Thermal Imaging Cameras — Resolution, NETD and Selection

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Choosing a thermal imaging camera by the numbers that matter: detector resolution against working distance (spot size ratio), thermal sensitivity (NETD), temperature range, lens and field of view, emissivity and reflected temperature as the error sources, electrical and mechanical survey practice including IR windows and safety distance, camera tiers from smartphone attachments to 640x480 professional units, and reporting that survives an insurer's reading.

The short version

Resolution is pixels on the defect, not pixels on the datasheet. A 320x240 detector at 2 m with a standard lens puts enough pixels on a contactor terminal to measure it; the same detector at 15 m does not. The working figure is spot size ratio — how many pixels cover the smallest object you must measure at your real working distance. Buy for the furthest measurement, not the brochure image.
NETD (thermal sensitivity) decides image quality in low-contrast scenes. 60–80 mK class is fine for electrical faults (they glow); ≤ 40 mK pays off on building fabric, refrigeration and slight-gradient mechanical work where the defect is half a degree.
Emissivity is the error source that matters. Shiny metal (emissivity 0.1–0.3) reads mostly reflections — a polished busbar can hide a 50 K rise. Measure on high-emissivity targets (cable insulation, taped or painted spots, oxidised surfaces), set emissivity and reflected apparent temperature, or the numbers are decorative.
Temperature difference under load is the diagnostic, not absolute temperature. Electrical surveys compare like-for-like phases at known load (≥ 40% is the working minimum); severity scales with delta-T and load correction, and a survey at idle finds nothing.
Tiers: smartphone attachments (FLIR ONE Pro, 160x120) for screening; pocket cameras (Fluke PTI120, HIK PocketE) for the toolbox; mid 320x240-class handhelds for routine surveys; professional 464x348 to 640x480 units (FLIR T540 class) with interchangeable lenses for programmes and reports.
Safety before pixels on live gear: opening energised switchboards for imaging is arc-flash territory — IR windows installed in panels, or de-energised verification, are the professional answers.

1. The four numbers on every datasheet, ranked

Spec | What it means | Working guidance |

Detector resolution | IR pixels (160x120 … 640x480) | With IFOV ~1.3 mrad class optics, a 320x240 camera measures a 10 mm target reliably at roughly 2–3 m; halve the distance or double the pixels for smaller targets — that is the spot-size arithmetic |

NETD | Smallest temperature difference the detector resolves (mK) | ≤ 60 mK general; ≤ 40 mK for low-contrast work |

Temperature range | Calibrated spans | " 20…+150 °C covers buildings/electrical LV; +650 °C spans motors, steam, most industry; 1,200 °C+ for furnaces and brazing-adjacent work |

Lens / FOV | Interchangeable optics on pro tiers | Telephoto for switchyards and high trays; wide for rooms; fixed-lens cameras lock your working distances |

Accuracy quoted as ±2 °C or ±2% is standard across tiers — it is emissivity and reflection handling, not datasheet accuracy, that separates good surveys from noise.

2. Emissivity and reflected temperature, practically

Surface | Typical emissivity | Practice |

Electrical tape, paint (non-metallic) | 0.93–0.96 | The reference targets — tape a spot where routine measurement is needed |

Cable insulation, rubber | 0.90–0.95 | Measure the cable near the lug rather than the shiny lug |

Oxidised steel, rusted surfaces | 0.7–0.9 | Usable with care |

Oxidised copper | ≈ 0.6–0.8 | Variable; verify with tape where it matters |

Polished aluminium, new copper, stainless | 0.05–0.3 | Mirrors for infrared: readings are mostly reflected scene — do not report numbers off bare bright metal |

Reflected apparent temperature is the second dial: in a 20 °C room it is benign; facing a hot engine block or the open sky it shifts low-emissivity readings by tens of degrees. The method (ISO 18434 thermography practice and every maker's manual agree): set emissivity for the actual target surface, measure and set reflected apparent temperature, keep the viewing angle inside ≈60° from normal, and state both settings in the report.

3. Electrical surveys: method and severity

The survey that finds faults: equipment under ≥ 40% load (record the actual current — severity is load-corrected since heating scales with I²), compare phases of the same circuit, image terminations, fuse holders (NH and cylindrical fuse gear is a classic finding), contactor and breaker terminals, busbar joints and cable lugs (crimp quality shows thermally).
Severity banding used across the industry: delta-T against similar component under similar load of 1–3 K: watch; 4–15 K: plan repair; >15 K: repair now — with the site's own criticality overlay. Safety: imaging requires line of sight; opening live

boards trades a survey for an arc-flash exposure. The professional pattern is IR windows fitted on switchboards at build or retrofit, imaged closed, with the window's transmission factored in — or imaging during planned de-energised verification. Motor and mechanical work reads bearings, couplings and belts against their twins (pair findings with alignment and bearing follow-ups); refrigeration and building surveys live at the sensitive-NETD end.

