Heat Exchangers

Critical to

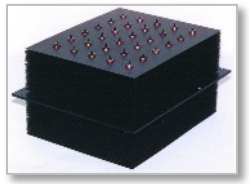
Products that Keep the World Running

BOYD CORPORATION

Boyd Heat Exchangers – Popular Uses

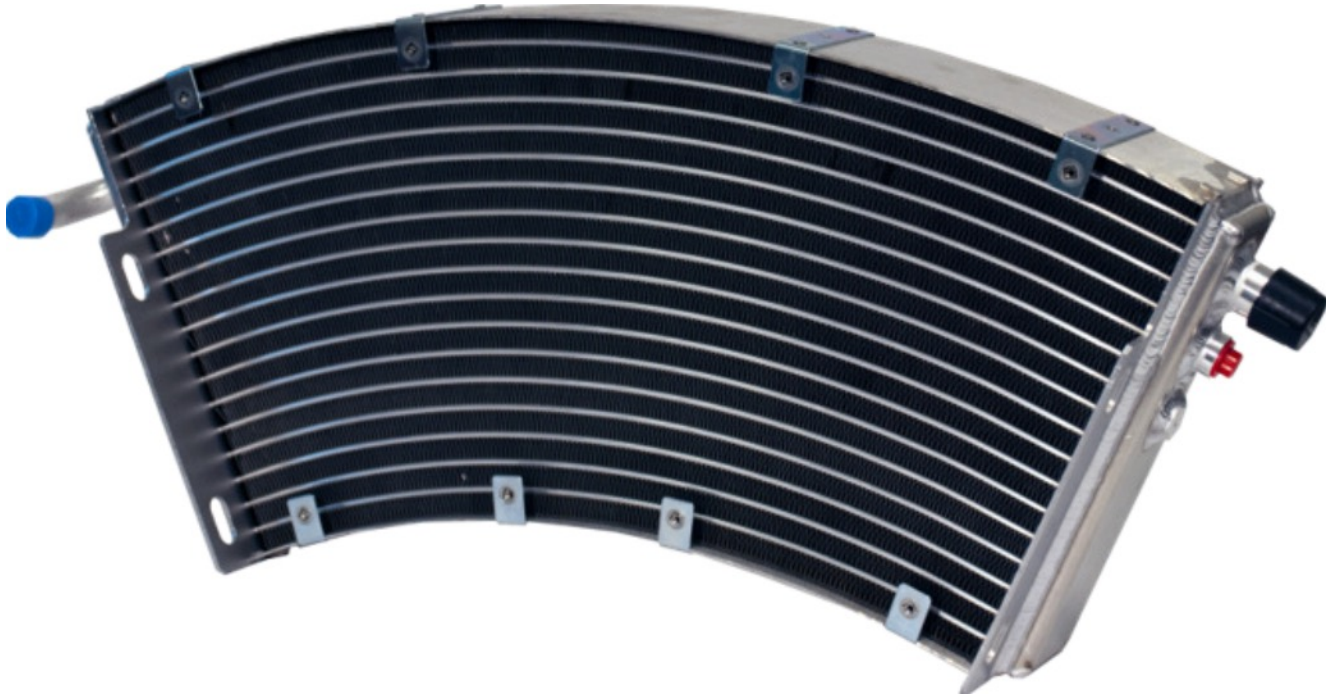
Boyd offers forward-thinking, scalable Integrated Liquid & Air System for most major industries. Heat Exchangers are an integral part of these systems and must be properly optimized to eject enough heat for the systems to operate at full performance. Boyd heat exchangers are engineered to be compact, lighter weight and high performing.

Boyd Solutions & Systems



Offering best in class standard heat exchanger product line quality and minimal joint interfaces.

Competitive differentiation for customization, world class at fully utilizing design space for heat exchangers that exceed performance specifications.



Data Centers & Networking
Rack Cooling
Cooling Distribution Units
Telecommunication Base Stations
Power Generation & Conversion

Transportation
EV & Charging Stations
Commercial Vehicles
Aviation

Defense
Ruggedized Vehicles
Satellite Facilities

Medical
Large Diagnostic Equipment
Testing

Industrial
Automation
Power Generation
Power Converting
Power Storage
Renewable Energy
Facility Cooling

Boyd Heat Exchangers

Plate-fin

Very high efficiency vacuum-brazed aluminum heat exchangers

Tube-fin

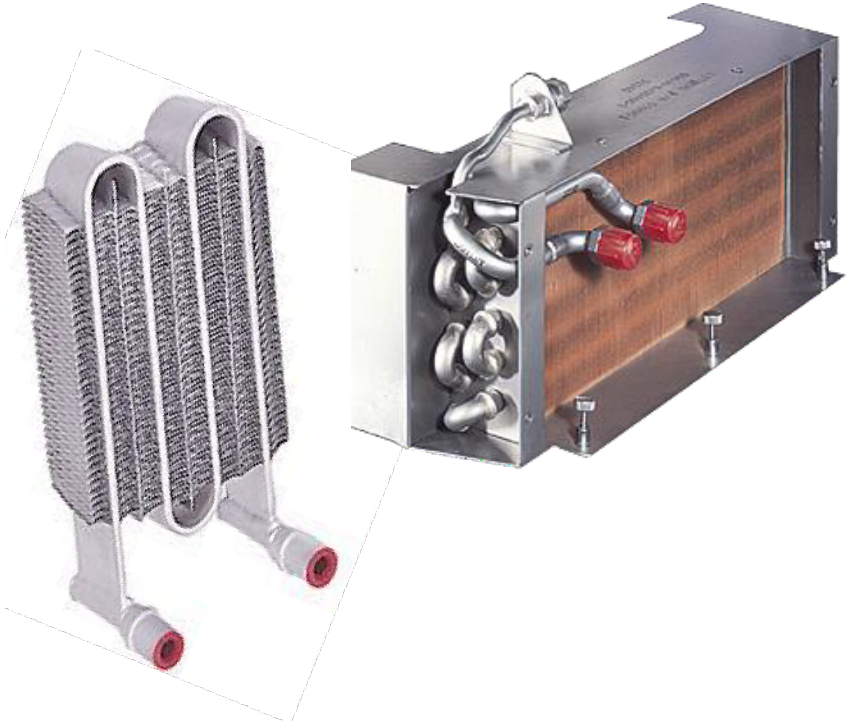
Copper, stainless, nickel, Inconel, Hastelloy

