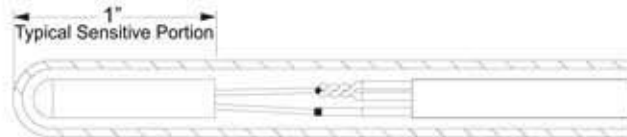




Configuration Code RT01  
**RTD Assemblies with Extension Leadwire**  
 Configuration Code RT02  
**RTD Assemblies with Sheath Terminations**

The RTD elements illustrated and described on this page are designed to measure temperature in a variety of process and laboratory applications. These RTDs are specifically designed for use in two different process temperature ranges and will provide accurate and repeatable temperature measurement through a broad range. Low range RTDs are constructed using Teflon® insulated silver plated copper internal leads, with potting compounds to resist moisture penetration. High range RTDs are constructed with nickel internal leads inside swaged MgO insulated cable to allow higher temperature measurements at the RTD element and to provide higher temperature lead protection along the sheath. The following tables allow customer selection of standard element materials, initial accuracies, sheath materials and diameters, mounting fittings and terminations. Custom built assemblies with non-standard specifications are available upon request.



## ORDER CODES

**Example Order Number:** R5T185L 48 3 - 006 - Page RTD-2 - Page RTD-3 - Page RTD-4 - Page RTD-5

### 1-1 Single Platinum RTD Elements

### 1-2 Available Sheath Diameters 316SS

### 1-4 Length

CODE	INITIAL ELEMENT ACCURACY @ 0 °C	BASE RESISTANCE @ 0 °C	TEMPERATURE COEFFICIENT	CODE			
<b>LOW RANGE WIRE WOUND (-200 to 204) °C [-328 to 400] °F</b>				<b>1/8" OD</b>	<b>3/16" OD</b>	<b>1/4" OD</b>	<b>3/8" OD</b>
R1T185L	± 0.1%	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	28	38	48	68
R3T185L	± 0.03%	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	28	38	48	68
R5T185L	± 0.01%	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	28	38	48	68
R1T192L	± 0.1%	100 Ω	$\alpha = 0.00392 \text{ } ^\circ\text{C}^{-1}$	28	38	48	68
R3T192L	± 0.03%	100 Ω	$\alpha = 0.00392 \text{ } ^\circ\text{C}^{-1}$	28	38	48	68
R1T125L	± 0.1%	200 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	N/A	38	48	68
<b>LOW RANGE THIN FILM (-40 to 204) °C [-40 to 400] °F</b>							
RBF185L	± 0.12%	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	28	38	48	68
RAF185L	± 0.06%	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	28	38	48	68
RBF155L	± 0.12%	500 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	28	38	48	68
RBF195L	± 0.12%	1000 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	28	38	48	68
<b>HIGH RANGE WIRE WOUND (-200 to 600) °C [-328 to 1112] °F</b>							
R1T185H	± 0.1%	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	28	38	48	68
R1T192H	± 0.1%	100 Ω	$\alpha = 0.00392 \text{ } ^\circ\text{C}^{-1}$	28	38	48	68

CODE
3 Digit 'X' Length

### 1-3 Element Connection

CODE	DESCRIPTION
2	2 wire
3	3 wire
4 <sup>[1]</sup>	4 wire

[1] Not available in duplex

### 1-1 Duplex Platinum RTD Elements

### 1-2 Available Sheath Diameters 316SS

### 1-2A

CODE	INITIAL ELEMENT ACCURACY @ 0 °C	BASE RESISTANCE @ 0 °C	TEMPERATURE COEFFICIENT	CODE		
<b>LOW RANGE WIRE WOUND (-200 to 204) °C [-328 to 400] °F</b>				<b>3/16" OD</b>	<b>1/4" OD</b>	<b>3/8" OD</b>
R1T285L	± 0.1%	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	38	48	68
R3T285L	± 0.03%	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	38	48	68
R5T285L	± 0.01%	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	38	48	68
R1T292L	± 0.1%	100 Ω	$\alpha = 0.00392 \text{ } ^\circ\text{C}^{-1}$	38	48	68
R3T292L	± 0.03%	100 Ω	$\alpha = 0.00392 \text{ } ^\circ\text{C}^{-1}$	38	48	68
<b>LOW RANGE THIN FILM (-40 to 204) °C [-40 to 400] °F</b>						
RBF285L	± 0.12%	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	38	48	68
RAF285L	± 0.06%	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	38	48	68
RBF295L	± 0.12%	1000 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	38	48	68
<b>HIGH RANGE WIRE WOUND (-200 to 600) °C [-328 to 1112] °F</b>						
R1T285H	± 0.1%	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	38	48	68
R1T292H	± 0.1%	100 Ω	$\alpha = 0.00392 \text{ } ^\circ\text{C}^{-1}$	38	48	68

CODE	NOMINAL SHEATH DIAMETER (inches)	TIP DIA. OD (inches)	TIP LENGTH (inches)
88R48	1/2	1/4	1 1/4
68R38	3/8	3/16	1 1/4
48R28	1/4	1/8	1 1/4

### REDUCED TIP RTD's

Table 1-2A lists RTD elements with reduced tip sheaths. To order, use order code numbers from Tbl. 1-2A in place of straight sheath order code numbers from Tbl. 1-2. Other reduced tips are available upon request. EXAMPLE: R1T185L88R483-006.

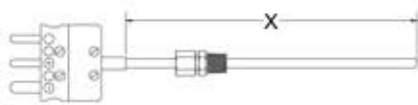
Consult factory for other RTD types.



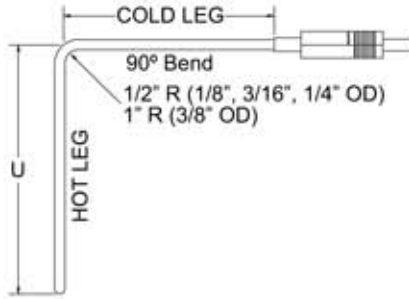
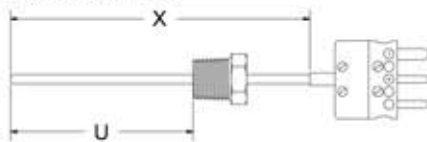
# Optional Sheath Mounting Fittings and Bends

Select Sheath Mounting or Bend Options as desired from tables below.

