

Professional Standard of the People's Republic of China for Building Industry

JG/T 438-2014

Vacuum insulation panels for buildings

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Foreword

This standard was drafted according to provisions of GB/T 1.1-2009.

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Vacuum insulation panels for buildings

1 Scope

This standard specifies terms, definitions, classifications, requirements, testing methods, inspection criteria, packaging, transportation and storage of vacuum insulation panels for buildings.

This standard is applicable to vacuum insulation panels of building heat preservations.

2 Normative References

This standard is indispensably cited by following documents. For dated references, only the edition cited applies to this standard. For undated references, the latest edition (including all errata) of the normative document cited shall apply.

GB/T 5464 *Non-combustibility test method of building materials*

GB/T 5486 *Test methods of inorganic rigid thermal insulation products*

GB 8624 *Classification for burning behavior of building materials and products*

GB/T 8811 *Test method for dimensional stability of rigid cellular plastics*

GB/T 8813 *Rigid cellular plastics-Determination of compression properties*

GB/T 10004-2008 *Plastic laminated films and pouches for packaging, dry lamination and extrusion lamination*

GB/T 10295 *Thermal insulation-Determination of steady-state thermal resistance and related properties-Heat flow meter apparatus*

GB/T 14402 *Reaction to fire test for building materials and products-Determination of the heat of combustion*

GB/T 20284 *Single combustion test for buildings or products*

3 Terms and Definitions

Following terms and definitions are applicable to this standard.

3.1 Vacuum insulation panels for buildings

It refers to panel materials for building heat preservations with core material and getter as filling and laminated barrier film as wrapping after being vacuumized and encapsulated.

3.2 Core material

Core material is made fibrous and powdered light inorganic materials as the filling for forming and heat insulation.

3.3 Getter

Materials to physically or chemically absorb gas

3.4 Laminated barrier film

Laminated film made from heat sealing material, gas-barrier material and protecting material after high-temperature bonding to block gas penetrations.

4 Product Classifications

4.1 Classifications

Refer to Table 1 for classifications of vacuum insulations for buildings according to thermal conductivity.

Table 1 Classification of Vacuum Insulation Panels for Buildings

Types of product	Range of thermal conductivity/[W/(m·K)]
Type I	≤ 0.005
Type II	> 0.005 and ≤ 0.008
Type III	> 0.008 and ≤ 0.012

4.2 Specifications

4.2.1 General specifications

Refer to Table 2 for general specifications of vacuum insulation panels for buildings.

Table 2 General Specifications of Vacuum Insulation Panels for Buildings

Unit: mm

Item	Dimensions
Length	300, 400, 500 and 600
Width	200, 250, 300, 400, 500 and 600
Thickness	7, 10, 13, 15, 17, 20, 25 and 30
Remarks: Edge seals are not contained in length, width and thickness of vacuum insulation panels for buildings.	

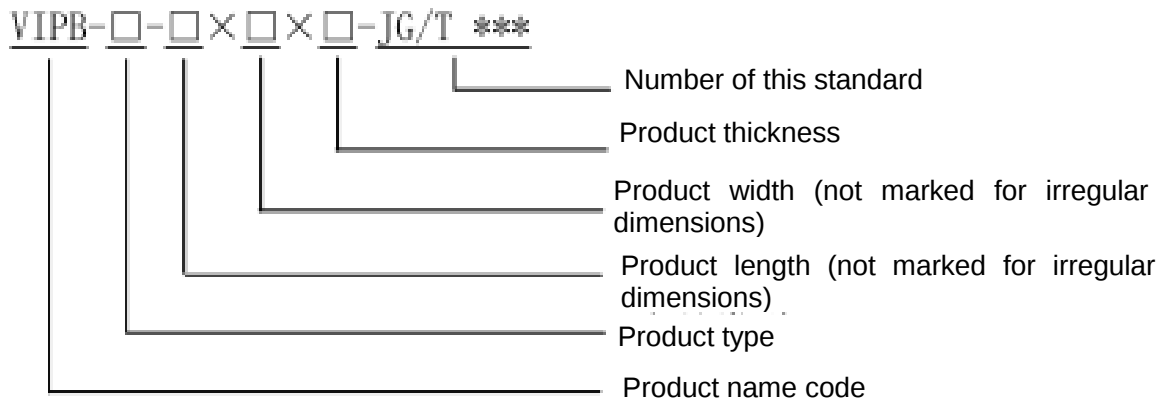
4.2.2 Irregular dimensions

Irregular dimensions of vacuum insulation panels for buildings shall be determined by both supplier and demander.

