The
ABC's of Diemaking & Diecutting

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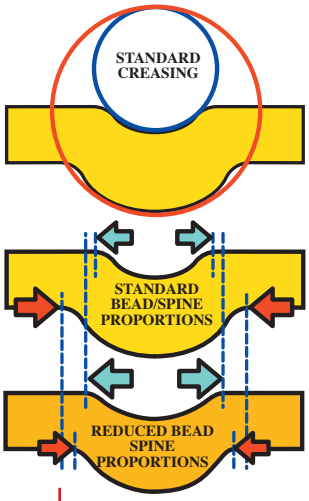
What is Reduced Bead Creasing?

"The farther backward you can look, the farther forward you are likely to see." *Winston Churchill*

As the name Reduced Bead Creasing suggests, this method of creasing uses a smaller, more precisely defined bead than a traditional crease. In making the transition to Reduced Bead Creasing, there are ***Seven*** key toolmaking and tool parameter changes from the traditional approach to tool design. These require a:

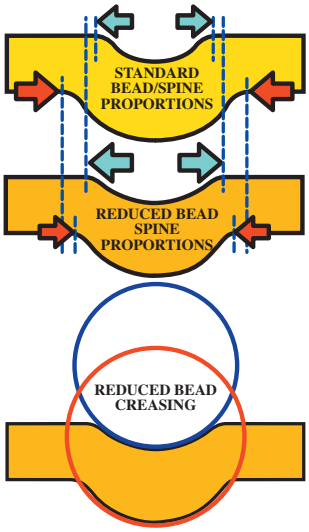
1: Proportionate-Smaller Bead
2: Higher Pointage Crease Rule
3: Wider Surface Delamination
4: Balanced Bead Delamination
5: Thinner Counter
6: Compression Gap
7: Compressive Formation



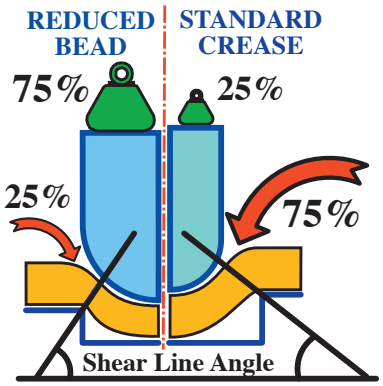
The relationship between the inner and outer profile, or the arc of the crease and the arc of the bead, formed between the crease rule and the caliper of the material in standard creasing are shown ***left***.

As this diagram shows, in the standard crease formulation the diameter of the inner segment of the Crease Arc is much smaller than the diameter of the outer segment of the Crease Arc.

By comparison the proportions of the reduced bead creasing formulation are shown ***right.*** In this diagram it shows the proportion of the arc formed by the crease rule and the shaped of the formed bead are almost identical.



By adopting a Reduced Bead approach to crease set-up, the roles of Tensile Draw and Compressive force are virtually reversed. ***See left***.



1: Proportionate-Smaller Bead

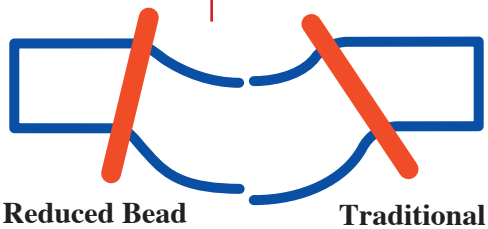
In reduced bead creasing the size of the bead is directly proportionate to the caliper of the paperboard being creased, and by comparison, in traditional creasing the caliper is only a part of the formula.

Channel Width
3 x Caliper = 0.045"

In reduced bead creasing the calculation requires simply multiplying the caliper of .015" for example, by 3, to give a channel width or crease bead width of 0.045." ***See left.*** Therefore, in this specification of a reduced bead calculation, the thickness or the pointage of the crease is not a key factor in the calculation of the channel width. However, the proportion of the arc formed by the tip of the crease and the arc formed by the formed bead **are** critical factors.

In addition, the more acute Shear Line Angle in reduced bead creasing, ***see below***, provides a more precise delamination of the bead generated, for essential bead folding flexibility, and it creates a more well defined and consistent crease folding failure point.

2: Higher Pointage Crease Rule



Reduced Bead Shear Line Angle **Traditional Shear Line Angle**

Why is a higher pointage than standard more effective?

