RJG
MOLD SMART

PRODUCT MANUAL

Flush-Mount 1 mm Cavity Temperature Sensor

TS-FM01-K



Training and Technology for Injection Molding

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PRODUCT MANUAL

Flush-Mount 1 mm Cavity Temperature Sensor

TS-FM01-K

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NOTES

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.

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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.*

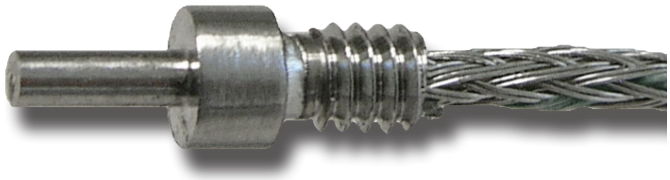
ABBREVIATIONS

DIA	diameter
MIN	minimum
MAX	maximum
R.	radius

NOTES

PRODUCT DESCRIPTION

The flush-mount 1 mm cavity temperature sensor TS-FM01-K analyzes temperature variation inside the mold cavity. The TS-FM01-K is designed for use with RJG, Inc.'s Lynx™ Quad Temperature Module LS-QTTB-K—which receives input from up to four thermocouples—and the eDART® or CoPilot® systems.



APPLICATIONS

The flush-mount sensor is made of stainless steel, and can be contoured, angled, and/or textured to match the cavity in which it is installed. The sensor's metal-sheathed wiring allows the sensor to be placed in molds with working temperatures of up to 752 °F (400 °C).

OPERATION

THERMOCOUPLES

Thermocouples are comprised of two wires of dissimilar materials that are joined at one end. The joined end of the wires is heated (or cooled) creating a continuous current at the center. The voltage produced is measured and correlated to the temperature.

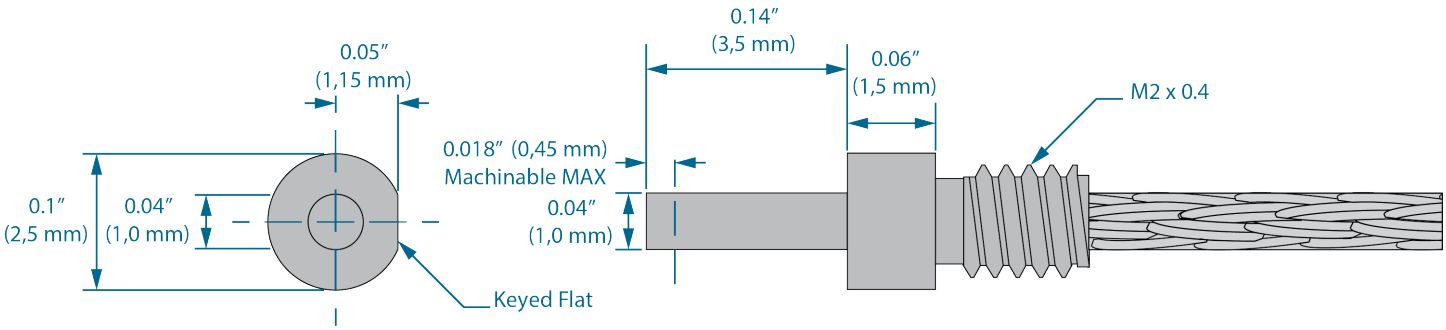
TYPE K THERMOCOUPLES

Type K thermocouples are a common base-metal thermocouple known for general purpose applications due to their response time, accuracy, and temperature measurement range.

Type K thermocouples have a measurement range of 0–707 °F (0–375 °C) with an accuracy of ±1.8 °F (±1.5 °C), or 707–752 °F (375–400 C°) with an accuracy of 0.4 % of reading.

DIMENSIONS

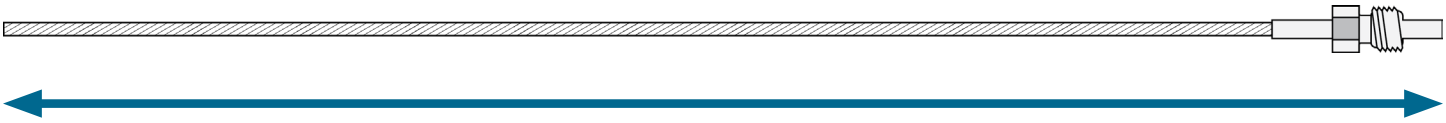
SENSOR



SENSOR CABLE

The TS-FM01-K sensor wire is available in three lengths. Length must be longer than needed to assure proper installation without tension on the lead wire.

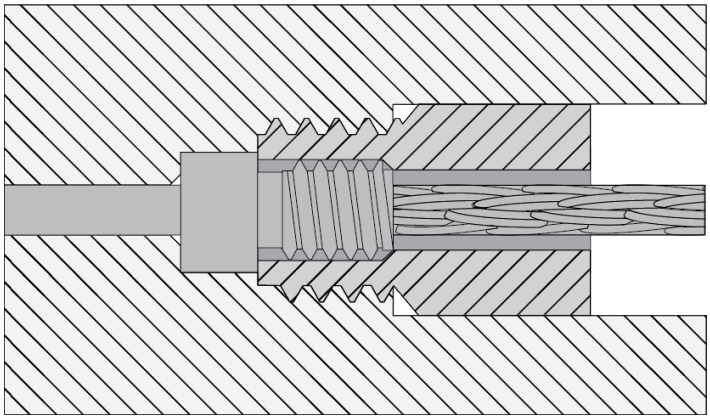
PART NUMBER	LENGTH
TS-FM01-K-.5m	19.7” (0.5 m)
TS-FM01-K-1m	39.4” (1.0 m)
TS-FM01-K-2m	78.7” (2.0 m)



INSTALLATION

INSTALLATION OVERVIEW

The TS-FM01-K flush-mount cavity temperature sensor may be installed using either of the two following installation methods.

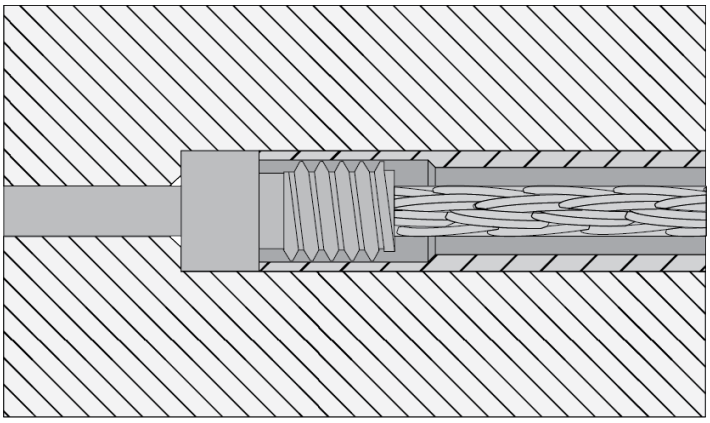


RETAINING NUT INSTALLATION

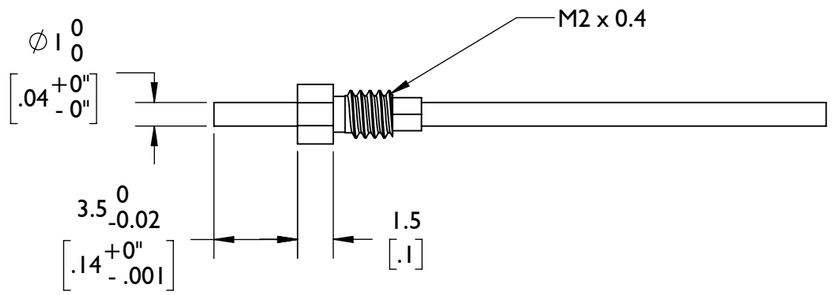
The sensor is inserted into and retained in the mold by a retaining nut. The retaining nut is threaded into the mold. The sensor tip reaches through to the mold cavity surface. The tip is machined to match the cavity's surface and/or contour.

