Shrimp Temperature Control

Hydronic & DX Refrigerant System Applications
Heating & Chilling

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Shrimp Design Temp Control Points

- Maturation – 27-28C
- PL Rearing - 28→32C
- Grow Out - 29→30C
- Pack Out – 14-15C

Delta Hatchery – GO – Pack Out
Major Shrimp Projects Completed

- GMSB - Summerland, Key FL – Hatchery **1992** (Delta “Buffalo” first story)
- Pen-Bur Farms, Buda Texas – GO
- Shrimp Culture Tech, Fort Pierce FL – Genetics
- GMSB, Cedeno, Honduras – Hatchery
- SyAqua, Mazatlán MX – Hatchery
- Natural Shrimp, La Coste’ TX – GO
- Global Blue Tech, Taft TX – GO-Hatchery-PO
- Seafood Products Development, Taft Texas – GO – Hatchery
- Planet Shrimp, Ontario Canada – GO
- Benchmark Genetics, Fellsmere FL -Genetic Broodstock
- Home Grown Shrimp, Indiantown FL GO **2023**

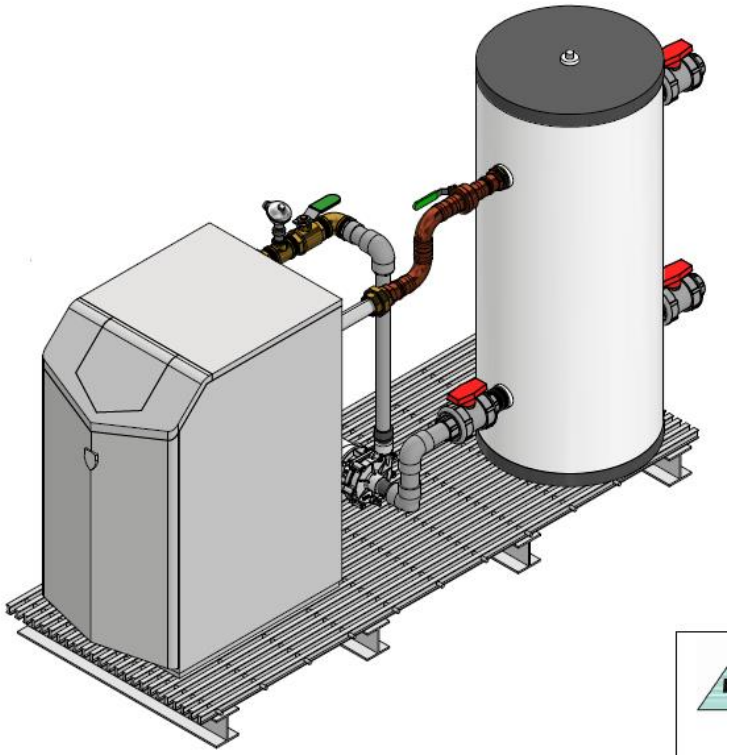
Types of Temp Control Systems

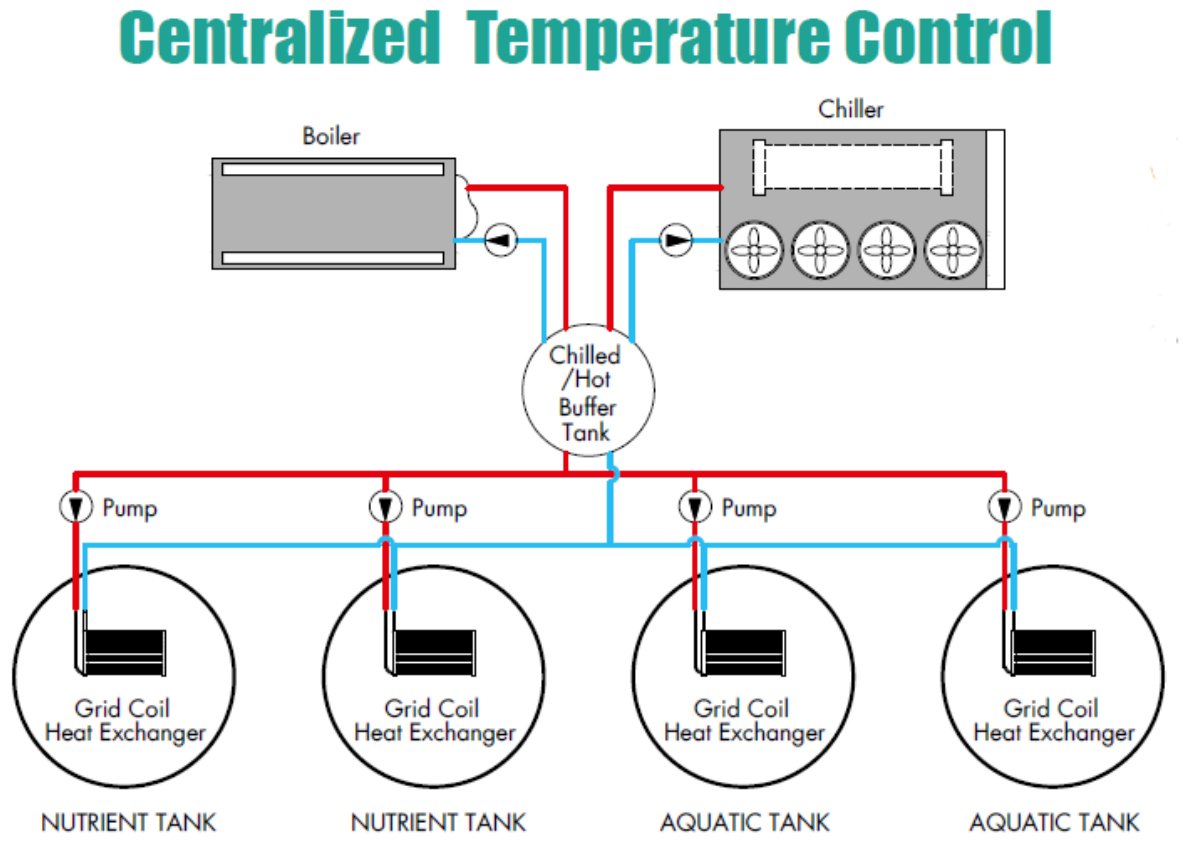
- Centralized Heating or Chilling System – Servicing multiple tanks of various size with independent temperature control capability
    - Central Hydronic Boiler Systems
    - Central Chiller System
- Single Point Heating or Chilling System – Service single tank or system a single temperature control capability
    - Single Point Hydronic Boiler System
    - Single Point DX Refrigerant Chiller/Heat Pump System

British Thermal Unit "BTU" change of temp in 1 lb. of H_20 by 1°F. One kW equals 3415 BTUs.

