

BARR – LEONARD COMPANY

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Nordhavn 120'

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HVAC review and comments

System;

- Circulated water for both, boiler heating and cooling.
- Chiller 32 Ton Cruisair system.
- Boiler 2 - Kabola Boilers
- Fan coil capacity, estimated; 38.4 tons, 461K btu's.
- Chiller loop gpm is; 115 gpm.
- Boiler is connected to the chiller loop via 2 – Brazed plate heat exchangers. Temperature of the loop is controlled by a thermal mixing valve.
- Boiler is connected to the domestic hot water circulation system via, 2 – Brazed plate heat exchangers (BPHE). Domestic Hot water temperature is controlled by a thermal mixing valve.

Issues;

- PVC sch 80 pipe and fittings (Max temp rating is; 140 degree F)ⁱ were used to connect the Brazed Plate Heat Exchangers (BPHE) to the plumbing, on both the chiller loop and the domestic hot water loop.
- PVC schedule 80 pipe specifications;ⁱ
 - Max temp rating is; 140 degree F
 - Maximum pressure rating of PVC Schedule 80 pipe is; 300psi
 - Pressure De-rating factor for PVC pipe @ 140 degree F is; .22.
 - Max temp rating is; 140 degree F
 - Threading requires a 50% reduction in pressure rating stated for plain end pipe @ 73°F
 - Pressure reduction do to temperature and pressure; $(140 * .5) * .22 = 33\text{psi}$.
 - Working pressure of Kabola boiler as listed on their web site is 43psi.ⁱⁱ
- On the chiller loop, the connection to the 2 - BPHE was with 2 – 1" Pex tubing. For a total of 4 – 1" connections. This is causing a restriction in the plumbing and reducing the overall flow of the chilled water loop.
- To carry the appropriate amount of water to equal 2-1/2" pipe (115gpm)ⁱⁱⁱ you would need; 10 – 1" pex tubes @12 gpm.ⁱⁱⁱ

Recommendations

- Replace all PVC schedule 80 pipe carrying boiler water with pipe material capable of carrying 180 degree F water for both chiller loop and domestic hot water circulating system.
- Replace all PVC schedule 80 pipe connected to heat exchangers that are connected to the boiler and have the possibility of the surface temperature exceeding 140 degree F.
- Chiller loop connection to heat exchanger need to be upsized to carry the appropriate amount of water in the 4-connections. These pipes need to be increased from the FPHE to the 2-1/2" main trunk line. The recommended size of these connections should be; 1-1/2" lines.
- CPVC Schedule 80 specifications^{iv}

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- Max working temp; 200
- Max working pressure; 400 psi
- Max working pressure at 200 degrees F; $400 * .20 = 80$ psi.
- Reduction for threaded fittings; $50\% 80 * .5 = 40$ psi
- It is not recommended to use CPVC Sch 80 threaded pipe in temperatures over 140 degrees F.
- Recommendation for piping material would be;
 - Copper
 - Mapress
 - Brazed
 - Mepla (185 degree F)^v
 - Mapress
 - Available in 2.5" (75mm)
- Confirm boiler data
 - Line size
 - Operating pressure
 - Operating temperature
 - Boiler loop pressure release valve release pressure.
- Confirm chiller loop gpm actual by getting pressure delta across pump
- Install pressure gauges across pumps;
 - Circulator pumps
 - Boiler pumps

Comments to recommendations;

- Failure to use proper pipe materials;
 - Repeat of same issue of fittings distorting and leaking.
 - Possibility of catastrophic failure of boiler side of plumbing, resulting in scalding hot water being released under pressure.
- Failure to increase chiller loop pipe connections to BPHE;
 - Low chiller loop water circulation issues;
 - Rated performance of fan coils not achieved.
 - Nuisance trips on chiller of;
 - Loop TD max
 - Low loop temp
 - Low pressure fault
 - Possibility of Chiller brazed plate heat exchanger freezing up and developing a leak to the refrigerant circuit.

ⁱ Charlotte Plastic Tech Manual;

[http://www.charlottepipe.com/Documents/PL_Tech_Man/Charlotte Plastics Tech Manual.pdf](http://www.charlottepipe.com/Documents/PL_Tech_Man/Charlotte_Plastics_Tech_Manual.pdf)

ⁱⁱ Kabola Web site; <http://www.marinetec-us.com/HR400.html>

ⁱⁱⁱ Dometic Cruisair Chiller Installation Manual

^{iv} Charlotte Plastic Tech Manual

^v Gerbert Mepla web site; http://catalog.geberit.com/public/product.aspx?cat=GB_GB-en_1&ch=201&p=38107