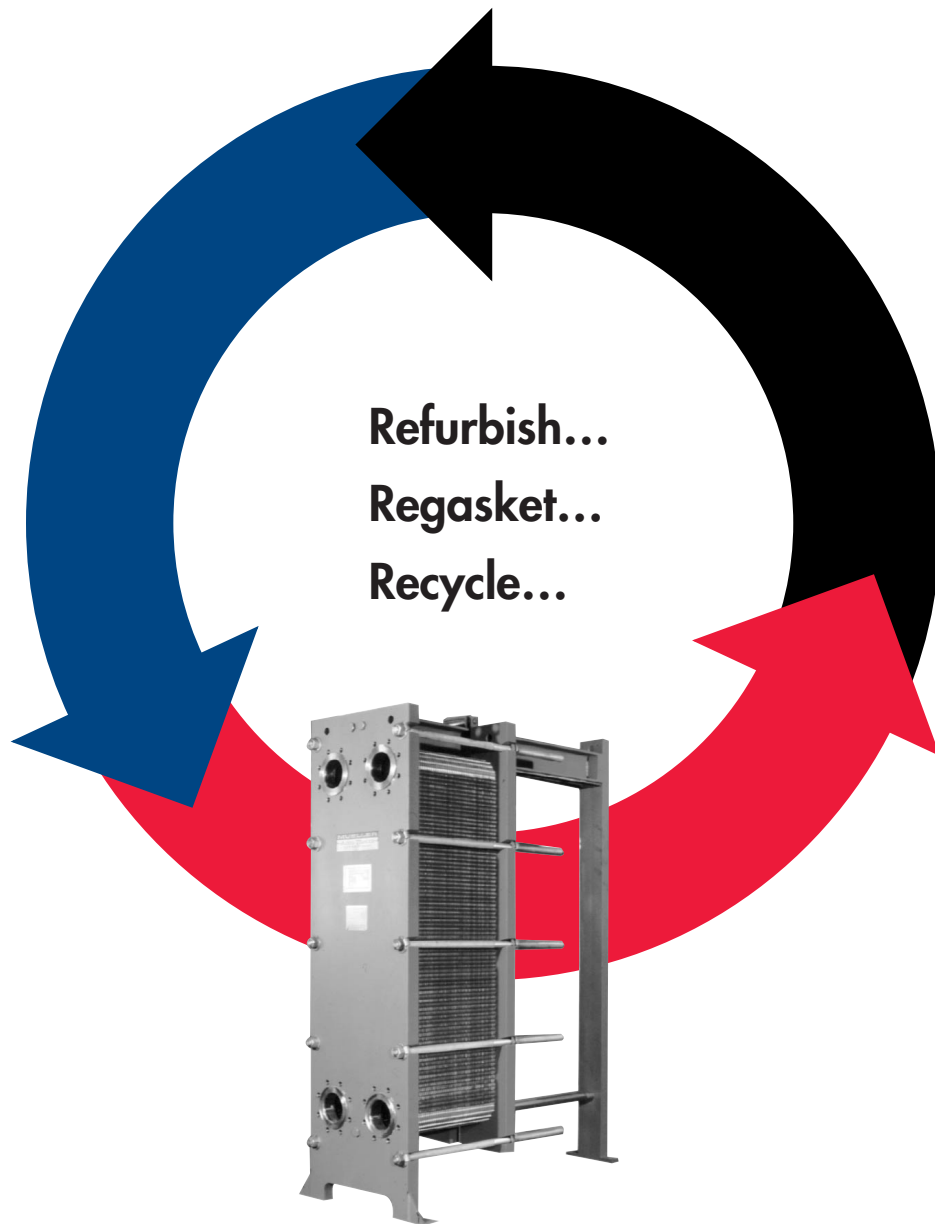


# Accu-Therm® Instructions

Installation • Operation • Maintenance



Part No. 9804186

Effective January 1, 1999  
Revised May 1, 2000

**MUELLER**®  
HEAT TRANSFER PRODUCTS

**ACCU-THERM<sup>®</sup>**  
**INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS**

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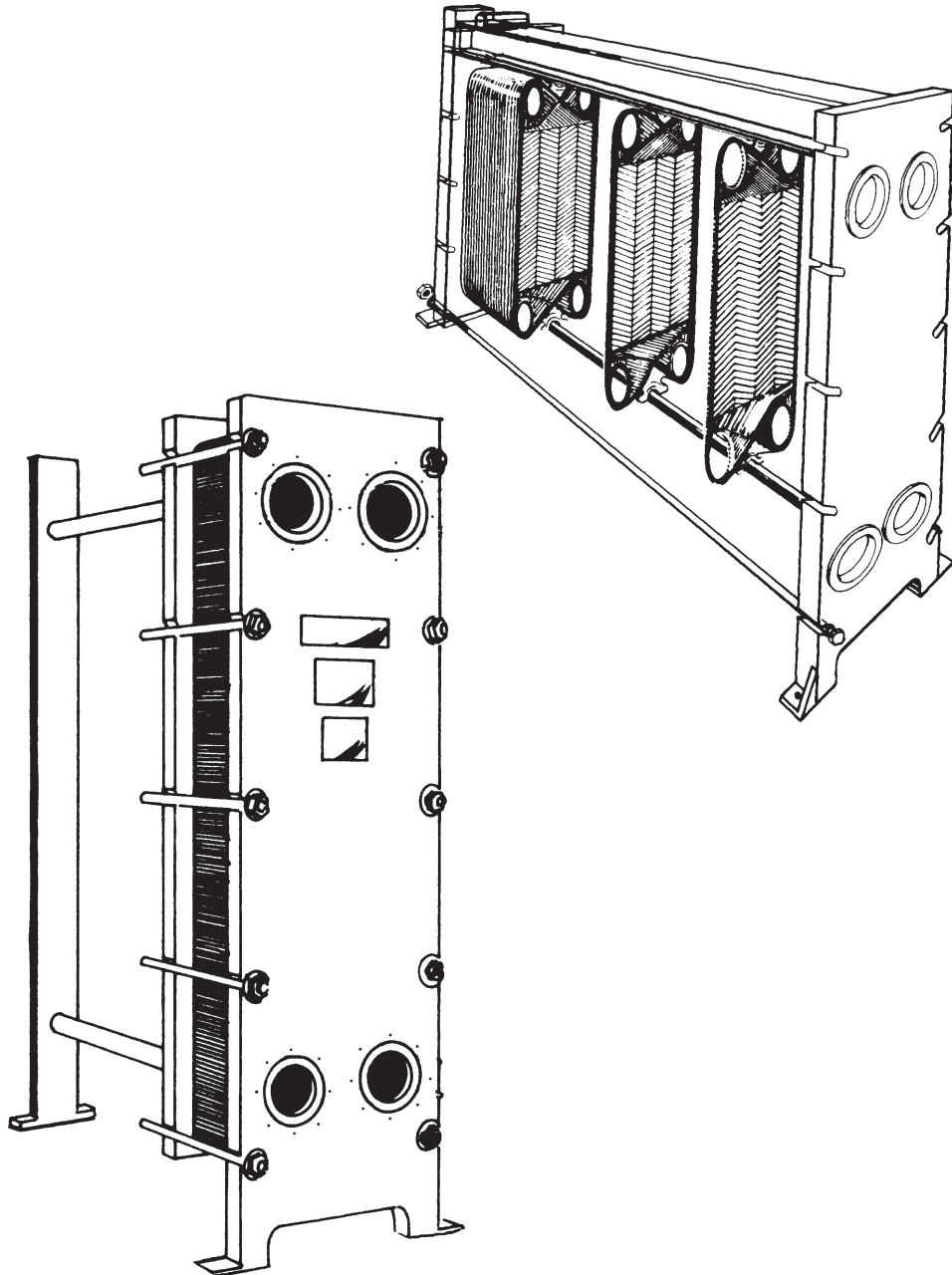
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# INTRODUCTION

## 1.0 Introduction

This Accu-Therm® Installation, Operation, and Maintenance Manual is intended as an instruction booklet for the newer user as well as providing new and helpful hints for previous users of plate-and-frame heat exchangers.



## SECTION 2.0 - GENERAL INFORMATION

### 2.1 Accu-Therm General Description

The Accu-Therm system is based on the modular-unit concept. This consists of standardized components such as frames, terminals, plates, and connections which can be assembled into compact, highly efficient compact plate heat exchangers that are custom-tailored to the customer's requirements. An Accu-Therm has the added feature that plate capacity may be expanded or deleted for reasonable changes in capacity demand (see Figures 1A and 1B).

**NOTE:** Typical maximum operating pressures range from 75 psig to 300 psig (contact Paul Mueller Company for higher pressure applications).

### 2.2 Plates

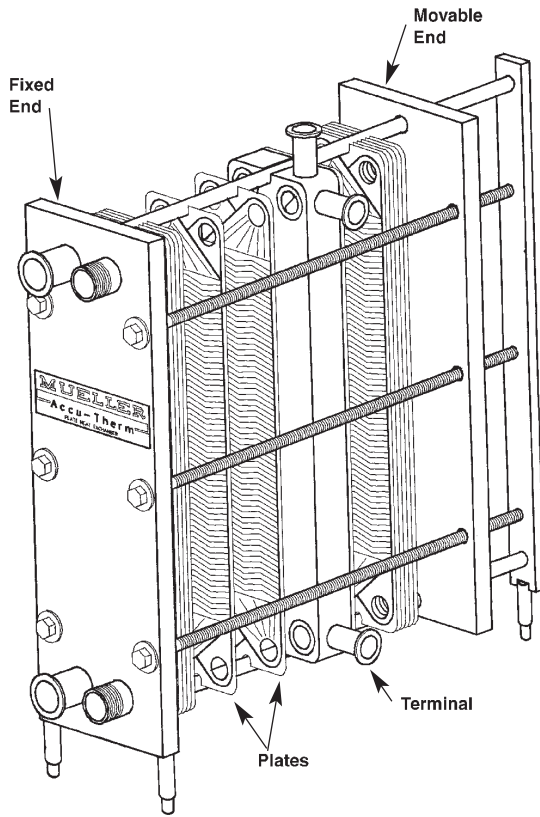
Accu-Therm plates are available in seven corrugation styles to better handle your heat transfer needs for high efficiency with various solutions and pressure-drop requirements.

- ▲ H = Horizontal
- ▲ V = Vertical
- ▲ P = High Pressure
- ▲ F = Fine Pattern, Horizontal
- ▲ G = Fine Pattern, Vertical
- ▲ FF = Free-Flow
- ▲ M = High Pressure

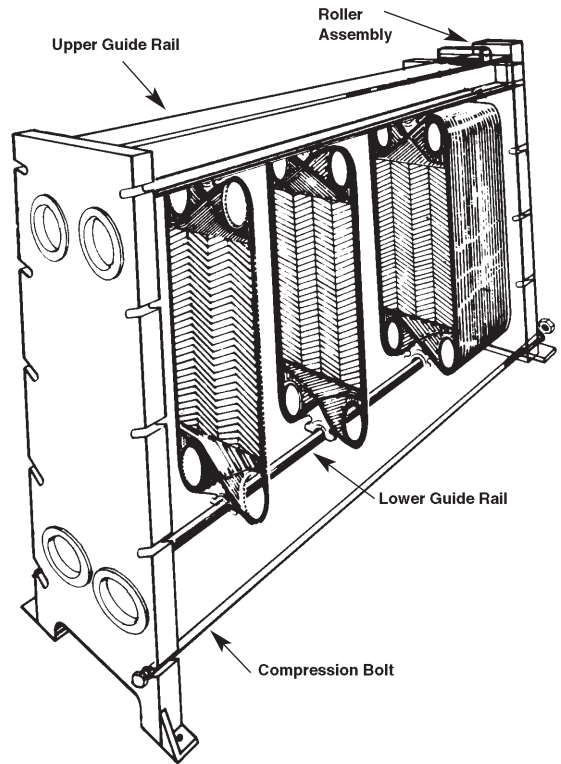
The plates are formed from most cold workable metals or alloys between two-piece hardened dies. This minimizes metal thinning which can occur with other forming methods. Pressed into the plates are grooves into which the gaskets fit, and corrugations or ribs. These corrugations or ribs tend to reinforce the plate, direct the flow, and increase heat transfer by inducing turbulence within the media flowing across the surface. The perimeter of plates and the porthole areas are bounded by a one-piece elastomeric gasket which is attached to the plate.

