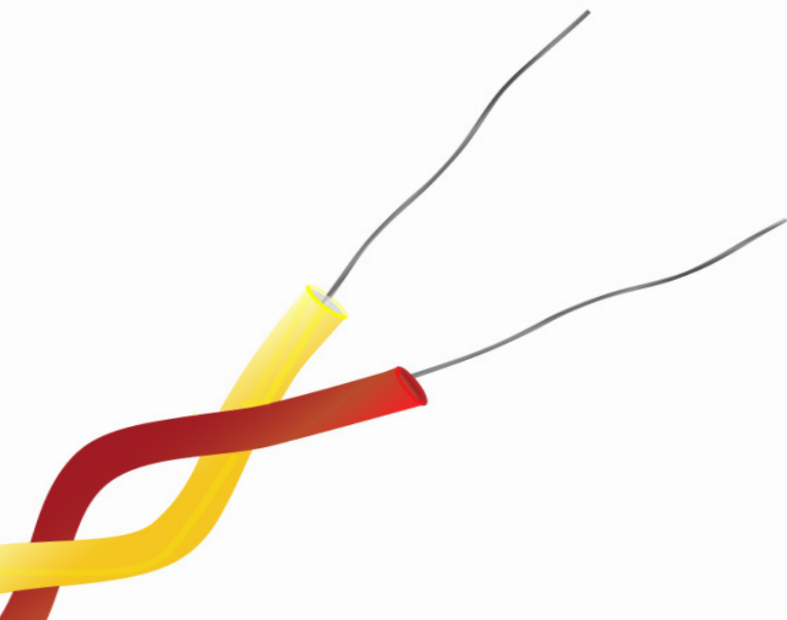


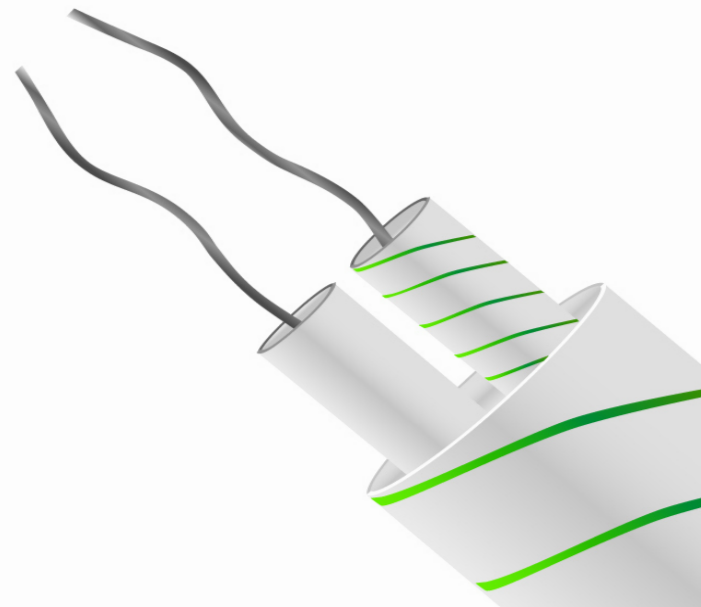
Thermocouple & PRT Cable / Wire Product Guide



Farnell[®]
AN AVNET COMPANY



Newark[®]
AN AVNET COMPANY



Which insulation Material?	usable temperature range	Application Note
PVC	-10°C to 105°C	Good general-purpose insulation for "light" environments. Waterproof and very flexible.
PFA (extruded)	-75°C to 250°C	Resistant to oils, acids other adverse agents and fluids. Good mechanical strength and flexibility. PTFE better for steam/elevated pressure environments
PTFE (taped & wrapped)	-75°C to 250/300°C	Resistant to oils, acids other adverse agents and fluids. Good mechanical strength and flexibility.
Glassfibre (varnished)	-60°C to 350/400°C	Good temperature range but will not prevent ingress of fluids. Fairly flexible but does not provide good mechanical protection.
High temperature glass fibre	-60°C to 700°C	Will withstand temperature up to 700°C but will not prevent ingress of fluids. Fairly flexible, not good protection against physical disturbance.
Ceramic Fibre	0 to 1000°C	Will withstand high temperature, up to 1000°C. Will not protect against fluids or physical disturbance.
Glassfibre (varnished) stainless steel overbraid	-60°C to 350/400°C	Good resistance to physical disturbance and high temperature (up to 400°C). Will not prevent ingress of fluids.