To a greater extent than the standard set-up the higher pointage crease applies a more even pressure to the surface of

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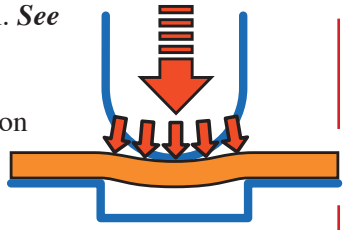
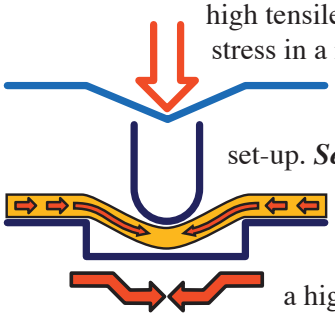
the paperboard or fluted material. ***See right***.



And while the act of shearing is on either side of the crease rule, it is important not to concentrate high tensile stress in a narrow section of what will become the spine of the crease, as it does in a traditional crease set-up. ***See left.***

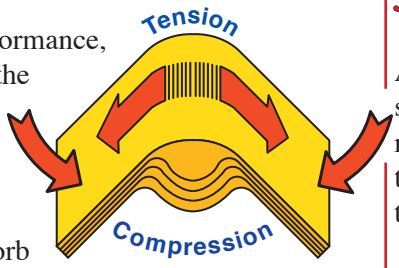


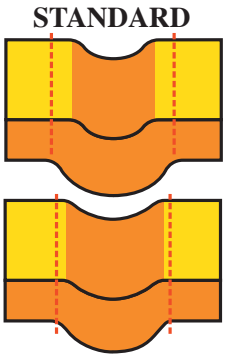
As a result, one of the important benefits of using a higher pointage crease than standard, is the impact on the area of surface or spine delamination.

3: Wider Surface Delamination

One of the key roles of the crease rule mounted in the steel rule die, is to generate internal delamination of the paperboard by compressing the material against the upper corners of each channel to form partially separated layers of material in the resulting crease bead. ***See above***.

This is critical to crease performance, because as the crease folds, the surface indented by the crease rule becomes the spine of the crease, and it is essential it is as flexible and as elastic as possible, to absorb and to compensate for the tensile stress the spine is subjected to. ***See right***.



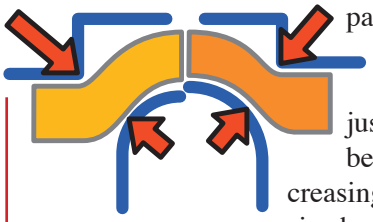


The advantage of the Reduced Bead crease over a Standard crease is first, the width of the surface delaminated area is larger, and secondly, the area of surface/spine delamination is more in proportion to the delamination area of the crease bead. ***See left.***

Finally, because with Reduced Bead Creasing there is far less tensile draw generated by this and other surrounding creases, and because the counter/matrix tool is much thinner, the formation of the crease bead and particularly the spine, is somewhat isolated from competitive tensile forces, further reducing the stress on the surface of the paperboard, which becomes the crease spine.

4: Balanced Bead Delamination

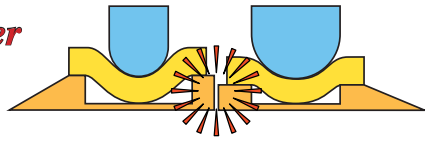
It is important to remember the goal is to create an effective paperboard hinge, and the engine room of the hinge is the crease bead. It is not just that the size of the bead has been reduced in this approach to creasing, but in how that reduction in size has impacted the structure and the performance attributes of the bead.



In reduced bead creasing, the shorter and more compressive action of shearing separation is more effective than the longer more lateral shearing action of the standard crease. ***See above***.

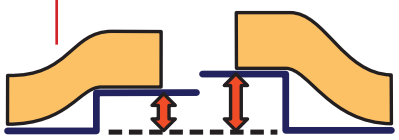
In summation, the reduced crease bead is smaller, it is more evenly delaminated, it requires less overall force to form than a standard crease, and the flexibility of the bead in folding is a significant advantage.

5: Thinner Counter



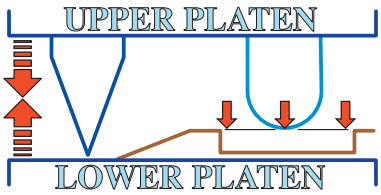
A key feature, and a significant benefit of reduced bead creasing, is this approach to male and female tool design uses a much thinner female counter/matrix than the standard crease. ***See above***.

In reduced bead creasing the thickness of the female tool, or the depth of the crease channel is only 75% of the caliper of the material being creased, rather than 100% of the caliper used in standard creasing. ***See left***.

