

## Fabrication

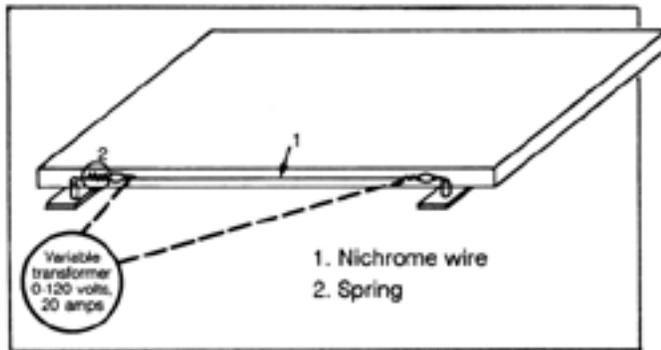
### #7 Line Bending

This brief gives advice for:

- Equipment
- Procedures
- Trouble Shooting
- Equipment Suppliers
- Additional Technical Information & Assistance

#### Equipment

##### Straight Nichrome Resistance Wire Heater



To bend ACRYLITE® FF acrylic sheet up to 1/8" (3mm) thick, the most commonly used piece of equipment is a straight nichrome wire resistance heater. The unit functions similarly to a household electric toaster by passing electricity through a wire.

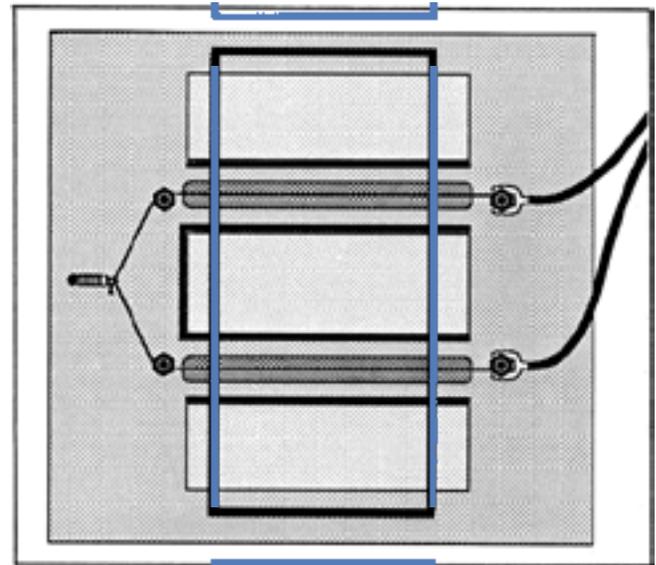
You can bend material thicker than 1/8" (3mm) on this unit, but the material must be flipped over halfway during the heating cycle.

In constructing the heater, use plywood for the base. The top surface should be insulation board or aluminum sheet to provide a smooth surface, helping prevent mark-off marks on the sheet as a result of contact. Aluminum is selected as the metal alternative because it is durable and does not absorb and re-radiate heat.

The heating element is a 17-gauge nichrome (nickel-chrome) wire. Attach the wire to a 120-volt, 20-amp variable transformer. Provide a spring as shown to keep the wire under tension. Allow space around the wire for free air flow to aid heat transfer from the wire to the part. Position the wire so it remains at least 1/8" from the sheet during heating. Ceramic stand-offs are useful in supporting the wire at a consistent height from the base (see last page for source of supply).

**CAUTION:** An unguarded nichrome wire is a burn/shock hazard. Provide a guard to prevent contact with the wire.

##### Modification for Multiple Line Bends

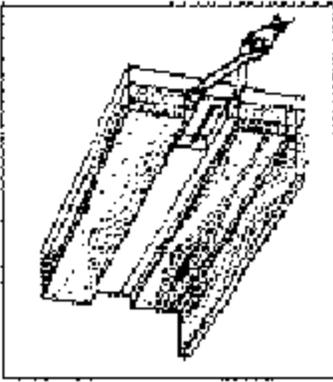


To perform multiple line bends, modify the heater as shown above. Where the wire joins the spring, include an insulation ring. Raise the unit's base so convection air from below flows through slots routed in the base as shown.