For maximum accuracy extension cables should be used and terminals and connectors should be of thermocouple materials to maintain continuity.

The materials are made according to internationally accepted standards as laid down in IEC 584 1,2 which is based on the international Practical Temperature scale ITS 90. Operating temperature maxima are dependent on the conductor thickness of the thermoelements. The thermocouple types can be subdivided in 2 groups, base metal and rare (noble) metal:

-200°C up to 1200°C – These thermocouples use base metals

Type K – Chromel-Alumel: The best known and dominant thermocouple belonging to the group chromium-nickel aluminium is type K. Its temperature range is extended (-200 up to 1100°C). Its e.m.f./ temperature curve is reasonably linear and its sensitivity is 41µV/°C

Type J – Iron-Constantan: Though in thermometry the conventional type J is still popular it has less importance in Mineral Insulated form because of its limited temperature range, - 200C to +750°C. Type J is mainly still in use based on the widespread applications of old instruments calibrated for this type. Their sensitivity rises to 55µV/°C.

Type E – Chromel-Constantan: Due to its high sensitivity (68µV/°C) Chromel-Constantan is mainly used in the cryogenic low temperature range (-200 up to +900°C). The fact that it is non magnetic could be a further advantage in some special applications.

Type N – Nicrosil-Nisil: This thermocouple has very good thermoelectric stability, which is superior to other base metal thermocouples and has excellent resistance to high temperature oxidation.

The Nicrosil-Nisil thermocouple is ideally suited for accurate measurements in air up to 1200°C. In vacuum or controlled atmosphere, it can withstand temperatures in excess of 1200°C. Its sensitivity of 39µV/°C at 900°C is slightly lower than type K (41µV/°C). Interchangeability tolerances are the same as for type K.

Type T – Copper-Constantan: This thermocouple is used less frequently. Its temperature range is limited to -200°C up to +350°C. It is however very useful in food, environmental and refrigeration applications. Tolerance class is superior to other base metal types and close tolerance versions are readily obtainable. The e.m.f./temperature curve is quite non-linear especially around 0°C and sensitivity is 42µV/°C.

0°C up to +1600°C – Platinum-Rhodium (Noble metal)

Thermocouples

Type S – Platinum rhodium 10% Rh-Platinum: They are normally used in oxidising atmosphere up to 1600°C. Their sensitivity is between 6 and 12 µV/°C.

Type R – Platinum rhodium 13% Rh-Platinum: Similar version to type S with a sensitivity between 6 and 14µV/°C.

Type B – Platinum rhodium 30% Rh-Platinum rhodium 6% Rh: It allows measurements up to 1700°C. Very stable thermocouple but less sensitive in the lower range. (Output is negligible at room temperature).

Historically these thermocouples have been the basis of high temperature in spite of their high cost and their low thermoelectric power. Until the launching of the Nicrosil-Nisil thermocouples, type N, they remained the sole option for good thermoelectric stability.

Length of cable runs and loop resistance.

The resistivity of extension and compensating cables varies according to the different conductor metals; the limit to cable lengths which can be accommodated by measuring instruments therefore depends on both the thermocouple type and instrument specifications. A general rule for electronic instruments is that up to 100 Ohms loop cable resistance (i.e. total of both legs) will not result in measurement errors.

Interference and Isolation.

With long runs, the cables may need to be screened and earthed at one end (at the instrument) to minimise noise pick-up (interference) on the measuring circuit.

Alternative types of screened cable construction are available and these include the use of copper or mylar screening. Twisted pair configurations are offered and these can incorporate screening as required.

