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Automatic revolving doors—Safety

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Foreword

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Automatic revolving doors—Safety

1 Scope This Japanese Industrial Standard specifies the safety requirements for automatic revolving doors and their test methods. However, manual revolving doors, semiautomatic revolving doors and other opening-and-closing type automatic and manual doors are excluded.

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions (including amendments) of the standards indicated below shall be applied.

JIS A 1551 *Test method for automatic door systems*

JIS B 9700-1 *Safety of machinery—Basic concepts, general principles for design—Part 1 : Basic terminology, methodology*

Remarks : ISO 12100-1 : 2003 *Safety of machinery—Basic concepts, general principles for design—Part 1 : Basic terminology, methodology* is identical with the said standard.

JIS B 9702 *Safety of machinery—Principles of risk assessment*

Remarks : ISO 14121 : 1999 *Safety of machinery—Principles of risk assessment* is identical with the said standard.

JIS B 9703 *Safety of machinery—Emergency stop—Principles for design*

Remarks : ISO 13850 : 1996 *Safety of machinery—Emergency stop—Principles for design* is identical with the said standard.

JIS B 9960-1 *Safety of machinery—Electrical equipment of machines—Part 1 : General requirements*

Remarks : IEC 60204-1 : 1997 *Safety of machinery—Electrical equipment of machines—Part 1 : General requirements* is equivalent to the said standard.

JIS C 4034-1 *Rotating electrical machines Part 1 : Rating and performance*

3 Definitions For the purpose of this Standard, the following definitions apply.

3.1 General

- a) **automatic revolving door** the door in which the action of starting, revolution, speed reduction and stopping are able to be controlled without a manual operation and has multiple door leaves (usually 2 to 4 door leaves) (see figure 1)

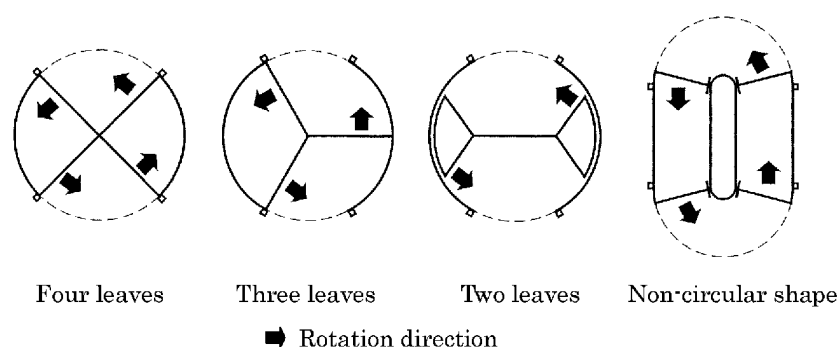


Figure 1 Automatic revolving door (example)

3.2 Components (mechanism, motive power, control related section)

a) **drive** the motor and the part related to drive incorporated or attached to the motor. For example, gearing, control, solenoid brakes.

b) **starter** a device which makes a door start

The starting method using a starter is classified into the following three types.

- 1) **manual starter** (a push button, a pull switch, an elbow switch, a key switch, a card key, entrance control equipment, etc. which passers-by or personnel to trigger)
 - 2) **automatic starter** (a motion sensor, a presence sensor, etc. which detect access of passers-by to a door)
 - 3) **remote starter** (a central control station, radio control, etc. which can make a door start from the location away from the door manually or automatically)
- c) **motion sensor** a device which sends a signal to a control system by sensing a motion of a person or an object, e.g. an infrared sensor, a photoelectric sensor, a pyroelectric sensor, a radar sensor
- d) **presence sensor** a device which sends a signal to a control system by sensing presence of a stationary object or a person, e.g. an infrared sensor, a photoelectric sensor, a mat switch
- e) **protective equipment** a device which sends a stopping signal or a braking signal to a control system in order to avoid or reduce hazards of passers-by or personnel, of which types are given, for example, as follows
- 1) **non-contact type protective equipment** (a photoelectric sensor, a radar sensor, etc. which actuate a sensor by blocking or reflecting a beam of light, an electric wave, a supersonic wave, etc. by a human body, or by changing the field of electrostatic capacity, etc. by access of a human body)
 - 2) **contact type protective equipment** (an edge sensor, a bumper switch, etc. to trigger when mechanical pressure is applied by the contact of a human body to the surface of a mat or an edge)

The protective equipment which is installed at the specific location of the door

structure section shall be as follows.

- 3) **leading mullion protective device** (a device installed at the mullion edge in order to reduce the impact generated when a person or an object gets caught between the door end edge of a door leaf and the leading mullion. The door end edge and leading mullion are as shown in Annex 1 figure 1.)
- 4) **leading edge protective device** (a device to reduce the impact generated when a person or an object collides with the leading edge of a door leaf. The leading edge is as shown in Annex 1 figure 1.)
- 5) **bottom stile sensor** (an electric or mechanical device installed at the bottom stile edge of a door leaf, which sends a signal to reduce or stop the rotation speed of a door leaf if a person or an obstruction is in the orbit of a door. The bottom stile edge is as shown in Annex 1 figure 1.)
- f) **control system** a system to generate the signal to control drive in such a manner that it receives signals from the starter, protective equipment and external signals, and processes them
- g) **door leaf** doors with usually 2 to 4 leaves which divide each zone of a revolving door
- h) **breakout** a function or its system whereby both or either one of a door leaf and a drum wall can be pushed open manually in the swing mode to allow emergency escape
- i) **fixed door leaf** the door leaf (or its part), which has no breakout function
- j) **drum wall** the circular fixed wall section which constitutes an automatic revolving door as well as a door leaf
- k) **canopy** the peripheral part between the ceiling of a revolving door and the roof, which includes the roof
- l) **mullion** the fixed pillar installed in order to constitute the drum wall and canopy
- m) **internal diameter** the distance between the inner surfaces of the drum wall of a revolving door (usually the inner surface diameter of a drum wall), which is used for indicating the size of a revolving door
- n) **effective clear opening width** the width between the drum wall opening edges facing each other or the width between the door end edge and the drum wall opening edge.