The plates are then assembled into a pack according to the flow arrangement and suspended from an upper guide rail or supported from lower guide bar. Compression bolts which draw the movable end frame to the fixed end frame are then used to tighten the plate pack to a measurement which is between the "A" minimum and the "A" maximum (located on flow chart and data sheets shipped with the unit) but never tighter than the "A" minimum. The minimum dimension is located on the data plate on the front of the Accu-Therm unit. The "A" dimension must be changed if plates are added or removed from the heat exchanger (see Figure 2A).

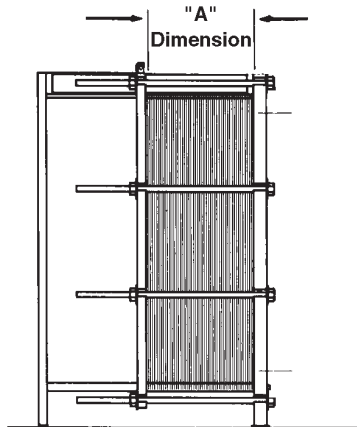
**Figure 1A - Sanitary Frame Design**



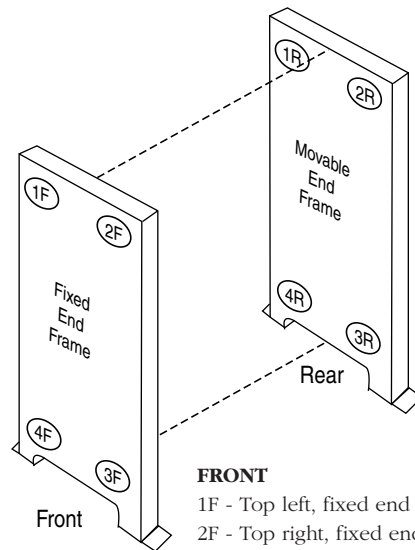
**Figure 1B - Industrial Frame Design**



**Figure 2A - "A" Dimension**



**Figure 2B - Port Configuration**



**FRONT**

- 1F - Top left, fixed end frame
- 2F - Top right, fixed end frame
- 3F - Bottom right, fixed end frame
- 4F - Bottom left, fixed end frame

**REAR**

- 1R - Top right, movable end frame
- 2R - Top left, movable end frame
- 3R - Bottom left, movable end frame
- 4R - Bottom right, movable end frame

## Table 1 - Plate Specifications

Listed below are various Mueller Accu-Therm plate heat exchanger nominal specifications.

Model	Height (in)	Width (in)	Typical Length* (in)	Typical Conn. Size	Normal Surface Range (ft <sup>2</sup> )	Typical Max. Flow GPM H <sub>2</sub> O**
AT4	23	8	12-22 <sup>7</sup> / <sub>8</sub>	1	15-50	50
AT10	37	14	14 <sup>1</sup> / <sub>2</sub> -50 <sup>1</sup> / <sub>2</sub>	2	13-273	200
AT20	56	24	20-159 <sup>3</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>2</sub> /3	28-1,279	450
AT402	39 <sup>1</sup> / <sub>4</sub>	27	20 <sup>1</sup> / <sub>2</sub> -159 <sup>1</sup> / <sub>2</sub>	4/6	16-106	1,150
AT405	56	27	20 <sup>1</sup> / <sub>2</sub> -159 <sup>7</sup> / <sub>8</sub>	4/6	48-1,495	1,150
AT40	70 <sup>1</sup> / <sub>4</sub>	27	33 <sup>7</sup> / <sub>8</sub> -159 <sup>7</sup> / <sub>8</sub>	4/6	99-2,292	1,150
AT805	63	36	34 <sup>5</sup> / <sub>8</sub> -160 <sup>5</sup> / <sub>8</sub>	6/8	105-2,440	2,600
AT80	85	36	34 <sup>5</sup> / <sub>8</sub> -160 <sup>5</sup> / <sub>8</sub>	6/8	181-4,186	2,600
AT1306	84 <sup>3</sup> / <sub>4</sub>	43	50 <sup>3</sup> / <sub>4</sub> -176 <sup>3</sup> / <sub>4</sub>	10/12	262-6,209	6,600
AT1309	99 <sup>1</sup> / <sub>2</sub>	43	50 <sup>3</sup> / <sub>4</sub> -176 <sup>3</sup> / <sub>4</sub>	10/12	363-8,622	6,600
AT130	106 <sup>3</sup> / <sub>4</sub>	43	50 <sup>3</sup> / <sub>4</sub> -176 <sup>3</sup> / <sub>4</sub>	10/12	413-9,804	6,600
AT180	126	56	160-250	14	*	**
AT2508	120	57	65-245	16/20	860-15,308	17,300
AT250	134	57	65-245	16/20	972-17,309	17,300
AT161FF	70 <sup>3</sup> / <sub>4</sub>	29	33 <sup>5</sup> / <sub>8</sub> -159 <sup>5</sup> / <sub>8</sub>	3/4	57-1,579	650
AT184FF	91	36	34 <sup>5</sup> / <sub>8</sub> -160 <sup>5</sup> / <sub>8</sub>	8	165-2,734	3,000

\*Actual length of a PHE depends on model, frame, and number of plates.

\*\*Actual maximum flow depends on port nozzle construction and varies from 13 to 30 FPS with titanium.

### 2.3 Plate Materials

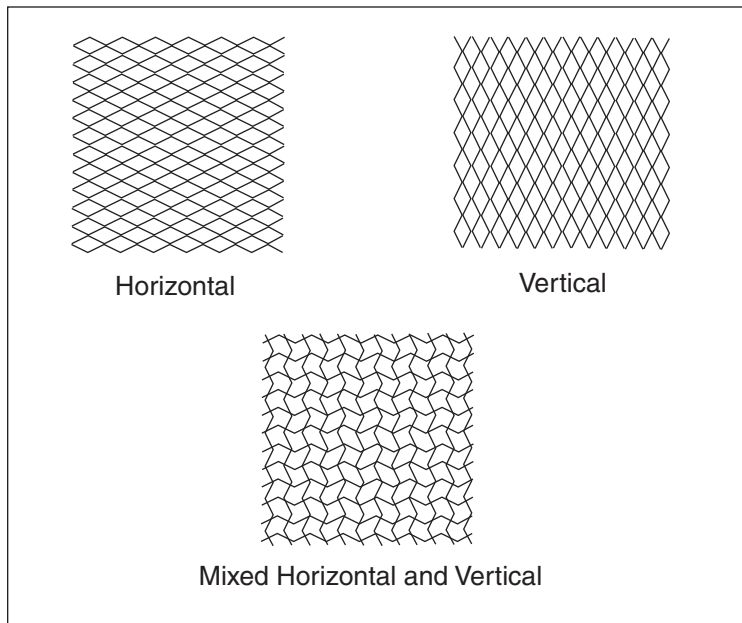
- ▲ 304 Stainless Steel
- ▲ 316 Stainless Steel
- ▲ Titanium
- ▲ Hastelloy® C-276

(Other materials may be available on a special-order basis.)

### 2.4 Mixed Plate Design

The Accu-Therm system combines two different plate embossings (see Figure 3), a vertical and a horizontal embossing, to provide a varying thermal optimization that can fall anywhere between the two. One plate has high heat transfer coefficients with higher pressure drops while the other has lower pressure drops with correspondingly lower heat transfer values. By combining the use of these plates, the thermal length of the plate pack can be varied to suit the customer's requirements and can provide a unit which is lower in cost.

**Figure 3 - Plate Patterns**



## 2.5 Plate Sequence and Flow Diagrams

A plate sequence and flow diagram are supplied with every Accu-Therm plate heat exchanger to describe plate arrangement and flow path through the unit.

Looking at the fixed end frame (see Figure 2B), the portholes are numbered clockwise from the top left porthole as 1F, 2F, 3F, and 4F. Looking at the movable end frame from the outside, the portholes are numbered counterclockwise from the upper right-hand porthole as 1R, 2R, 3R, and 4R.

Gaskets on all plates except the AT161FF plates face the fixed end frame. On the AT161FF they face the movable end frame. When looking at the gasketed side of all plates except the AT402 and AT161FF, if the non-gasketed ports are on the right-hand side, the plate is called a right-hand plate. Rotating the plate 180 degrees on the vertical plane puts the non-gasketed ports on the left-hand side and makes the plate a left-hand plate (see Figure 4). The pattern used on the AT402 and AT161 require a totally separate plate to make right-hand and left-hand configurations.

Figure 5 shows a typical plate sequence and flow diagram. The top double-dotted line indicates the fixed end frame while the bottom double-dotted line indicates the movable end frame. Each numbered line in the flow diagram indicates a plate. The open spaces in the numbered lines indicate the portholes for that plate. The style and openings are indicated to the right of the numbered lines. R indicates a right-handed plate; L indicates a left-handed plate. The numbers to the right of the Rs and Ls indicate the ports that need to be open in the plates. **Example:** R/1 2 3 4 indicate all four ports are punched out. RF or LF indicates right- or left-hand full-gasket plate which faces against the fixed end frame or terminal on non-free-flow units and the movable end frame or terminal on free-flow units.



Figure 4 - Right-Hand to Left-Hand Plate

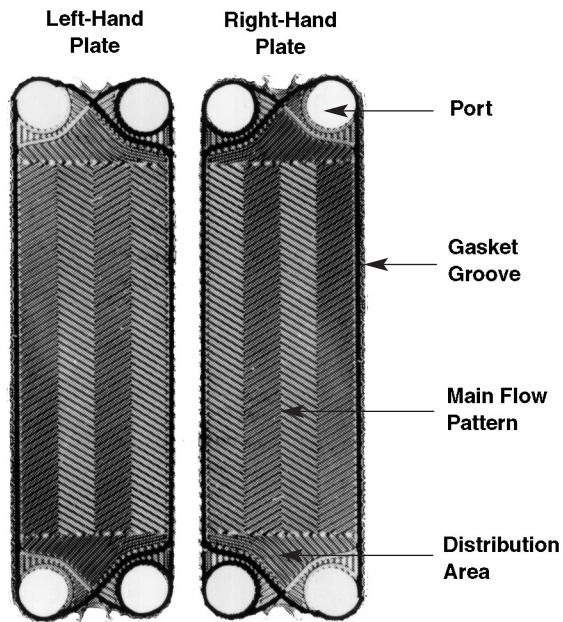
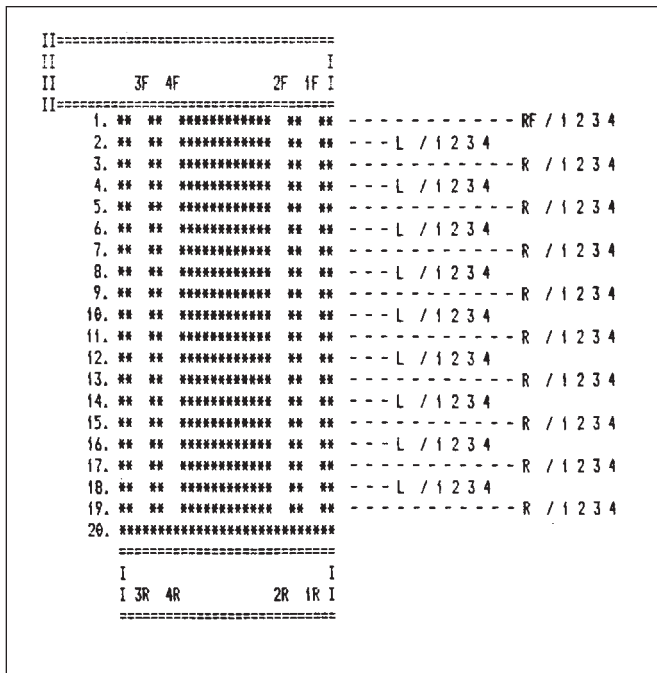


Figure 5 - Typical Plate Sequence and Flow Diagram



## 2.6 Plate Order and Arrangement

Most plates are bounded on the perimeter and porthole areas by a one-piece elastomeric gasket as shown in Figure 4. Most plates are punched with portholes in all four corners. The two non-gasketed ports will both be on one side of the plate (except 402 and 161 free-flow). This flow pattern created by the gasketed/non-gasketed ports is the mechanical feature which differentiates a left-hand from a right-hand plate.

