

# General Specifications

# Temperature Sensing Elements for Yokogawa Temperature Transmitters

GS 6B50A0-01E-A

## ■ GENERAL

In order for a temperature transmitter to function, the input to the transmitter must be provided by a temperature sensing element. The two most common types of temperature sensing elements being used in the industrial segment are the RTD (Resistance Temperature Detector) and the Thermocouple. There are over 400 manufacturers of temperature sensing elements. Many produce only the element, others purchase this element and package it for resale, and a few manufacture both the element and the complete sensor.

Yokogawa Corporation of America partners with Burns Engineering of Minnetonka, Minnesota. Burns is recognized as an industry leader for high quality, highly accurate temperature sensors. They have over 35 years of temperature sensor experience.

### RTD Advantages

- Provide stable output over wide temperature range
- Can be recalibrated to verify accuracy
- Offer long-term stability
- Follow a more linear curve than thermocouples
- Provide high sensitivity
- Provide accurate reading over narrow temperature spans

### Thermocouple Advantages

- Operate at temperatures over 1200°F
- Perform under extremely rugged applications
- Offer very fast response time to temperature changes
- Small size: sheath diameters can be less than 1/8" and as small as 0.001"
- Initial cost may be less in some applications

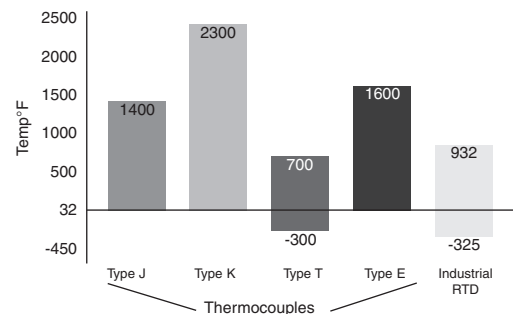
## ■ INTRODUCTION

The number of RTD's grows annually as a percentage of total temperature sales, according to reports from instrumentation surveys. Currently 57% of YTA transmitters sold require the addition of a temperature sensing element. Out of these elements sold, 92% are 100 ohm platinum RTDs.



## RTD and Thermocouple Ranges

The graph below shows the various temperature ranges for thermocouples and RTDs. The temperatures are shown in Fahrenheit.



## ■ PROTECTION (SHEATH MATERIALS)

The sensing element must be protected from its environment in a variety of ways. The most common sheath material is 316SS. For temperatures over 900°F, a sheath made of Inconel is recommended. Because of the minimal protection the sheath offers, thermowells are typically used in industrial applications. To ensure proper protection, review your assembly for the following.

- Mechanical protection such as pressure, flow or vibration
- Environmental protection from temperature, humidity and corrosion
- Electrical protection such as explosion proof, intrinsic safety or EMI/RFI interference

## ■ THERMOWELL TYPES

There are a variety of different thermowell configurations available. Yokogawa Corporation of America offers tapered and reduced tip wells as standard. They are available in threaded, welded and flanged process connections.

As a general guide, tapered wells provide greater stiffness for the same sensitivity. The higher strength to weight ratio provides these wells with a higher natural frequency than the equivalent length straight shank, which allows operation at higher fluid velocities. Reduced or stepped shank wells offer better response time to temperature fluctuations.

## ■ STEPPED THERMOWELLS

Pressure-Temperature Rating in lbs. per square inch

Material	Temperature-Fahrenheit						
	70	200	400	600	800	1000	1200
Brass	5000	4200	1000	—	—	—	—
Carbon Steel	5200	5000	4800	4600	3500	1500	—
AISI 304	7000	6200	5600	5400	5200	4500	1650
AISI 316	7000	7000	6400	6200	6100	5100	2500
Monel	6500	6000	5400	5300	5200	1500	—

## ■ TAPERED THERMOWELLS

Pressure-Temperature Rating in lbs. per square inch

Material	Temperature-Fahrenheit						
	70	200	400	600	800	1000	1200
Brass	5300	4750	1100	—	—	—	—
Carbon Steel	5950	5750	5450	5250	4000	1750	—
AISI 304	7800	7050	6400	6150	6000	5190	1875
AISI 316	7800	7800	7250	7100	6950	5800	2720
Monel	7450	6850	6150	6100	5940	1750	—

## ■ PRODUCT OFFERING

- TSE200 Wire Wound RTD
- TSE300 Thin Film RTD
- TSE100 Types J, K, E and T Thermocouples
- FM Approval Option (/AFM)
- Sanitary and Custom Configurations

Burns Engineering offers a type 'A' which is direct immersion and a type 'L' spring loaded sensor. Both have hex fittings on the top of the sensor which will allow for direct mounting to the YTA transmitter. This hex fitting also allows a coupling nipple, or union nipple extension to be attached. There are two sensors that are designed for use with connection heads. Type 'C', is a spring loaded sensor which is intended for use in connection heads 2 or 9. Type 'K', bayonet, is a twist-lock, spring loaded sensor which engages with the 5 explosion-proof connection head.

