

Z Option symbol

Circulating Fluid Automatic Recovery

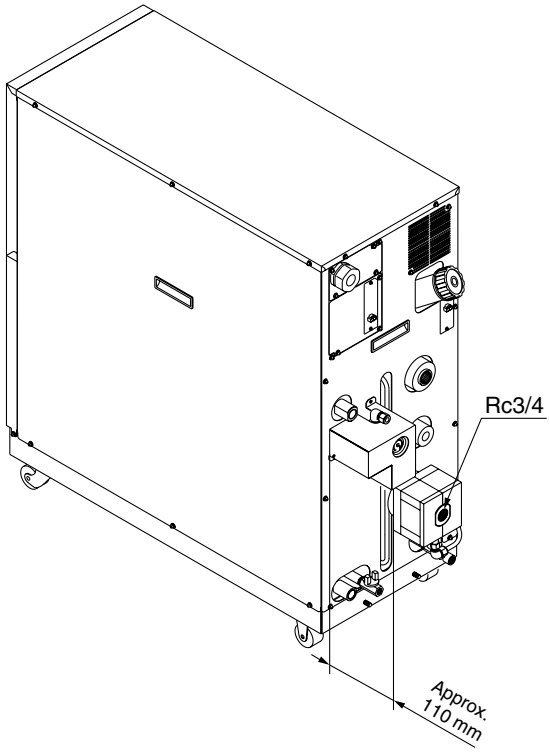
HRZ□□□−□□−Z

Circulating fluid automatic recovery

Select this option for customers who want to use the circulating fluid automatic recovery function.
The automatic recovery function is a device which can recover the circulating fluid inside pipings into a sub-tank of the Thermo-chiller by the external communication or operating display panel. Some components need to be fitted by the customer. For details, please consult "Product Specifications" information for these options.

Applicable model		HRZ001-H-Z HRZ001-H1-Z HRZ002-H-Z HRZ002-H1-Z	HRZ001-L-Z HRZ002-L-Z HRZ004-L-Z HRZ004-H-Z HRZ008-H-Z HRZ001-L2-Z HRZ004-L2-Z HRZ002-W-Z HRZ008-W-Z HRZ010-WS-Z HRZ010-W2S-Z HRZ001-L1-Z HRZ002-L1-Z HRZ004-L1-Z HRZ004-H1-Z HRZ008-H1-Z HRZ002-L2-Z HRZ008-L2-Z HRZ002-W1-Z HRZ008-W1-Z HRZ010-W1S-Z	HRZ008-L-Z HRZ008-L1-Z
Circulating fluid recoverable volume Note 1)	L	15	16	17
Purge gas	—	Nitrogen gas		
Purge gas supply port	—	Self-align fitting for O.D. ø8 Note 2)		
Purge gas supply pressure	MPa	0.4 to 0.7		
Purge gas filtration	μm	0.01 or less		
Regulator set pressure	MPa	0.15 to 0.3 Note 3)		
Recoverable circulating fluid temperature	°C	10 to 30		
Recovery start/stop	—	Start: External communication Note 4) or operation display panel / Stop: Automatic		
Timeout error	sec	Timer from recovery start to completion Stops recovering when the timer turns to set time. Possible set range: 60 to 300, at the time of shipping from the factory: 300		
Height difference with the customer system side	m	10 or less		

Note 1) This is the space volume of the sub-tank when the liquid level of the circulating fluid is within the specification. Guideline of the recovery volume is 80% of the circulating fluid recoverable volume.
Note 2) Before piping, clean inside the pipings with air blow, etc. Use the piping with no dust generation by purge gas. When using resin tube, where necessary, use insert fittings, etc. in order not to deform the tubings when connecting to self-align fittings.
Note 3) At the time of shipping from factory, it is set to 0.2 MPa.
Note 4) For details, please consult our "Communication Specifications" information.



Series HRZ
Specific Product Precautions 1

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Design

⚠Warning

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

1. For details, please consult our "Product Specifications" and thoroughly consider the adaptability between the customer's system and this unit.
2. Although the protection circuit as a single unit is installed, the customer is requested to carry out the safety design for the whole system.

Selection

⚠Caution

1. Model selection

In order to select the correct Thermo-chiller model, the amount of thermal generation from the customer's system, the operating circulating fluid, and its circulating flow are required. Select a model, by referring to the guideline to model selection on page 100.

2. Option selection

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

Handling

⚠Warning

1. Thoroughly read the Operation Manual.

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

Operating Environment/Storage Environment

⚠Caution

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

1. Environment like written in "Temperature Control Equipment Precautions."
2. Locations where spatter will adhere to when welding.
3. Locations where it is likely that the leakage of flammable gas may occur.
4. Locations where the ambient temperature exceeds the limits as mentioned below.
   During operation 10°C to 35°C
   During storage 0°C to 50°C (but as long as water or circulating fluid are not left inside the pipings)
5. Locations where the ambient relative humidity exceeds the limit as mentioned below.
   During operation 30% to 70%
   During storage 15% to 85%
6. (Inside the operation facilities) locations where there is not sufficient space for maintenance.
7. In locations where the ambient pressure exceeds the atmospheric pressure.

2. The Thermo-chiller does not have clean room specification. It generates dust from the pump inside the unit and the cooling fan for the unit inside.

Circulating Fluid

⚠Caution

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

Circulating Fluid

2. Use ethylene glycol that does not contain additives such as preservatives.

3. The condensation of ethylene glycol aqueous solution must be 60% or less. If the density is too high, the pump will be overloaded, resulting in occurrence of "Pump Breaker Trip FLT". Also, if the density is to low, the unit will freeze at lower temperatures, resulting in product failure.

4. Avoid water moisture entering the fluorinated fluid. Otherwise, the unit will freeze, resulting in product failure.

5. Use clear water (including for diluting ethylene glycol aqueous solution) which must meet the water quality standards as mentioned below.

Clear Water (as Circulating Water) Quality Standards

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

	Item	Unit	Standard value
Standard item	pH (at 25°C)	—	6.0 to 8.0
	Electrical conductivity (25°C)	[μS/cm]	100*1 to 300*2
	Chloride ion	[mg/L]	50 or less
	Sulfuric acid ion	[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	[mg/L]	50 or less
	Ionic state silica	[mg/L]	30 or less
Reference item	Iron	[mg/L]	0.3 or less
	Copper	[mg/L]	0.1 or less
	Sulfide ion	[mg/L]	Should not be detected.
	Ammonium ion	[mg/L]	0.1 or less
	Residual chlorine	[mg/L]	0.3 or less
	Free carbon	[mg/L]	4.0 or less

*1 Electrical conductivity ratio should be 100 [μS/cm] or more.
*2 In the case of [MΩ•cm], it will be 0.003 to 0.01.

Transportation/Transfer/Movement

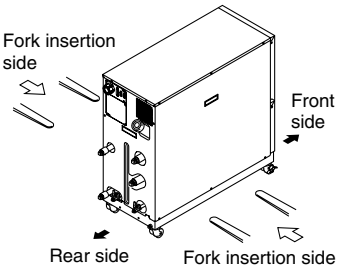
⚠Warning

1. Transportation by forklift

1. It is not possible to hang this product.
2. The fork insertion position is either on the left side face or right side face of the unit. Be careful not to bump the fork against a caster or level foot and be sure to put through the fork to the opposite side.
3. Be careful not to bump the fork to the cover panel or piping ports.

2. Transportation by casters

1. This product is heavy and should be moved by at least two people.
2. Do not grip the pipings on the rear side or the handles of the panel.



Series HRZ
Specific Product Precautions 2

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Mounting/Installation

⚠Caution

1. **Avoid using this product outdoors.**
2. **Install on a rigid floor which can withstand this product's weight.**
3. **Install a suitable anchor bolt for the anti-quake bracket taking into consideration the customers floor material.**
4. **Avoid placing heavy objects on this product.**

Piping

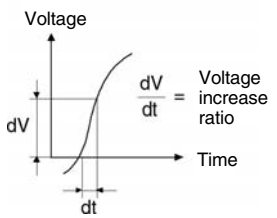
⚠Caution

1. **Regarding the circulating fluid pipings, consider carefully the suitability for shutoff pressure, temperature and circulating fluid.**
   If the operating performance specifications are regularly exceeded, the pipings may burst during operation.
2. **The surface of the circulating fluid pipings should be covered with the insulating materials which can effectively confine the heat.**
   Absorbing the heat from the surface of pipings may reduce the cooling capacity performance and the heating capacity may be shortened due to heat radiation.
3. **When using fluorinated liquid as the circulating fluid, do not use pipe tape.**
   Liquid leakage may occur around the pipe tape.
   For sealant, we recommend that you use the following sealant: SMC Part No., HRZ-S0003 (Silicone sealant)
4. **For the circulating fluid pipings, use clean pipings which have no dust, oil or water moisture inside the pipings, and blow with air prior to undertaking any piping works.**
   If any dust, oil or water moisture enters the circulating fluid circuit, inferior cooling performance or equipment failure due to frozen water may occur, resulting in bubbles in the circulating fluid inside the tank.
5. **The reciprocating total volume of the circulating fluid pipings must be less than the volume of the sub-tank.**
   Otherwise, when the equipment is stopped, the in-built alarm may activate or the circulating fluid may leak from the tank. Refer to the specifications table for the sub-tank volume.
6. **Select the circulating fluid pipings which can exceed the required rated flow.**
   For the rated flow, refer to the pump capacity table.
7. **For the circulating fluid piping connection, install a drain pan just in case the circulating fluid may leak.**
8. **Do not return the circulating fluid to the unit by installing a pump in the customer system.**

Electrical Wiring

⚠Caution

1. **Power supply and signal cable should be prepared by the customer.**
2. **Provide a stable power supply which is not affected by surge or distortion.**
   If the voltage increase ratio (dV/dt) at the zero cross should exceed 40 V/200 μsec., it may result in a malfunction.

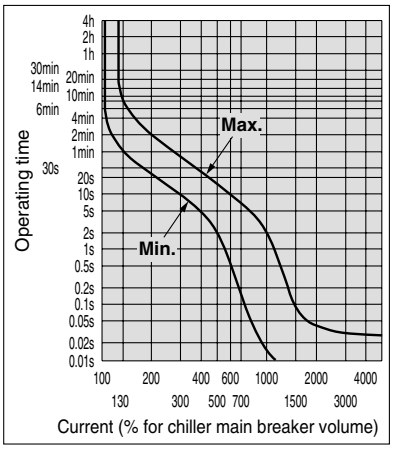


3. **This product is installed with a breaker with the following operating characteristics.**
   For the customer's machine (inlet side), use a breaker whose operating time is equal to or longer than the breaker of this product. If a breaker with shorter operating time is connected, the customer's machine could be cut off due to the inrush current of the motor of this product.

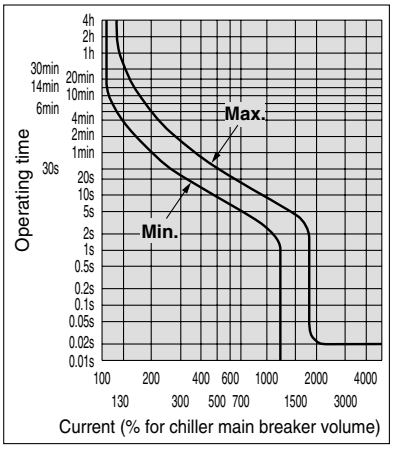
Breaker Operating Characteristics

Applicable model

HRZ001-L **HRZ001-H**
HRZ002-L **HRZ002-H**
HRZ004-L **HRZ004-H**
HRZ001-L1 **HRZ008-H**
HRZ002-L1 **HRZ001-H1**
HRZ004-L1 **HRZ002-H1**
HRZ001-L2 **HRZ004-H1**
HRZ002-L2 **HRZ008-H1**
HRZ004-L2 **HRZ002-W**
HRZ008-L2 **HRZ008-W**
HRZ002-W1
HRZ008-W1



HRZ008-L
HRZ008-L1
HRZ010-WS
HRZ010-W1S
HRZ010-W2S



Series HRZ
Specific Product Precautions 3

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Operation

⚠ Caution

1. Confirmation before operation

1. The circulating fluid should be within the specified range of "HIGH" and "LOW".
2. Be sure to tighten the cap for the circulating fluid port until the click sound is heard.

2. Emergency stop method

In the case of an emergency, press down the EMO switch which is fitted on the front face of this product.

Operation Restart Time

⚠ 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.

Maintenance

⚠ Warning

1. Do not operate the switch with wet hands or touch electrical parts such as an electrical plug. This will lead to an electrical shock.

2. Do not splash water directly on this product for cleaning. This will lead to an electrical shock or a fire.

3. When the panel was removed for the purpose of inspection or cleaning, mount the panel after works were done.

If the panel is still open, or running the equipment with the panel removed, it may cause an injury or electric shock.

⚠ Caution

1. In order to prevent a sudden product failure of the unit, replace the replacement parts every 36 months.

2. Perform an inspection of the circulating fluid every 3 months.

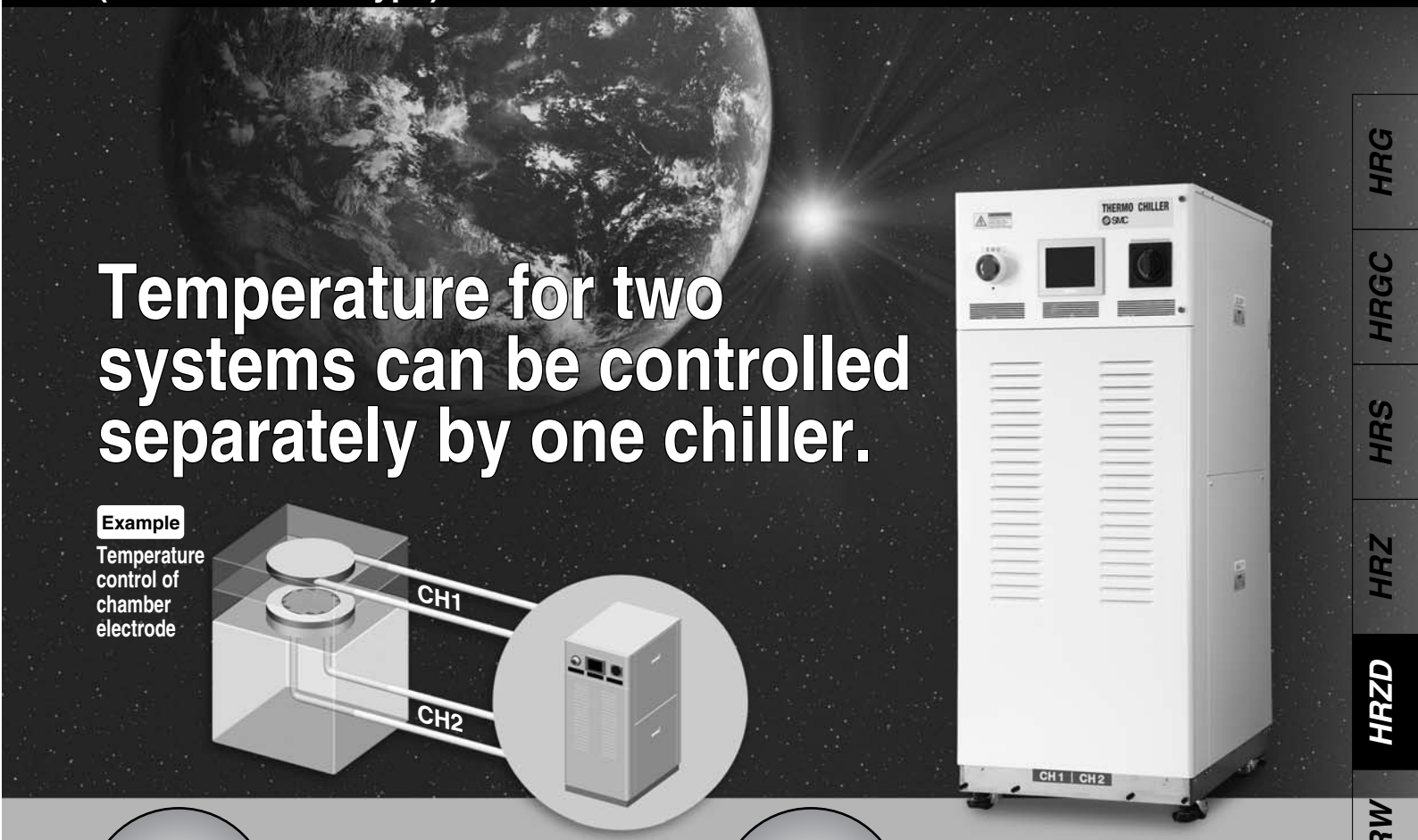
1. In the case of fluorinated fluids:
   Discharge the circulating liquid and avoid any dirty objects, or water moisture, or foreign objects entering the system.
2. In the case of ethylene glycol aqueous solution:
   Maintain the condensation at 60%.
3. In the case of clear water, deionized water:
   Replacement is recommended.

3. Check the water quality of cooling water every 3 months.

Regarding the water quality standards for cooling water, refer to "Temperature Control Equipment Precautions".

Refrigerated Dual Thermo-chiller *Series HRZD*

(Double inverter type)



Temperature for two systems can be controlled separately by one chiller.

Energy-saving

Double inverter type

More effective energy-saving is achieved through use of a **DC inverter compressor** and an **inverver** pump.

Power consumption:

Reduced by 84%

2.2 kWh/h

(Conventional model: 13.8 kWh/h)

Facility water consumption:

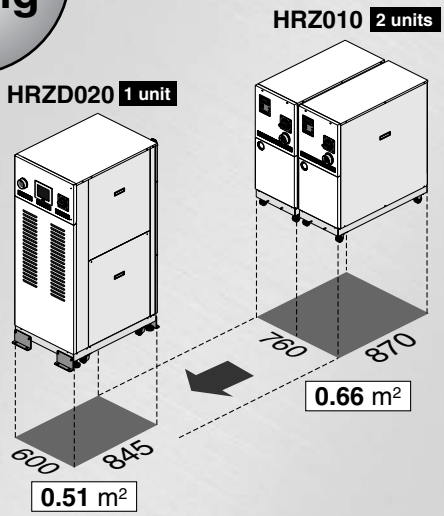
Reduced by 90%

4 L/min (Conventional model: 40 L/min)

Conditions: Circulating fluid temperature –10°C, Galden® HT135 x 20 L/min, Piping 3/4 inch x 4 m, Idling 50%, Process 50% operation with 2 kW customer load, 60 Hz

Space-saving

Footprint reduced by 23%



Reduced wiring, piping and labor

Single power cable, single facility-water piping system

Switchover from the conventional model is also possible.

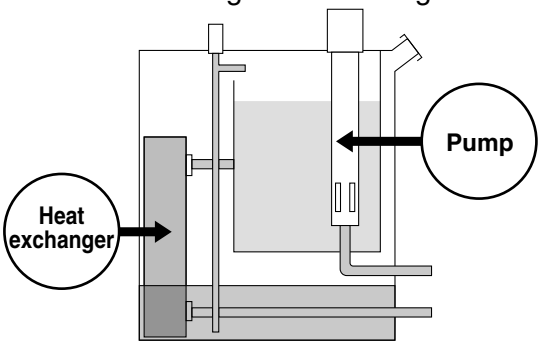
International standards: CE **SEMI Standard S2-0706, S8-0308, F47-0706**

- Temperature range setting: **–30 to 90°C** (Fluorinated fluid)
- Temperature stability: **±0.1°C**
- Circulating fluid flow range: **10 to 40 L/min**
- Cooling capacity: **Max. 10 kW x 2 ch**
- Type of circulating fluid:
  Galden® Fluorinert™
  Ethylene glycol aqueous solution
- Communications: (Standard equipment)
  Contact input/output
  Serial RS-485/RS-232C
  Analog communication
  (Selectable on the touch panel)

Leakless

All in Tank

Accommodation of a pump and a heat exchanger inside the tank can eliminate the external leakage of circulating fluid.

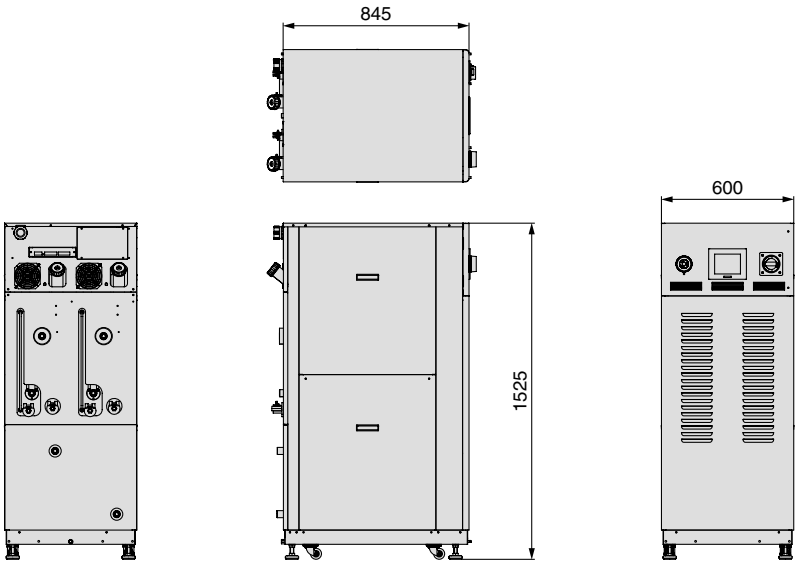


Specifications (Fluorinated Fluid Type)

Model	HRZD020-WS-WS	
Channel	1	2
Cooling method	Water-cooled refrigeration	
Cooling capacity Note 1) (kW)	9.5 (Circulating fluid temperature at 20°C)	9.5 (Circulating fluid temperature at 20°C)
Temperature range setting (°C)	–30 to 90	–30 to 90
Temperature stability (°C)	±0.1 Note 2)	±0.1 Note 2)
Circulating fluid flow range Note 3) (L/min)	10 to 40	10 to 40
Circulating fluid	–30 to 40°C: Galden® HT135 Note 4) Fluorinert™ FC-3283 Note 4) 20 to 90°C: Galden® HT200 Note 4) Fluorinert™ FC-40 Note 4)	
Refrigerant	R404A (HFC)	R404A (HFC)
Pump capacity Note 5) (MPa)	Max. 0.72 (at 20 L/min) With flow control function by inverter	Max. 0.72 (at 20 L/min) With flow control function by inverter
Main tank capacity Note 6) (L)	Approx.15	Approx.15
Sub-tank capacity Note 7) (L)	Approx.16	Approx.16
Circulating fluid connection port size (Outlet/Return port)	Rc3/4	Rc3/4
Facility water (°C/MPa)	10 to 35 / 0.3 to 0.7	
Facility water required flow rate Note 8) (L/min)	15 (Facility water temperature at 25°C)	15 (Facility water temperature at 25°C)
Facility water connection port size (Inlet/Outlet)	Rc1/2 (Single system for Channel 1, 2)	
Power supply	3-phase, 50/60 Hz, AC200, 200 to 208 V ±10%	
Main breaker capacity (A)	60	
Dimensions Note 9) (mm)	W600 x D845 x H1525	
Weight Note 10) (kg)	380	
Communications	Serial RS-485/RS-232C (D-sub9 pin), Contact input/output, Analog input/output (D-sub25 pin)	

Note 1) Values of facility water at 25°C, circulating fluid flow rate 20 L/min. Values when the heat generation source is directly connected to the circulating fluid circuit in this product. Common for 50/60 Hz.
Note 2) Values may go beyond the specified range depending on the operating condition.
Note 3) Depending on the piping specifications of the customer system, it may not be controlled by the set value.
Note 4) Galden® is a registered trademark of Solvay Solexis, Inc. Fluorinert™ is a trademark of 3M.
Note 5) Circulating fluid temperature at 20°C, Capacity at the outlet on this product. Common for 50/60 Hz.
Note 6) Minimum volume required for operating this product only. (Circulating fluid temperature at 20°C, including volume for the piping and the heat exchanger inside this product)
Note 7) Preliminary space volume without main tank capacity. Use for collecting circulating fluid inside the external piping or for preliminary injection.
Note 8) Required flow rate during the temperature drop. Possible to operate this product at approx. 1 to 2 L/min when there is no load.
Note 9) Dimensions between panels, not including the dimensions of protrusion such as a breaker handle.
Note 10) Weight in the dry state without circulating fluids

Dimensions



Circulating Fluid Temperature Controller

Water-cooled Thermo-chiller *Series HRW*

Refrigerant-free and energy saving type using no compressor.
Ideal for ordinary temperature and high temperature processes.

- Type of circulating fluid: **Fluorinated fluids/Ethylene glycol aqueous solution/Clear water, Deionized water**
- Temperature range setting: **20** to **90**°C
- Cooling capacity: **2** kW/**8** kW/**15** kW/**30** kW
- Temperature stability: ±**0.3**°C

More effective energy-saving through use of an inverter pump

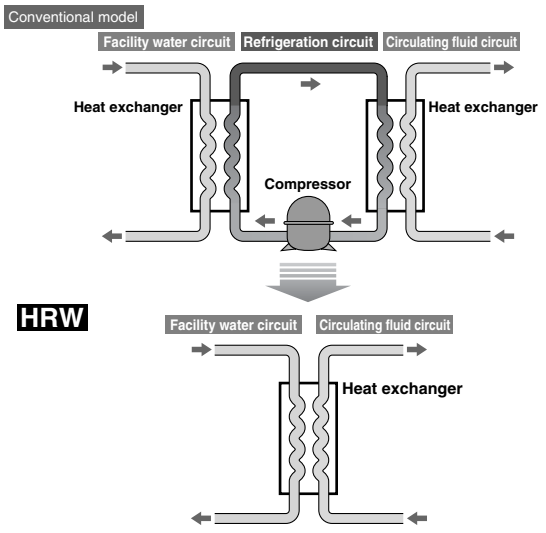
Inverter type
Power consumption
0.5 kWh/h
Facility water
1.2 L/min

- International standards: CE, cULus, SEMATECH S2-93, S8-95, SEMI Standard S2-0703, S8-1103, F47-0200

Energy-Saving and Refrigerant-free

Energy-saving and refrigerant-free (Ordinary temperature up to 90°C)

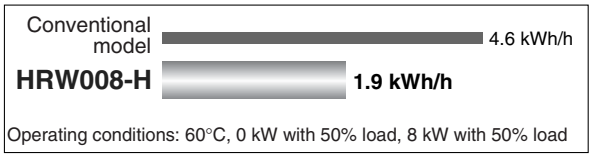
The water-cooled Thermo-chiller which does not use a compressor (refrigerant-free) is suitable for processes operating from ordinary temperature to 90°C. The energy-savings shown below can be achieved in comparison with existing models (depending on the conditions).



● Power consumption: Max. 59% reduction

(SMC comparison)

The power consumption can be reduced by direct heat exchange between the circulating fluid and facility water with no refrigerating circuit.

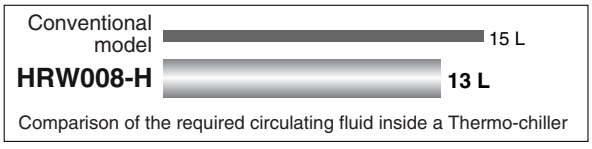


- Reduced running cost
- Contribution to the environmental preservation

● Circulating fluid: Max. 13% reduction

(SMC comparison)

Enhanced temperature control technology and the unique pump/tank construction achieved the reduced circulating fluid required for operation.

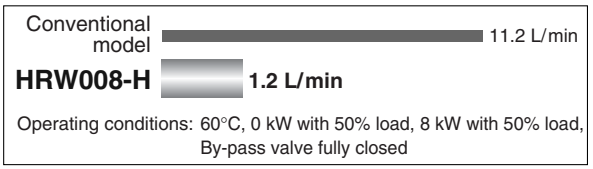


- Reduced initial cost
- Contribution to the environmental preservation

● Facility water: Max. 89% reduction

(SMC comparison)

The HRW series can achieve reduction in power consumption as it does not have a compressor, and reduction in the amount of facility water used because heat is exchanged directly with the circulating fluid.



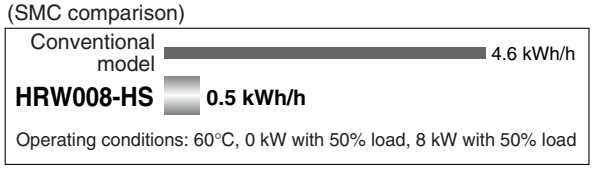
- Reduced facilities investment
- Space saved facility water equipment
- Reduced running cost

Pump Inverter Type

More effective energy-saving is achieved through use of an *inverter pump*.

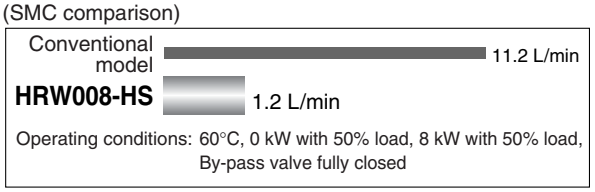
Power consumption: Max. 89% reduction

(SMC comparison)



● Facility water: Max. 89% reduction

(SMC comparison)



Space-Saving

Installation area: Max. 45% reduction

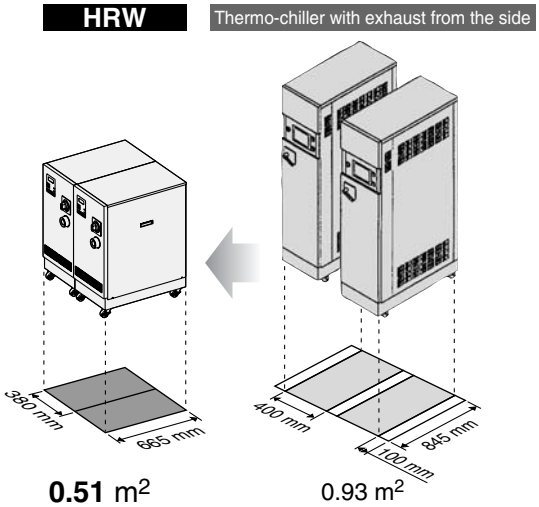
(SMC comparison)

(Forced exhaust from rear side)

By emitting the heat from the back, ventilation slits on the side are unnecessary offering reduced installation space.

Thermo-chiller with exhaust from the side:
Body space: W400 mm x D845 mm
Ventilation space: 100 mm

HRW008-H: Body space: W380 mm x D665 mm
Ventilation space: 0

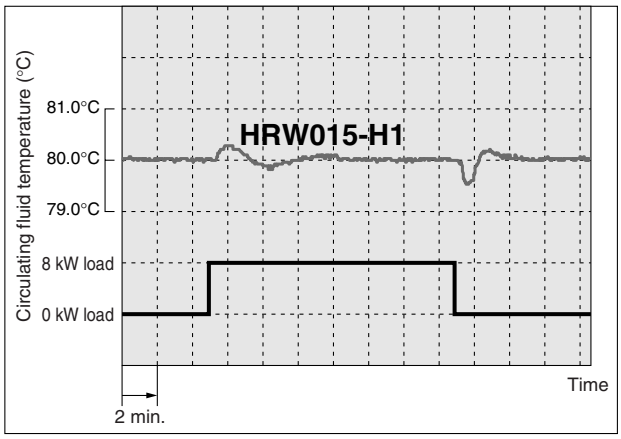


High Performance

Temperature stability: ±0.3°C

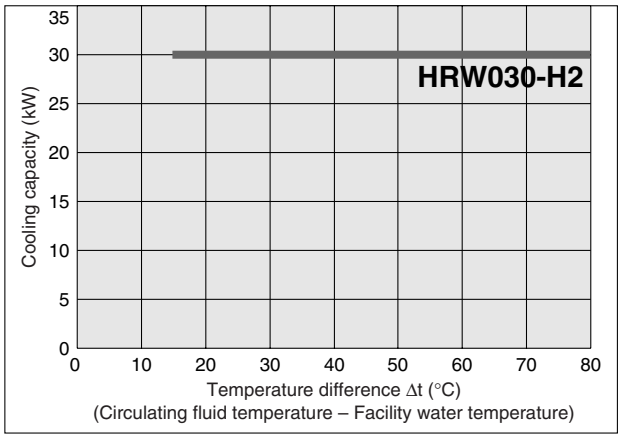
(when a load is stable)

Enhanced temperature control technology achieved ±0.3°C temperature stabilities when a load is stable.



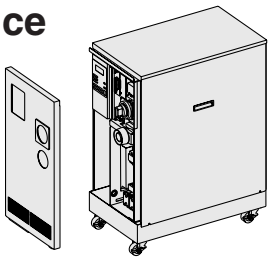
Cooling capacity: Max. 30 kW

Up to 30 kW cooling capacity achieved.

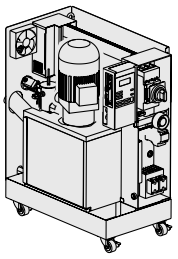


Easy maintenance

- Checking the electrical component parts accessible from the front side only



- Possible to replace the maintenance parts (such as a pump) without removing the pipings and discharging the circulating fluid.



- Various alarm displays (Refer to page 149.)

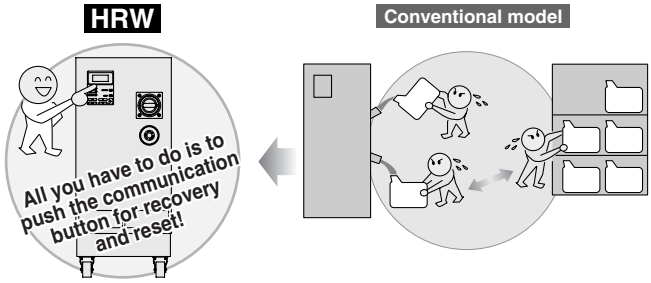
Easy Maintenance

Circulating fluid automatic recovery function

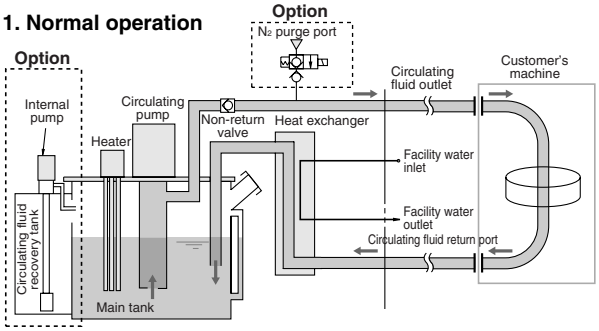
(Refer to "Options" on page 151.)

Circulating fluid inside a Thermo-chiller tank can be recovered automatically. (Recovery volume: 12 L)

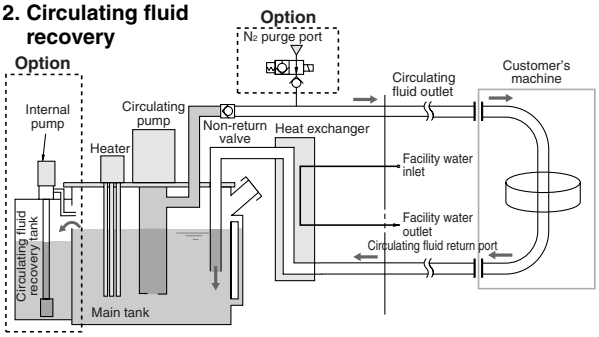
- Reduced maintenance time
- Faster operation
- Reduced circulating liquid loss by evaporation or spill



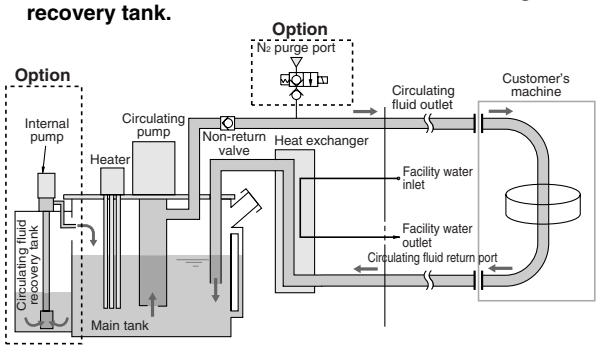
1. Normal operation



2. Circulating fluid recovery



3. Fluid returns to the main tank from the circulating fluid recovery tank.



Circulating fluid electrical resistivity control function

(Refer to "Options" on page 150.)

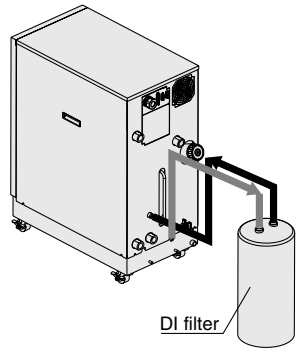
(DI control kit)

Electrical Resistivity Control

DI control kit

(Refer to “Options” on page 150.)

Electrical resistivity of circulating fluid (ethylene glycol aqueous solution and deionized water) can be controlled.



Communications

- Contact input/output signal
- Serial RS-485 communication
- Analog communication (Refer to “Options” on page 150.)
- DeviceNet communication (Refer to “Options” on page 150.)

DeviceNet™

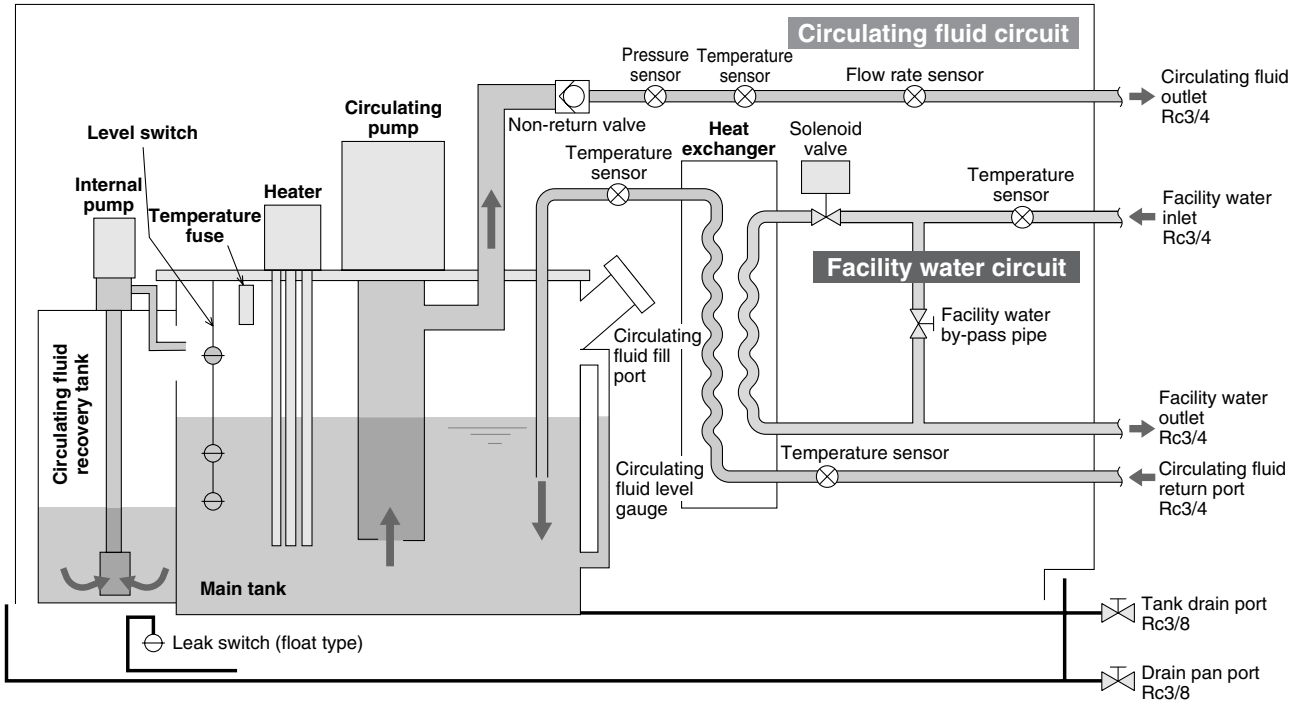
Wetted parts adopt the materials compatible for various circulating fluids.

(Stainless steel, EPDM, etc.)

- Fluorinated fluids: Flourinert™ FC-40
  GALDEN® HT200
- 60% ethylene glycol aqueous solution
- Deionized water/Clear water

Regarding the fluid other than the above, please contact SMC.
Flourinert™ is a trademark of 3M. GALDEN® is a registered trademark of Solvay Solexis, Inc.

Construction and Principles



Circulating fluid circuit

With the **circulating pump**, circulating fluid will be discharged to the customer’s machine side. After the circulating fluid will heat or cool the customer’s machine side, it will be returned to the **main tank** via the **heat exchanger**.
When the automatic circulating fluid recovery function, which recovers the circulating fluid from the customer's machine, is selected (refer to page 131), a **sub-tank** for recovery is installed. The **internal pump** is used to transfer a circulating fluid from the **sub-tank** to the **main tank**.

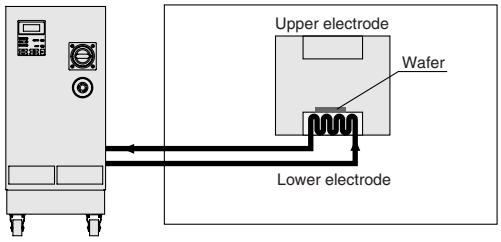
Facility water circuit

When the circulating fluid temperature rises higher than the set temperature, open the **solenoid valve** to introduce facility water to the **heat exchanger**.
When the circulating fluid temperature falls back below the set temperature, close the **solenoid valve** to shut off facility water to the **heat exchanger**.

Application Examples

Semiconductor

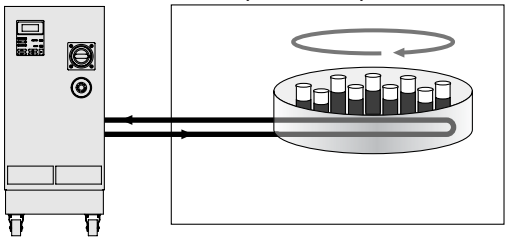
Example: Temperature control of chamber electrode



- **Etching equipment**
- **Spatter equipment**
- **Cleaning equipment**
- **Coating equipment**
- **Dicing equipment**
- **Tester, etc.**

Medical

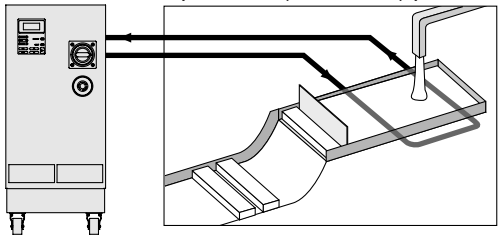
Example: Blood preservation



- **X-ray instrument**
- **MRI**
- **Blood preservation equipment**

Food

Example: Tofu (Bean curd) production

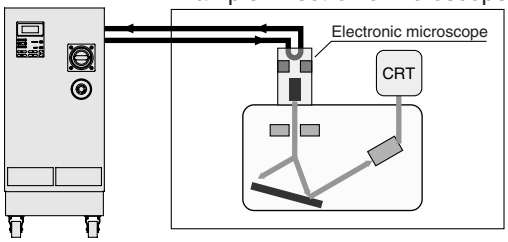


- **Bottle-cleaning machine**
- **Tofu (Bean curd) production equipment**
- **Noodle-making machine, etc.**

Water temperature control for forming tofu by mixing the boiled soybean milk and bittern

Analysis

Example: Electronic microscope

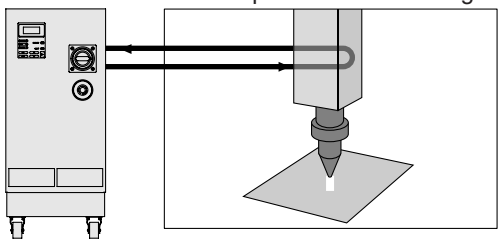


- **Electron microscope**
- **X-ray analytical instrument**
- **Gas chromatography**
- **Sugar level analytical instrument, etc.**

Prevents the distortion caused by the heat generated by the electronic gun in an electronic microscope.

Machine tool

Example: Laser machining

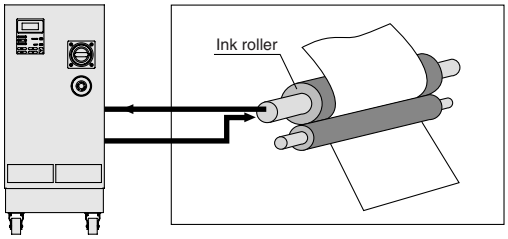


- **Wire cutting**
- **Grinder**
- **Spot welding**
- **Plasma welding**
- **Laser machining, etc.**

Temperature-controlling the laser generating tube enables the laser wave length to be optimised, improving the accuracy of the machined cross sectional area.

Printing

Example: Printing temperature control

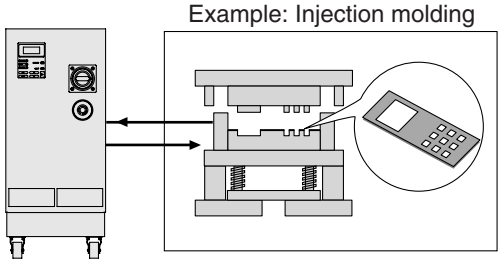


- **Offset printing machine**
- **Automatic developing machine**
- **UV equipment, etc.**

Temperature-controlling the ink roller enables to control the evaporation amount and viscosity of an ink and optimise the tint of colors.

Molding

Example: Injection molding



- **Plastic molding**
- **Rubber molding**
- **Wire cable coating machine**
- **Injection molding, etc.**

Temperature-controlling the mold results in improved product quality.

CONTENTS

Series HRW

Series HRW
Model Selection

Guide to Model Selection

1. How much is the temperature in degrees centigrade for the circulating fluid?

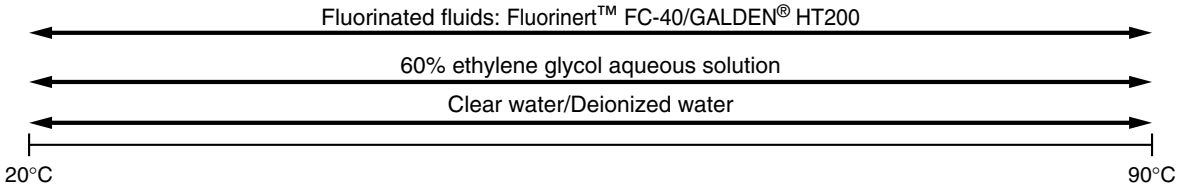
Temperature range which can be set with the Thermo-chiller

H: 20°C to 90°C

Example) Customer requirement: 50°C

2. What kind of the circulating fluids will be used?

Relationship between circulating fluid (which can be used with the Thermo-chiller) and temperature



Example) Customer requirement: Clear water

3. How much is the temperature in degrees centigrade for the facility water?

Temperature range which can be set with the Thermo-chiller

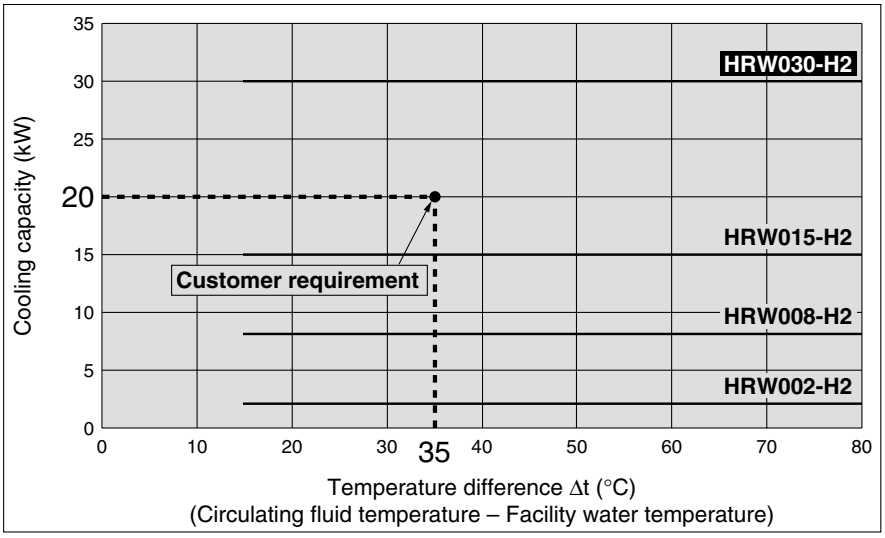
10°C to 35°C

Example) Facility water temperature of customer's machine: 15°C
Temperature difference between the circulating fluid and facility water is: 50 – 15 = 35°C.

4. What is the kW for the required cooling capacity?

Example) Customer requirement: 20 kW → **Plot the point where the temperature difference between the circulating fluid and facility water (35°C) intersects the cooling capacity (20 kW) in the cooling capacity graph.**

[Cooling Capacity Graph] Circulating Fluid: Clear Water/Deionized Water



The point plotted in the graph is the requirement from your customer. Select the Thermo-chiller models exceeding this point. In this case, select the **HRW030-H2**.

Required Cooling Capacity Calculation

Example 1: When the heat generation amount in the customer's machine is known.

Heat generation amount Q: 3.5 kW

Cooling capacity = Considering a safety factor of 20%, **3.5 x 1.2 = 4.2 kW**

Example 2: When the heat generation amount in the customer's machine is not known.

Obtain the temperature difference between inlet and outlet by circulating the circulating fluid inside the customer's machine.

Heat generation amount **Q**	: Unknown
Circulating fluid temperature difference Δ**T** (= **T2** – **T1**)	: 6.0°C (6.0 K)
Circulating fluid outlet temperature **T1**	: 20°C (293.15 K)
Circulating fluid return temperature **T2**	: 26°C (299.15 K)
Circulating fluid flow rate **L**	: 20 L/min
Circulating fluid	: Fluorinated fluid
	Density γ: 1.80 x 10^3 kg/m^3
	Specific heat **C**: 0.96 x 10^3 J/(kg·K) (at 20°C)

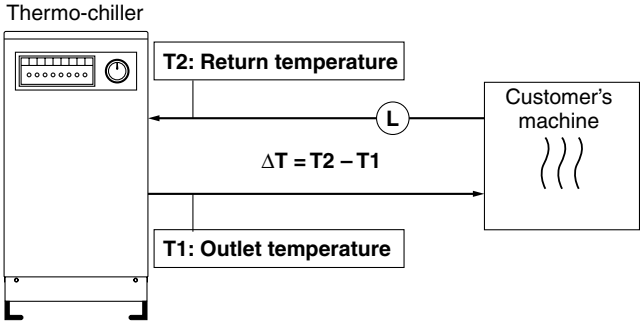
∗ Refer to page 139 for the typical physical property values by circulating fluid.

$$Q = \frac{\Delta T \times L \times \gamma \times C}{60 \times 1000}$$

$$= \frac{6.0 \times 20 \times 1.80 \times 10^3 \times 0.96 \times 10^3}{60 \times 1000}$$

= 3456 W = 3.5 kW

Cooling capacity = Considering a safety factor of 20%,
3.5 x 1.2 = 4.2 kW



Example of conventional measurement units (Reference)

Unknown
6.0°C
20°C
26°C
1.2 m^3/h
Fluorinated fluid
Density γ: 1.80 x 10^3 kg/m^3
Specific heat **C**: 0.23 kcal/kg·°C (at 20°C)

∗ Refer to page 139 for the typical physical property values by circulating fluid.

$$Q = \frac{\Delta T \times L \times \gamma \times C}{860}$$

$$= \frac{6.0 \times 1.2 \times 1.80 \times 10^3 \times 0.23}{860}$$

= 3.5 kW

Cooling capacity = Considering a safety factor of 20%,
3.5 x 1.2 = 4.2 kW

Model Selection

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.