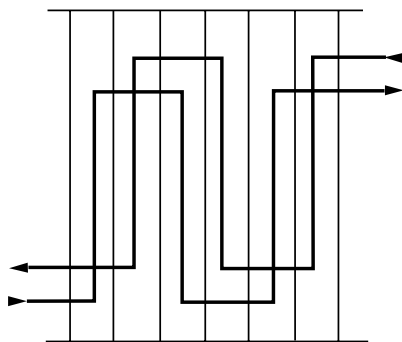
When the plates are loaded into the frame in an alternating left-hand/right-hand configuration as depicted in the typical flow diagram (Figure 5), one of the fluids is allowed full access to the face of a plate. Since each plate contacts two fluids, hot and cold on opposite sides, the very next plate in the plate pack will have non-gasketed ports on the opposite side to allow access to the second fluid. True counterflow is made possible in this manner.

## 2.7 Multiple-Pass and Fluid Arrangements

For certain applications, a thermal length longer than that of one plate is required. This can be done through the use of multiple passes to increase the thermal length. By not punching portholes at predetermined locations, any number of passes can be formed as shown by Figure 6.

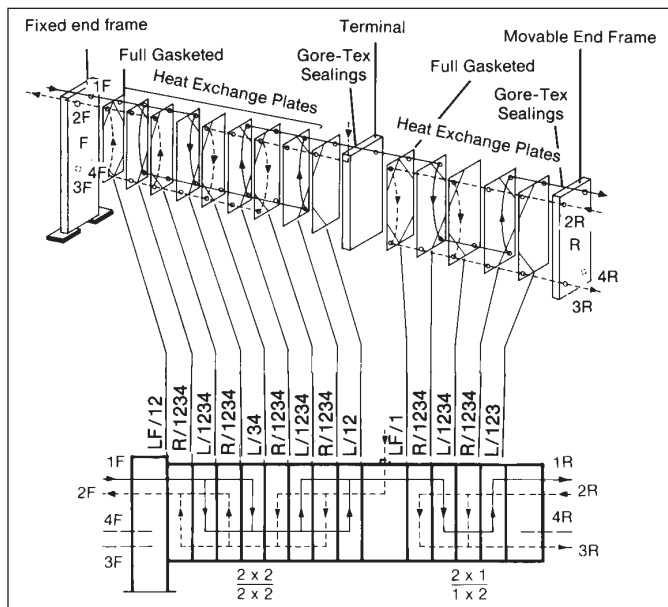
Units operating on more than two fluids are also possible by varying plate punching and through the use of terminal plates as shown in Figure 7.

**Figure 6 - Multiple-Passes**



**NOTE:** On multiple-pass units, it is possible to design fluid passage portions of the plate pack that could not be drained upon shutdown. In these instances, a small drainage hole is put through the bottom of the circular porthole area in non-punched plates. This has little if any effect upon heat transfer or flow performance of the unit.

**Figure 7 - Terminal Plates**

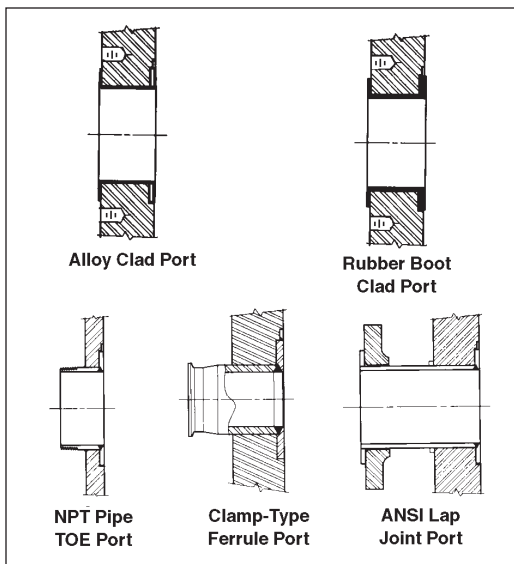


## 2.8 Frames

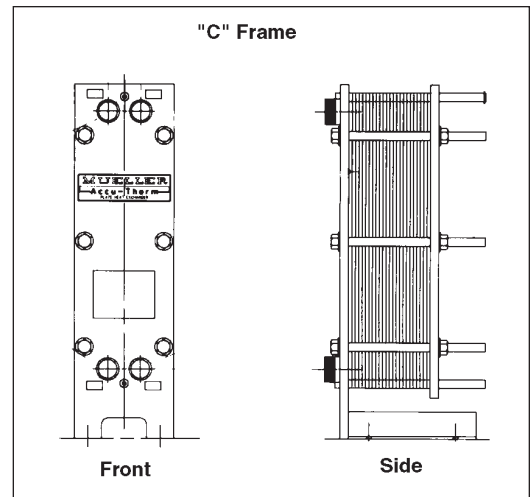
Accu-Therm frames are available in carbon steel and stainless steel and in a “C” or cantilevered frame and a “B” or “F” frame with upper and lower guide beam for larger quantities of plates. All carbon steel frames are sandblasted and painted with a chemical-resistant finish which is suitable for outdoor use. The compression bolts, nuts, and washers are zinc-plated; and shrouds are standard with units to help protect plates and gaskets and provide for ease of maintenance. Movable end frames and terminals are suspended from the top with a roller assembly to facilitate moving during opening. The upper guide beam or bar is used to mount the plate support channel and carry the movable end frame and terminals. The lower round guide bar acts as a locator for plates (see Figures 9A, 9B, and 9C). Some small-size Accu-Therm units are available with wall-mount “C” frames. Frame designs which meet 3A and FDA requirements are available on some Accu-Therm units.

Most Accu-Therm frames are available with elastomeric- clad (rubber boot), stud-mounted connections as standard. Alloy-clad, stud-mounted connections and ANSI lap joint with alloy-clad ports are also available. The standard connection for the smaller size Accu-Therm is 316L stainless steel pipe thread-one-end (TOE) NPT. Sanitary connections are clamp-type gasketed fittings (see Figure 8).

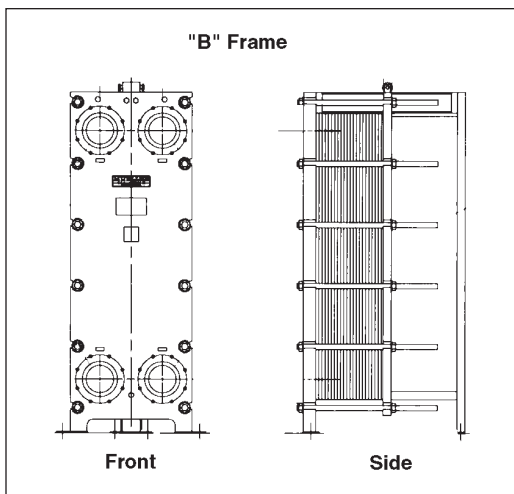
**Figure 8 - Connection Types**



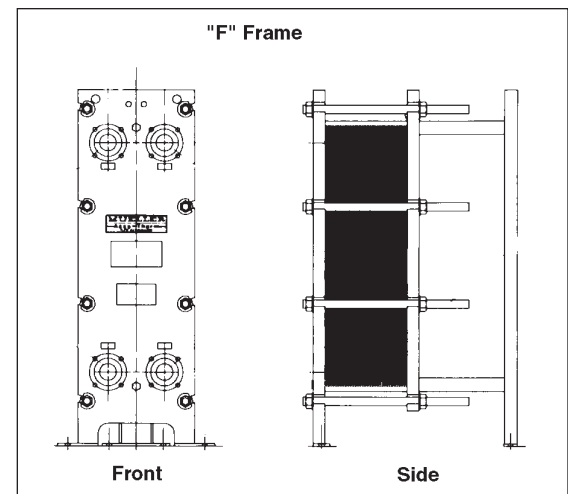
**Figure 9A - “C” Frame**



**Figure 9B - “B” Frame**



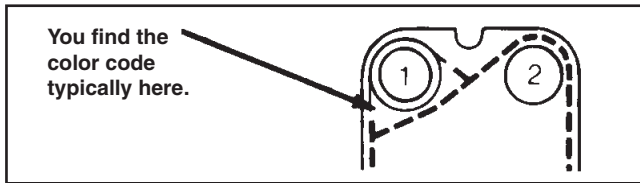
**Figure 9C - “F” Frame**



## 2.9 Gaskets

Paul Mueller Company will assist in selecting gaskets for your application but cannot guarantee the compatibility with your process.

Temperature limits are approximate and may vary with application and type of fluid. Optimum gasket life is obtained when operating temperatures are somewhat below these limits.



**Table 2 - Gasket Material List**

Type	Color Code
NBR (nitrile)	Black with one yellow code
EPDM	Black with one white code
EPDM (high-temp)	Black with one grey code
Butyl (resin-cured)	Black with one red code
Hypalon	Black with two white codes
Viton	Black with one silver and one red code
Viton G (acid)	Black with one silver & one green code or one grey & one red code
Silicone (FDA)	Red with non-code
NBR (FDA)	Black with one blue code
EPDM (FDA)	Grey with non-code or two grey codes
Viton (FDA)	Black with one silver and one blue code or one grey and one blue code

**NOTE:** The durometer of the gasket materials is 75 to 85. Please contact factory for process application assistance.

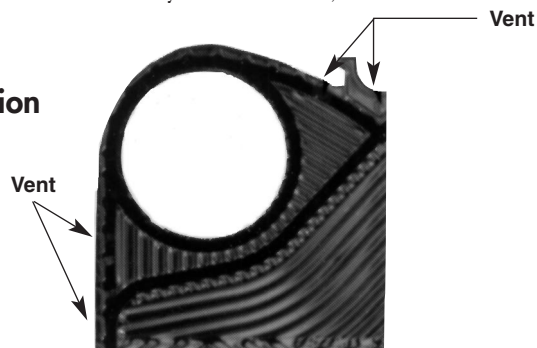
## 2.10 Gasket General Description

All gaskets are one piece and molded from various elastomers. Gaskets are designed with separate portions confining the hot and cold fluids with the interspace between the two vented to atmosphere (see Figure 10). This eliminates the possibility of mixing fluids. Most gaskets have been designed with positioning devices to ensure correct installation. All Accu-Therm gaskets are secured with either Loc-In or glue-in procedures.

The Loc-In feature is a custom-designed addition to the plate and gasket that holds the gasket in position without any glue. This is accomplished by a series of pinch points placed around the perimeter and through the appropriate gasket grooves. These pinch points coincide with indentations molded into the gasket.

