When a stamper first looks at a part print, he starts by asking many questions: What material is to be used for this part? How thick is the material? What will the daily, monthly, or yearly volume of the part be? How long will the part be in production? 1 year, 5 years, 10 years.

All these questions are important, but it does not tell us if the stamper has the right stamping press to run the job in. A tool shop, when preparing a quote, may propose a process that fits the stampers existing equipment rather than developing a process that best optimizes the efficiency of producing the part. In order to do this we need to know:

- Tonnage of press
- Bed size of press
- Shut height of press
- Stroke of press
- Feed line of press
- Min/Max strokes per minute (SPM)

Presses come in all shapes and sizes with respect to the bed size. Just like in the story of Goldilocks, the fit of the tooling to the bolster has to be just right, not too small and never to large. Mismatch in size of the tooling to the press can result in damage to the press, the tooling and unsafe conditions for people around the press along with a cost burden that makes running the part unprofitable. Physically sizing the tooling to the press is a key step in the design of any tool.

**Most Common Types of Transfer Processes**

In this section we will examine some of the most common types of transfer processes used. Just as you want to select the right press, selecting the right transfer process is just as important based on the part being produced.

**Shuttle 2-D Transfers:**
The tooling cost on a shuttle transfer tends to be very inexpensive. However, the transfer process can cause many design issues. All lifters must put the parts at the same height. There is no gaging to contain the part in the die open position. The part sits on open flat pads or rails with nothing keeping them in position before the transfer clamps up.

**Crossbar 2-D Transfers:**
This transfer process is easy to deal with in the tool. Typical part pickup method is by suction cups or in some cases magnets mounted to the crossbar system.

**Progressive to Walking Beam 2-D Transfer:**
This hybrid transfer process offers stampers the flexibility to run the tool in a traditional straight side press without having to deal with externally mounted transfer systems. Transfer components are designed and built as part of the die.

**Tri-Axis 3-D Transfer:**
All tooling components need to maintain clearance for the finger return path required to get back to the start position. Lower steels and die guidance as well ascams have to be cleared for the fingers and transfer bars. Upper components need to deal with the timing of upper steels relative to the incoming fingers.

**In-Die 3-D Transfer:**
Tools typically run at a faster SPM than externally mounted transfer systems. In die transfer systems they have all of the challenges of regular tri-axis transfers along with having to deal with the design complexity of in-die transfer components.
Why Choose a Transfer, Progressive or Line Die?

Why choose a Transfer Die?
- Maximize material savings.
- Possible elimination of offline or secondary operations.
- Less die maintenance due to ease of serviceability and adjustment.
- Better part quality control.

When do you choose a transfer process?
- At first opportunity to quote.
- If you don’t your competition might and they will have the advantages of the transfer process.

How do you know it makes sense financially?
- Make a strip layout for the progressive die.
- Make a flow chart for the transfer die.
- Compare material usage of both processes and calculate the difference.
- Analyze the GD&T information to see if the station line up allows the necessary control and adjustment to make the part to print.

Eliminating Offline/Secondary Operation

Utilizing a transfer process allows you to design the tool at a pitch to suit the requirements of the part, without sacrificing material usage. You are not restricted by the progression of the part. Form punches and trim punches can be more robust and easier to insert giving the die more life and serviceability.

Eliminating expensive offline operations, your parts go from coil to finished goods, which lessens the chance of your shipping a part that has not been fully processed. The ability to increase the pitch allows you to add inserts to your forms which gives you added adjustability, making it easier to deal with material variation and spring back.

Part Rotation: allows you to direct pierce or direct trim the part thus avoiding expensive cam operations.

Part Tipping: allows you to overbend or bend areas that cannot be easily bent in a progressive die.

Part Separating: allows you access to areas of the part for forming or piercing.

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Simulation can assist in predicting difficult stamping processes and evaluate material springback. Results from process and part simulation are reviewed allowing the designer to recommend feasible solutions to complex manufacturing problems.

One of the key areas for simulation as it relates to transfer automation is predicting the amount of springback so an informed decision can be made if part will be carried and positioned consistently throughout the process. Springback compensation may be required to have a stable and consistent process.

Starting with basic concept simulations all the way through complete process simulations can improve process and part reliability without having to create costly hard or soft tooling.

Through the use of simulation software stampers and tools shops are reducing cost and timing issues associated with late product changes. Decreased tryout time and costly tool alterations after build is just another reason why so many companies are investigating simulation of their parts before design freeze.

Transfer Die Considerations

After receiving an assignment to design a die for using a transfer process, a die designer considers many questions and factors concerning the specific project. These questions help the designer to create the best possible design for the project. If annual volume, press availability, or economic factors change, the die design may require major alteration.

