

Technical Tips

Using Bundle Breaker (rotary corrugated applications)

Bundle Breaker: a mechanical device designed specifically to separate 'ganged', multi-out sheets after they have been stacked in a predetermined quantity. This stack of multi out, connected parts is referred to as a 'bundle'.

Bundle Breaker Rule: a perforated steel rule installed into the cutting die replacing the common knife that joins one box or part to another. The purpose is to increase die cutter yield per impression by 'ganging' parts or multiples together and delivering them in a single sheet form out of the die cutter in one piece.

In General, bundle breaker rule is determined based on the following criteria:

- a) What is an acceptable edge finish of the separated parts?
- b) How easily will the wavy medium break/tear.
- c) Is the bundle break tear line parallel to the flute direction (with flutes) or perpendicular to the flute direction (cross flutes)?
- d) Will the bundle breaker rule be curved and installed around the die cut cylinder or straight and sit across the die cut cylinder.

For consistency and to easily calculate the holding/breaking factor, bundle breaker rule should be used as a continuous piece completely replacing the common knife. An exception would be when there are delicate design elements (such as long, narrow flaps with short score lines.) adjacent to the bundle breaker line. These will tend to be torn apart from the force and action of breaking the bundle. In these cases, install knife along these distances followed by the continuous bundle breaker rule.

Also, when installing continuous pieces of bundle breaker rule, the joint gap where the bundle breaker rule meets the perpendicular trim knife must be no greater than the specified bundle breaker gap. Failure to do this can result in an unacceptable tear out of the sheets.

How it works:

There are four possibilities for utilizing bundle breaker rule:

- Feeding cross corrugation using straight rule
- Feeding cross corrugation using curved rule
- Feeding with corrugation using straight rule
- Feeding with corrugation using curved rule

This discussion will begin with understanding how bundle breaker rule works when feeding sheets cross corrugation. Feeding cross corrugation means the flutes do not run in the same direction as the sheet is traveling. In other words, the flutes are running across the cylinder.

Feeding sheets CROSS CORRUGATION – Straight rule

When flutes and bundle breaker rule run across the cylinder (straight rule), a small notch style works best. The nick tags present after the break are less noticeable with a smaller notch and small notches will hold surprisingly well. These break lines will generally fold up to 180° either way without a complete burst. Many times the outside and inside liners are still completely in tact. Due to the nature of this type of break, significant force must be used and possible lateral motion incorporated to complete the break.

Side note: When using BB rule as a fold line that will later be torn off, folding does not always occur directly along the BB line. When inside resistance to the folding builds from the thickness of the corrugated, the fold may wander to the weakest point which many times is a neighboring flute line. Longer cuts with small notch gaps can improve the folding accuracy.

Feeding sheets CROSS CORRUGATION – Curved rule

When flutes run across the machine and bundle breaker rule runs around the machine, the break line is very fragile. Curved bundle breaker rule cuts as it enters and exits the inside liner of the corrugated paper due the rotational entry and exit geometry of the blade. This minutely elongates the actual length of the cut. Larger notch gaps are required. Usually .065" (1.7mm) gap size will suffice. The break in this scenario is very easy. The larger notch sizes are slightly more noticeable but there is rarely any tear out or ripping from the break process. The reason for this is that the break is a function of the inner and outer liners only. The medium is fixed in this direction and has no influence on the break.

