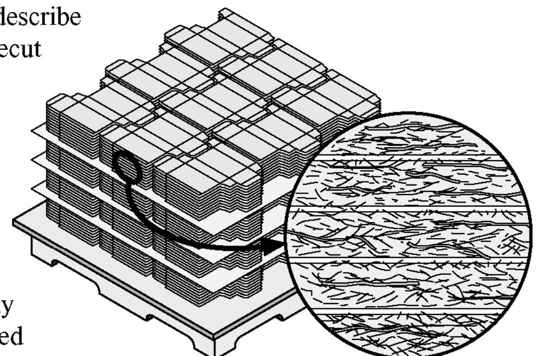
From the I.A.D.D., and DieInfo

Tech Notes

For Diemaking and Diecutting

TN-0004
January, 2005

How to Eliminate Dust & Loose Fiber in Platen Diecutting



Dust and Loose Fiber are terms used to describe the deterioration in the cleanliness of the diecut edge in platen diecutting. In practice this represents the accumulation of strands of paperboard, fiber, remaining firmly but loosely attached to the diecut edge, by secondary fiber, and/or by static attraction. It is important to note these particles are predominantly from the surface of the material being processed. This is particularly noticeable if the sides of a diecut and stripped load are examined as the build up of loose fiber and dust is difficult to ignore.

The top five recommended solutions to the problems of Dust & Loose Fiber are:

1. ***Implement Soft or "Thin" Cutting Plates.***
2. ***Footprint/Calibrate the cutting press to eliminate gross variables.***
3. ***Calibrate the steel rule die by adopting the dieboard preparation for ruling and the recommended ruling procedures.***
4. ***Adopt the highly effective floating knife practices for key knives in each design/layout.***
5. ***Use the integration of Two Sheet and Area patch-Up to create the most effective press leveling method, Combination Patch-Up.***

IADD
INTERNATIONAL ASSOCIATION of DIECUTTING and DIEMAKING

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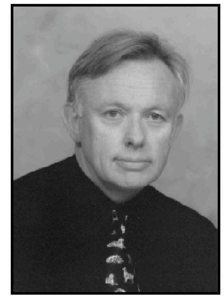
The Author



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 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.

This experience grew into DieInfo, publishing, consulting, training, auditing, and trade show organization, whose 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 On-Line Magazines and is a frequent contributor to leading industry publications. DieInfo is an IADD sponsor company and Carey has served as an 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.**

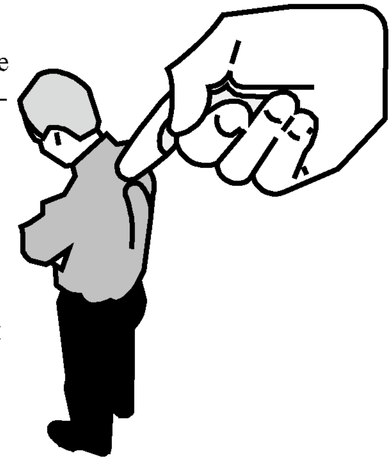
The International Association of Diecutting and Diemaking

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



The goal of this technical publication is to provide you with information, which will enable you to take action, to eliminate the problem of dust and loose fiber in platen diecutting. Naturally any significant change will require the cooperation of many members of the production team and those organizations who supply you with tools and material.

This will require you to become a teacher, a problem solver, a mentor, an effective communicator, a student, and a team builder! Manufacturing is about teamwork and improving the current system of manufacturing requires a consensus. Developing a consensus or an open-minded willingness to consider new ways to do things is far more difficult than solving the problem of dust and loose fiber!

It is useful to consider this quotation from William G. Dyer;

"People do not change easily or all at once. Most of us need a chance to try out new ways and to become familiar with new procedures."

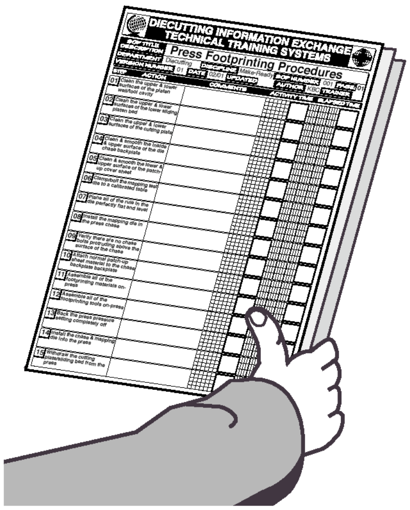
It is also useful to accept that ***Manufacturing is Research***. Every production run generates new problems, new results, new information, and the test of each procedure, each tool, and each material, provides new solutions. Unfortunately with so many different and conflicting methods and practices, and no unified standard approach valuable knowledge is lost every day. It is important to remember the basic goal of any professional manufacturing organization is knowledge and skill parity combined with procedural consistency.

Therefore, our goal is to seek the fastest, the best and the simplest method of doing things, and to continuously integrate individual knowledge and experience into a series of standard operating procedures. This requires a structured and logical approach to productive improvement. ***First*** by listing all of the current alternative procedures, ***second*** in implementing each technical option under the same conditions, ***third*** in discarding obsolete practices, ***fourth*** in developing a bullet proof specification for each approved method and ***fifth***, in developing a consensus in applying the most effective practice.

Realistically, the economics of converting, the drive for greater speed and yield, the demand for higher quality and better product consistency, the challenge of sustaining faster-simpler lower cost manufacturing have all undermined current methods and practices. The benefits of adopting a more effective method of diecutting paperboard is not really a choice, as the folding carton or fluted box purchaser is looking for an "***engineered-container,***" and the demand for consistent quality with lower costs and increasingly competitive turnaround time is non-negotiable.

Therefore, to achieve the productive benefits of precision diecutting we would recommend you use this manual in a number of ways. The manual is organized to present a series of technical pictures or storyboards designed to illustrate key elements of platen diecutting. Although it is critical to impart new knowledge, to invigorate traditional skills, and to energize current methods and procedures, this manual has another important purpose.

When suggesting radically different techniques to one's colleagues, and driving fundamental



change to long established, however flawed practices, there will be inevitable resistance. To support progressive improvement and to counter healthy technical skepticism, the manual should be used in a number of ways. These would include the following

- ***As an education tool for discussion, teaching and for training.***
- ***As a communication device to aid in developing an understanding of the converting process.***
- ***As a technical data base to build a foundation of knowledge and collect practical experience.***
- ***As a brainstorming format for the generation of innovative ideas.***
- ***As a problem solving guide to assist in developing solutions.***
- ***As the foundation for the creation of standard operating procedures.***
- ***As the basis for developing an effective manufacturing specification for converting.***
- ***As a reference work and the beginning of converting "library."***
- ***As a product and tool design guide.***
- ***As a weapon to eliminate aimless speculation!***

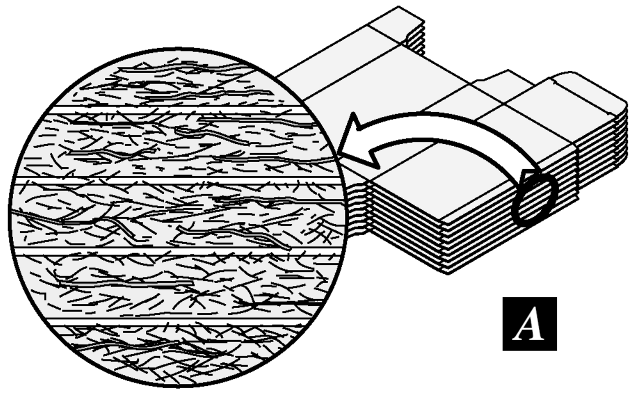
It is also useful to remember a quotation from George F. Nordenholt who stated:

"No matter how big and tough a problem may be, get rid of confusion by taking one little step toward solution. Do something. Then try again. At the worst, so long as you don't do it the same way twice, you will eventually use up all the wrong ways of doing it and thus the next try will be the right one!"

There are six key technical disciplines in Converting Manufacturing. ***These are Cutting, Creasing, Scoring, Perforating, Embossing, and Debossing***. To effectively diecut the wide and constantly changing range of cellulose materials, it is essential to learn, to understand, to master and to apply the skills of converting. The foundation discipline in converting is ***Cutting***, because without the stability generated by a kiss-cut impression, the performance of the other disciplines will be compromised and undermined. Dust and Loose Fiber are a quality benchmark in diecutting and a reliable early symptom of an unstable press make-ready.

And finally, as I am constantly searching for better, and faster, and simpler methods, if you have any questions, suggestions, or recommendations about the elimination of dust and loose fiber, I will be delighted to hear from you.

What is Dust & Loose Fiber?

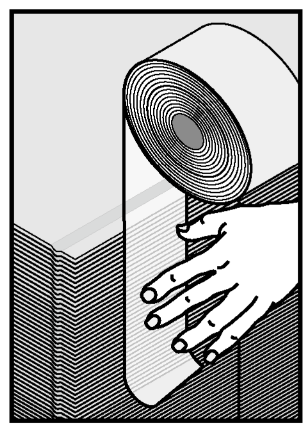


A

Dust and Loose Fiber are terms used to describe the deterioration in the cleanliness of the diecut edge in platen diecutting. In practice this represents the accumulation of strands of paperboard fiber, remaining firmly but loosely attached to the diecut edge, by secondary fiber, and/or by static attraction. It is important to note these particles are predominantly from the surface of the material being processed. This is particularly noticeable if the sides of a diecut and stripped stack of cartons are examined, as the build up of loose fiber and dust is difficult to ignore. ***See illustration A***.

B

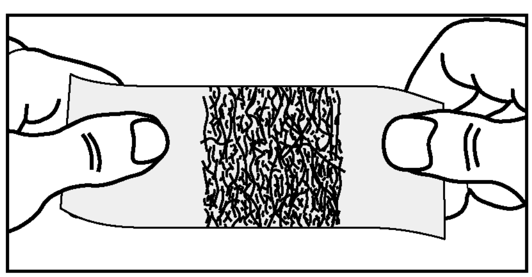
To detect the problem in the earliest stages it is a good practice to brush the side of a diecut load with a black clean cloth, ***see illustration B***, as this will clearly illustrate how severe the developing problem is. Another technique, requires pressing the surface of self adhesive packing tape to the cut edges of the stacked load, ***see illustration C***, pulling the tape free, and then examining the surface of the tape for dust, debris, and loose fiber build up. ***See illustration D***.



C

It is important to recognize there are several problems with the dust and loose fiber breakdown of the process, which include difficulty in downstream processing and serious problems in the customer packaging/cartoning process. Dust and Loose Fiber have several negative impacts on the converting manufacturing process, on the cartoning packaging line, and on the application the container or paperboard device is put to.

FIRST, the problem impacts the aesthetic appearance of the final product. It is ugly, unsightly, and it is difficult to hide! It also sends a clear message to the customer and to your colleagues, as it is hardly a sign of professional competence or technical excellence.

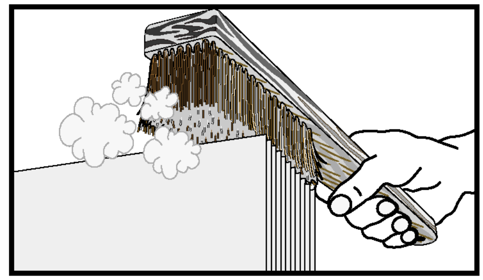


D

SECOND, there is a real danger of contamination of carton contents, in food, pharmaceutical, electronic, automotive, and medical products.

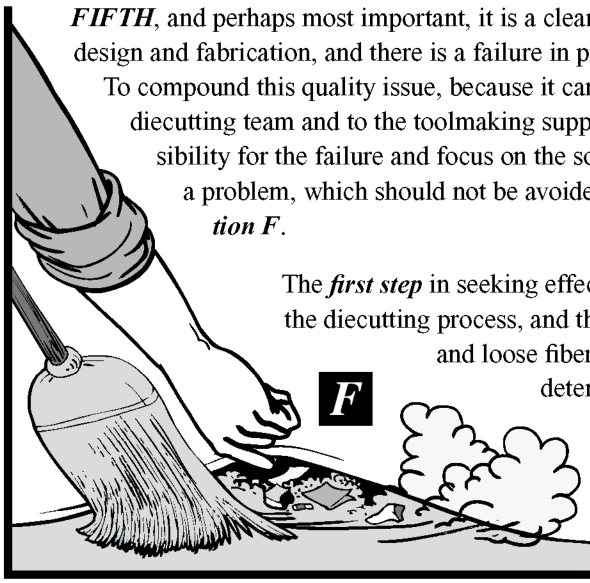
THIRD, the accumulation of paper dust and fiber will contaminate electronic sensors on all converting and packaging equipment, it will build up in mechanical linkages and machine oiling systems, it will build up in glue applicators, and it will undermine the efficiency of every subsequent carton and packaging process.

FOURTH, dust and loose fiber have to be removed and cleaned up. This involves hand brushing stacks of cartons to dislodge the fiber and dust, and to "***clean***" the finished product. ***See illustration E.***



E

This is labor intensive, it obviously raises costs and lowers profit, it reduces productive throughput, it makes meeting delivery schedules difficult, it is unpredictable, and because of static and variable procedures, the end result is rarely satisfactory.



F

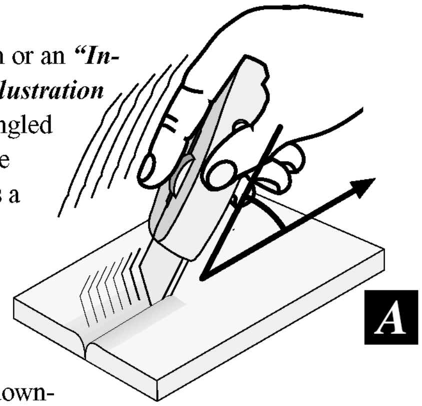
FIFTH, and perhaps most important, it is a clear signal there is a breakdown in tool design and fabrication, and there is a failure in press make-ready and set-up procedures. To compound this quality issue, because it can be eliminated, it is a signal to your diecutting team and to the toolmaking supplier that they need to accept some responsibility for the failure and focus on the solution to the problem! This is definitely a problem, which should not be avoided or swept under the carpet! ***See illustration F.***

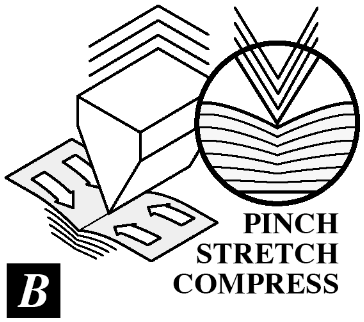
The ***first step*** in seeking effective solutions requires understanding the diecutting process, and the ***second step*** in determining how dust and loose fiber are generated. The ***third step*** requires determining the sources) of the problem, and finally, defining and prioritizing a series of technical options which will prevent the problem before we even get to the press! So let us first examine how platen diecutting works, and focus on the key factors, which cause dust and loose fiber.

Before you invest valuable time in reading and digesting the technical analysis of the problem of dust and loose fiber , 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.

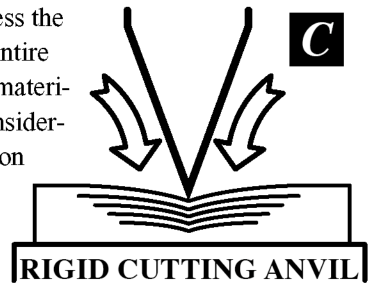
How Does Platen Diecutting Work?

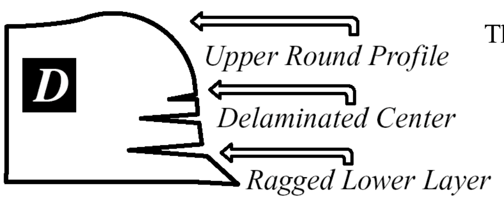
In using the term ***"cutting"*** the most obvious image would be a traversing action or an ***"Incremental"*** slicing motion using a common cutting tool like a Utility Knife. ***See illustration A***. In this type of cutting only part of the blade is being used, the blade would be angled to cut with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



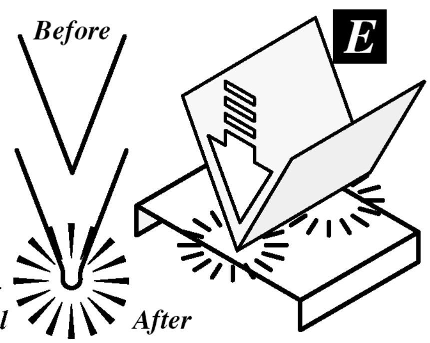


In contrast platen diecutting or ***"Simultaneous"*** splitting, positions the entire length of the blade cutting edge against the upper surface of the material. As the knife is driven downward the knife edge begins to compress the upper part of the material and to stretch and stress the surface. ***See illustration B***. Because the entire knife edge is attempting to penetrate the material at the same time or simultaneously, considerable force is required to overcome the resistance of the material to compression and to splitting. As with incremental and simultaneous cutting the material is trapped between the downward pressure of the cutting edge by a rigid anvil or cutting plate. ***See illustration C***.

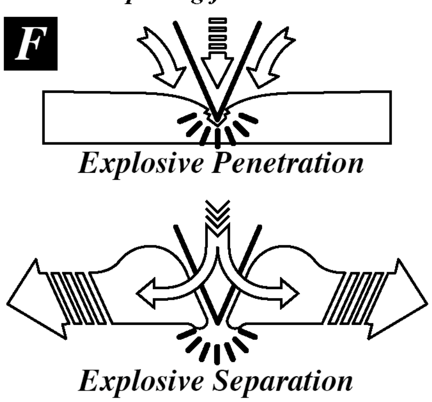




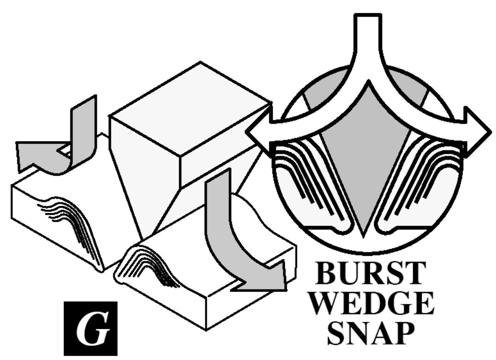
This is not an efficient form of cutting, as considerable pressure is required, the resulting cut edges are ragged and torn, ***see illustration D***, and the knife-edge is progressively damaged, as it ***"explodes"*** through the material, and the previously sharp blade repeatedly strikes the anvil surface with excessive force. ***See illustration E***.

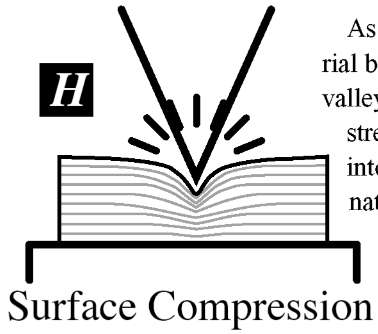


The correct method of describing hard anvil platen diecutting is to define it as a combination of two quite different but complimentary forces. These are ***"Explosive Penetration and Explosive Separation"***. This is critically important because the cutting action is actually a combination of ***vertical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

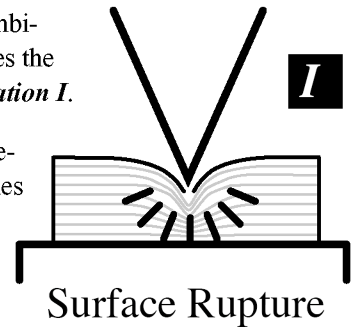


The final explosive separation action of platen diecutting is often referred to as Bursting, Wedging, or Snapping. ***See illustration G.*** Bursting and snapping obviously refer to the separation of the material under the stress of the displacement action of the knife/wedge, as the action of the knife bevel faces split the material apart.

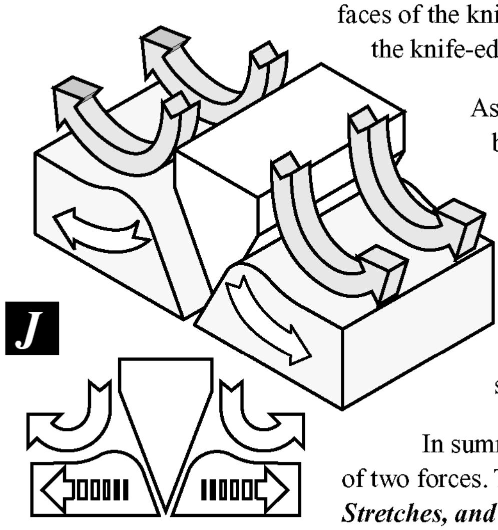




As the knife-edge makes contact with the material being converted, it pinches the material between the knife edge and the cutting anvil. The edge compresses the surface, creating a valley in the upper portion of the material. ***See illustration H***. The creation of this depression stretches the material 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. ***See illustration I***.

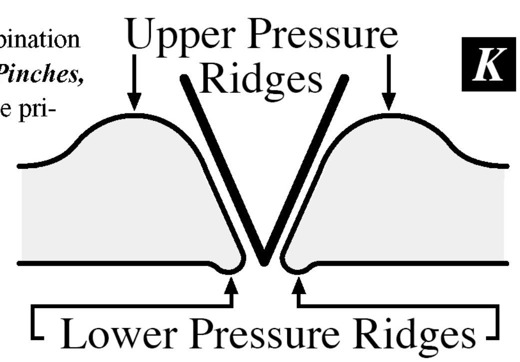


As soon as the surface is fractured the role of the knife-edge is diminished and the action of the knife bevel angles come into play. The vertical force of the knife-edge is now converted into a lateral splitting action, as the bevel surfaces of the knife, drive the material away at 90 degrees from the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

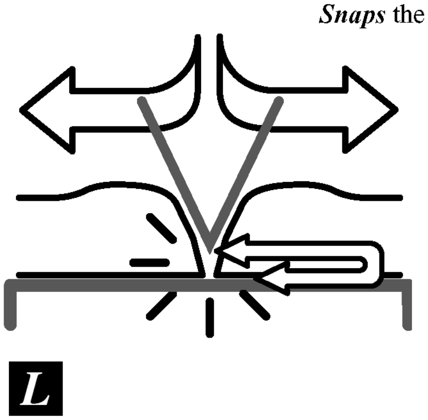


As the knife drives further toward the anvil, the degree of lateral force generated by the bevel faces causes temporary pressure ridges to build on the upper surface of the material, until the material snaps apart. ***See illustration K***. (These pressure ridges are termed "***temporary***" when cutting a ductile material, however, when diecutting a very dense material, the displacement of the ridges in platen diecutting, will probably become "***permanent***" disfiguring ridges on the edges of the diecut parts.) It is both important and interesting to note that the material splits apart before the knife edge makes contact with the anvil surface! ***See illustration L***.

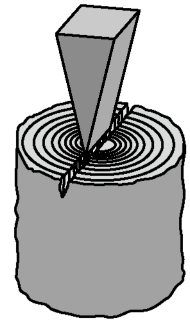
In summary: platen diecutting is a combination of two forces. The initial vertical force, which ***Pinches, Stretches, and Compresses*** the material, and the primary lateral force, which ***Bursts, Wedges, and Snaps*** the material apart.



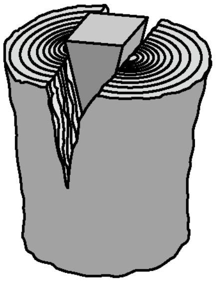
In principle and in practice the most accurate description of platen diecutting is to state that it is a ***Displacement Process***. This understanding is key to eliminating many potential problems in platen diecutting, and is particularly important in solving the problem of ***Flaking and Chipping*** of the diecut edge.



What is Displacement Diecutting?


A

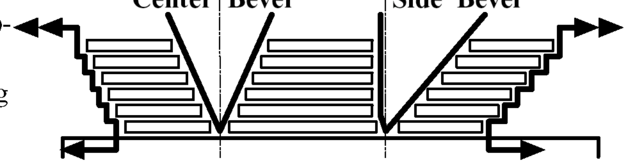
The dictionary defines the word displacement as: ***"The act of displacing (moving) physically out of position… the difference between the initial position and any later position."*** In platen diecutting this action can be most accurately described as ***"Wedging"*** and the action can be compared to splitting a 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. ***See illustration A***. However, almost immediately, the split is widened as the wedge is driven into the fracture, and the bevel surfaces force and tear the wood and fibers apart. ***See illustration B***.

B

In platen diecutting the knife is in reality a sharpened wedge, which just like the metal wedge driven into the end of the log, converts an initial vertical force into a lateral splitting action, as it is driven down through the material. ***Illustration C***, shows the displacement action of a ***Center-Bevel*** knife/wedge and a ***Side-Bevel*** knife-wedge.



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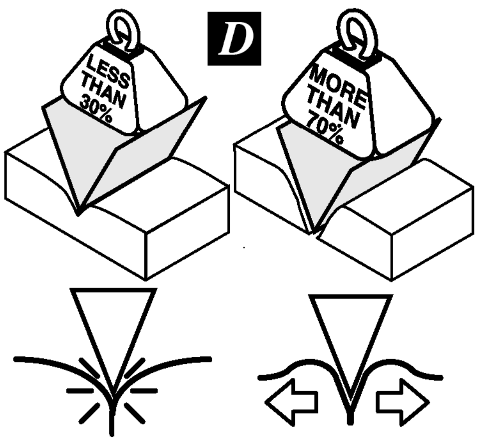
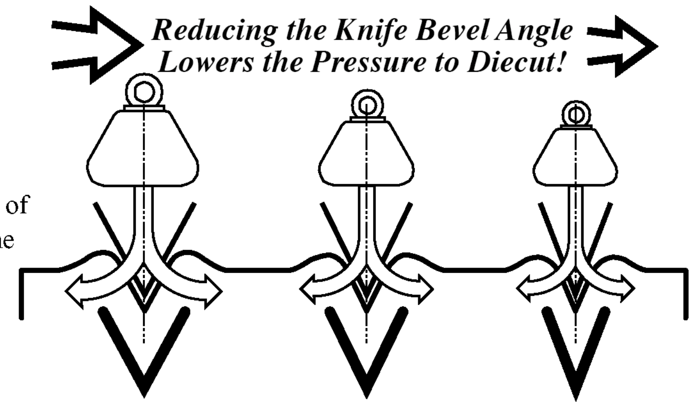


D

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***.

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***.



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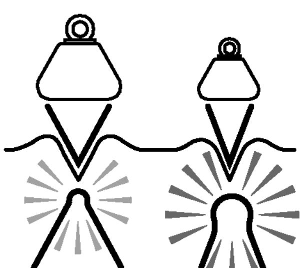
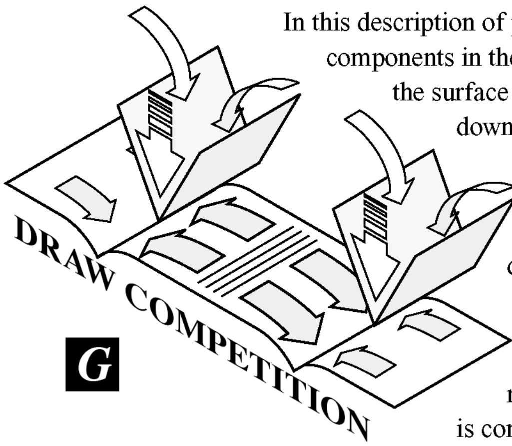

F

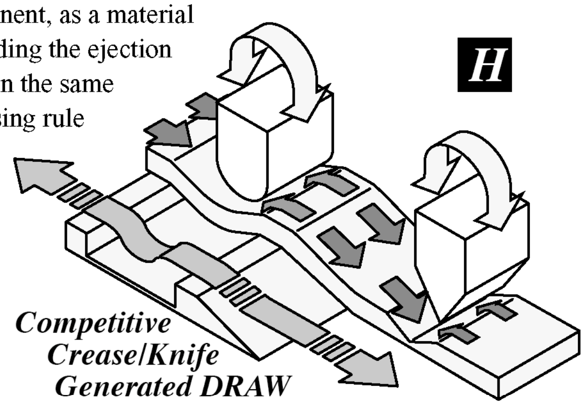
This principle of how a steel rule knife works in platen diecutting illustrates a key dilemma for the diemaker and the diecutter. A knife with a lower bevel angle, and particularly a ***Ground Edge Profile***, requires less pressure to diecut and is easier to control, but in contrast, a knife with a higher bevel angle, requires more diecutting pressure and is more difficult to control. The potential disadvantage of a lower bevel angle knife, is it is far more susceptible to compressive tip damage and swaging. ***See illustration F***.

Simply stated, the cutting edge of this blade gets damaged more quickly!

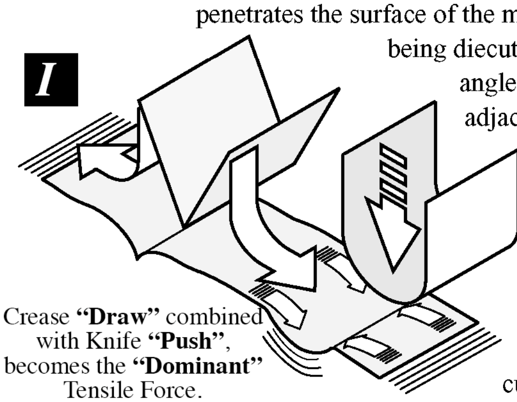


In this description of platen diecutting it is also important to understand the role of other components in the cutting process. For example, as every knife initially compresses the surface of the material to be diecut and pushes and stretches the surface down into a valley created by the knife tip, every other knife is doing the same thing at the same time. ***See illustration G***. This action creates high levels of lateral and ***competitive*** tensile stress as the material is deformed and stretched by different components in the steel rule die and crease tools mounted on the press cutting plate.

This phenomena is called ***"Draw"*** in platen diecutting, as every steel rule die component is competing with every other steel rule die component, as a material is converted. (Including the ejection material!) For example, in the same manner as the action of the knife the creasing rule is initially competing with the knife as the knife and the crease rule both ***"pull"*** material toward their centerline of vertical compressive effort. ***See illustration H***.



