Circulating Fluid Temperature Controller

Thermo-chiller Standard Type

Lightweight and Compact

Cooling capacity 9 kW

Weight 136 kg

Temperature stability ±0.5 °C (when a load is stable)

Set temperature range 5 °C to 35 °C

Max. ambient temperature 45 °C

Indoor use

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

- 3-phase 400 V

Water-cooled refrigeration
Air-cooled refrigeration

With heating function

Heating method using discharged heat makes a heater unnecessary.

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

Self diagnosis function and check display
41 types of alarm codes

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

Easy maintenance
Tool-less maintenance of filter

Environmental friendly R410A as refrigerant

Series HRS090

CAT.EUS40-64A-UK
The precision temperature control method by expansion valve and temperature sensor, realized high temperature stability of ±0.5 °C and a small-size tank.

Conventional multiple air-cooled condensers are arranged one above the other. Achieved a maximum reduction in the height of the product while expanding the cooling capacity, by providing overlapped air-cooled condensers.

Compact and lightweight

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

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

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

Reduction-height double condenser structure

Conventional multiple air-cooled condensers are arranged one above the other. Achieved a maximum reduction in the height of the product while expanding the cooling capacity, by providing overlapped air-cooled condensers.

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

Current model

Heating functions are required to maintain a constant temperature particularly in the winter when the ambient temperature is low.

Simple operation

Step 1 Press the key.
Step 2 Adjust the temperature setting with the keys.
Step 3 Press the key to stop.

Easy operation by these steps

Large digital display

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

Easy cleaning of the tank

An opening with a cap is included separately from the water inlet. Opening diameter: Ø 110

Easy check of the circulating fluid level

Tool-less inspection and cleaning of air-cooled condenser

For air-cooled refrigeration

Dustproof filter

It can be removed with no tools.

Easy to clean dust and cutting chips etc. stuck to the dustproof net with a brush or air blow.

With heating function

Heating method using discharged heat makes a heater unnecessary.

Temperature increase with heating capacity (Ambient temperature 32°C/50 Hz)

Circulating fluid temperature

Heating functions are required to maintain a constant temperature particularly in the winter when the ambient temperature is low.

Tank lid

The angled supply port facilitates the supply of circulating fluid.

Filter for circulating fluid fill port (Optional accessory on page 18)

After supplying the circulating fluid, the tank lid can be closed with the filter mounted.

Anchor bolt fixing bracket

Remove bracket when moving, using casters.

With unfixed caster

Rotation

Locking lever (front wheels only)

Filter for circulating fluid fill port

(Optional accessory on page 18)

Easy to clean dust and cutting chips etc. stuck to the dustproof net with a brush or air blow.

Ventilation

Dustproof filter

∗ For air-cooled refrigeration

It can be removed with no tools.

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It can be removed with no tools.

Easy to clean dust and cutting chips etc. stuck to the dustproof net with a brush or air blow.
Power supply (24 V DC) available

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

Globally compatible power supplies

(Europe, Asia, Oceania, Central and South America)

Transformer unnecessary

**Power supply** Applicable 380 to 415 V AC
Transformers are unnecessary even when used overseas.

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

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

  **Ex.** SE.02 “ON timer”

- **Unit conversion function**
  Temperature and pressure units can be changed.

  Orange indicator lights up.

- **Power failure auto-restart function**
  Automatic restart from stoppage due to power failure etc. is possible without pressing the key and remote operation.

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

- **Key-lock function**
  Can be set in advance to protect the set values from being changed by pressing keys by mistake.

- **Function to output a signal for completion of preparation**
  Notifies by communication when the temperature reaches the pre-set temperature range.

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

Electric conductivity control set

(With DI filter + Solenoid valve kit for control) (Optional accessory on page 17)

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

**Set control range:** 5.0 to 45.0 μS/cm

Particle filter set

(Optional accessory on page 17)

Removes foreign matter in the circulating fluid.

**Circulating Fluid Temperature Controller**

**Thermo-chiller** Standard Type

**Series HRS090**

**Step-down transformer**

380 V AC → 200 V AC

380 to 415 V AC

**Current model**

**HRS090**

**Power supply** (24 V DC) available

**Flow switch** Refer to page 7.

**Circulating fluid return port**

**Solenoid valve for control**

**Circulating fluid outlet**

**DI filter**

**Convenient functions**

- **Power supply (24 V DC) available**
  Power can be supplied from the terminal block on the rear side to external switches etc.

- **Globally compatible power supplies**
  (Europe, Asia, Oceania, Central and South America)

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  **HRS090**

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**Circulating Fluid Temperature Controller**

**Thermo-chiller** Standard Type

**Series HRS090**

**Power supply** (24 V DC) available

**Flow switch** Refer to page 7.

**Circulating fluid return port**

**Solenoid valve for control**

**Circulating fluid outlet**

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- **Independent operation of the pump**
  The pump can be operated independently while chiller is powered off. You can check piping leak and remove the air.
**Self diagnosis function and check display**

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

### Changeable alarm set values

<table>
<thead>
<tr>
<th>Setting item</th>
<th>Set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circulating fluid discharge temperature rise</td>
<td>5 to 55 °C</td>
</tr>
<tr>
<td>Circulating fluid discharge temperature drop</td>
<td>1 to 34 °C</td>
</tr>
<tr>
<td>Circulating fluid discharge pressure rise</td>
<td>0.05 to 0.6 MPa</td>
</tr>
<tr>
<td>Circulating fluid discharge pressure drop</td>
<td>0.05 to 0.6 MPa</td>
</tr>
</tbody>
</table>

**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.

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

**Ex. AL01 “Low level in tank”**

**Ex. AL28 “Pump maintenance”**

**Ex. drv. “Accumulated operating time”**

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

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

**Communication function**

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

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

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

**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.

1. Output 1: Temperature rise
2. Output 2: Pressure rise
3. Output 3: Operation status (start, stop, etc.)
### Applications