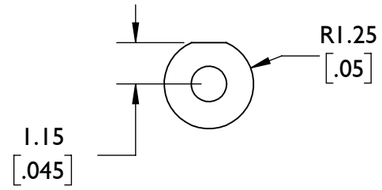
RETAINING SLEEVE INSTALLATION

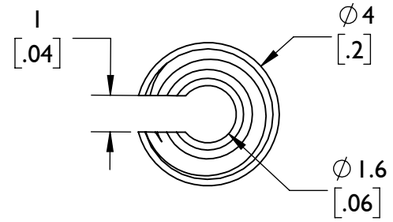
The sensor is inserted into and retained in the mold inside a retaining sleeve. The retaining sleeve is fixed in the mold. The sensor tip reaches through to the mold cavity surface. The tip is machined to match the cavity's surface and/or contour.

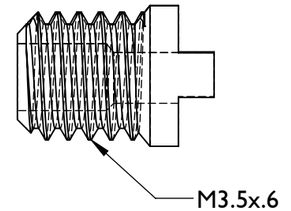


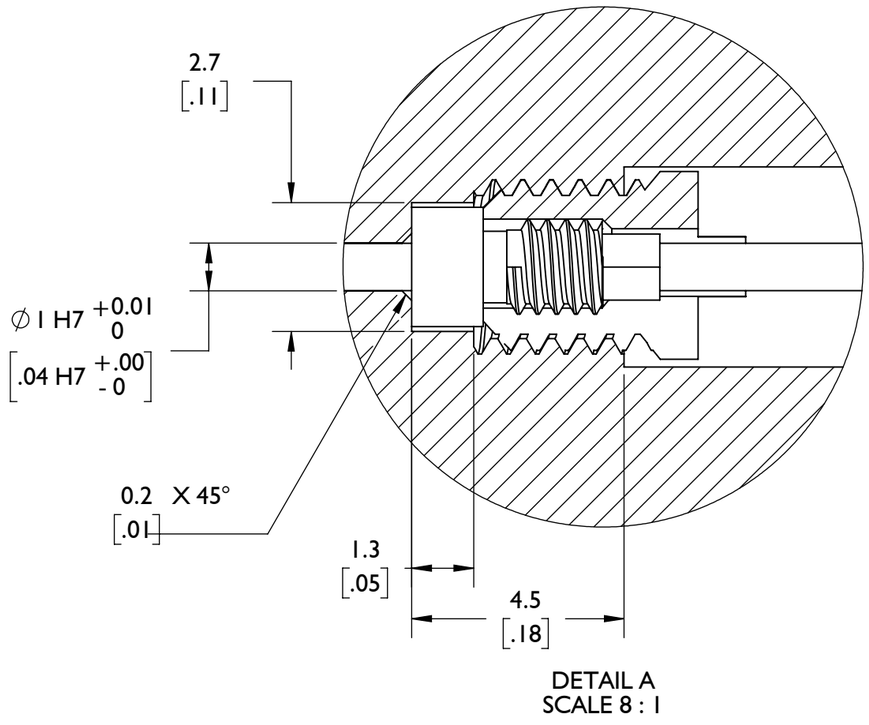
INSTALLATION SPECIFICATIONS—RETAINING NUT



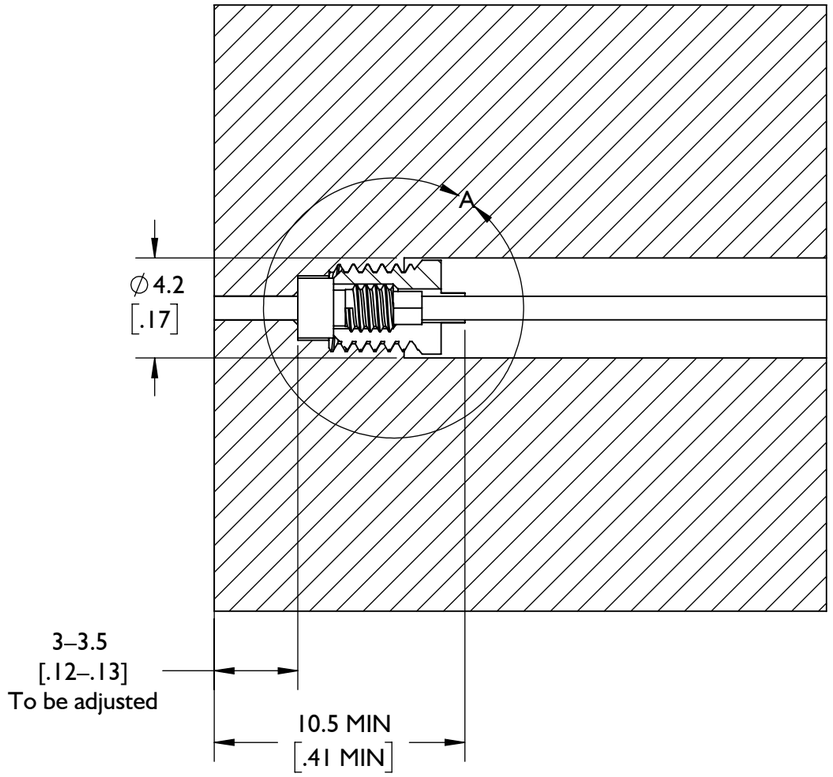








DETAIL A
SCALE 8 : 1



INSTALLATION SPECIFICATIONS—RETAINING NUT (*continued*)

RETAINING NUT & SENSOR POCKET

The included retaining nut requires a 0.41” (10,5 mm [1 at right]) MIN steel thickness for installation.

The machinable sensor tip has a length of 0.14” +0/-0.001 (3,5 mm +0/-0,02). The maximum removable material is 0.02” (0,45 mm); minimum sensor tip length cannot be less than 3,05 mm. A sensor tip depth of 0.12” (3,1 mm [2 at right]) is recommended.