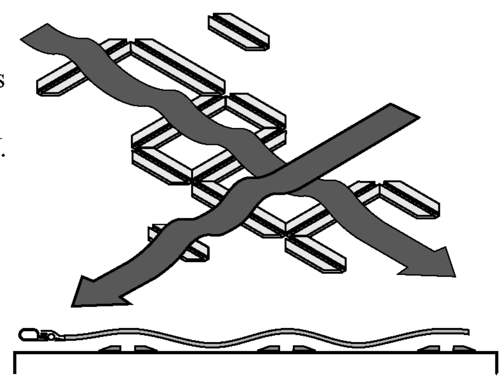
However, as soon as the knife-edge penetrates the surface of the material being diecut, the bevel angle of the blade, adjacent to the crease rule, is working in conjunction with the crease to displace and to drive the material toward the crease channel and away from the cutting knife. ***See illustration I***.



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

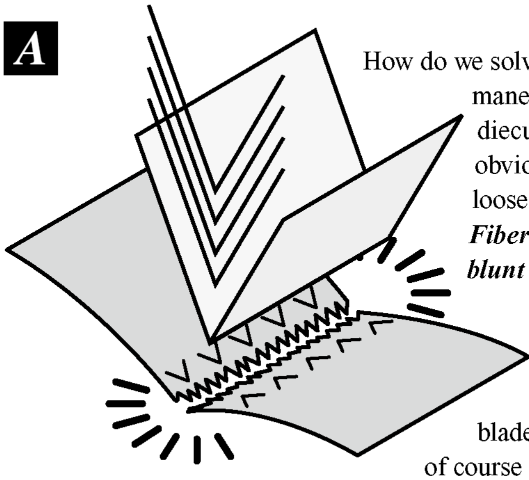
Further complicating the high level of tensile stress or draw, is the stretching of the diecut material as it is ***"wrapped"*** around other components mounted on the cutting plate, such as the crease female counter tool or individual matrix strips. ***See illustration J***.

How do these principles of platen diecutting compromise the converting process to generate dust and loose fiber failure?



The Generation of Dust & Loose Fiber: What are the Sources of the Problem?

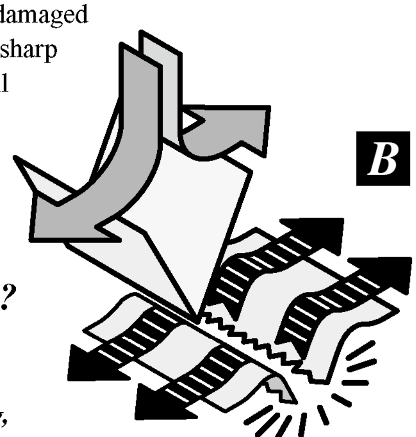
A



How do we solve the dust and loose fiber problem and permanently eliminate this type of failure from platen diecutting? Although it is necessary to pose the obvious question, what is the key source of dust and loose fiber, we know the answer! ***Dust and Loose Fiber are caused when the steel rule knife becomes blunt and the blade tip or cutting edge is damaged***.

We demonstrate our understanding of the cause, by removing the damaged knife and inserting a new, sharp blade! A new, sharper blade will of course work for a while, however, because nothing else has changed the new blade will rapidly suffer compressive edge damage, and the problem returns.

B

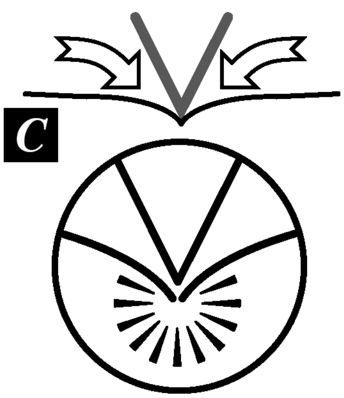


What is happening when the knife starts to get blunt?

In the previous chapter we identified diecutting as a combination of two forces, surface splitting, which was identified as a combination of ***Pinching, Stretching, & Compression*** of the upper layers of the material, described accurately as ***Explosive Penetration*** of the surface layers only. ***See illustration A***.

Surface Penetration

C

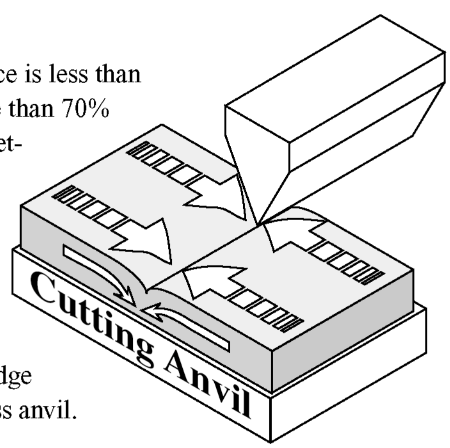


"The Focus of Diecutting"

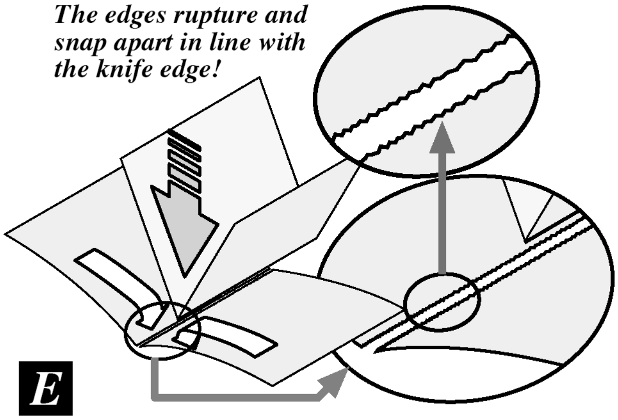
The second force in platen diecutting, which is appropriately called ***Explosive Separation***, consists of ***Bursting, Wedging & Snapping***, as the wedge displaces and pushes the material away from the Centerline of the knife blade. ***See illustration B***.

Although the ratio of pressure/force is less than 30% for surface rupturing, and more than 70% expended in splitting the material, getting the tip of the knife through the surface of the material, is one of the most critical events in platen diecutting. ***See illustration C***.

D



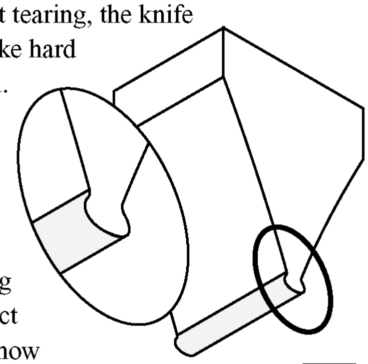
Let us examine this action more closely. Even when the blade is razor sharp the stamping action of the steel rule die causes the knife-edge to depress the surface of the material as it traps it against the rigid press anvil. ***See illustration D***.



E

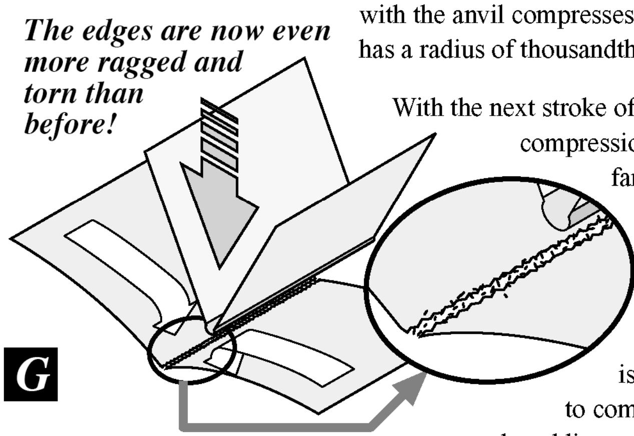
Eventually this combination of pinching, stretching and compression causes the surface to rupture and snap apart, with the split or tear in the material being diecut aligned with the cutting edge of the knife. ***See illustration E***.

Unfortunately, when overcoming the compressive resistance of a material to vertical surface deflection and rupturing and then knife/wedge induced displacement tearing, the knife tip can often travel too far and make hard contact with the steel cutting anvil.



F

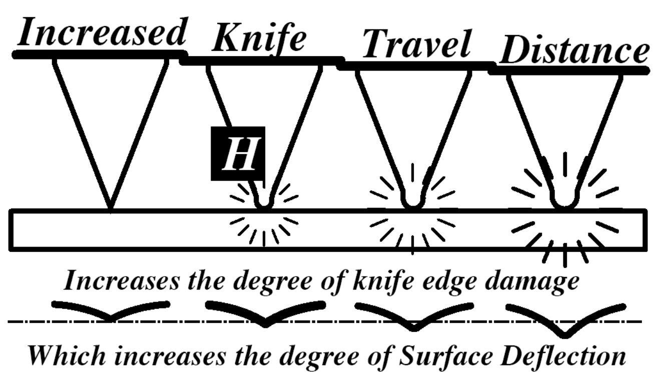
When the knife strikes the hardened steel cutting plate with excessive force, the tip of the knife is damaged and swaged, and the blade becomes blunt! ***See illustration F***. Even a small amount of contact is damaging as the original edge radius is only a few microns and the contact with the anvil compresses and swages the tip of the edge so it now has a radius of thousandths of an inch.



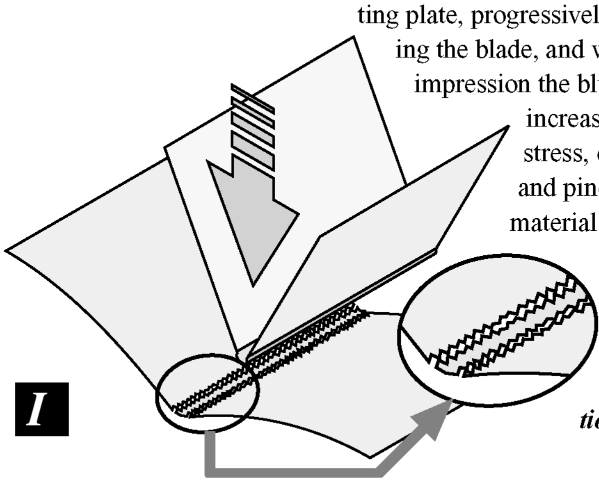
G

With the next stroke of the press, the blunt cutting edge increase the degree of material compression, and although the surface will eventually fracture, the edge is now far more ragged and uneven, ***see illustration G***, and the explosive energy much higher.

This is beginning to tear particles of the surface free from the rest of the material. But what happens when a knife is blunt in diecutting? The cut edge is not as clean, there are uncut fibers, and the diecutter is forced to compensate by adding more pressure to the knife!

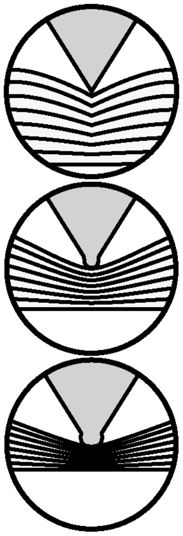


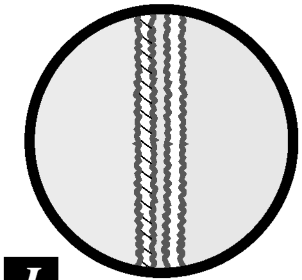
The excess pressure drives the knife-edge against the cutting plate, progressively damaging the blade, and with each impression the blunter knife increases tensile stress, compression and pinches the material into a deeper and deeper valley. ***See illustration H***.



I

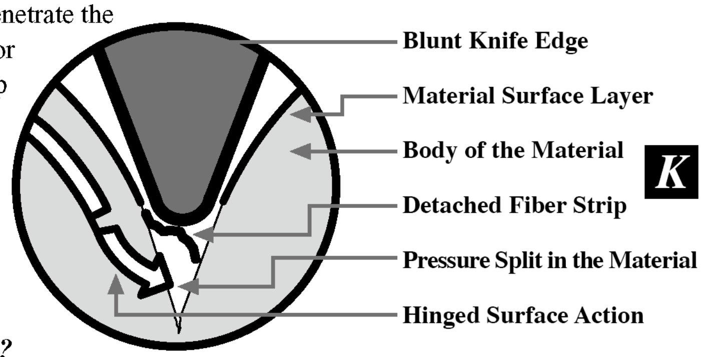
The degree of material compression and stretching is now at damaging levels, but as the knife pushes harder against a highly compressed material, there is a sudden release of energy when the surface tears apart, and the surface ruptures and splits, into three separate pieces. ***See illustration I***.




J

This central strip of individual strands of loose fiber or the matte of compressed surface fiber is not completely separated, but remains attached to the side of one of the diecut edges, ***see illustration J***, connected by secondary fiber. The tip of the knife pushes the fiber to one side, and it is crushed against the diecut edge by the face of the knife wedge. ***See illustration K***.

It is more difficult for the blunt knife to penetrate the surface of the material, and to compensate for non-cutting, the operator adds more patch-up material, which leads to greater knife damage! This in turn leads to greater material surface compression, which leads to greater resistance, added pressure, and unfortunately progressive knife tip damage. ***See illustration L***.

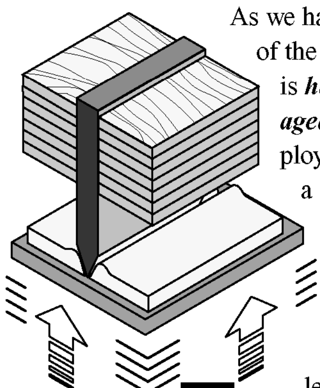


K

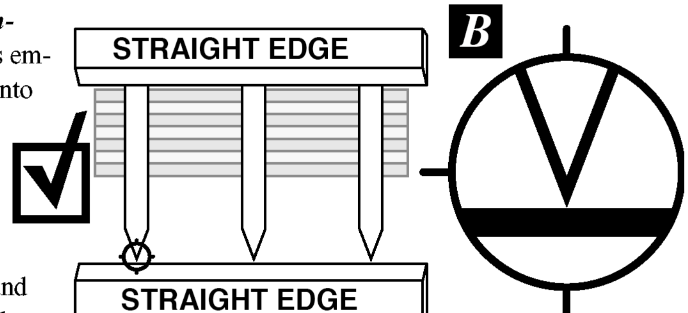
L

This poses another very important question?

How does an individual knife get damaged?


A

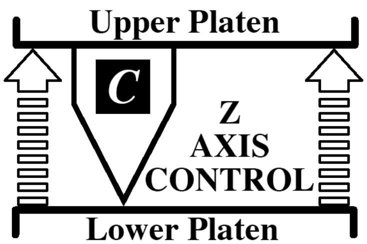
As we have already learned, knife-edge damage is caused by compression of the blade against the steel cutting anvil. The key part of the question is ***how does an individual knife get damaged?*** The diecutting converting process employs a steel rule die, which is inserted into a stamping mechanism, which drives the lower cutting plate/anvil and the material against the cutting edges. ***See illustration A***.



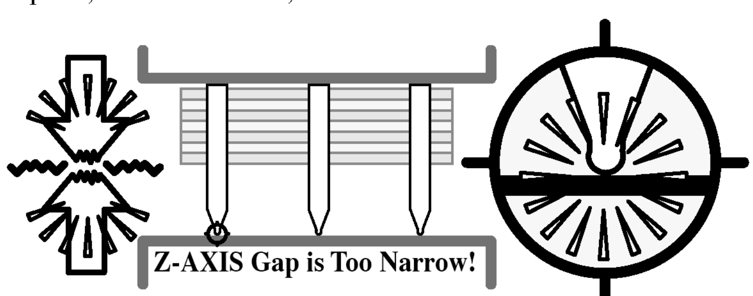
B

If the press anvil is perfectly flat and level, if the upper tool holder and steel anvil surface are exactly parallel, and if the steel rule die cutting edges are perfectly aligned in the same plane, ***see illustration B***, how can an individual knife get damaged?

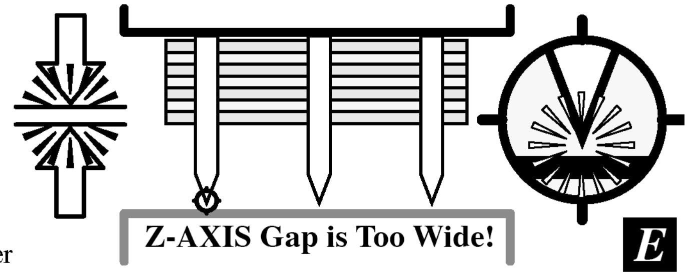
Obviously if the platen gap, or the Z-Axis distance, ***see illustration C***, is set too close, then it would be logical, that all of the knife-edges would be damaged. ***See illustration D***. Conversely if the platen gap is too far apart, the



C



D

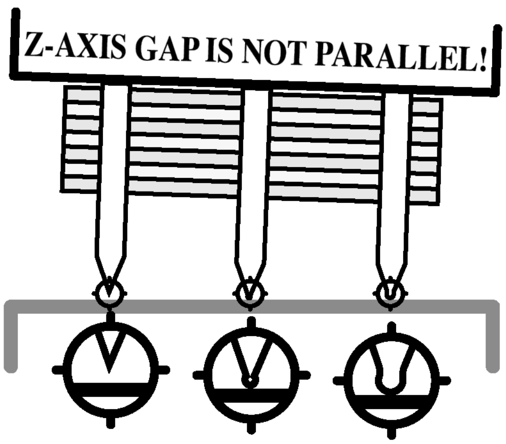


E

knife-edges will not make contact with the anvil surface, and none of the knife-edges will be damaged. ***See illustration E***.

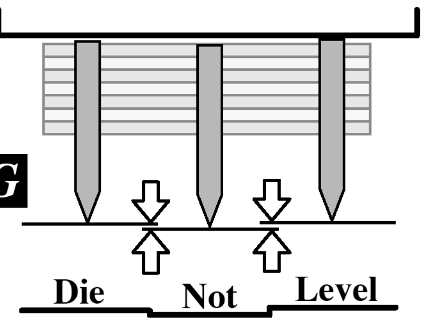
Even if the press deflects under pressure or the top tool holder and/or the lower anvil and top tool holder are not parallel, then only part of the die and some of the knives will suffer progressive edge compression. ***See illustration F***. So how does an individual knife in the middle of a steel rule die get badly damaged?

F



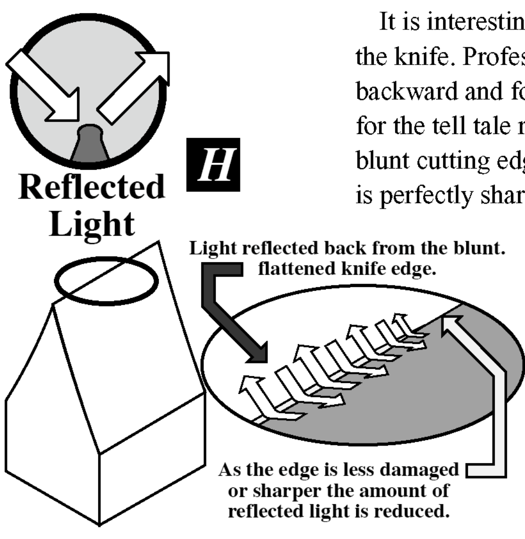
The only way an individual knife can get damaged is when a non-calibrated steel rule die is supplied, in which one or more of the knives is higher than the other knives in the die. ***See illustration G***.

G

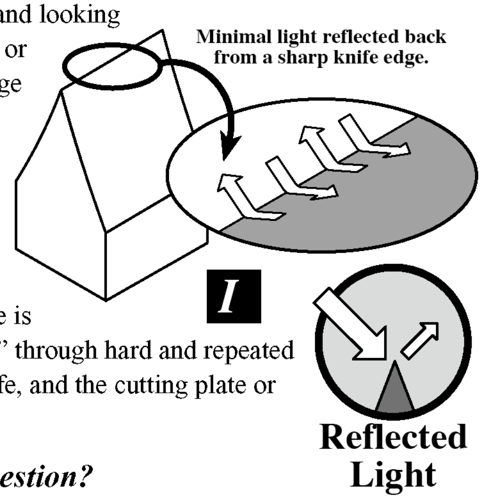


In summation, although steel rule knives will "***wear***" through the abrasive action of diecutting, over-pressurization and the knife striking the cutting plate with excessive force causes the majority of knife-edge damage. Of course factors such as the cumulative number of impressions, the type of material, the number of times the die has been "***made-ready***," the number of production runs on different presses, and the condition of the dieboard, will all impact the sharpness of the knife. But the reality of platen diecutting is the majority of knife-edge damage happens during the first diecutting make-ready sequence.

It is interesting to note the wear or the bluntness of a cutting knife is called the "***Candle***" of the knife. Professional knife makers assess the sharpness of a blade by pivoting the knife-edge backward and forward under a strong light source, and looking for the tell tale reflection of light from an imperfect or blunt cutting edge. ***See illustration H***. When the edge is perfectly sharp, there is no "***flat***" on the edge to reflect back the light to the eye of the knife-maker. ***See illustration I***.



H

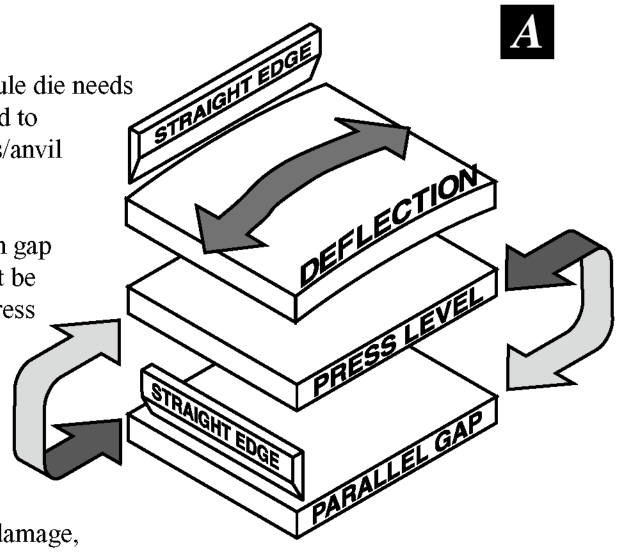


I

This is interesting, however, in platen diecutting the knife-edge is made blunt and develops "***candle***" through hard and repeated contact between the tip of the knife, and the cutting plate or diecutting press anvil.

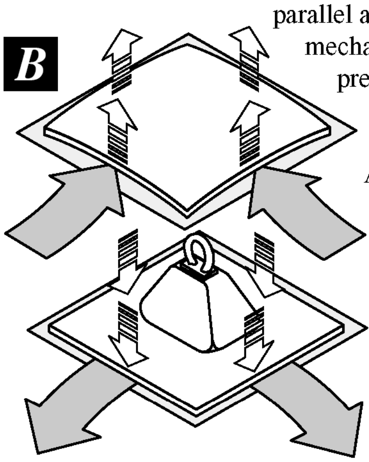
Which poses a further question?

How can the performance of the press cutting plate-anvil cause dust and loose fiber?

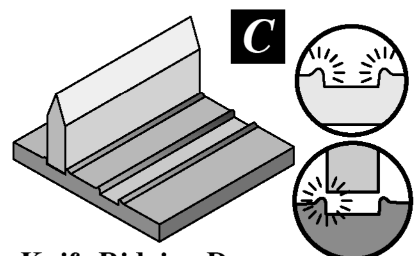


Diecutting is a male and female tool process. In other words the steel rule die needs an opposing anvil or a rigid cutting plate to trap the material against and to convert it into a diecut product or component. There are three key press/anvil parameters, which are critical to clean and consistent diecutting.

The press anvil or cutting plate must be perfectly flat & level, the platen gap or the distance between the upper tool holder and the cutting plate must be parallel at all times, and it is imperative the press mechanism should not deflect under the pressure of diecutting. ***See illustration A***.

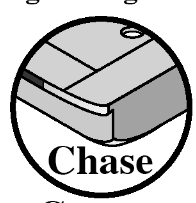


As we shall see in the recommendations, this requires Calibrating the Press to eliminate steel rule knife damage, and Pressure Balancing the steel rule die to prevent deflection of the press mechanism. To be effective in steel-to-steel platen cutting the steel rule die, the cutting plate, the chase, and the platen mechanism must be rigid, they must be perfectly flat and level, they must be deflection free under cutting load. In addition, the reciprocation mechanism must be precise and controlled through the entire stamping cycle.



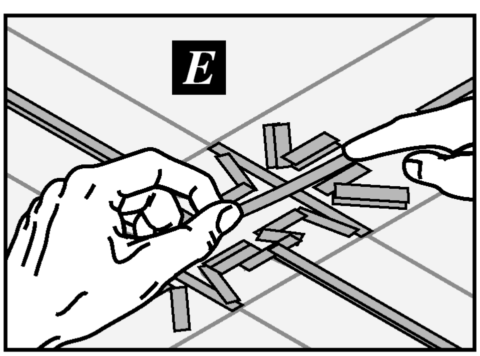
Knife Ridging Damage

But there are other key factors, which can undermine anvil rigidity, and which can lead to a rapid reduction in knife edge sharpness and integrity. These could be a domed/bowed cutting plate, ***see illustration B***, which flexes under cutting load, to give a soft, spongy and imprecise cutting action. It could be the cutting plate is worn and damaged by excessive use and by pitting of the undersurface by condensation driven rust and oxidation.

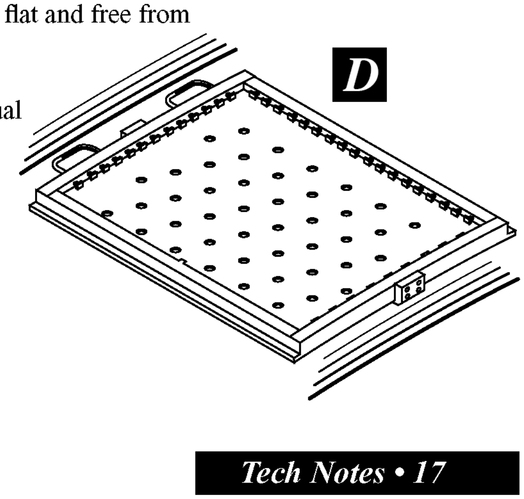


Chase Corner Damage

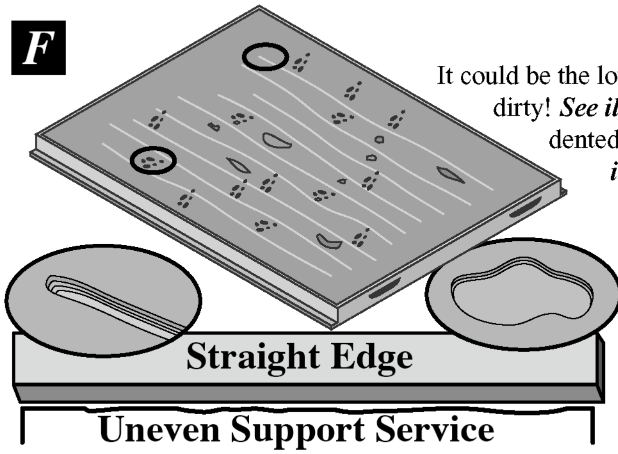
It could be a damaged chase back plate, in which the sacrificial surface is grooved and scarred with the welts derived from previous excess pressure cutting action, and damage to critical chase location rails and fixtures. ***See illustration C***. As important as it is for the cutting plate to be flat it is equally important that the press chase is also flat and free from distortion. ***See illustration D***.



It could be a soft, spongy, individual patch-up make-ready, behind the steel rule die, in which too many layers of patch-up tape have been used. ***See illustration E***.



F



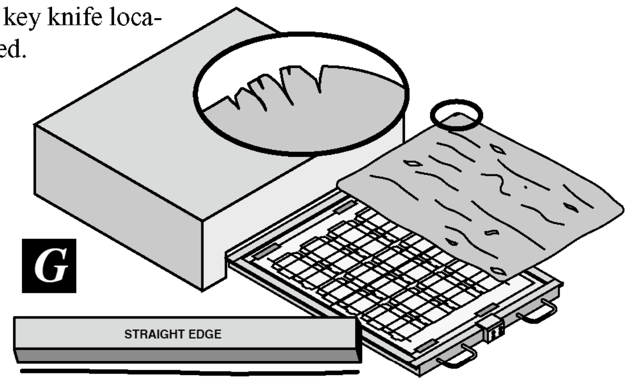
It could be the lower sliding bed of the press, is scarred, grooved, and most likely, dirty! ***See illustration F***. It could be the patch-up cover sheet, which is dented, damaged, and far from being perfectly flat and smooth. ***See illustration F***.

Effective kiss cutting is only possible when there are standard maintenance and regularly executed cleaning preventative actions, to preserve the integrity of the press, and to ensure the precision of the diecutting action.

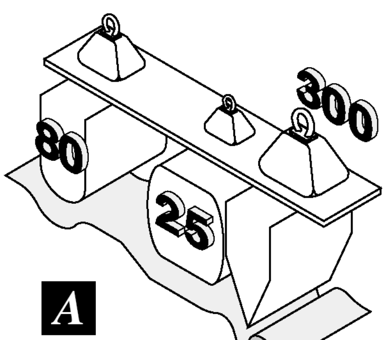
But all of these issues, as important as they are, do not account for every source of dust and loose fiber. Dust does not appear everywhere, and it is not a random occurrence, as in practice dust and loose fiber occur in key knife locations, which can generally be predicted.

Why is this?

In platen diecutting individual knife damage can be generated by the design, by the layout and by the concentration of converting activity around a specific knife.



G



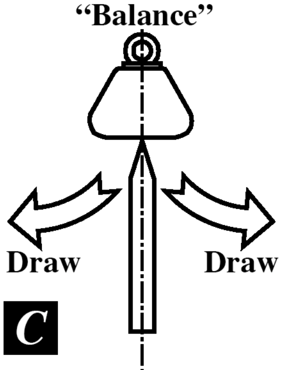
A

How does the product design, and the layout of diecut part contribute to knife-edge damage?

It is obvious dust & loose fiber failure does not happen on every knife, but on specific knives in a design and/or a design layout. Why would one knife get damaged, while other knives in the layout are undamaged?