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<thead>
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<th>Description</th>
<th>Notes</th>
</tr>
</thead>
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<td>Laser beam machine/ Laser welding machine</td>
<td>Cooling of the laser oscillation part and power source</td>
<td></td>
</tr>
<tr>
<td>X-ray (digital) instrument</td>
<td>Temperature control of X-ray tube and X-ray light sensing part</td>
<td></td>
</tr>
<tr>
<td>Arc welding machine</td>
<td>Cooling of the torch</td>
<td></td>
</tr>
<tr>
<td>Resistance welding machine (spot welding)</td>
<td>Cooling of the welding head electrodes, transformers and transistors (thyristors)</td>
<td></td>
</tr>
<tr>
<td>Packaging line (sealing of film and paper package)</td>
<td>Cooling of workpieces for bonding</td>
<td></td>
</tr>
<tr>
<td>Injection molding</td>
<td>Temperature control of sample and device</td>
<td></td>
</tr>
<tr>
<td>Atomizing device (food and cosmetics)</td>
<td>Temperature control of sample and device</td>
<td></td>
</tr>
<tr>
<td>Cleaning machine</td>
<td>Temperature control of cleaning solution</td>
<td></td>
</tr>
<tr>
<td>MRI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atomizing device</td>
<td>Temperature control of sample and device</td>
<td></td>
</tr>
<tr>
<td>Crushing machine</td>
<td>Cooling of the jacket</td>
<td></td>
</tr>
</tbody>
</table>
Global Supply Network

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

SMC Thermo-chiller Variations

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

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

* Only available for lower cooling capacities.
Flow Switch: Monitors flow rate and temperature of the circulating fluid. Refer to the catalogues on www.smc.eu.

Pressure Switch: Monitors pressure of the circulating fluid. Refer to the catalogues on www.smc.eu.

Fittings and Tubing: Refer to the catalogues on www.smc.eu.

Series | Material
---|---
T | Nylon
TU | Polyurethane
TH | FEP (Fluoropolymer)
TD | Modified PTFE (Soft fluoropolymer)
TL | Super PFA
TLM | PFA
CONTENTS
Series HRS090 Standard Type

Thermo-chiller Series HRS090

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<th>HRS090-A</th>
<th>40</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling method</td>
<td>Air-cooled refrigeration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refrigerant</td>
<td>R410A (HFC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control method</td>
<td>PID control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>5 to 45 °C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circulating fluid temperature</td>
<td>5 to 35 °C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling capacity</td>
<td>090 kW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating capacity</td>
<td>50/60 Hz / 4/2.2 kW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature stability</td>
<td>±0.5 °C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump capacity</td>
<td>Rated flow 50/60 Hz (Outlet)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum flow rate 50/60 Hz</td>
<td>29/45 l/min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum pump head</td>
<td>55/68 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum operating flow rate 50/60 Hz</td>
<td>29/45 l/min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tank capacity</td>
<td>18 L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circulating fluid outlet, circulating fluid return port</td>
<td>Rc 1 (Symbol F: G 1, Symbol N: NPT 1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tank drain port</td>
<td>Rc 1/4 (Symbol F: G 1/4, Symbol N: NPT 1/4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid contact material</td>
<td>Stainless steel, Copper (Heat exchanger brazing), Brass, Bronze, PTFE, FKM, EPDM, PVC, NBR, POM, PE, PP, Carbon, Ceramic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>3-phase 380 to 415 V AC (50/60 Hz)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applicable earth leakage breaker (Standard)</td>
<td>Rated current</td>
<td>20 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sensitivity of leak current</td>
<td>30 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated operating current 50/60 Hz</td>
<td>6.4/4.1 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated power consumption 50/60 Hz</td>
<td>4.4/5.6 (5.8/6.3) kW (kVA)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise level (Front 1 m/Height 1 m)</td>
<td>75 dB (A)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessories</td>
<td>Alarm code list stickers 2 pcs. (English 1 pc./Japanese 1 pc.), Operation Manual (for installation/operation) 2 pcs. (English 1 pc./Japanese 1 pc.), Y-strainer (40 meshes) 25A, Barrel nipple 25A, Anchor bolt fixing brackets 2 pcs. (including four M10 bolts)*9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (dry state)</td>
<td>Approx. 136 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 Use a 15 % ethylene glycol aqueous solution if operating in a place where the ambient temperature and/or circulating fluid temperature is 10 °C or less.

*2 Use fluid in condition below as the circulating fluid.

- Tap water: Standard of The Japan Refrigeration And Air Conditioning Industry Association (JRA GL-02-1994)
- 15 % ethylene glycol aqueous solution: diluted by tap water in condition above without any additives such as antiseptics.
- Deionized water: Electric conductivity 1 μS/cm or higher (Electric resistivity 1 MΩ·cm or lower)


*6 When circulating fluid outlet port pressure = 0.5 MPa.

*7 Fluid flow rate to maintain the cooling capacity and to keep the circulating fluid discharge pressure to 0.5 MPa or less. If the actual flow rate is lower than this, install a bypass piping.

*8 The anchor bolt fixing brackets (including four M10 bolts) are used for fixing to wooden skids when packaging the thermo-chiller. No anchor bolt is included.
Use fluid in condition below as the circulating fluid. Also, when there is a possibility of the facility water being frozen, make sure to discharge all the facility water from the facility water circuit.

Anchor bolt fixing brackets (including four M10 bolts) are used for fixing to wooden skids when packaging the thermo-chiller. No anchor bolt is included.

To be prepared by user. A specified earth leakage breaker is installed for option B [With earth leakage breaker].

