Peltier-Type Chiller

Thermo-con

Air-cooled  Water-cooled

Can precisely control the temperature of a heat source or process fluid.

- Temperature range setting: 10°C to 60°C
- Temperature stability: ±0.01°C to 0.03°C

Air-cooled Series HEC-A
- Air-cooled: Can be used in the environments with no cooling equipment.
- Cooling capacity: 230 W, 600 W

Water-cooled Series HEC-W
- Water-cooled: Can be used in the environments with facility water equipment.
- Cooling capacity: 140 W, 320 W, 600 W, 1200 W

Temperature control of a chamber electrode
Electron microscope
Laser machining
etc.

20% ethylene glycol

CAT.EUS40-49Aa-UK
Series HEC

- Compliant with safety standard for medical equipment IEC 60601-1 (Air-cooled/HEC002-A series)
- Power supply: Applicable to 100 V to 240 V (Air-cooled/HEC-A series, Water-cooled/HEC001-W, HEC003-W)
- Suitable to fluorinated fluids (Fluorinert™ FC-3283, GALDEN® HT135) (Water-cooled/HEC006-W, HEC012-W)
- Compatible with ethylene glycol 20% (Water-cooled/HEC001-W, HEC003-W)

Learning Control Function (Temp. control by external temperature sensor)

This function adjusts the fluid temperature to the set value with an automatic offset setting. Set the external temperature sensor at the circulating fluid inlet located just in front of the heat source, which allows the Thermo-con to sample the fluid temperature. This function is effective when automatically adjusting for heat exhaust from piping, etc. If the external temperature sensor is installed directly on the heat source, the learning control function may not work properly due to large heat volume or large temperature difference. Be sure to install the sensor at the circulating fluid inlet.

Principle of Peltier Device (Thermo-module)

A Peltier device (thermo-module) is a plate type element, inside which P-type semiconductors and N-type semiconductors are located alternately. If direct current is supplied to the Peltier device (thermo-module), heat is transferred inside the device, and one face generates heat and increases temperature while the other face absorbs heat and decreases temperature. Therefore, changing the direction of the current supplied to the Peltier device (thermo-module) can achieve heating and cooling operation. This method has a fast response and can shift quickly between heating and cooling, so temperature can be controlled very precisely.
The Thermo-con is constructed as shown in Figure 1. It intercepts a Peltier device (thermo-module) between the heat exchangers for the circulating fluid and facility water and controls the pulse width of supply direct current to achieve the target outlet temperature of circulating fluid precisely. The circulating fluid returns to the tank, and is transferred by the pump which is built in the Thermo-con, and goes through the heat exchangers and internal sensors and out from the circulating fluid outlet. Figure 2 shows an example of circulating fluid piping. The circulating fluid is transferred at a constant temperature by the pump.
When to Use Air-Cooled and Water-Cooled Thermo-con

Both air-cooled and water-cooled Thermo-cons are available. Select a proper Thermo-con by referring to the following.

**Air-cooled**
- No facility water equipment
  - Can install the unit easily without facility water equipment.
- Frequent piping changes
  - Can reduce the piping installation labour since facility water piping is not required.

**Water-cooled**
- Need to avoid effects of ambient temperature.
  - Since the unit is water-cooled, the ambient temperature will have little effect.
- Want to reduce the installation space.
  - Can reduce the space since the unit is compact.

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**Application Examples**

**Semiconductor**

- Example: Temperature control of a chamber electrode
  - Upper electrode
  - Water
  - Lower electrode

- **Air-cooled**
  - Etching equipment
  - Spatter equipment
  - Cleaning equipment

- **Water-cooled**
  - Coating equipment
  - Dicing equipment
  - Tester, etc.

**Medical**

- Example: Blood preservation
  - **Air-cooled**

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

**Machine tool**

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

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

- **Water-cooled**

**Analysis**

- Example: Electronic microscope
  - **Air-cooled**

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

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

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**Bonding of DVD including next generation**

**Cooling of semiconductor laser**

**Temperature control of die-cast mold**
Features ............................................ Page 1 to 3
Model Selection ................................ Page 5, 6

Air-cooled

Series HEC-A

• How to Order/Specifications ............... Page 7
• Cooling Capacity/Heating Capacity/
  Pump Capacity (Thermo-con Outlet) ...... Page 8
• Parts Description .......................... Page 9
• Dimensions ................................ Page 10, 11
• Connectors ................................. Page 12
• Alarm/Maintenance ...................... Page 13
• Options ........................................ Page 14
• Specific Product Precautions ............. Page 15 to 17

Water-cooled Series HEC-W

• How to Order/Specifications ............... Page 19, 20
• Cooling Capacity/Heating Capacity/
  Pump Capacity (Thermo-con Outlet)/
  Pressure Loss in Facility Water Circuit ... Page 21 to 23
• Parts Description .......................... Page 24
• Dimensions ................................ Page 25 to 27
• Connectors ................................. Page 28
• Alarm/Maintenance ...................... Page 29
• Options ........................................ Page 30
• Specific Product Precautions ............. Page 31, 32
**Guide to Model Selection**

1. **What radiation method will be used?**

   Without a cooling tower .......... Air-cooled HEC-A series  
   With a cooling tower .......... Water-cooled HEC-W series

   **When to Use Air-cooled and Water-cooled Thermo-con**
   - **<Air-cooled>**
     - No facility water equipment → Can install the unit easily without facility water equipment.
     - Frequent piping changes → Can reduce the piping installation labor since facility water piping is not required.
   - **<Water-cooled>**
     - Need to avoid effects of ambient temperature. → Since the unit is water-cooled, the ambient temperature will have little effect.
     - Want to reduce installation space. → Can reduce the space since the unit is compact.

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

   Temperature range which can be set with the Thermo-con: 10 to 60°C
   If a lower temperature (down to –20°C) or higher temperature (up to 90°C) than this range is necessary, select the Thermo-chiller HRZ series.

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

   **Circulating fluids that can be used in the Thermo-con**

<table>
<thead>
<tr>
<th>Model</th>
<th>Clear water</th>
<th>Fluorinert™ FC-3238 GALDEN® HT135</th>
<th>20% ethylene glycol</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEC001-W, HEC003-W</td>
<td>○</td>
<td>□</td>
<td>○</td>
</tr>
<tr>
<td>HEC006-W, HEC012-W</td>
<td>○</td>
<td>○</td>
<td>□</td>
</tr>
<tr>
<td>HEC002-A, HEC006-A</td>
<td>○</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

   ○ : Usable  □ : Unusable

4. **How much cooling capacity required?**

   Allows a safety factor of 20% over the capacity that is actually required, taking into account the changes in the operating conditions. If a larger capacity than this Thermo-con is necessary, select the Thermo-cooler HRG series or Thermo-chiller HRZ series.

   **Example 1** When the heat generation amount in the customer’s machine is known.

   Heat generation amount: 400 W

   Cooling capacity = Considering a safety factor of 20%, \( 400 \times 1.2 = 480 \text{ W} \)
Guide to Model Selection

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

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

Heat generation amount $Q$ = Unknown
Circulating fluid temperature difference $\Delta T = (T_2 - T_1)$: $0.8 \, ^\circ C$ (0.8 K)
Circulating fluid outlet temperature $T_1$: $25^\circ C$ (298.15 K)
Circulating fluid return temperature $T_2$: $25.8 \, ^\circ C$ (298.95 K)
Circulating fluid flow rate $L$: $3$ L/min
Circulating fluid: Water

Density $\gamma$: $1 \times 10^3 \, \text{kg/m}^3$
Specific heat $C$: $4.2 \times 10^3 \, \text{J/(kg} \cdot \text{K})$

$$Q = \frac{\Delta T \times L \times \gamma \times C}{60 \times 1000}$$
$$= \frac{0.8 \times 3 \times 1 \times 10^3 \times 4.2 \times 10^3}{60 \times 1000}$$
$$= 167 \, \text{W}$$

Cooling capacity = Considering a safety factor of 20%,
$$167 \, \text{W} \times 1.2 = 200 \, \text{W}$$

Example 3 When cooling the object below a certain temperature in certain period of time.

