PRODUCT MANUAL

Lynx™ Analog Single-Channel Strain Gage Button Sensors

T-445

Training and Technology for Injection Molding

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INTRODUCTION

Read, understand, and comply with all following instructions. This guide must be kept available for reference at all times.

DISCLAIMER

Inasmuch as RJG, Inc. has no control over the use to which others may put this material, it does not guarantee that the same results as those described herein will be obtained. Nor does RJG, Inc. guarantee the effectiveness or safety of any possible or suggested design for articles of manufacture as illustrated herein by any photographs, technical drawings, and the like. Each user of the material or design or both should make his own tests to determine the suitability of the material or any material for the design as well as the suitability of the material, process, and/or design for his own particular use. Statements concerning possible or suggested uses of the material or designs described herein are not to be construed as constituting a license under any RJG, Inc. patent covering such use or as recommendations for use of such material or designs in the infringement of any patent.

PRIVACY

ALERTS

The following three alert types are used as needed to further clarify or highlight information presented in the manual:

DEFINITION	*A definition or clarification of a term or terms used in the text.*
NOTES	*A note provides additional information about a discussion topic.*
CAUTION	*A caution is used to make the operator aware of conditions that can cause damage to equipment and/or injury to personnel.*

NOTES

PRODUCT DESCRIPTION

The analog single-channel strain gage sensor T-445 is an indirect (under pin), 0.625" (15,88 mm) button-style cavity pressure sensors that can withstand force range of up to 4,000 lb. (17,8 kN) and temperatures up to 250 °F (121 °C—standard sensors) or 425 °F (218 °C—high-temperature sensors). These rugged, reliable sensors have a flexible cable with a brazed stem at the body and a strain-relieved connector.

The exclusive Lynx™ technology sensors are designed for use with the RJG eDART® process control and monitoring system.

APPLICATIONS

SINGLE-CHANNEL SENSORS

Button-style cavity pressure sensors are suitable for injection molding applications in which the following conditions are met:

- Sensor will be installed behind an ejector, blade, or core pin.
- Applied plastic pressure is high enough to prevent poor sensor resolution, but low enough to prevent sensor damage.
- Sensor will be kept below 250 °F (121 °C) for standard models or 425 °F (218 °C) for high-temperature models in the mold; sensor connector will be kept below 140 °F (60 °C).
- Only one point of contact (single pin) to the sensor.

PROCESS MONITORING

A primary goal of process monitoring for the prediction of good versus bad parts, correlating cavity pressure to part conditions, and/or detecting short-shots dictates a sensor placement in the end-of-cavity (EOC) position; this location shows the maximum amount of variation of in-cavity pressure.

PROCESS CONTROL

A primary goal of molding machine control, flashed part detection, and/or gate seal detection dictates a sensor placement near the gate end of the part. Control sensors must be located in the "area of influence"; the region of the part where the material is last to flow.

To locate the area of influence, a material change from a translucent material to a colored material can be used to show the region where the first color appears (the area of influence(refer to bottom right).

ⓘ **NOTES** *RJG, Inc. recommends that EOC locations are not used for control as molding machines cannot react quickly enough to prevent damage to the mold or machine.*

OPERATION

INDIRECT/UNDER-PIN

The Lynx single-channel strain gage sensor is placed in a mold behind an ejector pin. As plastic is injected into the cavity, force is applied to the ejector pin; the plastic pressure force is transfered to the strain gage sensor.

EJECTOR PIN SIZES

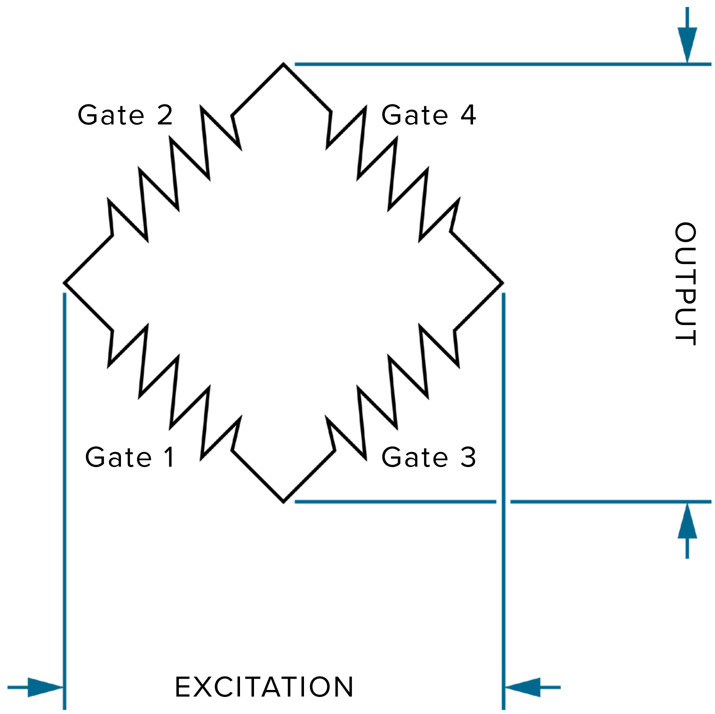
The size of the ejector pin impacts the amount of force applied to the sensor. Therefore, sensors are rated in terms of force (lb.) rather than pressure. Refer to the RJG, Inc. website at www.rjginc.com for sensor selection/ejector pin size chart.

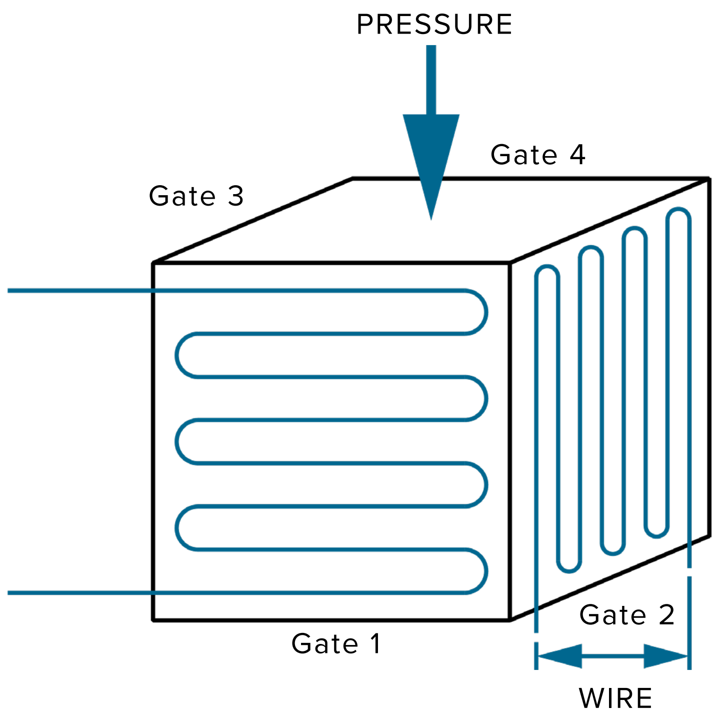
ANALOG STRAIN GAGE SENSORS

The strain gage uses a Wheatstone bridge (four strain gages positioned in a circuit) to measure deformation, or the change in resistance of the force over the sensor. The measurement is carried through the sensor cable, to the Lynx single-channel strain gage sensor adapter SG/LX1-S electronics case mounted on the outside of the mold.

The SG/LX1-S adapter is connected to the RJG, Inc. eDART System, which records and displays the sensor's measurement for operator aid in process monitoring and control.

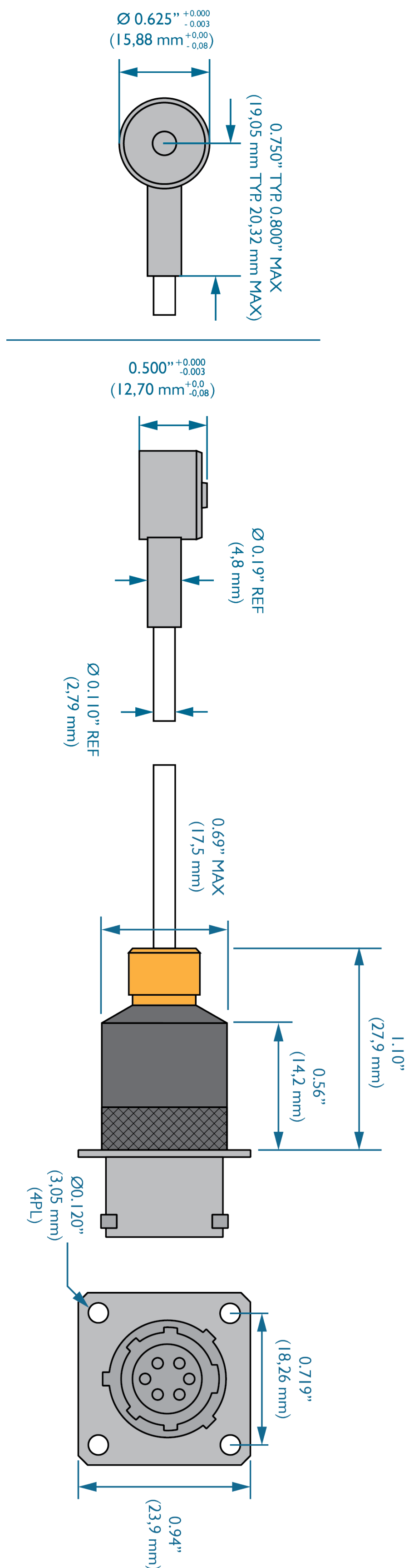
STRAIN GAGE OPERATING PRINCIPLE





DIMENSIONS

SENSOR

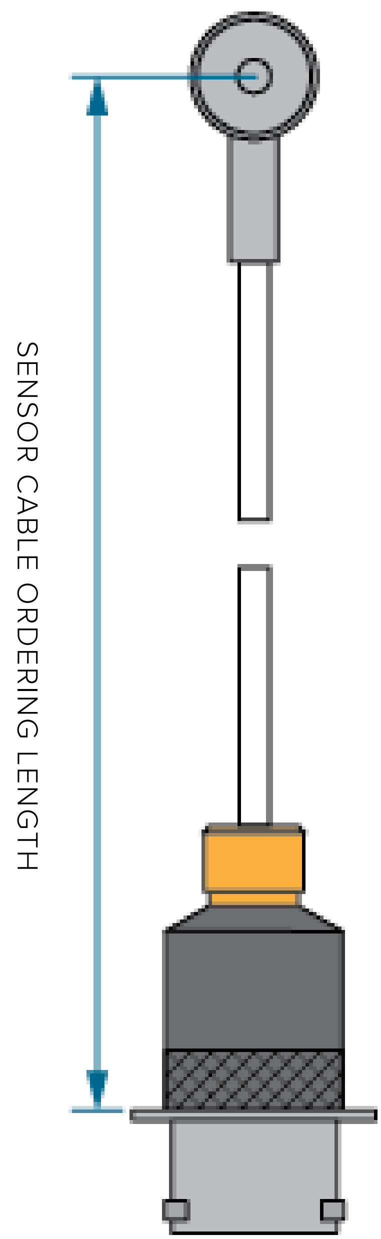


CABLE LENGTHS

Length must be longer than needed to facilitate safe installation and removal of connector from tool to prevent tension on the lead wire; generally, 2–3" (50–75 mm) of slack is sufficient. Use good sense to determine the appropriate cable length required for each application.

