



Model 119C12

High pressure ballistic pressure sensor, 120k psi, 0.25 pC/psi, accel comp., floating clamp nut

Installation and Operating Manual

**For assistance with the operation of this product,
contact the PCB Piezotronics, Inc.**

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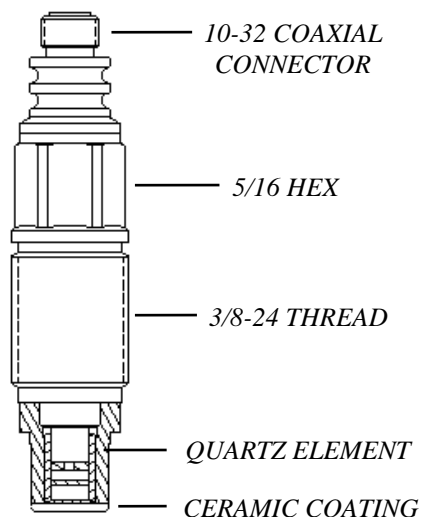
OPERATION MANUAL FOR QUARTZ PRESSURE SENSOR Series 118 & 119

1.0 INTRODUCTION

The 118 & 119 Series are acceleration-compensated, high pressure sensors primarily developed to measure ballistics chamber pressures for R & D and production testing of ammunition. They may also be used for explosive air blast and other high pressure measurements in extreme shock environments where ultra-fast, micro-second response is required. These types of tests are usually accompanied by large acceleration pulses, which can add considerable error to output signals of un-compensated sensors.

The shoulder seal design features a one-piece diaphragm machined integral with the housing for ruggedness. A ceramic coating is applied to the diaphragm to minimize flash temperature effects.

For applications where strain sensitivity from stress within the mounting port is a concern, the 118B1X and 119B1X utilize a floating clamp-nut design to reduce the effects, where "X" denotes pressure range.



2.0 DESCRIPTION

The 118 & 119 Series contain an acceleration-compensated piezo element. The quartz element contains an integral seismic mass that counteracts the acceleration effects of the end piece and diaphragm. This compensation acts to extend the frequency characteristics and enhance the transient response of the sensor.

The machined diaphragm is made from maraging steel, selected because of its high strength and durability. The combination of the short, rigid element and stiff diaphragm give these sensors a high natural frequency and linearity.

3.0 INSTALLATION

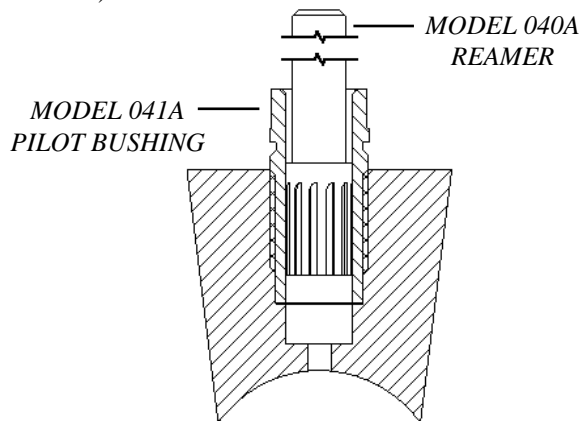
With a 3/8-24 (M10x1.0 for metric mount) mounting thread and flush diaphragm design, the 118 & 119 Series transducers mount directly in existing ports machined for PCB Series 108 & 109.

Unlike conventional diaphragm type sensors, the 118 & 119 Series are pressure sensitive over the entire frontal area. Extra care should be exercised to avoid bottoming in the mounting hole when recess mounted or when mounting into existing ports.

Install the sensor, using only one of the seals provided, with the aid of a torque wrench to monitor the mounting torque value. The recommended torque range can be found on the installation drawing. Seals should be replaced each time the sensor is re-installed.

3.1 MOUNTING IN EXISTING RECESSED PORTS

Before installing the sensor in previously used mounting ports, clean out the residue from previous tests. The port can be cleaned by hand reaming the 1/4 inch diameter hole using a PCB Model 040A end cutting reamer (040A07 for metric mount) guided by PCB Model 041A pilot bushing (M041A for metric mount).



Existing Recessed Ports

Pay particular attention to the sealing surface, keeping it free from tool chatter marks, nicks and other imperfections that could adversely affect the seal. If the sealing surface requires re-machining after prolonged use, refer to the installation drawing to ensure that the 1/4 inch hole is deepened to avoid bottoming of the sensor when re-installed.

