2.2 CONSTRUCTION

2.2.1 MATERIAL CONTACT

Before the development of silver electrical contacts, the first electric thermostats used mercury. Liquid mercury, enclosed in a glass bulb having two electrodes, established the contact between them by tilting, or more simply, a metal needle, by its movement, established the contact with the surface of the mercury.
Electrical contacts are currently rivets made of pure silver, or slightly alloyed with other metals or oxides (Cadmium, Nickel, Tin,)
Silver was chosen because it is the best known conductor of heat and electricity. Contact wears by micro vaporization at each open and close cycle. This vaporization is proportional to the strength and duration of the electric arc.
The thermal conductivity of the silver allows it to quickly evacuate the peak temperature occurring during opening of the contacts.
Its very good electrical conductivity allows for devices with very low contact resistance, generally less than 3 milliohms.
However it is not stainless and is gradually covered by a thin layer of silver oxide which is not electrically conductive.
This layer is easily vaporized during use in common household voltages (120V, 230V). However, for use in low voltage (less than 12V) and very low currents (a few milliamperes), the arc created when opening the contact is not sufficient to vaporize the contact.
This is the reason why, for low-power circuits, the contacts are protected against the oxidation by a thin layer of gold.

2.2.2 CONTACT GAP

After opening, the contacts are spaced by a gap. This gap, according to the device may vary from 1/10th to 3mm or more. An usual value in thermostats is 0.3 to 0.4 mm, which corresponds to micro-disconnection requested by electrical standards .
Smaller gap, which is the mechanical requirement to make low differential devices (see definition belows) cannot be used in high voltages, because, although there is no mechanical contact between the 2 contacts, an electrical arc can spontaneously appears in 380 or higher voltages: just adverse weather conditions such as high relative humidity may be sufficient.
A method to increase the contacts gap without requiring thermostats to provide significant movement, is the double break, used on some manual reset thermostats, which also reduces the risk of contact welding

2.3 CONDITIONS OF USE AND ELECTRICAL LIFE

In the specifications for an electromechanical thermostat, the expected life is described in terms of mechanical and electrical.
Electrical life :
This is specified as a minimum number of cycles (action of opening and closing) will make, carry, and break the specified load without contact sticking or welding, and without exceeding the electrical specifications of the device.
Mechanical life:
This is the number of operations which a thermostat can be expected to perform while maintaining mechanical integrity. Mechanical life is normally tested with no load or voltage applied to the power contacts, and is not part of this document.
Switch performance is influenced by a variety of factors, including: frequency of operation, type of load, temperature, humidity, altitude. Electrical ratings are been tentatively standardized in UL 1054, CSA22.55 or IEC61058-1 (Switches for appliances). IEC60730-x standards have specified testing methods and preferred electrical life classes for electrical control and safety switches. These life classes are (cycles):
300 000, 200 000, 100 000, 30 000, 20 000, 10 000, 6 000, 3 000 (1), 1000(1), 300 (2), 30(2)(4), 1(3).
1) Not applicable to thermostats or to other fast cycling actions.
2) Applicable only to manual reset.
3) Applicable only to actions which require the replacement of a part after each operation.
4) Can only be reset during manufacturer servicing.
The rating tables should be considered as working maximum for most applications. Hereunder are given some limitations that apply when they are used in other loads and voltages.
The current rating of thermostat switches is given in their technical data sheets for a resistive load in 250 or (and) 400V AC and a specified number of operations. When there is enough room, these values are printed on the product. In most of case, only the minimum mandatory information is printed. The cycle number is exceptionally printed, but this is one of the most critical parameter to estimate the expected life of the thermostat.

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