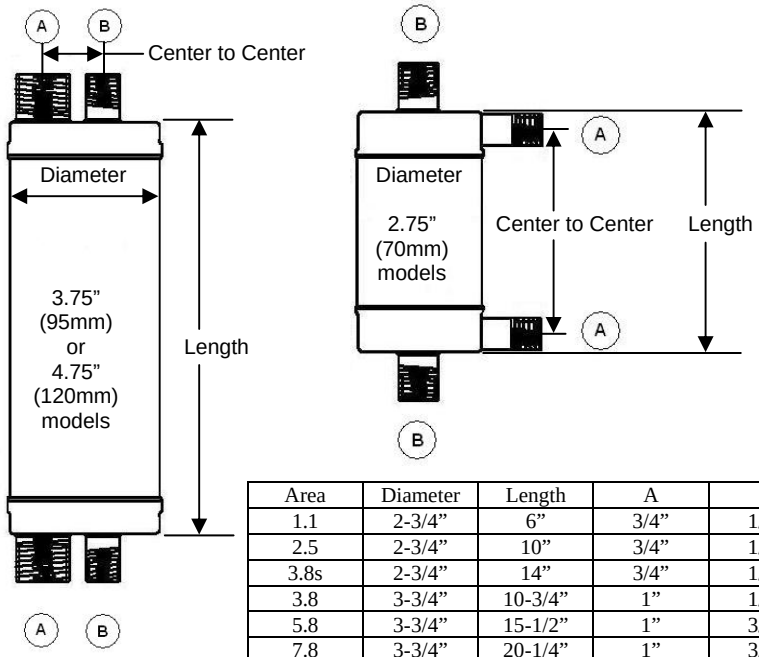
TherMax² HEAT EXCHANGERS

7010 LINDSAY DRIVE
MENTOR, OH 44060
USA/CANADA: 1-800-621-1998
Phone: (440) 974-1300
Fax: (440) 974-9561
www.processtechnology.com



Area	Diameter	Length	A	B	Ctr to Ctr
1.1	2-3/4"	6"	3/4"	1/2"	5"
2.5	2-3/4"	10"	3/4"	1/2"	8-7/8"
3.8s	2-3/4"	14"	3/4"	1/2"	12-7/8"
3.8	3-3/4"	10-3/4"	1"	1/2"	1-5/8"
5.8	3-3/4"	15-1/2"	1"	3/4"	1-5/8"
7.8	3-3/4"	20-1/4"	1"	3/4"	1-5/8"
15.0	4-3/4"	20-1/4"	1-1/4"	3/4"	2"

TherMax² SIZING

The thermal performance of **TherMax²** exchangers is directly affected by fluid flow rates and type of fluid. The performance curves shown are for soft water flowing on new, clean exchanger surfaces and do not include allowances for exchanger surface fouling. Variable flow rates, i.e. flow through a filter, have a direct affect on exchanger performance. Consequently, heating/cooling results will vary. Likewise, fouling and fluid types will affect the thermal performance of the **TherMax²** exchangers and specific allowances must be made in the design of the exchanger.

Fouling consists of: 1) Crystallization, i.e. coating of carbonates from "hard water"; 2) Sedimentation, "rust" or other fine particulates that coat exchanger surfaces; 3) Corrosion, chemical or electrolytic attack; 4) Organic, coating of algae or other organisms that are typically found in recirculated water; 5) Coking, the residue of a hydrocarbon at elevated temperature; 6) Polymerization, a reactive by-product of an organic fluid. Fouling is usually expressed as fouling resistance (hr, ft^2, °F/Btu) and ranges in value from 0.00025 to 0.002, and is included in the general equation as: $1/U = 1/h_i + 1/h_o$ + fouling resistance(s) where U = overall heat transfer coefficient (Btu/hr, ft^2, °F) and h_i, h_o are the two heat transfer surface film coefficients (Btu/hr, ft^2, °F).

Safety factors (**S.F.**) can be used to account for some typical flow variables and fouling encountered in the metal finishing industry. Use of other safety factors or allowances for projected variables are at the designer's discretion.

1) **S.F.** for 10 psig steam service (at exchanger) and low head pressure centrifugal pumps = 1.5.
2) **S.F.** for higher pressure steam service (i.e. > 30 psig) with steam flow through Circuit "A" and high pressure centrifugal or positive displacement sized metal pumps = 1.2.
3) **S.F.** for city water and "filtered" compatible chemical service = 1.4.
4) **S.F.** when using adjusted **U** values = 1.

Fluids other than soft water require determination of **A** (required exchanger area) using adjusted **U** values based on the fluid(s) involved.

