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游乐设施风险评价总则

Risk assessment for amusement ride—General principles

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Foreword

This standard was drafted according to the rules given in GB/T 1.1 – 2009

This standard is under the jurisdiction of National Technical Committee(SAC/TC 250) of Standardization for Ropeways and Amusement Equipments.

Chief drafting organizations of this standard: China Special Equipment Inspection and Research Institute, Jiangsu Province Special Equipment Safety Supervision and Inspection Institute, Shandong Special Equipment Inspection and Research Institute, Zhongshan Golden Horse Technology Entertainment Co., Ltd., Wenzhou Nanfang Amusement Equipment Engineering Co., Ltd., Shenzhen Huaqiang Fantawild Technology Co., Ltd., Shenzhen OCT Vision Inc.,Shanghai Special Equipment supervision and Inspection Technology Research Institute, Chongqing Special Equipment Inspection and Research Institute,Guangdong Special Equipment Inspection and Research Institute,Zhejiang Special Equipment Inspection and Research Institute,Wuhan Special Equipment Inspection and Research Institute,Beijing SBL Amusement Equipment Co., Ltd.

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Risk assessment for amusement ride

—General principles

1 Scope

This standard stipulates the basic principles and procedures of risk appraisal for amusement ride, confirmation of appraisal objects and factors, information collection, hazard identification, risk assessment, risk control, reappraisal, risk appraisal unit and personnel and risk appraisal documents.

This standard is applicable to the risk appraisal for amusement ride.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB 8408 Large-scale amusement device safety code

GB/T 20002.4- 2015 Drafting for special aspects in standards—Part 4:Safety aspects for their inclusion in standards

GB/T 20306 Amusement Devices Terminology

Provisions on the Safety Supervision of Large-scale Amusement Ride (Order No. 154 of the General Administration of Quality Supervision, Inspection and Quarantine)

3 Terms and definitions

Those defined by GB/T 20002.4-2015 and GB/T 20306 as well as the following terminologies and definitions are applicable to this document. For convenience, some terminologies and definitions mentioned in GB/T 20002.4-2015 are listed again as follows.

3.1

safety

The state that unacceptable risks have been eliminated.

[GB/T 20002.4-2015,definition 3.14]

3.2

risk

Combination of probability of occurrence of harm and its severity.

[GB/T 20002.4-2015, definition 3.9]

3.3

harm

Damage or injury to human health, and damage to property or environment.

[GB/T 20002.4-2015, definition 3.1]

3.4

hazard

The potential source that may cause harm.

[GB/T 20002.4-2015, definition 3.2]

3.5

residual risk

The risks that still exist after the implementation of measures for risk reduction.

[GB/T 20002.4-2015, definition 3.8]

3.6

risk estimation

Confirmation of the severity of harm and the probability of its occurrence.

3.7

risk analysis

Combination of the confirmation of appraisal objects and factors, information collection, hazard identification and risk assessment.

3.8

risk control measure

Methods for risk reduction.

3.9

risk assessment

Including the whole process of risk analysis and risk control.

3.10

intend use

Use based on the information provided by products and/or system, or use based on the mode understood generally when such information is not available.

[GB/T 20002.4-2015,definition 3.6]

3.11

reasonably foreseeable misuse

Use of products and/or system that is resulted from the easily foreseeable behavior of a person and that fails to follow the method and/or system provided by the supplier.

[GB/T 20002.4-2015,definition 3.7]

