INTERNATIONAL STANDARD

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Lifts (elevators), escalators and moving walks — Risk assessment and reduction methodology

Ascenseurs, escaliers mécaniques et trottoirs roulants — Méthodologie de l'appréciation et de la réduction du risque

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 14798 was prepared by Technical Committee ISO/TC 178, *Lifts, escalators and moving walks*.

This first edition of ISO 14798 cancels and replaces ISO/TS 14798:2006, which has been technically revised.

Introduction

The objective of this International Standard is to describe principles and set procedures for a consistent and systematic risk assessment methodology relevant to lifts (elevators), escalators, moving walks ("lifts", for short). The risk analysis and assessment principles and process described in this International Standard may, however, be used for assessment of risk relevant to equipment other than lifts.

This risk assessment methodology is a tool used to identify risk of harm resulting from various hazards, hazardous situations and harmful events. Knowledge and experience of the design, use, installation, maintenance, incidents, accidents and related harm are brought together in order to assess the risk during all phases of the life of lifts[1)] (elevators), escalators and moving walks (hereafter referred to as "lifts"), from design and construction up to decommissioning. The users of the methodology do not make medical judgements but, rather, evaluate events that can possibly lead to levels of harm defined in this International Standard. By itself, this International Standard does not provide a presumption of conformity to any safety requirements for lifts, including those noted in Clause 1.

NOTE Risk assessment is not an exact science, as there is a certain degree of subjectivity in the process.

It is recommended that this International Standard be incorporated into training courses and manuals so as to provide basic instructions on safety aspects to those involved in

a) assessing designs, operations, testing and use of lift equipment, and

b) writing of specifications or standards incorporating safety requirements for lifts.

This International Standard describes a qualitative methodology for risk assessment that relies very much on the judgement and deliberations of the members of the risk assessment team who carry out the assessment. To ensure the most realistic and consistent assessment, it is essential that the methodology be followed faithfully. Aids such as numeric methods of assessment that follow the format described in this International Standard are not precluded from use. It should, however, be recognized that numeric aids to qualitative methods may still retain some of the subjectivity inherent in the qualitative process.

Clause 3 describes the concepts of safety and risk assessment. Clause 4 describes the procedure of risk analysis, including risk estimation. The procedure for risk evaluation is set out in Clause 5 and assessment in Clause 6. Clause 7 deals with protective measures. Clause 8 specifies relevant documentation.

1) Hereafter in this International Standard, the term "lift" is used instead of the term "elevator". In addition, the term "lift" is also used instead of the terms "lifts, escalators and moving walks".

Lifts (elevators), escalators and moving walks — Risk assessment and reduction methodology

1 Scope

This International Standard establishes general principles and specific procedures for assessing risk.

The purpose of this International Standard is to provide a process for making decisions relevant to the safety of lifts during the

a) design, construction, installation and servicing of lifts, lift components and systems,

b) development of generic procedures for the use, operation, testing, compliance verification and servicing of lifts, and

c) development of technical specifications and standards affecting the safety of lifts.

While examples in this International Standard refer primarily to risks of harm to persons, the risk assessment procedure set out in this International Standard can be equally effective for assessing other types of risk relevant to lifts, such as the risk of damage to property and environment.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
cause
circumstance, condition, event or action that in a hazardous situation contributes to the production of an effect

2.2
effect
result of a cause in the presence of a hazardous situation

2.3
harm
physical injury or damage to the health of people, or damage to property or the environment

[ISO/IEC Guide 51:1999, 3.3]

2.4
harmful event
occurrence in which a hazardous situation results in harm

[ISO/IEC Guide 51:1999, 3.4]

NOTE In this International Standard, the term “harmful event” is interpreted as a combination of cause and effect.

2.5
hazard
potential source of harm

NOTE The term “hazard” can be qualified in order to define its origin or the nature of the expected harm (e.g. electric shock hazard, crushing hazard, cutting hazard, toxic hazard, fire hazard, drowning hazard).

[ISO/IEC Guide 51:1999, 3.5]

2.6
hazardous situation
circumstance in which people, property or the environment are exposed to one or more hazards

[ISO/IEC Guide 51:1999, 3.6]

2.7
life cycle
period of usage of a component or a lift system

2.8
protective measure
means used to reduce risk

NOTE Protective measures include risk reduction by inherently safe design, protective devices, personal protective equipment, information for use and installation and training

[ISO/IEC Guide 51:1999, 3.8]

2.9
residual risk
risk remaining after protective measures have been taken

[ISO/IEC Guide 51:1999, 3.9]

2.10
risk
combination of the probability of occurrence of harm and the severity of that harm

