

# SERV-RITE Wire and Cable

## Thermocouple and Thermocouple Extension Wire

### Technical Data

The following pages contain SERV-RITE wire technical data. This information covers ASTM E 230 letter designations and tolerances, color coding, stranded and solid constructions, selection considerations, how to read SERV-RITE wire product code numbers, metallic overbraid and wrap options, insulation or "Series," constructions and characteristics.

If you are unable to locate the stock product specifications required by your application, Watlow Gordon can custom manufacture a wire to meet your needs.

### Calibration and Certification

SERV-RITE thermocouple wire and elements can be factory calibrated and certified at an extra charge. Each thermocouple, coil, reel or spool of wire is then tagged to show the individual departure from curve. Once calibrated, their exact departure from the standard curve at any specified temperature is known and can be taken into account. Thermocouples and wire samples sent to the factory for calibrating must be at least 36 inches long.

The standard calibrating temperature points range from 32 to 2300°F (0 to 1260°C), depending on calibration, gauge size and insulation. Sub-zero and cryogenic calibration is available at fixed points, such as boiling helium, nitrogen and sublimated carbon dioxide, including temperatures down to -110°F (-80°C).

A certificate of calibration is furnished for all calibrated items. Each item calibrated is also tagged with the results.

### Common Certifications for Wire

The following standard certifications are available from Watlow Gordon. Requirements for these certifications must be stated on the order.

#### Certificate #1 - Certificate of Compliance/Conformity

This certification states that product is being supplied which meets the requirements of the purchase order.

#### Certificate #2 - Certificate of Compliance to ASTM E 230 Tolerance

This certification states that product is being supplied which meets the requirements of the purchase order, including the correct calibration type and tolerance.

This certification is also used when conformance to ASTM E 230 must be documented.

#### Certificate #3 - Certificate of Conformance to MIL Standard 45662A

This certificate is used to certify that our calibration system is in accordance with MIL-STD 45662A.

#### Certificate #4 - Certificate of Traceability to NIST

This certification is used to certify that the materials they receive is traceable to NIST via calibration data of the thermoelements used to manufacture the product.

#### Certificate #6 - Certificate of Calibration at Standard Calibration Points

This is a calibration certification offering the preproduction calibration values of the insulated wire product at the standard calibration check points.

#### Certificate #7A - Chemical and Physical Analysis of conductors in insulated wire products

This certification offers the nominal chemical composition of the alloy used in the insulated wire products.

#### Certificate #8 - Certificate of Calibration at Specified Temperatures

This is a calibration certification when post-production calibration data is desired. Calibration is performed in the Watlow calibration laboratory with NIST traceable calibration standards. In addition to the calibration data, the test standard, equipment, NIST traceability, and reference to applicable calibration procedures are stated.

**Note: Custom certifications are available upon request.**

#### SERV-RITE Wire Standard Calibration Temperatures

Calibration	Standard Calibration Points °F*
E	300, 500, 1000, 1600
J	200, 500, 1000, 1400
K	300, 500, 1000, 1600, 2000
N	300, 500, 1000, 1600, 2000
T	200, 500
BX	212, 400
CX	200, 300, 400, 500
EX	200, 400
JX	200, 400
KX	200, 300, 400
NX	200, 300, 400
RX	400
SX	400
TX	200, 400

\* Calibration not made when temperature exceeds wire insulation rating.

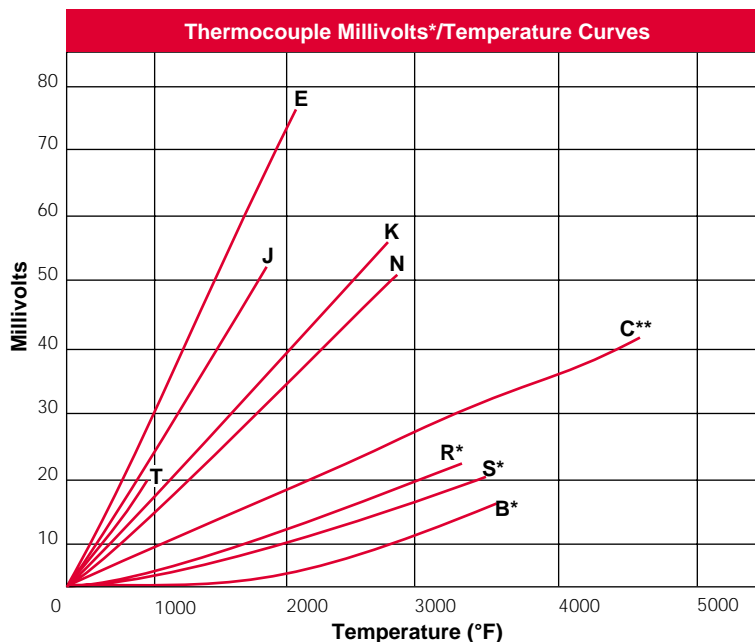
# SERV-RITE Wire and Cable

## Thermocouple and Thermocouple Extension Wire

### Technical Data

#### Calibration and Certification

Continued



ASTM E 230  
Symbol  
B\*  
C\*\*  
E  
J  
K  
N  
R\*  
S\*  
T

\*Millivolt values shown for C, R, S and B calibrations pertain to thermocouple calibrations only. RX, SX and BX constructions described in this catalog section are intended for use as **extension wire only** and will not exhibit the millivolt outputs shown.

