CONSTANTAN WIRE

AN INTRODUCTION TO CONSTANTAN AND ITS APPLICATIONS

Constantan is a copper-nickel alloy containing approximately 56 per cent copper, 42 per cent nickel. It is manufactured under close control from electrolytic copper and pure nickel, and is available in the form of wire.

Characteristics

Constantan has a number of special characteristics - some electrical, some mechanical - which makes it a remarkably versatile alloy. For certain applications, its high specific resistance and negligible temperature coefficient of resistance are its most important attributes. For others, the fact that Constantan offers good ductility, is easily soldered and welded and has good resistance to atmospheric corrosion is more significant.

Uses

Although the range of applications of Constantan is so wide, its uses fall into three principal categories.

First and foremost, it is an ideal alloy for winding heavy-duty industrial rheostats and electric motor starter resistances. High specific resistance, together with good ductility and resistance to corrosion are all-important requirements in this category, and Constantan satisfies the most demanding specifications. For such uses, Constantan is normally called for in the larger sizes of wire.

Secondly, Constantan is widely used in wire-wound precision resistors, temperature stable potentiometers, volume control devices and strain gauges. In the resistor field, its high resistance and negligible temperature coefficient of resistance are its main attractions. Many of these components are subject to quite wide variations of temperature and it is often vital that there should be a minimal change in resistance. Constantan meets such a requirement admirably.

The third main category of application exploits another characteristic of Constantan. This is the fact that it develops a high thermal E.M.F. against certain other metals. Constantan is therefore commonly used as a thermocouple alloy, in conjunction with copper up to 400^{0}C and with iron up to 800^{0}C.

PROPERTIES	Unit	Constantan
Nominal Composition	Nickel Manganese Iron Copper	42 per cent 1.25 per cent 0.25 per cent Balance
Nominal Specific Resistance at 20°C	Ohms per circular mil-foot Ohms per square mil-foot Microhm-cm	294 231 49
Temperature Coefficient of Resistance, Mean Value 20-100°C	Per degree C	±0.00002 %
Specific Heat	J/kg/°C	395
Thermal Conductivity at 100°C	W/m/°C	25.3
Melting point (approx.)	Degrees C	1210
Nominal Coefficient of Linear Expansion, Mean Value 20-200°C	Per degree C	0.0000145
Tensile Strength, Annealed	N/mm^2	480
Specific Gravity	g/cm^3	8.90

FACTORS FOR DETERMINING RESISTANCE AT TEMPERATURE

Temperature Degrees C	Resistance in ohms
20	1.000
100	1.002
200	1.002
300	1.001
400	1.005
500	1.017

Current/Temperature Characteristics

These values apply only to straight wire stretched horizontally in free air.

			Temperature				
Degrees C			100	200	300	400	500
	Diameter						
SWG	mm	in	Amperes necessary for given temperatures				
16	1.626	0.064	9.60	17.8	24.8	31.2	36.1
20	0.914	0.036	4.18	7.80	10.85	13.6	15.8
30	0.315	0.0124	0.91	1.73	2.39	3.00	3.46
32	0.274	0.0108	0.74	1.35	1.96	2.45	2.84
34	0.234	0.0092	0.60	1.09	1.57	1.95	2.26
36	0.193	0.0076	0.45	0.84	1.18	1.47	1.70

Resistance and Weight Data

Specific resistance 49 microhm-cm or 294 ohms per circular mil-foot at 20°C.

	Diameter		Superficial Area	Resistance per unit length		Weight		Length	
SWG	mm	in	cm^2/m	ohms/m	ohms/ft	g/m	1b/1000ft	m/kg	ft/lb
16	1.626	0.064	51.08	0.2355	0.07178	18.48	12.41	54.13	80.58
20	0.914	0.036	28.71	0.7445	0.2269	5.847	3.927	171.0	254.6
30	0.315	0.0124	9.896	6.273	1.912	0.6939	0.4660	1,441.0	2,146.0
32	0.274	0.0108	8.608	8.271	2.521	0.5261	0.3533	1,900.0	2,830.0
34	0.234	0.0092	7.351	11.40	3.474	0.3819	0.2565	2,619.0	3,899.0
36	0.193	0.0076	6.063	16.70	5.090	0.2606	0.1750	3,838.0	5,714.0