[ISO/IEC Guide 51:1999, 3.2]

2.11
risk analysis
systematic use of available information to identify hazards and to estimate the risk

[ISO/IEC Guide 51:1999, 3.10]

2.12
risk assessment
overall process comprising a risk analysis and a risk evaluation

[ISO/IEC Guide 51:1999, 3.12]

2.13
risk evaluation
consideration of the risk analysis results to determine if the risk reduction is required

2.14
scenario
sequence of a hazardous situation, cause and effect

2.15
severity
level of potential harm

3 General principles

3.1 Concept of safety

Safety, within this International Standard, is considered as freedom from unacceptable risk. There can be no absolute safety. Some risks, defined in this International Standard as residual risk, can remain. Therefore, a product or process (e.g. operation, use, inspection, testing, or servicing) can be only relatively safe. Safety is achieved by sufficient mitigation or reduction of the risk.

Safety is achieved by the search for an optimal balance between the ideal of absolute safety, the demand to be met by a product or process, and factors such as benefit to the user, suitability for purpose, cost effectiveness and conventions of the society concerned. Consequently, there is a need to review continually the established safety levels, in particular when experience necessitates review of the pre-set safety levels and when developments, both in technology and knowledge, can lead to feasible improvements to attain sufficient mitigation of the risk compatible with the use of a product, process, or service.

3.2 Concept of risk assessment

3.2.1 Safety is achieved by the iterative process of risk assessment (risk analysis and risk evaluation) and risk reduction (see Figure 1).

3.2.2 Risk assessment is a series of logical steps that enables, in a systematic way, the examination of hazards associated with lifts. Risk assessment is followed, whenever necessary, by the risk reduction process, as described in Clause 7. When this process is repeated, it gives the iterative process for eliminating hazards as far as possible and for implementing protective measures.

3.2.3 Risk assessment includes:

a) risk analysis

1) determination of the subject of analysis (see 4.3),

2) identification of scenarios: hazardous situations, causes and effects (see 4.4), and

3) risk estimation (see 4.5);

b) risk evaluation (see Clause 5).

3.2.4 Risk analysis provides the information required for the risk evaluation, which in turn allows judgements to be made on the level of safety of the lift and lift component, and any relevant process (e.g. operation, use, inspection, testing, or servicing).

3.2.5 Risk assessment relies on judgemental decisions. These decisions should be supported by qualitative methods complemented, as far as possible, by quantitative methods. Quantitative methods are particularly appropriate when the foreseeable severity and extent of harm are high. Qualitative methods are useful to assess alternative safety measures and to determine which one gives better protection.

NOTE The application of quantitative methods is restricted by the amount of useful data that is available, and in many applications, only a qualitative risk assessment is possible.

3.2.6 The risk assessment shall be conducted so that it is possible to note down the procedure that has been followed and the results that have been achieved (see Clause 8).

