Commercial and Residential Water Source Heat Pumps

Boiler/Tower and Geothermal Applications

PRODUCT GUIDE

CLIMATE MASTER
Water-Source Heat Pump Systems
**WINTER WARM-UP**

During recovery from night setback, most zones will require heating and will be extracting heat from the water loop. The boiler maintains the minimum water loop temperature according to a predetermined setpoint. The heat rejector is off. The warm-up period is typically one hour or less per day.

**WINTER OCCUPIED**

Most core zones will require cooling because of the internal heat gains discussed previously. Most perimeter zones will require heating. Because heat is being simultaneously rejected into and extracted from the water loop, both the boiler and the heat rejector remain off much of the time. The inherent sharing of energy within the water loop minimizes boiler and heat rejector operation and provides maximum system efficiency.

**SUMMER OCCUPIED**

All zones require cooling and are rejecting heat into the water loop. The heat rejector maintains the maximum water loop temperature according to a predetermined setpoint (fixed or outdoor reset). The boiler is off.

**WATER-SOURCE HEAT PUMPS**

Water-loop heat pump systems combine water-source heat pumps on a common piping loop with a heat rejector and boiler, which are used to maintain the circulating water temperature within a controlled range, typically from 15°C to 35°C. The most common heat rejectors are open cooling towers with isolating heat exchangers, closed-circuit evaporative coolers, or dry coolers. Boilers are usually gas, oil, or electric.

Each zone heat pump utilizes the water loop to provide heating or cooling at any time, during or after hours, regardless of the operating mode of the other heat pumps. This is accomplished without duplicate heat and cool distribution systems, without the double waste inherent in reheat modes, and without concurrent operation of the cooling source and boiler, unlike most HVAC systems that provide the same capabilities.

Water-loop heat pump systems also operate very efficiently at part-load conditions, such as when a small portion of the building remains occupied after hours. Only the required zone heat pumps are used, unlike systems that must keep a large central plant in operation at an inefficient scaled-back capacity in order to serve a small portion of the load.

A typical building has a perimeter with outside exposure that is directly affected by variable outdoor weather conditions and a core without outside exposure that is almost unaffected by the weather. In order to understand the energy sharing benefits of a water-source heat pump system, the interaction of the loads in the core and perimeter zones must be analyzed for occupied periods (internal gains present) and unoccupied periods (temperature setback/setup and little or no internal gains) throughout the year. For illustration, the following are the main energy consuming operating modes of an office building in a temperate climate.

**SOLUTION 1**
SOLUTION 1 EXAMPLE

A WATER-SOURCE EXAMPLE

As an example of how water-source heat pumps can handle a variety of different applications, the building shown to the right is a fictional bronze statue foundry company in the midwest portion of the United States. The first floor comprises their production floor and office space. The second floor of the building is reserved for future use. The cooling tower and boiler work as needed to maintain an average loop temperature between 15 to 35°C. Water-source heat pumps can efficiently operate in either heating or cooling mode under these conditions. This gives individual and specialized zone control for maximum comfort and the ability to change operation modes as needed.

WARM WEATHER (HIGH COOLING DEMAND)

A mixture of units in heating mode and units in cooling mode create a constant temperature in the water loop. In Balanced Mode, there is no need for heat injection or rejection via the boiler or cooling tower. The heat is simply moved from one zone to another.

COOL WEATHER (HIGH HEATING DEMAND)
GEOTHERMAL SYSTEMS

These “Boilerless/Towerless” heat pump systems use the natural thermal properties of the Earth to dissipate or capture heat for the water loop. Geothermal heat pumps operate in an identical fashion to water-source heat pump units. However, without the need for a boiler or cooling tower, they save substantial energy costs and space. The water loop system is underground and the units are inside the building. Thus, the environmentally friendly geothermal system preserves the architectural design of a building naturally.

