Gone are the days when a shear-slitting knifeholder was a primitive, cast-iron contraption that required a pocketful of wrenches every time a pattern change was made. It had to have the durability of an anvil because repositioning involved a lot of pounding with a hammer. Lost time, lost product and accidents were a fact of life. This, of course, is no longer acceptable.

Current knifeholders must be thought of as precision instruments, rather than blacksmith tools. As such, we expect more from them, and need to be more discerning about their usability, efficiency, design features and safety. This article will address some of these issues.

Rigidity, compliance, and vibration

The knifeholder must be compliant, that is: it must be able to absorb axial runout and lateral vibration without destructive “chatter.” The measure of a knifeholder’s compliance must be its overall harmonic response to the vibrations present in any machine system.

A massively heavy unit, without adequate compliance, may subject the blade to catastrophic lateral impact against the lower slitter, especially if a critical component vibrates. Therefore, we need to consider not just knifeholder weight and rigidity but the total dynamics of the unit — including the support system.

The most critical area in this regard is the method whereby the blade/hub assembly is attached to the knifeholder-support body. The use of spring plates should be considered. This allows the blade to tilt over the rim of the lower slitter and are troublesome for this reason.

If a knifeholder is to be used on machines where either edge of the lower slitter can be utilized, the ability to reverse the cant angle is a useful feature. This should be possible without the need to disassemble the unit merely to reverse the cant angle, and the precision, when reversed, should be unaffected. The use of precision-machined ever-present, lateral-machine vibration or absorb lateral anvil blade run-out.

Cant angle control

A basic law of shear slitting requires that the materials enter a “closed nip.” This means that the blade must be able to absorb lateral machine runout and lateral vibration without destructive “chatter.” The measure of a knifeholder’s susceptibility to vibration is not merely its weight and rigidity, but rather its overall harmonic response to the vibrations present in any machine system.

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The most critical area in this regard is the method whereby the blade/hub assembly is attached to the knifeholder-support body. The use of spring plates favors the “fork” — with significant blade to blade damage. On the other hand, an absolutely inflexible connection cannot disconnect the ever-present, lateral-machine vibration or absorb lateral anvil blade run-out.

Cant-angle control

A basic law of shear slitting requires that the materials enter a “closed nip.” This means that the extreme edges of both upper and lower blade must be in contact when the material enters the nip. Beyond this basic requirement, the amount of cant angle is less critical from the standpoint of slit quality but more critical from the standpoint of blade life. This statement can be verified by the presence of a myriad twin-arbor slitters throughout the world which slit critical products — despite the fact that twin-arbor slitters have no cant angle whatsoever.

Cant-angle control is a two-edged sword. The nip must be closed, as noted above, but excessive angle is very destructive to blade life. In practical reality, if all other slitting parameters are being met, 1 degree of cant angle should be considered maximum.

Especially important is the necessity that the blade be held truly vertical (90 degree) to the plane of the web, otherwise, it is impossible to guarantee a closed nip with such low cant angles. Knifeholder designs which incorporate springs in the blade retaining hubs, or as a part of a flexible hub-support mechanism itself, allow the blade to tilt over the rim of the lower slitter and are troublesome for this reason.

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components to fix the angle is not an option; any design that requires operator skill to interpret the cant angle, either by “eyeball” or by stick-on labels, is to be avoided.

**Set-up and repositionability**

Knifeholder design requirements vary according to frequency of pattern changes, machine accessibility, etc. If pattern changes do not interfere with in-line production, a simple, manual knifeholder, which can require a tool to secure the unit, may be adequate. In most instances, a simple rack-and-pinion system is fully acceptable. Then, there are applications in which time is of the essence, no interruption of the in-line process can be tolerated, and fully automated systems are required.

Since operator skill is a constant variable, the knifeholder must be intuitively simple. Extensive instruction manuals should not be necessary for day-to-day operation. Setting up a knifeholder during a pattern change should require no more than three separate operations (“place,” “set-up” and “engage”); preferably no more than two (“place/set-up” and “engage”). Otherwise, operator confusion could result.

Engaging or disengaging a slitter, once it has been set up, should not involve more than one operation; (“on” or “off”). The need to “tap it once or twice” with a hammer is sure evidence that the knifeholder design needs improvement.

