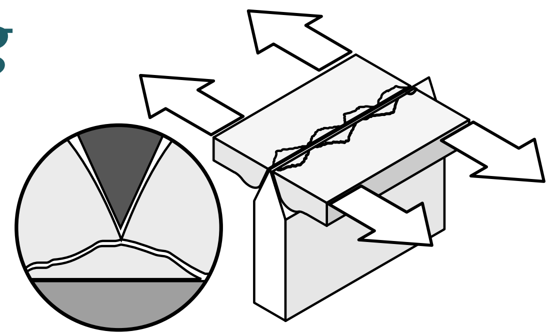
From the I.A.D.D. and DieInfo

Tech Notes

For Diemaking and Diecutting

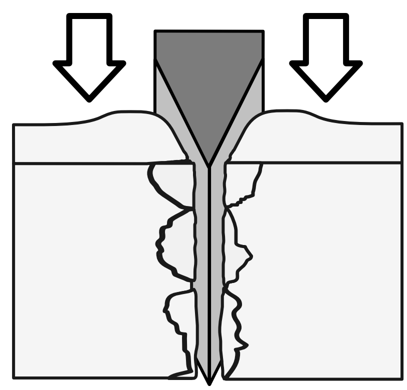
TN-0001
July, 2002

How to Eliminate Flaking in Platen Diecutting



Flaking is a premature lateral shearing of the underside of the material being diecut. This shearing is generated by the high level of diecutting lateral push & pull which grows progressively higher as the knife wedge penetrates further into the material.

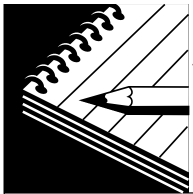
In most situations this would cause the material to snap along the centerline of the blade, but when the lateral internal stress is excessive, the material shears diagonally and fractures. Ultimately the blade makes contact with the anvil and the fractured, partially detached layers are cut, but remain firmly attached to the underside of each diecut edge.



The recommended solutions to the problem of flaking are:

- ***Reduce the Bevel Angle of Key Knives***
- ***Use Side Bevel Knife***
- ***Modify the Knife Bevel***
- ***Power Clamping***
- ***Cutting Plate Clamping***
- ***Silicone Profile Rubber Combination***
- ***Ejection Supporting Ejection***
- ***Isolate the Cutting Action***
- ***Reduce Crease Formation "Draw"***
- ***"Full" Profile Counter***
- ***Eliminate "Wrap-Around" Material Stretching***
- ***Calibrate the Platen Press & Steel Rule Die***
- ***Precision Press Leveling***
- ***Diecut Material Orientation***

IADD
INTERNATIONAL ASSOCIATION of DIECUTTING and DIEMAKING



Brainstorming, Notes & Ideas

"Many ideas grow better when transplanted into another mind than in the one where they sprung up." *Oliver Wendell Holmes*

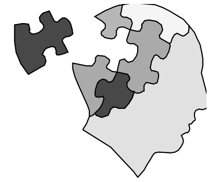


Table of Contents

For ordering information contact

International Association of Diecutting and Diemaking
651 Terra Cotta Ave, Ste 132
Crystal Lake, IL 60014
1.800.828.IADD
staff@iadd.org
www.iadd.org

or

DieInfo, Inc.
321 Cherry Street
Port Townsend, WA, 98368
1.360.385.4214
kevin@dieinfo.com
www.dieinfo.com

The Author

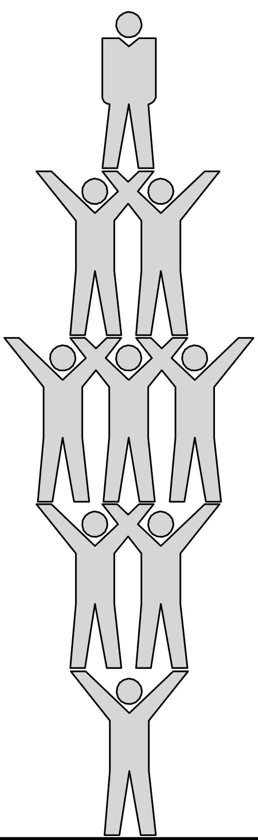
Kevin B Carey is the Technical Director of DieInfo and has been involved in converting, diecutting, diemaking, and related technology for more than 40 years.

Carey served a diemaking/diecutting apprenticeship in Europe, gaining experience as a Converting Master Craftsman, before becoming a trade union leader, a trainer, and a production supervisor. In 1979 he formed Lasercomb America and led it as President/CEO to become the leading innovator in commercial diemaking, CAD-CAM systems and related technology.

The experience gained in implementing progressive technology induced Kevin to change career paths in 1990 when he formed a training and process development organization dedicated to eduction in converting. First as a consultant, then as a trainer, a lecturer, and finally as an editor, the company began to define the problem of performance in converting manufacturing and to develop solutions to solve problems and fill knowledge gaps. It was apparent during this time there was a poor understanding of the difference between training and information and technical data management. Although poor performance is often seen as a training issue, it is more likely to be the absence of specific graphic information which can build confidence and competence in even the most inexperienced trainee.

"The whole object of the organization is to get co-operation, to get to each individual the benefit of all of the knowledge and all of the experience of all of the individuals."

Hamilton Barksdale



This experience grew into DieInfo. Publishing, consulting, training, auditing, and trade show organization, whose E-Business Technical Publishing and Information Center is on-line at www.dieinfo.com.

Kevin has given hundreds of presentations to the converting industry in Europe, the Pacific Rim, and North and South America. He is the editor of DieInfo magazine and is a frequent contributor to leading industry publications. Carey has served as an IADD Association Director in addition to his recognition as the Diemaker and Diecutter of the year in 1986.

Carey is available for in-house training and consulting and can be reached at kevin@dieinfo.com or by calling 1.360.385.4214.

The International Association of Diecutting and Diemaking

The IADD is a not-for-profit international trade association serving diecutters, diemakers, and industry suppliers worldwide. The Association serves as a worldwide leader and catalyst in inspiring industry success and the ultimate benefits to society that the industry provides. The vision of the IADD is to be the definitive resource for the diecutting converting industry, bringing together and serving people who convert soft to semi-rigid materials into various cut parts. By sharing collective knowledge, expertise and information, the IADD leads and stimulates creativity and innovation, provides opportunities for professional growth, serves the diverse needs of all industries engaged in diecutting and demonstrates commitment to ensuring progress through participation.

IADD provides conferences, educational and training programs, networking opportunities, a monthly magazine, technical articles, regional chapter meetings, publications and training manuals, recommended specifications, videos and surveys. IADD also presents the Diecutting Odyssey, a unique trade show and innovative concept in technical training featuring a hands-on Techshop™ where training programs come alive in an actual working diemaking and diecutting facility inside the exhibit area.

Visit www.iadd.org or call 1-815-455-7519 for more information about IADD.

Introduction

Diecutting-Converting is a flexible, highly efficient, low cost system of high volume manufacturing. The sheer diversity of the products cut, the materials used, the technology employed, and the applications fulfilled impact every area of our daily lives and our economy. But like any manufacturing process diecutting has strengths and weaknesses. It is more accurate to state diecutting has inherent technical challenges, which must be overcome, if productive success and consistent quality products and diecut parts are to be converted.

In diecutting the goal is to ***"Sell the First Impression"***, to maximize production speed and yield, and to minimize waste of time and particularly materials. In practice the secret of success in diecutting is to anticipate potential on-press problems, and to integrate solutions into the design and fabrication of the tools, and into the pre-press, pre-production procedures. This clearly requires a partnership between the diemaker and the diecutter.

It is important to note although flaking of the diecut edge is an ***"on-press"*** production problem, the majority of the solutions require modifying the design and the fabrication of the steel rule die and female creasing counter, many days before the diecutting operation may take place! Simply stated the problem of flaking must be solved by the diemaker if the diecutter is to achieve on-press success. In practice it is impossible to separate diemaking and diecutting, as they are both dependent upon each other for productive success.

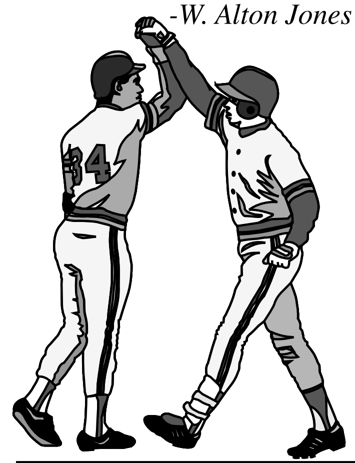
What does this mean? To generate consistent converting success, to generate exceptional quality diecut products, to meet or exceed productive goals, requires a close technical partnership between the diemaker and the diecutter. This mutually beneficial relationship will require communication, cooperation, innovation, and education. Every production run is research, and it is a test of both the diemakers knowledge and skill, and the diecutters ability and experience.

Every time the press runs, we are gaining new information and insights into how materials, tools, products, procedures, and people perform. Both the diemaker and the diecutter must participate and share this knowledge, to ensure new ideas, better techniques, and more effective methods are integrated into subsequent production operations.

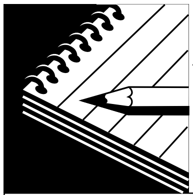
Flaking is an entirely predictable failure, which can be simply and effectively eliminated. This publication from the International Association of Diecutting and Diemaking, and DieInfo, is intended to illustrate some of the proven techniques and procedures, which have removed this perennial problem from diecutting manufacturing. We hope you find this information useful, and we would value your ideas, suggestions, improvements, and your feedback.

"The man who gets the most satisfactory results is not always the man with the most brilliant single mind, but rather the man who can best coordinate the brains and talents of his associates."

-W. Alton Jones

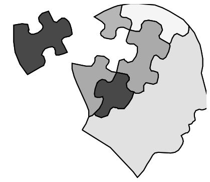


Before you invest valuable time in reading and digesting the technical analysis of the problem of flaking, you may consider skipping these sections and move directly to the solution section, and to the summary. However, if you are not completely confident of your understanding of the key principles of diecutting, we would recommend you review the information at some stage, and confirm or integrate these techniques with your existing knowledge.

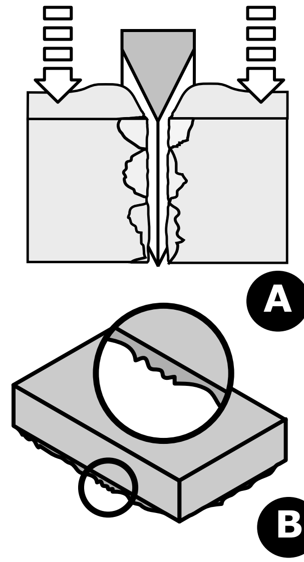


Brainstorming, Notes & Ideas

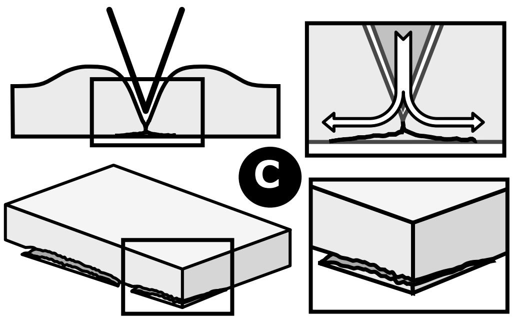
"Many ideas grow better when transplanted into another mind than in the one where they sprung up." *Oliver Wendell Holmes*



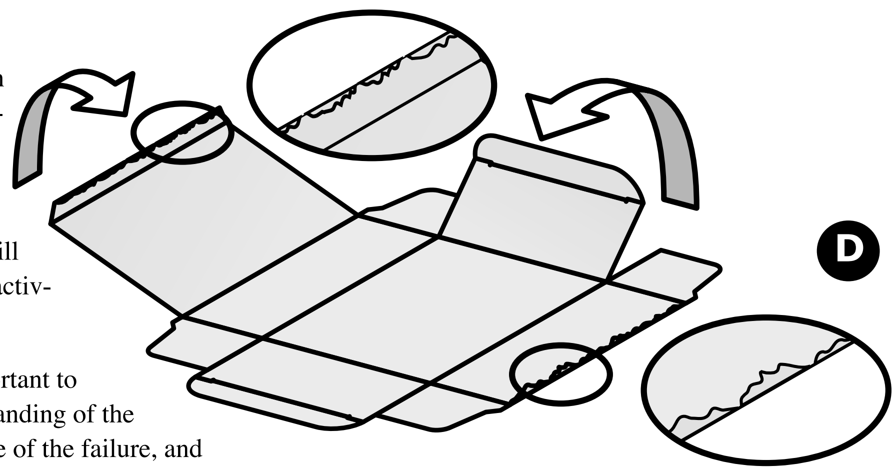
What is Flaking?



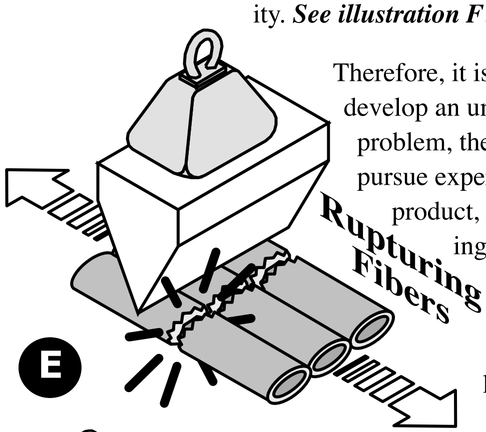
Flaking or chipping in platen diecutting is a tearing of the underside of the diecut part parallel to the diecut profile. ***Illustrations A, B, & C show different types of flaking***. Flaking or chipping of the underside of the diecut edge represents permanent damage to the converted product as the fractured and partially separated layers are neither simple nor cost effective to remove.



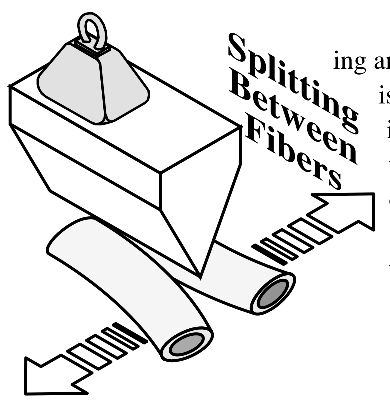
As a result, this type of processing failure usually leads to rejection of the product, even though the tearing is generally on the ***"inside"*** of the product, and not visible to the end user of the carton or the fluted container. ***See illustration D***. Unfortunately, flaking represents a type of failure, which is difficult to ignore, and also embarrassing to explain. In some applications tearing is fracturing of the perfected inner printed or coating layer of the paperboard, and not the material itself, however, the resulting disfigurement is equally unacceptable. In addition, for those diecut products, components, or point-of-purchase displays, where the failure is evident on exposed edges, it is vital to eliminate even a slight degree of flaking failure.

