Technical Information
Heating Exchangers - Heating & Cooling

General Information

In addition to direct heating with electric heating elements, Chromalox can provide heat exchangers for use with circulating hot or cold water systems or with steam as the heating media. The heat exchangers are designed to heat water solutions in plating baths and other corrosive applications and are available in Stainless Steel, Titanium or Teflon®. Check the Corrosion Guide in this section for proper sheath material selection. The procedures and calculations for using these heat exchangers are shown below: The procedures are based on closed and insulated tanks (see note below).

Using Steam Heating Media

The heating capacity requirements for using steam as the heating media can be determined from the following formula:

$$\frac{V \times \Delta T \times S_{PF}}{1000} = ft^2/hr$$

Where:
V = Gallons of liquid to be heated
ΔT = Desired temperature rise or change in temperature °F
S_{PF} = Steam pressure factor from Table 1
Ft^2 = Square feet of heat exchanger required to provide heat up in one hour

Calculation Procedure

1. **Determine** gallons in tank to be heated.

2. **Subtract** the temperature of the solution to be heated from the desired temperature.

3. **Locate** the usable steam pressure in Table 1 and determine the Steam Pressure Factor.

4. **Apply** the Steam Pressure Factor to the above equation and solve for area in square feet.

5. **Select** the heat exchanger from the product pages that matches the requirements.

Table 1 — Steam Pressure Factor

Exchangers	Steam Pressure Available (psig)						
	5	10	15	20	25	30	Above 30
Metal	0.55	0.50	0.42	0.37	0.30	0.27	Note[1]
Teflon®	2.2	2.0	1.7	1.5	1.3	1.1	Note[1]

1. Contact your Local Chromalox Sales office for recommendations for steam pressures over 30 psig.

Using Hot Water Heating Media

The heating capacity requirements for using hot water as the heating media can be determined from the following formula:

$$\frac{V \times \Delta T \times 8.33}{U \times (T_1 - T_2)} = ft^2/hr$$

Where:
V = Gallons of liquid to be heated
ΔT = Desired temperature rise or change in temperature °F
U = Factor for coil type
    U factor for Metal Coils — 90
    U factor for Teflon® Coils — 40
T_1 = Temperature of incoming hot water media
T_2 = Final temperature of solution to be heated
Ft^2 = Square feet of heat exchanger required to provide heat up in one hour

Calculation Procedure

1. **Determine** gallons in tank to be heated.

2. **Subtract** the initial temperature of the solution to be heated from the desired temperature.

3. **Determine** the proper U factor for the particular type heat exchanger selected.

4. **Determine** temperature of incoming hot water supply.

5. **Apply** the above equation and solve for area in square feet.

6. **Select** the heat exchanger from the product pages that matches the requirements.

The above equation gives the square feet of heat exchanger needed to complete the heat up operation in one hour. If more time is available, the coil surface area (ft^2) may be reduced by dividing the square feet from the above equation by the heat up time available. The correction factor can be used for time periods up to 4 hours maximum.

Note — When heating open tanks, the heat loss from the water surface must be added to the heating requirements (see Graph G-114S).

Using Cold Water Cooling Media

In electroplating operations, considerable heat is added to the plating solution by the plating current. Frequently it is desirable to cool the plating bath without diluting or upsetting the chemical balance by introducing cold water directly into the solution. Heat exchangers provide the ideal solution to this problem. The cooling capacity requirements for using cold water as the cooling media for a plating bath can be determined from the following formula:

$$\frac{V_R \times A_R \times 3.412 \text{ Btu/W}}{U \times (T_1 - T_2)} = ft^2/hr$$

Where:
V_R = Voltage of rectifier
A_R = Amperage or current of rectifier
U = Factor for coil type
    U factor for Metal Coils — 90
    U factor for Teflon® Coils — 40
T_1 = Final temperature of solution to be cooled
T_2 = Temperature of incoming cold water media
Ft^2 = Square feet of heat exchanger required to provide cool down in one hour

Calculation Procedure

1. **Determine** the watts of energy from the rectifier by multiplying the volts times amps. Convert watts to Btu by dividing by 3,412.

2. **Determine** the proper U factor for the particular type heat exchanger selected.

3. **Determine** temperature of incoming cold water supply.

4. **Subtract** the temperature of the cooling water from the desired temperature of the solution to be cooled. **CAUTION** — If the difference in temperature is less than 15°F, contact your Local Chromalox Sales office for assistance in determining proper coil size.

5. **Apply** the above equation and solve for area in square feet.

6. **Select** the heat exchanger from the product pages that matches the requirements.