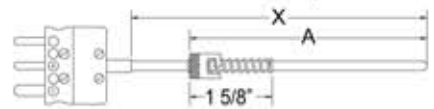
### COMPRESSION FITTING



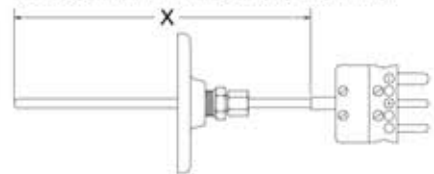
### FIXED BUSHING



### BAYONET CAP and SPRING (OPTION 13A)



### ADJUSTABLE FLANGE (OPTION 14)



## ORDER CODES

Example Order Number:

**R5T185L483-006 - 01A,304**

2

PAGE  
RTD 3

PAGE  
RTD 4

PAGE  
RTD 5

### 2-1 No Fitting or Bend Options

CODE	00
------	----

### 2-2 One-time Adjustable Compression Fittings

CODE	TYPE	NPT SIZE (inches)	PRESSURE RATED	AVAILABLE SHEATH DIAMETERS (inches)
01A	303 stainless steel	1/8	NO	1/8, 3/16, 1/4
05A	316 stainless steel	1/8	YES	1/8, 3/16, 1/4
05B	316 stainless steel	1/4	YES	1/8, 3/16, 1/4, 3/8
05C	316 stainless steel	1/2	YES	1/8, 1/4, 3/8
15A	Brass	1/8	NO	1/8, 3/16, 1/4
15B	Brass	1/4	NO	3/16, 1/4, 3/8
15C	Brass	1/2	NO	1/4, 3/8

### 2-3 Re-adjustable Compression Fittings

CODE	TYPE	NPT SIZE (inches)	AVAILABLE SHEATH DIAMETERS (inches)
10A	303 stainless steel	1/8	1/8, 3/16
10B	303 stainless steel	1/4	1/4, 3/8
10C	303 stainless steel	1/2	1/4, 3/8
12A	316 stainless steel	1/8	1/8, 3/16, 1/4
12B	316 stainless steel	1/4	1/8, 3/16, 1/4, 3/8
12C	316 stainless steel	1/2	1/8, 1/4, 3/8
11A	Brass	1/8	1/8, 3/16, 1/4
11B	Brass	1/4	1/8, 3/16, 1/4, 3/8
11C	Brass	1/2	1/4, 3/8
19C	Spring loaded SS well fitting	1/2	3/16, 1/4

Teflon® gland standard 204 °C [400 °F] max. For lava gland 649 °C [1200 °F] max. opt. 10A and 10B only use letter suffix "L" after compression fitting order code. EX: 10AL for lava gland.

### 2-6 Miscellaneous Options

CODE	TYPE	AVAILABLE SHEATH DIAMETER (inches)
13A __ [1]	Spring-loaded bayonet fitting	1/8, 3/16
14	Adjustable flange with brass compression fitting	1/8, 3/16, 1/4, 3/8
16A	Spring-loaded adjustable bayonet compression fitting	1/8

[1] When ordering fixed bayonet fitting specify dimension "A". EX: order code 13A06 is for a fixed bayonet adapter with 6" A Dimension.

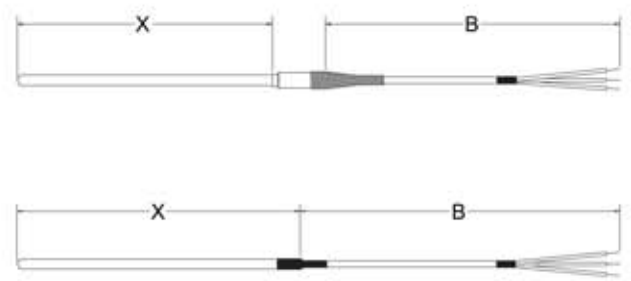
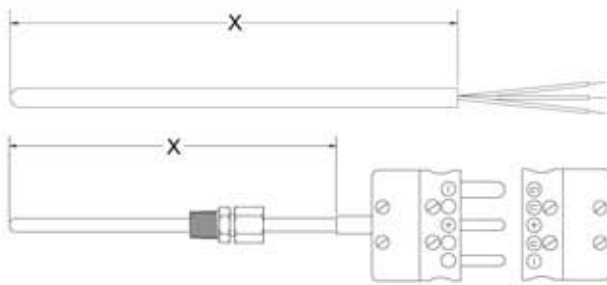
### 2-5 Fixed Bushings

CODE	MOUNTING THREAD NPT (inches)	AVAILABLE SHEATH DIAMETERS (inches)
316 SS		
8A __ [1]	1/8	1/8, 3/16, 1/4
8B __ [1]	1/4	1/8, 3/16, 1/4, 3/8
8C __ [1]	1/2	1/8, 3/16, 1/4, 3/8
8D __ [1]	3/4	1/8, 3/16, 1/4, 3/8

[1] When ordering fixed bushings, specify order code above, plus insertion length "U", as measured from hot tip to bottom of threaded bushing. EX: order code 8A06 is 1/8" NPT, 316 SS bushing located 6" from hot tip.

### 2-4 Sheath Bends

CODE	DESCRIPTION
2 __	Sheath bent 45°
3 __	Sheath bent 90°
2" minimum hot leg length	
When ordering bend options, specify hot leg dim. "U". <u>EX: order code 206</u> is a 45° bend with 6" hot leg. Total sheath length is Table 1 "X" length = hot leg plus cold leg.	



