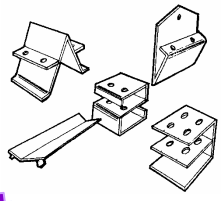
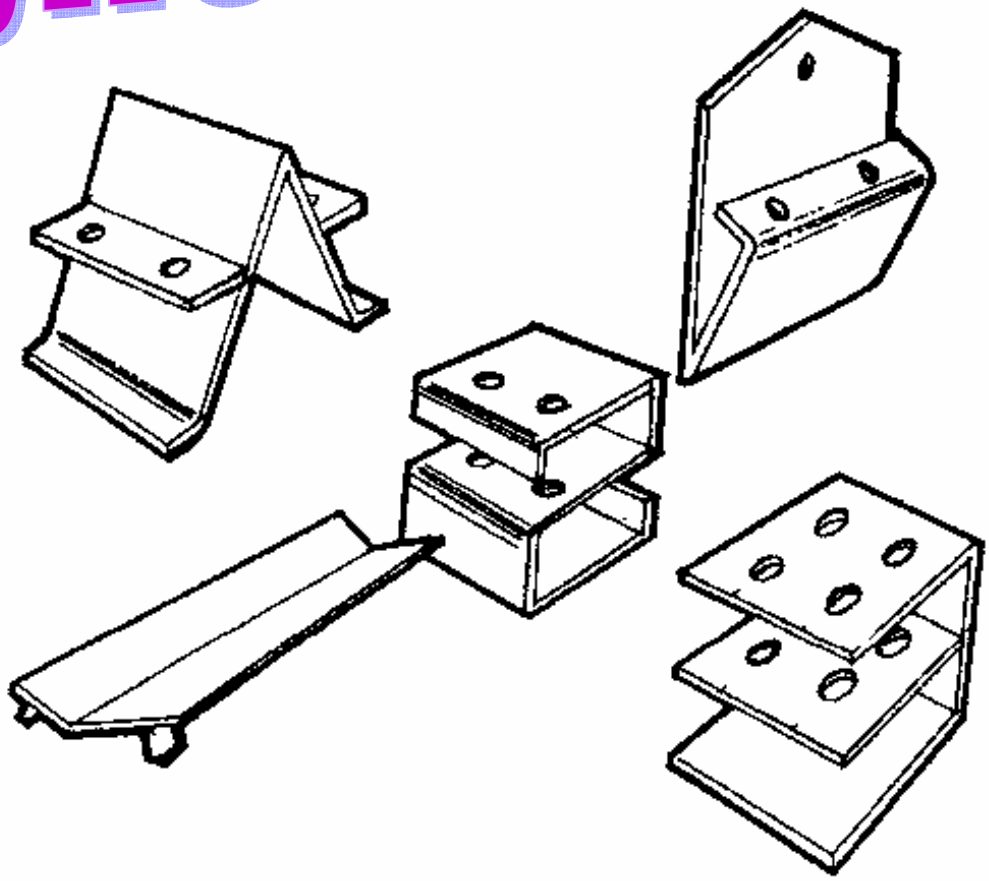


Acrylic Project

Organize With Plastic



Western Technical-Commercial School

School:

Integrated Technologies, TTI1O

Course:

Grade 9 juniors

Grade:

Mr. Franzen

Teacher:

michael.franzen@tel.tdsb.on.ca

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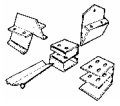
Acrylic Project

Project:

12

Pages:



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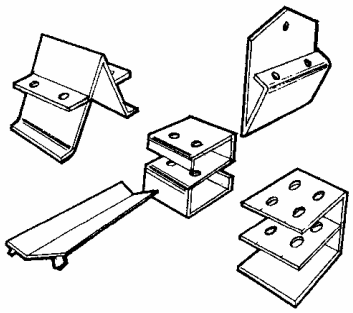
Acrylic Plastic

Organize This!



Situation:

With today having so many new plastic products introduced, replacing old and innovating new products for society, that there is now a great demand for employees in this industry. ***Innovative Plastics*** is a rapidly building company that is opening up a new division in Home/Office Products. Through a recent trade show, Innovative Plastics heard that there were some young fresh innovators with good working attitudes here at Western. They are looking for product designers, product marketers, and people with great hands-on-experience in the plastic industry.

