

**WOJCIESZAK & ASSOCIATES, INC.**

**CONSULTING ENGINEERS**

833 EAST 5<sup>TH</sup> STREET  
STUART, FLORIDA 34994  
(772) 286-8696



## **TECHNICAL BULLETIN**

<b>NO.</b>	<b>DATE</b>	<b>REVISION</b>
202	04/25/06	2

### **CHILLED-WATER, FOUR-PIPE (CHW) SYSTEM**

#### **Constraints**

1. House square footage      10,000 SQ. FT. or more
2. Smallest zone                      250 SQ. FT.

#### **System Description**

Chilled-water systems can be installed in residences over 10,000 square feet, however, because of the high initial cost, they are commonly found in residences 30,000 square feet and above. This system provides the most flexibility and has been described as providing a high level of comfort. The high level of comfort is achieved because of the system's ability to maintain nearly constant temperature and humidity levels within the house. Artwork, decorations and interior finishes are well preserved in this type of indoor climate and could be the reason some residences under 30,000 square feet have chilled-water systems.

The chilled water is produced by large compressors inside a chiller. One or two chilled-water pumps pump the 45°F chilled-water to the air handling units that sit in mechanical closets. The air handling units consist of a fan, a chilled water coil, and a hot water coil. The fan blows the room air over the chilled-water coil and delivers cold air to the room. This process warms up the chilled-water to about 55°F. The chilled-water is pumped back to the chiller.

A cooling tower is used, like in the water-cooled heat pump system, to provide cooling for the chiller's compressors. Condenser water is pumped to the cooling tower. The cooling tower has a fan that blows air across this water and cools the water before it returns back to the compressor.

The hot water coil inside the air handler has 140°F to 160°F water circulating through it. The fan blows room air over the coil and delivers the warmed air to the room. The hot water is cooled by about 10°F and it is pumped back to the boiler where it is heated back up. The hot water coil also serves to dehumidify the space as needed.

#### **Estimated Costs**

Obtain from an HVAC contractor.

#### **Notes:**

1. Equipment Replacement Frequency
  - Cooling tower fan motor      (every 4-5 years)
  - Cooling tower                      (every 10-15 years)
  - Chilled water pumps inside      (every 10-15 years)
  - Condenser water pumps outside (every 5-7 years)
  - Boiler outside                      (every 5-10 years)
  - Boiler pumps outside              (every 5-7 years)
  - Air Handling Units                  (every 15-20 years)
  - Chiller                                  (every 20 years)

#### **Indoor Equipment**

1. Air Handling Unit (AHU)
  - a. Typical mechanical closet/room size
    - 2-ton                                  48" x 42"
    - 3-ton                                  48" x 56"
    - 4-ton                                  49" x 56"
    - 5-ton                                  49" x 62"
  - b. Since there is only a fan and hot and chilled water coils, the chilled-water AHU is relatively quiet.
  - c. Location of equipment should be in areas where service personnel can easily access the equipment, via hallways in lieu of bedroom closets, for example. Filter changing and coil cleaning are routine maintenance.
  - d. For added comfort, two speed fans can be used for the AHU fan. The slow speed will provide a comfortable environment while the space is below maximum capacity; whereas the high speed can provide adequate cooling for maximum capacity.
2. Chiller and Chilled-Water Pumps
  - a. The chiller and pumps should be located inside a room far away from the main living/sleeping areas. Particular attention should be given to sound-proofing this room.



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b. Indoor mechanical room dimensions:

SQ. FT.	Length	Width	Height
10,000	15'	9'	8'
15,000	15'	9'	8'
20,000	18'	10'	8'
30,000	18'	10'	8'
40,000	18'	10'	8'
50,000	20'	12'	8'
60,000	22'	12'	8'
70,000	22'	12'	9'

3. It is best to locate the pumps for condenser water inside the building. This shelters the equipment from the harsh outdoor environment, thus extending its useful life. The pumps run continuously, therefore it makes it important to carefully locate this equipment and sound proof the room. Pumps may be located outside if no interior space is available.
4. A boiler is used to heat the condenser water and provide heating on cool days. It too may be located inside to be protected from the weather, but air for combustion has to be provided as well as flue venting for the flue gases. If no room is available inside, it may be located outside.

**Outdoor Equipment**

1. Cooling Tower

a. Typical cooling tower size

SQ. FT.	Length	Width	Height
10,000	7'-0"	4'-2"	6'-7"
15,000	11'-0"	4'-2"	5'-2"
20,000	11'-0"	4'-2"	6'-7"
30,000	15'-0"	4'-2"	6'-7"
40,000	18'-0"	4'-2"	6'-7"
50,000	18'-0"	4'-2"	6'-7"
60,000	15'-0"	7'-10"	6'-7"
70,000	15'-0"	7'-10"	6'-7"

- b. Because of the size of the cooling tower, a large space on the property is necessary. Although there are several options available for noise reduction, the tower

should be located far away from the residence or sound sensitive outdoor areas of the property. Local codes may limit the noise levels at adjacent property lines.