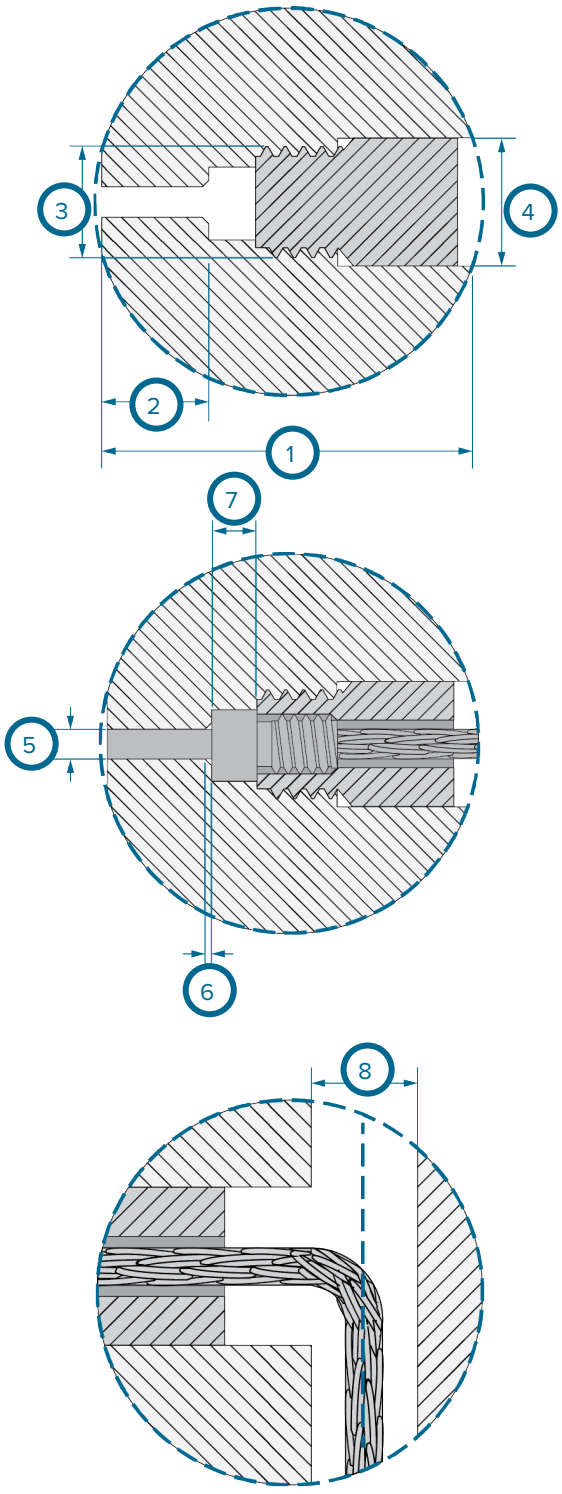
Retaining nut pocket DIA threaded M3,5x0.6 (3 at right).

Retaining nut pocket DIA 0.17” (4,2 mm [4 at right]).

Sensor tip DIA 0.04” H7 +0.00 (1,0 mm H7 +0,01 [5 at right]).

Chamfer 45° for 0.01” (0,2 mm [6 at right]) from sensor tip end to sensor body.

Sensor body pocket is 0.05” x DIA 0.11” (1,3 mm x DIA 2,7 mm [7 at right])—note the keyed flat on the sensor body.

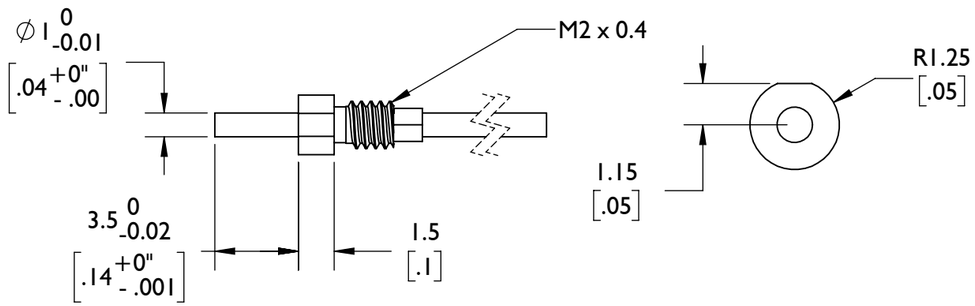


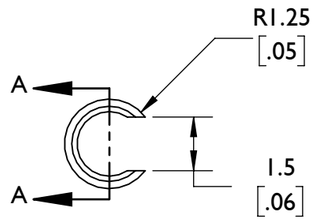
SENSOR CABLE CHANNEL

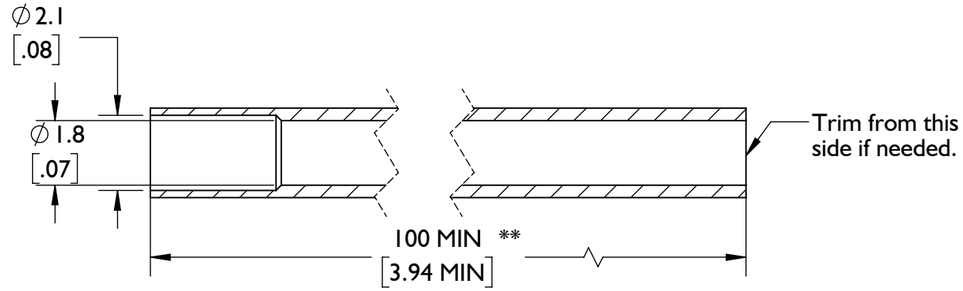
Mill cable channel of 0.12 x 0.12” (3,0 x 3,0 mm [8 at right]) to mold surface. Break all corners to avoid cable damage.

1	0.41” (10,5 mm) MIN	5	ø 0.04” H7 +0.00 (ø 1,0 mm H7 +0,01)
2	0.12” (3,1 mm) *recommended*	6	Chamfer 45° 0.01” (0,2 mm)
3	M3,5 x 0.6	7	0.05” x ø 0.11” (1,3 mm x ø 2,7 mm)
4	ø 0.17” (4,2 mm)	8	0.12 x 0.12” (3,0 x 3,0 mm)