4 Basic principle

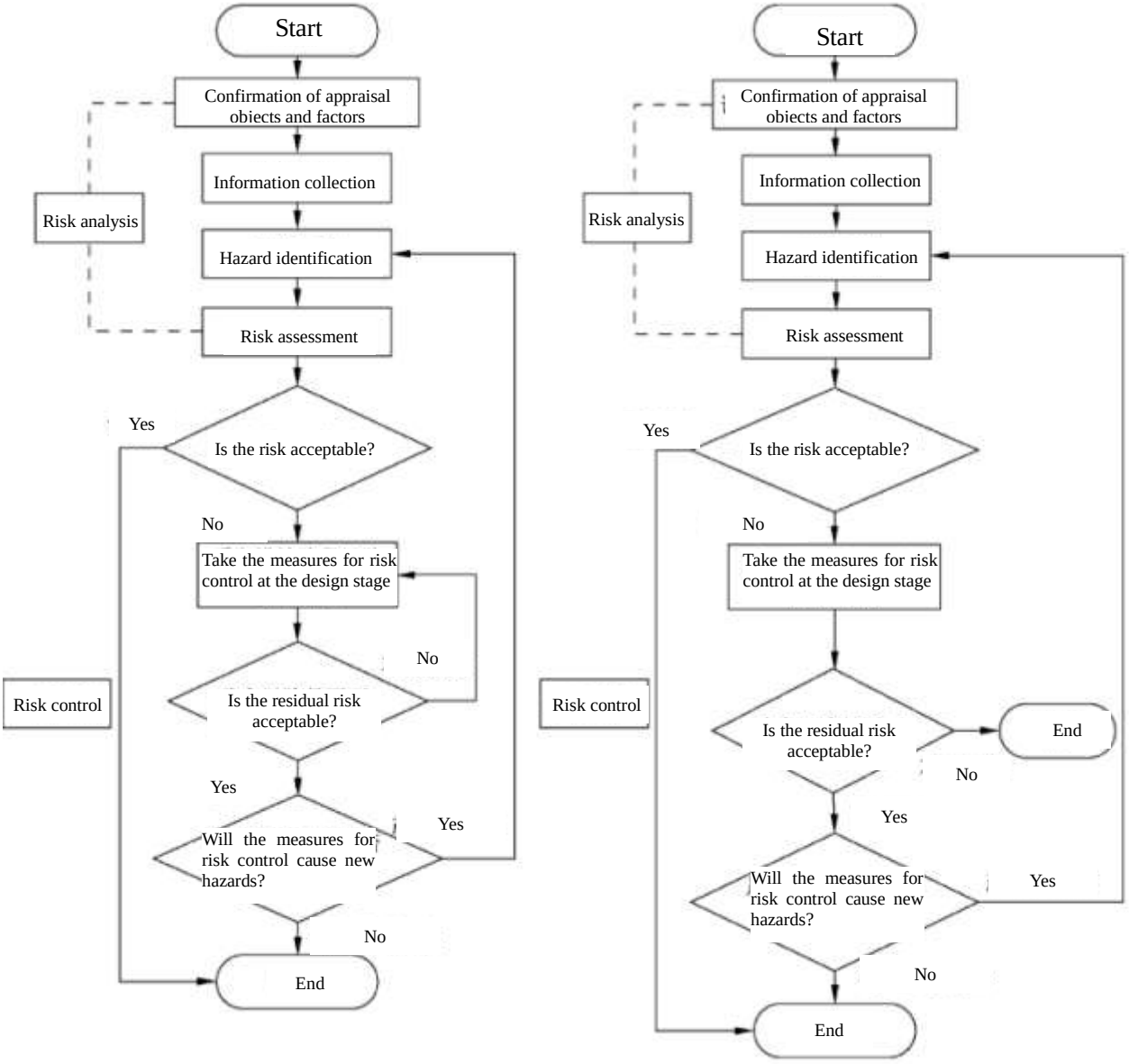
4.1 Risk is relative to safety. Safety is relative, without absolute safety. The safety mentioned in this standard refers to the state that unacceptable risks have been eliminated. It is through reducing risks to acceptable degree that safety is achieved.

4.2 Risk appraisal is a series of logical steps to analyze and evaluate the risks related to appraisal objects with system method. When necessary, measures for risk control shall be taken to reduce risks after risk appraisal. It is necessary to repeat the risk appraisal after taking specific measures for risk control to eliminate hazard and fully reduce risks.

