Fermilab

NuMI Air Cooling System
Heat Exchanger Specification
#MD-ENG-033

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Revision 1 – March 18, 2004
Revision 2 – April 7, 2004

1.0 Scope

1.1 The purpose of this heat exchanger is to cool a moist stream of air and to condense part of the water vapor in the air stream. The moist air stream is at atmospheric pressure. The coolant is a mixture of water and propylene glycol.

1.2 The heat exchanger shall consist of two coils that operate in parallel to cool the load stream. The term "unit" is used in this specification to denote the group of coils.

1.3 Vendor shall design the unit for the full load operating conditions.

1.4 *Revised:* Vendor shall estimate coil performance at the minimum load operating conditions in Section 4.0, or at the vendor's recommended minimum air flow rate if the specified air flow rate is too low to accurately estimate coil performance.

1.5 The unit will be installed in a closed loop, variable air volume cooling system, just upstream of the fan.

1.6 The unit will be installed inside a sheet metal duct.

1.7 The unit will be installed indoors. The indoor temperature range will be 50 to 80 °F. Relative humidity outside the air duct will be 50 to 90%.

1.8 Vendor technical and cost-saving suggestions are welcome.

1.9 *Revised:* Coils shall be rated in accordance with current edition of ARI Standard 410 and certified in accordance with the ARI Certification Program.

2.0 General Operating Conditions

2.1	Altitude	600 feet above mean sea level
2.2	Barometric pressure	14.4 psia
2.3	Process stream to be cooled	Air and water vapor
2.4	Process stream operating pressure	14.3 psia to 14.6 psia

2.5	Coolant	80% water, 20% propylene glycol by volume with industrial corrosion inhibitors
2.6	*Revised:* Coolant operating pressure	200 psi maximum
2.7	Fouling factor – air side	0.0005 hr-F-sq ft/Btu
2.8	Fouling factor – coolant side	0.001 hr-F-sq ft/Btu
2.9	Air flow orientation	Horizontal
2.10	Air flow direction	Air enters the coil from the left and exits to the right when looking at the water connections.
2.11	*Revised*: Air pressure drop	1.0" water column maximum
2.12	*Revised:* Coolant pressure drop	10 psi maximum

2.13 The coils shall be designed to keep water condensate from being entrained back into the air stream.

2.14 *Revised:* Free nitrogen in the air stream can combine with the condensate in the coil to form nitric acid. Nitric acid concentration can be up to 25%. The coil shall be protected from corrosion by nitric acid. Refer to Section 5.0, Fabrication Requirements, for coil corrosion protection.

3.0 Full Load Operating Conditions

3.1	Number of coils operating	All
3.2	Dry air standard volume flow rate	20,340 scfm
3.3	Dry air density, standard conditions	0.075 Lbm/cubic foot
3.4	Dry air mass flow rate	91,530 Lbm/hr
3.5	Air inlet temperature	73.6 °F
3.6	Air inlet specific humidity	0.0057 Lbm wv/Lbm dry air
3.7	Air exit temperature	40 °F
3.8	Air exit dew point temperature	40 °F
3.9	Coolant flow rate	100 US gpm

3.10	Coolant inlet temperature	30 °F
3.11	Heat exchanged	232.7 kW

3.12 Vendor shall provide air and coolant pressure drop in quotation.

4.0 Minimum Load Operating Conditions

4.1	Number of coils operating	1
4.2	Dry air standard volume flow rate	1,876 scfm or vendor's recommended minimum flow rate (paragraph 1.4)
4.3	Dry air density, standard conditions	0.075 Lbm/cubic foot
4.4	Dry air mass flow rate	8,441 Lbm/hr
4.5	Air inlet temperature	56.3 °F
4.6	Air inlet specific humidity	0.0093 Lbm wv/Lbm dry air
4.7	Air exit temperature	See 4.12.1.
4.8	Air exit dew point temperature	See 4.12.1.
4.9	Coolant flow rate	100 US gpm / See 4.12.2.
4.10	Coolant inlet temperature	30 °F / See 4.12.2.
4.11	Heat exchanged	20.6 kW

4.12 Vendor shall provide the following data on coil performance at the minimum load operating conditions:

4.12.1 Dry bulb and dew point temperatures for exit air with specified coolant conditions in the quotation.

4.12.2 *Revised:* Up to six cases with various conditions after receiving order.

5.0 Fabrication Requirements

5.1 *Revised:* Tube material: Copper, 0.035" wall thickness minimum.

5.2 *Revised:* Fin material: Aluminum.

5.3 *Revised:* Casing material: 304 stainless steel.

5.4 Material of construction for parts not in contact with the moist air stream: Vendor standard.

5.5 *Revised:* All coils shall be protected from corrosion by 25% nitric acid. Each coil shall be coated for corrosion protection by a cathodic epoxy electrocoat process modified for maximum edge coverage. The coating shall have high heat transfer efficiency, be flexible, and be applied by complete immersion.

5.6 *Revised:* Unit will be installed inside a sheet metal duct that has an inside width of 72". Coil face area shall be based on 72". The duct will be wider where the coils are installed to utilize 72" wide coil face area.

5.7 *Revised:* Each coil shall have three zones. Each zone shall have $^1/_3$ of the circuits in the coil. Each zone shall have its own water inlet and outlet headers.

5.8 *Revised:* Unit housing height, vertical to the airflow direction, shall not exceed 92". That is, combined heights of the casings shall not exceed 92".

5.9 *Revised:* Unit housing width, in the direction of the airflow, shall not exceed 16".

5.10 *Revised:* Water connections shall be threaded. Customer's coolant supply and return lines are copper tube.

5.11 The coils will be installed in the duct system through an opening in the side of the duct. The coils will be stacked one on top of the other. Vendor shall advise if the bottom coil can support the weight of the coil installed on top of it or if a structural frame is needed to support the top coil.

5.12 *Revised:* Turbulators can be used in the coolant tube.

6.0 Fabrication Approval Drawings

6.1 Vendor shall submit fabrication approval drawings with certified dimensions for the coil unit within 2 weeks after receiving an order.

6.2 Vendor's recommendations regarding stacking the coils and draining condensate from the stacked coils shall be shown on the fabrication approval drawings.