Glue-in gaskets are secured with a variety of adhesives, selected to ensure optimum material compatibility.

**Figure 10 - Vent Location**



## 2.11 Gasket Materials

Accu-Therm gaskets are available in the following materials:

- ▲ Nitrile (NBR)
- ▲ Ethylene Propylene Rubber (EPDM)
- ▲ Viton®
- ▲ EPDM (FDA)
- ▲ Viton (FDA)
- ▲ NBR (FDA)
- ▲ Silicone
- ▲ Butyl (resin-cured)
- ▲ Hypalon®

Care should be exercised when selecting elastomers for fluid and temperature compatibility. Where there are some questions as to compatibility, Paul Mueller Company can furnish gasket samples for actual field testing by customers.

## 2.12 Gasket Removal

Loc-In gaskets are simply lifted from groove. Care should be taken if the gasket is to be reused. Excessive stretching of the material during removal will prevent reinstallation.

Gaskets glued with epoxy adhesive may be removed by prying up the gasket (use caution so plates are not scratched) and pulling the gasket off the plate. Remove the adhesive residue by using a nylon or stainless steel wire brush or by immersing the plates in hot caustic for 12 to 24 hours or longer. Then brush lightly and rinse with hot water. The brush must be compatible with the plate material, as iron particles rubbed into the surface of stainless steel will cause accelerated rusting (do not use any steel brush on electropolished plates). After all old adhesive has been removed, but before new adhesive is applied, the gasket groove must be cleaned with a solvent which will remove any oils. Be sure to read Section 2.15, "Gasket Replacement," before proceeding with the regasketing process.

## 2.13 Adhesives

The adhesives used on Accu-Therm plate-and-frame heat exchanger gaskets vary due to the type of gasket material and temperatures required. Some adhesives have an upper temperature limit of 450°F.

The gasket's adhesive is used to hold the gaskets in place while installing the plates in the frame during assembly.

Some PHEs may have been assembled using contact adhesive, epoxy, or synthetic-rubber contact adhesive such as 3M 1099 or similar types of adhesive. These adhesives are of relatively low temperature; they are not recommended for higher temperature applications.

Adhesives may be removed with the use of a hot-air gun at 250°F, commercial liquid paint strippers, or a stainless steel wire brush and MEK solvent.

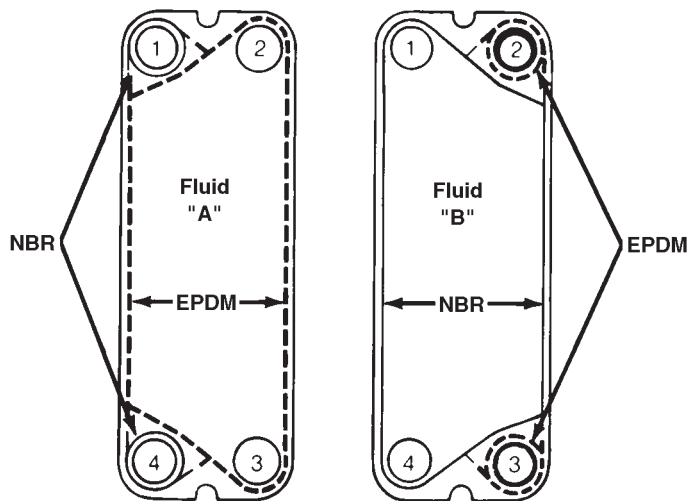


**CAUTION: When using commercial solvents and contact adhesives, follow the manufacturer's recommendations carefully, as many of these materials are hazardous!**

## 2.14 Dual Gasketing

Occasionally it becomes necessary to use two gasket materials to ensure fluid compatibility with both liquids. This is done by the alternating use of different elastomers for the porthole and face-gasketing areas as shown on Figure 11.

**Figure 11 - Dual Gasket Example**



## 2.15 Gasket Replacement

The plates and gaskets are the core of any Accu-Therm plate heat exchanger, so it's important to observe the gasket replacement procedures.

Installation of Loc-In gaskets is easily accomplished without any additional tools. Place the gasket over the groove, taking care to ensure proper alignment. Begin with the port areas by depressing the gasket into the pinch points built into the plate. After securing the port areas, move down the perimeter of the plate until the entire gasket is secured.

Large quantities of gaskets may be more easily handled, if a wooden tool is used to press the gaskets in place. Care should be used not to damage the plate or gasket with any sharp points or corners of the tool.

1. The adhesive remains in the gasket groove after gasket removal; so when replacing the gasket in a plate pack, it is important to remove the old adhesive and any oils or grease that may cause the new adhesive not to bond. Use a clean cloth soaked with a solvent to wipe the gasket groove. When possible, it is better to soak the plates in a caustic bath at 180°F to 200°F for 12 to 24 hours. This will help remove the adhesive and any oils and grease from plates. The gasket grooves will need to be wiped out with a good solvent before applying new adhesive.
2. Before applying the adhesive, determine the areas of the gasket groove that need to be bonded. You may use one of the last plates to be reworked or one not requiring rework for a pattern to determine the proper way the new adhesive and gasket should be applied. Two pieces of plywood slightly larger than the plates being reworked will be needed (approximately 1/2" thick). These pieces of plywood will be used to "sandwich" the regasketed plates. As the new gaskets are applied to the plates, they will be placed between the pieces of plywood for curing. Your pattern plate or another plate not requiring rework should always be the top or cover plate on the stack of freshly regasketed plates. Additional weight will also be necessary on the top piece of plywood to assure good adhesion. (See "C" below for more details on the amount of added weight necessary.) A large, clean, flat area is required for regasketing plates. Lay each clean gasket out flat prior to placing it on the plate. You will find this process makes it easier to properly install the gasket on the plate. Also, regasket only four or five plates at a time; then place them between the weighted pieces of plywood. By doing this, any excess adhesive will be forced out of the bottom of the groove before it begins to cure.

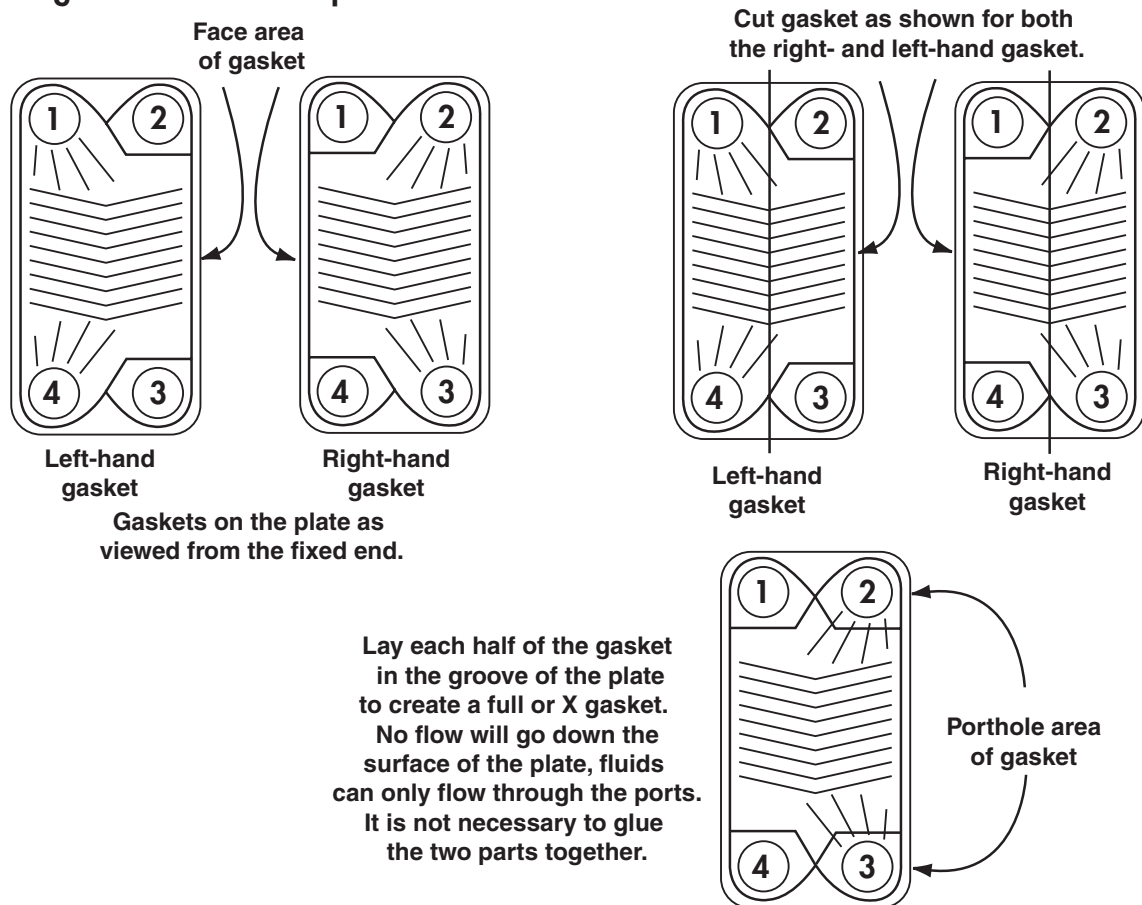
**NOTE:** This process is very important as excess cured adhesive in the bottom of the groove will cause damage to the plate pack and/or leakage when the plate pack is tightened in the frame.

- Apply the adhesive in the gasket groove using  $\frac{1}{16}$ " to  $\frac{1}{8}$ " bead of new adhesive; then smooth the adhesive out with finger or tool to help ensure an even layer of adhesive between the plate and gasket. Using fingertip pressure, make certain all areas of the gasket fit into the gasket groove (pay special attention to the port areas of the gasket). Then move the completed plates under the weighted plywood.

**NOTE:** Do not allow the adhesive to dry or skin over before applying the gasket. The amount of weight required for a specific plate pack will vary with the size and number of plates. A typical AT4 plate pack requires about 50 pounds and a typical AT130 plate pack may require as much as 1,500 pounds to achieve good gasket adhesion. If you are in doubt, contact the Paul Mueller Company service department for a recommended weight. There is no need to apply any adhesive to the gasket itself before applying it to the plate. Press the gasket into the gasket groove by hand and wipe off any excess adhesive with a cloth. If excess adhesive appears repeatedly, reduce the amount of adhesive being used.

- If a quantity of plates are to be regasketed, stack plates one on top of the other in a left-hand/right-hand manner to help compress the gaskets and adhesive evenly under the weighted plywood. Allow a four-hour setup time for immediate use or 24 hours for a full cure under typical room temperatures.
- When reinstalling the plates in unit, be sure to follow the flow chart to ensure the correct flow and thermal length. Make sure that the first plate has a full gasket on it. This means that there should be a gasket in all gasket grooves and that the porthole areas should have ring gasket or port gasket cut from standard gasket. This holds true for all units (see Figure 12). This ring at the nozzle's location prevents fluids from flowing against the frame, and the ring at non-port locations acts as support for the gasket groove channel. All gaskets should face toward the fixed end frame except AT161FF units which face movable end frame.

