# HEAT TRANSFER TUBE & COIL SIZING



## *TFE and METAL*

### QUICK ESTIMATION (BASED ON STEAM) HEAT-UP

***STEP 1*** Determine gallons in tank. Enter this amount at (A) in Figure 1.

***STEP 2*** Subtract the temperature of the media to be heated from the temperature to which it must be heated. Enter this amount at (B).

***STEP 3*** Locate your useable steam pressure in Steam Pressure Factor (see Chart A) and find the factor number. Enter this at (C).

***STEP 4*** Multiply A times B and that product by C. Divide the product by 1000. This is the square foot area you require for a one hour heat-up. If more time is available, coil surface area may be reduced by dividing the square foot area by the heat-up time available, up to 4 hours, maximum.

A. U.S. Gal. = Tank Width ____" x Length ____" x Depth ____" ÷ 231

B. Δ Temperature = Desired Temp. ___ °F - Initial Temp. ___ °F

C. Steam Pressure Factor = _____

***CHART A***

| Steam Pressure Available PSI | 5 | 10 | 15 | 20 | 25 | 50 |
|---|---|---|---|---|---|---|
| Steam Factor for Metal | .55 | .50 | .42 | .37 | .30 | .25 |
| Steam Factor for TFE | 2.75 | 2.50 | 2.10 | 1.85 | 1.50 | - |

*Consult factory for pressures above 50 lb. for metal and 30 lb. for TFE.*

***Figure 1.***

$$\frac{A\ (\text{GALLONS}) \times B\ (\Delta T) \times C\ (\text{STEAM FACT.})}{1{,}000} = \_\_\_\_ FT^2$$

### FORMULA FOR HOT WATER HEATING MEDIA

***STEP 1*** Determine Gallons in tank. Enter at (A) in Figure 2.

***STEP 2*** Subtract temperature of media to be heated from the temperature to which it is to be heated. Enter at (B).

***STEP 3*** Multiply A times B and multiply the product by 8.33. Enter answer at (C)

***STEP 4*** Subtract the required tank temperature from the temperature of your hot water supply. Enter this figure at (D).

***STEP 5*** Multiply D by 150 for all metals or 32 for TFE and enter answer at (E).

***STEP 6*** Divide line C by line E to determine square feet of area required. If more time is available, coil surface area may be reduced by dividing the square foot area by the heat-up time available, up to 4 hours, maximum.

$$\frac{\text{GALLONS IN TANK} \times \text{TEMPERATURE RISE REQUIRED} \times 8.33}{\frac{150}{32} \times (\text{HOT WATER TEMPERATURE} - \text{REQ'D TANK TEMPERATURE})} = FT^2 \text{ OF AREA REQ'D FOR ONE HOUR HEAT-UP}$$

***Figure 2***

$$\frac{(A) \times (B) \times 8.33}{\text{ALL METALS (150) X D}\ /\ \text{TFE (32) X D}} = \frac{(C)}{(E)} = FT^2 \text{ OF AREA REQ'D FOR ONE HOUR HEAT-UP}$$

### FORMULA FOR COOLING WITH ANY MEDIUM

This formula assumes that all electrical energy is dissipated in the tank as heat. In more efficient electrochemical conversions, the energy dissipated as heat may be less.

***STEP 1*** Determine watts by multiplying voltage times amperage delivered by the tank rectifier. Multiply this product times 3.412 to determine BTU's. Enter answer at (A) in Figure 3.

***STEP 2*** Subtract cooling liquid temperature from required tank temperature. Enter at (B). **CAUTION:** If this number is less than 15, consult factory for assistance in determining proper coil size.

***STEP 3*** Multiply line B times 150 for all metals or 32 for TFE and enter answer at (C).

***STEP 4*** Divide line A by line C to determine square feet of surface area required.

$$\frac{\text{VOLTS X AMPS X 3.412}}{\frac{150}{32} \times (\text{REQ'D TANK TEMPERATURE} - \text{COOLING LIQUID TEMP.})} = \text{SQUARE FT. OF SURFACE AREA REQUIRED}$$

***Figure 3***

$$\frac{(A)}{\text{ALL METALS (150) X (B)}\ /\ \text{TFE (32) X (B)}} = \frac{(A)}{(C)} = \text{SQUARE FT. OF SURFACE AREA REQUIRED}$$

**For a more in-depth analysis of your specific heat requirements, provide the following information to SERFILCO and we will gladly size your heat exchanger.**

Initial temperature_____

Desired temperature_____

Tank size: Length _____ Width _____ Height _____

Solution depth _____

Type of solution to be heated or cooled _____

Production load: Lbs./hr. _____ & inlet temp. _____

Agitation (type) _____

Rectifiers: Number _____ Voltage _____ Amp _____

Covered or uncovered tank _____

Insulated tank & tank material _____

Steam pressure at coil hook-up point _____

Cooling media _____ Inlet temp. _____ Flow rate _____

***Maximum flow rates, performance curves and pressure drops are determined at the factory for optimum design efficiency. Performance data is available by contacting SERFILCO.***

# DETERMINING SPECIFIC HEATING REQUIREMENTS FOR SERFILCO IMMERSION HEATERS

## TO DETERMINE THE HEATING REQUIREMENT OF A TANK

Obtain the following information:

1. TOTAL CUBIC FEET OF TANK. - Multiply the inside dimensions of the tank (depth x width x length).
2. TOTAL GALLONS OF SOLUTION - Multiply by 7.48 the cubic feet of the tank occupied by solution. (If the solution is normally 6" below the top of the tank, allow for this when calculating.)
3. AVERAGE AMBIENT (ROOM) TEMPERATURE AT WHICH TANK WILL BE USED.
4. TEMPERATURE LEVEL AT WHICH SOLUTION IS TO BE HELD.
5. HEAT-UP TIME DESIRED.

