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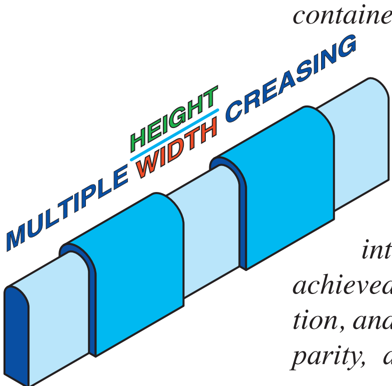
Tech Notes

For Diemaking and Diecutting

DIE.12.07
December, 2008

"The ABC's of Setting, Controlling & Adjusting Folding & Opening Force."

This training guide is a pictorial, step-by-step training program, which is designed to teach the specification and design of using the Compound Creasing Technique, in conjunction with the Reduced Bead Discipline, to set and control Folding Resistance and Opening or Springback Forces. The goal is to simplify the converting process; to improve diecutting, gluing and cartoning efficiency; and to optimize carton and container folding quality, consistency and repeatability.



As with any information introduced into the converting process these technical recommendations should be greeted with positive skepticism. The goal of the guide is to augment current knowledge, and it is not intended to immediately replace current methods and practices. However, these techniques are designed to be integrated and blended with current methods, into a systematic and a more effective approach to creasing. This should be achieved through teamwork, through discussion and brainstorming, through education, and through careful testing. The objective is knowledge, skill, and experience parity, and procedural uniformity. In other words, to get everyone to know what everyone knows, and then to work as a cohesive team, to find and apply the best consensus methods and practices.

*To get the best performance, to generate the best creasing and folding, and to produce the best quality cartons and containers, it is essential to have an open mind, to think outside of the **"box,"** and to continuously share all of our knowledge, all of our skill, and all of our experience.*

The best source for the knowledge, for the experience, for the resources, and for the technical discussion of subjects like this is the International Association of Diemaking and Diecutting.

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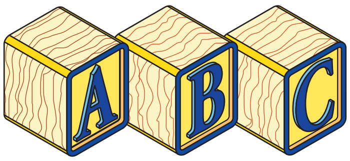
"The ABC's of Setting, Controlling & Adjusting Folding & Opening Force."



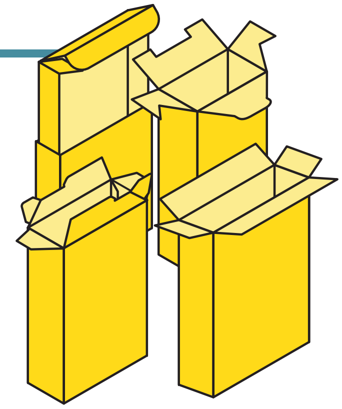


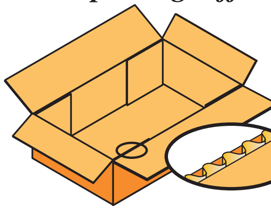
Table of Contents

The ABC's of Diemaking & Diecutting

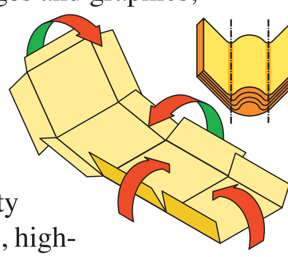
Article Title **"The ABC's of Setting, Controlling & Adjusting Folding & Opening Force."**

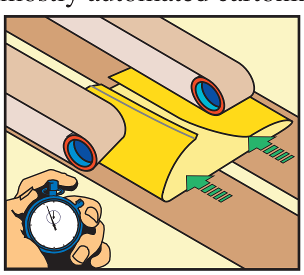
Introduction

"Insanity: doing the same thing over and over again and expecting different results." *Albert Einstein*



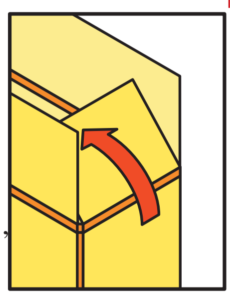
The folding paperboard carton and the fluted corrugated container are indispensable components of a diverse and continually changing consumer economy. Converted from renewable, recyclable materials, these simple ***"boxes"*** are critical to the manufacturing, the transportation, the storage, the protection and the distribution of a wide range of consumer and industrial products. Coupled with the ability to directly print images and graphics, text and instructions, and product descriptions, on the outer and the inner container surfaces, this utility storage device becomes a powerful point-of-purchase display and sales tool. The inherent flexibility of structural design and the low cost, high-speed diecutting process, coupled with the ability to deliver the cartons glued and pre-folded in a "flat" condition, ensure the erection and filling of the carton in mostly automated cartoning systems is efficient and cost effective.

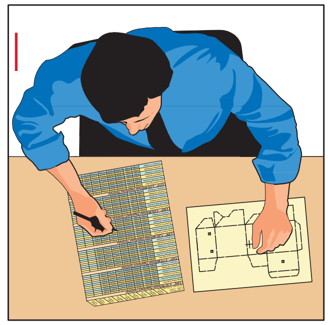




As with every production process, speed, productivity, and consistent performance are the benchmarks for success. The key converting attribute, which makes the carton and container successful, is the ability to crease and fold each material precisely, consistently, and with exacting repeatability, from carton to carton. These requirements demand converting consistency from die station to die station, from the first to the last diecutting impression, and from one product batch to the next.

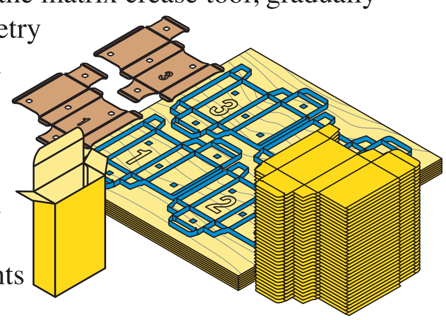
Unfortunately, it is not just folding without material failure which is the critical assessment of conformance to requirements. The key criteria is the ability to fold each carton panel or feature, through a specific range of rotation, with





a predictable and a consistent degree of ***folding resistance***, and that key folds in the design have a sufficient degree of resiliency, or ***opening force***, to aid in the automated, high speed erection of each carton.

The ability to pre-determine and pre-set the most effective male and female converting tool parameters, and the experience to prepare or make the diecutting press ready to ensure creasing and folding performance meets the specified cartoning requirements is the key challenge this publication is designed to address. The premise of this guide is that current methods and practices are not nearly precise enough, nor are they predicated on a scientific or a practical approach to crease design and parameter selection, which would form the basis for generating the correct degree of folding and opening force. In practice, the current design of the steel rule die and the female creasing tool rapidly increase progressive wear of the counter or the matrix crease tool, gradually undermining the geometry of the crease formation process, which eliminates consistency and repeatability from the converting process.



This publication presents a radical, a practical, a logical, and proven method to set and to precisely control folding and opening force in carton and container manufacturing.

What is Creasing?

"Life is like a game of cards. The hand that is dealt to you represents determinism; the way you play it is freewill." *Jawaharlal Nehru*

Creasing is one of six Converting Disciplines, ***see top of next page, column 1,*** however, the reason it has taken so long to adopt change, is there is a poor understanding of how a crease is formed and how it works.

A crease is effectively a paperboard hinge, however, the

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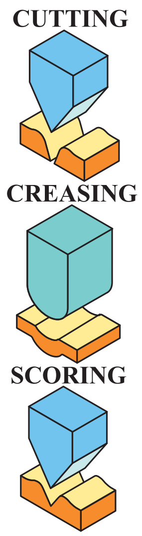
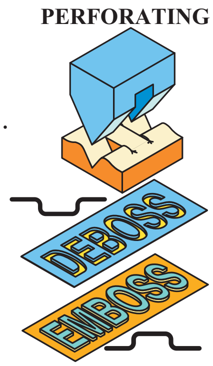
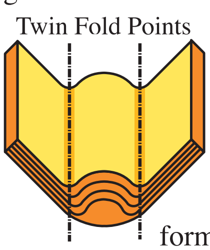
"Many ideas grow better when transplanted into another mind than in the one where they sprung up." Oliver Wendell Holmes



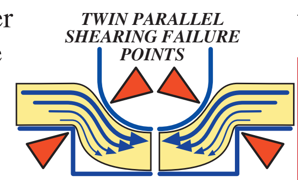
ability to create an effective fold point in paperboard requires generating a controlled failure in the material. The most important factor in creasing, is to understand that ***a crease is not a single fold but it is a double fold! See below left***.

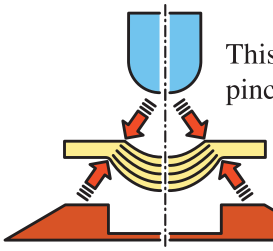


In practice, a crease is formed by twin, parallel shearing failures, ***see below right***, which are distanced to create a central deformation or bead, around which the two attached panels rotate. The greater the distance between the parallel failure lines, the greater the stress on the spine of the crease.

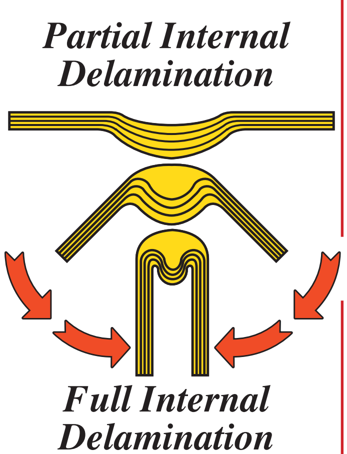


The material is sheared between matched lower corners of the female crease channel, and the upper faces of the male crease rule, which form the matching twin, shear points. ***See left***.

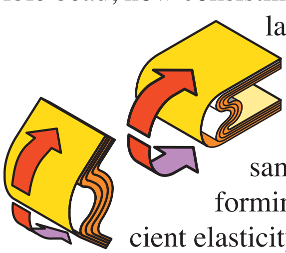


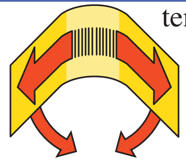


This combination of shearing and pinching causes the material to partially delaminate internally, however, it is when the panels are folded from zero to 90 degrees that the increase stress generated by the action of each lever, transforms the partial internal delamination into full internal delamination, and the crease/hinge is fully formed. ***See right***.



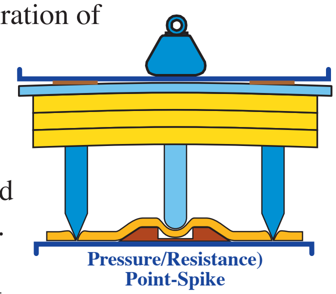
As the crease folds from 90 through 180 degrees, the inner surfaces of the panels move closer together, and the flexible bead, now consisting of layers of delaminated material, compresses laterally out of the way. ***See right***. At the same time, the thin layer of paperboard forming the spine of the crease has sufficient elasticity to stretch and to accommodate the

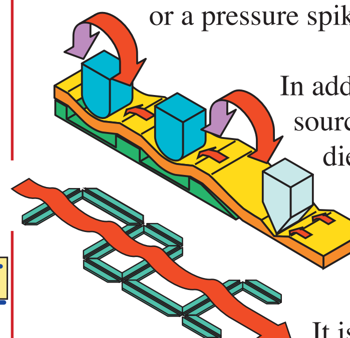




tensile stress generated by the folding action. ***See left***.

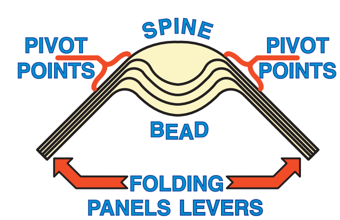
A crease/fold is a structural design feature, which is the key attribute enabling the formation of folding cartons and containers. However, it is important to recognize the generation of the crease imposes some key restraints on the diecutting process. To pinch and shear a material, pressure or compressive force must be generated between two opposing surfaces. Therefore, the formation of the crease creates a resistance point or a pressure spike in diecutting. ***See above***.





In addition, creasing is the primary source of tensile stress or draw in diecutting, and is the key force causing flaking, nick/tag failure and sheet break-up. ***See left***.

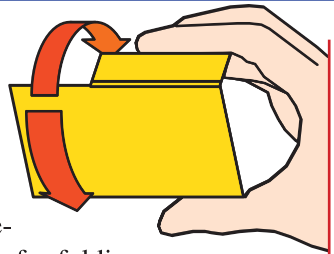
It is important to recognize that although the material in a crease is still one piece, the formation of the crease has created four distinct and important folding components. These are the Flexible Bead, Elastic Spine, Twin Crease Fold or Pivot Points, and the two attached Folding Panels of Levers. ***See right***. By manipulating the proportion and the interaction of these components, through a more effective selection of male and female tool parameters, the performance of the crease/fold can be precisely adjusted and controlled.



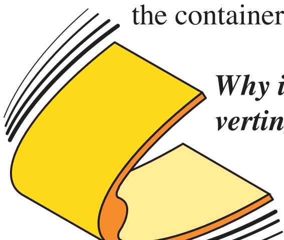
Why is Controlling Folding & Opening Force So Important?

"There is a great difference between knowing and understanding: you can know a lot about something and not really understand it." *Charles F. Kettering*

In the majority of folding carton or container manufacturing, generating a crease which will fold without the spine fracturing is considered a successful outcome. However, with more and more packaging requiring the automated insertion of the end product or contents into the container at high speed using a cartoning system, which is often designed for the specific folding box in use and for the specific application, the requirements for folding performance becomes a far more important issue.

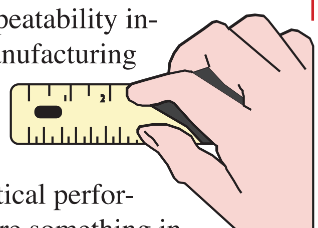


In practice this means some if not all of the creased panels must fold through 90 or 180 degrees with a specific degree of resistance, described as ***Folding Force***, and some of the folded panels must integrate a degree of ***Spring-Back or Opening Force***, which will aid in the section and filling of the container.

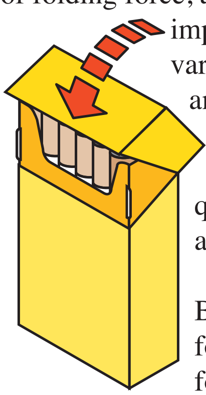


Why is this such a critical issue in converting cartons and containers?

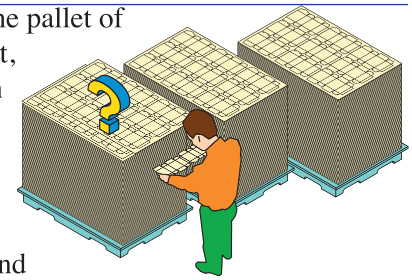
Many would consider a focus on a more precise converting process, designed to generate a creased paperboard carton or fluted container with a predictable and a consistent range of folding parameters, to be essential in meeting or exceeding customer packaging requirements. The professional converter recognize there is an unspoken commitment to consistency and repeatability inherent in the volume diecutting manufacturing process. They would assume that it is unreasonable to manufacture or supply a product in which the manufacturer failed to measure critical performance feature. If we fail to measure something in diecutting-manufacturing how do we know it is acceptable?



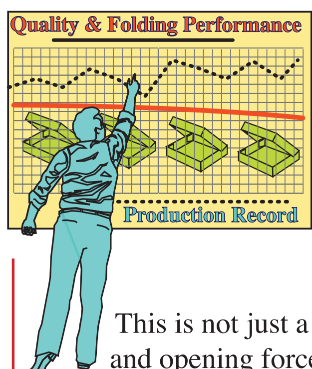
The challenge is cartoning and packaging equipment is designed and fabricated to accommodate a specific degree of folding force, and while it can be adjusted, it is obviously impossible to adjust for inconsistency and variation. The advantage of setting standards and measuring folding performance is it gradually expands the knowledge and the skill of the work teams, and improves the quality and the consistency of converting, and the speed and output of diecutting.



By contrast, if a specific benchmark/performance standard is not applied, fold force will inevitably vary from die station to die station, and from one pallet of diecut products to the next, throughout the production run. This also begs the question, who makes the decisions about folding acceptability and what criteria is used to assess and approve folding performance?



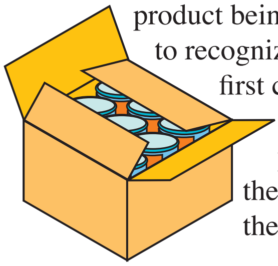
The advantage of setting performance standards and applying a procedurally consistent approach to designing and fabricating the male and female crease tools is it provides the designer, the diemaker, and the diecutter with feedback to enable them to adjust key tool parameters and achieve customer specified folding and opening force requirements.



The feedback of what happened, when compared to the goal will inevitably generate a data base of settings to enable precise conversion of each specific substrate, when using a specific structural design, to achieve a specific fold and open force outcome.

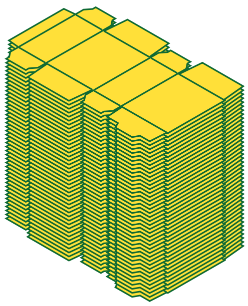
This is not just a benefit in terms of setting folding and opening force, but a greater understanding of what and how to adjust crease tool geometry will improve every aspect of creasing and folding an increasingly diverse range of paperboard and fluted material. The driving mission statement of all manufacturers is Safety-Speed-Quality-Cost, and while our current focus on quality is critical, so is the ability to improve diecutting productivity. By developing the ability to confidently pre-set and predetermine folding performance press down time, usually expended in making on-press adjustments to increase or decrease folding force, is eliminated.

Therefore, a key advantage of developing the skill and the experience to choose the most effective crease geometry to meet specific fold force standards is the ability to reduce waste of materials, waste of value added work-in-process, waste of resources, and waste of time. These benefits to the converting operation pale into insignificance when compared to the cost of cartoning waste, which includes the container and the



product being packaged! It is also important to recognize the productive impact on the first customer in the Customer-Supplier Chain, the gluing and finishing department, who have to contend with the inherent variability of the products they receive.

The primary reason why controlling folding and opening force is so important, is that is what we committed to when your organization took the order from the customer. You don't imagine your salesmen, when gaining approval for the submitted design, assured the customer that you would endeavour to make every carton different from every other carton in the order! The implication inherent to our process is we are selling a product, which will be identical in performance, to every other product supplied in that order!