Requirements:

As they will be offering prizes, job contracts and college assistance, students with the most innovative, home/office design with the use of acrylic plastic, ergonomics, high-tech look, practicality, functionality, marketing and process skills (SPICE) used. With your product(s), computer generated colour product advertisement; a cost spreadsheet showing material, sizes, weight of your product(s) will all be included in your own tri-fold portfolio. The company must see a number of skills performed, which must include a drilled hole, straight line bends, solvent-cementing of plastic joints, drape **or** stretch forming, all with smooth edges. The size of the product(s) has to be able to fit inside of your IT project box and weigh less than ½ kg. All final/good paper work must accompany a personal technology logo.

Resources:

For this project and the home/office acrylic design ideas and background resources are already in your notes. You are already familiar with the design process SPICE. research sources, bibliography, thumbnails, paper prototypes, orthographic, isometric and full size drawings from this course. Quattro Pro has an extensive help file for required spreadsheet information. Both class textbooks have some additional information, while the school library is always a good resource for ideas. Notes accompanied with this module are also a great resource. Other sources and resources can be found in catalogs of home and office supplies, jewelry or any other small items you would find in the home/office environment

Due: 5 Thumbnails _____, Final _____, Ortho DWG_____, ISO Ad _____.

Working with Acrylic Plastics

Precautions:

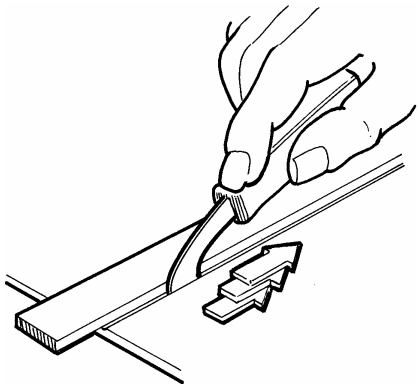
In terms of safety, it is important that care be taken whenever fabricating, or thermoforming any thermoplastic, heat produced may result in the release of vapors that are not good to breathe. Solvent cementing vapors is also important to ventilate and not breathe. Avoid forcefully breathing in any of theses vapors including polymer dusts which is created when cutting or sanding acrylic.

Acrylic Sheet Properties and Characteristics

1. **Strength:** 10,500 PSI (pounds per square inch)- concentrated stresses should be avoided
2. **Rigidity**: Not as rigid as other building materials, therefore will bend under load
3. **Thermal Expansion**: Far greater than glass or metal
4. **Breakage Resistance**: When properly finished 6 to 17 times stronger than glass. Nicks or chipped edges will result in extreme crack sensitive properties under impact
5. **Heat Resistance**: can be used at temperatures from -30° F up to 200° F (160° to 170° C)
6. **Weather Resistance**: very durable- sun, extreme cold, salt water spray, etc will not affect colour or finish
7. **Electrical Properties**: good insulator against electricity
8. **Chemical Resistance**: Generally an excellent resistance to many chemicals
9. **Light Transmission**: Clear has a light transmittance of 92% (clearer than glass) and translucent white has excellent light diffusing properties used widely for lighting fixtures and signs
10. **Light Weight**: Less than 50% as heavy as glass, and 43% as heavy as aluminum, one square foot of 1/8" thick Acrylic sheet weighs approximately ¾ lb

Cutting Acrylic Sheet

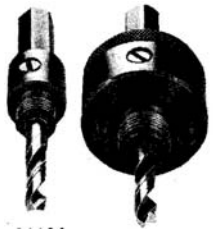
There are many ways to machine plastics. We will be using the basic tools previously used. It is important to realize that because acrylic as different properties than wood, this has to be taken in account. The following are some basic cutting methods:



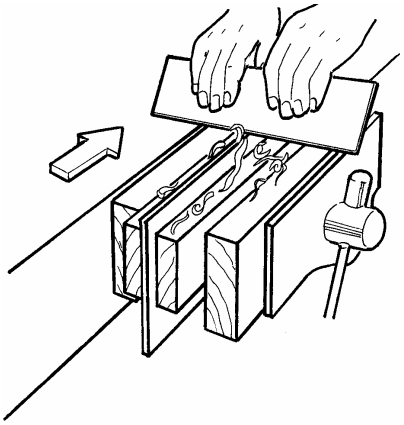
1) Scribing and breaking ¼" or less thick for straight cuts
   a) Use swivel blade Plasticutter to score paper
   b) Then with a firm grip and pressure score acrylic once for every 0.5 mm of thickness
   c) Position and hold sheet on table with one hand and apply

a downward pressure with the other hand on the short side of the break to "snap" the acrylic.