**RT02**

**ORDER CODES**

**RT01**

**Example Order Number:**

**R5T185L483-006-00 - 4, MC** or **R5T185L483-006-01A,304 - 16** - PAGE RTD-5 - PAGE RTD-6

**3-1 Plug and Jack Sheath Terminations**

CODE	DESCRIPTION
4	Standard plug
5	Standard jack
6	Miniature plug
7	Miniature jack
<b>Options</b>	
MC	Mating connector
CL	Compression L bracket to hold plug to sheath

**3-1 Sheath Terminations**

CODE	DESCRIPTION
14 <sup>[1]</sup>	Ceramic wafer block
22 <sup>[2]</sup>	3" individual leads with terminal pins

[1] Duplex available in 2 wire only  
 [2] High temp RTD's are supplied with 1" long transition

**3-2 Leadwire transitions**

*(Requires Tbl. 4 and 5 selections)*

CODE	DESCRIPTION
13 <sup>[1]</sup>	Same size transition with heat shrink tubing 104 °C [220 °F]
15	Extension leadwire transition with relief spring 204 °C [400 °F]
16	Extension leadwire transition with heat shrink tubing 104 °C [220 °F]
18 <sup>[1]</sup>	Same size transition without heat shrink tubing 204 °C [400 °F]
19	Extension leadwire transition without spring or heat shrink 204 °C [400 °F]
<b>Options</b>	
HT <sup>[1]</sup>	High temperature potting 538 °C [1000 °F] not available with option 13 or 16

[1] Not available with flex armor  
 [2] Not available with option 13 or 16. When specifying high temp potting with Flex Armor option 19 must be selected.

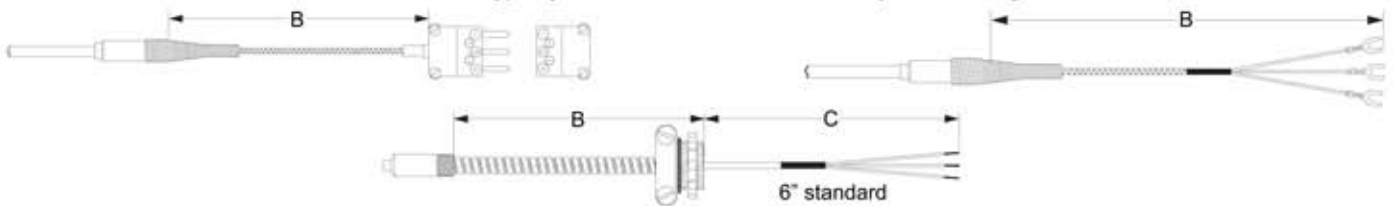
**3-2 Threaded Fittings with Extension Leadwire**

*(Requires Tbl. 4 and 5 selections)*

CODE	DESCRIPTION
6HN23	1/2" x 1/2" NPT steel hex nipple
8HN23	1/2" x 1/2" NPT stainless steel hex nipple
9HP23	1/2" NPT stainless steel bushing (no process threads)
8RNDC23	3/4" process x 1/2" NPT stainless steel hex nipple



Select desired leadwire type by order code number, followed by desired length in inches.



## ORDER CODES

Example Order Number:

**R5T185L483-006-01A,304-16**

**T3 036**

**PAGE  
RTD 5**

### 4 Extension Leadwire Type and B + C Dimension

CODE	DESCRIPTION	TEMP. RATING
<b>FIBERGLASS</b>		
F3J___	Fiberglass insulation - individual leads - stranded conductor (12" limit)	482 °C [900 °F]
F3___	Fiberglass insulation - stranded conductor	
F3A___	Fiberglass insulation - stranded conductor - flexible armor	
F3B___	Fiberglass insulation - stranded conductor - stainless steel overbraid	
<b>TEFLON®</b>		
T3J___	Teflon® insulation - individual leads - stranded conductor (12" limit)	204 °C [400 °F]
T3___	Teflon® insulation - stranded conductor	
T3A___	Teflon® insulation - stranded conductor - flexible armor	
T3B___	Teflon® insulation - stranded conductor - stainless steel overbraid	
M3___	Teflon® insulation - stranded conductor - stainless steel overbraid - Teflon® insulation	
T3M___	Teflon® insulation - stranded conductor - mylar shield	
T3MA___	Teflon® insulation - stranded conductor - mylar shield - flexible armor	
<b>KAPTON®</b>		
K3___	Kapton® insulation - stranded conductor	316 °C [600 °F]
K3A___	Kapton® insulation - stranded conductor - flexible armor	
K3B___	Kapton® insulation - stranded conductor - stainless steel overbraid	
<b>SILICON RUBBER</b>		
S3___	Teflon® insulation - stranded conductor - silicon rubber	204 °C [400 °F]
<b>COIL CORDS</b>		
C3060	PVC insulation - stranded conductor - coil cord - 60" extended length	104 °C [220 °F]
C3120	PVC insulation - stranded conductor - coil cord - 120" extended length	

Insert wire code number and 3 digit 'B' length in inches EX: T3036 = 36" B length

For assemblies requiring leadwire beyond the flexible armor (illustrated in 'C' in drawing), insert 3 digit 'C' length after armor length.  
EX: F3A036-012 = 36" B length with additional 12" 'C' length leads beyond armor.

All insulated leadwires in flexible armor are available with either extruded PVC or Teflon® covering over the flexible armor.  
Substitute suffix codes T (Teflon®) or P (PVC) for the suffix 'A' code above. EXAMPLE: T3T is Teflon® covered armor.

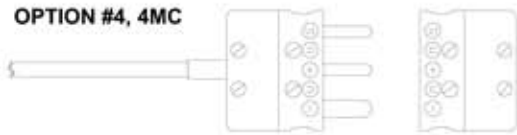


Select desired leadwire termination and options (if desired), by order code numbers below.

