Thermo Elite

BH 200
BH 300

Version 1.1

- Thank you very much for purchasing the product of Yamato Scientific Co., Ltd..
- Read this operating manual and the guarantee card thoroughly for the proper use of this product. Please keep both importantly after reading.

**Warning**: Before attempting to use the product, read the important warnings that appear in the text of this manual and get familiar with them.
For the important warnings, the following symbols are used depending on the level and content of danger.

⚠️ **Warning**

For personal accident prevention

Failure to observe them may result in bodily harm and severe accidents according to circumstances.

⚠️ **Caution**

For damage prevention of product

Failure to observe them or to correct trouble may damage the product itself or samples. In addition, information on performance and mis-operation, which is useful for operation and maintenance.
### Treatment in emergency

#### TROUBLE sign and error code / Cause

<table>
<thead>
<tr>
<th>Abnormality of temperature sensor</th>
<th>Breakdown of Triac circuit</th>
<th>Disconnection of heater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormality of temperature sensors</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Abnormality of Refrigerator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defect of main relay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormality of main relay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defect of electronic circuits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormality of electronic circuits</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Treatment method

Please record the kind of the code and turn off the power supply at once if the error code is displayed. When abnormality occurs, the exchange of parts or the check of the device is needed. Please report to the shop where you bought the product or the our company office or the our company service agency. Please inform of the generated error code when reporting.
Be sure to observe these rules

When using

⚠️ Warning

1. Please ground effectively to avoid the shock hazard by the leak.
   - Please use the ground outlet as much as possible.
   - If there is no earth terminal
     The earth construction is needed. Please consult the shop or the our company office.

2. Please note the installation place.
   - Please do not ground to the following places.
     - Place where combustible gas and corroded gas are generated
     - Place where surrounding temperature becomes 35°C or more
     - Place where temperature difference is violent
     - Damp place
     - Place which shines direct sunshine and adheres
     - Place where a lot of vibrations exist
   - Please install the space of 15 or more in the side and the back.

3. Please supply the power supply by a special switchboard and the outlet.
   - Please use the switchboard and the outlet which suits electric capacity of this machine.
     Electric capacity
     BH200: AC100V 13A
     BH300: AC100V 14A

GROUND OUTLET
POWER SUPPLY PLUG

Dipoles type outlet
Earth wire

⚠️ Caution

1. Please do not remodel
   - The remodeling act causes the break-down. Please never do.

2. Please ground to the horizontal place.
   - The trouble and the breakdown are caused when using while having inclined.
Warning

1. About the use of the liquid and cooling water
   - Please do not use the liquid with the explosion and toxicity.
   - Please do not flush cold water when using at high temperatures. (BH400/500)
   - Please do not mix water when you use oil in the examination tank. (BH400/500)

Caution

1. Please do the method of installing the hose correctly.
   - Please detach flexibility pipe or nipple for the short-circuit and install the attached hose entrance when using as a circulation tank. Securely connect to prevent water leak. When using silicon oil as bath liquid, select a hose resistive to silicon oil (e.g. fluorine rubber).

2. Notes concerning liquid used
   - The liquid poured into the examination tank must use water or alcoholic solution. (BH200/300)
   - The liquid poured into the examination tank must use water or the silicon oil. (BH400/500)
   - It evaporates for water and alcohol, etc. while using. Please replenish sometimes.
   - Please use the ethyl alcohol solution about alcohol. Be careful please not to freeze referring to a right table in proportion to the service temperature. Do not use neither automotive antifreeze nor the ethylene glycol liquid. (BH200/300)
   - Using well water or bad-quality water will cause accumulation of scale and copestone on the heater pump, etc. Be sure to use distilled water or pure water to prevent performance deterioration or malfunction.
   - The viscosity must use the one to 50CST at 80 °C or more about the silicon oil.

<table>
<thead>
<tr>
<th>Density of ethanol</th>
<th>Coagulation point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wt %</td>
<td>Vol %</td>
</tr>
<tr>
<td>4.8</td>
<td>6.0</td>
</tr>
<tr>
<td>11.3</td>
<td>14.0</td>
</tr>
<tr>
<td>13.8</td>
<td>17.0</td>
</tr>
<tr>
<td>16.4</td>
<td>20.2</td>
</tr>
<tr>
<td>17.5</td>
<td>21.5</td>
</tr>
<tr>
<td>18.8</td>
<td>23.1</td>
</tr>
<tr>
<td>20.3</td>
<td>24.8</td>
</tr>
<tr>
<td>22.1</td>
<td>27.0</td>
</tr>
<tr>
<td>24.2</td>
<td>29.5</td>
</tr>
<tr>
<td>26.7</td>
<td>32.4</td>
</tr>
<tr>
<td>29.9</td>
<td>36.1</td>
</tr>
<tr>
<td>33.8</td>
<td>40.5</td>
</tr>
<tr>
<td>39.0</td>
<td>46.3</td>
</tr>
<tr>
<td>46.3</td>
<td>53.8</td>
</tr>
</tbody>
</table>

3. Attention in handling
   - Please do not sprinkle water on the control part and the operation panel. When water splashes to an internal electrical component, the leak and the electric shock are caused.
   - The upper surface in the tank etc. become high temperatures, too, when using at the high temperature. Please note handling enough.
Name of each part and function

Main body: BH200

Operation panel
Control part
Lid
Drain entrance
Front grill
Outlet only for refrigerator
Leak breaker
Power supply cable
Connector for external output (DIN 7P)
Connector for external communication (DIN 7P)
Flexibility pipe for the short-circuit
The back of control part
Main body : BH300

