AccuTru
SENSOR TECHNOLOGIES

AccuTru ExL™
Furnace
Tubeskin Thermocouples

Dedicated to those organizations that value improved temperature measurement for critical processes

AccuTru
SENSOR TECHNOLOGIES

About ExL Tube Skin Thermocouples

SUPERIOR PERFORMANCE

Tube skin thermocouples fabricated ExL technology with MI-Dry®, deliver superior performance by reducing or eliminating virtual junction error (VJE) therefore giving a true reading of the sensor tip. (See page A-0 for more information on VJE.)

DESIGN TYPES

Numerous methods of measuring the skin temperature of tubes and pipes are available. Careful consideration should be give to design configuration and the sensor components.

Most methods require welding the sensor to the tube via a weld pad. The primary design function of the weld pad is to offer additional material, other than the sheath itself, to weld the sheath to the tube.

The weld pad material should be metallurgically compatible to the sheath (material) and to the heater tube (material). The dimensional criteria of the weld pad should be considered to be sure the welder has sufficient distance from the sheath material to prevent burning a hole in the sheath.

In order to get the most accurate temperature reading from the sensor, positive metal to metal contact between the sensor and the tube is essential. Many customers prefer the weld pad be bent to fit the same curvature of the tube O.D. to ensure efficient heat transfer to the sensor.

Most customers want to know the tube skin temperature closest to the burners. The thermocouple tip is welded to the surface that is close to the flame then curved around the tube O.D. to the backside (cold) of the tube and run along the tube until the sheath exists through wall of the furnace or boiler so the remainder of the sheath is protected from impingement from the flame. The thermocouple sheath is fixed to the tube at predetermined intervals with “weld clips”.
This is where ExL technology can usually help. Where temperatures at the tip may be lower, than those experienced along the rest of the thermocouple, VJE can and will occur with MgO TC’s.

Many designs include a “heat shield” filled with high temperature insulation over the sensor tip for optimal protection. The wall thickness of the shield and the material should be considered when welding.

Tubes inside a process heater or boiler, may elongate or “swing” due to high temperature conditions. It is advisable to increase the length of the sensor and form “expansion” loops to compensate for these conditions. It is common practice to fabricate the expansion loops between the furnace/ boiler exit and the first weld clip.

INSTALLATION

Where possible, the surface to which the weld pad is welded, the weld pad material, and the sensor sheath should all be manufactured out of the same materials.

A major cause of failure is improper welding technique. This is often caused by a rush to get the sensor installed; failure to adequately clean the surfaces to be welded, and difficulty in reach ing locations within confined spaces, making it hard for the welder to have adequate access to the pad in order to weld.

As much care as possible should be given to the preparation of the tube by removing dirt and particulates from the tube prior to welding the weld pad, heat shield and the weld clips. A wire brush or wire wheel is recommended for the tube surface preparation.

CAUTION! A grinding wheel is NOT recommended as grinding may remove too much metal from the tube and cause a weakness of the tube itself.

We suggest that the thermocouple be checked after the pad is welded to the tube, prior to welding the weld clips, to ensure the sensor is working properly.

An inspector may recommend that all components that require welding be covered with a “insulation blanket” to minimize heat stress to the tube.

WELD PADS

A variety of weld pads are available including standard flat weld pads, curved weld pads, “V” pads, “quick disconnect spring pads” and the “Lance” pads.

Welding flat pads to pipes should be avoided if the diameter of the pipe is so small that a flat pad will not fit properly on the tube. Using an improperly fitted pad will significantly increases the risk of weld failure and the sensor separating from the tube.

Quick disconnect spring pads are prone to failure over time as the spring weakens and allows the sensor to pop out of the pad.

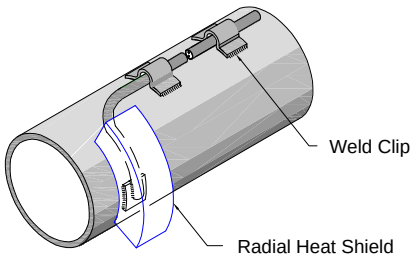
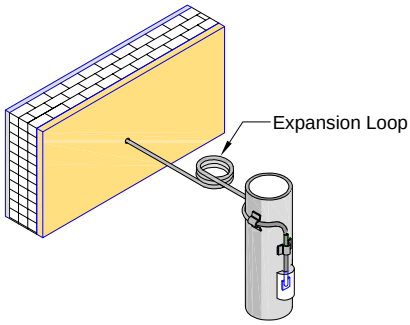
“V” pads decrease the risk of separation of the sensor from the tube, but welding is more difficult and improper welding can result in separation from the tube. In addition, this type of pad uses an exposed junction. If the junction begins to pick up contaminants from the tube, the sensor will begin to drift.