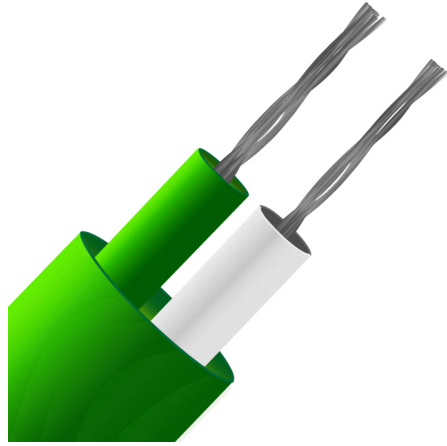
With mineral-insulated cables the use of the sheath for screening may raise problems. In certain forms the measuring point is welded to the sheath in order to reduce the response time; the screen is then connected directly to the sensor input of the instrument and is therefore ineffective. In thermocouples where the measuring point is welded to the protection tube it may be necessary to take special precautions against interference since the sheath tube can in this case act as an aerial.

Even if the measuring point is not welded to the protection tube it is inadvisable to use the sheath of a mineral-insulated thermocouple as a screen. Since it consists of non-insulated material there is a possibility with electrically heated furnaces that it can carry currents between the furnace material and the earthing point. These may result in measurement errors.

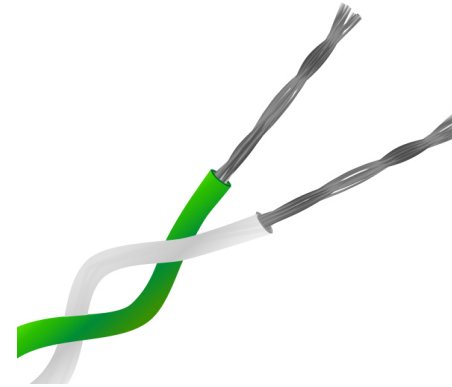
Generally, thermocouples in electrical contact with the protection tube can easily suffer interference from external voltages through voltage pick-up. In addition, two such inputs form a current loop through which the two inputs are connected together. Since such current loops form a preferred path for the introduction of interference, thermocouples should under these conditions always be isolated from each other, i.e. the amplifier circuits must have no electrical connection to the remaining electronics. This is already provided on most instruments intended for connection to thermocouples.

Ceramic materials used for insulating the thermocouples inside the protection tube suffer a definite loss of insulation resistance above 800 to 1000°C. The effects described can therefore appear at high temperatures even in thermocouples where the measuring junction is not welded to the protection tube. Here again full isolation is strongly recommended.

With electrically heated furnaces in the high-temperature range it is also necessary to consider that the increased conductivity of the ceramic insulating materials may cause the supply voltage to leak into the thermocouple. Here again full isolation against supply and earth potential with an insulating voltage exceeding the peak voltage of the supply (heater voltage) is essential.



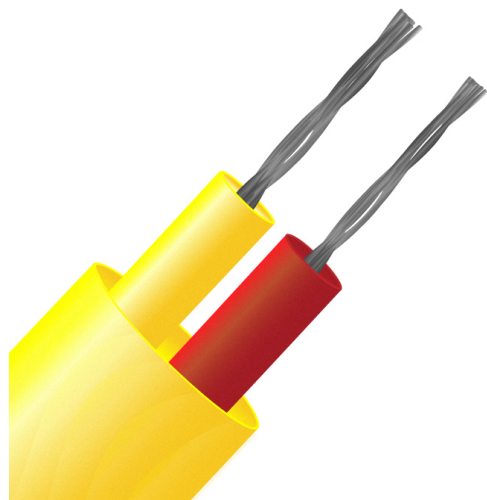
A PFA Insulated Flat Pair (IEC)



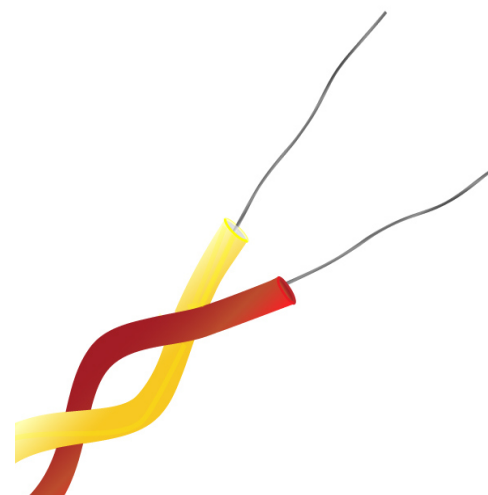
B PFA Insulated Twin Twist (IEC)

