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Fire Resistant Shutter

防火卷帘

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Fire Resistant Shutter

1 Scope

This standard specifies definitions, classifications, requirements, test methods and inspection rules as well as marking, packing, transportation and storage of fire resistant shutter.

This standard is applicable to smoke-proof fire resistant shutters in industrial and civil buildings.

Inorganic fiber composite fire resistant shutter specified in this standard is only applicable to indoor well-ventilated dry place.

2 Normative References

The following standards contain provisions which, by reference in this text, constitute provisions of this national standard. For dated reference, subsequent amendments (excluding amending errors) to, or revisions of, any of these publications do not apply. However, all parties coming to an agreement according to this standard are encouraged to study whether the latest editions of these documents are applicable. For any undated references, the latest editions of the documents referred to apply.

GB/T 1243 Short Pitch Transmission Precision Roller Chains and Chain Wheels (GB/T 1243-1997, eqv ISO 606: 1994)

GB/T 2828.1 Sampling Procedures for Inspection by Attributes - Part 1: Sampling Schemes Indexed by Acceptance Quality Limit (AQL) for Lot-by-lot Inspection (GB/T 2828.1-2003, ISO 2859-1:1999, IDT)

GB/T 3923.1 Textiles - Tensile Properties of Fabrics - Part 1: Determination of Breaking Force and Elongation at Breaking Force - Strip Method (GB/T 3923.1-1997, neq ISO/DIS 13934-1:1994)

GB 4717-1993 General Technical Conditions for Fire Alarm Control Units

GB/T 5454 Textiles - Burning behavior - Oxygen Index Method (GB/T 5454-1997, neq ISO 4589:1984)

GB/T 5455 Textiles - Burning Behavior - Vertical Method

GB/T 5464 Non-combustibility Test Method of Building Materials (GB/T 5464-1999, idt ISO 1182:1990)

GB/T 7633 Fire Resistance Tests - Door and Shutter Assemblies (GB/T 7633-1987, eqv ISO 3008:1976)

GB 8624-1997 Classification for Burning Behavior of Building Materials and Products

GB 9969.1 General Principles for Preparation of Instructions for Use of Industrial Products

GB/T 14436 General Principles of Industrial Product Guarantee Documents

GB 15930-1995 Fire Dampers - Tests

3 Terms and Definitions

For the purpose of this standard, the following terms and definitions apply.

3.1

Steel fire resistant shutter

A kind of shutter, consisted of curtain plate, guide rail, riser plate, lintel, box that are all made of steel materials as well as matched door roller and control box, which meets requirements on fire integrity

3.2

Inorganic fiber composite fire resistant shutter

A kind of shutter, consisted of curtain surface (with stainless steel wire or stainless wire rope matched inside) made of inorganic fiber materials and clamp plate, guide rail, riser plate, lintel and box that are all made of steel materials as well as matched door roller and control box, which meets requirements on fire integrity

3.3

Special type fire resistant shutter

A kind of shutter, consisted of curtain surface made of inorganic fiber materials or steel materials and guide rail, riser plate, clamp plate, lintel and box that are all made

6 Requirements

6.1 Appearance quality

6.1.1 Surface of metal parts of fire resistant shutter shall be free from crack, indentation and obvious concave-convex, hammered mark, bur, missing hole and other defects, and shall be evenly coated and plated for rust prevention; and shall be free from peeling and flowing.

6.1.2 Inorganic fiber composite curtain surface of fire resistant shutter shall be free from crack, broken corner, remedy, hole, inclination, jumper, breakage, visible unevenness in density of wrap and weft, color difference and other defects; the clamp plate shall be straight and fastened; warp direction of base cloth shall be the forced direction of curtain surface that shall be beautiful, straight and tidy.

6.1.3 Relative moving parts in the process of cutting, bending and sinker drilling shall be free from burrs.

6.1.4 Assembling and splicing points of all parts shall be free from misalignment; welding point shall be fastened; and the appearance shall be flat and smooth, free from slag inclusion, solder skips and loosening.

6.1.5 All fasteners shall be tightened and free from loosening.

6.2 Materials

6.2.1 Raw materials for inorganic fiber composite fire resistant shutter shall meet requirements on health and environmental protection, and materials explicitly prohibited by the State shall not be put into use.

