



THERMOCOUPLE WIRE & CABLE

UNIT I:

Plot No. 8, Balaji Industrial Park,
Street No. 2, Near Octroi Naka,
Gondal Road, Rajkot - 360004 (India)

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Plot No. 10, Balaji Industrial Park,
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CARSON™ Wire and Cable

Thermocouple and Thermocouple

Extension Wire Manufactured to Exacting Specifications

Since 1995, CARSON thermocouple wire and thermocouple extension wire have been known for premium performance and reliability. All stock and custom wire is manufactured in our plant where careful selection of materials, latest type of special machines and quality controls assure superior uniformity. While this section presents available stock wire products, HI TEMP SOLUTIONS can custom manufacture wire using alloys and insulation types to meet your specific application demands.

All CARSON thermocouple wire and thermocouple extension wire is manufactured under rigid quality controls. Hi Temp Solutions' wire products are manufactured following ISO 9001 standards. In addition, all EMF vs. temperature calibration procedures follow one or more of the following standards:

- ASTM E 207
- ASTM E 220
- AMS 2750

All testing has NABL traceability. Unless otherwise specified, all CARSON thermocouple wire and extension wire are supplied to meet Standard Tolerances of ASTM E 230. Special Tolerances are also available.

Performance Capabilities:

- Compliance with recognized agency tolerances
- Insulation temperature ranges from 200 to 1200°C
- Tolerances from $\pm 0.5^\circ\text{C}$ or $\pm 0.4\%$ / $\pm 0.5^\circ\text{C}$ or $\pm 0.4\%$



Features and Benefits:

- Type E, J, K, N and T thermocouple wire for virtually all applications.
- Type EX, JX, KX, NX, TX extension wire to match thermocouple type.
- Compensating extension wire for Type B, C*, R and S thermocouples permit fine tuning of temperature measuring circuit.
- Solid or stranded wire constructions to meet specific application requirements.
- Wide selection of insulation types to meet temperature, chemical, moisture and abrasion resistance objectives.

- Color coding available to comply with ANSI, BS, IEC, NFE, DIN and JIS standards.
- Select metallic over braids and wraps to enhance abrasion resistance.
- Stock RTD lead wire to meet virtually all industrial RTD applications.

*Not an ASTM E 230 symbol.

CARSON™ Wire and Cable

Thermocouple and Thermocouple

Technical Data

The following pages contain CARSON wire technical data. This information covers ASTM E 230 letter designations and tolerances, color coding, stranded and solid constructions, selection considerations, how to read CARSON 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, HI TEMP SOLUTIONS Gordon can custom manufacture a wire to meet your needs.

Calibration and Certification

CARSON 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 end 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. Subzero 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 TC Wire

The following standard certifications are available from Hi Temp Solutions. Requirements for these certifications must be stated on the order.

Certificate #A - Certificate of compliance/Conformity

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

Certificate #B - 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 #C - Certificate of Calibration at Specified Temperatures

Calibration	Standard Calibration Point (°C)*
E	200, 400
J	100, 200, 300
K	200, 300, 400
N	400
T	100, 150
BX	50
CX	100
EX	100, 200
JX	100
KX	100, 200
NX	100
RX	100
SX	100
TX	100

Á F M D P O O O P O M N R O N O P O O N P O N
exceeds wire insulation rating.

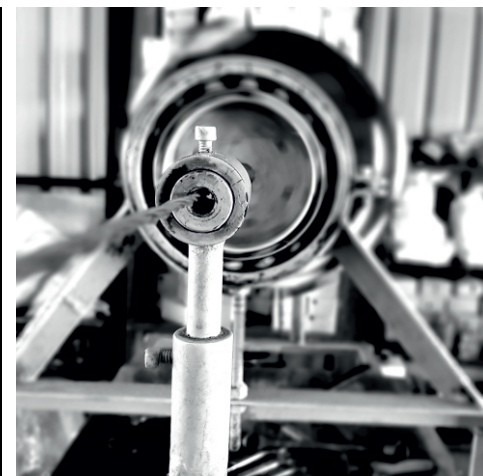
This is a calibration certification when post-production calibration data is desired. Calibration is performed in the Hi Temp Solutions calibration laboratory with NABL traceable calibration standards. In addition to the calibration data, the test standard, equipment, NABL traceability, and reference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

Certificate #D - Certificate of Traceability to NABL

This certification is used to certify that the materials they receive is traceable to NABL via calibration data of the thermo elements used to manufacture the product.