Type A & L:



Suitable for YTA or head mount

Type C:



Connection heads are available in polypropylene, aluminum or explosion proof and available with epoxy coating.

Type K:



For use with 5 head only

## RTD SPECIFICATIONS

### ■ TSE200 WIRE WOUND

**Element Resistance:** 100 ohms at 0°C nominal

**Temperature Coefficient of Resistance:** .00385 ohms/ohm/°C nominal, per IEC 751.

**Temperature range:** -200°C to 500°C

**Accuracy:** Available with Accuracy of ±.10% and ±.05% of resistance at 0°C with typical alpha accuracy of .00385 ±.000005 ohms/ohm/°C.

**Time constant:** Four seconds maximum for 63.2% response to step change in water moving at 3 fps.

**Repeatability:** Less than ±.04% change in ice point resistance after 10 consecutive cycles between -200 and 500°C.

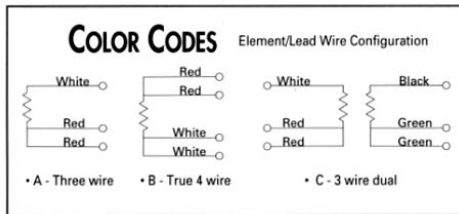
**Long term stability:** Less than ± .05% (± .13°C for a 100 ohm RTD) ice point resistance shift after 1000 hours at 400°C.

**Vibration resistance:** Less than ± .03% (± .075°C for a 100 ohm RTD) ice point shift for 30 minutes at 21g peak vibration; 5-350 Hz continuous sweep, at 20°C for unsupported stem lengths of 5-1/2 inches or less. Vibration resistance per ASTM procedure E644.

**Hysteresis:** .04% maximum between -200 and 500°C.

**Lead Wire:** Teflon™ insulated nickel-plated stranded copper, 22 AWG standard (24 AWG for dual).

**Sheath material:** High purity compacted ceramic insulation within 316 stainless steel sheath. Also available with Inconel™ 600 sheath.



### ■ TSE300 THIN FILM

**Element Resistance:** 100 ohms at 0°C nominal

**Temperature Coefficient of Resistance:** .00385 ohms/ohm/°C nominal, per IEC 751.

**Temperature range:** -50°C to 200°C

**Accuracy:** Available with Accuracy of ±.10% of resistance at 0°C with typical alpha accuracy of .00385 ±.0000135 ohms/ohm/°C.

**Time constant:** Six seconds maximum for 63.2% response to step change in water moving at 3 fps.

**Repeatability:** Less than ±.04% change in ice point resistance after 10 consecutive cycles between -50 and 200°C.

**Long term stability:** Less than ± .10% (± .26°C for a 100 ohm RTD) ice point resistance shift after 1000 hours at 200°C.

**Vibration resistance:** Less than ± .03% (.075°C for a 100 ohm RTD) ice point shift for 30 minutes at 21g peak vibration; 5-350 Hz continuous sweep, at 20°C for unsupported stem lengths of 5-1/2 inches or less. Vibration resistance per ASTM procedure E644.

**Hysteresis:** .08% maximum between -50 and 200°C.

**Lead Wire:** Teflon™ insulated nickel-plated stranded copper, 22 AWG standard (24 AWG for dual).

**Sheath material:** 316 stainless steel sheath is standard.

Note: Because of their intrinsic design, TSE200 wire wound RTDs will offer higher stability and accuracy than TSE300 thin film RTDs. TSE300 is the best choice for heavy-duty applications, where durability and economy are priorities.

### ■ TSE100

The TSE100 Thermocouples feature the same quality and reliability found in our high accuracy wire wound and thin film RTDs. The TSE100 features a proven, rugged design that utilizes mineral insulated bare wires in a metal sheath and special limits thermocouple wire (per ANSI MC 96.1) to ensure reliable performance. Design and construction details as well as associated temperature ranges for standard thermocouple types are outlined in the tables below.

Note: max. temperature of standard sealing material at cable/sheath transition is 200°C/392°F.