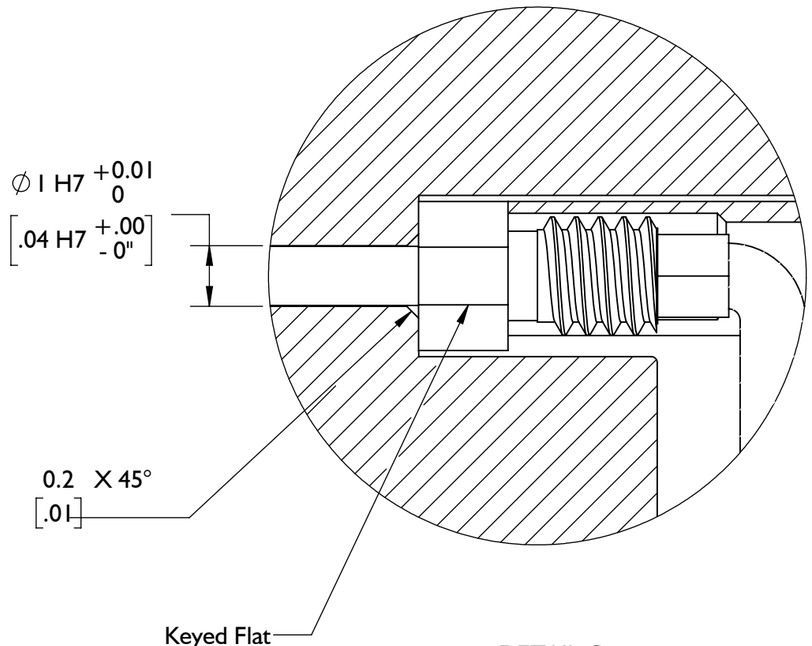
INSTALLATION SPECIFICATIONS—RETAINING SLEEVE



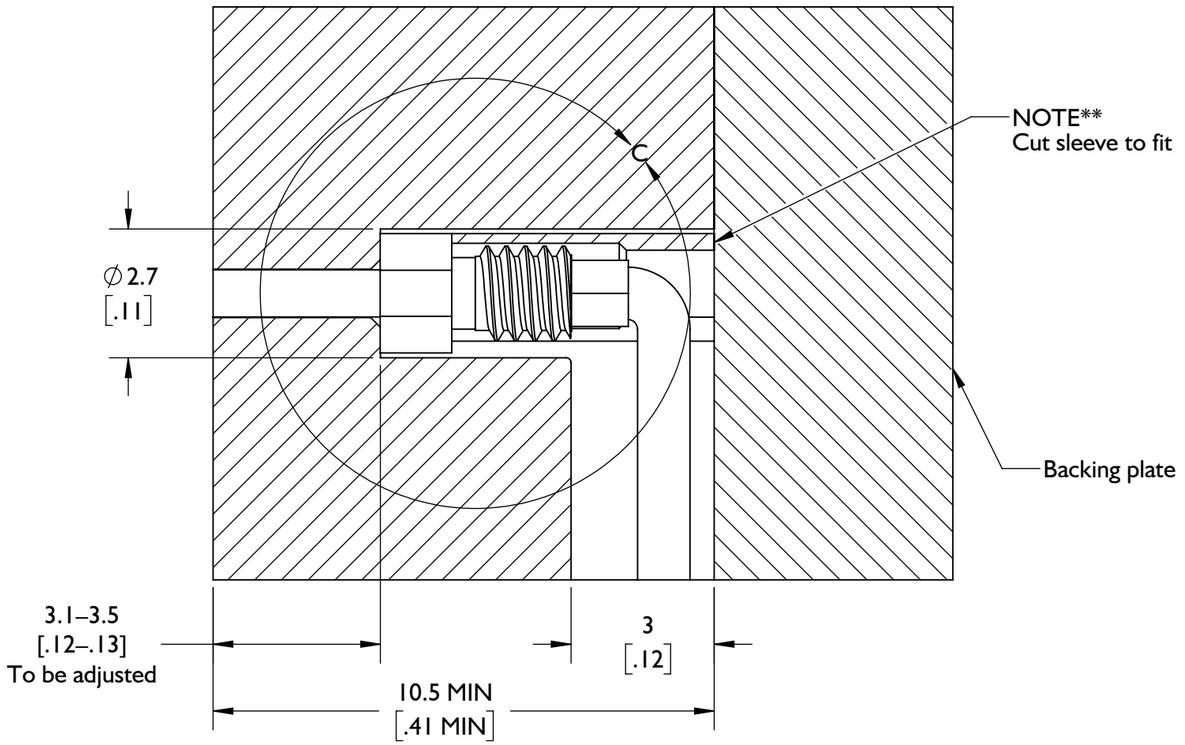




SECTION A-A
SCALE 6 : 1



DETAIL C
SCALE 10 : 1



INSTALLATION SPECIFICATIONS—RETAINING SLEEVE (*continued*)

RETAINING SLEEVE & SENSOR POCKET

The included retaining sleeve requires a 0.41” (1,5 mm [1 at right]) MIN steel thickness for installation.

The machinable sensor tip has a length of 0.14” +0/-0.001 (3,5 mm +0/-0,02). The maximum removable material is 0.02” (0,45 mm); minimum sensor tip length cannot be less than 3,05 mm. A sensor tip length of 0.12” (3,1 mm [2 at right]) is recommended.

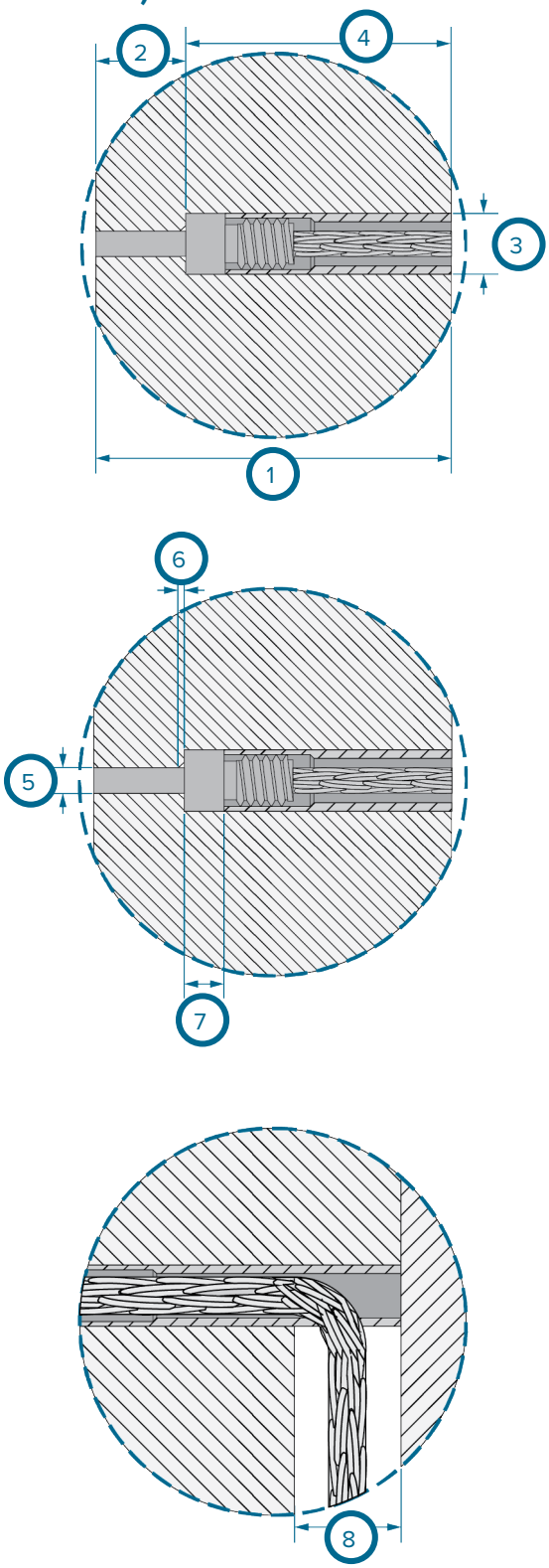
Retaining sleeve pocket DIA 0.11” (2,7 mm [3 at right]).

Retaining sleeve pocket length 3.94” (100 mm [4 at right]) MAX.

Sensor tip DIA 0.04” H7 +0.00 (1,0 mm H7 +0,01 [5 at right]).

Chamfer 45° for 0.01” (0,2 mm [6 at right]) from sensor tip end to sensor body.

Sensor body pocket is 0.05” x DIA 0.11” (1,3 mm x DIA 2,7 mm [7 at right])—note the keyed flat on the sensor body.



SENSOR CABLE CHANNEL

Mill cable channel of 0.12 x 0.12” (3,0 x 3,0 mm [8 at right]) to mold surface. Break all corners to avoid cable damage.

1	0.41” (10,5 mm) MIN	5	ø 0.04” H7 +0.00 (1,0 mm H7 +0,01)
2	0.12” (3,1 mm) *recommended*	6	Chamfer 45° 0.01” (0,2 mm)
3	ø 0.11” (2,7 mm)	7	0.05” x ø 0.11” (1,3 mm x ø 2,7 mm)
4	3.94” (100 mm) MAX	8	0.12 x 0.12” (3,0 x 3,0 mm)

SENSOR TIP MACHINING

Only grind the sensor if necessary to accurately fit the surface of the cavity; once a flush mount sensor tip has been modified it cannot be re-calibrated. Read and follow all instructions, and refer to the provided figures to properly machine flush-mount sensors.

DRY GRIND SPECIFICATIONS

Dry-grind the sensor head no more than 0.005” (0,127 mm) per pass. Do not submerse the sensor head in fluids. Sensors are not water tight; keep all connectors clean and dry.