Set-up cannot be taken lightly, as a fair amount of precision is needed. Most shear-slitting applications require the operator to place the unit within about 1.50-2.0 mm (about 1/16-in.) of the edge of the lower slitter edge. A significant amount of time and productivity is lost as the operator tests and re-tests the blade set-up. False starts because of a missed set-up are particularly wasteful.

Incorporating preset stops, or position locators to facilitate correct placement of the knifeholder, has been an important addition to knifeholder design in recent years. Look for design features that are robust and do not require an extra operation, such as sliding a tab in and out, or locating a reference edge before securing the unit to the guide bar.

**Side-load force regulation**

When springs are used to regulate side-loading, the preload placement of the blade has a significant impact on the actual side-load force. This means that the operator must place the slitter even more precisely and consistently at a predetermined distance away from the edge of the lower slitter edge during each setup. This may call for the use of shims, spacers or jigs to preset the unit, but because their use is dependent on operator competency, such knifeholders should be avoided whenever possible. Also, spring uniformity between spring-regulated knifeholders may be inconsistent, introducing yet another variable into the setting equation (Figure 1).

When pneumatics are used to control side-loading, initial blade placement is less critical. Unfortunately, most pneumatically actuated systems have the air cylinder axial to the blade centerline. When pneumatics are used to regulate side-loading, the pre-load placement of the blade has a significant impact on the actual side-load force. This means that the operator must place the slitter even more precisely and consistently at a predetermined distance away from the edge of the lower slitter edge during each setup. This may call for the use of shims, spacers or jigs to preset the unit, but because their use is dependent on operator competency, such knifeholders should be avoided whenever possible. Also, spring uniformity between spring-regulated knifeholders may be inconsistent, introducing yet another variable into the setting equation (Figure 1).

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Currently, the pneumatic approach is the preferred method of regulating side-load because it’s easily controlled and reliable. Increasing or decreasing the side-load force is as simple as changing the air pressure at the control console, in contrast to adjusting the placement of the unit itself (i.e.: “Hand me the hammer, Harry.”).

Engage and disengage sequencing

The knifeholder’s vertical and lateral strokes must be independent and sequential on both the engage and disengage cycles. The vertical stroke should be fully extended before the lateral stroke begins extension, otherwise a blade “crash” can occur. (Blade “crash” is usually defined by the operator as: “A condition, in which the RTPM blade has landed on top of the AT&RIV avul ring!”) In the same manner, the lateral stroke must be fully retracted before the vertical stroke begins retraction, otherwise the blade will “drag” over the edge of the lower ring and chipping may result.

This sequencing action must be followed for all shear-slitting systems, regardless of slitter design and is equally applicable to twin-shafted slitter systems, as well as individually mounted, traction-driven slitter systems.

For individual, traction-driven knifeholders, sequencing must be positively valued, rather than relying on a series of cascading orifices or sequential pressure chambers. These designs may become more impractical and unreliable as blade diameters are reduced during regrinding, creating a condition which requires that the knifeholder must extend further to maintain correct blade overlap.

A good test of the sequencing characteristics of any knifeholder is to set it for maximum vertical stroke and apply air pressure, noting the path the blade takes as it extends. It should fully extend its maximum vertical stroke first, and only then should it begin its lateral extension. If the lateral movement begins before the blade is fully extended vertically, the blade may come to rest on the perimeter of the counter blade, instead of against its side — the condition previously referred to as a blade “jump” or “crash.”

**Blade changing**

Removing a large, heavy knifeholder from the machine to change a blade is cumbersome and dangerous. Being forced to replace a blade while the unit is on the machine is also dangerous, especially if the slitters are in an awkward or inaccessible location. The use of fork wrenches, spanners, or hex wrenches to change blades on the machine should be eliminated for safety and efficiency reasons. Even the ubiquitous Allen key can cause problems if the operator cannot directly approach the blade retaining screws. Allen keys tend to accumulate under water holes.

The blade-clamping mechanism should be hassle-free and secure. Especially troublesome is the large rotating retainer nut, commonly used to secure the blade. This design requires an anti-rotation pin, which fits into a notch in the blade’s bore. Without this pin, the blade can rotate, which, in turn, can dangerously loosen or
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Four factors to consider in razor slitting

It may be the simplest and cheapest method available, but razor slitting still requires close attention to blade life, edge quality and operator safety.

By Reinhold Schabes, Applications Technology Manager, Tolland Corp.