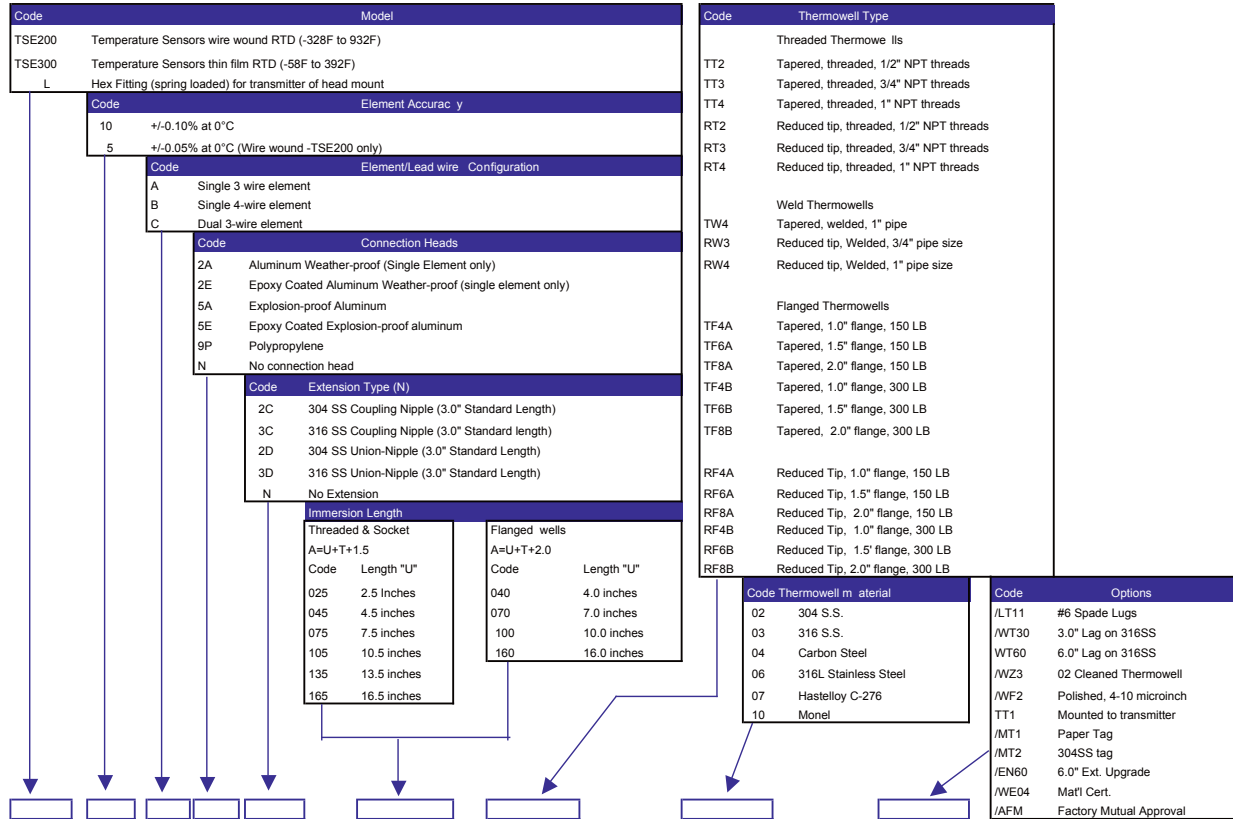
ANSI Thermocouple Type	Single element wire designations	Wire materials, generic and trade names	Magnetic	Sheath mat.	Lead wire color code	
					Individual wire insulator	Cable
T	TP TN	Copper Constantan	No No	316SS	Blue Red	Brown
J	JP JN	Iron Constantan	Yes No	316SS	White Red	Brown
E	EP EN	Chromel™ Constantan	No No	316SS	Purple Red	Brown
K	KP KN	Chromel™ Alumel™	No Yes	Inconel 600	Yellow Red	Brown

ANSI Thermocouple Type	Temperature Ranges	Special Limits (% applies to temperature measured in °C)
T	-200°C to -62.5°C (-328°F to -80.5°F) -62.5°C to 125°C (-80.5°C to 257°C) 125°C to 350°C (257°F to 662°F)	±0.8% ±0.5°C (±0.9°F) ±0.4%
J	0°C to 275°C (32°F to 527°F) 275°C to 750°C (527°F to 1382°F)	±1.1°C (±2.0°F) ±0.4%
E	-200°C to -170°C (-328°F to -274°F) -170°C to 125°C (-274°F to 257°F) 125°C to 870°C (257°F to 1598°F)	±0.8% ±0.5°C (±0.9°F) ±0.4%
K	0°C to 275°C (32°F to 527°F) 275°C to 1180°C (527°F to 2156°F)	±1.1°C (±2.0°F) ±0.4%