12, 24, 36, or 48"
304,8, 609,9, 914,4, 1219,2 mm

(>48" (1219,2) requires special order)



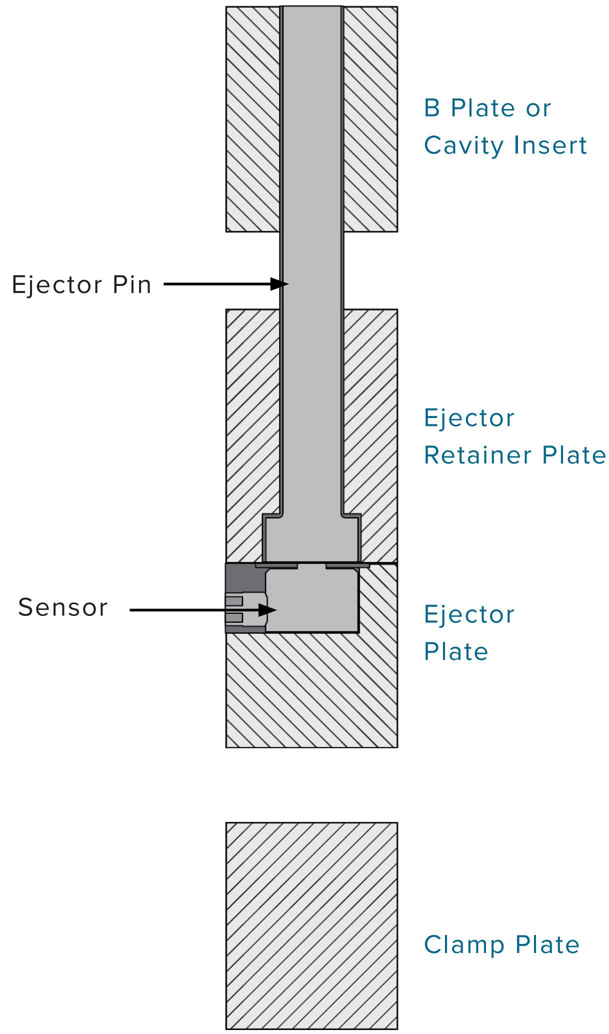
NOTES

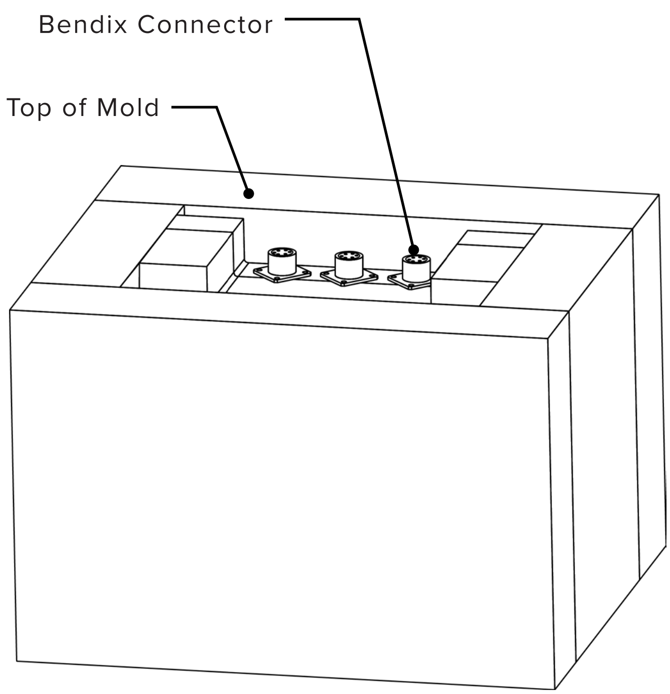
INSTALLATION

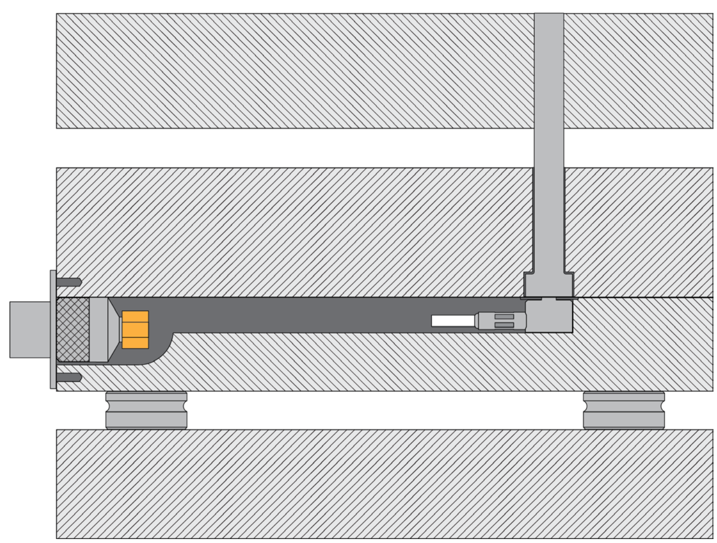
INSTALLATION OVERVIEW

The sensor's Bendix connector is mounted on the outside of the mold. A channel is machined into the mold for the sensor cable and sensor head. The sensor head is placed under the ejector pin. The ejector pin is retained in the ejector plate and reaches through to the B-Plate or cavity insert (refer to figures below and at right).

ⓘ **NOTES** *The sensor head pocket must be centered under the selected ejector pin.*

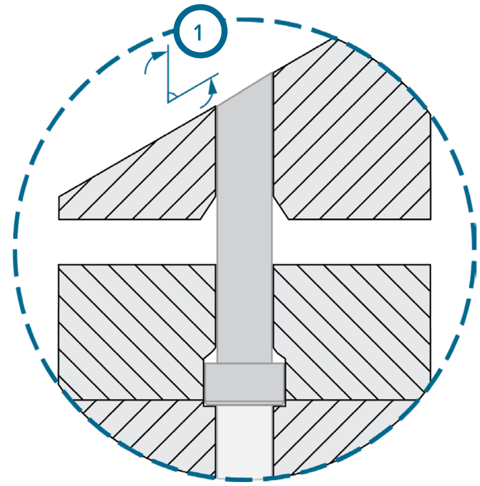






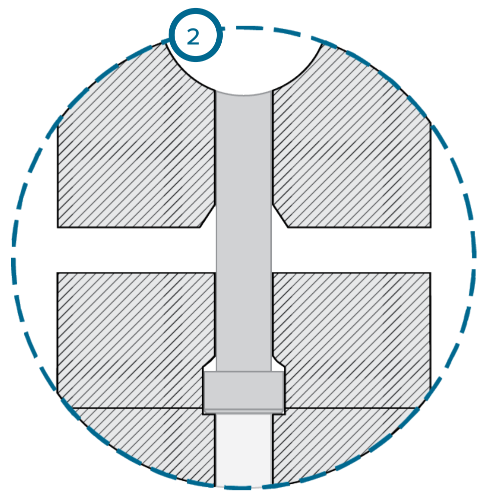
INSTALLATION OVERVIEW (*continued*)

ANGLED EJECTOR PINS



Ejector pins that are located onto angled surfaces of a part can utilize sensors depending upon the angle of the pin. The threshold for angled pin and sensor compatibility is 30° (1 at right). Any pin that is at an angle greater than this and not symmetrical must not be used for sensing cavity pressure. Beyond 30°, force is lost to friction as the pin is directed sideways into the mold steel instead of directly back onto the sensor. This effect will be magnified by smaller pins that are subjected to lower forces.