If waveform distortion occurs during prolonged testing, remove the sensor and clean the residue as illustrated above.

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3.2 PREPARING NEW MOUNTING PORTS

Refer to the installation drawing provided in this manual for instructions on mounting hole preparation. For best results, do not deviate from the steps outlined in this drawing.

To assist new mounting port preparation, PCB offers the 040B20 Tooling Kit (040B21 for metric mount). These installation kits provide all of the necessary tooling required to drill, ream, and tap the mounting ports for proper installation of the 108, 109, 118 and 119 Series transducers.

Use good machining practice in preparation of the mounting port, paying particular attention to the seal surface. It is important that this surface be perfectly smooth and free from tool chatter marks, nicks and other imperfections which might cause leaks at high pressures.

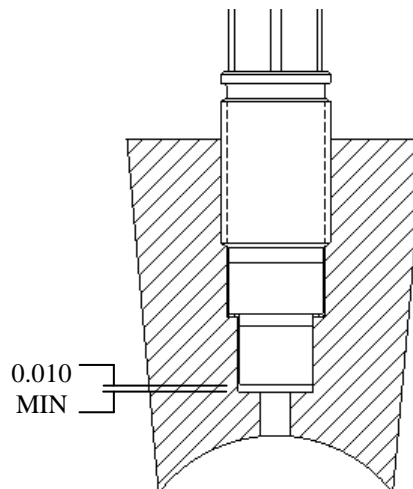
3.3 RECESSED MOUNT

The recessed installation is shown in the Recessed Mount figure. This type of mounting protects the sensor diaphragm from the effects of high-flash temperatures and particle impingement due to blast effects, thereby prolonging sensor life.

The recommended range of passage diameters is 0.090 to 0.125 inch (2.29 to 3.18 mm) diameter.

The limitation in this type of installation lies in the frequency-limiting effects of the passage due to its length.

The passage behaves like an underdamped second order system; the resonant frequency being determined by the passage length. The length may have a limiting effect on pressure pulse rise time and cause passage ringing in cases where the passage is too long.



Recessed Mount

The following relationship approximates this resonant frequency (f_r):

$$f_r = \frac{V}{4L} \quad (\text{Hz}) \quad (\text{EQ. 1})$$

Where: f_r = Resonant frequency of passage (Hz)

V = Velocity of sound in air (ft/sec)

L = Length of column (ft)

For air at room temperature, (EQ. 1) becomes:

$$f_r = \frac{3300}{L} \quad (\text{EQ. 2})$$

Where: L = Passage length (in)

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The natural frequency and approximate fastest pressure step rise time for various length passages is shown in the following chart. (Medium, air at 25°C).

PASSAGE LENGTH (in)	PASSAGE RESONANCE (kHz)	APPROX. FASTEST PULSE RISE TIME (uSec)
.050	66	5
.100	33	10
.200	16.5	20
.50	6.6	50
1.0	3.3	100

Passage Resonance vs. Passage Length

Actual resonant frequencies measured in practice may differ slightly from the chart values. These differences are due to variations in the velocity of propagation of sound in air caused by changes in temperature and pressure of the air in the passage.

For best matching of passage to diaphragm, maintain the 0.010 inch (0.254 mm) clearance ahead of the diaphragm, as shown in the Recessed Mount figure on the previous page.

3.4 FLUSH MOUNT

In the flush mount installation, there is no reduced area passage from the sensor diaphragm to the test chamber; rather the sensor diaphragm is mounted flush with (or slightly recessed from) the inside surface of the test chamber.

Use this type of installation only if space or rise time considerations preclude the use of recessed installation.

In severe pyrotechnic environments, sensor life may be severely limited with flush installation.

3.5 FLASH TEMPERATURE EFFECTS

The ceramic coating on the diaphragm of these sensors should render the flash thermal effect insignificant in most cases, especially when recessed mounted.

However, if more protection from flash thermal effects is required with the recessed mount, the passage can be filled with silicone grease (DC-4 or equivalent). Several layers of black vinyl electrical tape directly on the diaphragm have proven effective in many cases as well.

Flash temperature effects are usually longer term and will show up as a baseline shift long after the event to be measured has passed.

