A Selection Guide for DTL Series Heat Exchangers

This is your guide to sizing and selecting DTL series heat exchangers. We recommend that you read this page completely before continuing to the step-by-step procedure on the following pages.

The graphs in this guide present data for specific ranges of the given parameters. Operating the heat exchanger above or below these ranges is not recommended.

All charts related to thermal parameters (Steps 1 through 3) are for counterflow operation of the heat exchanger. Parallel flow will result in a significant reduction in thermal performance and is not recommended.

A worksheet is attached to this guide. Maintain this sheet as an original. Always work on a photocopy

Thermo Dynamics Ltd.
101 Frazee Avenue
Dartmouth, Nova Scotia
Canada, B3B-1Z4
Tel: (902) 468 - 1001
Fax: (902) 468 - 1002
www.thermo-dynamics.com
solarinfo@thermo-dynamics.com

TIPS FOR USING THIS GUIDE:

- Always specify counterflow operation for maximum performance.
- The heat exchanger can be mounted vertically if required, however, this may require special mounting brackets.
- If the sizing procedure suggests a non-standard length heat exchanger, use the next larger size or consider using two shorter heat exchangers.
- <u>Never</u> rely on the copper ports to support the heat exchanger.
- Consider using two or more heat exchangers when:
  a) the Heat Transfer Load, Q, is greater than 400 MBtu/h,
  b) space for locating the heat exchanger is limited, or
  c) temperature and flow parameters are outside the recommended range for a single heat exchanger.

Standard engineering symbols and subscripts have been used throughout this guide and are listed below. Units are displayed with each graph along with a table for conversion.

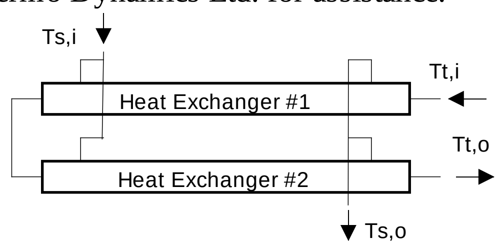
Symbols

A	Heat Exchanger Area
F	Flow Head loss
H	Modifying Factor
L	Heat Exchanger Length
LMTD	Log Mean Temperature Difference
M	Fluid Volume Flow Rate
P	Pumping Power
Q	Heat Transfer Load
U	Overall Heat Transfer Coefficient

Subscripts

i	Inlet Condition
o	Outlet Condition
s	Shell Side
t	Tube Side

The heat exchanger illustrated is comprised of two DTL series heat exchangers. The shell side flow is divided between the two heat exchangers. The full flow passes through the tube side of each heat exchanger. This plumbing arrangement is typical for oil-fired boilers, that is, where a relatively large temperature rise is required for the tube side fluid (potable water) and a relatively small temperature drop is required for the shell side flow. A QUICKPICK table for heat exchanger selection is available from Thermo Dynamics for selecting these heat exchangers. For special applications not covered by this guide, contact Thermo Dynamics Ltd. for assistance.

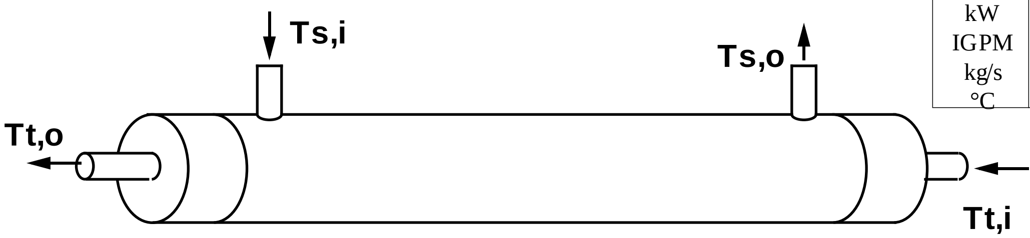


The DTL series heat exchanger is also capable of operating with natural circulation on the tube side. A separate guide has been prepared to assist in selection of heat exchangers for these applications. Consult the Thermo Dynamics for details and technical assistance.