OPTION #3



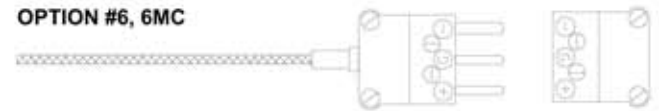
OPTION #4, 4MC



OPTION #8



OPTION #6, 6MC



## ORDER CODES

**Example Order Number:**

**R5T185L483-006-01A,304-16-T3036 - 4, MC**

5-1

5-2

### 5-1 Terminations

CODE	DESCRIPTION
0	Leads not stripped
2	2" split leads, 1/4" stripped
3	2" split leads with spade lugs
4	Standard plug
5	Standard jack
6	Miniature plug
7	Miniature jack
8	2" split leads with 1/4" female quick disconnects

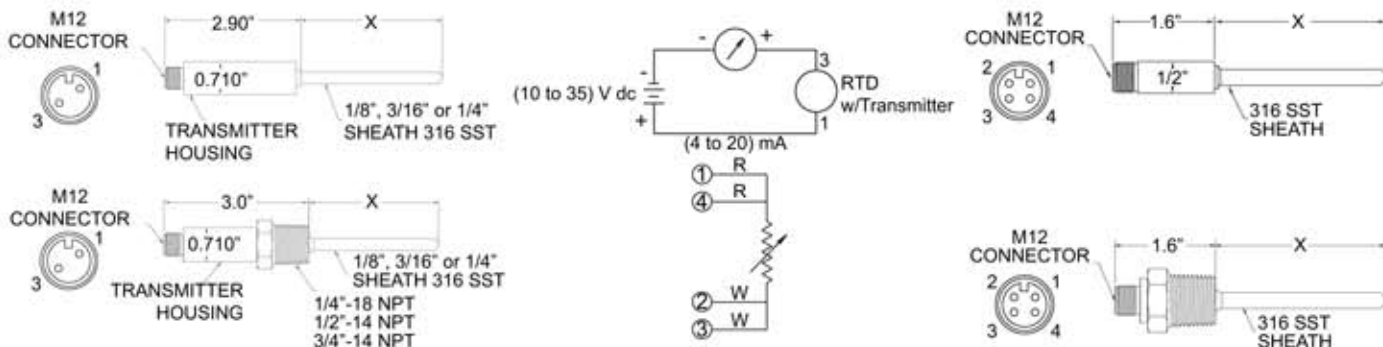
### 5-2 Options

CODE	DESCRIPTION
BX	1/2" NPT BX connector with Options 0, 2, 3, or 8
CC	Plug or jack secured to leads with cable clamp
CG	Cord Grip (1/2" NPT PVC)
MC	Mating connector
RB	Rubber boot



# Configuration Code RT03 Water-Tight RTD Assembly With Optional Series 450 Temperature Transmitter

RTD Assemblies house an optional Series 450 Temperature Transmitter (no connection head is required) that is ideal for monitoring temperature in small areas such as tanks and pipes. The water-tight construction meets the NEMA 6P, IP68 Protection Rating requirements. Standard units include a sensor, an M12 process connection housing, and optional transmitter. The transmitter is a 2-wire unit with an analog output. It has measurement input for Pt100 resistance thermometers (RTD) in 4 wire connections. Transmitters can be ranged from (-51 to 160) °C [-60 to 320] °F. With a 10 °C [18 °F] minimum span requirement. **The ambient temperature limits for the M12 connector is (-40 to 85) °C.**



## ORDER CODES

**Example Order Number:** **R1T185L** - **484** - **06** - **00** - **C45, T** - **450** - **U** - **S(0-200)** **F**

**1 Pt100 ( $\alpha=0.00385\text{ }^{\circ}\text{C}^{-1}$ ) RTD Assemblies**

CODE	INITIAL ELEMENT ACCURACY @ 0 °C
R1T185L	± 0.1%
R3T185L	± 0.03%
R5T185L	± 0.01%
RAF185L	± 0.06%
RBF185L	± 0.12%

See Instrument Section for total sensor and transmitter output accuracy.

**2 316 S.S. Sheath**

CODE	DIAMETER OD (inches)
284	1/8
384	3/16
484	1/4

**3 Immersion Length "X"**

Specify "X" length in inches using 2 digits, plus any fractional length desired. Examples: 04 = 4", 04(1/2) = 4.5"

**4.1 Sheath Fittings**

CODE	DESCRIPTION
00	No Fitting

**4.2 Re-Adjustable Compression Fittings**

CODE	DESCRIPTION	NPT (inches)	AVAILABLE SHEATH DIAMETERS (inches)
12A	Stainless Steel	1/8	1/8, 3/16
12B	Stainless Steel	1/4	3/16, 1/4
12C	Stainless Steel	1/2	1/8, 1/4

Teflon® gland standard 204 °C [400 °F] max.

**4.3 One-Time Adjustable Compression Fittings**

CODE	DESCRIPTION	NPT (inches)	AVAILABLE SHEATH DIAMETERS (inches)
05A	Stainless Steel	1/8	1/8, 3/16, 1/4
05B	Stainless Steel	1/4	1/8, 3/16, 1/4
05C	Stainless Steel	1/2	1/8, 1/4

**4.4 316SS Fixed Bushings**

CODE	MOUNTING THREAD NPT (inches)	AVAILABLE SHEATH DIAMETERS (inches)
8A	1/8	1/8, 3/16, 1/4
8B	1/4	1/8, 3/16, 1/4
8C	1/2	1/8, 3/16, 1/4
8D	3/4	1/8, 3/16, 1/4

When ordering fixed bushings, specify order code above plus insertion length "U", as measured from hot tip to bottom of threaded bushing. EX: code 8A06 is 1/8" NPT, 316 SS bushing located 6" from hot tip.