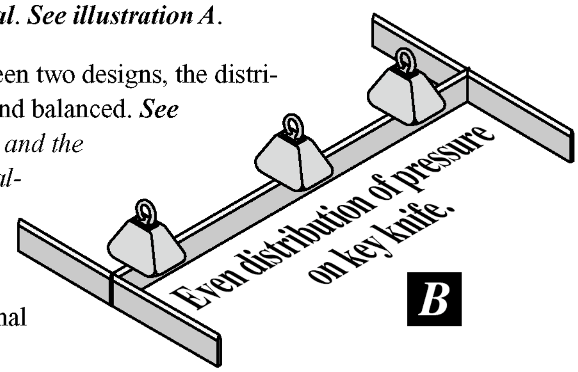
The answer is ***Pressure Balancing***. The standard formulae for calculating pressure in steel rule diecutting states that it requires ***300 pounds of pressure for every 1 inch of knife, 80 pounds of pressure for every inch of creasing rule, and 25 pounds of pressure for every square inch of ejection material***. ***See illustration A***.

Pressure "Balance"

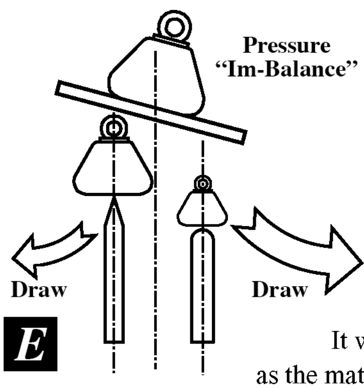


C

In a layout sharing a single knife between two designs, the distribution of pressure would be fairly even and balanced. ***See illustration B***. (*The pressure on the knife and the draw/pull acting on the knife would be balanced around the centerline of cutting edge effort.* ***See illustration C***.) However, if a crease and additional knives are added, in close proximity to the original

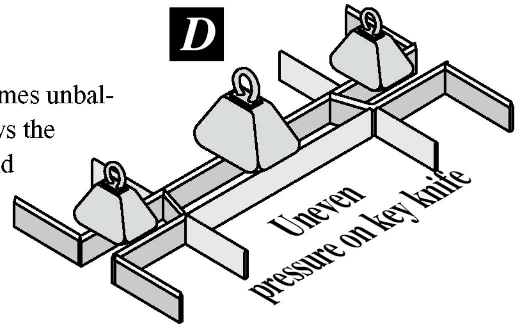


B



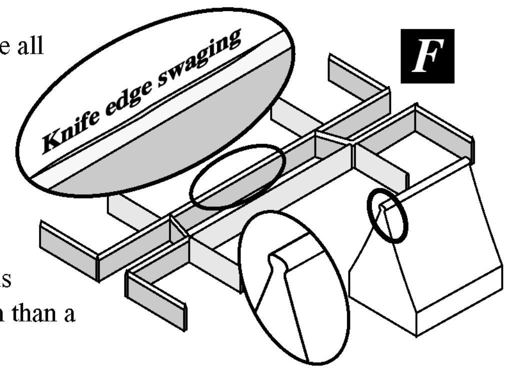
E

single knife, the distribution of pressure becomes unbalanced. ***See illustration D***. ***Illustration E*** shows the "***Unbalanced Pressure***" between the knife and the crease rule, the increase in "***Draw***" on the crease side of the knife, and the lateral shift of the center of effort from the cutting edge of the blade.



D

It will now require more pressure to get this specific knife to cut, as the material is being compressed in a concentrated area by knives, by creasing rule, and by ***rubber***. As a result, the control of cutting force in these areas is more difficult, and the knife edge will suffer swaging damage. ***See illustration F***.



F

All other steel rule die components, in close proximity to the original knife, are all competing by "***drawing***" and "***tensioning***" the surface layer, which increases the tensile stretching of the material being diecut. Therefore, dust and loose fiber is particularly prevalent on knives which are the center of a concentration of diecutting/converting activity, or the center of a high pressure cutting imbalance in the design/layout.

It is also noticeable how the generation of dust and loose fiber on a knife in this position will be much higher when the knife is cutting at right angles to the grain than a knife cutting parallel to the paperboard grain.

Clearly, there is a correlation between dust and loose fiber and the type of material being diecut, ***which poses a further question?***

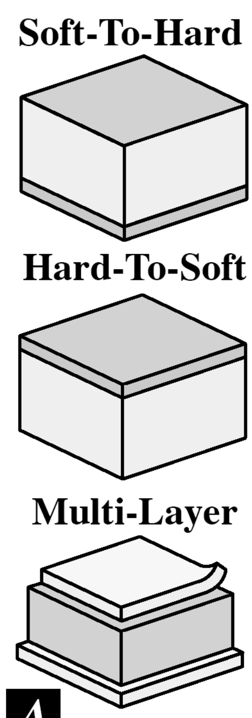
What role do paperboard parameters play in the generation of dust and loose fiber?

In considering the impact of paperboard type on the generation of dust and loose fiber it is important to remember in diecutting we cut three different types of material. ***These are Hard-to-Soft, Soft-to-Hard, and Combination or Multi Layered Material. See illustration A***.

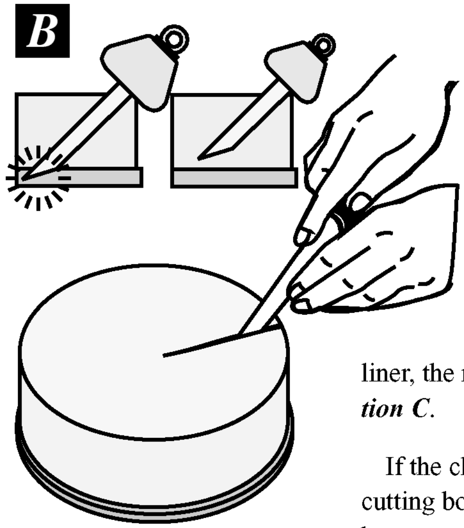
Hard-to-Soft may be a material where the surface has been coated, heavily varnished, or a special layer of fiber has been added to improve the aesthetic impact of the print finish and the graphic impact of the point of sale product.

Soft-to-Hard material often has a specialized lower fiber layer, to give the material greater tensile strength and stiffness. ***Combination*** or multi-layered material is usually a recycled material where different pulp/fiber layers are used to form the surface, the liner, and the "inside" of the material.

What is important in this understanding of paperboard construction is the position of the denser, harder layer to the cutting edge or tip of the knife blade. The most effective method of describing the difference in material reaction to cutting is by describing the action of cutting a cheesecake!



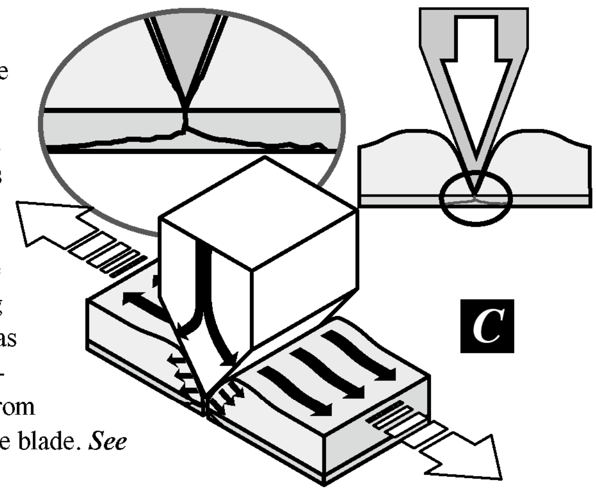
A



B

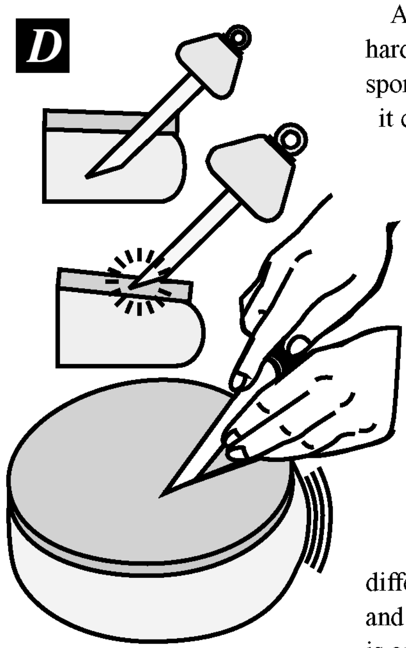
A cheesecake has a soft spongy topping, which makes up the majority of the confection, and a thin hard cookie crust, to support, strengthen and to provide a solid foundation for the cheesecake. When the cheesecake is cut the penetration of the knife into the sponge top of the cake meets little resistance, and requires minimal pressure, until the cookie crust is reached. ***See illustration B***.

At this point more force is needed to overcome the greater density and hardness of the cookie crust, and the crust layer will eventually burst apart rather than being sliced cleanly. This is the equivalent of ***Soft-to-Hard Diecutting***. When diecutting a paperboard with a similar construction, with softer upper layers and a thin hard liner, the material would be prone to flaking on the underside of the diecut edge. ***See illustration C***.



C

If the cheesecake were inverted on the cutting board with the sponge on the bottom, and the cookie crust on the top, and the same action repeated the results would be very different.

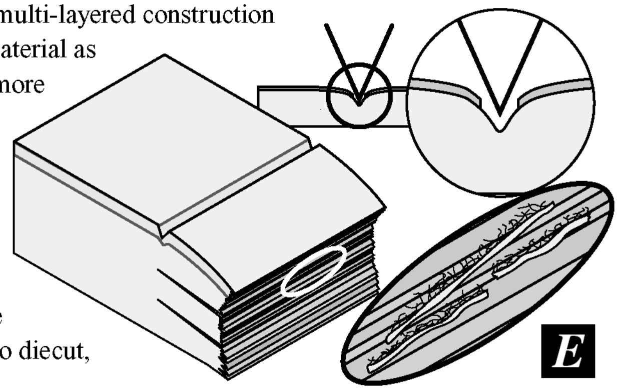


D

As the knife attempts to penetrate the hard, dense cookie crust, the supporting sponge is acting like a shock absorber, as it compresses under the pressure transferred through the cookie crust from the cutting knife edge or tip of the blade. ***See illustration D***.

Naturally, the cookie crust will eventually fracture and the cutting/splitting action will be completed, however, the cut edge would be uneven and ragged and the cheesecake will be somewhat squashed. This is the equivalent of ***hard-to-soft diecutting***. When diecutting a paperboard with a similar construction, in other words a denser, harder surface layer, the material would be more prone to dust and loose fiber from the upper surface of the diecut edge as it bursts apart on the explosive penetration of the knife edge or tip. ***See illustration E***.

The ***Combination or Multi-Layered*** material is often more complex to diecut, because the different layers of the material all have different properties, and react differently to penetration and to displacement separation. This multi-layered construction is often referred to as a "***balanced***" material as the paper maker intended to create a more even distribution of strength throughout the material, therefore, it is often difficult to predict the incidence of dust, loose fiber, and/or flaking.



E

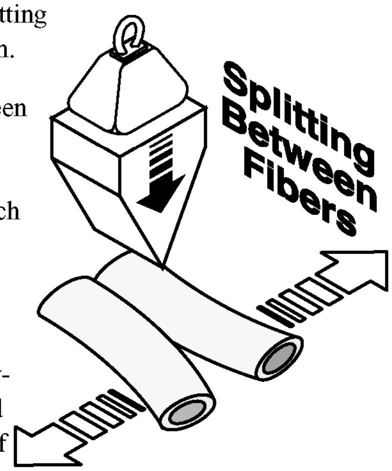
In addition, because the construction of this multi-layered and multiple density paperboard is more complex to diecut, it will offer greater resistance to compression, which will require greater knife cutting pressure. As the material will squeeze and then suddenly burst apart, the blade will "***snap***" through the material. Under these circumstances there is a real danger of the knife "***over-traveling***" and subsequently striking the cutting plate with damaging force.

In diecutting ***hard-to-soft***, ***soft-to-hard***, and ***combination paperboard***, the orientation of the knife to the predominant grain or fiber direction will make a significant difference in the generation of dust and loose fiber.

But why is there more dust and loose fiber when cutting at right angles to the grain of the paperboard?

As we have learned, it takes more pressure to diecut at right angles to the paperboard grain than it does parallel to the fiber direction. Which in practice means knives cutting across the grain have to be over pressured as the matte of fiber is more resistance, and the knife makes hard contact with the cutting plate.

A

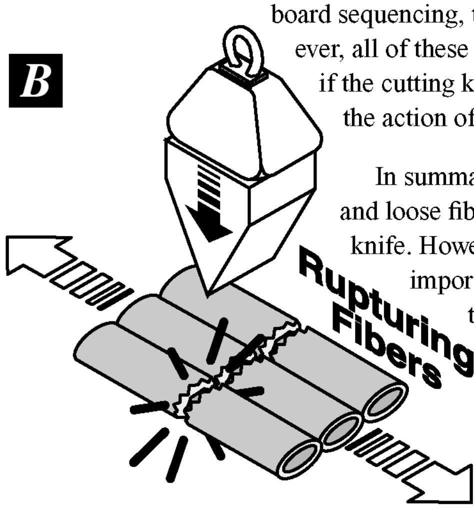


Generally in diecutting there is more patch-up adjustment necessary to the knives cutting across the grain than adjustment made to knives cutting parallel to the paperboard grain.

When examining these phenomena in more detail it is obviously easier to split between fibers, ***see illustration A***, even though the paperboard is more elastic in this direction. However, it is far more difficult to crush, fracture and split the matte of fiber apart, ***see illustration B***, and it is obvious the degree of debris, dust, and fiber strands will be much higher in this direction.

In considering the material there are obviously many other factors to consider, from the fiber type, to the density, to the moisture content, to the coating, to correct paperboard sequencing, to the caliper, and to caliper variation. However, all of these factors are minimized and often eliminated if the cutting knife can be kept at optimal sharpness and if the action of diecutting is controlled and precise.

B



In summation, we have identified the primary cause of dust and loose fiber in diecutting to be a blunt and damaged cutting knife. However, when considering our remedial options it is important to remember how other factors contribute to this cutting failure. These performance variables include the incorrect calibration of the steel rule die, the condition of the press and the cutting anvil, the hardness and rigidity of the cutting impression, the design of the diecut product and the layout, and material type and parameters.

We have examined many of the causes of the problem, now it is time to examine the many solutions available, to solve the problem of dust and loose fiber in platen diecutting.

Dust & Loose Fiber: What are the Solution(s) to the Problem

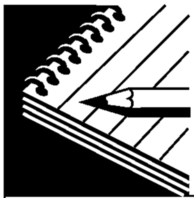
In reviewing everything we have learnt so far, the overall solution by now should be obvious. It is essential to minimize knife-edge damage and to preserve the sharpness and the cutting efficiency of the steel rule knife. Therefore, implementing one or a combination of the following tool, press, and procedural modifications will eliminate the problems of dust and loose fiber from platen diecutting. The areas of the process requiring change are:

1. **Cutting Plate/Anvil Modification**
   - 1.1 Soft Cutting Plate
   - 1.2 Work & Turn Cutting Plate

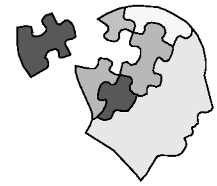
2. **Steel Rule Die Calibration**
   - 2.1 Dieboard Modification
     - 2.1.1 Dieboard Material Selection
     - 2.1.2 Dieboard Bridging Parameters
     - 2.1.3 Dieboard Machining
     - 2.1.4 Dieboard Stabilization
   - 2.2 "Floating" Knife Steel Rule Die
     - 2.2.1 Floating Knife Principles
     - 2.2.2 Dieboard Kerf/Rule Locks
   - 2.3 Ruling/Calibration
     - 2.3.1 Steel Rule Die Table
     - 2.3.2 Dieboard Preparation for Ruling
     - 2.3.3 The Ruling Procedure
   - 2.4 Steel Rule Die/Chase Preparation
     - 2.4.1 Chase Maintenance Procedures
     - 2.4.2 Steel Rule Die Lock-Up Procedures
     - 2.4.3 Patch-Up Cover Sheet Maintenance

3. **Platen Press Calibration**
   - 3.1 Press Footprinting
   - 3.2 Platen Stack Maintenance

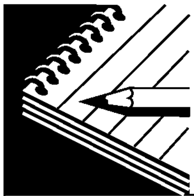
4. **Rigid Pressure Balanced Cutting Make Ready**
   - 4.1 Patch-Up Location
   - 4.2 Combination Patch-Up
   - 4.3 Double Patch-Up Sheets
   - 4.4 Pre-Production Pressure Calculation



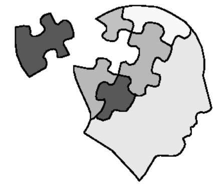
Brainstorming, Notes & Ideas



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

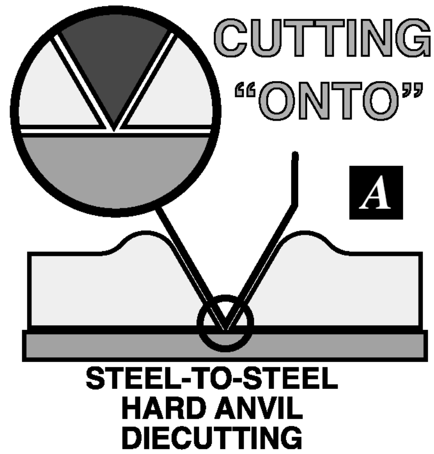


Brainstorming, Notes & Ideas

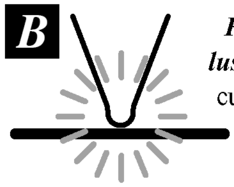


"Many ideas grow better when transplanted into another mind than in the one where they sprung up." *Oliver Wendell Holmes*

Solution 1.1: Soft Cutting Plate

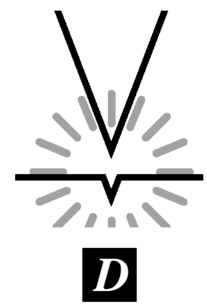


Platen Diecutting is a male/female stamping system. The upper frame of the press is the holder for the steel rule die, and the lower reciprocating frame represents the anvil, against which the material will be converted. It is vital in platen diecutting to have a rigid anvil, but it is not essential to have a Hard Anvil! There are basically two types of diecutting, ***Hard Anvil Diecutting*** & ***Soft Anvil Diecutting***.

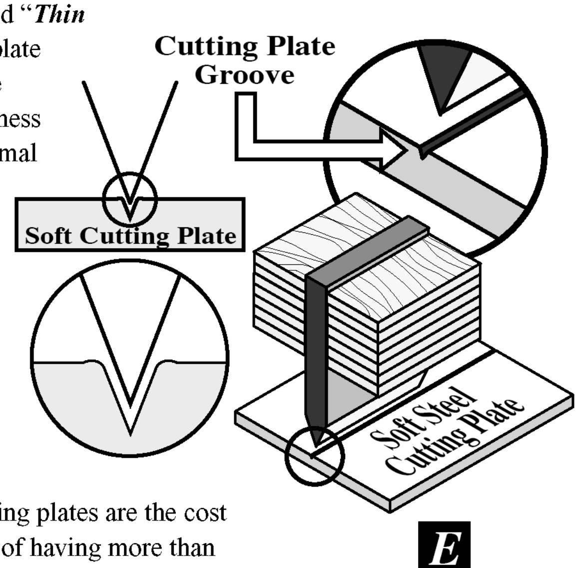


Hard Anvil Diecutting, or in other words "***cutting onto***", ***see illustration A***, employs a steel surface, whose hardness matches the cutting knife, to theoretically deliver a balance between the tip of the blade and the surface of the cutting plate. Unfortunately, if everything is not balanced effectively, striking the knife against this steel surface with excessive force will damage the cutting edge of the knife. This damage to the cutting edge primarily happens during the first few make-ready impressions! ***See illustration B***.

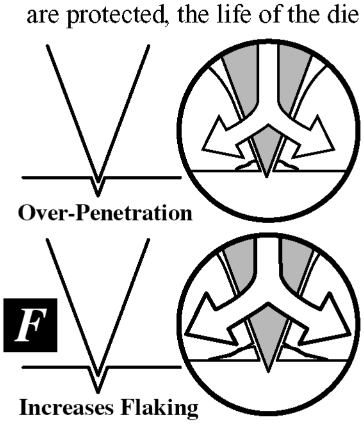
Soft Anvil Diecutting, or in other words "***cutting into***", ***see illustration C***, employs a softer cutting surface, which the knife may cut into, without damaging the integrity or sharpness of the cutting edge. This has the advantage of supporting the material effectively while keeping the knife as sharp as possible, for an indefinite period. ***See illustration D***.



The development of a hybrid "***Thin Plate***" or softer steel cutting plate enables the knife to indent the material, protecting the sharpness of the cutting edge, with minimal damage to every cutting knife in the steel rule die. ***See illustration E***.

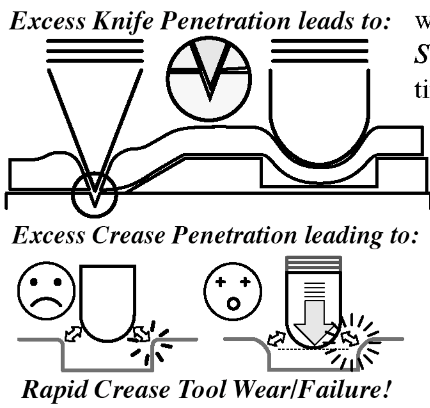


The advantage of soft cutting plates are obviously the knife-edges are protected, the life of the die is extended, dust and loose fiber are eliminated, quality and consistency are improved, the cutting make-ready is fast and simple, while material waste and press down time are minimized.

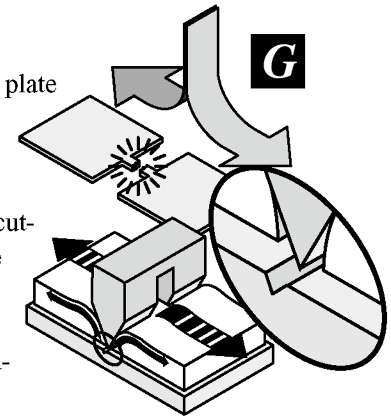


Some of the disadvantages of soft cutting plates are the cost of additional support plates, the practice of having more than one cutting plate for each job, and the cost of replacement, when the plate becomes so grooved it is no longer effective. A key diecutting disadvantage is if the knife is allowed to indent the cutting plate surface too far, flaking will increase. ***See illustration F***.

H



G

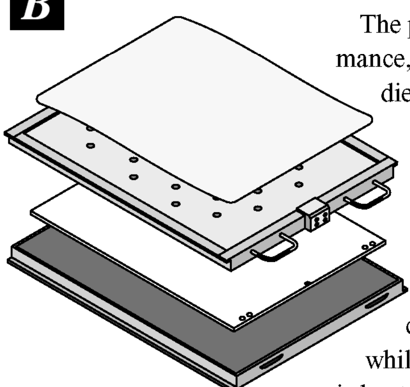


Although penetration of the knife tip into the soft cutting plate surface protects the integrity of the cutting edge, the resulting excess lateral displacement action of the knife/ wedge bevel faces will stress and fracture nick/tags. ***See illustration G***. Similarly, over penetration of the cutting rule and close proximity creasing rules will drive the crease rule deeper into the counter/matrix channel than the crease specification requires, leading to rapid channel wear and degrading folding performance. ***See illustration H***.

However, these issues are secondary to the advantage of protecting the sharpness of the cutting edge and the quality of the diecut part. Integrating hard and soft anvil diecutting through the use of a soft cutting plate, is simple, effective, and is an appropriate method of solving a perennial diecutting problem.

Solution 1.2: Work & Turn - Work & Tumble the Cutting Plate

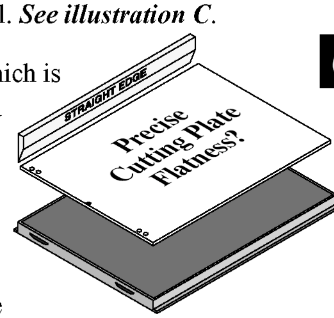
B



A

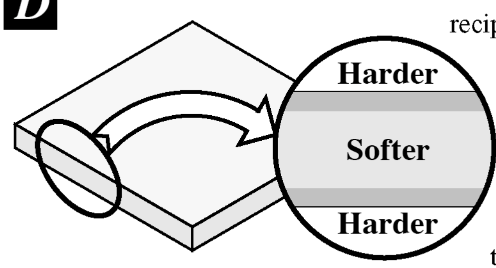
The primary goal in platen press make-ready is to achieve kiss cut performance, while protecting the sharpness of every cutting edge in the steel rule die. This is often classified as setting and maintaining a ***"Zero-Gap"*** between the tip of the knife and the surface of the cutting plate or anvil. ***See illustration A***. To achieve this degree of precision all of the components of the platen stack must be in optimal condition, ***see illustration B***, and the cutting plate in particular must be perfectly flat and level. ***See illustration C***.

C



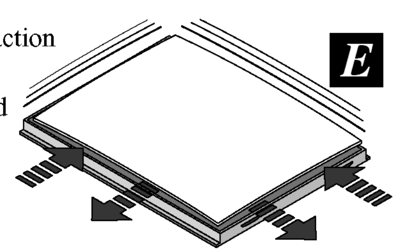
Unfortunately when using a standard cutting plate, which is case hardened, (the outer layers or skin of the steel is hard while the inside is softer. ***See illustration D***), and one which is kept in the same orientation and position, the cutting plate will gradually dome and bow. ***See illustration E***.

D



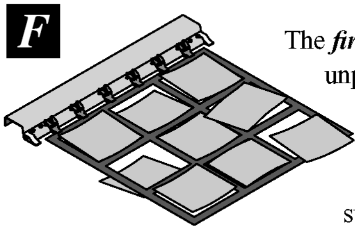
This creates several severe diecutting problems. As the press reciprocates the plate must be "***pushed***" flat against the lower sliding bed, which damages the cutting die, and causes the sheet to break-up as the die reciprocates away from the cutting plate. ***See illustration F***.

E



Compounding this problem this squeegee action of plate compression and release, draws air between the underside of the cutting plate and the upper surface of the sliding plate bed. This creates three problems.

F

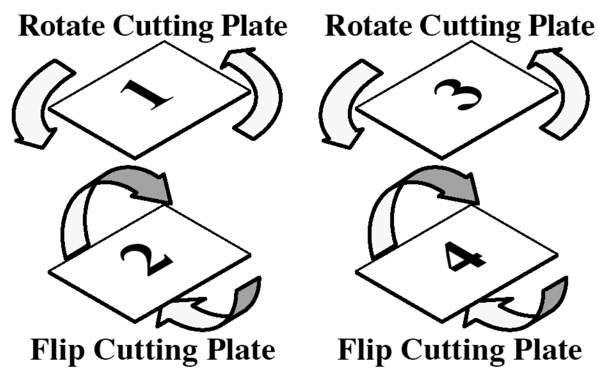


The ***first*** is the action of expulsing the air from the cutting plate adds unpredictable amounts of pressure to diecutting and abrades the cutting knives. The ***second*** is the flow of cold air under the hot cutting plate creates condensation, which leads to rust and pitting of the underside of the plate and the Recinol surface of the lower sliding bed. ***Finally***, the suction or air under the cutting plate draws paper dust, fiber, grease and oil, and debris, which gradually build up to undermine cutting performance.

The solution is to ***Work & Turn*** the cutting plate, rotate it through 180 degrees, once every two weeks. This should be alternated with ***Working & Flipping*** the cutting plate, inverting the cutting plate every two weeks. ***See illustration G***.

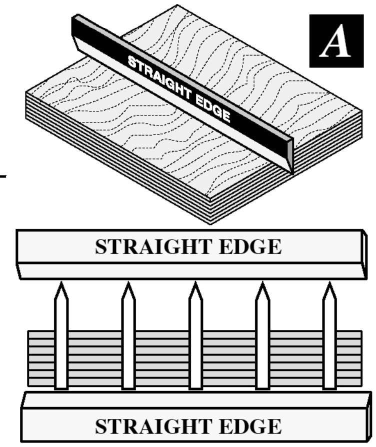
This simple procedure will keep the cutting plate perfectly flat, it will extend the life of the plate as both sides and all four quadrants are being used, it will eliminate the rust pitting of one side of the plate, and it will minimize knife-edge damage.

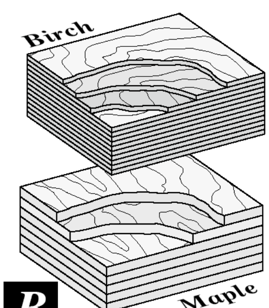
G



Solution 2.1.1: Dieboard Material Selection

A

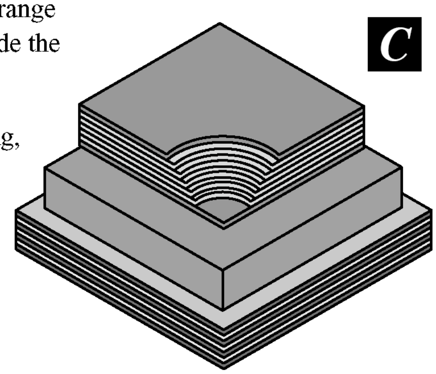




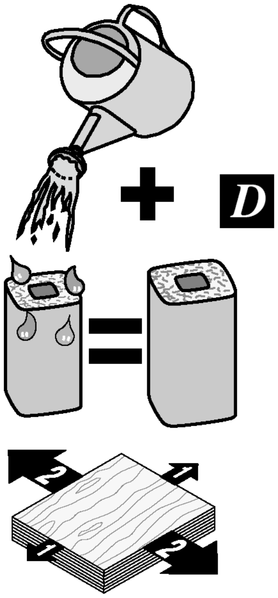
B

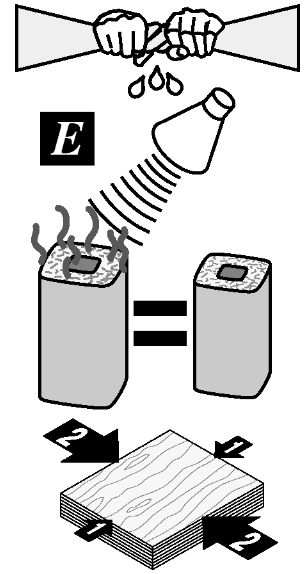
To ensure kiss cut diecutting, and to protect and preserve the sharpness of every knife blade, the toolholder, the plywood dieboard, must be perfectly flat, level and stable. ***See illustration A***. The standard dieboard material has been a Maple plywood with several layers, or birch plywood, with a greater number of thinner veneer layers. ***See illustration B***. However, recent developments of "***stabilized***" dieboards, are attracting attention because of laser machining consistency, inherent dimensional stability, and their resistance to warping, bowing or twisting. One of the materials, which have rapidly developed ardent supporters, is the material ***Rayform***, from the Rayner Company. ***See illustration C***. This illustration shows three different types of Rayform. Rayform is produced in a wide range of combinations from Solid Rayform, to various combinations of wood veneers, to provide the perfect match for the dieboard and the diecutting application.