The three most common methods of slitting flexible web materials are shear, crush (score), and razor. Of these three, razor has the lowest installed cost, being the simplest and cheapest method. It can be easily adapted to almost any machine, in almost any location. It is potentially the clearest method of slitting, assuming the appropriate materials are being slit.

A “cutting” or “skiving” action is created by pulling the material past the stationary blade. The resultant edge depends on the characteristics of the material, its thickness, density, rigidity, plasticity, coating, bonding and other factors. At issue are blade life, slit-edge quality and safety.

1. Safety

While the potential for bodily injury is not as great as with shear or crush (score) slitting equipment where rotating nips are involved, razor-slitting equipment is notorious for damaging fingers and hands. Safety innovations of the last few years are the advent of the tool-free removable blade cartridge, which allows blades to be changed off-machine, in a safer environment. This feature has done much to reduce hazards, machine down-time and improve blade-changing efficiency (Photo 3).

Safety

Knifeholder adjustment controls should be away from the rotating nip. The knifeholder’s engage and disengage actions should not be sudden, rapid movements which may startle an operator, or be too fast to get a hand out of harm’s way during setup. The knifeholder easy to reposeposition without putting hands close to the blade? Tools, shims, spacers or jigs should not be needed when making pattern changes. Blade guards should be robust and able to tolerate the occasional snarl that occurs during a web break. In some instances, automatic self-retracting, full-couverage blade guards may be required.

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The blade-retaining system must be fail-safe (avoid spin-on blade retaining nuts, as described earlier). Is there any possibility that the operator could install key-slotted blades so they can spin off if a screw works loose? On extremely high-speed machines, do the blade retaining screws have countersunk sockets to prevent the screw heads from releasing the blade? A blade flying off at 8,500 fpm is a serious hazard.

Blade changing should be done off-machine, in a safe environment, especially where access to the slitters is precarious. Unfortunately, many machines require the operator to hang to his toenails in half-light to change slitter blades. Blade-mounting systems that require the use of both hands to manipulate spanners, or wrenches to loosen the blade are especially dangerous under such conditions. The tool-free, removable blade cartridge is a major improvement to safety on these machines.

Blade handling should be minimized and done in a safe environment. The use of wax or other coatings to protect the blade edge is important, but the coating should be easily removable after the blade has been mounted on the slitter. This means that blade guards should not prohibit access to the blade once it has been mounted, nor interfere with complete removal of the wax coating.

If the guards do interfere with blade changing, then safety gloves should be worn. Large, heavy blades should be supplied as individually wax dipped rather than in a bundle, since separating the bundle itself can be dangerous — not to mention the possibility of nicking a blade edge.

After all is said and done, the knifeholder is a pivotal instrument in most industries involved with flexible webs. The tendency to think of slitting as an “afterthought,” and treat a knifeholder with the attitude that “any old device will do,” is being replaced with a greater appreciation of the importance of this seemingly insignificant part of most web-processing equipment.

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Wrap slitting using a grooved support roll. Large rolls require that only the blade tip be used for slitting. Oscillating slitting is not possible. Small rolls permit slitting to be done along the length of the blade edge, making oscillation possible.

One of the most important innovations of the last few years is the advent of the tool-free removable blade cartridge, which allows blades to be changed off-machine, in a safer environment. This feature has done much to reduce hazards, machine downtime and improve blade-changing efficiency.

Four factors to consider in razor slitting

It may be the simplest and cheapest method available, but razor slitting still requires close attention to blade life, edge quality and operator safety.

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The three most common methods of slitting flexible web materials are shear, crush (score), and razor. Of these three, razor has the lowest installed cost, being the simplest and cheapest method. It can be easily adapted to almost any machine, in almost any location. It is potentially the clearest method of slitting, assuming the appropriate materials are being slit.

A “cutting” or “slicing” action is created by pulling the material past the stationary blade. The resultant edge geometry depends on the characteristics of the material, its thickness, density, rigidity, plasticity, coating, bonding and other factors. At issue are blade life, slit-edge quality and safety.

1. Safety

While the potential for bodily injury is not as great as with shear or crush (score) slitting equipment, where rotating nips are involved, razor-slitting equipment is notorious for cuts and slashes that can be severe. Razors installed in the open span, where the blade must be removed in an emergency, is a potential hazard. The knifeholder’s engage and disengage action should not be sudden, rapid movements which may startle an operator, or be too fast to get a hand out of harm’s way during setup.