**5 M12 Connector Termination**

CODE	DESCRIPTION
45	No Process Connection
C45	1/2" NPT Process Connection
B45	1/4" NPT Process Connection
D45	3/4" NPT Process Connection

**OPTIONAL TRANSMITTER**

T	4 to 20 mA Temperature Transmitter (Requires Table 6 selection)
---	---

**6 Transmitter**

CODE	DESCRIPTION
450-00	Programmable Transmitter Unconfigured
450	Programmable Transmitter Configured

**7 Fault Signal**

CODE	DESCRIPTION
U	Upscale Burnout
D	Downscale Burnout

**8 Range**

CODE	DESCRIPTION
S	(lower limit - upper limit)

**9 Units**

CODE	DESCRIPTION
C	Celsius
F	Fahrenheit



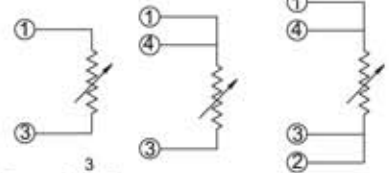
M12 Molded and Field Wireable cables are available for connection to Pyromation Water-Tight Assemblies with Optional Series 450 Transmitters. The M12 quick disconnect plug eliminates all external screw connections simplifying the electrical installation process and solving the problems caused by moisture, loose connections, and corrosion. They are faster to install and more secure than conventional field wired connections. Both are available in 2, 3, and 4 wire connection options and in straight or 90° angle styles. Molded cables are PVC insulated and meet NEMA 1, 3, 4, 6P and IEC IP68. Field Wireable Cable insulations are listed below and meet IP67 requirements. Cable lengths are manufactured to customer specifications. All M12 Molded Cables are supplied as 4 wire and are terminated as specified in part number.

## ORDER CODES

### M12 MOLDED CABLE



1 BROWN 2 WHITE  
4 BLACK 3 BLUE



**Example Order Number:**

**RT3E46MS - P3072 - 2**

#### 1 M12 Connector Options

CODE	NUMBER OF WIRES	DESCRIPTION
RT2E46MS	2	Straight M12 Molded Connector
RT3E46MS	3	
RT4E46MS	4	
RT2E46MA	2	90° Angle M12 Molded Connector
RT3E46MA	3	
RT4E46MA	4	

#### 2 Extension Cable

CODE	DESCRIPTION
P3_ _ _ [1]	22 AWG PVC insulation

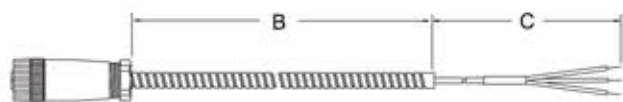
[1] Insert length in inches

#### 3 Terminations and Options

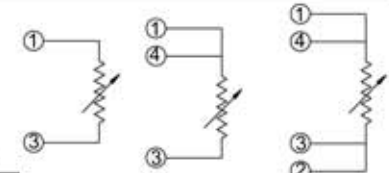
CODE	DESCRIPTION
0	No termination
2	2" split leads, 1/4" stripped
3	2" split leads with spade lugs
4	Standard plug
5	Standard Jack
Options	
BX	Box connector
CC	Cable clamp
CG	1/2" NPT plastic cord grip
MC	Mating connector
RB	Rubber boot

## ORDER CODES

### M12 FIELD WIREABLE CABLES



1 RED 2 WHITE  
4 RED 3 WHITE



**Example Order Number:**

**RT3E46S - T3072 - 2**

#### 1 M12 Connector Options

CODE	NUMBER OF WIRES	DESCRIPTION
RT2E46S	2	Straight M12 Connector
RT3E46S	3	
RT4E46S	4	
RT2E46A	2	90° Angle M12 Connector
RT3E46A	3	
RT4E46A	4	

#### 2 Extension Leadwire and B + C Dimension

CODE*	WIRE DESCRIPTION
P3_ _ _	Stranded; PVC insulation
P3A_ _ _	Stranded; PVC insulation w/flex armor
T3_ _ _	Stranded; Teflon® insulation
T3M_ _ _	Stranded; Teflon® with aluminum mylar shield and drain
T3A_ _ _	Stranded; Teflon® insulation w/flex armor

\*Insert 3 digit B length in inches. EXAMPLE: T3036=36" B length; for assemblies requiring leadwire beyond the flexible armor, insert 3 digit C length after armor length. EXAMPLE: T3A036-012=36" B length with additional 12" leads beyond armor.

#### 3 Terminations and Options

CODE	DESCRIPTION
0	No termination
2	2" split leads, 1/4" stripped
3	2" split leads with spade lugs
4	Standard plug
5	Standard jack
6	Miniature plug
7	Miniature jack
8	2" split leads with 1/4" female disconnects
Options	
BX	Box connector
CC	Cable clamp
CG	1/2" NPT plastic cord grip
MC	Mating connector
RB	Rubber boot



The information contained in the following pages is intended as a guideline for general RTD sensor usage. Specific applications and environmental conditions may require that other sensor element types, element materials, or construction styles be used to provide optimum temperature measurement results. The dimensions, temperature ratings, accuracies, and other specifications may vary to satisfy a particular application requirement. For further information and recommendations on specific applications, please consult with the factory.

## RTD ELEMENTS

Elements of several different materials, base resistances, temperature coefficients, accuracies, and construction styles are available for installation into final RTD temperature sensor assemblies to meet customer specifications. The most commonly used element throughout the USA and Europe is a wire-wound or thin film platinum with a base resistance of 100  $\Omega$  at 0  $^{\circ}\text{C}$  [32  $^{\circ}\text{F}$ ] and with a 0.003 85  $^{\circ}\text{C}^{-1}$  temperature coefficient.

A few USA companies, and most Japanese companies, use a similar 100  $\Omega$  platinum element, but with a 0.003 92  $^{\circ}\text{C}^{-1}$  temperature coefficient.

The NASC's standard element for either of these specified assemblies is a wire-wound type, in which the platinum winding is supported inside a ceramic body, although other process considerations may sometimes require the use of a thin film or "glassed-in" type of element. Elements of materials other than platinum are typically wire-wound on a core and covered with an insulating material such as Kapton<sup>®</sup>.