Cooled substance total volume $V$: $20$ L
Cooling time $h$: $15$ min
Cooling temperature difference $\Delta T$: Temperature difference: $10^\circ C$ (10 K). Cool from $30^\circ C$ (303 K) to $20^\circ C$ (293 K).
Circulating fluid: Clear water
Density $\gamma$: $1 \times 10^3 \, \text{kg/m}^3$
Specific heat $C$: $4.2 \times 10^3 \, \text{J/(kg} \cdot \text{K})$

* Refer to the information shown below for the typical physical property values by circulating fluid.

$$Q = \frac{\Delta T \times V \times \gamma \times C}{h \times 60 \times 1000}$$
$$= \frac{10 \times 20 \times 1 \times 10^3 \times 4.2 \times 10^3}{15 \times 60 \times 1000}$$
$$= 933 \, \text{W}$$

Cooling capacity = Considering a safety factor of 20%,
$$933 \, \text{W} \times 1.2 = 1120 \, \text{W}$$

Precautions on Model Selection

The flow rate of the circulating fluid depends on the pressure loss of the customer's machine and the length, diameter and resistance created by bends in the circulating fluid piping, etc. Check if the required flow rate of circulating fluid can be obtained before selecting.

Circulating Fluid Typical Physical Property Values

<table>
<thead>
<tr>
<th>Fluorinated Fluids</th>
<th>Physical property value</th>
<th>Density $\gamma$ [kg/m$^3$]</th>
<th>Specific heat $C$ [J/(kg·K)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$-10^\circ C$</td>
<td></td>
<td>$1.87 \times 10^3$</td>
<td>$0.87 \times 10^3$</td>
</tr>
<tr>
<td>$20^\circ C$</td>
<td></td>
<td>$1.80 \times 10^3$</td>
<td>$0.96 \times 10^3$</td>
</tr>
<tr>
<td>$50^\circ C$</td>
<td></td>
<td>$1.74 \times 10^3$</td>
<td>$1.05 \times 10^3$</td>
</tr>
<tr>
<td>$80^\circ C$</td>
<td></td>
<td>$1.67 \times 10^3$</td>
<td>$1.14 \times 10^3$</td>
</tr>
</tbody>
</table>

Water
Density $\gamma$: $1 \times 10^3$ [kg/m$^3$]
Specific heat $C$: $4.2 \times 10^3$ [J/(kg·K)]
# Peltier-Type Chiller
## Thermo-con (Air-cooled)
### Series HEC-A

## How to Order

**HEC 002 - A 5 B**

<table>
<thead>
<tr>
<th>Cooling capacity</th>
<th>Radiating method</th>
<th>Power supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>002 230 W</td>
<td><strong>A</strong> Air-cooled</td>
<td>5 100 to 240 VAC</td>
</tr>
<tr>
<td>006 600 W</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Option**

- None
- F With flow switch
- N NPT thread

+ The option should be specified when ordering.

### Communication

- A RS-485
- B RS-232C

+ Select B when communication is not used.

## Specifications
(For details, please consult our “Product Specifications” information.)

<table>
<thead>
<tr>
<th>Model</th>
<th>HEC002-A5A</th>
<th>HEC002-A5B</th>
<th>HEC006-A5A</th>
<th>HEC006-A5B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling method</td>
<td>Thermoelectric device (Thermo-module)</td>
<td>Forced air cooling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiating method</td>
<td>Forced air cooling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control method</td>
<td>Cooling/Heating automatic shift PID control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature/humidity</td>
<td>10 to 35°C, 35 to 80%RH (no condensation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circulating fluid</td>
<td>Clear water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>10.0 to 60.0°C (no condensation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling capacity</td>
<td>230 W Note 1)</td>
<td>600 W Note 2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating capacity</td>
<td>600 W Note 1)</td>
<td>900 W Note 2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature stability Note 3)</td>
<td>±0.01 to ±0.03°C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump capacity</td>
<td>Refer to performance chart.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tank capacity</td>
<td>Approx. 1.2 L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port size</td>
<td>IN/OUT Rc1/4</td>
<td>Rc3/8 (with plug)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetted parts material</td>
<td>Stainless steel 303, Stainless steel 304, EPDM, Ceramics, PPS glass 30%, Carbon, PE, Polyurethane</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>Single-phase 100 to 240 VAC ±10%, 50/60 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overcurrent protector</td>
<td>15 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current consumption</td>
<td>8 A (100 VAC) to 3 A (240 VAC)</td>
<td>10 A (100 VAC) to 4 A (240 VAC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm</td>
<td>Refer to alarm function.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communications</td>
<td>RS-485</td>
<td>RS-232C</td>
<td>RS-485</td>
<td>RS-232C</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 17.5 kg (including foot for fixing)</td>
<td>Approx. 27.5 kg (including foot for fixing)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessories</td>
<td>Power cable, Foot for fixing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety standards</td>
<td>CE marking, UL (NRTL) standards, Safety standard for medical equipment (IEC 60601-1)</td>
<td>CE marking, UL (NRTL) standards</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note 1) Conditions: Set temperature 25°C, Ambient temperature 25°C, Circulating flow rate 3 L/min

Note 2) Conditions: Set temperature 25°C, Ambient temperature 20°C, Circulating flow rate 8 L/min

Note 3) The indicated values are with a stable load without turbulence in the operating conditions. It may be out of this range in some other operating conditions.
The values shown on the performance chart are not guaranteed, but typical. Allow margins for safety when selecting the model.

**Cooling Capacity**

**HEC002**
- **Circulating fluid:** Clear water
- **Ambient temperatures:** 15°C, 25°C, 35°C

**HEC006**
- **Circulating fluid:** Clear water
- **Ambient temperatures:** 15°C, 20°C, 30°C

**Heating Capacity**

**HEC002**
- **Circulating fluid:** Clear water

**HEC006**
- **Circulating fluid:** Clear water

**Pump Capacity (Thermo-con Outlet)**

The pressure on the y-axis shows the discharge pressure of circulating fluid in the Thermo-con.

**HEC002**
- **Circulating fluid:** Clear water

**HEC006**
- **Circulating fluid:** Clear water
Parts Description

**HEC002**
- Power connector
- Handle
- Communication connector
  - RS-232C type: 1 pc.
  - RS-485 type: 2 pcs.
- Alarm connector
- External temperature sensor connector

**HEC006**
- Power connector
- Handle
- Communication connector
  - RS-232C type: 1 pc.
  - RS-485 type: 2 pcs.
- Alarm connector
- External temperature sensor connector

Additional components:
- Display/Operation panel
- Power switch
- Tank lid with gasket
- Circulating fluid level gauge
- Circulating fluid outlet
- Filter
- Circulating fluid inlet
- Drain (circulating fluid drain port)
Peltier-Type Chiller
Thermo-con (Air-cooled) Series HEC-A

Dimensions

<table>
<thead>
<tr>
<th>HEC002</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 x Plastic foot</td>
</tr>
<tr>
<td></td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>358</td>
</tr>
<tr>
<td></td>
<td>152</td>
</tr>
<tr>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

**Warning/Caution label**

**Display/Operation panel**

**Power switch**

**Alarm output connector**

**External temperature sensor connector**

**Power cable**

**Contents**

- Connector: IEC60320 C13 or equivalent
- Cable: 14AWG, O.D. ø8.4

<table>
<thead>
<tr>
<th>Wire colour</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>100 to 240 VAC</td>
</tr>
<tr>
<td>Black</td>
<td>100 to 240 VAC</td>
</tr>
<tr>
<td>Green/Yellow</td>
<td>PE</td>
</tr>
</tbody>
</table>