A related problem is the unintended rotation of the blade hub as the operator loosens or tightens the retaining screws. Designs that require the operator to use a second tool to prevent such rotation should be avoided.

The inclusion of an anti-rotation lock for blade changing gives evidence of the manufacturer’s concern for safety during the blade-changing sequence.

One of the most important innovations of the last few years is the advent of the tool-free removable blade cartridge, which allows blades to be changed off-machine, in a safer environment. This feature has done much to reduce hazards, machine downtime and improve blade-changing efficiency.

2. Principles of separation

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3. Installation parameters

The razor blade may be located in any one of several locations in the web path. The simplest is to slit in the open span between supporting surfaces, as is common in film extruders (Figure 1). Another location is in the valley between two closely spaced rollers. The advantage here is that the web is relatively taut, and does not “flutter” as severely as in a long open span. Both of these locations create a tangent slitting geometry, with little or no support for the web.

For example, slitting a rubber roll, which supports the web as it wraps around the roll to...
Trim slitting using razor blades poses a special challenge. Web tension must be balanced on both sides of the slitting blade. The narrower the trim strip, the more critical it is to have tension and support for the strip.

Figure 4:

The score slitting blade profile should be viewed as starting points in determining the optimum profile for any given material. Larger tip radii and included angles require more force to slit, even though durability is improved.

Figure 5:

Razor slitting is, in essence, the creation of a “controlled crack” immediately ahead of the blade edge. The mechanical properties of the material and the shape of the edge determine how and where the crack forms in the web, if the crack forms in the edge, the process is relatively stable. If this crack forms instead of the tip, the process may become unstable.

Figure 3:

The simplicity of score slitting is one of its main attractions, but slit-edge quality is highly dependent on important variables that must be addressed.

Score slitting, often referred to as “crush” slitting in international markets, is a common method of separating the web. Basically, a hardened steel disk is pressed against a rotating, hardened steel cylinder, creating a crushing nip into which the material is directed. The resultant nip force exceeds the ultimate yield of the material and the material is severed along the nip line. Changing slit widths is relatively easy because only the slitter is repositioned over the fixed anvil roll. That’s all there is to it. Simple, or so it seems.

Slit-edge quality is variable and depends on the material being slit, the blade-edge profile, blade-edge finish and anvil smoothness. Because slitting is a “crushing” action in the nip between the slitter blade and the anvil surface, it’s generally considered the dustiest of the slitting methods, delivering the poorest edge quality. Under a microscope, the resultant edge is ragged and frequently displays a ridge formed by material that has been displaced by the blade tip. Extremely dense or thick materials might require nip forces beyond the yield strength of the blade steel, making score slitting impractical.

Score-slitting variables can be separated into at least five different factors that affect the performance of the process. They include web material characteristics; nip forces their extent and effect on the blade and anvil roll; blade tip profiles; metallurgy of the slitter blades and anvil rolls; and mounting geometry of the blade relative to the anvil roll.

1. The web

Every material has its unique nip force requirements. The density, ductility, hardness, thickness and “grain” of the web determine the force required for plastic deformation to occur to displace the web around the tip of the slitter blade. Depending on the physical characteristics of the web, it might crumble, shatter, extrude or wrinkle. In fact, it might exhibit all of these reactions at various depths along the slit line.

One thing is certain: the web material must be displaced in an amount equaling the volume of the blade tip. This displaced material might be in the form of debris, a ridge along the slit edges, or a combination of both. The density of the material being slit is critical to determining the nip pressure for any given application. The nip pressure depends on the material properties: thickness, density, ductility, hardness, and strength. The nip pressure can be separated into at least five different factors that affect the performance of the process.
Five factors to consider in choosing score slitting

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The score slitting blade profile should be resized according to the specific material being slit, the expected amount of displacement, and the nip force required to displace the web. The nip force is determined by the nip width and the nip angle and is an important variable in the selection of the width and angle.

A typical utility razor blade may have a rather coarse grind finish, which rapidly polishes smoother during slitting. Unfortunately, this also means that the extreme tip is rapidly blunting at the same time. Sharper blades will have a longer service life compared to rougher blades. TiN or ceramic edges are the smoothest of all and give better service for the same reason.