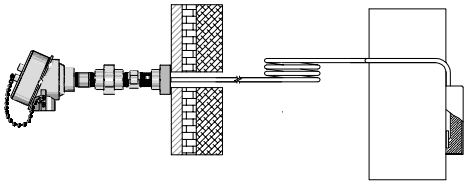
AccuTru’s Lance™ pad is an improvement to the V pad design. The pad offers the benefits of the V pad design but allows the use of a sealed sensor end, thus reducing the probability of drift.

Section 3 Index

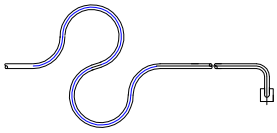
Furnace Tube Skin Thermocouples Thermocouple Assemblies

Section 3 Index Furnace Tube Skin Thermocouples

Options	Description	Page
	Radial Heat Shield and Weld Clips	3-D
	Expansion Loop Types	3-E



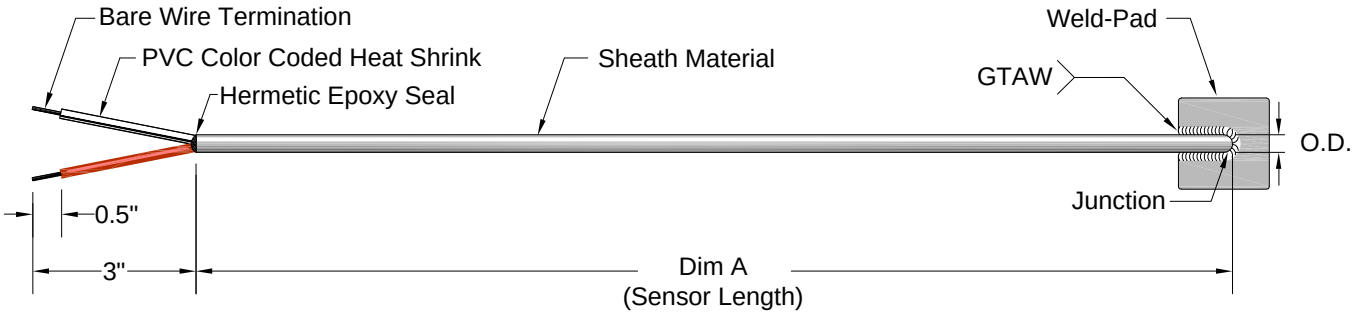
"Radial" Type Expansion Loop



Type "S" Expansion Loop

MODEL O1

Bare End Termination



O1 [ ] [ ] [ ] [ ] [ ] [ ] [ ] B X X [ ] [ ] [ ]

1. INSULATION
EXL = AccuTru Premium High Purity, Extended Life Special Limits of Error

MGO = Magnesium Oxide Special Limits of Error

2. CALIBRATION
K = Type K
J = Type J
N = Type N
T = Type T
E = Type E
DK = Dual Type K
DJ = Dual Type J
DN = Dual Type N
DT = Dual Type T
DE = Dual Type E

3. JUNCTION
U = Ungrounded
G = Grounded

4. SHEATH MATERIAL
600A = Alloy 600
316S = 316 SS
310S = 310 SS
304S = 304 SS
446S = 446 SS
276C = Hastelloy C276
HASX = Hastelloy X
TITN = Titanium
* Contact factory for other materials

5. SHEATH DIAMETER
188D = 0.188
250D = 0.250
375D = 0.375
* Contact factory for other diameters

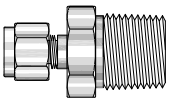
6. SENSOR LENGTH
(Dim A)
(In Inches xxx.xx)

7. TERMINATION
B = Bare Wire 3" Stripped Leads w/ PVC Color Coded Heat Shrink

8. LEAD WIRE LENGTH
X = Not Applicable with Bare End Termination

9. LEAD WIRE INSULATION
X = Not Applicable with Bare End Termination

10. COMPRESSION FITTINGS
X = NONE
C1 = 1/16" NPT SS
C2 = 1/8" NPT SS
C4 = 1/4" NPT SS
C6 = 3/8" NPT SS
C8 = 1/2" NPT SS
C12 = 3/4" NPT SS



11. WELD PAD OPTIONS
X = NONE
600A = Flat Alloy 600 1"x1"x1/8"
316S = Flat 316SS 1"x1"x1/8"
310S = Flat 310SS 1"x1"x1/8"
C600A = Curved Alloy600 1"x1"x1/8"
C316S = Curved 316SS 1"x1"x1/8"
C310S = Curved 310SS 1"x1"x1/8"
* Contact factory for other sizes