**Option (Fitting part)**

- NPT fitting specification (-N,-FN)
- Circulating fluid outlet NPT1/4
- Circulating fluid inlet NPT1/4
- Circulating fluid drain port (with plug) NPT1/4

**Power cable (Accessory)**

- Connector: IEC60320 C13 or equivalent
- Cable: 14AWG, O.D. ø8.4

- Wire colour: Black
  - Contents: 100 to 240 VAC

- Wire colour: Black
  -Contents: 100 to 240 VAC

- Wire colour: Green/Yellow
  -Contents: PE
Option (Fitting part)

- NPT fitting specification (-N, -FN)
- Circulating fluid outlet NPT3/8
- Circulating fluid inlet NPT3/8
- Circulating fluid drain port (with plug) NPT1/4

Power Cable (Accessory)

Connector: IEC 60320 C13 or equivalent
Cable: 14AWG, O.D. ø8.4

<table>
<thead>
<tr>
<th>Wire colour</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>100 to 240 VAC</td>
</tr>
<tr>
<td>Black</td>
<td>100 to 240 VAC</td>
</tr>
<tr>
<td>Green/Yellow</td>
<td>PE</td>
</tr>
</tbody>
</table>
Connectors

1. Power connector (AC)
   IEC 60320 C14 or equivalent
<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100 to 240 VAC</td>
</tr>
<tr>
<td>2</td>
<td>100 to 240 VAC</td>
</tr>
<tr>
<td>3</td>
<td>PE</td>
</tr>
</tbody>
</table>

2. Communication connector (RS-232C or RS-485)
   D-sub 9 pin (socket)
   Holding screw: M2.6
<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unused</td>
</tr>
<tr>
<td>2</td>
<td>RD</td>
</tr>
<tr>
<td>3</td>
<td>SD</td>
</tr>
<tr>
<td>4</td>
<td>Unused</td>
</tr>
<tr>
<td>5</td>
<td>SG</td>
</tr>
<tr>
<td>6-9</td>
<td>Unused</td>
</tr>
</tbody>
</table>

3. External sensor connector (EXT.SENSOR)
   D-sub 15 pin (socket)
   Holding screw: M2.6
<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>Unused</td>
</tr>
<tr>
<td>3</td>
<td>Terminal A of resistance temperature detector</td>
</tr>
<tr>
<td>4</td>
<td>Terminal B of resistance temperature detector</td>
</tr>
<tr>
<td>5</td>
<td>Terminal B of resistance temperature detector</td>
</tr>
<tr>
<td>6-14</td>
<td>Unused</td>
</tr>
<tr>
<td>15</td>
<td>FG</td>
</tr>
</tbody>
</table>

4. Alarm output connector (ALARM)
   D-sub 9 pin (pin)
   Holding screw: M2.6
<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Contact a for output cut-off alarm (open when alarm occurs)</td>
</tr>
<tr>
<td>2</td>
<td>Common for output cut-off alarm</td>
</tr>
<tr>
<td>3</td>
<td>Contact b for output cut-off alarm (closed when alarm occurs)</td>
</tr>
<tr>
<td>4-5</td>
<td>Unused</td>
</tr>
<tr>
<td>6</td>
<td>Contact a for upper/lower temp. limit alarm (open when alarm occurs)</td>
</tr>
<tr>
<td>7</td>
<td>Common for upper/lower temp. limit alarm</td>
</tr>
<tr>
<td>8</td>
<td>Contact b for upper/lower temp. limit alarm (closed when alarm occurs)</td>
</tr>
<tr>
<td>9</td>
<td>Unused</td>
</tr>
</tbody>
</table>
Series HEC-A

Alarm

This unit is equipped as standard with a function allowing 15 kinds of alarms to display on the LCD and can be read out by serial communication. Also, it can generate relay output for upper/lower temperature limit alarm and output cut-off alarm.

<table>
<thead>
<tr>
<th>Alarm code</th>
<th>Alarm description</th>
<th>Operation status</th>
<th>Main reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRN</td>
<td>Upper/Lower temp. limit alarm</td>
<td>Continue</td>
<td>The temperature has exceeded the upper or lower limit of the target temperature.</td>
</tr>
<tr>
<td>ERR00</td>
<td>CPU hung-up</td>
<td>Stop</td>
<td>The CPU has crashed due to noise, etc.</td>
</tr>
<tr>
<td>ERR01</td>
<td>CPU check error</td>
<td>Stop</td>
<td>The contents of the CPU cannot be read out correctly when the power supply is turned on.</td>
</tr>
<tr>
<td>ERR03</td>
<td>Back-up data error</td>
<td>Stop</td>
<td>The contents of the back-up data cannot be read out correctly when the power supply is turned on.</td>
</tr>
<tr>
<td>ERR04</td>
<td>EEPROM writing error</td>
<td>Stop</td>
<td>The data cannot be written to EEPROM.</td>
</tr>
<tr>
<td>ERR11</td>
<td>DC power supply failure</td>
<td>Stop</td>
<td>The DC power supply has failed (due to fan stop or abnormal high temperature) or the thermo-module has been short-circuited.</td>
</tr>
<tr>
<td>ERR12</td>
<td>Internal temp. sensor high temp. error</td>
<td>Stop</td>
<td>The internal temperature sensor has exceeded the upper limit of cut-off temperature.</td>
</tr>
<tr>
<td>ERR13</td>
<td>Internal temp. sensor low temp. error</td>
<td>Stop</td>
<td>The internal temperature sensor has exceeded the lower limit of cut-off temperature.</td>
</tr>
<tr>
<td>ERR14</td>
<td>Thermostat alarm</td>
<td>Stop</td>
<td>The thermostat has been activated due to filter clog or fan/pump failure, etc.</td>
</tr>
<tr>
<td>ERR15</td>
<td>Abnormal output alarm</td>
<td>Continue</td>
<td>The temperature cannot be changed even at 100% output due to overload or disconnection of the thermo-module.</td>
</tr>
<tr>
<td>ERR16</td>
<td>Low flow rate alarm (option)</td>
<td>Stop</td>
<td>The flow rate of the circulating fluid has dropped.</td>
</tr>
<tr>
<td>ERR17</td>
<td>Internal temp. sensor disconnection alarm</td>
<td>Stop</td>
<td>The internal temperature sensor has been disconnected or short-circuited.</td>
</tr>
<tr>
<td>ERR18</td>
<td>External temp. sensor disconnection alarm</td>
<td>Continue</td>
<td>The external temperature sensor has been disconnected or short-circuited. (Only detected when in learning control or external tune control)</td>
</tr>
<tr>
<td>ERR19</td>
<td>Abnormal auto tuning alarm</td>
<td>Stop</td>
<td>Auto tuning has not been completed within 20 minutes.</td>
</tr>
<tr>
<td>ERR20</td>
<td>Low fluid level alarm</td>
<td>Stop</td>
<td>The amount of circulating fluid in the tank has dropped.</td>
</tr>
</tbody>
</table>

Maintenance

Maintenance of this unit is performed only in the form of return to and repair at SMC’s site. As a rule, SMC will not conduct on-site maintenance. Separately, the following parts have a limited life and need to be replaced before the life ends.

Parts Life Expectation

<table>
<thead>
<tr>
<th>Description</th>
<th>Expected life</th>
<th>Possible failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump</td>
<td>3 to 5 years</td>
<td>The bearing is worn so the pump fails to transfer the circulating fluid, which results in temperature control failure.</td>
</tr>
<tr>
<td>Fan</td>
<td>5 to 10 years</td>
<td>The bearing uses up lubrication and makes the fan unable to supply enough air, which deteriorates the cooling and heating capacity.</td>
</tr>
<tr>
<td>DC power supply</td>
<td>5 to 10 years</td>
<td>The capacity of the electrolytic condenser decreases, and causes abnormal voltage which results in DC power supply failure and stops the Thermo-con.</td>
</tr>
<tr>
<td>Display panel</td>
<td>50,000 hours (approx. 5 years)</td>
<td>The display turns off when the backlight of the LCD reaches the end of its life.</td>
</tr>
</tbody>
</table>
### Series HEC-A Options

**With Flow Switch**

HEC□□□□-□-F

- With flow switch

This is an ON/OFF switch detecting low levels of the circulating fluid. When the fluid volume is 1 L/min. or less, “ERR16” is displayed and the Thermo-con stops. This switch is installed between the circulating fluid inlet and the tank, and built into the Thermo-con. Refer to page 2.