Feeding sheets WITH CORRUGATION – Straight rule

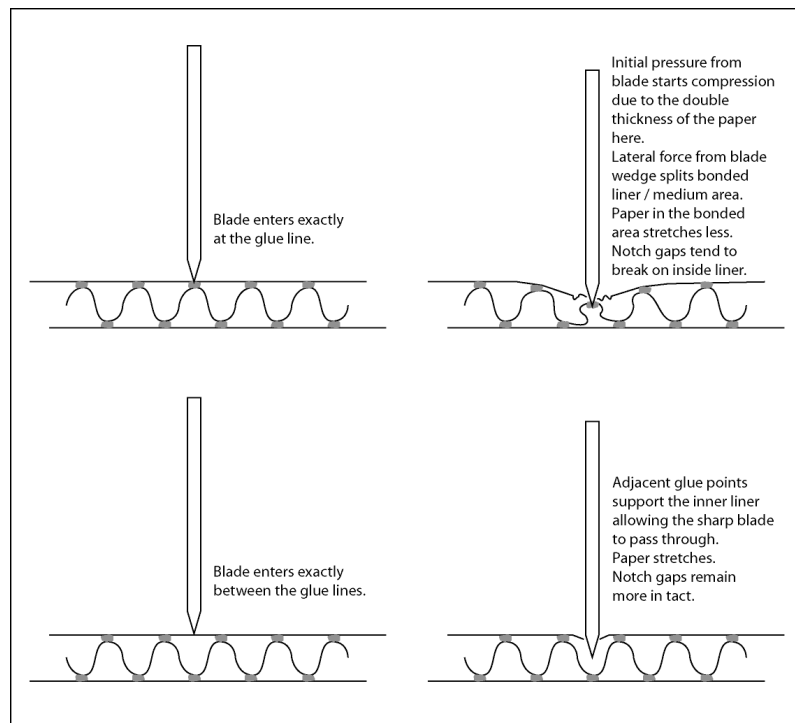
When flutes run through the machine and bundle breaker rule runs across the machine, the break is also fragile. This is the only occasion where a non standard, deeper top notch should be considered for single wall as the paper caliper increases to C and A

flute. The size for the notch width is .065" (1.7mm). The edge finish with this larger nick is noticeable but very consistent and uniform making the overall appearance generally acceptable. The corrugated in this scenario with the BB rule crossing the flutes results in a rigid structure to break. When the fold is attempted, force is directly applied to the outermost liner. The medium in this case does not hamper the break due to its inability to stretch.

Feeding sheets WITH CORRUGATION – Curved rule

When flutes run through the machine *and* the bundle breaker rule is curved, also running through the machine, the combination becomes the most challenging to control and manage. The medium of the corrugated is the primary variable and always a factor. The first situation that affects the bundle breaking performance is the specific entry point of the bundle breaker rule. There are two extremes of this occurrence. The first is when the cutting portion of the bundle breaker rule enters the corrugated exactly centered between two flute tip glue lines. The second is when the bundle breaker cut enters exactly into a glue line. Variations occur in every position between the two extremes.

As shown below in the top diagram, the BB rule enters at a flute tip. The combined liner and medium in this case are glued together and respond as one piece of thicker paper. The thicker, more stiff paper will resist the cut until the corrugated is partially or sometimes fully compressed.