Razor slitting is simple; no doubt about it. For many products and applications, it’s the best way to get the job done. But like any technology, it’s important to understand how it works, what its limitations are, how materials react “under the knife,” and what to do to make it function properly when things go wrong.
films, must be plastically deformed by the blade tip. This means that the tensile strength, elongation, and caliper thickness of the web become factors in slitting. High-elongation plastics, such as polyethylene, will extrude easily in the nip, while brittle plastics, such as styrene or acrylic, tend to crumble or shatter in the nip. Typical flexible packaging films can be slit with nip forces of 50,000 to 100,000 psi. Plastic sheet (greater than about 0.2 mm thick) might require very high nip forces of 200,000 psi and higher.

Metals must also be plastically deformed in the same manner, except that the tensile strength, ductility and caliper thickness parameters are even more critical. Usually only ductile metals such as aluminum or copper can be score-slit and only in a thickness classified as "foil." Expect to exert nip forces of 50,000 to 200,000 psi, depending on thickness.

2. The nip force

Because the nip induces compressive and tensile stress in the material, it becomes obvious that the nip force must be greater than the strength of the material. It must also be able to continue slitting during "transient events" (hard spots in the web, spills, folds due to wrinkles, etc.). Web speed also influences slitting because a form of "hydroplaning" may result due to the viscoelastic web property. A "low wave" could form in front of the nip if speeds are high enough. Under such circumstances, the nip force must be increased.

Determining the actual nip force is complex because it is a combination of the air pressure in the knifeholder, the piston area, the blade tip radius and blade tip included angle. If a lever arm is designed feature of the knifeholder, its mechanical advantage component must also be included.

If run-out of the slitter blade or anvil roll is present, or there is vibration in the slitting system, momentary impact forces and stresses could be extremely high, leading to severe chipping or catastrophic blade failure. In the same manner, interrupted slitting imposes a "shock factor" to the blade tip each time the blade drops off of the trailing edge of the sheet and impacts itself against the anvil roll.

Large-diameter blades will not drop as suddenly as small blades, just as larger automobile tires survive potholes easier than smaller tires. Blades that have been slotted to serve as perforating slitters suffer similar shock stresses at each edge in the performance of the blade, and as the blade goes over the slot, the more abrupt the shock.

Engaging the blade against the anvil roll should be slow and controlled to prevent shock to the blade tip. This is especially important where high nip forces are required to slit the material. For instance, when setting a heavy plastic sheet, a nip force of 200,000 psi might be required, and with a "soft start" engagement, the blade will "slam" into the anvil roll each time the operator turns on the slitter. Under these conditions, the shock could easily damage the blade.

3. The blade profile

Choosing the best score-blade profile usually involves some compromise between blade life and slit quality. Blade life is strongly determined by tip radius and tip angle as these two factors determine the stress concentration at the blade tip. With very few exceptions, all score-slit blades must have a small radius at the tip instead of a "sharp" edge that would fracture almost instantly as it is rotated against the hardened anvil shaft. This radius, unfortunately, is the reason slit quality is poorer than with other slitting methods—you are actually slitting with a blunted blade.

Silt quality is also strongly determined by the radius and included angle at the blade tip. A small tip radius displaces the web material easily, so slit quality is better, but tip erosion is severe. A small, included tip angle also displaces the web material easily, but blade chipping is a problem. As the tip radius and included angle are enlarged, blade life increases but slit quality decreases.

While the included angle of the blade tip is a constant, the tip radius continually flattens and enlarges as the blade wears. As the tip enlarges, the tip stress declines, and the rate of wear slows. Unfortunately, the nip force is now distributed over a larger "footprint" area, and slit quality deteriorates.

When regrinding score-slit blades, pay particular attention to the tip radius because achieving a precise radius is difficult. Because most grinding equipment does not have accurate profiling capability, operators generally grind the radius by "eye," so operator skill determines the accuracy of the radius. Surface finish is important; the tip should be smoothly polished, otherwise, rapid blade wear and dusty slitting will result.

Choosing an optimum blade profile is not always a straightforward process. The blade selection chart suggests typical profiles, but some experimentation might be necessary.

4. Metallurgy

Blade metallurgy determines a blade’s hardness vs. toughness. The primary metallurgical requirement for score-slit blades is shock resistance, which is described by the metal’s toughness. This is in contrast to shear slit blades in, which high abrasion-resistance (the metal’s hardness) is the dominant requirement. In general, toughness is usually more important than hardness when score slitting because score blades need good shock resistance in order to a series of cracks, or in the case of laminated products, delamination might occur and laminations might be laterally displaced.

