SEMETS381

Inspecting engineering products by thermography testing

Overview

This standard defines the competences you need to carry out stimulated and passive thermography testing inspection activities, on engineering materials, products and plant, in accordance with approved procedures. This includes active optically-stimulated thermographic techniques, such as flash and laser spot, as well as acoustic and electromagnetic stimulation. This can involve using manual, semi-automatic or fully automatic equipment.

You will be required to check inspection equipment, prepare products for inspection, identify test areas, check environmental conditions, material properties and surface conditions, set up and adjust equipment, carry out specified inspections, observe and record test indications and complete test reports. If appropriate and safe to do so, you may be expected to mark up the products, objects or structures to identify areas of interest and digital information of the signals produced. Your responsibilities will require you to comply with organisational policy and procedures And report any problems with activities or equipment that you cannot resolve or which are outside your permitted authority. You will take personal responsibility for your actions and for the quality and accuracy of your work.

You will have a good understanding of your work, and will provide an informed approach to the inspection of engineering products by using Thermography testing techniques. You will have adequate uncorrected or corrected vision in accordance with national standards to allow you to competently perform inspections. You will have an appreciation of hazards, safe working practice and safety precautions, have correct vision at all times and you will understand the risks posed by material defects/flaws and the consequences of component failure and how to carry out Thermography testing and use associated tools and equipment safely.

This standard is for anyone who inspects engineering products using thermography testing techniques.

Performance criteria

You must be able to:

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1. work safely at all times, complying with health and safety legislation and other relevant regulations, directives and guidelines
2. check that inspection equipment complies with specification requirements, is safe to use and fit for purpose
3. * *identify, confirm and carry out specified inspection checks against agreed acceptance criteria
4. prepare ambient conditions, checking they are satisfactory for tests to proceed
5. use appropriate screening of high-energy light sources to ensure the safety of all personnel in the vicinity of inspections
6. carry out specified thermography inspections to meet requirements
7. analyse and evaluate test indications
8. mark up products or equipment to show where there are indications of flaws
9. record accurately the results of the inspections in the appropriate format and in line with legislative and organisational requirements and pass to designated people
10. deal with problems within your control in line with organisational procedures without delay, reporting problems outside your control to designated people

Knowledge and understanding

You need to know and understand:

- relevant health and safety and other regulations, directives, national standards and guidelines and your responsibilities to yourself and others including those relating to quality control,
- hazards associated with thermography testing activities including electrical contact, moving mechanical parts and high temperatures
- safe working practice and specific safety precautions to minimise hazards when carrying out thermography testing activities and using associated equipment on engineering materials, products and plant including personal protective equipment (PPE) to be used and how to obtain it
- how to obtain and interpret job instructions/techniques and testing specifications
- how to interpret and evaluate test results to identify defects or variations from specification
- how to test parts in new manufacture or in-service
- why products may need to be tested by a range of different non-destructive testing methods including magnetic particle inspection, penetrant flaw detection, ultrasonics and radiography
- the benefits and uses of infrared thermography testing practice, the range of materials and products to which it is usefully applied, the range of thermography techniques, their relative strengths and weaknesses and the types of defect/flaws they can detect
- temperature, heat, absolute and relative temperature scales, heat transfer via conduction, convection, radiation and diffusivity and the application of heat and temperature theory to detect flaws in engineering materials
- corrective or compensating measures to negate the effects of factors that influence inspection sensitivity and the reliability of equipment performance (including emissivity, variation of emissivity with angle, excitation energy or power, environmental factors, camera sensitivity, external heat sources and thermal conductivity, diffusivity and emissivity) and other relevant factors
- ways of setting up, configuring and calibrating stimulated thermography inspection

equipment while taking account of differences in material properties of inspected products and calibration blocks including using specified calibration blocks, setting test sensitivity for products, coverage, field of view, resolution, accessibility, line of sight, flaw orientation, flaw size, component geometry, proximity of flaw to part edges and scanning and image resolution settings to detect flaws of specified sizes