Hydronic Heating & Chilling System

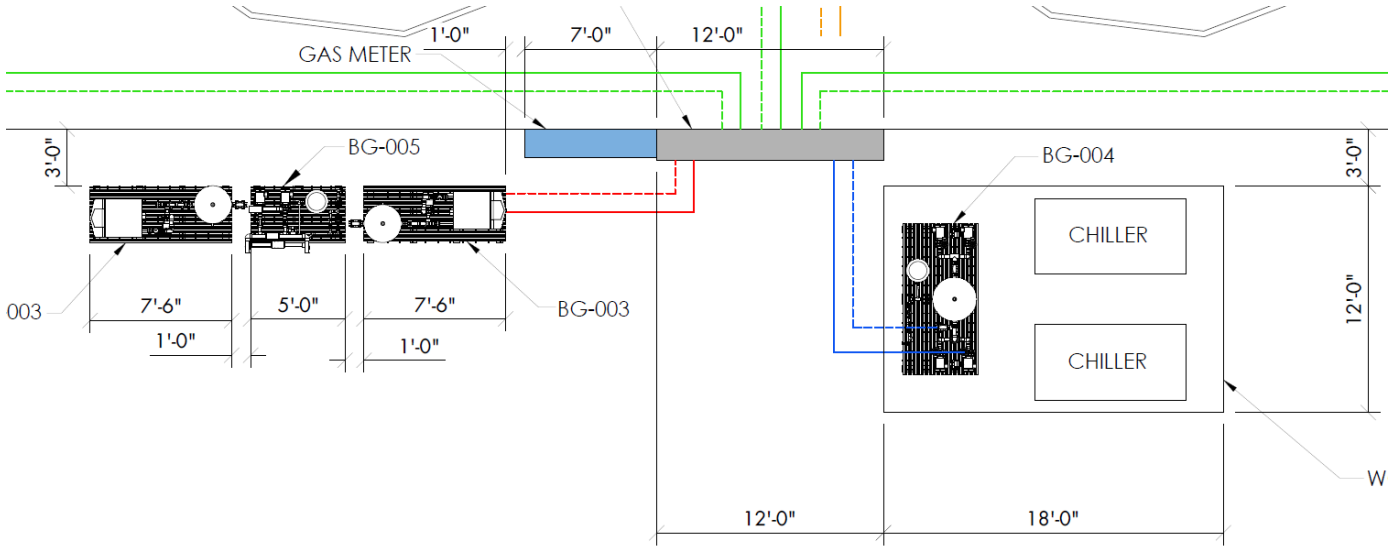
- Hydronic System is a closed loop pressurized system that circulates CW or HW to heat exchangers for tank temp control.