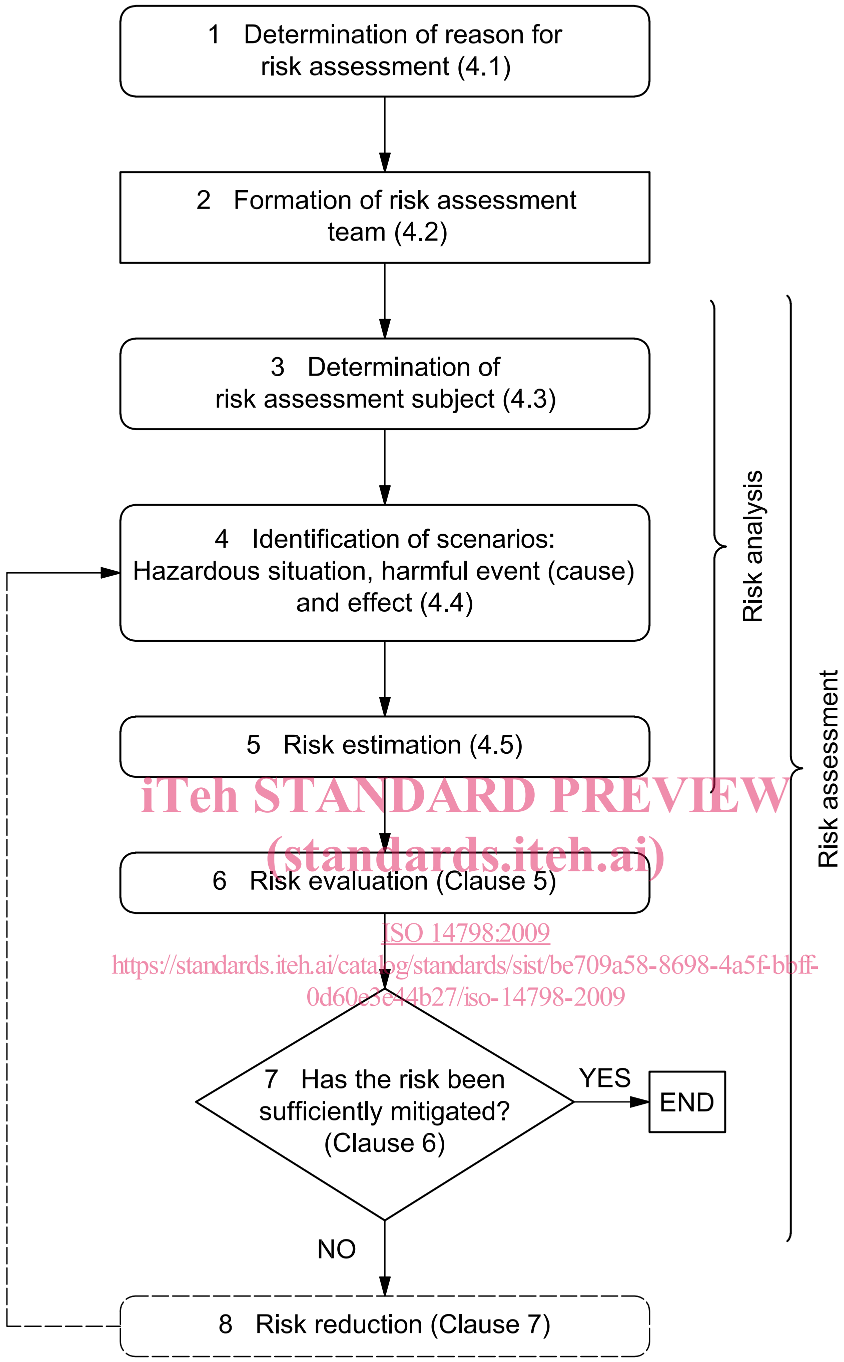


Figure 1 — Iterative process of risk assessment and risk reduction

4 Risk analysis procedure

4.1 Step 1 — Determination of the reason for conducting a risk assessment

Before a risk assessment process can start, the reason for the assessment should be determined. It can be, but is not limited to, the following:

a) verification that the risks are eliminated or sufficiently mitigated in relation to

   1) design for, or installation of, a lift or a component, or a subsystem thereof,

   2) the operation and use of a lift, or

   3) procedures for testing, inspection, servicing, or performing any other work with intent to maintain the lift or a lift component in its intended operating conditions;

   NOTE This especially applies to lifts and their components for which no recognized relevant safety standards are available.

b) development of standards and regulations that stipulate requirements related to lift safety.

4.2 Step 2 — Formation of a risk assessment team

4.2.1 General

Considering the variety in design, process and technology relevant to lifts, the diversity in the interests and working experience of lift experts, and in order to minimize any bias, a team approach for this risk assessment process is preferable.

NOTE Risk assessment carried out by an individual might not be as comprehensive as that carried out by a team.

4.2.2 Team members

Selection of the members of the risk assessment team, including the team moderator, is of paramount importance to the success of this risk assessment process.

The team should be comprised of individuals with varied interests and having experience in all fields that can be affected by the product or process being assessed.

EXAMPLE When assessing the design of a lift with a view to the safety of mechanics who will service the lift, the team can include persons with related work experience in construction, installation, testing, inspection and servicing, in addition to safety experts and experts in the design of various lift systems and subsystems.

Experts with specialized knowledge may be engaged in a consulting role for all or appropriate portions of the risk assessment process. Such participation can significantly enhance the quality of the results.

4.2.3 Team moderator

The team moderator should:

a) have an overall understanding of the product or process being assessed;

b) understand the risk assessment process;

c) be able to assume an impartial view free of any bias;

d) have “facilitating” abilities;

e) act as a facilitator rather than participant in the debates of the team, and

f) be able to facilitate arbitration when no team consensus can be reached.

NOTE For further information on the role and responsibilities of the moderator, refer to Annex E.