Flat tube

Vacuum-brazed, cost-effective heat exchangers

Also Available

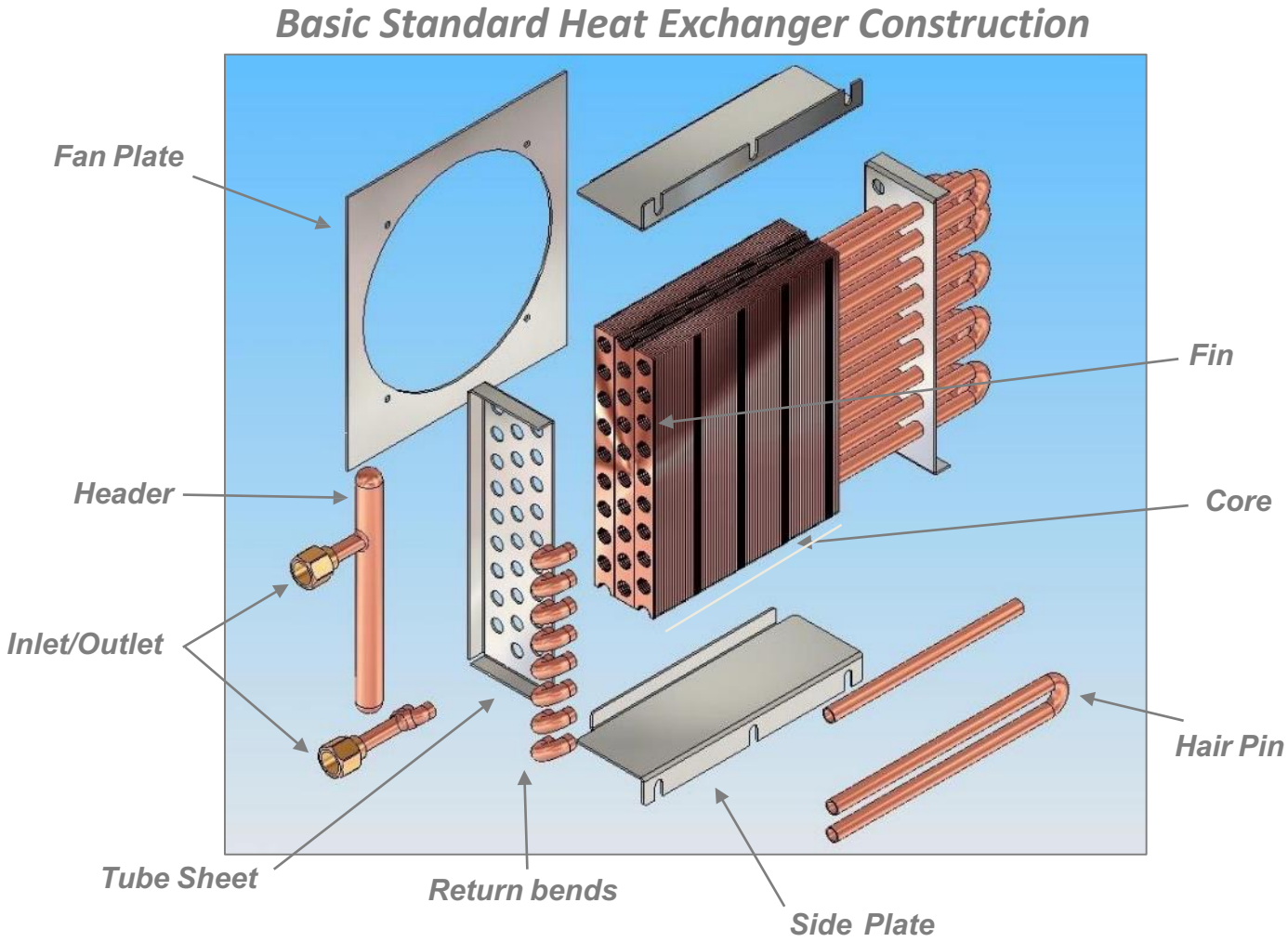
Bar & Plate, Non-traditional Shapes



Boyd Standard Heat Exchanger Construction

Popular Materials

- *Al, SS, Cu, CuNi, Nickel Alloys*

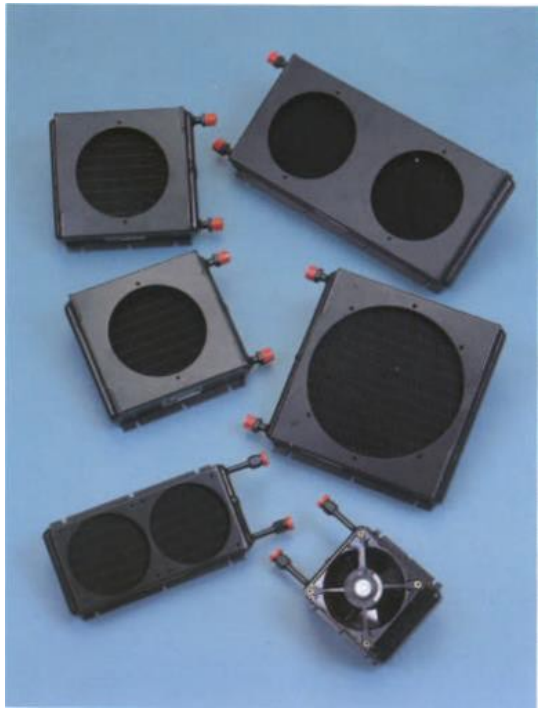


Standard Fin & Tube Constructions – Older Standard Lines

COPPER FIN & TUBE

OLD NAME: 6000 SERIES

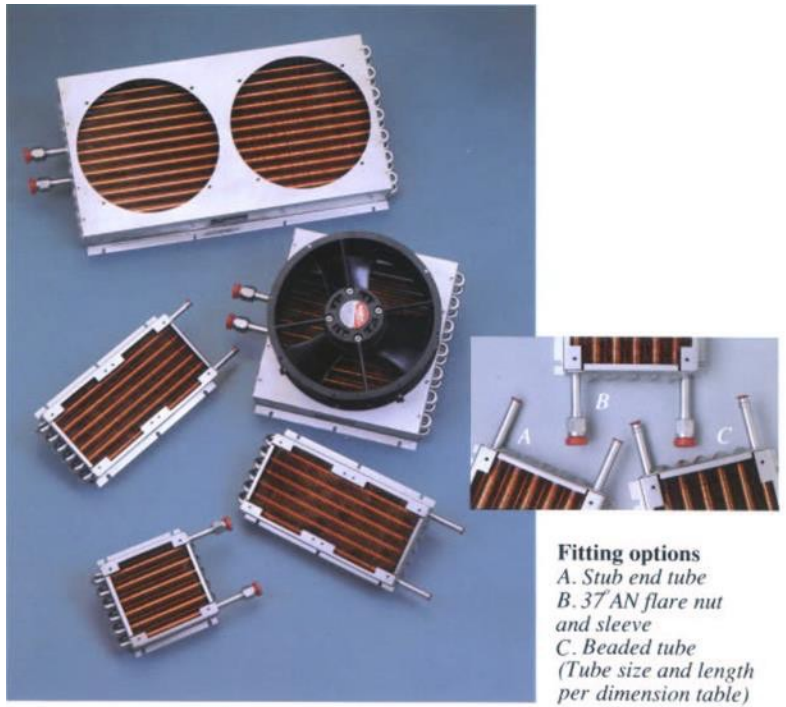
- Superior heat transfer – all Copper mechanically bonded core
- High Reliability – all Silver brazed joints
- Standard Fitting Options Available
- Rated at 200 PSIG at 400°F
- 100% Leak Tested



ALUMINUM FIN & TUBE

OLD NAME: 5000 SERIES

- Lightweight all Aluminum
- Max. Reliability – welded headers and frame enclosure with brazed core
- Standard Fitting Options Available
- Rated at 150 PSIG at 300°F
- 100% Leak Tested



STAINLESS STEEL FIN & TUBE

OLD NAME: 4000 SERIES

- Copper outer fin for improved performance