Certificate #E - 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.



CARSON™

Wire and Cable

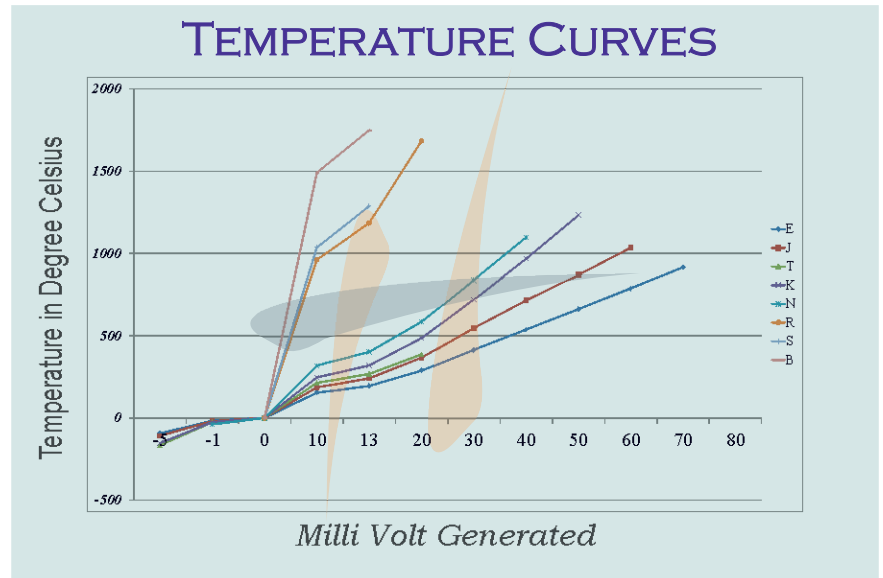
Thermocouple and Thermocouple Extension Wire

Technical Data Calibration and Certification Continued

Continued...

**Millivolt values shown for C, R, S and B calibrations pertain to thermocouple calibrations only. RX, SX and BX constructions described in this catalogue 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 Compensation Grade Alloys
B	BP	Platinum 30% Rhodium	BPX-PCLW-30-6
	BN	Platinum 6% Rhodium	Copper
C*	CP	W5Re (Tungsten 5% Rhenium)	Alloy 405
	CN	W26Re (Tungsten 26% Rhenium)	Alloy 426
E	EP	Chromel*	Chromel*
	EN	Constantan	Constantan
J	JP	Iron	Iron
	JN	Constantan	Constantan
K	KP	Chromel*	Chromel*
	KN	Alumel*	Alumel*
N	NP	Nicrosil	Nicrosil
	NN	Nisil	Nisil
R	RP	Platinum 13% Rhodium	Copper
	RN	Pure Platinum 100%	#11 Alloy
S	SP	Platinum 10% Rhodium	Copper
	SN	Pure Platinum 100%	#11 Alloy
T	TP	Copper	Copper
	TN	Constantan	Constantan

**Not an ASTM E 230 symbol.

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

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Thermocouple and Thermocouple Extension Wire

Technical Data Continued

ASTM E 230 Tolerances

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

Thermocouple	Extension Alloy	Composition	American Specification (ANSI MC 96.1)		
			EMF	At Temperature	Tolerance
			mV	°C	Standard
K	KPX-KNX (KX)	KPX (NiCr)	4.095	100.0	± 2.2 °C 0° - 200 °C
		KNX (NiAl)	8.137	200.0	
K	Cu-CuNi44 KCB (VX)*	Cu	4.095	100.0	± 2.2 °C 0° - 200 °C
		CuNi44	—	—	
J	JPX-JNX (JX)	JPX (Fe)	5.268	100.0	± 2.2 °C 0° - 200 °C
		JNX (CuNi44)	10.777	200.0	
T	TPX-TNX (TX)	TPX (Cu)	—	—	± 1 °C 0° - 100 °C
		TNX (CuNi44)	4.277	100.0	
S / R	Cu-CuNi3 (SX) (RX)	NPX (NiCr)	0.654	100.0	± 0.057 mV From 0°-200°C
		NNX (NiSi)	1.44	200.0	
N	NPX-NNX (NX)	NPX (NiCr)	2.774	100.0	± 2.2 °C 0° - 200 °C
		NNX (NiSi)	5.912	200.0	

