VIRALERT 3

SAFE | EASY | ACCURATE

LAND AMETEK

TEMPERATURE SCREENING BEST PRACTICE GUIDE

INTRODUCTION

Temperature screening can be an effective mitigation method to help slow the spread of COVID-19 and other highly infectious respiratory diseases.

It should be used to enhance core mitigation methods including social distancing, frequent hand hygiene, and the use of face coverings in public spaces.

Sometimes referred to, incorrectly, as fever screening systems, monitoring for elevated skin temperatures can provide a frontline temperature triage to identify individuals that may be exhibiting a higher than expected temperature.

A high surface temperature can be a strong indicator of a fever, a symptom of COVID-19, and therefore a reason for a further check to verify if an individual has a feverish temperature with a calibrated, tympanic 'in-ear' medical thermometer.

While temperature screening can be effective, the requirements for the equipment used to obtain a reliable, repeatable, and accurate measurement are very specific, and many systems currently being marketed for this purpose are inaccurate and inadequate for this task.

To be clear: there are no thermal temperature screening systems available on the market today that are able to diagnose COVID-19. However, if correctly specified and installed, they can accurately detect temperatures above a specified range or threshold, such as 100.4 °F (38 °C) , the Center for Disease Control (CDC) definition of fever.

This guide is designed to help you distinguish between appropriate technology, and equipment that is inadequate for reliable human skin temperature measurement.

It also contains advice about how to implement best practice protocols and how to avoid the common pitfalls in temperature screening.

EXPERTISE

AMETEK Land is a trusted expert, providing accurate, repeatable temperature measurement instrumentation to industry since 1947. We have been developing Human Temperature Screening systems to combat the spread of disease since the original Severe Acute Respiratory Syndrome (SARS) outbreak in 2003.

We are the original patent holders of 'in-scene' calibration techniques for human temperature measurement, which have been adopted as the 'gold-standard' for temperature screening by government bodies such as the Food & Drug Administration (FDA) in the United States of America.

The engineers, physicists and technicians at AMETEK Land are not medical experts and the VIRALERT Temperature Screening System is not a medical device. We are world renowned experts in non-contact temperature measurement and understand the challenges of measuring skin temperature in 'real-world' conditions that are typical to many temperature screening locations.

1. THE CHALLENGE OF ACCURATE SURFACE TEMPERATURE MEASUREMENT OF HUMANS

The amount of energy radiated by the human body is relatively low. Therefore, external factors that can adversely influence the measurement of temperature need to be seriously considered to provide a suitable level of accuracy.

Rapidly changing ambient conditions, reflections, and sources of heat in the measurement area can all adversely affect the accuracy of the measurement.

To overcome many of these issues, the concept of 'in-scene' calibration utilizes a constant temperature reference source, commonly referred to as a Blackbody Source (BBS) that is in the same frame of measurement as the person
being measured.

Using this method, algorithms can be developed by the manufacturer that can 'calibrate' the reading in 'real-time' to provide greater assurance of accuracy with varying ambient conditions.

The incorporation of a BBS into a temperature screening system does not guarantee accuracy. If the location of the BBS is not standardised, the compensation algorithm may require a complex set-up and can therefore be subject to error.

This source of error can be removed by integrating the BBS into the screening system, helping to produce reliable results

BENEFITS AND LIMITATIONS OF TEMPERATURE SCREENING

To recognise the difference between good and bad practice, a further understanding of the benefits and limitations of the different types of technology that can be used for temperature screening is critical.

Government guidance, recommendations, and mandates have been issued in many regions, such as in the USA by the Food & Drug Administration (FDA) and CDC, to add temperature screening to the core countermeasures of social distancing, frequent hand hygiene, and the use of face coverings.

There are different methods of temperature screening, which all have varying levels of ease of use, accuracy, repeatability, and practicality.

For example, a rectal temperature reading is considered to give an accurate measurement of core body temperature. Whilst accurate, if taken with a sensitive and calibrated medical thermometer, it is impractical and far from ideal for encouraging staff, customers, or visitors back to a facility.

Certified in-ear medical thermometers, again if calibrated, are also considered to give an accurate reading of body temperature. While more practical than the previous suggestion, this method also involves close contact. The use of this type of device is good for a final temperature check, but is not suitable to use in the main temperature screening process, as it increases close contact risk and will slow the movement of people considerably.

IN-EAR MEDICAL THERMOMETER

2. HAND-HELD NON-CONTACT THERMOMETERS

Temperature measurement can be undertaken using hand-held thermometers. However, many of these instruments have accuracies as low as ± 3.6 °F (±2 °C). This gives a margin of error likely to create many false positive or false negative readings when trying to detect elevated temperatures.