5 Procedure

The contents of risk appraisal include confirmation of appraisal objects and factors, information collection, hazard identification, risk assessment and risk control, as shown in Figure

1



a) Design stage **b) Service stage**

Figure 1 Risk Appraisal Process for Amusement Ride

6 Confirmation of appraisal objects and factors

6.1 For appraisal objects, characteristics of amusement ride, performance and intend use and reasonably foreseeable misuse and so on shall be specified.

6.2 For appraisal factors, consideration shall be given to equipment factor, personnel factor and environment factor and so on at all stages of the whole life cycle from design to scrapping.

6.3 For equipment, attention is generally paid to those factors, including but not limited to:

a)Damage and fault and others in equipment components and parts and all subsystems;

b)Different running modes;

c)Range of motion of amusement ride.

6.4 For personnel, attention is generally paid to those factors, including but not limited to:

a)Operation personnel and maintenance personnel with different training, experience or capability;

b)Name, age, height and weight and others of riders;

c)Workspace and others of operation personnel and maintenance personnel;

d)Range of activity and riding space of riders for amusement ride.

6.5 For environment, attention is generally paid to those factors, including but not limited to:

a) Running temperature requirements, humidity requirements, weather requirements and others required by amusement ride;

b) Requirements for running altitude of amusement ride;

c) Requirements for indoor and outdoor running and others of amusement ride.

7 Information collection

7.1 Information collection is the important step of risk appraisal, and accuracy, effectiveness and comprehensiveness of data directly affect correctness of the results of risk appraisal.

7.2 The risk appraisal for amusement ride requires the collection of technical requirements and service conditions and other information of equipment itself, generally including but not limited to the following contents:

a) Provisions and standards related to amusement ride, Provisions on the Safety Supervision of Large-scale Amusement Ride, GB 8408 and so on;

b)Historical accident records related to the same type of amusement rides as well as reason analysis;

c) Typical hazard source, damage, fault and failure mode of amusement ride as well as descriptions concerning its damageable part and damage degree;

d) Running records, maintenance and repairing records and historical inspection reports of operators;

e) Safety experience accumulated in manufacturing similar equipment by manufacturing and installation units;

f)Safety information and others related to similar equipment exposed by society media.

8 Hazard identification

8.1 For hazard identification for amusement ride, specific structures and features of the ride and typical hazard source, damage, fault and failure mode shall be combined to identify potential relevant hazards during manufacturing, installation, use, maintenance and repairing and others.

8.2 For hazards of amusement ride, it is suitable to consider those contents, including but not limited to: mechanical hazard, electrical hazard, noise hazard, heat hazard and the hazards related to man-machine engineering as well as material and environment.

9 risk assessment

9.1 Risk assessment shall be performed for each hazard discovered in Chapter 8.

9.2 The risk depends on the severity of harm and probability of its occurrence.

9.3 The severity of harm shall be assessed from personal injury, social influence and economic

loss and other aspects, generally including but not limited to the following factors:

a)Degree of health harm or damage, such as slight injury, serious injury and death;

b)Range of harm, such as one injured and many injured;

c)Social influence degree, such as big range of influence and poor nature;

d)Degree of economic loss, such as overall scrapping and local repair of equipment.

9.4 The severity of harm is divided in to 5 grades, as shown in Table 1.

Table 1 Grade of Severity of Harm

Grade of severity of harm	Description
1-very high	a) Personnel casualty; b) Huge social influence; c) Severe damage of equipment; d) Enormous economic losses Note: the severity of any of the above harm is grade 1

Table 1 (continued)

Grade of severity of harm	Description
2-high	a) Personnel's high-altitude retention for over one hour or injury; b) Large social influence; c) Relatively severe damage of equipment; d) Relatively large economic losses. Note: the severity of any of the above harm is grade 2
3-medium	Slight injury of personnel, with certain social influence, medium damage of equipment and medium economic losses Note: the severity of any of the above harm is grade 3
4-low	a) No injury or death of personnel; b) Possible need of starting emergency measures; c) Small social influence; d) Small damage of equipment; e) Small economic losses. Note: the severity of any of the above harm is grade 4
5-negligible	a) No influence; b) No injury or death of personnel; c) No social influence; d) No damage of equipment; e) No economic loss. Note: the severity of any of the above harm is grade 5