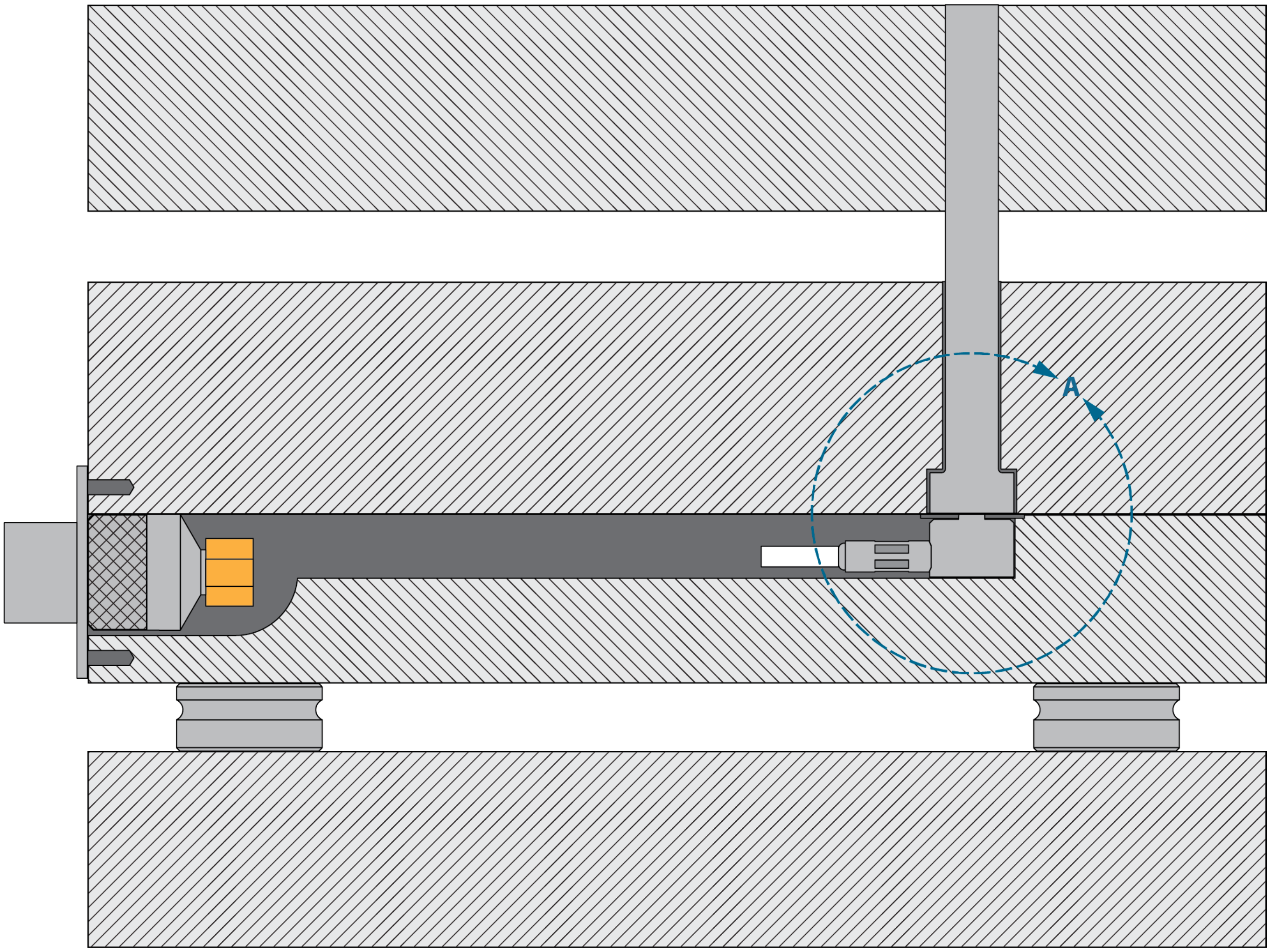
CONTOURED EJECTOR PINS

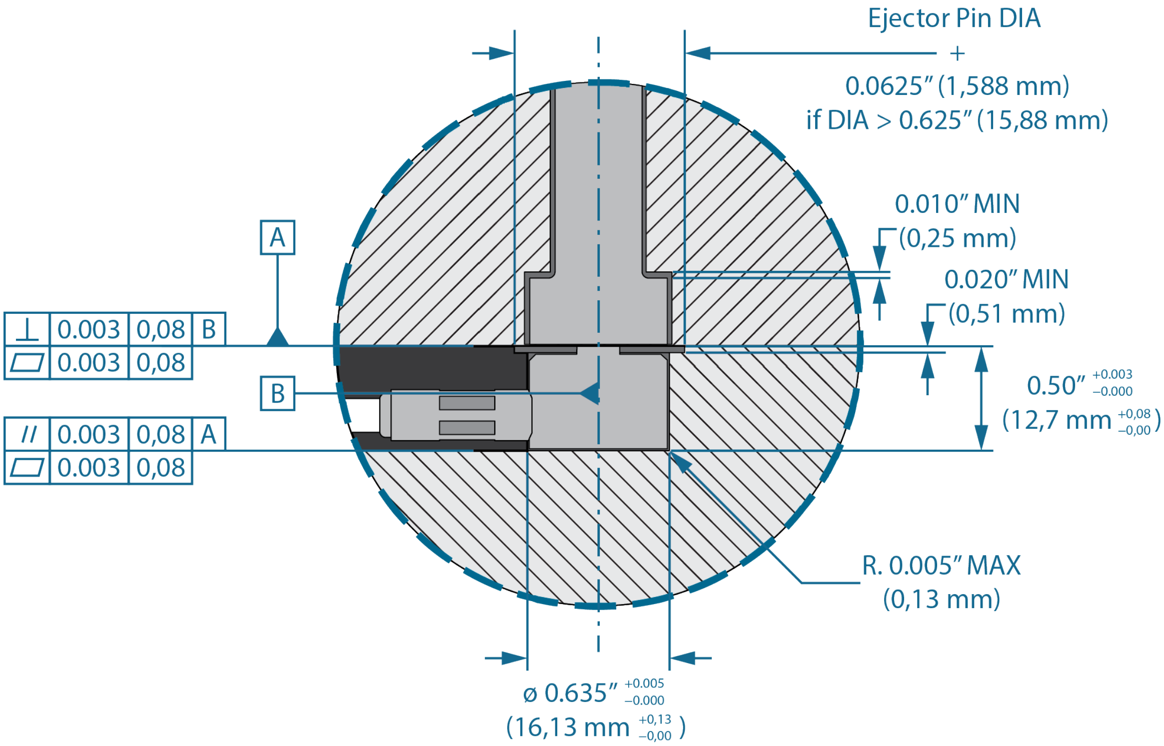


Ejector pins that are located onto contoured surfaces of a part can utilize sensors depending upon contour shape—a concave contour is acceptable (2 at right). A concave shape allows force from plastic pressure to properly be applied to the pin surface.

Do not use a convex contoured ejector pin. The convex shape is comparable to an angle of +30°, which loses force to friction on the pin sides instead of the pin face.

INSTALLATION SPECIFICATIONS





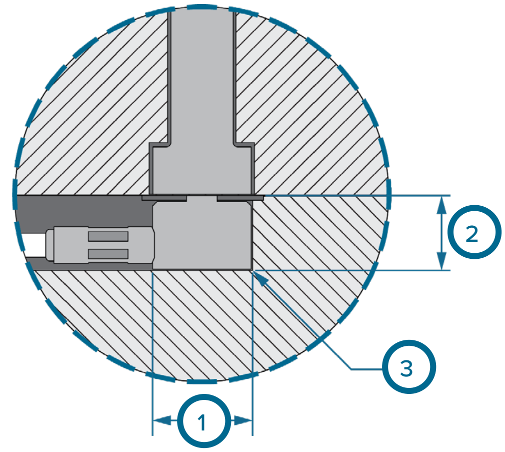
DETAIL A

INSTALLATION SPECIFICATIONS (*continued*)

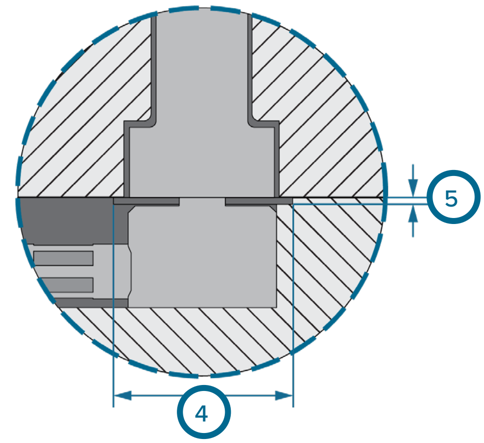
SENSOR POCKET MACHINING

Sensor pockets are machined into the ejector plate. The pockets must be concentric 0.635” +0.005/-0.0 (16,13 mm +0,13/-0,0 [1 at right]), and 0.50” +0.003/-0.0 (12,7 mm +0,08/-0,0 [2 at right]) tall.

- Use a “dead sharp” end mill to achieve correct radius—sensor pocket corner radius MAX R 0.005” (0,13 mm [3 at right]).

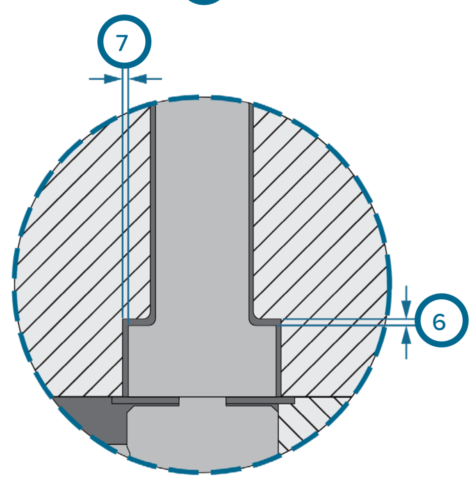


If the ejector pin is greater than 0.625” (15,88 mm), machine a counterbore pocket for the ejector pin head in the ejector plate that is equal to the ejector pin head DIA plus 0.0625” (1,588 mm) MIN by 0.020” (0,51 mm) MIN deep to allow the head of the ejector pin to clear the plate and rest only on the sensor when under pressure (4 & 5 at right).



EJECTOR PIN

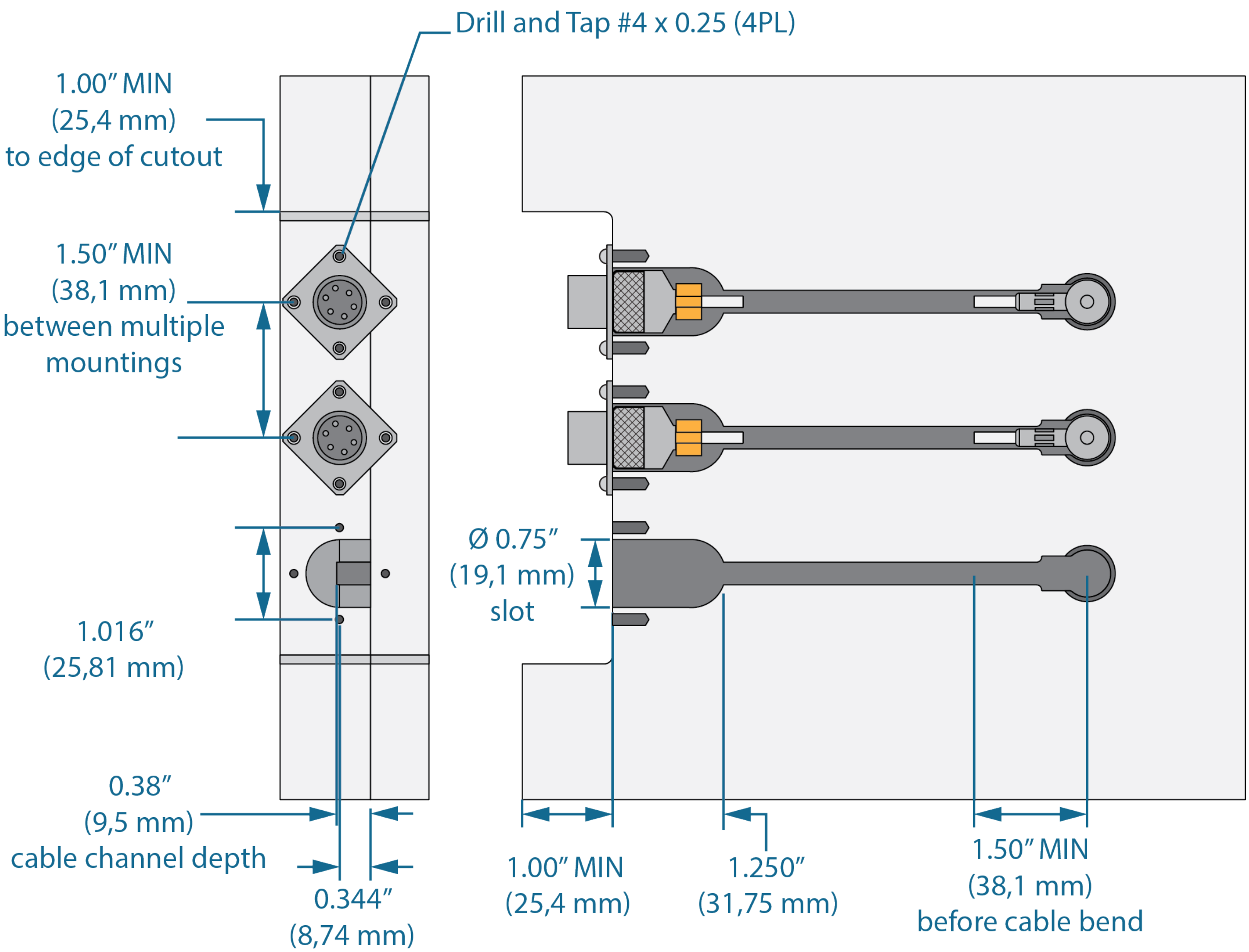
Choose an ejector pin appropriate for the application (refer to “Sensor and Ejector Pin Size” on page 29). Machine a pocket for the ejector pin head in the ejector retainer plate that is equal to the ejector pin head DIA plus 0.010” (0,25 mm [6 at right]) MIN per side by ejector pin head height plus 0.010” (0,25 mm [7 at right]) MIN to eliminate potential preload on the sensor when installed.



ⓘ **NOTES** *Ejector pin head clearance not to exceed 20% (1/5th) of part thickness at point of pin/part convergence.*

Hole basis for ejector pins is ISO standard clearance fit H7g6—H7g6 is a sliding fit suitable for precision location fits.