CONTOURING SPECIFICATIONS

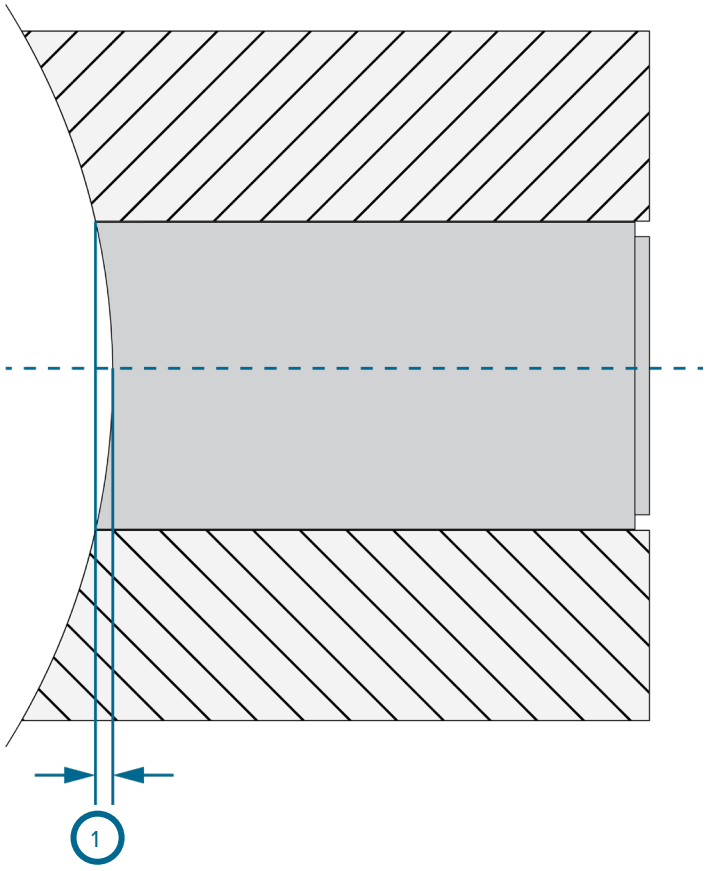
The sensor tip may be ground (dry) into a contour in order to match the cavity surface. Do not dry grind the sensor head more than 0.005” (0,127 mm) per pass. The sensor head may be contoured up to 0.02” (0,45 mm [1 at right]) from the top .

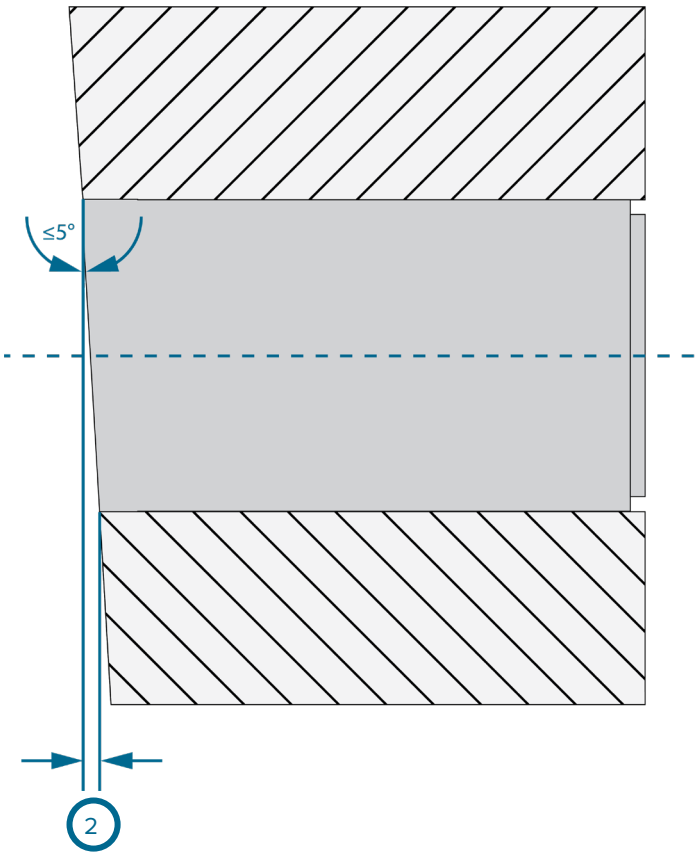
ANGLE SPECIFICATIONS

The sensor tip may be ground (dry) into an angle in order to match the cavity surface. Do not dry -grind the sensor head more than 0.005” (0,127 mm) per pass. The sensor head may be ground to an angle of no more than 5°, and no more than 0.02” (0,45 mm [2 at right]).

MACHINING SPECIFICATIONS

Dry Grind (per pass)	0,127 mm	0.005”
Contour	0,45 mm	0.012”
Angle 5°	0,45 mm	0.012”





ADDITIONAL MACHINING

Once a sensor is contoured or angled it can be installed into the tool in the proper orientation. Sensor alterations are not typically symmetrical, and ensuring that the sensor is correctly installed in the tool and that it remains in the proper orientation is critical.

FLUSH MOUNT SENSOR KEYING

Keying of a sensor can prevent the unwanted rotation of installed sensors. Read and follow all instructions to key a sensor—either for an previously-machined sensor pocket, or a new installation.

SENSOR KEYING A NEW INSTALLATION

A new sensor installation can be keyed by grinding down a flat onto one side of the sensor and using a mill to machine the sensor pocket to match. When the sensor is installed in the sensor pocket, the contact of the flat, or keyed, surfaces will prevent sensor rotation (refer to figure at bottom left).

MACHINING SPECIFICATIONS

Dry Grind (per pass)	0,127 mm	0.005”
Sensor Slot	0,30 mm	0.012”
Sensor Pocket Slot	0,30 mm	0.012”

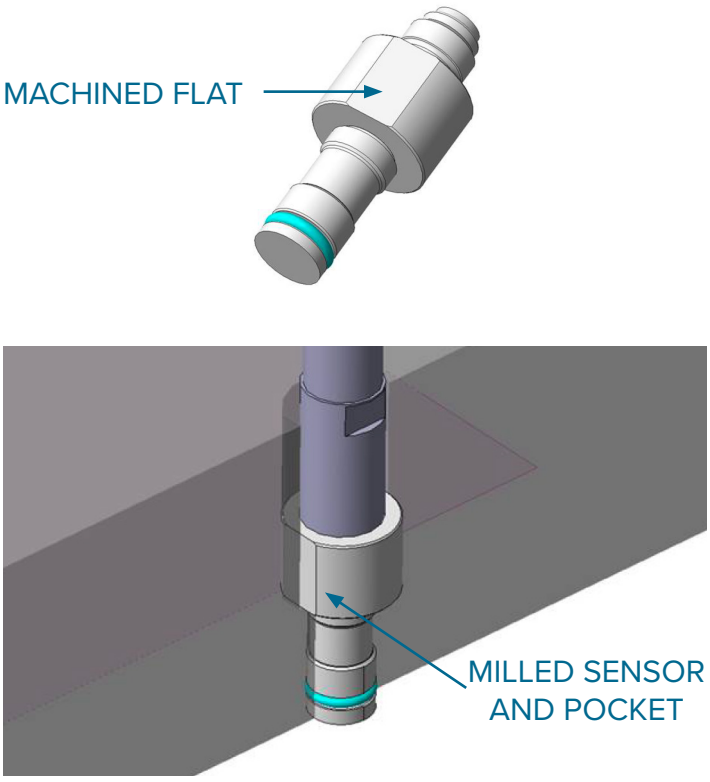
SENSOR KEYING A PREVIOUS POCKET

When a sensor pocket has previously been machined into a tool, a sensor can be keyed using a ball-nose end mill to create a slot on the sensor body, and a slot in the sensor pocket. A dowel is installed into the sensor and tool void created during milling to prevent sensor rotation (refer to figure at bottom left).