Operation panel

Control part

Lid

Front grill

Caster

Drain entrance

Outlet only for refrigerator

Leak breaker

Power supply cable

Connector for external communication (DIN 7P)

Connector for external output (DIN 7P)

Flexibility pipe for the short-circuit

The back of control part
Main body structural chart: BH200

- Float for water level surveying
- Cooling coil
- Pump exit
- Circulation pump
- Heat insulator
- Drain entrance
- Temperature sensor (Pt100°)
- Circulation liquid returns entrance
- Heater
- Tank on inside
- Refrigerator
**Operation panel**

**Attention**: A detailed explanation of controller’s specification, function, and operation method is described to the appended special owner guide. Please refer it.

- **POWER key**: Switch the controller from the stand-by state to the operating state, and vice versa.
- **MODE key**: Allow the functions, such as to enter, edit, and delete programs, to set the time, and to switch the time setting.
- **DISPLAY key**: The content of the sub display is switched. The content of the display is a set temperature, the remainder time, clock time, and an execution segment number.
- **MENU key**: The operation mode is selected. Each mode of the operation of a fixed value operation and an auto start and auto stops and the program operations can be selected.
- **ENTER key**: Input values of the set value (temperature, time, and clock time, etc.), the selection modes, and the execution segment numbers, etc. are fixed.
The set value (temperature, time, and clock time, etc.) is changed and the function provided in the function menu is selected.

It returns to the state before invalidating the content input immediately before and inputting.

The measurement temperature and the set value (temperature, time, and clock time, etc.) are displayed. Moreover, program information and error information, etc. are displayed.

Time a set temperature, the remainder time, and now and the execution segment number, etc. are displayed.

The operation is displayed.

blinks at the standby before begin to be operation.

The set temperature pattern of the be in operation is lighting displayed. The part under execution does the blinking display.

When an auto stop or the program operation ends, it blinks.

When abnormality is detected, it blinks.

When remotely driving (optional), it lights.

It lights while the function to lock the key of the operation panel is operating.

The operation mode under execution is lighting displayed.

The content (set temperature, remainder time, clock time, and execution segment) displayed in a sub-drop is lighting displayed.

When the heater is energizing, it lights.

When the time setting is a clock time set mode, it lights.
Preparation and check before using

Caution

1. Confirmation of outlet
   - Please insert the power supply plug in the outlet.
   - Please confirm whether the Refrigerator plug is connected with the outlet in the back of the controller. (BH200/300)

2. Confirmation of safety
   - Please turn on the leak breaker.
   - Please pour the liquid (water) into the examination tank.
   - Water level should be 3~5 cm below the upper edge. The external is made to circulate and the pump is operated and the water level falls when passing for a while when using. Please make to the above-mentioned water level by injecting the liquid again.
   - Please confirm whether independent temperature overheating prevention device is set in a temperature which is $15^\circ$ or more higher than the temperature of the tank used. (BH500)
   - Please stabilize by using stopper in the bottom in the tank when you use the throw type cooling device together. (BH400/500)

Warning

- To avoid the shock hazard, the use of the ground outlet is recommended.
- Please use the earth adapter (attached goods outside the standard) when you use the outlet of the dipoles type.
- Please connect the earth wire of the earth adapter with the earth of the power supply equipment side. Please do not connect to gas pipe and water pipe.
- Please do not use the divergence outlet. Because heat etc. are caused, it is dangerous.
- Please do not ground to the place where a flammable gas and corroded gas are generated.
Attention: Please operate according to the following procedures when the preparation for the operation is complete.

1. Turning on of power supply
   • Please turn on the leak breaker in the back of the controller.

   • The lighting display is done by a sub display at present time.

   • Please push the POWER SUPPLY key in the operation panel.

   • This machine becomes a stand-by state by turning on the power supply. Under such a condition, it is possible to shift to all operation modes by pushing the DRIVE MENU key.

2. Selection of operation menu
   • Press the DRIVE MENU key several times to select desired operating method.

   • It allows you to enter each parameter into a flashing menu.

3. Explanation of operation menu
   Fixed Temperature: It is a drive method of setting the temperature of the target and keeping the temperature constant.

   Auto stop: It is a drive method of stopping the state that a fixed value is driven at arbitrary after time passes or clock time.

   Auto start: It is a drive method the fixed value drive's beginning at after arbitrary time passes or clock time.

   Program: The operation is begun and is stopped at after arbitrary time passes or clock time. Moreover, the temperature can be changed at arbitrary set time and it be repeated.
Method of doing fixed temperature operation

<table>
<thead>
<tr>
<th>Selection of operation menu</th>
<th>Input of set temperature</th>
<th>Change in set temperature when fixed temp operation is being driven</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Please push the MENU key and select the fixed temp</td>
<td>• Please push the ENTER key after making a sub-display display an arbitrary set temperature pushing ˛˝ keys.</td>
<td>• Please push the ENTER key after making a sub-display display an arbitrary set temperature pushing ˛˝ keys.</td>
</tr>
<tr>
<td><img src="image" alt="MENU" /> The MENU key is pushed.</td>
<td><img src="image" alt="˛˝" /> Press ˛˝ keys several times. A sub-display is made to display the hoping set temperature.</td>
<td><img src="image" alt="˛˝" /> Press ˛˝ keys several times. A sub-display is made to display the hoping set temperature.</td>
</tr>
<tr>
<td><img src="image" alt="FIXED TEMP indicator" /> The indicator of the FIXED TEMP blinks.</td>
<td><img src="image" alt="ENTER" /> The ENTER key is pushed.</td>
<td><img src="image" alt="ENTER" /> The ENTER key is pushed.</td>
</tr>
<tr>
<td>• The temperature set last time is blinking and enters the state that a set temperature can be input in a sub-display.</td>
<td>• The fixed temperature operation is begun.</td>
<td>• The fixed temperature operation in the temperature newly set is begun.</td>
</tr>
</tbody>
</table>
Method of doing auto start operation

### Selection of operation menu
- Please select an AUTO START pushing the MENU key.

![MENU]

The MENU key is pushed.