1) Enter **TherMax²** Performance Curves using the calculated **UA** value and appropriate flow rates.
2) After verifying pressure drops and **TherMax²** exchanger selection, determine the design **U** by dividing the verified **TherMax²** exchanger **UA** by the exchanger **A** (area).
3) Use the following factors to determine an adjusted U:
   Gases: 0.03 times the design **U**
   Solvents: 0.30 times the design **U**
   Oils: 0.06 times the design **U**
4) Using this adjusted **U** and your calculated **Q** (Btu/hr), **LMTD** (°F), and **S.F.**, determine the required area (**A**) using the equation:
   A=**Q/U** X **LMTD** X **S.F.**
5) Select an appropriate **TherMax²** exchanger(s) and re-verify flow rates, pressure drops, etc.

Pressure drops through **TherMax²** exchangers are based on water or saturated stem. For fluids other than water or steam, some allowance must be made to more accurately reflect projected performance.

Use the following factors for adjusting **TherMax²** exchanger pressure drop data:

Solvents:	times 0.7
Light Oils:	times 1.5
Glycol/water:	times 1.8

For maximum gas flow other than 15 psig steam:

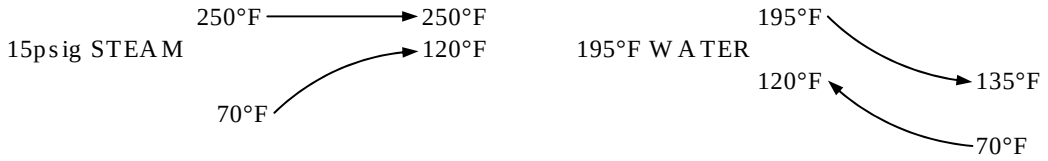
15 psig Air:	times 2.0

EXAMPLE: Heating water at 15 gpm from 70°F to 120°F using either 15 psig steam or 195°F hot water.

1. Calculate the mass flow rate of the fluid to be heated/cooled:
   Gallons/minute (gpm) X 60 minutes/hour X 8.35 pounds/gallon X fluid specific gravity.
   For water pumped at 15 gpm, 15 X 60 X 8.35 X 1.0 = 7,515 #/hr.

2. Calculate heat to be exchanged (**Q**) for heating the water from 70°F to 120°F:
   Q = mass flow rate X specific heat of fluid X change in temperature (°**F**).
   Q = 7,515 X 1.0 X 50°F = 375,750 Btu/hr.

3. Determine the heat exchanger temperature profile:
   - For steam heat, assume constant temperature of heating
   - For hot water heating or water cooling, unless otherwise specified, assume a hot water exit temperature of 15°F higher than the heated fluid temperature as shown below:



4. Determine the greater temperature difference (dT_{higher}) and smaller temperature difference ($dT_{smaller}$):
   - For steam, dT_{higher} = 250°F -70°F = 180°F and $dT_{smaller}$ = 250°F - 120°F = 130°F
   - For water, dT_{higher} = 195°F - 120°F = 75°F and $dT_{smaller}$ = 135°F - 70°F = 65°F

   Using these values and the LMTD nomograph, determine the log mean temperature difference (LMTD).
   - For steam, LMTD = 145°F
   - For water, LMTD = 70°F

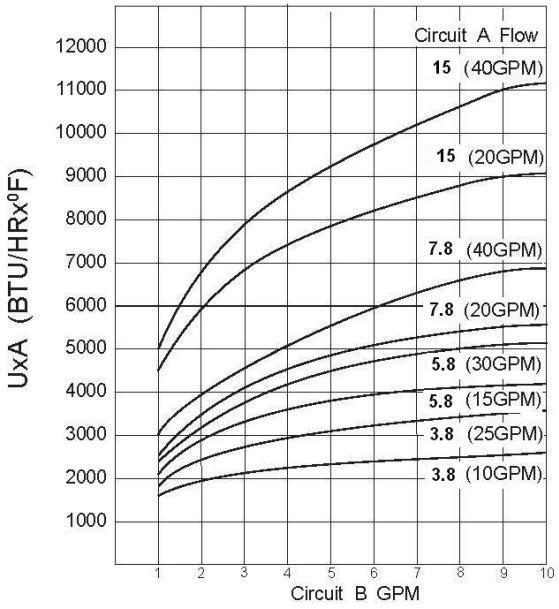
5. Determine heating flow rates:
   - For steam: = **Q** divided by the Latent Heat of Evaporation
     = 375,750 Btu/hr divided by 950 Btu/# = 396 #/hr
   - For water: = **Q** divided by the hot fluid temperature difference X specific heat of the fluid
     = 375,750 Btu/hr divided by (195°F - 135°F) X specific heat (1) = 6,263 #/hr;
     to convert #hr to GPM, divide #/hr by 500. 6,263/500 = 12.5 GPM