<table>
<thead>
<tr>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Circulating fluid</strong></td>
</tr>
<tr>
<td><strong>Circuiting fluid</strong></td>
</tr>
<tr>
<td>Tap water, 15% ethylene glycol aqueous solution, Deionized water</td>
</tr>
<tr>
<td><strong>Temperature stability</strong></td>
</tr>
<tr>
<td>5 to 35°C</td>
</tr>
<tr>
<td><strong>Heating capacity</strong></td>
</tr>
<tr>
<td>9.0 to 10.5 kW</td>
</tr>
<tr>
<td><strong>Cooling capacity</strong></td>
</tr>
<tr>
<td>1.7 to 2.2 kW</td>
</tr>
<tr>
<td><strong>Rated flow 50/60 Hz (Outlet)</strong></td>
</tr>
<tr>
<td>29 to 45 l/min</td>
</tr>
<tr>
<td><strong>Maximum flow rate 50/60 Hz</strong></td>
</tr>
<tr>
<td>55 to 68 l/min</td>
</tr>
<tr>
<td><strong>Maximum pump head</strong></td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td><strong>Minimum operating flow rate 50/60 Hz</strong></td>
</tr>
<tr>
<td>29 to 45 l/min</td>
</tr>
<tr>
<td><strong>Tank capacity</strong></td>
</tr>
<tr>
<td>18 L</td>
</tr>
<tr>
<td><strong>Tank drain port</strong></td>
</tr>
<tr>
<td>Rc 1/2 (Symbol F: G 1/2, Symbol N: NPT 1/2)</td>
</tr>
<tr>
<td><strong>Fluid contact material</strong></td>
</tr>
<tr>
<td>Stainless steel, Copper (Heat exchanger brazing), Brass, Bronze, PTFE, FKM, EPDM, PVC, NBR, POM, PE, PP, Carbon, Ceramic</td>
</tr>
<tr>
<td><strong>Pipe thread type</strong></td>
</tr>
<tr>
<td>F G (with Rc-G conversion fitting)</td>
</tr>
<tr>
<td>N NPT (with Rc-NPT conversion fitting)</td>
</tr>
<tr>
<td><strong>Electrical system</strong></td>
</tr>
<tr>
<td><strong>Rated current</strong></td>
</tr>
<tr>
<td>20 A</td>
</tr>
<tr>
<td><strong>Sensitivity of leak current</strong></td>
</tr>
<tr>
<td>30 mA</td>
</tr>
<tr>
<td><strong>Rated operating current 50/60 Hz</strong></td>
</tr>
<tr>
<td>6.4 to 6.7 A</td>
</tr>
<tr>
<td><strong>Rated power consumption 50/60 Hz</strong></td>
</tr>
<tr>
<td>3.4 to 4.2 (4.4 to 4.7) kW (kVA)</td>
</tr>
<tr>
<td><strong>Noise level (Front 1 m/Height 1 m)</strong></td>
</tr>
<tr>
<td>65 dB (A)</td>
</tr>
<tr>
<td><strong>Accessories</strong></td>
</tr>
</tbody>
</table>
| Alarm code list stickers 2 pcs. (English 1 pc./Japanese 1 pc.), Operation Manual (for installation/operation) 2 pcs. (English 1 pc./Japanese 1 pc.), Y-strainer (40 meshes) 25A, Barrel nipple 25A, Anchor bolt fixing brackets 2 pcs. (including four M10 bolts)

When multiple options are combined, indicate symbols in alphabetical order. Provided with an earth leakage breaker as standard.
Series HRS090 Standard Type

Cooling Capacity

HRS090-A-40 (50 Hz)

HRS090-A-40 (60 Hz)

HRS090-W-40 (50 Hz)

HRS090-W-40 (60 Hz)

Pump Capacity

HRS090-A-40
HRS090-W-40
For water-cooled type

Accessory: Y-strainer mounting view

* Mount it by yourself on the circulating fluid return port.
Operation Display Panel

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

List of Function

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

Alarm

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Alarm message</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL01</td>
<td>Low level in tank</td>
</tr>
<tr>
<td>AL02</td>
<td>High circulating fluid discharge temp.</td>
</tr>
<tr>
<td>AL03</td>
<td>Circulating fluid discharge temp. rise</td>
</tr>
<tr>
<td>AL04</td>
<td>Circulating fluid discharge temp. drop</td>
</tr>
<tr>
<td>AL05</td>
<td>High circulating fluid return temp.</td>
</tr>
<tr>
<td>AL06</td>
<td>High circulating fluid discharge pressure</td>
</tr>
<tr>
<td>AL07</td>
<td>Abnormal pump operation</td>
</tr>
<tr>
<td>AL08</td>
<td>Circulating fluid discharge pressure rise</td>
</tr>
<tr>
<td>AL09</td>
<td>Circulating fluid discharge pressure drop</td>
</tr>
<tr>
<td>AL10</td>
<td>High compressor intake temp.</td>
</tr>
<tr>
<td>AL11</td>
<td>Low compressor intake temp.</td>
</tr>
<tr>
<td>AL12</td>
<td>Low super heat temp.</td>
</tr>
<tr>
<td>AL13</td>
<td>High compressor discharge pressure</td>
</tr>
<tr>
<td>AL15</td>
<td>Refrigeration circuit pressure (high pressure side) drop</td>
</tr>
<tr>
<td>AL16</td>
<td>Refrigeration circuit pressure (low pressure side) drop</td>
</tr>
<tr>
<td>AL17</td>
<td>Refrigeration circuit pressure (low pressure side) drop</td>
</tr>
<tr>
<td>AL18</td>
<td>Compressor running failure</td>
</tr>
<tr>
<td>AL19</td>
<td>Communication error</td>
</tr>
<tr>
<td>AL20</td>
<td>Memory error</td>
</tr>
<tr>
<td>AL21</td>
<td>Dc time fuse cut</td>
</tr>
<tr>
<td>AL22</td>
<td>Circulating fluid discharge pressure sensor failure</td>
</tr>
<tr>
<td>AL23</td>
<td>Circulating fluid return pressure sensor failure</td>
</tr>
<tr>
<td>AL24</td>
<td>Compressor intake temp. sensor failure</td>
</tr>
<tr>
<td>AL25</td>
<td>Circulating fluid discharge pressure sensor failure</td>
</tr>
<tr>
<td>AL26</td>
<td>Compressor discharge pressure sensor failure</td>
</tr>
<tr>
<td>AL27</td>
<td>Compressor intake pressure sensor failure</td>
</tr>
<tr>
<td>AL28</td>
<td>Pump maintenance</td>
</tr>
<tr>
<td>AL29</td>
<td>Fan maintenance</td>
</tr>
<tr>
<td>AL30</td>
<td>Compressor maintenance</td>
</tr>
<tr>
<td>AL31</td>
<td>Contact input 1 signal detection</td>
</tr>
<tr>
<td>AL32</td>
<td>Contact input 2 signal detection</td>
</tr>
<tr>
<td>AL33</td>
<td>Compressor discharge temp. sensor failure</td>
</tr>
<tr>
<td>AL34</td>
<td>Compressor discharge temp. rise</td>
</tr>
<tr>
<td>AL35</td>
<td>Dustproof filter maintenance Note)</td>
</tr>
<tr>
<td>AL36</td>
<td>Power stoppage</td>
</tr>
<tr>
<td>AL37</td>
<td>Compressor discharge temp. sensor failure</td>
</tr>
<tr>
<td>AL38</td>
<td>Compressor discharge temp. rise</td>
</tr>
<tr>
<td>AL39</td>
<td>Compressor discharge temp. sensor failure</td>
</tr>
<tr>
<td>AL40</td>
<td>Dustproof filter maintenance Note)</td>
</tr>
<tr>
<td>AL41</td>
<td>Fan failure Note)</td>
</tr>
<tr>
<td>AL42</td>
<td>Compressor waiting</td>
</tr>
<tr>
<td>AL43</td>
<td>Fan failure Note)</td>
</tr>
<tr>
<td>AL44</td>
<td>Compressor over current</td>
</tr>
<tr>
<td>AL45</td>
<td>Pump over current</td>
</tr>
<tr>
<td>AL46</td>
<td>Incorrect phase error</td>
</tr>
<tr>
<td>AL47</td>
<td>Phase board over current Note)</td>
</tr>
</tbody>
</table>


