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Thermocouples Types · Conductor Combinations · Characteristics · National and International Standards

Code	Conductor Combinations +Leg	Conductor Combinations –Leg	National Standards for Output of Thermocouple Conductors. Those Standards noted in this column all conform with each other and are based upon IEC 60584.1:1995 & ITS-90	Approximate Generated EMF Change per Degree Celsius Change with Reference Junction at 0°C V/°C at 100°C	500°C	1000°C	Approximate Working Temperature Range of Measuring Junction. *NB. Not related to wire diameters and conductor insulating materials* CONTINUOUS °C	SHORT TERM
K	**NICKEL - CHROMIUM** Also known as: Chromel*, Thermokanthal KP*, NiCr, T1*, Tophel*	**NICKEL - ALUMINIUM** (MAGNETIC) Also known as: Ni-Al, Alumel*, Thermokanthal KN*, T2*, NiAl*	ANSI/MC96.1 BS EN 60584.1 Pt4:1996 DIN EN 60584.1: 1996 NF EN 60 584.1:1996 JISC 1602	42	43	39	0 to +1100	–180 to +1350
T	**COPPER**	**COPPER - NICKEL** Also known as: Constantan, Advance*, Cupron*	ANSI/MC96.1 BS EN 60584.1 Pt5:1996 DIN EN 60584.1: 1996 NF EN 60 584.1:1996 JISC 1602	46	–	–	–185 to +300	–250 to +400
J	**IRON** (MAGNETIC) Also known as: Fe	**COPPER - NICKEL** Also known as: Nickel-Copper, Constantan, Advance*, Cupron*	ANSI/MC96.1 BS EN 60584.1 Pt3:1996 DIN EN 60584.1: 1996 NF EN 60 584.1:1996 JISC 1602	54	56	59	+20 to +700	–180 to +750
N	**NICKEL - CHROMIUM - SILICON** Also known as: Nicrosil	**NICKEL - SILICON - MAGNESIUM** Also known as: Nisil	ANSI/MC96.1 BS EN 60584.1 Pt8:1996 DIN EN 60584.1: 1996 NF EN 60 584.1:1996 JISC 1602	30	38	39	0 to +1150	–270 to +1300
E	**NICKEL - CHROMIUM** Also known as: Chromel*, Tophel*, Chromium, Nickel	**COPPER - NICKEL** Also known as: Nickel-Copper, Constantan, Advance*, Cupron*	ANSI/MC96.1 BS EN 60584.1 Pt6:1996 DIN EN 60584.1: 1996 NF EN 60 584.1:1996 JISC 1602	68	81	–	0 to +800	–40 to +900
R	**PLATINUM - 13% RHODIUM**	**PLATINUM**	ANSI/MC96.1 BS EN 60584.1 Pt2:1996 DIN EN 60584.1: 1996 NF EN 60 584.1:1996 JISC 1602	8	10	13	0 to +1600	-50 to +1700
S	**PLATINUM - 10% RHODIUM**	**PLATINUM**	ANSI/MC96.1 BS EN 60584.1 Pt1:1996 DIN EN 60584.1: 1996 NF EN 60 584.1:1996 JISC 1602	8	9	11	0 to +1550	-50 to +1750
B	**PLATINUM - 30% RHODIUM**	**PLATINUM - 6% RHODIUM**	ANSI/MC96.1 BS EN 60584.1 Pt7:1996 DIN EN 60584.1: 1996 NF EN 60 584.1:1996 JISC 1602	1	5	9	+100 to +1600	+100 to +1820
G* (Formerly Code W)	**TUNGSTEN**	**TUNGSTEN 26% RHENIUM**	There are no officially recognised standards for Type G	5	16	21	+20 to +2320	0 to +2600
C* (Formerly Code W5)	**TUNGSTEN 5% RHENIUM**	**TUNGSTEN 26% RHENIUM**	There are no officially recognised standards for Type C	15	18	18	+50 to +1820	+20 to +2300
D* (Formerly Code W3)	**TUNGSTEN 3% RHENIUM**	**TUNGSTEN 25% RHENIUM**	There are no officially recognised standards for Type D	13	20	20	0 to +2100	0 to +2600

