



Solardrone

Adherence to *IEC TS 62446-3:2017*

The global standard for solar PV aerial thermography inspections.

This document is a summary of Solardrone's adherence to the technical specification set forth by the International Electrotechnical Commission (IEC). It is not the technical specification itself. Please refer to IEC TS 62446-3:2017 for the specification and comprehensive guidance*

*IEC TS 62446-3:2017, Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance - Part 3: Photovoltaic modules and plants - Outdoor infrared thermography, available at <https://webstore.iec.ch/>

IEC Item	Met	Description	Notes
Level - Simplified	Yes	Simplified Thermographic Inspection	SolarDrone Standard or Comprehensive Inspection meets the Simplified Inspection requirements.
Level - Detailed	Yes	Detailed Thermographic Inspection	SolarDrone Comprehensive Inspection meets the Detailed Inspection requirements.

Section: Inspection Equipment			
Equipment Date and Time	Yes	Must be synchronized prior and during inspection.	
IR Spectral Response	Yes	2-5 micron or 8-14 micron. Mid-wave infrared cameras (MWIR) operating wavelength 2-5 microns shall only be used for thermography of BOS components (e.g. fuses) due to the transparency of glass in range of 3 microns. The use of MWIR on PV modules can lead to measurement errors.	
Temperature sensitivity and calibration range	Yes	-20 degC to +120 degC	
Operating ambient air temperature	Yes	10 degC to +40 degC	
Thermal sensitivity	Yes	NETD \leq 0.1 K at 30 degC	
Geometric resolution	Yes	PV module: max 3cm of module edge per pixel ² . Electrical connections: resolution has to match the smallest area to be verified	
Absolute error of measurement	Yes	< +/- 2 K	
Adjustable parameters	Yes	Emissivity, Reflected Temperature	
Adjustable functions	Yes	Focus, temperature level and span	
Measurement functions	Yes	Measuring spot, measuring area with average and maximum temperature	
Calibration	Yes	Measuring system shall be traceably calibrated at least every two years. The calibration must be documented.	At time of writing, industry standard is that FLIR calibrates radiometric LWIR cameras (Tau 2 cores for Vue Pro R, Duo Pro R, XT, and XT2) at factory and does not provide paper certificates.

Documentation	Yes	Storing of the infrared picture with all radiometric information to be able to determine absolute temperatures.	All original radiometric data is available in SolarDrone online portal.
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Photo Camera for Documentation			
Visual Photos	Yes	One visual photo required for any thermal abnormality.	SolarDrone Comprehensive includes visible spectrum Linked Images.
Resolution	Yes	Significantly higher than IR image and similar field of view.	At least 12MP visible spectrum cameras are used.
Area of interest	Yes	Same area of interest of IR camera	Visible camera images are of the area of interest.

Ambient Condition Measurement			
Record of ambient conditions	Yes	Must be recorded.	
Irradiance	Yes	Irradiance sensor with calibration +/- 5%	
Ambient air temperature	Yes	Temperature sensor with calibration +/- 2K	
Wind speed	Yes	Estimated visual Bft scale or anemometer	
Cloud Coverage	Yes	Estimated with photo camera	
Degree of soiling	Yes	Estimated with photo camera	Soiling is identified in inspection report.
Module or string current	Yes	DC clamp ampere meter or inverter reading with calibration 2%	Inverter readings are typically reviewed by end customer, but can be transferred to SolarDrone to be included in inspection report.

Section: Inspection Procedure			
Applicable health and safety regulations	Yes		
Owner, operator, or authorized person gives inspector introduction to safety inspection regulations and details of plan and electrical layout.	Yes		Safety requirements are reviewed prior to site visit and electrical plans are provided via online portal.
A second person should be present and may be required.	Yes	-20 degC to +120 degC	Yes if required, a pilot may be required to have visual observer depending on FAA airspace restrictions.

At least one person shall have technical knowledge of the system and PV plants in general.	Yes		
Detailed inspection scope defined prior to inspection and agreed in writing	Yes		
Plant under operating conditions.	Yes		Yes. Please notify SolarDrone if there is a change in operating conditions prior to inspection.
Thermal steady state condition.	Yes		
Low soiling, if not cleaning recommended.	Yes		
Issues of intermittent or changing nature may not be captured at inspection time.	Yes		
Visual inspection of site prior to starting IR inspection is recommended.	Yes		

Environmental Conditions			
Irradiance	Yes	Greater than or equal to 600 W/m ² POA. Operating current \geq 30% of rated system current	
Wind speed	Yes	Less than or equal to 4 Bft or 28 km/h	
Cloud coverage	Yes	Less than or equal to 2 okta of sky covered by cumulus clouds	
Soiling	Yes	No or low.	Inspection purpose may be to measure soiling in which case it may be high.
After > 10% change in operating conditions	Yes	Recommend 15 minute waiting time	Yes, if specified.

Imaging Procedure			
Distance	Yes	Shall fulfill geometrical resolution	
Image orientation	Yes	As perpendicular to the PV module surface as possible	

Emissivity	Yes	Adjusted based on surface conditions	
DC-Load of plant	Yes	Measured to avoid measurements under undefined load conditions	Yes if provided, inverter readings are typically reviewed by end customer, but can be transferred to SolarDrone to be included.
Findings Location	Yes	Exact position shall be documented	
Simplified: No absolute temperatures	Yes		SolarDrone Standard inspection procedure
Detailed: Absolute temperatures are determined.	Yes		SolarDrone Comprehensive inspection procedure
Advanced qualifications needed	Yes		
Speed of camera	Yes	Chosen with respect to camera time constant. Typically ≤ 3 m/s	

Emissivity			
BOS Components	N/A	Should be accurately determined with thermography considerations	SolarDrone does not typically do BOS components unless specifically requested.
Glass	Yes	Typical 0.85 or 0.9	

Section: Software			
Emissivity	Yes		
Reflected Temperature	Yes		
Temperature Level and Span	Yes		
Measuring tools	Yes		

Section: Evaluation			
Identify maximum temperatures	Yes		
Temperature differences	Yes		
Temperature profiles	Yes		
Clouds	Yes		
Windspeed	Yes		
Mechanical stress	Yes		
Soiling	Yes		
Visual Inspection	Yes		

Irradiance and/or DC Load	Yes		
Previous inspection results taken into account	Yes		Yes if provided, SolarDrone can digitize historical reports.
Evaluation of IR images			
Patterns	N/A	Abnormality classified by known thermal pattern	SolarDrone does not typically do BOS components unless specifically requested.
Temperatures of point abnormalities	Yes	Algorithm to determine highest temperature in image	
Extended areas	Yes	Get mean temperatures of areas	
Relative Temperatures	Yes	Calculated between point abnormalities or extended areas	
Absolute Temperatures	Yes	Can be measured at point abnormalities or extended areas with uncertainty measurement	
Thermal Abnormalities	Yes		Typical 0.85 or 0.9
Classes of Abnormalities	Yes	1. nominal, 2. thermal abnormality, 3. safety relevant thermal abnormality	
Projection of temperature differences to nominal irradiance	Yes	Procedure for calculating normalized temperature difference	

Section: Inspection Report			
Name of Experts (PV expert, thermographer, attending persons)	Yes		
Make model of camera system	Yes		
Day and time	Yes		
Location	Yes		
Contractual Scope of inspection	Yes		
Environmental Conditions	Yes		
Soiling amount	Yes		
Inspection procedure	Yes		
Listing of thermal abnormalities and specific position			