

A. Die Cutting

1. Rotary or Flat Bed Die Cuts

The main method or standard means of die cutting involves the use of metal dies to give paper or substrate products specific shapes or designs that cannot be accomplished by a straight cut on a web press or a guillotine cutter. By using knife-edge cutting blades formed into a pattern or die, a machine presses the die into the material to produce the desired shape. Almost any shape can be created and applied to a diverse array of raw materials. Labels, envelopes, folders, cartons, and documents are only a few of the many printed products that can be die cut for added functionality.

Web presses often have a rotary die unit that is utilized for die cutting paper and label stocks. Although there are limitations on the types of dies and the paper selections that can be provided, rotary die cutting serves as an effective method for longer run quantities of printed materials requiring some type of die cut area.

Single sheet products require the use of a flat bed die and a flat bed cutting press to die cut the shape into the paper stock. The speed of this process is slower than a web press, but it does provide die cutting capabilities to a wider variety of paper stocks and printed products.

Typical samples of various die cuts from steel blades:

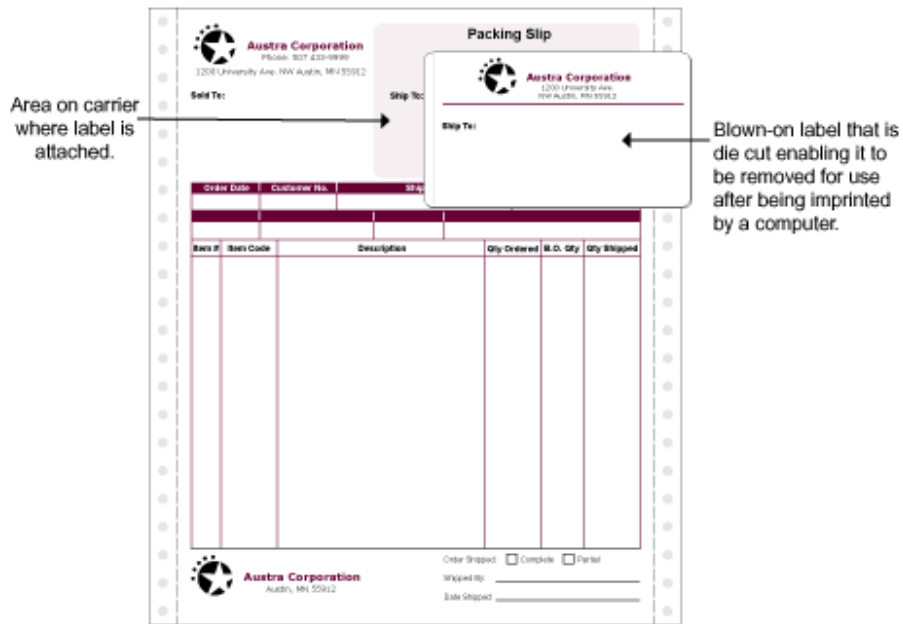
Cut Sheets or Integrated Products

Round Cornering
and Hanger Oval

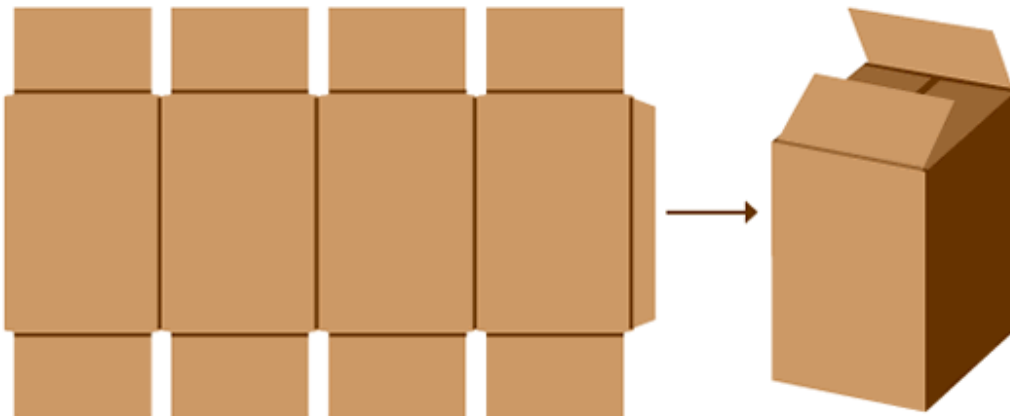


Tab Cut - for folders or dividers





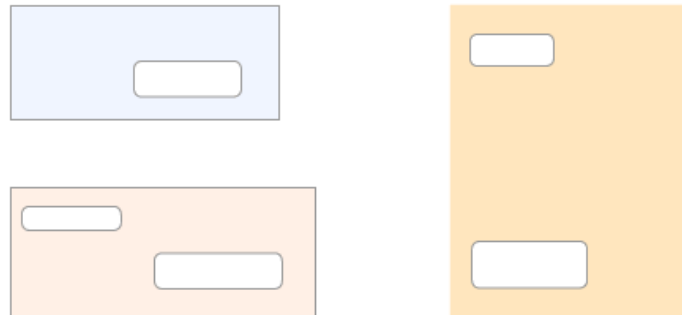
Cartons



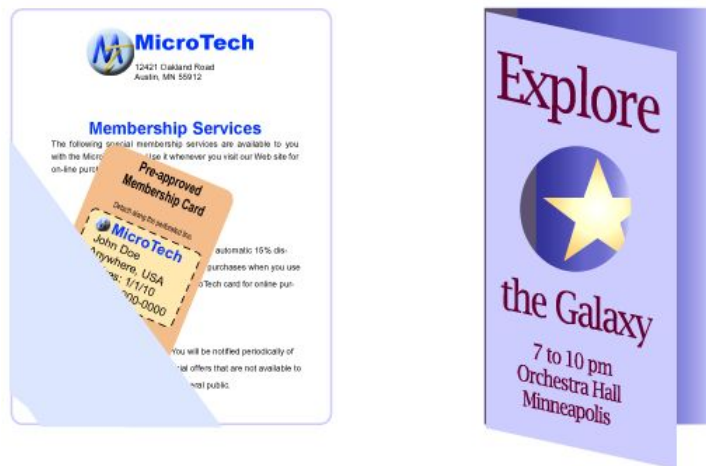
Die cutting areas away from a solid sheet of carton material enables a variety of folding and size configurations to be accomplished.

Window Envelopes

Non-standard window positions can be die cut and placed in any location to allow promotional messages to be viewed or to expose mailing addresses in non-standard positions.