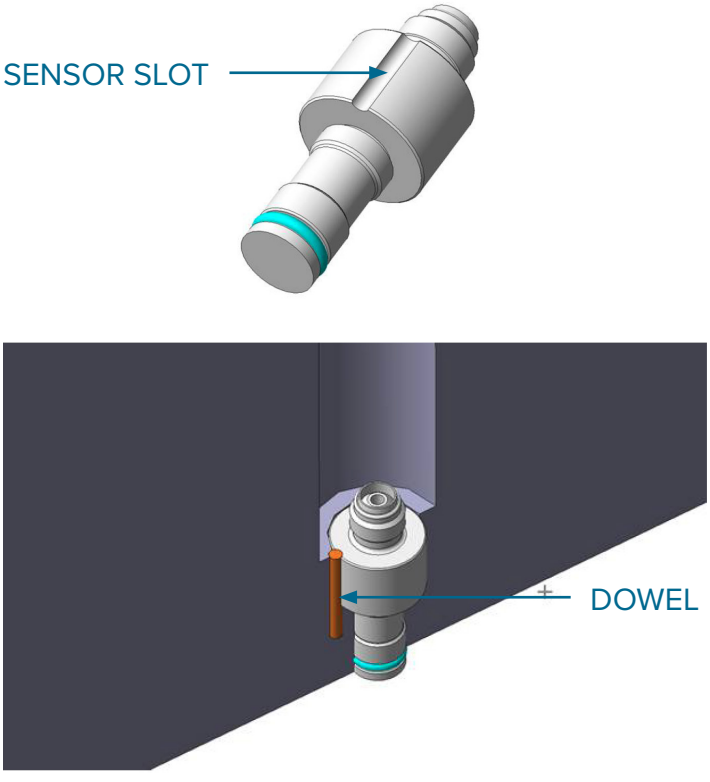
MACHINING SPECIFICATIONS

Milling (per pass)	0,127 mm	0.005”
Sensor Slot	0,5 mm	0.02”
Sensor Pocket Slot	0,5 mm	0.02”

SENSOR KEYING—NEW INSTALLATION



SENSOR KEYING—PREVIOUS POCKET



SENSOR WIRING

1. Remove cover.

- Remove screws (1) from LS-QTTB-K, then remove cover plate.

2. Remove shield plate.

- Remove screws (2) from shield plate(3), then remove shield plate(3).

3. Insert thermocouple wire.

- Feed thermocouple wire (4) through the mounting gasket and wire slot (5) in bottom of module.

4. Connect negative (-) lead.

- Connect white wire (6) to the negative terminal.

5. Connect positive lead (+).

- Connect green wire (7) to positive terminal.

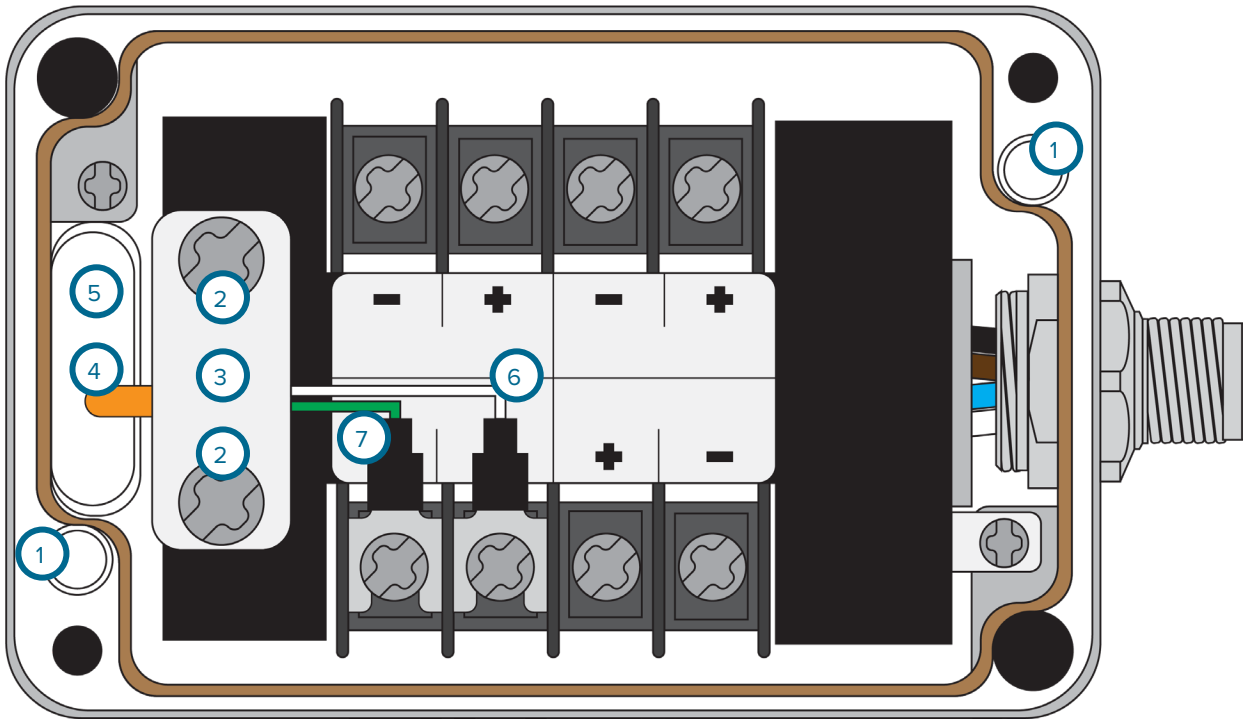
6. Install shield plate.

- Install shield plate (3) over the thermocouple wire with screws (2)—ensure the plate contacts the shield.

CAUTION *Do not over-tighten the plate; failure to comply will result in damage to equipment.*

7. Install cover plate.

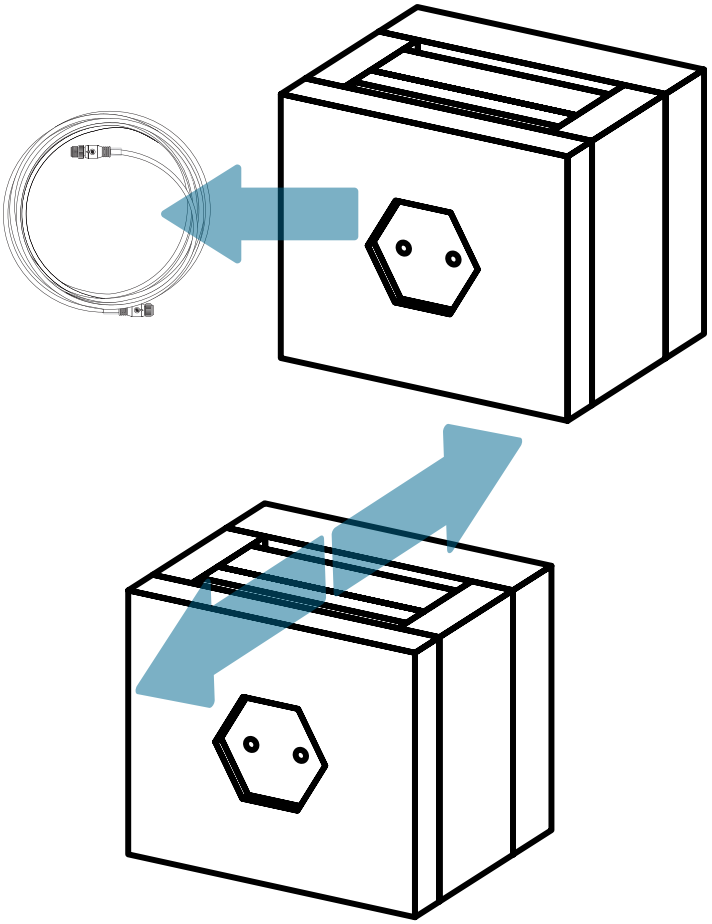
- Install LS-QTTB-K cover plate with screws (1).