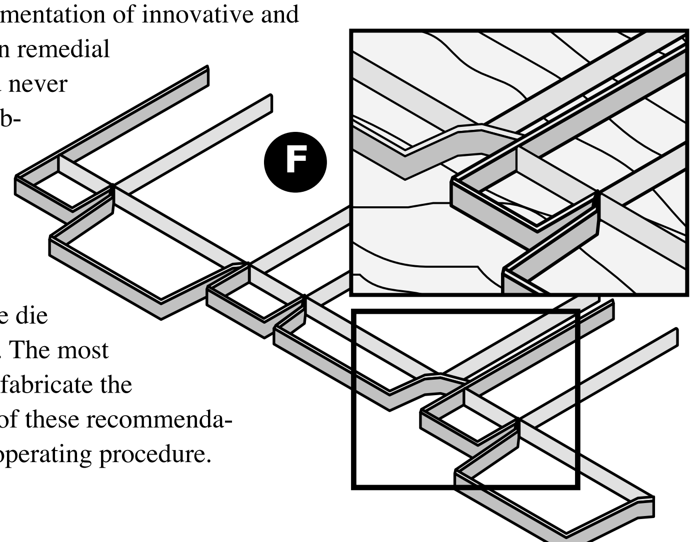


Fortunately, flaking is a predictable failure, which is surprisingly common in the platen diecutting process. It is most likely to occur when diecutting at right angles to the paperboard grain, ***see illustration E***, as the alignment of the fiber to the cutting edge of the blade, clearly illustrates. Also flaking will occur where there is a concentration of converting activity. ***See illustration F***.



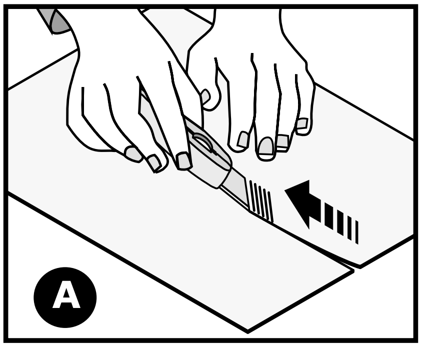
Therefore, it is important to develop an understanding of the problem, the cause of the failure, and pursue experiments with several alternative solutions, based upon the product, the application and the paperboard/material. By developing and practicing the implementation of innovative and practical pre-production remedial actions, Flaking should never become an on-press problem.



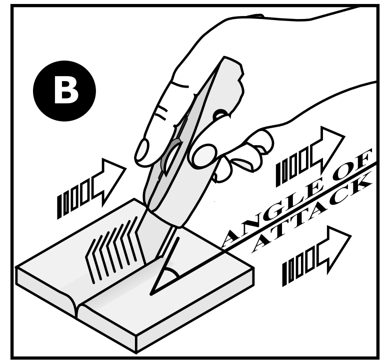


In summary, flaking and chipping of the diecut edge is almost inevitable, unless you integrate features into the steel rule die to prevent the problem happening. The most effective practice is to design and fabricate the steel rule die, with one or several of these recommendations implemented, as a standard operating procedure.

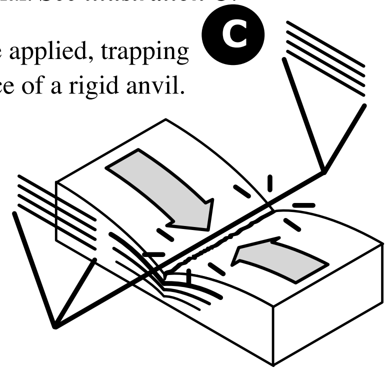
How Does Platen Diecutting Work?



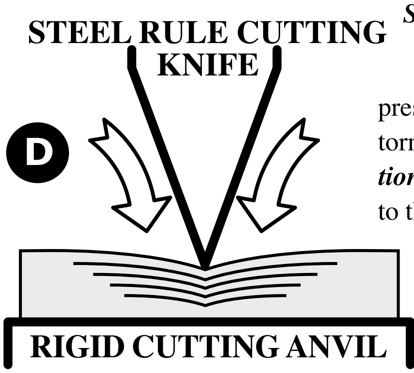
In using the term cutting the most obvious image would be a slicing action or an incremental cutting motion using a common cutting tool like a Utility Knife. ***See illustration A***. In this type of cutting only part of the blade is being used, the blade would be angled to cut with the minimum of force, and only a small part of the material is cut at one time. ***See illustration B***. This is efficient, and it generates a cleanly cut or smooth sliced edge.



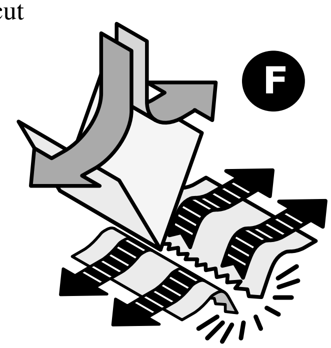
In contrast platen diecutting or simultaneous splitting, positions and presses down the entire length of the steel rule knife cutting edge upon the upper surface of the material. ***See illustration C***.



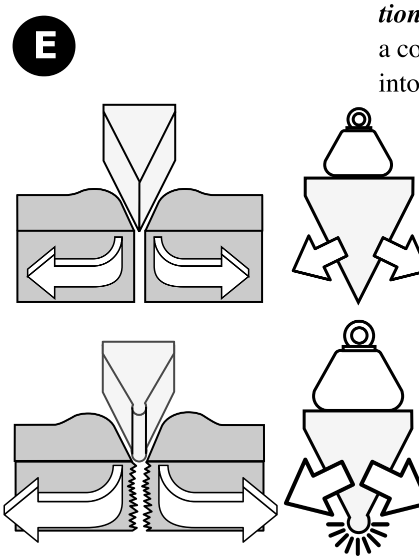
To diecut the material a considerable amount of force must be applied, trapping the material between the cutting edge of the knife and the surface of a rigid anvil. ***See illustration D***.



This is not an efficient form of cutting, as high levels of pressure are required, the resulting cut edges are ragged and torn, and the knife-edge is progressively damaged, ***see illustration E***, as it repeatedly strikes the anvil surface. This damage to the knife edge not only undermines cutting performance, but worst of all it raises the lateral displacement/splitting force, which will increase the chance of flaking and chipping of the diecut edge.



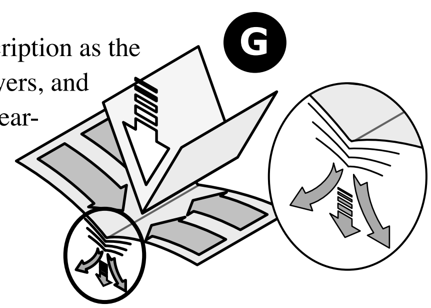
The correct method of describing hard anvil platen diecutting is to define it is a combination of two quite different but complimentary forces. These are ***Explosive Penetration*** and ***Explosive Separation***. This is critically important because the cutting action is actually a combination of vertical pinching force, which is rapidly converted into a horizontal or lateral splitting force as soon as the surface layer ruptures. ***See illustration F***.



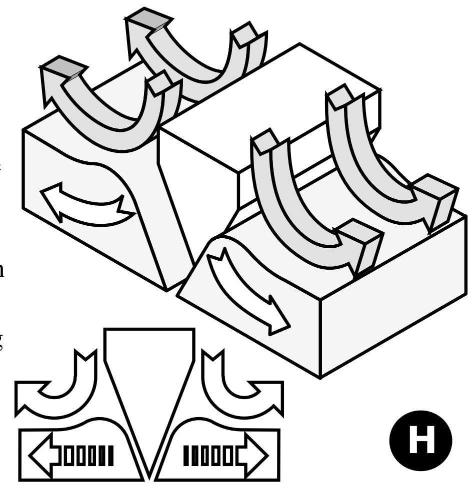
As the knife-edge makes contact with the material being converted, it pinches and compresses, creating a valley in the upper portion of the material. ***See illustration G.***

The creation of this depression stretches the material surface on both sides of the blade, down and into the valley created by the knife-edge. Eventually, the combination of surface stress and internal compressive force causes the surface to burst apart, in an explosive action.

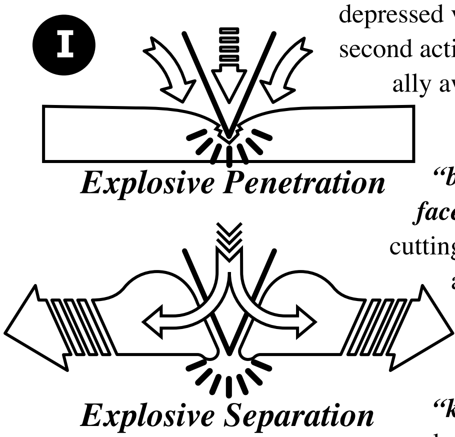
The word ***"Explosive"*** is used correctly in this description as the action of both the pressure rupturing of the surface layers, and the lateral splitting of the lower layers, are a violent, tearing-bursting action which snaps the material apart and is very different from our image of ***"cutting!"***



As soon as the surface is fractured the role of the knife-edge is diminished and the action of the knife bevel angles comes into play. The vertical force of the knife-edge is now converted into a lateral splitting action, as the bevel surfaces of the knife, drive the material away at 90 degrees from the knife-edge centerline. ***See illustration H***.



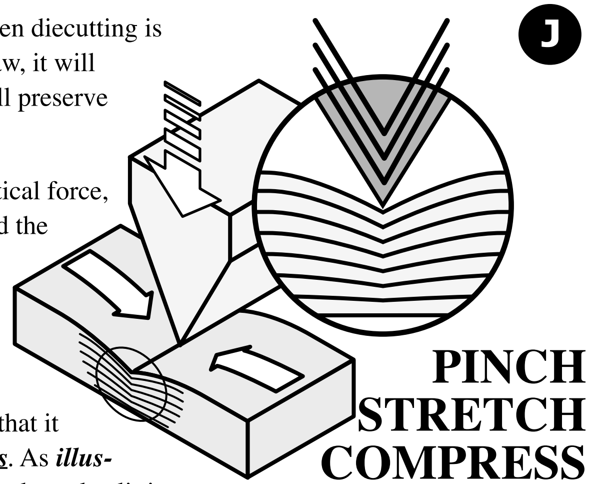
As the knife drives further toward the anvil the degree of lateral force generated by the bevel faces, grows higher and higher as it causes temporary pressure ridges to build on the upper surface of the material. In practice the material fails under the lateral stress of wedge penetration and the material snaps apart before the knife edge makes contact with the anvil surface! There are two key factors here which are important to reinforce. One of the key problems of diecutting is ***"Draw"*** or the generation of lateral tensile stretching of a material as it is diecut. The first action of the knife edge pulls material toward the depressed valley caused by the blade edge; however, the second action of the knife/wedge drives the material laterally away from the steel rule knife. ***See illustration I***.



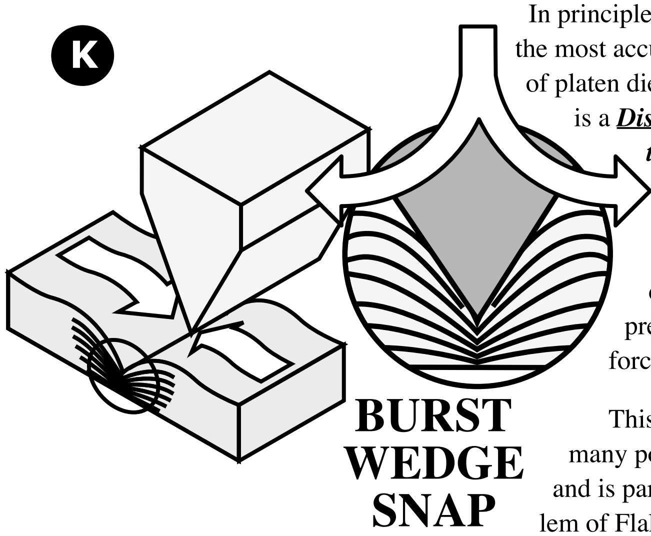
The second key factor in the description is in the words ***"before the knife edge makes contact with the anvil surface."*** There is no need for the knife edge to strike the steel cutting plate as the vast majority of materials have already split apart before the knife edge makes contact with the support anvil!

Therefore, the primary goal in platen diecutting is ***"kiss-cutting"*** as this will minimize draw, it will reduce the generation of flaking, and it will preserve and protect the sharpness of the knife cutting edge.

In summary platen diecutting is a combination of two forces. The initial vertical force, which ***Pinches, Stretches, and Compresses*** the material, ***see illustration J,*** and the primary lateral force, which ***Bursts, Wedges, and Snaps*** the material apart. ***See illustration K***.

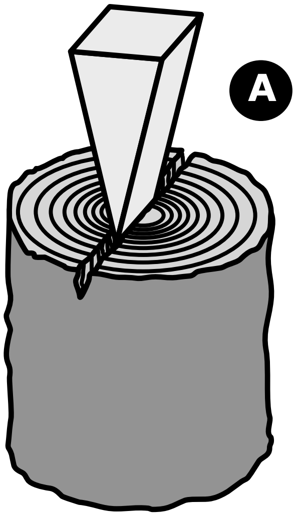


In principle and in practice the most accurate description of platen diecutting is to state that it is a ***Displacement Process***. As ***illustration K*** shows, the lateral splitting force generated by the bevels of the knife-wedge account for more than 70% of the force expended in platen diecutting, as they convert the vertical press stroke into a horizontal splitting force.



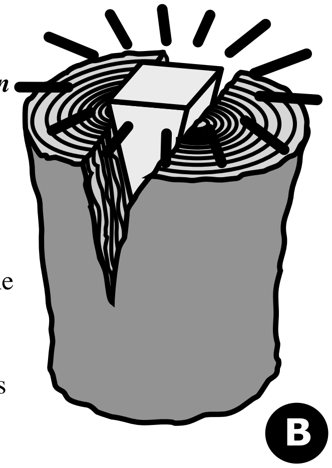
This understanding is key to eliminating many potential problems in platen diecutting, and is particularly important in solving the problem of Flaking.

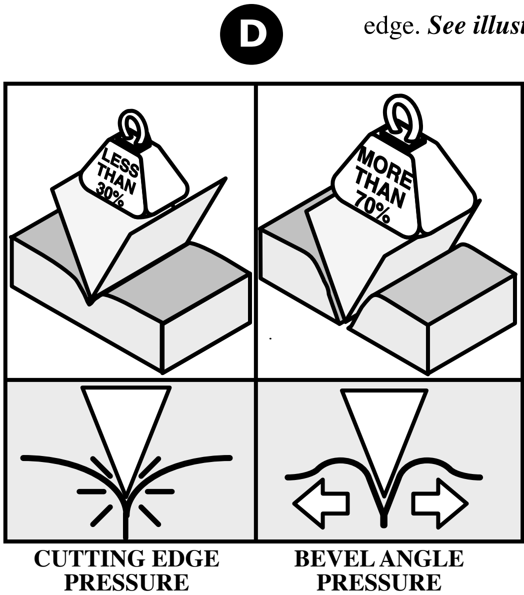
What is Displacement Diecutting?



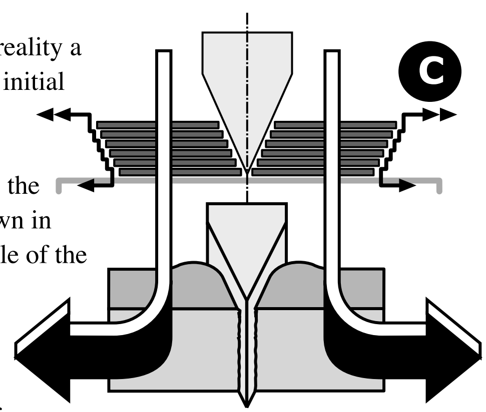
The dictionary defines the word displacement as ***…the act of displacing (moving) physically out of position… the difference between the initial position and any later position…*** In platen diecutting this action can be most accurately described as ***"Wedging"*** and the action can be compared to splitting a tree log with a steel wedge.