- Tonnage
- Bed size
- Strokes per minute (fixed or variable)
- Stroke length
- Shut height
- Drive type (servo or mechanical)
- Scrap opening locations
- Window size
- Make, type of drive (servo or mechanical)
- Pitch length (minimum and maximum)
- Clamp length (minimum and maximum)
- Lift height (minimum and maximum)
- Speed or control limitations
- Weight of bar and fingers (if available)
- Length of part life in years.
- Material type
- Thickness
- Complete data on part shape
- Tolerances
- Volume required per hour/day/month.
- Quick die change system with description
- Frequency of changeover
- Feed method (coil or blank)
- Feed method's accuracy
- Drop-off or finished part
- Lubrication specifications and amount
- Critical finish areas

You will also want to know the methods for loading material, the sequence of operations in a transfer press, and the details of manufacturing process before you start.
Material

Loading Methods

**Coil Fed Transfer**
Works well with square or rectangular blank shapes, but other shapes can result in inefficient material use. A zig-zag feed system sometimes can be used to improve material yield by nesting the blanks on the strip.

**Blank Fed Transfer**
Requires a blank destacker. This system offers the most efficient material use because blanks can be nested in various configurations and produced from coil in the blanking line/press at a faster rate. In some cases, purchased blanks are a good, cost-effective alternative.

A blank destacker also allows quick change of material for a part change or for material quality problems in a particular stack.

A blank destacker also eliminates one or more stations in the transfer and may allow the transfer to fit in a smaller press than otherwise possible. Other advantages of a destacker include uninterrupted production, output controlled by equipment rather than an operator, and improved safety.

**Two & Three-Axis Transfer System**
Is a two- or three-axis transfer required? Two axes usually allows for faster operations on a piece-per-minute basis because of the transfer mechanism’s decreased travel length. Sometimes the part configuration will work well with a two-axis transfer and in other cases the part shape does not allow two-axis operation, so a three-axis system is required.

**Speed**
Because pitch length is usually the longest transfer length, it is often the limiting factor in transfer speed. For maximum speed and because of press space constraints, dies are located as closely together as possible, and, ideally, the parts are oriented with the shortest

**Scrap**
During trimming, many pieces of material must be moved away from the dies. These small pieces of scrap must be disposed of quickly and automatically. One possibility is to add idle stations near the scrap chutes to keep the pitch length short. Of course, this can be done only if the press length can accommodate extra stations dimension in the pitch axis

**Transfer Stroke Distances**
The part is studied carefully to determine the amount of pitch, clamp, and lift motion required. These characteristics are then compared to the transfer system requested to determine if the part requirements and the transfer system are compatible

**Steel Grain Orientation**
Another factor is the orientation of the part in respect to the grain of the steel. If a coil feed is used, the orientation may result in excessive material loss and excessive scrap costs. In some cases, the grain must go in one direction because of the part length and the coil width that can be used
Material
Loading Methods

(Continued)

After the basic evaluation is completed, the manufacturing processing of the part from station to station is analyzed. This encompasses a step-by-step, detailed analysis of each of the following:

**Part Orientation:**
Decisions must be made at every station about the orientation of the part for ease of forming, life span of the die components, and accurate location of pickup during transfer. Often a small amount of tilt allows a punch to go squarely through the material rather than hit on an angle, causing side loading and potential punch breakage. Other times burr locations or extruded holes require major reorientation of the part, sometimes as much as 180 degrees or more.

In addition to part weight, the weights of the transfer arm, transfer fingers, and mechanism (or inertia) are factors in the ultimate speed of a unit. To minimize these weights, many transfer designers use high-strength, lightweight materials such as high-strength aluminum or ultrahigh-molecular-weight (UHMW) urethane for part contact fingers. This has the added value of eliminating or minimizing die damage in case the fingers are caught inside the die during tryout or because of a system failure.

**Mechanism Supports:**
On some transfers, supports exit at various points along the transfer bar to eliminate shake or excessive vibration. These locations and the locations of any die posts must be known to eliminate interference points during the design phase of the project. In some cases, the part must be held with a hand-type gripper so that rotation can occur. This type of gripper is usually avoided, if possible, because of its cost, weight, and unreliability.

**Finger Return Path:**
One of the most critical items of the transfer die design is the finger return path. The clearance between the fingers and the die components during the return stroke of the transfer must be analyzed to ensure there is no interference. If the transfer is mechanical, this is even more critical. Servo-type systems can vary the return profile of the fingers, allowing more clearance possibilities.