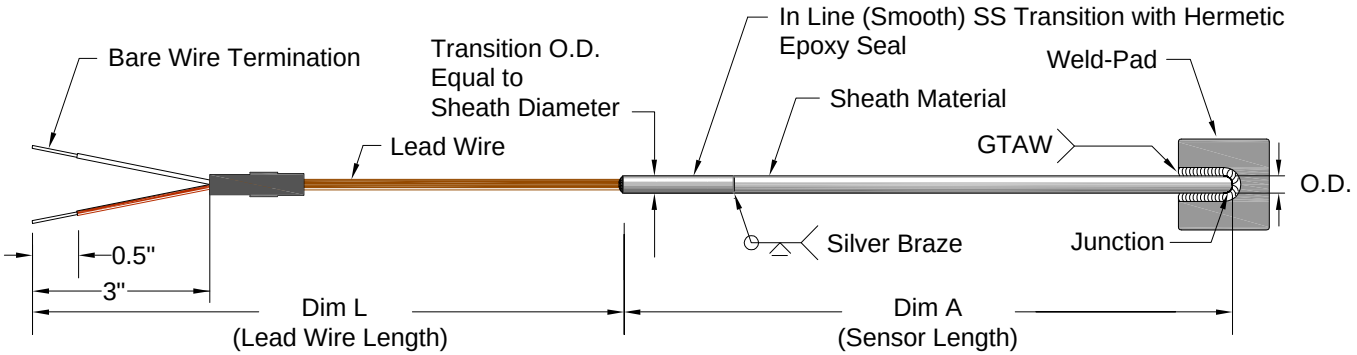

Flat Weld Pad


Curved Weld Pad
(Specify Tube OD)

12. OPTIONS
X = NONE
SEE PAGE 3-A FOR OTHER OPTIONS

MODEL O2

Lead Wire Extension



O2 | | | | | | | B | | | | | |

1. INSULATION
EXL = AccuTru Premium
High Purity, Extended Life
Special Limits of Error

MGO = Magnesium Oxide
Special Limits of Error

2. CALIBRATION
K = Type K
J = Type J
N = Type N
T = Type T
E = Type E
DK = Dual Type K
DJ = Dual Type J
DN = Dual Type N
DT = Dual Type T
DE = Dual Type E

3. JUNCTION
U = Ungrounded
G = Grounded

4. SHEATH MATERIAL
600A = Alloy 600
316S = 316 SS
310S = 310 SS
304S = 304 SS
446S = 446 SS
276C = Hastelloy C276
HASX = Hastelloy X
TITN = Titanium
* Contact factory for
other materials

5. SHEATH DIAMETER
188D = 0.188
250D = 0.250
375D = 0.375
* Contact factory for
other diameters

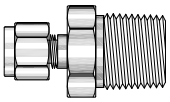
6. SENSOR LENGTH
(Dim A)
(In Inches xxx.xx)

7. TERMINATION
B = Bare Wire, Last .5 inches Stripped

8. LEAD WIRE LENGTH
(Dim L)
(In Inches xxx.xx)

9. LEAD WIRE INSULATION
T = Teflon (450°F)
G = Fiberglass (900°F)
K = Kapton/Kapton (450°F)
BT = SS Overbraid over Teflon
BG = SS Overbraid over Fiberglass
TBT = Teflon Over SS Overbraid over Teflon
TGT = Teflon Over SS Overbraid over Fiberglass

10. COMPRESSION FITTINGS
X = NONE
C1 = 1/16" NPT SS
C2 = 1/8" NPT SS
C4 = 1/4" NPT SS
C6 = 3/8" NPT SS
C8 = 1/2" NPT SS
C12 = 3/4" NPT SS



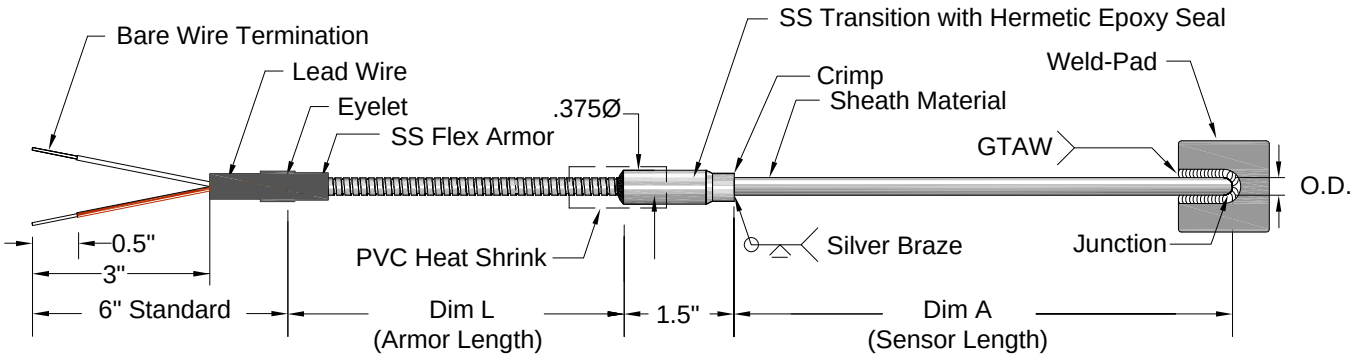
11. WELD PAD OPTIONS
X = NONE
600A = Flat Alloy 600 1"x1"x1/8"
316S = Flat 316SS 1"x1"x1/8"
310S = Flat 310SS 1"x1"x1/8"
C600A = Curved Alloy600 1"x1"x1/8"
C316S = Curved 316SS 1"x1"x1/8"
C310S = Curved 310SS 1"x1"x1/8"