For example, as a wedge is driven into the end grain of a log of wood, the split is initially formed by the sharpened leading edge of the steel wedge, in the same way the cutting edge of the steel rule knife penetrates the surface of the material being diecut. ***See illustration A.*** However, almost immediately, the split is widened as the wedge is driven into the fracture, and the bevel surfaces force, drive, and tear the wood and fibers apart. In the same way the bevel surfaces of the steel rule knife push the material being diecut apart away from the centerline of the cutting edge. ***See illustration B.***



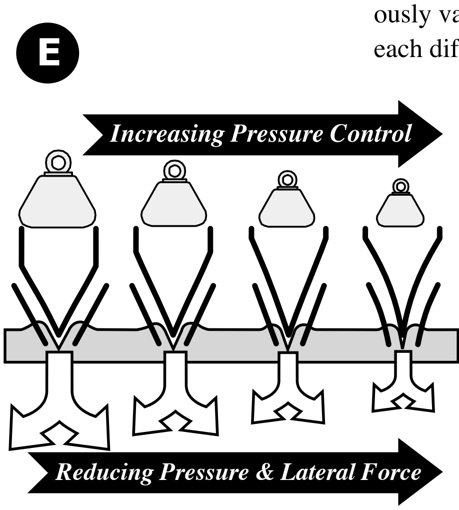


In platen diecutting the knife is in reality a sharpened wedge, which converts an initial vertical force into a lateral splitting action, as it is driven down through the material. ***See illustration C.*** Note the displacement angle of the layers shown in ***illustration C*** are identical to the angle of the cutting knife.

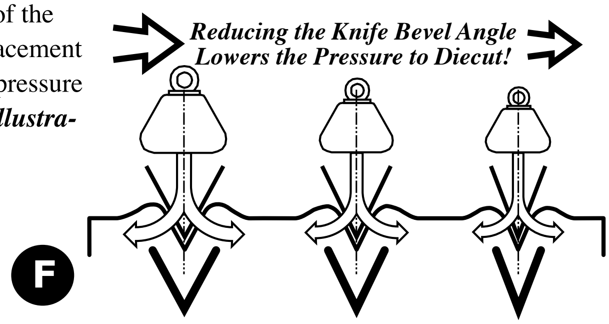


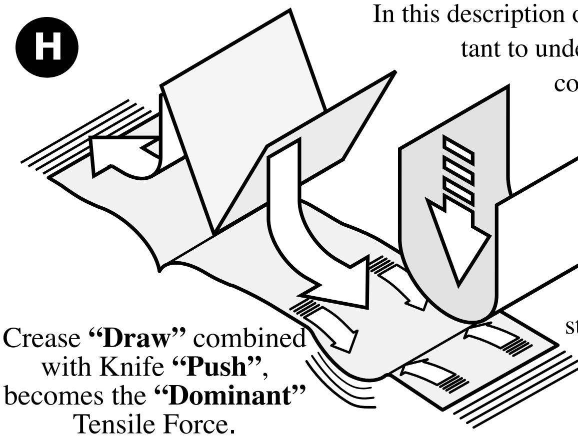
This is a key factor in platen diecutting as less than ***30%*** of the total force is required to split the surface of a material. However, more than ***70%*** of the total force is consumed in displacing the material, on either side of the blade until it splits apart. ***See illustration D.***

The amount of pressure required for knife penetration into the surface of the material, and then for lateral displacement separation of the material, will obviously vary based upon the density, the fiber characteristics, the composition, and fiber orientation of each different material.

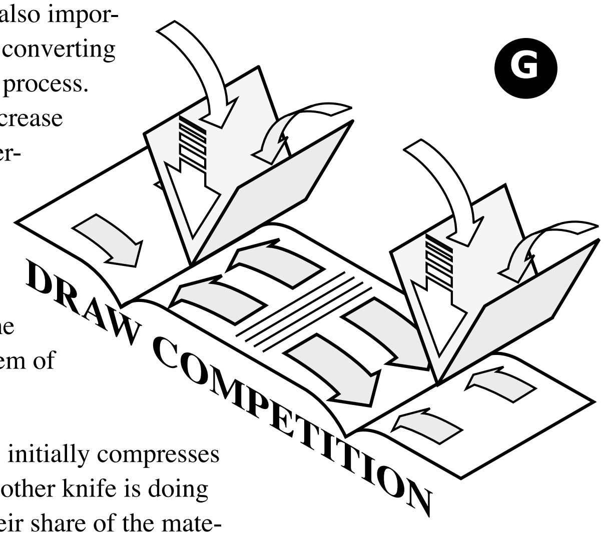


Furthermore, the degree of pressure splitting or separating any material is primarily a function of the bevel angle of the knife wedge. Therefore, as the bevel angle of the knife increases, the lateral displacement force increases, the overall pressure required to diecut is higher, and the degree of control of the process is reduced! ***See illustration E.*** Naturally, as the bevel angle of the knife decreases, the lateral displacement force decreases, and the overall pressure required to diecut is lower. ***See illustration F.***



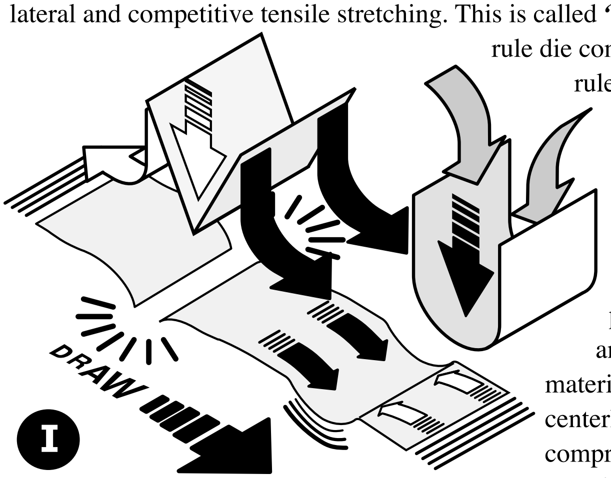


Crease **"Draw"** combined with Knife **"Push"**, becomes the **"Dominant"** Tensile Force.

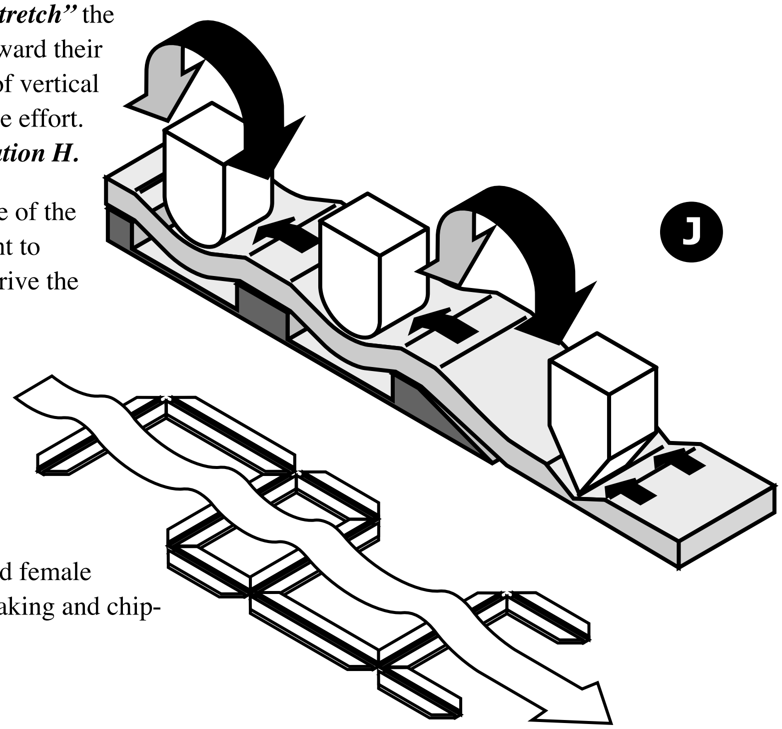


In this description of platen diecutting it is also important to understand the role of other converting components in the cutting process. These would include crease rules, scoring and perforating knives, and debossing and embossing tools, integrated into the steel rule die alongside the knives with the problem of flaking

For example, as every knife initially compresses the material and stretches it down into a valley created by the knife tip, every other knife is doing the same thing at the same time, and literally fighting with other knives for their share of the material! ***See illustration G.*** Therefore, it is initially the tip of each knife which creates high levels of lateral and competitive tensile stretching. This is called ***"Draw"*** in platen diecutting, as every steel rule die component is competing with every other steel rule die component. (Including the ejection material, even though the ejection pattern is supposed to be controlling and reducing the impact of draw!)



For example, in the same manner as the knife the creasing rule is initially competing with the knife as they both ***"pull"*** and ***"stretch"*** the material toward their centerline of vertical compressive effort. ***See illustration H.***

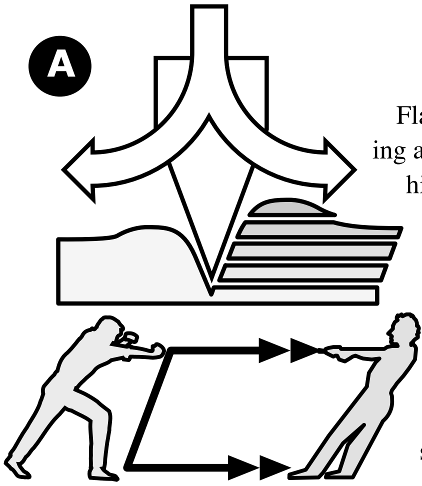


However, immediately the knife-edge penetrates the surface of the paperboard, the bevel angle of the blade, immediately adjacent to the crease rule, is working in conjunction with the crease to drive the paperboard toward the crease channel. ***See illustration I.***

Further complicating this now asymmetric, high level of tensile stress or draw, is the stretching of the diecut material as it is ***"wrapped"*** around components on the cutting plate, such as the crease female counter tool, and particularly when using individual matrix strips. ***See illustration J.***

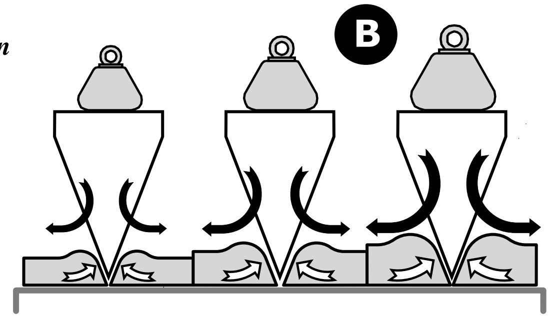
How do these forces generated by the action of the male and female tool compromise platen diecutting performance to generate flaking and chipping of the diecut edge?

Flaking: The Source(s) of the Problem



Diecutting
“PUSH & PULL”
Displacement

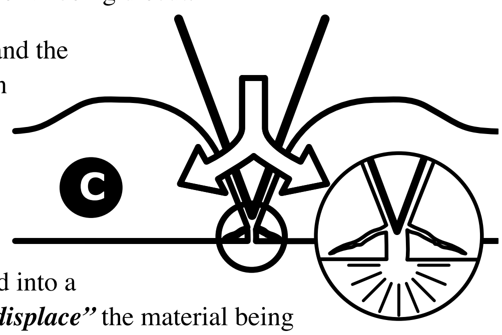
Flaking is a premature lateral shearing of the underside of the material being diecut. This shearing action is generated by the high level of lateral ***push & pull force***, which grows progressively higher as the knife wedge penetrates further and further into the material. ***See illustration A***.



The thinner the material the lower the lateral displacement force, and the thicker the material the higher the combination of horizontal push and pull exerts excess pressure on the material. ***See illustration B***.

In most situations this would cause the material to snap, along the centerline of the blade, but when the lateral internal stress is excessive, the material shears diagonally, and fractures. ***See illustration C.*** The majority of materials converted in the platen diecutting process, snap and separate before the cutting blade makes contact with the surface of the anvil. This may be after 50 - 60 - 70 - 80 - 90% penetration, depending upon the density, the toughness and the construction of the material being diecut.

Ultimately the blade makes contact with the anvil and the fractured, partially detached layers are cut, but remain firmly attached to the underside of each diecut edge. ***See illustration D.***



In spite of the appearance of the diecutting stamping process as a vertical cutting motion, the reciprocation of the tool and/or the platen is converted into a horizontal tearing or snapping action, as the blades ***“displace”*** the material being diecut, splitting the material apart.

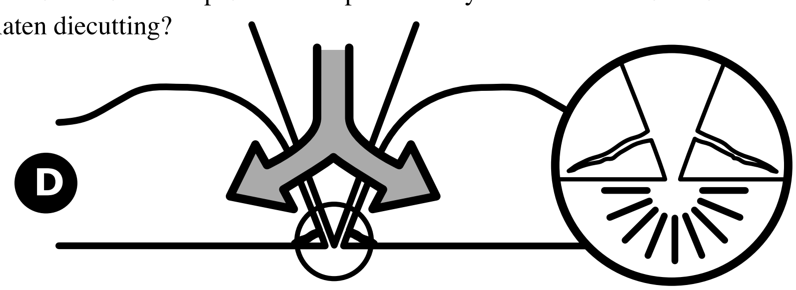
Therefore, the source of the flaking problem is the lateral push from the blade and the pull from the converting action of other components in the steel rule die. These key factors must be overcome by modifying the steel rule die to minimize and to control the impact of Lateral Tensile Stress or Diecutting Draw.

THE FLAKING SOURCES
Key Steel Rule Knife Parameters
Paperboard Construction & Attributes
Crease & Converting Tool Competition
Ejection Material Shape & Attributes
Knife Condition & Travel Distance
Anvil Type, Condition & Rigidity

The source of the flaking problem is outlined in the ***chart, at left.***

In summation, we know excess lateral tensile stress, ***push & pull***, cause a material to prematurely shear, before the knife can complete its task.

So how do we solve this problem and permanently eliminate this common failure in platen diecutting?