*Type VX, KCB are not included in ANSI

Thermocouple Type	Temperature Range F (C)	Tolerance-Reference Junction 32F (0C)			
		Grade	Standard Grade	Special Grade	
		Designation	Limits	Grade	Limits
		Grade	F (C) whichever is greater	Designation	F (C) whichever is greater
T	32 (0) to 700 (370)	T	±1.8 (1) or ±0.75%	TT	±0.9 (0.5) or 0.4%
J	32 (0) to 1400 (760)	J	±4 (2.2) or ±0.75%	JJ	±2 (1.1) or 0.4%
E	32 (0) to 1600 (870)	E	±3.1 (1.7) or ±0.50%	EE	±1.8 (1) or 0.4%
K or N	32 (0) to 2300 (1260)	K or N	±4 (2.2) or ±0.75%	KK or NN	±2 (1.1) or 0.4%
T*		T	±1.8 (1) or ±1.5%	TT	±0.9 (0.5) or 0.8%**
E*	-328 (-200) to 32 (0)	E	±3.1 (1.7) or ±1%	EE	±1.8 (1) or 0.5%**
K*	-328 (-200) to 32 (0)	K	±4 (2.2) or ±2%	KK	**
Extension Wire	-328 (-200) to 32 (0)				
		TX	±1.8 (1)	TTX	±0.9 (0.5)
TX	32 (0) to 212 (100)	JX	±4 (2.2)	JJX	±2 (1.1)
JX	32 (0) to 400 (200)	EX	±3.1 (1.7)	EEX	±1.8 (1)
EX	32 (0) to 400 (200)	KX or NX	±4 (2.2)	KKX or NNX	±2 (1.1)
KX or NX	32 (0) to 400 (200)				
		RX or SX	±9 (5)		
RX or SX	32 (0) to 400 (200)	BX***	±7.6 (4.2)		
BX	32 (0) to 212 (100)	BX	±6.7 (3.7)		
BX	32 (0) to 400 (200)	ALLOY***			

- 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. If used at higher temperatures these tolerances may not apply.
- 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.
- 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.
- 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.
- 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.
- Tolerances in the table apply to new and essentially homogeneous thermocouple compensating extension wire when used at temperatures within the range given above.
- 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.

*Special tolerance grade compensating extension wires are not available.

Thermocouple and Extension Wire Color Codes

T/C Type	IEC	BS	ANSI	NFE	DIN	JIS
B	Not Available	Not Available				
E						
J						
K						
N				Not Available	Not Available	Not Available
R						
S						
T						
U						
Vx						

Thermocouple and Thermocouple Extension Wire

Technical Data

Continued...

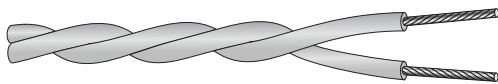
International Standards CARSON wire and cable complies with international standards and tolerances in both standard and special limits.

United States and International Color Coding

Standard ASTM E 230 colour coding (United States) is used on all insulated thermocouple wire and extension wire when type of insulation permits. In colour 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 colour codes relate to the compensating cable normally used. Additionally, various national and international standard agencies have adopted colour codes for the identification of thermocouple wire and products. These generally differ from those used by ASTM E 230.

Heat Resistance PVC Insulated Single Pairs

- Incorporates Heat Resistance (HR) PVC suitable for use in temperature range -30 Deg C to +105 Deg C.
- The Grade of PVC used on these construction is to BS7655:Part 4 Section 4.5 Type 5 Style 105 Deg C rate (15,000 hours at 105 Deg C).
- We offer a wide variety of constructions from simple bellwire to screened and armoured types in virtually all the thermocouple combinations.



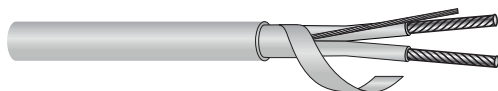
One pair of stranded conductors HR PVC insulated.
Pair twisted.



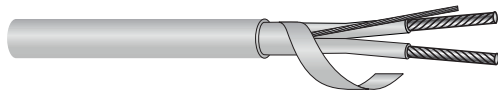
One pair of stranded conductors HR PVC insulated.
Pair laid flat & HR PVC sheathed.



One pair of solid conductors HR PVC insulated.
Pair laid flat & HR PVC sheathed.



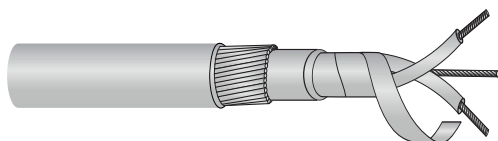
One pair of solid conductors HR PVC insulated.
Pair twisted. Screened with Mylar aluminium tape
in contact throughout with a bare tinned copper drain
wire. HR PVC sheathed.



