BALLUFF

# PROTECTING THE DIE AND PRESS

## How to Initiate a Sensor-Driven Error Proofing Program

**White Paper**

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**Metal formers today find themselves in a fight for survival. Increasingly, contracts are going to the companies that supply perfect parts all the time. Customers are not satisfied with suppliers that can give them high quality measured in parts per thousand. Today, they demand parts with zero defects. That means that metal stamping operations no longer have an option not to use the latest state-of-the-art production techniques.**

**Sensor-driven process improvement not only dramatically increases the percentage of perfect parts produced, it can save tens of thousands of dollars in lost production, unplanned downtime, and die repair due to crashed dies. It's surprisingly easy to get started – if you go about it in the right way.**

## Surviving the Initial Hurdles: First Steps to a Quality Process

First, eliminate the conditions that may lead to program failure by developing a process that stops the die only if parts are defective or the die is in danger. Get agreement within the entire organization that a quantum quality leap is necessary. Buy in from the operators is essential and often overlooked. The team must agree with and adhere to the new processes and procedures even though they may seem initially foreign or unnecessary. Everyone must understand how the sensors in a process eliminate errors and improve part quality or they will tend to ignore important process steps. Any other condition will result in bypassed sensors and operator distrust.

## Second, improve the process one step at a time.

**The Top Seven Reasons for Initiating an In-Die Sensing Program**

1. Reduce die repair hours
2. Prevent die crashes
3. Decrease press down time
4. Decrease the costs associated with secondary operations
5. Reduce excessive overtime labor
6. Prevent re-work and sorting
7. Reduce costs and loss of business associated with stamping process delays

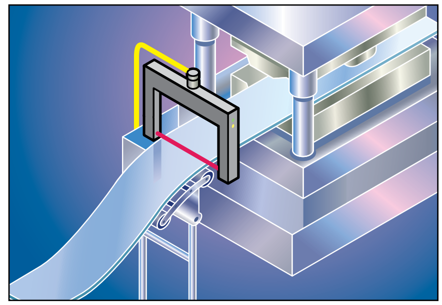
- For the first project, the engineering team should proceed with care, slowly at first, perhaps with just one die, so that the process of adding sensors to the die is understood at each step by everyone involved right from the beginning and all the way through. The payoff for this program lies with good results. Therefore, start with a problem die that is giving everyone a lot of trouble. Once improvements are made and the team has seen the benefits, the results will justify aggressively tackling other error-prone dies.
- Finding the right sensors to fit your application is as important as making sure they are installed in a way that protects them from the various elements in the tool room and pressroom. Your sensor supplier can be a great help in making those decisions.
- The right control package is key for a good die protection program. Defining the control system that receives the information from the sensors is also a critical part of the process. How many inputs are needed now and in the future as the program expands?
- Selecting a champion to lead your die protection program requires both mechanical and electronic skills. It is much easier to learn about sensors than it is to gain the years of experience and intuition that a seasoned die maker already possesses, and this knowledge and wisdom is required to properly lead the way in improving the stamping process. Find a strong candidate with a background rooted in die building and trouble shooting within your tool room. Then, find an avenue for acquiring the proper electronic skills. This will help create an individual capable on not only homing in on die problems and providing solutions to them, but also designing proactive applications from the design level up through production.

Finally, an organization needs a set of up-to-date basic technical die standards which to adhere. Without them, it is almost impossible to standardize on best processes – including standard sensor-driven error proofing techniques. Defining which features of new dies will require sensors is an important step in ensuring error proofing begins at the design level.

## Specific Sensor Suggestions to Improve the Stamping Process

The concept of mass production is founded in a repeatable, controlled process. Monitoring critical events during the press stroke and taking action whenever there is potential for die damage or misformed parts will help maintain the repeatability necessary for manufacturing high quality parts and maximizing tool life and productivity. It is especially important to monitor these four features of the stamping process:

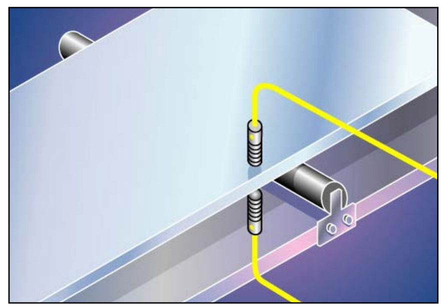
1. Progression of the strip. Short fed or buckled strips cause the most die damage during production.
2. Parts properly exiting the die. Double hitting even thin material can shear the entire die or cause part quality issues.
3. Foreign objects inside the die. By sensing each corner of the stripper on every hit, slugs, broken bolts, or other debris can be easily detected.
4. Misaligned blanks. In single-hit applications, preventing the press from cycling if the blank is out of location will ensure a high quality part. Sensors used to monitor part-in-place can easily detect a blank that is loaded incorrectly.



**A self-contained thru-beam fork sensor can continuously monitor strip feed, essential for peak press productivity.**

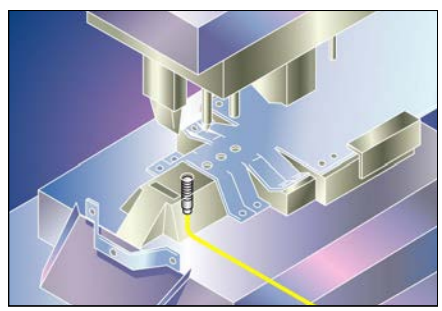
**Prevent Incorrect Feed**
A thru-beam fork sensor can detect buckle of the strip on the entry-side of the die. A buckled strip can cause severe damage to the tool and will also indicate a material or tooling problem.