- Max. Reliability – all welded stainless steel liquid circuit
- Standard Fitting Options Available
- Rated at 200 PSIG at 400°F
- 100% Leak Tested

Boyd Standard/ Customizable Heat Changers

Past Models – used L Fins

4000 Series → Aspen (A Fin)

5000 Series → ES HX (Flat Tube) OEM

6000 Series → Coils (M Fin)

	Liquid-to-Air Cooling						Liquid-to-Liquid Cooling		
	OEM	6000	Aspen	4000	ES	Plate Fin	Plate Fin L/L Cu Brazed	L/L Ni Brazed	
Delonized Water			●	■					■
Tap Water	●	■						●	
EGW	●	■			●	■	■	●	
Refrigerants	●	■			●	■	■	●	
Oils					●	■	■	●	
Fluorinert					●	■	■	●	

Our best value solutions are shown with ●

Our best performing solutions are shown with ■

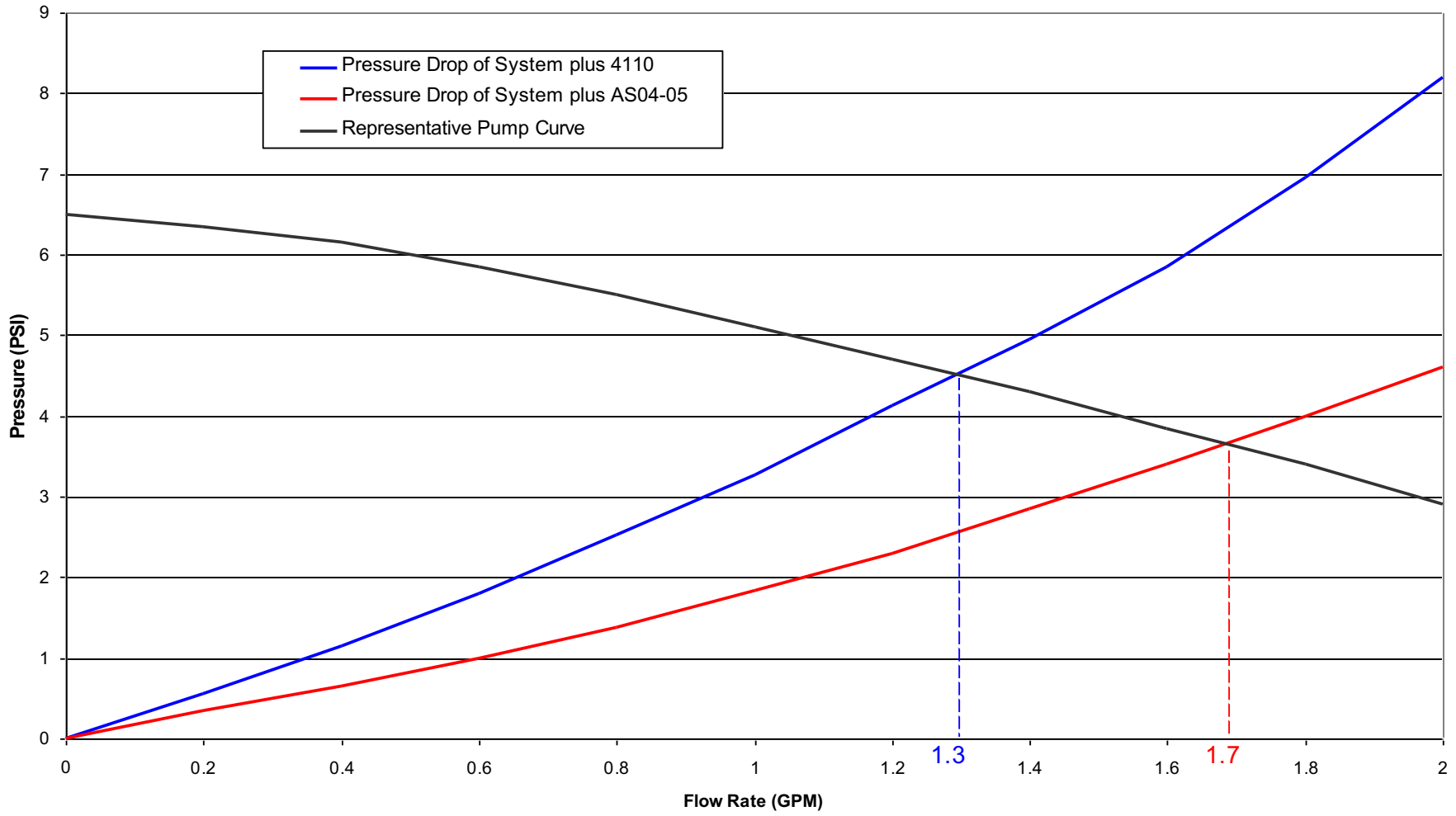
Aspen Series Details & Benefits

- High value
- 316L Stainless Steel tubes
- Copper fin
- TIG welded return bends
- Full collar 360° interference fit between tube and fin
- Very low air side pressure drop
- Very low liquid side pressure drop
- Compatible with standard fans
- Choice of fitting styles