STEP 1: Known Operating Parameters

Unit Conversions

From	To	Multiply by
kW	MBtu/hr	3.4123
IGPM	USGPM	1.2
kg/s	IGPM	13.19
°C	°F	1.8



Consider the following when allocating the heat transfer fluids:

- Fluids under high pressure and/or corrosive fluids are generally circulated through the tube side.
- Chemical cleaning is recommended. Mechanical cleaning is not possible with DTL Series heat exchangers.
- High viscosity fluid should be circulated on the shell side. Propylene glycol, for example, has higher viscosity than water.
- Head loss on the tube side of the heat exchanger is generally ten times less than the shell side head loss for equal flow rates.

1.1 Make a note of the following parameters in the boxes provided on the Worksheet.

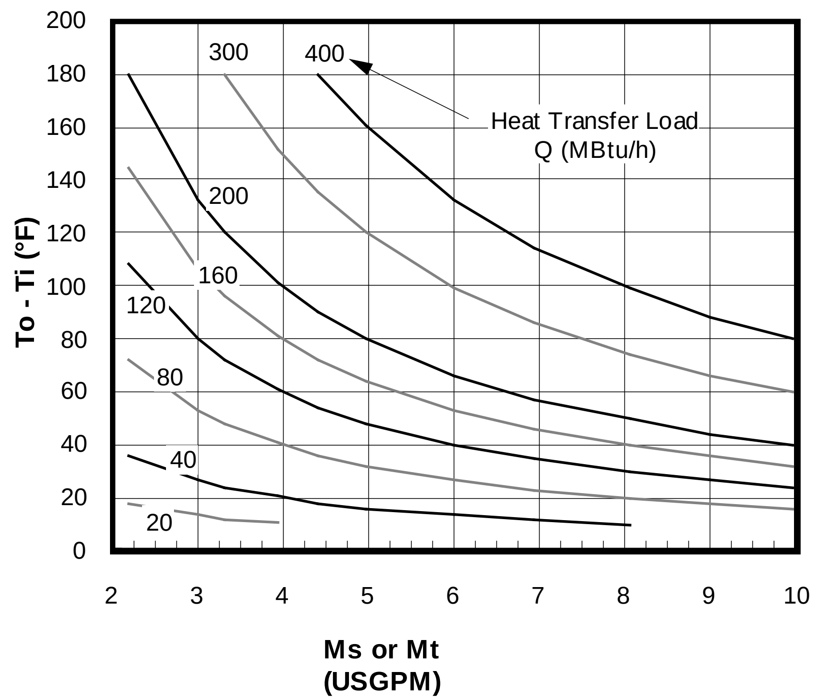
Shell Side Inlet Temperature, **Ts,i**
Tube Side Inlet Temperature, **Tt,i**
Heat Transfer Load, **Q**
Shell Side Outlet Temperature, **Ts,o**
Tube Side Outlet Temperature, **Tt,o**

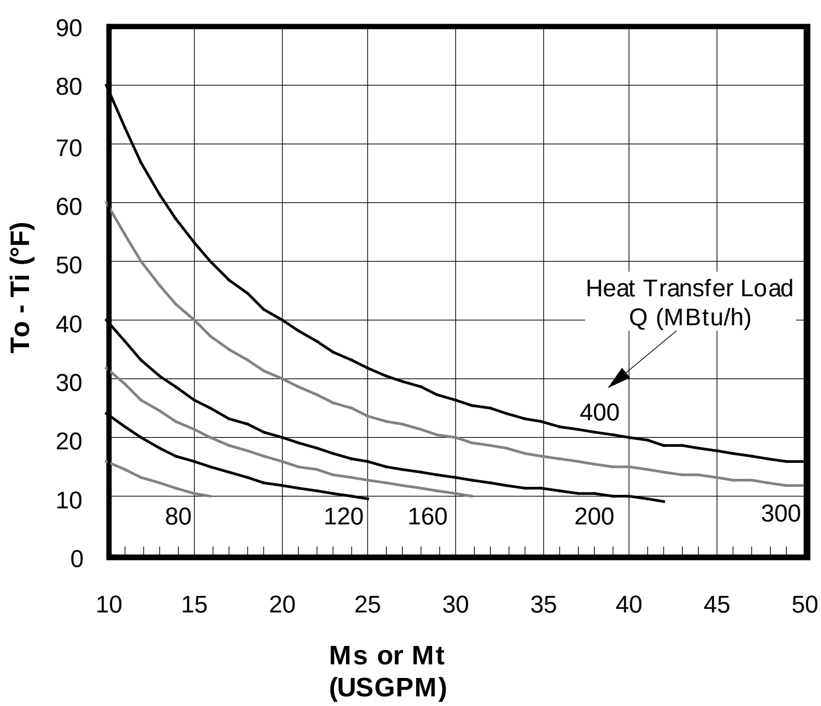
1.2 Use the figures given here to determine Ts,o and Tt,o from the flow rate or vice versa. The figures are for water as the working fluid.