Flat Weld Pad | Curved Weld Pad (Specify Tube OD)

12. OPTIONS
X = NONE
SEE PAGE 3-A FOR
OTHER OPTIONS

MODEL O3

SS Flex Armor Extension



O3 [ ] [ ] [ ] [ ] [ ] [ ] [ ] B [ ] [ ] [ ] [ ] [ ]

1. INSULATION
EXL = AccuTru Premium
High Purity, Extended Life
Special Limits of Error

MGO = Magnesium Oxide
Special Limits of Error

2. CALIBRATION
K = Type K
J = Type J
N = Type N
T = Type T
E = Type E
DK = Dual Type K
DJ = Dual Type J
DN = Dual Type N
DT = Dual Type T
DE = Dual Type E

3. JUNCTION
U = Ungrounded
G = Grounded

4. SHEATH MATERIAL
600A = Alloy 600
316S = 316 SS
310S = 310 SS
304S = 304 SS
446S = 446 SS
276C = Hastelloy C276
HASX = Hastelloy X
TITN = Titanium
* Contact factory for
other materials

5. SHEATH DIAMETER
188D = 0.188
250D = 0.250
375D = 0.375
* Contact factory for
other diameters

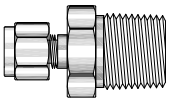
6. SENSOR LENGTH
(Dim A)
(In Inches xxx.xx)

7. TERMINATION
B = Bare Wire, Last .5 inches Stripped

8. ARMOR LENGTH
(Dim L)
(In Inches xxx.xx)

9. LEAD WIRE INSULATION
AT = Teflon (450°F) inside Armor
AG = Fiberglass (900°F) inside Armor
AK = Kapton/Kapton (450°F) inside Armor
PAT = Teflon inside Black PVC Jacketed Armor
PAG = Fiberglass inside Black PVC Jacketed Armor
TAT = Teflon inside White Teflon Jacketed Armor
TAG = Fiberglass inside White Teflon Jacketed Armor

10. COMPRESSION FITTINGS
X = NONE
C1 = 1/16" NPT SS
C2 = 1/8" NPT SS
C4 = 1/4" NPT SS
C6 = 3/8" NPT SS
C8 = 1/2" NPT SS
C12 = 3/4" NPT SS



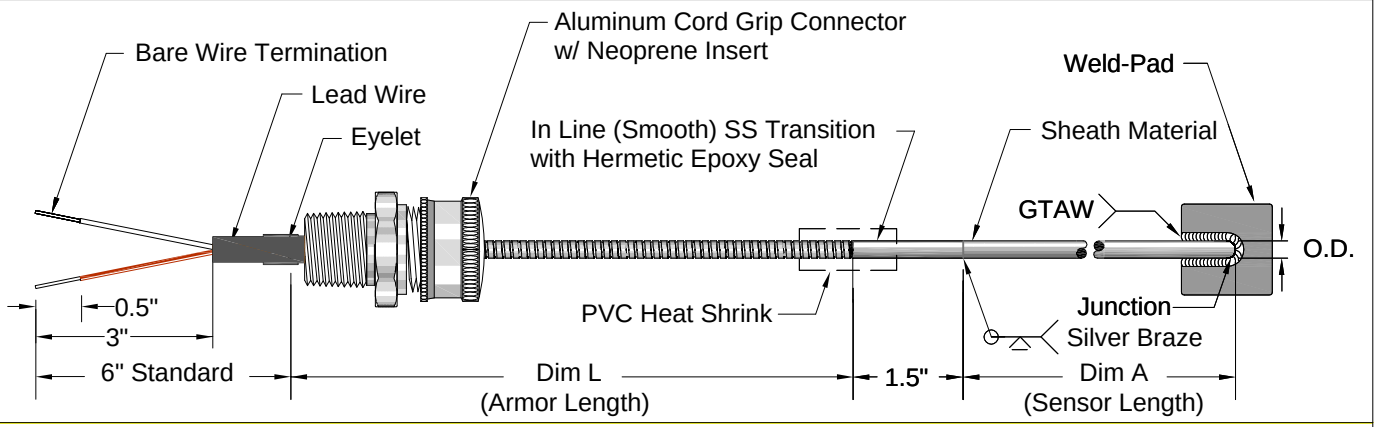
11. WELD PAD OPTIONS
X = NONE
600A = Flat Alloy 600 1"x1"x1/8"
316S = Flat 316SS 1"x1"x1/8"
310S = Flat 310SS 1"x1"x1/8"
C600A = Curved Alloy600 1"x1"x1/8"
C316S = Curved 316SS 1"x1"x1/8"
C310S = Curved 310SS 1"x1"x1/8"

(Specify Tube OD)