<table>
<thead>
<tr>
<th>Type</th>
<th>Applicable model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air-cooled</td>
<td>HEC002-A5□□□-F</td>
</tr>
<tr>
<td></td>
<td>HEC006-A5□□□-F</td>
</tr>
</tbody>
</table>

**NPT Thread**

HEC□□□□-□-N

- NPT thread

The connection parts of circulating fluid piping, facility water piping and circulating fluid drain port are NPT thread type.

<table>
<thead>
<tr>
<th>Type</th>
<th>Applicable model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air-cooled</td>
<td>HEC002-A5□□□-N</td>
</tr>
<tr>
<td></td>
<td>HEC006-A5□□□-N</td>
</tr>
</tbody>
</table>

Note) Options have to be selected when ordering the Thermo-con. It is not possible to add them after purchasing the unit.
Series HEC-A
Specific Product Precautions 1
Be sure to read this before handling. Refer to back cover for Safety Instructions, “Handling Precautions for SMC Products” (M-E03-3) and “Operation Manual” for Temperature Control Equipment Precautions. The Operation Manual can be downloaded from the SMC website: http://www.smc.eu

⚠️ Warning
1. This catalogue shows the specifications of the Thermo-con.
   1. Check detailed specifications in the separate “Product Specifications”, and evaluate the compatibility of the Thermo-con with customer’s system.
   2. Although the protection circuit as a single unit is installed, the customer is requested to carry out the safety design for the whole system.

Knowing
1. Thoroughly read the Operation Manual.
   Read the Operation Manual completely before operation, and keep this manual available whenever necessary.
2. If the set temperature is repeatedly changed by 10°C or more, the Thermo-con may fail in short periods of time.

⚠️ Warning
1. Keep within the specified ambient temperature and humidity range.
   Also, if the set temperature is too low, condensation may form on the inside of the Thermo-con or the surface of piping even within the specified ambient temperature range. Dew condensation can cause failure, and so must be avoided by considering operating conditions.
2. The Thermo-con is not designed for clean room usage.
   It generates dust from the pump inside the unit and the cooling fan.
3. Low molecular siloxane can damage the contact of the relay.
   Use the Thermo-con in a place free from low molecular siloxane.

⚠️ Warning
The rear side is opened.
Intake
Discharge
100 mm or more
The rear side is closed.
Intake
Discharge
200 mm or more

Note) The space must be 100 mm or more. Be sure that the ambient temperature is within the specification range.

⚠️ Caution
1. The inlet for radiation air must not be exposed to particles and dust as far as possible.
2. Do not let the inlet and outlet for radiation air get closed.

<HEC002>
If radiation is prevented, the set temperature may not be achieved depending on the value of the set temperature and the load. Keep a space of 100 mm for opened rear side or 200 mm for closed rear side respectively.

<HEC006>
The rear side is opened.
Intake
Discharge
500 mm or more
The rear side is closed.
Intake
Discharge
500 mm or more

---

System Design

Radiation Air

Handling

Operating Environment/Storage Environment
Caution

3. If more than one Thermo-con is used, consider their arrangement so that the downstream sides of the Thermo-cons suck radiation air from the upstream sides.

Otherwise, the performance at the downstream sides may deteriorate. Also, the set temperature may not be achieved depending on the value of the set temperature and the load. In such a case, take countermeasures such as changing the direction of the Thermo-cons to prevent the deterioration of performance.

4. If dust adheres to the filter, remove dust with a vacuum cleaner or a dry cloth.

5. Do not operate without the filter.

Otherwise, dust may accumulate on the heat sink and electrical components, causing abnormal heating.

Circulating Fluid

Caution

1. Use tap water or fluid which will not damage the wetted material.

(Stainless steel 303, Stainless steel 304, EPDM, Polypropylene, PE, PPE, Ceramics, Polyurethane)

2. Deionized water (with an electrical conductivity of approx. 1 μS/cm) can be used, but may lose its electrical conductivity.

Also, if a facility supplying deionized water is used, the Thermo-con may be damaged by static electricity.

3. If deionized water is used, bacteria and algae may grow in short periods of time.

If the Thermo-con is operated with bacteria and algae, its cooling capacity or the capacity of the pump may deteriorate. Exchange all deionized water regularly depending on the conditions (once a month as a guide).

4. If using a fluid other than water, please contact SMC beforehand.

5. The maximum operating pressure of circulating fluid circuit is 0.1 MPa.

If this pressure is exceeded, leakage from the tank in the Thermo-con can result.

6. Select a pipe with a length and diameter which allow a flow rate of 1 L/min or more (HEC002) or 3 L/min or more (HEC006) for the circulating fluid.

If the flow rate is less than these values, the Thermo-con cannot provide precise control, but also can fail because of the repeated cooling and heating operation.

7. A magnet driven pump is used as a circulating pump.

A fluid which contains metal powders such as iron powder cannot be used.

8. The Thermo-con must not be operated without circulating fluid.

The pump can break due to idling.

### Table: Circulating Fluid Quality Standards

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Standard value</th>
<th>Influence</th>
<th>Scale generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH (at 25°C)</td>
<td>—</td>
<td>6.0 to 8.0</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Electrical conductivity (μS/cm)</td>
<td>[μS/cm]</td>
<td>100* to 300*</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Chloride ion (Cl–)</td>
<td>[mg/L]</td>
<td>50 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Sulfuric acid ion (SO₄²⁻)</td>
<td>[mg/L]</td>
<td>50 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Acid consumption amount (at pH4.8)</td>
<td>[mg/L]</td>
<td>50 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Total hardness</td>
<td>[mg/L]</td>
<td>70 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Calcium hardness (CaCO₃)</td>
<td>[mg/L]</td>
<td>50 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Ionic state silica (SiO₂)</td>
<td>[mg/L]</td>
<td>30 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>[mg/L]</td>
<td>0.3 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>[mg/L]</td>
<td>0.1 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>0.1 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Residual chlorine (Cl)</td>
<td>[mg/L]</td>
<td>0.3 or less</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Free carbon (CO₂)</td>
<td>[mg/L]</td>
<td>4.0 or less</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

* In the case of [μL2–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.
Series HEC-A
Specific Product Precautions 3

Be sure to read this before handling. Refer to back cover for Safety Instructions, “Handling Precautions for SMC Products” (M-E03-3) and “Operation Manual” for Temperature Control Equipment Precautions. The Operation Manual can be downloaded from the SMC website: http://www.smc.eu

<table>
<thead>
<tr>
<th>Communication</th>
</tr>
</thead>
</table>

⚠️ Caution

1. The set value can be written to EEPROM, but only up to approx. 1 million times.
   In particular, pay attention to how many of times the writing is performed using the communication function.

<table>
<thead>
<tr>
<th>Maintenance</th>
</tr>
</thead>
</table>

⚠️ Warning

1. Prevention of electric shock and fire
   Do not operate the switch with wet hands. Also, do not operate the Thermo-con with water left on it.

2. Action in the case of error
   If any error such as abnormal sounds, smoke, or bad smell occurs, cut off the power at once, and stop supplying and conveying fluid. Please contact SMC or a sales distributor to repair the Thermo-con.