Marketing Materials



A variety of designs can be created to attract attention or provide additional functionality to the document.

2. Laser Engraving

A second method of die cutting, which has been developed in recent years, is called laser engraving. By using a computer-controlled beam of light to cut through the material, text and images can be accurately reproduced on a variety of paper stocks. By using a laser, manufacturers can provide an exceptionally high quality, well-detailed and fine-lined reproduction of intricate art and images or corporate logos.

The laser can create die cuts that have cut away areas which are very small in size, unlike a rotary or flat bed die cut which encounters difficulty in having a die made for small cut areas and further, has difficulty in stripping away the paper from the small cut out areas. A laser engraved die cut can be created to reproduce a 800 dpi (dots per inch) image allowing for a cut impression with a significant amount of clarity and definition.

Samples of Laser Engraved Die Cuts



3. Perf Cutting or Perforating

An alternative to die cutting that is sometimes used is perf cutting or perforating. Perforations or "perfs" are generally classified for print specifications in one of two ways: 1) bursting strength or 2) TPI, which is commonly called either "Ties Per Inch" or "Teeth Per Inch".

a. Burst and Tear Strength

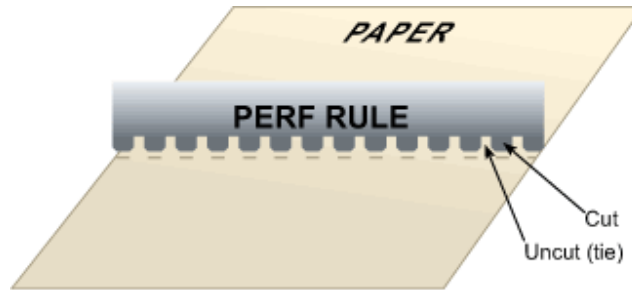
Burst strength is a measurement of the pressure (as measured on a burst strength gauge) that is required to detach the perforated section of a document. Tear strength is the physical effort necessary for removal of the perforated section. Tear strength can be categorized as "light release" which is easily torn, "medium release" which gives moderate resistance to removal, or "stiff release" which provides the greatest resistance from repeated handling and attempted removal.