12. OPTIONS
X = NONE
SEE PAGE 3-A FOR
OTHER OPTIONS

MODEL 04

Cord Grip Connector Over SS Flex Armor



O4 [ ] [ ] [ ] [ ] [ ] [ ] [ ] B [ ] [ ] [ ] [ ] [ ]

1. INSULATION
EXL = AccuTru Premium
High Purity, Extended Life
Special Limits of Error

MGO = Magnesium Oxide
Special Limits of Error

2. CALIBRATION
K = Type K
J = Type J
N = Type N
T = Type T
E = Type E
DK = Dual Type K
DJ = Dual Type J
DN = Dual Type N
DT = Dual Type T
DE = Dual Type E

3. JUNCTION
U = Ungrounded
G = Grounded

4. SHEATH MATERIAL
600A = Alloy 600
316S = 316 SS
310S = 310 SS
304S = 304 SS
446S = 446 SS
276C = Hastelloy C276
HASX = Hastelloy X
TITN = Titanium
* Contact factory for
other materials

5. SHEATH DIAMETER
188D = 0.188
250D = 0.250
375D = 0.375
* Contact factory for
other diameters

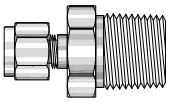
6. SENSOR LENGTH
(Dim A)
(In Inches xxx.xx)

7. TERMINATION
B = Bare Wire, Last .5 inches Stripped
H = See Page 3-B for Head Options
All Heads include a 3/4" NPT Conduit Connection, for 1/2" NPT Conduit Connection add Code 91 to field 12 .

8. ARMOR LENGTH
(Dim L)
(In Inches xxx.xx)

9. LEAD WIRE INSULATION
AT = Teflon (450°F) inside Armor
AG = Fiberglass (900°F) inside Armor
AK = Kapton/Kapton (450°F) inside Armor
PAT = Teflon inside Black PVC Jacketed Armor
PAG = Fiberglass inside Black PVC Jacketed Armor
TAT = Teflon inside White Teflon Jacketed Armor
TAG = Fiberglass inside White Teflon Jacketed Armor

10. COMPRESSION FITTINGS
X = NONE
C1 = 1/16" NPT SS
C2 = 1/8" NPT SS
C4 = 1/4" NPT SS
C6 = 3/8" NPT SS
C8 = 1/2" NPT SS
C12 = 3/4" NPT SS

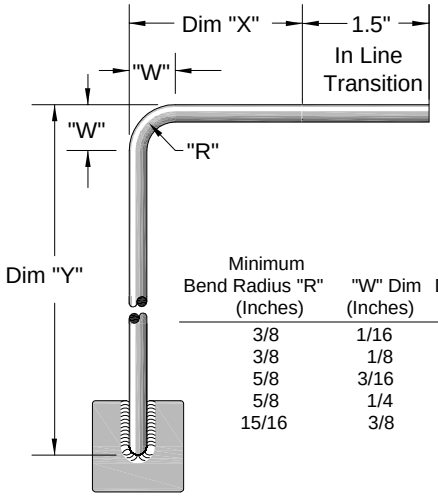


11. WELD PAD OPTIONS
X = NONE
600A = Flat Alloy 600 1"x1"x1/8"
316S = Flat 316SS 1"x1"x1/8"
310S = Flat 310SS 1"x1"x1/8"
C600A = Curved Alloy600 1"x1"x1/8"
C316S = Curved 316SS 1"x1"x1/8"
C310S = Curved 310SS 1"x1"x1/8"

Flat Weld Pad — Curved Weld Pad (Specify Tube OD)

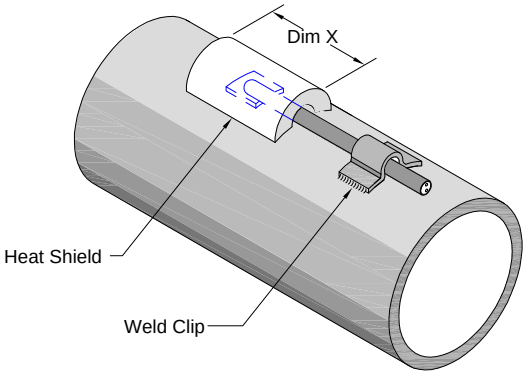
12. OPTIONS
X = NONE
SEE PAGE 3-A FOR
OTHER OPTIONS

Section 3 Thermocouple Requirements/Options

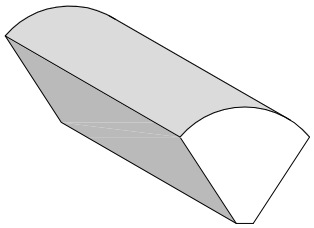


Minimum Bend Radius "R" (Inches)	"W" Dim (Inches)	Sheath Diameter (Inches)
3/8	1/16	1/16
3/8	1/8	1/8
5/8	3/16	3/16
5/8	1/4	1/4
15/16	3/8	3/8

