The Magic of "Microperfs"—and a Quick Study of Perforating

Gregory Zimmer, Zimmer Industries Incorporated, Hawthorne, NJ, USA

Perforation may be basically defined as, "a line of holes or slits for tearing at a particular place." Sounds simple enough, but a highly effective perforation must simultaneously provide a proper balance between the necessary perf strength and an acceptable ease of perf tearing. Conventional perforating rules often have difficulty creating that proper balance. Additionally, even on the rare occasions when a good balance of tearing and strength is achieved, the resultant torn, perfed edges often look and feel "rough" and crude.

The family of perforating rules collectively known as microperforating rules, (or more commonly, microperfs) has significant advantages over conventional perfs in the sometimes elusive pursuit of effectively balancing strength and tear ability and additionally providing torn perf edges that look and feel smooth and "clean."

How do microperfs work?

Microperfs have been around for about 20 years now. They have been made in Teeth Per Inch patterns ranging from 20 TPI up to and including 300 TPI, with the most commonly employed patterns falling between the 30 and 120 TPI range. The spaces or ties (the distances between each tooth, or the uncut areas) have been made as large as .020" (.51 mm.) and as small as .002" (.05 mm.) Microperfs have historically been made with one of two basic shapes of teeth, either a semi-V-shape or a square shape. See illustration 1.

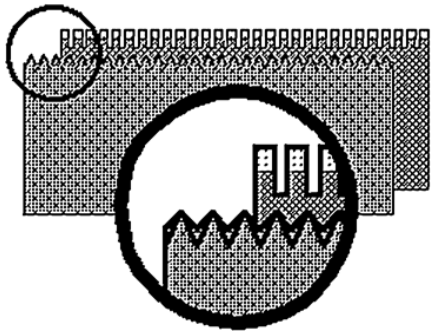

Illustration 1

The "secret" behind the "magic" of microperfs is actually just simple mathematics. Even though the spaces or ties of microperfs are extremely small, almost any reasonably desired perf strength can be achieved by simply employing the required (large) number of teeth per inch.

Historically, there has been a common misconception that the very small ties used in microperfs produce "weak" perfs. Just the opposite is true, when a large number of teeth are employed. The burst strength of a perforating rule may be determined by multiplying the number of teeth per inch by the size (in decimals) of the tie. For example, one of the most commonly used conventional perfs is 8 TPI with a .032" (.81 mm) tie or space between the teeth. Using the formula mentioned, multiplying 8 times .032", yields a 26% burst strength.

A microperf that creates a similar strength is 40 TPI with a .007" (.18 mm) tie. Multiplying 40 times .007", gives a 28% strength. Even though the strength is 2% higher for the microperf, it is still obvious that the microperfed material would tear more easily, because the ties (the uncut areas that eventually are torn) of the microperf are only .007", while the conventional perf has .032" ties (more than 4-1/2 times larger). It is also obvious that the edge created by the separated microperf will look a great deal smoother and cleaner than the edge produced by the conventional perf. See illustration 2.

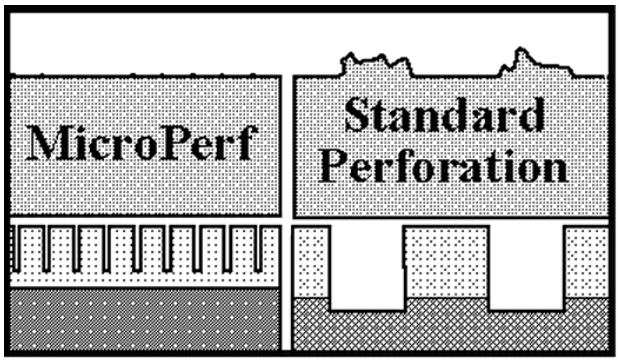

Illustration 2

Choosing an effective perf pattern

Let's compare another conventional perf and a microperf with the identical strength. A perf often used in converting is a 1/8" (3.17 mm) tooth (or 4 TPI) with a 1/8" (a .125") space or tie. The formula tells us that the burst strength of this perf is 4 times .125", producing a 50% strength. One of several microperfs that would equal this strength is a 50 TPI with a .010" (.25 mm) tie. The formula calls for 50 times .010" or a 50% strength. In this example, the difference in tearing ease and edge appearance and feel is even more pronounced than in the original comparison.

Many of the perfs commonly used in converting produce a 50% strength. There are quite a few options available that create a similar or identical strength in microperf configurations. Two such examples are: a 70 TPI with a .007" (.18 mm) tie (49% strength) and a 40 TPI with a .012" (.30 mm) tie (a 48% strength).

Microperfs even make it possible to create burst strengths of up to 70% with patterns such as 35 TPI with a .020" (.51 mm) tie. All microperfs, even the very strongest ones, tear easier and produce torn edges that are vastly superior to those provided by any and all conventional perfs.

PERFect applications

Some excellent applications for employing microperfs include: any difficult to tear material. Many plastics, Tyvek,™ tear resistant papers, etc, are perfect candidates for the use of microperfs. The reason for this is that the extremely small microperf ties always allow easy tearing, while still maintaining adequate perf strength.

Various packaging applications are also perfectly suited for the use of microperfs. User-friendly ease of tearing is certainly always desirable for the opening of packages. Additionally, the improved edge quality is a plus, especially in very demanding applications such as cosmetic, medical and pharmaceutical packaging. The use of microperf in automatic rule processors is increasing with the advent of more bendable rules made in coil form.