6.2.2 Raw materials for main parts of fire resistant shutter shall meet the requirements of corresponding national standards or professional standards.

6.2.3 Thickness of raw materials for main parts of fire resistant shutter should be adopted in accordance with Table 5.

Table 5 -- Thickness of Raw Materials **(Unit: mm)**

Parts	Thickness of raw materials
Curtain plate	Thickness (ordinary type): ≥1.0; thickness of any curtain sheet
Clamp plate	≥3.0
Riser plate	≥3.0
Guide rail	Buried type: ≥1.5; exposed type: ≥3.0

6.3.7.2 Surfaces of driving mechanism, bearing and chain shall be free from rust and shall be added with proper amount of lubricant as required.

6.3.7.3 Deflection of shaft of vertical shutter under normal operation shall be less than 1/400 of shaft length.

6.3.7.4 Shaft of side shutter shall be installed and vertical to foundation surface. Error of verticality shall be less than 1.5 mm/m. The total length shall be less than 5mm.

6.3.8 Door roller

Door roller for fire resistant shutter shall be approved product qualified in the test conducted by national fire detection organization and its performance shall be in accordance with Appendix A.

6.3.9 Control box

Control box for fire resistant shutter shall be approved product qualified in the test conducted by national fire detection organization and its performance shall be in accordance with Appendix B.

6.4 Performance requirements

6.4.1 Air pressure resistance

6.4.1.1 Curtain plate of steel fire resistant shutter shall be of certain air pressure resistant strength. At specified load, the curtain plate shall not fall off from the guide rail and its deflection shall be in accordance with Table 8.

6.4.1.2 Anti-derail device may be arranged between the curtain surface and the guide rail to prevent the plate from derailing.

6.4.2 Smoke-proof performance

6.4.2.1 Smoke control device for guide rail and lintel of fire resistant and smoke control shutter shall be in accordance with 6.3.4.5 and 6.3.5.1.

6.4.2.2 If differential pressure on both sides of curtain surface of fire resistant and smoke control shutter is 20 Pa, smoke leakage amount of the surface shall not be greater than $0.2m^3/(m^2 \cdot min)$ under standard condition (20℃, 101325Pa).

6.4.3 Operation stability

After the assembling of fire resistant shutter, the curtain surface shall operate stably in the guide rail without being derailed and obviously inclined; two curtain surfaces of double-curtain surface shutter shall be lifted simultaneously, and their height difference shall not be greater than 50mm.

Table 8 -- Deflection of Curtain Plate

Code	Air pressure	Deflection/mm					
		B≤2.5 m	*B*=3 m	*B*=4 m	*B*=5 m	*B*=6 m	*B*>6 m
50	490	25	30	40	50	60	90
80	784	37.5	45	60	75	90	135
120	1177	50	60	80	100	120	180
Note: air pressure resistance test may not be conducted for indoor steel fire resistant shutter and inorganic fiber							

6.4.4 Noise

Average noise caused by the startup/shutdown of fire resistant shutter shall not be greater than 85dB.

6.4.5 Electric startup/shutdown speed and deadweight descending speed

The speed during electric startup/shutdown of vertical shutter shall be 2m/min~7.5m/min. And its deadweight descending speed shall not be greater than 9.5m/min, while the speed during electric startup/shutdown of side shutter shall not be less than 7.5m/min. And that during electric startup/shutdown of horizontal shutter shall be 2m/min~7.5m/min.

6.4.6 Two-step shutdown performance

Fire resistant shutter installed at evacuation exit shall be provided with two-step closing performance which means that the control box automatically shuts down to the mid-position of fire resistant shutter and stops after receiving the alarm signal, then continues to shut down to a complete close after a 5s~60s delay; or after receiving the alarm signal for the first time, the control box shuts down to the mid-position of fire resistant shutter and stops, and continues to shuts down to a complete close after receiving the alarm signal for the second time.

6.4.7 Temperature-control release performance

Temperature control release device shall be arranged for fire resistant shutter; if the ambient temperature of temperature-sensing elements of the release device reaches 73℃±0.5℃, then the shutter shall fall off and shut down according to its deadweight.

