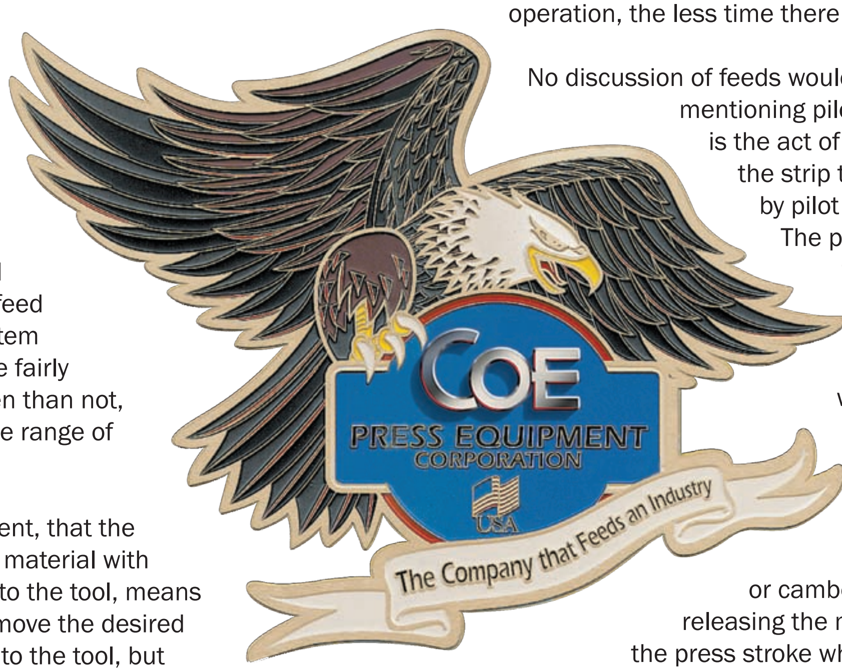
Press Feeds

In the majority of cases, a press feed must meet three criteria to be successful. First, it must be flexible in terms of set up. Second, it must deliver the material with sufficient precision into the tool, and third, it must feed at the correct time. In addition, there are many other important considerations that will ultimately determine just how effective the feed will be. Some of those considerations are the amount of time and skill required for job set up, the cost of energy to operate it, and how the feed interfaces with the system as a whole.

The feed needs to be flexible enough in its set up adjustment to accommodate the full range of applications that will ever be run on the line. It must allow adjustment to cover all set ups respective to feed length, material width and gauge, feed and pilot release timing as well as die heights. If the feed is for a dedicated system these variables will be fairly limited but, more often than not, it must address a wide range of applications.



The second requirement, that the feed must deliver the material with sufficient precision into the tool, means that it must not only move the desired amount of material into the tool, but it must place it precisely in the die in terms of front to back, side to side, and be square with the tool. Misalignment results in binding and short feeds due to slippage and strip buckling. Short feeding results in bad parts and broken dies. When they are new, nearly any feed, if properly installed and set up, is capable of delivering a level of length accuracy that is acceptable for most applications. They will generally retain that accuracy if properly maintained, but the amount of maintenance and set up time required will vary dramatically from one type of feed to the next.

Regardless of the feed that is chosen, when installed it must be positioned on center, square to the tool, and be rigidly mounted so that no movement can take place between the tool and the feed, for it to be able to deliver material correctly without binding and mis-feeding. In addition to proper feed installation, the tooling must be placed precisely on each set up as well. It is recommended that some sort of registration device, such as positive stops on the bolster, be used to insure consistent placement of the tooling. Without good quality material, proper straightening, and precise alignment there will be problems regardless of what feed is ultimately selected.

The third requirement, that the feed deliver material at the proper time, means that it must be capable of keeping up with the speed of the operation. The time that a feed actually has to deliver material is the result of the amount of time for one complete press or shear cycle, minus the time that the tooling is engaged, minus the time required to detect a mis-feed and stop the press. This means that the longer the die engagement, or the faster the speed of operation, the less time there is to feed.

No discussion of feeds would be complete without mentioning pilot release. Pilot release is the act of momentarily releasing the strip to allow it to be aligned by pilot pins in a progressive die. The pins in the die will correct for slight mis-feeds by pulling the material back into position. This feature is used primarily with progressive dies but it can be beneficial in applications that don't use non-progressive dies as well. A small amount of misalignment or camber can be tolerated by releasing the material at the bottom of the press stroke while, it is held by the tool even if there are no pilot pins. This momentary release helps relieve built up stress and binding of the strip through the feed due to misalignment or camber and alleviates walking problems.