THERMOCOUPLE TYPE		THERMOCOUPLE WIRE COLORS IEC 584-3
Type K	Positive (+)	Green
	Negative (-)	White

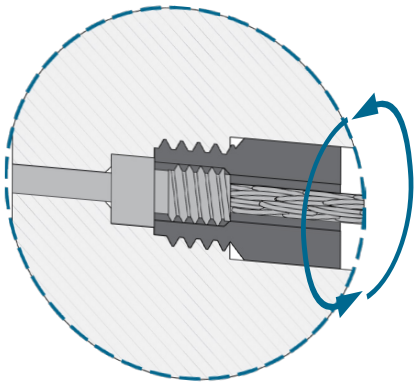
SENSOR REMOVAL

CAUTION *DO NOT pull on the sensor cable to remove sensor from the mold. Failure to comply will result in damage or destruction to sensor head, sensor cable, and/or mold. RJG is not responsible for improperly installed or removed sensors, sensor cables, or molds.*



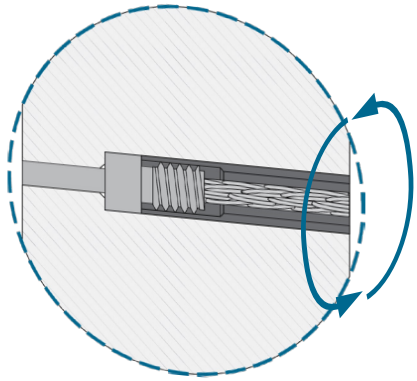
1. Disconnect sensor, sensor adapter cables, and other cables, and label them for future reference.

2. Depending on the particular mold and setup, disassemble/remove necessary plates and components to access the cavity plate in which the sensor(s) is(are) installed.



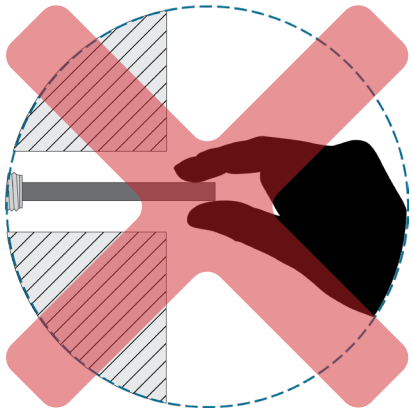
3. Depending on installation retention method, remove the retaining nut or retaining sleeve.

- Retaining Nut: Unthread the retaining nut from the mold.
- Retaining Sleeve: Unthread retaining sleeve from sensor.

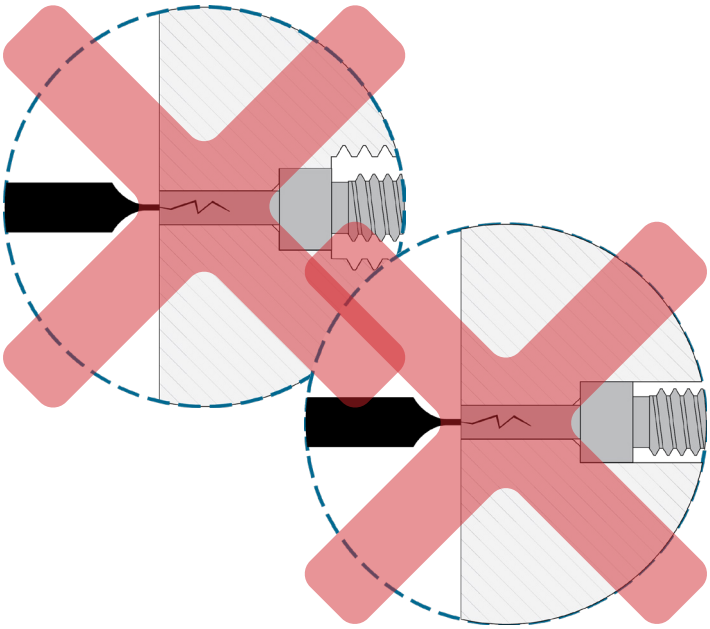


SENSOR REMOVAL (*continued*)

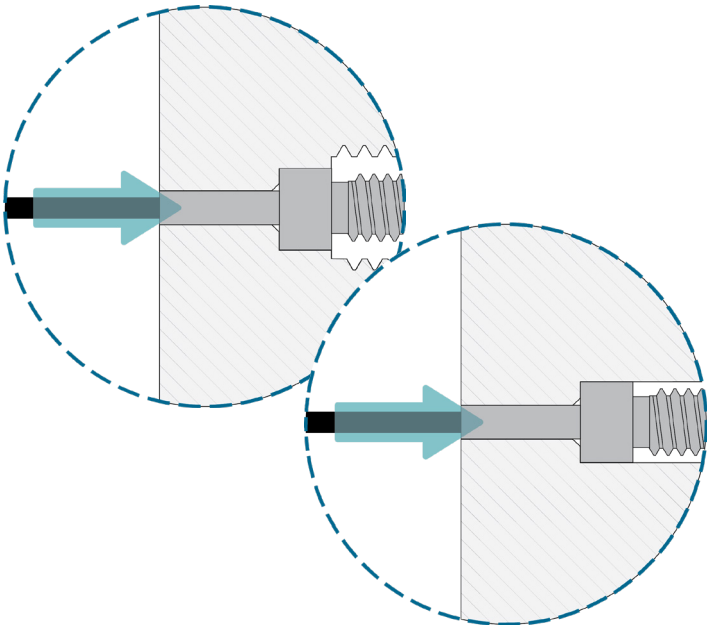
CAUTION *DO NOT pull on the sensor cable to remove sensor from the mold. Failure to comply will result in damage or destruction to sensor head, sensor cable, and/or mold. RJG is not responsible for improperly installed or removed sensors, sensor cables, or molds.*



CAUTION *Do not use a sharp implement to remove sensor to prevent the sensing face from being damaged. Failure to comply will result in damage or destruction to sensor and sensor calibration.*



4. To remove a sensor—DO NOT PULL ON SENSOR CABLE TO REMOVE SENSOR—gently tap/push the sensor from the cavity side with a fine pin or probe to slide the sensor body back through the mold. DO NOT USE SHARP IMPLEMENT TO REMOVE SENSOR.



5. After removal, clean and inspect the sensor for damage and visible wear.

MAINTENANCE

The TS-FM01-K temperature sensor requires little maintenance.

CLEANING

Keep sensor pocket, cable channel, and sensor components free from oil, dirt, grime, and grease.

TESTING & CALIBRATION

Thermocouples are known to have drift in calibration dependent upon time and temperature. To test calibration, check the thermocouple output against the thermocouple rating and electromagnetic field (EMF) tables in a known temperature source.

WARRANTY

RJG, INC. STANDARD THREE-YEAR WARRANTY

RJG, Inc. is confident in the quality and robustness of the TS-FM01-K sensors, and so are offering a three-year warranty on all RJG sensors. RJG's cavity temperature sensors are guaranteed against defects in material and workmanship for three years from the original date of purchase. 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.

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

TROUBLESHOOTING

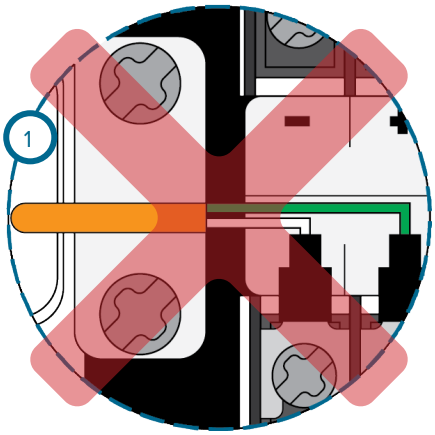
MEASUREMENT ERRORS

Errors in measurement can result from connection problems, lead resistance issues, or electrical noise.

