**Circulating Fluid Temperature Controller**

**Thermo-chiller**

**Compact Type**

**Space Saving**
Installation close to a wall is possible on both sides.

NEW Variations added
- Water-cooled refrigeration
- Cooling capacity: 1300 W, 2400 W (60 Hz)
- All models: CE marking and UL compliant
- Single-phase 100 VAC (50/60 Hz)
  115 VAC (60 Hz)

**Cooling capacity (60 Hz):**
- 1300 W/1900 W/2400 W

**Temperature range setting:**
- 5 to 40°C

**Temperature stability:** ±0.1°C

**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**
- 31 types of alarm codes

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

**Light-weight 40 kg**

**Series HRS**

Environmental compliance
- RoHS directive
- R407C as refrigerant

**CAT.ES40-55B**
No fluid leakage because the seal-less pump is used.

Adoption of the magnet pump

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 1: Press the keys.
→ Step 2: Adjust the temperature setting with the keys.
→ Step 3: Press the key to stop.
Easy operation by these steps

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

Tool-less maintenance of filter

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

Easy check of the circulating fluid level

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

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.

Heater is not necessary even when ambient temperature is low.

Features 1

This is just an example diagram. Refer to “Construction and Principles” on features 5 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.

- **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 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 31 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 31 types. This makes it easier to identify the cause of the alarm. Can be used before requesting service.

<table>
<thead>
<tr>
<th>Changeable alarm set values</th>
<th>Set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circulating fluid discharge temperature rise</td>
<td>5 to 48°C</td>
</tr>
<tr>
<td>Circulating fluid discharge temperature drop</td>
<td>1 to 39°C</td>
</tr>
<tr>
<td>Circulating fluid discharge pressure rise</td>
<td>0.05 to 0.75 MPa</td>
</tr>
<tr>
<td>Circulating fluid discharge pressure drop</td>
<td>0.05 to 0.18 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.

- **Displayed item**
  - Circulating fluid discharge temperature
  - Circulating fluid return temperature
  - Compressor gas temperature
  - Circulating fluid discharge port 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

<table>
<thead>
<tr>
<th>Laser machining</th>
<th>UV curing device (printing, painting, bonding and sealing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Cooling of laser irradiated part</td>
<td>- Cooling of UV lamp</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>X-ray (digital) Instrument</th>
<th>Electronic microscope</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Temperature control of X-ray tube and X-ray light sensing part</td>
<td>- Temperature control of electron-beam irradiated part</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Laser marker</th>
<th>Ultra sonic wave inspection machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Cooling of laser irradiated part</td>
<td>- Temperature control of ultra sonic wave laser part</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atomizing device (food and cosmetics)</th>
<th>Linear motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Temperature control of sample and device</td>
<td>- Temperature control of moving coil</td>
</tr>
<tr>
<td>Application Examples</td>
<td>Features</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>Packaging line</strong> (sealing of film and paper package)</td>
<td></td>
</tr>
<tr>
<td>Cooling of work pieces for bonding</td>
<td></td>
</tr>
<tr>
<td>Cooling water</td>
<td></td>
</tr>
<tr>
<td>Workpiece</td>
<td></td>
</tr>
<tr>
<td><strong>Cooling of die</strong></td>
<td></td>
</tr>
<tr>
<td>Cooling water</td>
<td></td>
</tr>
<tr>
<td><strong>Temperature control of paint material</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature control inside cabinet</td>
<td></td>
</tr>
<tr>
<td><strong>Cooling of vacuum pump</strong></td>
<td></td>
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<tr>
<td>Vacuum pump</td>
<td></td>
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<tr>
<td><strong>Shrink fitting machine</strong></td>
<td></td>
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<tr>
<td>Cooling of workpiece</td>
<td></td>
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<tr>
<td><strong>Gas cylinder cabinet</strong></td>
<td></td>
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<tr>
<td>Temperature control inside cabinet</td>
<td></td>
</tr>
<tr>
<td><strong>Concentrating equipment</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature control of concentration fluid</td>
<td></td>
</tr>
<tr>
<td><strong>Reagent cooling equipment</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature control of reagent</td>
<td></td>
</tr>
</tbody>
</table>
### Construction and Principles

#### Air-cooled HRS-A-□

- Resin tank
- Temperature sensor (For return)
- Evaporator
- Level switch
- Comp
- Compressor
- Filter
- Ventilation
- Drain port
- Pump
- HRS

#### Circulating fluid circuit

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

#### Refrigerating 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.

#### Water-cooled HRS-W-□

- Resin tank
- Temperature sensor (For return)
- Evaporator
- Level switch
- Comp
- Compressor
- Filter
- Ventilation
- Drain port
- Pump
- HRS