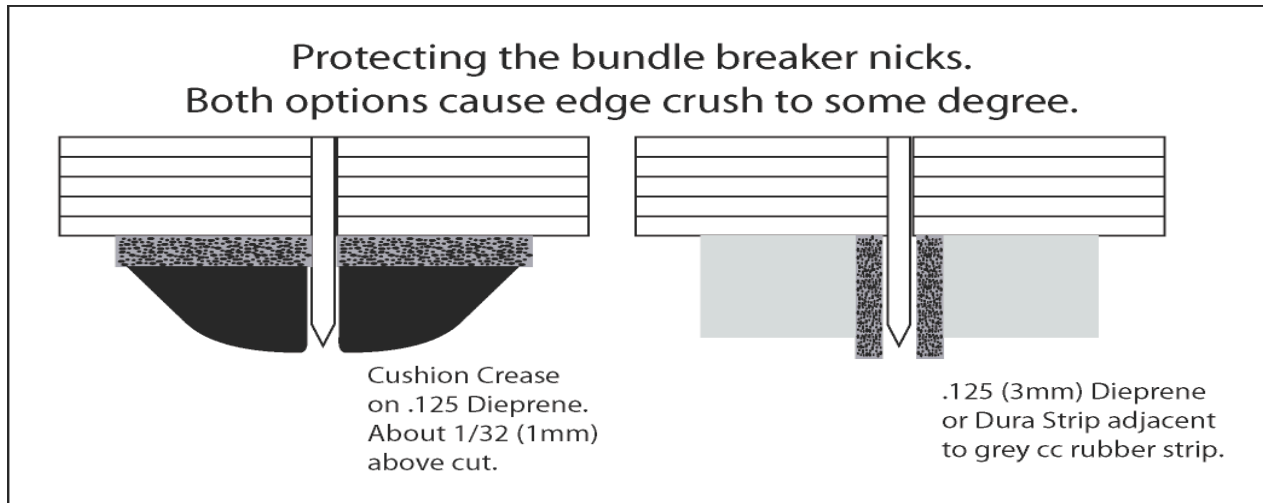


When the blade edge tries to get through, the lateral wedge force of the bevel stresses the nicks and the BB line breaks the die-side liner. The outer (print side) liner normally stays in tact.

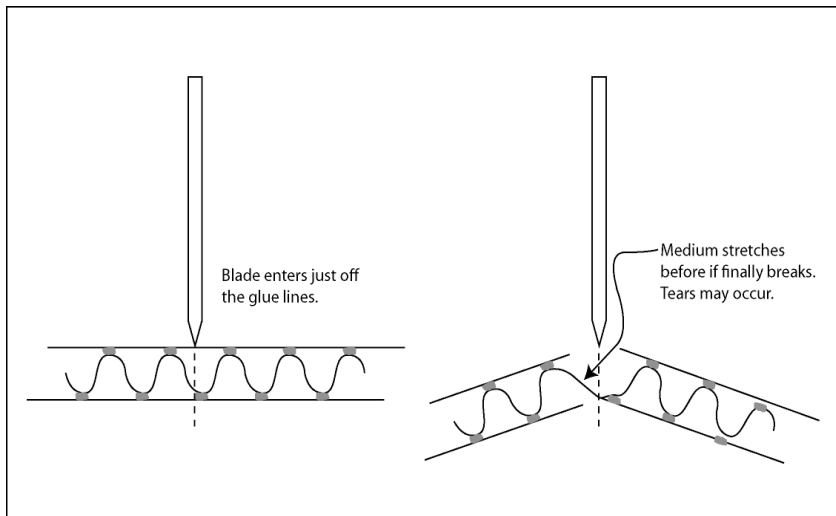
Conversely, in the lower diagram, when the BB rule enters exactly between the glue tips the blade generally passes through the inside liner with nicks still in tact. This is likely due to the support glue points on either side and the ability of the paper to stretch around the blade.

Of course, it is impractical and potentially impossible to plan the flute relationships to the blades entry position. This being the case it can be expected that inside liner breaks will occur and be fairly unpredictable.

Some success however, has been recognized to combat this situation with firm, yet slightly compressible rubber strips adjacent the BB rule to compress and push the paper toward the blade entry point i.e.: cushion crease on high density cellular build up. This pins the paper against the anvil during the penetration and reduces the movement of individual liners acting in separate directions. The dilemma here is that crushing this area is generally frowned upon. A second option would be the utilization of a narrow, high density, firm strip supported by a softer wider strip of medium density sponge next to the BB rule.



