Thermometer Specifications

The following are definitions and options that are important to know in order to select the best thermometer for the particular task:

1. **Temperature range:** The maximum temperature range of the application needs to be known to select the appropriate thermometer. In general, it is better to overstate the range slightly to allow some room for potential abuse. Another option is to identify a smaller range that is used 90% of the time and buy the majority of the units in that range to save cost, while getting a few more expensive units at the full range for the occasions that they are needed.

2. **Scale:** Some units come in Fahrenheit or Celsius exclusive forms, while others are user switchable. While it is nice to have both in a unit, if only one scale is commonly used, an non-switchable unit may be preferable to avoid confusion during usage.

3. **Accuracy:** Higher accuracy usually means higher price. The level of accuracy depends on the application. Generally ±0.5 to 1C accuracy is sufficient in the food industry whereas the pharmaceutical industry may require ±0.2 to 0.5C accuracy or better. It is important to note the scale used in comparisons though ±0.2C accuracy is not the same as ±0.2F accuracy.

4. **Resolution:** Often confused with accuracy, it is often 0.1 degree regardless of the accuracy. Many suppliers purposefully omit accuracy and list resolution on cheaper inaccurate product to make them look better.

5. **Water-Resistance:** Waterproof models are 2-3X the price of water resistant or not rated thermometers. However, if the application does involve exposure to water, the higher initial cost for a waterproof model may be worthwhile rather than having to constantly replace non-waterproof thermometers that fail from water exposure.

6. **Sensor Type (bimetal, type K, Pt100, Thermistors):**
   
a. Bimetal thermometers are the cheapest available by far and also the least accurate. Most plants are switching to digital, as they want better accuracy. Bimetals will go out of calibration by just being dropped so while they look durable they need to be continually rechecked and recalibrated. One feature is they all have a hex nut on the back that can be used to recalibrate them. (Problem is it can also be used to uncalibrate them) Also
although they state accuracies of ±2C the small dial and microscopic numbers and lines mean ±2C is typically wishful thinking. All our models have Lexan covers (some others actually have glass)

b. Thermistors are used in most pocket thermometers, dataloggers and some hand held thermometers. These use tiny resistor chips that respond to temperature changes to read the temperature. They are quite stable and rarely drift so recalibration is usually not needed or even advised. If they do start to drift it indicates damage and they should be replaced. This does not mean that calibration checks cannot or should not be done. The major disadvantage of thermistors is the range. They will at best operate from –80C to 150C (many have smaller ranges). The advantage especially for dataloggers is they consume very little power. The accuracy can vary from ±2C to very accurate ±0.1C or better depending on the thermistor make and model.

c. Thermocouples (type K, J, T etc.) –There are about 20+ different types of thermocouples available all with slightly different temperature ranges. The reason for this is to increase accuracy and allow use at higher or lower temperatures or for special use applications. We sell Type K thermometers as they are the most common and are reasonably accurate over a wide range. This technology measures the current flowing through 2 dissimilar metal strips bonded together. As temperatures change the coefficient of resistance changes through the 2 strips giving a change in the thermometer reading. The main disadvantage of thermocouples is if they are bent this coefficient will change throwing out the calibration. And probes tend to get bent a lot.

d. RTD (Pt100, PT1000) probes are usually regarded as the most accurate. This is because they use 4 wires versus 2 so if one wire is degraded (bending etc.) the other wires can be used to compensate. 2 & 3 wire models are also available but are less accurate. Typically these are used for high accuracy down to 0.01C accuracy. Pt100 thermometers and probes are usually more expensive also.

7. Features: (on/off, Min/max. etc) Thermometers, like most instruments, come available with a variety of features that usually mean a higher price as you want more. Note: more features are not always better as it can lead to confusion with end users.

a. On/Off: The most basic button allows users to turn unit on or off to save battery life. Many models also include Auto-Off feature that turns unit off after a certain period of inactivity to save battery life.
b. **C/F:** Centigrade/ Fahrenheit toggle button allows you to choose to view readings in C or F scale. Can be useful but also means if users do not make habit of confirming the scale readout is in, then you can get incorrect readings.

c. **Min/Max:** Minimum/Maximum button allows user to see the mum or maximum reading since unit was turned on or since unit was cleared. Some models have this function as you toggle through a feature button.

d. **Hold:** As the name says, this button when pressed holds the current reading. Used when taking multiple readings and you need to hold a reading to show to someone else.

e. **K, J, E, T:** Allows user to select type of thermocouple in use.

f. **0.1/1:** Allows user to select resolution of reading. Even if thermometer is not 0.1 degree accurate display can show this. Switching to 1 degree resolution means faster response instead of waiting for reading to stabilize.

g. **Low Battery Warning:** Not a button but a feature of some thermometers to indicate the battery is low and to change it as soon as possible.

h. **Dual Inputs:** Some thermometers have dual inputs to allow you to connect 2 different probes at the same time. This is useful for persons doing calibrations and/or checks of their probes or for HVAC applications doing differential temperature readings.

i. **Rubber Boot:** Optional or standard accessory with most hand held thermometers. Improves grip and drop shock resistance. Usually include flip out stand to allow thermometer to be placed on counter for readings at angle.

j. **Calibration nut/Offset adjustment:** Dial thermometers have a hex nut on the back to allow calibration adjustment (needed because they go out of calibration so easily). But also means they are easy to tamper with. Some digital thermometers come with offset screw on front or back for calibration adjustment. For thermocouples it is necessary as different thermocouples can vary and should be adjusted to the thermometer. Thermistors should not need adjustment and usually do not have offset adjustments. **Pocket thermometers** usually do not have them (normally thermistors used) but some do. Not a good idea as these are usually malfunctioning by the time they need recalibrated.

8. **Probe Type:** Probes come in a wide variety of types:

   a. Probe type should match thermometer E.g. Thermistor, Thermocouple JKET or PT100.
   b. **Usage:** Air, Penetration, Surface, General Purpose, Heavy Duty, etc.
   c. **Probe length:** Length of probe depends on customers needs. Note: the more of the probe immersed or inserted in the product the better
d. **Probe diameter:** The diameter will affect probe strength and responsiveness. Generally a wider diameter means less bending and breakage, but also means more mass and slower response.

9. **Durability:** Hard to define as a specification, but some instruments are built better than others and therefore survive drops or shocks better. With probes larger diameter or armored cables with stress relief connectors improve durability. Also rubber boots will improve shock resistant and grip.

10. **Traceable/ Serial Number:** In order to be traceable or certified, a unit will need a serial number. If it has been calibrated against an N.I.S.T standard it can be said to be traceable. Ideally a certificate with actual data should also be provided.

11. **Calibration/Certification:** Most instruments are factory calibrated to some degree but recent shipments seem to prove otherwise. Certification is usually extra and typically involves having the results of the calibration recorded and signed by a technician.