Technical information

ACRYLITE® extruded sheet (FF)

#12 Annealing

This brief gives advice for:

- **When to anneal**
- **Equipment**
- **Procedures**

When to Anneal

Annealing minimizes the effects of stress on items fabricated from ACRYLITE® sheet. It alleviates most of the stress induced by line bending, thermoforming, screen printing, cementing, machining, buffing, flame polishing and other fabrication operations. Annealing is recommended by Cyro in most cases.

The process reduces internal stresses in the sheet which can cause crazing (numerous tiny cracks in the material) when the acrylic comes in contact with solvents such as glass cleaners and some paints. Stress due to water absorption can also cause crazing. Annealing reduces to a minimum the likelihood that crazing or large scale cracking will occur. Also, studies have shown that annealing can increase bond strength by more than 50%.

Equipment

Forced Air Circulating Ovens

Anneal fabricated parts in forced air circulating ovens, assuring uniform temperatures and providing proper ventilation. Air velocity should be 150–250 feet per minute. Provide an oven controllable to within ± 10°F (± 6°C) to avoid uneven or excessive heating. Select oven size carefully. Provide large doors for large parts and smaller doors to avoid heat loss when you're inserting small parts.

Temperature control selection affects oven efficiency. You can use percentage timer controls, which control the percent of the time heaters are on, but such controls may not provide uniform heat. Or, you can use proportional time controls with step switches to vary heater output, but these may produce uneven temperatures. Controllers monitoring oven temperature and maintaining constant voltage into the heating elements seem to work best.

Commercial ovens designed for annealing and heating plastics are usually best. You can anneal with a restaurant type oven obtained from a restaurant supply house. Be sure the oven incorporates air circulation and accurate temperature control systems.

Procedures

To anneal ACRYLITE® sheet, heat it to 180°F (80°C), just below the deflection temperature, and cool slowly. Heat one hour per millimeter of thickness– for thin sheet, at least two hours total.

Cooling times are generally shorter than heating times – see the chart below. For sheet thicknesses above 8 mm, cooling time in hours should equal thickness in millimeters divided by four. Cool slowly to avoid thermal stresses– the thicker the part, the slower the cooling rate.

Wait until oven temperature falls below 140°F (60°C) before removing items. Removing a part too soon can offset annealing's positive effects.

While annealing ACRYLITE® sheet parts, support them to avoid stress. For example, a part's raised center section will need independent support– it can't be supported from the ends. Lack of support may inhibit relaxation or cause warpage.

Be sure parts are clean and dry before annealing. Remove paper masking to avoid baking it onto the material. Remove any spray masking, protective tape, or similar material. Plastic masking may remain in place.

If the only fabrication you have done is surface machining and you do not need to anneal cemented joints, heating time can be reduced. This reflects the fact that machining forms stresses only at and slightly below the surface, the entire sheet thickness does not need to be annealed. Heat at least two hours; cool the same amount of time. If holes have been drilled entirely through the sheet, position the part so heated air flows through the hole.

If you are annealing following cementing, allow the part to sit at least six hours to avoid bubble formation resulting from rapid solvent evaporation in the joint.

Sheet Thickness vs. Heating/Cooling Time

Thickness		Heating Time	Cooling Time	Cooling Rate
(in)	(mm)	(hours)	(hours)	(°F/hr.)
.080	2.0	2	2	28
.098	2.5	2.5	2	28
.118	3	3	2	28
.125	3.2	3.2	2	28
.177	4.5	4.5	2	28
.187	4.7	4.7	2	28
.220	5.6	5.6	2	28
.236	6.0	6	2	28
.375	9.5	9..5	2.5	22

Fire Precautions

ACRYLITE® sheet is a combustible thermoplastic. Precautions should be taken to protect this material from flames and high heat sources. ACRYLITE® 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® 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 for information on a specific product.

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