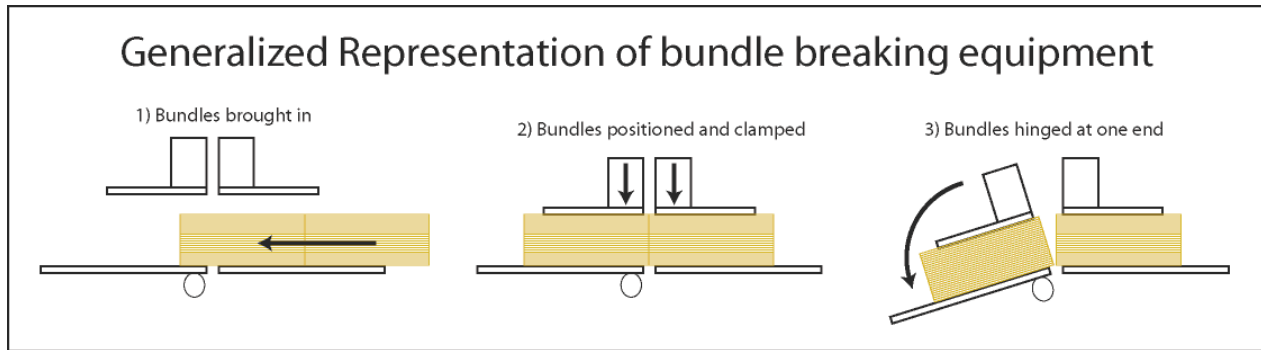
The next situation that causes potential problems is when the bundle breaker cuts anywhere other than dead center through the glue line. When this happens the perforation line passes through the medium leaving a connected segment of paper that is dimensionally longer from a fixed glue line than the inner or outer liners are.



When the corrugated is bent to be broken the medium must stretch out to full extension before it breaks. This occasionally results in an unsightly tear or ripping of the medium.

The action of the bundle breaking equipment, the height of the bundle, the grade of paper and the position where the BB rule entered the paper act together to affect the break angle. Most bundle breaker machines have four actions to break a bundle:

- 1) Bring the parts into the breaking equipment
- 2) Position and clamp the parts on both sides of the bundle breaker cut line.
- 3) Drop one end of the clamp platform that is holding the lead in bundle down to 'hinge' the parts.
- 4) Move back to a horizontal plane and convey the parts downstream. (not illustrated)



Depending on the amount of stretch the medium requires, if it isn't broken after the hinge action is employed, a tear out or ripping of the paper may result.

More basic facts:

.045" wide is the smallest notch that can be punched practically through 4 point (.056") rule. Smaller notch sizes are possible but only by utilizing specialized tooling to punch the steel. Another slower process is to grind in the notch. Both options are expensive, do not guarantee success and consequently won't always equate to added value.

Flutes going through the press and curved bundle breaker rule running parallel to the flute line is the most common practice in use today. This also happens to be the most unpredictable scenario as explained earlier. However, there are some points of note:

- 1) The initial products of some success were 1/8" x .045 and 1/8" x .055. After study and consideration, these two sizes will be replaced by .121 x .045 and .111 x .055. The NEW sizes are still very close to the nominal 1/8" cut segment but allow National Steel Rule to enhance the product uniformity and achieve better balance of hold percentages for the entire family of 5 products. (see guide on pages 8 – 11)
- 2) Any notch gap in low ECT single wall that exceeds .060" wide will likely result in some tear out of the medium and consequently ragged edges.
- 3) Low ECT is a tougher to break cleanly than a higher ECT in general. Heavier liners including the medium tend to cut and break cleaner.
- 4) Curved bundle breaker takes very low force to cut due to the action of curved cutting and the intermittent forces of the blade portion and the space portion. Because of this, the curved rule can be as much as .035" lower than the curved trim cutting rule. An example would be using

.937 BB rule with .970 curved cutting rule or .970 BB rule with 1" curved trim knives.

- 5) A .230 deep top-notch is recommended for all flute combinations to keep a reasonable depth standard. This notch depth teamed with the lower height BB rule keeps the top notch well away from the inside liner. Deeper top notching will only result in a weaker body of rule that will likely break over time. *Special Note: When using .230" deep top notches it is recommended to reduce the bottom notch from the standard 1/2" (12mm) to a 3/8" (9.5 mm) bottom notch to assure a decent amount of steel is left between the two notches.*
- 6) The most common issue is the parts do not stay together to reach the bundle breaker equipment or the parts stay together well enough but the finished edge is unacceptable. Occasionally the parts are held too well and do not break apart at the bundle breaker equipment.
- 7) It is recommended that bundle breaker rule be run as a continuous piece. Replacing the common knife with a full length of bundle breaker allows you to know what the '**hold percentage**' is.