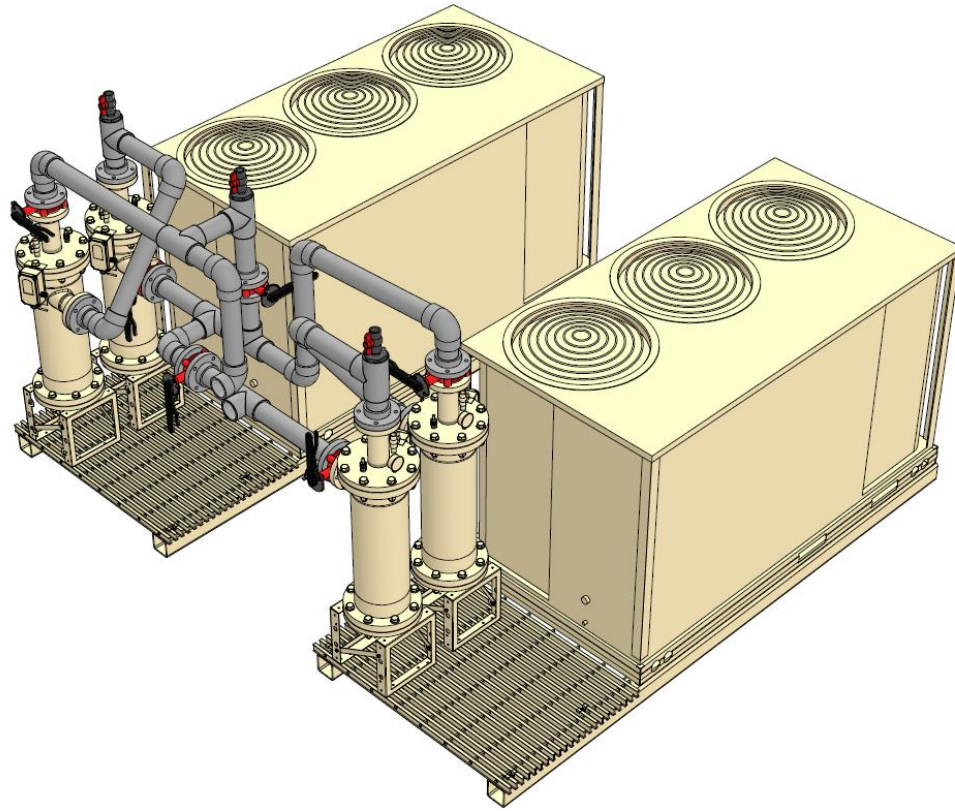




Hydronic Heating & Chilling System

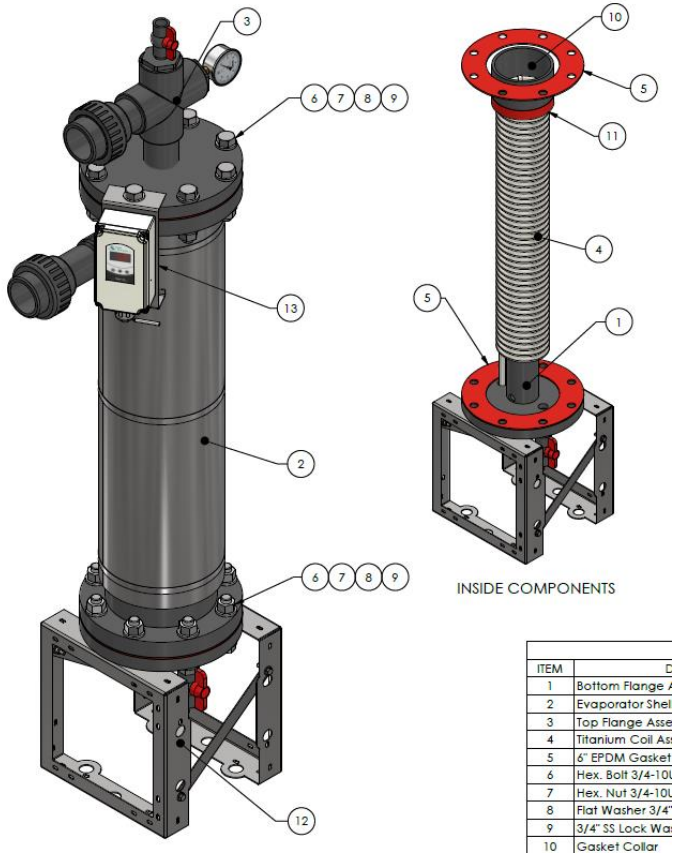
- Major Components: Water Chiller, Hot Water Boiler, Buffer Tank, Hydronic recirc-pumps, Titanium immersion heat exchangers, Temp controllers.



