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**Thermal insulating materials and  
products for buildings—Procedures  
for determining declared and design  
thermal values**

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ICS 91.100.60; 91.120.10

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## Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal of establishing a Japanese Industrial Standard from Japan Thermal Insulation Association (JTIA)/the Japanese Standards Association (JSA), with a draft of Industrial Standard based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

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In the event of any doubts arising as to the contents,  
the original JIS is to be the final authority.

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# Thermal insulating materials and products for buildings— Procedures for determining declared and design thermal values

**Introduction** This Japanese Industrial Standard has been prepared based on the second edition of **ISO 10456** *Building materials and products—Procedures for determining declared and design thermal values* published in 1999 with some modifications of the technical contents.

Portions with sidelines or underlines with dots are the matters modified the original International Standard. The modified contents and their explanations are shown in Annex 1 (informative).

**1 Scope** This Standard specifies methods for the determination of declared and design thermal values for thermally homogeneous insulating materials and products for building. It also gives procedures to convert values obtained under one set of conditions to those valid for another set of conditions. These procedures are valid for design ambient temperatures between  $-30\text{ }^{\circ}\text{C}$  and  $+60\text{ }^{\circ}\text{C}$ .

- NOTES
- 1 Conversion coefficients for temperature, valid for mean temperatures between  $0\text{ }^{\circ}\text{C}$  and  $30\text{ }^{\circ}\text{C}$ , and moisture are given in annex A (normative) and annex B (informative).
  - 2 This Standard does not give any conversion coefficients for the effect of ageing or other effects like convection or settlement.
  - 3 The International Standard corresponding to this Standard is as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and JIS are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

ISO 10456 : 1999 *Building materials and products—Procedures for determining declared and design thermal values*  
(MOD)

**2 Normative references** The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS A 1412-1 *Test method for thermal resistance and related properties of thermal insulations—Part 1 : Guarded hot plate apparatus*

NOTE **ISO 8302** : 1991 *Thermal insulation—Determination of steady-state thermal resistance and related properties—Guarded hot plate apparatus* is equivalent to the said standard.

JIS A 1412-2 *Test method for thermal resistance and related properties of thermal insulations—Part 2 : Heat flow meter apparatus*

NOTE **ISO 8301** : 1991 *Thermal insulation—Determination of steady-state thermal resistance and related properties—Heat flow meter apparatus* is equivalent to the said standard.

JIS A 1420 *Determination of steady-state thermal transmission properties—Hot box method*

NOTE **ISO 8990** : 1994 *Thermal insulation—Determination of steady-state thermal transmission properties—Calibrated and guarded hot box* is equivalent to the said standard.

**3 Definitions** For the purposes of this Standard, the following terms and definitions apply.

a) **declared thermal value**

expected value of a thermal property of an insulating material or product for building

- 1) assessed from measured data at reference conditions of temperature and humidity;
- 2) given for a stated fraction and confidence level;
- 3) corresponding to a reasonable expected service lifetime under normal conditions

b) **design thermal value**

value of thermal property of an insulating material or product for building under specific external and internal conditions which can be considered as typical of the performance of that material or product when incorporated in a building component

c) **material**

piece of a product irrespective of its delivery form, shape and dimensions, without any facing or coating

d) **product**

final form of a material ready for use, of given shape and dimensions and including any facings or coatings

**4 Symbols and units** The symbols and units are given in Table 1.

**Table 1 Symbols, quantities and units**

| Symbol    | Quantity                                         | Unit                           |
|-----------|--------------------------------------------------|--------------------------------|
| $F_a$     | ageing conversion factor                         |                                |
| $F_m$     | moisture conversion factor                       |                                |
| $F_T$     | temperature conversion factor                    |                                |
| $f_T$     | temperature conversion coefficient               | 1/K                            |
| $f_u$     | moisture conversion coefficient mass by mass     | kg/kg                          |
| $f_v$     | moisture conversion coefficient volume by volume | m <sup>3</sup> /m <sup>3</sup> |
| $R$       | thermal resistance                               | m <sup>2</sup> · K/W           |
| $T$       | temperature                                      | K                              |
| $\lambda$ | thermal conductivity                             | W/(m · K)                      |
| $u$       | moisture content mass by mass                    | kg/kg                          |
| $\Psi$    | moisture content volume by volume                | m <sup>3</sup> /m <sup>3</sup> |

## 5 Test methods and test conditions

**5.1 Test methods** Measured values from the following methods shall be used:

- a) guarded hot plate in accordance with **JIS A 1412-1**;
- b) heat flow meter in accordance with **JIS A 1412-2**;
- c) hot box in accordance with **JIS A 1420**.

**5.2 Test conditions** To avoid conversions, it is recommended that measurements be conducted under conditions corresponding to the selected set of conditions given in Table 2. The mean test temperature should be chosen so that the application of the temperature coefficients does not introduce a change of more than 2 % from the measured value.

The following testing conditions are required:

- a) measured thickness and density for identification;
- b) mean test temperature;
- c) moisture content of the specimen during test;
- d) age of the specimen and conditioning procedures before testing.

**6 Determination of declared values** The declared value shall be given under one of the sets of conditions a or b with reference temperature 10 °C (I) or 23 °C (II) in Table 2. The statistical calculations are given in annex C.