4.3 Marking

4.3.1 Marking method

Marking of vacuum insulation panels for buildings consists of product code, type, specification and number of this standard.



4.3.2 Marking example

Marking example of vacuum insulation panels for buildings:

Example 1:

Type-II vacuum insulation panels with length of 600mm, width of 400mm and thickness of 10mm for buildings:
VIPB-II-600×400×10-JG/T ****

Example 2:

Type-II vacuum insulation panels of irregular dimensions with thickness of 15mm for buildings:
VIPB-II-15-JG/T*****

5 Requirements

5.1 General requirements

5.1.1 Composite gas-barrier film shall contain one layer of aluminum coil or aluminized film at least with the total thickness not less than 100μm. Retention rate of alkali-resistant tensile breaking strength of the external reinforcing material shall not be lower than 50%. Oxygen penetration and vapor penetration of laminated barrier film shall comply with related requirements of GB/T 10004-2008.

5.1.2 All components of the core material shall be physically and chemically stable. Moreover, its thermal conductivity shall conform to requirements of relevant current national standards.

5.1.3 Under normal operation conditions, getters of vacuum insulation panels for buildings shall be able to maintain vacuum inside in the service life. Gas absorption volume of the getter shall meet requirement of relevant current national standards.

5.1.4 Edge seal of vacuum insulation panels for buildings shall not be wider than 50mm.

5.2 Appearance

The panel shall be free from any scratch and corrugation on its appearance and all seals shall be intact.

5.3 Dimensional deviations

Dimensional deviations of vacuum insulation panels shall conform to regulations of Table 3.

Table 3 Dimensional Deviations of Vacuum Insulation Panels for Buildings

Unit: mm

Item		Allowable deviation
Thickness	<15mm	+2 0
	≥15mm	+3 0
Length and width		±10
Panel surface flatness		2

5.4 Performance

All related performance indexes shall conform to regulations of Table 4.

Table 4 Performance Indexes of Vacuum Insulation Panels for Buildings

Item		Index		
		Type I	Type II	Type III
Thermal conductivity/[W/(m·K)]		≤0.005	≤0.008	≤0.012
Puncture strength/N		≥18		
Tensile strength vertical with panel surface/kPa		≥80		
Dimensional stability/%	Length and width	≤0.5		
	Thickness	≤3.0		
Compressive strength/kPa		≥100		

Surface moisture absorption/(g/m ²)		≤100		
Expansion rate vertical with panel surface after being punched/%		≤10		
Durability (30 cycles)	Thermal conductivity/[W/(m·K)]	≤0.005	≤0.008	≤0.012
	Tensile strength vertical with panel surface/kPa	≥80		
Combustion performance		Grade A (A2)		

6 Testing Methods

6.1 Testing environment

As for standard testing environment in laboratory, the air temperature is (23±2) °C and the relative humidity is (50±10) %. Both temperature and relative humidity shall be recorded during tests under other conditions.

6.2 Test sample

A whole vacuum insulation panel for buildings shall be used as the test sample. Any cutting equipment is not allowed for test sample. All samples for a test shall be of the same specifications and dimensions. Those samples for different tests shall be selected at random. Size of a standard test sample shall be 600mm×400mm and test sample size shall be specified in the testing report.

6.3 Appearance

Appearances shall undergo visual inspection.

6.4 Dimensional deviations

6.4.1 Measuring instruments

All measuring instruments shall be attached with measurement verification certificates. Meanwhile, their measuring range and precision must conform to following requirements.

