National Metrology Centre
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TECHNICAL REQUIREMENTS AND METROLOGICAL EVALUATIONS OF THERMAL IMAGERS FOR HUMAN TEMPERATURE SCREENING

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Thermal imager

- Thermal imager measures surface temperature and displays the temperature profile of objects.

- Very wide industry applications

    - Building sustainability
    - Energy sustainability
    - Thermal survey of electrical switch board
    - Firefighting
    - Biomedical
    - Civil surveillance
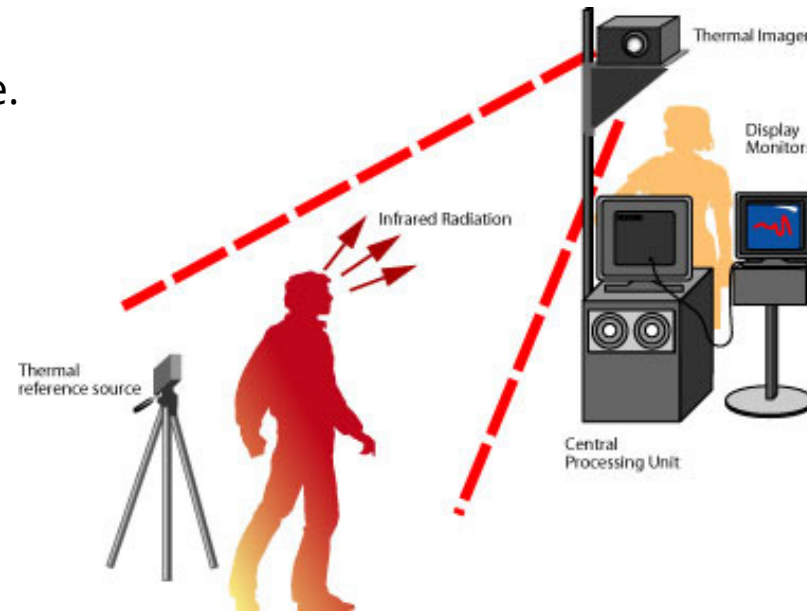
Thermal imager for <u>fever screening</u>

- Thermal image provides profile of facial skin temperature of a person.

- Temperature above a threshold, highlighted by a distinct colour, indicates an elevated temperature, i.e., <u>potential</u> febrile condition.

- People having elevated facial skin temperature will be further checked by using a clinical thermometer for confirmation.
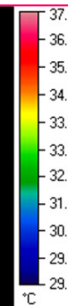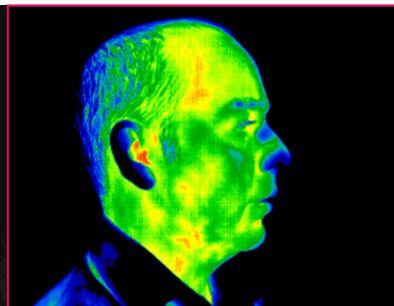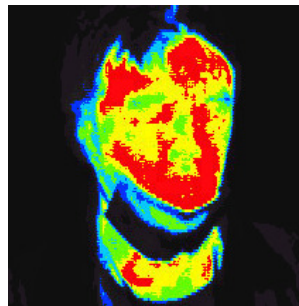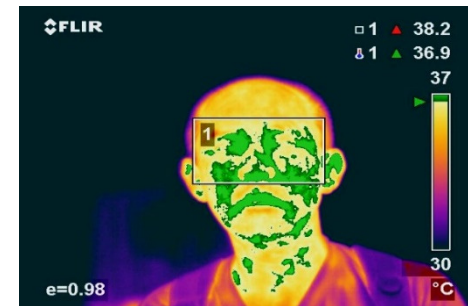
Thermal imager for <u>fever screening</u>

- Threshold is corrected for the difference between skin and body temperatures.

- 'Go or No-go' system.

- False positive & false negative.

Basic considerations when choosing a thermal imager for <u>fever screening</u>

- The number of detector pixels ≥ 320 x 240
  - ≥ 240 x 180 for facial area – single profile.

- Temperature measurement range (or equivalent temperature measurement range) 30 °C to 40 °C.

- Temperature resolution (or equivalent temperature resolution) ≤ 0.1 °C.

- Isotherm colour display mode with resolution ≤ 0.1 °C.

- Near real-time processing.

- Emissivity adjustment function.

Basic considerations when choosing a thermal imager for <u>fever screening</u>

- Suitable focusing distance, typically 0.5 m to 6 m.