Code 12 90° Bend Option
Specify "X" and "Y" Dimensions
Figure 3-A1



Heat Shield (Radiation Cover)
See Pages 3C and 3D
Figure 3-A2



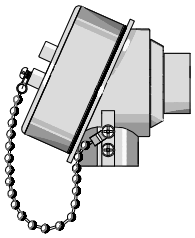
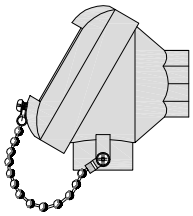
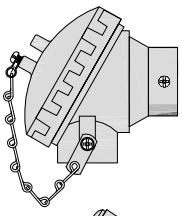
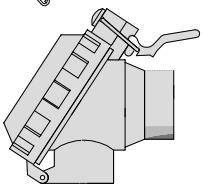
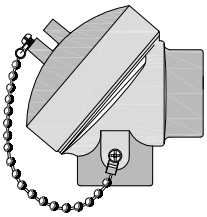
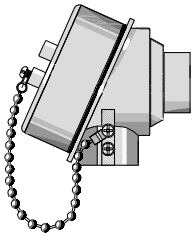
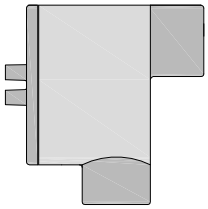
AccuTru Lance Pad (V Shape)
Contact Factory for Configuration
Figure 3-A3

Code	Options
11	NIST Calibration (Customer to Specify Points)
12	90° Bend (Specify "X" and "Y", See Figure 3-A1)
13	Certified Drawing
15	Magnetic Mounts (Contact factory)
	TERMINATION OPTIONS
21	Open Lugs
22	8 Gauge Lugs
	TRANSITION OPTIONS
31	In Line Transition (Same OD as Sensor)
32	1/4" OD Transition to replace standard 3/8" OD Transition
33	5/16" OD Transition x 5/8" Long to replace standard
34	High Temperature Epoxy (Rated to 311°F)
35	Ultra High Temperature Epoxy (Rated to 600°F)
36	High Temperature Cement
37	Silver Braze Transition to Sensor to replace Crimp
	Note: Stanadard Epoxy Temperature Rating is 266°F
	LEAD WIRE OPTIONS
41	24 GAUGE
42	18 GAUGE
43	Standard Limits of Error Wire
	CONNECTOR OPTIONS
62	Braze Adaptor to replace Tube Adaptor on Connector
	TAGS
71	SS Tag to replace Paper Tag
	FITTINGS
83	Additional Compression Fitting
	HEAD AND TERMINAL BLOCKS
91	1/2" NPT Conduit Connection
92	3/4" NPT Process Side Connection
95	Bakelite Terminal Block
96	Ground Screw on Head
	EXPANSION LOOPS
101	see Page 3-E

Section 3

Thermocouple Head Options

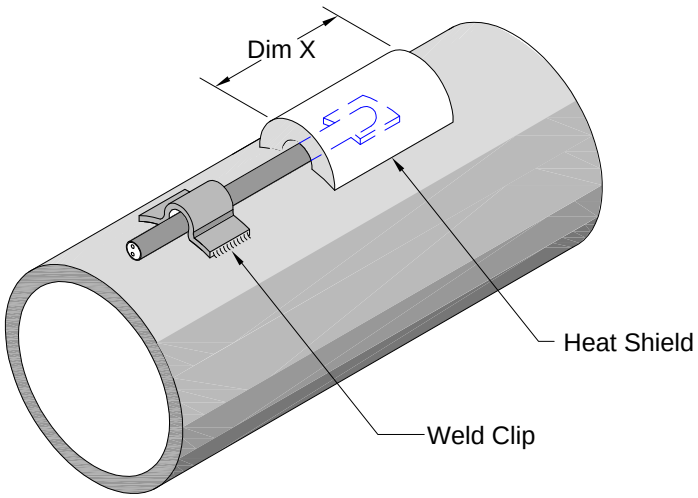
All Head Connections are 1/2" NPT Instrument x 3/4" NPT Conduit