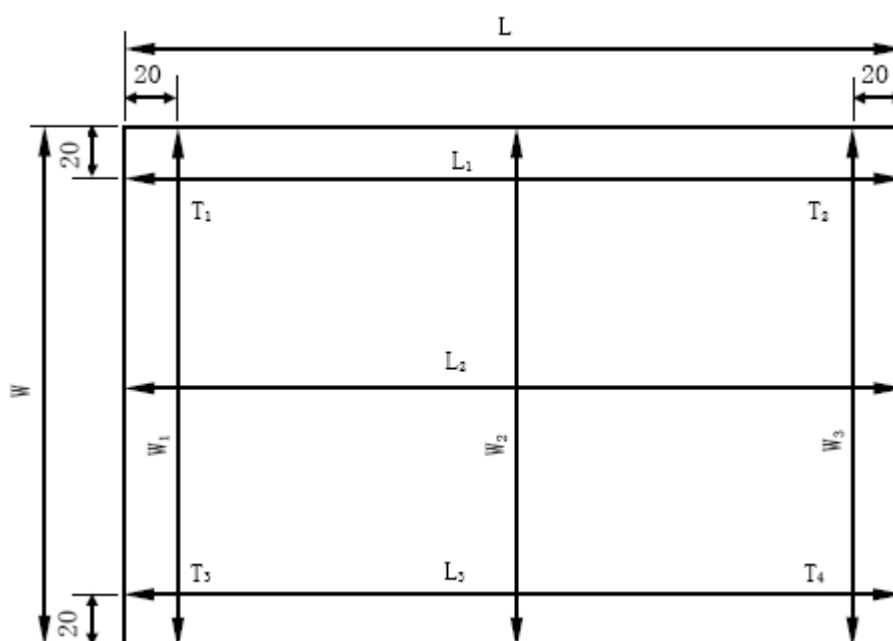
- a) Steel measuring tape: Measuring range 1000mm and precision 1mm;
- b) Flexible rule: Measuring range 3000mm and precision 1mm;
- c) Outside micrometer: Measuring range 25mm or 50mm and precision 0.01mm;
- d) Vernier caliper: Measuring range 200mm and precision 0.02mm.

6.4.2 Testing steps

6.4.2.1 Length, width and thickness

Measure length (L_1 , L_2 and L_3) and width (W_1 , W_2 and W_3) in three parts and thickness (T_1 , T_2 , T_3 and T_4) at four points of a test sample. These parts and points are shown in Figure 1. Results of length and width measurement are arithmetical mean of three measured values and the result of thickness measurement is arithmetical mean of four measured values.

Unit: mm



Notes:

L: Sample length;

W: Sample width.

Figure 1 Parts of a Test Sample for Dimension Measurement

6.4.2.2 Panel surface flatness

Guiding rule and feeler gauge are utilized to measure the maximum clearance between guiding rule and panel surface respectively along two diagonal lines of a test sample. Result of the measurement is the arithmetical mean of two measured values.

6.4.3 Testing results

Dimensional deviations of length, width and thickness are the arithmetical mean of differences of three test sample measuring results with nominal dimensions, which shall be accurate to 0.1mm. Deviation of panel surface flatness is the arithmetical mean of three test sample testing results, which is accurate to 1mm.

6.5 Thermal conductivity

Thermal conductivity shall be tested according to regulations of GB/T 10295. It is required to meter or measure center of a test sample under average testing temperature of $(25\pm 2)^{\circ}\text{C}$. Results of the test shall be arithmetical mean of three sample thermal conductivities and is accurate to $0.001\text{W}/(\text{m}\cdot\text{K})$.

6.6. Puncture strength

Puncture strength shall be tested according to Provision 6.6.13 of GB/T 10004-2008. Diameter of steel needle is 1.0mm and radius of spherical top of the steel needle is 0.5mm. Puncture point shall be set at center of the test sample. Loading velocity for the test is $(50\pm 5)\text{ mm/min}$. Results of the test shall be the arithmetical mean of three sample puncture strengths and shall be accurate to 1N.

6.7 Tensile strength vertical with panel surface

6.7.1 Test sample preparation

High-strength adhesives are applied to bond 100 mm×100 mm drawn steel plate to the center on upper surface of test sample. After adhesives are solidified, the same drawn steel plate shall be bonded to the center on lower surface of the test sample. Two steel plates shall be axially concentric. After adhesives are solidified, the test can be started.

6.7.2 Testing steps

Install the sample onto tension tester for strength determination. Special fixture of the tension tester has universal joint to adjust stress directions. The drawing speed is 5mm/min. The test sample is loaded till it is damaged. Measured tensile strength shall be selected according to regulations as follows.

- If the sample is directly damaged, the strength shall be the peak value (See Figure 2a);
- For the sample not directly damaged, the strength shall be the value just 2% lower than the nonproportional stress variation rate (See Figure 2b).