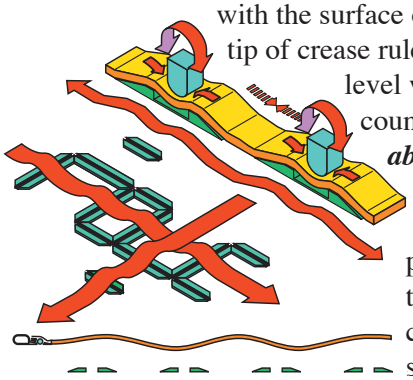


The thinner counter/matrix tool obviously limits competitive tensile draw forces to help to isolate the unencumbered formation of individual creases, and to prevent crease formation effecting surrounding creases and cutting knives.

6: Compression Gap

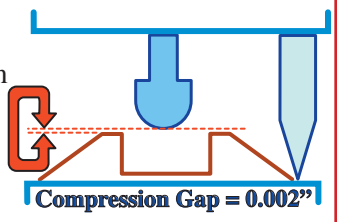


One of the more complex challenges of platen diecutting, is to achieve a perfect kiss-cut impression across the entire steel rule die layout. In standard creasing tool set up, if the knife is making perfect kiss cut contact with the surface of the cutting plate, the tip of crease rule in the die would be level with the surface of the counter or matrix tool. ***See above***



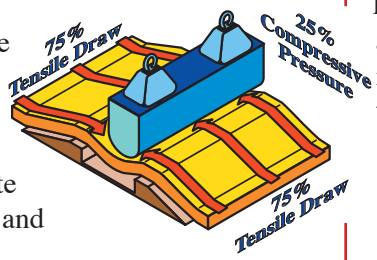
Any degree of over penetration of the tip of the crease into the counter channel and below the surface of the female tool, accelerates upper channel corner wear, and it increases the level of damaging tensile stress or lateral draw across the entire layout. ***See above***.

The integration of a Compression Gap in the Reduced Bead crease tool formula is an important setting adjustment, which is simply there to recognize the normal dynamic of press make-ready. ***See above***.



7: Compressive Formation

When using a thin narrow crease rule, a thicker counter, and a wider female tool channel, crease formation and shearing rely primarily upon, and generate excessive levels of tensile draw and stress. ***See right***.



Therefore, one of the primary differences between the Standard Crease Tool Set-Up and Reduced Bead Crease Tool Set-Up, is the standard crease uses more than 75% lateral draw as the crease formation force. ***See left***.

STANDARD CREASE
75% LATERAL DRAW
25% COMPRESSIVE FORCE

By comparison, the Reduced Bead Crease Set-Up is approximately 75% Compression Pressure, and less than 25% Lateral Draw. ***See below***.

The importance of this difference in tool set-up and crease formation forces cannot be underestimated. By using a majority of compressive force, reduced bead set-up minimizes damaging lateral tensile draw, it minimizes rapid and uneven tool wear, and the more vertical shearing action generates better delamination and folding flexibility.

REDUCED BEAD CREASE
25% LATERAL DRAW
75% COMPRESSIVE FORCE

To summarize, the seven tool set-up features which make Reduced Bead Creasing unique are:

1: Proportionate-Smaller Bead
2: Higher Pointage Crease Rule
3: Wider Surface Delamination
4: Balanced Bead Delamination
5: Thinner Counter
6: Compression Gap
7: Compressive Formation

Reduced Bead Creasing: Summary?

"Whatever one man is capable of conceiving, other men will be able to achieve" *Jules Verne*

Reduced Bead creasing is an innovative and an effective approach to creasing and folding paperboard. However, it should be initially used to solve difficult problems traditional creasing seems unable to cope with. In this way, the user gains experience with new methods and practices, while overcoming a challenging issue.

Fortunately, Reduced Bead Creasing is a highly effective solution. It provides a more reliable and a more predictable method of crease formation, and it generates a paperboard hinge, which will fold and unfold with remarkable consistency.

This short synopsis is an extract from a Tech Notes downloadable Manual entitled: "The ABC's of Specifying & Designing Optimal Reduced Bead Creasing." The Manual can be found at the DieInfo Web Site, with the identification number DIE.06.07

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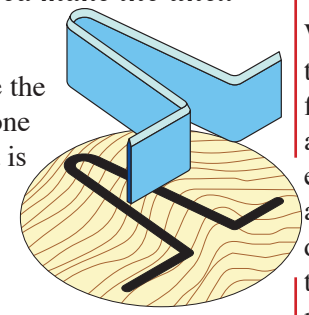
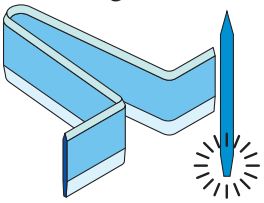
Diemaking: Taper Rule Base.