#### 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 user'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

- Circulating fluid temperature setting
- Start and stop
- Circulating fluid discharge temperature
- Circulating fluid discharge pressure
- Run and stop status

#### Ex. 2 Communication with the user's machine

- Alarm information
- Various setting information
- Preparation completion status

#### Ex. 3 Alarm and operation status (start and stop) 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 and stop)

#### Ex. 4 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.

- Alarm and operation status (start and stop)
- Input 1
- Input 2
- Low flow switch flow signal
- Output 1: Temperature rise
- Output 2: Pressure rise
- Output 3: Operation status (start and stop)
Basic Model
How to Order / Specifications

- Single-phase 100/115 VAC ................................................. P.1
- Single-phase 200 to 230 VAC ............................................. P.2

- Cooling Capacity / Pump Capacity / Required Facility Water Flow Rate .......... P.3
- Dimensions ................................................................. P.4
- Operation Display Panel .................................................. P.5
- Alarm ........................................................................ P.5
- Communication Function ................................................... P.6

Optional Accessories

1. Anti-quake Bracket ....................................................... P.7
2. Piping Conversion Fitting (Air-cooled refrigeration) ......................... P.7
3. Piping Conversion Fitting (Water-cooled refrigeration) ....................... P.7
4. Concentration Meter ...................................................... P.7

Calculation of Cooling Capacity

- Calculation of Required Cooling Capacity ............................................. P.8, 9
- Precautions for Calculation of Cooling Capacity ......................................... P.9
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Warranty ................................................................. P.10
Specific Product Precautions .................................................. P.11,12
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How to Order

Specify HRS 018-A for water-cooled refrigeration and HRS 012-W for air-cooled refrigeration.

Specifications

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<th>Model</th>
<th>HRS012-A...-10</th>
<th>HRS012-W...-10</th>
<th>HRS012-A...-10</th>
<th>HRS012-W...-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling method</td>
<td>Air-cooled refrigeration</td>
<td>Air-cooled refrigeration</td>
<td>Air-cooled refrigeration</td>
<td>Water-cooled refrigeration</td>
</tr>
<tr>
<td>Control method</td>
<td>PID control</td>
<td>PID control</td>
<td>PID control</td>
<td>PID control</td>
</tr>
<tr>
<td>Ambient temperature/humidity</td>
<td>Temperature: 5 to 40°C, Humidity: 30 to 70%</td>
<td>Temperature: 5 to 40°C, Humidity: 30 to 70%</td>
<td>Temperature: 5 to 40°C, Humidity: 30 to 70%</td>
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</tr>
<tr>
<td>Circulating fluid system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature range setting (°C)</td>
<td>9°C to 40°C</td>
<td>9°C to 40°C</td>
<td>9°C to 40°C</td>
<td>9°C to 40°C</td>
</tr>
<tr>
<td>Cooling capacity (50/60 Hz) (W)</td>
<td>1100/1300</td>
<td>1500/1700</td>
<td>1100/1300</td>
<td>1500/1700</td>
</tr>
<tr>
<td>Pump capacity (50/60 Hz) (MPa)</td>
<td>0.13/0.18 (at 7 l/min)</td>
<td>0.13/0.18 (at 7 l/min)</td>
<td>0.13/0.18 (at 7 l/min)</td>
<td>0.13/0.18 (at 7 l/min)</td>
</tr>
<tr>
<td>Rated flow (50/60 Hz) (l/min)</td>
<td>7/7</td>
<td>7/7</td>
<td>7/7</td>
<td>7/7</td>
</tr>
<tr>
<td>Tank capacity (l)</td>
<td>Approx. 5</td>
<td>Approx. 5</td>
<td>Approx. 5</td>
<td>Approx. 5</td>
</tr>
<tr>
<td>Circulating fluid system</td>
<td>Stainless steel, Copper (Heat exchanger brazing), Bronze, Alumina ceramic Carbon, PP, PE, POM, PEK, PVC, PTFE</td>
<td>Stainless steel, Copper (Heat exchanger brazing), Bronze, Alumina ceramic Carbon, PP, PE, POM, PEK, PVC, PTFE</td>
<td>Stainless steel, Copper (Heat exchanger brazing), Bronze, Alumina ceramic Carbon, PP, PE, POM, PEK, PVC, PTFE</td>
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</tr>
<tr>
<td>Facility water system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure range (MPa)</td>
<td>0.3 to 0.5</td>
<td>0.3 to 0.5</td>
<td>0.3 to 0.5</td>
<td>0.3 to 0.5</td>
</tr>
<tr>
<td>Required flow rate (50/60 Hz) (l/min)</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Net inlet-outlet pressure differential of facility water (MPa)</td>
<td>0.3 or more</td>
<td>0.3 or more</td>
<td>0.3 or more</td>
<td>0.3 or more</td>
</tr>
<tr>
<td>Port size (Rc1/2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetted parts material</td>
<td>Stainless steel, Copper (Heat exchanger brazing), Bronze, Synthetic rubber</td>
<td>Stainless steel, Copper (Heat exchanger brazing), Bronze, Synthetic rubber</td>
<td>Stainless steel, Copper (Heat exchanger brazing), Bronze, Synthetic rubber</td>
<td>Stainless steel, Copper (Heat exchanger brazing), Bronze, Synthetic rubber</td>
</tr>
<tr>
<td>Electrical system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circuit protector (A)</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Rated operating current (50/60 Hz) (A)</td>
<td>7.5/8.3</td>
<td>7.5/8.3</td>
<td>7.5/8.3</td>
<td>7.5/8.3</td>
</tr>
<tr>
<td>Rated power consumption (50/60 Hz) (kVA)</td>
<td>0.7/0.8</td>
<td>0.7/0.8</td>
<td>0.7/0.8</td>
<td>0.7/0.8</td>
</tr>
<tr>
<td>Noise level (50/60 Hz) (dB)</td>
<td>58/55</td>
<td>58/55</td>
<td>58/55</td>
<td>58/55</td>
</tr>
<tr>
<td>Accessories</td>
<td>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.</td>
<td>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.</td>
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</tr>
<tr>
<td>Weight (kg) (Note 11)</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