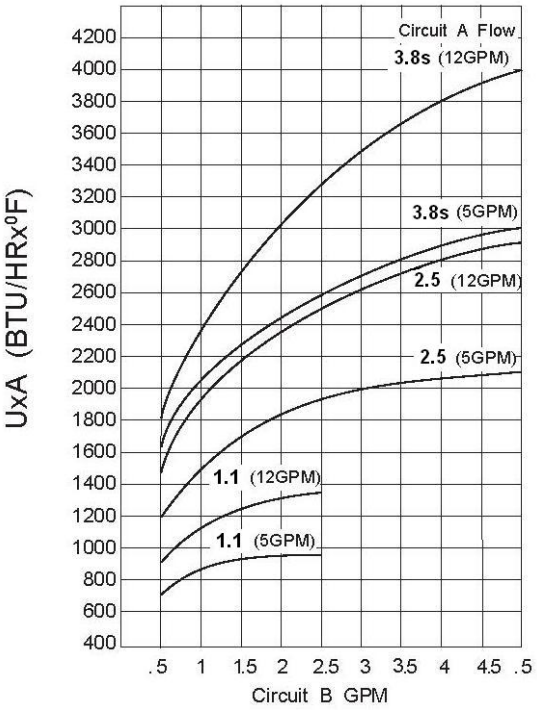
6. Determine the **TherMax²** exchanger required using the equation **UA = Q/LMTD X S.F.:**
   - For steam **UA** = (375,750/145) x 1.5 = 3,887 Btu/hr,°F
   - For water **UA** = (375,750/70) x 1.4 = 7,515 Btu/hr,°F

7. Select the appropriate **TherMax²** exchanger using the above data and design flow rates:
   - For steam, try model IS15.0-4.75-20.25
   - For water, try model IS15.0-4.75-20.25

8. Check **TherMax²** exchanger allowable pressure drops for calculated flow rates:
   - For steam, 15 gpm at Circuit "**B**" is an ***excessive dP***, while the 396#/hr at Circuit "**A**" is okay (<490 #/hr). Therefore, change to two (2) model IS3.8-3.75-10.75, **total UA** = 4000 (2000 X 2) Btu/hr,°F, with 7.5 gpm for Circuit "**B**" (10 psi dP) and 198 #/hr for Circuit "**A**" (<315 #/hr max.).
   - For water, 15 gpm in Circuit "**A**" is OK, while 12.5 gpm in Circuit "**B**" is an ***excessive dP***. Therefore, change to two (2) model IS5.8-3.75-15.5, **total UA** = 8000 (4000 X 2) Btu/hr,°F, with Circuit "**A**" in series at 15 gpm (min. flow 10 gpm) and Circuit "**B**" in parallel at 6.25 gpm (8 psi dP).

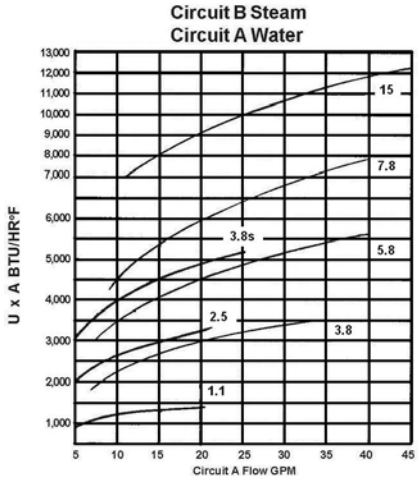
TherMax^2 PERFORMANCE CURVES

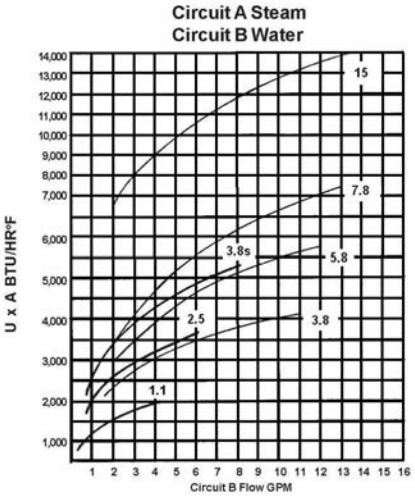




WATER vs. WATER PERFORMANCE CURVES

Enter curve at calculated U X A and move horizontally to intersect the appropriate Circuit A and Circuit B flow rates. Read square footage of required exchanger (3.8s is the 2 3/4" exchanger).