- Standard sizes
- Offset fan mounts ensure good air flow into the corners
- Built-in mounting slots
- 100% leak tested to 150 psi
- Capable of handling 6000 psi liquid pressure

Aspen Series Details & Benefits

Aspen Series heat Exchangers will work at a higher flow rate than a 4000 series HX



OEM Coil Details & Benefits

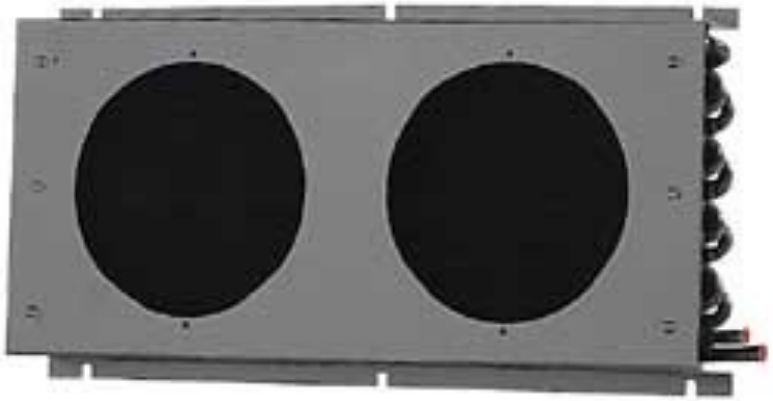
- Tough, galvanized steel frame
- Fluxless silver-brazed joints
- Thick walled tubes (.028” thick)
- Aluminum fin and copper tubes
- Full collar 360° interference fit between tube and fin
- Compatible with standard fans
- Choice of fitting styles
- Standard sizes
- Choice of optional fan mounts and black paint
- Offset fan mounts ensure good airflow into the corners
- Built-in mounting slots
- 100% leak-tested to 150 psi

ES Series Details & Benefits

- Our flat tube geometry provides the most heat transfer capability per unit area of any of our standard heat exchangers
- All aluminum construction
- High performance louvered fin
- Very clean, vacuum brazed
- Compatible with standard fans
- Standard sizes
- Choice of optional fan mounts and black paint
- Offset fan mounts ensure good air flow into the corners
- Built-in mounting slots
- 100% leak tested to 150 psi

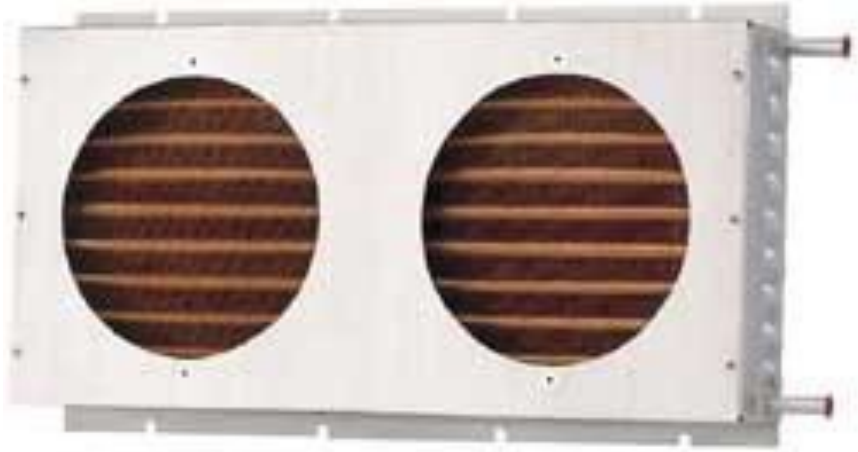
6000 Series Details & Benefits

- Fluxless silver-brazed joints
- Thick walled tubes (.028” thick)
- Copper fin and copper tubes
- Full collar 360° interference fit between tube and fin
- Compatible with standard fans
- Choice of fitting styles
- Standard sizes available off-the-shelf
- Painted black for aesthetics
- Offset fan mounts assure good air flow into the corners
- Built-in mounting slots
- 100% leak tested to 150 psi



4000 Series Details & Benefits

- 316L Stainless Steel tubes
- Copper fin
- TIG welded
- Full collar 360° interference fit between tube and fin
- Compatible with standard fans
- Choice of fitting styles
- Standard sizes
- Offset fan mounts ensure good air flow into the corners
- Built in mounting slots
- 100% leak tested to 150 psi

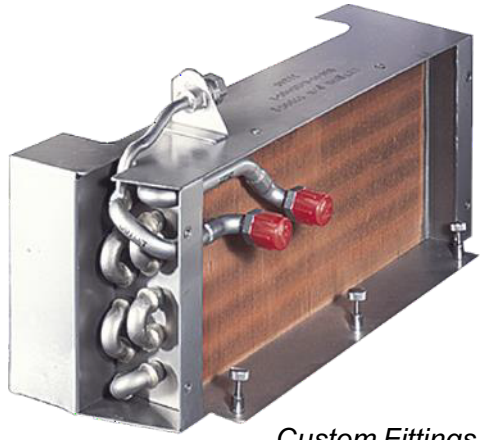


Custom Solutions

Simple

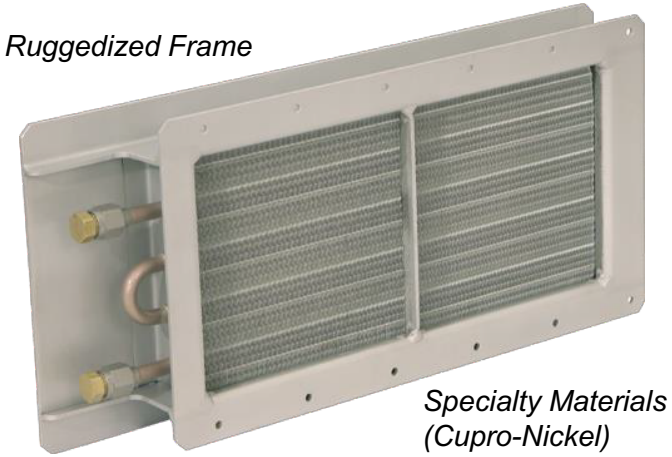
Impossible

- 90° Bends
- Different FPI
- Custom fittings
- Different core length
- Specialty materials
- Different number of tube rows
- Ruggedized frame
- Different fin pattern
- Anything other than 3/8” tubes