\*\*Not an ASTM E 230 Symbol—Tungsten 5% Rhenium/Tungsten 26% Rhenium.

### ASTM E 230 Letter Designations

Thermocouple and extension wires are generally ordered and specified by ASTM E 230 letter designations for wire type. Positive and negative legs are identified by the appropriate letter suffixes P and N, respectively.

ASTM E 230 Letter	Description	Thermocouple Grade Alloys	Extension or Compensating Grade Alloys
B	BP BN	Platinum 30% Rhodium Platinum 6% Rhodium	BPX-PCLW-30-6 Copper
C*	CP CN	W5Re (Tungsten 5% Rhenium) W26Re (Tungsten 26% Rhenium)	Alloy 405 Alloy 426
E	EP EN	Chromel® Constantan	Chromel® Constantan
J	JP JN	Iron Constantan	Iron Constantan
K	KP KN	Chromel® Alumel®	Chromel® Alumel®
N	NP NN	Nicrosil Nisil	Nicrosil Nisil
R	RP RN	Platinum 13% Rhodium Pure Platinum	Copper #11 Alloy
S	SP SN	Platinum 10% Rhodium Pure Platinum	Copper #11 Alloy
T	TP TN	Copper Constantan	Copper Constantan

\* Not an ASTM E 230 symbol.

Note: Watlow Gordon reserves the right to substitute equivalent materials.

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# SERV-RITE Wire and Cable

## Thermocouple and Thermocouple Extension Wire

### Technical Data

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#### ASTM E 230 Tolerances

Unless otherwise specified, all SERV-RITE thermocouple wire and extension wire is supplied to meet Standard Tolerances of ASTM E 230. Special Tolerances are also available. The standard and special tolerances for thermocouple and extension wires are given in the accompanying tables. Where tolerances are given in percent, the percentage applies to the temperature being measured.

### Initial Calibration Tolerances for SERV-RITE Wire And Cable

Reference Junction 32°F (0°C)

Calibration Type	Temperature Range °F (°C)		Tolerances (whichever is greater)			
			Standard (°C)		Special (°C)	
<b>Thermocouples</b> ① ③						
B	1600 to 3100	(870 to 1700)	②	(±0.5%)	②	(±0.25%)
E	32 to 1600	(0 to 870)	②	(±1.7 or ±0.5%)	②	(±1.0 or ±0.4%)
J	32 to 1400	(0 to 760)	②	(±2.2 or ±0.75%)	②	(±1.1 or ±0.4%)
K or N	32 to 2300	(0 to 1260)	②	(±2.2 or ±0.75%)	②	(±1.1 or ±0.4%)
R or S	32 to 2700	(0 to 1480)	②	(±1.5 or ±0.25%)	②	(±0.6 or ±0.1%)
T	32 to 700	(0 to 370)	②	(±1.0 or ±0.75%)	②	(±0.5 or ±0.4%)
E <sup>④</sup>	-328 to 32	(-200 to 0)	②	(±1.7 or ±1%)	②	⑤
K <sup>④</sup>	-328 to 32	(-200 to 0)	②	(±2.2 or ±2%)	②	⑤
T <sup>④</sup>	-328 to 32	(-200 to 0)	②	(±1.0 or ±1.5%)	②	⑤
<b>Extension Wires</b> ⑥ ⑦						
EX	32 to 400	(0 to 200)	±3.0	(±1.7)	±1.8	(±1.0)
JX	32 to 400	(0 to 200)	±4.0	(±2.2)	±2.0	(±1.1)
KX or NX	32 to 400	(0 to 200)	±4.0	(±2.2)	±2.0	(±1.1)
TX	32 to 200	(0 to 100)	±1.8	(±1.0)	±0.9	(±0.5)
<b>Compensating Extension Wires</b> ⑧ ⑨						
BX <sup>®</sup>	32 to 400	(0 to 200)	±7.6	(±4.2)	*	*
CX	32 to 500	(0 to 260)	±12.2	(±6.8)	*	*
RX, SX	32 to 400	(0 to 200)	±9.0	(±5.0)	*	*

① Tolerances in this table apply to new essentially homogeneous thermocouple wire, normally in the size range 0.25 to 3 mm in diameter (No. 30 to No. 8 AWG) and used at temperatures not exceeding the recommended limits on page 177. If used at higher temperatures these tolerances may not apply.

② At a given temperature that is expressed in °C, the tolerance expressed in °F is 1.8 times larger than the tolerance expressed in °C. Note: Wherever applicable, percentage-based tolerances must be computed from temperatures that are expressed in °C.

③ **Caution:** Users should be aware that certain characteristics of thermocouple materials, including the EMF vs. temperature relationship may change with time in use; consequently, test results and performance obtained at time of manufacture may not necessarily apply throughout an extended period of use. Tolerances given above apply only to new wire as delivered to the user *and do not allow for changes in characteristics with use*. The magnitude of such changes will depend on such factors as wire size, temperature, time of exposure and environment. It should be further noted that due to possible changes in homogeneity, attempting to recalibrate *used* thermocouples is likely to yield irrelevant results, and is not recommended. However, it may be appropriate to compare used thermocouples *in-situ* with new or known good ones to ascertain their suitability for further service under the conditions of the comparison.

