Technical Bulletin
Die Cutting & Embossing
Fome-Cor® & Gator™ Products

Date: March 17, 2004

Die Cutting and Embossing

Die cutting and embossing information is provided for the products listed below. Products marked with an "*" do not have a recommended application for die cutting and embossing.

Fome-Cor® Products	Gator™ Products
Fome-Cor® Board	Gatorfoam®
Specialty Products	***Specialty Products***
Acid-Free Fome-Cor® Board - *	GatorLite™ - * (exception 3/16")
Heat-Activated Fome-Cor® Board	Gatorplast®
Self-Adhesive Fome-Cor® Board	Gatorblanks® - *
JetMount®	
JetPrint Board™	
ValuBoard™	

Die Cutting:

Fome-Cor Products:

One of the most common applications for the Fome-Cor products is die cutting. Die cutting with steel rule dies allows the production of pieces of various level of intricacy. This process can utilize one of the unique features of genuine Fome-Cor, edge pillowing.

The key elements to consider when die cutting are the press, the steel rule, the ejection rubber and the substrate. Each of these elements must be selected properly to yield satisfactory results.

SUBSTRATE:

The substrate is the material to be die cut. In this case the substrate is Fome-Cor products. Fome-Cor is a laminate consisting of linerboard top and bottom layers, and a polystyrene core. The linerboard is a rigid paper product, similar to material used to manufacture lightweight cartons. The laminated structure yields excellent rigidity and strength to weight ratio.

The laminated structure of Fome-Cor results in some unique considerations for die cutting. The die cutting actually consists of a multi-step process as each layer of the laminate is cut sequentially.

When die cutting, the paper is the critical part of the laminate. The properties of the paper create the challenges encountered while die cutting. Linerboard is a rigid product and because of its rigidity, it is not flexible or ductile. Linerboard does not tend to stretch easily. As a result the top liner of Fome-Cor can tend crack if improperly die cut.

All machine-produced papers have a "grain". The grain runs along the length on the paper as it is manufactured. The grain direction is often referred to as the machine direction. The opposite direction is referred to as the cross machine direction.

The properties of the paper are different in the machine direction vs. the cross machine direction. Paper is more rigid and will stretch less in the machine direction. Paper cuts more easily along the grain rather than across the grain.

The polystyrene foam core can compress during die cutting. Fome-Cor has the unique property that the crushed foam will remain crushed. The foam does not tend to assume its original thickness. This results in the die cut edges remaining closed (about 40 to 60 mil residual foam thickness). This provides an ascemetrically pleasing rounded effect at die cut edges, called pillowing. This process can also be utilized to produce alternating raised and lowered areas (debossed or embossed).

PRESSES:

Fome-Cor is most commonly die cut on flat bed presses. The presses can be either moving platen type or "clam shell" type. Either type of press can be utilized without affecting the quality of the die cut. The key press consideration is proper "make ready". Make ready is the preparation of the press bed (anvil) to assure that the steel rule cuts evenly through the Fome-Cor without dulling the steel rules.

Typically Fome-Cor is cut on a "hard anvil" to give a pillowed edge. Make ready for this type of die cutting utilizes carbon paper. The press is lowered to the point where the steel rule just touches the anvil. The places where the rule fails to touch the anvil are built up with 1 mil thick shim tape. This process is repeated until a complete imprint of the steel rule is apparent.

Make ready is very important because the platen of the press does not necessarily close evenly. This can be caused by misalignment, uneven cutting loads or by deflection of the platen. As a rule of thumb, a 4 post press will deflect 1 mil per ft. Steel rules, that have been dulled by improper make ready will cut poorly, have increased cutting loads and can contribute to liner cracking problems.

STEEL RULES:

Steel rules are flat strips of steel with very uniform height. One edge of the steel rule is honed to yield a cutting surface. The key properties of cutting rules are hardness, flexibility, bevel type, thickness, uniformity of height and edge preparation method.

BEVEL TYPE:

There are three types of steel rules: 1.cutting rules, 2.scoring or creasing rules 3.serrated and perforating rules.

Cutting rules are the most common when die cutting Fome-Cor. These rules are used to both cut and pillow the edge. Cutting rules are divided into center bevel and side bevel. Center bevel rules have the cutting edge located in the center of the rule. Center bevel rules result in equal forces being placed on both sides of the piece to be cut. The distribution of forces can be important when attempting to minimize cracking.

Center bevel rules are either single bevel or double bevel (also called double double). Double bevel rules have two different tapers. This results in a thinner section of blade that is forced between the cut pieces. The cutting edge is thick enough to be durable.