Note 1) For water-cooled refrigeration
Note 2) For single-phase 100/115 VAC
Note 3) For water-cooled refrigeration
Note 4) For single-phase 100/115 VAC
Note 5) Use 15% ethylene glycol aqueous solution if operating in a place where the circulating fluid temperature is lower than 10°C.
Note 6) Water-cooled refrigeration
Note 7) The capacity of the product outlet when the circulating fluid temperature is 20°C.
Note 8) Required flow for cooling capacity or maintaining the temperature stability.
Note 9) 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 10) To be prepared by the user. Use an earth leakage breaker with sensitivity of 15 mA or 30 mA.
Note 11) Weight in the dry state without circulating fluids.
## Specifications

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Cooling method</strong></td>
<td>Air-cooled refrigeration</td>
<td>Water-cooled refrigeration</td>
<td>Air-cooled refrigeration</td>
<td>Water-cooled refrigeration</td>
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<tr>
<td><strong>Ambient temperature/humidity</strong></td>
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</tr>
<tr>
<td><strong>Circulating fluid system</strong></td>
<td>Fluid capacity: Clear water, 15% ethylene glycol aqueous solution</td>
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</tr>
<tr>
<td><strong>Temperature range setting (°C)</strong></td>
<td>Note 1: 5 to 40</td>
<td>Note 2: 5 to 40</td>
<td>Note 3: 5 to 40</td>
<td>Note 4: 5 to 40</td>
<td>Note 5: 5 to 40</td>
<td>Note 6: 5 to 40</td>
</tr>
<tr>
<td><strong>Pressure range (MPa)</strong></td>
<td>Note 1: 0.3 to 0.5</td>
<td>Note 2: 0.3 to 0.5</td>
<td>Note 3: 0.3 to 0.5</td>
<td>Note 4: 0.3 to 0.5</td>
<td>Note 5: 0.3 to 0.5</td>
<td>Note 6: 0.3 to 0.5</td>
</tr>
<tr>
<td><strong>Rated flow (50/60 Hz) (l/min)</strong></td>
<td>Note 1: 0.13/0.18 (at 7 mm)</td>
<td>Note 2: 0.13/0.18 (at 7 mm)</td>
<td>Note 3: 0.13/0.18 (at 7 mm)</td>
<td>Note 4: 0.13/0.18 (at 7 mm)</td>
<td>Note 5: 0.13/0.18 (at 7 mm)</td>
<td>Note 6: 0.13/0.18 (at 7 mm)</td>
</tr>
<tr>
<td><strong>Tank capacity (l)</strong></td>
<td>Approx. 5</td>
<td>Approx. 5</td>
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<tr>
<td><strong>Port size</strong></td>
<td>Rc1/2</td>
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<tr>
<td><strong>Wetted parts material</strong></td>
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<tr>
<td><strong>Circuit protector (A)</strong></td>
<td>Note 1: 10</td>
<td>Note 2: 10</td>
<td>Note 3: 10</td>
<td>Note 4: 10</td>
<td>Note 5: 10</td>
<td>Note 6: 10</td>
</tr>
<tr>
<td><strong>Rated operating current (50/60 Hz) (A)</strong></td>
<td>Note 1: 4.6/5.1</td>
<td>Note 2: 4.6/5.1</td>
<td>Note 3: 4.6/5.1</td>
<td>Note 4: 4.6/5.1</td>
<td>Note 5: 4.6/5.1</td>
<td>Note 6: 4.6/5.1</td>
</tr>
<tr>
<td><strong>Rated power consumption (50/60 Hz) (kVA)</strong></td>
<td>Note 1: 0.9/1.0</td>
<td>Note 2: 0.9/1.0</td>
<td>Note 3: 0.9/1.0</td>
<td>Note 4: 0.9/1.0</td>
<td>Note 5: 0.9/1.0</td>
<td>Note 6: 0.9/1.0</td>
</tr>
<tr>
<td><strong>Noise level (50/60 Hz) (dB)</strong></td>
<td>Note 1: 7/7</td>
<td>Note 2: 7/7</td>
<td>Note 3: 7/7</td>
<td>Note 4: 7/7</td>
<td>Note 5: 7/7</td>
<td>Note 6: 7/7</td>
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<td>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.</td>
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<td>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.</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>Note 1: 43</td>
<td>Note 2: 43</td>
<td>Note 3: 43</td>
<td>Note 4: 43</td>
<td>Note 5: 43</td>
<td>Note 6: 43</td>
</tr>
</tbody>
</table>