##### Coiled Resistance Wire

Coiled resistance wire can be substituted for straight wire as a heating element. Because coiled wire must be supported and because it is difficult to position the coils evenly, temperatures across the sheet's width may vary, causing uneven stresses and distortion. See the following section under *Procedures* entitled *Line Bending with Coiled Resistance Wire*.

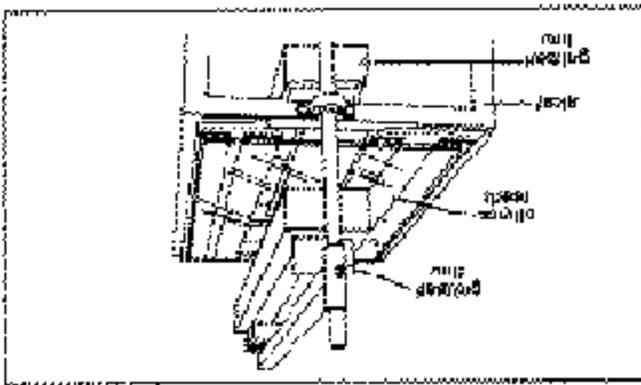
## Tubular Rod Heaters



To heat sheet thicker than 1/8" (3mm), use a tubular-rod heater with a heating rod like the heating element of an electric stove. Power the heater with a variable transformer. Place a reflector, preferably of split aluminum conduit for its good reflectivity,

beneath the rod. For shorter heating cycles, mount heaters above and below the sheet. Use water-cooled supports to avoid marks on the acrylic.

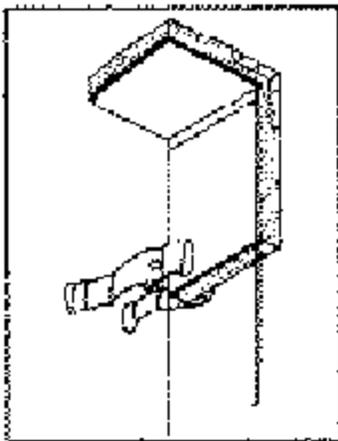
## Radiant Quartz Tube Heaters



Quartz tube heaters are among the most efficient sources of radiant energy. They look like a thin fluorescent light bulb. These units provide capability to bend ACRYLITE FF sheet 1/4" (6mm) thick or greater. The heater consists of a coiled resistance wire housed in a quartz-coated glass tube.

Use a reflector with a quartz tube heater for most efficient heating. For short heating cycles, mount heaters above and below the sheet. Power the heater(s) with a variable transformer.

## Cooling Jigs



Use a cooling jig like the one shown at left to assure that your bend is at the proper angle and to prevent the piece from "springing back" into its original shape. This is an all-purpose jig for 90° bends - you can modify it to suit the part. A cooling jig which exposes both sides of the heated

sheet to air will accelerate cooling and reduce stresses.

## Procedures

**Be sure to follow the manufacturer's safety recommendations for equipment and materials used with ACRYLITE FF sheet.**

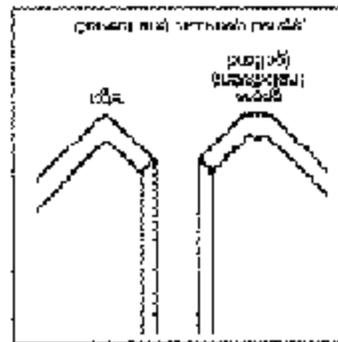
## Bending with a Straight Nichrome Wire Heater



Heat the material until it bends easily. Experience will teach you how long to heat each part. Don't overheat or lay ACRYLITE FF sheet directly on the heating element - doing so will blister and/or mark the sheet.

Bend the heated part to the desired shape and quickly place it in a cooling jig. To retain the bend while you do other work, secure the part in the jig with weights or

clamps. Cooling time normally equals heating time.



When line bending with only one heating element, be sure to bend away from the heated side. For example, if the nichrome wire is on the bottom, bend upwards.