When there is the shock absorbing material in a door end edge or in a drum wall opening edge, the effective clear opening width does not include the absorbing material size.

- o) **opening height** usually, a distance between the floor surface and the canopy undersurface
- p) **leading face** a front face in the traveling direction of a door leaf (see Annex 1 figure 1)

- q) **leading edge** all edges of the leading face of a door leaf (see Annex 1 figure 1)
- r) **door end edge** the outside edge of the leading face of a door leaf (see Annex 1 figure 1)
- s) **bottom stile edge** the bottom side edge of the leading face of a door leaf (see Annex 1 figure 1)
- t) **leading mullion** the first mullion through which a door leaf passes a drum wall (see Annex 1 figure 1)

3.3 Actuation

- a) **door end peripheral speed** the speed of the door end edge of a door leaf

3.4 Safety

- a) **limiting device** a device for limiting the actuation of a door leaf (one or multiple leaves) within the predetermined range
- b) **braking device** one of limiting devices, which is a device for reducing or stopping the rotational actuation of a door leaf such as an electric motor and control circuit used for a mechanical brake, a regenerative brake, and a dynamic brake
- c) **braking distance** the travel distance of a door end edge during the period from the beginning of braking to the stop of a door leaf
- d) **hazard area** an area where the hazard such as collision, getting entangled, getting caught exists (see Annex 1 figure 2, Annex 1 figure 3, Annex 1 figure 4 and Annex 1 figure 5)

4 Design method and procedure

4.1 General The risk assessment (see JIS B 9702) shall be performed based on the risk reduction process specified in figure 1 and figure 2 of JIS B 9700-1, and the removal of hazard or the risk reduction policy shall be repeatedly performed according to the 3 step-method of the offer of information for use (see figure 2 of JIS B 9700-1) with regard to the intrinsic safe design, safe protection, additional protection policy and residual risk.

4.2 Implementation of risk assessment

4.2.1 Outline The risk assessment is a process in which a risk analysis, a risk estimation and a risk evaluation are implemented in accordance with JIS B 9700-1 and JIS B 9702. In the risk analysis, all hazards which may occur in the future during the life cycle period of an automatic revolving door shall be identified. In order to identify the hazard, the examples to be referred of the main mechanical hazards caused by automatic revolving doors shall be given in Annex 2. Next, the risk estimation and the evaluation for the identified hazard shall be performed.

Although the hazard assumed for automatic revolving doors is mainly the mechanical hazard, it is not limited to them. For example, the hazardous situation occurred due

to the separation of parts or components in use also shall be taken into consideration. Furthermore, for the identification of hazard, the following matters shall be taken into consideration.

- a) Access of passers-by and personnel from all directions
- b) Consideration of passers-by such as small children, elderly people, handicapped persons, and the auxiliary equipment (wheelchair, etc.) for passage
- c) Operation of automatic revolving doors by the personnel who are engaged in the work including installation, maintenance, setting and cleaning
- d) Unexpected starting and stopping of automatic revolving doors
- e) Improper use of automatic revolving doors which is reasonably foreseeable
- f) Effect of failures of the control system including the protective equipment (emergence of new hazards)
- g) Hazards relevant to specific applications if necessary

4.3 Implementation of intrinsic safe design

4.3.1 Significant mechanical hazards and judgment for their control The significant mechanical hazards assumed with regard to automatic revolving doors are getting caught, collision, shearing and getting entangled, which are assumed to occur between the revolving door leaf and the mullion and between the revolving door leaf and the floor surface, and each mechanical hazard occurs as the hazard area in the traveling direction of a door leaf (see Annex 1 figure 2, Annex 1 figure 3, Annex 1 figure 4, and the Annex 1 figure 5). When passers-by and personnel enter these hazard areas, the necessary and sufficient design-criterion value for reducing and controlling mechanical hazards shall be provided assuming the degree of harm which each hazard gives to passers-by and personnel.

4.3.2 Implementation of intrinsic safe design and re-implementation of risk evaluation For the mechanical hazards assumed with regard to automatic revolving doors, the intrinsic safe design shall be performed so that the design-criterion value in accordance with 4.3.1 is satisfied. Furthermore, for the automatic revolving doors after the intrinsic safe design is implemented, it is necessary to perform the risk evaluation of hazards again. The structure and function for the intrinsic safe design which is applicable to automatic revolving doors shall be as given in the following examples.

- a) Limit of the maximum peripheral speed
- b) Limit of rotary force (weight saving of a door leaf, etc.)
- c) Securing of clearance
- d) Cutoff of a power mechanism and separation of a transmission section
- e) Flexibility of a door leaf and leading mullion (structure or material)

4.4 Safeguarding and additional protection When the sufficient control of hazards cannot be performed and a risk remains even if the intrinsic safe design is implemen-