C



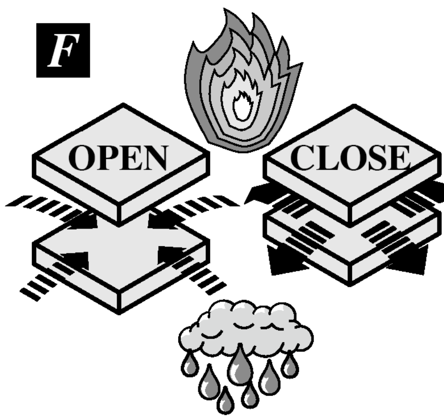
Because this can be lasercut with great kerf consistency, it is highly resistant to warping, it is not impacted by moisture change, critical knife seating is exceptional, and on-press performance demonstrates many cutting advantages.





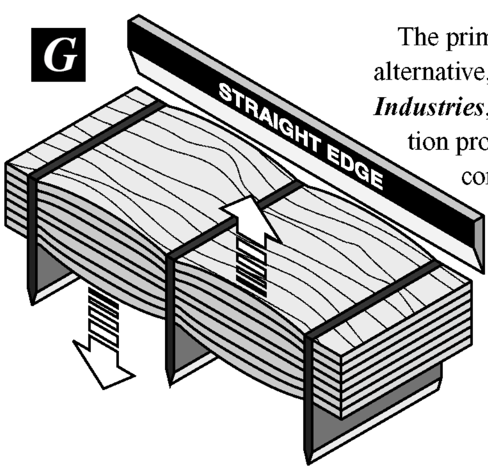
The problem with a standard dieboard is the wood layers are highly susceptible to changes in internal moisture content. As moisture is added the cellular fiber construction of each veneer layer will expand, and the dieboard will also expand. However, it is important to note the expansion will be twice as much parallel to the grain direction of the upper and lower veneers, than at right angles to the grain direction of the upper and lower veneers of the dieboard. ***See illustration D.*** In contrast if moisture is removed from the cellular fiber construction of each veneer layer each layer will contract, and the dieboard will also contract. However, it is important to note the contraction will be twice as much parallel to the grain direction of the upper and lower veneers, than at right angles to the grain direction of the upper and lower veneers of the dieboard. ***See illustration E.***

However, it is when the die is in the press the great diecutting advantages of a stabilized material over a standard wood dieboard show through. As the mechanical system works harder the press gets warm and then hot, with the reciprocating upper and lower platen drawing cold moist air into a hot environment! ***See illustration F***.

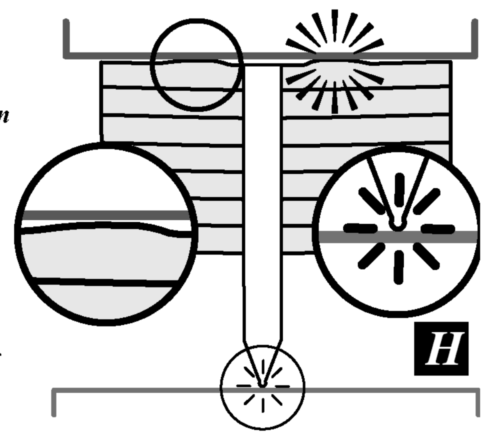


This increase in condensation/moisture begins to attack the dieboard as it penetrates into the cellular structure of the upper and lower veneer layers. This increase in moisture content, which will cause expansion of the outer upper and lower veneer layers, ***see illustration G***, has minimal impact on the dimensional integrity of the die, as the chase and the steel rule knives, act to stabilize and resist expansion and contraction.

However, there is nothing constraining the Z-Axis expansion, as the swelling outer skin of the plywood, changes the thickness of the dieboard. The upward expansion causes the ejection material to offer greater compression resistance, but it is the lower expansion, which gradually lifts cutting knives off their feet, which cause severe cutting problems. ***See illustration H***.

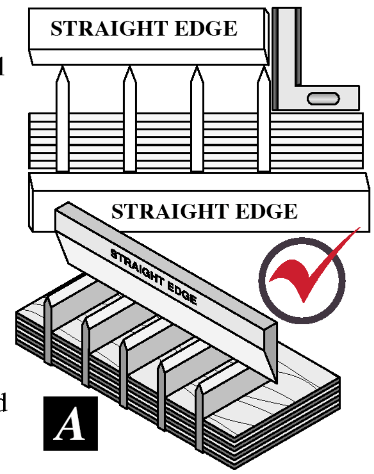


The primary advantage of a stabilized dieboard alternative, such as, or ***Permaplex***, from ***Weidmann Industries***, is this type of moisture dieboard distortion problem is non existent. And the feedback confirms this analysis, because when using a Rayform dieboard, diecutting performance is more consistent, there is less patch-up and press down time, and the incidents of dust and loose fiber are significantly reduced!

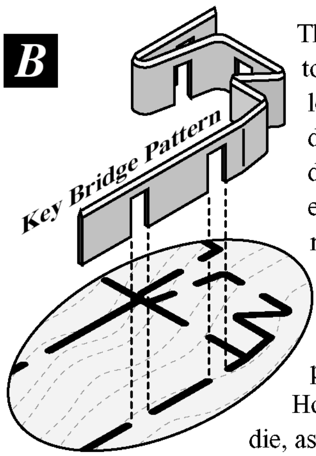


Solution 2.1.2: Dieboard Bridging Parameters

It may seem a contradiction to be discussing dieboard bridging when the subject is the elimination of dust and loose fiber. However, one of the key features of a well designed steel rule die, is "***Z-Axis Stability***", or the perfect seating of every knife so the tip of each cutting edge is precisely aligned with the tip of every other knife cutting edge. ***See illustration A***. This obviously is predicated on a flat, stable and rigid dieboard knife holder.



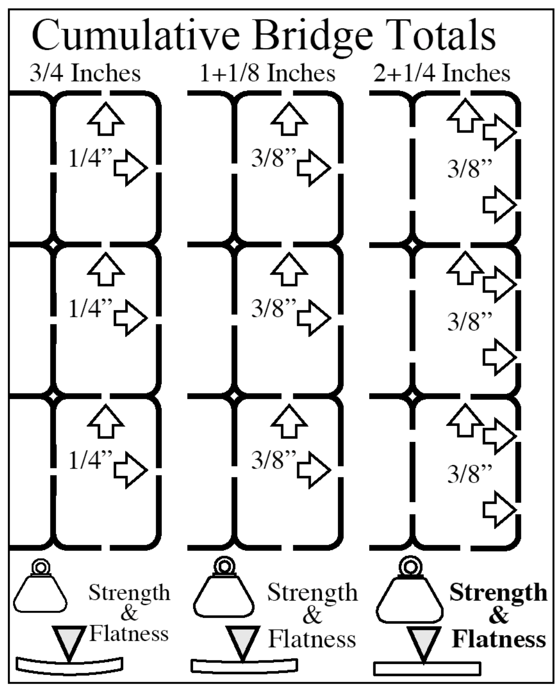
A



B

The dieboard design attributes play a key role in the finished tools dimensional flatness and stability. While it is often overlooked, a critically important feature of an effective steel rule die, is the ***bridging pattern***. ***See illustration B***. In any steel rule dieboard, the greater the number and the greater the width of every bridge, the more resistant the dieboard is to shrinkage and most important of all, to warping.

Professional diemakers have a bad habit of trying to reduce the number of bridges in a dieboard, because it is an additional process, which add cost and complexity to steel rule diemaking. However, this is in direct conflict with the objective of the steel rule die, as the bridging pattern is the primary controlling force in dieboard performance! Therefore, the number of bridges from one side of the dieboard to the other should be added together to give a ***Cumulative Bridging Value***. ***See illustration C***. In this illustration, each of the three die sections are identical, however the bridging pattern in each one is different. As wider bridges are added, and then more bridges, the strength and the stability of the dieboard increases dramatically.

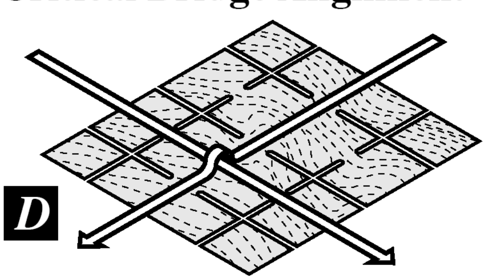


C

This vital discipline is an accurate measurement of the stability of the dieboard, and its ability to provide the flat, stiff and rigid toolholder essential to on-press kiss cut performance. Simply put the dieboard should be designed and fabricated with sufficient bridges per cavity to maximize the ***Kiss Cut Flatness***, the ***Dimensional Stability***, and the ***Diecutting Strength*** of the diecutting tool.

The second key attribute is the pattern of bridges. In several areas of the dieboard the bridge pattern should provide a perfect alignment from side to side, and from back-to-front. ***See illustration D***. Using the right number of bridges, with the correct widths, and alignment from one side of the dieboard to the other, irrespective of the design, is the only way to ensure optimal steel rule die - diecutting performance! This will protect the knife edges from premature damage, and help eliminate dust and loose fiber.

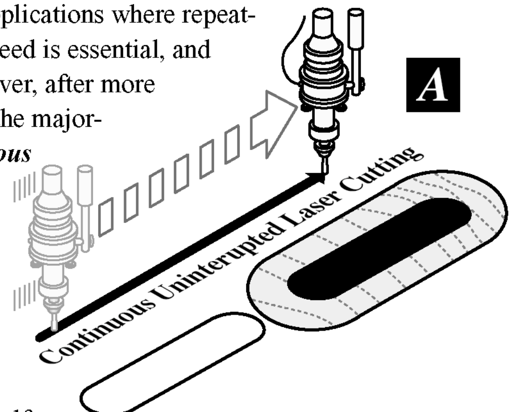
Critical Bridge Alignment

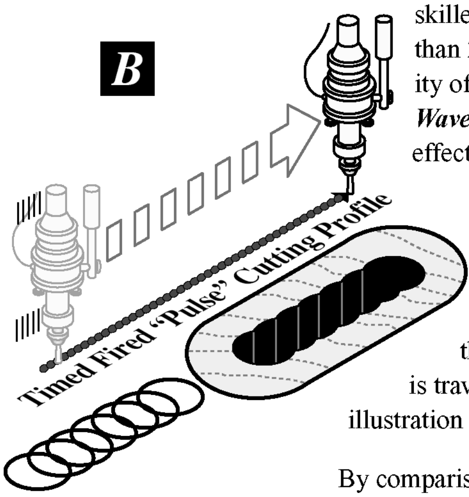


D

Solution 2.1.3: Dieboard Machining

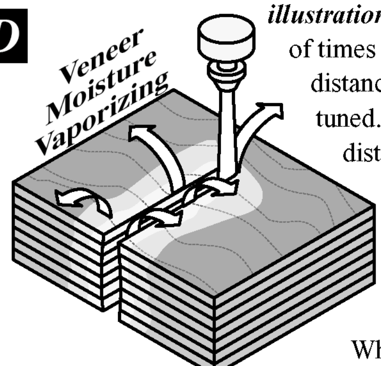
Lasercutting is firmly established as one of the most popular methods of machining dieboards. This machining method is used in applications where repeatability and precision are required; and where speed is essential, and skilled labor is difficult recruit. However, after more than 25 years of dieboard fabrication the majority of cutting is done using a ***Continuous Wave*** method rather than the more effective ***Pulse Cutting*** practice.

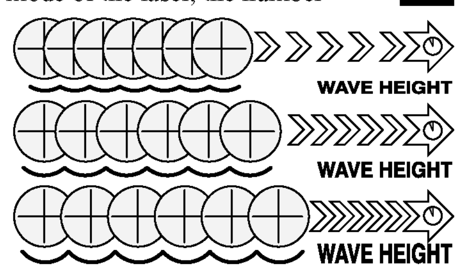




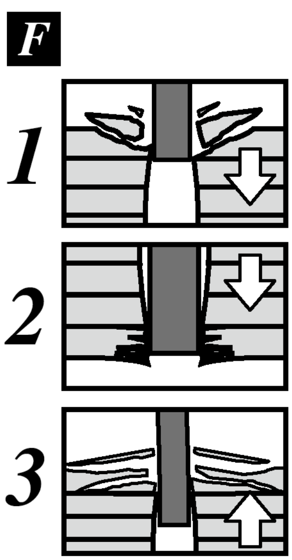
In the ***Continuous Wave or CW Mode*** the beam emerges from the nozzle and begins to burn a slot in the dieboard as the board or the laser resonator itself is traversed. ***See illustration A***. This is called continuous wave cutting because as the illustration shows the beam is "***on***" and cutting from the beginning of the kerf to the end.

By comparison in the Pulse cutting format the beam traverses the line as before but the laser is switched on and off, much in the same way a drill press operates. ***See illustration B***. By controlling the pulse mode of the laser, the number of times the laser fires for a given distance of travel can be precisely tuned. The number of pulses per distance of travel controls the degree of overlap between each round aperture fired into the dieboard. ***See illustration C***.

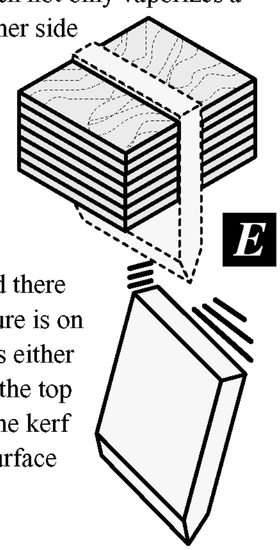




What are the advantages and disadvantages of either method? The disadvantage of CW lasercutting is it generates intense heat, which not only vaporizes a narrow slot in the dieboard it also evaporates all of the moisture from either side of newly lasercut slot. ***See illustration D***.

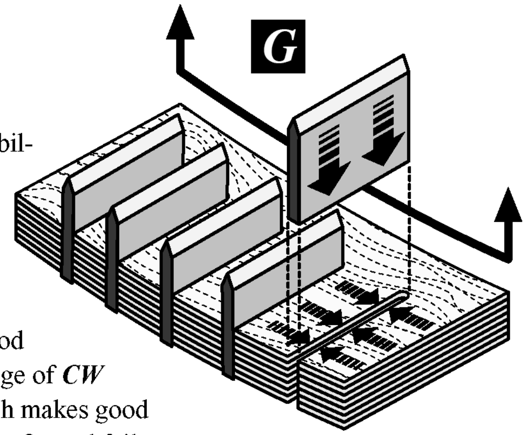


Therefore, using the most common "***Continuous Wave***" lasercutting method, produces dieboard kerf, which is a poor fit to the steel rule, and the results are often loose rules falling from the die on-press. ***See illustration E***.



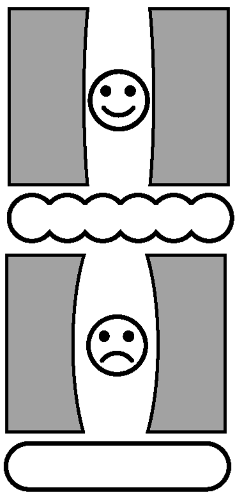
Conversely because control is more difficult in "***CW***" laser cutting, and there is intense commercial pressure or an internal deadline to meet, the pressure is on machining the dieboard as quickly as possible. Often, the resulting kerf is either too narrow, inconsistent from channel to kerf channel, and uneven from the top of the kerf channel to the bottom. As a result, driving the steel rule into the kerf channel causes surface delamination and damage, and severe dieboard surface veneer fracturing as knifes are removed. ***See illustration F***.

G



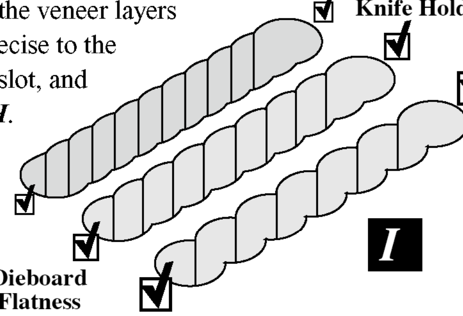
In the effort to balance speed and quality, combined with the potential instability of "*CW*" laser, setting the correct "*grip*" on the rule is compromised, and resulting kerf slots are often too tight. This will of course lead to a bowed dieboard, ***see illustration G***, as the accumulated lateral pressure stresses the dieboard and forces it to distort.

H



Why is Continuous Wave Cutting the standard method of creating a lasercut dieboard? The perceived advantage of ***CW Cutting is it is a third faster than Pulse Cutting***, which makes good economic sense, but it provides minimal diecutting benefit, and fails to generate a "***value-added***" steel rule die.

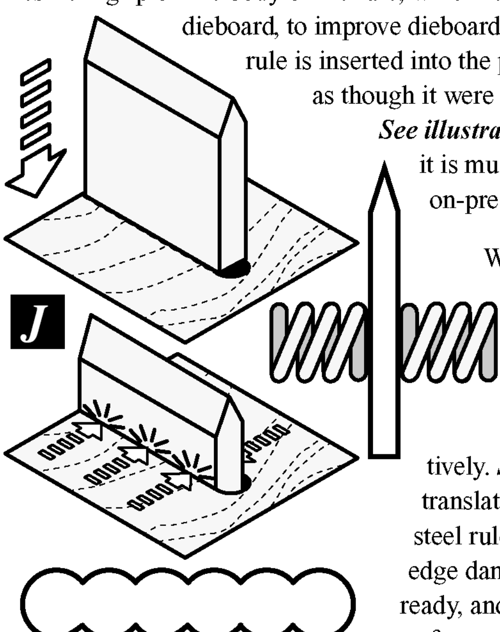
The advantage of pulse cutting is the power of the laser is concentrated when precisely focused in pulsing as opposed to the variation of continuous wave cutting which builds up excess heat in the veneer layers of the dieboard. This means the resulting slot is more precise to the required specification, it is more consistent from slot to slot, and the walls of the slot are more parallel. ***See Illustration H***.



I

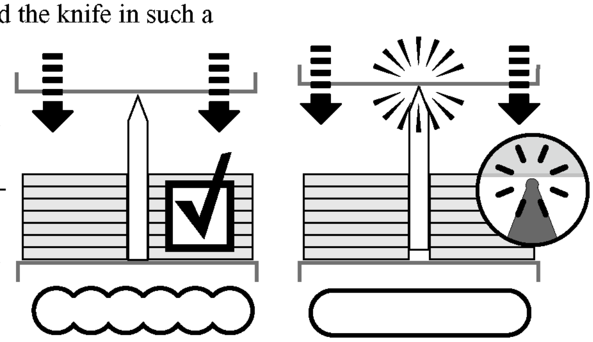
The most important advantage of pulse cutting is in the way it holds each steel rule securely in the dieboard. To provide this degree of control the number of pulses per distance traveled are tuned so there is a pulse overlap which generates a kerf wall with a serrated edge. The greater the number of serrations, the greater the resilient grip on the body of the rule, which reduces the lateral stress on the dieboard, to improve dieboard flatness and stability. ***See illustration I***. As the rule is inserted into the pulse cut slot the rule compresses each protrusion as though it were a spring tensioning and holding the rule securely. ***See illustration J***. The disadvantage of Pulse lasercutting is it is much slower than CW cutting, but it provides better on-press steel rule die, kiss-cut performance.

J



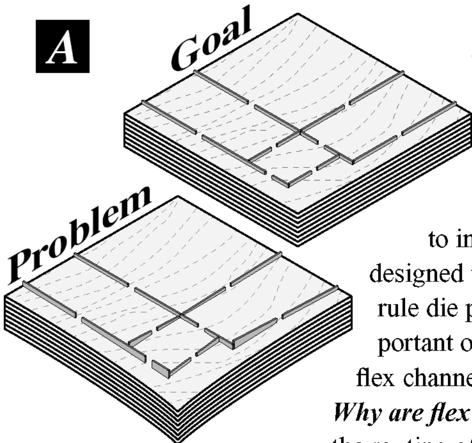
Why is this so important in eliminating dust and loose fiber? The important issue to remember is the dieboard is only a tool holder and the goal of the dieboard is to hold the knife in such a manner it can float, self level, and seat effectively. ***See illustration K***. Which translates into greater Z-Axis steel rule die precision, less knife-edge damage, simpler make-ready, and more consistent kiss cut performance.

K

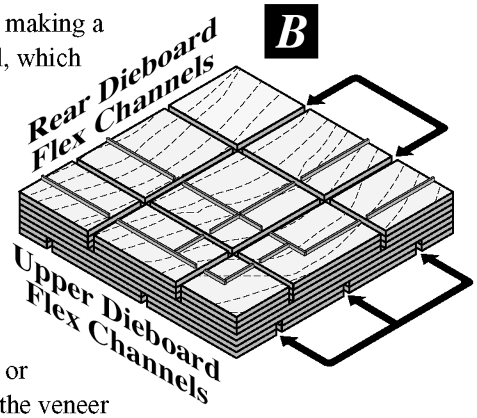


Solution 2.1.4: Dieboard Stabilization

A

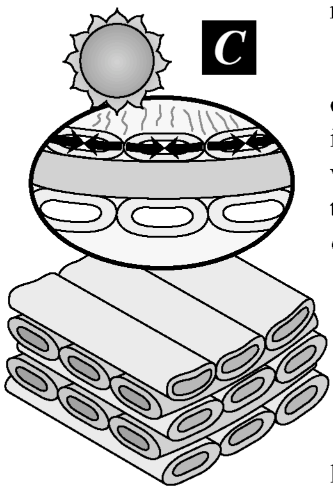


B

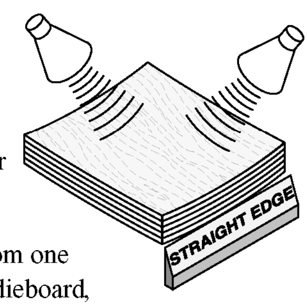


When using a plywood veneer panel for making a dieboard it is essential to create a tool, which avoids warping, distortion and cupping. ***See illustration A***. To ensure a stabilized dieboard it is essential to integrate three key machining attributes designed to stabilize and improve on-press steel rule die performance. The ***first*** and most important of these disciplines requires machining flex channels into the underside of the dieboard. ***Why are flex channels so important?*** Flex channels, or the routing of grooves through two or three layers of the veneer on the front and on the underside of a dieboard, ***see illustration B***, are important for two primary reasons.

C



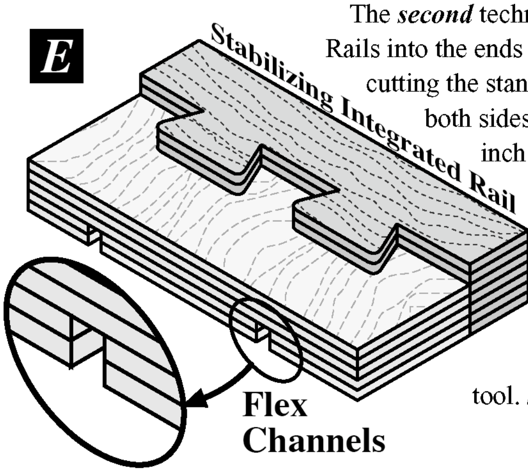
D



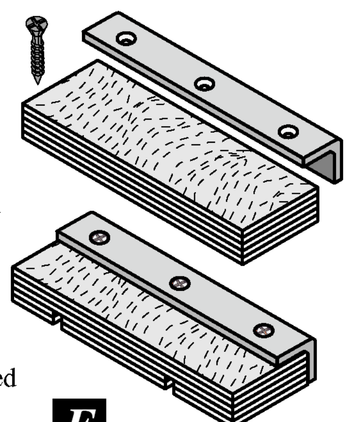
First, plywood is a composite multi layered material, which is made from wood or cellulose fiber, which is highly susceptible to moisture changes in the surrounding atmosphere. As the dieboard generally has only one face or veneer exposed, this layer dries out from the impact of drier air in the operation and the top veneer shrinks, causing the dieboard to cup upward. ***See illustration C***. This can be caused by the flow of drier air and/or a combination of heat-drying out the exposed upper veneers. ***See illustration D***.

Second, the insertion of steel rule and components in the die from one side only also generates both stacking and internal tension in the dieboard, which will also result in the dieboard warping as it is ruled. Flex channels minimize these problems and enable the steel rule die to be locked-up and bolted flat into the press chase and provide the press operator with a level tool capable of a fast kiss-cut make-ready.

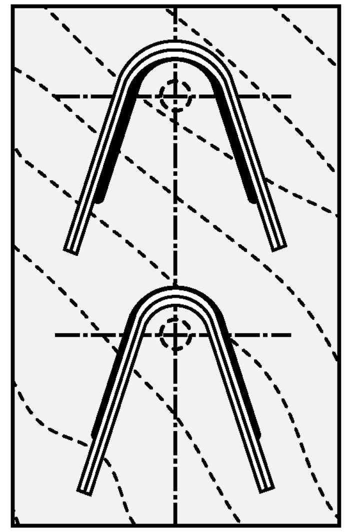
E



The ***second*** technical option requires integrating Dieboard Rails into the ends of the dieboard. Dieboard rails simply require cutting the standard 5/8 dieboard with a dovetail shape on both sides of the tool. Rails are then lasercut from 7/8-inch maple off cuts, or Rayform or Permaplex, to be a perfect press fit into the existing dovetail pattern, and are glued/clamped into the 5/8-inch dieboard. ***See illustration E***. A simple alternative is to use angle metal extrusion, which is screwed to the ends of the dieboard to stiffen and stabilize the finished tool. ***See illustration F***.



F

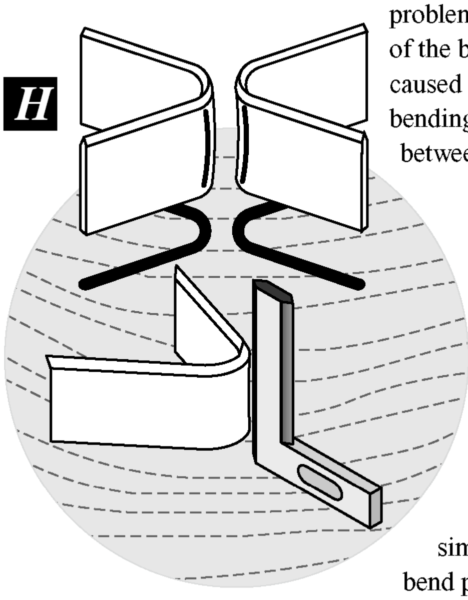


G

The ***third*** dieboard stabilization option requires integrating ***Bend Relief*** modification into lasercutting any radius in the dieboard. This is necessary because as steel rule is shaped the material on the inside of the bend is compressed while that material around the outside is obviously stretched.

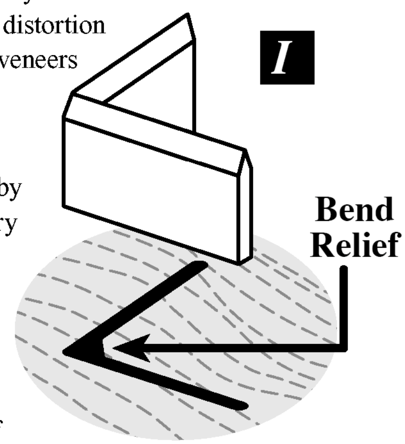
Therefore, depending upon arbor condition and hardness of the metal strip, the radius generated in the knife rarely matches the curvature of the kerf profile cut into the plywood diebase, with a radius which is too large or one which is too small. ***See illustration G***. This problem can be compounded by the lateral distortion of the bent shape, ***see illustration H***, which can be caused by knife dish, by arbor wear, by poor mechanical bending tool squareness, or by an inconsistent hardness between the bottom and the top of the steel strip.

H

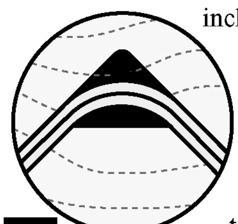


This mis-match between the finished shape and the lasercut profile will generate many diecutting problems. These can include knife-edge damage at the bend point; dieboard warping caused by tension between the knife and the kerf; slot distortion and stacking; delamination of the upper veneers of the dieboard; and poor seating of the cutting blade.

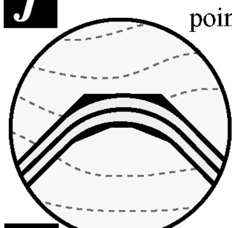
I



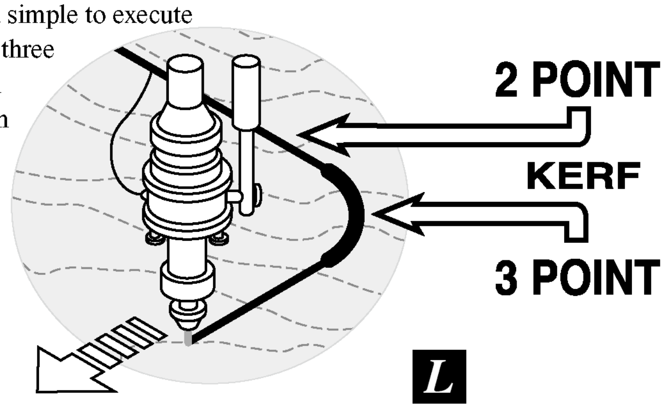
All of these problems can be eliminated, by simply cutting a bend relief shape around every bend point in the dieboard. ***See illustration I***. This is a highly effective and universally recommended practice as it solves so many problems and it has no disadvantages. There are several simple alternative methods of integrating this technique into a dieboard. These would include intersecting the lines and adding a straight relief cut, from the start and the end of the radius. ***See illustration J***. However, if the radius is large this approach would create a large cavity on both sides of the bent shape and provide no support for ejection material. To eliminate this problem a faceted bend relief shape is employed. ***See illustration K***. Another very effective and simple to execute technique is to designate each radius as a three point width rather ran a 2 point width, which enables the laser to automatically cut each radius as a 3 point kerf. ***See illustration L***.