The purpose and function of the perforated section often determines whether the perforation is to be an easy release variety (3 to 6 TPI) or a stiffer release (10 to 18 TPI). The weight of the stock combined with the TPI will also affect the burst strength.

b. Ties Per Inch (TPI)

Teeth per inch or ties per inch are both approximately the same count, but not the same dimensions. The tie or tab is the part of the perforation where the paper does not get cut, but remains intact to "tie" the paper together. The ties, or uncut areas, alternate with cut areas to form the perforation. The tied areas of the perforation are usually shorter in width

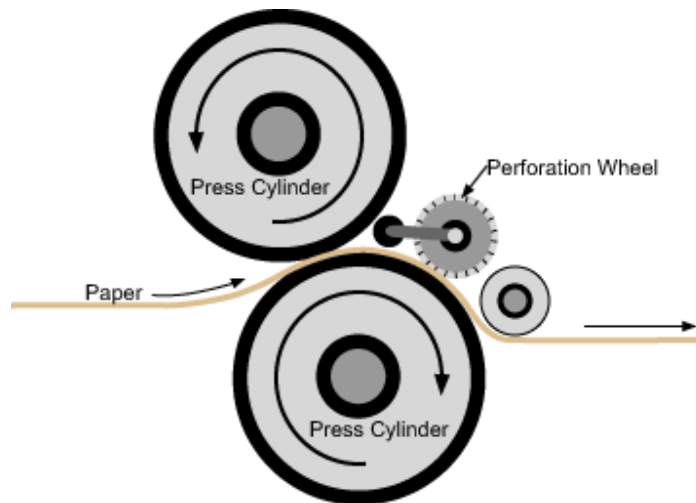
than the cut areas in order to allow for easier detachment of the sections separated by the perforation.



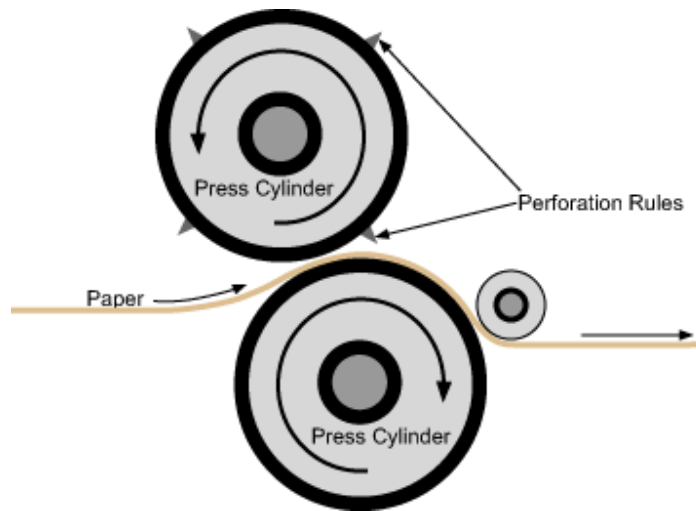
c. Application Methods

Products Printed and Perforated Online (Web Presses)

When a perforation must be applied parallel to the direction that the paper travels through the printing press, a steel segmented wheel is used. The segmented wheel rolls along the paper and applies the required cuts per inch as the paper is pulled through the press. Multiple perforations can be applied at the same time.

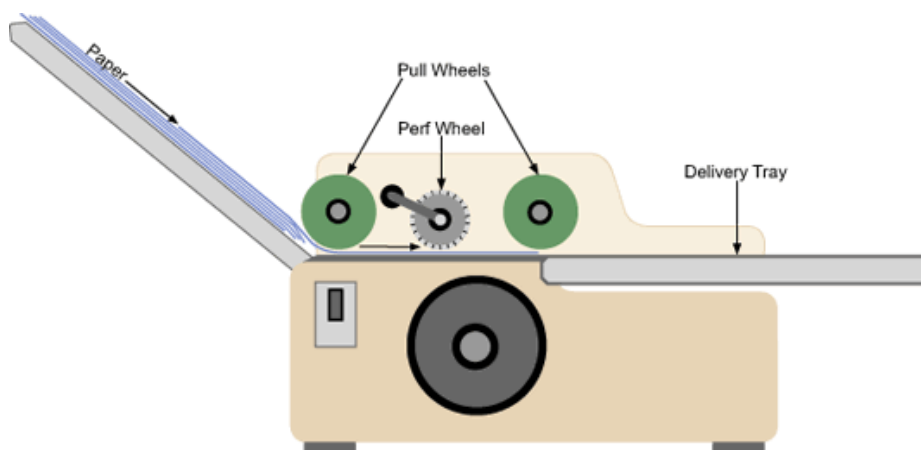


For perforations that must be perpendicular to the direction the paper travels through the printing press, steel perforation rules are used, which are inserted into cylinders on the press. As the cylinders revolve, the perforations are cut into the paper. More than one perpendicular perforation may be applied at one time, but the print supplier may be much more limited in the number and position of perpendicular perfs that can be applied at one time as compared to the number and positions of parallel perforations. Both parallel and perpendicular perforations can be applied at the same time.