2. Overall Outdoor Equipment Pad Size

SQ. FT.	Length	Width	Height
10,000	11'	9'	7'
15,000	15'	9'	6'
20,000	15'	9'	7'
30,000	19'	9'	7'
40,000	22'	9'	7'
50,000	22'	9'	7'
60,000	19'	12'	7'
70,000	19'	12'	7'

**Piping**

Chilled water piping is typically copper insulated with 2-inch thick foamglass insulation. Care should be made to locate piping in accessible locations above the ceiling where the insulation can be repaired when it wears out (15-20 years). The piping can also be run under ground and under the slab when welded steel is used.

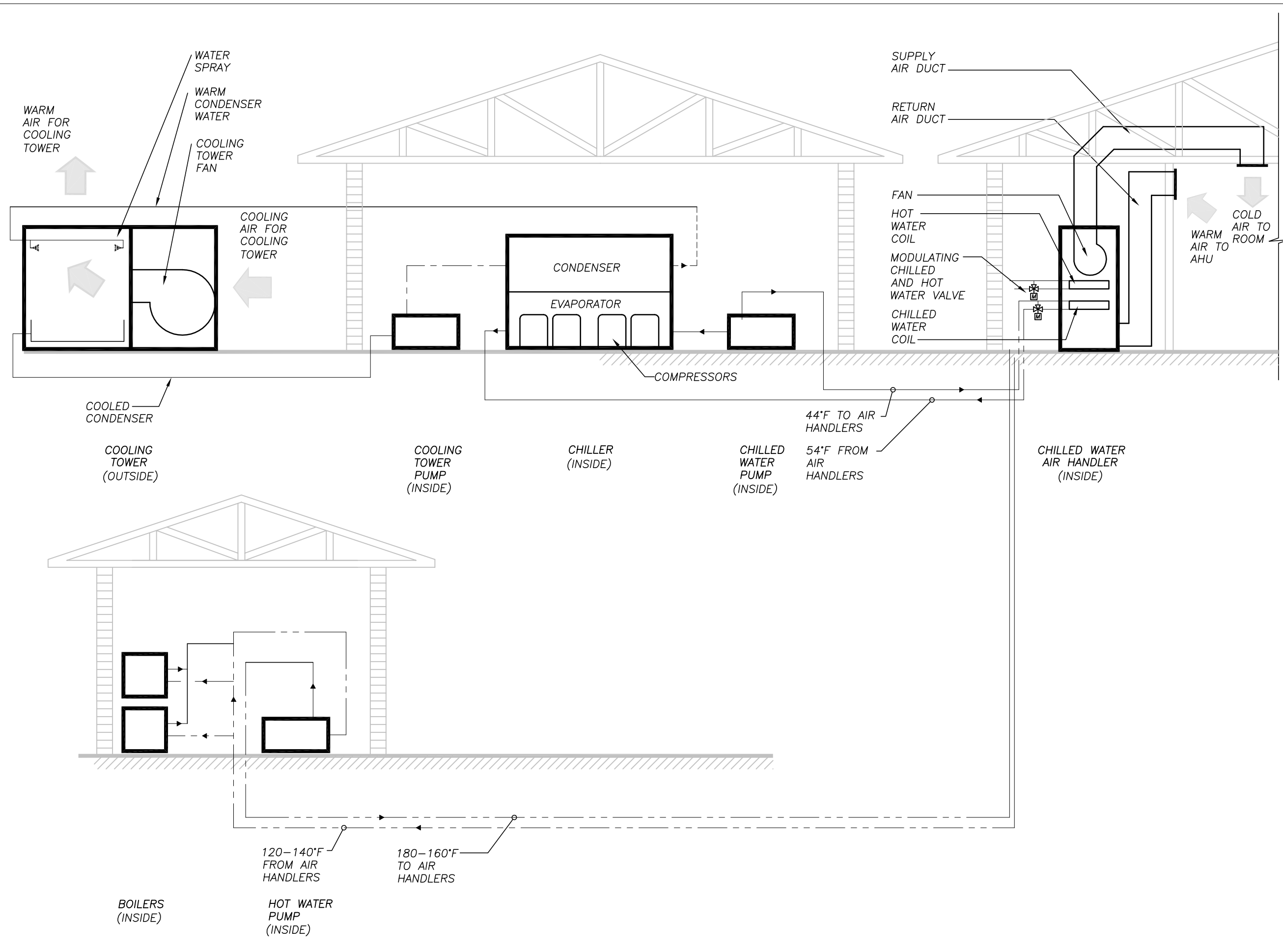
Condenser water piping is generally PVC underground and copper above ground and does not require insulation. It is usually run above the ceiling.

**Humidity Control**

Humidity control is available through the hot water coil on the air handling unit. The hot and chilled water coils work together to dry out the air.

**Energy Consumption**

Energy consumption is quite low in systems of 100 tons or more. However, in the smaller systems, there is not much difference between the chilled-water and water-cooled heat pump systems.



