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Approaches to Material Handling and Transport

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As diecutters know, from job to job and material to material there are challenges in reaching acceptable levels of cut quality, die life, accurate depth of cut…the list goes on. A whole book could be written about what happens in that split second a diecut is made. Challenging materials can cause major production delays and grey hairs, but you don't have to be in the game long to also know that sometimes getting the cut dialed in is the easy part.

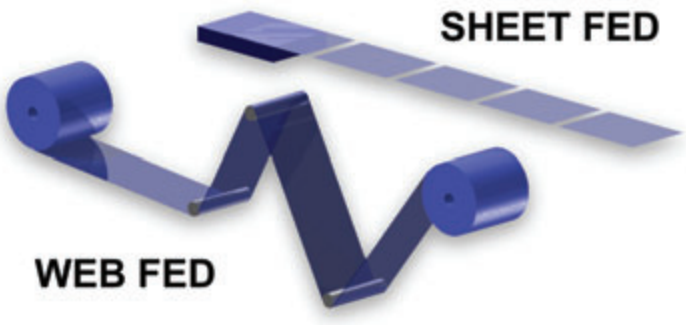

Diagram 1

Diagram 2

Often, the hard part is getting the material under the die in a controlled and repeatable fashion and then moved out to be stripped and collected or rewound. There are different methods that can be employed for material handling, be it in sheet form or web-based, and each has its own set of pros and cons. We'll look at each and gain a clear insight as to which might be best for your application.

Web, sheet or both?

Material handling can be split down to two base forms: web-fed systems and sheet-fed systems (see Diagram 1). It is almost always preferred to process material roll to roll (web fed). Web-based processing is more controlled, cleaner and lower in labor than processing material in sheet form, and it makes additional inline operations easier. However, the reality is that sometimes there isn't a choice. If you only have sheet-fed printers to work with or you have a material that can't be coiled, you're going to need to sheet feed your press. Though there are hybrid systems that can help bridge the gap and offer the benefits of web processing by converting the sheets to a web or vice versa.

Free loop web systems

Generally speaking, free loop systems are going to be the simplest form of web handling (see Diagram 2). They typically consist of a simple unwind station which pays out material as needed into a free loop. The material is then held in a controlled tension zone for processing, after which it is returned to an outbound free loop and rewound. These systems are small in footprint and have simple controls which lends to a relatively low cost. Free loop systems tend to induce very little stress on the material, and this allows them to process delicate materials quite well. Job changeover is usually fairly quick, as they have relatively simple web paths. The systems are inexpensive and quite versatile, but there are some drawbacks to them.

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MATERIAL HANDLING

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Diagram 3

Diagram 4

They don't tend to handle thin gauge materials very well since they rely on the mass of the material to allow it to "spool" off the roll, so lighter materials can be difficult, especially if they have a static charge creating an attraction. There is limited opportunity for additional processing, such as lamination or inspection, with these systems so they are usually reserved for parts that only require cutting.

Tensioned web

Tensioned web systems take it up a notch in terms of sophistication when compared to their free loop counterpart. This is where precision material handling and additional inline processing begin (see Diagrams 3 and 4).

Diagram 5

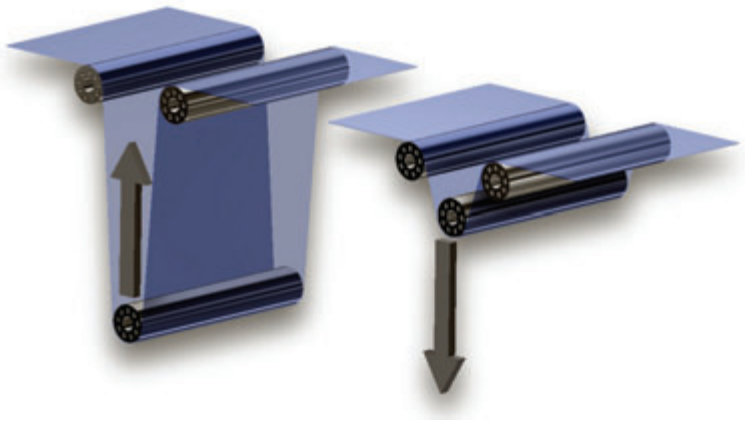

Diagram 6

These systems most often consist of an unwind station where the inbound web is held at a predetermined tension set point. The web is then moved into the cutting area and processed, after which it is then transported out and rewound under controlled tension. Since the material is held in a controlled fashion at all times, it presents the ideal opportunity to have additional inline processing, such as laminating/delaminating, pre/post inspections, part or matrix stripping, coating, printing—and in reality the sky is the limit. Another benefit of precise material movement is faster registration and cycle times of the press. Since the targets are presented to the vision system in a repeatable manner, the cameras can search a smaller area, decreasing search times (see Diagram 5).

No system is without drawbacks, however. Tensioned web systems cope with materials wonderfully, but can induce unwanted stresses on the material due to the moment of inertia associated with dancers and idlers (see Diagram 6). The web paths on these systems can be fairly intricate depending on the process of intent, so rethreading for job changeover can take longer than with free loop systems. Parts that have multiple processing steps or high tolerance requirements will usually dictate that a tensioned web system be utilized.

Sheet-fed systems

Sheet feeding a press can quite literally be as simple as an operator hand feeding the sheets, but we'll focus on automated systems (see Diagram 7). Sheet-fed systems consist of a set of suckers and gentle air blowers that separate and pick up an individual sheet from a stack and then present it to a belted conveyor or nip roller. Once the individual sheet is collected from the stack, it is then transported to the cutting platen, processed and transferred out.

