Thermobuffer Time Delay

Application Note

Overview

BAPI's Thermobuffer Temperature Sensor is used to simulate the temperature change of the contents of a freezer or cooler rather than the air temperature. The buffers are designed to be filled with food grade glycol (or can be left empty) to slow down the temperature response time. The slower response time eliminates temperature spikes associated with frequent door opening and decreases false alarms while maintaining long-term accuracy.

The Thermobuffer is available in three probe lengths: 1", 2" and 4" to offer various time delays. BAPI Thermobuffers save valuable shelf space by mounting to a wall or hanging from a clip. The unit is offered with a variety of temperature sensors and/or transmitters to interface with most monitoring systems and the buffer is available in machined 304 stainless steel or aluminum.

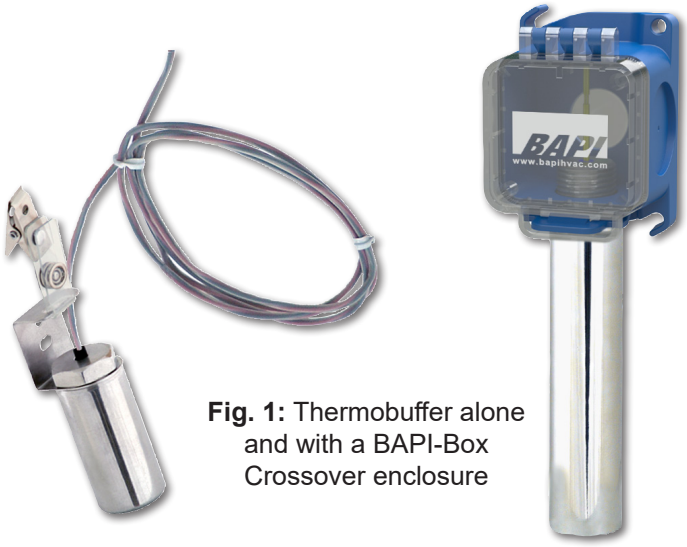
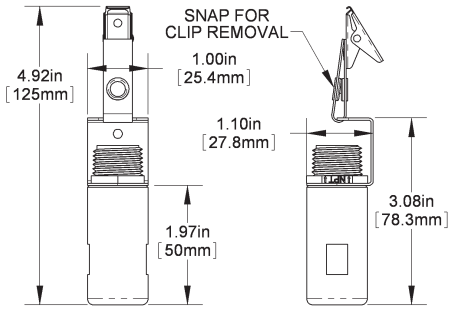
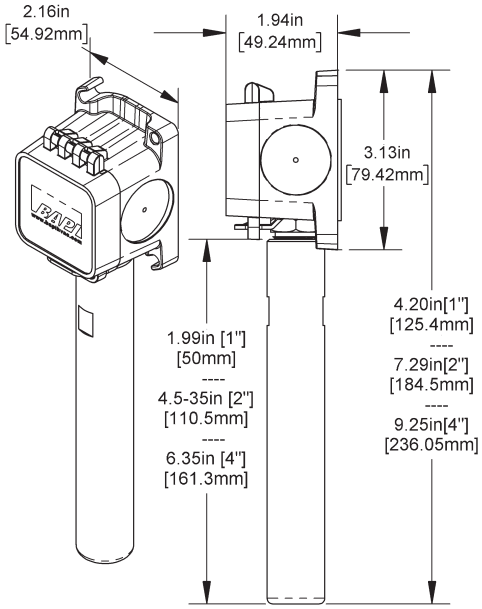


Fig. 1: Thermobuffer alone and with a BAPI-Box Crossover enclosure





Device Discussion

The greater the mass of an object, the slower the overall reaction time. This is why a low mass sensor like a thermistor bead has very fast reaction time. As more mass is added around the sensor to protect its delicate wire connections or ingress of water, the response time slows. The Thermobuffer takes advantage of this phenomenon to slow the temperature response time and mimic the slow temperature change of the contents in a refrigerator or freezer. This delayed response can never perfectly match the contents' response, but the concept can be used to prevent irritating high or low temperature alarms seen with lower mass sensors.

BAPI offers 1", 2" and 4" probes in buffers which can be filled with various liquids to further fine-tune the mass and alter the sensor response time. In this way the sensor can be made to more closely match the actual refrigerator contents being monitored. On the following page are the approximate delay times tested for the BAPI Thermobuffer.

Performance Chart Overview

The tables below show the approximate time delays for each buffer size using Food Grade Glycol, Water, Vegetable Oil or with a Dry (empty) buffer. The delay time constant listed is at 63.2% t which indicates that the temperature is 63.2% of the final step temperature change as the refrigerator door is opened. The step temperature used for the test below was 4°C to 24°C. However, the time constant is always the same whatever the temperature step change may be. The time constant is the same for both cold (refrigerator or freezer) and hot applications (incubator or paint booth).