9.5 Probability of occurrence of harm generally includes but is not limited to the following contents:

a) Probability that personnel are exposed to danger, including frequency of entering hazard zone, duration time in hazard zone, number of people entering hazard zone, need and nature of entering hazard zone (such as normal operation, maintenance or fault repair);

b) Probability of occurrence of hazardous events, including reliability and statistics of other data, historical accidents of amusement ride and the results compared with similar amusement rides;

c) Possibility of avoidance or limitation of the harm, including detectability of hazard (non-destructive testing and daily inspection for key parts), speed that hazard state causes harm (such as sudden, fast and slow), understanding of the risk (such as warning label, safety instruction and direct observation).

9.6The probability of occurrence of harm can be divided into 5 grades, as shown in Table 2.

Table 2 Grade of Probability of Occurrence of Harm

Grade of probability of occurrence of harm	Description
A-frequently	The harm may occur frequently within service life
B-probably	The harm may occur several times with service life
C-occasionally	The harm may occur once at least within service life
D-rarely or improbably	The harm may not occur, but may occur within service life
E-impossibly	The damage can never occur with service life

9.7Risk grade is performed based on the severity of harm (see 9.4) and assessment results of probability of occurrence of harm (see 9.6), as shown in Table 3. The risk is divided into grade I, grade II, grade III and grade IV.

Table 3 Risk Grade

Grade of severity of harm	Grade of probability of occurrence of harm				
	A	B	C	D	E
1	IV	IV	IV	III	I
2	IV	III	III	III	I
3	III	III	III	II	I
4	III	III	II	I	I
5	II	II	I	I	I

9.8 The following measures for risk control are taken based on different risk grades:

a) Grade I: there is no need of any measure;

b) Grade II: measures need to be taken to reach acceptable range;

c) Grade III: measures need to be taken to eliminate or reduce risks;

d) Grade IV: measures need to be taken immediately to eliminate or reduce risks.

10 Risk control

10.1 If the result of risk assessment shows that the risks need to be reduced, corresponding measures shall be taken to control risks based on specific conditions of different equipment.

10.2 The measures taken at the design stage are better than those taken by users at the service stage.

10.3 The steps adopted for risk control at the design stage are available in Figure 2. Firstly, risks shall be eliminated or reduced through taking inherently safe design measures, safety protection and supplemented protection measures at the design stage and utilizing information, warning label

and safety instructions and others. With regard to the case that risks still exist after measures are taken, relevant requirements and instructions shall be put forward in the user manual.

10.4 The steps adopted for risk control at the service stage are available in Figure 3. With regard to the in-service amusement ride, risks shall be eliminated or reduced through taking relevant organization measures, safety protection devices and personal protection equipment and arranging training and other measures.

10.5 It is unsuitable to use additional protection devices, personal protection equipment and provide information for users to replace improvement measurements in design.

10.6 If large residual risks still exist after the implementation of risk control measures, the equipment shall be scrapped; if the residual risks are within an acceptable range after the implementation of risk control measures, daily inspection, monthly inspection and annual inspection as well as other measures shall be taken to strengthen monitoring.