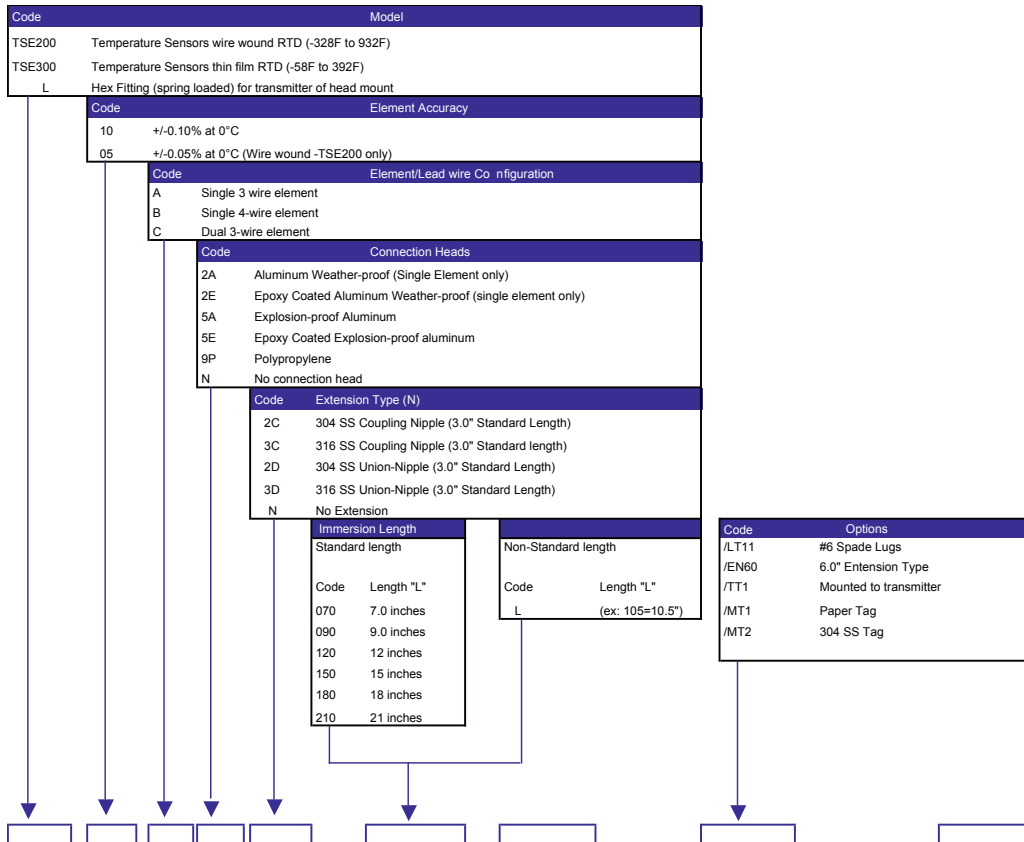
Sheath Diameter	Single Element AWG	Dual Element AWG
1/4"	16	18
3/16"	19	21
1/8"	22	24

**■ Certifications (AFM option):** FM Explosionproof approval Class I, Div I, Group B, C & D; Class II & III, Div I, Groups E, F & G. When attachment of FM approved sensor is required it must be to FM Explosion-proof transmitter or connection head (5A or 5E)