For flush mount installations, a silicone rubber coating approximately 0.010 inch thick can be effective; GE RTV type 106 is recommended, and is available from PCB as Model 065A67. Follow manufacturer's instructions to apply. It is best to recess the diaphragm 0.010 inch for this type of protection.

3.6 INSTALLING CABLES

Use only low-noise treated coaxial cable, such as PCB 003 Series, to connect the sensor to the charge amplifier, in-line voltage amplifier, or other high input impedance readout instrument. To protect the high impedance connection against moisture and contamination, shrink tubing or other equivalent connection protection is recommended. See the following page for typical circuit connections.

Excessive cable motion can generate noise and shorten cable life. For this reason, it is important to support sensor cables by tying them to rigid structures with adequate strain relief loops.

4.0 CALIBRATION

PCB 118 & 119 Series sensors are supplied with a calibration certification from the factory. Recalibration services are provided at the factory for a nominal fee.

Several charge amplifiers are specially designed for use with ceramic accelerometers measuring higher frequencies. In general, this type of charge amplifier is not suitable for calibration of quartz pressure sensors by quasi-static means.

Do not attempt to use a charge amplifier which has less than a 5000 second time constant in the "long time constant" mode.

Following thermal stabilization of the sensor, use a high pressure pump with dial reference sensor or a dead weight tester to apply pressure in desired increments to full scale. Release pressure after taking the reading and before proceeding to the next higher pressure level.

A calibration graph can be plotted using output voltage vs. input pressure to determine sensitivity and linearity.

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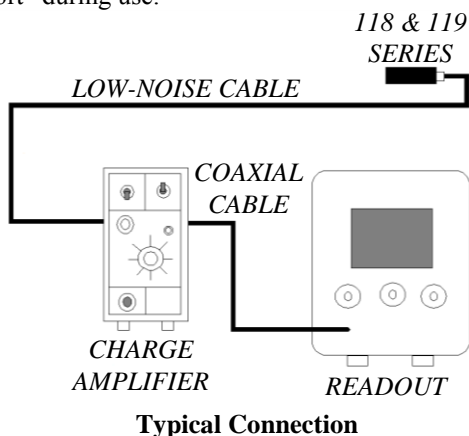
5.0 OPERATION

Most test set-ups will include 118 & 119 Series sensors coupled with charge amplifiers, as shown in the Typical Connection figure below. For applications where the location of the measurement is a long distance from where the data must be read, an in-line amplifier can be used to drive the signal. This configuration reduces the amount of noise in the data and can be seen in the Long Distance Connection figure to the right.

It is important to keep the charge amplifier input cable as short as practical. Input cable capacitance is directly related to cable length and is a major factor in the amount of electrical noise at the output of any charge amplifier.

Depress the ground button of the charge amplifier and adjust electrical zero if necessary. Range the amplifier as required to give the necessary full-scale voltage.

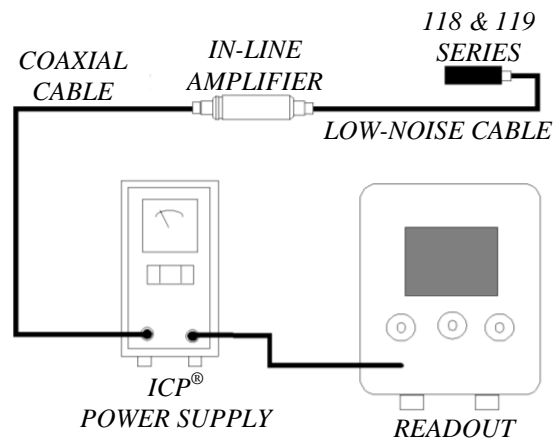
For normal, drift-free operation, switch the charge amplifier time constant selector to “medium” or “short” during use.



6.0 POLARITY

Since most charge amplifiers are inverting the input signal, 118 & 119 Series are designed to produce a negative output voltage for increasing pressure at the diaphragm.

Special positive output versions are available for use with our non-inverting ICP[®] source follower amplifiers.



7.0 MAINTENANCE

Regular inspection of the diaphragm, threads, and connector of the 118 & 119 Series sensors is good practice.

During use in damp environments or after a period of storage, the insulation resistance of these sensors may degrade (10^{12} ohms is normal). The only maintenance required on the 118 & 119 Series is cleaning of the connector to restore insulation resistance.