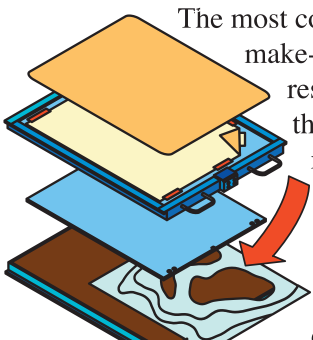


So how do we currently go about setting and controlling folding force?

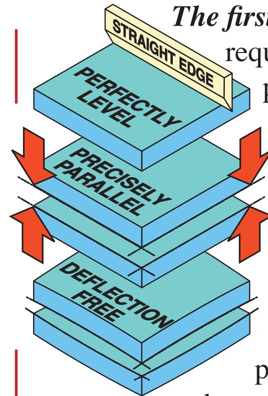
How is Folding Force Currently Controlled?

"We never stop investigating. We are never satisfied that we know enough to get by. Every question we answer leads on to another question. This has become the greatest survival trick of our species." *Desmond Morris*

The technical challenge in controlling folding and opening force in platen diecutting is overshadowed by the struggle to create a stable, balanced cutting make-ready, and then compounded by the difficulty of maintaining converting consistency throughout the production run.

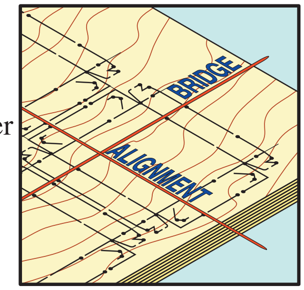


The most complex task in platen diecutting make-ready is attempting to balance resistance or pressure generated by the interaction between the steel rule die and the substrate being diecut. There are several key actions, which must be taken to minimize pressure variance in press make-ready and diecutting.

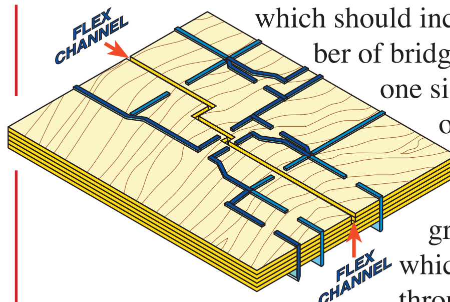


The first action is to calibrate the press, which requires mapping the press and creating a permanent metal underlay, which is inserted in the platen stack. ***See bottom of previous column***.

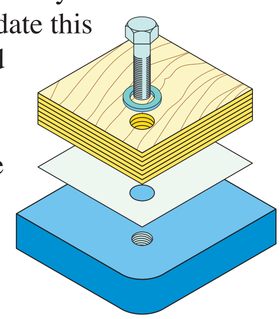
This proven technique is designed to compensate for normal variation in the flatness of the cutting and anvil surfaces; the common variation in the parallelism of the upper and lower platen; and the tendency for the platen to mechanically deflect under load. ***See above***.

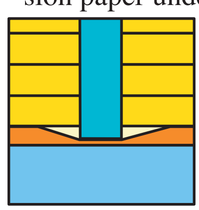


The second action is to Calibrate the Steel Rule Die. This technique is designed to minimize or eliminate dieboard warping, by using an effective, fully aligned bridging pattern, ***see above***, which should incorporate a higher number of bridges and alignment from one side of the dieboard to the other in several places.

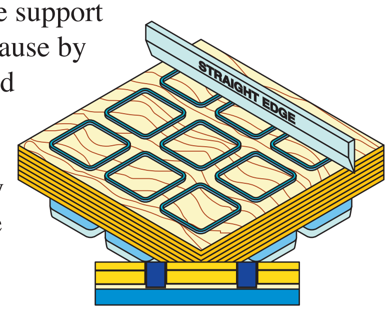


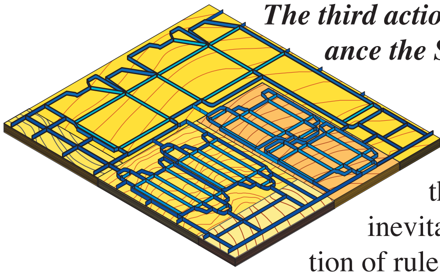
This is often integrated with flex channels, which are routed partially through the underside of the dieboard, to prevent warping caused by uneven moisture exposure. ***See above***. To consolidate this stable base or toolholder the dieboard is clamped to a calibrated precision diemaking ruling table during the entire ruling process, and this technique includes the insertion of thin protrusion paper under the dieboard. ***See right***.





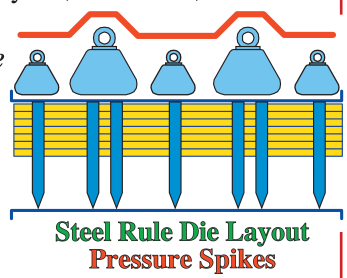
This important technique ensures every knife can make clean contact with the steel rule die support surface, because by protruding into the paper and past the bottom layer of the dieboard, ***see above***, every cutting edge is subsequently set or seated at precisely the same height. ***See right***.



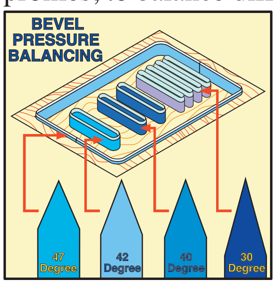


The third action is to Pressure Balance the Steel Rule Die.

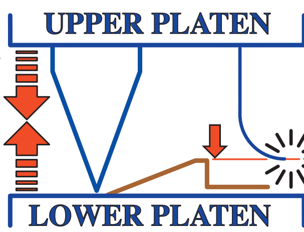
This technique is designed to minimize the impact of the often inevitable uneven distribution of rule in a design or a layout or a concentration of knife in a layout, ***see above***, which will cause high or low pressure/resistance areas across the die. ***See right***.



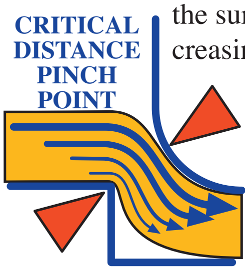
The technique for minimizing these pressure spikes is to mix and match knives with different bevel angles and different edge profiles, to balance different levels of resistance in the steel rule die. ***See left***.

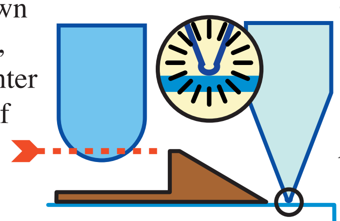


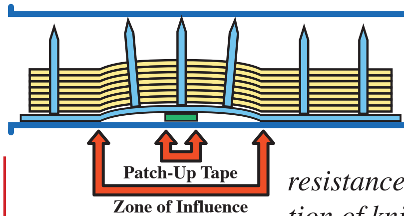
Unfortunately, as these techniques are rarely or effectively practiced, most press make-readies start the production run with an uneven distribution of pressure across the die, which translates to an uneven platen gap from one part of the die to another. So how does this normal pressure imbalance undermine the performance of the crease?



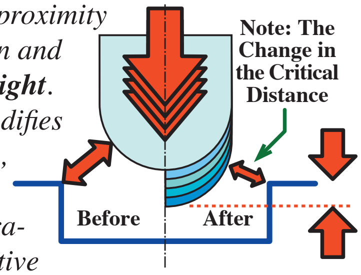
In the standard geometry for male and female crease tools, when the press is fully closed and the tip of each cutting knife is barely making kiss cut contact with the surface of the cutting plate, the tip of the creasing rule should be aligned with the plane formed by the upper surface of the female crease tool. ***See above***. This is very important because this setting establishes the ***Critical Distance in Creasing***, or the gap between the twin parallel strike surfaces, ***see left***, and if the crease should be forced down into the crease channel, ***see right***, and below the surface of the counter or matrix tool, the performance of the crease is significantly impaired.

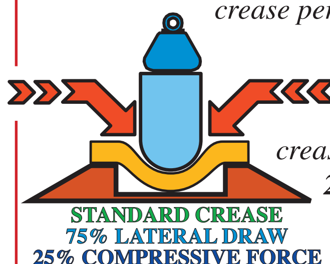




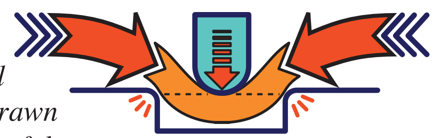


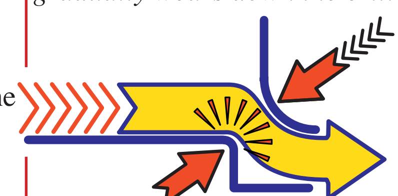
*Unfortunately, patching of the cutting rules to compensate for cutting edge compression damage or to overcome the resistance generated by a concentration of knives, is simply shimming or distorting the tool. **See above**. While this may solve cutting problems it causes close proximity crease rules to be driven down and into the crease channel. **See right**. This obviously changes or modifies the performance of the crease, However, this seemingly small change in crease penetration leads to two very destructive problems, which seriously compromise crease performance.*



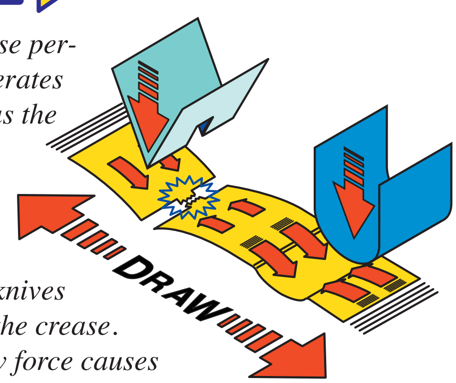


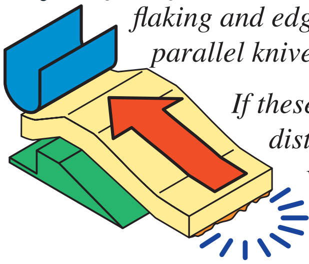
*For example, the standard crease set-up is designed to form a crease using **75% Lateral Draw and 25% Compressive Force. See left**. The major disadvantage of increased crease penetration into the female channel is the generation of excess levels of draw and tensile stress throughout the layout. **See right**. In addition, paperboard is a very abrasive material and as it is repeatedly drawn across the upper corner of the crease channel under considerable pressure, the abrasion gradually wears down the critical female crease shearing point, **see left**, impression by impression.*





*Unfortunately, the gradual increase in tensile stress not only destabilizes crease performance, it also generates more sheet break up as the excess draw fractures the nick/tags holding the diecut parts together, **see right**, particularly in those knives in close proximity to the crease. The same excess draw force causes*

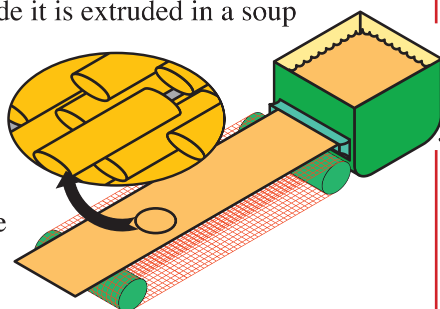




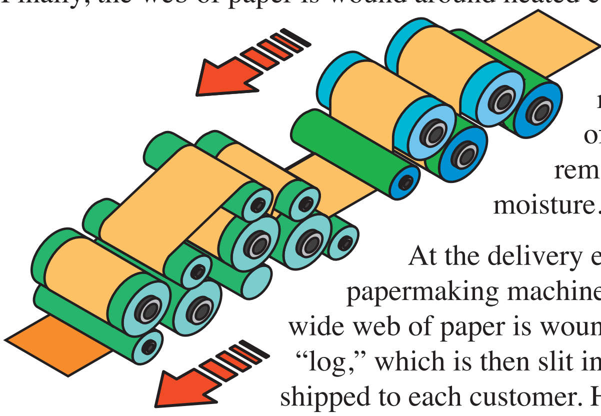
flaking and edge chipping on close proximity parallel knives. ***See left****.*

If these typical imbalances were evenly distributed throughout the layout it would be an issue to consider, however, with different amounts of pressure applied to different areas of the layout, it is obvious right from the beginning of the production run, that crease performance will vary from die station to die station.

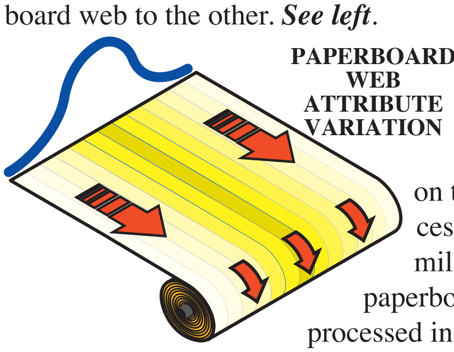
The fourth action is to Pressure Balance designed to stabilize converting is to Sequence the use of the paperboard. When paperboard is made it is extruded in a soup like stream of water and pulp from the head box onto a moving wire conveyor, which is designed to drain much of the water as it moves the pulp forward. ***See right***.



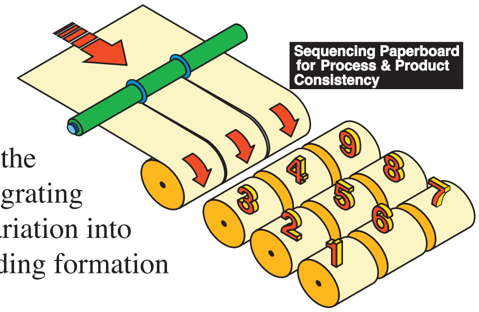
After the wire conveyor the Web of Paper is pressed between heavy cylinders, which consolidate the pulp and further squeeze out more water. Finally, the web of paper is wound around heated cylinders which evaporate much of the remaining moisture. ***See left***.



At the delivery end of the papermaking machine the very wide web of paper is wound into a "log," which is then slit into reels shipped to each customer. However, the key properties of every reel are not identical. Key attributes, such as caliper, moisture content, fiber loading and density will vary from one side of the paperboard web to the other. ***See left***.



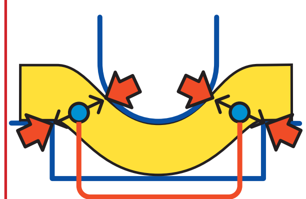
To minimize the impact of these inherent variables on the converting process, the paperboard mill recommends the paperboard reels are used and processed in a specific sequence. ***See right***. As this is rarely practiced in diecutting converting, even though it is recommended by the supplier, we are integrating another source of variation into the creasing and folding formation process.



Clearly as these four, critical recommendations are rarely consistently implemented, attempting to set and to sustain a specific degree of folding force and a specific degree of springback is extraordinarily difficult.

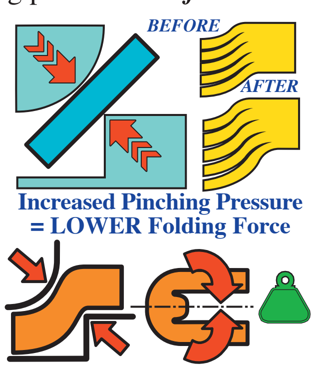
The question we face is: Given this set of circumstances, how do we change and control the degree of folding and opening force in specific creases?

As specified earlier in this section, folding force is controlled in creasing by adjusting the degree of internal delamination generated in the crease bead, the engine room of the crease. Internal delamination is adjusted by changing the degree of pinching force applies to the paperboard by the twin, parallel crease tool shearing points. ***See left***.

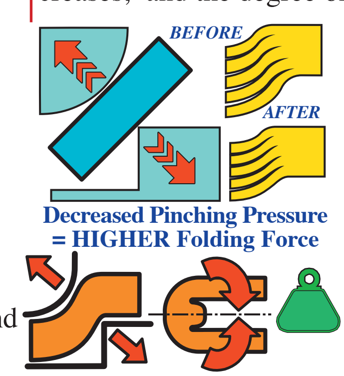


The ***Gap*** *between each* ***Parallel Shear Line*** *is called the* ***Critical Distance Spacing*** *& this parameter controls the overall performance of the* ***Bead.***

If the crease critical distance is reduced; the degree of pinching, shearing force increases; and the degree of internal delamination increases; and the force required to fold the crease is reduced. ***See right***.



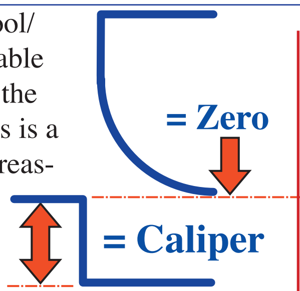
However, if the crease critical distance is increased; the degree of pinching, shearing force decreases; and the degree of internal delamination decreases; and the force required to fold the crease is increased. ***See left***.



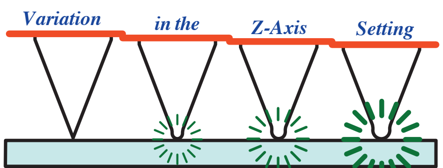
In most operations unfortunately the geometry of the male and female crease tool is based upon the traditional crease set-up, in which the tip of the male crease rule in the steel rule die is level with the plane formed by the up-

"Trust your own instinct. Your mistakes might as well be your own, instead of someone else's." Billy Wilder

per surface of the female creasing tool/ channel. ***See right***. Given the inevitable degree of variation in the Z-Axis of the die or the Platen Gap, ***see below***, this is a fundamentally flawed approach to creasing, never mind controlling folding and opening force.

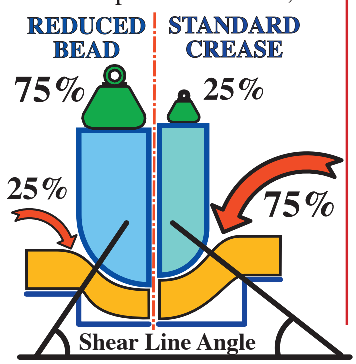


The alternative crease tool geometry system, the ***Reduced Bead Technique***, uses a fundamentally different approach to crease formation, which makes setting and sustaining precise control over folding and opening force much easier.



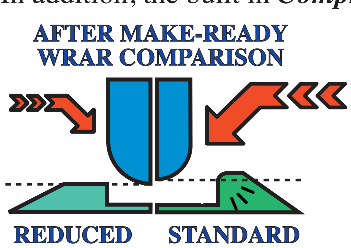
to Compensate for Progressive Knife Edge Damage

For example, Reduced Bead Creasing utilizes less than 25% Lateral Draw, and incorporates 75% Compressive Force, with the difference particularly significant when compared to the standard crease set-up. ***See right***.