Image	Type	Code	Conductors	Jacket	10 Metre Reel		25 Metre Reel		50 Metre Reel		100 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
A	K	IEC	1/0.3mm	Green	2918736	-	2081284	-	2918755	-	2918722	-
A	K	IEC	7/0.2mm	Green	2918754	-	2081285	-	2081286	-	2081287	-
A	J	IEC	7/0.2mm	Black	2918750	-	2081281	-	2081282	-	2918739	-
A	T	IEC	7/0.2mm	Brown	-	-	2081289	-	2081290	-	2081291	-

Image	Type	Code	Conductors	Jacket	50 Metre Reel		100 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
B	K	IEC	1/0.2mm	Green/White	2081277	-	2081278	49Y6567
B	K	IEC	7/0.2mm	Green/White	2081280	-	-	-
B	T	IEC	1/0.2mm	Brown/White	2081273	-	2081274	-
B	N	IEC	1/0.2mm	Pink/White	-	-	-	-



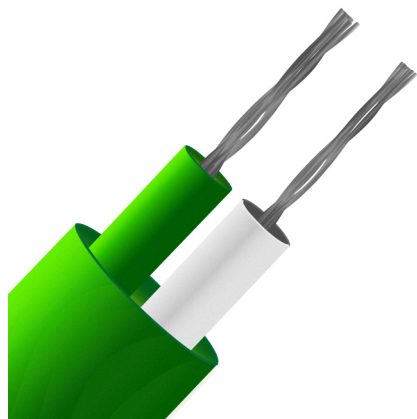
A PFA Insulated Flat Pair (ANSI)



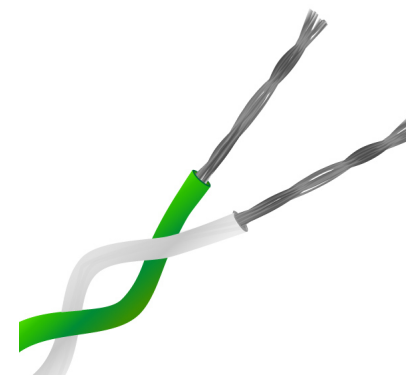
B PFA Insulated Twin Twist (ANSI)

Image	Type	Code	Conductors	Jacket	25 Metre Reel		50 Metre Reel		100 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
A	K	ANSI	7/0.2mm	Yellow	-	-	2443716	-	2443717	-

Image	Type	Code	Conductors	Jacket	25 Metre Reel		50 Metre Reel		100 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
B	K	ANSI	1/0.2mm	Yellow/Red	2443691	-	2443692	-	2443693	-
B	K	ANSI	7/0.2mm	Yellow/Red	2443694	-	2443695	-	2443696	-
B	K	ANSI	1/0.3mm	Yellow/Red	2443688	-	2443689	-	-	-
B	T	ANSI	1/0.3mm	Blue/Red	2443706	-	-	-	2443708	-
B	T	ANSI	1/0.2mm	Blue/Red	2443709	-	-	-	2443711	-



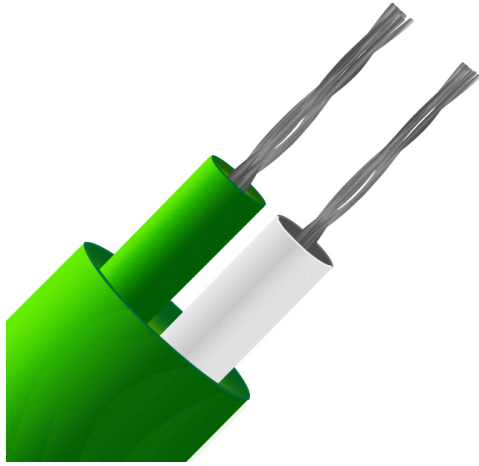
A PTFE Insulated Flat Pair (IEC)