The operation menu indicator of an AUTO START blinks.

- The sub-display displays TEMP allowing you to enter set temperature.

### Input of set temperature
- Please make a main display display an arbitrary set temperature by pushing \[ \triangle \] keys and push the ENTER key.

![\triangle \triangle]

Press \[ \triangle \triangle \] keys several times. A main display is made to display the hoping set temperature.

![ENTER]

The ENTER key is pushed.

- Sub-display displays TIME allowing you to enters when to begin the operation.

### Input of time
- Press \[ \triangle \triangle \] keys to blink start time (or clock time) on the main display, and press the ENTER key.

![\triangle \triangle]

Press \[ \triangle \triangle \] keys several times. A main display is made to display the hoping set time.

![ENTER]

The ENTER key is pushed.

- The STANDBY indicator of the operation monitor blinks on standby waiting for starting operation. The operation is begun after the set time passes.
### Method of doing auto stop operation

#### Selection of drive menu

- Please select an AUTO STOP pushing the MENU key.
  
  ![MENU](image)

  The MENU key is pushed.

  ![temp_indicator](image)

  The menu indicator of an AUTO STOP blinks.

  ![temp](image)

  It is displayed in a sub-display as TEMP and enters the state that a set temperature can be input.

#### Input of set temperature

- Please make a main display display an arbitrary set temperature pushing  button keys and push the ENTER key.
  
  ![temp_input](image)

  Press  keys several times. A main display is made to display the hoping set temperature.

  ![enter](image)

  The ENTER key is pushed.

  ![time_indicator](image)

  Sub-display displays TIME allowing you to enter when to end the operation.

#### Input of time

- Press  keys to blink stop time (or clock time) on the main display, and press the ENTER key.
  
  ![time_input](image)

  Press  keys several times. A main display is made to display the hoping set time.

  ![enter](image)

  The ENTER key is pushed.

  ![pump_indicator](image)

  The sub-display displays PUMP allowing you to select pump status after time is up.
Setting pump operation status

• Press ▼ ▲ keys to indicate pump status (ON or OFF) on the main display after operation stop. Please push the ENTER key afterwards.

Press ▼ ▲ keys several times. A main display displays ON or OFF.

on  off

Enter

The ENTER key is pushed.

• The sub-display displays WAIT allowing you to set the wait function.

Selection of wait function

• Press ▼ ▲ keys to indicate waiting function (ON or OFF) on the main display. Then press ENTER key.

Press ▼ ▲ keys several times. A main display displays ON or OFF.

on  off

Enter

The ENTER key is pushed.

• This operation activates the auto stop operation

Count time

• The timer of an auto stop starts to count down at the following.

When the wait function is turning on

It starts when set temperature has reached target value.

When the waiting function is OFF or when stop time is set in clock time.

It starts right after the auto stop operation is started.
Method of doing program operation

<table>
<thead>
<tr>
<th>Selection of operation menu</th>
<th>Input of execution program number</th>
<th>Input of time</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Please select the PROGRAM pushing the MENU key.</td>
<td>• Press ⬇️ ⬆️ keys to indicate an desired program number on the main display, and press the ENTER key.</td>
<td>• Press ⬇️ ⬆️ keys to blink start time (or clock time) on the main display, and press the ENTER key.</td>
</tr>
<tr>
<td><img src="image" alt="MENU" /></td>
<td>Press ⬇️ ⬆️ keys several times. A main display displays the program number. <strong>Attention</strong>: If the program does not exist, ⬇️ ⬆️ ⬇️ ⬆️ is blinking. Please create the new program.</td>
<td>Press ⬇️ ⬆️ keys several times. A main display displays the hoping set time.</td>
</tr>
<tr>
<td><img src="image" alt="Sub-display" /></td>
<td>The ENTER key is pushed.</td>
<td>The ENTER key is pushed.</td>
</tr>
<tr>
<td>🌞 ← ○</td>
<td>• Sub-display displays TIME allowing you to enter when to end the operation.</td>
<td>🌞 ← ○</td>
</tr>
<tr>
<td>🌞 ← ○</td>
<td>• The standby indicator on the operation monitor blinks waiting for programmed operation to start. The operation begins after the set time passes.</td>
<td></td>
</tr>
</tbody>
</table>
To switch to other operation modes while operating

This machine can be switched to other operation modes without stopping operation (seamless operation change).

Selection of operation menu

- During operation in a certain mode, press the MENU key to blink another operation menu indicator. In this time the operation menu indicator of current operation remains lighting.

  Press MENU key several times.

- This status allows you to enter each parameter into blinking or lighting operation menu.

  The indicator blinks or lights.