3. Regular inspection
   Check the following items at least once a month. The inspection must be done by an operator who has sufficient knowledge and experience.
   a) Check of displayed contents.
   b) Check of temperature, vibration and abnormal sounds in the body of the Thermo-con.
   c) Check of the voltage and current of the power supply system.
   d) Check for leakage and contamination of the circulating fluid and intrusion of foreign objects to it, and subsequent replacement of the fluid.
   e) Check for flow condition, temperature and filter of radiation air.
Peltier-Type Chiller
Thermo-con (Water-cooled)
Series HEC-W

How to Order

140 W, 320 W

<table>
<thead>
<tr>
<th>Model</th>
<th>HEC001-W5A</th>
<th>HEC001-W5B</th>
<th>HEC003-W5A</th>
<th>HEC003-W5B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling method</td>
<td>Thermoelectric device (Thermo-module)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiating method</td>
<td>Water-cooled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control method</td>
<td>Cooling/Heating automatic shift PID control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature/humidity</td>
<td>10 to 35°C, 35 to 80%RH (no condensation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circulating fluid</td>
<td>Clear water, 20% ethylene glycol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temp. range</td>
<td>10.0 to 60.0°C (no condensation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling capacity</td>
<td>140 W (Note 1)</td>
<td>320 W (Note 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating capacity</td>
<td>400 W (Note 1)</td>
<td></td>
<td>770 W (Note 1)</td>
<td></td>
</tr>
<tr>
<td>Temperature stability</td>
<td>±0.01 to 0.03°C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump capacity</td>
<td>Refer to performance chart.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tank capacity</td>
<td>Approx. 1.2 L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port size</td>
<td>IN/OUT: Rc3/8, Drain: Rc1/4 (with plug)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetted parts material</td>
<td>PPE, PP glass 10%, Alumina ceramics, Carbon, EPDM, Stainless steel 303, Stainless steel 304, PE, PP, NBR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>10 to 35°C (no condensation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure range</td>
<td>Within 1 MPa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required flow rate (Note 3)</td>
<td>3 to 7 L/min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port size</td>
<td>IN/OUT: Rc3/8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetted parts material</td>
<td>Stainless steel 303</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>Single-phase 100 to 240 VAC ±10%, 50/60 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overcurrent protector</td>
<td>10 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current consumption</td>
<td>3.5 A (100 VAC) to 1.5 A (240 VAC)</td>
<td>5.5 A (100 VAC) to 2.5 A (240 VAC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm</td>
<td>Refer to alarm function.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communications</td>
<td>RS-485</td>
<td>RS-232C</td>
<td>RS-485</td>
<td>RS-232C</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 12 kg</td>
<td>Approx. 13 kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessories</td>
<td>Power cable, Foot for fixing, Splashproof cover</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety standards</td>
<td>CE marking, UL (NRTL) standards, SEMI</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note 2) The indicated values are with a stable load without turbulence in the operating conditions. It may be out of this range in some other operating conditions.
Note 3) The flow rate over or below the set range may deteriorate performance or generate noise.
How to Order

- Model: HEC 012-W2B
- Radiating method: Water-cooled
- Power supply: 200 to 220 VAC
- Cooling capacity: 600 W
- Heating capacity: 900 W
- Option: None

Specifications (For details, please consult our “Product Specifications” information.)

<table>
<thead>
<tr>
<th>Model</th>
<th>HEC006-W2A</th>
<th>HEC006-W2B</th>
<th>HEC012-W2A</th>
<th>HEC012-W2B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling method</td>
<td>Thermoelectric device (Thermo-module)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiating method</td>
<td>Water-cooled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control method</td>
<td>Cooling/Heating automatic shift PID control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature/humidity</td>
<td>10 to 35°C, 35 to 80%RH (no condensation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circulating fluid (Note 1)</td>
<td>Clear water, Fluorinated fluid (Fluorinert™ FC-3283, GALDEN® HT135)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>10.0 to 60.0°C (no condensation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling capacity</td>
<td>600 W (Clear water), 400 W (Fluorinert™ FC-3283) (Note 2)</td>
<td>1200 W (Clear water), 800 W (Fluorinert™ FC-3283) (Note 3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating capacity</td>
<td>900 W (Clear water), 600 W (Fluorinert™ FC-3283) (Note 2)</td>
<td>2200 W (Clear water), 1500 W (Fluorinert™ FC-3283) (Note 3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature stability (Note 4)</td>
<td>±0.01 to 0.03°C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump capacity</td>
<td>Refer to performance chart.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tank capacity</td>
<td>Approx. 3 L</td>
<td>Approx. 5 L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port size</td>
<td>IN/OUT: Rc3/8, Drain: Rc1/4 (with plug)</td>
<td>IN/OUT: Rc3/4, Drain: Rc1/4 (with plug)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetted parts material</td>
<td>Stainless steel 303, Stainless steel 304, EPDM, Ceramics, PPS glass 30%, Carbon, PE, Polyurethane</td>
<td>Stainless steel 303, Stainless steel 304, EPDM, Ceramics, PP, PE, Polyurethane, SiC, PPS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>10 to 35°C (no condensation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure range</td>
<td>Within 1 MPa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required flow rate (Note 5)</td>
<td>8 to 10 L/min</td>
<td>10 to 15 L/min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port size</td>
<td>IN/OUT: Rc3/8</td>
<td>IN/OUT: Rc1/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetted parts material</td>
<td>Stainless steel 303, Stainless steel 304</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>Single-phase 200 to 220 VAC ±10%, 50/60 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overcurrent protector</td>
<td>10 A</td>
<td>15 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current consumption</td>
<td>5 A</td>
<td>10 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm</td>
<td>Refer to alarm function.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communications</td>
<td>RS-485</td>
<td>RS-232C</td>
<td>RS-485</td>
<td>RS-232C</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 25 kg (including foot for fixing)</td>
<td>Approx. 40 kg (including foot for fixing)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessories</td>
<td>Power cable, Foot for fixing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety standards</td>
<td>CE marking</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note 1) Fluorinert™ is a trademark of 3M and GALDEN® is a registered trademark of Solvay Solexis, Inc. Regarding the fluid other than the above, please consult with SMC.

Note 2) Conditions: Set temperature 25°C, Facility water temperature 20°C, Facility water flow rate 8 L/min, Ambient temperature 25°C.


Note 4) The indicated values are with a stable load without turbulence in the operating conditions. It may be out of this range in some other operating conditions.

Note 5) The flow rate over or below the set range may deteriorate performance or generate noise.
The values shown on the performance chart are not guaranteed, but typical. Allow margins for safety when selecting the model.
The values shown on the performance chart are not guaranteed, but typical. Allow margins for safety when selecting the model.

### Heating Capacity

#### HEC001
- **Circulating fluid:** Clear water
- **Circulating fluid:** 20% ethylene glycol

#### HEC003
- **Circulating fluid:** Clear water
- **Circulating fluid:** 20% ethylene glycol

#### HEC006
- **Circulating fluid:** Clear water
- **Circulating fluid:** FC-3283

#### HEC012
- **Circulating fluid:** Clear water
- **Circulating fluid:** FC-3283

---

**Thermo-con (Water-cooled) Series HEC-W**

---

- Facility water flow rate: 5 L/min
- Facility water flow rate: 8 L/min
- Facility water flow rate: 10 L/min
- Facility water temperature: 10°C
- Facility water temperature: 20°C
- Facility water temperature: 30°C
- Facility water temperature: 35°C

---

**SMC**

---

Page 22
**Pump Capacity (Thermo-con Outlet)**

**HEC001/003** Since a DC pump is used, the unit is not affected by power requirements.

![Graph showing pump capacity for HEC001/003](image)

20% ethylene glycol

**HEC006** Since a DC pump is used, the unit is not affected by power requirements.

![Graph showing pump capacity for HEC006](image)

Fluorinert™ FC-3283

**HEC012**

![Graph showing pump capacity for HEC012](image)

Water, Fluorinert™ FC-3283

**Pressure Loss in Facility Water Circuit**

**HEC001**

![Graph showing pressure loss for HEC001](image)

Facility water flow rate [L/min]

**HEC003**

![Graph showing pressure loss for HEC003](image)

Facility water flow rate [L/min]

**HEC006**

![Graph showing pressure loss for HEC006](image)

Facility water flow rate [L/min]

**HEC012**

![Graph showing pressure loss for HEC012](image)

Facility water flow rate [L/min]
Parts Description

HEC001/003

Display/Operation panel
Tank lid (with O-ring)
Circulating fluid inlet
Circulating fluid level gauge
Power switch
Handle
Facility water outlet
Facility water inlet
External temperature sensor connector
Alarm output connector
Communication connector
RS-232C type 1 pc.
RS-485 type 2 pcs.
Power connector
(Connect the attached power cable.)
Drain (Circulating fluid drain port)
Splashproof cover
Cooling fan
Communication connector
RS-232C type 1 pc.
RS-485 type 2 pcs.
Alarm output connector
External temperature sensor connector
Power connector
(Connect the attached power cable.)