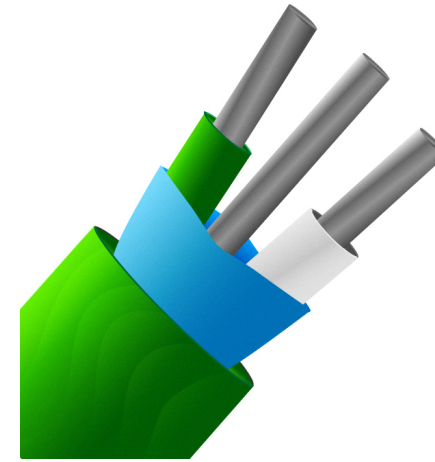
B PTFE Insulated Twin Twist (IEC)

Image	Type	Code	Conductors	Jacket	10 Metre Reel		25 Metre Reel		50 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
A	K	IEC	7/0.2mm	Green	2918715	-	7085904	68C2318	2918711	-
A	J	IEC	7/0.2mm	Black	2918733	-	2918705	-	2918719	-
A	T	IEC	1/0.3mm	Brown	2918751	-	2918716	-	2918718	-
A	T	IEC	7/0.2mm	Brown	2918717	-	-	-	2918720	-

Image	Type	Code	Conductors	Jacket	10 Metre Reel		25 Metre Reel		50 Metre Reel		100 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
B	K	IEC	1/0.2mm	Green/White	2918753	-	3358161	69C6662	1633495	-	1633497	-
B	K	IEC	1/0.315mm	Green/White	-	-	2918709	-	2918702	-	-	-
B	T	IEC	1/0.2mm	Brown/White	2918713	-	3358173	69C6663	1633498	-	1633499	-



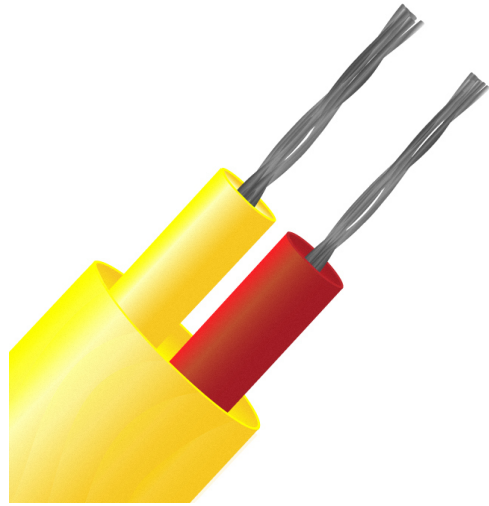
A PVC Insulated Flat Pair (IEC)



B PVC Insulated & Screened (IEC)

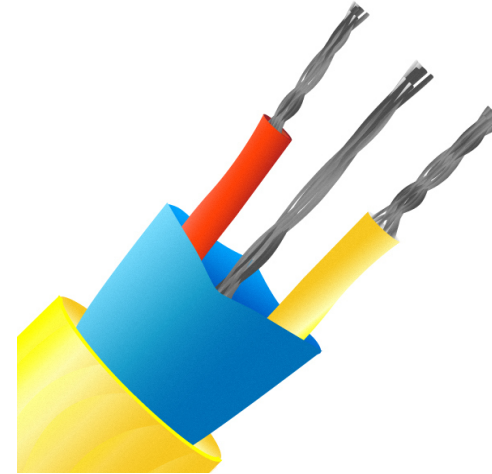
Image	Type	Code	Conductors	Jacket	10 Metre Reel		25 Metre Reel		50 Metre Reel		100 Metre Reel		200 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
A	K	IEC	7/0.2mm	Green	7082307	69C6503	2918768	-	7082319	69C6504	8598460	38K9412	2918748	-
A	J	IEC	7/0.2mm	Black	7082289	69C6502	2918731	-	7082290	22C8733	8598479	38K9408	2918710	-
A	T	IEC	7/0.2mm	Brown	-	-	2918757	-	7082344	69C6537	2420292	-	2918729	-

