Plan Your Way to a Bet ter Transfer System

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When transfer-die procedural guidelines are applied to tooling for part manufacturing and handling, all styles of transfer mechanisms can perform to expectations. However, as a metalformer, your main requirement is the number of parts that can be produced per day. Knowing the required strokes per minute (SPM) and how many parts are needed, you can determine which level of automation suits your application.

Maximizing SPM

A fine balance of die, transfer and press functions is applied to transfer systems to help metalformers maximize production SPM. Two distinct methods are used to determine maximum transfer SPM.

The first method considers only the transfer. Using this method, time values are assigned to finger travel, lift and linear motion. Time, mass and dynamic limits are used in the equation to determine maximum transfer SPM.

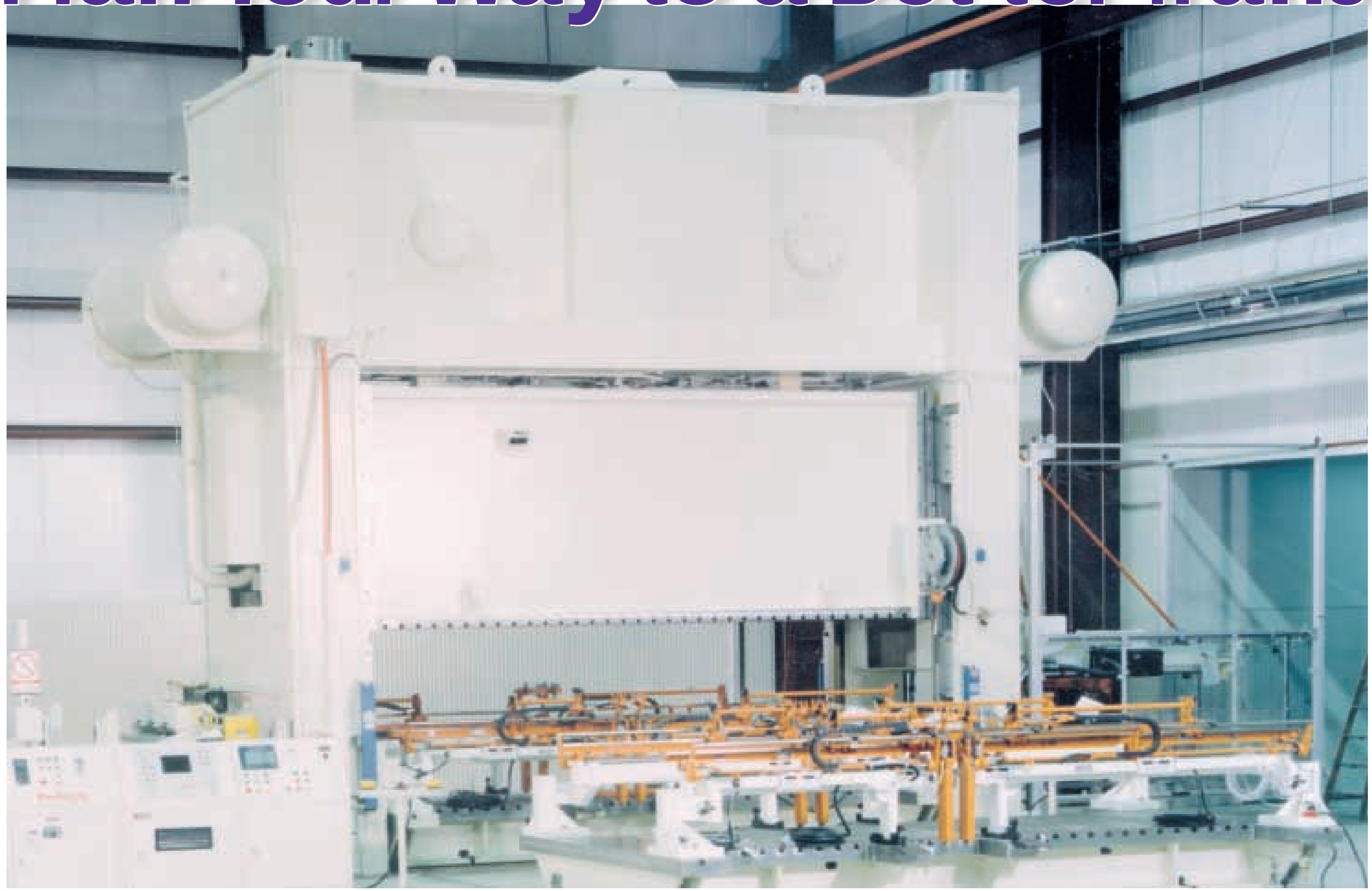
Usually, transfer-system suppliers not involved with die and press functions use this method. When die functions are added into the equation after the fact, they can affect production SPM dramatically.

