THE HEATING BOX™

Training Manual

Model KD-HBO100 & KD-HBC100

* KD-HB100 (Open-Loop System)  
* KD-HBC100 (Close-Loop System)

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KyungDong America, Inc. reserves the right to change specifications and/or designs without prior notice in anytime and without incurring obligations.
The Heating Box is an integrated heat transfer control station that accepts hot water from a heat source and then re-directs it as required to provide domestic hot water and/or heat to hydronic applications.

It works to direct hot water traffic in the most efficient and effective way to satisfy household demand.

The Heating Box simplifies the design and installation of any combination domestic hot water and hydronic heating system. It facilitates the application of single source heating appliances, like tankless water heaters, with hydronics and offers the benefits of design time savings, easy installation, space savings and energy savings.

The Heating Box is prefabricated with the highest quality components and guided by the computer precision control necessary to perfect domestic hot water and hydronics delivery.

The Heating Box can also be used with any type of hydronic heating application including radiant in-floor heat, radiant baseboard, hydronic air handlers, snow melting systems and spa/pool heating application like towel warmers etc.

A Heating Box makes perfect combination system for domestic hot water supply and space heating either in-floor or hydro heating application using one heater.
How Does It Work

• Domestic How Water Heating Only
  o Stand-by mode
  o Domestic mode is always in ready
  o Act like a normal water heater
  o 3-way valve is automatically set as Domestic hot water supply as needed

• Heating/Hot Water Supply
  o How water tap demand is ON
  o Priority switch activates
  o 3-way valve turn to domestic hot water supply mode
  o Pump and air handler fan stops
  o Hot water to tap is supplied
  o How water tap demand is off
  o Priority switch deactivates
  o 3-way valve goes back to heating mode
  o Pump and Fan is activated

• Heating Mode
  o Thermostat switch ON
  o 3-way valve turns to heating mode
  o Pump turns ON
  o Activates the Water Heater
  o All hot water supply is directed to the heating side
**Benefits**

- **Save Time / Money**
  - Designing Heating System
  - Installation / Labor

- **Save Energy**
  - Recycles heat from the Heat Source

- **Save Space**
  - Compact packaged in a tiny box

**Features**

- **Protect the Heat Source: (Hi-Limit Switch)**
  Return water temperature is about 5°F higher than the water heater setting temperature: 3-way valve turns to the domestic hot water supply mode, keep circulation pump ON until supply temperature is 9°F below the setting temperature of a 3-way valve for the heating mode.

- **Freezing Protection – Heat Source and Heating Appliance**
  When supply water temperature is less than 43°F, it automatically turns on the space heating mode for maximum 3 minutes or/and supply water temperature reaches 68°F, pump stop and it will go back to the stand by mode.
## Specifications

<table>
<thead>
<tr>
<th></th>
<th>Model KD-HBO100 Open system</th>
<th>Model KD-HBC100 Close system</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum Flow Rate</strong></td>
<td>0.5 GPM</td>
<td>0.5 GPM</td>
</tr>
<tr>
<td>(activate priority device)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Minimum Water Pressure</strong></td>
<td>7 PSI</td>
<td>7 PSI</td>
</tr>
<tr>
<td><strong>Hot and Cold Water Connections</strong></td>
<td>3/4” NPT</td>
<td>3/4” NPT</td>
</tr>
<tr>
<td><strong>Heat Source Supply &amp; Return</strong></td>
<td>3/4” NPT</td>
<td>3/4” NPT</td>
</tr>
<tr>
<td><strong>Space Heating Supply &amp; Return</strong></td>
<td>3/4” NPT</td>
<td>1” NPT</td>
</tr>
<tr>
<td><strong>Flat Heat Exchanger</strong></td>
<td>Not Applicable</td>
<td>80,000 Btu/Hour Each, Total 160,000 BTU/ Hour</td>
</tr>
<tr>
<td>(BTU/ Hour) each</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Expansion Tank</strong></td>
<td>1.8 Gallons</td>
<td>1.8 Gallons</td>
</tr>
<tr>
<td><strong>Electricity</strong></td>
<td>120VAC, 60 Hz, Max. 5A, Normal 2A</td>
<td>120 VAC, 60 Hz, Max 10A, Normal 4A</td>
</tr>
<tr>
<td><strong>Physical Size (W x H x D)</strong></td>
<td>15” x 25” x 10”</td>
<td>20” x 28” x 10”</td>
</tr>
</tbody>
</table>
Components