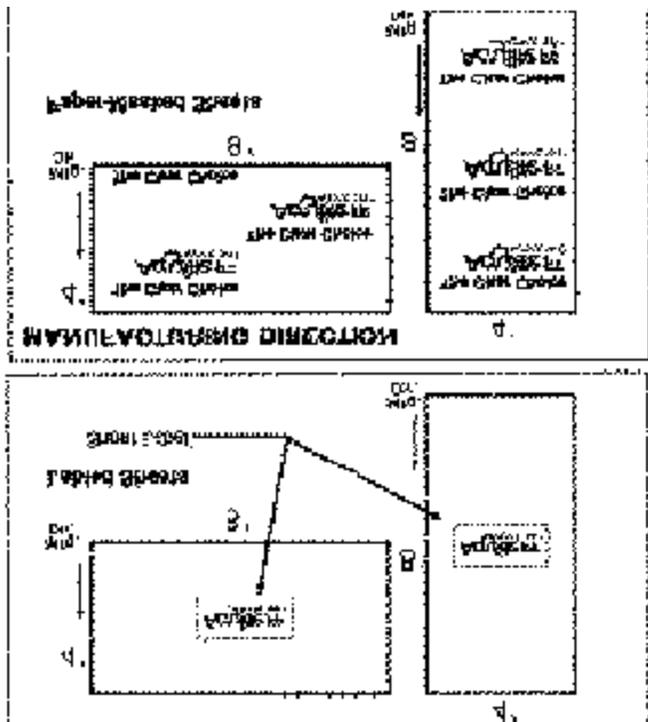
## Line Bending with Coiled Resistance Wire

Follow the procedures above for nichrome resistance wire line bending. Flip the piece over while heating to prevent uneven stresses in the bend area.

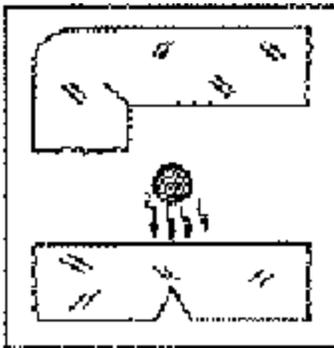
## Long Line Bends

When a bend line exceeds 24 inches in length, there is a tendency for the part to bow across the bend. This can also happen when a bend is made close to the edge of a sheet. To minimize bowing, restrict the width of the heated area or, v-groove the sheet along the desired bend line, as shown at right. When a line bend exceeds 36" in length, the part tends to bend unevenly (slight wave) along the bend due to shrinkage. To minimize this tendency, make the bend perpendicular to the manufacturing direction. You can tell manufacturing direction when the label or masking paper is still attached to the sheet. If there is a label, manufacturing direction is from

top to bottom as you read it. If masking paper is still on the sheet, manufacturing direction is from top to bottom as you read the words on the masking.



### Sharp Line Bends



For sharp line bends with no deflection, it is a good idea to v-groove the sheet, as shown at left. Use a v-rabbit router bit or a table saw, making two opposed 45° cuts. V-grooving the sheet reduces the material cross section at the point of bending, reducing stresses and

making bending easier. A wire heater beneath the cut will help create a sharp angle bend without deflections or bowing.

### Bending with a Tubular Heater

Bend the part as outlined above for a nichrome wire heater. The ACRYLITE FF sheet should be at least half an inch from the rod to avoid overheating.

### Bending with Quartz Tube Heaters

Bend the part as outlined above for a nichrome wire heater. The ACRYLITE FF sheet should be at least a half inch from the tube to avoid overheating.

### Gentle Bending

By changing the distance between supports, the worker can increase or decrease the width of the heated area, thus varying the curvature of the bend. In this way, the part can be bent with a gentle curve instead of a right-angle bend.

