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Condition monitoring and diagnostics of machines — Thermography —

Part 1:
General procedures

Surveillance et diagnostic de l'état des machines — Thermographie —

Partie 1: Procédures générales

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 18434-1 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration, shock and condition monitoring*, Subcommittee SC 5, *Condition monitoring and diagnostics of machines*.

ISO 18434 consists of the following parts, under the general title *Condition monitoring and diagnostics of machines — Thermography*:

- *Part 1: General procedures*

Image interpretation and diagnostics is to form the subject of a future Part 2.

Introduction

This part of ISO 18434 provides guidance on the use of infrared thermography (IRT) as part of a programme for condition monitoring and diagnostics of machines. IRT can be used to identify and document anomalies for the purposes of condition monitoring of machines. These anomalies are usually caused by such mechanisms as operation, improper lubrication, misalignment, worn components or mechanical loading anomalies.

IRT is based on measuring the distribution of radiant thermal energy (heat) emitted from a target surface, and converting this to a map of radiation intensity differences (surface temperature map) or *thermogram*. The thermographer therefore requires an understanding of heat, temperature and the various types of heat transfer as essential prerequisites when undertaking an IR programme. Thermal energy is present with the operation of all machines. It can be in the form of friction or energy losses, as a property of the process media, produced by the actual process itself or any combination thereof. As a result, temperature can be a key parameter for monitoring the performance of machines, the condition of machines, and the diagnostics of machine problems. IRT is an ideal technology to do this temperature monitoring because it provides complete thermal images of a machine, or a machine component, with no physical attachments (non-intrusive), requires little set-up, and provides the results in a very short period of time.

An important advantage of radiation thermometers over contact thermometers is their speed of response. The measured energy travels from the target to the sensor at the speed of light. The response of the instrument can then be in milliseconds or even microseconds. Another advantage is the sensitivity of the instruments in that they can detect and display a thermal “picture” composed of the very subtle temperature differences of the target.

Although extremely useful, IRT has a limitation in that radiometric sensing is susceptible to unacceptable error when used on most low emissivity surfaces.

Condition monitoring and diagnostics of machines — Thermography —

Part 1:
General procedures

1 Scope

This part of ISO 18434 provides an introduction to the application of infrared thermography (IRT) to machinery condition monitoring and diagnostics, where “machinery” includes machine auxiliaries such as valves, fluid and electrically powered machines, and machinery related heat exchanger equipment. In addition, IR applications pertaining to machinery performance assessment are addressed.

This part of ISO 18434:

- introduces the terminology of IRT as it pertains to condition monitoring and diagnostics of machines;
- describes the types of IRT procedures and their merits;
- provides guidance on establishing severity assessment criteria for anomalies identified by IRT;
- outlines methods and requirements for carrying out IRT of machines, including safety recommendations;
- provides information on data interpretation, and assessment criteria and reporting requirements;
- provides procedures for determining and compensating for reflected apparent temperature, emissivity and attenuating media.

This part of ISO 18434 also encompasses the testing procedures for determining and compensating for reflected apparent temperature, emissivity and attenuating media when measuring the surface temperature of a target with a quantitative IRT camera.

NOTE It is intended that future parts will address application-specific analysis guidelines.

2 Normative references

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

ISO 13372, *Condition monitoring and diagnostics of machines — Vocabulary*

ISO 13379, *Condition monitoring and diagnostics of machines — General guidelines on data interpretation and diagnostics techniques*

ISO 13381-1, *Condition monitoring and diagnostics of machines — Prognostics — Part 1: General guidelines*

ISO 17359, *Condition monitoring and diagnostics of machines — General guidelines*

ISO 18436-7, *Condition monitoring and diagnostics of machines — Requirements for qualification and assessment of personnel — Part 7: Thermography*

ASTM E1897, *Standard test methods for measuring and compensating for transmittance of an attenuating medium using infrared imaging radiometers*

3 Terms and definitions

For the purposes of this document the terms and definitions given in ISO 13372 and the following apply.

3.1
apparent temperature
uncompensated reading from an infrared thermography camera containing all radiation incident on the detector, regardless of its source

3.2
attenuating media
windows, filters, atmospheres, external optics, materials or other media that attenuate the infrared radiation emitted from a source

3.3
black body
ideal perfect emitter and absorber of thermal radiation at all wavelengths

NOTE This is described by Planck's law.

3.4
emissivity
ε
ratio of a target surface's radiance to that of a black body at the same temperature and over the same spectral interval

3.5
infrared thermography camera
IRT camera
instrument that collects the infrared radiant energy from a target surface and produces an image in monochrome (black and white) or colour, where the grey shades or colour hues are related to target surface apparent temperature distribution

NOTE Such images are sometimes called *infrared thermograms*.

3.6
image processing
converting an image to digital form and further enhancing the image to prepare it for computer or visual analysis

NOTE In the case of an infrared image or thermogram this could include temperature scaling, spot temperature measurements, thermal profiles, image manipulation, subtraction and storage.

3.7
infrared
IR
that portion of the electromagnetic continuum extending from the red visible wavelength, 0,75 µm, to 1 000 µm

NOTE Because of instrument design considerations and the infrared transmission characteristics of the atmosphere, most infrared measurements are made between 0,75 µm and 15 µm wavelengths.