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MACHINING

Foam can be used in the fabrication of variety of artifacts using common tools and machinery as recommended in this section.

General Rules

When machining Foam with high-speed equipment, using carbide tipped tools is recommended. Lower speeds usually work better and always use sharp tools to ensure smooth edges.

Cutting

Sheets of Foam up to 3 mm thick can be cut with a utility knife. Table and band saws, including routers, can be used to cut thicker gauges. Power shears or guillotines are not recommended. They can cause edges to be crushed.

Stamping and Die Cutting

Stamping and die cutting are cost-effective methods for the efficient manufacturing of large quantities of pieces where edges require no routed finish. For best results, it is very important to cut the material AT THE RIGHT TEMPERATURE (70-100 degrees F). As a rule the lower the sheet temperature, the less consistent the process and the edge finish. For complete instructions on die cutting, please call our toll free number on the back of this manual.

Note:

Avoid making shapes or cutting holes that require sharp corners because it creates a weak area that can be broken. Easing off these angles with a radius is recommended. (see illustration I)

Sawing

For best results, use carbide tipped *circular saw blade*s with a rake angle of 0 degrees to 15 degrees and a clearance angle of 10 degrees to 20 degrees with a tooth pitch of .080" to .400". Saw at a cutting speed of 8,000 to 12,000 feet per minute and a feed speed of 70 to 90 feet per minute. *(see illustration 2)*

When using *band saws*, high speed steel blades used for cutting wood or plastic are commended with 4 to 8 teeth per inch at a cutting speed of 3,000 to 5,000 feet per minute and a maximum feed speed of 40 feet per minute.

Drilling Holes

Holes may be drilled through Foam using the same methods employed for drilling wood. Carbide tipped drills are recommended with a point angle between 90 degrees and 110 degrees and with a spiral angle of 30 degrees. *(see illustration 3).* High feed and drilling speeds may hinder the efficiency of the drill by creating heat buildup. For best results, use sharp bits and lower speeds.

Routing and Milling

Foam may be slotted, beveled, rabbeted, etc. with routers or shapers commonly used for working wood. Carbide tipped cutters are preferred.

SURFACE TEREATMENT

Foam is a versatile material suitable for a variety of graphic applications ranging from signs to POP displays. Below are some helpful hints on how to prepare and use Foam for printing, painting, gluing, photo mounting and laminating.

Surface Preparation

It is always a good practice to clean the surface of the material to eliminate the possibility of any grease or dirt that may have contaminated the surface during handling. For best results, use Isopropyl alcohol or naphtha and clean lint-free cloth to wipe the surface. Avoid using paint thinners because they leave a residue on the surface that could interfere with the bonding of the paints, inks and adhesives.

Screen Printing

Foam has a consistent and smooth surface that lends itself to the permanent acceptance and retention of a variety of printing inks. One of the most commonly used methods screen printing. Follow the surface preparation instructions. It is always a good practice to test print before going into full production.

Note:

Mixing different brands of printing inks and solvents may reduce the longevity of the sign. A telltale indication is the premature cracking of the surface which is difficult to determine when first printed.

Scratches and dents will become accentuated when screen printed. Sanding down the affected area with a very fine sandpaper or using a

blow type heat gun is recommended to reduce the change of the scratch showing through the ink. Please refer to *Table 1* for a list of pre-approved ink manufactures.

Painting

In addition to screen printing, Foam also has the perfect surface for paint adhesion. There is no need to prime the surface before painting. Most conventional tools and painting methods will work successfully with Foam. However, for best results, follow the surface preparation guidelines introduces earlier. The surface of Foam will accept acrylic-based lacquers, urethane and vinyl based paints. Please refer to *Table 2* for a list of pre-approved paint manufactures.

For outdoor use, to minimize heat build up and possible deflection, pastel colors, rather than darker colors, are recommended. Painting the entire surface with dark colors is not advised.