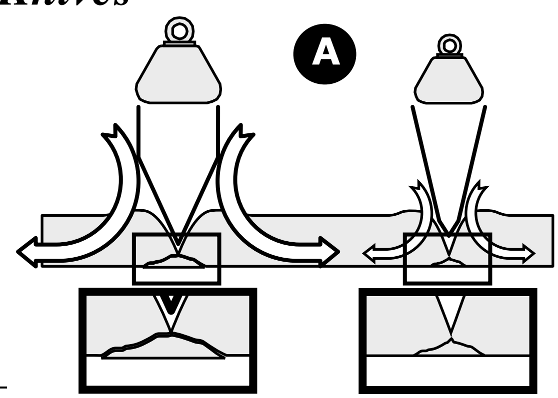
Flaking: The Solution(s) to the Problem

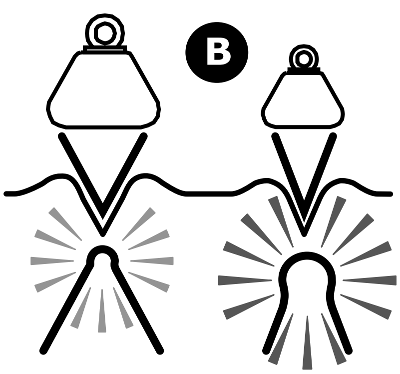
In reviewing everything we have learnt so far, the overall solution should now be obvious. It is essential to reduce the push of the knife and the pull of other components prematurely acting upon the paperboard, and it is vital to isolate and stabilize the paperboard immediately next to the knife as it is diecut. These demands require several pragmatic steel rule die and press actions. These are:

1. ***Reduce the Bevel Angle of Key Knives***
2. ***Clamp & Isolate the Material***
3. ***Implement Reduced Bead Creasing***
4. ***Calibrate the Press & Every Steel Rule Die***
5. ***Implement Precision Press Leveling***
6. ***Control Diecut Material Orientation***

Solution 1.1 Reduce the Bevel Angle of Key Knives

It is effective practice to reduce the bevel angle of each key knife, where you can predict flaking is likely to occur. This change will help to minimize and lower the displacement force generated by this knife as it converts vertical pressure into lateral splitting force, by minimizing and lowering the displacement force. This will reduce the lateral tensile stress on the paperboard, to reduce the generation of premature shearing on the underside of the cutting edges. ***See illustration A.***

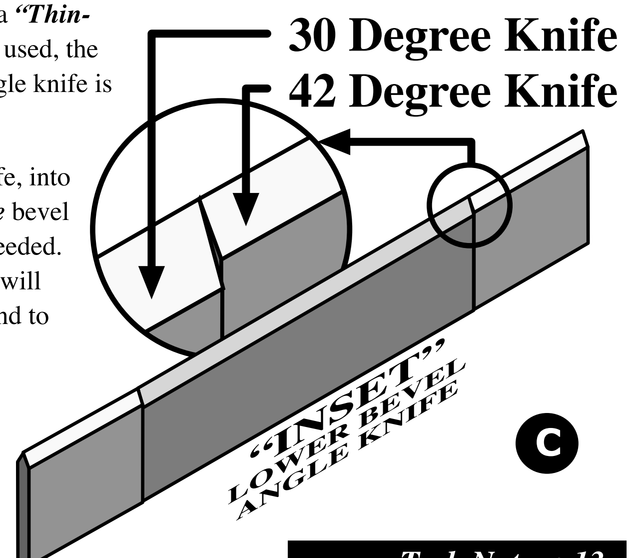




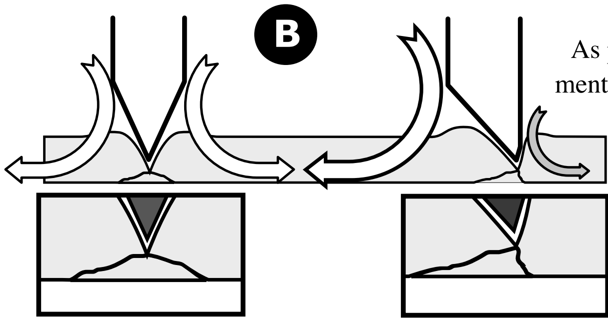
The reason we simply do not use a lower bevel knife throughout the die is, the lower the bevel angle of the knife the more susceptible the blade is to compressive edge damage. ***See illustration B***. However, if a ***"Thin-Plate"*** or softer cutting plate is being used, the potential damage to a lower bevel angle knife is significantly reduced.

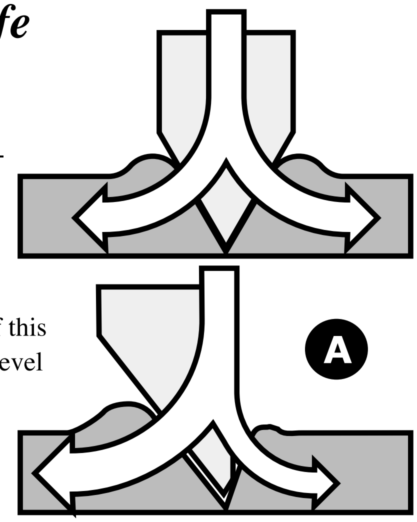
By inserting a ***30-degree*** bevel knife, into a steel rule die ruled with a ***42-degree*** bevel knife, the ***"inset knife"*** technique is used to position the knife where it is needed. ***See illustration C.*** The other knives in the die, the ***42-degree*** bevel knives, will actually act like bearers for this knife to protect it from over compression and to keep it sharp.

This is a simple and effective change to the steel rule die, which should become a standard operating procedure.



Solution 1.2: Use Side Bevel Knife

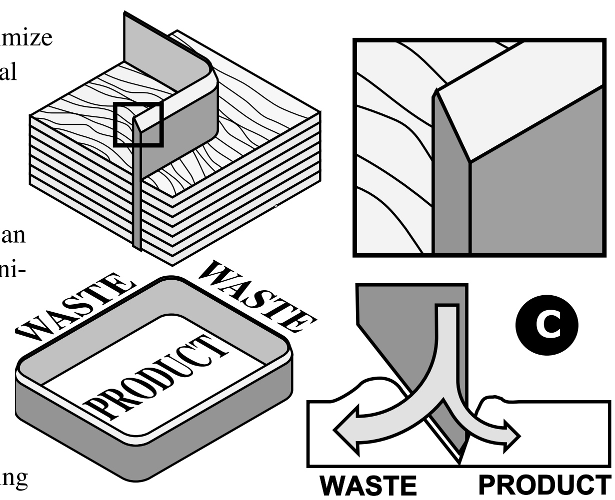


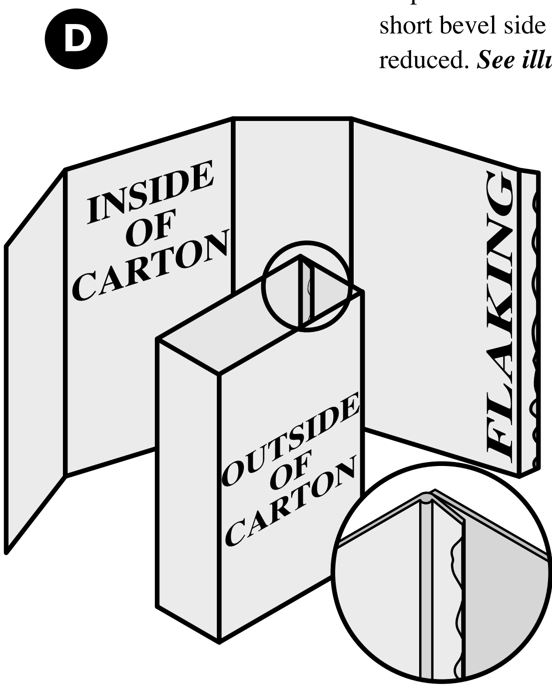


As platen diecutting is primarily a displacement or ***"wedging"*** action, it is logical to first reduce the bevel angle of the knife-wedge to lower the degree of lateral splitting force at the source. One of the most common examples of this type of application is the use of side bevel knife.

Side Bevel Knife has the predominant bevel on one-side of the blade, with the intention of pushing ridging or distortion of the material from the product side of the knife into the waste side of the blade. ***See illustration A.***

However, this knife can be used to minimize flaking, because by pushing all of the lateral displacement to one side, flaking on the short bevel side of the knife is greatly reduced. ***See illustration B.***

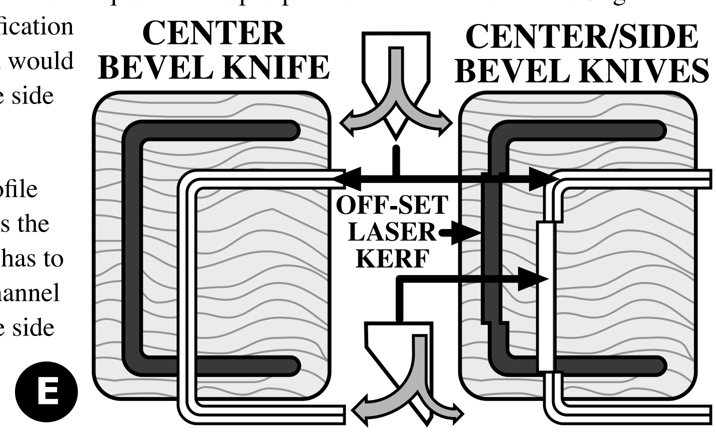




Therefore, this knife can be used effectively to minimize flaking, however, it should be used on the ***"outside"*** of the product, with the bevel to the waste, ***see illustration C,*** or where the flaking can be ***"pushed"*** into an area of the container, where it is not a visible issue. Such as the ***"inside"*** of a carton glue flap, where the tearing/chipping of the inner surface will be out of sight. ***See illustration D***.

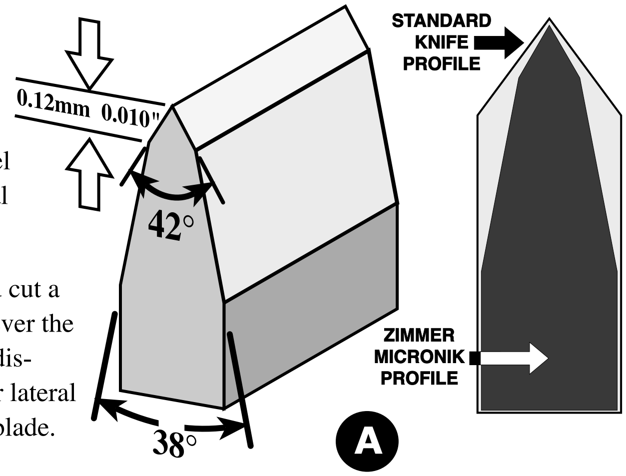
It is also important to note this knife is not easily interchangeable with an existing center bevel knife as the kerf has to be off-set to maintain the cutting edge of the side bevel knife in the correct dimensional location. ***See illustration E***. (This simply means this technique must be pre-planned and included in the original dieboard specification program, or an existing dieboard would have to be modified to accept the side bevel knife insert.)

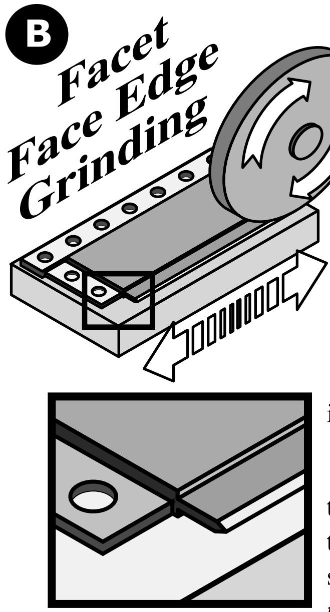
This change in the lasercut profile must obviously be pre-planned as the computer-aided-design program has to be modified to off-set the kerf channel in the correct direction where the side bevel knife will be placed.



Solution 1.3: Modify the Knife Bevel

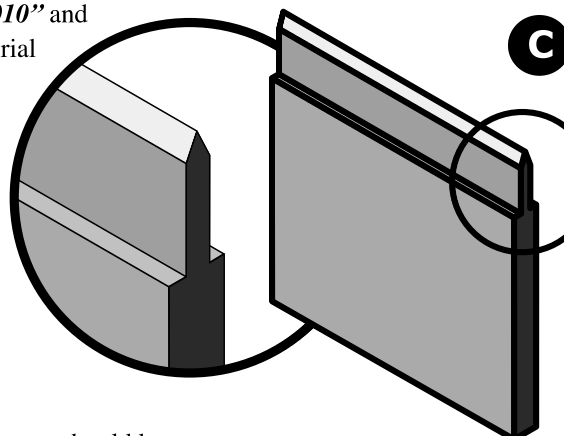
Following the previous theme of reducing the degree of lateral displacement ***"push"*** from the knife bevel it is useful to use a knife with a ***"modified"*** bevel, such as ***Zimmer MicroCut***. ***See illustration A***. This has a standard bevel to give the tip compressive resistance, but the secondary bevel is designed to reduce the pressure to diecut, and to lower the degree of lateral displacement force.





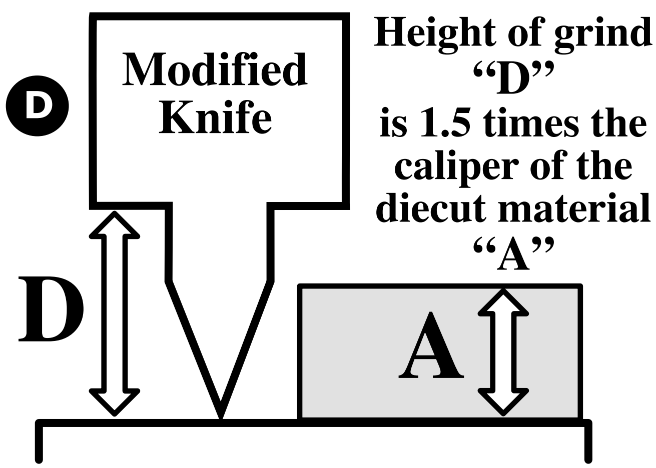
This means the knife will penetrate and cut a material with lower overall force, however the primary benefit is the narrower profile displaces less material and generates lower lateral push away from the cutting edge of the blade.

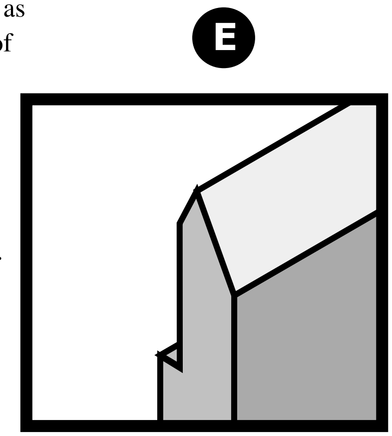
It is important to note the benefits of this type of knife are effective because the secondary ***"sleeker"*** bevel begins at a depth of ***0.010"*** from the cutting edge of the knife. Naturally this knife would be less effective on a material with a caliper of less than ***0.010"*** and increasingly effective as the caliper of the material increases.



Another very effective method of achieving the same outcome is to use a surface grinder to grind away part of the bevel on one or both sides of the cutting knife bevel faces. ***See illustration B & C***. This may seem rather extreme, however, the intention is to only process the knives required for key areas of the layout, which will be inserted using the ***"Inset-Knife"*** technique shown in the previous section.

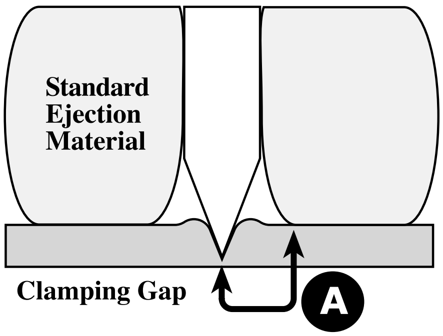
The height of the grind, from the tip of the blade to the bottom of the ground area, should be a minimum of 1.25 times the caliper of the material being diecut, ***see illustration D***, but not a great deal more as this can undermine the strength of the newly machined knife tip. In addition, this technique can be used on one side of the knife only, ***see illustration E***, which provides the ability to orientate the untouched bevel to the waste.

