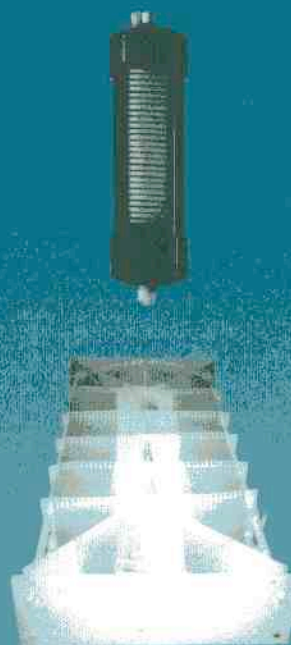


FLUOROTHERMTM

FLUOROPOLYMER IMMERSION HEAT EXCHANGERS

- Corrosion Resistant
- Compact
- Heats Or Cools
- Virtually Maintenance Free
- Non-Contaminating
- Low Fouling
- Long Lasting
- Cost Effective



Corrosion resistant heat exchangers with a 30 year history of unmatched performance in the plating, pickling, etching and galvanizing industries. The design and materials used in our products can withstand virtually any corrosive medium - whether for heating or cooling applications.

The universal corrosion resistance of fluoropolymers (such as Teflon[®]) and their "nonstick" characteristic - gives Fluorotherm heat exchangers a value far superior to metal alloy exchangers of stainless steel, titanium, zirconium, Hastelloy[®] and Inconel[®].

The proven Fluorotherm design delivers an optimum combination of performance and durability which is unmatched by graphite, glass or even other Teflon heat exchangers. There are 700 variations in frame dimensions to suit virtually every bath size..

In short, the final word in corrosion resistant heat exchangers is **FLUOROTHERM**. Visit our Internet web site <http://www.fluorotherm.com> for new and updated information.

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PRODUCTS

Fluorotherm heat exchangers, immersion coil, shell & tube and other custom types are designed, engineered and manufactured at Fluorotherm's facility in Fairfield, New Jersey, USA. Many of these products have established a long successful history of performance in ultra pure and chemically aggressive environments over the past 30 years. The following heat exchange products are available from Fluorotherm:

- Immersion heat exchangers of Polypropylene (PP), PTFE (Teflon®) frames and fluoroplastic PFA or FEP tubing
- Shell & Tube heat exchangers of FEP, PFA and PTFE tubing
- Conductive Teflon clad metal and other coils to handle very high pressures and/or to fit in tight spaces
- Fluoroplastic Mini - Coils to handle small volume baths and lower heat loads than our regular size immersion units
- Custom coils to meet specific bath or other geometries and heat load requirements
- Retractable, formed plastic coils that retain shape memory and are self-supporting

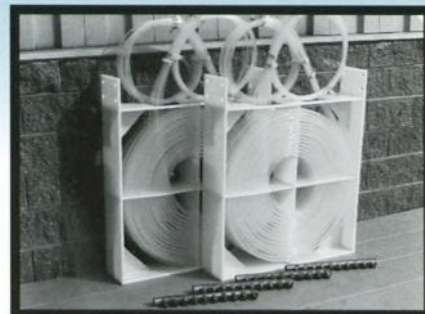


FIGURE 1 - PP FRAME HEAT EXCHANGER

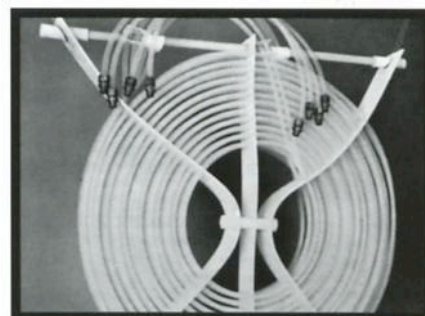


FIGURE 2 - PTFE FRAME HEAT EXCHANGER

WHY CONSIDER FLUOROTHERM IMMERSION HEAT EXCHANGERS?

1. **Experience** - Serving a wide industrial base, our references include worldwide leaders such as Allegheny Ludlum Corporation, US Steel, IBM Corporation, AT&T, INCO Alloys and Howmet Corporation.
2. **Product History** - Fluorotherm heat exchangers, previously known under the "Thermoron" trade name have served industry for the past 30 years.
3. **Design** - Our product designs undergo continuous evaluation and improvement - all based on feedback from our wide base of installations.