For details, refer to the Operation Manual. Please download it via our website, [http://www.smc.eu](http://www.smc.eu)
Communication Function

Contact Input/Output

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Connector type</strong></td>
<td>M3 terminal block</td>
</tr>
<tr>
<td><strong>Insulation method</strong></td>
<td>Photocoupler</td>
</tr>
<tr>
<td><strong>Rated input voltage</strong></td>
<td>24 V DC</td>
</tr>
<tr>
<td><strong>Operating voltage range</strong></td>
<td>21.6 to 26.4 V DC</td>
</tr>
<tr>
<td><strong>Rated input current</strong></td>
<td>5 mA TYP</td>
</tr>
<tr>
<td><strong>Input impedance</strong></td>
<td>4.7 kΩ</td>
</tr>
<tr>
<td><strong>Rated load voltage</strong></td>
<td>48 V AC or less/30 V DC or less</td>
</tr>
<tr>
<td><strong>Maximum load current</strong></td>
<td>500 mA AC/DC (resistance load)</td>
</tr>
<tr>
<td><strong>Minimum load current</strong></td>
<td>5 V DC 10 mA</td>
</tr>
<tr>
<td><strong>Output voltage</strong></td>
<td>24 V DC ±10 % 500 mA MAX (No inductive load)</td>
</tr>
</tbody>
</table>

Circuit diagram

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

Serial Communication

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

### Writing
- Run/Stop
- Circulating fluid temperature setting (SV)

### Readout
- Circulating fluid present temperature
- Circulating fluid discharge pressure
- Status information
- Alarm occurrence information

Circuit diagram

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

Please download the Operation Manual via our website, http://www.smc.eu
**Series HRS090 Options**

---

**J** Option symbol

**With Automatic Fluid Fill Function**

**HRS090-□□-□-J**

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

<table>
<thead>
<tr>
<th>Applicable model</th>
<th>HRS090-□□-□-J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid fill method</td>
<td>Built-in solenoid valve for automatic fluid filling</td>
</tr>
<tr>
<td>Fluid fill pressure [MPa]</td>
<td>0.2 to 0.5</td>
</tr>
<tr>
<td>Feed water temperature [°C]</td>
<td>5 to 40</td>
</tr>
</tbody>
</table>

---

**M** Option symbol

**Applicable to Deionised Water Piping**

**HRS090-□□-□-M**

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

Contact material for circulating fluid:
- Stainless steel (including heat exchanger brazing), SiC, Carbon, PP, PE, POM, FKM, NBR, EPDM, PVC, PTFE

*No change in external dimensions.*

---

Note) Select the option when ordering the thermo-chiller because the option cannot be added after purchasing the unit.
Series HRS090
Optional Accessories

1 Piping Conversion Fitting

This is a fitting to change the port from Rc to G or NPT.
- Circulating fluid outlet, Circulating fluid return port Rc 1 → NPT 1 or G 1
- Drain port Rc 1/4 → NPT 1/4 or G 1/4

(It is not necessary to purchase this when pipe thread type F or N is selected in “How to Order” since it is included in the product.)

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Contents</th>
<th>Applicable model</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRS-EP018</td>
<td>NPT thread conversion fitting set</td>
<td>HRS090-A-40</td>
</tr>
<tr>
<td>HRS-EP019</td>
<td>G thread conversion fitting set</td>
<td>HRS090-W-40</td>
</tr>
</tbody>
</table>

When option J (With automatic fluid fill function) is included, use the following part numbers.
- Automatic fluid fill port Rc 3/8 → NPT 3/8 or G 3/8
- Overflow port Rc 3/4 → NPT 3/4 or G 3/4

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

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Contents</th>
<th>Applicable model</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRS-EP021</td>
<td>G thread conversion fitting set</td>
<td></td>
</tr>
</tbody>
</table>

2 Bypass Piping Set

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

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Applicable model</th>
<th>Minimum operating flow rate (50/60 Hz) [l/min]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRS-BP005</td>
<td>HRS090-□□-40</td>
<td>29/45</td>
</tr>
</tbody>
</table>

Parts List

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hose (I.D.: 15 mm, Length: 700 mm)</td>
</tr>
<tr>
<td>2</td>
<td>Outlet piping assembly (With globe valve)</td>
</tr>
<tr>
<td>3</td>
<td>Return piping assembly</td>
</tr>
<tr>
<td>4</td>
<td>Barrel nipple (Size: 1 inch) (2 pcs.)</td>
</tr>
<tr>
<td>5</td>
<td>Union (Size: 1 inch) (2 pcs.)</td>
</tr>
<tr>
<td>6</td>
<td>Sealant tape</td>
</tr>
<tr>
<td>7</td>
<td>Operation Manual</td>
</tr>
</tbody>
</table>
3 Electric Conductivity Control Set

