

Detecting elevated body temperatures is often our first line of defense

April 1st, 2020

Written by: ITM Instruments



➊ The use of these instruments for the detection of body temperature is paramount

Detecting a person's body temperature to ensure it's not elevated, is often the first line of defence against virus infection propagation. There are several instruments and methods that facilitate this; however, they lead to varying risks of exposure for the person initiating the measurement. Seeing as we offer several solutions that greatly limit the level of exposure and that quickly and accurately allow you to determine if an individual has an elevated body temperature, we've put together this informational package that walks you through your options and the correct use of these instruments and how to value the results they provide you with.

The purpose of this screening is to differentiate people who are well from those who have a fever, not to measure absolute body temperatures. The absolute error measured on both the threshold values and the subjects who are screened will be the same, as long as the camera temperature is stable.

The use of these instruments for this application is paramount, as such, our team of experts are trained and ready to answer your questions and provide you with all of the support you require.

Infrared temperature devices (IR thermometers and thermal imagers) are used more and more as a first line of defence against virus infection propagation. Even though infrared sensors cannot detect the virus and it can't measure internal temperature like a medical thermometer would, it can quickly and from a safe distance, distinguish potentially ill people. Most people with fever will normally have a higher body temperature, this relationship has been proven multiple times, to the point that now there are even some infrared devices that are FDA-certified to screen people in high traffic public areas.

The reason infrared devices work for this application is based on the fact that skin is a high emitter of infrared radiation, making it an ideal surface to measure. But like all technologies there are things we need to understand before using such a device. Most of those issues are simply due to our lack of understanding. Don't worry, we'll explain this all to you properly and it's going to make complete sense.

1. Internal temperature is normally warmer than surface body or skin temperature. Which makes sense when we think about it... our skin is used as an insulator, meaning the surface body temperature or skin temperature is in fact the result of the heat coming from within as it goes through layer of skin, grease, muscle, etc.
2. Surface temperature (body temperature) can be affected by the environment. Heat from the sun, wind, rain, etc.

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Given this, you must be wondering, how can we make it work? Let's dig in...

We now understand that the reading from those devices will be lower than from an internal temperature, so when we are scanning for body temperature, we cannot set our threshold to the internal body temperature. However, we can instead monitor the body temperature of multiple subjects and therefore come up with a base line. From that base line we can add a degree or two and look for people with a temperature above that base line. Plus "X" degree (up to the user to determine), the greater the delta (difference between the values) the more chance we will miss people with a light fever, and the lower the delta the more people we will put aside for further testing.

Since our body acts as an insulator, and the composition will be different from one area to the other, the surface temperature of our body won't be uniform. We will have an area giving us a lower body temperature and another area giving us a higher body temperature. Establishing that another factor for us to consider is the surface area our detectors cover. For example, a single point thermometer will use a fairly large surface and will establish an average of this area. In the image, we can see that that the temperature in the tear duct and the mouth are much higher than the temperature of the nose and cheek.

This doesn't prevent us from using single point sensor, however, we need to understand the importance of always pointing to the same area and from a very close distance. Ensuring we get the surface area as small as possible to avoid the cold spots from affecting our reading too much, and thereby reducing the average temperature the device will give us.



ⓘ The temperature in the tear duct and the mouth are much higher than the temperature of the nose and cheek

Using the right tools to get the best results

Infrared temperature sensors (IR thermometers) vs. thermal imaging cameras

Both IR thermometers and thermal imaging cameras are valued solutions for this application, each coming with their own set of advantages and disadvantages. The main advantages of an IR thermometer are: lower cost, better portability, ease-of-use, and quick response time. Their disadvantages vary depending on the specific model, as not all IR thermometers are created equal. An IR thermometer which has alarm settings as well as adjustable emissivity settings is ideal. Two additional factors to consider are the need for an operator to manually measure each person which increases the time to screen a large group, as well as the operator needing to be closer to the measurement subject (2 to 6 inches or (5 to 15 cm)). In comparison, a thermal imager can be operated remotely.

While thermal imaging cameras measure the tear duct, IR thermometers should be pointed at a person's forehead. While pointing the laser at a person's forehead is safe, the laser beam should never be pointed towards or close to a person's eye as it can lead to serious issues, including blindness. Therefore, it's extremely important to use caution when operating an IR thermometer.