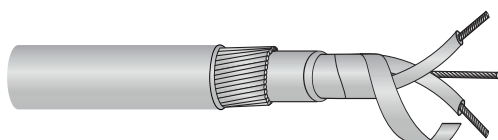
One pair of stranded conductors HR PVC insulated.
Pair twisted. Screened with Mylar aluminium tape
in contact throughout with a bare tinned copper drain
wire. HR PVC sheathed.



One pair of solid conductors HR PVC insulated.
Pair twisted & HR PVC sheathed.



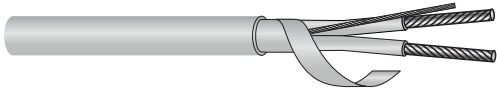
One pair of solid conductors HR PVC insulated.
Pair twisted. Screened with Mylar aluminium tape
in contact throughout with a bare tinned copper
drainwire. HR PVC bedded. Steel wire armoured and
HR PVC sheathed.



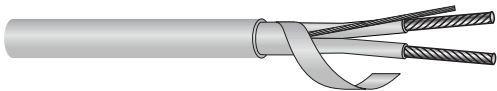
One pair of stranded conductors HR PVC insulated.
Pair twisted. Screened with Mylar aluminium tape
in contact throughout with a bare tinned copper
drainwire. HR PVC bedded. Steel wire armoured and
HR PVC sheathed.

Flame Retardant PVC Insulated Single Pairs

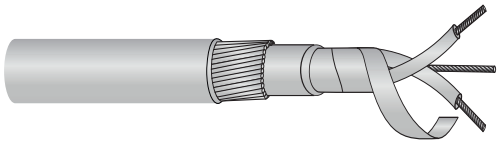
- Excellent properties for the reduced propagation of flame by incorporation of FR PVC compounds.
- Suitable for situations where there is a risk of fire.
- These cables also meet the requirements of Bs4066 Part 1:1980/ IEC 332.1:1979 covering tests on cables under fire conditions.
- The Oxygen Index Value is not less than 30 in accordance with Bs2782 Part 1:1989 Method 141.



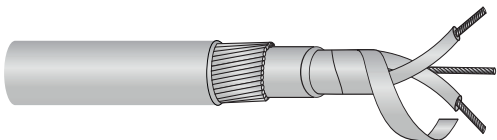
One pair of solid conductors FR PVC insulated.
Pair twisted. Screened with Mylar aluminium tape
in contact throughout with a bare tinned copper drain
wire. FR PVC sheathed.



One pair of stranded conductors FR PVC insulated.
Pair twisted. Screened with Mylar aluminium tape
in contact throughout with a bare tinned copper drain
wire. FR PVC sheathed.



One pair of solid conductors FR PVC insulated.
Pair twisted. Screened with Mylar aluminium tape
in contact throughout with a bare tinned copper
drain wire. FR PVC bedded. Steel wire armoured and
FR PVC sheathed.



One pair of stranded conductors FR PVC insulated.
Pair twisted. Screened with Mylar aluminium tape
in contact throughout with a bare tinned copper
drain wire. FR PVC bedded. Steel wire armoured and
FR PVC sheathed.

Flame Retardant Silicone Rubber Single Pairs

- Excellent properties for the reduced propagation of flame by incorporation of FR Silicone Rubber compounds.
- Suitable for situations where there is a risk of fire.
- Ideal for applications where, for short periods of time, the temperature can fluctuate, which would cause other cables to become inflexible and brittle.



One pair of stranded conductors Silicone Rubber insulated.
Pair twisted & Mylar taped. Silicone Rubber sheathed.



One pair of stranded conductors Silicone Rubber
insulated. Pair twisted & Mylar taped. St. St. wire
braided and Silicone Rubber sheathed.

Flame Retardant PVC Insulated Single Pairs



Performance Capabilities

- Continuous temperature rating:
220°F (105°C)

Features and Benefits

- Extruded PVC single conductor and duplex insulation for excellent moisture resistance.
- Non-propagating.
- UV light resistant.
- ASTM E 230 color code for easy identification.
- Excellent moisture resistance, good abrasion and chemical resistance.
- Additional abrasion resistance with optional stainless steel and tinned copper wire overbraids.
- Custom constructions available, consult factory.