**Monitor Material Thickness**
Double-hitting blanks in a single-hit or transfer tool can be devastating, especially when using thick material. Two analog inductive proximity sensors, one on either side of the material to measure thickness, can prevent loading more than one blank at a time. Because analog sensors can detect a range of thickness and not just presence of the blank, any change in the material thickness will be quickly measured by the sensors and a stop signal can be sent to the press. Formerly, a special input card or computer was needed to process the output of analog sensors, but today, small and affordable analog controllers with digital outputs make it easy to use existing press controllers. Analog measuring technology can easily be integrated into press controls using only digital inputs. These allow the user to create high and low set points that will send an output to the press controller when material exceeds its expected thickness.



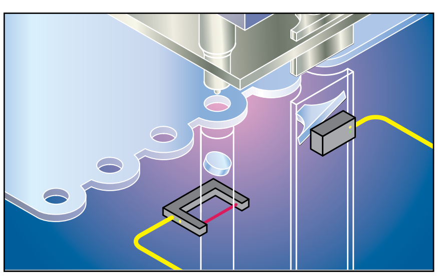
**Two paired analog proximity sensors make sure that no splices, welds, or double fed sheets enter the press.**

**Establish Proper Pilot Hole Detection**
A pierced or pilot hole can be used for detecting long and short feeds by embedding a normally-closed inductive proximity sensor in a lifter located directly under the hole. A normally closed sensor sends an output to the press when there is nothing in its sensing field. If the strip is fed either short or long, the edge of the hole will be in the field, preventing the sensor from signaling the press.



**Precise feed is assured by a buried inductive proximity sensor.**

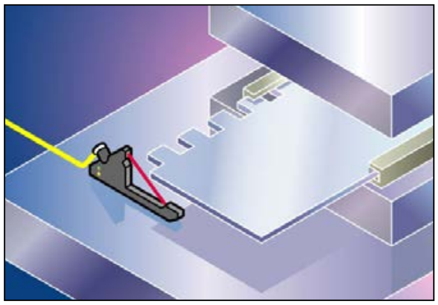
**Proper Slug Out Detection**



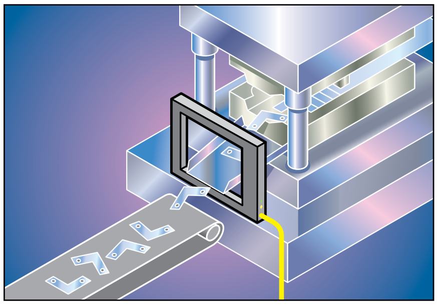
**Various styles of sensors, depending on the press set up, can confirm slug out condition.**

Slugs that fail to exit the die can stack up inside die sections, causing damage that can't be repaired simply by sharpening and shimming. Cracked die sections can create excessive downtime and man hours in repair. Imagine trying to replace a "slugged-up" pierce station on an inherited die that has no drawings to reference! Self-contained thru-beam sensors can easily detect slugs dropping through the bottom die shoe. Inductive flatpack sensors and ring sensors can be used with non-metallic tubes to sense slugs as they are guided into separate bins. Because slugs don't exit the die on every press stroke, using an inline signal adapter makes it easy to verify slugs have exited the die after a preset number of hits.

Innovative self-contained angle (or L-shape) thru-beam sensors can monitor "slug out" applications where other sensors might interfere with the die process. Angle sensors shoot a beam from corner to corner and allow for greater placement flexibility where self contained thru-beam "fork" sensors cannot be used. Here an angle thru-beam sensor verifies the final configuration of a part after slugs have been ejected.



Self-contained angle thru beam sensors are often used when other sensor styles will not fit the application.



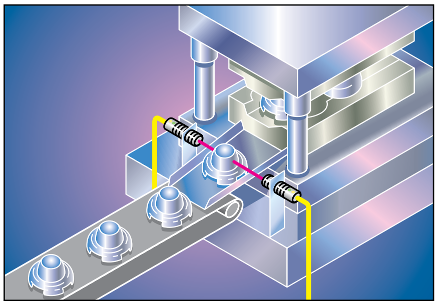
Optical window sensors are best for smaller part out applications where part trajectory may be different from one part to the next.

### Proper Part Out Detection

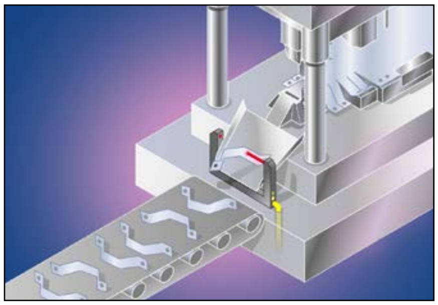
There are a host of solutions that can be used to verify part ejection. Dynamic optical windows or thru-beam fork sensors provide a unique solution for verification of parts ejection from stamping dies even when the parts eject at high speeds or at random orientations and trajectories. Stationary opaque or clear tubes or funnels can be installed within the sensor for "forced directional aiming" of finished parts.

Photoelectric sensors offer cost-effective, versatile solutions for end-of-strip and part out monitoring. Diffuse-reflective, retro reflective, and thru-beam styles are available with infra-red, visible red, or laser technology. Available form factors include metal or plastic enclosures in straight or right angle configurations.

These relatively simple sensor-based steps will provide a quantum leap in preventing die crashes while increasing the quality of parts and lowering the cost and duration of maintenance intervals in most stamping operations.



Standard photoelectric sensors can handle most part out tasks, given the right sensor application.



Self-contained fork sensors are best for larger part out applications where the part's shape or size will not fit through a specific aperture.

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