Cooled substance total volume **V** : 60 L
Cooling time **h** : 15 min
Cooling temperature difference Δ**T**: 20°C (20 K) (70°C – 50°C → 20°C)
Facility water temperature : 20°C (293.15 K)
Circulating fluid : Fluorinated fluid
Density γ: 1.74 x 10^3 kg/m^3
Specific heat **C**: 1.05 x 10^3 J/(kg·K) (at 50°C)

∗ Refer to page 139 for the typical physical property values by circulating fluid.

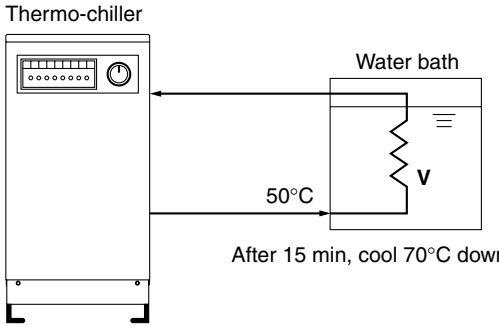
$$Q = \frac{\Delta T \times V \times \gamma \times C}{h \times 60 \times 1000}$$

$$\frac{20 \times 60 \times 1.74 \times 10^3 \times 1.05 \times 10^3}{15 \times 60 \times 1000} = 2436\ W = 2.4\ kW$$

Cooling capacity = Considering a safety factor of 20%,

2.4 x 1.2 = 2.9 kW (When the circulating fluid temperature is 50°C.)

(In this case, selected Thermo-chiller model will be the HRW008-H.)



After 15 min, cool 70°C down to 50°C.

Example of conventional measurement units (Reference)

0.06 m^3
0.25 h
20°C
20°C
Fluorinated fluid
Density γ: 1.74 x 10^3 kg/m^3
Specific heat **C**: 0.25 kcal/kg·°C (at 50°C)

∗ Refer to page 139 for the typical physical property values by circulating fluid.

$$Q = \frac{\Delta T \times V \times \gamma \times C}{h \times 860}$$

$$= \frac{20 \times 0.06 \times 1.74 \times 10^3 \times 0.25}{0.25 \times 860}$$

$$= 2.4\ kW$$

Cooling capacity = Considering a safety factor of 20%,

2.4 x 1.2 = 2.9 kW (When the circulating fluid temperature is 50°C.)

(In this case, selected Thermo-chiller model will be the HRW008-H.)

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

Precautions on Model Selection

1. Temperature difference between the circulating fluid and facility water

The HRW series exchanges heat between the circulating fluid and facility water directly, so it may not be possible to lower the circulating fluid temperature to the set temperature if the facility water temperature is too high. Check that the facility water temperature can be maintained for the circulating fluid temperature referring to the cooling capacity graph of each model before using.

2. Heating capacity

When setting the circulating fluid temperature at a higher temperature than the room temperature, the circulating fluid temperature will be heated with the Thermo-chiller. Heating capacity varies depending on the circulating fluid temperature. Also, the heating capacity varies depending on the circulating fluid temperature. Consider the heat radiation amount or thermal capacity of the customer's equipment. Check beforehand if the required heating capacity is provided, based on the heating capacity graph for the respective model.

3. Pump capacity

<Circulating fluid flow rate>

Pump capacity varies depending on the model selected from the HRW series. Also, circulating fluid flow varies depending on the circulating fluid discharge pressure. Consider the installation height difference between our Thermo-chiller and a customer's machine, and the piping resistance such as circulating fluid pipings, or piping size, or piping curves in the machine. Check beforehand if the required flow rate is achieved, using the pump capacity curves for each respective model.

<Circulating fluid discharge pressure>

Circulating fluid discharge pressure has the possibility to increase up to the maximum pressure in the pump capacity curves for the respective model. Check beforehand if the circulating fluid pipings or circulating fluid circuit of the customer's machine are fully durable against this pressure.

Circulating Fluid Typical Physical Property Values

∗ The above shown are reference values.
Please contact circulating fluid supplier for details.

Fluorinated Fluids

Physical property value / Temperature	Density γ	Specific heat C	
	[kg/m^3] [g/L]	[J/(kg·K)]	([kcal/kg·°C])
–10°C	1.87 x 10^3	0.87 x 10^3	0.21
20°C	1.80 x 10^3	0.96 x 10^3	0.23
50°C	1.74 x 10^3	1.05 x 10^3	0.25
80°C	1.67 x 10^3	1.14 x 10^3	0.27

60% Ethylene Glycol Aqueous Solution

Physical property value / Temperature	Density γ	Specific heat C	
	[kg/m^3] [g/L]	[J/(kg·K)]	([kcal/kg·°C])
–10°C	1.10 x 10^3	3.02 x 10^3	0.72
20°C	1.08 x 10^3	3.15 x 10^3	0.75
50°C	1.06 x 10^3	3.27 x 10^3	0.78
80°C	1.04 x 10^3	3.40 x 10^3	0.81

Water

Density γ: 1 x 10^3 [kg/m^3] [g/L] **Specific heat C: 4.2 x 10^3 [J/(kg·K)] (1.0 [kcal/kg·°C])**

Thermo-chiller Fluorinated Fluid Type
Series HRW

SEMI

How to Order

Fluorinated Fluid Type **HRW 002 – H □ – □**

Cooling capacity

Symbol	Cooling capacity
002	2 kW
008	8 kW
015	15 kW
030	30 kW

Option

Symbol	Option
Nil	None
C	Analog communication
D	DeviceNet communication
N	NPT fitting
Z	Circulating fluid automatic recovery

Temperature range setting

Symbol	Temperature range setting
H	20 to 90°C

Pump inverter control

Symbol	Pump inverter control
Nil	None
S	Applicable (Pump inverter type)

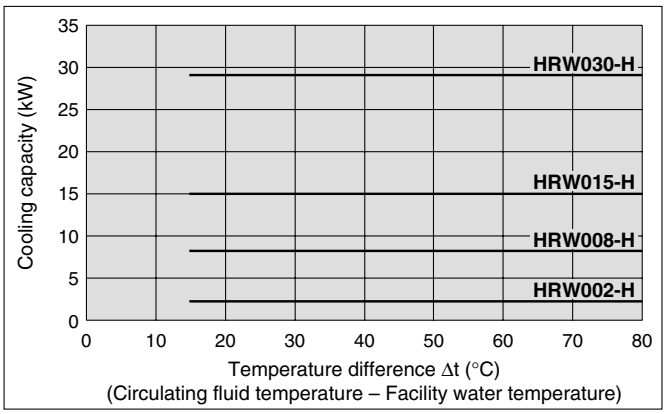
Specifications (For details, please consult our "Product Specifications" information.)

Model			HRW002-H HRW002-HS	HRW008-H HRW008-HS	HRW015-H HRW015-HS	HRW030-H HRW030-HS
Cooling method			Water-cooled			
Ambient temperature/humidity Note 1)			Temperature: 10 to 35°C, Humidity: 30 to 70%RH			
Circulating fluid system	**Circulating fluid** Note 2)		Fluorinert™ FC-40/GALDEN® HT200			
	Temperature range setting Note 1) **(°C)**		20 to 90			
	Cooling capacity (50/60 Hz common) (kW)		2	8	15	29
	Conditions	**Circulating fluid temperature (°C)**	Facility water temperature +15			
		Facility water temperature (°C)	10 to 35			
		Circulating fluid rated flow (L/min)	4	30	40	40
		Facility water required flow rate (L/min)	10	20	25	40
	Temperature stability Note 3) **(°C)**		±0.3			
	Pump capacity Note 4) **(50/60 Hz) (MPa)**		0.40/0.60 (at 4 L/min)	0.45/0.65 (at 30 L/min)	0.40/0.60 (at 40 L/min)	0.40/0.60 (at 40 L/min)
	Circulating fluid flow range Note 5) **(L/min)**		3 to 16	9 to 50		
	Tank capacity Note 6) **(L)**		Approx. 13		Approx. 14	
	Circulating fluid recovery tank volume Note 7) **(L)**		12			
	Port size		Rc3/4			
	Wetted parts material		Copper brazing (Heat exchanger), Stainless steel, EPDM, Silicone, PPS, Fluororesin			
Facility water system	**Temperature range (°C)**		10 to 35			
	Required flow rate Note 8) **(L/min)**		10	20	25	40
	Inlet pressure range (MPa)		0.3 to 0.7			
	Port size		Rc3/4			
	Wetted parts material		Copper brazing (Heat exchanger), Stainless steel, EPDM, Silicone, Bronze, Brass			
Electrical system	**Power supply**		3-phase 200/200 to 208 VAC ±10%			
	Max. operating current (A)		26			
	Breaker capacity (A)		30			
	Communications		Serial RS-485 (D-sub 9 pin) and Contact input/output (D-sub 25 pin)			
Dimensions Note 9) **(mm)**			W380 x D665 x H860			
Weight Note 10) **(kg)**			Approx. 90		Approx. 100	
Safety standards			UL, CE marking, SEMI (S2-0703, S8-1103, F47-0200), SEMATECH (S2-93, S8-95)			

Note 1) It should have no condensation.
Note 2) Fluorinert™ is a trademark of 3M and GALDEN® is a registered trademark of Solvay Solexis, Inc. Regarding the fluid other than the above, please contact SMC.
Note 3) Outlet temperature when the circulating fluid and facility water are rated flow, and the circulating fluid outlet and return port are directly connected. Installation environment, power supply, and facility water are within specification range and stable. Value obtained 10 minutes after the external load is stabilized. It may be out of ±0.3°C in some other operating conditions.
Note 4) The capacity at the circulating fluid outlet when the circulating fluid temperature is 20°C. Pump capacity at 60 Hz indicates the maximum capacity of the HRW□□□-HS (pump inverter type).
Note 5) Applicable to the HRW□□□-HS (pump inverter type) only.
Note 6) Minimum volume required for operating only the Thermo-chiller. (Circulating fluid temperature: 20°C, including the Thermo-chiller's internal pipings or heat exchanger)
Note 7) The automatic circulating fluid recovering function will be provided by selecting option Z for collecting the circulating fluid inside an external piping.
Note 8) Required flow rate for cooling capacity or maintaining the temperature stability.
Note 9) Panel dimensions. These dimensions do not include possible protrusions such as a breaker handle.
Note 10) Weight in the dry state without circulating fluids

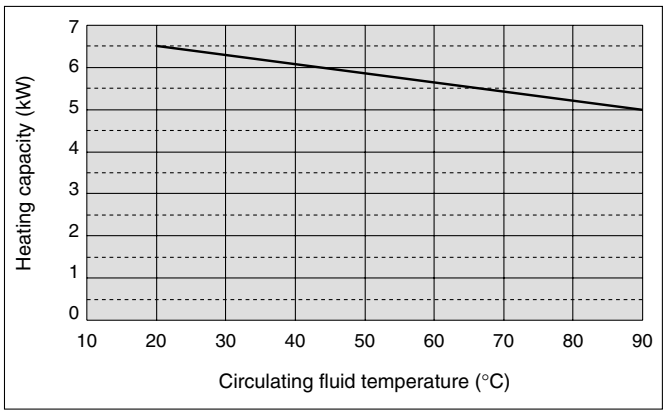
Cooling Capacity

HRW002-H/008-H/015-H/030-H
HRW002-HS/008-HS/015-HS/030-HS



Heating Capacity

HRW002-H/008-H/015-H/030-H
HRW002-HS/008-HS/015-HS/030-HS

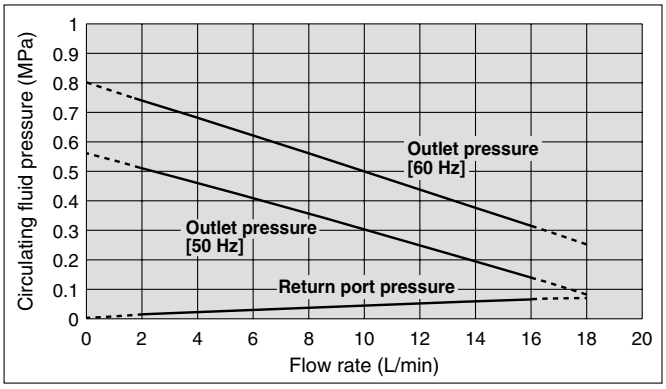


∗ When pump inverter is operating at frequency of 60 Hz (maximum).

Pump Capacity

HRW002-H
HRW002-HS

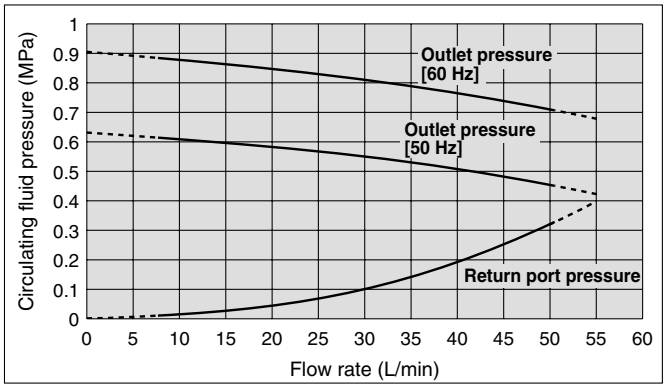
Circulating fluid: Fluorinated fluids
Circulating fluid temperature: 20°C



∗ If the circulating fluid flow drops below 2 L/min., the shutdown alarm activates and operation stops. Do not use the product when the flow exceeds 16 L/min., since the flow cannot be displayed accurately.
∗ Pump capacity at 60 Hz indicates the maximum capacity of the HRW002-HS (pump inverter type).

HRW008-H/015-H/030-H
HRW008-HS/015-HS/030-HS

Circulating fluid: Fluorinated fluids
Circulating fluid temperature: 20°C



∗ If the circulating fluid flow drops below 8 L/min., the shutdown alarm activates and operation stops. Do not use the product when the flow exceeds 50 L/min., since the flow cannot be displayed accurately.
∗ Pump capacity at 60 Hz indicates the maximum capacity of the HRW008-HS/015-HS/030-HS (pump inverter type).

Thermo-chiller Ethylene Glycol Type
Series HRW

SEMI

How to Order

Ethylene Glycol Type **HRW 002 – H 1 □ – □**

Cooling capacity

Symbol	Cooling capacity
002	2 kW
008	8 kW
015	15 kW
030	30 kW

Temperature range setting

Symbol	Temperature range setting
H	20 to 90°C

Ethylene glycol type

Pump inverter control

Symbol	Pump inverter control
Nil	None
S	Applicable (Pump inverter type)

Option

Symbol	Option
Nil	None
C	Analog communication
D	DeviceNet communication
N	NPT fitting
Y	DI control kit
Z	Circulating fluid automatic recovery

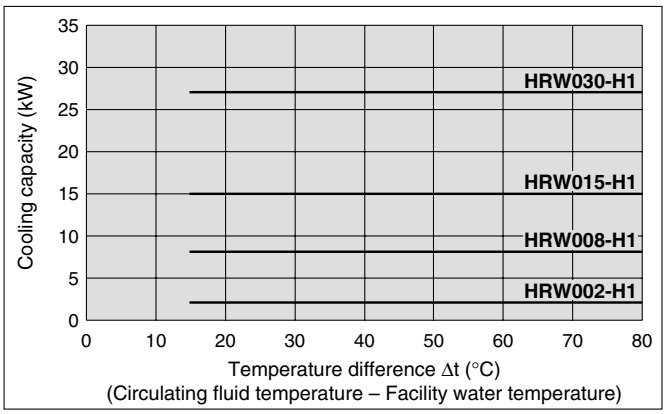
Specifications (For details, please consult our "Product Specifications" information.)

Model			HRW002-H1 HRW002-H1S	HRW008-H1 HRW008-H1S	HRW015-H1 HRW015-H1S	HRW030-H1 HRW030-H1S
Cooling method			Water-cooled			
Ambient temperature/humidity Note 1)			Temperature: 10 to 35°C, Humidity: 30 to 70%RH			
Circulating fluid system	Circulating fluid Note 2)		60% ethylene glycol aqueous solution			
	Temperature range setting Note 1)	(°C)	20 to 90			
	Cooling capacity (50/60 Hz common)	(kW)	2	8	15	27
	Conditions: Circulating fluid temperature	(°C)	Facility water temperature +15			
	Conditions: Facility water temperature	(°C)	10 to 35			
	Conditions: Circulating fluid rated flow	(L/min)	4	15	30	40
	Conditions: Facility water required flow rate	(L/min)	10	15	25	40
	Temperature stability Note 3)	(°C)	±0.3			
	Pump capacity Note 4) (50/60 Hz)	(MPa)	0.35/0.55 (at 4 L/min)	0.45/0.65 (at 15 L/min)	0.40/0.60 (at 30 L/min)	0.35/0.55 (at 40 L/min)
	Circulating fluid flow range Note 5)	(L/min)	3 to 16	9 to 50		
	Tank capacity Note 6)	(L)	Approx. 13			
	Circulating fluid recovery tank volume Note 7)	(L)	12			
	Port size		Rc3/4			
	Wetted parts material		Nickel brazing (Heat exchanger), Stainless steel, EPDM, Silicone, PPS, Fluororesin			
Facility water system	Temperature range	(°C)	10 to 35			
	Required flow rate Note 8)	(L/min)	10	15	25	40
	Inlet pressure range	(MPa)	0.3 to 0.7			
	Port size		Rc3/4			
	Wetted parts material		Nickel brazing (Heat exchanger), Stainless steel, EPDM, Silicone, Bronze, Brass			
Electrical system	Power supply		3-phase 200/200 to 208 VAC ±10%			
	Max. operating current	(A)	26			
	Breaker capacity	(A)	30			
	Communications		Serial RS-485 (D-sub 9 pin) and Contact input/output (D-sub 25 pin)			
Dimensions Note 9)		(mm)	W380 x D665 x H860			
Weight Note 10)		(kg)	Approx. 90			
Safety standards			UL, CE marking, SEMI (S2-0703, S8-1103, F47-0200), SEMATECH (S2-93, S8-95)			

Note 1) It should have no condensation.
Note 2) Dilute pure ethylene glycol with clear water. Additives invading wetting parts material such as preservatives cannot be used.
Note 3) Outlet temperature when the circulating fluid and facility water are rated flow, and the circulating fluid outlet and return port are directly connected. Installation environment, power supply, and facility water are within specification range and stable. Value obtained 10 minutes after the external load is stabilized (after stabilization with no load for HRW030-H1). It may be out of this range when a DI control kit (option Y) is used or in some other operating conditions.
Note 4) The capacity at the circulating fluid outlet when the circulating fluid temperature is 20°C. Pump capacity at 60 Hz indicates the maximum capacity of the HRW□□□-H1S (pump inverter type).
Note 5) Applicable to the HRW□□□-H1S (pump inverter type) only.
Note 6) Minimum volume required for operating only the Thermo-chiller. (Circulating fluid temperature: 20°C, including the Thermo-chiller's internal pipings or heat exchanger)
Note 7) The automatic circulating fluid recovering function will be provided by selecting option Z for collecting the circulating fluid inside an external piping.
Note 8) Required flow rate for cooling capacity or maintaining the temperature stability.
Note 9) Panel dimensions. These dimensions do not include possible protrusions such as a breaker handle.
Note 10) Weight in the dry state without circulating fluids

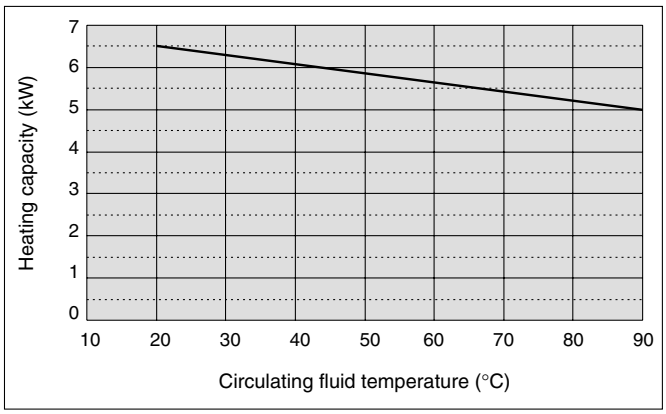
Cooling Capacity

HRW002-H1/008-H1/015-H1/030-H1
HRW002-H1S/008-H1S/015-H1S/030-H1S



Heating Capacity

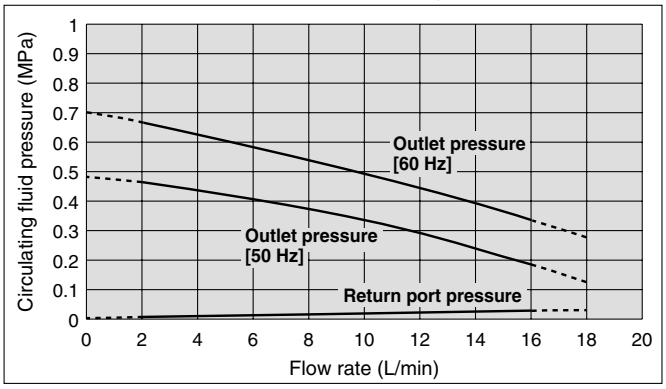
HRW002-H1/008-H1/015-H1/030-H1
HRW002-H1S/008-H1S/015-H1S/030-H1S



Pump Capacity

HRW002-H1
HRW002-H1S

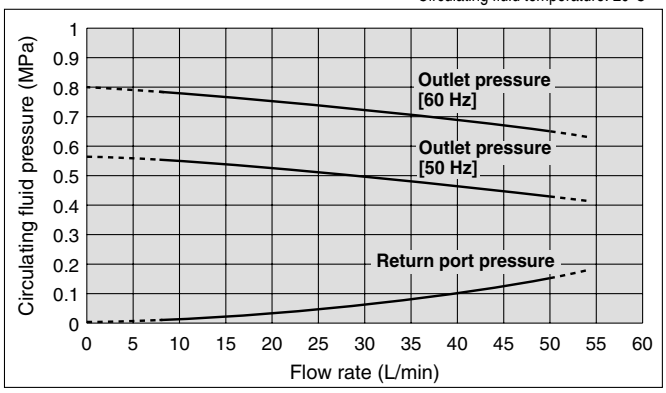
Circulating fluid: 60% ethylene glycol
Circulating fluid temperature: 20°C



∗ If the circulating fluid flow drops below 2 L/min., the shutdown alarm activates and operation stops. Do not use the product when the flow exceeds 16 L/min., since the flow cannot be displayed accurately.
∗ Pump capacity at 60 Hz indicates the maximum capacity of the HRW002-H1S (pump inverter type).

HRW008-H1/015-H1/030-H1
HRW008-H1S/015-H1S/030-H1S

Circulating fluid: 60% ethylene glycol
Circulating fluid temperature: 20°C



∗ If the circulating fluid flow drops below 8 L/min., the shutdown alarm activates and operation stops. Do not use the product when the flow exceeds 50 L/min., since the flow cannot be displayed accurately.
∗ Pump capacity at 60 Hz indicates the maximum capacity of the HRW008-H1S/015-H1S/030-H1S (pump inverter type).

Thermo-chiller Clear/Deionized Water Type

Series HRW

SEMI

How to Order

Clear/Deionized Water Type **HRW 002 – H 2 □ – □**

Cooling capacity

Symbol	Cooling capacity
002	2 kW
008	8 kW
015	15 kW
030	30 kW

Temperature range setting

Symbol	Temperature range setting
H	20 to 90°C

Clear/Deionized water type

Pump inverter control

Symbol	Pump inverter control
Nil	None
S	Applicable (Pump inverter type)

Option

Symbol	Option
Nil	None
C	Analog communication
D	DeviceNet communication
N	NPT fitting
Y	DI control kit
Z	Circulating fluid automatic recovery

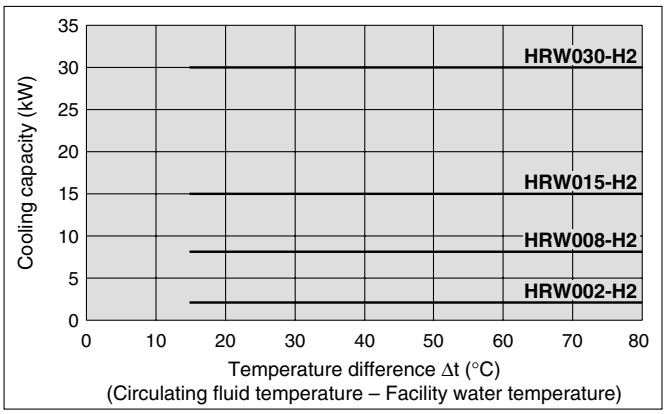
Specifications (For details, please consult our "Product Specifications" information.)

Model			HRW002-H2 HRW002-H2S	HRW008-H2 HRW008-H2S	HRW015-H2 HRW015-H2S	HRW030-H2 HRW030-H2S
Cooling method			Water-cooled			
Ambient temperature/humidity Note 1)			Temperature: 10 to 35°C, Humidity: 30 to 70%RH			
Circulating fluid system	Circulating fluid Note 2)		Clear water, Deionized water			
	Temperature range setting Note 1)	(°C)	20 to 90			
	Cooling capacity (50/60 Hz common)	(kW)	2	8	15	30
	Conditions: Circulating fluid temperature	(°C)	Facility water temperature +15			
	Conditions: Facility water temperature	(°C)	10 to 35			
	Conditions: Circulating fluid rated flow	(L/min)	4	15	30	40
	Conditions: Facility water required flow rate	(L/min)	10	15	25	40
	Temperature stability Note 3)	(°C)	±0.3			
	Pump capacity Note 4) (50/60 Hz)	(MPa)	0.35/0.55 (at 4 L/min)	0.45/0.65 (at 15 L/min)	0.40/0.60 (at 30 L/min)	0.35/0.55 (at 40 L/min)
	Circulating fluid flow range Note 5)	(L/min)	3 to 16	9 to 30		
	Tank capacity Note 6)	(L)	Approx. 13			
	Circulating fluid recovery tank volume Note 7)	(L)	12			
	Port size		Rc3/4			
	Wetted parts material		Nickel brazing (Heat exchanger), Stainless steel, EPDM, Silicone, PPS, Fluororesin			
Facility water system	Temperature range	(°C)	10 to 35			
	Required flow rate Note 8)	(L/min)	10	15	25	40
	Inlet pressure range	(MPa)	0.3 to 0.7			
	Port size		Rc3/4			
	Wetted parts material		Nickel brazing (Heat exchanger), Stainless steel, EPDM, Silicone, Bronze, Brass			
Electrical system	Power supply		3-phase 200/200 to 208 VAC ±10%			
	Max. operating current	(A)	26			
	Breaker capacity	(A)	30			
	Communications		Serial RS-485 (D-sub 9 pin) and Contact input/output (D-sub 25 pin)			
Dimensions Note 9)		(mm)	W380 x D665 x H860			
Weight Note 10)		(kg)	Approx. 90			
Safety standards			UL, CE marking, SEMI (S2-0703, S8-1103, F47-0200), SEMATECH (S2-93, S8-95)			

Note 1) It should have no condensation.
Note 2) If clear water or deionized water is used, please use water that conforms to Water Quality Standards of the Japan Refrigeration and Air Conditioning Industry Association (JRA GL-02-1994/cooling water system - circulation type - make-up water). The electrical conductivity of the deionized water used as the fluid varies depending on the operating conditions.
Note 3) Outlet temperature when the circulating fluid and facility water are rated flow, and the circulating fluid outlet and return port are directly connected. Installation environment, power supply, and facility water are within specification range and stable. Value obtained 10 minutes after the external load is stabilized (after stabilization with no load for HRW030-H2). It may be out of this range when a DI control kit (option Y) is used or in some other operating conditions.
Note 4) The capacity at the circulating fluid outlet when the circulating fluid temperature is 20°C. Pump capacity at 60 Hz indicates the maximum capacity of the HRW□□□-H2S (pump inverter type).
Note 5) Applicable to the HRW□□□-H2S (pump inverter type) only.
Note 6) Minimum volume required for operating only the Thermo-chiller. (Circulating fluid temperature: 20°C, including the Thermo-chiller's internal pipings or heat exchanger)
Note 7) The automatic circulating fluid recovering function will be provided by selecting option Z for collecting the circulating fluid inside an external piping.
Note 8) Required flow rate for cooling capacity or maintaining the temperature stability.
Note 9) Panel dimensions. These dimensions do not include possible protrusions such as a breaker handle.
Note 10) Weight in the dry state without circulating fluids

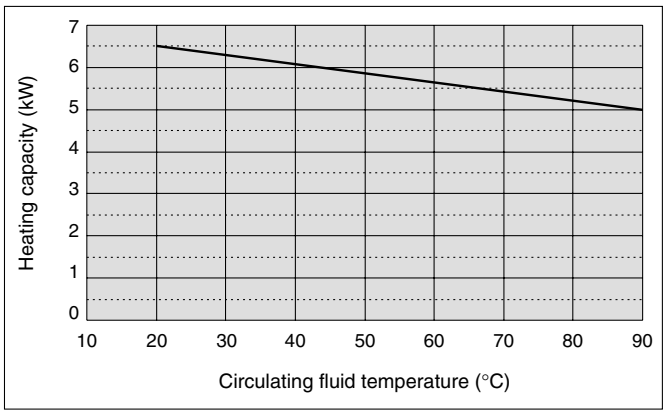
Cooling Capacity

HRW002-H2/008-H2/015-H2/030-H2
HRW002-H2S/008-H2S/015-H2S/030-H2S



Heating Capacity

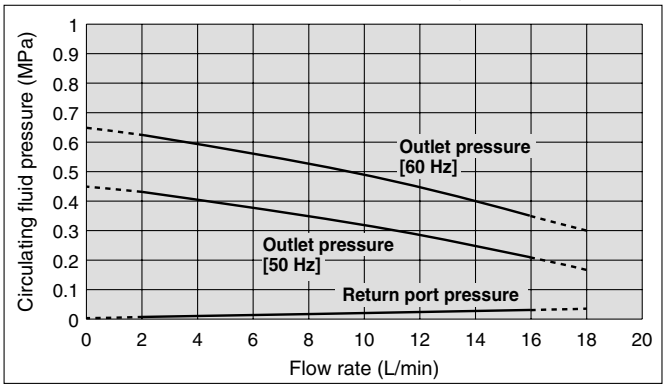
HRW002-H2/008-H2/015-H2/030-H2
HRW002-H2S/008-H2S/015-H2S/030-H2S



Pump Capacity

HRW002-H2
HRW002-H2S

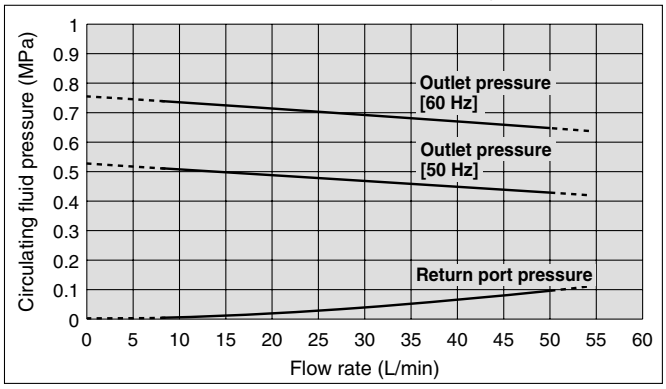
Circulating fluid: Clear water
Circulating fluid temperature: 20°C



∗ If the circulating fluid flow drops below 2 L/min., the shutdown alarm activates and operation stops. Do not use the product when the flow exceeds 16 L/min., since the flow cannot be displayed accurately.
∗ Pump capacity at 60 Hz indicates the maximum capacity of the HRW002-H2S (pump inverter type).

HRW008-H2/015-H2/030-H2
HRW008-H2S/015-H2S/030-H2S

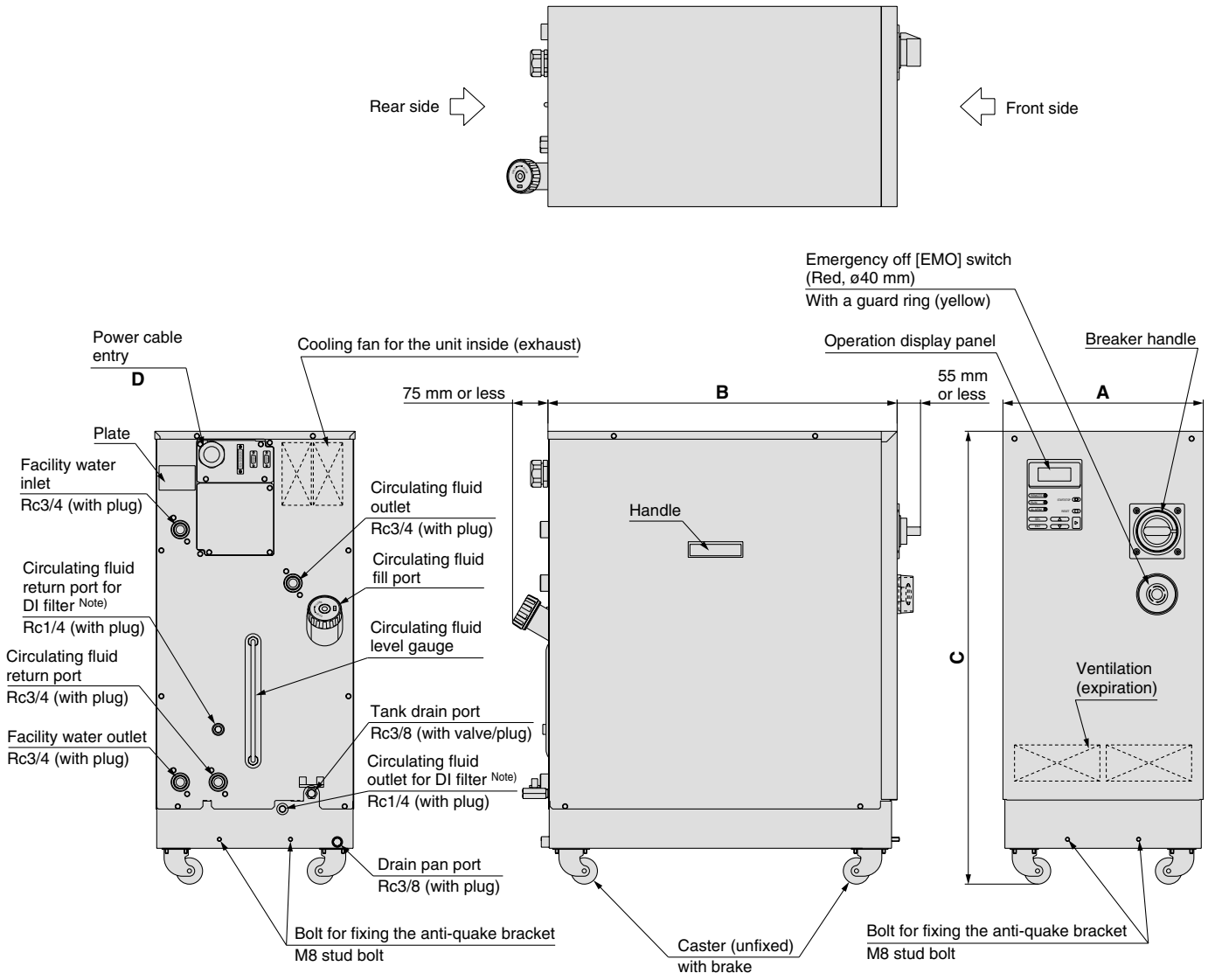
Circulating fluid: Clear water
Circulating fluid temperature: 20°C



∗ If the circulating fluid flow drops below 8 L/min., the shutdown alarm activates and operation stops. Do not use the product when the flow exceeds 50 L/min., since the flow cannot be displayed accurately.
∗ Pump capacity at 60 Hz indicates the maximum capacity of the HRW008-H2S/015-H2S/030-H2S (pump inverter type).

Common Specifications

Dimensions



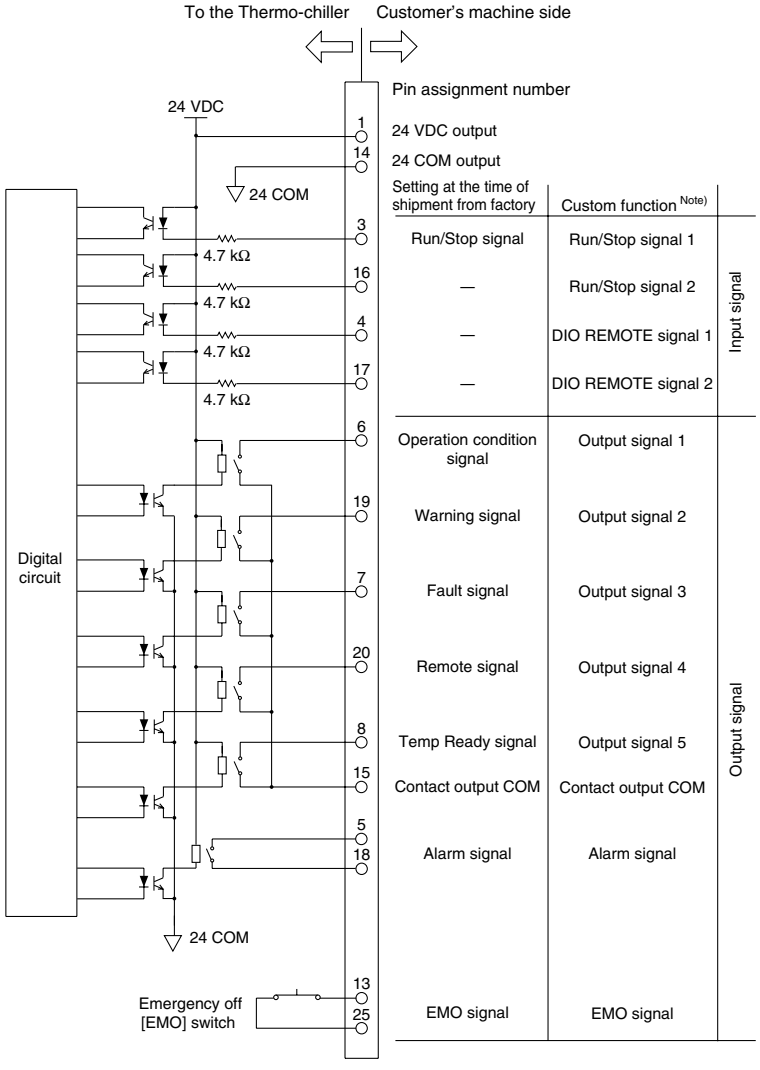
Note) Only when the DI control kit (option Y) is selected.

(mm)

Model			A	B	C	D
Fluorinated fluid type	Ethylene glycol type	Clear/Deionized water type				
HRW002-H	**HRW002-H1**	**HRW002-H2**	380	665	860	ø18.5 to 20.5
HRW008-H	**HRW008-H1**	**HRW008-H2**				
HRW015-H	**HRW015-H1**	**HRW015-H2**				
HRW030-H	**HRW030-H1**	**HRW030-H2**				

Communication Function (For details, please consult our “Communication Specifications” information.)

Contact Input/Output

Item		Specifications
Connector no.		P1
Connector type (on this product side)		D-sub 25 P type, Female connector
Fixing bolt size		M2.6 x 0.45
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
Output signal	Rated load voltage	48 VAC or less/30 VDC or less
	Maximum load current (total)	When using the power supply of the Thermo-chiller: 200 mA DC (resistance load/inductive load) When using the power supply of the customer’s machine: 800 mA AC/DC (resistance load/inductive load)
Alarm signal	Rated load voltage	48 VAC or less/30 VDC or less
	Maximum load current	800 mA AC/DC (resistance load/inductive load)
EMO signal	Rated load voltage	48 VAC or less/30 VDC or less
	Maximum load current	800 mA AC/DC (resistance load/inductive load)
Circuit diagram		

Note) The custom function is equipped for contact input/output. Using the custom function enables the customer to set the signal type for contact input/output or pin assignment numbers. For details, please consult “Communication Specifications” information.

Communication Function (For details, please consult our “Communication Specifications” information.)

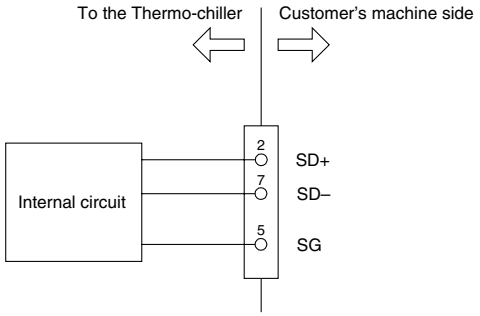
Serial RS-485

The serial RS-485 enables the following items to be written and read out.

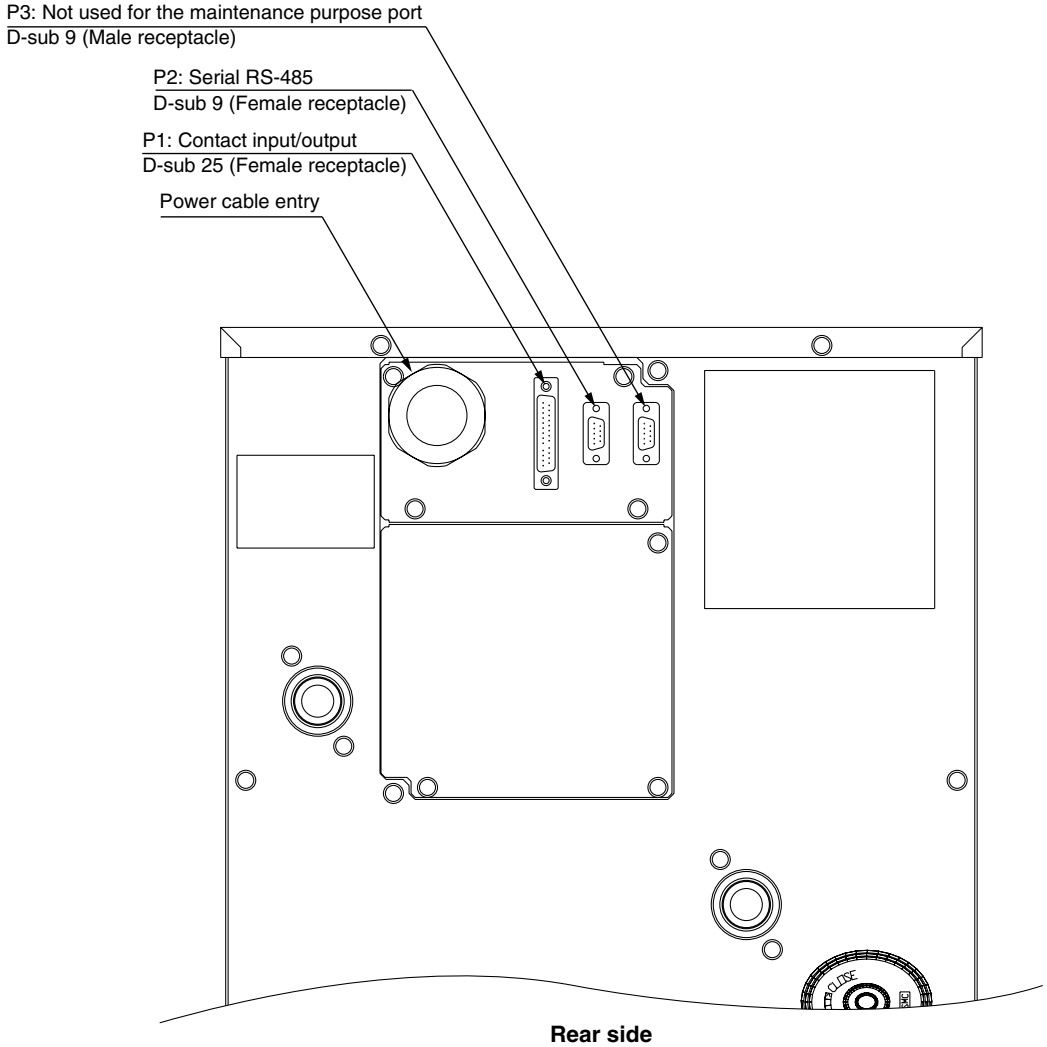
<Writing>
Run/Stop
Circulating fluid temperature setting
Circulating fluid automatic recovery start/stop*1

<Readout>
Circulating fluid present temperature
Circulating fluid flow
Circulating fluid discharge pressure
Circulating fluid electrical resistivity*2
Alarm occurrence information
Status (operating condition) information

*1 Only when the circulating fluid automatic recovery function (option Z) is selected.
*2 Only when the DI control kit (option Y) is selected.

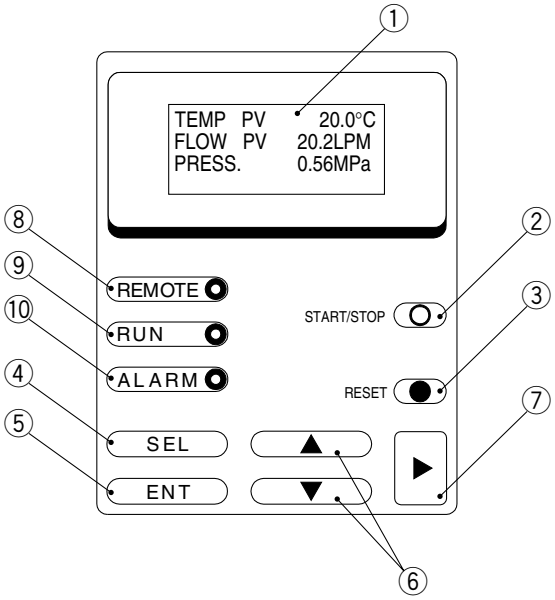
Item	Specifications
Connector no.	P2
Connector type (on this product side)	D-sub 9 P type, Female connector
Fixing bolt size	M2.6 x 0.45
Standards	EIA RS485
Protocol	Modicon Modbus
Circuit diagram	

Connector location



Rear side

Operation Display Panel



No.	Description	Function
①	**LCD**	Operating condition of this unit/Circulating fluid discharge temperature/Circulating fluid flow/ Circulating fluid discharge pressure/Setting value/Alarm message, etc. are displayed.
②	**[START/STOP] key**	Starts/Stops the operation.
③	**[RESET] key**	Stops the alarm buzzing. Resets the alarm.
④	**[SEL] key**	Switches the display.
⑤	**[ENT] key**	Decides the settings.
⑥	**[▲] [▼] key**	Moves the cursor and changes the setting values.
⑦	**[▶] key**	Moves the cursor.
⑧	**[REMOTE] indicator**	Lights up when the unit is in the remote status.
⑨	**[RUN] indicator**	Lights up when the unit is in the operating status.
⑩	**[ALARM] indicator**	Lights up when the unit is alarming.

Alarm

This unit can display 24 kinds of alarm messages as standard. Also, it can read out the serial RS-485 communication.

Alarm code	Alarm message	Operation status	Main reason
01	Water Leak Detect FLT	Stop	Liquid deposits in the drain pan of this unit.
02	Incorrect Phase Error FLT	Stop	The power supply to this unit is incorrect.
05	Reservoir Low Level FLT	Stop	The amount of circulating fluid tank is running low.
06	Reservoir Low Level WRN	Continue	The amount of circulating fluid tank is running low.
07	Reservoir High Level WRN	Continue	The amount of circulating fluid in the tank has increased.
08	Temp. Fuse Cutout FLT	Stop	Temperature of the circulating fluid tank is raised.
09	Reservoir High Temp. FLT	Stop	Temperature of the circulating fluid has exceeded the limitation.
10	Return High Temp. WRN	Continue	Temperature of returning circulating fluid has exceeded the limit.
11	Reservoir High Temp. WRN	Continue	Temperature of the circulating fluid has exceeded the limitation set by the customer.
12	Return Low Flow FLT	Stop	The circulating fluid flow has gone below the limit.
13	Return Low Flow WRN	Continue	Flow rate of the Thermo-chiller has dropped below the set value.
15	Pump Breaker Trip FLT	Stop	The protective equipment in the circulating fluid driving line has started.
17	Interlock Fuse Cutout FLT	Stop	Overcurrent is flown to the control circuit.
18	DC Power Fuse Cutout WRN	Continue	Overcurrent has flowed to the (optional) solenoid valve. (Only for the automatic circulating fluid recovery function - option Z)
19	FAN Motor Stop WRN	Continue	Cooling fan inside the compressor has stopped.
21	Controller Error FLT	Stop	The error occurred in the control systems.
22	Memory Data Error FLT	Stop	The data stored in the controller of this unit went wrong.
23	Communication Error WRN	Continue	The serial communications between this unit and customer's system has been suspended.
24	DI Low Level WRN	Continue	DI level of the circulating fluid has gone below the limitation set by the customer. (Only for DI control kit - option Y)
25	Pump Inverter Error FLT	Stop	The error occurred in the circulating pump inverter. This alarm is applicable to the HRW□□□-H□S only.
26	DNET Comm. Error FLT	Stop	The DeviceNet communications between this unit and customer's system has been suspended. (Only for DeviceNet communication specification - option D)
27	DNET Comm. Error WRN	Continue	An error has occurred in the DeviceNet communication system of this unit. (Only for DeviceNet communication specification - option D)
29	F.Water Low Temp. WRN	Continue	Temperature of facility water has dropped below the set temperature.
30	F.Water High Temp. WRN	Continue	Temperature of facility water has exceeded the set temperature.

Series HRW
Options

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

C Option symbol: Analog Communication

HRW□□ – □□ – C

Analog communication

In addition to the standard contact input/output signal communication and the serial RS-485 communication, analog communication function can be added.
The analog communication function enables to write and read out the following items.

<Writing>	<Readout>
Circulating fluid temperature setting	Circulating fluid present temperature
	Electrical resistivity*

* Only when the DI control kit (option Y) is selected.

Scaling voltage - circulating fluid temperature can be set arbitrarily by the customer.
For details, please consult our "Communication Specifications" information.

D Option symbol: DeviceNet Communication

HRW□□ – □□ – D

DeviceNet™

DeviceNet communication

In addition to the standard contact input/output signal communication and the serial RS-485 communication, DeviceNet function can be added.
DeviceNet function enables to write and read out the following items.

<Writing>	<Readout>
Run/Stop	Circulating fluid present temperature
Circulating fluid temperature setting	Circulating fluid flow
	Circulating fluid discharge pressure
Circulating fluid automatic recovery start/stop*1	Electrical resistivity*2
	Alarm occurrence information
	Status (operating condition) information

*1 Only when the circulating fluid automatic recovery function (option Z) is selected.
*2 Only when the DI control kit (option Y) is selected.

For details, please consult our "Communication Specifications" information.

N Option symbol: NPT Fitting

HRW□□ – □□ – N

NPT fitting

An adapter is included to change the connection parts of circulating fluid piping and facility water piping to NPT thread type. The adapter must be installed by the customer.

