SLOVENSKI STANDARD
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Toplotna izolacija - Kvalitativno zaznavanje toplotnih nepravilnosti v ovoju zgradbe - Infrardeča metoda

Thermal insulation -- Qualitative detection of thermal irregularities in building envelopes -- Infrared method

Isolation thermique -- Détection qualitiative d'irrégularités thermiques dans des enveloppes de bâtiments -- Méthode infrarouge

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91.120.10	Toplotna izolacija stavb	Thermal insulation

SIST ISO 6781:1997 **en**

International Standard 6781

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Thermal insulation — Qualitative detection of thermal irregularities in building envelopes — Infrared method

Isolation thermique — Détection qualitative d'irrégularités thermiques dans des enveloppes de bâtiments — Méthode infrarouge

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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 developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6781 was developed by Technical Committee ISO/TC 163, *Thermal insulation*, and was circulated to the member bodies in December 1982.

It has been approved by the member bodies of the following countries:

Australia	Egypt, Arab Rep. of	Norway
Austria	Finland	Spain
Belgium	France	Sweden
Canada	Italy	USA
Denmark	Japan	

The member bodies of the following countries expressed disapproval of the document on technical grounds:

Germany, F.R.
Netherlands

Printed in Switzerland

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0 Introduction

Irregularities in the thermal properties of the components constituting the external envelope of a building result in temperature variations over the surfaces of the structure. The surface temperature is also influenced by air flow within and/or through the envelope of the building. The surface temperature distribution can thus be used to detect thermal irregularities due, for example, to insulation defects, moisture content and/or air leakage, in the components constituting the external envelope of the building.

Thermography is a method of indicating and representing the temperature distribution over a part of a building envelope. In the context of this International Standard, thermography is carried out by means of an infrared radiation sensing system which produces an image based on the apparent radiance temperature. The thermal radiation (infrared radiation density), which depends on the surface temperature, is converted by the infrared radiation sensing system to produce a thermal image representing the relative intensity of thermal radiation from different parts of the surface. The radiation intensity is a function of the surface temperature, the characteristics of the surface and the sensor, and the ambient conditions. The procedure also involves interpretation of the thermal images (thermograms).

Valuable information for the application of this International Standard will be given in a Technical Report. This information, which was not regarded as suitable for inclusion in this International Standard, will cover the practical application of building thermography and the problems involved, instrumentation, test reports, educational requirements and certification, together with a bibliography.

1 Scope and field of application

This International Standard specifies a qualitative method, by thermographic examination, for detecting thermal irregularities in building envelopes. The method is used initially to identify wide variations in the thermal properties, including air tightness, of the components constituting the external envelopes of buildings.

The results obtained by means of this method have to be interpreted and assessed by persons who are specially trained for this purpose. (See annex D.)

This International Standard does not apply to the determination of the degree of thermal insulation and air tightness of a structure. For such determinations, examinations by other methods are required.

2 Definitions[1)]

For the purposes of this International Standard, the following definitions apply.

2.1 thermography: Determination and representation of surface temperature distribution by measuring the infrared radiation density from a surface, including interpretation of thermal images.

2.2 thermal image: Image which is given by an infrared radiation sensing system and which represents the apparent radiance temperature distribution over a surface.

2.3 thermogram: A recording of a thermal image.

2.4 radiance: Total amount of energy emanating from a surface per unit solid angle and unit projected area.

Radiance includes emitted radiation from a surface as well as reflected and transmitted radiation.

2.5 apparent radiance temperature: Temperature determined from the measured radiance.

This temperature is the equivalent black body temperature which would produce the radiance.

2.6 isotherm image: Thermal image with isotherms.

2.7 isotherm: A region of points having the same temperature.

In this context, an isotherm may refer to a feature used to outline, on the display, the points, lines or areas having the same infrared radiation density.

1) A vocabulary relating to thermal insulation will form the subject of ISO 7345.

3 Principle

Thermographic examination of parts of buildings comprises:

a) determination of the surface temperature distribution, over a part of a building envelope, from the apparent radiance temperature distribution obtained by means of an infrared radiation sensing system;

b) ascertainment of whether this surface temperature distribution is 'abnormal', i.e. if it is due, for example, to insulation defects, moisture content and/or air leakage;

c) estimation of the type and the extent of defects.