To restore insulation resistance, wipe the connector end with a clean cloth or paper towel dipped in Lenium[®] or an equivalent solvent, then rinse in isopropyl alcohol. The sensor should then be placed in a 250°F (120°C) oven for several hours. A vacuum oven, if available, will speed the process.

Contact the factory for further assistance if the insulation resistance cannot be restored.

ICP[®] is a registered trademark of PCB Piezotronics

Drawing Number: 21110

Revision: B

Model Number
119C12

CHARGE OUTPUT PRESSURE SENSOR

Revision: B
ECN #: 55114

	ENGLISH	SI	
Performance			
Sensitivity(± 15 %)	0.25 pC/psi	0.036 pC/kPa	
Measurement Range	100,000 psi	690,000 kPa	
Maximum Pressure	125,000 psi	862,000 kPa	
Resonant Frequency	≥ 400 kHz	≥ 400 kHz	
Rise Time(Reflected)	≤ 2 μ sec	≤ 2 μ sec	
Non-Linearity	≤ 2 % FS	≤ 2 % FS	[1]
Environmental			
Acceleration Sensitivity	0.02 psi/g	0.014 kPa/(m/s ²)	[2]
Temperature Range(Operating)	-300 to 400 °F	-184 to 204 °C	
Temperature Coefficient of Sensitivity	≤ 0.07 %/°F	≤ 0.126 %/°C	
Maximum Flash Temperature	4,000 °F	2,204 °C	
Maximum Vibration	2,000 g pk	19,600 m/s ² pk	
Maximum Shock	50,000 g pk	490,000 m/s ² pk	
Electrical			
Output Polarity(Positive Pressure)	Negative	Negative	
Capacitance	20 pF	20 pF	[2]
Insulation Resistance(at room temp)	≥ 10 ¹² Ohm	≥ 10 ¹² Ohm	
Physical			
Sensing Element	Quartz	Quartz	
Housing Material	C-300	C-300	
Diaphragm	C-300	C-300	
Sealing	Epoxy	Epoxy	
Electrical Connector	10-32 Coaxial Jack	10-32 Coaxial Jack	
Weight	.5 oz	14 gm	

OPTIONAL VERSIONS

Optional versions have identical specifications and accessories as listed for the standard model except where noted below. More than one option may be used.

H - Hermetic Seal		
Housing Material	17-4 Stainless Steel	17-4 Stainless Steel
Maximum Shock	20,000 g pk	196,200
Sealing	Welded Hermetic	Welded Hermetic
M - Metric Mount		
P - Positive Output Polarity		
W - Water Resistant Cable		

NOTES:

- [1]Zero-based, least-squares, straight line method.
- [2]Typical.
- [3]See PCB Declaration of Conformance PS158 for details.

SUPPLIED ACCESSORIES:

Model 065A06 Seal ring 0.318" OD x 0.250" ID x 0.010" thk 316L SS material (3)
Model PCS-2 Calibration of dynamic pressure sensors to full scale measurement range up to 100k psi

Entered: ND	Engineer: RPF	Sales: MV	Approved: RPF	Spec Number:
Date: 08/27/2024	Date: 08/27/2024	Date: 08/27/2024	Date: 08/27/2024	77297



All specifications are at room temperature unless otherwise specified.
In the interest of constant product improvement, we reserve the right to change specifications without notice.