FLUOROTHERM HEAT EXCHANGERS ARE:

- A source of dry heat, superior to steam sparge, therefore there is no dilution, volume build up in spent media, use of excessive boiler water treatment chemicals, inefficient energy usage or hazardous fumes in work area. Productivity improves as a result of uniform pickling or etching rates due to constant acid strength.
- Chemically inert to corrosive attack
- Non-contaminating
- Resilient to thermal and mechanical shock, unlike graphite or glass heat exchangers
- Leak free - because of their unique design, no joints, seals or welded connections
- Resistant to fouling
- Easy to repair on-site
- Easy to maintain
- Capable of handling high temperatures and pressures
- Of rugged, long life design
- Available in over 700 variations in overall dimensions - so there is at least one for your application - or we can custom make one for you.



FIGURE 3 - NOTE THE RELATIVELY CLEAN TUBES AFTER USE IN ACID PICKLING LINE

TECHNICAL INFORMATION

The size of the heat exchanger is determined by the heat load (heating or cooling), operating temperatures of the bath and the heating or cooling medium, pressure of the medium and size of the tank. These data are required in order for us to perform sizing calculations and may be found on the data sheet. Please call, fax or e-mail Fluorotherm in order to obtain a data sheet. Blank data sheet forms are also available on our Internet website.

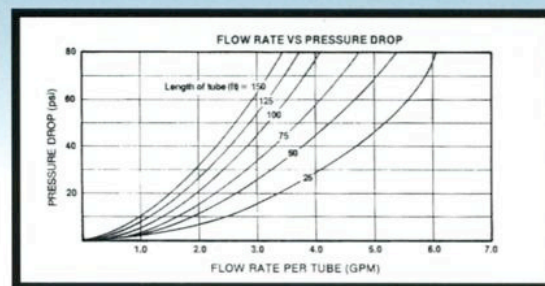


FIGURE 5
VARIATION OF PRESSURE DROP WITH FLOW RATE
FOR VARIOUS TUBE LENGTHS

The heat transfer surface area is determined by the tubing lengths used in each tube coil. Figure 5 shows pressure drops for various tube lengths.

Typical overall heat transfer coefficients range from 27-40 Btu/hr/sq.ft./deg F for FEP tubing and from 25 - 35 Btu/hr/sq.ft./deg F for PFA tubing. Our conductive tubing coils have significantly higher transfer coefficients which vary with the conditions of operation.

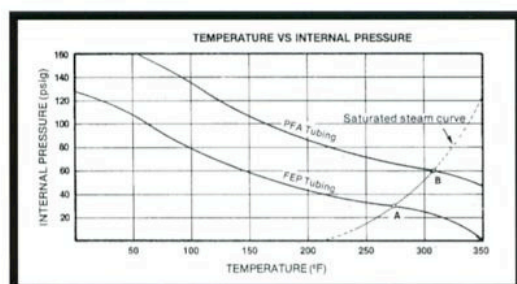


FIGURE 6
MAXIMUM RECOMMENDED PRESSURE AND
TEMPERATURE COMBINATIONS FOR
SAFE OPERATION

Figure 6 is a plot of tube internal pressure versus temperature and shows the operating limits for the two types of tubing.

HEAT EXCHANGER MODELS

We have over 700 standard model of heat exchangers. Models have an alphanumeric designation to denote size, heat transfer area, number of tubes, type of tubing and construction. Fluorotherm will provide the model number and heat exchanger details after a quotation has been developed for your application.

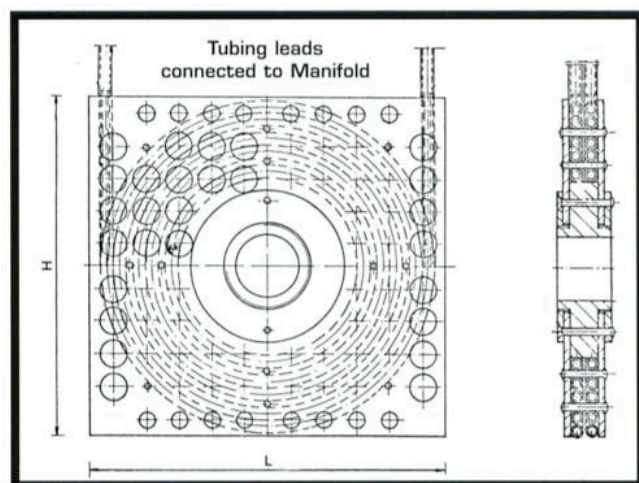


FIGURE 7 - PP FRAME UNIT

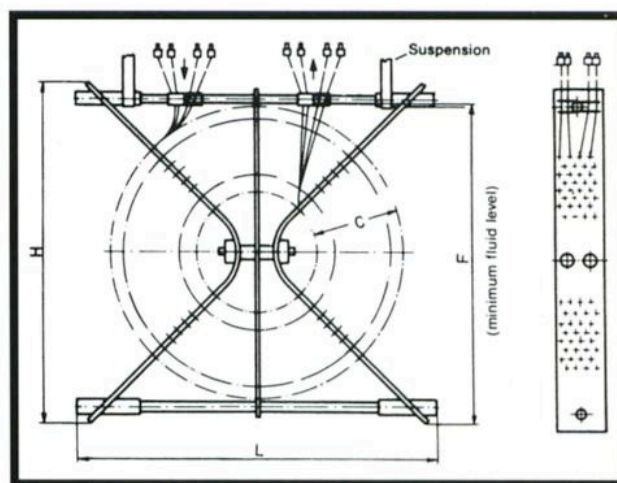


FIGURE 8 - PTFE FRAME UNIT

APPLICATIONS

Fluorotherm corrosion resistant heat exchangers are used in:

- Hot acid pickling, etching
- Acid and other corrosive chemical cooling
- Chemical holding tanks
- Metal, chrome, decorative and electroless copper, nickel and other plating applications
- Baths containing rinsing and stripping chemicals
- Ultra pure bath heating and cooling... and many other applications.

Fluorotherm heat exchangers are ideally suited for wire and metal pickling, metal plating, semiconductor etching, DI water heating and cooling, galvanizing, acid recovery systems, chemical processing, environmental systems, and maintenance plating for aircraft parts. The materials of construction can handle hot Nitric/HF, sulfuric, hydrochloric and other acids. Saturated steam up to 60 psig can be used for heating.

UNIQUE FEATURES

Unique Construction Provides Maximum Heat Transfer Surface

Fluorotherm immersion heat exchangers are rows of parallel fluoropolymer tubing coils optimally spaced to provide even flows, and supported by a sturdy support frame. This design assures full contact of the tubing surface with the outside fluid. The tubes are protected from incidental mechanical damage since they are fully contained and do not drift into the work areas.

FEP Or PFA Or Other Fluoropolymer Tubing - The Choice Is Yours

Fluorotherm heat exchangers have from one to a dozen or more heavy walled fluoropolymer tubes, each of which is tightly coiled in a circular or oval spiral. Only Fluorotherm heat exchangers offer you a choice of FEP or PFA or other fluoropolymer tubing. All fluoropolymer tubing types offered resist scale build up, facilitate fast and easy cleaning, allow high flow rates and virtually eliminate plugging problems. (Fig 4)

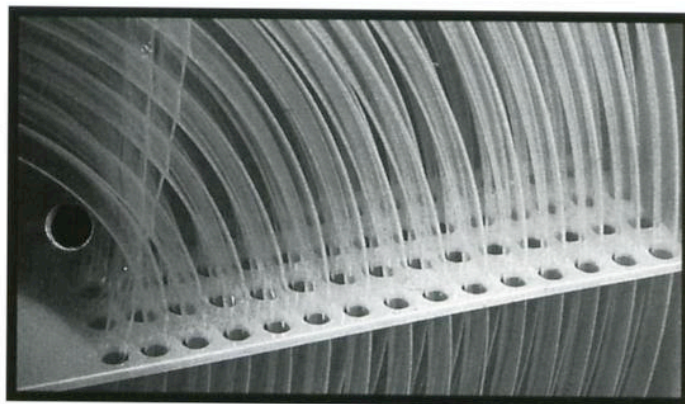


FIGURE 4
SLUDGE BUILDUP IS DISCOURAGED FROM THE GENEROUS TUBE SPACING PROVIDED

Choices Of Frame Material

Polypropylene (PP) frames offer high corrosion resistance at an economical price. The PP used is a high quality, rigid homopolymer that has outstanding resistance to chemical attack and may be safely used in most corrosive environments. Any standard corrosion guide will list compatible process baths. PP frames can be used with either FEP or PFA tubing. They are not recommended for use in bath temperatures above 210°F. PP frame heat exchangers are shown in Figure 1.

PTFE (Teflon and similar materials) offer the ultimate in corrosion resistance. PTFE frame units are shown in Figure 2. These frames are used for bath temperatures exceeding 200°F and up to 350°F. These models have no exposed materials that are susceptible to corrosive attack. All frame surfaces are 100% PTFE, which is inert to virtually all chemicals. Both PFA and FEP tubing can be used with PTFE frames.

EASY MAINTENANCE

Maintenance of Fluorotherm heat exchangers is easy - first, unlike other plastic or metal the tubing material is "nonstick" i.e., it inhibits the build up of sludge and foulants which reduce heat transfer efficiency. Any build up of film that does occur over time can be cleaned with a steam or hot water rinse. Second, the large spacing between tubes prevents bridging and allows vigorous fluid flow between the tubes. Unlike small diameter tubing, there is no bundling of the tubes restricting flow - a factor that reduces heat transfer over time. Figure 4 shows a typical tube spacing.