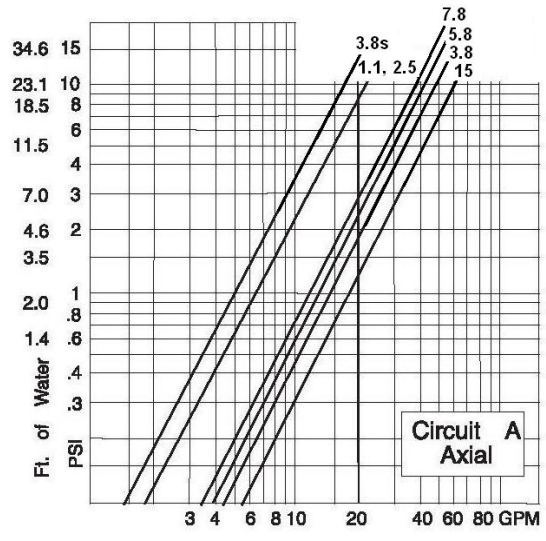


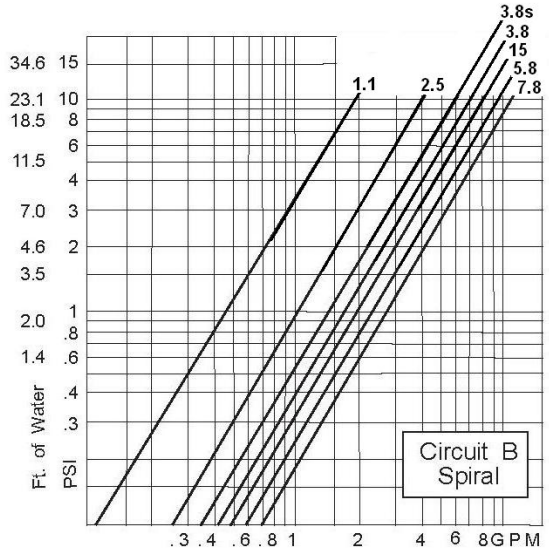
STEAM vs. WATER PERFORMANCE CURVES

Enter curve at calculated U X A and move horizontally to intersect appropriate Circuit A or Circuit B flow rate. Read square footage of required exchanger (3.8s is the 2 3/4" exchanger).

After selecting an exchanger, refer to curves on the next page and below to verify:

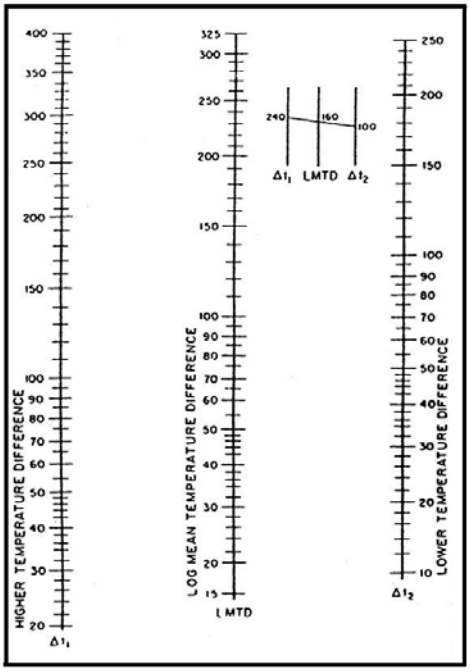
1) Pressure drop at actual flow rate. Use multiple or larger exchanger if pressure drop is excessive.
2) Minimum flow rates. Use smaller exchangers or a reduced U factor if flow rates are below minimum.
3) Maximum steam flow rate. Use multiple exchangers if flow rate is excessive.





WATER PRESSURE DROP CURVES

Enter curve at the design flow rate for Circuit A and Circuit B. Extend vertically until you intersect the appropriate exchanger square footage (3.8s is the 2 3/4" ex–changer). Read pressure drop in PSI (and feet of water).



L.M.T.D. NOMOGRAPH

Align higher (larger) temperature difference with the lower (smaller) temperature difference and read L.M.T.D. (log mean temperature difference) where this line crosses the center scale.