Model KD-HBO100

- Air Separator
- Thermostatic Mixing valve for Heating
- Heating Box Controller
- 3-Way Valve
- Expansion Tank
- Circulating Pump
- Priority switch with check valve
- Manual ball valve for expansion tank
- Thermostatic Mixing valve for Domestic Hot Water

Model KD-HBC100

- Domestic Hot water priority switch
- Pressure gauge for space heating
- Air separator and purge valve
- Heating Box controller
- Thermostatic mixing valve for space heating
- Flat heat exchanger
- Expansion Tank
- Space heating side circulator pump
- Heat source side circulator pump
- Thermostatic mixing valve for hot water
Pump Specifications

- **Pump: Armstrong E9B**
  - 3-way Valve: Actuator activation time 6 ~ 8 sec.
  - Thermostatic Mixing Valve: 86°F (30°C) ~ 140°F + (60°C+)
  - Expansion Tank: 1.8 Gallon
  - Flat Heat Exchanger: 80,000 BTU/Hour (Total 160,000 BTU)
Piping Connections

**Piping for Open-Loop System:**
Domestic hot water supply: ¾”
Space heating connection: ¾”

![Diagram of Open-Loop System]

**Piping for Closed-Loop System:**
Domestic hot water supply: ¾”
Space heating connection: 1”

![Diagram of Closed-Loop System]
Wiring Installations

Wiring:

Power Supply:  KD-HBO100, Open-Loop System 120 VAC 5A  
               KD-HBC100, Closed-Loop System 120 VAC 10A

Thermostat:

Air Handler:   Four wire connection  
               240 VAC power from air handler

Radiant Heating or Spa Water Re-Heating (ON/OFF switch)  
Toggle switch: OFF mode  
Two wires connected to W and R only
Applications

There are many applications you can apply with the Heating Box™ including radiant in-floor, radiant baseboard, hydronic air handlers, snow melting system and more.

In-Floor Radiant Space Heating System

Recommended application specifications:

1. ½” PEX or other comparable products with maximum 9” space
2. 150 ~ 350 feet tube length per loop
3. 0.75 ~ 1.25 GPM in each loop in depend on loop length
4. 6 ~ 8 Maximum loop
5. 20 °F temperature drop in each loop recommended
6. Recommended size of space is about 2000 sq ft maximum.
7. Recommended heat source (water heater) temperature is 180 °F and radiant heating supply temperature sets between 100 ~130 °F depend on applications.

Water heater set temperatures: 140, 160, 180 °F • Radiant heating supply temperatures: 120 °F
Fan-Assisted Hydro Heating System

Recommended application specifications:

1. 2.5 ~ 5 GPM flow rate
2. 30 ~ 35 °F temperature drop at 140 °F hot water supply to the air handler
3. Maximum 5 ton air handler for 2000 sq ft space

Water heater set temperature: 140, 160, 180 °F • Hydro heating supply temperature: 140 °F
Snow Melting System

Snow Melting System’s format and specifications are very similar to other heating applications. As a working media, Glycol (propylene or ethylene glycol) can be used and recommended to mix with water in this system.

Recommended application specifications:

1. ½" PEX or other comparable products with maximum 9" space
2. 150 ~ 250 feet tube length per loop
3. 0.75 ~ 1.25 GPM in each loop depend on the loop length
4. 6 ~ 8 Maximum loop
5. 20 °F temperature drop in each loop recommended
6. Recommended size of space is about 2000 sq ft maximum.
7. Recommended heat source (water heater) temperature is 180 °F and radiant heating supply temperature sets between 100 ~ 130 °F depend on the application.