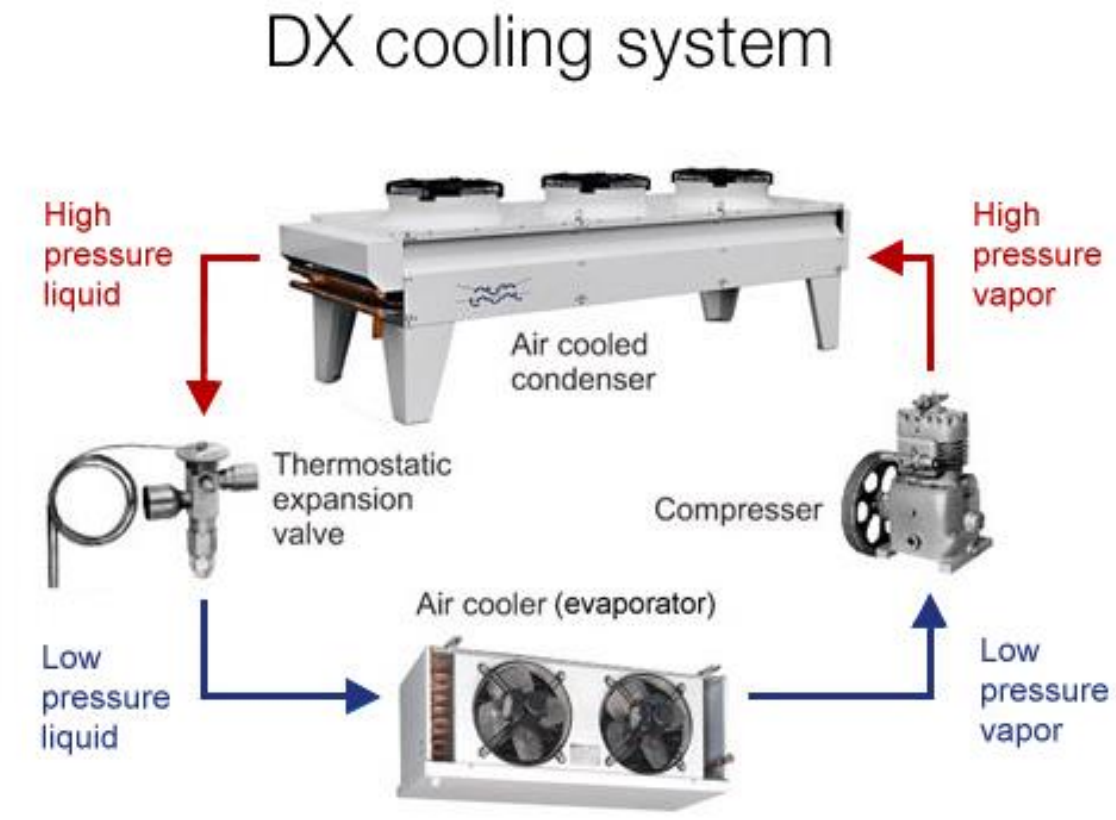


DX Refrigerant Heating & Chilling systems

- DX “Direct Exchange” Refrigerant is a closed loop pressurized system that circulates refrigerant through a single heat exchanger

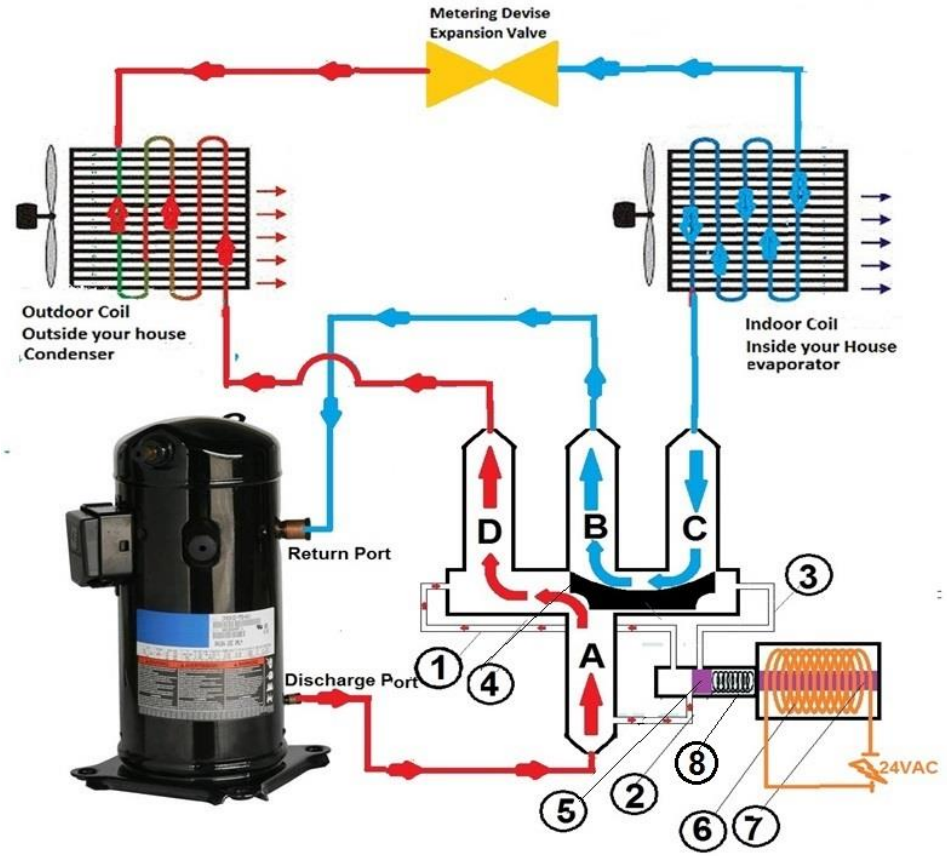


ITEM	D
1	Bottom Flange A
2	Evaporator Shel
3	Top Flange Asse
4	Titanium Coil As
5	6" EPDM Gasket
6	Hex. Bolt 3/4-10(
7	Hex. Nut 3/4-10(
8	Flat Washer 3/4"
9	3/4" SS Lock Wa
10	Gasket Collar