The platinum elements used in the NASC RTD assemblies are in accordance with the specifications set forth in the following standards:

### STANDARDS for 0.003 85 $^{\circ}\text{C}^{-1}$ TEMPERATURE COEFFICIENT ELEMENTS

1. American Society For Testing E 1157 - 97 and Materials. (ASTM)
2. International Electrotechnical IEC 60751 - 1995 Commission.

### STANDARDS for 0.003 92 $^{\circ}\text{C}^{-1}$ TEMPERATURE COEFFICIENT ELEMENTS

1. American Scientific Apparatus SAMA RC 21.4 - 1966 Manuf. Association:
2. Japanese Standard: JIS C 1604 - 1997

## RTD ELEMENT TERMINOLOGY and SPECIFICATIONS

**Temperature Coefficient:** Known as the "Alpha" value, and it is the average fractional change of element resistance per a 1  $^{\circ}\text{C}$  change in the element temperature over the range of (0 to 100)  $^{\circ}\text{C}$  [32 to 212]  $^{\circ}\text{F}$ . The temperature coefficient of resistance is expressed as ohms/ohm/ $^{\circ}\text{C}$  or  $^{\circ}\text{C}^{-1}$ .

**Accuracy:** A statement of the initial element accuracy when its base resistance value is measured at **one point only**, usually 0  $^{\circ}\text{C}$ .

**Repeatability-Stability:** The ability of an element to reproduce the same resistance or temperature reading each time it is at equilibrium at a given repeated temperature. Expressed as a  $\pm$  resistance or temperature value over a given temperature range. May also be expressed as the stability of its resistance. Typically platinum elements will not change more than 0.04% at 0  $^{\circ}\text{C}$  [32  $^{\circ}\text{F}$ ] after receiving ten consecutive shocks from (-200 to 600)  $^{\circ}\text{C}$  [-328 to 1112]  $^{\circ}\text{F}$ .

**Self-Heating:** RTD elements are not self-powered and require a small current be passed through the device to provide a voltage that can be measured. Self-heating is the rise of temperature within the element itself, caused by the current flowing through the element. This self-heating appears as a measurement error and is affected by the thermal conductivity and velocity of the process being measured; it is negligible for most applications. Typical platinum resistance elements would require 60 mV of power dissipation to cause a 1  $^{\circ}\text{C}$  [1.8  $^{\circ}\text{F}$ ] temperature measurement error when tested in water flowing at 3 ft/s.

**Time Constant:** The time required to sense 63% of a step temperature change from (25 to 80)  $^{\circ}\text{C}$  [77 to 176]  $^{\circ}\text{F}$  in water flowing at 3 ft/s.

**Interchangeability:** The amount of allowable difference in readings between two RTD's when placed side by side in a process at the same temperature. Determined by the allowable RTD tolerance at that particular temperature.

**Tolerance:** The amount of resistance error tolerated when the elements are measured at various temperature points. The NASC's 100 and 200 ohm platinum elements are offered in three base resistance tolerance bands as follows:

- Band 1:  $\pm 0.1\%$  @ 0  $^{\circ}\text{C}$  (Actual Elements Used Exceed DIN Class B Tolerances)
- Band 3:  $\pm 0.03\%$  @ 0  $^{\circ}\text{C}$  (Actual Elements Used Exceed DIN Class A Tolerances)
- Band 5:  $\pm 0.01\%$  @ 0  $^{\circ}\text{C}$  (Actual Elements Used Exceed DIN Class A Tolerances)

Elements of other values and of other materials are offered in the following base resistance tolerance bands:

- DIN Class A  $\pm 0.06\%$  @ 0  $^{\circ}\text{C}$
- DIN Class B  $\pm 0.12\%$  @ 0  $^{\circ}\text{C}$
- Class C  $\pm 0.2\%$  @ 0  $^{\circ}\text{C}$
- Class D  $\pm 0.5\%$  @ 0  $^{\circ}\text{C}$

**Vibration:** The NASC's fully assembled sheathed RTD sensors are designed to withstand an average vibration level of 30 G's using random vibrating frequencies from (20 to 2,000) HZ at ambient temperature. Supporting test results indicate that initial RTD tolerances remain as specified when tested at these vibration levels.

**Humidity Limits:** Sheaths, transition fittings, and lead seals capable of withstanding 100% humidity at normal atmospheric pressure, and at normal ambient temperatures.



**Pyromation Standard RTD Element Specifications**

ELEMENT MATERIAL <sup>[1]</sup>	RESISTANCE @ 0 °C	TEMPERATURE COEFFICIENT	OPERATING RANGE <sup>[2]</sup>	AVAILABLE ACCURACIES @ 0 °C	CATALOG ORDER CODES
Platinum	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	(-200 to 600) °C [-328 to 1112] °F	± 0.1% ± 0.03% ± 0.01%	R1T R3T R5T
Platinum	100 Ω	$\alpha = 0.00392 \text{ } ^\circ\text{C}^{-1}$	(-200 to 600) °C [-328 to 1112] °F	± 0.1% ± 0.03%	R1T R3T
Platinum	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	(-40 to 200) °C [-40 to 400] °F	± 0.12%	RBF
Platinum	100 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	(-40 to 200) °C [-40 to 400] °F	± 0.06%	RAF
Platinum	200 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	(-200 to 600) °C [-328 to 1112] °F	± 0.1% ± 0.03% ± 0.01%	R1T R3T R5T
Platinum	200 Ω	$\alpha = 0.00392 \text{ } ^\circ\text{C}^{-1}$	(-200 to 600) °C [-328 to 1112] °F	± 0.1% ± 0.03%	R1T R3T
Platinum	500 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	(-40 to 500) °C [-40 to 932] °F	± 0.12%	RBF
Platinum	1000 Ω	$\alpha = 0.00385 \text{ } ^\circ\text{C}^{-1}$	(-40 to 500) °C [-40 to 932] °F	± 0.12%	RBF
Copper	10 Ω	$\alpha = 0.00427 \text{ } ^\circ\text{C}^{-1}$	(-200 to 204) °C [-328 to 400] °F	± 0.2%	RCT
Nickel	120 Ω	$\alpha = 0.00672 \text{ } ^\circ\text{C}^{-1}$	(-200 to 204) °C [-328 to 400] °F	± 0.5%	RDT
Nickel-Iron	604 Ω	$\alpha = 0.00518 \text{ } ^\circ\text{C}^{-1}$	(-200 to 204) °C [-328 to 400] °F	± 0.5%	RDT

[1] Sensing elements of other materials, base values, and temperature coefficients are available upon request.

