

# Perforations

## Background

The purpose of this bulletin is to help educate and define different types of perforation blades used in the industry and how to select the appropriate perforation for each application.

## Perforation Blades

In the label industry perforation blades are made to cut through to the anvil (metal to metal) and are set into engraved rotary tools which can be made with multiple precision milled slots at equal or special locations around the roll. Perforation blades can also be engraved as part of a regular die cutting tool, depending on the complexity of the label. Paper and film facestock can be perforated, but generally in the label industry, it is only recommended to perforate paper liners.

Perforations with the appropriate cut to tie ratio are used when labels have to be fan folded as part of the finishing process. Perforations can be used in the machine or cross direction of the web. If used in the machine, direction perforation wheels are typically used, while blades or perforation rules are used in the cross direction.

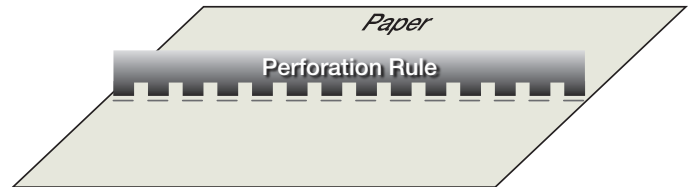
## Burst and Tear Strength

Perforations are classified according to burst strength or TPI (teeth per inch or ties per inch).

According to standard perforation rules, all perforations from 1-18 TPI should have a cut (gap) / tie size of .5 mm – 2 mm and a tooth size from .8 mm – 12 mm.

- > **Burst strength** is a measurement of the pressure that is required to separate a label or form at the perforated location. The weight and thickness of a substrate or paper liner will have an effect on the burst strength.
- > **Tear strength** is the resistance that a perforation offers in preventing a label or form from separating at the perforated locations.
  - **Light release** is easily torn (3-6 TPI)
  - **Medium release** has moderate tear resistance (7-10 TPI)
  - **High release** provides the greatest resistance (11-18 TPI)

## Selecting the appropriate Perforation TPI



**3-4 TPI** – When one section of the substrate needs to detach easily from another. This TPI is often applied in business forms that contain stubs.

**5-6 TPI** – Stronger than 3-4 TPI, this TPI has more tears, but is too loose for forms that must remain intact.

**7-10 TPI** – A medium release with moderate tear resistance, this TPI is commonly used for perforating the liner between labels so the end user can tear with ease.

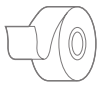
**11-14 TPI** – These perforations can be used in fan folding applications as the cut to tie ratio gives a stronger, more durable perforation in which the perforation would have to be folded to weaken the tie strength allowing for easier removal.

**15-18 TPI** – Mainly used for magazine inserts and mailers in commercial printing

## Cut to Tie Ratio

|                 |             |                  |             |
|-----------------|-------------|------------------|-------------|
| 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 |                  |             |

The illustration above is a general representation of the cut and tie dimensions of various perforations. The length of both the cut and tie sections can be shorter or longer depending on the specific application. As you can see, the hold percentage (tear strength) increases with the higher number of teeth per inch on a standard tie dimension of .032"



## Micro Perforations

Micro perforations, or invisible perforations, are designed with 28 – 45 TPI for ultra smooth perforations which tear easily. The teeth of micro perforations are more triangular in shape, or saw tooth, as compared to the regular TPI scale. The teeth have limited depths due to the way they are manufactured, making substrate thickness a concern. The die company should be able to recommend the appropriate depth for the thickness of the substrate.

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