Custom Fittings

Ruggedized Frame

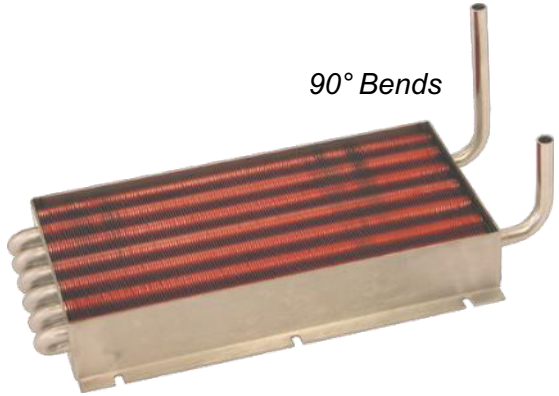


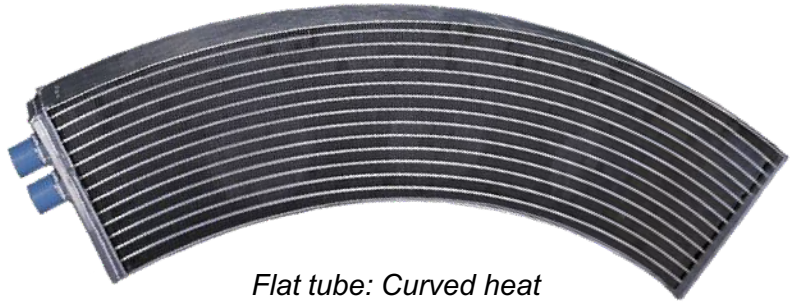
Specialty Materials (Cupro-Nickel)

Miniature TF HX

Flat tube takes a 0.25” radius without buckling

90° Bends



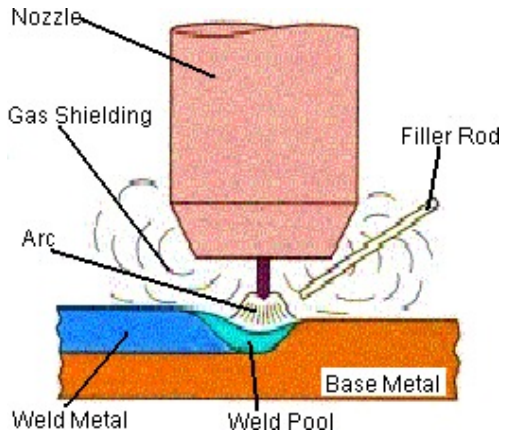


Flat tube: Curved heat exchanger

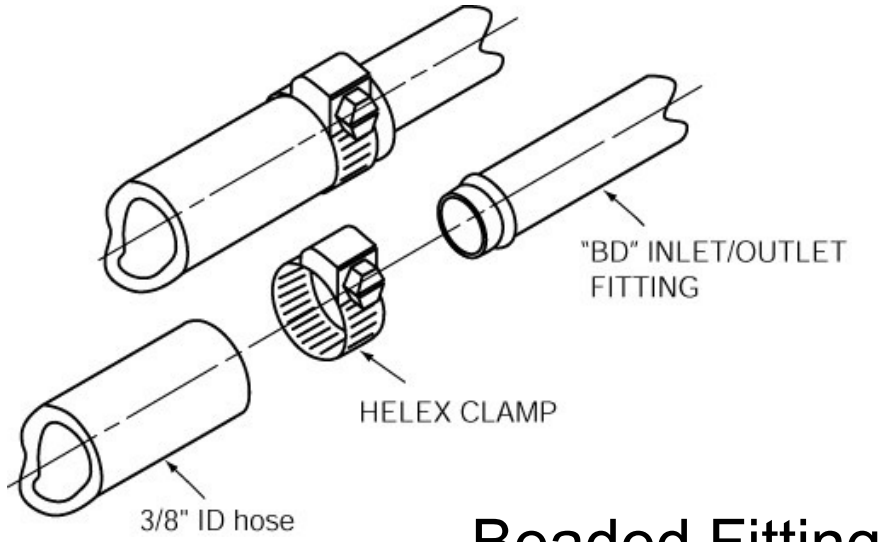
What is TIG Welding?

TIG (Tungsten Inert Gas) welding is a commonly used high quality welding process. TIG welding has become a popular choice of welding processes when high quality, precision welding is required. In TIG welding an arc is formed between a nonconsumable tungsten electrode and the metal being welded. Inert gas is fed through the torch to shield the electrode and molten weld pool. If filler wire is used, it is added to the weld pool separately

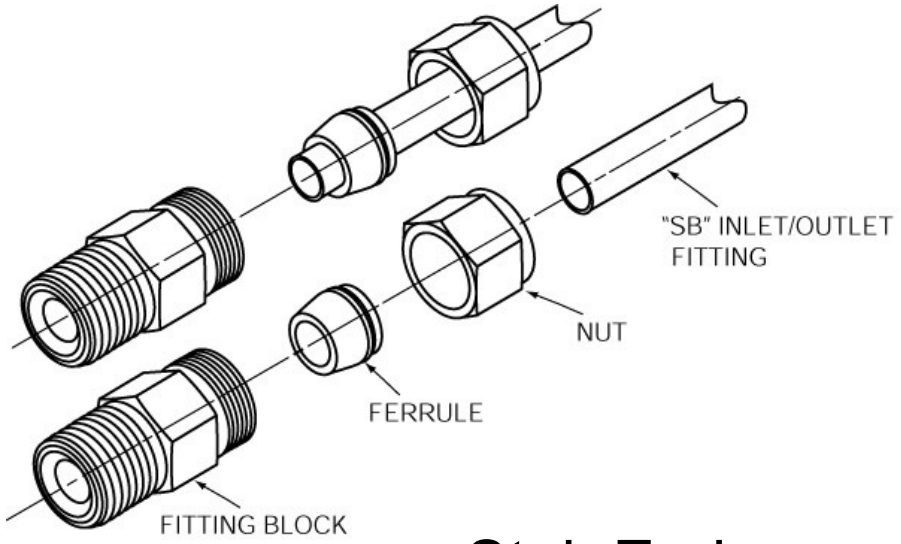
- Superior quality welds
- Welds can be made with or without filler metal
- Precise control of welding variables (heat)
- Free of spatter
- Low distortion



