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**Determination of Thermal Transmittance for
Architecture Aluminum Alloy Thermal Barrier Profiles**

建筑用铝合金隔热型材

传热系数测定方法

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Determination of Thermal Transmittance for Architecture Aluminum Alloy Thermal Barrier Profiles

1 Scope

This Standard stipulates the terms, definitions, method and principle, test equipment and devices, test sample, determination and test report for the determination of thermal transmittance for architecture aluminum alloy thermal barrier profiles.

This Standard is applicable to the determination of thermal transmittance for architecture aluminum alloy thermal barrier profiles.

2 Normative References

The following documents are indispensable to the application of this document. In terms of references with a specific date, only versions with a specific date are applicable to this document. In terms of references without a specific date, the latest versions (including all the modification lists) are applicable to this document.

GB/T 4132 Definitions of Terms Relating to Thermal Insulating Materials

GB/T 8170 Rules of Rounding off for Numerical Values & Expression and Judgement of Limiting Values

GB/T 10294 Thermal Insulation - Determination of Steady-state Thermal Resistance and Related Properties - Guarded Hot Plate Apparatus

GB/T 13475 Thermal Insulation - Determination of Steady-state Thermal Transmission Properties - Calibrated and Guard Hot Box

JJG 368-2000 Working Copper/Copper-Nickel Thermocouple

3 Terms and Definitions

Terms and definitions defined in GB/T 4132, and the following terms and definitions are applicable to this document.

3.1 Areal Density of Heat Flow Rate

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Areal density of heat flow rate refers to per unit area heat flow, which is vertical to the

0.04 W/(m•K). The actual value of thermal transmittance shall be provided by manufacturers, or, be determined in accordance with the methods stipulated in GB/T 10294. The parallelism of both sides of the thermal insulation board shall be not more than $\pm 0.5^\circ$. Thermal insulation board for calibration, which is known as calibration board for short, has the thickness of 20 mm or 60 mm.

5.4 Test Piece Frame

The texture of test piece frame shall comply with the stipulations in GB/T 13475. The thermal transmittance shall be not more than 0.04 W/(m•K). The thickness of test piece frame shall be not less than 300 mm.

5.5 Hot Box External Wall

The texture of hot box external wall shall comply with the stipulations in GB/T 13475. The thermal transmittance shall be not more than 0.04 W/(m•K). The thickness of hot box external wall shall be not less than 200 mm.

5.6 Hot Box Calibration

5.6.1 Parameters that the hot box needs to calibrate include: hot chamber external wall heat flow coefficient M_1 and test piece frame heat flow coefficient M_2 .

5.6.2 When the cold chamber draught fan of the hot box is constant-speed fan, the wind speed of the cold chamber draught fan shall be 3 m/s. In accordance with the methods in Appendix A, calibrate hot chamber external wall heat flow coefficient M_1 and test piece frame heat flow coefficient M_2 .

5.6.3 When the cold chamber draught fan of the hot box is adjustable-speed fan, in accordance with the methods in Appendix B, set up the wind speed. Then, in accordance with the methods in Appendix A, calibrate hot chamber external wall heat flow coefficient M_1 and test piece frame heat flow coefficient M_2 .

5.6.4 Hot box calibration shall be conducted at least once a year. If the location, structure or accessory of hot box changes, re-calibration will be needed.

6 Test Sample

In accordance with hot box's hole size, cut-take samples. The cutting inclination of the samples shall be $\pm 0.5^\circ$. The total effective projected area of the samples shall be not less than 30% of the hole area of the hot box. The effective projected area of sample refers to the larger one in the projected areas of both-side metal profile, indoors and outdoors, of the thermal barrier profile. Please refer to Figure 2 for the selection of effective projected area A_f of an individual sample. The sum of effective projected areas of multiple samples adopted in one test shall be considered as the total effective projected area of the samples.

various measured parameters (energy consumption value of maintaining constant hot chamber temperature; internal and external surface temperature of hot chamber external wall; temperature of test piece frame hot side surface and cold side surface; air temperature of hot chamber and cold chamber; temperature of thermal insulation board hot side surface and cold side surface) as a group of data.

7.6 Result Calculation

7.6.1 In accordance with Formula (1), calculate the thermal conductivity Λ_{fi} of thermal insulation board. The numerical value rounding-off rule shall comply with relevant stipulations in GB/T 8170. The result shall retain 2 decimal places.

$$\Lambda_{fi} = \frac{\lambda}{d} \quad \dots\dots\dots (1)$$

Where,

Λ_{fi} ---thermal conductivity of thermal insulation board (reciprocal of thermal insulation board's thermal resistance), expressed in [W/(m²•K)];

λ ---thermal conductivity coefficient of thermal insulation board, expressed in [W/(m•K)];

d ---thickness of thermal insulation board, expressed in (m).