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

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Description</th>
<th>Material</th>
<th>Q’ty</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRS-DI007</td>
<td></td>
<td>PC, PP</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>HRS090-□□-40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

4 Particle Filter Set

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

**Particle Filter Set**

**HRS-PF005-** [*H*]

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Accessory</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>—</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td><em>H</em></td>
<td>With handle</td>
<td></td>
</tr>
</tbody>
</table>

**Replacement Element**

**HRS-PF006**

---

**Parts List**

- **No.**
- **Description**
- **Material**
- **Q’ty**
- **Note**

**DI filter vessel (resin)**

**Element**

**DI filter inlet tube**

**DI filter outlet tube**

**Tapping screw (4 pcs.)**

**Mounting screw (4 pcs.)**

**DI control piping assembly**

**DI sensor assembly**

**Nipple (2 pcs.)**

**DI filter cartridge** (Part no.: HRS-DF001)

---

**DI filter cartridge**

**Electric Conductivity Control Set**

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

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Material</th>
<th>Q’ty</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Body</td>
<td>PC, PP</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Element</td>
<td>PP</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Extension piece</td>
<td>Stainless steel</td>
<td>2</td>
<td>Conversion from NPT to Rc</td>
</tr>
<tr>
<td>4</td>
<td>Handle</td>
<td>—</td>
<td>1</td>
<td>When -H is selected</td>
</tr>
<tr>
<td>5</td>
<td>Sealant tape</td>
<td>PTFE</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
Filter for Circulating Fluid Fill Port

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

**Filter for circulating fluid fill port**

**HRS-PF007**

<table>
<thead>
<tr>
<th>Material</th>
<th>Stainless steel 304, Stainless steel 316</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesh size</td>
<td>200</td>
</tr>
</tbody>
</table>

"After supplying the circulating fluid, the tank lid can be closed with the filter mounted."
Series HRS090

Cooling Capacity Calculation

Required Cooling Capacity Calculation

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

1. Derive the heat generation amount from the power consumption.
   - Power consumption \( P \): 7 [kW]
   
   \[
   Q = P = 7 \text{ [kW]}
   \]
   
   Cooling capacity = Considering a safety factor of 20 %, \( 7 \text{ [kW]} \times 1.2 = 8.4 \text{ [kW]} \)

2. Derive the heat generation amount from the power supply output.
   - Power supply output \( VI \): 8.8 [kVA]
   
   \[
   Q = P = V \times I \times \text{Power factor}
   \]
   In this example, using a power factor of 0.85:
   
   \[
   = 8.8 \text{ [kVA]} \times 0.85 = 7.5 \text{ [kW]}
   \]
   
   Cooling capacity = Considering a safety factor of 20 %, \( 7.5 \text{ [kW]} \times 1.2 = 9.0 \text{ [kW]} \)

3. Derive the heat generation amount from the output.
   - Output (shaft power etc.) \( W \): 13 [kW]
   
   \[
   Q = P = \frac{W}{\text{Efficiency}}
   \]
   In this example, using an efficiency of 0.7:
   
   \[
   = \frac{13}{0.7} = 7.3 \text{ [kW]}
   \]
   
   Cooling capacity = Considering a safety factor of 20 %, \( 7.3 \text{ [kW]} \times 1.2 = 8.8 \text{ [kW]} \)

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

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

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

- Heat generation amount by user’s equipment \( Q \) : Unknown [W] ([J/s])
- Circulating fluid : Tap water
- Circulating fluid mass flow rate \( qm \) : \( \left( \frac{\rho \times qv}{60} \right) \) [kg/s]
- Circulating fluid density \( \rho \) : 1 [kg/L]
- Circulating fluid (volume) flow rate \( qv \) : 35 [l/min]
- Circulating fluid specific heat \( C \) : 1.0 x 10³ [J/(kg·°C)]
- Circulating fluid outlet temperature \( T_1 \) : 293 [K] (20 °C)
- Circulating fluid return temperature \( T_2 \) : 296 [K] (23 °C)
- Circulating fluid temperature difference \( \Delta T \) : 3 [K] (\( T_2 \) – \( T_1 \))

Conversion factor: minutes to seconds (SI units) : 60 [s/min]

\[
Q = qm \times C \times (T_2 – T_1)
\]

\[
= \frac{\rho \times qv \times C \times \Delta T}{60} = \frac{1 \times 35 \times 4.186 \times 10^3 \times 3.0}{60} = 7325 \text{ [J/s]} = 7325 \text{ [W]} = 7.3 \text{ [kW]}
\]

Cooling capacity = Considering a safety factor of 20 %, \( 7.3 \text{ [kW]} \times 1.2 = 8.8 \text{ [kW]} \)

Example of conventional measurement units (Reference)

- Heat generation amount by user’s equipment \( Q \) : Unknown [cal/h] → [W]
- Circulating fluid : Tap water
- Circulating fluid weight flow rate \( qm \) : \( \left( \frac{\rho \times qv}{60} \right) \) [kgf/h]
- Circulating fluid weight volume ratio \( qv \) : 1 [kgf/L]
- Circulating fluid specific heat \( C \) : 1.0 x 10³ [cal/(kg·°C)]
- Circulating fluid outlet temperature \( T_1 \) : 20 [°C]
- Circulating fluid return temperature \( T_2 \) : 23 [°C]
- Circulating fluid temperature difference \( \Delta T \) : 3 [°C] (\( T_2 \) – \( T_1 \))

Conversion factor: hours to minutes : 60 [min/h]
Conversion factor: kcal/h to kW : 860 [(cal/h)/W]

\[
Q = \frac{q_m \times C \times (T_2 – T_1)}{860}
\]

\[
= \frac{1 \times 35 \times 1.0 \times 10^3 \times 3.0}{860} = 7325 \text{ [W]} = 7.3 \text{ [kW]}
\]