Composite webs, such as paper, textiles and nonwovens, are of relatively low density, with interfiber voids that permit some displacement of the material by the slitter blade tip. Thus, nip forces can be relatively low, ranging from 50,000 psi for tissue to 150,000 psi for lightweight boards.

Laminated webs, such as pressure-sensitive labels, might exhibit interlayer slippage or displacement along the slit edge as each layer struggles to make way for the...
Solid webs, such as extruded or cast plastic films, must be plastically deformed by the blade tip. This means that the tensile strength, elongation and caliper thickness of the web become factors in slitting. High-elongation plastics, such as polyethylene, will extrude easily in the nip, while brittle plastics, such as styrene or acrylic, tend to crumble or shatter in the nip. Typical flexible packaging films can be slit with nip forces of 50,000 to 100,000 psi. Plastic sheet (greater than about 0.2 mm thick) might require very high nip forces of 200,000 psi and higher.

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withstand the internal stress caused by the nip force, especially if run-out, blade bounce or “chattering” is present. Because the blade exerts considerable cyclical force as it rotates against the anvil roll, the metal suffers repetitive stress-cycle failure. The smaller the slitter blade, the quicker the repetitive stress cycles accumulate. As the number of revolutions accumulate, the slitter blade edge begins to fatigue; it chips, the anvil surface becomes grooved and slit quality deteriorates. Increasing the nip pressure to improve slit quality results in even faster metal failure. Blade life is therefore fixed by the parameters of metal durability, nip stress, and a number of stress cycles (actual number of slitter revolutions at any given nip stress).

At the same time, blades need good abrasion resistance. Some compromise must be made because shock resistance and abrasion resistance usually occupy opposite ends of the steel formula equation. While it is not practical to list all the various steel formulas available for slitter blades, some generalizations are helpful. A relatively low carbon-content (under 1 percent) and low chromium-content (under 5 percent) steel has better shock resistance than abrasion resistance. Conversely, a high carbon-content (above 1 percent) and high chromium-content (above 5 percent) has better abrasion resistance than shock resistance, especially if the alloy includes significant amounts of tungsten, molybdenum or vanadium. That is an oversimplification of a complex topic, but it conveys the basic concept.

Regarding hardness, the anvil roll must be significantly harder than the slitter blades, otherwise severe grooving occurs. A Rockwell hardness of 64C is usually considered minimum. This suggests that the slitter blade hardness be about 4 to 6 hardness points lower—Rockwell 58C being a typical value. The blade should be hardened throughout, not merely surface-hardened, otherwise the softer core metal cannot support the stresses.

5. Mounting geometry

Score slitting is normally configured for a wrap-slitting mode instead of a tangent web path. Some web materials might become unstable under the influence of the rolling nip of the score blade, especially if there is a tendency for the blade to track to one side. Under these conditions, wrap slitting maintains better control of the web after it leaves the slitting nip. The slitter speed should be synchronized with the web speed.

Occasionally, under light-duty applications, the wrapped web has been used to drive the anvil roll, but web tension must be constant and adequate, or the anvil roll rotation will be erratic. Under these conditions the web must be able to freely rotate the anvil shaft even during acceleration, as well as provide torque for the slitters themselves.

When mounting score slitters, it’s important that the centerline of the blade is placed slightly downstream of the centerline of the anvil roll, otherwise the blade might track laterally, creating stress and abrasion at the blade tip. This “crawling” action can be likened to tire misalignment on an automobile; severe “toe-in” or “toe-out” forces the tire to scrub laterally on the pavement. The same thing can happen if the slitter wheel is not mounted slightly beyond the center of the anvil roll. The goal is to have a slight weather vaning action. The actual offset is not critical; a reasonable offset is about 1/8 of blade diameter.

The diameter of the anvil roll determines the maximum speed of the slit. The roll should not pass through periods of vibration during acceleration, which is an indication that it’s of marginal diameter. Slitter blade wear be severe under these conditions. As speeds increase, run-out, vibration, and anvil roll bounce might create a destructive “chatter” between the slitter blade and the anvil roll, which in turn creates extremely high momentary stresses at the blade tip, resulting in rapid metal failure. Increasing the diameters of the anvil roll and slitter wheels — to reduce component rpm and raise critical speed value—is usually a better long-term solution than trying to buy slitter blades made of an exotic steel.