HEC006/012

Display/Operation panel
Tank lid (with gasket)
Circulating fluid level gauge
Power switch
Handle
Facility water outlet
Facility water inlet
Splashproof cover
Circulating fluid inlet
Circulating fluid outlet
Drain (Circulating fluid drain port)
### Dimensions

**HEC001-W5**

**HEC003-W5**

---

**Warning/Caution label**

- 4 x width 5

**Tank lid**

- (with O-ring)

**Foot**

- (Accessory)

**Display/Operation panel**

- 321

**Handle**

- 100

**Splashproof cover**

- (Accessory)

**Circulating fluid inlet**

- Rc3/8

**Facility water inlet**

- Rc3/8

**Facility water outlet**

- Rc3/8

**Circulating fluid outlet**

- Rc3/8

**External temperature sensor connector**

- 150

**Alarm output connector**

- 128

**Communication connector**

- 82

**Power connector**

**Model no. label**

**Drain (Circulating fluid drain port)**

**Power switch**

**Circulating fluid level gauge**

**Power Cable (Accessory)**

- Connector: IEC 60320 C13 or equivalent
- Cable: 14AWG, O.D. ø8.4

<table>
<thead>
<tr>
<th>Wire colour</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>100 to 240 VAC</td>
</tr>
<tr>
<td>Black</td>
<td>100 to 240 VAC</td>
</tr>
<tr>
<td>Green/Yellow</td>
<td>PE</td>
</tr>
</tbody>
</table>

For NPT thread specification (-N), all fittings (including those at the circulating fluid drain port) are made of NPT.
For NPT thread specification (-N), all fittings (including those at the circulating fluid drain port) are made of NPT.

Power Cable

Connector: IEC 60320 C13 or equivalent
Cable: 14AWG, O.D. ø8.4

<table>
<thead>
<tr>
<th>Wire colour</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>200 to 220 VAC</td>
</tr>
<tr>
<td>Black</td>
<td>200 to 220 VAC</td>
</tr>
<tr>
<td>Green/Yellow</td>
<td>PE</td>
</tr>
</tbody>
</table>
**Series HEC-W**

### Dimensions

#### HEC012-W2

![Dimensions Diagram]

- **Facility water outlet**: Rc1/2
- **Circulating fluid outlet**: Rc3/4
- **Fan**: 361
- **Communication connector**: 165
- **Alarm output connector**: 187
- **External temperature sensor connector**: 281
- **Power connector**: 494
- **Display/Operation panel**: 306
- **Warning/Caution label**: 300
- **Foot (Accessory)**: 165
- **Power cable (Accessory)**: 404
- **Circulating fluid level gauge**: 550
- **Tank lid with gasket**: 281
- **Handle**: 190
- **Communication connector**: 40
- **Alarm output connector**: 361
- **External temperature sensor connector**: 187
- **Power connector**: 494
- **Display/Operation panel**: 306
- **Warning/Caution label**: 300
- **Foot (Accessory)**: 165
- **Power cable (Accessory)**: 404
- **Circulating fluid level gauge**: 550
- **Tank lid with gasket**: 281
- **Handle**: 190
- **Communication connector**: 40
- **Alarm output connector**: 361
- **External temperature sensor connector**: 187
- **Power connector**: 494
- **Display/Operation panel**: 306
- **Warning/Caution label**: 300
- **Foot (Accessory)**: 165
- **Power cable (Accessory)**: 404

#### Power Cable

- **Connector**: DDK CE05-6A18-10SD-D-BSS or equivalent
- **Cable**: 14AWG, O.D. ø8.4

<table>
<thead>
<tr>
<th>Wire colour</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>200 to 220 VAC</td>
</tr>
<tr>
<td>Black</td>
<td>200 to 220 VAC</td>
</tr>
<tr>
<td>Green/Yellow</td>
<td>PE</td>
</tr>
</tbody>
</table>

For NPT fitting specification (-N), all fittings (including those at the circulating fluid drain port) are made of NPT.
Connectors

HEC006-W2□/001-W5□/003-W5□

1. Power connector (AC)
   IEC 60320 C14 or equivalent
   HEC006-W2□
   HEC01-W5□
   HEC003-W5□

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>200 to 220 VAC</td>
</tr>
<tr>
<td>2</td>
<td>200 to 220 VAC</td>
</tr>
<tr>
<td>3</td>
<td>PE</td>
</tr>
<tr>
<td>4</td>
<td>100 to 240 VAC</td>
</tr>
<tr>
<td>5</td>
<td>100 to 240 VAC</td>
</tr>
<tr>
<td>6</td>
<td>PE</td>
</tr>
</tbody>
</table>

2. Communication connector (RS-232C or RS-485)
   D-sub 9 pin (socket)
   Holding screw: M2.6

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unused</td>
</tr>
<tr>
<td>2</td>
<td>RD</td>
</tr>
<tr>
<td>3</td>
<td>SD</td>
</tr>
<tr>
<td>4</td>
<td>Unused</td>
</tr>
<tr>
<td>5</td>
<td>SG</td>
</tr>
<tr>
<td>6-9</td>
<td>Unused</td>
</tr>
<tr>
<td>10</td>
<td>FG</td>
</tr>
</tbody>
</table>

3. External sensor connector (EXT.SENSOR)
   D-sub 15 pin (socket)
   Holding screw: M2.6

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>Unused</td>
</tr>
<tr>
<td>3</td>
<td>Terminal A of resistance temperature detector</td>
</tr>
<tr>
<td>4</td>
<td>Terminal B of resistance temperature detector</td>
</tr>
<tr>
<td>5</td>
<td>Terminal B of resistance temperature detector</td>
</tr>
<tr>
<td>6-14</td>
<td>Unused</td>
</tr>
<tr>
<td>15</td>
<td>FG</td>
</tr>
</tbody>
</table>

4. Alarm output connector (ALARM)
   D-sub 9 pin (pin)
   Holding screw: M2.6

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Contact a for output cut-off alarm (open when alarm occurs)</td>
</tr>
<tr>
<td>2</td>
<td>Common for output cut-off alarm</td>
</tr>
<tr>
<td>3</td>
<td>Contact b for output cut-off alarm (closed when alarm occurs)</td>
</tr>
<tr>
<td>4-5</td>
<td>Unused</td>
</tr>
<tr>
<td>6</td>
<td>Contact a for upper/lower temp. limit alarm (open when alarm occurs)</td>
</tr>
<tr>
<td>7</td>
<td>Common for upper/lower temp. limit alarm</td>
</tr>
<tr>
<td>8</td>
<td>Contact b for upper/lower temp. limit alarm (closed when alarm occurs)</td>
</tr>
<tr>
<td>9</td>
<td>Unused</td>
</tr>
</tbody>
</table>

HEC00-W2□

Power connector (AC)
   DDK CE05-2A18-10PD-D or equivalent

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>200 to 220 VAC</td>
</tr>
<tr>
<td>B</td>
<td>200 to 220 VAC</td>
</tr>
<tr>
<td>C</td>
<td>Unused</td>
</tr>
<tr>
<td>D</td>
<td>PE</td>
</tr>
</tbody>
</table>

Other connectors are the same as those for the HEC006-W2□.
## Alarm

This unit is equipped as standard with a function allowing 15 kinds of alarms to display on the LCD and can be read out by serial communication. Also, it can generate relay output for upper/lower temperature limit alarm and output cut-off alarm.

