

Resistive Load

Resistive loads can be purely resistive or of the tungsten-heater load type. A resistive load that has no heating element is the easiest for a switch to handle, and the switch's rating is based on this type of load. A resistive load is one in which 100% of the load is composed of resistive devices. Current through the contacts is constant throughout the make, carry and breaking actions for the switch. Contact erosion is very low for switching purely resistive loads .

Lamp Load

When a switch closes on a lamp load, the switch sees a short duration inrush current because the cold resistance of the lamp filament is very low. The surge current as the switch closes can be many times the steady state current. As the lamp filament heats up to operating temperature, the resistance of the filament increases and the current decreases to the lamp's rated steady state.

Motor

Motor loads present yet another brutal environment for switch contacts. Closing the switch contact on a motor start-up load causes very large current surges of about 3 to 8 times the running current.

Inductive Load

As a switch on an inductive load is opened, the inductor, or transformer, induces a counter option "voltage" in the circuit. This voltage opposes any change in the circuit current and can reach hundreds of volts. This extremely high voltage can restrike the arc as the switch contacts open resulting in severely eroded or welded contacts.

Capacitive

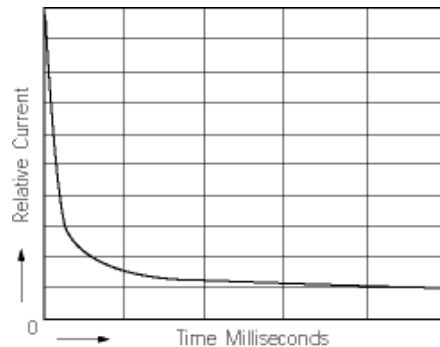
With such loads as DC power supplies, welding machines, and strobe charging units the inrush current is even more damaging than with inductive loads. To the switch a capacitive load appears as a dead short as the switch closes. In the first few milliseconds the inrush current can sometimes reach 100 times the steadystate current of the circuit. Even worse for the switch, this inrush occurs before the contact bounce has subsided. This produces severe arcing and contact erosion. The contacts may stick or weld upon closure and prevent the switch from opening.

INDUCTIVE DC LOADS

In AC circuits the voltage and current are varying in a sinusoidal pattern; both the voltage and current cross the zero reference 120 times per second for 60Hz. Therefore, probability of closing or opening a switch when the voltage and current are at their maximum in AC circuits is remote.

In DC circuits the voltage and current do not vary and are always at their rated levels.

Therefore, when opening or closing a switch on a DC load, the arc developed is more severe, more energetic, and lasts longer causing more contact erosion and a shorter switch life. A switch intended for a DC circuit should have its AC capacity rerated for DC.



Typical Tungsten Inrush Curve

OPERATING RANGE

Three contact materials are commonly used in switches: gold, silver, and gold over silver. These materials give the options of low level, power level, plus combined power and low level ratings.

Low Level ~ 0.4VA maximum @ 20V AC or DC maximum

Gold plated contacts are recommended for dry circuits, which are defined as very low energy. In circuits where the voltage is below 28 volts DC and current is below 100 milliamps (dry circuits), no arc develops as the contacts open or close. So, the tarnish remains. Eventually without the arc, the contacts become so encrusted that the switch is unable to close the circuit due to the high contact resistance. The solution to this is plating the silver contacts with gold,

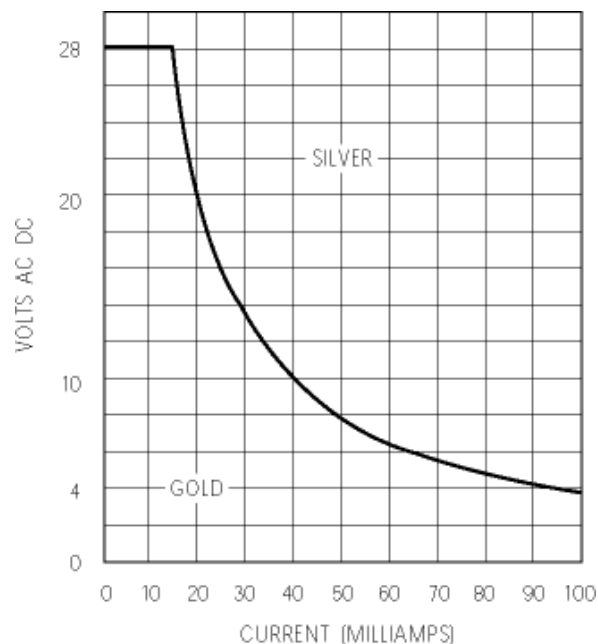
which does not tarnish. Gold plated contacts close under low voltage and low current conditions indefinitely, or for the mechanical life of the switch.

Power Level ~ 100mA to 10 amps @ 125V AC

Silver contacts are recommended for electrical levels above 0.4VA. Although silver tarnishes, it is a good conductor and this electrical energy is sufficient to break through the tarnish to give reliable performance. The oxidation which coats the contact surfaces with a hard layer of insulative contamination is removed by arcing. In circuits where the voltage is above about 12 volts DC and the current above .5 amps, an arc develops during opening or closing of the contacts. This arc keeps the oxidation cleaned off.

Power or Low Level

Gold over silver contacts are used in applications requiring both dry and power circuits. Gold over silver contacts have dual ratings as further described below.



DUAL RATINGS

The dual rated option is suitable where identical switches are used in both a logic and a power level circuit within the same application. Dual rated switches enable the user to install the same switch in both a logic level (dry circuit) and a power level circuit.

Once a dual rated contact material switch has been used at a power level it cannot then be used at a logic level. The gold over silver contact material provides a reliable, tarnish free, contact surface for logic level switching. When a gold-placed over silver switch is used in power level circuit, the gold plating is removed by contact arcing. If an attempt is then made to use this same switch in a logic level circuit (where no arcing occurs). The low current condition cannot provide adequate contact wiping or cleaning.