There is a common misconception that a programmable transfer system can compensate for a lack of attention in die design relative to the transfer function. This misconception is the reason many transfer systems or transfer presses in the field actually produce parts below projected SPM and efficiencies.

The second method combines transfer, die and press functions into the equation to attain maximum transfer production SPM. Time is an independent function of press crank speed and has no relationship to press stroke, transfer motion or die function until the vertical distance required to produce the stamping is determined and assigned.

It is possible to expand this travel to accommodate die travels, transfer motions and press stroke, which are all related, and develop a timing chart, or interference curve, for transfer motion. Die functions taken into consideration with the second method include draw depth, upper and lower pad travels, and guide-pin engagement.

The die designer needs an interference curve that considers proper die, transfer and press timing that conform to the metalformer's production SPM requirement. With the interference curve in hand, the die designer can create a die that conforms to the metalformer's stated specifications.



When selecting a transfer system for your press, know the number of parts needed and the required strokes per minute. Armed with these details and with proper attention to die design, you can determine the level of automation you need.

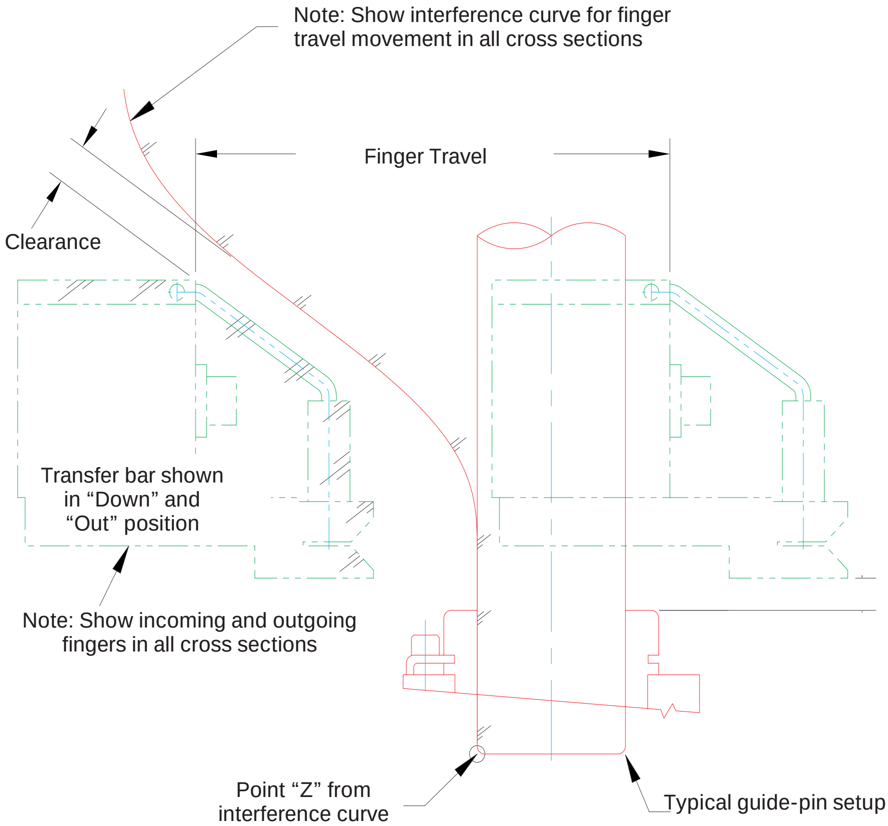
Transfer Systems

The **mechanical transfer system** driven off the press crank provides positive motion on every stroke of the press. A production worker cannot change the transfer motion. The mechanical configurations from power takeoff may limit this method's flexibility in linear motion, finger travel and finger lift for future parts.