Varnishing

Always follow the surface preparation instructions previous mentioned. Air-dried varnishes are recommended. Due to the nature of Foam, over-baked varnishes are not suitable. Most available varnishes in the market will touch dry in 60 minutes and thoroughly dry in 24 hours.

Table 1 Screen Printing Inks

Manufacturer's Name	Trade Name	Type of Ink
Colonial Printing Ink Corp.	C99, Gloss Vinyl	Solvent Base
Colonial Printing Ink Corp.	D40	Ultra Violet
Nazdar Company	System 2	Solvent Base
Nazdar Company	GV Series 44000	Solvent Base
Nazdar Company	Series 9700	Solvent Base
Nazdar Company	Plastics Plus	Solvent Base
Nazdar Company	Series 70000	Solvent Base
Nazdar Company	Series 2700	Water Base
Nazdar Company	Series 3200 & Series 3600	Ultra Violet
T. W. Graphics		Water Base

Table 2 Painting

Manufacurer's Name	Trade Name	Type of Paint
Sherwin Williams	Polane	Polyurethane Base
Schwartz Chemical Company	Rez-N-Lac	Vinyl Base

Glues and Adhesives

There are a variety of solvent-based glues and adhesives in the market that can be used bonding Foam to itself and other materials. For best results, InteFoam sheets must be dry, clean and free of oil or grease.

MEK (Methyl Ethyl Ketone). THP (Tetra Hydro Furan) or common PVC pipe glues work well. Make sure glue joints have a close fit tolerance. Spray adhesives work well for light duty applications such as mounting photographs and other lightweight graphics. Contact, rubber, epoxy and urethane based adhesives work well with specific non-PVC substrates.

PHOTO MOUNTING AND LAMINATING

Foam is a tough, abuse-resistant substrate that can be used for photo mounting and the transfer of film overlays. It has many advantages over known materials, such as MDO, cardboard and paper backed foams. Corners remain true during tough handling. It can be stripped, repositioned, salvaged and reused in case of an error. Once laminated, it can be worked using stand methods of further conversion.

There are many methods for mounting and laminating that vary according to the type of adhesive used and whether it is done manually or using presses. Pressure sensitive spray adhesives or transfer adhesive films with resin coated papers that can be peeled from the adhesive work well for photo mounting and laminating.

The use of a laminating machine may be required for removing air bubbles caused during the mounting process. To perform this function, it is recommended to use between 10 to 15 psi of surface pressure to prevent distortions of the photo or the laminate being mounted. Please refer to Table 3 for pre-approved adhesives for photo mounting and laminating.

Note:

Sheets largely covered by laminates, vinyl film, carpet, paints, etc., may deflect when exposed to direct sunlight or sustained heat due to the expansion and contraction differential of the covering material and the Foam substrate. Covering should be done with caution and due consideration of the environmental conditions. In-place testing is always recommended.

Table 3 Adhesives for Photo Mounting

Manufacturer's Name	Trade Name	Type of Adhesive
Radiant Technology	Surestik SS2203	Double coated polyester tape with acrylic adhesive
Seal Products	ProBond	Spray adhesive

THERMOFORMING

Foam is a thermoplastic. It becomes soft when exposed to intensive heat. This characteristic gives the material thermoforming capabilities. However, since it is expanded PVC foam, it is important to know that it lacks the draw depth of solid PVC sheets. Heat bending, pressure and vacuum forming are among the methods that may be used to thermoform Foam. Depending on the method used, the optimum heating temperature of the sheet should range between 250 degrees F and 350 degrees F

Heat Bending

Heat bending is a common process that does not require sophisticated equipment. Most bending can be accomplished with strip or radiant heaters, hot air ovens, and, for thin panels, hot air welding guns.