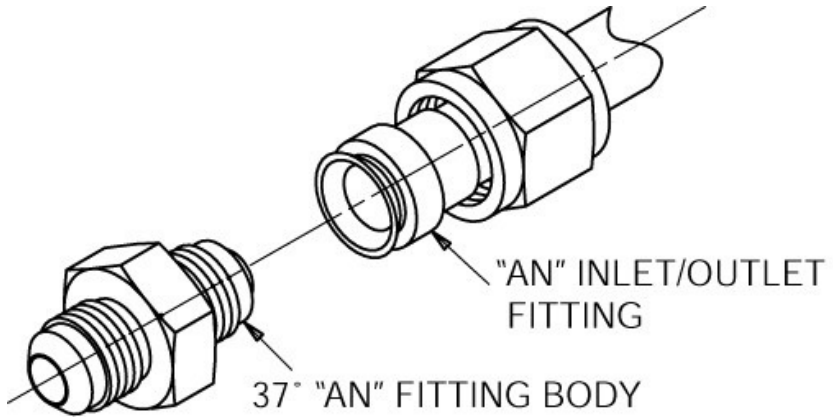
Standard Fittings



Beaded Fitting



Stub End
Fitting



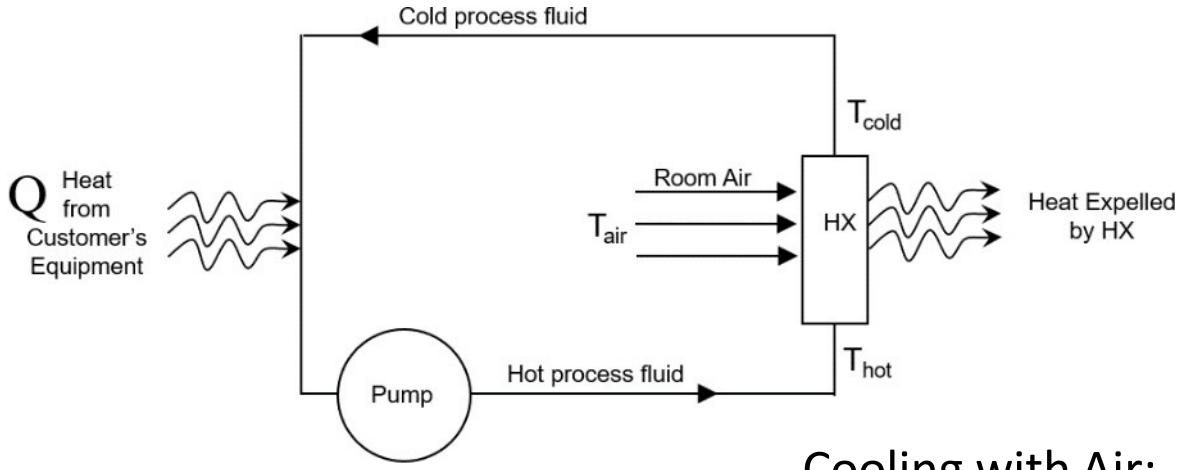
AN Flare
Fitting

Sizing a Heat Exchanger

$$\text{Thermal Performance} = \frac{Q}{T_{hot} - T_{air}}$$

Thermal performance tells us how big the heat exchanger needs to be.

- The inverse of thermal resistance
- A large number is good



Cooling with Air:

$T_{air} < T_{hot}$

Example

Q = 5000 Watts (the customer's heat load)

T_{hot} = 70° C (the customer's maximum allowable temperature)

T_{air} = 20° C (the temperature of the room air)

$$\frac{Q}{T_{hot} - T_{air}} = \frac{5000\ \text{Watts}}{70°\,\text{C} - 20°\,\text{C}}$$

$$= \frac{5000\ \text{Watts}}{50°\,\text{C}}$$

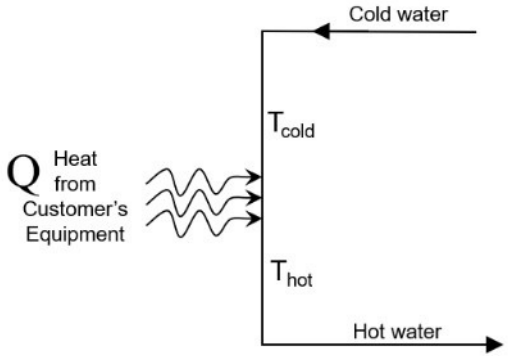
$$= 100\ \frac{\text{W}}{°\text{C}}$$

Determining Outgoing Temperatures

Water supply may be customer specific.

Define T_{cold} by water supply properties.