④ Thermocouples and thermocouple materials are normally supplied to meet the tolerances specified in the table for temperatures above 0°C. The same materials, however, may not fall within the tolerances given for temperatures below 0°C in the second section of the table. If materials are required to meet the tolerances stated for temperatures below 0°C the purchase order must so state. Selection of materials usually will be required.

⑤ Special tolerances for temperatures below 0°C are difficult to justify due to limited available information. However, the following values for Types E and T thermocouples are suggested as a guide for discussion between purchaser and supplier: *Type E:* -200 to 0°C ±1.0°C or ±0.5% (whichever is greater); *Type T:* -200 to 0°C ±0.5 or ±0.8% (whichever is greater).

Initial values of tolerance for Type J thermocouples at temperatures below 0°C and special tolerances for Type K thermocouples below 0°C are not given due to the characteristics of the materials.

⑥ Tolerances in the table represent the maximum error contribution allowable from new and essentially homogeneous thermocouple extension wire when exposed to the full temperature range given above. Extension grade materials are not intended for use outside the temperature range shown.

⑦ Thermocouple extension wire makes a contribution to the total thermoelectric signal that is dependent upon the temperature difference between the extreme ends of the extension wire length. The actual magnitude of any error introduced into a measuring circuit by homogeneous and correctly connected extension wires is equal to the algebraic difference of the deviations at its two end temperatures, as determined for that extension wire pair.

⑧ Tolerances in the table apply to new and essentially homogeneous thermocouple compensating extension wire when used at temperatures within the range given above.

⑨ Thermocouple compensating extension wire makes a contribution to the total thermoelectric signal that is dependent upon the temperature difference between the extreme ends of the compensating extension wire length.

⑩ Special compensating extension wires are not necessary with Type B over the limited temperature range 32 to 125°F (0 to 50°C), where the use of non-compensated (copper/copper) conductors introduces no significant error. For a somewhat larger temperature gradient of 32 to 210°F (0 to 100°C) across the extension portion of the circuit, the use of non-compensated (copper/copper) extension wires may result in small errors, the magnitude of which will not exceed the tolerance values given in the table above for measurements above 1800°F (1000°C). Proprietary alloy compensating extension wire is available for use over 32 to 400°F (0 to 200°C) temperature range.

\* Special tolerance grade compensating extension wires are not available.

## SERV-RITE Wire and Cable

### Thermocouple and Thermocouple Extension Wire

#### Technical Data

Continued

#### International Standards

SERV-RITE wire and cable complies with international standards and tolerances in both standard and special limits.

#### United States and International Color Coding

Standard ASTM E 230 color coding (United States) is used on all insulated thermocouple wire and extension wire when type of insulation permits. In color coding, the right is reserved to include a tracer to identify the ASTM E 230 type. Thermocouple grade wire normally has a brown overall jacket. For Types B, R and S the color codes relate to the compensating cable normally used. Additionally, various national and international standard agencies have adopted color codes for the identification of thermocouple wire and products. These generally differ from those used by ASTM E 230.

#### Thermocouple and Extension Wire Color Codes

Overall/Positive (+)/Negative (-)

T/C Type	ASTM E 230 T/C	ASTM E 230 Extension	UK BS 1843	Germany DIN 43710	Japan JIS C1610-1981	IEC 584-3
B (overall)	—	Grey	—	Grey	Grey	—
BP	—	+Grey	—	+Red	+Red	—
BN	—	-Red	—	-Grey	-White	—
E (overall)	Brown	Purple	Brown	Black	Purple	Violet
EP	+Purple	+Purple	+Brown	+Red	+Red	+Violet
EN	Red-	-Red	-Blue	-Black	-White	-White
J (overall)	Brown	Black	Black	Blue	Yellow	Black
JP	+White	+White	+Yellow	+Red	+Red	+Black
JN	-Red	-Red	-Blue	-Blue	-White	-White
K (overall)	Brown	Yellow	Red	Green	Blue	Green
KP	+Yellow	+Yellow	+Brown	+Red	+Red	+Green
KN	-Red	-Red	-Blue	-Green	-White	-White
N (overall)	Brown	Orange	—	—	—	—
NP	+Orange	+Orange	—	—	—	—
NN	-Red	-Red	—	—	—	—
R (overall)	—	Green	Green	—	Black	Orange
RP	—	+Black	+White	—	+Red	+Orange
RN	—	-Red	-Blue	—	-White	-White
S (overall)	—	Green	Green	White	Black	Orange
SP	—	+Black	+White	+Red	+Red	+Orange
SN	—	-Red	-Blue	-White	-White	-White
T (overall)	Brown	Blue	Blue	Brown	Brown	Brown
TP	+Blue	+Blue	+White	+Red	+Red	+Brown
TN	-Red	-Red	-Blue	-Brown	-White	-White

SERV-RITE Wire and Cable



See colored version on the inside back cover.

# SERV-RITE Wire and Cable

## Thermocouple and Thermocouple Extension Wire

### Technical Data

Continued

#### **Solid and Stranded Conductors**

Thermocouple wire and extension wire are usually solid conductors. When greater flexibility is required, either may be ordered in stranded construction.

Stranded wire is specified when flexibility is a major concern. It is manufactured by using several smaller gauge strands grouped together to form the desired gauge size. This is accomplished by twisting the smaller gauge wires together. The twisting also adds to the flexibility of the wire.