1	ø 0.635” +0.005/-0.0 (16,13 mm +0,13/-0,0)	4	DIA + 0.0625” (1,588 mm) MIN
2	0.005” (0,127 mm) MAX R.	5	0.020” (0,51 mm) MIN
3	0.50” (12,7 mm)	6	0.010” (0,25 mm) MIN
7	0.010” (0,25 mm) MIN per side		


Drill and Tap #4 x 0.25 (4PL)
1.00″ MIN
(25,4 mm)
to edge of cutout
1.50″ MIN
(38,1 mm)
between multiple
mountings
Ø 0.75″
(19,1 mm)
slot
1.016″
(25,81 mm)
0.38″
(9,5 mm)
cable channel depth
0.344″
(8,74 mm)
1.00″ MIN
(25,4 mm)
1.250″
(31,75 mm)
1.50″ MIN
(38,1 mm)
before cable bend

INSTALLATION SPECIFICATIONS (*continued*)

SENSOR CABLES

Machine a cable channel width of 0.25” (6,0 mm) and depth of 0.38” (9,5 mm).

1. Sensor Cable Bend

The sensor cable must not be bent within 1.50” (38,1 mm) MIN of center of the sensor head.

2. Excess Cable Pocket

If necessary, a cable pocket may be machined to store excess cable. This requires 0.50” (12,7 mm) MIN internal radius for the cable to coil.

3. Self-Locking Cable Guides

Use self-locking cable guides in cable channels to retain the sensor cable.

SENSOR CONNECTOR RECESS CUTOUT

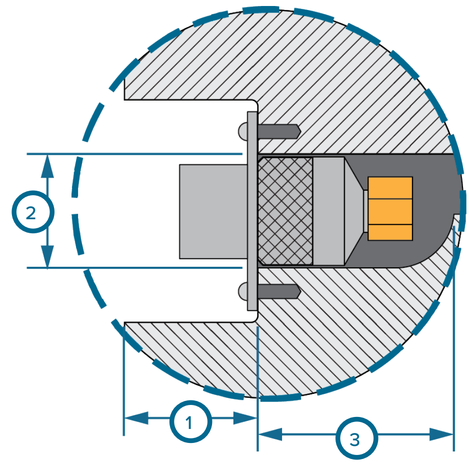
Recess the connection side of the bendix connector in the mold for protection. Cut a pocket 1.00” (25,4 mm [1 at right]) MIN deep by 1.00” (25,4 mm) MIN from center to the edge of the cutout wide.

Cut a slot diameter of 0.75” (19,1 mm) by 1.250” (31,75 mm [2 & 3 at right]) for the bendix connector in the ejector retainer plate.

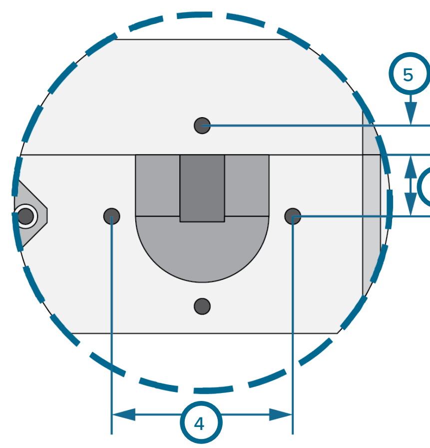
SENSOR CONNECTOR MOUNTING

Drill and tap four #4 x 0.25” mounting holes for each bendix connector/sensor; mounting locations are centered over the connector slot, 1.016” (25,81 mm [4 at right]) apart with one set of two oriented horizontally and the other vertically, forming a cross over the slot.

One mounting hole is located on the ejector plate 0.164” (4,17 mm [5 at right]) from the ejector plate/ejector retainer plate division, with the other three located on the ejector retainer plate 0.344” (8,74 mm [6 at right]) from the ejector plate/ejector retainer plate division.



ⓘ **NOTES** *Ensure a 1.5” (38,1 mm) MIN spacing between sensor connector mountings.*

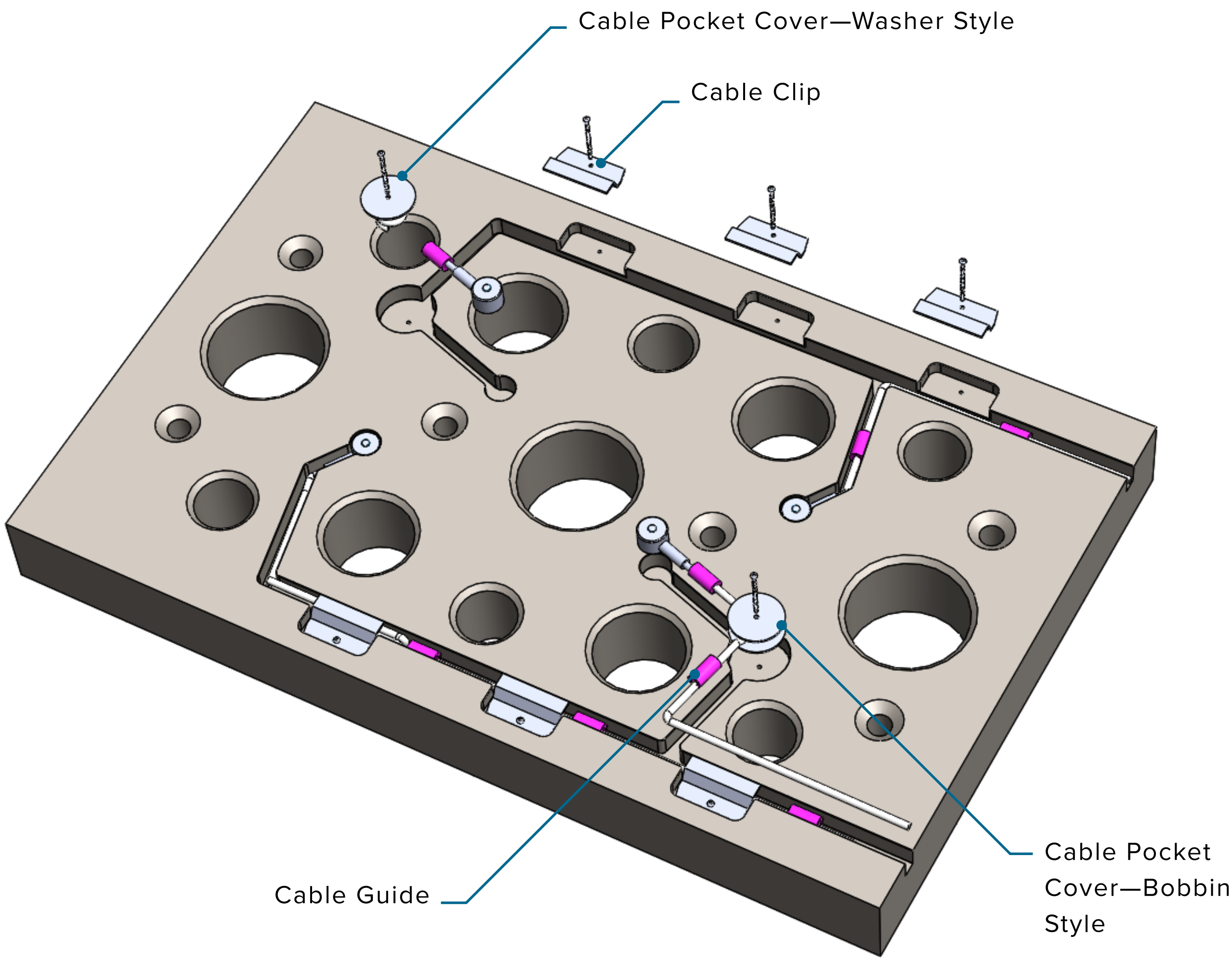


1	1.00” (25,4 mm) MIN
2	0.75” (19,1 mm)
3	1.250” (31,75 mm)
4	1.016” (25,81 mm)
5	0.164” (4,17 mm)
6	0.344” (8,74 mm)

SENSOR CABLE RETENTION

INSTALLATION SPECIFICATIONS (*continued*)

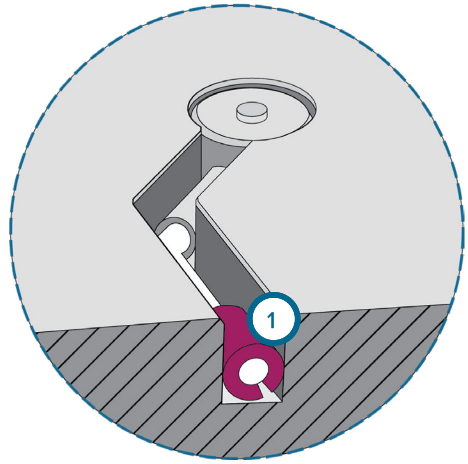
Sensor cable retention strategies must be considered during the mold design phase. Cables are often not the exact size needed, or do not easily remain in the cable channels during assembly and must be retained using one or more of the following methods.



INSTALLATION SPECIFICATIONS (*continued*)

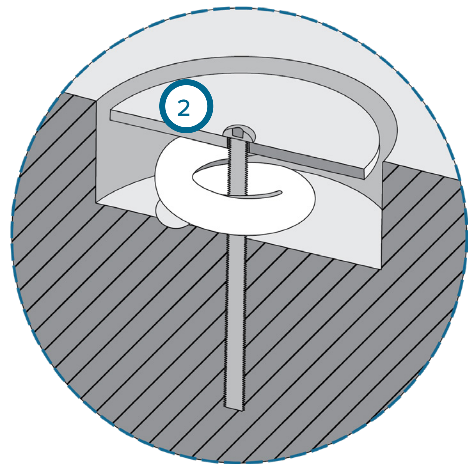
1. Cable Guides

Use self-locking cable guides (1 at right) in cable channels to retain the sensor cable. Cable guides are silicone rubber tubes with a slot in them to accommodate the sensor cable; the cable guides fit snugly within the cable channel dimensions provided.



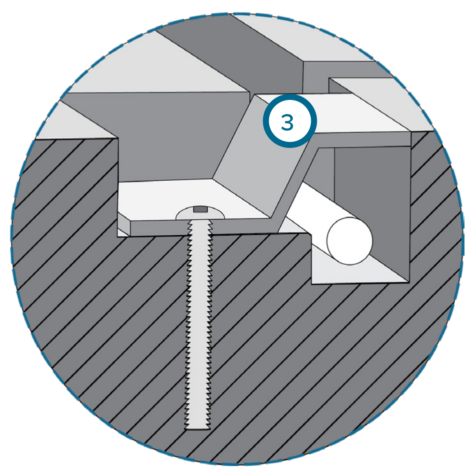
2. Cable Pocket Covers

If excess cable pockets are present, it may be useful to provide a cover (2 at right) for the cable pocket with which to retain extra cable. Though RJG does not currently provide a solution specifically for this application, plastic or metal discs with a centrally-located hole, retained by a single bolt through the center, can be used to easily retain cable within the pocket. Alternatively, a bobbin-style device can be used similarly to retain cable within a pocket.



3. Cable Clips

Cables may also be retained in channels using cable clips (3 at right); RJG does not currently provide this solution. Clips can be formed from sheet or plate metal and retained by machine screws. The clips can supplement or replace the use of silicone rubber cable guides, enabling an easier assembly of the tool.



NON-STANDARD INSTALLATIONS

STATIC (NON-MOVING) EJECTOR PINS

While cavity pressure sensor installation with moving, or "working" ejector pins is recommended, in some situations a non-moving or "static" pin must be utilized; static ejector pins may be used in the ejector plate as described previously in "Installation Specifications" on page 7. Read and follow all instructions, and refer to the provided figures to properly install sensors with static ejector pins.