4.3 Step 3 — Determination of the subject of risk assessment and related factors

4.3.1 Determination of the subject of the assessment

Once the reason for a risk assessment process is determined in accordance with 4.1, the subject of the assessment shall be determined as precisely as possible. Without limiting generalities, the subject may include one or more of the following:

a) complete lift system

   1) for a specific load, speed, travel, or range thereof,

   2) for any location type, e.g. indoor or exposed to weather, in a public building or private residence, or in a factory or school,

   3) for a specified or unspecified life cycle (see 4.3.2.2),

   4) powered by any drive type (e.g. electric or hydraulic),

   5) in a building that is accessible to the general public or that has strictly controlled use and access thereto, and

   6) for the transportation of persons from the general public, a defined category of persons, goods only, or a combination thereof;

b) component or subsystem of a lift in a), such as

   1) enclosure of lift car, lift well, machine room or machinery space,

   2) drive system or braking system, during normal operation or in case of emergency;

   3) entrances to lift car and lift well (hoistway), machine room or well pit area,

   4) operation control or motion control, incorporating diversified or specific technologies, and

   5) locking devices;

c) persons in relation to a lift in a), such as those who

   1) use the lift for transportation,

   2) are in, or could gain access to, the area where any part of the lift is located or operated,

   3) perform any work on, or in the vicinity of, a lift, such as installing, testing, inspection, servicing, repairing, altering, rescuing, or cleaning (e.g. cleaning pit, car or well enclosures),

   4) have certain physical disabilities, and

   5) perform specific functions, e.g. fire fighting or transportation of hospital patients;

d) processes related to a lift or its components, such as

   1) installation,

   2) service,

   3) repair,

   4) cleaning,

   5) testing,

   6) modernization,

   7) replacement, and

   8) rescue.

4.3.2 Determination of any additional factors and data to be considered

4.3.2.1 General

In addition to the reason (see 4.1) and the subject (see 4.3.1) for the risk assessment, any additional factors that can modify or clarify the subject shall be determined, and any experience with similar products should be taken into consideration in the course of the assessment.

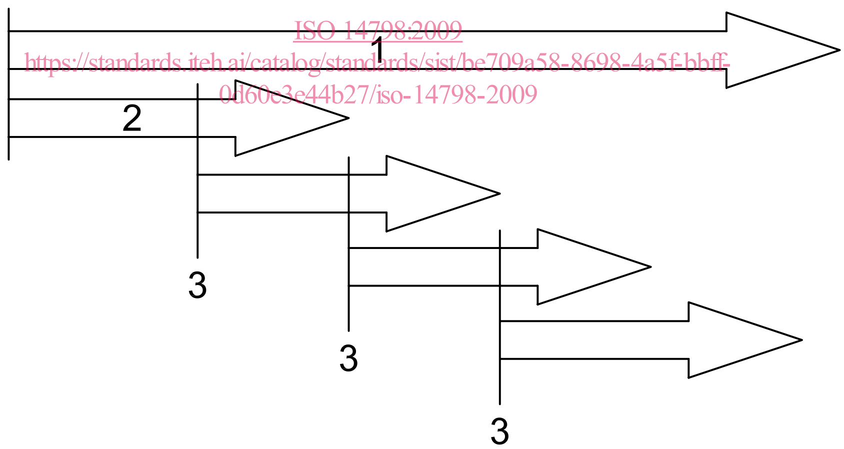
4.3.2.2 Life cycle of the subject being assessed

4.3.2.2.1 The intended life cycle is an important factor in determining the probability that a given event will occur. It does not, however, always come into play. If a standard is being written to address intrinsic safety, the life cycle need not be taken into account.

EXAMPLE A safe gap can be defined by "a dimension not exceeding *x*". This requirement is not related to time. Exceeding "*x*" is deemed to be unsafe.

4.3.2.2.2 Life cycle does have a role when considering the probability that a particular event will occur due to a component failure. In this situation, the life cycle of the system incorporating the component shall be considered. If, for example the system is to perform its function for 8 years, then the life of components shall at least match this to avoid a high probability of failure and, therefore, the occurrence of a given event. If, however, the component, through preventive maintenance, is replaced before failure occurs, the probability of the occurrence of a given event is low.

EXAMPLE 1 If a component expected to perform its safety function no longer than 8 years is incorporated in a lift system that is expected to operate safely during a 20-year interval, the lift will do so only if the component is replaced with a new one in intervals of less than 8 years, as shown in Figure 2.



Key

1 time of system life cycle, 20 years

2 component life cycle, 8 years

3 time of replacement (prior to expected end of component life cycle end)

Figure 2 — Replacement of components with a component life cycle shorter than the system life cycle

EXAMPLE 2 If a component critical for lift safety could fail once, twice or thrice during the life cycle of a lift system, the probability of the failure of the component, as well as the probability of an unsafe condition occurring on the lift system, would be estimated as "C — occasional" when estimating the risk in accordance with 4.5.4 and Table C.2 of Annex C. If, however, there is a programme in place to regularly replace the component before the end of its lifetime, the probability of an unsafe condition occurring in the lift system would be estimated as "D — remote" or "E — improbable", depending on the reliability of the component, as well as the reliability of the replacement programme.