The most widely used stranding combination consists of seven small strands. This yields a fairly round construction and allows the use of various connection systems that are designed for round solid wires. SERV-RITE wire's standard items use this seven strand construction.

While most stranded wire is specified for its flexibility, there is another less common reason for its use. When a very specific resistance is required, the stranded conductors allow "fine tuning" the finished conductor's resistance. By replacing fine wires with slightly larger wires, the conductor's resistance can be adjusted to within a few percent of any given target resistance.

When flexibility or resistance are of prime concern, SERV-RITE wire or cable can be designed for your particular application.

### Conductor Sizes

Wire Size B & S Gauge	Solid		Stranded			
	Diameter		Diameter		Number of Strands	Strand Gauge
inch	(mm)	inch	(mm)			
14	0.064	(1.630)	0.076	(1.930)	7	22
16	0.051	(1.290)	0.060	(1.520)	7	24
18	0.040	(1.020)	0.048	(1.220)	7	26
20	0.032	(0.813)	0.038	(0.965)	7	28
22	0.025	(0.635)	0.030	(0.762)	7	30
24	0.020	(0.508)	0.024	(0.610)	7	32
26	0.016	(0.406)				
28	0.013	(0.330)				
30	0.010	(0.254)				
32	0.008	(0.203)				
34	0.006	(0.152)				
36	0.005	(0.127)				

#### **Ohms per Double Feet**

The use of analog based instrumentation, make conductor resistance an important consideration in selecting the wire gauge best suited for your

application. The table below lists the nominal ohms per double feet for thermocouple and thermocouple extension wire. Ohms per double feet is the total resistance, in ohms, for both conductors, per foot.

#### **Nominal Resistance for Thermocouple Alloys in Ohms per Double Feet at 20°C**

B & S Gauge	Diameter		BX	CX*	E	J	K	N	RX,SX	T
	inch	(mm)								
2	0.258	(6.543)			0.011	0.006	0.009	0.012		
4	0.204	(5.189)			0.017	0.009	0.014	0.019		
6	0.162	(4.115)			0.028	0.014	0.023	0.030		
8	0.129	(3.264)			0.044	0.023	0.036	0.048		
10	0.102	(2.588)			0.070	0.036	0.058	0.077		
12	0.081	(2.053)	0.015	0.058	0.111	0.057	0.092	0.123	0.006	0.048
14	0.064	(1.630)	0.024	0.093	0.177	0.091	0.147	0.195	0.010	0.076
16	0.051	(1.290)	0.039	0.147	0.281	0.145	0.233	0.310	0.016	0.120
18	0.040	(1.020)	0.063	0.238	0.453	0.234	0.376	0.500	0.025	0.194
20	0.032	(0.813)	0.098	0.372	0.709	0.367	0.589	0.783	0.040	0.304
22	0.025	(0.645)	0.156	0.592	1.129	0.584	0.937	1.245	0.063	0.483
24	0.020	(0.508)	0.248	0.941	1.795	0.928	1.490	1.980	0.100	0.768
26	0.016	(0.406)	0.395	1.495	2.853	1.476	2.369	3.148	0.159	1.221
28	0.013	(0.320)	0.628	2.378	4.537	2.347	3.767	5.006	0.253	1.942
30	0.010	(0.254)	0.999	3.781	7.214	3.731	5.990	7.960	0.402	3.088
32	0.008	(0.203)	1.588	6.012	11.470	5.933	9.524	12.656	0.639	4.910
34	0.006	(0.152)	2.525	9.560	18.239	9.434	15.145	20.126	1.016	7.808
36	0.005	(0.127)	4.015	15.200	29.000	15.000	24.080	32.000	1.615	12.415
14 Stranded	0.076	(1.930)	0.022	0.085	0.161	0.083	0.134	0.178	0.009	0.069
16 Stranded	0.060	(1.520)	0.035	0.134	0.256	0.133	0.213	0.283	0.014	0.110
18 Stranded	0.048	(1.220)	0.056	0.214	0.408	0.211	0.338	0.450	0.023	0.174
20 Stranded	0.038	(0.965)	0.090	0.340	0.648	0.335	0.538	0.715	0.036	0.277
22 Stranded	0.030	(0.762)	0.143	0.540	1.031	0.533	0.856	1.137	0.057	0.441
24 Stranded	0.024	(0.610)	0.227	0.859	1.639	0.848	1.361	1.808	0.091	0.701

\*Not an ASTM E 230 symbol

## SERV-RITE Wire and Cable

### Thermocouple and Thermocouple Extension Wire

#### Technical Data

Continued

#### How to Select Wire to Suit Your Requirements

The following information will acquaint you with some of the nomenclature involved with thermocouple wire and thermocouple extension wire. By spending a few minutes reading this information orders can be placed quickly and accurately.

#### Thermocouple Wire or Thermocouple Extension Wire

There are some significant differences between the wire used to actually measure temperature and the wire used to carry the millivoltage signal to an instrument.

The most obvious difference is the color-code used to identify the wire itself. In most cases, thermocouple grade wire is identified by its overall brown color. The exceptions in the SERV-RITE wire product line are the very high temperature yarns such as those used in the Series 301 and 350. Of course, the overall color code is not used when there is no overall covering as in SERV-RITE wire Series 505, 511 and 314.