Printed Products Perforated Offline

There are occasions when perforations are added as an offline process, after the product has been printed. Generally, products that have a perforation applied offline are for smaller quantities and have been printed on sheet fed presses. Large quantities are more economical to print and perf in one operation at a web press. Many products that are perfed offline are sent through equipment that can apply only full-length perforations and use wheels similar to those used on a web press. The perforating wheels apply full perforations either parallel or perpendicular to the grain of the paper, depending on the direction the paper is sent through the equipment. To apply both parallel and perpendicular perforations, the paper is sent through the equipment twice. To help save time, some products can be manufactured with several printed copies on one large sheet so that when the sheet is sent through the perfining equipment, the perforations are applied to all of the copies on the large sheet at the same time. The large sheets are then cut into individual finished pieces.



Some offline folding machines are multifunctional, allowing applications to be perforated or perforated and folded.

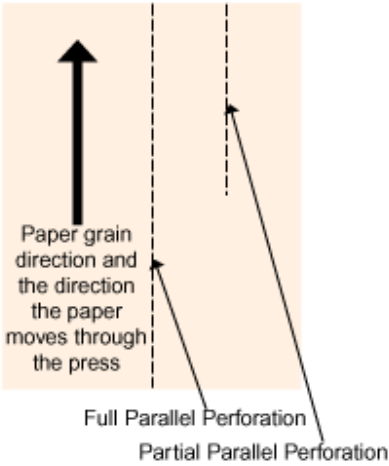
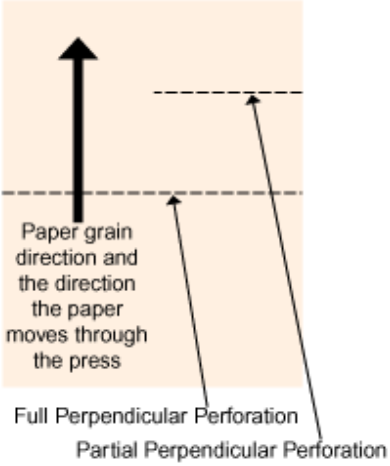
Perforations that are more complicated, such as a perforation that borders a detachable business card or a rolodex card within a larger sheet, can be applied with a perf cutting method, which is accomplished much the same as **die cutting**. Perforating blades, which contain cut and uncut areas, are constructed into a pattern. The cut area of the blade strikes through the material while the uncut segment or tie of the blade does not cut the paper, enabling the perforated area to remain attached to the document until it is to be removed.



A platen press can be used to apply a complicated perforation to an application. As shown in the example above, this method is often used for applying the perforation that surrounds a removable card.

Perforation Direction Designation

Parallel Perforation:	Perpendicular Perforation:
<ul style="list-style-type: none"> • Parallel perforations run in the same direction that the paper travels through the press. • The number and position of the 	<ul style="list-style-type: none"> • Perpendicular perforations run in the opposite direction that the paper travels through the press.

<p>perforations is usually not critical for full parallel perforations.</p> <ul style="list-style-type: none"> • Partial perforations do not run the full size of the printed piece. • The number and position of partial perforations are limited. Consult your supplier for information on these limitations. 	<ul style="list-style-type: none"> • There are limitations on the number and position of perforations allowed. • Partial perpendicular perforations do not run the full size of the printed piece. • The number and position of partial perforations are limited. Consult your supplier for information on these limitations.
<p style="text-align: center;">Parallel Perforation</p>  <p style="text-align: center;">Paper grain direction and the direction the paper moves through the press</p> <p style="text-align: center;">Full Parallel Perforation Partial Parallel Perforation</p>	<p style="text-align: center;">Perpendicular Perforation</p>  <p style="text-align: center;">Paper grain direction and the direction the paper moves through the press</p> <p style="text-align: center;">Full Perpendicular Perforation Partial Perpendicular Perforation</p>