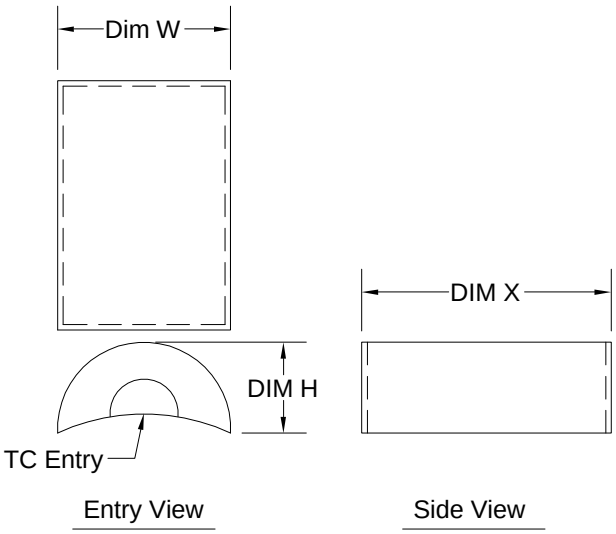
Description	Part Number	Head
General Purpose **Screw Cover with SS Chain** Supplied with ceramic terminal block. (Consult Factory for Sensor's over 1/4" OD)		
Aluminum	A1G	
Stainless Steel	S2G	
General Purpose NEMA 4X **Screw Cover with SS Chain** Supplied with ceramic terminal block.		
Aluminum	A3R	
Cast Iron	I3R	
Stainless Steel	S3R	
General Purpose Economical **Screw Cover with SS Chain** Supplied with ceramic terminal block.		
Aluminum	A4G	
Poly/White, FDA Approved	P4G	
Nylon/Gray	N4G	
General Purpose **Clamp Cover** Supplied with ceramic terminal block.		
Aluminum	A8G	
General Purpose Heavy Duty **Screw Cover with SS Chain** Supplied with ceramic terminal block.		
Aluminum	A9G	
Cast Iron	I9G	
Cast Iron (Gasket for NEMA 4, Ground Screw)	I9H	
Explosion Proof - FM/CSA **Class I, Div. 1, Gr. B,C, & D, Class II, Div. 2 Gr. E,F,&G (See Note 1)** **Screw Cover with SS Chain** Supplied with ceramic terminal block. Phenolic Blocks available.		
Aluminum, NEMA 4	A1P	
Stainless Steel, NEMA 4X	S2X	
Large Explosion Proof **Class I, Div. 1, Gr. B,C, & D, Class II, Div. 2 Gr. E,F,&G (See Note 1)** **No Chain** Supplied with phenolic or nylon barrier terminal strip.		
Aluminum, NEMA 4	A6E	
Cast Iron Body/ Aluminum Cover, NEMA 4	I6E	

Note 1:
In Group "B" Atmospheres, all conduit runs must have a sealing fitting(not supplied) field installed adjacent to the enclosure

Section 3

Heat Shield (Radiation Cover) and Weld Clips





HEAT SHIELD P/N: HS [ ] [ ] [ ] [ ] [ ]

1. SHIELD MATERIAL
600A = Alloy 600
316S = 316 SS
310S = 310 SS
* Contact factory for materials

2 THERMOCOUPLE DIAMETER
(In Inches xxx.xxx)
250D = 1/4" Dia. Sheath Thermocouple
375D = 3/8" Dia. Sheath Thermocouple

3. PIPE/TUBE DIAMETER
(Actual Diameter In Inches xxx.xxx)

4. LENGTH DIM "X"
(In Inches xxx.xxx)

5. FIBER INSULATION
X = None
FN = Ceramic Fiber Blanket
WC = Weld Clips

WELD CLIP P/N: WC [ ] [ ] [ ] [ ]

1. CLIP MATERIAL
600A = Alloy 600
316S = 316 SS
310S = 310 SS
* Contact factory for materials

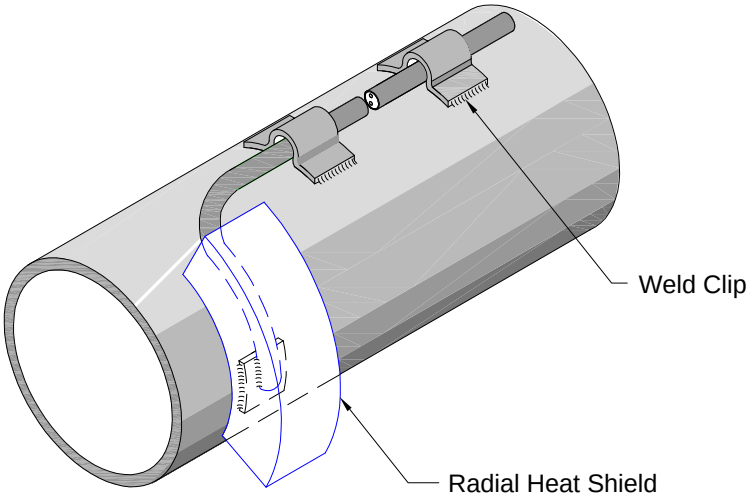
2 THERMOCOUPLE DIAMETER
(In Inches xxx.xxx)
250D = 1/4" Dia. Sheath Thermocouple
375D = 3/8" Dia. Sheath Thermocouple

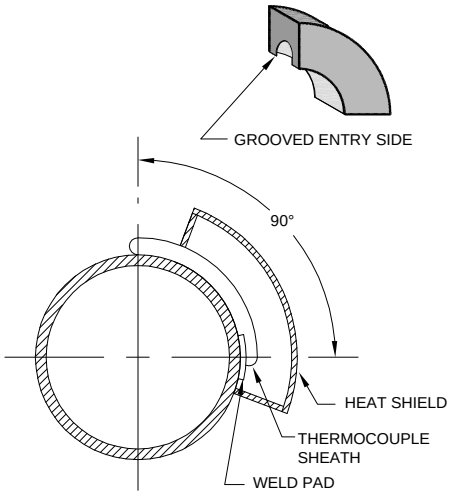
3. PIPE/TUBE DIAMETER
(Actual Diameter In Inches xxx.xxx)