Y Option symbol: DI Control Kit

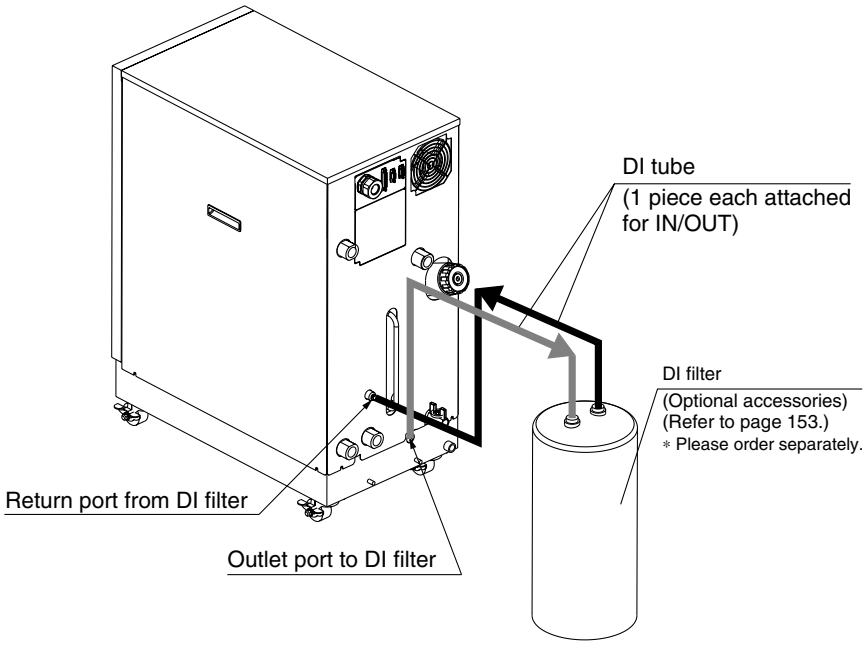
HRW□□ – □□ – Y

DI control kit

Select this option if you want to maintain the electrical resistivity (DI level) of the circulating fluid at a certain level. However, some components have to be fitted by customer. For details, refer to specification table for this option.
Please note that this is not applicable to the fluorinated liquid type.

Applicable model		HRW0□□-H1-Y	HRW0□□-H2-Y
Allowable circulating fluid	—	60% ethylene glycol aqueous solution	Deionized water
DI level display range	MΩ•cm	0 to 20	
DI level set range	MΩ•cm	0 to 20 Note)	
Solenoid valve hysteresis for control	MΩ•cm	0 to 0.9	
DI level reduction alarm set range	MΩ•cm	0 to 20	

Note) The DI filter is needed to control the DI level. (SMC Part No.: HRZ-DF001)
Please purchase additionally because the DI filter is not included in this option. Also, if necessary, additionally purchase the insulating material for the DI filter. (SMC Part No.: HRZ-DF002)



* Install the DI filter outside the Thermo-chiller for piping. Secure the space for installing the DI filter in the rear side of the Thermo-chiller.
* It may go outside of the temperature stability range of ±0.3°C when this option is used in some operating conditions.

Z Option symbol

Circulating Fluid Automatic Recovery

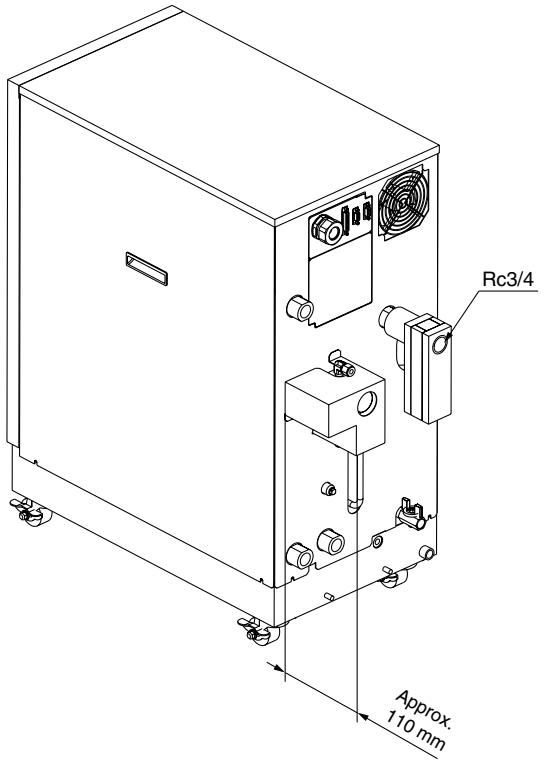
HRW□□ – □□ – Z

Circulating fluid automatic recovery

Select this option for customers who want to use the circulating fluid automatic recovery function.
The automatic recovery function is a device which can recover the circulating fluid inside pipings into a sub-tank of the Thermo-chiller by the external communication or operation display panel.
Some components need to be fitted by the customer. For details, consult “Product Specifications” information for these options.

Applicable model		Common for all models
Circulating fluid recoverable volume Note 1)	L	12
Purge gas	—	Nitrogen gas
Purge gas supply port	—	Self-align fitting for O.D. ø8 Note 2)
Purge gas supply pressure	MPa	0.4 to 0.7
Purge gas filtration	μm	0.01 or less
Regulator set pressure	MPa	0.15 to 0.3 Note 3)
Recoverable circulating fluid temperature	°C	10 to 40
Recovery start/stop	—	Start: External communication Note 4) or operation display panel / Stop: Automatic
Timeout error	sec	Timer from recovery start to completion Stops recovering when the timer turns to set time. Possible set range: 60 to 300, at the time of shipping from the factory: 300
Height difference with the customer system side	m	10 or less

Note 1) This is the space volume of the sub-tank when the liquid level of the circulating fluid is within the specification. Guideline of the recovery volume is 80% of the circulating fluid recoverable volume.
Note 2) Before piping, clean inside the pipings with air blow, etc. Use the piping with no dust generation by purge gas. When using resin tube, where necessary, use insert fittings, etc. in order not to deform the tubings when connecting to self-align fittings.
Note 3) At the time of shipping from factory, it is set to 0.2 MPa.
Note 4) For details, please consult our “Communication Specifications” information.



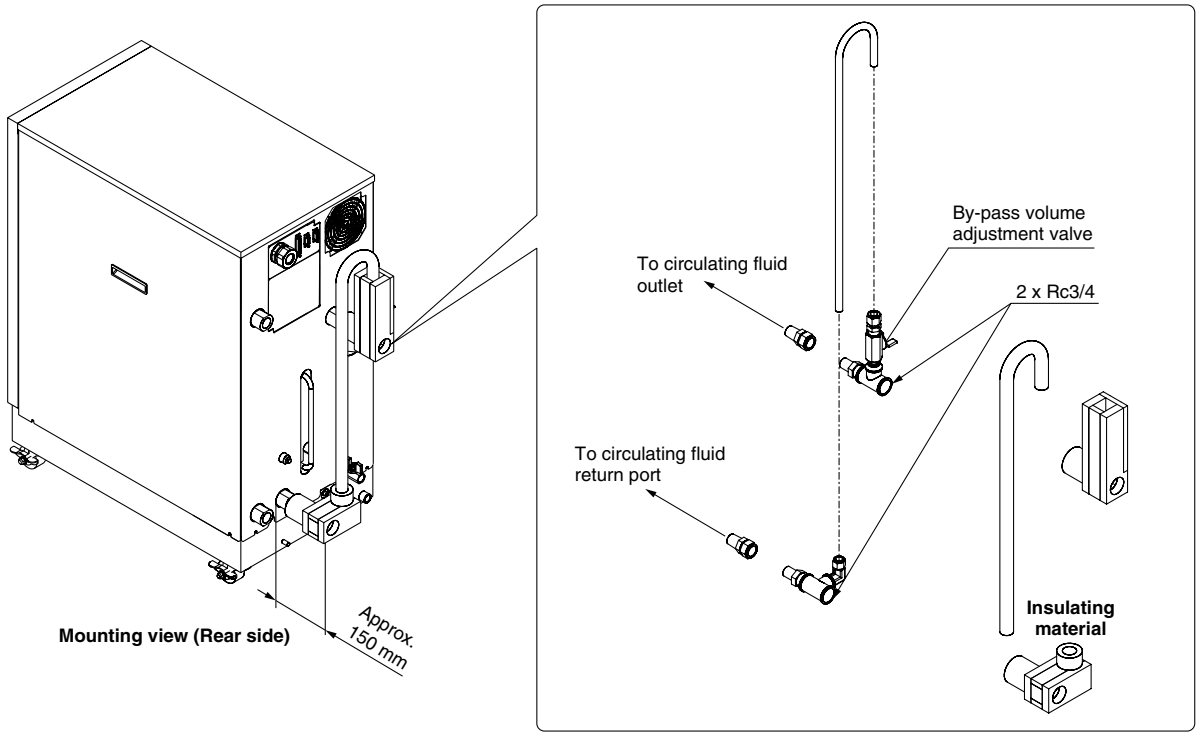
Optional Accessories 1

Note) Necessary to be fitted by the customer.

By-pass Piping Set

When the circulating fluid goes below the rated flow, cooling capacity will be reduced and the temperature stability will be badly affected. In such a case, use the by-pass piping set.

Part no.	Applicable model
HRW-BP001	Common for all models

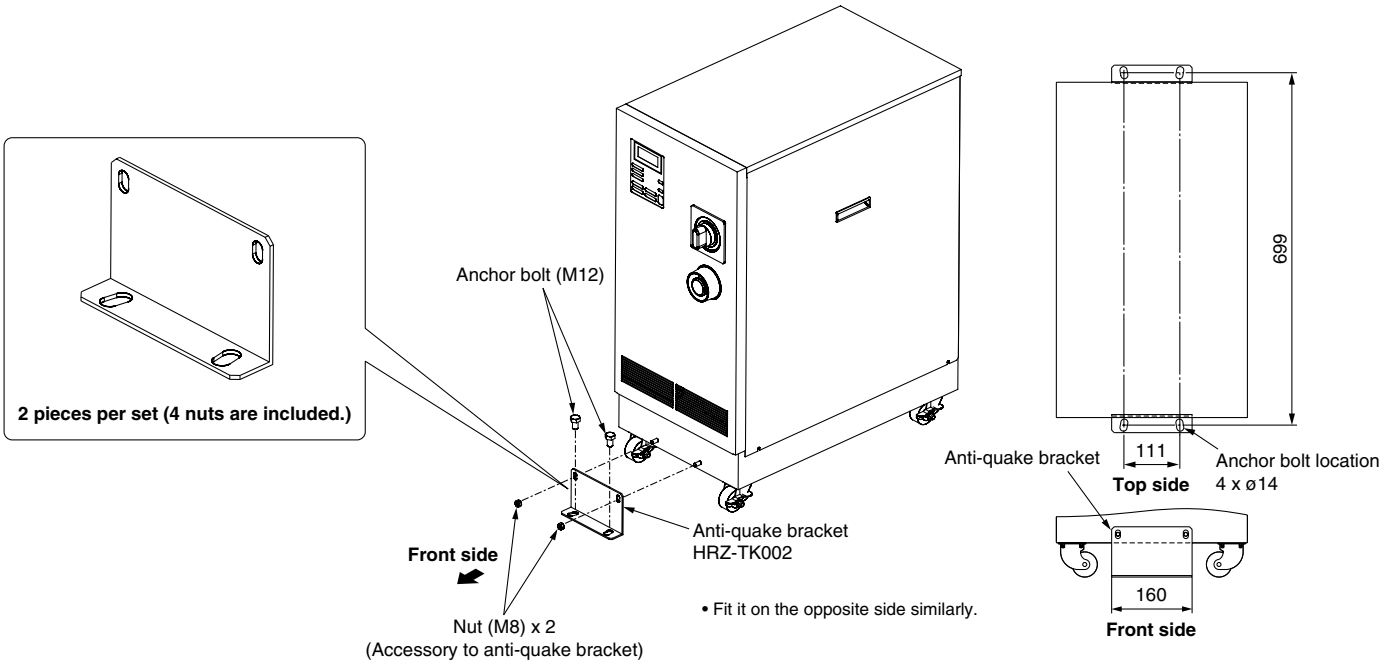


Anti-quake Bracket

Bracket for earthquakes
Prepare the anchor bolts (M12) which are suited to the floor material by the customer.

Part no.	Applicable model
HRZ-TK002	Common for all models

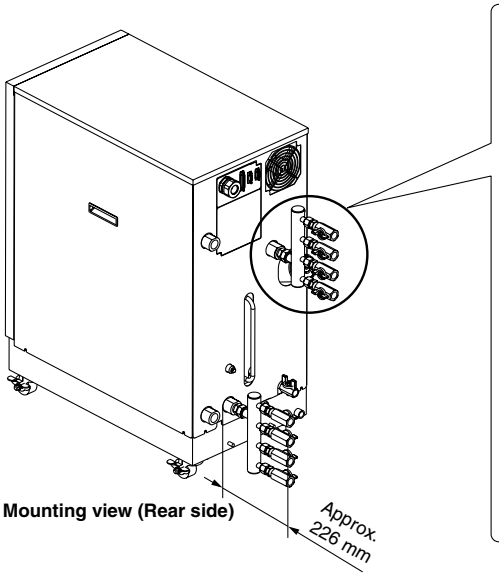
Note) 2 pieces per set (for 1 unit) (HRZ-TK002)



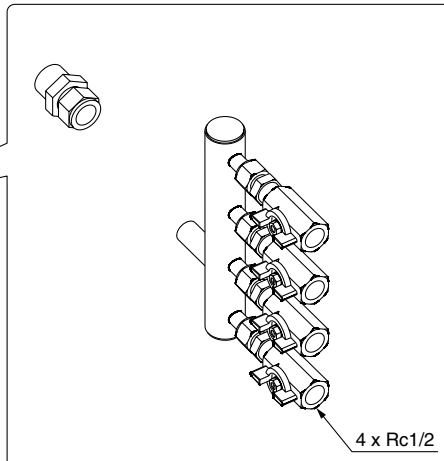
4-Port Manifold

4-branching the circulating fluid enables 4 temperature controls at the maximum with the 1 unit Thermo-chiller. Order the heat insulator for 4 port manifold (HRW-MA002) separately if necessary.

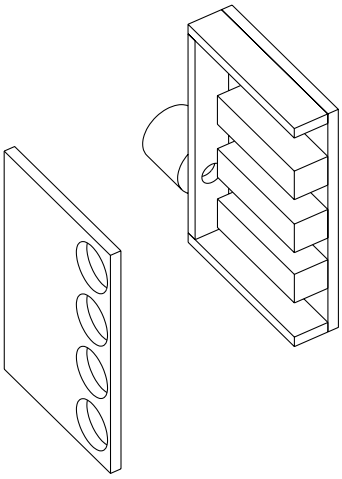
Part no.	Applicable model
HRW-MA001	Common for all models
HRW-MA002	



Mounting view (Rear side)



HRW-MA001 (2 pcs./set)



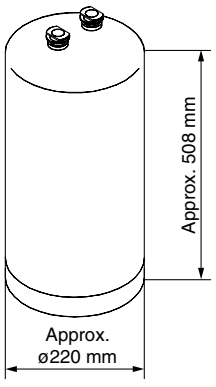
HRW-MA002 (2 pcs./set)

DI Filter

This is the ion replacement resin to maintain the electric resistivity of the circulating fluid.
Customers who selected the DI control kit (option Y) need to purchase the DI filter separately.

Part no.	Applicable model
HRZ-DF001	Common for all models which can select the DI control kit. (option Y)

Note) The DI filters are consumable. Depending on the status (electrical resistivity set value, circulating fluid temperature, piping volume, etc.), product life cycles will vary accordingly.

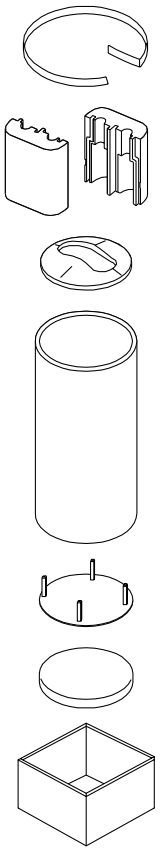


Weight: Approx. 20 kg

Insulating Material for DI Filter

When the DI filter is used at a high temperature, we recommend that you use this insulating material to protect the radiated heat from the DI filter or possible burns. We also recommend that you use this to prevent heat absorption from the DI filter and to avoid forming condensation.

Part no.	Applicable model
HRZ-DF002	Common for all models which can select the DI control kit. (option Y)



Optional Accessories 2

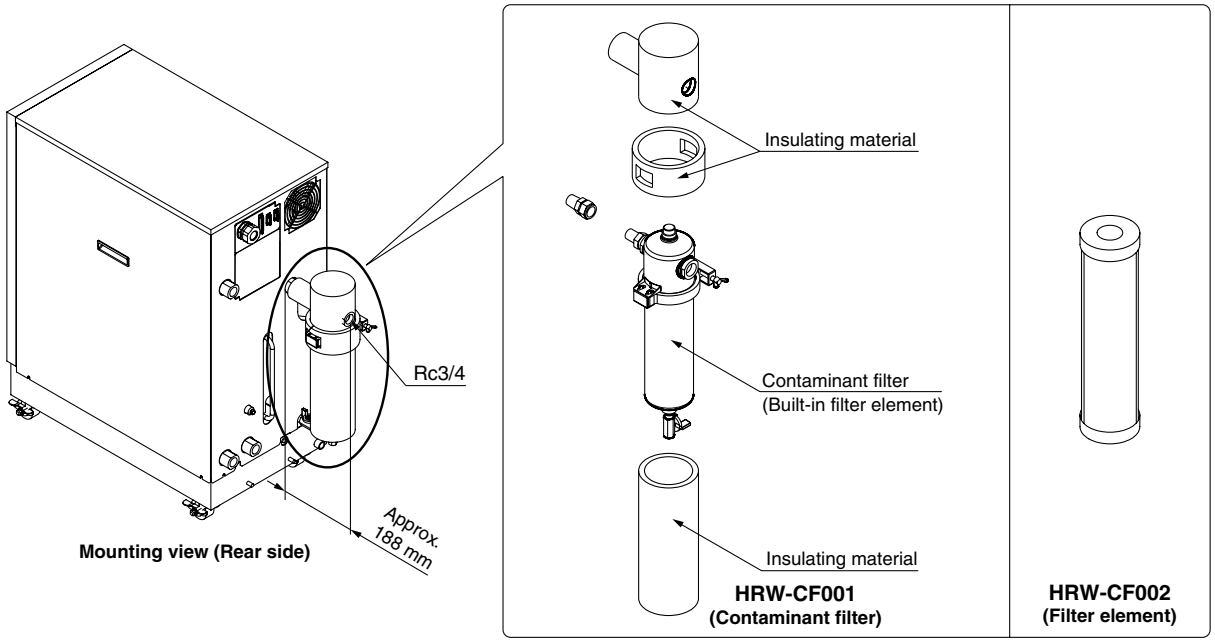
Note) Necessary to be fitted by the customer.

Contaminant Filter

A filter mounted in the circulating fluid circuit to eliminate the dust which is contained in the circulating fluid. (Filtration: 20 μm) It is provided with its own heat insulator.

Part no.	Applicable model
HRW-CF001	Common for all models
HRW-CF002	

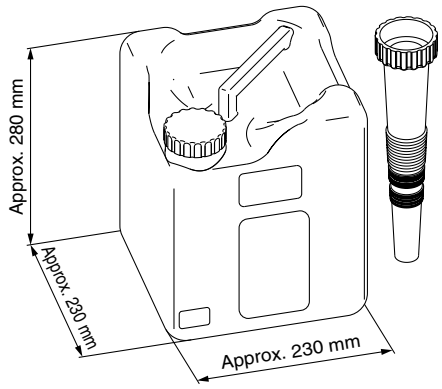
Note) The internal element of the contaminant filter (part no.: HRW-CF002) is a replacement part. The period in service depends on the operating conditions.



60% Ethylene Glycol Aqueous Solution

This solution can be used as a circulating fluid for ethylene glycol-type Thermo-chillers. (Capacity: 10 L)

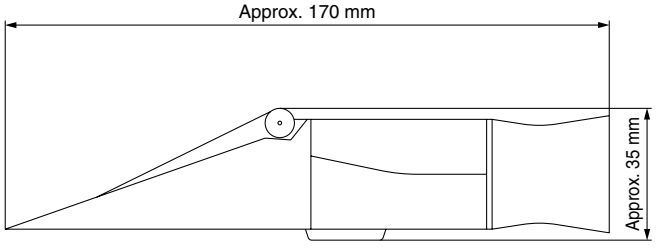
Part no.	Applicable model
HRZ-BR001	Common for all ethylene glycol-type models



Concentration Meter

This meter can be used to control the concentration of ethylene glycol aqueous solution regularly.

Part no.	Applicable model
HRZ-BR002	Common for all ethylene glycol-type models



Series HRW
Specific Product Precautions 1

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Design

⚠ Warning

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

1. For details, please consult our "Product Specifications" and thoroughly consider the adaptability between the customer's system and this unit.
2. Although the protection circuit as a single unit is installed, the customer is requested to carry out the safety design for the whole system.

Selection

⚠ Caution

1. Model selection

In order to select the correct Thermo-chiller model, the amount of thermal generation from the customer's system, the operating circulating fluid, and its circulating flow are required. Select a model, by referring to the guideline to model selection on page 136.

2. Option selection

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

Handling

⚠ Warning

1. Thoroughly read the Operation Manual.

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

Operating Environment/Storage Environment

⚠ Caution

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

1. Environment like written in "Temperature Control Equipment Precautions."
2. Locations where spatter will adhere to when welding.
3. Locations where it is likely that the leakage of flammable gas may occur.
4. Locations where the ambient temperature exceeds the limits as mentioned below.
   During operation 10°C to 35°C
   During storage 0°C to 50°C (but as long as water or circulating fluid are not left inside the pipings)
5. Locations where the ambient relative humidity exceeds the limit as mentioned below.
   During operation 30% to 70%
   During storage 15% to 85%
6. (Inside the operation facilities) locations where there is not sufficient space for maintenance.
7. In locations where the ambient pressure exceeds the atmospheric pressure.

2. The Thermo-chiller does not have clean room specification. It generates dust from the pump inside the unit and the cooling fan for the unit inside.

Circulating Fluid

⚠ Caution

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

2. Use ethylene glycol that does not contain additives such as preservatives.

3. The condensation of ethylene glycol aqueous solution must be 60% or less. If the condensation is too high, the pump will be overloaded, resulting in occurrence of "Pump Breaker Trip FLT".

4. Avoid water moisture entering the fluorinated fluid.

5. Use clear water (including for diluting ethylene glycol aqueous solution) which must meet the water quality standards as mentioned below.

Clear 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
Standard item	pH (at 25°C)	—	6.0 to 8.0
	Electrical conductivity (25°C)	[μS/cm]	100 to 300*
	Chloride ion	[mg/L]	50 or less
	Sulfuric acid ion	[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	[mg/L]	50 or less
	Ionic state silica	[mg/L]	30 or less
Reference item	Iron	[mg/L]	0.3 or less
	Copper	[mg/L]	0.1 or less
	Sulfide ion	[mg/L]	Should not be detected.
	Ammonium ion	[mg/L]	0.1 or less
	Residual chlorine	[mg/L]	0.3 or less
	Free carbon	[mg/L]	4.0 or less

* In the case of [MΩ•cm], it will be 0.003 to 0.01.

Transportation/Transfer/Movement

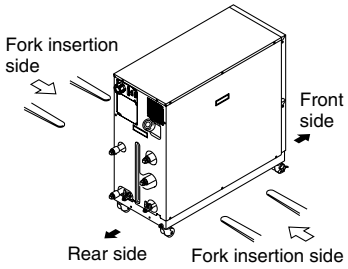
⚠ Warning

1. Transportation by forklift

1. It is not possible to hang this product.
2. The fork insertion position is either on the left side face or right side face of the unit. Be careful not to bump the fork against a caster or level foot and be sure to put through the fork to the opposite side.
3. Be careful not to bump the fork to the cover panel or piping ports.

2. Transportation by casters

1. This product is heavy and should be moved by at least two people.
2. Do not grip the pipings on the rear side or the handles of the panel.



Series HRW
Specific Product Precautions 2

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Mounting/Installation

⚠ Caution

1. **Avoid using this product outdoors.**
2. **Install on a rigid floor which can withstand this product's weight.**
3. **Please install a suitable anchor bolt for the anti-quake bracket taking into consideration the customers floor material.**
4. **Avoid placing heavy objects on this product.**

Piping

⚠ Caution

1. **Regarding the circulating fluid pipings, consider carefully the suitability for shutoff pressure, temperature and circulating fluid.**

   If the operating performance specifications are regularly exceeded, the pipings may burst during operation.

2. **The surface of the circulating fluid pipings should be covered with the insulating materials which can effectively confine the heat.**

   Absorbing the heat from the surface of pipings may reduce the cooling capacity performance and the heating capacity may be shortened due to heat radiation.

3. **When using fluorinated liquid as the circulating fluid, do not use pipe tape.**

   Liquid leakage may occur around the pipe tape.
   For sealant, we recommend that you use the following sealant:
   SMC Part No., HRZ-S0003 (Silicone sealant)

4. **For the circulating fluid pipings, use clean pipings which have no dust, oil or water moisture inside the pipings, and blow with air prior to undertaking any piping works.**

   If any dust, oil or water moisture enters the circulating fluid circuit, inferior cooling performance or equipment failure due to frozen water may occur, resulting in bubbles in the circulating fluid inside the tank.

5. **Select the circulating fluid pipings which can exceed the required rated flow.**

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

6. **For the circulating fluid piping connection, install a drain pan just in case the circulating fluid may leak.**

7. **Do not return the circulating fluid to the unit by installing a pump in the customer system.**

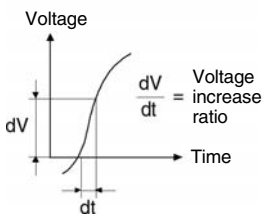
Electrical Wiring

⚠ Caution

1. **Power supply and signal cable should be prepared by the customer.**

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

   If the voltage increase ratio (dV/dt) at the zero cross should exceed 40 V/200 μsec., it may result in a malfunction.

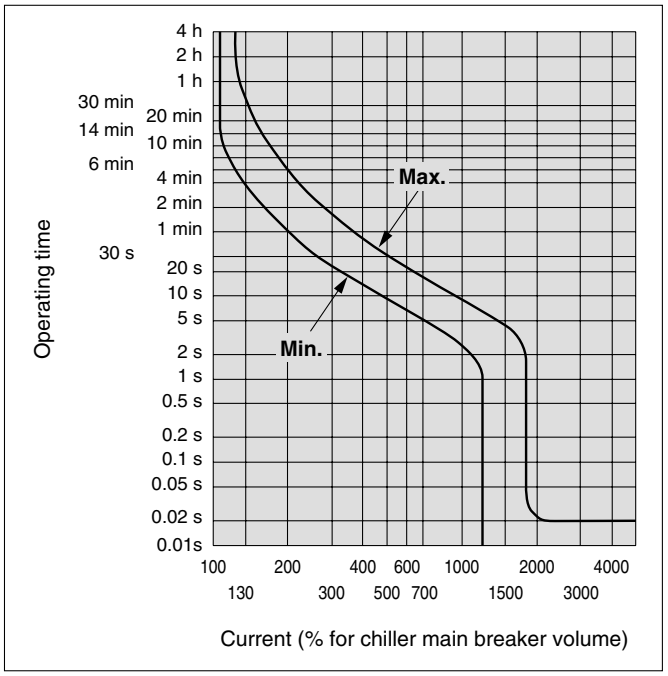


3. **This product is installed with a breaker with the following operating characteristics.**

   For the customer's machine (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 customer's machine could be cut off due to the inrush current of the motor of this product.

Breaker Operating Characteristics

Common for all models



Series HRW
Specific Product Precautions 3

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Operation

⚠Caution

1. Confirmation before operation

1. The circulating fluid should be within the specified range of "HIGH" and "LOW".
2. Be sure to tighten the cap for the circulating fluid port until the click sound is heard.

2. Emergency stop method

In the case of an emergency, press down the EMO switch which is fitted on the front face of this product.

Maintenance

⚠Warning

1. Do not operate the switch with wet hands or touch electrical parts such as an electrical plug. This will lead to an electrical shock.

2. Do not splash water directly on this product for cleaning. This will lead to an electrical shock or a fire.

3. When the panel was removed for the purpose of inspection or cleaning, mount the panel after works were done.

If the panel is still open, or running the equipment with the panel removed, it may cause an injury or electric shock.

⚠Caution

1. In order to prevent a sudden product failure of the unit, replace the replacement parts every 36 months.

2. Perform an inspection of the circulating fluid every 3 months.

1. In the case of fluorinated fluids:
   Discharge the circulating liquid and avoid any dirty objects, or water moisture, or foreign objects entering the system.
2. In the case of ethylene glycol aqueous solution:
   Maintain the condensation at 60%.
3. In case of clear water, deionized water:
   Replacement is recommended.

3. Check the water quality of facility water every 3 months.

Regarding the water quality standards for facility water, refer to "Temperature Control Equipment Precautions".

Thermo-con Air-cooled Water-cooled Series HEC

Can precisely control the temperature of a heat source or process fluid.

Precisely control the temperature of the circulating fluid by using the Peltier device. Generates little vibration, and is refrigerant-free and environmentally friendly.
Can control the temperature of the heat source by using the external temperature sensor (sold separately). (Automatically adjusts to the effects of ambient temperature.)

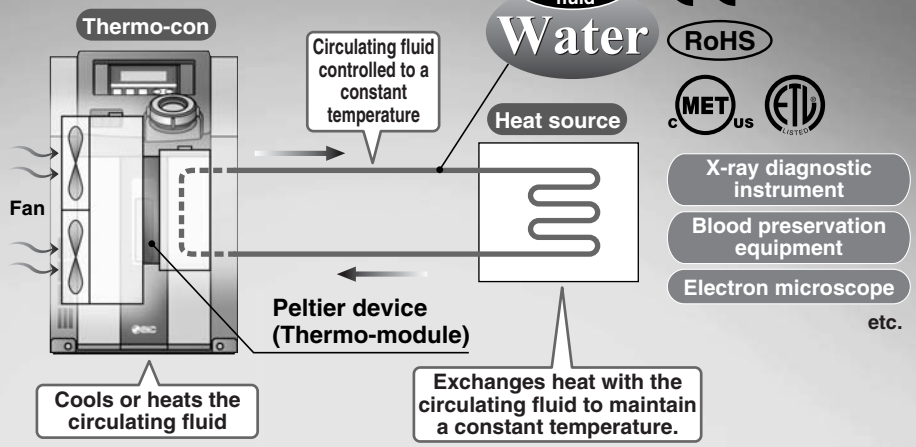
- **Temperature range setting:**
  10°C to 60°C
- **Temperature stability:**
  ±0.01°C to 0.03°C

Added cooling capacity of 140 W and 320 W (water-cooled), and 600 W (air-cooled).

140W: W184 x H262 x D321
320W: W184 x H262 x D321
230W: W210 x H393 x D436
600W: W240 x H390 x D455
600W: W240 x H390 x D455
1200W: W300 x H448 x D523

Air-cooled Series HEC-A

- **Air-cooled: Can be used in the environments with no cooling equipment.**
- **Cooling capacity: 230 W, 600 W**

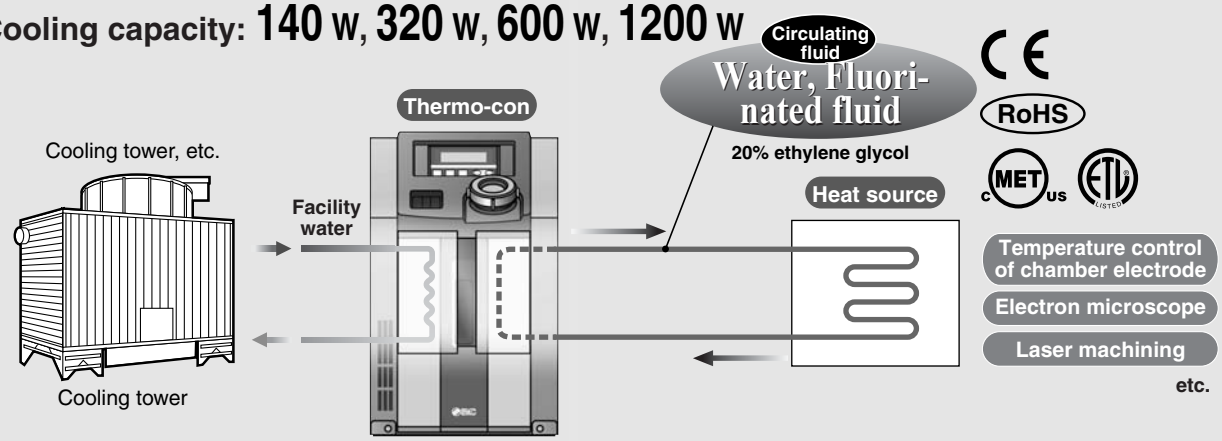


RoHS

X-ray diagnostic instrument
Blood preservation equipment
Electron microscope
etc.

Water-cooled Series HEC-W

- **Water-cooled: Can be used in the environments with facility water equipment.**
- **Cooling capacity: 140 W, 320 W, 600 W, 1200 W**



RoHS

Temperature control of chamber electrode
Electron microscope
Laser machining
etc.

- **Compliant with safety standard for medical equipment IEC 60601-1 (Air-cooled/HEC002-A series)**
- **Power supply: Applicable to 100 V to 240 V (Air-cooled/HEC-A series, Water-cooled/HEC001-W, HEC003-W)**
- **Suitable to fluorinated fluids (Fluorinert™ FC-3283, GALDEN® HT135) (Water-cooled/HEC006-W, HEC012-W)**
- **Compatible with ethylene glycol 20% (Water-cooled/HEC001-W, HEC003-W)**

Learning Control Function (Temp. control by external temperature sensor)

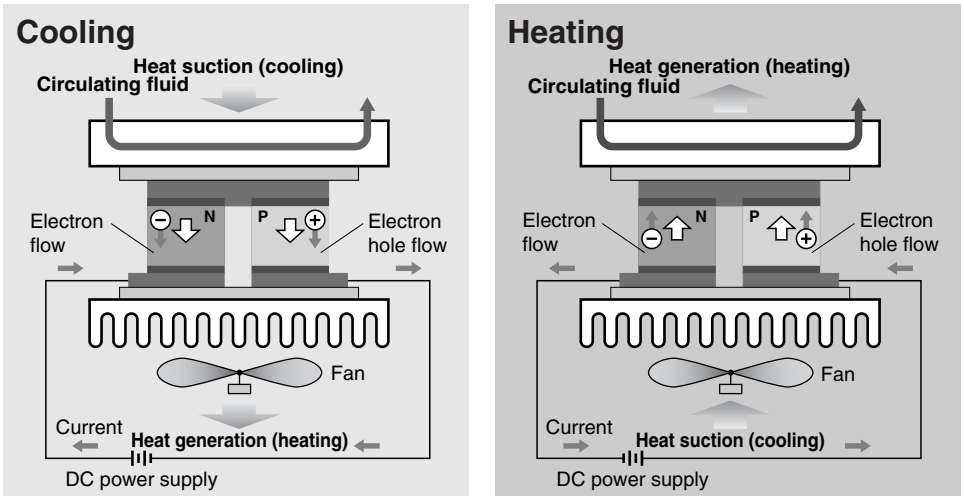
This function adjusts the fluid temperature to the set value with an automatic offset setting. Set the external temperature sensor at the circulating fluid inlet located just in front of the heat source, which allows the Thermo-con to sample the fluid temperature. This function is effective when automatically adjusting for heat exhaust from piping, etc. If the external temperature sensor is installed directly on the heat source, the learning control function may not work property due to large heat volume or large temperature difference. Be sure to install the sensor at the circulating fluid inlet.

Principle of Peltier Device (Thermo-module)

A Peltier device (thermo-module) is a plate type element, inside which P-type semiconductors and N-type semiconductors are located alternately. If direct current is supplied to the Peltier device (thermo-module), heat is transferred inside the device, and one face generates heat and increases temperature while the other face absorbs heat and decreases temperature. Therefore, changing the direction of the current supplied to the Peltier device (thermo-module) can achieve heating and cooling operation. This method has a fast response and can shift quickly between heating and cooling, so temperature can be controlled very precisely.

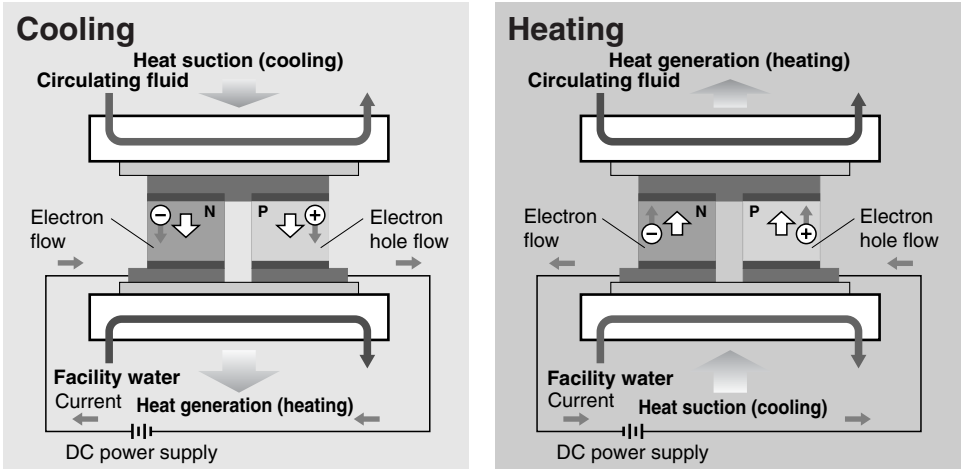
Air-cooled

Series HEC-A



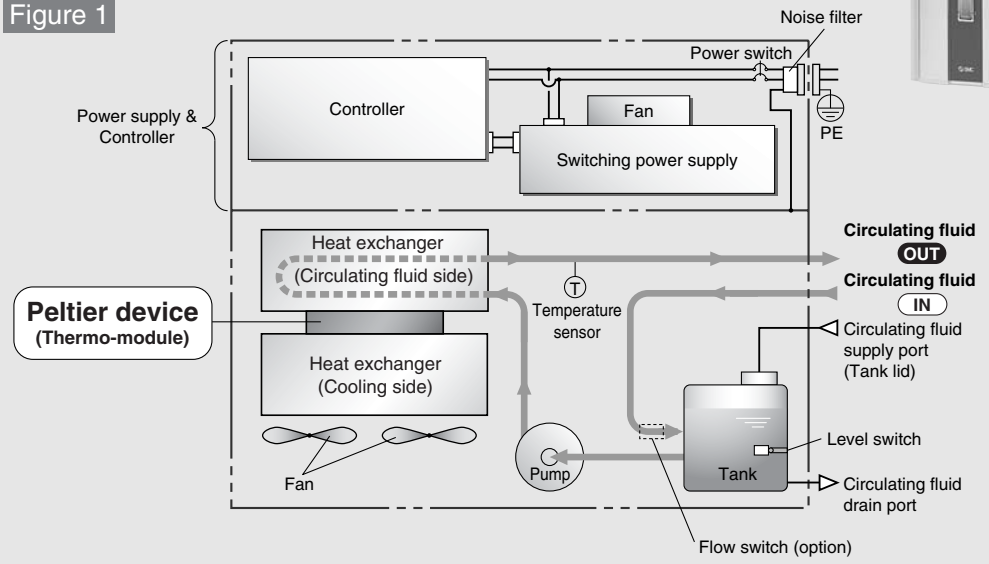
Water-cooled

Series HEC-W



Air-cooled Series HEC-A

Figure 1



Water-cooled Series HEC-W

Figure 1

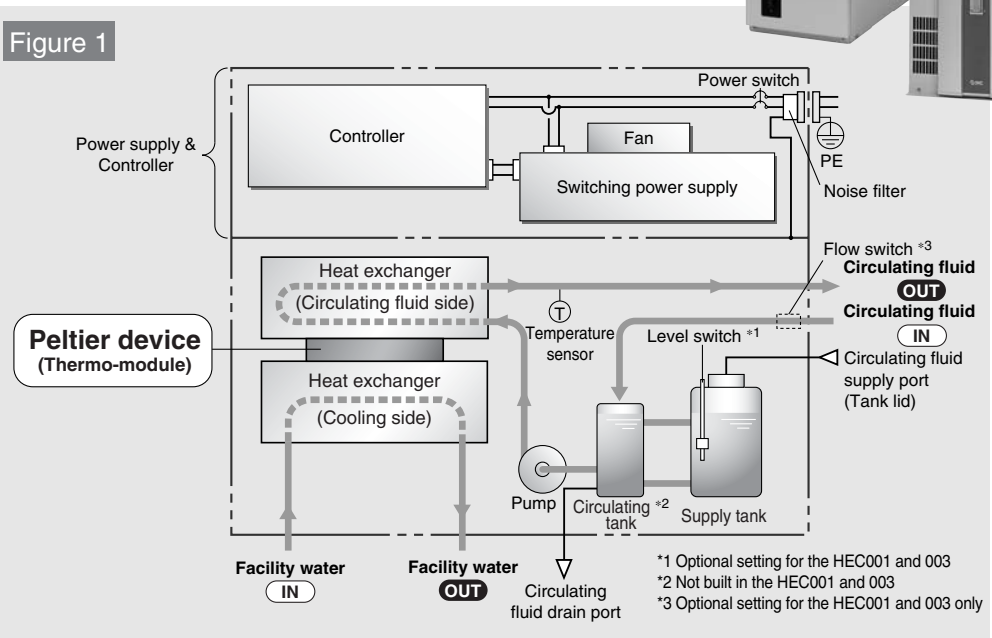
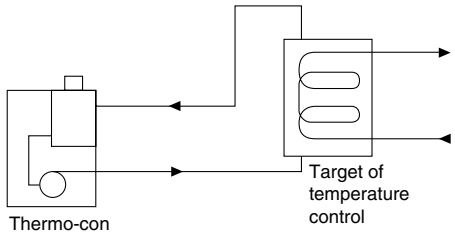


Figure 2 Example of circulating fluid piping



The Thermo-con is constructed as shown in Figure 1. It interposes a Peltier device (thermo-module) between the heat exchangers for the circulating fluid and facility water and controls the pulse width of supply direct current to achieve the target outlet temperature of circulating fluid precisely.
The circulating fluid returns to the tank, and is transferred by the pump which is built in the Thermo-con, and goes through the heat exchangers and internal sensors and out from the circulating fluid outlet.
Figure 2 shows an example of circulating fluid piping. The circulating fluid is transferred at a constant temperature by the pump.

When to Use Air-Cooled and Water-Cooled Thermo-con

Both air-cooled and water-cooled Thermo-cons are available. Select a proper Thermo-con by referring to the following.

Air-cooled

- No facility water equipment → Can install the unit easily without facility water equipment.
- Frequent piping changes → Can reduce the piping installation labor since facility water piping is not required.

Water-cooled

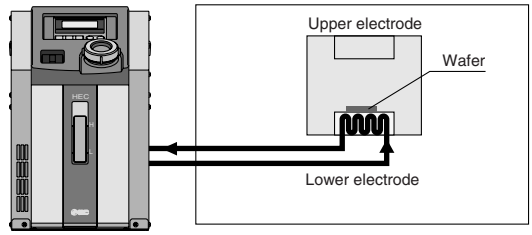
- Need to avoid effects of ambient temperature. → Since the unit is water-cooled, the ambient temperature will have little effect.
- Want to reduce the installation space. → Can reduce the space since the unit is compact.

Application Examples

Semiconductor

Air-cooled Water-cooled

Example: Temperature control of a chamber electrode

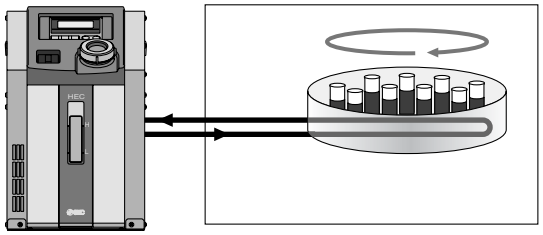


- **Etching equipment**
- **Spatter equipment**
- **Cleaning equipment**
- **Coating equipment**
- **Dicing equipment**
- **Tester, etc.**

Medical

Air-cooled

Example: Blood preservation

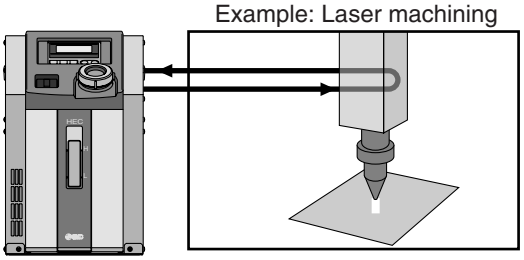


- **X-ray diagnostic instrument**
- **MRI**
- **Blood preservation equipment**

Machine tool

Air-cooled Water-cooled

Example: Laser machining



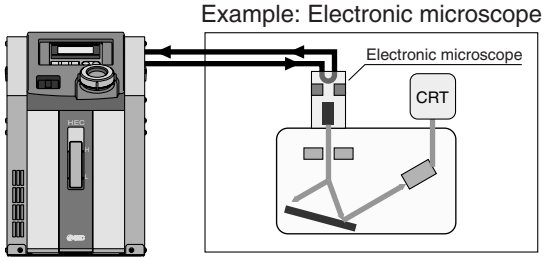
- **Wire cutting**
- **Grinder**
- **Spot welding**
- **Plasma welding**
- **Laser machining, etc.**

Temperature-controlling the laser generating tube enables the laser wavelength to be optimised, improving the accuracy of the machined cross sectional area.

Analysis

Air-cooled Water-cooled

Example: Electronic microscope



- **Electron microscope**
- **X-ray analytical instrument**
- **Gas chromatography**
- **Sugar level analytical instrument, etc.**

Prevents the distortion caused by the heat generated by the electronic gun in an electronic microscope.

Bonding of DVD including next generation Air-cooled Water-cooled

Cooling of semiconductor laser Air-cooled Water-cooled

Temperature control of die-cast mold Air-cooled Water-cooled

CONTENTS

Air-cooled
Series HEC-A

Water-cooled *Series HEC-W*

Series HEC
Model Selection

Guide to Model Selection

1. What radiation method will be used?

Without a cooling tower ····· Air-cooled HEC-A series
With a cooling tower ····· Water-cooled HEC-W series

When to Use Air-cooled and Water-cooled Thermo-con

<Air-cooled>
- No facility water equipment → Can install the unit easily without facility water equipment.
- Frequent piping changes → Can reduce the piping installation labor since facility water piping is not required.

<Water-cooled>
- Need to avoid effects of ambient temperature. → Since the unit is water-cooled, the ambient temperature will have little effect.
- Want to reduce installation space. → Can reduce the space since the unit is compact.

2. How much is the temperature in degrees centigrade for the circulating fluid?

Temperature range which can be set with the Thermo-con: 10 to 60°C

If a lower temperature (down to –20°C) or higher temperature (up to 90°C) than this range is necessary, select the Thermo-chiller HRZ series.

3. What kind of the circulating fluids will be used?

Circulating fluids that can be used in the Thermo-con

Model	Clear water	Fluorinert™ FC-3238 GALDEN® HT135	20% ethylene glycol
HEC001-W, HEC003-W	○	×	○
HEC006-W, HEC012-W	○	○	×
HEC002-A, HEC006-A	○	×	×

○: Usable ×: Unusable

4. How much cooling capacity required?

Allows a safety factor of 20% over the capacity that is actually required, taking into account the changes in the operating conditions. If a larger capacity than this Thermo-con is necessary, select the Thermo-cooler HRG series or Thermo-chiller HRZ series.

Example 1 **When the heat generation amount in the customer's machine is known.**

Heat generation amount: 400 W

Cooling capacity = Considering a safety factor of 20%, **400 x 1.2 = 480 W**

Guide to Model Selection

Example 2 | **When the heat generation amount in the customer's machine is not known.**

Obtain the temperature difference between inlet and outlet by circulating the fluid inside the customer's machine.

Heat generation amount **Q** : Unknown
Circulating fluid temperature difference ΔT (= **T2** – **T1**) : 0.8°C (0.8 K)
Circulating fluid outlet temperature **T1** : 25°C (298.15 K)
Circulating fluid return temperature **T2** : 25.8°C (298.95 K)
Circulating fluid flow rate **L** : 3 L/min
Circulating fluid : Water
Density γ: 1 x 10^3 kg/m^3
Specific heat **C**: 4.2 x 10^3 J/(kg•K)

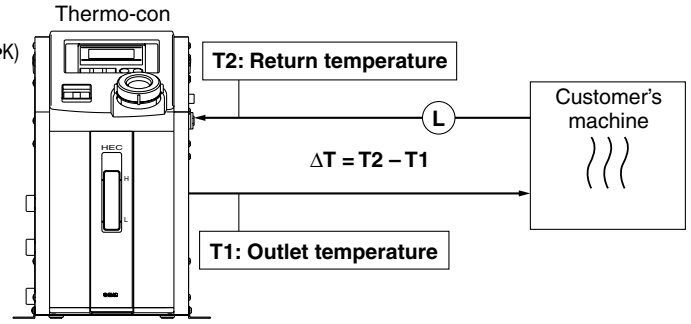
$$Q = \frac{\Delta T \times L \times \gamma \times C}{60 \times 1000}$$

$$= \frac{0.8 \times 3 \times 1 \times 10^3 \times 4.2 \times 10^3}{60 \times 1000}$$

$$= 167\ W$$

Cooling capacity = Considering a safety factor of 20%,

167 W x 1.2 = 200 W



Example 3 | **When cooling the object below a certain temperature in certain period of time.**

Cooled substance total volume **V** : 20 L
Cooling time **h** : 15 min
Cooling temperature difference ΔT : Temperature difference: 10°C (10 K). Cool from 30°C (303 K) to 20°C (293 K).
Circulating fluid : Clear water
Density γ: 1 x 10^3 kg/m^3
Specific heat **C**: 4.2 x 10^3 J/(kg•K)

∗ Refer to the information shown below for the typical physical property values by circulating fluid.

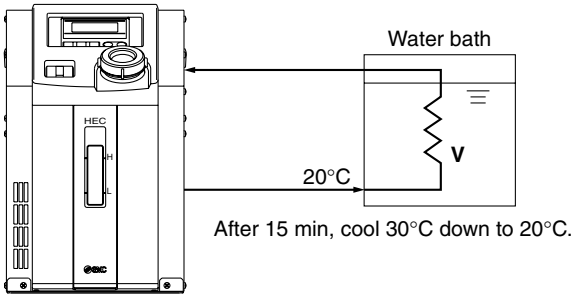
$$Q = \frac{\Delta T \times V \times \gamma \times C}{h \times 60 \times 1000}$$

$$= \frac{10 \times 20 \times 1 \times 10^3 \times 4.2 \times 10^3}{15 \times 60 \times 1000}$$

$$= 933\ W$$

Cooling capacity = Considering a safety factor of 20%,

933 W x 1.2 = 1120 W



Precautions on Model Selection

The flow rate of the circulating fluid depends on the pressure loss of the customer's machine and the length, diameter and resistance created by bends in the circulating fluid piping, etc. Check if the required flow rate of circulating fluid can be obtained before selecting.

Circulating Fluid Typical Physical Property Values

Fluorinated Fluids

Physical property value / Temperature	Density γ [kg/m^3]	Specific heat C [J/(kg·K)]
–10°C	1.87 x 10^3	0.87 x 10^3
20°C	1.80 x 10^3	0.96 x 10^3
50°C	1.74 x 10^3	1.05 x 10^3
80°C	1.67 x 10^3	1.14 x 10^3

Water

Density γ: 1 x 10^3 [kg/m^3] **Specific heat C: 4.2 x 10^3 [J/(kg·K)]**

Peltier-Type Chiller
Thermo-con (Air-cooled)
Series HEC-A

How to Order

HEC 002 – A 5 B – ☐

Cooling capacity

002	230 W
006	600 W

Radiating method

A	Air-cooled

Power supply

5	100 to 240 VAC

Communication

A	RS-485
B	RS-232C

∗ Select B when communication is not used.

Option

Nil	None
F	With flow switch
N	NPT thread

∗ The option should be specified when ordering.

Specifications (For details, please consult our "Product Specifications" information.)