A false positive is an incorrect high-temperature reading, and the potential of stopping numerous people who do not show signs of elevated temperature or fever. The alternative could be readings in the normal range for individuals that are actually exhibiting a high temperature and potentially have a fever and infection.

Non-contact hand-held thermometers offer a seemingly low-cost option for temperature screening. However, the inaccuracy of results can be made significantly worse by inconsistent measurement distances and measurement of different areas of the face.

This is likely to create a problematic user experience and, importantly, this type of technology requires the violation of social distancing guidelines. The person carrying out the measurement will need to get within a few inches of the individual being measured. This increases the risk of infection of the those carrying out the temperature screening, and subsequently everyone else entering the facility.

In addition, the 'hidden' cost of staff wages for carrying out temperature screening is not often considered, as each handheld thermometer requires an operator.

The employee wage cost could easily exceed £18,000 per year ($16,000 per year) for a facility operating 40 hours a week, or £76,000 ($63,000 per year) for a facility operating 24/7.

ARE HAND-HELD THERMOMETERS ADEQUATE FOR TEMPERATURE SCREENING?

Logic dictates that one risk mitigation method should not contravene another; therefore, frontline temperature screening triage procedures should use non-contact temperature measurements to avoid unnecessary contravention of social distancing guidance.

- ✓ Low cost purchase ~£40/$50
- ✓ Apparently easy to use

- ✗ High cost of ownership – staff wages
- ✗ Poor accuracy ±3.6 °F (±2 °C)
- ✗ High chance of false positives and negatives
- ✗ Anxiety-causing and invasive user experience
- ✗ Can create greater risk than no screening

3. MULTI-PERSON AND CROWD SCANNING SYSTEMS

Non-contact, high-resolution thermal imagers are being offered to provide multi-person or crowd-scanning thermal screening.

As covered previously, taking accurate skin surface temperature measurements requires the integration of a blackbody heat source at a known distance from the measurement device. This then requires software integration to build an algorithm to provide 'in-scene' real-time calibration for accurate temperature measurement.

Measuring multiple people at the same time creates uncertainty. Any accurate measurement in this scenario depends on knowing the distance from each person to the measurement device and compensating for that in the algorithm. It is also very hard to ensure that a measurement is taken from the same location from one individual to the next, or even to ensure that they are looking at the measurement device when required.

Add to this the need for the measurement to be taken without a face covering and glasses on, and it becomes very difficult to implement such a solution without contravening recommended best practice.

ARE CROWD SCANNING AND MULTI-PERSON SYSTEMS GOOD IDEAS FOR TEMPERATURE SCREENING?

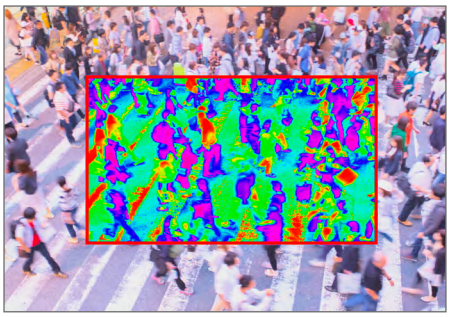
High-resolution crowd scanning or multiple person thermal screening is problematic in terms of blackbody integration, and therefore can suffer from inaccuracy of measurement.

Indeed, the FDA has issued advice to this effect, available here.