Note 1) For water-cooled refrigeration
Note 2) It should have no condensation.
Note 3) If clear water is to be used, use water conform to Clear Water Quality Standard of the Japan Refrigeration and Air Conditioning Industrial Association (JRA GL-02-1994 cooling water system - circulating type - make-up water).
Note 5) Use a 15% ethylene glycol aqueous solution if operating in a place where the circulating fluid temperature is lower than 10°C.
Note 6) Outlet temperature when the circulating fluid flow is rated flow, and the circulating fluid discharge port and return port are directly connected.
Note 7) The capacity at the product outlet when the circulating fluid temperature is 20°C.
Note 8) Required flow for cooling capacity or maintaining the temperature stability.
Note 9) To be prepared by the user. Use an earth leakage breaker with sensitivity of 30 mA.
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) This is the flow necessary 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 temperatures of 25°C.
**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 tightened with the recommended torque shown below.

**Mounting/Installation**

<table>
<thead>
<tr>
<th>Connection thread</th>
<th>Applicable tightening torque (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3</td>
<td>0.63</td>
</tr>
<tr>
<td>M4</td>
<td>1.5</td>
</tr>
<tr>
<td>M5</td>
<td>3</td>
</tr>
<tr>
<td>M6</td>
<td>5.2</td>
</tr>
<tr>
<td>M8</td>
<td>12.5</td>
</tr>
<tr>
<td>M10</td>
<td>24.5</td>
</tr>
<tr>
<td>M12</td>
<td>42</td>
</tr>
</tbody>
</table>

**Piping**

**Caution**
1. Regarding the circulating fluid pipings, consider carefully the suitability for shut off 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.

**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 user.
2. Ensure a stable power supply with no voltage surges and distortion.
   In particular, operating failure can result when the voltage ramp rate \( \frac{dV}{dt} \) exceeds 40 V/200 \( \mu \)sec at the zero cross-over point.

\[ \frac{dV}{dt} = \text{Voltage ramp rate} \]

\[ \text{Voltage} \]
The basic operation of the product is controlled through the operation display panel on the front of the product.

