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Non-destructive testing - Thermographic testing - Part 1: General principles

Zerstörungsfreie Prüfung - Thermografische Prüfung - Teil 1: Allgemeine Grundlagen

Essais non destructifs - Analyse thermographique - Partie 1: Principes généraux

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Non-destructive testing - Thermographic testing - Part 1: General principles

Essais non destructifs - Analyses thermographiques -
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This draft European Standard is submitted to CEN members for formal vote. It has been drawn up by the Technical Committee CEN/TC 138.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (FprEN 16714-1:2016) has been prepared by Technical Committee CEN/TC 138 “Non-destructive testing”, the secretariat of which is held by AFNOR.

This document is currently submitted to the Formal Vote.

Non-destructive testing — Thermographic testing consists of the following parts:

- *Part 1: General principles*
- *Part 2: Equipment*
- *Part 3: Terms and definitions*

FprEN 16714-1:2016 (E)**1 Scope**

This European Standard specifies the general principles for thermography of non-destructive testing. Thermographic testing is used for the detection and localization of discontinuities (e.g. cracks, delamination and inclusions) in different materials (e.g. composites, metals and coatings).

Usually a thermal stimulation is required. The choice of thermal stimulation depends on the application (e.g. type of material, geometry of test object, type of defects to be determined).

Acceptance criteria are not defined in this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1330-1, *Non destructive testing - Terminology - Part 1: List of general terms*

EN 1330-2, *Non destructive testing - Terminology - Part 2: Terms common to the non-destructive testing methods*

FprEN 16714-2:2016, *Non-destructive testing — Thermographic testing — Part 2: Equipment*

FprEN 16714-3:2016, *Non-destructive testing — Thermographic testing — Part 3: Terms and definitions*

EN ISO 9712, *Non-destructive testing - Qualification and certification of NDT personnel (ISO 9712:2012)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1330-1, EN 1330-2 and FprEN 16714-3:2016 apply.

4 Apparatus

According to FprEN 16714-2:2016.

5 Preparation for testing**5.1 Test instruction**

A test instruction shall be prepared that specifies the minimum test requirements relating to each of the items listed in 5.4.

5.2 Description of method

If required, for example by a product standard or contract, a description of the method shall be prepared.

5.3 Availability of test instruction and description of method

Copies of the test instruction and, if applicable, of the description of the method shall be made available to the responsible personnel.

5.4 Preparation criteria

The following points shall be taken into account or stipulated in preparing for the test:

- a) position, accessibility and geometry of the objects under test;
- b) purpose of testing;
- c) scope of test;
- d) area to be tested;
- e) kind of expected inhomogenities (e.g. geometry, orientation, depth, surface breaking or not);
- f) test requirements, especially those relating to:
 - spatial resolution;
 - temporal resolution;
 - thermal resolution;
 - measurement precision;
- g) apparatus, including:
 - selection of appropriate energy source and its characteristic parameters;
 - selection of IR camera and its characteristic parameters;
 - spatial set up of energy source, IR camera and test object;
 - verification of test equipment (regarding proper working);
- h) test procedure including:
 - optimization of the spatial set up (e.g. field of view, focusing, avoiding reflection);
 - criteria of notation (e.g. size, location, number of indications);
 - measurement parameters;
- i) ambient conditions at the time of testing;
- j) operational state of the objects under test at the time of testing;
- k) surface properties, such as emission, transmission and reflection, of the objects under test;
- l) personnel qualifications and duties (see Clause 7);
- m) scope of test report (see Clause 9).

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5.5 Reference test specimens

For controlling the set-up of the whole measurement system as well as the selected measurement parameters, at least one of three different kinds of reference test specimens shall be used:

- **Type 1:** Reference test specimen for calibration check and/or testing the measurement system;
- **Type 2:** Reference test specimen with artificial defects for quantification of detection sensitivity for a distinct type of material;
- **Type 3:** Reference test specimen with natural defects for quantification of detection sensitivity for a distinct type of material (original test object).

Reference test specimens of **type 1** are used preliminary for testing single components as well as the whole measurement set-up (e.g. black body, large metal plate). Prior to and/or during testing, the proper function and, if required, calibration of the infrared camera has to be checked. For controlling the temperature calibration, a calibrated black body should be used at two different temperatures being relevant for the test. Deviations should not exceed the accuracy of the actual calibration. Further function controls have to be performed according to FprEN 16714-2:2016. If the energy is introduced by homogeneous radiation, the spatial homogeneity of the radiation source should be tested using e.g. a large blackened metal plate.

Reference test specimens of **type 2** include artificial defects like flat bottom holes, notches or step wedges with different geometry made of the same material as the object under test. Additionally, any anisotropic thermal material properties have to be considered, e.g. as for CFRP. For enabling unique defect identification as well as for evaluating the detection limits of the measurement system for these defects, several type 2 reference test specimens may be necessary to cover all of the expected defects.

Reference test specimens of **type 3** are real test specimens with natural defects as they are generated during the production process or during the life of the part. Kind of material, geometry and surface condition are similar to those of the test objects. The defects should be characterized by any non-destructive method, e.g. computed tomography, ultrasonic testing.

5.6 Apparatus check

Steps shall be taken to ensure that the apparatus to be used for the test is operating correctly, i.e. in accordance with the technical specifications using one of the reference test specimens (see 5.5).

Individual performance of each component can be checked by reference test specimen of type 1 and the global performance of the system using the test specimen of type 2 or 3.

5.7 Surface and emissivity

The performance of temperature measurements on the object under test is influenced by the emissivity and irradiation coming from the surrounding environment, which has to be taken to account.

In the case of objects with low emissivity, i.e. with high reflectance or transmittance, a coating having high emissivity may be applied, if necessary. Type, thickness and further parameters of the coating have to be adapted to the application. This should be determined using a reference test specimen of type 2 or 3.