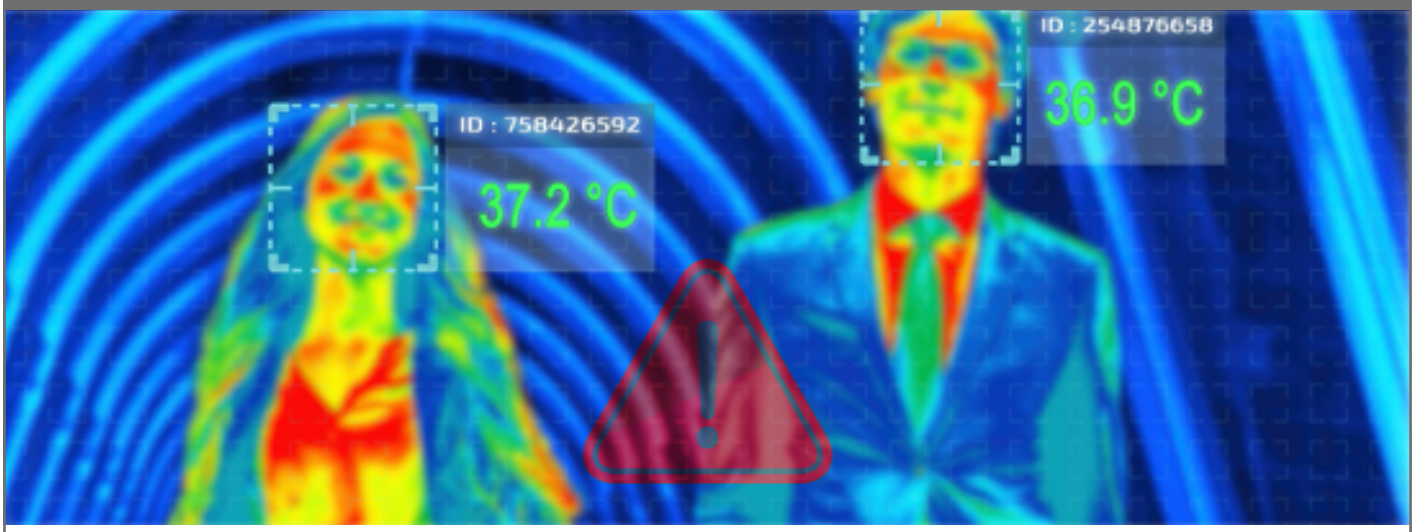
CLICK TO VIEW FDA ADVICE

Furthermore, the cost of thermal imagers increases per pixel, and higher resolution can mean a much higher price tag.

For the price of a high-resolution system, up to six VIRALERT systems can be purchased to give similar or higher throughput with assured accuracy.



SUMMARY - CROWD SCANNING THERMAL IMAGERS



- ✓ Low cost of ownership
- ✓ Automated – maintains social distance
- ✗ High cost – up to 6 times the price of the VIRALERT 3
- ✗ Accuracy questionable if no integrated blackbody source
- ✗ Facial recognition – creates privacy issues
- ✗ Inadvertent false positives and negatives

4. THE GOLD STANDARD OF TEMPERATURE SCREENING – 'IN-SCENE' CALIBRATION WITH INTEGRATED BLACKBODY SOURCE (BBS)

As we have seen, the seemingly cheap option of using a handheld thermometer comes with hidden expense and potential to create more risk than it can mitigate, when used for thermal screening.

At the other end of the market, we have covered how seemingly high specification, high-resolution systems can be just as inaccurate as handheld devices, yet cost many times the price of the VIRALERT.

It is possible to measure temperature accurately using a non-contact infrared thermometer or thermal imager. However, this is a challenge as the amount of heat energy (infrared radiation) emitted by the human body is relatively small (~100 Watts, equivalent to an incandescent light bulb) and therefore this presents a challenge in making reliable measurements in non-ideal conditions.

Ideal conditions would typically entail zero solar radiation or reflections (a dark room) with a constant ambient temperature and a measurement time for each individual stretching into minutes with the person kept in the same place (restrained) during the measuring process – hardly practical.

A proven method, patented by AMETEK Land, to minimise the effects of the surrounding environment, uses the integration of a blackbody heat source.

A blackbody is a precision-engineered component that provides a reference heat source to a very tight tolerance. This can be viewed in the same frame as the individual that is being measured.

If the distance of the blackbody and the person measured is known, it is possible to 'calibrate' the measurement in 'real-time', in non-ideal conditions, using a feedback loop and algorithm in the associated software.

An important point to note here is that these distances are 'known' and understood. This means that a unit with an integrated blackbody at a specified fixed distance removes potential errors in complicated software set-ups where the blackbody is a separate unit that can be mounted in different locations relative to the thermal imager.

There is a lot to consider here and possibly get wrong. That is why the VIRALERT 3 has been designed to address these challenges with an integrated Blackbody Source (BBS) to give 'in-scene' real-time calibration in real-world settings – reliable, repeatable results at a safe distance.

To complete the roundup, the table below gives an overview of single-person thermal screening with an integrated blackbody. Note that not all systems are created equally.

If the blackbody is separate or offered as an option, then you can assume that the system set-up and chance of error are much higher than with the VIRALERT's integrated blackbody.

OVERVIEW - INTEGRATED BLACKBODY THERMAL SCREENING

- ✓ Low cost of ownership
- ✓ Automated – maintains social distance
- ✓ Integrated blackbody – real-world accuracy
- ✓ Face detection to avoid error readings

✗ The statements on the left are only accurate and of value if a high-quality blackbody reference source is integrated in real-time with the measurement software to provide reliable 'in-scene' calibration

5. SEASONAL SKIN SURFACE TEMPERATURE VARIATION

With seasonal variations in ambient temperatures, an associated variation in the skin surface temperature can occur.

To better account for these variations and prevent false negatives during winter months when a lower skin surface temperature may be exhibited, we recommend using a trending function to account for these differences and highlight temperatures that are above the current average, but still below the alarm threshold.

Best practice dictates that installations should be in an internal temperature-controlled environment. However, as many installations will be at the entrance to a building, many users will have entered directly from outside.

All non-contact temperature measurement systems use, with varying reliability, an algorithm to estimate core body temperature from a surface or skin temperature measurement.

The VIRALERT 3 system software has been upgraded to address this issue automatically.