8) When bundles won't break:

- a. Reduce the stack height. Reducing the height to the bundle breaker will reduce the force to break.
- b. Install a bundle breaker rule with a *lighter* hold percentage. (see table on last page)

9) When Multiple outs break apart at the die cutter:

- a. Install a bundle breaker rule with a *heavier* hold percentage. (see table on last page)

A discussion about 'hold percentage'

Hold percentage is the cut to gap ratio of the bundle breaker rule. A .121" cut x .045" gap BB rule calculates to be 27.1% of uncut material with 72.9% cut per inch. At .111" cut x .055" gap, the BB rule calculates to be a 33.1% hold to cut relationship. The higher the percentage of hold is, the greater the overall holding strength. When operations go from a .121 x .045 to a .111 x .055 BB rule they are not only increasing the notch width which allows for more paper fibers in the nick but they are also increasing the hold percentage by 3%.

If parts are breaking apart prematurely there are three choices:

- 1) Increase both the gap and cut size while maintaining the same ratio. This does nothing to the hold percentage but does increase hold power due to the larger nick size. *The larger the nick gap the more fibers of paper there are to be broken.*
- 2) Leave the notch gap the same size and reduce the knife portion. This increases the hold percentage over a length of bundle breaker rule. Even

though the notch gap isn't any stronger, the accumulation of more notch gaps per inch will directly relate to increased holding power.

- 3) Increase the notch gap size and reduce the cut length. This increases the number of fibers in each notch gap as well as boosts the hold percentage per inch.

Next Generation Bundle Breaker Rule *FAMILY*

Testing has demonstrated the numerous variables associated with bundle breaking. One variable that National Steel Rule can control is the way the cut action is designed. The listed products will be designed symmetrically with regard to the teeth patterns. Balance will be achieved in place of a random notch to teeth relationship. This design balance will equalize the forces during cutting and provide smooth consistent cutting.

See following page for: Recommended Bundle Breaker Combinations



National Steel Rule

Recommendation for Bundle Breaker Products – Page 1 of 4

Flutes THROUGH Press – CURVED RULE Applied

Note: Top notch depth = .230" , Bottom notch depth .375"

APPLICATION: Replace entire common knife.

<i>Product Name</i>	<i>Suggested Use</i>
<i>045 Extra Light</i>	<i>Use at .030 below curved cut, (.937 for .970/.970 for 1.00 curved knife) on low-test board and long common knives over 16" where the length of the hold assists the stabilization out of the die cutter yet remains breakable. Also use when "045 Light" is too strong. This product has a 25% hold.</i>
<i>045 Light</i>	<i>Use at .030 below curved cut, (.937 for .970/.970 for 1.00 curved knife). This is a good starting point for most applications of low to medium test board for common knife replacement lengths of 2" – 16". Also use as alternate if "045 Extra Light" is too weak or "045 Medium" is too strong. This product has a 27% hold.</i>
<i>045 Medium</i>	<i>Use at .030 below curved cut, (.937 for .970/.970 for 1.00 curved knife). This is good for medium to high-test single wall where break is less likely to tear and a bit more hold is desired. The nick size of this product is the same as the "045 Light" but the hold percentage is increased. Use as alternate if "045 Light" is too weak or "055 Heavy" is too strong. This product has a 30% hold.</i>
<i>055 Heavy</i>	<i>Use at .030 below curved cut, (.937 for .970/.970 for 1.00 curved knife). This is a durable hold for high-test single wall and low-test double wall. The .055" nick size is .010 larger than the "045 Medium". Additional hold is achieved by the increased nick size as well as an increased hold percentage. Use as an alternate when "045 Medium" is too weak or "055 Extra Heavy" is too strong. This product has a 33% hold.</i>



National Steel Rule

Recommendation for Bundle Breaker Products – Page 2 of 4

Flutes THROUGH Press – STRAIGHT RULE Applied

Note: Top notch depth = .230" , Bottom notch depth .375"