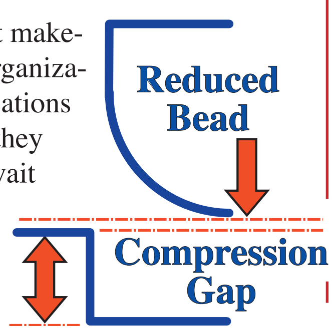


Naturally, the reduction in tensile stress or draw reduces abrasive wear on female channel strike surfaces, ***see below***, and it also reduces premature nick/tag failure and significantly lowers the incidents of flaking and edge chipping.

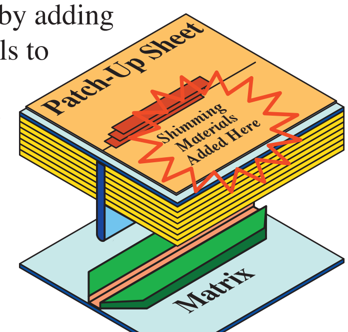
In addition, the built in ***Compression Gap***, ***see below***, is designed to reflect the inevitable variation in the distribution of pressure in platen make-ready, to virtually eliminate the destructive penetration of the crease rule into the female crease tool channel.



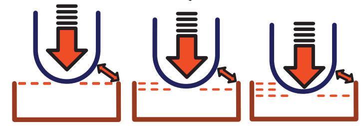
As a result of all of these inherent make-ready problems the majority of organizations make no changes or modifications to basic crease tool geometry, as they recognize it is more effective to wait until the press make-ready is complete, and the process is theoretically stabilized. Therefore, folding and opening force



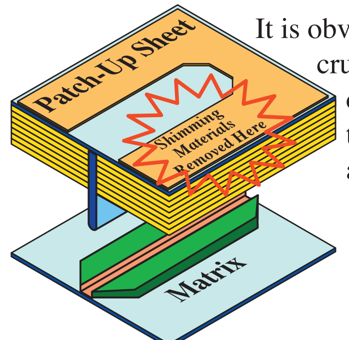
is generally adjusted on press by adding patch-up or shimming materials to individual creases, ***see right***, and/or by removing shimming materials from individual creases. ***See below***.



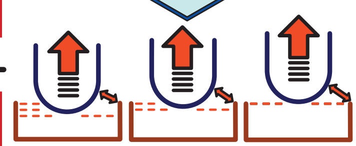
This approach to changing and/or controlling internal delamination of the crease bead is obviously fundamentally flawed, as the problems with diecutting stability, the struggle with consistency and the failure to generate repeatability in every platen diecutting production run are simply ignored.



Drive the Crease Rule Deeper Into the Channel and Increase Delamination Force



It is obvious current methods are crude and imprecise; they are costly in terms of material, time and resource waste; and they consistently fail to deliver the quality product we originally assured our client we were capable of delivering!



Pull the Crease Rule Out of the Channel to Decrease Delamination Force

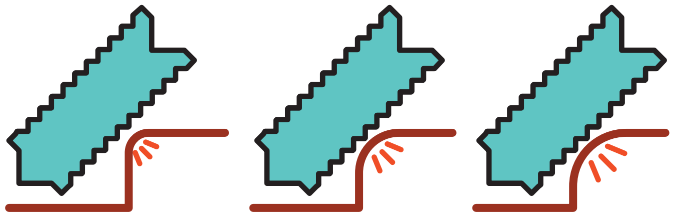
So what are the critical requirements in setting performance goals for folding and opening force?

What are the Requirements of Folding & Opening Force?

"It is only an error in judgement to make a mistake, but it shows infirmity of character to adhere to it when discovered." *Christian Bovee*

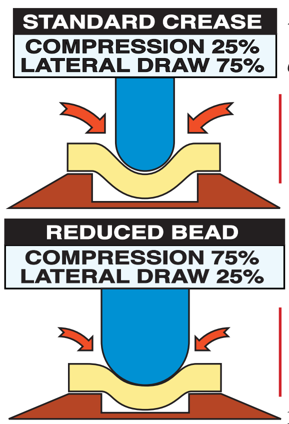
Of all the requirements in folding carton or container manufacturing the most critical is ***Consistency & Repeatability***. Even when this is not clearly discussed or expressly specified it is the inherent implication of any volume manufacturing process. It is difficult but not impossible to deal with a deviation from a standard, however, it is virtually impossible to deal with random variation from a standard.

The problem with attempting to guarantee consistency or repeatable performance standards is the traditional set-up for male-female tooling geometry in creasing generates variable results from the first impression. One of the key pinching surfaces progressively degrades as the production run progresses, and each impression forces the abrasive paperboard across the upper corner of the crease channel. ***See below***.



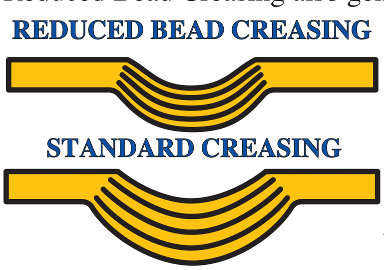
PROGRESSIVE ABRASIVE CHANNEL WEAR

Therefore, to minimize this form of progressive wear, the first choice to be made in ensuring consistent creasing and folding performance is to adopt the ***Reduced Bead Creasing Formula*** for determining all tooling parameters.

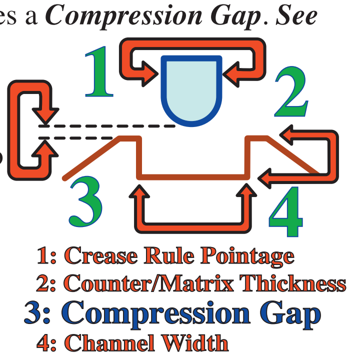


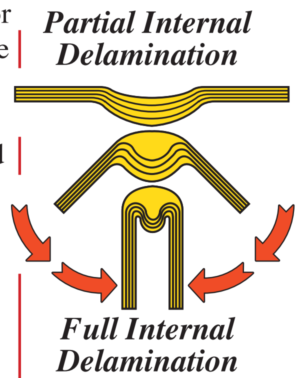
The reason Reduced Bead Creasing is more effective than the traditional alternative is Reduced Bead Creasing relies upon Compressive Force rather than Tensile Stress in the formation of the bead. ***See right***.

Reduced Bead Creasing also generates a proportionately smaller bead, which is more evenly delaminated, ***see left***, and a bead which folds with greater precision, and with the virtual elimination of spine fracturing.

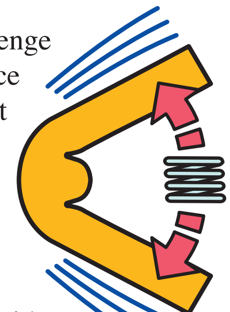


The reason this method of creasing is so wear resistant, apart from the reduction in lateral draw formation force, is the basic formula incorporates a ***Compression Gap***. ***See below***. ***The Compression Gap***, which increases as the caliper of the material being creased increases, is designed to absorb and to compensate for the inherent and often inevitable reduction in the platen gap caused by patch-up tool shimming during make-ready.

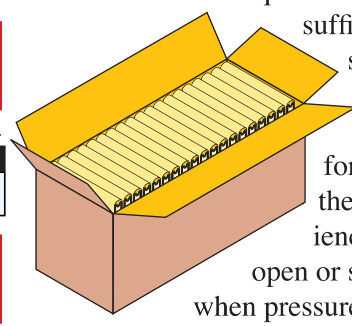


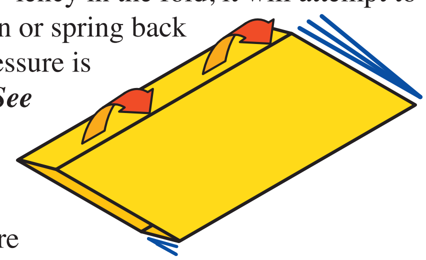


Therefore, using the Reduced Bead Parameters for the geometry of the male and female tooling in creasing results in a more effective and a more controlled fold, which has greater consistency and greater repeatability, and the tools last two to three times longer than when using the traditional tool set-up!

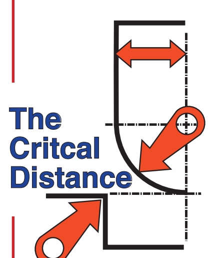


The second challenge in setting and sustaining fold & open force standards is in understanding the inherent conflict in setting two different folding characteristics in a single fold. The first requirement is to control the degree of resistance it takes to fold the panels through 90 and then 180 degrees. ***See above***. The second requirement, is to provide sufficient opening force, springback, or fluff, ***see above***, so that even after a carton has been packed under pressure for weeks or months, ***see left***, there is sufficient inherent resiliency in the fold, it will attempt to open or spring back when pressure is removed from the fold. ***See right***.

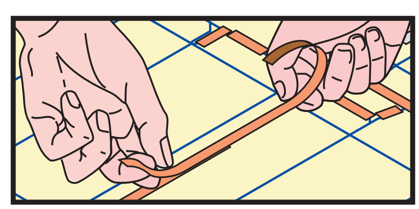




These folding and opening force requirements are illogical and difficult to achieve. First we have a system of creasing, which results in rapid abrasion of one of the two key pinch points in the ***Critical Distance***, ***see left***, and we add this instability to a diecutting system in which the platen gap is constantly being reduced by patching to compensate for progressive damage to the cutting edges of the steel rule knives. ***See below***.



Given this unstable crease formation platform it is not surprising achieving any degree of precision and repeatability in folding and opening force has always been a struggle.



The key problems of platen diecutting instability can be largely resolved by executing four important process actions. These are:

1: Pressure Balancing the Steel Rule Die

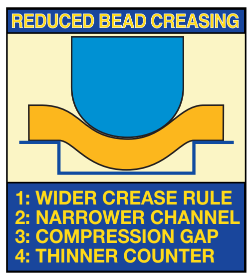
2: Pressure Leveling the Steel Rule Die

3: Calibrating the Steel Rule Die

4: Calibrating the Platen Diecutting Press.

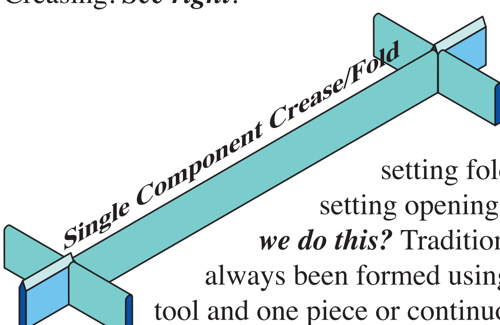
It would also be a great advantage to:

5: Correctly Sequence Paperboard Materials

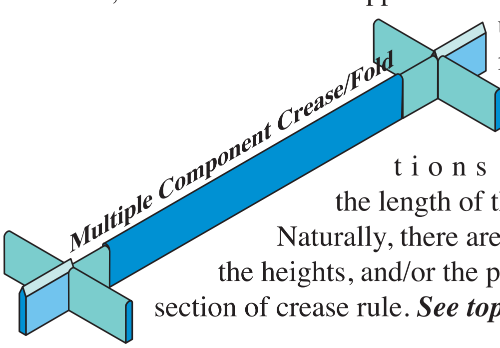


However, even when these profoundly important and extraordinarily simple changes are made it is vital to implement two disciplines to ensure optimal control of folding and opening force.

The first we have discussed, which is the implementation of Reduced Bead Creasing. ***See right***.

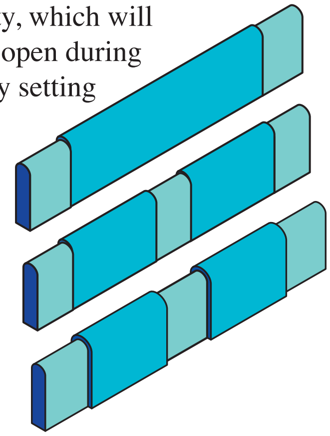


The second is to separate tool parameters for setting folding force and for setting opening force. ***How do we do this?*** Traditionally a crease has always been formed using a one piece male tool and one piece or continuous female tool. ***See left***.

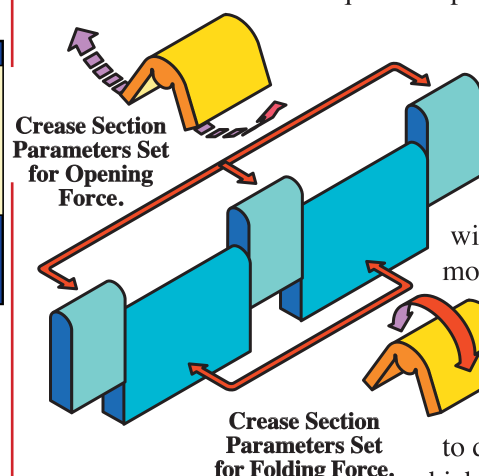


However, the more advanced approach to crease tool set up is to make the male crease rule in three sections or in five sections depending upon the length of the fold. ***See left***. Naturally, there are no limitations on the heights, and/or the pointages of each section of crease rule. ***See top of next column***.

Obviously, the longer sections of the crease are designed to set the resistance for the controlled failure of the material, which is the correct definition of a paperboard crease. And of course, the shorter sections of crease rule are designed to provide that essential flexibility, which will enable the panels to flex slightly open during cartoning erection. ***See below***. By setting up the crease/fold using separate tools within a single fold to generate the degree of folding force required and to generate the degree of springback required, we have gained control of a difficult process.

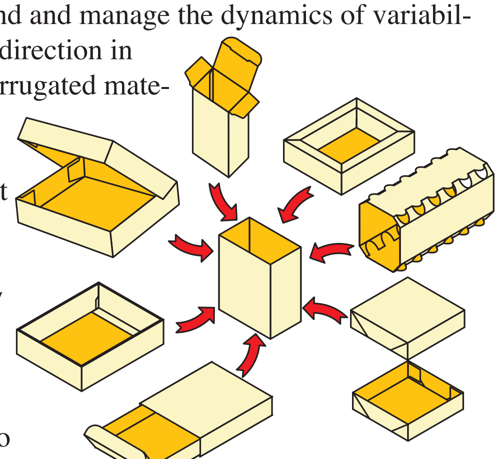


This technique is called ***Compound Creasing***, and it will be discussed in detail in subsequent chapters.



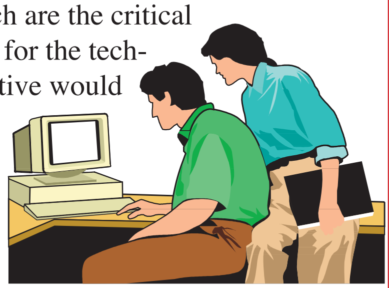
Getting back to the requirements of setting and controlling folding force and opening force, with the addition of a more stable and a more precise method of creasing, we can begin to measure the results, and to draw conclusions which will aid in building up a data base of tool parameters. It is absolutely critical to be able to learn from each production run and from each selection of tool parameters so that subsequent production set-ups can be more precise and more reliable.

This approach to creasing provides us with the ability to isolate and to adjust key tool parameters; to learn how paperboard and fluted material react to the formation of a hinge; to understand and manage the dynamics of variability and grain/flute direction in paperboard and corrugated material; the ability to learn how tools wear, how to select the most wear resistant settings and when and how to make changes; the ability to accurately predict performance and to pre-prepare the correct



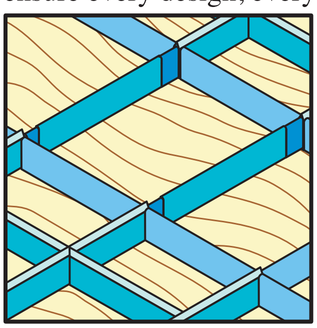
set-up; and most important of all, the ability to meet and to exceed customer cartoning requirements.

To aid in an education element of this initiative it is a great advantage to have a video of the packing line to show the CAD Designer, the Diemaker, and the Diecutter how the packaging line works and the specifics of the challenge they must overcome. In addition, the knowledge of how the carton folds and erects, how the sequence of folding and assembly happens, and which are the critical fold is essential information for the technical team. Even more effective would be a visit to the end user to see the cartoning line in action. However...



To help in accurate feedback, those companies who have the greatest success in managing the control of folding and opening force are those companies who have a fold and open force measuring device on the press during the make-ready and production phase of the specific job.

Essentially manufacturing is continuous research, and by setting up a more bullet proof system of male and female crease tooling, which can be individually adjusted, this will ensure every design, every paperboard, and every converting cycle, will add to a body of knowledge, and enable the work team to more precisely and more consistently control folding and opening force in carton and in container manufacturing.

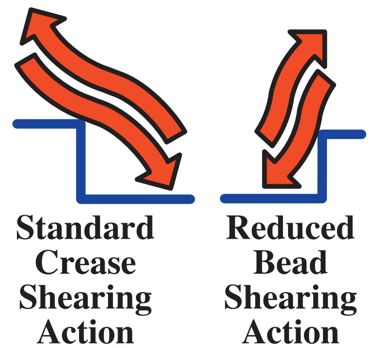


Let us examine the technique of Compound Creasing.

What is the Compound Crease Technique?

"Things which come to us easily have no significance. The satisfaction we get in life comes when we do something which is difficult; when there is sacrifice involved." *Barry Goldwater*

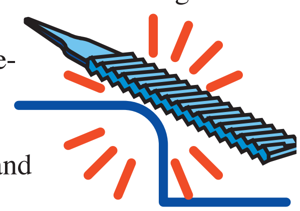
As we have seen from earlier sections, the standard crease formula which defines the geometry and the relationship between the male crease rule and the female counter or matrix channel, relies primarily on lateral draw to form the crease/bead. However when considering this key formation force it is important to note the difference in the shearing angle between standard creasing and Reduced Bead Creasing. ***See right***.



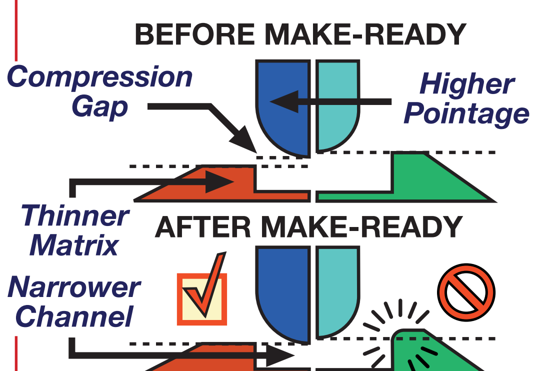
This formation dynamic creates a major problem for setting, controlling and adjusting folding and opening force. The key problem is stability.