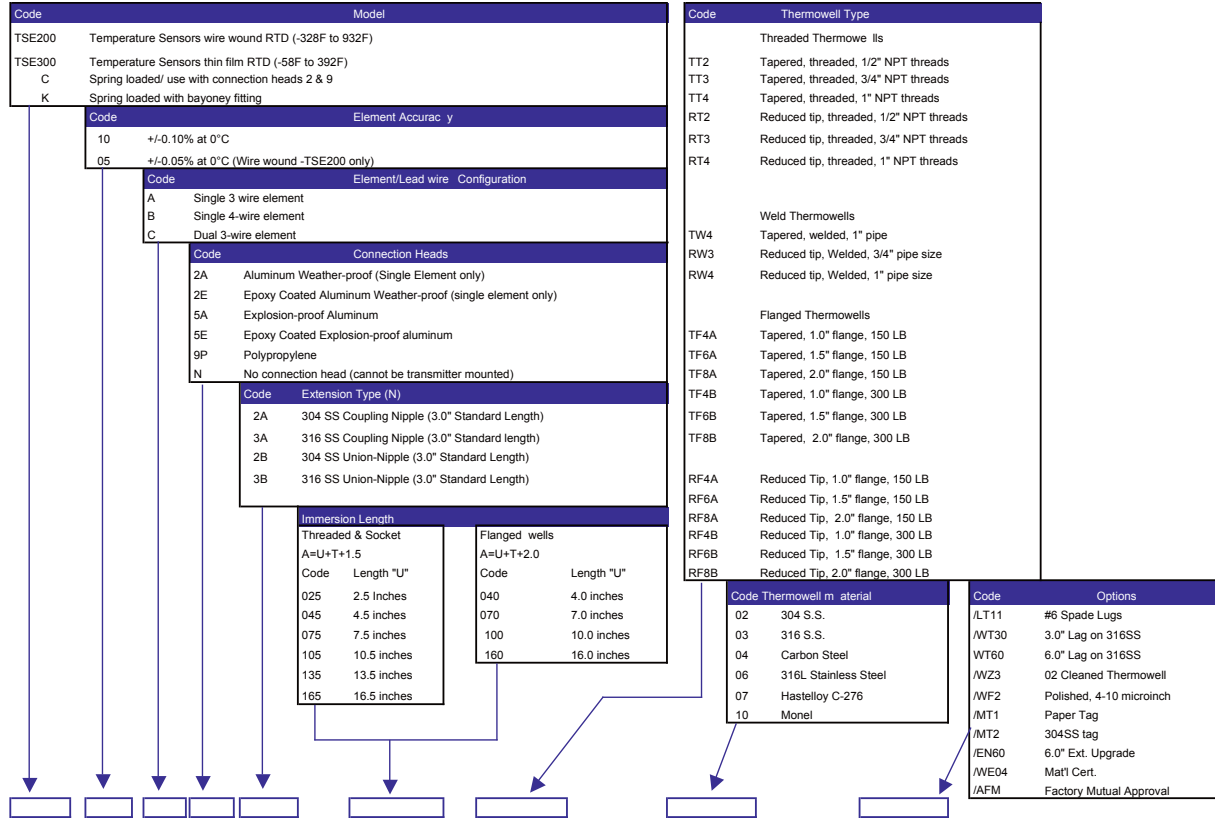
## TYPE L SPRING LOADED HEX FITTING PLATINUM RTD WITH THERMOWELL



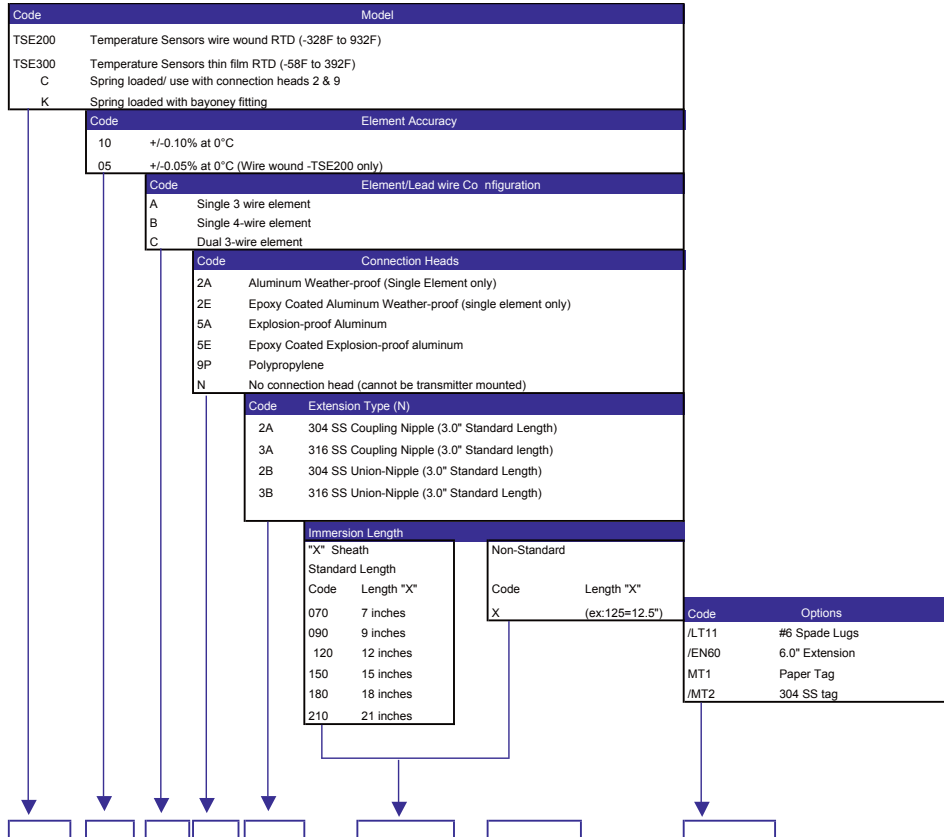
## TYPE L SPRING LOADED HEX FITTING PLATINUM RTD WITHOUT THERMOWELL



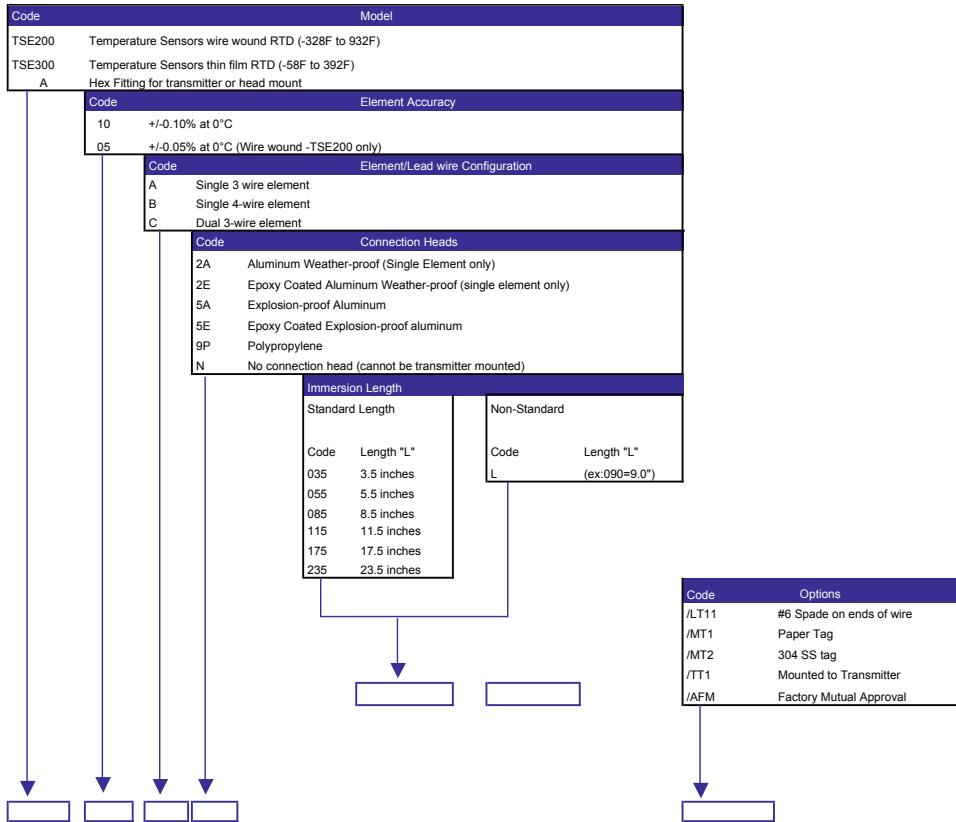