Basic Premises:

- Minimum radius of bend should be 3 times the sheet gauge. (see illustration 4)
- Heating time 30 to 50 seconds per millimeter of thickness.
- Leave at least 20 times sheet gauge for border when hot line bending angles.
- Heat both sides when bending sheets 5mm to 10mm.
- Always make sure material is cooled before using after bending.

Pressure and Vacuum Forming

Both of these methods require the use of air circulating ovens capable of reaching temperatures between 260 degrees F and 280 degrees F or radiant heat panels capable of reaching temperatures exceeding 700 degrees F. The usage of molds is required for the thermoforming process. These methods are ideal for consistent, high production projects require more elaborate details than hot wire bending.

Basic Premises:

- Molds should not have sharp angles. (see illustration 5)
- Molds should have at least 5 degrees draft angles.
- Temperature should not exceed 750 degrees F for top heating and 650 degrees F for bottom heating.
- Heating time should be between 15 and 20 seconds per millimeter of thickness
- Sheets must be securely clamped to molds to minimize shrinkage
- Sheets must be completely cooled before removing from mold.

WELDING

There are several methods for welding plastics. The most common are butt welding and hot air welding or gas welding. Note that welds on expanded PVC foam are usually not as strong as those of solid PVC

Butt Welding

Butt welding is recommended for gauges 4mm and over. This method allows fusion by simply joining two ends together under pressure after ends have been heated to an optimum bonding state. This pressure must be maintained until the material is completely cooled. *(see illustration 6)*

Hot Air Welding

Hot air welding is accomplished with the use of a hot air gun and a welding rod. *(see illustration 7)* The temperature can be regulated and this method allows great flexibility. Rods made of Type I PVC are preferred, but Type II can also work well. Welding is accomplished by feeding the rod through the gun and applying pressure on the rod as the sheet and rod are heated simultaneously.

For best results, the temperature of the air at the tip of the rod should be 680 degrees F. Welding pressure should be approximately 2 to 3lbs. depending on rod diameter. Under optimum conditions, welding 10 to 18 inches per minute can be accomplished.

INSTALLATION

Foam PVC is a low-density material that can be compressed relatively easily. When securing the material in place, make sure the clamping force is spread evenly over a large area.

All extruded products have grain determined by the direction of the extrusion which is the length of the sheet. The grain direction offers greater flexural strength when compared to the cross grain direction. Because of this characteristic, make sure the grain direction is parallel to the floor when making flag-type signs.

Note:
Most thermoplastics tend to become hard and brittle in cold temperatures just as exposure to wide variations in temperature and

outdoor direct installation to concrete or metal surfaces may cause deflection. Please read the following instructions carefully.

Free Hanging Signs

When installing free hanging signs such as aisle markers in supermarkets, bookstores, and home centers, locate holes 1” or more from the vertical edge and at least ¾” from the horizontal edge. Use grommets to prevent wear and stress. The supporting chains should be installed at a 30 degree to 45 degree angle. *(see illustration 8)* If perfectly vertical chains must be installed, use a plastic or aluminum clip-on “U” channel and position holes as desired. *(see illustration 9)*

Fastening

Ambient temperature should always be taken into consideration when attempting to fasten Foam to walls, poles, frames, wood and other plastics. As a thermoplastic, InteFoam is susceptible to expansion or contraction when there are significant changes in temperature. Dark colors tend to absorb more heat when exposed to direct sunlight.

When using bolts or screw for mounting, it is recommended to drill oversized or slotted holes positioned at least 1” from the edges in order to compensate for this characteristic common to most plastics *(see illustration 10)* Grommets or a dab of silicone in the holes will create a tighter hold.

To allow stress relief from expansion, bolts, and screws should only be moderately tightened. Apply the coefficient of linear expansion from *Table 4* to the total temperature swing differential to calculate your specific requirements.

Thread cutting and thread forming screws may be used to mount lightweight objects to Foam. Use moderate torque pressure to avoid stripping the threads.