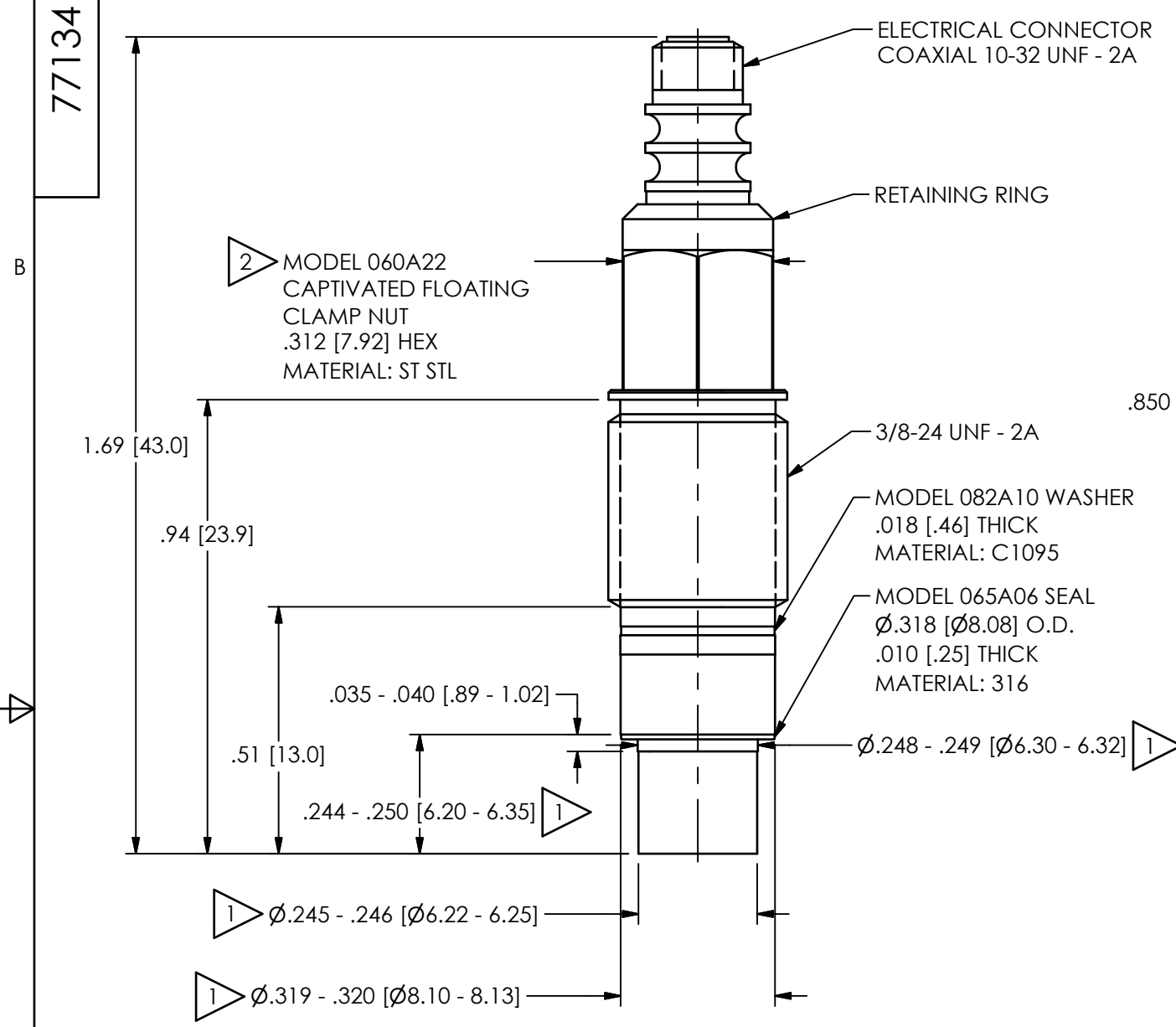
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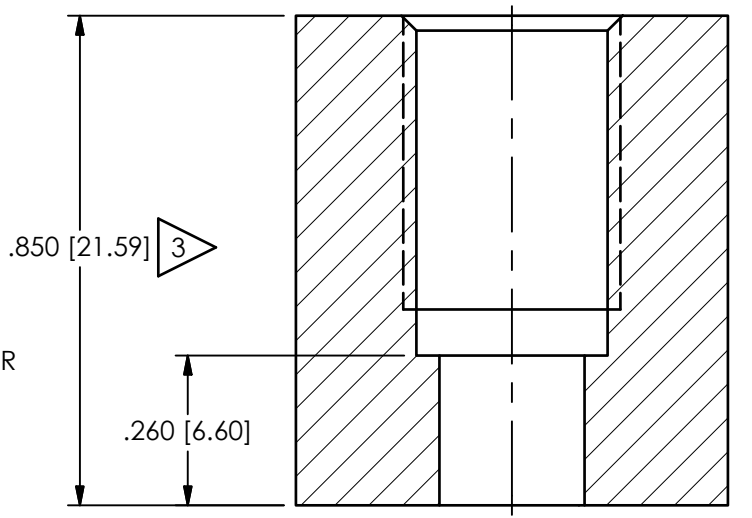
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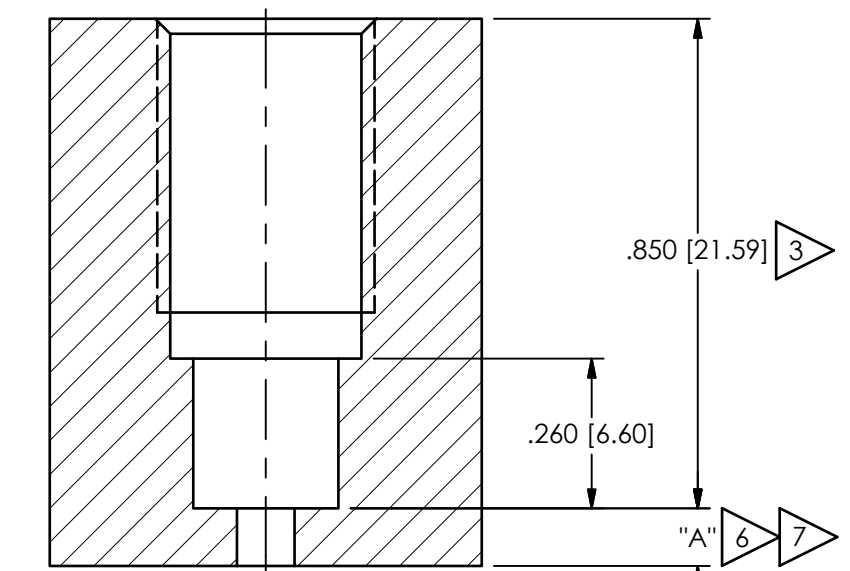
REVISIONS		
REV	DESCRIPTION	DIN
NR	RELEASED TO DRAFTING	53262