Model			HEC002-A5A	HEC002-A5B	HEC006-A5A	HEC006-A5B
Cooling method			Thermoelectric device (Thermo-module)			
Radiating method			Forced air cooling			
Control method			Cooling/Heating automatic shift PID control			
Ambient temperature/humidity			10 to 35°C, 35 to 80%RH (no condensation)			
Circulating fluid system	**Circulating fluid**		Clear water			
	Operating temperature range		10.0 to 60.0°C (no condensation)			
	Cooling capacity		230 W Note 1)		600 W Note 2)	
	Heating capacity		600 W Note 1)		900 W Note 2)	
	Temperature stability Note 3)		±0.01 to ±0.03°C			
	Pump capacity		Refer to performance chart.			
	Tank capacity		Approx. 1.2 L			
	Port size	**IN/OUT**	Rc1/4		Rc3/8	
		Drain	Rc1/4 (with plug)			
	Wetted parts material		Stainless steel 303, Stainless steel 304, EPDM, Ceramics, PPS glass 30%, Carbon, PE, Polypropylene			
Electrical system	**Power supply**		Single-phase: 100 to 240 VAC ±10%, 50/60 Hz			
	Overcurrent protector		15 A			
	Current consumption		8 A (100 VAC) to 3 A (240 VAC)		10 A (100 VAC) to 4 A (240 VAC)	
	Alarm		Refer to alarm function.			
	Communications		RS-485	RS-232C	RS-485	RS-232C
Weight			Approx. 17.5 kg (including foot for fixing)		Approx. 27.5 kg (including foot for fixing)	
Accessories			Power cable, Foot for fixing			
Safety standards			CE marking, UL (NRTL) standards, Safety standard for medical equipment (IEC60601-1)		CE marking, UL (NRTL) standards	

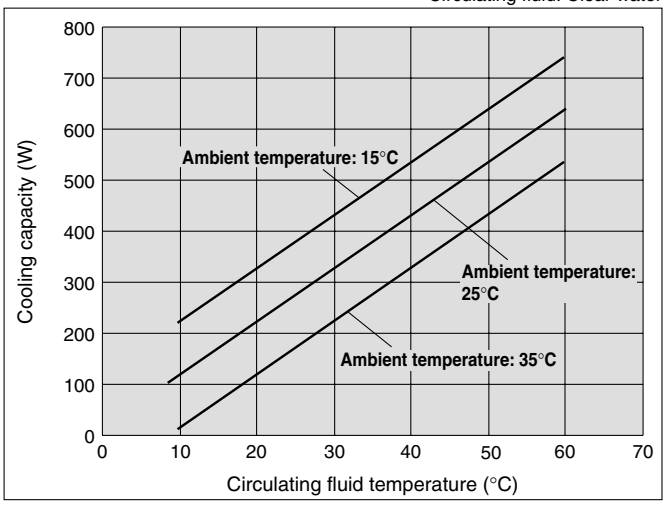
Note 1) Conditions: Set temperature 25°C, Ambient temperature 25°C, Circulating flow rate 3 L/min
Note 2) Conditions: Set temperature 25°C, Ambient temperature 20°C, Circulating flow rate 8 L/min
Note 3) The indicated values are with a stable load without turbulence in the operating conditions. It may be out of this range in some other operating conditions.

The values shown on the performance chart are not guaranteed, but typical. Allow margins for safety when selecting the model.

Cooling Capacity

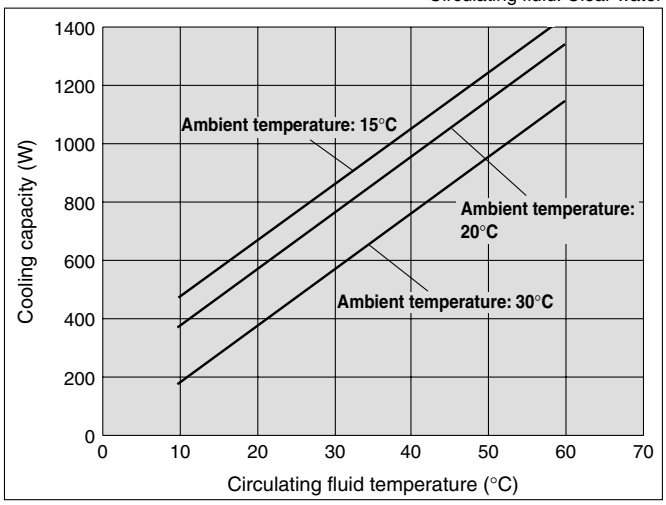
HEC002

Circulating fluid: Clear water



HEC006

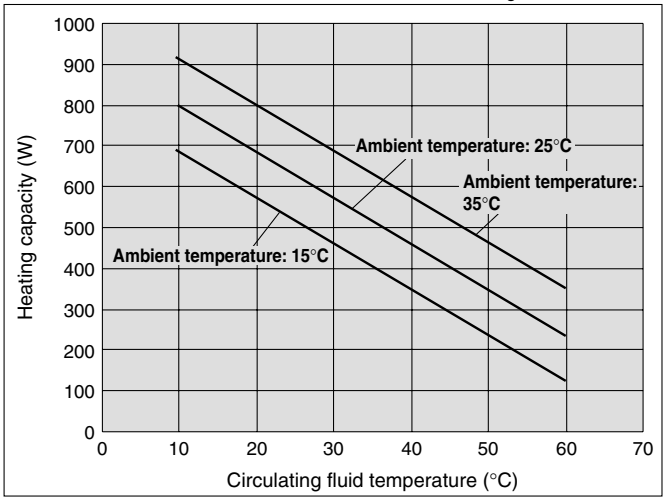
Circulating fluid: Clear water



Heating Capacity

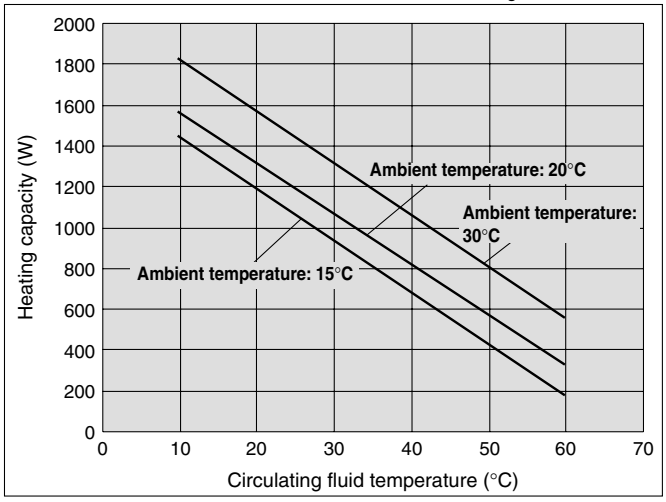
HEC002

Circulating fluid: Clear water



HEC006

Circulating fluid: Clear water

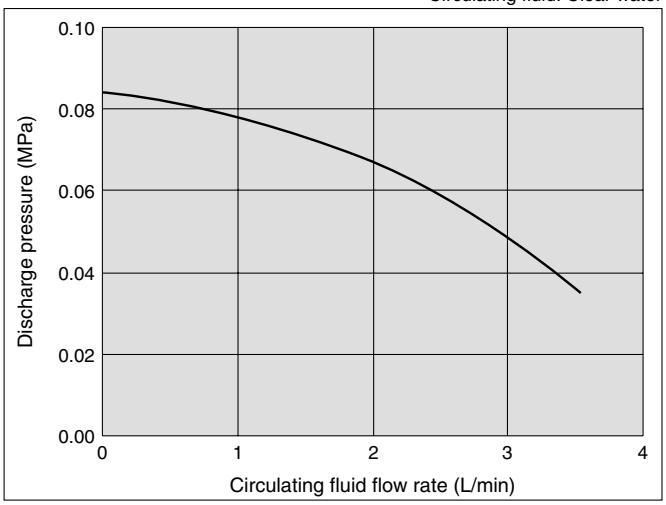


Pump Capacity (Thermo-con Outlet)

The pressure on the y-axis shows the discharge pressure of circulating fluid in the Thermo-con.

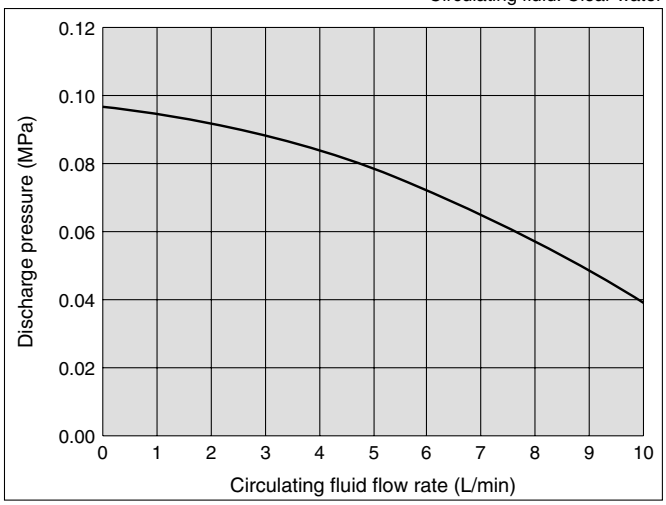
HEC002

Circulating fluid: Clear water



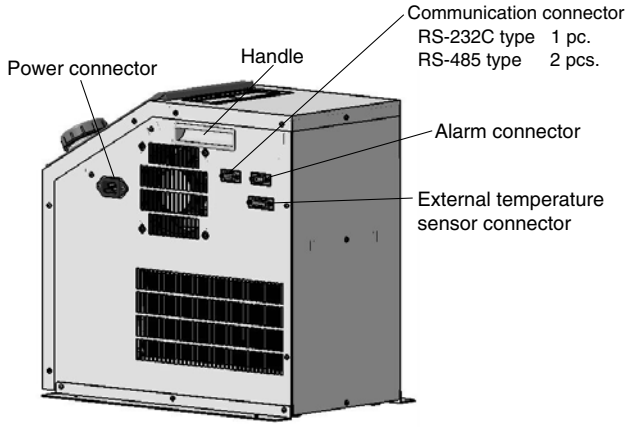
HEC006

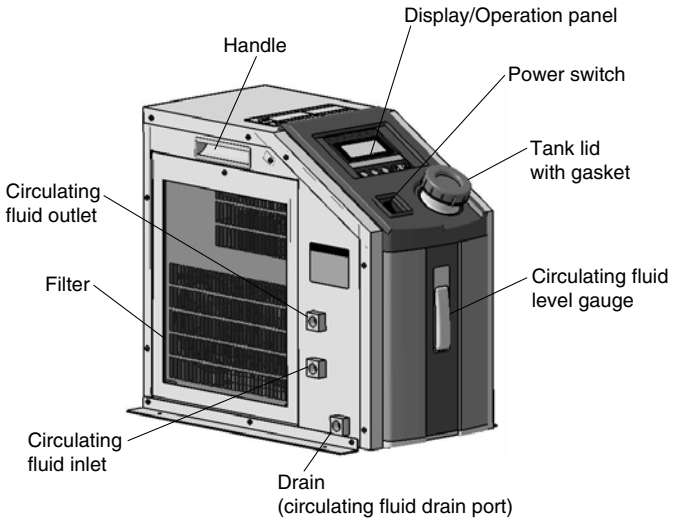
Circulating fluid: Clear water



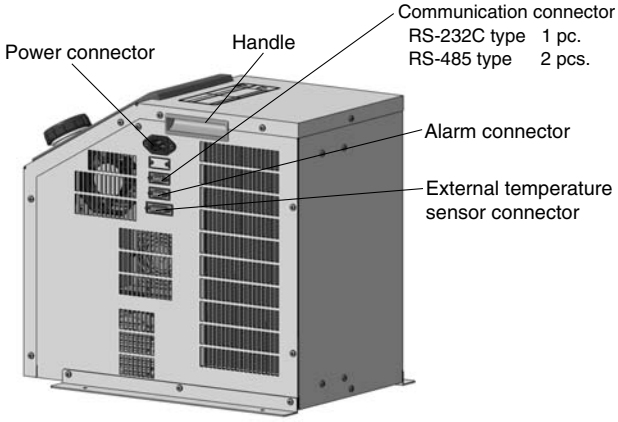
Parts Description

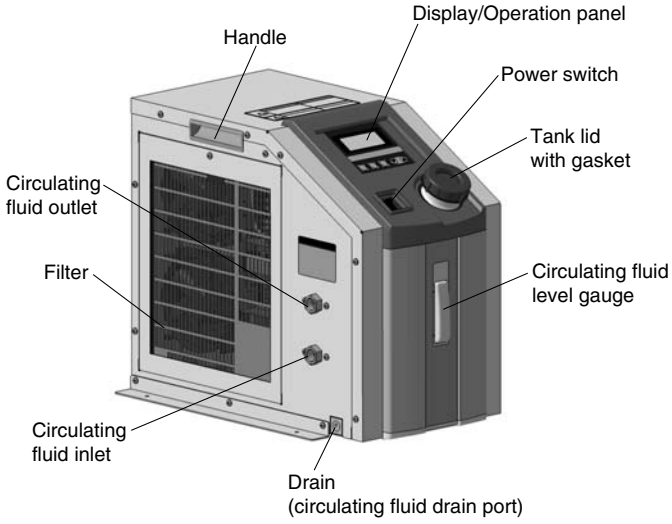
HEC002





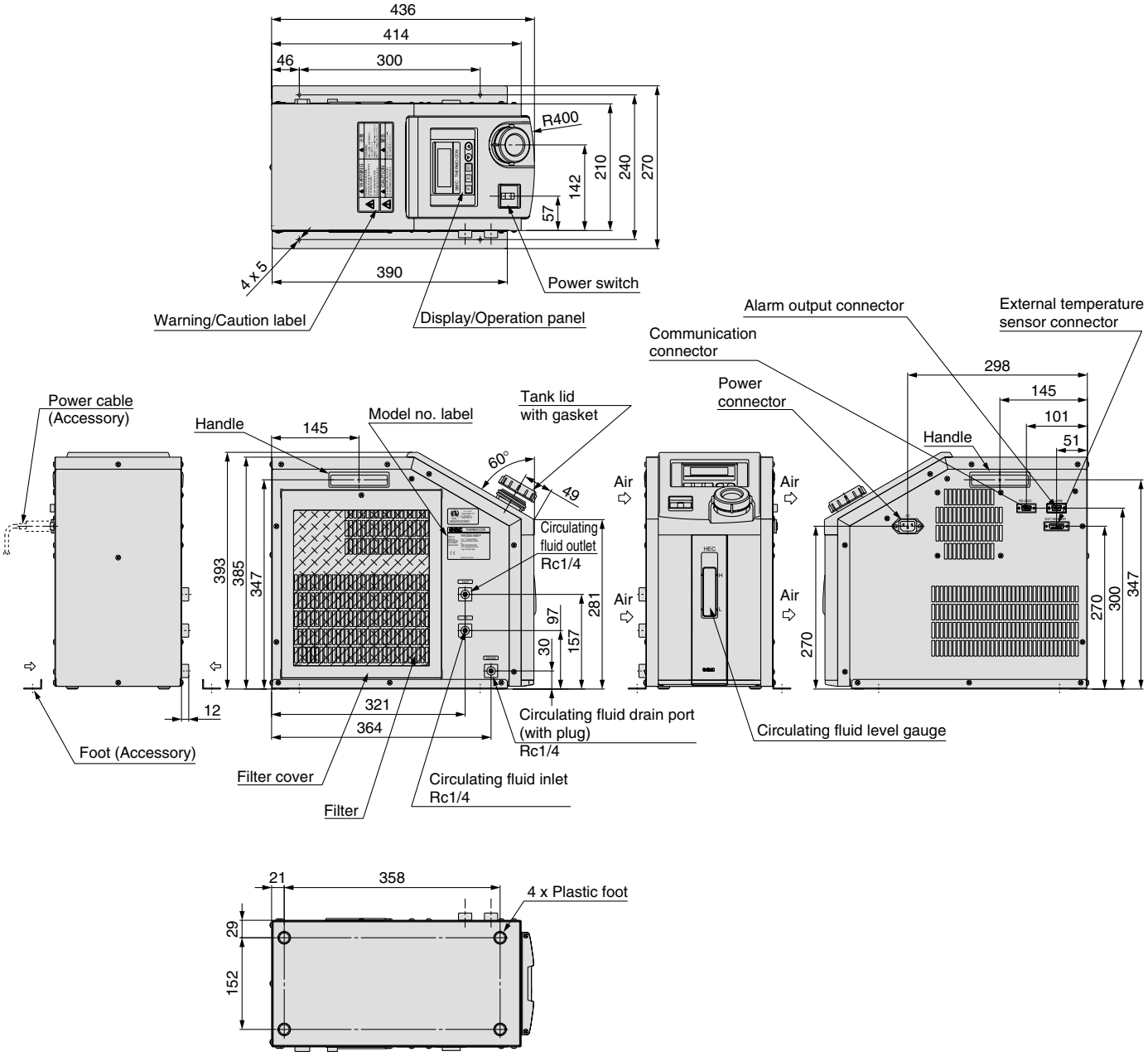
HEC006





Dimensions

HEC002



Option (Fitting part)

NPT fitting specification (-N, -FN)

Circulating fluid outlet
NPT1/4

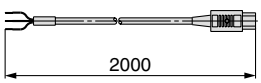
Circulating fluid inlet
NPT1/4

Circulating fluid drain port (with plug)
NPT1/4

Power Cable (Accessory)

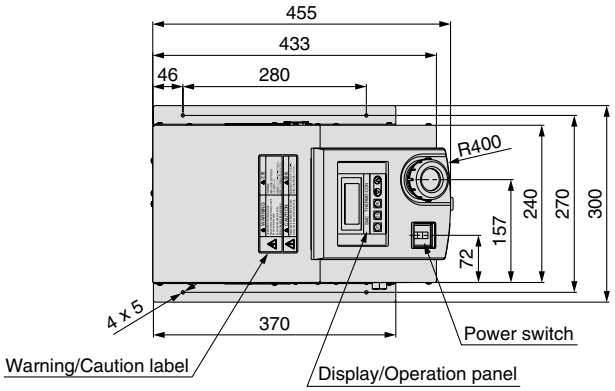
Connector: IEC60320 C13 or equivalent
Cable: 14AWG, O.D. ø8.4

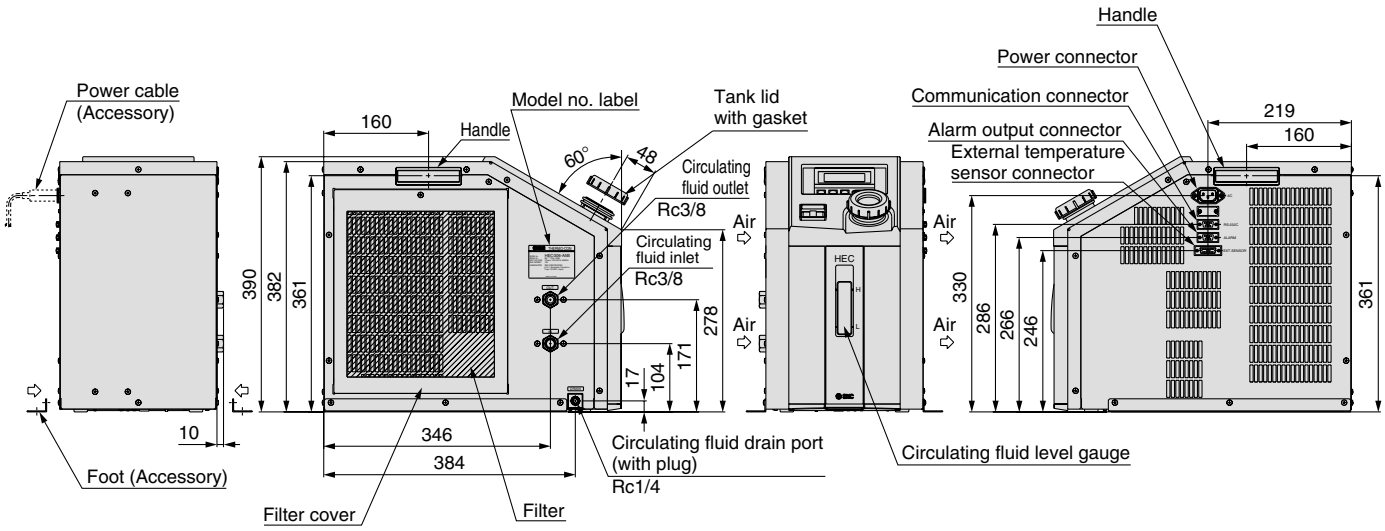
Wire color	Contents
Black	100 to 240 VAC
Black	100 to 240 VAC
Green/Yellow	PE

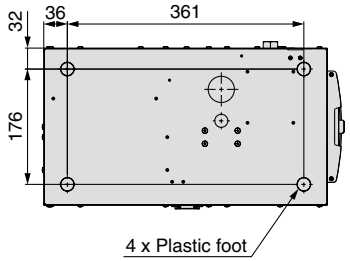


Dimensions

HEC006

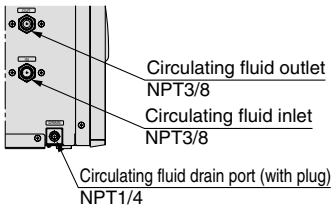






Option (Fitting part)

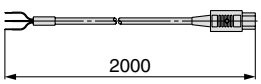
NPT fitting specification (-N, -FN)



Power Cable (Accessory)

Connector: IEC60320 C13 or equivalent
Cable: 14AWG, O.D. ø8.4

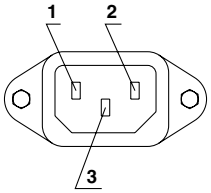
Wire color	Contents
Black	100 to 240 VAC
Black	100 to 240 VAC
Green/Yellow	PE



Connectors

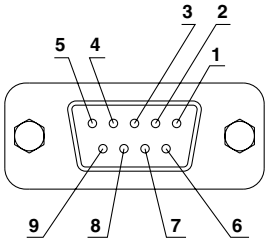
1. Power connector (AC)
IEC60320 C14 or equivalent

Pin No.	Contents
1	100 to 240 VAC
2	100 to 240 VAC
3	PE



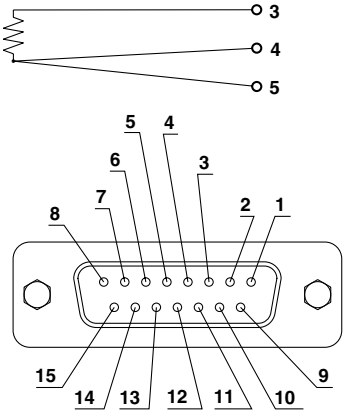
2. Communication connector (RS-232C or RS-485)
D-sub 9 pin (socket)
Holding screw: M2.6

Pin No.	Signal contents	
	RS-232C	RS-485
1	Unused	BUS+
2	RD	BUS–
3	SD	Unused
4	Unused	Unused
5	SG	SG
6-9	Unused	Unused



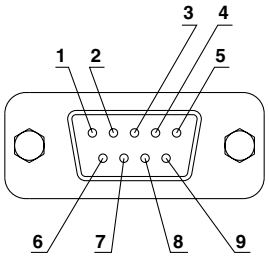
3. External sensor connector (EXT.SENSOR)
D-sub 15 pin (socket)
Holding screw: M2.6

Pin No.	Signal contents
1-2	Unused
3	Terminal A of resistance temperature detector
4	Terminal B of resistance temperature detector
5	Terminal B of resistance temperature detector
6-14	Unused
15	FG



4. Alarm output connector (ALARM)
D-sub 9 pin (pin)
Holding screw: M2.6

Pin No.	Signal contents
1	Contact a for output cut-off alarm (open when alarm occurs)
2	Common for output cut-off alarm
3	Contact b for output cut-off alarm (closed when alarm occurs)
4-5	Unused
6	Contact a for upper/lower temp. limit alarm (open when alarm occurs)
7	Common for upper/lower temp. limit alarm
8	Contact b for upper/lower temp. limit alarm (closed when alarm occurs)
9	Unused



Alarm

This unit is equipped as standard with a function allowing 15 kinds of alarms to display on the LCD and can be read out by serial communication. Also, it can generate relay output for upper/lower temperature limit alarm and output cut-off alarm.

Alarm

Alarm code	Alarm description	Operation status	Main reason
WRN	Upper/Lower temp. limit alarm	Continue	The temperature has exceeded the upper or lower limit of the target temperature.
ERR00	CPU hung-up	Stop	The CPU has crashed due to noise, etc.
ERR01	CPU check error	Stop	The contents of the CPU cannot be read out correctly when the power supply is turned on.
ERR03	Back-up data error	Stop	The contents of the back-up data cannot be read out correctly when the power supply is turned on.
ERR04	EEPROM writing error	Stop	The data cannot be written to EEPROM.
ERR11	DC power supply failure	Stop	The DC power supply has failed (due to fan stop or abnormal high temperature) or the thermo-module has been short-circuited.
ERR12	Internal temp. sensor high temp. error	Stop	The internal temperature sensor has exceeded the upper limit of cut-off temperature.
ERR13	Internal temp. sensor low temp. error	Stop	The internal temperature sensor has exceeded the lower limit of cut-off temperature.
ERR14	Thermostat alarm	Stop	The thermostat has been activated due to filter clog or fan/pump failure, etc.
ERR15	Abnormal output alarm	Continue	The temperature cannot be changed even at 100% output due to overload or disconnection of the thermo-module.
ERR16	Low flow rate alarm (option)	Stop	The flow rate of the circulating fluid has dropped.
ERR17	Internal temp. sensor disconnection alarm	Stop	The internal temperature sensor has been disconnected or short-circuited.
ERR18	External temp. sensor disconnection alarm	Continue	The external temperature sensor has been disconnected or short-circuited. (Only detected when in learning control or external tune control)
ERR19	Abnormal auto tuning alarm	Stop	Auto tuning has not been completed within 20 minutes.
ERR20	Low fluid level alarm	Stop	The amount of circulating fluid in the tank has dropped.

Maintenance

Maintenance of this unit is performed only in the form of return to and repair at SMC's site. As a rule, SMC will not conduct on-site maintenance. Separately, the following parts have a limited life and need to be replaced before the life ends.

Parts Life Expectation

Description	Expected life	Possible failure
Pump	3 to 5 years	The bearing is worn so the pump fails to transfer the circulating fluid, which results in temperature control failure.
Fan	5 to 10 years	The bearing uses up lubrication and makes the fan unable to supply enough air, which deteriorates the cooling and heating capacity.
DC power supply	5 to 10 years	The capacity of the electrolytic condenser decreases, and causes abnormal voltage which results in DC power supply failure and stops the Thermo-con.
Display panel	50,000 hours (approx. 5 years)	The display turns off when the backlight of the LCD reaches the end of its life.

Series HEC-A
Options

Note) Options have to be selected when ordering the Thermo-con. It is not possible to add them after purchasing the unit.

F Option symbol

With Flow Switch

HEC□□□-□□□-F

F: With flow switch

This is an ON/OFF switch detecting low levels of the circulating fluid.
When the fluid volume is 1 L/min. or less, "ERR16" is displayed and the Thermo-con stops. This switch is installed between the circulating fluid inlet and the tank, and built into the Thermo-con.
Refer to page 161.

Type	Applicable model
Air-cooled	**HEC002-A5□-F**
	HEC006-A5□-F

N Option symbol

NPT Thread

HEC□□□-□□□-N

N: NPT thread

The connection parts of circulating fluid piping, facility water piping and circulating fluid drain port are NPT thread type.

Type	Applicable model
Air-cooled	**HEC002-A5□-N**
	HEC006-A5□-N

Series HEC-A
Specific Product Precautions 1

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

System Design

⚠Warning

1. This catalog shows the specifications of the Thermo-con.

1. Check detailed specifications in the separate "Product Specifications", and evaluate the compatibility of the Thermo-con with customer's system.
2. Although the protection circuit as a single unit is installed, the customer is requested to carry out the safety design for the whole system.

Handling

⚠Warning

1. Thoroughly read the Operation Manual.

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

2. If the set temperature is repeatedly changed by 10°C or more, the Thermo-con may fail in short periods of time.

Operating Environment/Storage Environment

⚠Warning

1. Keep within the specified ambient temperature and humidity range.

Also, if the set temperature is too low, condensation may form on the inside of the Thermo-con or the surface of piping even within the specified ambient temperature range. Dew condensation can cause failure, and so must be avoided by considering operating conditions.

2. The Thermo-con is not designed for clean room usage.

It generates dust from the pump inside the unit and the cooling fan.

3. Low molecular siloxane can damage the contact of the relay.

Use the Thermo-con in a place free from low molecular siloxane.

Radiation Air

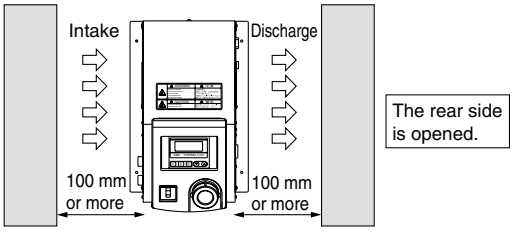
⚠Caution

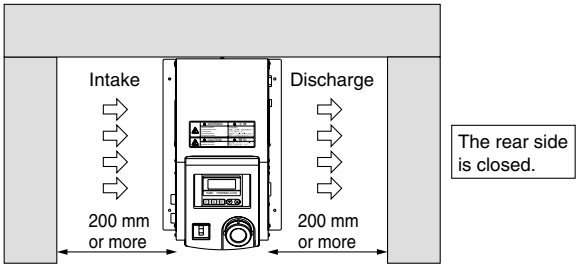
1. The inlet for radiation air must not be exposed to particles and dust as far as possible.

2. Do not let the inlet and outlet for radiation air get closed.

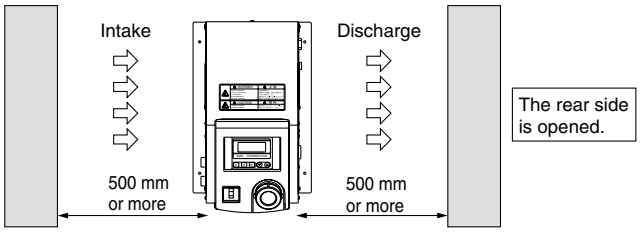
<HEC002>

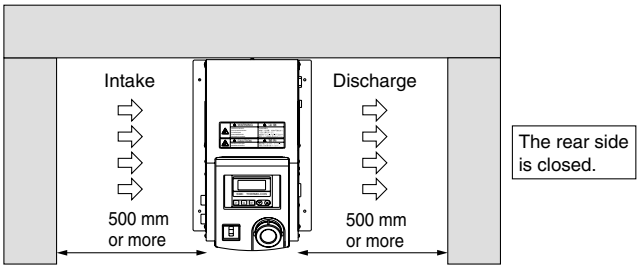
If radiation is prevented, the set temperature may not be achieved depending on the value of the set temperature and the load. Keep a space of 100 mm for opened rear side or 200 mm for closed rear side respectively.





<HEC006>





Note) The space must be 500 mm or more. Be sure that the ambient temperature is within the specification range.

Series HEC-A
Specific Product Precautions 2

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Radiation Air

⚠Caution

3. If more than one Thermo-con is used, consider their arrangement so that the downstream sides of the Thermo-cons suck radiation air from the upstream sides.

Otherwise, the performance at the downstream sides may deteriorate. Also, the set temperature may not be achieved depending on the value of the set temperature and the load. In such a case, take countermeasures such as changing the direction of the Thermo-cons to prevent the deterioration of performance.

4. If dust adheres to the filter, remove dust with a vacuum cleaner or a dry cloth.

5. Do not operate without the filter.

Otherwise, dust may accumulate on the heat sink and electrical components, causing abnormal heating.

Circulating Fluid

⚠Caution

1. Use tap water or fluid which will not damage the wetted material.

(Stainless steel 303, Stainless steel 304, EPDM, Polypropylene, PE, PPE, Ceramics, Polyurethane)

2. Deionized water (with an electrical conductivity of approx. 1 μS/cm) can be used, but may lose its electrical conductivity.

Also, if a facility supplying deionized water is used, the Thermo-con may be damaged by static electricity.

3. If deionized water is used, bacteria and algae may grow in short periods of time.

If the Thermo-con is operated with bacteria and algae, its cooling capacity or the capacity of the pump may deteriorate. Exchange all deionized water regularly depending on the conditions (once a month as a guide).

4. If using a fluid other than water, please contact SMC beforehand.

5. The maximum operating pressure of circulating fluid circuit is 0.1 MPa.

If this pressure is exceeded, leakage from the tank in the Thermo-con can result.

6. Select a pipe with a length and diameter which allow a flow rate of 1 L/min or more (HEC002) or 3 L/min or more (HEC006) for the circulating fluid.

If the flow rate is less than these values, the Thermo-con cannot provide precise control, but also can fail because of the repeated cooling and heating operation.

7. A magnet driven pump is used as a circulating pump.

A fluid which contains metal powders such as iron powder cannot be used.

8. The Thermo-con must not be operated without circulating fluid.

The pump can break due to idling.

Circulating Fluid

⚠Caution

9. If the tank lid is opened after the supply of circulating fluid, the circulating fluid may spill out depending on the condition of external piping.

10. If an external tank is used, the circulating fluid may spill out from the internal tank lid depending on where the external tank is installed.

Check that the internal tank has no leakage if using an external tank.

11. If there is a point where fluid is released to atmosphere externally (tank or piping), minimize the piping resistance at the circulating fluid return side.

If the piping resistance is too large, the piping may be crushed, or the built-in circulator tank may be deformed or cracked because the pressure in the piping for return will become negative. The built-in circulator tank is made of resin (PE). Therefore, the tank may be crushed if the pressure is negative. Special attention must be paid if the flow rate of the circulating fluid is high. To avoid getting negative pressure less than –0.02 MPa, the piping for return should be as thick and short as possible to minimize the piping resistance. It is also effective to restrict the flow rate of circulating fluid or remove the gasket of internal tank for the release to atmosphere.

12. Fluorinated fluid is outside of the specifications.

If it is used in the Thermo-con, static electricity will be generated by the flow of fluid. This static electricity may be discharged to the board of the Thermo-con, causing damage or operation failure and loss of data of such as set temperature. Also, as the specific gravity of the fluorinated fluid is 1.5 to 1.8 times of water, the pump will be overloaded, which also causes fluorinated fluid to be outside the specifications. Therefore, if fluorinated fluid is used, please contact SMC and we will introduce a suitable special product (water-cooled type).

13. Avoid operation with cavitation or bubbles due to low fluid level in the tank. This may shorten the pump life.

14. If clear water is used, it should satisfy the quality standards shown below.

Clear Water (as Circulating Water) Quality Standards

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

	Item	Standard value
Standard item	pH (at 25°C)	6.0 to 8.0
	Electrical conductivity (25°C)	100*1 to 300*2 [μS/cm]
	Chloride ion	50 [mg/L] or less
	Sulfuric acid ion	50 [mg/L] or less
	Acid consumption amount (at pH4.8)	50 [mg/L] or less
	Total hardness	70 [mg/L] or less
	Calcium hardness	50 [mg/L] or less
	Ionic state silica	30 [mg/L] or less
Reference item	Iron	0.3 [mg/L] or less
	Copper	0.1 [mg/L] or less
	Sulfide ion	Should not be detected.
	Ammonium ion	0.1 [mg/L] or less
	Residual chlorine	0.3 [mg/L] or less
	Free carbon	4.0 [mg/L] or less

*1 Electrical conductivity should be 100 [μS/cm] or more.
*2 In the case of [MΩ•cm], it will be 0.003 to 0.01.

Series HEC-A
Specific Product Precautions 3

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Communication

⚠Caution

1. The set value can be written to EEPROM, but only up to approx. 1 million times.

In particular, pay attention to how many of times the writing is performed using the communication function.

Maintenance

⚠Warning

1. Prevention of electric shock and fire

Do not operate the switch with wet hands. Also, do not operate the Thermo-con with water left on it.

2. Action in the case of error

If any error such as abnormal sounds, smoke, or bad smell occurs, cut off the power at once, and stop supplying and conveying fluid. Please contact SMC or a sales distributor to repair the Thermo-con.

3. Regular inspection

Check the following items at least once a month. The inspection must be done by an operator who has sufficient knowledge and experience.

a) Check of displayed contents.
b) Check of temperature, vibration and abnormal sounds in the body of the Thermo-con.
c) Check of the voltage and current of the power supply system.
d) Check for leakage and contamination of the circulating fluid and intrusion of foreign objects to it, and subsequent replacement of the fluid.
e) Check for flow condition, temperature and filter of radiation air.

Peltier-Type Chiller
Thermo-con (Water-cooled)
Series HEC-W

How to Order

140 W, 320 W **HEC 003 – W 5 B –** ☐

Cooling capacity

001	140 W
003	320 W

Radiating method

W	Water-cooled

Power supply

5	100 to 240 VAC

Communication

A	RS-485
B	RS-232C

∗ Select B when communication is not used.

Option

Nil	None
F	With flow switch
N	NPT thread
L	With level switch

∗ The option should be specified when ordering.

Specifications (For details, please consult our "Product Specifications" information.)

Model		HEC001-W5A	HEC001-W5B	HEC003-W5A	HEC003-W5B
Cooling method		Thermoelectric device (Thermo-module)			
Radiating method		Water-cooled			
Control method		Cooling/Heating automatic shift PID control			
Ambient temperature/humidity		10 to 35°C, 35 to 80%RH (no condensation)			
Circulating fluid system	**Circulating fluid**	Clear water, 20% ethylene glycol			
	Operating temp. range	10.0 to 60.0°C (no condensation)			
	Cooling capacity	140 W Note 1)		320 W Note 1)	
	Heating capacity	400 W Note 1)		770 W Note 1)	
	Temperature stability Note 2)	±0.01 to 0.03°C			
	Pump capacity	Refer to performance chart.			
	Tank capacity	Approx. 1.2 L			
	Port size	IN/OUT: Rc3/8 Drain: Rc1/4 (with plug)			
	Wetted parts material	PPE, PP glass 10%, Alumina ceramics, Carbon, EPDM, Stainless steel 303, Stainless steel 304, PE, PP, NBR			
Facility water system	**Temperature range**	10 to 35°C (no condensation)			
	Pressure range	1 MPa or less			
	Required flow rate Note 3)	3 to 7 L/min			
	Port size	IN/OUT: Rc3/8			
	Wetted parts material	Stainless steel 304			
Electrical system	**Power supply**	Single-phase: 100 to 240 VAC ±10%, 50/60 Hz			
	Overcurrent protector	10 A			
	Current consumption	3.5 A (100 VAC) to 1.5 A (240 VAC)		5.5 A (100 VAC) to 2.5 A (240 VAC)	
	Alarm	Refer to alarm function.			
	Communications	RS-485	RS-232C	RS-485	RS-232C
Weight		Approx. 12 kg		Approx. 13 kg	
Accessories		Power cable, Foot for fixing, Splashproof cover			
Safety standards		CE marking, UL standards, SEMI			

Note 1) Circulating fluid/Clear water conditions: Circulating fluid set temperature 20°C, Flow rate 5 L/min., Facility water temperature 20°C, Flow rate 5 L/min., Ambient temperature 25°C
Note 2) The indicated values are with a stable load without turbulence in the operating conditions. It may be out of this range in some other operating conditions.
Note 3) The flow rate over or below the set range may deteriorate performance or generate noise.

How to Order

600 W, 1200 W **HEC 012 – W 2 B –** ☐

Cooling capacity

006	600 W
012	1200 W

Radiating method

W	Water-cooled

Power supply

2	200 to 220 VAC

Option

Nil	None
N	NPT thread

∗ The option should be specified when ordering.

Communication

A	RS-485
B	RS-232C

∗ Select B when communication is not used.

Specifications (For details, please consult our "Product Specifications" information.)

Model		HEC006-W2A	HEC006-W2B	HEC012-W2A	HEC012-W2B
Cooling method		Thermoelectric device (Thermo-module)			
Radiating method		Water-cooled			
Control method		Cooling/Heating automatic shift PID control			
Ambient temperature/humidity		10 to 35°C, 35 to 80%RH (no condensation)			
Circulating fluid system	**Circulating fluid** Note 1)	Clear water, Fluorinated fluid (Fluorinert™ FC-3283, GALDEN® HT135)			
	Operating temperature range	10.0 to 60.0°C (no condensation)			
	Cooling capacity	600 W (Clear water), 400 W (Fluorinert™ FC-3283) Note 2)		1200 W (Clear water), 800 W (Fluorinert™ FC-3283) Note 3)	
	Heating capacity	900 W (Clear water), 600 W (Fluorinert™ FC-3283) Note 2)		2200 W (Clear water), 1500 W (Fluorinert™ FC-3283) Note 3)	
	Temperature stability Note 4)	±0.01 to 0.03°C			
	Pump capacity	Refer to performance chart.			
	Tank capacity	Approx. 3 L		Approx. 5 L	
	Port size	IN/OUT: Rc3/8 Drain: Rc1/4 (with plug)		IN/OUT: Rc3/4 Drain: Rc1/4 (with plug)	
	Wetted parts material	Stainless steel 303, Stainless steel 304, EPDM, Ceramics, PPS glass 30%, Carbon, PE, Polyurethane		Stainless steel 303, Stainless steel 304, EPDM, Ceramics, PP, PE, Polyurethane, SiC, PPS	
Facility water system	**Temperature range**	10 to 35°C (no condensation)			
	Pressure range	1 MPa or less			
	Required flow rate Note 5)	8 to 10 L/min		10 to 15 L/min	
	Port size	IN/OUT: Rc3/8		IN/OUT: Rc1/2	
	Wetted parts material	Stainless steel 303, Stainless steel 304			
Electrical system	**Power supply**	Single-phase: 200 to 220 VAC ±10%, 50/60 Hz			
	Overcurrent protector	10 A		15 A	
	Current consumption	5 A		10 A	
	Alarm	Refer to alarm function.			
	Communications	RS-485	RS-232C	RS-485	RS-232C
Weight		Approx. 25 kg (including foot for fixing)		Approx. 40 kg (including foot for fixing)	
Accessories		Power cable, Foot for fixing			
Safety standards		CE marking, UL standards			

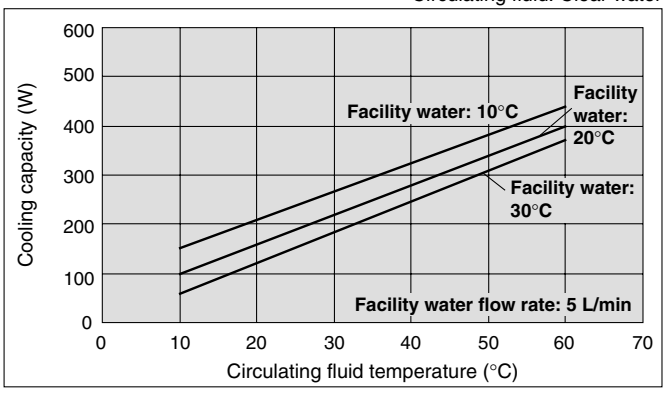
Note 1) Fluorinert™ is a trademark of 3M and GALDEN® is a registered trademark of Solvay Solexis, Inc. Regarding the fluid other than the above, please consult with SMC.
Note 2) Conditions: Set temperature 25°C, Facility water temperature 20°C, Facility water flow rate 8 L/min, Ambient temperature 25°C,
Note 3) Conditions: Set temperature 25°C, Facility water temperature 20°C, Facility water flow rate 10 L/min, Ambient temperature 25°C,
Note 4) The indicated values are with a stable load without turbulence in the operating conditions. It may be out of this range in some other operating conditions.
Note 5) The flow rate over or below the set range may deteriorate performance or generate noise.

The values shown on the performance chart are not guaranteed, but typical. Allow margins for safety when selecting the model.

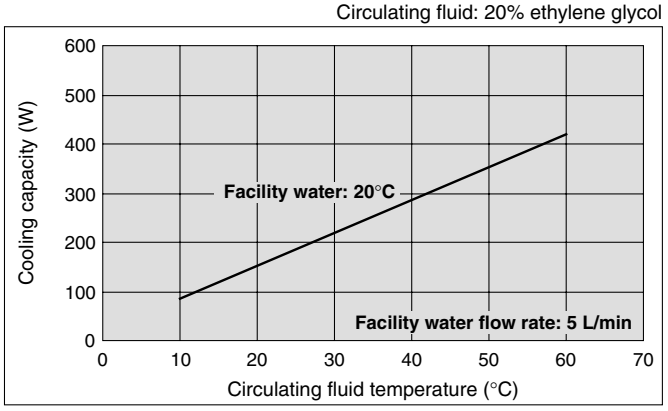
Cooling Capacity

HEC001

Circulating fluid: Clear water

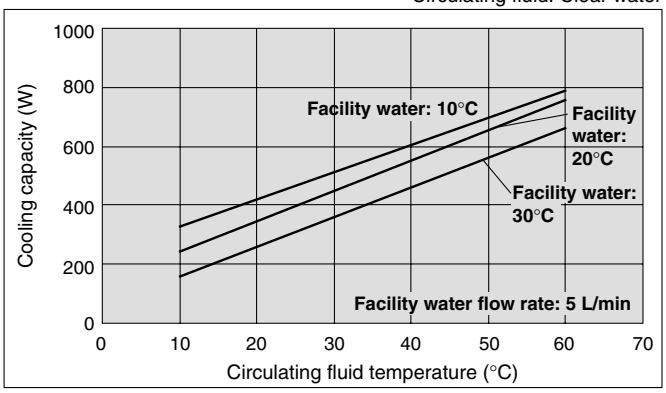


Circulating fluid: 20% ethylene glycol

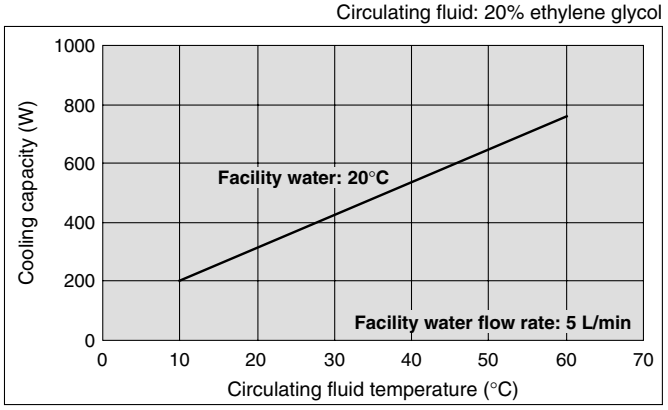


HEC003

Circulating fluid: Clear water

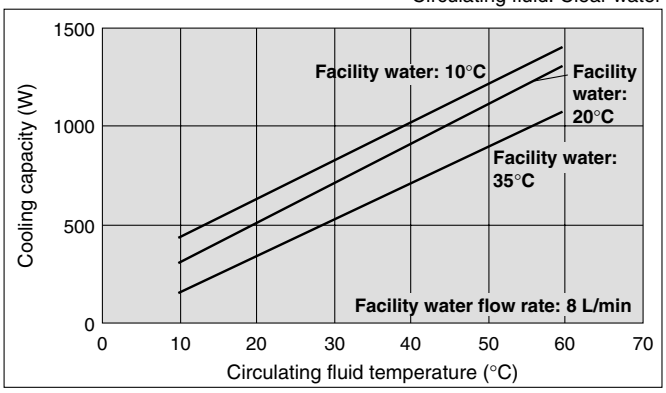


Circulating fluid: 20% ethylene glycol

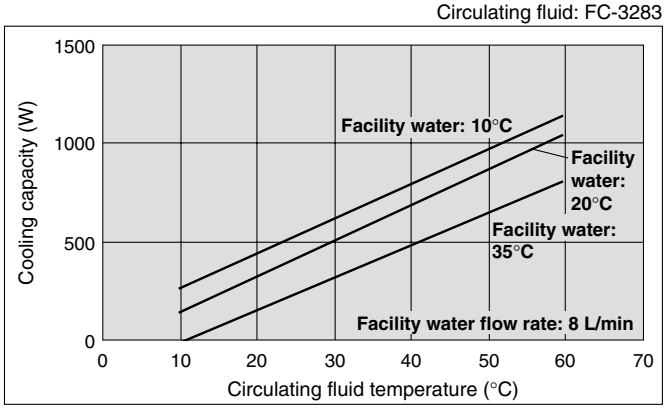


HEC006

Circulating fluid: Clear water

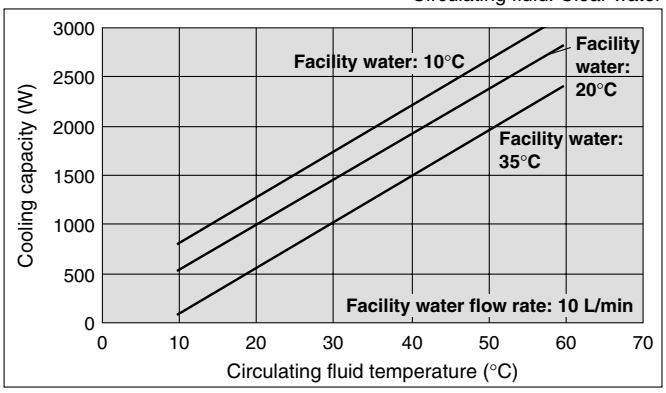


Circulating fluid: FC-3283

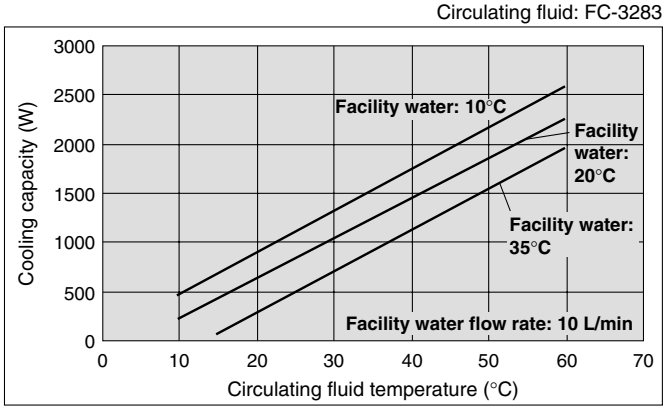


HEC012

Circulating fluid: Clear water



Circulating fluid: FC-3283

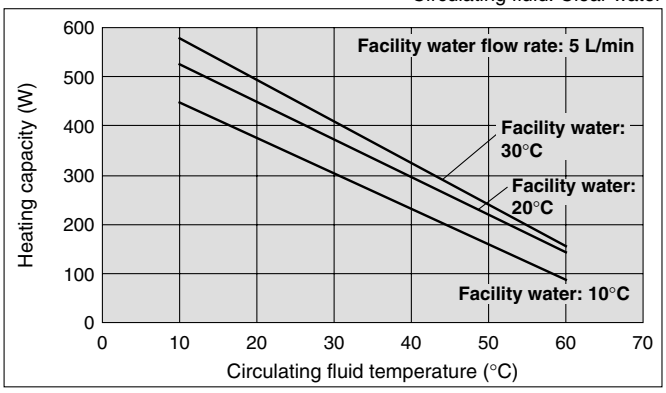


The values shown on the performance chart are not guaranteed, but typical. Allow margins for safety when selecting the model.