Because the excessive use of lateral tensile stress in stretching the paperboard toward and into the female crease channel, the key upper channel strike points of the female tool, ***see below***, are subjected to a combination of pressure and abrasion, which progressively changes the Critical Distance as the paperboard or fluted material literally file the channel material away. ***See below right***.

In practice this means the geometry of the crease is changing from impression to impression, and while the change from one sheet to the next is only slight, the change from load to load, and from the start to the end of the production run is significant.

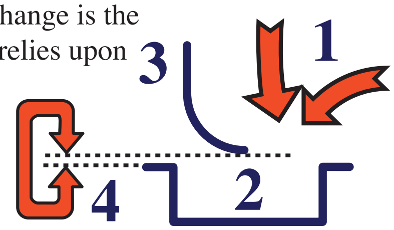


The standard setting, particularly because make-ready and production shimming of the cutting knives, drives the male crease rule deeper and deeper into the channel, is not a viable choice when controlling crease folding performance, and consistency is critical. ***See below left***. Naturally, this is another variable , which is constantly changing the critical distance and the degree of force with which the crease folds.



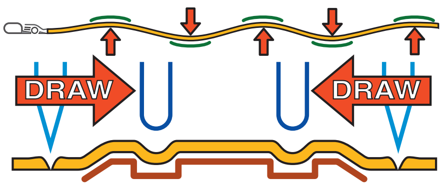
Therefore, the most important first step in implementing the Compound Crease Technique is to eliminate the use of the Standard Crease Formula, and adopt the Reduced Bead Formula.

The main reason for this change is the standard crease geometry relies upon lateral force, while the Reduced Bead geometry relies upon compressive force, and the formula includes a compression gap to compensate for knife/tool shimming. ***See right***.

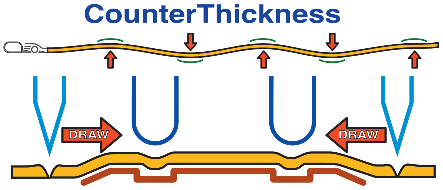


1: Compression rather than Lateral Force
2: A Narrower Crease Channel
3: A Wider Crease Rule
4: A Tool-to-Tool Compression Gap

It should also be noted that one of the important sources of lateral tensile stress of draw in diecutting and in creasing is the necessity to stretch and deform the paperboard or fluted material around the ***"protruding"*** counter or matrix strips.

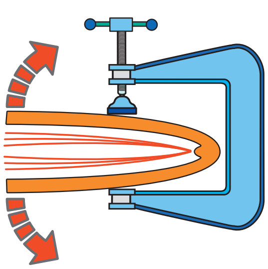


Standard Creasing & CounterThickness

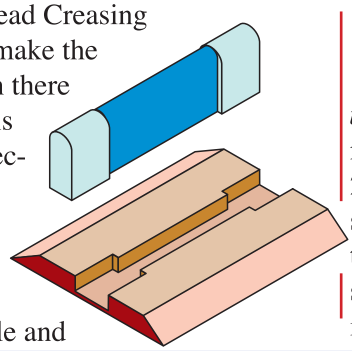


Reduced Bead Creasing & Thinner Counter

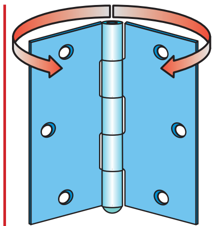
While both standard creasing and reduced bead creasing utilize ***"protruding"*** counters or matrix strips, the fact that the Reduced Bead Female Tool is much thinner than the Standard Crease Female Tool, ***see above***, is another critical factor in adopting Reduced Bead for this application.



It is difficult if near impossible to consistently generate a precise controlled failure/paperboard hinge, which will accurately balance the conflicting needs of folding force and springback or opening force. ***See left***. This is particularly difficult when using a system of traditional crease set-up, which is inherently unstable and unpredictable. Even adopting the more stable and more repeatable Reduced Bead Creasing method, it makes little sense to make the task complex and difficult, when there is a practical alternative, which is simple, straightforward, and effective. ***See right***.

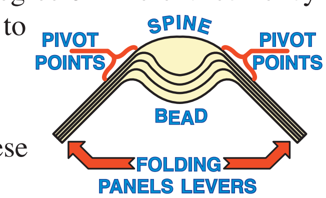


In a previous section we defined compound creasing as the technique of segmenting the male and female tooling for a single fold, ***see left***, to enable each individual section of male and female tooling, to be set-up to deliver different crease formation and folding properties.



Before considering Compound Creasing it is important to understand how the degree of folding force and springback force is adjusted and controlled in paperboard creasing.

How do we adjust the resistance of a paperboard to folding, and how do we control the degree of inherent resiliency which causes the folded material to springback open?

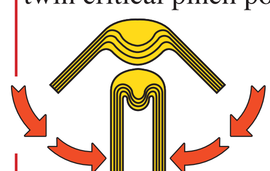


A paperboard crease consists of four components. ***See above***. These components are:

- ***Twin Folding Panels/Levers***
- ***Twin Pivot Points***
- ***Crease Spine***
- ***Crease Bead***

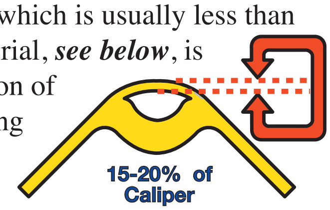
The interaction between the male rule and the female channel generates twin parallel shear lines in the material, and the lateral shearing action between the offset shear points, ***see above***, creates a protrusion of paperboard in the channel, forming a bead of material. The bead of paperboard is not a solid welt of material as the shearing action, at the critical distance pinch points, creates partial internal delamination of the bead. ***See above right***. The stress generated in the material by being trapped and sheared between the twin critical pinch points causes the bead to partially separate into internal layers of material.

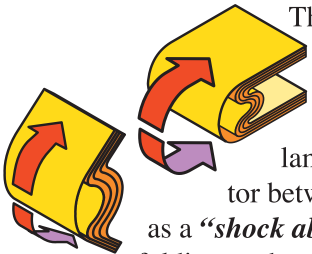
Partial Internal Delamination



Full Internal Delamination

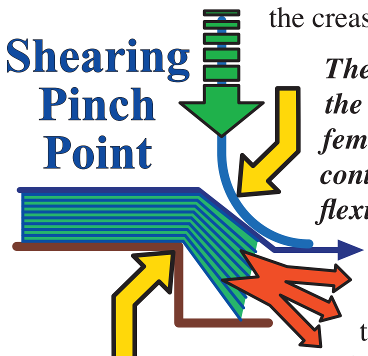
This is called ***partial internal delamination*** because it requires the leverage of the folding panels as they are folded through 90 and then 180 degrees to ***convert the partial internal delamination into full internal delamination. See above***. Simultaneously, the spine of the crease, which is usually less than 20% of the thickness of the material, ***see below***, is stretching around the outer portion of the folded panels, and is absorbing some more of the stress of folding.





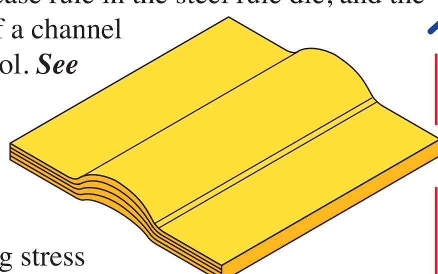
The bead is often referred to as the ***"engine room"*** of the crease as it is critical to the success of the folding action. An effectively delaminated bead is a flexible connector between the folded panels and it acts as a ***"shock absorber"*** to absorb the stress of folding as the panels are rotated. ***See above left***.

It is the ***"degree"*** of flexibility, which controls the amount of force required to fold the attached panels. If the bead is highly flexible the force required to fold the panels is lower, and the degree of spingback is much lower. If the bead is less flexible the force required to fold the panels is higher, and the degree of springback is correspondingly higher. Flexibility in a crease bead is directly proportionate to the degree of partial and full internal delamination generated by the crease formation process.

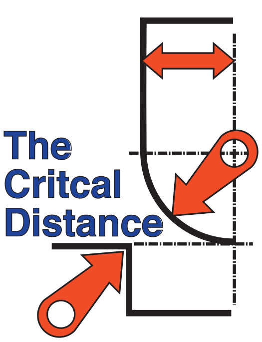


Therefore, how do we adjust the geometry of the male and female tooling to adjust and control bead delamination and flexibility?

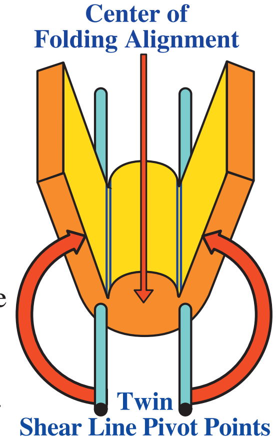
A crease is generated through a controlled internal failure of the paperboard enabling the material to hinge and fold at a specific point. The controlled failure is achieved by pinching and shearing the material between matching upper and lower tool surfaces. These surfaces are the twin faces of the crease rule in the steel rule die, and the parallel upper corners of a channel formed in the female tool. ***See above***.



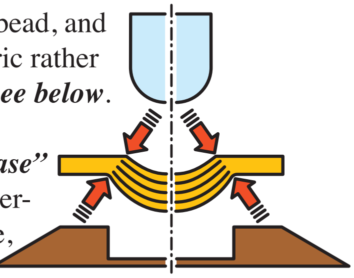
When the material is simultaneously pinched and laterally sheared in this manner, the resulting stress causes the material to partially delaminate and form a raised bead of flexible material. ***See above***. The degree of pinching force required to achieve a specific reduction in the stiffness of the material, is related to the distance between these surfaces. This is referred to as the ***Critical Distance*** in creasing. ***See left***.



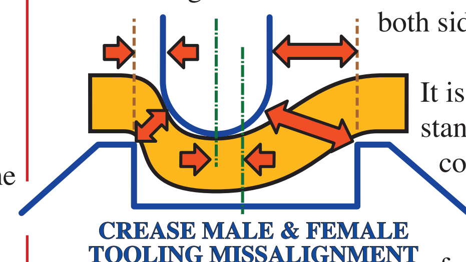
It is important to note that the action of creasing a paperboard in this manner creates twin parallel lines of shearing, and it is around those shear failure points that the attached panel rotates. ***See right***. In other words, although the crease is generally regarded as a single fold, it is in fact a combination of two parallel folds, which pivot on each side of the central bead. ***See below***.



The reason this is important in creasing is it is critical to ensure the tools are properly aligned, ***see below***, so that the pinching /shearing force is balanced on both sides of central bead, and the resulting crease is symmetric rather than asymmetrically formed. ***See below***.

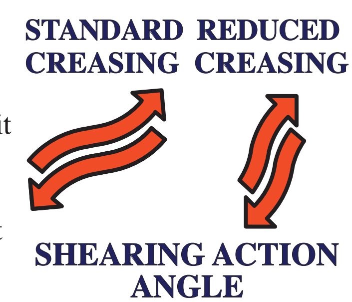


Although the ***"One-Sided Crease"*** shown in the illustration is generally regarded as a disadvantage, there are situations when it is an advantage to set different levels of pinching force on both sides of a crease.

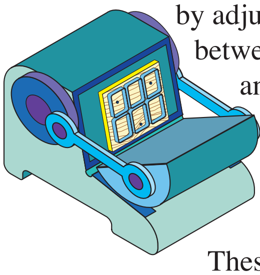


It is important to note that standard creasing uses a combination of vertical compressive force and lateral shearing force to form the crease, and the primary difference between standard creasing tool geometry and reduced bead creasing tool geometry is the angle at which these forces are applied. ***See below***.

In terms of the goal of setting Fold Force Pressure or Resistance, and setting Opening Force Resiliency or Springback it should be obvious that the greater the degree of internal bead delamination, the easier it is to fold and the lower the degree of internal bead delamination, the more difficult it will be to fold and/or the fold will have greater resistance. Therefore, the goal is to adjust different parts of a single fold to have different attributes.



The greater lengths of the crease should be set to fold with a specific degree of resistance and the shorter lengths of the crease should be set to deliver a specific degree of resilient opening force.

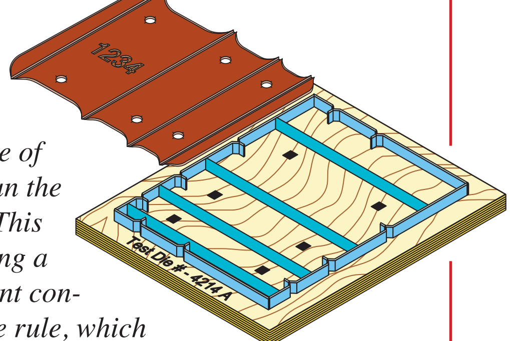


The bottom line is the degree of internal bead delamination, and therefore, the degree of folding flexibility, is controlled by adjusting the Critical Distance or the gap between the upper steel rule die crease rule and the lower creasing channel upper corners, when the press is fully closed on impression. The Critical Distance can be adjusted using and/or combining the following four techniques. These four methods are as follows:

Crease Height Adjustment

Crease Height Adjustment: ***Overview***

It is obviously more effective and efficient to conduct testing off press, using standardized test dies, and a clam shell platen diecutter. ***See above****.*



However, many feel it is more effective to conduct this type of testing on the type of machine that will run the production orders. This is accomplished using a test die, with different configurations of crease rule, which are matched with female fiberglass counters. ***See above right****.*

This is usually completed at the end of a production run, using the paperboard from the current job to complete the test on the specific paperboard being converted. However, this should not preclude other paperboards being tested while the set-up is on-press.

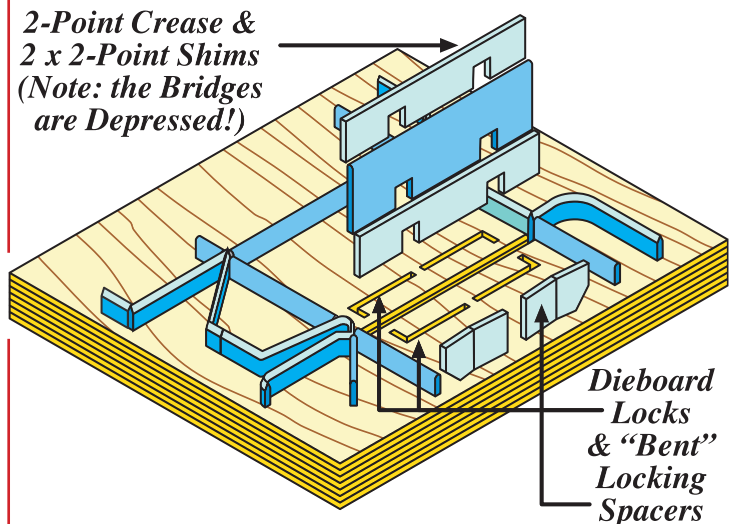
An added benefit to this approach is the paperboard is being tested after printing and graphic processing, which is obviously a more realistic test of the performance of closing and opening force.

The last, and most time consuming option is to prepare the dieboard for changes in crease rule, and prepare the matching fiberglass counters/matrix, and to conduct the testing and selection of tool parameters as a part of the normal make-ready process.

Crease Height Adjustment: ***Advantages***

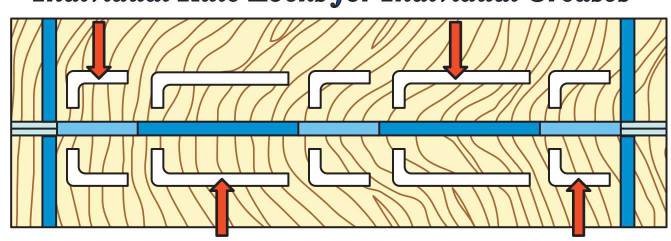
The advantages are as follows:

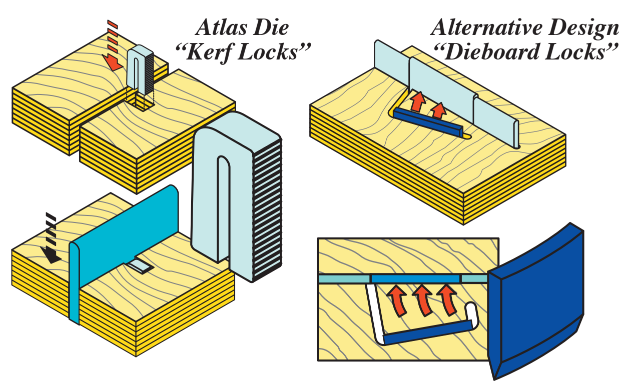
- ☑ *Changeover Simplicity - when combined with dieboard locks or kerf locks, removing and replacing a rule is not difficult.* ***See below****.*



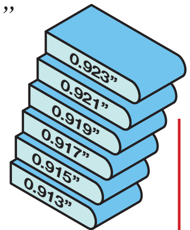
- ☑ *Changeover Speed - when combined with dieboard locks or kerf locks removing and replacing a rule is fast and straightforward.* ***See below****.*

Individual Rule Locks for Individual Creases





- ☑ *Changeover Accuracy - because there are multiple heights of creasing rule commercially available it is* *not difficult to make adjustments in 0.001" increments.* ***See right.***

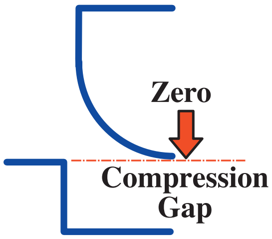


☑ *Tool Rigidity - the steel rule provides a hard and wear resistance strike surface as one half of the Critical Distance.*

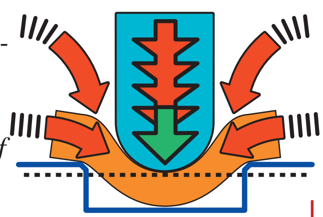
Crease Height Adjustment: ***Disadvantages***

The disadvantages are as follows:

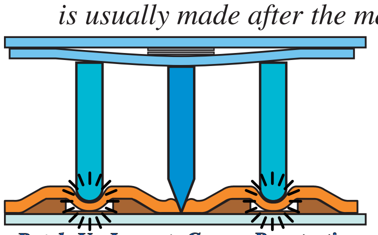
☒ *Reducing the Compression Gap - if the compression gap is reduced or even eliminated there is no flexibility for inherent changes in the Z-Axis in response to cutting variation.* ***See left.***



☒ *Generating Crease Penetration - if there is no Compressional Gap or the adjustment in height of the crease is greater than the gap, then the tip of the crease will protrude below the plane formed by the surface of the female crease tool. This results in excess draw and tensile stress, in rapid upper corner wear of the channel, and it results in higher incidents of sheet break-up.* ***See right.***