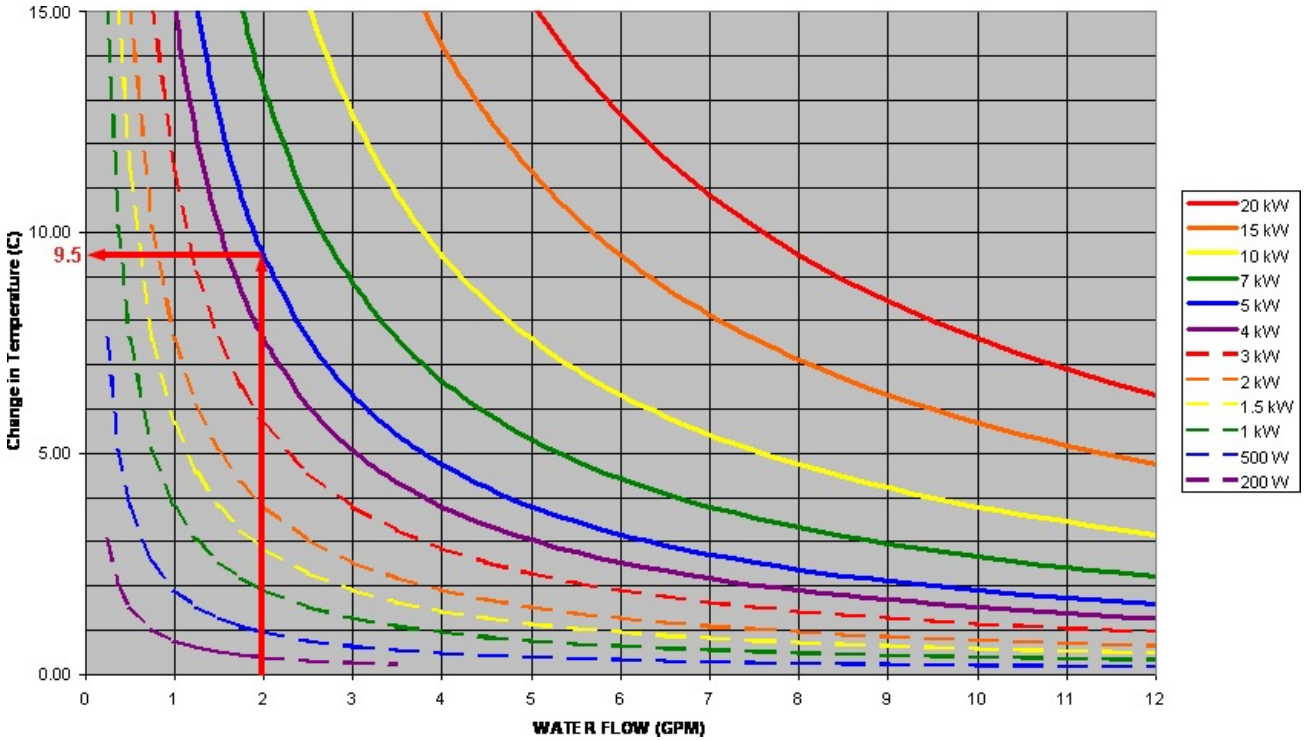
Use the Heat Capacity graphs to calculate T_{hot}:



Heat Capacity Equation:

$$T_{hot} = T_{cold} + \frac{Q}{\rho \cdot \dot{v} \cdot C_p}$$

$$\Delta T = T_{hot} - T_{cold} = \frac{Q}{\rho \cdot \dot{v} \cdot C_p}$$



Example

Q = 5000 Watts (the customer's heat load)

Flow = 2 gallons per minute, water

T_{cold} = 50° C (the customer's desired cooling temperature)

Tair = 20° C (the temperature of the room air)

$$\frac{Q}{T_{hot} - T_{air}} = \frac{Q}{T_{cold} + \Delta T - T_{air}}$$

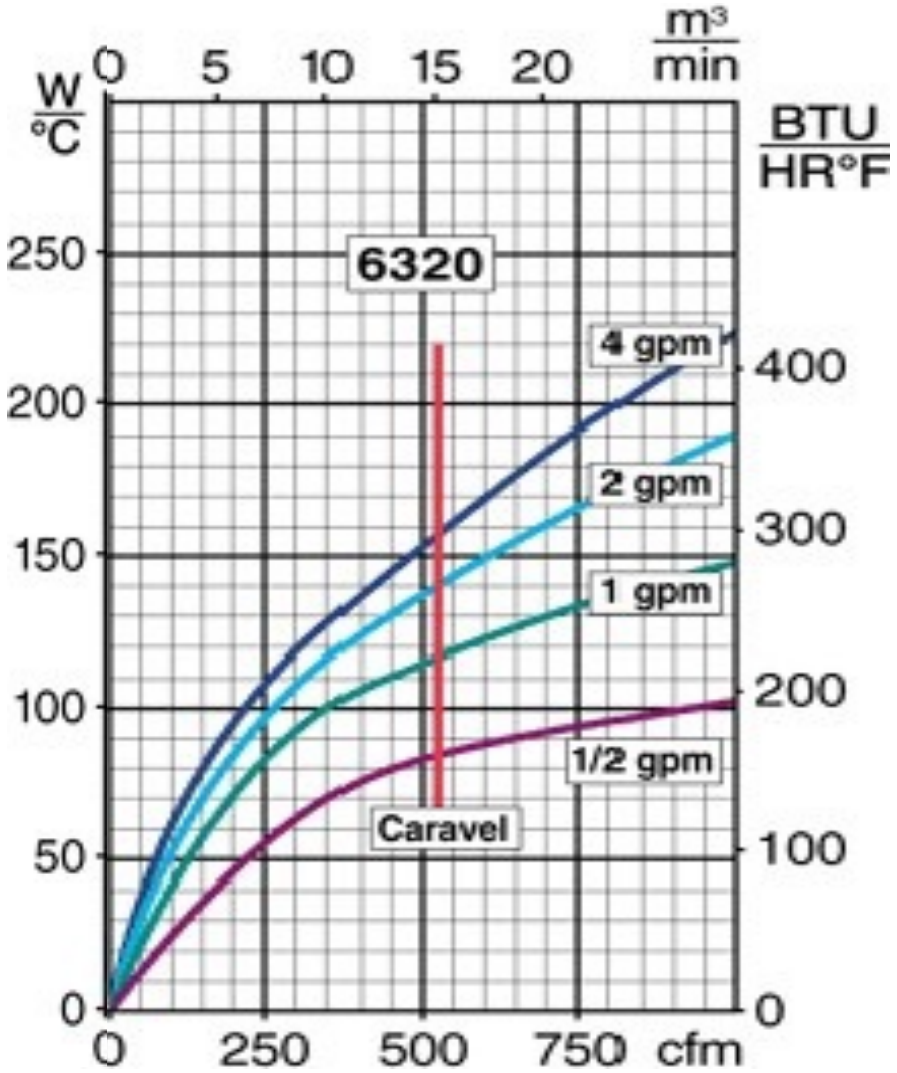
$$= \frac{5000\ \text{Watts}}{50^\circ\text{C} + 9.5^\circ\text{C} - 20^\circ\text{C}}$$