<table>
<thead>
<tr>
<th>Alarm code</th>
<th>Alarm description</th>
<th>Operation status</th>
<th>Main reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRN</td>
<td>Upper/Lower temp. limit alarm</td>
<td>Continue</td>
<td>The temperature has exceeded the upper or lower limit of the target temperature.</td>
</tr>
<tr>
<td>ERR00</td>
<td>CPU hung-up</td>
<td>Stop</td>
<td>The CPU has crashed due to noise, etc.</td>
</tr>
<tr>
<td>ERR01</td>
<td>CPU check error</td>
<td>Stop</td>
<td>The contents of the CPU cannot be read out correctly when the power supply is turned on.</td>
</tr>
<tr>
<td>ERR03</td>
<td>Back-up data error</td>
<td>Stop</td>
<td>The contents of the back-up data cannot be read out correctly when the power supply is turned on.</td>
</tr>
<tr>
<td>ERR04</td>
<td>EEPROM writing error</td>
<td>Stop</td>
<td>The data cannot be written to EEPROM.</td>
</tr>
<tr>
<td>ERR11</td>
<td>DC power supply failure</td>
<td>Stop</td>
<td>The DC power supply has failed (due to abnormal high temperature) or an irregular voltage has occurred or the thermo-module has been short-circuited.</td>
</tr>
<tr>
<td>ERR12</td>
<td>Internal temp. sensor high temp. error</td>
<td>Stop</td>
<td>The internal temperature sensor has exceeded the upper limit of cut-off temperature.</td>
</tr>
<tr>
<td>ERR13</td>
<td>Internal temp. sensor low temp. error</td>
<td>Stop</td>
<td>The internal temperature sensor has exceeded the lower limit of cut-off temperature.</td>
</tr>
<tr>
<td>ERR14</td>
<td>Thermostat alarm</td>
<td>Stop</td>
<td>The thermostat has been activated due to insufficient of the facility water or high temperature.</td>
</tr>
<tr>
<td>ERR15</td>
<td>Abnormal output alarm</td>
<td>Continue</td>
<td>The temperature cannot be changed even at 100% output due to overload or disconnection of the thermo-module.</td>
</tr>
<tr>
<td>ERR16</td>
<td>Pump failure or low circulating fluid level alarm</td>
<td>Stop</td>
<td>The pump has been overloaded or the flow switch is activated.</td>
</tr>
<tr>
<td>ERR17</td>
<td>Internal temp. sensor disconnection alarm</td>
<td>Stop</td>
<td>The internal temperature sensor has been disconnected or short-circuited.</td>
</tr>
<tr>
<td>ERR18</td>
<td>External temp. sensor disconnection alarm</td>
<td>Continue</td>
<td>The external temperature sensor has been disconnected or short-circuited. (Only detected when in learning control or external tune control.)</td>
</tr>
<tr>
<td>ERR19</td>
<td>Abnormal auto tuning alarm</td>
<td>Stop</td>
<td>Auto tuning has not been completed within 20 minutes.</td>
</tr>
<tr>
<td>ERR20</td>
<td>Low fluid level alarm</td>
<td>Stop</td>
<td>The amount of circulating fluid in the tank has dropped and the level switch is activated.</td>
</tr>
</tbody>
</table>

*1 The HEC012 only
*2 Optional for the HEC001 and HEC003 only (Not available for the HEC006)
*3 Optional for the HEC001 and HEC003

## Maintenance

Maintenance of this unit is performed only in the form of return to and repair at SMC’s site. As a rule, SMC will not conduct on-site maintenance. Separately, the following parts have a limited life and need to be replaced before the life ends.

## Parts Life Expectation

<table>
<thead>
<tr>
<th>Description</th>
<th>Expected life</th>
<th>Possible failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump</td>
<td>3 to 5 years</td>
<td>The bearing is worn so the pump fails to transfer the circulating fluid, which results in temperature control failure.</td>
</tr>
<tr>
<td>Fan</td>
<td>5 to 10 years</td>
<td>The bearing uses up lubrication and makes the fan unable to supply enough air, which increases the internal temperature of the Thermo-con, and activates the overheating protection of the power supply and generates the alarm.</td>
</tr>
<tr>
<td>DC power supply</td>
<td>5 to 10 years</td>
<td>The capacity of the electrolytic condenser decreases, and causes abnormal voltage which results in DC power supply failure and stops the Thermo-con.</td>
</tr>
<tr>
<td>Display panel</td>
<td>50,000 hours (approx. 5 years)</td>
<td>The display turns off when the backlight of the LCD reaches the end of its life.</td>
</tr>
</tbody>
</table>
**Series HEC-W Options**

**F**  
**With Flow Switch**

HEC[---]%28---F  
*With flow switch*

This is an ON/OFF switch detecting low levels of the circulating fluid. When the fluid volume is 1 L/min. or less, “ERR16” is displayed and the Thermo-con stops. This switch is installed between the circulating fluid inlet and the tank, and built into the Thermo-con. Refer to page 2.

<table>
<thead>
<tr>
<th>Type</th>
<th>Applicable model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water-cooled</td>
<td>HEC001-W5-%28-F</td>
</tr>
<tr>
<td></td>
<td>HEC003-W5-%28-F</td>
</tr>
</tbody>
</table>

**N**  
**NPT Thread**

HEC[---]%28---N  
*NPT thread*

The connection parts of circulating fluid piping, facility water piping and circulating fluid drain port are NPT thread type.

<table>
<thead>
<tr>
<th>Type</th>
<th>Applicable model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water-cooled</td>
<td>HEC001-W5-%28-N</td>
</tr>
<tr>
<td></td>
<td>HEC003-W5-%28-N</td>
</tr>
<tr>
<td></td>
<td>HEC006-W2-%28-N</td>
</tr>
<tr>
<td></td>
<td>HEC012-W2-%28-N</td>
</tr>
</tbody>
</table>

**L**  
**With Level Switch**

HEC[---]%28---L  
*With level switch*

This switch is used to detect a LOW level of tank fluid. When the fluid level becomes below the LOW level, “ERR20” is displayed and the Thermo-con stops. This switch is installed in the circulating fluid tank and built into the Thermo-con. Refer to page 2.

<table>
<thead>
<tr>
<th>Type</th>
<th>Applicable model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water-cooled</td>
<td>HEC001-W5-%28-L</td>
</tr>
<tr>
<td></td>
<td>HEC003-W5-%28-L</td>
</tr>
</tbody>
</table>

Other models include a level switch as standard equipment.

Note) Options have to be selected when ordering the Thermo-con. It is not possible to add them after purchasing the unit.
Series HEC-W
Specific Product Precautions 1

Be sure to read this before handling. Refer to back cover for Safety Instructions, “Handling Precautions for SMC Products” (M-E03-3) and “Operation Manual” for Temperature Control Equipment Precautions. The Operation Manual can be downloaded from the SMC website: http://www.smc.eu

⚠️ Warning

1. This catalogue shows the specifications of the Thermo-con.
   1. Check detailed specifications in the separate “Product Specifications”, and evaluate the compatibility of the Thermo-con with customer’s system.
   2. Although the protection circuit as a single unit is installed, the customer is requested to carry out the safety design for the whole system.

⚠️ Warning

1. Thoroughly read the Operation Manual.
   Read the Operation Manual completely before operation, and keep this manual available whenever necessary.
2. If the set temperature is repeatedly changed by 10°C or more, the Thermo-con may fail in short periods of time.