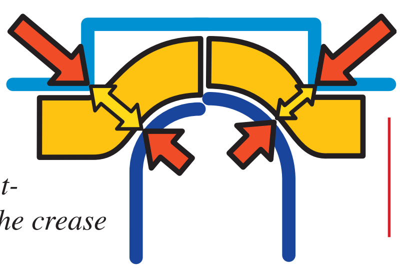
☒ *Increase Pressure/Resistance - as the adjustment is usually made after the make-ready is complete, any change in the height of the crease rule will temporarily increase resistance and generate a pressure spike where the crease is inserted.* ***See left.***


Patch-Up Impacts Crease Penetration

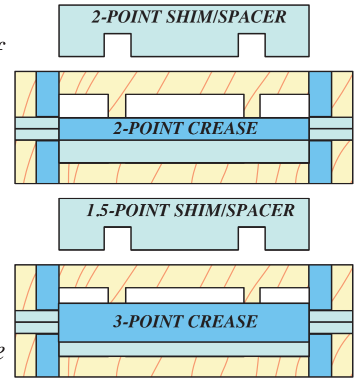
☒ *Lost Press Time - while this is not a technical issue, the time the press is not producing as the crease rules are changed is a logistical and cost factor which must be considered.*

Crease Height Adjustment: ***Technical Options***

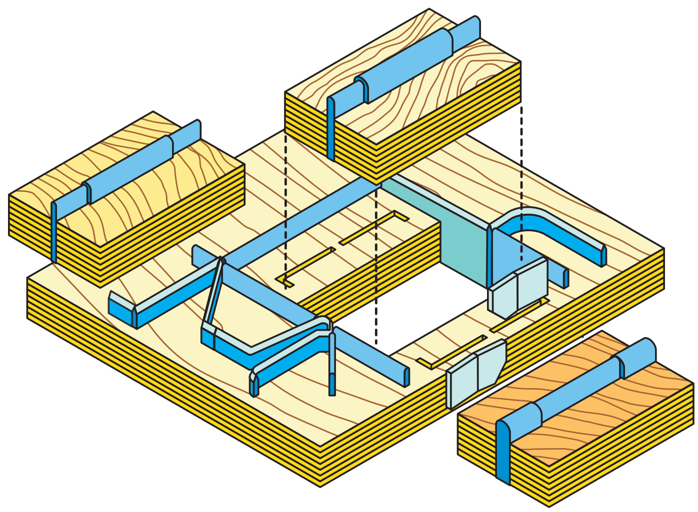
In the Crease Height Adjustment the height of the crease rule in the steel rule die is either increased or decreased depending upon the change to the Critical Distance required. ***See right.***



In practice this is straightforward. Particularly if the crease rule is held in position by Dieboard Locks, or by Kerf Locks. ***See illustrations on previous page.*** *The locks are released/removed and a higher or lower crease reinserted into the kerf channel and the locks are re-engaged.*



It is also possible to change both the crease rule height and the pointage of the rule being inserted. Naturally, this would have to be pre-planned and pre-prepared for a higher width of kerf channel. This can be as simple as removing shims to insert a higher pointage crease rule or inserting shims to move to a lower pointage rule. ***See above.*** *It is also obvious this would be simpler if there were no bridges in the crease rule to be changed, but this is often not a viable option.*



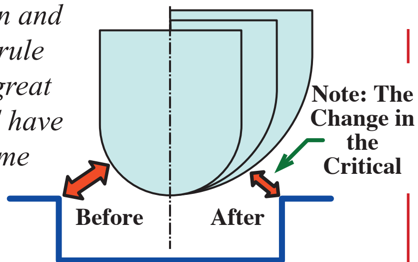
It is an advantage to prepare replacement blocks, which include different pointages of kerf channel. In this scenario the entire block is removed, and replaced with a block with either higher pointage, or higher rule height, and/or a combination of both. ***See above.***

It is obviously critical to record all of the tooling changes and the resulting impact on folding and opening force.

Crease Height Adjustment: ***Summary***

Adjusting the height of the crease rule is an effective technical option in regulating folding and opening force in folding, however, if there is insufficient Compression Gap or the crease rule protrudes below the surface of the female tool, the advantages are lost in resulting converting instability.

In practice the precision and the flexibility of crease rule height adjustment is a great advantage, but it would have to be combined with some of the other technical options to provide maximum benefit.



Crease Pointage Adjustment

Crease Pointage Adjustment: ***Overview***

Crease height adjustment is a very effective method of reducing or increasing the critical distance, ***see above****, as it does so without increasing the degree of penetration of the tip of the crease toward and into the female channel.*

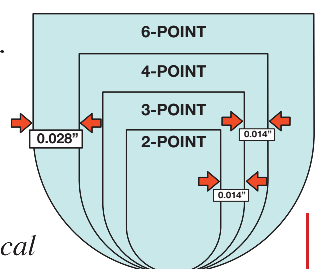
However, this method does require some pre-preparation of the dieboard to accept the thicker or thinner crease rule, and there is obviously non-productive on-press time expended in making the changes.

Crease Pointage Adjustment: ***Advantages***

The advantages are as follows:

☑ *This technique reduces the Critical Distance without increasing tensile stress or by generating and increase in Draw Forces.*

☑ *This technique reduces the Critical Distance without significantly increasing abrasive wear of the upper corners of the female channel.*



☑ *This technique reduces the Critical Distance by changing from a Lateral Crease Formation Shearing Action to a Vertical Crease Formation Shearing Action.*

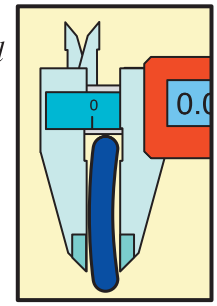
☑ *This technique is relatively simple to execute.*

Crease Pointage Adjustment: ***Disadvantages***

The disadvantages are as follows:

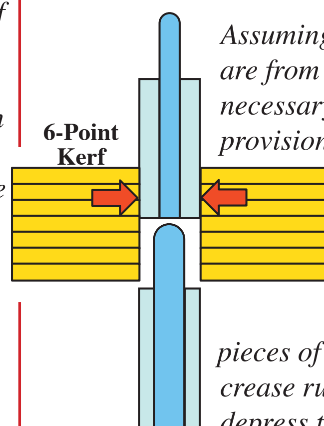
☒ *There are severe technical restraints in the degree to which the Critical Distance can be altered in this manner. For example there is a gap of 0.014" between 2, 3, and 4-point, and there is a gap of 0.028" between 4-point and 6-point.* ***See above****.*

☒ *There are potential variables introduced using this method as the practice of substituting 3-on-2, and 4-on-2, introduces the problem os crease profile consistency and centrality, and the added challenge of rule dish.* ***See right****.*



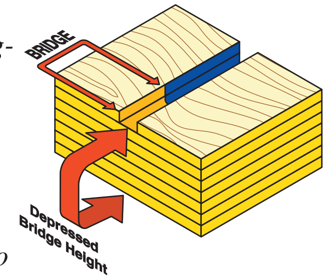
☒ *Although the method does not increase penetration travel distance of the tip of the crease rule toward and into the female channel, and reduction in the critical distance will increase the resistance of the formation of the crease and cause a minor pressure spike around the changed crease rule.*

Crease Pointage Adjustment: ***Technical Options***



Assuming the range of crease rule options are from 2-point to 6-point it is obviously necessary to machine the kerf to include the provision of 2-point spacers on both sides of the original 2-point crease, or 1.5-point spacers on either side of the 3-point crease. ***See left****.*

To avoid having many separate pieces of spacing rule/shims, because of the crease rule bridge pattern, it is useful to depress the bridges, ***see below****, which will allow the spacing rule to be bridged also.*



Although depressing the bridges has reduced the problem of using three pieces of shims to lock the crease rule into position, it is an advantage to integrate Dieboard Locks, on both sides of the crease rule to tension and lock the shims and the crease rule into position. ***See page 13, column two****.*

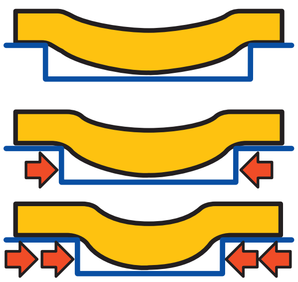
Crease Pointage Adjustment: ***Summary***

Adjusting the pointage of the crease to reduce the Critical Distance is an effective technical option, but because there are limited pointages of crease rule, with a considerable thickness gap between each size, the use of this method is rather limited.

Channel Width Adjustment

Channel Width Adjustment: ***Overview***

The Channel Width Adjustment is the most effective method of increasing or decreasing the Critical Dis-



tance, because it also controls the proportion and the delamination of the crease bead. ***See left****.*

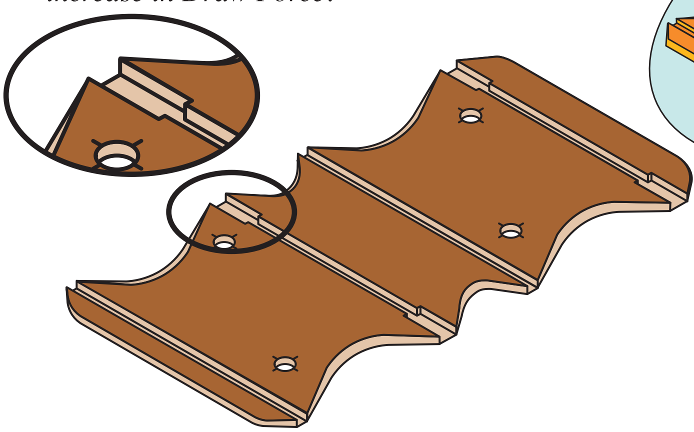
This is important both in terms of being able to generate the smallest bead for the material with the greatest degree of flexibility, which translates into ease or low resistance to folding; compared to the ability to generate a wider, proportionately larger bead, with lower flexibility, but higher resistance to folding.

The Channel Width Adjustment provides the greatest degree of precision when it is combined with the fiberglass counter, as the channel width can be increased and/or decreased in minute, precise increments.

Channel Width Adjustment: ***Advantages***

The advantages are as follows:

☑ *This technique changes the Critical Distance without increasing tensile stress or by generating an increase in Draw Force.*



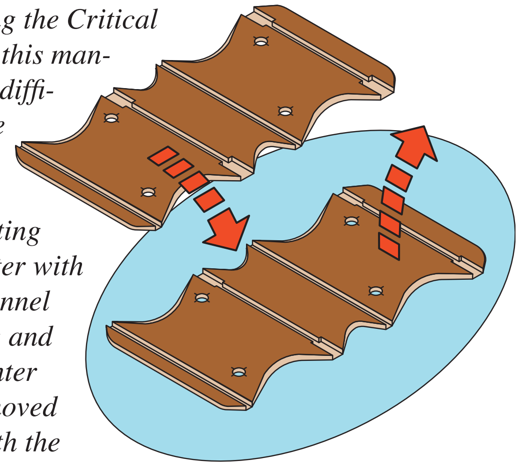
☑ *This technique changes the Critical Distance precisely because it has the greatest degree of adjustment flexibility compared to the other methods.*

☑ *This technique changes the Critical Distance and it controls the proportion and the delamination of the crease bead, which is the most effective method of controlling folding and opening force.*

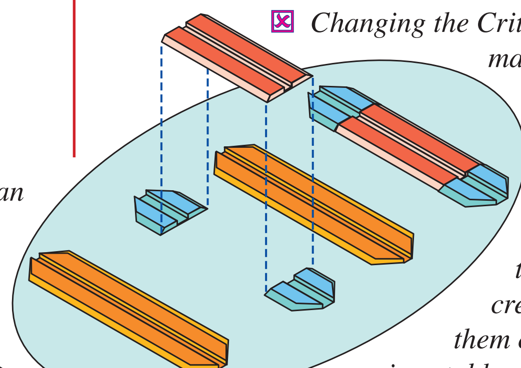
Channel Width Adjustment: ***Disadvantages***

The disadvantages are as follows:

☒ *Changing the Critical Distance in this manner is more difficult because it requires the design and machining of a multi-width channel fiberglass counter.* ***See above****.*



☒ *Changing the Critical Distance in this manner is more difficult because it requires designing and fabricating a new counter with the new channel dimensions; and the old counter must be removed on-press with the new counter transferred into position to replace it.* ***See above****.*



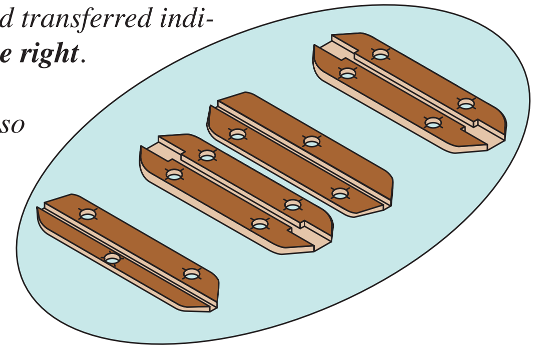
☒ *Changing the Critical Distance in this manner is more difficult because it requires combining several individual and different widths of Matrix Strip, positioning them accurately on the crease rule, transferring them on-press, and generating stable creasing throughout the production run.* ***See left****.*

☒ *Changing the Critical Distance in this manner using Matrix is more difficult because there are limited numbers of channel widths and of matrix heights.*

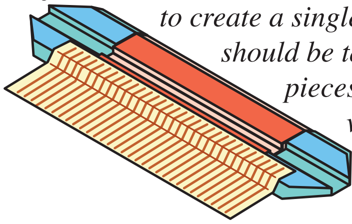
Channel Width Adjustment: ***Technical Options***

The most effective option for this using channel width adjustment is to machine a complete fiberglass counter, with the different widths of channel machined for the key folds to be controlled. ***See left, column one.***

An effective alternative is to machine individual crease sections, which contain the multi-width channel, and are removed and transferred individually. ***See right****.*



Matrix is also a solution, however, once the individual pieces are transferred



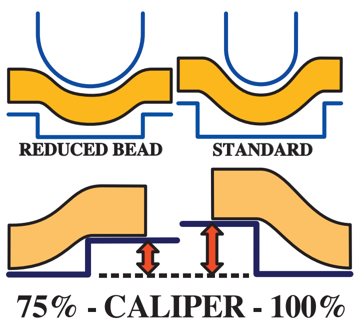
*to create a single multi-width fold, the edges should be taped to prevent the short pieces of matrix moving during converting and production. This will protect the stability of the three pieces, and prevent them being **"drawn"** out of register with the crease rule. **See left.***

*Channel Width Adjustment: **Summary***

While this is certainly the most effective technical option for precisely controlling the Critical Distance, it requires significant preparation to enable simple changeover from one set of crease parameters to the next.

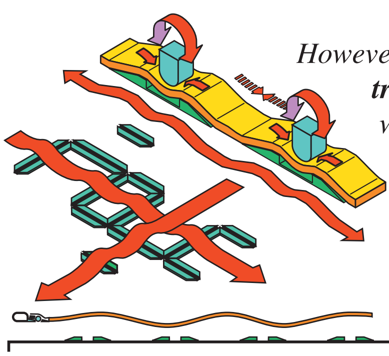
Obviously, this is a technique which is best perfected in testing, so the need to change and experiment with different crease parameters is eliminated from production orders.

Channel Height Adjustment



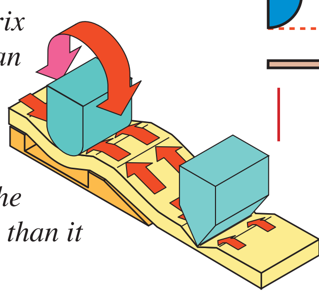
*Channel Height Adjustment: **Overview***

*In traditional creasing methods the thickness of the female tool is set to the caliper of the paperboard being creased, however, when using the Reduced Bead Technique, the thickness of the female tool is a proportion of the caliper of the paperboard being creased. **See above**.*



*However, both methods are **"Protruding Tools"**, **see left**, which simply means the material being creased must be deformed and stretched around the female tool sitting on the surface of the cutting plate. **See below**.*

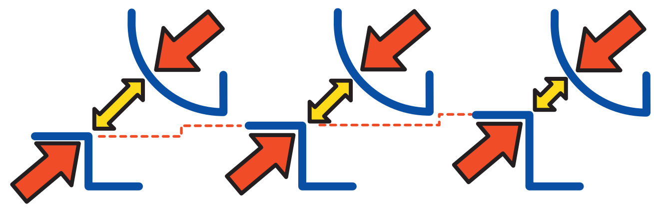
Reducing the thickness of the Matrix or the Counter is therefor always an advantage, as it reduces lateral draw and tensile stress in platen diecutting. In crease formation, any increase in thickness of the female tool creates more problems than it solves.