- Data logging function.

- Self-check/Non-Uniformity Correction (NUC) interval selection possibility.

- Integration time for temperature readings (may be different from that of the images).

- Indication of pixel locations.

- Minimum allowable pixel size for temperature readings.

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# Critical parameters with suggested specifications

- Drift between self-corrections ≤ 0.3 ºC.

- Minimum Detectable Temperature Difference (MDTD) ≤ 0.4 ºC.

- Non-Uniformity ≤ 0.3 ºC.

- Distance effect ≤ 0.3 ºC.

- Calibration of threshold temperature.

- Threshold temperature stability ≤ 0.3 ºC.

Evaluation of drift between self-corrections

- Drift between self-corrections – maximum permissible drift is 0.3 ºC with interval of 3 minutes.

- It affects all other critical parameters.

Drift of thermal imager's temperature reading (self-correction ▲)
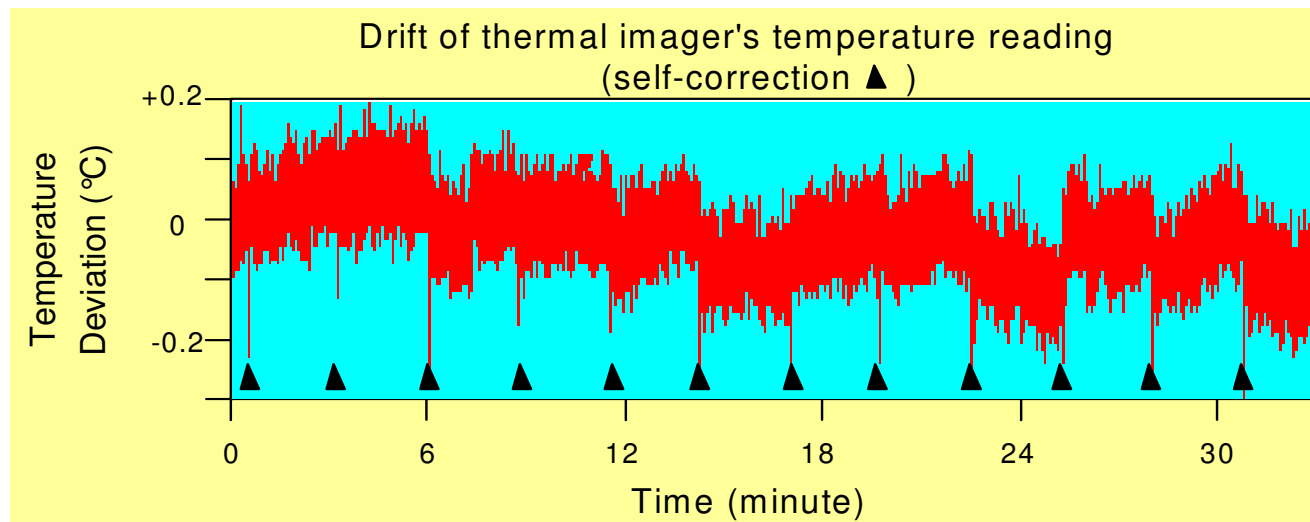
Evaluation of MDTD

- Minimum detectable temperature difference (MDTD).

- **Maximum permissible difference is 0.4 °C.**

- MDTD is defined as the temperature difference corresponding to 5% to 95% target area colour change.
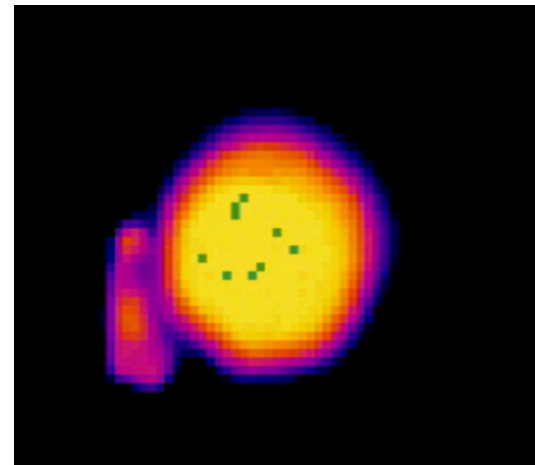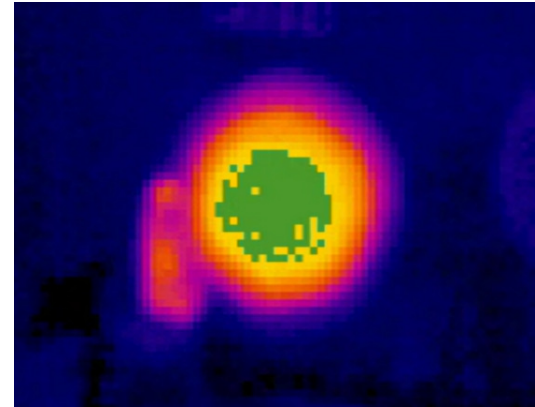
Evaluation of MDTD

- Reflects ability of the system to detect small temperature differences for sufficiently large target.