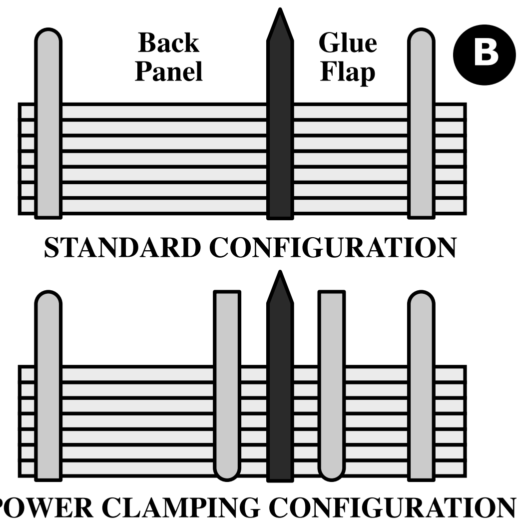




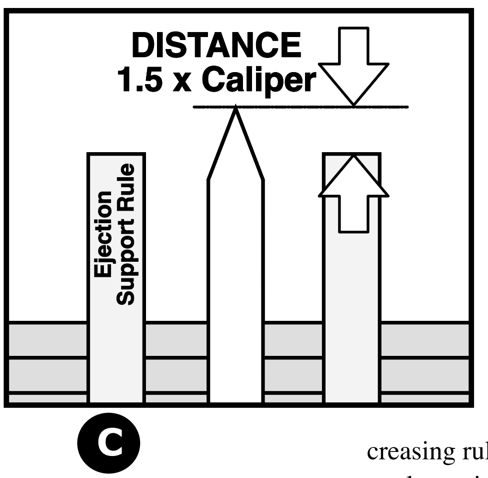
Although this may seem very different, and seemingly complex, it is fast and easy, and this technique provides the diemaker with a great deal of design and diecutting flexibility, and the diecutter with an effective flake eliminator!

Solution 2.1: Cutting Plate Clamping

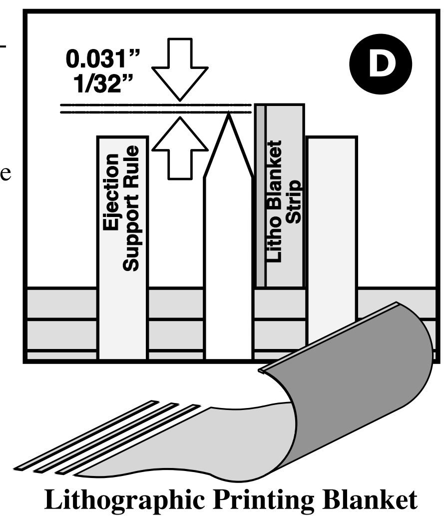




In attempting to isolate the material immediately next to the knife, specialized shaped rubber will make a difference, however, the gap between the inner surface of the rubber and the tip of the knife, ***see illustration A,*** will still allow flaking to occur. In addition, standard die ejection rubber begins to lose its compressive resiliency as the production run progresses, which will allow flaking to develop or to intensify!

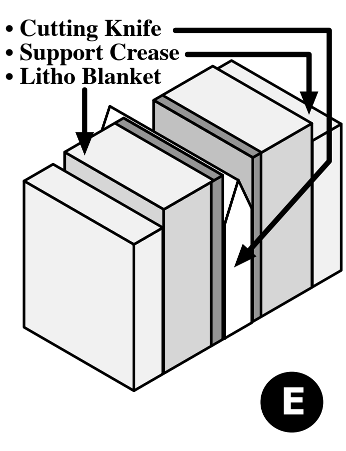


To provide an effective alternative clamping method, the dieboard is modified to include additional kerf slots in the dieboard, on either side of the knife where flaking is predicted to occur. ***See illustration B.*** As with many of the potential solutions this technique must be pre-planned and executed prior to an on-press crisis. Plan for Flaking, as this is a relatively simple, fail-safe method of making absolutely sure flaking will not happen.

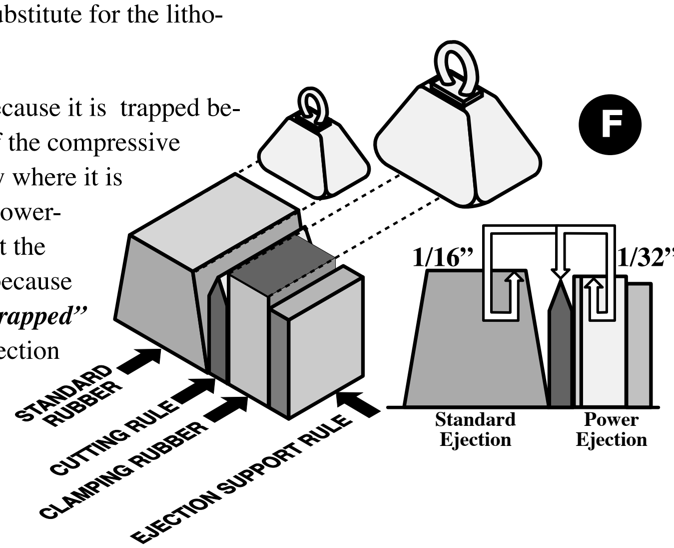


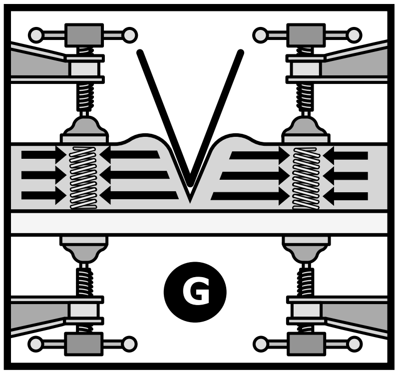
The gap between the inside surface of these rules and the knife outer surface should be made slightly less than the thickness of the ejection material to be inserted. When the die is ruled, creasing rules are inserted in these slots. The creasing rules are lower in height than the cutting blade by 1.5 times the caliper of the material being diecut. ***See illustration C.***

When the die is rubbered, high-density ejection material, (strips of discarded printers Lithographic Blanket is ideal), are positioned between the knife and the support-creasing rule. ***See illustration D & E.*** Also specialized ejection like Green Grilla would be an effective substitute for the lithographic printers blanket.



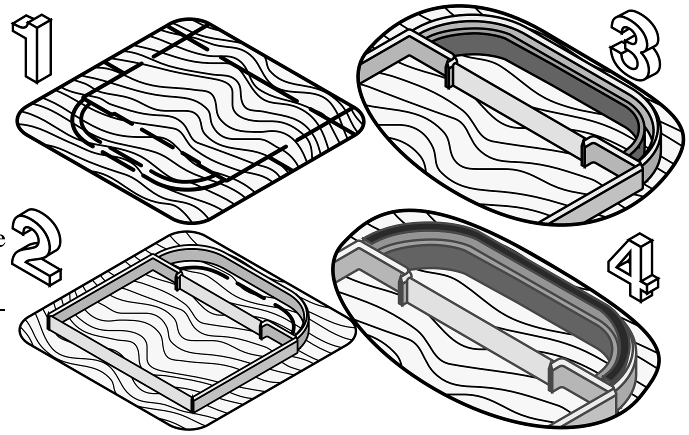
When the rubber is compressed, because it is trapped between two rigid barriers, the force of the compressive clamping is not just focused precisely where it is needed, but it is several times more powerful, than if rubber where used without the stiffening crease support. However, because the compressive resistance of this ***“Trapped”*** rubber is so high, the height of the ejection material is only set so it protrudes 1/32 of an inch higher than the knife-edge. ***See illustration F.***





G

This technique is called ***"Power Ejection"***, as it enables tremendous compressive clamping to be focused in a very narrow strip alongside the cutting knife. ***See illustration G.*** (Obviously this technique would have to be modified if the material being diecut was a compressible material such as a fluted paperboard!)

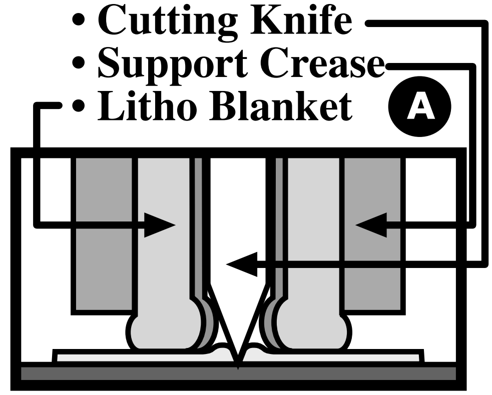


H

This technique is also particularly effective where there are curved surfaces, as this approach is equally effective for this type of shape. ***Illustration H*** shows the application of Power Clamping to an potential problem of flaking around the profile of a carton feature. The principle applied in this solution is designed to clamp and isolate the material with sufficient compressive force, which neither the displacement action of the knife nor the draw from other tool components can cause the material to prematurely shear and separate.

The key here, as always, is Pre-Planning!

Solution 2.2: Cutting Plate Clamping

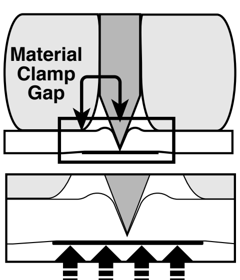


A

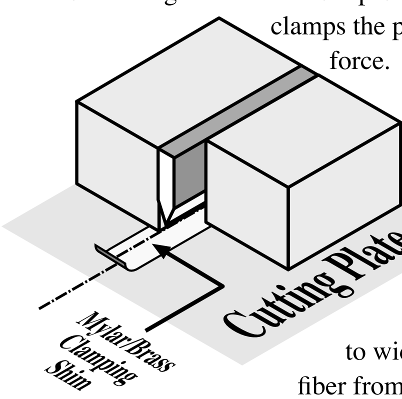
Power Ejection Clamping

The previous method of more narrowly isolating the paperboard as close to the cutting action as possible, by trapping the paperboard against the cutting plate, using dense and reinforced ejection strips, ***see illustration A***, is a proven technique, but it does require pre-planning and preparation.

However, for short production runs, clamping can actually be added to the surface of the cutting plate where the knife is striking. A strip of hard Mylar or Brass Shim can be adhered to the cutting plate directly under the cutting knife, ***see illustration B***, and when the knife strikes this material on the cutting plate, it will obviously create a narrow groove, much like a soft cutting anvil. This both protects the knife edge and clamps the paperboard with greater force.



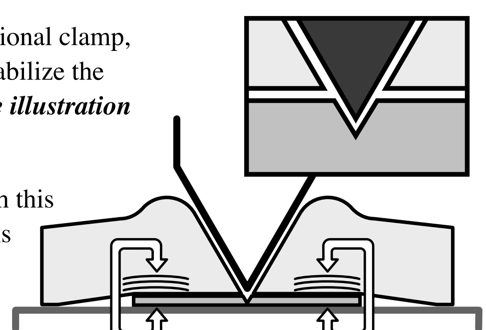
Anvil Clamping Gap Filler



B

This will act as an additional clamp, to further compress and stabilize the material as it is diecut***. See illustration C.***

The disadvantage with this approach is the groove begins to widen and get damaged as fiber from the explosive cutting action accumulates in the plate groove. However, for a short production run this is remarkably effective.

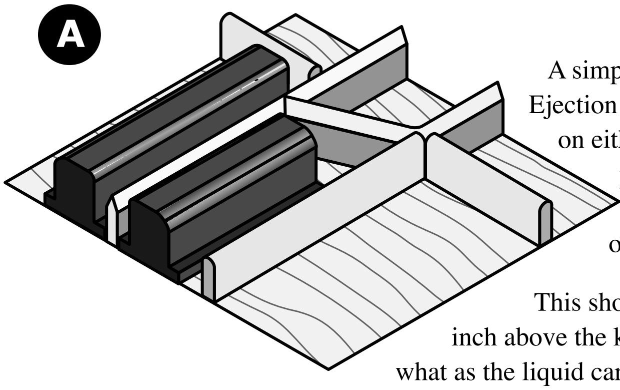


"SOFT"
Anvil Sacrificial Cutting Clamping Shim Plate

C

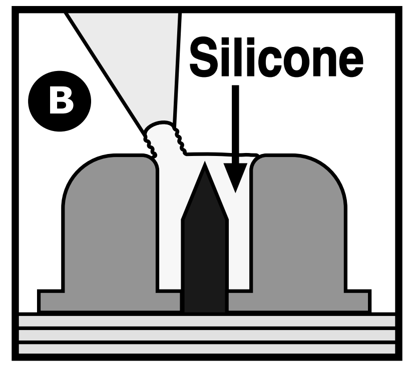
Solution 2.3: Silicone Profile Rubber Combination

A



A simple modification for dies, which are already made and do not have the Power Ejection Clamp kerf dieboard slots and creasing supports, is to use profile rubber on either side of the cutting blade. ***See illustration A.*** However, to generate more powerful and more effective clamping the gap between the inner surface of the rubber and the outer surface of the knife is filled with Liquid Silicone or Bathroom Caulk. ***See illustration B.***

B

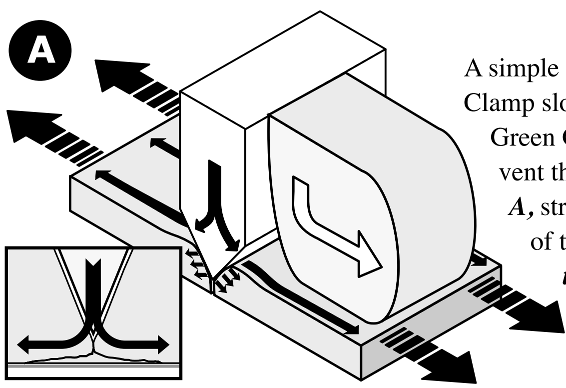


This should be added to a height of 1/16 of an inch above the knife as the material will shrink somewhat as the liquid carrier evaporates, and it has the disadvantage of requiring the material to cure for approximately 24 hours.

It is important to use pure silicone as some of the products are diluted. Therefore, make sure you read the label before making your purchase. This will ensure both maximum compressive resistance and excellent resiliency.

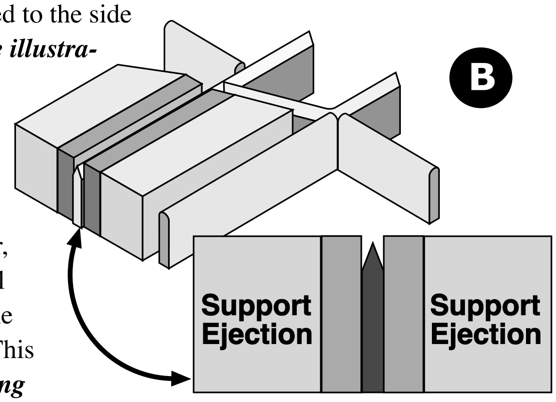
Solution 2.4: Ejection Supporting Ejection

A



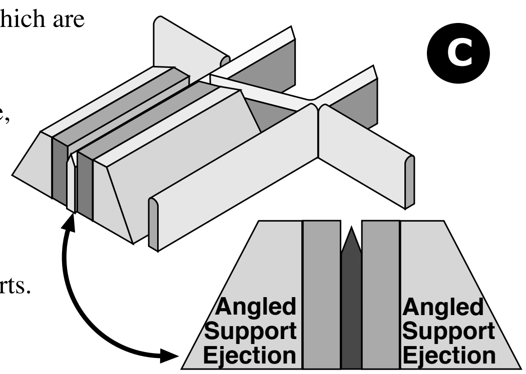
A simple modification for dies which are already made and do not have the Power Ejection Clamp slots is to use strips of Lithographic Printing Blanket or an ejection material such as Green Grilla, as specified in ***Solution 2.1***. However, to provide the support and to prevent the rubber strip bending away from the knife as it is compressed, ***see illustration A,*** strips of a dense rubber are added to the side of the narrow clamping strip. ***See illustration B.***

B

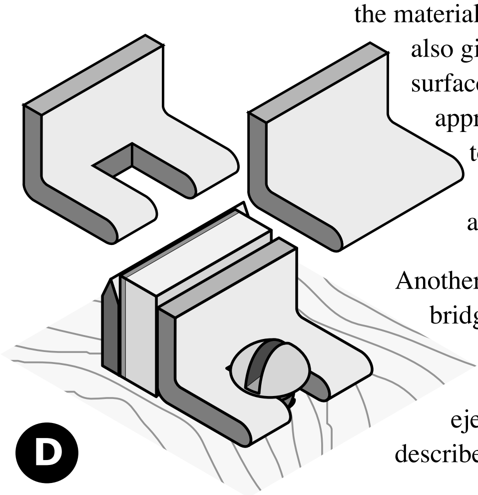


To prevent marking, because of trapping the material being diecut between the rubber and the crease matrix or fiber glass counter, the material can be angled on one side, as this will also give a larger footprint for adhesion to the surface of the dieboard. ***See illustration C.*** This approach enables the same ***Power Clamping*** technique as described in ***Solution 2.1***, and is an effective alternative for steel rule dies which are already in place.