Image	Type	Code	Conductors	Jacket	10 Metre Reel		25 Metre Reel		50 Metre Reel		100 Metre Reel		200 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
B	K	IEC	7/0.2mm	Green	7086131	68C2315	2918740	-	7086143	68C2316	8598487	38K9413	2918712	-
B	J	IEC	7/0.2mm	Black	-	-	2918759	-	8598509	-	8598495	-	-	-
B	T	IEC	7/0.2mm	Brown	2918741	-	2918727	-	2918725	-	2420293	-	2918726	-
B	Vx	IEC	7/0.2mm	Green	2918743	-	2918761	-	2918745	-	7086155	-	2918732	-



A

PVC Insulated Flat Pair (ANSI)



B

PVC Insulated & Screened (ANSI)

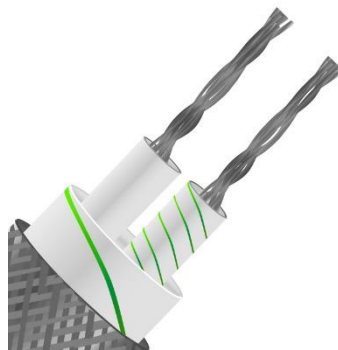
Image	Type	Code	Conductors	Jacket	25 Metre Reel		100 Metre Reel		200 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
A	K	ANSI	7/0.2mm	Yellow	2443685	-	2443686	-	2443687	-
A	J	ANSI	7/0.2mm	Black	-	-	2443680	-	-	-
A	T	ANSI	7/0.2mm	Blue	2443703	-	2443704	-	2443705	-
A	Vx	ANSI	7/0.2mm	Yellow	-	-	-	-	2443714	-

Image	Type	Code	Conductors	Jacket	25 Metre Reel		100 Metre Reel		200 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
B	K	ANSI	7/0.2mm	Yellow	-	-	-	-	2443702	-
B	J	ANSI	7/0.2mm	Black	2443682	-	-	-	2443684	-

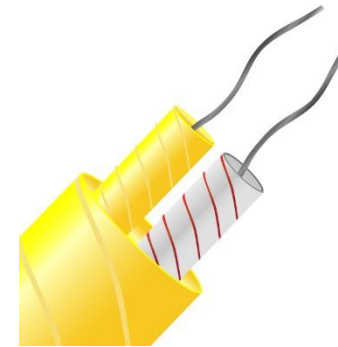
Glassfibre Insulated Thermocouple Cable (IEC / ANSI)



A Glassfibre Insulated (IEC)



B Glassfibre Insulated with Stainless Steel Overbraid (IEC)

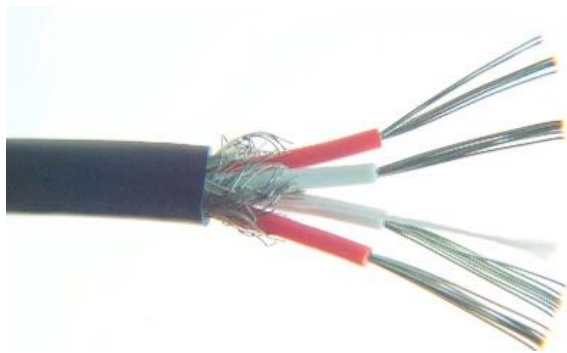


C Glassfibre Insulated with Stainless Steel Overbraid (ANSI)

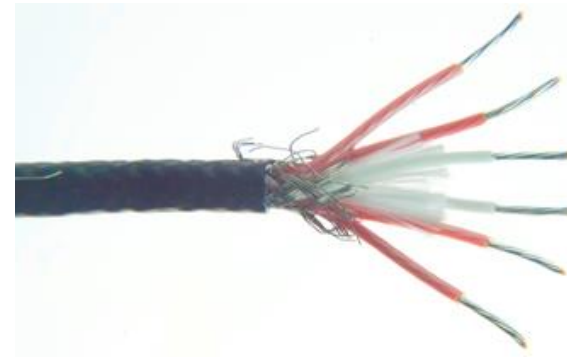
Image	Type	Code	Conductors	Jacket	10 Metre Reel		25 Metre Reel		50 Metre Reel		100 Metre Reel		200 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
A	K	IEC	1/0.3mm	Green/White	7085930	68C2313	2918760	-	7085941	68C2314	2918735	-	2918746	-

