

Description of temperature controls

Electromechanical devices



Disc thermostats

Used as control thermostats or as a safety thermostat with manual reset, these thermostats have a disc made of two different metals laminated together for temperature sensing element. These two metals have different expansion coefficients. Therefore a bulging disc will gradually change shapes with increasing temperature until it suddenly goes from concave to convex. It takes the same way to its original form when temperature drops. This sudden change activates a contact blade. These thermostats exist with single two or three pole contacts. Technology to obtain accurate temperatures and low differentials is complex and few manufacturers offer accurate values and low differentials. JPC is one of the very few manufacturers offering three poles models.



Bulb and capillary control thermostats

The bulb and capillary thermostats are composed of a closed chamber with a bulb, a capillary and a metal bellows. The liquid (or sometimes gas) located inside this enclosure, expands depending on the temperature and deforms the bellows. This deformation is transmitted to a snap-action switch mechanism. The displacement of the bellows by a threaded shaft allows temperature adjustments. A capillary breakage causes the loss of filling fluid, and in general in this case, the contact remains closed. The most common ranges go from -35 to +320°C. Higher set points up to 750°C are possible but they require capillary liquids that withstand these temperature without boiling. JPC is one of the very few companies manufacturing these models. These high temperature versions (ranges above 400 °C) use a liquid metal as filling liquid, usually a Sodium Potassium eutectic. In case of breakage of the bulb or the capillary, this product is flammable on contact with water or atmospheric moisture. It is therefore necessary to take this point into account in their applications.

The capillary thermostats are subject to parasite drift due to temperature variations on the capillary and the bellows. The bulb and capillary thermostat differential is usually not adjustable, and is about 2.5% of the temperature range. They are available in single pole or three pole versions.



Bulb and capillary thermostats with explosion proof electrical contacts

Built on the same mechanical basis than the standard thermostats, and achievable within the same temperature ranges, these thermostats use an explosion-proof micro switch which is a unique design concept developed by JPC. The advantage of this system is to avoid heavy and expensive IIB or IIC metal boxes, and to allow temperature set point adjustment without the need to switch off the electrical power supply. The thermostat can be fitted in Y8 series standard waterproof enclosures, but its output cable connection must necessarily take place in an "increased safety" enclosure or outside the hazardous areas. The most recent versions include a built in increased safety enclosure. Depending of models, electrical rating can go from 5A 250V SPDT to 15A400V SPDT. 2 poles versions are also available.



Liquid expansion bulb and capillary cut-outs with fixed temperature setting

These devices operate on a principle similar to the liquid expansion bulb and capillary thermostats and are not adjustable. They include a reset button to close the electrical contact when it has opened after a temperature rise.

There is one variant of these cut out, with a fail-safe mechanism. It automatically opens the contacts if the capillary or bulb are leaking or cut.

The Diastat membrane is artificially inflated. Leakage causes the bursting of the membrane below its nominal thickness at room temperature, and a special mechanism will detect the abnormal displacement, which is similar to a very low ambient temperature sensing. The disadvantage of this system is that these fail-safe limiters also switch off when the ambient temperature drops below a certain value, generally between -10 and -20 °C.

The artificial inflation of the membrane also greatly increased the volume of liquid it contains, thus makes them highly sensitive to temperature, with temperature drifts up to 0.3 °K / °K.

They can be used as a high limit safety device in addition to a mechanical thermostat or an electronic controller. They are available in single pole, two, three or four poles versions. They usually only have open on rise contacts.



Liquid expansion bulb and capillary cut-outs with adjustable set point

These devices operate on the same principle as the control thermostats, but feature a reset button to close the electrical contact when it opened after a temperature rise. They can be used as an overheating safety system behind a mechanical thermostat or an electronic controller. JPC is one of the few manufacturers offering this kind of thermostats with the same adjustment ranges than the control thermostats, and a change-over contact (which enables to signal a defect without relaying), and with ranges up to 750 °C.



Limiters bulb and capillary fixed temperature, vapor pressure (also called boiling)

These devices operate on a different principle than liquid expansion thermostat. They use a simple mechanism, invented 50 years ago by the Wilcolator company, combining the snap action of a bumped disc actuated by the huge pressure increase due to the boiling of liquid in a closed chamber. This design concept provides very simple mechanisms. Technology lies in the selection of liquids with different boiling points. Operating temperatures ranges are linked to the liquid used and its boiling temperature. Capillary length is also limited due to pressure losses induced during boiling, hindering its operation.

It is necessary that a relatively large volume of liquid is boiled to cause the membrane tripping. This is the reason why the capillary end measuring temperature is spiraled. If the capillaries are not spiraled, at least 30cm of it must be immersed in the controlled liquid. They are never adjustable and have a reset button to switch one the electrical contact when it is open as a result of an increase in temperature. As the filling is carried out under vacuum, a leak in the train thermostat triggers the mechanism. Unlike liquid filled systems sensitive to changes in temperature, they do not trigger when the temperature drops below a limit. However, they are slightly sensitive to changes in atmospheric pressure, which limits their use in altitude. They can be used as a safety system of a mechanical thermostat behind overheating or an electronic controller. They are available with single pole, 2, 3 and 4 poles contacts. They usually have open on temperature rise contacts. Some models developed by JPC have SPDT and DPDT contacts.



Failsafe bulb and capillary cut out with explosion proof switch

Built on the same mechanical base than failsafe boiling cut-outs, and achievable within the same temperature ranges, these thermostats use an explosion proof switch. The advantage of this system is to avoid heavy and expensive IIB or IIC explosion proof housings. The thermostat output cable connection must necessarily take place in an "increased safety" enclosure or outside the hazardous areas. The most recent versions include a built in increased safety "e" enclosure. Depending on models, electrical rating can go from 5A 250V SPDT to 15A 400V SPDT. 2 poles versions are also available.