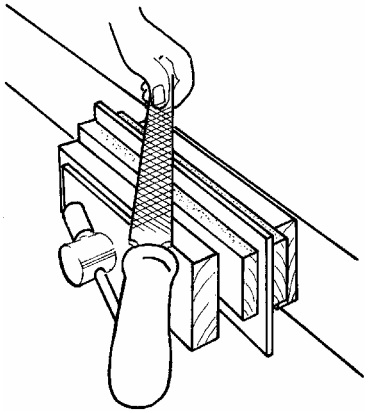
2) Band Saw for cuts that are curved or formed parts are rough trimmed.
   a) They can also be used to make straight cuts
   b) Remember to keep fingers away from and in-front of blade area with guard/guide always as low as possible
   c) Internal cuts could be accomplished by use of drilled holes and jigsaw (more about Jigsaw later)
   d) If working with unmasked acrylic sheet, take care to protect prior to cutting to avoid scratching flat surface



3) Hole Saws used to drill large holes in object, sizes from ½" to 2".
   a) Generally one large circular cutting blade with a pilot twist drill in the center
   b) Work must be held securely in the drill press.
   c) Should drill half of the sheet on one side then flip over and cut the rest of the way on the other side
4) Scraping edges to remove nicks or burrs
   a) Hold acrylic in bench vice securely
   b) Push or draw the tool along the edge of your work with a steady pressure, keeping the scrapping operation square
   c) Use the flat for a flat finish, and the inside V for beveled edges
   d) Hint: you could also use a hand planner to straighten a wobbly edge if required



5) Jig Saw to be used to cut straight or curved lines
   a) Excellent for completing large internal holes
   b) Make sure work is secured, as vibration can damage work, and cutting blade does not cut into table
   c) Insure there is cardboard underneath to protect the acrylic



Finishing Acrylic Sheet

Always be careful not to scratch the flat surface, as it is easier to avoid, rather than having to remove them later

1. Edges can be finished to a high-gloss shine by:
   a. Filing/scraping: nice straight even strokes
   b. Sanding: wood block with rough 300+, then 600 grade wet sand paper

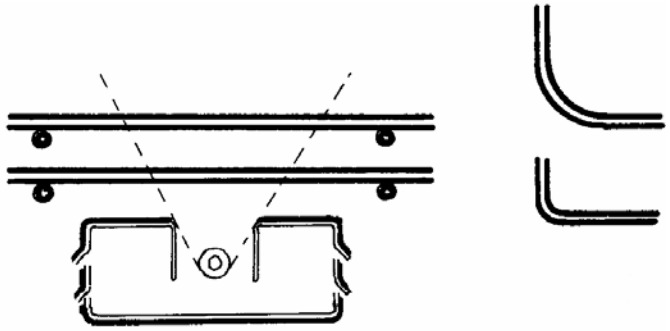
2. Pull off wax paper protection
3. Buff: using small amount of polishing compound buff lightly to avoid burning plastic on first wheel, second wheel is for shinning
4. Wash with water and check closely to make sure all edges and surface is smooth

Heat Forming

As Acrylic plastic is a thermoplastic material, when heated to approximately 340°F it becomes soft and pliable and can be formed into almost any shape. As the acrylic cools, it will harden and retain formed shape as it was held. There are three basic methods of heat forming, namely:

1. Strip heating of line bends
2. Drape forming of two dimensional-curves
3. Stretch forming of three-dimensional shapes

It is highly recommended that a prototype made out of paper be made prior to actually cutting, bending and forming is made to save time, make sure that design will work (part of SPICE)



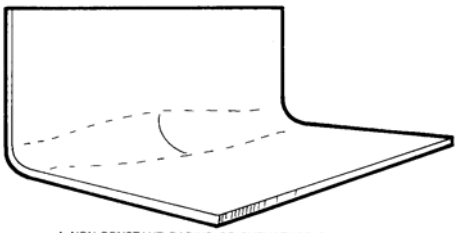
HOW CHANGING THE HEIGHT OF THE RESTS CHANGES THE AREA HEATED, AND ALTERS THE BEND RADIUS