- The subsequent operation procedure is the same as the operation procedure of each mode.
Method of using DISPLAY key

The content of the display of a sub-display can be switched one by one as follows by pushing DISPLAY key.

- **1**: HOLD is displayed.
- **2**: However, WAIT is displayed in the waiting status.
- **3**: During repeat operation, however, number of times for remaining repeat is displayed by the DISPLAY SELECTOR key.
An undermentioned function is equipped in this machine. Use of these functions is initiated by MODE key.

- Press the MODE key to display any of the following function menus on the main display. The menus can be brought up one by one with keys.

<table>
<thead>
<tr>
<th>Main display</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUPP</td>
<td>Strength setting of circulating pump. It is a function to set strength of circulating pump by the kind of the liquid and the humidity region examination purpose, etc. in the tank.</td>
</tr>
<tr>
<td>REFR</td>
<td>Refrigerator operation selection. It is a function that the drive can be stopped when the Refrigerator need not be driven according to a surrounding temperature and the examination temperature. (BH200/300)</td>
</tr>
<tr>
<td>coal</td>
<td>Communication lockout. It is a function to select whether to respond to it when there is a communication demand from the host computer connected via the communication interface.</td>
</tr>
<tr>
<td>ClaF</td>
<td>Setting at date and time. It is a function to set a present date and time.</td>
</tr>
<tr>
<td>ProG</td>
<td>Program edit. It is a function to input and to edit the drive program.</td>
</tr>
<tr>
<td>dELP</td>
<td>Program deletion. It is a function to delete the program of the current which became unnecessary.</td>
</tr>
<tr>
<td>time</td>
<td>Switching between duration and clock time. This function is used to select either clock time setting or duration setting, for example, in auto start mode etc. When the product is shipped, duration is set.</td>
</tr>
<tr>
<td>LocH</td>
<td>Setting and release of key lock. It is a function to invalidate input to the key and to prevent the mis-operation.</td>
</tr>
<tr>
<td>beep</td>
<td>Warning buzzer. It is a function to select whether to operate the warning buzzer when abnormality occurs.</td>
</tr>
<tr>
<td>AccuF</td>
<td>Display accumulated time. This function displays accumulated time of POWER key on state in the range from 0 to 49999.</td>
</tr>
<tr>
<td>Hold</td>
<td>Hold. It is a function to interrupt the passage of set time.</td>
</tr>
</tbody>
</table>
Method of doing strength setting of circulating pump

Function menu selection

• First of all, please push the MODE key. Next, please make a main display display PUMP with keys and push the ENTER key.

![MODE key pushed](image)

The MODE key is pushed.

![Arrow](image)

Press keys several times. A main display is made to display PUMP.

![PUMP](image)

Press keys several times. A main display is made to display PUMP.

![ENTER](image)

The ENTER key is pushed.

• Sub-display displays PUMP allowing you to set strength of circulating pump to a sub display.

Set input

• Please make a main display blinking display arbitrary strength by pushing keys and push the ENTER key.

![Arrow](image)

Press keys several times. A main display displays strength of the pump.

Attention: Strength of the pump is 1-10. 10 is strongest circulation strength.

![ENTER](image)

The ENTER key is pushed.

![Arrow](image)

• Sub-display displays PUMP allowing you to set strength of circulating pump to a sub display.
Setting operation status of refrigerator

Function menu selection

• First of all, please push the MODE key. Next, please make a main display display REFR with \[\downarrow\ \uparrow\] keys and push the ENTER key.

The MODE key is pushed.

Press \[\downarrow\ \uparrow\] keys several times. A main display is made to display REFR.

The ENTER key is pushed.

Sub-display blinks REFR allows you to set the operation mode of the Refrigerator.

Set input.

• Press \[\downarrow\ \uparrow\] keys to display desired operation status on the main display, and press the ENTER key.

Press \[\downarrow\ \uparrow\] keys several times. A main display displays CONT or OFF.

Attention: CONT means the continuous running and OFF mean the stop.

The ENTER key is pushed.

Notes

• This function is equipped only in BH200/300.
• When it is 45℃ or more in set temperature, the refrigerator stops automatically even if the refrigerator is continuously driving.
• The refrigerator is recommended to be set in turning off as long as there is no heat load special environmental temperature +10℃ or more a set temperature. It is from respect to a preferable usage of the saving of safety and the energy of the equipment.

Notes

• This function is equipped only in BH200/300.
• When it is 45℃ or more in set temperature, the refrigerator stops automatically even if the refrigerator is continuously driving.
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Incidental function

Usage of external output

**Attention**: The program method, the set method, and the communication interface are described in detail to the appended owner guide only for the controller. Please refer to it.

1. **Specification of connector**

From the back of Thermo Elite

<table>
<thead>
<tr>
<th>Pin number</th>
<th>Name of signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>ᶃ</td>
<td>DC+12V</td>
</tr>
<tr>
<td>ᶄ</td>
<td>Time-up output(open collector)</td>
</tr>
<tr>
<td>ᶅ</td>
<td>DC+12V</td>
</tr>
<tr>
<td>ᶥ</td>
<td>External warning output (open collector)</td>
</tr>
<tr>
<td>ᶦ</td>
<td>Temperature output (+)</td>
</tr>
<tr>
<td>ᶧ</td>
<td>Temperature output (-)</td>
</tr>
<tr>
<td>ᶨ</td>
<td>Shield (analog signal)</td>
</tr>
</tbody>
</table>

2. **Notes concerning liquid used**

- Unit of output voltage: 5mV/°
- The output is 0mV at 0° in measurement temperature.