If wind shear forces are a consideration, using large diameter washers is recommended to spread the load forces over a larger area.

WEATHERABILITY

Due to the natural UV inhibitors in white Foam, it tends to perform very well in outdoor conditions. Colors have the tendency to fade over time when exposed to direct sunlight. However, Foam colors perform the best in the industry. Several years of research have resulted in formulations that make Foam colors stand out. We recommend performing your own testing by putting Foam and other manufactures' color chips, side by side, under the same environmental conditions. The results will astound you.

FIRE RESISTANCE

conforms to UL94 V0, UL94 5V and UL48, which allows to be used in the manufacturing of electric signs.

FORMULATION PARAMETERS

contains no lead or heavy metals in its formulation. Please refer to *Table 5* for Chemical Resistance Chart.

Table 4 Example of Effects of Thermal Expansion

Coefficient of Linear Expansion	Total Temperature Difference (°F)	48" Span	96" Span
6 x 10^{-5}~ 8 x 10^{-5} in/in/°C	0 ~ + 110	+0.174" ~ +0.232"	+0.348" ~ +0.465"
3.3 x 10^{-5} ~ 4.4 x 10^{-5} in/in/°F	0 ~ -20	-0.032" ~ -0.042"	-0.064" ~ -0.084"

Table 5 Chemical Resistance

Reagent	Code	Reagent	Code
Glacial Acetic Acid	2	Turpentine	1
Hydrogen Peroxide (30%)	1	Sodium Carbonate Solution (20%)	1
Acetone	4	Toluene	4
Hydrofluoric Acid (40%)	1	Methyl Alcohol	1
Ammonium Hydroxide (Concentrate)	1	Sulfuric Acid (Concentrate)	1
Hydrochloric Acid (Concentrate)	1	Sodium Hydroxide Solution (Concentrate)	1
Carbon Tetrachloride	3	Citric Acid (10%)	1
Most Detergents	1	Ethyl Alcohol	1
Seed or Mineral Oils	1	Ethyl Acetrate	4

Resistance Codes: 1 - Inert: 2 - Limited; 3 - Very Limited; 4- Non Resistant

TECHNICAL SPECIFICATIONS: Foam

I. TYPICAL PROPERTIES

PROPERTY	TEST METHOD	UNIT	VALUE
PHYSICAL			
Specific Gravity	ASTM D 792	g/cm^3	0.75
Water Absorption	ASTM D 570	%	.30
Shore D Hardness	ASTM D 2240	—	52
MECHANICAL			
Tensile Strength at Yield	ASTM D 638	psi	3,000
Elongation at Break	ASTM D 638	.%	15
Flexural Modulus	ASTM D 790	Psi	130,000
Impact Strength(Charpy Unnotched)	ASTM D 256	ft lb/in^2	7
Dielectric Strength	ASTM D 149	kv/mm	12
THERMAL			
Heat Distoration Temperature (under load at 264 psi)	ASTM D 648	°F	140
Coefficient of Linear Expansion	ASTM D 696	In/in/°F	35 x 10^-6
Thermal Conductivity	ASTM D 177	Btu in/hr ft^2 °F	0.50

II. FLAMMABILITY STANDARDS

OTHER PROPERTY		RATING
THERMAL		
UL 94	V0	Passed
UL 94	5V	Passed
UL 48	N/A	Passed

III. AVAILABILITY

	STANDARD	CUSTOM
SIZE	4ft x 8ft (48” x 96”)	Available upon request
COLORS 1/8” (3mm) & ¼” (6mm)	White, Black, Beige, Dark Gray, Light Gray, Red, Dark Yellow, Dark Blue, Green	Available upon request
GAUGES In millimeters	1 through 6, 10 & 12.7	Available upon request

The information contained herein is true and accurate to the best of our knowledge. All recommendations and suggestions are made with guarantees. This information is to be used by individuals with technical skill at their own discretion and risk.