Cooling capacity = Considering a safety factor of 20 %, \( 7.3 \text{ [kW]} \times 1.2 = 8.8 \text{ [kW]} \)
Required Cooling Capacity Calculation

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

Heat quantity by cooled substance (per unit time) \( Q \) : Unknown [\( W \)] (\( [J/s] \))

Cooled substance : Water

Cooled substance mass \( m \) : \( (= p \times V) \) [kg]

Cooled substance density \( \rho \) : 1 [kg/L]

Cooled substance total volume \( V \) : 150 [L]

Cooled substance specific heat \( C \) : 4.186 \times 10^3 [J/(kg·K)]

Cooled substance temperature when cooling begins \( T_0 \) : 303 [K] (30 [°C])

Cooled substance temperature after \( t \) hour \( T_t \) : 293 [K] (20 [°C])

Cooling temperature difference \( \Delta T \) : 10 [K] (= \( T_0 - T_t \))

Cooling time \( \Delta t \) : 900 [s] (= 15 [min])

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

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

Cooling capacity = Considering a safety factor of 20 %,

\[ 7.0 \ [kW] \times 1.2 = 8.4 \ [kW] \]

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. Check the radiation rate and heat capacity of the user's equipment and check beforehand if the required heating capacity is provided.

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

   <Circulating fluid discharge pressure>
   Circulating fluid discharge pressure has the possibility to increase up to the maximum pressure in the pump capacity curves. Check beforehand if the circulating fluid pipings or circulating fluid circuit of the user's equipment are fully durable against this pressure.

Circulating Fluid Typical Physical Property Values

1. This catalogue uses the following values for density and specific heat in calculating the required cooling capacity.
   Density \( \rho \): 1 [kg/L] (or, using conventional unit system, weight volume ratio \( \gamma = 1 \) [kgf/L])
   Specific heat \( C \): 4.19 \times 10^3 [J/(kg·K)] (or, using conventional unit system, \( 1 \times 10^3 \) [cal/(kgf·°C)])

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

<table>
<thead>
<tr>
<th>Temperature ( ^\circ C )</th>
<th>Density ( \rho ) [kg/L]</th>
<th>Specific heat ( C ) [J/(kg·K)]</th>
<th>Conventional unit system</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 ( ^\circ C )</td>
<td>1.00</td>
<td>4.2 \times 10^3</td>
<td>1.00 \times 10^4</td>
</tr>
<tr>
<td>10 ( ^\circ C )</td>
<td>1.00</td>
<td>4.19 \times 10^3</td>
<td>1.00 \times 10^4</td>
</tr>
<tr>
<td>15 ( ^\circ C )</td>
<td>1.00</td>
<td>4.18 \times 10^3</td>
<td>1.00 \times 10^4</td>
</tr>
<tr>
<td>20 ( ^\circ C )</td>
<td>1.00</td>
<td>4.18 \times 10^3</td>
<td>1.00 \times 10^4</td>
</tr>
<tr>
<td>25 ( ^\circ C )</td>
<td>1.00</td>
<td>4.18 \times 10^3</td>
<td>1.00 \times 10^4</td>
</tr>
<tr>
<td>30 ( ^\circ C )</td>
<td>1.00</td>
<td>4.18 \times 10^3</td>
<td>1.00 \times 10^4</td>
</tr>
<tr>
<td>35 ( ^\circ C )</td>
<td>0.99</td>
<td>4.18 \times 10^3</td>
<td>0.99 \times 10^4</td>
</tr>
<tr>
<td>40 ( ^\circ C )</td>
<td>0.99</td>
<td>4.18 \times 10^3</td>
<td>0.99 \times 10^4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature ( ^\circ C )</th>
<th>Density ( \rho ) [kg/L]</th>
<th>Specific heat ( C ) [J/(kg·K)]</th>
<th>Conventional unit system</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 ( ^\circ C )</td>
<td>1.02</td>
<td>3.91 \times 10^3</td>
<td>1.02 \times 10^4</td>
</tr>
<tr>
<td>10 ( ^\circ C )</td>
<td>1.02</td>
<td>3.91 \times 10^3</td>
<td>1.02 \times 10^4</td>
</tr>
<tr>
<td>15 ( ^\circ C )</td>
<td>1.02</td>
<td>3.91 \times 10^3</td>
<td>1.02 \times 10^4</td>
</tr>
<tr>
<td>20 ( ^\circ C )</td>
<td>1.01</td>
<td>3.91 \times 10^3</td>
<td>1.01 \times 10^4</td>
</tr>
<tr>
<td>25 ( ^\circ C )</td>
<td>1.01</td>
<td>3.91 \times 10^3</td>
<td>1.01 \times 10^4</td>
</tr>
<tr>
<td>30 ( ^\circ C )</td>
<td>1.01</td>
<td>3.91 \times 10^3</td>
<td>1.01 \times 10^4</td>
</tr>
<tr>
<td>35 ( ^\circ C )</td>
<td>1.01</td>
<td>3.91 \times 10^3</td>
<td>1.01 \times 10^4</td>
</tr>
<tr>
<td>40 ( ^\circ C )</td>
<td>1.01</td>
<td>3.91 \times 10^3</td>
<td>1.01 \times 10^4</td>
</tr>
</tbody>
</table>