FLUSH INSTALLATION



RECESSED INSTALLATION



- 8 CAUTION: DO NOT TOUCH SEAL SURFACE WITH TAP WHEN TAPPING HOLE
- 7 DIMENSIONS "A" & "B" TO SUIT USER REQUIREMENTS
- 6 KEEP DIMENSION "A" AS SHORT AS POSSIBLE, SEE OPERATING GUIDE FOR OPTIMUM PASSAGE LENGTH
- 5 THESE DIAMETERS TO BE CONCENTRIC TO WITHIN .001 [.03] TIR
- 4 SEAL SURFACE SHOULD BE FLAT & FREE OF TOOL MARKS WITH A MINIMUM FINISH OF 63 [1.6] FOR BEST RESULTS
- 3 DIMENSIONS SHOWN ARE FOR A .850 [21.59] THICK WALL. COUNTERBORE FOR THICKER WALLS
- 2 RECOMMENDED MOUNTING TORQUE ON .312 [7.92] HEX: 27-32 FT-LB [37-43 N-m]
- 1 MATERIAL: C-300 MARAGING STEEL

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:		DRAWN		CHECKED		ENGINEER			
DIMENSIONS IN INCHES DECIMALS XX ±.01 XXX ±.005 ANGLES ± 2 DEGREES		NJF 10/21/22		JDM 10/21/22		NJL 10/21/22			
DIMENSIONS IN MILLIMETERS [IN BRACKETS] DECIMALS X ± 0.3 XX ± 0.13 ANGLES ± 2 DEGREES		TITLE							
CABLE TOLERANCES IN ENGLISH 1"≤ LENGTH < 1' = +1' / - 0 1'≤ LENGTH < 5' = +2' / - 0 5'≤ LENGTH < 100' = +6' / - 0 100'≤ LENGTH = +1' / - 0		CABLE TOLERANCES IN METRIC 2.54cm ≤ LENGTH < 30.5cm = +2.54cm / - 0 30.5cm ≤ LENGTH < 1.5m = +5.1cm / - 0 1.5m ≤ LENGTH < 30.5m = +15.2cm / - 0 30.5m ≤ LENGTH = +30.5cm / - 0		INSTALLATION DRAWING MODEL 119 SERIES PRESSURE SENSOR				PCB PIEZOTRONICS AN AMPHENOL COMPANY 3425 WALDEN AVE. DEPEW, NY 14043 (716) 684-0001 E-MAIL: sales@pcb.com	
FILLETS AND RADII .003 - .005		FILLETS AND RADII 0.07 - 0.13						CODE IDENT. NO. 52681	
				SCALE: 3X		SHEET 1 OF 1			