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**Plastics - Burning behavior - Intermediate-scale fire-
resistance testing of fiber-reinforced polymer composites**

塑料 燃烧性能 纤维增强聚合物

复合材料的中等尺寸耐火测试

(ISO 30021:2013, MOD)

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Plastics - Burning behavior - Intermediate-scale fire-resistance testing of fiber-reinforced polymer composites

Warning -- All persons involved in the management and conduct of the fire resistance test shall pay attention that toxic and/or harmful smoke and gases may be released during the test, which is dangerous. There is also a risk of mechanical injury during the construction of test assemblies or devices, testing and disposal of residues and waste. It is critical to assess all potential hazards and health risks, and to identify and provide safety precautions. In addition, it is essential to issue written safe operating procedures and train relevant personnel to ensure that all personnel in the laboratory follow the procedures at all times.

1 Scope

This document describes a method for the determination of the fire resistance of non-loadbearing individual members made of fibre-reinforced plastics (FRP) when being heated on one side.

This document applies to FRP products whose end-use dimensions are generally smaller than those specified in GB/T 9978.1, such as fire barriers used in the transportation industry.

This document applies to FRP products with a substantially flat surface, and also to sandwich panel members containing reinforced components and surfaces made of FRP.

2 Normative references

The following documents contain the provisions which, through normative reference in this document, constitute the essential provisions of this document. For the dated referenced documents, only the versions with the indicated dates are applicable to this document; for the undated referenced documents, only the latest version (including all the amendments) is applicable to this document.

GB/T 2035 Terms and definitions for plastics (GB/T 2035-2008, ISO 472:1999, IDT)

GB/T 5907.2 Fire protection vocabulary - Part 2: Fire prevention

GB/T 9978.1 Fire-resistance tests—Elements of building construction—Part 1: General requirements (GB/T 9978.1-2008, ISO 834-1:1999, MOD)

ISO 834-12 Fire resistance tests - Elements of building construction - Part 12: Specific requirements for separating elements evaluated on less than full scale furnaces

EN 1363-2 Fire resistance tests - Part 2: Alternative and additional procedures

3 Terms and definitions

The terms and definitions defined in GB/T 2035, GB/T 5907.2, and ISO 834-12 apply to this document.

4 General rule

The fire resistance of a vertically or horizontally oriented intermediate-scale specimen is determined by exposing its surfaces to the conditions specified in ISO 834-12. The time-temperature curve specified in EN 1363-2 can also be used when it needs to be related to the end-use conditions of the product under test.

5 Instruments and equipment

5.1 General requirements

The test equipment shall include combustion furnaces, restraints and support frames, and other instruments in accordance with GB/T 9978.1 or ISO 834-12, and contain specimen mounting frames in accordance with 5.2.

5.2 Specimen mounting frame

The specimen mounting frame (hereinafter referred to as the frame) shall be made of non-combustible materials, namely steel or concrete. During the test, the structure of the frame shall be strong enough to support the specimen at a high temperature. Deformation of the frame shall not adversely affect the specimen.

NOTE: The specimen is not stressed in this test.

The frame lining in direct contact with the specimen shall be made of non-combustible materials, such as calcium silicate board, with a dry density of (950 ± 100) kg/m³ and a minimum thickness of 50 mm. When the test is carried out under the high-temperature conditions specified in ISO 834-12, the frame shall be strong enough to support the specimen.

6 Specimens

6.1 Number of specimens

For symmetrical structures or members requiring fire protection only from one specific side, one specimen shall be tested. For asymmetric structures requiring fire protection on both sides, two specimens shall be tested so that each side of the member is exposed to flame.

6.2 Dimensions

The vertical and horizontal dimensions of the specimen should not be less than (1000 ± 30) mm. The configuration of the specimen shall be representative of the end use of the member, for which purpose the size of the specimen shall be increased to that of the end use condition. The length and width of the FRP specimen mounted in the vertical and horizontal directions should be 1.5 m. The specimen shall be mounted in such a way as to reflect the end-use conditions, including when there are reinforcing members and/or thermal insulation systems.