The working differences between the two wires is that the thermocouple "extension" wire is not calibrated above 400°F (204°C). The temperature rating of the insulations used on some extension grade wire exceeds this 400°F temperature. This is to allow the wire to survive occasional contact with hot parts or furnace walls.

This catalog lists certain specific insulations for thermocouple and extension grade wire. However, virtually any of SERV-RITE wire insulation systems can be applied to either thermocouple or extension wire.

The following explains the meanings of the terms used in the tables of this section.

#### Single Conductor Insulation

This item identifies the type of insulation used on the individual thermoelements. Certain part numbers use a combination of insulations. When there is a combination, the insulations are listed in their order of application.

#### Duplex Conductor Insulation

This item lists the overall insulation when one is used. Some constructions which have no overall insulation use this area to describe the duplexing method—i.e. twisting, "ripcord", etc.

#### Temperature Rating

Most constructions are rated for both continuous use and for single reading applications. The continuous use temperature is considered to be the highest temperature at which that particular construction will survive indefinitely. The single reading temperature has been determined by actual tests. Each insulation system will perform differently when exposed to this temperature. Generally, the construction will perform at this temperature and produce an accurate reading. However, after exposure to this temperature, the wire will exhibit less flexibility and/or abrasion resistance. Because of this, it is unlikely that the wire could be removed from the application and then replaced after exposure to the "single reading temperature."

#### Recommended Upper Temperature Limit for Protected Thermocouple Wire

Thermocouple Type	No. 8 Gauge °F (°C)	No. 14 Gauge °F (°C)	No. 20 Gauge °F (°C)	No. 24 Gauge °F (°C)	No. 28 Gauge °F (°C)
E	1600 (870)	1200 (650)	1005 (540)	805 (430)	805 (430)
J	1400 (760)	1095 (590)	895 (480)	700 (370)	700 (370)
K and N	2300 (1260)	1995 (1090)	1795 (980)	1600 (870)	1600 (870)
T		700 (370)	500 (260)	395 (200)	395 (200)

Table courtesy of ASTM.

# SERV-RITE Wire and Cable

## Thermocouple and Thermocouple Extension Wire

### Technical Data

#### How to Select Wire to Suit Your Requirements

Continued

#### ASTM E 230 Color Code

Generally, SERV-RITE wire has color codes wherever possible. The exceptions are the high temperature yarn constructions such as the 301 and 350 Series. Color coding of the 511 and 512 Series is accomplished by including a colored thread or "tracer" under the tape.

#### Physical Properties

**Abrasion Resistance** is rated fair, good, or excellent and is based on the wall thickness of the construction and how well it survives with other insulations of similar thicknesses. The 511 Series receives an excellent rating because the thin wall of polyimide tape will survive better than almost any other insulation applied in the same wall thickness.

The "absolute" abrasion resistance of a construction will depend not only on the type of insulation but on thickness at which it is applied.

**Moisture Resistance** ratings are given for the wire in the "as received" condition. In the case of fiberglass insulated wire, the moisture resistance is achieved by the use of impregnations or spirally applied tapes called moisture barriers. The impregnations and/or tapes will burn off at temperatures below the upper useful operating temperatures of the fiberglass. The thermoplastic insulations (PVC and the fluoroplastics) and the polyimide insulated constructions will maintain their moisture resistance up to their "continuous" temperature rating.

**Chemical Resistance** ratings are given as they relate to most common chemicals. These ratings apply to the insulation types and not necessarily to the type of impregnation used. Consult factory for specific applications.

#### UL® Listed PLTC Wire And Cable

Watlow Gordon offers UL® listed SERV-RITE thermocouple and extension wire and cable for PLTC (Power Limited Tray Cable) applications. The following insulation Series have these approvals:

- 502
- 507
- 509
- 510
- 900
- 1000

All these insulation Series have the following physical characteristics:

- UL® listed Type PLTC—300 Volt
- Passes IEEE 383 70,000 BTU/Hr flame test
- Passes VW-1 flame test
- UL® listed under Subject 13
- Non-propagating
- Flame retardant
- UV light resistant

#### How to Read SERV-RITE Wire Code Numbers

Product code numbers for SERV-RITE wire are made up of three sets of figures separated by slashes. These figures convey the following data:

- The first set consists of a letter and two numerals. The letter is the ASTM E 230 Type designation for wire type. The numerals signify the wire B&S gauge.
- The second set consists of a single number. For thermocouple wire, 1 indicates solid, while 3 indicates stranded. For extension wire, 5 indicates solid, while 7 indicates stranded. The use of ODD numbers also indicates that the wire is manufactured to Standard Tolerances. If Special

Tolerances are desired, this figure MUST be changed to the next higher EVEN digit when ordering.

- The third set consists of three numerals signifying SERV-RITE wire insulation type or "Series."

#### Example:

1 2 3 4 5 6 7  
K 2 0 / 1 / 3 0 4

1. ASTM E 230 Letter Designation (Calibration)

2-3. B & S Gauge

4. Conductor Type/Tolerance

- 1 = Thermocouple grade, solid wire, standard tolerance
- 2 = Thermocouple grade, solid wire, special tolerance
- 3 = Thermocouple grade, stranded wire, standard tolerance
- 4 = Thermocouple grade, stranded wire, special tolerance
- 5 = Extension grade, solid wire, standard tolerance
- 6 = Extension grade, solid wire, special tolerance
- 7 = Extension grade, stranded wire, standard tolerance
- 8 = Extension grade, stranded wire, special tolerance

5-7. Insulation Type (Series)

## SERV-RITE Wire and Cable

### Thermocouple and Thermocouple Extension Wire

#### Technical Data Metallic Overbraids and Wraps

Continued

Although standard SERV-RITE wire products are designed to yield a high degree of abrasion resistance, it is sometimes necessary to add an additional metallic covering to further enhance this property. The following are the available overbraids and wraps.