Output voltage(V) versus Measurement temperature(°)

3. **External warning output**

- Transistor open collector output

<table>
<thead>
<tr>
<th>Output load</th>
<th>Power supply DC12V</th>
</tr>
</thead>
<tbody>
<tr>
<td>sink current</td>
<td>MAX 100mA</td>
</tr>
</tbody>
</table>

Specification of output relay: MATSUSHITA JAI-F-TM-DC12V / OMRON G2R-1A-T DC12V

**TROUBLE sign** (Blink to a main display the error code)

- Blinking

External warning output

- ON

4. **Time-out output**

- Transistor open collector output

<table>
<thead>
<tr>
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</table>

Specification of output relay: MATSUSHITA JAI-F-TM-DC12V / OMRON G2R-1A-T DC12V

**Blink to the FINISH indicator**

- Blinking

Time-out output

- ON
There are two kinds of safety devices for overheat prevention. They are an automatic overheat prevention of controller (auto return) and an independent temperature overheating prevention device (manual return) composed of circuit and sensor independent of the controller. Double safety measures are considered to this machine.

1. **Range of set temperature and function**

   **Range of set temperature**
   
   0 – 399 °

   **Input method**
   
   A digital switch of the treble is used. Please turn the drum of each digit and make to an arbitrary value. Please note that the digit of 100 can input only the numerical value to 0-3.

   **Function**
   
   When rising more than the temperature which the measurement temperature set in an independent temperature overheating prevention device, the heater output is intercepted. The leak breaker becomes and the function becomes effective while turned on. ER07 blinks to a main display when an independent temperature overheating prevention device operates and the blinking display is done and the sign of abnormality (TROUBLE) blinks. When the independent temperature overheating prevention device is activated during heater ON, ER07 and ER03 are alternately displayed.

2. **How to use**

   • Please set 15 ° or more higher than set temperatures of this machine usually.
   • Please make to a value which is very higher than the room temperature to set an appropriate value for the protection of the sample etc. Moreover, please set 15 ° or more higher than the highest, set temperatures in the driven temperature pattern.
   • Be careful please not to lower more than an in-flight temperature and be careful not to drive a set temperature of an independent temperature overheating prevention device as a low setting. Please do setting over again after turning off the leak breaker once when you operate this machine by mistake. Please refer to item (P24) of the safety device and the error code when this machine operates depending on other causes.

3. **Notes**

   • The digit of 100 of a digital switch can input only the numerical value to 0-3. There is a possibility damaging the switch when the drum is forcibly turned.
   • It is likely not to notice to the change of a set temperature when a set switch is cleaned the hand's touching the switch. Please confirm whether a set temperature is an appropriate value before begin to be come in contact with this machine and to be driven.
Drive continuance after power supply returns
(in case of auto return)

The operation of the controller to whom the automatic return mode is set is as follows when blacking out while driving.

1. **Power failure in program drive**
   When measured temperature after power restoration is out of the waiting band based on target temperature just before power failure, operation will enter the waiting status regardless of the wait setting of a segment currently executed. The timer that controls progress of operation will stop and operation will enter the waiting status even if the waiting function has been set to OFF in this segment. (This is called forced wait) When the remainder time is selected with the display change key at the forced wait, it is displayed in a sub-display as FW. The power failure period is not added as drive time. The remainder time immediately after the remainder time immediately before generation of the power failure and the return of the power supply is a par.

2. **Power failure in auto stop drive**
   Only when the operation stop time is set to duration, not clock time, the compulsory waiting mode will be activated. When the remainder time is selected with the display change key at the forced wait, it is displayed in a sub-display as FW. The time under the power failure is not added as drive time. The remainder time immediately after the remainder time immediately before generation of the power failure and the return of the power supply is a par. However, when the drive end time is set at clock time, the power failure period is counted partially at the drive time. The remainder time immediately after the return of the power supply is a value by which the power failure period was subtracted at the remainder time immediately before the power failure. The drive begins immediately after the return of the power supply when becoming drive beginning time for the power failure period.

3. **Power failure because of state of drive beginning waiting (auto start mode etc.)**
   When the operation start time is set to duration, not clock time, duration of power failure will not be counted as waiting time. The remainder time immediately after the remainder time immediately before generation of the power failure and the return of the power supply is a par. However, when the drive end time is set at clock time, the power failure period is counted partially at waiting time. The remainder time immediately after the return of the power supply is a value by which the power failure period was subtracted at the remainder time immediately before the power failure. The drive begins immediately after the return of the power supply when becoming drive beginning time for the power failure period.

4. **Power failure during operation with fixed set point or during soak operation (auto start mode).**
   After the power supply returns when the power failure occurs while executing these drives which do not depend at time, this machine restarts the drive aiming at the temperature set before blacking out.

5. **Notes**
   The BH series of a standard specification automatically restarts the drive when fed power again after blacking out.
The self-diagnosis function built into by the controller and the independent safety device from the controller are installed in this machine. The table below shows the cause and the processing method when the safety device operates. When the safety device operates, the error code is displayed to a main display. Deal with it according to the processing method shown here.