Spa Water Heating System

The spa water heating system has also a similar format to the snow melting system except the glycol mixture. It is not encouraged adding any chlorine mixture to our system. The recommended set temperature for spa water should be below 105 °F.
Water Filling and Purging System

Please follow the steps below:

1. Make sure all electrical power is turned off before filling the system with water.
2. Double check all domestic hot water faucets are fully closed.
3. Conduct pressure & water leak test with/without pressurizing pipe system. Shut off the valve to the expansion tank must be closed to prevent damage to the expansion tank. When conducting test with pressurized air, test pressure must not exceed 50 PSI, before testing, check the pressure relief valve and see if it is within the test pressure range.
4. Pre-Purge; open main cold water supply valve and slowly open the purge until water leaks and shut the purge valve this clears the air out of the system.
5. Turn on power to the heating unit and built-in thermostat.
6. System Purge: This Heating Box™ will start circulating water. Please check with the purging valve by slowly opening until water leaks and shut the valve again to see whether there is any air left in the system. Keep repeating this step until there isn’t any air left in the entire piping system.
Dip Switch Settings

* Above picture shows Space Heating’s return temperature and Dip Switches.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Heat Source Temperature</th>
<th>4</th>
<th>ON</th>
<th>CLOSE TYPE</th>
<th>OFF</th>
<th>OPEN TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>158°F (70°C)</td>
<td>5</td>
<td>ON</td>
<td>EXTRA PUMP ON</td>
<td>OFF</td>
<td>EXTRA PUMP OFF</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>122°F (50°C)</td>
<td>6</td>
<td>ON</td>
<td>CELSIUS(°C)</td>
<td>OFF</td>
<td>FAHRENHEIT(°F)</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>140°F (60°C)</td>
<td>7</td>
<td>ON</td>
<td>EXTRA POWER ON</td>
<td>OFF</td>
<td>EXTRA POWER OFF</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>181°F (83°C)</td>
<td>8</td>
<td>OFF</td>
<td>EXTRA PUMP OFF</td>
<td>OFF</td>
<td>EXTRA POWER OFF</td>
</tr>
</tbody>
</table>

Heating Return Temperature  
- 115 or -046

Heating Supply Temperature  
5140 or 5060

Domestic Hot Water Temperature  
H120 or H049

Heat Source Setting Temperature  
180F or 082°C
Domestic Hot Water Supply

**WARNING**

Over 122°F (50 °C) water temperature is dangerous to human body and it cause scalds and burns resulting in serious personal injury and/or death. Typical factory set temperature for domestic hot water is 120°F.
Space heating water temperature is typically recommended at 120°F for a radiant space heating and above 140°F for a fan coil space heating. The Heating Box™ continuously monitors the temperature of space heating and returning water temperatures. The temperature of space heating side can be adjusted from 86 F (30 C) to 140 F+ (60 C+).
This section gives a general idea to design a space heating system; it can vary system to system and case by case.

Initial step in any heating system design is to determine the heating requirements (same as “heat loss”) of each individual room or area. More accurate heat loss calculation is to assure the potential of maximum energy savings and to achieve maximum level of comfortness. By using the conventional heat loss calculations for radiant heating design can result to over size the system.

As an example, when desired room temperature is 65 °F ~ 70 °F and ambient temperature is -10 °F at seasonal low temperature, following resistance to heat flow values can be used for basic heat loss calculations in each construction site.

<table>
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<tr>
<th>Constructed Components and Sections</th>
<th>R Factor at -10 °F Seasonal Temperature</th>
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<tr>
<td>Ceiling</td>
<td></td>
</tr>
<tr>
<td>R-19 Insulation</td>
<td>5</td>
</tr>
<tr>
<td>R-30 Insulation</td>
<td>3</td>
</tr>
<tr>
<td>R-38 Insulation</td>
<td>2.5</td>
</tr>
<tr>
<td>Interior above Heated Ceiling</td>
<td>0</td>
</tr>
<tr>
<td>Walls</td>
<td></td>
</tr>
<tr>
<td>R-11 Insulation</td>
<td>8</td>
</tr>
<tr>
<td>R-19 Insulation</td>
<td>5</td>
</tr>
<tr>
<td>Interior wall between rooms</td>
<td>0</td>
</tr>
<tr>
<td>Floor</td>
<td></td>
</tr>
<tr>
<td>Un-insulated wood frame over a crawl space</td>
<td>18</td>
</tr>
<tr>
<td>R-11 insulation</td>
<td>8</td>
</tr>
<tr>
<td>R-19 Insulation</td>
<td>5</td>
</tr>
<tr>
<td>R-30 Insulation</td>
<td>3</td>
</tr>
<tr>
<td>Un-insulated slab on grade</td>
<td>13</td>
</tr>
<tr>
<td>R-10 insulated slab on grade</td>
<td>4</td>
</tr>
<tr>
<td>Interior between heated spaces</td>
<td>0</td>
</tr>
<tr>
<td>Window</td>
<td></td>
</tr>
<tr>
<td>Single Glazed</td>
<td>80</td>
</tr>
<tr>
<td>Double Glazed</td>
<td>40</td>
</tr>
<tr>
<td>Door</td>
<td></td>
</tr>
<tr>
<td>1-1/2” Wood</td>
<td>35</td>
</tr>
</tbody>
</table>