J



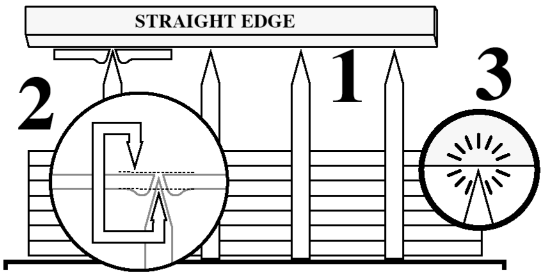
K



L

These simple, inexpensive, and yet essential dieboard design and fabrication practices, will significantly improve the chances of a effective kiss-cut dieboard, minimize knife edge damage, and reduce the chance of dust and loose fiber.

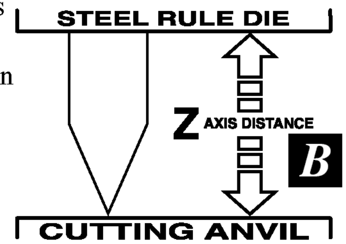
Solution 2.1.1: Floating Knife Principles



Three Key Knife/Steel Rule Die Features
1: Height Consistency Knife-to-Knife.
2: Correct Knife Working Surface Angle
3: Perfect Edge Sharpness/Integrity

A

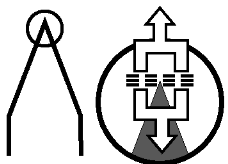
The entire focus of platen diecutting is concentrated on the tip of the knife, and only the amount of the cutting edge, which penetrates the material being diecut. The knife has to be mounted into a rigid toolholder, the machined steel rule dieboard. The primary focus of this tool is to precisely position the knife so the important tip of the blade, and specifically the top edge of the knife is seated at exactly the same height as every other knife held in the dieboard. This discipline is designed to protect and extend the effective sharpness of the cutting edge of every blade in the steel rule die. ***See illustration A***.



B

This is called the ***Z-Axis Measurement*** of the Steel Rule Die and Platen Gap. ***See illustration B***. This is the minimal distance between the upper steel rule die and the lower cutting surface, which when set will ensure kiss-cut performance, with no damage to the cutting edge of each blade. Given the degree of variation, in the height of commercial steel rule blades, ***see illustration C***, variation in the parameters of each blade are rarely the source of diecutting variation, knife edge damage, and excessive patch-up.

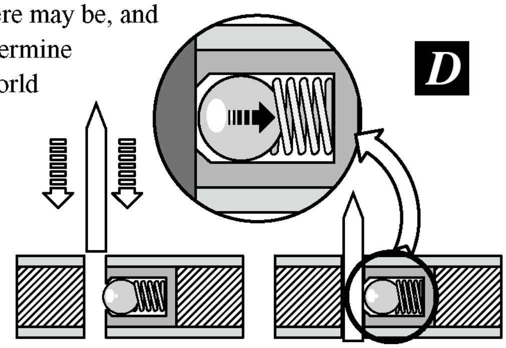
HEIGHT TOLLERANCE
Plus **0.001"**
Minus **0.000"**



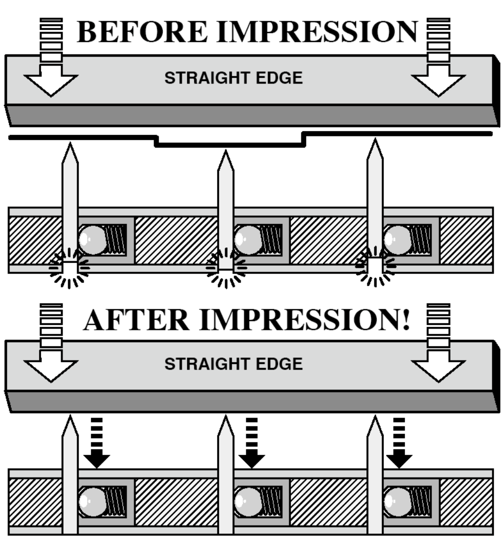
C

However, in the daily race against time and aggressive schedule deadlines, it is rare that everything is in optimal condition. The press may not be perfectly level, the dieboard may be warped, the cutting plate may be bowed, and there may be, and generally are, a number of variables, which undermine kiss-cut performance. In response to this real world situation professionals began working on the concept of a ***"Floating Knife"*** die, or a ***"Self Leveling"*** cutting knife. The goal was to create a die where the blades would minimize knife-edge damage, by finding their own level, within the die and within the press.

D

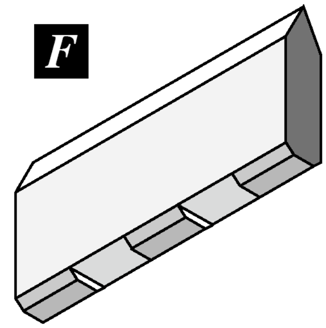


E



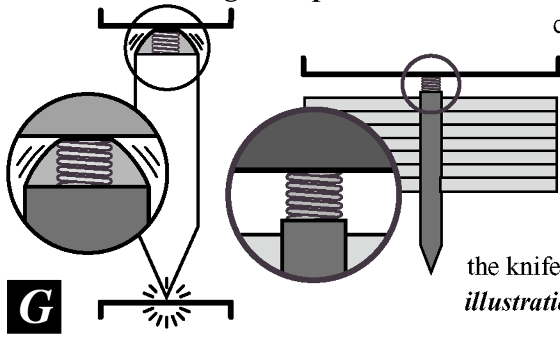
One of the most advanced forms of this self leveling kiss cut dieboard was the commercial success of the ***NeverNever Die from Atlas Die***. This customized dieboard held the knives in place with sprung loaded ball bearings, which were set into one sidewall of each kerf slot. ***See illustration D***.

The spring-loaded ball has sufficient tension to allow the knife to be inserted, and to prevent the steel rule falling or being pulled from the dieboard. However, when the initial impression is taken on-press, the knives would seat perfectly with no damage to the cutting edges, and ensure a perfect kiss-cut make-ready every time. ***See illustration E***. Naturally, as this dieboard makes it easy to properly insert every knife to the correct seating and the correct height, the use of the cutting plate on the press as a steel rule die leveling device is rarely necessary.

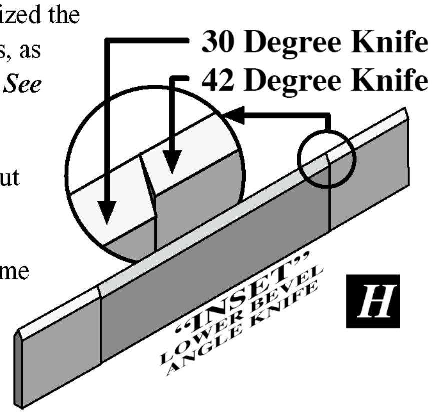


This ***"Self-Leveling"*** steel rule die is an extraordinarily innovative steel rule diemaking technique, which delivers exceptional kiss cut performance, by enabling the knife to float and ***"seat"*** perfectly, thereby avoiding knife edge damage, and the generation of dust and loose fiber.

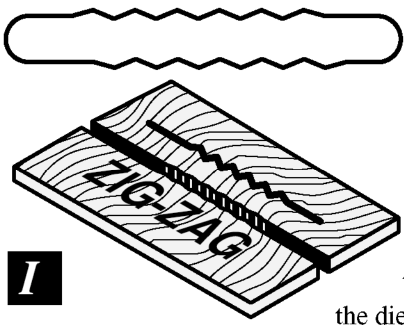
Shock Absorbing Compression "Feet"



Another highly successful innovation changed the way the knife worked, by making it self-leveling. ***See illustration F.*** In this product the base of the knife was made with integrated ***"feet"***, which were in fact softer, more malleable sections of metal. When the anvil pressurized the knife tip the feet would compress, as the knife settled to the base of the kerf slot. ***See illustration G.***

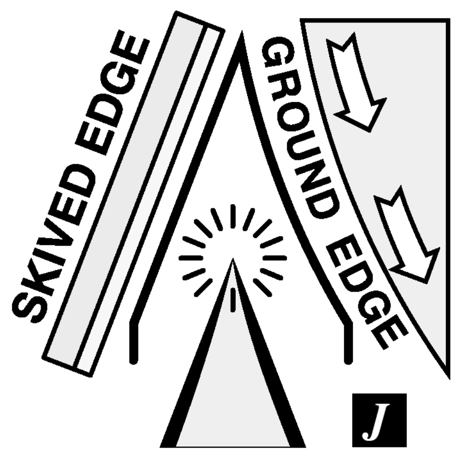


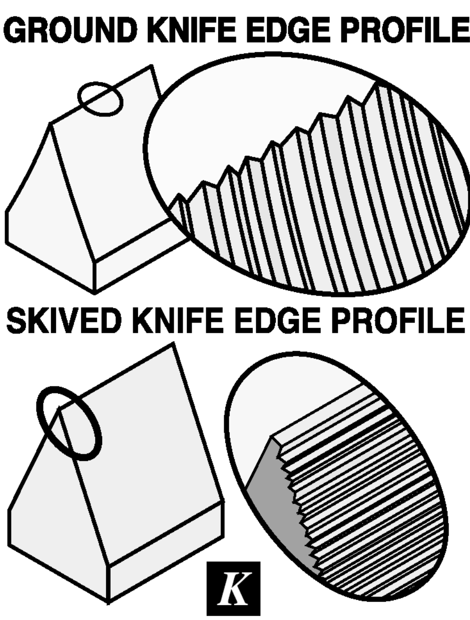
This not only protected the sharpness of the cutting edge; it gave perfect kiss cut performance across the entire steel rule die.



The most common method of achieving the same results, without all of the specialized technology and materials, was to implement the ***Inset Knife Technique. See illustration H.***

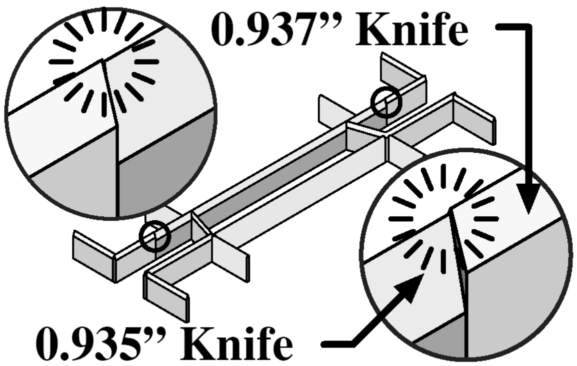
In this discipline the die is made as normal using the standard knife currently in use. However, where dust and loose fiber could be predicted, there was an alternative knife inserted into the dieboard. This length of kerf should be pulse cut with a relatively loose fit, or if only a Continuous Wave laser is available, the ***"Zigzag Kerf Technique"*** should be employed. ***See illustration I.***





A lower bevel knife would be selected, as the lower the bevel angle the sharper the knife and the more efficiently it will penetrate the surface of a material. This section of knife should also be a ***Ground Edge Knife*** rather than a ***Skived Edge Knife.***

Apart from the sharpness advantage of the concave ground knife bevel surface, over the flat skived knife surface, ***see illustration J***, the vertical ground knife machining striations give a sharp, almost serrated edge in comparison to the flatter, more even skived knife edge. ***See illustration K.***



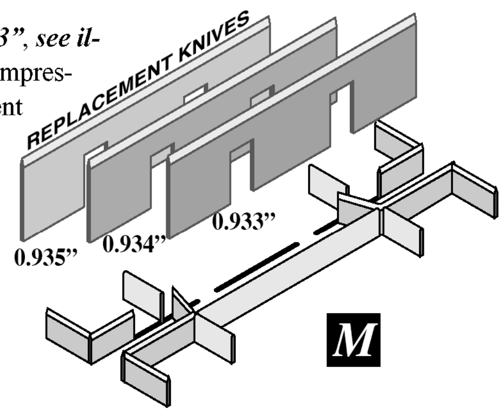
L

What is critical is the height of the ***Inset Knife*** should be surface ground down from the standard height of the knife in the die, ***0.937"***, to a height of ***0.935" See illustration L***.

This will keep this knife sharp, the other knives will act as bearers, and as the standard knives are compressed during the make-ready sequence the Inset Knife will be perfectly positioned to cut a clean, smooth, dust free diecut edge. It is very important to make sure this knife is a ***"floating"*** blade and it can be inserted and removed easily from the dieboard, without compromising cutting performance. This requires a system of dieboard locks.

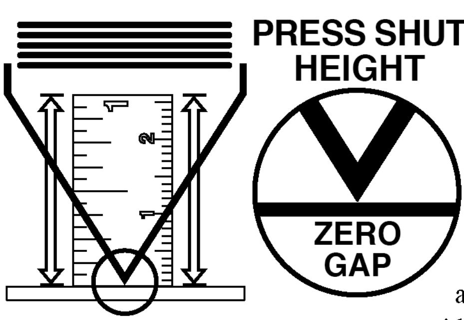
A further refinement of this technique is to have multiple height replacement knives. Realistically, with the best effort sometimes the cutting impression proves to be unstable, and key knives are again damaged, even when the lower height inset knife technique is employed. To counter this two or three sets of knives are made at slightly different heights.

This could include ***0.0935", 0.0934", and 0.0933"***, ***see illustration M***, therefore, no matter the degree of compression of the majority of knives, the quick replacement blades ensure a sharp knife and the fast change-over to a sharp knife prevent dust and loose fiber at all times. This may seem an excessive effort to the diemaker, but the ability to quickly exchange a blunt knife for an sharp knife, which is machined down to the new ***"compressed edge,"*** simplifies life for the diecutting pressman.



M

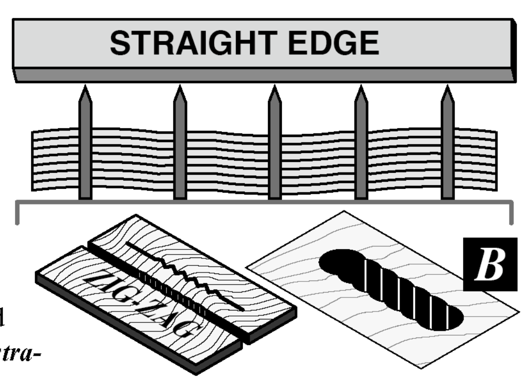
Solution 2.1.2: Dieboard Kerf/Rule Locks



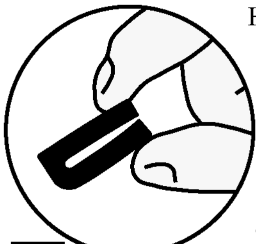
A

To ensure a steel rule knife performs precisely and consistently, it is vital it is positioned so the cutting edge of every blade in the dieboard, is set to barely touch or kiss cut the surface of the press cutting plate. ***See illustration A***.

This requires a loose cut kerf/slot, a pulse kerf/slot, or a zigzag cutting profile, to enable the knife to seat at the optimal cutting height, without suffering compressive edge damage. This technique will certainly ensure the knife is seated, and at the correct kiss-cutting height, even though the dieboard may be warped, bowed and twisted. ***See illustration B***.

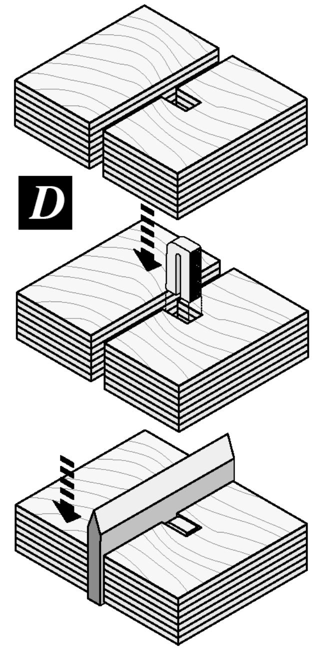


B



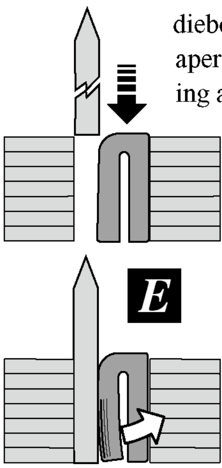
C

However, in direct conflict with this blade self leveling requirement, the blade must also be clamped with sufficient lateral force to prevent the knife from being pulled from the dieboard, and to keep it vertical and rigid, under cutting pressure. The solution to this problem are ***Kerf Locks,*** a commercial product sold by many die suppliers, or ***Dieboard Locks***, which take advantage of the natural resiliency of plywood, and are easy to design and laser cut into the dieboard.



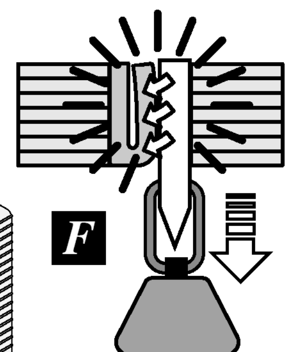
D

The kerf lock is a plastic component shaped like a miniature horseshoe, ***see illustration C***, which fits into a specially cut aperture set into the wall of the dieboard kerf. With the Kerf Lock in position, the knife is pushed down into the aperture, with one side against the plywood wall of the cavity and one side pressing against the kerf lock. ***See illustration D***.



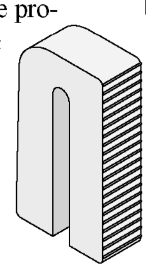
E

The remarkable feature of this simple device is it is easy to compress the horseshoe lock with vertical downward pressure, ***see illustration E***, but almost impossible to compress it when the pressure is reversed, as when the knife held by the lock is being pulled from the dieboard. ***See illustration F***. (Although the focus is on the ability of Kerf Locks and Dieboard Locks to provide steel rule knife self leveling ability, both these techniques are excellent to combat the potential for loose rules.)



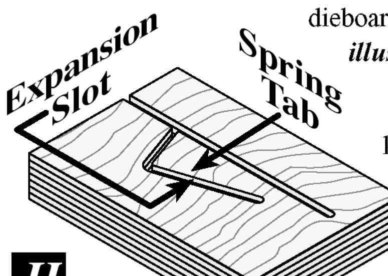
F

To aid in this intense gripping force the sides of the Kerf Lock are provided with serration's to assist the grip on the knife. ***See illustration G***. The kerf lock holds the knife securely for diecutting, and it will allow the knife to seat, and to self-level.



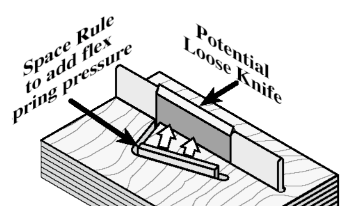
G

Dieboard Locks use a similar principle of lateral clamping and are effective as they use the natural resiliency of wood veneer. The dieboard lock is a kerf shape cut into the dieboard alongside the blade to be clamped in position. ***See illustration H***.



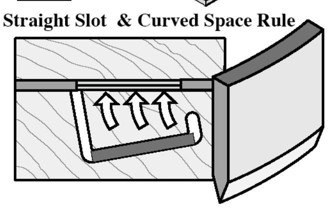
H

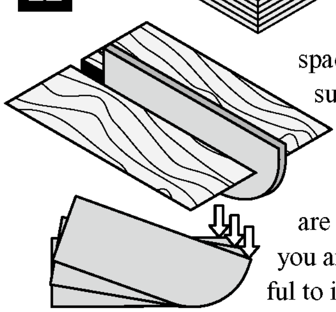
The rule to be clamped is simply inserted into the kerf, and a slightly curved spacing rule is driven into the kerf lock. ***See illustration I***. The impact of lateral ***"stacking"*** ensure the insertion of the spacer deflects the Spring Tab laterally to clamp the steel rule knife securely. To assist in removing the spacer/clamp, so the original knife can be easily removed, the end of the spacer is curved or cut at a 45 degree angle, so downward pressure from a chisel will cause it to pivot up out of the dieboard. ***See illustration J***.



I

Straight Slot & Curved Space Rule

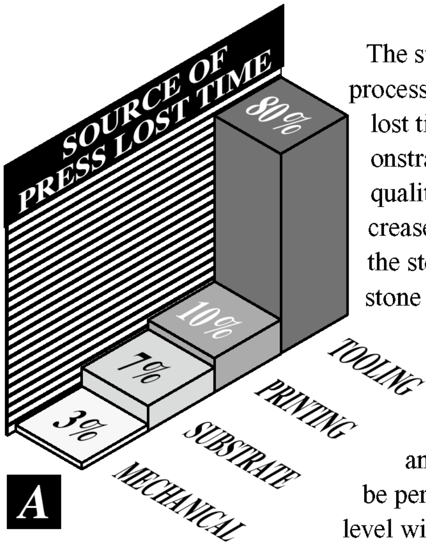




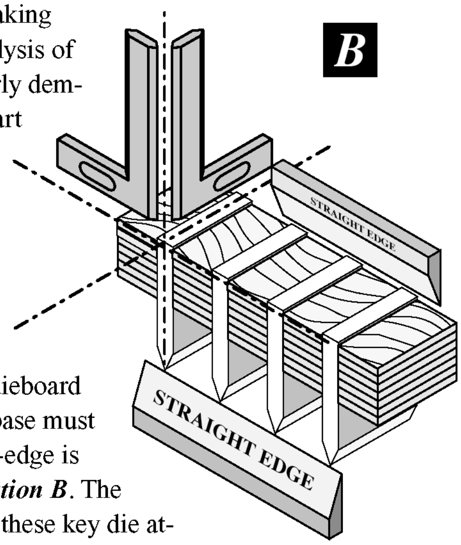
J

These steel rule knife-clamping systems are simple, they are inexpensive, and they are remarkably effective. And even if you are not practicing the complete inset knife technique, it is useful to integrate dieboard clamps where you anticipate dust and loose fiber, as changing the knife is fast, safe and easy!

Solution 2.3.1: Steel Rule Die Table



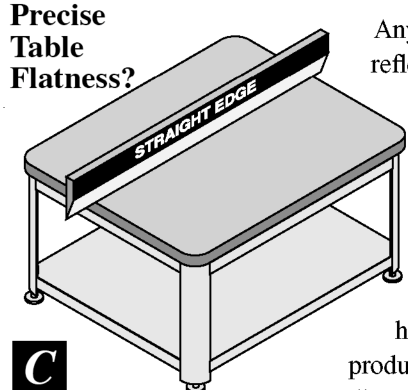
A



B

The steel rule diecutting process is primarily a toolmaking process. One need look no further than a statistical analysis of lost time in diecutting, ***see illustration A***, which clearly demonstrates the impact of tooling on productivity and part quality. No matter what other tools are employed; to crease, to strip, and to separate product from waste, the steel rule die is the foundation tool or the cornerstone of the process.

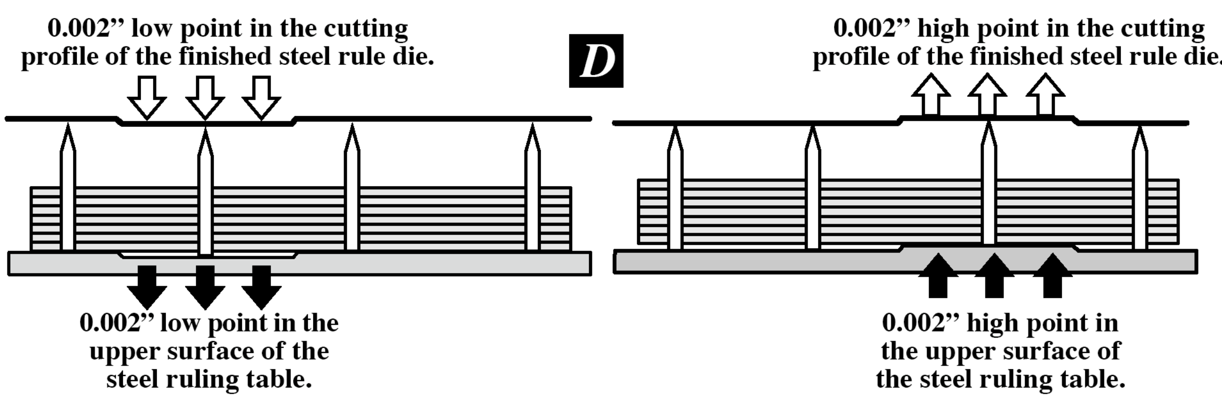
However, to achieve the ultimate goal of diecutting, to sell the first impression, the die must be made precisely. This means the dieboard and the steel rule knives inserted in the plywood base must be perfectly seated on the same plane and every knife-edge is level with every other knife-edge in the die. ***See illustration B***. The most important piece of equipment in the generation of these key die attributes is the diemaker's ruling table. ***See illustration C***.



C

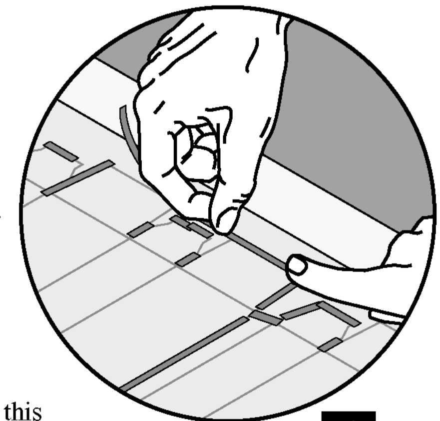
Any variation in the surface of the ruling table, either a high point or a low point, will be reflected in a high point and/or a low point in the cutting profile of the finished steel rule die. ***See illustration D.*** To generate the degree of kiss cut, Z-Axis steel rule die precision, essential to achieve a quality, stable cutting impression, it is vital the flatness of the assembly and ruling table matches the tolerance of the cutting knives! This requires a solid steel rigid surface, which must be ***Mattison Ground*** to flatness complimenting even the most precise kiss cutting tool application.

It is vital in any manufacturing process to understand your customer application and how the parts of components you are fabricating will enhance or detract from the next production activity, and/or from the customer process. One of the most critical failures in diemaking and/or in diecutting is to underestimate the importance steel rule die knife seating, and how the flatness and the condition of the ruling surface is translated into on-press tool damage, a slow unstable cutting make-ready, poor diecut part quality, and low productive output!



D

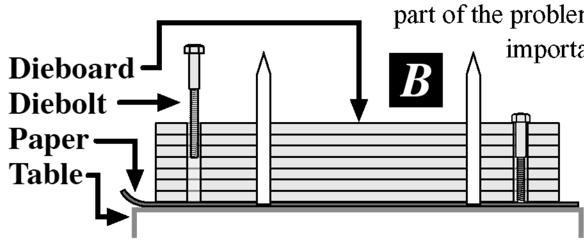
Solution 2.3.2: Dieboard Preparation for Ruling



A

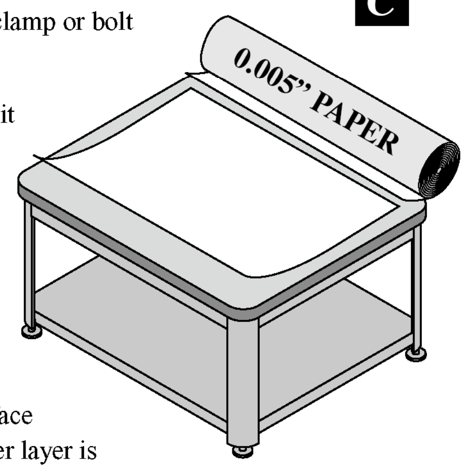
One of the most important activities in preparing a diecutter for production is the action of leveling the impression to generate 100 percent kiss cutting. A modern diecutting press is the culmination of years of design experience, the product of outstanding engineering skill, utilizes the most up-to-date material, and is assembled under rigorous conditions. Given these exacting construction criteria, ***why*** is it necessary to adhere thin pieces of brown paper to the back of the tool or under the cutting plate to ensure the steel rule die will cut evenly? ***See illustration A***.

Although the diemaker is not in a position to improve press mechanical performance it is vital the steel rule die is fabricated to be part of the solution rather than a part of the problem. There are three key facets to this important discipline.



B

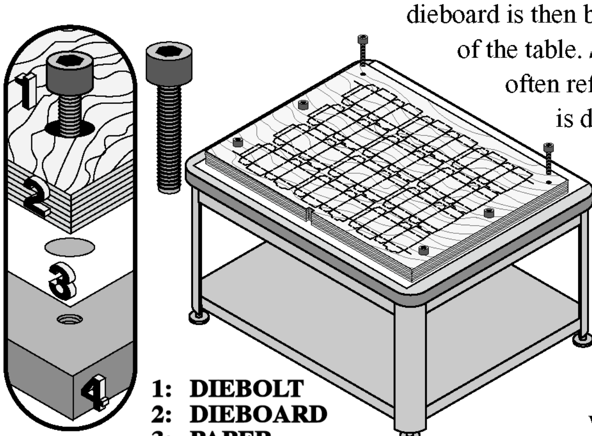
To ensure precise on-press kiss-cut performance it is vital the steel rule die is perfectly level, with every steel rule, component or punch seated squarely in the plywood dieboard. To provide the diecutter with a tool, which meets these important criteria, it is necessary to first clamp or bolt the dieboard to the ruling bench. ***See illustration B***.