- Major Components: Condenser (compressor and condenser coil), “TEV” Thermal Expansion Valve (regulated refrig flow into HEX), Titanium Evaporator (heat exchanger), Temp controllers.

- The DX Heat Pump has the capability to heat or chill by controlling the directional flow of refrigerant between condenser and evaporator with a “reversing valve”.



When to use a CW/HW Hydronic Loop System

(HW Boilers & Water Chillers)

1. Large aquaculture tank systems 50K+ Gal
2. Multi-tank system with independent temp control requirement
3. Insufficient 3PH electrical service for commercial DX equipment
4. Lower first dollar capital investment for large BTU systems
5. High exchange rates with large dT requiring large BTU load

When “not” to use a CW/HW Hydronic Loop System

(HW Boilers & Water Chillers)

1. Utilizing carbon-based NG and LP gas is not available or desirable
2. A high-cost technical MEP installation may exceed equip cost
3. Heat Pump DX systems able provide both heat & chill capacity
4. Requires skilled maintenance “technician” to T/S hydronic issues
5. A large leak in system can cause pressure loss and shut-downs

When to use a DX Refrigerant Loop System

(Heat Pump & Chillers)

1. One unit is sufficiently sized for the heat or chill load
2. Consider DX over Hydronic if 3PH power is available on site
3. Small single point temp control application < 50K gal volume
4. Efficient energy operation is required; provided by the refrigeration cycle producing more energy during liquid to vapor phase change than is required to compress the vapor back to liquid. The ratio is Coefficient of Performance (COP) which has range of 1.5 to 3
5. No skilled maintenance staff to maintain a hydronic systems

When not to use a DX Refrigerant Loop System

(Heat Pump & Chillers)

1. Potential higher first dollar cost than equally sized hydronic system
2. Inadequate 3PH power supply available for the thermal load
3. Minimal heat capacity for large commercial aquaculture systems
4. Multiple HP units exceed the cost of a hydronic boiler package
5. Northern climates reduce HP's capacity due to cold air temps

Thermal Sizing Consideration for Capacity selection

1. Make-up exchange flow and dT
2. Tank surface area evaporation
3. Thermal loses to ground
4. Startup loads and Volume Recovery
5. UV lamp kW
6. Pump motor horsepower
7. Indoor ambient air & humidity conditions
8. Biomass density in Boi-Floc environment
9. Degas and aeration cfm rates

Aquatic System Thermal Design Considerations

- Consider tenting tanks if practical to reduce SA heat losses
- Consider insulating the tank bottoms with polystyrene
- Consider using SC**80** C&PVC piping for CW/HW distribution
- Design tempered effluent discharge to a common heat recovery sump
- Consider adjustable variable speed EC motors for pumps and fans
- Consider simple automation controls to adjust motor speeds based on temperature or CO2 to reduce energy consumption
- Pre-temper make up water using heat recovery to reduce energy
- Consider hybrid equipment designs to include boiler, HP’s and HRU.
- Employ competent mechanical technician with HVAC/electrical knowledge

Hybrid Thermal System Equipment Configuration

- Consider solar photovoltaic to offset 24 hr pumping electric HP
- Consider solar thermal to heat large make-up reservoir tanks
- Design large production systems with 20% of heat load by HP
- Design large production systems with 80% heat load by H-E boiler skid
- Design effluent piping with heat recovery system to temper exchange water

Delta Hydronics Aquatic Heat & Chill Specialist

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