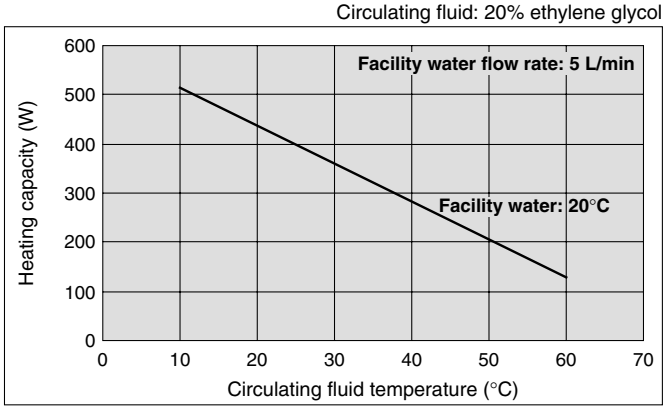
Heating Capacity

HEC001

Circulating fluid: Clear water

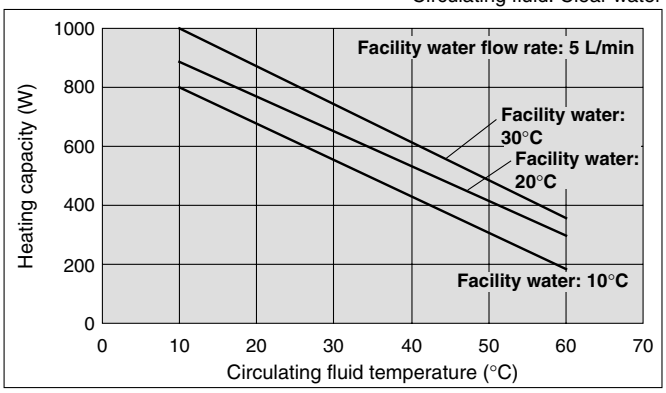


Circulating fluid: 20% ethylene glycol

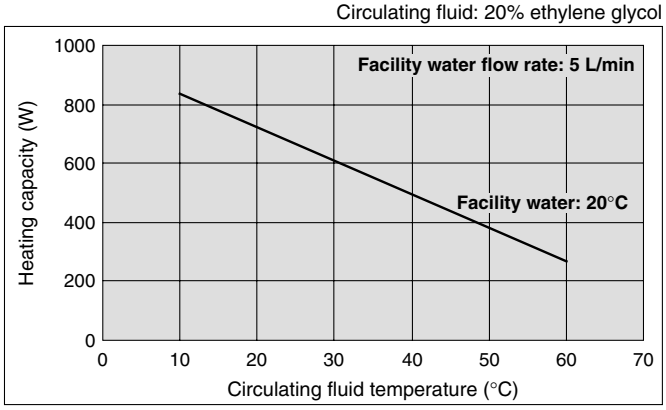


HEC003

Circulating fluid: Clear water

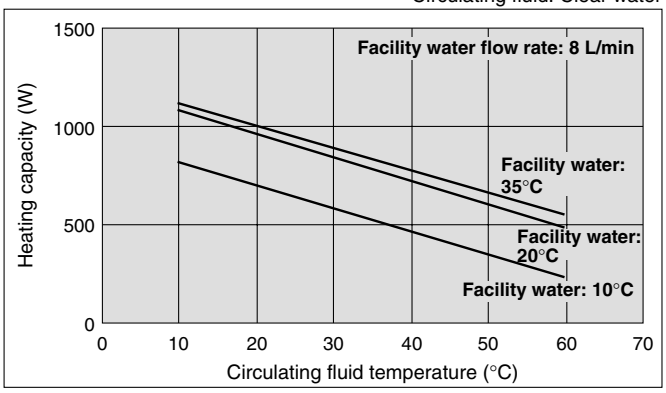


Circulating fluid: 20% ethylene glycol

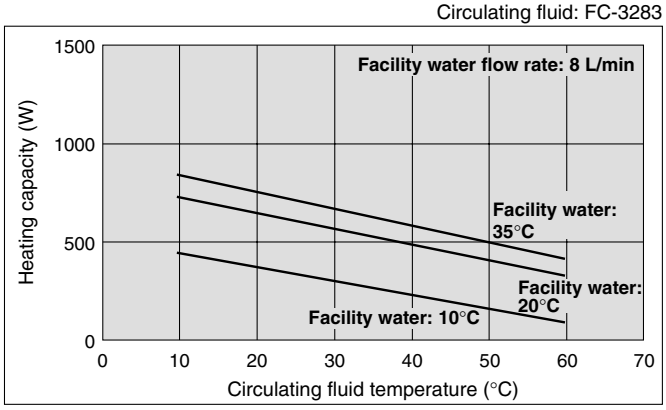


HEC006

Circulating fluid: Clear water

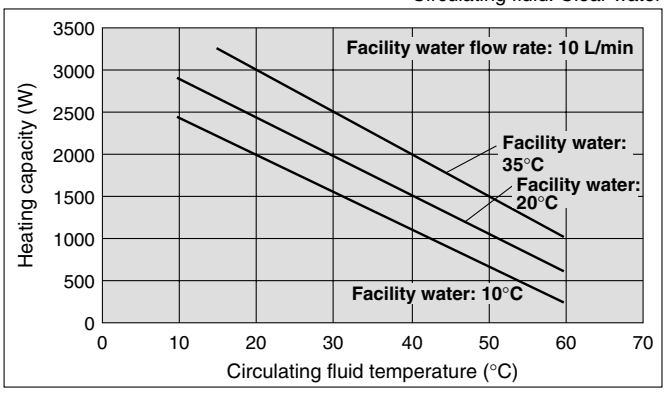


Circulating fluid: FC-3283

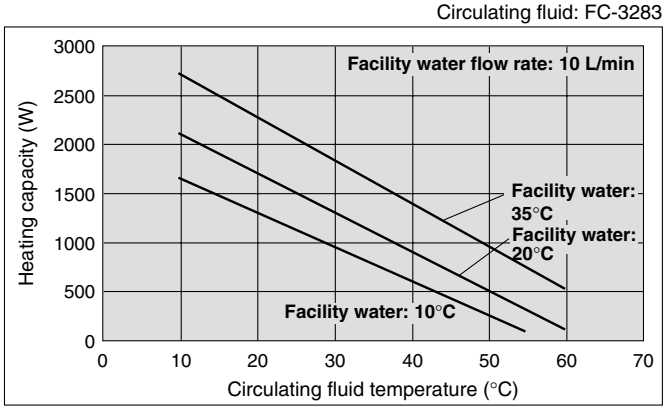


HEC012

Circulating fluid: Clear water

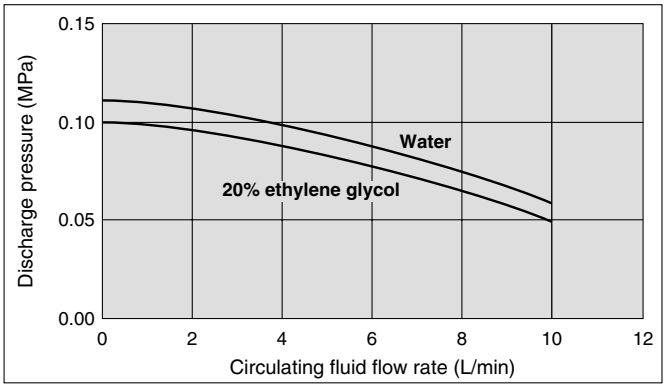


Circulating fluid: FC-3283

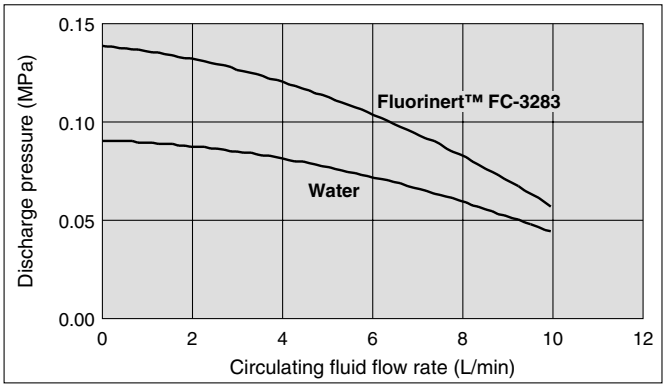


Pump Capacity (Thermo-con Outlet)

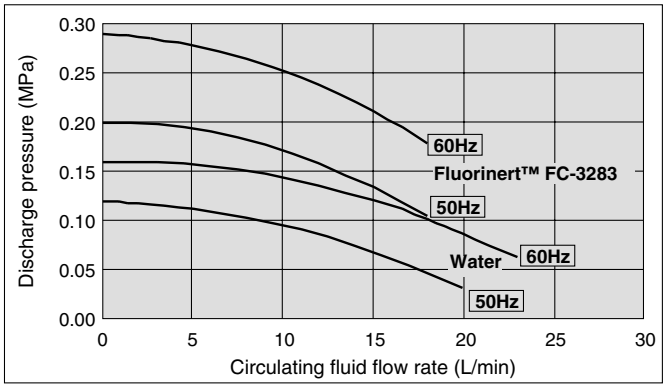
HEC001/003
Since a DC pump is used, the unit is not affected by power requirements.



HEC006
Since a DC pump is used, the unit is not affected by power requirements.

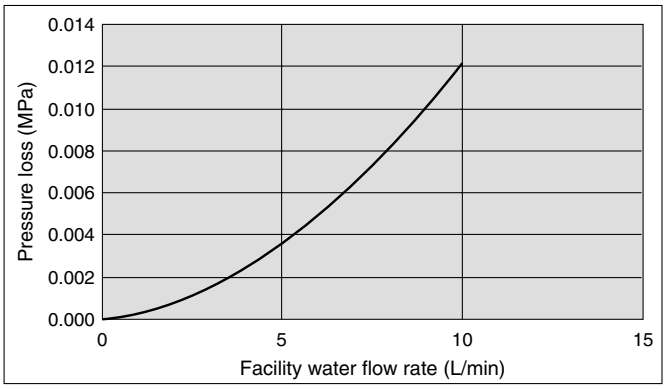


HEC012

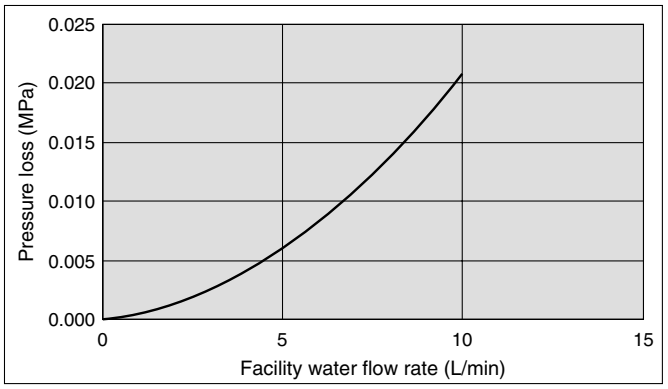


Pressure Loss in Facility Water Circuit

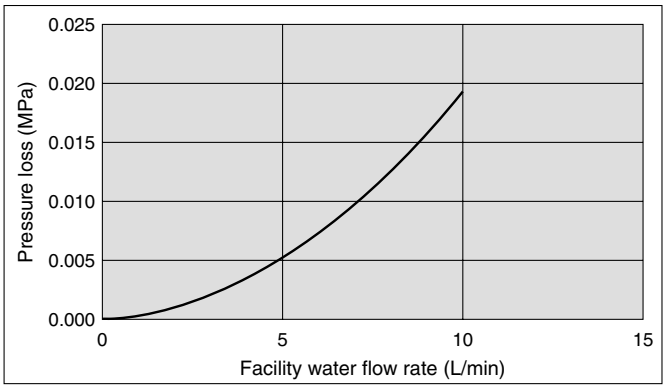
HEC001



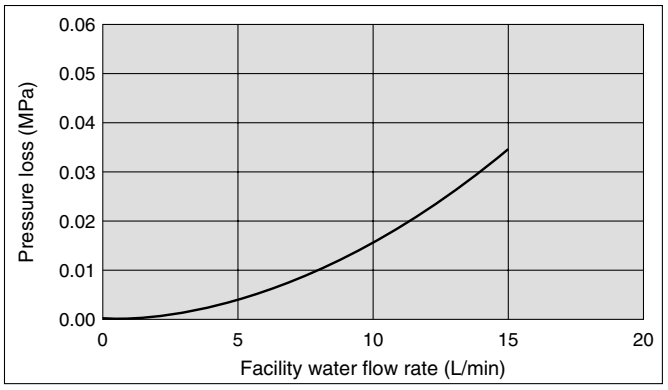
HEC003



HEC006

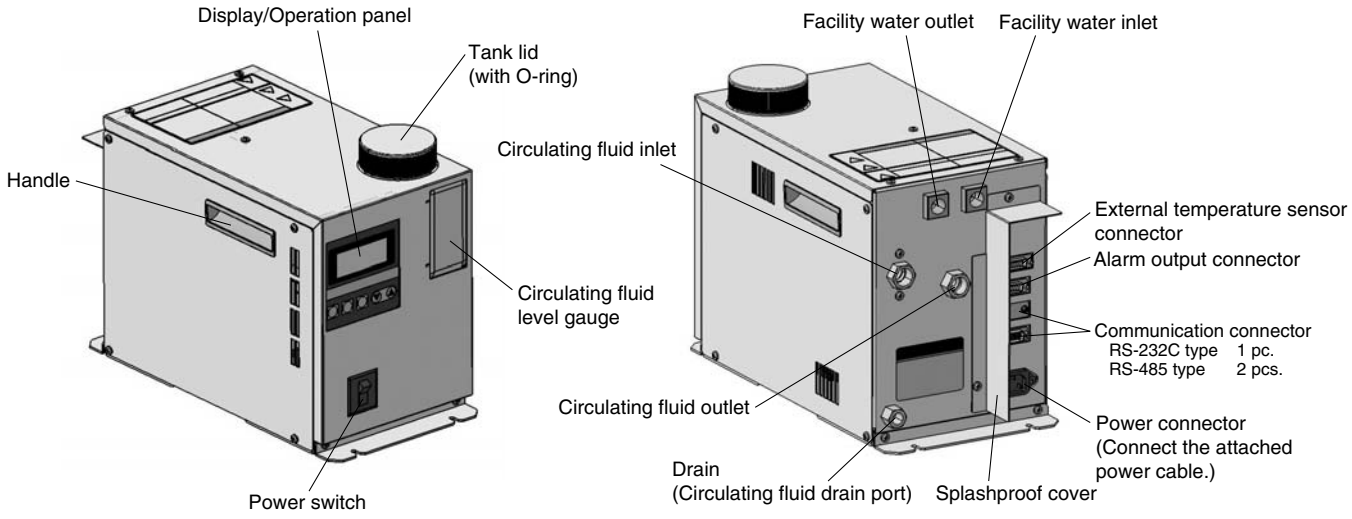


HEC012

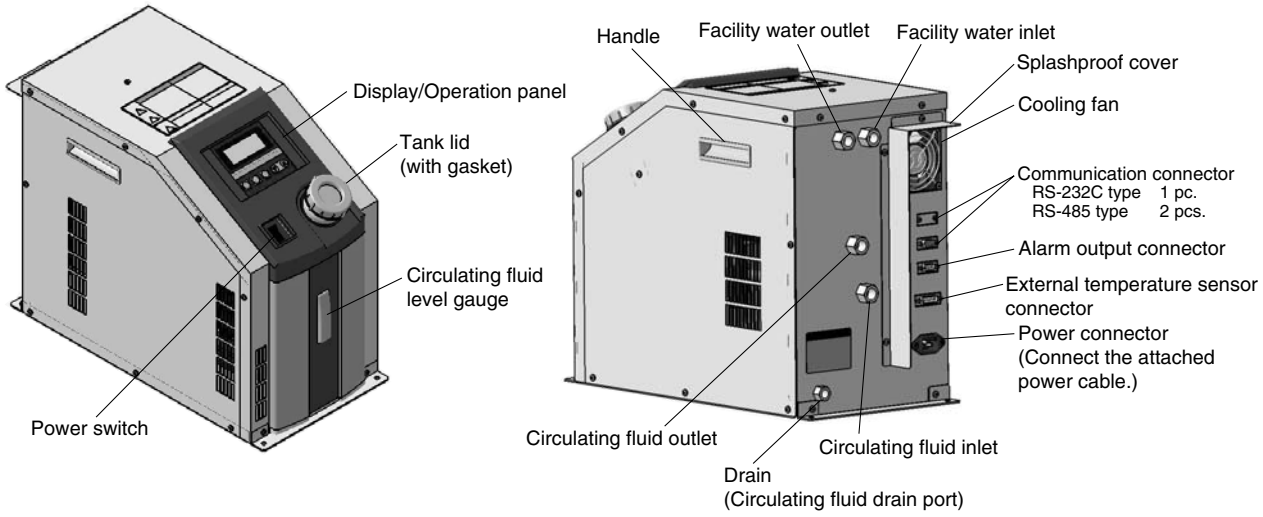


Parts Description

HEC001/003

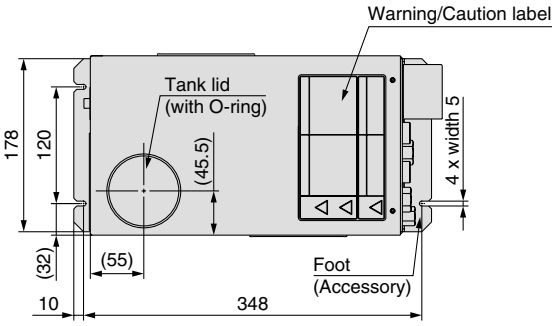


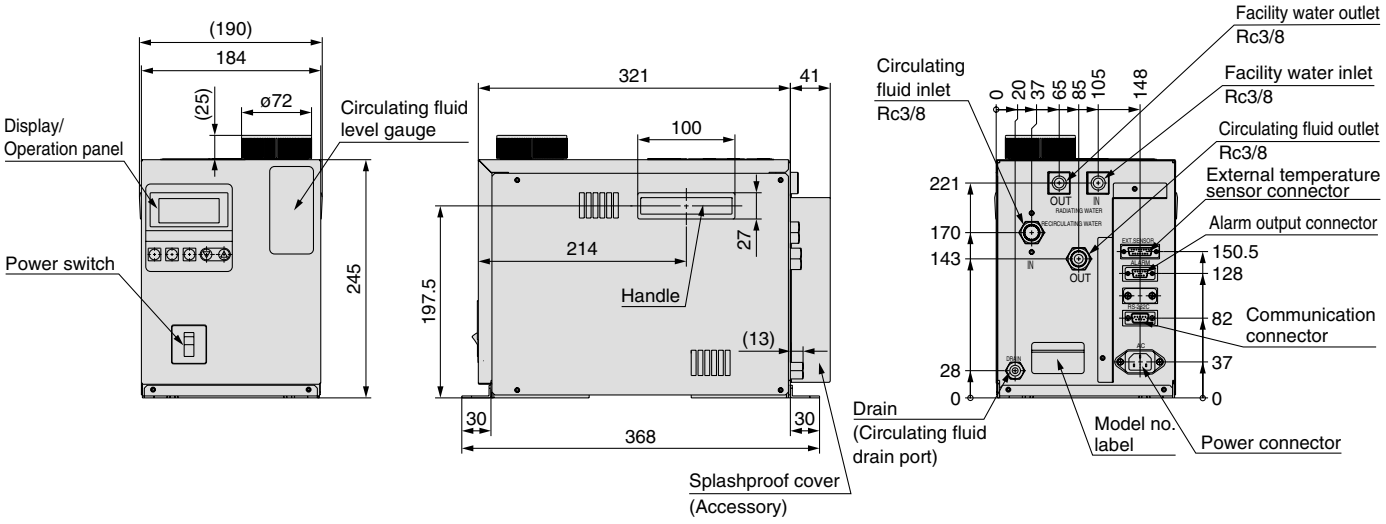
HEC006/012



Dimensions

HEC001-W5□/003-W5□



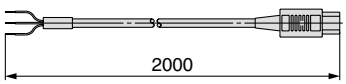


For NPT thread specification (-N), all fittings (including those at the circulating fluid drain port) are made of NPT.

Power Cable (Accessory)

Connector: IEC60320 C13 or equivalent
Cable: 14AWG, O.D. ø8.4

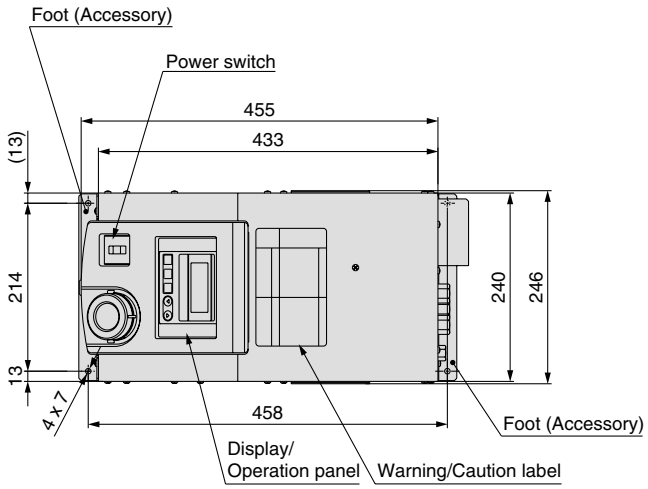
Wire color	Contents
Black	100 to 240 VAC
Black	100 to 240 VAC
Green/Yellow	PE

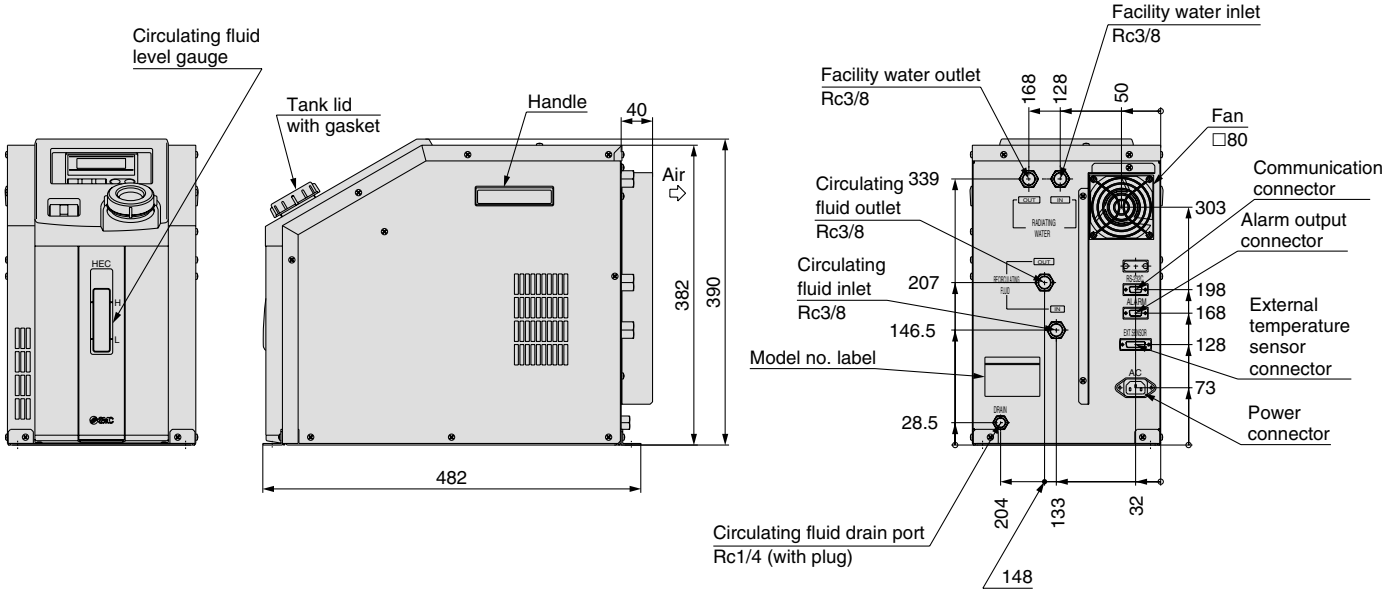


Power cable (Accessory)

Dimensions

HEC006-W2□



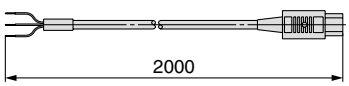


For NPT thread specification (-N), all fittings (including those at the circulating fluid drain port) are made of NPT.

Power Cable

Connector: IEC60320 C13 or equivalent
Cable: 14AWG, O.D. ø8.4

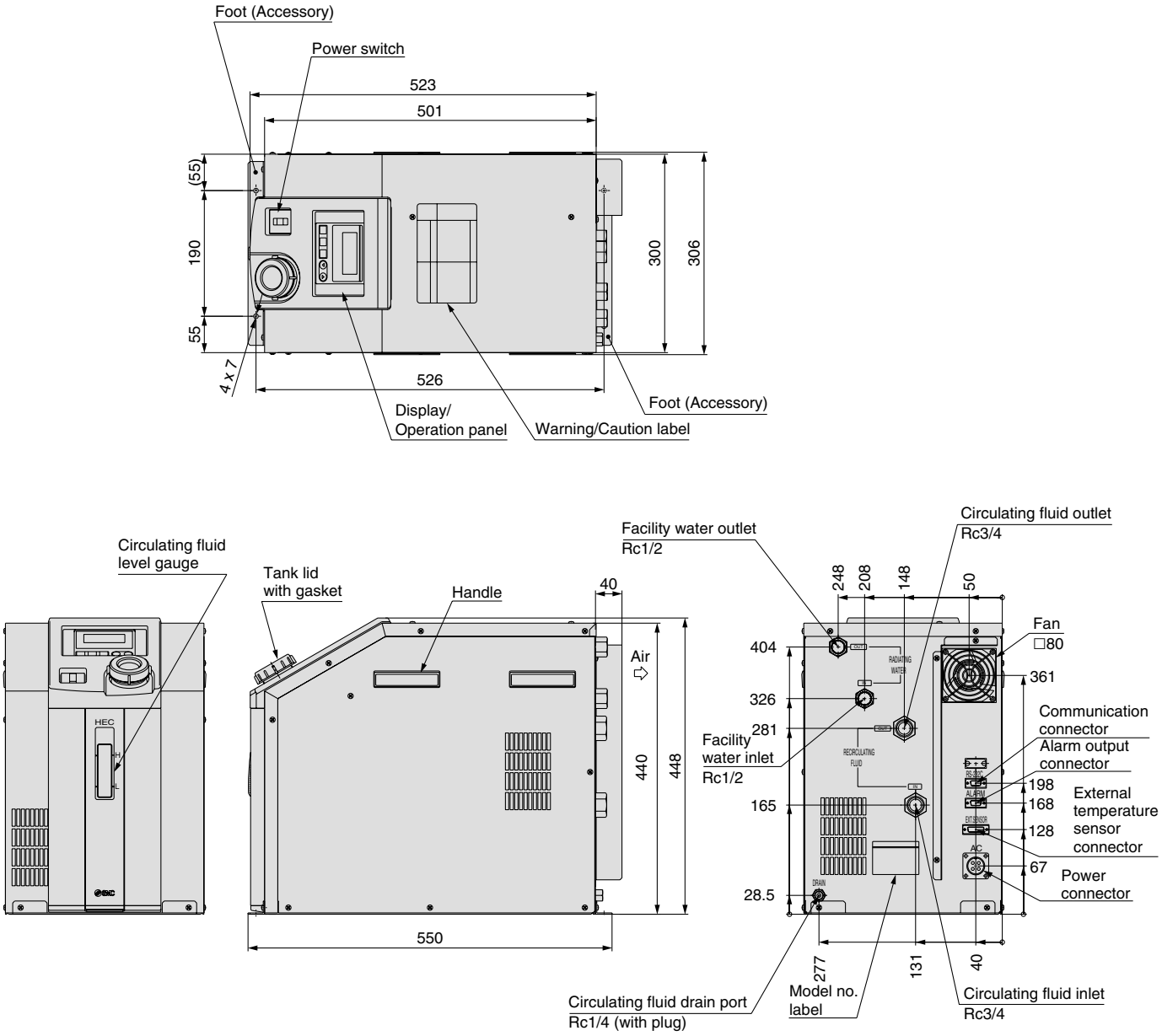
Wire color	Contents
Black	200 to 220 VAC
Black	200 to 220 VAC
Green/Yellow	PE



Power cable (Accessory)

Dimensions

HEC012-W2□

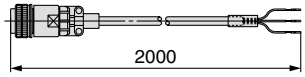


For NPT fitting specification (-N), all fittings (including those at the circulating fluid drain port) are made of NPT.

Power Cable

Connector: DDK CE05-6A18-10SD-D-BSS or equivalent
Cable: 14AWG, O.D. ø8.4

Wire color	Contents
Black	200 to 220 VAC
Black	200 to 220 VAC
Green/Yellow	PE



Power cable (Accessory)

Connectors

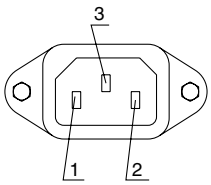
HEC006-W2□/001-W5□/003-W5□

1. Power connector (AC)
IEC60320 C14 or equivalent **HEC006-W2□**

Pin No.	Contents
1	200 to 220 VAC
2	200 to 220 VAC
3	PE

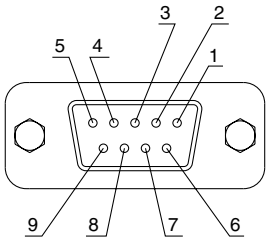
HEC001-W5□ **HEC003-W5□**

Pin No.	Contents
1	100 to 240 VAC
2	100 to 240 VAC
3	PE



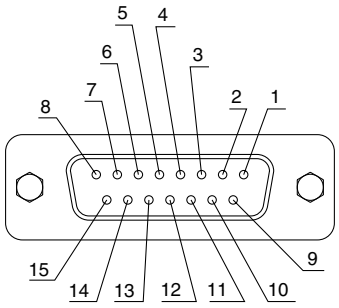
2. Communication connector (RS-232C or RS-485)
D-sub 9 pin (socket)
Holding screw: M2.6

Pin No.	Signal contents	
	RS-232C	RS-485
1	Unused	BUS+
2	RD	BUS–
3	SD	Unused
4	Unused	Unused
5	SG	SG
6-9	Unused	Unused



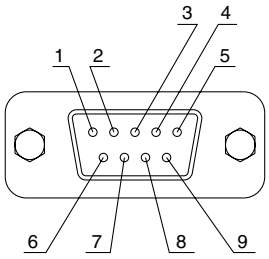
3. External sensor connector (EXT.SENSOR)
D-sub 15 pin (socket)
Holding screw: M2.6

Pin No.	Signal contents
1-2	Unused
3	Terminal A of resistance temperature detector
4	Terminal B of resistance temperature detector
5	Terminal B of resistance temperature detector
6-14	Unused
15	FG



4. Alarm output connector (ALARM)
D-sub 9 pin (pin)
Holding screw: M2.6

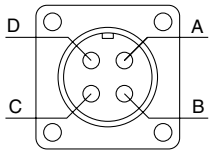
Pin No.	Signal contents
1	Contact a for output cut-off alarm (open when alarm occurs)
2	Common for output cut-off alarm
3	Contact b for output cut-off alarm (closed when alarm occurs)
4-5	Unused
6	Contact a for upper/lower temp. limit alarm (open when alarm occurs)
7	Common for upper/lower temp. limit alarm
8	Contact b for upper/lower temp. limit alarm (closed when alarm occurs)
9	Unused



HEC012-W2□

Power connector (AC)
DDK CE05-2A18-10PD-D or equivalent

Pin No.	Contents
A	200 to 220 VAC
B	200 to 220 VAC
C	Unused
D	PE



Other connectors are the same as those for the HEC006-W2□.

Alarm

This unit is equipped as standard with a function allowing 15 kinds of alarms to display on the LCD and can be read out by serial communication. Also, it can generate relay output for upper/lower temperature limit alarm and output cut-off alarm.

Alarm code	Alarm description	Operation status	Main reason
WRN	Upper/Lower temp. limit alarm	Continue	The temperature has exceeded the upper or lower limit of the target temperature.
ERR00	CPU hung-up	Stop	The CPU has crashed due to noise, etc.
ERR01	CPU check error	Stop	The contents of the CPU cannot be read out correctly when the power supply is turned on.
ERR03	Back-up data error	Stop	The contents of the back-up data cannot be read out correctly when the power supply is turned on.
ERR04	EEPROM writing error	Stop	The data cannot be written to EEPROM.
ERR11	DC power supply failure	Stop	The DC power supply has failed (due to abnormal high temperature) or an irregular voltage has occurred or the thermo-module has been short-circuited.
ERR12	Internal temp. sensor high temp. error	Stop	The internal temperature sensor has exceeded the upper limit of cut-off temperature.
ERR13	Internal temp. sensor low temp. error	Stop	The internal temperature sensor has exceeded the lower limit of cut-off temperature.
ERR14	Thermostat alarm	Stop	The thermostat has been activated due to insufficient of the facility water or high temperature.
ERR15	Abnormal output alarm	Continue	The temperature cannot be changed even at 100% output due to overload or disconnection of the thermo-module.
ERR16	Pump failure ∗1 or low circulating fluid level alarm ∗2	Stop	The pump has been overloaded ∗1 or the flow switch is activated ∗2.
ERR17	Internal temp. sensor disconnection alarm	Stop	The internal temperature sensor has been disconnected or short-circuited.
ERR18	External temp. sensor disconnection alarm	Continue	The external temperature sensor has been disconnected or short-circuited. (Only detected when in learning control or external tune control.)
ERR19	Abnormal auto tuning alarm	Stop	Auto tuning has not been completed within 20 minutes.
ERR20	Low fluid level alarm ∗3	Stop	The amount of circulating fluid in the tank has dropped and the level switch is activated.

∗1 The HEC012 only
∗2 Optional for the HEC001 and HEC003 only (Not available for the HEC006)
∗3 Optional for the HEC001 and HEC003

Maintenance

Maintenance of this unit is performed only in the form of return to and repair at SMC's site. As a rule, SMC will not conduct on-site maintenance. Separately, the following parts have a limited life and need to be replaced before the life ends.

Parts Life Expectation

Description	Expected life	Possible failure
Pump	3 to 5 years	The bearing is worn so the pump fails to transfer the circulating fluid, which results in temperature control failure.
Fan	5 to 10 years	The bearing uses up lubrication and makes the fan unable to supply enough air, which increases the internal temperature of the Thermo-con, and activates the overheat protection of the power supply and generates the alarm.
DC power supply	5 to 10 years	The capacity of the electrolytic condenser decreases, and causes abnormal voltage which results in DC power supply failure and stops the Thermo-con.
Display panel	50,000 hours (approx. 5 years)	The display turns off when the backlight of the LCD reaches the end of its life.

Options

Note) Options have to be selected when ordering the Thermo-con. It is not possible to add them after purchasing the unit.

F Option symbol

With Flow Switch

HEC□□□-□□□-F

With flow switch

This is an ON/OFF switch detecting low levels of the circulating fluid.
When the fluid volume is 1 L/min. or less, "ERR16" is displayed and the Thermo-con stops. This switch is installed between the circulating fluid inlet and the tank, and built into the Thermo-con. Refer to page 161.

Type	Applicable model
Water-cooled	**HEC001-W5□-F**
	HEC003-W5□-F

N Option symbol

NPT Thread

HEC□□□-□□□-N

NPT thread

The connection parts of circulating fluid piping, facility water piping and circulating fluid drain port are NPT thread type.

Type	Applicable model
Water-cooled	**HEC001-W5□-N**
	HEC003-W5□-N
	HEC006-W2□-N
	HEC012-W2□-N

L Option symbol

With Level Switch

HEC□□□-□□□-L

With level switch

This switch is used to detect a LOW level of tank fluid. When the fluid level becomes below the LOW level, "ERR20" is displayed and the Thermo-con stops. This switch is installed in the circulating fluid tank and built into the Thermo-con. Refer to page 161.

Type	Applicable model
Water-cooled	**HEC001-W5□-L**
	HEC003-W5□-L

Other models include a level switch as standard equipment.

Series HEC-W
Specific Product Precautions 1

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

System Design

⚠Warning

1. This catalog shows the specifications of the Thermo-con.

1. Check detailed specifications in the separate "Product Specifications", and evaluate the compatibility of the Thermo-con with customer's system.
2. Although the protection circuit as a single unit is installed, the customer is requested to carry out the safety design for the whole system.

Handling

⚠Warning

1. Thoroughly read the Operation Manual.

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

2. If the set temperature is repeatedly changed by 10°C or more, the Thermo-con may fail in short periods of time.

Operating Environment/Storage Environment

⚠Warning

1. Keep within the specified ambient temperature and humidity range.

Also, if the set temperature is too low, condensation may form on the inside of the Thermo-con or the surface of piping even within the specified ambient temperature range. Dew condensation can cause failure, and so must be avoided by considering operating conditions.

2. The Thermo-con is not designed for clean room usage.

The pump and fan generate dust.

3. Low molecular siloxane can damage the contact of the relay.

Use the Thermo-con in a place free from low molecular siloxane.

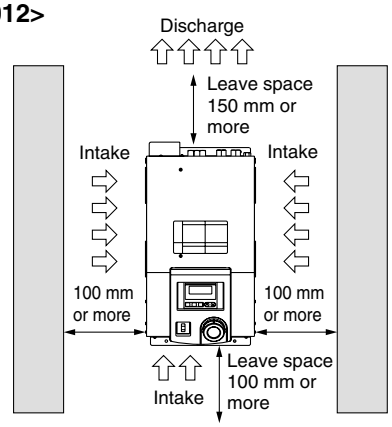
Operating Environment/Storage Environment

⚠Warning

4. Installation conditions

If the space for the intake and discharge of air is insufficient, the amount of transferred air will decrease, which can impair the performance and life of the product. Therefore, keep the conditions illustrated below for installation. Also, if ambient temperature is expected to be over 35°C, vent or exhaust air to prevent the increase of ambient temperature over 35°C.

<HEC006/012>



<HEC001/003>

It is not necessary to leave space for ventilation. Install the product while taking working space for installation and maintenance into account. However, ventilation must be also considered so that ambient temperature does not excessively rise.

Facility Water

⚠Caution

1. If the temperature of the facility water is too low, it can cause formation of dew condensation inside the heat exchanger.

Supply facility water with a temperature over the atmospheric dew point to avoid the formation of dew condensation.

2. If the facility water piping is connected to multiple machines, the facility water exchanges heat at the upstream side and its temperature will become higher as it goes downstream.

Limit the number of connected Thermo-cons to two per facility water system, and if more than two Thermo-cons are to be connected, increase the number of systems.

Circulating Fluid

⚠Caution

1. Use tap water or fluid which will not damage the wetted parts material as described in this catalog's specifications.

(PPE, PP glass 10%, Alumina ceramics, Carbon, EPDM, Stainless steel 303, Stainless steel 304, PE, PP, NBR)

2. Deionized water (with an electrical conductivity of approx. 1 μS/cm) can be used, but may lose its electrical conductivity.

Series HEC-W
Specific Product Precautions 2

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Circulating Fluid

⚠Caution

3. If deionized water is used, bacteria and algae may grow in a short period.

If the Thermo-con is operated with bacteria and algae, its heat exchanging capacity or the capacity of the pump may deteriorate. Exchange all deionized water regularly depending on the conditions (once a month as a guide).

4. If using a fluid other than this catalog, please contact SMC beforehand.

5. The maximum operating pressure of circulating fluid circuit is 0.1 MPa.

If this pressure is exceeded, leakage from the tank in the Thermo-con can result.

6. Select a pipe with a length and diameter which allow a flow rate of 3 L/min or more for the circulating fluid.

If the flow rate is less than 3 L/min, the Thermo-con cannot provide precise control, but also can fail because of the repeated cooling and heating operation.

7. A magnet driven pump is used as a circulating pump.

A fluid which contains metal powders such as iron powder cannot be used.

8. The Thermo-con must not be operated without circulating fluid.

The pump can break due to idling.

9. If the tank lid is opened after the supply of circulating fluid, the circulating fluid may spill out depending on the condition of external piping.

10. If an external tank is used, the circulating fluid may spill out from the internal tank lid depending on where the external tank is installed.

Check that the internal tank has no leakage if using an external tank.

11. If there is a point where fluid is released to atmosphere externally (tank or piping), minimize the piping resistance at the circulating fluid return side.

If the piping resistance is too large, the piping may be crushed, or the built-in circulator tank may be deformed or cracked because the pressure in the piping for return will become negative. The built-in circulator tank is made of resin (PE). Therefore, the tank may be crushed if the pressure is negative. Special attention must be paid if the flow rate of the circulating fluid is high. To avoid getting negative pressure less than –0.02 MPa, the piping for return should be as thick and short as possible to minimize the piping resistance. It is also effective to restrict the flow rate of circulating fluid or remove the gasket of internal tank for the release to atmosphere.

12. If fluorinated fluid is used in the Thermo-con (HEC006/012), static electricity will be generated by the flow of fluid. This static electricity may be discharged to the board of the Thermo-con, causing damage or operation failure and loss of data of such as set temperature.

Ground pipe in order to remove static electricity.

13. Avoid operation with cavitation or bubbles due to low fluid level in the tank. This may shorten the pump life.

Circulating Fluid

⚠Caution

14. If clear water is used, it should satisfy the quality standards shown below.

Clear Water (as Circulating Water) Quality Standards

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

	Item	Standard value
Standard item	pH (at 25°C)	6.0 to 8.0
	Electrical conductivity (25°C)	100*1 to 300*2 [μS/cm]
	Chloride ion	50 [mg/L] or less
	Sulfuric acid ion	50 [mg/L] or less
	Acid consumption amount (at pH4.8)	50 [mg/L] or less
	Total hardness	70 [mg/L] or less
	Calcium hardness	50 [mg/L] or less
	Ionic state silica	30 [mg/L] or less
Reference item	Iron	0.3 [mg/L] or less
	Copper	0.1 [mg/L] or less
	Sulfide ion	Should not be detected.
	Ammonium ion	0.1 [mg/L] or less
	Residual chlorine	0.3 [mg/L] or less
	Free carbon	4.0 [mg/L] or less

*1 Electrical conductivity should be 100 [μS/cm] or more.
*2 In the case of [MΩ•cm], it will be 0.003 to 0.01.

Communication

⚠Caution

1. The set value can be written to EEPROM, but only up to approx. 1 million times.

In particular, pay attention to how many of times the writing is performed using the communication function.

Maintenance

⚠Warning

1. Prevention of electric shock and fire

Do not operate the switch with wet hands. Also, do not operate the Thermo-con with water left on it.

2. Action in the case of error

If any error such as abnormal sounds, smoke, or bad smell occurs, cut off the power at once, and stop supplying and conveying fluid. Please contact SMC or a sales distributor to repair the Thermo-con.

3. Regular inspection

Check the following items at least once a month. The inspection must be done by an operator who has sufficient knowledge and experience.

a) Check of displayed contents.
b) Check of temperature, vibration and abnormal sounds in the body of the Thermo-con.
c) Check of the voltage and current of the power supply system.
d) Check for leakage and contamination of the circulating fluid and intrusion of foreign objects to it, and subsequent replacement of water.
e) Check for leakage, quality change, flow rate and temperature of facility water.

Peltier-Type

Thermoelectric Bath Series HEB

Accurately controls the temperature of liquid in the bath.

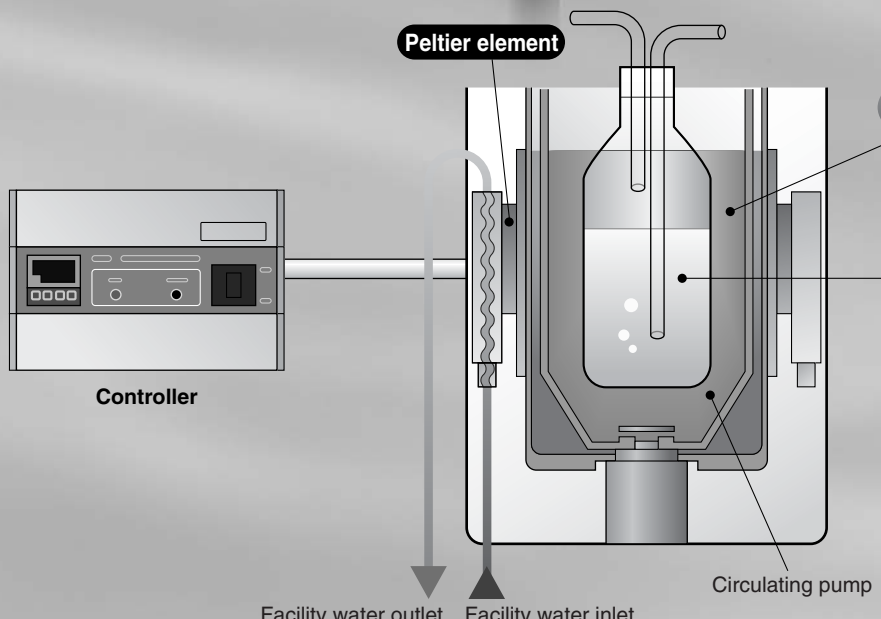
Temperature stability: ±0.01°C

Temperature distribution: ±0.02°C in the bath

- **Environmentally friendly and refrigerant-free**
- **Heaterless**
- **Function to detect abnormal heating and temperature sensor errors comes standard.**
- **Light and compact**
- **Greatly reduced vibration and operating noise when compared with the refrigerated type.**

W250 x H180 x D340

W200 x H332 x D207



Circulating fluid

Water, Fluorinated liquid

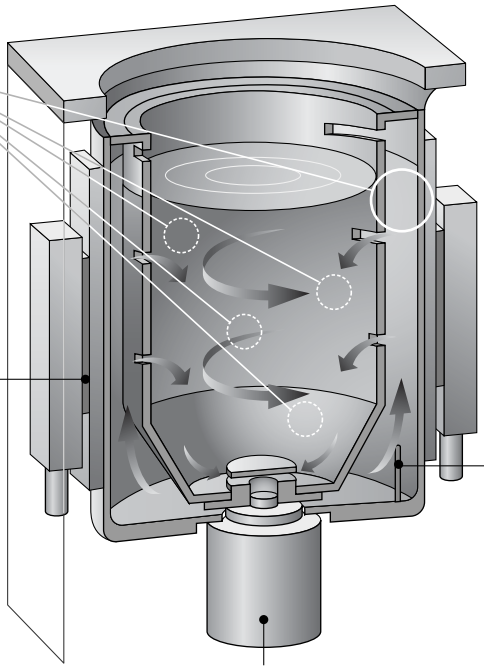
Fluorinert™ GALDEN®

Applications

- Chemicals for MOCVD
- Diffusion gas
- Various samples, materials and parts
- Chemicals and liquids with high viscosity

Features

Exclusively developed dual tank construction to provide consistent temperature at any position in the bath



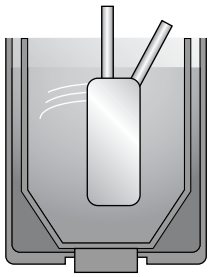
Peltier element
(Thermo-module, Thermoelectric device)

Temperature sensor
- Accurate display by measuring the circulating fluid with a temperature sensor directly

Circulating pump

Application Examples

Semiconductor

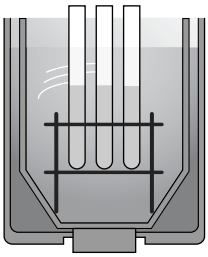


Evaporation of chemicals for MOCVD
Temperature control of diffusion gas

Various tests

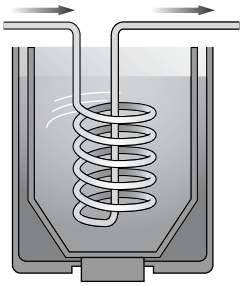
Thermal test with immersion

Physical and chemical analysis



Temperature control of various samples, materials and parts

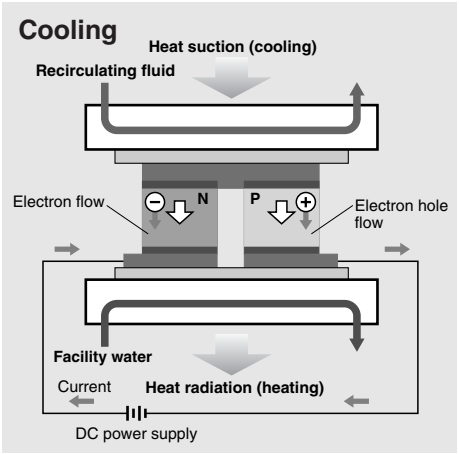
Various chemical processes

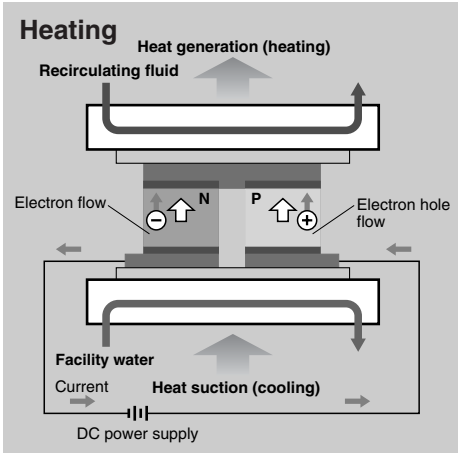


Indirect temperature control of chemicals and liquids with high viscosity

Principle of Peltier Device (Thermo-module, Thermoelectric device)

A Peltier device (thermo-module, thermoelectric device) is a plate type element, inside which P-type semiconductors and N-type semiconductors are located alternately. If direct current is supplied to the Peltier device, heat is transferred inside the device, and one face generates heat and increases temperature while the other face sucked heat and decreases temperature. Therefore, changing the direction of the current supplied to the Peltier device can achieve heating and cooling operation. This method has a fast response and can shift quickly between heating and cooling, so temperature can be controlled very precisely.





Peltier-Type Thermoelectric Bath

Series HEB

Controller

Liquid tank

How to Order

Combination (Controller + Liquid tank)

HEB C 002 – W A 10 – □

Shape of bath

C	Round

Cooling capacity

002	140 W

Radiating method

W	Water-cooled

Communication

A	RS-485
B	RS-232C

Liquid tank size

10	ø130 x H180

Option

Nil	Rc1/4
N	NPT1/4

∗ The option should be specified when ordering.

Liquid tank

HEB C 002 – H W 10 – □

Shape of bath

C	Round

Cooling capacity

002	140 W

Liquid tank

Radiating method

W	Water-cooled

Liquid tank size

10	ø130 x H180

Option

Nil	Rc1/4
N	NPT1/4

∗ The option should be specified when ordering.

Controller

HEBC002 – C A

Controller

Communication

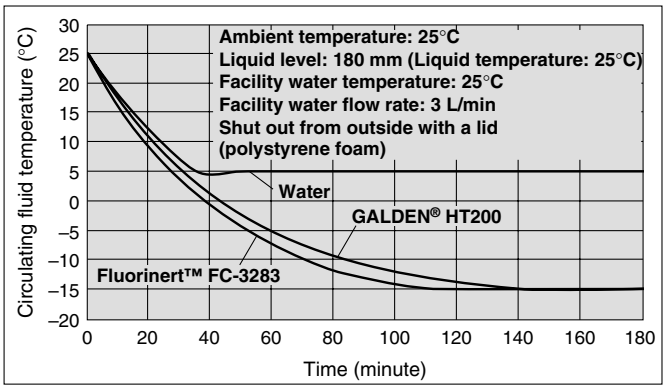
A	RS-485
B	RS-232C

Specifications (For details, please consult our "Product Specifications" information.)