*Channel Height Adjustment: **Advantages***

The disadvantages are as follows:

☑ *Changing the height of the female tool channel is an effective method of changing the Critical Distance. **See below**.*

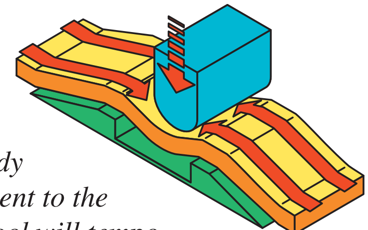


Adjusting the Critical Distance

*Channel Height Adjustment: **Disadvantages***

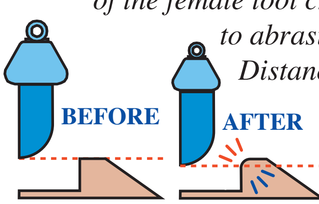
☒ *Reducing the Compression Gap - if the compression gap is reduced or even eliminated there is no flexibility for inherent changes in the Z-Axis in response to cutting variation.*

☒ *Generating Crease Penetration - if there is no Compressional Gap or the adjustment in thickness of the female tool is greater than the gap, then the tip of the crease will protrude below the plane formed by the surface of the female crease tool. This results in excess draw and tensile stress, in rapid upper corner wear of the channel, and it results in higher incidents of sheet break-up. **See right**.*



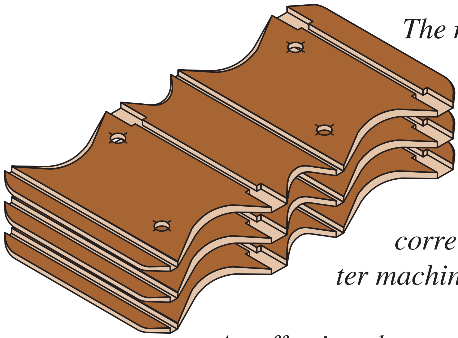
☒ *Increase Pressure/Resistance - as the adjustment is usually made after the make-ready is complete any adjustment to the thickness of the female tool will temporarily increase resistance and generate a pressure spike where the crease is inserted.*

☒ *Upper Corner Channel Wear - as the upper corner of the female tool channel is both the most susceptible to abrasive wear, **see left**, and is the Critical Distance shearing point most subjected to compression and abrasion, this is not an effective option.*

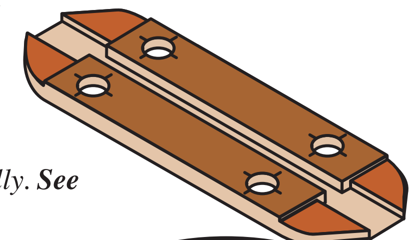


☒ *Increase Tensile Stress - as any increase in the thickness of the female tool adds to the degree of tensile stress, draw, and wear on the upper corners of the female channel, this is not the most effective technical option to adjust the Critical Distance.*

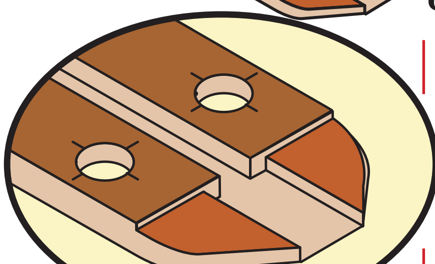
Channel Height Adjustment: **Technical Options**



The most effective option for this channel height adjustment is to machine a complete fiberglass counter, with the correct thickness of counter machined. ***See left.***



An effective alternative is to machine individual crease sections, which contain the thicker or thinner multi-width channel, and are removed and transferred individually. ***See right.***



Matrix is also a solution, however, once the individual pieces are transferred to create a single multi-width fold, the edges should be taped to prevent the short pieces of matrix moving during converting and production.

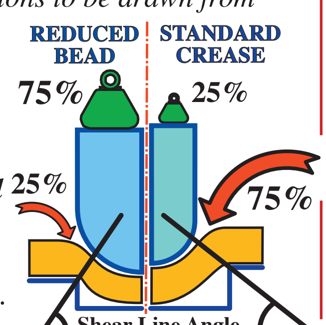
Channel Height Adjustment: **Summary**

Adjusting the height of the female channel is an effective technical option in regulating folding and opening force in folding, however, if there is insufficient Compression Gap or the crease rule protrudes below the surface of the female tool, the advantages are lost in resulting converting instability.

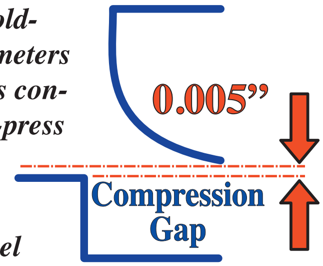
What is Compound Creasing: Summary

There are a number of conclusions to be drawn from reviewing the four methods of adjusting the Critical Distance.

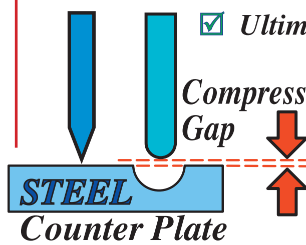
☑ ***Adopt the Reduced Bead Creasing Method as this will provide the most stable and the most accurate crease formation method. See right.***



☑ ***Complete all testing of folding and opening force parameters before any production run is considered, to minimize any on-press adjustment.***



☑ ***The most effective solution is to use the Channel Width Adjustment to control the Critical Distance, build in a minimum of 0.005" compression gap, and if necessary use precise adjustments in the height of the crease to provide on-press fine tuning. See above.***



☑ ***Ultimately convert those orders which require precise control of folding and opening force to a steel counter plate. As preciously, use an integrated Compression Gap and Crease Height Adjustment on-press for fine tuning if and when necessary. See left.***

How to Implement the Compound Crease Technique?

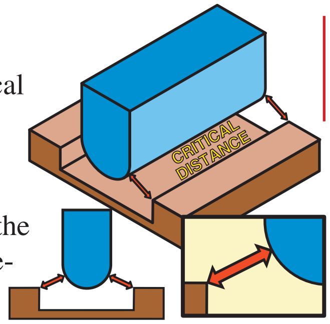
"When you cannot make up your mind which of two evenly balanced courses of action you should take—choose the bolder." *W. J. Slim*

Having defined the separation of Folding and Opening Force in a single fold, by segmenting the crease and/or the female counter/matrix tools, as the most effective manner of controlling folding performance, how do we specify and design the Compound Crease?

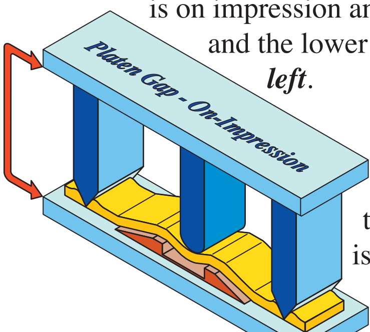
There are four factors which control folding force and folding springback in a crease. The four factors are organized in terms of their relative importance in controlling and or adjusting folding and opening force. These are:

- ***The Critical Distance***
- ***Critical Distance Spacing (Bead Width)***
- ***Fold Panel Lever Width***
- ***Fold Panel Lever Length***

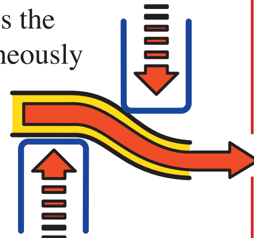
The Critical Distance



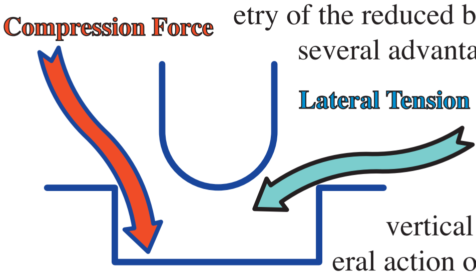
As previously specified, the Critical Distance in Creasing, the gap between the face of the male crease rule and the upper corner of each female tool channel, ***see right***, is the most important setting or measurement in crease formation. It is important to note the Critical Distance is measured/calculated when the diecutting press is on impression and the gap between the upper and the lower platen is fully closed. ***See left***.



In terms of controlling folding and opening force the Critical Distance setting is vital because the resulting partial internal delamination of the material, which generates the crease bead, is caused by being simultaneously pinched and sheared between two opposing and offset surfaces. ***See right***.

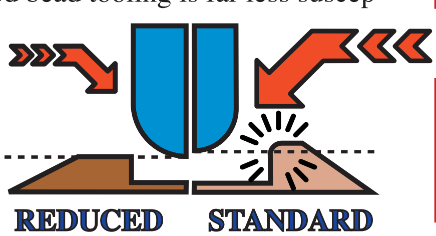


Both traditional creasing and reduced bead creasing employ compressive material shearing to form the crease, however, the geometry of the reduced bead tools provides several advantages.

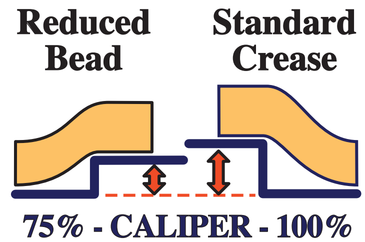


The ***first*** is, because the shearing action is more vertical than the more lateral action of traditional crease formation, ***see above*** , less force is required and the degree of delamination is more even and more consistent.

The ***second*** is, because the reduced bead setting utilizes compressive force rather than the lateral force of traditional crease formation, reduced bead tooling is far less susceptible to rapid abrasive wear. ***See right***.

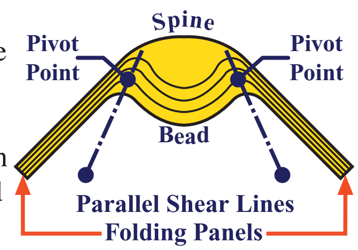


The ***third*** is, because the bead generated in reduced bead creasing is smaller than the traditional crease bead size, it is not necessary to use as thick a female tool, ***see right***, which significantly reduces the tensile stress, which in turn accelerates crease tool failure.



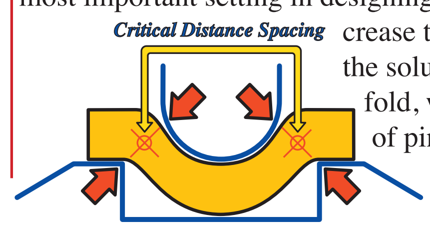
The ***fourth*** is, the reduced bead creasing method has less impact on cutting and is less impacted by cutting variation and subsequent adjustment, the crease generated and the resulting folding force are more stable and more consistent.

It is important to recognize that the Critical Distance will be set for and be unique to each paperboard type, including caliper and grain direction, and to the specific folding application. An important by-product of converting is the continual search for the most effective Critical Distance Setting, as each production run and each press cycle will yield more accurate setting data, to improve subsequent crease tool design.



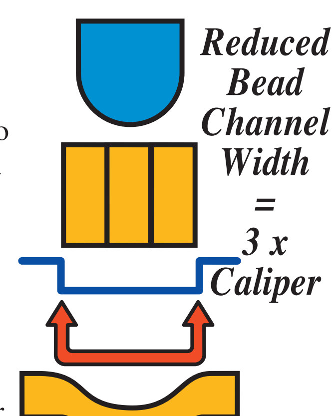
The Critical Distance Spacing

Although the specification of the Critical Distance is the most important setting in designing an effective male/female crease tool geometry, it is part of the solution. A crease is a double fold, with twin parallel centers of pinching force or shear points, with two identical Critical Distance settings. ***See above***. What is missing is the distance or the gap between each Critical Distance shear point center of activity. ***See above left***.

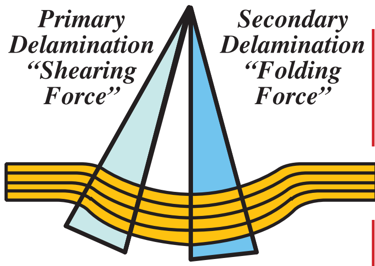


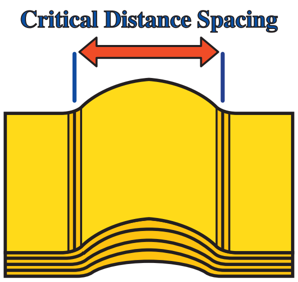
The Gap between each Crease Parallel Shear Line is called the Critical Distance Spacing, which controls the overall size of the bead and force required to fold.

This is usually determined in creasing by focusing on the channel width. In the example to the right the foundation formula of ***Reduced Bead Creasing,*** for calculating the ***Channel Width***, which is ***3 times the Caliper***. This illustrates a focus on channel width which is simply another way of defining the distance between the Critical Shear



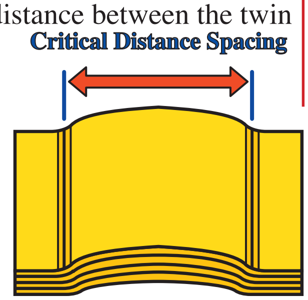
Points. This is important because an effective crease consists of two pinched and delaminated Primary areas, which are generated by the shearing force applied at the Critical Distance. ***See right***. And a crease consists of two delaminated Secondary areas, which are partially generated by formation force, with the internal layering of the material merging at the centerline of the crease bead. However, the partial internal delamination of the crease bead only becomes full internal delamination when the panels are folded through 90 and 180 degrees.



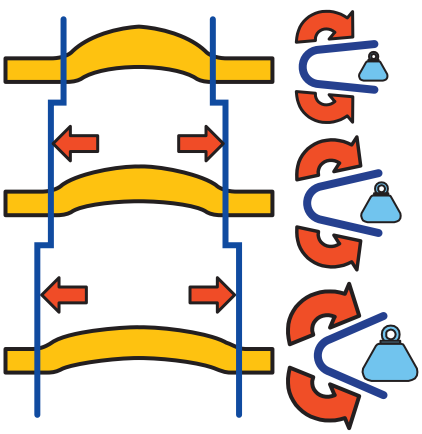


Why is this Important?

Clearly the first step in developing an optimal fold is finding the optimal critical distance between the male crease rule and the upper corner of the female channel for a specific paperboard or folding application. However, the second step is determining the distance between the twin parallel shear points. The Critical Distance in the example ***above***, is identical to the Critical Distance in the ***example to the right***, but the Critical Distance Spacing is quite different.



However, if you examine the bead profiles in the two examples above, it is obvious that as the spacing between the Critical Distance Shear Points is increased, the degree of internal delamination toward the center of the bead is reduced. As the Spacing between the Critical Distance Shear Points is increased it is more and more difficult for the degree of shearing force to enable the internal delamination to meet at the center of the bead.

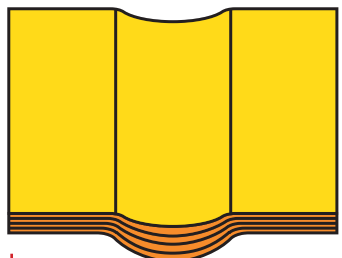


This provides a basic, and an important folding guideline. As the Critical Distance Spacing is increased the degree of force required to fold the panels attached to the crease also increase. ***See left.***

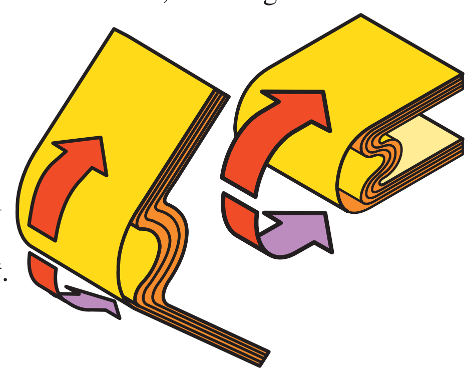
Now we have two important folding force adjustment controls. The first, the Critical Distance, controls the degree of pinching force, which regulates the hinge force at the twin shear points, and the second, the degree of bead flexibility, which regulates the degree of folding force for the attached panels.

Fold Panel Lever Width

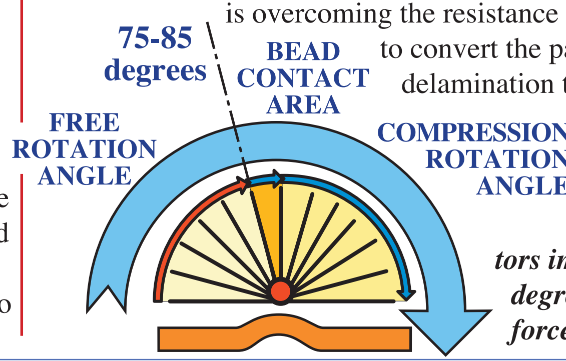
Unfortunately, although it is a common misconception, setting the Critical Distance and the Critical Distance Spacing, is only half of the job. The problems which are still unresolved are all related to the proportion of the panels attached to the crease, and to the degree of leverage they bring to bear on the paperboard hinge mechanism.

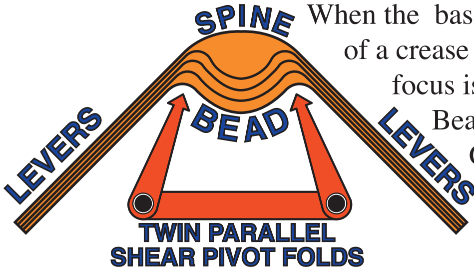


Remember an earlier critical definition, which is consistently overlooked, that crease formation generates a bead which is partially internally delaminated. ***See above***. Therefore, the hinge mechanism is only partially complete, and it takes the folding action of the attached panels to transform the partial internal delamination into full internal delamination. ***See right***.

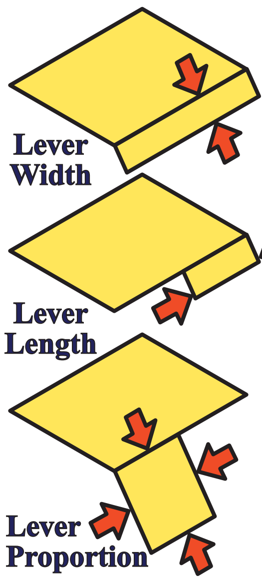


To complete crease/hinge formation requires applying compressive stress to the partially delaminated bead of the crease, and this is accomplished by folding the panels intersected by the crease-hinge. As the panels are folded around the bead, through the first 75 to 80 degrees of rotation there is minimal resistance, however, at approximately 75 to 85 degrees of rotation the resistance to folding climbs rapidly. The additional force required to fold is overcoming the resistance of the bead to convert the partial internal delamination to full internal delamination. ***See left***. ***But what are the factors impacting this degree of applied force?***

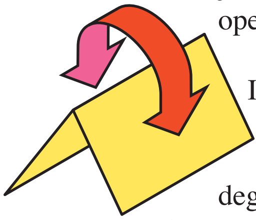




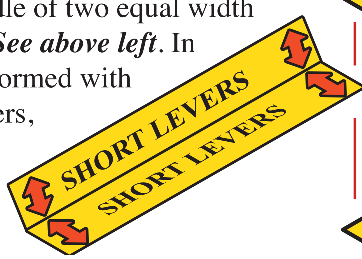
When the basic components of a crease are defined, the focus is obviously on the Bead, the Spine of the Crease, and the twin Critical Distance Shear Points. But the fourth component, the folding panels connected by the bead are very important as it is the leverage generated by folding these panels, which applies compressive stress on the bead, to complete the internal delamination action. In the ***illustration above***, the levers are equal length, and the application of stress is balanced on both sides of the bead.

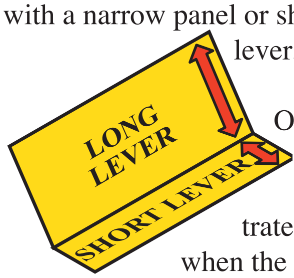


However, such symmetry and balance is rare in folding carton and container applications, and we are forced to deal with the Length, the Width and the Proportion of the Panel Levers, see right, if we are to set, control and adjust folding and opening force.