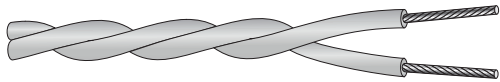
Applications

- Laboratories
- Industrial equipment
- Hydrocarbon processing plants
- Automotive

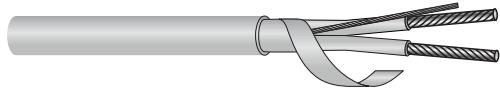
Temperature Range	Resistance Properties		
	Moisture	Chemical	Abrasion
220°F (105°C)	Excellent	Good	Good

PTFE & Kapton Insulated Single Pairs

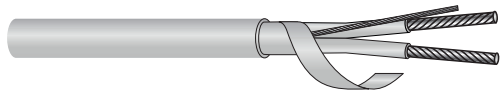
- PTFE is ideal for higher temperature applications up to 250 Deg C when Heat Resistance PVC is not adequate.
- It is also excellent for cryogenic temperature down to -75 Deg C.
- PTFE will withstand attack from virtually all known chemicals, oils and fluids.
- We offer a wide variety of constructions from simple twisted pairs to screened types in virtually all the thermocouple combinations.



One pair of stranded conductors PTFE insulated.
Pair twisted.



One pair of solid conductors PTFE insulated.
Pair twisted. Screened with Mylar aluminium tape
in contact throughout with a bare tinned copper drain
wire. PTFE sheathed.



One pair of stranded conductors PTFE insulated.
Pair twisted. Screened with Mylar aluminium tape
in contact throughout with a bare tinned copper drain
wire. PTFE sheathed.



One pair of stranded conductors PTFE insulated.
Pair twisted. PTFE sheathed.



One pair of stranded conductors PTFE
insulated. Pair twisted & Mylar taped. St. St. wire
braided and PTFE sheathed.



One pair of stranded conductors PTFE insulated.
Pair laid flat and PTFE sheathed.



One pair of solid conductors. Negative conductor
Kapton insulated. Pair laid flat and Kapton sheathed.



One pair of solid conductors PTFE insulated.
Pair twisted.



One pair of solid conductors PTFE insulated.
Pair laid flat and PTFE sheathed.

Fibreglass and Ceramic Fibre Insulated Single Pairs

- Excellent for High Temperature applications up to 460 Deg C for Fibreglass, 1200 Deg C for High Temperature Fibreglass and 1200 Deg C for Ceramic Fibre.
- Suitable for use at normal air ambient temperature where there is possibility of hot spot which might damage lower rated cables such as PVC or PTFE.
- We offer a wide variety of constructions from simple twisted pairs to screened types in virtually all the thermocouple combinations.



One pair of solid conductors. Each conductor double glass fibre lapped and silicone varnished. Pair laid flat, glass fibre braided overall and silicone varnished.



One pair of solid conductors. Each conductor double glass fibre lapped, glass fibre braided and silicone varnished. Pair laid flat, glass fibre braided overall and silicone varnished.



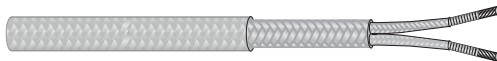
One pair of solid conductors. Each conductor double glass fibre lapped, glass fibre braided and silicone varnished. Pair twisted, glass fibre braided overall and silicone varnished.



One pair of stranded conductors. Each conductor double glass fibre lapped, glass fibre braided and silicone varnished. Pair laid flat, glass fibre braided overall and silicone varnished.



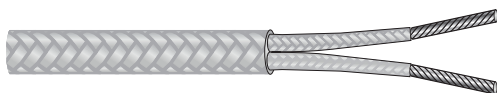
One pair of stranded conductors. Each conductor double glass fibre lapped, glass fibre braided and silicone varnished. Pair laid flat, glass fibre braided and silicone varnished. Stainless Steel wire braided overall.



One pair of solid conductors. Each conductor double high temperature glass fibre lapped, high temperature glass fibre braided and high temperature varnished. Pair laid flat, glass fibre braided and high temperature varnished. Stainless Steel wire braided overall.