CONNECTION PROBLEMS

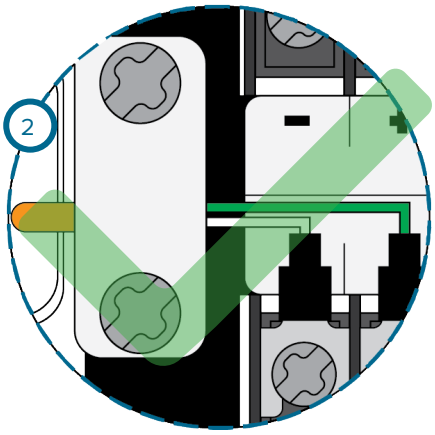
Connections must be clean and free from oil, dirt, grime, and grease.

If shielded wire is used, the wire must run under the LS-QTTB-K shield plate (1 & 2 at right). The shield plate should be tightened and have good contact with the shielded thermocouple wire to reduce radio-frequency (RF) interference susceptibility.



WIRE EXTENSIONS

Thermocouple wires are typically thin, and have a high resistance, making them sensitive to noise. If extra wire is needed, use thermocouple extension wire between the thermocouple and measurement instrument. Thermocouple wire is much thicker and thus has a lower resistance.



NOISE

Electromagnetic interference (EMI), or RF, is caused by electric devices such as motors, and can result in measurement reading errors. If noise is suspected, turn off all equipment that is suspect while monitoring the reading to determine the source.

Thermocouples and wiring can short or open circuit causing error in signals. Check the thermocouple with a standard volt meter across the positive and negative leads to determine if the circuit is functioning correctly.

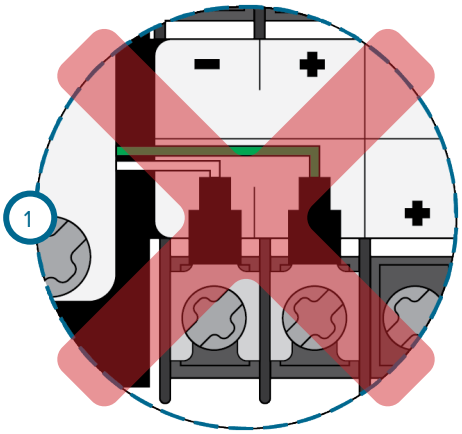
INSTALLATION ERRORS

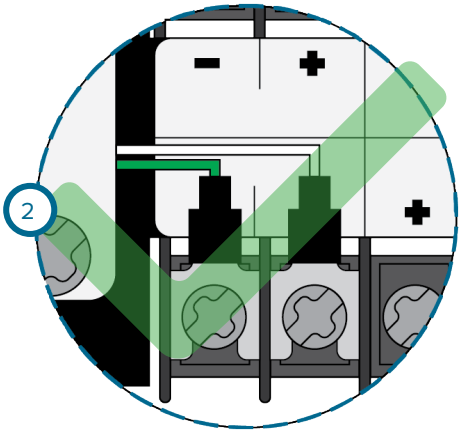
REVERSED CONNECTIONS

Connections must not be reversed (1 & 2 at right). Reversed leads will provide a reading which will vary in the opposite direction relative to ambient temperature.

LOOSE CONNECTIONS

Ensure connections are firmly in place, but are no over-tightened. Over-tightening may crush the wires.





CUSTOMER SUPPORT

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

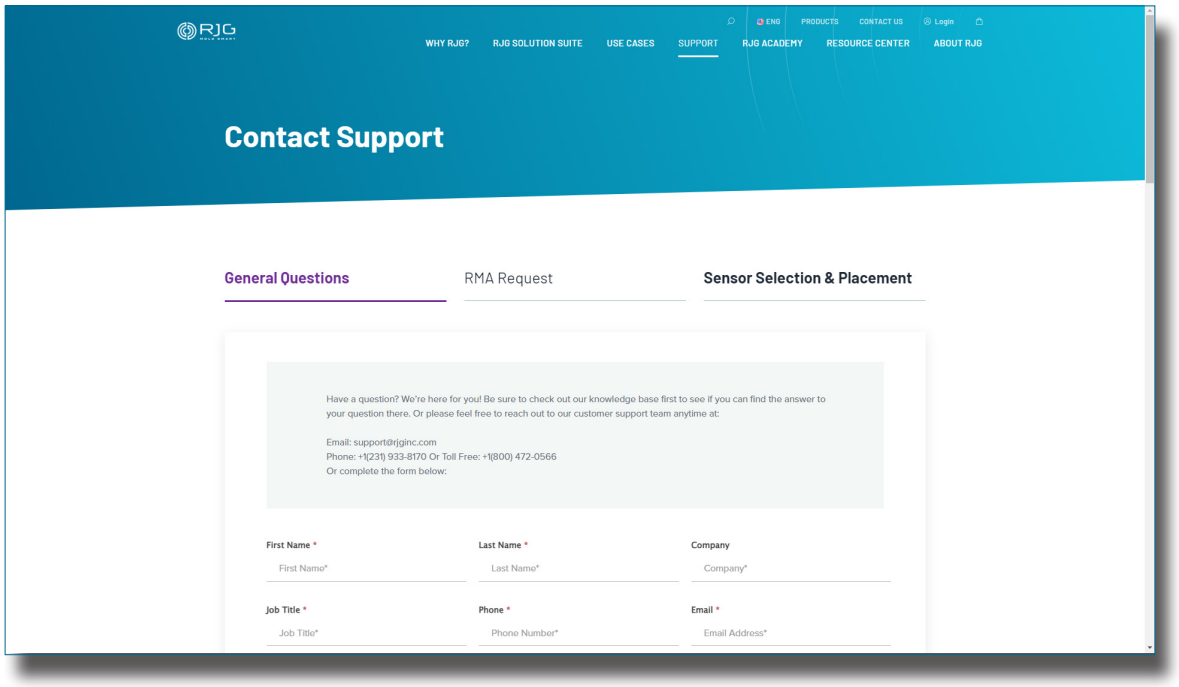
RJG, Inc. Customer Support

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P: +1.231.933.8170

E: CustomerSupportGroup@rjginc.com

www.rjginc.com/support



NOTES

RELATED PRODUCTS

COMPATIBLE PRODUCTS

The TS-FM01-K temperature sensor is compatible with other RJG, Inc. products for use with the eDART process control and monitoring system.

LYNX QUAD TEMPERATURE TERMINAL—TYPE K LS-QTTB-K

The Lynx quad temperature module LS-QTTB-K (1 at right) connects up to four TS-FM01-K temperature sensors to the eDART process control and monitoring system in order to track barrel zone, mold, and mold coolant temperatures.



SIMILAR PRODUCTS

RJG, Inc. offers the following additional temperature sensors for flush-mount and cavity temperature applications.

SPRING-LOADED 1.5 MM TEMPERATURE SENSOR TS-SL01.5-K

The TS-SL01.5-K 1.5 mm spring-loaded temperature sensor (2 at right) analyzes temperature variations inside the mold cavity when used with the Lynx quad temperature module LS-QTTB-K and the eDART system.



PRESS-FIT 3 MM CAVITY TEMPERATURE SENSOR TS-PF03-K

The TS-PF03-K 3 mm press-fit cavity temperature sensor (3 at right) analyzes temperature variation inside the mold cavity when used with the Lynx quad temperature module LS-QTTB-K and the eDART system.



NOTES

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