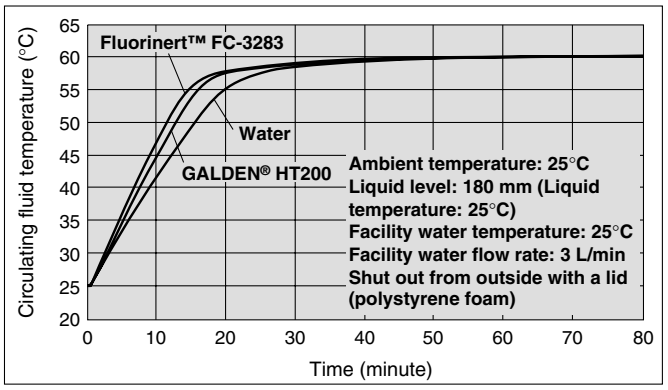
Model		HEBC002-WA10	HEBC002-WB10
Cooling method		Peltier device (Thermo-module, Thermoelectric device)	
Radiating method		Liquid tank: Water-cooled, Controller: Forcible air-cooled	
Control method		Cooling/Heating automatic shift PID control	
Ambient temperature/humidity		10 to 35°C, 35 to 80%RH	
Circulating fluid system	Application fluid Note 1)	Clear water, Fluorinated liquid (Fluorinert™ FC-3283, GALDEN® HT135, HT200)	
	Set temperature range Note 1) Note 5)	–15.0 to 60.0°C (5 to 60°C for water)	
	Cooling capacity Note 2)	140 W (Water)	
	Heating capacity Note 2)	300 W (Water)	
	Temperature stability Note 3)	±0.01°C	
	Temperature distribution Note 3)	±0.02°C	
	Tank dimensions	Internal diameter ø130 x Liquid level 188 mm	
Facility water system	Temperature	10 to 35°C (no condensation)	
	Pressure range	0.5 MPa or less	
	Flow rate Note 4)	3 to 5 L/min	
	Port size	IN/OUT: Rc1/4	
	Wetted parts material	Stainless steel 303, Stainless steel 304, FEP, A6063 (anodized)	
Electrical system	Power supply	Single-phase, 100 to 240 VAC, 50/60 Hz	
	Overcurrent protector	10 A	
	Current consumption	4 A (100 VAC) to 2 A (240 VAC)	
	Alarm (With alarm output connector)	1) Overheating of liquid tank (which activates the thermostat) 2) Controller output voltage reduction 3) Controller fan rotation stopped	
Communications		RS-485	RS-232C
Weight		Liquid tank: Approx. 8.5 kg Controller: Approx. 6.5 kg	
Accessories		Power cable (2 m), DC cable, Signal cable (3 m each)	
Safety standards		CE marking, UL (NRTL) standard	

Note 1) GALDEN® is a trademark of Solvay Solexis and Fluorinert™ is a trademark of 3M. For other fluids, please contact SMC.
Note 2) Determined under the following conditions: water as the recirculating fluid, set temperature 25°C, facility water temperature 25°C, flow rate 3 L/min, ambient temperature 25°C, and sealed from outside air with a lid.
Note 3) Differs depending on the operating conditions.
Note 4) An appropriate range is from 3 to 5 L/min. To prevent damage to the radiating system, do not supply a flow over the maximum flow rate of 8 L/min.
Note 5) When the temperature is set high, the liquid temperature inside of the liquid tank and the temperature inside of the thermostat could differ greatly depending on the heating mode at start-up, and the thermostat could then begin operating and stop the output. Confirm that there is no problem by carrying out an operating test beforehand.

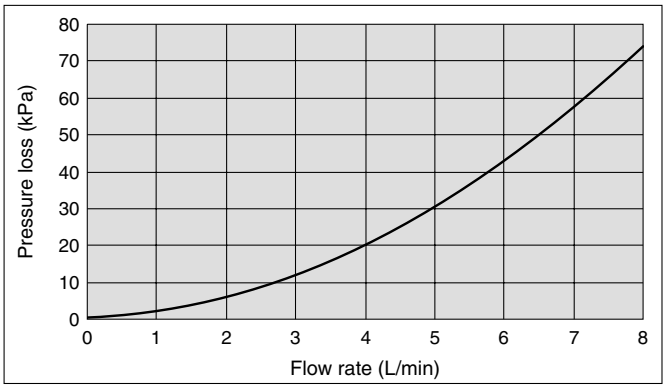
Cooling Capacity



Heating Capacity

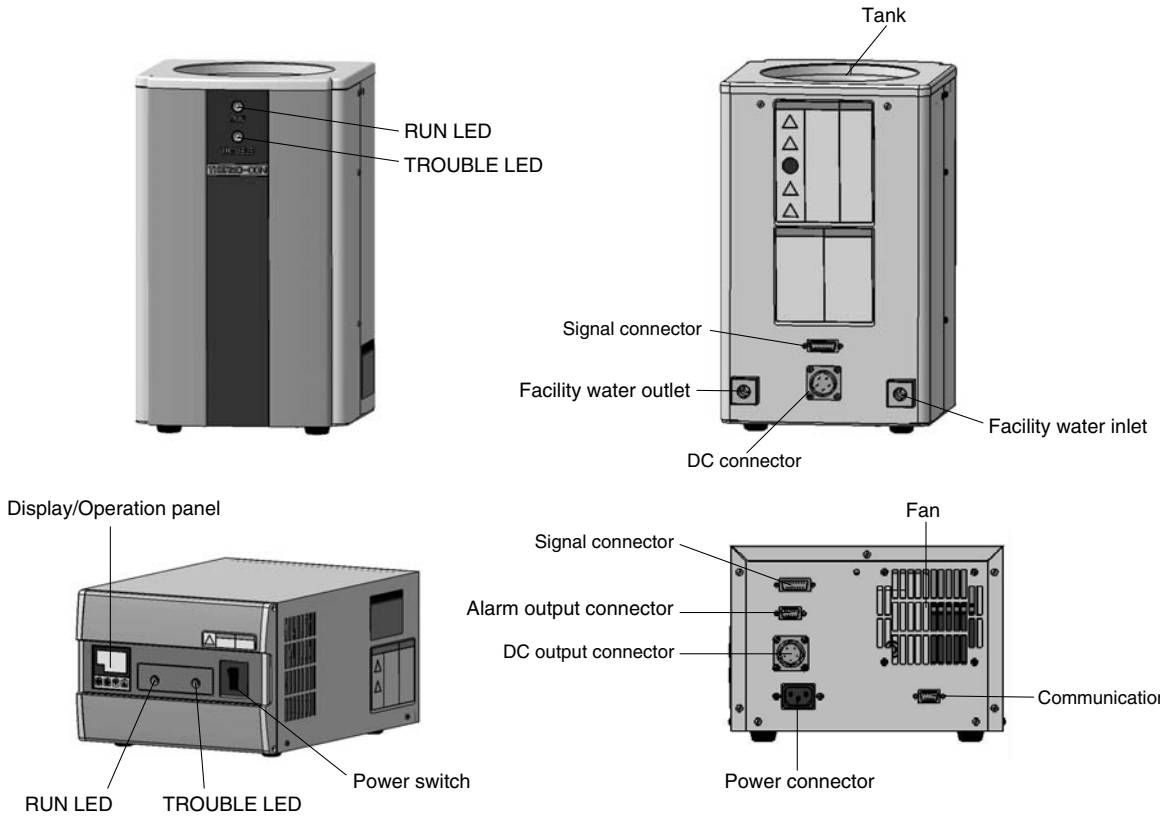


Pressure Loss in Facility Water Circuit



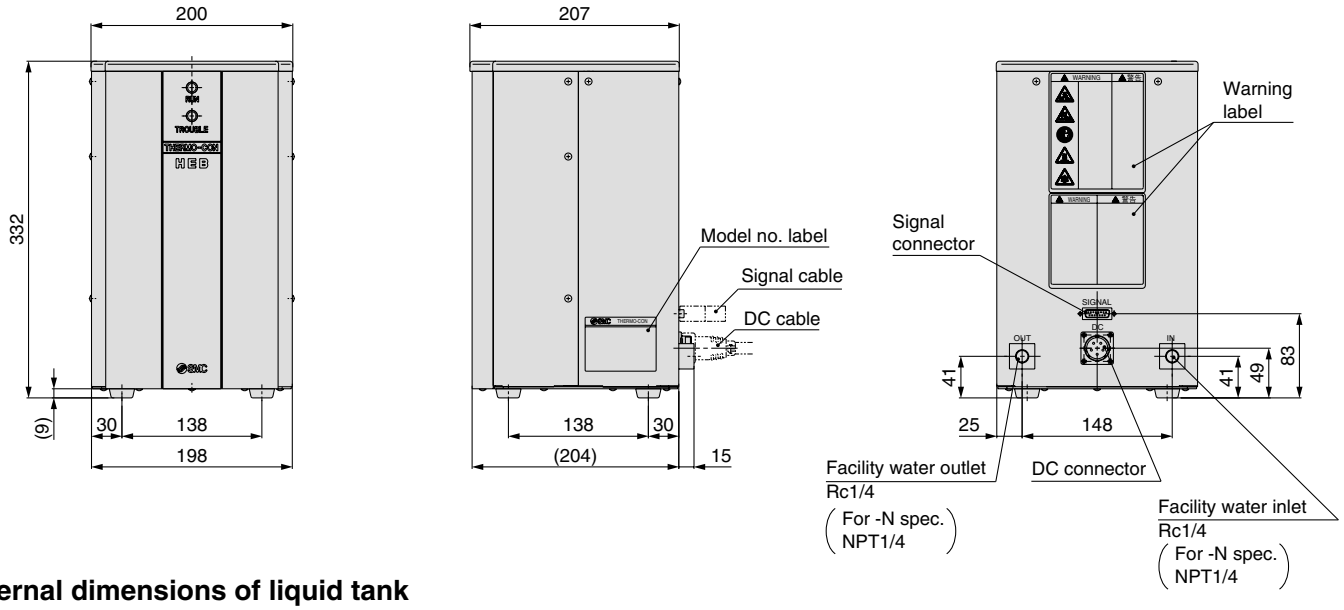
The values shown on the performance chart are not guaranteed, but typical. Allow margins for safety when selecting the model.

Parts Description

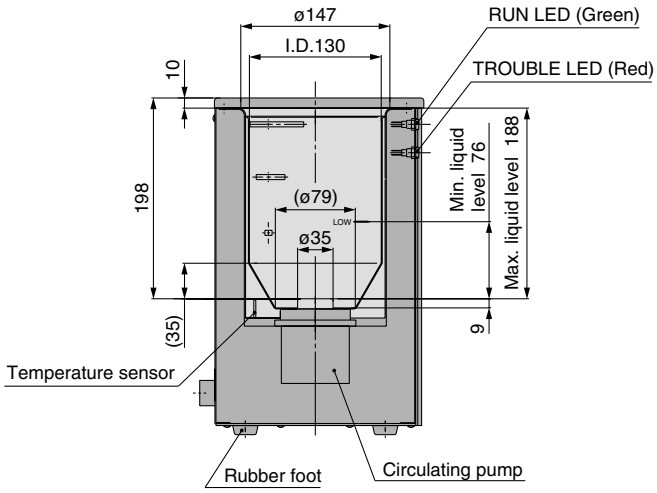


Dimensions

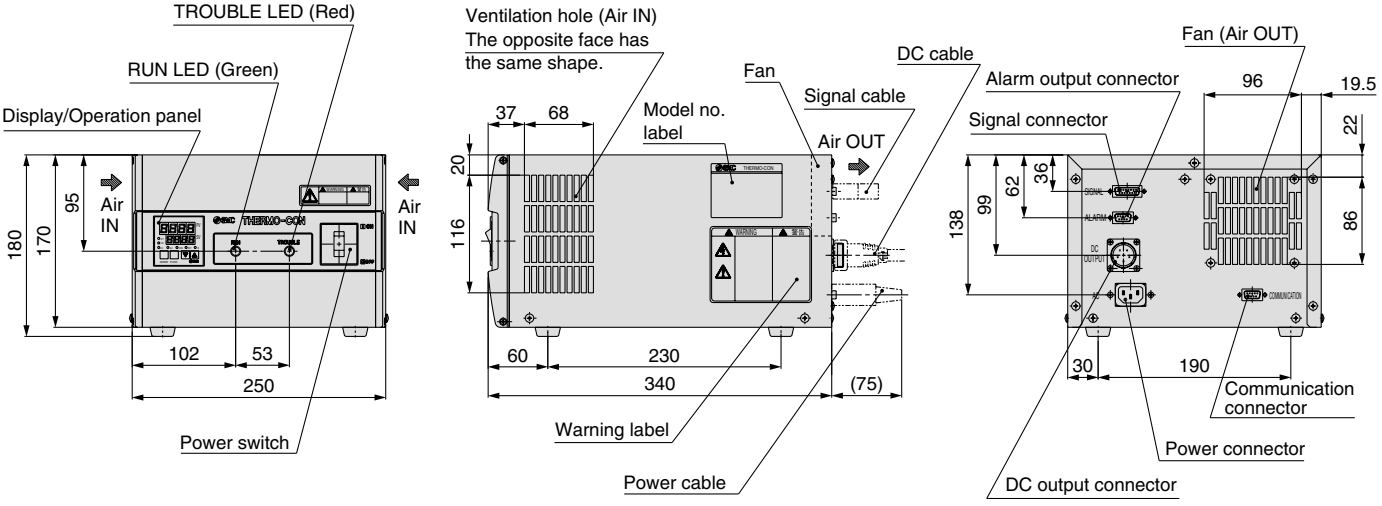
Liquid tank



Internal dimensions of liquid tank



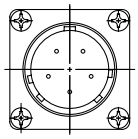
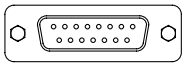
Controller



Connectors

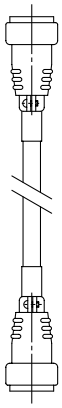
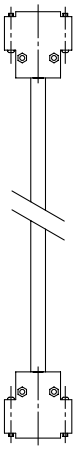
Water Bath and Controller Connection

■ **Connector for water baths**

DC connector (male connector)	Signal connector (male connector)
Nanaboshi Electric Mfg. Co., Ltd.: **NJC-245-RM UL CSA**	**Hirose Electric Co., Ltd.:** **CDA-15P** **Holding screw M2.6**
	

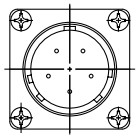
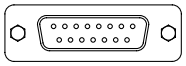
Connection **Connection**

■ **Connection cable**

DC cable	Signal cable
Nanaboshi Electric Mfg. Co., Ltd.: **NJC-245-PF UL CSA** **Female connector**	**Hirose Electric Co., Ltd.:** **CDA-15S** **Holding screw M2.6**
	**Female connector**  **Male connector**
Male connector **Nanaboshi Electric Mfg. Co., Ltd.** **NJC-245-PM UL CSA**	**Hirose Electric Co., Ltd.:** **CDA-15P** **Holding screw M2.6**

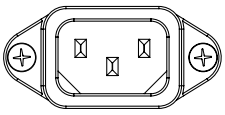
Connection **Connection**

■ **Connector for controllers**

DC connector (female connector)	Signal connector (female connector)
Nanaboshi Electric Mfg. Co., Ltd.: **NJC-245-RF UL CSA**	**Hirose Electric Co., Ltd.:** **CDA-15S** **Holding screw M2.6**
	

Power Cable Connection

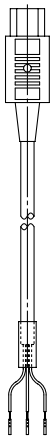
■ **Connector for controllers**

Power connector
IEC60320 C-14 or equivalent **Male connector**


Connection

■ **Power cable**

Connector side
IEC60320 C-13 or equivalent
Female connector



AWG14

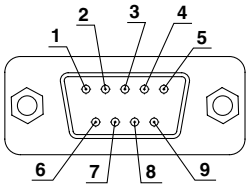
	Signal contents
Black 1	100 to 240 VAC (L)
Black 2	100 to 240 VAC (N)
Green/Yellow	PE

Connector for External Equipment

Connectors that fit with a communication connector and an alarm output connector should be prepared by customer.

■ **Alarm output connector**
Hirose Electric Co., Ltd.: CDE-9P
Holding screw M2.6
Fitting connector: CDE-9S or equivalent

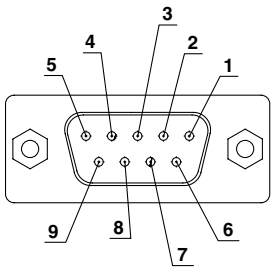
Pin No.	Signal contents
1	Contact for upper/lower temperature limit deviation alarm (open when alarm occurs)
2	Upper/lower temperature limit deviation alarm common
3-4	Unused
5	Contact for output cut-off alarm (open when alarm occurs)
6	Common for output cut-off alarm
7-9	Unused



Alarm output connector
D-sub 9 pin (male type)

■ **Communication connector**
Hirose Electric Co., Ltd.: CDE-9S
Holding screw M2.6
Fitting connector: CDE-9P or equivalent

Pin No.	Signal contents	
	HEBC002-WA10	**HEBC002-WB10**
1	RS-485 T/R (A)	Unused
2	RS-485 T/R (B)	RS-232C RX
3	Unused	RS-232C TX
4	Unused	Unused
5	Unused	RS-232C SG
6-9	Unused	Unused



Communication connector
D-sub 9 pin (female type)

Maintenance

Maintenance of this unit is performed only in the form of return to and repair at SMC's site. As a rule, SMC will not conduct on-site maintenance. Separately, the following parts have a limited life and need to be replaced before the life ends.

Parts Life Expectation

Description	Expected life	Possible failure
Circulating pump	3 to 5 years	The circulating fluid cannot be fed due to worn bearing and/or insufficient capacity of electrolytic capacitor, which results in temperature controlling failure.
Fan	5 to 10 years	The capacity of the fan lowers due to the end of lubricating performance of the bearing, which results in increase of internal temperature of the Controller. The overheat protective function at the inside of the power supply starts, the output stops and the display goes off.
DC power supply	5 to 10 years	Abnormal voltage is generated and the display goes off due to insufficient capacity of electrolytic capacitor.

Series HEB
Specific Product Precautions 1

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

System Design

⚠Warning

1. The catalog shows the specifications of the Thermoelectric Bath.

1. Check detailed specifications in the separate "Product Specifications", and evaluate the compatibility of the Thermoelectric Bath with customer's system.
2. The Thermoelectric Bath is equipped with a protective circuit independently, but the whole system should be designed by the customer to ensure safety.

Handling

⚠Warning

1. 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. Avoid using the Thermoelectric Bath in an environment where it could be splashed by fluids (including mist) such as water, salt water, oil, chemicals, or solvents.

2. The Thermoelectric Bath is not designed for clean room usage.

It generates dust from the pump inside the tank and the cooling fan in the controller.

3. Low molecular siloxane can damage the contact of the relay.

Use the Thermoelectric Bath in a place free from low molecular siloxane.

4. Reserve a space of 50 mm or more at the ventilation hole of the controller.

Radiation Air

⚠Caution

1. The ventilation hole for radiation air must not be exposed to particles and dust as far as possible.

2. Do not let the inlet and outlet for radiation air get closed.

If radiation is prevented, the internal power supply will overheat, causing the protective circuit to be activated and stopping the Thermoelectric Bath.

3. If more than one Thermoelectric Bath is used, consider their arrangement so that the downstream sides of the Thermoelectric Bath suck radiation air from the upstream sides.

Circulating Fluid

⚠Caution

1. Do not use fluids other than those described in the specification.

Otherwise, the pump will be overloaded and may break. If such a fluid is used, please contact SMC beforehand.

2. The Thermoelectric Bath must not be operated without circulating fluid.

The pump breaks by empty driving.

3. The circulating fluid may evaporate, lowering the level in the tank.

Significant reduction of the fluid level can break the circulating pump as well as causing the performance to deteriorate. Use with appropriate liquid level at all times.

4. The pump can be broken by foreign objects entering the circulating pump.

Control to prevent any foreign object from entering the fluid. If the fluid is fluorinated liquid and it is set to a temperature below freezing point, steam from the atmosphere will form ice (frost) when entering the fluid. Be sure to remove this ice (frost) regularly.

5. If water is used for the circulating fluid, set its temperature to over or more 5°C to prevent it from being frozen.

Facility Water

⚠Caution

1. The maximum operating pressure of facility water is 0.5 MPa.

If this value is exceeded, the internal piping of the tank can break, causing leakage of facility water.

2. Do not supply a flow rate of 8 L/min or more which can break the facility water piping.

3. Appropriate range of the flow rate of the facility water is 3 to 5 L/min.

Flow rate higher than this range will not slightly affect the cooling and heating capacity. However, a flow rate below 3 L/min will reduce the cooling and heating capacity significantly.

Communication

⚠Caution

1. The set value can be written to EEPROM, but only up to approx. 100,000 times.

In particular, pay attention to how many of times the writing is performed using the communication function.

Series HEB
Specific Product Precautions 2

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Maintenance

⚠Warning

1. Prevention of electric shock and fire

Do not operate the switch with wet hands. Also, do not operate the Thermoelectric Bath with water or fluid left on it.

2. Action in the case of error

If any error such as abnormal sounds, smoke, or bad smell occurs, cut off the power at once, and stop supplying facility water. Please contact SMC or a sales distributor to repair the Thermoelectric Bath.

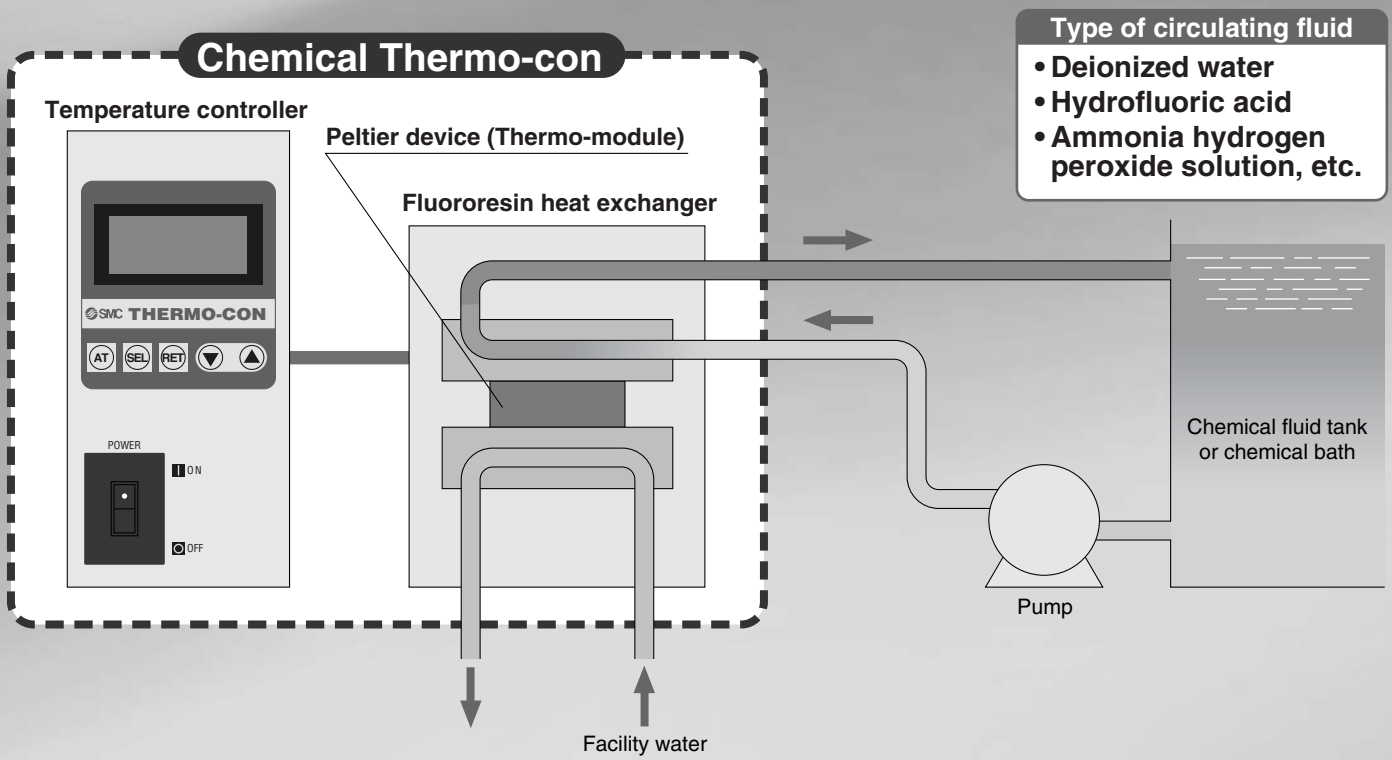
3. Regular inspection

Check the following items at least once a month. The inspection must be done by an operator who has sufficient knowledge and experience.

a) Check of displayed contents.
b) Check of temperature, vibration and abnormal sounds in the body of the Thermoelectric Bath.
c) Check of the voltage and current of the power supply system.
d) Check for leakage and contamination of the recirculating fluid and intrusion of foreign objects to it.
e) Check radiation air flow condition and temperature.
f) Check for leakage, quality change, flow rate and temperature of facility water.

Chemical Thermo-con *Series HED*

Fluororesin heat exchanger allows **direct temperature control for chemicals!!**



Type of circulating fluid
- Deionized water
- Hydrofluoric acid
- Ammonia hydrogen peroxide solution, etc.

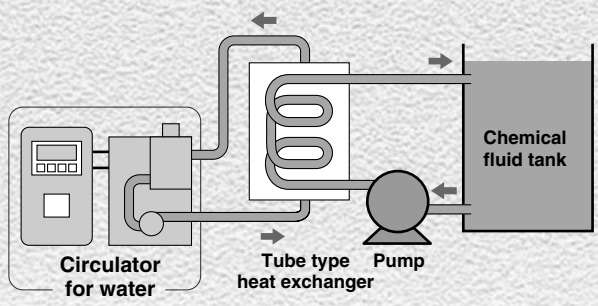
Industry-leading withstand pressure **0.35** MPa!!

- With leakage detection function
- Operating temperature range: **10°C to 60°C**
- Temperature stability: **±0.1°C**
- Cooling capacity (with water):
  300 W, 500 W, 750 W
- International standards:
  CE SEMI Standard S2-0706, F47-0706
- Environment friendly: RoHS

Allows direct control of chemical temperature.

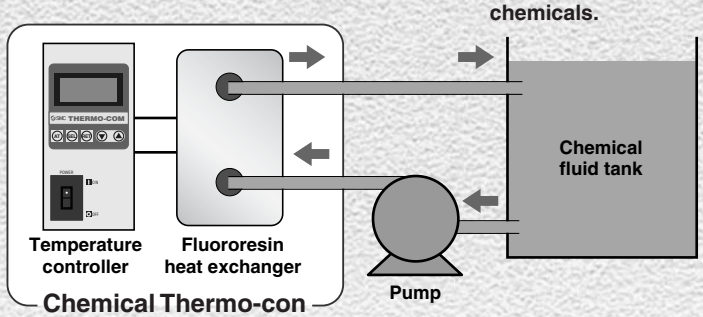
- PFA wetted parts material prevents contamination from metal ion elution.
- No need for a tube-type heat exchanger.

Indirect temperature control



Direct temperature control

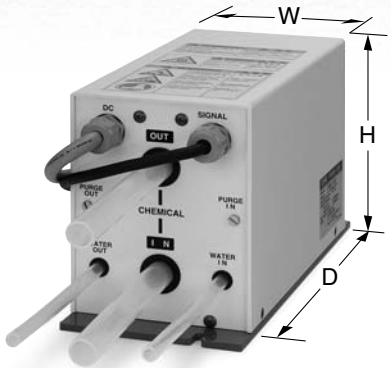
No need for a tube-type heat exchanger. Can directly control temperature of chemicals.



Chemical Thermo-con
Series HED

Compact and Light

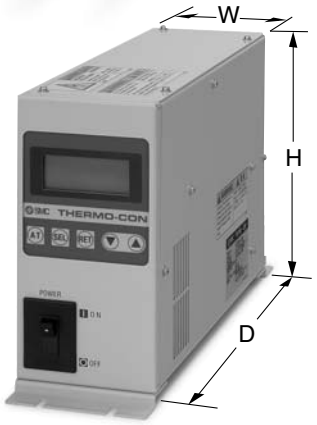
- Self-developed heat exchanger matched to the configuration of the Peltier device (Thermo-module). Compact and light



Heat Exchanger

Model	W	D	H	Weight
HED003	130	263	170	8 kg
HED005	150	294	222	14 kg
HED007				15 kg

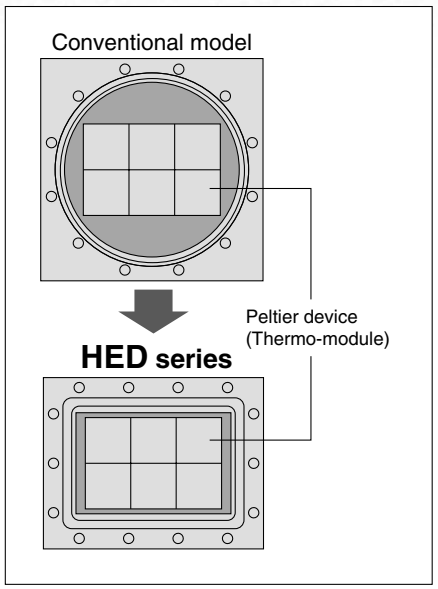
The outline dimensions do not include protruding parts such as the foot flange and tube.



Temperature Controller

Model	W	D	H	Weight
HED003	100	320	215	6 kg
HED005	140	350	215	8 kg
HED007	165	447	215	13 kg

The outline dimensions do not include protruding parts such as the foot flange, screw and connector.



Applications

- Cleaning equipment
- Plating equipment
- Wet etching equipment, etc.

Applicable Fluid Examples

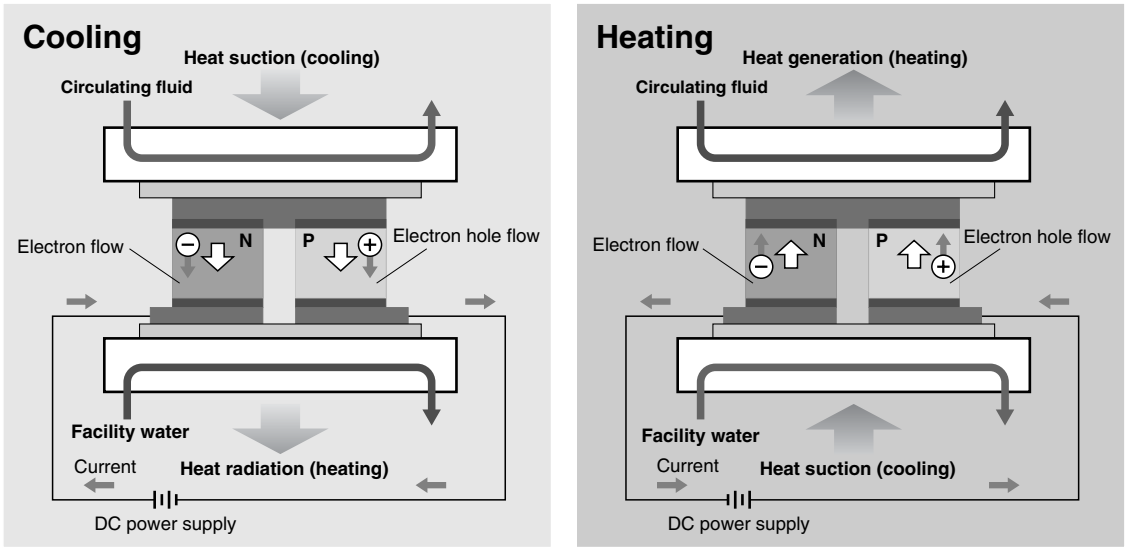
Chemical	Operating temperature range	Chemical	Operating temperature range
Deionized water	10 to 60°C	Ammonia hydrogen peroxide solution	10 to 60°C
Hydrofluoric acid	10 to 40°C	Sodium hydroxide	10 to 60°C
Sulfuric acid (except fuming sulfuric acid)	10 to 50°C	Ozone water	10 to 60°C
Copper sulfate solution	10 to 50°C		

∗ No condensation

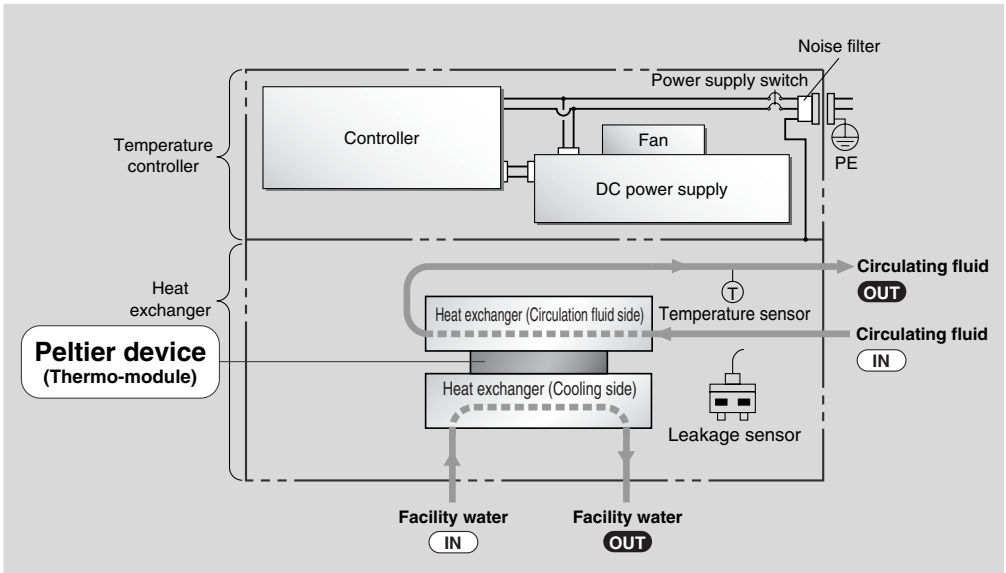
Note) Chemial Thermo-con is not designed to be explosion proof, so it is not suitable for flammable fluids.

Principle of Peltier Device (Thermo-module, Thermoelectric device)

The Peltier device (thermo-module, thermoelectric device) is plate-shape solid state element with P-type, N-type semiconductor arrayed alternately. When direct current is supplied to the element, heat moves from one surface to another along with electron flow in N-type semiconductor and electron hole in P-type semiconductor. As a result of the heat move, one surface of the element absorbs heat and decrease temperature. And other surface heats up. When the DC current is switched to reverse direction, the heat move will also be reverse direction. Therefore, Peltier element can achieve heating effect as well as cooling effect depending on the current direction. It can achieve high speed switching and precise temperature control.



Construction and Principle



The temperature controller controls the circulating fluid in the heat exchanger. A temperature sensor (platinum resistance temperature detector) installed in the heat exchanger sends a signal to the controller, which changes the temperature of the circulating fluid by adjusting the output direction and energizing time of the built-in DC power supply based on the difference between the set and measured temperatures.
This product can be used safely since the sensor to detect leakage of the circulating fluid is installed as a standard device.

Series HED
Model Selection

Guide to Model Selection

Example 1: When the heat generation amount in the customer's machine is known.

Heat generation amount Q: 400 W (at 25°C)

Cooling capacity = Considering a safety factor of 20%, select **400 W x 1.2 =** **480 W (at 25°C)** or more.

Example 2: When the heat generation amount in the customer's machine is not known.

Obtain the temperature difference between inlet and outlet by circulating the circulating fluid inside the customer's machine.

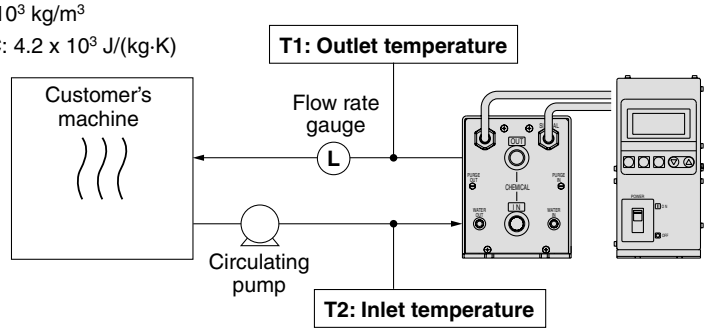
Heat generation amount **Q** : Unknown
Circulating fluid temperature difference Δ**T** (= **T2** – **T1**) : 1.0°C (1.0 K)
Circulating fluid outlet temperature **T1** : 20°C (293.15 K)
Circulating fluid inlet temperature **T2** : 21°C (294.15 K)
Circulating fluid flow rate **L** : 7 L/min
Circulating fluid : Water
Density γ: 1 x 10^3 kg/m^3
Specific heat **C**: 4.2 x 10^3 J/(kg·K)

$$Q = \frac{\Delta T \times L \times \gamma \times C}{60 \times 1000}$$

$$= \frac{1 \times 7 \times 1 \times 10^3 \times 4.2 \times 10^3}{60 \times 1000}$$

$$= 490\ W$$

Cooling capacity = Considering a safety factor of 20%,
490 x 1.2 = **588 W**



Example 3. In cases where cooling the object below a certain temperature and period of time.

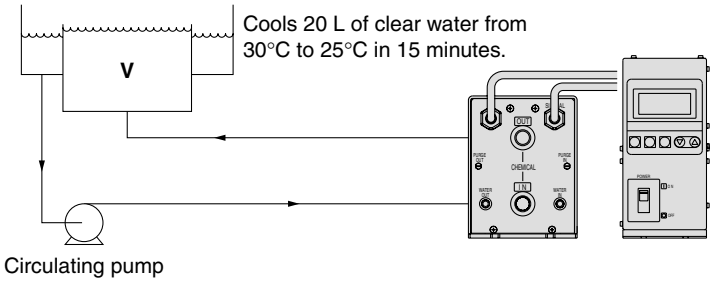
Cooled substance total volume **V** : 20 L
Cooling time **h** : 15 min
Cooling temperature difference Δ**T** : 5°C (5 K)
Circulating fluid : Clear water
Density γ: 1 x 10^3 kg/m^3
Specific heat **C**: 4.2 x 10^3 J/(kg·K)

$$Q = \frac{\Delta T \times V \times \gamma \times C}{h \times 60 \times 1000}$$

$$= \frac{5 \times 20 \times 1 \times 10^3 \times 4.2 \times 10^3}{15 \times 60 \times 1000}$$

$$= 467\ W$$

Cooling capacity = Considering a safety factor of 20%,
467 x 1.2 = **560 W**



Precautions on Model Selection

The flow rate of the circulating fluid depends on the internal resistance of the customer's machine and the length, diameter and resistance created by bends in the circulating fluid piping, etc. Check if the required flow rate of circulating fluid can be obtained before using.

Chemical Thermo-con
Series HED

SEMI

RoHS

Temperature controller

Heat exchanger

How to Order

Part number of set (Temperature controller + Heat exchanger)

Note) The model numbers of the temperature controller and heat exchanger are printed respectively on the product name label.

HED 007 – W 2 B 13

Chemical Thermo-con

Cooling capacity

003	300 W
005	500 W
007	750 W

Radiating method

W	Water-cooled

Power supply

2	Single-phase: 180 to 242 VAC 50/60 Hz

Communication

A	RS-485
B	RS-232C

Tube size

13	1/2" x 3/8"
19	3/4" x 5/8"

Combination in Set

Part number of set	Heat exchanger model	Temperature controller model
HED003-W2A13	HED003-HW13	HED003-C2A
HED003-W2A19	HED003-HW19	
HED003-W2B13	HED003-HW13	HED003-C2B
HED003-W2B19	HED003-HW19	
HED005-W2A13	HED005-HW13	HED005-C2A
HED005-W2A19	HED005-HW19	
HED005-W2B13	HED005-HW13	HED005-C2B
HED005-W2B19	HED005-HW19	
HED007-W2A13	HED007-HW13	HED007-C2A
HED007-W2A19	HED007-HW19	
HED007-W2B13	HED007-HW13	HED007-C2B
HED007-W2B19	HED007-HW19	

Heat exchanger

HED 007 – H W 13

Cooling capacity

003	300 W
005	500 W
007	750 W

Heat exchanger

Radiating method

W	Water-cooled

Tube size

13	1/2" x 3/8"
19	3/4" x 5/8"

∗ The tube size should be specified when ordering.

Temperature controller

HED 007 – C 2 B

Cooling capacity

003	300 W
005	500 W
007	750 W

Temperature controller

Power supply

2	Single-phase: 180 to 242 VAC 50/60 Hz

Communication

A	RS-485
B	RS-232C

Main Specifications (For details, please consult our "Product Specifications" information.)

Heat Exchanger Specifications

Heat exchanger model		HED003-HW13	HED003-HW19	HED005-HW13	HED005-HW19	HED007-HW13	HED007-HW19
Cooling capacity (Water) Note 1)		300 W		500 W		750 W	
Heating capacity (Water) Note 1)		600 W		1000 W		1800 W	
Cooling/Heating method		Peltier device (Thermoelectric device, Thermo-module)					
Radiating method		Water-cooled					
Operating temperature range		10.0 to 60.0°C (depending on the type of circulating fluid)					
Circulating fluid	**Applicable fluid** Note 2)	Deionized water, Hydrofluoric acid, Ammonia hydrogen peroxide solution, etc.					
	Wetted parts material	PFA					
	Operating pressure Note 3)	0 (atmospheric pressure) to 0.35 MPa					
	Tube size (PFA tube)	1/2" x 3/8"	3/4" x 5/8"	1/2" x 3/8"	3/4" x 5/8"	1/2" x 3/8"	3/4" x 5/8"
Facility water	**Temperature**	10 to 35°C (no condensation)					
	Wetted parts material	FEP, Stainless steel 304, Stainless steel 316					
	Max. operating pressure	0.5 MPa					
	Tube size	IN/OUT: FEP tube 3/8" x 1/4"					
	Flow rate	5 to 10 L/min					
Ambient temperature/humidity		Temperature: 10 to 35°C, Humidity: 35 to 80%RH (no condensation)					
Dimensions Note 4)		W130 mm x D263 mm x H170 mm		W150 mm x D294 mm x H222 mm		W150 mm x D294 mm x H222 mm	
Weight		Approx. 8 kg		Approx. 14 kg		Approx. 15 kg	
Applied temperature controller		HED003-C2A HED003-C2B		HED005-C2A HED005-C2B		HED007-C2A HED007-C2B	

Note 1) The conditions are as follows.
Circulating fluid: Water (Circulating flow rate 15 L/min, Set temperature 25°C), Facility water temperature 25°C, Facility water flow rate 5 L/min, Ambient temperature 25°C
Note 2) For the compatibility between the circulating fluid and materials, refer to "Applicable Fluids".
Note that the Chemical Thermo-con is not designed to be explosion proof so it is not suitable for flammable fluids.
Note 3) Install the heat exchanger in the discharge side of a circulating pump. Do not use at location where a negative pressure is applied.
The circulating fluid pump should be prepared by the customer.
Note 4) The outline dimensions do not included protruding parts such as the foot flange and tube.

Temperature Controller Specifications

Temperature controller model		HED003-C2A	HED003-C2B	HED005-C2A	HED005-C2B	HED007-C2A	HED007-C2B
Communication		RS-485	RS-232C	RS-485	RS-232C	RS-485	RS-232C
Control method		Cooling/Heating automatic shift PID control					
Operating temperature range		10.0 to 60.0°C (no condensation)					
Temperature stability Note 1)		Within ±0.1°C (with stable load)					
Temperature sensor		Resistance thermometer Pt100 Ω, 3-wires, class A, 2 mA (for both internal control sensor and external sensor) The external sensor should be prepared by the customer.					
Main functions		Auto-tuning, Sensor fine adjustment, Offset, Learning control, External sensor control, Set value memory, Upper/Lower temperature limit alarm, Output shutdown alarm, Remote ON/OFF, Leakage detection					
Ambient temperature/humidity		Temperature: 10 to 35°C, Humidity: 35 to 80%RH (no condensation)					
Power supply spec.	**Power supply**	Single-phase: 180 to 242 VAC 50/60 Hz					
	Rated current	3 A		5 A		14 A	
Dimensions Note 2)		W100 mm x D320 mm x H215 mm		W140 mm x D350 mm x H215 mm		W165 mm x D447 mm x H215 mm	
Weight		Approx. 6 kg		Approx. 8 kg		Approx. 13 kg	
Applied heat exchanger Note 3)		HED003-HW13 HED003-HW19		HED005-HW13 HED005-HW19		HED007-HW13 HED007-HW19	

Note 1) This value is with a stable load with no disturbance and cannot be achieved in some operating conditions.
Note 2) The outline dimensions do not included protruding parts such as the foot flange, screw and connector.
Note 3) The temperature controller should be connected with a specific series of heat exchanger. If connected with a different series of heat exchanger, it may not operate normally. (The HED003 and HED005 series use the same connector, so be careful for incorrect wiring.)

⚠Caution

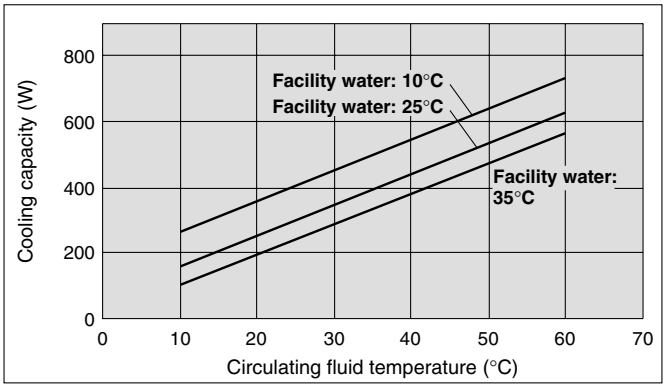
- **For the combination of the heat exchanger and temperature controller, refer to "Combination in Set".**

The values shown on the performance chart are representative and not guaranteed. Allow a margin for safety to device when choosing the product.