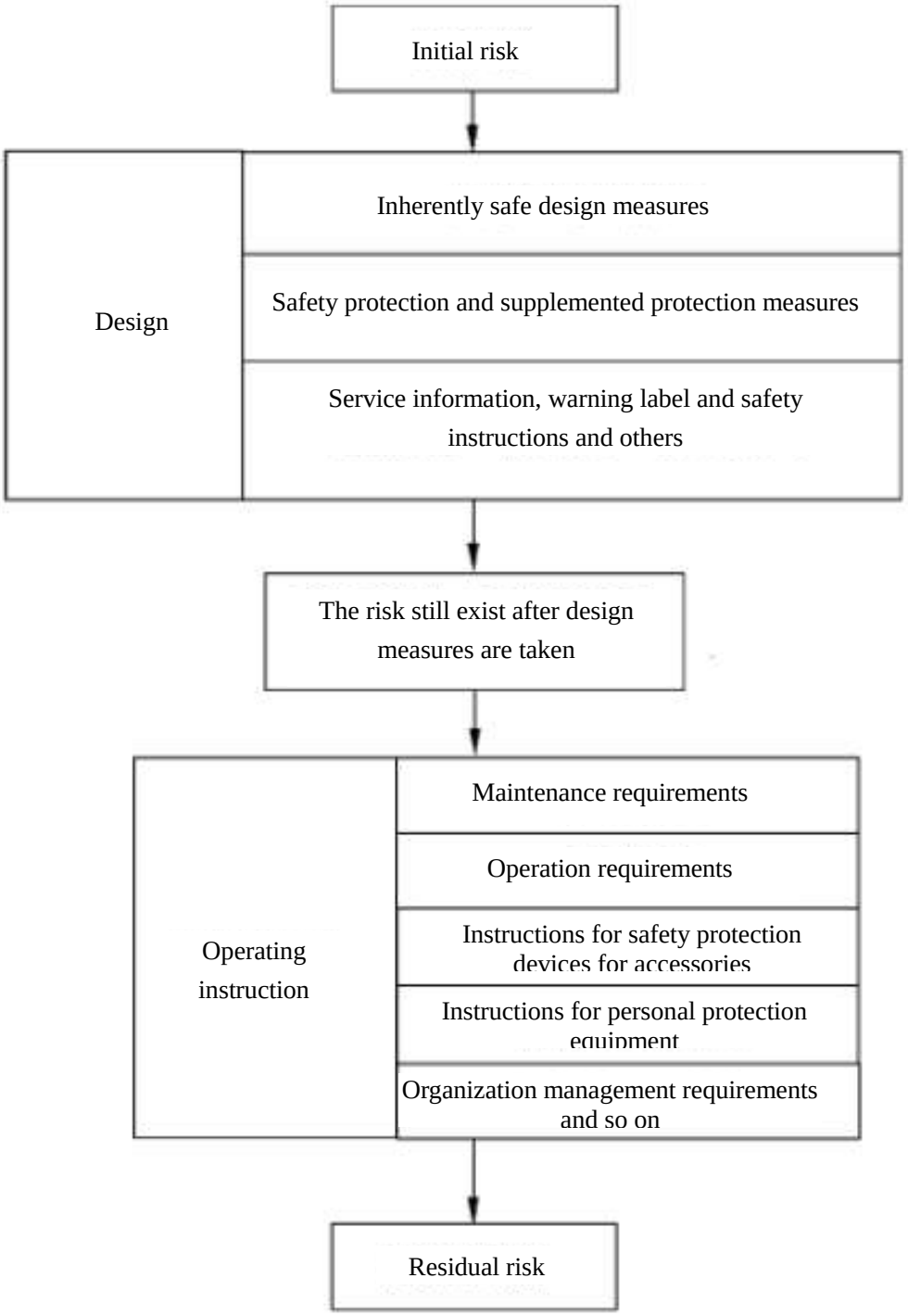


Figure 2 Measures for Risk Control at the Design Stage

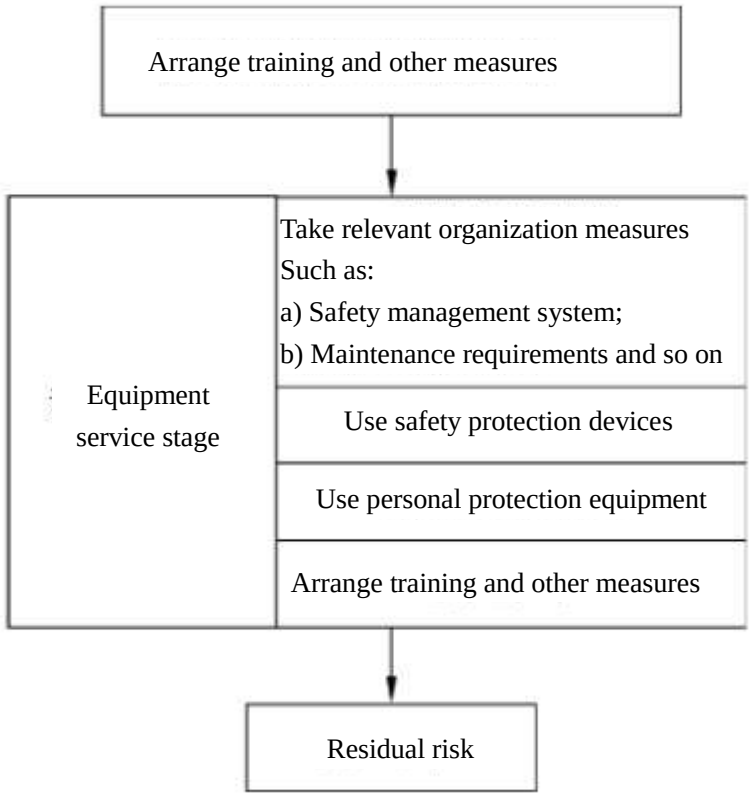


Figure 3 Measures for Risk Control at the Service Stage

11 Reappraisal

11.1 If the result of risk assessment reaches the requirements, the risk appraisal is finished.
11.2 If a measure for risk control is required to be taken, the appraiser shall inspect whether a new hazard is introduced or other risks are increased when a new measure is taken, and repeat the risk appraisal.

12 Risk appraisal unit and personnel

12.1 The inspection and testing organization or design manufacturing unit or operator which is in charge of risk appraisal for amusement ride shall have more than 2 risk appraisers and possess corresponding operation guidance documents.
12.2 The personnel who engage in risk appraisal for amusement ride shall get familiar with provision and standards of amusement ride, possess corresponding professional knowledge (such as machinery, electrical engineering, control, civil engineering and hydraulic pressure), have working experience in amusement ride industry for more than 3 years, and have received the training of risk appraisal technology and standard.

13 Risk appraisal documents

13.1 General

13.1.1 Risk appraisal documents are composed of plans or operation instructions, risk appraisal

records and risk appraisal reports.

13.1.2 The records and reports of risk appraisal shall be accurate and intact and signed by corresponding responsible personnel.

13.1.3 Appraisal records and reports shall be kept for a long term until the amusement ride is scrapped.