Material Safety Data Sheet

Manufacturer

1. PRODUCT INDENTIFICATION

Product Name	PVC Sheet
Product Code	Inte001
Chemical Family	Vinyl Polymers
Chemical Name	Polyvinyl Chloride Sheet
CAS No	N/A
	Integral Skin Expanded Foam PVC Sheet Clear PVC Sheet Rigid PVC Sheet (Type I and II) Expanded Foam PVC Sheet
Formula	Proprietary
Technical Information	512-874-3760

2. PRODUCT INGREDIENTS

No.	Components	CAS No.	Percent	OSHA PEL
1	PVC Sheet	9002-86-2	70-95%	5 mg/M^3 (respirable dust)
2	Calcium Carbonate	1317-65-3	0-20%	10 mg/M^3 (total dust)
3	Titanium Dioxide	13465-67-7	0-20%	110 mg/M^3 (total dust)
4	Proprietary	Mixtures	0-3%	Not Established

3. PHYSICAL/CHEMICAL PROPERTIES

Physical Form	Solid
Color	Finished sheet with colors specified
Odor	Insignificant
Molecular Weight	Ranging from 60,000 – 150,000
Boiling Point	N/A
Melting Point	Not established
Freezing Point	N/A
Solubility in Water	None
Specific Gravity	0.5-1.4 (water = 1)
Vapor Density	N/A (air = 1)
Evaporation Rate	None (Butyl Acetate = 1)
Vapor Pressure	N/A
% Volatile	None
pH	N/A

The physical date presented above are typical values and should not be construed as a specification.

4. FIRE HAZARD DATE AND FIGHTING METHOD

Flash Point	n/a
Autoignition	n/a
Flammable Limits in Air **(LEL, %)** **(UEL, %)**	 n/a n/a
Extinguishing Media	Dry chemical, foam water, or carbon dioxide
Special Fire Fighting Procedure	In the event of a fire, wear NIOSH approved, positive pressure, self-contained breathing apparatus (SCBA) and full protective clothing. Evacuate all personnel from anger area. Use dry chemical, foam, water or carbon dioxide to extinguish fire.
Unusual Fire and Explosion Hazards	PVC will not continue to burn after ignition without an external fire source. However, when forced to burn, the major gaseous products of the combustion of PVC are carbon monoxide, carbon, dioxide, and hydrogen chloride.

5. HUMAN HEALTH DATA

Emergency Overview	During a Fire Emergency			
Primary Route(s) of Exposure	▣ Inhalation	□ Ingestion	▣ Eye	▣ Skin Contact
Potential Health Effects and Symptoms of Over-Exposure During a fire emergency, when this product is burned, it may generate smoke.				
Eye Contact	Smoke from a fire emergency may cause eye irritation			
Skin Contact	Molten plastics from a fire may cause skin burns			
Inhalation	Smoke from a fire emergency may cause respiratory irritation			
Ingestion	Unlikely			
Medical Conditions Aggravated by Over-Exposure Available toxicological information and the physical/chemical properties of the material suggests that there is no evidence that this product aggravates an existing medical condition				
Carcinogenicity	**NPT**: No	**IARC**: No	**OSHA**: No	

6. FIRST AID MEASURES

Eye Contact	Immediately flush eyes with water for at least 15 minutes. Do not rub the eyes. If irritation develops, consult a physician.
Skin Contact	If burned by molten plastics, get medical attention immediately.
Inhalation	If smoke from burning plastics is inhaled, remove subject to fresh air immediately. If symptoms develop. Seek immediate medical attention.
Ingestion	Unlikely
Notes to Physician	Treat symptomatically and supportively
Other Instructions	Never give anything by mouth to an unconscious person.