6.4.8 Fire resistance

The fire resistant rating of fire resistant shutter shall be in accordance with Table 4.

7 Test Methods

7.1 Appearance quality

Appearance quality of fire resistant shutter shall be visually inspected combined with hand touching.

7.2 Materials

7.2.1 Inspection sheet and quality guarantee list on main materials of fire resistant shutter shall be provided by the manufacturer. Thickness of the materials is measured by caliper.

7.2.2 Fold decorative cloth or base cloth of inorganic fiber composite fire resistant curtain surface in forward and reverse direction 4 times and put it in low temperature test chamber. Adjust the temperature of the test chamber to 20℃±2℃ and maintain it for 30 min± 5 min, then reduce the temperature to -20℃±2℃ at the rate not greater than 5℃/min (not greater than the average in 5 min) and maintain it for 48h, then take out the decorative cloth or base cloth from the low-temperature chamber, observe whether it's brittle crack and still elastic. Fold decorative cloth or base cloth of inorganic fiber composite fire resistant curtain surface in forward and reverse direction 4 times and put it in high temperature test chamber. Adjust the temperature of the test chamber to 20℃±2℃ and maintain it for 30 min± 5 min, then increase the temperature to +50℃±2℃ at the rate not greater than 5℃/min (not greater than the average in 5 min) and maintain it for 48h, then take out the decorative cloth or base cloth from the low-temperature chamber, observe whether it's adhered.

7.2.3 Combustion performance for decorative cloth of inorganic fiber composite fire resistant curtain surface shall be inspected according to GB/T 5454 and GB/T 5455, and that of base cloth shall be inspected according to GB/T 5464.

7.2.4 Breaking strength for various textiles of inorganic fiber composite fire resistant curtain surface shall be inspected according to GB/T 3923.1.

7.3 Parts

7.3.1 Dimension tolerance

7.3.1.1 Length (L) of steel fire resistant shutter plate is measured with steel tape at $h/2$. Width (h) and thickness (s) is measured with a caliper at 50 mm from both ends of the curtain surface and $L/2$, from which the average is taken, see Figure 5.

7.3.7.3 Error of perpendicularity of side shaft is measured according to the requirements of 7.3.4.4.

7.3.8 Door roller

Performances for door roller of fire resistant shutter are measured in accordance with Appendix A.

7.3.9 Control box

Performances for control box of fire resistant shutter are measured in accordance with Appendix B.

7.4 Performance requirements

7.4.1 Air pressure resistance

7.4.1.1 Test equipment

Air pressure resistance test equipment of the plate is shown in Figure 7. Test equipment includes the following parts:

a) Adjustable support: with locking device, air pressure resistance test for curtain plates with different lengths may be carried out by adjusting support.

b) Sandbag: the mass of each sandbag is 3.0 kg, the sand with loose thickness of 1500 kg/m^3 is filled in for loading of the test piece.

c) Deflectometer: measure and display deflection of the test piece, precision: ± 1.0 mm.

d) Others: ruler, steel tape, caliper and platform scale.

7.4.1.2 Test piece

Randomly take three of the curtain sheets with identical production condition, and mesh them horizontally into shutter as test piece.

7.4.1.3 Test procedure

a) Measure the mass and dimension of the test piece and calculate the area.

b) Install the test piece in the guide rail groove of the adjustable support with its windward side upward.

Q_0 - the measured smoke leakage of the equipment, [$m^3/(m^2 \cdot min)$];

T_0 - the gas temperature in the measuring pipeline when measuring the smoke leakage of the equipment, (℃);

B_0 - the atmospheric pressure when measuring the smoke leakage of the equipment, (Pa);

P_0 - the gas pressure at the flowmeter when measuring the smoke leakage of the equipment, (Pa).

7.4.3 Operation stability

Visual inspection is carried out for operation stability of fire resistant shutter. Height difference between two curtain surfaces of the double-curtain surface shutter is measured with steel tape.

7.4.4 Noise

Noise of the fire resistant shutter in operation is measured with sound level meter from which the vertical distance to the surface of the shutter is 1 m, and to the ground is 1.5 m. Three points in horizontal direction shall be measured, from which the average is taken.

7.4.5 Electric startup/shutdown speed and deadweight descending speed

Electric startup/shutdown speed and deadweight descending speed of the fire resistant shutter is measured with steel tape and stopwatch.