* More detail heat loss data can be collected from the heating design software and heating design engineers.
From above table, factor in areas as square feet to figure out heat loss calculation (or required heat calculation and unit for the heat requirement is BTU/hr in each section.

Pipe spacing in a radiant floor heating installation can directly affect the heat output. The commonly recommended pipe spacing is 8” ~ 9” with ½” PEX pipe. Also the typical pipe lengths are from 150’ to 450’ in each loop where pipe lengths can be calculated (in each loop, heating area times by 1.3). For an example, if heating area is 200 square feet, pipe lengths are approximately 260’.

Finally calculating the each loop requires flow rate divides by the total required heat output (BTU/Hour) by 500 times the design $\Delta T$ of the system. A design $\Delta T$ of 28 °F is considered optimum for on-demand tankless water heaters.

\[
\frac{\text{Required heat output (BTU/Hr) each loop}}{\text{Flow Rate}} = \frac{\text{Total required heat output (BTU/Hour) each loop}}{500 \times \Delta T}
\]

This is very rough formula to design a radiant heating system, please consult you’re your heating design engineer for more accuracy of your heating system design.
Limited Warranty

THE HEATING BOX™ LIMITED WARRANTY

The limited warranties contained within this document are the only warranties given with your Heating Box™ Model KD-HBO100 and supersede any prior warranties. All other warranties, expressed or implied, including the implied warranty of merchantability or the implied warranty of fitness for a particular purpose are hereby disclaimed. Our sole obligation under this warranty, and the purchaser’s sole remedy, is limited to repair or replacement of the Heating Box™ Model KD-HBO100, Model KD-HBC100, or one of its parts. The owner will be responsible for any other costs incurred including labor costs for servicing or replacing the part or unit, shipping, delivery and handling of the replacement part or unit, costs for permits or materials necessary for the repair, or incidental costs resulting from damage external to the unit resulting from the failure.

The Heating Box™ Model KD-HBO100 or Model KD-HBC100 warranty coverage will be limited to the original purchaser of the unit, in its original installation location, and only if the installation is made in North America. In addition, the warranty will only apply if the unit is installed in accordance with all state, local and federal codes, and if the installation, service and maintenance are performed following the installation and Operation Manual included with the unit.

The Heating Box™ Model KD-HBO100 or Model KD-HBC100 you have purchased is warranted to be free of defects and materials and workmanship for a period of five years from the date of purchase. Your warranty registration card must be completed and mailed to KyungDong America to establish your installation date.

EXCLUSIONS FROM WARRANTY

Any for the following actions shall void this limited warranty:
1. Abuse, alterations, neglect, misuse or misapplications.
2. Improper maintenance.
3. Use in conjunction with any unapproved device or devices.
4. Installation in an area with a corrosive atmosphere.
5. Incorrect water supply pressure.
6. Incorrect sizing.

The following are not covered by this warranty:
1. Damage resulting from fire, flood, accidents or other Acts of God.
2. Damage resulting from water freezing inside the unit or the piping.
3. Damage resulting from use with well water and water with high pH and/or high hardness levels.

TO SUBMIT A CLAIM

Report claims to KyungDong America, Inc. by calling 1-800-519-8794.