$$= \frac{5000\ \text{Watts}}{39.5^\circ\text{C}}$$

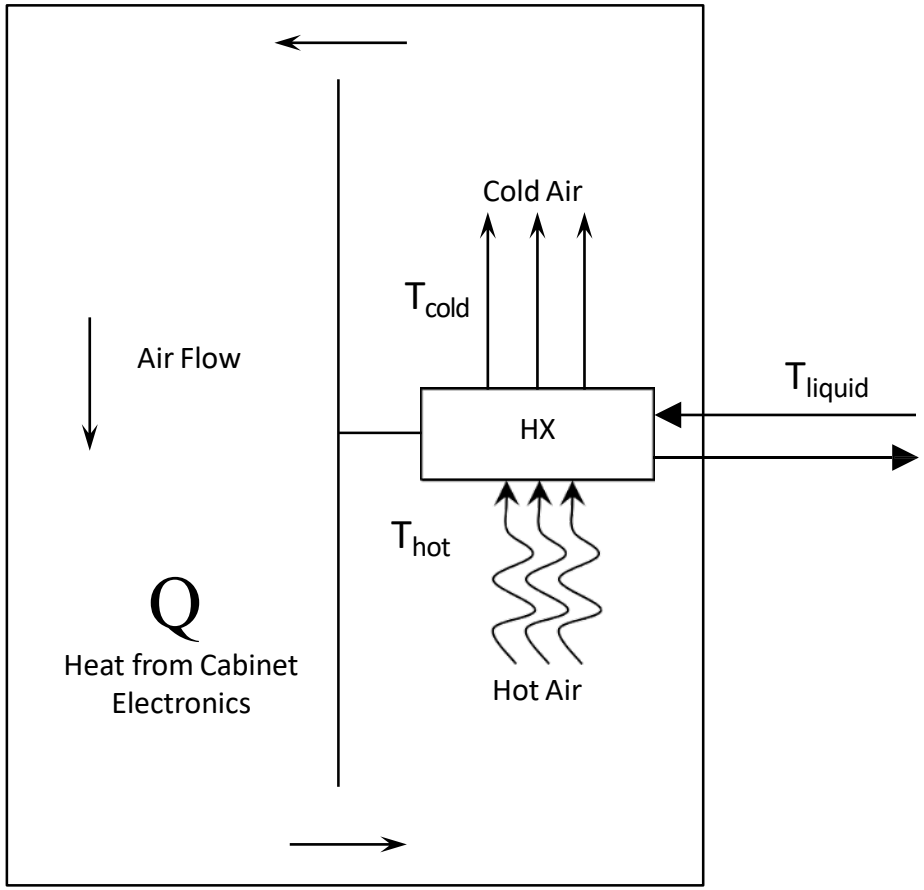
$$\cong 127\ \frac{\text{W}}{^\circ\text{C}}$$

Effect of Flow Rate

- Heat Exchanger Performance varies by Flow Rate
- Heat Exchanger performance decreases at lower flow rates
- Example:
  - At 2 GPM, 140 W / °C
  - At 1 GPM, 115 W / °C



Cabinet Cooling



Cooling with Liquid:

$T_{liquid} < T_{hot}$

Q = 5000 Watts (the customer's heat load)

T_{hot} = Unknown

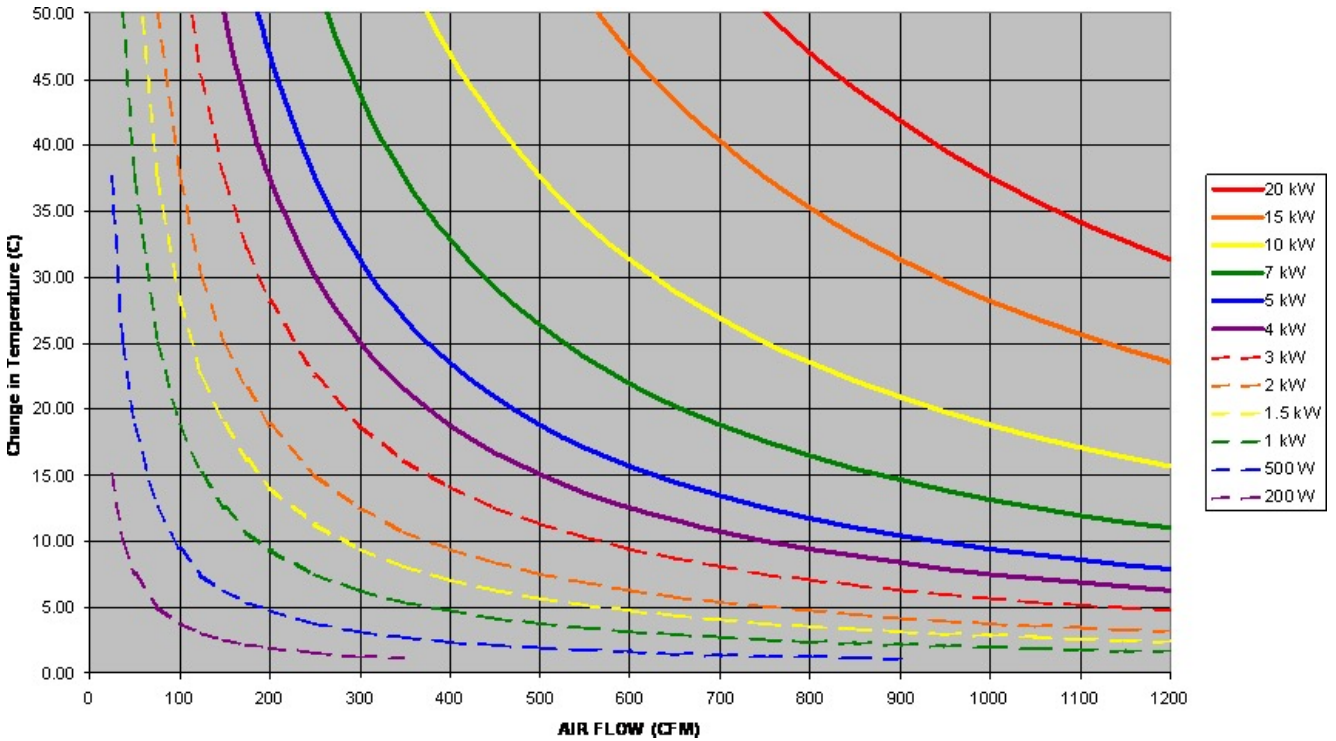
T_{cold} = 50° C

T_{liquid} = 20° C (the temperature of the facility water)

500 cfm of air going through the cabinet

- See heat capacity curves to determine ΔT

$$\frac{Q}{T_{hot} - T_{liquid}} = \frac{Q}{T_{cold} + \Delta T - T_{liquid}}$$



Product Spotlight: Expanded Tube Heat Exchanger