Remarks: The nonproportional stress variation rate is the isochronous variation rate and the time interval is 1s.

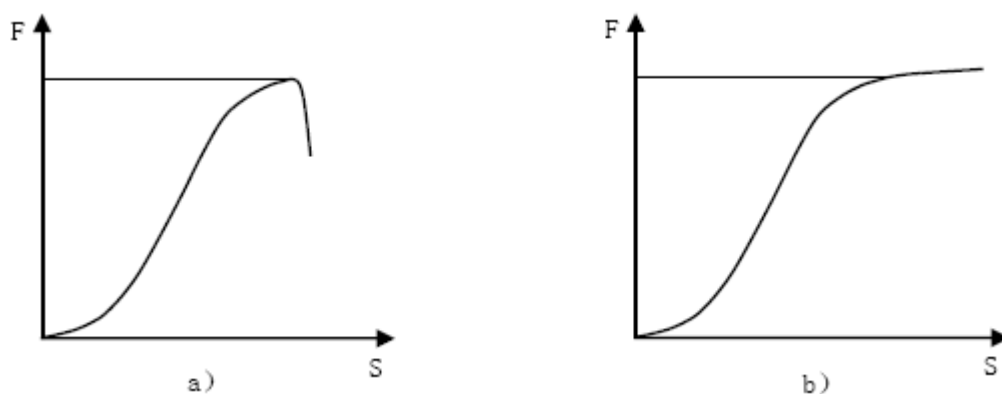


Figure 2 Stress-Displacement Curves

6.7.3 Testing results

Tensile strength vertical with panel surface shall be calculated with equation (1). The arithmetical mean of four moderate numbers among six pieces of testing data shall be cited as the result accurate to 1kPa.

$$R = \frac{F}{A} \times 10^3 \dots\dots\dots (1)$$

In the equation,

R: Tensile strength vertical with panel surface (unit: kPa);

F: Determined strength (unit: N);

A: Adhesive area ($10,000\text{mm}^2$).

6.8 Dimensional stability

Dimensional stability shall be tested with methods specified in GB/T 8811.

- a) Dimensions shall be measured according to positions and methods specified in 6.4.2.1;
- b) Testing temperature $(70\pm 2)^\circ\text{C}$ and test duration 48h;
- c) Results of the test are arithmetical mean of three sample dimension variation rates and shall be accurate to 0.1%.

6.9 Compressive strength

Compressive strength shall be tested with methods specified in GB/T 8813. Compressed area for this test is located at center of the test sample. The test sample is compressed at the rate of compressing by 10% of initial thickness of the sample every minute. Deformation corresponding to compressive stress of 25N is cited as the zero point of deformation. The determined strength is equal to compressive stress under 10% relative deformations. Results of the test are arithmetical mean of three pieces of sample test data and shall be accurate to 1kPa.

6.10 Surface moisture absorption

Surface moisture absorption shall be tested according to regulations of GB/T 5486 and equation (2). Test results are arithmetical mean of three pieces of sample test data and shall be accurate to 1g/m^2 .

$$B = \frac{1}{2} \times \frac{M}{L \cdot W} \times 10^6 \quad \dots\dots\dots (2)$$

In the equation,

B: Surface moisture absorption (unit: g/m^2);

M: Mass (unit: g);

L: Length (unit: mm);

W: Width (unit: mm).

6.11 Expansion rate vertical with panel surface after puncture

6.11.1 Testing process

The test shall be accomplished according to positions and methods specified in 6.4.2.1. The testing process is described as follows.

- a) Measure sample thickness before puncture;
- b) Punch the sample with methods specified in 6.6;
- c) Keep the sample horizontally under standard testing environmental of laboratory;
- d) Measure sample thickness after puncture.

6.11.2 Testing results

Expansion rate vertical with panel surface after puncture shall be calculated with equation (3). Results of the test are arithmetical mean of three pieces of sample test data and shall be accurate to 1%.

$$C = \frac{H_1 - H_0}{H_0} \times 100\% \quad \dots\dots\dots (3)$$

In the equation,

C: Expansion rate vertical with panel surface after puncture (%);

H_0 : Thickness before puncture (unit: mm);

H_1 : Thickness after puncture (unit: mm).