Selecting the Proper TPI

- There may be special requirements that should be considered for the perforation, such as the repeated or excessive handling of the perforated stock.
- Outline any additional processing that will be required on the paper stock such as imprinting or folding, and how the end user will detach the perforated section.
- Consider the function of the perforation such as folding or bursting (folding enables the document to fit into an envelope).
- Consider the properties of the stock to be perforated:
 - Weight or thickness of the stock.
 - Stock elasticity or "spring back" of the material.
 - Stock content such as plastic, label substrate, or recycled material (recycled stock has shorter fibers).
 - The coating on the stock, which can cause the perforation to become lighter in depth than what was anticipated and less likely to detach as desired unless this factor is considered.

- Consider the bursting strength that is required and the tear strength desired.

Perforation Selection Chart

The following perforation patterns are general representations of the cut and uncut dimensions of the perforation. The length of the cut and uncut sections can be shorter or longer depending on special requirements of the perforated product. The patterns shown are merely standard dimensions and can be changed if necessary.

3 Tooth x .032"	10% of Hold	10 Tooth x .032"	32% of Hold
4 Tooth x .032"	13% of Hold	11 Tooth x .032"	35% of Hold
5 Tooth x .032"	16% of Hold	12 Tooth x .032"	39% of Hold
6 Tooth x .032"	19% of Hold	14 Tooth x .032"	45% of Hold
7 Tooth x .032"	22% of Hold	16 Tooth x .032"	51% of Hold
8 Tooth x .032"	26% of Hold	17 Tooth x .032"	54% of Hold
9 Tooth x .032"	29% of Hold		

- **3 to 4 TPI:** When one section of a document needs to detach easily from another section, 3 and 4 tie perforations are good choices. They are not recommended for a sheet that must remain intact for long periods of time because the ties are too loose.
- **5 to 6 TPI:** Because there are more ties per inch, 5 and 6 tie perforations are stronger than the 4 TPI, but they are still too loose to be used for documents that must remain intact for long periods of time.
- **7 to 10 TPI:** 7 TPI through 10 TPI perforations are stronger than the 4 or 6 TPI and help to keep the document intact until it is ready to be detached. They are most often used as a perforation within the document that allows the user to remove a section of the document.
- **11 to 14 TPI:** The 11 to 14 TPI category is also referred to as a "statement perf". They are most often used as a perf within a document that allows the user to remove a section of the document. For example, the top or bottom section of a "statement of account" form may be detached and sent back with a payment. The perforations are durable so it is best to fold the perforated section to weaken the perforation allowing for easier detachment.
- **16 to 17 TPI:** 16 and 17 TPI are stronger than the statement perforations and must be folded to weaken the perforation so that it detaches more easily. They are often used on magazine inserts and mailers.
- **Letteredge or Invisible Perf:** As the name implies, this perf is nearly invisible and leaves a clean, smooth edge after the perforation is detached. The most common ties per inch for letterhead perfs are 50, 66, and 72. Most print providers use one of these ties per inch as the standard for all of their letteredge perfs unless a specific TPI is requested. A letteredge perforation does not work well on paper stock heavier than 24 lb. bond because it is too difficult to control the depth of the perforation. Using a stock that is too heavy in weight may result in a perforation

that does not detach properly. If you are unsure of which TPI to use, you should discuss the options with your print supplier.

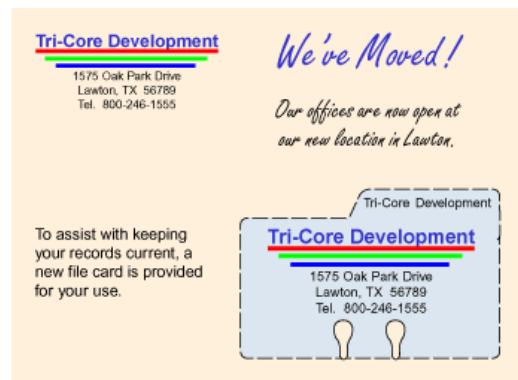
Samples of Perforations

Print materials can contain multiple perforations enabling a variety of tasks to be accomplished for additional processing of the document.



A 3-up direct mailer with a horizontal perforation for bursting, following the laser personalization of the copy.

A Rolodex Cutout Used as a Perf Cut / Die Cut



Note: Always check with the supplier of the product to insure that the required die cut or perforation can be accomplished on the material desired, with the shape requested, and in the locations indicated.