Operation Display Panel

The product has 31 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

<table>
<thead>
<tr>
<th>No.</th>
<th>Digital display (7-segment and 4 digits)</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Digital display (7-segment and 4 digits)</td>
<td>PV Displays the circulating fluid current discharge temperature and pressure and alarm codes and other menu items (codes).</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>[°C] [°F] lamp</td>
<td>[ °C ]</td>
<td>Equipped with a unit conversion function. Displays the unit of display temperature (default setting: °C).</td>
</tr>
<tr>
<td>3</td>
<td>[MPa] [PSI] lamp</td>
<td>[ MPa ]</td>
<td>Equipped with a unit conversion function. Displays the unit of display pressure (default setting: MPa).</td>
</tr>
<tr>
<td>4</td>
<td>[REMOTE] lamp</td>
<td>[REMOTE]</td>
<td>Enables remote operation (start and stop) by communication. Lights up during remote operation.</td>
</tr>
<tr>
<td>5</td>
<td>(RUN) lamp</td>
<td>[RUN]</td>
<td>Lights up when the product is started, and goes off when it is stopped. Flashes during standby for stop or anti-freezing function, or independent operation of the pump.</td>
</tr>
<tr>
<td>6</td>
<td>[ALARM] lamp</td>
<td>[ALARM]</td>
<td>Flashes with buzzer when alarm occurs.</td>
</tr>
<tr>
<td>7</td>
<td>(SEL) key</td>
<td>[SEL]</td>
<td>Changes the item in menu and enters the set value.</td>
</tr>
<tr>
<td>8</td>
<td>(SEL) key</td>
<td>[SEL]</td>
<td>Increases the set value.</td>
</tr>
<tr>
<td>9</td>
<td>(SEL) key</td>
<td>[SEL]</td>
<td>Press the [SEL] key simultaneously. Increases the set value.</td>
</tr>
<tr>
<td>10</td>
<td>[RUN/STOP] key</td>
<td>[RUN/STOP]</td>
<td>Makes the product start or stop.</td>
</tr>
<tr>
<td>11</td>
<td>[MENU] key</td>
<td>[MENU]</td>
<td>Shifts the main menu (display screen of circulating fluid discharge temperature and pressure) and other menus (for monitoring and entry of set values).</td>
</tr>
<tr>
<td>12</td>
<td>[SELECT] key</td>
<td>[SELECT]</td>
<td>Enables remote operation (start and stop) by communication. Lights up during remote operation.</td>
</tr>
<tr>
<td>13</td>
<td>[RESET] key</td>
<td>[RESET]</td>
<td>Stops the alarm buzzer and resets the [ALARM] lamp.</td>
</tr>
</tbody>
</table>

#### Alarm Codes

<table>
<thead>
<tr>
<th>Alarm code</th>
<th>Alarm message</th>
<th>Operation status</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL01</td>
<td>Low level in tank</td>
<td>Stop</td>
</tr>
<tr>
<td>AL02</td>
<td>High circulating fluid discharge temperature</td>
<td>Stop</td>
</tr>
<tr>
<td>AL03</td>
<td>Circulating fluid discharge temperature rise</td>
<td>Continue^1</td>
</tr>
<tr>
<td>AL04</td>
<td>Circulating fluid discharge temperature drop</td>
<td>Continue^1</td>
</tr>
<tr>
<td>AL05</td>
<td>High circulating fluid return temperature (60°C)</td>
<td>Stop</td>
</tr>
<tr>
<td>AL06</td>
<td>High circulating fluid discharge pressure</td>
<td>Stop</td>
</tr>
<tr>
<td>AL07</td>
<td>Abnormal pump operation</td>
<td>Stop</td>
</tr>
<tr>
<td>AL08</td>
<td>Circulating fluid discharge pressure rise</td>
<td>Continue^1</td>
</tr>
<tr>
<td>AL09</td>
<td>Circulating fluid discharge pressure drop</td>
<td>Continue^1</td>
</tr>
<tr>
<td>AL10</td>
<td>High compressor intake temperature</td>
<td>Stop</td>
</tr>
<tr>
<td>AL11</td>
<td>Low compressor intake temperature</td>
<td>Stop</td>
</tr>
<tr>
<td>AL12</td>
<td>Low super heat temperature</td>
<td>Stop</td>
</tr>
<tr>
<td>AL13</td>
<td>High compressor discharge pressure</td>
<td>Stop</td>
</tr>
<tr>
<td>AL14</td>
<td>Refrigerating circuit pressure (high pressure side) rise</td>
<td>Stop</td>
</tr>
<tr>
<td>AL15</td>
<td>Refrigerating circuit pressure (low pressure side) rise</td>
<td>Stop</td>
</tr>
</tbody>
</table>

^1 “Stop” or “Continue” are default settings. The user can change them to “Continue” and “Stop”. For details, read the Operation Manual.

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

Contact I/O

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector type (to the product)</td>
<td>MC 1.5/12-GF-3.5</td>
</tr>
<tr>
<td>Input signal</td>
<td></td>
</tr>
<tr>
<td>Insulation method</td>
<td>Photo coupler</td>
</tr>
<tr>
<td>Rated input voltage</td>
<td>24 VDC</td>
</tr>
<tr>
<td>Operating voltage range</td>
<td>21.6 VDC to 26.4 VDC</td>
</tr>
<tr>
<td>Rated input current</td>
<td>5 mA TYP</td>
</tr>
<tr>
<td>Input impedance</td>
<td>4.7 kΩ</td>
</tr>
<tr>
<td>Contact output signal</td>
<td></td>
</tr>
<tr>
<td>Rated load voltage</td>
<td>48 V or less / 30 V or less</td>
</tr>
<tr>
<td>Maximum load current</td>
<td>AC/DC 500 mA (resistance load)</td>
</tr>
<tr>
<td>Output voltage</td>
<td>24 VDC ±10% 0.5 A Max</td>
</tr>
</tbody>
</table>