6.12 Durability

6.12.1 Sample processing

Nine samples are submerged into water for 1d. Three of them are samples after the determination of the thermal conductivity. After samples are taken out of water, use a wet towel to wipe away moistures from the surface. Then all samples are put into high and low alternating temperature humidity test chamber for 30 temperature humidity

refrigerating cycles. After being taken out of the test chamber, they are kept under standard laboratory testing environment for 2d. Conditions of the cycle are specified as follows.

- a) Heat samples to $(70\pm5)^\circ\text{C}$ and realize humidity of $(90\pm5)\%$ in 1h and keep the environment for 3h;
- b) Heat samples to $(-20\pm5)^\circ\text{C}$ in 1h and keep the environment for 3h.

6.12.2 Testing process and result

Thermal conductivity and tensile strength vertical with panel surface are determined with methods given in 6.6 and 6.7. Test sample for the determination of thermal conductivity is the same as described in 6.6.

6.13 Combustion performance

Combustion performance shall be tested with methods specified in GB/T 5464, GB/T 14402 or GB/T 20284 and determined with methods specified in GB 8624.

7 Inspection Criteria

7.1 Classification of inspections

7.1.1 Inspection items

Product inspection includes delivery inspection and type inspection. See Table 5 for specific inspection items.

Table 5 Classifications of Inspection Items of Vacuum Insulation Panels for Buildings

Items	Delivery inspection	Type inspection	Criteria	Methods	Sample qty. (Sample)
Appearance	√	√	5.2	6.3	3
Dimensional deviation	√	√	5.3	6.4	3
Thermal conductivity	√	√	5.4	6.5	3
Puncture strength	√	√		6.6	3
Tensile strength vertical with panel surface	—	√		6.7	6
Dimensional stability	—	√		6.8	3
Compressive strength	—	√		6.9	3
Surface moisture absorption	—	√		6.10	3
Expansion rate vertical with panel surface after puncture	—	√		6.11	3
Durability	—	√		6.12	9
Combustion performance	—	√		6.13	3

7.1.2 Delivery inspection

Delivery inspection shall be conducted once a batch during normal productions.

7.1.3 Type inspection

Type inspection shall be implemented under one of following circumstances.

- The inspection shall be launched once a year during normal productions;
- The inspection shall be launched upon production of new products or verification for product finalization;
- Results of the delivery inspection encounter great difference with results of the previous type inspection;
- Main materials or production technologies have suffered great changes;

e) Production is restarted after more than one year of shutdown.

7.2 Sampling scheme

Every 4,000m² of vacuum insulation panel featuring the same material, technology and specification for buildings shall be defined as one batch. Panels with the total area smaller than 4000m² shall be also deemed as one batch. Samples of standard specifications and deviations are used for type inspection and shall be picked out at random from conforming ones based on the delivery inspection.

7.3 Determination rules

7.3.1 Delivery inspection

Once all inspection items have complied with related requirements, products in batch are qualified. Upon any nonconformity in some items, the inspection towards nonconforming items shall be doubled and all products in this batch will be deemed qualified after all items conform to related requirements based on further inspection. If there is still nonconformity after further inspection, products in this batch are defined as defective ones.

7.3.2 Type inspection

When all inspection items meet related requirements, products in this batch are qualified. In case of any nonconforming item, these products are deemed defective.

8 Marking, Packaging and Storage

8.1 Marking

Every vacuum insulation panel for buildings shall be affixed with trademarks and related marks.

8.2 Packaging

Vacuum insulation panels shall be packaged with cartons and protected with soft materials to prevent all surfaces, edges and angles from scratch, collision or deformation. Following details shall be given on the packaging.

- a) Product name and trademark;
- b) Product marking and quantity;
- c) Date or batch number of production;
- d) Product conformity identification;
- e) Name and address of manufacturer.

8.3 Transportation

Vacuum insulation panels shall be placed horizontally for transportation. During transportation, they shall be horizontally laid and fully contacted and properly fastened with transportation equipment. Any open flame is strictly prohibited. They shall not be compacted or impacted with sharp objects so as to avoid damage and deformation.

8.4 Storage

Vacuum insulation panels shall be classified and stored according to specific models and specifications. Compression shall be avoided during storage. They shall be kept away from corrosive medium and fire source and stored into a dry and ventilating place to avoid long-time strong sunlight in the open air.