7.4.6 Two-step shutdown performance

Visual inspection is carried out for two-step shutdown performance of the fire resistant shutter. Time delay interval is measured with stopwatch.

7.4.7 Temperature-control release performance

7.4.7.1 Operating temperature of temperature-control release device

Three sets of temperature-control release device are selected to conduct test according to 5.1 in GB 15930-1995. If the operating temperatures of the temperature-control release devices are all qualified, then the operating temperature will be judged qualified, or else, it will be judged unqualified.

Note: if effective inspection report is provided, the test may not be carried out.

7.4.7.2 Linked performance of temperature-control release device

After installation and commissioning, open the fire resistant shutter to upper limit, cut off the power, and heat the temperature-control release device so that its heat element moves, then observe the descending and shutdown of the shutter.

7.4.8 Fire resistance

The fire resistance rating of fire resistant shutter shall be tested according to GB/T 7633. For fire resistance rating of steel fire resistant shutter and inorganic fiber composite fire resistant shutter, their fire integrity shall be measured according to GB/T 7633; for fire resistance rating of special type fire resistant shutter, its fire integrity and insulation shall be measured according to GB/T 7633.

Note: if the tested party or client requires to measure the heat radiation intensity on the unexposed surface of the shutter, the inspection may be carried out in accordance with GB/T 7633 or the method provided by the tested party or client, but the result is not the judgment basis for fireproof performance of the shutter.

8 Inspection Rules

8.1 End-of-manufacturing inspection

8.1.1 Inspection items are 6.1, 6.2.1, 6.2.2, 6.2.3, 6.3.1, 6.3.3, 6.3.4.2 and 6.3.7.3.

8.1.2 End-of-manufacturing inspection is in accordance with GB/T 2828.1, general inspection level II is adopted, and acceptance quality limit is 6.5 with sampling plan of one normal inspection.

8.1.3 Fire resistant shutter shall be inspected by quality inspection department of the manufacturer according to end-of-manufacturing inspection item, and each item shall be qualified, and they shall not be delivered until the certificate is signed and issued.

8.2 Type inspection

8.2.1 Inspection items are all the contents required by the standard.

8.2.2 Type inspection shall be carried out under any of the following circumstances:

a) Trial production and design appraisement of new products or existing products during transfer-plant production;

b) There is major change in the structure, material, process and critical procedure of the product which may influence the product performance.

c) Restoration of production after shutdown for over 1 year.

d) The result of delivery inspection differs greatly from that of the last type inspection.

e) Significant quality accident occurs.

f) Requested by quality supervision institutions.

8.3 Inspection quantity and judgment rules

Randomly take a set of fire resistant shutter from the same batch of products qualified in end-of-manufacturing inspection. If inspection items are all qualified, the batch of products will be judged qualified for type inspection; if the inspection items listed in Table 9 are all qualified, at most 4 items (including 4 Items) in other inspection items are unqualified, but qualified after repair, the batch of products will be judged qualified for type inspection; if the inspection items listed in Table 9 are all qualified, more than 4 items in other inspection items are unqualified, or any one of the inspection items in Table 9 is unqualified, the batch of products will be judged unqualified for type inspection; on this occasion, double sampling is needed for the batch of products for re-inspection for the unqualified items. If all items of the re-inspection are all qualified, the batch of products, except those unqualified in the first inspection, will be judged qualified for type inspection; if one item of the re-inspection is still unqualified, the batch of products will be judged unqualified for type inspection.

Table 9 -- Inspection Items

Item	Fire resistance	Air pressure resistance	Two-step shutdown performance	Operation stability	Smoke leakage of curtain surface	Temperature-control release performance
Steel fire resistant shutter	√	√	√	√		√
Steel fire resistant smoke-proof	√	√	√	√	√	√
Inorganic fiber composite fire resistant shutter	√		√	√		√
Inorganic fiber composite fire resistant smoke-proof shutter	√		√	√	√	√

Appendix A

(Normative)

Requirements and Test Methods for Door Roller of Fire Resistant Shutter

A.1 Requirements

A.1.1 Appearance and parts

A.1.1.1 The enclosure of door roller shall be complete, free from unfilled corner, obvious cracks and deformation.