Strip heating of line bends

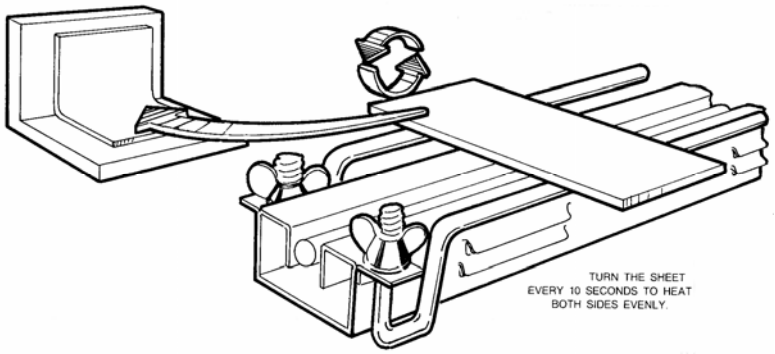
This method is used if a bend along a straight line is required. Only a small portion of the plastic is heated and saves time and better results are obtained. It is highly recommended that before you heat the area to bend, to have some sort of temporary set-up to bend your acrylic, whether it is a sharp or larger radi bend with a preset angle

Steps involved, include:

1) Wax paper must be removed and all edges should be previously finished
2) Mark with washable marker sections to bend
3) Make sure temporary set-up for bend is ready to go
4) Turn-on strip heater and let heat up
5) Heat section as marked and turn over every 10 seconds to allow even heating (total time is for about 1 to 4 minutes depending on thickness) and prevent over heating and uneven heating resulting in bowing and burning
6) Once section to bend is soft and pliable, turn off heater and



A NON-CONSTANT RADIUS OF CURVATURE CAN BE DUE TO OVERHEATING.



TURN THE SHEET EVERY 10 SECONDS TO HEAT BOTH SIDES EVENLY.

transfer over to temporary set-up with angle and proper radi. This must be done with-in seconds as acrylic will start to cool immediately.

7) Once in place, hold form until acrylic has naturally cooled off

Heating and Forming

Whenever using the oven to heat and form, whether it is Drape or Stretch forming, there are some common rules that the user must be aware of: Oven should be preheated to approximately 320° to 340° F (160° to 170° C). It is important that acrylic is heated thoroughly and uniformly so that forming can be completed before temperature of heated acrylic has dropped below forming temperature.

- If piece is forced after this point internal stresses or "crazing" will result.
- On the other hand if the acrylic becomes overheated from leaving it in too long or too high a temperature, its surface will become to soft causing "mark-off" as the piece will pick up any minor imperfections in mould.

When heating up a acrylic, expect approximately 2% shrink, therefore cut sheet/design 2% larger. Make sure all wax paper and residue is removed from acrylic before heating. Acrylic, once heated properly ready for forming, it will feel like a sheet of soft, pure rubber. Piece must be formed quickly, and then allowed to cool slowly on mould until it is below 175°F.

Moulds for Forming

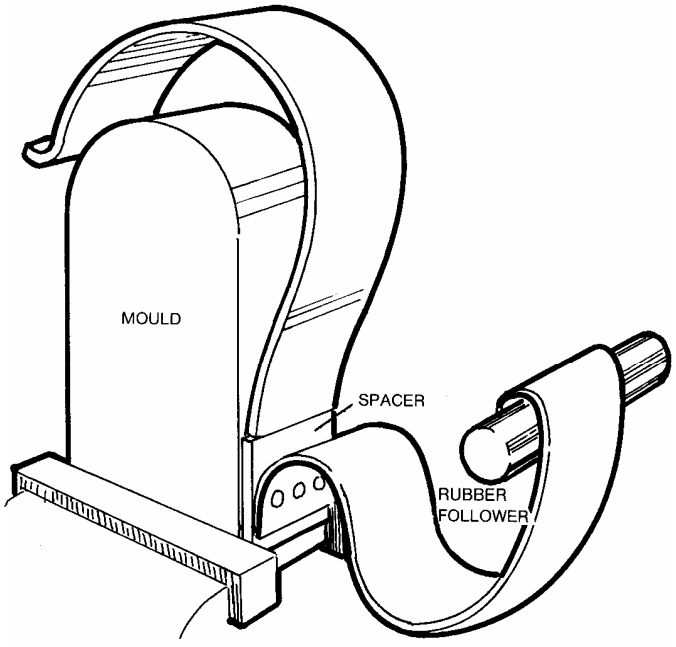
Moulds can be used to make 2 dimensional or 3 dimensional shapes. Moulds can be made from white pine, mahogany, masonite die stock, sheet metal, heavy cardboard or a combination of these materials. Moulds tend to be slightly longer and higher to allow for contraction after cooling. Moulds can be made very complex on board with cleats, or very simple with added hand co-ordination to produce your formed piece.