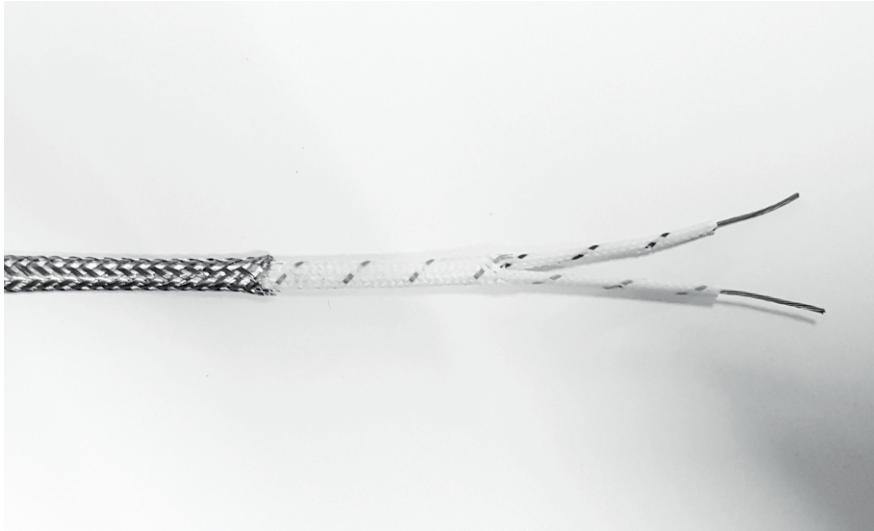


One pair of solid conductors. Each conductor double high temperature glass fibre lapped, high temperature glass fibre braided and high temperature varnished. Pair laid flat, glass fibre braided and high temperature varnished.



One pair of solid conductors. Each conductors ceramic fibre braided and high temperature varnished. Pair laid flat, Ceramic fibre braided and high temperature varnished.

Fibreglass and Ceramic Fibre Insulated Single Pairs



Performance Capabilities

- Continuous temperature rating: 900°F (480°C)
- Single reading: 1000°F (540°C)

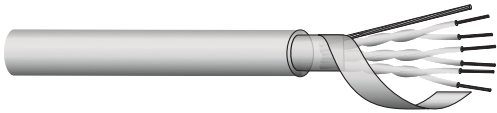
Features and Benefits

- Fiberglass braid single conductor and overall insulation impregnated with modified resin for protection.
- Twisted conductors for reduced electrical interference.
- Color coded conductors for easy installation.
- Good moisture and chemical resistance, fair abrasion resistance.
- Additional abrasion resistance with optional stainless steel and tinned copper wire overbraids.

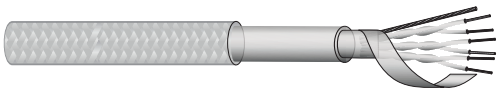
Temperature Range	Resistance Properties		
	Moisture	Chemical	Abrasion
900°F (480°C)	Good	Good	Fair

PTFE Insulated MultiPairs

- PTFE is ideal for higher temperature applications up to 250 Deg C when Heat Resistance PVC is not adequate.
- It is also excellent for cryogenic temperature down to -75 Deg C.
- PTFE will withstand attack from virtually all known chemicals, oils and fluids.
- By using multipair, the problem of having many unwieldy single pair cables is eliminated.
- Available with and without St. St. braid in the more popular conductor combinations.



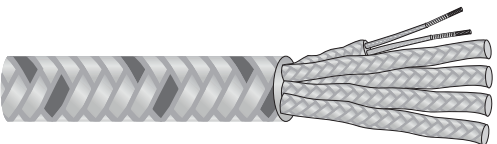
One pair of stranded 7/0.2mm conductors. Each conductor PTFE insulated. Pairs twisted and bunched. Screened with Mylar aluminium tape in contact throughout by a bare tinned copper drainwire. PTFE sheathed overall.



One pair of stranded 7/0.2mm conductors. Each conductor PTFE insulated. Pairs twisted and bunched. Screened with Mylar aluminium tape in contact throughout by a bare tinned copper drainwire. PTFE sheathed. St. St. braided overall.

Fibreglass Insulated MultiPairs

- Excellent for high temperature applications up to 460 Deg C.
- Suitable for use at normal air ambient temperature where there is possibility of hot spot which might damage lower rated cables such as PVC or PTFE.
- By using multipair, the problem of having many unwieldy single pair cables is eliminated.
- PTFE will withstand attack from virtually all known chemicals, oils and fluids.
- Available with and without St. St. braid in the more popular conductor combinations.



One pair of stranded 7/0.2mm conductors. Each conductor PTFE insulated. Pairs twisted and bunched. Screened with Mylar aluminium tape in contact throughout by a bare tinned copper drainwire. PTFE sheathed overall.



One pair of stranded 7/0.2mm conductors. Each conductor PTFE insulated. Pairs twisted and bunched. Screened with Mylar aluminium tape in contact throughout by a bare tinned copper drainwire. PTFE sheathed. St. St. wire braided overall./