#### Stainless Steel Wire Braid (S)

This, the most popular of the overbraids, uses 300 series stainless steel and is available on virtually all standard SERV-RITE wire offerings. It is an economical method of extending the life of thermocouple and extension wire. Several of our standard wire items are available from stock with a stainless overbraid. Non-stock items are available on a special order basis.

#### Alloy 600 Wire Braid (N)

Most commonly specified on high temperature SERV-RITE wire yarn insulations, the Inconel braid offers a higher operating temperature than the series 300 stainless steel overbraid. When this braid is specified on SERV-RITE's Series 350 the performance of the material is only surpassed by metal-sheathed cables. Consult factory for availability on specific wire items.

#### Tinned Copper Wire Overbraid (C)

When there is a possibility of electrical interference in the area of the thermocouple installation, it may be necessary to shield the wire from electrical "noise." Several of our standard products use aluminized tapes as an intrinsic shield. However, when shielding is needed on other constructions, a tinned copper shield can be specified on special order.

#### Half Oval Galvanized Wrap and Stainless Steel Spiral Wrap (G) or (W)

Certain constructions are available with a spirally applied galvanized or stainless steel wrap. The wrap yields a tough mechanical coating that survives well in most outdoor applications. Consult factory for the availability on specific catalog items. To add a metallic overbraid or wrap, insert the letter designator as follows:

#### How to Select Wire

##### Code Number

##### 1. ASTM E 230 Calibration<sup>Ⓛ</sup>

B J S  
C\* K T  
E N

##### 2-3. B & S Gauge

14 to 36

##### 4. Conductor Type/Tolerance<sup>Ⓜ</sup>

- 1 = Thermocouple grade, solid wire, standard tolerance
- 2 = Thermocouple grade, solid wire, special tolerance
- 3 = Thermocouple grade, stranded wire, standard tolerance
- 4 = Thermocouple grade, stranded wire, special tolerance
- 5 = Extension grade, solid wire, standard tolerance
- 6 = Extension grade, solid wire, special tolerance
- 7 = Extension grade, stranded wire, standard tolerance
- 8 = Extension grade, stranded wire, special tolerance

##### 5. Metallic Overbraids (optional)

S = Stainless steel  
N = Alloy 600  
C = Tinned copper

##### 6-8. Insulation Series

Refer to Insulation chart below.

##### 9-11. Color Code

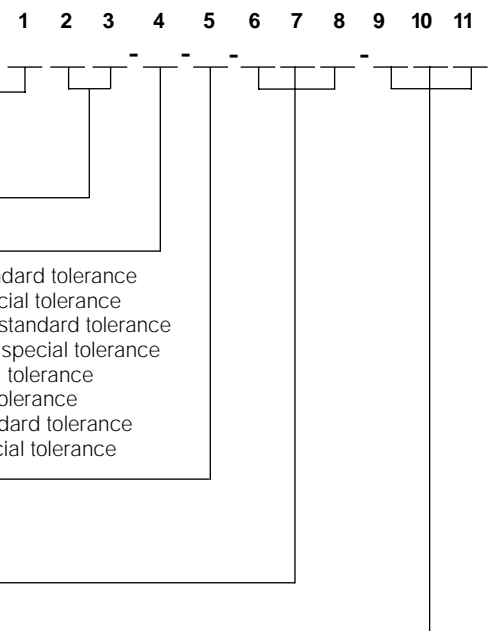
Blank = ASTM E 230 (formally ANSI MC96.1)  
BSC = BS 1843  
DIN = DIN 43710  
JIS = JIS C 1610-1981  
IEC = IEC 584-3

\*Not an ASTM E 230 symbol.

<sup>Ⓛ</sup> Color coding will be to ASTM E 230 standards, unless specified.

<sup>Ⓜ</sup> Stranded conductors will be seven strand constructions. Consult factory for other configurations.

**Note:** Product normally shipped in 1,000 foot spools. However, random lengths may be shipped, if not specified. Consult factory for special packaging.



#### Made-to-order

If you are unable to locate the stock SERV-RITE wire product that meets your unique application, Watlow Gordon can manufacture the exact wire product that does. With short lead times, Watlow Gordon can make-to-order any combination of wire type and insulation with metallic

overbraids, wraps or shielding, in designated standards. Simply review "How to Order," at the end of this section, define your requirements and call your Watlow representative to place your order and confirm specifications.



# SERV-RITE Wire and Cable

## Thermocouple and Thermocouple Extension Wire

### Technical Data

#### Construction and Characteristics

The following table lists the available SERV-RITE wire insulation series for thermocouple and extension wire. Further construction and characteristic explanations are contained in the pages referenced in the extreme right column of this table.