- The smaller the better.

- MDTD and false negative and false positive - optimal threshold value.

False positive

Threshold

Reduced threshold

False Negative
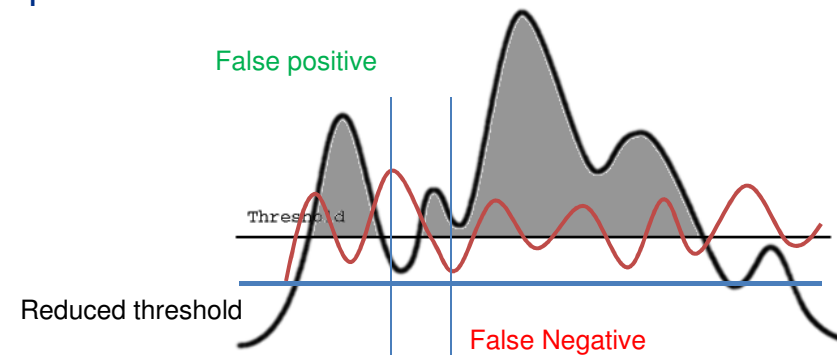
Evaluation of uniformity

- Uniformity: Maximum permissible temperature difference (or equivalent temperature difference) at various locations distributed across the target plane or <u>workable target plane</u> is 0.3 ℃.

- The smaller the better.

- Poor uniformity limits the usage to the central area of the display.

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Evaluation of distance effect

- Distance effect – maximum permissible difference is **0.3 °C with ± 0.5 m** from the nominal target distance.

    - Selection of working distance
        - Safety concern of the operator
        - Quality of camera

    - It's still the best if a person under screening stands still in front the camera at the target distance
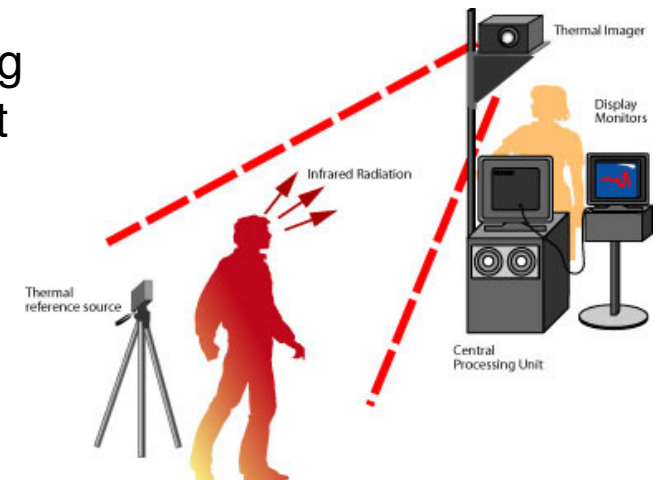
Evaluation of threshold temperature and its stability

- Threshold temperature – traceability to ITS-90.

    - Setting a proper threshold temperature – study on correlation between the skin temperature and body core temperature is beyond the scope of technical evaluation of thermal imagers.

- Stability of threshold temperature.

    - Good threshold temperature stability ensure reliability of screening.

- Maximum variation of threshold temperature in certain period of time provides an indication of threshold stability.

Evaluation of stability of threshold temperature

- Stability of threshold temperature.