15 % Ethylene Glycol Aqueous Solution

<table>
<thead>
<tr>
<th>Temperature ( ^\circ C )</th>
<th>Density ( \rho ) [kg/L]</th>
<th>Specific heat ( C ) [J/(kg·K)]</th>
<th>Conventional unit system</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 ( ^\circ C )</td>
<td>1.02</td>
<td>0.93 \times 10^3</td>
<td>1.02 \times 10^4</td>
</tr>
<tr>
<td>10 ( ^\circ C )</td>
<td>1.02</td>
<td>0.93 \times 10^3</td>
<td>1.02 \times 10^4</td>
</tr>
<tr>
<td>15 ( ^\circ C )</td>
<td>1.02</td>
<td>0.93 \times 10^3</td>
<td>1.02 \times 10^4</td>
</tr>
<tr>
<td>20 ( ^\circ C )</td>
<td>1.01</td>
<td>0.93 \times 10^3</td>
<td>1.01 \times 10^4</td>
</tr>
<tr>
<td>25 ( ^\circ C )</td>
<td>1.01</td>
<td>0.93 \times 10^3</td>
<td>1.01 \times 10^4</td>
</tr>
<tr>
<td>30 ( ^\circ C )</td>
<td>1.01</td>
<td>0.94 \times 10^3</td>
<td>1.01 \times 10^4</td>
</tr>
<tr>
<td>35 ( ^\circ C )</td>
<td>1.01</td>
<td>0.94 \times 10^3</td>
<td>1.01 \times 10^4</td>
</tr>
<tr>
<td>40 ( ^\circ C )</td>
<td>1.01</td>
<td>0.94 \times 10^3</td>
<td>1.01 \times 10^4</td>
</tr>
</tbody>
</table>

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

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

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

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

3. Use non-corrosive materials for fluid contact parts of circulating fluid.

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

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

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

- **Selection**

- **Model selection**

   For selecting a model of thermo-chiller, it is required to know the heat generation amount of the user's equipment. Obtain the heat generation amount, referring to "Cooling Capacity Calculation" on pages 19 and 20 before selecting a model.

- **Handling**

  Thoroughly read the Operation Manual.

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

**Operating Environment / Storage Environment**

**Warning**

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

   1. Outdoors
   2. In locations where water, water vapor, salt water, and oil may splash on the product.
   3. In locations where there are dust and particles.
   4. In locations where corrosive gases, organic solvents, chemical fluids, or flammable gases are present. (This product is not explosion proof.)
   5. In locations where the ambient temperature/humidity exceeds the limits as mentioned below or where condensation occurs.

      During transportation/storage: -15 °C to 50 °C, 15 % to 85 %

      (But as long as water or circulating fluid are not left inside the pipings)

      During operation: 5 °C to 45 °C, 30 % to 70 %

      (However, use a 15 % ethylene glycol aqueous solution if operating in a place where the ambient temperature or circulating fluid temperature is 10 °C or less.)

6. In locations where condensation may occur.

7. In locations which receive direct sunlight or radiated heat.

8. In locations where there is a heat source nearby and the ventilation is poor.

9. In locations where temperature substantially changes.

10. In locations where strong magnetic noise occurs.

    (In locations where strong electric fields, strong magnetic fields and surge voltage occur.)

11. In locations where static electricity occurs, or conditions which make the product discharge static electricity.

12. In locations where high frequency occurs.

13. In locations where damage is likely to occur due to lightning.

14. In locations at altitude of 3000 m or higher (Except during storage and transportation)

    For altitude of 1000 m or higher

    Because of lower air density, the heat radiation efficiencies of the devices in the product will be lower in the location at altitude of 1000 m or higher. Therefore, the maximum ambient temperature to use and the cooling capacity will lower according to the descriptions in the table below.

    Select the thermo-chiller considering the descriptions.

   ① Upper limit of ambient temperature: Use the product in ambient temperature of the described value or lower at each altitude.

   ② Cooling capacity coefficient: The product's cooling capacity will lower to one that multiplied by the described value at each altitude.

<table>
<thead>
<tr>
<th>Altitude (m)</th>
<th>Upper limit of ambient temperature [°C]</th>
<th>Cooling capacity coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1000 m</td>
<td>45</td>
<td>1.00</td>
</tr>
<tr>
<td>Less than 1500 m</td>
<td>42</td>
<td>0.85</td>
</tr>
<tr>
<td>Less than 2000 m</td>
<td>38</td>
<td>0.80</td>
</tr>
<tr>
<td>Less than 2500 m</td>
<td>35</td>
<td>0.75</td>
</tr>
<tr>
<td>Less than 3000 m</td>
<td>32</td>
<td>0.70</td>
</tr>
</tbody>
</table>

15. In locations where strong impacts or vibrations occur.

16. In locations where a massive force strong enough to deform the product is applied or a weight from a heavy object is applied.

17. In locations where there is not sufficient space for maintenance.

18. Bevelled place

19. Insects or plants may enter the unit.

2. The product is not designed for clean room usage. It generates particles internally.
**Series HRS090**

**Specific Product Precautions 2**

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

---

### Transportation / Carriage / Movement

**⚠️ Warning**

1. This product is heavy. Pay attention to safety and position of the product when it is transported, carried and moved.
2. Read the Operation Manual carefully to move the product after unpacking.

**⚠️ Caution**

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

The product will be delivered in the packaging shown below.

![Forklift and wooden skid with packaging](image)

#### <When packaged>

<table>
<thead>
<tr>
<th>Model</th>
<th>Weight [kg]</th>
<th>Dimensions [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRS090-A-40</td>
<td>163</td>
<td>Height 1290 x Width 470 x Depth 1180</td>
</tr>
<tr>
<td>HRS090-W-40</td>
<td>151</td>
<td></td>
</tr>
</tbody>
</table>

2. **Moving with forklift**

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

![Forklift insertion side](image)

3. **Moving with casters**

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

---

### Installation

**⚠️ Warning**

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

**⚠️ Caution**

1. Install on a rigid floor which can withstand this product’s weight.
2. Refer to the Operation Manual for this product, and secure an installation space that is necessary for the maintenance and ventilation.

#### <Air-cooled refrigeration>

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

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

#### <Heat radiation amount/Required ventilation rate>

<table>
<thead>
<tr>
<th>Model</th>
<th>Heat radiation amount [kW]</th>
<th>Differential temp. of 3 °C between inside and outside of installation area</th>
<th>Differential temp. of 6 °C between inside and outside of installation area</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRS090-A-40</td>
<td>17</td>
<td>290</td>
<td>145</td>
</tr>
</tbody>
</table>
Caution

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

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

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

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

5. This product series are constant-temperature fluid circulating machines with built-in tanks. Do not install equipment on your system side such as pumps that forcibly return the circulating fluid to the unit. Also, if you attach an external tank that is open to the air, it may become impossible to circulate the circulating fluid. Proceed with caution.

