
**Condition monitoring and diagnostics of
machines — Requirements for
qualification and assessment of
personnel —**

**Part 7:
Thermography**

iTeh STANDARD PREVIEW

*Surveillance et diagnostic d'état des machines — Exigences relatives à
la qualification et à l'évaluation du personnel —*

Partie 7: Thermographie

ISO 18436-7:2008

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Contents

Page

Foreword	iv
Introduction.....	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Classification of personnel (thermography).....	2
4.1 General	2
4.2 Category I	2
4.3 Category II	3
4.4 Category III	3
5 Eligibility.....	4
5.1 General	4
5.2 Education	4
5.3 Training.....	4
5.4 Experience	5
6 Examinations	6
6.1 Examination content	6
6.2 Conduct of examinations.....	7
6.3 Supplementary examination	7
Annex A (normative) Training course requirements and minimum training hours for thermography personnel	8
Annex B (normative) Training course sub-topics	13
Bibliography.....	16

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 18436-7 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration, shock and condition monitoring*, Subcommittee SC 5, *Condition monitoring and diagnostics of machines*.

ISO 18436 consists of the following parts, under the general title *Condition monitoring and diagnostics of machines — Requirements for qualification and assessment of personnel*:

- *Part 1: Requirements for certifying bodies and the certification process*
- *Part 2: Vibration condition monitoring and diagnostics*
- *Part 3: Requirements for training bodies and the training process*
- *Part 4: Field lubricant analysis*
- *Part 5: Lubricant laboratory technician/analyst*
- *Part 6: Acoustic emission*
- *Part 7: Thermography*

Introduction

Using thermography to monitor condition and diagnose faults in machinery is a key activity in predictive maintenance programmes for most industries. Other non-intrusive technologies including vibration analysis, acoustic emission, lubricant analysis, and motor current analysis are used as complementary condition analysis tools. Those in the manufacturing industry who have diligently and consistently applied these techniques have experienced a return on investment far exceeding their expectations. However, the effectiveness of these programmes depends on the capabilities of individuals who perform the measurements and analyse the data.

A programme, administered by an assessment body, has been developed to train and assess the competence of personnel whose duties require the appropriate theoretical and practical knowledge of machinery monitoring and diagnostics.

This part of ISO 18436 defines the requirements against which personnel in the non-intrusive machinery condition monitoring and diagnostics technologies associated with infrared thermography for machinery condition monitoring are to be qualified and the methods of assessing such personnel.

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Condition monitoring and diagnostics of machines — Requirements for qualification and assessment of personnel —

Part 7: Thermography

1 Scope

This part of ISO 18436 specifies the requirements for qualification and assessment of personnel who perform machinery condition monitoring and diagnostics using infrared thermography.

A certificate or declaration of conformity to this part of ISO 18436 will provide recognition of the qualifications and competence of individuals to perform thermal measurements and analysis for machinery condition monitoring using portable thermal imaging equipment. This procedure may not apply to specialized equipment or other specific situations.

This part of ISO 18436 specifies a three-category classification programme that is based on the technical areas delineated herein.

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2 Normative references

[ISO 18436-7:2008](https://standards.iteh.ai/catalog/standards/sist/565c13e1-cae1-4a9c-9bdc-6544236b0a8e/iso-18436-7-2008)

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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 13374 (all parts), *Condition monitoring and diagnostics of machines — Data processing, communication and presentation*

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 17359:2003, *Condition monitoring and diagnostics of machines — General guidelines*

ISO 18434-1, *Condition monitoring and diagnostics of machines — Thermography — Part 1: General procedures*

ISO 18436-1:2004, *Condition monitoring and diagnostics of machines — Requirements for training and certification of personnel — Part 1: Requirements for certifying bodies and the certification process*

ISO 18436-3, *Condition monitoring and diagnostics of machines — Requirements for qualification and assessment of personnel — Part 3: Requirements for training bodies and the training process*

3 Terms and definitions

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

3.1 significant interruption
absence or change of activity which prevents the assessed individual from practising the duties corresponding to the category within the defined scope for

- a) a continuous period in excess of 365 days or
- b) two or more periods for a total time exceeding two-fifths of the total period of validity of the certificate or declaration

4 Classification of personnel (thermography)

4.1 General

Individuals assessed as conforming to the requirements of this part of ISO 18436 shall be classified in one of three categories depending upon their qualifications. They shall have demonstrated the necessary skills in thermal condition monitoring for their category as indicated in Annex A.

Personnel classified as Category II need to have all the knowledge and skills expected of personnel classified as Category I, while personnel classified as Category III need to have all the knowledge and skills expected of personnel classified as Category II.

4.2 Category I

Individuals classified as Category I are qualified to perform infrared thermography according to established and recognized procedures. Personnel classified as Category I shall be able to:

- a) apply a specified thermographic measurement technique;
- b) set up and operate the thermal imaging equipment for safe thermographic data collection;
- c) identify, prevent, minimize and control poor data acquisition and error sources;
- d) perform basic fault detection, severity assessment and diagnosis in accordance with established instructions;
- e) perform basic image post-processing (measurement tools, emissivity adjustments, span and scale adjustments, etc.);
- f) maintain a database of results and trends;
- g) verify the calibration of thermographic measurement systems;
- h) evaluate and report test results and highlight areas of concern.