Circuit diagram

- The pin numbers and output signals can be set by the user. 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 present temperature (PV)
  - Circulating fluid discharge pressure (SV)
  - Status information
  - Alarm occurrence information

- **Readout**
  - Circulating fluid present temperature (PV)
  - Circulating fluid discharge pressure (SV)
  - Status information
  - Alarm occurrence information

Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector type</td>
<td>D-sub 9-pin, Female connector</td>
</tr>
<tr>
<td>Protocol</td>
<td>Modicon Modbus compliant/Simple communication protocol</td>
</tr>
<tr>
<td>Standard</td>
<td>EIA standard RS-485</td>
</tr>
<tr>
<td></td>
<td>EIA standard RS-232C</td>
</tr>
</tbody>
</table>

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/](http://www.smcworld.com/)
Optional Accessories

1. Anti-quake Bracket
   Bracket for earthquakes
   Prepare the anchor bolts (M8) which are suited to the floor material by user. (Anti-quake bracket thickness: 1.6 mm)
   Part No. HRS-TK001 (For single unit)

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

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

4. Concentration Meter
   Can be used to control the concentration of ethylene glycol aqueous solution regularly.
   Part No. HRZ-BR002
Series HRS
Calculation of Cooling Capacity

Example 1: When the heat generation amount in the user’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 user’s machine.

1. Derive the amount of heat generated from the power consumption.

   Power consumption \( P \): 1000 [W]
   \[ Q = P = 1000 \text{ [W]} \]
   Cooling capacity = Considering a safety factor of 20%,
   \[ 1000 \text{ [W]} \times 1.2 = 1200 \text{ [W]} \]

2. Derive the amount of heat generated from the power supply output.

   Power supply output \( V \times I \): 1.0 [kVA]
   \[ Q = P = V \times I \times \text{Power factor} \]
   In this example, using a power factor of 0.85:
   \[ = 1.0 \text{ [kVA]} \times 0.85 = 0.85 \text{ [kW]} = 850 \text{ [W]} \]
   Cooling capacity = Considering a safety factor of 20%,
   \[ 850 \text{ [W]} \times 1.2 = 1020 \text{ [W]} \]

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 user’s machine. Please be sure to check it carefully.

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

Obtaining the temperature difference between inlet and outlet by circulating the circulating fluid inside the user’s machine.

Obtaining the temperature difference between inlet and outlet by circulating the circulating fluid inside the user’s machine.

\[ Q = q_m \times \rho \times C \times (T_2 - T_1) \]
\[ = \rho \times q_v \times C \times (T_2 - T_1) \]
\[ = \frac{1 \times 10 \times 4.2 \times 10^3 \times 2.0}{60} \]
\[ = 1400 \text{ [J/s]} = 1400 \text{ [W]} \]

Cooling capacity = Considering a safety factor of 20%,
\[ 1400 \text{ [W]} \times 1.2 = 1680 \text{ [W]} \]

Example of the conventional measurement units (Reference)

Amount of heat generated by machine \( Q \): Unknown [cal/h] \( \rightarrow \) [W]
Circulating fluid weight: volume ratio \( \gamma \)
Circulating fluid specific heat capacity \( C \)
Circulating fluid outlet temperature \( T_1 \)
Circulating fluid return temperature \( T_2 \)
Circulating fluid temperature difference \( \Delta T \)
Conversion factor: hours to minutes

\[ Q = q_m \times \rho \times C \times (T_2 - T_1) \]
\[ = \frac{1 \times 10 \times 4.2 \times 10^3 \times 2.0}{60} \]
\[ = 1400 \text{ [J/s]} = 1400 \text{ [W]} \]

Cooling capacity = Considering a safety factor of 20%,
\[ 1400 \text{ [W]} \times 1.2 = 1680 \text{ [W]} \]
Calculation of Cooling Capacity

Calculation of Required Cooling Capacity

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

Heat dissipated by cooled substance (per unit time) \( Q \) : Unknown [W] (/s)
Cooled substance : Water
Cooled substance mass \( m \) : \( (= p \times V) \) [kg]
Cooled substance density \( p \) : 1 [kg/dm\(^3\)]
Total volume of the object being cooled down \( V \) : 20 [dm\(^3\)]
Specific heat capacity of cooled substance \( C \) : 4.2 x 10\(^{-3}\) [cal/(kgf·°C)]
Temperature of cooled substance 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])

\[ Q = m \times C \times (T_0 - T_t) \]
\[ \Delta t \times 12 \]
\[ = 1120 \text{ [W]} = 1120 \text{ [W]} \]

Cooling capacity = Considering a safety factor of 20%,
1120 [W] x 1.2 = 1344 [W]

Thermo-chiller

After 15 minutes, cool \( T \) down to 20°C.