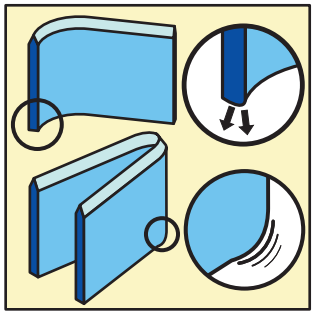
"Doesn't expecting the unexpected make the unexpected become the expected?"



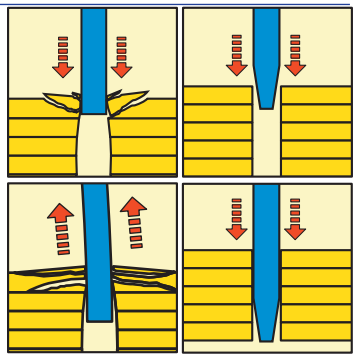
When ruling complex shapes, where the dieboard is potentially weak and prone to veneer layer damage, **see right**, it is a significant advantage to bevel the base of the rule, ***see below***, using a standard grindstone.



This provides several key advantages in both diemaking and in diecutting make-ready. The first advantage is in rule shaping or bending the knife. When a knife is bent, the outside of the bend point is stretched and the inside of the bend point is compressed. Unfortunately, the compressed material on the inside of the bend point has to go somewhere, and it ***"swages"*** downward to create a protrusion on the base of the rule. ***See right***. This obviously causes the bent shape to be higher at this point, which results in on-press cutting edge damage.



The second advantage, is ruling is faster, easier and safer, as positioning and driving the rule into the dieboard with the wedge shaped rule base, is very simple. The added advantage to this ***"wedge"*** shape, is damage to the upper veneers on either side of the kerf channel is eliminated, ***see right***, and even when reruling the dieboard, there is far less veneer delamination as the rule is pulled from the channel.



Finally, the tapered rule base results in far less kerf wall insertion damage, which preserves and protects the dieboard from premature damage. Added to this, the tapered shape requires less force to drive the knife into position, the rule ***"seats"*** perfectly, ***see above***, and cleaning the dieboard is a far less time consuming activity.

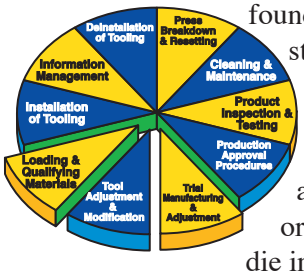
Editorial: What is the "Real" Cost of a Steel Rule Die?

"Not everything that can be counted counts, and not everything that counts can be counted." *Einstein*

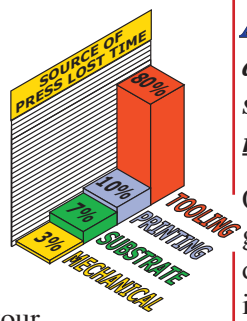
When purchasing a steel rule die you are investing in two distinct but hopefully integrated disciplines. The first is knowledge, skill and experience in diemaking and toolmaking. The second is knowledge, skill and experience in diecutting. You are also making the dangerous assumption, that your toolmaker is enthusiastically dedicated to converting excellence, and recognizes that the pursuit of expertise in diecutting is the foundation for mutual diemaking and diecutting success.

Naturally, you could eliminate this lottery approach to diecutting by creating and continuously updating the most valuable tool in diecutting, a detailed specification of how the die will be designed, machined, fabricated, and finished. With this blueprint for success, the diemaker simply has to follow your detailed instructions, and toolmaking becomes the simple and easy process it should be.

It is useful to remember the statistical breakdown of press make-ready, which consists of ten disciplines, and which is built around the



foundation tool of the process, the steel rule die. ***See left***. When you examine every breakdown of make-ready or press changeover time, the majority can be directly attributed to steel rule die rework or linked to the performance of the die in some manner.

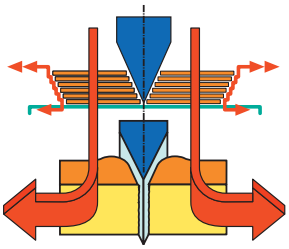


When lost time or non-productive time in the production phase of the diecutting is examined, it is obvious the majority of stoppages are associated with the performance of the various tools used in the process. ***See right***. Therefore, it is essential you and your colleagues recognize the importance of developing your own specification for the steel rule die and other tools. The people with the most knowledge of your process are your own team and if they do not take an active and a detailed participation in tools specification and design you have only yourself to blame for poor performance.