APPLICATION: Replace entire common knife

<i>Product Name</i>	<i>Suggested Use</i>
<i>045 Medium</i>	<i>Use at SAME HEIGHT as straight cut. This is generally too light for across the flute applications unless the common knife is very long. Use with applications of low to medium test board for common knife replacement lengths of over 16". Also use as alternate if "045 Medium" is too strong. This product has a 30% hold.</i>
<i>055 Heavy</i>	<i>Use at SAME HEIGHT as straight cut. This is good for starting point for most work up to medium test single wall. The nick size of this product is larger to offer the added hold needed for straight rule across the flutes. Use as alternate if "045 Medium" is too weak or "055 Extra Heavy" is too strong. This product has a 33% hold.</i>
<i>055 Extra Heavy</i>	<i>Use at SAME HEIGHT as straight cut. This is a durable hold for medium to high-test single wall and low-test double wall. Additional hold is significantly increased while maintaining a reasonable nick size. Caution should be used on long common knives over 16" as the break force may be challenged. Use as an alternate when "055 Heavy" is too weak. This product has a 37% hold.</i>



National Steel Rule

Recommendation for Bundle Breaker Products – Page 3 of 4

Flutes Across Press – STRAIGHT RULE Applied

Note: Top notch depth = .230" , Bottom notch depth .375"

APPLICATION: Replace entire common knife.

<i>Product Name</i>	<i>Suggested Use</i>
<i>045 Extra Light</i>	<i>Use at SAME HEIGHT as straight cut on low-test board and long common knives over 16" where the length of the hold assists the stabilization out of the die cutter yet remains breakable. Also use when "045 Light" is too strong. This product has a 25% hold.</i>
<i>045 Light</i>	<i>Use at SAME HEIGHT as straight. This is a good starting point for most applications of low to medium test board for common knife replacement lengths of 2" – 16". Also use as alternate if "045 Extra Light" is too weak or "045 Medium" is too strong. This product has a 27% hold.</i>
<i>045 Medium</i>	<i>Use at SAME HEIGHT as straight cut. This is good for medium to high-test single wall where break is less likely to tear and a bit more hold is desired. The nick size of this product is the same as the "045 Light" but the hold percentage is increased. Use as alternate if "045 Light" is too weak or "055 Heavy" is too strong. This product has a 30% hold.</i>
<i>055 Heavy</i>	<i>Use at SAME HEIGHT as straight cut. This is a durable hold for high-test single wall and low-test double wall. The .055" nick size is .010 larger than the "045 Medium". Additional hold is achieved by the increased nick size as well as an increased hold percentage. Use as an alternate when "045 Medium" is too weak or "055 Extra Heavy" is too strong. This product has a 33% hold.</i>



National Steel Rule

Recommendation for Bundle Breaker Products – Page 4 of 4

Flutes Across Press – CURVED RULE Applied

Note: Top notch depth = .230" , Bottom notch depth .375"

APPLICATION: Replace entire common knife

<i>Product Name</i>	<i>Suggested Use</i>
<i>045 Medium</i>	<i>Use at .030 below curved cut, (.937 for .970/.970 for 1.00 curved knife). This is generally too light for across the flute applications unless the common knife is very long. Use with applications of low to medium test board for common knife replacement lengths of over 16". Also use as alternate if "045 Medium" is too strong. This product has a 30% hold.</i>
<i>055 Heavy</i>	<i>Use at .030 below curved cut, (.937 for .970/.970 for 1.00 curved knife). This is good for starting point for most work up to medium test single wall. The nick size of this product is larger to offer the added hold needed for straight rule across the flutes. Use as alternate if "045 Medium" is too weak or "055 Extra Heavy" is too strong. This product has a 33% hold.</i>
<i>055 Extra Heavy</i>	<i>Use at .030 below curved cut, (.937 for .970/.970 for 1.00 curved knife). This is a durable hold for medium to high-test single wall and low-test double wall. Additional hold is significantly increased while maintaining a reasonable nick size. Caution should be used on long common knives over 16" as the break force may be challenged. Use as an alternate when "055 Heavy" is too weak. This product has a 37% hold.</i>