Temperature Rating <sup>®</sup>		Series	Single Conductor		Duplex Conductors		ASTM Color Coded	Physical Properties			Notes	Page No.
Continuous Reading	Single Reading		Insulation	Impregnation	Insulation	Impregnation		Abrasion Resistance	Moisture Resistance	Chemical Resistance		
<b>Thermocouple and Thermocouple Extension Wire Constructions</b>												
190°F (88°C)	190°F (80°C)	308- 002	Double Cotton Wrap	—	Twisted, with Double Cotton Braid	Light Lacquer Coating	Yes	Fair	Fair	Poor		NA
220°F (105°C)	220°F (105°C)	502 or 502/UL	PVC	—	PVC	—	Yes	Good	Excellent	Good		195, 210
220°F (105°C)	220°F (105°C)	503	PVC	—	PVC Twisted W/Cotton	—	Yes	Good	Excellent	Good		NA
220°F (105°C)	220°F (105°C)	505	PVC	—	Ripcord	—	Yes	Good	Excellent	Good		197
220°F (105°C)	220°F (105°C)	510 or 510/UL	PVC	—	PVC Twisted	—	Yes	Good	Excellent	Good	Aluminum/ Polyester shield with Drain Wire	202, 212
220°F (105°C)	220°F (105°C)	900 or 900/UL	PVC	—	PVC Twisted/ Cabled	—	Yes	Good	Excellent	Good	Aluminum/ Polyester shield with Drain Wire	208, 213
220°F (105°C)	220°F (105°C)	1000 or 1000/UL	PVC	—	PVC Twisted/ Cabled	—	Yes	Good	Excellent	Good	Aluminum/ Polyester shield with Drain Wire <sup>®</sup>	209, 214
300°F (150°C)	300°F (150°C)	504	Nylon	—	Nylon	—	Yes	Excellent	Fair	Good	Overall Jacket is clear	196
300°F (150°C)	390°F (200°C)	514	Tefzel <sup>®</sup>	—	Tefzel <sup>®</sup>	—	Yes	Excellent	Excellent	Excellent		206
300°F (150°C)	390°F (200°C)	515	Tefzel <sup>®</sup>	—	Tefzel <sup>®</sup> Twisted	—	Yes	Excellent	Excellent	Excellent	Aluminum/ Polyester shield with Drain Wire	NA
400°F (204°C)	500°F (260°C)	506	FEP Extr.	—	FEP Extr.	—	Yes	Excellent	Excellent	Excellent		198
400°F (204°C)	500°F (260°C)	507 or 507/UL	FEP Extr.	—	FEP Extr.	—	Yes	Excellent	Excellent	Excellent		199, NA

CONTINUED

Tefzel<sup>®</sup> is a registered trademark of E.I. du Pont de Nemours & Company.

# SERV-RITE Wire and Cable

## Thermocouple and Thermocouple Extension Wire

### Technical Data

#### Construction and Characteristics

Continued

Temperature Rating <sup>®</sup>		Series	Single Conductor		Duplex Conductors		ASTM Color Coded	Physical Properties			Notes	Page No.
Continuous	Single Reading		Insulation	Impregnation	Insulation	Impregnation		Abrasion Resistance	Moisture Resistance	Chemical Resistance		
<b>Thermocouple and Thermocouple Extension Wire Constructions</b> Continued												
400°F (204°C)	500°F (260°C)	509 or 509/UL	FEP Extr.	—	FEP Extr. Twisted	—	Yes	Excellent	Excellent	Excellent	Aluminum/Polyester shield with Drain Wire	201, 211
400°F (204°C)	500°F (260°C)	1900	FEP Extr.	—	FEP Extr. Twisted/Cabled	—	Yes	Excellent	Excellent	Excellent	Aluminum/Polyester shield with Drain Wire	NA
400°F (204°C)	500°F (260°C)	2000	FEP Extr.	—	FEP Extr. Twisted/Cabled	—	Yes	Excellent	Excellent	Excellent	Aluminum/Polyester shield with Drain Wire <sup>®</sup>	NA
500°F (260°C)	600°F (315°C)	508	TFE Tape Fused	—	TFE Tape Fused	—	Yes	Good	Excellent	Excellent		200
500°F (260°C)	550°F (290°C)	516	PFA	—	PFA	—	Yes	Good	Excellent	Excellent		207
500°F (260°C)	550°F (290°C)	517	PFA	—	PFA Twisted	—	Yes	Good	Excellent	Excellent	Aluminum/Polyester shield with Drain Wire	NA
550°F (290°C)	650°F (340°C)	155	Glass Braid	Modified Resin	SERVTEX <sup>®</sup> Braid	Modified Resin	Yes	Good	Good	Good	Impregnation retained to 400°F (204°C)	184
550°F (290°C)	650°F (340°C)	157	TFE Tape (not fused) Glass Braid	Modified Resin	SERVTEX Braid	Modified Resin	Yes	Good	Good	Good	Impregnation retained to 400°F (204°C); TFE good to 500°F (260°C)	185
600°F (315°C)	800°F (430°C)	511	Fused Polyimide Tape	—	None Twisted	—	Both legs have tracer	Excellent	Excellent	Excellent	FEP binder melts at approx. 500°F (260°C)	203