APPROXIMATE TIME DELAY IN SECONDS

Sales Name	Description	Air	Veg. Oil	Glycol	Water
BA/*-TB-M304-1	1” SS buffer	419	810	968	1128
BA/*-TB-M304-2	2” SS buffer	1757	2277	2793	2836
BA/*-TB-M304-4	4” SS buffer	2470	3024	3937	4154
BA/*-TB-MAL-2	2” Aluminum buffer	1159	1810	1883	2382
BA/*-TB-MAL-4	4” Aluminum buffer	1832	2414	3120	3189

APPROXIMATE TIME DELAY IN MINUTES & SECONDS

Sales Name	Description	Air	Veg. Oil	Glycol	Water
BA/*-TB-M304-1	1” SS buffer	6:59	13:30	16:08	18.48
BA/*-TB-M304-2	2” SS buffer	29:17	37:57	46:33	47:16
BA/*-TB-M304-4	4” SS buffer	41:10	50:24	65:37	69:14
BA/*-TB-MAL-2	2” Aluminum buffer	19:18	30:10	31:23	39:42
BA/*-TB-MAL-4	4” Aluminum buffer	30:32	40:14	52:00	53:09

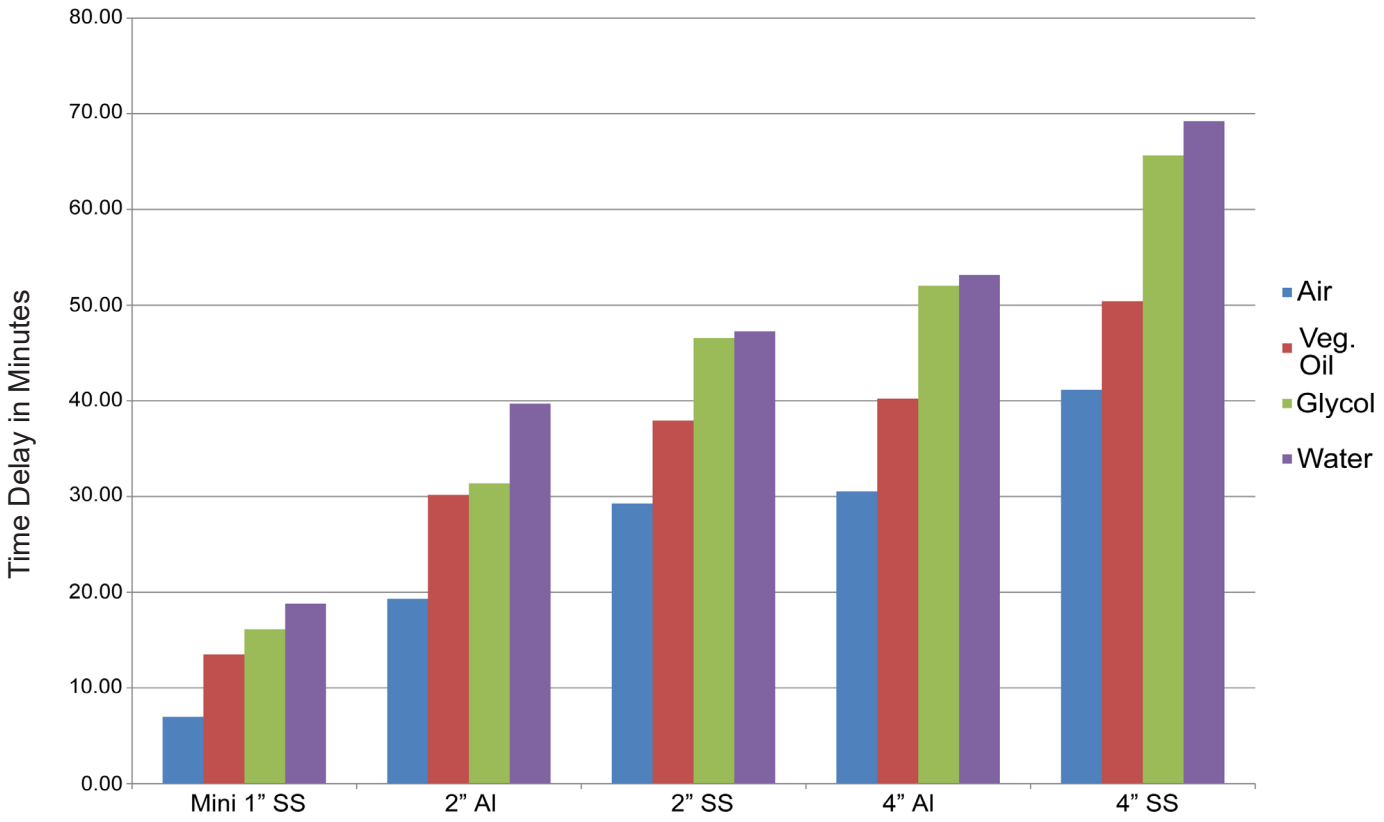
Notes:
1. A Bead Thermistor is about 5 seconds
2. The time above is equal to 63.2%t of the final temperature reading
3. The buffer will not work according to the table if the lowest possible temperature is below the freezing temperature of the liquid.

FREEZING POINT OF THE LIQUIDS ABOVE (OIL WILL NOT FREEZE BUT BECOMES A THICK SOLID)

Vegetable Oil	Water & Glycol 40%	Water & Glycol 50%	Water & Glycol 60%	Fresh Water	Sea Water (3.2%)	Saturated Salt Water (23.3%)
-4°F Solid	-8°F	-29°F	-55°F	32°F	28.4°F	-55°F

Performance Chart Overview continued...

Chart 1: Time Delay in Minutes for each BAPI Thermobuffer & Liquid



Thermobuffer Length and Material Type (at 63.2%t) SS = Stainless steel, Al = Aluminum

Notes:
1. The length in inches is the length of the probe used not the length of the buffer.
2. The buffer will not work according to the graph if the lowest possible temperature is below the freezing temperature of the liquid.

Conclusion

Most refrigerator applications will work best using the Mini 1" SS Thermobuffer hanging under the shelf. Large walk-in coolers have more mass and may have the door open for much longer for restocking, so a longer buffer time may work best.

Steps to determine the proper Thermobuffer to use:

1. Determine the normal time contents of the freezer/refrigerator.
2. In what time-span and what temperature would the contents in the freezer/refrigerator be in danger of spoilage?
3. Cut this time-span in half and select the Thermobuffer that best fits the halved time criteria.