For 50/50 or 40/60 propylene glycol/water mixtures multiply (To-Ti) by 1.1.

If To - Ti gives a negative result then simply drop the negative sign when using the graphs at the right.

Always operate within the range of parameters provided. This will ensure that flow is turbulent but not excessively noisy.





STEP 2: The Overall Heat Transfer Coefficient

Unit Conversions

From	To	Multiply by
IGPM	USGPM	1.2
Btu/h-ft2-°F	W/m2-K	5.68

2.1 Estimate the Degree of Fouling:

Light Fouling - Distilled water

Moderate Fouling - Treated boiler feedwater, below 120°F (50°C)

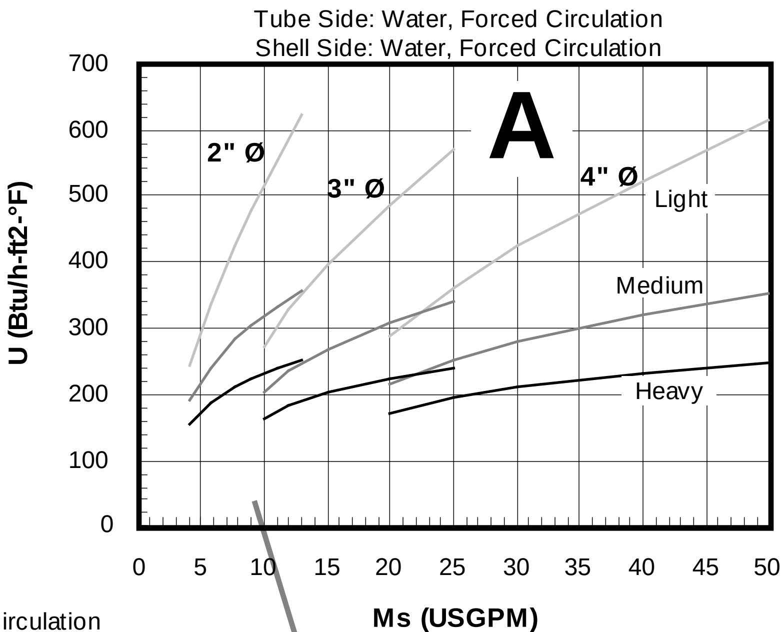
Heavy Fouling - Treated boiler feedwater above 120°F (50°C), River water, Well water, propylene glycol /water.