OPERATIONAL FLEXIBILITY - HEAT AND COOL WITH THE SAME UNIT

Each tube is individually connected to external inlet and outlet manifolds. This design avoids any weldments (always weak spots with Teflon and similar materials) and is modular - a Fluorotherm feature specifically engineered to enhance operational versatility. For instance, an electroplating operation might use a six-tube exchanger in which two tubes are used with steam to bring the bath up to operating temperature and the remaining four tubes are used with cold water to remove the electrical heat.

PROTECTION FROM BOILER/CHILLER DAMAGE

This modular design is a great advantage in the unlikely event that a tube becomes damaged - you simply disconnect the damaged tube and leave the good tubes in operation. In this way, the Fluorotherm heat exchanger can continue to operate without risk of diluting your process bath or siphoning costly, corrosive chemicals into a boiler or chiller. Your production can continue uninterrupted until a convenient downtime occurs. At that time, the damaged tubing can be quickly repaired, on-site, using the simple Fluorotherm repair fitting. In either case, the heat exchanger is returned to near 100% efficiency.

PERSONNEL SAFETY

External manifolds are located away from dangerous fluids and fumes. These are the only connections you will have to make. They are not welded joints - the probability of steam or hot condensate leak is minimized - in fact we are not aware of any known occurrence throughout the long history of this heat exchanger design.

INSTALLATION OF THE HEAT EXCHANGER

MOUNTING

Standard Polypropylene or PTFE support brackets are provided so that the heat exchanger can be mounted along the width or length of the tank. The bracket/heat exchanger assembly is bolted on to the lip of the tank. If the tank does not have pockets, Fluorotherm can build a pocket, space permitting, for easy installation on the tank wall. The heat exchanger may also be placed at the tank bottom. Other mounting options are possible depending upon the availability of space in your tank. Fluorotherm can design and build custom brackets to suit your specific mounting requirements.

MANIFOLDS

Stainless steel or plastic manifolds are provided for multiple tube coil units. There are two manifolds, per exchanger, for inlet and outlet. Manifolds are generally located external to the tank. This design provides for easy identification and isolation of a tube, should an unlikely break occur. The heat exchanger can continue to operate without disrupting your process.

TUBE CONNECTIONS

Tube leads extend from the heat exchanger body to connect to the manifolds. Standard tube lead lengths provided are 5 feet.

SHIELD

A tube cage protection shield is recommended when there are moving parts in the vicinity of the heat exchanger. The shield protects the tube coils from being accidentally hit and damaged. Shields are either welded or bolted on to the heat exchanger frame.

HOW DO I GET A QUOTE ?

The quickest, most reliable way is to either call in with the operating data that you have or send us a completed data sheet. Data sheets may be obtained from Fluorotherm by fax or phone request. Alternatively, a blank form that can easily be filled out is available on our website. You may simply e-mail the completed form to "sales@fluorotherm.com". Don't worry, if you don't have all the data - we will call you to verify the important ones. We will confirm your key data in writing in our quotation.



FIGURE 9 - MOUNTING BRACKETS

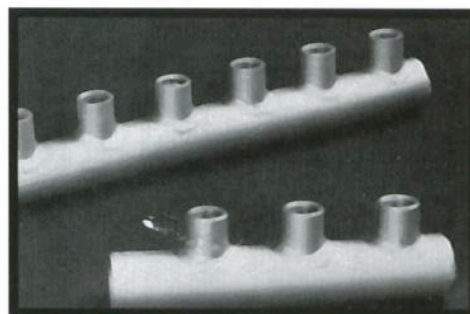


FIGURE 10 - STAINLESS STEEL MANIFOLD

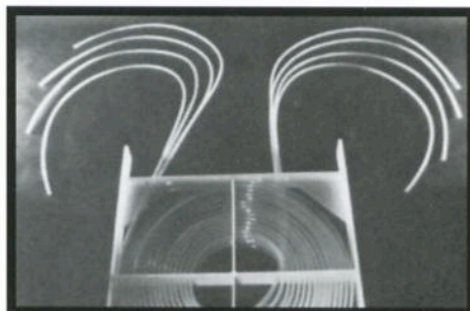


FIGURE 11 - TUBE LEADS

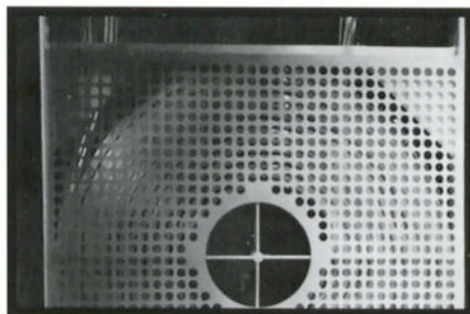


FIGURE 12 - PROTECTION SHIELD

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