1. Static Ejector Pins Overview

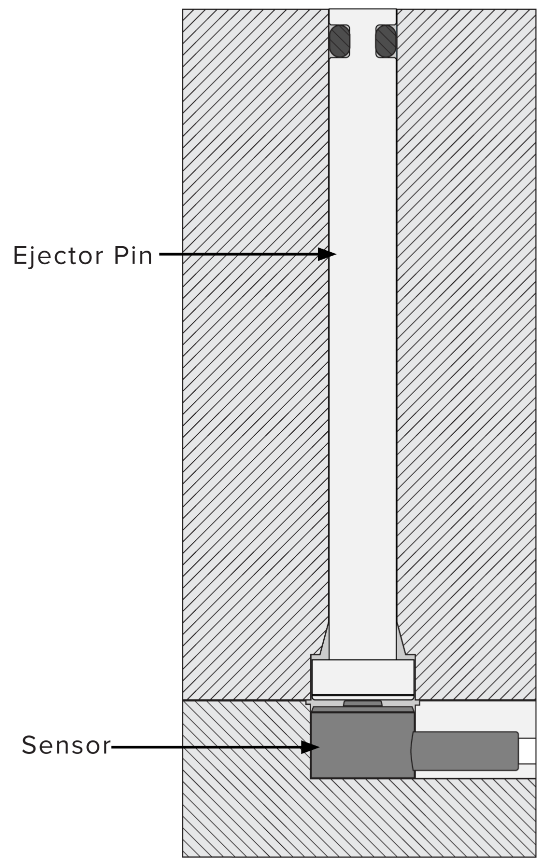
Static ejector pins are non-moving pins which sit on top of button-style sensors to transfer plastic pressure in the cavity to the sensor in a mold plate. Unlike moving ejector pins which self-clean during each ejection cycle, static pins can allow build-up of material around the pin over time. Static pins should have an O-ring on the end of the pin to prevent contamination build-up that contributes to measurement errors, allowing the sensors to read accurately over time.

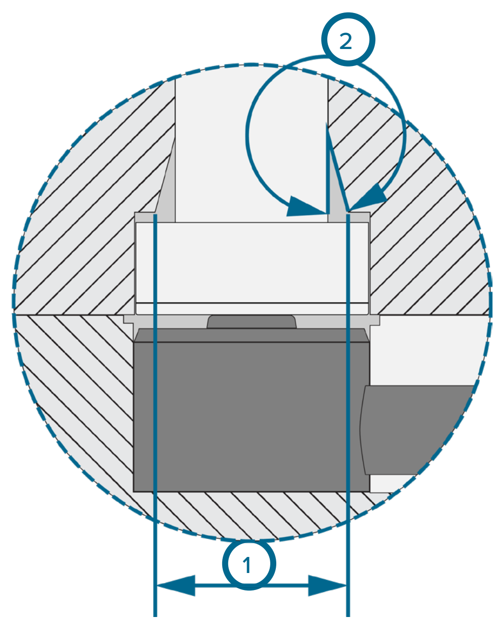
Successful static pin installation provides lower sensor and installation costs; easier sensor maintenance; flexibility in sensor and pin sizing; and freedom in sensor location.

2. Ejector Pin Bore and Lead-In

A standard ejector pin bore in which the ejector pin is able to freely move is recommended for most installations; provide a lead-in—of greater than the O-Ring outside diameter (OD [1 at right])—from the ejector pin head pocket to the ejector pin bore of 15° MAX (2 at right). For small O-Rings (0.04" [1,0 mm]), the tolerancing of the bore may affect the compression of the O-Ring, and additional attention to the tolerancing of the bore may be required.

STATIC PIN INSTALLATION





NON-STANDARD INSTALLATIONS (*continued*)

3. Ejector Pin and Counter-Bore Clearance

Always use standard ejector pin clearances when installing cavity pressure sensors under static ejector pins to prevent damage or destruction of the pins, sensors, and mold. Proper ejector pin head and counter-bore clearance will allow the static pin to move freely in the ejector pin bore.

4. O-ring Sizing

O-ring sizes are designated by inside diameter (ID [1 at right]) and cross section (CS [2 at right]), usually in inches. A 0.072 X 0.036 O-ring would have an ID of 0.072” and a CS of 0.036”.

The O-ring is installed in the ejector pin’s groove. The groove is measured by diameter (3 at right) and width (4 at right). The diameter is cut to ensure O-ring stretch of 0–10%. The depth is cut to ensure O-ring compression of 20–35%. Ensure the pin end before O-Ring groove is 0.030” (0,76 mm [4 at right]) MIN for steelsafe.

5. O-Ring Materials

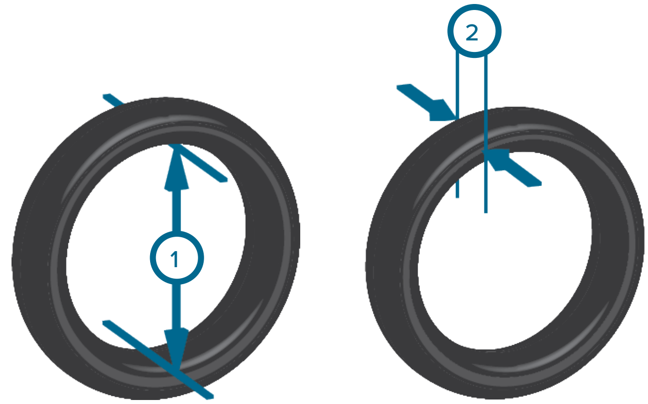
A 70 durometer silicone rubber (70SLR) is preferred for most molding applications, and is usually available in stock. High-temperature and some LSR applications required 75 durometer Viton (75Viton)—this is not normally stocked, and often requires an 8-week lead time.

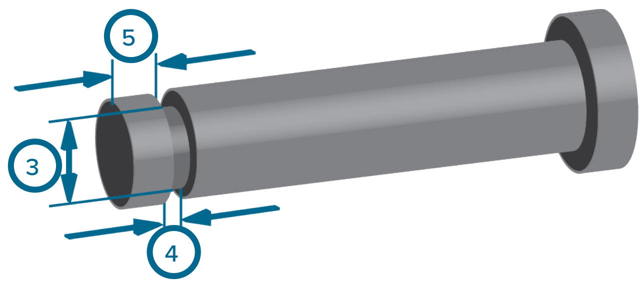
6. O-Ring Sources

Apple Rubber (www.applerubber.com) provides a good selection of O-rings in stock, and provides strong technical assistance. Minimum orders are usually $50 for in-stock items.

7. Tolerancing

Tolerancing usually has little impact on o-ring function. However, very small O-rings may require additional attention to the tolerancing of the bore and the groove ID.





8. O-Ring Installation

Improper O-ring installation can cause tears if it is pulled over the sharp ejector pin edge. Use an installation tool constructed of the same diameter as the ejector pin, with a tapered end.

The end can be ground, usually by a grinding wheel, and buffed by a wire wheel to remove any burrs. Slide the O-ring onto the tapered end of the installation tool, and then slide onto the end of the static pin. (Refer to figure below.)

9. Pin and O-Ring Bore Installation

Use an O-ring lubricant to help prevent damage when inserting the pin into the bore. Many silicone-based lubricants can damage silicone O-rings.

RJG, Inc. recommends P-80 THIX lubricant from International Products Corporation (http://www.ipcol.com/shopexd.asp?id=31). Spin the pin as it is being inserted to ease installation and limit potential O-ring damage.

10. O-Ring Selection Table

Nominal Pin Size	Pin DIA (in.)	Pin DIA Tolerance (in.)	Material	O-Ring # (IDXCS)	Width (G)	Width Tolerance (±)	Groove DIA (C)	Groove DIA Tolerance (±)	Bore DIA (A)	Bore Tolerance	Max. Angle (°)	Min. DIA (H)
3/64	0.047	-0.0002/ -0.0003	70SLR	0.025 X 0.013	0.023	±0.003	0.0259	0.001	0.0469	0.0003	15	0.057
1 mm	0.039	-0.0002/ -0.0003	70SLR	0.028 X 0.008	0.012	±0.003	0.0285	0.00003	0.0394	0.0003	15	0.045
1 mm	0.039	-0.0002/ -0.0003	70SLR	0.018 X 0.012	0.018	±0.003	0.0193	0.0009	0.0394	0.0003	15	0.044
1.5 mm	0.059	-0.0002/ -0.0003	70SLR	0.033 X 0.018	0.027	±0.003	0.0341	0.001	0.0591	0.0003	15	0.071
1.5 mm	0.059	-0.0002/ -0.0003	70SLR	0.035 X 0.016	0.024	±0.003	0.0371	0.001	0.0591	0.0003	15	0.070
1.5 mm	0.059	-0.0002/ -0.0003	70SLR	0.028 X 0.020	0.030	±0.003	0.0301	0.001	0.0591	0.0003	15	0.071
1/16	0.063	-0.0002/ -0.0003	70SLR	0.035 X 0.016	0.024	±0.003	0.0395	0.001	0.0625	0.0003	15	0.073
1.6 mm	0.063	-0.0002/ -0.0003	75VITON	0.032 X 0.018	0.032	±0.005	0.037	0.001	0.0630	0.0003	15	0.074
1.6 mm	0.063	-0.0002/ -0.0003	70SLR	0.035 X 0.016	0.024	±0.005	0.040	0.001	0.0630	0.0003	15	0.073
1.6 mm	0.063	-0.0002/ -0.0003	70SLR	0.028 X 0.022	0.033	±0.005	0.037	0.001	0.0630	0.0003	15	0.082
5/64	0.078	-0.0002/ -0.0003	70SLR	0.050 X 0.018	0.027	±0.005	0.052	0.001	0.0781	0.0003	15	0.089
5/64	0.078	-0.0002/ -0.0003	70SLR	0.047 X 0.022	0.033	±0.003	0.048	0.001	0.0781	0.0003	15	0.093
5/64	0.078	-0.0002/ -0.0003	70SLR	0.051 X 0.020	0.030	±0.003	0.051	0.001	0.0781	0.0003	15	0.092
5/64	0.078	-0.0002/ -0.0003	70SLR	0.051 X 0.016	0.024	±0.003	0.055	0.001	0.0781	0.0003	15	0.088
5/64	0.078	-0.0002/ -0.0003	70SLR	0.047 X 0.016	0.024	±0.003	0.052	0.001	0.0781	0.0003	15	0.085

NON-STANDARD INSTALLATIONS (*continued*)