<table>
<thead>
<tr>
<th>Safety device</th>
<th>Display</th>
<th>Cause and processing method</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak Breaker</td>
<td>No display</td>
<td>Please report to our customer service section and confirm the cause.</td>
<td></td>
</tr>
<tr>
<td>Motor thermal protector</td>
<td>No display</td>
<td>Overheating of motor: Please report to our customer service section.</td>
<td></td>
</tr>
<tr>
<td>Automatic overheat protector.</td>
<td>No display</td>
<td>Heat of sample: Please decrease the sample.</td>
<td></td>
</tr>
<tr>
<td>Sensor abnormality detection</td>
<td>TROUBLE sign blinking Er.01 blinking</td>
<td>Disconnection of temperature sensor: Please report to our customer service section.</td>
<td></td>
</tr>
<tr>
<td>Triac short-circuit detection</td>
<td>TROUBLE sign blinking Er.02 blinking</td>
<td>Short-circuit of Triac: Please report to our customer service section.</td>
<td></td>
</tr>
<tr>
<td>Heater short-circuit detection</td>
<td>TROUBLE sign blinking Er.03 blinking</td>
<td>Disconnection of heater: Please report to our customer service section.</td>
<td></td>
</tr>
<tr>
<td>independent temperature overheating prevention device</td>
<td>TROUBLE sign blinking Er.07 blinking</td>
<td>Incorrect setting of independent temperature overheating prevention device: Please set correctly. Heat of sample: Please decrease the sample. Defect of independent temperature overheating prevention device: Please report to our customer service section.</td>
<td>BH500 and the machine equipped with independent temperature overheating prevention device</td>
</tr>
<tr>
<td>Main relay defect detection</td>
<td>TROUBLE sign blinking Er.10 blinking</td>
<td>Breakdown of main relay: Please report to our customer service section.</td>
<td></td>
</tr>
<tr>
<td>Refrigerator abnormality detection</td>
<td>TROUBLE sign blinking Er.03 blinking</td>
<td>Dropout of the plug of refrigerator: Please connect with the outlet in the back of the control part. The refrigerator is abnormal: Please report to our customer service section.</td>
<td>BH200/300</td>
</tr>
<tr>
<td>Water level abnormality detection</td>
<td>TROUBLE sign blinking Er.20 blinking</td>
<td>Decrease in water level: Add liquid to reservoir. Rise of water level (thermal expansion): Decrease liquid from reservoir. Defect of water level detector: Please report to our customer service section.</td>
<td>The equipment goes back to the normal state automatically when liquid level becomes normal.</td>
</tr>
</tbody>
</table>
**Maintenance method**

**Check and maintenance usually**

**Warning**
- Please pull out the power supply plug from the outlet if it is necessary when checking and maintaining.
- Please execute after the equipment returns to normal temperature.
- Please never decompose the equipment.

**Caution**
- Please wipe the part of the resin and the dirt of the operation panel with the soft cloth often squeezed. Wiping with benzine, thinner or kurenzah etc., rubbing with the scrubbing brush will cause the transformation, changing in quality, and discoloration.
- Please check the function of leak Breaker according to an undermentioned procedure.
  - Please connect the power supply code and put into the energized state.
  - Please turn on the switch of leak Breaker.
  - Push the red test button of earth leakage circuit-breaker with the point such as pens. If the switch is turned off, the function is normal.
- Please clean the fin of the condenser according to an undermentioned procedure. (BH200/300)
  - Please remove the grill in front of the main body of the device.
  - Please remove the dust which is about the surface of the condenser fin with the cleaner etc. (Be careful please not to crush the fin)
- Please check the movement of an independent temperature overheating prevention device according to an undermentioned procedure. (BH500 and only equip with an independent temperature overheating prevention device)
  - Please execute the fixed value drive at a suitable set temperature.
  - Afterwards, please set the operating temperature of an independent temperature overheating prevention device in a value which is 5°C lower than the driven temperature.
  - The heater circuit is intercepted several seconds later when the operation is normal and an TROUBLE sign and ER07 blink at the same time. The warning buzzer rings when the warning buzzer function is set in turning on.

**Attention**: Please check these every month. Moreover, execute the check on leak Breaker and an independent temperature overheating prevention device before an uninhabited drive at long period continuous running and nighttime.

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**When not used for a long term or abandoned**

**Caution**
- Please turn off the power supply and pull out the power supply plug.
- Please pull out the liquid in the examination tank.
- Dust must not enter when you use the silicon oil.
- Please do the lid to the examination tank or transfer the liquid to a fixed container.

**Warning**
- Please do not leave this machine in the place where the child plays when you abandon.
1. When you request the repair

- Please record the error code, turn off the power supply switch, and pull out the power supply plug if abnormality occurs by any chance. Please report to the shop or the our company office.
- Content wanting to tell when reporting
  - Form of product
  - Product number
  - Date of purchase (Please look at the guarantee book or the rating plate pasted to the main body)
  - Content of breakdown (It is detailed)
- Please present the guarantee book when the person of the person in charge of service visits.

2. Guarantee book

- The guarantee book is passed from the shop or the our company office. Please keep it importantly after confirming the filling in matter such as the shop name and the purchase days and often reading.
- It is for one year at guaranteed term from purchase day. When the breakdown occurs within the guaranteed term, our company repairs free of charge according to the condition described to the guarantee book.
- Please consult the shop or the our company office about the following repair at the guaranteed term. When the function can be maintained by repair, we repair the equipment upon your request on charge basis.

3. The lowest possession periods of parts for repair

- After discontinuance of manufacturing, the lowest possession periods of parts for repair of this machine are for seven years. Parts for the repair are parts necessary to maintain the performance of the product.