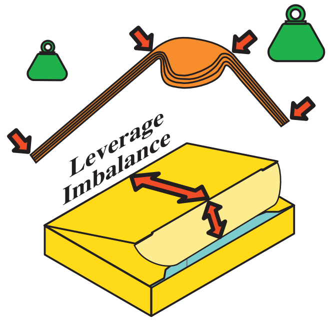


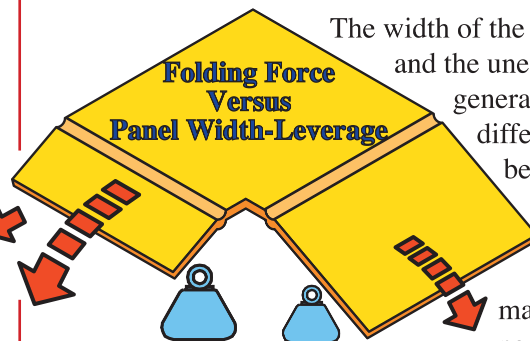
In designing crease tools one of the most dangerous assumptions is that every crease is subjected to the same degree of leverage as it is folded. We design the male and female crease tools as though every hinge was perfectly in the middle of two equal width and well proportioned panels. ***See above left***. In practice we can have a crease formed with two narrow panels or short levers, ***see right***, and/or we can have a crease formed with a wide panel, or long lever, combined with a narrow panel or short lever. ***See below***.





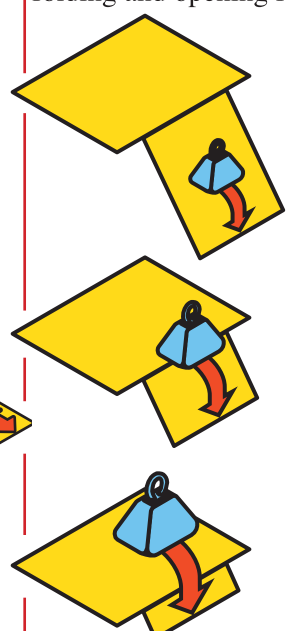
Obviously, we could have a crease intersecting two wide panels or long levers, but this is not illustrated as this is no a problem. However, when the long lever is combined with a short lever, the internal delamination on the short lever side of the crease is poorly formed, because there is insufficient leverage to cause the crease/bead to properly delaminate. This will lead to a ***"one-sided or asymmetric"*** crease bead, and the shorter panel will be highly resistant to folding. ***See right***. In this example, although the short Tuck-In flap will fold, it can be highly resistant to high speed packaging, and it may cause the carton to open prematurely.



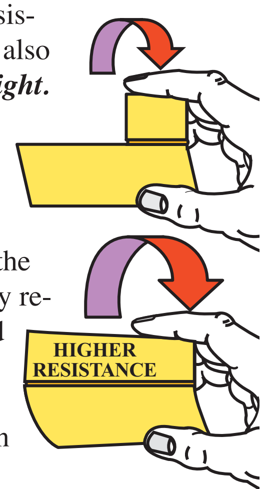


The width of the folding panel and the unequal leverage generated by panels of different widths can be a significant disadvantage in folding carton and container manufacturing, particularly as it is often ignored. But in attempting to precisely set and control folding and opening force, it is dangerous to ignore this common design attribute. ***See above***.

Fold Panel Lever Length

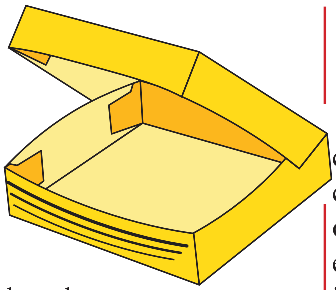


As we have seen in the examples in the previous column as the width of the panel levers is reduced, in proportion to the opposing panel, ***see left***, the degree of pressure required to fold or the amount of resistance to folding increases dramatically. In addition, in a similar fashion as the length of the panel lever is increased, the degree of resistance to folding also increases. ***See right.***

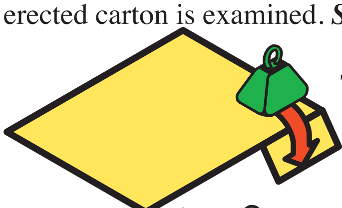


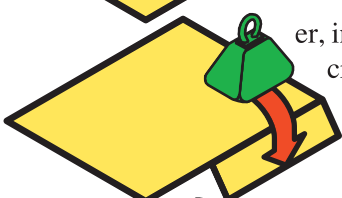
As the illustration to the right shows, it is relatively easy to fold a panel with a short lever length, but as the length of the lever increases, it not only requires progressively more force to fold the panel, but the act of folding will cause distortion and deflection of the panel as it is folded. It is most common for the two factors of lever width and

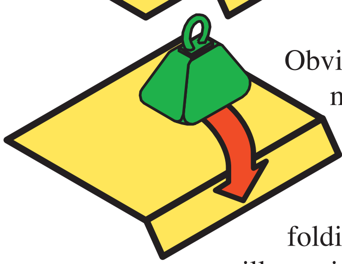
lever length to combine to create a difficult folding task. The most obvious example of this is the narrow and relatively long glue flap on most cartons, which will be highly resistant to folding and will require considerable pressure to prevent the glue flap panel distortion as it is folded. ***See above***.



Even though the panels may be successfully folded in gluing and in cartoning, the inherent resistance to the folding process causes distortion and permanent deflection of the panels, evident when the erected carton is examined. ***See right.***

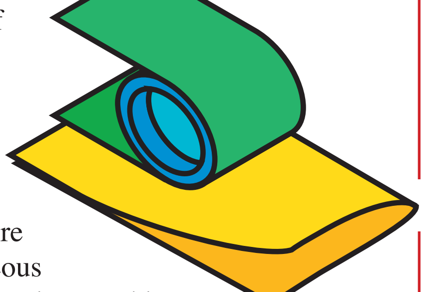




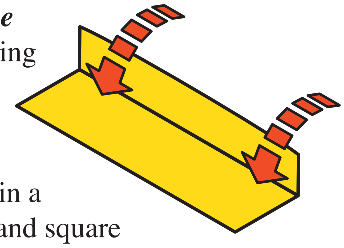


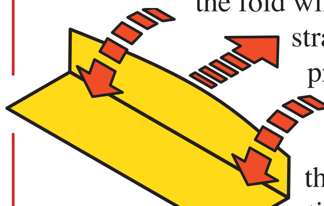
The basic principle is similar to the previous example of the impact of increasing/decreasing panel/lever width, however, in this case it is the increase/decrease in the length of the lever, which causes the dramatic change in the force required to fold the panels. ***See left***.

Obviously, there are a number of methods of folding and gluing in finishing and packaging, and the traditional gluing action is more of an incremental folding process. ***See below.*** This will certainly mitigate the distortion and deflection of the folded panels, but it is important to note it will significantly slow the gluing process down and make control and consistency of output far more complex and unpredictable, and the results will still show a degree of panel and carton bowing.



In some cartoning and packaging systems the erection of the carton or container follows a more straightforward simultaneous folding action, where the entire panel is folded in one smooth action. ***See right***. However, in many cartoning systems this type of panel is only folded through 90 degrees, with the assumption that the fold will retain a straight and square profile , but when there is great resistance to folding, because of the short lever width and/or the long lever length, the combination results in server distortion to the folded panel and to the finished container. This can be overcome by pre-breaking the key creases, by applying addition force in packaging, and by over folding the problem panels to reduce resistance. However, this is clearly not an professional approach to converting, when there is a simple and effective alternative, which eliminates these issues.

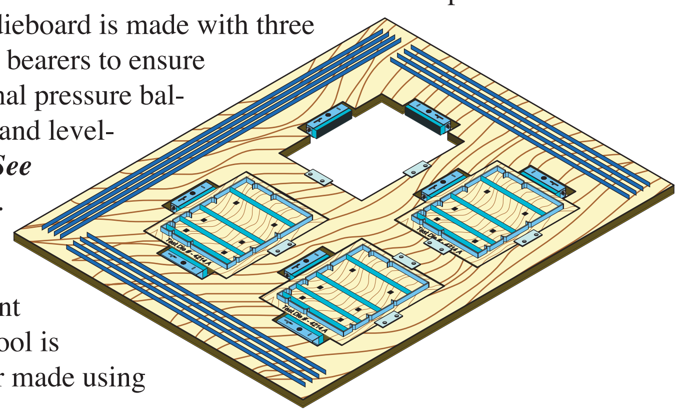




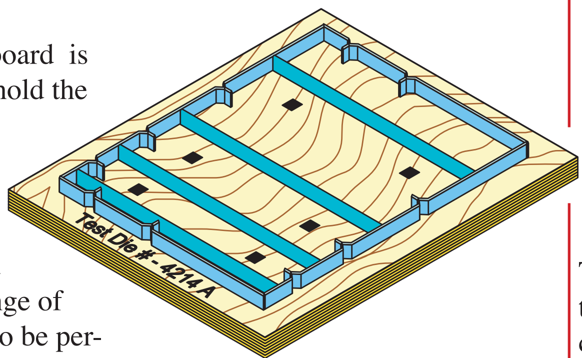
Setting, controlling, adjusting, and developing competence in the four key crease tool and design attributes listed below requires developing a specification and design procedure, which will ensure on-press success and end user product satisfaction.

- ***The Critical Distance***
- ***Critical Distance Spacing (Bead Width)***
- ***Fold Panel Lever Width***
- ***Fold Panel Lever Length***

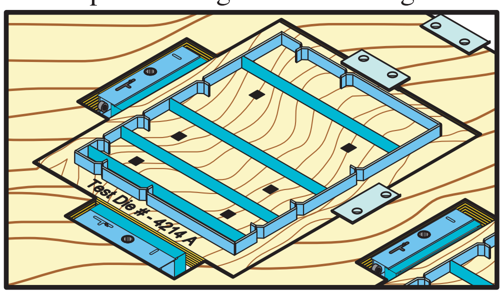
To begin developing a specification it is essential to set-up a practical testing program. This can be done on a Clam Shell Platen Press, however, it would be more effective if the testing were done on the press used for production work. The simplest approach to this challenge is to create a test die which fits into the format of a sheet fed platen diecutter. The dieboard is made with three sided bearers to ensure optimal pressure balance and leveling. ***See right***. It is important this tool is either made using



a stable dieboard material such as Rayform, or Permaplex. This tool represents a long term investment and it is also important that the test results generated in the use of this tool are not compromised by a warped or a distorted dieboard.



The test dieboard is designed to hold the 4 individual test dies, ***see right***, which will enable a complete range of crease tests to be performed on each material. Note the test die has an ***Identification Number***, laser etched into the surface of the tool, and there are counter holes, designed to accept the fiberglass counter registration pins.



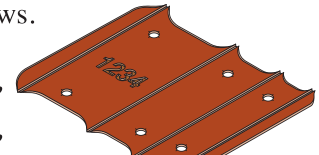
To enable the individual test dies to be exchanged and rotated, they are secured in the test die using Speed Quoins from the Bar Plate Company. The Quoins are permanently bolted into a recess machined into two sides of each individual cavity, to enable fast changeover of individual test dies.

As a further safety precaution a security plate made from steel rule is attached to the surface of the dieboard so it overlaps the test die after it is inserted into the cavity. ***See above***. This adds a few minutes to the exchange of each test die, however it is designed to prevent the test die from falling from the dieboard if the quoin should become loose. These quoins are unlikely to work loose, but this is a sensible precaution.

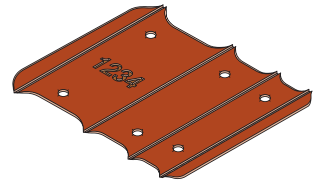
Crease Test Die Parameters

To accomplish a comprehensive range of testing it is necessary to set tool parameters to the caliper of the material being tested. In creasing, the female tool is adjusted to the caliper of the material by being supplied in a range of thicknesses intended to match each caliper of material being used.

In most operations the range of fiberglass material thicknesses are ***approximately*** as follows.



❶ ***Counter Thickness: 0.017"***
❷ ***Counter Thickness: 0.020"***
❸ ***Counter Thickness: 0.024"***
❹ ***Counter Thickness: 0.028"***
❺ ***Counter Thickness: 0.032"***
❻ ***Counter Thickness: 0.036"***



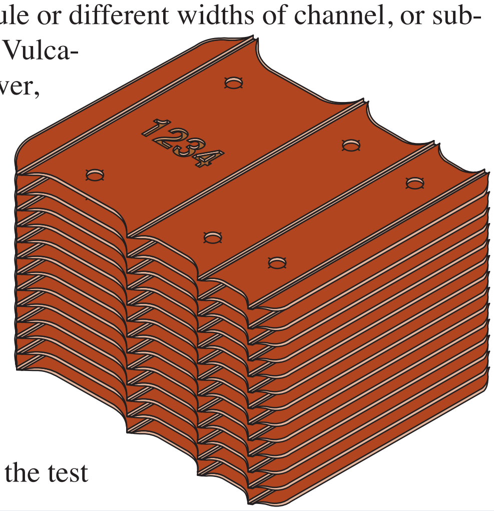
Therefore, we have six thicknesses of counter, which sets the height of the creasing rule we can use. As a result, the creasing rule height to be used with these counter material thicknesses is as follows:

❶ ***Thickness: 0.017" - 0.918" Crease Height***
❷ ***Thickness: 0.020" - 0.915" Crease Height***
❸ ***Thickness: 0.024" - 0.911" Crease Height***
❹ ***Thickness: 0.028" - 0.907" Crease Height***
❺ ***Thickness: 0.032" - 0.903" Crease Height***
❻ ***Thickness: 0.036" - 0.900" Crease Height***

The next logical question is what channel parameters do we need to test? The range is as follows:

① ***Channel Widths: 0.045" 0.050" 0.055" 0.060"***
② ***Channel Widths: 0.065" 0.070" 0.075" 0.080"***
③ ***Channel Widths: 0.085" 0.090" 0.095" 0.100"***
④ ***Channel Widths: 0.105" 0.110" 0.115" 0.120"***

Of course, this approach does not preclude using different heights of crease rule or different widths of channel, or substituting Matrix or Vulcanized Fiber. However, this approach will provide a comprehensive foundation to implement the testing program.



The final piece in the puzzle is the pointage of the crease rule used in the test die. The most common thicknesses of crease pointage are 2 Point, 3 Point and 4 Point. It is my contention that 2 Point Crease Rule should not be used, however, many people still use this thickness so it is included in the die specification.

Test Die Design & Fabrication

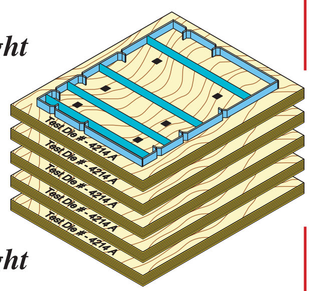
Six heights of crease rule have initially been identified as the important test parameters. Therefore, 3 individual test dies are required for each height of creasing.

❶ ***3 Test dies 0.918" Crease Height***

1 @ 2 Point +

1 @ 3 on 2 Point +

1 @ 4 on 2 Point



❷ ***3 Test dies 0.915" Crease Height***

1 @ 2 Point +

1 @ 3 on 2 Point +

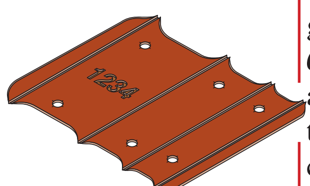
1 @ 4 on 2 Point

❸ ***3 Test dies 0.911" Crease Height***

1 @ 2 Point +

1 @ 3 on 2 Point +

1 @ 4 on 2 Point



❹ ***3 Test dies 0.907" Crease Height***

1 @ 2 Point +

1 @ 3 on 2 Point +

1 @ 4 on 2 Point

❺ ***3 Test dies 0.903" Crease Height***

1 @ 2 Point +

1 @ 3 on 2 Point +

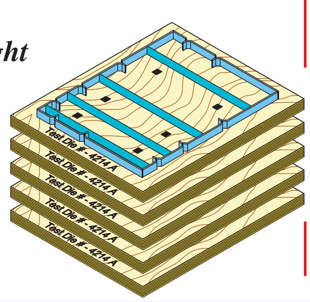
1 @ 4 on 2 Point

❻ ***3 Test dies 0.900" Crease Height***

1 @ 2 Point +

1 @ 3 on 2 Point +

1 @ 4 on 2 Point



To cover all of the crease heights, it is necessary to fabricate 18 individual test dies to the specifications above. Note: it is obviously important to add counter holes for transferring fiberglass counters on press, and each individual test die should have an identification number laser etched into the dieboard surface. Finally, each die should be rubbered using a slightly softer election than usual.

Counter Test Parameters

Now that we have specified the counter thicknesses, the channel widths, and the crease heights, it is relatively simple to specify the individual counters. For each height of creasing we need ***16 counters,*** in the appropriate thickness. Therefore, as we have specified ***6 heights of crease rule*** in testing, we need a total of ***6 x 16, or 96 Counters.***

For example: for the ***Counter Thickness of 0.020"*** and the matching ***Crease Height of 0.915"***, we need 1 counter with channel widths of ***0.045"***, and 1 counter with channel widths of ***0.050"***, and 1 counter with channel widths of ***0.055",*** etc, all the way to the counter 16 in this set, which would have channel widths of ***0.120".***

This is repeated for each thickness of counter material, generating ***16 counters with channel widths from 0.045" to 0.120" in each set.*** Naturally, when testing thinner materials the number of counters in each set can be reduced as the chance of using a ***0.120"*** wide channel with a ***0.017"*** counter and conversely, when testing thicker materials, the potential of using a ***0.045"*** channel with a ***0.036"*** counter are fairly limited.

Each counter program should be identical, however, it is critically important to rout an identification code for each thickness of counter material, and for each channel width into the surface of each counter. It is easy to get confused in the beginning!

The counters should be carefully cleaned and stored in a safe and secure location after each use. Any damage or problems should be reported and the counter replaced immediately.

Counter Test Documentation

Diecutting - converting is always a race against the clock, and although this system of testing and evaluating crease parameters against different paperboards is fast and easy, there is a danger of neglecting the important documentation of results. This may be tedious, but it is critically important, and one member of the team must accept responsibility for both keeping samples and for recording the results from each test.