10. O-Ring Selection Table (continued)

Nominal Pin Size	Pin DIA (in.)	Pin DIA Toler-ance (in.)	Material	O-Ring # (IDXCS)	Width (G)	Width Toler-ance (±)	Groove DIA (C)	Groove DIA Tol-erance (±)	Bore DIA (A)	Bore Tol-erance	Max. Angle (°)	Min. DIA (H)
2.0 mm	0.079	-0.0002/ -0.0003	70SLR	0.045 X 0.022	0.033	±0.003	0.048	0.001	0.0787	0.0003	15	0.093
2.0 mm	0.079	-0.0002/ -0.0003	70SLR	0.050 X 0.018	0.027	±0.003	0.053	0.001	0.0787	0.0003	15	0.090
3/32	0.094	-0.0002/ -0.0003	70SLR	0.051 X 0.028	0.039	±0.005	0.053	0.001	0.0938	0.0003	15	0.106
3/32	0.094	-0.0002/ -0.0003	70SLR	0.063 X 0.020	0.030	±0.005	0.064	0.001	0.0938	0.0003	15	0.105
2.5 mm	0.098	-0.0002/ -0.0003	70SLR	0.047 X 0.024	0.032	±0.005	0.048	0.001	0.0984	0.0003	15	0.097
2.5 mm	0.098	-0.0002/ -0.0003	70SLR	1.4 X 0.6	0.032	±0.005	0.067	0.00099	0.0984	0.0003	15	0.115
2.5 mm	0.098	-0.0002/ -0.0003	70SLR	1.6 X 0.5	0.032	±0.005	0.067	0.00099	0.0984	0.0003	15	0.112
2.5 mm	0.098	-0.0002/ -0.0003	70SLR	1.5 X 0.7	0.047	±0.005	0.057	0.0005	0.0984	0.0003	15	0.113
2.5 mm	0.098	-0.0002/ -0.0003	70SLR	1.2 X 0.6	0.032	±0.005	0.065	0.001	0.0984	0.0003	15	0.114
2.5 mm	0.098	-0.0002/ -0.0003	70SLR	1.4 X 0.6	0.032	±0.005	0.058	0.001	0.0984	0.0003	15	0.107
2.5 mm	0.098	-0.0002/ -0.0003	70SLR	0.047 X 0.032	0.048	±0.005	0.048	0.001	0.0984	0.0003	15	0.113
2.5 mm	0.098	-0.0002/ -0.0003	70SLR	0.046 X 0.034	0.051	±0.005	0.048	0.001	0.0984	0.0003	15	0.117
2.5 mm	0.098	-0.0002/ -0.0003	75VITON	0.047 X 0.036	0.054	±0.005	0.049	0.001	0.0984	0.0003	15	0.122
1/8	0.125	-0.0002/ -0.0003	70SLR	0.072 X 0.036	0.054	±0.005	0.074	0.001	0.1250	0.0003	15	0.147
1/8	0.125	-0.0002/ -0.0003	70SLR	0.076 X 0.030	0.045	±0.005	0.078	0.001	0.1250	0.0003	15	0.139

NON-STANDARD INSTALLATIONS (*continued*)

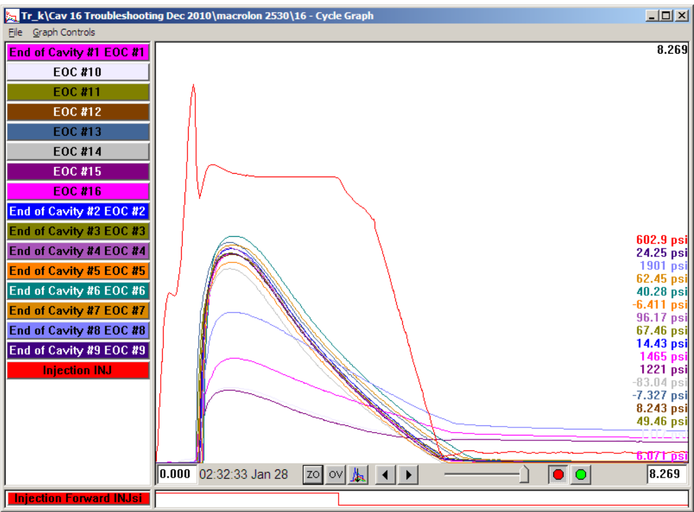
10. O-Ring Selection Table (continued)

Nominal Pin Size	Pin DIA (in.)	Pin DIA Toler-ance (in.)	Material	O-Ring # (IDXCS)	Width (G)	Width Toler-ance (±)	Groove DIA (C)	Groove DIA Tol-erance (±)	Bore DIA (A)	Bore Tol-erance	Max. Angle (°)	Min. DIA (H)
4.0 mm	0.157	-0.0002/ -0.0003	70SLR	0.098 X 0.026	0.039	±0.005	0.111	0.001	0.1575	0.0003	15	0.164
4.0 mm	0.157	-0.0002/ -0.0003	70SLR	0.0106 X 0.026	0.031	±0.005	0.114	0.0019	0.1570	0.0003	15	0.167
3/16	0.188	-0.0002/ -0.0003	70SLR	0.116 X 0.038	0.057	±0.005	0.127	0.001	0.1875	0.0003	15	0.204
5.0 mm	0.197	-0.0002/ -0.0003	70SLR	0.136 X 0.040	0.060	±0.005	0.134	0.001	0.1969	0.0003	15	0.215
5.0 mm	0.201	-0.0002/ -0.0003	70SLR	0.138 X 0.039	0.059	±0.005	0.140	0.001	0.2010	0.0003	15	0.219
6.0 mm	0.236	-0.0002/ -0.0003	70SLR	0.165 X 0.045	0.068	±0.005	0.165	0.001	0.2362	0.0003	15	0.256
1/4	0.250	-0.0002/ -0.0003	70SLR	0.169 X 0.047	0.071	±0.005	0.178	0.002	0.2500	0.0003	15	0.274
5/16	0.313	-0.0002/ -0.0003	70SLR	0.224 X 0.45	0.068	±0.005	0.238	0.005	0.3125	0.0003	15	0.333
3/8	0.375	-0.0002/ -0.0003	70SLR	0.276 X 0.059	0.089	±0.005	0.287	0.004	0.3750	0.0003	15	0.409
3/8	0.375	-0.0002/ -0.0003	70SLR	0.299 X 0.047	0.071	±0.005	0.304	0.003	0.3750	0.0003	15	0.401
3/8	0.375	-0.0002/ -0.0003	70SLR	0.291 X 0.045	0.068	±0.005	0.308	0.003	0.3750	0.0003	15	0.401

NON-STANDARD INSTALLATIONS (*continued*)

11. Sensor Readings

Data from the same mold is pictured below (typical results—not guaranteed).

Without O-Ring Installation	With O-Ring Installation
	

Above Left: Three sensors are reading too low due to contamination—without O-rings installed.

Above Right: The template and solid lines after four months of continuous production; the sensors continue to read consistently with O-rings installed.

Proper installation will provide a long service life of O-rings inside the mold. Only in the event of the following two instances will O-rings require replacement:

12. Flashing

If material flashes around the pin, it is necessary to pull the pin and remove the flashed material during regular preventative maintenance cycles. The O-ring must be replaced.

13. O-Ring Damage

When a pin is removed for inspection and/or cleaning during mold maintenance, inspect the O-ring for damage. Repeated installation and removal can cause nicks, cuts, or other damage to O-rings. Damaged O-rings must be replaced.

NON-STANDARD INSTALLATIONS (*continued*)

MULTIPLE EJECTOR PINS

Ejector pins are often grouped in small areas that do not allow for traditional cavity pressure senor installation. Read and follow all instructions, and refer to the provided figures to properly install sensors with multiple ejector pins.

1. Multiple Ejector Pin and Sensor Placement

When multiple ejector pins are located too closely together to permit cavity pressure sensor placement under a single pin, a cover plate can be utilized to allow a selected pin to contact the sensor and prevent other pins from interfering.

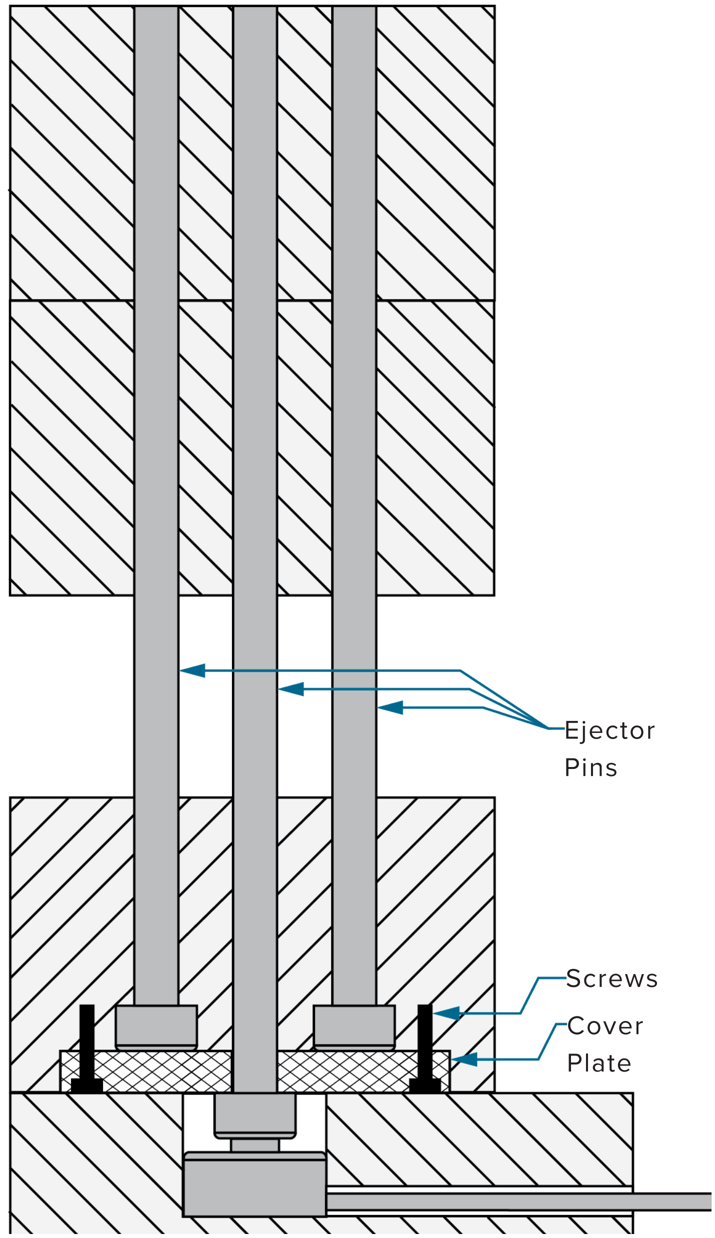
The ejector pin retainer plate is modified to fit the cover plate so that it is recessed and flush with the ejector plate, and covers the area of the sensor body and unused ejector pins. The cover plate is mounted with four screws.

The cover plate mounting screws must be flush with the ejector plate and must not be in contact with the ejector pins, since constant pressure on the screws will cause them to fail.

2. Ejector Pin and Counter-Bore Clearance

Always use standard ejector pin clearances when installing cavity pressure sensors under ejector pins to prevent damage or destruction of the pins, sensors, and mold. Proper ejector pin head and counter-bore clearance will allow the static pin to move freely in the ejector pin bore.

PIN, SENSOR, & PLATE INSTALLATION



NOTES

MAINTENANCE

Strain gage sensors require little maintenance.

CLEANING

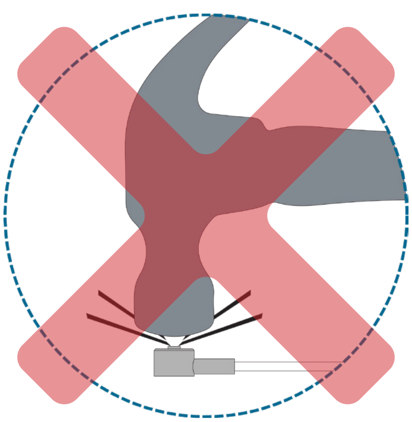
Pull sensors from the mold and clean out the pockets and channels when a mold is pulled for preventative maintenance. Sensors must be installed in pockets which are free from oil, dirt, grime, and grease.