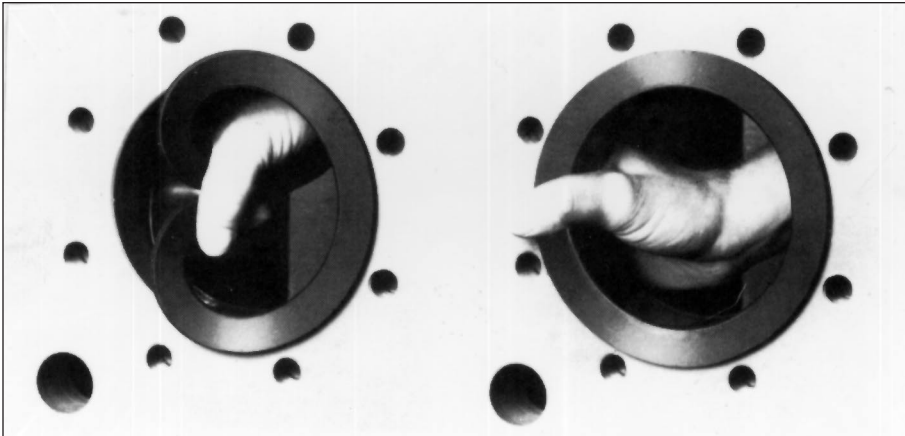
**Figure 12 - Gasket Replacement**



## 2.16 Elastomeric Port-Liner Replacement

On an Accu-Therm with elastomeric port liners, it is possible to change the port liners. When this is necessary, the worn liner can be removed with a flat-blade screwdriver or similar tool. The replacement port liner can then be installed. Care should be taken to prevent tearing or puncturing the replacement port liner during installation (see Figure 13).

**Figure 13 - Elastomeric Port-Liner Replacement**



## 2.17 Gasket Storage

The following procedures should be observed for properly storing elastomeric gaskets:

1. Gaskets should be stored loosely in a manner which will not crease them.
2. Sealed plastic bags are recommended for storage containers.
3. Keep gaskets out of direct sunlight.
4. Gasket storage areas should not be located near motors, welders, or other sources of ozone.
5. Storage temperatures should be within the 60°F to 90°F range. Low temperatures may cause crystallization in some elastomers.
6. Gaskets should be used on a first-in, first-out basis.
7. Store all gasket materials separately to ensure proper gasket replacement and fluid compatibility when changing.



## SECTION 3.0 - INSTALLATION

### 3.0 Installation

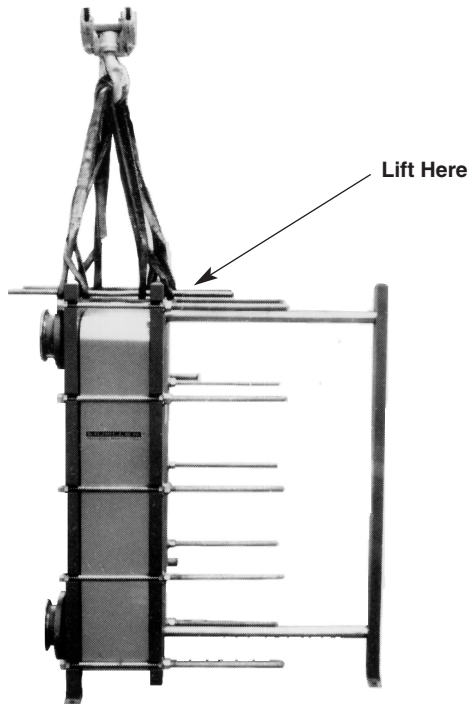
All units should be installed level and with ample room to allow for opening with wrenches and to add or remove heat exchanger plates. For maintenance of the plate pack, allow a space equal to the width of the exchanger on the right-hand side as you face the exchanger. This will permit removal and installation of the plates or plate pack. Adequate room for piping should also be allowed. Piping supports should be provided, especially with designs like the loose-flange, lap-joint type, as these nozzles can take no pipe or stress loadings. Flexible piping should be utilized where units are subjected to vibration or coupled to pumps, and pumps should always be located a minimum of six pipe diameters from nozzle connections. Piping, valving, pumps, and controls must be designed and installed so that the heat exchanger will never be subjected to a negative pressure (vacuum). Vacuum on a standard-design plate heat exchanger will cause plate and gasket damage and result in leakage. Necessary pressure-relief and vacuum-breaker valves must be a part of every installation. Some Accu-Therm units can be used in a vacuum application but these units are of special design. Units may or may not be grouted to foundations depending upon customer preference.

### 3.1 Lifting Instructions (for Skid-Mounted Units)

The Accu-Therm is shipped mounted to a skid in a vertical position. It must not be laid down. The skid may be lifted by a fork lift or crane of sufficient capacity, or the Accu-Therm may be lifted by cables attached to the fixed and movable frame. Two rods of sufficient strength to support the plate heat exchanger may be slipped through the two lift holes at the top of the frame and sling loops placed over these rods, or standard anchor or chain shackles may be placed in the lift holes at the top of the frame. Usual good rigging practices must be observed when lifting an Accu-Therm as when lifting any heavy piece of equipment.

**NOTE:** Never lift an Accu-Therm by the nozzle connections (see Figure 14).

**Figure 14 - Lifting Instructions for Skid-Mounted Units**



## 3.2 Piping

Piping practices must be used that will create a no-load connection at the Accu-Therm nozzle. If the nozzle connection is subjected to load forces, bending movements, or vibration, leaks could result. Standard, good pipe-fitting practices must be used. These practices are standard with industry and as such will not be addressed in detail in these instructions.

All piping must be flushed clean prior to attaching the heat exchanger. The exchanger performance will be restricted by any contaminants left in the piping.

**NOTE:** Pipes should not be permanently installed in the opening space between the movable rear plate and the rear support beam. Connections to the movable plate should be provided with detachable pipe bends at the side or pointed upward so that opening the unit is not impeded by the permanently fitted pipe.

## 3.3 Start-Up

During initial start-up, both fluids should be admitted into the unit simultaneously and slowly. Be sure that all air is bled out of the heat exchanger to avoid pressure shock. Unit should be observed for leaks. If leaking, remove all pressure within unit and tighten "A" to a shorter dimension. Refer to data plate on the plate heat exchanger for "A" dimension. Plate-pack tightening should follow the sequence described on the following page. The plate pack must never be tightened beyond the "A" minimum dimension. If it is, the plates may be damaged to an extent that they will no longer be suitable for use.

Air-vent valves should be installed in the piping as required to eliminate trapped air from the Accu-Therm. Surges (pressure spikes) of fluids due to quick-action valves should be avoided. Piston-type pumps should be fitted with dampers. Some applications require a special start-up procedure.

## 3.4 Plate-Pack Assembly and Tightening Sequence

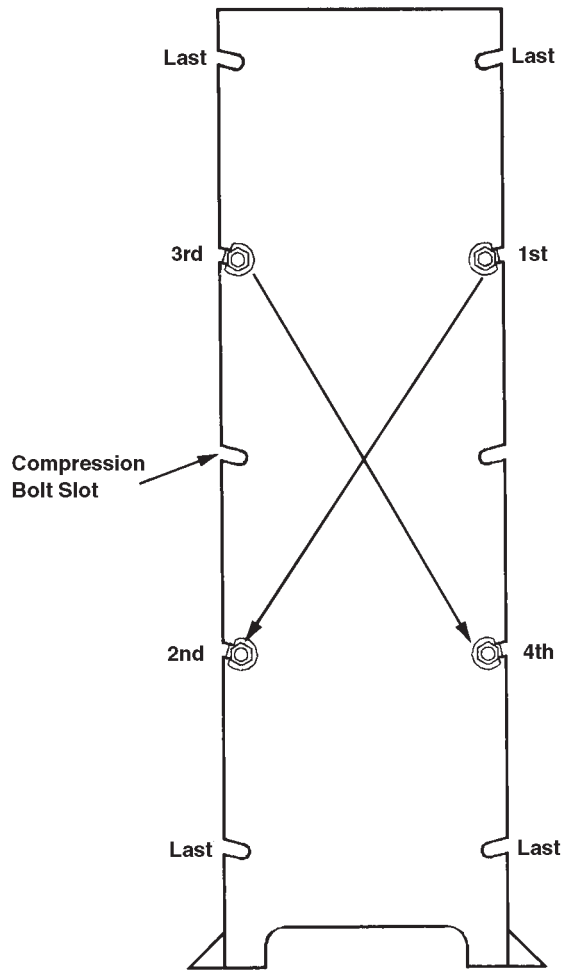
Plates are supported by the upper and lower guide rails and installed by tilting the plate and then rotating it until it is parallel to the stationary frame. Starting at the fixed end, install the plates in sequential order (follow flow diagram), making sure that the plates nest together properly. After all plates are installed, the movable end frame is moved by hand against the plate pack. Two pairs of compression bolts are inserted into frame bolt slots, one pair two slots from the top and one pair two slots from the bottom (see Figure 15).

These bolts are then tightened small amounts each in a diagonal pattern until the "A" maximum dimension is reached (see Figure 15 below and Figure 2A on page 2). The remaining bolts should be added during the tightening process. This helps maintain parallel positioning of the fixed and movable frames and makes final tightening easier. The unit should be tightened to a final dimension less than the "A" maximum but never less than the "A" minimum dimension. At this point, the plate heat exchanger should be hydrostatically tested. If further tightening of the unit is required, all internal pressure must be relieved.

The plate pack may be tightened in the same manner, using care to maintain parallel positioning of the fixed and movable end frames and being sure that the plate pack is never tightened tighter than the "A" minimum dimension. If a seal cannot be attained by tightening the plate pack to the "A" minimum dimension, the plate heat exchanger should be relieved of all internal pressures and cooled to below 100°F before being opened for inspection.

**NOTE:** After unit is run at elevated temperatures for a period of time and then allowed to cool, gaskets may harden. Hardened gaskets may leak when cold. This problem can normally be alleviated by gradually bringing the hot side back up to normal operating temperatures. One of the best ways to do this is by circulating warm water through the unit and continually increasing its temperature. As the temperature of the gaskets rise, they will tend to soften and reseal. Leaks should diminish and finally end as the original operating temperature is reached.

**Figure 15 - Plate-Pack Assembly and Tightening Sequence**



### **3.5 Precautions During Start-Up**

During start-up and operation, avoid pressure spikes. Locate all shut-off valves on the inlet connections; do not use rapid-closing valves. If unit is to be mounted above a process tank and pump, provide with a check valve to avoid water hammer upon starting with drained piping.

**NOTICE: The designs and specifications in this manual are subject to change without notice.**

## SECTION 4.0 - MAINTENANCE

### 4.1 Unit Shutdown

Cool the unit to below 100°F and drain it of all fluid. If unit is to remain unused for long periods of time, the plate pack should be loosened until all compression pressure is off the gaskets. Shrouds should be left on units during operation and storage to prevent particles which may collect on the plates from dropping onto gaskets upon opening.

### 4.2 Unit Disassembly

Using all of the compression bolts, begin to loosen each bolt (in a diagonal pattern) one turn at a time until any trapped fluid drains from the unit. Remove the bottom set of bolts and proceed to loosen the remaining bolts until the unit is completely uncompressed. At this time, the movable end frame is manually moved toward the rear.



**CAUTION: To avoid injury to workers or damage to plates, exercise care when removing compression bolts, rolling the movable end frame, or unloading plates to prevent plates from falling from the unit.**

### 4.3 Removal of Plates

Plates may be removed by tilting the bottom of the plate toward the movable end until it clears the lower guide bar and then rotating the plate until it disengages the upper guide rail. Gloves should be worn for this procedure, and enough hand support should be used to prevent dropping of the plate. Care should be taken to prevent damage to gaskets with plate edges. When plates are removed, stack them on a clean, flat surface to prevent iron particles or dirt from being embedded in gasket surfaces.

**NOTE:** After unit has been exposed to elevated temperatures for a period of time, gaskets may tend to adhere to the adjacent plate. This condition will be apparent when the unit is opened for servicing. If this occurs and servicing requires that the seal be broken, the plates which are adhered should be carefully pried apart using a putty knife, straight-edge screwdriver blade, or similar thin, flat device. Each time a unit is opened, there is a chance for gasket damage to occur; therefore, the number of times a unit is opened should be held to a practical minimum.