6.3 Structure

The specimens should include all reinforcing members that are parts of the end-use configuration of the FRP product.

NOTE: ISO 10295-1 specifies fire resistance tests for penetration-proof seals in building elements.

6.4 Thermal insulation of specimens

In the end use, an additional thermal insulation system is required on the FRP member, and such FRP members need to have fire resistance. If the additional thermal insulation system is used under the end-use conditions, the thermal insulation system shall be mounted and fixed on the specimen as closely as possible to the end-use condition.

The thermal insulation system is usually mounted on the side where the fire risk is greater. During the test, the thermal insulating side of the specimen shall be exposed to the combustion furnace.

In the thermal insulation system representative of end-use conditions, the specimen shall be provided with a vertical joint and/or a horizontal joint.

7 Conditioning and test environment

The specimen shall be conditioned for at least 24 hours at a temperature of (23 ± 2) °C and a relative humidity of 50%~75%, and shall be tested in an environment with a

The furnace temperature controlled by the thermocouple (8.2) shall comply with the temperature conditions specified in GB/T 9978.1. The time-temperature curve specified in EN 1363-2 can also be used when it needs to be related to the end-use conditions of the product under test.

8.7 Measurement and observation

8.7.1 Temperature and pressure

The temperature and furnace pressure of all thermocouples shall be measured and recorded in accordance with the provisions of GB/T 9978.1 or ISO 834-12, and the recording interval shall not exceed 1 min.

8.7.2 Smoke and gas penetration

Observe the deformation of the specimen, the penetration of smoke and/or hot gas through the specimen and other phenomena (if any), and record the time of occurrence. The penetration of hot gas shall be checked with absorbent cotton.

8.7.3 Deformation and formation of holes and cracks

When measuring, attention shall be paid to the generation and development of holes or cracks on the unexposed surface of the specimen, because this problem will be considered when determining the integrity time (that is, the time when holes and cracks lead to integrity failure); the integrity time shall be determined and recorded in accordance with GB/T 9978.1.

8.7.4 Deflection

During the test, the deflection of the center of the specimen shall be measured at least once per minute, and the deflection measurement accuracy shall be ± 2 mm.

NOTE: The application guidance on deflection measurement has been given in GB/T 9978.1.

8.7.5 Photographing

During the test and after the test, the specimen shall be photographed, and the date and time of photographing shall be recorded.

NOTE: A video recording of the unexposed surface is useful for recording the time when integrity failure occurs.

8.8 Test termination

According to the provisions of GB/T 9978.1, the test of FRP specimens may be terminated due to one or more of the following reasons:

- a) There is a safety problem for personnel or the equipment is about to be damaged;
- b) The failure criteria specified in the product standard are met;
- c) The entrusting party requests it.

However, in the case of b), the test can be continued to obtain more data.

8.9 Observation after the test

After the test, the condition of and any damage to the specimen, including the thermal insulation system, shall be observed and recorded.

9 Test report

The test report shall include the following contents:

- a) the document number;
- b) test date;
- c) laboratory name and address;
- d) the name and address of the test-entrusting party;
- e) the name and address of the manufacturer of the product;
- f) the name and/or trademark (if any) of the product;
- g) assembly steps, construction details and components (including reinforcing members) of the specimen, with accompanying drawings (including dimensions of the components) and, if possible, photos;
- h) the general structure of the composite material, such as the number of layers, thickness, and composition;
- i) all information pertaining to the position of the thermocouple on the unexposed surface and its method of connection to the specimen;
- j) heating conditions, such as the time-temperature curve of GB/T 9978.1 or EN 1363-2;
- k) test duration;
- l) temperature and pressure measurement results and the graph plotted along the running time of the test;

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