Side bevel rules have one side that is essentially flat and the opposite side is sloped or beveled. The flat side should be placed toward the Fome-Cor piece to be saved. The bevel is toward the scrap piece. This results in additional compressive force being placed on the scrap (or bleed off side). Cracking tends to be directed in this direction.

Cutting rules can be coated with Teflon to reduce cutting friction and therefore cutting force. This can be effective but it is unclear how long the Teflon coating will last.

SCORING OR CREASING RULES:

Scoring or creasing rules are used to create a fold line. Scoring rules are shorter than standard rules. These rules cut through the top liner but leave the bottom liner intact. This technique is also referred to as slit scoring or "short knifing". This method is often used when additional materials are laminated to the Fome-Cor products.

Unique to Fome-Cor, because of its foam structure, is the capability to crease cleanly. Creasing rules create a crease line on the top liner. Creasing rules should have curved edges and shorter than cutting rules. Fome-Cor is general creased without the use of a matrix. Wider creasing rules make folding Fome-Cor easier. Creasing rules can be used to emboss patterns in the noted Fome-Cor products.

EDGE PREPARATION:

The edge of the steel rule can be prepared in either of two methods: 1.grinding or 2.drawing. Ground edge rules have micro-scratches on the cutting edge. This can result in a blade that has a reduced cutting force. The disadvantage of this type of rule is that it is difficult to maintain the uniform blade height. Drawn edge blades are made by drawing the blade through a die. This produces a uniform blade height and a smooth blade surface.

SERRATED AND PERFORATING RULES:

Serrate rules are used to cut Fome-Cor without closing the edge. These rules have lower cutting force than straight rules. When they are used to cut Fome-Cor the board is not compressed past the point that it will rebound. The result is that the edge is left open. The best serrated edge rules to use are 12 -20 teeth per inch, side bevel rule. The unbeveled side should be placed toward the good piece.

When using a 12-tooth rule, the cut piece will have an unclosed edge with fine serration marks. A 20-tooth rule will slightly indent the top liner but the serration marks will be almost invisible.

The side toward the bevel (bleed off area) will be partially closed with more noticeable serration marks. Serrated rules must always be used with a soft anvil because the teeth must penetrate completely through the bottom liner.

Perforating rules can be used to slit score the top liner. Perforating rules typically have 22 to 60 teeth per inch. These rules should be shorter than the cutting rules so they only penetrate the top liner. Perforating rules should not be used to through cut completely through Fome-Cor.

These rules require much more cutting force because the gullets between the teeth tend to fill with cut liner and foam.

EJECTION AND STRIPPING RUBBER:

Ejection and stripping rubber is essential when cutting Fome-Cor. It serves two purposes. The first purpose is to eject the part from the die after the press opens. The second purpose is to assist edge pillowing and to prevent cracking. Rubber used to merely remove the part from the die is called ejection rubber, rubber used to prevent cracking is called stripping rubber. Liner cracking problems need to be considered whenever coated products such as Fome-Cor are die cut.

In order to better understand the role of the ejection rubber, it is helpful to understand the dynamics of die cutting. Briefly the process is as follows: The press begins to close. The ejection rubber contacts the liner and begins to compress, the steel rule contacts the top liner. The rubber and rule press on the Fome-Cor, and the supporting polystyrene core begins to compress. The liner stretches. The stretching continues until the force exerted by the core and the liner is sufficient to cause the liner to "burst". If the liner has a weak spot the liner can crack before the burst occurs.

Stripping rubber serves to spread the liner stretching over a larger area and reduce local stresses. This reduces the tendency to crack.

TYPES OF EJECTION AND STRIPPING RUBBER:

Ejection rubber can be either closed cell or open cell. The cell structure can be determined by blowing air through the rubber.

Open cell has interconnecting cells. It will allow you to blow air through it. Open cell foam should only be used with flat dies. This type rubber resists fatigue better but does not stretch as well. Open cell rubber will typically last longer than closed cell rubber.

Closed cell ejection rubber is composed of nitrogen filled cells or bubbles. The tensile strength is excellent. It can be stretched and used on both flat and rotary dies. Its life expectancy is less that of open cell rubber.

RUBBER HARDNESS:

Rubber is rated by its hardness. Typical Shore "00" Udometer hardness ratings are:

Soft	20 - 40
Medium	30 - 50
Hard	40 - 60

To aid in denoting a udometer for the ejection rubber a manufacturer will often use a color designation.