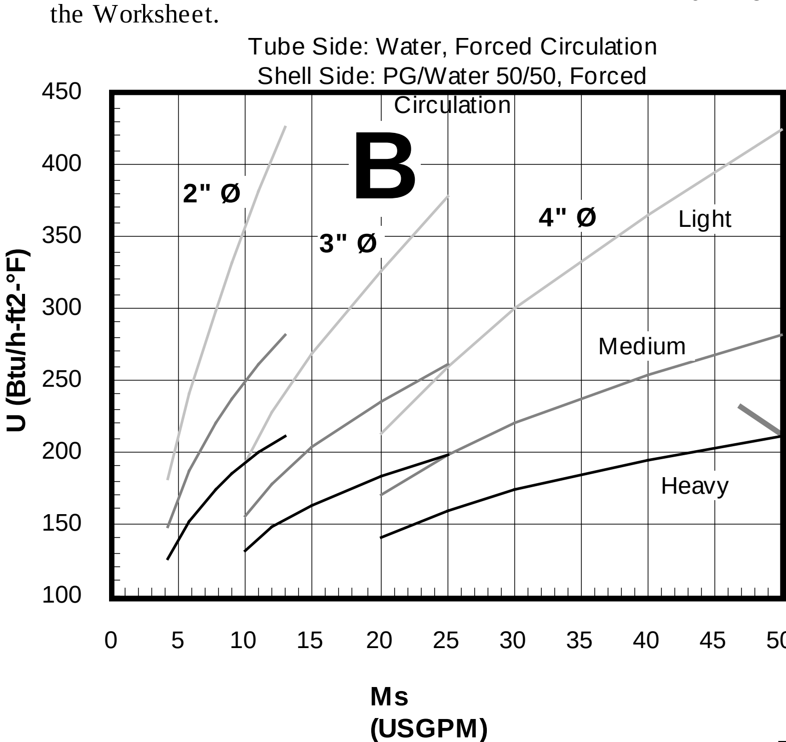
2.2

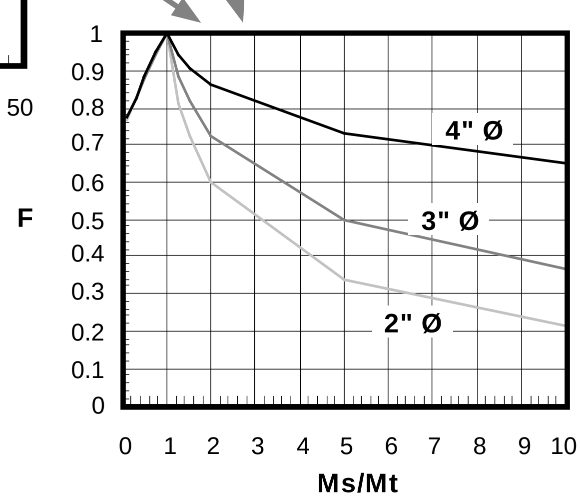
Estimate the overall heat transfer coeffient, U, from the appropriate graph using the shell side flow rate, Ms. Two cases are presented (A and B). Both are valid for forced circulation on the shell and tube sides only.

If the hotter fluid is circulated on the tube side, then increase U by 10%.

Make a note of U in the box provided on the Worksheet.