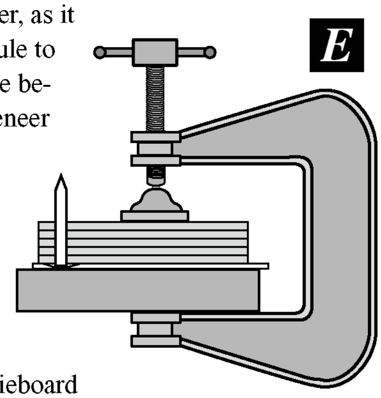
C

This discipline speeds up ruling, it will eliminate prematurely fractured miters, it minimizes rule insertion distortion, it is safer, and it provides the most effective method of tool calibration. Pounding rule into a warped or even a perfectly level dieboard, which is not secured, will increase the difficulty of controlling the precise depth of rule insertion, and guarantee on-press knife damage and dust and loose fiber!

The ***second*** step in correctly ruling a dieboard requires inserting a layer of 0.005" paper between the dieboard and the table surface. ***See illustration C***. The dieboard is then bolted or clamped to the surface of the table. ***See illustration D***. This paper layer is often referred to as the ***"Indentation"*** layer, as it is designed to allow the base of the rule to compress the paper, and protrude below the surface of the lowest veneer layer in the dieboard.

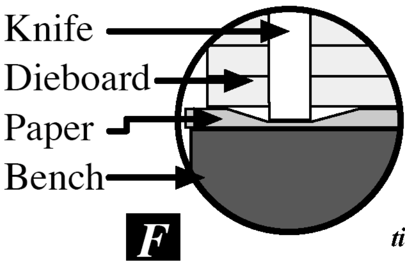


D

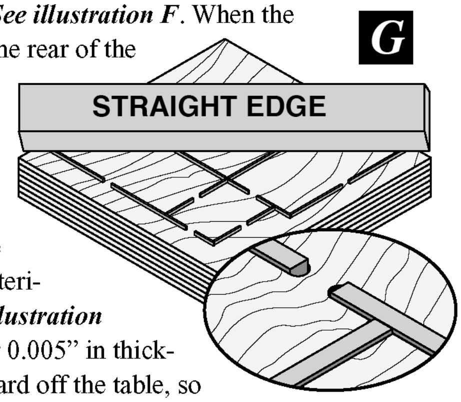


E

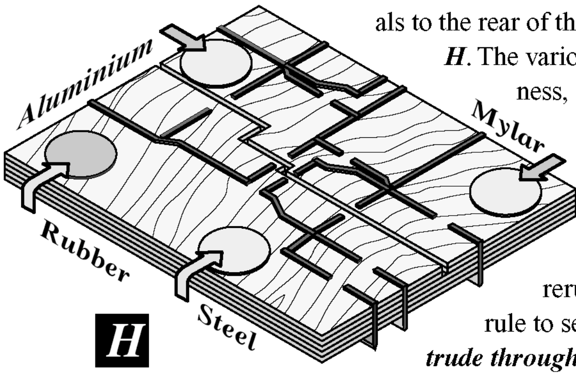
An effective alternative is to clamp the dieboard to the ruling table surface using a C-Clamp. ***See illustration E***. As with the bolting technique there is a 0.005" thick paper layer between the dieboard and the ruling table.



As the die is ruled and each knife is planed and seated level in the dieboard, the base of each rule indents the layer of paper material. ***See illustration F***. When the dieboard is complete and inverted for cleaning the rear of the tool, all of the knives should be perfectly level, and seated at the correct height, and protruding through the back of the dieboard. ***See illustration G***.

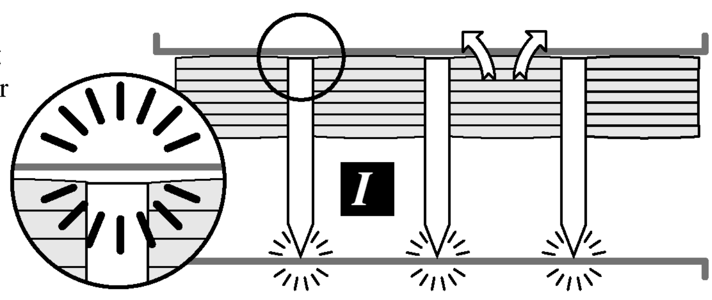


A very effective alternative method of achieving the same result is to attach spacers made from various materials to the rear of the dieboard, prior to ruling. ***See illustration H***. The various types of spacers are 0.003” or 0.005” in thickness, and are intended to lift the dieboard off the table, so driving steel rule into the kerf slots, will cause the base of each rule to seat on the table surface, and protrude below the bottom surface of the dieboard.

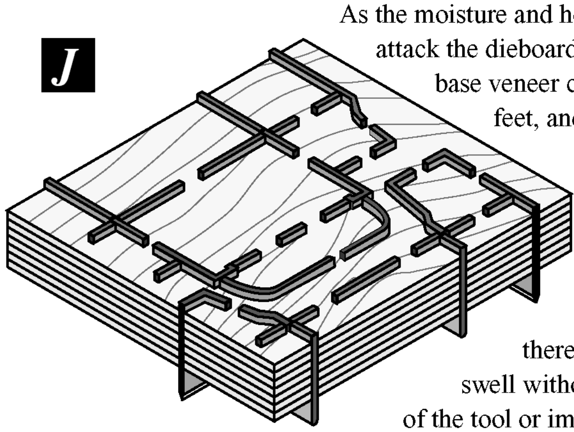


These “***spacers***” can be left attached to the dieboard for future reruling or they can be removed, as they have done their job in getting the rule to seat and protrude effectively. ***Why is having the base of the knives protrude through the back of the dieboard so important?***

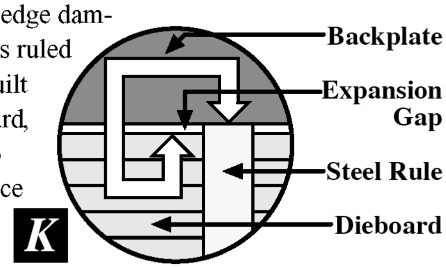
Plywood is hygroscopic and will readily absorb heat and moisture. However, it is under the impact of the ***Platen Well*** during the diecutting production environment that the performance of the dieboard will be compromised. This is where the intrusion of moisture will have the greatest impact on dieboard and steel rule die stability. Although the steel rule inserted into the dieboard stiffens and stabilizes the tool preventing excessive lateral shrinkage or expansion, the height of the dieboard is unrestrained in any way.

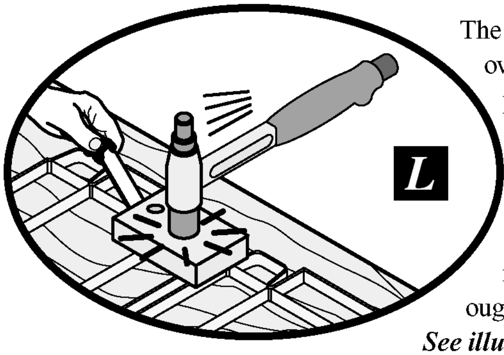


As the moisture and heat attack the dieboard the base veneer can begin to expand and swell, forcing the surrounding knives off their feet, and effectively increasing the height of the knife. ***See illustration I***.



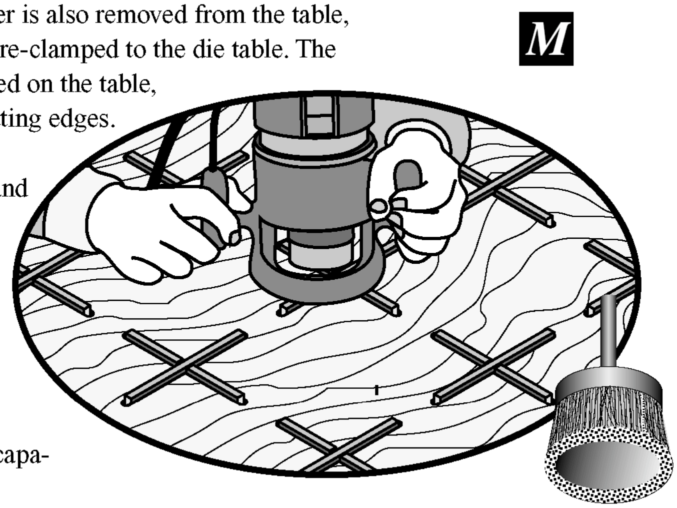
Naturally this increases the height of these knives, which inevitably leads to compressive edge damage. However, if the die is ruled with an expansion gap built in to the base of the dieboard, there is room for the dieboard to swell without changing the performance of the tool or impacting the press makeready. ***See illustration J & K***.





The correct ruling procedure would require a final overall planing of the steel rule die with a composition plastic block and a large, heavy steel hammer. ***See illustration L***. The dieboard is unclamped or unbolted, the dieboard is inverted so it is resting on the protrusion paper, and a router or a pneumatic power tool with a rotary wire brush attachment is used to thoroughly scour and clean the back of the dieboard. ***See illustration M***.

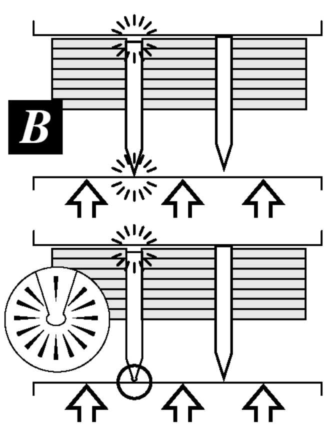
The dieboard is removed from the table, the protrusion paper is also removed from the table, the table is cleaned carefully, and the ruled die is re-bolted or re-clamped to the die table. The planing process is repeated, and the die is removed and inverted on the table, with some protective strips of material to protect the knife cutting edges. The back of the die is once again thoroughly scoured with the rotary wire brush, and then it is carefully examined for level and consistent rule seating.

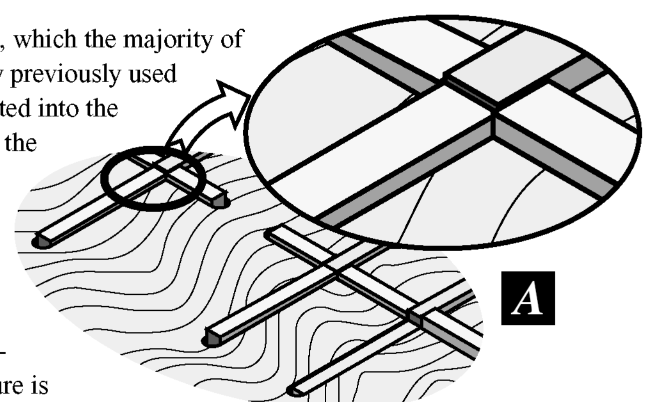


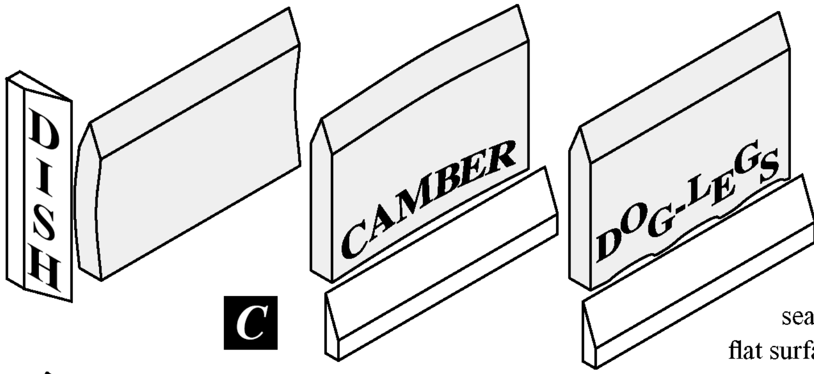
Unfortunately, most diemakers regard this type of preparatory discipline as unnecessary, which flies in the face of all of the evidence from the majority of their customers. Diecutting customers in every converting application are consistently struggling to achieve a fast, precise press makeready, to sustain kiss cut quality and to match the productive capability of the diecutting press!

Solution 2.3.3: The Ruling Procedure

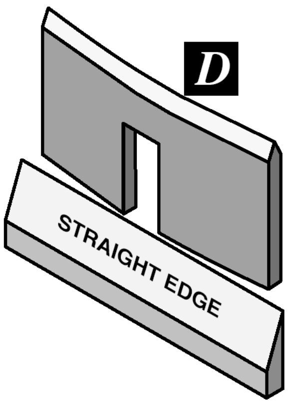
The Achilles Heel of diecutting is a problem in diemaking, which the majority of professionals ignore! If you carefully inspect the back of any previously used steel rule die, you would suspect the base of every rule inserted into the dieboard would be at precisely the same level? The reality is the majority of dieboards when inspected in this manner would clearly show the steel rule has not been inserted or seated correctly. ***See illustration A***. What is remarkable about this common failure is even though one or more press production runs may have been completed, the incorrect seating of the rule remains unaffected by the enormous pressure of diecutting! However, the cutting edge of the poorly seated blade is severely compressed, swaged, and damaged! ***See illustration B***.

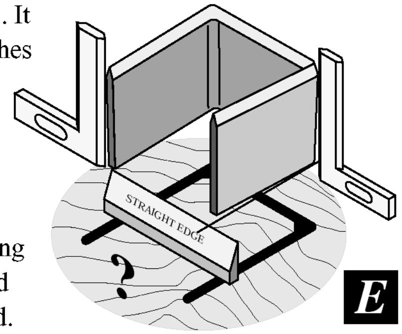






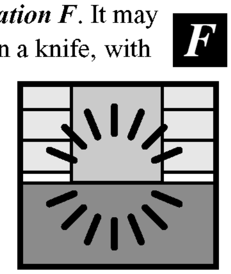
Improper steel rule seating can also be generated by variation in the key properties of the rule, and/or caused by poor machining and shaping of each blade. The most likely cause of variation in steel rule can be the result of ***Dish***, ***Camber***, and/or ***Dog-Legs*** in the steel rule strip. ***See illustration C***. In practice, at least one rule from each batch of rule inserted into a steel rule die should be inspected for seating flatness. This simply means setting the rule on a flat surface, to see if there is rule camber, dog legs, concavity, or even twist in longer lengths. It should also be a standard practice not to mix different batches of rule in the same dieboard, and to carefully qualify each new batch of steel rule.

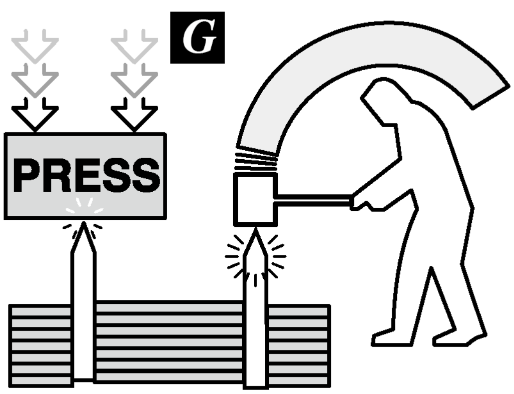




One of the more common forms of machining variation is the result of bridge distortion, ***see illustration D***, and/or because of non-square shaping. ***See illustration E***. Assuming the steel rule is correct and the rule is machined and shaped precisely, the next step is to insert the rule into the dieboard.

It is vital to drive the rule completely into and through the clamped dieboard so the base of the rule makes hard contact with the surface of the ruling table. ***See illustration F***. It may be hard to accept but a diemaker with a mallet can exert greater pressure on a knife, with significantly less edge damage, by comparison to a press, which can exert less pressure, but inflict significant damage to the cutting edge of the knife! ***See illustration G***.

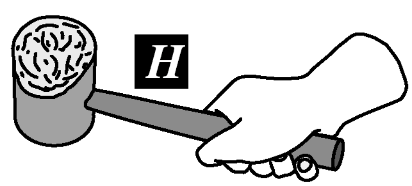




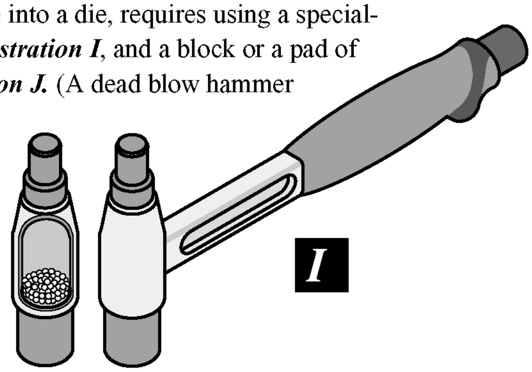
Lower Pressure Per Inch Maximum Seating Edge Damage!

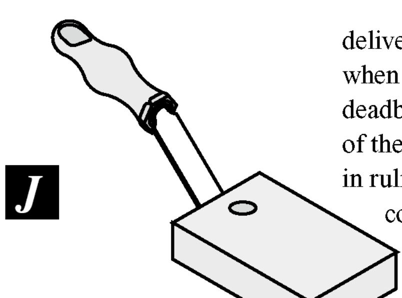
Greater Pressure Per Inch Minimal Seating Edge Damage!

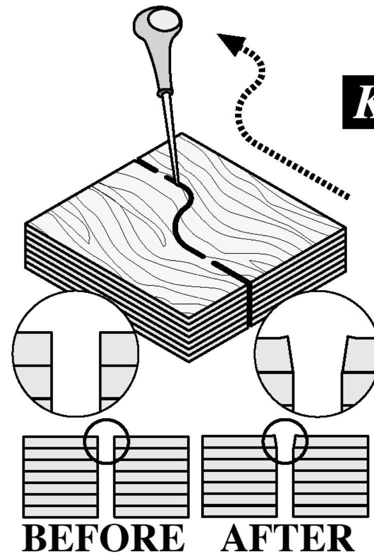
If the dieboard is not leveled correctly during ruling, the press make-ready will damage many of the knives, and result in an ineffective make-ready, poor quality and excess material waste.



When ruling the dieboard it is more effective to avoid the standard mallet, whose fixed head will wear unevenly, depending upon whether the diemaker is left or right handed. ! ***See illustration H***. The correct tool to insert rule into a die, requires using a specialized dead blow hammer, ***see illustration I***, and a block or a pad of plastic compound. ***See illustration J.*** (A dead blow hammer delivers 30% more force for the same effort when compared to a standard mallet. The deadblow hammer protects the hands and arm of the user, and is faster and more effective in ruling a steel rule die!) The use of this tool combination will ensure the knives are driven downward squarely, without rule distortion, and to minimize the damage to the kerf walls.

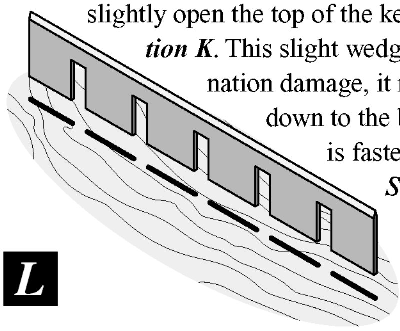






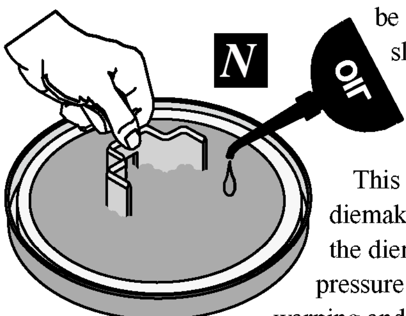
K

To improve rule insertion, to prevent kerf wall damage, to eliminate loose rule, and to ensure optimal rule seating, ***three techniques*** provide excellent diecutting benefits. The ***first*** requires implementing the ***Kerf Open Technique***, which employs a marlinespike to slightly open the top of the kerf slot in the surface of the dieboard. ***See illustration K***. This slight wedging of the upper veneer, prevents insertion delamination damage, it reduces the degree of carbon deposits being driven down to the base of the kerf, it minimize knife distortion, and it is faster and safer, particularly when inserting long knives! ***See illustration L***. This innovative technique can also be accomplished automatically using the Gerber Profiler.

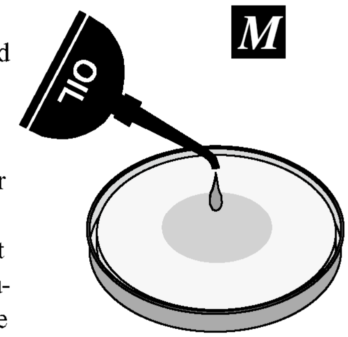


L

The ***second*** is the ***Oil Ruling Technique***. This long established procedure requires the use of a shallow lid from a cookie tin, which has soft foam inserted, and then the foam is soaked with standard motor oil. ***See illustration M***. Every piece of rule inserted into the dieboard, and particularly knife should be depressed into the surface of the foam, to accumulate a slight coating of oil, on the base of the rule. ***See illustration N***. This is then spread over the walls of the plywood kerf slot as the knife is driven into the dieboard.



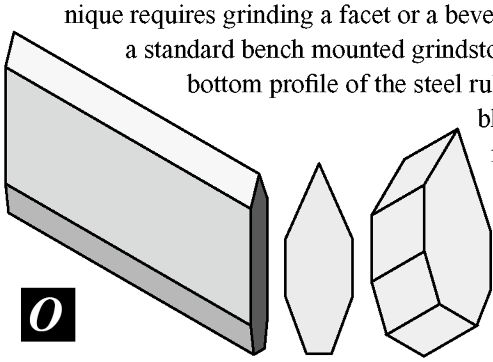
N



M

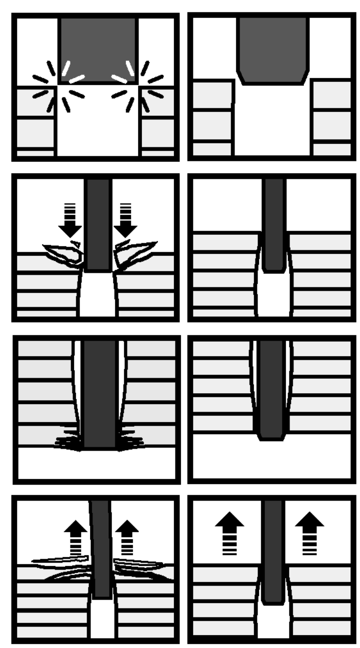
This is an important technique, which provides both the diemaker and the diecutter with many practical advantages. For the diemaker it ensures the knife can be inserted with minimal pressure. It coats the kerf walls with a protective coat to prevent warping and loose rule shrinkage. It reduces veneer damage, particularly if the die is eventually reruled. For the diecutter, the oiled steel rule die will kiss cut more effectively, the elimination of dieboard warping limits knife edge damage, the effective life of the tool is extended, and this approach to steel rule diemaking significantly lowers the time required to set the cutting impression.

The ***third technique*** is used selectively on key knives, such as the ***Inset Knife Technique*** described earlier, on any critical internal knives, and any complex knife shapes, which are difficult to match to the kerf path because of overbending and/or underbending. This technique requires grinding a facet or a bevel on both sides of the base of the knife, using a standard bench mounted grindstone. ***See illustration O***. This change to the bottom profile of the steel rule knife ensure it can be inserted easily, the blade will not damage the kerf walls, and most important of all, the knife will seat cleanly at the base of the dieboard kerf channel. ***See illustration P***.



O

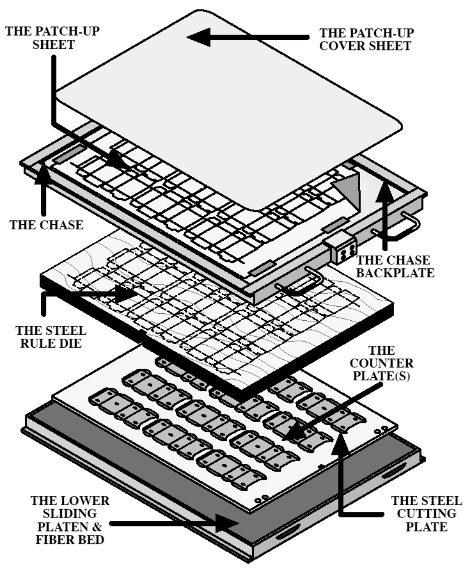
These are practical and pragmatic techniques, which are proven to help in ensuring an optimal steel rule cutting die, which will in turn minimize on-press knife-edge damage and eliminate dust and loose fiber.



P

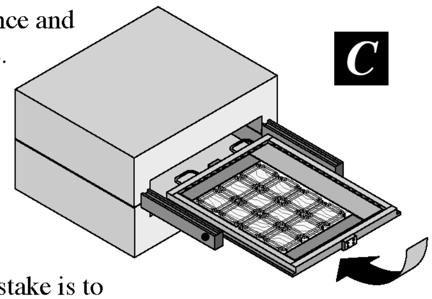
Solution 2.4.1: Chase Maintenance Procedures

A



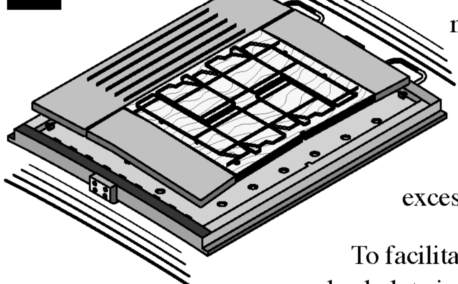
Between the upper tool holder of the platen diecutter and the bed of the machine are a number of key components. This is called the ***Platen Stack*** and consists of several layers of tools and components, including the steel rule die. ***See illustration A***. The performance and the condition of ever tool and every component is critical to the quality and the productivity of the diecutting process. Although the focus in this section is on the condition of the steel rule die and the cutting chase, it is dangerous to ignore the impact poor maintenance and cleaning of the other components will have.

C

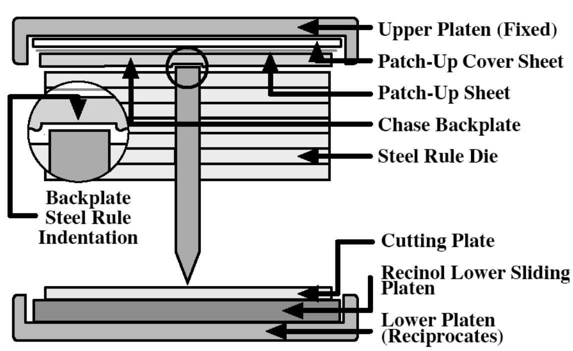


For example the steel rule die is "***locked***" into a press chase, ***see illustration B,*** which enables the tool to be accurately inserted into the cutting press. ***See illustration C.*** The reason the word ***"locked"*** is highlighted, is it a common mistake is to use excess pressure, which distorts the steel rule die and the chase, as ***illustration B*** clearly shows.

B



The chase consists of an outer frame and an integrated backing plate through which bolts are used to attach the steel rule die securely to the chase backplate. The backplate serves several purposes. It is a stiffening device to prevent the frame distorting, it is a method of attaching the die, to both reinforce the stiffness of the chase and the die, and it acts as a support plate for the base of the steel rule die. In fact it is more accurate to refer to the chase backplate as a sacrificial surface, as it is designed to get damaged and to provide a buffer to absorb diecutting excess pressure.

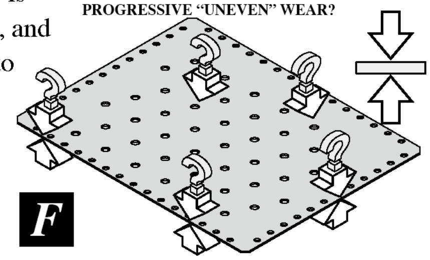


D

To facilitate this role the chase backplate is actually softer then the steel rule, which is pressurized against its surface. ***See illustration D***. As make-ready after make-ready, and production run after production run progress, the impact of each impression drives the base of some of the knives and creasing rule into the backplate to create grooves and scars. ***See illustration E***.

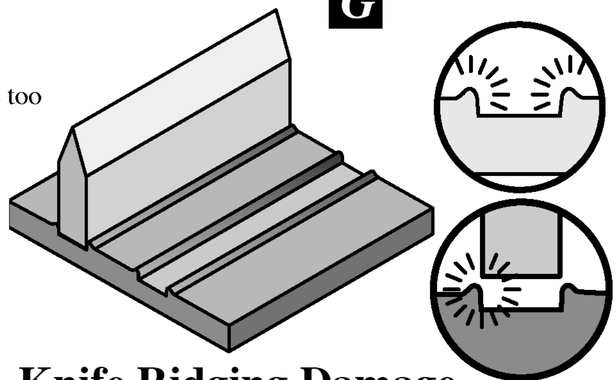
E

It is important to point out that if the press were stabilized and footprinted, and the die properly leveled, this type of damage is unlikely to occur. However, progressive wear, and particularly "***uneven***" wear is a critical factor to consider in older chases, and even those which have been maintained correctly. ***See illustration F***.



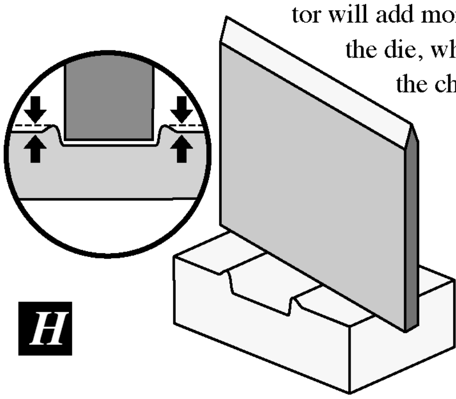
F

G



Knife Ridging Damage

If each indentation was a simple channel the problem would not be too severe, however, each indentation is a groove in the surface of the backplate, and the displaced metal from the formation of the indentation, forms a ridge on either side of this channel. ***See illustration G***. If this is left in place the next steel rule die inserted into the chase may be actually resting upon these metal welts, with some of the knives riding on the ridges. ***See illustration H***. The levelness of the die is compromised, knife-edge damage results, and dust and loose fiber is inevitable! To compound the problem, the press operator will add more and more pressure to the die, which will create new grooves and further damage to the chase backplate, as he or she attempts to overcome the problem in the only way available to them.