## Trouble Shooting

Problem	Cause	Solution
<b>Bubbling or Blistering</b>	Overheating	Lower heat; Reverse or turn over work. Increase sheet-heater distance
	Wet material	Pre-dry sheet
<b>Wrinkling</b>	Narrow heating	Widen heated area Increase bend radius (bend radius at least twice sheet thickness)
	Bending part the wrong way	Bend away from heated side
<b>Mark-off (stray marks on sheet surface)</b>	Surface contact	Avoid overheating Cover jig with felt Reduce areas of contact in cooling jig
<b>Bow Effect</b>	Stresses from heated and unheated areas	Use straight nichrome wire to decrease width of heated area
		Design reverse curve in cooling jig
	Inherent shrinkage in sheet	Heat entire part in oven
		Use a v-groove bend line
		Bend sheet perpendicular to direction of manufacture - see foregoing drawing

## Equipment and Materials Suppliers

The suppliers listed below offer materials and equipment suitable for use with ACRYLITE FF sheet. Authorized ACRYLITE Sheet Distributors may also offer materials and equipment.

### Variable Transformers

#### Superior Electric Company

383 Middle Street  
Bristol, CT 06010  
860-585-4500  
Fax: 860-589-2136  
www.superiorelectric.com

#### Staco Energy Products

301 Gaddis Blvd.  
Dayton, OH 45403  
937-253-1191  
Fax: 937-253-1723  
www.stacoenergy.com

## Nichrom Wire/Strip Heaters

### Pelican Wire Company

6266 Taylor Road  
Naples, FL 34109-1896  
941-597-8555  
Fax: 941-597-9783  
www.pelicanwire.com

## Ceramic Stand-offs

### CHROMALOX

Edwin L. Wiegand Division  
Emerson Electric Co.  
103 Gamma Drive Extension  
Pittsburgh, PA 15238  
412-967-3800  
Fax: 412-967-5148  
www.chromalox.com

## Equipment

### Edge Finisher Corporation

16 Stony Hill Road  
Bethel, CT 06801  
203-796-7923  
Fax: 203-796-7924  
www.edgefinisher.com

### FTM, Inc.

6160 Cobblestone Road  
Placerville, CA 95667  
530-626-1986  
Fax: 530-642-2602  
www.thefabricatorssouce.com

### C.R. Clarke & Company

4407 Vineland Road - Suite D5  
Orlando, FL 32811  
800-676-7133  
www.crclarke.co.uk

## Additional Technical Information and Assistance

We invite you to visit our TechKnowlogy Center on [www.cyro.com](http://www.cyro.com).

Visitors have immediate access to frequently asked questions, technical concerns, physical properties, processing conditions, fabrication tips, regulatory compliance information, engineering guidelines, tips for troubleshooting, and hundreds of other facts about acrylics from one of North America's leading manufacturers of acrylic-based polymer and sheet products.



## Sales Offices

For the name of your local Authorized Distributor, call 800-631-5384, visit [www.cyro.com](http://www.cyro.com), or contact the nearest regional sales office.

### Fire Precautions

ACRYLITE FF sheet is a combustible thermoplastic. Precautions should be taken to protect this material from flames and high heat sources. ACRYLITE FF sheet usually burns rapidly to completion if not extinguished. The products of combustion, if sufficient air is present, are carbon dioxide and water. However, in many fires sufficient air will not be available and toxic carbon monoxide will be formed, as it will when other common combustible materials are burned. We urge good judgement in the use of this versatile material and recommend that building codes be followed carefully to assure it is used properly.

### Compatibility

Like other plastic materials, ACRYLITE FF sheet is subject to crazing, cracking or discoloration if brought into contact with incompatible materials. These materials may include cleaners, polishes, adhesives, sealants, gasketing or packaging materials, cutting emulsions, etc. See the Tech Briefs in this series for more information, or contact your ACRYLITE Sheet Distributor or the CYRO Technical Center for information on a specific product.

### Important Notice:

The information and statements herein are believed to be reliable but are not to be construed as a warranty or representation for which we assume legal responsibility. Users should undertake sufficient verification and testing to determine the suitability for their own particular purpose of any information or products referred to herein. NO WARRANTY OF FITNESS FOR PARTICULAR PURPOSE IS MADE. Nothing herein is to be taken as permission, inducement or recommendation to practice any patented invention without a license.