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**Wrap slitting blade profiles**

Wrap slitting is best limited to relatively thin, flexible products that tolerate the compound bending that occurs in the slitting nip. Blade profile choices are limited, and setup is more demanding. Some suggestions:

- **A tip grind angle of 35 degrees to 45 degrees will serve as a general-purpose blade when wrap slitting.**
- **Attention must be given to the ability of the material to pass the slitter blade without damage due to crowding in the lower slitter groove.** Thus, a blade with these grind angles is best suited for supple webs that can tolerate rubbing against the blade.
- **When slitting multiple layers of materials, as in a sheeter, wrap slitting is usually preferred.** Two layers slit relatively well, but each additional layer appears to exponentially degrade slit quality. The blade tip must be extremely thin; a 45 degree is considered the minimum angle, and 60 degrees is common. When slitting thicker, denser webs, it's important to keep blades as thin as possible, because it's very difficult to prevent the outer transition corner from damaging the web.
- **A tip grind angle of 0 degrees (square) to 15 degrees can be used with good results on dense, nonfibrous materials provided the face width of the blade is wide enough to keep the outer transition corner from damaging the web.**
- **A back bevel on the contact face of the upper blade ring is important.** Whenever the blades have the potential of being tilted out of vertical alignment with the lower slitter, this vertical relationship between the upper blade and the lower blade is referred to as a rake angle, and can be a source of confusion regarding slit geometry. As the upper blade tilts over the rim of the lower slitter, the blade tip may extend beyond the edge of the slitter. When this occurs, the rake angle must be adjusted to accommodate this additional web material. When slitting metals in noncontact applications, this angle may be eliminated entirely for maximum edge durability. The back bevel on the contact face of the upper blade is important, and the more severe the angle, the more difficult it is to prevent the blade from damaging the web.

**Tangent slitting ring considerations**

The profile of the lower slitter ring, while not the same as that of the upper blade profile, should also be considered. The majority of lower slitter rings are of a simple cylindrical shape, providing support for the web as the upper blade shears the material. On rare occasions, a very pointed lower slitter blade may be designed to project up into the web line in the same manner as upper blades. A bevel, often referred to as a "back bevel" or "undercut," on the contact faces of both the lower and upper slitter blades is important. On the lower slitters, the back bevel acts as a dust-relief angle, preventing an accumulation of slitter debris from forming on the blade's edge. When the webs of the primary and lower slitter rings are in contact, this particular form of damage can be quite effective. A typical 30 degree bevel is used on lower slitter blades to prevent the outer edge from damaging the web. The lower slitter profile is often referred to as a "square" or "square edge" blade.
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Purpose” blades, optimum slitting may require
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y, how the material is deflected as it passes
trough the slitting nip. Wrap and tangent slitters deflect the web in distinctly different ways, it’s nec-
less to recognize how blade profile contributes to this deflection and its influence on the slit edge.

Minimizing web damage

The lower slitting grooves in wrap systems limit free deflection of the web, crowding it into the
grooves. Compound bending of the web in the slitting zone is a characteristic of wrap slitting; thus blade-tip dimensions should be reduced to minimize this potential source of web damage. Very slender blades, having steep, compound grind
angles are designed to keep blade-tip profiles to a minimum in the slitting zone. Hollow grinding is another means of reducing blade profiles, while permitting a somewhat more durable grind angle at the extreme blade tip. It is for these reasons that wrap slitting is best suited for thin, flexible materials.

Tangent slitting does not restrict free deflection of the web as it passes through the slitters, because there is greater available space between adjacent lower slitter rings. Compound bending of the web is not as severe, and may be entirely avoided if the blade is suitably ground. Blade-grind angles can be lower, resulting in more durable edges and longer blade life. Almost any material can be tangent slit, but especially in the case of rigid webs, a tangent slitting system is the method of choice.

Blade-edge durability and slit-edge quality may be at opposite ends of the equation, and some compromise may be required. Sharply pointed blade tips may produce better slit edges, but wear rapidly. At the other extreme, square-edged blades may produce lower slit quality, but are more durable.

Tangent slitting blade profiles

With the above principles in mind, here are suggestions for profile selection that occur in the slitting nip. Blade profile choices are limited, and setup is more demanding. Some suggestions:

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