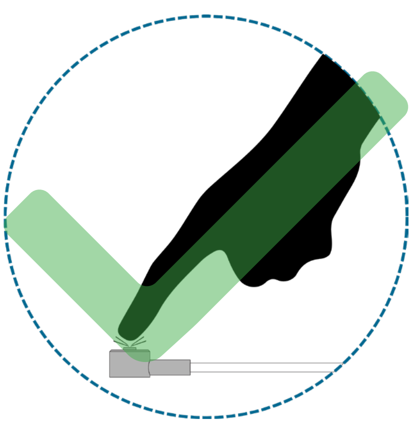
TESTING & CALIBRATION

TESTING SENSORS

Basic force tests are easily performed on the T-445 sensor; a small, even amount of force applied to the sensor head loading nub is sufficient to determine if the sensor is correctly reading pressure.

CAUTION *NEVER strike the sensor head with excessive force; failure to comply will result in damage or destruction of sensor.*





The eDART Raw Data Viewer can be used to test T-445 sensors. The Raw Data Viewer displays the status of the sensor, either Valid, No Reply, Stale, or Invalid.

A Valid sensor has raw counts that change when force is applied to the sensor; this indicated a properly working sensor.

A No Reply sensor is not communicating with the eDART; the sensor may be unplugged.

A Stale sensor indicates a sensor that is unused.

An Invalid sensor will indicate a failure of either Over-range (Ovrng) or Under-range (Undrng). The Ovrng indicates the sensor's calibration has changed too far in a positive direction outside of the upper specification. The Undrng indicates that the sensor's calibration has changed too far in a negative direction, and the sensor may report a number below zero when load is applied.

CALIBRATION

RJG recommends that sensors be calibrated every year, but the need for regular calibration depends largely on the accuracy required for the application and the requirements of individual quality systems and industry regulations.

RJG sensors are designed to hold calibration for operating life. The vast majority stay within a 2% accuracy specification, which is sufficient for most customer applications.

COMMON FACTORS AFFECTING SENSOR RECALIBRATION

4. Required Application Accuracy

Some applications require more accuracy than others. If using cavity pressure control on a precise part with a narrow processing window, it may be important to maintain sensor calibration to within 1%.

If simply detecting short shots, calibration shifts of 5% or more may be tolerated. As a point of reference, a 2% calibration error means that a cavity pressure of 3,000 psi (207 bar) may read as low as 2,940 psi (203 bar), or as high as 3,060 psi (211 bar), which is insignificant in most applications. For most applications, calibration accuracy of 2% is more than sufficient, and is used by RJG as the specification for repaired sensors.

5. Quality System Regulations

If US Food and Drug Administration (FDA) quality system requirements must be met, or those of other stringent quality systems, sensor calibration may be required. However, even in these cases, there is often flexibility to adjust guidelines to meet the needs of the application.

6. Sensor Cycle Count

In the most aggressive environments, it takes at least 100,000 cycles for a sensor to show significant calibration errors. In more typical applications, calibration will remain stable for 500,000–1,000,000 cycles. Even then, many sensors in the field with multiple millions of cycles show little calibration shift. If a sensor is in a low volume mold that sees fewer cycles, the need for sensor recalibration is minimized.

7. Sensor Load

The higher the peak load on the sensor, the more the loading nub can wear—and the higher the potential for calibration shift. Low force sensors (125-pound sensors, for example) show less calibration shift than high force sensors (2000-pound sensors); sensors that run at the lower end of their force range (less than 40% of full scale) show less calibration shift than sensors that run at the high end of their range.

8. Sensor Operating Temperature

The higher the mold temperature, the greater the potential for calibration shift. Below 212 °F (100 °C), calibration usually remains stable. Sensors running at 300–400 °F (150–200 °C) have a greater potential for permanent calibration shift over time.

9. Visible Sensor Wear

It is normal for the loading nub to show some wear. However, if the wear pattern exceeds half the diameter of the loading nub, the sensor calibration is more likely to have shifted significantly.

10. Sensor Zero Offset Shift

The zero offset is the reading of the sensor with no load applied. While not directly related to the sensor calibration, the zero offset does provide indication that the sensor's calibration may be suspect.

11. Abnormal Readings

A sensor reading abnormally high or low relative to template or to other sensors can be an indication of a calibration shift. Before sending the sensor back, check for other more common causes of erroneous readings, such as incorrect sensor pocket dimensions, sensor preload, contamination in the sensor pocket, and binding ejector pin due to misalignment, debris/ contamination, or galling.

WARRANTY

RJG, INC. STANDARD THREE-YEAR WARRANTY

RJG, Inc. is confident in the quality and robustness of the T-445 cavity pressure sensors, and so are offering a three-year warranty on all RJG cavity pressure sensors. RJG's cavity pressure sensors are guaranteed against defects in material and workmanship for three years from the ship date. The warranty is void if it is determined that the sensor was subjected to abuse or neglect beyond the normal wear and tear of field use, or in the event the sensor has been opened by the customer. This new warranty policy is the most generous offered in the cavity pressure sensor industry, with one year being the most common.

PRODUCT DISCLAIMER

RJG, Inc. is not responsible for the improper installation of this equipment, or any other equipment RJG manufactures.

Proper RJG equipment installation does not interfere with original equipment safety features of the machine. Safety mechanisms on all machines should never be removed.

NOTES

INSTALLATION ERRORS

EJECTOR PIN ISSUES

1. Pin size, expected pressure,and/or expected temperature not appropriate for selected sensor.

- Refer to “Sensor and Ejector Pin Size” on page 29.

2. Ejector pin is located behind mold surface with angle greater than 30° (1 at right).

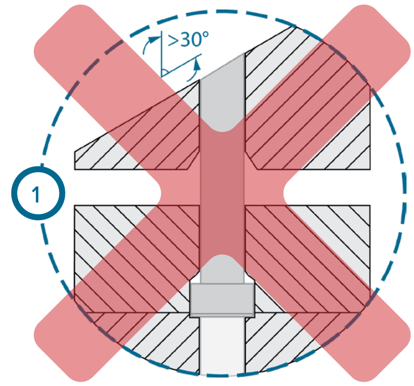
- Angles greater than 30° cause excessive side-load friction and influence sensor accuracy.

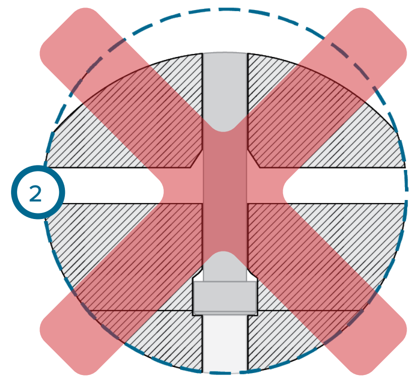
3. Ejector pin is contoured convexly.

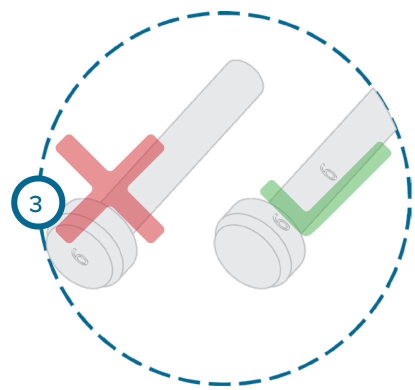
- The ejector pin must not but contoured convexly (2 at right). . The convex shape deflects pressure off of the pin similar to a +30° angle, preventing the pin from properly transferring cavity pressure to the sensor head, thus creating an inaccurate reading. Beyond 30°, force is lost to friction as the pin is directed sideways into the mold steel instead of directly back onto the sensor. This effect will be magnified by smaller pins that are subjected to lower forces.

4. Pin is engraved on head (3 at right).

- Pin heads must remain flat. Engrave pins on the side if necessary.



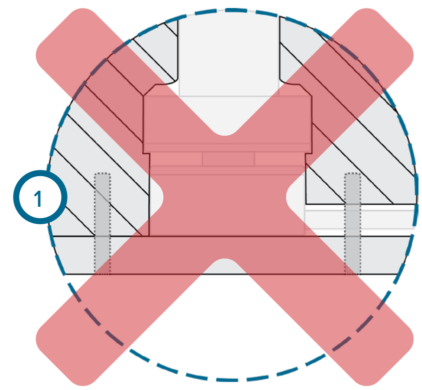




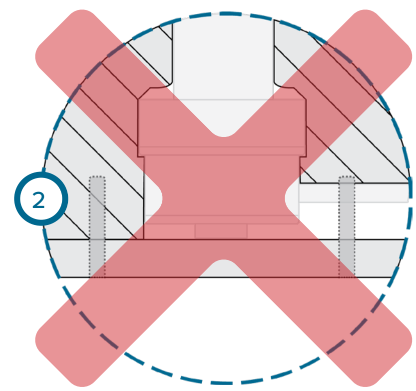
INSTALLATION ERRORS (*continued*)

SENSOR HEAD ISSUES

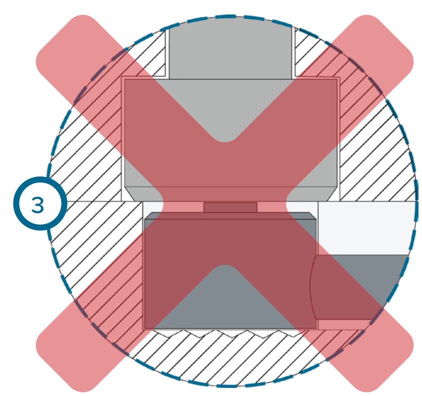
1. Ejector Pin head diameter is larger than sensor pocket diameter (1 at right).
   - Counterbore the ejector plate, or chamfer the pin head to ensure that the pin rests only on the sensor nub.



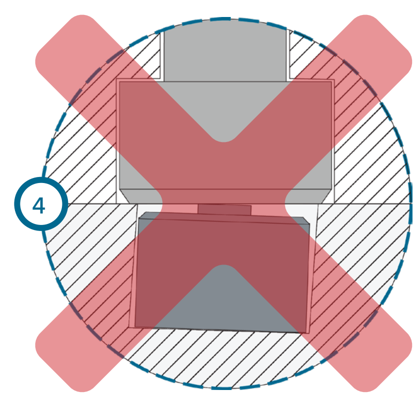
2. Sensor head is installed incorrectly (2 at right).
   - The sensor nub must face the ejector pin. DO NOT install the sensor head upside-down.



3. Sensor pocket surface is not smooth (3 at right).
   - The mold surface must have a finish of $\sqrt[32]{}$ or better; the sensor pocket must have a smooth surface.