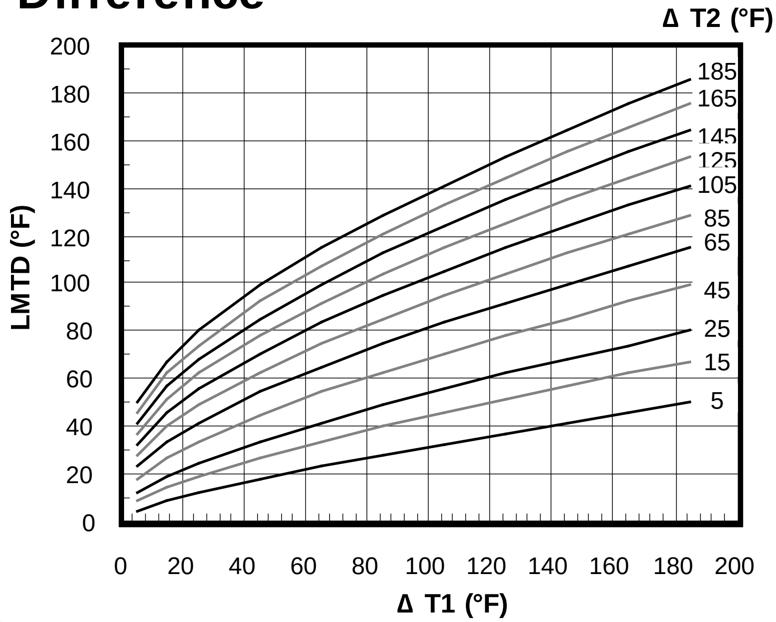




2.3 Calculate the ratio of shell side to tube side flow rates, Ms/Mt.

2.4 Estimate the factor, F, using the flow rate ratio and make a note in the box provided on the Worksheet.

STEP 3: Log Mean Temperature Difference



Unit Conversions

From	To	Multiply by
°C	°F	1.8

3.1 Calculate Δ T1 and Δ T2 using the equations provided on the Worksheet.

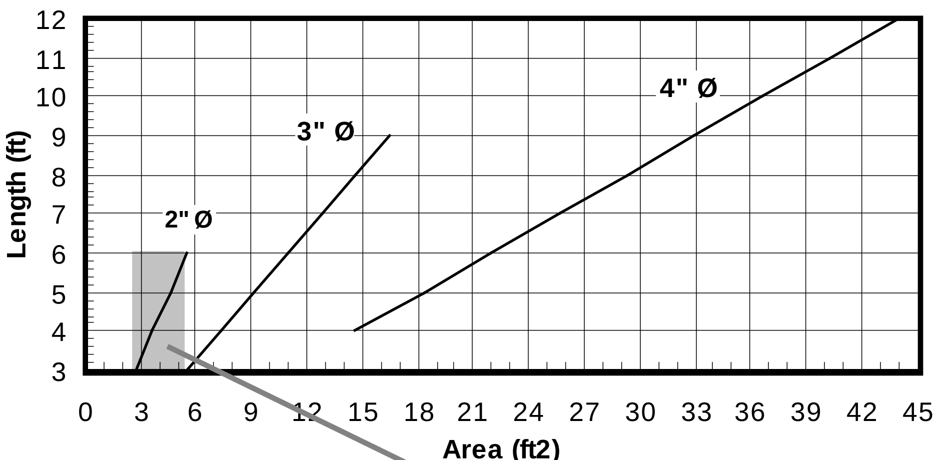
If the above calculations result in a negative value for Δ T1 and/or Δ T2 then simply drop the negative sign prior to using the graph at the right.

3.2 Estimate LMTD from the graph. Make a note of LMTD in the box provided on the Worksheet.

STEP 4: Heat Exchanger Length

Unit Conversions

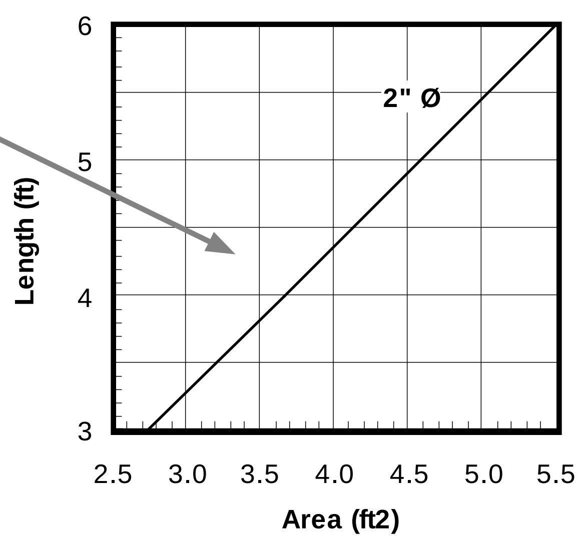
From	To	Divide by
m	ft	0.3048
m2	ft2	0.0929



$$A = \frac{Q \times 1000}{F \times U \times LMTD}$$

4.1 Calculate the required heat exchanger area using the formula given above. Record the result in the box provided on the Worksheet.

4.2 Use the heat exchanger area, A, and shell diameter, to determine the heat exchanger length from the appropriate graph. Record the heat exchanger length in the box provided on the Worksheet.