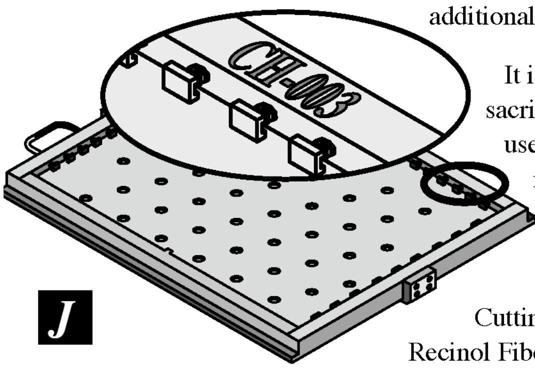


H

I

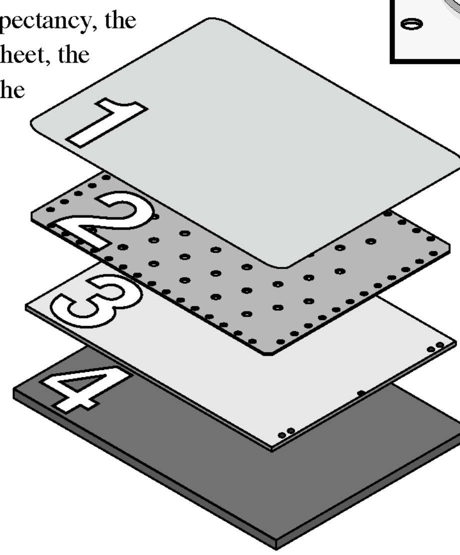
The solution, is every chase backplate should be carefully inspected, planed flat using a large diamond sharpening stone, to remove protruding welts and scars, brushed with a scouring solution to remove adhesive and dirt, and cleaned thoroughly, using a rust inhibitor. ***See illustration I***.

To organize this key maintenance activity it is useful to emboss an identification number on the side rail of each chase. ***See illustration J***. This will enable the creation of a maintenance log and a record of the number of make-readies the chase has been through, and the total of production impressions. This would also include problems and issues with each individual chase, and note any modifications made to the chase, such as additional die bolt holes.



J

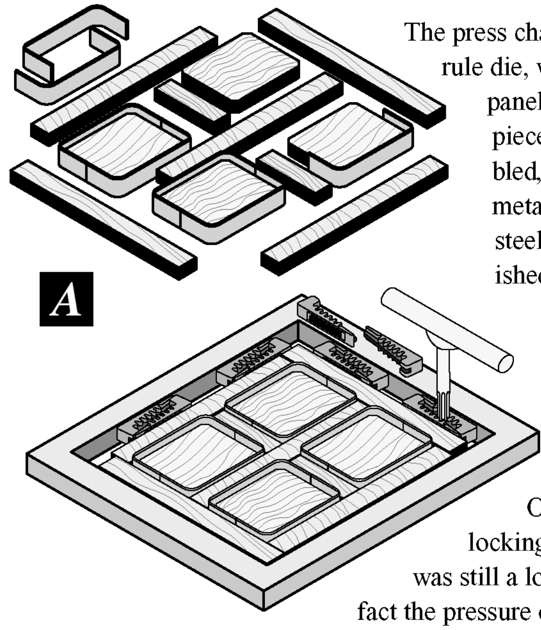
It is useful to remember the platen stack has four sacrificial surfaces, each with a different planned useful life, and a life which can be extended by regular careful maintenance. These surfaces are, in terms of life expectancy, the Patch-Up Cover Sheet, the Chase Backplate, The Cutting Plate, and the Recinol Fiber Sliding Platen Bed. ***See illustration K***.



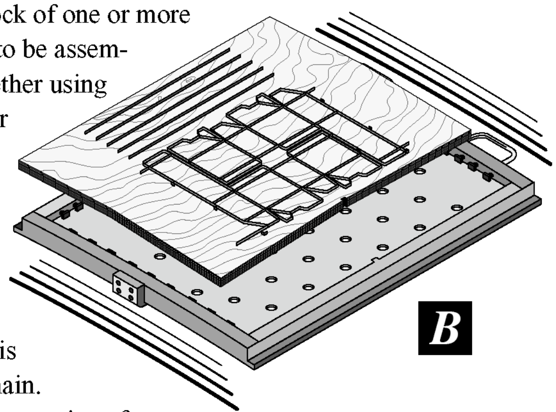
K

The greatest danger in diecutting is a failure to understand how all of the platen stack components are supposed to work and how they work together. Do not underestimate the potential negative impact of these hidden components, and protect their performance by implementing a weekly chase inspection and maintenance program.

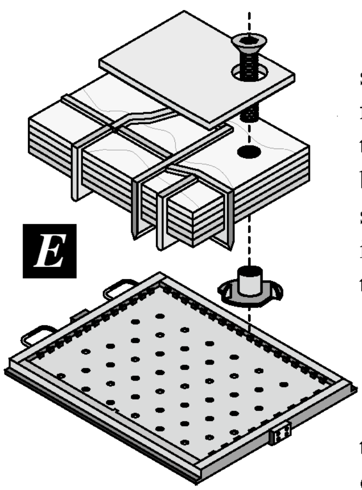
Solution 2.4.2: Steel Rule Die Lock-Up Procedures

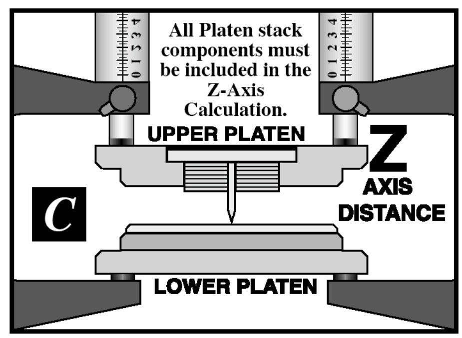


The press chase evolved at a time when one of the leading methods of fabricating a steel rule die, was called the block die system. This dieboard was in fact made with every panel being a separated sawn block of one or more pieces of plywood. The die had to be assembled, ruled, and then locked together using metal toothed quoins, in an outer steel frame to secure the finished tool. ***See illustration A***.



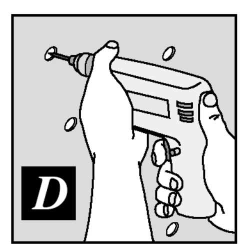
Although this method of toolmaking has long since been discarded some of the legacies of this system of toolmaking remain. One of those bad habits is the practice of locking the steel rule die into the press chase, with excessive pressure, as though this was still a loose collection of individual components. This is no longer necessary, and in fact the pressure of lock-up adds to the potential for the die/chase combination to warp and bow. ***See illustration B***.

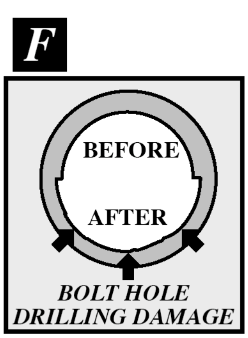




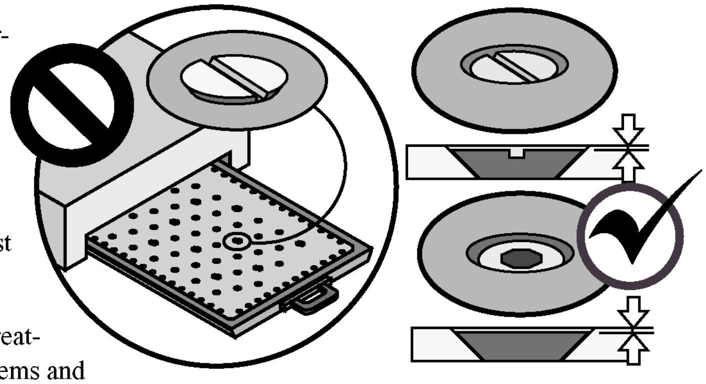
The correct method of lock-up simply requires positioning the one-piece die in the chase, adding light finger pressure to secure the tool, and then bolting the dieboard in place! Once the dieboard is securely bolted then a little more pressure can be added for security, but there is no need, and in fact it is damaging to use more than the minimal amount of pressure to do this!

The Z-Axis Control feature of an effective steel rule die encompasses the chase/die combination when they are integrated together. ***See illustration C***. Two further key points. ***First***, if your chases are already bowed and distorted by years of excess pressure they need to be replaced! Second, if you drill through the back of the chase backplate, ***see illustration D***, to position bolts in the dieboard, ***see illustration E***, you are severely damaging the chase backplate bolt holes. ***See illustration F***. You may be undermining any chance of an effective on-press cutting make-ready. The chase boltholes should be already lasercut in the dieboard and in the correct position, to facilitate simple, easy bolting.



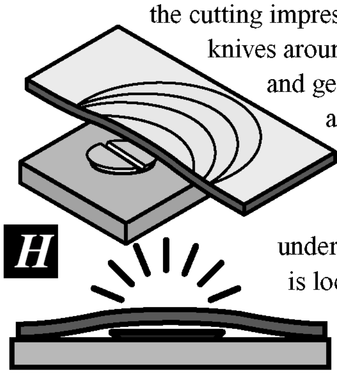


Finally, one of the most frustrating elements of being a diecutting trainer is many of the problems, which undermine on-press performance, are both trivial to fix and yet persistently ignored. If you wish to accelerate damage to a steel rule die and if you wish to expend excess time in patching-up. If you are determined to permanently damage the chase, the cutting plate



G

and the patch-up cover sheet, leave the heads of the bolts securing the die in the chase, protruding above the chase backplate surface. ***See illustration G***. This obviously deflects the chase cover sheet, ***see illustration H***, and creates a high point in the cutting impression, which will damage any knives around the position of the bolt head and generate cutting variation and dust and loose fiber!

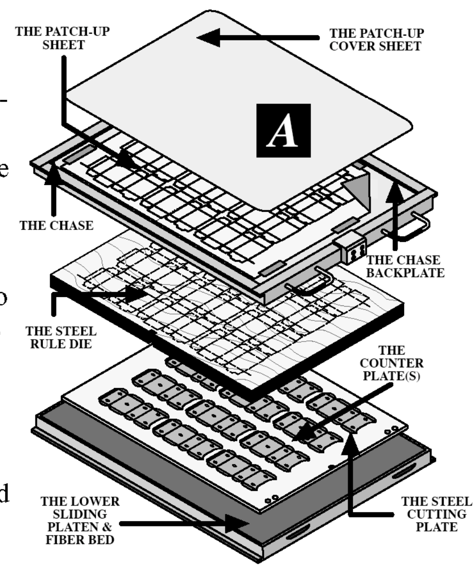


H

This is a common error, creating serious make-ready problems and undermining both productive output and product quality. When the die is locked and bolted into the chase, run your hand or a straight edge across the backplate surface to detect any bolt head protrusion.

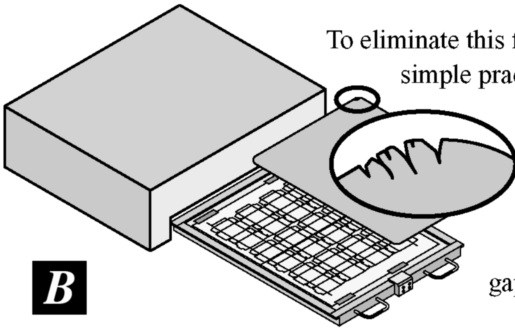
Solution 2.4.3: Patch-Up Cover Sheet Maintenance

Another key press stack component, and another sacrificial material is the ***Patch-Up Cover Sheet***. ***See illustration A***. This is both a shock absorber and it protects the patch-up sheet attached to the back of the chase, from damage and oil build-up. In spite of the seemingly insignificant role of this platen stack component it has the same degree of importance as the height precision of the steel rule in the die! In fact it should be considered as another layer of the die, and the condition of the patch-up cover sheet should be evaluated with the same degree of precision as the cutting tool.



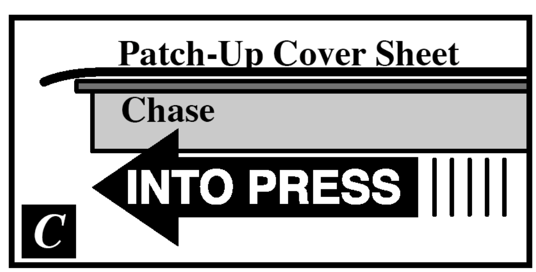
The flatness and condition of every component in the platen stack is critical to cutting performance, therefore it is vital the patch-up cover sheet is subjected to an equally rigorous inspection, cleaning, and maintenance procedure.

Finally, these tools are usually damaged at the off-lay edge as the chase and the patch-up cover sheet is reinserted into the platen gap. As the space here is limited the cover sheet material is often damaged and the leading edge is cut and scarred. ***See illustration B***.

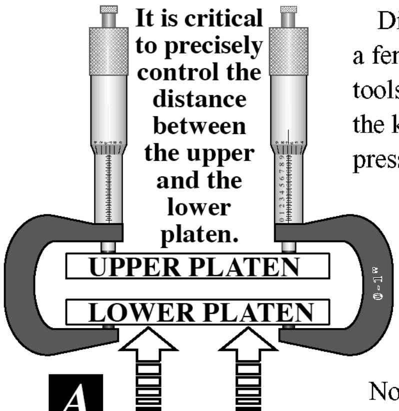


B

To eliminate this from happening it is a simple practice to overlap the leading edge of the cover sheet over the end of the chase so it curves down slightly, as it is inserted into the platen gap. ***See illustration C***.



Solution 3.1: Press Footprinting

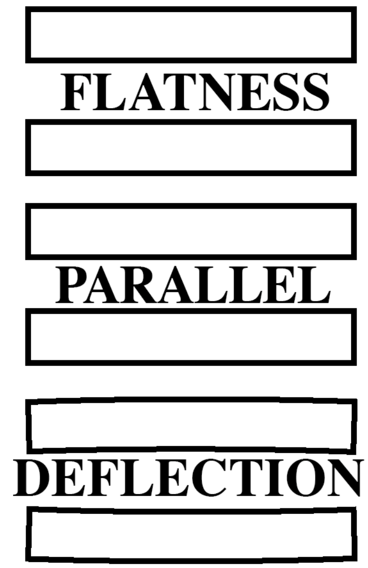


A

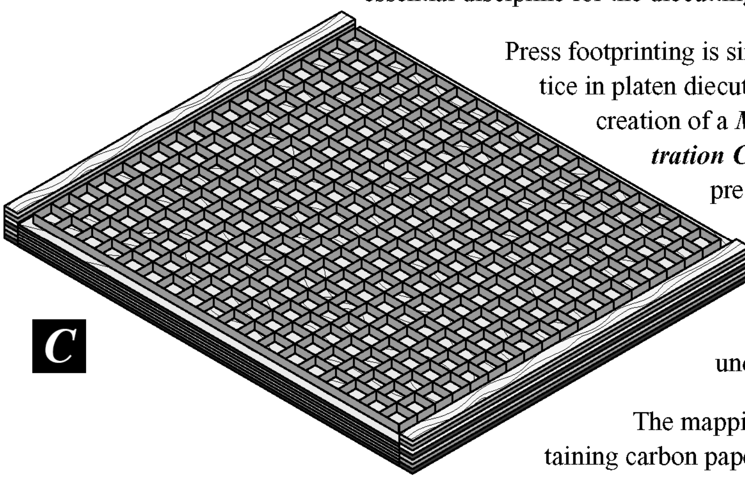
Diecutting is a stamping process, which requires the interaction of a male steel rule die with a female anvil to trap, diecut, and convert the material trapped between the upper and lower tools. The ability to kiss cut perfectly and/or the ability to precisely set the platen gap between the knife edges and the cutting plate or anvil, ***see illustration A***, is the most important setting in press make-ready.

If the press surfaces are not perfectly flat and level, if the upper and lower tool holders are not absolutely parallel, and if the mechanism deflects or distorts under diecutting press, ***see illustration B***, the productive potential of the press will be severely inhibited.

No matter if a press is new or old, or if it is has been mechanically leveled and maintained, press calibration is an essential discipline for the diecutting process.



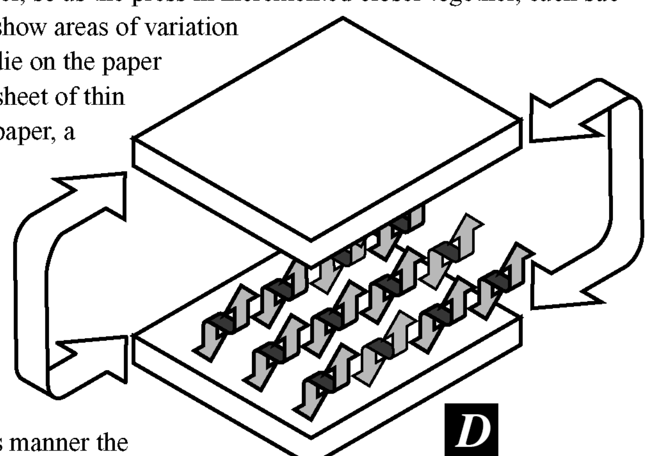
B



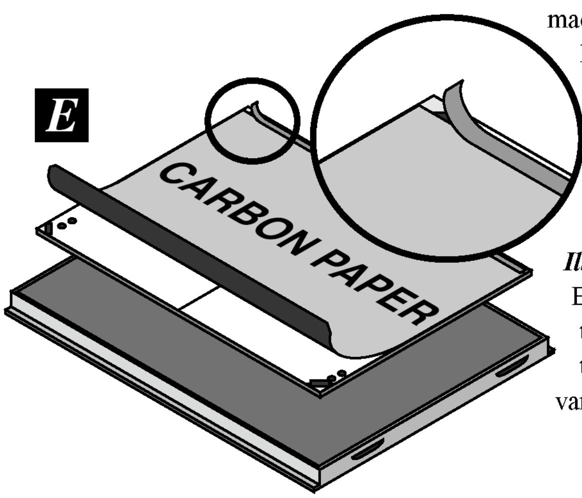
C

Press footprinting is simply a foundation practice in platen diecutting. This requires the creation of a ***Mapping Die***, ***see illustration C***, which will be used to precisely measure, record, or map, how level the press surfaces are, how far they are out of parallel, and how much the press distorts under impressional load. ***See Illustration D***.

The mapping tool is used in conjunction with a paper sandwich containing carbon paper, so as the press in incremented closer together, each successive impression will show areas of variation in the imprinted pattern of the test die on the paper surface. The sandwich is simply a sheet of thin machine finished paper, a layer of carbon paper, and a cover sheet to protect the carbon paper. ***See Illustration E.*** By footprinting the press in this manner the technique will generate a map of the various layers or levels of variation across the entire cutting surface of the

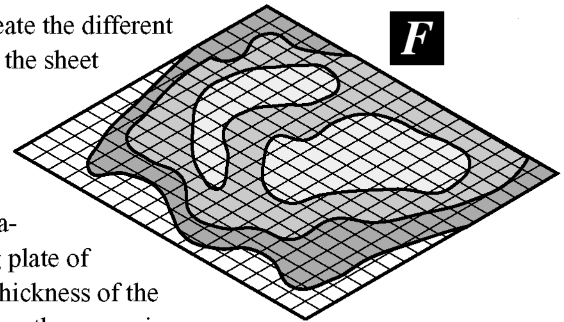


D



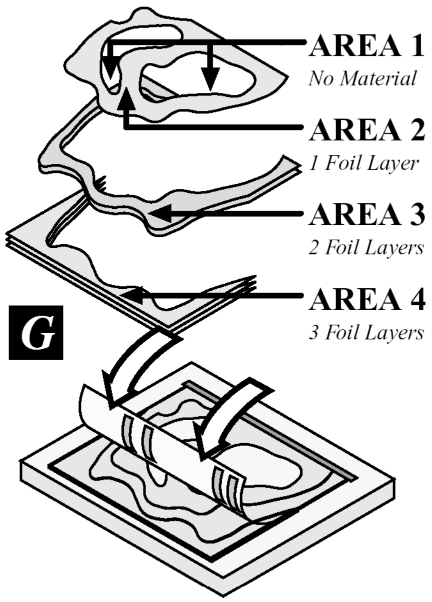
E

press. ***See illustration F***. The map shown is color coded to more clearly delineate the different pressure variation areas. In practice each area of pressure variation marked on the sheet would be done with a different color marker, to avoid confusion!



F

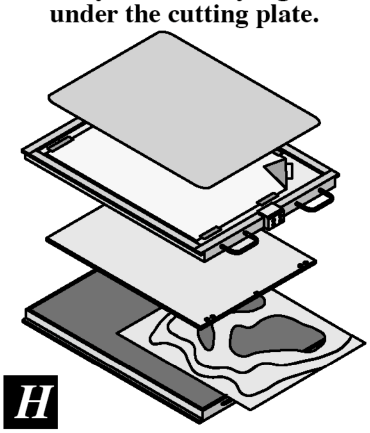
This map can then be used as a guide to create an accurate metal underlay from industrial foil materials, ***see illustration G***, which will be permanently positioned under the cutting plate of the press. ***See illustration H***. The thickness of the foil sheets is somewhat dependent on the press size and the degree of variation in flatness, but using 0.002” thick material is generally the most effective choice.



G

Press footprinting is important because it simplifies the creation of a stable kiss-cut cutting make-ready, it reduces the damage and extends the life of the steel rule die, and it ensures faster press speed and yield, with greater product quality and consistency. As our goal is to eliminate dust and loose fiber, and the source of the problem is knife-edge damage, this practice is no longer a choice but a necessity!

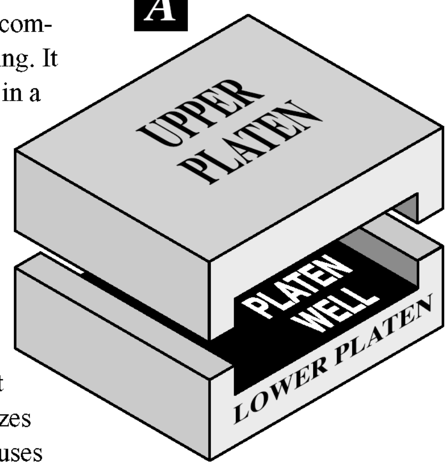
Underlay is accurately registered under the cutting plate.



H

Solution 3.2: Platen Stack Maintenance

A



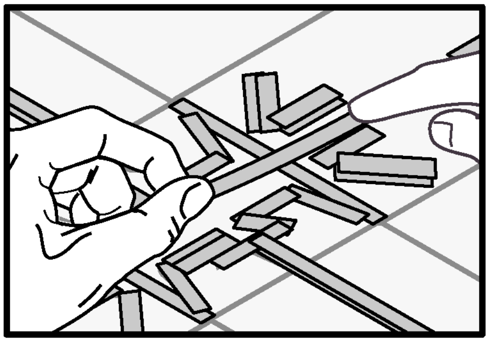
Nobody likes to clean! The problem is in platen diecutting the cleanliness of the press components and the well of the machine, are critical to set-up speed and precision in converting. It is easy to forget the investment in each specific diecutting technology was an investment in a high performance machine. Inevitably as machines age and deteriorate the original performance specifications are eroded.

However, this is a choice each company and each team makes. How often have you seen a beautifully preserved automobile, which performs as well as it did the day it rolled of an assembly line? ***Why is platen stack cleanliness so important?***

The build up of dirt in any precise mechanism leads to accelerated wear and damage, it unbalances the distribution of pressure, it traps air between components, it leads to rust and surface etching, it damages the steel rule dies and other tools, and it simply destabilizes the process. Dirt adds time to every job, it adds complexity, it adds unpredictability, it causes process variation, and inevitably it undermines diecut part quality. If that were not enough the accumulation of dirt can lead to accidents in inserting and removing tooling from the press.

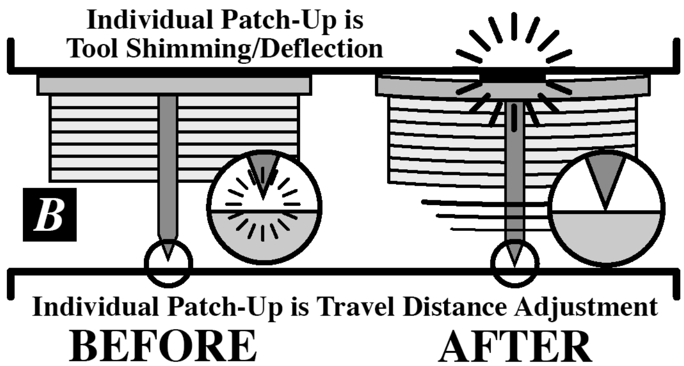
It is essential to implement a weekly inspection, cleaning, and maintenance procedure for all the tools in the platen stack, and for the upper and lower surfaces of the platen well.

Solution 4.1: Patch-Up Location

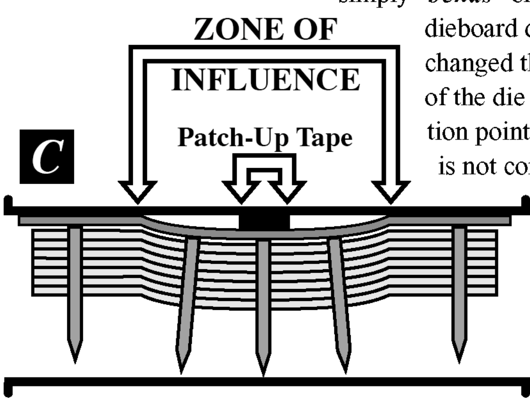


A

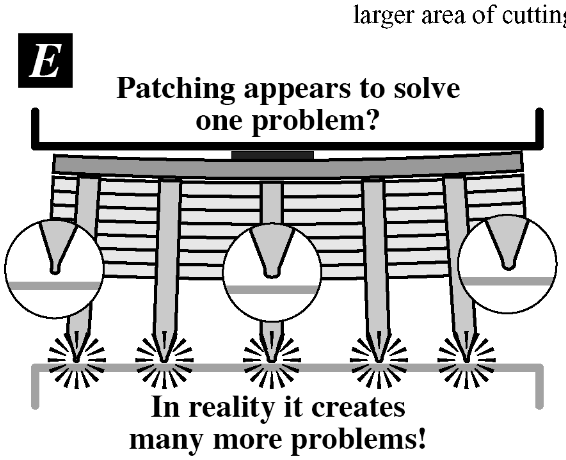
The goal of effective diecutting is to prepare so thoroughly that individual patch-up becomes unnecessary. The primary reason for this is to save time, because once individual patch-up begins, the degree of control the operator has over the process falls dramatically. So time is the primary issue, however, cutting quality and diecutting stability, material and resource waste, and the sheer unpredictability of the production run, are not unimportant issues! Unfortunately, if cutting is not complete the diecutter is forced to resort to individual knife patch-up. ***See illustration A***. The irony is the use the name "***individual,***" in that it is impossible to selectively change the pressure on a single knife!



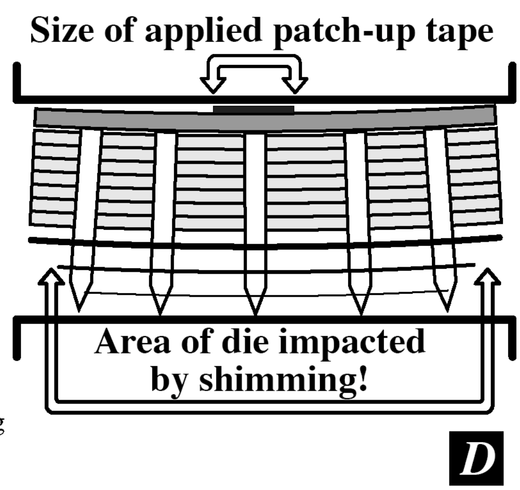
The patching activity may apparently solve an immediate cutting problem but it also creates other issues, which inevitably lead to more and more shimming. The addition of any shim on the underside of a die simply "***bends***" or "***distorts***" the dieboard downward by changed the thickness of the die at the insertion point of the patch material. ***See illustration B***. Unfortunately, this change to the die is not confined to the individual knife but an area of the dieboard 10 to 20 times larger than the width of the patch-up material. ***See illustration C***.



This is called the Pressure Zone for obvious reasons. Unfortunately, the patch-up added to one knife now affects all of the knives in the immediate vicinity of the shim material. ***See illustration D***. As a result these knives will strike the cutting plate with more force, which will cause knife edge compression and damage. ***See illustration E***. This will lead to further patch-up compensation, which will generate a larger and larger area of cutting knife damage.

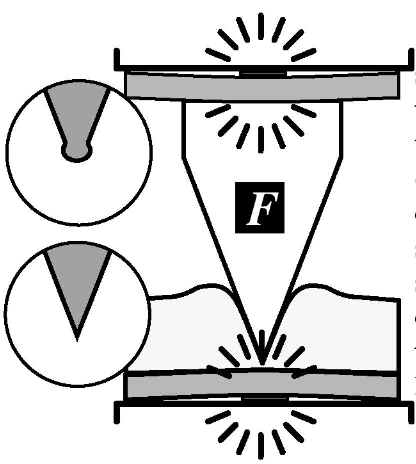


This is why patch-up is so unpredictable, because even the smallest adjustment to one knife causes damage to another knife. This knife has to be shimmed which causes damage to another knife… and on and on and on! But there is a far less damaging

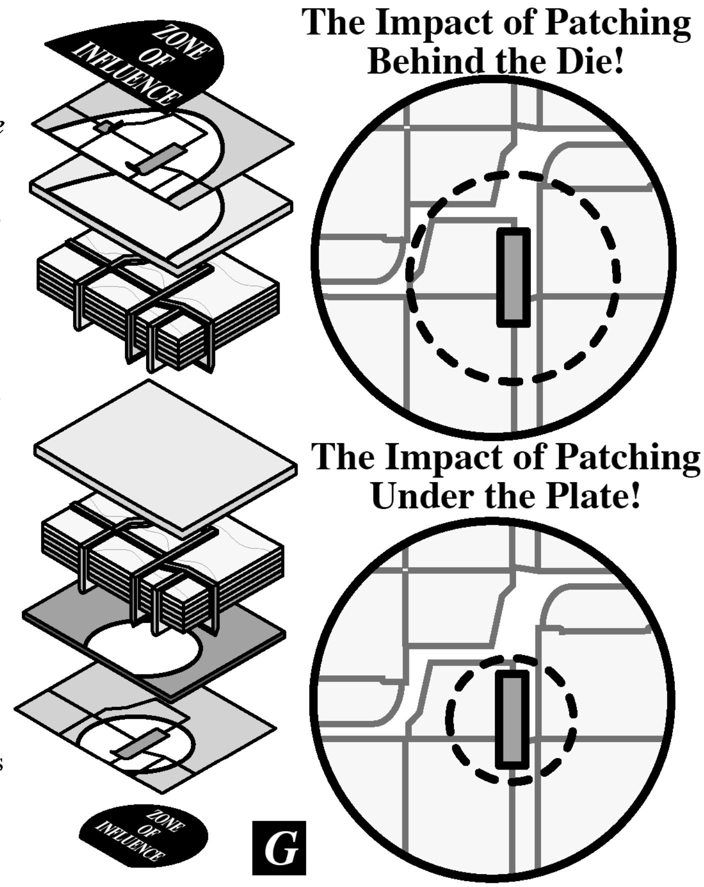


and a far more accurate location for the patch-up tape. ***Under the cutting plate!*** Individual shimming or pressure compensation is far more effective under the cutting plate because there is far less deflection and the pressure zone is much smaller. ***See illustration F***.