CHART A

Area	Circuit	Steam Pressure 15 PSIG	Steam Pressure 50 PSIG
1.1	A	180	310
	B	50	100
2.5	A	180	310
	B	80	140
3.8s	A	180	310
	B	80	140
3.8	A	315	540
	B	80	140
5.8	A	315	540
	B	180	310
7.8	A	315	540
	B	180	310
15.0	A	490	850
	B	180	310

MAXIMUM STEAM FLOW in #/HR (CHART A)

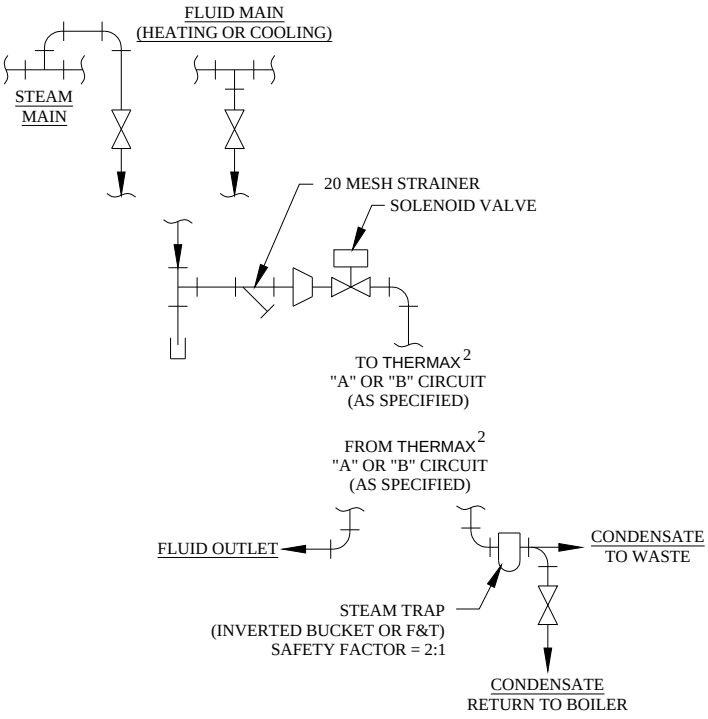
Locate the selected exchanger square footage (3.8s is the 2 3/4"exchanger) and read maximum steam flow for appropriate Circuit. Use multiple exchangers if flow exceeds maximum.

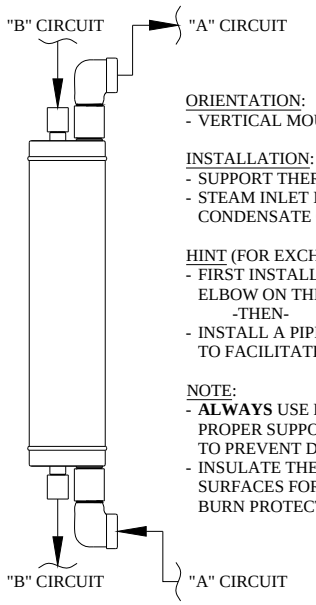
CHART B

Area	Circ. A	Circ. B
1.1	4.0	1.5
2.5	5.0	3.0
3.8s	5.0	4.5
3.8	10.0	4.0
5.8	10.0	5.0
7.8	15.0	6.0
15.0	20.0	6.0

MINIMUM FLOW RATE in GPM (CHART B)

Locate the selected exchanger square footage (3.8s is the 2 3/4' exchanger) and read minimum flow for appropriate Circuit.





ORIENTATION:
- VERTICAL MOUNTING PREFERED.

INSTALLATION:
- SUPPORT THERMAX INDEPENDENT OF PIPING.
- STEAM INLET MUST BE ON TOP WITH CONDENSATE OUTELT ON BOTTOM CONNECTION.

HINT (FOR EXCHANGERS 3.8 SQ.FT AND LARGER):
- FIRST INSTALL A PIPE COUPLING AND STREET ELBOW ON THE "A" CIRCUIT,
  -THEN-
- INSTALL A PIPE COUPLING ON THE "B" CIRCUIT TO FACILITATE FIELD PIPING.

NOTE:
- **ALWAYS** USE PROPER TOOLS AND PROVIDE PROPER SUPPORT FOR PIPING AND EXCHANGER TO PREVENT DAMAGE DURING INSTALLATION.
- INSULATE THERMAX SURFACES AND PIPING SURFACES FOR HEAT CONSERVATION OR PERSONNEL BURN PROTECTION.

WARNING **TherMax²** exchangers can operate at temperatures sufficient to cause personal injury. **Always** cover the exposed exchanger surfaces and any connecting piping surfaces with thermal insulation of sufficient thickness to prevent bums.

WARNING **TherMax²** exchangers are under pressure during operation and may contain extremely hot, corrosive fluid. **Always** wear the protective equipment described in the **M.S.D.S.** for the particular chemistry(ies) circulating in the **TherMax²** exchanger when performing any maintenance. In addition, **always** wear additional thermal protective equipment to minimize the possibility of sustaining burns and other injuries.