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FOUR-PIPE (CHW)  
SYSTEM**

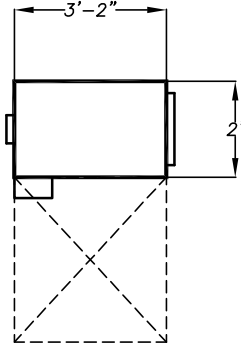
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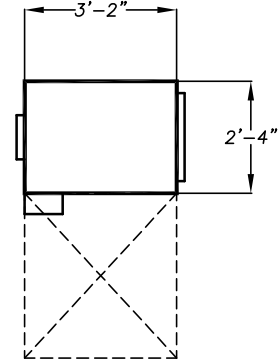
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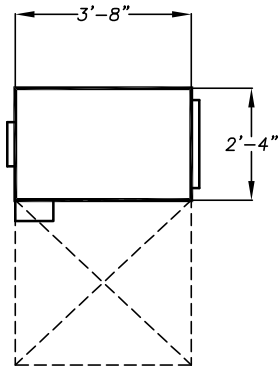
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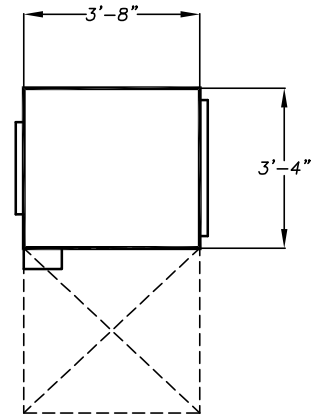
1 TON - TRANE BCHB 012



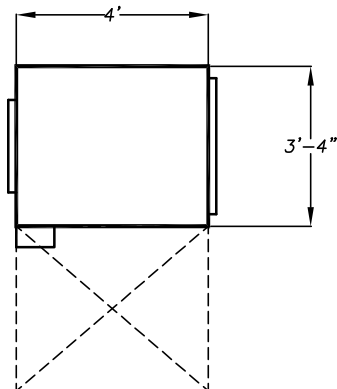
1-1/2 TON - TRANE BCHB 018



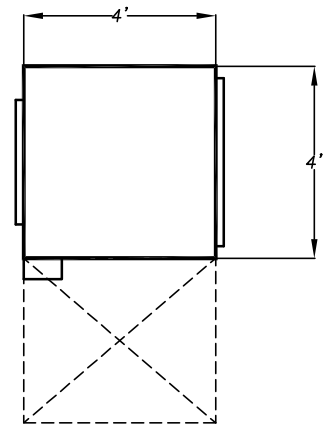
2 TON - TRANE BCHB 024



3 TON - TRANE BCHB 036



4-1/2 TON - TRANE BCHB 054



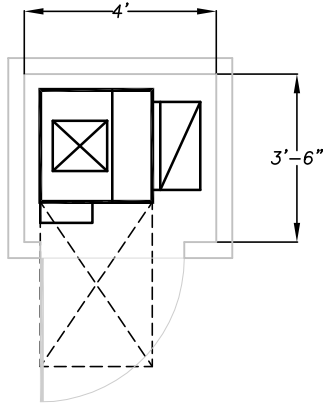
6 TON - TRANE BCHB 072

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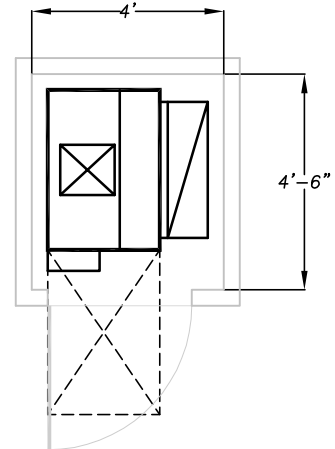
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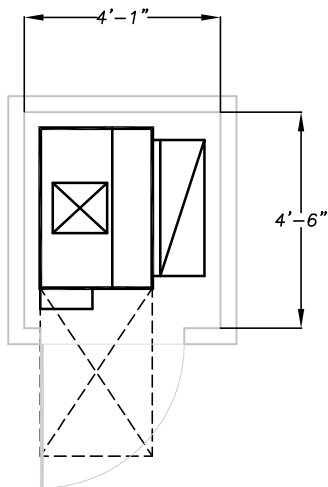
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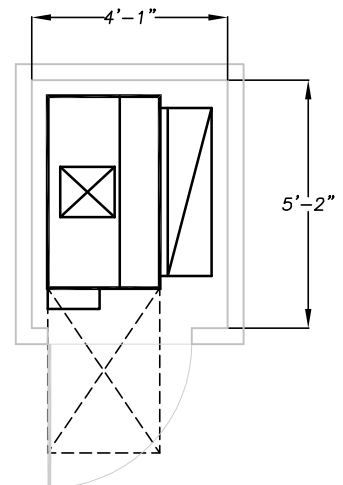
2 TON - TRANE BCVB 024



3 TON - TRANE BCVB 036



4-1/2 TON - TRANE BCVB 054



6 TON - TRANE BCVB 072