



BASIC CONSTRUCTION

Wirewound resistors usually consist of a substrate of high grade special ceramic material of high mechanical stability onto which is wound, at constant pitch, a single layer wire or ribbon resistance element.

For less demanding applications a glass fibre cord is used as a substrate instead of the ceramic material (Types SKA... KKA).

The ends of the winding are attached to the external terminations via caps or lugs by welding or hard soldering, thus providing reliable electrical and mechanical internal connections. The resistance elements are protected by a coating of cement or glaze against adverse mechanical and environmental conditions.

RESISTOR MATERIALS

Special alloys with different specific resistance are used as wire material for the resistance elements. Most commonly used are:

WM 50 (Class 1)

Copper nickel alloy with small additions of manganese (without iron and zinc) is preferred for cemented types.

The medium temperature coefficient is:

-10 ... -80x10⁻⁶/K between +20°C ... +150°C,
DIN designation CUNi 44.

WM 110 (Class 3)

Nickel chromium alloy with additions of iron is preferred for vitreous types, it is oxidation proof and antimagnetic.

The medium temperature coefficient is:

+100 ... +180x10⁻⁶/K between +20°C ... +150°C,
DIN designation NiCr 6015.

If special characteristics are requested, we can also use other resistance wires upon request.

In addition to round wires, elements based upon ribbon shaped materials are available. In these the ribbon is corrugated and wound edgewise onto the substrate to maximise the amount of material that can be applied in a single winding (Types GBS ... ZBS ...).

For low resistance values the alloy WM 10 (copper nickel) with a temperature coefficient of +650 ... +750x10⁻⁶/K, DIN designation CUNi 6 is offered.

SURFACE PROTECTION

The coating applied on wirewound resistors (glazing, cement, lacquering) fixes the winding mechanically and prevents short-circuits. It protects the resistance elements against mechanical damage and detrimental contamination by the environment. The protective coating also provides electrical insulation.

GLAZING

For types in the ranges G ..., GWS, GW, GWK, RW only high quality special glazes are used. The temperature changes occurring frequently during operation should not cause any cracks in the glaze and the resistance element must remain encapsulated.

Moreover at high temperatures and d.c. current load no electrolytic effects should occur. Our glaze provides a high dielectric strength and a high insulation resistance and it is also resistant to all the usual washing and cleaning chemicals.

CEMENT

The principal material is a phosphate cement which is resistant to mold and termites and has been well proved over many years. Owing to the fine grain structure of the cement, cemented wirewound resistors generally cannot be designated as absolutely suited for tropical i.e. high humidity environments.

RESISTANCE VALUE

Rated Resistance

Rated resistance is the value marked on the components.

Critical Resistance Value

Critical resistance is that resistance value at which the rated voltage has the same value as the maximum permissible continuous voltage.

Tolerance

Tolerance is the permissible deviation from the rated value.

Resistance Ranges

Preferred resistance values are those of the ranges E 12, E 24 and E 48 as per IEC 63.

Rated Load

The rated load is defined in the catalog at an ambient temperature of 70°C (40°C, 25°C) at which it is ensured that the fixed stability limits of the specification are not exceeded.

Temperature Coefficient of Resistance Value

The temperature dependence of the resistance value is usually defined as temperature coefficient. Temperature coefficient is the quotient of the relative resistance change

$\Delta R/R$ and the temperature difference thus.

$$TC [ppm] = \frac{\Delta R}{R} \times \frac{1}{\vartheta} \times 10^6$$

The temperature coefficient is stated in ppm (parts per million) and refers to a temperature difference of 1 Kelvin.

Temperature Characteristic

The temperature dependence of the resistance value can also be defined as temperature characteristic. The temperature characteristic is the reversible change of resistance value appearing in a defined temperature range and is expressed in %.

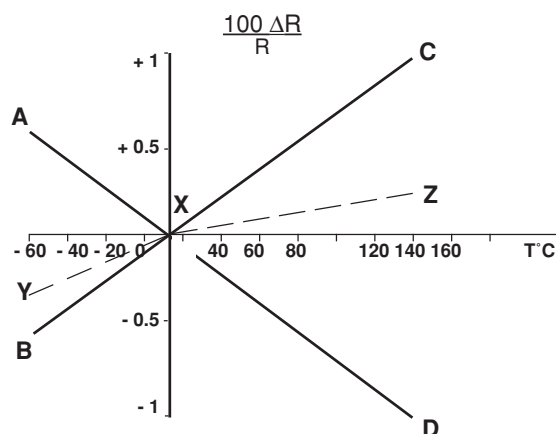
$$\text{Characteristic [\%]} = 100 \times \frac{\Delta R}{R}$$

Diagram

A, B, C, D represent the limits of the resistance change at the lower and upper category temperature.

AX, BX, XC, XD are the limit curves over the total temperature range.

YX/XZ is an example of the course of resistance change of a resistor with non-linear temperature coefficient.



DERATING CURVE

This curve shows the maximum permissible loss as a function of the ambient temperature.

LIMITING VOLTAGE IN CONTINUOUS OPERATION

This voltage is the maximum permissible operating voltage which may be applied continuously to the resistor without exceeding the maximum temperature in the middle of the resistor. This means that starting on the “critical” resistance value the load decreases with increasing resistance values.

D.C. STABILITY

Resistors of the type ranges GWS, GW and GWK were formerly produced in a.c. and d.c. versions. With a.c. resistors a d.c. operation caused an electrolytic reaction, the consequence of which could be a breakdown of the winding. To avoid this effect we now only produce resistors suited both to a.c. and d.c. operation. It is therefore no longer necessary to specify a.c. or d.c. operation when ordering.

STABILITY IN TROPICAL SURROUNDINGS

Vishay vitreous wirewound resistors have a fully sealed coating, i.e. all parts of the resistance element are entirely protected against atmospheric oxygen and influence of humidity.

ADJUSTABLE RESISTORS

The tap position may only be changed by completely loosening the sliding lug, and this should only be done when the resistor is not in operation.

CHARACTERISTICS - PARAMETERS							
MODEL	ENDURANCE		SHELF LIFE	DAMP HEAT, STEADY STATE			
	1000h $\frac{\Delta R}{R}$ [%]	5000h $\frac{\Delta R}{R}$ [%]	5000h @ 25°C $\frac{\Delta R}{R}$ [%]	40°C 95% $\frac{\Delta R}{R}$ [%]	112d	56d	21d
G 20	≤ 4	≤ 6	≤ 0.1	≤ 0.2		*	
GWS ...					*		
GWK...		≤ 3	≤ 0.1	≤ 0.2	*		
RW. / ..						*	
Z 30. Cl. 1		≤ 3	≤ 0.2				*
Cl. 3		≤ 3	≤ 0.2				*
ZWS... Cl. 1		≤ 2	≤ 0.1			*	
Cl. 3		≤ 3	≤ 0.2	≤ 1			*
ZWK... Cl. 1		≤ 2	≤ 0.1				*
Cl. 3		≤ 3	≤ 0.2				*
KKA..	≤ 3 ¹⁾ ≤ 5 ²⁾		≤ 1				*
KKE..	≤ 3 ¹⁾ ≤ 5 ²⁾		≤ 1				*
KKE..Si	≤ 2		≤ 1	≤ 2			*

¹⁾ at t = 70 °C

²⁾ for WM 10