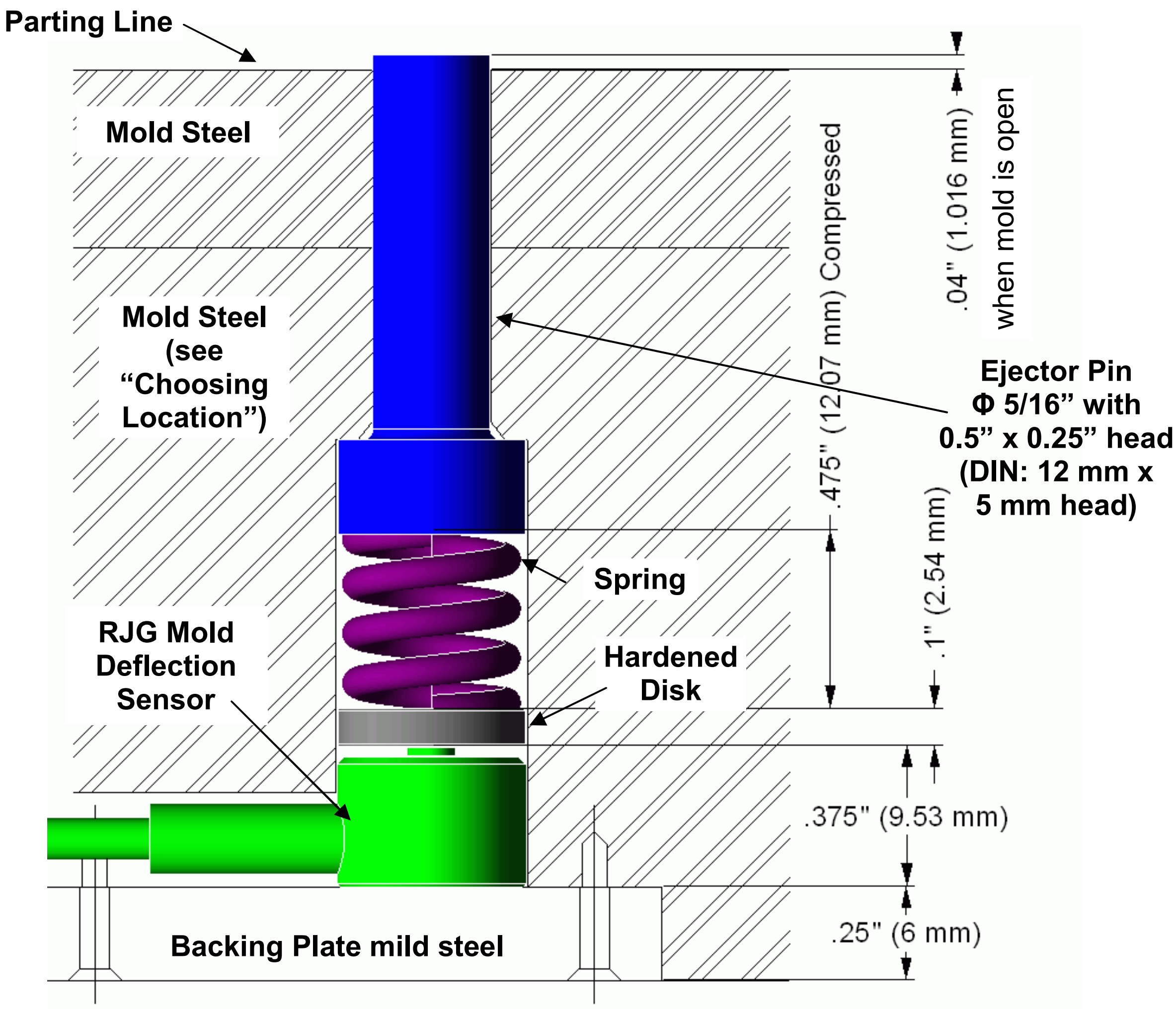
RJG Mold Deflection Sensor Installation and Use

RJG's Mold Deflection sensor measures how much the mold parting line has opened on each cycle. The sensor mounts in the clamp plate with a 5/16" ejector pin protruding .040" into the parting line area of the mold (<u>not</u> into the cavity). The pin transmits force through spring to a Lynx^{TM} force sensor especially calibrated to measure deflection. When the mold clamps the pin is pressed flush with the parting line and the full force is applied to the sensor. This is recorded as "zero deflection". As the mold "cracks" the force decreases. For each incremental decrease in force the sensor reports an increase in deflection. The sensors are calibrated to assume .040" (1.016 mm) maximum deflection.

<u>Figure 1: Mold Deflection Sensor Assembly as Installed</u>



The Mold Deflection Sensor comes in a kit containing the following:

- One Lynx^{TM} Mold Deflection Sensor (connects to the *eDART*™).
- One Spring, 0.5 ± 0.016" long, 0.48" diameter, 4.5 turns of 0.085" 302 stainless wire
- One hardened disk (0.500" +0/-.003" diameter, 0.100" +.002/-.001" thick).