The **slide-driven, all-mechanical transfer system** is configured to manufacture all shapes and sizes of parts. A simple manual cam change can provide a new transfer motion. Parts from 1 in. to 100 in. wide can be run manually moving the unit closer to the centerline of the die while maintaining minimal finger stickout to guarantee higher SPM with no finger flexing.

Historically, once you establish finger travel and lift and optimize SPM, there is no need to change these motions. Many metalformers report that eliminating changeover on the plant floor greatly increases efficiency.

Transfer-Finger, Interference-Curve Diagram



On the design plan of the die and all cross-sections, show both incoming and outgoing transfer fingers and the interference curve in the cross section of each station.

The **servo-driven, electronically linked, programmable-transfer system** operates independently of press operation. The programmability of the transfer provides flexibility of transfer motions. Speed and position of linear motion, finger travel and lift are directly related to the speed and position of the press slide.

With a servo-drive for linear motion and slide-driven finger motion transfer system, the servo drive changes linear motion from one part to another. Transfer-finger and lift motions are achieved by a single component attached to the press slide. This component can be changed for future parts when die-design considerations require new specifications to maintain maximum SPM.

A finite motion path for transfer fingers for all styles of transfer, whether mechanical or servo, should be established at the time of die design to achieve maximum SPM.

If dies are designed without predetermined motion paths—or interference curves—the following problems can occur at tryout:

- Die-to-automation interference;
- Need for remachining of die and/or automation;
- Reduced production rates;
- Loss of integrity of die and/or automation from machining to "make things work;"
- Shift from paper engineering to on-the-floor trial-and-error to achieve production requirements.

With these problems, tryout can extend well into the production stage. Also, plant-floor troubleshooting causes more deterioration of tooling fingers and dies, resulting in poor-quality stamping at reduced rates.

Tool-Design Tips

For tooling and part-transfer-system development to be successful, tool suppliers must adhere to the required engineering techniques. This includes construction of a transfer-die flow chart (see sidebar).

The transfer-die flow chart is similar to a strip layout for a progressive die, less the carrier ribbon. Starting a project with a flow chart can help:

Increase profits. A comprehensive flow chart can provide efficiencies to maximize return on investment (ROI).

Keep the project on time. Flow charts can help you adhere to project time frames by expediting communication among the die designer, die builder, press manufacturer and transfer builder.

Create accurate budgets. By processing parts before setting budgets, costs can be accurately predicted and time frames can be correctly established.

Expose possible problems. By developing a product's automatic process in advance, manufacturing problems can be exposed before product finalization. Manufacturing solutions are solved on paper, not on the plant floor.

Properly size the press. When you know part-process parameters, you can specify the proper-sized press and avoid operational compromises and any additional expenses.

Reduce tooling costs. Flow charts remove uncertainty—and thus added costs—from the tooling proposal process. They provide a structured method that tooling suppliers can use to accurately develop their proposals for transfer tooling.

Avoid scrap problems. Flowcharting is used as a tool to plan for scrap removal. Scrap can negatively impact the overall efficiency of your operation if its removal is not planned in advance.

Optimize SPM. The flow chart defines die and transfer timing conditions, which helps optimize SPM.

Determine your ROI at the start of the project. Since flow charts help you establish accurate budgets and time frames as they relate to anticipated unit volume, they can help you determine your competitive position.

When applying transfer-finger tooling, simultaneously start finger design with the tool designer—after flow-charting. This proven engineering method eliminates the need for transfer-finger adjustment once the die and transfer are completed and ready to launch.

The simultaneous engineered approach allows you to increase profit by adjusting on paper rather than in the production press.

Die Designer's Checklist

The die designer's checklist is the next critical step in achieving expected efficiencies and higher annual throughput:

• On the die design, show all flow-chart information. On the plan of the die and all cross-sections, to avoid transfer unit-to-die interference, show an outline of the transfer unit, the transfer mounting brackets and the transfer bar and junction box.

• Show incoming and outgoing transfer fingers and the interference curve in the cross section of each station (see "Transfer-Finger, Interference-Curve Diagram" illustration).

• Dimension and locate the die stations relative to the press centerline. Hold the dimension between the centerline of each station to ±0.015 in. nonaccumulative.