- Maximum variation of temperature reading
  in at least 24-h period is 0.3 °C.
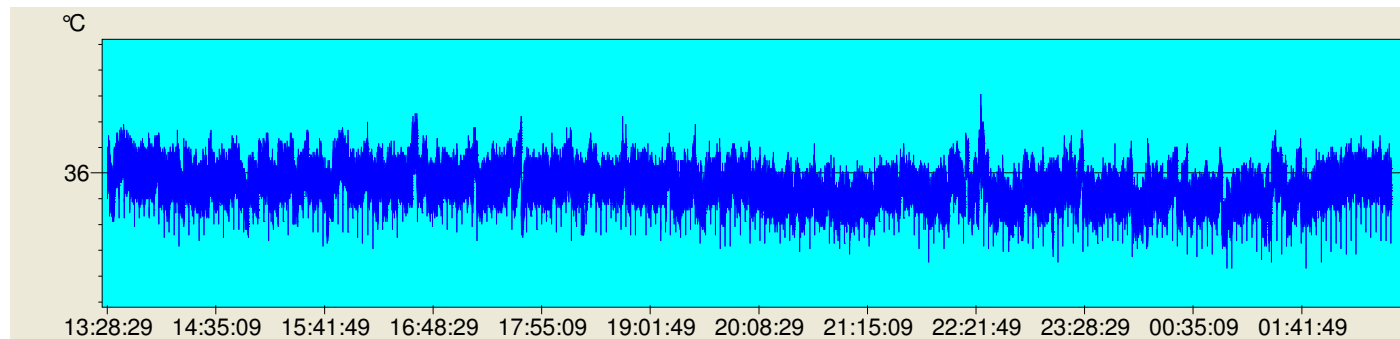
Observations

- Failure to meet non-uniformity and MDTD requirements are most common.

- Threshold stability data logging was not available in many thermal imagers.

- Wrong emissivity compensation algorithm is quite common.

- Thermal imagers should be evaluated before deployment for fever screening.
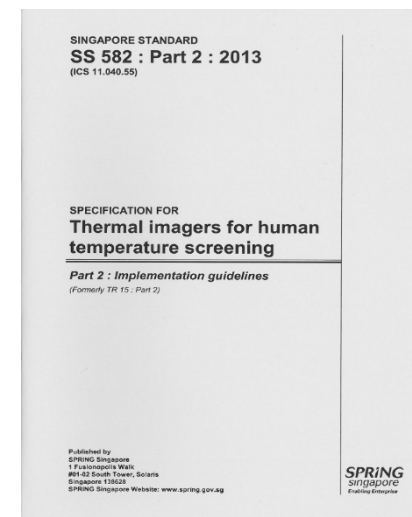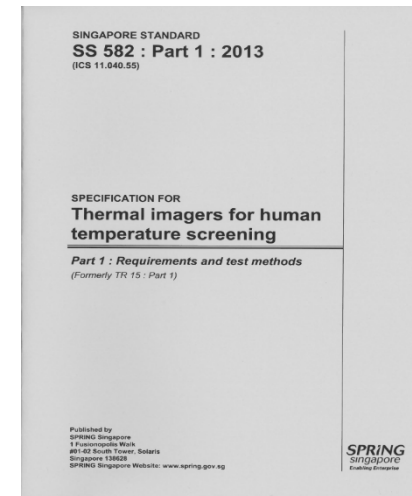
Evaluation results and Singapore Standard (SS) "Thermal Imagers for Human Temperature Screening" (SS582)

- A Singapore Technical Reference (TR15 Part 1: 2003; Pert 2: 2004) and its corresponding Singapore Standard SS582 Part 1/2: 2020) "Thermal Imagers for Human Temperature Screening" were developed based on the critical parameters and evaluation results.

- The TR15 was first of its kind worldwide and provided bases for development of the following two ISO/IEC standards:

    - **IEC 80601-2-59: 2008** Medical electrical equipment – Part 2-59: Particular requirements for basic safety and essential performance of screening thermographs for human febrile temperature screening.

    - **ISO/TR 13154: 2009** Medical electrical equipment – Deployment, implementation and operational guidelines for identifying febrile humans using a screening thermograph.

Singapore Standard (SS) 582

- The SS582 is jointly developed by the stakeholders, thermal imager suppliers and users in Singapore

- To help fighting COVID-19, a new edition, the SS582 Part 1/2: 2020, will be published soon

- It will be freely accessible once published

- Watch out at https://www.singaporestandardseshop.sg/ for updates

- Share your feedback with us!

SINGAPORE STANDARD
SS 582 : Part 1 : 2013
(ICS 11.040.55)

SPECIFICATION FOR
Thermal imagers for human temperature screening

Part 1 : Requirements and test methods
(Formerly TR 15 : Part 1)

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(ICS 11.040.55)

SPECIFICATION FOR
Thermal imagers for human temperature screening

Part 2 : Implementation guidelines
(Formerly TR 15 : Part 2)

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