In order to determine whether the observed variations in the thermal insulation properties are abnormal, the thermograms obtained are compared with the anticipated temperature distribution over the surface, determined by the design characteristics of the building envelope and by the environment at the time of examination. The anticipated temperature distributions can be determined by means of 'reference thermograms' (see 5.3 and annexes A, B and C), calculations or other investigations. This determination is based on drawings and other construction documents relating to the external envelope and to the installations of the building under investigation.

The general procedure for the interpretation of thermal images is represented schematically in figure 1.

Additional information on thermography is given in annex D.

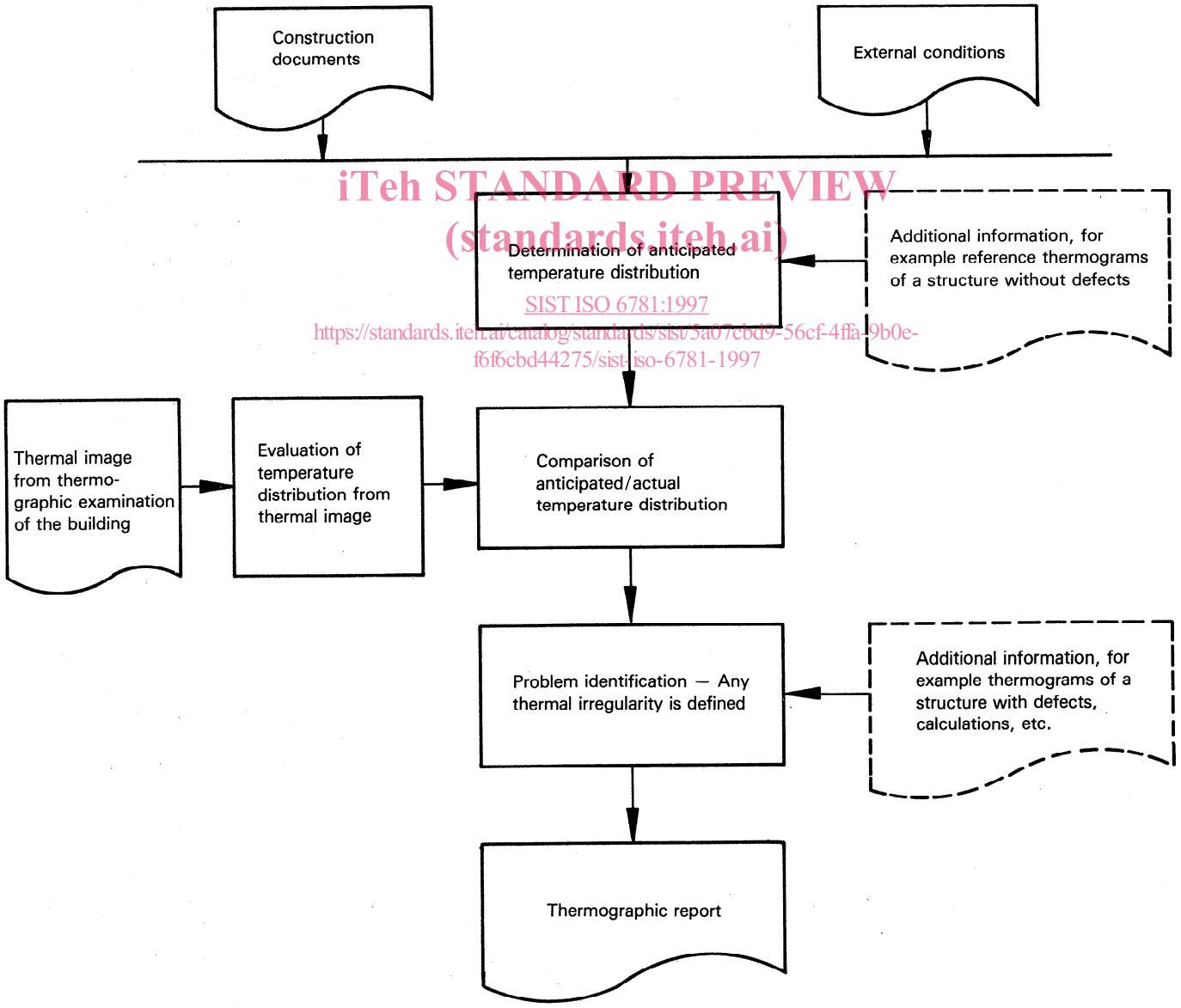

Figure 1 — General procedure for the interpretation of thermal images in thermographic examinations
(Dotted boxes indicate suggested use of additional information)