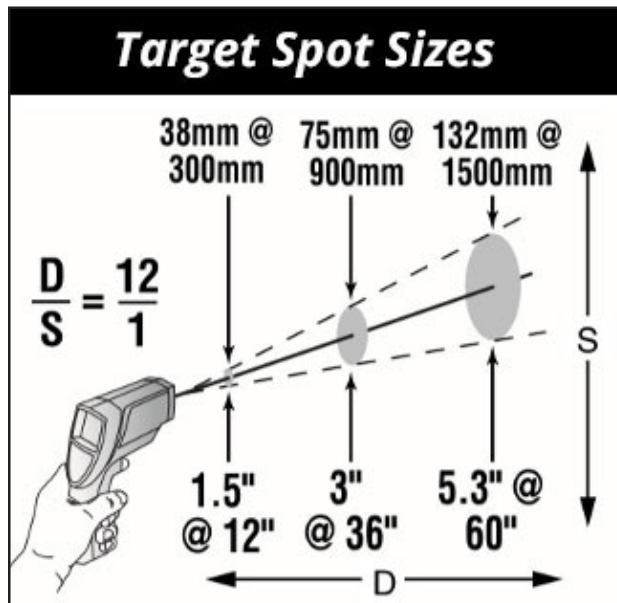


IR Thermometers options for every budget ⓘ

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If your IR thermometer features adjustable emissivity, you'll want to set this to 0.98 which is equal to the emissivity of human skin. From there take 3-5 sample measurements of people you are certain do not have a fever, and create an average value to compare against. If you have alarm settings, set a high alarm proportional to your previously obtained average. Even without features such as adjustable emissivity and alarms, if you have properly obtained an average reading, you should be able to screen for any abnormalities.

Here is an example of the spot size ratio of an infrared sensor (IR thermometer). For this particular one, we are at a distance of 300 mm, our spot size is 38 mm, which is much bigger than a normal tear duct. Note that the closer you are to a subject, the higher the chance of the laser reflecting into a person's eyes (see above safety note).

There are also single point infrared sensors that combined a thermal image, which take you beyond the limitations of single-spot IR thermometer. Allowing you to see the hot spots and providing you with the opportunity to aim at that particular area.

Some thermal imagers have a zone covering the full face with a high temperature marker, allowing you to get the max temperature in that zone, which will be more precise. In a case like this, the resolution of the camera will play a role in the size of that hot spot and will also determine the distance we should be from the person... the higher the resolution the further away you can be from the person. In some cases where someone would like to look at people from a further distance, the use of telephoto lens will give them that flexibility.

2 main types of thermal imaging cameras

There are two main types of thermal imaging cameras: handheld and fixed.



Handheld

Handheld thermal imaging cameras can be a great tool compared to the infrared thermometer as it provides the extra feature of hot spot detection and measurement. Some handheld options can also be deployed rapidly as they can be mounted on a tripod, and some even have a video output, allowing you to see the image on a monitor remotely.

Fixed

Fixed thermal imaging cameras are great for more permanent applications. Ideal if you're looking to have a camera installed permanently to monitor people entering an area. You can even add alarm capability and these fixed cameras can be easily displayed in remote location. Allowing for multiple cameras to be set at different building entrances and all displayed in one room (ie: security guard house).