GEOTHERMAL EARTH LOOPS

Geothermal Earth Loops come in several different configurations depending on space availability and soil properties. Chances are at some point you have either stood over, or walked across a geothermal loop field. Loop fields can be located under parking lots, landscaped areas, or any number of other locations. All earth loops use high-density polyethylene pipe to circulate either water or an antifreeze mixture. All joints and connection fittings are thermally fused to prevent leaks and most piping comes with a 25 year or longer warranty.

LAKE LOOPS

Lake loops utilize a “slinky” assembly of geothermal loop piping placed at the bottom of a pond, lake, or other large body of water. An extremely cost effective loop system, lake loops are an easy alternative if the option is available.

VERTICAL LOOPS

Vertical loops utilize bore holes drilled to an average depth of 76 meters. Once the loop pipe is inserted into the bore, it is grouted using a Bentonite mixture for maximum thermal conductivity. When space is limited, vertical loops are the most common type of geothermal loop installed.

WELL SYSTEMS

Most commonly known as “Open Loop”, well systems pump water out of a nearby body of water or water well, and then discharge the water into another body of water or water well. Well systems usually employ a plate heat exchanger inside the building to keep the building water loop separated from the well water. This prevents any contaminates from affecting unit performance and extends system life. Well systems are often the most efficient as the well water is always at the same temperature year-round.

HORIZONTAL LOOPS

Horizontal loops utilize trenches dug to an average depth of 1.5 to 2 meters. As one of the more cost effective loops to install, horizontal loops are commonly found in open fields, parks or under parking lots.
A GEOTHERMAL EXAMPLE

Using the same building model, the cooling tower and boiler are replaced with a geothermal vertical loop field. Identical in overall zone operation, the building benefits by having less overall equipment and reduced operation costs. Building aesthetics are also improved by eliminating outdoor equipment, and additional space is gained by eliminating the boiler and additional support equipment.

The cooling tower and boiler can be eliminated in the geothermal application freeing up space used for equipment for other use. Only a small amount of room is needed for loop circulation equipment.
TRANQUILTY® COMPACT (TC) SERIES
- Models 006 (1.8 kW) through 060 (17.6 kW)
- EarthPure® [HFC-410A] refrigerant
- Galvanized steel construction
- Epoxy powder painted galvanized steel drain pan
- Sound absorbing glass fiber insulation
- Double isolation compressor mounting for quiet operation
- Insulated divider and separate compressor/air handler compartments
- Scroll compressors (rotary for size 018 and below)
- TXV metering device
- Microprocessor controls standard (optional DXM and/or DDC controls)
- LonWorks, BACnet, Modbus and Johnson N2 compatibility options for DDC controls
- Factory-mounted hanger brackets for horizontal units
- Unit Performance Sentinel performance monitoring system
- Eight safeties standard
- Extended range (-6.7 to 48.9°C) capable
- Wide variety of options including factory installed service disconnect

TRANQUILTY® LARGE (TL) SERIES
- Vertical sizes 084 (24.6 kW) through 300 (87.9 kW)
- Unit configuration can be ordered with, or converted to front or back return and top, front, or back discharge.
- Electrical box can be field converted to be on front or back of unit
- Electrical power can enter from the front or either side of unit
- Water and drain can be connected to either side
- Dual refrigeration circuits (TL168, 192, 240, 300)
- Exceeds ASHRAE 90.1 efficiencies
- TXV metering device
- Extended range (-6.7 to 48.9°C) capable
- Microprocessor controls standard (optional DXM and/or DDC controls)
- LonWorks, BACnet, Modbus and Johnson N2 compatibility options for DDC controls
- Unit Performance Sentinel performance monitoring system
TRANQUILITY® CONSOLE (TRC) SERIES

- Models 09 (2.6 kW) through 18 (5.3 kW)
- EarthPure® (HFC-410A) zero ozone depletion refrigerant
- High efficiency rotary compressors
- Two-piece chassis/cabinet design
- Galvanized steel cabinet with durable Polar Ice powder coat finish and black "matte" finish on subbase
- Slope top/aluminum rigid bar supply air grille. Front or bottom return
- Extended range (-6.7 to 48.9°C) capable
- Advanced digital auto or manual-change-over unit mounted controls with temperature display (°C or °F) and fault indication
- Remote-mounted controls available
- Microprocessor controls standard (optional DXM and/or DDC controls)
- LonWorks, BACnet, Modbus and Johnson N2 compatibility options for DDC controls
- Right or left-hand piping arrangement
- Unit Performance Sentinel™ performance monitoring system
- Eight safeties standard
- Wide variety of options including coated air coil