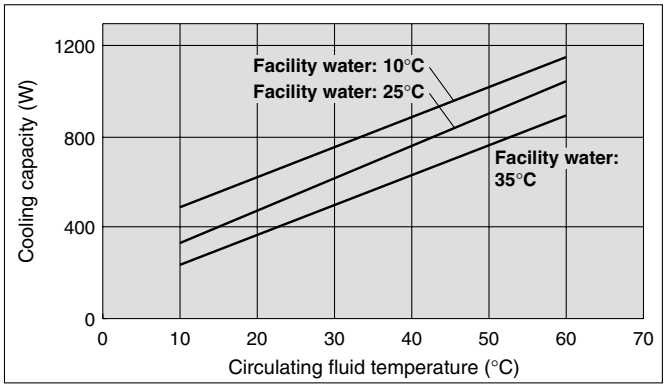
Cooling Capacity

<Conditions> Circulating fluid: Clear water, Circulating fluid flow rate: 15 L/min, Facility water flow rate: 5 L/min

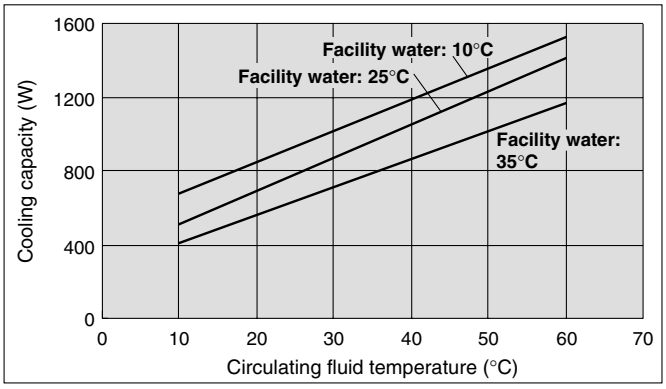
HED003



HED005



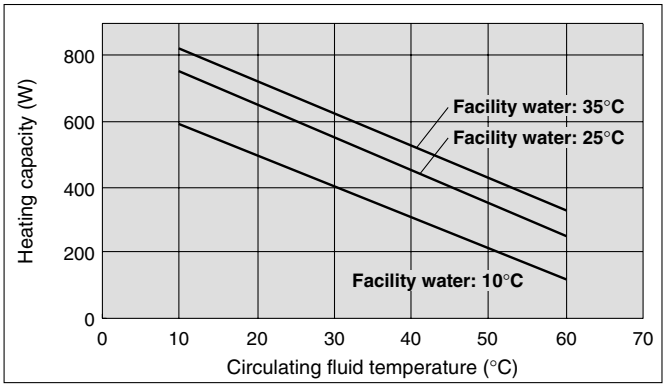
HED007



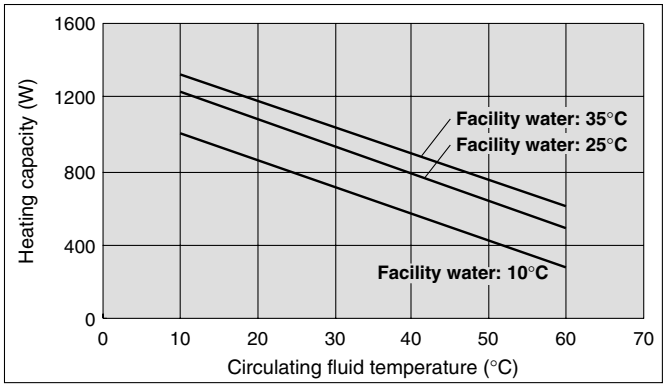
Heating Capacity

<Conditions> Circulating fluid: Clear water, Circulating fluid flow rate: 15 L/min, Facility water flow rate: 5 L/min

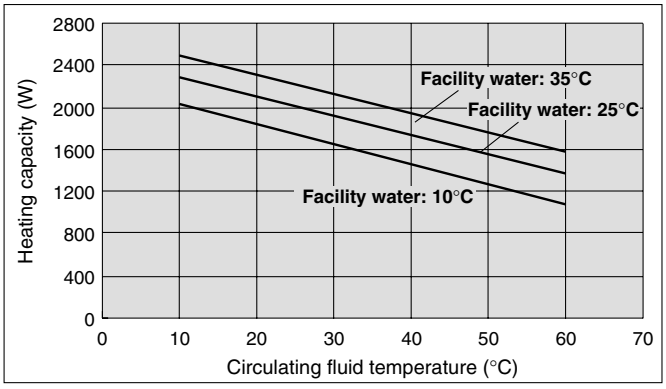
HED003



HED005

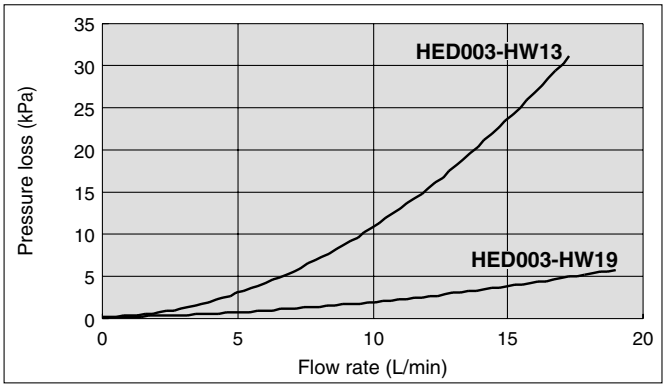


HED007

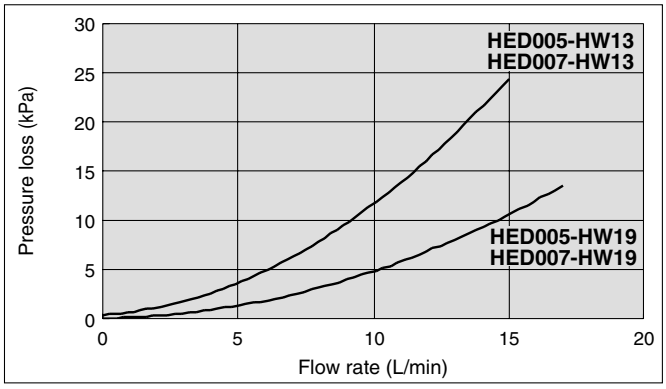


Pressure Loss in Circulating Fluid Circuit <Condition> Clear water

HED003

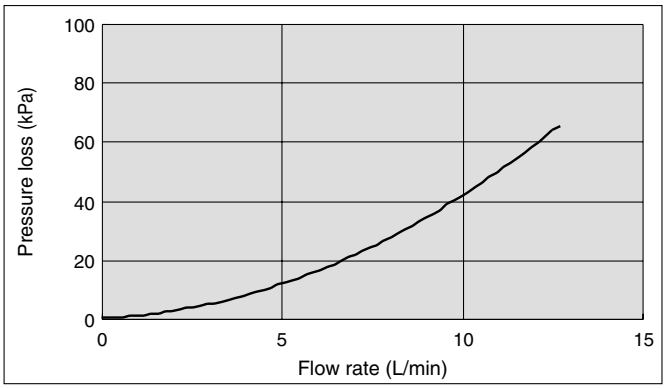


HED005/007

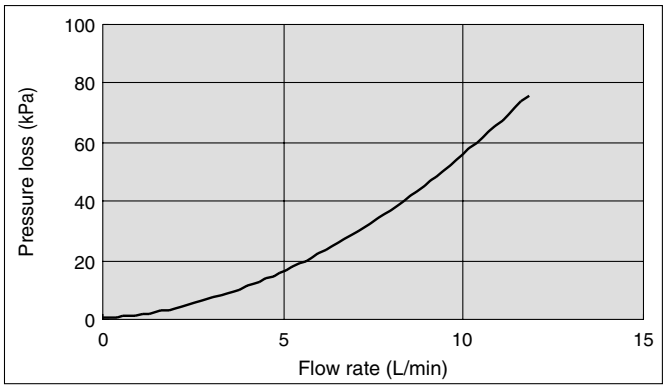


Pressure Loss in Facility Water Circuit <Condition> Clear water

HED003



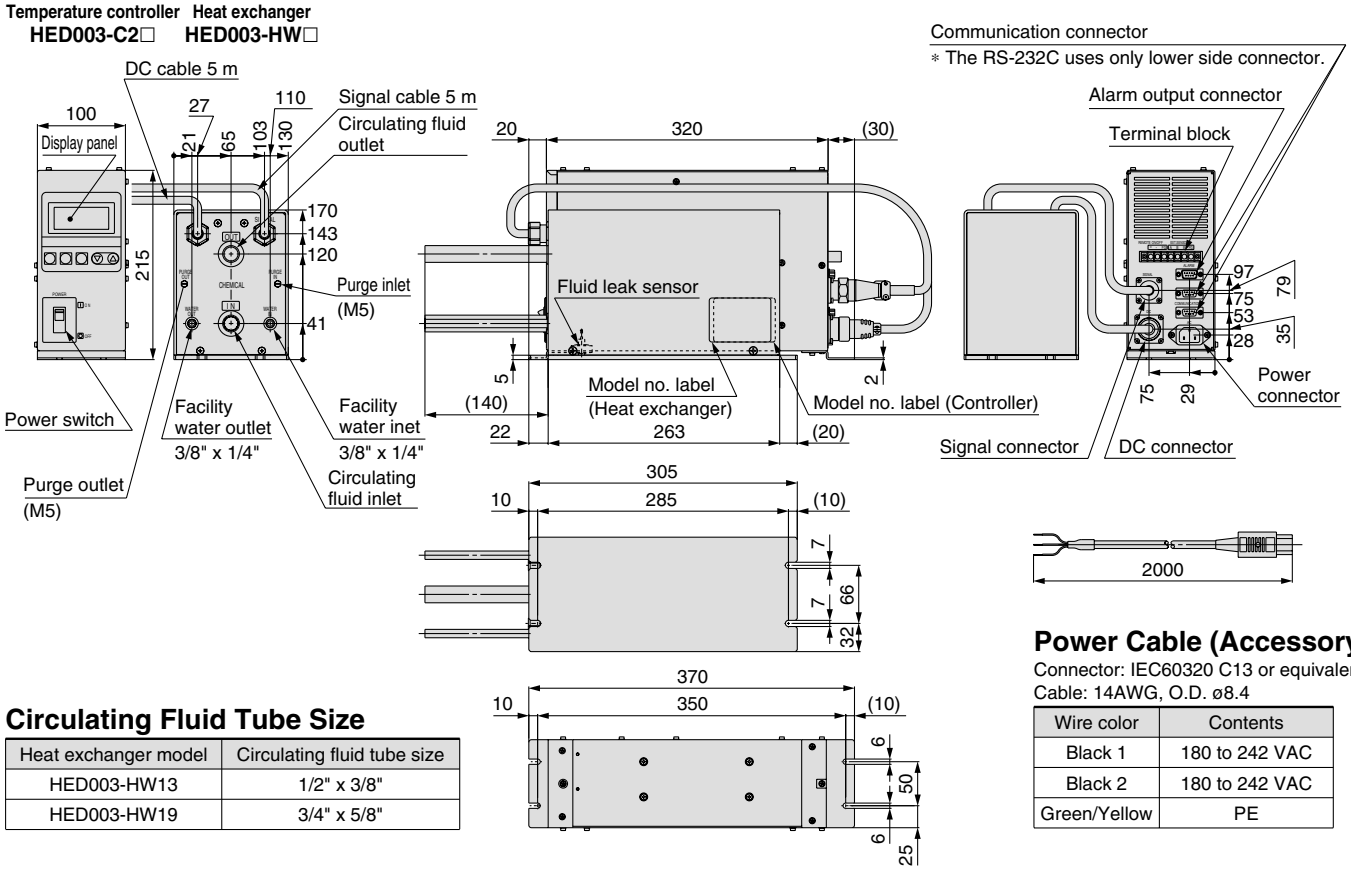
HED005/007



Dimensions

HED003-W2□□

Temperature controller HED003-C2□ Heat exchanger HED003-HW□



Circulating Fluid Tube Size

Heat exchanger model	Circulating fluid tube size
HED003-HW13	1/2" x 3/8"
HED003-HW19	3/4" x 5/8"

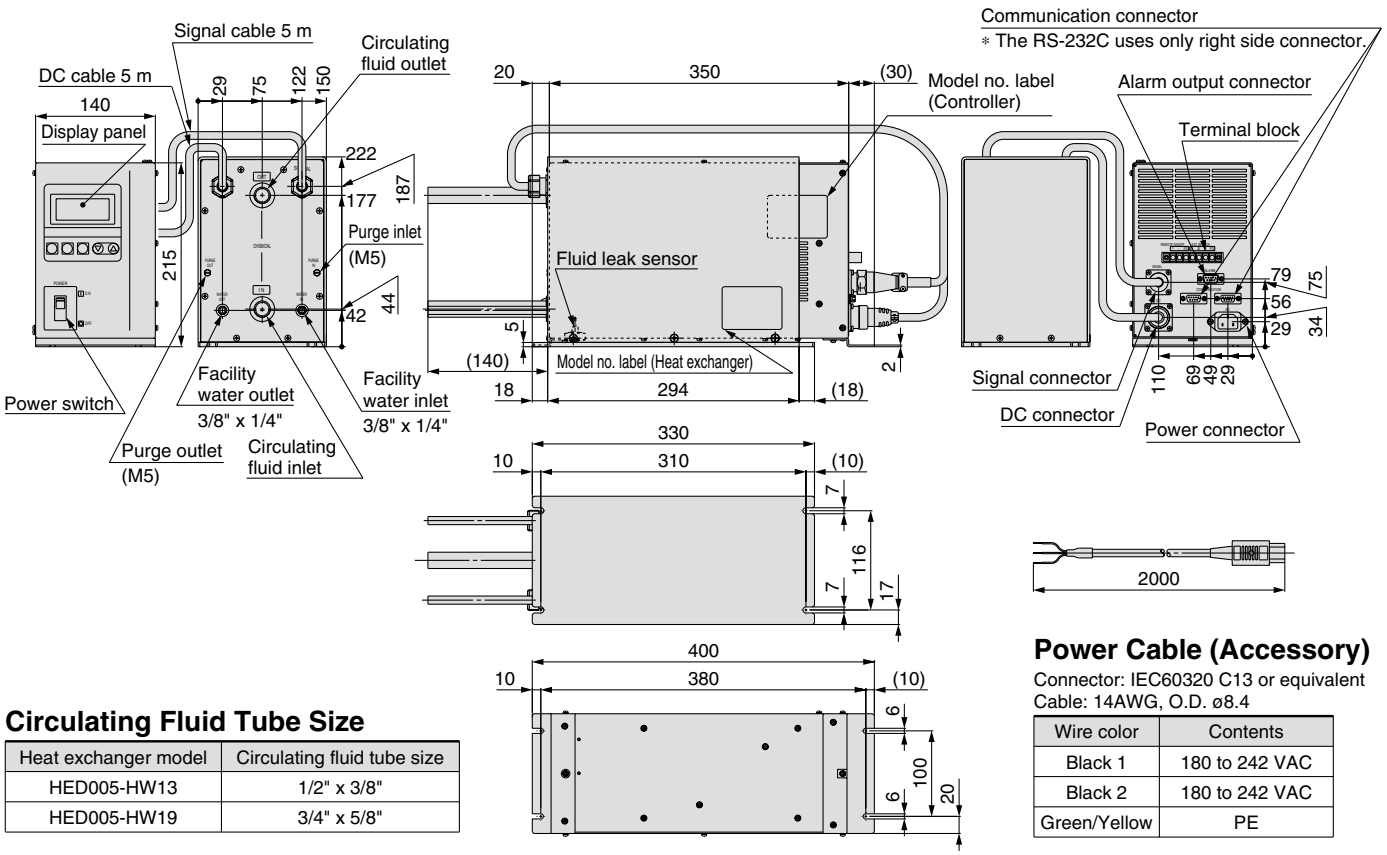
Power Cable (Accessory)

Connector: IEC60320 C13 or equivalent
Cable: 14AWG, O.D. ø8.4

Wire color	Contents
Black 1	180 to 242 VAC
Black 2	180 to 242 VAC
Green/Yellow	PE

HED005-W2□□

Temperature controller HED005-C2□ Heat exchanger HED005-HW□



Circulating Fluid Tube Size

Heat exchanger model	Circulating fluid tube size
HED005-HW13	1/2" x 3/8"
HED005-HW19	3/4" x 5/8"

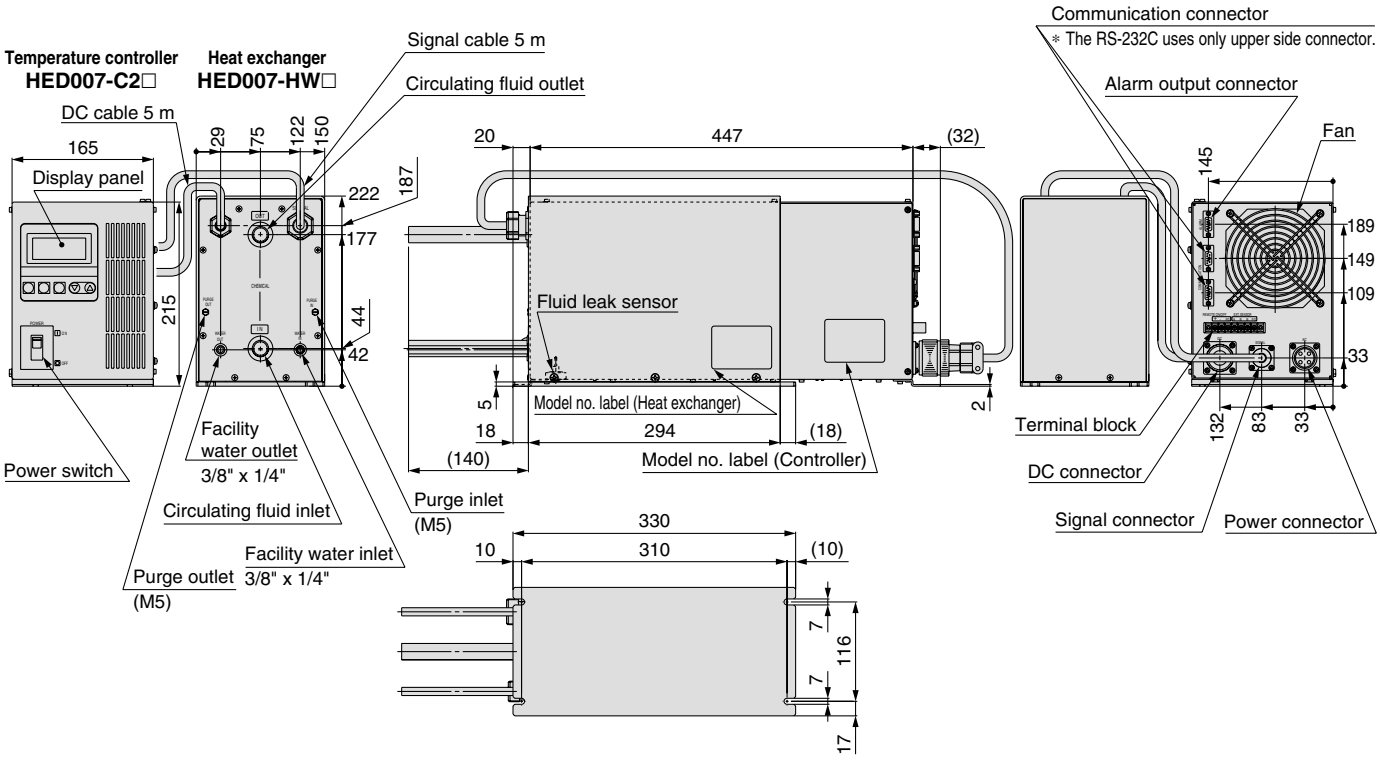
Power Cable (Accessory)

Connector: IEC60320 C13 or equivalent
Cable: 14AWG, O.D. ø8.4

Wire color	Contents
Black 1	180 to 242 VAC
Black 2	180 to 242 VAC
Green/Yellow	PE

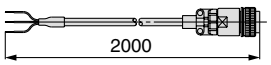
Dimensions

HED007-W2□□



Circulating Fluid Tube Size

Heat exchanger model	Circulating fluid tube size
HED007-HW13	1/2" x 3/8"
HED007-HW19	3/4" x 5/8"



Power Cable (Accessory)

Connector: DDK CE05-6A18-10SD-D-BSS
Cable: 12AWG, O.D. ø11.8

Wire color	Contents
Black 1	180 to 242 VAC
Black 2	180 to 242 VAC
Green/Yellow	PE

Connectors

- Use the special power cable included with the temperature controller.
- Connect the DC cable and signal cable that come from the heat exchanger to the DC and signal connectors of the temperature controller.
- Prepare other required connectors and wiring by the customer.

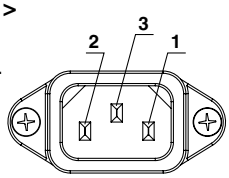
1. Power connector

<For HED003-C2□, HED005-C2□>

IEC60320 C14 or equivalent

Connect the included special power cable.

Pin No.	Signal contents
1	180 to 242 VAC
2	180 to 242 VAC
3	PE



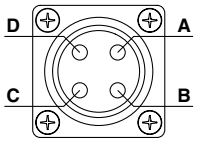
Power connector (HED003-C2□, HED005-C2□)

<For HED007-C2□>

DDK Ltd. CE05-2A18-10PD-D

Connect the included special power cable.

Pin No.	Signal contents
A	180 to 242 VAC
B	180 to 242 VAC
C	Unused
D	PE



Power connector (HED007-C2□)

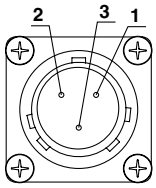
2. DC connector

<For HED003-C2□, HED005-C2□>

Nanaboshi Electric Mfg. Co., Ltd.: NJC-243-RF (UL, CSA)

Connect the DC cable connector of the heat exchanger.

Pin No.	Signal contents
1	DC output
2	DC output
3	FG



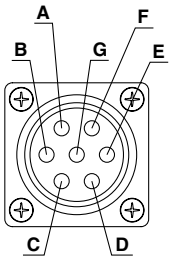
DC connector (HED003-C2□, HED005-C2□)

<For HED007-C2□>

DDK Ltd. D/MS3102A20-15S

Connect the DC cable connector of the heat exchanger.

Pin No.	Signal contents
A	DC output
B	DC output
C	DC output
D	DC output
E	DC output
F	DC output
G	FG



DC connector (HED007-C2□)

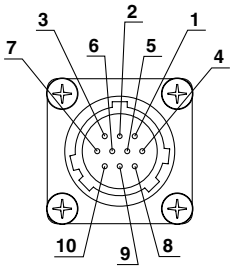
3. Signal connector

<Common to HED003-C2□, HED005-C2□, HED007-C2□>

Tajimi Electronics Co., Ltd.: TRC01-A16R-10FA

Connect the signal cable connector of the heat exchanger.

Pin No.	Signal contents
1	Thermostat +
2	Thermostat –
3	Terminal A of resistance temperature detector
4	Terminal B of resistance temperature detector
5	Terminal B of resistance temperature detector
6	Fluid leak sensor +24 V
7	Fluid leak alarm signal input
8	Fluid leak 24VE
9-10	Unused
Grounding	FG



Signal connector

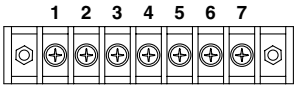
4. Terminal block

<Common to HED003-C2□, HED005-C2□, HED007-C2□>

Morimatsu Co., Ltd.: M111A-7A, for holding screw M3

Connection cable: 22AWG or more, max. 10 m

Pin No.	Signal contents
1	Remote ON/OFF +
2	Remote ON/OFF –
3	FG
4	External sensor: Terminal A of resistance temperature detector
5	External sensor: Terminal B of resistance temperature detector
6	External sensor: Terminal B of resistance temperature detector
7	FG



Terminal block

A short pin is installed between No. 1 and No. 2 pins to short-circuit it (Remote ON) when shipped.

Remote ON/OFF signal

Circuit voltage: 24 VDC ±10%; passing current: 2.9 to 4.3 mA

Exterior sensor signal

Applicable sensor: Pt100 Ω; passing current: 2 mA

5. Alarm output connector: D-sub 9 pin

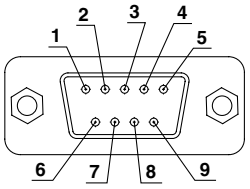
<Common to HED003-C2□, HED005-C2□, HED007-C2□>

OMRON Corp. XM2A-0901 or equivalent, holding screw M2.6

Fixed contact point (load resistance: 125 VAC, 0.3 A; 30 VDC, 2 A)

Connection cable: With shielding 22AWG or more, max. 10 m

Pin No.	Signal contents
1	Contact a for output cut-off alarm (open when alarm occurs)
2	Common for output cut-off alarm
3	Contact b for output cut-off alarm (closed when alarm occurs)
4	Contact a for upper/lower temp. limit alarm (open when alarm occurs)
5	Common for upper/lower temp. limit alarm
6	Contact b for upper/lower temp. limit alarm (closed when alarm occurs)
7-9	Unused



Alarm output connector D-sub 9 pin (pin type)

6. Communication connector: D-sub 9 pin

OMRON Corp. XM2D-0901 or equivalent, holding screw M2.6

Connection cable: With shielding 22AWG or more

1) Common to HED003-C2A, HED005-C2A, HED007-C2A

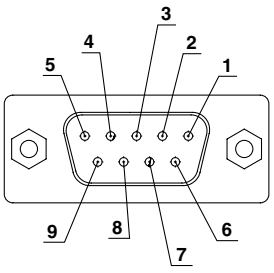
RS-485

Pin No.	Signal contents
1	RS-485 BUS +
2	RS-485 BUS –
3	Unused
4	Unused
5	SG
6-9	Unused

2) Common to HED003-C2B, HED005-C2B, HED007-C2B

RS-232C

Pin No.	Signal contents
1	Unused
2	RS-232C RD
3	RS-232C SD
4	Unused
5	SG
6-9	Unused



Communication connector D-sub 9 pin (socket type)

Alarm

This unit has failure diagnosis function. When an failure happens, its failure mode is displayed on the LCD display in the controller and it can be read out through the serial communication, and has relay outputs for upper/lower temperature limit alarm and shutdown alarm.

Alarm code	Alarm description	Operation status	Main reason
WRN	Upper/Lower temp. limit alarm	Continue	The temperature has exceeded the upper or lower limit of the set temperature.
WRN	Remote OFF alarm	Stop	The remote ON/OFF contact is set to be off. (This alarm is not generated by the relay output.)
ERR00	CPU hung-up	Stop	The CPU has crashed due to noise, etc.
ERR01	CPU check failure	Stop	The contents of the CPU cannot be read out correctly when the power supply is turned on.
ERR03	Back-up data error	Stop	The contents of the back-up data cannot be read out correctly when the power supply is turned on.
ERR04	EEPROM writing error	Stop	The data cannot be written to EEPROM.
ERR05	EEPROM input over time error	Stop	The number of times of writing to EEPROM has exceeded the maximum value.
ERR11	DC power voltage failure	Stop	Momentary loss of AC power supply, DC power supply has excessive temperature, or the thermo-module has been short-circuited.
ERR12	Internal sensor value is high.	Stop	The internal temperature sensor has exceeded the upper limit where the Chemical Thermo-con is set to stop.
ERR13	Internal sensor value is low.	Stop	The internal temperature sensor has exceeded the lower limit where the Chemical Thermo-con is set to stop.
ERR14	Thermostat alarm	Stop	The thermostat has been activated due to insufficient flow rate of the circulating fluid or facility water or high temperature.
ERR15	Output failure alarm	Continue	The temperature cannot be changed even at 100% output, due to overload or disconnection of the thermo-module.
ERR17	Cutoff/short of internal sensor	Stop	The internal temperature sensor has been disconnected or short-circuited.
ERR18	Cutoff/short of external sensor	Continued by normal control	The external temperature sensor has been disconnected or short-circuited. (Only detected when in learning control, auto-tuning operation 2, or external sensor control)
ERR19	Auto-tuning failure	Stop	Auto-tuning has not been completed within 60 minutes.
ERR21	Fan alarm	Stop	The air-cooled fan alarm of the power supply has been activated.
ERR22	Leak alarm	Stop	The fluid leak sensor has detected leakage of fluid.

Maintenance

Please prepare back-up equipment as necessary to minimize the downtime.

1) Heat exchanger

The heat exchanger will not be repaired in principle.

Only the return to SMC for an investigation within warranty will be accepted. The return unit has to be completely decontaminated with appropriate method such as use of neutralizing agent before return to SMC.

2) Temperature controller

Maintenance of the temperature controller will be performed only at SMC. SMC will not support on-site maintenance. The following parts have published life time. To make a maintenance return schedule is recommended based on the following parts life expectation.

Parts Life Expectation

Description	Expected life	Possible failure
Fan	5 to 10 years	Lack of fan cooling because of the life time of the bearing. It will activate the overheat protection of DC power supply and generate alarm.
DC power supply	5 to 10 years	End life of electrolytic condenser. It will generate DC power supply alarm.
Display panel	50,000 hours (approx. 5 years)	End life of backlight of LCD.

Applicable Fluids

Chemical Compatibility Table against the Wetted Parts Material in Chemical Thermo-con

Chemical	Concentration	Operating temperature range	Compatibility
Hydrofluoric acid	HF: 10% or less	10 to 40°C	○ Note 2)
Buffered hydrogen fluoride	HF: 10% or less	10 to 40°C	○ Note 2)
Hydrofluoric acid and Nitric acid mixture	HF: 5% or less HNO_3: 5% or less		△
Nitric acid (except fuming nitric acid)	HNO_3: 5% or less		△
Hydrochloric acid	HCl: 5% or less		△
Copper sulfate solution	H_2SO_4: 96% or less	10 to 50°C Note) HED007 10 to 30°C	○ Note 2)
Sulfuric acid (except fuming sulfuric acid)	H_2SO_4: 96% or less	10 to 50°C Note) HED007 10 to 30°C	○ Note 2)
Ozone	—	10 to 60°C	○
Ammonium hydroxide	NH_3: 5% or less	10 to 60°C	○ Note 2)
Ammonia hydrogen peroxide solution	NH_3: 5% or less H_2O_2: 20% or less	10 to 60°C	○ Note 1) 2)
Sodium hydroxide	NaOH: 50% or less	10 to 60°C	○ Note 2)
Deionized water	—	10 to 60°C	○ Note 1)
Ultra pure water	—	10 to 60°C	○ Note 1)

How to read the table:
○: Useable
△: Consult with SMC separately.

- The Chemical Compatibility Table shows reference values only and does not guarantee successful use of chemicals in products.
- SMC is not responsible for the accuracy of this data or for any damage arising out of the use of these chemicals.
- Chemial Thermo-con is not designed to be explosion proof, so it is not suitable for flammable fluids.

Note 1) Static electricity may be generated. Anti-static electricity countermeasures should be implemented.
Flow friction may generate static electricity, which can cause electric discharge to the temperature sensor or other devices and cause a malfunction.
It is possible to discharge electricity by using a conductive PFA tube, metal piping (metal flexible hose), or other type of tubing, and by installing a ground line.

Note 2) Permeation of the chemical may be possible. The permeated chemical may have a moderate corrosion to inside components and it may effect their life time. If the chemical has high concentration, permeation becomes greater, which effects the service life. In case the fluid has a possibility to generate corrosive gas, SMC recommends a nitrogen purge of the enclosure. N_2 purge ports are located at the piping connection side of the heat exchanger.

Series HED
Specific Product Precautions 1

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

System Design

⚠ Warning

This catalog shows the specifications of the Chemical Thermo-con.

1. Check detailed specifications in the separate "Product Specifications", and evaluate the compatibility of the Chemical Thermo-con with the customer's system.

2. The Chemical Thermo-con is equipped with a protective circuit independently, but the whole system should be designed by customer to ensure safety.

Handling

⚠ Warning

1. 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. Keep within the specified ambient temperature and humidity range. Also, if the set temperature is too low, condensation may form on the inside of the Chemical Thermo-con or the surface of piping even within the specified ambient temperature range. Dew condensation can cause failure, and so must be avoided by considering operating conditions.

2. The Chemical Thermo-con is not designed for clean room usage. The fan will generate dust.

3. Low molecular siloxane can damage the contact of the relay. Use the Chemical Thermo-con in a place free from low molecular siloxane.

Piping

⚠ Warning

1. Piping must be designed taking the whole system into consideration.

For this product and future equipment, design of the piping system should be performed by a knowledgeable and experienced person.

The fitting is not attached, and should be prepared separately by customer.

Select a fitting suitable for the material and dimensions of the tube. When connecting the fitting, use a specific tool specified by fitting manufacturer.

Piping

⚠ Warning

2. Work performed on the piping should be done by a knowledgeable and experienced person.

If work performed on the piping is done by a less knowledgeable and inexperienced person, it will likely lead to operating fluid leakage, etc.

3. Confirm the leakage of fluid.

Fluid leakage can cause dangerous accidents. Be sure to confirm that the hose or tubing is not pulled out and that there is no leakage in the fitted parts.

4. Confirm that the resin tube is not kinked or collapsed.

If a resin tube is used, it should be checked for the presence and possibility of kink or collapse.

5. Countermeasures against fluid leakage

Water drops may accumulate due to leakage of circulating fluid or facility water, or condensation on the piping. Install the Chemical Thermo-con with a drip pan, fluid leak sensor and exhaust system.

If leakage is detected, cut off the circulating pump with a hardware interlock, and cut off the power to the Chemical Thermo-con.

Depending on the type of chemical used (circulating fluid), it may have a harmful effect on the surrounding equipment and the human body.

⚠ Caution

1. Before piping

Confirm that dust, scales etc., in contact with piping is cleaned up or air blown (flushing) before piping.

2. Take care over the direction of fluid.

Do not mistake the direction of "IN" and "OUT" for the facility water system and circulating fluid system.

3. Take countermeasures against condensation.

Depending on the operating condition, condensation may occur on the piping. In such a case, take countermeasures such as installing insulation material, etc.

4. Avoid electrostatic discharge.

If a fluid with low conductivity such as deionized water is used as the circulating fluid, static electricity generated by flow friction may be discharged to the temperature sensor and malfunction the Chemical Thermo-con. Consider measures to minimize the discharge of static electricity from the circulating fluid to signal line including the temperature sensor.

For example, a PFA conductive tube or metal piping (metal flexible hose) can be used to provide grounding to the piping of the external sensor and to discharge.

Series HED
Specific Product Precautions 2

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Electrical Wiring

⚠Warning

1. Electrical wiring job should be performed by a knowledgeable and experienced person.

Power supply facilities and wiring works should be implemented in accordance with the electric facilities technical standards and provisions and conducted correctly.

2. Mounting a dedicated earth leakage breaker.

As a countermeasure against current leakage, install an earth leakage breaker in the main power supply.

3. Confirmation of power supply

If this product is used with voltages other than specified, it will likely lead to a fire or an electrical shock. Before wiring, confirm the voltage, capacity, and frequency.
Confirm that the voltage fluctuation is within the specified value.

4. Grounding

Be sure to ground (frame ground) with class D grounding. (grounding resistance of 100 Ω or less)
Can be grounded with the PE line of the power supply cable.
Also, do not use together with equipment that generates a strong electrical magnetic noise or high frequency noise.

5. Wiring cable should be handled with care.

Do not bend, twist or pull the cord or cable.

6. Wire with an applicable cable size and terminal.

In the event of attaching a power supply cable, use a cable and terminal size which is suitable for the electrical current of each product.
Forcibly mounting with an unsuitable size cable will likely result in a fire.

7. Avoid wiring the signal line and power line in parallel.

Since there may be a possibility of malfunction from noise, avoid parallel wiring between the temperature sensor line, communications line, signal line of alarm line, etc. and the power line and high voltage line. Also, do not place them in the same wiring tube.

8. Check for incorrect wiring.

Incorrect wiring can damage the Chemical Thermo-con or cause malfunction. Be sure to check wiring is connected properly.

9. Check the model of the Chemical Thermo-con.

The HED003 and HED005 series use the same connector. If the temperature controller and heat exchanger of different models are combined by mistake, an alarm may be generated and the specified performance may not be obtained. Be sure to check the combination of models.

Facility Water Supply

⚠Warning

1. Be sure to supply the facility water.

1. Prohibition of water-cut operation, very little flow rate of water operation.
   Do not operate under the condition that there is no facility water or where there is very little flow rate of water is flowing. (Facility water flow rate range: 5 to 10 L/min)
   In this kind of operation, facility water temperature may become extremely higher. It is dangerous enough the material of hose may soften and burst when the piping supplying the facility water is connected with hose.
2. Actions to be taken when an emergency stop occurs due to extremely high temperature.
   In case a stop occurs due to extremely high temperature resulting from a decrease in the facility water flow rate, do not immediately flow facility water. It is dangerous enough the material of hose may soften and burst when the piping supplying the facility water is connected with hose. First, naturally let it cool down, and removing the cause of the flow rate reduction. Secondly, make sure that there is no leakage again.

⚠Caution

1. Facility water quality

1. Use the facility water within the specified range.
   When using with other fluid than facility water, please consult with SMC.
2. When it is likely that foreign objects may enter the fluid, install a filter (20 mesh or equivalent).

Facility Water Quality Standards

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

	Item	Standard value
Standard item	pH (at 25°C)	6.5 to 8.2
	Electrical conductivity (25°C)	100* to 800 [μS/cm]
	Chloride ion	200 [mg/L] or less
	Sulfuric acid ion	200 [mg/L] or less
	Acid consumption amount (at pH4.8)	100 [mg/L] or less
	Total hardness	200 [mg/L] or less
	Calcium hardness	150 [mg/L] or less
	Ionic state silica	50 [mg/L] or less
Reference item	Iron	1.0 [mg/L] or less
	Copper	0.3 [mg/L] or less
	Sulfide ion	Should not be detected.
	Ammonium ion	1.0 [mg/L] or less
	Residual chlorine	0.3 [mg/L] or less
	Free carbon	4.0 [mg/L] or less

* Electrical conductivity should be 100 [μS/cm] or more.

2. If the temperature of the facility water is too low, it can cause formation of condensation inside the heat exchanger.

Supply facility water with a temperature over the atmospheric dew point to avoid the formation of dew condensation.

3. If the facility water piping is connected to multiple machines, the facility water exchanges heat at the upstream side and its temperature will become higher as it goes downstream.

Limit the number of connected Chemical Thermo-cons to two per facility water system, and if more than two chemical thermo-cons are to be connected, increase the number of systems.

Series HED
Specific Product Precautions 3

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and back pages 2 to 5 for Temperature Control Equipment Precautions.

Mounting

⚠Caution

1. Mount and install horizontally.

When mounting, fix the foot of the Chemical Thermo-con by tightening the screws to the specified torque below.

Recommended Mounting Torque

Device to mount	Thread size	Applicable tightening torque N·m
Heat exchanger	M6	1.5 to 2.5
Temperature controller	M5	1.5 to 2.5

Circulating Fluid

⚠Caution

1. Applicable fluids

For the compatibility between the material of components and fluid, refer to "Applicable Fluids" (page 216). Please contact SMC for fluids other than those described on the check list.

2. Caution for the use of fluids with high permeation

When the Chemical Thermo-con is used for a fluid with high permeation into fluorine resin, the permeation can affect its life. If the fluid also generates corrosive gas, perform N_2 supply and exhaust (N_2 purge) inside the heat exchanger.

3. Caution for the use of deionized water

If deionized water is used, bacteria and algae may grow in a short period. If the Chemical Thermo-con is operated with bacteria and algae, the performance of the heat exchanger may deteriorate. Exchange all deionized water regularly depending on the conditions (once a month as a guide).

4. Prohibition of small flow rate

Be sure to avoid operation with the circulating pump stopped or with extremely small flow rate of recirculating fluid (7 L/min or less for water). Otherwise, the Chemical Thermo-con will repeat change cooling and heating operation, which may shorten the life of the Peltier element significantly, and it will become unable to control the temperature accurately. When the circulating pump is stopped, stop the temperature control of the Chemical Thermo-con as well by using the remote ON/OFF function.

5. Operating pressure range of circulating fluid

The operating pressure range is 0 to 0.35 MPa. Do not use with negative pressure which can cause the Chemical Thermo-con to fail. (Specifically, install the heat exchanger at the secondary (discharge) side of the circulating pump.) Also, avoid excessive pressure being applied to the circulating fluid circuit by a clogged filter or fully closed valve.

6. Prohibition of fluid pulsation

If a pump generating pulsation is used, install a damper to absorb the pulsation directly before the Chemical Thermo-con. Fluid pulsation can break the Chemical Thermo-con.

Communication

⚠Caution

1. The set value can be written to EEPROM, but only up to approx. 1 million times.

In particular, pay attention to how many of times the writing is performed using the communication function.

Maintenance

⚠Warning

1. Prevention of electric shock and fire

Do not operate the switch with wet hands. Also, do not operate the Chemical Thermo-con with water or fluid left on it.

2. Action in the case of error

If any error such as abnormal noise, smoke, or bad smell occurs, cut off the power at once, and stop supplying faciity water. Please contact SMC or a sales distributor to repair the Chemical Thermo-con.

3. Regular inspection

Check the following items at least once a month. The inspection must be done by an operator who has sufficient knowledge and experience.

a) Check of displayed contents.
b) Check of temperature, vibration and abnormal sounds in the body of the Chemical Thermo-con.
c) Check of the voltage and current of the power supply system.
d) Check for leakage and contamination of the circulating fluid and intrusion of foreign objects to it, and subsequent replacement water.
e) Check for leakage, quality change, flow rate and temperature of facility water.

4. Wearing of protective clothing

Some fluids can be dangerous when handled incorrectly. Wear protective clothing for safety during maintenance. In particular, observe the MSDS of the circulating fluid, and wear protective goggles, gloves and mask for the operation of the Chemical Thermo-con accompanied with the use of fluids.

Goggles　Mask　Gloves　Safety shoes

Technical Data CONTENTS

Refrigeration Circuits, Peltier Devices, Cooling Sources

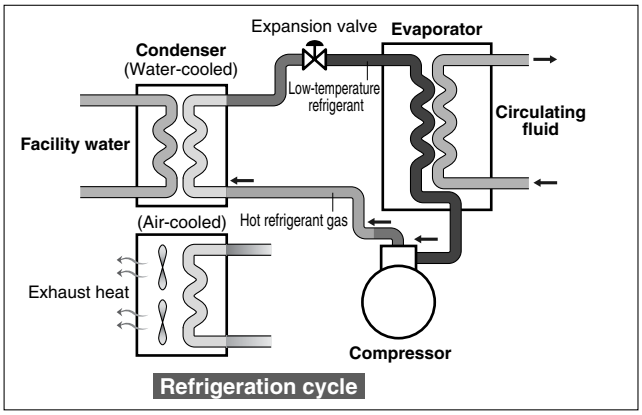
● **Compressor**
A compressor draws in low-pressure chlorofluorocarbon (CFC) refrigerant gas, compresses the gas and then discharges it as a high-pressure, high-temperature gas. Compressors are classified into various types (reciprocating, rotary, screw, etc.) according to the mechanical compression method used.

● **Refrigerator**
A compressor that compresses a refrigerant gas. These are called refrigerators to distinguish them from machines such as air compressors.

● **CFC refrigerant**
CFC (chlorofluorocarbon) refrigerants are organic compounds made up of elements including carbon, hydrogen, chlorine and fluorine. They are referred to generically using the DuPont brand name of Freon®.
When CFCs are used as heat-transfer mediums and circulated inside refrigeration circuits, causing heating and cooling during their condensation and evaporation phase changes, the CFCs are referred to as CFC refrigerants.

● **Specified CFC**
Due to their stability as a chemical substance and their safety with respect to humans, CFCs came to be widely used as industrial materials, particularly refrigerants. However, it was later recognized that when CFCs (and HCFCs (hydrochloro-fluorocarbons)) containing chlorine are released into the atmosphere, they rise up into the ozone layer and deplete it.
This resulted in the establishment of the Montreal Protocol in 1987, which classified CFCs such as Freon R12 and HCFCs such as Freon R22 as "specified CFCs" and prohibited their manufacture. As a result, their use has now almost completely died out.
Instead of specified CFCs and HCFCs, SMC products now use HFC refrigerants such as R134a and R404A that have an ozone depletion potential (ODP) of zero.

● **Fundamentals of refrigeration circuits**
In a refrigeration circuit, refrigerant gas injected into the circuit repeatedly travels through a cycle of compression, condensation, expansion and evaporation, creating high-temperature and low-temperature sections in the circuit. The compressor compresses low-pressure refrigerant gas and discharges the gas at a high temperature and pressure level. The hot, pressurized refrigerant gas enters the condenser where it is cooled by the external air or cooling water and condenses to form a high-pressure liquid refrigerant. As the high-pressure liquid refrigerant passes through a constricting mechanism, such as an expansion valve, it rapidly depressurizes and some of the refrigerant evaporates. The release of evaporation heat causes the refrigerant itself to cool so that it becomes a combination of gas and liquid at a low-temperature and pressure level. In its combined gas-liquid state, the refrigerant enters the evaporator where it continually evaporates while absorbing the heat within the evaporator, thereby cooling the interior of the evaporator. When the refrigerant emerges from the evaporator, it evaporates entirely and becomes a low-pressure refrigerant gas. The low-pressure refrigerant gas is then drawn into the compressor and again becomes a high-temperature, high-pressure gas as the cycle is repeated.



Refrigeration cycle

● **Condenser**
A heat exchanger used to condense high-temperature, high-pressure refrigerant gas. A condenser has the function of releasing heat drawn up by the refrigeration circuit to the outside. Condensers can be air-cooled or water-cooled, depending on the cooling method used.

● **Air-cooled condenser**
Air-cooled condensers are generally made up of copper tubes through which the refrigerant flows, with numerous thin aluminum fins attached around the outside of the tubes. Outside air is forced over the fins by a device, such as a fan motor, to cool the pipes to the ambient temperature and condense the refrigerant gas.
If an air-cooled condenser is installed inside a building, it can be used to heat the interior of the building since the heat generated by the refrigeration circuit is released as waste heat from the outside of the condenser. The room in which an air-cooled condenser is installed must have adequate ventilation or air-conditioning equipment.

● **Water-cooled condenser**
A heat exchanger that uses cooling water to cool and condense the coolant. Water-cooled condensers can be used in environments, such as large factories where cooling tower water or the cooling water for an air-conditioning system can be circulated and used.
Depending on their construction, heat exchangers can be double-pipe type, shell-and-tube type or plate type units.

● **Refrigerant dryer**
In a refrigeration circuit, a refrigerant dryer consists of filters that absorb and remove moisture inside the refrigeration circuit. Refrigerant dryers are normally installed in pipes carrying liquid refrigerant after it emerges from the condenser.

● **Expansion valve**
A component that creates an expansion in the refrigeration circuit. As the refrigerant passes through this valve, a large pressure loss results, thereby making it possible to create high-pressure and low-pressure segments within the refrigeration circuit.
There are several types of expansion valve, including constant-pressure expansion valves and thermal expansion valves. Such types allow the size of the valve aperture to be adjusted using refrigerant pressure or temperature feedback from an outlet passage.

● **Capillary tube**
The capillary tubes used in refrigeration circuits are simply small-caliber copper tubes, normally used in the expansion step, that act as a fixed restrictor in the refrigerant passage.

● **Evaporator**
A heat exchanger used to cool the target substance (e.g., water or air) using the evaporative heat from a low-temperature, low-pressure combined gaseous and liquid refrigerant in the refrigeration circuit.

● **Cooler**
→ Evaporator

● **Accumulator**
A tank installed in a refrigeration circuit on the inlet side of the compressor. A compressor is a component designed to compress gas, so a malfunction will occur if any liquid coolant enters the compressor. Installing an accumulator has the function of separating out the coolant gas that is sucked into the compressor and any remaining refrigerant, and of preventing the liquid refrigerant from being sucked into the compressor. The inclusion of an accumulator creates a system that is highly resistant to variability in factors such as the cooling load.

● **Hot gas by-pass**
A refrigeration circuit sometimes includes a circuit that allows high-temperature, high-pressure refrigerant gas (hot gas) discharged from the compressor to by-pass the condenser so that it reaches the evaporator (on the low-pressure side) without being condensed. This prevents the evaporator temperature (on the low-pressure side) from dropping too far and reduces the risk of liquid refrigerant being drawn into the compressor when the cooling load is low (if there is nothing to refrigerate), thereby ensuring more stable functions of the refrigeration circuit.
This also allows a flow of hot gas to be intentionally directed to the evaporator with the aim of heating the evaporator rather than cooling it.

● **Water control valve**
A water control valve, installed on the cooling water pipe for a water-cooled condenser, used to adjust the amount of cooling water flowing to the condenser. Water control valves can be either pressure-regulated or temperature-regulated, with the amount of flow regulated using feedback from the condensing pressure or condensing temperature, respectively.
When the cooling water temperature is low, a large flow of cooling water to a water-cooled condenser reduces the condensing pressure and lowers the cooling capacity. In this sort of situation, a water control valve restricts the cooling water flow and maintains the condensing pressure at the desired value. Water control valves also have the function of reducing water consumption by preventing unnecessarily large flows of cooling water.

● **Inverter control**
In compressors that use an ordinary AC motor, the motor rotation rate is fixed according to the frequency of the AC power supply, with the result that the refrigerant discharge rate is also fixed. Inverter control in a refrigeration circuit is the use of an inverter to vary the compressor rotation rate and thereby control the rate of refrigerant circulation.
This provides means of saving energy by, for example, running the compressor at a slower rate when the cooling load is low.

● **Protective devices in refrigeration circuits**
In refrigeration circuits, protection must be provided for electrical components such as compressors, and against abnormal refrigerant pressures. Protective measures for compressors (motors) include protective devices such as overload relays (built into the compressor to detect overcurrent and overheating), thermal relays (fitted externally to detect motor overcurrent) and temperature switches.
The devices used to protect against pressure faults include pressure switches, safety valves and rupture disks. However, in refrigeration circuits built into compact devices, the protective devices are often confined to just overload relays, or just thermal relays and pressure switches depending on the anticipated level of risk.

● **Facility water**
The cooling water flowing through a water-cooled condenser used to expel waste heat generated in the refrigeration circuit to the outside.
In ordinary factories or buildings, fluids such as cooling tower water or chiller water are used as facility water.

● **Cooling tower**
A cooling tower is a facility that uses cooling water to expel the waste heat circulated and collected inside a factory or other building into the outside air. Cooling towers are installed in outdoor locations such as on the rooftops of buildings. The cooling water is sprayed down like a shower from the top of the cooling tower and forcibly brought into contact with the outside air by a fan motor. As well as being directly cooled by the temperature of the outside air, the partial evaporation of the cooling water itself draws off evaporation heat, cooling the water further.
Because cooling towers are directly cooled by the outside air, the resulting cooling water temperature varies seasonally depending on the climatic conditions. In addition, the cooling water cannot theoretically be cooled to a temperature any lower than 5°C above the wet-bulb temperature of the outside air.

● **Peltier device**
An element with a structure made up of alternating layers of flat P-type and N-type semiconductors arrayed in series. When a direct current flows through the element, heat moves from one plate surface to the next, so that one surface is cooled as the opposing surface is heated. This is referred to as the Peltier effect.
By changing the direction of current flow, the direction of heat movement can also be changed, providing a simple means of cooling and heating.

● **Thermo-module**
→ Peltier device

● **Thermoelectric device**
→ Peltier device

● **Thermoelectric system**
A temperature control system that uses a Peltier element to directly cool and heat a liquid, gas or solid.
Heat exchangers suitable for fluids are installed on both sides of the Peltier element, with the fluid to be temperature-controlled on one side of the element while the heat exchanger on the other side is used to dissipate heat.

Fluid Control and Heat-related

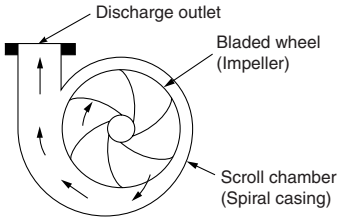
● **Pump capacity/Water-supply capacity**
A pump's water-supply capacity is indicated by the amount of water it can cause to flow at a given pressure (lifting height).
The characteristic curve (pump curve) that indicates the correlation between pressure and flow rate varies depending on the pump type, and thus, the user must check that the type of pump selected is suitable for the intended application.

● **Lifting height/Pressure**
Lifting height (in meters) is often used instead of pressure to indicate the pump capacity. Lifting height is a numerical value that indicates the capacity of a pump in terms of the height (in meters) to which it can lift a fluid.
The value for pressure is obtained by multiplying the lifting height by the density of the fluid; for example, if a pump capable of generating a lifting height of 10 meters is used to pump water, which has a density of 1 kg/L, the unit pressure generated by the pump is 1 kgf/cm^2 (0.1 MPa).
If a more dense fluid is used, the pressure is higher even though the lifting height remains the same.

● **Pipe resistance**
When water or another fluid is caused to flow through a passage composed of pipes, valves, etc., the pressure differential generated by friction between the various devices and the fluid is known as “pipe resistance.” A synonymous term is “pressure loss.”

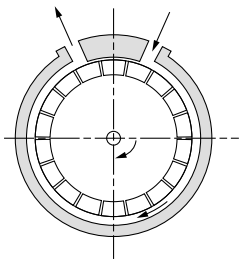
● **Centrifugal pump**
This is one type of pump in which a bladed wheel (impeller) spins inside the pump chamber (casing), applying centrifugal force to the fluid. This force is converted to pressure that discharges the fluid. A large volume of fluid can be pumped, but it is difficult to attain high pressure. When high-pressure is desired, a type fitted with multistage impellers can be used.
This is a low-lifting height, high-flow volume pump.

Centrifugal pump



● **Vortex pump**
In this type of pump, a bladed wheel (impeller) spins inside the pump chamber (casing), applying centrifugal force to the fluid. This force is converted to pressure that discharges the fluid. As in a centrifugal pump, the fluid is discharged using centrifugal force, but the impeller has more blades than in a centrifugal pump, and in the pump chamber (casing), the aperture (clearance) is set more narrowly, allowing for a higher discharge pressure.
The pressure and flow characteristics attained are somewhere between that of a centrifugal pump and a vane pump.
This is a mid-lifting height, mid-flow volume pump.

Vortex pump

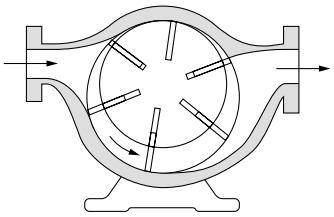


● **Turbine pump**
→ Vortex pump

● **Cascade pump**
→ Turbine pump

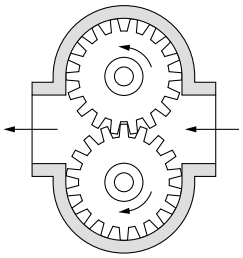
● **Vane pump**
In this type of pump, vanes set in a rotor inside the pump chamber brush against the inside walls of the chamber as they rotate, pushing out and discharging the fluid that is surrounded by the vanes, rotor and pump chamber walls. This is a type of PD (positive displacement) pump.
This is a high-lifting height, low-flow volume pump.
The vanes slide against the interior walls of the pump chamber, generating abrasion powder. In addition, this type of pump is susceptible to entry of foreign objects such as outside debris, etc.

Vane pump



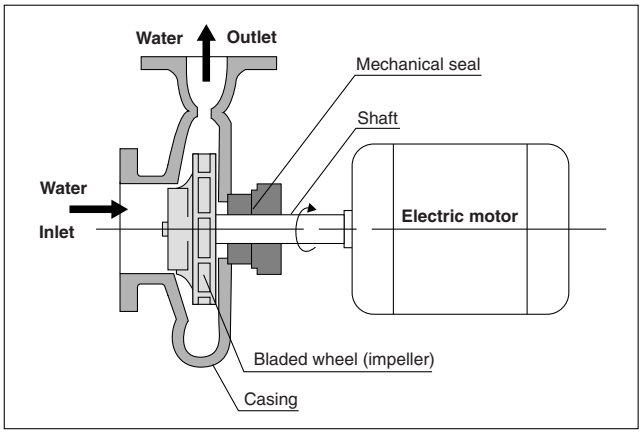
● **Gear pump**
Like the vane pump, this is a type of PD (positive displacement) pump, in which a pair of gears meshes with one another and rotates, pushing the fluid through the gap between them and discharging it.
This is a high-lifting height, low-flow volume pump.

Gear pump

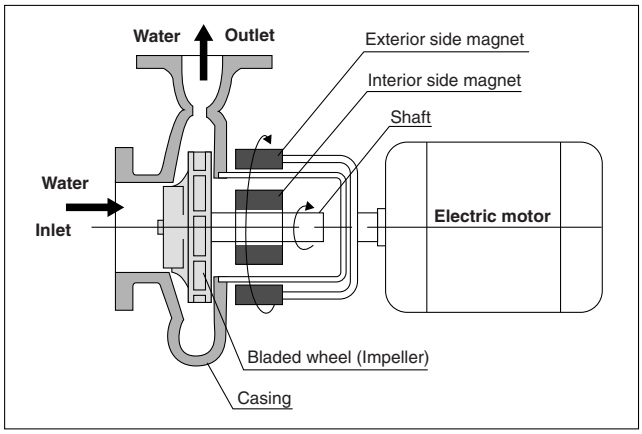


● **Sealing mechanism**
The bladed wheel (impeller) in the pump chamber through which the fluid passes is linked to the shaft of the external electric motor, and the rotation of the impeller discharges the fluid. As water or other fluids seeping through the motor shaft and reaching the electric motor can cause short circuits and other damage, it is necessary to have a mechanism sealing the pump chamber off from the shaft. This is known as a “sealing mechanism.”
There are mechanical seal types, magnet coupling types and others.

