Newsletter

Choosing the right window for infrared temperature sensors

In some applications it is desirable or necessary to mount an infrared temperature sensor behind a window to protect it from particularly harsh environmental conditions; this is often the case when monitoring a process inside a furnace, oven or pressure vessel. However, it is important to know what type of window to use, as this can have a huge impact on the accuracy of the measurements the sensor makes.

If an application requires a window, the first thing to consider is that the infrared sensor used will need to have adjustable emissivity (as, for example, offered by the the PyroUSB series from Calex Electronics). This feature will be needed to compensate for the transmission losses in the window. The size of these losses will vary greatly with the window material used and its thickness, but there will always be some level of loss.

To calculate the emissivity value that should be used, the transmission of the window should be multiplied by the emissivity value of the target to be measured. Therefore:

Emissivity value to be used = Emissivity of target X Transmission of window

Material choice

The next, and possibly most crucial, aspect to consider is what material to use for the window. This will depend on the wavelength at which the infrared sensor operates, and the temperature and pressure the window itself will need to withstand. The table below shows the wavelength, transmission and maximum temperature at which some common window materials can be used.

Window Material	Transmission Range	Approximate Transmission	Maximum Temperature
Zinc Selenide (ZnSe)	4 to 14 µm	72%	250℃
Germanium (Ge)	2 to 14 µm	46%	70℃
Calcium Flouride (CaF2)	0.2 to 7 µm	94%	1200℃
Sapphire (Al203)	0.2 to 4.5 µm	85%	2000℃
Quartz Crystal (SiO2)	0.4 to 3 µm	92%	490℃

The environment in which the window will be placed will also impact on the selection of window material. For example, Zinc Selenide and Calcium Flouride are both water soluble so should not be used in areas where steam or water vapour will be present for extended periods of time.

Dimensions

Once the window material has been selected, the next consideration must be the dimensions of the window. The diameter used will depend on the field of view of the infrared sensor that will operate through it. The visible diameter of the window must be larger than the measurement spot of the infrared sensor. Therefore the amount of the window obscured by mounting must be added to the required visible diameter to ensure there are no obstructions to the sensor's field of view.

The thinner the window, the less the transmission losses will be. However, if the window will be under pressure, for example as part of a vacuum chamber, then the pressure it will need to withstand will have to be taken into consideration when specifying its thickness. For a circular window the thickness required to avoid deformation can be calculated using the equation below:

T = K x [(p x D^2)/S]^1/2

For a clamped window K = 0.866

D is the unsupported diameter

p is the pressure differential

For an unclamped window K = 1.06

T is the minimum thickness of the window

S is the apparent elastic limit

To provide the maximum possible transmission, windows should be kept clean and free of scratches. A lint-free cloth or air puffer should be used to remove loose particles from the surface.

All of these windows are available from Calex and, despite their exotic natures, are relatively inexpensive, especially when compared to the cost of repairing the lens of an infrared temperature sensor.

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