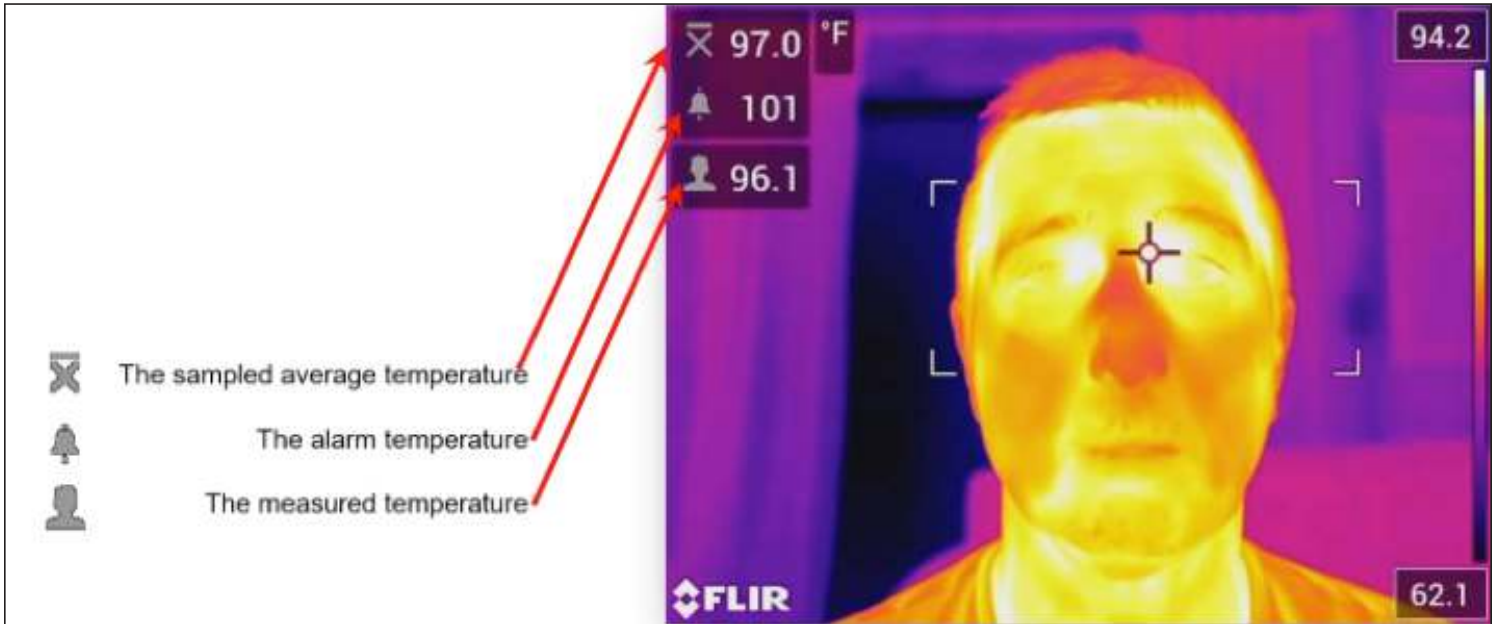
⬇ Whether handheld or fixed, thermal imagers are your top of the line options

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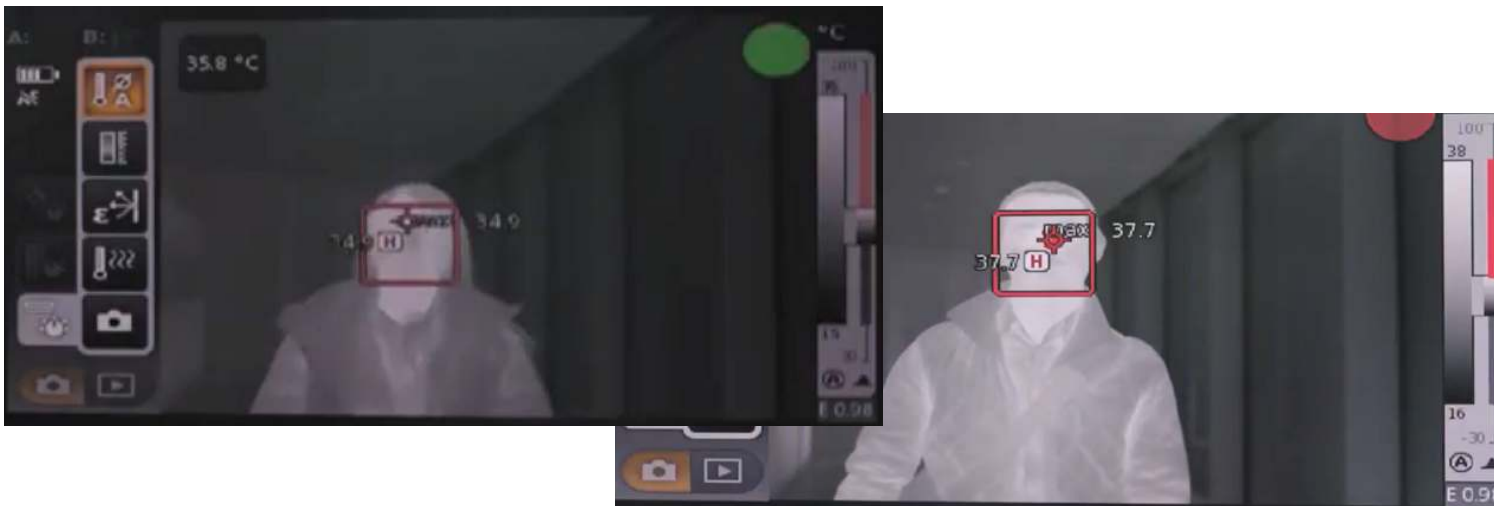
Alarm settings can simplify the process



④ An image from a FLIR thermal imager using the screening mode

Some camera models, whether handheld or fixed even have special alarms for this purpose. Below is an image from a FLIR thermal imager using the screening mode. In this mode an average temperature is determined after reading the body temperatures of a few healthy people, then an alarm is set based on that temperature plus "X" degree (up to the user to determine). Allowing for all people coming into the area to be monitored and compared to that alarm.