● **Mechanical seal pump**
This is a general terms for pumps that use mechanical seals for the sealing mechanism.
The rotating seal mounted on the motor shaft side and the fixed seal mounted on the pump chamber side rotate, and their surfaces touch one another, sealing off the fluid. As a result, there is a slight, external leakage of fluid. The volume of leakage increases over time, so it is necessary to replace the seal portions regularly.
This type can be used for applications where the motor shaft and impeller are directly linked and there is high-shaft power.



● **Magnet pump**
This is a general term for pumps that use magnetic coupling for the sealing mechanism.
Using magnetism to couple the rotor on the inside of the pump chamber to the permanent magnet mounted on the motor shaft side, with the pump chamber wall between them, the rotation is conveyed to the rotor inside the pump chamber. Since the pump chamber can be completely separated, pump chamber can be completely sealed off, so there is absolutely no external leakage.
Since a large magnet coupling is needed, this type of pump is more difficult to make in small sizes than the mechanical seal type, and the cost is also higher.



● **DC canned pump**
A pump with a seal-less construction combining the motor and the pump in one. It can be made in compact sizes with absolutely no external leakage of fluid. A DC brushless motor is used.

● **Pump heat input**
The volume of heat applied to the circulation loop, generated by the operation of the pump. When calculating the overall volume of heat applied to the circulation loop, it is necessary to consider the volume of heat generated by the pump, along with that of the object being cooled.
The pump converts the electrical power entering the motor into the kinetic energy of the fluid, which causes the fluid to circulate. This kinetic energy is reduced as a result of undergoing pressure loss inside the piping, and eventually the entirety of the kinetic energy is released into the circulating fluid as heat.
While there are differences depending on the type of pump, for rough calculations, the nominal heat emitted from the pump can be treated as the pump heat input.

● **Solenoid valve**
A component that switches the flow of fluid from ON to OFF, or changes the direction by moving the plunger (iron core) using the force of electromagnetism.

● **Relief valve**
When the inlet pressure exceeds a set level, this valve opens to release the outlet pressure.

● **Flow sensor/Flow switch**
These components monitor the flow rate of the fluid. The flow sensor measures the flow rate linearly. The flow switch only has the function of commencing operation when the flow rate reaches a certain level, and does not perform measurement of the flow volume.

● **Particle filter**
A filter that removes debris and other particles.

● **Check valve**
A check valve is a device that prevents reverse flow of the fluid, keeping it flowing in one direction only.

● **Non-return valve**
→ Check valve

● **Level switch**
A switch that detects the fluid level inside the liquid tank. There are many different types, but the most common type employs a floating buoy, which causes a lead switch (magnetic switch) to turn ON and OFF.

● **DI filter**
A filter that is filled with ion exchange resin used to remove leftover ions from the water. DI stands for “deionized,” while “DI water” is deionized water, or water with its ions removed.

Fluid Properties, Materials, Physical Values

● **Density, specific gravity**
The mass per unit of volume, measured in units of [kg/m^3]. Specific gravity is the ratio of the density of a given substance to the density of water (1.0 [g/cm^3]), and is a dimensionless quantity. When expressing this quantity within the CGS system of units, density and specific gravity have the same value.

● **Degree of viscosity**
Thickness of a fluid. The units used to express absolute degree of viscosity are [Pa·s] units, but it is often expressed within the CGS system of units with [P] (Poise).
1 [Pa·s] = 10 [P]
The value obtained by dividing absolute degree of viscosity by density is called the kinetic viscosity. This can be measured in [m^2/s] units, but in general, [St] (Stokes) are used.
1 [St] = 0.0001 [m^2/s]

● **Specific heat, specific heat capacity**
The heat energy required to increase the temperature of an object by a certain temperature interval, under specific pressure and volume conditions.
The specific heat of water: 1 [cal/g·K] = 4.184 x 10^3 [J/kg·K]

● **Cooling capacity**
The volume of heat (heat energy) that temperature control equipment can absorb (cool) per unit of time, at an arbitrary temperature.

● **Heat load**
→ Cooling capacity

● **Heat**
Terms such as heat, heat load, cooling capacity, etc., that are used in this catalog, indicate quantities of heat that can be absorbed or radiated per unit of time. As a result, the units employed are [W] = [J/s] (work rate) or [kcal/hr].
1 kW = 860 kcal/hr

● **Specific resistance**
A value indicating the electrical insulating properties of a liquid, and the unit used is [Ω·cm]. When expressing the specific resistance of deionized water, it is sometimes called “DI level.” At 25°C, the specific resistance of theoretically 100% deionized water is 18.3 [MΩ·cm].

● **Electrical conductivity**
A value indicating the ease with which electricity passes through a liquid, and is inversely proportional to the specific resistance. The unit used is [S/m], incorporating [S] (Siemens), the opposite of [Ω] (resistance).
At 25°C, the electrical conductivity of theoretically 100% deionized water is 0.055 [μS/m].

● **Clear water**
Water that has been filtered and distilled and any impurities eliminated. It is also known as purified water.

● **Deionized water**
Water that has had any impurities or ion elements removed. It is obtained by removing ion elements with ion exchange resin, after filtering out impurities with a particle filter. Its theoretical specific resistance has a limit of 18.3 [MΩ·cm], but it is impossible to actually attain this value. As a general rule, water with a specific resistance of 1 to 10 MΩ·cm is referred to as deionized water.

● **Ethylene glycol aqueous solution**
Ethylene glycol is a type of alcohol, and adding it to water causes the freezing point of the water to drop. It is a major ingredient in antifreeze for automobiles. At a concentration of 60%, the freezing point drops to –40°C or lower, but the viscosity increases as the temperature drops, so taking fluidity into account, it is practical to consider about –20°C as the minimum temperature.
By adding ethylene glycol to deionized water, it is possible to raise the fluid's specific resistance, so it can be used for applications where circulating fluid with high insulating properties is desired.

● **Propylene glycol aqueous solution**
Propylene glycol is a type of alcohol, and adding it to water causes the freezing point of water to drop. Like ethylene glycol, it is a major ingredient in antifreeze for automobiles.
It has lubricating properties, and is characteristically non-volatile.

● **Fluorinated fluids**
Inert fluids in the fluorine series. There are many types, including perfluoropolyether (PFPE), perfluorocarbon (PFC), hydrofluoropolyether (HFPE), and hydrofluoroether (HFE), but they share the characteristic of high electrical insulation properties, and grades can be selected with appropriate fluidity even at low temperatures, such as –100°C, and high temperatures, such as 200°C and above.
They are chemically inert and non-poisonous.
Products are sold on the market, such as Fluorinert, made by 3M, and GALDEN, made by Solvay Solexis.

● **GALDEN®**
The product name of a fluorinated fluid manufactured by Solvay Solexis. It is a perfluoropolyether with a high polymer compound, and various grades can be selected with differing temperature ranges and viscosity ranges depending on the degree of polymerization.

● **Fluorinert™**
The product name of a fluorinated fluid manufactured by 3M. Its basic structure is a perfluorocarbon, but it has a wide variety of chemical structures, and various grades can be selected with differing temperature and viscosity ranges.

● **Circulating fluid, constant temperature circulating fluid**
Fluid that circulates among the customer's equipment, with temperature controlled by a chiller.
Taking freezing temperature, boiling point, electrical insulation properties and so on into consideration, clear water, deionized water, ethylene glycol aqueous solution, fluorinated fluids, etc., can be selected depending on the application.

Temperature Measurement and Control

● **PT sensor, platinum resistance temperature detector**
A type of temperature sensor taking advantage of the properties of platinum (Pt), which has an electrical resistance that increases in proportion to the temperature. A sensor with the specification Pt 100 Ω has a resistance of 100 Ω at 0°C. As the resistance value is relatively small, and the sensor is easily influenced by the resistance value of the conductive wires, an input circuit is generally used which cancels out the resistance value of the conductive wires, by using, for instance, 3-wire or 4-wire wiring configurations and long conductive wires.

● **RTD (Resistance Temperature Detector)**
→ PT sensor

● **Thermo couple**
This is created by forming a loop, connecting the ends of two wires made of two different metals, and by keeping the two wires at separate temperatures at the connecting point. Thermoelectric power is generated according to this temperature differential (the Seebeck effect).
As a sensor, by keeping the end of one wire at a standard temperature and measuring the thermoelectric power generated, it can determine the temperature of the other wire terminal. A thermo couple is a sensor employing this principle.

● **Thermistor**
A temperature sensor employing a semiconductor with electrical resistance that changes in accordance with the temperature. There are two types,
PTC: positive temperature coefficient (a type for which the resistance increases as the temperature rises)
NTC: negative temperature coefficient (a type for which the resistance decreases as the temperature rises.)
The resistance value is generally large, amounting to several MΩ, and there is little influence from the resistance of the conductive wires, so a 2-wire configuration is generally used.

● **Thermostat**
A switch that turns ON or OFF when it reaches a certain set temperature. Most thermostats are bimetallic.
They are sometimes used for direct temperature control, such as switching a heater ON or OFF, but are also used often for safety circuits which switch OFF when the temperature becomes abnormally high.
The switch can be returned to its original position either automatically or manually.

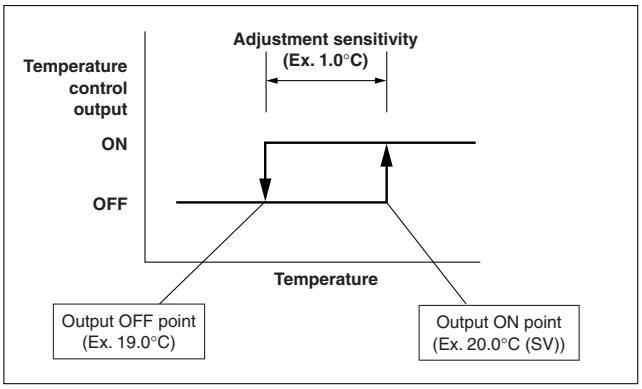
● **Temperature fuse**
A fuse in which an internal metal wire melts, breaking the circuit when exposed to a temperature exceeding the set temperature. When this kind of fuse blows, it cannot be reset and must be replaced.

● **PV**
PV: Process Value. In temperature control equipment, this indicates the current temperature measured by the temperature sensor.

● **SV**
SV: Set Value. In temperature control equipment, this indicates the target value (set value) for performing temperature control.

● **ON/OFF temperature control**
A control method for adjusting temperature by turning temperature control output ON or OFF relative to the set temperature.
When the temperature is above (below) the set temperature, output of the refrigerator (heater) is turned ON, and when the temperature is below (above) the set temperature, output is turned OFF.
Since there are only two operating rates relative to the set temperature, 0% or 100%, this is also called 2-position control.

● **Adjustment sensitivity (Hysteresis)**
When the PV is extremely close to the SV in ON/OFF control, there may be "chattering" where the temperature control output repeatedly turns ON/OFF with small temperature variations, and this may have an adverse impact on output relays and connected equipment. To prevent this, spacing is provided between ON and OFF operation to stabilize control. This operation spacing is called adjustment sensitivity (hysteresis).
For example, if the cooling output ON point (SV) is set to 20.0°C and hysteresis is set to 1.0°C, then cooling output will go OFF when temperature drops to 19.0°C, and go ON when temperature rises to 20.0°C.



● **PID control**
A control method for producing temperature control output by comparing the temperature difference between the input value from the temperature sensor (PV) and the set temperature (SV), and using a combination of P (Proportional) operation, I (Integral) operation and D (Derivative) operation.
Output is linearly variable from 0 to 100%, and this enables smooth temperature control with no temperature wavering.
P (Proportional) operation: Operation where the amount of output is varied from 0 to 100% in proportion to the deviation between PV and SV (temperature difference). The range of temperatures for performing proportional operation (proportional band) must be input as a parameter.
I (Integral) operation: Operation where the temperature discrepancy is corrected by adjusting the amount of output relative to the time that deviation between PV and SV has continued. Since the amount of output is determined in response to the time that deviation continues, the integral time must be input as a parameter.
D (Derivative) operation: Operation where output is produced in accordance with the derivative (speed of change) of the temperature deviation. This is used to quickly correct sudden temperature variations when there is a sudden change in the ambient environment or load. The derivative time is input as a parameter, and the longer the derivative time, the stronger the correction output that is produced.

● **ARW width (Anti-Reset Windup width)**
Range of integral operation used for PID control. This value is used to designate the range for calculating the integral term, to suppress buildup of the integral component.

● **Auto-tuning**
In PID control, P, I, D and each parameter must be optimally set for the balance of the heat capacity of all parts where the circulation loop is connected. Auto-tuning refers to a function for automatically determining the setting of those parameters.
SMC's temperature control equipment is shipped with PID parameters set at factory shipment to the greatest common factor for the various use conditions. However, if those parameter settings are likely to be unsuitable for the actual operating environment, some models provide a function which can automatically set parameters by using auto-tuning.

● **Time division proportional output**
When controlling output of a heater or other device via a relay or SSR, this method of operation makes the ratio of ON time to OFF time proportional to the control output over a fixed time (0.2 to 1.0 sec) in accordance with a previously set time cycle.
For example, if the control cycle is 1.0 sec, and the control output is 70%, then the ON time will be 0.7 sec and the OFF time 0.3 sec.

● **PWM control**
→ Time division control

● **Offset function**
Function for shifting the target temperature for actual temperature control from SV by adding or subtracting a separately set offset value (+ or – a certain number of °C) to or from the set temperature (SV).
For example, if the temperature upon arrival at the object of temperature control is shifted higher (or lower) relative to the temperature discharged from the chiller because a certain amount of heat input is received from piping due to the effects of ambient temperature, this offset value is set to correct that effect.

● **Learning control**
A function for automatically calculating and setting the offset value (correction value for the set temperature).
A temperature sensor (external sensor) is provided near the object to be temperature controlled, and those signals are input to the chiller. The offset value is automatically calculated from the deviation between the discharged temperature and the external sensor.

● **External sensor**
Temperature sensor mounted to the outside of temperature control equipment and used for learning control etc.

● **Band width, Temperature upper/lower limit width**
Temperature range for outputting alarms etc., when PV deviates by more than a fixed temperature from the set temperature (SV).

Power Supply, Electrical Equipment

● **Power supply frequency**
There are two frequencies for commercial AC power: 50 Hz and 60 Hz. The AC motors installed in temperature control equipment turn at a rotation speed corresponding to the power supply frequency. When operating with a 60 Hz power supply, the rotation speed is generally 10% faster than with 50 Hz. In the case of a pump, the flow rate and pressure increase, and in the case of a compressor in a refrigeration circuit, the cooling capacity increases. Current consumption also increases in the same way.
In the case of a resistance load, such as a DC pump or heater, performance does not depend on the frequency.

● **Three-phase power supply**
With three-line AC current or AC voltage, the phases of the lines are shifted by 120°.
The current values of each line are $1/\sqrt{3}$ smaller than single phase with the same level of transmitted power, so thinner wires can be used. There is also the advantage that a rotating magnetic field can be easily produced. (It is possible to use a 3-phase motor with a simple structure.)
A 3-phase power supply is used for equipment with high output.

● **Breaker**
A device which protects load circuits and wires by breaking the circuit when an abnormal current flows in an outlet circuit due to problems such as overload or shorting. Depending on the application, a breaker may be called a motor breaker, circuit protector or other names. Ground fault circuit interrupters monitor both current in the main circuit and leakage current, and break the circuit if leakage current is too high.

● **Relay**
A switch which turns a mechanical contact ON/OFF with the power of an electromagnet (solenoid). This makes it possible to turn ON/OFF the high power of the contact with the low power needed to drive the electromagnet only, and thus relays are used for amplification. They are also frequently used as logic elements in sequence circuits.

● **Electromagnetic contactor**
An electric device for turning power circuits ON/OFF to start and stop power equipment (e.g. motors, heaters). Just like a relay, these devices open or close a mechanical contact with the power of a solenoid. The principle of operation is the same as a relay, but a contactor is designed for high-voltage and large current.

● **Thermal relay**
A circuit protection device incorporated into the power input circuit of a motor to provide output when motor overcurrent is detected. It is comprised of a heater which heats up in response to current, and a bimetal which opens and closes a contact in response to that heat. Since the thermal relay itself cannot open and close a high capacity power circuit, the main circuit for a motor or other device is broken by incorporating a control circuit with an electromagnetic contactor or relay.

● **Electromagnetic switch**
A device integrating an electromagnetic contactor with a thermal relay.

● **Overload relay**
This has the same structure as a thermal relay, and is used for the same purpose. Overload relays built into the compressors of small refrigeration circuits are installed on the wall of the compressor, and are actuated not by heat due to overcurrent but by the temperature of the compressor itself. In many small compressors, the main circuit is directly broken by the overload relay.

● **Impedance protection**
A type of motor protection generally used for small AC fan motors and other small motors.
The motor is constructed so that it will not rise above a certain temperature, even when locked for some reason, due to the inherent impedance (AC resistance) of the motor coil itself. Therefore, the motor itself is protected against burnout, even though no thermal relay or other protective device is installed.

● **Solid state relay (SSR)**
A relay which enables switching of high power using low power by using a thyristor or other semiconductor element. In comparison with an electromagnetic relay, this type has no mechanical moving parts, and thus is capable of high-speed switching. SSRs are compact, and have a long service life.
However, this does not mean that contacts are physically isolated. The fact that there is some leakage current even when the device is OFF must be taken into account.

● **Phase reversal relay (Plugging relay)**
A switch which monitors the phase sequence of a 3-phase main power supply, and issues a warning if anything is abnormal.
When driving a 3-phase motor with a 3-phase power supply, the motor will turn backwards if the phase sequence of wiring is wrong. This relay is installed to prevent such reverse rotation. These relays are also called plugging relays.

● **DC power supply**
A device which produces DC power from commercial AC power. DC power is for CPUs inside equipment and other control circuits. Peltier elements for Peltier circulators, thermoelectric baths and other equipment are driven with DC power, so they have a high-capacity DC power supply built-in.

● **EMO circuit**
An EMO (EMergency Off) circuit is an electrical circuit provided to shut off all power and ensure safe conditions when an emergency stop button (EMO button) is pressed in an emergency.

● **Hardware interlock**
This is an equipment control circuit for shutting off power in case of trouble. The circuit is logically configured using only relays and other hardware, and does not use software running on the CPU.

● **RS232C**
A standard for serial communication. This is the communication standard when connecting a PC with an acoustic coupler or modem, and is used for one-to-one communication between PCs.
Since RS232C itself only roughly stipulates the use of wiring systems and other hardware, detailed hardware specifications and software protocols are determined independently by each equipment manufacturer.

● **RS485**
A standard for serial communication. Only one-to-one communication between devices can be done with RS232C, but with RS485 it is possible to communicate simultaneously with multiple devices by wiring them in a chained, multidrop fashion, and providing addresses via software.
Since RS485 itself only roughly stipulates the use of wiring systems and other hardware, detailed hardware specifications and software protocols are determined independently by each equipment manufacturer. Actual detailed protocols are determined independently by each equipment manufacturer.

● **DeviceNet**
A standard for serial communication.
An open network owned by ODVA (Open DeviceNet Vendor Association Inc.), a non-profit organization headquartered in the US. This is a field network standard covering a wide scope, from the sensor level to the device level.

● **Analog communication**
A method of communicating with external devices using voltage output such as 0 to 10 V. This enables output of PV (measured temperature etc.) and reception of values like SV (set temperature).

● **Signal input/output, I/O**
Input/Output signals such as alarm signal, or operation signals. Since there are various communication methods depending on the equipment model, such as relay output and open collector output, communication specifications must be checked before wiring.

● **Insulation withstand voltage**
Electric potential difference where an insulator material will not be destroyed. In withstand voltage testing at product shipment from the factory, a high AC voltage of 1.5 kV (varies depending on the model) is applied between the electric circuit conductor and the chassis (grounded). Then it is checked that there is no flow of leakage current above the reference value.

● **Insulation resistance**
Electrical resistance between the conductor inside the device and the chassis (grounded). In insulation resistance testing at product shipment from the factory, it is checked that the resistance value with a measured DC voltage of 500 V (or 250 V) is at or above the reference value (a value such as 1 MΩ; varies depending on the model).

Safety Standards

● **CE marking**
For machinery and other equipment distributed in the EU (European Union), it is mandatory to display the CE mark. To display the CE mark, a product must declare itself to be in compliance with EU Directives. The main EU Directives relating to the products in this catalog are the Machinery Directive, EMC Directive and Low Voltage Directive. Each directive requires product compliance with the corresponding EN Standard (European Standard).

● **UL standards**
Standards of a non-profit testing organization founded by the US National Fire Protection Association.
In the US, some states and municipalities require UL certification for the sale of electrical products.

● **CSA standards**
Safety standards by the Canadian Standard Association, a non-governmental Canadian standardization organization.
Electrical products distributed in Canada must be CSA certified.

● **NRTL (National Recognized Test Laboratories)**
Testing organizations capable of certification (of UL or CSA standards etc.) which have been recognized according to Occupational Safety and Health Law set forth by OSHA (the US Occupational Safety and Health Administration). At present, 18 organizations have been recognized as NRTLs. UL and CSA are examples of certified organizations.

● **eti mark**
eti (Electro-Test Inc.) is the mark that demonstrates compliance with UL standards.

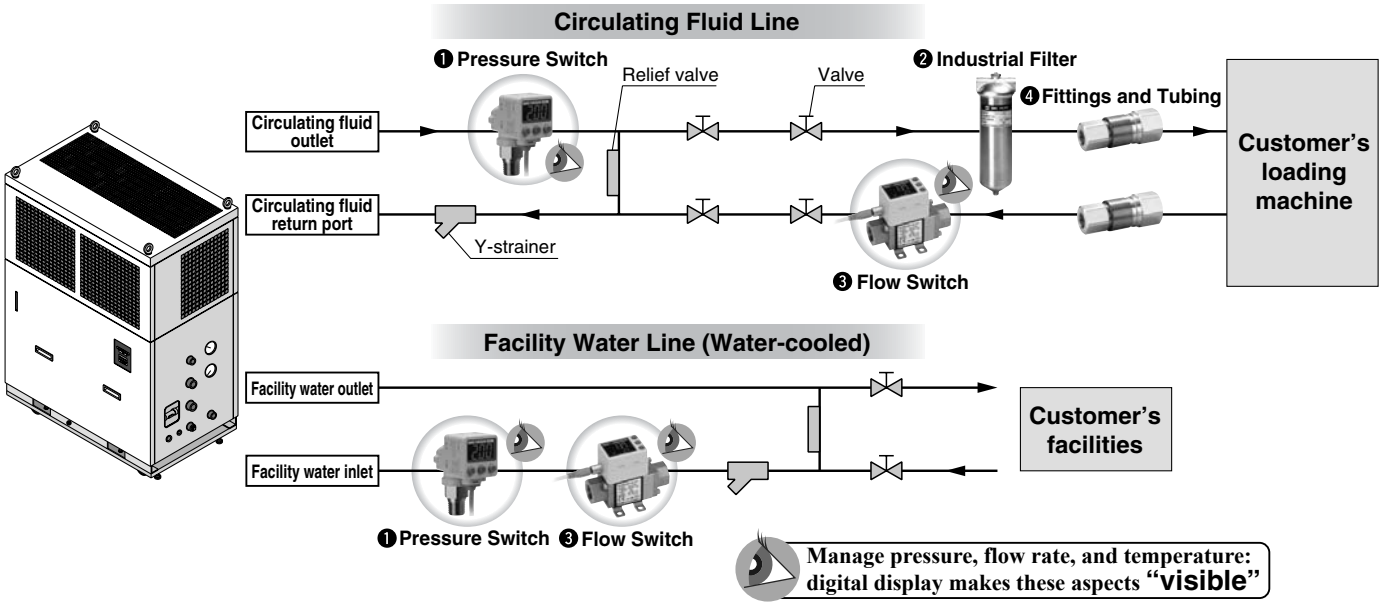
● **ETL mark**
Intertek ETL SEMKO is an NRTL, and issues the ETL mark. This mark demonstrates compliance with UL standards.

● **SEMI S2**
SEMI is an international industry association of companies producing equipment and materials for the manufacture of semiconductors and flat panel displays. It has established its own standards as safety guidelines for the design of semiconductor manufacturing equipment.
SEMI S2 requirements relate to the work environment, health and safety for products used in semiconductor manufacturing, and cover chemical, radiation, electrical, physical, mechanical, environmental, fire, earthquake, emissions and ergonomics, as well as quality, documentation and manuals etc. Many semiconductor manufacturers require that equipment operating in their plants comply with SEMI S2.

● **SEMI S8**
SEMI S8 is a guideline on ergonomics which is more detailed than the ergonomic requirements in Section 14 of SEMI S2.

● **SEMI F47**
SEMI F47 is a SEMI standard which stipulates guidelines regarding voltage sag immunity.
Semiconductor manufacturers require this standard for temperature control equipment, just like SEMI S2.

Temperature Control Equipment
Related Products



Refer to Best Pneumatics No. 6 for details.

① Pressure Switch: Monitors pressure of the circulating fluid and facility water.

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

Series	Type	Rated pressure range
ISE80	Positive pressure	−0.100 to 1.000 MPa
Features	● Suitable for a wide variety of fluids with stainless diaphragm ● IP65 ● RoHS compliant ● Low leakage. VCR®, Swagelok® compatible fittings can be selected. ● With one-touch fitting (Straight, Elbow) ● Back piping, Underside piping	

Pressure Sensor for General Fluids *PSE56□*

Separate type sensor

Series	Type	Rated pressure range
PSE564	Positive pressure	0 to 500 kPa
PSE560	Positive pressure	0 to 1 MPa
Features	● Wetted parts: Stainless steel 316L ● IP65 ● Suitable for a wide variety of fluids ● Analog output (voltage/current) ● Low leakage. VCR®, Swagelok® compatible fittings can be selected.	

Multi-Channel Digital Pressure Sensor Controller *PSE200*

Separate type monitor

Series	Features
PSE200	● Four sensors can be connected. ● Applicable sensors: PSE53□, 54□, 56□ ● Capable of controlling various different applications from one controller ● 4 inputs, 5 outputs

2-Color Display Digital Pressure Sensor Controller *PSE300*

Separate type monitor

Series	Features
PSE300	● Applicable sensors: PSE53□, 54□, 550, 56□ ● Compatible with voltage input and current input ● Response time: 1 ms ● Space-saving, capable of vertical and horizontal contact mounting ● Panel mount, Bracket, DIN rail mount

Related Products

Refer to Best Pneumatics No. 7 for details.

② Industrial Filter: Filters the circulating fluid and facility water.

Industrial Filter/Vessel Series *FGD*

Series	Port size	Max. operating pressure	Temperature (°C)
FGD	Rc3/8, 1/2, 3/4	0.7, 1 MPa	Max. 80
Features	● Ideal for low-flow filtration (Max. 60 L/min) ● Possible to select the antistatic specification (FGDE, FGDF).		

High-Precision Filter for Fluid *FGH*

Series	Port size	Max. operating pressure	Temperature (°C)
FGH	Rc3/8 to 1	1 MPa	Max. 80
Features	● Filtration efficiency: Removing over 99%		

Quick Change Filter *FQ1*

Series	Port size	Max. operating pressure	Temperature (°C)
FQ1	Rc1/2, 3/4, 1	1 MPa	Max. 80
Features	● Ideal for low flow filtration (Max. 30 L/min) ● No tools required ● Takes only 60 seconds for element replacement.		

Refer to Best Pneumatics No. 6 for details.

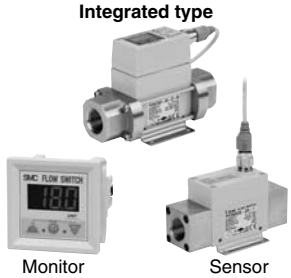
③ Flow Switch: Monitors the flow rate of the circulating fluid and facility water.

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

Series	Set flow rate range (L/min)
PF3W	0.5 to 4
	2 to 16
	5 to 40
Features	● Flow rate sensor with three-color display and two-screen display ● Integrated with temperature sensor ● 40% reduction (compared with SMC PF2W) ● IP65 compliant, Grease-free ● Operating fluid temperature 0 to 90°C

Digital Flow Switch for Water *PF2W*

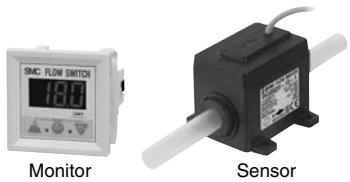
Integrated type



Separate type

Series	Set flow rate range (L/min)
PF2W	0.5 to 4
	2 to 16
	5 to 40
	10 to 100
Features	● Integrated type and Separate monitor type are available. ● Switch output, Accumulated pulse output, Analog output ● Capable of switching back and forth between cumulative and instantaneous flow ● Capable of operating at temperatures as high as 90°C ● IP65

Digital Flow Switch for Deionized Water and Chemicals *PF2D*



Separate type

Series	Set flow rate range (L/min)
PF2D	0.4 to 4
	1.8 to 20
	4.0 to 40
Features	● Body sensor: New PFA, Tube: Super PFA ● Low-particle generation, Excellent flow-through characteristics

4-Channel Flow Monitor *PF2□200*

For deionized water and chemicals

For water

Series	Applicable sensor		Set flow rate range (L/min)
PF2W200/201	For water	PF2W5	0.35 to 4.50
			1.7 to 17.0
			3.5 to 45.0
			7 to 110
PF2D200/201	For deionized water/ chemicals	PF2D5	0.25 to 4.50
			1.3 to 21.0
			2.5 to 45.0
Features	● One controller can handle four units' worth of flow volume maintenance. ● Four different flow ranges can be connected to one controller.		

Refer to Best Pneumatics No. 6 for details.

④ Fittings and Tubing

S Coupler

Series KK

- Fluid: **Air, Water**
- Applicable tube O.D.: **ø3.2 to ø16**
- Applicable hose I.D./O.D.: **5/8 to 11/16**
- Port size: **M5 to 25A(3/4)**

S Coupler/Stainless Steel (Stainless Steel 304)

Series KKA

- Fluid: **Air, Water**
- Port size: **6A to 50A (1/8 to 11/2)**

Metal One-touch Fittings

Series KQB2

- Fluid: **Air, Water**
- Applicable tube O.D.: **ø3.2 to ø16**

Stainless Steel 316 One-touch Fittings

Series KQG2

- Fluid: **Air, Water, Steam**
- Applicable tube O.D.: **ø3.2 to ø16**

Stainless Steel 316 Insert Fittings

Series KFG2

- Fluid: **Air, Water, Steam**
- Applicable tube O.D.: **ø4 to ø16**

Fluoropolymer Fittings

Series LQ

- Fluid: **Deionized water, Chemicals, etc.** (Please contact SMC for details.)
- Applicable tube O.D.: **ø3 to ø25**

Tubing

Series T□

Series	Material	Fluid	O.D.
T	**Nylon**	Air, Water	**ø4 to ø16**
TU	**Polyurethane**	Air, Water	**ø4 to ø16**
TH	**FEP** (Fluoropolymer)	Air, Water, Inert gas	**ø4 to ø12**
TD	**Modified PTFE** (Soft fluoropolymer)	Air, Water, Inert gas	**ø4 to ø12**
TL	**Super PFA**	Deionized water, Chemicals, etc. Note)	**ø4 to ø19**

Length: Rolls up to 500 m in length are available, but please contact SMC for details because the maximum roll length varies depending on the tubing material and outer diameter. (Available with made-to-order specifications)

Note) Please contact SMC for details.

Temperature Control Equipment
Warranty

1. Conditions of warranty

When a nonconformance should take place to our temperature control equipment, we will repair the unit without charge in accordance with our current terms and conditions.

This free repair covers the replacement of all nonconforming parts, their adjustment and checks. Please note that the disassembled parts will be the property of SMC.

2. Period of warranty

The warranty period of the product is 1 year in service or 1.5 years after the product is delivered.

3. Items out of warranty

The following cases are not subject to warranty.

1. Nonconformance caused by implementing no check-up (daily check-up, regular check-up) specified by SMC.
2. Nonconformance caused by the usage other than stipulated in the operating manual or outside the specification designated by SMC.
3. Nonconformance caused by remodeling which is not permitted by SMC.
4. Nonconformance caused by the usage other than the specified circulating fluid or facility water.
5. Nonconformance caused by elapsing. (painted surface, plated surface discolored naturally)
6. Sensuous phenomenon which is not affected functionally (sound, noise, vibration, etc.)
7. Nonconformance caused by natural disasters such as earthquake, typhoon, water disaster, accidents, or fire hazard.
8. Nonconformance caused by the installation environment stipulated in the operating manual.
9. Nonconformance caused by no observation to the following 5, “Items to be observed by customer.”

4. Exemption from liability

1. Cost for daily check-up, regular check-up.
2. Cost for repair by a third party other than the designated distributors or agents.
3. Cost for moving this unit and installation or dislocation.
4. Cost for replacement or replenishment of the component parts or liquid other than specified.
5. Cost for inconvenience or loss caused by not being able to use the unit. (Telephone charge, warranty for job suspension, commercial loss, etc.)
6. Cost or compensation, etc. stipulated other than the above 1. “Conditions of warranty.”

5. Items to be observed by customer

In order to use this product safely, the correct usage and check-up by customer are necessary.

Please be sure to observe the following things. Please note that we may decline the repair request upon warranty in case that the following things are not observed.

1) Use the unit in accordance to the proper handling as mentioned in the Operation Manual.
2) Conduct inspection and maintenance (daily check-up, regular check-up) as mentioned in the Operation Manual.
3) Record the inspection and maintenance results as mentioned in the Operation Manual.

6. How to ask a repair upon warranty

When a warranty repair is requested, please contact the nearest sales distributor.

With this, we will repair the unit upon warranty.

We promise a repair for free on the basis of the above mentioned periods or terms. Therefore, nonconformance occurred after the warranty period will be charged in principle.

⚠ 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.

⚠ Caution: **Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

⚠ Warning: **Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.

⚠ Danger : **Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

*1) ISO 4414: Pneumatic fluid power – General rules relating to systems.
ISO 4413: Hydraulic fluid power – General rules relating to systems.
IEC 60204-1: Safety of machinery – Electrical equipment of machines.
(Part 1: General requirements)
ISO 10218-1: Manipulating industrial robots - Safety.
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 catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.
The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

3. 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. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.
1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.
3. An application which could have negative effects on people, property, or animals requiring special safety analysis.
4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

⚠Caution

1. The product is provided for use in manufacturing industries.
The product herein described is basically provided for peaceful use in manufacturing industries.
If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.
If anything is unclear, contact your nearest sales branch.

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.*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 catalog 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.

Temperature Control Equipment Precautions 1

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and the main text for Specific Product Precautions on every series.

Selection

⚠ Warning

1. Confirm the specifications.

Fully understand the applications, environment, fluids and other operating conditions. Use this product within the specified range shown in this catalog. Using outside the specified range can cause injury, damage, or malfunction. When in doubt, please contact SMC beforehand.

2. Secure the performance margin.

When you consider the product's cooling/heating performance or flow characteristics, allowance must be made because there are heat loss from the piping, etc. or pressure drop.

Operating Environment/Storage Environment

⚠ Warning

1. Observe the ambient temperature range.

The operating ambient temperature range must be within the specification range shown in this catalog.
Use caution because using beyond the range will lead to damage, breakage or malfunction.

2. Avoid using and storing in the following environment because it will lead to malfunction.

1. In locations where water, water steam, salt water, and oil may splash on the product.
2. In locations where a large amount of particles are airborne.
3. In locations with an atmosphere of corrosive or explosive gases, solvents, or chemicals.
   (This product is not explosion proof.)
4. In locations which receive direct sunlight or radiated heat.
   (Protect from direct sunshine to avoid the resin from deteriorating by ultraviolet rays or increasing the temperature.)
5. In locations where temperature substantially changes.
6. In locations where there is a heat source nearby and the ventilation is poor.
   (Insulate the heat source or ventilate well to avoid damages caused by the heat or temperature increase, such as softening.)
7. In locations where condensation occurs.
8. In locations where strong magnetic noise occurs.
   (In locations where strong electric fields, strong magnetic fields and surge voltage occur.)
9. In locations where static electricity occurs, or conditions which make the product discharge static electricity.
10. In locations where high frequency occurs.
11. In locations where damage is likely to occur due to lightning.
12. In locations where impacts or vibrations occur.
13. In conditions where a massive force strong enough to deform the product is applied or a weight from a heavy object is applied.
14. In locations more than 1000 m in altitude (except storage, transportation).

Fluid

⚠ Warning

1. Type of fluids

1. The operating fluids must be used within the specified range shown in this catalog.
   Please consult with SMC when using the product with other fluids.
2. Depending on the combination, foreign matter, chemical leakage and catalysts may change the piping material and operating fluid qualities.
3. When solid foreign objects may be mixed with a fluid, install a filter to remove them.

Transportation/Transfer/Movement

⚠ Warning

1. Product transfer should be performed by a knowledgeable and experienced person.

Especially, transferring a heavy object is dangerous.
Use adequate caution to prevent falling down or dropping accidents from occurring.

2. Avoid transportation in the following environment because it will lead to breakage.

1. In conditions where strong shock and vibrations occur.
2. In operating and storage environments other than those specified.

3. Caution when transferring a heavy object

This product is heavy. Use adequate caution to avoid injury when picking up and setting down the product, and falling and dropping accidents should be avoided.

4. Before moving this product, remove operating fluid, facility water from the inside of this product.

Mounting/Installation

⚠ Warning

1. Installation should be performed by a knowledgeable and experienced person.

Especially, installation of a heavy object is dangerous.
Use adequate caution to avoid falling and dropping accidents from occurring.

⚠ Caution

1. Provide space for ventilation and maintenance.

Provide enough space for the ventilation requirement of each equipment. Otherwise, a cooling malfunction or operation stoppage may occur. Also, provide space required for maintenance.

2. Verify the mounting orientation.

Mount and install horizontally.

Temperature Control Equipment Precautions 2

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and the main text for Specific Product Precautions on every series.

Piping

⚠ Warning

1. Design the piping for the whole system.

For this product and future equipment, design of the piping system should be performed by a knowledgeable and experienced person.

2. Work performed on the piping should be done by a knowledgeable and experienced person.

If work performed on the piping is done by a less knowledgeable and inexperienced person, it will likely lead to operating fluid leakage, etc.

3. Thoroughly read the Operation Manual.

Read the Operation Manual completely before piping. Also, keep the manual available whenever necessary.

4. Tighten threads with the proper tightening torque.

When installing piping, etc., follow the given torque levels below.

Piping Tightening Torque

Connection thread	Proper tightening torque (N·m)
M5	1.5 to 2
Rc 1/8	7 to 9
Rc 1/4	12 to 14
Rc 3/8	22 to 24
Rc 1/2	28 to 30
Rc 3/4	28 to 30
Rc 1	36 to 38
Rc 1 1/4	40 to 42
Rc 1 1/2	48 to 50
Rc 2	48 to 50

5. Confirm the leakage of fluid.

Confirm that the hose or tubing is not pulled out and that there is no leakage in the fitted parts.

⚠ Caution

1. Refer to the Fittings and Tubing Precautions (Best Pneumatics No. 6) for handling one-touch fittings.

2. Preparation before piping

Before piping is connected, it should be thoroughly blown out with air (flushing) or washed to remove chips, cutting oil and other debris from inside the pipe.

3. Use caution regarding the flowing direction of the fluid.

When installing piping to a product, do not mistake the flow direction of supply port, etc. Check “IN” and “OUT” or labels and the operating manual before connection.

4. Sealant tape

When installing piping or fitting into a port, ensure that sealant material does not enter the port internally. When using sealant tape, leave 1.5 to 2 threads exposed on the end of pipe/fitting.

5. Take countermeasures against condensation.

Depending on the operating condition, condensation may occur in the piping. In such a case, take countermeasures such as installing insulation material, etc.

Temperature Control Equipment Precautions 3

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and the main text for Specific Product Precautions on every series.

Electrical Wiring

⚠ Warning

1. Electrical wiring job should be performed by a knowledgeable and experienced person.

Power supply facilities and wiring works should be implemented in accordance with the electric facilities technical standards and provisions and conducted correctly.

2. Mounting a dedicated earth leakage breaker.

As a countermeasure against current leakage, install an earth leakage breaker in the main power supply.

3. Check the power supply.

If this product is used with voltages other than specified, it will likely lead to a fire or an electrical shock. Before wiring, confirm the voltage, volume, and frequency.
Confirm that the voltage fluctuation is within ±10% of the specified value.

4. Grounding

Be certain to ground (frame ground) with class D grounding (grounding resistance of 100 Ω or less).
Can be grounded with the PE line of the power supply cable.
Also, do not use together with equipment that generates a strong electrical magnetic noise or high frequency noise.

5. Wiring cable should be handled with care.

Do not bend, twist or stretch the cord or cable.

6. Wire with an applicable size cable and terminal.

In the event of attaching a power supply cable, use a cable and terminal size which is suitable for the electrical current of each product.
Forcibly mounting with an unsuitable size cable will likely result in a fire.

7. Avoid wiring the signal line and power line in parallel.

Since there may be a possibility of malfunction from noise, avoid parallel wiring between the temperature sensor line, communication line, signal line of alarm line, etc. and the power line and high voltage line. Also, do not place them in the same wiring tube.

Facility Water Supply
(Water-cooled refrigeration)

⚠ Warning

1. Be certain to supply the facility water.

1. Prohibition of water-cut operation, very little flow rate of water operation.
   Do not operate under the condition that there is no facility water or where there is very little flow rate of water is flowing. In this kind of operation, facility water temperature may become extremely higher. It is dangerous enough the material of hose may soften and burst when the piping supplying the facility water is connected with hose.
2. Actions to be taken when an emergency stop occurs due to high temperature.
   In case a stop occurs due to extremely high temperature resulting from a decrease in the facility water flow rate, do not immediately flow facility water. It is dangerous enough the material of hose may soften and burst when the piping supplying the facility water is connected with hose.
   First, naturally let it cool down by removing the cause of the flow rate reduction. Secondly, confirm that there is no leakage again.

⚠ Caution

1. Facility water quality

1. Use the facility water within the specified range as shown below.
   When using with other fluid than facility water, please consult with SMC.
2. When it is likely that foreign objects may enter the fluid, install a filter (20 mesh or equivalent).

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
Standard item	pH (at 25°C)	—	6.5 to 8.2
	Electrical conductivity (25°C)	[μS/cm]	100* to 800*
	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

* In the case of [MΩ•cm], it will be 0.00125 to 0.01.

Temperature Control Equipment Precautions 4

Be sure to read this before handling. Refer to back page 1 for Safety Instructions and the main text for Specific Product Precautions on every series.

Operation

⚠ Warning

1. Handle and operate after the safety of this product and the whole system are confirmed.

For this product and incidental equipment, operate this product by a knowledgeable and experienced person.

2. Before operation, confirm the safety of mounting, installation, piping and electrical wiring conditions.

1. Confirm that the mounting and installation conditions are safe.
2. Confirm that the circulating fluid is filled and that the fluid level is within the display range.
3. Confirm whether the valve is open or closed and that the hose and resin tube are not twisted.
   It is dangerous when the valve in the piping is closed because the circulating fluid and the facility water will not flow and the fluid pressure will increase.
4. Confirm the flow direction of the fluid.
   Be certain that the flow direction of the fluid (inlet/outlet direction) is connected correctly.
5. Confirm that the electrical wiring condition is safe.
   Incorrect wiring will lead to malfunction or breakage of the product. Confirm that there is no error in wiring before operation.
6. When using the product with a 3-phase power supply, confirm the connection.
   If the phase order is incorrect, the pump, etc. will run in reverse, or the phase-reversal relay will activate and the product will not operate.
   In this case, after cutting off the main power supply, reverse 2 wires out of the 3 wires and connect them in the correct phase order.

3. Do not remove the external panel during energization or operation.

If removed, there are the dangers of electrical shock, burn, frostbite, injury from a rotating object.

4. Avoid operating with a lower flow.

Avoid operating with a lower flow because the temperature control may become unstable or the service life of the pump may shorten.

5. Confirm the safety during the operation.

During the operation, if an emergency is detected, stop this product immediately and cut off the power supply breaker.

6. When not used for long periods of time, confirm the safety once again prior to beginning its operation.

Maintenance

⚠ Warning

1. Perform maintenance inspection according to the procedures indicated in the operating manual.

If handled improperly, malfunction and damage of machinery or equipment may occur.

2. Maintenance operations

Improper handling of compressed air is dangerous. Therefore, in addition to observing the product specifications, replacement of elements and other maintenance activities should be performed by personnel having sufficient knowledge and experience pertaining to pneumatic equipment.

3. Pre-maintenance inspection

When removing this product, cut off the electric power, and be certain to shut off the supply pressure and exhaust the compressed air in the system. Proceed only after confirming that all pressure has been released to the atmosphere.

4. Post maintenance inspection

After installation or repair, reconnect compressed air and electricity and conduct appropriate inspections to confirm proper operation. If there is an audible air leakage, or if the equipment does not operate properly, stop operation and confirm that the equipment is installed correctly.

5. Modification prohibited

Do not modify or reconstruct the unit.

6. Stopping for long periods of time

When not using for long periods of time, remove the fluid (circulating fluid, facility water) and cut off the main power supply.

7. Removal of product

Take the stop/inspection measures and confirm that there is no danger before the product is removed.
In the event of removing the product, discharge the used fluid and clean the inside of the piping.
When a dangerous fluid or polluted fluid is left, it is likely that the polluted area will be enlarged or an accident will occur.

8. Disposal of product

When the product is disposed, it must be in compliance the ordinance or rules of the local municipality.
Ask for help from a professional industrial waste disposal company.
In particularly, in the case of a refrigerated type product, entrust a company to collect the refrigerant, etc.
In that case, the customer may be requested to submit a certificate that is showing the type of operating fluid and whether any quantity is left. These procedures are the responsibility of the customer.

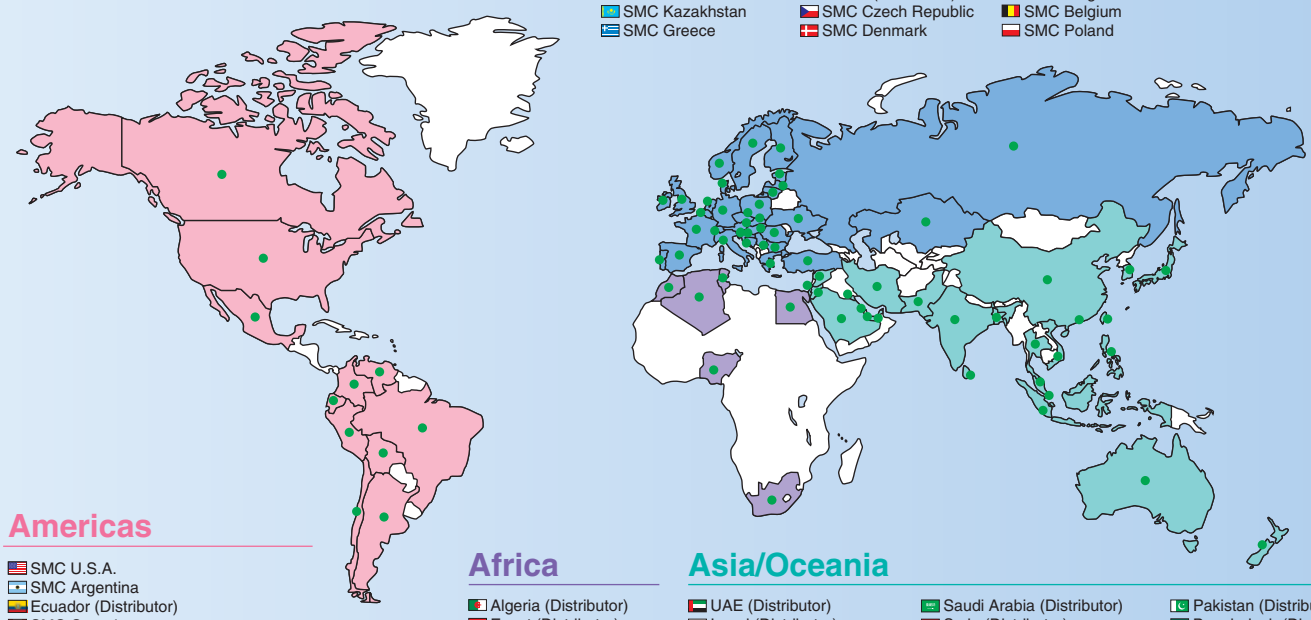
9. Preparation of a backup product

In order to keep the downtime of a customer's system to a minimum, prepare a backup product, when necessary.

360 sales bases in 78 countries. SMC's Global Service Network extends throughout the world.

Europe

- SMC Ireland
- SMC U.K.
- SMC Italy
- Ukraine (Distributor)
- SMC Estonia
- SMC Austria
- SMC Netherlands
- SMC Kazakhstan
- SMC Greece
- SMC Croatia
- SMC Switzerland
- SMC Sweden
- SMC Spain
- SMC Slovakia
- SMC Slovenia
- Serbia (Distributor)
- SMC Czech Republic
- SMC Denmark
- SMC Germany
- SMC Turkey
- SMC Norway
- SMC Hungary
- SMC Finland
- SMC France
- SMC Bulgaria
- SMC Belgium
- SMC Poland
- Bosnia and Herzegovia (Distributor)
- SMC Portugal
- SMC Latvia
- SMC Lithuania
- SMC Romania
- SMC Russia



Americas

- SMC U.S.A.
- SMC Argentina
- Ecuador (Distributor)
- SMC Canada
- SMC Colombia
- SMC Chile
- SMC Brazil
- SMC Venezuela
- Peru (Distributor)
- SMC Bolivia
- SMC Mexico

Africa

- Algeria (Distributor)
- Egypt (Distributor)
- Tunisia (Distributor)
- Nigeria (Distributor)
- South Africa (Distributor)
- Morocco (Distributor)

Asia/Oceania

- UAE (Distributor)
- Israel (Distributor)
- Iran (Distributor)
- SMC India
- Indonesia (Distributor)
- SMC Australia
- Qatar (Distributor)
- SMC Korea
- Kuwait (Distributor)
- Saudi Arabia (Distributor)
- Syria (Distributor)
- SMC Singapore
- Sri Lanka (Distributor)
- SMC Thailand
- SMC Taiwan
- SMC China
- SMC New Zealand
- Bahrain (Distributor)
- Pakistan (Distributor)
- Bangladesh (Distributor)
- Shoketsu SMC Philippines
- Viet Nam (Distributor)
- SMC Hong Kong
- SMC Malaysia
- Jordan (Distributor)
- SMC Japan

Yamatsuri Plant (Fukushima Prefecture)

SMC's temperature control equipment has been efficiently manufactured with SMC's originally developed, integrated production system at Yamatsuri Plant.

Integrated chiller production line at Yamatsuri Plant

Revision history

Edition B
- Addition of the inverter type to Water-cooled Thermo-chiller, HRW series.
- Addition of the 140 W and 320 W types to Thermo-con (water-cooled), HEC series.
- Addition of the 600 W type to Thermo-con (air-cooled), HEC series.
- Addition of an option (NPT fitting) and optional accessories (60% ethylene glycol aqueous solution, concentration meter) to Thermo-chillers, HRZ and HRW series.
- Addition of deionized water and 15% ethylene glycol aqueous solution as circulating fluids for Thermo-cooler, HRGC series. MY

Edition C
- Addition of Thermo-chiller compact type, HRS series.
- Addition of options and optional accessories to Thermo-cooler HRGC series.
- Addition of Dual Thermo-chiller, HRZD series. PP

SMC Corporation

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D-DN

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