4 Infrared radiation sensing system

The infrared radiation sensing system shall comprise

a) infrared radiation sensor(s), operating at a wavelength greater than 2 µm, and which can sense apparent radiance temperatures of interest with sufficient resolution; [1)]

b) a device which renders visible and displays, in the form of a thermal image, the apparent radiance temperature over the surface being examined;

c) a device which makes it possible to record the thermal image;

d) means of establishing temperature levels on the surface under examination.

During the test period, no significant drift in the infrared radiation sensing system shall occur.

5 Thermographic examination

5.1 General test requirements

In order to define the actual test requirements, and in particular the side of the building envelope (outdoors or indoors) from which the thermographic examination is to be performed, the following factors need to be considered:

— the specifications and capabilities of the thermographic equipment;

— the characteristics of the building envelope, i.e. the respective locations of structural and insulating layers;

— the radiative properties of the cladding materials;

— climatic factors;

— accessibility for easy inspection;

— influences of the environment;

— other factors of importance.

The temperature drop across the envelope shall be sufficiently large to permit the detection of thermal irregularities. For ease of interpretation, the thermographic examination should preferably be carried out with constant temperature- and pressure drops across the envelope. (The interpretation of thermograms taken under non-steady state conditions requires a higher degree of expertise and knowledge of building physics.) This implies, among other things, that the test shall not be carried out when the outside or inside air temperature is liable to vary considerably, or when the structure is exposed to direct solar radiation, or when the wind varies markedly.

These general requirements shall be considered when a thermographic examination is carried out. The actual requirements may be varied according to the thermal properties of the building envelope under examination and the characteristics of the infrared radiation sensing system used. They may also be varied to take account of the local climate. The conditions shall be taken into account when carrying out the examination and when evaluating the thermograms, and shall be carefully recorded in the thermographic report (see clause 6).

Example of an actual set of test requirements taken from Scandinavian conditions. These test requirements must be adapted to meet the specific climatic conditions of a particular geographic region. For Scandinavian conditions, the following test requirements are likely to ensure approximate steady state conditions for a lightweight building structure[2)], when the thermographic examination is to be carried out from the inside:

a) For at least 24 h before the start of the examination, and during the examination, the air temperature drop across the building envelope shall be at least 10 °C. During the same period, the air temperature drop shall not vary more than ± 30 % from its value at the start of the examination. During the examination, the indoor air temperature shall not vary by more than ± 2 °C.

b) For at least 12 h before the start of the examination, and during the examination, the surfaces of the envelope under examination shall not be exposed to direct solar radiation.

c) The minimum and maximum temperatures at the place of examination shall be known for a period of 24 h before the start of the thermographic examination, for example by means of a maximum/minimum thermometer or by information from a weather station. The solar radiation conditions at the place of examination shall be known for a period of 12 h before the start of the thermographic examination.

5.2 Procedure

When available, drawings and other construction documents relating to the building envelope to be examined shall be consulted. The emissivity of the surface materials shall be evaluated from appropriate tables.

Information concerning outside air temperature, cloudiness, precipitation and any moisture on the outside of the building, together with wind conditions, shall be recorded. The geographical orientation of the building with respect to the points of the compass shall also be recorded.

Whenever necessary, a pressure drop shall be produced across the building envelope, or the examination shall be carried out at an appropriate time. The thermographic examination shall be carried out from the low pressure side.

1) Experience in field tests has shown that a minimum resolvable temperature difference of 0,3 °C at a surface temperature of 20 °C and at a spatial frequency of 0,052 cycle/mm would be sufficient for the purposes of this International Standard.

2) The time to reach nearly steady state conditions varies with the characteristics of the external envelope of the building. For a heavy masonry structure, this time may be several days. Alternatively, it may be advantageous to perform the survey under non-steady state conditions.