

## **9.Heat transfer fluid**

In addition to the recommended silicone oils, other fluids may also be used with this calibration bath. Different fluids have different properties and may be more suitable for specific applications. This section will provide information about the properties of the fluid to select proper fluid for operating ADT835.

### **9.1.1 Temperature range**

Temperature range is often the most important consideration when selecting a heat transfer fluid. The recommended silicone fluid is one of the few fluids that can be used over the entire temperature range of ADT835 and is one of the safest fluids for calibration applications due to its low flammability, reactivity, and toxicity.

Fluids often become too viscous or freeze below the lowest usable temperature. At the highest temperatures, fluids may begin to oxidize, deteriorate, polymerize, volatilize, smoke, or burn.

The bath must be operated within the safe and usable temperature range of the fluid being used. The lower limit of the fluid's temperature range is determined by the fluid's freezing point or the temperature at which the fluid becomes very viscous. The upper limit is usually limited by conditions such as evaporation, flammability, or chemical decomposition of the fluid. Evaporation of the fluid at higher temperatures may affect temperature stability because condensed fluid can drip from the cover back into the bath.

If the bath temperature range is below the full temperature range of ADT835, limit it via the "Set point limit" (see "Temperature output" for details) so that the bath temperature does not exceed the safe operating temperature range of the fluid.

### **9.1.2 Viscosity**

Viscosity is a measure of the fluid's thickness and how easily it can be poured and mixed. Viscosity affects the temperature uniformity and stability within the bath. ADT835 performs best when the fluid viscosity is 50 centistokes or less. The lower the viscosity, the easier the fluid is to stir, and the better the temperature uniformity and stability.

Silicone oils become more viscous over time. Silicone oils operating near the upper end of their temperature range will quickly deteriorate and thicken. Check the fluid regularly to make sure it stirs easily and is below the viscosity limit.

Fluids with extremely low viscosities may splash when stirred vigorously. You may need to slow down the stirring speed.

### **9.1.3 Specific heat**

Specific heat is a measure of a fluid's ability to store heat. Heat capacity affects the rate at which this product heats or cools. Silicone fluid has a low heat capacity, allowing this bath to change temperature up to 2 times faster than other fluids, such as water.

#### **9.1.4 Thermal conductivity**

Thermal conductivity is a measure of how easily heat flows through a fluid. The thermal conductivity of a fluid affects control stability, temperature uniformity, and temperature stabilization time. In fluids with higher thermal conductivity, heat is dispersed faster, which uniformly improves the performance of the calibration bath.

#### **9.1.5 Thermal expansion**

Thermal fluid expands when heated. This can cause the fluid level in this bath to rise or fall as the temperature changes. Silicone fluids expand more than some other fluids. It is best to use an "Overflow Tank" to prevent the fluid from overflowing from the top of the bath. Check the fluid frequently and add fluid when the level drops below the "MIN" mark. If you do not use an overflow tank, be sure to pay close attention to the fluid level and remove any excess fluid to prevent it from overflowing from the edge of the bath.

#### **9.1.6 Resistivity**

Resistivity describes a fluid's ability to resist the flow of electrical current. In some applications (such as measuring the resistance of a temperature sensor), it is important that the fluid has little or no surge. In these cases, a fluid with an extremely high resistivity should be considered

#### **9.1.7 Life of heat transfer fluid**

Many heat transfer fluids degrade over time due to evaporation, water absorption, gelation, or chemical decomposition. Usually the heat transfer fluids degrade more significantly when used near their upper temperature limits. Heat transfer fluids with a higher temperature range can be changed less frequently.

#### **9.1.8 Safety**

When selecting a heat transfer fluid, there are always safety issues to consider. Some heat transfer fluids can be toxic, causing damage to the eyes, skin, or by inhaling their vapors. Ventilation must be used if hazardous or offensive vapors are produced. Heat transfer fluids can also be flammable, requiring specialized firefighting equipment and procedures.

An important property to consider is the flash point of the heat transfer fluid. The flash point is the temperature at which the vapor begins to burn when there is enough vapor, enough oxygen is present, and an ignition source is applied. The flash point can be open cup or closed cup, with the closed cup temperature always being lower than the open cup temperature. In the case of a calibration bath, both scenarios are possible. The closed cup temperature represents the vapor that is retained within the bath, while the open cup temperature represents the vapor that overflows the bath.

### 9.1.9 Silicone oil

Silicone oil is usually the best choice for the heat transfer fluid of ADT835. Silicone oil products have various temperature ranges and viscosities. As a general rule, please choose a heat transfer fluid with the highest temperature range and a viscosity that does not exceed 50 centistokes at the lowest operating temperature.

The following table lists some physical property data of silicone oil in the same series as our recommended heat transfer oil for user reference

Table 69 Physical property data of silicone oil

| Parameters                        | Unit            | 5.0 cSt | 10.0 cSt | 20.0 cSt | 50 cSt            | 100 cSt             | 200 cSt            | 350 cSt            |
|-----------------------------------|-----------------|---------|----------|----------|-------------------|---------------------|--------------------|--------------------|
| Specific gravity at 25°C          | -               | 0.913   | 0.935    | 0.949    | 0.96              | 0.964               | 0.967              | 0.969              |
| Flash Point, Closed Cup           | °C              | 134     | 211      | 246      | 318<br>(open cup) | > 326<br>(open cup) | ><br>326(open cup) | ><br>326(open cup) |
| Acid Number, BCP                  | trace           | trace   | trace    | -        | trace             | trace               | trace              | trace              |
| Melt Point                        | °C              | -70     | -60      | -52      | -41               | -28                 | -27                | -26                |
| Pour Point                        | °C              | -100    | -100     | -84      | -70               | -65                 | -65                | -50                |
| Surface Tension at 25°C           | dynes/cm        | 19.7    | 20.1     | 20.6     | 20.8              | 20.9                | 21                 | 21.1               |
| Volatile Content at 150°C         | %               | 4.5     |          |          | 0.3               | 0.02                | 0.07               | 0.15               |
| Viscosity Temperature Coefficient |                 | 0.55    | 0.56     | 0.59     | 0.59              | 0.6                 | 0.6                | 0.6                |
| Coefficient of Expansion          | cc/cc/°C        | 0.00105 | 0.00108  | 0.00107  | 0.00104           | 0.00096             | 0.00096            | 0.00096            |
| Thermal Conductivity at 50°C      | g cal/cm·sec·°C | -       | 0.00032  | 0.00034  | 0.00037           |                     |                    |                    |

### 9.1.10 Limitations and Disclaimers

Every effort has been made to ensure the accuracy of these graphs; however, no guarantee can be given as to the suitability of the data for a particular application. Operation near the limits of a property (such as flash point or viscosity limit) may result in loss of safety or degraded performance. Sources of information on certain properties may vary, and company's safety regulations and personal judgment regarding flash point, toxicity, etc. must be considered. Users should read the Material Safety Data Sheet (MSDS) and make your own judgment.

We assume no responsibility for suitability for an application or for any injury, damage to equipment, product, or facility arising from the use of these heat transfer fluids.