C

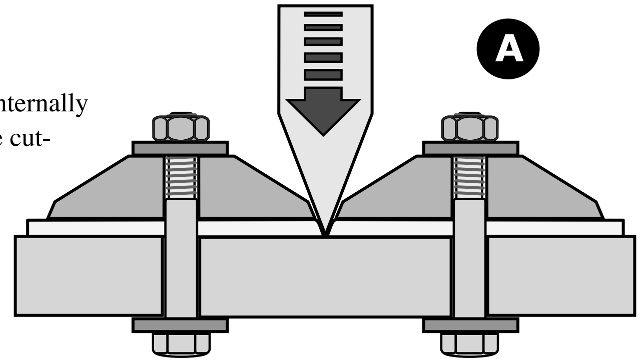


Another alternative requires cutting creasing rule, bridging the material, and bending it so it can be positioned and screwed into the surface of the dieboard to support the ejection material in the same manner as the described ejection of the Power Clamping supports.



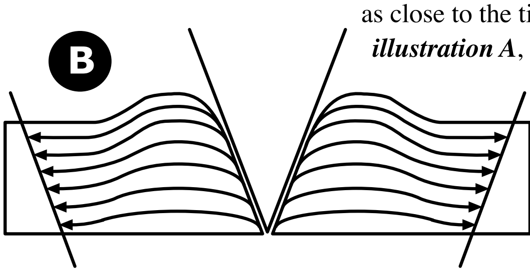
D

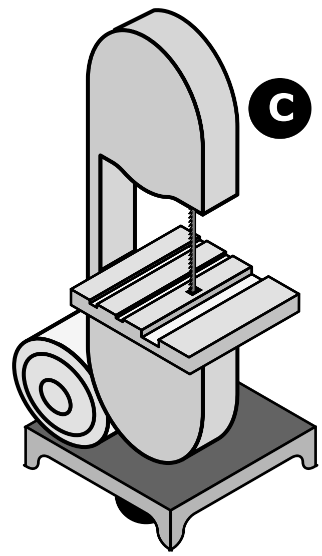
Solution 2.5: Lateral Compressive Clamping



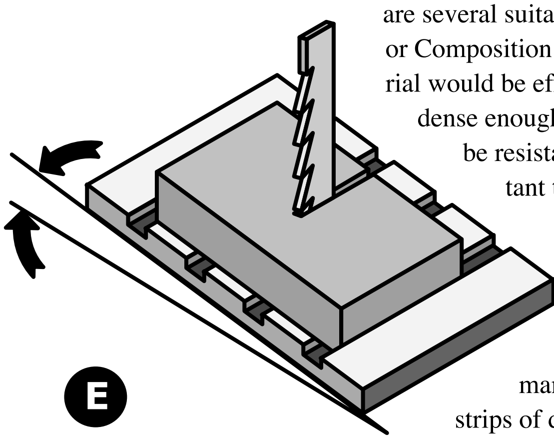
The source of the flaking problem is the paperboard laterally shears and internally delaminates before it can fully separate under the displacement action of the cutting knife. The majority of the remedial actions require either lowering the displacement force of the knife, minimizing draw/tensile stress from external sources, and in clamping the material to prevent the upper layers of the paperboard moving and delaminating before the paperboard splits apart.

Clearly, if it were possible to clamp the material with sufficient force and as close to the tip of the knife as possible, ***see illustration A***, then it would be difficult for the upper layers of the material to prematurely laterally shear, because of the increasing displacement force of the knife bevel. Although this may seem impractical there is a proven solution, which is simple to implement using standard ejection materials and a table bandsaw.

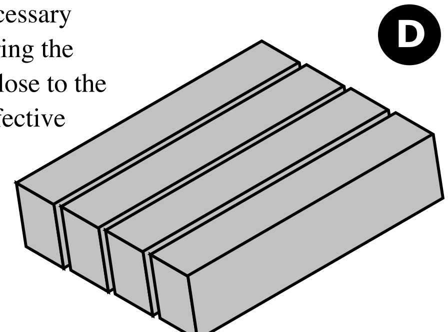


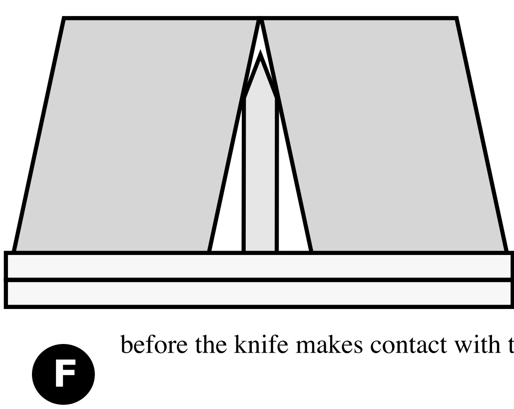


The goal is to clamp as close to the tip of the knife as possible and with sufficient force to prevent the material laterally delaminating, ***see illustration B***, under the pressure of the knife wedge. There are several suitable materials on the market, such as Green Grilla or Composition Cork, but in reality any very dense ejection material would be effective in this application. The material should be dense enough so it is unlikely to collapse internally, it should be resistant to ***"Compression-Set,"*** and to be highly resistant to deformation under load.

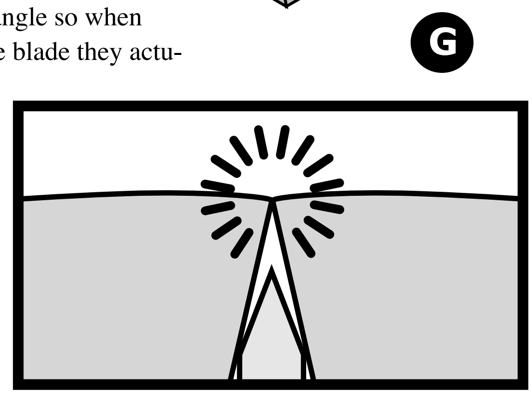


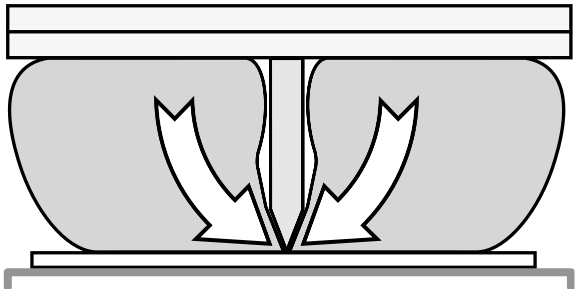
To achieve the degree of clamping necessary to prevent premature paperboard shearing the ejection material must be brought as close to the tip of the knife as possible, The most effective manner to create an ejection clamp is to cut strips of dense rubber on a standard band saw, ***see illustration D***, with the table set at an angle, ***see illustration E & E***, based upon the height of the wood, the pointage of the knife, and the bevel angle of the blade. ***See illustration F***.





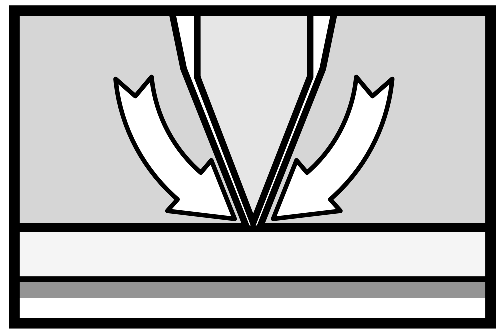
The ejection strips are cut at an angle so when they are placed on either side of the blade they actually make hard contact above the cutting edge of the knife. ***See illustration G***. The height of the ejection material above the cutting edge is set at 1/16" or 1.5 millimeters to ensure the rubber begins to compress against the material, before the knife makes contact with the paperboard.





H

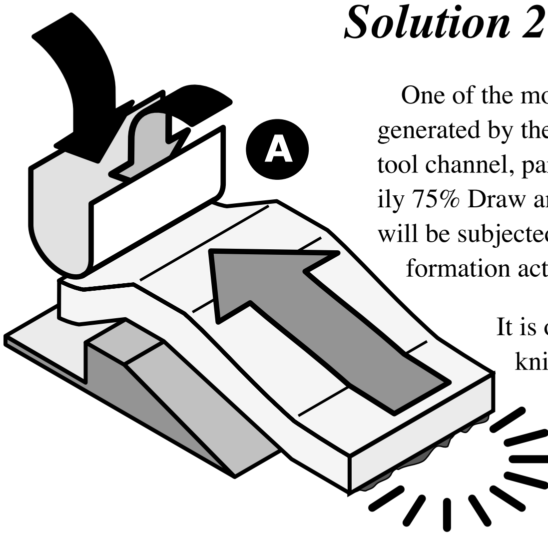
The angle of the strip is also an advantage as any compressive force will tend to drive the rubber in toward the tip of the knife. ***See illustration H***. As the rubber is compressed against the material, as the press cycles shut, the normal deformation of the rubber will close the gap between the two strips and force the knife to push through the rubber to get to the material. ***See illustration I***. This will exert significant clamping force on the paperboard immediately before and as the knife penetrates, to limit the ability of the paperboard to shift laterally.



I

This is a simple and an effective system, using standard ejection materials, and non-complex machining techniques. When the ejection material is used in this manner it will minimize and prevent flaking or chipping of the underside of the diecut edge.

Solution 2.6: Isolate the Cutting/Creasing Action



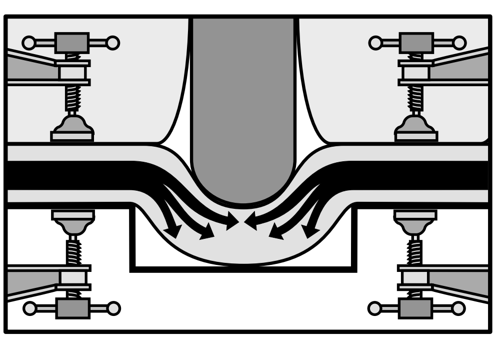
A

One of the most common causes of flaking is the high level of tensile stress and draw force generated by the action of the creasing rule as it punches the paperboard or fluted material into a tool channel, parallel to the cutting knife. ***See illustration A.*** Standard crease formation is primarily 75% Draw and 25% Compression, therefore, any parallel knives in close proximity to the crease will be subjected to a significant increase in lateral pull, away from the knife and toward the crease formation action.

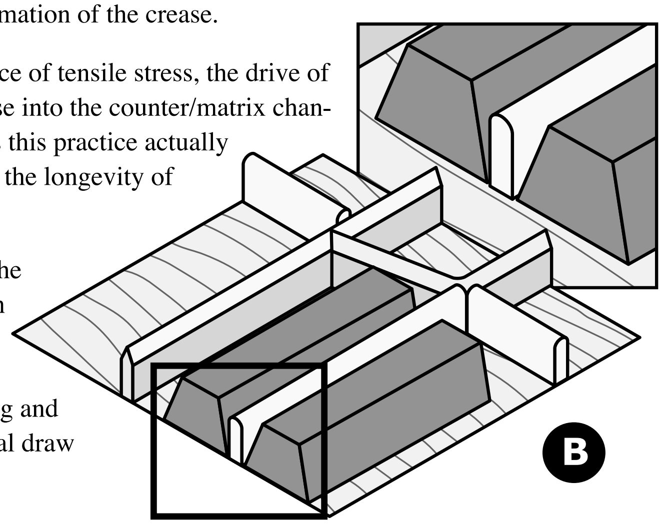
It is obviously important to isolate the action of the crease from the action of the cutting knife, and an effective tool to achieve this is standard ejection material. An effective clamping option is to add dense ejection strips on either side of the creasing rule immediately adjacent and parallel to the knife where flaking is predicted to occur. ***See illustration B.*** Although the goal is to prevent excess crease draw impacting the knife on one side of the crease, ejection is added to both sides of the crease to ensure balanced formation of the crease.

This technique attacks another source of tensile stress, the drive of the material on either side of the crease into the counter/matrix channel, ***see illustration C,*** as this practice actually improves the quality and the longevity of crease performances!

C

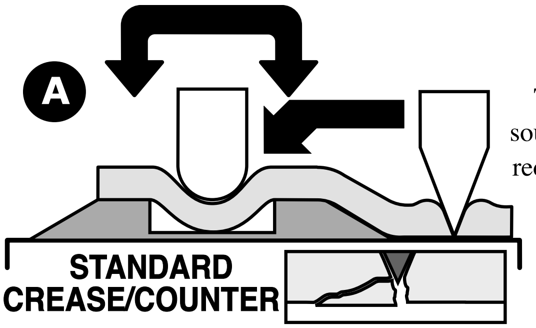


This again reinforces the important role of ejection in diecutting, and particularly in this example, as a method of controlling and limiting destructive lateral draw forces.