4. QTY PER THERMOCOUPLE

NOTE: Contact Factory for Heat Shield Configuration Detail

Section 3 Radial Heat Shield (Radiation Cover) and Weld Clips





RADIAL HEAT SHIELD P/N: RHS [ ] [ ] [ ] [ ]

1. SHIELD MATERIAL
600A = Alloy 600
316S = 316 SS
310S = 310 SS
* Contact factory for materials

2 THERMOCOUPLE DIAMETER
(In Inches xxx.xxx)
250D = 1/4" Dia. Sheath Thermocouple
375D = 3/8" Dia. Sheath Thermocouple

3. PIPE/TUBE DIAMETER
(Actual Diameter In Inches xxx.xxx)

4. LENGTH DIM "X"
(In Inches xxx.xxx)

5. FIBER INSULATION
X = None
FN = Ceramic Fiber Blanket
WC = Weld Clips

WELD CLIP P/N: WC [ ] [ ] [ ]

1. CLIP MATERIAL
600A = Alloy 600
316S = 316 SS
310S = 310 SS
* Contact factory for other materials

2 THERMOCOUPLE DIAMETER
(In Inches xxx.xxx)
250D = 1/4" Dia. Sheath Thermocouple
375D = 3/8" Dia. Sheath Thermocouple

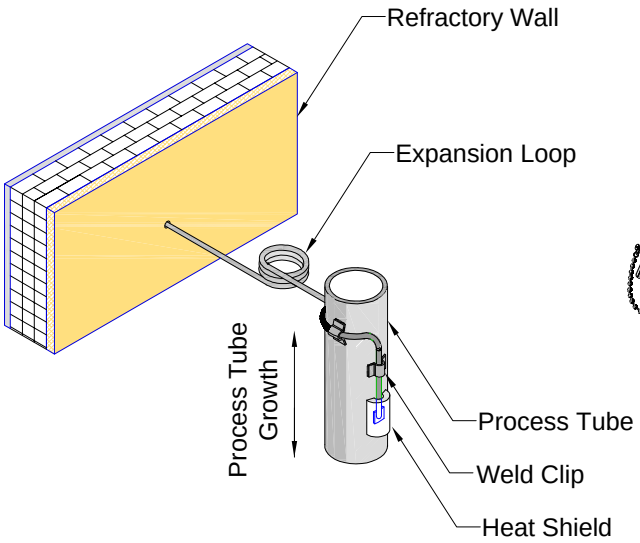
3. PIPE/TUBE DIAMETER
(Actual Diameter In Inches xxx.xxx)

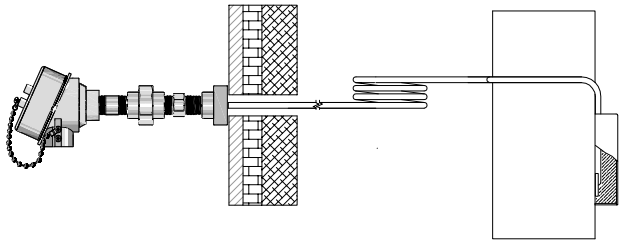
4. QTY PER THERMOCOUPLE
(In Inches xxx.xxx)

NOTE: Contact Factory for Heat Shield Configuration Detail

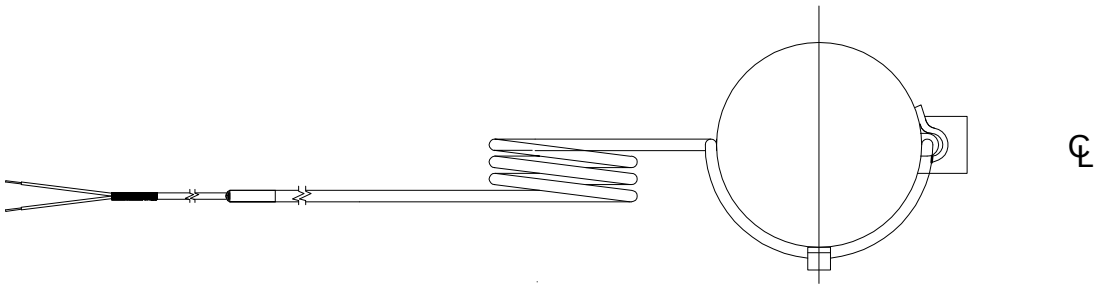
Section 3

Expansion Loops





Note: Specify Number of Loops



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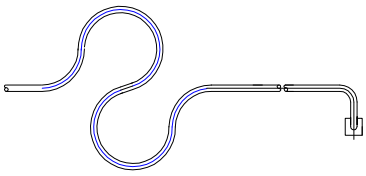
Expansion Loop Perpendicular to Pipe



Type "S" Expansion Loop