TRANQUILITY® MODULAR WATER-TO-WATER (TMW) SERIES

- Models 036 (10.5 kW) through 340 (100 kW)
- Copeland scroll compressors
- Dual independent refrigeration circuits (120 and 340)
- Exclusive single side service access (front of unit) allows multiple units to be installed side-by-side for large capacity installations
- Top water connections, staggered for ease of manifolding multiple units (170 and 340)
- Heavy gauge galvanized steel construction with polyester powder coat paint and stainless steel front access panels
- Insulated compressor compartment
- Extended range (-5 to 45°C) capable
- Microprocessor controls standard LonWorks, BACnet, Modbus and Johnson N2 compatibility options for DDC controls
- Compressor "run" and "fault" lights on the front of the cabinet (170 and 340)
- Seven safeties standard
- Options include UltraQuiet sound attenuation package and cupro-nickel heat exchanger(s)

FEATURE COMPARISON:

Packaged and Console Series

<table>
<thead>
<tr>
<th>Standard Features</th>
<th>Factory Installed Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>EarthPure® (HFC-410A) Refrigerant</td>
<td>Microprocessor CXM Controls</td>
</tr>
<tr>
<td>Microprocessor CXM Controls</td>
<td>Copper Coil</td>
</tr>
<tr>
<td>TXV</td>
<td>Dual Level Compressor Isolation</td>
</tr>
<tr>
<td>Dual Level Compressor Isolation</td>
<td>Field Convertible Discharge (Horizontal Units)</td>
</tr>
<tr>
<td>3 Access Panels</td>
<td>Scroll Compressors</td>
</tr>
<tr>
<td>Scroll Compressors</td>
<td>Factory Installed Hanger Brackets (Horizontal Units)</td>
</tr>
<tr>
<td>Remote Reset at Thermostat</td>
<td>Condensate Overflow Protection</td>
</tr>
<tr>
<td>Condensate Overflow Protection</td>
<td>Cupro-Nickel Coil</td>
</tr>
<tr>
<td>High Static Blower</td>
<td>Extended Range Operation (-6.7 to 48.9°C)</td>
</tr>
<tr>
<td>Extended Range Operation (-6.7 to 48.9°C)</td>
<td>Auto-Flow Regulation</td>
</tr>
<tr>
<td>Auto-Flow Regulation</td>
<td>Two-Way Control Valve</td>
</tr>
<tr>
<td>Two-Way Control Valve</td>
<td>DownFlow Configuration</td>
</tr>
<tr>
<td>DownFlow Configuration</td>
<td>Desuperheater Coil</td>
</tr>
<tr>
<td>Desuperheater Coil</td>
<td>DDC Controller</td>
</tr>
<tr>
<td>DDC Controller</td>
<td>Deluxe DXM Controller</td>
</tr>
<tr>
<td>Deluxe DXM Controller</td>
<td>Coated Air Coil</td>
</tr>
<tr>
<td>Coated Air Coil</td>
<td></td>
</tr>
</tbody>
</table>

1. High efficiency rotary or scroll compressor depending on model.
2. Size 060 only.
ClimateMaster’s manufacturing facility in Oklahoma City, Oklahoma, U.S.A.

ClimateMaster works continually to improve its products. As a result, the design and specifications of each product at the time for order may be changed without notice and may not be as described herein. Please contact ClimateMaster’s Customer Service Department at +1-405-745-6000 for specific information on the current design and specifications. Statements and other information contained herein are not express warranties and do not form the basis of any bargain between the parties, but are merely ClimateMaster’s opinion or commendation of its products.