Another natural for the use of microperfs is on flexible, machined or chemically milled dies. Employing microperfs on the cutting edges of a flexible die provides the ability to microperforate in virtually endless shapes. Applications have included one as exotic as perfing the edges of US postage stamps with a 120 TPI pattern.

Microperfs can be used to create highly effective, strong, yet easy opening, "tear strips," by simply placing two parallel lines of microperf a small distance (such as 3/16" or 4.75 mm) apart and creating a "pull tab" that allows the tear strip to be opened.

Some converters have successfully used microperfs (sometimes in small pieces) to hold together sheets that otherwise might "fall apart" with conventional nicking. This might be seen as a way to create super strong nicking, without sacrificing product edge quality. The successful application of microperfs in diecutting has the potential to increase press yields. There has certainly been a major increase in the usage of recycled papers over the recent years. Microperfs, with their excellent strengths, are perfect for recycled stocks.

"Exotic" applications

A unique application for microperf is to use it for the scoring or creasing of various plastic films. This may be effectively accomplished by controlling the penetration of the teeth into the plastic. The two patterns most successfully used for this application are the 100 and 120 TPI configurations.

The creation of an oxygen barrier perforation is another exotic application of microperf involving the use of two plies of plastic (and or foil). Microperfing one ply with a very weak microperf pattern (such as 3% strength) and laminating it to an un-perfed ply, (the oxygen barrier ply) can create a two ply material that is an oxygen barrier, yet can easily and cleanly open (tear) when desired because the un-perfed ply will follow the weaker microperfed line while tearing.

A patented diecutting product such as MicroNik, while most often referred to as a cutting rule, may also be viewed as an "exotic" microperf. This is a very sleek steel rule with microscopic nicks precision cut at prescribed intervals along the cutting edge. The most common, standard pattern has 4 nicks of .007" (.18 mm) per inch. The sleek bevel minimizes the "wedging" affects of cutting, while the microscopic nicks hold the sheet together, in a manner similar to conventional microperfing.

A product of this type often increases press speeds and yields, eliminates the need for hand or machined nicking, improves stripping and or blanking and produces product edges that look and feel almost as if they have not been nicked at all. See illustration 3. As you can see, the applications for microperfs are virtually endless.

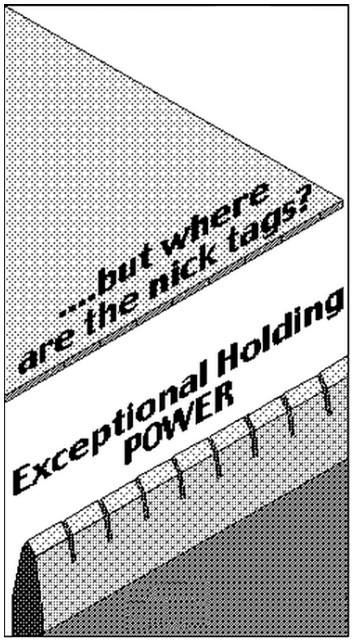

Illustration 3

Microperf tooth designs

Early on, we mentioned the shapes of teeth used in microperfs. It should be noted that the V-shaped tooth rule is usually less expensive than the square tooth version. Due to the various depths of the different V tooth

rules, the rules are limited as to the thickness of material they can be used on.

If the V-shaped perf is used on materials whose thickness is more than the depth of the rule's gullets, the rule may fully cut the stock, rather than perforate it. In all applications where the material may be thicker than the depths of the gullets of the V-shaped tooth and or where the perf needs to be consistent in strength throughout the entire thickness of the material, the square tooth shape must be used.

A new variation of microperf is being developed. It aims to fall between the two current designs, taking some advantages from both. It will be designed for ease of bending, be less expensive and available in coil form.

The productive impact of microperf

Many industries have not yet fully recognized and or taken advantage of the many benefits that microperfs routinely make possible. It may be possible that the relatively small extra cost of microperf is the reason some companies fail to properly consider the many significant, positive aspects this unique perf makes possible.

When weighed against the benefits to be gained, the extra cost per impression is very negligible. For example, if a die (or any other perf application) had 20 feet of standard perf rule in it and that rule was replaced with microperf, the additional cost would be around $23.

On a 250,000 run, that would translate to an "extra cost" of $.00009 per impression and that of course would not take into account the probable production and product improvements that microperfs often provide. It would seem obvious that cost should not be a factor overall.

Conclusion

Short and sweet—microperfs economically create perforations that are almost any strength they need to be, yet those perforations always tear easier and create product edges that look and feel vastly superior to those created by any and all conventional perforations.

That's the true "magic" of microperfs, the perforating rules that can make you a "Master Magician," when it comes to vastly improving both your standard and specialty perforating applications.

Gregory Zimmer is the CEO of Zimmer Industries Incorporated, manufacturers of steel cutting (serrated and standard), creasing, perforating and microperforating rules. He may be reached at 1-800-225-0108 x12 or via email at greg@zimmerind.com. Visit the company's website at www.zimmerindustriesinc.com.

For more information contact
Gregory Zimmer
National Steel Rule Vice President
g.zimmer@steelrule.com
Or visit www.steelrule.com
Tel: 800-922-0885
Tel: 908-862-3366
Fax: 908-862-5339