Image	Type	Code	Conductors	Jacket	10 Metre Reel		25 Metre Reel		50 Metre Reel		100 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
B	K	IEC	7/0.2mm	Green/White	2918721	-	7086337	68C2317	2918737	-	2918738	-
B	J	IEC	7/0.2mm	Black/White	2918724	-	7086349	68C2312	2918752	-	2918723	-

Image	Type	Code	Conductors	Jacket	25 Metre Reel		50 Metre Reel		100 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
C	K	ANSI	1/0.3mm	Yellow/Red	2443697	-	-	-	2443699	-



A PVC insulated & screened



B PFA insulated & screened

Image	Type	Conductors	Jacket	Cores	10 Metre Reel		25 Metre Reel		50 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
B	PRT	7/0.2mm PVC	Black	4	7218734	68C2284	7218746	68C2285	2918769	-

Image	Type	Conductors	Jacket	Cores	10 Metre Reel		25 Metre Reel		50 Metre Reel		100 Metre Reel	
					Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
D	PRT	7/0.2mm PFA	Black	4	1289661	24M9121	2918772	-	2918771	-	2918770	-



Farnell Order Code	Newark Order Code
2897470	62AC8741

The Thermocouple Welder is a compact, simple-to-use instrument designed for thermocouple and fine wire welding.

It is primarily designed for use by sensor manufacturers to produce commercial grade thermocouple junctions; it is ideal for producing large numbers of exposed junction thermocouples for test and development laboratories. The L60 Thermocouple Welder is ideally suited to transducer and RTD extension lead attachment.

Use of the Thermocouple Welder does not require special skills and most operatives will be capable of producing quality work with little practice. The instrument is supplied with a full range of user accessories including a footswitch.

Suitable for use with wires of up to 1.1mm diameter an argon gas shield facility is included but a satisfactory thermocouple junction is produced without the need for argon. The output energy of the L60 Thermocouple Welder can be varied up to 60 Joules.

- Simple to use Thermocouple Welder
- Designed to produce commercial grade thermocouple junctions
- Also suitable for other fine wire work
- Front panel or footswitch operation
- Argon gas shield facility

Supplied complete with the following accessories:

- Wire Holding Pliers & Lead
- Safety Glasses
- Magnifying Eyeglass
- Carbon Electrodes
- Spare 2A Fuse
- Argon Hose
- Mains Lead
- Footswitch for greater ease of use
- Impact Clip
- Welder Pen & Plate



Colour Codes: Thermocouple Extension and Compensating Wires and Cables

INSULATION COLOUR CODES Extension and Compensating leads

TYPE	CONDUCTORS +/-	◀ FORMER STANDARD ▶				Cable Code
		BRITISH BS1843: 1952	AMERICAN ANSI/MC 96.1	GERMAN DIN 43713/43714	IEC 60584-3(2007) BS EN60584-3(2008)	
EX	NICKEL CHROMIUM/CONSTANTAN (Nickel/Chromium/Copper Nickel, Chrome/Constantan, T1 Advance, NiCr/Constantan)					EX
J	IRON*/CONSTANTAN (Iron/Copper Nickel, FE/Konst Iron/Advance, FE Constantan I/C)					JX
K	NICKEL CHROMIUM/ NICKEL ALUMINIUM* (NC/NA, Chromel /Alumel), C/A, T1/T2, NiCr/Ni, NiCr, NiAL)					KX
N	NICROSIL/NISIL					NX NC
T	COPPER CONSTANTAN (Copper/Copper Nickel, Cu/Con, Copper Advance)					TX
Vx	COPPER CONSTANTAN (LOW NICKEL) (Cu/Constantan) Compensating for K (Cu/Constantan)					KCB
U	COPPER/COPPER NICKEL Compensating for Platinum 10% or 13% Rhodium/Platinum (codes 'S' and 'R' respectively) (Copper/Cupronic Cu/CuNi, Copper/No.11 Alloy)					RCA SCA

* Magnetic

FOR THERMOCOUPLE
CONNECTORS
body colours are similar
to outer sheath colours