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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 1456-2021

Replacing GB/T 1456-2005

Test method for flexural properties of sandwich constructions

夹层结构弯曲性能试验方法

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1 Scope

GB/T 1456-2021 is the Chinese national standard on test method for flexural properties of sandwich constructions, in the field of rubber and plastic industries. The /T suffix marks it as a recommended standard: it is not compulsory by itself, but it becomes binding as soon as a contract, a tender or a customer specification calls it up - which in practice is how most foreign buyers meet it. It was issued on 31 December 2021 by the State Administration for Market Regulation; Standardization Administration of China, and has been in force since 1 July 2022. Classification: ICS 83.120, CCS Q23. This page is published from the official record of the standard held by the Chinese standards administration: the identification, the dates, the classification and the issuing body are taken from there. The clause text, the tables and the numeric limits are in the document itself, which is delivered complete in English translation.

This document specifies the test principle, test equipment, test pieces, test conditions and conditioning of test pieces, test procedures, test results and processing and test report for flexural properties of sandwich constructions. This document applies to the determination of the appearance bending strength and appearance bending modulus of sandwich constructions subjected to bending, the bending stiffness and shear stiffness of sandwich constructions, the stress and elasticity modulus of sandwich-construction face sheets, the shear stress and shear modulus of sandwich-construction cores; it also applies to the

determination of flexure adhesive layer strength between the facing and the core of a sandwich construction.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 1446, Fiber-reinforced plastics composites - The generals

GB/T 3356-2014, Test method for flexural properties of orientational fiber reinforced polymer matrix composite materials

GB/T 3961, Terms for fibre reinforced plastics

3 Terms and definitions

Terms and definitions determined by GB/T 3961 and the following ones are applicable to this document.

3.1 Tension or compression strength of facing The maximum stress of the sandwich construction under the action of bending load when the facing is damaged.

3.2 Core shear strength The maximum shear stress of the sandwich construction under the action of bending load when the core fails.

3.3 Flexure adhesive layer strength The maximum shear stress of the sandwich construction under the action of bending load when the adhesive layer is damaged.

3.4 Overhanging beam three point bending A bending test where there is a long beam with overhanging arm, a concentrated load is applied in the midspan, and three displacement sensors are installed on the midspan and two overhanging points, to measure the deflection of the midspan, left and right overhanging points.

3.5 Appearance bending strength Bending strength of the sandwich construction.

3.6 Appearance bending modulus Flexural modulus of the sandwich construction.

3.7 Nominal thickness of facing The thickness of facing that is obtained by theoretical calculation (design value) or by measuring the blank facing.

4 Test principle

Measure the tension or compression strength of facing by three point bending of the long-beam test piece of the sandwich construction; measure the core shear strength by three point bending of the short-beam test piece of the sandwich construction; measure the

bending stiffness and shear stiffness by overhanging beam three point bending of the long-beam test piece of the sandwich construction, so as to determine the elasticity modulus of facing and shear modulus of core.

5.3 Place a hard rubber gasket between the loading indenter and the test piece, where the size is not smaller than the indenter spacer, the thickness is 3 mm ~ 5 mm, and the length shall cover the width of the test piece.

5.4 Deformation measuring equipment such as displacement sensor, with an accuracy of

0.001 mm.

5.5 Dimension measuring equipment such as vernier caliper, with an accuracy of

0.01 mm.

6 Test pieces

6.1 The test piece shall be of rectangular shape with a rectangular cross-section.

6.2 The thickness of the test piece shall be the same as that of the sandwich-construction product. When the thickness of the sandwich-construction product is not fixed, in order to determine the tension or compression strength of facing, core shear strength or shear modulus of core, it is recommended that the core thickness be 15 mm, and the thickness of facing be

0.3 mm ~

6.3 The width of the test piece shall be less than half of the span, and not less than twice the total thickness. The width of the test piece is recommended to be 60 mm. For lattice cores such as honeycomb and corrugation, the width of the test piece shall include at least 4 complete lattices.

6.4 The length of the test piece is the span plus 40 mm or half of the thickness, whichever is larger. When an overhanging arm is required, the length shall meet the overhanging arm, and the span shall be calculated and selected according to the test purpose:

a) When measuring the core shear strength, the span of the three-point bending (see Figure 1) shall satisfy Formula (1): Where: L - support span, in millimeters (mm); σ_{fd} - allowable tension or compression stress of facing, in megapascals (MPa); t_f - thickness of facing, in millimeters (mm); τ_{cb} - core shear strength, in megapascals (MPa).

Note 1: All the same formula symbols in the text have a unified meaning; the symbols in the subsequent formulas shall refer to the definition of the previous formula symbol.

Note 2: The allowable stress is provided by the designer; the tensile strength, compressive

strength and shear strength are provided by the manufacturer or obtained by testing according to the national standards for the corresponding materials.

b) When measuring the tension or compression strength of facing, the span of the three-point bending shall satisfy Formula (2): Where: σ_{fb} - tension and compression strength of facing, in megapascals (MPa); τ_{cd} - allowable shear stress of core, in megapascals (MPa).

c) When measuring the bending stiffness and shear stiffness of the sandwich construction, use the overhanging beam three point bending (see Figure 2), where the span is generally the value of Formula (1), the length a of the overhanging arm is one-third or one-half of the span, which is increased depending on the deformation device such as the displacement sensor.

d) For composite sandwich constructions such as fiber reinforced plastics, see Appendix A for spans, overhanging arm lengths, etc.

6.5 When measuring the appearance bending strength and appearance bending modulus, the width of the test piece is 60 mm, and the span-thickness ratio and length are as specified in Table 1 in GB/T 3356-2014.

6.6 For orthotropic constructions, the test pieces are divided into two types: longitudinal and transverse.

6.7 Test piece processing shall be in accordance with the provisions of GB/T 1446.

7 Test conditions and conditioning of test pieces

The test environmental conditions and conditioning of test pieces shall be in accordance with the provisions of GB/T 1446. Where: σ_{af} - tensile and compressive stress in the facing, in megapascals (MPa). When P is the maximum load, and failure phenomena such as breaking or compressive wrinkling of facing occur, the result calculated by Formula (6) is the tension or compression strength of facing.

9.4 The bending stiffness of the sandwich construction is calculated according to Formula (7): Where: D - bending stiffness of the sandwich construction, in Newton square millimeters ($N \cdot mm^2$); a - overhanging arm length, in millimeters (mm); ΔP - load increment of the initial segment of the load-deflection curve, in millimeters (mm); f_1 - deflection increment of the overhanging point corresponding to ΔP (take the average value of the left and right points), in millimeters (mm).

9.5 The elasticity modulus of facing is calculated according to (8): Where: E_f - elasticity modulus of facing, in megapascals (MPa); J - moment of inertia of the sandwich construction, in fourth power millimeters (mm^4).

Note: The bending stiffness of core and the facing itself has been omitted in Formula (9).