Timing is critical to a successful pilot release so it is best if it's easily adjusted for each tool. Mechanically actuated pilot release insures synchronization with the press at almost any speed but the adjustment procedure is somewhat cumbersome. Air operated pilot release is easier to adjust if a programmable cam is available but it has a limited speed capability - although some units are capable of speeds as high as 400 SPM. Servo driven pilot release is available as an option from a few manufacturers. It has the advantage of being completely programmable and is capable of very high speeds but is an expensive option.

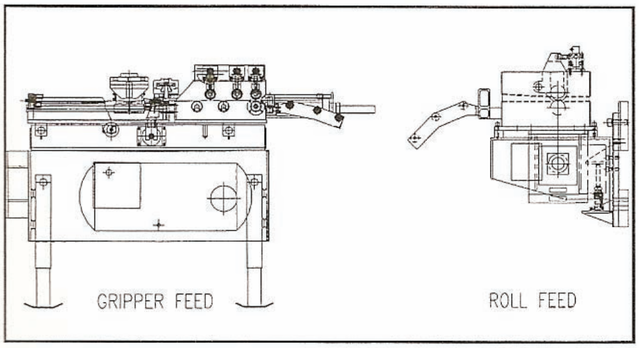


FIGURE 6

There are two basic feed types, roll feeds and gripper feeds, as shown in Figure 6. The first category, the roll feed, can be either powered by the press, or it can be powered by its own self contained drive system. Roll feeds that are driven by the press, such as rack and pinion or cam feeds, are always synchronized to the rotation of the press. It always begins its motion at some predetermined point in the press cycle and finishes at another predetermined point regardless of press speed or die engagement. Although the index speed must increase or decrease to keep pace with the press, the feed can draw as much power as it needs from the press to accomplish this, within the limitations of the mechanical coupling to the press. This differs from a self powered unit, which begins its motion in response to a signal from the press, but which has a finite, minimum amount of time in which it is capable of indexing, which is based on the amount of power it can deliver, and the load that it sees. The result of this is that the point at which it finishes can therefore vary with the press speed. The faster the press runs, the later in the stroke a self powered unit will finish as opposed to press driven units, which always start and finish at the same point in the stroke regardless of press speed.

This synchronization feature makes press driven feeds ideal for high speed indexing, feeding "in die" transfers, or for use with unloaders and other applications that require feed motion to be tied to press rotation in order to avoid a collision. Due to the lack of adjustment in timing, the feed motion for all dies cannot begin until a point in the stroke at which the deepest draw die disengages, which limits the feed window to the worst case scenario. On the other hand, air and servo powered feeds operate independently of the press and can be adjusted to begin feeding as soon as the die opens,

Inherent in their design, press driven feeds exhibit a very smooth motion which is called an s-curve move profile, as opposed to the trapezoidal move profile used by most other feeds. An s-curve motion profile means that the rate of acceleration varies throughout the index, resulting in the elimination of the sharp transitions in velocity, which can cause slippage with other feeds. Most self-powered feeds go from a stationary condition directly into a fixed rate of acceleration, resulting in a sharp velocity transition called a "jerk" point. These jerk points occur at the beginning, middle, and end of each move. Press driven feeds, on the other hand, make gradual transitions in velocity, with high acceleration and deceleration in the interim. This results in the elimination of these jerk points, while retaining the ability to make very high-speed indexes with good accuracy.

Drawbacks to most press driven feeds lie in their difficulty of adjustment, feed length limitations, lack of inching capability, and absence of controls interface. Most require that gear sets, rollers, or mechanical linkages be changed to adjust feed length. They are also somewhat limited in their range of feed length adjustment. Since they are directly coupled to the press rotation, they lack the ability to jog the strip for threading. Additionally, because of the lack of electrical controls, mechanical feeds cannot accept set up information from or provide feedback to press control, or automation systems.

Servo driven roll feeds have been used in press feeding for a number of years now. The initial apprehension with this developing technology is disappearing as the technology matures. Nearly every manufacturer of press feeding equipment now has an offering in this area. The concept involves the use of a closed loop positioning drive, usually a servo (but sometimes a stepper) to control the index position of the feed rolls.

Servo driven roll feeds share many of the advantages with the press driven variety, such as minimal space requirement, low maintenance, and high speeds. However, servo feeds also provide benefits that press driven units cannot. The fact that they utilize a microprocessor based control gives them an added dimension. Features such as programmable move patterns, self diagnostics, auto correction, and the ability to communicate with automation - just to name a few - set them apart from other types of feeds.