Thermocouple Output Tolerances IEC 60584.2:1993, *see note A below*

TYPE	Tolerance Class 1	Tolerance Class 2	Tolerance Class 3	Notes
K	Temperature Range –40°C to +375°C Tolerance Value ±1.5°C Temperature Range 375°C to 1000°C Tolerance Value ±0.004 |t|	–40°C to +333°C ±2.5°C 333°C to 1200°C ±0.0075 |t|	–167°C to +40°C ±2.5°C –200°C to –167°C ±0.015 |t|	Most suited to oxidising atmospheres, it has a wide temperature range and is the most commonly used.
T	Temperature Range –40°C to +125°C Tolerance Value ±0.5°C Temperature Range 125°C to 350°C Tolerance Value ±0.004 |t|	–40°C to +133°C ±1.0°C 133°C to 350°C ±0.0075 |t|	–67°C to +40°C ±1.0°C –200°C to –67°C ±0.015 |t|	Excellent for low temperature and cryogenic applications. Good for when moisture may be present.
J	Temperature Range –40°C to +375°C Tolerance Value ±1.5°C Temperature Range 375°C to 750°C Tolerance Value ±0.004 |t|	–40°C to +333°C ±2.5°C 333°C to 750°C ±0.0075 |t|	– – – –	Commonly used in the plastics moulding industry. Used in reducing atmospheres as an unprotected thermocouple sensor. NB. Iron oxidises at low (rusts) and at high temperatures.
N	Temperature Range –40°C to +375°C Tolerance Value ±1.5°C Temperature Range 375°C to 1000°C Tolerance Value ±0.004 |t|	–40°C to +333°C ±2.5°C 333°C to 1200°C ±0.0075 |t|	–167°C to +40°C ±2.5°C –200°C to –167°C ±0.015 |t|	Very stable output at high temperatures it can be used up to 1300°C. Good oxidation resistance. Type N stands up to temperature cycling extremely well.
E	Temperature Range –40°C to +375°C Tolerance Value ±1.5°C Temperature Range 375°C to 800°C Tolerance Value ±0.004 |t|	–40°C to +333°C ±2.5°C 333°C to 900°C ±0.0075 |t|	–167°C to +40°C ±2.5°C –200°C to –167°C ±0.015 |t|	Has the highest thermal EMF output change per °C. Suitable for use in a vacuum or mildly oxidising atmosphere as an unprotected thermocouple sensor.
R	Temperature Range 0°C to +1100°C Tolerance Value ±1.0°C Temperature Range 1100°C to 1600°C Tolerance Value ±(1 +0.003 (t · 1100)°C	0°C to +600°C ±1.5°C 600°C to 1600°C ±0.0025 |t|	– – – –	Used for very high temperature applications. Used in the UK in preference to Type S for historical reasons. Has a high resistance to oxidation and corrosion. Easily contaminated, it normally requires protection.
S	Temperature Range 0°C to +1100°C Tolerance Value ±1.0°C Temperature Range 1100°C to 1600°C Tolerance Value ±(1 +0.003 (t · 1100)°C	0°C to +600°C ±1.5°C 600°C to 1600°C ±0.0025 |t|	– – – –	Type S has similar characteristics to Type R as shown directly above.
B	Temperature Range – Tolerance Value – Temperature Range – Tolerance Value –	– – 600°C to 1700°C ± 0.0025 |t|	600°C to +800°C ±4.0°C 800°C to 1700°C ±0.005 |t|	Type B has similar characteristics to Types R and S but is not so popular. Generally used in the glass industry.
G* (Formerly Code W)	Temperature Range – Tolerance Value – Temperature Range – Tolerance Value –	0°C to +425°C * ±4.5°C 425°C to 2320°C ±1.0%	– – – –	Formerly known as Code W. Tungsten Rhenium alloy combinations offer reasonably high and relatively linear EMF outputs for high temperature measurement up to 2600°C and good chemical stability at high temperatures in hydrogen, inert gas and vacuum atmospheres. They are not practicable for use below 400°C. Not recommended for use in oxidising conditions.
C* (Formerly Code W5)	Temperature Range – Tolerance Value – Temperature Range – Tolerance Value –	0°C to +425°C * ±4.4°C 425°C to 2320°C ±1.0%	– – – –	Formerly known as Code W5. See technical notes for Type G directly above.
D* (Formerly Code W3)	Temperature Range – Tolerance Value – Temperature Range – Tolerance Value –	0°C to +400°C * ±4.5°C 400°C to 2320°C ±1.0%	– – – –	Formerly known as Code W3. See technical notes for Type G directly above.

* Codes G, C and D and the tolerance values shown above are not officially recognised symbols or standards.
* Trade names.

Note A
1. The tolerance is expressed either as a deviation in degrees Celsius or as a function of the actual temperature.
2. Thermocouple materials are normally supplied to meet the tolerances specified in the table for temperatures above –40 deg C. These materials however, may not fall within the tolerances for low temperatures given under Class 3 for Types T, E and K thermocouples. If thermocouples are required to meet limits of Class 3, as well as those of Class 1 and/or Class 2, the purchaser should state this, as selection of materials is usually required.