A.1.1.2 The surface of coating part shall be smooth, and free from such defects as obvious bubble, wrinkle, spot, sagging, etc.

A.1.1.3 The part of door roller shall not be made of flammable and combustible material.

A.1.1.4 The operating device of door roller shall be for the convenience of users.

A.1.2 Basic performance

A.1.2.1 The rated output torque of door roller shall meet the design requirements. The manufacturer shall provide inspection certificate.

A.1.2.2 The internal contracting brake shall be reliable with the brake force not less than 1.5 times of the balance weight in rated output torque; the sliding displacement shall not be greater than 20mm.

A.1.2.3 The door roller shall be provided with flexible and reliable manual operating device whose installation position shall be convenient for operation. There shall be free from slide and impact during operating fire resistant shutter to start up and shut down with manual operating device.

A.1.2.4 The door roller shall be provided with such functions as electric startup/shutdown and constant-speed descending by the deadweight of fire resistant shutter. The electric startup/shutdown and the descending speed of deadweight shall meet the requirements of 6.4.5, and the arm strength to start deadweight-descending of fire shutter shall not be greater than 70N.

A.1.2.5 The door roller shall be equipped with automatic limit device which is able to

stop automatically when the fire resistant shutter startup/shutdown to upper/lower limit with the resetting error less than 20mm.

A.1.3 Mechanical life

After balance weight in rated output torque, the cycle times of startup/shutdown operation of door roller shall not be less than 2000.

Note: a cycle of roller shutter means the duration from shutdown to complete opening state then to complete shutdown.

A.1.4 Noise

The noise of door roller shall not be greater than 65dB during no-load operation.

A.1.5 Power supply performance

When the fluctuation range of the AC network supply voltage is less than or equal to +10% of the rated voltage and no less than -15% of that, the door roller shall be capable of normal operation.

A.1.6 Safety performance

A.1.6.1 Insulation resistance

Under normal atmospheric condition, the electrical insulation resistance of door roller shall be greater than 20MΩ.

A.1.6.2 Voltage resistance

The test voltage (1760V, 50 Hz) shall be able to be applied between live parts and enclosure of the door roller for 1 min without punctuation, surface flashover or scanning. After the test, its performance shall meet the requirements of A.1.2.

A.1.7 Stability in climatic environment

The door roller shall be able to withstand each test under specified climatic environment of Table A.1. After the test, its performance shall be in accordance with those specified in Table A.1.2.

A.2 Test methods

A.2.1 Appearance and parts

Figure A.1 -- Equipment for Basic Performance Test

A.2.2.3 Test items

A.2.2.3.1 Output torque

Start up and shut down the door roller after connecting the weight and shaft; measure and calculate the output torque of door roller.

A.2.2.3.2 Brake force

The weight is added to 1.5 times of the balance weight under rated output torque of door roller, then start the door roller to observe its operating condition; shut down the door roller and visually inspect its brake condition, then measure the sliding displacement with straight ruler.

A.2.2.3.3 Manual operation performance

The manual operation performance of door roller shall be visually inspected.

A.2.2.3.4 Electric startup/shutdown speed, deadweight descending speed and arm strength

The electric startup/shutdown speed and deadweight descending speed shall be measured with tape and stopwatch. The deadweight descending arm strength is measured with spring-loaded thrust meter (the precision: ±2 N) or weight.

A.2.2.3.5 Resetting error

After the door roller is fitted into the shutter (or by the virtue of the test equipment in Figure A.1) under normal operation condition, start the door roller and make it operate for a while, then shut down the door roller to measure the resetting error with straight ruler.

A.2.3 Mechanical life

After balancing weight under rated output torque with the test device shown in Figure A.1, start/shut down the door roller so as to be complete open, then make it descend to complete shutdown to finish a cycle. The door roller stops for 25 min after each continuous operation for 5min; repeat the above-mentioned action and inspect the mechanical life of door roller. The test may be conducted continuously by manual or mechanical method to lower the operating temperature of door roller.

A.2.4 Noise

Appendix B

(Normative)

Requirements and Test Methods for Control Box of Fire Resistant Shutter

B.1 Requirements

B.1.1 Appearance

B.1.1.1 All components and parts of control box shall be installed firmly; the control organ shall be flexible and reliable.