VIRALERT 3 CAMERA SYSTEM AND SOFTWARE SCREEN

The system can be set to use a rolling mean average of the last 10 readings taken during the same four-hour period on previous days.

This allows for ambient variations, for instance between morning and afternoon measurements, to be taken into consideration.

The system has two levels of alert; the standard elevated temperature alert for those above the specified threshold (typically 100.4 °F / 38 °C) and a seasonal trend alarm to alert when a temperature above the nominal recent averages has been measured.

This enhances the effectiveness of the temperature screening, accounting for the seasonal variations in ambient and skin surface temperature that are likely to be experienced by a majority of users.

6. TEMPERATURE SCREENING BEST PRACTICE

In conclusion, temperature screening can be a valuable addition to core mitigation measures and provide an additional level of resilience for businesses and organizations against COVID-19.

Temperature screening systems are only recommended for frontline triage and it is strongly recommended that all elevated temperatures are checked with a calibrated medical tympanic 'in-ear' thermometer as a final verification of a high or fever temperature.

Non-contact frontline triage of temperatures prevents unnecessary close contact. Note appropriate Personal Protective Equipment (PPE) should be used when carrying out close contact tympanic measurements.

To do this effectively, a system with an integrated blackbody source (BBS) that can offer 'real-time' calibration is required to give accurate temperature screening results.

Beyond this, the chance of error with systems that use a separate BBS is substantially higher than systems with a fixed BBS.

The VIRALERT is the only product on the market to offer this feature at present.

Put simply, handhelds are inaccurate, with a high cost of ownership and increased risk of infection, while high-resolution imagers can still suffer from inaccuracies and have a very high cost.

To make these systems viable, seasonal variation of changing skin surface temperature needs to be considered and a suitable trend alarm implemented to make the system effective throughout the year.

Having covered the benefits and limitations of different types of temperature screening technology, the following section provides some practical advice to help implement best practices for selecting a location for temperature screening facilities and developing a suitable process.

7. TEMPERATURE MEASUREMENT AREA RECOMMENDATIONS

To ensure accuracy, defining a specific area to conduct temperature screening is recommended, whether this is a standalone system or one that is integrated into door access and time and attendance systems.

Factors to consider are:

- Site the system to view a neutral background for maximum accuracy (black walls are not recommended)
- Keep heat sources outside of the field of view of the thermal imager
- Ensure exterior doors and HVAC vents are excluded from the field of view of the thermal imager
- Prevent reflective surfaces and windows from influencing the measurement area
- Maintain a stable ambient environment with between 68-75 °F (20-24 °C) and less than 50% humidity

8. TEMPERATURE MEASUREMENT PROCEDURE RECOMMENDATIONS

To provide accurate results and comply with guidance such as that issued by the FDA, we recommend the following points are included in your temperature screening procedure:

- Only scan one individual at a time
- Glasses, masks, hats, and hoods should be removed
- Long hair covering the face should be moved
- Define the process for handling individuals who exhibit an elevated temperature reading above the established temperature threshold and avoid cross-contamination
- Temperature screening systems should not be viewed as standalone solutions to mitigating risk; instead, they should be part of a broader strategy following set processes and policies for use.

Therefore, consider the inclusion of these best practices:

- Provide clear signage to communicate designated temperature screening areas
- Incorporate a health survey that follows CDC guidelines for screening all individuals (employees, contractors, vendors, and visitors) entering your facility
- Your policy should consider PPE requirements and provide solutions
- Develop a protocol for handling individuals who test above the established temperature threshold. We strongly recommend an in-ear measurement with a calibrated medical tympanic thermometer as a definitive check
- Integrate temperature screening systems into existing security infrastructure like access control and visitor management

Additional tips for your temperature screening system set-up:

- Allow time for temperature stabilization in the scanning area after installation.
- If separate units, position the blackbody at the same distance and plane to the area where the individuals will be measured
- Set the thermal imager at a height that allows a suitable field of view of those being screened
- If the thermal imager and blackbody are separate units and are accidentally bumped, they may require recalibration
- Understand that skin temperature measurement can be affected by factors such as exposure to high and low ambient temperatures, or by individuals that have been exercising immediately prior to measurement (riding a bicycle into work, etc).

Disclaimer:

The VIRALERT 3 Temperature Screening System is not a medical device. It cannot detect COVID-19 or any other diseases. AMETEK Land are not medical experts. AMETEK Land are trusted experts who have provided accurate, repeatable temperature measurement instrumentation to industry since 1947. The VIRALERT 3 Temperature Screening System incorporates an 'in-scene' thermal calibration heat source to provide greater accuracy when measuring subjects for elevated body surface temperature which can indicate a fever. We recommend that all elevated temperature readings are verified with an approved and calibrated medical thermometer.

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