After this information is known the following calculations can be made:

$$\frac{A \times 1.0^{*} \times 8.35^{**} \times B}{3412 \times C} = \_\_\_\_\_$$

$$D \times E = \_\_\_\_\_$$

* Specific heat of water. Insert specific heat of your solution here.
** Weight of water. Insert specific weight of your solution here.

**Add the results of both calculations. The total is the Kilowatt requirement of the tank.**

**A** = Total gallons of solution
**B** = Difference between ambient temperature and desired solution temperature.
**C** = Desired heat-up time (hours).
**D** = Heat loss of tank. Refer to chart below.
**E** = Square feet of top of tank (multiply length x width)

## AMPS FOR SELECTION OF CONTROLS

| HEATER WATTS | AMPS FOR HEATING LOAD | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SINGLE PHASE | | | | | | THREE PHASE (BALANCED) | | | | |
| | 120V | 208V | 230V | 240V | 460V | 480V | 208V | 230V | 240V | 460V | 480V |
| 1,000 | 8.4 | 4.8 | 4.4 | 4.2 | 2.2 | 2.1 | 2.8 | 2.6 | 2.5 | 1.3 | 1.2 |
| 2,000 | 16.7 | 9.7 | 8.7 | 8.4 | 4.4 | 4.2 | 5.6 | 5.1 | 4.9 | 2.6 | 2.5 |
| 3,000 | 25.0 | 14.5 | 13.1 | 12.5 | 6.6 | 6.3 | 8.4 | 7.6 | 7.3 | 3.8 | 3.7 |
| 4,000 | 33.4 | 19.3 | 17.4 | 16.7 | 8.7 | 8.4 | 11.2 | 10.1 | 9.7 | 5.9 | 4.9 |
| 6,000 | 50.0 | 28.9 | 26.1 | 25.0 | 13.1 | 12.5 | 16.7 | 15.1 | 14.5 | 7.6 | 7.3 |
| 8,000 | 66.7 | 38.5 | 34.8 | 33.4 | 17.4 | 16.7 | 22.3 | 20.2 | 19.3 | 10.1 | 9.7 |
| 9,000 | 75.0 | 43.3 | 39.2 | 37.5 | 19.6 | 18.8 | 25.1 | 22.7 | 21.7 | 11.4 | 10.9 |
| 12,000 | 100.0 | 57.7 | 52.2 | 50.0 | 26.1 | 25.0 | 33.4 | 30.2 | 29.0 | 15.1 | 14.5 |
| 18,000 | 150.0 | 86.6 | 78.3 | 75.0 | 39.2 | 37.5 | 50.1 | 45.3 | 43.4 | 22.7 | 21.7 |
| 27,000 | 225.0 | 129.9 | 117.4 | 112.5 | 58.7 | 56.3 | 75.1 | 67.9 | 65.1 | 34.0 | 32.6 |
| 36,000 | 300.0 | 173.1 | 156.6 | 150.0 | 78.3 | 75.0 | 100.1 | 90.5 | 86.8 | 45.3 | 43.4 |

## SURFACE LOSSES IN KILOWATTS FROM OPEN HOT WATER TANK

| | | | | | |
|---|---|---|---|---|---|
| 80° | - | 130° | .16 | 180° | .50 |
| 85° | .01 | 135° | .18 | 185° | .55 |
| 90° | .02 | 140° | .21 | 190° | .60 |
| 95° | .04 | 145° | .24 | 195° | .66 |
| 100° | .05 | 150° | .27 | 200° | .72 |
| 105° | .065 | 155° | .30 | 205° | .80 |
| 110° | .09 | 160° | .34 | 210° | .87 |
| 115° | .10 | 165° | .37 | 215° | .95 |
| 120° | .12 | 170° | .41 | 220° | 1.04 |
| 125° | .14 | 175° | .45 | | |

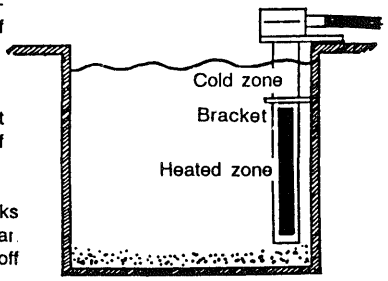
**Multiply square footage of surface by above factor.**

## TYPICAL HEATER INSTALLATION

Be certain heater is properly connected in compliance with all codes and per instructions which accompany heater.

Solution level must be at least one inch below junction box. Junction box must not be submerged.

Solution level must always remain above heated zone of heater.




Heater should remain at least 2" above sludge at bottom of tank.

***CAUTION:*** All heated tanks should be equipped with an emergency automatic shut-off device.

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