It is commonly believed that rubber compresses. In fact rubber actually distorts. Pressure in one-area results in expansion in another. Foamed rubber compresses until the bubbles are essentially flattened and then begins to distort. The amount of compression before distortion depends on the durometer rating of the foamed rubber. Solid rubber immediately distorts upon compression. Restrained rubber, compressed to the point of distortion, can create a great deal of force. This will crush Fome-Cor or even bend the steel rules. As a rule of thumb, soft open cell rubber will compress 50 - 60% before distortion. Hard, open cell rubber will compress 20 - 30%.

The proper techniques for the use of ejection rubber with Fome-Cor include:

1. The ejection rubber should be at least the height of the steel rule and preferably 1/16” - 1/8" higher than the rule.

2. The ejection rubber should not touch the steel rule. This prevents dragging on the blade or getting the rubber cut by the rule. This also prevents the liner from being pulled away from the rule by the distorting rubber.
3. Medium to hard rubber is most commonly used. It is best to completely rubber the rules to prevent cracking and achieve uniform pillowing.
4. On critical areas, soft rubber can be used for additional build-up to prevent cracking. Critical areas are usually near tight bends or sharp points. For these areas, the stripping rubber can be built up as much as 1/4" above the rule height.
5. The rubber should be selected to allow it to fully compressed between the steel rules without crushing the Fome-Cor or bending the rules when the press is fully closed.
6. A more gradual pillowing effect can be obtained by using wider, soft rubber stripping. Stripping rubber from 1-2" wide is commonly used.
7. Fome-Cor can be bent while attempting to die cut a small piece from a large sheet. To prevent bending, the dieboard should be lined with a sheet of soft, low density (2-3 lbs/ft3) polyurethane foam about 3/4" thick.

Die Cutting 3/8" – ST: Die cutting ST with the pillowed edges can be successfully done. This type of die cutting has somewhat different requirements than for cutting thinner Fome-Cor. ST is 3/8" thick. This is about twice as thick as the 327C Fome-Cor. The additional thickness must be compensated for during die cutting.

The dieboard should be 1/2 inch thick and the rule 1.125" high. A 3-pt, long, side bevel, coated rule works best. The rule should be continuously lined inside and out with medium to hard ejection rubber.

The ejection rubber should be placed 1/16" away from the rule on both sides rule. A continuous sheet of soft rubber can also be used in place of the strips of ejection rubber. If cracking results with the continuous rubber, the outer 1/2" of the soft continuous rubber should be replaced with strips of medium rubber.

When designing the figure to be die cut into ST Fome-Cor, it is best to avoid sharp corners and narrow spaces. A minimum distance of 1 inch is recommended between pieces. When sharp corners cannot be avoided, additional, very soft, foam rubber should be added on top of the ejection rubber to avoid localized cracking.

Gator Products:

GatorLite 3/16" and Gatorplast are die-cuttable.

The 3/16-inch and 1/2-inch Gatorplast boards can be die cut using side bevel and serrated-edge steel rules. It is also possible to die cut 3/16" Gatorplast with a standard rule. When cutting ½" Gatorplast, care should be taken to ensure that the cutting rule is long enough to accommodate the board and the ejection rubber comfortably.

Embossing:

Fome-Cor Products:

Attractive 3-dimensional effects can be achieved by the embossing of Fome-Cor products in 1/8", 3/16" and 3/8". The 3/16 inch, 327C product produces the best embossed effects. The 3/8" product sometimes referred to as "ST". Special considerations for embossing ST are noted below.

Embossing particularly enhances foil laminates, glossy lithographs or high gloss screen prints.

Embossing utilizes the same board characteristics that allow edges to be closed or "pillowed" when die cutting. Fome-Cor compressed beyond a certain critical point will retain the pattern of the compression. This feature of Fome-Cor is utilized in the embossing process. The resulting displays are both unique and eye catching.

Embossing is done by using an embossing die on a flat bed die cutting press such as a clam shell, clicker or a fixed platen press. The embossing can be done as part of the die cutting step or if desired, as a separate operation. The portions of the Fome-Cor board that are compressed are referred to as embossed and the portions not compressed are referred to as debossed. Posters and displays that have been laminated or screen printed can be embossed later.

Small, straight line areas can be embossed by using a scoring rule mounted in a standard dieboard. Simple "line shapes" can also be produced by bending scoring bars. The score bars will produce pillowed sections in the center of the board.