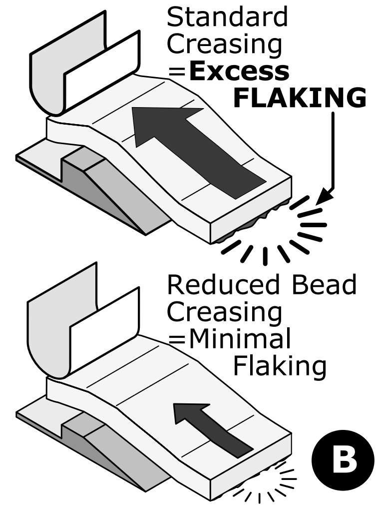


B

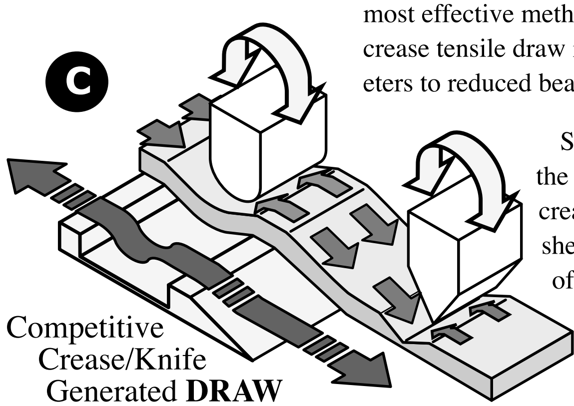
Solution 3.1: Reduce Crease Formation Draw



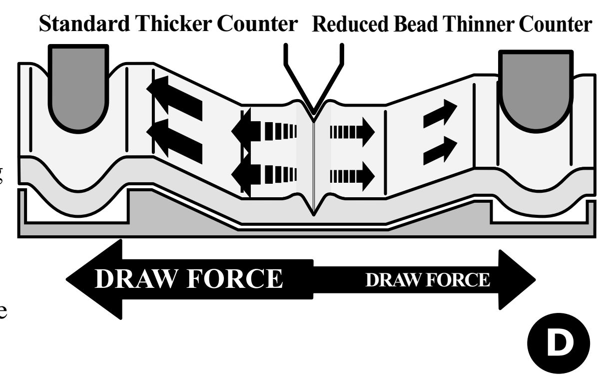
The actions defined so far have attacked the source of the problem, the push from the knife, by reducing the bevel angle/displacement force, and the pull from other knives, and by isolating the material using Power Clamping. However, it is necessary to further reduce the impact of pull, draw, and tensile stress generated from parallel crease formation. ***See illustration A***.



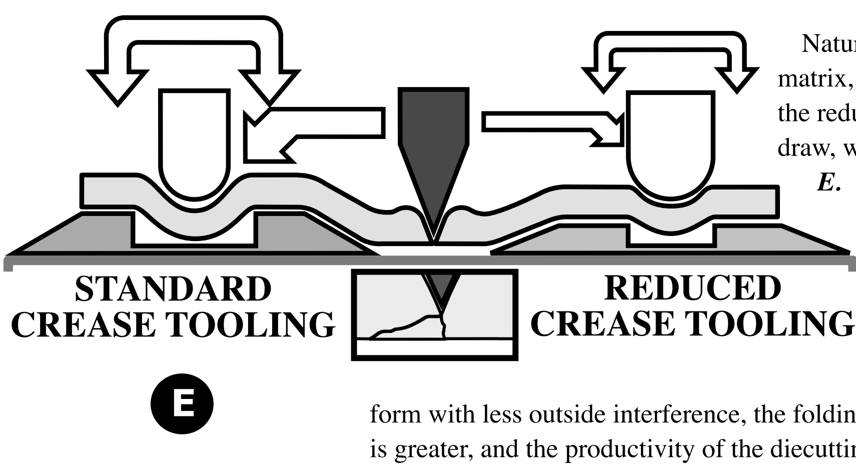
Standard crease formation primarily utilizes lateral draw and tensile shearing to form the crease bead, however, one of the most effective methods of achieving a reduction in standard crease tensile draw is to convert from standard creasing parameters to reduced bead creasing. ***See illustration B.***



Standard creasing relies primarily on stretching and pulling the material across the crease/counter tool, wrapping and stretching the paperboard around the female crease tool toward each channel, and then by driving the material into the channel to shear the material and form the crease. ***See illustration C.*** Naturally, this distortion of the paperboard adds to the push from the knife to create, high levels of lateral tensile draw, which ultimately pull paperboard away from the cutting knife, which increases the prevalence of flaking.



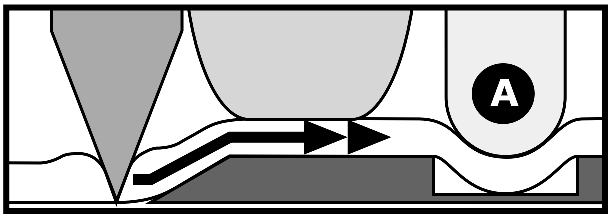
In direct contrast reduced bead creasing primarily relies on compressive crease formation, as it utilizes a much thicker creasing rule with a narrow channel. ***See illustration D.*** In addition, the thickness of the counter or matrix, which is now based upon a much smaller bead than the standard crease, can be much thinner.



Naturally, this reduction in the thickness of the counter or matrix, when combined with the much lower tensile pull from the reduced bead creasing action, minimizes lateral tensile draw, which lowers the incidence of flaking. ***See illustration E.***

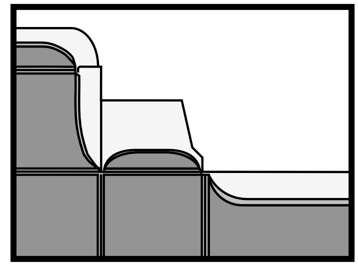
In practice reduced bead creasing lowers the overall tensile stress associated with platen diecutting, which provides many benefits in terms of simpler, more effective cutting. This partial isolation of cutting from creasing and vice versa, not only allows both to perform with less outside interference, the folding and cutting quality of the folding carton or container is greater, and the productivity of the diecutting process is improved.

Solution 3.2: Implement "Full" Profile Counters



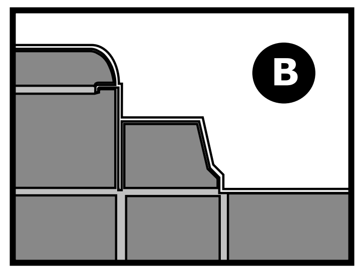
One of the key source of flaking is the stretching and wrapping of the paperboard around the profile of the female tool. ***See illustration A***. It is not unusual to skive or bevel the edges of the counter or Matrix strip at an acute angle, to prevent this stress point, as this transition edge is often a generator of flaking.

STANDARD "CUT-BACK" COUNTER PROFILE



An effective alternative technique, which has several other benefits, is to use a ***"Full Profile"*** fiber glass counter, rather than the traditional counter shape which is cut away from the areas of the design where there are knives. ***See illustration B.***

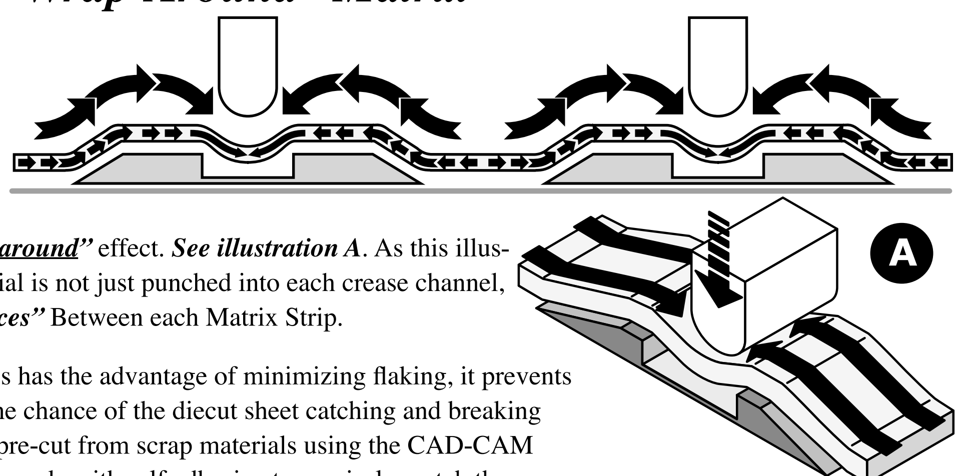
"FULL-PROFILE" COUNTER SHAPE



This will eliminate problems with marking, it reduces material stretching, and it also allows the ejection material to clamp with far greater force, close to the cutting knife action, minimizing the degree of flaking.

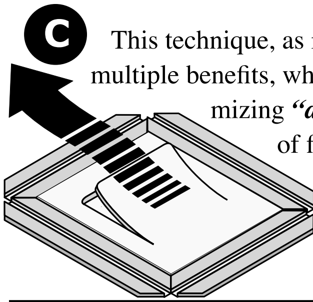
Creating ***"Full Profile"*** counter make-ready is a technique that has been in use for more than 50 years! However, although it was ***"lost"***, it is just as effective at minimizing draw, preventing marking/shadowing, and eliminating flaking.

Solution 3.3: Eliminate "Wrap-Around" Matrix Paperboard Stretching

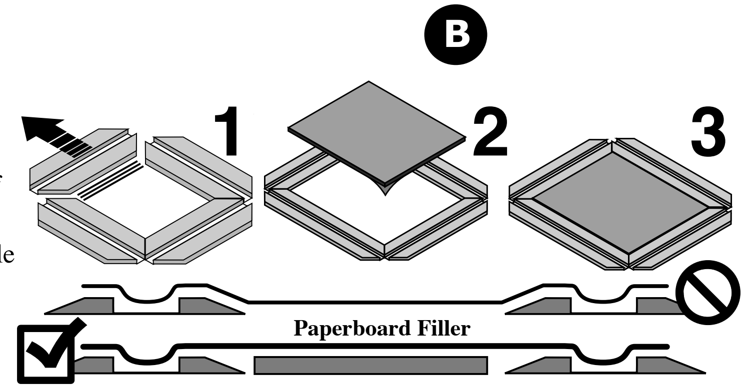


When using Matrix Strips to form a crease, it is important to fill the open areas, between matrix strips to reduce the additional tensile stress generated by this ***"wrap around"*** effect. ***See illustration A***. As this illustration shows the paperboard or fluted material is not just punched into each crease channel, but it must also be wrapped around the ***"spaces"*** Between each Matrix Strip.

Filling the spaces between the matrix strips has the advantage of minimizing flaking, it prevents the matrix strip ***"creeping"***, and it reduces the chance of the diecut sheet catching and breaking apart on these strips. The filler panel can be pre-cut from scrap materials using the CAD-CAM tangentially controlled plotting table and pre-made with self adhesive to precisely match the gaps between each matrix strip. ***See illustration B***. It is an advantage to integrate a ***"Lifter"*** or ***"Flyer"*** into each filler panel as this will reduce sheet break-up, reduce wear of the matrix channel walls, and generate higher press speed. ***See illustration C.***

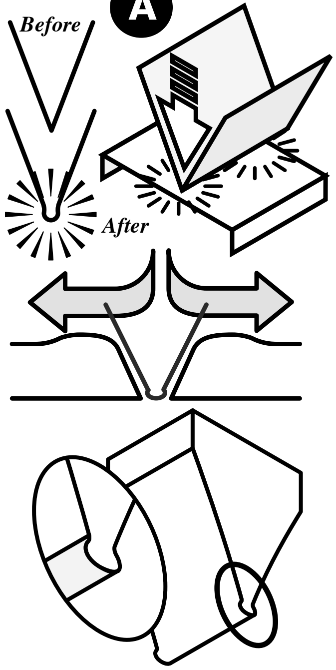


This technique, as many, specified in this manual has multiple benefits, which extend beyond the task of minimizing ***"draw"*** forces increasing the degree of flaking. However, simply in-terms of minimizing flaking caused by excess stretching and draw, this simple technique is very effective.

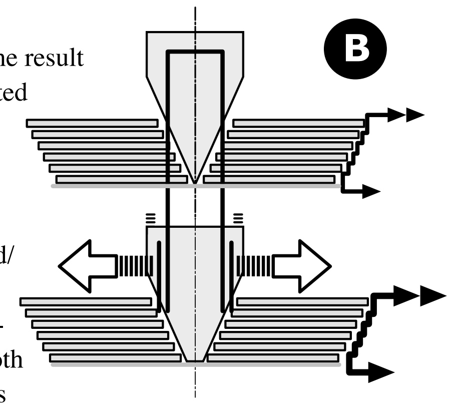


Solution 4: Calibrate the Platen Press & Steel Rule Die

A

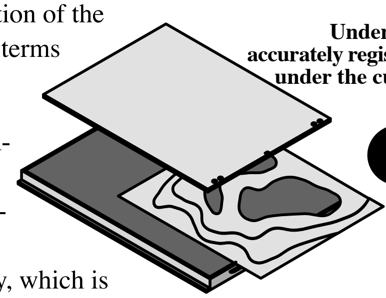


B



One of the common weaknesses of platen diecutting is the result of a knife penetrating too far through a paperboard or a fluted material. This happens because the knife-edge tip initially suffers compressive damage as it strikes the cutting plate with excessive force. ***See illustration A***.

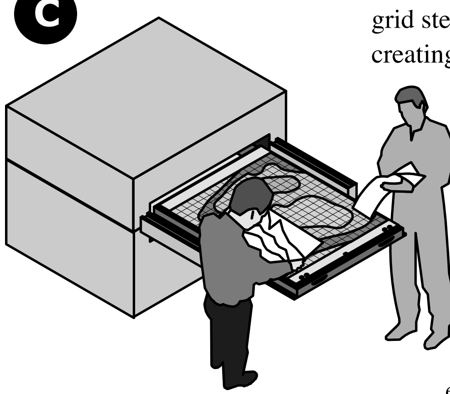
To compensate the travel distance of the press is adjusted/ shimmed by adding patch-up tape. This has the effect of driving the knife further into the paperboard, which significantly increasing the degree of displacement push from both knife bevel faces, ***see illustration B,*** which inevitably leads to excess flaking on the diecut edge. (Note in illustration B the width of the wedge at the top of the material in the second illustration. This demonstrates that even a slight amount of damage to the tip of any knife in the die, and the subsequent over-penetration of the knife-wedge into paperboard, has serious consequences, in terms of excess displacement force, and inevitably, flaking!)



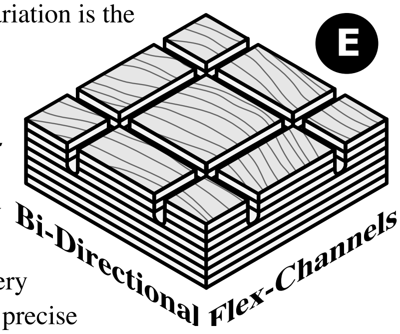
D

To eliminate this type of steel rule die damage, it is essential to ***"footprint"*** the platen mechanism, by mapping the platen cutting surfaces, ***see illustration C***, using a mapping-grid steel rule die specifically made for the purpose, and by creating a permanent metal pressure compensation underlay, which is inserted under the cutting plate. ***See illustration D.*** Once the platen is calibrated or footprinted the next area of potential variation is the steel rule die.

C

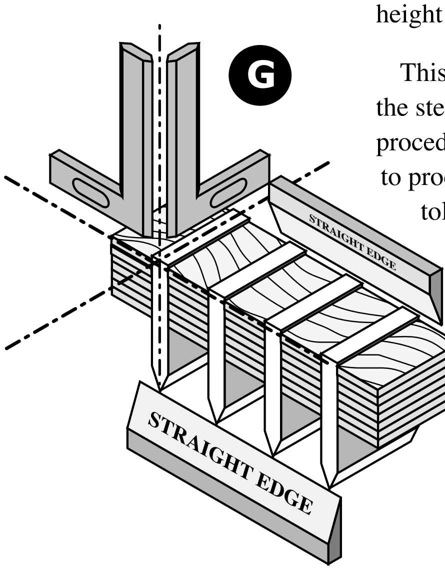


E

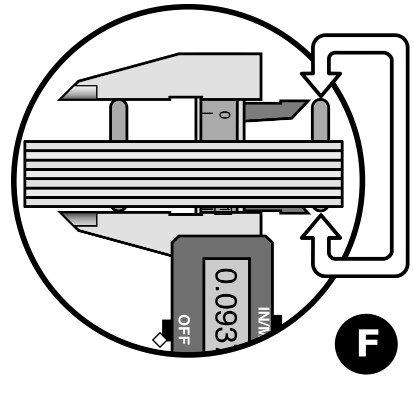


Therefore, to complete the process it is critical to fabricate the dieboard with flex channels, ***see illustration E***, and to insert the steel rule into the dieboard, so every knife is perfectly seated and level with every other knife in the dieboard. ***See illustration F.*** It is easy to underestimate the importance of making sure every steel rule is perfectly seated in the dieboard and is sitting at the precise height it should be to generate an optimal kiss-cut impression.