4. When thinking the equipment breaks down

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Please confirm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak Breaker of turning on is not displayed to time now by a sub display.</td>
<td>• Is the power supply code surely connected with the outlet or the switchboard?</td>
</tr>
<tr>
<td></td>
<td>• The power will not be supplied.</td>
</tr>
<tr>
<td>The temperature changes. Or, does not reach the temperature of hope.</td>
<td>• The heat load will be too large.</td>
</tr>
<tr>
<td></td>
<td>• The viscosity of the liquid will be too large. The passage resistance will be too large. (When using as a circulation tank)</td>
</tr>
<tr>
<td></td>
<td>• Does not the voltage of the power supply decrease?</td>
</tr>
<tr>
<td>The refrigerator does not work. (BH200/300)</td>
<td>• Is the plug of the refrigerator connected with the outlet for the refrigerator in the back of the control part?</td>
</tr>
<tr>
<td></td>
<td>• Is not the drive function selection of the refrigerator set in turning off?</td>
</tr>
<tr>
<td>Specification table</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Form</strong></td>
<td>BH200</td>
</tr>
<tr>
<td><strong>Performance ↓</strong></td>
<td></td>
</tr>
<tr>
<td>Range of temperature setting (°C)</td>
<td>-30.0 to +100</td>
</tr>
<tr>
<td>Range of operation temperature (°C)</td>
<td>-20 to 80</td>
</tr>
<tr>
<td>Temperature adjustment accuracy (°C)</td>
<td>0.01 to 0.02 (Ethanol 50% sol., RT25, No-load)</td>
</tr>
<tr>
<td>Ability of circulating pump</td>
<td>Max. pump head: 3(mH2O), Max. stream flow: 20(l/min) (Refrigerant: Water, Water temperature: 25°C)</td>
</tr>
<tr>
<td>Cooling ability (kcal/h)</td>
<td>150(at 20°C, RT25°C)</td>
</tr>
<tr>
<td><strong>Function and composition ↓</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature adjustment machine</td>
<td>IVCR type controller (Zero crossover switching, PID microprocessor control)</td>
</tr>
<tr>
<td>Sensor</td>
<td>Pt100 A class (three line type)</td>
</tr>
<tr>
<td>Temperature set method</td>
<td>Digital setting depending on 0°C keys</td>
</tr>
<tr>
<td>Temperature display method</td>
<td>Digital on a main display (A set temperature is displayed to a sub display)</td>
</tr>
<tr>
<td>Resolution of setting and display temperature</td>
<td>0.1°C</td>
</tr>
<tr>
<td>Other displays</td>
<td>Drive monitor (represents the state of control)</td>
</tr>
<tr>
<td>Timer function</td>
<td>1 minute to 99 hours 59 minutes, 100 hours to 999 hours</td>
</tr>
<tr>
<td>Timer resolution</td>
<td>1 minute or 1 hour</td>
</tr>
<tr>
<td>Drive function</td>
<td>Fixed value drive, Auto start drive, Auto stop drive, Program drive: Arbitrary pattern, Max.16 segment (repetition and ramp operation, etc.), Refrigerator drive function (There is no refrigerator energizing indicator)</td>
</tr>
<tr>
<td>Other incidental functions</td>
<td>Memory backup, Key lock, Multiplication time function (up to 49999 hours), Holding, Function that enable to change the strength of jet stream (10 step changeability), Calendar timer, Clock, External warning output, Time-up output, External communication (RS422A correspondence), Output terminal (Seven pin connector), Communication terminal (eight pin connectors)</td>
</tr>
<tr>
<td>Heater (made of SUS)</td>
<td>1.0kw</td>
</tr>
<tr>
<td>stirring mechanism</td>
<td>Stirring by jet stream</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>Compression machine output 150W</td>
</tr>
<tr>
<td>Refrigerant</td>
<td>R22</td>
</tr>
<tr>
<td>Other compositions</td>
<td>Drain entrance (with stopping), Stainless flexibility tube with heat insulation for circulation</td>
</tr>
<tr>
<td>Safety device</td>
<td>Leak Breaker, Thermal protector (for stirring motor), The float type High/Low level liquid level detector (Low level only for BH400), Self-diagnosis function (Automatic overheating protector, The sensor is abnormal, Heater disconnection, Triac short circuit, Main relay is defective, Buzzer warning in abnormal circumstances, The refrigerator is abnormal)</td>
</tr>
<tr>
<td>Refrigerator automatic operation stop</td>
<td>It is shutdown at 45°C or more in set temperature</td>
</tr>
<tr>
<td><strong>Standard ↓</strong></td>
<td></td>
</tr>
<tr>
<td>Capacity of reservoir (l)</td>
<td>13</td>
</tr>
<tr>
<td>Size of reservoir (W×D×H mm)</td>
<td>389×226×150</td>
</tr>
<tr>
<td>The outside size (W×D×H mm)</td>
<td>654×492×615</td>
</tr>
<tr>
<td>Power supply</td>
<td>AC100V 13A</td>
</tr>
<tr>
<td><strong>Standard attached goods</strong></td>
<td>Stainless hose entrance for external circulation (Rc1/2, Outside diameter 14mm, 2mm)</td>
</tr>
<tr>
<td><strong>Attached goods outside standard</strong></td>
<td>Digital printer, independent temperature overheating prevention device, By-pass tube for external circulation, Insulated hose for external circulation, Cable for external communication, Personal computer connection interface, (RC23), Multi wick cable for output, (All model commonness)</td>
</tr>
</tbody>
</table>
Chart of connecting wires