**Table 2 Declared value conditions**

| Property                                                                                                                                                                  | Sets of conditions |             |                  |             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------|------------------|-------------|
|                                                                                                                                                                           | I (10 °C)          |             | II (23 °C)       |             |
|                                                                                                                                                                           | a                  | b           | a                | b           |
| Reference temperature                                                                                                                                                     | 10 °C              | 10 °C       | 23 °C            | 23 °C       |
| Moisture                                                                                                                                                                  | $u_{\text{dry}}$   | $u_{23/50}$ | $u_{\text{dry}}$ | $u_{23/50}$ |
| Ageing                                                                                                                                                                    | aged               | aged        | aged             | aged        |
| $u_{\text{dry}}$ is a low moisture content reached by drying.<br>$u_{23/50}$ is the moisture content when in equilibrium with air at 23 °C and relative humidity of 50 %. |                    |             |                  |             |

- NOTES 1 The declared value shall be determined either at a thickness large enough to neglect the thickness effect, or the declared values for smaller thicknesses shall be based on measurements at those thicknesses.
- 2 The data used shall be either directly measured values according to the test methods given in 5.1, or obtained indirectly by making use of an established correlation with a related property such as density.
- 3 When all data have not been measured under the same set of conditions, they shall first be brought to one set of conditions (see clause 8). Then a statistical single value estimate shall be calculated.

Annex D refers to International Standards (ISO 3207, ISO 2602 and ISO 2854) on statistics that may be used.

- 4 During calculations no value shall be rounded to less than three significant figures.
- 5 The declared value is the estimated value of the statistical single value, rounded according to the following rules:

- a) for thermal conductivity given in watts per metre kelvin [W/(m·K)]:

- $\lambda \leq 0.08$  : rounding to nearest higher 0.001 W/(m·K)  
 $0.08 < \lambda \leq 0.20$  : rounding to nearest higher 0.005 W/(m·K)  
 $0.20 < \lambda \leq 2.00$  : rounding to nearest higher 0.01 W/(m·K)  
 $2.0 < \lambda$  : rounding to nearest higher 0.1 W/(m·K)

and/or:

- b) for thermal resistance given in square metres kelvin per watt (m<sup>2</sup>·K/W) as the nearest lower value rounded to not more than two decimals or three significant figures.

## 7 Determination of design values

**7.1 General** Design values can be obtained from a declared value, measured values or standardized tabulated values (annex A).

- a) Measured data can be either directly measured values according to the test methods given in 5.1, or obtained indirectly by making use of an established correlation with a related property such as density.
- b) If the set of conditions for declared, measured or standardized tabulated values (annex A) can be considered relevant for the actual application, those values can be used directly as design values. Otherwise, conversion of data shall be undertaken according to the procedure given in clause 8.
- c) The design value shall be rounded according to the rules given in clause 6:
  - for thermal conductivity, as the nearest higher value in watts per metre kelvin [W/(m·K)];
  - for thermal resistance, as the nearest lower value in square metres kelvin per watt (m<sup>2</sup>·K/W).

The statistical calculations are given in annex C.

**7.2 Design values derived from declared values** When the design value is calculated from the declared value and is based on the same statistical evaluation, the declared value shall be converted to the design conditions. Information on how to derive design values based on another statistical evaluation other than the one applicable to the declared value is given in annex D.

**7.3 Design values derived from measured values** When necessary all data shall first be converted to the design conditions. Then a statistical single value estimate shall be calculated. Annex D refers to International Standards (ISO 3207, ISO 2602 and ISO 2854) on statistics that can be used.

**7.4 Design values derived from tabulated values** Standardized tabulated values (annex A) can be used when the set of conditions for them is available.

## 8 Conversion of available data

### 8.1 General

- a) Conversion coefficients derived from measured values according to the test methods referred to in 5.1 may be used instead of the values in annex A.
- b) Conversions of thermal values from one set of conditions ( $\lambda_1, R_1$ ) to another set of conditions ( $\lambda_2, R_2$ ) are carried out according to the following expressions:

$$\lambda_2 = \lambda_1 \cdot F_T \cdot F_m \cdot F_a \dots\dots\dots (1)$$

$$R_2 = \frac{R_1}{F_T \cdot F_m \cdot F_a} \dots\dots\dots (2)$$

**8.2 Conversion for temperature** The factor  $F_T$  for temperature is determined by:

$$F_T = e^{f_T(T_2 - T_1)} \dots\dots\dots (3)$$

where

$f_T$  is the temperature conversion coefficient;

$T_1$  is the temperature of the first set of conditions;  
 $T_2$  is the temperature of the second set of conditions.

**8.3 Conversion for moisture** The factor  $F_m$  for moisture content is determined as follows.

a) **Conversion of moisture content given as mass by mass:**

$$F_m = e^{f_u(u_2 - u_1)} \dots\dots\dots (4)$$

where

$f_u$  is the moisture content conversion coefficient mass by mass;  
 $u_1$  is the moisture content mass by mass of the first set of conditions;  
 $u_2$  is the moisture content mass by mass of the second set of conditions.

b) **Conversion of moisture content given as volume by volume:**

$$F_m = e^{f_\psi(\Psi_2 - \Psi_1)} \dots\dots\dots (5)$$

where

$f_\psi$  is the moisture content conversion coefficient volume by volume;  
 $\Psi_1$  is the moisture content volume by volume of the first set of conditions;  
 $\Psi_2$  is the moisture content volume by volume of the second set of conditions.

#### 8.4 Age conversion

- a) The ageing depends upon the material type, facings, structures, the blowing agent, the temperature and the thickness of the material. For a given material the ageing effect can be obtained from theoretical models validated by experimental data. There are no simple rules to correlate ageing over time for a given material.
- b) No conversion is needed when the measured conductivity or resistance already takes account of ageing effects.
- c) If a conversion factor  $F_a$  is used, it shall allow the calculation of the aged value of the thermal property corresponding to a time not less than half the working lifetime of the product in the application concerned.

NOTES 1 The working lifetime is often taken as 50 years.

2 No conversion coefficients are given in this Standard to derive the ageing factor  $F_a$ .