G



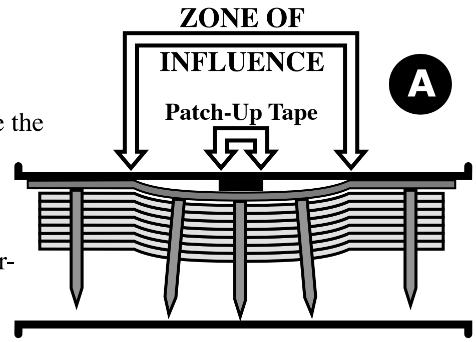
This leveling or ***"calibration"*** of all of the knives and the steel rule in a dieboard should be a standard operating procedure. The goal of effective steel rule diemaking is to produce a die which matches the extraordinary height tolerance of the principle tool, the steel rule knife! ***See illustration G***.



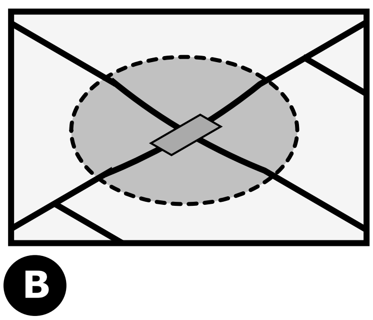
F

When you examine how the compressed tip of a damaged blade causes greater displacement force, which leads to flaking and a number of other serious converting problems, it is important not underestimate the importance of regular press calibration and the fabrication of a calibrated steel rule die.

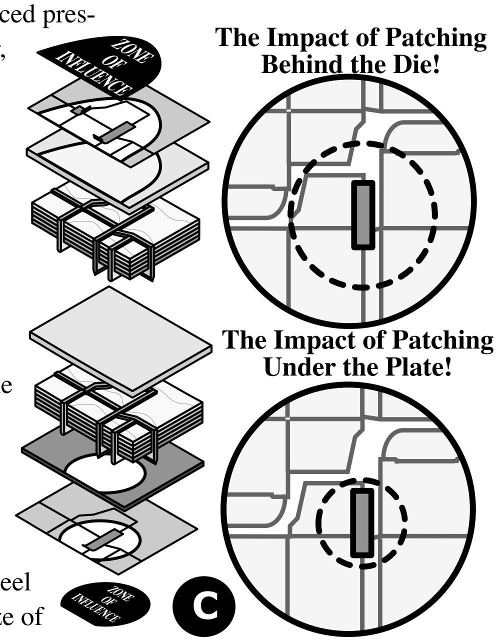
Solution 5: Precision Press Leveling



The goal in platen diecutting is to cut with minimal pressure, and to protect and preserve the sharpness of the knife cutting edges as long as possible. As compressive knife-edge tip damage increases, excess draw, excess penetration, and progressive steel rule die and counter/matrix wear, generate more and more flaking and dust and loose fiber.



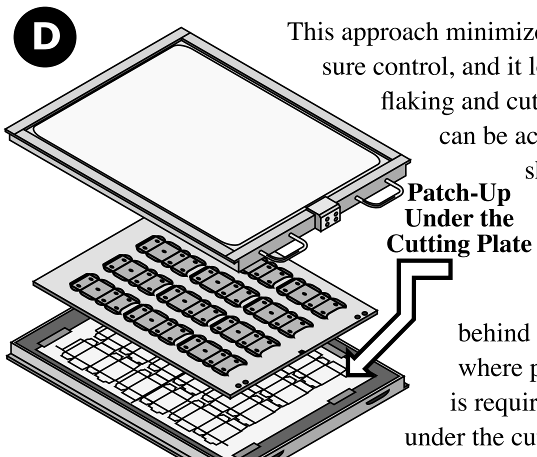
The principle solution is to ***footprint the diecutting press and the steel rule die***, to minimize cutting make-ready time, and to minimize excess unbalanced pressure and progressive knife edge damage. However, when patching to compensate for this damage, ***how and where,*** shim materials are added to the diecutting press makes a dramatic impact of cutting performance and stability.



Most patch-up is done behind the cutting die. Unfortunately patch-up or shimming, is simply bending and inconsistent distortion of areas of the steel rule dieboard to ***"add"*** pressure on a single knife. ***See illustration A.*** While the addition of any material to the back of the die will change the force acting upon a knife, it changes the pressure on all of the knives and components in the immediate area, where the shim tape is added. ***See illustration B.*** This is called the ***Zone of Influence*** as ***illustration A*** shows. Although the illustration shows a single pressure zone it is important to remember that every piece of patch-up tape added creates a new, and often over-lapping pressure zone!

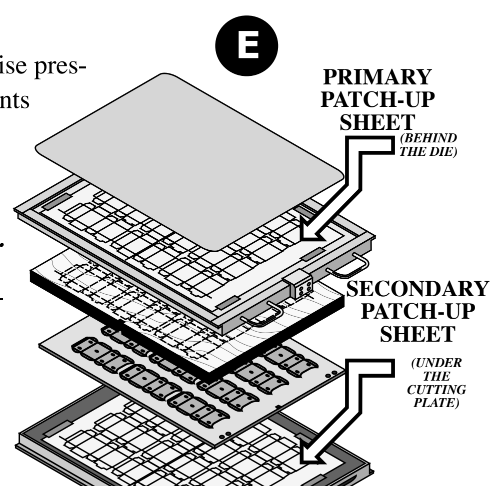
In practice the most effective location for patch-up of shimming material is under the cutting plate, ***see illustration C,*** as this gives the greatest accuracy, it minimizes the detrimental impact of the ***"pressure zone"***, it has the least impact on other knives and steel rule die components, and it requires far less patch-up tape. (Note in illustration C the size of the area of the ***"Pressure Zone"*** from patching under the cutting plate at the bottom of the illustration, compared to the area of the ***"Pressure Zone"*** from patching behind the steel rule die, at the top of the diagram.)

Patching-up under the cutting plate is simply accomplished by using a patch-up sheet under the cutting plate only. ***See illustration D.***

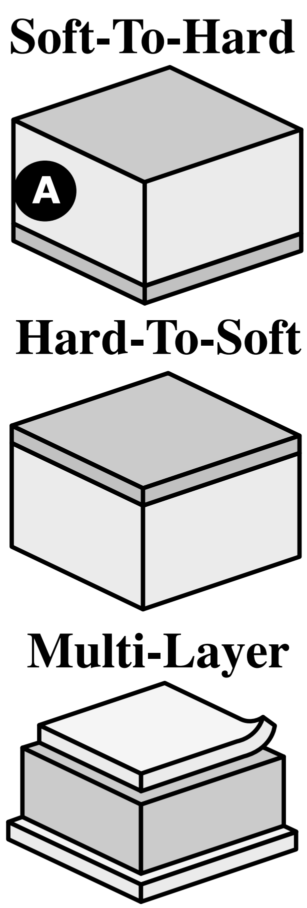


This approach minimizes excess pressure and gives more precise pressure control, and it lowers knife edge damage, which prevents flaking and cutting variation. An effective alternative can be accomplished by using two patch-up sheets, one under the cutting plate and one behind the die. ***See illustration E.***

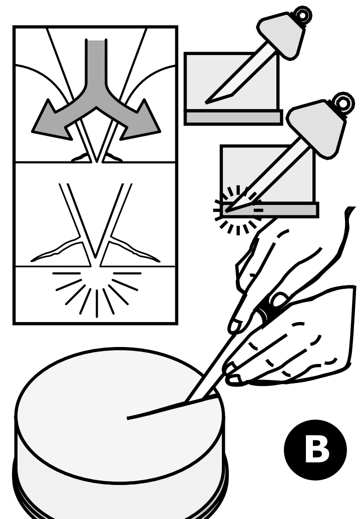
Applying this technique, the majority of press leveling would be done behind the cutting die, but the latter stages, where precision individual knife adjustment is required, the patch-up would be executed under the cutting plate.



Solution 6: Diecut Material Orientation

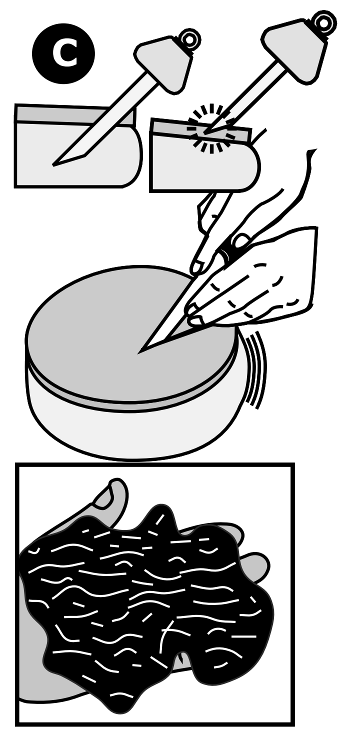


In practice the ability to orient a paperboard or a fluted material in a specific way is rarely an option available to the diemaker or to the diecutter. However, it is important to understand the role the material plays in the process, and how the orientation of the material to the cutting knife impacts the final results. In platen diecutting we cut three types of material. These are ***Hard-to-Soft***, ***Soft-to-Hard***, and ***Combination***, or ***Multi-Layered*** material. ***See illustration A***. Hard-to-soft may be a material where the surface has been coated, heavily varnished, or a special layer of pulp has been added to improve the aesthetic impact of the print finish and the finished product.



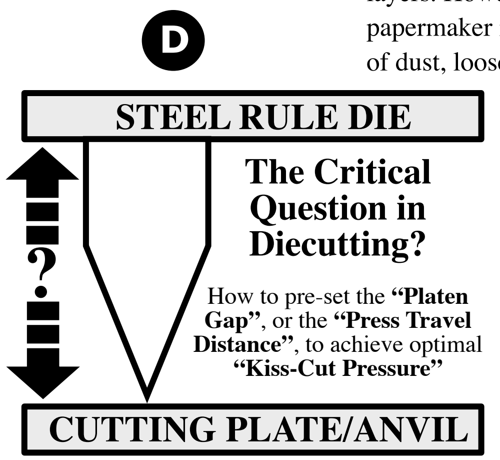
In diecutting the ***Soft-to-Hard*** material, which has a specialized lower fiber layer, to give the material greater tensile strength and stiffness, the primary problem is flaking. (To visualize this type of paperboard and what happens when it is cut, it is useful to compare the material to a cheesecake, which has a sponge top, ***soft***, and a dense cookie crust, ***hard***.) ***See illustration B***. Diecutting a ***Soft-to-Hard*** material, will require greater pressure to diecut, and it will be very resistant to lateral displacement splitting, giving excess levels of flaking.

In diecutting the ***Hard-to-Soft*** material, which has a harder/denser upper layer it will compress more, it will stretch more, and it will generate greater draw. This will increase flaking; however, the primary issue with this material will be dust and loose fiber. ***See illustration C.*** (This can be compared to cutting a cheesecake upside down, with the cookie crust to the top, ***Hard-to-Soft***.)



The ***Combination*** material is usually a recycled material where different pulp layers are used to form the surface, the liner, and the ***"inside"*** of the material.

The ***Multi-Layered*** material may be even more complex to diecut, as it has the combination of dense upper and lower layers. However, this is often a ***"balanced"*** material as the papermaker intended, and it is difficult to predict the incidence of dust, loose fiber, and/or flaking.



Both the problems of flaking and the problems of dust and loose fiber, and in fact all incidents of poor or inconsistent cutting, are functions of an incorrect or an inconsistent setting between the tip of the knife and the surface of the anvil. That is why Press Calibration and Steel Rule Die Calibration are just the most basic requirements of an effective press make-ready, and the first step in preventing flaking from becoming an on-press issue.

Summary

This technical publication has covered several problem areas and solutions, with the goal of eliminating flaking from platen diecutting. The following is a list of the solutions and recommendations, however, there is one Critical Recommendation. This is to assume flaking ***will*** happen on any and every job and ***always*** take remedial pre-production action to eliminate the potential problem.

Therefore, implement these solutions and modify the steel rule die in advance. It is important to ensure valuable press time is not lost in fighting to minimize flaking, once the press run has begun. The recommended Solutions to the problem of flaking were:

1.1 Reduce the Bevel Angle of Key Knives
1.2 Use Side Bevel Knife
1.3 Modify the Knife Bevel
2.1 Power Clamping
2.2 Cutting Plate Clamping
2.3 Silicone Profile Rubber Combination
2.4 Ejection Supporting Ejection
2.5 Lateral Compressive Clamping
2.6 Isolate the Cutting Action
3.1 Reduce Crease Formation "Draw"
3.2 "Full" Profile Counter
3.3 Eliminate "Wrap-Around" Material Stretching
4 Calibrate the Platen Press & Steel Rule Die
5 Precision Press Leveling
6 Diecut Material Orientation

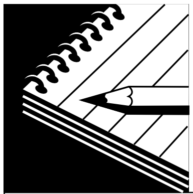
The majority of these recommendations require changes to current methods and practices, and add a degree of complexity to the steel rule die process. They are prioritized to reflect their relative importance, and to ensure optimal on-press performance several should become standard practice on every steel rule die.

However, to simplify things and to be recognize the daily race against the clock, I would make ***three*** recommendations:

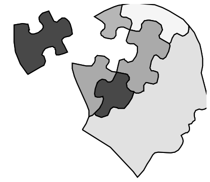
1. As soon as the design and layout are approved, insist the steel rule die includes the ***2.1 Power Clamping Recommendation***.

2. Where there are existing dies, adopt either of these pragmatic options and implement ***2.3: Silicone Rubber Combination, or 2.4: Ejection Supporting Ejection, or 2.5 Lateral Compressive Clamping***.

3. When facing an on-press flaking problem, with time running out, a delivery deadline approaching, and the need to take fast action, I would recommend, ***2.3: Cutting Plate Clamping***. This is not a long-term solution, but in an emergency, if done correctly, it will get you out of a jam. Remember, as in all these recommendations you should have the correct materials available, and you should practice the technique when there is less production pressure.

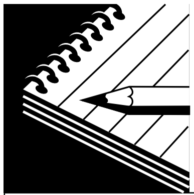


Brainstorming, Notes & Ideas

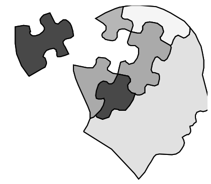


"Many ideas grow better when transplanted into another mind than in the one where they sprung up." *Oliver Wendell Holmes*

DieInfo, Inc
321 Cherry Street - Port Townsend, WA 98368
1-360-385-4214 www.dieinfo.com - kevin@dieinfo.com



Brainstorming, Notes & Ideas



"Many ideas grow better when transplanted into another mind than in the one where they sprung up." *Oliver Wendell Holmes*

DieInfo, Inc

321 Cherry Street - Port Townsend, WA 98368

1-360-385-4214 www.dieinfo.com - kevin@dieinfo.com