• Provide rough locators/pilot pins in the lower die station to contain the part in all directions. The purpose of the rough locator or pilot pin is to maintain part location when the transfer fingers retract. All rough part locators and pilot pins require a minimum lead of 0.25 in. and a minimum gauging surface of 0.50 in. Note that the transfer system is not a gauging device.

• Show and dimension part attitude in the die lifted position, and hold it to ±0.015 in. in all stations.

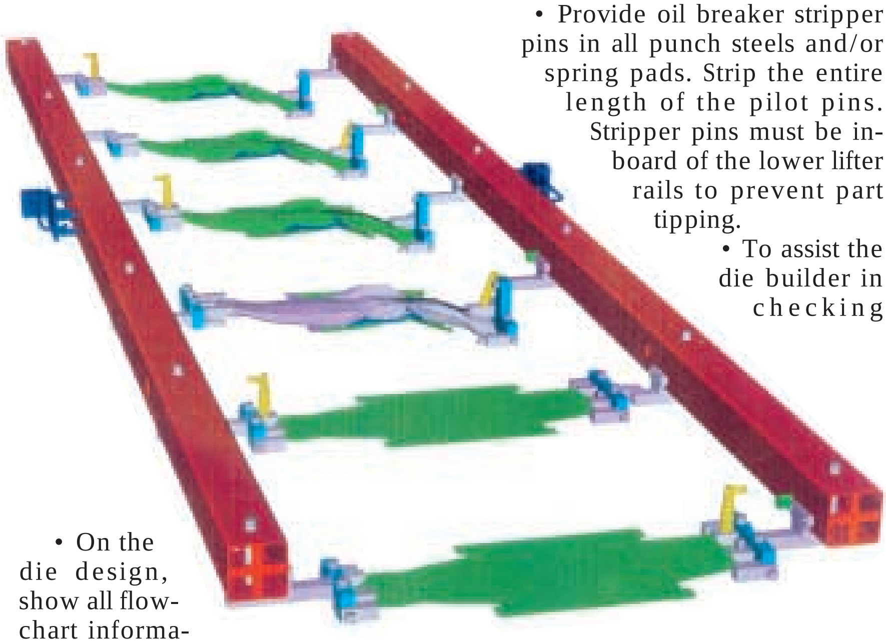
• Provide sufficient die lift to maintain a minimum of 0.62-in. clearance between the lower die steels and the part to allow for transfer fingers.

• Ensure that the part lifter operates smoothly and lifts the part to the correct passline, or part-pickup position, consistently.

• Provide oil breaker stripper pins in all punch steels and/or spring pads. Strip the entire length of the pilot pins. Stripper pins must be inboard of the lower lifter rails to prevent part tipping.

• To assist the die builder in checking the location of dies to the transfer and for scribing parts referencing centerlines of dies, the centerlines of each die set must have positive identification. For example, provide two 0.500-in.-dia. construction holes on the centerline of the station at a specific dimension from the centerline of the die.

The interference curve mentioned above is the critical aspect for all transfer automation to achieve maximum SPM and maximum part production. An interference curve, used properly at the start-up of die design and followed through the die build, minimizes plant-floor alterations on the production press. **MF**



A pre-engineered transfer bar assembly.

The first phase for a part-transfer application has the tool designer developing a transfer flow chart showing the following items:

- *Work to be performed in each station, including progressive die operations;*
- *Transfer-bar, finger-travel, lift and linear-motion requirements;*
- *Press information such as bolster size, stroke, shut height, SPM, column opening and location, and type of press drive (eccentric, link, etc.);*
- *How the part is lifted off the draw binder surface to allow space for a finger under a part for pickup;*
- *Part-lifter locations to avoid transfer-finger interference;*
- *All part-gauging locations to avoid interference with transfer fingers;*
- *Part height and attitude in work position, die lifted position, and transfer position;*
- *Location of stations relative to the press centerline;*
- *Approximate location, length and diameter of guide pins and bushings in plan view and side elevation;*
- *Scrap removal process (location of conveyors, chutes, etc.);*
- *Pilot holes to help locate parts and check transfer fingers to die stations (providing pilot holes aids in locating the part on the dies and assists in checking the transfer fingers to parts in position);*
- *Approximate location of oil breaker stripper pins in all punch steels and/or spring pads.*