Therefore, although the goal is to eliminate individual patch-up tape adjustment, when it is necessary, the location, which will ensure optimal performance, is to position patch-up tape and materials under the cutting plate. ***See illustration G***. By patching up under the cutting plate the ***Zone of Influence*** is reduced, the area of tool deflection or shimming is smaller, and the precision of patch-up is far more accurate.

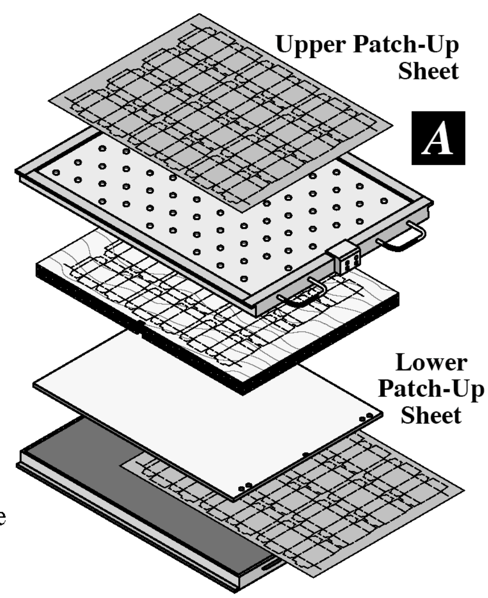


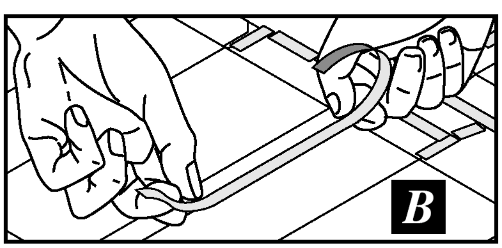
As illustration G shows, patching under the cutting plate reduces the degree of knife edge compressive damage, it ensures a more solid and stable cutting impression, it minimizes knife edge wear, and it reduces the incidents of dust and loose fiber.



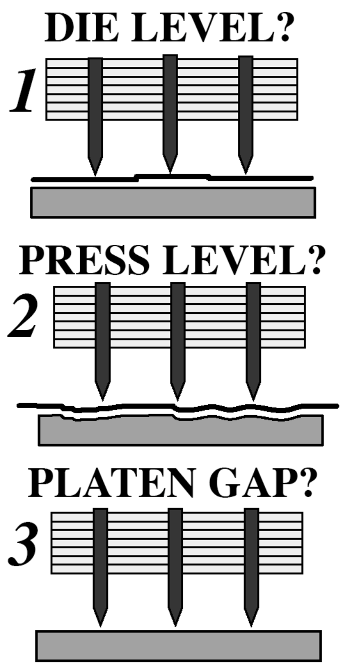
Solution 4.2: Combination Patch-Up

One of the most fundamental disciplines in setting up a diecutting press for production is the shimming or the patching of the steel rule die to achieve an even kiss cut impression. Patching is made possible by attaching an exact plotted paper image of the design/layout to the back of the die, behind the die/chase or under the cutting plate of the press. ***See illustration A***.



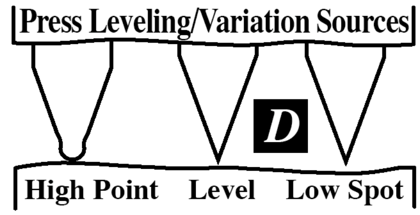


After setting the initial impression the diecutter examines the partially diecut sheet and marks those areas of the design where the knife is not completely penetrating the material or the diecut edge has a degree of webbing of uncut material. This is then followed by adhering thin strips of tape to the paper image of the die precisely aligned with the knife, which is not cutting completely. ***See illustration B***.



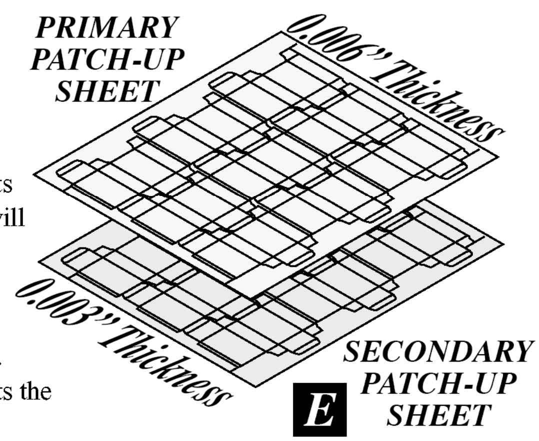
C

This procedure is repeated until every knife in the die is completely cutting through the material.

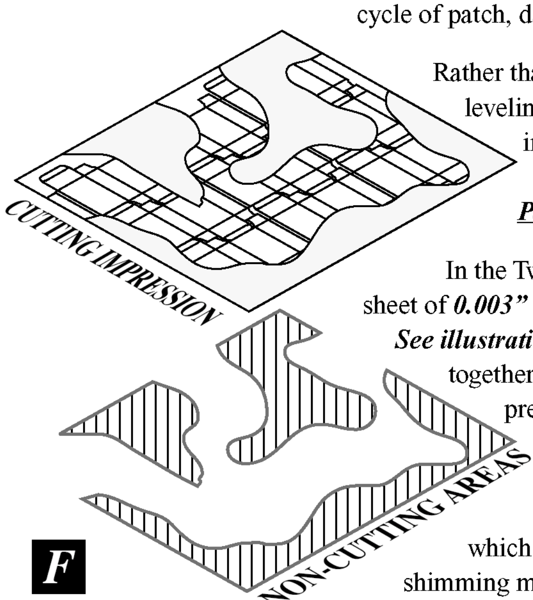


Unfortunately this practice is slow, it is inconsistent, and it leads to excessive knife-edge damage in the die, the very thing it is trying to compensate for. There are three key questions to be asked as part of the press leveling discipline! ***1: Is the Press Level? 2: Is the die Level? 3: Is the gap between the tools set at the optimal distance? See illustration C.*** Obviously if there is a need to make patch-up adjustment, one or more of the three key press settings is not correct!

Although, there are three reasons why shimming or patching is necessary, the most common is the steel rule die is not correctly leveled or calibrated. There are three key sources of variation, which results in the need to add patch-up tape. The ***first*** is obviously the knife is not reaching the cutting plate to completely sever the material. ***Secondly*** the knife has suffered compressive damage and more pressure is required to compensate, and ***third*** there is a low spot in the press cutting plate/anvil, which prevents the knife-edge making contact with the cutting surface. ***See illustration D***.



When patch-up is added the tool must deflect and bend around this added thickness of material. This means the knife, which was adjusted, will be affected, but other components in the die in the vicinity of the patch-up tape will be effected. The problem is if the knives in the immediate area were previously cutting, they will now strike the plate with excessive force, and they will suffer compressive edge damage. These knives will require patching, which starts the cycle of patch, damage, and patch again!



Rather than immediately go to patch-up tape there is a faster, simpler method of press leveling which will minimize knife-edge damage and generate a more rigid cutting impression. This is called ***Combination Patch-Up,*** which is in fact the combination of two methods of patch-up adjustment, ***Two-Sheet Patch-Up & Area Patch-Up.***

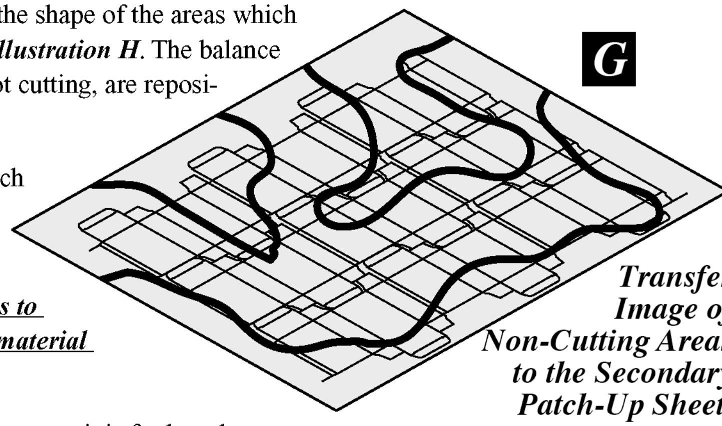
In the Two-Sheet Patch-Up discipline the first step is to create a secondary patch-up sheet of ***0.003" in thickness***, in addition to the original patch-up sheet of ***0.006" in thickness***. ***See illustration E***. The two patch-up sheets are combined in a double layer, and are attached together either behind the die or under the cutting plate in the normal position for the press in use. An impression is taken and cutting performance evaluated, however, this time the sheet is examined from the perspective of an overall distribution of pressure, distinguishing between cutting and non-cutting areas. In practice this means taking a large black marker and tracing those areas of the layout, which are not cutting onto the diecut sheet. ***See illustration F***. Normally, patch-up or shimming materials would be added individually to these areas, however, this time a different approach is used.

The pattern of the *NON-CUTTING* areas is transferred to the thinner of the two patch-up sheets. ***See illustration G***. However, and this is critically important, the shape of the areas which ***ARE CUTTING*** are torn free form this patch-up sheet. ***See illustration H***. The balance of this patch-up sheet, or the areas of the design which are not cutting, are repositioned under the original patch-up sheet. ***See illustration I***.

What is most important and most significant in this approach to press leveling, is it is a ***Pressure Reduction System*** rather than a ***Pressure Increasing System***

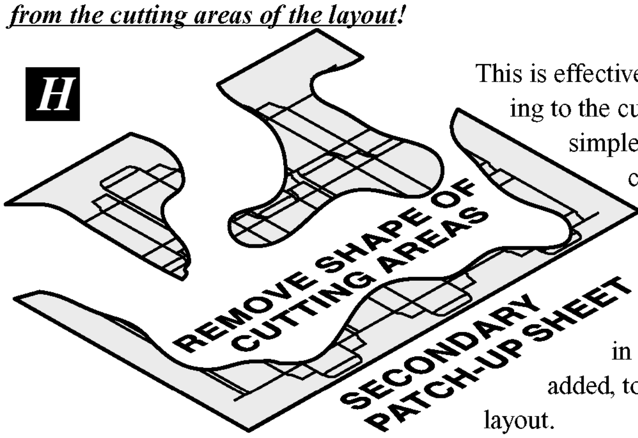
Instead of adding individual pressure/shimming materials to the non-cutting areas of the layout this procedure removes material from the cutting areas of the layout!

G



Transfer Image of Non-Cutting Areas to the Secondary Patch-Up Sheet.

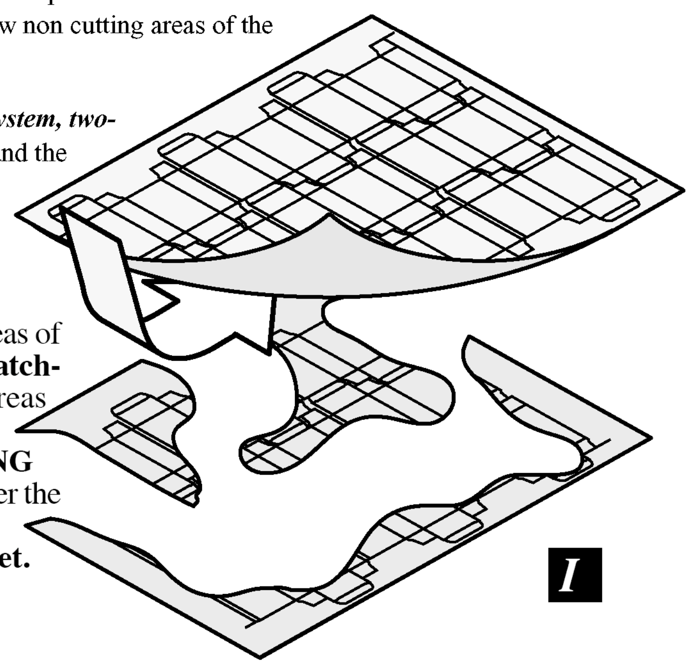
H



This is effective because it is far less damaging to the cutting knives in the die, it is fast and simple, and it provides a much harder, better cutting make-ready. On taking a second impression the same procedure is followed, however, the remaining small amount of non cutting areas are treated using the area patch-up method, in which torn pieces of thin material are added, to the few non cutting areas of the layout.

This means the process has moved from a ***pressure reduction system, two-sheet patch-up***, to a ***pressure increasing system, area patch-up***, and the combination is naturally called ***Combination Patch-Up.***

Finally, using a third impression, any remaining small amount of non cutting knives are patched in the traditional manner using individual pieces of thin adhesive tape.

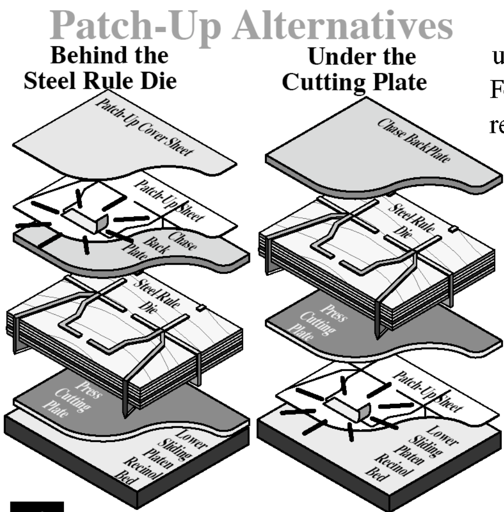


The remaining areas of the **Secondary Patch-Up Sheet**, the areas which are **NOT CUTTING** are reinserted under the **Primary Patch-Up Sheet.**

I

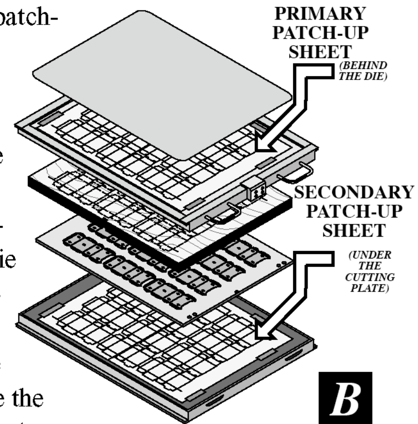
Two-Sheet/Combination Patch-Up is considered the most effective method to start the press leveling sequence and is the standard approach for professional diecutters around the world. By removing pressure from the knives, which are cutting, the pressure is balanced between the knives cutting and the knives, which are not cutting. It is certainly different from current procedures and there is obviously a short but important learning cycle. However, ***Two Sheet & Combination Patch-Up*** is so effective, so fast, and so consistent, they must be adopted as the standard press leveling procedure. This is an important discipline in press set-up and a very effective approach to minimizing knife edge damage, and the elimination of dust and loose fiber.

Solution 4.3: Double Patch-Up Sheets



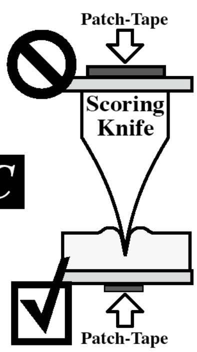
A

Most diecutting presses are setup to have a patch-up sheet positioned behind the steel rule die. For most pressure adjustment situations this is reasonably effective, however, there are pressure adjustment applications where a more precise alternative is essential. In patching there are two basic alternatives. The patch-up tape can be placed behind the cutting die or under the cutting plate or anvil. However, in practice the closer the patch-up tape is to the cutting edge of the knife the more effective the patch-up and the more precise the degree of pressure control. ***See illustration A***.



One effective option is the practice of ***Double Sheet or Precision Patch-Up***. This practice requires the use of two patch-up sheets. One patch-up sheet is positioned behind the steel rule die as normal and a second patch-up sheet is inserted under the cutting plate. ***See illustration B***.

The standard patch-up sheet is used for gross leveling and the patch-up sheet positioned under the cutting plate is used for precision patching where control is critical. ***Where would this be appropriate and more effective than the standard approach?***



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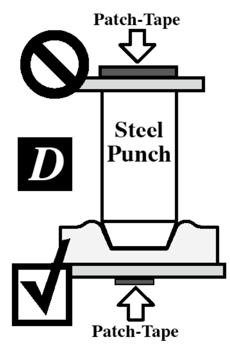
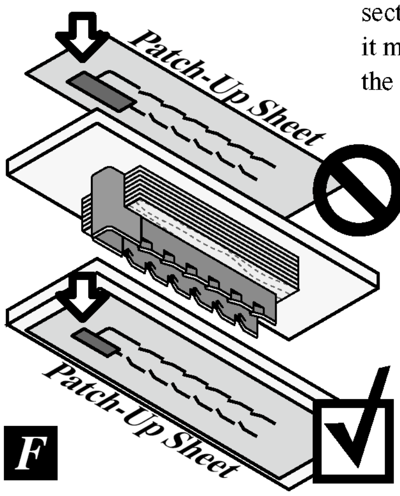


Patching up under the cutting plate provides far greater accuracy, control and diecutting stability when adjusting scoring knives in a design. ***See illustration C***. In the same way patching up under the cutting plate would be far more effective in controlling steel punch diecutting performance. ***See illustration D***. The same technique provides great advantage if there are critical internal cuts or locks in the design, ***See illustration E***, or where there are tear strips or tear out sections of a design. ***See illustration F***. Patching up under the cutting plate is far more precise, it minimizes tool deflection, and it concentrates the patch-up tape to the knife or knives being adjusted.



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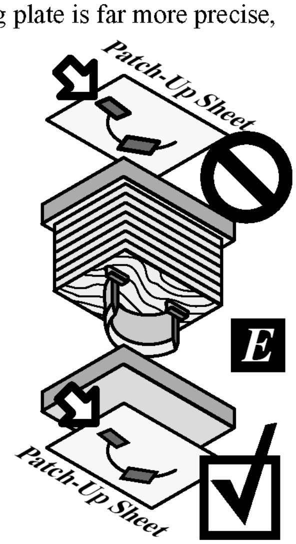
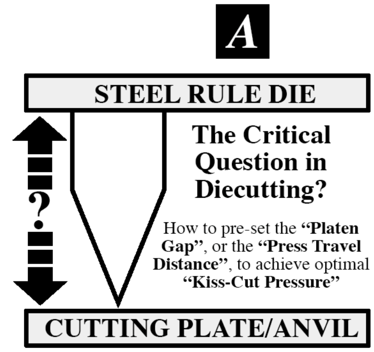


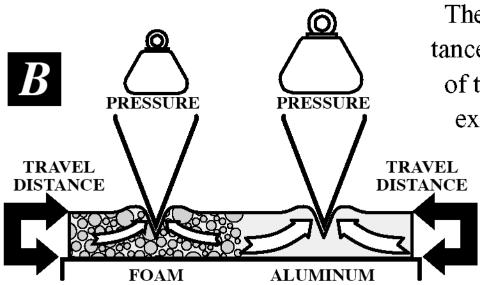
Although the majority of presses are set-up for the patch-up adjustment sheet to be positioned behind the die, adding this ***Double Patch-Up Sheet*** is a very effective alternative. In fact it is so effective, many diecutters simply use a patch-up sheet under the cutting plate, for all their patch-up adjustment.

Therefore, in practice, patching-up under the cutting plate is an important technical alternative when it is necessary to protect a key knife from compressive edge damage, where it is critical to deliver optimal cutting performance and stability throughput the production run, and where it is important to eliminate the generation of dust and loose fiber.

Solution 4.4: Pre-Production Pressure Calculation

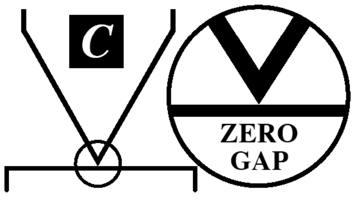


One of the most difficult and time consuming tasks facing the on-press make-ready team, is to determine the most effective setting for press "***pressure***". Although the term "***pressure***" is commonly used, the operator is really changing the distance of travel of the tool in the press to increase or to decrease the gap between the lower platen and the upper tool. ***See illustration A***.

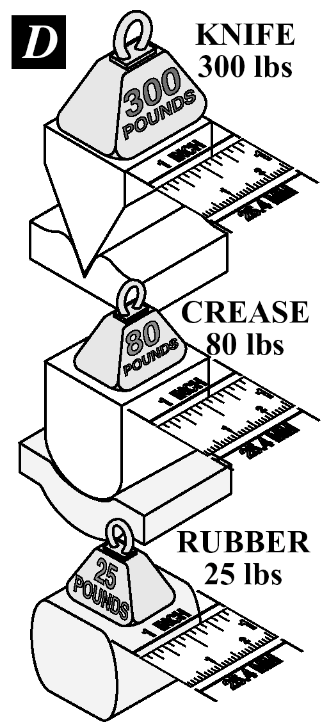


The term pressure is really referring to the resistance of the material being diecut to the penetration of the cutting rule into and through the material. For example, ***illustration B,*** shows two identical thicknesses of material being diecut. However, one is a soft foam, while the other is a dense aluminum. Although the pressure to diecut each material is very different, the travel distance of the tool/press for both materials is identical!

The problem is setting the platen gap too close, will cause the knife-edges to suffer damage, undermining diecut part quality. If the gap is set too far apart, excessive shimming results in a "***soft***" make-ready and poor cutting performance. The entire focus of diecutting is setting the gap between the tip of every knife and the surface of the cutting plate to achieve a Zero Gap. ***See illustration C***.



As this is so critical to optimal performance, it is surprising more professional diecutters do not use the standard formulation for pre-calculating press tonnage.



The basic pressure calculation in platen diecutting states for every lineal inch of knife in a die 300 pounds of pressure is required, for every one inch of creasing rule 80 pounds of pressure is required, and for every square inch of ejection rubber, 25 pounds of pressure is required. ***See illustration D***. Fortunately it is not even necessary to work out the calculation because many CAD systems will generate the tonnage automatically when a design layout is complete. Therefore, the information should be supplied with the job bag or work order as the die is being fabricated.

This formula is not absolutely precise because there is no mention of the caliper of the material being diecut, its density, or grain direction. Also the pointage and or the bevel angle of the knife and the pointage of the crease rule are ignored. Finally, the thickness of the counter, and the penetration of each crease into each counter channel or the size of the die and the balance of the pressure in the layout are not included. The formulation represents a consistent starting point or a basic benchmark. When this formula is used on each press for each caliper of material and the pre-calculation compared to actual production run tonnage, the formula can be precisely tuned until it is very accurate. Naturally, the new customized formula would be for each individual press and for each type of material being diecut on that press.

However, for those organizations that utilize this information the benefit in terms of fast make-ready, reduced waste, improve quality, and higher yield are impossible to ignore.

Summary

This technical publication has covered several problem areas and solutions, with the goal of eliminating dust & loose fiber from platen diecutting. The following is a list of the solutions and a recommendation for which to use; however, there is one Critical Recommendation. Which is, assume dust & loose fiber will happen on any and/or every job and always take remedial pre-production action. Therefore, implement these solutions, modify the steel rule die in advance, so valuable press time is not lost in fighting to minimize this type of difficult to control variation, once the press run has begun.

The recommended Solutions to the problem of dust & loose fiber were:

1. ***Cutting Plate/Anvil Modification***
   - ***1.1 Soft Cutting Plate***
   - ***1.2 Work & Turn Cutting Plate***

2. ***Steel Rule Die Calibration***
   - ***2.1 Dieboard Modification***
     - ***2.1.1 Dieboard Material Selection***
     - ***2.1.2 Dieboard Bridging Parameters***
     - ***2.1.3 Dieboard Machining***
     - ***2.1.4 Dieboard Stabilization***
   - ***2.2 "Floating" Knife Steel Rule Die***
     - ***2.2.1 Floating Knife Principles***
     - ***2.2.2 Dieboard Kerf/Rule Locks***
   - ***2.3 Ruling/Calibration***
     - ***2.3.1 Steel Rule Die Table***
     - ***2.3.2 Dieboard Preparation for Ruling***
     - ***2.3.3 The Ruling Procedure***
   - ***2.4 Steel Rule Die/Chase Preparation***
     - ***2.4.1 Chase Maintenance Procedures***
     - ***2.4.2 Steel Rule Die Lock-Up Procedures***
     - ***2.4.3 Patch-Up Cover Sheet Maintenance***

3. ***Platen Press Calibration***
   - ***3.1 Press Footprinting***
   - ***3.2 Platen Stack Maintenance***

4. ***Rigid Pressure Balanced Cutting Make Ready***
   - ***4.1 Patch-Up Location***
   - ***4.2 Combination Patch-Up***
   - ***4.3 Double Patch-Up Sheets***
   - ***4.4 Pre-Production Pressure Calculation***

Key Recommendations

The majority of these recommendations require changes to current methods and practices, and add a degree of complexity to the steel rule die process. It is important you evaluate each recommendation and given the reality of your diemaking and diecutting operation, set your own priority to an action plan to eliminate dust and loose fiber. However, it would be remiss of me not to add my recommended priority. Therefore, I would recommend you take the following actions in the following order.

First, as is so simple, so effective, and eliminates much steel rule knife damage, and dust and loose fiber… ***Implement 1.1 Soft Cutting Plates***

Second, as is so important, so effective, and eliminates much steel rule knife damage, and dust and loose fiber… ***Implement 3.1 Press Footprinting***

Third, as the foundation tool in the platen diecutting process is the steel rule die it is vital to calibrate this tool to ensure optimal on-press kiss cut ability. Therefore, you must ...***Implement 2.3.2 Dieboard Preparation for Ruling*** & ***2.3.3 The Steel Rule Die Ruling Procedure***

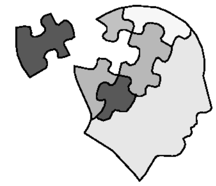
Fourth, as dust and loose fiber only occur on key knives, it is important to prepare these knives to optimize their ability to float, to self level, and to avoid knife edge damage. ***Recommendation 4*** is designed to prevent knife-edge damage, to keep the cutting edge sharp, and to provide maximum flexibility to the diemaker and to the diecutter. Therefore, you should... ***Implement 2.1.1 Floating Knife Principles*** (Particularly, the ***Inset Knife Technique***.)

Fifth, as a key part of getting a perfect kiss cut impression is pressure leveling and pressure balancing, I would urge you to... ***Implement 4.2 Combination Patch-Up.***

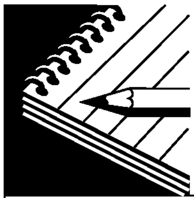
To summarize my recommendations:

1. ***Implement Soft or "Thin" Cutting Plates.***
2. ***Footprint/Calibrate the cutting press to eliminate gross variables.***
3. ***Calibrate the steel rule die by adopting the dieboard preparation for ruling and the recommended ruling procedures.***
4. ***Adopt the highly effective floating knife practices for key knives in each design/layout.***
5. ***Use the integration of Two Sheet and Area patch-Up to create the most effective press leveling method, Combination Patch-Up.***

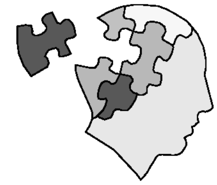
Brainstorming, Notes & Ideas



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



Brainstorming, Notes & Ideas



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

We hope you have enjoyed this technical publication from the ***International Association of Diemaking and Diecutting*** and from ***DIEINFO***. It was our goal to share our knowledge, experience, and expertise, to help you and your colleagues improve the diemaking and the diecutting process. If you have any comments, criticism, suggestions, or recommendation for improvement in this publication, we would be delighted to hear from you.

Below is an overview of some of the services provided by ***DieInfo*** to the Converting Industry. For more information call ***Kevin at 1-360-385-4214, or email kevin@dieinfo.com***.

DIEINFO *is an education & training organization focused upon optimizing diemaking and diecutting productivity. DieInfo provides a range of innovative services for the converting industry professional and technology support company. These services include:*

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If you have a number of issues in diemaking and in diecutting, and require an in-depth technical analysis, you may wish to consider a ***DieInfo Technical Audit*** of your process.

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- ☑ ***Analyze the operation to determine strengths and weaknesses***
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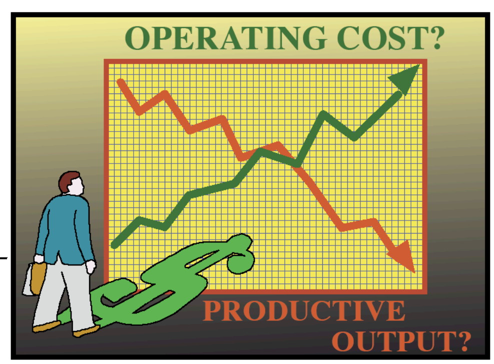

For more information *about this detailed systematic evaluation of the process and generation of a practical plan of action call*
Kevin @ 1-360-385-4214 *or email me at **kevin@dieinfo.com***
*to **request a Diecutting Audit Data Sheet**.*

DieInfo, Inc.
321 Cherry Street • Port Townsend, WA 98368
360.385.4214 • kevin@dieinfo.com
www.dieinfo.com