4.3 Category II

Individuals classified as Category II are qualified to perform infrared thermography according to established and recognized procedures. Personnel classified as Category II shall be able to:

- a) select the appropriate infrared thermography technique and understand its limitations;
- b) apply thermography theory and techniques, including measurement and interpretation of survey results;
- c) specify the appropriate hardware and software;
- d) perform advanced fault diagnoses;
- e) recommend appropriate field corrective actions;
- f) perform advanced image post-processing (image, trending, montage, subtraction, superimposition, statistical analysis, etc.);
- g) use generally recognized advanced techniques for infrared thermography and fault diagnosis in accordance with established procedures;
- h) prepare reports on equipment condition, fault diagnoses, corrective actions and the effectiveness of repairs;
- i) be aware of the use of alternative or supplementary condition monitoring technologies; and
- j) provide guidance to and supervise Category I personnel.

4.4 Category III

Individuals classified as Category III are qualified to perform infrared thermography according to established and recognized procedures. Personnel classified as Category III shall be able to:

- a) develop and establish thermographic programmes, procedures and instructions including determination of machines for periodic/continuous monitoring, frequency of testing, the use of advanced techniques, etc.;
- b) determine severity assessment and acceptance criteria for new, in-service and faulty equipment;
- c) interpret and evaluate codes, standards, specifications and procedures;
- d) designate the particular test methods, procedures and instructions to be used;
- e) perform prognostics for fault conditions;
- f) recommend appropriate types of thermodynamic (radiation-, convection-, conduction-based) corrective actions;
- g) recommend appropriate types of machinery engineering corrective actions;
- h) provide guidance to and supervise Category I and II personnel; and
- i) recommend the use of alternative or supplementary condition monitoring technologies.

5 Eligibility

5.1 General

Candidates should have a combination of education, training and experience to ensure that they understand the principles and procedures applicable to thermographic measurement and analysis.

It is advised that all candidates have their colour perception assessed by the Ishihara 24 plate test. A record of test results should be retained and presented to the assessment body upon request. In the event that a colour perception deficiency, indicated by misreading four or more of the 24 plates, is detected during the Ishihara test, a further “task specific” test is to be carried out by the employer to ascertain whether the detected colour perception deficiency affects the individual's ability to satisfactorily perform analysis of thermographic data using colour palettes. Failure to pass this test may require the candidate to use a monochrome palette. This “task specific” test, and any requirement to use a monochrome palette, is to be documented and a record of the test made available to the assessment body upon request.

5.2 Education

Candidates seeking classification do not need to provide evidence of formal education to establish eligibility. However, it is recommended that candidates for Category I and Category II have at least a secondary school graduate qualification or its equivalent. Category II and III candidates shall be able to manipulate simple algebraic equations, use a basic scientific calculator, and be familiar with the operation of personal computers. Successful completion of two or more years of mechanical technology or mechanical engineering at an accredited college, university, or technical school is highly recommended for candidates seeking classification to Category III.

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5.3 Training

5.3.1 Introduction

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To be eligible to apply for assessment based on this part of ISO 18436, the candidates shall provide evidence of successful completion of training based on the requirements of Annex A. The documents in the Bibliography should be used as the domain of knowledge for the training syllabus. Such training shall be compliant with the requirements of ISO 18436-3. The minimum duration of training is shown in Table 1. Training should be in the form of lectures, demonstrations, practical exercises or formal training courses.

Qualification requirements shall be in accordance with this part of ISO 18436. Training time devoted to each subject shall be in accordance with Annex A and Table 1. See Annex B for a non-exhaustive list of the topics and sub-topics to be covered.

Table 1 — Minimum duration of cumulative training (hours)

Category I	Category II	Category III
32	64	96

Training may be modularized into two or more subject areas covering general scientific principles and application-specific knowledge in order to allow for mutual recognition between non-destructive testing and condition monitoring assessment bodies.

5.3.2 Training for supplementary classification

A modular training course designed to cover those topics specific to thermography-based condition monitoring may be undertaken.

Such supplementary training courses shall cover the topics outlined in Annex A for subjects five (5) through eleven (11) inclusive. The duration of such training shall comply with the durations stated in Annex A for the relevant subject areas.

5.3.3 Additional training on machine knowledge

In addition to the training hours shown in Table 1, candidates should attend machinery and component training, or equivalent on-the-job training, of at least a similar duration to that specified in Table 1.

Such training shall be in addition to any formal education compliant with 5.2, inclusive of any college or university education. If undertaken, the additional training shall cover the design, manufacturing, installation, operation and maintenance principles of machines and components, the failure modes and mechanisms associated with each principle, and the typical thermodynamic behaviours associated with each mechanism. Such training shall be validated by verifiable records.

5.3.4 Mature candidate entry

Mature candidate entry may be allowed at the discretion of the assessment body.

Mature candidates may not need to have attended a course of training at Category II. Such candidates may apply for direct entry to Category II, without the need to have previously held classification at Category I, providing they can produce verifiable documentary evidence of training and experience that satisfies the requirements for both Category I and Category II qualifications.

Candidates shall have at least five years of documented experience without significant interruption in thermography-based condition monitoring of machines for Category II. Candidates shall provide evidence of completion of an equivalent course of training in accordance with Annex A.

Such candidates should apply to the assessment body under the mature candidate route. If a significant interruption exists, the candidate may be required to undertake further training as determined by the assessment body.

5.4 Experience

5.4.1 To be eligible to apply for assessment based on this part of ISO 18436, the candidate shall provide evidence to the assessment body of experience in the field of thermography-based machinery condition monitoring in accordance with Table 2. Classification to Category II and Category III requires previous classification at the lower category.

Table 2 — Minimum cumulative practical, interpretation and programme management experience requirements (months and hours)

Category I	Category II	Category III
12 months	24 months	48 months
400 h ^a	1 200 h ^a	1 920 h ^a
^a Denotes the actual thermography experience hours that are required.		