

# Wire-wound Power Resistors Terminology Glossary

## **Ayrton-Perry Winding**

Winding of two wires in parallel but opposite directions to give better cancellation of magnetic fields than is obtained with a single winding.

Wirewound technology has long been known as a leading technology for power resistor needs. The most critical drawback with this technology is that it is inherently inductive. This is logical given that a wirewound inductor and a wirewound resistor are made with essentially the same materials and processes. This fact limits the use of wirewounds for applications with high switching speeds, which require low inductance.

Now the same standard wirewounds can be used for these applications by using a non-inductively wound version. This manufacturing method greatly reduces the inductance of any given resistor size and value combination, however it does not completely eliminate the inductance. A non-inductively wound wirewound has one winding in one direction and one in the other direction; known as Ayrton Perry winding. This non-inductive winding is available in all Token standard wire-wound resistor series.

## **Dynamic Braking Resistors**

Dynamic braking resistors are used on VFDs (AC variable frequency drives) to dissipate energy that is produced in the motor as the drive provides braking torque to stop the motor. The resistors are either used alone for decelerating or in conjunction with compressed air brakes for stopping. The excitation voltage of the traction motors generally comes from a static converter powered by the overhead catenary and operates as a DC voltage transformer.

Token's BOX, and RNW wirewound resistors are used for most dynamic braking applications. These are conveniently provided on L-shaped mounting brackets or in standard enclosures with louvered or screened covers. For heavy duty applications that require even higher wattage, we recommend Token's Oval Edge-Wound DOE, and Power-Wound DST resistor elements.

## **Neutral Grounding Resistor**

A suitably rated power resistor that is connected between the neutral of a transformer (or generator) and the system ground. It serves to limit fault currents and prevent damage to the equipment.

## Rated Continuous Current

The current expressed in amperes (RMS), that the device can carry continuously under specified service conditions without exceeding the allowable temperature rise.

## What is a Ground Fault

A Ground Fault is an unwanted connection between the system conductors and ground. Ground faults often go unnoticed and can cause problems with plant production processes. They can also shut down power and damage equipment, which disrupts the flow of production leading to hours or even days of lost productivity.

Undetected ground faults pose potential health and safety risks to personnel. Ground faults can lead to safety hazards such as equipment malfunctions, fire and electric shock. Ground faults cause serious damage to equipment and to your processes. This damage can seriously affect your bottom line.

## Power Dissipation

This is a measure of the amount of power that a resistor can dissipate without causing it to overheat. Resistors are manufactured in standard power ratings and mostly these are in fractions of 1 Watt with some larger carbon and metal resistors available in 1 Watt to about 5 Watts. Higher power ratings are available. Wirewound resistors are normally available in power ratings of up to about 50 W. However, industrial wirewound types are made by component manufacturers in much higher power ratings to the specification of the customer.

## Industrial Variables & Adjustable Wirewound Resistor - Resistive Controls

Controls that produce a varying voltage using resistance are called either adjustable or variable resistors (potentiometers). Although both types of control may be functionally the same, it is the way they are connected that differentiates between the two types.

A common construction is for the control to have three connections. One connected to a sliding contact called the wiper and the other two to either end of a fixed resistor called the track. The wiper is able to be moved along the track either by use of a linear sliding control or a rotary “wiper” contact. Both linear and rotary controls have the same basic operation.

## High Power Wirewound Resistors

Industrial high power wirewound resistors are high temperature, high power non-inductive resistor types generally coated with a vitreous or glass epoxy enamel for use in resistance banks or DC motor/servo control and dynamic braking applications. The resistance wire is wound around a ceramic or porcelain tube covered with mica to prevent the alloy wires from moving when hot. Wirewound resistors are available in a variety of resistance and power ratings. With one main use of High Power Wire-wound Resistor is in the electrical heating elements of an electric fire which converts the electrical current flowing through it into heat with each element dissipating up to 20000W, (20kW) of energy.

Because the wire is wound into a coil, it acts like an inductor causing them to have inductance as well as resistance and this affects the way the resistor behaves in AC circuits by producing a phase shift at high frequencies especially in the larger size resistors. The length of the actual resistance path in the resistor and the leads contributes inductance in series with the “apparent” DC resistance resulting in an overall impedance path  $Z$ . Impedance ( $Z$ ) is the combined effect of resistance ( $R$ ) and inductance ( $X$ ), measured in ohms and for a series AC circuit is given as, Equation  $Z^2 = R^2 + X^2$ .

When used in AC circuits this inductance value changes with frequency (inductive reactance,  $X_L = 2\pi fL$ ) and therefore, the overall value of the resistor changes. Inductive reactance increases with frequency but is zero at DC (zero frequency). Then, wirewound resistors must not be designed into AC or amplifier type circuits where the frequency across the resistor changes. However, Token offers special wirewound non-inductive resistors winding Ayrton-Perry Method are also available for alternative choice.