4. Camera tiers and who they serve

Tier | Resolution class | Catalogue example | Serves |

Smartphone attachment | 160x120 | FLIR ONE Pro (USB-C) | Screening, documentation of the obvious, every supervisor's pocket |

Pocket camera | 120x90 … 160x120, rugged | Fluke PTI120, HIK PocketE | Electricians' daily checks, quick fault confirmation |

Mid handheld | 256x192 … 320x240 | FLIR Ex/Exx class and equivalents | Routine plant surveys at normal working distances |

Professional | 464x348 … 640x480, interchangeable lenses | FLIR T540 class | Survey programmes, switchyards, reports to insurers and class |

The tier question is the same use-pattern arithmetic as videoscopes and calibrators: screening lives low, evidence lives high. One professional unit shared by a reliability group plus pocket units distributed widely beats a drawer of mid-tier cameras nobody owns.

5. Reports that hold up

A thermography finding that survives scrutiny carries: the radiometric image and a visual photo, target identification (panel, circuit, phase), load at the time, emissivity and reflected temperature settings, distance and lens, the comparison reference (twin phase or twin machine), delta-T, severity band and recommended action, and the camera's identity with its calibration status — thermal cameras are calibrated instruments on 1–2 year cycles like any other reference (traceability logic here). Insurers and class surveyors increasingly ask for exactly this structure; cameras in the mid tier upward generate it natively.

How buying works at cballast. We quote thermal cameras across the tiers with lenses, IR windows and calibration certificates itemised, against the survey programme they will serve. Accounts are vetted at onboarding; first order prepaid; established accounts on credit terms with repeat discounts; public bodies and utilities invoiced against purchase order from the first order. RFQs to sales@cballast.com.

Frequently asked questions

What thermal camera resolution do I need?Enough pixels on the smallest target at your real working distance: 160x120 screens at arm's length; 320x240 measures standard electrical components at 2–3 m; 640x480 or a telephoto lens for switchyards, high cable trays and small targets at distance. Work the spot-size arithmetic before buying, not after.
What is NETD on a thermal camera?Noise-equivalent temperature difference: the smallest temperature difference the detector distinguishes from noise, quoted in millikelvin. 60–80 mK serves electrical fault-finding; 40 mK and better pays off on building fabric, refrigeration and slight mechanical gradients where defects are fractions of a degree.
Why does a shiny busbar read cold when it is hot?Low emissivity: polished metal emits poorly and reflects the room instead, so the camera reports the reflected scene. Measure on adjacent insulation, oxidised or taped surfaces (emissivity ~0.95), set the camera's emissivity and reflected apparent temperature accordingly, and never report absolute numbers off bright bare metal.
What temperature rise on an electrical connection is serious?Compared with its twin phase under the same load: 1–3 K is worth watching, 4–15 K is a planned repair, above 15 K is an act-now finding — corrected for load, since a fault at 30% load grows as the square of current. Absolute temperature alone, without load and comparison, is not a finding.
Can I survey a switchboard without opening it?Through installed IR windows, yes — that is their purpose, and retrofitting them to critical boards converts every future survey from an arc-flash exposure into a routine scan. Plastic covers and steel doors are opaque to thermal cameras; "scanning the closed door" images the door.
Who supplies FLIR, Fluke and Hikmicro thermal cameras?cballast.com quotes thermal cameras from pocket to professional tier, IR windows, lenses and calibration, matched to the survey programme described. Write the use case to sales@cballast.com.

References and related guides

Standards and sources referenced: ISO 18434-1 (thermography in condition monitoring); IEC 62446-3 (thermography context for PV); NETA/industry delta-T severity practice; maker documentation for FLIR, Fluke and Hikmicro ranges; NFPA 70E arc-flash context for live-panel work.

Laser shaft alignment — tools, tolerances and method

Industrial videoscopes — borescope selection

Circuit breaker coordination and selectivity

Enclosure climate control — heaters and fans

Process calibrators — Beamex, Fluke, Druck

Questions on a tier, a lens or an IR window: write to sales@cballast.com. We answer whether or not you buy from us.

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