## TYPE C & K SPRING LOADED PLATINUM RTD WITH THERMOWELL



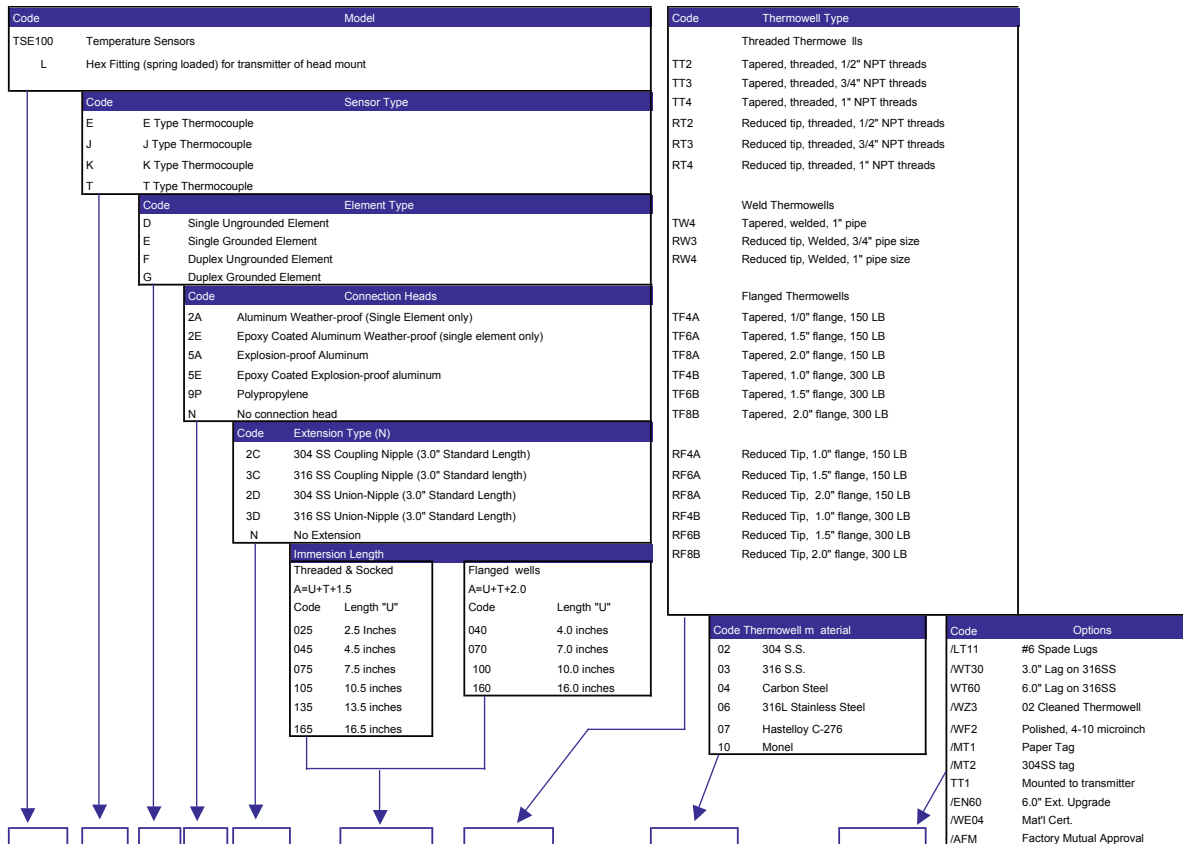
## TYPE C & K SPRING LOADED PLATINUM RTD WITHOUT THERMOWELL



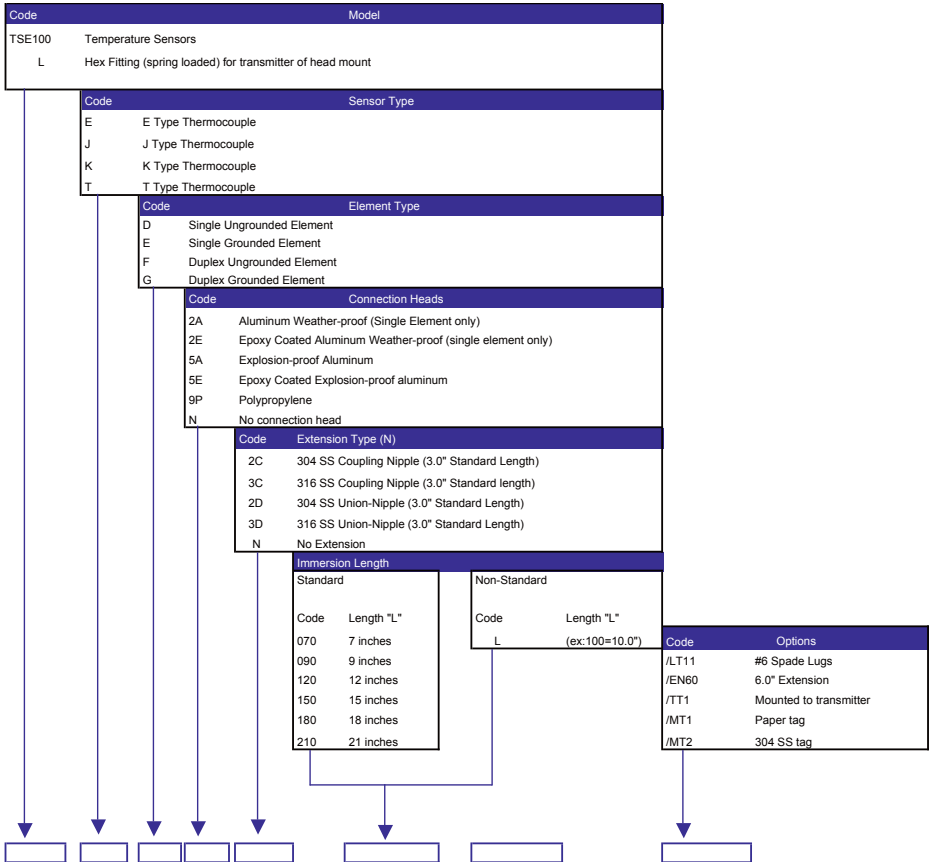