**Post Locations:**
To eliminate obstacles to the transfer of parts, the die set pins are almost always located in the upper shoe. This allows clearance for the transfer fingers to work as soon as possible during the upstroke to allow the maximum time for finger retraction during the downstroke.

**Feed Line Height:**
At the same time that orientation is decided, feed line height must be determined to minimize transfer distance and maximize the speed of the system. Care must be exercised to make sure that the part orientation allows a satisfactory pickup point for the part in all stations, before and after the stamping operation. Lifters must be provided to allow access for the fingers without losing location or control of the

The weight and size of the part determine the acceleration and deceleration that can be used without losing control. Of course, the finger design also plays a part in this control. Excessive weight limits the peak speeds, which in turn affect the final average transfer time or speed, part.
Transfer Press Simulation

What if there were a way to do a home-line runoff using 3-D transfer simulation software? What if a die designer and die builder could load the dies into the press, position the transfer bars and fingers, identify transfer motion bottlenecks, find crashes and interferences, and create the optimum tri-axis motion curves virtually? By running all the checks before building the die, a designer and die builder could get rid of the pitfalls, headaches, blame games, extra back-and-forth shipping, rework, missed deadlines—and the accompanying profit losses.

It sounds too good to be true, right? Yet, 25 years ago the same thinking surrounded proposals for draw forming metal parts using virtual software. Fast-forward to present day, and look at all the benefits forming simulation contributes to the stamping industry.

There are 3 methods to check interference in a transfer tool.

1. Manually – Very time consuming in a press that could be costing $300 - $400 / hr. Also high risk.
2. Simulator – Still very time consuming but will typically detect most interferences.
3. Transfer Animation – Animation can be performed quickly and adjustments can be made to improve efficiency.

Transfer Press Simulation Capabilities

Transfer simulation software currently is being used to validate 3-D die designs and their ability to function with the transfer press and transfer system.

Transfer simulation software not only puts the press, die, and transfer system into motion, it also automatically finds crashes and close calls throughout the entire press cycle. The software finds interferences and clearance violations automatically, rather than manually, to reduce the risk of human error.

Because it’s just not possible for the operator’s human eye to create the best transfer motion curves, the software can be used on both new and existing tooling to improve the transfer motion and timing and increase production rates.

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Acceleration and velocity specifications are factored into the transfer system for accurate production rates. It can run a full kinematic analysis through 360-degree press and transfer motion. Parts can be rotated, tipped, flipped over with grippers, and slid into position with actuators.

It finds all crashes, close calls, and inefficient transfer system curves, and makes adjustments.

Servo press ram locations and transfer system locations are both fully programmable and associative to each other. Strokes per minute (SPM) can be calculated and improved on-the-fly. Transfer motion can be optimized for best part control and highest feasible SPM.

Clamp, pitch, and lift motions are independently adjustable to achieve the best motion possible for a given stamping die and transfer system.

Press ram motion is fully programmable so even the most current servo press lines can have their ram motion and transfer system motion programmed simultaneously for the highest possible production rates.

Moving Forward
Results show faster setup of the die and transfer system, better success at home-line runoff, increased production rates, and higher profits for everyone involved. If anything has been learned from forming simulation, it’s that it is easier and less costly to make changes when the designs are on the screen rather than when the dies are machined and built.

Summary/Conclusion
There are several considerations that need to be evaluated when designing dies that will be run in a transfer press. Just because a stamper has presses it doesn’t mean they have the proper presses to run the tooling. When the proper evaluation is not done the results or outcome could be negative. If you do not have the proper tools or skills to do a proper evaluation identify a partner to support you with your evaluation. Proper evaluation using the technologies available
Solving the Industries Most Complex Problems

Die Cad Group, Inc. is a leading provider of product & process simulation, metal stamping tool designs, special purpose machine designs, and transfer press animation. Founded in 1995 the company has experienced exceptional growth as it continually seeks to find creative solutions to the industry’s most complex problems. Die Cad’s staff of tooling and design experts have over 450+ years of notable industry experience. Specializing in line dies, transfer dies, progressive dies, blank dies and hot stamping dies for the automotive, off-highway, furniture and white goods industries.

Utilizing Catia V5, Unigraphics (UG) NX, Pam-Stamp and Autform software Die Cad has the requisite capabilities to deal with the industry’s most demanding design requirements. Additionally, Die Cad’s technical services group provides program management, process evaluation & improvement, sourcing strategy, and education services. ISO-9000 and WBENC certified, Die Cad Group is a supplier partner to our customers. We are dedicated to finding optimal part configurations and ideal processes to achieve the best process...best efficiency...best cost for each part.

Brad Rine
Senior Manager