Example of the conventional measurement units (Reference)

Heat dissipated by cooled substance (per unit time) \( Q \) : Unknown [cal/h] \( \rightarrow \) [W]
Cooled substance : Water
Cooled substance weight \( m \) : \( (= p \times V) \) [kg]
Cooled substance weight (volume ratio) \( γ \) : 1 [kgf/l]
Total volume of the substance being cooled down \( V \) : 20 [l]
Specific heat capacity of cooled substance \( C \) : 1.0 x 10\(^3\) [cal/(kgf·°C)]
Temperature of cooled substance 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]

\[ Q = m \times C \times (T_0 - T_t) \]
\[ \frac{Δt \times 860}{15 \times 860} \]
\[ = 1120 \text{ [W]} \]

Cooling capacity = Considering a safety factor of 20%,
1120 [W] x 1.2 = 1344 [W]

Precautions for Calculation of Cooling Capacity

1. Heating capacity
   When the circulating fluid temperature is set above room temperature, it needs to be heated by the product. The heating capacity depends on the circulating fluid temperature. Consider the radiation rate and heat capacity of the user’s machine and confirm that the necessary heating capacity is secured beforehand.

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 our chiller and a user’s machine, and the piping resistance such as circulating fluid pipings, or piping size, or piping curves in the machine. Confirm 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. Confirm beforehand if the circulating fluid pipings or circulating fluid circuit of the user’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 x 10\(^3\) [cal/(kgf·°C)] (or, using conventional unit system of units, 1 x 10\(^3\) [cal/(kgf·°C)])

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

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Density ( ρ ) [kg/dm(^3)]</th>
<th>Specific heat ( C ) [cal/(kgf·°C)]</th>
<th>Conventional unit system</th>
</tr>
</thead>
<tbody>
<tr>
<td>5°C</td>
<td>1.00</td>
<td>4.2 x 10(^3)</td>
<td>1.00 x 10(^5)</td>
</tr>
<tr>
<td>10°C</td>
<td>1.00</td>
<td>4.19 x 10(^3)</td>
<td>1.00 x 10(^5)</td>
</tr>
<tr>
<td>15°C</td>
<td>1.00</td>
<td>4.19 x 10(^3)</td>
<td>1.00 x 10(^5)</td>
</tr>
<tr>
<td>20°C</td>
<td>1.00</td>
<td>4.19 x 10(^3)</td>
<td>1.00 x 10(^5)</td>
</tr>
<tr>
<td>25°C</td>
<td>1.00</td>
<td>4.19 x 10(^3)</td>
<td>1.00 x 10(^5)</td>
</tr>
<tr>
<td>30°C</td>
<td>1.00</td>
<td>4.19 x 10(^3)</td>
<td>1.00 x 10(^5)</td>
</tr>
<tr>
<td>35°C</td>
<td>0.99</td>
<td>4.18 x 10(^3)</td>
<td>0.99 x 10(^5)</td>
</tr>
<tr>
<td>40°C</td>
<td>0.99</td>
<td>4.18 x 10(^3)</td>
<td>0.99 x 10(^5)</td>
</tr>
</tbody>
</table>

15% Ethylene Glycol Aqueous Solution

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Density ( ρ ) [kg/dm(^3)]</th>
<th>Specific heat ( C ) [cal/(kgf·°C)]</th>
<th>Conventional unit system</th>
</tr>
</thead>
<tbody>
<tr>
<td>5°C</td>
<td>1.02</td>
<td>3.91 x 10(^3)</td>
<td>1.02 x 10(^5)</td>
</tr>
<tr>
<td>10°C</td>
<td>1.02</td>
<td>3.91 x 10(^3)</td>
<td>1.02 x 10(^5)</td>
</tr>
<tr>
<td>15°C</td>
<td>1.02</td>
<td>3.91 x 10(^3)</td>
<td>1.02 x 10(^5)</td>
</tr>
<tr>
<td>20°C</td>
<td>1.01</td>
<td>3.91 x 10(^3)</td>
<td>1.01 x 10(^5)</td>
</tr>
<tr>
<td>25°C</td>
<td>1.01</td>
<td>3.91 x 10(^3)</td>
<td>1.01 x 10(^5)</td>
</tr>
<tr>
<td>30°C</td>
<td>1.01</td>
<td>3.91 x 10(^3)</td>
<td>1.01 x 10(^5)</td>
</tr>
<tr>
<td>35°C</td>
<td>1.01</td>
<td>3.91 x 10(^3)</td>
<td>1.01 x 10(^5)</td>
</tr>
<tr>
<td>40°C</td>
<td>1.01</td>
<td>3.92 x 10(^3)</td>
<td>1.01 x 10(^5)</td>
</tr>
</tbody>
</table>

Note) The above values are for reference. Contact the circulating fluid supplier for details.
1. Conditions of warranty
When a nonconformance should take place to our thermo-chiller, 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 operation 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, etc.)
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 operation manual.
9. Nonconformance caused by no observation to the following 5, “Items to be observed by user.”