Testo thermal imagers use a similar approach, with a color indicator in the top right side showing a Green or Red dot depending if people are under or above the alarm threshold. These images offer visuals of this.



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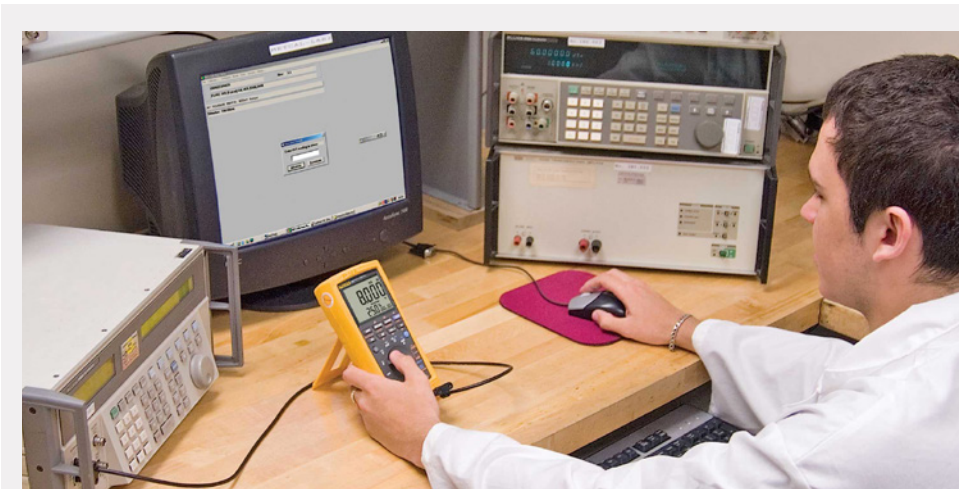
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However, to get more reliable results, a good test protocol should always be put in place to limit the potential error not related to the technology, rather from the variations from subject to subject. Some of these variations are the environment, the distance, the amount of time the subject was in front of the camera, is the subject wearing a hat, glasses, or something else that is covering their face.

In conclusion, infrared sensors (IR thermometers) or thermal imaging cameras, can both be great tools in helping you distinguish potentially ill subjects quickly and from a safe distance, allowing you to direct them to more extensive testing.

As with all instruments, the importance of ensuring your instrument is calibrated to the highest standard is of the utmost importance in ensuring that the measurements you're taking are accurate. Specific to applications involving the detection of body temperatures, we take additional steps to calibrate your instruments, involving adjustments to human skin tones and narrowing of the temperature range. Thus, resulting in more accurate results for this application.

[...] the importance of ensuring your instrument is calibrated to the highest standard is of the utmost importance [...]



Our laboratory technicians provide calibrations that verify that your new or existing equipment is performing consistently at high levels of operation and accuracy. Ensuring that our calibrations meet the most stringent quality requirements that are traceable to NRCC standards. Details at: www.ITM.com/lab

CALIBRATION CERTIFICATE

Calibration Certificate

Customer: ABC COMPANY
Certificate: C301863-00-01

UNIT IDENTIFICATION	
Manufacturer: FLUKE	Serial: 7562011
Model: 744	ID: INV884
Description: PROCESS CALIBRATOR	
CALIBRATION DATE	
Cal Date: 23-Oct-2019	Temperature: 24.47 °C
Due Date: 23-Oct-2020	Humidity: 37.06 %
	Barometric Pressure: N/A

GENERAL INFORMATION

Procedure: FLUKE 744: (SPEC-1Y) BS-232-2508,3458 Rev: 1

As Received: Selon les Normes/With Specification

As Returned: Tel que Reçu/As Received

Remark: N/A

EVALUATION VS. STANDARDS USED				
ID	Manufacturer	Model	Cal Date	Exp Date
0000	HEWLETT PACKARD	5064	1-Feb-2019	4-Feb-2020
0000	FLUKE	5064	1-Nov-2019	3-Nov-2020

The certificate is accredited using measurement standards traceable to the National Measurement System Standards (NMSS) part of the National Research Council of Canada (NRC) or the National Institute of Standards and Technology (NIST), or to accepted national standards for measurement, and is issued by metrology self-accreditation institutions. Measurement uncertainty given for the report is based on a coverage factor of 2 (95% confidence level of measurement).

Evaluated/Calibrated by: G. Home
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Certificate Number: C301863-00-01
Issue: ITM000001-01

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