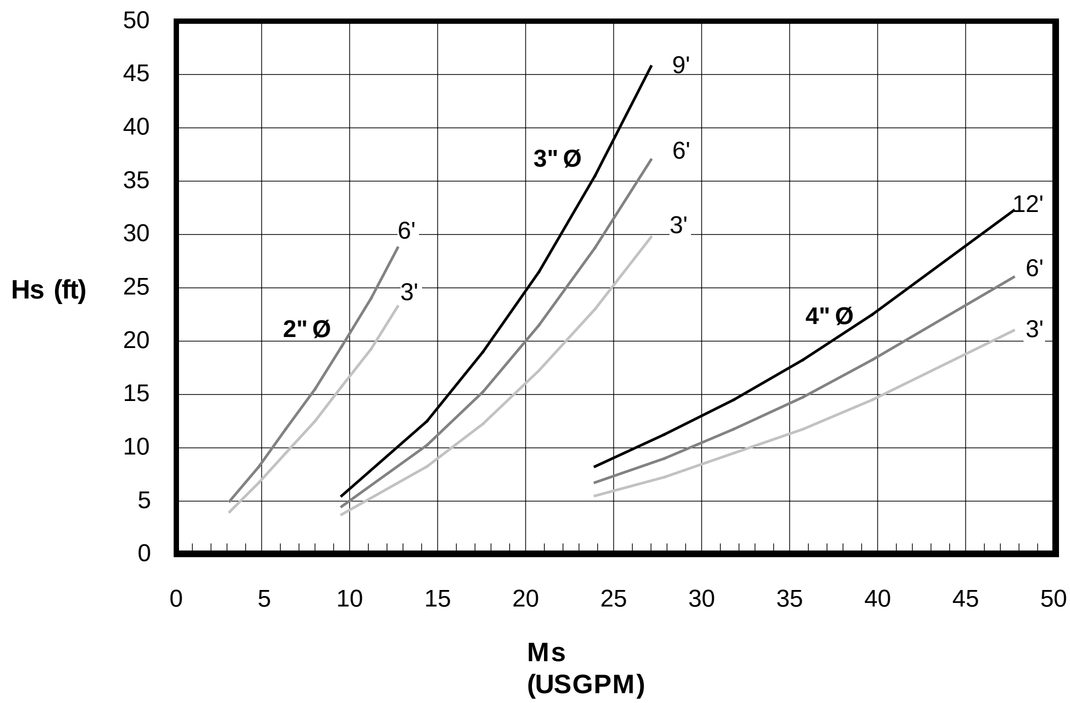


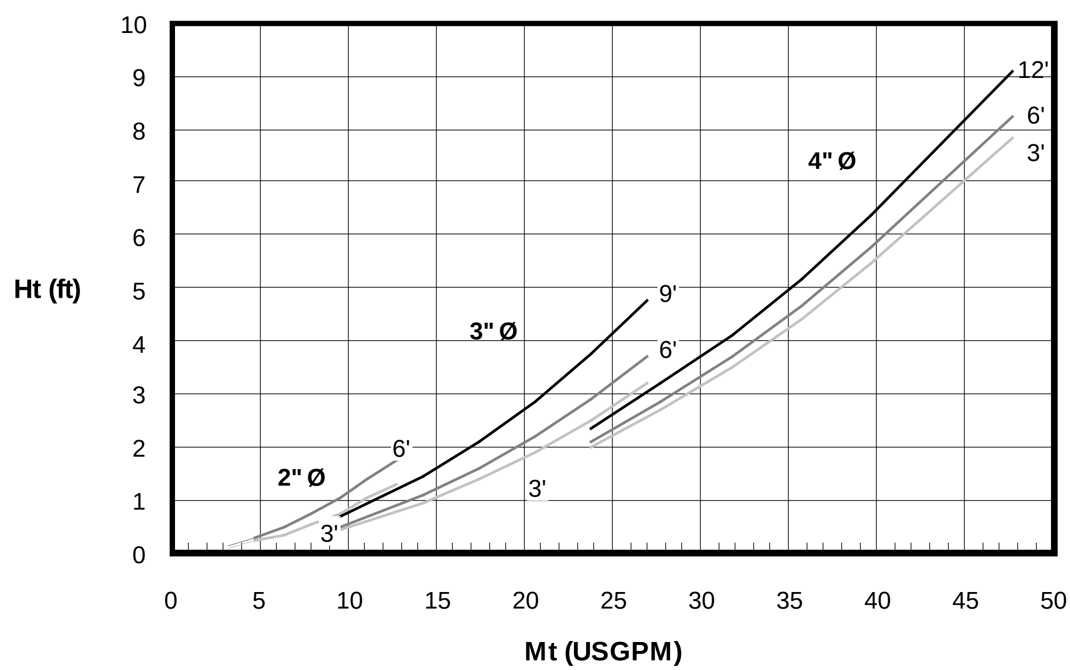
STEP 5: HEAD LOSS

Unit Conversions

From	To	Multiply by
psi	ft	2.307
IGPM	USGPM	1.20

Use the graphs below to estimate the head loss for the shell side and tube side flow through the DTL series heat exchangers. The head loss is useful for pump sizing and estimating the operating costs of the heat exchanger. Given the heat exchanger length, shell diameter and corresponding flow rates, estimate the head loss and record it in the box provided on the Worksheet. A procedure for estimating the operating costs of the heat exchanger is given on the Worksheet.
Note: The graphs below are not valid for natural circulation flow.

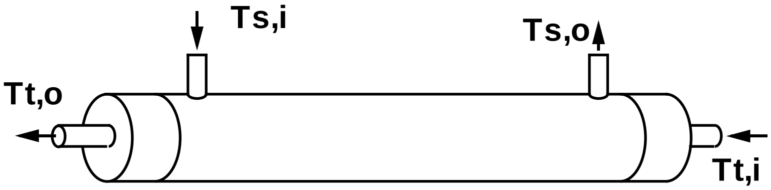




Date:	File number:
Job Number:	Sized By:

DTL WORKSHEET

Use this page to record the various parameters that are found throughout the procedure. Photocopy this page and keep it as a permanent copy of the sizing information.



Known Operating Parameters			Section	Results		
Ts,i		°F	**2.2 or 2.3**	U		Btu/h-ft2-°F
Tt,i		°F		Ds		inches
Q		MBtu/h	**2.4**	Ms/Mt		
Ts,o		°F	**2.5**	F		
Tt,o		°F	**3.1**	Δ T1 = Ts,i - Tt,o		°F