B.1.1.2 Inside the control box shall be clean and free from impurities. The routing inside the box shall be even and errorless.

B.1.2 Main parts

B.1.2.1 Indicator light

a) The indicator lights of control box shall differ in their colors: the red one refers to the fire alarm signal, the yellow or light yellow one refers to fault signal and the green one refers to normal operation of power supply. And the colors beyond the above-mentioned may serve the purpose of other functions.

b) All the indicator lights shall be clearly marked with their functions.

c) Under the operating condition of general environment, the indicator light shall be clearly visible from 3m away.

B.1.2.2 Wiring terminals

All the wiring terminals shall be clearly ad firmly marked with serial number and symbol whose meaning shall be provided in the product instructions.

B.1.2.3 Switches and keys

The switches and keys of control box shall be firm and durable, and they shall be marked with their functions at the position thereupon or nearby. The switches and buttons (boxes) of control box shall be installed for the convenience of operator.

B.1.3 Basic performance

B.1.3.1 General requirements

The control box shall be equipped with operating buttons or boxes; under normal operation, the electric startup/shutdown of fire resistant shutter is controlled by operating buttons.

B.1.3.2 Fire alarm performance

The control box is able to directly or indirectly receive the fire alarm signal from fire detector or fire control center. And it shall complete the following actions automatically once receiving the fire alarm signal:

a) Send out audible and visual alarm signals.

b) Control the fire resistant shutter to complete two-step shutdown. It means that the control box automatically shuts down to the mid-position of fire resistant shutter and stops after receiving the alarm signal, then continues to complete shutdown after a 5s~60s-delay; or after receiving the alarm signal for the first time, the control box shuts down to the mid-position of fire resistant shutter and stops, and continues to complete shutdown after receiving the alarm signal for the second time.

c) Send out the feedback signal, feed the positional status signal of fire resistant shutter back to fire control center so as to realize the online control of fire center.

B.1.3.3 Escape performance

When fire hazard happens, if fire resistant shutter lies below the mid-position, and manually operate any one of the buttons of the control box, the fire resistant shutter shall be able to open automatically to the mid-position, then it shall continue shutting down to complete close after a 5s~60s delay.

B.1.3.4 Fault alarm performance

B.1.3.4.1 The control box shall be arranged with a protective device for the phase sequence of power supply which prevents the roller shutter from reversion when the power supply is in open phase or the phase sequence is in fault.

B.1.3.4.2 When the fire detector is disconnected or in fault, the control box is able to send out audible and visual alerting signals.

B.2.3.3 Escape performance

The fire resistant shutter is at the state of shutdown, and make the control box to be in the state of fire alarm. Manually operate any one of the buttons, and visually inspect the startup, time delay and shutdown condition of fire resistant shutter. Measure the time delay of fire resistant shutter with stopwatch.

B.2.3.4 Fault alarm performance

B.2.3.4.1 Randomly power off any one phase or swop any two phases of the power supply; manually operate the buttons of control box; visually inspect the action condition of fire resistant shutter and the alarm condition of control box.

B.2.3.4.2 Disconnect the fire detector and visually inspect the alarm condition of control box.

B.2.4 Power supply performance

Connect the control box with the fire resistant shutter, then with the power grid via pressure regulating equipment. Regulate the pressure regulating equipment. The input voltage of control box is made to be 110% and 85% of rated operating voltage respectively; measure the basic performance of control box according to the requirements of B.2.3. The voltage of the voltage regulator shall be regulable between 0V~500V.

B.2.5 Safety performance

B.2.5.1 Insulation resistance

The insulation resistance of control box shall be measured according to the requirements of 5.8.3 in GB 4717-1993 and the test equipment required shall meet the requirements of 5.8.4 in GB 4717-1993.

B.2.5.2 Voltage resistance

The voltage resistance of control box shall be measured according to the requirements of 5.9.3 in GB 4717-1993 and the test equipment required shall meet the requirements of 5.9.4 in GB 4717-1993. After the test, the basic performance of door roller shall be measured according to the requirements of B.2.3.

B.2.6 Stability in climatic environment

B.2.6.1 High temperature test

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