BH200/300
<table>
<thead>
<tr>
<th>Sign</th>
<th>Part name</th>
<th>Code number</th>
<th>Specification</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Power supply cable</td>
<td>2-13-001-0006</td>
<td>T2-3-c</td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td>Power cable for refrigerator</td>
<td>2-13-001-0005</td>
<td>T2-3b</td>
<td></td>
</tr>
<tr>
<td>ELB</td>
<td>Leak Breaker</td>
<td>2-06-005-0019</td>
<td>BJ S1531</td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>Terminal block</td>
<td>2-07-023-0002</td>
<td>Moll-Ofx5p</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Heater</td>
<td>BF 400-30020</td>
<td>AC100V 1KW</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Motor for pump</td>
<td>2-14-007-0002</td>
<td>U-2035-1</td>
<td></td>
</tr>
<tr>
<td>Tr</td>
<td>Transformer</td>
<td>2-18-000-0022</td>
<td>AC100V</td>
<td></td>
</tr>
<tr>
<td>POWER 2</td>
<td>Power supply substrate</td>
<td>1-24-000-0011</td>
<td>Hitec CR</td>
<td></td>
</tr>
<tr>
<td>PLANAR</td>
<td>Control substrate</td>
<td>1-24-000-0008</td>
<td>Hitec CR</td>
<td></td>
</tr>
<tr>
<td>PIO 2</td>
<td>Display substrate</td>
<td>1-24-000-0009</td>
<td>Hitec CR</td>
<td></td>
</tr>
<tr>
<td>RF</td>
<td>Refrigerator</td>
<td>3-01-002-0006</td>
<td>UF-S210ML BH200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Refrigerator</td>
<td>3-01-002-0005</td>
<td>NU401ALE BH300</td>
<td></td>
</tr>
<tr>
<td>SSR 1</td>
<td>Solid-state relay</td>
<td>2-16-000-0010</td>
<td>YLT-SSR-01</td>
<td></td>
</tr>
<tr>
<td>SSR 2</td>
<td>Solid-state relay</td>
<td>2-16-000-0017</td>
<td>G3R-1025LN</td>
<td></td>
</tr>
<tr>
<td>X1</td>
<td>Relay</td>
<td>2-05-000-0011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X2</td>
<td>Relay</td>
<td>2-05-000-0011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT1,2</td>
<td>Current detection element</td>
<td>2-17-001-0002</td>
<td>CLT-6-5-400</td>
<td></td>
</tr>
<tr>
<td>Pt</td>
<td>Sensor</td>
<td>1-16-003-0029</td>
<td>Pt100 A class</td>
<td></td>
</tr>
<tr>
<td>FSW</td>
<td>Float switch</td>
<td>2-02-001-0004</td>
<td>AHR541161</td>
<td></td>
</tr>
<tr>
<td>CN1</td>
<td>receptacle</td>
<td>2-08-000-0039</td>
<td>DIN8P</td>
<td></td>
</tr>
<tr>
<td>CN2</td>
<td>receptacle</td>
<td>2-08-000-0038</td>
<td>DIN7P</td>
<td></td>
</tr>
</tbody>
</table>
About attached goods outside the standard

A variety of attached goods outside the standard are prepared in the Thermo Elite BH series.

1. **Cable for external communication**

**OBK 10**

- Cable which combined plugs connected with connector in the back of control part with terminal box

2. **Communication protocol converter**

**RC 23**

- RC23 is a converter which converts RS232C of the personal computer into RS422A. There is no need for RC23 when your computer has RS422A communication interface.

- **Auxiliary goods**: Exclusive use AC adapter, Special cable (The terminating resistance of 100 ℧ has been connected. Two kinds of cables (3 meter long and 10 meter long) are available. Specify which cable you need when you place an order.)

- **To drive two or more Thermo Elites at the same time**, another special cable and the change of communication ID number are needed. In that case, please consult the our company office.
3. Multi wick cable for temperature output, alarm output and end output

OBL 10

4. Joint for by-pass pipe

OBH 30

- It is a joint which can do the circulation cooling to the spectrophotometer etc. at the same time by diverging from the short-circuit pipe of the pump circulation. The divergence connection part is a hose entrance of 6 mm. The divergence flowing quantity is a range of a-b. Divergence pump head is a range of a-b.
Attention: Please request the following options when you place an order of Thermo Elite. After installation the order for these options cannot be accepted.

5. Digital printer OBH60

OBH 60

The following information can be printed out by using Digital Printer OBH60.

Character Record Mode
- Measured Temperature
- Set point
- Wait state
- Strength of pump
- Alarming state
- Accumulated time
- Time of the record

Graphic Record Mode
The measured temperature of the liquid in the reservoir is recorded by the time based graph.

Immediate Date Record Mode
The information at desired time can be recorded. The contents of the information is the same as that of Character Record Mode.

When the main body of the equipment detects abnormality, information when generated abnormally is printed.

When the power supply is intercepted due to the power failure etc., the date, the time of the intercepted point, and the date and the time of the returning point are printed immediately after the power supply return.

6. Independent temperature overheating prevention device
(BH500 is equipped normally)

OBH 50

The equipment is independent safety device besides the one built into the controller. Double safety measures can be considered.

Range of temperature setting: 0—399°C 3-digit digital switch
Sensor: K-thermocouple (Control sensor: Double sensor stored in the same protection tube as Pt100Ω)