Sheet-fed systems tend to be fairly inexpensive as it's a well developed method of material handling that's been around for a long time. Sheet feeding material tends to slow down press cycle times due to press having to wait for the next sheet to be advanced into the cutting area and the addition of another progression length (see Diagram 8). You will also see vision registration systems slow down due to a less controlled presentation to the cameras. They tend to have more theta error for the system to correct due being loose in the stack before they are picked up, and this also can add to the amount of time needed for registration (see Diagram 9). Job changeover times can be longer if the sheet size varies.

Hybrid systems

Converters in the sheet-fed world took notice of the benefits of web-based converting systems a long time ago but were slow to make the change due to the high investment from switching an entire shop' s methodology of material handling. Hybrid systems allow the sheet-based converter to bridge the gap and employ the spoils of web-based converting while still utilizing their core sheet-based competencies (see Diagram 10).

Sheet to web systems typically consist of a standard sheet feeder that is coupled to a specially designed lamination unit. The sheet feeder presents one sheet at a time to the laminator. The lamination unit has two roll feeds. One roll feed receives the sheet from the sheet feeder and is used to place it at a controlled interval. The second is used to laminate the sheets in a consistent spacing to a web of material that is either above or below the sheet, depending on the construction of the part. Once the sheets have been laminated to the web, the material is moved to the cutting platen or can be processed with inline operations, such as hot melt glue coatings, additional laminations, inspections, etc., prior to being diecut.

Diagram 7

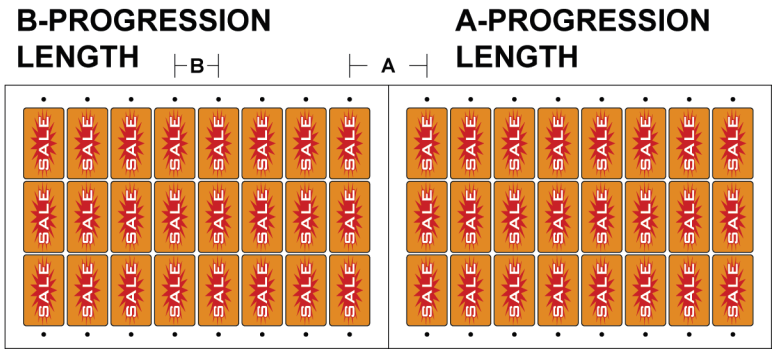

Diagram 8

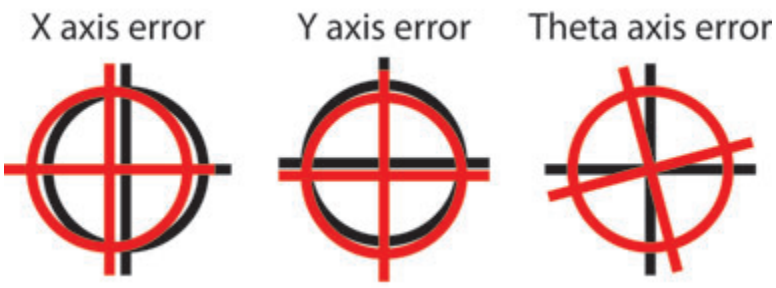

Diagram 9

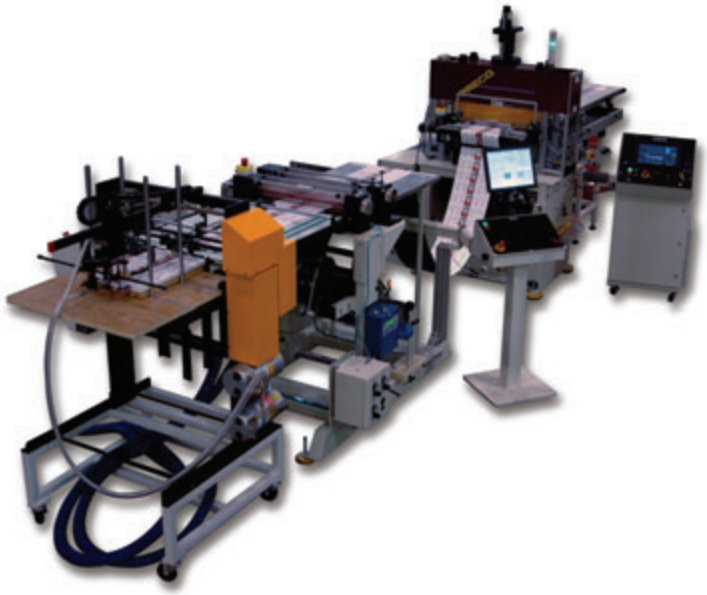

Diagram 10

Hybrid systems incorporate benefits of web-based handling, but also some of the drawbacks of sheet-fed systems. There is still potential for the sheets to have slight variance during placement which leads to small increases in registration cycles, and job changeover times can be considerably longer if changing sheet sizes regularly.

Each type of material handling system has its place, but unfortunately there isnt a single solution that can cover the entire gamut for diecutters.

General converters and job shops will most often be served well by free loop and/or sheet-fed systems. Because of their simplicity, it is often a simple process to switch back and forth between the two on the same diecutting press, allowing converters to offer multiple options to customers. Medical device and electronics manufactures often will be best served by tensioned web systems. This type of web handling is often necessary to maintain the high tolerance standards associated with these products and affords more options for value-added operations such as packaging and inspections. Label and promotional product diecutters are beginning to reap the rewards of hybrid systems, as they allow them to add operations such as hot melt gluing, lowering the cost of adhesive applications and eliminating waste liners.

As diecutters continue to push limits, so too must equipment manufactures to meet the demand for robust and versatile machines.

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