- levels of defects/flaws that are acceptable in products and the influence of defects on service/ performance of products, materials and structures
- infrared radiation including electromagnetic spectrum, wavelength region including short, medium and long wave ranges and their impact on surveys and Planck, Wien and Boltzmann Laws
- radiation energy exchange including emittance, reflectance and transmittance, emissivity, determining and evaluating emissivity, how emissivity is affected by surface finish, the angle of measurement and blackbodies, reflectance from spectral and diffused surfaces, transmittance/absorption of materials, radiation leaving the target, radiation exchange at target surface and radiation impinging on target surface.
- thermographic equipment including the functions and characteristics of infrared cameras, their performance and calibration requirements
- Infrared image and data analysis and interpretation
- data analysis techniques used in flash thermography, long-pulse thermography and lock-in thermography, how to recognise changes in equipment response, analyse trends, draw conclusions about probable causes and establish thermal severity criteria.
- care and control of thermographic equipment including checking condition
- the importance of accurate test reports, the data and information required, organisational formats and how to prepare and complete them
- the extent of your own responsibility and whom you should report to if you have problems that you cannot resolve

Scope/range

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1. Carry out all of the following during the inspections:

- obtain the required thermography detection equipment and materials, and check that they are in a safe and usable condition
- use appropriate personal protective equipment
- comply with job instructions/techniques, NDT testing inspection specifications, risk assessments and other relevant safety standards

- use appropriate screening of any high-energy light source to ensure the safety of all personnel in the vicinity of the inspection
- follow the defined testing procedures/techniques, and apply safe working practices and procedures at all times
- leave the work area in a safe condition on completion of the activities

2. Obtain the correct configuration of equipment, as required by the procedures/techniques or work Instructions, including **1** of the following:

- heat excitation equipment (flash lamp)
- reference pieces or blocks.
- thermography IRT camera
- appropriate optical lenses
- environmental meters, high emissivity tapes, foil

3. Prior to undertaking an Inspection, carry out and record **3** of the following equipment parameters

- image resolution/image size
- number of images obtained/length of time images are recorded
- heating excitation energy. Range, span and level settings
- colour palette
- emissivity value
- spot, circle, line and box functions and isotherms
- reflected apparent temperature
- camera-to-target distance
- atmospheric temperature
- relative humidity

4. Preparation prior to commencing an inspection to include carrying out **5** of the following as appropriate:

- identify the inspection areas
- check that the inspection are correctly prepared for testing
- check for key reference (datum) markings
- recognise and deal with material condition, coatings, heat-treated condition, corrosion and contamination
- check for surface roughness, scuffing, scratching or marking, which may generate unwanted signals.
- recognise and compensate for reflections from solar gain
- recognise and compensate for convection effects of wind and rain
- recognise and compensate for environmental conditions due to atmospheric transmission versus distance and
- CO□ in atmosphere
- recognise and compensate for the effect of moisture and solid particles in the atmosphere
- recognise and compensate for temperature changes due to thermal capacitance or mass transport, phase change,
- energy conversion or direct transfer differences.

5. Preparation prior to undertaking a thermography inspection, carry out **all of** the following ambient condition checks (where appropriate) that could influence the actual temperatures recorded:

- air temperature
- reflective apparent temperature
- relative humidity
- wind speed
- establish the surface emissivity of the object

6. Carry out **all** of the following, in accordance with instructions and procedures:

- specified equipment
- correct flaw size measurement technique.

- recording conclusions of observations
- analysing and interpreting results to identify defects of variations from specification

7. Carry out an Inspection on **1** of the following:

- composite material
- thermal barrier coating
- electrical apparatus
- mechanical equipment
- civil applications
- buildings
- industrial process plant
- other specific products

8. Follow the correct procedure to deal with materials or structures that fall into **all of** the following categories:

- components, materials or structures which meet the specification
- components, materials or structures with identified defects/flaws
- components, materials or structures requiring further investigation
- components, materials or structures requiring other inspection methods

9. Complete the inspection activities, to include carrying out **all** of the following:

- marking up defective components, materials or structures with all relevant information
- recording all the required details of the inspection in the appropriate format
- handing over the inspection details to the designated people

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Developed by	Enginuity
Version Number	1
Date Approved	30 Mar 2021
Indicative Review Date	01 Mar 2024
Validity	Current
Status	Original
Originating Organisation	Enginuity
Original URN	SEMETS381
Relevant Occupations	Engineering, Engineering and Manufacturing Technologies, Engineering Technicians
Suite	Non Destructive Testing, Engineering Technical Support Suite 3
Keywords	Non Destructive Testing, Inspecting, Engineering Products,