13.2 Plans or operation instructions

Risk appraisal plans or operation instructions shall be prepared in accordance with relevant provisions, standards and the requirements of this document.

13.3 Risk appraisal records

Risk appraisal records shall include site records of risk appraisal and meeting materials as well as other process documents, generally including but not limited to the following elements:

a)Risk appraisal objects and descriptions;

b)Specific risk appraisal methods;

c)Risk appraisers and so on.

13.4 Risk appraisal reports

13.4.1The process and result of risk appraisal for amusement ride shall form a risk appraisal report and be kept as technical materials.

13.4.2The risk appraisal report generally includes but is not limited to the following contents:

a) Risk appraisal object, such as name of amusement ride or subsystem;

b) Relevant information and profile of the amusement ride, such as technical parameters, manufacturing unit and design unit;

c) Hazard, hazard source or hazard state of the amusement ride;

d) Corresponding probability of occurrence of harm and its severity for each hazard, hazard source or hazard state;

e) Process of risk evaluation and confirmation of risk grade;

f) Specific measures for risk control taken for each hazard, hazard source or hazard state;

g) Overall conclusion of risk appraisal;

h) Basic information and signature of risk appraisers;

i) Reference materials of risk appraisal, such as: provisions and standards, known accidents and fault materials, inspection, testing and check results, reliable materials of parts.