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 user
In order to use this product safely, the correct usage and check-up by user 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.
Series HRS
Specific Product Precautions 1

Be sure to read this before handling.
Refer to back cover for the Safety Instructions, “Handling Precautions for SMC Products” (M-E03-3) and the Operation Manual for Temperature Control Equipment Precautions. Please download the Operation Manual via our website. http://www.smcworld.com/

**Warning**

1. This catalog shows the specification of a single unit.
   1) Confirm the specification of the single unit (contents of this catalog) 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.

**Selection**

1. Model selection
   For selecting a model of thermo-chiller, it is required to know the heat generation amount of a user’s machine. Obtain the heat generation amount, referring to “Calculation of Cooling Capacity” in this catalog before selecting a model.

**Warning**

1. Thoroughly read the Operation Manual.
   Read the Operation Manual completely before operation, and keep a copy on-site, for future reference.

**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, 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.

**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 in the below table (including water used for dilution of ethylene glycol aqueous solution).

**Clear Water (as Circulating Fluid) Quality Standard**
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>Unit</th>
<th>Standard value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH (at 25°C)</td>
<td></td>
<td>6.8 to 8.0</td>
</tr>
<tr>
<td>Chloride ion (Cl-)</td>
<td>mg/L</td>
<td>100 to 300</td>
</tr>
<tr>
<td>Sulfate ion (SO4²-)</td>
<td>mg/L</td>
<td>50 or less</td>
</tr>
<tr>
<td>Acid consumption amount (at pH4.8)</td>
<td>mg/L</td>
<td>50 or less</td>
</tr>
<tr>
<td>Total hardness</td>
<td>mg/L</td>
<td>70 or less</td>
</tr>
<tr>
<td>Calcium hardness (CaCO3)</td>
<td>mg/L</td>
<td>50 or less</td>
</tr>
<tr>
<td>Ionic state silica (SiO2)</td>
<td>mg/L</td>
<td>30 or less</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>mg/L</td>
<td>0.3 or less</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>mg/L</td>
<td>0.1 or less</td>
</tr>
<tr>
<td>Ammonium ion (NH4+)</td>
<td>mg/L</td>
<td>0.1 or less</td>
</tr>
<tr>
<td>Residual chlorine (Cl)</td>
<td>mg/L</td>
<td>0.3 or less</td>
</tr>
<tr>
<td>Free carbon (CO2)</td>
<td>mg/L</td>
<td>4.0 or less</td>
</tr>
</tbody>
</table>

- In the case of [M2 cm], it will be 0.003 to 0.01.

3. Use ethylene glycol aqueous solution which does not contain additives such as antiseptics.
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.
Facility Water Supply

**Warning**

(Water-cooled refrigeration)

1. Supply pressure should be 0.5 MPa or less.
   When 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**

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
   • Confirm 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 user'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**

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 user'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**

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 user'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.

<Periodical inspection every one month>

1. Cleaning the ventilation hole
   If the fin portion of the air-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>

   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.

Series HRS
Specific Product Precautions 2

Be sure to read this before handling.

Refer to back cover for the Safety Instructions, "Handling Precautions for SMC Products" (M-E03-3) and the Operation Manual for Temperature Control Equipment Precautions.

Please download the Operation Manual via our website. http://www.smcworld.com/
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:** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

**Warning:** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.

**Danger:** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

#### 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.

#### 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 machinery 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 in or a place exposed to direct sunlight.
   2. Installation on equipment in conjunction with atomic energy, railways, 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 and 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.

#### Danger

1. The product is cut, and read and understand the specific product precautions of all relevant mentioned above are implemented and the power from any appropriate source have been confirmed.

2. For any failure or damage reported within the warranty period which is clear 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. Also, even within the warranty period, the repair of a product due to the use of a vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

### Limited warranty and Disclaimer

#### Compliance Requirements

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

#### 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.\(^2\)

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.

### 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.

### Record of changes

**Addition of single phase 100 VAC (50 Hz)/2400 W (60 Hz), 2100 W (50 Hz), 2400 W (60 Hz)**

**Addition of water-cooled refrigeration**

**Addition of single phase 100 VAC (50/60 Hz), 115 VAC (60 Hz)**

**All models, CE marking and UL compliant**

NY

### Safety Instructions

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