Other Types of Thermocouples

Nicrosil-Versus-Nisil Thermocouples

Type K can be significantly impaired by two characteristic types of change which can occur in their temperature electromotive force characteristics, one, a gradual and generally cumulative drift in thermal EMF on long exposure at high temperatures, secondly, a short-term change in thermal EMF on heating in the temperature range approximately 250 to 550°C. The conventional nickel base thermocouples (T/C's) - though long accepted have suffered temperature dependent thermoelectric instabilities. To overcome these problems, resarchers developed the Nicrosil-verse-Nisil thermocouple. Given the letter designation Type N, Type N thermocouple has virtually the same EMF output as the Type K, and has been used in similar applications.

Physical Data

	NICROSIL	NISIL
Applications	Positive thermoelement	Negative thermoelement
Composition	Ni/14.2 Cr/1.4 Si	Ni/4.4 Si/.1 Mg
EMF*	Positive to Pt	Negative to Pt
Color Code	Orange	Red
Magnetic	No	No
Resistivity, ohms/cmf	560	220
Melting point, °C	1410	1400
Specific heat (cal/gm/°C at 20°C)	.11	.12
Density, 1b/cu in	.308	.314
Temp. coef. of resistance ohms/ohms/°C X 10^{-6}	+130	+1000
Thermal Conductivity (cal/sec/cm/°C)	.031	.055
Thermal coef. of expansion, X 10^{-6}, 20 to 100°F	13.3	12.1
Yield strength, psi	60,000	55,000
Tensile strength, psi	110,000	95,000
% elongation	30	35

*in accordance with NBS 161

Platinel *Thermocouples

This noble metal thermocouple combination, was designed for high temperature indication and control in turbo-prop engines. This type approximates within reasonable tolerances to the Type K thermocouple. The actual two types have been produced, they are called Platinel I and Platinel II. The negative thermoelement in both thermocouples is a 65 percent gold-35 percent palladium alloy (Platinel 1503), but the positive one in Platinel I is composed of 83 percent palladium, 14 percent platinum, and 3 percent gold (Platinel 1786), while that used in Platinel II contains 55 percent palladium, 31 percent platinum, and 14 percent gold (Platinel 1813). Platinel II is the preferred type and has better mechanical fatigue properties. The EMF output of these combinations differ very little.

*Trademark of the Englehard Industries, Inc.

Platinum 15 Percent Iridium-Versus-Palladium Thermocouples

The platinum 15 percent iridium versus palladium was developed for high EMF output. This combination combines the desirable characteristics of noble metals with a higher output signal.

Platinum 5 Percent Molybdenum-Versus-Platinum .1 Percent Molybdenum Thermocouples

Platinum alloys containing rhodium are not suitable for use under neutron irradiation since the rhodium changes slowly to palladium. This causes a drift in the calibration of thermocouples containing rhodium. However, this thermocouple is suitable in the helium atmosphere of a gas-cooled atomic reactors. It offers good stability at temperatures up to 2552°F (1400°C). The EMF output of the thermocouple is high and increases in a fairly uniform manner with increasing temperature.

Iridium Rhodium-Versus-Iridium Thermocouples

Iridium rhodium-versus-iridium thermocouples are suitable for measuring temperature to approximately 3632°F (2000°C), and generally are used above the range of platinum rhodium-versus-platinum thermocouples. They can be used in inert and vacuum atmospheres and in vacuum, but not in reducing, and they may be used in oxidizing atmospheres with shortened life span.

Iridium Rhodium-Versus-Platinum Rhodium Thermocouples

Platinum-40 percent rhodium alloy has been chosen by Lewis Research Center NASA as a substitute for an iridium thermoelement in combustor gas streams at pressures above 20 atmospheres and temperatures nearing 2912°F (1600°C). The thermocouple, consisting of a positive element of iridium 40 percent rhodium and a negative element of platinum 40 percent rhodium, showed reasonable oxidation resistance under these conditions.

Geminol Thermocouples**

The Geminol thermocouple was developed primarily for improved resistance to deterioration in reducing atmospheres. The positive thermoelement has been adjusted specifically to combat in reducing atmospheres the destructive corrosion known as "green rot". The substitution of an 80 percent nickel-20 percent chromium type alloy for conventional (Type KP) 90 percent nickel-10 percent chromium alloy positive thermoelement, and a 3 percent silicon in nickel alloy for the conventional (Type KN) manganese-aluminum-silicon in nickel alloy negative thermoelement, results in a more oxidation-resisting thermocouple.

**Trademark of the Driver-Harris Company