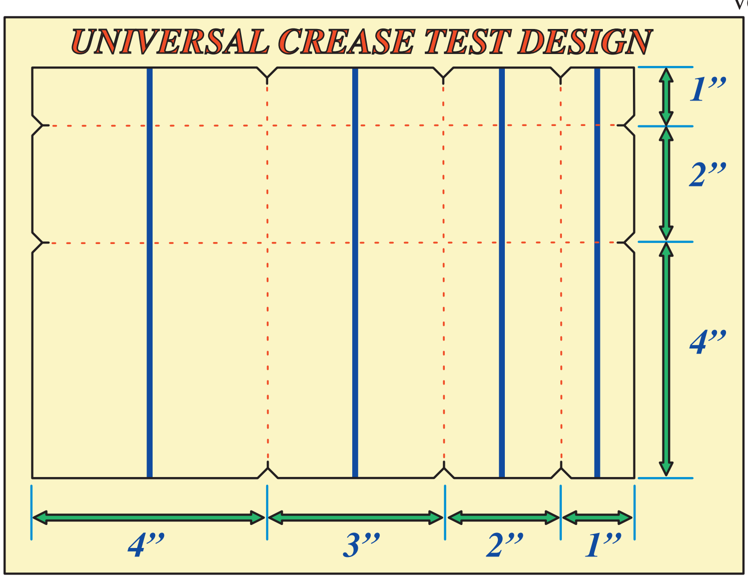
In this way, the team can evaluate results, choose the most effective parameters, and change the specification for subsequent production orders.

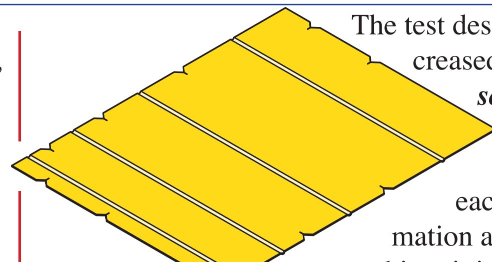
Counter Test Summary

This outline, of the testing tools and the recommended parameters are designed to establish a baseline crease/fold paperboard testing program. But it is only an outline. The team should evaluate these recommendations, and make changes to the tools and to the tool parameters, to more closely match the experiments and tests they wish to implement, to prove or disprove the theories and the practices outlined in this manual.

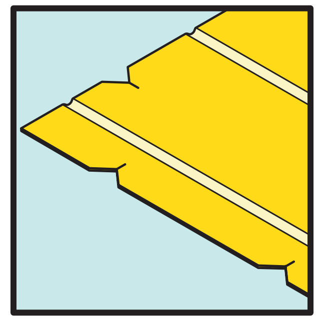
The Test Design Configuration

Testing and evaluating converting parameters and the most effective crease-tool geometry against specific design constraints and paperboards is always a worthwhile investment. However, in this case we are seeking information, which will turn a paperboard into a precise hinge, with very specific folding characteristics. Therefore the testing tool and the test design had to reflect a careful focus on the Critical Distance, the Critical Distance Spacing, the Lever Width and the Lever Length. The design of the testing die and pattern for counter design is shown ***below***.

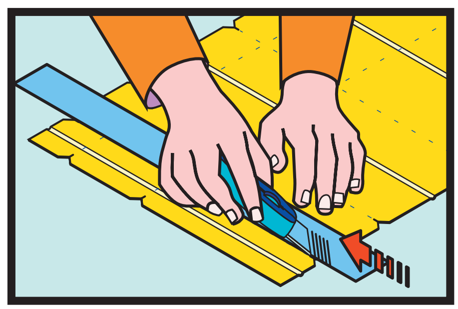




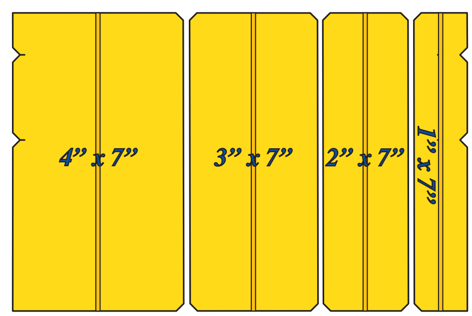
The test design is cut and creased in a single piece, ***see left***, however, to isolate and to accurately measure each of the crease formation attributes we are researching it is necessary to be able to precisely cut the design into smaller pieces. To accomplish this around the periphery of the test piece there are angle cut outs, which are designed to be guides to enable the test piece to be accurately cut into smaller section after it is diecut and converted. ***See right.***



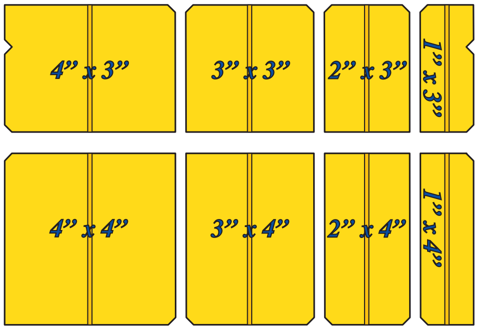
To cut the diecut part accurately simply requires aligning a straight edge with the ***"V-Cut"*** in the profile, and inserting a Utility Knife in the ***"starter"*** cut at the point of the ***V-Cut***, ***see left***, it is relatively easy to cut the original part above into smaller pieces to test each of the four parameters we are focused upon.



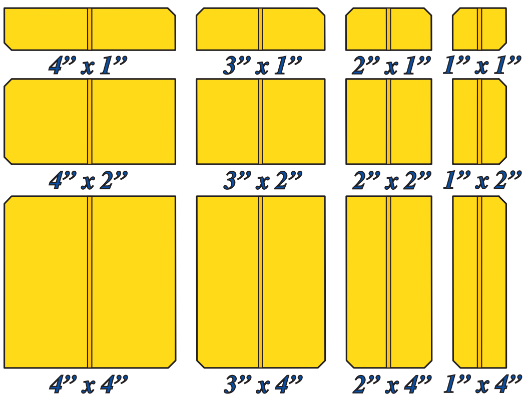
By cutting the test piece into four sections, using the three vertical V-Cuts, we are able to test and evaluate four different pieces with gradually narrowing Lever Width and a long Lever Length.



This test will enable an evaluation of the four key attributes we are focused upon, and it will also test the viability of the male/female crease tools set-up with the specific paperboard being evaluated. This is critical, because before working on folding and opening force it is vital to determine the most effective set-up for the standard creasing. In addition, it is obviously an advantage to conduct this test both ***With and Against*** the paperboard or fluted material grain.

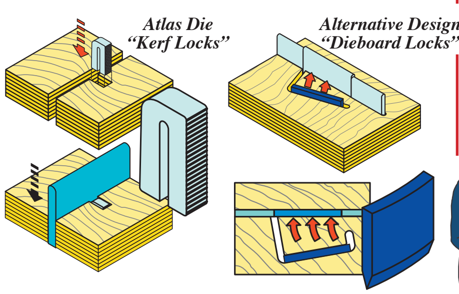


For the next test sequence the test piece is cut vertically into four sections, and then horizontally to produce eight test pieces, or creased sections. ***See right.*** In using a ***Score Bend Test Machine*** to measuring the difference between the four inch by four inch test piece and the other test pieces we can begin to develop a measurement of the lineal increase/decrease in resistance based upon changes in Lever Length, and how that impacts folding resistance and spring back force.



In the same way by measuring the difference in resistance between the four inch by four inch test piece, and the three inch by four inch test piece, and the two inch by four inch test piece, and the one inch by four inch test piece, we gain a clear understanding of how the impact of a increase or a decrease in Lever Width impacts folding and opening force.

Finally, by cutting the original test piece into 12 accurate pieces, ***see above***, we have a complete range of samples to determine the most effective crease tool geometry for "standard" creasing, and the most effective crease tool geometry for the shorter crease sections designed to increase folding resistance and springback force.



By testing each paperboard, both creasing Parallel to and at Right Angles to the paperboard grain, we have the basic information to specify Compound Creasing for the first job. Naturally, this would be tested and evaluated on-press after make-ready is complete, and as we have seen from earlier examples, it is a significant advantage to build in Dieboard Locks and or Kerf Locks to enable precise on-press changes, if they are needed. ***See bottom of previous column.***

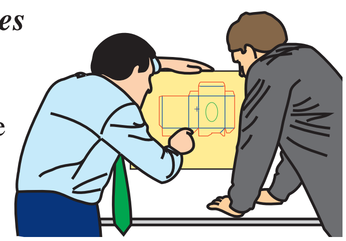
This testing procedure will provide the foundation for exceptional converting creasing, and it will form the basis for using the Compound Crease Technique to specify and design a folding carton or a fluted container, with precise control of Folding Resistance and Springback Force.

What are the Advantages of the Compound Crease Technique?

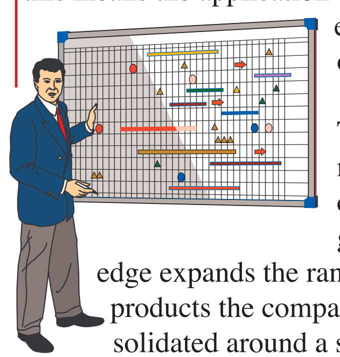
"Thought and theory must precede all salutary action; yet action is nobler in itself than either thought or theory." *William Wordsworth*

The ability to develop a standardized, an efficient and an effective approach to setting and delivering precise control of Folding & Opening Force is clearly an important strategic advantage. The benefits of this approach fall under four headings.

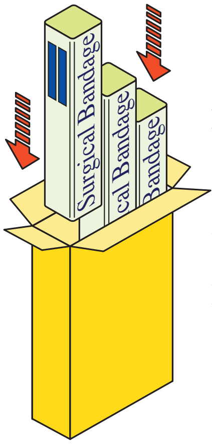
- ***Organizational Advantages***
- ***Technical Advantages***
- ***Performance Advantages***
- ***Strategic Advantages***



In terms of ***Organizational Advantages*** the sales team have the confidence of assuring the customer representative, they are capable of meeting and or exceeding the customer packaging requirements. This confidence is continually reinforced as every production job consolidates experience, technical data, and ***"How-To"*** adjust and control folding and opening force. In practice, this means the application of gained knowledge and experience will ensure every production order gets better and better.



This has the advantage of eliminating rejections and claims, and costly rework. The progressive gain in experience and knowledge expands the range and the sophistication of the products the company can offer. All of which is consolidated around a system of converting manufactur-



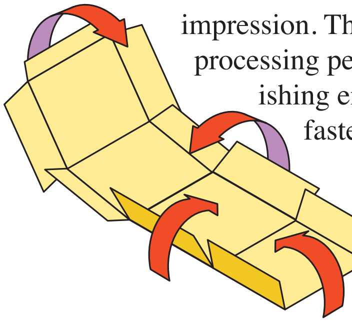
ing which is inherently more predictable in scheduling, in throughput, and in delivery. The bottom line. The organization has more confidence in its ability to meet and/or to exceed even the most stringent of folding and container cartoning requirements.

In terms of ***Technical Advantages*** the establishment of a series of proven methods and practices eliminates guess work and on-press experimentation, to simplify and streamline the set-up process. With a standardized approach to controlling folding and opening force the knowledge and the experience gained from every cycle is converted into more and more effective techniques and to personnel confidence. The ability to make precise and effective adjustments, to accurately tune folding and opening force builds confidence and competence, as the changes are fast, simple and straightforward.

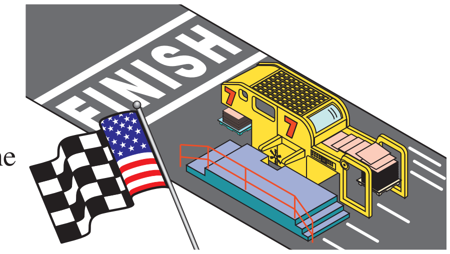
The investment in Pre-Production Testing proves to be an investment in excellence as the on-press set-up procedure is based upon pragmatic results and repeatable settings.

In terms of ***Performance Advantages*** the this approach to precise setting of folding resistance and springback force and the establishment of a standardized set of practices and procedures results in faster press make-ready and set-up. It eliminates on-press experimentation, excess lost press time, and it increases throughput, it improves yield and it reduces resource waste.

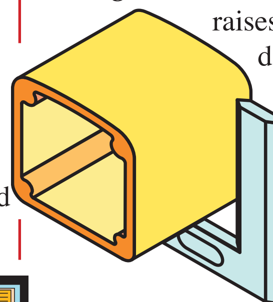
The adoption of Reduced Bead Creasing Techniques ensures any crease and fold settings are more stable and more repeatable, and the results are more consistent from die-station to die-station and from the first impression to the last impression. This also results in improved processing performance in gluing and finishing ensuring every process enjoys a faster cycle time.



The precision of adjustment, the flexibility of adjustment, and the range of adjustment ensures the press team has the ability to adjust for variation in paperboard properties, in the condition of the steel rule die, and in the inherent variability of press make-ready.



In terms of ***Strategic Advantages*** the improved performance of the folding cartons and fluted containers, provides an ***"Engineered Container"*** approach to converting, which raises the bar and establishes or consolidates the organizations reputation in the market place and in the industry. With the ability to deliver increased cartoning and packaging productivity, to improve speed and yield, to reduce fulfillment cost, and to ensure greater processing repeatability, the competitive advantages enable the company to pursue and secure the most lucrative accounts.

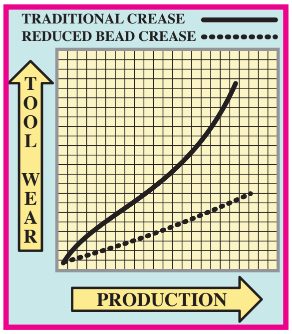


The real ***Strategic Advantage*** is the company elevates its competence, its confidence, and its capabilities to become a ***World Class Converting Organization.***

How to Control Folding & Opening Force: Summary?

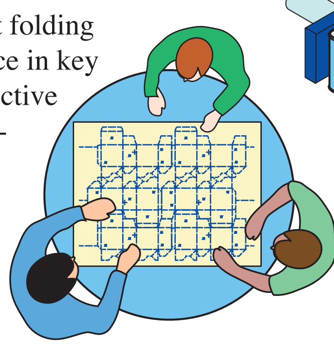
"If you have great talents, industry will improve them; if moderate abilities, industry will supply their deficiencies. Nothing is denied to well-directed labor; nothing is ever to be attained without it." *Joshua Reynolds*

The choices are as stark as they are simple. Stay with an approach to setting and folding and opening force, which is inherently variable, inconsistent and unpredictable, or invest in a series of methods and practices, which provide precise control, greater consistency, and dependable repeatability? Unfortunately, the traditional creasing system or the traditional approach to setting the geometry of the male and female crease tooling is imprecise, unstable, and it is inherently variable. ***Make the change, Now!***



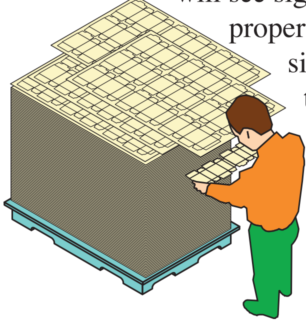
Therefore, even before considering working on setting fold resistance and springback force, the first decision should be to convert all creasing to the Reduced Bead Creasing approach. ***See left.***

Although the Reduced Bead Creasing technique of setting up the tool geometry for the male crease rule and the female channel will improve folding performance, consistency and repeatability, and it will improve current methods of setting and controlling folding force, the discipline of separating or dividing individual folds into different sections, each with different tool geometry, will significantly improve folding control and it will eliminate all of the guesswork and failure!

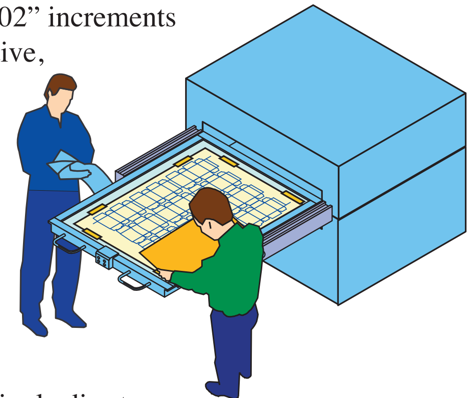


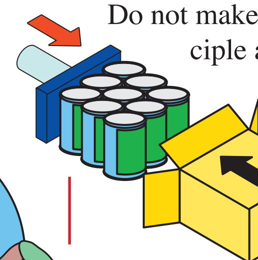
The ability to individually adjust folding resistance and/or springback force in key individual folds is critical to effective carton and container manufacturing. The investment in testing will provide the groundwork for greater knowledge and experience; for exceptional cartoning-packaging performance; and it will establish the reputation of the organization as an accomplished converting supplier.

The technique of Compound Creasing is straightforward, logical, simple to understand, and relatively easy to implement. Do not over-complicate the discipline! The basic principle is painfully simple! We are changing those few key crease/folds in each design which are critical to folding and erection, and dividing individual creases into separate pieces, each with different tool parameters. That is it!



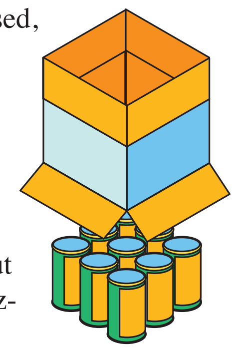
Even if you ignore the female tool and just change crease height/pointage in the various sections of the crease you will see significant change in the folding properties of the crease. This could be as simple as determining in advance that the lengths of the shorter ***"spring-back"*** crease rules will be standardized at 1/2 , 3/4, or 1 inch lengths. When the job is ready for production the operator has a box with the ***"standard"*** length of Springback crease, in different heights, 0.002" increments would be most effective, in sufficient number to replace the existing crease sections in the die. By integrating the dieboard locks or kerf locks, previously specified, into the dieboard, the standardized crease sections in a single die station could be rapidly exchanged, the new crease parameters tested, and the entire layout changed over to the new setting in a matter of minutes.





Do not make this a complex challenge, when the principle and the practice are obviously simple and straightforward.

This is an opportunity to elevate the performance attributes of every carton or container produced, to match or to exceed even the most exacting requirements of the customer cartoning-packaging requirements. In reality this is delivering what was promised, or at the very least implied at the beginning of the sales process.



This innovative and radical change to ineffective standard operating procedures is not just about producing World Class Converting Products. But it is about reducing press make-ready time, minimizing press down-time, lowering time and resource waste, and accelerating throughput in gluing and finishing. By lowering the complexity and the challenging of accurately setting folding resistance and springback opening force in creasing, we improve quality, we improve productivity, we reduce operating cost, and we establish a reputation for converting excellence.

And ultimately, that is the goal in learning how to control folding resistance and springback force.