⚠️ Warning

1. Keep within the specified ambient temperature and humidity range.
   Also, if the set temperature is too low, condensation may form on the inside of the Thermo-con or the surface of piping even within the specified ambient temperature range. Dew condensation can cause failure, and so must be avoided by considering operating conditions.
2. The Thermo-con is not designed for clean room usage.
   The pump and fan generate dust.
3. Low molecular siloxane can damage the contact of the relay.
   Use the Thermo-con in a place free from low molecular siloxane.

⚠️ Warning

4. Installation conditions
   If the space for the intake and discharge of air is insufficient, the amount of transferred air will decrease, which can impair the performance and life of the product. Therefore, keep the conditions illustrated below for installation. Also, if ambient temperature is expected to be over 35°C, vent or exhaust air to prevent the increase of ambient temperature over 35°C.

⚠️ Warning

1. If the temperature of the facility water is too low, it can cause formation of dew condensation inside the heat exchanger.
   Supply facility water with a temperature over the atmospheric dew point to avoid the formation of dew condensation.
2. If the facility water piping is connected to multiple machines, the facility water exchanges heat at the upstream side and its temperature will become higher as it goes downstream.
   Limit the number of connected Thermo-cons to two per facility water system, and if more than two Thermo-cons are to be connected, increase the number of systems.

⚠️ Caution

1. Use tap water or fluid which will not damage the wetted parts material as described in this catalogue’s specifications.
   (PPE, PP glass 10%, Alumina ceramics, Carbon, EPDM, Stainless steel 303, Stainless steel 304, PE, PP, NBR)
2. Deionised water (with an electrical conductivity of approx. 1 μS/cm) can be used, but may lose its electrical conductivity.
Circulating Fluid

Caution

3. If deionized water is used, bacteria and algae may grow in a short period.
   If the Thermo-con is operated with bacteria and algae, its heat exchanging capacity or the capacity of the pump may deteriorate. Exchange all deionized water regularly depending on the conditions (once a month as a guide).

4. If using a fluid other than this catalogue, please contact SMC beforehand.

5. The maximum operating pressure of circulating fluid circuit is 0.1 MPa.
   If this pressure is exceeded, leakage from the tank in the Thermo-con can result.

6. Select a pipe with a length and diameter which allow a flow rate of 3 L/min or more for the circulating fluid.
   If the flow rate is less than 3 L/min, the Thermo-con cannot provide precise control, but also can fail because of the repeated cooling and heating operation.

7. A magnet driven pump is used as a circulating pump.
   A fluid which contains metal powders such as iron powder cannot be used.

8. The Thermo-con must not be operated without circulating fluid.
   The pump can break due to idling.

9. If the tank lid is opened after the supply of circulating fluid, the circulating fluid may spill out depending on the condition of external piping.

10. If an external tank is used, the circulating fluid may spill out from the internal tank lid depending on where the external tank is installed.
   Check that the internal tank has no leakage if using an external tank.

11. If there is a point where fluid is released to atmosphere externally (tank or piping), minimize the piping resistance at the circulating fluid return side.
    If the piping resistance is too large, the piping may be crushed, or the built-in circulator tank may be deformed or cracked because the pressure in the piping for return will become negative. The built-in circulator tank is made of resin (PE). Therefore, the tank may be crushed if the pressure is negative. Special attention must be paid if the flow rate of the circulating fluid is high. To avoid getting negative pressure less than –0.02 MPa, the piping for return should be as thick and short as possible to minimize the piping resistance. It is also effective to restrict the flow rate of circulating fluid or remove the gasket of internal tank for the release to atmosphere.

12. If fluorinated fluid is used in the Thermo-con (HEC006/012), static electricity will be generated by the flow of fluid. This static electricity may be discharged to the board of the Thermo-con, causing damage or operation failure and loss of data of such as set temperature.
    Ground pipe in order to remove static electricity.

13. Avoid operation with cavitation or bubbles due to low fluid level in the tank. This may shorten the pump life.

Circulating Fluid

Caution

14. If clear water is used, it should satisfy the quality standards shown below.

Clear Water (as Circulating Water) Quality Standards
The Japan Refrigeration and Air Conditioning Industry Association
JRA GL-02-1994 "Cooling water system – Circulating type – Supply water"

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Standard value</th>
<th>Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH (at 25°C)</td>
<td>—</td>
<td>6.0 to 8.0</td>
<td>○</td>
</tr>
<tr>
<td>Electrical conductivity (25°C)</td>
<td>[µS/cm]</td>
<td>100° to 300°</td>
<td>○</td>
</tr>
<tr>
<td>Chloride ion (Cl⁻)</td>
<td>[mg/L]</td>
<td>50 or less</td>
<td>○</td>
</tr>
<tr>
<td>Sulfuric acid ion (SO₄²⁻)</td>
<td>[mg/L]</td>
<td>50 or less</td>
<td>○</td>
</tr>
<tr>
<td>Acid consumption amount (at pH4.8)</td>
<td>[mg/L]</td>
<td>50 or less</td>
<td>○</td>
</tr>
<tr>
<td>Total hardness</td>
<td>[mg/L]</td>
<td>70 or less</td>
<td>○</td>
</tr>
<tr>
<td>Calcium hardness (CaCO₃)</td>
<td>[mg/L]</td>
<td>50 or less</td>
<td>○</td>
</tr>
<tr>
<td>Ionic state silica (SiO₂)</td>
<td>[mg/L]</td>
<td>30 or less</td>
<td>○</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>[mg/L]</td>
<td>0.3 or less</td>
<td>○</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>[mg/L]</td>
<td>0.1 or less</td>
<td>○</td>
</tr>
<tr>
<td>Sulfide ion (S₂⁻)</td>
<td>[mg/L]</td>
<td>Should not be detected</td>
<td>○</td>
</tr>
<tr>
<td>Ammonium ion (NH₄⁺)</td>
<td>[mg/L]</td>
<td>0.1 or less</td>
<td>○</td>
</tr>
<tr>
<td>Residual chlorine (Cl)</td>
<td>[mg/L]</td>
<td>0.3 or less</td>
<td>○</td>
</tr>
<tr>
<td>Free carbon (CO₂)</td>
<td>[mg/L]</td>
<td>4.0 or less</td>
<td>○</td>
</tr>
</tbody>
</table>

* In the case of [µL/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.

Communication

Caution

1. The set value can be written to EEPROM, but only up to approx. 1 million times.
   In particular, pay attention to how many times the writing is performed using the communication function.

Maintenance

Warning

1. Prevention of electric shock and fire
   Do not operate the switch with wet hands. Also, do not operate the Thermo-con with water left on it.

2. Action in the case of error
   If any error such as abnormal sounds, smoke, or bad smell occurs, cut off the power at once, and stop supplying and conveying fluid. Please contact SMC or a sales distributor to repair the Thermo-con.

3. Regular inspection
   Check the following items at least once a month. The inspection must be done by an operator who has sufficient knowledge and experience.
   a) Check of displayed contents.
   b) Check of temperature, vibration and abnormal sounds in the body of the Thermo-con.
   c) Check of the voltage and current of the power supply system.
   d) Check for leakage and contamination of the circulating fluid and intrusion of foreign objects to it, and subsequent replacement of water.
   e) Check for leakage, quality change, flow rate and temperature of facility water.

http://www.smc.eu
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.

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.

Compliance Requirements

1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.

2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulations of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

SMC products are not intended for use as instruments for legal metrology.

Measurement instruments that SMC manufacturers 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 ordered by the metrology (measurement) laws of each country.

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).

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

**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.

1) ISO 4414: Pneumatic fluid power – General rules relating to systems.

ISO 4413: Hydraulic fluid power – General rules relating to systems.

IEC 60204-1: Safety of machinery – Electrical equipment of machines.

(Part 1: General requirements)

ISO 10216-1: Manipulating industrial robots - Safety.

etc.