[2] Stated operating ranges are typical values and are dependant upon the sensing element, element substrate, and the construction style of the total sensor assembly. Sensor assemblies to exceed the stated limits may be available upon request.

**Typical 100 OHM Platinum Element Tolerances**

TEMPERATURE		CLASS B (0.12%) <sup>[1]</sup> TOLERANCE ±[0.30 + 0.0050  t ] °C		BAND 1 (0.1%) <sup>[1]</sup> TOLERANCE ±[0.26 + 0.0042  t ] °C		CLASS A (0.06%) <sup>[1]</sup> TOLERANCE ±[0.15 + 0.0020  t ] °C		BAND 3 (0.03%) <sup>[1]</sup> TOLERANCE ±[0.08 + 0.0017  t ] °C		BAND 5 (0.01%) <sup>[2]</sup> TOLERANCE ±[0.03 + 0.0017  t ] °C	
°C	[°F]	°C	[°F]	°C	[°F]	°C	[°F]	°C	[°F]	°C	[°F]
-200		1.30		1.10		0.55		0.42		0.37	
-100		0.80		0.68		0.35		0.25		0.20	
0		0.30		0.26		0.15		0.08		0.03	
100		0.80		0.68		0.35		0.25		0.20	
200		1.30		1.10		0.55		0.42		0.37	
300		1.80		1.52		0.75		0.59		0.54	
400		2.30		1.94		0.95		0.76		0.71	
500		2.80		2.36		1.15		0.93		0.88	
600		3.30		2.78		1.35		1.10		1.05	

where: |t| = value of temperature without regard to sign, °C

[1] The equations represent values for 3 and 4-wire PRTs. Caution must be exercised with 2-wire PRTs due to lead resistance.

[2] This tolerance can only be met with a 4-wire PRT.



## RTD ASSEMBLY CONSTRUCTION STYLES

### Low Range - Thin Film Construction (L) (-40 °C to 204) °C [-40 °F to 400] °F

The element is welded to teflon insulated silver plated copper leads, and then placed inside a specially cleaned stainless steel sheath. The space surrounding the element and leads is filled and loosely packed with alumina oxide powder to provide good heat transfer times and to provide a damping cushion against vibration and mechanical shock. The filled sheath is then sealed with low temperature epoxies to prevent moisture penetration.

### Standard Low Range (L) (-200 °C to 204) °C [-328 °F to 400] °F

The element is welded to teflon insulated silver plated copper leads, and then placed inside a specially cleaned stainless steel sheath. The space surrounding the element and leads is filled and loosely packed with alumina oxide powder to provide good heat transfer times and to provide a damping cushion against vibration and mechanical shock. The filled sheath is then sealed with low temperature epoxies to prevent moisture penetration.

### Standard High Range (H) (-200 °C to 600) °C [-328 °F to 1112] °F

The element is welded to nickel leads that are insulated with compacted magnesium oxide (MgO) powder inside the stainless steel sheath. The void surrounding the element is packed with MgO powder and the sheath tip is welded closed with a stainless steel cap. The leads and sheath are sealed with low temperature epoxies to prevent moisture penetration.

## MECHANICAL SPECIFICATIONS

The following specifications are those found on standard construction RTD sensor assemblies.

### Sheath Materials

MATERIAL	CODE	APPLICATION DATA	NOTES
316 SS	8	Superior Corrosion Resistance	Used as standard sheath material on all but 1/16" OD sheaths
Inconel 600	3	Excellent Corrosion and Oxidation Resistance at High Temperatures	

### Sheath Mounting Fitting Dimensions

CODE	STYLE	SHEATH OD (Inches)	NPT SIZE (Inches)	LENGTH (Inches)
01A	303 SS one-time adjustable	1/16, 1/8, 3/16, 1/4	1/8	1 5/16
05A	316 SS one-time adjustable	1/16, 1/8, 3/16, 1/4	1/8	1 1/4
05B	316 SS one-time adjustable	1/8, 3/16, 1/4, 3/8	1/4	1 7/8
05C	316 SS one-time adjustable	1/8, 1/4, 3/8	1/2	1 13/16
15A	Brass one-time adjustable	1/8, 3/16, 1/4	1/8	1 1/4
15B	Brass one-time adjustable	3/16, 1/4, 3/8	1/4	1 3/8
15C	Brass one-time adjustable	1/4, 3/8	1/2	1 1/2
10A	303 SS re-adjustable	1/16, 1/8, 3/16	1/8	1 1/4
10B	303 SS re-adjustable	1/4, 3/8	1/4	2 7/16
10C	303 SS re-adjustable	1/4, 3/8	1/2	2 7/16
12A	316 SS re-adjustable	1/16, 1/8, 3/16, 1/4	1/8	1 1/4
12B	316 SS re-adjustable	1/8, 3/16, 1/4, 3/8	1/4	1 1/2
12C	316 SS re-adjustable	1/8, 1/4, 3/8	1/2	1 3/4
11A	Brass re-adjustable	1/16, 1/8, 3/16, 1/4	1/8	1 19/64
11B	Brass re-adjustable	1/8, 3/16, 1/4, 3/8	1/4	1 9/16
11C	Brass re-adjustable	1/4, 3/8	1/2	1 13/16
19C	303 SS spring-loaded well ftg.	3/16, 1/4	1/2	2 1/4
8A	316 SS fixed bushing	All sizes	1/8	5/8
8B	316 SS fixed bushing	All sizes	1/4	11/16
8C	316 SS fixed bushing	All sizes	1/2	15/16
8D	316 SS fixed bushing	All sizes	3/4	1
6HN	Steel hex fitting	1/8, 3/16, 1/4, 3/8	1/2	2
8HN	316 SS hex fitting	1/8, 3/16, 1/4, 3/8	1/2	2
8RND	316 SS reducing hex fitting	1/8, 3/16, 1/4, 3/8	1/2 x 3/4	2
9HNB	303 SS hex fitting	1/8, 3/16, 1/4, 3/8	1/4	1 3/16
13A	Fixed bayonet fitting	1/8, 3/16	N/A	1 5/8
14	Adjustable flange	1/8, 3/16, 1/4, 3/8	N/A	1 1/2
16A	Adjustable bayonet fitting	1/8	N/A	1 5/8