SERV-RITE Wire and Cable

CONTINUED

# SERV-RITE Wire and Cable

## Thermocouple and Thermocouple Extension Wire

### Technical Data

#### Construction and Characteristics

Continued

Temperature Rating <sup>®</sup>		Series	Single Conductor		Duplex Conductors		ASTM Color Coded	Physical Properties			Notes	Page No.
Continuous	Single Reading		Insulation	Impregnation	Insulation	Impregnation		Abrasion Resistance	Moisture Resistance	Chemical Resistance		
<b>Thermocouple and Thermocouple Extension Wire Constructions</b> Continued												
600°F (315°C)	800°F (430°C)	512	Fused Polyimide Tape	—	Fused Polyimide Tape	—	Both legs have tracer	Excellent	Excellent	Excellent	FEP binder melts at approx. 500°F (260°C)	204
600°F (315°C)	800°F (430°C)	513	Fused Polyimide Tape	—	Fused Polyimide Tape	—	Yes	Excellent	Excellent	Excellent	FEP binder melts at approx. 500°F (260°C)	205
900°F (480°C)	1000°F (540°C)	302	Double Glass Braid	Modified Resin	Glass Braid	Modified Resin	Yes	Good	Good	Good	Impregnation retained to 400°F (204°C)	187
900°F (480°C)	1000°F (540°C)	303	Enameled Conductors/ Glass Braid	Modified Resin	Glass Braid	Modified Resin	Yes	Fair	Good	Good	Impregnation retained to 400°F (204°C)	NA
900°F (480°C)	1000°F (540°C)	304	Glass Braid	Modified Resin	Glass Braid	Modified Resin	Yes	Fair	Good	Good	Impregnation retained to 400°F (204°C)	188
900°F (480°C)	1000°F (540°C)	305	Double Glass Wrap	Modified Resin	Glass Braid	Modified Resin	Yes	Fair	Good	Good	Impregnation retained to 400°F (204°C)	189
900°F (480°C)	1000°F (540°C)	306	Glass Braid	—	Glass Braid	—	No	Fair	Fair	Good		NA
900°F (480°C)	1000°F (540°C)	307	TFE Tape (not fused) TFE coated glass	—	TFE Coated Glass Braid	—	Yes	Good	Excellent	Excellent	TFE good to 500°F (260°C)	190
900°F (480°C)	1000°F (540°C)	313	Glass Braid	Modified Resin	Glass Braid	Modified Resin	Yes	Good	Good	Good	Impregnation retained to 400°F (204°C)	191

CONTINUED

# SERV-RITE Wire and Cable

## Thermocouple and Thermocouple Extension Wire

### Technical Data

#### Construction and Characteristics

Continued

Temperature Rating <sup>①</sup>		Series	Single Conductor		Duplex Conductors		ASTM Color Coded	Physical Properties			Notes	Page No.
Continuous	Single Reading		Insulation	Impregnation	Insulation	Impregnation		Abrasion Resistance	Moisture Resistance	Chemical Resistance		
<b>Thermocouple and Thermocouple Extension Wire Constructions</b> Continued												
900°F (480°C)	1000°F (540°C)	315	Glass Braid	Modified Resin	Twisted	—	Yes	Good	Good	Good	Impregnation retained to 400°F (204°C)	NA
1300°F (705°C)	1600°F (870°C)	309	High Temp. Glass Braid	—	High Temp. Glass Braid	Modified Resin	Both legs have tracer	Good	Fair	Good	Impregnation retained to 400°F (204°C)	NA
1300°F (705°C)	1600°F (870°C)	311	High Temp. Glass Braid	—	High Temp. Glass Braid	Modified Resin	No	Fair	Fair	Good	Coating retained to 300°F (149°C)	NA
1300°F (705°C)	1600°F (870°C)	314	High Temp. Glass Braid	Modified Resin	Twisted	—	Yes	Good	Good	Good	Impregnation retained to 400°F (204°C)	192
1300°F (705°C)	1600°F (870°C)	321	High Temp. Glass Braid	Modified Resin	High Temp. Glass Braid	Modified Resin	Yes	Good	Good	Good	Impregnation retained to 400°F (204°C)	193
1800°F (980°C)	2000°F (1095°C)	301	Vitreous Silica Fiber	—	Vitreous Silica Fiber	—	No	Fair	Fair	Good		186
1800°F (980°C)	2000°F (1095°C)	365	Vitreous Silica Fiber	—	Vitreous Silica Fiber	—	No	Fair	Fair	Good		NA
2200°F (1205°C)	2600°F (1430°C)	350	Ceramic Fiber	—	Ceramic Fiber	—	No	Good	Fair	Good		194
2200°F (1205°C)	2600°F (1430°C)	355	Ceramic Fiber	—	Ceramic Fiber	—	No	Good	Fair	Good		NA
<b>RTD Leadwire Constructions</b>												
220°F (105°C)	220°F (105°C)	701	PVC	—	PVC	—	Yes**	Good	Excellent	Good	RTD Leadwire	215
400°F (204°C)	500°F (260°C)	704	FEP Extr.	—	FEP Extr. Twisted	—	Yes**	Excellent	Excellent	Excellent	RTD Leadwire	216
900°F (480°C)	1000°F (540°C)	705	Glass Braid	Modified Resin	Glass Braid	Modified Resin	Yes**	Fair	Good	Good	RTD Leadwire	217

①Thermocouple extension grade wire is only calibrated up to 400°F (204°C).

②Individual and overall

\*\*Not an ASTM E 230 color code.