7.6.2 In accordance with Formula (2), calculate thermal transmittance coefficient K . The numerical value rounding-off rule shall comply with relevant stipulations in GB/T 8170. The result shall retain 2 decimal places.

$$K = \frac{\Phi_{in} - M_1 \cdot \Delta\theta_{ek} - M_2 \cdot \Delta\theta_{sur} - \Lambda_{fi} \cdot \Delta\theta_{s,fi} \cdot A_{fi}}{A_f \cdot \Delta\theta_n} \quad \dots\dots\dots (2)$$

Where,

K ---thermal transmittance coefficient, expressed in [W/(m²•K)];

Φ_{in} ---energy consumption of maintaining constant hot chamber temperature, expressed in (W);

$\Delta\theta_{ek}$ ---average temperature difference between internal and external surface of hot chamber external wall, expressed in (K);

$\Delta\theta_{sur}$ ---average temperature difference between test piece frame hot side surface and cold side surface, expressed in (K);

$\Delta\theta_n$ ---during test, air temperature difference between hot chamber and cold chamber,

Appendix A

(Normative)

Heat Flow Coefficient Calibration Method

A.1 An Overview of Method

Adopt a calibration board, whose thickness is around 60 mm. Transform the temperature difference between the hot chamber and the external environment; the temperature difference between the cold chamber and the hot chamber. Calculate hot chamber external wall heat flow coefficient M_1 and test piece frame heat flow coefficient M_2 .

A.2 Calibration of Heat Flow Coefficient

A.2.1 In accordance with B.2.1, install a calibration board, whose thickness is around 60 mm.

A.2.2 In accordance with B.2.2, install a thermocouple.

A.2.3 Set up the test ambient temperature of the hot box to be 25 °C; relative ambient humidity shall be not more than 60%. In accordance with 7.4, set up hot box test conditions. In accordance with 7.5, record the first piece of data.

A.2.4 Set up the test ambient temperature of the hot box to be 20 °C. Maintain the ambient humidity and the hot box test conditions unchanged, comply with 7.5 to record the second piece of data.

A.2.5 In accordance with (A.1) and (A.2) simultaneous equations, calculate hot chamber external wall heat flow coefficient M_1 and test piece frame heat flow coefficient M_2 . The numerical value rounding-off rule shall comply with relevant stipulations in GB/T 8170. The result shall retain 3 decimal places.

$$\Phi_{in,1} = M_1 \cdot \Delta\theta_{ek,1} + M_2 \cdot \Delta\theta_{sur,1} + \Lambda_{fi} \cdot \Delta\theta_{s,fi,1} \cdot A_{fi} \dots\dots\dots (A.1)$$

$$\Phi_{in,2} = M_1 \cdot \Delta\theta_{ek,2} + M_2 \cdot \Delta\theta_{sur,2} + \Lambda_{fi} \cdot \Delta\theta_{s,fi,2} \cdot A_{fi} \dots\dots\dots (A.2)$$

Where,

$\Phi_{in,1}$, $\Phi_{in,2}$ ---hot chamber heating power in the first and the second record, expressed in (W);

$\Delta\theta_{ek,1}$, $\Delta\theta_{ek,2}$ ---average temperature difference between internal and external surface of hot chamber external wall in the first and the second record, expressed in (K);

Appendix B

(Normative)

Cold Chamber Draught Fan Speed Setting Method

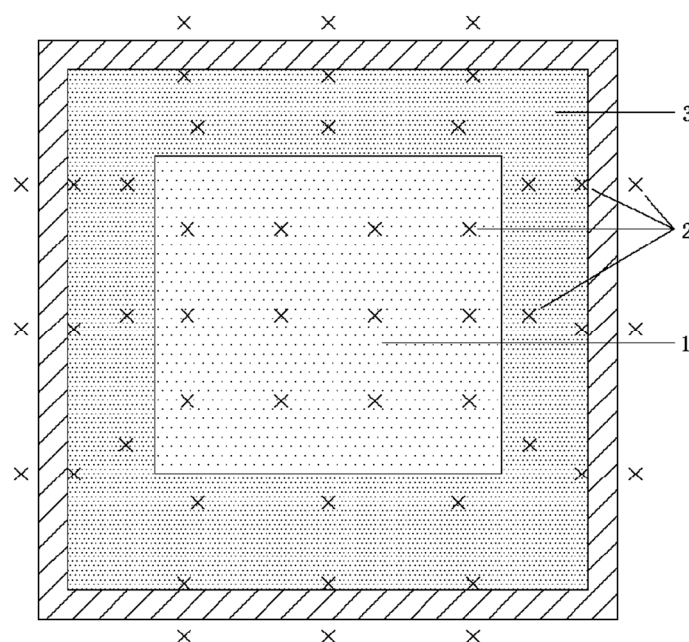
B.1 An Overview of Method

Adopt a calibration board, whose thickness is around 20 mm. Operate the equipment, calculate the total surface thermal resistance of the calibration board. Through adjustment of the wind speed of the cold chamber draught fan, make the total surface thermal resistance of the calibration board reach the stipulated value. Then, adopt the wind speed of the cold chamber draught fan at that moment as the set value of the cold chamber draught fan speed in the subsequent calibration and determination.

B.2 Cold Chamber Draught Fan Speed Setting

B.2.1 In the test piece frame, near the hot chamber, place a calibration board, whose thickness is around 20 mm. The end face of the calibration board shall tightly cling to the test piece frame. Both sides of the calibration board shall not exceed the surface of the test piece frame, as it is shown in Figure 1. Use sealing gum to seal up the installation clearance.

B.2.2 In accordance with GB/T 13475, or, hot box instruction, install thermocouple in hot box space, and on hot chamber external wall and test piece frame. On the calibration board, comply with area to uniformly distribute thermocouple, as it is shown in Figure B.1.



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