### 4.4 Replacing Plates

When replacing plates with spares in stock, simply remove and replace the old plate with one of the same size, porthole configurations, and gasket material. If no spares are available, a damaged plate punched 1-2-3-4 may be removed along with an adjacent plate that is similarly punched. This will only slightly, if even noticeably, reduce overall heat transfer of the unit. If this method is used, reduce the "A" dimension by the multiplier stamped on data plate times number of plates removed.

### 4.5 Replacement Plate and Gasket Ordering

When ordering replacement parts, include the unit serial number, part number, and quantity of parts to be ordered. This information is permanently attached to the fixed end frame.

## 4.6 Back Flushing

As Accu-Therm units contain many contact points to withstand pressure differentials, particulates and especially fibers can build up at this point. This problem can be greatly reduced and sometimes eliminated by simply reversing the flow on the fouled side. In some applications, the flows can be simultaneously reversed on the hot and cold sides thus preserving true counterflow heat transfer. This allows continuous process operation while simultaneously cleaning the unit.

## 4.7 Manual Cleaning Instructions

Plates may be individually cleaned while still hanging in the unit or when removed. A high-pressure water wand may be used as long as the steam is “not” directed at or under a plate gasket.

**Iron particles embedded in stainless steel plates will accelerate rusting and corrosion. It is recommended that a fiber bristle or wire brush of the same alloy as the plates be used to clean plates.**

## 4.8 Frame Maintenance

Painted steel frames should be touched up or repainted as necessary to prevent rusting. A coating of suitable lubricant should be kept on the thread-use area of the frame compression bolts, the upper and lower guide rails, and any bearing surfaces to facilitate ease of opening and closing the Accu-Therm when maintenance is required.

## 4.9 Storage Procedures

The following steps should be taken with units that are to be in storage three months or longer:

1. Completely drain the unit.
2. Loosen compression bolts until they are no longer under tension.
3. Place gasketed blind flanges on all nozzles and plug all other openings.
4. Leave shroud in place.
5. Store unit in a location that is above freezing. Extremely low temperatures can alter gasket properties by elastomeric crystallization.
6. Coat bolt threads and unpainted carbon steel parts with light grease or oil.
7. Store unit away from electric motors and welding areas, as high levels of ozone are very destructive to gaskets.

## 4.10 Corrosive Media and Their Potency

The corrosion resistance of a piece of equipment is dependent not only on the selection of the most suitable alloy but also upon the correct treatment of the material during welding, cold working, and subsequent mechanical and chemical treatments of the surface.

Even with ideal selection and proper handling of plate materials, chemical resistance is not assured. Under certain conditions, an alloy may react with its environment causing a measurable change in the material which can lead to corrosion damage.

The objective of this section is to inform the equipment operator of the limitations of chemical cleaning and sterilizing agents in order to avoid localized spot and crevice corrosion.

The main cause of crevice and spot corrosion of stainless steel is the absorption of chloride ions into the passive area of the steel. Chloride ions gain access to plate surfaces by:

- ▲ Product contact
- ▲ Process water
- ▲ Cooling media
- ▲ Detergents and sterilizing agents

The corrosive action of chloride ions is enhanced by:

- ▲ Concentration
- ▲ Duration
- ▲ Temperature
- ▲ Pressure
- ▲ Reduced pH values
- ▲ Positive-drop redox potential

The effect of the above factors below a critical level can rarely be determined on a microscale. With concentration and local reductions of the pH value in crevices, local overheating with the buildup of lime deposits, etc., it is essential that all gaskets are properly seated and glued and that a provision is made to thoroughly rinse the equipment so that penetration of the cleaning solutions behind the gaskets cannot occur.

- ▲ Above a critical level, which is detectable with a test electrode, the passivity of the steel breaks down and local spot corrosion occurs.
- ▲ Redox potential means the equilibrium potential in an electrolytic reaction when ion migration occurs in a conductive media.

**NOTE:** Warranty does not cover corrosion of plates.

## 4.11 Clean-In-Place (CIP) Systems

Clean-in-place systems have come into broad use due to a number of advantages:

- ▲ Timesaving
- ▲ Cost savings resulting from the use of less chemical solution
- ▲ Elimination of unit openings on hazardous duties, etc.

## 4.12 Detergents and Sterilizing Agents

The corrosive action of detergents and sterilizing agents is mainly attributable to the action of chloride ions and can be avoided if the materials are used in the proper manner. Besides the detergents and sterilizers, a major source of chloride ions may be the water used to dilute concentrates of the above.

In order to avoid corrosion, it is suggested that the following concentrations, temperatures, and duration not be exceeded. Because of the nature of cleaning solutions used in CIP systems and the fact that they are used solely under the customer's control, the following procedures are offered as guidelines with no liability passing onto Paul Mueller Company as a result of their use. Supplier's recommendations and instructions should be followed closely.

1. Cleaning with a caustic-based detergent:

Concentration:	Up to 5 percent
Temperature:	Up to 185°F

Contact time may be maintained for as long as three hours with a chloride content as high as 500 ppm, as alkaline solutions tend to inhibit corrosion caused by chlorides. Surface discoloration may occur, but this does not indicate corrosion.

2. Combined detergent and sterilizer (based upon sodium hydroxide and sodium hypochlorite): It is essential that a pH of 11 is maintained during the cleaning phase when using this mixture.

Concentration:	Up to 5 percent
Temperature:	Up to 160°F

Due to the rapid degradation of the hypochlorite, the upper-limit contact time of one hour is very critical. Continually monitor the cleaning process and discontinue as soon as plates are clean.

3. Acid cleaning based on phosphoric and/or nitric acid:

Concentration:	Up to 5 percent
Temperature:	Up to 195°F
Duration:	Up to 1 hour

Nitrate ions only inhibit chloride ions when used in high concentrations. Care must be taken, however, in maintaining the flooding of the unit during the cleaning phase, as nascent hydrochloric-acid gas above the liquid level can cause corrosion.

4. Sterilization using sodium hypochlorite:

Concentration:	Up to 300-ppm active chlorine
Temperature:	Up to 70°F, 2 hours maximum
Duration:	Up to 140°F, 30 minutes maximum

5. Sterilization using acetic acid: The corrosive action is determined by the chloride content of the diluting water which is 300 ppm maximum.

1. Cold sterilizing:

Concentration (volume):	Up to .15 percent*
Temperature:	Up to 70°F
Duration:	Up to 24 hours

2. Hot sterilizing:

Concentration (volume):	Up to .0075 percent*
Temperature:	Up to 195°F
Duration:	Up to 30 minutes

*\*100% acetic acid.*

6. Sterilization using iodophor: For use with dilution water with up to 300-ppm chlorides:

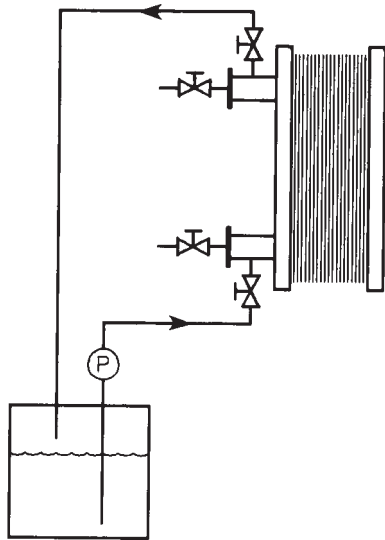
Concentration: 50 ppm

Temperature: 85°F

Final rinsing with cold water should follow all CIP procedures and be continued until all detergent or sterilant residues have been removed. The unit may now be drained of rinse water and put back into service.

Most CIP systems utilize inexpensive plastic pumps for cleaning. These pumps are generally of a capacity much less than the process pumps. For this reason, it is extremely important to pump cleaning solution in a bottom-to-top flow so as to totally flood the unit. In multiple-pass units, it will be necessary to pump the solution through one nozzle for half the time and then to reverse the flow for the remainder. This will guarantee the wetting of all plate surfaces by the cleaning solution (see Figure 16).

**Figure 16 - Cleaning Solution Flow**



### 4.13 Precautions

Cleaners using a hydrochloric or hydrofluoric-acid base, including inhibited grades, may never be used. Avoid the use of an acid cleaner after using a detergent which may contain active chlorine compounds, as hydrochloric acid may be produced as a result of interaction left in crevices and behind gaskets. This promotes rapid crevice corrosion in these areas. When using nitric and phosphoric acids, caustic soda, or hypochlorite solutions in the food industry, these should be approved food-grade compounds. Manufacturer's recommendations for the storage and use of proprietary compounds should be followed closely. Care must be taken when using these products as many are hazardous.



## SECTION 5.0 - TROUBLESHOOTING

### 5.1 Excessive Temperatures

The normal maximum operating temperature for a plate heat exchanger is approximately 150°F. Higher temperatures may be reached with special gasket and adhesive materials. Operating any plate heat exchanger at temperatures above the design temperature of the gasket material will result in accelerated gasket and adhesive failure. Excessive temperature gasket failures are indicated by a hard, shiny-surfaced gasket face. Quite often, these gaskets are so brittle they can be crumbled with the fingers. Points to look for are:

- ▲ Excessive hot-side fluid or steam temperatures
- ▲ Unit being operated under conditions for which it was not designed
- ▲ Superheated steam
- ▲ Cold fluid stoppage on units operating at upper gasket temperatures

Corrective measures should include checking for excessive operating temperatures and lowering where needed or replacing with higher temperature gaskets. If the unit is being used for services other than those for which it was designed, the necessary adjustments or gasket replacement should be done to ensure gasket compatibility with the operating temperature.

Quite often high pressure steam is put through a reducing station without going through a de-superheater. The steam is now at a lower pressure while still retaining much of its previous high-pressure temperature. This, of course, has a very detrimental effect upon gaskets and greatly reduces the overall performance of the heat exchanger because of the decreased availability of latent heat while steam is in the superheated state.

Plates and gaskets will generally be at a temperature between the hot and cold fluids. Intermittent cold-flow conditions can cause problems in units operating at borderline temperature conditions. As the cold flow is interrupted, the unit will begin to come up to the temperature of the hot fluid and damage gaskets if upper temperatures are exceeded. This can be alleviated by ensuring a constant cold-side flow or by throttling down the hot side during flow interruption.

### 5.2 Excessive Pressure and Spikes

The normal maximum operating pressure for a plate heat exchanger is 150 psig for ASME®-code units and 100 psig for non-code units. ASME units require ASME relief devices per UG-125 of ASME Code, Section VIII, Div. I, Preventing Excessive Pressure. However, plate heat exchangers which can operate at pressures up to 300 psig or more are available.

Operating a plate heat exchanger above its design pressure will result in gasket sealing problems. These problems vary depending on the type of plate being used but are most often indicated by protruding gaskets which will extrude between plates and be visible on the perimeter of the plate pack. Leakage may or may not be present; but in either case, steps must be taken to correct the situation. Excessive pressure must be reduced to limits within the design pressure of the unit. All regulating and throttling valves are to be placed on the inlet sides of the exchanger. Excessive lengths of piping being stopped by valves on nozzle outlets can cause tremendous pressure on gaskets, and this is to be avoided at all times.

Pressure spikes can also cause extremely high pressures. Some of the causes are totally closed systems without allowances for expansion, booster-pump start-up, and rapid-acting control valves. When these conditions exist, they should be handled with vented closed systems, slow-acting control valves, and accumulators whenever possible.

Negative pressure (vacuum) on a standard-design plate heat exchanger may also result in gasket leakage problems. A plate heat exchanger must never be subjected to vacuum (unless designed for vacuum application) during normal operations or during start-up and shut-down procedures.