4. Sensor and ejector pin are not perpendicular (4 at right).
   - The sensor and ejector pin must be perpendicular.

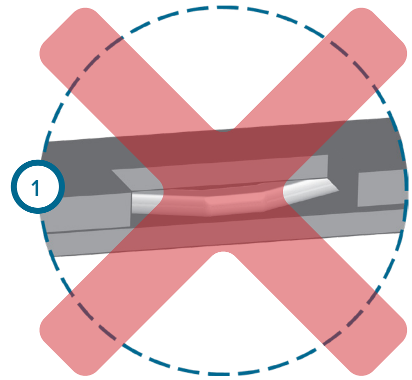


INSTALLATION ERRORS (*continued*)

CASE AND CABLE ISSUES

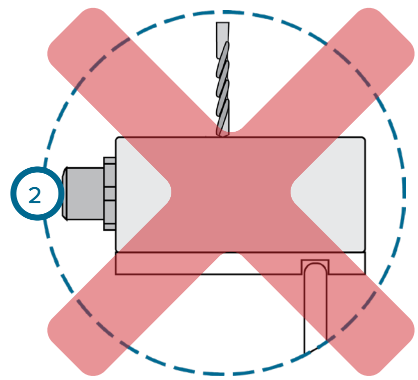
1. Sensor cable is pinched during mold assembly (1 at right).
2. Sensor case is mounted on surface that exceeds temperature rating.

- Do not mount the Lynx case on surface that exceeds the recommended temperature rating. Contact RJG, Inc. Customer support for high-temperature applications.



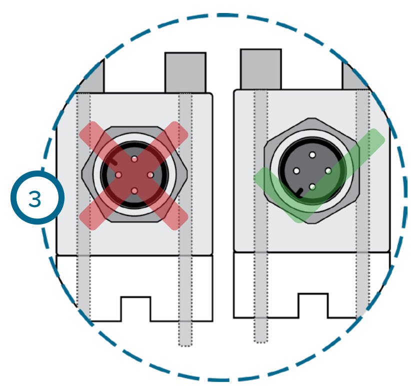
3. Lynx case is drilled to accommodate alternate mounting (2 at right).

- NEVER drill the Lynx case. Failure to comply will result in damage or destruction to equipment and void of warranty.



4. Orientation of Lynx connector on Lynx case is altered from OEM (3 at right).

- The Lynx connector on the Lynx case is keyed. DO NOT attempt to change key orientation by loosening or tightening the Lynx connector on the Lynx case. Failure to comply will result in damage to equipment and void of warranty.



WIRING FAILURE

The most common cause of failure are short circuits or broken wires. Measure wire resistances and refer to the following tables to determine if the sensor has had a wiring failure.

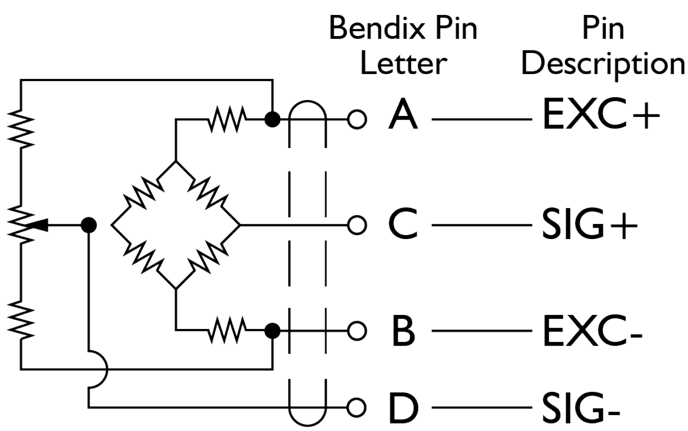
RESISTANCE READINGS

PINOUT	RESISTANCE
pin A to pin C	260–365 W
pin B to pin D	260–365 W
pin B to pin C	260–365 W
pin A to pin B	350–550 W
pin A to pin D	260–365 W
pin C to pin D	350 W ±5 W

PIN ASSIGNMENT

PIN	GREY CABLE COLOR CODE	YELLOW CABLE COLOR CODE
A	orange/white	black
B	blue/white	white
C	white/orange	blue
D	white/blue	brown
E	drain	drain

PINOUT SCHEMATIC



SENSOR AND EJECTOR PIN SIZE

SELECTION CHARTS

The charts below are only a guide. In order to assure correct sensor selection for an application, please contact RJG.

Locate the pin size that will be used and match it to the location on the part (near the end of fill or near the gate). The recommended sensor is the intersection of the row and column.

1. Imperial Units

	RECOMMENDED SENSOR FOR EXPECTED PLASTIC PRESSURE/PIN SIZE			
Pin Size	**5,000 psi**	**10,000 psi**	**15,000 psi**	**20,000 psi**
23/64				T-445
3/8				T-445
13/32			T-445	T-445
7/16			T-445	T-445
15/32			T-445	T-445
1/2		T-445	T-445	T-445
9/16		T-445	T-445	
5/8		T-445		
11/16	T-445	T-445		
3/4	T-445			
7/8	T-445			
1.0	T-445			

SENSOR AND EJECTOR PIN SIZE (continued)

2. Metric Units

	RECOMMENDED SENSOR FOR EXPECTED PLASTIC PRESSURE/PIN SIZE			
Pin Size	**5,000 psi**	**10,000 psi**	**15,000 psi**	**20,000 psi**
9,0 mm				T-445
9,5 mm				T-445
10,0 mm			T-445	T-445
11,0 mm			T-445	T-445
12,0 mm			T-445	T-445
13,0 mm		T-445	T-445	
14,0 mm		T-445	T-445	
15,0 mm		T-445	T-445	
16,0 mm		T-445		
17,0 mm	T-445	T-445		
18,0 mm	T-445	T-445		
19,0 mm	T-445			
20,0 mm	T-445			

CUSTOMER SUPPORT

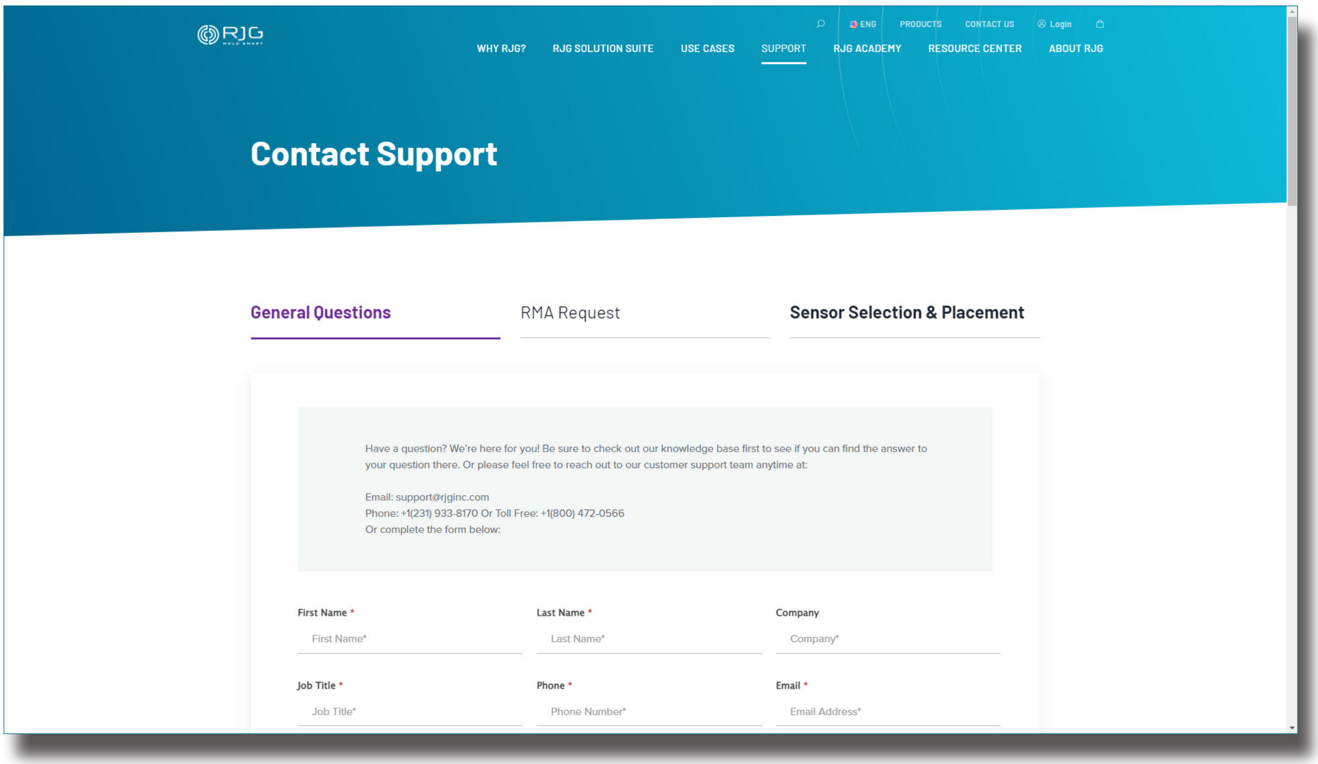
Contact RJG's Customer Support team by phone or email.

RJG, Inc. Customer Support

P: 800.472.0566 (Toll Free)

P: +1.231.933.8170

www.rjginc.com/support



NOTES

RELATED PRODUCTS

COMPATIBLE PRODUCTS

The T-445 line of senors are compatible with other RJG, Inc. products for use with the eDART process control and monitoring system.

ANALOG SINGLE-CHANNEL STRAIN GAGE SENSOR CABLE T-520

The Analog Single-Channel Strain Gage Sensor Cable T-520 (1 at right) interfaces the RJG, Inc. Lynx strain gage cavity pressure sensors and the Single-Channel Strain Gage Surface Mount Sensor Adapter SG/LX1-S in eDART™ applications.

SINGLE-CHANNEL STRAIN GAGE SURFACE-MOUNT SENSOR ADAPTER SG/LX1-S

The Single-Channel Strain Gage Surface-Mount Sensor Adapter SG/LX1-S (2 at right) interfaces a single Lynx strain gage cavity pressure sensor, sensor cable T-520, and the eDART system.

eDART PROCESS CONTROLLER

The eDART is a process monitoring and control system for plastic injection molding applications, providing a plethora of process tools from sorting parts to monitoring cavity pressure. The eDART process controller (3 at right) is the base hardware unit for the eDART system.

SIMILAR PRODUCTS

RJG, Inc. offers a wide array of cavity pressure sensors for each application—strain gage, single-channel, multi-channel, and digital.

LYNX SINGLE-CHANNEL STRAIN GAGE BUTTON SENSOR LS-B-159-4000

The Lynx Single-Channel Strain Gage Button Sensor LS-B-159-4000 (1 at right) provides the same strain gage technology, indirect installation style, and force rating as the T-445 sensor, but with Lynx™ digital technology built-in.

LYNX MULTI-CHANNEL STRAIN GAGE SYSTEM

The Lynx Multi-Channel Strain Gage system (2 at right) saves real estate on the mold providing simplified installation of up to eight sensors to one connection point on the mold.

1. Eight-Channel Strain Gage Adapter with Mold ID SG/LX8-S-ID

The SG/LX8-S-ID adapter resides on the molding machine, allowing technicians to move molds easily by disconnecting and connecting the connector cable. A Lynx cable then connects the adapter to the eDART system.

2. Eight-Channel Sensor Plate with Mold ID SG-8

The SG-8 plate resides on the mold allowing users to interface up to eight multi-channel strain gage sensors. A Lynx cable then connects the plate to the adapter and the eDART system.

3. Lynx Multi-Channel Strain Gage Button Sensors MCSG-B-127-50/125/500/200 and MCSG-B-159-4000

The MCSG-B-127-50/125/500/2000 and MCSG-B-159-4000 sensors provide the same strain gage technology and indirect installation style as the LS-B-147-50/125/500/2000 and LS-B-159-4000 sensors, but are compatible with the multi-channel components.

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