Drape and Stretch Forming

Drape forming is used to drape a sheet over a mould and allowing it to cool where as stretch forming could involve positive and negative moulds, jigs, peg and press, etc.

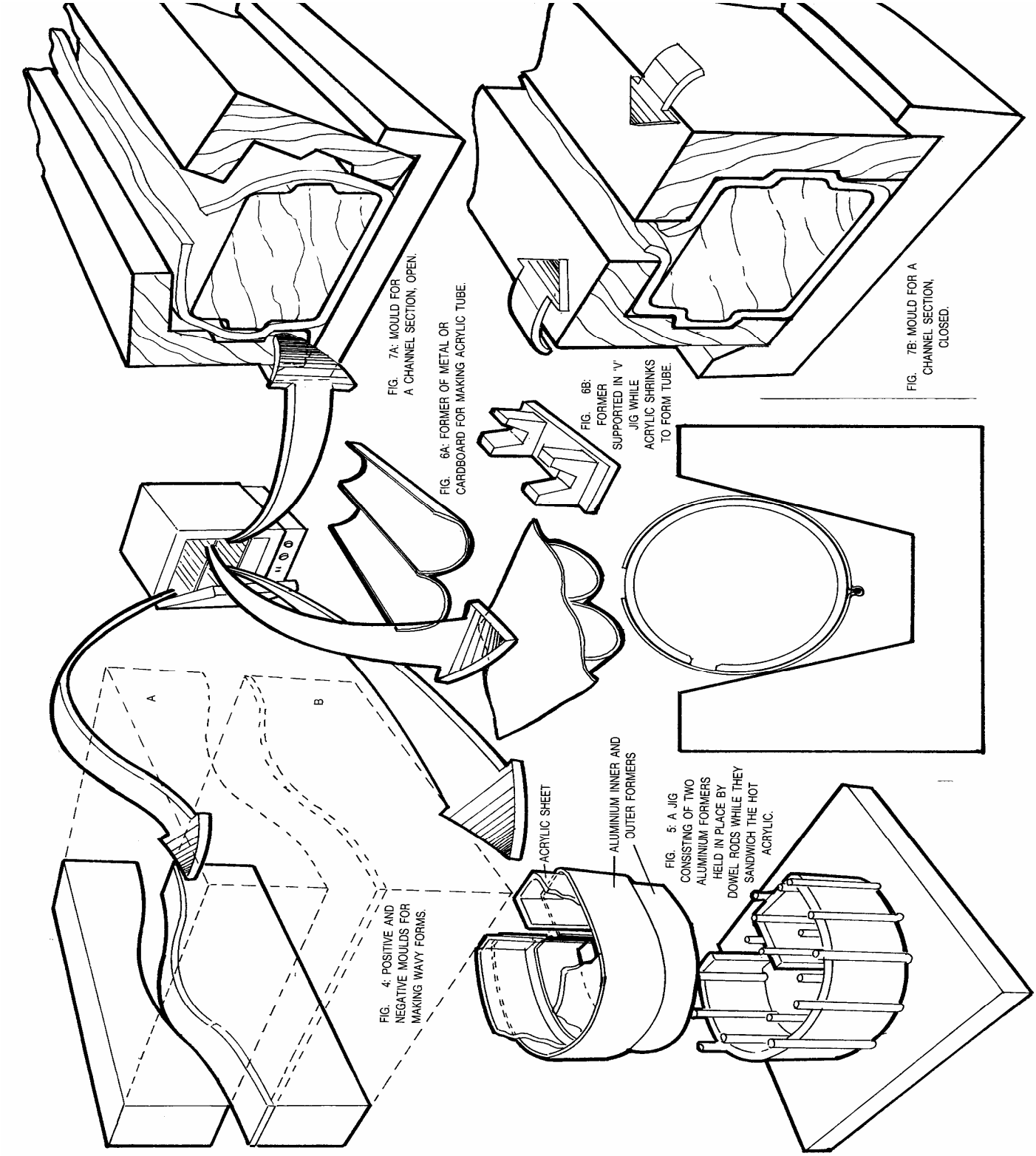
Steps involved included:

1) Make sure your mould is ready to go, and have a pair of gloves near by for handling the hot acrylic when needed
2) Preheat oven to 320° to 340° F
3) Leave your acrylic piece in the oven for approximately 10 minutes depending on thickness
4) When acrylic is ready, put into mold and hold until your piece is cooled down



PUTTING A LARGE-RADIUS CURVE INTO A STRIP OF HOT ACRYLIC.

Some Samples of Stretch Thermoforming



Joining Acrylic Sheet

There are three possible methods, which include using mechanical means such as bolts, thermal methods such as welding, or chemical boding such as solvent cementing. The most common method of joining acrylic sheets is using acrylic solvent cement.

In terms of safety, it is important not to breathe the cement vapors as they may cause drowsiness, dizziness, intoxication, or nausea. It is also important to not unnecessarily touch solvent cement, as it may not be healthy.

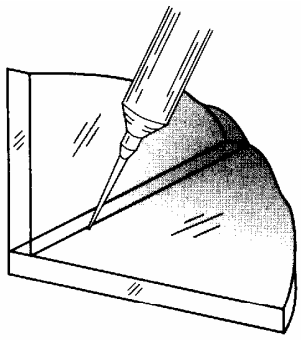
Cementing acrylic is relatively easy, following these simple steps:

Preparation of joint:

1. Parts must fit well without force
2. Parts should not be polished, as this tends to round edges
3. Well-cemented joints will be free of air bubbles and watertight.

Cement solvents work by softening and swelling the acrylic sheet, permitting actual cohesion of the parts Generally capillary action method is most common, where using squeeze bottle applicator with parts already together, put a little solvent along crack. This will get drawn up into joint, as long as the parts have a good fit. Tape may be used to limit the flow of solvent in case of run-off when needed in certain situations.

Initial setting time will take 2-5 minutes depending on type of solvent cement, temperature and humidity, but will actually take about 20-30 minutes to set about 50%, a day for about 90% and about 5 days to fully set. Highly recommend that a waiting period of at least 30 minutes before continuing to work with project. Masking can be used to control where the solvent comes in contact, as it will tend to spoil finish of acrylic

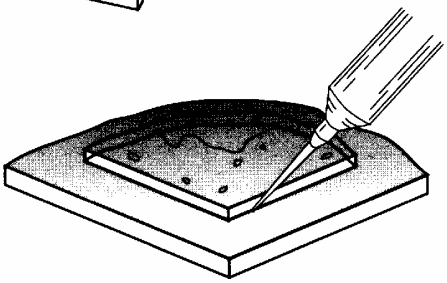


Use a hypodermic needle, eye dropper, or other convenient dispenser.

Parts should fit without forcing or flexing before cementing. There should be no visible gaps.

Do not attempt to cement parts when the temperature is less than 65°F.

Clamping pressure used to hold pieces being cemented together should not exceed 1 psi. Joint should set in 2 to 5 minutes.