### 5.3 Fluid Incompatibility

This is evidenced by swelling of gaskets upon unit opening, tacky or liquid surface to gaskets, and gaskets falling off plates. Advice should be obtained from factory personnel whenever these conditions are encountered. Quite often, minute quantities of tramp contaminants in the fluid can have a large effect upon some elastomers. Fluid sample testing and gasket coupon testing of various elastomers in the customer's process fluid can determine the proper compound to use. In extremely difficult cases, a dual-gasketing system using two different gasket materials on the fluids may solve the problem.

### 5.4 Leak Detection and Elimination

Because of vented area between portholes and plate faces, barring corrosion completely through plates, fluids cannot cross within the Accu-therm unit. If any leakage does occur, it will be to the outside of the unit and observed as a puddle.

If a unit happens to start leaking, check operating temperatures, pressures, and the "A" dimensions. When pressures and/or temperatures are in excess of design conditions, take measures to correct them and restart the unit. If the above are within design conditions, allow the unit to cool to ambient temperature and relieve the pressure on all fluid circuits within the unit. At this time, begin tightening the compression bolts in the prescribed manner but do not go below the "A" dimension. If the unit still continues to leak, it may contain damaged or worn-out gaskets. Open the unit and individually examine gaskets for particulates or damage and wear. Remove those gaskets which appear to be bad and replace with new gaskets.

If there appears to be a problem with fluid crossing—that is, internal leakage—this indicates a condition that has been favorable for corrosion, causing pinholes through the plates. The damaged plate or plates may be located by two methods for single-pass units:

1. Unit is shut down and all pressure within it is relieved. The piping on one side of the unit is now removed to allow viewing of the portholes for the length of the plate pack. At this time, pressure is again turned on to the piped side, and leakage may be observed by shining a flashlight into the porthole to view and locate the leak.
2. With multiple-pass units, the above procedure will only allow partial viewing of the plate pack because of the non-punched portholes in some locations. In this case, the unit is opened and all plates are either wiped dry or allowed to air dry. The compression bolts are then replaced, and the unit is retightened to the "A" minimum dimension. One side only is now pressurized for approximately 15 minutes. Pressure is then relieved and the unit is now reopened. Carefully separate the plates one at a time, going from movable frame to fixed frame. It will be noticed that every other flow channel is wet with a dry channel in between. When you find two adjacent wet channels, you have located the bad plate. It will be one of the two plates in the center.

Once the suspected leaking plate is located, you may confirm with visual inspection or dye-penetrant techniques.

If the plate at fault is punched 1-2-3-4, the unit may be rapidly put back on line by removing an adjacent plate with the same punching. Heat transfer will be reduced only to a minor extent. If this punching arrangement is other than above, you will have to remove and replace the faulty plate(s) before restart. Always reduce the "A" dimension when removing plates by the thickness of the gasketed plates. The amount of reduction in the "A" dimension necessary for each plate removed may be obtained by using the multiplier shown on the data plate.

## 5.5 Pipe Loading

Accu-Therm offers a variety of port arrangements to suit customer requirements. The alloy-clad studded port is offered as standard with elastomeric liners, and ANSI lap-joint loose flange connections offered as alternates. The loose flange connection cannot withstand external loading, and all piping must be supported and preferably connected to the unit with flexible connections. While it is always considered good engineering practice to support all piping, the clad and lined ports can take considerably more load as the frame takes the support rather than a nozzle.

In all port configurations, pumps should be mounted a minimum of six pipe diameters from nozzle flanges.

## 5.6 Assistance and Field Service

Paul Mueller Company maintains a large in-house group of highly specialized engineering and service personnel to deal with questions and problems related to Accu-Therm. These groups are at your disposal at all times to help with and answer questions pertaining to:

- ▲ Design
- ▲ Gasket Compatibility
- ▲ Maintenance
- ▲ Engineering
- ▲ Plate Compatibility
- ▲ Field Service
- ▲ Systems
- ▲ Installation
- ▲ Applications
- ▲ Operation
- ▲ In-House Servicing and Regasketing

If you have questions pertaining to the above or have a request for quotation, contact the Mueller Service Department, Paul Mueller Company, P.O. Box 828, Springfield, Missouri 65801-0828. Call 1-800-MUELLER (1-800-683-5537) or fax 417-831-6642.

## **SECTION 6.0 - ACCU-THERM FACTORY REFURBISHING PROGRAM**

Paul Mueller Company offers a variety of service levels to keep your Accu-Therm unit operating at peak performance.

### **6.1 Loose Plates Only (not a pack)**

1. Clean, dye penetrant leak check, and install gasket.

**NOTE:** Loose plates and gaskets are warranted for materials and workmanship only.

### **6.2 Complete Plate Packs Only (not a unit)**

1. Clean, dye penetrant leak check, and install gaskets.
2. Clean, dye penetrant leak check, install gaskets, and assemble into plate pack.
3. Clean, install gaskets, assemble into plate pack, and pressure test (in PMC test frame).

**NOTE:** Plate packs that are tested in PMC test frame are warranted for 60 days from the date of shipment. Plate packs not tested are warranted for materials and workmanship only.

### **6.3 Complete Units**

Clean, install gaskets, assemble into plate pack, and pressure test. Blast and repaint frame, replace or repair ports and other parts as applicable. Frame labor for touch-up work only will be on a time and material basis. Maximum (not to exceed) values can be established prior to start of any work.

**NOTE:** Refurbished complete units are warranted for a period of one year from the date of shipment.

### **6.4 Notes**

1. Some tinting may remain on certain plates after cleaning, depending upon their type and length of service. This tinting does not impact the heat transfer performance of the plate.
2. No surface deposits or fouling will remain on the finished, cleaned plate.
3. Gaskets that are removed from plates for cleaning will not be reused or returned unless specifically arranged prior to order.
4. Components that are replaced on a complete unit will not be returned to the customer unless specifically arranged prior to order.
5. All items to be returned for refurbishing must first be approved in writing by PMC. An MSDS (Material Safety Data Sheet) must be submitted prior to consideration for approval. Tagging information will be provided by PMC upon approval.
6. A Certificate of Cleanliness must accompany all shipments.

**Contact the factory for your refurbishing needs.**

## SECTION 7.0 - SUPPLEMENTS

### 7.1 Gaskets for the Multipass Accu-Therm

Gore-Tex® joint sealant is now used on many industrial Accu-Therm plate heat exchangers in place of the conventional rubber port ring gasket. This composition of TFE fluorocarbon material meets or exceeds the stringent requirements of industrial plate-and-frame applications.

**Specifications and characteristics:**

**Size:** 1/4 inch (Mueller Part No. 9813259) or 1/2 inch (Mueller Part No. 9813260)

**Temperature range:** -450°F to 600°F

**Pressure rating:** 3,000 psi

**Application:** Compatible with corrosive chemicals, food, beverage, steam, pharmaceutical, and dairy products.

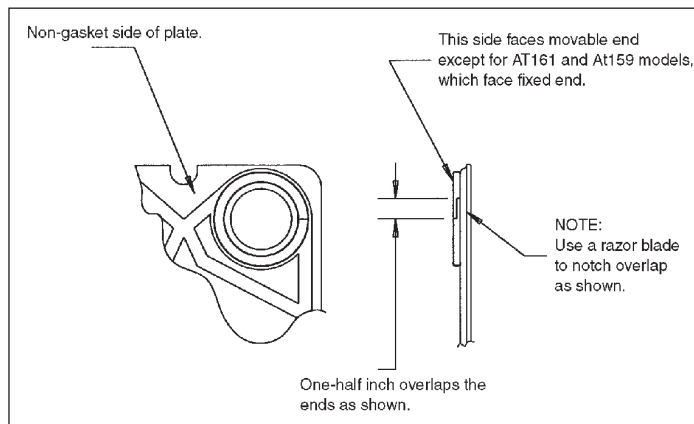
**FDA-approved.**

**No age deterioration.**

**Easy installation:** Soft, pliable texture which conforms to proper configuration with a self-adhesive strip. The ends are overlapped to complete the gasket. See drawing for details.

**Gore-Tex joint sealant:** Normally used on the last plate against the movable end plate. It may be used on divider plates within the plate pack. Gore-Tex joint sealant is a one-time gasket. It should be replaced if the plate pack is opened for any reason. Ports with rubber boots do not require Gore-Tex.

**Figure 17 - Gore-Tex Installation**



**Table 3 - Gasket Material Required Per Port**

PHE Model	Port Size (in)	Gore-Tex per Port (in)
AT4	1	7 <sup>1</sup> / <sub>4</sub>
AT10	2	9 <sup>1</sup> / <sub>4</sub>
AT20	2 <sup>1</sup> / <sub>2</sub>	13 <sup>1</sup> / <sub>4</sub>
AT402	4	18 <sup>1</sup> / <sub>4</sub>
AT405	4	18 <sup>1</sup> / <sub>4</sub>
AT40	4	18 <sup>1</sup> / <sub>4</sub>
AT805	6	26 <sup>1</sup> / <sub>2</sub>
AT80	6	26 <sup>1</sup> / <sub>2</sub>
AT1306	10	41 <sup>1</sup> / <sub>2</sub>
AT1309	10	41 <sup>1</sup> / <sub>2</sub>
AT130	10	41 <sup>1</sup> / <sub>2</sub>
AT180	14	54 <sup>1</sup> / <sub>2</sub>
AT161FF	3	13 <sup>1</sup> / <sub>4</sub>
AT184FF	6	23 <sup>1</sup> / <sub>2</sub>

**NOTES:**

1. Gore-Tex joint sealant should be used on all plates that seal against the movable (fixed for AT161FF and AT159FF) divider plate or terminals with its non-gasket side.
2. Clean both sealing surfaces of dirt and scale.
3. Remove the tape backing from the adhesive strip on Gore-Tex joint sealant with the adhesive side down on the center line of the sealing area as shown in detail.

## 7.2 Removal of Alignment Tabs on Replacement Plate Packs

Most production Accu-Therm plates have alignment tabs which help align the plate pack and prevent the plates from shifting. The tabs project beyond the gasket face and cause a sealing problem on the first plate as it tries to seal against the fixed end frame of the exchanger. The tabs are generally located near the ports, either on the outside edge or on the top and bottom center of the plate. These tabs must be removed on the first plate, or the fixed end frame must be countersunk to accommodate the tab projection beyond the gasket face.

Recent production plate heat exchangers have this modification made in the factory. Replacement plates used in existing frames need to be modified prior to installation.

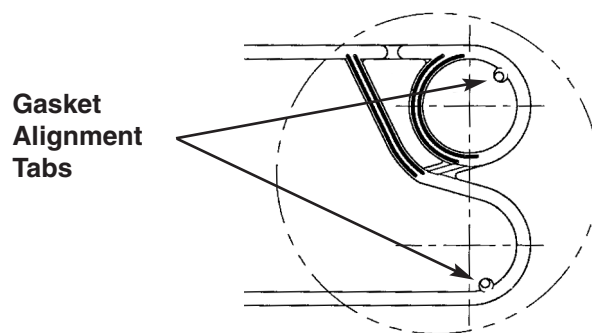
To accomplish this modification, locate the alignment tabs and grind them flush with the other high points on the plates. The tabs are always located in an area which is external to the gasketed surfaces. Grinding will not cause a leak between plates. Most model Accu-Therm plates have external tabs around the perimeter of the plate. The tabs are generally located across from the ports, as with the Model AT4 plate. Some models have “bent” locking tabs which are approximately 1" by 1" and are located in the top and bottom center of the plate. The tabs project forward to lock with the plates in front. For this alignment tab, the first 3-4 plates must have the tabs removed because the projection is more than one plate deep. Earlier design Model AT40FF and AT130 have these bent tabs for alignment.