Circulating Fluid

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

2. When water is used as a circulating fluid, use tap water that conforms to the appropriate water quality standards. Use tap water that conforms to the standards shown below (including water used for dilution of ethylene glycol aqueous solution).

Tap Water (as Circulating Fluid) Quality Standards
The Japan Refrigeration and Air Conditioning Industry Association
JRA GL-02-1994 “Cooling water system – Circulation type – Make-up water”

<table>
<thead>
<tr>
<th>Item</th>
<th>Standard value</th>
<th>Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH (at 25°C)</td>
<td>6.0 to 8.0</td>
<td></td>
</tr>
<tr>
<td>Electric conductivity (μS/cm)</td>
<td>100* to 300*</td>
<td></td>
</tr>
<tr>
<td>Chloride ion (Cl^-) [mg/l]</td>
<td>50 or less</td>
<td></td>
</tr>
<tr>
<td>Sulfuric acid ion (SO_4^{2-}) [mg/l]</td>
<td>50 or less</td>
<td></td>
</tr>
<tr>
<td>Acid consumption amount (at pH 6.8) [mg/l]</td>
<td>50 or less</td>
<td></td>
</tr>
<tr>
<td>Total hardness [mg/l]</td>
<td>70 or less</td>
<td></td>
</tr>
<tr>
<td>Calcium hardness (CaCO_3)  [mg/l]</td>
<td>50 or less</td>
<td></td>
</tr>
<tr>
<td>I onic state silica (SiO_2) [mg/l]</td>
<td>30 or less</td>
<td></td>
</tr>
<tr>
<td>Iron (Fe) [mg/l]</td>
<td>0.3 or less</td>
<td></td>
</tr>
<tr>
<td>Copper (Cu) [mg/l]</td>
<td>0.1 or less</td>
<td></td>
</tr>
<tr>
<td>Sulfide ion (S_2^-) [mg/l]</td>
<td>Should not be detected</td>
<td></td>
</tr>
<tr>
<td>Ammonium ion (NH_4^+) [mg/l]</td>
<td>0.1 or less</td>
<td></td>
</tr>
<tr>
<td>Residual chloride [Cl^-] [mg/l]</td>
<td>0.3 or less</td>
<td></td>
</tr>
<tr>
<td>Free carbon (CO_2) [mg/l]</td>
<td>4.0 or less</td>
<td></td>
</tr>
</tbody>
</table>

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

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

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.

Facility Water Supply

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

Required facility water system

**Heat radiation amount/Facility water specifications**

<table>
<thead>
<tr>
<th>Model</th>
<th>Heat radiation [kW]</th>
<th>Facility water specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRS090-W□□ □□</td>
<td>17</td>
<td>Refer to “Facility water system” in the specifications on page 10.</td>
</tr>
</tbody>
</table>

Warning

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

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

If the voltage increase ratio (dV/dt) at the zero cross should exceed 40 V/200 μsec., it may result in a malfunction.

<For option B [With earth leakage breaker]>

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

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

Electrical Wiring

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

**Corrosion Scale generation**
Series HRS090
Specific Product Precautions 4

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

Facility Water Supply

⚠️ Warning

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

Use tap water that conforms to the standards shown below.

Tap Water (as Facility Water) Quality Standards
The Japan Refrigeration and Air Conditioning Industry Association

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Standard value</th>
<th>Influence Corrosion</th>
<th>Scale/growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH (at 25 °C)</td>
<td>—</td>
<td>6.5 to 8.2</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Electric conductivity (25 °C)</td>
<td>μS/cm</td>
<td>100* to 800*</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Chlorine (Cl^-)</td>
<td>[mg/l]</td>
<td>200 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Sulfuric acid ion (SO4^2-)</td>
<td>[mg/l]</td>
<td>100 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Total hardness</td>
<td>[mg/l]</td>
<td>200 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Calcium hardness (CaCO3)</td>
<td>[mg/l]</td>
<td>150 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Ionic state silica (SiO2)</td>
<td>[mg/l]</td>
<td>50 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>[mg/l]</td>
<td>1.0 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>[mg/l]</td>
<td>0.3 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Sulfide ion (S2^-)</td>
<td>[mg/l]</td>
<td>Should not be detected</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Ammonium ion (NH4^+)</td>
<td>[mg/l]</td>
<td>1.0 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Free carbon (CO2)</td>
<td>[mg/l]</td>
<td>0.3 or less</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Reference item

* In the case of [M2±cm], it will be 0.001 to 0.01.
* ○ Factors that have an effect on corrosion or scale generation.
* Even if the water quality standards are met, complete prevention of corrosion is not guaranteed.

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

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

Operation

⚠️ Warning

1. Confirmation before operation

1) The fluid level of a tank should be within the specified range of H (High) and L (Low). When exceeding the specified level, the circulating fluid will overflow.

2) Remove the air.
   - Conduct a trial operation, looking at the fluid level.
   - Since the fluid level will go down when the air is removed from the user's piping system, supply water once again when the fluid level is reduced. When there is no reduction in the fluid level, the job of removing the air is completed.
   - Pump can be operated independently.

2. Confirmation during operation

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

3. Emergency stop method

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

⚠️ Caution

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

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

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

Maintenance

⚠️ Caution

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

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

- Periodical inspection during the winter season>
   If there is a risk of the circulating fluid and facility water freezing when the product is stopped, release the circulating fluid and facility water in advance.

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

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 product will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalogue information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.
   The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

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

4. 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 catalogue.
   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 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, whichever is first.\(^2\)
   Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.

2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided. This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.

3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalogue for the particular products.
   \(^2\) Vacuum pads are excluded from this 1 year warranty. A vacuum pad is a consumable part, so it is warranted for a year after it is delivered. Also, even within the warranty period, the warranty is void if the vacuum pad is damaged due to the detemination 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.

Caution

SMC products are not intended for use as instruments for legal metrology.
Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country. Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.

Safety Instructions

Be sure to read “Handling Precautions for SMC Products” (M-E03-3) before using.