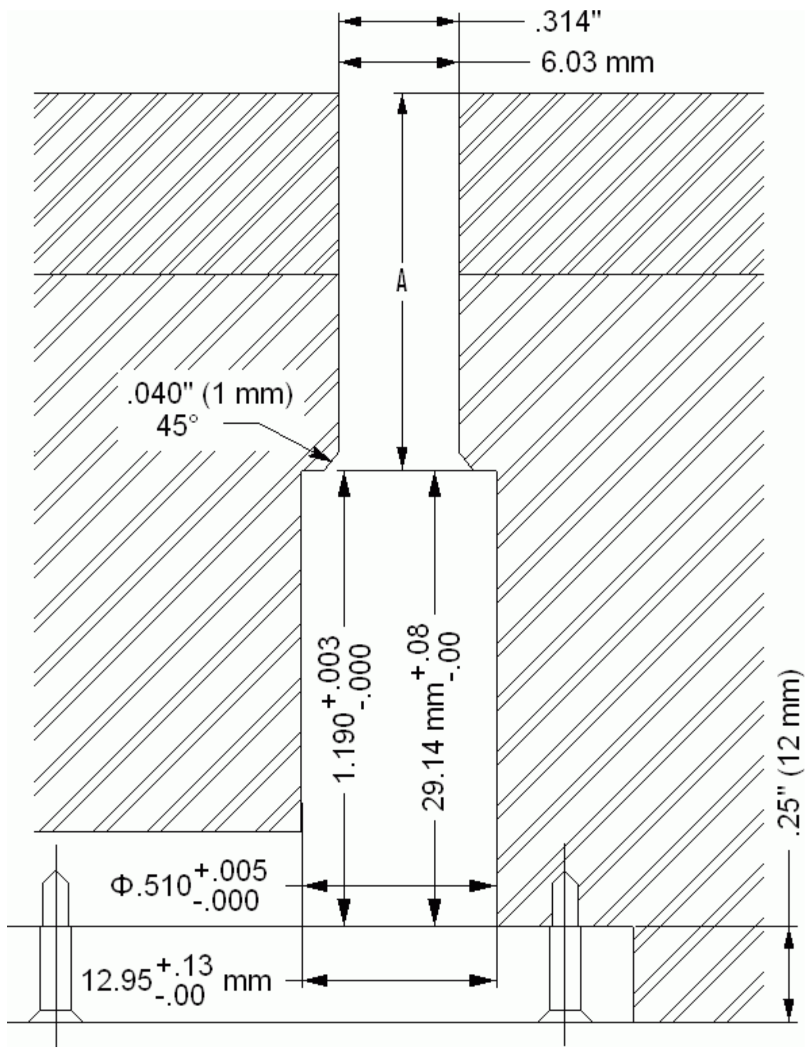
The customer supplies the pin shown in the drawing and of the proper length necessary to reach the parting line plus 0.040". The customer also supplies the backer plate and screws for it. The sensor and assembly may be installed in either the moving or the fixed half of the mold.

Choosing a Location: Essential Points

- The typical single deflection test point would be in the center of the mold if there is no cavity or runner on the parting line there.
- If there is a cavity in the center then you could install two mold deflection sensors, one on either side of the cavity. Or you could choose a position where flash is most likely to occur.
- The sensor may be placed on the A or B side of the mold. It could also be installed in the sprue puller plate of a 3 plate mold. It will show the same deflection either way. Placing the mold deflection assembly in the A side may avoid support pillars.
- If you are concerned about "rocking" of the mold as in a machine without tie bars or if there is an off-center pressure load on the mold then several sensors could be placed in different locations, especially for initial testing.
- If there is flash in a certain area and you want to know if the parting line is opening or if there is some other problem then place a mold deflection sensor in that area.

Cutting the Pocket for the Assembly

Figure 2: Pocket Dimensions Without Sensor Assembly



Sensor, Spring & Pin Head Hole

The hole depths are calculated for inch or metric standard pin sizes. The 5/16 inch ejector pin has a ½" head ¼" thick. The 6 mm DIN pin has a 12 mm diameter head 5 mm thick. Thus the numbers are specific to each pin.

The springs come with a ± 0.016" (0.4 mm) tolerance. The hole depth is designed to accept springs of minimum and maximum length, preloading the smallest and not over-loading the longest.

The hole diameter is the same as that used for the standard RJG ½" button sensor.

Dimension A and Pin Length

Dimension "A" = mold height – hole depth – backer plate depth. Then the pin length = dimension A + pin head height + 0.040" (1.016 mm). The sensor is internally calibrated for this length. The precision of the reading is therefore directly related to the precision of the length extension of the pin when the mold is open.

Pin Guide Hole

This hole should be cut for typical clearance for moving ejector pins.