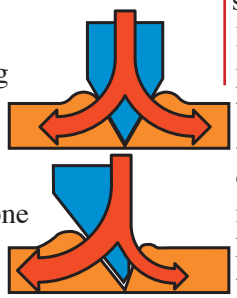
The Bottom Line? Press Make-Ready & Production Performance begin when the steel rule die is specified and designed, and if you wait until on-press make-ready to consider speed, quality & productivity in diecutting, your chances of success are severely limited.

What is Side Bevel Knife?

"Flattery is all right, if you don't inhale." *Stevenson*



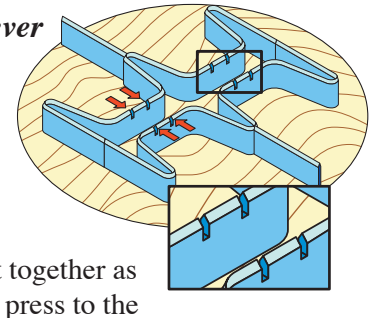
The majority of the steel rule cutting knives used in diecutting is center bevel knife. This simply means the cutting edge is machined into the center of the top of the steel strip creating a balanced wedge shape with a sharp edge. The bevel angles on both side of this knife/wedge are identical, and as platen diecutting is primarily a displacement action, the distortion of the material by the bevel angles of the blade is the same on both sides of the knife. ***See above***.



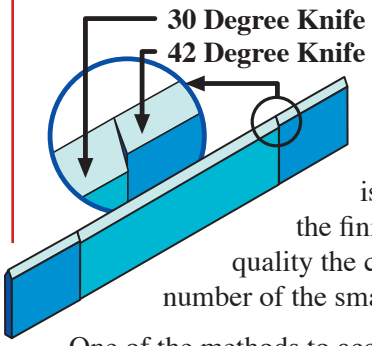
However, side bevel knife creates a cutting edge in the same way, but the cutting edge is offset from the center of the steel strip, ***see right***, and is close to one edge of the strip. This creates a large bevel on one side of the edge and a small support bevel on the other side of the cutting edge. This is made so the displacement action on the side with the large bevel will create all of the distortion in the ***"waste"*** part of the material, while the other side with the small bevel will penetrate the ***"product"*** with minimal distortion to the material.

Nick Strength versus Knife Bevel Angle?

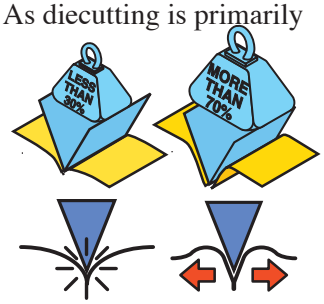
"Always & never are the two words you should <u>always</u> remember <u>never</u> to use." *Johnson*



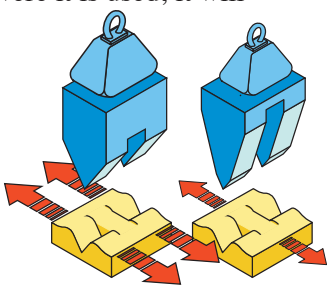
One of the most important goals in toolmaking and in diecutting is to hold the sheet together as it passes from one unit of the press to the next. This is accomplished by grinding a pattern of gaps into the knife profile of the steel rule die. ***See above***. Unfortunately, a nick is a permanent disfigurement of the finished product and to improve quality the challenge is to use the smallest number of the smallest size of nicks.



One of the methods to accomplish this is to use the insert knife technique. ***See above***. This is where a short section of a knife with a lower bevel angle than the original knife in the die is inserted into the profile of the design where nicks are to be positioned. As diecutting is primarily a displacement action, with more than 70% of the splitting force coming from the bevel faces of the knife, ***see right***, a reduction in this angle will significantly reduce the stress on the tag of material.

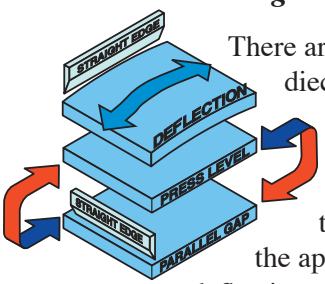


This is the best of both worlds. The reduced bevel angle will increase the holding power of smaller nicks, ***see below***, it will ensure faster press speeds, it will minimize flaking were it is used; it will lower the pressure for material penetration, therefore reducing the degree of dust & loose fiber; and it will improve the quality of the diecut part. There are a number of lower bevel angles knives which are perfect for this Inset Knife application.