Servo drives have been used for positioning applications in manufacturing for a couple of decades. The technology has matured to the point that these drives are more reliable and less expensive than they were in the past. The number of domestic and foreign manufacturers has increased dramatically in the past few years. The increased reliability, modularity, and self-diagnostic features of servo systems has done a lot to ease the fears that existed earlier, although even now it may still require a considerable degree of technical expertise to isolate some problems.

Servo driven roll feeds also differ from press driven units in that they are available in a wide variety of configurations including conventional two and four rolls units, feeder/

straighteners, unwinder/feeder/straighteners, and zigzag units. Feed control packages range in sophistication from simple to use, single setup controls with thumbwheels or keypads, to systems that allow programming elaborate multiaxis move patterns, control of auxiliary functions and devices, as well as offering varying levels of memory and communications capability.

Most servo feeds manufactured today utilize a trapezoidal move profile with its four distinct jerk points that can cause slippage but some are also available with controls that can execute s-curve move profiles. Systems that are electronically synchronized to press rotation are available as well. These units require a special controls package and feedback device, either a resolver or encoder, that is attached to the press crank to track press rotation. There top speeds are still limited by the available drive power as opposed to press driven feeds which can run as fast as the press and tooling are capable of.

Gripper feeds employ a linear motion to move the strip as opposed to the rotary action of roll feeds. They are available in a wide variety of sizes from very simple, compact, low cost press mounted units to large cabinet mounted models which include pull through straighteners. Gripper feeds utilize a pair of clamps; one remaining stationary called the retainer, and the other moving in feed and return strokes called the gripper. During the feed stroke the retainer releases the strip as the gripper clamps and moves it forward through the top half of the press cycle while the tool is open. On the return stroke the gripper releases the strip and the retainer holds it while the gripper retracts away from the press through the bottom half of the press cycle while the tool is closed. Since it usually takes about as much time for the return stroke as it does for the feed stroke, gripper feeds are limited to a 180 degree feed window at maximum operating speed.

The gripper and retainer clamps can be cylinders, air or hydraulic powered, or they can be one-way roller mechanisms that hold the strip in one direction but allow it to roll freely past in the opposite. With cylinder powered clamps, the timing of the clamp and release is critical to accurate feeding and can be a limiting factor in terms of speed. If the timing is not correct the strip can be free at times to fall back resulting in short feeds. Clamping is actuated by solenoid valves or air logic valves. Timing can be controlled either electrically or through valve porting.

The pulling force for the gripper can be provided by an air or hydraulic cylinder, hydraulic motor, or by a servo motor. The gripper is usually supported by guide bars or rails and is driven by cylinder rods, chain and sprockets or ball screws. With air or hydraulic powered units the feed length is set by adjusting a positive stop. The gripper moves between the adjustable stop and a stationary stop, and employs a cushion of some sort to soften the blow at the end of each stroke. Feed length adjustment may require the use of tools and often involves some trial and error which usually results in longer set up times.

Servo powered gripper feeds utilize a closed loop servo drive coupled to a ball screw and nut to position the gripper, and do not use stops or cushions. Feed set up information is programmed into the control unit via an operator interface, or can be serially downloaded from another device. The control unit then commands the servo drive to position the gripper accordingly. Servo driven units enjoy many of the advantages of electronic roll feeds in terms of programmability and the ability to interface with press automation systems.

Gripper feeds are limited to a specific maximum feed length based on the model that is selected. The longest feed length requirement must be anticipated at the time of purchase. The disadvantage of this is that each additional increment of length costs more money, and the longer feed length capability dictates that the machine itself become longer and therefore requires more valuable floor space. The tendency is to buy the shortest machine that will fill the need. If there is ever a need to run a feed length that is longer than the machine was designed for then it must perform multiple cycles on each press stroke commonly referred to as “multi-stroking”. This capability requires an optional and more expensive controls package, and because of the time required for the return stroke, the press usually must be operated in the single cycle mode when multi-stroking.

Air powered grip feeds are generally inexpensive and are commonly used in conjunction with pull through straighteners to provide a cost effective alternative to roll feeds with powered straighteners, for applications requiring low to moderate speeds and limited feed lengths. Their low purchase price will be offset in time by the higher set up and maintenance costs and the high cost of energy to operate them. Compressed air is often an expensive medium of energy with losses due to leaks, pressure drops and contamination. Because of the many moving parts and wear components, maintenance costs can be quite high. These machines require timely maintenance to sustain good accuracy and performance.

In conclusion, it’s safe to say that there are as many ways to feed a press as there imaginations out there. There are many important considerations in the purchase, set up, and operation of this equipment that will determine how productive it will be. If the system is to work at maximum efficiency, then each component of the system must complement the others. Discuss each application in depth with potential customers so that you can bring the benefit of your insight and experience to their advantage.