Wire Channel

The wire channel is also the same ¼" x ¼" used with standard RJG button sensors.

Backing Plate

The Backing plate design is left to the toolmaker. The ¼" thickness is typical but not critical. It should cover and protect the wires out to the outside of the mold but not apply force to the sensor stem.

Note on Tolerances: All tolerances have been already calculated for the proper pre-load of the spring, expansion under load etc. Do not add or subtract any for "windage" or "good measure."

Installing the Sensor

- Cut a ¼ x ¼" channel for the wire to reach mold surface where you want to mount the Lynx™ case.
- Cut a pocket to the side of the channel as a place to coil the extra wire, if needed.
- Use the supplied tubular wire retainers or putty to keep the wire in the channel when assembling the mold.

Application Notes for RJG's Mold Deflection Sensor

Overview

The four "Plastics Variables", the material and the shape of the cavity are the central concepts in systematic injection molding. Heat, flow, pressure and temperature are what the plastic "knows" and what determine how the part is made within a given shape.

It is commonly assumed that the cavity shape, being cut in steel, is a constant. This is not strictly true. If you apply enough pressure inside the cavity to exceed the ability of the clamp to keep it closed then the mold and platen will bend and thus change the shape of the cavity. The "Cavity Shape" becomes the hidden 5th cavity variable. And it follows that the size of the part is related to that shape. The Mold Deflection sensor measures this change in shape so that you can detect changes that may affect the part or solve problems related to deflection.

Another use for this sensor is in coining applications. In these applications the mold deflection sensor can accurately measure the distance that the mold is coined open during fill before full clamping. This lets you repeat the coining process accurately on different presses. However, if a coining stroke greater than 0.04" (~1 mm) is required contact RJG for a different spring size.

Calibration, Auto-Zero and Auto Scale

When injection begins the *eDART*™ assumes that the parting line is closed so it records the value from the mold deflection sensor as zero. Then, when the mold is fully open the sensor must be at its maximum deflection as determined by the tooling. The sensors have the number ".040 inches full scale" programmed into them. The *eDART*™ knows this and can now compute a scale factor for the sensor based on the zero and full scale values.

Thus the accuracy of the sensor is dependent on the accuracy of the .040" pin extension above the parting line. Furthermore we have selected the spring such that it will compress about 43% of its rated load limit. The manufacturer recommends that we use this range so as to not put a set in the spring and so that it works in the linear portion its force range. These calculations take into account worst case tolerances in spring lengths, hole depth, disk thickness and sensor sizes.

eDART™ Setup

- The *eDART™* requires mold clamped to zero the mold deflection sensor. The zero point will be when *Seq. Module Input / Mold Clamped* goes on. This works with coining in which the mold remains open at the start of injection. Since zero is fully clamped then you can see the amount of coining opening.
- On the "Sensor Locations" page each sensor appears with the type name "*Mold Deflection*". This cannot be changed because it is programmed into the sensor. From the "Location" column pick list select a location that most closely describes where the sensor is positioned. Add ids for each position around the face of the mold. We usually use "Parting Line" unless the sensor is in an odd position in a block.
- If you are not certain where each sensor is located in a multiple deflection sensor installation you can place a piece of plastic over each one individually and clamp the mold until the mold protect stops it. Then the sensor showing a decrease in the deflection value on the sensor locations page must be the one with the tape.
- It may be possible to stack springs for wider coining openings. But the tolerances would multiply and the hole would need to be cut to preload the actual spring stack to 1 – 2 lbs of force. The spring constant is 424 lb / inch for one spring. Two springs stacked on top of each other would be 212 lb / inch allowing a 0.080" (~ 2 mm) pin extension. The sensor would need to be custom calibrated by RJG for 0.080" pin extension in its internal scale factor.

Analysis

- The eDART does not auto-add *Mold Deflection* to the cycle graph so you need to add it with "Add Curve" if you are curious about its shape.
- When the mold opens you will see the mold deflection curve on the cycle graph shoot up to its full scale, .040", for as long as the mold is open. Do not be concerned. This is normal and is not included in the calculation of peak deflection.
- Use the template on the cycle graph to compare the mold deflection curve made in one press to that made on another. This can show problems with clamp action.
- The eDART computes a *Peak / Mold Deflection* number that can you can use to compare numerically the deflection to that which was active when the template was made.

Containment

- You can set an alarm or a warning on "*Peak / Parting Line Gap*". This can be used to prevent improperly sized parts from being shipped to your customer by limiting the change in shape of the cavity.

Control

- You can set a V->P transfer setpoint on mold deflection using the "More" button on the "V to P Transfer" tool (*eDART™* Release 8.5 and above). This creates a backup to prevent blowing the mold too far open.
- While not an automated "control" you can, in essence, "control" mold deflection between presses by noting how much deflection you see compared to the deflection seen in the tryout press. Then you may insert shims behind the mold in appropriate locations to match the mold deflection between presses.