Ms		USGPM	**3.1**	Δ T2 = Ts,o - Tt,i		°F
Mt		USGPM	**3.2**	LMTD		°F
			4.1	Area		ft2
			4.2	Length		ft

Operating Costs:

Power Consumption = $\frac{\text{Ms x Hs}}{5.29} + \frac{\text{Mt x Ht}}{5.29} = \frac{\square \text{ x } \square}{5.29} + \frac{\square \text{ x } \square}{5.29} = \square$ Watts

Hours of Pump Operation per Year

kWh/yr = **Power** Consumption x Hours / 1000

$/kWh **Electrical** Energy Cost

$/Year = $/kWh x kWh/Year

Note that there are generally several heat exchangers that will satisfy the given operating conditions. The heat exchanger that gives the lowest overall total cost should be selected. Remember that the cost of the pump and installation must be considered in the overall cost of the heat exchanger. Cost of pumping through connecting pipe must also be considered.

Standard Sizes Available

Shell Diameter (in)	Number of Tubes	Shell Lengths Available (ft)
2	7	3,4 and 6
3	14	3,4,6,8 and 9
4	28	4,6,8,9 and 12

Special orders available upon request.

PLACING AN ORDER:
Specify the model number in the spaces provided.

Contact Thermo Dynamics Ltd. at
Tel. (902) 468-1001
Facsimile (902) 468-1002
Email: thermody@atcon.com

Quantity ____ **Model D** ____ **T** ____ **L** ____