It is best to use score bars with rounded edges to avoid liner cracking. The score bar should also be rubbered with soft ejection rubber if cracking is an issue. Straight score lines easier to "emboss" in the grain direction than across the grain when this is an option. Score bars located less than 3/4 inches apart will compress the board between the score bars slightly. Score bars should be at least 3/4” from the edge of the board.

Score bars should extend to the die cut, pillowed edge if possible. If this is not possible, the score bars should gradually taper off (less depth of compression) to avoid a sharp
edge that would puncture the liner.

The sheet of 3/16” Fome-Cor can be compressed to a residual thickness of 30 - 40 mils. Fome-Cor will bounce back slightly from its maximum compression. The force to accomplish this maximum compression with a cutting rule or scoring bar is about 150 - 200 lbs per linear inch. This force varies depending on cutting geometry. The closer the rules, the greater the required cutting force. Insufficient cutting force will result in the bottom liner not being completely cut and it will tear when ejected.

Embossing or compressing of large areas can be done by utilizing an embossing die. The embossing die is a plate, attached to dieboard that will compress additional areas of the Fome-Cor. The pattern of the embossing die is often matched to the screen print or lithograph. The depth of embossing can be varied, typical embossing die would compress to a residual thickness no less than 60 - 80 mils. The force required would be about 100 lbs per square inch compressed. The embossing depth can be less if desired.

The embossing force will vary depending on the configuration of the piece and the depth of compression.

The embossing can be done during the die cutting operation or as a separate operation. The decision to separate the operations may depend on the capability of the press to provide the required cutting power. If the press cannot provide sufficient power, the bottom edges of the Fome-Cor may not be cut through. This problem would require cutting and embossing in separate operations.

The embossing die should be designed to avoid puncturing the top liner. To accomplish this, it is necessary to follow the same basic rules as die cutting. Sharp points or angles should be avoided. Spacing should be adequate to avoid excessive liner stretch. The embossing die should be fabricated with smooth rounded edges. The angle of the edge should be no sharper than about 30 degrees.

Embossing dies can be made from various materials including metal (copper, brass etc), rigid plastics or pressed board. The material of construction of the die is usually selected based of on available fabrication techniques, complexity of the design and intended life.

Embossing 3/8" ST: Several different methods can be used to emboss ST. A hand engraved hard rubber die can be used. Embossing dies can also be made from hard plastics or metal. These dies are more durable than the hard rubber dies. Plastic and metal embossing dies should be lined with a thin layer of soft ejection rubber to avoid cracking.

The die should be designed to compress the ST to a thickness of no less than 60 mils in any place to avoid high cutting loads. When estimating the residual thickness, the soft ejection rubber should be assigned a value of 1/3 of its original thickness.

Simple patterns can be made in ST using rounded edge creasing rules. It is necessary to continuously line the creasing rules with soft to medium ejection rubber to avoid cracking. The ends of the creasing rule should be tapered to avoid a sharp point at the end of the rule. The creasing rules should be spaced 3/4" apart and should be at least 3/4" from the edge of the part.

The embossing dies should not have any sharp points or edges. The die should be designed with both rounded edges and rounded (vertical) contours.

Gator Products:
No Gator products are embossable.

For details about our full line of Fome-Cor or Gator products, call (800) 438-1701 to request printed product literature or visit our web site at www.fomecor.com or www.gatorfoam.com.

Additional product/technical support documents are available from this service, including:

- **Product Information Sheets** – describing the features and benefits of each graphic arts board in the Fome-Cor and Gator™ board lines and designed to aid in your product selection/specification process. Products available include:

Fome-Cor Product Line

1. Fome-Cor®
2. Acid-Free Fome-Cor
3. Heat-Activated Fome-Cor
4. Self-Adhesive Fome-Cor
5. JetMount®
6. JetPrint Board™
7. ValuBoard™

Gator Product Line

1. Gatorfoam®
2. GatorLite™
3. Gatorplast®
4. Gatorblanks®

- **Technical Bulletins** – describing the following decorating/fabricating techniques that may be used with Gator and Fome-Cor board products:
    1. Direct Printing and Painting
    2. Mounting
    3. Laminating
    4. Cutting
    5. Die cutting/Embossing
    6. Framing

- **Products for Use –** describing other manufacturers' products that are recommended for use with Gator and Fome-Cor boards.

Alcan Composites USA
3480 Taylorsville Hwy
Statesville, NC 28625
(800) 438-1701 telephone
(704) 878-2708 fax
www.gatorfoam.com
www.fomecor.com
www.alcancompositesusa.com

LIMITED WARRANTY

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