Many Accu-Therms have been produced with countersunk end frames to accommodate the alignment tabs, so always check the frame before grinding the plates. Rarely will Models AT20, AT40, and AT80 have countersunk frames. We now remove alignment tabs from first plate.

Gaskets have similar tab projections which are designed to interlock the plates. These gasket tabs project beyond the normal gasket surface and must be cut off the first gasket only. Some gaskets also have an embossment or irregularity on the front face and this too must be removed. A razor blade is used to trim the gaskets. Please see Figure 18, “Gasket Detail for Model AT4” which illustrates the tabs and their location.

When divider plates are used within a plate pack, the tabs must be removed on the plate and gasket which seal against the divider plate in the same manner used for the end frame.

**Figure 18 - Gasket Detail for Model AT-4**



## GLOSSARY

- “A” Dimension**—The inside measurement between the fixed end frame and the movable end frame. The plate pack is compressed to this dimension to seal from leaks. If plates are added or removed from the heat exchanger the “A” dimension must be recalculated.
- “A” Maximum**—Typically the largest “A” dimension that will prevent leaks from the heat exchanger.
- “A” Minimum**—The smallest “A” dimension that will prevent leaks from the heat exchanger. This dimension must never be exceeded or plate damage is probable.
- Adhesive**—Used to hold the gaskets in place. The adhesive type used depends on gasket material and exchanger design conditions.
- Alignment Tabs**—Small projections stamped into the plate that help align the plate pack and prevent plates from shifting during operation.
- B Frame**—Heavy frame utilizing steel beams for support of large moveable frame and plate pack.
- C Frame**—Compact, cantilever-type frame for use in limited space. Used for the smaller size designs, up to AT405.
- Clamp-Type Ferrule Connection**—A port made by welding a clamp-type ferrule into the appropriate port on the exchanger.
- Compression Bolts**—Bolt and nut assemblies which draw the moveable end frame to the fixed end frame to tighten the plate pack.
- Counterflow**—Fluids flow in the opposite direction in the plate heat exchanger resulting in the greatest effective temperature difference and the least heat transfer area.
- Distribution Area**—Area of the plate between and immediately after the ports that the product or heating and cooling medium contact. The distribution area spreads the media across the full width of the plate.
- Divider Plate**—A heavy plate that does not serve as a heat transfer surface, but only to divide the plate pack into different zones. Typically used when substantially different plate types are used in one plate pack.
- Double-Wall Plate**—Two identical plates nested together and fully welded at the ports, creating a two-layer heat transfer wall. Used to provide product isolation and positive leak detection should failure occur in a plate. Any leaks are then directed to the outside perimeter of the plate.
- Dual Gasket**—When it is necessary to use two gasket materials for fluid compatibility, a dual gasket is used. Each fluid contacts a separate gasket material only. A dual gasket is cut and assembled from two other gaskets of differing composition.
- Expansion**—Mueller frames are designed to accommodate a minimum of 20% increase in plate number beyond the original design.
- F Frame**—Intermediate size frame. Available up to size AT40.
- Fixed End Frame**—A metal plate used along with the moveable end frame to compress the plate pack. The fixed end frame usually contains inlet or outlet ports.
- Flow Diagram**—Describes the flow path of the heating or cooling medium and the product through the exchanger. Included with each new unit shipment and upon request.
- Frame**—The basic supporting structure of the heat exchanger.

**Full Gasket Plate**—A plate with all gasket grooves filled and facing against the fixed frame, moveable frame, or terminal plate.

**Gasket Groove**—Track formed for retaining the gasket when the plate is pressed.

**Gasket**—Gaskets fit into grooves pressed into the plate and provide the seal between adjacent plates. All gaskets are one piece and molded from various elastomers.

**Glued-In Gasket**—Gaskets are glued into place with various adhesives depending on gasket materials and temperature. This provides the ultimate holding power for units that require frequent opening.

**Industrial Frame Design**—Non-food grade design frame.

**Lap-Joint Connection**—A connection formed by a flanged pipe and slip on flange.

**Left-Hand Plate**—When facing the plate with the gasket toward you (except AT402 and AT161FF), if the nongasketed port is on the left side, the plate is called a left-hand plate.

**Lift Holes**—Exchangers that are skid mounted for shipment are provided with lift holes in the fixed and moveable end frames. Accu-Therm plate heat exchangers are not to be lifted by nozzle connections.

**Locked-In Gasket**—A gasket held in the plate gasket groove by mechanical tension.

**Lower Guide Rail**—A locator for plates and the moveable end frame installed at the lower portion of the frame.

**Moveable End Frame**—A metal plate that combines with the fixed end frame to compress the plate pack. The moveable end frame may contain inlet or outlet ports.

**Multipass**—To increase the thermal length required for a process, multiple passes can be formed by not punching plate ports at predetermined locations.

**Non-Punched Plate**—A plate with no ports punched in it.

**Plate Hanger**—A stainless steel formed channel that supports the plates in the frame, installed under the upper guide rail.

**Plate Pack**—The number of plates to be compressed between fixed and moveable end frames.

**Plate Sequence**—Describes the arrangement of plates in an exchanger.

**Plate Type**—Each pressed plate has a unique pattern which creates the heat transfer characteristics for that type:

**F Type**— This plate has a fine, horizontal pattern.

**FF Type**— A Free-Flow heat transfer plate designed to be used in exchangers with fluids containing fibers or particles that can block flow paths in conventional exchangers.

**G Type**— This plate has a fine, vertical pattern.

**H Type**— Horizontal embossing develops higher heat transfer rates and greater pressure drop.

**M Type**— This plate is designed for high heat transfer rates and high-pressure applications.

**P Type**— This plate is designed for high-pressure applications.

**V Type**— Vertical embossing develops lower heat transfer rates and lower pressure drop.



**Plate**—Sheets of various metals pressed between two hardened dies that form a heat transfer surface. Hardened dies prevent uneven thinning of the material. Grooves are pressed into the plates for gaskets and corrugations that create the highly efficient heat transfer surface.

**Port Liner**—Pressed or inserted into studed ports to protect against erosion and corrosion of frame material. These linings are made out of different elastomers, stainless steel, or other alloys.

**Port**—Inlet or outlet connections located on the fixed or moveable frame or terminal plate to allow flow of product and heating or cooling medium. This also refers to the circular punched area of the plate.

**Punched Plate**—A plate that has ports punched in it according to the flow diagram.

**Right-Hand Plate**—When facing the plate with the gasket toward you (except AT402 and AT161FF), if the non-gasketed port is on the right side, the plate is called a right-hand plate.

**Roller Assembly**—Mounted on top of the larger moveable end frames and terminals to facilitate ease of moving.

**Sanitary Frame Design**—Sanitary designed exchangers have stainless steel frames, clamp-type sanitary ferrules, and FDA-approved gaskets.

**Shroud**—A lightweight metal jacket surrounding the plate area of the exchanger. The shroud protects gaskets and plates from accumulation of debris and provides OSHA-approved personnel protection from leaks.

**Single Pass**—The product flows down the length of the plate only once before going into the outlet.

**Studded Port Connection**—A port that accepts a standard ANSI flanged pipe. Standard connection on all but the smallest Accu-Therm unit. All ports can be fully lined for protection of frame and plates.

**Terminal Plate**—Heavy divider plate in plate pack that divides the Accu-Therm into multiple units. Allows fluids to enter or leave the exchanger through special ports oriented perpendicular to the axis of the exchanger.

**Thread One End**—316 stainless steel pipe Threaded on One End. This is one type of connection used on the Accu-Therm unit.

**Tightening Sequence**—The order that compression bolts are tightened until the plate pack is compressed to the “A” dimension.

**Upper Guide Rail**—Supports and guides the plates and the moveable end frame.







# WARRANTY

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## Mueller® Accu-Therm® Plate Heat Exchanger

### General Provisions

Paul Mueller Company (*hereinafter referred to as Company*) warrants to the original purchaser/user (*hereinafter referred to as the Customer*) that all equipment or parts thereof manufactured by it will be free from defects in material and workmanship only, under normal use and service, for a period of one year from the date of original shipment.

The *Company* shall not be liable for any loss of profit, loss by reason of plant shutdown, non-operation or increased cost of operation, loss of product or materials, or other special or consequential loss or damages. This warranty will not apply to any equipment (or parts thereof) which has been subjected to accident, alteration, abuse, or misuse. Misuse may constitute but not be limited to: subjecting the heat exchanger to temperature, pressure, or vacuum beyond the design limitations; compression of the plate pack beyond the minimum dimension; or improper disassembly or assembly by the *Customer*, or uses other than those intended by the *Company*. The *Company* will warrant thermal performance of the unit in conformance with original specifications only, since process changes such as flow rates, temperatures, or media will affect thermal performance. The *Company* cannot warrant against any fouling or plugging for any design. The *Company* will aid in the selection of gasket, plate, and adhesive material but will assume no liability for material compatibility with *Customer's* products or media. The *Company* is not responsible for corrosion or suitability for use of any material in any particular application. The corrosion resistance and suitability for use of a material is dependent on operating environment, and conditions, cleaning, practices, and many other factors beyond the control of the *Company*. The user of this equipment bears total responsibility for corrosion or suitability for use of all materials in their particular application. This warranty is in lieu of all other warranties, expressed or implied, (including the implied warranty of merchantability and fitness) and of all other obligations or liabilities on the part of the *Company*, and the *Company* will neither assume nor authorize any other person to assume for it any other obligation or liability in connection with this equipment.

### Components Not Manufactured By the Company

Components not manufactured by the *Company*, but furnished as part of its equipment (for example: motors, starters, thermometers, controls, etc.), will be warranted by the *Company* only to the extent of the component manufacturer's warranty.

### Return of Parts or Equipment to Company Plant

Permission to return any parts or equipment must be obtained, in writing, and must be returned with transportation costs prepaid. Any used heat-exchanger, plate, or gasket that is being returned must be accompanied by a "Certificate of Use and Cleanliness" (available upon request) and a Manufacturer's Safety Data Sheet similar to OSHA Form 20. In the event that equipment (or parts thereof) manufactured by the *Company* is returned to the *Company* plant, the *Company* obligation will be limited to repairing or replacing parts which, upon examination, are found (to the satisfaction of the *Company*) to be defective in either material or workmanship. No transportation charges will be paid by the *Company* unless written approval for transportation charges is given by the *Company*.

### Visit to Company Plant Before Shipment

When the *Customer* plans to install *Mueller* equipment in a manner (or at such distance from the *Company* plant) that will make it impractical to return it for in-warranty repairs, the *Customer* is encouraged to visit the *Company* plant before shipment to inspect and, when possible, witness testing of the equipment.

### Repair of Equipment Installed in the Continental United States

Should an in-warranty failure occur, and it is, in the judgement of the *Company*, impractical to return the equipment for repairs, the *Company* will arrange for the repairs to be made by its personnel or, at its option, sublet to a qualified company. The *Customer* will be expected to cooperate by making the equipment available and accessible when the work is scheduled and is expected to provide the necessary utilities.

If local labor conditions prohibit such work being done by *Company* personnel under the conditions and at the rates payable by its contracts with its employees, the *Company* obligation shall be limited to supervision of the work, replacement of defective parts, and labor costs in an amount equal to the amount which would be payable for a reasonable number of hours required to make the repairs at the rates payable under the terms of *Company* contracts with its employees. In such an event, all labor costs shall be paid by the *Customer* and the *Company* will reimburse the *Customer* to the extent set forth above.

### Repair of Equipment Installed Outside the Continental United States

Should an in-warranty failure occur, and it is, in the judgement of the *Company*, impractical to return the equipment for repairs, the *Company* obligation shall be limited, and the *Company* shall have the options of either sending a service representative to repair (or supervise the repairs) or granting a reasonable allowance for having the repairs made locally.

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