Design Engineer's Guide to Series 11 Bimetallic Temperature Switch Selection

Introduction

Bimetallic temperature switches are widely used in OEM systems requiring passive thermal control. Their simplicity, low cost, and reliability make them ideal for non-electronic sensing environments. This guide expands on prior documentation to provide a comprehensive design perspective for engineers considering the Series 11 temperature switch from Compac Engineering, including the PEPI slow-action bimetallic switch used in the 11-800 model, encapsulation material effects, and dynamic response behaviors.

Operating Principle of the PEPI Bimetallic Switch

The PEPI slow-action switch is based on a curved bimetal disc consisting of two metals with different thermal expansion rates. As temperature increases, the disc gradually bends until it actuates a contact. This 'creep-action' mechanism provides tight tolerance and minimal contact bounce but results in slower response times than snap-action variants.

The actuation temperature is calibrated during manufacturing, and the PEPI device may offer +/-5°C accuracy, depending on model and configuration. Reset behavior (the temperature at which the switch re-opens or re-closes) depends on both internal hysteresis and external thermal gradients.

Encapsulation Effects from Plastic Housings

In the Series 11 assembly, the PEPI switch is encapsulated within a molded thermoplastic body. This enclosure serves both mechanical and environmental purposes but affects heat transfer and delay.

Key effects of housing materials include:

- - **Thermal Conductivity**: Plastics like PP, POM (Acetal), and PVDF act as thermal insulators compared to metals. This causes delayed actuation as heat must conduct through the plastic mass before reaching the switch.
- - **Material Thickness**: Thicker housings or designs with air gaps slow the transfer even further, adding lag.
- - **Fluid Coupling**: If the switch housing is in direct contact with a flowing liquid, heat transfer may improve. However, stagnant fluid zones or surface fouling can impair this effect.

Comparison of Housing Materials

The following thermoplastics are used in Series 11 switch variants:

- - **Polypropylene (PP)**: Low cost, chemically resistant to water-based and mildly acidic fluids. Max operating temp: ~100°C. Low thermal conductivity and slow heat transfer.
- - **Acetal (POM)**: High mechanical strength and dimensional stability. Good chemical resistance to hydrocarbons. Thermally stable to ~110°C. Slightly higher conductivity than PP.
- - **PVDF (Kynar)**: Highly resistant to strong acids, oxidizers, and solvents. Operates to 150°C. Very low permeability and high durability. Still thermally insulative.

Effect of Rate of Temperature Change

Due to the creep-action mechanism and housing thermal resistance, the switch response is not instantaneous. The following behaviors must be considered:

- - **Rapid Temperature Rise**: If liquid temperature rises quickly, the internal switch may lag behind. In this case, actual actuation may occur several degrees above the nominal setpoint.
- - **Slow Temperature Rise**: A gradual increase gives the switch time to thermally equalize with the fluid, resulting in actuation closer to the marked setpoint.
- - **System Inertia**: Plastic thermal mass and enclosure geometry add delay. This must be factored into setpoint selection, especially in fast-reacting systems.

Recommendations for Design Engineers

When specifying a Series 11 temperature switch, engineers should:

- - Select a switch rated 3–5°C lower than the desired system control point for fast-heating environments.
- - Consider Acetal or PVDF housings for better thermal transfer or harsher chemicals.
- - Use direct immersion mounting or ensure housing is fully wetted for optimal response.
- - Test the assembled system for real-world thermal lag. Adjust final setpoint selection based on observed behavior.

Conclusion

The Series 11 bimetallic temperature switch offers dependable, passive temperature control. However, the plastic encapsulation significantly influences response behavior. Proper understanding of thermal lag, fluid dynamics, and material selection is essential to choosing the correct setpoint. PEPI’s precision-engineered switch elements, combined with proper enclosure selection, can meet demanding industrial needs when applied thoughtfully.