## TYPE A GENERAL PURPOSE DIRECT IMMERSION PLATINUM RTD



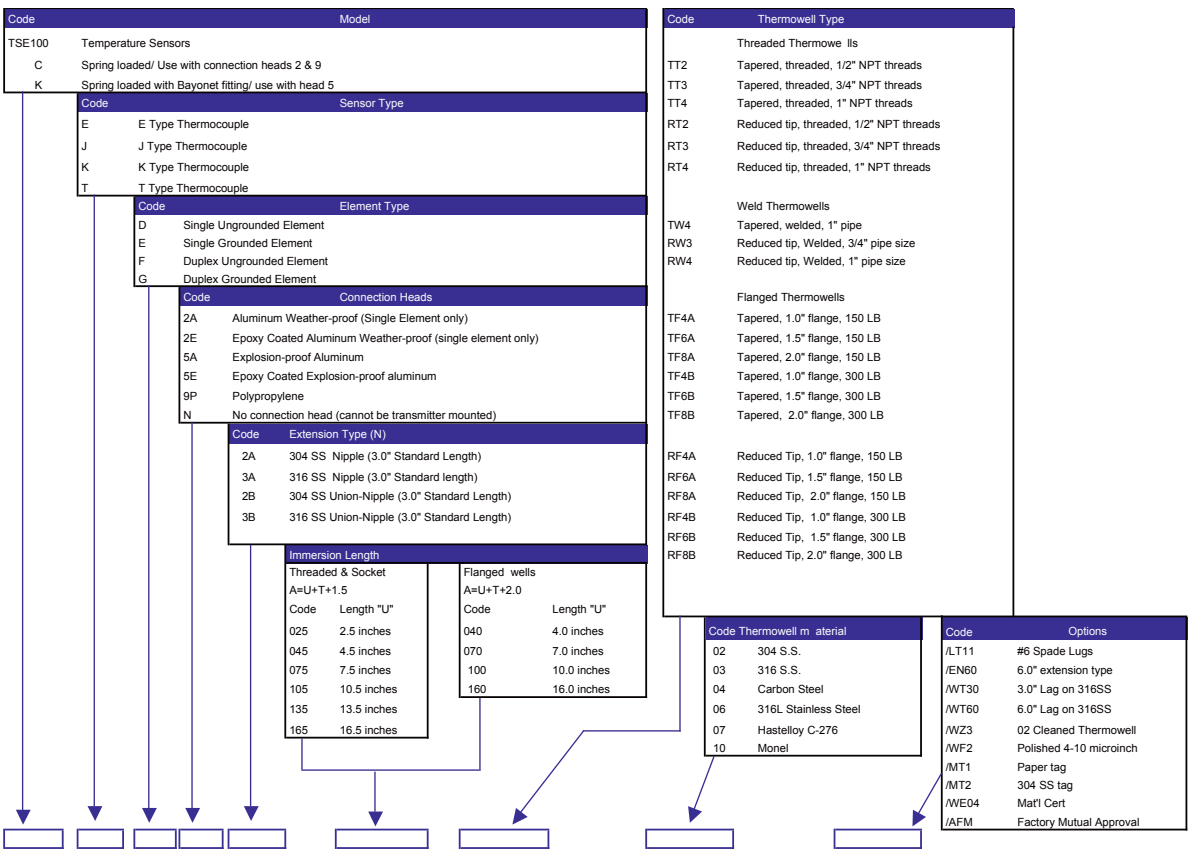
## TYPE L SPRING LOADED HEX FITTING THERMOCOUPLE WITH THERMOWELL



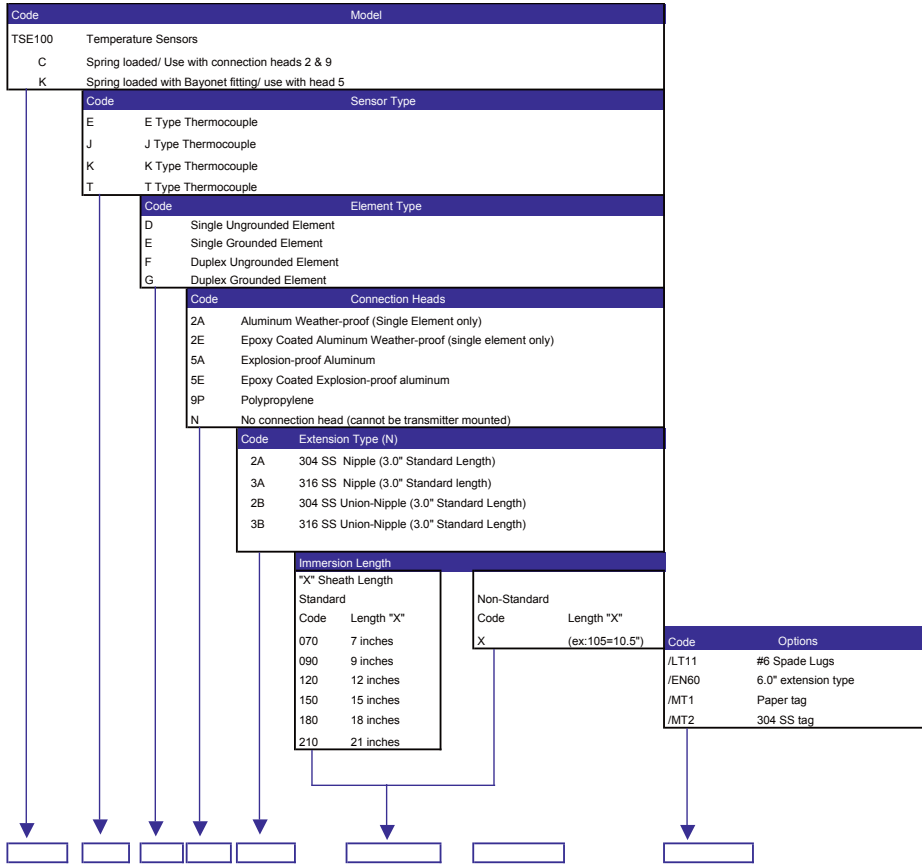
## TYPE L LOADED HEX FITTING THERMOCOUPLE WITHOUT THERMOWELL



## TYPE C & K SPRING LOADED THERMOCOUPLE WITH THERMOWELL



## TYPE C & K SPRING LOADED THERMOCOUPLE WITHOUT THERMOWELL



## TYPE A GENERAL PURPOSE DIRECT IMMERSION THERMOCOUPLE