7. EXPOSURE CONTROLS & PERSONAL PROTECTION RECOMMENDATIONS

Eye Protection	Wear safety glasses during sheet cutting or fabricating process.			
Skin Protection	Wear gloves when cutting or fabricating sheets by hand			
Respiratory Protection	Fire fighter should wear NIOSH approved self-contained breathing apparatus (SCBA) during fire emergency			
Engineering Control	Ventilation Requirement:	□Local Exhaust	□Specific	▣ General
Required Work/Hygiene Procedure	Do not eat, drink or smoke in work area. Wash hands thoroughly after handling especially before eating, drinking, smoking, chewing gum, or using restroom facility			
Exposure Guidelines				
No.	P			
Components	PVC Sheet			
OSHA-PEL	n/a			
ACGIH-TLV	n/a			

8. ACCIDENTAL RELEASE CONTROL MEASURES

Response to Spills	N/A

9. HANDLING AND STORAGE

Handling	Use with care. Wear gloves if necessary when cutting or fabricating sheet.
Storage	Store in a cool dry, well-ventilated area away from sources of extreme hear or fire. *Note: Electrical buildup is possible*
Container Use	N/A

10. STABILITY AND REACTIVITY

Stability	Stable
Conditions to Avoid	Fire or extreme heat
Hazardous Decomposition	If burned, it will generate carbon dioxide, carbon monoxide, HC1.
Hazardous Polymerization	Will not occur

11. DISPOSAL CONSIDERATIONS

Disposal Method	It must be disposed of in accordance with Federal, State and local environmental control regulations.
Recycle/Reclaim	Recycling of PVC sheet should be encouraged where possible

12. TRANSPORT INFORMATION

DOT Shipping Name	Not listed
DOT Label	Not applicable
DOT Hazard Class	Not regulated
UN/NA Number	Not applicable
Hazard Label(s)	Not applicable
Hazard Placard(s)	Not applicable
Packing Group	Not applicable
Bulk Packaging	Not applicable
RQ	Not applicable
Emergency Response Guide (ERG) No.	Not applicable

13. TOXICOLOGICAL INFORMATION

The information provided below can be subject to misinterpretation. Therefore, it is essential that the following information be interpreted by individuals trained in its evaluation.

Chemical	PVC Sheet
Toxicity Date	A review of the scientific literature did not indicate specific toxicological information for PVC sheet.

14. ECOLOGICAL INFORMATION

No data is available on the adverse effects of this product on the environment.

15. REGULATORY INFORMATION

Regulatory Information: PVC Sheet	
OSHA Status	Not listed, non-hazardous
EPA Clean Air Act Status	Not listed
EPA Clean Water Act Status	Not listed
TSCA Status	All ingredients are listed on TSCA Inventory (40CFR710)
CERCLA RQ	Not Listed
SARA Title III: PVC Sheet	
Section 302*	None *Reportable quantity of extremely hazardous substance, Sec. 302 *Threshold planning quantity, extremely hazardous substance, Sec. 302
Section 313**	None

	**Toxic chemical, Sec. 313. **Category as required by Sec. 313 (40CFR372.65C) must be used on Toxic Release Inventory Form.
Section 311/312* **	None ***Hazard category for SARA Sec. 311/312 reporting H1=acute health hazard H2=chronic health hazard P3=fire hazard P4=sudden release of pressure hazard P5=reactive hazard
RCRA Status	It is the responsibility of the product user to determine at the time of disposal whether a material containing the product or derived from the product should be classified as a hazardous waste (40CFR261.20-24)
Other Regulatory Information The following chemicals are specifically listed by individual states; other product-specific health and safety data in other sections of the MSDS may also be applicable for state requirements. For details on your regulatory requirements, you should contact the appropriate agency in your state.	
State	None
Chemical	PVC Sheet
Regulation	None
Product Name	PVC Sheet
International	None

16. OTHER INFORMATION

NFPA	**HMIS**
Fire-1	Health-0
Health-0	Flammability-1
Reactivity-0	Reactivity-0
Specific Hazard- None	Personal Protection Index-E

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.