### Compression Fitting Pressure Rating Table

CODE	05A	05A, 05B 05C	05A, 05B	05A, 05B 05C	05B, 05C
Sheath O.D. & Wall Thickness	1/6" O.D. x 0.0077"	1/8" O.D. x 0.012"	3/16" O.D. x 0.020"	1/4" O.D. x 0.028"	3/8" O.D. x 0.049"
TEMPERATURE	MAXIMUM ALLOWANCE WORKING PRESSURE (PSIG)				
(-29 to 149) °C [-20 TO 300] °F	3300	2850	3150	3350	3900
204 °C [400 °F]	3200	2750	3050	3250	3800
260 °C [500 °F]	3000	2550	2850	3000	3500
316 °C [600 °F]	2800	2400	2700	2850	3300
371 °C [700 °F]	2700	2350	2600	2750	3200
427 °C [800 °F]	2650	2300	2550	2650	3100
482 °C [900 °F]	2600	2200	2450	2600	3050
538 °C [1000 °F]	2400	2100	2300	2450	2850

Calculations are based on the following criteria: 316 stainless steel sheath, ultimate tensile stress of 75000 PSI for seamless tube, Conservative Barlow Formula and safety factor of 4.0.

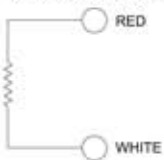


## ELEMENT CONNECTIONS

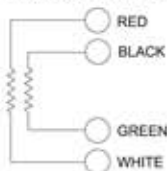
RTD sensor assemblies are available with two, three, and four wire leads. Two wire connected elements do not provide lead resistance compensation for the measuring device. Three and four wire connected elements provide a means for compensating for lead resistance between the sensor and the measuring device.

**Two-Wire:** Provides one connection to each end of the element. This construction is suitable where the resistance of the lead wire may be considered as an additive constant in the circuit, and particularly where the changes in lead resistance due to ambient temperature changes may be ignored.

### 2 WIRE SINGLE



### 2 WIRE DUPLEX

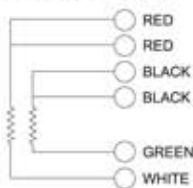


**Three-Wire:** Provides one connection to one end of the element and two to the other end of the element. Connected to an instrument designed to accept three wire input, sufficient compensation is usually achieved for leadwire resistance and temperature change in leadwire resistance. This is the most commonly used configuration.

### 3 WIRE SINGLE

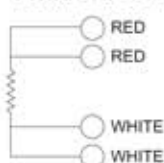


### 3 WIRE DUPLEX

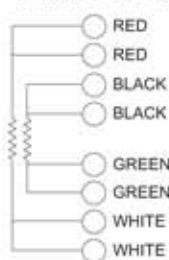


**Four-Wire:** Provides two connections to each end of the element to completely compensate for leadwire resistance and temperature change in leadwire resistance. This configuration is used where highly accurate temperature measurement is vital.

### 4 WIRE SINGLE



### 4 WIRE DUPLEX



## LEADWIRE RESISTANCE

Lead resistance has a large effect on RTD temperature measurement accuracy. A two wire circuit provides no compensation and can provide large measurement errors. The following table shows the effects of leadwire resistance on temperature measurements using low temperature RTD assemblies with copper leadwire.

### Leadwire Resistance

LEADWIRE WIRE GAUGE	RESISTANCE OHMS PER FOOT	UNCOMPENSATED 2-WIRE CIRCUITS	
		MAX. LENGTH FOR 1 °F ERROR	ERROR IN °F PER DOUBLE FT.
30	0.133	0.81 ft.	1.24 °F
24	0.0333	3.2 ft.	0.31 °F
22	0.0213	5.1 ft.	0.198 °F
20	0.0148	7.27 ft.	0.14 °F
18	0.0083	13.0 ft.	0.077 °F
16	0.0052	20.7 ft.	0.048 °F

### Leadwire Transition Fitting Dimensions

CODE	SHEATH DIAMETER (inches)	FITTING OD (inches)	FITTING LENGTH (inches)	
			WITH SPRING	W/O SPRING
15, 16, 19	1/8	1/4	2 1/4	1 1/4
15, 16, 19	1/8 [1]	3/8	2 1/2	1 1/4
15, 16, 19	3/16	3/8	2 1/2	1 1/4
15, 16, 19	1/4	3/8	2 1/2	1 1/4
15, 16, 19	3/8	7/16	2 1/4	1 1/2

[1] Used with flexible armor tubing and duplex RTD's

### Flexible Armor Tubing

DESCRIPTION	DIMENSIONS (inches)	MAX. TEMP RATING
304 SS Flexible Armored Tubing	0.188 ID x 0.275 OD	1600 °F
PVC Covered 304 SS Flexible Armored Tubing	0.188 ID x 0.343 OD	212 °F
Teflon® Covered 304 SS Flexible Armored Tubing	0.188 ID x 0.313 OD	400 °F