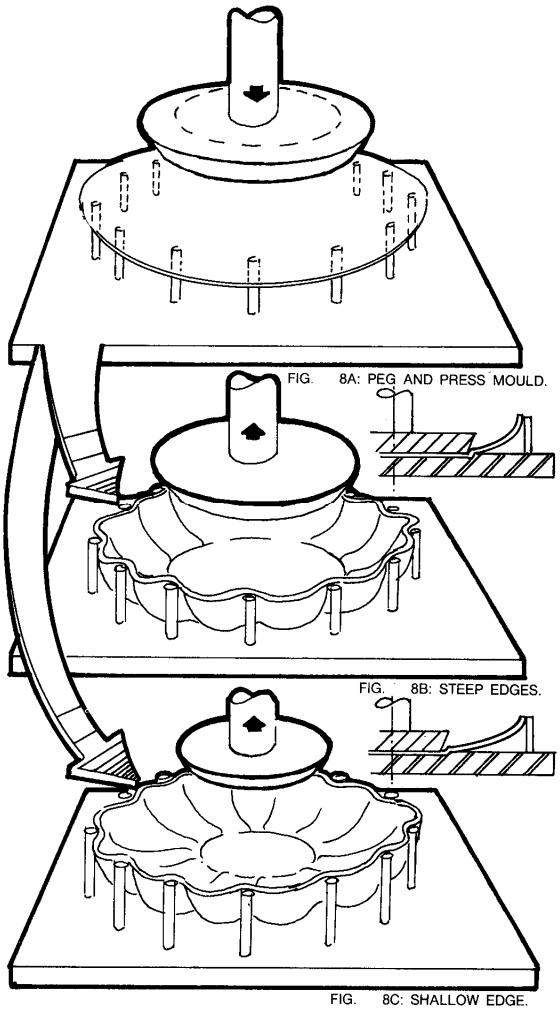
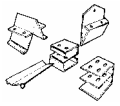


FIG. 8A: PEG AND PRESS MOULD.

FIG. 8B: STEEP EDGES.

FIG. 8C: SHALLOW EDGE.

Name:



Date: Sect.#:

Check List for Project Module

All work where possible must have a complete header, computer generated using previous made related templates with your logo. When handing in everything, double check prior to handing in by checking off the following items in chronological order:

(If Required) Related Explanations Below↓

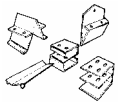
- ☐ Duatang or report cover
- ☐ Title page
- ☐ Table of contents
- ☐ Module information
- ☐ *5 detailed thumbnail ideas, full page with legend
- ☐ * Detailed final rough sketch, full page
- ☐ * Orthographic drawing with boarder, full page
- ☐ * Isometric drawing- computer or hand
- ☐ SPICE, steps you took, separate ½ a page typed
- ☐ Conclusion reflection, separate ½ a page typed
- ☐ This check list- with items handed in, checked off
- ☐ Final self and peer evaluation paper
- ☐ Diskette holder and good diskette with your all of your files on it

*All due date components handed in will have the teachers initial along with a plus #, OT, or minus # showing if they were completed on time. These positive and negatives will directly affect your mark

You will be responsible for handing in one of depending on your situation:

A) A full report with a finished acrylic organizer in project box **or** ,

B) A full report including everything above *except finished acrylic organizer* **and** theory questions.



Index of Key Terms and Phrases:

Find ten new key terms or phrases and include the page number in the table below:

	New Key Term or Phrase	Page #
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Acrylic Plastic

How Organized was it?

Peer Marker: _____

Activity Process and Product Steps	Total Marks	Self Mark	Peer Mark	Earned Marks
Requirements Met: Finished home/office product(s) 1) with a drilled hole, straight bend, solvent cement joint, drape or stretch form, fit inside project box, weight less than ½ kg 2) Colour Computer generated advertisement of product(s) 3) Spreadsheet showing materials, sizes, and weight 4) Report holder with clear front 5) Personal Technological logo on all final papers	10			
Research and Information: 1) Resources and bibliography shown 2) Sample ideas that rough were based on	5			
Solutions: rough ideas and designs: 1) Product(s)-Thumbnails, orthographic sketches, isometric, plans and prototype 2) Rough notes 3) Spreadsheet- material lists, supplies, amounts, sizes, and weight	25			
Final Design/Solution: Product: Your final full size orthographic drawing showing dimensions ISO Advertisment - final full size	10			
Workmanship and Construction: Product(s) practical, functionality, efficient, well put together Smooth edges, accurate bends, good workmanship	20			
Finished Product or Solution: Final product look, ergonomics, innovative Report completion, process all present If you had to do this project again what would you change or include: _____ _____ _____ _____ _____	20			

Final mark:
Based on % finished and completion and fulfillment of requirements of the problem. Fill in your total evaluation both peer and self → **90**

Project Due_____

Note: All rough work must be handed in with this evaluation sheet stapled on the top in portfolio!