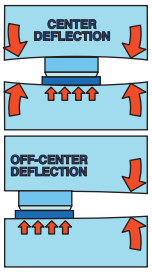


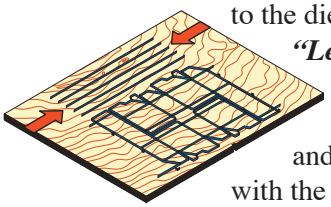
Correct Press Leveling Knives?

"You don't have to agree with me, but its quicker."

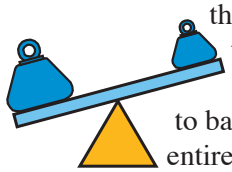


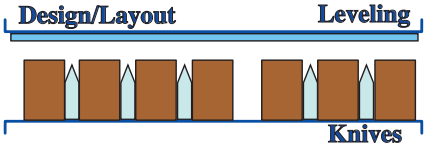
There are three key questions in platen diecutting. ***Are the press surfaces level, are they parallel, and how much will they deflect under load? See left***. Depending upon the type of press and the application, mechanical deflection will be centered or off-center. ***See right***. This is eliminated or at least minimized by using Press Stops, Adjustable Bearers, or Leveling Knives, which are added to the dieboard. ***See left***. The ***"Leveling Knives"*** are simply full lengths of the same knife used in the design/layout, and are inserted into the dieboard with the cutting edge up.



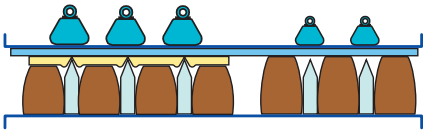


This is can be an effective technique, unfortunately the majority of the time it is done in such a way it is literally a waste of time! The most effective method of evaluating the use of leveling knives is to regard the press as a Teeter-Totter. ***See left***. The purpose of the leveling knife is to balance pressure or resistance across the entire platen surface. For example, in the configuration to the ***right***, the knives & the ejection in the design/layout are theoretically balanced by the leveling knives & ejection to the rear of the platen surface. At this stage everything is balanced, however, when the substrate to be diecut is added, we immediately have an imbalance. ***See right***.

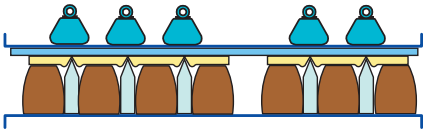


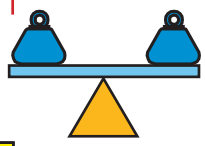


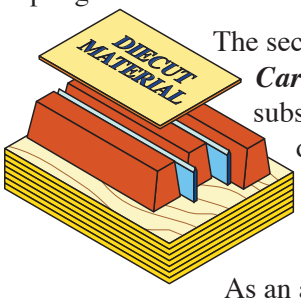
Why is this?



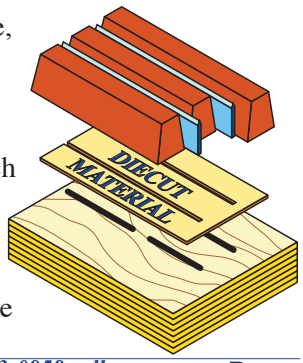
In the design/layout the platen is trapping ejection, the substrate, and the action of the knife, however, in the leveling knife area we only have knife and ejection. Therefore, to precisely balance the diecutting action it is necessary to add a strip of substrate to the leveling knives. ***See right***. Now pressure or resistance is balanced across the entire surface of the platen and the Teeter-Totter will be level. ***See left***. So what is missing in the majority of Leveling Knife set-ups is the inclusion of a strip of the substrate in the leveling knife area. This can be accomplished in two ways. The first and most obvious is a strip of the material to be diecut is simply super glued to the surface of the ejection material. ***See left***.







The second method uses the ***"Ejection Carding"*** technique, in that the strip of substrate is glued to the surface of the dieboard and the ejection material is glued directly to the surface of this material. ***See below***.



As an alternative, many have found the most effective solution is to use a higher durometer, higher density ejection material on the leveling knives, such as Green G'rilla. In addition, to ensure proper balance the patch-up sheet attached to the rear of the chase must be the full size of the chase back-plate!